RPS Energy

MAIL ROOM
SALLE DE COURIER

2013 AUG 30 A 10:57

NEB/ONE

August 30th, 2013

National Energy Board,
444 Seventh Avenue SW,
Calgary, Alberta,
T2P 0X8

Dear Gary Woo:

RE: TGS NOPEC Geophysical Company ASA, Petroleum Geo-Services and Multi Klient Invest AS (TGS/PGS/MKI) Northeastern Canada 2D Seismic Survey (the project) under section 5.1 (b) of the *Canada Oil and Gas Operations Act Incomplete Application*

On 31 May 2013 RPS Energy received a letter from the National Energy Board requesting additional information for the above noted project, in particular;

"During the public meetings, TGS, PGS and MKI were unable to answer various questions from community members and committed to following up with more information. Response to these outstanding questions, including those listed in Appendix A, should be filed with the Board along with confirmation that this information has also been provided to the communities and the four fisheries organizations."

MKI Response:

Much of the information presented in the following material can be found in the environmental Assessment (EA) document filed by Multi Klient Invest AS (MKI) to the NEB. The EA as made available to the public through the NEB website. The information from the EA Report, as well as additional project specific information would have been made available at the community meeting had MKI received advance notice of the purpose of their participation.

MKI trusts that the information compiled from EA report, as well as information from additional research, sufficiently addresses the specific concerns and inquiries presented during the community meeting. We welcome the opportunity to further discuss the project with community representatives in the near future.

Attached please find:

1. Supplementary Report II provides responses to Appendix A.

2. Supplementary reports III, IV, V and VI, provide additional responses to the communities.

   - Supplementary Report III - Iqaluit
   - Supplementary Report IV - Qikiqtarjuaq

- Supplementary Report V - Pond Inlet
- Supplementary Report VI - Clyde River

Supplementary Reports (II – VI) have been uploaded onto an RPS ftp site and communities notified via Hamlet office by NEXUS Coastal Resource Management.

MKI will begin an IQ study in three of the communities. Below is a September Meeting Schedule

- September 10 at Qikiqtarjuaq
- September 12 at Pond Inlet
- September 13 at Clyde River

NEXUS Coastal personnel will meet with representatives in the communities of Qikiqtarjuaq, Pond Inlet and Clyde River to discuss plans for the IQ project and to deliver MKIs Supplementary Reports in person. The travel schedule includes a stop in Iqaluit to meet with and provide the report to the City Council and record Council suggestions, observations and conclusion

Further from NEB's letter

"There has been a lack of information and communication to date regarding how local and/or scientific and Inuit Qaujimajatuqangit or traditional knowledge, and information provided by potentially affected Inuit groups and /or persons has been or will be considered in the project design, including mitigation measures. TGS/PGS and MKI are asked to describe in detail the information obtained from communities and organizations that relate to the project design.TGS/PGS and MKI should indicate how this information has affected the project design, and if not, why".

MKI Response:

MKI has reviewed questions and comments from stakeholders during community engagement meetings held to develop the Project Plan. In particular;

MKI has contracted NEXUS Coastal Resource Management to carry out an IQ Study in the following three (3) communities - Clyde River, Pond Inlet, Qikiqtarjuaq. The next scheduled visit to these communities is in mid-September. The information gathered throughout this study will be used to inform the project.

To further satisfy community concerns, Multi Klient Invest AS (MKI) contracted NEXUS Coastal Resource Management (NEXUS) to assess the interaction of between certain marine mammal's species and MKIs proposed 2D seismic survey in Baffin Bay and Davis Strait. Results were used to inform MKIs acquisition plan for the proposed seismic survey. This assessment includes the following 'species of interest': narwhal, beluga whale, bowhead whale, walrus, bearded seal, ringed seal and harp seal.

This Interaction report discusses migration trends adequate to plan MKI's 2D seismic program. It is not meant as a definitive migration route assessment of the species of interest, noted above. The Proponent cannot guarantee that a species will or will not be found in the survey area outside of the timeframe discussed in this report.

This report is based on government, research and organizational studies/reports published between 1980 and 2013 that include a range of methodologies (satellite tracking, workshops, aerial surveys, etc). Nonetheless whale, seal and walrus migration routes and habitats are poorly documented, hence the interaction maps include only documented summer and winter habitat ranges in the vicinity of the survey area.

The Survey Acquisition Plan and Interaction Assessment are attached. All reports mentioned here will be put on the RPS' ftp site for the communities to access

ACCESS to this dedicated FTP site:

To access the FTP site go to Start > Run, remove anything that is currently in there and type ftp.rpsgroup.com and press ok. Once there you should get a login screen to enter the details.

Alternatively you can access the FTP site through an FTP client. An examples of this is Filezilla (http://filezilla-project.org/download.php)'

Username: MKI.FTP
Password: yBchcTVD (Case sensitive)

MKI will comply with the "Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment" and will have a Passive Acoustic Monitoring (PAM) system and operator onboard to monitor whale vocalizations.

MKI will have a community Liaison Officer in each of the four (4) communities for the duration of the project. It will employ two Inuit Observers; one on the seismic vessel and the other on the support vessel. Qualified Marine Mammal Observers (MMOs) hired from the communities and Community Liaison Officers (CLOs) will ensure information is communicated. Once the first year's acquisition program is complete, MKI will return to the communities to report on the survey program and MMO and Inuit observes will report on what they observed while onboard and will provide a Final Observations Report on sightings during the survey.

MKI and its CLOs will work with Baffin Fisheries Coallition and Arctic Fisheries Association to share the timing and location of the program in an effort to avoid interaction between the respective operations.

MKI as the "Operator" has made and continues to make effects to explain industry information. A translator has been provided in all meetings and translated material.

Comment from NEB's letter

"TGS/PGS and MKI should provide an estimated survey acquisition Plan for each survey season."

RPS Energy

MKI Response:

Attached Baffin Bay/Davis Strait survey acquisition plan and Interaction Assessment. The Acquisition Plan is confidential and should not be put on the website or made public in any other fashion.

NEB's final request

"TGS/PGS and MKI should provide an approximate Project schedule for each survey season and a rationale for the schedule which references considerations to wildlife and other environmental factors."

MKI Response:

Attached Baffin Bay/Davis Strait "Survey Acquisition Plan" and "Interaction Assessment".

If you require anything further, please feel free to contact me at (902) 492-0281.

Yours truly,

Darlene Davis
RPS Energy Canada Ltd.

List of Attachements

Supplementary Report II		Response to Appendix A
Appendices		
Appendix	A	List of Acronyms
Appendix	B	Definitions
Appendix	C	Environmental Reports Newfoundland & Labrador
Appendix	D	Sound
Appendix	E	Sound Modelling
Supplementary Report III		Additional response to Iqaluit
Supplementary Report IV		Additional response to Qikiqtarjuaq
Supplementary Report V		Additional response to Pond Inlet
Supplementary Report VI		Additional response to Clyde River
Acquisition Plan		
Interaction Assessment		
Inuktitut (translated)		Executive Summary Supplementary II
Inuktitut (translated)		Executive Summary (Sound Modelling)
Electronic Copy		CD Attached

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ᒪᐃ 31, 2013

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TGS NOPEC-ᑯᑦ ᓄᓇᐅᑉ ᑕᐅᑦᑐᖓᓂᒃ ᐃᖅᑲᓇᐃᔭᖅᑎᐅᑦᓗᑎᒃ ᑲᒻᐸᓂᐅᔪᑦ,
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ᖁᑐᕐᒋᐅᖅᑎᑦᑎᔨᓂᒃ **ASA (TGS/PGS/MKI)**ᑲᓇᑕᐅᑉ ᑭᕙᑖᓂ
ᐅᑭᐅᖅᑕᖅᑐᖓᓂᒪᕐᕈᐃᓕᖓᔪᑎᒍᑦ ᑐᓴᖅᓴᐅᑎᑦᑎᑦᓗᑎᒃ ᖃᐅᔨᓴᖅᑎᑦ.

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ᑕᒃ ᑯᐊ ᑎᑎᕋᖅᑕᐅᓱᒪᓕᕆᓂ ᐊᖅᑭᒃᑯ ᓱᐊᓚᕆᐅᓕᖅᖢᑎᒃ ᑭᐅᓂᒃ ᓴᓇᓕᕆᓂ ᑲᑎᕋᖅᑕᐅᓱᒪᓕᕆᓂ ᐅᓂᒃ ᑲᓇᑕᒥ 31, 2013. ᑎᑎᕋᖅᑕᑦ ᑭᐅᓂᒃ ᓴᓇᓕᕆᓂ ᐊᖅᑭᒃᑯᐅᓕᕆᓂᒃ ᒪᑐ TGS-NOPEC-ᒥᑦ ᓄᓇᕗᑦ ᑕᐅᑦ ᑐᖓᓂᒃ ᐃᖅᑲᓇᐃᔨᖅᑎᑕᐅᓂᒃ ᑲᑎᒪᔨᓂᒃ (TGS), ᐅᖅᓱᓱᐊᖅᑐᒃ ᓴᓇᓕᕆᓂᒃ ᑯᓘᓐ (PGS) ᐊᑦᑕᓗᒃ ᒪᑐ ᒪᑦᑕᐃᓕᒃᑯᑦ ᐃᓐᓇᐅᑉ ᑲᑎᒪᔨᓂᒃ ᑎᑭᐅᓂᖅᑐᑦ ᐱᓇᓱᐊᖅᑐᒃ ᐱᓕᕆᔨᒃᑯᑦ (MKI) ᑐᒃ ᓱᓴᐅᑎᖅᑐᑐᒃ ᑲᑎᕋᖅᑕᐅᓱᒪᓕᕆᓂᒃ ᑲᑎᒪᔨᓂᒃ ᐱᓕᕆᔨᒃᑯᑦ ᐱᓕᕆᓂᒃᑐᑦ ᐃᓕᓴᕐᓂᐊᕐᓂᒃ ᓴᓇᓕᕆᓂᒃ ᐃᓕᓴᕐᓂᐊᕐᓂᒃ ᐊᑐᖅᑐᑦ

ההכרעה נתקבלה פה אחד לאחר שמיעת עדויות ובחינת מסמכים שהוגשו מטעם הצדדים. בית הדין הדגיש כי אין בכוונתו להתערב בשיקול דעתה של הרשות המקומית בכל הנוגע לתכנון ולפיתוח, אלא לבחון אך ורק את חוקיות ההליך ואת שמירת זכויותיהם של התושבים. בהתאם לכך, נקבע כי יש לבטל את ההחלטה מהטעמים שפורטו לעיל, וכי על הרשות המקומית לשוב ולדון בעניין בהרכב חדש ובמועד שייקבע בתוך 90 ימים מיום מתן פסק הדין.

בנוסף לביטול ההחלטה, חייב בית הדין את הרשות המקומית בתשלום הוצאות המשפט של העותרים בסך 12,500 ש"ח, וכן בתשלום שכר טרחת עורך דין בסך 35,000 ש"ח. סכומים אלה ישולמו תוך 30 יום מיום מתן פסק הדין, שאם לא כן יישאו הפרשי הצמדה וריבית כחוק. בית הדין ציין כי התנהלות הרשות המקומית בהליך זה, ובפרט אי-מתן מענה לפניות התושבים במשך למעלה משנה, מהווה שיקול מחמיר בעת קביעת שיעור ההוצאות.

לאחר מתן פסק הדין הגישה הרשות המקומית בקשה לעיון חוזר, בטענה כי נפלה טעות בחישוב שטחי הציבור שנדרשו לצורך הקצאת מגרשים חלופיים. בקשה זו נדחתה בהחלטה מנומקת מיום 14.3.2005, בקבעו כי הטענות הועלו כבר במהלך הדיון המקורי ואין בהן כדי להצדיק שינוי בתוצאה. בית הדין הוסיף כי הרשות המקומית רשאית לפנות בהצעה חלופית במסגרת הליך נפרד, ככל שתמצא לנכון.

בעקבות פסק הדין הוקמה ועדת מעקב מיוחדת, שבראשה עמד עו"ד יוסף בן-ארי, ובה נציגי העותרים ונציגי הרשות המקומית. הוועדה התכנסה לראשונה ביום 2.5.2005 ונדרשה להגיש דוח ביניים תוך 120 יום. בדוח שהוגש ביום 1.9.2005 הומלץ על הקצאת 42 מגרשים חלופיים בשכונת נווה-אורנים, הסמוכה למקום המגורים המקורי, ועל הקמת מבנה ציבור חדש בן 1,200 מ"ר. ההמלצות אומצו על ידי הרשות המקומית בישיבתה מיום 20.9.2005, ובכך הסתיים הליך היישום.

בשנת 1957 הוקמה בעיר מערכת חשמל עירונית, שהתבססה על תחנת כוח קטנה ועל רשת חלוקה מקומית. עד שנת 1980 גדל מספר הצרכנים ל-3,200, והתחנה המקורית לא עמדה עוד בעומסי השיא. בשנת 1984 הוחלט להקים תחנת כוח חדשה ולהרחיב את הרשת, ובשנת 1986 נחנכה התחנה החדשה בהספק של 12 מגה-וואט. בשנת 1990 הוקמה חברת החשמל העירונית בע"מ, שהחליפה את המחלקה העירונית.

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ההתנגדות לשינוי נובעת לעתים קרובות מהפחד שהשינוי יפגע בדברים שאנו אוהבים ומעריכים. לדוגמה, אם אנו אוהבים את הדרך שבה הדברים נעשים כעת, אנו עלולים להתנגד לשינוי מכיוון שאנו חוששים שהוא יפגע בדרך זו. (Ramos, 2001; Ramos, 2003; Ramos, 2008) ישנן מספר דרכים להתמודד עם התנגדות לשינוי. אחת הדרכים היא לתקשר בצורה ברורה ופתוחה על השינוי, מדוע הוא נחוץ ומה היתרונות שלו. דרך נוספת היא לערב את האנשים המושפעים מהשינוי בתהליך קבלת ההחלטות, כך שיוכלו להביע את דעותיהם ולהרגיש שהם חלק מהתהליך. (Ramos, 2009, p. 45; Ramos, 2010, NPC-ד מס' 1983: NWMB-ד מס' 2000; ראו גם Ramos, 2010). יש לזכור כי התנגדות לשינוי היא תגובה טבעית ואנושית, ועל כן יש להתייחס אליה בסבלנות ובהבנה. (Ramos, 2008).

כדי להתמודד עם התנגדות לשינוי, ישנן מספר אסטרטגיות שניתן ליישם. אחת האסטרטגיות היא לתקשר בצורה ברורה ופתוחה על השינוי, מדוע הוא נחוץ ומה היתרונות שלו. אסטרטגיה נוספת היא לערב את האנשים המושפעים מהשינוי בתהליך קבלת ההחלטות, כך שיוכלו להביע את דעותיהם ולהרגיש שהם חלק מהתהליך. (Ramos, 2006). בנוסף, חשוב להיות סבלניים ולתת לאנשים זמן להסתגל לשינוי. ניתן גם להציע תמיכה והכשרה לאנשים שמתקשים להסתגל לשינוי. (Ramos, 2001; Ramos, 2003; Ramos, 2008; ראו גם Ramos, 2009, p. 45; Ramos, 2010, NPC-ד מס' 1983: NWMB-ד מס' 2000; ראו גם Ramos, 2010). יש לזכור כי התנגדות לשינוי היא תגובה טבעית ואנושית, ועל כן יש להתייחס אליה בסבלנות ובהבנה. (Ramos, 2008).

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The quick brown fox jumps over the lazy dog.
Sphinx of black quartz, judge my vow.
Pack my box with five dozen liquor jugs.
How vexingly quick daft zebras jump!
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000

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Executive Summary

This document has been prepared in response to a letter received from the National Energy Board dated May 31, 2013. The letter was provided in response to TGS-NOPEC Geophysical Company ASA (TGS), Petroleum Geo-Services (PGS) and Multi Klient Invest AS (MKI) Application for Northeastern Canada 2D Seismic Survey Geophysical Operations Authorization application.

Research conducted to respond to the questions and concerns was completed through a review of reports from scientific and academic researchers, government departments, community organizations, non-governmental organizations, and the private sector. All supporting information referenced in this report is freely accessible to the general public and will be provided to the communities. This document is comprised of six sections with each section addressing comments and questions from the community meetings.

Section 1: Narwhal ice entrapment in the fall of 2008.

Researchers have discussed the possibility of two different causes for the 2008 narwhal entrapment in ice near Pond Inlet, Nunavut. Mads-Peter Heide-Jørgensen worked on both papers which provide different conclusions as to the potential causes of the narwhal entrapment.

Laidre and colleagues (2012) identified progressive later autumn ice formation in narwhal summering areas. Narwhal may have adjusted their migration patterns as a result of ice freezing later in the year (compared to previous years). The sudden temperature drop two days before the entrapment event may have caused a sudden freeze-up, not allowing the narwhal enough time to swim to open water. The authors question whether entrapment events on summering areas are random or resulting from narwhals adapting to changes in the time of sea ice freeze-up by prolonging time spent in summer grounds.

The second potential cause of the narwhal entrapment is from a short term increase in noise in the ocean. Prior to the narwhal entrapment, noise was produced from an earthquake (northwest of Resolute Bay on October 5, 2008) (CBC, 2008) and seismic survey (offshore Baffin Bay from late September until early October). Heide-Jørgensen and colleagues (2013) suggest that a seismic survey may be causally linked to the narwhal entrapment. The sudden increase in noise in the ocean may have startled the narwhal and caused them to remain in their summer grounds. The authors recommend for studies to be completed on the direct effects of seismic surveys on narwhal prior to seismic surveys in narwhal habitats.

Section 2: Reports from previous seismic projects.

During the community meetings it was recommended that the research should be limited to studies on seismic surveys in Baffin Day, Davis Strait, Beaufort Sea, and other northern

locations. NEXUS Coastal reviewed several reports and documents that looked at changes in behaviour of whales and seals near seismic surveys.

The behaviour of bowhead whales was assessed from aircraft observations during four seismic surveys in the Beaufort Sea from 1981 to 1984. Ljungblad and colleagues (1988) reported short term behavioural changes amongst bowhead whales when a seismic survey is less than 10km away. However, normal behaviour resumed about an hour after the seismic survey left the area. Another study (Richardson et al., 1986) used information obtained from both opportunistic and controlled observations on the behavioural reactions of bowhead whales to seismic surveys from 1980 to 1984 in the Beaufort Sea. Their research concluded that activities of bowhead whales 6-99km away from seismic survey vessels were usually similar to whales not exposed to external sound. They also reported a range of bowhead behavioural reactions closer to seismic surveys. Some whales oriented away from a seismic survey at a range of 2-4.5km, while other whales continued normal activities 3-5km away. Bowhead whale stopped feeding at the bottom of the ocean at a range of 3km away from a seismic survey. Monitoring results of a 2 year marine seismic survey in the Beaufort Sea (2001-2002) identified that bowhead whales were sighted further away (1957m) during active seismic operations compared to inactive periods (1368m) (Miller *et al.,* 2005). Bowhead whales did not display large scale avoidance of the survey area (Miller *et al.,* 2005).

The behaviour of adult, male sperm whales in polar waters exposed to sound from remote (more than 20km away) seismic survey vessel was researched by Madsen and colleagues (2000). They concluded that sperm whales did not show avoidance behaviour and stayed in the area during the seismic survey except for in the presence of pilot whales since pilot whale pods have been known to bother larger whales and cause them to leave an area. It is estimated that the sperm whales received sound levels of approximately 124dB re 1μPa²s. While the results of the study are not a regulatory consideration, it does prove useful in understanding sperm whale behaviour within a known sound field.

The feeding behaviour of gray whales near Sakhalin Island, Russia was monitored during a 3D seismic survey in 2001. Yazvenko and colleagues (2007) reported that the seismic survey did not affect how often gray whales ate. Aerial surveys were completed before, during, and after the seismic survey to record gray whale behaviour. Mitigation measures for the project ensured that gray whales did not receive sound levels greater than 163 dB (rms) re 1μPa (the corresponding distance was not provided).

Harris and colleagues (2001) discussed ringed and bearded seals behaviour around a 3D seismic survey in shallow, near shore waters in the Beaufort Sea in 1996. Seals partially avoided a zone (<150m from the sound source) during the seismic survey, but did not move much beyond 250m.

Many of the available reports assessed were from seismic surveys in the Beaufort Sea. We could not find available reports assessing the interaction of marine mammals and seismic surveys in Greenlandic waters. Instead, we reviewed Environmental Assessments for two of the most recent seismic surveys (2D and 3D in Greenlandic waters). In the EA for Shells 2013 2D seismic survey, they included marine mammal sightings for their 2012 3D seismic survey in

Baffin Bay (Shell, 2013). They did not see any bowhead, beluga, or narwhals during the transit to the survey area or during the seismic survey. NEXUS Coastal also reviewed assessments of the harvest levels of whale species in Greenland. The amount of whales harvested did not decrease since Greenland began seismic surveys in 2007 (FAO, 2013) and Greenlandic hunters reported seeing increased number of narwhals.

Two reports provided information on the length of time whales required to resume normal behaviour after a seismic survey had left the area. Ljungblad and colleagues (1988) assessed behavioural data collected by visual observations on aircrafts between 1981 and 1984 taken from multiple seismic surveys in the Beaufort Sea. Bowhead whales resumed normal behaviour one hour after the seismic survey left the area. In the Preliminary Impact Assessment of Regional Offshore Seismic Surveys in Greenland, Mosbech and colleagues (2000) stated that both opportunistic observations and systematic studies indicated that whales moderately react to seismic activities but usually resume their normal behaviour within 48 hours after the seismic survey has left the area.

Section 3: Labrador and Newfoundland Project

In 2012, Multi Klient Invest AS (MKI) conducted a 2D seismic survey utilizing the M/V Sanco Spirit on the Northeast Newfoundland slope. Environmental data collected during this survey has been compiled into a Final Environmental Report. The seismic survey took place between 4th September and 8th November 2012. This report is produced to comply with the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) regulations. The environmental data in this report includes marine mammal and seabird observations and fisheries communications for the duration of the survey. This report has been attached as Appendix C for your review.

Section 4: Marine Seismic Sound/Source

Refer to Appendix D for a comparison of naturally occurring and anthropogenic sounds.

Section 5: Acoustic Modelling in Survey Area

JASCO Applied Sciences Ltd. (JASCO) conducted an acoustic modelling study for Arcis Seismic Solutions (Arcis), a TGS company, to characterize acoustic propagation from an airgun array operating along proposed (Year 1) survey lines within the Canadian waters of Baffin Bay and Davis Strait. This report has been attached as Appendix E.

Section 6: Effects of Sound on Marine Mammals

Known effects of sound generated during seismic surveys on marine mammals behaviour was reviewed for narwhal, beluga and bowhead whales, ringed and bearded seals, walrus and polar bears. The intensity of sound, measured in decibels (dB) produced by the source is a primary cause of physical and behavioural effects on marine mammals. Animal responses to noise are highly variable, depending on species, individuals, age, sex, physical state, presence of offspring, prior experience, characteristics of the noise source, and other factors.

Information compiled for this analysis included data on the known effects of seismic surveys on marine mammals; information on migratory routes of the various species; and observations made on the behaviour and activity of the marine mammal populations during the summer months.

Analysis of known narwhal migratory patterns (Dietz et al., 2008; Dietz et al., 2001; Heide-Jørgensen et al., 2003) suggest there is potential for four out of the five narwhal populations to interact with the proposed seismic survey. However, the survey can be designed and scheduled to prevent interaction with narwhal based on both the timing and location of migratory routes.

Based on information available on the migration routes of three beluga populations (Richard et al., 1998; NAMCO, n.d.; Heide-Jørgensen et al., 2003; DFO, 2002; DFO, 2009; Richard, 2010; NPC, 2009) known to migrate near the proposed survey area, it can be concluded that the other two populations may not interact with the proposed seismic survey. The migration route for the Western-Northern-Southern Hudson Bay beluga population which enters Frobisher Bay is unknown. However, it is unlikely that these beluga whales will interact with the seismic survey.

Bowhead whales migrate either south along Baffin Island or cross Baffin Bay to the west coast of Greenland (Reeves et al., 1983; NWMB, 2000; Ferguson et al., 2010). It is possible that bowhead whales may encounter the proposed seismic survey. However, the survey can be scheduled so as to limit interaction with bowhead whales.

The High Arctic walrus population summering and wintering areas are not located in the survey area (Stewart, 2008). Northern Hudson Bay- Hudson Strait- Southeastern Baffin Island-Northern Labrador walrus may be in the survey area when the survey is being conducted since they are known to migrate along a corridor between Qikiqtarjuaq and Greenland (COSEWIC, 2006). A Temporary Threshold Shift as a result of sound from seismic surveys has not been documented for walrus (U.S. Department of the Interior, 2011).

Bearded and ringed seals are likely to be in the survey area (Shell, 2013; NPC, 2009; Kovacs, n.d., Finley et al., 1983). However, both seals have been known only to display a change in behaviour when they are within 250m of a seismic survey (Harris et al., 2001).

It is unlikely that polar bears will be in the vicinity of the seismic survey since polar bears remain close to shore, on land, or near ice packs (the survey will only operate in open water areas) (Taylor et al., 2001).

Information provided in this document and in the Environmental Assessment for the proposed seismic survey indicates that with an effective survey design, the effect to whales, seals, walrus and polar bears can be minimized.

Section 7: Arctic Fisheries Alliance Information Requests

The location of the seismic activity associated with this project will not take place in the vicinity of any native harvest area. Native Harvest areas are identified by those being within the settlement zone.

JASCO
APPLIED SCIENCES

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JASCO Applied Sciences (ᓴᔨ ᑯ ᖅᑲᐅᔪᓴ ᖅᑎᖅᓴᒃ)
Suite 2305, 4464 Markham St.
Victoria, BC V8Z 7X8 Canada
ᐅᖅᑳᐅᑎᖅᓱᒃ : +1-250-483-3300
ᓯᑲᓴᵇ ᑯᑦ : +1-250-483-3301
ᖅᑲᓪᑕᐅᔪᑎᒍᑦ ᑐᕋᑭᑎᖅᓱᒃ : www.jasco.com

ᐅᔨ ᒍᑎ 23, 2013 27 August 2013

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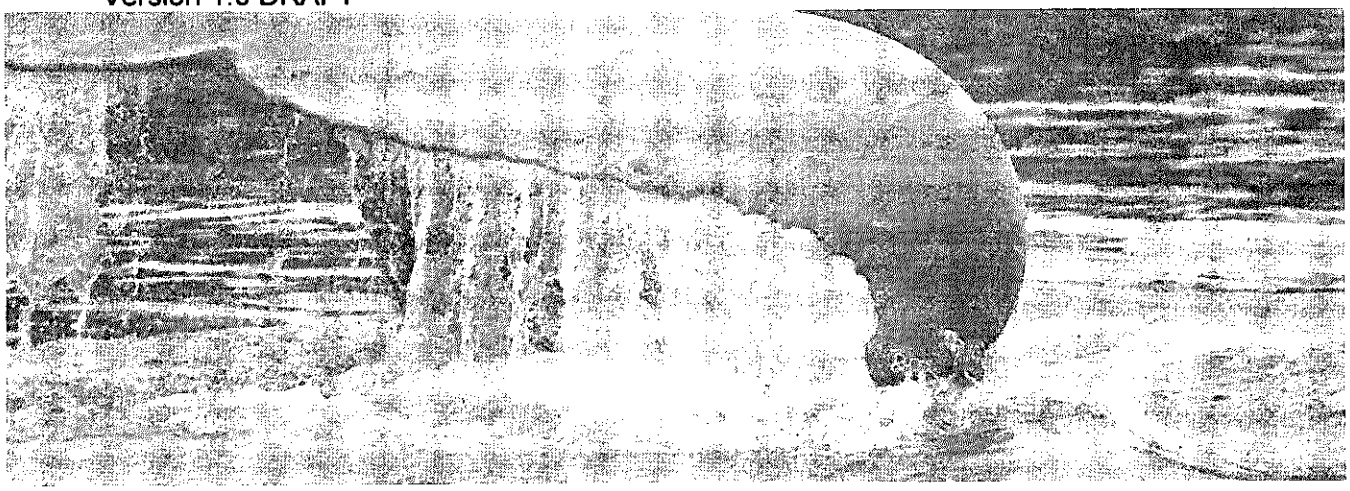

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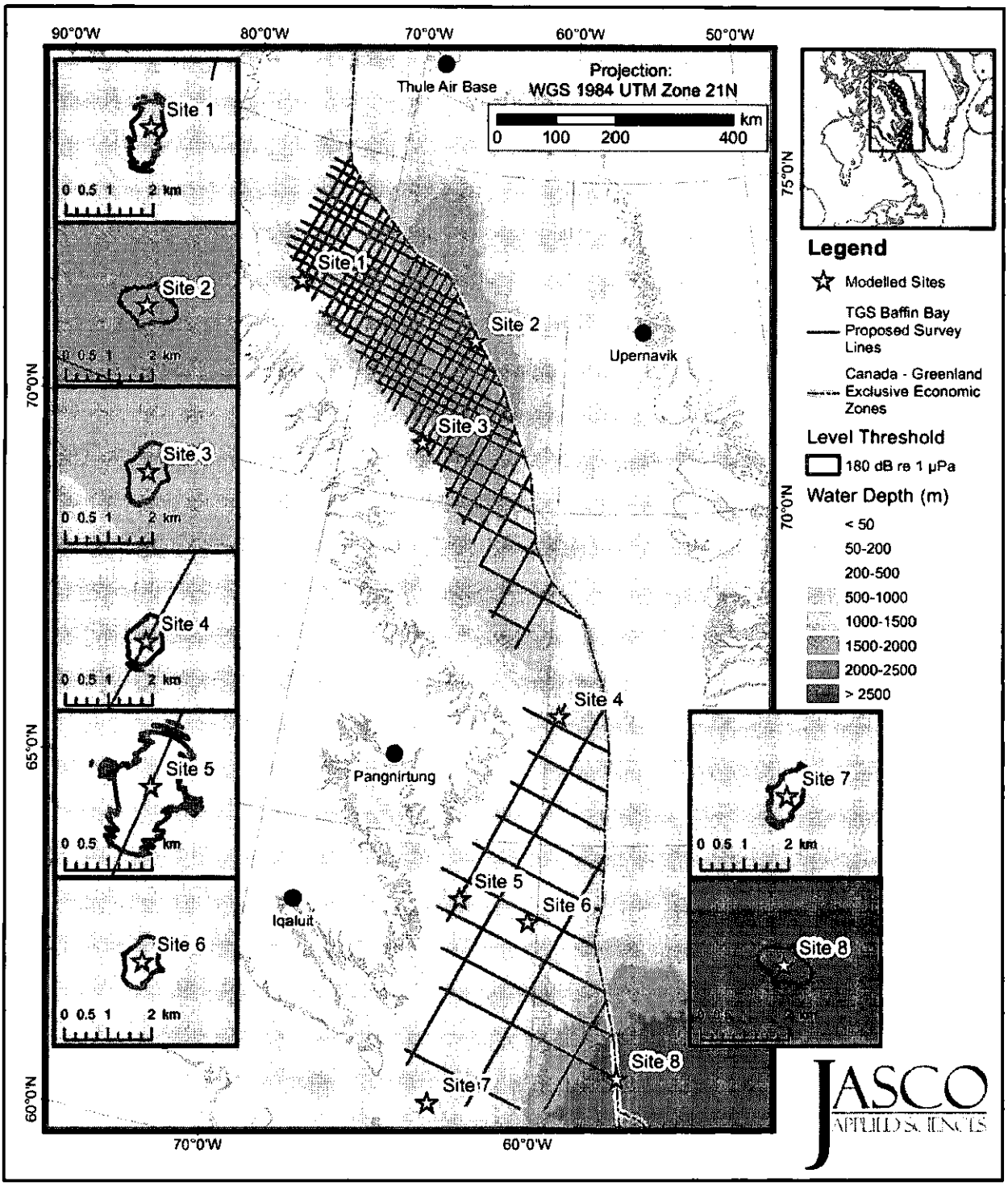
1. ᓇᐃᓕ ᓕᒥᐊᖅᑕᐅᓯᒪᔪᓕ

ᖃᓄ ᑯ ᖃᐅᔨᓴᓄᖅᑎᑦ ᑯᖓᓐ ᓯᓂᑎᑦ . (JASCO) ᖃᐅᔨᓴᓄ ᐃᓕ ᔪᑎᖅ ᓂᓪᓕᐅᖅ ᒪᑕ ᐊᖅ ᓯᓄ ᑐᓄᖅᓴᐅᑎᑦ ᑎᓯᓂᐅᖅᑎᑦ ᑎᓕ ᔪᑎᓂᓪᓚᖅᖃᓕᒫᖅ (Arcis), TGS-ᑯᓗ ᓄᑦ ᑲᒃ <ᓂᒥᓴᐅᔨᓕᒫᖅ , ᓇᓄᓇᐃᖅᑕᐅᓯᒪᔪᓕᖅᑐᑦ ᓄᑦᑕᐅᑦ ᑐᓄᑦ ᑐᓴᓄᖅᑎᑦᑎᓄᖅ ᑐᓴᖅᓴᐅᓂᒃᑲᓐᓂᑐᑦ ᑐᓄᑦ >ᑦ ᓕᒃ ᓯᓕᓴ ᑎᑦᑐᓄᒃ ᐊᑐᖅᓂᒃ ᑎᑦ ᓄᑦᑐᑦ ᖃᐅᔨᓴᓄ ᐃᓂᖅᑐᖅᑐᑦ ᐃᓕᓴᐅᓂ ᐅᓇᑦᑐᓕᒫᖅ ᔪᓇᖅᑐᑦ ᐊᓕᖅᓂᐊᓕᖅᑐᑦ ᐃᓕᖅᓂᒃ ᐃᓕᓴᐅᓂ ᐅᓇᑦᑐᓕᒫᖅ ᐃᓕᖅᓂᒃ ᐃᓄᐃᑦᑐᓕᒫᖅ ᐃᓕᖅᓂᒃ ᐃᓄᐃᑦᑐᓕᒫᖅ ᐃᓄᐃᑦᑐᓕᒫᖅ ᐃᓄᐃᑦᑐᓕᒫᖅ

ᓇᓗᓇᐃᔭ ᐅᑎᑦ 1, ᖃᓄᑦ ᑎᓴ ᓂᖅᑐᓂᕐᒧᑐᖅᓗᑐᑎᒃ (R_{max}) ᐊᒃᓪ ᒪ ᓗ 95% ($R_{95\%}$) ᖃᐅᐱᔭ ᕈ ᐊᖅᑎᑕ ᐅᓴᓯᐅᑦ ᑎᑭᑦᑐᓂᒃ ᑎᑭᑦᑐᓂᒃ ᓂᕐᒥᓂᒃ ᐅᑦᓪ ᖃᓄᐃᓕᓂᒃ ᑎᑭᑦᑐᓂᒃ ᓂᕐᒥᓂᒃ rms SPL; 10 Hz to 2 kHz)-ᓴᒥᓂᒃ ᐅᓐᖓᓴᒍ 180 dB re 1 µPa-ᒥᑦ, ᑐᖓᓴᓐ ᐃᑎᑦ ᓗᑎᑦ ᖃᓄᑦ ᑎᖅᓴᖅᓂᕐᒧᑐᖅᓗᑐᑎᒃ ᐃᑎᓂᓴᒪᑦ ᑐᓂᓴᖅᑎᑦ .

ᖃᐅᔨᓴᒥᐊᖅ ᐃᓕᓴᕆᔨᑦ	R_{max} (m)	$R_{95\%}$ (m)
ᖃᐅᔨᓴᓗᖅ ᐃᓕᓴᕆᔨᖅ 1	1 021	878
ᖃᐅᔨᓴᓗᖅ ᐃᓕᓴᕆᔨᖅ 2	729	614
ᖃᐅᔨᓴᓗᖅ ᐃᓕᓴᕆᔨᖅ 3	810	659
ᖃᐅᔨᓴᓗᖅ ᐃᓕᓴᕆᔨᖅ 4	689	567
ᖃᐅᔨᓴᓗᖅ ᐃᓕᓴᕆᔨᖅ 5	1 592	1 398
ᖃᐅᔨᓴᓗᖅ ᐃᓕᓴᕆᔨᖅ 6	613	560
ᖃᐅᔨᓴᓗᖅ ᐃᓕᓴᕆᔨᖅ 7	796	657
ᖃᐅᔨᓴᓗᖅ ᐃᓕᓴᕆᔨᖅ 8	680	596



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JASCO
APPLIED SCIENCES

Underwater Sound Propagation from a 4718 in^3 Airgun Array

Baffin Bay/Davis Strait 2-D Seismic Survey Program–Summary

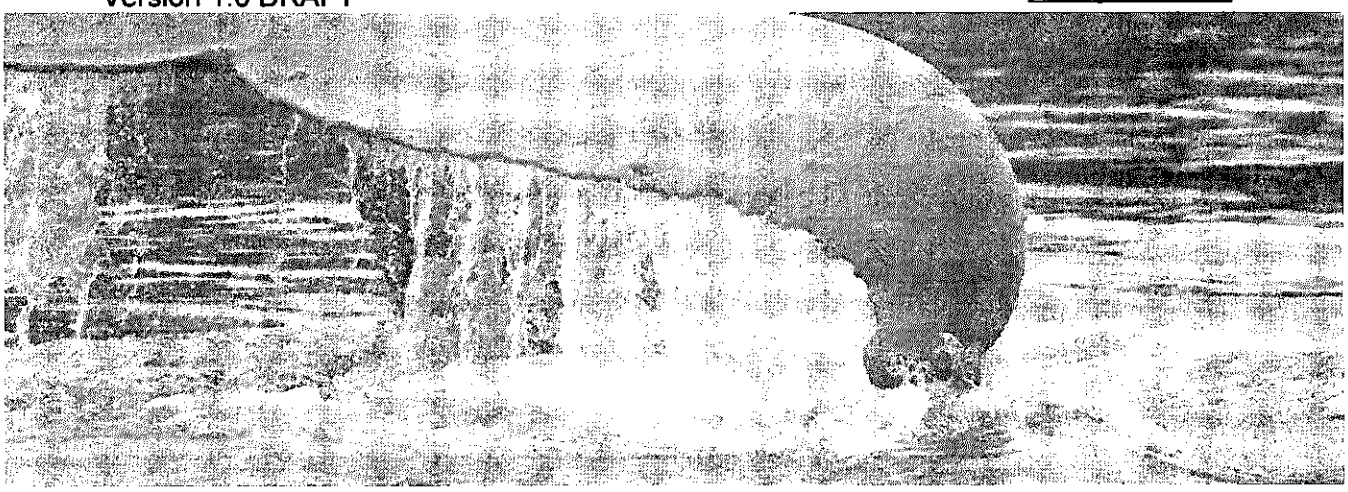
Submitted to:
Troy Nelson
Arcis Seismic Solutions
Calgary, AB

Author:
Marie-Noël R. Matthews

24 August 2013

P001204-002
Document 00637
Version 1.0 DRAFT

JASCO Applied Sciences
Suite 2305, 4464 Markham St.
Victoria, BC V8Z 7X8 Canada
Tel: +1-250-483-3300
Fax: +1-250-483-3301
www.jasco.com



Document Version Control

Version	Date	Name	Change
1.0		M.-N. R Matthews	Draft released to client for review.

Suggested citation:

Matthews, M.-N. R. 2013. *Underwater Sound Propagation from a 4718 in^3 Airgun Array: Baffin Bay/Davis Strait 2-D Seismic Survey Program–Summary*. JASCO Document 00637, Version 1.0 DRAFT. Technical report by JASCO Applied Sciences for Arcis Seismic Solutions.

1. Summary

JASCO Applied Sciences Ltd. (JASCO) conducted a study for Arcis Seismic Solutions (Arcis), a TGS company, to characterize sound propagation from an airgun array operating along proposed survey lines within Canadian waters of Baffin Bay and Davis Strait.

Root-mean-square sound pressure levels (rms SPLs) for August were modelled at eight sites. Based on the sound speed characteristics of the water column, August was chosen to produce conservative results for the operational months (June to October). The eight modelled sites were chosen to represent the various water depths in the survey area.

The underwater sound fields predicted by the propagation models were sampled so that the received sound level at each point in the horizontal plane was taken to be the maximum value over all modelled depths for that point. The resultant maximum-over-depth sound fields are presented below in two formats: as tables of distances to the 180 dB re 1 µPa (rms SPL), and as contour maps showing the directivity of the 180 dB re 1 µPa (rms SPL) threshold.

For all non-explosive sources, researchers have expressed concerns about temporary and/or permanent hearing impairment to cetaceans at broadband received rms SPLs of 180 dB re 1 µPa or greater, and to pinnipeds at broadband received rms SPLs of 190 dB re 1 µPa or greater (MMPA 2007). Note, however, that the *Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment* (DFO 2007) states that a circular safety zone extending 500 m from the array must be observed.

Distances to 180 dB re 1 µPa (rms SPL) depend mainly on the water depth at the array location and on the acoustic properties of the seafloor. Sound propagation at Site 5, the shallowest modelled site, produced the longest distances to rms SPL of 180 dB re 1 µPa, while sound propagation at Site 8, the deepest modelled site, produced the shortest distances (Table 1 and Figure 1).

Table 1. Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances from the airgun array to sound pressure level (rms SPL; 10 Hz to 2 kHz) of 180 dB re 1 µPa, based on modelled maximum-over-depth values.

Sites	R_{max} (m)	$R_{95\%}$ (m)
Site 1	1 021	878
Site 2	729	614
Site 3	810	659
Site 4	689	567
Site 5	1 592	1 398
Site 6	613	560
Site 7	796	657
Site 8	680	596

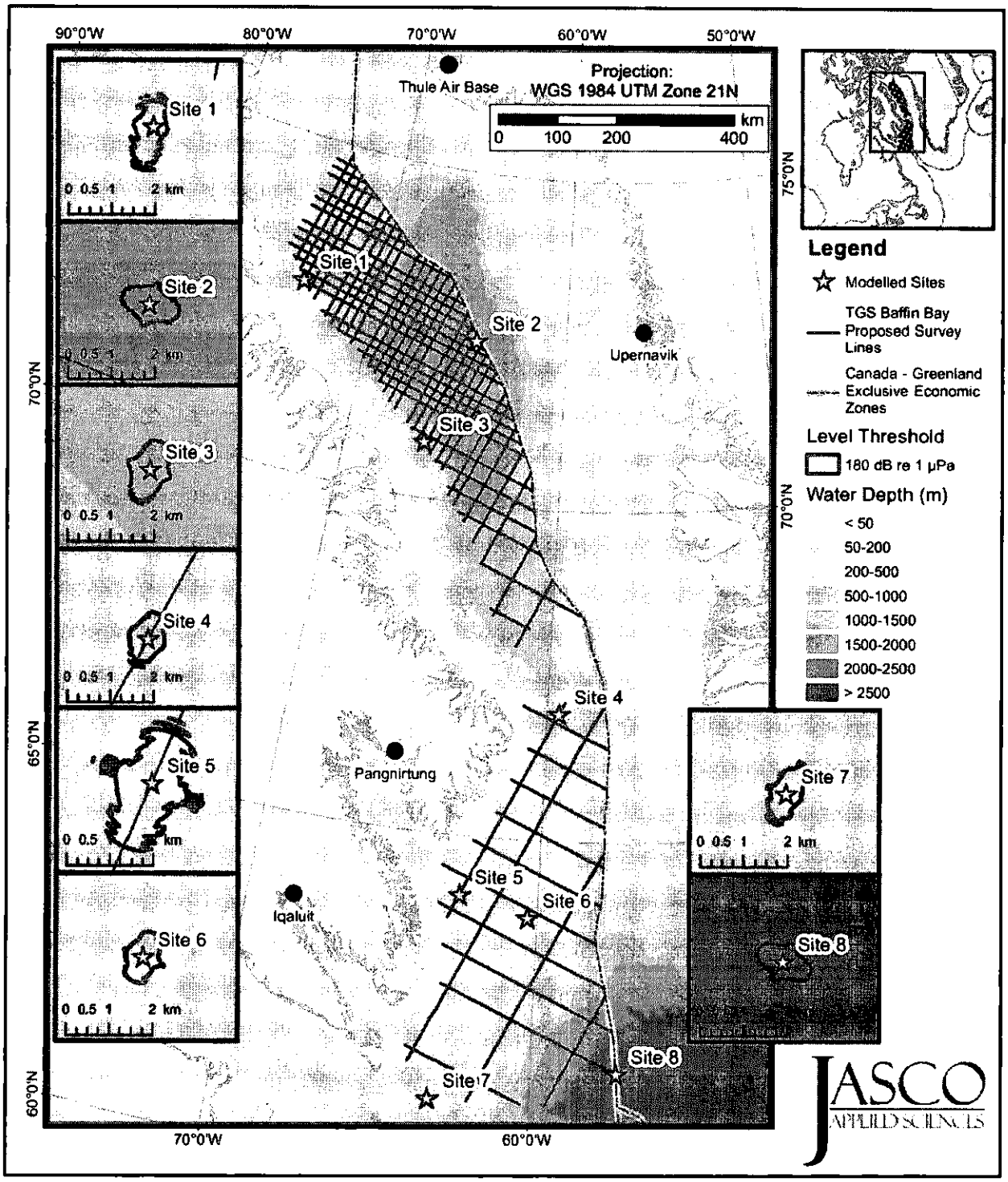


Figure 1. Overview of modelled root-mean-square sound pressure level (rms sPL) of 180 dB re 1 µPa at Sites 1–8.

Supplementary Report II

Follow-Up to the National Energy Board Letter dated May 31, 2013

Information provided in response to

Appendix 1

TGS-NOPEC Geophysical Company ASA, Petroleum Geo-Services and Multi Klient Invest AS (TGS/PGS/MKI) Northeastern Canada 2D Seismic Exploration Survey.

August 22, 2013

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Executive Summary

This document has been prepared in response to a letter received from the National Energy Board dated May 31, 2013. The letter was provided in response to TGS-NOPEC Geophysical Company ASA (TGS), Petroleum Geo-Services (PGS) and Multi Klient Invest AS (MKI) Application for Northeastern Canada 2D Seismic Survey Geophysical Operations Authorization application.

Research conducted to respond to the questions and concerns was completed through a review of reports from scientific and academic researchers, government departments, community organizations, non-governmental organizations, and the private sector. All supporting information referenced in this report is freely accessible to the general public and will be provided to the communities. This document is comprised of six sections with each section addressing comments and questions from the community meetings.

Section 1: Narwhal ice entrapment in the fall of 2008.

Researchers have discussed the possibility of two different causes for the 2008 narwhal entrapment in ice near Pond Inlet, Nunavut. Mads-Peter Heide-Jørgensen worked on both papers which provide different conclusions as to the potential causes of the narwhal entrapment.

Laidre and colleagues (2012) identified progressive later autumn ice formation in narwhal summering areas. Narwhal may have adjusted their migration patterns as a result of ice freezing later in the year (compared to previous years). The sudden temperature drop two days before the entrapment event may have caused a sudden freeze-up, not allowing the narwhal enough time to swim to open water. The authors question whether entrapment events on summering areas are random or resulting from narwhals adapting to changes in the time of sea ice freeze-up by prolonging time spent in summer grounds.

The second potential cause of the narwhal entrapment is from a short term increase in noise in the ocean. Prior to the narwhal entrapment, noise was produced from an earthquake (northwest of Resolute Bay on October 5, 2008) (CBC, 2008) and seismic survey (offshore Baffin Bay from late September until early October). Heide-Jørgensen and colleagues (2013) suggest that a seismic survey may be causally linked to the narwhal entrapment. The sudden increase in noise in the ocean may have startled the narwhal and caused them to remain in their summer grounds. The authors recommend for studies to be completed on the direct effects of seismic surveys on narwhal prior to seismic surveys in narwhal habitats.

Section 2: **Reports from previous seismic projects.**

During the community meetings it was recommended that the research should be limited to studies on seismic surveys in Baffin Day, Davis Strait, Beaufort Sea, and other northern

locations. NEXUS Coastal reviewed several reports and documents that looked at changes in behaviour of whales and seals near seismic surveys.

The behaviour of bowhead whales was assessed from aircraft observations during four seismic surveys in the Beaufort Sea from 1981 to 1984. Ljungblad and colleagues (1988) reported short term behavioural changes amongst bowhead whales when a seismic survey is less than 10km away. However, normal behaviour resumed about an hour after the seismic survey left the area. Another study (Richardson et al., 1986) used information obtained from both opportunistic and controlled observations on the behavioural reactions of bowhead whales to seismic surveys from 1980 to 1984 in the Beaufort Sea. Their research concluded that activities of bowhead whales 6-99km away from seismic survey vessels were usually similar to whales not exposed to external sound. They also reported a range of bowhead behavioural reactions closer to seismic surveys. Some whales oriented away from a seismic survey at a range of 2-4.5km, while other whales continued normal activities 3-5km away. Bowhead whale stopped feeding at the bottom of the ocean at a range of 3km away from a seismic survey. Monitoring results of a 2 year marine seismic survey in the Beaufort Sea (2001-2002) identified that bowhead whales were sighted further away (1957m) during active seismic operations compared to inactive periods (1368m) (Miller *et al.,* 2005). Bowhead whales did not display large scale avoidance of the survey area (Miller *et al.,* 2005).

The behaviour of adult, male sperm whales in polar waters exposed to sound from remote (more than 20km away) seismic survey vessel was researched by Madsen and colleagues (2000). They concluded that sperm whales did not show avoidance behaviour and stayed in the area during the seismic survey except for in the presence of pilot whales since pilot whale pods have been known to bother larger whales and cause them to leave an area. It is estimated that the sperm whales received sound levels of approximately 124dB re 1µPa²s. While the results of the study are not a regulatory consideration, it does prove useful in understanding sperm whale behaviour within a known sound field.

The feeding behaviour of gray whales near Sakhalin Island, Russia was monitored during a 3D seismic survey in 2001. Yazvenko and colleagues (2007) reported that the seismic survey did not affect how often gray whales ate. Aerial surveys were completed before, during, and after the seismic survey to record gray whale behaviour. Mitigation measures for the project ensured that gray whales did not receive sound levels greater than 163 dB (rms) re 1µPa (the corresponding distance was not provided).

Harris and colleagues (2001) discussed ringed and bearded seals behaviour around a 3D seismic survey in shallow, near shore waters in the Beaufort Sea in 1996. Seals partially avoided a zone (<150m from the sound source) during the seismic survey, but did not move much beyond 250m.

Many of the available reports assessed were from seismic surveys in the Beaufort Sea. We could not find available reports assessing the interaction of marine mammals and seismic surveys in Greenlandic waters. Instead, we reviewed Environmental Assessments for two of the most recent seismic surveys (2D and 3D in Greenlandic waters). In the EA for Shells 2013 2D seismic survey, they included marine mammal sightings for their 2012 3D seismic survey in

Baffin Bay (Shell, 2013). They did not see any bowhead, beluga, or narwhals during the transit to the survey area or during the seismic survey. NEXUS Coastal also reviewed assessments of the harvest levels of whale species in Greenland. The amount of whales harvested did not decrease since Greenland began seismic surveys in 2007 (FAO, 2013) and Greenlandic hunters reported seeing increased number of narwhals.

Two reports provided information on the length of time whales required to resume normal behaviour after a seismic survey had left the area. Ljungblad and colleagues (1988) assessed behavioural data collected by visual observations on aircrafts between 1981 and 1984 taken from multiple seismic surveys in the Beaufort Sea. Bowhead whales resumed normal behaviour one hour after the seismic survey left the area. In the Preliminary Impact Assessment of Regional Offshore Seismic Surveys in Greenland, Mosbech and colleagues (2000) stated that both opportunistic observations and systematic studies indicated that whales moderately react to seismic activities but usually resume their normal behaviour within 48 hours after the seismic survey has left the area.

Section 3: Labrador and Newfoundland Project

In 2012, Multi Klient Invest AS (MKI) conducted a 2D seismic survey utilizing the M/V Sanco Spirit on the Northeast Newfoundland slope. Environmental data collected during this survey has been compiled into a Final Environmental Report. The seismic survey took place between 4th September and 8th November 2012. This report is produced to comply with the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) regulations. The environmental data in this report includes marine mammal and seabird observations and fisheries communications for the duration of the survey. This report has been attached as Appendix C for your review.

Section 4: Marine Seismic Sound/Source

Refer to Appendix D for a comparison of naturally occurring and anthropogenic sounds.

Section 5: Acoustic Modelling in Survey Area

JASCO Applied Sciences Ltd. (JASCO) conducted an acoustic modelling study for Arcis Seismic Solutions (Arcis), a TGS company, to characterize acoustic propagation from an airgun array operating along proposed (Year 1) survey lines within the Canadian waters of Baffin Bay and Davis Strait. This report has been attached as Appendix E.

Section 6: Effects of Sound on Marine Mammals

Known effects of sound generated during seismic surveys on marine mammals behaviour was reviewed for narwhal, beluga and bowhead whales, ringed and bearded seals, walrus and polar bears. The intensity of sound, measured in decibels (dB) produced by the source is a primary cause of physical and behavioural effects on marine mammals. Animal responses to noise are highly variable, depending on species, individuals, age, sex, physical state, presence of offspring, prior experience, characteristics of the noise source, and other factors.

Information compiled for this analysis included data on the known effects of seismic surveys on marine mammals; information on migratory routes of the various species; and observations made on the behaviour and activity of the marine mammal populations during the summer months.

Analysis of known narwhal migratory patterns (Dietz et al., 2008; Dietz et al., 2001; Heide-Jørgensen et al., 2003) suggest there is potential for four out of the five narwhal populations to interact with the proposed seismic survey. However, the survey can be designed and scheduled to prevent interaction with narwhal based on both the timing and location of migratory routes.

Based on information available on the migration routes of three beluga populations (Richard et al., 1998; NAMCO, n.d.; Heide-Jørgensen et al., 2003; DFO, 2002; DFO, 2009; Richard, 2010; NPC, 2009) known to migrate near the proposed survey area, it can be concluded that the other two populations may not interact with the proposed seismic survey. The migration route for the Western-Northern-Southern Hudson Bay beluga population which enters Frobisher Bay is unknown. However, it is unlikely that these beluga whales will interact with the seismic survey.

Bowhead whales migrate either south along Baffin Island or cross Baffin Bay to the west coast of Greenland (Reeves et al., 1983; NWMB, 2000; Ferguson et al., 2010). It is possible that bowhead whales may encounter the proposed seismic survey. However, the survey can be scheduled so as to limit interaction with bowhead whales.

The High Arctic walrus population summering and wintering areas are not located in the survey area (Stewart, 2008). Northern Hudson Bay- Hudson Strait- Southeastern Baffin Island-Northern Labrador walrus may be in the survey area when the survey is being conducted since they are known to migrate along a corridor between Qikiqtarjuaq and Greenland (COSEWIC, 2006). A Temporary Threshold Shift as a result of sound from seismic surveys has not been documented for walrus (U.S. Department of the Interior, 2011).

Bearded and ringed seals are likely to be in the survey area (Shell, 2013; NPC, 2009; Kovacs, n.d., Finley et al., 1983). However, both seals have been known only to display a change in behaviour when they are within 250m of a seismic survey (Harris et al., 2001).

It is unlikely that polar bears will be in the vicinity of the seismic survey since polar bears remain close to shore, on land, or near ice packs (the survey will only operate in open water areas) (Taylor et al., 2001).

Information provided in this document and in the Environmental Assessment for the proposed seismic survey indicates that with an effective survey design, the effect to whales, seals, walrus and polar bears can be minimized.

Section 7: Arctic Fisheries Alliance Information Requests

The location of the seismic activity associated with this project will not take place in the vicinity of any native harvest area. Native Harvest areas are identified by those being within the settlement zone.

Opening

Much of the information presented in the following material can be found in the environmental Assessment (EA) document filed by Multi Klient Invest AS (MKI) to the NEB. The EA as made available to the public through the NEB website. The information from the EA Report, as well as additional project specific information would have been made available at the community meeting had MKI received advance notice of the purpose of their participation.

MKI trusts that the information compiled from EA report, as well as information from additional research, sufficiently addresses the specific concerns and inquiries presented during the community meeting. We welcome the opportunity to further discuss the project with community representatives in the near future.

Introduction

This report was prepared in response to a letter (May 31, 2013) from the National Energy Board (NEB) to RPS Energy. The letter from the NEB was provided in response to TGS-NOPEC Geophysical Company ASA (TGS), Petroleum Geo-Services (PGS) and Multi Klient Invest AS (MKI) Application for Northeastern Canada 2D Seismic Survey Geophysical Operations Authorization application. The NEB reviewed the application, letters of comment, subsequent filings, and information received during public meetings conducted by the NEB in the communities of Pond Inlet, Clyde River, Qikiqtarjuaq, and Iqaluit from April 29th, 2013 to May 2, 2013.

The letter summarized issues identified by the NEB which requires follow up from TGS/PGS/MKI. Each issue is presented in a section in this report (Table 1). Transcript references refer to the transcripts from the April 29-May 3 meetings prepared by the NEB (available on the NEB website).

Table 1: Report sections and related discussion topics in Appendix 1 (NEB letter dated May 31, 2013)

Section	Matter raised during the public meetings	Transcript Reference
Section 1: Narwhal ice entrapment in the fall of 2008.	Change in narwhal migration or narwhal stranding incident in the fall of 2008.	Vol. 1, para 167 and 633
Section 2: Reports from previous seismic projects	The effects of marine seismic projects on wildlife as observed from previous marine seismic projects, specifically projects conducted in Greenland.	Vol. 1, para 178; Vol. 3, para 1361, 1362, 1363, 1462, 1466, and 1467
Section 3: Labrador and Newfoundland Project	How many times Marine Mammal Observers required shut downs for the project in Labrador and Newfoundland waters.	Vol. 3, para 1778

Section	Matter raised during the public meetings	Transcript Reference
Section 4: Marine Seismic Sound	Acoustic properties or modeling of marine seismic including information indicating how far travels sound and specifically how the sound would compare to the sound of a .22 rifle firing or a whale. MKI committed to providing a video that demonstrates the comparison of air guns and sound sources that are familiar to community members.	Vol. 1, para 237, 255, 263, 277 and 673; Vol. 3, para 1326, 1341, 1694
Section 5: Acoustic Modelling in Survey Area	Sound modeling as it relates to the project area.	Vol. 3, para 1346
Section 6: Effects of Sound on Marine Mammals	The effects of sound on marine mammals.	Vol. 1, para 627, 884 and 886; Vol. 2, para 1184
	What effect the project will have on walrus migration.	Vol. 4, para 2070
	What effect the project will have on bearded seals and ringed seals.	Vol. 4, para 2073
	What effect the project will have on polar bears.	Vol. 4, para 2076
Section 7: Arctic Fisheries Alliance Information Requests	Arctic Fisheries Alliance presentation and requests	Vol. 3, para 1595 to 1638.

This report has been written to provide information to the communities in response to their expressed concerns and questions. All articles and reports referenced will be sent to the communities on a USB drive. All articles and reports referenced are available through search engines (such as: www.google.com; www.scholar.google.com) on the internet.

Documents previously prepared by MKI and distributed to the communities are available on the NEBs website.

1 Narwhal entrapment in ice in the fall of 2008.

Background: On November 15, 2008, Pond Inlet residents found approximately 200 narwhal trapped in breathing holes. This number later increased to 628 narwhal in over 20 breathing holes[1]. The nearest open water was 50km away, and it was determined that the animals had no chance of escaping to open water. A harvest of 628 narwhal occurred[2].

The cause of the 2008 Pond Inlet narwhal ice entrapment has been a topic of interest and discussion within Nunavut communities and with academic researchers. Entrapments occur more frequently in Disko Bay, Greenland than anywhere else. Disko Bay is an area where prevailing northwest winds, an influx of warm water from the south and a jagged coastline combine to create very volatile ice conditions. More than 3,000 belugas were trapped at Disko Bay in 1955, and another 1,000 in 1970 and six hundred belugas and narwhals trapped in 1968[3].

Two possible causes were proposed for the 2008 Pond Inlet narwhal entrapment in ice.

1.1 Ice is forming later in the year[4]

The air temperature in early November 2008 varied between -23°C and -12°C. From November 13 to November 24 the air temperature dropped to -32°C with wind consistently blowing at 2-3m/s (a light breeze) from the south. The sudden decrease in air surface temperature led to open water freezing. For example, with 3 days of -19°C air temperature, ice can grow to 14cm thick. This is beyond the limit of narwhal ice-breaking ability.

Narwhal were found trapped in ice on November 15, two days after the sudden temperature drop. This limits narwhals to open water on which ice can grow rapidly. The entrapment occurred within the narwhal summering ground, which suggests that the whales had delayed their departure from their summering grounds to their wintering grounds. Laidre and colleagues (2012) have concluded that ice formation is occurring progressively later in the year in the narwhal summer habitats. Three narwhal populations located around Pond Inlet (Eclipse Sound, Somerset Island and Admiralty Inlet) generally begin their fall migration from mid-September until early October[5]. Narwhal either migrate to wintering grounds in Baffin Bay or to west-Greenland

1.2 Sudden increase in ocean noise

The second potential explanation of the narwhal entrapment is that it was caused from a sudden increase in noise in the ocean. Prior to the narwhal entrapment, noise was produced from an earthquake (northwest of Resolute Bay on October 5, 2008) (CBC, 2008) and seismic survey (offshore Baffin Bay from late September until early October).

From late September until early October 2008, a seismic survey took place in Baffin Bay[6]. The authors hypothesized that there may be a causal connection with the seismic survey interrupting

the narwhals outward migration to their wintering grounds. (However, as noted above, there is also evidence that the migration has generally been shifting to later in the season due to other climatic factors.)

On October 7, 2008, there was 5.7 magnitude earthquake 755 km northwest of Resolute Bay[7]. A 5.0 magnitude earthquake produces a sound roughly 235 dB[8], which is louder than a seismic survey. The noise may have startled the narwhal and as a result interrupted their outward migration from their summering grounds to their wintering grounds.

1.3 Summary

We don't know the exact cause of the 2008 Pond Inlet narwhal entrapment in ice. Researchers have identified two possible explanations: narwhal were trapped in ice due to a rapid drop in temperature or the sudden increase in noise in the ocean. In this situation, we are trying to explain how the narwhals became trapped by looking back at the event to identify potential causes. In the 2-3 weeks before the entrapment, the sound produced from the earthquake and seismic program would have dissipated, while the air temperature dropped significantly a few days before entrapment. We may never know the real reason why or how narwhals became trapped in ice.

Inuit and scientific researchers have discussed the importance of conducting research to document narwhal behaviour around sound produced by humans. As development proceeds in Nunavut, ocean noise is increased from these activities. Airplanes, cargo ships, transport boats, fishing boats, military submarines, and seismic surveys all produce sound. It is important to understand how whales behave around anthropogenic (man-made) sound. Activities can be planned (scheduling and operational) to limit interaction with marine mammals.

2 Reports from previous seismic projects

NEXUS Coastal reviewed available published reports and documents that included observations of marine mammals near active seismic surveys. The reports were published by government organizations, private sector companies, and academic researchers. Published research involving studies on marine mammals in captivity were excluded due to the potential differences in behaviour in the different environments (experimental versus natural).

The focus of the literature review was on animals present in northern waters such as Baffin Bay, Davis Strait, and the Beaufort Sea. Attendees at the community meetings had requested reports that focused on whales and seals in the Arctic since they were under the impression that the EA had only used information on southern whale populations. Communities reported that northern whales and seals respond differently to noise than southern whales[9].

Information compiled in the review indicate that whale and seal responses to noise are highly variable, depending on age, sex, physical state, presence of offspring, prior experience, characteristics of the noise source, and other factors[10].

The “Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals” provides case studies and analysis on seismic surveys throughout the world[11]. This document forms the basis for Canadian standards on mitigating the effects of seismic surveys on marine wildlife[12].

Hamlet Councils, HTOs, and community members also requested to see reports on the effects on marine mammals of seismic surveys conducted in Greenland. Many of the Marine Mammal Observer reports are the possession of the company that conducted the seismic survey. This information is not available to the public.

Reports from and studies[13] which are available include analysis of seismic survey effects on marine mammals in northern waters are summarized below.

2.1 Reports which include observations on whales

Source: Miller, G.W., V.D. Moulton, R.A. Davis, M. Holst, P. Millman, A. MacGillivray, and D. Hannay (2005). Monitoring seismic effects on marine mammals—southeastern Beaufort Sea, 2001-2002.p. 511-542. *In* Armsworthy, S.L., Cranford, P.J. and K. Lee. (2005). Offshore Oil and Gas Environmental Effects Monitoring: Approaches and Technologies. Battelle Press, Columbus Ohio. 629p.
Study/Project: Devon Canada Corporation conducted a two-year marine seismic program offshore of the Mackenzie Delta in the southeastern Beaufort Sea during 2001 and 2002. Data was collected from aerial surveys, Marine Mammal Observers, and Passive Acoustic Monitoring. The seismic survey occurred in relatively shallow water (minimum water depth of 10m).
Observation: Beluga whale sighting rates at distances of 10-20km from the seismic survey were significantly lower than those in areas 20-30 km from the seismic source, where sightings were unexpectedly high. Belugas closest to the seismic survey (1540-2500m) would have received sound levels of approximately 165dB re 1 µPa.
Bowhead whales were sighted further away (1957m) during active seismic operations compared to inactive periods (1368m). Bowheads tended to be closer to the vessel during inactive periods. The aerial surveys did not document bowhead avoidance of the seismic operations area.
Discussion: Beluga whales tended to move away from an operating seismic vessel to a distance of 20-30km. At a minimum, the distance by which bowhead whales avoided seismic operations was about 600m greater than the average distance by which they avoided general vessel operations. The seismic survey did not include post-survey monitoring.
Implication: Beluga whales may display avoidance behaviour to a seismic survey up to 20km away. During an active seismic survey, bowhead whales were sighted approximately 2km away from the seismic survey. Bowhead whales did not display large scale avoidance of the survey area.

Source: Patterson, H., Blackwell, S.B., Haley, B., Hunter, A., Jankowski, M., Rodriques, R., Ireland, D. and W. Funk. (2007). Marine mammal monitoring and mitigation during open water seismic exploration by Shell Offshore Inc. in the Chukchi and Beaufort Seas, July-September 2006: 90-day report. LGL Draft Report P891-1. Report from LGL Alaska Research Associates Inc., Achorage, AK, King Cite, Ont, and Greenridge Sciences Inc., Goleta, CA, for Shell Offshore Inc, Houston, TX, and National Marine Fisheries Service, Silver Spring, MD. 199p.
Study/Project: seismic surveys in the Chukchi and Beaufort Seas during the summer of 2006
Observation:
Chukchi Sea Survey Results: The seismic surveys were active for 1092 hours. Visual observations were recorded for 2788 hours, of which 1366 hours was useable due to visibility conditions. Spotted and ringed seals were the most abundant marine mammals identified in the Chukchi Sea surveys. The only large whale seen during seismic periods was a minke whale. However, gray whales were seen most often in non-seismic periods. Gray whales sightings tended to be clustered and their distribution is more likely an indication of distribution of food resources than a response to seismic activity. Fifteen of 17 walrus observed during non-seismic period swam away from the boat. Whale behaviour was recorded for 41 sightings. One sighting occurred during an active seismic period. Most of the whales (45%) swam parallel to the seismic vessel.
A total of 10 power downs and 38 shut downs of the air source was required due to sighting of seals and walrus within or approaching the marine mammal safety zone. Whales did not approach the sound source and therefore did not require the seismic survey to shut down.

Beaufort Sea Survey Results: The seismic survey was active for 10 hours. This included four hours of useable results. No sightings were noted during the limited periods of seismic surveying.
Discussion: No marine mammal was observed during the Beaufort Sea seismic survey.
Implication: No marine mammal was observed during the seismic survey

Source: Madsen, P.T., Mohl, B., Nielsen, B.K and M. Wahlberg. (2002) Male sperm whale behaviour during exposures to distant seismic survey pulses. *Aquatic Mammals, 28(3):* 231-240.
Study/Project: Seismic survey off Andenes, northern Norway in 2000.
Observation: Andenes (northern Norway) is a location in which adult male sperm whales inhabit all year round (presumably for feeding). The active seismic survey vessel would have been between 20 and 140km SW of this location while operating. Adult male sperm whales were observed for 12 of a 13 day seismic survey. On July 17, no sperm whales were observed, however, the following day, a large pod of long-finned pilot whales were observed in the area (pilot whales are known to harass sperm whales). Adult male sperm whales were observed remaining in the area into September after the seismic survey finished.
Discussion: Adult male sperm whales did not move away from the operating seismic survey. The one day when no sperm whales were observed may be explained by the presence of long-finned pilot whales the following day.
Implication: Adult male sperm whales did not change their behaviour in the presence of a seismic survey.

Source: Yazvenko, S.B., McDonald, T.L., Blokhin, S.A., Johnson, S.R., Melton, H.R., Newcomer, M.W., Nielson, R. and P.W. Wainwright. (2007). Feeding of western gray whales during a seismic survey near Sakhalin Island, Russia. *Environmental Monitoring Assessment, 134:* 93-106
Study/Project: 3D seismic survey in shallow, near-shore waters of Sakhalin Island, Russia from July 19- November 19, 2001.
Observation: The 3D seismic survey took place when a population of gray whales were feeding off the coast of Sakhalin Island, Russia. Aerial surveys were carried out throughout the seismic survey, in partto record feeding activity (indicated by mud plumes) of grey whales before, during and after the seismic survey. Statistical analysis indicated that a seismic survey did not change the frequency of mud plumes created by western grey whales. Mitigation measures for the project ensured that gray whales did not receive sound levels greater than 163dB (rms) re 1µPa (the corresponding distance was not provided).
Discussion: After analysis of grey whale feeding behaviour prior, during and after a seismic survey, it was concluded that seismic surveys do not affect grey whales while they are feeding.
Result: The 3D seismic survey did not affect gray whale feeding behaviour.
Implication: No implications. Gray whales are not located in the survey area.

Source: Ljungblad, D.K., Wursig, B., Swartz, S.L., Keene, J.M. (1988). Observations on the behavioural responses of bowhead whales (*Balaena mysticetes)* to active geophysical vessels in the Alaskan Beaufort Sea. *Arctic, 41(3):* 183-194.
Study/Project: From 1981-1984, behavioural data (through visual observations on aircrafts) was collected on bowhead whales at varying distances from operating seismic survey vessels.
Observation: The following bowhead whale behaviours were assessed: surfacing, respiration and dive characteristics at varying distances from an active seismic survey vessel. Four

instances of seismic survey vessels approaching different bowhead whale pods over three years were recorded:

- Seismic survey vessel 3.5 to 8.2 km away: subtle behavioural response
- Seismic survey vessel 3.5 to 7.6 km away: partial avoidance (some whales left, while other whales remained in the observation area)
- Seismic survey vessel 1.3 to 7.2 km away: total avoidance (all whales leave the observation area).

Discussion: Similarities among experiments suggest that short-term behavioural changes, such as bowheads leaving the observation area, occur when bowhead whales are exposed to seismic surveys less than 10km away. However, these behavioural changes diminish within one hour after disturbance.
Implication: Bowhead whales may change their behaviour when they are within 10km of a seismic survey. Normal bowhead whale behaviour resumed one hour after the seismic survey left the area.

Source: Richardson, W.J., Wursig, B., and C.R. Greene, Jr. (1986). Reactions of bowhead whales, *Balaena mysticetes,* to seismic explorations in the Canadian Beaufort Sea.
Study/Project: Opportunistic and controlled observations on the behavioural reactions of bowhead whales to seismic surveys from 1980 to 1984. Observations were made from an aircraft[14].
Observation: Activities of bowhead whales 6-99km away from seismic survey vessels were usually similar to those of whales not exposed to man-made noise (including seismic surveys). Bowheads usually continued normal activities when an airgun was operational 3-5km away (received levels 118-133dB re: 1µPa). Bowheads oriented away from seismic surveys at ranges of 2-4.5km (received levels 134-124dB re: 1µPa). Surfacing and respiration behaviour did not change dramatically when an airgun was operational 2-5km away. Bowhead whale near bottom feeding stopped at a range of 3km. There were no observations of bowhead whale behaviour post seismic survey.
Discussion: Bowhead whales did not change their behaviour to operating seismic survey vessels from up to six km away. Once the distance between vessel and whale was closer, some behavioural changes were observed, such as the bowheads stopped feeding.
Implication: Bowhead whales may change their behaviour within 6km of a seismic survey vessel.

Source: Moulton, V.D. and M. Holst (2010). Effects of seismic survey sound on cetaceans in the Northwest Atlantic. *Environmental Studies Research Funds Report No. 182.* St. John's 28p.
Study/Project: Monitoring data on marine mammals from eight 3D seismic surveys (three areas offshore Newfoundland and one area offshore Nova Scotia) from 2003-2008 was collected and analysed. Seismic surveys were carried out in both deep (greater than 2000m) and shallow (less than 200m) water. Sighting data was grouped separately for baleen whales, large toothed whales and small dolphins[15].
Observation: Baleen whales were seen further away, less often and moving away from the seismic vessel during operations. Different dolphin species were consistently seen within several kilometres of the seismic vessel during seismic and non-seismic periods. Dolphins were often detected 200-300m further away from the seismic vessel during seismic vs. non-seismic periods. However, there was no significant difference between the numbers of dolphin sightings during seismic vs. non-seismic periods. Long-finned pilot whales often approached the operating vessel within 150m. In most cases, dolphins avoid seismic activity at a distance of 1km or less.

Discussion: This study reported that baleen whales appear to be sensitive to sound from seismic surveys. This was indicated by baleen whales moving away from the seismic vessel and being observed less often during seismic periods compared to non-seismic periods. Behavioural and anatomical evidence suggests that baleen whales hear well at frequencies below 1kHz where most of the energy from the sound source is focused.
Large toothed whales and delphinids often moved away from an operating seismic vessel (200-300m), but there was no significant difference in sighting rates. These results suggest that large toothed whales and delphinids may display localized displacement (200-300m). However, these species remain in the area as indicated by there being no significant difference in sighting rates in times active and inactive seismic periods.
Implication: Baleen whales, such as the bowhead whale, move further away and are seen less often during an active seismic survey. Toothed whales and delphinids move further away (200m-3000m) from an active seismic survey but their diving patterns (indicated by how frequent the whales are observed) do not change.

Source: Shell. (2013). Shell Greenland A/S 2013 Site Survey in Baffin Bay Blocks 5 (Anu) and 8 (Napu). Preliminary Environmental Impact Assessment
Study/Project: The EIA is for a two-dimensional high resolution seismic survey in Blocks 5 and 8. The EIA includes results of Shell's 2012 seismic survey in Baffin Bay.
Observation: Sightings from Shell's 2012 seismic survey in Baffin Bay included numerous seals, primarily harp, ringed and hooded seals, but also bearded and harbour seals. Most whales were observed during transit to and from the survey area, with sightings of sperm whale, minke whale and sei whale within the license blocks. One polar bear was also seen within the two license blocks (Figure 1). It was not indicated if the seismic survey was stopped due to the proximity of a whale or seal to the operating seismic survey.
Discussion: The location or name of the 2012 seismic survey project was not provided in the EIA. Additional research identified that Shell completed a 3D seismic survey and coring in lease blocks 5 and 8 in 2012 (Figure 2)[16]. The EIA for the 3D seismic survey indicated that the project would operate from July until October, 2012 in water depths of 150m to 700m[17].
The report did not say if the seismic survey was stopped due to marine mammals entering the safety zone (800m for whales and 500m for other marine mammals).
During the seismic survey no bowhead, narwhal or beluga whales were seen during transit to the survey area or during surveying. In the category of 'large whales' it is not known if any of the 'large whales' observed were bowhead whales (Figure 1).
Implication: The proposed Baffin Bay and Davis Strait seismic survey would occur in the general vicinity of the Shell 2012 3D seismic survey in Greenland waters (both occur in the deep waters of Baffin Bay). The 2012 Shell survey did not report sightings of narwhal, bowhead and beluga whales in the survey area or in transit to the survey area. This observation may be from the whales avoiding the survey area, or that the whales have yet to begin their fall migration to their wintering grounds.

Species	All observations		In license blocks	
	No. of animals	No. of observations	No. of animals	No. of observations
Harp Seal	1404	556	907	451
Unidentified seal	230	205	191	170
Long-finned pilot whale	167	14	56	3
Ringed seal	119	117	109	107
Hooded Seal	89	86	78	77
White-beaked dolphin	26	7	4	1
Sperm whale	20	15	16	13
Humpback whale	18	4		
Fin whale	17	14	3	2
Minke whale	15	12	3	3
Bearded seal	14	13	13	12
Sei Whale	14	5		
Large whale	12	12	3	3
Harbour porpoise	9	4		
Unidentified whale	8	5		
Fin/Sei whale	5	2		
Bottlenose Whale	4	2	1	1
Harbour seal	2	1	2	1
Hooded/bearded seal	1	1	1	1
Polar bear	1	1	1	1
Grand Total	**2175**	**1076**	**1388**	**846**

Figure 1: Preliminary results of Marine Mammal Observer observations during Shell's 2012 seismic survey in Baffin Bay (table 5-18 in Shell, 2013)

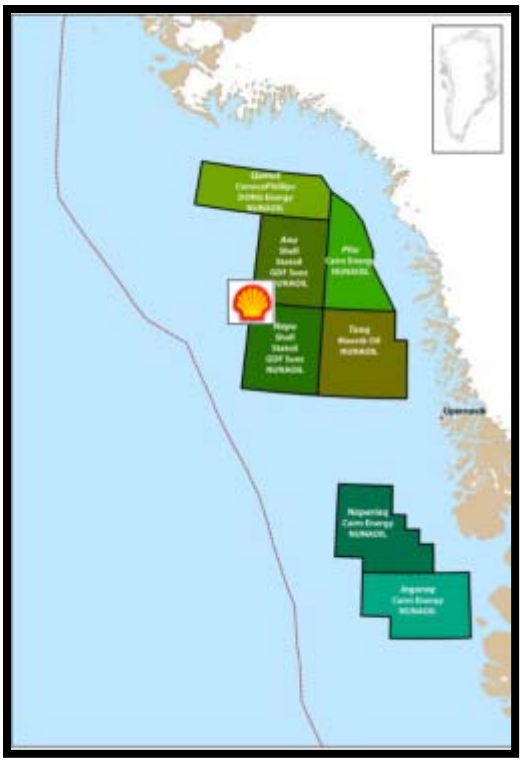

Figure 2: Shell lease block sites off Greenland

2.2 Reports which include observations on seals

Source: Harris, R.E., Miller, G.W., and W.J. Richardson. (2001). Seal responses to airgun sounds during summer seismic surveys in the Alaskan Beaufort Sea. *Marine Mammal Science, 17(4):* 795-812.
Study/Project: 3D seismic survey in shallow, near-shore waters of the Beaufort Sea near Prudhoe Bay from July 24 to September 18, 1996.
Observation: Ringed seals, bearded seals and spotted seals are common in the area. The seismic survey occurred on 49 of 57 days. Seals were observed through binoculars and flood lights (at night). Seals partially avoided a zone (<150m from the sound source) during the seismic survey, but did not move much beyond 250m. Seals were more likely to 'swim away' during an active seismic survey than when no sound was being produced. No seals were observed to leave the general area of operation during the active seismic survey.
Discussion: Observations from this study indicate that ringed, bearded and spotted seals may not be significantly affected by an operating seismic survey. The most common behaviour was that seals were swimming away from the sound source to a distance of 250m. This distance is well within the marine mammal exclusion zone (500m) for this project.
Implication: Ringed, bearded, and spotted seals were not affected at a distance of 250m from an active seismic survey. Phocid seals, which include ringed and bearded seals have low hearing sensitivity below 1kHz, though they can hear underwater sounds at frequencies up to 60kHz and make calls between 90Hz and 16kHz[18].

Source: Frost, K.J and L.F. Lowry. (1988). Effects of industrial activities on ringed seals in Alaska, as indicated by aerial surveys. *In:* Sackinger, W.M., Jeffries, M.O. (1988). Port and ocean engineering under arctic conditions (Vol II). Symposium of noise and marine mammals. Fairbanks, Alaska.
Study/Project: In the spring of 1982, a simulated seismic survey was generated on ice to observe the rates at which seals abandoned breathing holes.
Observation: Seals were three times as likely to abandon breathing holes and lairs within 150 metres of a seismic survey.
Discussion: This study supports ringed seals reactions to seismic sources (Harris et al., 2001); however, there are a number of differences in the study design. The simulated seismic source was simulated by using trucks and instruments on ice to simulate seismic sound. As well, marine seismic surveys generally occur in ice free waters away from haul out locations of seals.
Implication: Ringed seals change their behaviour within 150m of a seismic source.

Source: Shell. (2013). Shell Greenland A/S 2013 Site Survey in Baffin Bay Blocks 5 (Anu) and 8 (Napu). Preliminary Environmental Impact Assessment
Study/Project: The EIA is for a two-dimensional high resolution seismic survey in Blocks 5 and 8. The EIA includes results of Shell's 2012 seismic survey in Baffin Bay.
Observation: Sightings from Shell's 2012 seismic survey in Baffin Bay included numerous seals, primarily harp, ringed and hooded seals, but also bearded and harbour seals (Figure 1). It was not indicated if the seismic survey was stopped due to the proximity of a whale or seal to the operating seismic survey.
Discussion: The location or name of the 2012 seismic survey project was not provided in the EIA. Additional research identified that Shell completed a 3D seismic survey and coring in lease blocks 5 and 8 in 2012 (Figure 2)[19]. The EIA for the 3D seismic survey indicated that the project would operate from July until October, 2012 in water depths of 150m to 700m[20].
The report did not say if the seismic survey was stopped due to marine mammals entering the safety zone (800m for whales and 500m for other marine mammals). The seismic survey was intended to operate from July until October. Bearded seals and ringed seals were identified in the National Energy Board meetings as seals which individuals would like more information on. In the 2012 Shell Baffin Bay seismic survey, 109 ringed seals and 13 bearded seals were seen in the survey area. There were 1399 animals sighted in the survey area.
Implication: The proposed Baffin Bay and Davis Strait seismic survey would occur in the general vicinity of the Shell 2012 3D seismic survey in Greenland waters (both occur in the deep waters of Baffin Bay). The 2012 Shell seismic survey identified both ringed and bearded seals. It is likely that the proposed seismic survey will also encounter ringed and bearded seals.

Source: Miller, G.W., V.D. Moulton, R.A. Davis, M. Holst, P. Millman, A. MacGillivray, and D. Hannay (2005). Monitoring seismic effects on marine mammals—southeastern Beaufort Sea, 2001-2002.p. 511-542. *In* Armsworthy, S.L., Cranford, P.J. and K. Lee. (2005). Offshore Oil and Gas Environmental Effects Monitoring: Approaches and Technologies. Battelle Press, Columbus Ohio. 629p.
Study/Project: Devon Canada Corporation conducted a two-year marine seismic program offshore of the Mackenzie Delta in the southeastern Beaufort Sea during 2001 and 2002. Data was collected from aerial surveys, Marine Mammal Observers, and Passive Acoustic Monitoring. The seismic survey occurred in relatively shallow water (minimum water depth of 10m).
Observation: Both ringed seals and bearded seals were observed by aerial surveys, Marine Mammal Observers, and Passive Acoustic Monitoring. Ringed seals were observed most often during the seismic program.

In 2001, seals were observed slightly closer to the vessel during non-seismic periods compared to seismic periods, indicating that seals may have been exhibiting some avoidance of the sound produced from the seismic survey. However, the observed difference between distances at which seals were initially observed during non-seismic and seismic periods (average distance from the sound source of 150 vs. 210 m, respectively) were minor and the avoidance behaviour was localised to a few individuals. It was estimated that seals at a distance of 210 m would have been exposed to sound levels of 190 dB re 1 µPa.
Contrary to the 2001 findings, in 2002 results showed that seals were observed closer to the seismic vessel during seismic periods than during non-seismic periods (average distance from the sound source of 153 vs. 236 m respectively).
Discussion: Combined data from 2001 and 2002 suggest that there were minor and variable effects on seals within a few hundred metres (150m-236m) of the seismic vessel as a result of seismic operations. The marine mammal safety zone for the proposed project is 500m from the sound source. Therefore the seismic survey would stop if a seal were to be observed in this area.
Implication: Observations from this study indicate that seals are not displaced by seismic operations, which agrees with findings from other similar studies in the Beaufort Sea.

2.3 Reports from Greenland

A common theme throughout the NEB organized community meetings was the concern that seismic surveys may affect Inuit's ability to successfully harvest marine mammals (whales, seals, walrus and polar bears). Like in Nunavut, marine mammals are a large part of Inuit food and culture in Greenland. Many people at community meetings requested information from Greenland as they are actively completing seismic surveys in Baffin Bay.

NEXUS Coastal searched for sources of government reports and scientific research reports as well as reports from the seismic survey companies to provide insight into possible effects from seismic surveys in Baffin Bay on Inuit harvesting activities in Greenland. Unfortunately, such reports or documents are not publically available. NEXUS Coastal undertook an examination of the harvest levels of whales and seals by Inuit in Greenland. Seismic surveying is a relatively recent development in Baffin Bay[21] and only began in Greenland waters in Baffin Bay in 2007. Therefore, the review focused only on Inuit whale and seal harvest levels before and after the commencement of these seismic surveys.

Comparing the number of marine mammals harvested before and during seismic surveys can provide insight as to whether seismic surveys are affecting the number of marine mammals available. This analysis assumes that there has been little or no change in Inuit hunting efforts.

The information for this analysis came from the United Nations Food and Agriculture Organization (FAO)[22], academic literature, and other public documents.

Hunting whales in Greenland is a long-standing traditional and commercial activity. FAO provides information on catches of whales kill in Greenland (Table 2)[23]. Quota systems are in place for blue whales, fin whales, sperm whales and pilot whales[24]. Seismic surveys began in

2007 and no changes were detected in the harvest of these whales following the implementation of seismic surveys.

Table 2: Capture production by species for Greenland (FAO, 2010)

Species[25]	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Whales										
Minke whale	153	149	198	190	180	181	167	152	168	195
Fin whale	8	13	9	13	14	10	12	14	10	5
Humpback whale	2	5	2	-	-	-	-	-	-	9
Bowhead whale	-	-	-	-	-	-	1	-	3	3
Sperm whale	-	-	-	-	1	-	-	-	-	-
Long-finned pilot whale	62	38	195	265	345	46	287	182	443	216
Killer whale	2	21	5	14	2	-	3	23	13	7
Beluga	456	424	423	247	157	137	120	185	279	109
Narwhal	667	672	647	595	466	411	331	454	653	228
Seals and Walrus										
Walrus	333	297	273	153	198	141	135	82	163	67
Harp Seal	84,165	65,810	64,735	63,763	84,317	92,612	81,010	77,600	128,296	58,029
Harbour Seal	5	6	81	88	75	1	33	42	7	2
Ringed Seal	65,865	68,736	67,229	56,935	71,232	73,268	60,835	61,354	97,158	39,954
Bearded Seal	2,016	1,652	1,361	985	954	1,458	1,181	1,077	1,880	899
Hooded Seal	5,010	3,606	4,351	3,766	2,924	4,229	2,496	2,087	3,101	1,461

Greenland Inuit concentrate their hunting efforts on narwhal and beluga whales and harp and ringed seals as indicated by the increased animal capture (Table 2). Whales are included in Table 2 to show potential effects of seismic surveys on whales. If certain whales change their behaviour around seismic surveys, then the ability of Inuit to harvest the animal may decrease[26].

The Greenland Home Rule Government introduced a quota system for narwhal and beluga harvesting in West Greenland in 2004. The International Whaling Commission, the North Atlantic Marine Mammal Commission (NAMMCO), the Canada/Greenland Joint Commission on Narwhal and Belugas (JCNB), and other non-government organizations collectively determine

the number of narwhal and beluga that can be harvested. Quota-setting organizations must consider the fact that narwhal and beluga populations are highly migratory and are harvested in several regions (DFO, 2008)[27].

The Greenland quota system was set in place in 2004 to protect belugas and narwhals after increasing catches were being reported despite declining populations and no increase in hunting efforts (Figure 3). A licence is now required under the quota to hunt narwhals in West Greenland (Nielsen and Mielby, 2013)[28]. The increase in narwhal catches before the quota system was introduced is suggested to be a result of climate change and easier access to whales by hunters (Nielsen, 2009) [29]. The quota in West Greenland is set at 300 narwhals and 165 belugas, which is higher than the level recommended by biologists from the Greenlandic Institute of Natural Resources and the NAMMCO (Ecoadvise & Communication, 2013)[30].

The narwhal population in West Greenland is separated into at least two populations. The stock separation is not clear, but there are distinct populations in Baffin Bay and in Smith Sound (between Greenland and Ellesmere Island). According to traditional knowledge, the Smith Sound stock either migrates to Canada (past Ellesmere Island) or stays in Smith Sound. There are no reliable estimates for the Melville Bay narwhal stock, which is the stock that is known to overwinter in central Baffin Bay; therefore accurate quotas cannot be set for specific stocks in West Greenland (Nielsen, 2009) [31].

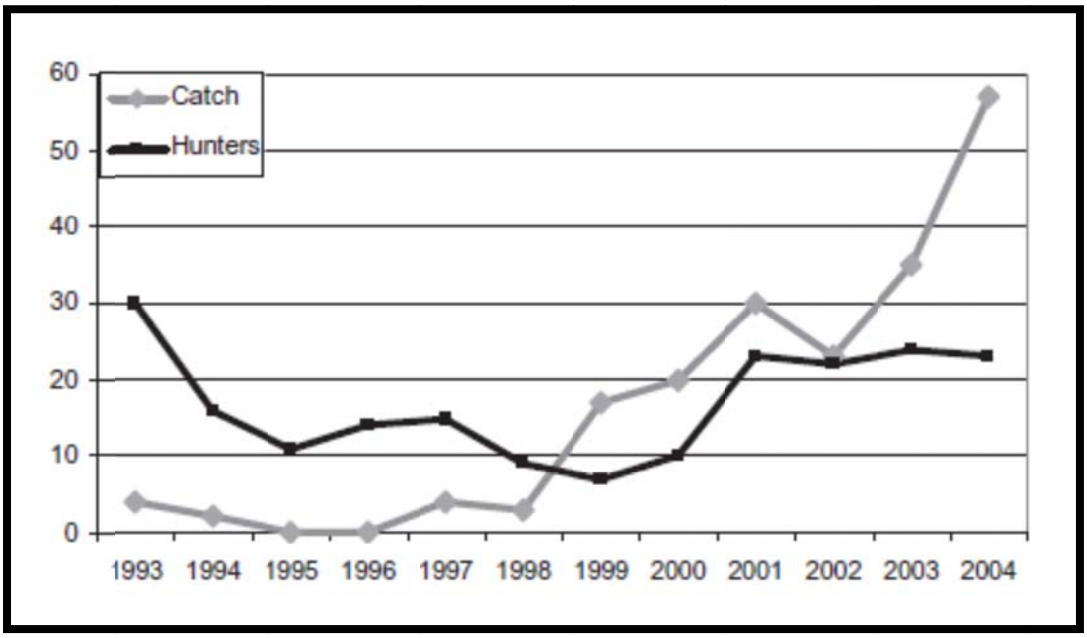

Figure 3: Narwhal catch by hunters from Siorapaluk and total number of hunters from 1993-2004 (from Nielsen, 2009).

Seismic activity began after the implementation of a quota system for narwhal and beluga hunting in West Greenland. Therefore, catches are kept at a set rate and it is impossible to tell if catches have increased or decreased since seismic activity began. In 2004, narwhal and beluga stocks were declining (Alvarex-Flores & Heide-Jorgensen, 2004)[32]. However, both stocks have reportedly stabilized or been increasing since stock surveys began in 2007, after both

introduction of quotas and after seismic surveys began (Greenland Institute of Natural Resources, 2012)[33].

DISCUSSION

It appears that harvest of minke whales, fin whales, humpback whales, long-finned pilot whales, beluga whales, narwhal, walrus, harp seal, ringed seal, bearded seal and hooded has not changed since seismic survey activity began in 2007[34]. For the more traditionally harvested species of narwhal and beluga, overharvesting and declining populations led to the introduction of a quota system in 2004. Since the introduction of this quota, stocks have apparently been increasing in size. It appears that harvest rates since 2007 have not been negatively affected by seismic surveying.

3 Labrador and Newfoundland Project

Environmental Report from NL 2012 Program

See Appendix C

4 Marine Seismic Source

Vol. 1, para 237, 255, 263, 277 and 673; Vol. 3, para 1326, 1341, 1694

“Acoustic properties or modeling of marine seismic including information indicating how far travels sound and specifically how the sound would compare to the sound of a .22 rifle firing or a whale”, “MKI committed to providing a video that demonstrates the comparison of air guns and sound sources that are familiar to communities.”

MKI believes that audio representation would be more effective than a video to best represent “seismic sound”. We propose to present a “representation” recording of the seismic source sound in future meetings while supplementing it with the other deliverables such acoustic modelling, sound comparison tables, etc.

See Appendix D

5 Acoustic Modelling in Survey Area

See Appendix E

6 Effects of Sound on Marine Mammals

MKI prepared and distributed a ‘Supplementary Report’ to communities (Kimmirut, Iqaluit, Pangnirtung, Qikiqtarjuaq, Clyde River, and Pond Inlet) in November 2012. Communities were provided paper and electronic copies of the report in Inuktitut and English.

The Supplementary Report provided information on how seismic surveys are conducted, the known effects of seismic sound on fish, whales, and seals, and the proposed project’s mitigation measures. This report was prepared in response to comments brought forward during community information sessions held in June and October, 2012.

During the National Energy Board meetings with the communities of Iqaluit, Qikiqtarjuaq, Clyde River and Pond Inlet, additional questions were asked about the effects of the project on specific marine mammals. Marine mammals identified by community members at the meetings include narwhal, beluga, bowhead, walrus, bearded seals, ringed seals and polar bears. Overall, community representatives wanted to know if the proposed project would affect the migration of whales, seals, walrus, and polar bears or on the physical wellbeing of animals themselves.

This section includes observations from past seismic surveys, information on the marine mammal’s migration paths and their behaviours during summer months. Information was obtained from Inuit Knowledge studies, scientific journals, government reports and seismic operator’s reports. The information was analysed to determine what effects, if any, the proposed seismic survey may have on marine mammals.

As requested in meetings (community, Hamlet, and HTO), this section will only include observations and reports focused on seismic surveys in northern waters. These reports include 2D, 3D, and 4D seismic surveys acquired from the 1980s until present. Many of the reports do not provide details on the level of sound the whales and seals receive from the seismic survey.

If there are no reports discussing the behaviour of a marine mammal to sound from seismic surveys then DFOs most recent review of the effects of seismic sound on marine mammals is referenced.

6.1 Seismic Surveys, Whales and Seals

SEISMIC SURVEYS

Marine seismic surveys are conducted to map geologic formations below the seafloor. A seismic survey includes the following (Figure 4):

1. The sound source uses a piston to force compressed air into the water column generating a sound wave. The sound source is towed by the research vessel 6-10 metres (18-30 feet) below the surface of the water.
2. Sound waves travel downward through the water and into the underlying rock formations below the seafloor. The sound waves bounce back off the different layers of sedimentary rocks, return to the surface of the water.
3. The returning sound waves are detected by hydrophones (underwater microphones) spaced less than 2m apart and embedded in a cable or streamer 6-12 kilometres (18,000- 36,000 feet) long. The cable and hydrophones are referred to as a 'streamer'.
4. The information collected during the survey is then analyzed using computer programs that produce images of the different types of rock layers lying beneath the seafloor.

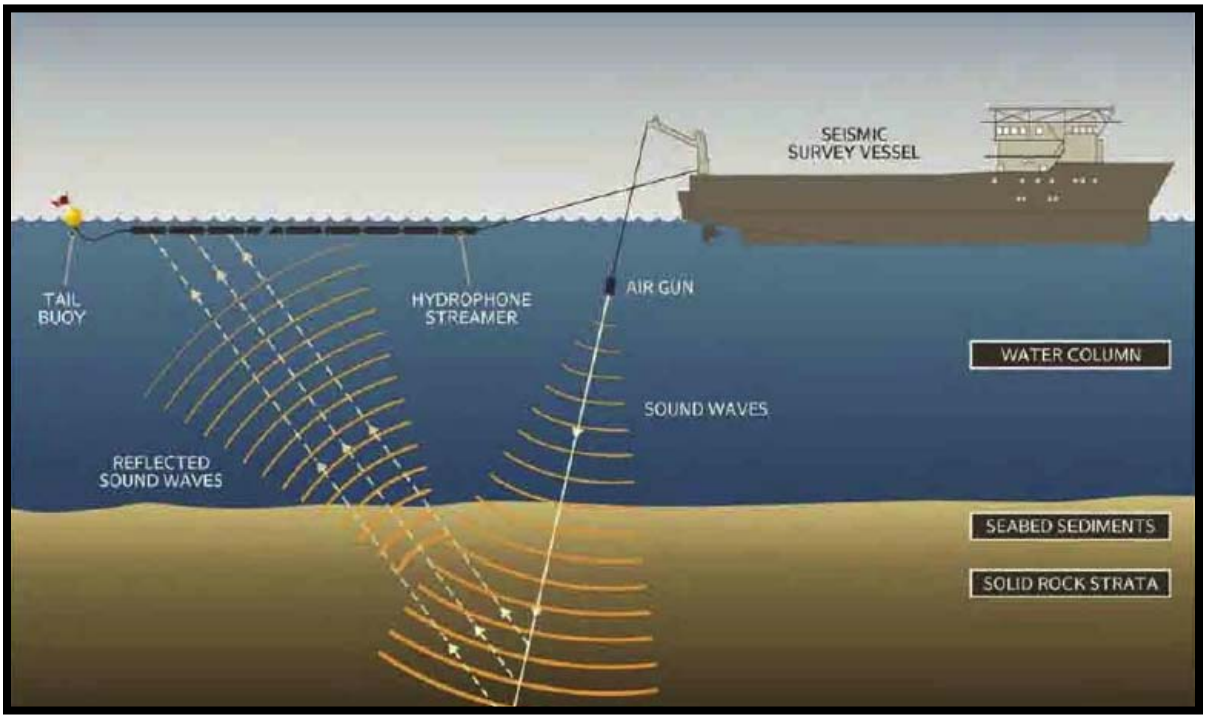

Figure 4: Seismic survey diagram (Sikumuit. 2008. Sikumuit Environmental Management Ltd. 175 Hamlyn Road. St. John's, Newfoundland and Labrador, A1E 5Z5)

WHALES AND SEALS

Information sources used by officials to regulate seismic surveys to minimize impacts on marine mammals include the following:

- Captive Studies: These studies use animals being held in captivity to measure auditory sensitivity, auditory function and the effects of noise exposure. It is important to note, however, that general behavioural changes in animals due to their unnatural surroundings may affect their natural responses to sound.
- Field Studies: These studies are based on opportunistic observations made from vessels on the behaviour of whales in the observable vicinity of a seismic survey vessel.
- Modelling: These research studies involve computer-based mathematical models and are used to predict the effect of sound on the hearing of marine mammals.
- Tracking devices: Transponders or radio beacons attached to marine mammals to track and document individual underwater behaviour, physiological responses and obtain information on the environment.

Governments, communities, researchers, and non-governmental organizations are generally concerned with the effect of the sound intensity on whales, seals and walrus. Whale responses to noise are highly variable, depending on species, individuals, age, sex, physical state, presence of offspring, prior experience, characteristics of the noise source, and other factors[35]. Suspected effects on marine mammals from seismic surveys:

- Mortality and physical effects: stranding/mortality, hearing impairment and non-auditory effects (for example, ship strikes).
- Direct behavioural effects: displacement, migratory diversion, changes in dives and respiratory patterns, and changes in social behaviour and vocalization patterns.

There are two categories characterizing the effect of sound on marine mammals hearing:

- Permanent Threshold Shift (PTS): permanent reduction in hearing sensitivity.
- Temporary Threshold Shift (TTS): temporary hearing loss (completely recoverable within minutes to hours).

PTS and TTS are qualitative indicators used in preparing guidelines to mitigate the effects of sound on whales and seals. Mitigation measures for this project include ensuring that marine mammals do not receive sound levels that could result in a permanent reduction in hearing sensitivity (PTS).

Existing reports and studies on whales and seals related to the sound intensity received from sound sources have led to researchers recommending guidelines for seismic surveys. For exposure to multiple sound pulses (like seismic surveys), permanent threshold shift (loss of hearing, not recoverable) is assumed to occur if the following sound exposure level is exceeded:

- Whales: approximately 198 dB re 1µPa²s
- Seals : approximately 186 dB re 1µPa²s

DFO used this and other information in preparing the *Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment*[36]. As stated in the Environmental Assessment for the project, the received sound level at 500m from the sound source is 180dB re 1µPa?. Therefore, based on available information, whales and seals should not be permanently affected from the proposed seismic survey. Changes in behaviour may be observed. Based on previous reports and studies, these changes are temporary.

Physical Effect of Acoustic Sounds on Marine Mammals

There have been no documented cases of marine mammal (whales, seals and walruses) mortality or permanent loss of hearing upon exposure to oil and gas exploration seismic surveys[37].

Behavioural Effect of Acoustic Sounds on Marine Mammals

In field studies, behavioural responses to sounds (seismic surveys, drilling platforms and rigs, airplanes, sonar, commercial shipping, recreational boating) have been recorded for a few whale species in a limited range of conditions[38]. Responses include startle and fright, avoidance, and changes in behaviour and vocalization patterns. However, behavioural observations are variable and some findings are contradictory. The biological significance of behavioural changes (for example, reproducing, feeding, or having offspring) has not been measured.

The primary cause of behavioural effects on marine mammals from seismic surveys is thought to be from the intensity of sound received by marine mammals. There are many sources of naturally occurring and anthropogenic (man-made) sound in the oceans. Whales communicating, rain, earthquakes, sea ice fracturing and pieces of ice breaking off icebergs are examples of naturally occurring sound in the oceans. Boats (recreational and commercial), fishing, harbour dredging, seismic surveys, and military boats are a few of the sources from humans that contribute to the amount of sound in the ocean. Seismic sources generate sound and the sound waves are directed downwards towards the ocean floor. As the sound wave moves through the ocean, the sound intensity decreases.

The sound eventually reaches fish, whales, and other marine life. The loudness of the sound (sound intensity) when it reaches marine life is the focus of discussion and research by scientific and academic researchers, government, and industry. The animal's response to the received sound is highly variable, depending on species, individuals, age, sex, physical state, presence of offspring, prior experience, characteristics of the noise source, and other factors[39].

Section 6.2 provides available reports on the reaction of whales and seals to sound. Reports indicate that behavioural reactions of whales and seals to seismic surveys were variable. Whale's normal behavioural patterns often resumed 48 hours after the seismic survey left the

area[40]. A whale's normal behaviour is different between and within species. Behaviour can be normal for an individual when it is consistent with the most common behaviour for that individual. Normal is also used to describe when an individual's behaviour conforms to the most common behaviour in the group (known as conforming to the norm). For some whale species, research has been conducted to determine how much time whales spend on different activities in an attempt to determine 'normal behaviour'. For example, sperm whales spend 80% of their time foraging and 20% of their time resting[41]. While for other species, normal behaviour is defined as the behaviour observed prior to an event (for example, predator attacking) occurring[42].

6.2 Narwhal (*Monodon monoceros*), *Qilalugaq qernartaq*

The narwhal is a toothed whale that inhabits ice covered arctic seas, feeding on benthic flatfish, shrimp and squid. Natural predators include polar bears and killer whales. In Canadian waters two populations of Narwhal are recognized, based on their summer distribution. The Baffin Island population is estimated between 60, 000 and 80, 000 animals, while the Hudson Bay population is approximately 5000 animals (Richard, 2007)[43]. Narwhal are harvested by Inuit and co-managed by Department of Fisheries and Oceans (DFO), the Nunavut Wildlife Management Board (NWMB), and local Hunters and Trappers Organizations (HTOs) through the 2013 Narwhal Integrated Fishery Management Plan. Narwhal in the eastern Canadian Arctic have been identified as a species of special concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). International management efforts are currently coordinated by the *Canada/Greenland Joint Commission* on Conservation and *Management* of *Narwhal* and Beluga.

In Canada, six management units have been identified based on summering aggregations or stocks of the two populations (Baffin Island and Hudson Bay) (Figure 5). Narwhal management units are as follows:

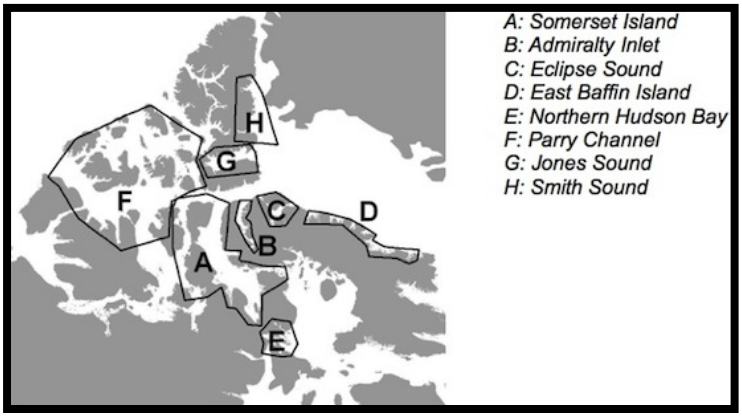

Figure 5: Proposed DFO narwhal management units for the 2013 narwhal integrated fishery management plan

- Somerset Island
- Admiralty Inlet
- Eclipse Sound
- East Baffin Island
- Jones Sound, Smith Sound and Parry Channel
- Northern Hudson Bay

NARWHAL MIGRATION

There are three papers published by academic and scientific researchers which discuss the Canadian narwhal migration and provide information on where and when narwhal are located.

Heide-Jørgensen, M.P., Dietz, R., Laidre, K.L., Richard, P., Orr, J. and H.C. Schmidt. (2003). The migratory behaviour of narwhals (*Monodon monoceros*). *Canadian Journal of Zoology, 81:* 1298-1305.

Narwhals were captured and tagged at Creswell Bay, Somerset Island, Nunavut over a two year period (9 narwhals were tagged in August, 2000 and 7 narwhals were tagged in August, 2001). By mid-September, most narwhal were within 200km of Somerset Island. By early October, narwhal began to migrate east out of Lancaster Sound with most whales remaining close to

shore near Devon Island. By early November, narwhal reached their overwintering area in Baffin Bay. Somerset Island narwhal generally maintained an offshore migration to their overwintering grounds.

Dietz, R., Heide-Jørgensen, M.P., Richard, P.R. and M. Acquarone. (2001). Summer and fall movements of narwhals (*Monodon monoceros)* from Northeastern Baffin Island towards Northern Davis Strait. *Arctic, 54(3):* 244-261.

Ten narwhal were captured and tagged over a two year period (between August 8 and 24, 1997 and August 14 and 25, 1998) in Tremblay Sound, Nunavut (Figure 6). During the summer, tagged narwhals stayed within by the Bylot Island area, including Tremblay Sound, Milne Inlet, Eclipse Sound, Navy Board Inlet, Oliver Sound and Pond Inlet. Four whales were monitored on their southward migration, along the east coast of Baffin Island to their wintering grounds. In both years, the whales left the Bylot Island area between September 20 and 29[44]. Generally, the Eclipse Sound narwhal travelled south along Baffin Island remaining close to fjords until they reached Broughton Island and moved into the deep part of Baffin Bay (narwhal overwintering ground). This trip generally ended between October 13 and November 7.

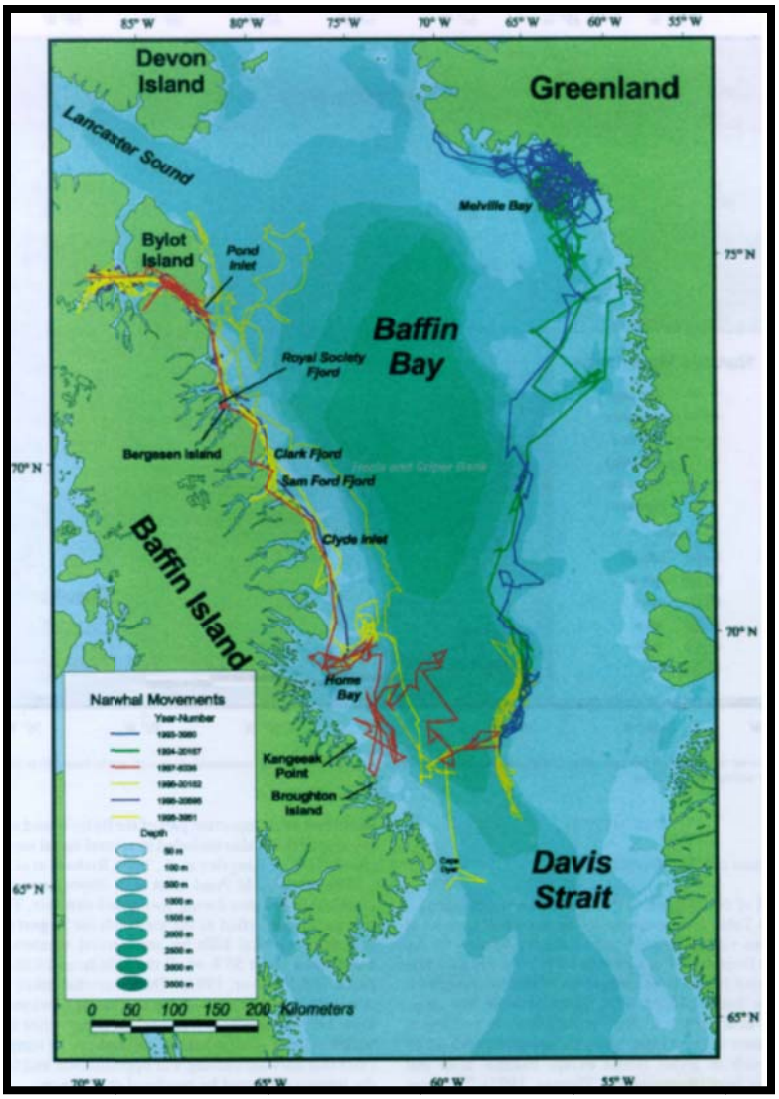

Figure 6: Fall migration of four narwhal tagged over a two year period (1997-1998**)** (from Dietz et al., 2001)

Dietz, R., Heide-Jørgensen, M.P., Richard, P., Orr, J., Laidre, K., and H.C. Schmidt. (2008). Movements of narwhals (*Monodon monoceros)* from Admiralty Inlet monitored by satellite telemetry. *Polar Biology, 31:* 1295-1306.

Thirteen Narwhals were captured and tagged at Kakiak Point in Admiralty Inlet, Nunavut over a two year period (between August 10 and 23, 2003 and 8 narwhals were tagged between August 10 and 23, 2004) (Figure 7). On average, the whales left their summering range (Admiralty Inlet) between September 14 and October 11, and completed their southern migrations between October 17 and November 15. Admiralty Inlet narwhal generally migrated 100km or further offshore from the coastline in 500m or deeper waters.

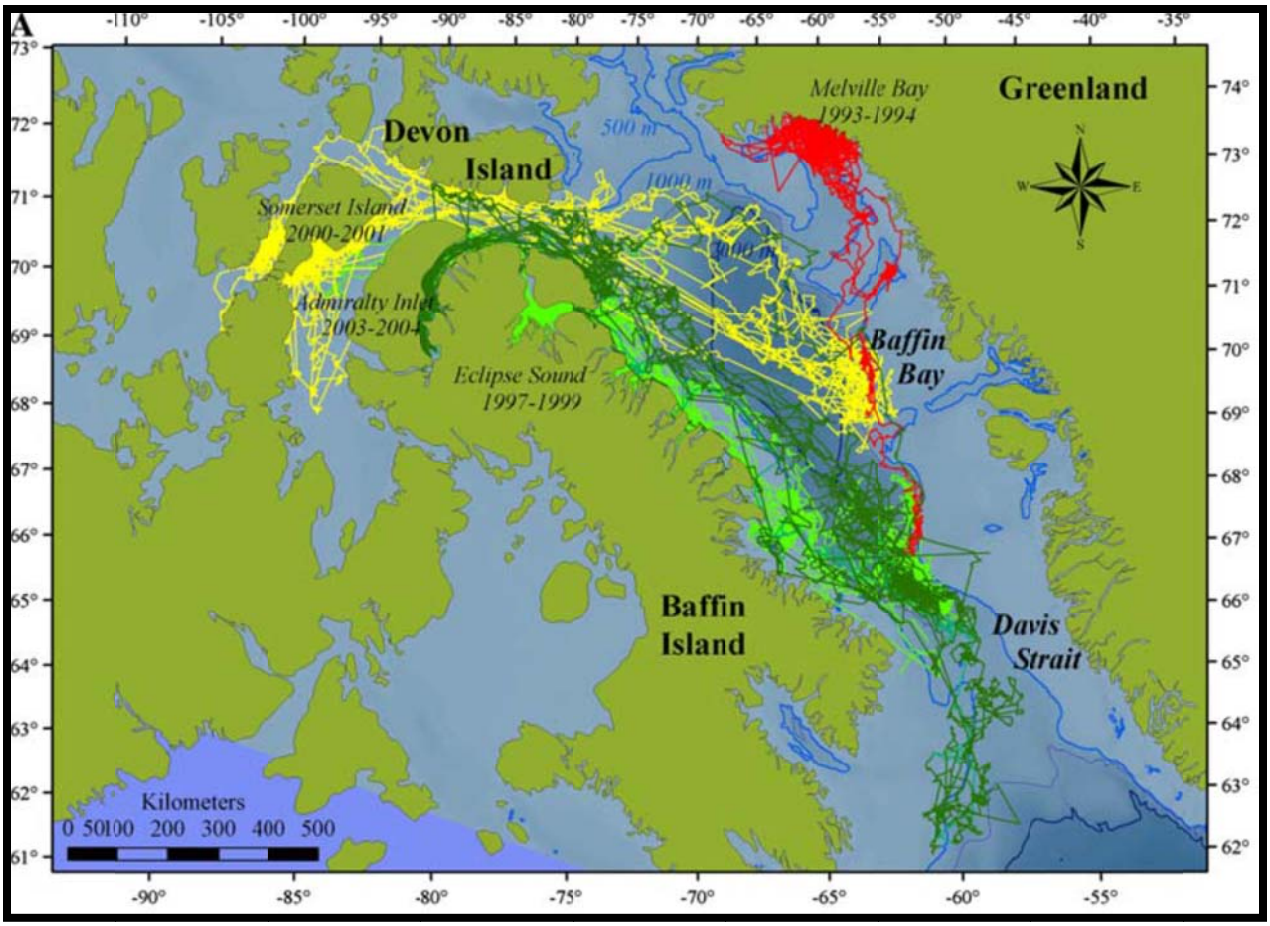

Figure 7: Comparative analysis of narwhal migration
From Admiralty Inlet (dark green), Somerset Island (yellow) and Eclipse Sound (light green). Red lines represent narwhal from Melville Bay, Greenland (Dietz et al., 2008).

Nunavut Planning Commission (2009). State of Knowledge in Maps. Nunavut Planning Commission. 28p.

Narwhal range extends throughout the entire Baffin Bay and Davis Strait region as well as the High Arctic. Narwhal summering and winter ranges were not identified on the map (Figure 8).

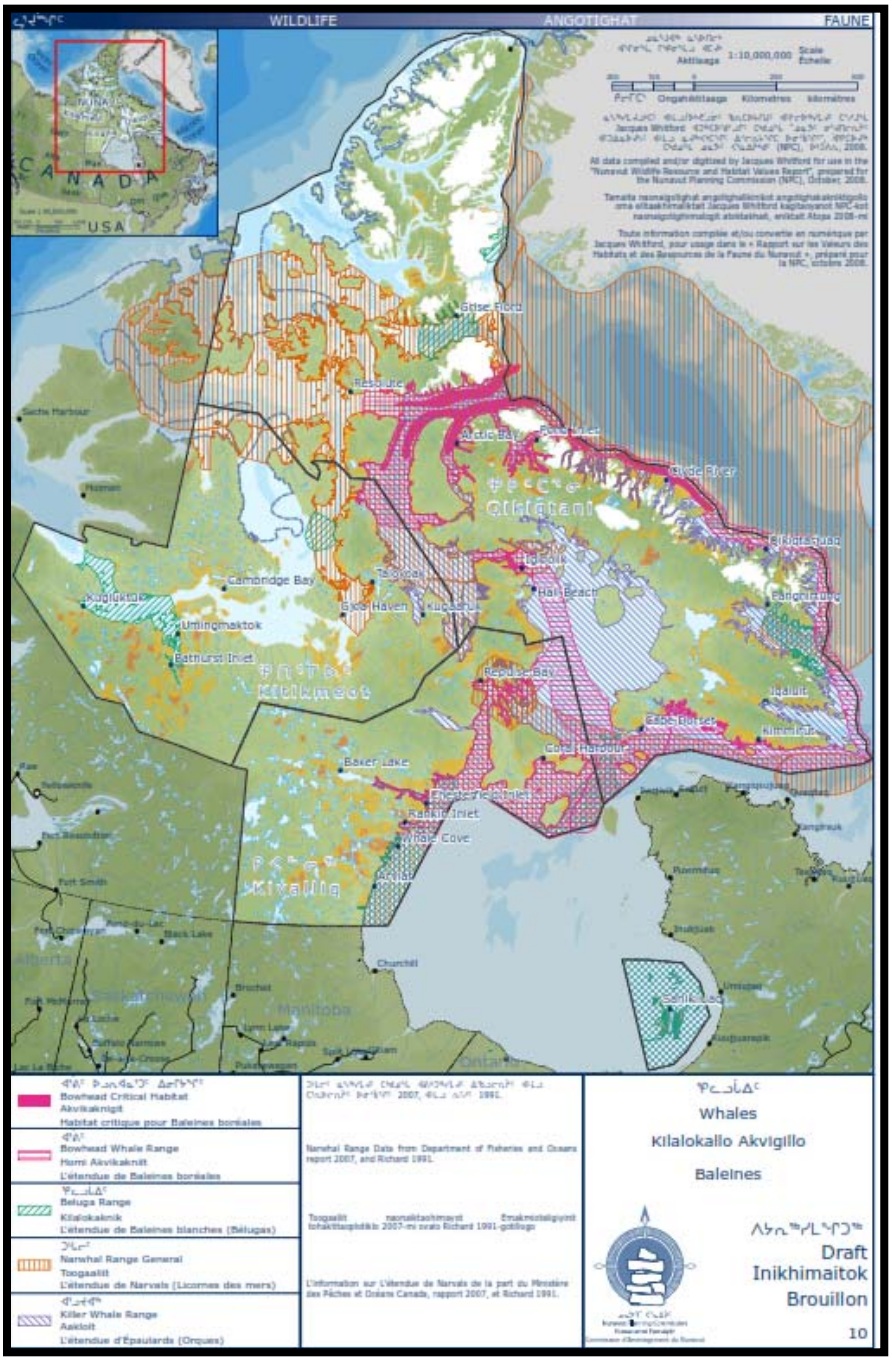

Figure 8: Narwhal range (orange) (from NPC, 2009).

SUMMARY

Information from three tagging studies on the Eclipse Sound, Somerset Island and Admiralty Inlet narwhal management units provide insight into the migration paths of narwhal (Table 3). Eclipse Sound and Admiralty Inlet narwhal generally remain close to shore while travelling south along eastern Baffin Island and move offshore once they reach Broughton Island, heading towards their overwintering grounds. These narwhal begin their migration earlier (around mid-September) compared to Somerset Island narwhal. Somerset Island narwhal begin their fall migration in early October and travel offshore to their overwintering grounds in Baffin Bay. All three management units (Eclipse Sound, Somerset Island, and Admiralty Inlet) reach their overwintering grounds around the same time (mid-November).

Table 3: Summary of narwhal fall migration

Narwhal Management Unit	Fall Migration Begin	Arrival at Wintering Grounds	Migratory patterns	Source
Eclipse Sound	September 20 to 29	October 13 to November 7	Generally close to Baffin Island travelling in fjords. Move out into Baffin Bay at Broughton Island.	Dietz et al., 2001
Somerset Island	Early October	Early November	Direct offshore to Baffin Bay	Heide-Jørgensen et al., 2003
Admiralty Inlet	September 14 to October 11	October 15 to November 15	Generally within 100km offshore, or along the 500m contour line.	Dietz et al., 2006

NARWHAL BEHAVIOUR DURING SUMMER MONTHS

During the summer months, narwhal migrate to various fjords and inlets around Baffin Island. This migration appears to be related to calving needs, and not feeding opportunities[45]. However, during the summer, narwhal do feed on Arctic cod (*Boreogadus saida),* Greenland halibut (*Reinhardtius hippoglossoides),* squid (*Gonatus fabricii)*, redfish (*Sebastes marinus),* and polar cod (*Arctogadus glacialis)*[45]*.*

A study by Finley and Gibb (1982) analyzed the summer diet of narwhal in Pond Inlet[46]. It was noted that narwhal feed at the ice edge in spring, when the ice begins to break up in July, narwhals move through the cracks and use seal holes to move toward traditional summering areas. Finally, when the ice is gone, narwhal remain in their traditional summering grounds, engaged in local movements. Narwhals calve in their traditional summering grounds in July and August.

NARWHAL AND SEISMIC SURVEYS

There are no available reports on the effects of seismic surveys on narwhals from past seismic surveys.

There is no available information from DFO on the known effect of sound from seismic survey equipment on narwhal. DFO provides regulations on how to limit potential effects from seismic sound on baleen whales, toothed whales, and seals.

The Canadian Science Advisory Secretariat completed a review of recent scientific information on the effects of sound from airguns on marine mammals[47]. Narwhal were not discussed in the report. This may be a result of an absence of information on the interaction between narwhal and seismic sound. In this paper the authors discussed potential behavioural and physiological effects on toothed whales (odontocetes), baleen whales (mysticetes), seals and walrus (pinnipeds), and polar bears (fissipeds).

Whales' (toothed and baleen) hearing can be impaired if the received sound level from multiple sound exposures is 230 dB re 1µPa. Very little information addresses the potential for functional consequences of physical and behavioural effects, chronic effects, and indirect effects of seismic survey sound on marine mammals.

DISCUSSION

The level of sound at a distance of 500m from the source (the extent of the marine mammal safety zone) is 180dB re 1µPa. It is understood that if a narwhal were to enter the safety zone, the surveying activity would stop until the animals pass through the zone. At this distance, research indicates that narwhal should not be negatively affected by sound. An individual whale's hearing can be impaired if the received sound level from multiple sound exposures is 198 dB re 1µPa^{2}s or greater.

There is an absence of available information of how narwhal behave around seismic surveys. This may be an indication that due to their natural migratory patterns, narwhal have not come into contact with seismic surveys or that they avoid surveying activities when migrating. Currently, the behavioural effects on narwhal from seismic surveys are unknown.

It is unlikely that narwhal will be in the survey area during July and August. Available research indicates that narwhal remain in their summering grounds, located along the coast of Baffin Island and in the fjords and bays of Baffin Island and Ellesmere Island, to calve in July and August. These narwhal are known to eat a variety of marine animals in their summering grounds.

It appears that narwhal begin their migration to their overwintering grounds in September. Narwhal that undergo a longer migration (travelling south down Baffin Island) begin their migration earlier compared to narwhal that travel directly offshore to their overwintering grounds.

Based on available information, it is understood that Eclipse Sound, Admiralty Inlet, and Somerset Island narwhal will enter the survey area beginning in October. However, this is gradually changing, as narwhal remain longer in the fjords and bays since the ice is forming later around Baffin Island. The seismic survey can be scheduled to limit potential interaction with narwhal using up-to-date information on the timing and location of migratory routes.

6.3 Beluga (*Delphinapterus leucas*), *Qilalugaq*

The beluga whale inhabits arctic and subarctic waters, feeding opportunistically on benthic species including octopus, crab, squid, snails, and a variety of fish species. Natural predators include polar bears, killer whales, and Greenland sharks. Belugas have a circumpolar distribution, migrating between shallow bays and estuaries to more southern ice packs and polynas. The International Whaling Commission (IWC) recognizes 29 subpopulations of Beluga[48]. There are seven populations[49] of beluga which inhabit Canadian waters, representing approximately 72, 000 - 144, 000 animals[50]. Beluga whales are harvested by Inuit hunters for subsistence, and are managed by DFO through Resource Management Boards composed of Inuit and Government representatives. COSEWIC identified the Cumberland Sound beluga population as “Threatened” while the Eastern Hudson Bay and Baffin Bay-Eastern High Arctic populations are listed as “Special Concern”[51].

BELUGA MIGRATION

There are three beluga whale populations whose summer or winter range are within proximity to the proposed MKI seismic survey: Eastern High Arctic- Baffin Bay; Western-Northern-Southern Hudson Bay; Cumberland Sound.

Richard, P.R., Heide-Jørgensen, M.P. and D. St. Aubin. (1998). Fall movements of Belugas (*Delphinapterus leucas)* with Satellite-linked Transmitters in Lancaster Sound, Jones Sound, and Northern Baffin Bay. *Arctic, 51(1):*5-16.

Six adult beluga whales were tagged with satellite-linked transmitters in the Canadian High Arctic in mid-September 1995. All but one beluga moved to the eastern side of Devon Island, staying close to shore while migrating. Arctic cod, an important prey of belugas occur in large schools near the shores in the Canadian High Arctic. The six tagged belugas spent between two and five weeks moving around eastern Jones Sound, Lady Ann Strait, and over the deep gully southeast of Coburg Island where they dove to depths of 400-800m, presumably to feed on Greenland halibut, squid, and octopus. All six belugas left Jones Sound around October 15-21 to go to the North Water.

Due to the small sample size, the results of this study were not sufficient to determine the extent of movement of belugas between the Canadian High Arctic and Greenland. It does provide a glimpse into the migratory nature of High Arctic belugas.

North Atlantic Marine Mammal Commission. (n.d.) Status of Marine Mammals in the North Atlantic: The Beluga Whale. North Atlantic Marine Mammal Commission. Tromsø, Norway. 12p.

Beluga whale seasonal movements depend on both oceanographic conditions (primarily the dynamics of ice cover) and the distribution of their prey species Belugas in the Canadian Eastern High Arctic- Baffin Bay population migrate to western Greenland or winter in the North

Water in Baffin Bay. Other beluga whales overwinter in the mouth of Cumberland Sound, Hudson Strait, and Hudson Bay.

Heide-Jørgensen, M.P., Richard, P., Dietz, R., Laidre, K.L., Orr, J. and H.C. Schmidt. (2003). An estimate of the fraction of belugas (*Delphinapterus leucas)* in the Canadian high Arctic that winter in Greenland. *Polar Biology, 26:* 318-326.

Based on the total number of belugas satellite-tracked in Canada between 1995 and 2001 with tags that lasted beyond October 1, approximately 15% of belugas in the Canadian high Arctic moved to west Greenland for the winter. The belugas that moved to west Greenland from Canada did so before or near October 1. Their migration path followed the North Water of Baffin Bay then along the coast of west Greenland.

DFO. (2002). Cumberland Sound Beluga. Stock Status Report. E5-32(2002).

Cumberland Sound belugas remain in Cumberland Sound year round (Figure 9). Their overwintering grounds are at the mouth of Cumberland Sound.

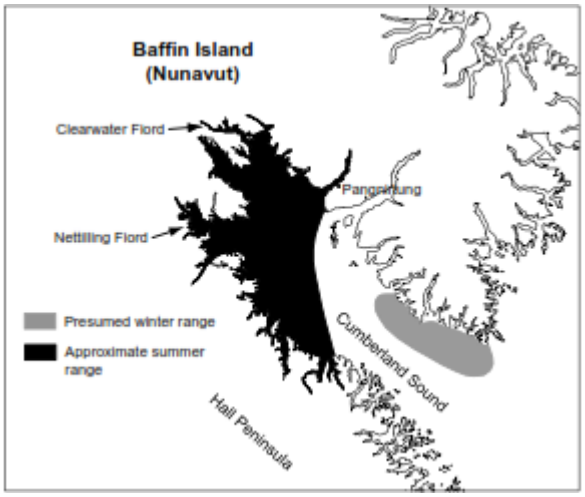

Figure 9: Cumberland Sound beluga whale range

DFO. (2009). Stock definition of Belugas and Narwhals in Nunavut. DFO Canadian Science Advisory Secretariat. Science Advisory Report 2009/079.

Belugas harvested near Iqaluit are thought to be from the Western-Northern-Southern Hudson Bay beluga stock. Most belugas caught around Kimmirut are harvested in autumn when the Western-Northern-Southern Hudson Bay beluga stock has moved into the Hudson Strait.

Richard, P.R. (2010). Stock definition of belugas and narwhals in Nunavut. *Canadian Science Advisory Secretariat. 2010/22.*18p.

All beluga's tagged in the Western-Northern-Southern Hudson Bay stock wintered in Hudson Strait.

Eastern High Arctic-Baffin Bay beluga stock were tagged at Cunningham Inlet and Elwin and Creswell bays, and then tracked into Peel Sound in late July- early August. They migrated east along Devon Island coast in September and October. Many entered Jones Sound, but wintered in the North Water polyna of northern Baffin Bay. A few moved to west Greenland for the winter.

Individual whales from the Cumberland Sound beluga stock were tagged near Clearwater Fiord and followed similar patterns of seasonal movements in Cumberland Sound. No whales left the Sound during autumn. They wintered in a polyna at the northeast corner of the mouth of Cumberland Sound.

Nunavut Planning Commission (2009). State of Knowledge in Maps. Nunavut Planning Commission. 28p.

The beluga whales' habitat extends from eastern Hudson Bay to Cumberland Sound to Jones Sound (Figure 10).

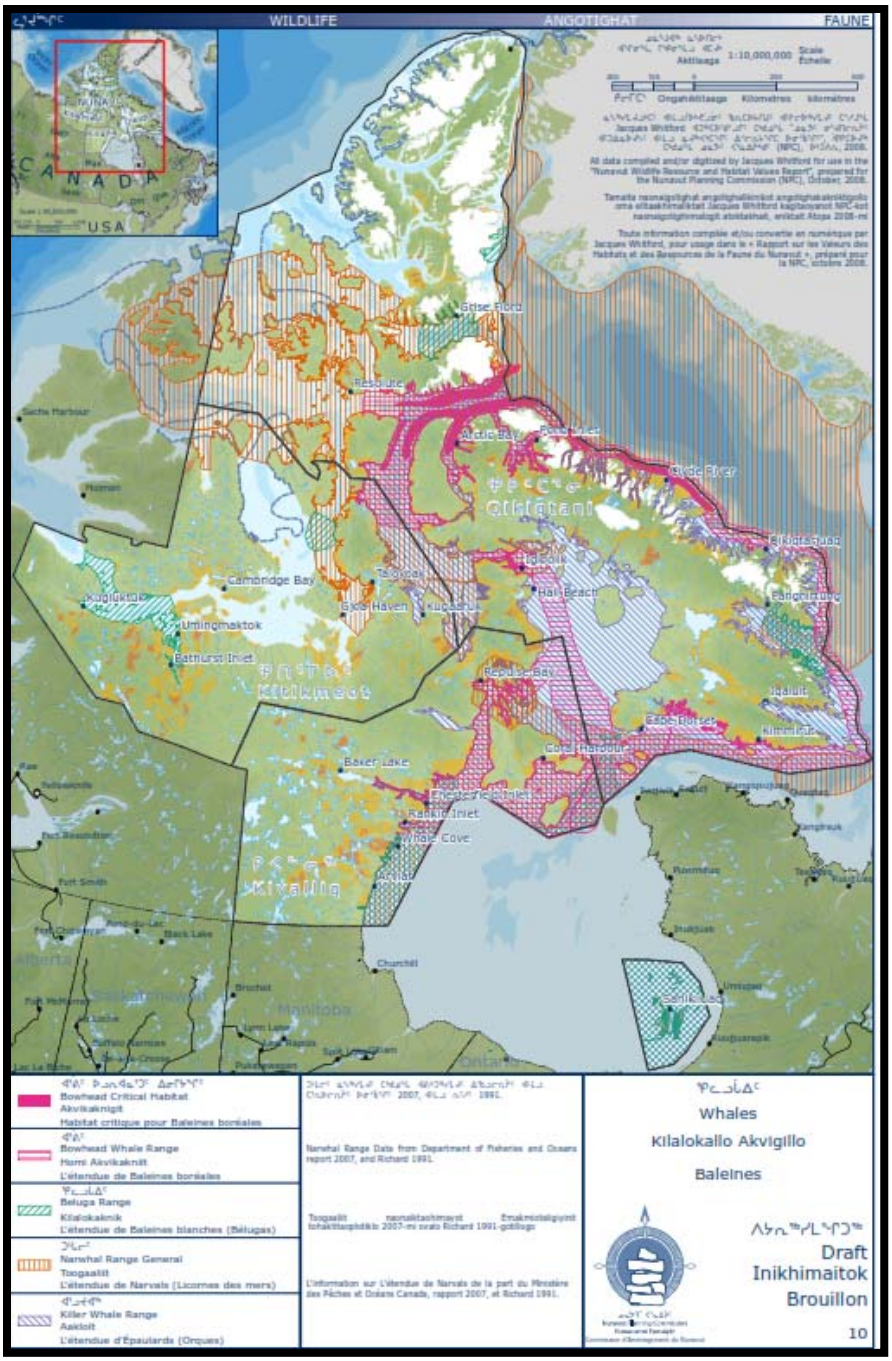

Figure 10: Beluga whale range (green) (from NPC, 2009).

COSEWIC. (2004). COSEWIC assessment and update status report on the beluga whale *Delphinapterus leucas* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Ix + 70p.

Beginning in mid-August, belugas begin to move away from the estuarine areas. Some populations, such as the High Arctic-Baffin Bay appear to make long journeys to deep-water areas away from land where they spend several weeks diving to the sea floor and engage in what appears to be intensive feeding activity. In mid to late September, belugas begin to actively move towards their winter areas (Figure 11).

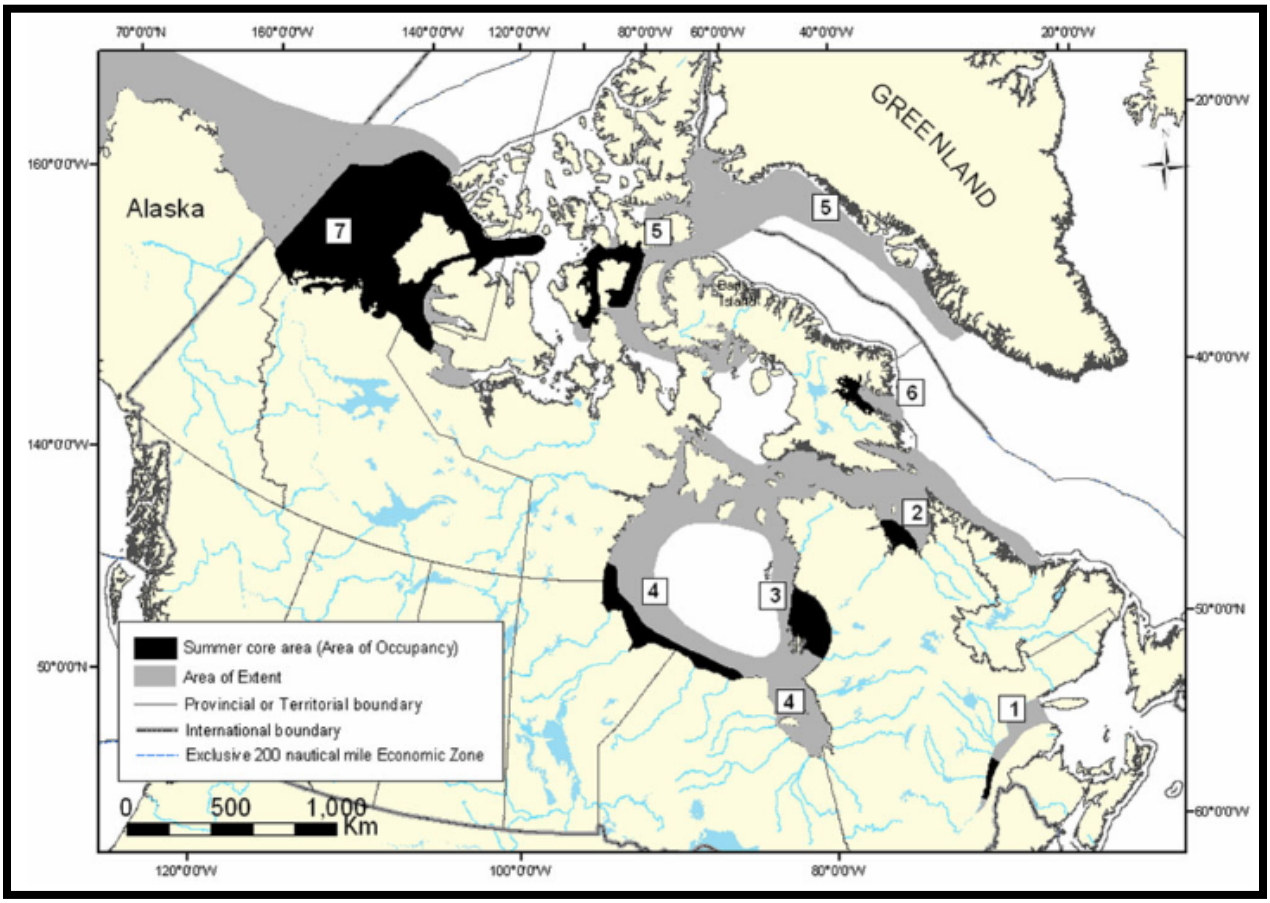

Figure 11: Location of the Canadian Beluga populations
1. St. Lawrence Estuary; 2. Ungava Bay; Eastern Hudson Bay; 4. Western Hudson Bay; 5. Eastern High Arctic-Baffin Bay; 6. Cumberland Sound; 7. Eastern Beaufort Sea

BELUGA BEHAVIOUR DURING SUMMER MONTHS

COSEWIC. (2004). COSEWIC assessment and update status report on the beluga whale *Delphinapterus leucas* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. lx + 70p.

During the summer when the fast ice has broken up or completely disappeared, belugas are found along the coastlines and in relatively shallow waters. At this time, belugas spend time in river estuaries where they moult.

Researchers think that beluga whales moult, feed, and calve during the summer. These activities may vary from one location to another.

In late summer they appear to feed intensively, often in deep areas somewhat distant from centres of their summer distribution. There is no direct evidence of prey species involved in summer feeding. Arctic cod have a deep water distribution in these areas, suggesting they may be a food source. Inuit in Arctic Bay and Pangnirtung report that belugas feed extensively on Greenland halibut at the floe edge. Belugas also eat capelin, saffron cod, and marine invertebrates.

BELUGA AND SEISMIC SURVEYS

Miller, G.W., V.D. Moulton, R.A. Davis, M. Holst, P. Millman, A. MacGillivray, and D. Hannay (2005). Monitoring seismic effects on marine mammals—southeastern Beaufort Sea, 2001-2002.p. 511-542. *In* Armsworthy, S.L., Cranford, P.J. and K. Lee. (2005). Offshore Oil and Gas Environmental Effects Monitoring: Approaches and Technologies. Battelle Press, Columbus Ohio. 629p.

The results are from a two year marine seismic program offshore of the Mackenzie Delta in the southeastern Beaufort Sea during 2001 and 2002. The marine mammal safety zone was 1000m. At this distance, the expected received sound levels was estimated to be 180dB re 1 µPa. Data was collected through aerial surveys, Marine Mammal Observers, and Passive Acoustic Modelling. Beluga whale sighting rates at distances of 10-20km from the seismic survey were significantly lower than those in areas 20-30 km from the seismic source, where sightings were unexpectedly high. Belugas closest to the seismic survey (1540-2500m) would have received sound levels of approximately 165dB re 1 µPa.

The 180dB radius for the proposed project is 500m (marine mammal safety zone).

DISCUSSION

Beluga whales appear to be sensitive to sound. Researchers reported that beluga whales changed their behaviour within 20km of an active seismic survey. The general behavioural change was to leave the area of the seismic survey.

The Eastern High Arctic- Baffin Bay beluga whale population primarily overwinter in the North Water while approximately 15% of the population continues the migration eastward towards western Greenland. Belugas generally reside in Cumberland Sound year round. Belugas from

the Western-Northern-Southern Hudson Bay population appear to migrate north along Baffin Island and are hunted in Iqaluit and Kimmirut. The exact migration pattern for the Western-Northern-Southern Hudson Bay population is not known; however, it is likely that the belugas remain close to Baffin Island while migrating.

During the summer, beluga whales remain close to shore and can be located in estuarine areas and shallow water. Belugas can eat capelin, saffron cod, and marine invertebrate in the summer. Belugas may travel to deeper waters to feed on Arctic cod or Greenland halibut.

Despite beluga whale's sensitivity to seismic surveys it is unlikely that the proposed seismic survey will interact with the whales. Since beluga whales spend the majority of the summer in coastal areas, and their wintering areas are not located in the proposed seismic survey area, it is unlikely that the seismic survey will interact with beluga whales.

6.4 Bowhead, (*Balaena mysticetus*), *Arviq*

Bowhead whales frequent the edge of pack ice and move closer to shore during the summer months, feeding on crustacean zooplankton. Bowheads have few natural predators; killer whales represent their greatest threat. The whales have a circumpolar distribution, migrating great distances through the Canadian Arctic. There are approximately 7000 and 10 000 animals remaining in the wild in five populations, three of which occur in Canada[52]. The Western Canada-Eastern Greenland bowhead population occurs in Baffin Bay. Bowhead whales are hunted by Inuit for subsistence and are co-managed by DFO, the Nunavut Wildlife Management Board, and the Nunavik Marine Region Wildlife Board. COSEWIC lists bowhead whales as 'Threatened'[53].

BOWHEAD MIGRATION

Reeves, R., Mitchell, E., Mansfield, A. and M. McLaughlin. (1983). Distribution and Migration of the Bowhead Whale, *Balaena mysticetes,* in the Eastern North American Arctic. *Arctic, 36(1):* 5-64.

Historic (as early as 1719) whaling records and present-day trends were used to analyse the distribution of Bowheads in the Eastern Arctic. Opportunistic observations of whale harvests were used in the report. This may restrict the bowhead observations to those being close to shore, and not in the middle of Baffin Bay and Davis Strait. Nonetheless, the authors suggest that there has been little indication of bowhead whales deviating from historic migration routes.

In the winter, bowheads are mainly distributed from the northeast coast of Labrador to the Greenland coast between Sukkertoppen and Godhaven. In spring, bowheads follow the ice edge northward in Davis Strait. Some bowheads enter Hudson Strait and move westwards into Hudson Bay. During May and June, Bowheads move into Cumberland Sound and by June or July, bowheads reach the floe edge off Pond Inlet and Lancaster Sound. During summer months, bowheads enter the sounds, fjords, and inlets in the High Arctic. Bowheads are also found in northwestern Hudson Bay and western Foxe Basin[54] (Roes Welcome Sun and Repulse Bay) in the summer.

The fall migration begins in September and continues through October. Some whales that summered in the High Arctic move south along the coast of Baffin Island, reaching Cumberland Sound where a large concentration occurs in late autumn. Others cross to the West Greenland coast and begin to reappear at Upernavik in late September and October. Bowhead whales that entered Prince Regent Inlet may proceed southward through Fury and Hecla Strait into Foxe Basin. These whales may move eastward through Hudson Strait in the fall.

Nunavut Wildlife Management Board. (2000).Final report of the Inuit Bowhead Knowledge Study. *Nunavut Wildlife Management Board*, Iqaluit, NU. 101p.

This report includes the results of several workshops with Inuit communities throughout Nunavut. The report includes discussion on a number of topics which include population ecology of bowheads, distribution and migration, ecology and behaviour, and cultural and traditional importance of bowheads to Inuit and management of bowheads. This summary will include information on bowhead whale movement during summer and fall[55].

*Aujaq (*Summer): Bowheads have many different summering areas, with whales being widely but patchily distributed in inshore waters around Baffin Island. Some whales are still migrating to their summering areas during summer. In Foxe Basin, northern Hudson Bay and northeast Baffin Island, some whales are beginning their southward/offshore migrations.

Ukiassaaq (Early Fall): In early fall, bowhead whales are distributed in near-shore waters, but the southward and offshore migrations have begun. There is a migration of bowheads south along the east coast of Baffin Island. In the High Arctic (around Grise Fiord), bowheads are moving to the outer parts of their inshore summering habitat and beginning their southward and offshore migration. Bowheads also leave Cumberland Sound at this time. Bowheads are reported in the near shore waters of Repulse Bay and Igloolik/Hall Beach in the early fall. It was indicated that the whales were heading south from these areas towards northeastern Hudson Bay and Hudson Strait.

Ukiaq (Fall): During fall, as the southward and offshore migration continues, bowhead whales appear only in a few scattered locations. Only southern communities (Qikiqtarjuaq, Igloolik, and Kimmirut) have bowhead whales in their vicinity at this time.

Calendar months associated with Inuit seasons for the High Arctic

- *Aujaq*: mid-July to early September
- *Ukiassaaq*: early September to late October
- *Ukiaq:* late October to early January

Wheeler, B., Gilbert, M. and S. Rowe. (2012). Definition of critical summer and fall habitat for bowhead whales in the eastern Canadian Arctic. *Endangered Species Research, 17:* 1-16.

Bowhead critical habitat was identified from an analysis of information from published and grey literature, and bowhead specialists. Information on bowhead whale location was obtained from DFO (figure 1 in Wheeler et al., 2012), the private sector (figure 2 in Wheeler et al., 2012), and historic whaling records (figure 3 in Wheeler et al., 2012). The authors identified 'highly suitable habitat'[56] for bowhead (Figure 12). This information is supported by bowhead concentration areas identified by Inuit in late spring, summer and early fall (Figure 13) (see summary NWMB report).

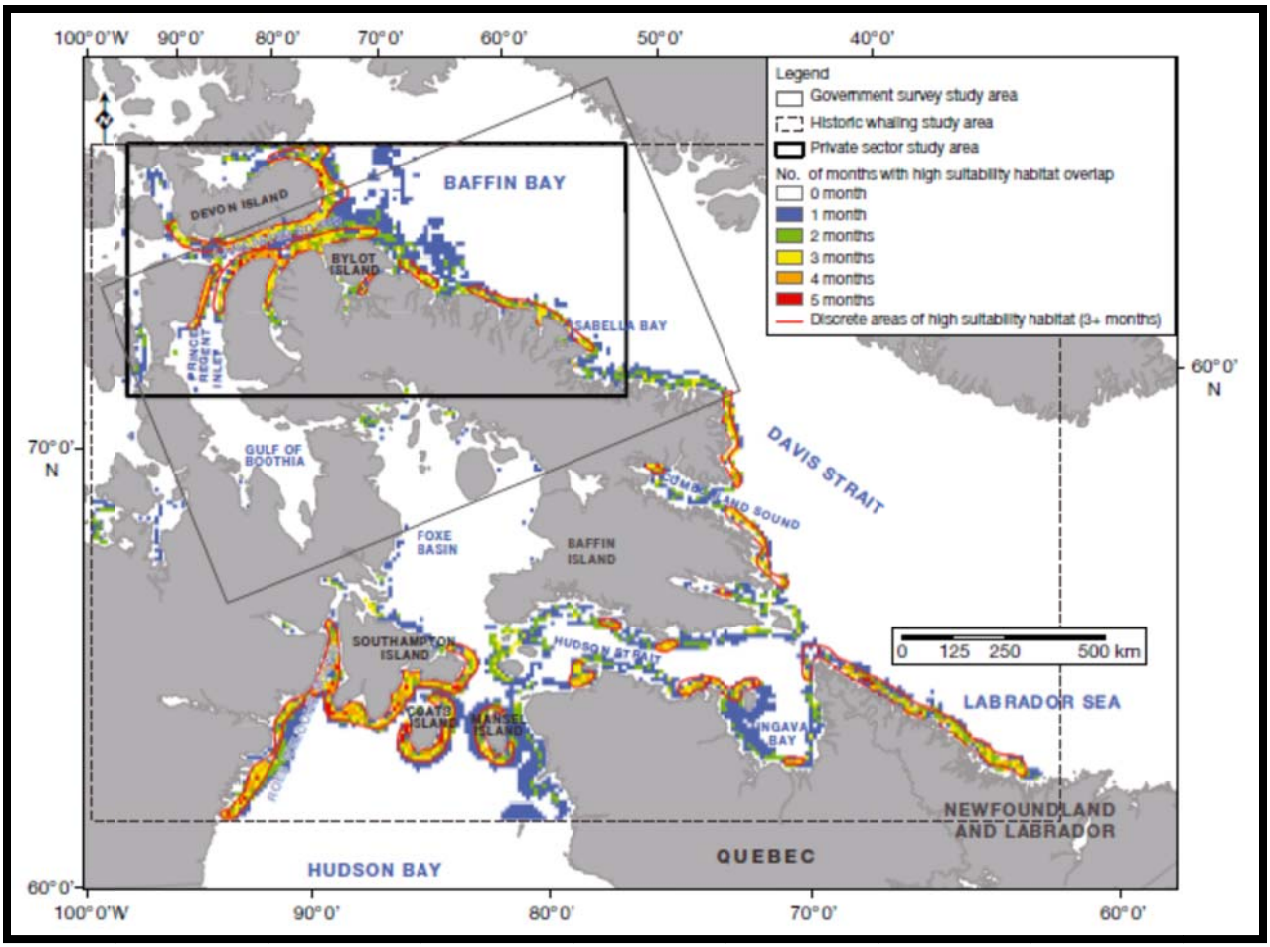

Figure 12: Highly suitable habitat map from June to October (figure 4 in Wheeler et al., 2012)

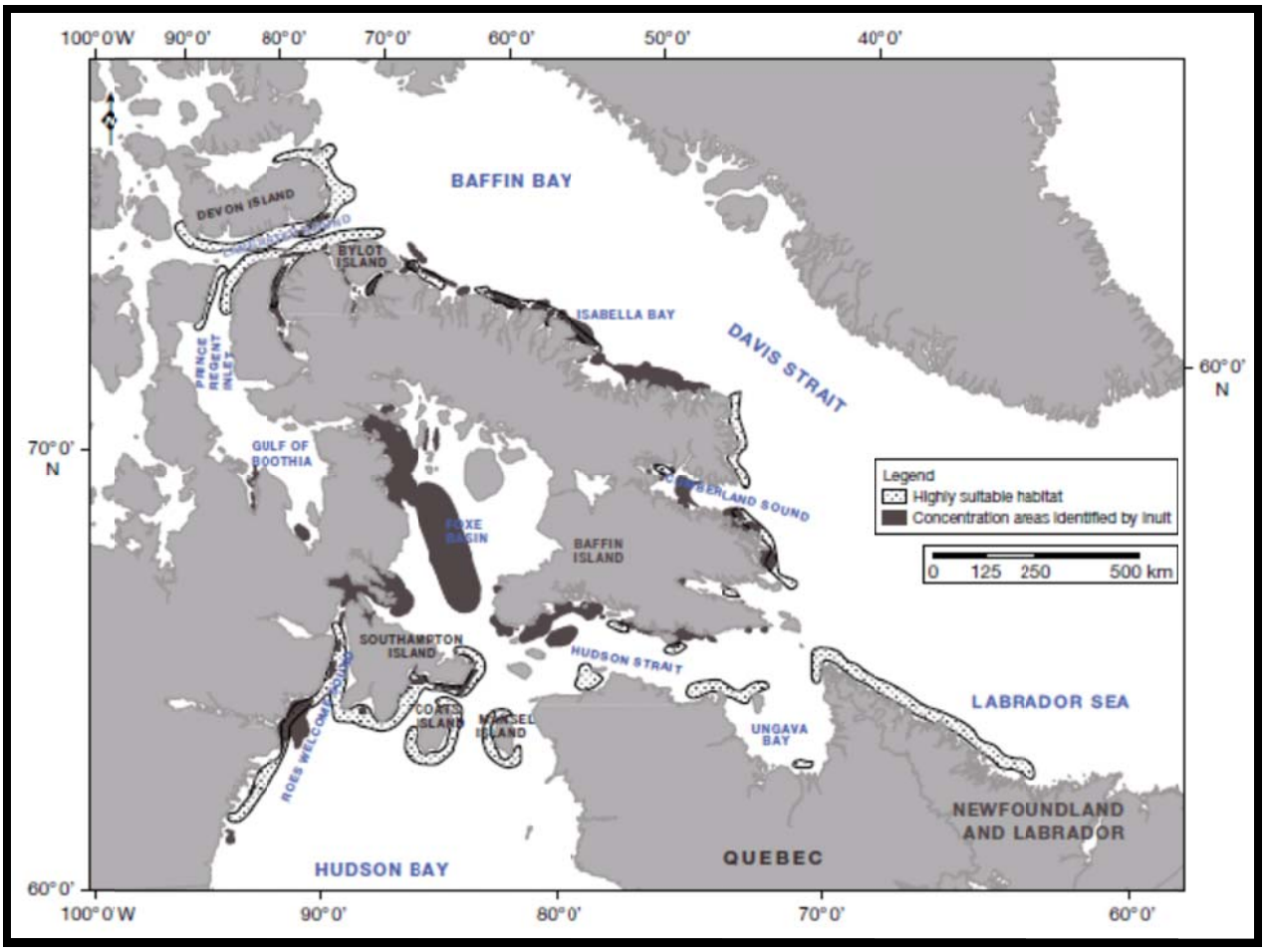

Figure 13: Comparison of highly suitable habitat with bowhead concentration areas identified by Inuit (figure 6 in Wheeler et al., 2012)

Ferguson, S.H., Dueck, L., Loseto, L.L. and S.P. Luque. (2010). Bowhead whale *Balaena mysticetes* seasonal selection of sea ice. *Marine Ecology Progress Series, 411:* 285-297.

Twenty-seven bowhead whales from the Western Canada-Eastern Greenland population were tagged with satellite transmitters in July from 2002 to 2003 in Foxe Basin and then in 2004 to 2006 in Cumberland Sound. There was an indication of two migrations during the summer-autumn period indicated by peaks in movement rates. These occurred around July 22 when the whales moved from the spring to summer range and around October 29 when whales were returning from the summer to the winter range. Movement rate is a good indicator that migrations have begun as bowhead whales travel long distances between their summer and wintering grounds. This is in comparison to the relatively low movement rates when bowheads are in their summering grounds, indicating that bowheads generally remain in the same area throughout the summer[57]. Figure 14 illustrates the movement of the tagged bowhead whales from July until early winter[58]. Bowhead whale movement patterns include a behavioural preference for ice-edge habitat[59] and the avoidance of competition from other baleen whales.

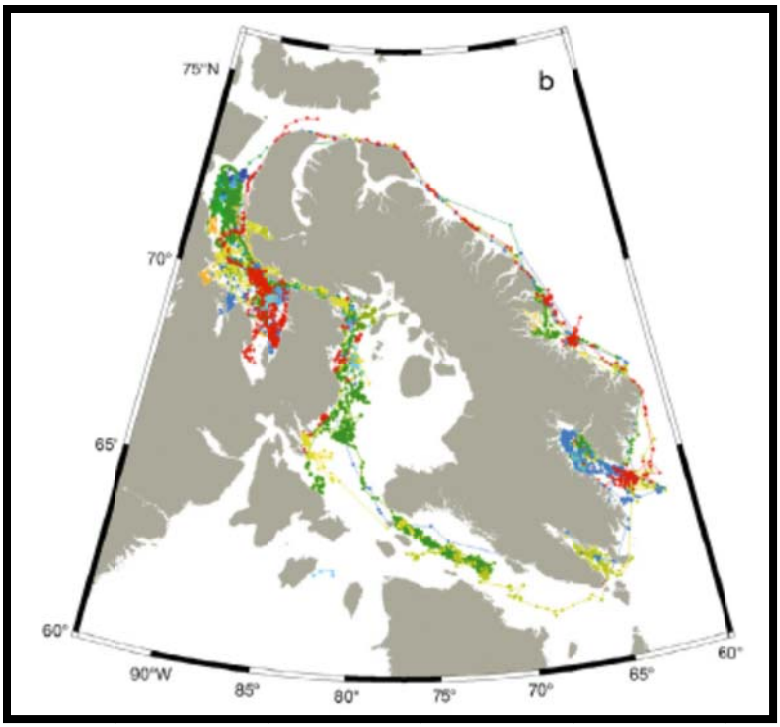

Figure 14: Movement of 27 tagged bowhead whales (fig.1 in Ferguson et al., 2010)

Nunavut Planning Commission (2009). State of Knowledge in Maps. Nunavut Planning Commission. 28p.

Bowhead whale critical habitat is along the western coast of Baffin Bay south of Clyde River into Lancaster Sound in the coastal region (Figure 15). Critical habitat is also located in Hudson Strait. Bowhead range is generally located in the coastal region of eastern Baffin Island, north through Lancaster Sound and south through Hudson Strait into Hudson Bay and Foxe Basin.

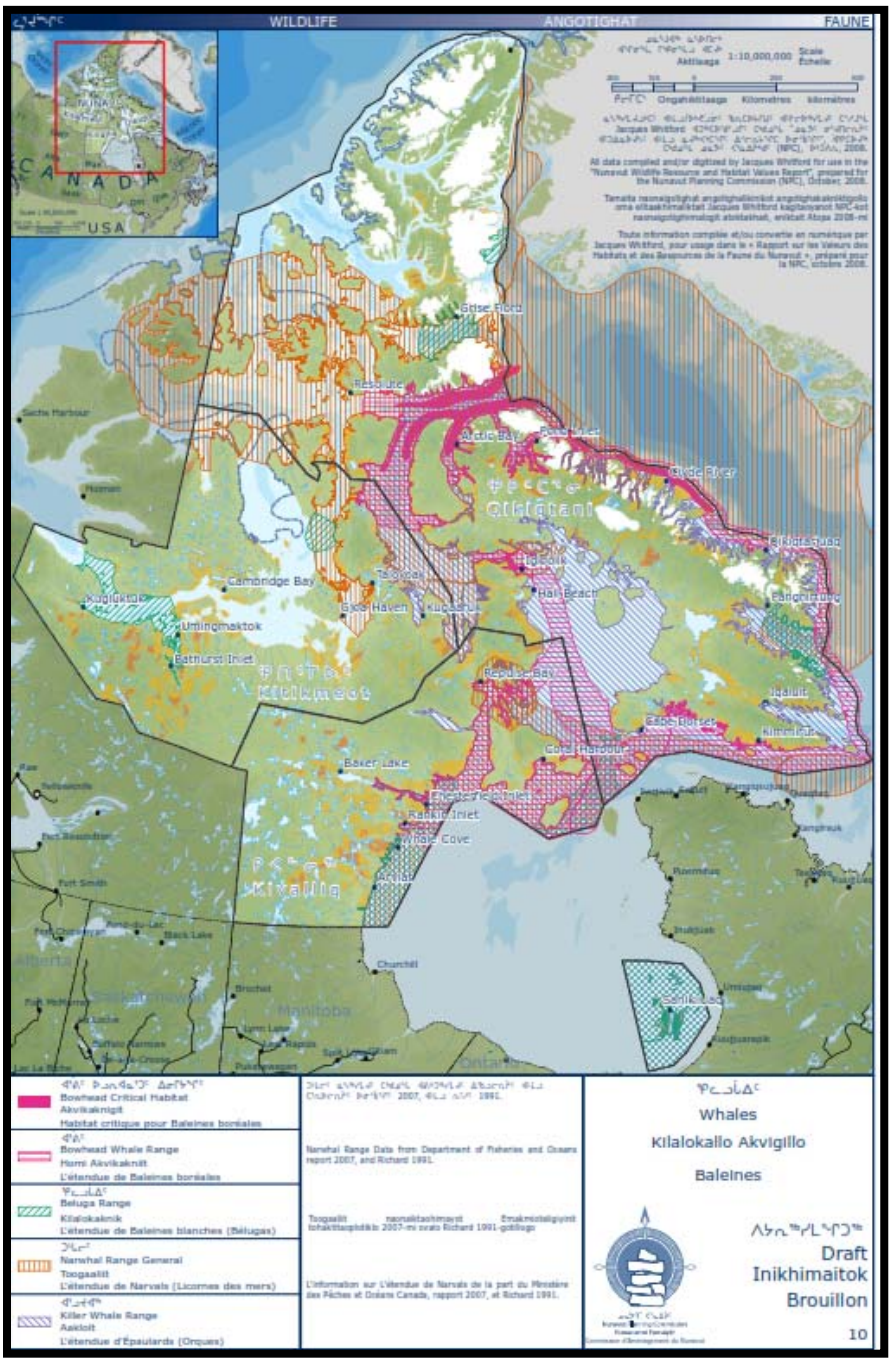

Figure 15: Bowhead whale critical habitat and habitat range (pink) (from NPC, 2009).

SUMMARY

Available reports provide information on general movements of the Western Canadian-Eastern Greenland bowhead whale population (Table 4). Based on this information the seasonal migration of the Western Canadian-Eastern Greenland bowhead whale population can be inferred (Figure 14). This migration pattern has been discussed in research reports which have involved tagging bowhead whales and reports from Inuit knowledge studies. Reports indicate that bowhead whales can begin their migration in early September.

Table 4: Summary of bowhead whale fall migration for Western Canada-Eastern Greenland population

Source	Data collection method	Bowhead Migration Begin	Migration path[60]
Reeves et al., 1983	Historic and contemporary data from records and archives	Begins in September, continues into October	1) Cross Baffin Bay from Lancaster Sound to Greenland 2) Travel south down Baffin Island toward Cumberland Sound
NWMB, 2000	Workshops with Inuit communities	*Ukiassaaq* (Early September to late October)	1) Whales from the High Arctic move south along the coast of Baffin Island or offshore 2) Whales in Cumberland Sound move south to Hudson Strait
Wheeler et al., 2012	Government, private sector and historical whaling records	No information	Report identified bowhead whale highly suitable habitat. The habitat (in and around Baffin Island) identified agrees with information obtained on bowhead whale migration
Ferguson et al., 2010	Satellite telemetry from 27 tagged bowhead whales	Bowhead whales began their fall migration on October 29.	Bowhead whales remained close to Baffin Island throughout the study.
NPC, 2009	Workshops with Inuit	No information	Bowhead highly suitable habitat and range (close to shore along Baffin Island, in Lancaster Sound, Hudson Strait and Foxe Basin) is similar to information obtained in other studies



Figure 16: Western Canada-Eastern Greenland Bowhead Whale population migratory pattern (green=spring; black=summer; orange=fall; purple=winter) (map courtesy of Google Earth). These lines are to show trends in bowhead whale migration.

During the spring migration, bowhead whales remain close to the floe edge which is generally located across Davis Strait towards Newfoundland and out to Sukkertoppen, Greenland. As the floe edge recedes, bowheads migrate north, remaining close to the east coast of Baffin Island. Some whales will go through Hudson Strait and remain in Foxe Basin and Hudson Bay, while the other whales migrate towards Lancaster Sound and spend time in the Gulf of Boothia and Prince Regent Inlet. During the summer time, bowhead whales remain in the many inlets, bays, and fjords in the High Arctic.

During the fall migration, bowhead whales in the High Arctic take one of two migration paths. Some bowhead whales begin their migration south along the east coast of Baffin Island, while other whales cross northern Baffin Bay and arrive near Upernavik, Greenland. It is at this time that large congregations of bowhead whales may occur in Cumberland Sound. As fall approaches, bowhead whales continue their southward migration. Bowhead whales from Foxe

Basin and Hudson Bay head eastward across Hudson strait. The whales then congregate at the floe edge outside of Davis Strait in the winter (Figure 16)

A report by Heide-Jørgensen and colleagues (2003)[61] assessed the movements of two tagged bowhead whales[62] as they began their spring migration from Disko Bay, Greenland through Baffin Bay to Lancaster Sound. Disko Bay is approximately 425km south of Upernavik, Greenland. Over an average of 9 to 10 days, in May and June, the bowhead whales traversed the ice pack filled Baffin Bay. It is suggested that Bowhead whales occur in seasonal aggregations along the coasts of Eastern Baffin Island and Western Greenland and traverse offshore areas only when moving and/or migrating to other concentration areas.

BOWHEAD BEHAVIOUR DURING SUMMER MONTHS

Bowhead whales primarily feed in late summer, early fall on pelagic and epibenthic zooplankton. Feeding can occur in late winter and early spring[63]. The Eastern Canada-Western Greenland bowhead whales are predominately located in Lancaster Sound, Isabella Bay, Prince Regent Inlet, Admiralty Inlet, Cumberland Sound, and the Gulf of Boothia in the summer months[64].

BOWHEAD AND SEISMIC SURVEYS

Behavioural and anatomical evidence suggests that baleen whales hear well at frequencies below 1kHz where most of the energy from the sound source is focused[65]. Therefore, bowheads, which are baleen whales, may be more sensitive to sound from seismic surveys than toothed whales. Observations on bowhead whale behaviour in response to seismic surveys corroborate that bowhead whales may be affected by seismic surveys; however, these observations suggest a threshold in which bowhead may react to seismic surveys. Table 5 provides a summary on the available information of the reaction between seismic surveys and bowhead whales:

Table 5: Summary on bowhead behavioural reactions to seismic surveys

Distance between bowhead whale and seismic vessel	Change in bowhead whale behaviour	Source
1.957km	Bowhead whales were sighted further away (1957m) during active seismic operations compared to inactive periods (1368m).	Miller et al., 2005
1.3-7.2km	Yes. Whales leave observation area	Ljungblad et al.,1988
2-4.5km	Yes. Bowheads oriented away from seismic survey. Remained in area.	Richardson et al., 1986
3km	Yes. Bowhead stopped bottom feeding	Richardson et al., 1986
3.5-8.2km	Yes. Subtle behaviour response	Ljungblad et al.,1988
3.5-7.6km	Yes. Partial avoidance (some whales left, while other whales remained in the observation area)	Ljungblad et al.,1988

Distance between bowhead whale and seismic vessel	Change in bowhead whale behaviour	Source
Instances of seismic surveys effecting and not effecting whales (no references provided)		Mosbech et al., 2000
3-5km	No. Bowheads maintained normal activities	Richardson et al., 1986
6-99km	No. Activities of bowheads in this area were the same compared to bowheads not near an active seismic survey	Richardson et al., 1986

According to available report, bowhead whales which changed their behaviour in the presence of a seismic survey normally resumed to their pre-seismic survey behaviour within one[66] or 48 hours[67] after interacting with a seismic survey.

DISCUSSION

Based on observations recorded on the interaction between seismic surveys and bowhead whales, it appears that bowhead whales may change their behaviour in the presence of seismic surveying. Bowhead whales have been observed to exhibit a variety of behavioural responses to sound from seismic surveys. It was reported that bowhead whales left the survey area within a range of 1.3km-7.2km from the sound source. However, some bowhead whales did not change their behaviour when an operating seismic survey was within 3km. Ljungblad and colleagues (1988) reported that bowhead whales resumed pre-seismic survey behaviour within one hour after the survey left the area. When seismic survey vessels stopped operating and remained in the area to observe bowhead whales, the whales resumed normal behaviour within one hour.

The Western Canada-Eastern Greenland bowhead population spend most of their summer in the fjords and sounds of Baffin Bay. It is unlikely that the MKI seismic survey will interact with bowhead whales at this time. Bowhead whales begin their fall migration in September and follow one of two migration routes; they either travel south along eastern Baffin Island or east across Baffin Bay to western Greenland. It is possible that migrating bowhead whales may encounter the proposed survey activity; however, the survey can be scheduled so as to limit this interaction.

6.5 Walrus (*Odobenus rosmarus*), *Aiviq*

The Atlantic Walrus inhabits arctic coastal regions, preferring shallow water with high bivalve productivity, where they feed primarily on clams and urchins. Natural predators include killer whales and sharks. Walrus require ice or low rocky shores with steep sub- tidal zones to 'haul out'. Atlantic Walrus can range from the high arctic to the more southerly latitudes of Nova Scotia and the Saint Lawrence River. Five populations are recognized for management purposes, with an approximate total population of 15 000[68]. Walrus are hunted by Inuit for subsistence, and is managed by DFO subject to the terms of the Nunavut Land Claims Agreement and the *Fisheries Act*. Atlantic Walrus are listed as "Special Concern" by COSEWIC.

WALRUS MIGRATION

Stewart, R. (2008). Redefining Walrus Stocks in Canada. *Arctic, 61(3):* 292-308.

Eighteen walrus were tagged with satellite transmitters between 1993 and 2004 in the fjords on south-west Devon Island, Grinnel Peninsula (Devon Island), Bathurst Island, Norfolk Inlet and Goose Fiord (adjacent to western Jones Sound). The tagged walrus wintering areas occurred in Cardigan Strait- Fram Sound area at the west end of Jones Sound, the floe edges of Jones and Lancaster Sound and in the North Water polyna.

The walrus tagged in this study are thought to belong to the North Water stock (stock 5 in Figure 17)

Born, E.W., Gjertz, I and R.R. Reeves. (1995). Population assessment of Atlantic walrus (*Obdenus rosmarus rosmarus*). Meddelelser Nr. 138. Oslo: Norsk Polar Institute. 100p.

The Northern Hudson Bay-Hudson Strait- Southeastern Baffin Island- Northern Labrador (stock 3 in Figure 17) may have some connection with southern and eastern Hudson Bay and with Central West Greenland. Walruses occur year round along portions of the coast of eastern Baffin Island south of Clyde Inlet and in the Hudson Strait. Although areas of summer concentrations have been identified (e.g. outer parts of Cumberland and Hall peninsulas, Lady Franklin Island group, Loks Land), some of these groups may undertake fairly long migrations while others are thought to move relatively short distances according to ice conditions and availability of food.

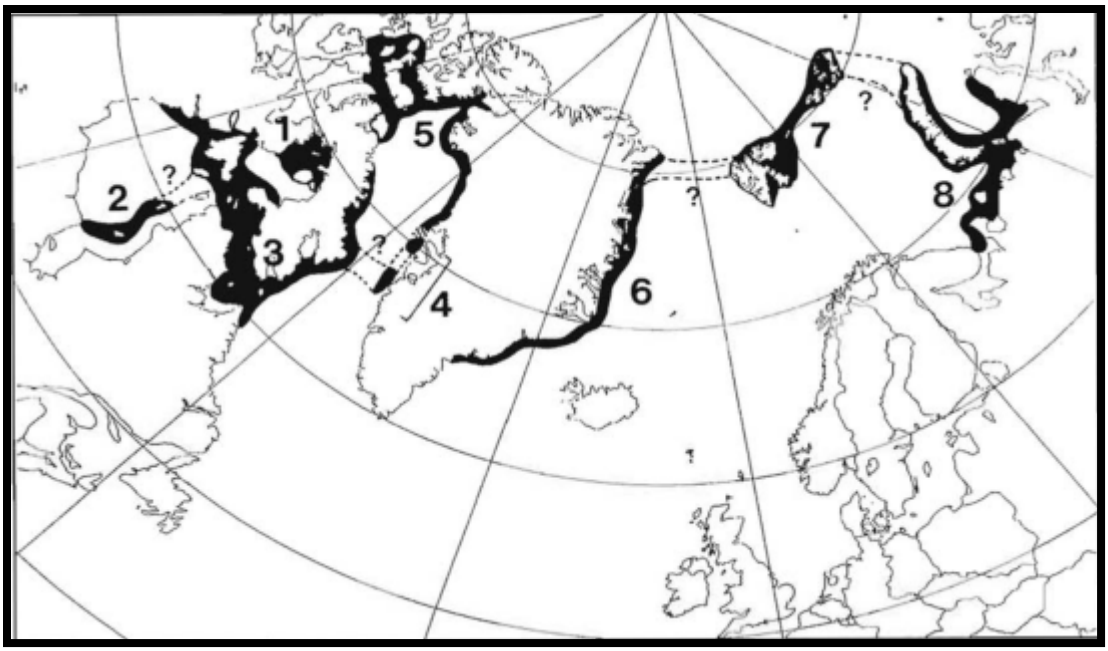

Figure 17: Delineation of walrus stocks
(1. Foxe Basin; 2. Southern and Eastern Hudson Bay; 3. Northern Hudson Bay; 4. Western Greenland; 5. North Water; 6. Eastern Greenland; 7. Svalbard; 8. Kara Sea (Figure 3 in Born et al., 1995).

COSEWIC. (2006). COSEWIC assessment and update status report on the Atlantic walrus *Odobenus roasmarus rosmarus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Ix+65p. (www.sararegistry.gc.ca/status/status_e.cfm)

For the most part, the Northern Hudson Bay-Hudson Strait- Southeastern Baffin Island-Northern Labrador (stock 3 in Figure 17) walrus stock remains close to land during the summer months. However, there have been observations of walruses offshore over deep waters between southeastern Baffin Island and western Greenland. This migration path has not been documented as indicated in Figure 17.

The High Arctic population (stock 5, also known as North Water, in Figure 17) is separated geographically from other Canadian walrus populations to the south. This population is shared with Greenland and extends southwards to Disko Island, Greenland.

Walrus live in Foxe Basin (stock 1 in Figure 17) year round in relatively shallow waters. Walruses can also be found in the Gulf of Boothia (accessible from Fox Basin and Lancaster Sound); however these animals are believed to come from the Baffin Bay population to the north.

Nunavut Planning Commission (2009). State of Knowledge in Maps. Nunavut Planning Commission. 28p.

Walrus summering ranges occur off Qikiqtarjuaq, south of Cumberland Sound, southeastern Frobisher Bay, the mouth of Hudson Strait, in Hudson Bay, and Foxe Basin. Walrus wintering range includes the eastern Ellesmere Island in the High Arctic (Figure 18). Walrus are found year round in northern Foxe Basin and western Jones Sound.

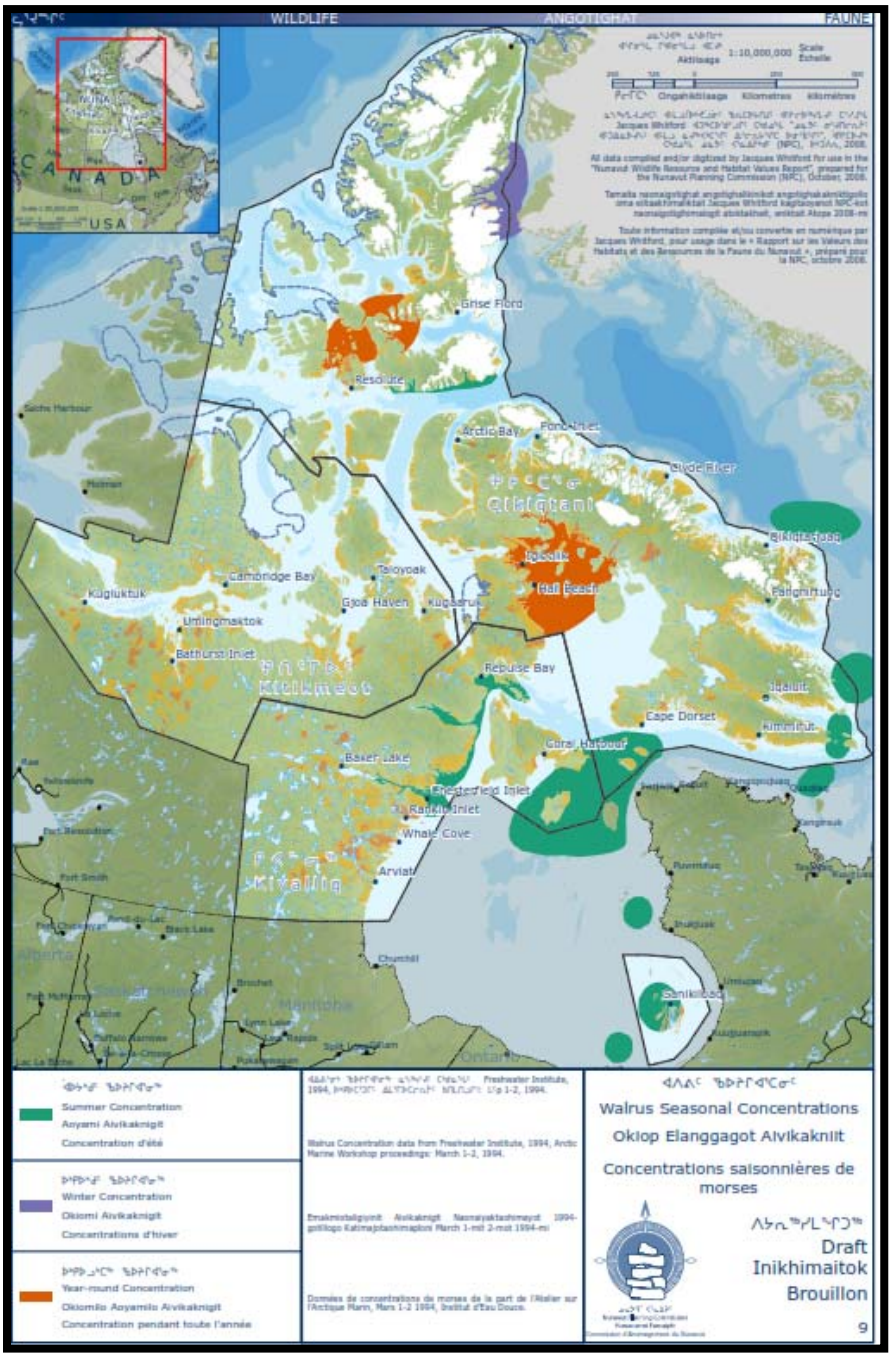

Figure 18: Walrus seasonal habitat range (from NPC, 2008)

WALRUS BEHAVIOUR DURING SUMMER MONTHS

During the summer the walrus population is segregated by age and sex, with mature males forming separate groups[69]. In many areas, walrus haul out on land, but they may also rest on floating ice.

Born, E.W., Gjertz, I and R.R. Reeves. (1995). Population assessment of Atlantic walrus (*Obdenus rosmarus rosmarus*). Meddelelser Nr. 138. Oslo: Norsk Polar Institute. 100p.

Haul out platforms are usually ice pans although terrestrial haul out sites are used in the ice-free summer and autumn period.

Fisher, K.I., and R.E.A. Stewart. (1997). Summer foods of Atlantic walrus, *Obdenus rosmarus rosmarus,* in northern Foxe Basin, Northwest Territories. *Canadian Journal of Zoology, 75:* 1166-1175.

Walrus in Foxe Basin eat more prey in September to November compared to July. If the feeding behaviour of walrus in Foxe Basin is similar to walrus in Baffin Bay, then it can be expected that walrus remain close to shore in September until November to feed on bivalves and mollusks in waters less than 100m.

Fay, F.H. and J.J. Burns. (1988). Maximal Feeding Depths of Walruses. Arctic, 41(3), 239-240.

Walruses feed mainly on benthic invertebrates in waters less than 80m deep.

WALRUS AND SEISMIC SURVEYS

There are no available reports analyzing the potential effects of seismic surveys on walrus.

DFO describes the hearing ability of walrus and does not provide information on the effects of seismic surveys to walrus[70]. A Temporary Threshold Shift as result of sound from seismic surveys has not been documented for walrus[71].

DISCUSSION

Reports indicate that the Foxe Basin and High Arctic walrus populations do not interact with the Northern Hudson Bay-Hudson Strait- Southeastern Baffin Island- Northern Labrador population.

Behavioural characteristics suggest that walrus preferentially spend the summer months close to land where they can haul out (as available ice is limited) and eat bivalves located on the ocean floor. This routinely occurs in coastal areas within 80 metres of water.

Walrus have been reported travelling between Canada (off Qikiqtarjuaq) and Greenland during the summer months; however, it is not known how many walrus make this journey and what time of year this journey takes place. We suggest that the walrus congregation area off Qikiqtarjuaq identified by Inuit may be the starting point for the route walrus take between Canada and Greenland.

Therefore, except for the few offshore areas where walrus congregate in the summer, and a suspected migration route between Canada and Greenland, it is unlikely that walrus would come within close proximity to the proposed seismic survey.

The apparent absence of reports assessing the interaction between seismic surveys and walrus may be an indication that walrus are generally not located in areas where seismic surveys have been completed. Available reports indicate that walrus generally remain close to land with a few offshore areas in southern Baffin Bay (near Qikiqtarjuaq, Iqaluit, and Kimmirut) where walrus congregate in the summer.

6.6 Bearded Seal (*Erignathus barbatus*), *Udjuk*

The Bearded seal inhabits ice flows and shallow waters, feeding on crabs, clams, squid, and fish in the Arctic. Natural predators include polar bears, sharks, and walrus. Bearded seals have a circumpolar distribution, found throughout southern latitudes of the Arctic, along the coasts of Labrador and the northern coasts of Newfoundland. They require ice flows to haul out, although occasionally haul out on land. The population of Bearded Seals is not known (DFO, 2011)[72]. The seals are hunted by Inuit for subsistence and are managed by the DFO (2011) through the *2011-2015 Integrated Fisheries Management Plan for Atlantic Seals*. The SARA and COSEWIC status for bearded seals is 'Data Deficient'.

BEARDED SEAL MIGRATION

Finley, K.J. and W.E. Renaud. (1980). Marine Mammals Inhabiting the Baffin Bay North Water in Winter. *Arctic, 30(4):* 724-738.

Aerial surveys over the North Water were completed in 1978 and 1979. Bearded seals were seen in deep water (200-500m) near SE Ellesmere Island in 1979. Bearded seals are mostly restricted to areas where ice cover is thin or broken. Since they are normally bottom feeders, they must have access to relatively shallow areas where benthic prey is available.

Finley, K.J. and C.R. Evans. (1983). Summer Diet of the Bearded Seal (*Erignathus barbatus)* in the Canadian High Arctic. *Arctic, 36(1):* 82-89

During the summer, bearded seal are found widely distributed in small numbers throughout much of the archipelago. In the eastern Canadian High Arctic, bearded seals are hunted in fjords, primarily from July to October.

Shell. (2013). Shell Greenland A/S 2013 Site Survey in Baffin Bay Blocks 5 (Anu) and 8 (Napu). Preliminary Environmental Impact Assessment

Fourteen bearded seals were observed by Marine Mammal and Seabird Observers throughout a 2012 3D seismic survey in Baffin Bay blocks 5 and 8 (includes transit time to survey area). Thirteen bearded seals were observed in the survey area. The report did not indicate if the bearded seals appeared in the 500m safety zone for seals.

Nunavut Planning Commission (2009). State of Knowledge in Maps. Nunavut Planning Commission. 28p.

The Nunavut Planning Commission prepared a report which used IQ to prepare maps depicting wildlife and Inuit use of the land and resources. Figure 19 shows areas of high bearded seal density. These areas include the western side of Hudson Bay, northern Fox Basin, and Lancaster Sound.

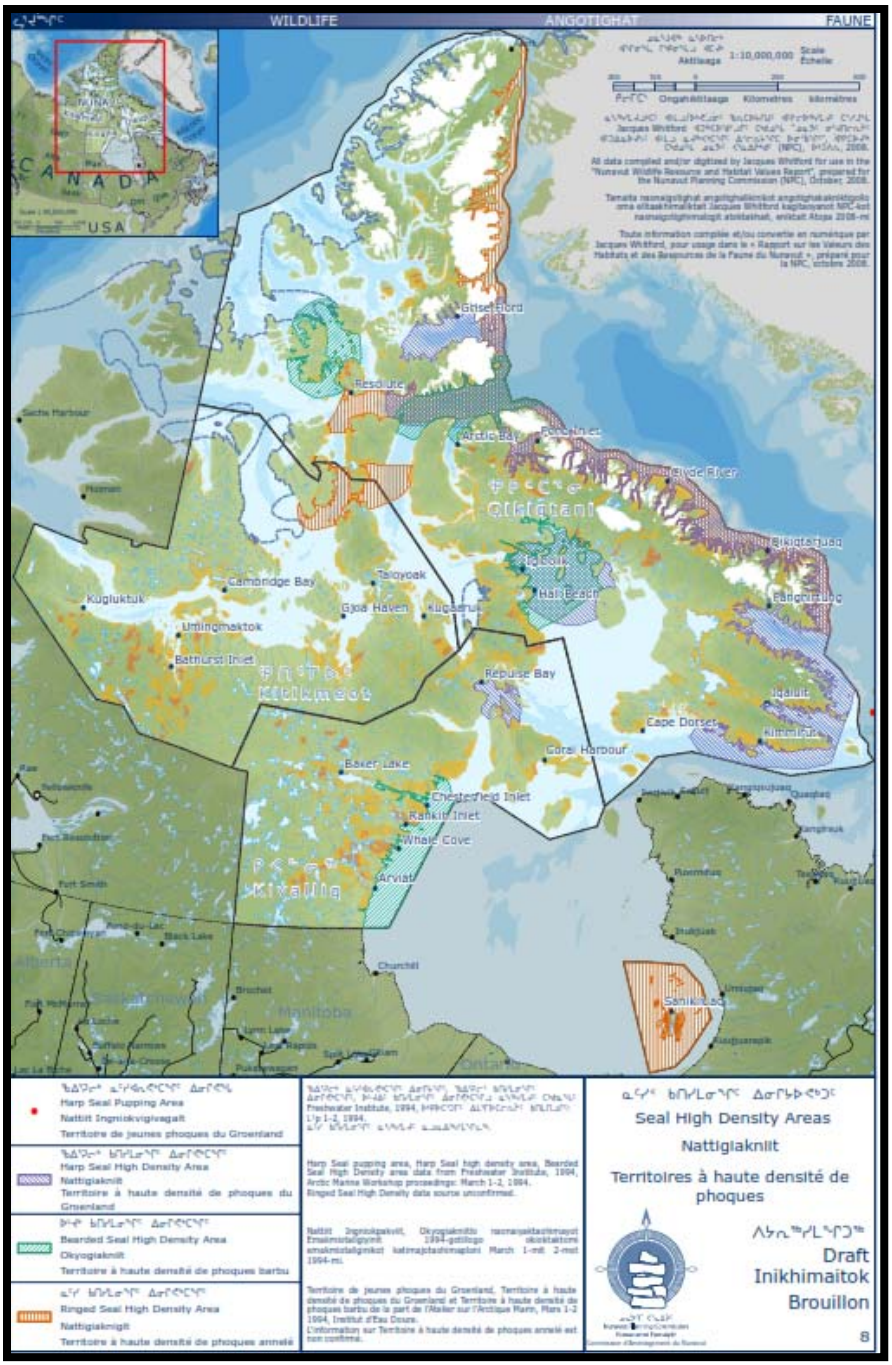

Figure 19: Seal High Density Areas (Nunavut Planning Commission, 2008)

BEARDED SEAL BEHAVIOUR DURING SUMMER MONTHS

Finley, K.J. and C.R. Evans. (1983). Summer Diet of the Bearded Seal (*Erignathus barbatus)* in the Canadian High Arctic. *Arctic, 36(1):* 82-89

Stomach contents of 34 bearded seals harvested in three High Arctic communities (Grise Fiord, Pond Inlet and Clyde River) during the summers of 1978 and 1980 were examined. At least 12

species of fish were present in the stomach contents, but sculpin and arctic cod comprised the bulk of the diet.

BEARDED SEAL AND SEISMIC SURVEYS

Bearded seals were observed to swim away from an active seismic survey to a distance of 250m (Harris et al., 2001) in the Beaufort Sea. During this seismic survey (3D seismic survey in 1996 in the Beaufort Sea), no seals were observed to leave the survey area during an active seismic survey (Harris et al., 2001). In Shell's 2012 3D seismic survey off Greenland in lease blocks 5 and 8, 13 bearded seals were observed by Marine Mammal and Seabird Observers in the survey area. It was not specified if the bearded seals entered the 500m safety zone.

DISCUSSION

Bearded seals spend a large portion of the summer in coastal areas and in the many fjords and bays within and around Baffin Island and Ellesmere Island. Being benthic feeders, bearded seals must remain near relatively shallow waters (approximately 80m) to eat. Both Inuit and scientific observations indicate areas where bearded seals are most likely to be observed as close to land.

Bearded seals have been known to venture into deeper water, particularly off Ellesmere Island in the High Arctic. There is no known summer migration of bearded seals in the deep waters of Baffin Bay or Davis Strait. Bearded seals were observed in the deep waters of Baffin Bay and Davis Strait during the 2012 3D seismic survey by Shell.

The documented effects of seismic surveys on bearded seals appear to be negligible beyond 250m. This was demonstrated in a 3D seismic survey in the Beaufort Sea in 1996. In this survey, bearded seals did not move beyond 250m away from an active seismic survey vessel.

Therefore, with the mitigation measures proposed for this seismic survey, it is unlikely that bearded seals will be negatively affected. Specifically, the seismic survey will stop if a seal (or any other marine mammal) is within 500m of an active sound source.

6.7 Ringed Seal (*Pusa hispida*), *Natsik*

The Ringed Seal inhabit ice flows and pack ice, feeding on shrimp, cod, herring, smelt, whitefish, sculpin, and various other small fish and crustaceans. Ringed seals have a circumpolar distribution. Ringed seals haul out on ice year round, although they occasionally use land as well. The total population of Ringed seals is estimated at over one million (DFO, 2011)[73]. The seals are hunted by Inuit for subsistence and are managed by the DFO (2011) through the *2011-2015 Integrated Fisheries Management Plan for Atlantic Seals.* Ringed Seals are listed as "Not at Risk" by COSEWIC.

RINGED SEAL MIGRATION

Born, E.W., Teilmann, J., Acquarone, M. and F.F. Riget. (2004). Habitat use of Ringed Seals (*Phoca hispida)* in the North Water Area (North Baffin Bay). *Arctic, 57(2):* 129-142.

Twenty-three ringed seals were tracked for an average of 108 days from August 12, 1996 until June 30, 1999 in the North Water area. Four seals left the North Water area. During all seasons, the seals that remained in the North Water area, spent about 90% of their time in coastal (less than 100m deep) waters in the eastern parts of the North Water area. Individual movements were significantly greater during the open-water season than during winter and spring. Maximum dive depths were 500 m outside of the North Water area and 376m inside. It was suggested that prey availability determined the depths of dives for ringed seals.

Kovacs, K.M. (n.d.). Background document for development of a circumpolar ringed seal (*Phoca hispida)* monitoring plan. Retrieved June 19, 2013 from http://www.arlis.org/docs/vol1/D/778551575.pdf

In the summer and fall, when land-fast ice is not available, ringed seals show considerable diversity in their distribution patterns. Some animals remain in the general vicinity of their breeding sites (along packs of ice) while others disperse along coastlines where ice from glaciers is available. Ringed seals are generally found at highest densities over shallow to mid-depths (100-200m) of water. Ringed seals try to remain where there is some ice coverage throughout the year. When seals are offshore, sea ice concentration and the time of year influenced habitat selection by ringed seals.

Information regarding seasonal and inter-annual movement patterns of ringed seals is somewhat limited. Near Baffin Bay, ringed seals seem to leave coastal areas in the summer, while in other, generally more northern areas, large influxes of ringed seals occur during the open water period.

Finley, K.J., Miller, G.W., Davis, R.A. and W.R. Koski. (1983). A distinctive large breeding population of ringed seals (*Phoca hispida)* inhabiting the Baffin Bay pack ice. *Arctic, 36(2):* 162-173.

There may be two populations of ringed seals in Baffin Bay based on morphological and ecological differences. Small numbers of ringed seals were seen during aerial surveys in May, but the peak of haul-out in both offshore and coastal areas occurred during the latter half of June and into early July.

Group sizes were similar in offshore and coastal areas, although they tended to increase in size towards July. Ringed seals were distributed throughout the offshore pack ice and the coastal fast ice of NW Baffin Bay (north of Clyde River). Few seals were seen in peripheral areas of the pack-ice fields where the ice was more active and broken.

Nunavut Planning Commission (2009). State of Knowledge in Maps. Nunavut Planning Commission. 28p.

High density ring seal locations include south-eastern Hudson Bay and coastal areas of Lancaster Sound (Figure 19).

RINGED SEAL BEHAVIOUR DURING SUMMER MONTHS

Kovacs, K.M. (n.d.). Background document for development of a circumpolar ringed seal (*Phoca hispida)* monitoring plan. Retrieved June 19, 2013 from http://www.arlis.org/docs/vol1/D/778551575.pdf

Invertebrate prey seems to become more important to ringed seals in most areas during the open-water season. During the late summer, fall, and winter, ringed seals eat to gain weight for the fasting period during late March or early April until late summer. During the fasting period, females would have given birth and are lactating, while males defend their underwater territories and interact with adult females as they become available for copulation.

RINGED SEAL AND SEISMIC SURVEYS

Ringed seals were observed to swim away from an active seismic survey to a distance of 250m (Harris et al., 2001) in the Beaufort Sea. During this seismic survey (3D seismic survey in 1996 in the Beaufort Sea), no seals were observed to leave the survey area during an active seismic survey (Harris et al., 2001).

In Shell's 2012 3D seismic survey off Greenland in lease blocks 5 and 8, 109 ringed seals were observed by Marine Mammal and Seabird Observers in the survey area. It was not specified if the ringed seals entered the 500m safety zone.

DISCUSSION

During the summer months, ringed seals can either be found near the coast of Baffin Island or offshore in northern Baffin Bay and the North Water. There may be two populations of ringed seals with one group preferring coastal fast ice, while the other prefers offshore pack ice. Seals

use the ice to ‘haul out’ and to protect their pups. In the summer months, when the ice in Baffin Bay breaks up and melts, some ringed seals move towards the coast, while other seals remain in the remnants of ice in the North Water.

During the summer, ringed seals eat to restore their weight after an intense fasting period (females have pups, while males protect their territory). Ringed seals tend to prefer invertebrate species at this time of year.

Since the majority of ringed seals either remain close to pack ice in northern Baffin Bay and the North Water or near coastal areas, it is unlikely that the proposed seismic survey will interact with large numbers of ringed seals.

The documented effects of seismic surveys on bearded seals appear to be negligible beyond 250m. This was demonstrated in a 3D seismic survey in the Beaufort Sea in 1996. In this survey, bearded seals did not move beyond 250m away from an active seismic survey vessel.

With the mitigation measures proposed for this seismic survey, it is unlikely that bearded seals will be negatively affected. Specifically, the seismic survey will stop operating if a seal (or any other marine mammal) is found within the 500m marine mammal safety zone around the sound source.

6.8 Polar Bears (*Ursus maritimus*), *Nanuq*

Polar bears inhabit arctic ice sheets and coastal waters; they typically hunt seals, but also feed on a variety of opportunistic food sources. Polar bears have a circumpolar distribution and are present on land during the summer, but rely on ice flows during the remainder of the year to hunt seals. There are generally 19 recognized populations of Polar bears with a worldwide population of approximately 20 000 – 25 000[74]. Twelve[75] populations reside in Canadian waters with three populations near the seismic survey area: Baffin Bay, Lancaster Sound, and Davis Strait.

In Canada, polar bears are managed by provincial governments, territorial governments, and wildlife management boards (Stewart & Lockhart, 2005)[76]. The bears are hunted by Inuit and Cree for subsistence, as well as for commercial sport hunting. SARA and COSEWIC (2008) both list Polar Bears as a species of "Special Concern".

POLAR BEAR MIGRATION

Unlike other marine mammals, polar bears in different management units may have similar migratory patterns. Since polar bears spend time on land and are highly dependent on the ice floe, their migration from summering to wintering grounds are highly variable each year. One reason for this they are highly dependent on ice floe for travel and hunting.

There is some information on the migration of polar bears in Hudson Bay, with little information on polar bears in other management units. The focus on polar bears in Hudson Bay may be an indication of the increased attention to this management unit as the polar bears often venture into southern communities[77]. Trends in polar bears movements in the Baffin Bay, Parry Channel, and Davis Strait management units are discussed (please refer to Figure 20 for polar bear management units).

Read, C.J. and S.E. Stephansson. (1976). Distribution and Migration Routes of Marine Mammals in the Central Arctic Region. Fisheries and Marine Service. Technical Report No. 667. Environment Canada.

In the winter, hunters find polar bears in Prince Regent Strait, the waters to the northwest of Baffin Island. The polar bears aggregate here due to open water and lead-ice areas in this region. Areas containing open water and lead-ice are also present in Lancaster Sound and polar bears are hunted there in the winter.

Tayler, M. and J. Lee. (1995). Distribution and Abundance of Canadian Polar Bear Populations: A Management Perspective. *Arctic, 48(2):* 147-154.

This study identified polar bear movements by marking polar bears and noting areas where they were later seen again. This allowed for the delineation of polar bear populations by area, although no physical or genetic barriers to interaction between populations are identified. These delineations can be used for management purposes (Figure 20).

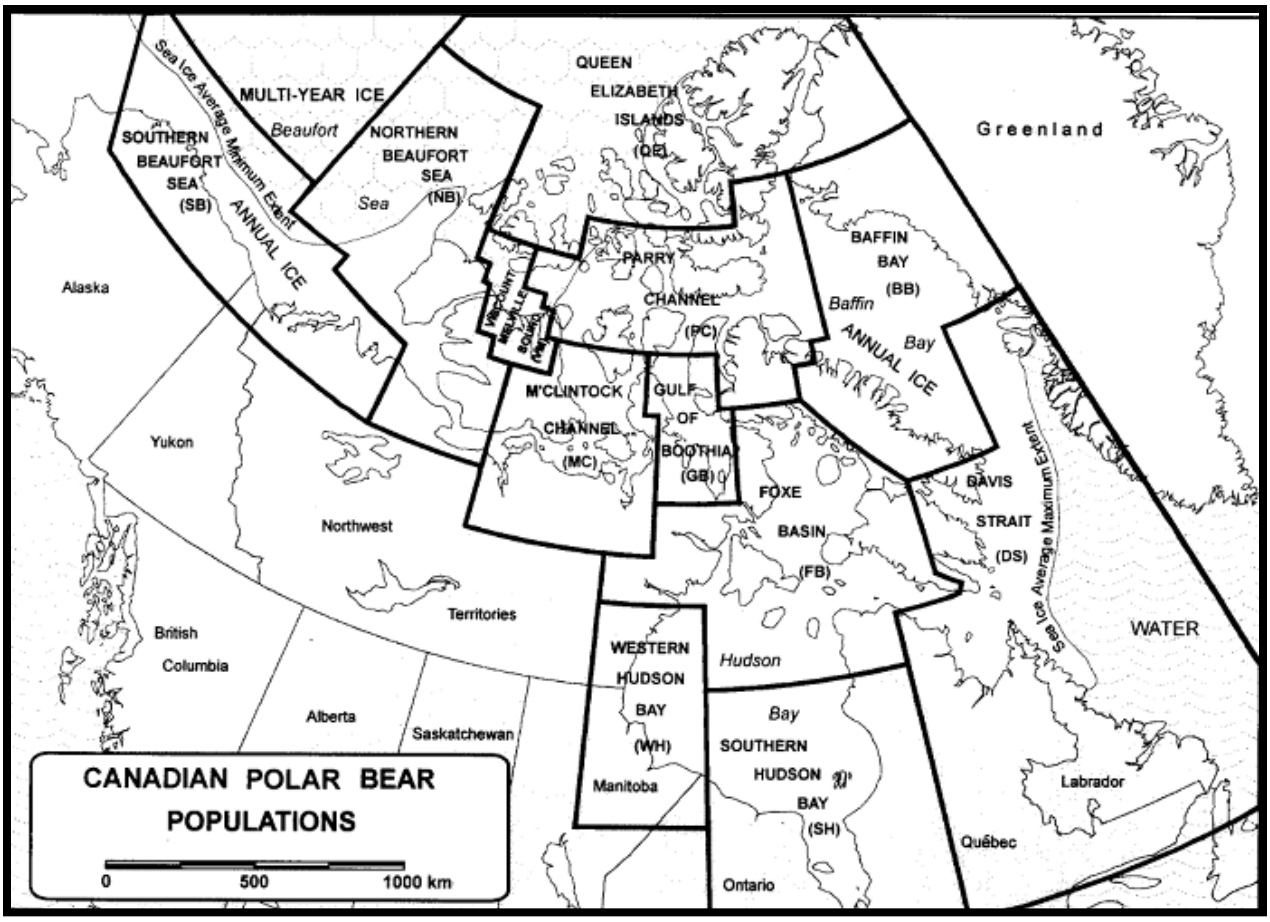

Figure 20: Polar bear management units in Canada

Taylor, M.K., Akeeagok, S., Andraishek, D., Barbour, W., Born, E.W., Calvert, W., Cluff, H.D., Ferguson, S. Laake, J., Rosing-Asvid, A., Stirling, I., and F. Messier. (2001). Delineating Canadian and Greenland polar bear (*Ursus maritimus*) populations by cluster analysis of movements. *Canadian Journal of Zoology, 79*: 690-709.

Baffin Bay and Davis Strait are covered with pack ice from December to July, which polar bears can use for hunting. In the late summer and fall (August-November) polar bears move on shore; however, in Baffin Bay the sea ice tends to come earlier and last longer than in Davis Strait, suggesting that the bears may be able to stay at sea for a longer period of time and spend less time on land. Polar bears in Baffin Bay and Davis Strait spend the open water seasons (August – November) on Baffin Island, Bylot Island, and the northern Labrador coast. The two populations (Baffin Bay and Davis Strait) could interact but tend to remain separate populations. This is likely due to the disappearance of consolidated pack ice from the central Baffin Bay during spring and summer, forcing bears to either eastern Baffin Island or the Melville Bay area.

In Lancaster Sound, polar bears are abundant during the ice-cover season in Lancaster Sound there is always ice along the coast and in inlets and bays that is heavily used by polar bears for movement and feeding. Prince Regent Inlet has a high density of polar bears during the spring.

Polar bears also use the pack ice in Lancaster Sound, on the side closer to Baffin Bay during the spring and early summer.

POLAR BEAR BEHAVIOUR DURING SUMMER MONTHS

Polar bears rely on the sea ice for movement and hunting, therefore, when sea ice is sparse or disappears in the late summer and early fall, polar bears move on shore.

Stirling, I., & Parkinson, C. L. (2006). Possible effects of climate warming on selected populations of polar bears (Ursus maritimus) in the Canadian Arctic. Arctic, 261-275.

Observed numbers of polar bears on land during the open water season are increasing. This is likely due to climate change and earlier break-up of sea ice, resulting in polar bears retreating to land earlier. Moving on shore earlier means that polar bears are starving from a shortage of food and may be entering into human communities in search of alternative food sources.

POLAR BEAR AND SEISMIC SURVEYS

There are no reports specifically addressing how polar bears respond to marine seismic activity. Environment Canada did not identify marine seismic surveys as a threat to polar bears[78]. This is likely due to the fact that polar bears are not solely marine animals and can escape the sound created by seismic activity if they wish.

Airgun effects on polar bears have not been studied; however, polar bears on ice floes would be less affected by sound from seismic surveys.

The received sound level produced by the seismic source will be less than other marine mammals, as polar bears generally remain at the surface or within a few metres of the surface[79]. The sound source will be within 6-10 metres of the surface with the sound being directed to the bottom of the ocean.

DISCUSSION

Polar bears move onto the land when sea ice melts in the late summer and fall. Therefore, it is unlikely[80] that seismic surveys conducted offshore during the late summer and fall will affect polar bears as they will be either on land or on the ice near the shore at this time.

6.9 Summary

Table 6: Summary of potential effects of the proposed seismic survey to narwhal, beluga, and bowhead whales, ringed and bearded seals, walrus and polar bears

Population	Summer Distribution	Winter Distribution	Migration	Potential interaction with seismic survey
Narwhal				
Somerset Island	Gulf of Boothia	Offshore Baffin Bay (north)	Leave summer grounds in early October, arriving in early November	Possible interaction. Migration route likely to overlap with survey area. Overwintering area is in the survey area.
Admiralty Inlet	Admiralty Inlet	Offshore Baffin Bay (south)	Travel south along Baffin Island in mid-September, then east to Baffin Bay near Broughton Island arriving mid-October	Possible interaction. Overwintering area is in the survey area.
Eclipse Sound	Bylot Island	Offshore Baffin Bay (south)	Travel south along Baffin Island in late September, then east to Baffin Bay at Broughton Island arriving around mid-October	Possible interaction. Overwintering area is in the survey area.
East Baffin Bay	Coastal region between Clyde River to Qikiqtarjuaq	Offshore Baffin Bay (south)	No information is available. It is assumed they follow Admiralty Inlet and Eclipse Sound narwhal migrations	Possible interaction. Overwintering area is in the survey area
Parry Channel, Jones Sound and Smith Sound	Parry Channel, Jones Sound and Smith Sound	North Water	*no tagging studies completed. Presumably direct migration to the North Water	No interaction. Summer and winter areas are not in survey area
Beluga				
Canadian High Arctic	Lancaster Sound, Gulf of Boothia, Beaufort Sea	North Water and/or West Greenland	Northern migration to the North Water, or continued on to the coast of west Greenland	No interaction. Summer and winter habitats are not in survey area. Based on satellite tagging, migration path is north of the survey area.
Cumberland Sound	Cumberland Sound	Cumberland Sound	No migration. Beluga whales remain in Cumberland Sound	No interaction. Summer and winter habitats are not in survey area. Beluga remain in

Population	Summer Distribution	Winter Distribution	Migration	Potential interaction with seismic survey
			all year round.	Cumberland Sound
Western-Northern-Southern Hudson Bay	Hudson Bay	Hudson Strait	Beluga whales have travelled as far north as Iqaluit. Since they overwinter in Hudson Strait, it is unlikely that belugas travel offshore into Baffin Bay into late fall.	Limited to no interaction. The migration route taken by the belugas from Hudson Bay to Frobisher Bay (Iqaluit) is unknown.
Bowhead				
Western Canada-Eastern Greenland	Widely distributed in the inshore waters around Baffin Island.	West Greenland; Cumberland Sound; Hudson Strait	Bowhead whales in the High Arctic either move south along Baffin Island toward Cumberland Sound or cross northern Baffin Bay to Upernavik, Greenland. As fall approaches, all other bowhead whales migrate south along Baffin Island and overwinter at the floe edge in Davis Strait	Possible interaction during fall migration which may begin in the mid-September. Generally, bowhead whales displayed mild behavioural changes within 8.2km of a seismic survey. There were also instances of no response within 3km of a seismic survey.
Walrus				
Northern Hudson Bay- Hudson Strait-Southeastern Baffin Island-Northern Labrador	Along the coast of Eastern Baffin Island, south of Clyde Inlet and in the Hudson Strait	Along the coast of Eastern Baffin Island, south of Clyde Inlet and in the Hudson Strait	Walrus have been recorded travelling between Canada and Greenland during the summer. This is a suspected migration corridor off Qikiqtarjuaq.	Possible interaction. Walrus have been recorded travelling between Canada and Greenland during the summer. This is a suspected migration corridor off Qikiqtarjuaq.
High Arctic	High Arctic	North Water and West Greenland, south to Disko Island.		No interaction. Summering and overwintering areas are not in study area.
Bearded Seal				
One population. Ranges from the High Arctic south along Baffin Island	High Arctic, south along Baffin Island in the fjords and bays	High Arctic, south along Baffin Island in the fjords and bays	Not known	It is likely that bearded seals may occur in the survey area. However, bearded seals do not exhibit behavioural changes beyond 250m from the sound source.

Population	Summer Distribution	Winter Distribution	Migration	Potential interaction with seismic survey
				Therefore, the mitigation measures should prohibit potential effects
Ringed Seal				
Circumpolar. Found in Baffin Bay, south to Labrador, Northern Newfoundland and the northeast Gulf of Saint Lawrence	North Water, along coastlines where ice is available, or offshore	North Water, coastal areas	In the summer months, when the ice in Baffin Bay breaks up and melts, some ringed seals move towards the coast, while other seals remain in the remnants of ice in the North Water	It is likely that ringed seals may occur in the survey area. However, bearded seals do not exhibit behavioural changes beyond 250m from the sound source. Therefore, the mitigation measures should prohibit potential effects
Polar Bear				
Circumpolar. Three populations are near the survey area: Parry Channel, Baffin Bay and Davis Strait	Primarily on land. May be present in the waters of Baffin Bay, Davis Strait and the North Water	Mainly on the ice in Baffin Bay, Parry Channel, and Davis Strait	No district migration route.	Limited interaction. Polar bears will be most likely close to shore or on land.

7 Arctic Fisheries Alliance Information Requests

Presentation Questions in response to mitigation measures in section 5.2:

- *The seismic activity will not take place near any harvest area*
- *The Community Liaison Officer will maintain communication with the company to provide updates to the Hamlet Council, HTAs and the community.*
- *A Fisheries Liaison Officer will maintain communication with all fishing vessels near the vicinity of the seismic survey*
- *The seismic vessel will avoid all active fixed gear fishing area*

Arctic Fisheries Alliance Questions

1. *The seismic activity will not take place near any native harvest area*

AFA requests that the phrase 'near any native harvest area' be clarified:

- *How will these native harvest areas be identified?*

Section 5.2 (7) the location of the seismic activity associated with this project will not take place in the vicinity of any native harvest area. Native Harvest areas are identified by those being within the Inuit Settlement Zone.

All proposed program activities will occur seaward of Canada's 12 nautical mile boundary, to the east of the land-fast ice limit. No Geophysical data will be recorded within the Land Fast Ice Zone. Information related to commercial fishing is provided in Section 5.2 of the Environmental Assessment.

- *What will the defined minimum safe distance be?*

MKI will define the minimum safe distance ~ 12 km buffer (for seismic vessel turning radius) from the land-fast ice and territorial sea boundaries, to the western end of the seismic lines.

- *A Fisheries Liaison Officer will maintain communication with all fishing vessels near the vicinity of the seismic survey*
- *The statement 'near the vicinity' lacks a specific definition. AFA suggests this be better defined*

Fishers have noted that good communications, exchange of plans and gear locations, understanding of fishing practices and co-operation at sea are the keys to addressing this issue. MKI will establish advance communications with representatives of any fisheries and DFO survey teams that may be present in the survey area. Open lines of communication between the commercial fishery and the proposed seismic survey program should prevent potential adverse effects. Prior to the commencement of the program a "Notice to Mariners" is issued by the Survey Vessel and the Fisheries Liaison Officer initiates and maintains radio communications between fishing vessels throughout the project. There is not specific distance.

- AFA insists that this measure be expanded to include wording to the effect: "*The Fisheries Liaison Officer will send a daily email to the four turbot quota holders of daily vessel location and planned tracks*"

MKI will send daily email to Arctic Fisheries Alliance contact and Baffin Fisheries Coalition. MKI will also have a community contact in each community that will be notified every 12 hours of vessel position. Acquisition Plan and scheduling of acquisition lines will be shared with AFA and BFC prior to commencement of the survey. The proponent, AFA and BFC can exchange each other's location and season's planning.

2. *The seismic vessel will avoid all active fixed gear fishing areas*

- *At what distance will the seismic vessel circumvent active fixed fishing gear?*

Potential impacts on fishing gear will be mitigated by avoiding active fixed gear fishing areas during the survey. If gear is deployed in a survey area, the diligence of the Fisheries Liaison Officer (FLO), good at-sea communications and mapping of current fishing locations have usually proven effective at preventing such conflicts. Thus for, Seismic vessels avoid fixed gear as to protect both the fishing and seismic equipment.

- AFA insists that the minimum safe distance (MSD) between the seismic vessel, its towed array and the fishing gear be established and noted in the mitigation measures.
- To ensure the MSD, the Fisheries Liaison Officer should communicate fixed fishing gear areas with the seismic vessel.
- If catch rates are determined to have reduced as a result of the testing, how will we (*AFA)* be compensated?

MKI will meet with AFA representatives to coordinate activities to mitigate potential concerns and so no lost fishing time occurs.

In case of accidental damage to fishing gear, the operator will have available a gear damage compensation contingency plan to provide appropriate and timely compensation to any affected fisheries participants. The Notices to Shipping filed by the vessel will also inform fishers that they may contact the SPOC, if they believe that they have sustained survey-related gear damage. The Operator is familiar with the C-NLOPB / CNSOPB Compensation Guidelines Respecting Damages Related to Offshore Petroleum Activity (C-NLOPB / CNSOPB, 2002), and with programs developed jointly by the fisheries industry and offshore petroleum operators (e.g. by the Canadian Association of Petroleum Producers and other Operators) as alternatives to claims through the courts, to address all aspects of compensation for attributable gear damage. These programs include provisions for paying compensation for lost or damaged gear, and any additional financial loss that is demonstrated to be associated with the incident. The programs include mechanisms for claim payments and dispute resolution. The operator will implement similar procedures to settle claims promptly for any gear damage that may be caused by survey operations, including the replacement costs for lost or damaged gear, and any additional financial loss that is demonstrated to be associated with the damage, as recommended under the C-NLOPB Guidelines. The operator will provide the NEB with the details of any compensation to be paid.

[1] http://www.cbc.ca/news/canada/north/story/2008/11/26/narwhals-pond.html
[2] The Pond Inlet community and DFO discussed the narwhal ice entrapment and due to environmental conditions, it was decided that the community would harvest the narwhal.
[3] Struzik, E. (2009). Fatal trap in the Arctic ice. *The Vancouver Sun*. Retrieved July 24, 2013 from http://www2.canada.com/vancouversun/news/weekendreview/story.html?id=c2353580-28c9-47da-ac50-29ab93b67ba5&p=2
[4] Laidre, K., Heide-Jorgensen, M.P., Stern, H. & Richard, P. (2012). Unusual narwhal sea ice entrapments and delayed autumn freeze-up trends*. Polar Biology, 35*: 149-154.
[5] Dietz, R., Heide-Jørgensen, M.P., Richard, P., Orr, J., Laidre, K., and H.C. Schmidt. (2008). Movements of narwhals (Monodon monoceros) from Admiralty Inlet monitored by satellite telemetry. Polar Biology, 31: 1295-1306.
[6] Heide-Jorgensen, M.P., Hansen, R.G., Westdal, K., Reeves, R.R., Mosbech, A. (2013). Narwhals and seismic exploration: Is seismic noise increasing the risk of ice entrapments? *Biological Conservation, 158*:50-54.
[7] CBC (2008). Arctic Ocean earthquake rattles Nevada seismograph. Retrieved 17 December 2012 from http://www.cbc.ca/news/canada/north/story/2008/10/07/arctic-quake.html
[8] Decibelcar. (2010). Decibel equivalent table. Retrieved 14 December 2012 from http://www.decibelcar.com/menugeneric/87.html
[9] It has been suggested that southern (non-Arctic) whales are used to noise in the ocean due to the increased use (commercial and non-commercial) of southern oceans. This may have increased southern whales abilities to tolerate man-made noise, such as seismic surveys and therefore respond differently.
[10] Weilgart, L.S. (2007). The impacts of anthropogenic ocean noise on cetaceans and implications for management. *Canadian Journal of Zoology, 85*, 1091-1136.
[11] Abgrall, P., V.D. Moulton, and W.J. Richardson. (2008). Updated review of scientific information on impacts of seismic survey sound on marine mammals, 2004-present. *Canadian Science Advisory Secretariat.*
[12] DFO. (2010). Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment. *Department of Fisheries and Oceans.* <http://www.dfo-mpo.gc.ca/oceans-habitat/oceans/im-gi/seismic-sismique/pdf/statement-enonce_e.pdf>
[13] If more than one report focused on the same seismic survey, only one report was included in the summary
[14] Throughout the paper, the authors recognize that the noise produced from the aircraft may have affected the bowheads, particularly in shallow waters. Therefore, in some instances, the behavioural reactions of bowheads to noise may be from the combined noise of seismic surveys and an aircraft.
[15] Data was not combined across all whale species due to the different hearing capabilities of different species
[16] Blaauw, R. (August 13, 2012). Shell in the Arctic: Presentation to Ecologic Institute's Arctic Summer Camp. Retrieved June 19, 2013 from http://arcticsummercollege.org/sites/default/files/Blaauw_Energy%20and%20Resources_August%2013%202012.pdf
[17] Shell. (2012). Environmental Impact Assessment: 2012 Anu-Napu 3D seismic survey in Baffin Bay Blocks 5 and 8.
[18] Richardson, W.J., Greene, C.R., Malme, C.I. and D.H Thomson. (1995). Marine mammals and noise. *Academic Press, Inc.* San Diego, CA. 576p *In:* Cameron, M.F., Bengtson, J.L., Boveng, P.L., Jansen, J.K., Kelly, B.P., Dahle, S.P., Logerwell, E.A., Overland, J.E., Sabine, C.L. Waring, G.T., and J.M. Wilder. (2010). Status review of the bearded seal *(Erignathus barbatus*). *US Department of Commerce.*NOAA Technical Memorandum. NMFS-AFSC-211, 246p.
[19] Blaauw, R. (August 13, 2012). Shell in the Arctic: Presentation to Ecologic Institute's Arctic Summer Camp. Retrieved June 19, 2013 from http://arcticsummercollege.org/sites/default/files/Blaauw_Energy%20and%20Resources_August%2013%202012.pdf
[20] Shell. (2012). Environmental Impact Assessment: 2012 Anu-Napu 3D seismic survey in Baffin Bay Blocks 5 and 8.
[21] Heide-Jørgensen, M. P., Hansen, R. G., Westdal, K., Reeves, R. R., & Mosbech, A. (2013). Narwhals and seismic exploration: Is seismic noise increasing the risk of ice entrapments?. *Biological Conservation, 158*, 50-54.
[22] The FAO through the International Whaling Commission (IWC) establishes international regulations to ensure proper and effective conservation and management of whale stocks. The FAO keeps up to date information on the harvest of whales, seals and fish
[23] FAO (2010). FAO Yearbook: Fishery and Aquaculture Statistics (Capture Production). 609p.
[24] Greenland Quota for Big Whales. Retrieved June 25, 2013 from http://naalakkersuisut.gl/en/Naalakkersuisut/Press-Statements/2013/01/Whales
[25] FAO has recorded Greenland hunting multiple dolphin species
[26] One concern is that the seismic survey would change whale's migration routes. If this were to occur, then fewer whales would be present at their summering or wintering grounds where they are either hunted or eat to restore fat lost in the previous season. If whales are prevented from eating, there is a chance that they may not survive. Therefore, Inuit would have less animals to harvest the following season.
[27] DFO. 2008. Total Allowable harvest recommendations for Nunavut narwhal and beluga populations. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2008/035.
[28] Nielsen, M. R., & Meilby, H. (2013). Quotas on Narwhal (Monodon monoceros) Hunting in East Greenland: Trends in Narwhal Killed per Hunter and Potential Impacts of Regulations on Inuit Communities. *Human Ecology*, 1-17.

[29] Nielsen, M. R. (2009). Is climate change causing the increasing narwhal (Monodon monoceros) catches in Smith Sound, Greenland?. *Polar Research*, *28*(2), 238-245.
[30] News website from Denmark. Retrieved from http://www.ecoadvise.dk/news_narwhal.html.
[31] Nielsen, M. R. (2009). Is climate change causing the increasing narwhal (Monodon monoceros) catches in Smith Sound, Greenland?.*Polar Research*, *28*(2), 238-245.
[32] Alvarez-Flores, C. M., & Heide-Jørgensen, M. P. (2004). A risk assessment of the sustainability of the harvest of beluga (Delphinapterus leucas (Pallas 1776)) in West Greenland. *ICES Journal of Marine Science: Journal du Conseil*, *61*(2), 274-286.
[33] Retrieved from http://www.natur.gl/en/birds-and-mammals/marine-mammals/narhval/beluga-and-narwhals-numbers-are-recovering-in-greenland/.
[34] These species have an average capture of 50 individuals per year. A complete list of whale, seal and walrus species is in Table 2.
[35] Weilgart, L.S. (2007). The impacts of anthropogenic ocean noise on cetaceans and implications for management. *Canadian Journal of Zoology, 85*, 1091-1136
[36] DFO. (2010). Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment. *Department of Fisheries and Oceans.* <http://www.dfo-mpo.gc.ca/oceans-habitat/oceans/im-gi/seismic-sismique/pdf/statement-enonce_e.pdf>
[37] DFO. (2004). Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. DFO Canadian Science Advisory Secretariat Habitat Status Report 2004/002; Abgrall, P., V.D. Moulton, and W.J. Richardson. (2008). Updated review of scientific information on impacts of seismic survey sound on marine mammals, 2004-present. Canadian Science Advisory Secretariat.
[38] Weilgart, L.S. (2007). The impacts of anthropogenic ocean noise on cetaceans and implications for management. *Canadian Journal of Zoology, 85*, 1091-1136.; Gordon, J., Gillespie, D., Potter, J., Frantzis, A., Simmonds, M.P., Swift, R., and D. Thompson. (2004). A review of the Effects of Seismic Surveys on Marine Mammals. *Marine Technology Society Journal, 37(4)*: 16-34.; McDonald, M.A., Hildebrand, J.A. and S.C. Webb. (1995). Blue and find whales observed on a seafloor array in the Northeast Pacific. *Journal of the Acoustical Society of America, 98(2):* 712-721.
[39] Weilgart, L.S. (2007). The impacts of anthropogenic ocean noise on cetaceans and implications for management. *Canadian Journal of Zoology, 85*, 1091-1136
[40] Mosbech, A., Dietz, R. and J. Nymand. (2000). Preliminary Environmental Impact Assessment of Regional Offshore Seismic Surveys in Greenland. National Environmental Research Institute. 25p.
[41] Cure, C., Antunes, R., Alves, A.C., Visser, F., Kvadsheim, P.H., and P.J.O. Miller. (2013). Responses of male sperm whales (*Physeter macrocephalus*) to killer whale sounds: implications for anti-predator strategies. *Scientific Reports, 3(1579):* 1-7.
[42] Laidre, K.L., Heide Jørgensen, M.P. and J.R. Orr. (2006). Reactions of Narwhals, *Monodon monoceros,* to killer whales, *Orcinus orca,* Attacks in the Eastern Canadian Arctic. *The Canadian Field Naturalist, 120(4):* 457-465.
[43] Richard, Pierre. (2007). Underwater World: Narwhal. Fisheries and Oceans Canada. Retrieved from: http://www.dfo-mpo.gc.ca/science/publications/uww-msm/pdf/narwhal-narval-eng.pdf
[44] One narwhal left the Bylot Island area, then returned and stayed from September 26 to October 21. The whale eventually travelled to their overwintering grounds by November 7.
[45] Finley, K.J. and E.J. Gibb. (1982). Summer diet of the narwhal (*Monodon monoceros)* in Pond Inlet, northern Baffin Island. *Canadian Journal of Zoology, 60:* 3353-3363.
[46] Narwhal located around Pond Inlet is a part of the Eclipse Sound narwhal management unit. It is assumed that the other narwhal exhibit similar behaviour to the Eclipse Sound narwhal.
[47] Abgrall, P., V.D. Moulton, and W.J. Richardson. (2008). Updated review of scientific information on impacts of seismic survey sound on marine mammals, 2004-present. *Canadian Science Advisory Secretariat*
[48]COSEWIC. (2004). COSEWIC assessment and update status report on the beluga whale Delphinapterus leucas in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Ix + 70p. ; Culik, Boris. (2010). Odontocetes. The toothed whales: "Delphinapterus leucas". UNEP/CMS Secretariat, Bonn, Germany. http://www.cms.int/reports/small_cetaceans/index.htm
[49] Beluga whale populations are based on summer distributions and genetic differences
[50] Richard, Pierre. (2002). Underwater World: Beluga Whale. Fisheries and Oceans Canada. Retrieved from: http://www.dfo-mpo.gc.ca/science/publications/uww-msm/pdf/beluga-eng.pdf
[51] Species at Risk. Retrieved June 24, 2013 from http://www.dfo-mpo.gc.ca/species-especes/search-species-recherche-especes-eng.htm
[52] DFO. (2012). The Bowhead Whale (Hudson Bay-Foxe Basin Population). Retrieved from http://www.dfo-mpo.gc.ca/species-especes/species-especes/bowheadfoxe-borealefoxe-eng.htm'; NOAA. (2012). Bowhead Whale (Balaena mysticetus). Office of Protected Resources. Retrieved from: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/bowheadwhale.htm#population
[53] The bowhead whale (Eastern Canada-Western Greenland population). Retrieved June 24, 2013 from http://www.dfo-mpo.gc.ca/species-especes/species-especes/bowheadwhale-baleineboreale2-eng.htm

[54] This may be part of the Foxe Basin and Hudson Bay bowhead whale population
[55] The report indicated that the bowhead whale sightings are to some extent due to observer effort. Most observations are within the marine-use zones of the communities.
[56] Highly suitable habitat is areas predicted to be used by bowheads more often than expected by chance, relative to habitat available in the environment.
[57] Only six tagged whales transmitted information into the winter months, therefore it was difficult to obtain accurate movement rates for bowhead whales in the winter
58 The authors do not state when the tags stopped transmitting information, however analysis on six whales was completed for the winter.
59 Commonly, zooplankton, copepods and eupausiids congregate at the ice edge. These species are an important part in the bowhead whale diet. Furthermore, ice packs provide bowhead whales protection from killer whales. Bowhead whales use sea ice to avoid killer whales and it is thought that killer whales avoid areas of heavy sea ice due to their large dorsal fin.
[60] Migration path assumes a general summering ground in the High Arctic around Lancaster Sound
[61] Heide-Jorgensen, M.P., Laidre, K.L., Wig, O., Jensen, M.V., Dueck, L., Maiers, L.D., Schmidt, H.C. and R.C. Hobbs. (2003). From Greenland to Canada in Ten Days: Tracks of Bowhead Whales, *Balaena mysticetes,* across Baffin Bay. *Arctic, 55(1):* 21-31.
[62] Five bowhead whales were tagged in the study, however only two bowhead whales migrated across Baffin Bay from Disko Bay, Greenland to Lancaster Sound, Canada.
[63] Ferguson, S.H., Dueck, L., Loseto, L.L. and S.P. Luque. (2010). Bowhead whale Balaena mysticetes seasonal selection of sea ice. Marine Ecology Progress Series, 411: 285-297.
[64] Wheeler, B., Gilbert, M. and S. Rowe. (2012). Definition of critical summer and fall habitat for bowhead whales in the eastern Canadian Arctic. Endangered Species Research, 17: 1-16.
[65] Moulton, V.D. and M. Holst (2010). Effects of seismic survey sound on cetaceans in the Northwest Atlantic. Environmental Studies Research Funds Report No. 182. St. John's 28p.
[66] Ljungblad, D.K., Wursig, B., Swartz, S.L., Keene, J.M. (1988). Observations on the behavioural responses of bowhead whales (*Balaena mysticetes)* to active geophysical vessels in the Alaskan Beaufort Sea. *Arctic, 41(3):* 183-194
[67] Mosbech, A., Dietz, R. and J. Nymand. (2000). Preliminary Environmental Impact Assessment of Regional Offshore Seismic Surveys in Greenland. *National Environmental Research Institute.* 25p.
[68] COSEWIC 2006. COSEWIC assessment and update status report on the Atlantic walrus Odobenus rosmarus rosmarus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 65 pp. (www.sararegistry.gc.ca/status/status_e.cfm).
[69] Stewart, R. (2008). Redefining walrus stocks in Canada. *Arctic, 61(3):* 292-308.
[70] Abgrall, P., V.D. Moulton, and W.J. Richardson. (2008). Updated review of scientific information on impacts of seismic survey sound on marine mammals, 2004-present. *Canadian Science Advisory Secretariat*
[71] U.S. Department of the Interior Bureau of Ocean Energy Management. (2011). Chukchi Sea Planning Area: Environmental Assessment. *OCS EIS/EA BOEM 2011-061.* 301p.
[72] DFO. (2011). 2011-2015 Integrated Fisheries Management Plan for Atlantic Seals. Retrieved from: http://www.dfo-mpo.gc.ca/fm-gp/seal-phoque/reports-rapports/mgtplan-planges20112015/mgtplan-planges20112015-eng.htm
[73] DFO. (2011). 2011-2015 Integrated Fisheries Management Plan for Atlantic Seals. Retrieved from: http://www.dfo-mpo.gc.ca/fm-gp/seal-phoque/reports-rapports/mgtplan-planges20112015/mgtplan-planges20112015-eng.htm
[74] Aars, Jon, ed. (June 2005). "Polar Bears". 14th Working Meeting of the IUCN/SSC Polar Bear Specialist Group 32. Seattle, Washington, United States: IUCN.
[75] Researchers have identified 12 or 13 polar bear populations in Canada. The difference can be linked to different population criteria used by researchers.
[76] Stewart, D.B., and Lockhart, W.L. 2005. An overview of the Hudson Bay marine ecosystem. Can. Tech. Rep. Fish. Aquat. Sci. 2586: vi + 487 p.
[77] Polar bears are often located in Inuit communities as well. However, there may be a research bias to studying migration patterns of polar bears that visit southern communities.
[78] The main threats to polar bears are related to climate change and hunting activities. Retrieved from http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=18E4D45A-CB74-41EE-B1A4-DFCCFF4B8173
[79] Richardson, W.J., Wursig, B., and C.R. Greene, Jr. (1986). Reactions of bowhead whales, *Balaena mysticetes,* to seismic explorations in the Canadian Beaufort Sea.; Richardson, W.J., C.R. Greene, Jr., C.I. Malme and D.H. Thomson. (1995). Marine Mammals and Noise. Academic Press, San Diego, CA. 576 p. *In:* Abgrall, P., V.D. Moulton, and W.J. Richardson. (2008). Updated review of scientific information on impacts of seismic survey sound on marine mammals, 2004-present. *Canadian Science Advisory Secretariat.*
[80] One polar bear was seen during Shell's 2012 3D seismic survey in Baffin Bay and Davis Strait

Supplementary Report III

Follow-Up to the National Energy Board Letter dated
May 31, 2013

Information provided in response to

IQALUIT

TGS-NOPEC Geophysical Company ASA, Petroleum Geo-Services and Multi Klient Invest AS (TGS/PGS/MKI) Northeastern Canada 2D Seismic Exploration Survey.

August 22, 2013

Iqaluit Questions

The following questions were asked during the National Energy Board's (NEB) meeting in Iqaluit, Nunavut on May 2, 2013. Each question and response is referenced to the report provided by the NEB, 'Public Review of the TGS-NOPEC Geophysical ASA (TGS), Petroleum Geo-Services (PGS) and Multi Klient Invest AS (MKI) Northeastern Canada 2D Seismic Survey Application, Volume 4'. Some original responses have been edited to ensure clarity. Verbatim responses can be found on the NEB website (www.neb.com)

Line numbers are referenced in brackets (Line xxxx).

To understand the context of each question, please refer to the Transcript Report for Iqaluit on the National Energy Board website.

A list of acronyms used in this report can be found in Appendix A.

1. ***Q: I am curious to know how -- from my understanding is it's outside of the Nunavut settlement area that this is occurring, but how are you coordinating with the Nunavut Impact Review Board or how are they integrated into this process at all? (Line 2005)***

Response:

The National Energy Board has the responsibility to deal with issues offshore outside the 12 nautical mile zone. The Nunavut Impact Review Board has the responsibility within the 12 nautical mile zone. The Nunavut Impact Review Board referred this to the National Energy Board because it is within the jurisdiction of their responsibility.

2. ***Q: So in your presentation at one point you said that the NEB will be making a recommendation. So who is that recommendation going to? (Line 2007)***

Response:

It is delegated to me (D. Hamilton, NEB Member) as a board member to review the application and provide a recommendation to the full board. The full board then makes a decision based on my report, and the recommendations, whether to grant or deny the application. Therefore, it is the full board that makes the final decision.

3. ***Q: My question is how are those effects going to be monitored or is there going to be any other third-party responsible for ensuring that -- you know -- fish aren't disturbed***

or traditional harvesting areas aren't being altered by the seismic process? (Line 2009)

Response:

For commercial fishing, there is a Fisheries Liaison Officer on the vessel whose duty it is to report back the operations to the fishing industry. There will also be a Marine Mammal Observer on board who has the authority to cease the operation until the whales have passed. There is a passive acoustic monitoring system on board as well, which ensures that once the seismic activity has stopped they can hear if the whales are still in the area. All of this information will go back to the communities.

4. ***Q: I guess my question also was trying to address not only the marine mammals that are impacted but other fish and invertebrates species as well. (Line 2013)***

Response:

The Fisheries Liaison Officer is the one who report on that. It is standard in the industry to ensure constant communication with the fishing industry to ensure it is not negatively impacted.

5. ***Q: Has there been studies to show what the -- you know, the migration patterns are at the time and would there be studies after the surveys to determine if there's been any negative impact, you know, by these surveys? (Line 2021)***

Response:

A lot of studies have gone on at the fisheries biology levels that look at individuals. There has been research on pelagic, benthic, ground fish and crustaceans. The results of which show no net negative impact on the biota. Your question is more about impact on collective populations. The industry standard is to stop the survey when a pelagic spawning aggregate passes through the area, not because of a proven long-term effect, but because of the perception of one. The long-term effects are much more complex, requiring an understanding of multiple complex factors.

6. ***Q: Should there be negative impacts, how and when would that be measured because this survey is supposed to be a five-year survey I believe initially? Is there going to be any attempt to measure the impact of these seismic surveys after each year or is there going to be -- something that's going to be done after the -- you know, at the end of the five-year period? (Line 2222)***

Response:
It is very difficult to measure the impacts on any marine population. The effects of seismic surveys, climate change, nutrient balances or water quality are all complex factors, and are interrelated. Trying to separate the effects of one factor is not possible.

7. ***Q: What happens if there is damage, okay, if it's determined that there's been damage to the -- you know, to maybe the marine ecology or maybe fish are not spawning properly or the marine life has altered its migration patterns? What sort of, I guess, guarantees are there, would there be bonds, would there be insurance or something like that to ensure that those who have been negatively impacted because this is an entire, really, I would say an entire nation could be affected by this? (Line 2223)***

Response:

Compensating for these changes is highly unlikely because it cannot be understood why there has been a given change. What is important, and is the point here, is to ensure a positive relationship between stakeholders. It is about working together to avoid problems, identifying conflicting activities and behaviors and avoiding them. These kinds of things are more important than the issue of potential compensation.

8. ***Q: Will there be a (fisheries biomass) study done before and after? (Line 2047)***

Response:

No, one is not planned at this time.

9. ***Q: Marine mammals, what does that mean? That's a very large term. (Line 2055)***

Response:

The Project proponent committed to providing information after the meetings.

Additional Response Information

Marine mammals are a diverse group of 128 species that rely on the ocean for their existence. The following marine mammal species have been identified in the Environmental Assessment as having the potential to be in the survey area at any point in the year: ringed seal, bearded seal, harp seal, harbour seal, hooded seal, Atlantic walrus, killer whale, beluga whale, narwhal, bowhead whale, harbour porpoise and polar bear (LaPierre et al., 2011).

Source

LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

10. ***Q: Okay, do you have an agreement with the Nunavut Impact Review Board for in the future oil and gas development? (Question asked to the National Energy Board) (Line 2062)***

Response:

NEB Response: Yes, the National Energy Board has a Memorandum of Understanding with the Nunavut Impact Review Board.

11. ***Q: This is a very interesting -- the Nunavut Impact Review Board is required to take into account Inuit -- how you might need to guide as part of their process. What process does NEB have to incorporate that? (Line 2064)***

Response:

NEB Response: There is no established process to do that. It is not required as part of the Environmental Impact Review but companies submit it as part of the application.

12. ***Q: I want to know from the company if it will affect walrus migration routes. (Line 2070)***

Response:

The Project proponent committed to providing information after the meetings.

Additional Response Information:

Available reports indicate that walrus generally remain close to land with a few offshore areas in southern Baffin Bay (near Qikiqtarjuaq, Iqaluit and Kimmirut) where walrus congregate in the summer.

Behavioural evidence suggests that walrus preferentially spend the summer months close to land (as available ice is limited) where they can haul out and eat bivalves located on the ocean floor (Fisher and Stewart, 1997; Fay and Burns, 1988). This routinely occurs in coastal areas within 80 – 100 m of water (Fay and Burns, 1988).

Walrus have been recorded travelling between Canada (off Qikiqtarjuaq) and Greenland during the summer months (COSEWIC, 2006); however, it is not known if a few or many walrus make this journey nor at what time of year this journey takes place. It is suggested that the walrus congregation area off Qikiqtarjuaq identified by Inuit (NPC, 2009) may be the starting point for the walrus migration between Canada and Greenland.

Therefore, except for the few offshore areas where walrus congregate in the summer and a suspected migration route between Canada and Greenland, it is unlikely that walrus would come within close proximity to the proposed seismic survey.

For more information on walrus and the known effects of sound please refer to Section 6 in the 'Supplementary Report II'.

Sources

Fay, F.H. and J.J. Burns. (1988). Maximal Feeding Depths of Walruses. Arctic, 41(3), 239-240
Fisher, K.I., and R.E.A. Stewart. (1997). Summer foods of Atlantic walrus, Obdenus rosmarus rosmarus, in northern Foxe Basin, Northwest Territories. Canadian Journal of Zoology, 75: 1166-1175.
COSEWIC. (2006). COSEWIC assessment and update status report on the Atlantic walrus Odobenus roasmarus rosmarus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Ix+65p. (www.sararegistry.gc.ca/status/status_e.cfm)
Nunavut Planning Commission (2009). State of Knowledge in Maps. Nunavut Planning Commission. 28p.

13. Q: Seals, bearded seal, ring seal, ugjuk, bearded seal are very important to Inuit. That is a fall migration time. What effect will this project have on them? (Line 2073)

Response:

The Project proponent committed to providing information after the meetings.

Additional Response Information:

Bearded seals are generally located in the fjords and bays around Baffin Island and Ellesmere Island, where shallow coastal waters offer a variety of food sources in the summer. Both scientific and Inuit observations indicate bearded seals are most likely to be located near the shore, but they sometimes venture into deeper water. There are no known summer migrations that occur in the deep waters of Baffin Bay or Davis Straight. In the Beaufort Sea, it was documented that a seismic survey did not affect bearded seals behaviour at a distance of 250 m or further (Harris *et al*., 2001).

In the summer, ringed seals can be located on the coasts of Baffin Island or offshore in northern Baffin Bay and the North Water. The majority of these seals remain close to pack ice in northern Baffin Bay, or along the coastline in more southern regions. It is unlikely that the proposed survey will interact with migrations of ringed seals. In the Beaufort Sea, a seismic survey did not affected ringed seals behaviour at a distance of 250 m or further (Harris *et al.,* 2001).

Marine Mammal Observers on board the seismic vessel and supply vessel will have the authority to shut down the source if a marine mammal (including seals) comes within the 500 m safety zone.

For more information on the known effects of sound on seals, whales, walrus and polar bears please refer to Sections 2 and 6 of the 'Supplementary Report II'

Sources

Harris, R.E., Miller, G.W., and W.J. Richardson. (2001). Seal responses to airgun sounds during summer seismic surveys in the Alaskan Beaufort Sea. *Marine Mammal Science, 17(4*): 795-812.

14. Q: Polar bears; there's a lot of information, both traditional knowledge, scientific. Traditional knowledge, I've learned from Pond Inlet that there are polar bears that live on icebergs and they hunt from them. What affects will you have on them? (Line 2076)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

Polar bears rely on sea ice for movement and hunting. In the summer months when ice recedes polar bears migrate onto the land. It has been observed that due to increased warming from climate change polar bears are moving on land earlier in the season (Stirling & Parkinson, 2006). Polar bears are not solely marine animals and can haul out on either land or ice.

The seismic activity in this project is proposed for the late summer and early fall in offshore locations. The operation will be staying far from the coastlines and avoiding ice whenever possible. There are currently no reports addressing specific effects of seismic activity on polar bears that say it is unlikely they will interact with the seismic activity.

For more information on polar bears please see Section 6 of the 'Supplementary Report II'.

Source

Stirling, I., & Parkinson, C. L. (2006). Possible effects of climate warming on selected populations of polar bears (*Ursus maritimus*) in the Canadian Arctic. *Arctic*, 261-275.

15. Q: It was already brought up but Inuit traditional harvesting, what is your understanding of it from each individual community, at this point? (Line 2078)

Response:

The relationship between Inuit communities in Qikiqtani and traditional resources is much stronger than almost anywhere else in the Americas and it is probably the last place where this close relationship is seen. One of the reasons why the proponent has done more community engagement than the bare minimum is because they want to understand and develop a relationship with the communities. The use of traditional foods as a staple is much higher than in any other area found in the region.

The project proponent understands the importance of traditional harvesting food sources to Inuit communities throughout Nunavut. The proponent is committed to protecting the environment and the wildlife that Inuit communities rely on. Thus, the proponent has implemented a number of mitigation measures to alleviate any potential negative impact *(Please refer to the Environmental Assessment for a complete list of the mitigation measures for the project).*

In addition, the proponent is conducting an IQ Study to ensure that local knowledge is integrated into the proposed project. The IQ Study will cover important aspects of Inuit culture and

knowledge including traditional harvesting activities, harvesting geographical areas and species of interest in each of the communities.

16. Q: You've done -- I would say from my understanding, the company and the seismic or the two different consultants, they visited approximately 12 to 14 times. What have you learned in that time? (Line 2079)

Background: The project proponent and associated representatives have visited the communities on five different occasions in the last two years to begin discussion about this proposed project. Through the course of the visits comments, questions and concerns from communities were documented and responses provided.

Response:

The proponent has done more community engagement than the minimum requirement because they want to understand and develop a positive relationship with the communities. The use of traditional foods as a staple is greater than in any other area found in the region. That said, the proponent is not interested in trying to cause problems. It is not interested in doing anything that will jeopardize food supplies and these conversations have taken place in the past.

There are a lot of factors that influence changes that are being seen in the North. These include other development projects (such as mining operations), the increased use by other nations of the Northwest Passage because of climate change, and increased shipping; all of which are having an impact. The message seems to be: No change is the only acceptable change. This project is not trying to be the source of all the change. The real question is: Who gets to make the decision? That is outside of the scope of this project. That is an issue that takes place at another table but it is an important issue.

17. Q: What sub-lethal effects will you monitor afterwards? (after MKI has finished the seismic survey) (Line 2098)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The operator will follow the 'Statement of Canadian Practice on the Mitigation of Seismic Sound in the Marine Environment' developed by Fisheries and Oceans Canada (DFO, 2007).

Source DFO. (2010). Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment. *Department of Fisheries and Oceans.* http://www.dfo-mpo.gc.ca/oceans-habitat/oceans/im-gi/seismic-sismique/pdf/statement-enonce_e.pdf

18. Q: Will you take that (traditional knowledge) into account? (Line 2106)

Response:

Yes, that is part of these meetings, listening to the community.

19. Q: So will you put in a new project design based on what you've heard this week, to the National Energy Board to decide? (Line 2109)

Response:

Considerations are made based on these discussions, the feedback provided from communities and fisheries, and from there the schedule and the timing of certain survey lines can be adjusted.

20. Q: But Inuit won't know this before the NEB decides -- what you've incorporated? And how are you going to incorporate that? How can you properly incorporate that? The NEB has a deadline of Friday for comments before it decides. How can that be? (Line 2111)

Response:

The community engagement process is ongoing; the company will be communicating with and responding to the community before, during and after operations.

21. Q: Will the actual company be going back besides the community liaison officer? (Line 2120)

Response:

Yes, that is correct. A person will be identified that the community feels is the proper person to speak for the community as a liaison.

Additional Response Information:

The engagement team will be going back to the communities with responses to the questions that have been asked during the National Energy Board meetings, as well as to complete an IQ study.

22. Q: Your communication with the company and how you interact with them afterwards, will it be the company? (Line 2124)

Response:

The company will communicate with the community.

23. Q: How much are you going to invest in this project for the first year? (Line 2133)

Response:

That will come out in the benefits plan that will be submitted to AANDC in terms of how much money is going to put forward.

24. Q: Who are the actual bodies behind that that are investing in that? You said there were two: TGS and PGS. So there's nobody beyond that? (Line 2138)

Response:

That is correct; PGS and TGS are taking all the risk.

25. Q: That's the biggest concern right now is: How can Inuit benefit? (Line 2145)

Response:

The Project proponent committed to providing information after the meetings.

Additional Response Information:

The proponent is committed to building a positive working relationship with the communities of Baffin Island. MKI will be employing Inuit as observers during the project; a Fisheries Liaison Officer will also be employed for the project and a Community Liaison Officer to represent each community for the duration of the project.

26. Q: And the way I read it there was one part where they say they have data, what was it? Anyway -- yeah, but I think I was more curious -- one of the things I wanted to know is if they got historical data can't that be used already? (Line 2163)

Response:

One of the reasons it mentions historical data in here is that there is not a lot of geophysical data available. Also, you can try and use old data to identify where to look, but as a comparison it would be the equivalent of an old black and white television versus a new high definition television. It makes a big difference when trying to identify where the oil could potentially be.

27. Q: So what kind of understanding was done -- or what kind of process or understanding happened with NIRB so that they're completely separate processes and it's not involved at all? (Line 2181)

Response:

For reference, see the last paragraph on page 3. The company had forwarded the project description to the Nunavut Planning Commission saying the project was outside the boundaries of the north Baffin regional land use plan and no conformity review was planned. Therefore, they did not forward the project to the Nunavut Impact Review Board. If they had deemed there to be trans-boundary affects they we would have started a dialogue. It is their responsibility to do that, and in this case they did not deem it applicable.

28. Q: Sorry, so you're saying that it was -- it's up to the planning commission to determine whether a project has trans-boundary impacts or not, and only under that circumstance will they forward it to NIRB? (Line 2186)

Response:

I think that's correct. That's their responsibility under the NSA under all the agreements.

29. Q: Which is when Canadian Environmental Assessment Agency (CEAA) was in place? (Line 2188)

Response:

Yes, in 2011.

30. CEAA was no longer in place in 2011? (Line 2192)

Response:

Yes, in 2011 it was in place. In 2012, CEAA was no longer in place.

31. Q: Other than what you've provided tonight, is there any other written materials for review that actually permits, you know, enough information to actually provide a written response other than having to do independent research? (Line 2214)

Response:

In response to the meetings, an extension may be issued to ensure that information from the communities is received. The other information collected from the company is all on the website (www.neb.com).

Appendix A: Acronyms

AANDC: Aboriginal Affairs and Northern Development Canada

AFA: Arctic Fisheries Alliance

BFC: Baffin Fisheries Coalition

CEAA: *Canadian Environmental Assessment Act*

CLO: Community Liaison Officer

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

DFO: Fisheries and Oceans Canada

EA: Environmental Assessment

FLO: Fishery Liaison Officer

HTO: Hunter and Trapper Organization

IQ: Inuit Qaujimajatuqangit

MKI: Multi Klient Invest AS

MMO: Marine Mammal Observer

NAFO: Northwest Atlantic Fisheries Organization

NEB: National Energy Board

NIRB: Nunavut Impact Review Board

NTI: Nunavut Tunngavik Inc.

NWMB: Nunavut Wildlife Management Board

PGS: Petroleum Geo-Services

TGS: TGS-NOPEC Geophysical ASA

UN: United Nations

VMS: Vessel monitoring system

Supplementary Report IV

Follow-Up to the National Energy Board Letter dated May 31, 2013

Information provided in response to

Qikiqtarjuaq

TGS-NOPEC Geophysical Company ASA, Petroleum Geo-Services and Multi Klient Invest AS (TGS/PGS/MKI) Northeastern Canada 2D Seismic Exploration Survey.

August 22, 2013

Qikiqtarjuaq Questions

The following questions were asked during the National Energy Board's meeting in Qikiqtarjuaq, Nunavut on May 1, 2013. Each question and response is referenced to the report provided by the NEB, 'Public Review of the TGS-NOPEC Geophysical ASA (TGS), Petroleum Geo-Services (PGS) and Multi Klient Invest AS (MKI) Northeastern Canada 2D Seismic Survey Application, Volume 3'. Some original responses have been edited to ensure clarity. Verbatim responses can be found on the NEB website (www.neb.com).

Line numbers are referenced in brackets (Line xxxx).

To understand the context of each question, please refer to the Transcript Report for Qikiqtarjuaq on the National Energy Board website.

A list of acronyms used in this report can be found in Appendix A.

1. ***Q: Can you explain how strong is that sound coming out of that cannon and give an example of something we know out of a cannon? (Line 1325)***

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

Statement from MKI in the meeting: "*Yeah, we've been asked that in the other community meetings so we're going to put together -- Troy here is going to put together an example video giving some demonstrations of the sound and how loud it would be comparative to other things that people would be familiar with."*

MKI believes that audio representation would be more effective than a video to best represent "seismic sound". We propose to present a "representation" recording of the seismic source sound in future meetings while supplementing it with the other deliverables such acoustic modelling, sound comparison tables, etc. (See Appendix D & E – Supplementary Report II)

2. ***Q: Do you have any studies that have been done on marine mammals with this that could be brought to everybody's attention? (Line 1343)***

Response:

Yes, in the environmental assessment documents there are references for other studies done on marine mammals and there is also information on sound modelling.

Additional Response Information:

Further information is available in the Environmental Assessment (LaPierre *et al*., 2011) and in Sections 2, 4 and 5 of the 'Supplementary Report II'.

Source

LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

3. Q: But has it (seismic survey) been done on the Greenland? (Line 1353)

Response:

Yes, TGS and PGS have both done seismic surveys on in Greenland.

4. Q: Have they had any environmental feedback on what they've done (seismic in Greenland)? (Line 1362)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

There are no available public reports on environmental feedbacks from seismic surveys conducted in Greenland. Shell provided information on the whales and seals observed during their 2012 seismic survey in the Environmental Assessment for their 2013 seismic survey (Shell, 2013). Bowhead, beluga and narwhal whales were not seen during the transit to the survey area or in the survey area.

This report is further discussed in Section 2 of the 'Supplementary Report II' report.

Source:

Shell. (2013). Shell Greenland A/S 2013 Site Survey in Baffin Bay Blocks 5 (Anu) and 8 (Napu). Preliminary Environmental Impact Assessment

5. Q: Can that (environmental feedback from Greenland) be made available? (Line 1364)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

A renewed interest in oil exploration in Greenland in the 2000s has led to extensive seismic survey activity on the Greenland side of Baffin Bay. No reports on the environmental impact have been made available. If these reports are made available the proponent will ensure the information is provided to the communities.

6. ***Q: If I understand correctly what you were saying, do you have information when they did the surveying – seismic surveying in the Beaufort Sea? Do you have any information on that? (Line 1389)***

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

There have been a number of published reports on the interactions of seismic surveys with whales and seals in the Beaufort Sea. There are more reports from seismic surveys occurring in other oceans. Due to community requests, reports are only included if they occur in Baffin Bay/Davis Strait and similar environments (i.e. Arctic).

These reports are summarized in Section 2 of the 'Supplementary Report II'.

Table 1 shows the seismic surveys that have occurred in the Beaufort Sea since 2008. Reports and documents that provide information on seismic surveys before 2008 are included with other seismic surveys on the land. Information was not available on the specific details of marine seismic surveys in the Beaufort Sea prior to 2008.

Table 1: Seismic surveys in the Beaufort Sea since 2008

Year	# Projects	2D (KM)	3D (KM²)	Source
2012	2	224.1	3580	Northern Petroleum and Mineral Resources Branch. (2013).
2011	0	0	0	Northern Oil and Gas Branch. (2012).
2010	3	6124.8	0	Northern Oil and Gas Branch (2011).
2009	2	1487.8	1576.7	Northern Oil and Gas Branch (2010).
2008	3	N/A (2 projects)	N/A (1 project)	Northern Oil and Gas Branch (2009).

Sources

Northern Petroleum and Mineral Resources Branch. (2013). Northern Oil and Gas Annual Report 2012. Report: QS-8666-000-EE-A1. Retrieved from: Aboriginal Affairs and Northern Development Canada. Website: http://www.aadnc-aandc.gc.ca/eng/1367341676920/1367341870731

Northern Oil and Gas Branch. (2012). Northern Oil and Gas Annual Report 2011. Report: QS-8509-120-EE-A1. Retrieved from: Aboriginal Affairs and Northern Development Canada. Website: http://www.aadnc-aandc.gc.ca/eng/1335971994893/1335972853094

Northern Oil and Gas Branch. (2011). Northern Oil and Gas Annual Report 2010. Report: QS-8509-110-EE-A1. Retrieved from: Aboriginal Affairs and Northern Development Canada. Website: http://www.aadnc-aandc.gc.ca/eng/1314983577776/1314983984416

Northern Oil and Gas Branch. (2010). Northern Oil and Gas Annual Report 2009. Report: QS-8509-100-EE-A1. Retrieved from: Aboriginal Affairs and Northern Development Canada. Website: http://www.aadnc-aandc.gc.ca/eng/1100100036906/1100100036920

Northern Oil and Gas Branch. (2009). Northern Oil and Gas Annual Report 2008. Report: QS-8509-090-EE-A1. Retrieved from: Aboriginal Affairs and Northern Development Canada. Website: http://www.aadnc-aandc.gc.ca/eng/1100100037185/1100100037199

7. ***Q: To continue on the same direction here, can you explain what do you know that we don't know – all of us, what is the impact on marine mammals that you know that we don't know? Please explain. (Line 1400)***

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

Possible effects of seismic surveying on marine mammals are dependent on a number of factors such as the age, sex, physical state of the animal, the presence of offspring, prior experience with seismic surveying and others (Weilgart, 2007).

Interactions between seismic surveys and marine mammals range from whales and seals being curious and approaching the seismic vessel to displaying avoidance behaviour. There have been no documented cases of mortality in marine mammals due to seismic surveys (DFO, 2004; Abgrall, Moulton & Richardson, 2008).

The project proponent is committed to protecting the environment. As such, mitigation measures have been prepared to minimize potential effects from the seismic survey on marine mammals. There will be two experienced Marine Mammal Observers (MMOs) and two Inuit Observers working to identify marine mammals within a 500 m safety zone. It is the responsibility of the MMO to shut down the seismic source if a marine mammal is spotted within the 500 m safety zone.

For more detailed information on the effects of seismic sound on marine mammals, please refer to Sections 2 and 6 of the 'Supplementary Report II'. The projects mitigation measures can be found in the Environmental Assessment (LaPierre et al., 2011).

Sources

Weilgart, L.S. (2007). The impacts of anthropogenic ocean noise on cetaceans and implications for management. *Canadian Journal of Zoology, 85*, 1091-1136

DFO. (2004). Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. DFO Canadian Science Advisory Secretariat Habitat Status Report 2004/002

Abgrall, P., V.D. Moulton, and W.J. Richardson. (2008). Updated review of scientific information on impacts of seismic survey sound on marine mammals, 2004-present. *Canadian Science Advisory Secretariat.*

LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

8. Q: But are these surveys were done at the same extent that you have in mind? (Line 1405)

Response:

Yes, and, in fact, they were more intensive surveys because they were 3D surveys whereas these are 2D surveys.

9. Q: With the same kind of equipment? (Line 1407)

Response:

Recently, yes.

10. Q: Do you know anything on the migratory runs of these in this area that you have in mind? (Line 1410)

Response:

The environmental assessments are compiling that information.

Additional Response Information:

Please refer to Section 6 in the 'Supplementary Report II' for information on the migratory patterns and general information of narwhal, bowhead, beluga, walrus, ringed seals, bearded seals and polar bears. The Environmental Assessment contains additional information on these and other species (LaPierre et al., 2011).

Sources

LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

11. Q: How long would they be in the waters during the seismic testing? How long would it take? (Line 1416)

Response:

The plan for 2013 would take approximately 2 months. The testing is planned for September and early October.

12. Q: And also you said you all start from Grise, is the – are you starting from Grise or are you starting from south? Are you going up or coming down? (Line 1437)

Response:

It would of course depend on how much ice there is, but there needs to be flexibility in the plan whether it would start in the South or North. Feedback from the communities would help to determine where to start. Part of these processes here helps to formulate that plan.

Additional Response Information:

The map below illustrates the proposed survey area over a five year period (Figure 1). The proposed survey area does not go as far north as Grise Fiord. However, if the proposed survey is approved then there are a number of factors that will influence the survey schedule, including: ice conditions, weather, fishing vessels, and local community input regarding harvesting practices and marine mammal migration. It should be noted that although the proponent has applied to NEB for a five year approval, the results of the first year will dictate whether or not the proponent returns the following year. The proponent expects to collect the data in three years, that may or may not be consecutive.

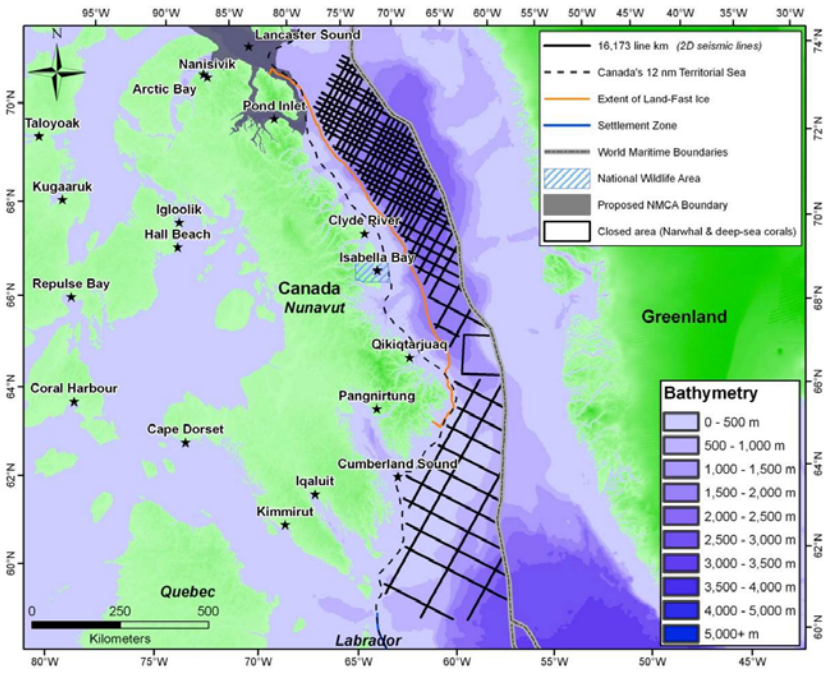

Figure 1: Proposed seismic survey project with survey lines over 5 years

13. Q: Okay. So let's say NEB approves your proposal and do the survey in September, October and for us if we notice a big difference on marine mammals in our area, who do we contact and tell them it's affecting our animals? Can that seismic survey stop? (Line 1439)

Response:

Contact should be made with the company via the Community Liaison Officer who is in direct contact with the vessel. Afterward, there would be a discussion about what exactly was the issue.

14. Q: Just to clarify, your graphic up here, your plan, should we understand that the line – the density of the lines is the density of the survey – of the seismic survey and there's less survey down south then north of Baffin? (Line 1444)

Response:

That map shows the entire five year plan. The map up here shows the density that would be started with.

15. Q: Oh, it's a five-year program, every year from September to October? (Line 1446)

Response:

The surveying months would change each year depending on the season and on the ice. The tentative three year schedule for acquisition would likely be mid-August to early October (up to 60 days).

16. Q: So should we understand that this is being done on five-year time? So everybody understand that this is for five years, they're going to be surveying and doing seismic sounding in the whole area for five years. Five years of mammal intrusion; is that the understanding? (Line 1448)

Response:

No, that is not it. The project will take five years to complete. The map shows the overall coverage; it will be done in stages.

Additional Response:

The results of year 1 will determine whether or not the proponent returns in future years. It should be noted that the program will take three years to collect and may not be collected in consecutive years.

17. Q: So every year – every year there'll be seismic- ? (Line 1450)

Response:

The density of coverage is not going to be the same every year, it will vary as the project progresses until the grid is gradually filled in.

Additional Response:

The results of year 1 will determine whether or not the proponent returns in future years. It should be noted that the program will take three years to collect and may not be collected in consecutive years.

18. Q: Okay fine. And you have no clue on marine mammal's life and migration routes on this area. You have no clue of that at this time or do you? (Line 1454)

Response:

That information is included in the Environmental Assessment document.

Additional Response Information:

Please refer to Section 6 of the 'Supplementary Report II' for information on the migratory patterns and general information of narwhal, bowhead, beluga, walrus, ringed seals, bearded seals and polar bears.

The Environmental Assessment contains additional information on these and other species (LaPierre *et al.*, 2011).

Sources

LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

19. Q: And just to come back to Greenland, nobody was interested of seeing what Greenland had as reports on the environmental impact of those seismic testing in their country? Is there - like I'm saying, a study should be available from what they experienced. And nobody was interested of seeing what happened there? (Line 1460)

Response:

That information was collected in Greenland and was given to the regulatory authorities there.

20. Q: So – but you don't know? (Line 1464)

Response:
With regards to the information in Greenland, some of that information is public so you can look it up.

Additional Response Information:

Extensive research on reports relating to seismic surveys on the western coast of Greenland has been completed. There are no public reports[1] that assess the environmental impact of seismic activity in Greenland. If any such report becomes publically available, the project proponent is committed to providing it to the communities.

21. Q: But more specifically on environmental impact, do you have any information from Greenland on that you could share with us? (Line 1467)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

Extensive research on reports relating to seismic surveys on the western coast of Greenland has been completed. There are no public reports[2] that assess the environmental impact of seismic activity in Greenland. If any such report becomes publically available, the project proponent is committed to providing it to the communities.

22. Q: The airgun that you'll be using, according to that, there will be a difference within shallow and deep water – deeper water. Which one is louder, is it in the shallower or deeper water, or is the sound the same thing all the way? (Line 1477)

Response:

The sound does not change in shallower or deeper water. It may go longer distances, but the

[1] Shell's 2013 Environmental Assessment for a 2D seismic survey provided marine mammal sightings for their 2012 3D seismic survey in Baffin Bay. Please see Section 2 of the 'Supplementary Report II'.
[2] Shell's 2013 Environmental Assessment for a 2D seismic survey provided marine mammal sightings for their 2012 3D seismic survey in Baffin Bay. Please see Section 2 of the 'Supplementary Report II'.

actual sound from the source is the same.

23. ***Q: Even the sound – even if it's shallow, have you done any study how far it goes under the sea bed? Whether a shallow or deep, what study have you done that it will be the same before you reach the depth or the seabed? What's – how is it? If it's very deep and the seabed is very deep, how many metres is it and how many metres does it go down even if it's in shallow waters? (Line 1480)***

Response:
This is the reason why the seismic survey is being done. The goal is to map and see the substructures beneath the sea floor because companies don't know, and that's why these surveys are done. How the sound is reflected back up will depend on the geology underneath the sea floor, and so it will vary. That is the kind of data that has to be analyzed after the project. This kind of information can take up to a year to analyze.

Additional Response Information:

In marine surveys, seismic waves can penetrate up to 6000 metres below the seafloor (CAPP, 2005).

Source
CAPP (Canadian Association of Petroleum Producers. (2005) SEISMIC SURVEYS The search for Oil and Gas In Offshore Atlantic Canada. Retrieved From: www.capp.ca/getdoc.aspx?DocID=90917

24. ***Q: So if I go back to the map again, the density that is shown in the deep portion, 5,000 metres are closer to each another because it's deeper. Is that correct? No? (Line 1493)***

Response:

Those lines were determined by geologists because of certain formations in the geological substructure that may be an area of interest.

25. ***Q: So if you're deep or not deep, it's the same distance between the lines. That's what you are saying to me? (Line 1495)***

Response:

The distance can vary, depending on the geology. Some areas require more attention that others, and therefore a denser grid.

26. ***Q: So the distance of the lines is the interest of the area. Is that right? That means there's more – there's more seismic movement there in those areas? (Line 1498)***

Response:

It means there is more potential for investigation.

27. Q: So that means more sounding in those areas? (Line 1500)

Response:

If we do more lines, there will be more sound, yes.

28. Q: So more closer together, probably? (Line 1502)

Response:

The work will be done over time, in phases. Once a line in done it is not done again.

29. Q: In between let's say. You'll go in between the lines? (Line 1505)

Response:

Yes, in the next phase.

30. Q: And you have no idea on the migratory routes of these marine mammals? (Line 1508)

Response:

We have baselines through DFO and other studies, which have been factored into the EA. The other big component is gathering traditional knowledge through the communities, as there also exits information on that.

Additional Response Information:

Please refer to Section 6 of the 'Supplementary Report II' for information on the migratory patterns and general information of narwhal, bowhead, beluga, walrus, ringed seals, bearded seals and polar bears.

The Environmental Assessment contains additional information on these and other species (LaPierre *et al.*, 2011).

Source

LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

31. Q: Are you aware that there's a box (protected area) around the Cape Dwyer? You'll definitely stay away from that? (Line 1514)

Response:

Yes, the proponent will not go into the protected area.

32. Q: How come you have not invited environmental people that have the knowledge on seismic sounding? And you are supposed to be the advocate and the protection of the environment. How come? Explain to us. (Line 1540)

This question was asked to representatives from the National Energy Board

Response:

NEB Response: "When a company, such as MKI, applies to do seismic testing they must file an Environmental Assessment, among other things. That EA requires the company to bring us the most recent information. Once we have reviewed it we hear from communities and then ask the company what they are doing to mitigate potential impacts. This is part of that process".

33. Q: So why are you (the project proponent) here today? (Line 1564)

Response:

NEB Response: "They (*MKI)* are part of the process of evaluation of their application to get a licence. The company is here today to answer questions from the community".

Additional Response:

It should be noted that MKI was originally invited to the meetings as observers, and they would only be required to answer operational questions. Had MKI be advised that they would be required to answer a broader range of questions they would have sent up additional resources.

34. Q: CLO, community liaison officer, fishery liaison officers, and marine mammal observers, how many of each are you employing and for how long? (Line 1576)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

For this proposed project there will be four Community Liaison Officers (one for each community), two experienced Marine Mammal Observers and two Inuit Observers and one Fisheries Liaison Officers for the duration of the program.

The MMOs and FLOs will be working five weeks on, five weeks off for the duration of the project (this is dependent on weather and ice). The Community Liaison Officer will be working to help build capacity within the communities, and to keep the community and proponent updated on the project.

35. Q: What is the safe distance that he (person) can go diving while you're doing your survey? (Line 1586)

36.

Response:

The surveying would be taking place far away from where people would be diving. The general distance from a seismic vessel is anywhere from 500 to 1500 metres.

Additional Response:
The International Association of Diving Contractors has worked with the International Association of Geophysical Contactors and has created a minimum guideline of between 500 and 1500 meters for divers to be near seismic activity.

37. Q: Because this is a five-year program, is it going to be 2D the whole time or will there be 3D seismic acquisition during that time? (Line 1591)

Response:

Only 2D surveys are to be conducted.

38. Q: So AFA requests that the phrase 'near any harvesting area' be clarified. How will this native harvest area be identified? What will the defined minimum safe distance be? At what distance will the seismic vessel circumvent active fishing gear? (Line 1601)

Response:

Most of the questions that you have in here and most of the practices that you would like to do in here are what we do elsewhere, so we do this in Labrador and Newfoundland with the FLOs on board the boat, the fishing liaison officers, the MMOs, and also through the process here.

And the way that we've laid out the survey lines as such is to do most of this avoidance and, you know, what I've seen here, I think the way our survey is laid out and with the communications that you wold like to do from the FLO to the other fishers that are out in the area, that's not an issue.

You know, we have—email reports can be done on a daily basis. That's routine for us to do and for the FLO to send those in to the communities. So we really—I don't see any issue in any of this.

And its standard practice for us, what you put in here. So that's part of our procedures that we use when conducting surveys.

We will be in discussions with the fisheries organizations and look at scheduling, to address how we will schedule the survey activities. The seismic operations does not want to get around any type of fixed fishing gear or any type of fishing vessels that might have gear out. Therefore, knowing where fishing activity is going to occur during what time period is a very important aspect of determining the schedule for the seismic activity.

Additional Response Information:

Section 5.2 (7) the location of the seismic activity associated with this project will not take place in the vicinity of any native harvest area. Native Harvest areas are identified by those being within the Inuit Settlement Zone.

All proposed program activities will occur seaward of Canada's 12 nautical mile boundary, to the east of the land-fast ice limit. No Geophysical data will be recorded within the Land Fast Ice Zone.

Information related to commercial fishing is provided in Section 5.2 of the Environmental Assessment.

MKI will define the minimum safe distance ~ 12 km buffer (for seismic vessel turning radius) from the land-fast ice and territorial sea boundaries, to the western end of the seismic lines.

Fishers have noted that good communications, exchange of plans and gear locations, understanding of fishing practices and co-operation at sea are the keys to addressing this issue. MKI will establish advance communications with representatives of any fisheries and DFO survey teams that may be present in the survey area. Open lines of communication between the commercial fishery and the proposed seismic survey program should prevent potential adverse effects. Prior to the commencement of the program a "Notice to Mariners" is issued by the Survey Vessel and the Fisheries Liaison Officer initiates and maintains radio communications between fishing vessels throughout the project. There is not specific distance.

39. Q: So we – actually we are asking for better clarification, so you just said that it's (fisheries concerns) not an issue. So what does this mean? (Line 1614)

Response:

The scheduling of the survey activities and the location means they should not conflict with any native harvesting. Also, the presence of the fisheries liaison officer will make it known if any fishing activates taking place near the area.

Additional Response:

The scheduling of the survey acquisition will not conflict with any native harvesting within the Land Fast Ice Area. Furthermore with the employment of the FLO onboard the seismic vessel this will ensure communication with the commercial fleet to avoid any other potential conflict. The presence of the FLO will make it known if any fishing activities are taking place.

40. Q: So I mean – what I mean – can we get feedback from you in writing according to what we said here? (Line 1621)

Response:

There are no issues with this kind of communication. Between the fisheries liaison officers and the community liaison officers there will be constant contact with the industry and the community to ensure that everyone knows what is being done and where. If there is activity going on in the area where the survey is taking place then changes can be made to accommodate that.

41. ***Q: If that happened, the catch rate is reduced, what kind of compensation you had put in place? (Line 1628)***

Response:

That would be looked into on a case-by-case basis. There would have to be considered where the vessel was in relation to the fishing, and the communications received from the community.

42. ***Q: Do you know if we would be able to receive the VMS data? (Question from proponent to AFA). (Line 1646)***

Response:

Yes, catch rates and daily data can be shown. A comparison can be made from last year, before the activity taking place, and this year, if it is happening.

43. ***Q: His question was – the way I understood him – if it's going to hurt the fishing industries for the four fishing companies, are they going to be compensated? (Line 1651)***

Response:

Trying to pinpoint the reason for a decline in a fishery is a complex subject that includes multiple and interrelated variables. It is almost impossible to lay blame in one place. In terms of compensation between industries, a lot of discussion and communication needs to happen in order to negotiate outcomes.

44. ***Q: How often would you do seismic testing in one evening? I mean, one day, how many seismic shots would you do within a day? (Line 1666)***

Response:

It would be an impulse every 15 to 20 seconds during the day while recording is being done on the survey line.

Additional Response

This may actually be as frequent as 10- 15 seconds.

45. ***Q: And what kind of feedback did you get from Pond and Clyde? How did they feel? (Line 1681)***

Response:

Every time I've gone to communities in the past, each community has asked what the other community thinks and the same response has always been given: the opinions of each community is respected, but it is not appropriate to say what others think. That may best be communicated between the communities themselves.

NEB Response: And I'm sure you can appreciate that we respect that so I will say the same thing. In this case, the comments of each community will be on the NEB's website but I think the principles of engagement are that each community's information is theirs and should be respected.

46. Q: Why don't we take it one year at a time, find out first? (Line 1690)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The results of the first year will determine whether or not the proponent will return in subsequent years.

47.* Q: *If I was a diver here in Qikiqtarjuaq would I hear the sound of that cannon that is about, I would say, 200 km away? (Line 1692)

Response:

Other communities have also asked for models of how the sound dissipates with distance. This information can be provided. In the EA, there is a table of model distances over which the sound dissipates.

Additional Response Information:

The sound from the survey can travel for hundreds of kilometres; however, the sound dissipates as it travels further from the source. The International Association of Diving Contractors guidelines specify a safe operating distance of between 500 and 1500 m (1.5 km) near seismic activity. At a distance of 200 km it is unlikely that a diver could hear the seismic activity.

48. Q: So you can't tell me now if I'm going to hear it or not, if I'm underwater? (Line 1696)

Response:

The International Association of Diving Contractors has worked with the International Association of Geophysical Contractors and has created a minimum guideline of between 500 and 1500 metres for divers to be near seismic activity.

49. Q: So if there's activity in front of Clyde River, it should have no effect in this (Qikiqtarjuaq) area? (Line 1701)

Response:

No, not typically.

50. Q: Have you done a model of the channel here – that is here, at 3,000, 4,000 metres, in length like that and how would it react? (Line 1703)

Response:

Yes, that is part of the standard Environmental Assessments.

51. Q: With CEAA changing and you acknowledging that an environmental assessment is not required under CEAA, what is the process moving forward because this is an operation permit for one year? How about moving forward? So moving forward, how will the communities communicate with the NEB? (Line 1712)

Response:

The company has applied for a five year permit. The National Energy Board can approve it for the full five years, or for one year, subject to annual approvals. If the one year permit is awarded they are required to report back annually all matters to the community at the end of the year.

52. Q: How much timeframe do they have to report back to the community? Like what I have learned in the past, some organizations report back six months after what they did or some of them over a year. Do they have certain days to report back to the community? (Line 1727)

Response:

The permit would require them to report annually, so they would have one year between reports. The board could condition them to report on a more frequent basis.

53. Q: You mentioned that 1,500 metres for a diver, what effect would that have at 1,500 metres, lethal, sub-lethal? (Line 1731)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The International Association of Diving Contractors has worked with the International Association of Geophysical Contractors and has created a minimum guideline of between 500 and 1500 metres for divers to be near seismic activity.

54.* Q: *What is the safety zone for those divers (Gulf Coast), and is there any hearing protection required or special hearing protection to mitigate? (Line 1733)

Response:

If there is diving going on in the area, you can contact the diving superintendent and they will give the minimum distances wanted for operations. Generally, that is between 500 and 1500 metres.

55.* Q: *Do you (TGS and PGS) have board members? Like your company, does it have board members? (Line 1738)

Response:

Yes, TGS and PGS are publically traded companies and with board members.

56.* Q: *Like if the hunters notice a big difference in marine mammals are you guys going to listen? (Line 1741)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The project proponents are committed to building relationships with the communities. The proponent wants to ensure that the line of communication remains open between the community and themselves, and it is for this reason that the Community Liaison Officer position was created. The Community Liaison Officer will work in each individual community and report back to the proponent on any topics of interest, observations or questions the community may have.

57. Q: And are you going to listen to HTO, their concerns? (Line 1748)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

MKI sees the issues of the HTO as important. The project proponents are committed to building relationships with the communities. The proponent wants to ensure that the line of communication remains open between the community and themselves, and it is for this reason that the community liaison officer position was created. The Community Liaison Officer will work in each individual community and report back to the proponent on any topics of interest, observations or questions the community may have.

58. Q: What kind of plan do you have for the loss of food if it should happen? Do you have any kind of plan for compensation or – to replace what we lost? (Line 1763)

Response:

There is no set plan in place at the moment. The community liaison officers will ensure that if people are seeing changes that information will go into the project. The company is trying to figure out the best way to make sure there is no change in the food supply.

59. Q: Can you talk about how many times – you mentioned Labrador and Newfoundland a project that happened last year – how many times the MMO officer required a shutdown? (Line 1778)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

Environmental reports from Newfoundland and Labrador 2012 survey is attached as Appendix C

60. ***Q: How can you ensure that you get people with the right knowledge, the right training process – "constitution" and I mean that they have a lot of power to shut down the boat and have the construction to actually follow through with that? (Line 1782)***

Response:

Part of the training process is to be aware of the procedures that have to be adhered to.

61. ***Q: Any animals that die, like halibut and other animals, do you have plans to avoid killing type of animal? (Line 1790)***

Response:

There has been research around the world done on the effects of seismic surveys on marine wildlife. If an animal is exposed to super intense sound at some point an effect would be seen. That kind of high intensity and focused sound is not what will happen in these surveys. The purpose of this project is to gather geological data having as minimal impact as possible on the local wildlife. That is why so much research goes into this subject area.

62. ***Q: How is the company proposing to select the fisheries liaison officer for the project? How is the process of you – have you negotiated or are you working out to hire that individual? (Line 1811)***

Response:

Candidates that are proposed to us will be considered and then they will go through a selection process from there.

63. ***Q: Proposed (fisheries liaison officer candidates) by who? (Line 1814)***

Response:

By the community.

64. ***Q: So that means – so I had understanding that three communities will be select – will send their candidates when the boat is adjacent to the community? (Line 1817)***

Response:

Yes, there would be crew changes taking place at intervals during the survey and a candidate would be onboard the vessel.

65. Q: So correct me if I'm wrong; there will be – there will be four marine mammal observers; correct, three on the ship, the seismic ship, and one on the support ship? (Line 1823)

Response:

That is correct. There will be four Marine Mammal Observers, 2 on the seismic vessel and 2 on the support vessel.

Additional Response Information:

There will two experienced Marine Mammal Observers and two Inuit Observers employed for the duration of the project.

66. Q: And they will be rotated every five weeks? (Line 1825)

Response:

That is correct.

67. Q: There will be one Fishery Liaison Officer for the five weeks and then one for the second five weeks? (Line 1827)

Response:

Correct.

68. Q: And there'll be a Community Liaison Officer in each community as well? (Line 1829)

Response:

Yes.

69. Q: It's still not clear to me who would consult with to hire (Fisheries Liaison Officer). (Line 1834)

Response:

Communities will be invited to propose candidates.

70. Q: Can you clarify the MMO? Who is training the MMO? (Line 1839)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The project proponent sponsored a MMO training class in Iqaluit at the Arctic College in 2011. The proponent will employ two Inuit Observers for this project.

71. Q: Oh. So it (training MMO's) hasn't started yet, naturally, no? (Line 1841)

Response:

A class at the Arctic College has been sponsored and has already trained people.

72. Q: And those (MMO training) companies are under contract, under you? (Line 1845)

Response:

No, they are not. The training was done through the Arctic College and the MMO training companies are not associated with the proponent.

73. Q: Okay compared to a sonar system, the seismic locator or the seismic sound, how does that compare to the – a typical boat sonar, for example? How strong is it or how much stronger is it or is it comparable? It's (sonar) not comparable? (Line 1850)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

Please see Appendix D & E for a discussion on sound and the terms used to describe sound: frequency and intensity.

Sonar and seismic are similar in a variety of ways, but there are significant differences, which justify individual consideration (Table 2). Both methods use a sound source to create energy waves in the water. When these waves encounter objects or materials they send back reflective waves, which are received and interpreted to understand characteristics of surrounding areas.

Table 2: Sonar vs seismic survey comparison

	Sonar	**Seismic Survey**
Sound Source	Electro-acoustic sound source	Air pressure pistons
Frequency	Low-frequency (<1000 Hz); mid-frequency (1-20 kHz); and high frequency (>20 kHz)	5-300 Hz
Directionality	Horizontal	Vertical
Sound intensity 1 m from sound source	Military usage (Low Frequency Array): 235 dB re 1 µPa	235-240 dB re 1 µPa
	Commercial/Personal usage (mid to high frequency): 150-235 dB re 1 µPa	

Source

Hildebrand, J. (n.d.) Impacts of Anthropogenic Sound on Cetaceans. *International Whaling Commission.*
BCMEM. (2003). Sonar Versus Seismic: What are the Differences? British Columbia Ministry of Energy and Mines.

74. Q: Has there been studies done on echolocation mammals like bull whales or narwhals or belugas with this type of seismic study? (Line 1859)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

Beluga and other toothed whales hear best at frequencies of 20-100 kHz (LGL Ltd., 2012). The hearing threshold of these species increase progressively (poor hearing) outside of this 20-100 kHz range. Belugas are capable of hearing seismic and vessel-generated sounds at lower frequencies, but these sounds are not within their best hearing range. Sounds need to be at or above hearing threshold to be readily detectable. Sounds must also be at or greater than ambient noise levels in order to be detected.

Beluga whales have been observed to change behaviour as far as 20 km from seismic activity (Miller *et al.*, 2008; Harris *et al.*, 2007). It has been estimated that beluga whales received sound level at 150 dB re 1µPa rms (LGL Ltd., 2012).

Belugas and narwhal generally summer in coastal areas, and their wintering grounds are not near the seismic survey area. It is unlikely they will come into contact with the seismic activity.

It is important to note that there will be a marine mammal observer on board the vessel at all times and will have the authority to halt operations if any marine mammal is spotted within the 500 m safety zone.

For more detailed information on the known effects of sound from seismic surveys on narwhal, bowhead, beluga, walrus, ringed seals, bearded seals and polar bears, please refer to Section 6 of the “Supplementary Report II”. The Environmental Assessment contains additional information on these and other species (LaPierre *et al*., 2011).

Sources

LGL Ltd., environmental research associates. (2012). Environmental Impact Assessment: 2012 Anu-Napu 3D seismic survey in Baffin Bay Blocks 5 and 8. 201p.
Miller, G.W., V.D. Moulton, R.A. Davis, M. Holst, P. Millman, A. MacGillivray, and D. Hannay (2005). Monitoring seismic effects on marine mammals—southeastern Beaufort Sea, 2001-2002.p. 511-542. In Abgrall, P., V.D. Moulton, and W.J. Richardson. (2008). Updated review of scientific information on impacts of seismic survey sound on marine mammals, 2004-present. Canadian Science Advisory Secretariat.
Harris, R.E., T. Elliot, and R.A. Davis. 2007. Results of mitigation and monitoring program, Beaufort Span 2-D marine seismic program, open-water season 2006. LGL Rep. TA4319- 1. Rep. from LGL Ltd., King City, Ont., for GX Technology Corp., Houston, TX. 48 p. In Abgrall, P., V.D. Moulton, and W.J. Richardson. (2008). Updated review of scientific information on impacts of seismic survey sound on marine mammals, 2004-present. Canadian Science Advisory Secretariat.
LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

75. Q: But just to come back to my question, there has been no studies done with the seismic on these echo sounding animals? (Line 1864)

Response:

The short answer is yes and that is part of the environmental impact assessment. In the impact assessments, there is an assessment of the different species in the bay, their migration, the signs on impact of seismic on those species or comparable species and then an assessment of the risk.

And there were also some issues brought up in some of the previous meetings, I understand, and more information has been provided subsequent to that, to complete the picture as with respect to impacts.

So it's there and it's unfortunate that we didn't bring the marine biologists here today with us. We apologize for that and that is why we have a bit of a hard time giving you specific information on the impacts right now but I can assure you that it's part of the assessment that is also being looked at by the NEB now. And we've tried to address all concerns as best we can there and in subsequence communications.

76. Q: Can we give you our concern and ask you to come to the community to hear the concerns? (Line 1873)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The project proponent is committed to ensuring effective communication is maintained with communities throughout this project. The proponent will be hiring community liaison officers in each community as a means of ensuring that both the community and proponent are updated on any project developments. The proponents want to continue a dialogue with the communities not only leading into the start of the project but during the project.

77. Q: If a community find a problem and if they want a vessel or the seismic study to be stopped right away and if we were to write a letter to you in regards to our concern and wanting the ship to be hauled or stopped from doing its study, would you be able to? (Line 1888)

Response:

Yes, any concern, complaint or anything brought to the proponent's attention would be addressed. It would be investigated and if it was serious enough, or put into risk the safety of the community or the environment, the project can be stopped.

78. Q: Do you have any idea of the counts of mammals and behaviors that are occurring in the Strait here? Is there any assessment done at the present time on that? Do we know how many bowhead whales? Do we know how many narwhals? Do we know

how many species and the counts on that that is occurring and their migration routes? Do we know anything of all that at the moment? (Line 1894)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

It is estimated that between 60, 000 – 80, 000 narwhal frequent the High Arctic, Baffin Bay and Davis Strait (Pierre, 2007). Due to historical commercial whaling, less than 450 bowheads remain in the Baffin Bay-Davis Strait population. The ranges, migration routes and other information on these marine mammals, and others, can be found in the Environmental Assessment (LaPierre *et al.*, 2011), however, some of the data sources are proprietary and cannot be revealed.

Please refer to Section 6 in the 'Supplementary Report II' for information on the migratory patterns and general information of narwhal, bowhead, beluga, walrus, ringed seals, bearded seals and polar bears. The Environmental Assessment contains additional information on these and other species (LaPierre *et al*., 2011).

Sources

LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

Richard, Pierre. (2007). Underwater World: Narwhal. Fisheries and Oceans Canada. Retrieved from: http://www.dfo-mpo.gc.ca/science/publications/uww-msm/pdf/narwhal-narval-eng.pdf

NOAA. (2012). Bowhead Whale (Balaena mysticetus). Office of Protected Resources. Retrieved from: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/bowheadwhale.htm#population

79. Q: The Fisheries and Ocean don't even know the belugas and the only time -- this is the only year that they're doing this study, first time. But you said you knew. Now, you don't know? (Line 1908)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

To clarify, this is an area of expanding research. DFO conducts research on population estimates, migration routes and behavioural patterns of marine mammals (along with fish, invertebrates and other marine life). The large distribution and abundance of marine mammals across Canada makes completing research on a yearly basis difficult. There is available information on the majority of marine mammals in Canada. However, some of the information may be several years old.

Through this project, Marine Mammal Observers will collect additional information on marine mammals seen in the study area. This information can be used in collaboration with Inuit knowledge and scientific knowledge to inform decisions on marine mammal management.

80. Q: How will this affect the narwhal? ... What's going to be the observation? Is it going to be a visual observation on the ocean of how many mammals are going around or is it going to be a sonar or you know, interpretation of what's in the water? What is the whole story here? (Line 1920)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

Available research indicates that narwhal remain in their summering grounds throughout the summer (July and August) to have babies and eat. Narwhal eat a variety of marine species during the summer while they remain in their summering grounds.

It is unlikely that narwhal will be in the survey area during July and August. At this time, narwhal are present along the coast of Baffin Island and in the many fjords and bays of Baffin Island and Ellesmere Island. It appears that narwhal begin their migration to their overwintering grounds beginning in September and continuing until October. Narwhal that undergo a longer migration (travelling south down Baffin Island) begin their migration earlier compared to narwhal that travel directly offshore to their overwintering grounds.

Based on available information, it appears that in Eclipse Sound, Admiralty Inlet and Somerset Island narwhal will enter the survey area beginning in October. However, this may change as narwhal are spending more time in the fjords and bays as the ice around Baffin Island has begun to freeze later in the year.

It is unlikely that the proposed seismic survey will interact with narwhal in August or September. Once narwhal migrations begin in September, based on satellite tracking, narwhal may enter the survey area in October. At this time, based on available information the 500 m marine mammal safety zone will help limit negative effects to narwhal. Due to the lack of available studies and/or reports, the change, if any, of narwhal behaviour to seismic sound is not known.

For more information on the effects of seismic surveying on narwhal and other marine mammals, please refer to Section 6 of the 'Supplementary Report II'. The Environmental Assessment contains additional information on these and other species (LaPierre *et al*., 2011).

Source

LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

81. Q: And maybe, you know, we could ask ourselves the question, why are -- maybe part of our plan is being screwed up in many ways and many species are being disturbed and, you know, it's maybe a lot of impact of a lot of things. But maybe this is part of an impact, you know? (Line 1928)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The project proponent is very committed to protecting the environment. There are mitigation measures in place to limit the amount of impact the survey will have on the environment and wildlife.

Please refer to the Environmental Assessment for a description of mitigation measures for the project (LaPierre *et al.,* 2011). Community members can report any changes in marine mammal behaviour to the Community Liaison Officer. The Community Liaison Officer will maintain communication with the proponent throughout the project providing a direct link between the community and the company.

MKI has contracted NEXUS Coastal Resource Management to produce the attached "Interaction Assessment" which has been used to inform the "Acquisition Plan".

Source

LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

Appendix A: Acronyms

AANDC: Aboriginal Affairs and Northern Development Canada

AFA: Arctic Fisheries Alliance

BFC: Baffin Fisheries Coalition

CEAA: *Canadian Environmental Assessment Act*

CLO: Community Liaison Officer

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

DFO: Fisheries and Oceans Canada

EA: Environmental Assessment

FLO: Fishery Liaison Officer

HTO: Hunter and Trapper Organization

IQ: Inuit Qaujimajatuqangit

MKI: Multi Klient Invest AS

MMO: Marine Mammal Observer

NAFO: Northwest Atlantic Fisheries Organization

NEB: National Energy Board

NIRB: Nunavut Impact Review Board

NTI: Nunavut Tunngavik Inc.

NWMB: Nunavut Wildlife Management Board

PGS: Petroleum Geo-Services

TGS: TGS-NOPEC Geophysical ASA

UN: United Nations

VMS: Vessel monitoring system

Supplementary Report V

Follow-Up to the National Energy Board Letter dated
May 31, 2013

Information provided in response to

Pond Inlet

TGS-NOPEC Geophysical Company ASA, Petroleum Geo-Services and Multi Klient Invest AS (TGS/PGS/MKI) Northeastern Canada 2D Seismic Exploration Survey.

August 22, 2013

Pond Inlet Questions

The following questions were asked during the National Energy Board's meetings (afternoon and evening) in Pond Inlet, Nunavut on April 29, 2013. Each question and response is referenced to the report provided by the NEB, 'Public Review of the TGS-NOPEC Geophysical ASA (TGS), Petroleum Geo-Services (PGS) and Multi Klient Invest AS (MKI) Northeastern Canada 2D Seismic Survey Application, Volume 1'. Some original responses have been edited to ensure clarity. Verbatim responses can be found on the NEB website (www.neb.com)

Line numbers are referenced in brackets (Line xxxx).

To understand the context of each question, please refer to the Transcript Report for Pond Inlet on the National Energy Board website.

A list of acronyms used in this report can be found in Appendix A.

1. ***Q: The wildlife in our area, if there were any damages or if they're dying off, where can we turn to ask people of Pond Inlet if there's any damages, if we were to see another strange things happening? (Line 96)***

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The project proponent is committed to protecting the environment. There are mitigation measures in place to limit the amount of impact the survey will have on the environment and wildlife. Please refer to the Environmental Assessment for a complete list of mitigation measures (LaPierre *et al*., 2011).

Community members can report observations to the Community Liaison Officer. The Community Liaison Officer will maintain communication with the proponent throughout the project serving as a direct link between the community and the company. Community members can also report observations directly to the Department of Fisheries and Oceans and/or the National Energy Board.

Source

LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

Q: ***Do you have any precautions that would least affect these areas where seabird nest? (Line 106)***

Response:

The Marine Mammal Observers are trained to look for seabirds as well, but all of the work is being done offshore, a long distance from any shoreline bird colony. Each community will have a Community Liaison Officer to who will communicate with the vessel in order to know what is going on when and where

2. Q: What contingency plans do you have to further protect the food? (Line 113)

Response:

In order to go to certain latitudes the vessel has to comply with Canadian Coast Guard regulations. It also goes through yearly inspections from Det Norske Veritas, one of the major inspection agencies. This means that it has to comply with international and Canadian requirements. There is also a pollution plan and insurance.

3. Q: What other things could you do if that were – if the cable were to snap? (Line 120)

Response:

The cable is equipped with 'retrievers' which are basically flotation devices that would bring the cable up to the surface if it snapped. A support vessel, in advance of the actual survey ship, is used to monitor for sea ice. Satellite imagery is used as well. Ice is avoided whenever possible to minimize potential risks.

4. Q: So if there was to be an oil spill, my question would be: How long about would it take to get it cleaned up in the bottom of the sea? Because we still can see the bottom of the sea, from that testing, it's still there and they pretended to clean it up with different types of chemicals and they're poisonous. (Line 150)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

There are a number of ways oil can occur in the marine environment. Oil can be naturally occurring in the environment (Elders have described seeing oil seeps in Scott Inlet), or from vessels, and oil production and extraction. This Project does not include oil production or extraction.

The project proponent has protocols in place to prevent and clean up environmental damage caused by a vessel. These protocols adhere to international standards and regulations. The *Arctic Shipping Pollution Prevention Act* and the Arctic Shipping Pollution Prevention Regulators develop the protocols for having a vessel in Arctic waters. The vessel will have contingency plans and safety management systems on board. Also, the vessel will avoid areas of ice, as the survey cannot be completed near ice. This will reduce the chance of collision with an iceberg or ice floe.

5. ***Q: First of all, the question I'd like to pose is that project that you want to do is in Arctic obviously, where the ice -- where there's ice. Have you ever experienced and worked on the same scenario in different world or other countries? (Line 173)***

Response:

Yes, we've worked extensively throughout Greenland, and the partners we have contracted here have also conducted work in Greenland, the Russian Arctic and off Norway. We have both recent and long term experience in the arctic region.

6. ***Q: If you can tell me relatively true, while you're doing this project which animal would have the most effect -- which negative effect have you noticed most on animals during your projects? (Line 178)***

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

It is difficult to determine which animal species would potentially be the most affected by surveying activities. Responses to seismic activity by marine mammals are highly variable ranging from interest to avoidance. These responses can depend on a variety of factors including the age and sex of the animal, its physical state, the presence of offspring, prior experiences with seismic surveying and other environmental factors (Weilgart, 2007).

While there are no documented cases of marine mammal mortality due to seismic surveying (DFO, 2004; Abgrall, Moulton & Richardson, 2008), there are a wide range of behavioural responses to seismic sound, including startle, fright, avoidance and changes in physical behaviour and vocalization (Gordon *et al.,* 2003; Weilgart, 2007; McDonald *et al*., 1995). Marine Mammal Observers will be on board the survey vessel and can stop the survey if marine mammals enter the 500 m safety zone.

For more detailed information on the effects of sound on marine mammals, please refer to Sections 2 and 6 of 'Supplementary Report II'.

Sources

Weilgart, L.S. (2007). The impacts of anthropogenic ocean noise on cetaceans and implications for management. *Canadian Journal of Zoology, 85*, 1091-1136.
DFO. (2004). Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. DFO Canadian Science Advisory Secretariat Habitat Status Report 2004/002
Abgrall, P., V.D. Moulton, and W.J. Richardson. (2008). Updated review of scientific information on impacts of seismic survey sound on marine mammals, 2004-present. *Canadian Science Advisory Secretariat.*
Gordon, J., Gillespie, D., Potter, J., Frantzis, A., Simmonds, M.P., Swift, R., and D. Thompson. (2004). A review of the Effects of Seismic Surveys on Marine Mammals. *Marine Technology Society Journal, 37(4)*: 16-34
McDonald, M.A., Hildebrand, J.A. and S.C. Webb. (1995). Blue and find whales observed on a seafloor array in the Northeast Pacific. *Journal of the Acoustical Society of America, 98(2):* 712-721.

7. ***Q: I understand I will be getting an answer in the future, but when? (Line 186)***

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The answers to all the community questions are based on the best scientific and Inuit information accessible and will be provided back to each community as provided in this document. The answers will be provided to the National Energy Board and posted on their website.

8. ***Q: It seems there are documents stating there are reserves, many, many reserves. And not too long ago I had asked within the Legislative Assembly about the sea near Clyde River in the ocean, the ocean sea, and you stated you didn't know whether there were any reserves and further clarification after you're done dealing with this, then what? (Line 188)***

Response:

These seismic surveys are done to help map the sub-surface geology beneath the water. This information is used by the oil and gas companies to do the drilling. The seismic surveys are done first and the information collected is used by the oil and gas companies to assess whether this area has potential for them to come and drill for the oil and gas. The seismic survey allows for a more educated analysis and better decision making as to where to drill and where not to drill.

9. ***Q: After you're done with this project, you had stated that perhaps after four or five years -- I think it was five years -- the information you collect, who do you then sell -- who do you then sell this information -- who will you sell this information to, to oil companies? (Line 198)***

Response:

If oil and gas lease blocks are released offshore here, companies could potentially express interest to use the information to determine if they interested in working here. This is still in development and at this time it is undetermined who would potentially want to use the information.

10. ***Q: What -- from your study surveys (in Greenland, Russia, etc) did you find that you were not expecting? (Line 206)***

Response:

The biggest thing was weather changes as surveys could be taken later into the season than expected.

11. Q: First of all, my question is especially for the sea mammals or for whales. When you do -- when you do the seismic, how -- have you done studies to find out how much your seismic numbers affect the marine wildlife, like narwhal? (Line 217)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

Seismic surveying uses air pressure to create sound that is capable of penetrating under the seafloor (this does not harm the seafloor, no holes are created). The effects of sound produced from seismic surveys noise on marine mammals have been studied, and no documented cases of mortality have been recorded (DFO, 2004; Abgrall, Moulton & Richardson, 2008). Observations from past seismic surveys have demonstrated that marine mammals do demonstrate a wide range of behavioural responses including startle, fright, avoidance and changes in physical behaviour and vocalization (Gordon *et al*., 2003; Weilgart, 2007; McDonald *et al*., 1995).

There are few reports describing how long it takes marine mammals to return to the normal behaviour as displayed before the seismic survey began. One report indicated that whale behavioural patterns often resumed 24 hours after the seismic survey left the area (Mosbech *et al*., 2000). Another report documented that bowhead whales resumed normal behaviour one hour after the seismic survey stopped (Ljungblad *et al*., 1988).

Researchers have recommended guidelines for seismic surveys based on existing reports and studies on whale and seal responses to the sound levels received from seismic surveys. For exposure to multiple sound pulses (like seismic surveys), permanent threshold shift (loss of hearing, not recoverable) is assumed to occur if the sound exposure level is exceeded:

- Cetaceans (whales): approximately 198 dB re 1µPa²
- Pinnipeds (seals): approximately 186 dB re 1µPa²

DFO prepared the *Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment* (DFO, 2010). The Statement of Canadian Practice formalizes and standardizes the mitigation measures in Canada with respect to the conduct of seismic surveys in the marine environment.

As stated in the Environmental Assessment for the project, the received sound level at 500 m from the sound source is 180 dB (LaPierre *et al*., 2011). Therefore, based on available information, whales and seals should not be permanently affected from the proposed seismic survey. However, changes in behaviour may be observed, and these are thought to be temporary based on previous reports and studies.

For more information on the effects of the sound on marine mammals refer to Sections 2 and 6 of the ‘Supplementary Report II’.

Sources

Weilgart, L.S. (2007). The impacts of anthropogenic ocean noise on cetaceans and implications for management. *Canadian Journal of Zoology, 85*, 1091-1136.
DFO. (2004). Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. DFO Canadian Science Advisory Secretariat Habitat Status Report 2004/002
Abgrall, P., V.D. Moulton, and W.J. Richardson. (2008). Updated review of scientific information on impacts of seismic survey sound on marine mammals, 2004-present. *Canadian Science Advisory Secretariat.*
Gordon, J., Gillespie, D., Potter, J., Frantzis, A., Simmonds, M.P., Swift, R., and D. Thompson. (2004). A review of the Effects of Seismic Surveys on Marine Mammals. *Marine Technology Society Journal, 37(4)*: 16-34
McDonald, M.A., Hildebrand, J.A. and S.C. Webb. (1995). Blue and find whales observed on a seafloor array in the Northeast Pacific. *Journal of the Acoustical Society of America, 98(2):* 712-721.
Ljungblad, D.K., Wursig, B., Swartz, S.L., Keene, J.M. (1988). Observations on the behavioural responses of bowhead whales (*Balaena mysticetes)* to active geophysical vessels in the Alaskan Beaufort Sea. *Arctic, 41(3):* 183-194.
Mosbech, A., Dietz, R. and J. Nymand. (2000). Preliminary Environmental Impact Assessment of Regional Offshore Seismic Surveys in Greenland. National Environmental Research Institute. 25p.
DFO. (2010). Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment. Department of Fisheries and Oceans. http://www.dfo-mpo.gc.ca/oceans-habitat/oceans/im-gi/seismic-sismique/pdf/statement-enonce_e.pdf
LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

12. Q: When they know this information already, why do you need to do further studies in this area? (Line 225)

Response:

The seismic information is much higher quality and allows the companies to pin point exactly where to drill. Although they may already have previous information telling them there is oil in the area, this seismic survey would help prevent companies from having to drill exploratory wells to try and find exactly where the reserves are located.

13. Q: Mr. Speaker, I want to ask, the seismic testing, do they bring their poppers like seismic equipment? (Line 233)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The seismic vessel will bring all necessary equipment to conduct the survey. The equipment will include a seismic survey vessel, a sound source, hydrophone cables (streamer), and a supply vessel.

14. Q: From there, for example, I will use as an example on asking about it, that this ship from there starts popping seismic activity, firing its seismometer, how long -- how far would the sound carry? (Line 236)

Response:

This information has been compiled and is available through the National Energy Board. Basically there is a 10-50 kilometre radius where the sound level is above the background noise in the ocean. This area is not lethal or necessarily harmful.

15. Q: Water -- sound travels differently through water than sound. How far away would the sound reach; would it reach Greenland? How many kilometres can the sound reach in water? (Line 237)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:
Sound travels further in the water than in the air. Noise from other boats, and natural events, like earthquakes and rain[1] can be heard throughout the ocean. This constant background noise is present throughout the ocean.

The sound source will be pointed at the bottom of the ocean. However, there will be some sound that travels outwards from the sound source and sound will bounce off the ocean floor to be reflected back to the survey equipment.

The effect of the seismic survey in a distance, will contribute to this background noise, but only for a short period of time.

Appendix D & E

16. Q: Who has the authority to stop this? Maybe the NBA (sic), who holds the -- the authority to say 'yes' or 'no'? (Line 265)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The proposed seismic survey is occurring in the offshore of Baffin Bay and Davis Strait, which is outside of the 12 nautical mile territorial sea boundary. As a result, the regulatory authority for this project is the National Energy Board (NEB). Based on a review of the proponent's application, the NEB has the authority to approve or decline the application. The communities will not have a vote for approval or rejection. However, the community does have the right to voice their concerns, have the right to be informed and provide input.

Nunavut is a territory, thus distributing much of the power to the federal government. That is what the UN Declaration of the Rights of Indigenous Peoples is all about. Often the communities look at the company as the other side. Building relationships with companies can strengthen the community's interest with external organizations and agencies.

[1] Rain can increase background noise in the ocean by up to 35dB across a range of frequencies from 100Hz to more than 20kHz. (Wilson *et al*., 1985 *in* Hildebrand, J. (2004) Impacts of Anthropogenic Sound on Cetaceans. *International Whaling Commission* 32p.

17. Q: Twenty-two (.22) short -- long rifles -- that air gun? (Line 280)

Response:

A comparison table will be provided to indicate how a .22 rifle sounds next to the sounds of the actual seismic source, that way a visual and numerical comparison can be made.

Additional Response Information:

MKI believes that audio representation would be more effective than a video to best represent "seismic sound". We propose to present a "representation" recording of the seismic source sound in future meetings while supplementing it with the other deliverables such acoustic modelling, sound comparison tables, etc. (Appendix D & E)

Q: Again, Troy, how long would that (sound modelling) take to happen as well? Is that a long project or something you could do within a fairly short time frame? (Line 284)

Response:

One or two weeks to ensure that the proper information is provided to the community.

18. Q: My first question perhaps: Baffin Bay, if you went into all the survey in Baffin Bay, where would you start? From the north or from the south and work your way up? What's the plan? Where would you start? (Line 307)

Response:

That is still undecided. First, the feedback from the communities is collected. Then the planning incorporates the local knowledge received and an actual route for the survey is decided upon based on all the information.

19. Q: Why do you want to do your survey during the fall? (Line 312)

Response:

In order to avoid ice and bad weather.

20. Q: If you would follow the exact routes, you'd have a very long distance to travel. I don't understand this 8 kilometre. When you do a project this big, you will travel 8 kilometres a day, however, would you finish your project in five years, at 8 kilometres per day? (Line 317)

Response:

The 8 kilometres is actually the length of cable the vessel tows. It is constantly moving and travels at a speed of 8 kilometres per hour.

21. Q: It would be possible to finish this project in five year at 5 kilometres per hour? (Line 322)

Response:

Yes, models show that with 5000 sail line kilometres to be surveyed it can be finished within a 60 day period.

22. Q: Which map are you – will you be using the two years ago original map or this one or that one? (Line 330)

Response:

The maps have changed because of input from the communities. The hope is to achieve in 2013 what is shown on the most recent map.

23. Q: This year alone, you'll be doing that and I heard – overheard five-year project? (Line 335)

Response:
Yes, the permission would be for a five year project.

24. Q: If you have the basic information with one year, first year, why more studies within the next five years once you have the basic information? (Line 337)

Response:

The idea is to do a coarse grid at first in order to get a base map of the area, and then to fill in the gaps to try and get a better resolution by surveying between previous survey lines.

25. Q: Can you give us more information, in more detail, with first, second, third, fourth and five year plan with your proposal? (Line 342)

Response:

Yes, a model of those survey lines can be made based on project goals and provide an estimate on the timing.

26. Q: You gave us, two year ago, I notice South Baffin had less line and, as of today, with the National Energy Board map, I see there's more lines than two years ago. Why is this? (Line 345)

Response:

The lines are actually a polygon representation of the grid. This is an area, and not survey lines. The previous information we provided shows the survey lines.

27. Q: Two years ago, the gentleman right here proposed this map to us to Hamlet Council and the National Energy Board map is this one and there's more lines with National Energy Board and two years ago there was less lines with South Baffin. Why am I seeing more lines today? (Line 348)

Response:

The lines are actually a polygon representation of the grid. This is an area, and not survey lines. The previous information we provided shows the survey lines.

28. Q: My question is, first question is once we finish this consultation, after you finish the community consultation, when would you (NEB) have to decide on this project or proposed project? (Line 361)

Response:

NEB Response: After the community consultations, all the information that the proponent has been committed to provide will be collected, considered and reviewed so that recommendations can be made. Then the full board will make a decision whether to approve, approve with conditions or deny the proposed project. The reviewed report will go to the board in mid-to-late May. The company would like to start work in July, so the final decision will be made public before that time.

29. Q: I have two questions; the people who are going to do a seismic study, have you included any person to go on your ship, traditional Inuit? (Line 390)

Response:

Yes, there will be local people from the communities on the vessels as observers and also people who will liaison from each of the communities so that you are able to keep in touch with the vessel and vice versa.

30. Q: Divided to a statements here, community liaison officer and marine mammal observer, community member of Pond Inlet, whether they will be getting an employee or will you get an employee from outside the community. I want clarification, thank you. (Line 406)

Response:

Yes, we would like to have an employee from inside the community. There has been training done at the university here to give people the background on Marine Mammal Observations and weather reporting.

31. Q: Is the marine mammal observer or the liaison officer notice a big attack, what kind of authority does that person will have? Will he able to stop the project? (Line 409)

Response:

Yes, if a marine mammal enters the mitigation zone the Marine Mammal Observer will have the right to stop the surveying.

32. ***Q: Here in Nunavut, they don't have a ship like Coast Guard ships. If you guys had an accident or the ship had hit a piece of ice, what mitigation emergency plans do you have for the nearest community? Would you wait for the Coast Guard at the nearest community or would the Coast Guard ship go with the St. John's oceans? Would you be dragged in to St. John's oceans? What would be the set-up? (Lines 411-413)***

Response:

PGS has mitigation measures that involve adhering and complying with everything required from a regulatory point of view. There is a support vessel that is important for mitigation and emergency measures. There is also an emergency response plan in place long before the surveying starts that contains all the contacts needed for issues from medical to mechanical.

33. Q: If you had an incident in Baffin Bay, do I just ignore your help call while I have my 60-foot boat? Do I just ignore your big ship if there was an incident? (Line 418-419)

Response:

That depends on the situation and the conditions. The hope would be for any possible help to come, and in the opposite situation, if something were to happen to a community member's boat the survey team would be happy to come and assist.

34. Q: My other question would be: As we all know, Arctic is a unique place in Canada and there's a lot of information, data within scientific area. How could these scientific data's be more accurate to us as a community member? (Line 424)

Response:

Any information that is not proprietary data will be shared. This includes information about marine mammals, fish, sea birds, sea state fishing activity, etc.

35. Q: How can Nunavut be part of National Energy Board Member? (Line 436)

Response:

Currently there are no members of the National Energy Board from Nunavut, however there are open positions for 'Temporary Board Member' and the information on where to apply for those positions can happily be provided.

36. Q: My question is the fisheries -- haven't you got any documentation from Fisheries Coalition? That's my first question. You got any comments from them? (Line 510)

Response:

There have been several meetings with the Baffin Fisheries Coalition in Iqaluit, Halifax and St. John's. Contact has been maintained with them at all stages of the community engagements about where and when they are fishing. That information has been passed on to the company.

37. Q: As you know, I have talked to you before and my second question is, there are -- is it okay if you guys do this type of study where there's lots of wildlife? (Line 513)

Response:

The timing of the study is done to have the least potential impact on wildlife migration and fishing activity. The Marine Mammal Observers on the vessel are there so that if marine mammals are observed they can shut down operations and wait for the mammals to pass through the mitigation zone.

38. Q: There's lots of oil and they will -- the oil companies will want the oil that you said you'll just do site testings, and you said you have to look for oil through seismic testing. Are you going to explain it properly and define it about -- define the seismic testing that we can understand, now, right now? (Line 518)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

Marine seismic surveys are conducted to determine geologic features below the seafloor. The seismic survey process includes the following steps:

1. A piston (sound source) generates a sound when it quickly releases compressed air into the water. The sound source is towed by the research vessel 6-10 metres (18-30 feet) below the surface of the water.
2. The sound generated by the source travels through the water as a sound wave to the seafloor. Some of the sound will bounce off different layers (types) of sediments and rocks and return back to surface of the water.
3. The sound that returns to the surface of the water is detected by hydrophones. Hydrophones will be towed by the vessel on a cable that is 6-12 kilometres (18,000- 36,000 feet) long. The cable is also called a streamer.
4. The information collected is analyzed using computer programs that can produce an image of the different rock layers beneath the seafloor.

39. Q: How can you understand this (referring to oil spill cleanup), that we need food too? (Line 522)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The project proponent understands the importance of traditional food sources to communities throughout Nunavut. The proponent is committed to protecting the environment and the wildlife that Inuit rely on. Thus, the proponent has prepared mitigation measures to minimize potential negative impacts (please refer to the Environmental Assessment for the complete list of mitigation measures). In addition, the proponent is conducting an IQ Study to ensure that local knowledge is integrated into the proposed project. The proponent has committed to installation of Passive Acoustic Monitoring onboard the seismic vessel to listen for mammals.

Source

LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

40. Q: How are you going to supply us with food if it had such a negative impact in our waters? How can you help us if you -- if there was a big impact to our wildlife? (Line 523)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

Food security in northern communities is a complex issue, which is affected by multiple factors, not all of which are fully understood. Even if the proposed project did not occur there are still a variety of issues, which could affect arctic food sources. The effects of increased shipping, fallout from atmospheric pollution, decreasing nutrient abundance, climate change effects or changes in water quality would all still occur. These changes could also affect the health or abundance of a species in a given year.

To address issues related to this project, the company will continue to have ongoing discussions with the communities. This will help identify community concerns and observations. There will be a Community Liaison Officer (CLO) in each community. The CLO will serve as a link between the community and project proponent throughout the duration of the proposed project. Any concerns or observations in a community can be brought forward to the CLO who will pass the information on to the project proponent.

Two experienced Marine Mammal Observers and two Inuit Observers will be employed onboard the vessels for the duration of the project, looking for marine mammals within the 500 m safety zone. If a marine mammal comes within the safety zone, the seismic source will shut down as per the Statement of Canadian Practice.

Fisheries Liaison Officer maintains daily communication with the fishing fleets in Baffin Bay and Davis Strait.

For more information on the known effects of sound from seismic surveys on marine mammals, please refer to section 2 in the ‘Supplementary Report II’. The complete list of mitigation measures for the project can be found in the Environmental Assessment (LaPierre *et al*., 2011).

Source

LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

41. Q: That what I've heard before that in our waters -- between Clyde River and Pond Inlet, in our waters, in the low land areas, that there's a oil gushing all the time. You know about that; right? Or …? Do you know about that or are you going to look for more oil even though you know about that oil gushing out all the time? (Line 552-553)

Response:

Yes, we are aware of the oil seeps. The objective of the study is to determine the geology of the area, and to identify the exact location of the oil deposits. Although the oil may seep out in one location, the actual deposit may be some distance away due to sub-surface geology.

42. Q: When you first started from your first seismic testing and when we object to it you guys stopped. So you haven't done anything else or any testing with the vessel at all since the last time when we object to the testing? Are you going to go on or are you here to clarify everything, whether you're going to do the testing or not? (Line 562-563)

Response:

The testing has not started. Right now the proponent is seeking approval (from the NEB) to do the testing. To receive approval, the project has to be able to justify the effects it would have, and any mitigation measures which would be taken in the case approval was granted.

43. Q: Did you do any seismic testing last year? (Line 569)

Response:

This company has never done any testing in Baffin Bay.

44. Q: According to your comment and that they'll be an observer on the ship, how many miles are you going to do the air gun or shoot to the bottom of the sea? How many minutes or how often? (Line 573-574)

Response:

The seismic shots are done according to the vessel speed. Generally there is a pop done every 15-20 seconds.

Additional Response Information:

There are 16,173 km of survey lines that would be completed over five years. Whether or not the proponent returns in subsequent years will depend on the results of the first year. It should be noted this data will be collected in three years that may not be consecutive. The first year plan is to collect approximately 5000km of data.

45. Q: On one of the previous slides that had the more detailed lines, are those the actual routes that you're planning on testing? (Line 598)

Response:

Some of the maps we have put up have polygons on them which do not represent the survey lines, they are depicting an area. The map with the survey lines can be found in the discussion paper.

46. Q: And the boat that you're planning on using, that's not a boat you own; correct? That's a boat you rent? (Line 609)

Response:

The vessel is under a long term charter agreement to PGS and MKI. It is run by Sanco Shipping out of Norway.

47. Q: I'm wondering what year you rented the boat specific for this test? (Line 612)

Response:

It is not rented specifically for this test. It is a long term charter. The vessel has also worked off Newfoundland and Labrador, Brazil and West Africa.

48. Q: What is the planned approval date for this project? (Line 617)

Response:

I will be making a recommendation to the board in mid-May, and after that the board will make a decision. The work, if approved, is planned to start in July so the approval would come before.

49. Q: Just wondering from the environmental aspect, what studies have you investigated and what things have you taken into consideration from previous studies done? And amongst that, what changes have you made to your proposed testing as a result of those studies, any studies that you may have read or done. (Line 622-623)

Response:

The communities will be provided with studies on the known effects of sound on marine mammals, as well as, the sound generated by the whales themselves in order to give an idea of the comparison and how far sound travels, etc. All of this information is in previous studies, which will be forwarded to the communities.

50. Q: If this testing does go ahead and for some strange reason we happen to see whale beachings, what are your plans with that? (Line 631)

Response:

That is part of the rationale behind the mitigation zone (*500 m marine mammal safety zone)*, to avoid those kinds of circumstances. The relationship between the community and the company is very important. People can report in to try and find out what has caused it. In some cases there may be other causes, but keeping open lines of communication is what is important.

51. Q: And I'm just wondering like, what most people are saying is a lot of reluctance when it comes to this going ahead. I'm wondering if it's the same kind of feeling, same vibe you're getting from the members of all the other communities that you've been in? (Line 637)

Response:

That is a question asked in each community, and the goal is not to pit community against community. In each location there are people who are in favour of it and people who are concerned about it. In all cases there is a mix of opinions.

52. Q: As you were talking, when that you would stop the ship if there were any marine mammals coming up, what kind of a gun -- airgun do you have or dynamite would you use? (Line 647)

Response:

The source ray uses compressed air to create the sound. The elements have compressed air in them and a piston inside moves to release the air.

53. Q: Are they going to affect the crustacean on the seabed because they are the food for the other marine mammals? (Line 653)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

There are no known cases of invertebrate mortality due to exposure to seismic surveying in field conditions (DFO, 2004), however, in experimental conditions (less than 5 m) lethal and/or sub-lethal effects have been observed (LaPierre, 2011). Studies have been conducted on the effects of seismic sound on Snow Crab (DFOC, 2004; Christian *et al*., 2003) and Dungeness Crab (Pearson *et al*., 1994). The results of these studies have not shown any long term or serious pathological, physiological or behavioural effects. It is unlikely that crustaceans will be negatively affected by this project.

Sources

Christian, J.R., A. Mathieu, D.H. Thomson, D. White, and R.A. Buchanan. 2003. Effect of seismic energy on snow crab (*Chionoecetes opilio*). Environmental Studies Research Funds Report No. 144. Calgary, AB, Canada. November.
DFO. 2004. Potential impacts of seismic energy on snow crab. Canadian Science Advisory Secretariat Habitat Status Report 2004/003.
Pearson, W., J. Skalski, S. Sulkin, and C. Malme. 1994. Effects of seismic energy releases on the survival and development of zoeal larvae of Dungeness crab (*Cancer magister*). Marine Environmental Research 38:93-113.
LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

54. Q: And you had a -- when the Whaling Committee was here, the study area that you want to do is calving ground for bowhead whales and other whales; are they going to be affected? (Line 654)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

It is unknown as to the exact calving locations of bowhead whales. Inuit have observed bowhead calves in Isabella Bay and north of Isabella Bay (NWMB, 2000). Calves are frequently seen in the Arctic Bay area (NWMB, 2000). Bowhead whales are thought to give birth during the summer months up until August (NWMB, 2000). Based on where the seismic survey activity will take place and where known bowhead calving areas are, it is unlikely that bowhead calving areas will be affected.

In order to limit the disturbance of the surveying on any marine mammal species there will be a Marine Mammal Observer on the vessel at all times who will have the authority to shut down the source if any marine mammals are spotted in the 500 m safety zone.

For more information the known effects of seismic surveying on whales and other marine mammals please refer to Section 2 of the 'Supplementary Report II'.

Source

Nunavut Wildlife Management Board. 2000. Final Report of the Inuit Bowhead Knowledge Study. Nunavut, Canada.

55. Q: In deeper waters, does the sound wave travel -- does it spread, the sound wave when you're doing testing? (Line 673)

Response:

The sound travels out in all directions, but it gets fainter the farther it moves away. Sound travels further in water than air, but the decibel levels (or level of sound intensity) are not the same. This is the kind of information will be passed onto the communities.

Additional Response Information:

Appendix D & E

56. Q: And who is going to monitor the ship activities? (Line 677)

Response:

The ship is monitored by the company from shore 24 hour, seven days a week. There is also the community liaison and shore representatives who can be brought into the community.

57. Q: Want to talk about a little bit of the ship: Where would the ship start discharging the -- discharge water going up to the site? (Line 681)

Response:

All the ballast water is contained onboard, as per regulations. Nothing is discharged. Dirty oil and other materials are stored onboard until they can be discharged at a port capable of handling those types of materials.

58. Q: Like there's always packs of ice, and even the little ices, can they bounce back the sound waves, like, bounce them back down? (Line 685)

Response:

Operationally ice is avoided as it can damage the equipment. Everything possible is done to avoid the ice. First, there is a support vessel that goes out in front. Also, all the latest satellite data is used. Local knowledge will also be used. Available tools and sources of information will be used to try and avoid ice.

Additional Response Information:

The seismic survey vessel will try to avoid all areas with ice present as it impedes the vessel's progress, presents the potential for damaged equipment and can lower data quality. In order to avoid the areas with ice present several methods are used. The support vessel scouts ahead of the survey vessel, satellite imagery is used and local knowledge from the communities will be sought. It is not always possible to avoid ice, as it often moves freely in the water.

59. Q: And can I -- I'd like to know more about passive acoustic monitoring or did we talk about that too? (Line 691)

Response:

There are two types of monitoring used for marine mammals that can be used during a seismic survey. The first is using Marine Mammal Observers to visually observe for marine mammals that surface at the top of the water. The second is the use of passive acoustic monitoring which uses a hydrophone to listen for whales communicating under the water. Even when the ship is not running the seismic source it is monitoring for whales by listening for them in the water.

60. Q: What if commercial quantities are not found, what then, what good the drilling would be if they even find the commercial quantities of oil and gas? (Line 696)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The purpose of this survey is to locate areas where there are high probability of oil and gas.

There will be no exploratory drilling or extraction during this project. This project is to complete 2D Seismic Survey. Any future project would require proponents to apply for permits and complete the required tasks associated with the application.

Communities will have the opportunity to be involved in future projects occurring in Baffin Bay and Davis Strait.

61. Q: With the change in CEAA (Canadian Environmental Assessment Act), what opportunity will the communities have to express any kind of concerns with this project if it goes ahead beyond this hearing? What is the process moving forward in the future? (Line 702-703)

Response:

NEB Response: Now that the CEAA has been repealed for seismic activity a similar process will be continued where companies are asked to waive their confidentiality for environmental matters. Going forward all questions and concerns regarding environmental matters go on the public registry, as it would have under CEAA. In a way there is still a commitment to an EA whether there is a CEAA or not. There is a mandate under the *Canada Oil and Gas Operations Act* to ensure there is environmental protection for all projects authorized under the act.

62. Q: When you have an environmental assessment, you look at what the communities or whatever, the affected people what do they value the most. And I'd like to know from the environmental assessment what Pond Inlet values from -- you've mentioned that you've been to this community I think three or four times now. So I'd like to know what you've learned from Pond Inlet and how you've incorporated it into your environmental assessment because that's what they want to know. (Line 708-709)

Response:

The environmental assessment was performed by another consulting company. As for what people value, there are three main things that come up in community meetings; traditional food sources, the environment and the ability to have a say in the project. All of these things are being included in the design of this project.

63. Q: If all the wildlife moved away from this area, how are we going to have food? Because of the seismic testing, because they're not good for animals and we have the best nutrition food in the North. (Line 723)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The project proponent understands the importance of traditional food sources to Inuit communities throughout Nunavut. The proponent is committed to protecting the environment

and the wildlife that Inuit communities rely on. Thus, the proponent has implemented a number of mitigation measures to alleviate any potential negative impact.

Food security in northern communities is a complex issue, which is affected by multiple factors, not all of which are fully understood. Even if the proposed project did not occur there are still a variety of issues, which could affect arctic food sources. The effects of increased shipping, fallout from atmospheric pollution, decreasing nutrient abundance, climate change effects or changes in water quality would all still occur. These changes could also affect the health or abundance of a species in a given year.

For more information on the effects of seismic surveying on marine mammals, please refer to Sections 2 and 6 of the 'Supplementary Report II'. Mitigation measures for the project can be found in the project's Environmental Assessment (LaPierre et al., 2011)

Source:

LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

64. Q: In June -- and you said that you could change or you're going to start doing the testing in June? (Line 733)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The proponent is unable to begin the survey until approval has been received from the National Energy Board. Upon approval the proponent will be coordinating the survey schedule with feedback from the communities, fisheries organizations and government. The survey will only be operating in the ice-free months, the acquisition plan provided is from mid-August to mid-September.

65. Q: Are you not going to have any study done beside a boat or a vessel (aerial survey)? (Line 738)

Response:

An aerial survey using a plane has been considered but the weather conditions in Nunavut can limit the ability to travel by plane, while still allowing for marine transit.

66. Q: The sea mammals -- polar bears, walrus, whales, seals, square flippers -- are you going to stop this testing just for these animals? And now, think about the sea ducks, sea birds who eat from the underwater, the different type of seabirds? (Line 739)

Response:

With respect to the marine mammals that are out there, it is not just whales that would stop the surveying. Any mammal, such as a polar bear or dolphin, regardless of the species would stop the operation.

67. Q: The animals at the seabed I don't want them harmed, and also the fish in the seabed that doesn't come up for air, that stays in the water. Maybe have they made us understand or have they make you understand that turbot -- where turbot -- where they go at certain months, especially in the fall, through the deep water on the seabed? That they know where they migrate at which month maybe if you know about that, can you answer this question? (Line 748-749)

Response:

Yes, there are two ways; one is scientific surveys done to assess the resource. There is also the fisheries liaison officer who works to ensure that there is communication between the fishing industry and the survey vessel.

68. Q: I heard that there will be an Inuit observer on the ship looking for animals. There will be more than one Inuk on the ship? (Line 754)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The proponent is committed to protecting the environment and wildlife. The proponent has developed mitigation measures to limit potential negative impact (please refer to Environmental Assessment, Mitigation Measure Section).

Two experienced Marine Mammal Observers and two Inuit Observers will be employed for the duration of the project. The observers onboard the vessels are looking for marine mammals. MMOs will keep a detailed log of what species are observed, and where and when they were observed. If a marine mammal is seen within the 500 m-safety zone the seismic source shuts down. Once MMOs no longer see a marine mammal within the 500 m-safety zone for 30 minutes, the 20-minute ramp up procedure will begin. (As per the Statement of Canadian Practice)

Source

LaPierre, Tony., Arnott, Alexandra., Hawkins, Chris., Simpson, Kent., & Davis, Darlene.(2011). Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Baffin Bay And Davis Strait Offshore Eastern Canada By Multi Klient Invest As. RPS Energy. Report No. HOPH417(B)

69. Q: Can you answer it? If not, you cannot. If they have a federal government and Greenland had agreement? (Line 758)

Response:

Some work has been done in Greenland in the past, and it would need to be confirmed to see if some of the information on the agreements with the Greenland government and the authorities over there could be released. There are a lot of things that are confidential in those documents and, to tell the truth, it would need to be checked to see if that would be releasable.

70. Q: If you do testing in the lower water or near the sea bed, are they going to have the same sound or the strength? (Line 762)

Response:

The source makes the same noise no matter how deep or shallow the water is. The effects it has when it reaches the floor in deeper water will be different, but they do not turn it up or down based on water depth.

71. Q: Do you know the percentage of how much spill there is? (Line 770)

Response:

This project is not about drilling for oil, it is about seismic surveys.

Additional Response Information:

This project is only conducting the seismic surveying operations required to locate potential oil reserves under the sea floor. There will be no drilling as part of this project; nothing will be going down to the seafloor that could release any oil. The only potential for a spill comes from the surveying vessel itself. This vessel carries approximately 500, 000 litres of fuel but has a full safety plan, as legally required. There is also a support vessel on hand that has containment equipment onboard sufficient to deal with the unlikely possibility of a catastrophic event occurring to the vessel and causing a spill.

72. Q: So what you're saying is it's 50/50 percent chance? So if it would spill, do you have a proper -- proper safety plan? (Line 777-778)

Response:

The ship has to have a safety plan and everything is in place in the documents submitted to the NEB and the authorities. The ship itself only carries fuel oil. There is nothing going down to the bottom that could release any oil.

73. Q: My question is due to the high current and all that, it would spread, maybe rapidly. Would the ship be able to keep up with a spill? (Line 783)

Response:

That would depend on the type of spill it would have. The only oil that could spill would be due to a catastrophic event onboard the vessel. The vessel has a full safety plan. There is also a support vessel on hand that has containment equipment onboard. The amount of fuel that could spill would be about 500, 000 liters.

74. Q: And would you still drill if it's -- even if it's a small rate of oil? (Line 787)

Response:

There is no drilling involved in this project. All we do is test the ocean floor with sound waves, looking for formations in the rock. Nothing actually goes into the ocean floor.

75. Q: So my last question is, since you're testing, does that mean you're planning to drill some day? (Line 789)

Response:

No, the project proponent does not drill, that is up to the oil companies. The information acquired here would go to companies and to the government and they would decide if it was viable to drill for oil or not. Depending on the results it could be decided to drill for oil, or not to drill for oil.

76. Q: It is written down here that the National Energy Board will review an assessment done -- it's written under that as an assessment -- what I understand is that we are asking for permission or not? (Line 802)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The proposed seismic survey would occur offshore of Baffin Bay and Davis Strait in an area that falls outside of the 12 nautical mile territorial sea boundary. As a result, the regulatory authority for this project is the National Energy Board. The NEB will review the application and decide if the project can or cannot proceed. The communities will not have a vote for approval or rejection. However, the community does have the right to voice their concerns, have the right to be informed and provide input to the project.

Nunavut is a territory, thus distributing much of the power to the federal government. That is what the UN Declaration of the Rights of Indigenous Peoples is all about. Often the communities look at the company as the other side. Building relationships with companies can strengthen the community's interest with external organizations and agencies.

77. Q: And can you make agreement if there is approval that you can compensate the North for a trillion dollars for loss of animals? (Line 806)

Response:

NEB Response: As part of the approval of a seismic survey, if it is approved, there needs to be a benefit plan and that is not something that the NEB approves. That is something that the government, your government, has to work out with the company.

The company has to have approval of a benefit plan by the government of Canada and AANDC, have to approve that benefit agreement. NEB has no say in that. That is an agreement between the government and the company.

Additional Response Information:

The project proponent will seek benefit approval from the necessary authorities. The project proponent is committed to building a positive working relationship with the communities of Baffin Island.

78. Q: When you make an explosion, whatever dies, will you be counting the dead animals; for example, walrus? (Line 827)

Response:

The source of the sound is not actually an explosion, it uses compressed air. Also, any observations about animals, dead or alive, would be reported to the community. If there was a animal dead in the water that was caused by some other source, it would be reported to the community as well.

79. Q: Do you own the vessel? (Line 833)

Response:

The vessel is on a long term lease charter agreement, and it is crewed by people from the company.

80. Q: Is that the one (reference to page 3, Figure 1 of the package)? How long is that thing that is dragging by the ship? (Line 839)

Response:

Yes, it is. It is 8100 metres in length.

81. Q: And how deep is that thing underneath the water? (Line 841)

Response:

The cable that records the information is 8100 metres in length and is towed at 25 metres under water. The source is 14 metres in length and is towed at 9 metres under water.

82. Q: That's safe enough for the ice to go by? (Line 849)

Response:

Yes, it is enough for the ice to go by. As mentioned earlier, operations will avoid ice. There is a scout vessel that goes ahead to look out for ice. Satellite data is also used.

83. Q: The streamer, like with the icebergs, would you have to stop for a while if there was to be an iceberg on your way, a huge iceberg? (Line 851)

Response:

Yes, in the event of ice the course of the vessel would be adjusted to avoid it.

84. Q: The testing area, if there was -- even if there's too much ice build-up, do you just continue doing seismic testing? (Line 853)

Response:

No, if there is too much ice the course is adjusted for an area where there is no ice.

85. Q: The testing area that you did, do you go back to do anymore study to see if you've missed anything or when you have to go to another location? (Line 855)

Response:

The surveying process provides real time feedback, so if there are problems or if anything was missed it would be known right away.

86. Q: Your airgun, does it go straight down? And once it touched -- so it takes back the information from the seabed to your cable? (Line 858)

Response:

Yes, the source sends the pulse straight down and the sound reflections (echos) return to the sensors located on the cable being pulled behind the boat. There are compasses and monitors on the sensors so their locations are known in relation to the boat. This allows the vessel and gear to move out of the way of obstacles, such as icebergs.

87. Q: The airgun, is it very loud under water, say every half hour? (Line 863)

Response:

As mentioned before, the sound goes out about every 15-20 seconds into the water.

88. Q: Say you have eight hours a day and all that time for the eight hours, you do this testing or do you take a break at all if there's any -- or if there's too much ice in the area where you want to do the study? (Line 866)

Response:

The breaks occur at the end of the survey lines, indicated by the black lines on the slide. If ice is encountered, operations would stop and turn around, or move out of its way.

89.* Q: *The square lines, how large are they each, is it one mile, two miles? (Line 869)

Response:

The lines vary in length, but to put it in perspective, the space between these lines is approximately 100 kilometres. If the first line were finished, in order to do the second line it would take approximately 15 hours to travel the distance between the lines.

90. Q: You're going to get pretty close to Lancaster Sound. Have you done anything there, Button Point? Since you're going to go near Lancaster Sound, when you're doing the testing, do you go near the land or can you see the land? (Line 873, 874)

Response:

No, the vessel will be far enough offshore that land cannot be seen.

91. Q: My first question is do you guys know what the maximum decibel that a marine mammal can take? (Line 884)

Response:

This information has been collected and is being forwarded to the communities.

92. Q: Can we not try to get the gas that are already seeping out to see if there's any other oil and make fitted tunnels? (Line 916)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

The project proponent is aware of naturally occurring oil seeps, such as the one in Scott Inlet. While it is helpful to know where these locations are, formations in the substructure may cause seeps to occur at great distances from the source. The purpose of the survey is to gain a broad understanding of the geology of the entire area to see where oil reserves are located.

93. Q: How can we lower the sound of the air gun or decimal sound? Maybe you can find out through the satellite where the oils are? Maybe there's a technology? (Line 925)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

No method for surveying deep marine geology has been developed that is more accurate, time efficient, or has fewer environmental impacts than the use of a towed air source array and hydrophones contained in a long streamer.

94. Q: How can you do type of any activity without doing a huge effect, negative effect? (Line 928)

Response:

The project proponent committed to providing information after the meetings.

Additional Response Information:

Mitigation measures have been prepared to limit potential effects a project may have on the environment. This project will implement the following mitigation measures:

- Community Liaison Officer: maintain communication with the project proponent to provide updates to the Hamlet Council, Hunters and Trappers Organizations and community on the project.

- Fisheries Liaison Officer: will maintain communication with all fishing vessels near the vicinity of the seismic survey. The officer will update the survey vessel on known fishing activities in the area and will provide relevant information to DFO.

- Marine Mammal Safety Zone: a safety zone of 500 m (1640.42 feet) from the sound source has been established. If a whale, seal, polar bear or walrus (any species of mammal) is identified within the safety zone, the seismic source will be shut down.

- Marine Mammal Observer: are on the vessels looking for marine mammals. MMOs will keep a detailed log of what species are observed, and where and when they were observed. If a marine mammal is seen within the 500 m safety zone, the seismic source shuts down. Once MMOs do not see a marine mammal within the 500 m safety zone for 30 minutes, the 20-minute ramp up procedure will begin.

- Ramp up Procedure: is when the survey vessel gradually increases the intensity of the air source (sound) over 20 minutes. This procedure is used to allow for fish and marine mammals to move away from the survey area.

- Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment: The project proponent is following the "Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment" in order to avoid or minimize the impacts on marine life. The Statement of Practice outlines the necessary and appropriate mitigation measures for seismic surveys.

95. Q: MKI, I think it's important for Inuit to know who is coming here to work, what companies are paying for this work. So that's my question. (Line 935)

Response:

The program is a joint venture between PGS and TGS. MKI is a division of PGS. The permit is going under MKI but the program is shared as a joint venture between the two companies. PGS and TGS will be funding and operating this program.

96. Q: What is the -- what are you -- what is the rush of this meeting? (Line 941)

Response:

The meeting is being sponsored by the National Energy Board because they are responsible for reviewing the application and making a decision on whether to approve or deny the project. This project has been ongoing since 2011, and MKI and its partners have been holding community consultations for two or three years now. An environmental assessment is being provided and now communities are being asked to give feedback. The company has been invited to this meeting to answer any questions. It was advertised in newspapers, on the radio and on posters in the community. Apologies if it appears the meeting has been too fast for some, but advanced advertising of this meeting was done in the best possible manner.

Appendix A: Acronyms

AANDC: Aboriginal Affairs and Northern Development Canada

AFA: Arctic Fisheries Alliance

BFC: Baffin Fisheries Coalition

CEAA: *Canadian Environmental Assessment Act*

CLO: Community Liaison Officer

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

DFO: Fisheries and Oceans Canada

EA: Environmental Assessment

FLO: Fishery Liaison Officer

HTO: Hunter and Trapper Organization

IQ: Inuit Qaujimajatuqangit

MKI: Multi Klient Invest AS

MMO: Marine Mammal Observer

NAFO: Northwest Atlantic Fisheries Organization

NEB: National Energy Board

NIRB: Nunavut Impact Review Board

NTI: Nunavut Tunngavik Inc.

NWMB: Nunavut Wildlife Management Board

PGS: Petroleum Geo-Services

TGS: TGS-NOPEC Geophysical ASA

UN: United Nations

VMS: Vessel monitoring system

Supplementary Report VI

Follow-Up to the National Energy Board Letter dated May 31, 2013

Information provided in response to

Clyde River

TGS-NOPEC Geophysical Company ASA, Petroleum Geo-Services and Multi Klient Invest AS (TGS/PGS/MKI) Northeastern Canada 2D Seismic Exploration Survey.

August 22, 2013

Clyde River Questions

The following questions were asked during the National Energy Board's (NEB) meeting in Clyde River, Nunavut on April 30, 2013. Each question and response is referenced to the report provided by the NEB, 'Public Review of the TGS-NOPEC Geophysical ASA (TGS), Petroleum Geo-Services (PGS) and Multi Klient Invest AS (MKI) Northeastern Canada 2D Seismic Survey Application, Volume 1'. Original responses have been edited to ensure clarity. Verbatim responses can be found on the NEB website (www.neb.com)

Line numbers are referenced in brackets (Line xxxx).

To understand the context of each question, please refer to the Transcript Report for Clyde River on the National Energy Board website.

A list of acronyms used in this report can be found in Appendix A.

1. ***Q: How do you know that's the area for that (closed area, narwhal in deep-sea corals)? Did you study it and find narwhals there or is there a study based on that? (Line 1013)***

Response:

The area is designated by the Department of Fisheries and Oceans based on their information.

Additional Response Information:

Since 1998, fishing effort restrictions have been in place to limit the time spent by vessels fishing for Greenland halibut (turbot) in NAFO Div. 0A (sub-zone 2.1) in an area identified as a narwhal overwintering area. In 2006, DFO Fisheries Management, following discussions with DFO Science, decided that a significant portion of the southern narwhal overwintering grounds that includes deep-water coral locations should be closed to all Greenland halibut fishing (fixed and mobile gears) (DFO, 2007). Contributing factors for this decision included the status of "special concern" of the narwhal that use this area, the importance of halibut in its diet during the winter, concerns over narwhal entanglement in gillnets, and the presence of deep-sea corals, which may play an important role in this ecosystem (DFO, 2007).

Source

DFO. (2007). Development of a Closed Area in NAFO 0A to protect Narwhal Over-Wintering Grounds, including Deep-sea Corals. *DFO Canadian Science Advisory Secretariat Science Response. 2007/002.*

2. ***Q: Is there another reason besides exploration activities that you're going to use it for? (Line 1017).***

Response:

No, the intent of the activity is for exploration of oil deposits.

3. ***Q: Beside that box on page 4, do you know of other feeding areas? (Line 1023)***

Response:

The Project proponent committed to providing information after the meetings.

Additional Response Information:

Whales and seals are often found in locations for one of three reasons: calving, mating and feeding. While some animals return to the same location year after year, others may rotate between several preferred locations. These locations often have similar geographic and oceanic characteristics (for example, fjords with a similar water depth and water temperature) which provide a suitable habitat for the animal. For example, narwhals in the High Arctic visit multiple fjords and bays during the summer months, while there are some beluga populations, such as the Cumberland Sound population, that remain in Cumberland Sound throughout the entire year. Reports from both Inuit and scientific researchers have identified that there is suitable habitat for bowhead whales along the eastern coast of Baffin Island.

Studies and observations of where marine mammals tend to be during specific months of the year do not guarantee that is where they will be found in future years. Whales and seals are opportunistic foragers and will eat at times and locations where food is available. There are areas where whales are frequently found, such as Lancaster Sound, Cumberland Sound, Narwhal and Deep-Sea Coral Closed Area and the many fjords and bays around Baffin Island. However, whales and seals are not present in these locations year-round. They may only spend one week or several weeks at a particular location depending on the availability of food.

The proposed survey will likely take place during the months of September and October. During this time whales and seals are finishing up their summer activities and preparing to migrate to their wintering grounds. The summering grounds for many of these animals occur in coastal regions around Baffin Island and in the High Arctic. The wintering grounds for the whales and seals are widely dispersed and include the North Water, the west coast of Greenland, Baffin Bay, Foxe Basin, Hudson Bay and at the floe edge south of Davis Strait.

The timing and path of the fall migration for whales and seals are different for each species. Please see Section 6 in the “Supplementary Report II” for a comprehensive analysis.

4. ***Q: For mammals, halibuts and turbot won't be included in there (500 m marine mammal safety zone) eh? (Line 1030)***

Response:

No, fish will not be included. It will include marine mammals within the mitigation (*500m marine mammal safety zone)* zone.

5. ***Q: Us, people from Nunavut, are we not in Canada? Is that not our water? That's my first question. (Line 1041)***

Response:

The Government of Nunavut regulates the waters within 12 nautical miles, whereas the federal government regulates anything outside 12 nautical miles. For oil and gas exploration this means the National Energy Board has responsibility. The ocean waters inside the 12 nautical mile limit and outside the 12 nautical mile limit are Canadian waters, the different areas are used only to differentiate between the areas where the different levels of government have responsibility.

6. ***Q: When there's a -- when we feel that there's going to be activities happening in our area because we have to live with -- we have to live and buy food with money, especially in the ocean, and if we lose our food source would you take over our land and forget about the communities? (Line 1053)***

Response:

This question refers to the fundamental relationship between Indigenous Peoples and the Government of Canada, and is beyond the scope of the project.

7. ***Q: If this project was to proceed, would you -- would there be any benefits to us? (Line 1058)***

Response:

One benefit will be the Community Liaison Officer for the operation while it is going on.

Additional Response Information

Two Inuit Marine Mammal Observers and the Fisheries Liaison Officers will be hired from Nunavut communities.

8. ***Q: Once you start the seismic testing the whales are probably going to move to other locations. Are there going to be any effect on our mammals? Are there going to be any effect on our mammals or not? (Line 1063)***

Response:

Marine mammal observers will be onboard the boats and operations will comply with regulations. They will have the ability to call the control room and stop the operation if marine mammals are sighted in the mitigation zone (*500m marine mammal safety zone)*.

9. ***Q: Who is supporting you within Nunavut? (Line 1079)***

Response:

There is no way of saying that one community is in favour of the project and another community is against it. In all communities you find people who are excited about the opportunities presented by projects like this, and others who have concerns.

10. ***Q: And someone mentioned that there would be observer on the ship or vessel if something should happen? (Line 1087)***

Response:

Yes, there will be marine mammal observers on board and they will comply with the regulations.

11. ***Q: My question is about the benefits plan: Have you discussed the benefits plan with Inuit? (Line 1098)***

Response:

Yes, we have started to discuss the benefits plan. There will be follow-up meetings with each of the communities to discuss these benefits, which will include more than fiscal benefits; such as employment opportunities, and the benefits of mutual relationships.

12. ***Q: And who is the requirement for you to discuss it with? Is it the communities? Is it a central organization? (Line 1106)***

Response:

NEB Response: For clarification, the National Energy Board has no say in the benefits plan, however, it cannot issue the licence until the benefits plan has been agreed upon. So far, the Hamlet offices are the initial focus for discussions but advice from other umbrella organizations will also be taken into consideration.

13. Q: And have they (Nunavut Tunngavik Inc.) discussed it (benefits plan) with the community? (Line 1116)

Response:

This is unclear at this time as it is an internal matter for Nunavut Tunngavik Inc (NTI).

14. Q: And it's very interesting that -- who gets to determine on what pace and how development happens? (Line 1119)

Response:

The Project proponent committed to providing information after the meetings.

Additional Response Information

It is hard to determine exactly what pace development occurs at. Projects could be approved quickly if there are no problems with a proposed project, or it could take a long time to get to a point where all stakeholders are satisfied with a project. How development happens is determined by guidelines and procedures that are followed by the regulatory organization.

For this project, involving offshore seismic surveys, regulation falls under the jurisdiction of the National Energy Board. Other federal departments, such as Natural Resources Canada, Fisheries and Oceans Canada, Environment Canada, and Parks Canada are notified of the project to determine if they may have a responsibility or interest in the proposed activities.

The environmental assessment process (for this project) involves discussions with federal government, territorial government, and local Inuit people and organizations. These discussions are an important part of approving development projects. For the proposed seismic survey, community engagement helps to identify Inuit use and knowledge of the area so that the proposed project will not impact or have minimal impact on traditional and current use of marine space and resources.

15. Q: That looking at the map -- is that -- all the described areas in the squares is the whole thing that you're planning? (Line 1129)

Response:

Yes, that would be the total program over multiple years.

16. Will there be a way to clean that (oil spills from drilling) up? (Line 1147)

Response:

Drilling is not our expertise, and although this is a valid question it is better posed to one of the major oil companies that do the drilling (reiteration of the point that the project is not an oil exploration project but a seismic survey).

17. Q: Is there something that we can do as a community? There's a question to NEB. You know we can talk and say our feelings about this and all that, but what can we do in legal terms to stop this as a community? Can we -- is there a way for us to complain and say: "That little box is not the only area where narwhals eat"? What legal -- something legal that we can use to stop them? Is there anything? (Line 1153)

Response:

NEB Response: In terms of the responsibilities of the National Energy Board, we have to ensure that the activity that Multi Klient Invest AS (MKI) is proposing can be done safely for communities, workers, the people who fish in the area and to protect the environment. It is our responsibility under law to ensure that the company complies with everything they have said they are going to do, taking into account any comments, conditions or recommendations that are made by any of the communities. If the company does not meet these conditions, or cannot prove they can meet these conditions, their application will be denied.

18. Q: Can you elaborate a little bit more on those? I don't understand the writing on there (page 10, "Non-Seismic Data Collection Activities"). (Line 1166)

Response:

Generally, passive acoustic monitoring is used in conjunction with observer sightings from the MMOs (Marine Mammal Observer) to better understand where the marine mammals are located. The gravity metre is a listening device, or a passive recording instrument, located in the hull of the ship. It measures differences in the gravity of the Earth and does not make any noise.

19. Q: Wouldn't their information be -- would they be getting different information than what Geological Survey is going to get? (Line 1173)

Response:

The Geological Survey is looking for geohazards like earthquakes, not oil. They would need the same level of approval undertake a survey to look for oil.

20. Q: So their equipment (for a Geological Survey) cannot penetrate like the seismic testings? (Line 1177)

Response:

My understanding is that it is in very shallow water, it's not a survey that looks at the offshore areas proposed here.

21. Q: Why don't we get an example of -- why didn't we get a sample of the sound before you started coming here? You probably know how it effects the marine mammals. (Line 1180)

Response:

A lot of work has been done with seismic surveys in other places and a lot of that information is used in doing the environmental assessment. The document has been submitted by the companies to the NEB for the approval process. It has a section on marine mammals and the effects on marine mammals.

Additional Response Information:

Additional information on the known effects of sound from seismic surveys to marine mammals can be found in Section 6 of the 'Supplementary Report II'.

Appendix D & E

22. Q: Is there a monitor in the ship to see how much fish there are in the area that you're surveying? (Line 1181)

Response:

As standard procedure, there have been interactions with the Baffin Fisheries Coalition and the Arctic Fisheries Alliance to make sure the vessel does not go through at the same time the fishing vessels are operating. There is also Fisheries Liaison Officers who will communicate with the fishing industry and a Community Liaison Officer who will communicate with the community, so there is constant interaction.

23. Q: I mean regulatory bodies are in Calgary and in the middle of Canada. Why are there over there and not on Baffin Island where they're closer? (Line 1191)

Response:

NEB Response: The National Energy Board is based in Calgary. There are office employees in the Northwest Territories, but not in Nunavut. If this application is approved, inspectors and monitors would be coming to ensure that the company is complying with all the conditions.

24. Q: And I think it would be -- make it a lot easier if they had a -- even if you don't speak Inuktitut, even if you Qallunaat, at least you'll be present in the -- in this area. We're talking to you even if we don't speak Qallunaat. Can you answer that? (Line 1195)

Response:

NEB Response: Your question and written comments will be taken to the Chairman of the National Energy Board and put to the board to see if they would be interested in having an employee here.

25. Q: So I'd like to ask the company if they could just confirm for the people of Clyde River, if the application was approved, how many marine mammal observers would you have from each community, how would they be selected, how many Fishery liaison officers would you have on the ship and where would they come from and how would -- how are you -- would you choose the community liaison officers for the communities? (Line 1209)

Response:

So far, MKI and TGS have taught marine mammal (*observer)* classes, which have trained 12 people here.

Additional Response Information:

MKI has providing MMO training to two classes of Environmental Students at Iqaluit Arctic College. There will two experienced Marine Mammal Observers and two Inuit Observers employed for the duration of the project. Typically there is one FLO employed for the duration of the project. First opportunity for these positions will be given to local Nunavut residents that show an interest and prove to be qualified candidates. The Community Liaison officer will be selected from each community which continue to be identified through community engagement team (NEXUS Coastal Resource Management).

26. Q: How many Fishery Liaison Officers and Community Liaison Officers, if there are some and the same? (Line 1224)

Response:

There would be one Community Liaison Officer for each community and Fisheries Liaison Officers.

27. Q: And I think there's a requirement or the company will have committed and may be required, if it gets approved, that they would report through the community liaison officers back to the communities annually, if not any time. Is that -- I'd like to confirm that because that would be a requirement that you are committed to do. (Line 1242)

Response:

Yes, that is -- that is correct. Communication would go through the Community's Liaison Officer.

28. Q: From seismic testing you've done in the Atlantic and Labrador region, has there ever been mammals dying, seals or narwhals or beluga, anything like that? (Line 1249)

Response:

No deaths have been recorded. The company keeps record of all mammal observations while the vessel is conducting seismic surveys. For the recent surveys off of Newfoundland and Labrador, observation reports were submitted to Newfoundland Petroleum Board. There is a comprehensive report on all the observations and daily logs combined from both the FLOs and the MMOs (marine mammal observers) on board the boat, as well as the Inuit MMOs that on board. These reports may not be public yet but if they are they can be accessed from the Newfoundland Petroleum Board.

Additional Response Information:

There have been no documented cases of marine mammal (whales, seals and walruses) mortality or permanent loss of hearing upon exposure to oil and gas exploration seismic surveys (DFO, 2004; Abgrall, Moulton and Richardson, 2008). We have summarized reports and journal articles, which assess the effect of sound from seismic surveys on whales and seals in northern waters. This information can be found in Section 2 of the 'Supplementary Report II'. Available Marine Mammal Observer reports from seismic surveys in Labrador and Newfoundland waters are found in Section 3 of the 'Supplementary Report II'.

Sources

DFO. (2004). Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. DFO Canadian Science Advisory Secretariat Habitat Status Report 2004/002

Abgrall, P., V.D. Moulton, and W.J. Richardson. (2008). Updated review of scientific information on impacts of seismic survey sound on marine mammals, 2004-present. Canadian Science Advisory Secretariat.

29. Q: What monitoring program do you have afterwards to determine if you've affected any animals? (Line 1251)

Response:

There are no continued observations after the survey is complete.

30. ***Q: So when you're done with the surveying and oil companies want to buy the results, is there like an estimate for how much you would sell it for? (Line 1253)***

Response:

That information is not released to the public, as it is confidential contractual information between both the partners.

31. ***Q: Then the benefits agreement you said you were -- you didn't say you were negotiating but you were talking with organizations. What would that be based on, the numbers there? (Line 1255)***

Response:

Yes, that goes with the discussions with each one of the communities.

32. ***Q: So as a community would we say we want $10 billion; does it work like that? (Line 1257)***

Response:

The benefits are made up of different things; including jobs as community liaison officers, marine mammal observers. The community can also take advantage of support service job opportunities, and the expertise that the project brings to the region. That is some of the basis of the benefits plan.

33. ***Q: The project you are proposing, proposing to use airguns seems like it's already approved and it has pictures. What's going to happen? (Line 1260).***

Response:

The use of airguns is included in the proposal to the National Energy Board, however the project has not been approved yet. This is part of the process right now.

Appendix A: Acronyms

AANDC: Aboriginal Affairs and Northern Development Canada

AFA: Arctic Fisheries Alliance

BFC: Baffin Fisheries Coalition

CEAA: *Canadian Environmental Assessment Act*

CLO: Community Liaison Officer

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

DFO: Fisheries and Oceans Canada

EA: Environmental Assessment

FLO: Fishery Liaison Officer

HTO: Hunter and Trapper Organization

IQ: Inuit Qaujimajatuqangit

MKI: Multi Klient Invest AS

MMO: Marine Mammal Observer

NAFO: Northwest Atlantic Fisheries Organization

NEB: National Energy Board

NIRB: Nunavut Impact Review Board

NTI: Nunavut Tunngavik Inc.

NWMB: Nunavut Wildlife Management Board

PGS: Petroleum Geo-Services

TGS: TGS-NOPEC Geophysical ASA

UN: United Nations

VMS: Vessel monitoring system

Supplementary Report

TGS NOPEC Geophysical Company ASA, Petroleum GeoServices and Multi Klient Invest AS
Northeastern Canada 2D Seismic Exploration Survey

November 2012

Supplementary Report

This report has been prepared in response to comments brought forward during community information sessions held in June and October, 2012. All sources referenced throughout the report will be available at the hamlet office, or provided by email, upon request.

This report provides a summary of information compiled from past research. It will not address unsubstantiated concerns expressed by some environmental organizations regarding development of natural resources in general.

Seismic Surveys

Marine seismic surveys are conducted to determine geologic features below the seafloor. The seismic survey process includes the following steps:

1. A piston (sound source) generates a sound when it quickly releases compressed air into the water. The sound source is towed by the research vessel 6-10 metres (18-30 feet) below the surface of the water.
2. The sound generated by the source travels through the water as a sound wave to the seafloor. Some of the sound will bounce off different layers (types) of sediments and rocks and return back to surface of the water.
3. The sound that returns to the surface of the water is detected by hydrophones. Hydrophones will be towed by the vessel on a cable that is 6-12 kilometres (18,000- 36,000 feet) long. The cable is also called a streamer.
4. The information collected is analyzed using computer programs that can produce an image of the different rock layers beneath the seafloor.

Marine Fish

Much of the research and knowledge of Arctic marine fish is restricted to Arctic cod due to its ecological importance and to Greenland halibut due to its economic importance. It is understood that there are two types of possible effects from high intensity sound on fish:

- Physical Effects: includes any changes in the fish itself, which may include death.
- Behavioural Effects: can result in changes in swimming direction and location.

There have been no documented cases of fish mortality upon exposure to sound from seismic air sources under field operating conditions (DFO, 2004) and airguns cause no physical damage to fish at distances greater than 12 metres (36 feet) (Gausland, 2000).

Behavioural effects on fish from seismic surveys are understood to be short term, with the duration of the effect less than the duration of the exposure (DFO, 2004). Behavioural effects on fish may affect commercial fisheries catch rates, however those rates are also dependent on many environmental factors. A Norwegian study observed a 132% increase in gillnet catches for Greenland Halibut, while long line catches decreased by 16% during the seismic survey

(Lokkeborg, Ona, Vold & Salthaug, 2012). To limit the potential effect of sound on commercial fisheries, mitigation measures provided by DFO (2010) will be followed.

The potential impact of a 3D seismic survey killing fish larvae and eggs in a fish population (0.18% per day) is below the naturally mortality (5-15% per day) observed in a fish population and, therefore is within the natural variability of fish and larvae mortality (Saetre & Ona, 1996 in LaPierre et al., 2011).

Whales and Seals

Information sources which inform management and policy decisions on seismic surveys with respect to marine mammals include the following:

- Captive Studies: have been used to measure auditory sensitivity, auditory function and the effects of noise exposure. However general behavioural changes in animals due to their captivity may affect natural responses to sound.
- Field Studies: opportunistic observations made by vessels on the behaviour of whales in the observable vicinity of a seismic survey vessel.
- Modelling: computer programs are used to predict the effect of sound on whales ears.
- Tracking devices: uses instruments attached to seals and whales to track individuals and document their underwater behaviour, physiological responses and obtain information on the environment.

Potential effects from seismic surveys on whales and seals include the following:

- Mortality and physical effects: stranding/mortality, hearing impairment and non-auditory effects (for example, ship strikes).
- Direct behavioural effects: displacement, migratory diversion, changes in dives and respiratory patterns, and changes in social behaviour and vocalization patterns.

There is very little information on the following effects of seismic surveys on whales and seals: functional consequences of physical and behavioural effects, chronic effects and indirect effects.

Physical Effect of Acoustic Sounds on Marine Mammals

There have been no documented cases of marine mammal mortality (whales, seals and walruses) upon exposure to oil and gas exploration seismic surveys (DFO, 2004; Abgrall, Moulton & Richardson, 2008).

Behavioural Effect of Acoustic Sounds on Marine Mammals

In field studies, behavioural responses to sounds[1] have been recorded for a few whale species in a limited range of conditions (Gordon et al. 2003; Weilgart, 2007; McCauly et al., 1998;

[1] sounds for this study include seismic surveys, drilling platforms and rigs, airplanes , sonar, commercial shipping, recreational boating

McDonald et al., 1995). Responses include startle and fright, avoidance, and changes in behaviour and vocalization patterns. However, behavioural observations are variable, some findings are contradictory, and the biological significance of these effects has not been measured.

The primary cause of physical and behavioural effects on marine mammals caused by seismic surveys is the intensity of sound, measured in decibels (dB), produced by the seismic source. Responses to noise can be highly variable, depending on species, individuals, age, sex, physical state, presence of offspring, prior experience, characteristics of the noise source, and other factors (Weilgart, 2007).

There are two categories to qualify the effect of sound on marine mammals hearing:

- Permanent Threshold Shift (PTS): permanent reduction in hearing sensitivity.
- Temporary Threshold Shift (TTS): temporary hearing loss (completely recoverable over time spans of minutes to hours).

The United States National Marine Fisheries Service and Department of Fisheries and Oceans have identified, that for high intensity sounds, whales and seals should not be exposed to impulsive sounds (such as those produced by seismic surveys) with levels greater than 180dB and 190dB respectively (Abgrall et al., 2008). This information has been incorporated into the "Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment" (DFO, 2010). For this project, the anticipated sound intensity at 500 metres (approximately 1500 feet) from the sound source is 180dB. Therefore, if a marine mammal is observed within the 500 metre safety zone, the seismic survey will stop operating.

To date, there has been no specific documentation that TTS or PTS occurs when marine mammals are exposed to sequences of airgun pulses under realistic field conditions (Gordon, 1998; DFO, 2004; Abgrall et al., 2008).

Whales and seals that may interact with the proposed seismic survey project include narwhal, beluga, bowhead, ringed seal, bearded seal, harp seal, and hooded seal.

Studies on the effects of sound on specific species are as follows:

- Narwhal
    - There are no known studies specifically on the effects of sound on narwhal. From conversations with hunters and elders, it was explained that narwhals are sensitive to sound. However, it is unknown what sound level would negatively affect narwhals.
- Beluga
    - Generally exhibited avoidance behaviour when swimming less than 1.5 km away from the sound source at a level of 163 dB (Awbrey and Stewart, 1983).

    - Observed to exhibit avoidance of seismic survey vessels of 10 to 20 km when sound levels reach 150 dB (Abgrall et al., 2008).
- Bowhead
    - Summering bowheads showed no detectable avoidance of seismic surveys, no change in general activities or call activities (Richardson et al., 2007 in Weilgart 2007).
    - Overt avoidance behaviour at ranges of 6-8km, swimming away from the vessels and air source (Gordon et al., 2003).
    - A pattern of shorter surfacing, shorter dives, few blows per surfacing, and longer intervals between blows when exposed to anthropogenic noise (Hildebrand, 2004).
    - Changes in call detection rates in response to airgun activity have been found for bowhead whales (Stone & Tasker, 2006).
- Ringed and Bearded Seals
    - A study observed the following behaviour of those seals sighted when the seismic airgun was operational (Harris et al., 2001):
        - 18% looked, 2% approached, 5% swam parallel to the boat's track, 36% dove, and 39% swam away
        - Seals might reduce exposure to the sounds by remaining at the surface
        - No seals were observed to leave the general area of operation during seismic activity
- Harp Seal
    - There are no known studies of the impact of seismic surveys on harp seals.
- Hooded Seal
    - There are no known studies of the impact of seismic surveys on hooded seals.

Mitigation Measures

The project proponent will implement the following mitigation measures:

Community Liaison Contact

The Community Liaison Officer will maintain communication with the project proponent to provided updates to the Hamlet Council, Hunters and Trappers Organization and community on the project. As well, they will work closely with the Hamlet on developing proposals, projects, and reports to advance economic development opportunities and build capacity within the community.

Fisheries Liaison Officer

The Fisheries Liaison Officer will maintain communication with all fishing vessels near the vicinity of the seismic survey. The officer is solely responsible for communicating with the fishing industry. The officer will update the survey vessel on known fishing activities in the area and will provide relevant information to DFO.

Marine Mammal Safety Zone

A safety zone of 500m (1500 feet) from the sound source has been established. If a whale, seal or walrus is identified within the safety zone, the seismic survey stops.

Marine Mammal Observer

Marine Mammal Observers (MMOs) are on the survey vessel looking for marine mammals. MMOs will keep a detailed log of what species are observed, and where and when they were observed. If a marine mammal is seen within the 500m-safety zone, the seismic survey stops. Once MMOs do not see a marine mammal within the 500m-safety zone for 30 minutes, the 20-minute ramp up procedure will begin.

Ramp Up Procedure

The ramp up procedure is when the survey vessel gradually increases the intensity of the air source (sound) over 20 minutes. This procedure is used to allow for fish and marine mammals to move away from the survey area. If a marine mammal enters the 500m-exclusion zone during this 20-minute 'ramp up' procedure, the airguns will be shut down. The ramp up procedure occurs each time the air source is turned on.

Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment

The project proponent is following the "Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment" in order to avoid or minimize the impacts on marine life. The Statement of Practice outlines the necessary and appropriate mitigation measures for seismic surveys.

References

Abgrall, P., V.D. Moulton, and W.J. Richardson. (2008). Updated review of scientific information on impacts of seismic survey sound on marine mammals, 2004-present. *Canadian Science Advisory Secretariat.*

Awbrey, F.T. and B.S., Stewart. (1983) Behavioural responses of wild beluga whales (Delphinapterus leucas) to noise from oil drilling. *Sea World Research Institute.*

Department of Fisheries and Oceans Canada (DFO). (2004). Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. *DFO Canadian Science Advisory Secretariat.* Habitat Status Report 2004/002.

DFO. (2010). Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment. *Department of Fisheries and Oceans.* <http://www.dfo-mpo.gc.ca/oceans-habitat/oceans/im-gi/seismic-sismique/pdf/statement-enonce_e.pdf>

Gausland (2000). Impact of seismic surveys on marine life. *The Leading Edge*, 19(8), 903-905.

Gordon, J.C.D., Gillespie, D., Potter, J., Frantzis, A., Simmonds, M.P., Swift, R. & Thompson, D. (2003). A review of the effects of seismic survey on marine mammals. *Marine Technology Society Journal,* 37(4), 14-32.

Harris, R.E., G.W. Miller and W.J. Richardson. (2001). Seal responses to airgun sounds during summer seismic surveys in the Alaskan Beaufort Sea. *Society of Marine Mammalogy.* 17(4), 795-812.

Hildebrand, J. (2004). Impacts of Anthropogenic Sound on Cetaceans. University of California, San Diego. IWCSC-56-E13-2004.

LaPierre, T., Arnott, A., Hawkins, C., Simpson, K. & Davis, D. (2011). Environmental Impact Assessment for Marine 2D Seismic Reflection Survey Baffin Bay and Davis Strait Offshore Eastern Canada by Multi Klient Invest AS.

Lokkeborg, S., Ona, E., Vold, A. & Salthaug, A. (2012). Sounds from seismic air guns: gear- and species-specific effects on catch rates and fish distribution. *Canadian Journal of Fisheries Aquatic Science,* 69, 1278-1291.

McCauly, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J. & McCabe, K. (2000). Marine Seismic Surveys- A Study of Environmental Implications. *APPEA Journal,* 692-708.

McDonald, M.A, Hildebrand, J.A. & Webb, S.C. (1995). Blue and fin whales observed on a seafloor array in the Northeast Pacific. *Journal of the Acoustical Society of America,* 98(2), 712-721.

Stone, C.J., & Tasker, M.L. (2006). The effects of seismic airguns on cetaceans in UK waters. *Journal of Cetacean Research and Management*, 8(3), 255-263.

Weilgart, L.S. (2007). The impacts of anthropogenic ocean noise on cetaceans and implications for management. NRC Research Press.

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TGS NOPEC Geophysical Company ASA, Petroleum GeoServices and Multi Klient Invest AS-ᑯᑦ

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ᐃᐱᔨᑦ ᑲᑦ , 2007; ᒪᑲᑕᓂᐊᓯᖏᓐ ᓗ, 1998; ᒪᖅ ᑭᓚᓂᑦ ᐊᓯᖏᓐ ᓗ, 1995). ᖁᓕᐃᓕᓴᕐᕕᑕᑭᑎᑎᑦᑕᐅᓕᖅᑐᖅᑐᓂᑦ
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ᐊᒪᑦ ᒪᓗᐅᒪᔨᕐᓂᒥᒃ ᓂᕆᐊᖅᑐᑦ ᐃᓕᓴᕐᕆᒃ ᑎᑎᓂᐅᑕ ᐱᐅᓯᖅᓱᒥᑲᒃ ᐊᑭᐅᔨᖅᑕᑦ ᑎᑎᓂᐅᑕ ᐊᒪᑦ ᒪᓗ
ᓂᓪ ᓕᐊᔭᑦ ᔨᓯᓚᖅ ᑕᒥᒃ ᑎᑎᓂᐅᑕ . ᑭᓯᐊᓂᓗ, ᐱᐅᓯᖏᓐᖅᑐᒃ ᖁᑎᖃᖅ ᕿᑎᖅᑐᖅ ᓂᕆᐊᖅᑐᑦ
ᐊᑦ ᓴᑭᖅᓂᒥ ᑕᓯᐅᖏᓕᓂᑦ ᑕᐅᖅᓱ, ᐃᓕᓴᖅ ᓗᖅᑲᓴᓴᑦᑐᖅᑎᑦ ᐊᑦ ᓴᑭᖏᖅᑐ ᓂᓂᒥᓂᒥ ᑎᐊᒪ ᒪᓕᒃ ᐸᒃ ᑐᓂᒃ ,
ᐊᒪᑦ ᒪᓗᐃᒪᔨᕐᓂᒥᒃ ᓂᕆᐊᖅᑐᑦ ᐃᓕᓴᕐᕆᒃ ᑎᑎᓂᐅᑕ ᐱᐅᓯᖅᓱᒥᑲᒃ ᐊᑭᐅᔨᖅᑕᑦ ᑎᑎᓂᐅᑕ ᐊᒪᑦ ᒪᓗ
ᐊᓯᖏᓐᖅᑐᒃ ᑕᐅᖅ ᐃᓕᓴᕆᓂ ᑐᓂᒃ (ᐃᓕᓴᕐᕕᑕᑭᑎᑎᑦᑕᐅᓕᖅᑐᖅᑐᓂᑦ ᐱᐅᓯᖅᓱᒥᑲᒃ ᐊᑭᐅᔨᖅᑕᑦ ᑎᑎᓂᐅᑕ ᐊᒪᑦ ᒪᓗ
ᐃᓕᓴᕐᕆᒃ ᑐᓂᐅᒃ ᐃᓕᓴᕆᓂ ᑐᓂᒃ (ᐃᐱᔨᑦ ᑲᑦ , 2007).

ᒪᖅᑭᐅᐃᑎᒍᑦ ᐋᖅᑭᒃᐳᒃ ᑕᐅᔨᒪᓕᕐᓂᐅᖅᑎᑭᓐᓄᑦ ᐅᖅᑎ ᒪᑕ ᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂ ᐱᐅᓯᖅᓱᒥᑲᒃ ᑕᖏᕐᕋᐅᓵᓴᓴᖅ ᓂᕆᐊᖅᑎᑦ
ᑐᓵᔪᑦ ᔪᓐᓇᖅᐳᒃ ᐃᓕᓴᕐᕆᒃ ᑎᑎᓂᐅᑕ ᐱᐅᓯᖅᓱᒥᑲᒃ ᐊᑭᐅᔨᖅᑕᑦ ᑎᑎᓂᐅᑕ ᐊᒪᑦ ᒪᓗ ᐃᓕᓴᕐᕆᒃ ᑐᓂᐅᒃ
ᐃᓕᓴᕆᓂ (ᑎᐊᔨᓪᓚᑦ), ᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂ ᑐᓂᒃ ᖁᑎᖃᖅᑐᖅᑐᑎᑦ . ᔨᓂᐅᖅᑐᓴᓕᓂᑦ
ᖁᓕᐃᓕᓴᕐᕕᑕᑭᑎᑎᑦᑕᐅᓕᖅᑐᖅᑐᓂᑦ ᖁᓂ ᑎᑎᒃ ᑐᓴᒪᑦ ᐊᑦ ᔪᑦᓯᑦᑐᖅ ᓂᕆᐊᖅᑐᒥᒃ ᑕᑭᐅᓂ ᐅᖅᑎᑦ , ᐊᑐᓂᐅᒪᓕᕐᓂᐅᖅᑎᑭᓐᓄᑦ ,
ᐃᓕᒃᑲ ᑯᑎ ᑐᓂᑦ , ᐅᑭᐅᓂᖅᑕᑦ , ᐊᖏᓴᓪ ᒡᒃᓯᖅᑕᑦ , ᐊᑦ ᓇᓪ ᒡᒃᓯᖅᑕᑦ ᓗᒍ, ᑎᑎᓂᐅᑕ ᖁᑎᖃᖅᑐᖅᑐᑎᑦ ᑐᓂᐅᒃ ,
ᐱᐊᓪᒡᓗᓐᓂᖅᑲᓪᓗᒍ, ᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂᕆᔨᓂᐅᑕᐅᓯᒪᓂᕐᓂᖅᑲᓪᓗᒍ, ᓇᓗᖏᓐᓄᑦᑲᓪᓗᒍᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂᑦᑎᓪᓗᑦ , ᐊᒪᑦ ᒪᓗ
ᐊᓯᖏᓐᖅᑐᒃ ᑕᐅᖅ ᐃᓕᓴᕆᓂ ᑐᓂᒃ (ᐃᐱᔨᑦ ᑲᑦ , 2007).

ᒪᖅᑭᐅᐃᑎᒍᑦ ᐋᖅᑭᒃᐳᒃ ᑕᐅᔨᒪᓕᕐᓂᐅᖅᑎᑭᓐᓄᑦ ᐅᖅᑎ ᒪᑕ ᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂ ᐱᐅᓯᖅᓱᒥᑲᒃ ᑕᖏᕐᕋᐅᓵᓴᓴᖅ ᓂᕆᐊᖅᑎᑦ
ᑐᓵᔪᑦ ᔪᓐᓇᖅᐳᒃ ᐃᓕᓴᕐᕆᒃ ᑎᑎᓂᐅᑕ ᐱᐅᓯᖅᓱᒥᑲᒃ ᐊᑭᐅᔨᖅᑕᑦ ᑎᑎᓂᐅᑕ ᐊᒪᑦ ᒪᓗ ᐃᓕᓴᕐᕆᒃ ᑐᓂᐅᒃ
ᐃᓕᓴᕆᓂ (ᑎᐊᔨᓪᓚᑦ), ᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂ ᑐᓂᒃ ᖁᑎᖃᖅᑐᖅᑐᑎᑦ . ᔨᓂᐅᖅᑐᓴᓕᓂᑦ
ᖁᓕᐃᓕᓴᕐᕕᑕᑭᑎᑎᑦᑕᐅᓕᖅᑐᖅᑐᓂᑦ ᖁᓂ ᑎᑎᒃ ᑐᓴᒪᑦ ᐊᑦ ᔪᑦᓯᑦᑐᖅ ᓂᕆᐊᖅᑐᒥᒃ ᑕᑭᐅᓂ ᐅᖅᑎᑦ , ᐊᑐᓂᐅᒪᓕᕐᓂᐅᖅᑎᑭᓐᓄᑦ ,
ᐃᓕᒃᑲ ᑯᑎ ᑐᓂᑦ , ᐅᑭᐅᓂᖅᑕᑦ , ᐊᖏᓴᓪ ᒡᒃᓯᖅᑕᑦ ᑎᑎᓂᐅᑕ ᐊᑦ ᓇᓪ ᒡᒃᓯᖅᑕᑦ ᓗᒍ, ᑎᑎᓂᐅᑕ ᖁᑎᖃᖅᑐᖅᑐᑎᑦ ᑐᓂᐅᒃ ,
ᐱᐊᓪᒡᓗᓐᓂᖅᑲᓪᓗᒍ, ᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂᕆᔨᓂᐅᑕᐅᓯᒪᓂᕐᓂᖅᑲᓪᓗᒍ, ᓇᓗᖏᓐᓄᑦᑲᓪᓗᒍᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂᑦᑎᓪᓗᑦ , ᐊᒪᑦ ᒪᓗ
ᐊᓯᖏᓐᖅᑐᒃ ᑕᐅᖅ ᐃᓕᓴᕆᓂ ᑐᓂᒃ (ᐃᐱᔨᑦ ᑲᑦ , 2007).

ᒪᓕᒃᑭᐅᒍᑦ ᐊᑦᓯᒃᑭᐅᒃ ᑕᐅᔨᒪᓕᕐᓂᐅᖅᑎᑭᓐᓄᑦᑐᖅ ᐅᖅᑎ ᒪᑕ ᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂ ᑎᑎᓂᐅᑕ ᐃᓕᓴᕐᕆᒃ ᑐᓂᐅᒃ
ᑐᓵᔪᑦ ᔪᓐᓇᖅᐳᒃ ᐃᓕᓴᕐᕆᒃ ᑎᑎᓂᐅᑕ ᐱᐅᓯᖅᓱᒥᑲᒃ ᐊᑭᐅᔨᖅᑕᑦ ᑎᑎᓂᐅᑕ ᐊᒪᑦ ᒪᓗ ᐃᓕᓴᕐᕆᒃ ᑐᓂᐅᒃ
ᐃᓕᓴᕆᓂ (ᑎᐊᔨᓪᓚᑦ), ᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂ ᑐᓂᒃ ᖁᑎᖃᖅᑐᖅᑐᑎᑦ . ᔨᓂᐅᖅᑐᓴᓕᓂᑦ
ᖁᓕᐃᓕᓴᕐᕕᑕᑭᑎᑎᑦᑕᐅᓕᖅᑐᖅᑐᓂᑦ ᖁᓂ ᑎᑎᒃ ᑐᓴᒪᑦ ᐊᑦ ᔪᑦᓯᑦᑐᖅ ᓂᕆᐊᖅᑐᒥᒃ ᑕᑭᐅᓂ ᐅᖅᑎᑦ , ᐊᑐᓂᐅᒪᓕᕐᓂᐅᖅᑎᑭᓐᓄᑦ ,
ᐃᓕᒃᑲ ᑯᑎ ᑐᓂᑦ , ᐅᑭᐅᓂᖅᑕᑦ , ᐊᖏᓴᓪ ᒡᒃᓯᖅᑕᑦ ᑎᑎᓂᐅᑕ ᐊᑦ ᓇᓪ ᒡᒃᓯᖅᑕᑦ ᓗᒍ, ᑎᑎᓂᐅᑕ ᖁᑎᖃᖅᑐᖅᑐᑎᑦ ᑐᓂᐅᒃ ,
ᐱᐊᓪᒡᓗᓐᓂᖅᑲᓪᓗᒍ, ᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂᕆᔨᓂᐅᑕᐅᓯᒪᓂᕐᓂᖅᑲᓪᓗᒍ, ᓇᓗᖏᓐᓄᑦᑲᓪᓗᒍᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂᑦᑎᓪᓗᑦ , ᐊᒪᑦ ᒪᓗ
ᐊᓯᖏᓐᖅᑐᒃ ᑕᐅᖅ ᐃᓕᓴᕆᓂ ᑐᓂᒃ (ᐃᐱᔨᑦ ᑲᑦ , 2007).

ᒪᓂᑭᐅᒍᑦ ᐋᖅᑭᒃᐳᒃ ᑕᐅᔨᒪᓕᕐᓂᐅᖅᑎᑭᓐᓄᑦᑐᖅ ᐅᖅᑎ ᒪᑕ ᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂ ᑎᑎᓂᐅᑕ ᐃᓕᓴᕐᕆᒃ ᑐᓂᐅᒃ
ᑐᓵᔪᑦ ᔪᓐᓇᖅᐳᒃ ᐃᓕᓴᕐᕆᒃ ᑎᑎᓂᐅᑕ ᐱᐅᓯᖅᓱᒥᑲᒃ ᐊᑭᐅᔨᖅᑕᑦ ᑎᑎᓂᐅᑕ ᐊᒪᑦ ᒪᓗ ᐃᓕᓴᕐᕆᒃ ᑐᓂᐅᒃ
ᐃᓕᓴᕆᓂ (ᑎᐊᔨᓪᓚᑦ), ᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂ ᑐᓂᒃ ᖁᑎᖃᖅᑐᖅᑐᑎᑦ . ᔨᓂᐅᖅᑐᓴᓕᓂᑦ
ᖁᓕᐃᓕᓴᕐᕕᑕᑭᑎᑎᑦᑕᐅᓕᖅᑐᖅᑐᓂᑦ ᖁᓂ ᑎᑎᒃ ᑐᓴᒪᑦ ᐊᑦ ᔪᑦᓯᑦᑐᖅ ᓂᕆᐊᖅᑐᒥᒃ ᑕᑭᐅᓂ ᐅᖅᑎᑦ , ᐊᑐᓂᐅᒪᓕᕐᓂᐅᖅᑎᑭᓐᓄᑦ ,
ᐃᓕᒃᑲ ᑯᑎ ᑐᓂᑦ , ᐅᑭᐅᓂᖅᑕᑦ , ᐊᖏᓴᓪ ᒡᒃᓯᖅᑕᑦ ᑎᑎᓂᐅᑕ ᐊᑦ ᓇᓪ ᒡᒃᓯᖅᑕᑦ ᓗᒍ, ᑎᑎᓂᐅᑕ ᖁᑎᖃᖅᑐᖅᑐᑎᑦ ᑐᓂᐅᒃ ,
ᐱᐊᓪᒡᓗᓐᓂᖅᑲᓪᓗᒍ, ᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂᕆᔨᓂᐅᑕᐅᓯᒪᓂᕐᓂᖅᑲᓪᓗᒍ, ᓇᓗᖏᓐᓄᑦᑲᓪᓗᒍᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂᑦᑎᓪᓗᑦ , ᐊᒪᑦ ᒪᓗ
ᐊᓯᖏᓐᖅᑐᒃ ᑕᐅᖅ ᐃᓕᓴᕆᓂ ᑐᓂᒃ (ᐃᐱᔨᑦ ᑲᑦ , 2007).

- <u>ᐊᒋᐃᓐ ᓇᖅᑐᒥᒃ ᑐᓴᒪᑦ ᓄᓇᕗᓐ ᐊᓯᖏᓐᖅᑐᒃᓴᑦ ᓇᓗᖏᓐᓄᑦᑲᓪᓗᒍᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂᑦᑎᓪᓗᑦ (PTS)</u>: ᐊᒋᐃᓐ ᓇᖅᑐᒥᒃ ᑐᓴᒪᑦ ᓄᓇᕗᓐ ᐊᓯᖏᓐᖅᑐᒃᓴᑦ ᓇᓗᖏᓐᓄᑦ ᐊᒋᐃᓐ ᓇᖅᑐᒥᒃ ᑐᓴᒪᑦ ᓄᓇᕗᓐ ᐊᓯᖏᓐᖅᑐᒃᓴᑦ ᓇᓗᖏᓐᓄᑦ.
- <u>ᐊᑯᓂᐅᔪᓐᓇᖅᑐᑦ ᑐᓴᒪᑦ ᑐᓴᒪᑦ ᓄᓇᕗᓐ ᐊᓯᖏᓐᖅᑐᒃᓴᑦ ᓇᓗᖏᓐᓄᑦᑲᓪᓗᒍᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂᑦᑎᓪᓗᑦ (TTS)</u>: ᐊᑯᓂᐅᖅᑐᑦ ᑐᓂᐅᒃ ᑐᓴᒪᑦ ᓄᓇᕗᓐ ᐊᓯᖏᓐᖅᑐᒃᓴᑦ ᓇᓗᖏᓐᓄᑦᑲᓪᓗᒍᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂᑦᑎᓪᓗᑦ (ᖁᒃᐱᒍᓱᖅᓯᓐᓂᖅᑲᓪᓗᒍᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂᑦᑎᓪᓗᑦ ᓗᒍ ᒥᓂ ᓂᓂ ᓴᓐ ᓂᓂ ᐃᑲᖁᓂ ᓴᓐ ᓂᓂ ᐅᓂᓯᓕᓂᖅᑎᑦ ᓗᒍ ᐊᒋᐃᓐ ᓇᖅᑐᒥᒃ ᑐᓴᒪᑦ ᓄᓇᕗᓐ ᐊᓯᖏᓐᖅᑐᒃᓴᑦ ᓇᓗᖏᓐᓄᑦ ᐊᒋᐃᓐ ᓇᖅᑐᒥᒃ ᑐᓴᒪᑦ ᓄᓇᕗᓐ ᐊᓯᖏᓐᖅᑐᒃᓴᑦ ᓇᓗᖏᓐᓄᑦ).

ᐊᒥᐊᓚᒃᒥᐅᓂ ᐃᒪᖁᑎᑦᑕᐅᓕᖅᑐᖅᑐᓂᑦ ᐱᓕᓂ ᑎᑎᖅᑑᖅᑐᖅᑐᑎᑦ ᐊᑦ ᓴᑭᖅᓂᒥ ᑕᓯᐅᖏᓕᓂᑦ
ᐃᒪᖁᑎᑦᑕᐅᓕᖅᑐᖅᑐᓂᑦ ᐅᖅᑎᑦ ᓗᒍ ᐊᓂᓂᑦᑎᓪᓗᑦᑐᖅᑎᑦ ᐊᑦ ᓴᑭᖏᖅᑐ ᓂᓂᒥᓂᒥ ᑎᐊᒪ ᒪᓕᒃ ᐸᒃ ᑐᓂᒃ ,
ᐱᓯᓂᐅᒪᓕᕐᓂᐅᖅᑎᑭᓐᓄᑦ ᐊᑦ ᓴᑭᖏᖅᑐ ᓂᓂᒥᓂᒥ ᑎᐊᒪ ᒪᓕᒃ ᐸᒃ ᑐᓂᒃ ᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂ ᑎᑎᓂᐅᑕ ᐃᓕᓴᕐᕆᒃ ᑐᓂᐅᒃ
ᐃᓕᓴᕆᓂ (ᓂᐲᑦ ᓗᒍ ᑐᓴᖅᓴᐅᑎᑕᐅᓯᒪᓂ ᑎᑎᓂᐅᑕ ᐃᓕᓴᕐᕆᒃ ᑐᓂᐅᒃ ᐃᓕᓴᕆᓂ ᖁᑎᖃᖅᑐᖅᑐᑎᑦ ᑐᓂᐅᒃ)
ᖁᓂ ᑎᑎᓂ ᓂᓪᓕᖅᑎᑦ ᐃᓕᓴᕐᕆᒃ ᑎᑎᓂᐅᑕ 180 ᑎᓂᔪᓐᓂ ᓂᓂ 190 ᑎᓂᔪᓐᓇᖅᑐᓂ ᓄᓇᓕᒃ ᑐᓴᐅᑎᓂ ᓗᒍ (ᐊᔪᐃᑦᑐᓂ ᐊᓯᖏᓐ ᓗᒍ, 2008). ᑕᒃ ᑯᐊ ᑐᓴᓴᓂᖅ ᐃᓕᓴᕐᕕᑕᑭᑎᑎᑦᑕᐅᓕᖅᑐᖅᑐᓂᑦ (ᐊᑐᓂᓪᓚᑦᑕᐅᓕᖅᑐᖅᑐᑎᑦ) "ᑲᓇᑕᐅᓯᒪᓂ ᐊᒥᓱᑲᒪᒃᑯᓂᑦ ᑐᓂᐅᒃ ᐃᓕᓴᕆᓂ ᑐᓂᒃ ᖁᑎᖃᖅᑐᖅᑐᑎᑦ ᐊᒥᓱᑲᒪᒃᑯᓂᑦ ᖁᑎᖃᖅᑐᖅᑐᑎᑦ ᐊᒪᑦ ᒪᓗ ᐃᓕᓴᕐᕆᒃ ᑐᓂᐅᒃ ᐃᓕᓴᕆᓂ

ᑕᐃᒪᓕᓪ, ᑕᓂᐅᒥ ᐅᒪᔨᓂᒃ ᑕᑯᓪᓕᖏᖅ ᓂᐲᑎᒃ 500 ᒥᑕᑦ ᐃᓚᐋᓂᑦ ᑐᓂ, ᑐᓴᖏᓐᓂᒃ ᑎᑎᖅᑐᑦ ᑎᑎᓂᒃ ᖃᐅᔨᓴᖏᓪᓗᑎᑦ ᓄᖅᑲᖅ ᓇᖏᒃᖢᖏᓪᓗᑎᑦ ᓕᑕ.

ᐃᓐᓇᓗᑦ ᑎᑭᑦ ᑐᐃ, ᑎᑎᕆᖏᑕᐅᓯᒪᔨᓂᒃ ᐱᑕᖏᑲᒥᒃᓴᑦ ᓕᑕᓐᓄᒃ ᐃᒪᓐᓇᖅᑐᑦ TTS ᐅᓐᖓᔪᓐᓂᑦ PTS ᐊᓯᔾᔨᑉᑐᑕᐅᓕᖏᖅᑐᒃᓴᑦ ᓯᒪᓂᒥᒃ ᓇᓂ ᑕᑯᐅᒥ ᐃᒪᔨᕐᓂᐅᔨᑦ ᓯᐢᑎ ᓗᐊᔨᑐᐃᓐᓇᑦ ᓇᖕᒥᐊᖏᖏᖅᑕᐅᑦ ᑐᓴᖏᓐᓂᒃ ᐃᒪᔨᕐᓂᐅᔨᑦ (ᑯᐊᑕᓐ, 1998; ᐃᒪᐢ ᒥᐅᑕᓕᑯᓚᒃ ᑯᑦ, 2004, ᐊᐱᐊᑯᖏᑦ ᐊᓯᖏᒥ ᓗ, 2008).

ᖃᓄᐃᓚᐃᑦ ᐊᒻ ᒪᓗᓇᑦ ᑎᑦ ᑐᓴᖏᓐᓂᒃ ᑎᓂᕋᖏᑐᒃ ᖃᐅᔨᓴᖏᓪᓗᑎᑦ ᓂᕆᑕᒪᓂᐅᔪᓕᒫ ᖃᐅᒪ ᓕᓯᐊᓕᑕᐃᓐᓇᖅᑐᖓᓕᒫᒥᒃ ᓂᐲᑎᒃ ᐃᓕᓴᐅᑎᑦ ᑐᓂᓯᓂᒃ, ᖃᓄᐃᓚᓴᖏᓐᓂ, ᐊᖏᓪᓗᖏᓐᓂ, ᓇᑦ ᑐᖏᓐᓂ, ᐅᑎᕐᔪᓐᓂ, ᖃᐅᔨᓴᖏᓐᓂ, ᐊᒻ ᒪᓗᓇᑦ ᓯᕐᓚᓐᓂ.

ᖃᐅᔨᓴᖏᓪᓗᑎᑦ ᓂᐅᖏᑲ ᑕᖅᓯᒪᔨᔪᑦ ᑐᓴᖏᓐᓂᒃ ᑎᑎᖅᑐᑦ ᐃᓕᓐᓂᐊᑎᑦ ᑎᑐᐃᓐᓇᖅᑐᖓᓕᒫᒥᒃ ᓂᓪ ᓇᖕᒥ ᐅᔨᒪᔨᓴᖏᓪᓗᑎᑦ ᑕᐃᔾᔨᐅᓕᖏᓐᓄᑦ ᐃᒪᓐᓇᖅᑐᖓ :

- ᑐᐃᓚᓕᑦ
    - ᖃᐅᔨᓴᖅᑕᐅᓯᒪᓂᕐᓂᒃ ᓇᓗ ᓴᓐᔪᑕᐅᓯᒪᔪᓕᑦ ᓕᑦ ᒋᖅᑐᑐᒃ ᐃᓕᓐᓂᐸᒃ ᑎᑎᕋᐅᖏᓪᓗᑎᑦ ᑕᖅᓯᒪᓕᑦ ᓕᓴᐃᒪᓕᖅᑐᖓ ᑐᐃᓚᓕᑦ ᖃᐅᔨᓴᖏᓪᓗᑎᑦ ᑎᑎᖅᑐᑦ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔨᓂᒃ ᑎᑎᖅᑐᑦ ᖃᐅᔨᓴᖅᑐᖓᓕᒫᒥᒃ ᓂᐲᑎᒃ ᐃᓕᓴᐅᑎᑦ ᐃᓐᓇᐃᓐᓇᖅᑐᖓᓕᒫᒥ

- ᓂᓪ ᓕᐊᓂᓗᓐᓂ ᑕᖏᑐ ᖃᓄ ᓂᖏᓐ ᐊᖅ ᐃᓕᖅ ᓂᓪ ᑭᓇᖅᓄᐅᑎᑦ ᑎᓂᕆᑲᖅᑎᑦ ᓗᐃ ᓱᖅ ᓗ ᐳᕐᑐᐃᐅᓐ ᓂᓗ ᐊᓱᒃ ᓴᖅᓱᒪᓕᓚᖅᐸᓐ ᓂᓗᓐ
ᖃᐅᔨᓴᐅᑎᖓ ᑕᖅᓱᒪᓕᓚᖅᑐᑦ (ᓱᓕᔅᓐ ᐊᒃ ᒪᓗᑦᑎᓐ ძᖅ, 2006).

- ᓄᖅ ᑎᑦ ᐊᒃ ᒪᓗᐅᓗᒃ ᓴᐃᑦ
  - ᖃᐅᔨᓴᖅ ᓂᕆᑲᖅᑐᑎᑎᒃ ᐅᓐ ᓴᐅᓱᓚᓕᐅᖅ ᒪᑕ ᓄᖅ ᑎᑦ ᑕᑯᓴᐅᖅᑕᖅ ᑕᖅᑐᑦ
    ᑐᑭᓯᓕᑦᑎᐊᖅᑐᖅᓯᒪᓂᖅ ᐅᖅᑕᖅᑐᑦ ᐊᒃᓱᖅ ᓄᖅ ᑎᑦ ᑕᑯᓴᐅᖅᑕᖅᑐᑦ ᑐᑭᓯᓕᑦᑎᐊᖅᑐᖅᓯᒪᓂᖅ
    ᐃᒪᓐᓇᐅᑎᖅᑐᖅᓯᒪᓂᖅ (ᕿᐃᐊᑦᓱᑦ ᐊᓱᓂᒃ ᓗ, 2001):
    - 18 ᐳᖅᓴᓂᒃ ᑕᑯᓐ ᓴᖅᑭᑎᓐ ᓄᖅᑐᑎᒃ, 2 ᐳᖅᓴᓂᒃ ᐅᕐᓗᑎᑦ ᓗᓂᒃ, 5 ᐳᖅᓴᓂᒃ ᐅᒥᐊᑦ ᐊᑐᖅᑕᖅᑐᑎᒃ ᓕᐊᓂᖏᓐᓇᑦ ᓄᓀᖏᓚᖅᑐᓂᒃ, 36 ᐳᖅᓴᓂᒃ ᐊᖅᑲᖅᓴᖅ ᑐᓂᒃ, ᐊᒃ ᒪᓗ 39 ᐳᖅᓴᓂᒃ ᐅᖏᓪ ᓗᑦ ᐃᖏᕐ ᖁᓕᐊᖅᑐᓂᒃ
    - ᓄᖅ ᑎᑦ ᐃᒃ ᒪᖅᓯᐅᓕᓚᐅᓂ ᑎᑕᐅᓴᓐ ᓄᖅ ᓂᕆ ᒥᓐ ᓂᕆ ᒥᓐ ᒥᑭᓂᖅᑎᑦ ᑎᓭᔪᓐ ᓄᖅᑐᑦ ᑐᑦᓯᑎᒃ
      ᐳᐃᓂᒪᐃᓐ ᓄᖅᑐᑦ ᐅᖏᓪᓗᒥ ᐃᓐᓇᐅᑎᖅᑐᖅ
    - ᓄᖅ ᑎᑎᖅ ᓂᕆ ᑕᖅᓱᒪᓕᓚᐅᖅᓯᒪᓕᖅᑐᑦ ᑐᖓᓂᒃ ᐊᐅᓚ ᓕᓚᐊᖅᑐᓂᒃ ᐱᓕᕆᔨᖅᑐᑦ ᑐᑦᓯᑎᒃ
      ᑐᑭᓯᓕᑦᑎᐊᖅᑐᖅᓯᒪᓂᖅ ᑐᑦᓯᑎᒃ ᑎᑦ

- ᖃᐅᔨᓴᖅᑕᐅᓂᒃ
  - ᖃᐅᔨᓴᖅᑕᐅᓂᒃ ᖃᐅᔨᓴᖅᑎᑦᓯᐅᑎᓕᕆᓂᒃ ᐱᑕᖃᖅᖢᓕᑦ ᖃᐅᔨᓴᖅᑎᑦᓯᐅᑎᓕᕆᓂᒃ ᐱᑕᖃᖅᖢᓕᑦ ᖃᐅᔨᓴᖅᑕᐅᓂᒃ
    ᑐᑭᓯᓕᑦᑎᐊᖅᑐᖅᓯᒪᓂᖅ ᖃᐅᔨᓴᖅᓴᓂ ᓂᐅᒃᑯᓂᒃ ᐃᓐᓇᐅᑎᖅᑐᖅᓯᒪᓂᖅ ᐱᑕᖃᖅᖢᓕᑦ ᖃᐅᔨᓴᖅᑕᐅᓂᒃ
    ᖃᐅᔨᓴᖅᑕᐅᓂ.

- ᓄᖅ ᓂᐲᐃᑦ
  - ᖃᐅᔨᓴᖅᑕᐅᓂᒃ ᖃᐅᔨᓴᖅᑎᑦᓯᐅᑎᓕᕆᓂᒃ ᐱᑕᖃᖅᖢᓕᑦ ᖃᐅᔨᓴᖅᑕᐅᓂᒃ
    ᑐᑭᓯᓕᑦᑎᐊᖅᑐᖅᓯᒪᓂᖅ ᖃᐅᔨᓴᖅᓴᓂ ᓂᐅᒃᑯᓂᒃ ᐃᓐᓇᐅᑎᖅᑐᖅᓯᒪᓂᖅ ᐱᑕᖃᖅᖢᓕᑦ ᖃᐅᔨᓴᖅᑕᐅᓂᒃ
    ᓄᖅ ᓂᐲᐃᑦ.

ᖃᐅᔨᓴᕐᕕᒃᑐᑦ ᑎᑦ ᑕᐃᓕᒪᓂᖅ

ᐱᑕᖃᖅᖢᓄᐃᓐᓄᑦ ᓄᖅᑐᓗᒍᑦ ᐃᓕᑕᕆᔨᓕᑦᑐᑦ ᐊᑐᓕᖅᑎᑦᓯᐅᑎᖅᑐᑦ ᓂᐲᒪᓂᐊᖅᑐᑦ ᐃᓐᓇᐅᑎᖅᑐᖅᓯᒪᓂᖅ ᐃᓕᑦ ᓇ
ᖃᐅᔨᓴᕐᕕᒃᑐᑦ ᑎᑦ ᑕᐃᓕᒪᓐᓇᕆᔨᑦᑐᖓᓂᒃ:

ᓄᓇᕗᑦᓯᐅᑦ ᑭᓄ ᓱᖅᑐᑦ ᑎᑎᕋᖅ

ᓄᓇᕗᑦᓯᐅᑦ ᑭᓄ ᓱᖅᑐᑦ ᑎᑎᑦ ᓗᓂᐃᓄᖅᑲᖅᑎᑎᕋᖅᑐᖅᓯᒪᓕᖅᑐᑦ ᑐᓴᕆᔨᖅᑐᑦ ᑕᑯᓴᐅᖅᑕᖅᑐᖅ ᓄᖅ
ᐱᑕᖃᖅᖢᓕᑦᑎᐊᖅᑎᑎᑦᓯᐅᑦ >ᖅᑐ ᐱᑕᖃᖅᖢᓪᓚᕆᑦ ᓂᖅ ᐃᓕᑕᕆᔨᖅᑐᑎᒃᑕᑎᑎᑦᓯᐅᑦ ᑐᓴᕆᔨᖅᑐᑦ ᓄᓇᕗᑦᓯᐅᑦ ᑕᑯᓴᐅᖅᑕᖅᑐᑦ ᑎᑦ ᓂᐲᑦ ᓕᒥ
ᕿᐊᓪᓚᓕ ᓴᓐ ᑯᓂ ᑲᑎᒪᔨᑎᑎᒍᑦ, ᐊᖏᔪᓕᓴᓐ ᑎᑦ ᒪᑭᑎᐊᖅᑐᖅᓯᒪᓂᖅ ᓗᑲᑐᑦᑎᓐᓂᖅᑐᖅᓯᒪᓂᖅ ᐊᓪᓚᓕ ᓕᒥ ᓄᓇᕗᑦᓯᐅᑦ
ᓄᓇᖅᑲᖅᑎᑐᑎᒃ ᑐᑦᓯᑎᒃ ᐃᓐᓇᐅᑎᖅᑐᖅᓯᒪᓂᖅ ᑎᑦ. ᐊᓪᓚᓕ ᓕᒥ ᑕᐅᓴᖅ, ᕿᐊᓪᓚᓕ ᓴᓐ ᑯᓂ ᓄᖅ
ᐱᑕᖃᖅᖢᓕᑦᑎᐊᖅᑎᑎᑦᓯᐅᑦ ᑐᓴᕆᔨᖅᑐᑦ ᐃᓐᓇᐅᑎᖅᑐᖅᓯᒪᓂᖅ ᐃᓕᑦ ᓇᓕᒥᐅᑦ ᑕᐅᓴᖅᑐᓂᒃ, ᐱᑕᖃᖅᖢᓪᓚᕆᑦ
ᐊᓪᓚᓕ ᓕᒥ ᐅᖏᓪᓗᒥ ᐅᓂᒃᑳᖅᓯᒪᓕᓴᓐ ᓂᐲᑦ ᓕᒥᐊᑕᐅᑦ ᐃᓐᓇᐅᑎᖅᑐᖅᓯᒪᓂᖅ ᑐᓴᕆᔨᖅᑐᑦ ᑕᑯᓴᐅᖅᑕᖅᑐᑦ
ᐱᓪᓚᕆᑦ ᑕᑯᓴᐅᖅᑕᖅᑐᑦᑎᐊᖅᑐᖅᓯᒪᓂᖅ ᐊᓪᓚᓕ ᓕᒥ ᓄᓇᕗᑦᓯᐅᑦ ᑐᓴᕆᔨᖅᑐᑦ ᑕᑯᓴᐅᖅᑕᖅᑐᑦ ᑎᑦ ᓂᐲᑦ
ᓄᓇᕗᑦᓯᐅᑦ.

ᐃᓕᖅ ᓂᕿᑐᓴ ძᐢᓂ ᑭᓄ ᓱᖅᑐᑦ ᑎᑎᕋᖅ

ᐃᓕᖅ ᓂᕿᑐᓴ ძᐢᓂ ᑭᓄ ᓱᖅᑐᑦ ᑎᑎᑦᓴᐅᑎᕋᖅᑐᖅᓯᒪᓕᖅᑐᑦ ᑐᓴᕆᔨᖅᑐᑦᓯᐅᑎᓕᕆᓂᒃ ᐱᑕᖃᖅᖢᓕᑦ ᑎᑦ ᓂᐲᑦ
ᖃᐅᔨᓴᖅᑕᐅᓂᒃ ᓇᐃᔨᓴᐅᑎᖅᑐᖅᓯᒪᓂᖅ ᐃᓐᓇᐅᑎᖅᑐᖅᓯᒪᓂᖅ ᐃᓕᖅ ᓂᕿᑐᓴᒥ ᐱᑕᖃᖅᖢᓕᑦ ᑎᑦ ᓂᐲᑦ ᓄᓇᕗᑦᓯᐅᑦ
ᐱᑕᖃᖅᖢᓕᑦᑎᐊᖅᑐᖅᓯᒪᓂᖅ ᑎᑦ ᓂᐲᑦ ᓄᓇᕗᑦᓯᐅᑦ ᑭᓄ ᓱᖅᑐᑦ ᐃᓕᖅ ᓂᕿᑐᓴᒥ ᓇᓂᓐ ᓇᐃᔨᓴᐅᑎᖅᑐᖅᓯᒪᓂᖅ. ᑭᓐ ᓗ
ᐱᑕᖃᖅᖢᓕᑦᑎᐊᖅᑐᖅᓯᒪᓂᖅ ᑭᓄᓐᓄᑦ ᐃᓕᑕᕆᔨᖅᑐᑦ ᑎᑦ ᓂᐲᑦ ᓄᓇᕗᑦᓯᐅᑦ ᑭᓄ ᓱᖅᑐᑦ ᐃᓕᖅ ᓂᕿᑐᓴᒥ ᓇᓂᓐ ᓇᐃᔨᓴᐅᑎᖅᑐᖅᓯᒪᓂᖅ. ᑭᓐ ᓗ

TGS NOPEC-ᑯᑦ ᓇᓗᓴᑦ ᑕᐅᑦ ᑐᖅᓯᓂᒃ ᐃᖅᑲᓇᐃᔨᖅᑎᑕᑦ ᓄᑎᒃ ᑲᒪ ᐸᓂᐅᔨᑦ , ᐅᖅᓯᐊᓗᓂᒃ ᓴᓪᓕᓐᓄᒃ ᑯᓘᓂᒃ ᓂᐅᐊᓕᓐᓂᒃ ᑐᑭᓯᒪᓕᕆᓂᖅ ᑐᓴᕐᓂᒃ ᑲᑎᖅᑕᐅᑦ ᑎᑎ ᓄᓇᒃ ᑐᑭᓯᒪᓕᕆᓂᖅ ᑐᓴᕐᓂᒃ ᑲᒪᒋᔭᐅᓂᖅ ᑐᑭᓯᒪᓕᕆᓂᖅ ᑐᓴᕐᓂᒃ ᑲᑎᖅᑕᐅᑦ ᑎᑎ ᓄᓇᒃ

ᑐᑭᓯᒋᐊᖅ ᓄᐅᔨᓐᓄᑦ ᓇᖅᑐᑦ ᐊᑎᖓ

Abgrall, P., V.D. Moulton, and W.J. Richardson. (2008). Updated review of scientific information on impacts of seismic survey sound on marine mammals, 2004-present. *Canadian Science Advisory Secretariat.*

Awbrey, F.T. and B.S., Stewart. (1983) Behavioural responses of wild beluga whales (Delphinapterus leucas) to noise from oil drilling. *Sea World Research Institute.*

Department of Fisheries and Oceans Canada (DFO). (2004). Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. *DFO Canadian Science Advisory Secretariat.* Habitat Status Report 2004/002.

DFO. (2010). Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment. *Department of Fisheries and Oceans.* <http://www.dfo-mpo.gc.ca/oceans-habitat/oceans/im-gi/seismic-sismique/pdf/statement-enonce_e.pdf>

Gausland (2000). Impact of seismic surveys on marine life. *The Leading Edge*, 19(8), 903-905.

Gordon, J.C.D., Gillespie, D., Potter, J., Frantzis, A., Simmonds, M.P., Swift, R. & Thompson, D. (2003). A review of the effects of seismic survey on marine mammals. *Marine Technology Society Journal,* 37(4), 14-32.

Harris, R.E., G.W. Miller and W.J. Richardson. (2001). Seal responses to airgun sounds during summer seismic surveys in the Alaskan Beaufort Sea. *Society of Marine Mammalogy.* 17(4), 795-812.

Hildebrand, J. (2004). Impacts of Anthropogenic Sound on Cetaceans. University of California, San Diego. IWCSC-56-E13-2004.

LaPierre, T., Arnott, A., Hawkins, C., Simpson, K. & Davis, D. (2011). Environmental Impact Assessment for Marine 2D Seismic Reflection Survey Baffin Bay and Davis Strait Offshore Eastern Canada by Multi Klient Invest AS.

Lokkeborg, S., Ona, E., Vold, A. & Salthaug, A. (2012). Sounds from seismic air guns: gear- and species- specific effects on catch rates and fish distribution. *Canadian Journal of Fisheries Aquatic Science,* 69, 1278-1291.

McCauly, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J. & McCabe, K. (2000). Marine Seismic Surveys- A Study of Environmental Implications. *APPEA Journal,* 692-708.

McDonald, M.A, Hildebrand, J.A. & Webb, S.C. (1995). Blue and fin whales observed on a seafloor array in the Northeast Pacific. *Journal of the Acoustical Society of America,* 98(2), 712-721.

Stone, C.J., & Tasker, M.L. (2006). The effects of seismic airguns on cetaceans in UK waters. *Journal of Cetacean Research and Management*, 8(3), 255-263.

Weilgart, L.S. (2007). The impacts of anthropogenic ocean noise on cetaceans and implications for management. NRC Research Press.

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Research Document 2008/087 | **Document de recherche 2008/087**

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Updated Review of Scientific Information on Impacts of Seismic Survey Sound on Marine Mammals, 2004-present

Évaluation actualisée des renseignements scientifiques relatifs à l'impact des bruits sismiques sur les mammifères marins, de 2004 jusqu'à présent

Patrick Abgrall[1], Valerie D. Moulton[1] and W. John Richardson[2]

[1]LGL Limited, environmental research associates
388 Kenmount Road, P.O. Box 13248, Stn A
St. John's, NL A1B 4A5

[2]LGL Limited, environmental research associates
22 Fisher Street, P.O. Box 280
King City, ON L7B 1A6

* This series documents the scientific basis for the evaluation of fisheries resources in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

* La présente série documente les bases scientifiques des évaluations des ressources halieutiques du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

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Ce document est disponible sur l'Internet à:

http://www.dfo-mpo.gc.ca/csas/

ISSN 1499-3848 (Printed / Imprimé)
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ABSTRACT

This document provides an updated review of recent scientific information on the effects of seismic survey sound from airgun(s) on marine mammals. It reviews conclusions in the Canadian Science Advisory Secretariat (CSAS) Habitat Status Report 2004/002 and describes published information that has become available since 2004 (through February 2008). The types of impacts reviewed closely follow those outlined in the original CSAS Habitat Status Report and include mortality and physical effects, direct behavioural effects, functional consequences of physical and behavioural effects, chronic effects, and indirect effects.

The review of ***mortality and physical effects*** considers strandings/mortality, hearing impairment, and non-auditory effects. There is no conclusive evidence that airgun pulses cause stranding or death in marine mammals, or non-auditory effects (e.g., gas bubble formation). However, incidents involving beaked whale strandings near naval exercises which used mid-frequency sonar suggest a need for caution in conducting seismic surveys in areas occupied by beaked whales. A key paper (Southall et al. 2007) provides new recommendations for injury criterion in marine mammals exposed to sound. Permanent threshold shift (PTS) in hearing is recommended as an injury criterion. On a SEL (sound exposure level) basis, there is a risk of PTS when received sound levels exceed 15 dB above the SEL which may elicit temporary threshold shift (TTS) in hearing. On a peak pressure basis, sounds might cause immediate PTS if received sound levels exceed 6 dB above TTS_{peak} threshold. For exposure to multiple pulses like those from airgun(s), PTS is assumed to occur if either of the following SEL or peak pressure criterion are exceeded:

- Cetaceans: ~198 dB re 1 $\mu Pa^2 \cdot s$ or 230 dB re 1 µPa (peak)
- Pinnipeds: ~186 dB re 1 $\mu Pa^2 \cdot s$ or 218 dB re 1 µPa (peak)

The ***direct behavioural effects*** considered include displacement and migratory diversion, changes in dive and respiratory patterns, changes in social behaviour, and changes in vocalization patterns. Baleen whales generally tend to avoid at least the immediate area around operating airguns, but avoidance radii are quite variable. Bowhead and gray whales in summer feeding habitat often exhibit only localized avoidance of airgun sources. Dolphins show variable responses to seismic surveys but seem more responsive than suspected earlier. Beluga whales exhibited 10-20 km avoidance of a seismic vessel; received sound levels were estimated at 150-130 dB re 1 µPa (rms). In contrast, there is little evidence that sperm whales avoid seismic surveys and a study of ringed seals concluded that they showed very limited avoidance of an operating airgun array. Dive and respiratory patterns vary in response to seismic exposure. Some preliminary analyses suggest that foraging attempts by sperm whales in the Gulf of Mexico decrease during seismic exposure. There are also variable results reported for changes in vocalization patterns of marine mammals in response to seismic sounds. Some baleen and toothed whales continued calling in the presence of seismic operations while others stopped calling and resumed after the survey.

Very little information addresses the potential for ***functional consequences of physical and behavioural effects***, ***chronic effects***, and ***indirect effects*** of seismic survey sound on marine mammals. Masking effects of pulsed sounds on marine mammal calls another natural sounds are expected to be limited, although there are very few specific data on this.

RÉSUMÉ

Le document offre une évaluation actualisée des renseignements scientifiques relatifs aux effets sur les mammifères marins du bruit que produisent les canons à air employés pour les levés sismiques. Ses auteurs reviennent sur les conclusions du Rapport sur l'état des habitats 2004/002 du Secrétariat canadien de consultation scientifique (SCCS) (MPO, 2004a) et décrivent les renseignements parus depuis 2004 (jusqu'en février 2008). Les types d'incidences examinés suivent de près ceux décrits dans le Rapport sur l'état des habitats du SCCS. Ils comprennent la mortalité et les effets physiques, les effets comportementaux directs, les conséquences fonctionnelles des effets physiques et comportementaux, les effets chroniques et les effets indirects.

L'analyse de l'aspect ***mortalité et effets physiques*** porte sur les échouements et les morts, la perte d'audition et les effets extra-auditifs. On n'a pas de preuve concluante que les impulsions de canon à air provoque l'échouement ou la mort des mammifères marins, ni qu'elles ont des effets extra-auditifs (p. ex. la formation de bulles gazeuses). Cela dit, l'échouement de baleines à bec au voisinage de sites d'exercices navals qui mettaient en jeu des sonars à moyenne fréquence appelle à la prudence lorsqu'il s'agit d'effectuer des levés sismiques dans des zones fréquentées par cette espèce. Un article fondamental (Southall *et al.*, 2007) recommande de nouveaux critères relatifs aux atteintes physiologiques chez les mammifères marins exposés au bruit. Les auteurs recommandent d'inclure la perte d'audition permanente, ou déplacement permanent de seuil (PTS, de l'anglais *permanent threshold shift*), parmi les critères. Du point de vue du niveau d'exposition sonore (SEL – *sound exposure level*), il y a risque de PTS lorsque le niveau sonore perçu dépasse de 15 dB le SEL susceptible de produire une perte d'audition temporaire, ou déplacement temporaire de seuil (TTS, de l'anglais *temporary threshold shift*). Du point de vue de la pression de crête, il peut y avoir perte d'audition permanente immédiate, si le niveau sonore perçu dépasse de 6 dB la limite inférieure du $TTS_{crête}$. Dans le cas d'une exposition à des impulsions multiples comme celles émises par des canons à air, on suppose que le PTS survient si soit le critère de SEL, soit le critère de pression de crête qui suivent sont dépassés :

- Cétacés : ~198 dB re 1 $\mu Pa^2 \cdot s$ ou 230 dB re 1 µPa (crête);
- Pinnipèdes : ~186 dB re 1 $\mu Pa^2 \cdot s$ ou 218 dB re 1 µPa (crête).

Les ***effets comportementaux directs*** pris en considération comprennent le déplacement et la déviation des voies migratoires, ainsi que la modification des régimes de plongée et de respiration, du comportement social et des vocalisations. Les baleines à fanons évitent généralement les parages immédiats des canons à air en activité, mais le rayon d'évitement varie beaucoup. Les baleines boréales et les baleines grises qui se trouvent dans leurs aires d'alimentation estivales n'ont souvent qu'une réaction d'évitement localisé. Les dauphins ont des réponses variées aux levés sismiques, mais ils semblent réagir davantage qu'on le soupçonnait. Les bélugas étudiés ont évité les navires sismiques dans un rayon de 10 à 20 km; les niveaux sonores perçus étaient estimés à entre 150 et 130 dB re 1 µPa (rms). Par contre, il y a peu d'indications que le cachalot macrocéphale évite les tirs sismiques, et une étude sur des phoques annelés a conclu qu'ils manifestaient une réaction très limitée d'évitement face à une batterie de canons à air en activité. Les régimes de plongée et de respiration varient en réaction à l'exposition à des bruits sismiques. D'après certaines analyses préliminaires, la quête de nourriture de cachalots macrocéphales dans le golfe du Mexique diminue durant les tirs. On rapporte des résultats variés pour ce qui est des changements dans les vocalisations des mammifères marins en réponse aux bruits sismiques. Certaines baleines à fanons et baleines à dents ont continué leurs appels au cours d'opérations sismiques, tandis que d'autres les ont interrompus pour les reprendre quand les levés se sont terminés.

On a très peu de renseignements sur les ***conséquences fonctionnelles des effets physiques et comportementaux***, les ***effets chroniques*** et les ***effets directs*** éventuels des bruits sismiques sur les mammifères marins. On suppose que les effets de masque des impulsions sur les appels des mammifères marins et sur d'autres sons naturels sont limités, mais il y a peu de données précises sur le sujet.

INTRODUCTION

The following document provides an updated review of recent scientific information on the effects of seismic survey sound from airgun(s) on marine mammals (i.e., data that became available from 2004 through early 2008). It reviews conclusions in the Canadian Science Advisory Secretariat (CSAS) Habitat Status Report 2004/002 (DFO 2004a) and describes published information that has become available since 2004. Lawson and McQuinn (2004) highlighted much of the background information relating to the effects of seismic sounds on marine mammals up to 2004. Due to the limited information on the subject, conference abstracts, papers, and other unpublished or "grey literature" that have often not been externally or peer-reviewed are included, in addition to peer-reviewed literature. Also, in some instances, literature published prior to 2004 is cited for contextual purposes. Additional recent reviews of the effects of sound from seismic surveys, and sources of anthropogenic noise in general, on marine mammals can be found in Gordon et al. (2004), NRC (2005), Nowacek et al. (2007), Southall et al. (2007), Weilgart (2007), and Tyack (2008).

INTRODUCTION

Le présent document offre une évaluation actualisée des renseignements scientifiques relatifs aux effets sur les mammifères marins du bruit que produisent les canons à air employés pour les levés sismiques. Ses auteurs reviennent sur les conclusions du Rapport sur l'état des habitats 2004/002 du Secrétariat canadien de consultation scientifique (SCCS) (MPO, 2004a) et décrivent les renseignements parus depuis 2004 et jusqu'au début de 2008. Lawson et McQuinn (2004) ont considéré une bonne partie des renseignements de base concernant les effets des ondes sismiques sur les mammifères marins jusqu'en 2004. Comme les informations sur le sujet sont peu nombreuses, nous incluons, outre les publications évaluées par les pairs, une « littérature grise » qui, souvent, n'a pas fait l'objet d'un examen externe ou d'une révision par des spécialistes – résumés de conférence, communications et d'autres documents non publiés. Parfois, pour fournir un contexte, nous citons des documents publiés avant 2004. D'autres analyses documentaires ont été faites récemment des effets du bruit produit par les levés sismiques, et des bruits anthropiques en général, sur les mammifères marins. Citons Gordon *et al.* (2004), NRC (2005), Nowacek *et al.* (2007), Southall *et al.* (2007), Weilgart (2007) et Tyack (2008).

IMPACTS OF SEISMIC SOUND ON MARINE MAMMALS

Mortality and Physical Effects

Strandings and Mortality

DFO (2004a) concluded that "although whale strandings have been linked to exposure to anthropogenic sound, exposure to seismic sound is considered unlikely *to cause direct marine mammal mortality".*

Marine mammals close to underwater detonations of high explosives can be killed or severely injured, and the auditory organs are especially susceptible to injury (Ketten et al. 1993; Ketten 1995). Airgun pulses are less energetic and have slower rise times, and there is no proof that they can cause serious injury, death, or stranding even in the case of large airgun arrays. However, the association of mass strandings of beaked whales with naval exercises and, in one case, a seismic survey, has raised the possibility that beaked whales exposed to strong "pulsed" sounds may be especially susceptible to injury and/or behavioural reactions that can lead to stranding.

Strandings and mortality may be due to various noise-related causes, including (1) swimming in avoidance of a sound into shallow water; (2) a change in behaviour (such as a change in dive profile, staying at depth longer than normal, or remaining at the surface longer than normal) that might contribute to tissue damage, gas bubble formation, hypoxia, cardiac arrhythmia, hypertensive hemorrhage or other forms of trauma; (3) a physiological change such as a vestibular response leading to a behavioural change or stress-induced hemorrhagic diathesis, leading in turn to tissue damage; and (4) tissue damage directly from sound exposure, such as through acoustically mediated bubble formation and growth or acoustic resonance of tissues. There are

IMPACT DES BRUITS SISMIQUES SUR LES MAMMIFÈRES MARINS

Mortalité et effets physiques

Échouements et morts

Le MPO (2004a) conclut que « même si les échouements de baleines ont été liés à l'exposition à des sons anthropiques, on considère qu'il est peu probable que l'exposition à des bruits sismiques cause la mortalité directe de mammifères marins ».

Les mammifères marins qui se trouvent à proximité d'une détonation sous-marine d'explosifs peuvent en mourir ou être gravement blessés, et leurs organes auditifs sont particulièrement fragiles (Ketten *et al.,* 1993; Ketten, 1995). Les impulsions des canons à air sont moins puissantes et ont un temps de montée plus long; rien ne prouve qu'elles peuvent entraîner des blessures graves, la mort ou l'échouement, même lorsque de grosses batteries sont employées. Cependant, l'association d'échouements massifs de baleines à bec avec des exercices navals et, dans un cas, avec une étude sismique, a montré la possibilité que l'exposition à de forts signaux sonores « impulsionnels » rende ces cétacés particulièrement vulnérables à des atteintes physiologiques et/ou comportementales qui peuvent les amener à s'échouer.

Diverses causes attribuables à des perturbations sonores peuvent expliquer les échouements et les morts : (1) les animaux nagent vers les eaux peu profondes pour s'éloigner de la source; (2) la perturbation provoque un changement de comportement (par exemple, le profil de plongée se modifie, les animaux restant en profondeur ou à la surface plus longtemps que d'habitude) susceptible de provoquer divers traumatismes – lésion des tissus, embolie gazeuse, hypoxie, arythmie cardiaque, hémorragie hypertensive ou autres; (3) un changement physiologique, telle une réaction du système vestibulaire, amenant une modification du comportement ou une diathèse hémorragique induite par le stress, laquelle amène une lésion des tissus; (4) des lésions directement imputables à l'exposition sonore, en raison des bulles de gaz

increasing indications that gas-bubble disease, induced in supersaturated tissue by a behavioural response to acoustic exposure, could be a pathologic mechanism for the strandings and mortality of some deep-diving cetaceans exposed to sonar, although the evidence of a causal connection remains circumstantial (Cox et al. 2006; Southall et al. 2007).

qui se forment et augmentent ou de la résonance acoustique dans les tissus. Il y a de plus en plus d'indications que l'embolie gazeuse, qui se constitue dans un tissu sursaturé par suite d'une réaction comportementale à une exposition acoustique, pourrait être un mécanisme pathologique de l'échouement et de la mort de certains cétacés à plongées profondes exposés à des sonars, bien que les preuves d'un lien causal demeurent circonstanciels (Cox *et al.*, 2006; Southall *et al.*, 2007).

Of concern for cetaceans, particularly beaked whales, is that tissue damage and live strandings may be induced at received sound levels that are lower than had previously been anticipated and, in particular, at levels lower than those that induce auditory damage (e.g., reviewed in Dolman and Simmonds 2006). The growing evidence that mid-frequency sonar is associated with certain strandings and mortality of beaked whales (Cox et al. 2006; D'Spain et al. 2006) has raised concern about the possibility that seismic surveys might at times have similar effects.

Ce qui préoccupe chez les cétacés, en particulier chez les baleines à bec, est que les lésions des tissus et les échouements d'animaux vivants seraient provoqués par des niveaux sonores captés plus faibles que prévu et, en particulier, plus faibles que ceux qui produisent des dommages auditifs (voir notamment l'analyse de Dolman et Simmonds, 2006). Devant les preuves s'accumulant qu'un sonar à moyenne fréquence aurait joué un rôle dans l'échouement et la mort de baleines à bec (Cox *et al.*, 2006; D'Spain *et al.*, 2006), on craint que les levés sismiques puissent parfois avoir des effets analogues.

Seismic pulses and mid-frequency sonar signals are quite different. Sounds produced by airgun arrays are broadband impulses with most of the energy below 1 kHz. Typical military mid-frequency sonars emit non-impulse sounds at frequencies of 2–10 kHz, generally with a relatively narrow bandwidth at any one time (though the frequency may change over time). Thus, it is not appropriate to assume that there is a direct connection between the effects of military sonar and seismic surveys on marine mammals. However, evidence that sonar signals can, in special circumstances, lead (at least indirectly) to physical damage and mortality (e.g., Jepson et al. 2003; Fernández et al. 2004, 2005a; Cox et al. 2006) suggests that caution is warranted when dealing with exposure of marine mammals to any high-intensity pulsed sound.

Les impulsions sismiques et les signaux sonars de moyenne fréquence sont très différents. Les sons produits par les batteries de canons à air sont des impulsions large bande, dont l'essentiel de l'énergie est émise sous 1 kHz. Les sonars militaires de moyenne fréquence émettent habituellement des signaux non impulsionnels à des fréquences d'entre 2 et 10 kHz, en général dans une bande plutôt étroite à un moment donné (mais la fréquence peut changer avec le temps). Ainsi, il ne convient pas de présumer qu'il y a un lien direct entre les effets des sonars militaires et ceux des dispositifs sismiques sur les mammifères marins. Cela dit, les indications selon lesquelles les signaux sonars peuvent mener, dans des circonstances particulières, du moins indirectement, à des dommages physiques et à des décès (voir notamment Jepson *et al.*, 2003; Fernández *et al.*, 2004, 2005a; Cox *et al.*, 2006) incitent à la prudence lorsqu'il est question d'exposer les mammifères marins à toute impulsion sonore de forte

There is no conclusive evidence of cetacean strandings as a result of exposure to seismic surveys. Speculation concerning a possible link between seismic surveys and strandings of humpback whales in Brazil (Engel et al. 2004) was not well founded (International Association of Geophysical Contractors [IAGC] 2004; International Whaling Commission [IWC] 2007). In September 2002, there was a stranding of two Cuvier's beaked whales in the Gulf of California, Mexico, when the Lamont-Doherty Earth Observatory (L-DEO) seismic vessel R/V Maurice Ewing was operating a 20-airgun, 8490-in^3 airgun array in the area. It is uncertain when the whales came ashore and thus, how close the seismic vessel had been when the whales stranded. However, the seismic vessel was on a survey line approaching the stranding site and had a closest point of approach of 33.3 km around the time the live-stranded beaked whales were discovered by fishermen (Hildebrand 2005). The link between the stranding and the seismic surveys was inconclusive and not based on any physical evidence (Hogarth 2002; Yoder 2002). Nonetheless, that plus the incidents involving beaked whale strandings near naval exercises involving use of mid-frequency sonar suggests a need for caution in conducting seismic surveys in areas occupied by beaked whales.

Hearing Impairment

DFO (2004a) determined that the significance of TTS effects, were they to occur, are likely to be unimportant, unless it resulted in PTS; or other threats that normally could be avoided by acoustic means, such as those from predators or entanglement in fishing gear, occur concurrently.

Temporary or permanent hearing

intensité.

Il n'y a pas de preuve concluante que des cétacés se seraient échoués après avoir été exposés à des bruits sismiques. L'hypothèse d'un lien possible entre des levés sismiques et l'échouement de rorquals à bosse au Brésil (Engel *et al.*, 2004) n'était pas bien fondée (International Association of Geophysical Contractors [IAGC], 2004; International Whaling Commission [IWC], 2007). En septembre 2002, deux baleines à bec de Cuvier se sont échouées dans le golfe de Californie, sur les côtes mexicaines, au moment où le navire sismique *Maurice Ewing* de l'observatoire terrestre Lamont-Doherty (L-DEO) effectuait des tirs au moyen d'une batterie de 20 canons à air de 8 490 po^3 dans le secteur. On ne sait pas avec exactitude quand les baleines se sont échouées et donc à quelle distance se trouvait le navire sismique. Toutefois, celui-ci se trouvait sur une ligne de levé approchant le site d'échouement et son point de rapprochement maximal était de 33,3 km vers le moment où des pêcheurs ont découvert les baleines échouées encore vivantes (Hildebrand, 2005). Le rapport établi entre l'échouement et les études sismiques n'était pas concluant, et aucune preuve matérielle ne le corroborait (Hogarth, 2002; Yoder, 2002). Néanmoins, cet incident et les échouements de baleines à bec dans les parages de sites d'exercices navals faisant appel à des sonars de moyenne fréquence incitent à la prudence lorsqu'on effectue des levés sismiques dans des secteurs occupés par des baleines à bec.

Perte d'audition

D'après le MPO (2004a), le degré d'importance des effets d'élévation temporaire du seuil auditif, s'ils se produisent, est probablement insignifiant, à moins qu'ils résultent en un déplacement permanent du seuil ou que se matérialisent au même moment d'autres menaces que les mammifères marins évitent normalement par des moyens acoustiques, notamment des prédateurs ou des engins de pêche dans lesquels ils s'enchevêtrent.

Une perte temporaire ou permanente d'audition

impairment is a possibility when marine mammals are exposed to very strong sounds (Goold and Coates 2006), and temporary threshold shift (TTS) has been demonstrated and studied in certain captive odontocetes and pinnipeds exposed to strong sounds (reviewed in Southall et al. 2007). However, there has been no specific documentation that TTS let alone PTS occurs when marine mammals are exposed to sequences of airgun pulses under realistic field conditions. Current U.S. National Marine Fisheries Service (NMFS) policy regarding exposure of marine mammals to high-level sounds is that, for situations under U.S. jurisdiction, cetaceans and pinnipeds should not be exposed to impulsive sounds with received levels ≥180 and 190 dB re 1 μPa_{rms} respectively (NMFS 2000). Those criteria have been used in establishing the safety (=shutdown) radii for numerous seismic surveys in both U.S. and Canadian waters. However, those criteria were established before there was any information about the minimum received levels of sounds necessary to cause auditory impairment in marine mammals. As discussed below,

- the 180-dB criterion for cetaceans is probably quite precautionary, i.e. lower than necessary to avoid temporary threshold shift (TTS), let alone permanent auditory injury, at least for delphinids and similar species for which TTS measurements are available;

- the 190-dB criterion for pinnipeds may not be as precautionary, at least for harbour seals; there are indications that the TTS threshold in the harbour seal is lower than in odontocetes (Southall et al. 2007:443);

- the level associated with the onset

est possible quand les mammifères marins sont exposés à des sons très forts (Goold et Coates, 2006). On a montré et étudié un déplacement temporaire de seuil (ou TTS, de l'anglais *temporary threshold shift*) chez certains odontocètes et pinnipèdes en captivité qui avaient été exposés à des sons forts (analyse de Southall *et al.*, 2007). Cela dit, on ne trouve aucune indication précise dans la documentation d'une perte d'audition temporaire et encore moins permanente chez les mammifères marins exposés à des séquences d'impulsions provenant de canons à air dans des conditions réalistes d'emploi. La politique en vigueur du National Marine Fisheries Service (NMFS) des États-Unis concernant l'exposition des mammifères marins à des niveaux sonores élevés précise que, dans les situations qui ressortissent aux États-Unis, les cétacés et les pinnipèdes ne devraient pas être exposés à des impulsions sonores dont les niveaux perçus seraient respectivement de ≥ 180 et 190 décibels rapportés à une pression efficace de 1 micropascal (expression notée dB re 1 μPa_{rms}) (NMFS, 2000). Ces critères ont servi à définir le rayon de sécurité (= arrêt) de nombreux levés sismiques dans les eaux canadiennes et américaines. Cependant, ils ont été établis avant qu'on dispose d'informations sur les niveaux sonores minimaux de réception nécessaires pour occasionner une perte d'audition chez les mammifères marins. Comme il est indiqué plus bas,

- Le critère de 180 dB pour les cétacés est probablement très prudent, c.-à-d. inférieur au niveau nécessaire pour éviter un TTS, à plus forte raison une perte d'audition permanente, du moins chez les delphinidés et espèces similaires pour lesquelles on dispose de mesures de TTS.

- Le critère de 190 dB à l'égard des pinnipèdes n'est peut-être pas aussi prudent, du moins pour les phoques communs; il semble que le TTS se produise à un niveau inférieur chez le phoque commun que chez les odontocètes (Southall *et al.*, 2007:443).

- Le niveau à partir duquel se produit un

of TTS is often considered to be a level below which there is no danger of permanent damage; TTS is a normal and temporary phenomenon occurring when animals (and humans) are exposed to strong sounds, and it does not constitute injury (e.g., Kryter 1985; Southall et al. 2007).

- the minimum sound level necessary to cause permanent threshold shift (PTS) is higher, by a variable and generally unknown amount, than the level that induces barely-detectable TTS; the actual PTS threshold is likely to be well above the level causing onset of TTS (Southall et al. 2007).

NMFS is developing new noise exposure criteria for marine mammals that account for the available scientific data on TTS, the expected offset between the TTS and PTS thresholds, differences in the acoustic frequencies to which different marine mammal groups are sensitive, and other relevant factors. Preliminary information about this process, and about the possible structure of the new criteria, was given by NMFS (2005); D. Wieting in http://mmc.gov/sound/plenary2/pdf/plenary2summaryfinal.pdf; and Miller et al. (2005b). Detailed recommendations for new science-based noise exposure criteria for marine mammals, frequency weighting procedures, and related matters were published in early 2008 (Southall et al. 2007).

Southall et al. (2007) suggest that thresholds for injury (and behavioural responses) should be examined separately for five functional hearing groups: low-frequency cetaceans (mysticetes, for which the functional

TTS est souvent considéré comme un niveau en deçà duquel il n'y a pas de danger de dommage permanent; le TTS est un phénomène normal et provisoire qui se produit lorsque des animaux (et des humains) sont exposés à des bruits forts, et il ne constitue pas une lésion (voir notamment Kryter, 1985; Southall *et al.*, 2007).

- Le niveau sonore minimal nécessaire pour entraîner un déplacement permanent de seuil (ou PTS, de l'anglais *permanent threshold shift*) est plus élevé – la différence varie et elle est mal connue – que le niveau qui provoque un TTS à peine décelable; en réalité, la limite inférieure de la perte d'audition permanente est vraisemblablement beaucoup plus élevée que celle d'une perte d'audition temporaire (Southall et *al.*, 2007).

Le NMFS définit de nouveaux critères d'exposition au bruit chez les mammifères marins qui tiennent compte des informations scientifiques dont on dispose maintenant sur le TTS, l'écart attendu entre le niveau d'apparition d'une perte d'audition temporaire et celui d'une perte permanente, les différences de fréquences acoustiques auxquels divers groupes de mammifères marins sont sensibles et d'autres facteurs pertinents. le NMFS (2005), D. Wieting (http://mmc.gov/sound/plenary2/pdf/plenary2summaryfinal.pdf) et Miller *et al.* (2005b) ont donné les renseignements préliminaires sur la démarche et sur la structure possible des nouveaux critères. Des recommandations détaillées ont été publiées au début de 2008 (Southall *et al.*, 2007) au sujet des nouveaux critères scientifiques d'exposition au bruit chez les mammifères marins, des procédés de pondération des fréquences et de sujets connexes.

Selon Southall *et al.* (2007), les valeurs limites conduisant à des atteintes physiologiques (et à des modifications de comportement) devraient être examinées séparément pour cinq groupes d'acuité auditive : cétacés basse fréquence (mysticètes, dont le champ fonctionnel

hearing range is concluded to be 7 Hz to 22 kHz); mid-frequency cetaceans (the majority of odontocetes, 150 Hz to 160 kHz); high-frequency cetaceans (remaining odontocetes, 200 Hz to 180 kHz); pinnipeds in water (75 Hz to 75 kHz) and pinnipeds in air (75 Hz to 30 kHz). This review discusses low-frequency cetaceans (mysticetes), mid- and high-frequency cetaceans collectively, under "odontocetes", and pinnipeds in water. Seismic surveys are assumed to be of little relevance to "pinnipeds in air".

d'audibilité se situerait entre 7 Hz et 22 kHz), moyenne fréquence (la plupart des odontocètes; champ entre 150 Hz et 160 kHz) et haute fréquence (le reste des odontocètes; champ entre 200 Hz et 180 kHz), les pinnipèdes dans l'eau (entre 75 Hz et 75 kHz) et les pinnipèdes dans l'air (entre 75 Hz et 30 kHz). Nous examinons les cétacés basse (mysticètes), moyenne et haute fréquences collectivement dans la catégorie « odontocètes » ainsi que les pinnipèdes dans l'eau. Nous supposons que les levés sismiques touchent peu les « pinnipèdes dans l'air ».

Several aspects of the monitoring and mitigation measures that are now often implemented during seismic survey projects are designed to detect marine mammals occurring near the airgun array, and to avoid exposing them to sound pulses that might, at least in theory, cause hearing impairment (e.g., Barlow and Gisiner 2006; Holst et al. 2006; McCauley and Hughes 2006; Weir and Dolman 2007). In addition, many cetaceans show some avoidance of the area with ongoing seismic operations (see Displacement and Migratory Diversion section, below). In these cases, the avoidance responses of the animals themselves will reduce or (most likely) avoid the possibility of hearing impairment.

Plusieurs aspects des mesures de surveillance et d'atténuation des effets qui sont maintenant souvent appliquées au cours des campagnes sismiques sont destinés à déceler la présence de mammifères marins près des batteries de canons à air et à éviter d'exposer ces animaux à des impulsions sonores qui pourraient, du moins en théorie, causer une baisse d'audition (voir notamment Barlow et Gisiner, 2006; Holst *et al.*, 2006; McCauley et Hughes, 2006; Weir et Dolman, 2007). En outre, de nombreux cétacés évitent la zone des tirs sismiques (voir plus bas la section « Déplacement et déviation des voies migratoires »). Dans ces cas, la réaction d'évitement des animaux réduira ou (très probablement) annulera la possibilité d'une perte d'audition.

Temporary Threshold Shift (TTS).—TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter 1985). While experiencing TTS, the hearing threshold rises and a sound must be stronger in order to be heard. At least in terrestrial mammals, TTS can last from minutes or hours to (in cases of strong TTS) days. For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the noise ends. TTS is not considered an injury (Southall et al. 2007). Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals,

Déplacement temporaire de seuil (TTS) – le TTS est la forme la plus légère de déficit auditif que peut produire l'exposition à un son fort (Kryter, 1985). Il s'agit d'une élévation récupérable du seuil d'audition; le son doit alors être plus fort pour être entendu. Chez les mammifères terrestres, du moins, le TTS peut durer des minutes ou des heures, voire (dans les cas d'un TTS prononcé) des jours. Chez les mammifères terrestres et marins, si le bruit est égal ou légèrement supérieur à celui qui provoque la perte temporaire d'audition, la sensibilité auditive est rapidement récupérée une fois que l'exposition au bruit cesse. Le TTS n'est pas considéré comme une atteinte physiologique (Southall *et al.*, 2007). On a obtenu peu de données sur les niveaux et les durées du son nécessaires pour produire un

and none of the published data concern TTS elicited by exposure to multiple pulses of sound. Available data on TTS in marine mammals are reviewed in some detail by Southall et al. (2007).

faible TTS chez les mammifères marins, et aucune information publiée ne concerne le TTS provoqué par l'exposition à des impulsions sonores multiples. Southall *et al.* (2007) analysent dans un certain détail les données disponibles sur le TTS chez les mammifères marins.

Mysticetes: There are no data, direct or indirect, on levels or properties of airgun (or other) sounds that are required to induce TTS in mysticetes. The frequencies to which mysticetes are most sensitive are lower than those to which odontocetes are most sensitive, and natural background noise levels at those low frequencies tend to be higher. As a result, auditory thresholds of baleen whales within their frequency band of best hearing are believed to be higher (less sensitive) than are those of odontocetes at their best frequencies (Clark and Ellison 2004). From this, it is suspected that received levels causing TTS onset may also be higher in mysticetes than in odontocetes. In any case, Southall et al. (2007) conclude that it would be precautionary to assume that TTS would not occur in mysticetes at received levels any lower than those causing TTS in odontocetes.

Mysticètes : Il n'y a pas de données, directes ou indirectes, sur les niveaux ou les propriétés des sons produits par des canons à air (ou d'autres sources) qui produiront un TTS chez les mysticètes. Les fréquences auxquelles les mysticètes sont le plus sensibles sont inférieures à celles auxquelles les odontocètes sont le plus sensibles, et les niveaux sonores de fond à ces basses fréquences tendent à être plus élevés. Par conséquent, on croit que les seuils d'audition des baleines à fanons dans la plage des fréquences qu'ils entendent le mieux sont plus élevés (sensibilité moindre) que les seuils des odontocètes aux fréquences qu'elles entendent le mieux (Clark et Ellison, 2004). Ce qui amène à présumer que les niveaux perçus qui occasionnent un TTS pourraient aussi être plus élevés chez les mysticètes que chez les odontocètes. En tout cas, Southall *et al.* (2007) concluent qu'il serait prudent de supposer que le TTS ne se produira pas chez les mysticètes à un niveau perçu plus faible que celui qui cause un TTS chez les odontocètes.

Odontocetes: There are empirical data on the sound exposures that elicit onset of TTS in captive bottlenose dolphins and belugas. The majority of these data concern non-impulse sound, but there are some limited published data concerning TTS onset upon exposure to a single pulse of sound from a watergun (Finneran et al. 2002). A detailed review of these data can be found in Southall et al.(2007). The following summarizes some of the key results.

Odontocètes : Il existe des données empiriques sur les expositions au bruit qui provoquent le TTS chez les dauphins à gros nez et les bélugas en captivité. L'essentiel des données porte sur les bruits non impulsionnels, mais quelques données ont été publiées sur le TTS provoqué par l'exposition à une seule impulsion provenant d'un canon à eau (Finneran *et al.*, 2002). Southall *et al.* (2007) font un examen détaillé de ces données. Voici un résumé des principaux résultats.

There is recent information corroborating earlier expectations that the effect of exposure to strong transient sounds is closely related to the total amount of acoustic energy that is received. Finneran et al.(2005) examined the effects of tone duration on TTS in bottlenose dolphins.

Des informations récentes corroborent les prévisions antérieures que l'effet de l'exposition à de forts bruits transitoires est étroitement lié à la quantité totale d'énergie acoustique captée. Finneran *et al.* (2005) ont examiné les effets de la durée du signal sonore sur le TTS chez les dauphins à gros nez. Les dauphins à gros nez

Bottlenose dolphins were exposed to 3 kHz tones for periods of 1, 2, 4 or 8 s, with hearing tested at 4.5 kHz. For 1-s exposures, TTS occurred with SELs of 197 dB, and for exposures >1 s, SEL ≥195 dB resulted in TTS. (SEL is equivalent to energy flux, in dB re 1 $\mu Pa^2 \cdot s$) At an SEL of 195 dB, the mean TTS (4 min after exposure) was 2.8 dB. Finneran et al. (2005) suggested that an SEL of 195 dB is the likely threshold for the onset of TTS in dolphins and beluga exposed to mid-frequency tones of durations 1-8 s (i.e., TTS onset occurs at a near-constant SEL, independent of exposure duration). That implies that a doubling of exposure time results in a 3 dB lower TTS threshold.

ont été exposés à des signaux de 3 kHz pour des périodes de 1, 2, 4 ou 8 secondes, et on a testé leur ouïe à 4,5 kHz. Le TTS se produisait à un niveau d'exposition sonore (SEL – *sound exposure level*) de 197 dB à 1 seconde. Dans le cas d'expositions plus longues (>1 s), un SEL ≥195 dB produisait un TTS. (Le SEL équivaut au flux d'énergie en dB re 1 $\mu Pa^2 \cdot s$). À un SEL de 195 dB, le TTS moyen (4 minutes après l'exposition) était de 2,8 dB. Finneran *et al.* (2005) ont avancé qu'un SEL de 195 dB est le niveau probable d'apparition du TTS chez les dauphins et les bélugas exposés à des signaux sonores de fréquence moyenne et d'une durée d'entre 1 et 8 secondes (c.-à-d. que le TTS se produit à un SEL presque constant, indépendamment de la durée d'exposition). Ainsi, doubler la durée d'exposition abaisse de 3 dB le seuil de perte d'audition temporaire.

Mooney *et al.* (2005) exposed a bottlenose dolphin to octave-band noise ranging from 4 to 8 kHz at SPLs of 160 to 172 dB re 1 µPa for periods of 1.8 to 30 min. Recovery time depended on the shift and frequency, but full recovery always occurred within 40 min. Consistent with the results of Finneran et al.(2005) based on shorter exposures, Mooney *et al.* reported that to induce TTS in a bottlenose dolphin, there is an inverse relationship of exposure time and SPL; as a first approximation, as exposure time was halved, an increase in noise SPL of 3 dB was required to induce the same amount of TTS. In other words, for toothed whales receiving single short exposures to non-impulse sound, the TTS threshold appears to be, to a first approximation, a function of the total energy received (Finneran et al. 2002, 2005).

Mooney *et al.* (2005) ont exposé un dauphin à gros nez à des niveaux sonores par bandes d'octaves d'entre 4 et 8 kHz à un niveau de pression acoustique (SPL – *sound pressure level*) de 160 à 172 dB re 1 µPa pour des périodes de 1,8 à 30 min. Le temps de récupération dépendait du décalage et de la fréquence, mais la récupération était toujours complète dans les 40 minutes. Mooney *et al.* ont indiqué que pour produire le TTS chez le dauphin à gros nez, il y avait un rapport inverse entre la durée d'exposition et le SPL, ce qui vient confirmer les résultats de Finneran *et al.* (2005) obtenus après des expositions plus courtes; comme approximation première, en réduisant de moitié la durée d'exposition, il fallait augmenter la pression acoustique de 3 dB pour provoquer le même TTS. En d'autres mots, dans le cas des baleines à dents soumises à une exposition courte à des signaux non impulsionnels, le seuil de perte d'audition temporaire semble être, à première approximation, fonction de l'énergie totale perçue (Finneran *et al*., 2002, 2005).

The TTS threshold for odontocetes exposed to a single impulse (from a watergun) appeared to be somewhat lower than for exposure to non-impulse sound. This was expected, based on evidence from terrestrial mammals showing that broadband pulsed sounds

Chez des odontocètes exposés à une impulsion unique (d'un canon à eau), le TTS se serait produit à un niveau un peu inférieur que dans le cas d'une exposition à un signal non impulsionnel. C'est ce que laissaient présager les données obtenues à l'égard de mammifères terrestres, qui indiquaient que les impulsions en

with rapid rise times have greater auditory effect than do non-impulse sounds (Southall *et al.* 2007). The received energy level of a single seismic pulse that caused the onset of mild TTS in the beluga, as measured without frequency weighting, was ~186 dB re 1 $\mu Pa^2 \cdot s$ or 186 dB SEL (Finneran et al. 2002)[1]. Given that the rms level of an airgun pulse (in dB re 1 µPa measured over the duration of the pulse) is typically 10–15 dB higher than the SEL for the same pulse, a single airgun pulse might need to have a received level of ~196–201 dB re 1 μPa_{rms} in order to produce brief, mild TTS. Exposure to several strong seismic pulses that each have received levels near 190 dB_{rms} (175–180 dB SEL) could result in cumulative exposure of ~186 dB SEL and thus slight TTS in a small odontocete, assuming that the TTS threshold upon exposure to multiple pulses is (to a first approximation) a function of the total received pulse energy.

bande large avec front de montée rapide ont un effet plus grand sur l'audition que des signaux non impulsionnels (Southall *et al.*, 2007). Le niveau d'énergie perçu d'une impulsion sismique unique ayant causé un léger TTS chez le béluga, mesuré sans pondération de fréquence, était de ~186 dB re 1 $\mu Pa^2 \cdot s$ ou de 186 dB SEL (Finneran *et al.*, 2002)[1]. Comme le niveau efficace (ou niveau rms, de l'anglais *root mean square*) d'une impulsion de canon à air (en dB re 1 µPa mesuré sur la durée de l'impulsion) est habituellement plus élevé de 10 à 15 dB que le niveau d'exposition sonore (SEL) pour la même impulsion, pour qu'une unique impulsion de canon à air produise un léger et bref TTS, il faudrait peut-être que le niveau perçu soit d'environ 196 à 201 dB re 1 μPa_{rms}. L'exposition à plusieurs impulsions sismiques fortes dont chacune aurait un niveau perçu approchant 190 dB_{rms} (175-180 dB SEL) pourrait donner une exposition cumulée de ~186 dB SEL et donc produire un léger TTS chez un petit odontocète, en supposant que la valeur d'apparition d'une perte d'audition temporaire sous l'effet d'une exposition à des impulsions multiples est (en première approximation) fonction de l'énergie impulsionnelle totale captée.

Insofar as we are aware, there are no published data confirming that the auditory effect of a sequence of airgun pulses received by an odontocete is a function of their cumulative energy. Southall et al. (2007) consider that to be a reasonable, but probably somewhat precautionary, assumption. It is precautionary because, based on data from terrestrial mammals, one would expect that a given energy exposure would have somewhat less effect if separated into discrete pulses, with potential opportunity for partial auditory recovery between pulses. However, as

Pour autant que nous sachions, aucune donnée n'a été publiée confirmant que l'effet auditif d'une séquence d'impulsions de canon à air perçues par un odontocète soit fonction de leur énergie cumulée. Southall *et al.* (2007) considèrent l'hypothèse raisonnable, bien que probablement un peu prudente. Prudente, parce que, d'après les données sur les mammifères terrestres, on s'attendrait à ce que l'exposition à une énergie donnée ait un effet moindre si on la divise entre des impulsions distinctes, avec possibilité de récupération partielle de l'audition entre les impulsions. Cependant, la vitesse de récupération du TTS chez les mammifères marins a encore été très

[1] *If the low-frequency components of the watergun sound used in the experiments of Finneran et al. (2002) are downweighted as recommended by Miller et al. (2005a) and Southall et al. (2007) using their M_{mf}-weighting curve, the effective exposure level for onset of mild TTS was 183 dB re 1 $\mu Pa^2 \cdot s$ (Southall et al. 2007).*

[1] *Si on sous-pondère les éléments basse fréquence du signal émis par le canon à eau dans les expériences de Finneran et al. (2002), comme le recommandent Miller et al. (2005a) et Southall et al. (2007) au moyen de leur courbe de pondération M_{mf}, le niveau effectif d'exposition provoquant un léger TTS était de 183 dB re 1 $\mu Pa^2 \cdot s$ (Southall et al., 2007).*

yet there has been little study of the rate of recovery from TTS in marine mammals, and in humans and other terrestrial mammals the available data on recovery are quite variable. Southall et al. (2007) conclude that - until relevant data on recovery are available from marine mammals - it is appropriate to not to allow for any assumed recovery during the intervals between pulses within a pulse sequence.

peu étudiée, et les données disponibles pour les humains et d'autres mammifères terrestres varient beaucoup. Southall *et al.* (2007) ont conclu qu'il convient – jusqu'à ce qu'on dispose des données utiles sur la récupération chez les mammifères marins – de ne pas supposer qu'il y a récupération dans les intervalles entre les impulsions d'une séquence.

The above TTS information for odontocetes is derived from studies on the bottlenose dolphin and beluga. There is no published TTS information for other types of cetaceans. However, preliminary evidence from a harbour porpoise exposed to airgun sound suggests that its TTS threshold may have been lower (Lucke et al. 2007).

Les informations précitées au sujet du TTS chez les odontocètes proviennent d'études sur le dauphin à gros nez et le béluga. Il n'y a pas de renseignements publiés au sujet du TTS chez d'autres types de cétacés. Néanmoins, les indications préliminaires de l'exposition d'un marsouin commun aux signaux d'un canon à air laissent à penser que la valeur limite du TTS pourrait être plus basse (Lucke *et al.*, 2007).

Additional data are needed to determine the received sound levels at which small odontocetes would start to incur TTS upon exposure to repeated, low-frequency pulses of airgun sound with variable received levels. At the present state of knowledge, it is necessary to assume that the effect is directly related to total energy even though that energy is received in multiple pulses separated by gaps.

Il faut recueillir plus d'informations pour déterminer la limite d'apparition d'un TTS chez des petits odontocètes exposés à des impulsions basse fréquence répétées d'un canon à air, étant donné des niveaux perçus variés. En l'état actuel des connaissances, il faut supposer que l'effet est directement lié à l'énergie totale, même si cette énergie est reçue sous forme d'impulsions multiples séparées par des intervalles.

Pinnipeds: In pinnipeds, TTS thresholds associated with exposure to brief pulses (single or multiple) of underwater sound have not been measured. Initial evidence from more prolonged (non-pulse) exposures suggested that some pinnipeds (harbour seals in particular) incur TTS at somewhat lower received levels than do small odontocetes exposed for similar durations (Kastak et al. 1999, 2005; Ketten et al. 2001). Kastak et al. (2005) reported that the amount of threshold shift increased with increasing SEL in a California sea lion and harbour seal. They noted that, for non-impulse sound, doubling the exposure duration from 25 to 50 min (i.e., a +3 dB change in SEL) had a greater effect on TTS than an increase of 15 dB (95 vs. 80 dB) in

Pinnipèdes : On n'a pas mesuré chez les pinnipèdes le seuil de perte d'audition temporaire associé à l'exposition à de brèves impulsions sonores (uniques ou multiples) sous l'eau. Selon les premières données disponibles sur des expositions plus longues à des signaux non impulsionnels, certains pinnipèdes (le marsouin commun en particulier) éprouvent un TTS à un niveau perçu légèrement inférieur à celui qui provoque une perte d'audition temporaire chez de petits odontocètes exposés pour une durée analogue (Kastak *et al.*, 1999, 2005; Ketten *et al.*, 2001). Kastak *et al.* (2005) indiquent que le déplacement du seuil avait augmenté en même temps que le niveau d'exposition sonore chez une otarie de Californie et un marsouin commun. Ces auteurs ont remarqué que, dans le cas de

exposure level. Mean threshold shifts ranged from 2.9–12.2 dB, with full recovery within 24 hr (Kastak et al. 2005). Kastak et al. (2005) suggested that, for non-impulse sound, SELs resulting in TTS onset in pinnipeds may range from 183 to 206 dB re 1 $\mu Pa^2 \cdot s$, depending on the absolute hearing sensitivity.

signaux non impulsionnels, doubler la durée d'exposition de 25 à 50 minutes (c.-à-d. une augmentation du SEL de +3 dB) avait un plus grand effet sur le TTS que l'augmentation de 15 dB (95 dB plutôt que 80) du niveau d'exposition. Les déplacements moyens de seuil allaient de 2,9 à 12,2 dB, l'ouïe se rétablissant complètement dans les 24 heures (Kastak *et al.*, 2005). Kastak *et al.* (2005) avancent que, dans le cas de signaux non impulsionnels, les SEL qui provoquent l'apparition de TTS chez les pinnipèdes se situeraient entre 183 et 206 dB re 1 $\mu Pa^2 \cdot s$, le niveau variant selon la sensibilité auditive absolue.

As noted above for odontocetes, it is expected that—for impulse sound—the onset of TTS would occur at a lower cumulative SEL given the assumed greater auditory effect of broadband impulses with rapid rise times. The threshold for onset of mild TTS upon exposure of a harbour seal to impulse sounds has been indirectly estimated as being an SEL of ~171 dB re 1 $\mu Pa^2 \cdot s$ (Southall et al. 2007). That would be equivalent to a single pulse with received level ~181–186 dB re 1 μPa_{rms}, or a series of pulses for which the highest rms values are a few dB lower.

Comme dans le cas précité des odontocètes, on s'attend à ce que le TTS apparaisse, sous l'effet d'impulsions, à un SEL cumulatif inférieur, puisqu'on prête aux impulsions en bande large, dont le temps de montée est très bref, un plus grand effet sur l'audition. On a estimé indirectement le niveau d'exposition sonore à partir duquel apparaît un léger TTS chez un phoque commun exposé à des signaux impulsionnels à SEL de ~171 dB re 1 $\mu Pa^2 \cdot s$ (Southall *et al.*, 2007). Voilà qui équivaudrait à une impulsion unique avec niveau perçu de ~181–186 dB re 1 $\mu Pa_{rms,}$ ou à une série d'impulsions pour lesquelles les valeurs efficaces les plus fortes sont inférieures de quelques décibels.

At least for non-impulse sounds, TTS onset occurs at appreciably higher received levels in California sea lions and northern elephant seals than in the harbour seal (Kastak et al. 2005). Thus, the first two species would presumably need to be closer to airgun array before TTS would be a possibility. Insofar as we are aware, there are no data to indicate whether the TTS thresholds of other pinniped species are more similar to those of the harbour seal or to those of the two less-sensitive species.

Au moins dans le cas des signaux non impulsionnels, le TTS apparaît à des niveaux perçus sensiblement plus élevés chez l'otarie de Californie et l'éléphant de mer boréal que chez le phoque commun (Kastak *et al.*, 2005). Ainsi, il faudrait sans doute que les deux premières espèces soient plus près de la batterie de canons à air pour qu'un TTS soit possible. Pour autant que nous sachions, on ne dispose pas de données indiquant si la valeur limite du TTS chez d'autres espèces de pinnipèdes s'approche davantage de celles du phoque commun que de celles des deux espèces moins sensibles.

Fissipeds: There are no available data on TTS in sea otters and polar bears. However, TTS is considered unlikely to

Fissipèdes : Il n'y a pas de données sur le TTS chez les loutres de mer et les ours blancs. Cela étant, on considère peu probable qu'ils

occur in sea otters or polar bears if they are on the water surface, given the pressure release effect at the water's surface. Furthermore, sea otters tend to inhabit shallow coastal habitats whereas marine seismic surveys are generally conducted within deeper offshore areas.

Likelihood of Incurring TTS from Airgun Pulses: DFO (2004a) concluded that the significance of TTS on marine mammals exposed to seismic surveys is likely to be unimportant. Most cetaceans show some degree of avoidance of seismic vessels operating an airgun array. It is unlikely that these cetaceans would be exposed to airgun pulses at a sufficiently high level for a sufficiently long period to cause more than mild TTS, given the relative movement of the vessel and the marine mammal. TTS would be more likely in any odontocetes that bow- or wake-ride or otherwise linger near the airguns. However, while bow- or wake-riding, odontocetes would be near the surface where levels of sound pulses are reduced by pressure-release and Lloyd-mirror (interference) effects (see Appendix A). But if bow- or wake-riding animals were to dive intermittently near airguns, they would be exposed to strong sound pulses, possibly repeatedly. If some cetaceans did incur mild or moderate TTS through exposure to airgun sounds in this manner, this would very likely be a temporary and reversible phenomenon. However, it should be noted that even a temporary reduction in hearing sensitivity could be deleterious in the event that, during that period of reduced sensitivity, a marine mammal needed its full hearing sensitivity to detect approaching predators, or for some other reason.

Some pinnipeds show avoidance reactions to airguns, but their avoidance reactions are not as strong or consistent as those of cetaceans. Pinnipeds occasionally seem to be attracted to operating seismic vessels. There are no specific data on TTS thresholds of

subissent un TTS s'ils sont à la surface de l'eau, étant donné la détente de la pression dans l'air. Par ailleurs, les loutres de mer privilégient les habitats côtiers peu profonds, alors que les études sismiques s'effectuent généralement dans les zones plus profondes du large.

Probabilité d'un TTS provoqué par les impulsions d'un canon à air : Le MPO (2004a) a conclu que le degré d'importance des effets des levés sismiques sur le seuil d'audition des mammifères marins exposés serait probablement négligeable. La plupart des cétacés cherchent à éviter les navires sismiques qui font fonctionner une batterie de canons à air. Il est peu probable qu'ils soient exposés à des impulsions assez fortes sur une période assez longue pour leur occasionner davantage qu'un léger TTS, vu le déplacement des navires et des mammifères les uns par rapport aux autres. Le TTS serait plus probable chez les odontocètes qui nagent dans les vagues d'étrave ou le sillage des navires ou qui traînent autrement près des canons à air. Cependant, les odontocètes qui se laissent porter par la vague d'étrave ou nagent dans le sillage d'un navire se trouveraient près de la surface, où les impulsions sont réduites en raison des effets de détente et du miroir de Lloyd (interférences) (voir l'annexe A). Par contre, si ces animaux plongeaient par intermittence près des canons, ils seraient exposés à de fortes impulsions sonores, peut-être à répétition. S'il arrivait que certains cétacés subissent un TTS léger ou moyen suite à une exposition de ce genre aux tirs de canon à air, l'effet serait très probablement provisoire et réversible. Cela dit, il est à remarquer que même une réduction temporaire de la sensibilité auditive pourrait être néfaste si un mammifère marin avait besoin à ce moment-là de toute son acuité pour déceler l'approche de prédateurs ou pour une autre raison.

Certains pinnipèdes cherchent à éviter les canons à air, mais leurs réactions d'évitement ne sont pas aussi fortes ni aussi régulières que celles des cétacés. Les pinnipèdes semblent à l'occasion attirés par les navires sismiques en campagne. Il n'y a pas de données précises sur le niveau auquel

pinnipeds exposed to single or multiple low-frequency pulses. However, given the indications of a lower TTS threshold for the harbour seal than for odontocetes exposed to impulse sound (see above), it is possible that some pinnipeds close to a large airgun array could incur TTS.

apparaît le TTS chez les pinnipèdes exposés à des impulsions basse fréquence uniques ou multiples. Cependant, comme il semble que ce niveau soit plus faible chez le phoque commun que chez les odontocètes exposés à des impulsions sonores (voir plus haut), il est possible que certains pinnipèdes qui se trouvent à proximité d'une grosse batterie de canons à air subissent une perte d'audition temporaire.

NMFS (1995, 2000) concluded that cetaceans and pinnipeds should not be exposed to pulsed under-water noise at received levels exceeding, respectively, 180 and 190 dB re 1 μPa_{rms}. Those sound levels have not been considered to be the levels above which TTS might occur. Rather, they were the received levels above which, in the view of a panel of bioacoustics specialists convened by NMFS before TTS measurements for marine mammals started to become available, one could not be certain that there would be no injurious effects, auditory or otherwise, to marine mammals. As summarized above, data that are now available imply that TTS is unlikely to occur in various odontocetes (and probably mysticetes as well) unless they are exposed to a sequence of several airgun pulses stronger than 190 dB re 1 μPa_{rms}. On the other hand, for the harbour seal and any species with similarly low TTS thresholds (possibly including the harbour porpoise - Lucke et al. 2007), TTS may occur upon exposure to one or more airgun pulses whose received level equals the NMFS "do not exceed" value of 190 dB re 1 μPa_{rms}. That criterion corresponds to a single-pulse SEL of 175–180 dB re 1 $\mu Pa^2 \cdot s$ in typical conditions, whereas TTS is suspected to be possible (in harbour seals) with a cumulative SEL of ~171 dB re 1 $\mu Pa^2 \cdot s$.

Le NMFS (1995, 2000) a conclu que les cétacés et les pinnipèdes ne devraient pas être exposés à des impulsions sonores sous-marines dont le niveau perçu dépasserait, respectivement, 180 et 190 dB re 1 μPa_{rms}. Ces niveaux ***ne*** sont ***pas*** considérés comme les niveaux au-dessus desquels un TTS se produirait. Plutôt, il s'agissait des niveaux perçus au-dessus desquels on ne pouvait être certain qu'il n'y aurait pas d'atteintes, auditives ou autres, chez les mammifères marins, de l'avis d'un groupe de bioacousticiens réunis par le NMFS à l'époque où on ne disposait pas encore de mesures de TTS chez les mammifères marins. Comme nous le résumons plus haut, les données qui sont maintenant disponibles font croire que le TTS est peu probable chez divers odontocètes (et probablement chez les mysticètes aussi), à moins qu'ils soient exposés à une séquence de plusieurs impulsions de canon à air plus fortes que 190 dB re 1 $\mu Pa_{rms.}$ Par contre, le phoque commun et toute autre espèce chez qui le TTS apparaît à un niveau bas (y compris peut-être le marsouin commun – Lucke *et al.*, 2007), pourraient subir un TTS s'ils étaient exposés à une ou plusieurs impulsions de canon à air dont le niveau perçu égale la valeur « à ne pas dépasser » fixée par le NMFS de 190 dB re 1 $\mu Pa_{rms.}$ Ce critère correspond à un SEL d'impulsion unique de 175-180 dB re 1 $\mu Pa^2 \cdot s$ dans des conditions types, alors qu'on soupçonne que le TTS est possible (chez le phoque commun) à un SEL cumulatif de ~171 dB re 1 $\mu Pa^2 \cdot s$.

It has been shown that most large whales and many smaller odontocetes show at least localized avoidance of ships and associated seismic operations (see Displacement and Migratory Diversion section, below). Even when avoidance is

Il a été montré que la plupart des grandes baleines et bon nombre de petits odontocètes évitent, du moins de façon localisée, les navires et leurs signaux sismiques (voir plus loin la section « Déplacement et déviation des voies migratoires »). Même si l'animal se

limited to the area within a few hundred meters of an airgun array, that should usually be sufficient to avoid the possibility of TTS based on what is currently known about thresholds for TTS onset in cetaceans. In addition, ramping up airgun arrays, which is standard operational protocol for many seismic operators, should allow cetaceans near the airguns at the time of startup to move away from the seismic source and to avoid being exposed to the full acoustic output of the airgun array. Three species of baleen whales that have been exposed to the onset of pulses from single airguns showed avoidance, specifically gray whales [Malme et al. 1984, 1986, 1988]; bowhead whales [Richardson et al. 1986, Ljungblad et al. 1988] and humpback whales [Malme et al. 1985, McCauley et al. 1998, 2000a, b]. Since startup of a single airgun is equivalent to the start of a ramp-up (=soft-start), this strongly suggests that many baleen whales will begin to move away during the initial stages of a ramp-up. Thus, most baleen whales will likely not be exposed to high levels of airgun sounds provided the ramp-up procedure is applied. Likewise, many whales close to the trackline are likely to move away before the sounds from an approaching seismic vessel become sufficiently strong for there to be any potential for TTS or other hearing impairment. Therefore, there is little potential for baleen whales or odontocetes that show avoidance of ships or airguns to be close enough to an airgun array to experience TTS. The potential of a cetacean incurring TTS may be higher in confined areas (e.g., narrow coastal fjords) where options for avoiding a seismic vessel may be limited, or in animals (some odontocetes; many pinnipeds) that show little or no avoidance response. In the event that a few individual cetaceans did incur TTS through exposure to strong airgun sounds, this is a temporary and reversible phenomenon.

contente d'éviter le secteur dans un rayon de quelques centaines de mètres de la batterie de canons à air, cela devrait suffire à éviter un TTS, d'après ce qu'on sait maintenant du seuil de perte d'audition temporaire chez les cétacés. De plus, le démarrage progressif des tirs, qui fait partie du mode opératoire normalisé de beaucoup d'opérateurs sismiques, devrait permettre aux cétacés qui sont dans le voisinage au moment du démarrage de s'éloigner de la source sismique afin d'éviter d'être exposés à toute la puissance acoustique de la batterie. Trois espèces de baleines à fanons exposées aux premières impulsions d'un canon à air isolé ont montré un comportement d'évitement, précisément les *baleines grises* (Malme *et al.*, 1984, 1986, 1988), les *baleines boréales* (Richardson *et al.*, 1986; Ljungblad *et al.*, 1988) et les *rorquals à bosse* [Malme *et al.*, 1985; McCauley *et al.*, 1998, 2000a, b). Comme le démarrage d'un seul canon à air équivaut au démarrage progressif d'une batterie, ces résultats permettent bien de penser que de nombreuses baleines à fanons vont s'éloigner dans les premiers moments d'un démarrage progressif. Ainsi, la plupart des baleines à fanons ne seront vraisemblablement pas exposées aux sons puissants des tirs de canon à air, pour autant que le mode de démarrage progressif soit appliqué. De même, de nombreuses baleines se trouvant à proximité de la trajectoire s'éloigneront probablement avant que les signaux émis d'un navire sismique qui s'approche deviennent assez forts pour provoquer un TTS ou toute autre perturbation auditive. Par conséquent, il y a peu de risques que les baleines à fanons ou les odontocètes qui tendent à éviter les navires ou les canons à air s'en approchent assez près pour subir un TTS. Le risque qu'un cétacé subisse une perte d'audition temporaire est peut-être plus élevé en zone confinée (p. ex. dans les étroits fjords côtiers), où il est difficile d'éviter un navire sismique, ou chez les animaux (certains odontocètes et de nombreux pinnipèdes) qui ne montrent pas ou montrent peu de réactions d'évitement. S'il s'avérait que quelques individus chez les cétacés subissent un TTS par suite de l'exposition à de fortes détonations de canon à air, le phénomène serait provisoire et réversible.

Permanent Threshold Shift (PTS).— When PTS occurs, there is physical damage to the sound receptors in the ear. In severe cases, there can be total or partial deafness, whereas in other cases, the animal or human has an impaired ability to hear sounds in specific frequency ranges.

Déplacement permanent de seuil (PTS) – La perte d'audition permanente suppose qu'il y a lésion des organes de réception du son de l'oreille. Dans les cas graves, il survient une surdité partielle ou totale; autrement, l'animal, ou l'humain, a une capacité diminuée d'entendre les sons dans certaines plages de fréquence.

There is no specific evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns. However, given the possibility that some mammals close to an airgun array might incur TTS, there has been further speculation about the possibility that some individuals occurring very close to airguns might incur PTS. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage in terrestrial mammals. Relationships between TTS and PTS thresholds have not been studied in marine mammals, but are assumed to be similar to those in humans and other terrestrial mammals. PTS might occur at a received sound level at least several decibels above that inducing mild TTS if the animal were exposed to strong sound pulses with rapid rise time. The specific difference between the PTS and TTS thresholds has not been measured for marine mammals exposed to any sound type. However, some reasonable assumptions can be made based on TTS and PTS data from terrestrial mammals exposed to impulses (Southall et al. 2007).

Il n'y a pas de preuve particulière que l'exposition aux bruits impulsionnels de canon à air occasionne un PTS chez aucun mammifère marin, même lorsque les tirs proviennent de grosses batteries. Cela dit, étant donné la possibilité que certains mammifères à proximité d'une batterie puissent subir une perte temporaire d'audition, on s'est de nouveau intéressé à la possibilité que certains individus à proximité des canons à air subissent une perte permanente. L'apparition unique ou occasionnelle d'une légère perte d'audition temporaire n'est pas l'indication d'une lésion permanente chez les mammifères terrestres. Les relations entre les niveaux d'apparition des pertes temporaire et permanente n'ont pas été étudiées chez les mammifères marins, mais on suppose qu'ils sont analogues à ceux chez les humains et d'autres mammifères terrestres. Un PTS pourrait être provoquer par un niveau sonore perçu supérieur d'au moins plusieurs décibels au niveau provoquant un léger TTS si l'animal était exposé à de fortes impulsions sonores dont le front de montée est rapide. La différence précise entre la valeur limite du PTS et celle du TTS n'a pas été mesurée chez les mammifères marins exposés à quelque type de son que ce soit. Cependant, des hypothèses raisonnables peuvent être avancées d'après les données de TTS et de PTS chez les mammifères terrestres exposés à des impulsions (Southall *et al.*, 2007).

On an SEL basis, Southall et al. (2007:441-4) estimated that received levels would need to exceed the TTS threshold by at least 15 dB for there to be risk of PTS. Thus, for cetaceans they

D'après le niveau d'exposition sonore (SEL), Southall *et al.* (2007:441-4) ont estimé qu'il faudrait que les niveaux perçus dépassent la valeur limite d'un TTS d'au moins 15 dB pour qu'il y ait risque de PTS. Ainsi, ces auteurs

estimate[2] that the PTS threshold might be a cumulative SEL (for the sequence of received pulses) of ~198 dB re 1 $\mu Pa^2 \cdot s$[(2)]. Additional assumptions had to be made to derive a corresponding estimate for pinnipeds, as there are no specific published data concerning received levels of impulse sounds associated with TTS onset in pinnipeds. Southall et al. estimate that the PTS threshold could be a cumulative SEL of ~186 dB re 1 $\mu Pa^2 \cdot s$ in the harbour seal; for the California sea lion and northern elephant seal the PTS threshold would very likely be higher.

estiment[2] que la valeur limite de PTS chez les cétacés pourrait être un SEL cumulé (pour la séquence d'impulsions captées) de ~198 dB re 1 $\mu Pa^2 \cdot s$. Il a fallu formuler d'autres hypothèses pour effectuer une estimation correspondante à l'égard des pinnipèdes. En effet, aucune donnée précise n'a été publiée concernant les niveaux perçus d'impulsions sonores qui provoqueraient un TTS chez les pinnipèdes. Southall *et al.* estiment que le seuil de perte d'audition permanente pourrait s'établir à un SEL de ~186 dB re 1 $\mu Pa^2 \cdot s$ chez le phoque commun; dans le cas de l'otarie de Californie et de l'éléphant de mer boréal, cette valeur limite serait très probablement plus élevée.

Southall et al. (2007) also note that, regardless of the cumulative received energy (SEL), there is concern about the possibility of PTS if a cetacean or pinniped received one or more pulses with a very high peak pressure. Based on data from terrestrial mammals, a precautionary assumption is that impulse sounds might cause immediate PTS if the received peak pressure were 6 dB (or more) above than the TTS threshold as measured on a peak-pressure basis (Southall et al. 2007). They conclude that PTS might occur if cetaceans (as exemplified by belugas and bottlenose dolphins) and pinnipeds (as exemplified by the harbour seal) were exposed to peak pressures exceeding 230 or 218 dB re 1 µPa (peak), respectively. A peak pressure of 230 dB re 1 µPa (3.2 bar · m, 0-pk) would only be found within a few meters of the largest airguns used in most airgun arrays (Caldwell and Dragoset 2000). A peak pressure of 218 dB re 1

Southall *et al.* (2007) indiquent aussi que, quelle que soit l'énergie cumulée reçue (SEL), un PTS est à craindre si un cétacé ou un pinnipède devait subir une ou plusieurs impulsions avec une pression de crête très élevée. D'après les données sur les mammifères terrestres, on peut prudemment supposer que les impulsions sonores pourraient occasionner un PTS immédiat si la pression de crête perçue se situait 6 dB (ou plus) au-dessus du seuil de perte d'audition temporaire, mesuré d'après la pression de crête (Southall *et al.,* 2007). Ces auteurs concluent que le PTS pourrait se produire si les cétacés (par exemple les bélugas et les dauphins à gros nez) et les pinnipèdes (par exemple le phoque commun) étaient exposés à des pressions de crête dépassant 230 ou 218 dB re 1 µPa, respectivement. Une pression de crête de 230 dB re 1 $\mu Pa^2 \cdot s$ (3,2 barres · m, 0-crête) ne se ferait ressentir qu'à quelques mètres des plus gros canons à air utilisés dans la plupart des batteries (Caldwell et Dragoset, 2000). Une pression de crête de 218 dB re 1 µPa pourrait

[2] This is based on the evidence from Finneran et al. (2002) that the TTS threshold in a beluga exposed to a watergun pulse is about 186 dB re 1 $\mu Pa^2 \cdot s$ (flat weighted), or 183 dB re 1 $\mu Pa^2 \cdot s$ after discounting the low-frequency components that are not heard well by odontocetes; and on evidence that the PTS threshold, on an SEL basis, would be at least 15 dB higher than the TTS threshold (Southall et al. 2007).

[2] D'après les indications de Finneran et al. (2002), selon lesquelles le seuil de perte d'audition temporaire chez un béluga exposé à l'impulsion d'un canon à eau est d'environ 186 dB re 1 $\mu Pa^2 \cdot s$ (en pondération horizontale), ou 183 dB re 1 $\mu Pa^2 \cdot s$ déduction faite des éléments de basse fréquence que n'entendent pas bien les odontocètes. L'hypothèse se fonde aussi sur des indications que le seuil de perte d'audition permanente, d'après le SEL, serait supérieur d'au moins 15 dB au seuil de perte d'audition temporaire (Southall et al., 2007).

µPa could be received somewhat farther away; to estimate that specific distance, one would need to apply a model that accurately calculates peak pressures in the near-field around an array of airguns.

Although it is unlikely that airgun operations during most seismic surveys would cause PTS in cetaceans, caution is warranted given the limited knowledge about noise-induced hearing damage in marine mammals. Commonly applied monitoring and mitigation measures, including visual monitoring, ramp-ups, and power-downs/shutdowns of the airguns when mammals are seen within the "safety radii", are expected to minimize the already-low probability of exposure of cetaceans to sounds strong enough to potentially induce PTS.

Non-Auditory Physiological Effects

DFO (2004a) determined that exposure to seismic sound under field operating conditions is unlikely to result in damage to non-auditory body tissues of marine mammals but that other sound sources operating simultaneously with seismic operations should be evaluated.

Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance, and other types of organ or tissue damage (Cox et al. 2006; Southall et al. 2007). It is possible that some marine mammal species (i.e., beaked whales) may be susceptible to injury and/or stranding when exposed to some types of strong transient sounds. However, studies examining such effects are very limited. If any such effects do occur, they would probably be limited to unusual situations when animals might be exposed at close range for unusually long periods, when the sound is strongly channeled with less-than- normal

être perçue un peu plus loin; pour estimer la distance précise, il faudrait appliquer un modèle qui calcule avec exactitude les pressions de crête dans le champ proche autour d'une batterie de canons à air.

Bien qu'il soit peu probable que des tirs sismiques de canon à air occasionnent un PTS chez les cétacés, la prudence s'impose, puisqu'on connaît mal les dommages auditifs que peut causer le bruit chez les mammifères marins. Les mesures de surveillance et d'atténuation communément appliquées, y compris la surveillance visuelle, le démarrage progressif et la diminution de puissance ou l'arrêt des canons à air lorsque des mammifères sont découverts dans le « rayon de sécurité », devraient réduire au minimum la probabilité déjà faible d'exposition des cétacés à des bruits suffisamment forts pour provoquer un PTS.

Effets physiologiques extra-auditifs

Le MPO (2004a) considère qu'il est peu probable que l'exposition à des bruits sismiques dans des conditions de prospection en mer résulte en des dommages aux tissus autres que du système auditif chez les mammifères marins, mais qu'il convient d'évaluer la présence concomitante d'autres sources sonores.

Les lésions ou effets physiologiques extra-auditifs que pourraient théoriquement subir les mammifères marins exposés à des forts bruits sous l'eau englobent les effets du stress, les effets neurologiques, la formation de bulles gazeuses, la résonance et d'autres types d'atteintes aux organes ou aux tissus (Cox *et al.*, 2006; Southall *et al.*, 2007). Il est possible que certaines espèces de mammifères marins (baleines à bec) subissent des atteintes ou s'échouent lorsque exposées à certains types de sons transitoires puissants. Or, les études de ces effets sont rares. Pour autant qu'ils se produisent, ces effets se cantonneraient probablement à des situations inhabituelles – animaux exposés de près pour une période anormalement longue, son fortement canalisé avec une perte de propagation inférieure à la normale, ou dispersion des animaux

propagation loss, or when dispersal of the animals is constrained by shorelines, shallows, etc. Airgun pulses, because of their brevity and intermittence, are less likely to trigger resonance or bubble formation than are more prolonged sounds. DFO (2004a) concluded that exposure to seismic sound under field operating conditions is unlikely to result in non-auditory physiological effects.

Until recently, it was assumed that diving marine mammals are not subject to the bends or air embolism. Jepson et al. (2003) first suggested a possible link between mid-frequency sonar activity and acute and chronic tissue damage that results from the formation in vivo of gas bubbles, based on the beaked whale stranding in the Canary Islands in 2002 during naval exercises. Fernández et al. (2005a) showed those beaked whales did indeed have gas bubble-associated lesions as well as fat embolisms. Fernández et al. (2005b) also found evidence of fat embolism in three beaked whales that stranded 100 km north of the Canaries in 2004 during naval exercises. Examinations of several other stranded species have also revealed evidence of gas and fat embolisms (e.g., Arbelo et al. 2005; Jepson et al. 2005a; Méndez et al 2005). Most of the afflicted species were deep divers. There is speculation that gas and fat embolisms may occur if cetaceans ascend unusually quickly when exposed to aversive sounds, or if sound in the environment causes the destabilization of existing bubble nuclei (Potter 2004; Arbelo et al. 2005; Fernández et al. 2005a; Jepson et al. 2005b; Cox et al. 2006). Even if gas and fat embolisms can occur during exposure to mid-frequency sonar, there is no evidence that that type of effect occurs in response to airgun sounds.

contrainte par le rivage, les hauts-fonds, etc. Les impulsions de canon à air, en raison de leur brièveté et de leur intermittence, sont moins susceptibles de provoquer la résonance ou la formation de bulles gazeuses que les sons qui se prolongent. Le MPO (2004a) a conclu que l'exposition aux bruits de l'exploration sismique est peu susceptible d'avoir des effets physiologiques extra-auditifs.

Jusqu'à récemment, on supposait que les mammifères marins plongeurs ne risquaient pas d'atteintes ostéo-arthro-articulaires (ou *bends*) ni d'embolie gazeuse. Jepson *et al.* (2003) ont été les premiers à signaler un lien possible entre l'utilisation d'un sonar à moyenne fréquence et des atteintes aiguës et chroniques des tissus provoquées par la formation *in vivo* de bulles gazeuses. Cette hypothèse a été avancée après l'échouement de baleines à bec aux îles Canaries en 2002, au cours d'exercices navals. Fernández *et al.* (2005a) ont montré que ces baleines à bec avaient subi des lésions provoquées par des bulles gazeuses ainsi que des embolies graisseuses. Fernández *et al.* (2005b) ont aussi constaté des embolies graisseuses chez trois baleines à bec qui se sont échouées à 100 km au nord des Canaries en 2004, au cours d'exercices navals. L'examen de plusieurs autres espèces dont des spécimens se sont échoués a aussi révélé la présence d'embolies gazeuses et graisseuses (voir notamment Arbelo *et al.*, 2005; Jepson *et al.*, 2005a; Méndez *et al.*, 2005). La plupart des victimes appartenaient à des espèces à plongées profondes. On suppose que les embolies se produisent si les cétacés remontent avec une rapidité inhabituelle lorsqu'ils sont exposés à des bruits aversifs ou si le bruit ambiant déstabilise des noyaux gazeux présents (Potter 2004; Arbelo *et al.*, 2005; Fernández *et al.*, 2005a; Jepson *et al.*, 2005b; Cox *et al.*, 2006). Même si des embolies gazeuses ou graisseuses peuvent survenir à l'exposition à un sonar à moyenne fréquence, rien n'indique que ce genre d'effet se produit en réaction aux émissions de canon à air.

In general, little is known about the potential for seismic survey sounds to cause non-auditory physical effects in marine mammals. Available data suggest that such effects, if they occur at all, would be limited to short distances and probably to projects involving large arrays of airguns. The available data do not allow identification of a specific exposure level (if any) above which such effects can be expected (Southall et al. 2007), or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. Marine mammals that show behavioural avoidance of seismic vessels, including most baleen whales, some odontocetes, and some pinnipeds, are especially unlikely to incur non-auditory physical effects. Also, mitigation measures typically employed during seismic programs, including shut-downs of the airguns (or power-downs in jurisdictions where such partial shut-downs are applied), will reduce any such effects that might otherwise occur.

En général, on connaît peu le risque que les bruits sismiques occasionnent des effets physiques extra-auditifs chez les mammifères marins. Selon les données dont on dispose, de tels effets, pour autant qu'ils se produisent, seraient limités à des courtes distances et supposeraient probablement l'utilisation de grosses batteries de canons à air. Les données ne permettent pas de déterminer un niveau d'exposition précis (s'il en est) auquel apparaîtraient les effets (Southall et al., 2007) ni de prévoir valablement le nombre de mammifères marins qui pourraient être affectés. Les mammifères marins qui montrent un comportement d'évitement des navires sismiques, y compris la plupart des baleines à fanons, certains odontocètes et certains pinnipèdes, sont particulièrement peu susceptibles de subir des effets physiques extra-auditifs. En outre, les mesures d'atténuation habituellement employées durant les campagnes sismiques, y compris l'arrêt des canons à air (ou la diminution de puissance, dans les territoires où de telles interruptions partielles sont prévues), réduiront tous les effets qui pourraient survenir.

Direct Behavioural Effects

Effets comportementaux directs

Displacement and Migratory Diversion[3]

DFO (2004a) concluded that "exposure to seismic sound can result in displacement and/or migratory diversion in some marine mammals, but this effect is species, individual, and contextually-related. The ecological significance of such effects is unknown, but there are conditions under which [the consequences of] the worst-case scenarios could be high."

Déplacement et déviation des voies migratoires[3]

Le MPO (2004a) conclut que « l'exposition à des bruits sismiques peut résulter en un déplacement et/ou une déviation des voies migratoires chez certains mammifères marins, mais ces effets dépendent de l'espèce, de l'individu et du contexte. Le degré d'importance écologique de ces effets est inconnu, mais il existe des conditions dans lesquelles les scénarios de la pire éventualité auraient de fortes incidences ».

Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (Wartzok et al. 2004; Southall et al. 2007). If a marine mammal does react briefly to an underwater sound by changing its

Les réactions au bruit dépendent de l'espèce, de la maturité, de l'expérience, de l'activité en cours, du stade reproducteur, du moment de la journée et de bien d'autres facteurs (Wartzok *et al.*, 2004; Southall *et al.*, 2007). Si un mammifère marin réagit brièvement à un son sous-marin en modifiant son comportement ou

[3] *This section also considers changes in feeding behaviour.*
[3] *Cette partie porte aussi sur la modification du comportement alimentaire.*

behaviour or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or the species as a whole (NRC 2005). However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on the animals could be significant. Given the many uncertainties in predicting the quantity and types of impacts of noise on marine mammals, it is common practice to estimate how many mammals were present within a particular distance of industrial activities, or exposed to a particular level of industrial sound. That likely overestimates the numbers of marine mammals that are affected in some biologically-important manner.

en s'éloignant un peu, les impacts du changement ont peu de chances d'être importants pour cet animal, encore moins pour la population ou pour l'espèce dans son ensemble (NRC 2005). Par contre, si une source sonore déplace des mammifères marins d'une importante zone d'alimentation ou de reproduction durant une longue période, les impacts sur ces animaux pourraient être importants. Vu les nombreuses incertitudes qui entachent la prévision de la quantité et du type d'impacts du bruit sur les mammifères marins, il est de pratique courante d'estimer combien de mammifères sont présents à une distance donnée d'activités industrielles ou qui sont exposés à un niveau donné de bruit industriel. Cette façon de faire surestime probablement le nombre de mammifères marins touchés d'une façon qui soit importante sur le plan biologique.

The sound criteria used to estimate how many marine mammals might be disturbed to some biologically important degree by a seismic program are based on behavioural observations during studies of several species. However, information is lacking for many species. Detailed studies of short-term responses (or lack thereof) have been done on humpback, gray, bowhead and sperm whales, and on ringed seals. Less detailed data are available for some other species of baleen whales, small toothed whales, and sea otters.

Les critères acoustiques utilisés pour estimer comment de nombreux mammifères marins pourraient être perturbés de façon importante sur le plan biologique par un programme sismique se fondent sur les comportements observés au cours d'études de plusieurs espèces. Cependant, les informations manquent pour de nombreuses espèces. Des études détaillées des réactions (ou de l'absence de réactions) à court terme ont été faites chez le rorqual à bosse, la baleine grise, la baleine boréale et le cachalot macrocéphale , ainsi que chez le phoque annelé. On dispose de données moins détaillées pour certaines autres espèces de baleines à fanons, de petites baleines à dents et de loutres de mer.

Mysticetes.—Mysticetes tend to avoid operating airguns, but avoidance radii are quite variable. Whales often reportedly show no overt reactions to airgun pulses at distances beyond a few kilometres, even though the airgun pulses remain well above ambient noise levels out to much longer distances. However, mysticetes exposed to strong noise pulses from airguns often react by deviating from their normal migration heading and/or interrupting their feeding and moving away. Recent studies and reviews on this topic include Gordon et al.

Mysticètes – Les mysticètes évitent généralement les tirs des canons à air, mais le rayon d'évitement est assez variable. Il semble que, souvent, les baleines ne montrent pas de réactions évidentes aux impulsions de canon à air lorsqu'elles se trouvent à plus de quelques kilomètres de distance, même si ces signaux impulsionnels sont beaucoup plus puissants que le bruit ambiant sur des distances beaucoup plus longues. Cela dit, les mysticètes exposés aux fortes impulsions sonores des canons à air réagissent souvent en s'écartant de leur voie de migration habituelle et/ou en arrêtant de s'alimenter pour s'éloigner. Les

(2004), Miller et al. (2005b), Moulton and Miller (2005), Stone and Tasker (2006), Gailey et al. (2007), Yazvenko et al. (2007a,b), and Weir (2008).

Recent Studies of Mysticete Reactions: It has been suggested that South Atlantic humpback whales wintering off Brazil may be displaced or even strand upon exposure to seismic surveys (Engel et al. 2004). The evidence for this was circumstantial, subject to alternative explanations (IAGC 2004), and not consistent with results from direct studies of humpbacks exposed to seismic surveys in other areas and seasons. After allowance for data from subsequent years, there was "no observable direct correlation" between strandings and seismic surveys (IWC 2007).

Results from bowhead whale studies show that responsiveness of a given species of mysticete to seismic surveys can be quite variable depending on the activity of the whales (e.g., migrating vs. feeding). Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular, are unusually responsive, with substantial avoidance occurring out to distances of 20–30 km from a medium-sized airgun source, where received sound levels were on the order of 130 dB re 1 μPa_{rms} (Miller et al. 1999; Richardson et al. 1999). However, more recent studies of bowhead whales (Miller et al. 2005b; Harris et al. 2007) corroborate earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources. In summer, bowheads typically begin to show avoidance reactions at a received level of about 160–170 dB re 1 μPa_{rms} (Richardson et al. 1986; Ljungblad et al. 1988; Miller et al. 2005a). Some individual bowheads on the feeding grounds apparently begin to react at distances a few kilometres away, beyond the distance at which observers on the

études et les analyses documentaires publiées récemment sur le sujet comprennent celles de Gordon *et al.* (2004), Miller *et al.* (2005b), Moulton et Miller (2005), Stone et Tasker (2006), Gailey *et al.* (2007), Yazvenko *et al.* (2007a,b), et Weir (2008).

Études récentes des réactions des mysticètes : Il a été avancé que les rorquals à bosse de l'Atlantique Sud hivernant au large du Brésil pourraient être déplacés ou même amenés à s'échouer par l'exposition à des tirs sismiques (Engel *et al.*, 2004). Les preuves de ce comportement étaient indirectes, et d'autres explications étaient possibles (IAGC, 2004). L'hypothèse ne s'accorde pas avec les résultats d'études directes de rorquals à bosse exposés à des tirs sismiques dans d'autres secteurs et à d'autres saisons. Une fois tenu compte des données des années ultérieures, il a été conclu qu'il n'y avait « aucune corrélation directe observable » entre les échouements et les levés sismiques (IWC, 2007).

Les résultats d'études chez la baleine boréale montre que la sensibilité d'une espèce donnée de mysticètes aux tirs sismiques peut être plutôt variable, selon l'activité des baleines (p. ex. migration ou alimentation). Les baleines boréales qui migrent vers l'Ouest et traversent la partie alaskienne de la mer de Beaufort à l'automne, en particulier, montrent une sensibilité inhabituelle : elles manifestent une réaction importante d'évitement à des distances d'entre 20 et 30 km d'un dispositif de canons à air de taille moyenne, quand elles reçoivent un niveau sonore de l'ordre de 130 dB re 1 μPa_{rms} (Miller *et al.*, 1999; Richardson *et al.*, 1999). Cela dit, des études plus récentes (Miller *et al.*, 2005b; Harris *et al.*, 2007) corroborent des données antérieures selon lesquelles, durant la période estivale d'alimentation, les baleines boréales ne sont pas aussi sensibles aux sources sismiques. À l'été, ces baleines commencent habituellement à manifester une réaction d'évitement à un niveau perçu d'environ 160-170 dB re 1 μPa_{rms} (Richardson *et al.*, 1986; Ljungblad *et al.*, 1988; Miller *et al.*, 2005a). Certains sujets dans les aires d'alimentation commencent apparemment à réagir à quelques kilomètres, mais trop loin pour que les observateurs à bord du navire

ship can readily observe bowheads (Richardson et al. 1986; Citta et al. 2007), but some others allow the seismic vessel to approach close enough for observers on the ship to see the whales (Harris et al. 2007). Although feeding bowheads often remain within a few kilometres of an active seismic vessel, statistical analysis showed evidence of subtle changes in surfacing, respiration and diving cycles when feeding bowheads were exposed to lower-level pulses from distant seismic operations (Richardson et al. 1986). Feeding whales may exhibit subtle changes in behaviour in response to the sounds, but the need to feed apparently reduces the tendency to move away.

puissent les observer (Richardson *et al.*, 1986; Citta *et al.*, 2007), mais d'autres baleines boréales laissent le navire sismique s'approcher suffisamment pour que les observateurs à bord puissent les voir (Harris *et al.*, 2007). Même si les baleines boréales en quête de nourriture demeurent souvent à quelques kilomètres d'un navire qui procède à des tirs sismiques, l'analyse statistique révèle de petites modifications dans les cycles de remontée, de respiration et de plongée quand elles étaient exposées à de faibles impulsions provenant de tirs sismiques lointains (Richardson *et al.*, 1986). Les baleines qui s'alimentent modifient parfois légèrement leur comportement en réaction aux bruits, mais le besoin de se nourrir réduit apparemment la tendance à s'éloigner.

Recently published data on the responses of western Pacific gray whales to 3D seismic exploration on their feeding grounds off Russia's Sakhalin Island have considerably augmented earlier data on effects of seismic surveys on feeding gray whales. One part of this Sakhalin study involved intensive daily aerial surveys to document the distribution and abundance of the whales, and their bottom feeding activity as evident through observation of mud plumes on the water surface (Yazvenko et al. 2007a, b). The aerial surveys did not find a statistically significant effect of the seismic survey on the frequency of occurrence of mud plumes of gray whales and concluded that the 2001 seismic survey had no measurable effect on bottom feeding activity (Yazvenko et al. 2007a). Analyses revealed a localized redistribution of some gray whales within the feeding area when the seismic survey was fully operational, but the total number of gray whales observed remained stable during the seismic survey (Yazvenko et al. 2007b). Simultaneous shore-based observations determined that the relative number of western gray whales and pods recorded did not significantly differ during periods when seismic surveys were occurring compared to periods without seismic surveys and to post-seismic periods

Des données ont récemment été publiées sur les réactions de baleines grises du Pacifique occidental à une exploration sismique tridimensionnelle menée dans leurs aires d'alimentation au large de l'île russe de Sakhaline. Ces données ont considérablement enrichi les informations antérieures sur les effets des levés sismiques sur les baleines grises en quête de nourriture. L'étude de Sakhaline a compris une intense campagne de reconnaissances aériennes quotidiennes pour documenter la répartition et l'abondance des baleines ainsi que leur activité d'alimentation sur le fond par l'observation des panaches de boue à la surface de l'eau (Yazvenko *et al.*, 2007a, b). Les reconnaissances aériennes n'ont pas montré un effet statistiquement significatif des tirs sismiques sur la fréquence d'observation des panaches de boue soulevés par les baleines grises. Il en a été conclu que les levés sismiques de 2001 n'avaient pas eu d'effet mesurable sur l'activité d'alimentation sur le fond (Yazvenko *et al.*, 2007a). Les analyses ont révélé une redistribution localisée de certains individus dans l'aire d'alimentation lorsque la campagne sismique battait son plein, mais le nombre total de baleines grises observées est demeuré stable durant la campagne (Yazvenko *et al.*, 2007b). Des observations simultanées à partir du rivage ont déterminé que le nombre relatif d'individus et de groupes de baleines grises occidentales n'était pas tellement différent

(Gailey et al. 2007). However, exposure to seismic sounds did have statistically significant effects on some measures of movement behaviour. Studies of the effectiveness of monitoring and mitigation measures determined that the techniques used were successful in reducing exposure of feeding gray whales to seismic sound to levels that did not result in serious disturbance effects (Johnson et al. 2007). Acoustic measurements at the start of the seismic survey determined that reduction of the originally-planned air gun array to 14 airguns and 1,640 in^3 (Rutenko et al. 2007), combined with establishment of a 4–5 km buffer zone, were effective in ensuring that western gray whales were not exposed to received levels exceeding a pre-selected "do not exceed" level of 163 dB re 1 μPa_{rms} (Johnson et al. 2007).

durant les tirs qu'entre les périodes de tir ou après la campagne sismique (Gailey *et al.*, 2007). Cependant, l'exposition à des bruits sismiques avait des effets statistiquement significatifs sur certains aspects mesurés du comportement de déplacement. Des études sur l'efficacité des mesures de surveillance et d'atténuation ont déterminé que les techniques utilisées réussissaient à réduire l'exposition des baleines grises en quête de nourriture au bruit sismique pour ramener l'exposition à des niveaux ne provoquant pas de perturbations importantes (Johnson *et al.*, 2007). Les mesures acoustiques prises au début des levés sismiques ont montré que la réduction de la taille de la batterie prévue à l'origine, qui a été ramenée à un dispositif de 14 canons à air d'un volume de 1 640 po^3 (Rutenko *et al.*, 2007), conjuguée à l'établissement d'une zone tampon de 4 ou 5 km, a réussi à empêcher l'exposition des baleines grises occidentales à des niveaux sonores perçus dépassant un seuil fixé de 163 dB re 1 μPa_{rms} (Johnson *et al.*, 2007).

Gray whales in British Columbia exposed to seismic survey sounds with received levels up to about 170 dB re 1 µPa $_{P-P}$ did not appear to be disturbed (Bain and Williams 2006). However, the small sample size (four sightings) and complex topography of the study area prevent any meaningful conclusions from being drawn.

En Colombie-Britannique, les baleines grises exposées à des bruits sismiques dont les niveaux perçus allaient jusqu'à environ 170 dB re 1 µPa crête à crête n'ont pas paru perturbées (Bain et Williams, 2006). Toutefois, la petitesse de l'échantillon (quatre observations) et la topographie complexe de la zone d'étude empêchent de tirer des conclusions sérieuses.

Among wintering humpback whales off Angola (n = 52 useable groups), there were no significant differences in encounter rates (sightings/hr) when a 24-airgun array (3147 in^3 or 5085 in^3) was operating vs. silent (Weir 2008). There was also no significant difference in the mean CPA (closest observed point of approach) distance of the humpback sightings when airguns were on vs. off (3050 m vs. 2700 m, respectively).

Parmi des rorquals à bosse hivernant au large de l'Angola (*n* = 52 groupes utilisables), l'utilisation d'une batterie de 24 canons à air (3 147 po^3 ou 5 085 po^3) n'a pas provoqué de différence importante dans le taux de rencontre (n^{bre} d'observations par heure) par rapport à lorsqu'il n'y avait pas de tirs (Weir, 2008). Il n'y a pas eu non plus de différence appréciable du point de rapprochement maximal (PRM) moyen observé des rorquals au moment où les canons tiraient et au moment où ils ne tiraient pas (3 050 m contre 2 700 m).

Various species of Balaenoptera (blue, sei, fin, and minke whales) have quite regularly been reported in areas of the North Atlantic ensonified by airgun pulses.

Diverses espèces de la famille des balénoptéridés (rorquals bleus, rorquals boréals, rorquals communs et petits rorquals) ont été signalées assez

Sightings by observers on seismic vessels (201 surveys) off the United Kingdom from 1997 to 2000 suggest that, at times of good sightability, numbers of rorquals seen are similar when airguns are active and inactive (Stone and Tasker 2006). Although the available data for individual species did not show significant displacement in relation to seismic surveys, when data from all baleen whales were combined, median distances (CPA) from the airguns were found to be significantly larger (~1600 m vs. 1000 m; see Figure 4 in Stone and Tasker 2006) and whales tended to head away from the vessel during seismic vs. non-seismic periods (Stone and Tasker 2006).

Similarly, in a study on the Scotian Slope, near the Gully submarine canyon (now a Marine Protected Area), Moulton and Miller (2005) found little difference in sighting rates (after accounting for water depth) and initial average sighting distances of balaenopterid whales when airguns were operating (mean = 1324 m) vs. silent (mean = 1303 m). However, there were indications that these whales were more likely to be moving away when seen during airgun operations. Baleen whales at the average sighting distance during airgun operations would have been exposed to sound levels (via direct path) of about 169 dB re 1 μPa_{rms} (Moulton and Miller 2005).

Ship-based monitoring studies of baleen whales (blue, fin, sei and minke whales) offshore Newfoundland (Orphan Basin and Laurentian Sub-basin) found no more than small differences in sighting rates and swim directions during seismic vs. non-seismic periods (Moulton et al. 2005, 2006a,b). Analyses of CPA data yielded variable results. The CPA of baleen whales sighted from the seismic vessels was, on average, significantly closer during non-seismic periods vs. seismic

régulièrement dans les zones de l'Atlantique Nord insonifiées par les impulsions de canon à air. Des observateurs à bord de navires sismiques (201 levés) au large du Royaume-Uni entre 1997 et 2000 ont signalé que, en périodes de bonne visibilité, le nombre de rorquals aperçus était analogue quand les canons à air tiraient que quand ils ne tiraient pas (Stone et Tasker, 2006). Les données disponibles pour chaque espèce n'ont pas montré que les tirs provoquaient un déplacement significatif, mais une fois réunies les données sur toutes les baleines à fanons, la distance moyenne (PRM) des canons à air s'est avérée beaucoup plus grande (~1 600 m contre 1 000 m; voir la figure 4 dans Stone et Tasker, 2006), et les baleines tendaient à s'éloigner du navire quand ses canons tiraient plutôt que quand ils étaient silencieux (Stone et Tasker, 2006).

Pareillement, dans une étude menée sur le talus Scotian, près du canyon sous-marin du Goulet (lequel est maintenant une aire marine protégée), Moulton et Miller (2005) ont trouvé peu de différence dans les taux d'observation (compte tenu de la profondeur de l'eau) et les distances moyennes initiales d'observation des balénoptéridés entre les moments où les canons à air tiraient (moyenne = 1 324 m) et les moments où ils étaient silencieux (moyenne = 1 303 m). Cela dit, il semble que les baleines aperçues au moment des tirs étaient plus susceptibles de s'éloigner. À la distance moyenne d'observation durant les tirs, les baleines à fanons auraient été exposées à des niveaux sonores (sur une trajectoire directe) d'environ 169 dB re 1 μPa_{rms} (Moulton et Miller, 2005).

Des études de surveillance des baleines à fanons (rorquals bleus, rorquals communs, rorquals boréals et petits rorquals) effectuées à partir de navires au large de Terre-Neuve (bassin Orphan et sous-bassin Laurentien) n'ont trouvé que de légères différences dans les taux d'observation et les directions où nageaient les baleines durant les tirs sismiques et durant les périodes sans tir (Moulton *et al.*, 2005, 2006a, b). Les analyses des données du point de rapprochement maximal ont livré des résultats variables. En

periods in 2004 in the Orphan Basin (means 1526 m vs. 2316 m, respectively; Moulton et al. 2005), but did not differ significantly (and were farther away during non-seismic periods) in 2005 in the Orphan Basin (973 m vs. 832 m, respectively; Moulton et al. 2006a) or in the Laurentian Sub-basin (means 1928 m vs. 1650 m; Moulton et al. 2006b). The authors of these reports, concluded that, based on observations from the seismic vessel, some mysticetes exhibited localized avoidance of seismic operations (Moulton et al. 2005,2006a).

2004, le PRM des baleines à fanons aperçues à partir des navires sismiques était, en moyenne, beaucoup plus près durant les périodes de levés sismiques qu'autrement dans le bassin Orphan (moyenne de 1 526 m contre 2 316 m; Moulton *et al.*, 2005). Par contre, aucune différence significative n'a été relevée en 2005 (et le PRM était plus éloigné durant les périodes où il n'y avait pas de levés) dans le bassin Orphan (973 m c. 832 m; Moulton *et al.*, 2006a) et dans le sous-bassin Laurentien (moyenne de 1 928 m c. 1 650 m; Moulton *et al.*, 2006b). Les auteurs des rapports ont conclu que, d'après les observations à partir du navire sismique, certains mysticètes montraient une réaction d'évitement localisé face aux tirs (Moulton *et al.*, 2005, 2006a).

Synthesis: Mysticetes tend to avoid operating airguns, but avoidance radii are quite variable. Whales are often reported to show no overt reactions to airgun pulses at distances beyond a few kilometres, even though the airgun pulses remain well above ambient noise levels out to much longer distances. However, studies done since the late 1990s of humpback and especially migrating bowhead whales show that reactions, including avoidance, sometimes extend to greater distances than documented earlier. Avoidance distances often exceed the distances at which boat-based observers can see whales, so observations from the source vessel may be biased. Studies indicate monitoring over broader areas may be needed to determine the range of potential effects of some larger seismic surveys (Miller et al. 1999; Bain and Williams 2006; Moore and Angliss 2006).

Synthèse : Les mysticètes tendent à éviter les tirs de canon à air, mais les rayons d'évitement varient pas mal. On signale souvent que les baleines ne montrent pas de réactions manifestes aux impulsions des canons à air à plus de quelques kilomètres, même si ces impulsions demeurent bien supérieures au bruit ambiant sur des distances beaucoup plus longues. Cela dit, des études réalisées depuis la fin des années 1990 chez le rorqual à bosse et surtout chez les baleines boréales migratrices révèlent que les réactions, y compris d'évitement, surviennent parfois à des distances beaucoup plus grandes que celles qui avaient été documentées auparavant. Comme les distances d'évitement dépassent souvent les distances auxquelles les observateurs à bord de bateaux peuvent apercevoir les baleines, les observations à partir du navire source peuvent être biaisées. Des études indiquent que la surveillance sur des zones plus vastes sera peut-être nécessaire pour déterminer l'éventail des effets possibles de campagnes sismiques d'envergure (Miller *et al.*, 1999; Bain et Williams, 2006; Moore et Angliss, 2006).

Some mysticetes show considerable tolerance of seismic pulses. However, when the pulses are strong enough, avoidance or other behavioural changes become evident. Because the responses

Certains mysticètes montrent une tolérance considérable à l'égard des impulsions sismiques. Toutefois, quand les impulsions sont assez fortes, une réaction d'évitement ou une autre modification du comportement se

become less obvious with diminishing received sound level, it has been difficult to determine the maximum distance (or minimum received sound level) at which reactions to seismic become evident and, hence, how many whales are affected.

manifestent. Comme les réactions deviennent moins évidentes à mesure que le niveau sonore perçu diminue, il a été difficile de déterminer la distance maximale (ou le niveau sonore perçu minimal) à laquelle les réactions aux tirs sismiques se manifestent et, donc, de déterminer combien de baleines sont touchées.

Studies of gray, bowhead, and humpback whales have determined that received levels of pulses in the 160–170 dB re 1 μPa_{rms} range seem to cause obvious avoidance behaviour in a substantial fraction of the animals exposed. In the case of migrating bowhead whales, avoidance extends to lower received sound levels and larger distances. However, in other situations, various mysticetes tolerate exposure to full-scale airgun arrays operating at closer distances, with only localized avoidance and minor changes in activities.

Des études chez la baleine grise, la baleine boréale et le rorqual à bosse ont déterminé que des niveaux perçus d'impulsions dans la plage de 160-170 dB re 1 μPa_{rms} semble occasionner un comportement d'évitement manifeste chez une bonne proportion des animaux exposés. Dans le cas des baleines boréales en migration, l'évitement se manifeste à des niveaux sonores perçus moins élevés et sur des distances plus longues. Par contre, dans d'autres situations, divers mysticètes tolèrent l'exposition à des batteries complètes de canons à air tirant à distance rapprochée, ne manifestant qu'un évitement localisé et ne modifiant que légèrement leurs activités.

Data on short-term reactions (or lack of reactions) of cetaceans to impulsive noises do not necessarily provide information about long-term effects. It is not known whether impulsive noises affect reproductive rate or distribution and habitat use in subsequent days or years. Furthermore, effects likely vary among species, locations, and times of year, and depending on past exposure to seismic sounds. In general, among mammals, mysticetes are relatively long-lived, mature late, have relatively low reproductive rates, and require high maternal investment in young. This is particularly true for bowhead and right whales. Thus, the female's ability to provide adequate care to her offspring during a prolonged period of dependency is critical to the continued recovery and long-term viability of these populations. These life history traits support the need to avoid disturbance in certain seasons or locations (Wilson et al. 2006). It has been suggested that migrating bowheads may warrant special consideration among mysticetes in terms of documented

Les données sur les réactions (ou sur l'absence de réactions) à court terme des cétacés à des bruits impulsionnels ne fournissent pas nécessairement d'informations sur les effets à long terme. On ne sait pas si les bruits impulsionnels modifient le taux de reproduction ou la répartition et l'utilisation de l'habitat dans les jours ou les années qui suivent. De plus, les effets varient probablement entre les espèces, entre les lieux et entre les moments de l'année, et dépendent de l'exposition passée à des bruits sismiques. En général, par comparaison aux autres mammifères, les mysticètes vivent assez longtemps, atteignent la maturité tard et ont un taux de reproduction relativement faible, et les jeunes exigent un grand investissement maternel. C'est particulièrement vrai chez la baleine boréale et la baleine noire de l'Atlantique Nord. Ainsi, la capacité de la femelle de prendre un soin adéquat de sa progéniture durant la longue période de dépendance de celle-ci est cruciale pour que les populations continuent de se rétablir et soient viables à long terme. Ces particularités du cycle biologique confirment le besoin d'éviter de perturber ces

deflection impacts of seismic operations, particularly during the spring when ice may constrain migration pathways (Wilson et al. 2006). However, given the remarkable abilities of bowheads to travel through heavy ice, and the impossibility of conducting conventional seismic surveys in heavy ice, this does not seem likely to be an issue.

Odontocetes.—Few studies similar to the more extensive baleen whale/seismic pulse work have been reported for odontocetes, and none similar in size and scope to the studies of humpback, bowhead, and gray whales. However, a systematic study on sperm whales has been done (see Jochens et al. 2006; Miller et al. 2006), and there is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies (e.g., Smultea et al. 2004; Moulton and Miller 2005; Bain and Williams 2006; Holst et al. 2006; Stone and Tasker 2006; Weir 2008).

Seismic operators and marine mammal observers regularly see dolphins and other small odontocetes near operating airgun arrays, but in general there seems to be a tendency for most delphinids to show some limited avoidance of operating seismic vessels, on the order of 1 km or less (e.g., Moulton and Miller 2005; Holst et al. 2006; Weir 2008). Some dolphins (and Dall's porpoises) seem to be attracted to the seismic vessel and floats, and some ride the bow wave of the seismic vessel even when large arrays of airguns are active (e.g., MacLean and Koski 2005; Moulton and Miller 2005). Nonetheless, small toothed whales often tend to head away, or to maintain a somewhat greater distance from the

animaux à certaines saisons ou dans certains lieux (Wilson *et al.*, 2006). On a laissé entendre que les baleines boréales migratrices mériteraient peut-être une attention particulière parmi les mysticètes pour ce qui est de documenter l'effet de déport qu'auraient sur elles les tirs sismiques, surtout au printemps, lorsque la glace contraint le parcours migratoire (Wilson *et al.*, 2006). Cela dit, vu la capacité remarquable des baleines boréales de se déplacer dans un encombrement de glaces et vu l'impossibilité d'effectuer des levés sismiques conventionnels dans de la glace épaisse, il ne semble pas justifier de s'attarder à cet aspect.

Odontocètes – Peu d'études semblables aux vastes travaux effectués sur l'effet des impulsions sismiques sur les baleines à fanons ont été recensées à l'égard des odontocètes, et aucune de l'envergure des études effectuées chez les rorquals à bosse, les baleines boréales et les baleines grises. Cependant, une étude systématique a été réalisée chez les cachalots macrocéphales (voir Jochens *et al.*, 2006; Miller *et al.*, 2006), et il y a une quantité croissante d'informations sur les réactions de divers odontocètes aux levés sismiques d'après les études de surveillance (voir notamment Smultea *et al.*, 2004; Moulton et Miller, 2005; Bain et Williams, 2006; Holst *et al.*, 2006; Stone et Tasker, 2006; Weir, 2008).

Les opérateurs sismiques et les observateurs de mammifères marins voient régulièrement des dauphins et d'autres petits odontocètes près de batteries qui déchargent leurs canons à air, mais, en général, il semble que la plupart des delphinidés montrent une réaction restreinte d'évitement des navires sismiques en activité, dans un rayon de l'ordre de 1 km ou moins (voir notamment Moulton et Miller, 2005; Holst *et al.*, 2006; Weir, 2008). Certains dauphins (et le marsouin de Dall) paraissent attirés par les navires et les flotteurs sismiques, et certains se laissent porter dans les vagues d'étrave du navire même lorsque de grosses batteries de canons à air fonctionnent (voir notamment MacLean et Koski, 2005; Moulton et Miller, 2005). Cela dit, les petites baleines à dents

vessel, when a large array of airguns is operating than when it is silent (see Stone and Tasker 2006; Weir 2008). The beluga may be a species that (at least at times) shows long-distance avoidance of seismic vessels. Aerial surveys during seismic operations in the southeastern Beaufort Sea recorded much lower sighting rates of beluga whales within 10–20 km of an active seismic vessel. These results were consistent with the low number of beluga sightings reported by observers aboard the seismic vessel, suggesting that some belugas might be avoiding the seismic operations at distances of 10–20 km (Miller et al. 2005a). Similarly, very few belugas were observed during a recent seismic monitoring program in the southeastern Beaufort Sea (Harris et al. 2007).

s'éloignent souvent d'un navire qui décharge sa grosse batterie ou se tiennent à plus grande distance que lorsqu'il ne tire pas (voir Stone et Tasker, 2006; Weir, 2008). Le béluga est peut-être une espèce qui (du moins parfois) montre une réaction d'évitement à grande distance des navires sismiques. La reconnaissance aérienne au cours de levés sismiques dans le sud-est de la mer de Beaufort a donné des taux d'observation du béluga beaucoup plus faibles dans un rayon de 10 à 20 km d'un navire sismique en activité. Ces résultats s'accordent avec le peu d'individus aperçus par les observateurs à bord du navire, ce qui fait supposer que certains bélugas pourraient éviter les tirs sismiques à des distances de 10-20 km (Miller *et al.*, 2005a). De même, très peu de bélugas ont été observés au cours d'un récent programme de surveillance sismique dans la partie sud-est de la mer de Beaufort (Harris *et al.*, 2007).

During two National Science Foundation (NSF)-funded L-DEO seismic surveys in which a large 20-airgun array (~7,000 in3) was used, sighting rates of delphinids were lower and initial sighting distances were farther away from the vessel during seismic than non-seismic periods (Smultea et al. 2004; Holst et al. 2005a, 2006). The mean CPA for delphinids for both cruises was significantly farther during seismic (1043 m) than during non-seismic (151 m) periods. Surprisingly, during one of these cruises in the southeastern Caribbean, nearly all acoustic detections of odontocetes (including delphinids and sperm whales) were made during airgun operations (Smultea et al. 2004). In contrast, during the second survey (off the Yucatán Peninsula, Mexico), acoustic detection rates of odontocetes were nearly five times higher during non-seismic vs. seismic periods (Holst et al. 2005a).

Au cours de deux campagnes sismiques de l'observatoire terrestre Lamont-Doherty financées par la Fondation nationale des sciences des États-Unis, le fonctionnement d'une grosse batterie de 20 canons à air (~7 000 po^3) a fait baisser le taux d'observation de delphinidés et augmenter la distance d'observation initiale par rapport au navire par comparaison à lorsqu'il n'y avait pas de tirs sismiques (Smultea *et al.*, 2004; Holst *et al.*, 2005a, 2006). Le point de rapprochement maximal moyen des delphinidés au cours des deux campagnes était sensiblement plus éloigné durant les tirs sismiques (1 043 m) que durant les périodes silencieuses (151 m). Étonnamment, au cours d'une de ces campagnes dans le sud-est de la mer des Caraïbes, presque toutes les détections acoustiques d'odontocètes (y compris de delphinidés et de cachalots macrocéphales) ont été faites durant les tirs de canon à air (Smultea *et al.*, 2004). Par contre, au cours de la seconde campagne (au large de la péninsule du Yucatán, au Mexique), le taux de détection acoustique d'odontocètes a été presque cinq fois plus élevé durant les périodes silencieuses que durant les périodes de tirs (Holst *et al.*, 2005a).

An analysis of observations taken during 201 seismic surveys in UK and adjacent waters indicated that small odontocetes showed a greater range of responses to seismic surveys than did mysticetes or larger odontocetes, including significant declines in sighting rates during periods of seismic surveys (Stone and Tasker 2006). On the other hand, larger odontocetes (long-finned pilot whales, killer whales and sperm whales) showed little response to airgun activities and no reduction in sighting rates during periods of seismic surveys. Stone and Tasker (2006) suggested that avoidance behaviours exhibited by small odontocetes, and to a lesser extent by other cetaceans, appeared to be temporary.

Two seismic surveys were completed in the Orphan Basin, off Newfoundland and Labrador, in 2004 and 2005 (Moulton et al. 2005, 2006a). During both surveys, dolphin sighting rates, taking temporal variation into consideration, were higher during non-seismic periods than during seismic periods, although this difference was only statistically significant in 2004. The mean CPA of dolphins was significantly closer during non-seismic periods (652 m) vs. seismic periods (807 m) in 2005, but the difference was not statistically significant in 2004 (705 m vs. 665 m, respectively). The sighting rates of large odontocetes, primarily sperm whales, (taking temporal variation into consideration) and CPAs did not differ statistically between seismic periods vs. non-seismic periods in 2004 or 2005 in the Orphan Basin. The authors concluded that based on observations from the seismic vessel some odontocetes exhibited localized avoidance of seismic operations (Moulton et al. 2005, 2006a). Similar results for odontocetes were observed during a marine mammal monitoring program in the Laurentian Sub-basin (Moulton et al. 2006b). A major study of sperm whales in the Gulf of Mexico found that they did not show any large-scale avoidance reactions to operating airguns (Jochens et al. 2006).

L'analyse des observations faites au cours de 201 levés sismiques dans les eaux du Royaume-Uni et dans les eaux avoisinantes montre que les petits odontocètes ont eu un éventail plus large de réactions aux tirs sismiques que n'en ont eu les mysticètes ou les grands odontocètes. Notamment, le taux d'observation des petits odontocètes chutait durant les périodes de tirs (Stone et Tasker, 2006). Au contraire, les grands odontocètes (globicéphales noirs, épaulards et cachalots macrocéphales) ont peu réagi aux tirs des canons à air, et le taux d'observation n'a pas diminué en période de tirs. Stone et Tasker (2006) ont indiqué que le comportement d'évitement manifesté par les petits odontocètes, et dans une moindre mesure par d'autres cétacés, semblait temporaire.

Deux campagnes sismiques ont été réalisées dans le bassin Orphan, au large de Terre-Neuve-et-Labrador, en 2004 et en 2005 (Moulton *et al.*, 2005, 2006a). Au cours des deux campagnes, le taux d'observation des dauphins, compte tenu de la variation temporelle, a été plus élevé en périodes silencieuses qu'en périodes de tirs, bien que la différence n'ait été statistiquement significative qu'en 2004. Le PRM moyen des dauphins était sensiblement plus près en périodes silencieuses (652 m) qu'en périodes de tirs (807 m) en 2005, mais la différence n'a été statistiquement significative qu'en 2004 (705 m contre 665 m). Les taux d'observation des grands odontocètes, principalement les cachalots macrocéphales (compte tenu de la variation temporelle) et les PRM n'ont pas montré de différence statistiquement significative entre les périodes de tirs et les périodes silencieuses en 2004 ou en 2005 dans le bassin Orphan. Les auteurs concluent, d'après les observations à partir du navire sismique, que certains odontocètes ont manifesté un évitement localisé des tirs (Moulton *et al.*, 2005, 2006a). On a obtenu des résultats analogues chez les odontocètes dans le contexte d'un programme de surveillance des mammifères marins dans le sous-bassin Laurentien (Moulton *et al.*, 2006b). Une vaste étude des cachalots macrocéphales dans le golfe du Mexique a montré qu'ils ne manifestaient pas de réactions à grande

Similarly, a recent study off Angola found no significant effect of a prolonged seismic operation on sperm whale sighting rates or distances (Weir 2008).

échelle d'évitement des tirs de canon à air (Jochens *et al.*, 2006). De même, une étude récente au large de l'Angola n'a pas révélé qu'une campagne sismique prolongée avait eu d'effet important sur le taux d'observation ou la distance des cachalots macrocéphales (Weir, 2008).

Reactions of odontocetes to a single airgun or other small airgun source are not well documented, but do not seem to be very substantial (e.g., Stone 2003). Results from three NSF-funded L-DEO seismic surveys using small arrays (up to three GI guns totalling up to 315 in^3) were inconclusive. During surveys in the Eastern Tropical Pacific (Holst et al. 2005b) and in the Northwest Atlantic (Haley and Koski 2004), detection rates were slightly lower during seismic operations compared to non-seismic periods. However, mean CPAs were closer during seismic operations during one cruise (Holst et al. 2005b), and greater during the other cruise (Haley and Koski 2004). Interpretation of the data was confounded by the fact that survey effort and/or number of sightings during non-seismic periods during both surveys was small.

Les réactions d'odontocètes à un seul canon à air ou à un autre petit dispositif de tirs à air comprimé ne sont pas bien documentées, mais elles semblent considérables (voir notamment Stone, 2003). Les résultats de trois levés sismiques de l'observatoire terrestre Lamont-Doherty financés par la Fondation nationale des sciences n'ont pas été concluants; on utilisait de petites batteries (jusqu'à trois canons GI pour un volume total d'au plus 315 po^3). Au cours de levés dans la partie est de l'océan Pacifique tropical (Holst *et al.*, 2005b) et dans le nord-ouest de l'Atlantique (Haley et Koski, 2004), les taux de détection étaient légèrement inférieurs durant les tirs sismiques que durant les périodes silencieuses. Toutefois, les PRM moyens ont été plus près durant les tirs au cours d'une campagne (Holst *et al.*, 2005b), et plus éloignés durant l'autre campagne (Haley et Koski, 2004). Le fait qu'il s'agissait de petites campagnes et que le nombre d'observations en périodes silencieuses a été faible dans les deux cas a constitué un facteur de confusion dans l'interprétation des données.

Porpoises, like delphinids, show variable reactions to seismic operations, and reactions apparently depend on species. The limited available data suggest that harbour porpoises show stronger avoidance of seismic operations than Dall's porpoises (Stone 2003; MacLean and Koski 2005; Bain and Williams 2006). In Washington State waters, the harbour porpoise - despite being considered a high-frequency specialist - appeared to be the species affected by the lowest received level of sound (<145 dB re 1 μPa_{rms} at a distance > 70 km) (Bain and Williams 2006). In contrast, Dall's porpoises seem relatively tolerant of airgun operations (MacLean and Koski 2005; Bain and Williams 2006). This

Les marsouins, comme les delphinidés, manifestent face aux tirs sismiques des réactions variées, qui dépendent apparemment de l'espèce. D'après le peu de données disponibles, il semble que le marsouin commun montrent une réaction d'évitement plus forte que celle du marsouin de Dall (Stone, 2003; MacLean et Koski, 2005; Bain et Williams, 2006). Dans les eaux de l'État de Washington, le marsouin commun – pourtant considéré comme un amateur de hautes fréquences – semble être une espèce touchée par le niveau sonore perçu le plus bas (< 145 dB re 1 μPa_{rms} à une distance de > 70 km) (Bain et Williams, 2006). Par contre, le marsouin de Dall paraît plutôt tolérant aux tirs des canons à air (MacLean et Koski, 2005; Bain et Williams, 2006). Cette différence

apparent difference in responsiveness of these two porpoise species is consistent with their relative responsiveness to boat traffic and some other acoustic sources (Richardson et al. 1995; Southall et al. 2007).

apparente de sensibilité entre les deux espèces de marsouin s'accorde avec leur sensibilité relative à la circulation des navires et à d'autres sources sonores (Richardson *et al.*, 1995; Southall *et al.*, 2007).

There are no specific data on the behavioural reactions of beaked whales to seismic surveys. Most beaked whales tend to avoid approaching vessels of other types (e.g., Würsig et al. 1998; see also Sorensen et al. 1984). They may also dive for an extended period when approached by a vessel (e.g., Kasuya 1986). It is likely that these beaked whales would normally show strong avoidance of an approaching seismic vessel, but this has not been documented explicitly. However, northern bottlenose whales sometimes are quite tolerant of slow-moving vessels (see Reeves et al. 1993; Hooker et al. 2001). However, those vessels were not emitting airgun pulses. Northern bottlenose whales have been observed from seismic vessels during periods of airgun operations (Moulton et al. 2006a,b).

Il n'y a pas de données précises sur le comportement des baleines à bec en réaction à des levés sismiques. La plupart des baleines à bec tendent à éviter tout navire qui s'approche (voir notamment Würsig *et al.*, 1998; Sorensen *et al.*, 1984). Elles peuvent aussi plonger pour un long moment lorsqu'un navire s'approche (voir notamment Kasuya, 1986). Il est probable que ces baleines manifesteraient normalement une forte réaction d'évitement à un navire sismique s'approchant, mais le fait n'a pas été explicitement documenté. Cela dit, les baleines à bec communes sont parfois très tolérantes des navires qui avancent lentement (voir Reeves *et al.*, 1993; Hooker *et al.*, 2001). Dans les cas relevés, cependant, les navires n'émettaient pas d'impulsions de canon à air. Les baleines à bec communes ont été observées à partir de navires sismiques durant des tirs (Moulton *et al.*, 2006a,b).

Conclusion: Dolphins and porpoises are often seen by observers on active seismic vessels, occasionally at close distances. However, some studies show localized avoidance. Belugas summering in the Beaufort Sea tended to avoid waters out to 10–20 km from an operating seismic vessel (Miller et al. 2005b). Recent studies show little evidence of avoidance reactions by sperm whales to airgun pulses, contrary to earlier indications.

Conclusion : Des dauphins et des marsouins sont souvent aperçus par des observateurs à bord de navires sismiques en activité, à l'occasion de près. Toutefois, certaines études révèlent un évitement localisé. Les bélugas passant l'été dans la mer de Beaufort tendent à éviter les parages (10-20 km) d'un navire sismique en activité (Miller *et al.*, 2005b). Des études récentes ont trouvé peu d'indications d'une réaction d'évitement chez les cachalots macrocéphales face aux impulsions de canon à air, contrairement à ce qui avait été indiqué antérieurement.

Odontocete reactions to large arrays of airguns are variable. For delphinids and Dall's porpoises,significant disturbance seems to be confined to a smaller radius than has been observed for the more responsive of the mysticetes, belugas, and harbour porpoises. For delphinids and Dall's porpoises (and also pinnipeds), strong reactions seem to be largely

Les réactions des odontocètes à de grosses batteries de canons à air varient. Chez les delphinidés et le marsouin de Dall, les perturbations importantes semblent confinées à un rayon plus court que celui observé chez les mysticètes, bélugas et marsouins communs parmi les plus sensibles. Chez les delphinidés et le marsouin de Dall (ainsi que chez les pinnipèdes), les réactions fortes se limitent

limited to the area within 1 or 2 km of airgun arrays. Given the available data on typical received levels of airgun array sound at those distances, a ≥170 dB re 1 μPa_{rms} disturbance criterion is probably more appropriate for delphinids, Dall's porpoises (and pinnipeds) than the ≥160 dB criterion that is often used. The 160 dB criterion originated from studies of gray, bowhead and humpback whales, and its blanket application to odontocetes is not well justified.

Pinnipeds.—Monitoring results from the Canadian Beaufort Sea during 2001-2002 were variable (Miller et al. 2005b). During 2001, sighting rates of seals (mostly ringed seals) were similar during all seismic states, including periods without airgun operations. However, seals were seen closer to the vessel (on average) during non-seismic than during seismic periods. In contrast, during 2002, sighting rates of seals were higher during non-seismic periods than seismic operations, and seals tended to be seen farther from the vessel during non-seismic compared to seismic activity (a marginally significant result). The combined data for both years showed that sighting rates were higher during non-seismic periods compared to seismic periods, and that sighting distances were similar during both seismic states. Miller et al. (2005b) concluded that seals showed very limited avoidance to the operating airgun array. That conclusion was consistent with results from six seasons of seismic monitoring in the Alaskan Beaufort Sea (Harris et al. 2001; Moulton and Lawson 2002).

In summary, visual monitoring from seismic vessels has shown only slight (if any) avoidance of airguns by pinnipeds, and only slight (if any) changes in behaviour. This, and other studies, indicate that pinnipeds frequently do not avoid the area within a few hundred meters of an operating airgun array. This indicates that most pinnipeds are

largement à une distance de 1 à 2 km des batteries. Selon les données disponibles sur les niveaux sonores habituellement perçus des canons à air à ces distances, un critère de perturbation de ≥ 170 dB re 1 μPa_{rms} convient probablement mieux à l'égard des delphinidés et du marsouin de Dall (ainsi que des pinnipèdes) que le critère de ≥ 160 dB qui est souvent utilisé. Le critère de 160 dB provient d'études chez la baleine grise, la baleine boréale et le rorqual à bosse, et son application généralisée à tous les odontocètes se justifie mal.

Pinnipèdes – Les résultats de surveillance dans la partie canadienne de la mer de Beaufort en 2001-2002 ont varié (Miller *et al.*, 2005b). En 2001, les taux d'observation des phoques (surtout du phoque annelé) ont été similaires à toutes les étapes de la campagne sismique, même en périodes silencieuses. Cependant, les phoques s'approchaient davantage du navire, en moyenne, durant les périodes silencieuses que durant les périodes de tirs. En revanche, en 2002, les taux d'observation des phoques ont été plus élevés durant les périodes silencieuses que durant les tirs, et les phoques étaient vus en général plus loin du navire quand il n'y avait pas de tirs (résultat marginalement significatif). La combinaison des données des deux années a montré que les taux d'observation étaient plus élevés en périodes silencieuses, et que les distances d'observation étaient analogues, avec ou sans tir. Miller *et al.* (2005b) ont conclu que les phoques manifestaient une réaction très restreinte d'évitement à l'égard des batteries de canons à air en activité. Cette conclusion s'accordait avec les résultats de six saisons de surveillance sismique dans la partie alaskienne de la mer de Beaufort (Harris *et al.*, 2001; Moulton et Lawson, 2002).

En résumé, la surveillance visuelle à partir de navires sismiques a montré une réaction d'évitement légère (ou nulle) des canons à air de la part des pinnipèdes et seulement une modification légère (ou aucune modification) du comportement. Ce résultat, et ceux d'autres études, indiquent que les pinnipèdes souvent n'évitent pas la zone de quelques centaines de mètres autour d'une batterie de canons à air qui

apparently not much disturbed even by the rather close approach of an operating seismic vessel. On the other hand, this lack of avoidance is a concern because it suggests that one cannot rely on pinnipeds to move away before received levels of airgun sound approach those that may cause TTS (and perhaps even PTS in certain cases).

Fissipeds.—No information on sea otter and polar response to seismic sounds has become available since 2004. From past studies, it appears that sea otters may be less responsive to marine seismic pulses than other marine mammals (Riedman 1983, 1984). Also, sea otters spend a great deal of time at the surface feeding and grooming. While at the surface, the potential noise exposure of sea otters would be much reduced by the pressure release effect at the surface.

Airgun effects on polar bears have not been studied. However, polar bears on the ice would be unaffected by underwater sound. Sound levels received by polar bears in the water would be attenuated because polar bears generally do not dive much below the surface and received levels of airgun sounds are reduced near the surface because of the pressure release effect at the water's surface (Greene and Richardson 1988; Richardson et al. 1995).

Changes in Dive and Respiratory Patterns

DFO (2004a) concluded that "exposure to seismic sound can result in changes in dive and respiratory patterns of some marine mammals, but this effect is expected to vary with species, individual, and context. The ecological significance of such effects is unknown, but there are conditions under which [the consequences of] the worst-case scenarios could be high."

tire. La plupart des pinnipèdes ne sembleraient donc pas très perturbés même par la présence plutôt rapprochée d'un navire sismique en activité. Cette absence de réaction d'évitement est préoccupante, car elle signifie qu'on ne peut compter que les pinnipèdes s'éloigneront avant que le niveau perçu de bruit sismique approche le niveau qui pourrait occasionner un TTS (voir dans certains cas un PTS).

Fissipèdes – On ne dispose d'aucune information sur la réaction à des bruits sismiques de la loutre de mer et de l'ours polaire depuis 2004. D'après les études passées, il semble que la loutre de mer soit moins sensible aux impulsions de la sismique marine que d'autres mammifères marins (Riedman, 1983, 1984). De plus, la loutre de mer passe beaucoup de temps à la surface pour s'alimenter et faire sa toilette. Lorsqu'elle se trouve à la surface, l'exposition éventuelle est très réduite en raison de la détente de pression.

L'effet des canons à air sur l'ours blanc n'a pas été étudié. Toutefois, quand il se trouve sur la glace, l'ours ne serait pas affecté par le bruit sous-marin. Le niveau sonore perçu dans l'eau serait atténué, parce que l'ours blanc, en général, ne plonge pas très loin de la surface, et les niveaux perçus des sons provenant des canons à air sont réduits près de la surface, en raison de la détente de pression à la surface de l'eau (Greene et Richardson, 1988; Richardson *et al.*, 1995).

Changements dans les régimes de plongée et de respiration

Le MPO (2004a) conclut que « l'exposition à des bruits sismiques peut résulter en des changements dans les régimes de plongée et de respiration chez certains mammifères marins, mais on s'attend à ce que ces effets varient selon l'espèce, l'individu et le contexte. Le degré d'importance écologique de ces effets est inconnu, mais il existe des conditions dans lesquelles le pire des scénarios pourrait avoir de fortes incidences ».

Recent results from the sperm whale tagging studies in the northern Gulf of Mexico have shown that, among eight tagged sperm whales exposed to airgun sounds, neither gross diving behaviour nor direction of movement changed for any of the individuals exposed to onset of seismic airgun sounds. These observations were obtained at the onset of gradual ramp-up at ranges of 7–13 km or during full-power exposures 1.5–12.8 km from the airguns (Jochens et al. 2006). However, some changes in foraging behaviour were observed that suggested avoidance of deep dives near operating airguns. Foraging behaviour was disrupted by airguns at exposure levels ranging from <130 to 162 dB re 1 μPa_{P-P} at distances of roughly 1–12 km from the sound source. The sample size was small. These results raise questions about the efficacy of ramp-up as a mitigation strategy for sperm whales, i.e., whether they swim away from oncoming seismic vessels. However, the observations may not be relevant to sperm whales in habitats where there has been less seismic exploration than the Gulf of Mexico (Jochens et al. 2006). Sperm whales in the Gulf of Mexico may be habituated to airgun pulses.

Les résultats récents d'une étude par marquage menée dans le nord du golfe du Mexique et portant sur le cachalot macrocéphale montrent que, sur huit cachalots macrocéphales marqués qui ont été exposés aux impulsions de canon à air, aucun des individus exposés aux impulsions de départ n'a modifié son comportement général de plongée ou la direction dans laquelle il se mouvait. Ces observations ont été faites au début du démarrage progressif des canons à des distances de 7 à 13 km, ou pendant l'exposition à la pleine puissance des canons, à des distances de 1,5 à 12,8 km (Jochens *et al*., 2006). On a toutefois observé certains changements dans leur quête de nourriture, les cachalots semblant éviter de plonger en profondeur à proximité des canons à air en activité. La quête de nourriture a été perturbée à des niveaux d'exposition allant de moins de 130 à 162 dB re 1 µPa crête à crête, à des distances d'environ 1 à 12 km de la source sonore. La taille de l'échantillon était petite. Ces résultats mettent en question l'efficacité de la méthode du démarrage progressif (élévation graduelle du niveau de bruit) comme mesure d'atténuation pour les cachalots macrocéphales, c'est-à-dire qu'on ne sait pas si ces cachalots s'éloignent à l'approche des navires sismiques. Toutefois, les observations qui précèdent pourraient ne pas s'appliquer aux cachalots macrocéphales dont l'habitat fait moins souvent l'objet de prospection sismique que le golfe du Mexique (Jochens *et al*., 2006). Il est possible que les cachalots macrocéphales du golfe se soient habitués aux impulsions des canons à air.

Shore-based observations of western gray whales on their feeding grounds indicated that most measures of surfacing, respiration and diving behaviour were not significantly correlated with seismic survey variables (Gailey et al. 2007). After accounting for effects of temporal and environmental covariates, they found no correlation between seismic variables and the mean number of whale exhalations per minute at the surface, mean time at the surface, and mean number of exhalations per minute during a

Des observations, à partir de l'île Sakhaline, de baleines grises dans leur aire d'alimentation ont révélé qu'il n'y avait pas de corrélation significative de la plupart des mesures concernant leurs comportements de nage à la surface, de respiration et de plongée avec les variables des levés sismiques (Gailey *et al*., 2007). Après avoir considéré les effets des covariables temporelles et environnementales, aucune corrélation n'a été observée entre les variables sismiques et le nombre moyen d'expirations par minute à la surface, la durée moyenne où les baleines demeuraient à la

whales' surface-to-dive cycle. In contrast, at higher received sound energy exposure levels, whales were observed to stay under water longer between respirations (a result contrary to some previous data from gray and bowhead whales).

surface et le nombre moyen d'expirations par minute pendant leur cycle surface-plongée. Par contre, lorsqu'elles étaient exposées à des niveaux d'énergie acoustique plus élevés, on a observé que les baleines restaient plus longtemps sous l'eau entre les respirations (un résultat contraire à certaines données antérieures sur les baleines grises et sur les baleines boréales).

Changes in Social Behaviour

DFO (2004a) concluded that *"it is unknown if exposure to seismic sound can result in changes in marine mammal social behaviour but if it were to occur there are conditions under which the worst-case consequences of such changes could be highly significant."*

Changements dans le comportement social

Le MPO (2004a) conclut que *« on ne sait pas si l'exposition à des bruits sismiques peut résulter en des changements dans le comportement social des mammifères marins, mais s'ils se produisaient, il existe des conditions dans lesquelles le pire des scénarios pourrait avoir des conséquences très importantes ».*

Previous studies described in this review and past reviews mainly relate to the effects of seismic surveys on marine mammal distribution, movements, and avoidance (or lack thereof) during feeding, migration, and (in some cases) unspecified activities. There are no published studies aimed at examining the specific impacts of seismic surveys on social behaviours such as mating, cooperative feeding, or aggressive interactions.

Les études décrites dans notre évaluation et dans des évaluations antérieures concernent surtout les effets des levés sismiques sur la répartition des mammifères marins, leurs mouvements et leur réaction ou absence de réaction d'évitement au cours de la recherche de nourriture, la migration et, dans certains cas, d'autres activités non précisées. Aucune étude n'a été publiée qui cible les effets précis des levés sismiques sur les comportements sociaux des mammifères marins, comme l'accouplement, l'alimentation en coopération ou les interactions agressives.

Changes in Vocalization Patterns

DFO (2004a) concluded that "*it is known that exposure to seismic sound can result in changes in marine mammal vocal behaviour, and when it occurs, there are conditions under which the worst-case consequences could be highly significant."*

Changements des vocalisations

Le MPO (2004a) conclut que *« on sait que l'exposition à des bruits sismiques peut résulter en des changements dans le comportement de vocalisation chez les mammifères marins et, lorsque cela se produit, il existe des conditions dans lesquelles le pire des scénarios pourrait avoir des conséquences très importantes ».*

Several studies demonstrate that various marine mammals adapt the source levels or frequencies of their calls in response to the levels and frequencies of background sounds (reviewed in Tyack 2008). However, the available information pertains mainly to continuous or prolonged sounds, not to low-duty-cycle

Plusieurs études montrent que divers mammifères marins adaptent le niveau d'émission ou la fréquence de leurs appels en fonction des niveaux et des fréquences des sons ambiants (analyse de Tyack, 2008). Toutefois, les renseignements disponibles à ce sujet touchent principalement les sons continus ou prolongés et non les sons à petit facteur de

sounds such as seismic pulses.

Some baleen and toothed whales are known to continue calling in the presence of seismic operations and often can be heard between the seismic pulses (e.g., Richardson et al. 1986; McDonald et al. 1995; Greene et al. 1999a,b; Nieukirk et al. 2004; Smultea et al. 2004). Although there has been one report that sperm whales ceased calling when exposed to pulses from a very distant seismic ship (Bowles et al. 1994), a more recent study reports that sperm whales off northern Norway continued calling in the presence of seismic pulses (Madsen et al. 2002). That has also been shown during recent work in the Gulf of Mexico (Tyack et al. 2003; Smultea et al. 2004; Jochens et al. 2006). Dolphins and porpoises commonly are heard calling while airguns are operating (e.g., Gordon et al. 2004; Smultea et al. 2004; Holst et al. 2005a,b). There is one recent summary report indicating that calling fin whales distributed in one part of the North Atlantic went silent for an extended period starting soon after the onset of a seismic survey in the area (Clark and Gagnon 2006). It is not clear from that preliminary paper whether the whales ceased calling as a behavioural response to seismic noise or because of masking (see below).

An early study in the Canadian Beaufort Sea showed that bowhead whales continue to call in the presence of airgun sounds, with the types of calls being unchanged (Richardson et al. 1986). A subsequent study in the Alaskan Beaufort Sea provided evidence of a reduction in bowhead calling (or at least call detection rate) when airgun sounds were present (Greene et al. 1999a,b). However, it is uncertain whether that change was a function of altered calling rate upon receipt of airgun sounds, or altered

forme, comme les impulsions sismiques.

On sait que certaines espèces de baleines à fanons et de baleines à dents continuent leurs appels au cours d'opérations sismiques et elles se font souvent entendre entre deux impulsions sismiques (voir notamment, Richardson *et al*., 1986; McDonald *et al*., 1995; Greene *et al*., 1999a, b; Nieukirk *et al*., 2004; Smultea *et al*., 2004). Bien qu'on ait signalé une fois que des cachalots macrocéphales avaient cessé leurs appels alors qu'ils étaient exposés à des impulsions provenant d'un navire sismique très éloigné (Bowles *et al*., 1994), une étude plus récente indique que des cachalots macrocéphales observés au nord de la Norvège ont continué à émettre leurs appels malgré des impulsions sismiques (Madsen *et al*., 2002). Cette observation a aussi été faite lors d'études récentes menées dans le golfe du Mexique (Tyack *et al*., 2003; Smultea *et al*., 2004; Jochens *et al*., 2006). Des dauphins et des marsouins sont fréquemment entendus pendant que des canons à air sont déchargés (voir notamment, Gordon *et al*., 2004; Smultea *et al*., 2004; Holst *et al*., 2005a, b). Un rapport sommaire récent indique que les appels de rorquals communs répartis dans une partie de l'Atlantique Nord ont cessé pendant une longue période, peu après le début d'un levé sismique dans ce secteur (Clark et Gagnon, 2006). Ce rapport préliminaire ne permet pas d'établir clairement si le silence des rorquals constitue une réponse comportementale aux bruits sismiques ou si leurs appels ont été masqués (voir plus bas).

Une étude ancienne dans la partie canadienne de la mer de Beaufort a montré que les baleines boréales continuent leurs appels en présence des sons produits par les canons à air, sans changer les types d'appel (Richardson *et al*., 1986). Une étude ultérieure dans la partie alaskienne de la mer de Beaufort a permis de prouver la diminution du nombre d'appels des baleines boréales (du moins la diminution du taux de détection des appels) en présence des signaux émis par les canons à air (Greene *et al*., 1999a,b). Toutefois, il n'est pas certain que le changement ait été lié à une modification

distribution of the whales (which was independently demonstrated to occur - Miller et al. 1999; Richardson et al. 1999).

A series of seismic surveys in the Chukchi and Beaufort seas from July to November 2006 examined the distribution and relative levels of vocal activity of bowhead and beluga whales as determined via passive acoustic detection (Funk et al. 2007). (Similar follow-on work, not yet widely reported, was done in 2007.) The results from 2006 indicated that there was insufficient evidence to evaluate whether or not the distribution and relative levels of vocal activity of bowhead and beluga whales were affected by the airgun sounds. The authors warn that until much more is known about the variations in the acoustic behaviours of bowhead whales and the natural factors influencing calling behaviour, relationships between bowhead acoustic behaviour and airgun activity will remain anecdotal and speculative. There are indications that various features of bowhead calling behaviour are correlated with a variety of natural environmental variables, and possibly with variable levels of industrial sound (Blackwell et al. 2008).

Functional Consequences of Physical and Behavioural Effects

Reduced Communication and Echolocation Efficiency

DFO (2004a) concluded that "*it is unknown if exposure to seismic sound can result in reduced communication or echolocation efficiency in marine mammals.*"

du taux d'appel causée par le captage des sons produits par les canons à air ou à une modification dans la répartition des baleines (modification qui a été constatée par ailleurs [Miller *et al*., 1999; Richardson *et al*., 1999]).

Un ensemble de levés sismiques effectués de juillet à novembre 2006 dans la mer des Tchouktches et dans la mer de Beaufort ont permis d'étudier la répartition de même que les niveaux relatifs d'activité vocale des baleines boréales et des bélugas par détection acoustique passive (Funk *et al*., 2007). Une étude ultérieure similaire, dont les résultats ne sont pas encore tous connus, a été menée en 2007. Les résultats de l'étude de 2006 indiquent que les preuves étaient insuffisantes pour évaluer si les émissions des canons à air jouaient ou non sur les niveaux relatifs d'activité vocale et sur la répartition des baleines boréales et des bélugas. Les auteurs ont précisé que, tant qu'une quantité beaucoup plus importante de renseignements n'aura pas été recueillie sur les variations du comportement acoustique des baleines boréales et sur les facteurs naturels qui influent sur les vocalisations, les liens entre le comportement d'appel des baleines boréales et les émissions des canons à air demeureront anecdotiques et basés sur des suppositions. Certains indices donnent à penser que diverses caractéristiques du comportement d'appel des baleines boréales sont corrélées avec un éventail de variables environnementales naturelles et, possiblement, avec des niveaux variables de sons d'origine industrielle (Blackwell *et al*., 2008).

Conséquences fonctionnelles des effets physiques et comportementaux

Efficacité réduite de la communication et de l'écholocation

Le MPO (2004a) conclut que *« on ne sait pas si l'exposition à des bruits sismiques peut résulter en une réduction de l'efficacité d'écholocation chez les mammifères marins ».*

Masking effects of pulsed sounds on marine mammal calls and other natural sounds are expected to be limited, although there are very few specific data on this. Because of the intermittent nature and low duty cycle of seismic pulses, animals can emit and receive sounds in the relatively quiet intervals between pulses. Most studies that have examined the potential adverse effects of masking caused by anthropogenic underwater sounds have involved exposure of marine mammals to sounds that are often continuous or nearly continuous, and are not airgun pulses. This section deals only with airgun and similar pulsed sounds.

On présume que les effets de masquage des impulsions sonores sur les appels des mammifères marins et sur les autres sons naturels sont limités, bien qu'il y ait très peu de données précises à ce sujet. La nature intermittente et le petit facteur de forme des impulsions sismiques font que les animaux peuvent émettre et recevoir des sons pendant l'intervalle de silence relatif entre les impulsions. La plupart des études qui ont porté sur les effets potentiellement néfastes du masquage causé par les bruits sous-marins d'origine humaine traitaient aussi de l'exposition des mammifères marins aux sons qui sont souvent continus, ou presque, et qui ne sont pas des impulsions produites par des canons à air. Cette section ne traitera que des sons qui proviennent des canons à air et des sons impulsionnels semblables.

An anthropogenic sound source will mask (i.e., reduce) the effective communication or echolocation distance of a marine mammal only if overlaps the sound signal in time and frequency. If little or no overlap occurs between the sound and the frequencies used, communication and echolocation are not expected to be disrupted or masked. As reviewed in Appendix A, most energy in sound pulses emitted by seismic airgun arrays is at low frequencies, with strongest spectrum levels below 200 Hz,considerably lower spectrum levels above 1,000 Hz, and smaller amounts of energy emitted up to ~150kHz. These low frequencies are mainly used by mysticetes, but generally not by odontocetes, pinnipeds, or fissipeds (see Appendix B). Strong anthropogenic sounds are presumed not to interfere with signalling of marine mammals that are using frequencies outside the range of the anthropogenic sounds. Furthermore, the discontinuous nature of seismic pulses makes significant masking effects unlikely even for mysticetes.[4] Studies demonstrating that cetacean species continue to call in the

Une source sonore d'origine humaine aura un effet de masque, c'est-à-dire réduira la distance effective de communication ou d'écholocation d'un mammifère marin seulement si les sons émis chevauchent le signal vocal de l'animal en durée et en fréquence. Si le chevauchement est très léger ou nul, la communication et l'écholocation ne devraient pas être perturbées ou masquées. Comme le montre l'analyse présentée à l'annexe A, la majeure partie de l'énergie produite par les impulsions sonores des batteries de canons à air sismiques est de basse fréquence; les niveaux spectraux étant pour l'essentiel sous les 200 Hz, une part considérablement moindre au-dessus de 1 000 Hz, et de petites quantités de l'énergie émises jusqu'à ~ 150 kHz. Ces basses fréquences sont principalement utilisées par les mysticètes, et généralement pas par les odontocètes, les pinnipèdes et les fissipèdes (voir l'annexe B). On présume que les sons forts d'origine humaine ne devraient pas gêner les signaux des mammifères marins qui utilisent des fréquences qui se situent hors de la gamme de fréquence des sons d'origine humaine. De plus, les impulsions sismiques étant intermittentes, il est peu probable qu'elles produisent un effet de masquage significatif,

presence of seismic operations are described in the previous section, Changes in Vocalization Patterns.

même pour les mysticètes.[4] Les études qui montrent que les cétacés continuent leurs appels au cours d'opérations de prospection sismique sont présentées plus haut à la section « Changements des vocalisations ».

There is no information on masking of pinniped calls by pulsed sounds like airgun signals, but any such masking is expected to be minimal due mainly to the low duty cycle of airgun pulses.

Aucune donnée n'existe sur le masquage des appels des pinnipèdes par les impulsions sonores telles que les signaux sismiques, mais on présume que ce masquage devrait être minime, principalement à cause du petit facteur de forme des impulsions des canons à air.

Masking effects of seismic pulses are expected to be negligible in the case of polar bears and sea otters due to their use of in-air rather than underwater calls.

Les effets de masquage des impulsions sismiques devraient être négligeables pour les ours blancs et les loutres de mer, puisque leurs appels se font hors de l'eau.

Hampered Passive Acoustic Detection of Prey and Predators

Capacité diminuée de détection acoustique passive des proies et des prédateurs

DFO (2004a) concluded that "*it is unknown whether exposure to seismic sound can hamper the passive acoustic detection of prey by marine mammals. DFO also concluded that it is unknown whether exposure to seismic sound could increase the vulnerability of marine mammals to predators."*

Le MPO (2004a) conclut que *« on ne sait pas si l'exposition à des bruits sismiques pourrait diminuer la capacité de détection acoustique passive de proies chez les mammifères marins ». Le MPO conclut aussi que « on ne sait pas si l'exposition à des bruits sismiques pourrait accroître la vulnérabilité des mammifères marins à leurs prédateurs ».*

No studies, either recent or older, have specifically examined the potential effects of seismic sound on the abilities of marine mammals to detect prey and/or predators. It is also unknown which, if any, species of marine mammals would use passive acoustic detection of prey as an important feeding strategy, with perhaps the exception of transient killer whales (e.g., Barrett-Lenard et al. 1996; Deecke et al. 2005). In general, masking by airgun signals is unlikely to have much effect on passive acoustic detection of prey. The

Aucune étude, récente ou non, n'a analysé de façon précise les effets potentiels des bruits sismiques sur la capacité des mammifères marins de détecter les proies et les prédateurs. On ignore aussi quelles espèces de mammifères marins, s'il en existe, auraient recours à la détection acoustique passive des proies comme grande stratégie d'alimentation, à l'exception, peut-être, des épaulards migrateurs (voir notamment Barrett-Lenard *et al*., 1996; Deecke *et al*., 2005). De manière générale, le masquage produit par les impulsions des canons à air risque peu d'avoir

[4]Near the source, the predominant part of a seismic pulse is about 10–20 ms in duration and the interpulse interval is typically 10-12 s, resulting in a low duty cycle (<5%). Other sounds are audible in the gaps except perhaps in the unusual situation where there is strong reverberation of sound that persists for much of the gap between received pulses.

[4] Près de la source sonore, la majeure partie d'une impulsion sismique dure environ 10 à 20 ms, et l'intervalle entre les impulsions dure habituellement de 10 à 12 s, ce qui se traduit par un petit facteur de forme (< 5 %). D'autres sons sont audibles pendant les intervalles, sauf, peut-être, dans des cas exceptionnels où une forte réverbération du son persiste pendant presque tout l'intervalle entre les impulsions captées.

low duty cycle of the pulses means that audibility of other sounds will be little affected during the intervals between pulses.

beaucoup d'effets sur la détection acoustique passive des proies. Le petit facteur de forme des impulsions signifie que l'audibilité des autres sons est peu touchée pendant les intervalles entre les impulsions.

For similar reasons, vulnerability to predators is unlikely to be much affected through masking by airgun signals. However, ability to detect predators could, at least in theory, be impaired if a marine mammal's auditory sensitivity was reduced either temporarily or - more importantly - permanently (TTS or PTS, respectively).

Pour des raisons analogues, la vulnérabilité aux prédateurs est peu susceptible d'être accrue par l'effet de masquage produit par les impulsions des canons à air. Toutefois, la capacité des animaux de détecter les prédateurs pourrait, du moins en théorie, être réduite si le seuil d'audition d'un mammifère marin est déplacé de façon temporaire (TTS) ou, dans des cas plus graves, de façon permanente (PTS).

Hampered Avoidance of Anthropogenic Threats (such as ship strikes, net entanglement)

Capacité diminuée d'évitement des menaces anthropiques (collision avec des navires, enchevêtrement dans les filets)

DFO (2004a) concluded that *"it is a concern that exposure to seismic sound could reduce the ability of marine mammals to avoid anthropogenic threats, but the risk has not been demonstrated."*

Le MPO (2004a) conclut que *« le fait que l'exposition à des bruits sismiques pourrait réduire la capacité des mammifères marins d'éviter des menaces anthropiques est préoccupant, mais le risque n'a pas été prouvé. »*

While nearly all species of large whale have been victims of collisions with ships (Laist et al. 2001; Jensen and Silber 2003; Vanderlaan and Taggart 2007), right whales are especially vulnerable, likely in large part because of certain characteristic behaviours during which they may be less aware of their surroundings. Controlled exposure experiments in the right whale summer feeding area in the Bay of Fundy showed that right whales did not respond to the playback of the sound made by a 120-m container ship passing within 100 m in spite of the fact that they were apparently able to hear it (Nowacek et al. 2004). When exposed to alert signals, right whales responded by swimming strongly to the surface, a response likely to increase rather than decrease the risk of collision (Nowacek et al. 2004).

Bien que presque toutes les espèces de baleines de grande taille soient victimes de collisions avec des navires (Laist *et al*., 2001; Jensen et Silber, 2003; Vanderlaan et Taggart, 2007), les baleines noires sont particulièrement vulnérables, probablement surtout à cause de certains comportements caractéristiques où elles sont moins à l'affût de ce qui les entoure. Des expériences en milieu contrôlé dans l'aire d'alimentation estivale de la baleine noire, dans la baie de Fundy, ont montré que les baleines noires ne réagissaient pas lorsqu'on leur faisait entendre la reproduction du bruit produit par un navire porte-conteneurs de 120 mètres, à une distance d'environ 100 mètres, malgré le fait qu'elles étaient, selon toute vraisemblance, capables de l'entendre (Nowacek *et al*., 2004). Lorsqu'elles étaient exposées à des signaux d'alerte, les baleines noires réagissaient en nageant vigoureusement vers la surface, réaction susceptible de faire augmenter plutôt que d'atténuer les risques de collision (Nowacek *et al*., 2004).

Evidence suggests that a greater rate of mortality and serious injury correlates with a greater vessel speed at the time of a ship strike (Laist et al. 2001; Vanderlaan and Taggart 2007). Most lethal and severe injuries to large whales resulting from documented ship strikes have occurred when vessels were travelling at 14 knots or greater (Laist et al. 2001). Vanderlaan and Taggart (2007), using a logistic regression modelling approach based upon vessel strike records, found that for vessel speeds greater than 15 knots, the probability that a collision will result in a lethal injury (mortality or severely injured) approaches 1. The probability that a collision will result in lethal injury declined to approximately 20 % at speeds of 8.6 knots and to less than 5 % at of 4 knots (Vanderlaan and Taggart 2007). Considering the reduced speed at which seismic survey vessels travel during periods of active seismic surveying (typically 4.5 to 5 knots), plus the extra noise that they emit relative to routine vessel traffic, the risk of lethal injury from a vessel strike, would be limited. However, if exposure to seismic pulses causes TTS or (worse) PTS in marine mammals, this could lead to a reduction in their ability to detect and avoid approaching vessels.

Les données disponibles donnent à penser qu'à des taux plus élevés de mortalité et de blessures graves correspond une plus grande vitesse des navires au moment des collisions (Laist *et al*., 2001; Vanderlaan et Taggart, 2007). Selon les données disponibles, la plupart des blessures graves ou mortelles chez les baleines de grande taille qui ont été victimes de collisions avec des navires se sont produites alors que les navires allaient à 14 nœuds ou plus (Laist *et al*., 2001). À l'aide de modèles de régression logistique fondés sur les registres de collisions des navires, Vanderlaan et Taggart (2007) ont découvert que, pour les navires dont la vitesse était supérieure à 15 nœuds, la probabilité qu'une collision entraîne des blessures mortelles (blessures graves ou décès) était près de 1. La probabilité qu'une collision entraîne des blessures mortelles baisse à environ 20 % à une vitesse de 8,6 nœuds et à moins de 5 % à une vitesse de 4 nœuds (Vanderlaan et Taggart, 2007). Compte tenu de la vitesse à laquelle les navires sismiques se déplacent pendant les périodes de prospection (généralement entre 4,5 et 5 nœuds) et le bruit supplémentaire qu'ils produisent en circulant, les risques de blessures mortelles découlant d'une collision devraient être limités. Toutefois, si l'exposition à des impulsions sismiques entraîne un TTS, ou pire, un PTS chez des mammifères marins, la capacité des ces derniers de détecter et d'éviter les navires qui s'approchent pourrait être réduite.

Hampered Parental Care or Bonding

DFO (2004a) concluded that *"it is unknown if exposure to seismic sound can hamper parental care or bonding in marine mammals."*

No studies had, or have since, examined this potential effect.

Capacité diminuée de soigner les petits ou de former des liens parentaux

Le MPO (2004a) conclut que *« on ne sait pas si l'exposition à des bruits sismiques peut réduire la capacité de soin des petits ou de formation de liens parentaux chez les mammifères marins ».*

Aucune étude n'a porté sur ces effets éventuels.

Chronic Effects (e.g., stress-related physiological changes, reduced fecundity)

DFO (2004a) concluded that *"it is unknown if exposure to seismic sound can result in chronic effects, such as immuno-supression or reduced fecundity, on marine mammals."*

Romano et al. (2004) examined the effects of single underwater impulse sounds from a seismic water gun (up to 228 dB re 1 µPa peak-to-peak pressure) and single pure tones (SPL up to 201 dB re 1 µPa) on the nervous and immune systems of a beluga whale and a bottlenose dolphin. They found that neural-immune changes to noise exposure were minimal. Although levels of some stress-released substances (e.g., catecholamines) changed significantly with exposure to sound, levels returned to baseline after 24 hours. Further information about the occurrence of noise-induced stress in marine mammals is not available at this time. Tyack (2008) summarizes evidence from other animals concerning the importance of physiological stress in affecting resilience and fitness, and discusses the potential relevance to marine mammals.

Effets chroniques (changements physiologiques causés par le stress, fécondité réduite)

Le MPO (2004a) conclut que *« on ne sait pas si l'exposition à des bruits sismiques peut résulter en de tels effets chroniques [immunosuppresion ou diminution de la fécondité] chez les mammifères marins ».*

Romano *et al*. (2004) ont examiné les effets des impulsions sonores sous-marines isolées provenant d'un canon à air (pression crête à crête allant jusqu'à 228 dB re 1 µPa) de même que des sons purs isolés (niveau de pression acoustique allant jusqu'à 201 dB re 1 µPa) sur les systèmes nerveux et immunitaire d'un béluga et d'un dauphin à gros nez. Les chercheurs ont noté que les changements d'ordre neuro-immunitaire liés à l'exposition aux bruits étaient minimes. Bien qu'on ait observé un changement significatif de la concentration des substances sécrétées en situation de stress (p. ex. catécholamines) lorsque les animaux étaient exposés aux sons, les concentrations sont revenues à la normale au bout de 24 heures. D'autres renseignements sur l'occurrence du stress causé par le bruit chez les mammifères marins ne sont pas disponibles pour le moment. Tyack (2008) résume les résultats portant sur d'autres animaux et sur l'importance du rôle que joue le stress physiologique sur la résilience et sur la condition physique, et explique en quoi ces résultats sont pertinents pour les mammifères marins.

Indirect Effects (e.g., reduced prey availability)

DFO (2004a) concluded that *it is unknown if exposure to seismic sound can result in indirect effects, such as reduced prey availability (through displacement or reduced catchability) on marine mammals.*

No studies had, or have since, examined this potential indirect effect. Studies of fish responses to airgun pulses often show temporary changes in fish behaviour (e.g., McCauley et al. 2000a,b; Wardle et al.

***Effets indirects* (p. ex. disponibilité réduite de proies)**

Le MPO (2004a) conclut *qu'on ne sait pas si l'exposition à des bruits sismiques peut résulter en de effets indirects sur les mammifères marins, par exemple réduire la disponibilité des proies, soit par déplacement de celles-ci soit par la réduction de leur capturabilité.*

Aucune étude ciblée n'existe concernant cet effet indirect possible. Les études qui portent sur la réponse des poissons aux émissions des canons à air montrent souvent des changements temporaires de comportement

2001; Hassel et al. 2003; Slotte et al. 2004), which in some situations might have short-term consequences for availability of prey to fish-eating marine mammals.

(voir notamment McCauley *et al*., 2000a, b; Wardle *et al*., 2001; Hassel *et al*., 2003; Slotte *et al*., 2004) qui, dans certaines situations, pourraient avoir des conséquences à court terme sur la disponibilité des proies pour les mammifères marins qui se nourrissent de poissons.

LITERATURE CITED

Arbelo, M., M. Méndez, E. Sierra, P. Castro, J. Jaber, P. Calabuig, M. Carrillo, and A. Fernández. 2005. Novel “gas embolic syndrome” in beaked whales resembling decompression sickness. Abstr. 16th Bienn. Conf. Biol. Mar. Mamm., 12–16 Dec. 2005, San Diego, CA.

Bain, D.E. and R. Williams. 2006. Long-range effects of airgun noise on marine mammals: responses as a function of received sound level and distance. Working Paper SC/58/E35 presented to the IWC Scientific Committee, IWC Annual Meeting, 1-13 June, St. Kitts and Nevis. 13 p.

Barlow, J. and R. Gisiner. 2006. Mitigating, monitoring and assessing the effects of anthropogenic sound on beaked whales. Journal of Cetacean Research and Management 7(3):239-249.

Barrett-Lennard, L.G., J.K.B. Ford, and K.A. Heise. 1996. The mixed blessing of echolocation: differences in sonar use by fish-eating and mammal-eating killer whales. Animal Behaviour 51(3):553-565.

Blackwell, S.B., T.L. McDonald, R.M. Nielson, C.S. Nations, C.R. Greene Jr.,and W.J. Richardson. 2008. Effects of Northstar on bowhead calls, 2001-2004. p. 12-1 to 12-44 In: W.J. Richardson (ed.), Monitoring of industrial sounds, seals, and bowhead whales near BP's Northstar oil development, Alaskan Beaufort Sea, 1999-2004. [Comprehensive report, 3rd update, Feb. 2008]. LGL Rep. P1004. Rep. from LGL Ltd. (King City, Ont.), Greeneridge Sciences Inc. (Santa Barbara, CA), WEST Inc. (Cheyen, WY) and Applied Sociocultural Research (Anchorage, AK) for BP Explor. (Alaska) Inc., Anchorage, AK.

Bowles, A.E., M. Smultea, B. Würsig, D.P. DeMaster, and D. Palka. 1994. Relative abundance and behavior of marine mammals exposed to transmissions from the Heard Island Feasibility Test. Journal of the Acoustical Society of America 6(4):2469-2484.

Caldwell, J. and W. Dragoset. 2000. A brief overview of seismic air-gun arrays. The Leading Edge 19(8,Aug.):898-902.

Citta, J.J., L.T. Quakenbush, R.J. Small, and J.C. George. 2007. Movements of a tagged bowhead whale in the vicinity of a seismic survey in the Beaufort Sea. Poster Paper, Soc. Mar. Mammal. 17th Bien. Meet., Cape Town, South Africa.

Clark, C.W. and W.T. Ellison. 2004. Potential use of low-frequency sounds by baleen whales for probing the environment: Evidence from models and empirical measurements. p. 564-589 In J.A. Thomas, C.F. Moss and M. Vater, (eds.), Echolocation in Bats and Dolphins. University of Chicago Press, Chicago, IL.

Clark, C.W. and G.C. Gagnon. 2006. Considering the temporal and spatial scales of noise exposures from seismic surveys on baleen whales. Intern. Whal. Commis. Working Pap. SC/58/E9. 9 p.

Cox, T.M., T.J. Ragen, A.J. Read, E. Vos, R.W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D’amico, G. D’spain, A. Fernández, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J. Hildebrand, D. Houserp, R. Hullar, P.D. Jepson, D. Ketten, C.D. Macleod, P. Miller,S. Moore, D.C. Mountain, D. Palka, P. Ponganis, S. Rommel, T.

Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Meads, and L. Benner. 2006. Understanding the impacts of anthropogenic sound on beaked whales. Journal of Cetacean Research and Management 7(3):177-187.

Deecke, V.B., J.K.B. Ford, and P.J.B. Slater. 2005. The vocal behaviour of mammal-eating killer whales: communicating with costly calls. Animal Behaviour 69(2):395-405.

DFO. 2004a. Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. DFO Can. Sci. Advis. Sec. Habitat Status Report 2004/002.

Dolman, S.J. and M.P. Simmonds. 2006. An updated note on the vulnerability of cetaceans to acoustic disturbance. Paper SC/58/E22 presented to the IWC Scientific Committee, IWC Annual Meeting, 1-13 June, St. Kitts and Nevis.

D'Spain, G.L., A. D'Amico, and D.M. Fromm. 2006. Properties of the underwater sound fields during some well documented beaked whale mass stranding events. Journal of Cetacean Research and Management 7:223-238.

Engel, M.H., M.C.C. Marcondes, C.C.A. Martins, F.O. Luna, R.P. Lima, and A. Campos. 2004. Are seismic surveys responsible for cetacean strandings? An unusual mortality of adult humpback whales in Abrolhos Bank, northeastern coast of Brazil. Working Paper SC/56/E28 presented to the IWC Scientific Committee, IWC Annual Meeting, 19-22 July, Sorrento, Italy. 8p.

Fernández, A., M. Arbelo, R. Deaville, I.A.P. Patterson, P. Castro, J.R. Baker, E. Degollada, H.M. Ross, P. Herráez, A.M. Pocknell, E. Rodríguez, F.E. Howie, A. Espinosa, R.J. Reid, J.R. Jaber, V. Martin, A.A. Cunningham, and P.D. Jepson. 2004. Pathology: whales, sonar and decompression sickness (reply). Nature 28(6984).

Fernández, A., J.F. Edwards, F. Rodriquez, A.E. de los Monteros, P. Herráez, P. Castro, J.R. Jaber, V. Martin, and M. Arbelo. 2005a. "Gas and fat embolic syndrome" involving a mass stranding of beaked whales (Family Ziphiidae) exposed to anthropogenic sonar signals. Veterinary Pathology 42:446-457.

Fernández, A., M. Méndez, E. Sierra, A. Godinho, P. Herráez, A.E. De los Monteros, F. Rodrigues, and M. Arbelo. 2005b. New gas and fat embolic pathology in beaked whales stranded in the Canary Islands. p. 90 In Abstracts of the 16th Biennial Conference on the Biology of Marine Mammals, 12-16 December 2005, San Diego, CA.

Finneran, J.J., C.E. Schlundt, R. Dear, D.A. Carder, and S.H. Ridgway. 2002. Temporary shift in masked hearing thresholds in odontocetes after exposure to single underwater impulses from a seismic watergun. Journal of the Acoustical Society of America 111(6):2929-2940.

Finneran, J.J., D.A. Carder, C.E. Schlundt, and S.H. Ridgway. 2005. Temporary threshold shift in bottlenose dolphins (*Tursiops truncatus*) exposed to mid-frequency tones. Journal of the Acoustical Society of America 118(4):2696-2705.

Funk, D. W., R. Rodrigues, D. S. Ireland, and W. R. Koski (eds.). 2007. Joint Monitoring Program in the Chukchi and Beaufort seas, July-November 2006. LGL Alaska Report P891-2, Report from LGL Alaska Research Associates, Inc., LGL Ltd., Greeneridge Sciences, Inc., Bioacoustics Research Program, Cornell University, and Bio-Wave Inc. for

Shell Offshore, Inc., ConocoPhillips Alaska, Inc., and GX Technology, and National Marine Fisheries Service, U.S. Fish and Wildlife Service. 316 p. plus appendices.

Gailey, G., B. Würsig, and T.L. McDonald. 2007. Abundance, behavior, and movement patterns of western gray whales in relation to a 3-D seismic survey, Northeast Sakhalin Island, Russia. Environmental Monitoring and Assessment 134(1-3):75-91. doi: 10.1007/s10661-007-9812-1.

Goold, J.C. and R.F.W. Coates. 2006. Near source, high frequency air-gun signatures. Paper SC/58/E30 presented to the IWC Scientific Committee, IWC Annual Meeting, 1-13 June, St. Kitts and Nevis.

Gordon, J., D. Gillespie, J. Potter, A. Frantzis, M.P. Simmonds, R. Swift, and D. Thompson. 2004. A review of the effects of seismic surveys on marine mammals. Marine Technology Society Journal 37(4):16-34.

Greene, C.R., Jr. and W.J. Richardson. 1988. Characteristics of marine seismic survey sounds in the Beaufort Sea. Journal of the Acoustical Society of America 83:2246-2254.

Greene, C.R., Jr., N.S. Altman, and W.J. Richardson. 1999a. Bowhead whale calls. p. 6-1 – 6-23 In W.J. Richardson, (ed.), Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1998. LGL Rep. TA2230-3. Prepared by LGL Ltd., King City, ONT, and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Houston, TX, and NMFS, Anchorage, AK, and Silver Spring, MD. 390 p.

Greene, C.R., Jr., N.S. Altman and W.J. Richardson. 1999b. The influence of seismic survey sounds on bowhead whale calling rates. J. Acoust. Soc. Am. 106(4, Pt. 2):2280. [Abstract]

Haley, B., and W.R. Koski. 2004. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic program in the Northwest Atlantic Ocean, July–August 2004. LGL Report TA2822-27. Prepared by LGL Ltd. environmental research associates, King City, ONT, for Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, and NMFS, Silver Spring, MD. November.

Harris, R.E., G.W. Miller and W.J. Richardson. 2001. Seal responses to airgun sounds during summer seismic surveys in the Alaskan Beaufort Sea. Marine Mammal Science 17(4):795-812.

Harris, R.E., T. Elliot, and R.A. Davis. 2007. Results of mitigation and monitoring program, Beaufort Span 2-D marine seismic program, open-water season 2006. LGL Rep. TA4319-1. Rep. from LGL Ltd., King City, Ont., for GX Technology Corp., Houston, TX. 48 p.

Hassel, A., T. Knutsen, J. Dalen, S. Løkkeborg, K. Skaar, Ø. Østensen, E.K. Haugland, M. Fonn, Å. Høines, and O.A. Misund. 2003. Reaction of sandeel to seismic shooting: A field experiment and fishery statistics study. Institute of Marine Research, Bergen, Norway.

Hildebrand, J.A. 2005. Impacts of anthropogenic sound. p. 101-124 In: J.E. Reynolds III, W.F. Perrin, R.R. Reeves, S. Montgomery, and T.J. Ragen, (eds.), Marine Mammal Research: Conservation beyond Crisis. John Hopkins Univ. Press, Baltimore, MD. 223 p.

Hogarth, W.T. 2002. Declaration of William T. Hogarth in opposition to plaintiff's motion for temporary restraining order, 23 October 2002. Civ. No. 02-05065-JL. U.S. District Court, Northern District of California, San Francisco Div.

Holst, M., M.A. Smultea, W.R. Koski, and B. Haley. 2005a. Marine mammal and sea turtle monitoring during Lamont-Doherty Earth Observatory's marine seismic program off the Northern Yucatán Peninsula in the Southern Gulf of Mexico, January–February 2005. LGL Report TA2822-31. Prepared by LGL Ltd. environmental research associates, King City, ONT, for Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, and NMFS, Silver Spring, MD. June. 96 p.

Holst, M., M.A. Smultea, W.R. Koski, and B. Haley. 2005b. Marine mammal and sea turtle monitoring during Lamont-Doherty Earth Observatory's marine seismic program in the Eastern Tropical Pacific Ocean off Central America, November–December 2004. LGL Report TA2822-30. Prepared by LGL Ltd. environmental research associates, King City, ONT, for Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, and NMFS, Silver Spring, MD. April. 125 p.

Holst, M., W.J. Richardson, W.R. Koski, M.A. Smultea, B. Haley, M.W. Fitzgerald, and M. Rawson. 2006. Effects of large- and small-source seismic surveys on marine mammals and sea turtles. Eos Transactions of the American Geophysical Union 87(36), Joint Assembly Supplement, Abstract OS42A-01. 23-26 May, Baltimore, MD.

Hooker, S.K., R.W. Baird, S. Al-Omari, S. Gowans, and H. Whitehead. 2001. Behavioural reactions of northern bottlenose whales (*Hyperoodon ampullatus*) to biopsy darting and tag attachment procedures. Fisheries Bulletin 99:303-308.

IAGC. 2004. Further analysis of 2002 Abrolhos Bank, Brazil humpback whale strandings coincident with seismic surveys. Houston, TX.

IWC. 2007. Report of the standing working group on environmental concerns. Annex K to Report of the Scientific Committee. J. Cetac. Res. Manage. 9 (Suppl.):227-260.

Jensen, A.S. and G.K. Silber. 2003. Large whale ship strike database. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-OPR-. 37p.

Jepson, P.D., M. Arbelo, R. Deaville, I.A.P. Patterson, P. Castro, J.R. Baker, E. Degollada, H.M. Ross, P. Herráez, A.M. Pocknell, F. Rodríguez, F.E. Howie, A. Espinosa, R.J. Reid, J.R. Jaber, V. Martin, A.A. Cunningham, and A. Fernández. 2003. Gas-bubble lesions in stranded cetaceans. Nature 425(6958):575-576.

Jepson, P.D., D.S. Houser, L.A. Crum, P.L. Tyack, and A. Fernández. 2005a. Beaked whales, sonar and the "bubble hypothesis". Abstr. 16th Bienn. Conf. Biol. Mar. Mamm., 12–16 Dec. 2005, San Diego, CA.

Jepson, P.D. R. Deaville, I.A.P. Patterson, A.M. Pocknell, H.M. Ross, J.R. Baker, F.E. Howie, R.J. Reid, A. Colloff, and A.A. Cunningham. 2005b. Acute and chronic gas bubble lesions in cetaceans stranded in the United Kingdom. Vet. Pathol. 42(3):291-305.

Jochens, A., D. Biggs, D. Engelhaupt, J. Gordon, N. Jaquet, M. Johnson, R. Leben, B. Mate, P. Miller, J., Ortega-Ortiz, A., Thode, P. Tyack, J. Wormuth, and B. Würsig. 2006. Sperm

whale seismic study in the Gulf of Mexico; Summary Report, 2002-2004. OCS Study MMS 2006-034. MMS, Gulf of Mexico OCS Region, New Orleans, LA. 345 p.

Johnson, S.R., W.J. Richardson, S.B. Yazvenko, S.A. Blokhin, G. Gailey, M.R. Jenkerson, S.K. Meier, H.R. Melton, M.W. Newcomer, A.S. Perlov, S.A. Rutenko, B. Würsig, C.R. Martin, and E.D. Egging. 2007. A western gray whale mitigation and monitoring program for a 3-D seismic survey, Sakhalin Island, Russia. Environmental Monitoring and Assessment 134(1-3):1-19. doi: 10.1007/s10661-007-9813-0.

Kastak, D., R.L. Schusterman, B.L. Southall, and C.J. Reichmuth. 1999. Underwater temporary threshold shift induced by octave-band noise in three species of pinnipeds. J. Acoust. Soc. Am. 106(2):1142-1148.

Kastak, D., B.L. Southall, R.J. Schusterman, and C. Reichmuth Kastak. 2005. Underwater temporary threshold shift in pinnipeds: effects of noise level and duration. Journal of the Acoustical Society of America 118(5):3154-3163.

Kasuya, T. 1986. Distribution and behavior of Baird's beaked whales off the Pacific coast of Japan. Sci. Rep. Whales Res. Inst. 37:61-83.

Ketten, D.R. 1995. Estimates of blast injury and acoustic trauma zones for marine mammals from underwater explosions. p. 391-407 In R.A. Kastelein, J.A. Thomas, and P.E. Nachtigall, (eds.), Sensory Systems of Aquatic Mammals. De Spil Publishers, Woerden, Netherlands.

Ketten, D.R., J. Lien and S. Todd. 1993. Blast injury in humpback whale ears: evidence and implications. Journal of the Acoustical Society of America 94(3, Pt. 2):1849-1850. (Abstract)

Ketten, D.R., J. O'Malley, P.W.B. Moore, S. Ridgway, and C. Merigo. 2001. Aging, injury, disease, and noise in marine mammal ears. J. Acoust. Soc. Am. 110(5, Pt. 2):2721.

Kryter, K.D. 1985. The Effects of Noise on Man. 2nd edition. Academic Press, Orlando, FL. 688p.

Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet and M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science 17(1): 35-75.

Lawson, J., I. McQuinn, 2004. Review of the Potential Hydrophysical-related Issues in Canada, Risks to Marine Mammals, and Monitoring and Mitigation Strategies for Seismic Activities. DFO Can. Sci. Advis. Sec. Res. Doc. 2004/121.

Ljungblad, D.K., B. Würsig, S.L. Swartz, and J.M. Keene. 1988. Observations on the behavioral responses of bowhead whales (*Balaena mysticetus*) to active geophysical vessels in the Alaskan Beaufort Sea. Arctic 41(3):183-194.

Lucke, K., P.A. Lepper, M.-A. Blanchet and U. Siebert. 2007. Testing the auditory tolerance of harbour porpoise hearing for impulsive sounds. Poster Paper presented at Conference on Noise and Aquatic Life, Nyborg, Denmark, Aug. 2007.

MacLean, S.A. and W.R. Koski. 2005. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic program in the Gulf of Alaska, August–September 2004. LGL

Report TA2822-28. Prepared by LGL Ltd. environmental research associates, King City, ONT, for Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, and NMFS, Silver Spring, MD. 102 p.

Madsen, P.T., B. Mohl, B.K. Nielsen, and M. Wahlberg. 2002. Male sperm whale behavior during exposures to distant seismic survey pulses. Aquatic Mammals 28(3):231-240.

Malme, C.I., P.R. Miles, C.W. Clark, P. Tyack, and J.E. Bird. 1984. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior/Phase II: January 1984 migration. BBN Report 5586. Prepared by Bolt Beranek & Newman Inc., Cambridge, MA, for MMS, Alaska OCS Region, Anchorage, AK.

Malme, C.I., P.R. Miles, P. Tyack, C.W. Clark, and J.E. Bird. 1985. Investigation of the potential effects of underwater noise from petroleum industry activities on feeding humpback whale behavior. BBN Report 5851; OCS Study MMS 85-0019. Prepared by BBN Labs Inc., Cambridge, MA, for MMS, Anchorage, AK.

Malme, C.I., B. Würsig, J.E. Bird, and P. Tyack. 1986. Behavioral responses of gray whales to industrial noise: feeding observations and predictive modeling. Outer Continental Shelf Environmental Assessment Program, Final Report. BBN Rep. 6265. OCS Study MMS 88-0048. Prepared by BBN Labs Inc., Cambridge, MA, for NMFS and MMS, Anchorage, AK.

Malme, C.I., B. Würsig, B., J.E. Bird, and P. Tyack. 1988. Observations of feeding gray whale responses to controlled industrial noise exposure. p. 55-73 In W.M. Sackinger, M.O. Jeffries, J.L. Imm, and S.D. Treacy,(eds.), Port and Ocean Engineering Under Arctic Conditions. Vol. II. Symposium on Noise and Marine Mammals. University of Alaska Fairbanks, Fairbanks, AK.

McCauley, R.D., M.-N. Jenner, C. Jenner, K.A. McCabe, and J. Murdoch. 1998. The response of humpback whales (*Megaptera novaeangliae*) to offshore seismic survey noise: preliminary results of observations about a working seismic vessel and experimental exposures. APPEA (Austral. Petrol. Product. Explor. Assoc.) Journal 38:692-707.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000a. Marine seismic surveys: Analysis of airgun signals; and effects of air gun exposure on humpback whales, sea turtles, fishes and squid. Report from Centre for Marine Science and Technology, Curtin University, Perth, Western Australia, for Australian Petroleum Production Association, Sydney, NSW. 188 p.

McCauley, R.D., J. Fewtrell, A.J. Duncan, M.-N. Jenner, M-N., C. Jenner, R.I.T. Prince, A. Adhitya, K. McCabe and J. Murdoch. 2000b. Marine seismic surveys - a study of environmental implications. APPEA (Austral. Petrol. Product. Explor. Assoc.) Journal 40(May):692-708.

McCauley, R.D. and J.R. Hughes. 2006. Marine seismic mitigation measures – perspectives in 2006. Paper SC/58/E44 presented to the IWC Scientific Committee, June 2006 (unpublished), 10 p. Paper available from the IWC Secretariat: secretariat@iwcoffice.org.International Whaling.

McDonald, M.A., J.A. Hildebrand, and S.C. Webb. 1995. Blue and fin whales observed on a seafloor array in the Northeast Pacific. Journal of the Acoustical Society of America 98(2, Pt. 1):712-721.

Méndez, M., M. Arbelo, E. Sierra, A. Godinho, M.J. Caballero, J. Jaber, P. Herráez, and A. Fernández. 2005. Lung fat embolism in cetaceans stranded in Canary Islands. Abstr. 16th Bienn. Conf. Biol. Mar. Mamm. 12–16 Dec. 2005, San Diego, CA.

Miller, G.W., R.E. Elliott, W.R. Koski, V.D. Moulton, and W.J. Richardson. 1999. Whales. p. 5-1 – 5-109 In W.J. Richardson, (ed.), Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1998. LGL Report TA2230-3. Prepared by LGL Ltd., King City, ONT, and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Houston, TX, and NMFS, Anchorage, AK, and Silver Spring, MD. 390 p.

Miller, J.H., A.E. Bowles, B.L. Southall, R.L. Gentry, W.T. Ellison, J.J. Finneran, C.R. Greene Jr., D. Kastak, D.R. Ketten, P.L. Tyack, P.E. Nachtigall, W.J. Richardson and J.A. Thomas. 2005a. Strategies for weighting exposure in the development of acoustic criteria for marine mammals. Journal of the Acoustical Society of America 118:2019 (Abstract). Presentation available at: http://www.oce.uri.edu/faculty_pages/miller/Noise_Weighting_10_18_2005.ppt. (accessed March 10, 2009)

Miller, P.J., P.L. Tyack, M.P. Johnson, P.T. Madsen, and R. King. 2006. Techniques to assess and mitigate the environmental risk posed by use of airguns: recent advances from academic research programs. Eos Transactions of the American Geophysical Union 87(36), Joint Assembly Supplement, Abstract S42A-03. 23-26 May 2006, Baltimore, MD.

Mooney, T.A., P.E. Nachtigall, W.W.L. Au, M. Breese, and S. Vlachos. 2005. Bottlenose dolphins: effects of noise duration, intensity, and frequency. p. 197 In Abstracts of the 16th Biennial Conference on the Biology of Marine Mammals, 12-16 December 2005, San Diego, CA.

Moore, S.E. and Angliss, R.P. 2006. Overview of planned seismic surveys offshore northern Alaska, July-October 2006. Paper SC/58/E6 presented to IWC Scientific Committee, IWC Annual Meeting, 1-13 June, St Kitts and Nevis.

Moulton, V.D. and J.W. Lawson. 2002. Seals, 2001. p. 3-1 to 3-48 In: W.J. Richardson (ed.), Marine mammal and acoustical monitoring of WesternGeco's open-water seismic program in the Alaskan Beaufort Sea, 2001. LGL Rep. TA2564-3. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Houston, TX, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD.

Moulton, V.D. and G.W. Miller. 2005. Marine mammal monitoring of a seismic survey on the Scotian Slope, 2003. p. 29-40. In: Lee, K., H. Bain and G.V. Hurley (eds.), Acoustic monitoring and marine mammal surveys in the Gully and Outer Scotian Shelf before and during active seismic programs. Env. Stud. Res. Funds Rep. No. 151. 154 p. + xx.

Moulton, V.D., B.D. Mactavish and R.A. Buchanan. 2005. Marine mammal and seabird monitoring of Chevron Canada Resources' 3-D seismic program on the Orphan Basin, 2004. LGL Rep. SA817. Rep. by LGL Limited, St. John's, NL, for Chevron Canada

Resources, Calgary, AB, ExxonMobil Canada Ltd., St. John's, NL, and Imperial Oil Resources Ventures Ltd., Calgary, AB. 90 p. + appendices.

Moulton, V.D., B.D. Mactavish, R.E. Harris and R.A. Buchanan. 2006a. Marine mammal and seabird monitoring of Chevron Canada Limited's 3-D seismic program on the Orphan Basin, 2005. LGL Rep. SA843. Rep. by LGL Limited, St. John's, NL, for Chevron Canada Resources, Calgary, AB, ExxonMobil Canada Ltd., St. John's, NL, and Imperial Oil Resources Ventures Ltd., Calgary, AB. 111 p. + appendices.

Moulton, V.D., B.D. Mactavish and R.A. Buchanan. 2006b. Marine mammal and seabird monitoring of ConocoPhillips' 3-D seismic program in the Laurentian Sub-basin, 2005. LGL Rep. SA849. Rep. by LGL Limited, St. John's, NL, for ConocoPhillips Canada Resources Corporation, Calgary, AB. 97 p. + appendices.

Nieukirk, S.L., K.M. Stafford, D.K. Mellinger, R.P. Dziak, and C.G. Fox. 2004. Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean. Journal of the Acoustical Society of America 115(4):1832-1843.

NMFS. 1995. Small takes of marine mammals incidental to specified activities; offshore seismic activities in southern California. Federal Register 60(200, 17 Oct.):53753-53760.

NMFS. 2000. Small takes of marine mammals incidental to specified activities; marine seismic-reflection data collection in southern California. Federal Register 65(60, 28 Mar.):16374-16379.

NMFS. 2005. Endangered fish and wildlife; notice of intent to prepare an environmental impact statement. Fed. Regist. 70(7, 11 Jan.):1871-1875.

Nowacek, D.P., M.P. Johnson and P.L. Tyack. 2004. North Atlantic right whales (*Eubalaena glacialis*) ignore ships but respond to alerting stimuli. Proceedings: Biological Sciences 271(1536): 227-231.

Nowacek, D.P., L.H. Thorne, D.W. Johnston, and P.L. Tyack. 2007. Responses of cetaceans to anthropogenic noise. Mammal Rev. 37(2):81-115.

NRC. 2005. Marine mammal populations and ocean noise, determining when noise causes biologically significant effects. The National Academy Press, Washington, DC.

Potter, J.R. 2004. A possible mechanism for acoustic triggering of decompression sickness symptoms in deep-diving marine mammals. Paper presented to the 2004 IEEE International Symposium on Underwater Technology, Taipei, Taiwan, 19–23 April 2004. Available at http://www.zifios.com/documentos-oficiales/documentos/Singapore_John_R_Potter_UT04.pdf. (accessed March 10, 2009)

Reeves, R.R., E. Mitchell, and H. Whitehead. 1993. Status of the northern bottlenose whale, *Hyperoodon ampullatus*. Canadian Field-Naturalist 107:490-508.

Richardson, W.J., B. Würsig, and C.R. Greene. 1986. Reactions of bowhead whales, *Balaena mysticetus*, to seismic exploration in the Canadian Beaufort Sea. Journal of the Acoustical Society of America 79(4):1117-1128.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. Academic Press, San Diego, CA. 576 p.

Richardson, W.J., G.W. Miller, and C.R. Greene, Jr. 1999. Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea. Journal of the Acoustical Society of America 106(4, Pt. 2):2281. (Abstract)

Riedman, M.L. 1983. Studies of the effects of experimentally produced noise associated with oil and gas exploration and development on sea otters in California. Rep. from Center for Coastal Marine Studies, Univ. Calif. Santa Cruz, CA, for U.S. Minerals Manage. Serv., Anchorage, AK. 92 p.

Riedman, M.L. 1984. Appendix D/Effects of sounds associated with petroleum industry activities on the behavior of sea otters in California. In: Malme, C.I., P.R. Miles, C.W. Clark, P. Tyack and J.E. Bird (eds.), Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior Phase II: January 1984 migration. Rep. from Bolt Beranek and Newman Inc., Cambridge, MA, for U.S. Minerals Manage. Serv., Anchorage, AK. D-1 to D-12 p.

Romano, T.A., M.J. Keogh, C.Kelly, P. Feng, L. Berk, C.E. Schlundt, D.A. Carder, and J.J. Finneran. 2004. Anthropogenic sound and marine mammal health: measures of the nervous and immune systems before and after intense sound exposure. Canadian Journal of Fisheries and Aquatic Sciences 61:1124-1134.

Rutenko, A.N., S.V. Borisov, A.V. Gritsenko, and M.R. Jenkerson. 2007. Calibrating and monitoring the western gray whale mitigation zone and estimating acoustic transmission during a 3D seismic survey, Sakhalin Island, Russia. Environmental Monitoring and Assessment 134(1-3):21-44.

Slotte, A., K. Hansen, J. Dalen, and E. Ona. 2004. Acoustic mapping of pelagic fish distribution and abundance in relation to a seismic shooting area off the Norwegian coast. Fish. Res. 67: 143-150.

Smultea, M.A., M. Holst, W.R. Koski, and S. Stoltz. 2004. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic program in the Southeast Caribbean Sea and adjacent Atlantic Ocean, April-June 2004. LGL Report TA2822-26. Prepared by LGL Ltd. environmental research associates, King City, ONT, for L-DEO, Columbia University, Palisades, NY. 106 p.

Sorensen, P.W., R.J. Medved, M.A.M. Hyman and H.E. Winn. 1984. Distribution and abundance of cetaceans in the vicinity of human activities along the continental shelf of the northwestern Atlantic. Marine Environmental Research 12(1):69-81.Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aquatic Mammals 33(4):411-522.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas and P.L. Tyack. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aquatic Mammals 33(4):411-522.

Stone, C.J. 2003. The effects of seismic activity on marine mammals in UK waters 1998-2000. JNCC Report 323. Joint Nature Conservation Committee, Aberdeen, Scotland.

Stone, C.J. and M.L. Tasker. 2006. The effects of seismic airguns on cetaceans in UK waters. J. Cetacean Res. Manage. 8(3):255-263.

Tyack, P.L. 2008. Implications for marine mammals of large-scale changes in the marine acoustic environment. Journal of Mammalogy 89(3):549-558.

Tyack, P., M. Johnson, and P. Miller. 2003. Tracking responses of sperm whales to experimental exposures of airguns. p. 115-120 In A.E. Jochens and D.C. Biggs, (eds.), Sperm whale seismic study in the Gulf of Mexico/Annual Report: Year 1. OCS Study MMS 2003-069. Prepared by Texas A&M University, College Station, TX, for MMS, Gulf of Mexico OCS Region, New Orleans, LA.

Vanderlaan, A.S.M. and C.T. Taggart. 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. Marine Mammal Science 23(1): 144-156.

Wardle, C.S., T.J. Carter, G.G. Urquhart, A.D.F. Johnstone, A.M. Ziolkowski, G. Hampson and D. Mackie. 2001. Effects of seismic air guns on marine fish. Cont. Shelf Res. 21(8-10): 1005-1027.

Wartzok, D., A.N. Popper, J. Gordon, and J. Merrill. 2004. Factors affecting the responses of marine mammals to acoustic disturbance. Mar. Technology Soc. J. 37(4):6-15.

Weilgart, L.S. 2007. The impacts of anthropogenic ocean noise on cetaceans and implications for management. Canadian Journal of Zoology 85(11):1091-1116.

Weir, C.R. 2008. Overt responses of humpback whales (*Megaptera novaeangliae*), sperm whales (*Physeter macrocephalus*), and Atlantic spotted dolphins (*Stenella frontalis*) to seismic exploration off Angola. Aquatic Mammals 34(1):71-83.

Weir, C.R. and S.J. Dolman. 2007. Comparative review of the regional marine mammal mitigation guidelines implemented during industrial seismic surveys, and guidance towards a worldwide standard. Journal of International Wildlife Law and Policy 10(1):1-27.

Wilson, J., L. Rotterman, and D. Epperson. 2006. Minerals Management Service overview of seismic survey mitigation and monitoring on the U.S. Outer Continental Shelf. Paper SC/58/E8 presented to IWC Scientific Committee, IWC Annual Meeting, 1-13 June, St. Kitts and Nevis.

Würsig, B., S.K. Lynn, T.A. Jefferson, and K.D. Mullin. 1998. Behaviour of cetaceans in the northern Gulf of Mexico relative to survey ships and aircraft. Aquatic Mammals 24(1):41-50.

Yazvenko, S.B., T.L. McDonald, S.A. Blokhin, S.R. Johnson, S.K. Meier, H.R. Melton, M.W. Newcomer, R. Nielson, V.L Vladimirov, and P.W. Wainwright. 2007a. Distribution and abundance of western gray whales during a seismic survey near Sakhalin Island, Russia. Environmental Monitoring and Assessment 134(1-3):45-73. doi: 10.1007/s10661-007-9809-9.

Yazvenko, S.B., T.L. McDonald, S.A. Blokhin, S.R. Johnson, H.R. Melton, M.W. Newcomer, R. Nielson, and P.W. Wainwright. 2007b. Feeding of western gray whales during a seismic survey near Sakhalin Island, Russia. Environmental Monitoring and Assessment 134(1-3):93-106. doi: 10.1007/s10661-007-9810-3.

Yoder, J.A. 2002. Declaration of James A. Yoder in opposition to plaintiff's motion for temporary restraining order, 28 October 2002. Civ. No. 02-05065-JL. U.S. District Court, Northern District of California, San Francisco Division.

APPENDIX A: CHARACTERISTICS OF AIRGUN PULSES

Airguns function by venting high-pressure air into the water. The pressure signature of an individual airgun consists of a sharp rise and then fall in pressure, followed by several positive and negative pressure excursions caused by oscillation of the resulting air bubble. The sizes, arrangement,and firing times of the individual airguns in an array are designed and synchronized to suppress the pressure oscillations subsequent to the first cycle. The resulting downward-directed pulse lasts only 10 to 20 ms, with only one strong positive and one strong negative peak pressure (Caldwell and Dragoset 2000).

The predominant energy emitted from airguns is at relatively low frequencies. For example, typical high-energy airgun arrays emit most energy at 10–120 Hz. However, the pulses contain some energy up to 500–1,000 Hz and above (Goold and Fish 1998; Potter et al. 2007). Substantial high-frequency energy output of up to 150 kHz was found during tests of 60 in^3 and 250 in^3 airguns (Goold and Coates 2006). In fact, the output of these airguns covered the entire frequency range known to be used by marine mammals. This output included substantial energy levels as to be clearly audible to most, if not all, cetacean species (Goold and Coates 2006). Other recent studies—including controlled studies of sperm whales in the Gulf of Mexico (Tyack et al. 2006)—have also found that airgun arrays exposed animals to significant sound energy above 500 Hz (Goold and Fish 1998; Sodal 1999). These data increase concerns about the potential impacts of seismic sounds on odontocetes with poor low-frequency hearing but good higher-frequency hearing.

Levels of anthropogenic underwater sounds, including those produced by seismic surveys, have been increasing worldwide. Concurrently, there is growing concern by the general public, researchers, government entities, and others regarding exposure of marine mammals to these sounds (e.g., Hildebrand 2004; Marine Technology Society 2004; Simmonds et al. 2006). In a comparison of anthropogenic underwater sound sources, airgun arrays worldwide were estimated to introduce 3.9 x 1013 Joules of energy into the ocean, second only to the potential release of energy from underwater nuclear explosions and ranking above military sonars (Moore and Angliss 2006). As a result, there has been increasing interest in and studies on methods to estimate the numbers of animals exposed to various sound levels and to mitigate exposure to these sounds (e.g., Hollingshead and Harrison 2005).

Recent attention has focused on developing sound exposure criteria appropriate to the acoustic sensitivities of various marine mammal groups and species (e.g., Hollingshead and Harrison 2005; Miller et al. 2005; Southall et al. 2007). These exposure criteria have important implications for identifying appropriate “safety radii” and sound exposure limits, including balancing mitigation with goals of geophysical seismic studies conducted by industry, universities and others (e.g., Barton et al. 2006). Various empirical data are being collected, and modeling and predictions of the propagation and received levels of airgun sounds are being developed and applied (e.g., Breitzke et al. 2006; Diebold et al. 2006; Frankel et al. 2006; Miller et al. 2006; Racca et al. 2006; Turner et al. 2006; Tyack et al. 2006). These recent studies are affecting the way underwater sound is modeled. For example, DeRuiter et al. (2005) reported that on-axis source levels and spherical spreading assumptions alone insufficiently describe airgun pulse propagation and the extent of exposure zones.

Several important mitigating factors need to be kept in mind regarding the characteristics of seismic airgun arrays compared to other types of underwater anthropogenic sounds. (1) Airgun arrays produce intermittent sounds involving emission of a strong sound pulse for a small fraction of a second followed by several seconds of near silence. In contrast, some other sources produce sounds with lower peak levels that are continuous or discontinuous, but persist

for much longer durations than seismic pulses. (2) Airgun arrays are designed to transmit strong sounds downward through the seafloor, and the amount of sound transmitted in near-horizontal directions is considerably reduced. Nonetheless, they also emit sounds that travel horizontally toward non-target areas. (3) An airgun array is a distributed source, not a point source. The nominal source level is an estimate of the sound that would be measured from a theoretical point source emitting the same total energy as the airgun array. That figure is useful in calculating the expected received levels in the far field (i.e., at moderate and long distances). However, because the airgun array is not a single point source, there is no one location within the near field (or anywhere else) where the received level is as high as the nominal source level.

The strengths of airgun pulses can be measured in different ways, and it is important to know which method is being used when interpreting quoted source or received levels. Geophysicists usually quote peak-to-peak levels, in bar-meters or (less often) dB re 1 µPa-1 m. The peak (= 0-to-peak) level for the same pulse is typically about 6 dB less. In the biological literature, levels of received airgun pulses are often described based on the "average" or "root-mean-square" (rms) level, where the average is calculated over the time interval encompassing 90% of the total acoustic energy from a single pulse. The rms value for a given airgun pulse is typically about 10 dB lower than the peak level, and 16 dB lower than the peak-to-peak value (Greene 1997; McCauley et al. 1998, 2000). A fourth measure that is increasingly being used is the energy, or sound exposure level (SEL), in dB re 1 $\mu Pa^2 \cdot s$. Because the pulses are <1 s in duration, the numerical value of the SEL energy value is lower than the rms pressure level but the units are different. Because the level of a given pulse will differ substantially depending on which of these measures is being applied, it is important to be aware which measure is in use when interpreting any quoted pulse level. In the past, NMFS has commonly referred to rms levels when discussing levels of pulsed sounds that might "harass" marine mammals, but SEL values are coming into wider use for this purpose.

Seismic sound received at any given point will arrive in several ways. These include sound arriving via a direct path through the water, indirect paths that include reflection from the sea surface and bottom, and other indirect paths including transmission through the bottom sediments. Sounds propagating via indirect paths travel longer distances and often arrive later than sounds arriving via a direct path. (However, sound traveling in the bottom may travel faster than that in the water, and thus may, in some situations, arrive slightly earlier than sound traveling along the direct path despite traveling a greater distance.) These variations in travel time effectively lengthen the duration of the received pulse, or may cause two or more received pulses from a single emitted pulse. Near the source, the predominant part of a seismic pulse is about 10–20 ms in duration. In comparison, the pulse duration as received at long horizontal distances can be much greater. For example, for one airgun array operating in the Beaufort Sea, pulse duration was about 300 ms at a distance of 8 km, 500 ms at 20 km, and 850 ms at 73 km (Greene and Richardson 1988).

An important aspect of sound propagation is that received levels of low-frequency underwater sounds diminish close to the water's surface because of pressure-release and interference phenomena that occur at and near the surface (Urick 1983; Richardson et al. 1995). Paired measurements of received airgun sounds at depths of 3 m vs. 9 m or 18 m have shown that received levels are typically several decibels lower at 3 m (Greene and Richardson 1988). For a marine mammal at the surface, whose auditory organs are within 0.5–1 m of the surface, the received level of the predominant low-frequency components of the airgun pulses would be further reduced. Conversely, in deep water, the received levels at deep depths can be considerably higher than those at relatively shallow (e.g., 18 m) depths and the same horizontal distance from the airguns (Tolstoy et al. 2004a, b).

In addition, research conducted in shallow-water environments has recently shown that when the seafloor is within the near field of the source array, the associated partitioning of energy can cause uncharacteristically rapid loss of energy with distance (Diebold et al. 2006). These data suggest that, in some shallow water environments, recent mitigation measures may be more conservative than necessary. Empirical site-specific data collected in situ may facilitate identification of the most appropriate safety radii in these shallow-water and other environments (Turner et al. 2006).

Recent reports suggest that monitoring seismic airgun sound over broad areas may be needed to determine the scale of potential effects of seismic surveys (e.g., Bain and Williams 2006). Pulses of underwater sound from open-water seismic exploration are often detected 50–100 km from the source location, even during operations in nearshore waters (Greene and Richardson 1988; Burgess and Greene 1999). At those distances, the received levels are low: <120 dB re 1 μPa_{rms}. However, faint seismic pulses are sometimes detectable at even greater ranges (e.g., Bowles et al. 1994; Fox et al. 2002). In fact, recent data show that, in deep water areas, low-frequency airgun signals can sometimes be detected thousands of kilometres from their source. For example, sound from seismic surveys conducted offshore of Nova Scotia, the coast of western Africa, and northeast of Brazil were reported as a dominant feature of the underwater noise field recorded along the mid-Atlantic ridge (Nieukirk et al. 2004). In addition, considerably higher levels can occur at distances out to several kilometres from an operating airgun array. A further consideration is that, with depending on propagation conditions, received levels are not necessarily a simple declining function of distance. For example, Madsen et al. (2006) reported that received levels of the first arrivals of seismic pulses at 12 km were as high as received levels 2 km from the seismic array. In some situations, secondary sound arrivals can have higher received levels at 5–12.6 km from the source than they do at ranges closer to (Madsen et al. 2006).

Literature Cited

Bain, D.E. and R. Williams. 2006. Long-range effects of airgun noise on marine mammals: responses as a function of received sound level and distance. Paper SC/58/E35 presented to the IWC Scientific Committee, IWC Annual Meeting, 1-13 June, St. Kitts and Nevis. 13 p.

Barton, P., J. Diebold, and S. Gulick. 2006. Balancing mitigation against impact: a case study from the 2005 Chicxulub seismic survey. Eos Transactions of the American Geophysical Union 87(36), Joint Assembly Supplement, Abstract OS41A-04. 23-26 May, Baltimore, MD.

Bowles, A.E., M. Smultea, B. Würsig, D.P. DeMaster, and D. Palka. 1994. Relative abundance and behavior of marine mammals exposed to transmissions from the Heard Island Feasibility Test. Journal of the Acoustical Society of America 96(4):2469-2484.

Breitzke, M., O. Boebel, S. El Naggar, W. Jokat, G. Kuhn, F. Niessen, H. Schenke, B. Werner, and J. Diebold. 2006. Broadband sound pressure field characteristics of marine seismic sources used by R/V Polarstern. Eos

Transactions of the American Geophysical Union 87(36), Joint Assembly Supplement, Abstract OS41A-02. 23-26 May, Baltimore, MD.

Burgess, W.C. and C.R. Greene, Jr. 1999. Physical acoustics measurements. p. 3-1 – 3-63 In W.J. Richardson, (ed.), Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1998. LGL Rep. TA2230. Prepared

by LGL Ltd., King City, ON, and Greeneridge Sciences, Inc., Santa Barbara, CA, for Western Geophysical, Houston, TX, and NMFS, Anchorage, AK, and Silver Spring, MD.

Caldwell, J. and W. Dragoset. 2000. A brief overview of seismic air-gun arrays. The Leading Edge 19(8, Aug.):898-902.

DeRuiter, S.L., Y-T. Lin, A.E. Newhall, P.T. Madsen, P.J.O. Miller, J.F. Lynch, and P.L. Tyack. 2005. Quantification and acoustic propagation modeling of airgun noise recorded on DTAG-tagged sperm whales in the Gulf of Mexico. p. 73 In Abstracts of the 16th Biennial Conference on the Biology of Marine Mammals, 12-16 December, San Diego, CA.

Diebold, J.B., M. Tolstoy, P.J. Barton, and S.P. Gulick. 2006. Propagation of exploration seismic sources in shallow water. Eos Transactions of the American Geophysical Union 87(36), Joint Assembly Supplement, Abstract OS41A-03. 23-26 May, Baltimore, MD.

Fox, C.G., R.P. Dziak, and H. Matsumoto. 2002. NOAA efforts in monitoring of low-frequency sound in the global ocean. Journal of the Acoustical Society of America 112:2260. (Abstract).

Frankel, A., W.J. Richardson, S. Carr, R. Spaulding, and W. Ellison. 2006. Estimating the acoustic exposure of marine mammals to seismic sources of the R/V Maurice Langseth. Eos Transactions of the American Geophysical Union 87(36), Joint Assembly Supplement, Abstract OS42A-05. 23-26 May, Baltimore, MD.

Goold, J.C. and P.J. Fish. 1998. Broadband spectra of seismic survey air-gun emissions, with reference to dolphin auditory thresholds. Journal of the Acoustical Society of America 103:2177-2184.

Goold, J.C. and R.F.W. Coates. 2006. Near source, high frequency air-gun signatures. Paper SC/58/E30 presented to the IWC Scientific Committee, IWC Annual Meeting, 1-13 June, St. Kitts and Nevis.

Greene, C.R., Jr. 1997. An autonomous acoustic recorder for shallow arctic waters. Journal of the Acoustical Society of America 102(5, Pt.2):3197.

Greene, C.R., Jr. and W.J. Richardson. 1988. Characteristics of marine seismic survey sounds in the Beaufort Sea. Journal of the Acoustical Society of America 83:2246-2254.

Hildebrand, J. 2004. Sources of anthropogenic noise in the marine environment. Paper presented at the International Policy Workshop on Sound and Marine Mammals, London, September 28-30. Held by Marine Mammal Commission and Joint Nature Conservation Committee.

Hollingshead, K R. and J. Harrison. 2005. Taking marine mammals incidental to maritime activities: an “insurance policy” for scientific, industrial and military maritime activities? p. 129 In Abstracts of the 16th Biennial Conference on the Biology of Marine Mammals, 12-16 December, San Diego, CA.

Madsen, P.T., M. Johnson, P.J.O. Miller, N. Aguilar de Soto, J. Lynch, and P.L. Tyack. 2006. Quantitative measures of air gun pulses recorded on sperm whales (Physeter macrocephalus) using acoustic tags during controlled exposure experiments. Journal of the Acoustical Society of America 120(4):2366–2379.

Marine Technology Society. 2004. Human-generated ocean sound and the effects on marine life. Marine Technology Society Journal 7:1-82.

McCauley, R.D., M.-N. Jenner, C. Jenner, K.A. McCabe, and J. Murdoch. 1998. The response of humpback whales (Megaptera novaeangliae) to offshore seismic survey noise: preliminary results of observations about a working seismic vessel and experimental exposures. APPEA (Austral. Petrol. Product. Explor. Assoc.) Journal 38:692-707.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J.Murdoch, and K. McCabe. 2000. Marine seismic surveys: Analysis of airgun signals; and effects of air gun exposure on humpback whales, sea turtles, fishes and squid. Report from Centre for Marine Science and Technology, Curtin University, Perth, Western Australia, for Australian Petroleum Production Association, Sydney, NSW.

Miller, J.H., A.E. Bowles, B.L. Southall, R.L. Gentry, W.T. Ellison, J.J. Finneran, C.R. Greene Jr., D. Kastak, D.R. Ketten, P.L. Tyack, P.E. Nachtigall, W.J. Richardson and J.A. Thomas. 2005. Strategies for weighting exposure in the development of acoustic criteria for marine mammals. Journal of the Acoustical Society of America 118:2019 (Abstract). Presentation available at: http:/www.oce.uri.edu/faculty_pages/miller/Noise_Weighting_ 10_18_2005.ppt.

Miller, P.J., P.L. Tyack, M.P. Johnson, P.T. Madsen, and R. King. 2006. Techniques to assess and mitigate the environmental risk posed by use of airguns: recent advances from academic research programs. Eos Transactions of the American Geophysical Union 87(36), Joint Assembly Supplement, Abstract OS42A-03. 23-26 May 2006, Baltimore, MD.

Moore, S.E. and Angliss, R.P. 2006. Overview of planned seismic surveys offshore northern Alaska, July-October 2006. Paper SC/58/E6 presented to IWC Scientific Committee, IWC Annual Meeting, 1-13 June, St Kitts and Nevis.

Nieukirk, S.L., K.M. Stafford, D.K. Mellinger, R.P. Dziak, and C.G. Fox. 2004. Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean. Journal of the Acoustical Society of America 115(4):1832-1843.

Potter, J.R., M. Thillet, C. Douglas, M. Chitre, Z. Doborzynski, and P. Seekings. 2007. Visual and passive acoustic marine mammal observations and high-frequency seismic source characteristics recorded during a seismic survey. IEEE Journal of Oceanic Engineering 32(2):469-483.

Racca, R., D. Hannay, and S. Carr. 2006. Current state of acoustic wave propagation modeling and its use in the estimation of impact on marine mammals. Eos Transactions of the American Geophysical Union 87(36), Joint Assembly Supplement, Abstract OS42A-04. 23-26 May, Baltimore, MD.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. Academic Press, San Diego, CA. 576 p.

Simmonds, M.P., S.J. Dolman, and L. Weilgart, eds. 2006. Oceans of Noise 2004: A WDCS Science Report. Whale and Dolphin Conservation Society, Chippenham, UK.

Sodal, A. 1999. Measured underwater acoustic wave propagation from a seismic source. Proceedings of the Airgun Environmental Workshop, 6 July, London, UK.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas and P.L. Tyack. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aquatic Mammals 33(4):411-522.

Tolstoy, M., J. Diebold, S. Webb, D. Bohnenstiehl, and E. Chapp. 2004a. Acoustic calibration measurements. Chapter 3 In: W.J. Richardson, ed. Marine mammal and acoustic monitoring during Lamont-Doherty Earth Observatory's acoustic calibration study in the northern Gulf of Mexico, 2003. Revised. Prepared by LGL Ltd., King City, ONT, for Lamont-Doherty Earth Observatory, Palisades, NY, and NMFS, Silver Spring, MD.

Tolstoy, M., J.B. Diebold, S.C. Webb, D.R. Bohenstiehl, E. Chapp, R.C. Holmes, and M. Rawson. 2004b. Broadband calibration of R/V Ewing seismic sources. Geophysical Research Letters 31:L14310.

Turner, S., M. Zykov, and A. MacGillivray. 2006. Preliminary acoustic level measurements of airgun sources from ConocoPhillips' 2006 seismic survey in Alaskan Chukchi Sea. Prepared by JASCO Research Ltd., Victoria, BC.

Tyack, P.L., M.P. Johnson, P.T. Madsen, P.J. Miller, and J. Lynch. 2006. Biological significance of acoustic impacts on marine mammals: examples using an acoustic recording tag to define acoustic exposure of sperm whales, Physeter catodon, exposed to airgun sounds in controlled exposure experiments. Eos Transactions of the American Geophysical Union 87(36), Joint Assembly Supplement, Abstract OS42A-02. 23-26 May, Baltimore, MD.

Urick, R.J. 1983. Principles of Underwater Sound. 3rd edition. Peninsula Publishing, Los Altos, CA. 423 p.

APPENDIX B: HEARING ABILITIES OF MARINE MAMMALS

The hearing abilities of marine mammals are functions of the following (Richardson et al. 1995; Au et al. 2000):

1. Absolute hearing threshold (the level of sound barely audible in the presence of significant ambient noise) at the frequency in question. The “best frequency” is the frequency with the lowest absolute threshold.

2. Critical ratio (the signal-to-noise ratio required to detect a sound at a specific frequency in the presence of background noise around that frequency).

3. The ability to localize sound direction at the frequencies under consideration.

4. The ability to discriminate among sounds of different frequencies and intensities.

Marine mammals rely on the use of underwater sounds to communicate and gain information about their surroundings. Experiments also show that they hear and may react to many anthropogenic sounds including sounds made during seismic exploration. Seismic surveys often use sonar systems simultaneously with airguns; however, the majority of studies that have examined the potential impacts of seismic surveys on marine mammals have focused on the impacts of airguns rather than sonar.

Baleen Whales (Mysticetes)

The hearing abilities of mysticetes have not been studied directly. However, the anatomy of the baleen whale inner ear seems to be well adapted for detection of low-frequency sounds (Ketten 1991, 1992, 1994, 2000). Behavioural evidence also indicates that they hear well at low frequencies <1 kHz (see Richardson et al. 1995). The sound levels that they can detect below 1 kHz are probably limited by increasing levels of natural ambient noise at decreasing frequencies; at frequencies below 1 kHz, natural ambient levels tend to increase (see Richardson et al. 1995; Clark and Ellison 2004).

The hearing systems of mysticetes are thought to be more sensitive to low-frequency sounds than are the ears of the small odontocetes that have been studied directly. Thus, mysticetes are likely to hear airgun pulses farther away than can small odontocetes and, at closer distances, airgun sounds may seem more prominent to mysticetes than to odontocetes. However, mysticetes have commonly been seen well within the distances where seismic sounds would be detectable and yet often show no overt reaction to those sounds. Behavioural responses by mysticetes to seismic pulses have been documented, but received levels of pulsed sounds necessary to elicit behavioural reactions are typically well above the assumed minimum detectable levels (Malme et al. 1984, 1988; Richardson et al. 1986, 1995; McCauley et al. 2000; Johnson et al. 2007).

However, some studies do suggest that mysticetes may also be able to hear and respond to much higher frequency sounds. Mysticetes produce sounds at frequencies up to 8 kHz and, for humpback whales, to >24 kHz (Au et al. 2001, 2006). Watkins (1986) noted that some mysticetes reacted to pinger sounds up to 28 kHz, but not to pingers or sonars emitting sounds at >36 kHz. Todd et al. (1992) reported that mysticetes reacted to sonar sounds at 3.5 kHz when received levels were 80–90 dB re 1 µPa. Migrating gray whales reacted to a 21–25 kHz whale-finding sonar with a source level of 215 dB re 1 µPa-m (Frankel 2005). Southall et al.

(2007) concluded that the functional hearing range for ysticetes as a group is from about 7 Hz to 22 kHz.

Toothed Whales (Odontocetes)

Hearing abilities of some odontocetes have been studied in detail (reviewed by Richardson et al. 1995; Au et al. 2000; Southall et al. 2007). Hearing sensitivities as a function of frequency have been determined for several species. The small- to moderate-sized odontocetes that have been the subject of audiology studies have relatively poor hearing sensitivity at frequencies below 1 kHz, but extremely good sensitivity at and above several kHz. There are very few data on the absolute hearing thresholds of most of the larger, deep-diving odontocetes, such as the sperm and beaked whales. However, Mann et al. (2005) and Cook et al. (2006) both report that a Gervais' beaked whale showed evoked potentials from 5–80 kHz, with the best sensitivity at 40–80 kHz. Southall et al. (2007) concluded that the functional hearing range for "mid-frequency" and "high-frequency" cetaceans as groups are from about 150 Hz to 160 kHz and from about 200 Hz to 180 kHz, respectively.

Despite the relatively poor sensitivity of small odontocetes at the low frequencies that contribute most of the energy in pulses of sound from airgun arrays, the sounds are sufficiently strong that their received levels sometimes remain above the hearing thresholds of odontocetes at distances out to several tens of kilometres (Richardson and Würsig 1997). However, there is no evidence that small odontocetes react to airgun pulses at such long distances, or even (with the exception of belugas.Miller et al. 2005) at intermediate distances where sound levels are well above the ambient noise level.

Seals and Sea Lions (Pinnipeds)

Behavioural measures of hearing are available for five species of earless seals (phocids), two species of eared seals (otariids), and the walrus (reviewed in Richardson et al. 1995:211ff.; Kastak and Schusterman 1998, 1999; Kastelein et al. 2002; Southall et al. 2007). In comparison with odontocetes, pinnipeds tend to have lower best frequencies, lower high-frequency cutoffs, better auditory sensitivity at low frequencies, and poorer sensitivity at the best frequency. In particular phocid seals have better sensitivity at low frequencies (1 kHz) than do odontocetes.

Below 30–50 kHz, the hearing thresholds of most tested pinniped species are essentially flat down to about 1 kHz, and range from 60–85 dB re 1 µPa. Measurements for a harbour seal indicate that, below 1 kHz, its thresholds deteriorate (increase) gradually to ~97 dB re 1 µPa at 100 Hz (Kastak and
Schusterman 1998). The northern elephant seal appears to have better underwater sensitivity than does the harbour seal, at least at low frequencies (Kastak and Schusterman 1998, 1999). For the otariids, the high frequency cutoff is lower, and the sensitivity at low frequencies (e.g., 100 Hz) is poorer than for phocids, at least for harbour and elephant seals.

The underwater hearing of a walrus has been measured at frequencies from 125 Hz to 15 kHz (Kastelein et al. 2002). The range of best hearing was 1–12 kHz, with maximum sensitivity (67 dB re 1µPa) occurring at 12 kHz.

Southall et al. (2007) concluded that the functional hearing range for pinnipeds in water as a group is from about 75 Hz to 75 kHz. This range is primarily based on data for phocids, and as such, would be lower for otariids.

Sea Otter and Polar Bear (Fissipeds)

No data are available on the hearing abilities of sea otters (Ketten 1998), although the in-air vocalizations of sea otters have most of their energy concentrated at 3 to 5 kHz (McShane et al. 1995; Thomson and Richardson 1995). Sea otter vocalizations are considered to be most suitable for short-range communication among individuals (McShane et al. 1995).

Data on the specific hearing capabilities of polar bears are also largely lacking. A recent study of in-air hearing of polar bears involved use of the auditory evoked potential method while tone pips were played to anesthetized bears (Nachtigall et al. 2007). Hearing was tested in ½ octave steps from 1 to 22.5 kHz and best hearing sensitivity was found between 11.2 and 22.5 kHz. These data suggest that polar bears have sensitive hearing over a wide frequency range.

Polar bear behaviour (e.g., remaining on the ice, at the water surface, or on land) reduces or avoids their exposure to underwater sounds. Similarly, the tendency of sea otters to be at the water surface (or on land) much of the time would reduce their exposure to underwater sounds.

Literature Cited

Au, W.W.L., A.N. Popper, and R.R. Fay. 2000. Hearing by Whales and Dolphins. Springer Handbook of Auditory Research Volume 12. Springer-Verlag, New York, NY. 458 p.

Au, W., J. Darling, and K. Andrews. 2001. High-frequency harmonics and source level of humpback whale songs. Journal of the Acoustical Society of America 110:2770.

Au, W.W.L., A.A. Pack, M.O. Lammers, L.M. Herman, M.H. Deakos and K. Andrews. 2006. Acoustic properties of humpback whale songs. J. Acoust. Soc. Am. 120(2):1103-1110.

Clark, C.W. and W.T. Ellison. 2004. Potential use of low-frequency sounds by baleen whales for probing the environment: Evidence from models and empirical measurements. p. 564-589 In J.A. Thomas, C.F. Moss and M. Vater, (eds.), Echolocation in Bats and Dolphins. University of Chicago Press, Chicago, IL.

Cook, M.L.H., R.A. Varela, J.D. Goldstein, S.D. McCulloch, G.D. Bossart, J.J. Finneran, D. Houser, and A. Mann. 2006. Beaked whale auditory evoked potential hearing measurements. Journal of Comparative Physiology A 192:489-495.

Frankel, A.S. 2005. Gray whales hear and respond to a 21–25 kHz high-frequency whale-finding sonar. Page 97 in Abstracts of the 16th Biennial Conference on the Biology of Marine Mammals, 12-16 December 2005, San Diego, CA.

Johnson, S.R., W.J. Richardson, S.B. Yazvenko, S.A. Blokhin, G. Gailey, M.R. Jenkerson, S.K. Meier, H.R. Melton, M.W. Newcomer, A.S. Perlov, S.A. Rutenko, B. Würsig, C.R. Martin, and E.D. Egging. 2007. A western gray whale mitigation and monitoring program for a 3-D seismic survey, Sakhalin Island, Russia. Environmental Monitoring and Assessment 134(1-3):1-19.

Kastak, D. and R.J. Schustermn. 1998. Low-frequency amphibious hearing in pinnipeds: methods, measurements, noise and ecology. Journal of the Acoustical Society of America 103: 2216-2228.

Kastak, D. and R.J. Schusterman. 1999. In-air and underwater hearing sensitivity of a northern elephant seal (Mirounga angustirostris). Canadian Journal of Zoology 77:1751-1758.

Kastelein, R.A., P. Mosterd, B. van Santen, M. Hagedoorn, and D. de Haan. 2002. Underwater audiogram of a Pacific walrus (Odobenus rosmarus divergens) measured with narrow-band frequency-modulated signals. Journal of the Acoustical Society of America 112:2173-2182.

Ketten, D.R. 1991. The marine mammal ear: specializations for aquatic audition and echolocation. p. 717-750 In D. Webster, R. Fay and A. Popper, (eds.) The Biology of Hearing. Springer-Verlag, Berlin.

Ketten, D.R. 1992. The cetacean ear: form, frequency, and evolution. p. 53-75 In J.A. Thomas, R.A. Kastelein, and
A. Ya Supin, (eds.), Marine Mammal Sensory Systems. Plenum, New York.

Ketten, D.R. 1994. Functional analysis of whale ears: adaptations for underwater hearing. IEEE Proceedings of Underwater Acoustics 1:264-270.

Ketten, D.R. 1998. Marine mammal auditory systems: a summary of audiometric and anatomical data and its implications for underwater acoustic impacts. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-256. Southwest Fisheries Science Center, La Jolla, CA.

Ketten, D.R. 2000. Cetacean ears. p. 43-108 In W.W.L. Au, A.N. Popper, and R.R. Fay, (eds.), Hearing by Whales and Dolphins. Springer-Verlag, New York.

Malme, C.I., P.R. Miles, C.W. Clark, P. Tyack, and J.E. Bird. 1984. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior/Phase II: January 1984 migration. BBN Report 5586. Prepared by Bolt Beranek & Newman Inc., Cambridge, MA, for MMS,Alaska OCS Region, Anchorage, AK.

Malme, C.I., B. Würsig, B., J.E. Bird, and P. Tyack. 1988. Observations of feeding gray whale responses to controlled industrial noise exposure. p. 55-73 In W.M. Sackinger, M.O. Jeffries, J.L. Imm, and S.D. Treacy, (eds.), Port and Ocean Engineering Under Arctic Conditions. Vol. II. Symposium on Noise and Marine Mammals. University of Alaska Fairbanks, Fairbanks, AK.

Mann, D.A., R.A. Varela, J.D. Goldstein, S.D. McCulloch, G.D. Bossart, J.J. Finneran, D. Houser, and M.L.H. Cook. 2005. Gervais' beaked whale auditory evoked potential hearing measurements. p. 178-179 In Abstracts of the 16th Biennial Conference on the Biology of Marine Mammals, 12-16 December 2005, San
Diego, CA.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J.Murdoch, and K. McCabe. 2000. Marine seismic surveys: Analysis of airgun signals; and effects of air gun exposure on humpback whales, sea turtles, fishes and squid. Report from Centre for Marine Science and Technology, Curtin University, Perth, Western Australia, for Australian Petroleum Production Association, Sydney, NSW.

McShane, L.J., J.A. Estes, M.L. Riedman, and M.M. Staedler. 1995. Repertoire, structure, and individual variation of vocalizations in the sea otter. Journal of Mammalogy 76:414-427.

Miller, G.W., V.D. Moulton, R.A. Davis, M. Holst, P. Millman, A. MacGillivray, and D. Hannay. 2005. Monitoring seismic effects on marine mammals—southeastern Beaufort Sea, 2001-2002. p. 511-542 In S.L. Armsworthy, P.J. Cranford, and K. Lee, (eds.), Offshore Oil and Gas Environmental Effects Monitoring/Approaches and Technologies. Battelle Press, Columbus, OH.

Nachtigall, P.E., A.Y. Supin, M. Amundin, B. Röken,,T. Møller, A. Mooney, K.A. Taylor, and M. Yuen. 2007. Polar bear Ursus maritimus hearing measured with auditory evoked potentials. Journal of Experimental Biology 210:1116-1122.

Richardson, W.J. and B. Würsig. 1997. Influences of man-made noise and other human actions on cetacean behaviour. Marine and Freshwater Behavioral Physiology 29:183-209.

Richardson, W.J., B. Würsig, and C.R. Greene. 1986. Reactions of bowhead whales, Balaena mysticetus, to seismic exploration in the Canadian Beaufort Sea. Journal of the Acoustical Society of America 79:1117-1128.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. Academic Press, San Diego, CA. 576 p.
Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas and P.L. Tyack. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aquatic Mammals 33(4):411-522.

Thomson, D.H. and W.J. Richardson. 1995. Marine mammal sounds. p. 159-204 In W.J. Richardson, C.R. Greene, Jr., C.I. Malme, and D.H. Thomson, Marine Mammals and Noise. Academic Press, San Diego, CA. 576 p.

Todd, S., J. Lien, and A. Verhulst. 1992. Orientation of humpback whales (Megaptera novaengliae) and minke whales (Balaenoptera acutorostrata) to acoustic alarm devices designed to reduce entrapment in fishing gear. Pages 727-739 in J.A. Thomas, R.A. Kastelein, and A. Ya. Supin, eds. Marine Mammal Sensory
Systems. Plenum, New York.

Watkins, W.A. 1986. Whale reactions to human activities in Cape Cod waters. Marine Mammal Science 2:251-262.

ICES Journal of Marine Science, 61: 274–286. 2004
doi:10.1016/j.icesjms.2003.12.004

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A risk assessment of the sustainability of the harvest of beluga (*Delphinapterus leucas* (Pallas 1776)) in West Greenland

Carlos M. Alvarez-Flores and Mads Peter Heide-Jørgensen

Alvarez-Flores, C. M. and Heide-Jørgensen, M. P. 2004. A risk assessment of the sustainability of the harvest of beluga (*Delphinapterus leucas* (Pallas 1776)) in West Greenland. – ICES Journal of Marine Science, 61: 274–286.

Risk assessments to assess the efficiency of management procedures to regulate removals of marine mammals have rarely been conducted. Using Bayesian methods, we conducted a risk assessment on a harvested beluga population off West Greenland. The population size in recent years was estimated to be 22% of the size in 1954. Results indicate that current catches are unsustainable and that continuation of this situation represents a 90% probability that the population will become extinct in 20 years. The analyses suggest that the harvest should be reduced to no more than 130 animals. Constant catch quotas represent a greater risk of depletion compared with catch limits that are a function of harvest rate and population size. An alternative gradual reduction schedule is proposed as a viable strategy, reducing the harvest in 5 years and adjusting the subsequent quota using a harvest rate of 0.5 of R_{max}, with updates in the abundance. This analysis is presented as an alternative for cases where an immediate catch reduction is desirable but not feasible for marine mammal populations that appear vulnerable or in danger and where catch and abundance data are available.

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Keywords: beluga hunt, Greenland, risk assessment.

Received 25 February 2003; accepted 5 December 2003.

C. M. Alvarez-Flores: School of Aquatic and Fishery Sciences, University of Washington, Box 355020, Seattle, WA 98195, USA. Present address: Resource Assessment and Conservation Engineering, Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, 7600 Sand Point Way N.E. Building 4, Seattle, WA 98115, USA. M. P. Heide-Jørgensen: Greenland Institute of Natural Resources Boks 570, DK-3900 Nuuk, Greenland. Present address: National Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, 7600 Sand Point Way N.E. Building 4, Seattle, WA 98115, USA. Correspondence to C. M. Alvarez-Flores: tel: (206) 526-4316; fax: (206) 526-6723; e-mail: Carlos.Alvarez@noaa.gov

Introduction

Management of marine species is not limited to the evaluation of the biological characteristics of the resource, as social and political considerations also play an important role in the final decisions. Therefore, management alternatives should be evaluated in terms of their ability to meet some specific management goals. If a biologically desirable strategy cannot be implemented immediately, the manager should know the risk of departing from the optimum (Hilborn, 1997). Methods for evaluating harvesting strategies for marine mammal populations have incorporated means of accounting for the associated uncertainties but usually offer a single estimate of the maximum allowable removal. These methods include the Potential Biological Removals (PBR; Wade, 1998) used mainly by the US government, and the Revised Management Procedure (RMP; Cooke, 1995) of the International Whaling Commission (IWC). Such methods work efficiently under specific, institutionally dictated management goals.

The beluga (*Delphinapterus leucas*) has long been part of the Inuit hunting culture, providing meat for humans and dogs, and the nutritious skin and blubber called "mattak" in Greenland or "muktuk" in North America. However, in several areas where large-scale harvesting has taken place (e.g. Svalbard, Cook Inlet, Saint Lawrence river, Ungava Bay, East Hudson Bay, and Cumberland Sound), the beluga stocks have apparently been reduced in numbers and/or there has been a contraction in the spatial distribution (Gjertz and Wiig, 1994; O'Corry-Crowe and Lowry, 1997; Kingsley, 2002). In West Greenland, the introduction of new hunting methods and the subsequent large catches is assumed to have resulted in the disappearance of belugas from most of the area south of 65°N (Heide-Jørgensen, 1994). Apparently, the beluga either abandoned some fjords where they were previously found in large numbers or the fraction of the population with affinity for these fjords were eliminated through overharvesting. Indeed, belugas are no longer found in many areas where they were harvested during their seasonal migrations.

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The main winter distribution in West Greenland has recently been monitored as a proxy for indications of changes in population size (Heide-Jørgensen *et al.*, 1993; Heide-Jørgensen and Reeves, 1996). Survey results indicate that the relative abundance of belugas wintering off West Greenland has declined considerably since 1981. The population estimate for 1998–1999 is 7941 individuals (95% CI: 4264–14 789; Heide-Jørgensen and Acquarone, 2002).

We examine the current harvest in West Greenland, assuming that all belugas in the area belong to a single stock. Alternative management strategies are evaluated for their ability to ensure that the declining trend is stopped, if possible, allowing for some harvest. Although a risk assessment approach is not unknown in the fishery literature (e.g. Punt and Walker, 1998), it has rarely been applied to marine mammals (e.g. Maunder *et al.*, 2000). We present this assessment as a case where management alternatives are weighted by the amount of risk of not meeting pre-determined goals. Options are offered to administrators, providing time and opportunity to develop economic alternatives for the people affected by drastic reductions in a catch that represents an important source of income. This requires an estimate of the sustainability of different catch levels over the next 5–10 years.

Simultaneous with our study, two independent assessments were conducted on the same stock. One used the IWC HITTER-FITTER model (Butterworth *et al.*, 2002), while the other used Bayesian methods and included belugas from Canadian waters (Innes and Stewart, 2002). These studies were restricted to the estimation of population parameters and of potential yields to be recommended as catch limits. In contrast, after estimating population parameters, we considered a range of alternative catch scenarios and evaluated the risk of not achieving a specific management goal. The underlying philosophy of this approach is discussed.

Methods

Harvest statistics

The catch statistics span a time-series from 1954 to 1999. The difficulty in collecting accurate catch data along the entire coastline of West Greenland prohibits conventional estimates of the uncertainty associated with the data. Instead, the available information has been corrected for potential levels of underreporting and for animals struck and lost to provide three sets (low, medium, and high) based on different assumptions (Heide-Jørgensen and Rosing-Asvid, 2002). We selected the average between the high and medium values as an appropriate balance between potential overestimates and underestimates of the true number of kills. The average was assumed to be an accurate observation of the kill with no associated uncertainty (Table 1). The same approach was applied by Butterworth *et al.* (2002). An alternative approach would be to incorporate a model parameter that accounts for negative bias in the catch as suggested by Innes and Stewart (2002). Their estimate of the correction parameter increased the average catch by 40%, whereas the mean of medium and high catches increased the catch by approximately 30%. Noting that the distribution of the correction parameter was skewed towards smaller values, the two approaches appear to give roughly comparable estimates of the numbers killed.

The catch in 1954 was noticeably higher than in all other years. This was caused by the occurrence of a phenomenon known as "ice entrapment", during which Arctic cetaceans

Table 1. Annual catch of belugas in West Greenland (average between the maximum and medium values reported by Heide-Jørgensen and Rosing-Asvid, 2002). NB: data for 1999 were not available at the time of analysis (presumed catch was 600).

Year	Catch
1954	2 262
1955	459
1956	601
1957	692
1958	373
1959	468
1960	361
1961	392
1962	369
1963	253
1964	367
1965	539
1966	748
1967	790
1968	1 515
1969	1 225
1970	1 717
1971	825
1972	1 050
1973	1 312
1974	1 027
1975	829
1976	1 470
1977	1 067
1978	909
1979	942
1980	1 127
1981	1 381
1982	1 210
1983	816
1984	1 039
1985	822
1986	896
1987	874
1988	508
1989	764
1990	1 295
1991	696
1992	957
1993	842
1994	585
1995	740
1996	599
1997	653
1998	825
1999	(275)

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may get trapped in ice that forms rapidly and prevents access to open water. An ice entrapment in 1954 included about 3000 belugas (Golodnoff, 1956). When an ice entrapment of this magnitude occurs in Disko Bay, it is unlikely to go unnoticed, and hunters take advantage of the situation. Ice entrapments have occurred in other years (Heide-Jørgensen *et al.*, 2002), but none of the recent events was as large as the one in 1954.

Abundance

Population trends have been monitored through aerial surveys in selected years between 1981 and 1999 (Figure 1) that provide indices of relative abundance (Table 2). The surveys in 1981 and 1982 differed from later surveys in the type of aircraft used, survey design, methods for extrapolation, and personnel involved (Heide-Jørgensen *et al.*, 1993; Heide-Jørgensen and Acquarone, 2002).

An estimate of absolute abundance is only available for 1998 and 1999, when the correction factor (and its variance) for missed and submerged animals could be estimated. The estimated absolute abundance for 1998/1999 (combining data for the 2 years) is 7941 animals (CV: 0.32; Heide-Jørgensen and Acquarone, 2002). This value was assumed to apply to 1998 in our calculations.

Using the entire series of indices of relative abundance (1981−1999), a first attempt to derive an estimate of the intrinsic rate of population increase (R_{max}) yielded a value

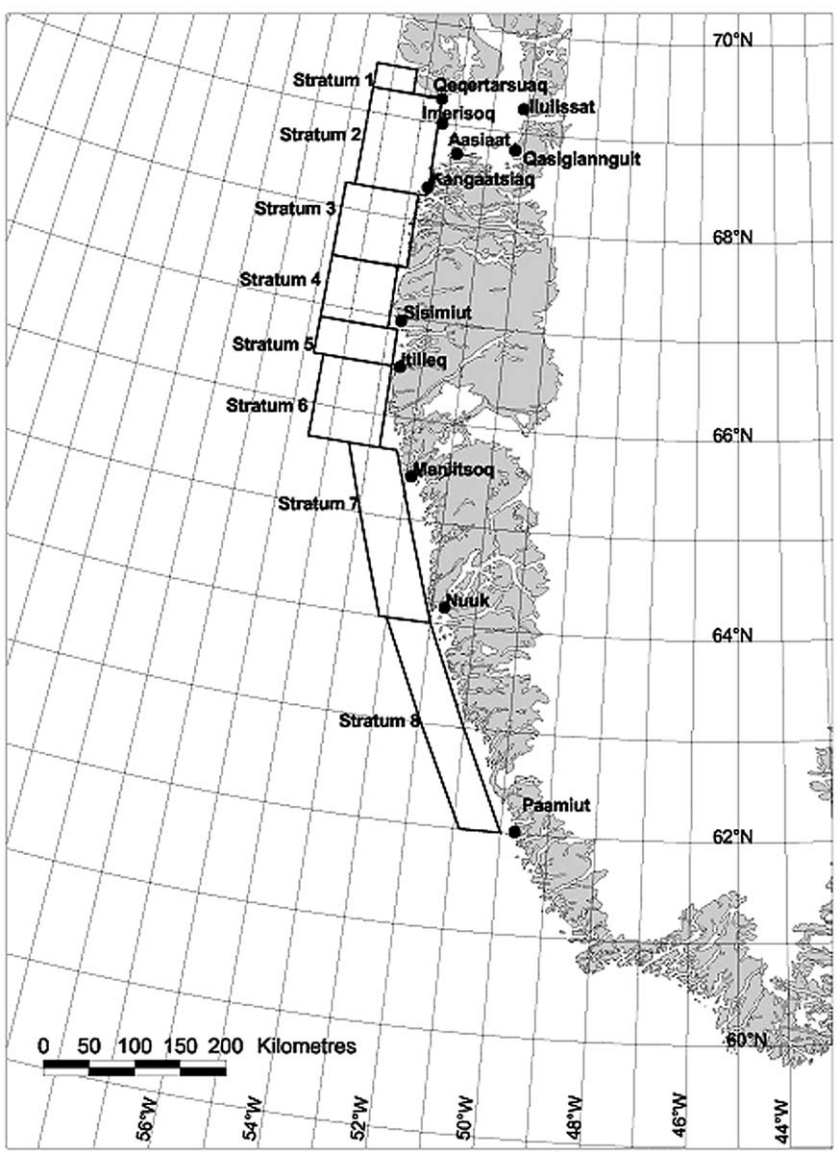

Figure 1. The West Greenland coastline and the strata used in the aerial survey design.

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Table 2. Indices (standard error) of relative abundance of belugas in West Greenland (estimates for 1981, 1982, and 1991 from Heide-Jørgensen *et al.*, 1993; others from Heide-Jørgensen and Acquarone, 2002).

Year	Index (s.e.)
1981	3 776 (1 008)
1982	2 192 (400)
1991	1 471 (356)
1993	899 (192)
1994	1 196 (188)
1998	929 (221)
1999	735 (201)

close to zero, which was considered inconsistent with the available information on beluga biology. This effect could be traced back to the indices for 1981 and 1982. Because survey design and methods were different, data for these years were removed from the analysis initially. However, to make these data usable, separate re-scaling parameters of relative abundance were estimated for 1981, 1982, and 1990–1999.

Model structure

A simple discrete generalized logistic model was used to represent the dynamics of the population. The particular form used was a difference equation variant of the Pella and Tomlinson (1969) model:

$$N_{t+1} = N_t + N_t R_{max}(1 - (N_t/K)^z) - C_t, \quad (1)$$

where N is the abundance, in numbers, at time t or t + 1 (in years), R_{max} is the discrete intrinsic rate of increase, K is the pre-exploited population size (here assumed to be equal to the population in 1954), z is a parameter that determines the population size where productivity is maximum (also known as the "shape parameter"; for simplicity, z was arbitrarily fixed to a value of 3, which sets the Maximum Sustainable Yield at 63% of K), and C_t is the number of animals removed by the fishery in year t, including killed but lost whales. It is assumed that all animals recruit to the exploitable population and that there is no selection for specific age groups or sex in the hunt.

Parameter estimation

Population parameters were estimated in two different ways, by maximum likelihood (MLE; Punt and Hilborn, 1996; Hilborn and Mangel, 1997) and by Bayesian integration (Gelman *et al.*, 1995; Punt and Hilborn, 1997). MLE was based on non-linear fitting of the model to both the relative and the absolute abundance estimates, assuming that their residuals are normally distributed. This choice is arbitrary because the number of strata in the aerial surveys (n = 8) is not large enough to approximate normality, but being an estimate obtained by pooling, a lognormal is even more unlikely. Anyway, the predicted trends obtained based on one assumption about error distribution or the other should not differ by much. Likelihood profiles (Punt and Hilborn, 1996; Hilborn and Mangel, 1997) were also generated. Parameter estimates were obtained by minimization of the negative log likelihood of the objective function:

$$-\ln L(\text{data}\,|\,\text{parameters}) = \sum_y -\ln L(\text{data}_y\,|\,\text{parameters}), \quad (2)$$

where the year-specific likelihood for any estimate of absolute abundance is given (ignoring constants) by

$$-\ln L(\hat{A}_y|\theta) = \ln(\sigma_{Ay}) + (\hat{A}_y - A_y)^2/2\sigma^2_{Ay}, \quad (3)$$

where $\hat{A}_y$ is any observed estimate of absolute abundance, A_y is the model-predicted abundance, θ is the vector of parameters in the model (Equation (1)), σ_{Ay} is the standard error associated with each estimate of absolute abundance, and subscript y refers to year.

The year-specific likelihood for any estimate of relative abundance is given by:

$$-\ln L(\hat{I}_y|\theta) = \ln(\sigma_{Iy}) + (\hat{I}_y - (q_i \times N_y))^2/2\sigma^2_{Iy}, \quad (4)$$

where $\hat{I}_y$ is the observed index of abundance, N_y is the expected absolute abundance, σ_{Iy} is the standard error associated with each estimate of relative abundance, q_i is the re-scaling parameter for periods i = 1 to 3 (1981, 1982, 1991–1999), and $q_i \times N_y$ is the associated expected index of relative abundance at year y.

Posterior probability distributions for population parameters were calculated by means of Bayesian integration using the Markov Chain Monte Carlo (MCMC) method (Gelman *et al.*, 1995). Prior probability distributions were uniform, bounded between 0.01 and 0.08 for R_{max} and between 14 000 and 120 000 for K. An additional parameter q was estimated that re-scales the relative abundance in relation to the absolute estimate. The prior distribution for q was completely uninformative (uniform and unbounded). Two approaches were followed to estimate q. One single q is estimated if the 1981 and 1982 indices of abundance are removed from the series. In the other option, q values are estimated separately for 1981 and 1982 and for the period 1990–1999.

A Bayesian posterior distribution was also obtained for a derived parameter specified to evaluate the actual state of depletion of the population as a consequence of the harvest: the ratio of the population size in the last year with catch data to the estimated abundance in 1954 (K_{1954}).

MLE, likelihood profile calculation and MCMC simulation for Bayesian estimation of parameters were conducted using AD Model Builder (© Otter Research).

Risk assessment

Derived parameters (V_p), which represent the ratios of the population size after p years of harvest against the population size at the time when the catch limits were introduced, were calculated to evaluate the consequences of

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future catch restrictions. These parameters are obtained by first saving a sample of the sets of individual model parameters obtained during the MCMC process. When a large number of simulations are run and convergence in the Markovian chain is achieved (a large sample is also desirable), the sample closely resembles the joint posterior distribution of the parameters. The population is then projected without process error (natural variability is not considered) using all the sampled sets of parameters. This assumption could lead to underestimation of the risk, particularly if no feedback is obtained through future surveys. During the projections, a proposed catch scheme is subtracted from each population trajectory (one for each set of parameters sampled from the Markovian chain), resulting in the posterior distribution of future population size after a number of years. For a future trend scenario presented by each set of parameters, the final population is compared to what it was right before a policy is implemented, evaluating in this way the effect of future harvests. The total risk of not meeting a management goal (e.g. stop population decline) is calculated by constructing the cumulative probability of population change. This procedure incorporates the uncertainty around the parameters into the process of calculating the future status of a population. This is a useful way to propose that the specific outcome for the application of a policy is not absolute, and that the real situation can differ from the prediction.

Three different trials (A, B, and C) were conducted to evaluate the risk of not meeting a management goal (Table 3). The management goal in the trials A and B was to stop the population decline (reference point: $V_p = 1$). In trial C, the goal was to avoid extinction (reference point: $V_p = 0$).

Table 3. Trials conducted for the risk assessment of the hunt for belugas in West Greenland (CC: constant catch quota; HR: harvest rate; PBR: potential biological removal; F_r: recovery factor; V_p: N_{t+p}/N_t; R_{max}: intrinsic rate of increase; for options in the reduction plan see Table 5).

Trial A: comparison of management strategies ($V_p = 1$; ref.:1999)	
HR	CC
1999–2004; 1999–2009	1999–2004; 1999–2009
PBR F_r-1	150
PBR F_r-0.5	200
$0.75R_{max}$	300
$0.5R_{max}$	500

Trial B: reduction plan ($V_p = 1$; ref.: 2001)		
CC	CC first 5 yr, followed by HR	
2001–2010	2001–2010	2001–2030
All options	All options	Options 3 and 5; HR = PBR F_r-1

Trial C: probability of extinction ($V_p = 0$; ref.: 2001)

CC: 100, 300, 500, 700, and 1 000 individuals
Projections: 10, 20, 30, 40, and 50 yr

Trial A compared the performance of two choices for setting catch limits: (1) constant annual catch quota or (2) quota set as a function of population size and a constant harvest rate, applied over both a 5-year and a 10-year period. This evaluation was conducted before information on the catch for 1998 was available and therefore parameter estimates used in the simulations (Bayesian means: $K = 30\,610$ and $R_{max} = 0.035$) differ slightly from the final estimates shown in Table 5. Given that differences were small, we decided not to redo these trials, because the comparison of the performances of the two approaches, our main purpose, remains valid.

Constant catch limits were set to 150, 200, 300, and 500 removals per year. Catches based on harvest rates were specified as for PBR:

$$PBR = 0.5 \times N_{min} \times R_{max} \times F_r, \quad (5)$$

where F_r is a "recovery factor" that can be incorporated into the PBR calculation as 1 if the stock is above the level of maximum net productivity (MNPL, also known as N_{msy}) or <1 if the population is below MNPL (we used 0.5), and

$$N_{min} = \hat{N} \times e^{-\nu\sqrt{\ln(1+CV(\hat{N})^2)}}. \quad (6)$$

N_{min} is a conservative estimate of the population size with a negative bias, estimated as a lower (20th in this case) percentile of the confidence interval of a survey-based point estimate $\hat{N}_t$ considered the "best" available estimate; ν is a constant that determines the percentile of the lognormal distribution represented by N_{min}, fixed to 0.842 for the 20th percentile.

Additional harvest rates were set to correspond to $0.5R_{max}$ and $0.75R_{max}$,coinciding with MSY rates if the shape parameter z equals 1 and 3 (default), respectively. If a harvest rate is applied, the estimate of abundance for 1998 is used to calculate the catch for the following 5 years ($HR \times \hat{N}_{1998}$). If the trial projects the population for 10 years, then in year 2004, an estimate of abundance (e.g. from a survey) is simulated by sampling from a lognormal distribution with a mean equal to the predicted value for the year and a CV of 0.2. This simulated estimate of abundance is multiplied by the harvest rate to obtain the new catch level.

In a first approach, catch options were calculated using harvest rates by direct utilization of the Bayesian means of R_{max} calculated without the 1981–1982 abundance data but with catch data up to 1999 (because catch data for 1999 were incomplete, we assumed a kill of 600 animals). As an alternative management scheme to mitigate the effects of a drastic reduction in the catch and to give managers and hunters time to develop economic alternatives, trial B involved gradual catch reductions and an evaluation of the outcome after 10 years. Because the priority at this point is to prevent further depletion of the population, the reference point for evaluation is the probability that the population

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after 10 years is smaller than in 2001. Because management policies in our scenario will be applied from 2001 onwards, catches had to be assumed for 1999 (600) and 2000 (700). The situation under a constant removal of 700 animals (option 1) is compared to five alternative scenarios (Table 4).

The same analysis was conducted again under the same catch options as those applied for the first 5 years, but adjusting catches for the remaining 5 years to a new "observation" of abundance obtained in 2005 (see above). The use of new estimates of abundance represents the common feedback mechanism in situations where new catch limits (based on harvest rates) are estimated based on updated knowledge about the managed stock. The same four (constant) harvest rate alternatives tested in trial A were used in this case. In addition, this experiment was repeated projecting 30 years ahead for: (1) the scenario that is proposed as the "best" alternative (option 3, see Results) and (2) for the scenario where such action is delayed for 2 years (option 5). In both cases, catches after year 2005 are calculated using harvest rates applying PBR with $F_r = 1$. Population "estimates" are again obtained every 5 years by simulation to adjust the catch.

In trial C, the probability that the population will become extinct was calculated projecting the population forward during 10, 20, 30, 40, and 50 years. In each case, catches were kept constant at 100, 300, 500, 700, and 1000 animals.

Results

Parameter estimates and current status of the stock

Figure 2 shows the likelihood profiles and posterior probability distributions for the estimated parameters. The posterior probability of R_{max} was very similar to the prior within the interval 0.01–0.08. To better demonstrate the degree of uncertainty associated with this parameter, another estimation was conducted, expanding the upper bound to 0.15, and the resulting profile and posterior distribution are shown in Figure 2A. The posterior probabilities and profiles for the other parameters are better defined than those for R_{max}.

Table 5 provides a summary of the point estimates of population parameters obtained with the complete data set

Table 4. Evaluated options for harvest reduction.

	Year						
Option	2001	2002	2003	2004	2005	2006	2007–2010
1	700	700	700	700	700	700	700
2	500	300	300	300	300	300	300
3	500	300	150	100	100	100	100
4	100	100	100	100	100	100	100
5	700	700	500	300	150	100	100
6	0	0	0	0	0	0	0

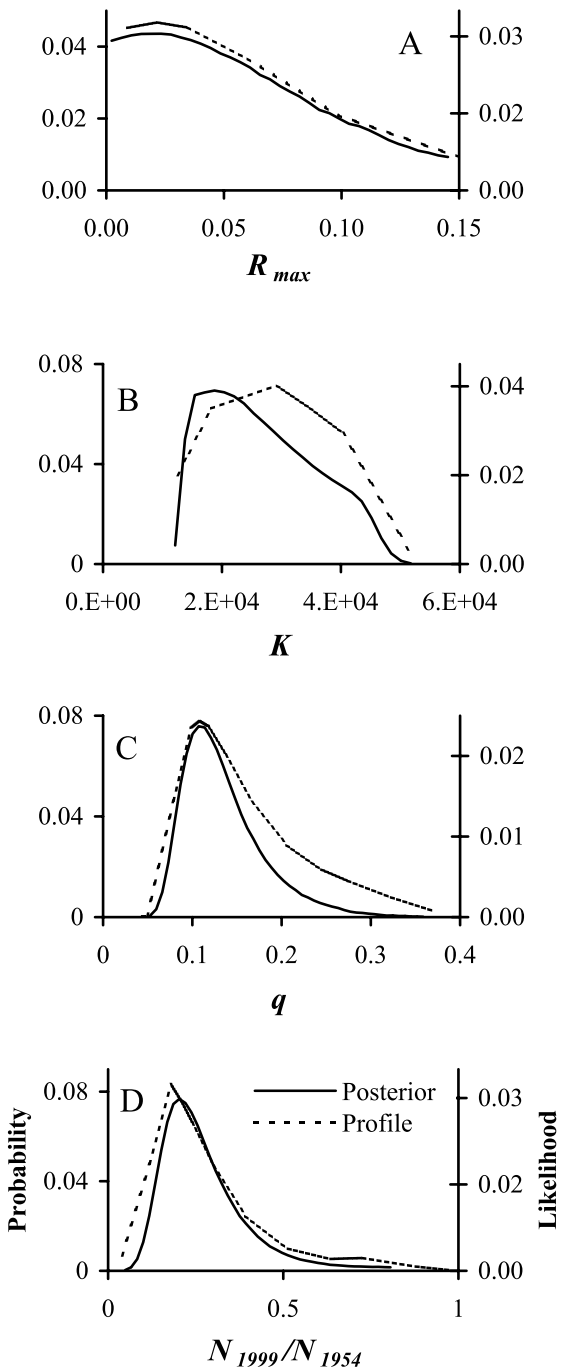

Figure 2. Posterior probability distributions and likelihood profiles for the parameters of population dynamics of belugas in West Greenland. (A) Maximum rate of increase; (B) population size in 1954; (C) scaling parameter; and (D) level of depletion.

(assuming a catch of 600 in 1999) and without the 1981–1982 indices of relative abundance. Using the Bayesian means ($R_{max} = 0.034$ and $K = 31\,522$) obtained without the 1981–1982 abundance (but after including the 1998

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Table 5. Parameter estimates for beluga in West Greenland based on all survey indices (all) and excluding the 1981/1982 surveys (MLE: maximum likelihood estimate; BM: Bayesian mean; K_{1954}: population size in 1954; R_{max}: intrinsic rate of increase; N_{act}/K_{1954}: depletion rate measured as the ratio between actual stock size in 1999 relative to K_{1954}).

	All (3 q's)		Excluding 1981–1982 (q)	
	MLE	BM	MLE	BM
K_{1954}	34 806	23 948	34 806	31 522
R_{max}	0.022	0.059	0.022	0.034
N_{act}/K_{1954}	0.21	0.28	0.21	0.22

catches) to estimate the replacement yield of the population $(N_t R_{max}(1 - N_t/K))$, a plot of the replacement yield and catch, both standardized by dividing by K, shows that the kill consistently has exceeded the sustainable catch (Figure 3). The conclusion must be that the stock historically has been overexploited and that the actual kill is still too high. This result is in agreement with the point estimate (Bayesian mean) of the level of depletion that, despite differences in parameter estimates, consistently shows a population size that is near 20% of the original size (Table 5). Under the assumptions of the model, there is a 95% probability that the population is currently $\leq$38% of the size in 1954.

Probability of extinction

If 1000 animals are caught per year, there is a 99% probability that the population will be extinct in 20 years (Figure 4). At the actual catch level (around 700 animals), the estimated probability of extinction is 90% after 20 years, and 99% after 50 years. A catch of 100 animals shows a small probability (3%) of extinction after 50 years.

Alternative management strategies and allowable catch

Figure 5 summarizes the population response under the uncertainty associated with the knowledge that can be extracted from the data about the parameters. The figure compares the cumulative posterior probability distributions of population status after 5 and 10 years of implementing different quota regimes under the two management strategies (fixed quota and fixed harvest rates). In these figures, a V_p value of 1 corresponds to the management objective of "stop decline". Larger V values imply that the population is increasing and thus the management objective has been met; lower values indicate a decline.

A fixed catch of 500 animals will cause the population to continue to decline with high probability (Figure 5A, B). When this strategy is used, there is no feedback mechanism to adjust the catch to changes in population size. Under these conditions and given the uncertainty, the longer the time an overharvesting policy is applied, the greater the probability that the population will decline. Even a small constant catch of 150 animals implies a total risk of about 20% that the population will not grow.

In contrast, if future catch limits are based on a constant harvest rate and an updated estimate of absolute abundance, the risk of continued population decline is of concern only when harvest rate is set at $0.75R_{max}$ (Figure 5C, D). Use of any of the lower harvest rates implies, at the most, a small risk of population decline. Because the catch is adjusted in time with the acquisition of new information on the population response, the probability of a decline in population size becomes smaller as time progresses.

Table 6 compares the catch levels that result by applying alternative harvest rates directly to the actual stock size estimated for 1999 (7941). The most aggressive policy under the most optimistic scenario suggests a sustainable

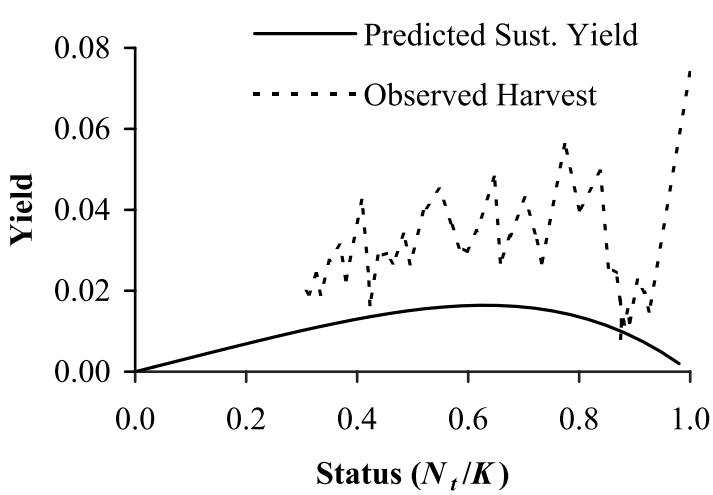

Figure 3. Trajectory of the observed harvest of beluga in West Greenland compared with the sustainable yield as predicted using the Bayesian mean of logistic parameters (both standardized by dividing by pre-exploitation size).

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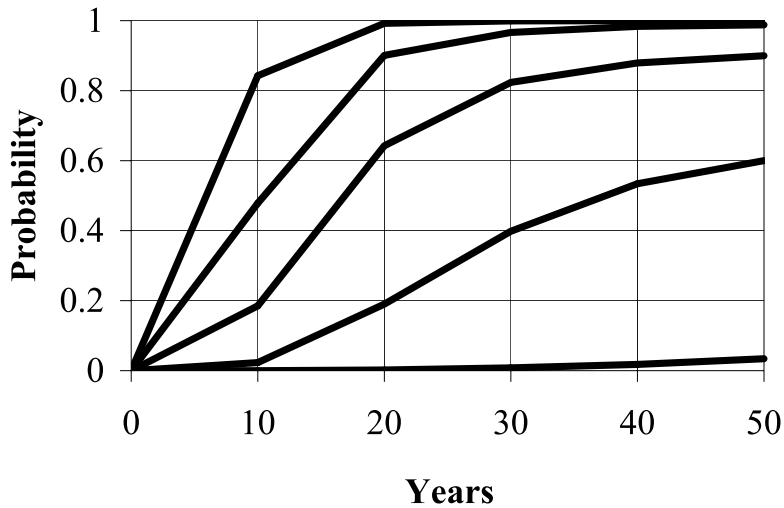

Figure 4. Probability of extinction at different times based on different constant catch levels (from top to bottom: 1000, 700, 500, 300, and 100 animals).

catch of about 200 animals given the current population size, while a more conservative approach under less optimistic scenarios suggests a sustainable catch of <100 animals per year. A moderate approach using a harvest rate of half the Bayesian mean of R_{max} defines a sustainable catch of about 130 animals.

The maximum probabilities of population decline under different strategies considered are presented in Table 7. These probabilities must be interpreted as the upper bound of an open interval such that the actual probability of decline is smaller than the bound and indicate that if the management goal is to prevent decline in 10 years, the only way to be 100% sure that the population will not have declined after 10 years is by either banning any catch or immediately reducing the catch to the PBR value obtained with an F_r of 0.5. The next lowest probabilities are achieved if the annual catch is reduced to 100 animals for the first 5 years and harvest rates are used for the following 5 years (option 4) or by exclusively using harvest rates. However, if the management goal is expanded to prevent population decline after 30 years, the feedback effect of the application of harvest rates during the following 25 years reduces the uncertainty, and the probability of a decline under the combination of catch option 3 and PBR with F_r of 0.5 is reduced from 37% to 17%.

Discussion

Estimates of population parameters are in general consistent with each other, except the Bayesian means for R_{max} and K using the entire data set (Table 5). We have not examined these differences and cannot explain them formally, but they may be related to the added uncertainty of two extra parameters (q_1, q_2, and q_3 instead of a single q) for estimation. The estimate of R_{max} with the complete data set but only one q estimated was close to zero, a situation that could occur only if the production was extremely low or if natural mortality was very high. To our knowledge, there is no evidence of either one except the observed ice entrapment events that do not occur very often. Whatever the causes, these results indicate that the indices of relative abundance obtained in the past are not strictly comparable, which is probably related to recorded changes in survey design and methods.

The uncertainty around R_{max} is very large (Figure 2), resulting in a poorly defined posterior distribution (and likelihood profile) within the original bounds of the prior (0.01−0.08). This is an indication of the limitations of the information contained in the available data (i.e. poor contrast in the abundance data). However, the point estimates between 0.03 and 0.04 (Table 5) are in accordance with the expectations based on information for a long-lived species with similar life history characteristics (Reilly and Barlow, 1986). Also, simulation studies using beluga life history parameters derived from field data predicted that populations could potentially grow at 2−3% (Beland *et al.*, 1988).

From the management point of view, the resulting narrow posterior distribution of the level of depletion of the population (N_{1999}/N_{1954}) is more important. This result is consistent with earlier simulations suggesting that the estimate of this depletion parameter is usually robust and reliable (Alvarez-Flores, 2002). Most of the probability density in the posterior distribution of depletion level is observed in population sizes much lower than the MNPL ($\sim$0.6K; cf Figure 2D). This is consistent with the permanent state of overexploitation since 1954 (Figure 3). Continuation of this trend represents a serious threat for the beluga population.

Three alternative ways to manage the hunt for belugas in West Greenland may be considered. Although decisions

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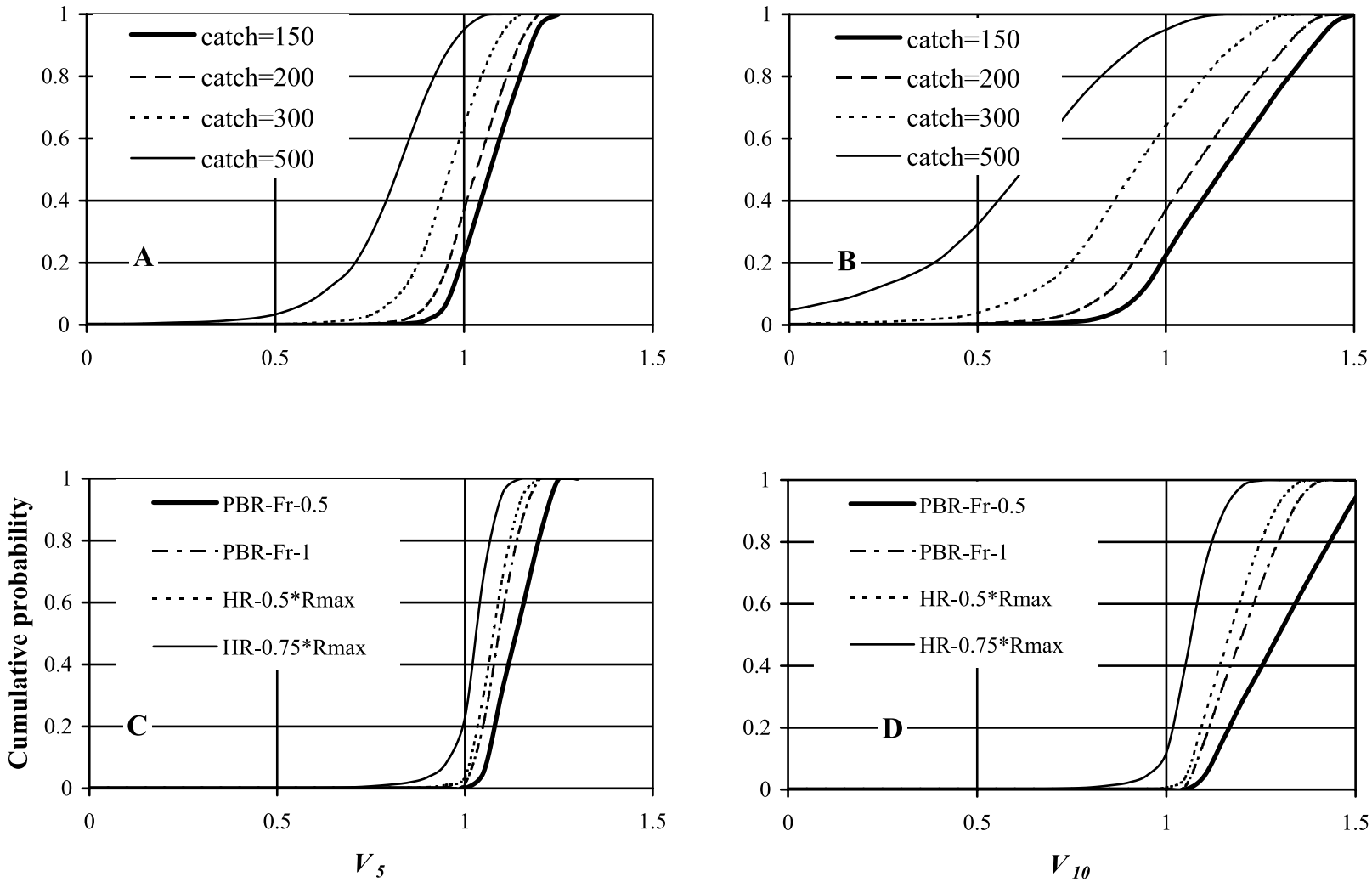

Figure 5. Comparison of cumulative posterior probabilities of population status of belugas in West Greenland after applying constant catch quota (top panels) or different harvest rates (bottom panels) for 5 (left panels) and 10 (right panels) years (no 1998−1999 data).

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Table 6. Direct calculation of catch options (C) based on different harvest rates and using alternative estimates of R_{max} (estimated excluding 1981–1982 abundance indices but with catch data for 1998 and catch of 600 assumed for 1999) and N.

	BM		MLE
R_{max}	0.034		0.022
N		7 941	
C ($0.75R_{max}$)	202		131
C ($0.5R_{max}$)	135		87
N_{min}		6 721	
C (PBR F_r-1)	114		74

Table 7. Maximum probabilities of population decline for reduction plan options 1–6 for the first 5 years followed by fixed-catch quota (see Table 5) or by different harvest rate strategies for the next 5 years, and for a strategy based exclusively on harvest rates (n.a.: not applicable). Also shown are the probabilities for a strategy based on selected options (3 and 5) for the first 5 years, followed by a selected harvest rate strategy for the next 25 years based on updated abundance estimates every 5 years.

	Projection (yr)	1	2	3	4	5	6	HR
Fixed	10	0.99	0.76	0.47	0.27	0.74	0.00	n.a.
$0.5R_{max}$	10	0.93	0.61	0.43	0.18	0.78	0.00	0.06
$0.75R_{max}$	10	0.97	0.70	0.51	0.21	0.85	0.00	0.34
PBR $w/F_r = 1$	10	0.92	0.59	0.41	0.17	0.76	0.00	0.03
PBR $w/F_r = 0.5$	10	0.88	0.54	0.37	0.15	0.71	0.00	0.00
PBR $w/F_r = 0.5$	30			0.17		0.40		

on management alternatives are a political rather than a scientific issue, we comment on them because of the strong biological implications of each one and their potential socio-economic effects. In the first scenario that no action is taken at all, belugas most likely will go extinct in West Greenland and with them all future economic, cultural, and nutritional benefits from this resource. If this alternative is selected, hunters should be advised to take measures to find alternative sources of future income to compensate for the loss of profit of a restricted catch. Even if hunters do so, it is unlikely that this alternative would provide an acceptable long-term solution given the biological, cultural, and economic loss.

The second alternative is to immediately impose a sharp reduction of harvest level. This may be the more desirable solution from the conservation point of view. If the catch is drastically reduced or even eliminated, the stock should start to recover immediately. Unfortunately, the recovery of a marine mammal stock is slow and it will take decades before the hunters may enjoy the benefits of the recovery. The decision here revolves around the question of whether the hunters can and must give up the current levels of benefit to ensure that future generations can use the resource sustainably at a safe maximum potential.

The third alternative provides an intermediate solution that combines a gradual catch reduction plan, thereby allowing managers and hunters to develop economic alternatives to buffer the transition from a high-catch regime to a low-catch regime, with the primary objective of at least having a low risk of further decline of the stock.

Given the uncertainty associated with parameter estimates, we analysed the relevant question of what level of catch may be recommended from different perspectives. Depending on which harvest rate and estimation method was used, catch options at the present stock size ranged between 74 and 202 animals (Table 6), suggesting a median value around 130. Because of the inertia involved in updating appropriate catch limits for the following years, situations where 100 animals or more were annually removed were tested and compared to catch quota based on harvest rates that were adjusted with new survey data of abundance after 5 years. The results indicate that complete ignorance of parameter values and abundance propagates any positive or negative effects on future population size: the longer the constant catch policy is applied, the larger the uncertainty about the future population. On the contrary, use of a harvest rate strategy reduces the uncertainty because of the feedback provided by new estimates of population size. Even if the population is projected 5 years forward with a fixed-catch policy, predictions of future population sizes are better if they are followed by a harvest rate strategy than those obtained when continuing the fixed-quota policy. The reason for this is that the uncertainty in parameter values is being incorporated in the update. Therefore, each trial results in a different catch limit. For the same reasons, and contrary to the results using fixed quota, applying harvest rates enhances our certainty about the potential outcomes in time. This characteristic has been previously suggested in the context of a description of ways to ensure that management procedures are robust to associated uncertainties (Butterworth *et al.*, 1997).

Based on the current status of the population, the analyses favour a drastic reduction in the catch and use of a harvest rate to set future catches. The required reduction is so large that opponents could argue that the estimate of R_{max} is negatively biased (e.g. through severe underestimation of abundance) and that this error would disproportionately affect the hunters. Therefore, it is useful to consider the consequences of underestimating R_{max}. Assuming that the West Greenland population could maintain life history characteristics that are distinct from other populations, R_{max} values >0.07 (upper bound for the prior set at 0.08) would require either a calving interval of <3 years (which is unlikely; Hazard, 1988), or unrealistically high survivorship values relative to a longevity of 30 years. Assuming $R_{max} = 0.07$ and applying a harvest rate of 0.5 of R_{max} with the current estimate of population size, the catch limit would be 277 animals, less than half of the current harvest. Clearly, the population cannot sustain the present harvest pressure and if the trend continues, the population will soon become extinct.

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Proceeding with a catch reduction for a resource with great social and cultural value is a difficult matter. Imposing an immediate severe catch limit is likely only to be eventually exceeded, given the limitations in monitoring the cumulative catch during a hunting season, but a biologically acceptable limit implies a severe and sharp reduction from the current kill levels. The controversy about how much the catch must be reduced increases because alternative scenarios (defined by the ranges in the posterior probabilities of the parameters) suggest that the catch could be greater than the suggested 130. Although overoptimistic scenarios are associated with high risk and their use requires extreme caution, the catch for the next years even under the most optimistic scenario should not exceed 200 animals.

A gradual reduction program combined with quota based on harvest rates and a feedback every so often has good chances of succeeding in achieving the goal of recovery (Table 7). If ultimate recovery is the primary goal, the time that this may take will have to be established in terms of a combination of socio-economic and biological factors. If the management goal is to prevent any further decline in 10 years (NAMMCO, 2000), the probability that this goal will not be met may be relatively high (taking, for example, option 3 and PBR F_r-0.5: 37%; Table 7) even if the most likely event is no decline. However, this is to some extent an artificial perspective. When using a feedback control, the probability of not meeting the management goal becomes smaller as the policy is applied longer. For instance, the probability of population decline after 30 years for option 3 is reduced to 17%.

We stress that the alternative of a gradual reduction plan differs from an immediate severe reduction in that the transition time may make the effects less difficult to cope with for the hunters. Of course, the population will be reduced even further and recovery to maximum sustainable levels will take longer. On the other hand, the development of an economic alternative should be an essential element of management. If the beluga catch would be completely banned, the hunting effort may be redirected to other species without planning. Then, the problem would simply be relocated, not eliminated.

Previous attempts to determine the allowable catch of monodontid populations have been restricted to the calculation of limits on numbers taken as fixed proportions of population size (Sergeant, 1981; Kingsley, 1989).

The relevant parameter estimates presented are similar to those reported by Innes and Stewart (2002) and Butterworth *et al.* (2002). For example, the Bayesian mean of the level of depletion is here estimated to be near 20%, with relatively small variations depending on model structure, which is in the upper range of values estimated by Butterworth *et al.* (2002). However, these authors made each estimate of depletion dependent on a specific assumption about a parameter used as a proxy for the maximum growth rate, while we estimated the posterior probability distribution for the intrinsic rate of increase from the data, avoiding any assumptions about population growth rates. Innes and Stewart (2002), also using Bayesian methods, estimated that the mean of the posterior distribution of the maximum rate of population change was 1.037. This value is approximately equivalent to 0.037 if expressed as intrinsic growth rate, which is close to our own Bayesian mean estimate (0.034). Both Innes and Stewart (2002) and Butterworth *et al.* (2002) offer estimates of sustainable yield and use these as limits to be considered "to secure against possible further reduction of the population over the immediate future" (Butterworth *et al.*, 2002). Despite this assertion, they did not consider specific management goals.

Even though the three papers assessed the current status of the beluga population off West Greenland and results were similar overall, our work differs fundamentally. Although we agree that the population is overexploited and that catches must be substantially reduced, we considered it unrealistic to suggest that such course of action could be implemented immediately. Therefore, we formally evaluated a wide range of alternative scenarios, ranging from no action to a complete ban.

To our knowledge, the only evaluation of alternative management options in a formal risk assessment in relation to marine mammals refers to the by-catch of Hooker sea lions in the squid fishery of New Zealand (Maunder *et al.*, 2000). These authors evaluated the ability of alternative decisions to reach a goal of population recovery simultaneously with economic losses associated with these decisions.

A stepwise approach has been applied to gradually reduce the by-catch mortality of dolphins in the tuna fishery (IATTC, 1997). The management action was not evaluated in terms of its ability to reach a specific population size of dolphins, because the ultimate goal was a by-catch close to zero. What is relevant here is that the parties involved recognized the impossibility of reducing the by-catch in the immediate short term and realized that the only way to reach an agreement was to propose a gradual reduction programme.

Although the simplicity of our population model may be subject to debate, the principles proposed can also be applied if a model of higher complexity is required. The most important lesson is that a formal risk evaluation of the full range of alternative management options, with incorporation of different sources of uncertainty, is possible. This range should cover the entire array of views of all parties involved so that the consequences of reaching the conservation goal can be weighed against the consequences for the people using the resource.

We acknowledge that there are sources of uncertainty other than those incorporated in the analysis. (1) Kills by hunters during ice entrapment events (Siegstad and Heide-Jørgensen, 1994; Heide-Jørgensen *et al.*, 2002) may be considered as part of the natural mortality if the animals would not survive anyway. To what extent the effects of "natural" mass mortality are represented in the estimated intrinsic rate of increase remains unknown and additional

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modelling may be required. (2) The population has been exploited for centuries and the population in 1954 is undoubtedly a biased estimate of pre-exploitation population size. Although catch data for earlier years are available, they require a substantial review (Heide-Jørgensen and Rosing-Asvid, 2002) before they could be used. An alternative approach would be to account for bias in K, but this would require the estimation of a large number of additional parameters. (3) The possible existence of sub-stocks (cf. Palsbøll *et al.*, 2002) has been ignored because of insufficient knowledge. (4) Intrinsic model performance in relation to particular characteristics of the data used (Punt, 1995) has not been addressed. (5) Trying to quantify the overall uncertainty associated with the bias in the catch data would be in line with the intention of our analysis. The problem with incorporating formal bias parameters is that their sheer number may prohibit estimation. (6) The decision about an appropriate value of the shape parameter (z; associated with the relative population size at which the Maximum Sustainable Yield may be taken: MNPL/K) is a difficult one. A sensitivity analysis indicated that MNPL/K values <0.5 or >0.8 are unlikely for marine mammals (Taylor and DeMaster, 1993). These authors also showed that multiple factors affect the value of z, that their individual effect is not easily inferred, and that empirical data are scarce. From the perspective of incorporating all possible sources of uncertainty, it would have been more appropriate to release the assumption and to use a semi-informative prior. We opted to assume a shape parameter resulting in a MNPL/K value of 0.63, within the range of 0.6–0.7 applied in sensitivity analyses testing the performance of methods to calculate allowable catches of marine mammals (IWC, 1992; Wade, 1998).

Acknowledgements

This study was funded by the Greenland Institute of Natural Resources. We thank Laura Litzky, Glenn VanBlaricom, Robert Suydam, and two anonymous reviewers for their valuable input.

References

Alvarez-Flores, C. 2002. Uncertainty in the management of activities affecting marine mammal populations. The tuna–dolphin conflict, a case study. Doctoral dissertation, University of Washington, Seattle, USA. 134 pp.

Beland, P., Vazina, A., and Martineau, D. 1988. Potential for growth of the St. Lawrence (Quebec, Canada) beluga whale (*Delphinapterus leucas*) population based on modelling. Conseil International pour l'Exploration de la Mer, 45: 22–32.

Butterworth, D. S., Cochrane, K. L., and de Oliveira, J. A. A. 1997. Management procedures: a better way to manage fisheries? The South African experience. *In* Global Trends: Fisheries Management, American Fisheries Society, Symposium Series, 20, pp. 83–90. Ed. by E. K. Pikitch, D. D. Huppert, and M. P. Sissenwine. American Fisheries Society, Bethesda, Maryland.

Butterworth, D. S., Plagányi, É. E., and Geromont, H. F. 2002. Resource assessment and projections for the belugas off West Greenland using the population model HITTER-FITTER. *In* Belugas in the North Atlantic and the Russian Arctic, NAMMCO Scientific Publications, vol. 4, pp. 211–224. Ed. by M. P. Heide-Jørgensen, and Ø. Wiig. NAMMCO, Tromsø. 270 pp.

Cooke, J. G. 1995. The International Whaling Commission's revised management procedure as an example of a new approach to fishery management. *In* Whales, Seals, Fish and Man. Proceedings of the International Symposium on the Biology of Marine Mammals in the North East Atlantic, pp. 647–657. Ed. by A. S. Blix, L. Wallaoe, and O. Ulltang. Elsevier Science B. V., Amsterdam and New York.

Gelman, A., Carlin, J. B., Stern, H. S., and Rubin, D. B. 1995. Bayesian Data Analysis. Chapman & Hall, New York.

Gjertz, I., and Wiig, Ø. 1994. Distribution and catch of white whales (*Delphinapterus leucas*) at Svalbard. *In* Studies of White Whales (*Delphinapterus leucas*) and Narwhals (*Monodon monoceros*) in Greenland and Adjacent Waters, pp. 93–97. Ed. by E. W. Born, R. Dietz, and R. R. Reeves. Meddelelser om Grønland, Bioscience. 39.

Golodnoff, M. 1956. Den store savssat. (The big savssat). Grønland, 7: 269–280.

Hazard, K. 1988. Beluga whale, *Delphinapterus leucas*. *In* Selected Marine Mammals of Alaska: Species Accounts with Research and Management Recommendations, pp. 195–235. Ed. by J. W. Lentfer. Marine Mammal Commission, Washington D.C.

Heide-Jørgensen, M. P. 1994. Distribution, exploitation and population status of white whales (*Delphinapterus leucas*) and narwhals (*Monodon monoceros*) in West Greenland. *In* Studies of White Whales (*Delphinapterus leucas*) and Narwhals (*Monodon monoceros*) in Greenland and Adjacent Waters, pp. 135–149. Ed. by E. W. Born, R. Dietz, and R. R. Reeves. Meddelelser om Grønland, Bioscience. 39.

Heide-Jørgensen, M. P., and Acquarone, M. 2002. Size and trends of the bowhead, beluga and narwhal stocks wintering off West Greenland. *In* Belugas in the North Atlantic and the Russian Arctic, NAMMCO Scientific Publications, vol. 4, pp. 191–210. Ed. by M. P. Heide-Jørgensen, and Ø. Wiig. NAMMCO, Tromsø. 270 pp.

Heide-Jørgensen, M. P., and Reeves, R. R. 1996. Evidence of a decline in beluga, *Delphinapterus leucas*, abundance off West Greenland. ICES Journal of Marine Science, 53: 61–72.

Heide-Jørgensen, M. P., and Rosing-Asvid, A. 2002. Catch statistics for belugas in West Greenland 1862 to 1998. *In* Belugas in the North Atlantic and the Russian Arctic, NAMMCO Scientific Publications, vol. 4, pp. 127–142. Ed. by M. P. Heide-Jørgensen, and Ø. Wiig. NAMMCO, Tromsø. 270 pp.

Heide-Jørgensen, M. P., Lassen, H., and Teilmann, J. 1993. An index of the relative abundance of wintering belugas, *Delphinapterus leucas*, and narwhals, *Monodon monoceros*, off West Greenland. Canadian Journal of Fisheries and Aquatic Sciences, 50: 2323–2335.

Heide-Jørgensen, M. P., Richard, P., Ramsay, M., and Akeeagok, S. 2002. Three recent ice entrapments of Arctic cetaceans in West Greenland and the eastern Canadian High Arctic. *In* Belugas in the North Atlantic and the Russian Arctic, NAMMCO Scientific Publications, vol. 4, pp. 143–148. Ed. by M. P. Heide-Jørgensen, and Ø. Wiig. NAMMCO, Tromsø. 270 pp.

Hilborn, R. 1997. Uncertainty, risk, and the precautionary principle. *In* Global Trends: Fisheries Management, American Fisheries Society, Symposium Series, 20, pp. 100–106. Ed. by E. K. Pikitch, D. D. Huppert, and M. P. Sissenwine. American Fisheries Society, Bethesda, Maryland.

Hilborn, R., and Mangel, M. 1997. The Ecological Detective. Confronting Models with Data. Princeton University Press, Princeton.

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IATTC 1997. Annual Report of the Inter-American Tropical Tuna Commission. Scripps Institution of Oceanography. La Jolla, California 92037-1508, USA.

Innes, S., and Stewart, R. E. A. 2002. Population size and yield of Baffin Bay beluga (*Delphinapterus leucas*) stocks. *In* Belugas in the North Atlantic and the Russian Arctic, NAMMCO Scientific Publications, vol. 4, pp. 225–238. Ed. by M. P. Heide-Jørgensen, and Ø. Wiig. NAMMCO, Tromsø. 270 pp.

IWC 1992. C procedure: formal description. Report of the International Whaling Commission, 42: 99–103.

Kingsley, M. 1989. Population dynamics of the narwhal *Monodon monoceros*: an initial assessment (Odontoceti: Monodontidae). Journal of Zoology (London), 219: 201–208.

Kingsley, M. C. S. 2002. Status of the belugas in the St. Lawrence estuary, Canada. *In* Belugas in the North Atlantic and the Russian Arctic, NAMMCO Scientific Publications, vol. 4, pp. 239–258. Ed. by M. P. Heide-Jørgensen, and Ø. Wiig. NAMMCO, Tromsø. 270 pp.

Maunder, M. N., Starr, P. J., and Hilborn, R. 2000. A Bayesian analysis to estimate loss in squid catch due to implementation of a sea lion population management plan. Marine Mammal Science, 16(2): 413–426.

NAMMCO 2000. Report of the Scientific Committee Working Group on the population status of beluga and narwhal in the North Atlantic. North Atlantic Marine Mammal Commission, University of Tromsø, 9037 Tromsø, Norway.

O'Corry-Crowe, G. M., and Lowry, L. F. 1997. Genetic ecology and management concerns for the beluga whale (*Delphinapterus leucas*). *In* Molecular Genetics of Marine Mammals, pp. 249–274. Ed. by A. E. Dizon, S. J. Chivers, and W. F. Perrin. The Society for Marine Mammalogy, Special Publication No. 3.

Palsbøll, P., Heide-Jørgensen, M. P., and Berubé, M. 2002. Analysis of mitochondrial control region nucleotide sequences from Baffin Bay belugas, *Delphinapterus leucas*: detecting pods or sub-populations. *In* Belugas in the North Atlantic and the Russian Arctic, NAMMCO Scientific Publications, vol. 4, pp. 39–50. Ed. by M. P. Heide-Jørgensen, and Ø. Wiig. NAMMCO, Tromsø. 270 pp.

Pella, J. J., and Tomlinson, P. K. 1969. A generalized stock production model. Bulletin of the Inter-American Tropical Tuna Commission, 13: 420–496.

Punt, A. E. 1995. The performance of a production-model management procedure. Fisheries Research, 21: 349–374.

Punt, A. E., and Hilborn, R. 1996. Biomass dynamics models. User's Manual. FAO Computerized Information Series (Fisheries), No. 10. Rome, FAO.

Punt, A. E., and Hilborn, R. 1997. Fisheries stock assessment and decision analysis: the Bayesian approach. Reviews in Fish Biology and Fisheries, 7: 35–63.

Punt, A. E., and Walker, T. I. 1998. Stock assessment and risk analysis for the school shark (*Galeorhinus galeus*) off southern Australia. Marine and Freshwater Research, 49: 719–731.

Reilly, S. B., and Barlow, J. 1986. Rates of increase in dolphin population size. Fishery Bulletin (Washington, D.C.), 84(3): 527–533.

Sergeant, D. E. 1981. On permissible exploitation rates of Monodontidae. Reports of the International Whaling Commission, 31: 583–588.

Siegstad, H., and Heide-Jørgensen, M. P. 1994. Ice entrapments of narwhals (*Monodon monoceros*) and white whales (*Delphinapterus leucas*) in Greenland. *In* Studies of White Whales (*Delphinapterus leucas*) and Narwhals (*Monodon monoceros*) in Greenland and Adjacent Waters, pp. 151–160. Ed. by E. W. Born, R. Dietz, and R. R. Reeves. Meddelelser om Grønland, Bioscience. 39.

Taylor, B. L., and DeMaster, D. P. 1993. Implications of non-linear density dependence. Marine Mammal Science, 9(4): 360–371.

Wade, P. R. 1998. Calculating the limits to allowable human-caused mortality of cetaceans and pinnipeds. Marine Mammal Science, 14(1): 1–37.

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ARCTIC
VOL. 57, NO. 2 (JUNE 2004) P. 129–142

Habitat Use of Ringed Seals (*Phoca hispida*) in the North Water Area (North Baffin Bay)

ERIK W. BORN,[1] JONAS TEILMANN,[2] MARIO ACQUARONE[2] and FRANK F. RIGET[2]

(*Received 24 February 2003; accepted in revised form 16 October 2003*)

ABSTRACT. In conjunction with the International North Water Polynya Study in Smith Sound (northern Baffin Bay) in 1997–99, we examined the area use and diving activity of 23 ringed seals (*Phoca hispida*) that had been equipped with satellite transmitters on the Greenland side of the North Water (NOW) area. The study covered the period 12 August 1996–30 June 1999. Contact with the seals was maintained for an average of 108 days (range: 8–332 days). Four seals emigrated from the NOW area. During all seasons, the seals that remained in the area spent about 90% of the time in coastal (< 100 m deep) waters in the eastern parts of the NOW area. The total area visited by the seals during the open-water season ranged between 10 300 km^2 (1996) and 18 500 km^2 (1998), corresponding to about 15% to 25% of the entire NOW area. In winter, the total area visited by the seals varied between 2500 km^2 (1996–97) and 7000 km^2 (1998–99), and in spring, between 800 km^2 (1999) and 2100 km^2 (1997). Individual movement was significantly greater during the open-water season than during winter and spring. Maximum dive depths recorded were over 500 m (maximum for the instrument) outside and 376 m inside the NOW, for a 96 kg male seal. Non-adult seals spent about 99% of the time in waters less than 100 m deep, and more than 92% of the time in the upper 50 m. In contrast, adults tended to spend more time at greater depths. The study indicated that (1) the ringed seals took advantage of the generally lighter ice conditions in the eastern NOW, and (2) that non-adults likely exploited ice-associated amphipods and young polar cod (*Boreogadus saida*), and adults, mainly older polar cod and cephalopods taken at greater depths.

Key words: ringed seal, *Phoca hispida*, North Water, polynya, satellite telemetry, habitat use, diving behaviour

RÉSUMÉ. Conjointement avec l'étude internationale sur la polynie de l'Eau du Nord dans le détroit de Smith (partie nord de la baie de Baffin) menée de 1997 à 1999, on a examiné l'utilisation de cette zone et l'activité de plongée de 23 phoques annelés (*Phoca hispida*) munis d'émetteurs-satellite du côté groenlandais de la région de l'Eau du Nord («NOW»). L'étude a couvert la période allant du 12 août 1996 au 30 juin 1999. Le contact avec les phoques a été maintenu pendant une moyenne de 108 jours (étendue: 8–332 jours). Quatre phoques ont émigré de la zone NOW. Durant toutes les saisons, les phoques qui restaient dans la zone passaient environ 90% du temps dans des eaux côtières (profondeur < 100 m) dans les secteurs orientaux de NOW. La superficie totale visitée par les phoques durant la saison d'eau libre allait de 10 300 km^2 (1996) à 18 500 km^2 (1998), correspondant à environ 15 à 25% de toute la zone NOW. En hiver, l'étendue totale fréquentée par les phoques allait de 2500 km^2 (1996–1997) à 7000 km^2 (1998–1999), et au printemps, de 800 km^2 (1999) à 2100 km^2 (1997). Les déplacements individuels étaient de beaucoup plus grands durant la saison d'eau libre qu'au cours de l'hiver et du printemps. Les profondeurs maximales de plongée enregistrées dépassaient 500 m (limite de l'instrument) à l'extérieur de la zone NOW et 376 m à l'intérieur, pour un phoque mâle de 96 kg. Les phoques non adultes passaient environ 99% du temps dans des eaux à une profondeur ne dépassant pas 100 m, et plus de 92% du temps dans les 50 m supérieurs. En revanche, les adultes avaient tendance à passer plus de temps à de plus grandes profondeurs. L'étude révèle 1) que les phoques annelés tiraient parti du fait qu'il y avait moins de glace dans la partie orientale de NOW, et 2) que, selon toute vraisemblance, les non-adultes exploitaient amphipodes et jeune morue polaire (*Boreogadus saida*) associés à la glace, les adultes se nourrissant surtout de morue polaire plus âgée et de céphalopodes prélevés à de plus grandes profondeurs.

Mots clés: phoque annelé, *Phoca hispida,* Eau du Nord, polynie, télémesure par satellite, utilisation de l'habitat, plongée

Traduit pour la revue *Arctic* par Nésida Loyer.

[1] Greenland Institute of Natural Resources, P.O. Box 570, DK-3900 Nuuk, Greenland; contact address: c/o Danish Polar Center, Strandgade 100H, DK-1401 Copenhagen, Denmark; ewb@dpc.dk

[2] National Environmental Research Institute, Department of Arctic Environment, Frederiksborgvej 399, P.O. Box 358, DK-4000, Roskilde, Denmark

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INTRODUCTION

The North Water (NOW) of the Smith Sound–northern Baffin Bay region between Greenland and Ellesmere Island (Canada) is one of the largest recurrent polynyas (70 000 – 80 000 km^2) in the Arctic (e.g., Lewis et al., 1996; Barber et al., 2001a; Mundy and Barber, 2001). Polynyas remain open in winter and become ice-free early in spring; thus, they are areas of relatively high biological productivity, which begins earlier there than in ice-covered areas at the same latitudes (e.g., Stirling et al., 1981; Klein et al., 2002; Ringuette et al., 2002). Birds and marine mammals use polynyas for feeding and mating, and marine mammals use them as overwintering grounds as well (e.g., Vibe, 1950; Brown and Nettleship, 1981; Stirling et al., 1981; Stirling, 1997). Large colonies of dovekies (*Alle alle*) and thick-billed murres (*Uria lomvia*) in the North Water (e.g., Kampp, 1990; Boertmann and Mosbech, 1998; Kampp et al., 2000; Pedersen and Falk, 2001) testify to the area's great productivity, particularly on its eastern side. Vibe (1950) suggested that animal life was richer on the eastern versus the western side of the polynya due to earlier ice breakup and inflow of a nutrient rich and relatively warm current from southern Greenland (Kiilerich, 1933; Grøntved and Seidenfaden, 1938).

The International North Water Polynya Study was conducted from 1997 through 1999, with emphasis in 1998, to document physical and biological processes (Barber et al., 2001b; Deming et al., 2002). We examined the use of the NOW area by ringed seals (*Phoca hispida*) as one component of that international study.

Ringed Seal Ecology

Ringed seals are abundant year-round residents at both eastern and western margins of the NOW (Vibe, 1950; Born and Knutsen, 1989), as evidenced by large annual harvests by the Inuit living in Jones Sound, Canada (Reeves et al., 1998), and the Thule area, NW Greenland (Teilmann and Kapel, 1998).

Ringed seals prefer annual landfast ice with good snow cover in fjords and bays with complex coastlines (e.g., McLaren, 1958a, b), but they also range widely in offshore pack ice (e.g., Finley et al., 1983). Adult ringed seals tend to winter under stable nearshore ice, whereas subadults are often found at the edges of the landfast ice (e.g., McLaren 1958a). In winter, ringed seals spend most of their time in the water or in subnivean lairs on the stable ice, but after the breeding season (March–early May), they haul out on the ice to molt until ice breakup (Vibe, 1950; McLaren, 1958a, b; Smith, 1973, 1987; Smith and Hammill, 1981). Ice breakup usually occurs in late July in the eastern areas of the NOW (Vibe, 1950; Born et al., 2002). Although the ringed seals feed relatively little (e.g., Smith, 1973, 1987) during the molt, they feed intensively during the open-water period (from late July until late October) in pelagic and demersal habitats (e.g., Smith, 1987; Weslawski et al., 1994). They are euryphagous, eating a variety of crustaceans, mainly the hyperiid amphipod *Themisto* (*Parathemisto*) *libellula*, and fish, mainly polar cod, *Boreogadus saida*, and arctic cod, *Arctogadus glacialis* (e.g., McLaren, 1958a; Weslawski et al., 1994; Siegstad et al., 1998; Wathne et al., 2000; Holst et al., 2001). Some evidence suggests that juveniles and adults forage in different habitats (Holst et al., 2001).

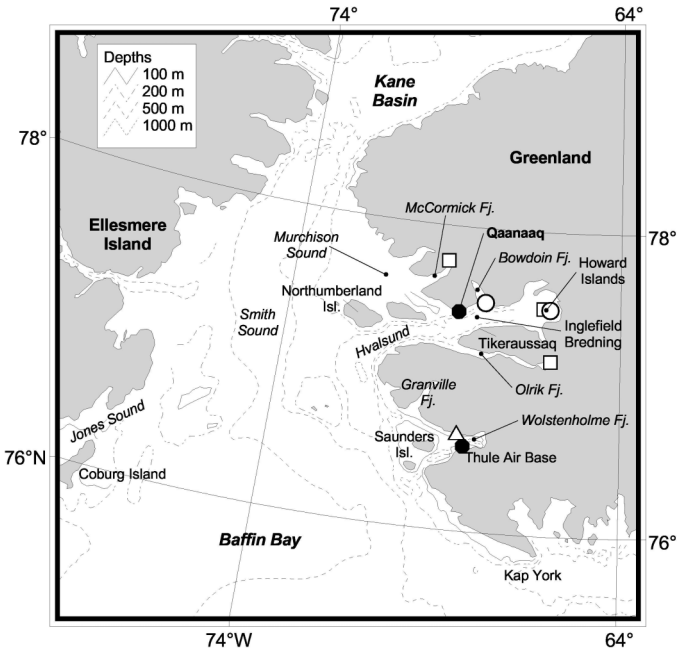

FIG. 1. Map with bathymetry of the North Water study area, indicating sites where 23 ringed seals were caught and equipped with satellite-linked radio transmitters in 1996 (squares), 1997 (open circles), and 1998 (triangle).

Studies of Ringed Seal Movement and Distribution in the NOW

Previous studies of ringed seal movement in the NOW area included information on gross movement of some seals that were tagged between 1988 and 1997 (Kapel et al., 1998) and studies of movement, mainly during summer and fall, that used satellite transmitters (Heide-Jørgensen et al., 1992; Teilmann et al., 1999). To present an overall picture of habitat use by ringed seals in the NOW area, the seals tracked by Teilmann et al. (1999) are included in the present study. Holst and Stirling (2001) presented preliminary information, based on shipboard censuses, on the distribution and abundance of ringed seals in the NOW area during August 1997, April to July 1998, and September 1999.

Ringed seals have relatively great "ecological flexibility" (i.e., high mobility, ability to survive the winter in ice-covered waters, broad spectrum of food taken in all strata of the water column). Consequently, we assumed that ringed seals fitted with satellite transmitters could help identify geographical areas and water-column strata of

TABLE 1. Basic data on 23 ringed seals caught in the North Water area in 1996, 1997, and 1998 that were monitored via satellite telemetry between 12 August 1996 and 30 June 1999.

ID no.[1]	Date of Tagging	Tagging Site	Sex	Body Mass (kg)	Age Class[2]	Transmitter Type[3]	No. of Days with Contact
1858-96	12 August 1996	McCormick Fj.	m	26	S	A	137
3984-96	21 August 1996	Olrik Fj.	f	25	S	A	46
1857-96	22 August 1996	Olrik Fj.	f	24	S	A	134
4345-96	24 August 1996	Olrik Fj.	m	26	S	A	113
3985-96	25 August 1996	Olrik Fj.	m	82	A	A	58
4344-96	31 August 1996	Howard Isl.	m	34	S	A	146
1856-96	1 September 1996	Howard Isl.	m	29	S	A	127
1859-96	12 September 1996	Tikeraussat	f	25	S	A	29
1857-97	19 June 1997	Bowdoin Fj.	m	38	P	B	17
1856-97	21 June 1997	Bowdoin Fj.	m	39	P	B	31
1858-97	22 June 1997	Bowdoin Fj.	f	83	A	B	13
3984-97	27 June 1997	Bowdoin Fj.	m	47	A	B	8
11271-97	12 August 1997	Howard Isl.	m	96	A	B	253
11273-98	30 July 1998	Wolstenholme Fj.	m	24	S	C	8
4347-98	2 August 1998	Wolstenholme Fj.	m	33	S	D	98[4]
11272-98	2 August 1998	Wolstenholme Fj.	m	33	S	C	70
1857-98	3 August 1998	Wolstenholme Fj.	f	27	S	D	332
1859-98	5 August 1998	Wolstenholme Fj.	f	29	S	D	12
3985-98	10 August 1998	Wolstenholme Fj.	f	40	P	C	95[4]
11274-98	10 August 1998	Wolstenholme Fj.	f	22	S	C	12[4]
3984-98	11 August 1998	Wolstenholme Fj.	m	26	S	D	98
1858-98	11 August 1998	Wolstenholme Fj.	m	31	S	D	320
1856-98	13 August 1998	Wolstenholme Fj.	f	28	S	D	124

[1] Suffix indicates year of tagging.

[2] Age class (see Methods): S = Subadult; P = Pubescent; A = Adult.

[3] Types of satellite-linked radio transmitter: A = ST-6, continuous transmission; B = ST-10, transmission suspended after four hours of haul-out; C = same as "B" but with continuous transmission; D = SSC3, transmission suspended after four hours of haul-out. The units used in 1996 recorded dives only down to 250 m, whereas those deployed in 1997 and 1998 all recorded depths down to 500 m.

[4] Shot or netted by Inuit from the Thule area. Data not included in summary of system performance.

biological productivity. We studied the seasonal distribution of ringed seals and their diving behavior in the NOW area (i.e., the North Water polynya sensu stricto and adjacent fjords) by outfitting 23 seals with satellite transmitters in the Thule region from 1996 through 1998.

METHODS

Field Activities and Study Animals

We caught 23 ringed seals using modified drift gill nets (cf. Kapel et al., 1998; Teilmann et al., 1999) at different locations in the Thule region (76° to 78°30'N, 66° to 73° W; Fig. 1), and then attached a satellite-linked radio transmitter to each seal (Table 1). All seals were handled and treated according to Greenland regulations and law concerning animal care.

The overall activity of subadult seals may differ from that of adult seals because the two groups usually occupy different coastal ice habitats, behave differently during the mating season, and may have different diving capability and diet (McLaren, 1958a; Teilmann et al., 1999; Holst et al., 2001). Therefore, the study animals were categorized at capture, on the basis of body length and mass, as subadults, pubescents, or adults (Born et al., 2002, and references therein; Table 1).

The Satellite Transmitters

Different types of satellite transmitters were used (Table 1), but the configuration, battery capacity, and mass of the transmitters were similar to those described in Teilmann et al. (1999). All transmitters were manufactured by Wildlife Computers (Seattle, U.S.A.). The sampling protocol of the transmitters was described in Teilmann et al. (1999) and Born et al. (2002). On all seals except three, the unit was positioned with the antenna pointing backward. On seals 1859-98, 3984-98, and 1856-98 (Table 1), the antenna pointed forward.

Sampling of Dive Activity

The transmitters sampled "time" and "pressure" (depth) every 10 seconds. These data were stored in six-hour blocks and then relayed to the satellite during the following 24 hours. Three types of dive data were used to describe the vertical use of the NOW area by the seals: (1) Daily maximum dive depth (MDD), (2) number of dives per day, and (3) time spent in each depth interval (Time At Depth, or TAD). Dive data were stored in 10 user-defined intervals that were organized as follows for analysis: 0–50 m, 51–100 m, 101–200 m, ≥ 201 m. Haul-out periods (Born et al., 2002) were extracted from the activity data before analyses and presentation of diving activity.

Organization of Data and Statistical Analyses

Data on movements and dive behavior were collected via the Argos Location Service Plus system (Toulouse, France; cf. Harris et al., 1990; www.cls.fr). The software program Satpak 3.14 (Wildlife Computers, 1997) was used to validate locations and dive data received.

In analyzing the activity of the study animals, we defined three "ecological seasons" based on ice and light conditions and the basic life history of ringed seals: (1) "Summer" or the "open-water season" (1 August–31 October), the time between breakup of the landfast ice and its formation in the fall; (2) "Winter" (1 November–31 March), when the fjords are covered with fast ice and darkness prevails for most of the time; and (3) "Spring" (1 April–31 July), when the seals are breeding and spend progressively more time hauling out. The spring season ends with the breakup of the fast ice.

Information on ice formation, ice coverage, and ice type was determined from ice charts provided by the Canadian Ice Services (Environment Canada) and from National Oceanic and Atmospheric Administration (NOAA) infrared satellite images. In addition, information on ice formation and ice breakup was obtained from people living in the Thule area. In 1996, a dense layer of fast ice formed in the Inglefield Bredning by 1 November (Teilmann et al., 1999). Fast ice formed in the fjords of the Thule area by 10 November in 1997 and by 9 November in 1998 (Born et al., 2002). Local residents reported that in 1998, breakup of the landfast ice occurred on 17 July in Wolstenholme Fjord and around 28 July in Inglefield Bredning.

At 77° N, there is 24-hour daylight between 22 April and 21 August, and darkness prevails from 1 November until 12 February.

We produced digital maps of the North Water area, with the permission of the Canadian Hydrographic Service, from Bathymetric Map 817-A (scale 1:2 000 000; Canadian Hydrographic Service). In some cases, the existing bathymetric contours were refined and corrected on the basis of soundings made during the NOW cruises (courtesy: L. Fortier, Département de Biologie, Université Laval, Québec, Canada).

The extension of the North Water polynya varies annually and seasonally (e.g., Barber et al., 2001a). However, in the present paper, the NOW area was defined as the waters (including adjacent fjords) between ca. 75°45' N (southern entrance to Jones Sound, Ellesmere Island) and ca. 79° N (position in some years of the "ice bridge" between Canada and Greenland in northern Smith Sound and southern Kane Basin).

We used ArcView 3.0a to map seal movement and calculate distances and rates of movement. Except for one seal, we used only location classes 1, 2, and 3, for which theoretical radial precision has been specified by Argos as less than 1000 m (cf. Harris et al., 1990; Anon., 1996). Because of a general lack of good-quality locations from an adult male (11271-97), class 0 locations (for which accuracy is not specified by Argos) were included in the analyses.

The areas visited by the seals ("ranges") were mapped using the locations from all seals that transmitted during the season in question. A daily location for each seal was selected using the highest quality class available. Total seasonal ranges for all seals combined were calculated using the fixed-kernel method (Seaman and Powell, 1996) using the ArcView extension "Animal Movement v. 2.04" (Hooge et al., 1999) and "ArcGIS Spatial Analyst 1.1" (ESRI, http://www.esri.com/software/arcgis/arcgisxtensions/ spatialanalyst/index.html). The 95% probability contours of the seasonal ranges were depicted (Figs. 2 and 3).

Monthly gross movement of a seal was determined by summing all linear distances (km) between consecutive locations received for an individual during a month. Monthly net movement, or shift in geographic position, of each animal was defined as the linear distance (km) between first and last locations recorded each month. Following Amstrup et al. (2001), these estimators of movement or displacement were calculated only if 20 or more days had elapsed between the first and last locations recorded during a month.

To minimize uncertainty in determining swimming speed from distance between locations and time, we included only cases for which (1) the combined theoretical uncertainty was less than 10% of the "point" distance between the two positions, (2) time elapsed between the two locations was between 0.5 and 6 hours (Teilmann et al., 1999), and (3) at least five estimates of speed were available per season.

We used analysis of variance (ANOVA) to test the influence of four factors—sex, age class, season of deployment, and position of the transmitter (i.e., antenna pointing backward or forward)—on the performance of the transmitters (i.e., number of days of contact with the transmitters). The data on duration were $\log_{10}$-transformed to obtain normality and homoscedasticity.

Movement data were ln-transformed and ANOVA (factors: sex, age, season, and the interaction between sex and season) was applied to test for differences in gross movement, net movement, and swimming speed during the three seasons. Seasonal differences in range size were tested with ANOVA (and Tukey post hoc test) weighted with number of seals.

ANOVA was also used to test differences in diving behavior. For analyses of MDD, ANOVA and Tukey-Kramer post hoc tests were made, whereas Wilcoxon Signed Rank analyses were used to test for differences among age groups in time spent at various depths (TAD).

Pearson's correlations were used to analyze the relationships between MDD and the deepest map depth in areas visited by a seal during the same day. This analysis included only seals that remained in the NOW area and were equipped with transmitters able to record depths down to 500 m (Table 1) and for which at least 45 pairs of MDD and map readings were available.

TABLE 2. The number of ringed seals, by age group, that provided dive data in each of the 12 months during 1996–98. Data are given in this format: Number of individual seals transmitting dive data in the month/average number of hours with dive data per seal (standard deviation of the average number of hours).

	No.	Jan	Feb	Mar	Apr	May	Jun
Adult	4	1/474	1/216	1/108	1/174		2/69(13)
Pubescent	3						2/159(38)
Subadult	16	3/68(35)	2/111(55)	2/177(30)	2/165(89)	2/228(85)	2/369(13)
		Jul	Aug	Sep	Oct	Nov	Dec
Adult	-	1/84	2/237(225)	2/327(412)	1/426	1/420	1/474
Pubescent	-	2/240(221)	1/498	1/732	1/606	1/150	
Subadult	-		13/423(218)	14/648(93)	14/475(188)	9/263(170)	7/226(145)

To detect whether there was a relationship between total body mass and the tendency of the seals to use different strata of the water column, a weighted (1/variance) regression was made of daily MDD regressed on total body mass (TBM).

Daily number of dives summed per month by the three age classes were not all normally distributed (Shapiro-Wilk test; adults: $p = 0.047$; pubescents: $p = 0.555$; subadults: $p = 0.018$); therefore, a Wilcoxon Signed Rank test was used to explore for differences among age classes in dive activity. A Kruskal-Wallis test was used to test for differences in dive activity among seasons (winter, summer, spring).

Statistical analyses were conducted using the software Statview for Windows 4.5 (1992–97, Abacus Concepts), Systat 9.0 (1999, SPSS Inc.), and SAS (1990, SAS Inst. Inc.).

RESULTS

Seals Studied and Performance of the Transmitters

Sixteen (70%) of the seals that we monitored were subadults, three were pubescent, and four were adults. Fourteen were males and nine were females. Total body mass ranged between 22 and 96 kg (Table 1).

Contact with the transmitters was maintained for an average of 108 days (SD = 96, range: 8 to 332 d, $n = 20$; three seals killed by hunters were not included; Table 1). Season of deployment was the only variable that significantly influenced the number of days of contact with the seals ($F = 5.54$, $p = 0.03$, $df = 4/1$). Contact was maintained longer with the transmitters that were deployed during the open-water season (mean = 130 d, SD = 95, range: 12–332 d, $n = 16$) than with those deployed during spring (mean = 17 d, SD = 10, range: 8–31 d, $n = 4$). Among transmitter types, the direction of the antenna was the only factor that was statistically significant ($F = 7.35$, $p = 0.02$, $df = 3/1$). The units with the antenna pointing backward transmitted longer (mean = 113 d, SD = 102, range: 8–332 d, $n = 17$) than those with the antenna pointing forward (mean = 78 d, SD = 59, range: 12–124 d, $n = 3$).

The satellite-transmitted data from all years combined allowed us to map the ringed seals' spatial use of the NOW for nearly an entire annual cycle (Table 2).

Horizontal Use of the NOW Area

Nineteen of the seals remained in the North Water area throughout the study period, and four seals left the area.

Two subadult seals (3985-96, 1858-96) emigrated from the NOW area in August 1996 (Teilmann et al., 1999), and one adult seal (11271-97) moved offshore around 15 August 1997. After the formation of landfast ice in the Thule area around 10 November 1997, the adult remained offshore in the polynya (Fig. 2B) until 2 December, when it moved south. This seal stayed at ca. 73°30' N, 58°50' W in NE Baffin Bay until transmission stopped on 11 April 1998 (Fig. 3B). The fourth emigrant was a subadult (1859-98) that left the tagging site in Wolstenholme Fjord on 5 August 1998 and moved south along the Greenland coast, where contact was lost on 16 August 1998 at 74°23' N, 64°26' W (Fig. 2C).

The seasonal variation in spatial use of the NOW area by the 19 seals that remained there was reflected in the distribution of relocations, in the monthly gross and net movement, and in individual swimming speed. Gross and net movement (Table 3) and speed did not differ between months, sexes, or age groups within any of the seasons (ANOVAs, $p > 0.05$), and this activity is therefore summarized for all seals, by season, from summer to spring:

Summer: During summer or the open-water season, the six seals that were monitored in 1996 stayed along the eastern shores of the NOW, primarily between 77° and 78°30' N (Fig. 2A).

Before seal 11271-97 emigrated from the North Water area, it stayed on the eastern side of the NOW area and in southern Kane Basin. Maximum dive depth readings down to 376 m and the relocations indicated that this seal visited the central parts of the NOW area, where the depths are greater than 500 m (Fig. 2B).

Of nine seals that stayed in the NOW area in 1998, six remained near the tagging site in Wolstenholme Fjord. The majority of the relocations from these "inshore" seals came from areas where water depths are less than 100 m (Fig. 2C). Three 1998 seals made excursions offshore into the central parts of the NOW area (Fig. 2D).

The four seals that left coastal areas in 1997 and 1998 spent widely different fractions of their total offshore time

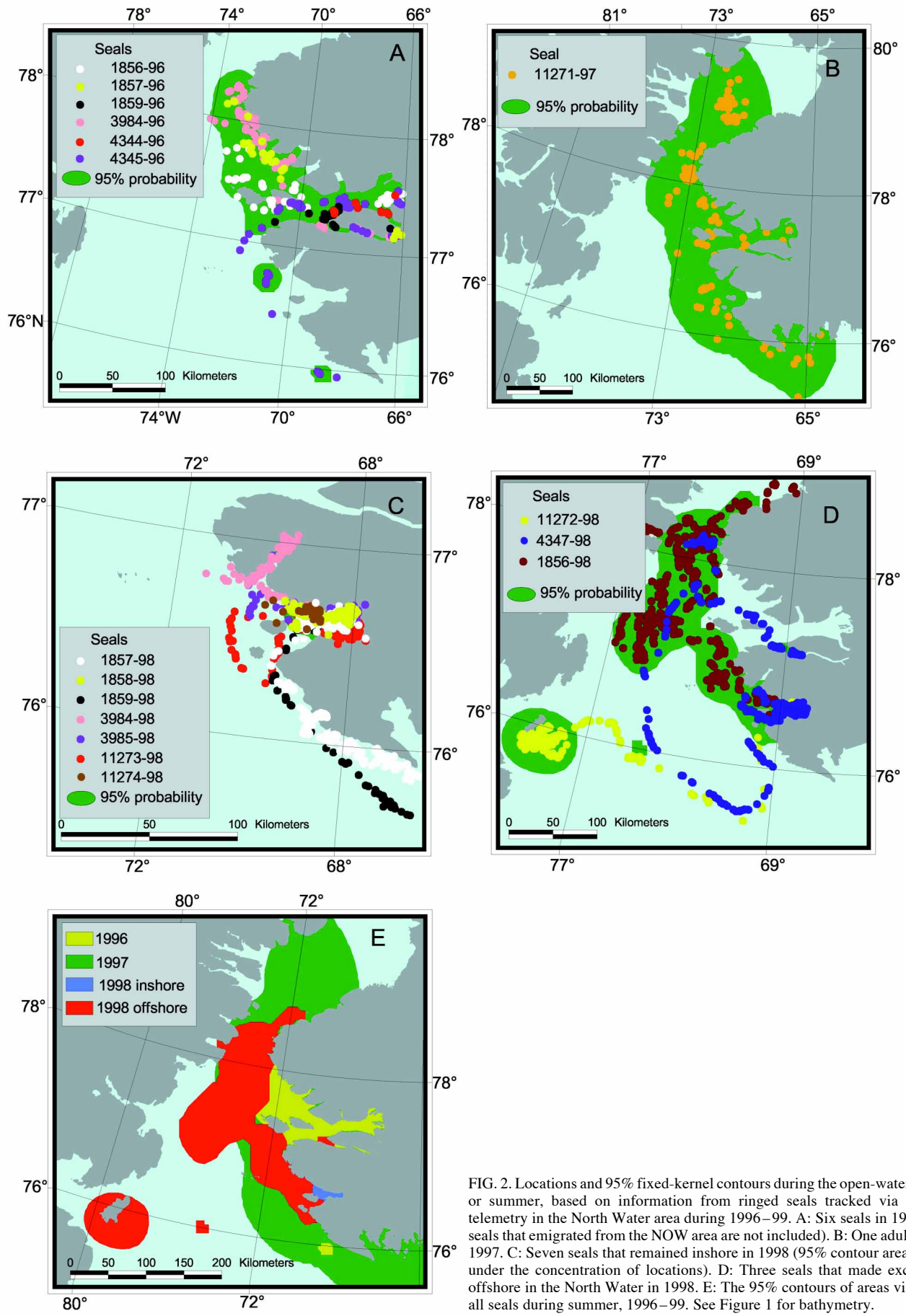

FIG. 2. Locations and 95% fixed-kernel contours during the open-water season or summer, based on information from ringed seals tracked via satellite telemetry in the North Water area during 1996–99. A: Six seals in 1996 (two seals that emigrated from the NOW area are not included). B: One adult seal in 1997. C: Seven seals that remained inshore in 1998 (95% contour area hidden under the concentration of locations). D: Three seals that made excursions offshore in the North Water in 1998. E: The 95% contours of areas visited by all seals during summer, 1996–99. See Figure 1 for bathymetry.

TABLE 3. Monthly gross and net movement distances (cf. Methods), by season, of ringed seals tagged with satellite transmitters in the NOW area, 1996–99.

Season	Open water		Winter		Spring	
	Gross	Net	Gross	Net	Gross	Net
Mean (km/month)	407	61	75	14	91	22
SD (km/month)	245	64	74	15	79	27
Seals (n)	13	13	3	3	3	3
Months (n)	28	28	4	4	6	6
Min (km/month)	49	2	4	0	12	1
Max (km/month)	940	222	164	31	201	68

TABLE 4. Fixed-kernel contour ranges, by season, of ringed seals that were tracked via satellite telemetry in the NOW area, 1996–99.

Year	Season	Number of Seals	95% Contour Area (km^2)
1996	Open-water	7	10292
	Winter (1996/97)	3	7097
1997	Spring	4	2104
	Open water	1	48950
1998	Open water (inshore)	6	569
	Open water (offshore)	3	17924
	Winter (1998/99)	2	2535
1999	Spring	2	815

in the central parts of the NOW area. (Time used offshore = % of days (n) in the NOW area: 11271-97: 97% (n = 99); 4347-98: 19% (n = 98); 1856-98: 50% (n = 124); 11272-98: 14% (n = 70).)

Overall, the distribution of locations received from all the seals during the open-water seasons of 1996, 1997, and 1998 clearly reflects their preference for the eastern parts of the NOW area (Fig. 2E).

Monthly mean gross movement (407 km/month) and mean net movement (61 km/month) were significantly higher during the summer open-water season than during winter and spring ($p < 0.01$; Table 3). Mean swimming speed during summer was 1.6 km/h (SD = 0.5, range: 1.0–2.8 km/h, $n = 14$ seals). Although the seals tended to travel faster during summer than during winter and spring, this tendency was not significant ($p = 0.79$).

Winter: During winter, the seals remained on the eastern side of the polynya, in areas that are covered with first-year fast ice during this season, or at the edge of this ice (Figs. 3A and 3D). Two subadult seals (1857-98, tracked for 332 days, and 1858-98, tracked for 320 days) were remarkably stationary during the entire survey period. Between 15 November and 6 June, seal 1857-98 transmitted regularly from a shallow-water location close to the coast (76°02' N, 67°34' W; Fig. 3D), probably in the shear zone between fast ice and moving pack ice. The monthly net movement of this seal during winter was only 0.03 km/month. Seal 1858-98 stayed for the entire period in Wolstenholme Fjord, where it wintered in fast ice at eastern Saunders Island (Fig. 3D). Monthly net movement of this seal during winter averaged 2.2 km/month.

For all seals during winter, mean gross movement was 75 km/month and mean net movement 14 km/month (Table 3), and swimming speed averaged 1.3 km/h (SD = 0.9, range: 0.9–2.7, $n = 4$ seals). These three estimators of movement did not differ between winter and spring ($p > 0.05$).

Spring: Seals were monitored during spring in 1997 and 1999. The four pubescent and adult seals that were monitored from late June 1997 (Table 1) remained in the fast ice–covered Bowdoin Fjord and Inglefield Bredning until transmissions stopped on 21 July (Fig. 3C).

The two subadult seals (1857-98; 1858-98) that transmitted during the spring of 1999 stayed close to their wintering sites (Fig. 3E). On 6 June, however, 1857-98 moved from the area where it had wintered north along the coast, and by 24 June, it had returned to the area where it was originally captured (Fig. 3E). The monthly net movements indicated increased movements of both seals during spring (km/month; seal 1857-98: April = 0.7, May = 68; seal 1858-98: April = 1.6, May = 1.4, June = 32).

Mean gross movement and net movement of all seals during spring were 91 and 22 km/month, respectively (Table 3), and mean traveling speed was 1.5 km/h (SD = 0.5, range: 1.1–2.2, $n = 4$ seals).

Total Ranges: The tendency of the seals to expand their use of the NOW area during summer was also reflected in the seasonal variation in the size of total areas visited. The ranges of the animals during the open-water seasons 1996 and 1998 were ca. 10 300 km^2 and 18 500 km^2, respectively (Table 4). The area visited by the single adult male that was tracked during summer in 1997 was ca. 49 000 km^2 (Table 4). The ranges of movement varied from ca. 2500–7100 km^2 during winter to ca. 800–2100 km^2 in spring (Table 4). Total ranges during the open-water season (inshore range in 1998 not included) were significantly larger (ANOVA, $p = 0.04$), than ranges during winter and spring (no difference between the two latter seasons; $p > 0.05$).

Vertical Use of the NOW Area

Generally, the dive data indicated that while non-adult seals occasionally explored the water column down to the sea floor, they spent much of their time foraging at depths shallower than 50 m. Adults, in contrast, spent much more time at greater depths.

The daily maximum dive depth reflects the vertical exploratory activity of the seals in a general way. The mean MDD of the 15 seals (TBM: 22–96 kg) with transmitters that recorded dives down to 500 m was positively correlated with TBM (MDD in m = 1.27 • (TBM in kg) + 85.52, $p = 0.002$, $r^2 = 0.398$). While moving around offshore in the eastern parts of the NOW area until early December, the 96 kg adult male (11271-98) dove regularly to between 300 and 376 m depth. This seal made the deepest dive recorded in this study—beyond the 500 m depth-reading capability of the instrument—on 28 January 1999 at 73°25' N, 58°55' W (i.e., in NE Baffin Bay south of the North Water area).

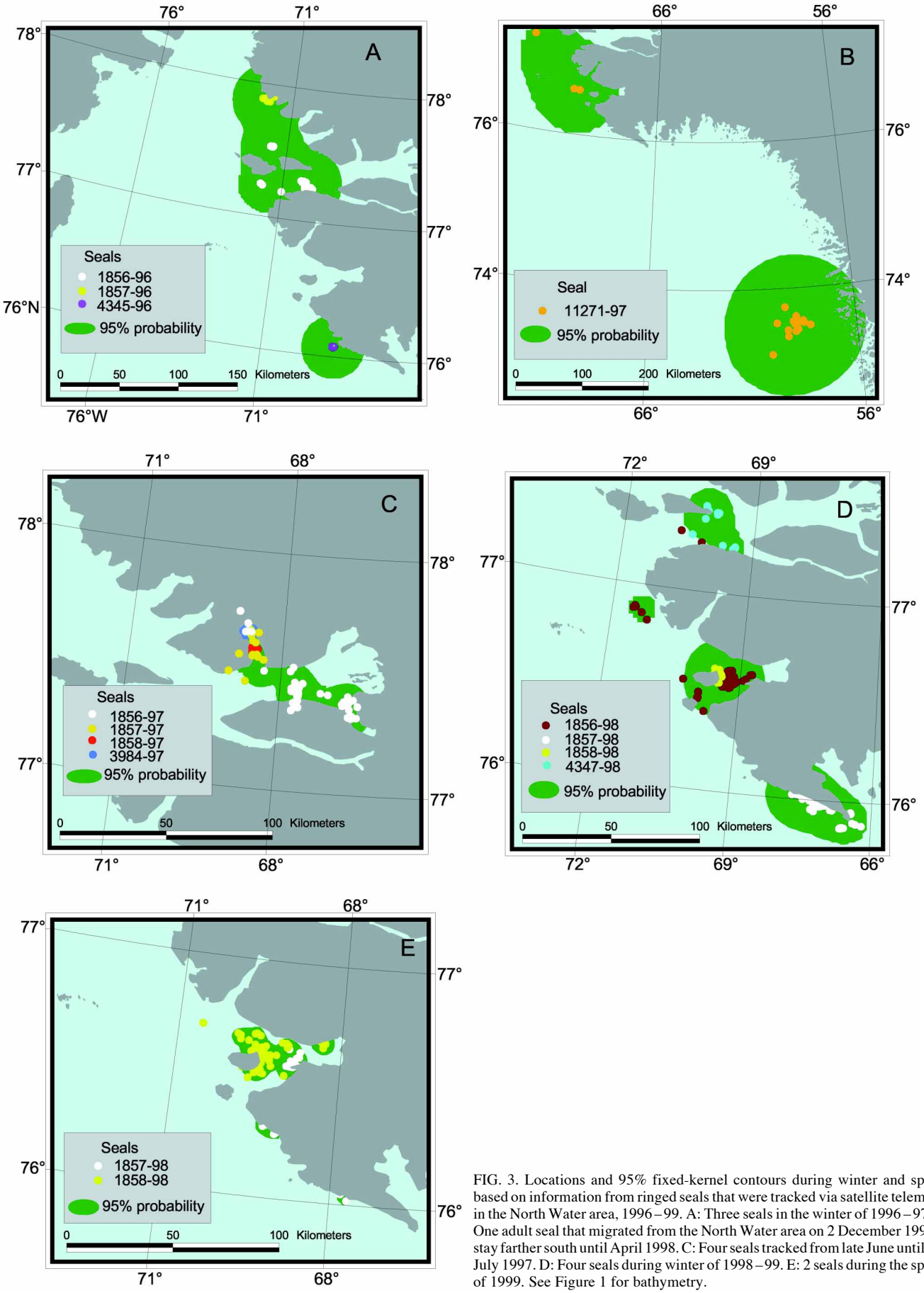

FIG. 3. Locations and 95% fixed-kernel contours during winter and spring based on information from ringed seals that were tracked via satellite telemetry in the North Water area, 1996–99. A: Three seals in the winter of 1996–97. B: One adult seal that migrated from the North Water area on 2 December 1997 to stay farther south until April 1998. C: Four seals tracked from late June until late July 1997. D: Four seals during winter of 1998–99. E: 2 seals during the spring of 1999. See Figure 1 for bathymetry.

TABLE 5. Correlations between daily maximum dive depth (MDD) and water depth in North Water areas visited by a seal the same day, as inferred from location data of seven seals.

Seal ID	*r*	*p*	No. of records of MDD with Map Depths (*n*)	No. of records of MDD > 100 m (% of all records *n*)	Highest daily MDD on Days with a Map Depth (m)	Highest Daily MDD on *all* days (m)
11273-98	0.40	**0.001**	73	16 (22)	156	156
3985-98	0.14	0.38	45	21 (47)	224	232
1857-98	0.40	**< 0.001**	101	23 (23)	252	252
3984-98	0.16	0.19	70	20 (29)	184	184
1856-98	-0.20	0.07	80	70 (88)	340	360
1858-98	0.63	**< 0.001**	80	23 (29)	320	320
4347-98	0.41	**< 0.001**	87	70 (80)	288	288

The four pubescent and adult seals that transmitted during June–July from Inglefield Bredning and Bowdoin Fjord, where water depths exceed 600 m (Fig. 1; Fig. 3C), did not dive deeper than about 250 m.

The seals that stayed in the NOW area in 1998 dove to MDD of approximately 156–360 m (Table 5). For some of these animals, the MDD was correlated with the maximum depth in the area visited during the same day (Table 5), indicating a tendency to explore the entire water column down to the seafloor.

Three subadult seals that made offshore excursions into the central parts of the NOW area (Fig. 2D), where water depths exceed 500 m, did not dive deeper than about 300 m while there (maximum depths recorded 220, 328, and 288 m, respectively).

There were no trends with time in MDD ($p > 0.05$) for 11 of the 15 seals equipped with transmitters that recorded dives down to 500 m. However, MDD did decrease with time for three seals, and increased for one. The MDD of seals 11272-98, 1857-98, and 1858-98 decreased gradually (r^2 between 0.13 and 0.50; p between < 0.001 and 0.06), indicating that they made shallower dives as time progressed. This was particularly pronounced in 1857-98 and 1858-98, which stayed in shallow coastal waters until late June 1999. During winter and spring, the MDD of seal 1857-98 averaged 15.2 m (SD = 7.3, range: 4–36 m, $n = 35$ days with MDD), and the MDD of 1858-98 averaged 19.6 m (SD = 13.5, range: 8–72 m, $n = 19$). The MDD of seal 3984-98 increased with time ($r^2 = 0.16$, $p = 0.008$) from 13 August to 27 October 1998. During August, this seal moved from shallow waters in Wolstenholme Fjord into Granville Fjord, where it spent September and most of October (until transmission stopped) in front of a glacier at the head of this fjord.

Adult seals generally made fewer dives than pubescent seals, and pubescents made fewer dives than the subadults (Wilcoxon Signed Rank tests, $p < 0.05$; Fig. 4). Overall, the average number of dives per day of adults was 182 (SD = 61.4, range: 120–312 dives/day, $n = 11$ months). Pubescent seals made an average of 324 dives per day (SD = 44.9, range: 264–384 dives/day, $n = 6$ months), whereas subadults dove 409 times per day on average (SD = 55.0, range: 336–528 dives/day, $n = 11$ months). In adults, the number of dives per day differed significantly with season

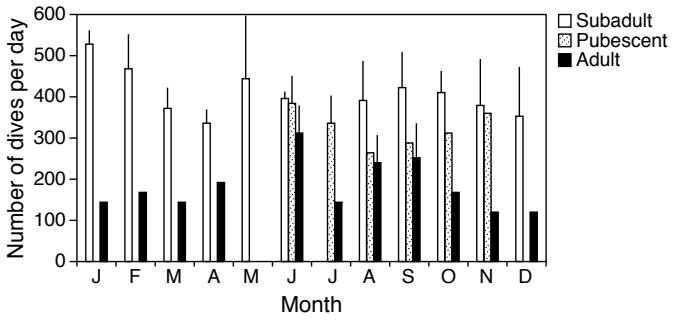

FIG. 4. Seasonal variation in number of dives per day of subadult, pubescent, and adult ringed seals in the North Water area (1996–99). For each seal, we calculated the monthly mean of number of dives per day. Bars represent the mean dive activity of all seals, and lines the standard deviations. For number of seals per month, see Table 2.

(winter lower than summer and spring; $p = 0.026$). The other two age groups showed no seasonal trend in the daily number of dives (subadults, $p = 0.69$; pubescent seals: $p = 0.39$).

The time-at-depth (TAD) data indicated that all age groups except for adults spent the majority of time in the upper 50 m of the water column, with limited seasonal variation. During the open-water season, subadult seals spent an average of 92% and pubescents 90% of the time between 0 and 50 m, whereas adults spent an average of only 66% of the time in this depth range (Fig. 5). During winter, subadults used 96% and pubescent seals spent 93% of the time in depths shallower than 50 m, whereas adults averaged only 47% of the time at depths shallower than 50 m. The single adult (11271-97) that was monitored during winter and early spring used progressively more time deeper than 50 m (Fig. 5). All seals foraged at similar depths in June and July (i.e., time of maximum haul-out on the ice) spending about 90% of their time at depths less than 50 m (Fig. 5).

The three subadult "offshore" seals (Fig. 2D) spent an average of 94% (SD = 1.62) of the time in the upper 50 m of the water column while visiting the central parts of the NOW. Overall, these seals spent only 0.5% of the time (SD = 0.20) deeper than 100 m. In contrast, the adult seal (Fig. 2B) spent an average of about 17.5% (SD = 3.1) of the time below 100 m while in the central parts of the NOW area (Fig. 5).

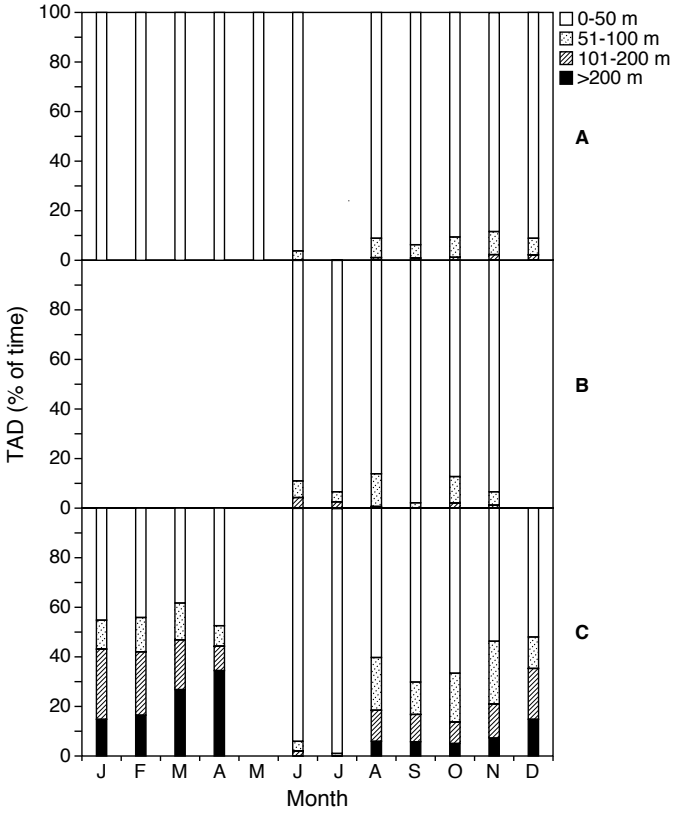

FIG. 5. Time allocation (% of total time monitored) to specified depth categories (Time-At-Depth, or TAD), by month and age group, in ringed seals in the North Water area, 1996–99. A: Subadults, B: Pubescent seals, C: Adults. Note that the depth intervals are not of equal size. The TAD per month was determined for each seal. A bar represents the average TAD for all individual seals in that month (for number of seals per month, see Table 2).

DISCUSSION

Limitations of the Study

The NOW study focused on the physical and biological processes, particularly during 1998, when an extensive, multidisciplinary icebreaker-based study was conducted (reviewed in Deming et al., 2002). We had hoped to be able to monitor the ringed seals during all of 1998. However, because the satellite transmitters did not operate long enough in 1997, and because seals were more difficult to catch then, our study overlapped with only the latter half of the NOW emphasis period. About 70% of the 23 study animals were immature seals (likely less than three years old at capture), and 14 (61%) were males. Thus the age composition of the study animals was representative of the catch of ringed seals in NW Greenland, which has a surplus of young seals and a sex ratio that is skewed towards males (cf. Teilmann and Kapel, 1998), and likely also of the ringed seal population, which generally has a high proportion of young individuals (e.g., Smith, 1973, 1987). However, because the transmitters on pubescent and adult animals generally performed less reliably, the present study mainly addresses the use of habitat by subadult seals.

We decided to catch the seals as close to the polynya area as possible and therefore operated in the populated Thule area that borders the North Water to the east. The effects of tracking seals that had been caught on only one side of the polynya area could not be assessed a priori, but it is possible that the picture of their movement patterns was influenced by a tendency of the seals to show fidelity to the area where they were caught. Although some long-distance movements of ringed seals have been reported (e.g., Heide-Jørgensen et al., 1992; Kapel et al., 1998; Teilmann et al., 1999), there are indications that ringed seals may show site tenacity both within and between years (Smith and Hammill, 1981; Kapel et al., 1998; Gjertz et al., 2000).

However, despite these limitations, we believe that the behavior of the seals monitored in this study allows for some general inferences about the spatial use of the NOW area by ringed seals.

Horizontal Use of the NOW Area

Our data indicated that the ringed seals tagged in the eastern part of the NOW area stayed in the eastern areas with relatively shallow water (< 100 m) and spent little time in the central polynya area in Smith Sound.

The icebreaker-based NOW study confirmed that the earlier ice breakup in the eastern parts of the NOW area favors marine production and animal abundance in general along the Greenland coast (Holst and Stirling, 2001; Klein et al., 2002; Ringuette et al., 2002 and references therein).

Despite the apparent site tenacity, we think that the distribution of the seals in our study was influenced by the general distribution and availability of prey, and we suggest that a key factor influencing the spatial use by the seals was the occurrence of polar cod (*B. saida*). In the Thule area, polar cod constituted 80% to 90% by mass of the diet of ringed seals (all age classes) in 1985 and 1998 (Siegstad et al., 1998). In Jones Sound, adult ringed seals mainly consumed arctic cod (*A. glacialis*), and polar cod comprised only about 16% of the diet by mass in 1998. In this area, subadults foraged mainly on the hyperiid amphipod *T. libellula* (Holst, 2000, cited in Hobson et al., 2002a; Holst et al., 2001). However, a study of stable isotope ratios ($\delta^{13}C$, $\delta^{15}N$) that likely represent dietary integrations over one to two months indicated that during late spring to early summer (1998), the diet of ringed seals on both sides of the NOW consisted primarily of polar cod (Hobson et al., 2002a).

Polar cod sometimes move in large shoals during the open-water season (Falk-Petersen et al., 1986; Born and Knutsen, 1988; Finley et al., 1990; Crawford and Jorgenson, 1996). Most polar cod ingested by ringed seals in Thule were young (age inferred from length; Gjøsæter and Ajiad, 1994; Siegstad et al., 1998), indicating that the seals fed on shoaling polar cod of uniform age class.

The crustacean *T. libellula* can also occur in swarms during summer and winter (Cross, 1982; Percy, 1993;

Wathne et al., 2000; Auel et al., 2002). A patchy distribution of crustaceans (including *T. libellula*) in the NOW was indicated in a study of the diet of dovekies (Pedersen and Falk, 2001).

The occurrence of their principal prey in localized shoals and swarms may govern the movements of predatory ringed seals during the open-water season, when they move around more to detect concentrations of food. Furthermore, during winter and spring, ringed seals are associated with their breeding holes in the fast ice and subnivean lairs, which in itself may reduce their horizontal mobility (Kelly and Quakenbush, 1990).

During the open-water season, harp seals (*P. groenlandica*) , narwhals (*Monodon monoceros*), dovekies, and thick-billed murres migrate in substantial numbers to the coastal areas and fjords of the Thule area to exploit the same prey as ringed seals (Vibe, 1950; Born, 1986; Kampp, 1990; Born et al., 1994; Heide-Jørgensen et al., 1994; Kampp et al., 2000; Pedersen and Falk, 2001; Hobson et al., 2002b). However, despite increased competition for food during summer from other marine mammals and sea birds, the ringed seals in our study stayed near the coast of the Thule area.

One seal moved from Thule to spend September and the first half of October at Coburg Island at the entrance to Jones Sound (Fig. 2D), where there is a large colony of thick-billed murres. The enhanced marine productivity in this area (Hobson et al., 2002b) was probably the reason that the seal stayed there.

Vertical Use of the NOW Area

The upper water layers in the NOW area are relatively active biologically (e.g., Ringuette et al., 2002). We found that ringed seals foraged in the upper 100 m of the water column almost exclusively, with a clear preference for the upper 50 m. Our findings were similar to those of Gjertz et al. (2000) at Svalbard, where about 50% of all dives between July and May were to depths less than 20 m, and about 90% to depths less than 100 m. For two seals that visited offshore pack ice areas, diving was significantly shallower there than in coastal areas (Gjertz et al., 2000).

There is probably no real need for ringed seals to use time at greater depths in the NOW area. First-year polar cod generally occur between 0 and 80 m, typically associated with ice (Craig et al., 1981; Bradstreet et al., 1986; Falk-Petersen et al., 1986; Lønne and Gulliksen, 1989), whereas older and larger polar cod can be found between 200 and 400 m depth (Falk-Petersen et al., 1986; Wathne et al., 2000). Like the polar cod, the crustacean *T. libellula* occurs in concentrations in the upper 100 m of the water column (Cross, 1982; Percy, 1993; Wathne et al., 2000; Auel et al., 2002). In the northeastern Barents Sea, at latitudes comparable to those of the NOW (about 77° and 79° N), about 80% of the standing biomass (including important ringed seal food) was distributed in the upper 200 m, while less than 1% was below 300 m (Wathne et al., 2000). The fact that huge concentrations of thick-billed murres find food in the upper layers of the water column in the North Water (Falk et al., 2002) reflects the high productivity of those strata, particularly on the eastern side.

The dives in the NOW by subadult, pubescent, and adult seals were very shallow during June and July, when the seals also spend a greater proportion of time on the ice (Born et al., 2002). The two subadults that were studied in the fast ice habitat during winter and spring dove only to shallow depths. This may reflect the fact that during these periods, the seals prey upon polar cod and crustaceans directly under the ice. In contrast, the 96 kg adult continued to make deep dives during winter.

Records of the daily maximum dive depth indicated that the seals occasionally dove to the sea floor. Lydersen and Hammill (1993) found a similar positive correlation between MDD and bottom depths for three ringed seal pups that were monitored with time-depth recorders at Svalbard. These excursions to the bottom may be in search of benthic prey. Ringed seals are known to take benthic food in the NOW area (Siegstad et al., 1998; Holst et al., 2001). In Thule, the third most important prey by weight was the bottom-living sea snail, *Liparis* spp. (Siegstad et al., 1998).

Dive duration and depth are positively correlated with body mass in ringed seals (Kelly and Wartzok, 1996; Teilmann et al., 1999; Kunnasranta, 2001). Hence, the MDD may reflect the physical limits of the diving capability of the individual seals (Teilmann et al., 1999). In the present study as well, daily maximum dive depth was correlated with total body mass. The diving capability of ringed seals increases with age (synonymous with total body mass), so older and larger seals can dive deeper than smaller seals and consume more fish (e.g., older polar cod), as indicated by the studies of Bradstreet and Cross (1982) and Holst et al. (2001). Adult 11271-97 spent more time at depths beyond 200 m during winter and early spring, when located in NE Baffin Bay at about 73°30' N, 58°50' W. Bottom-trawling in October 2001 at 73°41' N, 58°59' W, close to where 11271-97 wintered, showed that polar cod of 8.5–21.0 cm length made up ca. 40% of the biomass at 150 m. At another trawling station in NE Baffin Bay (73°46' N, 59°40' W), polar cod made up ca. 80% of the biomass at 350 m (O. Ankjær Jørgensen, pers. comm. 2002). Although this survey did not get farther north (Jørgensen, 2002), it indicated that polar cod is available as ringed seal prey at greater depth in northern Baffin Bay and probably also in the NOW area.

Cephalopods have also been reported in the diet of ringed seals from the North Water. Holst et al. (2001) reported finding *Bathypolypus arcticus* in the stomachs of ringed seals from the Thule area. This species is typically found between 200 and 600 m depth (O'Dor and Macalaster, 1983). Another cephalopod, *Gonatus fabricii*, which is widely distributed around Greenland (Kristensen, 1984) and can occur at great depths (Lu and Clarke, 1975), has been found in stomachs of ringed seals in NW Greenland

(Siegstad et al., 1998). We think that cephalopods are also likely prey of ringed seals — probably adult seals — at greater depths in the NOW area.

ACKNOWLEDGEMENTS

This paper is a contribution to the International North Water Polynya Study. The present project received financial support from the Danish Environmental Protection Agency as part of the environmental support program DANCEA (Danish Cooperation for Environment in the Arctic), the Greenland Institute of Natural Resources, and the National Environmental Research Institute, Department of Arctic Environment, Denmark. We wish to thank the following for valuable assistance in the field and their inspiring company: Kristian Eipe, Kurt Thomsen, Tornge Qaviaq, Sven-Erik Ascanius, Kim Diget Christensen, and Nina C. Born. Drs. Christina Lockyer (Age Dynamics, Lyngby, Denmark) and Michael Kingsley (Greenland Institute of Natural Resources, Nuuk) are thanked for offering useful comments on the manuscript. The constructive comments offered by three reviewers (Dr. Robert E.A. Stewart, Department of Fisheries and Oceans, Winnipeg; Dr. Andrew Derocher, Department of Biological Sciences, University of Alberta; and one anonymous reviewer) are gratefully acknowledged.

REFERENCES

AMSTRUP, S.C., DURNER, G.M., McDONALD, T.L., MULCAHY, D.M., and GARNER, G.W. 2001. Comparing movement patterns of satellite-tagged male and female polar bears. Canadian Journal of Zoology 79:2147–2158.

ANON. 1996. Argos user's manual. Toulouse-Cedex, France: ARGOS CLS.

AUEL, H., HARJES, M., DA ROCHA, R., STÜBING, D., and HAGEN, W. 2002. Lipid biomarkers indicate different ecological niches and trophic relationships of the Arctic hyperiid amphipods *Themisto abyssorum* and *T. libellula*. Polar Biology 25(5): 374–383.

BARBER, D.G., HANESIAK, J.M., CHAN, W., and PIWOWAR, J. 2001a. Sea-ice and meteorological conditions in northern Baffin Bay and the North Water polynya between 1979 and 1996. Atmosphere-Ocean 39(3):343–359.

BARBER, D.G., MARSDEN, R., MINNETT, P., INGRAM, G., and FORTIER, L. 2001b. Physical processes within the North Water (NOW) polynya. Atmosphere-Ocean 39(3):163–166.

BOERTMANN, D., and MOSBECH, A. 1998. Distribution of little auk (*Alle alle*) breeding colonies in the Thule district, northwest Greenland. Polar Biology 19:206–210.

BORN, E.W. 1986. Observations of narwhal (*Monodon monoceros*) in the Thule area (NW Greenland), August 1984. Reports of the International Whaling Commission 36:387–392.

BORN, E.W., and KNUTSEN, L.Ø. 1988. Observationer af narhval (*Monodon monoceros*) i Kangerlussuaq (Inglefield Bredning, Avanersuaq, Nordgrønland), 30. juli – 11. august 1988 (Observations of narwhals, *Monodon monoceros*, in Kangerlussuaq, Inglefield Bredning, Avanersuaq, Nordgrønland, 30 July – 11 August 1988). Greenland Home Rule, Department of Wildlife Management, Technical Report No. 1. 1–13. (In Danish with an English summary).

———. 1989. Observationer af havpattedyr og havfugle i nordlige Smith Sund, sydlige Kane Basin og Buchanan Bay, august 1988 (Observations of marine mammals and seabirds in northern Smith Sound, southern Kane Basin and Buchanan Bay, August 1988). Greenland Home Rule, Department of Wildlife Management, Technical Report No. 6. 1–6. (In Danish with an English summary).

BORN, E.W., HEIDE-JØRGENSEN, M.P., LARSEN, F., and MARTIN, A.R. 1994. Abundance and stock composition of narwhals (*Monodon monoceros*) in Inglefield Bredning (NW Greenland). In: Born, E.W., Dietz, R., and Reeves, R.R., eds. Studies of white whales (*Delphinapterus leucas*) and narwhals (*Monodon monoceros*) in Greenland and adjacent waters. Meddelelser om Grønland, Bioscience 39:51–68.

BORN, E.W., TEILMANN, J., and RIGET, F. 2002. Haul-out activity of ringed seals (*Phoca hispida*) determined from satellite telemetry. Marine Mammal Science 18(1):167–181.

BRADSTREET, M.S.W., and CROSS, W.E. 1982. Trophic relationships at High Arctic ice edges. Arctic 35(1):1–12.

BRADSTREET, M.S.W., FINLEY, K.J., SEKERAK, A.D., GRIFFITHS, W.B., EVANS, C.R., FABIJAN, M.F., and STALLARD, H.E. 1986. Aspects of the biology of arctic cod, *Boreogadus saida*, and its importance in arctic marine food chains. Canadian Technical Report of Fisheries and Aquatic Sciences 1491. 193 p.

BROWN, R.G.B., and NETTLESHIP, D.N. 1981. The biological significance of polynyas to arctic colonial birds. In: Stirling, I., and Cleator, H., eds. Polynyas in the Canadian Arctic. Canadian Wildlife Service Occasional Paper 45:59–70.

CRAIG, P.C., GRIFFITHS, W.B., HALDORSON, L., and ELDERLY, H.M. 1981. Ecological studies of polar cod, *Boreogadus saida*, in Beaufort Sea coastal waters, Alaska. Canadian Journal of Fisheries and Aquatic Sciences 39:395–406.

CRAWFORD, R.E., and JORGENSON, J.K. 1996. Quantitative studies of arctic cod (*Boreogadus saida*) schools: Important energy stores in the Arctic food web. Arctic 49(2):181–193.

CROSS, W.E. 1982. Under-ice biota at the Pond Inlet ice edge and in adjacent fast ice areas in spring. Arctic 35(1):13–27.

DEMING, J.W., FORTIER, L., and FUKUCHI, M. 2002. The International North Water Polynya Study (NOW): A brief overview. Deep-Sea Research II 49:4887–4892.

FALK, K., BENVENUTI, S., DALL'ANTONIA, L., GILCHRIST, G., and KAMMP, K. 2002. Foraging behaviour of thick-billed murres breeding in different sectors of the North Water polynya: An inter-colony comparison. Marine Ecology Progress Series 231:293–302.

FALK-PETERSEN, I.B., FRIDVOLL, V., GULLIKSEN, B., and HAUG, T. 1986. Occurrence and age/size relations of polar cod *Boreogadus saida* (Lepechin) in Spitsbergen coastal waters. Sarsia 71:235–245.

FINLEY, K.J., MILLER, G.W., DAVIS, R.A., and KOSKI, W.R. 1983. A distinctive large breeding population of ringed seals (*Phoca hispida*) inhabiting the Baffin Bay pack ice. Arctic 36(2):162–173.

FINLEY, K.J., BRADSTREET, M.S.W., and MILLER, G.W. 1990. Summer feeding ecology of harp seals (*Phoca groenlandica*) in relation to arctic cod (*Boreogadus saida*) in the Canadian high Arctic. Polar Biology 10:609–618.

GJERTZ, I., KOVACS, K.M., LYDERSEN, C., and WIIG, Ø. 2000. Movements and diving of adult ringed seals (*Phoca hispida*) in Svalbard. Polar Biology 23:651–656.

GJØSÆTER, J., and AJIAD, A.M. 1994. Growth of polar cod, *Boreogadus saida* (Lepechin) in the Barents Sea. ICES Journal of Marine Science 51:115–120.

GRØNTVED, J., and SEIDENFADEN, G. 1938. The Godthaab Expedition 1928. The phytoplankton of waters west of Greenland. Meddelelser om Grønland 82(5). 380 p.

HARRIS, R.B., FANCY, S.G., DOUGLAS, D.C., GARNER, G.W., AMSTRUP, S.C., McCABE, T.R., and PANK, L.F. 1990. Tracking wildlife by satellite: Current systems and performance. United States Department of the Interior, Fish and Wildlife Service. Fish and Wildlife Technical Report 30. 52 p.

HEIDE-JØRGENSEN, M.P., STEWART, B.S., and LEATHERWOOD, S. 1992. Satellite tracking of ringed seals *Phoca hispida* off northwest Greenland. Ecography 15:56–61.

HEIDE-JØRGENSEN, M.P., DIETZ, R., and LEATHERWOOD, S. 1994. A note on the diet of narwhals (*Monodon monoceros*) in Inglefield Bredning (NW Greenland). In: Born, E.W., Dietz, R., and Reeves, R.R., eds. Studies of white whales (*Delphinapterus leucas*) and narwhals (*Monodon monoceros*) in Greenland and adjacent waters. Meddelelser om Grønland, Bioscience 39:213–216.

HOBSON, K.A., FISK, A., KARNOVSKY, N., HOLST, M., CAGNON, J.-M., and FORTIER, M. 2002a. A stable isotope ($\delta^{13}C$, $\delta^{15}N$) model for the North Water food web: Implications for evaluating trophodynamics and the flow of energy and contaminants. Deep-Sea Research II 49:5131–5150.

HOBSON, K.A., GILCHRIST, G., and FALK, K. 2002b. Isotopic investigations of seabirds of the North Water polynya: Contrasting trophic relationships between the eastern and western sectors. Condor 104:1–11.

HOLST, M., and STIRLING, I. 2001. Distribution and abundance of ringed seals (*Phoca hispida*) in the North Water Polynya, northern Baffin Bay. Abstract. The 14th Biennial Conference on Marine Mammals, 28 November–3 December 2001, Vancouver, British Columbia, Canada. 101.

HOLST, M., STIRLING, I., and HOBSON, K.A. 2001. Diet of ringed seals (*Phoca hispida*) on the east and west sides of the North Water Polynya, northern Baffin Bay. Marine Mammal Science 17(4):888–908.

HOOGE, P.N., EICHENLAUB, W., and SOLOMON, E. 1999. The animal movement program. Anchorage: U.S. Geological Survey, Alaska Biological Science Center. http://www.absc.usgs.gov/glba/gistools/index.htm.

JØRGENSEN, O.A. 2002. Survey for Greenland halibut in NAFO Divisions 1A–1D, 2002. NAFO Scientific Commission Research Document No. 4637. 31 p.

KAMPP, K. 1990. The thick-billed murre population of the Thule district, Greenland. Arctic 43(2):115–120.

KAMPP, K., FALK, K., and PEDERSEN, C.E. 2000. Breeding density and population of little auks (*Alle alle*) in a north-west Greenland colony. Polar Biology 23:517–521.

KAPEL, F.O., CHRISTIANSEN, J., HEIDE-JØRGENSEN, M.P., HÄRKÖNEN, T., BORN, E.W., KNUTSEN, L.Ø., RIGET, F., and TEILMANN, J. 1998. Netting and conventional tagging used to study movements of ringed seals (*Phoca hispida*) in Greenland. In: Heide-Jørgensen, M.P., and Lydersen, C., eds. Ringed seals in the North Atlantic. NAMMCO Scientific Publications Vol. 1. Tromsø, Norway: North Atlantic Marine Mammal Commission. 211–228.

KELLY, B.P., and QUAKENBUSH, L.T. 1990. Spatiotemporal use of lairs by ringed seals (*Phoca hispida*). Canadian Journal of Zoology 68:2503–2512.

KELLY, B.P., and WARTZOK, D. 1996. Ringed seal diving behaviour in the breeding season. Canadian Journal of Zoology 74:1547–1555.

KIILERICH, A. 1933. Nordvandet. Forsøg på forklaring af det isfrie område i Smith Sund (The North Water: An attempt to explain the mechanisms of the ice-free area of Smith Sound). Geografisk Tidsskrift 36:53–61. (In Danish).

KLEIN, B., LEBLANC, B., ZHI-PING, M., BERET, R., MICHAUD, J., MUNDY, C.-J., VON QUILLFELDT, C.H., GARNEAU, M.-È., ROY, S., GRATTON, Y., COCHRAN, J.K., BÉLANGER, S., LAROUCHE, P., PAKULSKI, J.D., RIVKIN, R.B., and LEGENDRE, L. 2002. Phytoplankton biomass, production and potential export in the North Water. Deep-Sea Research II 49:4983–5002.

KRISTENSEN, T.K. 1984. Biology of the squid *Gonatus fabricii* (Lichtenstein, 1818) from West Greenland waters. Meddelelser om Grønland, Bioscience 13:1–17.

KUNNASRANTA, M. 2001. Behavioural biology of two ringed seal (*Phoca hispida*) subspecies in the large European lakes Saimaa and Ladoga. Ph.D dissertation. University of Joensuu, Finland. 86 p.

LEWIS, E.L., PONTON, D., LEGENDRE, L., and LEBLANC, B. 1996. Springtime sensible heat, nutrients and phytoplankton in the North Water Polynya. Canadian Arctic Continental Shelf Research 16:1775–1792.

LØNNE, O.J., and GULLIKSEN, B. 1989. Size, age and diet of polar cod, *Boreogadus saida* (Lepechin 1773), in ice covered waters. Polar Biology 9:187–191.

LU, C.C., and CLARKE, M.R. 1975. Vertical distribution of cephalopods at 40° N, 53° N and 60° N at 20° W in the North Atlantic. Journal of the Marine Biology Association of the U.K. 55:143–163.

LYDERSEN, C., and HAMMILL, M.O. 1993. Diving in ringed seal (*Phoca hispida*) pups during the nursing period. Canadian Journal of Zoology 71(5):991–996.

McLAREN, I.A. 1958a. The biology of the ringed seal (*Phoca hispida* Schreber) in the eastern Canadian Arctic. Fisheries Research Board of Canada Bulletin 118. 97 p.

———. 1958b. The economics of seals in the eastern Canadian Arctic. Arctic Circular 1. Fisheries Research Board of Canada. 94 p.

MUNDY, C.J., and BARBER, D.G. 2001. On the relationship between spatial patterns of sea ice type and the mechanisms which create and maintain the North Water (NOW) polynya. Atmosphere-Oceans 39:327–341.

O'DOR, R.K., and MacALASTER, E.G. 1983. *Bathypolypus arcticus*. In: Boyle, P.R., ed. Cephalopod life cycles. Vol 1. London: Academic Press. 401–410.

PEDERSEN, C.E., and FALK, K. 2001. Chick diet of dovekies *Alle alle* in Northwest Greenland. Polar Biology 24:53–58.

PERCY, J.A. 1993. Reproduction and growth of the Arctic hyperiid amphipod *Themisto libellula*. Polar Biology 13(2):131–139.

REEVES, R.R., WENZEL, G., and KINGSLEY, M.C.S. 1998. Catch history of ringed seals (*Phoca hispida*) in Canada. In: Heide-Jørgensen, M.P., and Lydersen, C., eds. Ringed seals in the North Atlantic. NAMMCO Scientific Publications Vol. 1. Tromsø, Norway: North Atlantic Marine Mammal Commission. 100–129.

RINGUETTE, M., FORTIER, L., FORTIER, M., RUNGE, J.A., BÉLANGER, S., LAROUCHE, P., WESLAWSKI, J.-M., and KWASNIEWSKI, S. 2002. Advanced recruitment and accelerated population development in Arctic calanoid copepods of the North Water. Deep-Sea Research II 49:5081–5099.

SEAMAN, D.E., and POWELL, R.A. 1996. An evaluation of the accuracy of kernel density estimators for home range analysis. Ecology 77:2075–2085.

SIEGSTAD, H., NEVE, P.B., HEIDE-JØRGENSEN, M.P., and HÄRKÖNEN, T. 1998. Diet of the ringed seal (*Phoca hispida*) in Greenland. In: Heide-Jørgensen, M.P., and Lydersen, C., eds. Ringed seals in the North Atlantic. NAMMCO Scientific Publications Vol. 1. Tromsø, Norway: North Atlantic Marine Mammal Commission. 229–241.

SMITH, T.G. 1973. Population dynamics of the ringed seal in the Canadian eastern Arctic. Fisheries Research Board of Canada Bulletin 181. 55 p.

———. 1987. The ringed seal, *Phoca hispida*, of the Canadian western Arctic. Canadian Bulletin of Fisheries and Aquatic Sciences 216. 81 p.

SMITH, T.G., and HAMMILL, M.O. 1981. Ecology of the ringed seal, *Phoca hispida*, in its fast ice breeding habitat. Canadian Journal of Zoology 59:965–981.

STIRLING, I. 1997. The importance of polynyas, ice edges, and leads to marine mammals and birds. Journal of Marine Systems 10:9–21.

STIRLING, I., CLEATOR, H., and SMITH, T.G. 1981. Marine mammals. In: Stirling, I., and Cleator, H., eds. Polynyas in the Canadian Arctic. Canadian Wildlife Service Occasional Paper 45. 45–58.

TEILMANN, J., and KAPEL, F.O. 1998. Exploitation of ringed seals (*Phoca hispida*) in Greenland. In: Heide-Jørgensen, M.P., and Lydersen, C., eds. Ringed seals in the North Atlantic. NAMMCO Scientific Publications Vol. 1. Tromsø, Norway: North Atlantic Marine Mammal Commission. 130–151.

TEILMANN, J., BORN, E.W., and ACQUARONE, M. 1999. Behaviour of ringed seals tagged with satellite transmitters in the North Water polynya during fast-ice formation. Canadian Journal of Zoology 77(12):1934–1946.

VIBE, C. 1950. The marine mammals and the marine fauna in the Thule district (Northwest Greenland) with observations on the ice conditions in 1939-41. Meddelelser om Grønland 150(6). 115 p.

WATHNE, J.A., HAUG, T., and LYDERSEN, C. 2000. Prey preference and niche overlap of ringed seals *Phoca hispida* and harp seals *P. groenlandica* in the Barents Sea. Marine Ecology Progress Series 194:233–239.

WESLAWSKI, J.M., RYG, M., SMITH, T.G., and ØRITSLAND, N.A. 1994. Diet of ringed seals (*Phoca hispida*) in a fjord of West Svalbard. Arctic 47(2):109–114.

WILDLIFE COMPUTERS. 1997. SDR satellite-linked time-depth recorder, Version 3.14. Instruction Manual. Redmond, Washington: Wildlife Computers.

E.W. BORN ❖ I. GJERTZ ❖ R. R. REEVES

POPULATION ASSESSMENT OF ATLANTIC WALRUS

NORSK POLARINSTITUTT

MEDDELELSER NR. 138
OSLO 1995



E.W. BORN, I. GJERTZ and R.R. REEVES

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(*ODOBENUS ROSMARUS ROSMARUS* L.)



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OSLO 1995



E.W. BORN, Greenland Institute of Natural Resources, Copenhagen Section, Tagensvej 135, DK-2200 Copenhagen, Denmark

I. GJERTZ, Norwegian Polar Institute, P.O. Box 5072, Majorstuen, N-0301 Oslo, Norway

R.R. REEVES, Okapi Wildlife Associates, 27 Chandler Lane, Hudson, Québec, J0P 1H0, Canada

© Norsk Polarinstitutt, Middelthuns gate 29, 0301 Oslo, Norway
Editor of text and illustrations: Annemor Brekke
Cover photo: Ian Gjertz: Walrus at Tusenøyane, Svalbard.
Graphic design/production: Grimshei Grafiske, Lørenskog, Norway
Printed December 1995
ISBN 82-7666-096-7

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PREFACE

The exploitation and conservation status of Atlantic walruses (*Odobenus rosmarus rosmarus* L.) has never become an issue of widespread public controversy, as it has for whales, and some seals. However, a coordinated approach to walrus conservation was given some impetus in 1987 when the government of the Netherlands proposed that the walrus be listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Although this proposal was withdrawn before being put to a vote at the 6th Conference of the Parties to CITES, an agreement was reached among the walrus range states to exchange scientific information on a regular basis (Stewart *et al.*1993:56). An International Workshop on Population Ecology and Management of Walruses, held in Seattle, Washington, USA, in March 1990 (Fay *et al.*1990), constituted the first meeting of the Walrus International Technical and Scientific Committee, which includes representatives from Norway, Greenland/Denmark, the USA, Canada, Russia and the Netherlands. This workshop, which was followed by a second in January 1993 in Winnipeg, Manitoba, Canada (Stewart *et al.*1993), was the first attempt to address concerns about walrus conservation on an international, range-wide basis.

No formal bilateral, multilateral or international body had been assigned, or had assumed, the responsibility for assessing and conserving the stocks of Atlantic walruses until the North Atlantic Marine Mammal Commission (NAMMCO) included Atlantic walruses on its list of priority species (Anon. 1993a). In 1994 the Council of NAMMCO requested advice from its Scientific Committee on matters relating explicitly to the Atlantic walrus. Specifically, the Commission asked for: 1) advice on stock identity for management purposes, 2) an assessment of abundance in each stock area, 3) an assessment of the long-term effects on stocks caused by present removals in each stock area and 4) an assessment of the effects of recent environmental changes (*e.g.* disturbance, pollution) and changes in the walrus's food supply.

The present report, which was prepared in response to a request from the Scientific Committee, was intended to provide the background of available information needed to evaluate the present status of the Atlantic walrus at the meeting of the NAMMCO Scientific Committee in Copenhagen, 31 January – 2 February 1995. The report covers the entire range of *Odobenus rosmarus rosmarus*.

ABSTRACT

This report summarizes available information on distribution, numbers and exploitation of Atlantic walruses (*Odobenus rosmarus rosmarus* L.) for an assessment of their present status. The effects on walruses of various human activities other than hunting (*e.g.* disturbance, pollution, fishery interactions) are also evaluated. Although few studies have been done to explicitly address questions of the genetic relatedness of different groups of Atlantic walruses, eight putative stocks have been proposed on the basis of distribution, history of exploitation, and the existence of independent management regimes. These stocks are: 1) Foxe Basin, 2) Southern and Eastern Hudson Bay, 3) Northern Hudson Bay – Hudson Strait – Southeastern Baffin Island – Northern Labrador, 4) Western Greenland, 5) North Water (Baffin Bay – Eastern Canadian Arctic), 6) Eastern Greenland, 7) Svalbard – Franz Joseph Land, and 8) Kara Sea – Southern Barents Sea – Novaya Zemlya. Several of these stocks are shared by different countries (*i.e.* Canada, Greenland, Norway and Russia).

Throughout their range Atlantic walruses were heavily exploited, primarily by European whalers and sealers, causing reductions in their range and numbers. Atlantic walruses are still hunted by residents of Canada and Greenland. In nearly all areas Atlantic walruses apparently remain well below historical levels of abundance. An evaluation based on estimates of current population size, landed catch and loss, and an annual net recruitment rate of 2-5% indicates that the Western Greenland (4) and North Water (5) stocks are currently subject to over-exploitation and probably are declining. The Foxe Basin (1) stock appears to be stable, whereas the status of other Canadian stocks (2, 3) is unknown. There are recent signs that the eastern Atlantic stocks of walruses (6, 7, 8) are either stable or increasing. Although walruses can be negatively affected by various human activities apart from hunting, quantification of the long-term effects of these activities cannot be achieved with the data presently available. This report emphasizes that serious gaps exist in the information necessary for assessing the current status of Atlantic walruses. More and better data are needed in relation to population delineation and size, landed catch, unreported kill and losses, reproduction rates, natural mortality and population responses to human activities other than hunting.

INTRODUCTION

The walrus, *Odobenus rosmarus*, has a disjunct circumpolar distribution. Two subspecies – the Atlantic walrus, *O. r. rosmarus*, and the Pacific walrus, *O. r. divergens* – have long been recognized. A third subspecies, *O. r. laptevi*, confined to the Laptev Sea, was suggested by Chapskii (1940). The status of this taxon is, however, questionable (Fay 1982, 1985).

The Atlantic walrus, which is the focus of this report, ranges from the eastern and central Canadian Arctic eastward to the Kara Sea. Several more or less well defined subpopulations or stocks exist within this range (Figs 1 and 3, Reeves 1978).

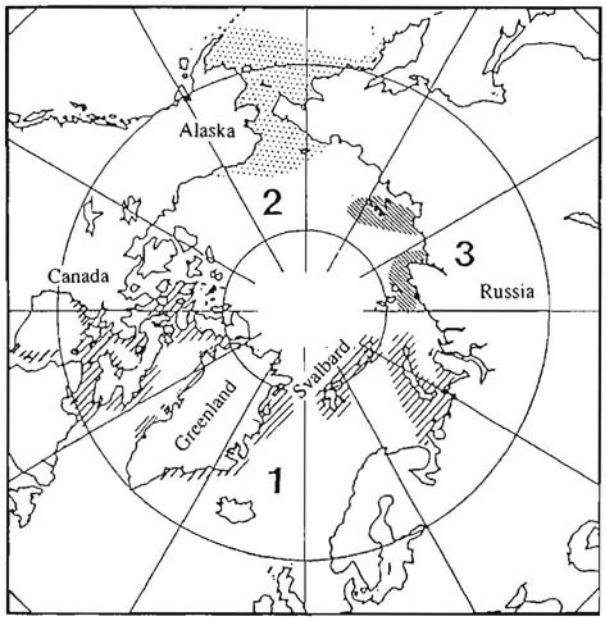


Fig. 1. Approximate normal limit of present distribution of walruses. 1: Atlantic walruses, 2: Pacific walruses, 3: Laptev walruses; taxonomic status uncertain (modified from Fay 1985).

The total population of Atlantic walruses prior to the European discovery of North America (including Greenland), Svalbard, and the islands of far northern Eurasia must have been at least in the hundreds of thousands. This conclusion is inescapable when one considers the observations reported by early explorers, whalers and sealers, as well as the magnitude of the killing. The commercial exploitation of walruses for their oil, tusk ivory and hides proceeded on an enormous scale, with no checks whatsoever to ensure sustainability. As a result, by the mid 20th century the aggregate population of the Atlantic walrus had been reduced in nearly all areas and its range had shrunk substantially. Large herds that once hauled out on island and mainland beaches in cold temperate and subarctic latitudes have been exterminated, and the bulk of the population is now confined to remote parts of the Arctic.

The walrus was always important to Inuit economy; in many areas it was a critical subsistence resource. Walrus meat is excellent food for sled dogs as well as people; the hide is strong and durable; the blubber produces good-quality oil for burning; and the ivory has always been popular for constructing tools and weapons and, more recently, for carving. Availability of walruses, particularly during winter, influenced settlement patterns in the eastern Canadian Arctic and Greenland. The rapid depletion of walrus stocks by foreign commercial hunters severely compromised the resource base of many northern communities. This loss, or at least greatly reduced availability, of a valuable resource has helped limit the options of northern people as they seek to re-establish economic self-sufficiency and political independence.

We stress that certain biological characteristics of walruses make them particularly vulnerable to exploitation and to changes in the environment:

Walruses have a comparatively narrow ecological niche. Their populations probably depend on: 1) the availability of large areas of shallow water (80 m or less) with suitable bottom substrate to support a productive bivalve community, 2) the presence of reliable open water over rich feeding areas, particularly in winter when access to many feeding areas is denied due to ice cover, and 3) the presence of haul-out areas in close proximity to feeding areas. Haul-out platforms are usually ice pans although terrestrial haul-out sites (uglit; ugli in singular – terminology borrowed from Inuktitut) are used in the ice-free summer and autumn period (Davis *et al.* 1980).

Their narrow trophic niche and restricted distribution make walruses vulnerable to environmental changes and also relatively easy to hunt. These animals' gregariousness and dependence on uglit made it possible for European and American whalers and sealers to exploit them very intensively even before the development of mechanized transport and modern weapons. Their tusks make them economically valuable to present-day Inuit hunters. With modern hunting technology involving



Fig. 2. A male walrus hauled out at Andréetangen, Edgeøya, in Svalbard. Male Atlantic walruses may grow as heavy as their Pacific counterparts (Wiig and Gjertz in press). The stout tusks and numerous skin tubercles are characteristic of adult males. Photo: I. Gjertz

long-ranging boats and powerful firearms, hunters now have access to nearly all of the habitat that is still occupied by walruses. Adult females and males, with their comparatively high yields of ivory and meat, are hunted selectively. Furthermore, in all areas where walruses are hunted, losses appear to be high. This harvesting pattern involves a high risk of further depleting the stocks of Atlantic walruses.

Structure of this Report

1. Overview: A brief summary of the status of Atlantic walruses, by region, is presented at the front of the report for readers who wish only to have such an overview. In the main body of the report, following the summary, we present the detailed information on which the summary is based.

When the available information was considered sufficient, we attempted a crude analysis of sustainable yield and compared the result with the estimated removal rate for the stock. Simulation of a hypothetical walrus population indicated that maximum net productivity (MNP) ranges between 2 and 5% of the total population size (DeMaster 1984). For a population at carrying capacity, K, MNP may be lower than 2% (Fay *et al.*1989), whereas under favorable environmental conditions (and low density of walruses in relation to K) MNP may perhaps be as high as 7% per year (Sease and Chapman 1988). In our crude analyses of the effects of removals we assumed that annual sustainable yield – or replacement yield – of Atlantic walruses ranges between 2 and 5% of the stock estimate.

The overview also includes the conclusions of our assessment of the effects on walruses of disturbance, pollution and changes in food availability.

2. Distribution, Catch History and Status, by Region: Separate sections are devoted to geographical regions which may or may not represent "stock" areas in a strict sense (see Report of *ad hoc* Working Group on the Atlantic Walrus; NAMMCO 1995). The partitioning into stocks was made on the basis of our knowledge of major ecological factors that determine distribution of walruses such as ice cover, polynyas, distribution of shallow banks with suitable walrus habitat, migration routes and availability of terrestrial haul-out sites. Within each of the geographically defined sections, we tried to include information on historical and current distribution, seasonal movements, age and sex composition, stock identity, population size (past and present), hunting methods, catch levels and composition of catches and hunting loss (for estimation of total removals).

3. Summary of Regulatory Actions: Regulations applying to walrus stocks in each of the range states are summarized.

4. Assessment of Environmental Problems: Separate summaries are given for the various types of known, suspected or potential threats to Atlantic walrus stocks, other than hunting. These summaries are not subdivided by geographical region.

5. Walrus Life History and Parameters: This brief overview of the biology and ecology of walruses is provided as background only.

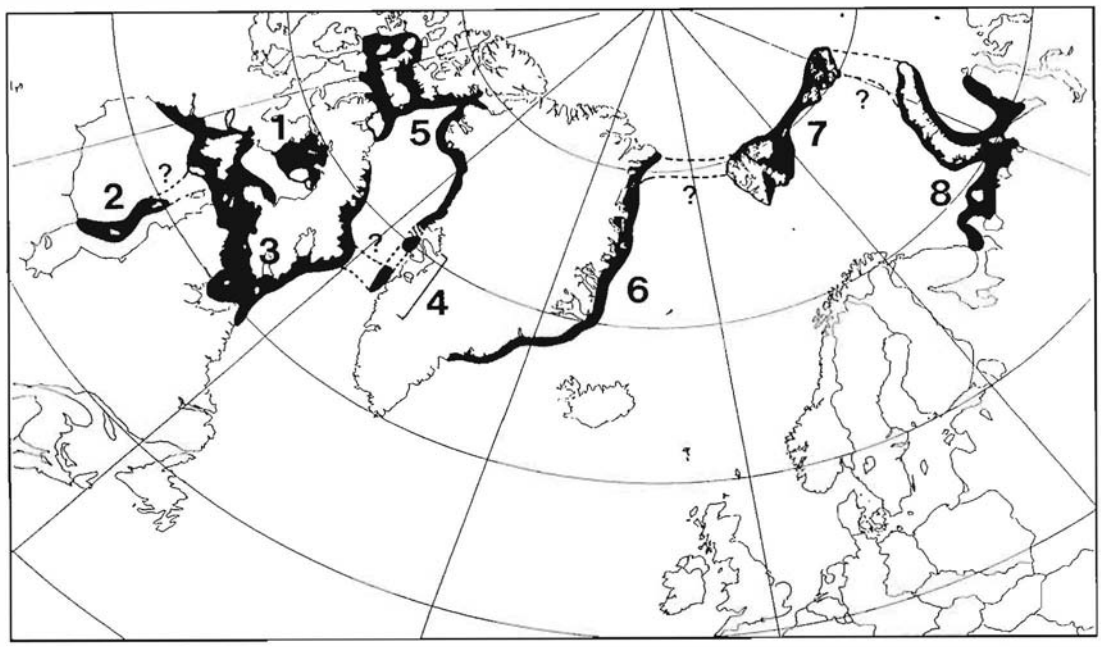


Fig. 3. Delineation of proposed stocks (sub-units) used in this review of the status of the Atlantic walrus.

SUMMARY OF STATUS

The status of eight presumed stocks of walruses (see also Report of *ad hoc* Working Group on the Atlantic Walrus; NAMMCO 1995) is reviewed in this report. These stocks are:

1. Foxe Basin, 2. Southern and Eastern Hudson Bay, 3. Northern Hudson Bay – Hudson Strait – Southeastern Baffin Island – Northern Labrador, 4. Western Greenland, 5. North Water (Baffin Bay – Eastern Canadian Arctic), 6. Eastern Greenland, 7. Svalbard – Franz Joseph Land, and 8. Kara Sea – Southern Barents Sea – Novaya Zemlya (Table 1, Fig. 3).

Stock 1 – Foxe Basin

Walrus distribution, movements and body growth patterns indicate that the group in Foxe Basin is largely isolated from other groups to the north (via Fury and Hecla Strait) and south (western Hudson Strait and Southampton Island area).

Aerial surveys have confirmed that walruses are now distributed mainly on the east side of northern Foxe Basin during the open-water season (Orr *et al.*1986). Although it is generally believed that the distribution of walruses has changed since the 1940s and 1950s so that they are now much less common on the western side of Foxe Basin, the stock is still large relative to those in other parts of the subspecies' range.

Available data are not sufficient for rigorously assessing trends in the population in northern Foxe Basin. Cosens *et al.*(1993:12) indicated that the population numbers about 5500 animals based on incomplete aerial surveys in 1988 and 1989. The estimated current removal rate of about 300 animals per year may exceed sustainable yield (Table 1).

Stock 2 – Southern and Eastern Hudson Bay

The large gap in walrus distribution along the west coast of Hudson Bay (approximately from Dawson Inlet south to Cape Henrietta Maria) provides a basis for considering the walruses in southern and eastern Hudson Bay as separate from those in northwestern Hudson Bay. However on the east side of the bay the distribution of walruses may have been continuous historically from the Belcher Islands northward to the mouth of Hudson Strait. The apparent decline in numbers and reduced range of walruses in eastern Hudson Bay, with no obvious corresponding changes in northern Hudson Bay and western Hudson Strait, can be interpreted as suggesting that there is limited exchange between eastern Hudson Bay and these areas.

We have no recent information on the status of the groups of walruses that hauled out, at least until the 1970s, on the Belcher, King George, Sleeper, and Ottawa islands. They are undoubtedly fewer in number and less widely distributed than earlier this century, but it is possible that hunting pressure is now less severe than it was during the days when sled dogs were the primary means of winter transportation.

The walruses in southern Hudson Bay are not hunted off the Ontario coast, when they haul out in

Table 1. Assessment of Atlantic walrus by stock area. The current status (D) of different stocks of Atlantic walruses is evaluated based on estimates of stock size (A) and total annual removal (landed catch plus losses, B and C.) Qualifiers are added to indicate quality of underlying data.

STOCK AND AREA	Stock size (A)	Quality of (A)*	Landed catch (B)	Quality of (B)*	Loss# % (C)	Total removal (B and C)	Females % of (B)	SY	Stock status (D)	Assess-ment quality*
1 Foxe Basin	5500	P	200	F	32	300	33	110-275	Stable?	F
2 S and E Hudson Bay	(500)?	P	35+	P	30##	50	?	10-25	Unknown	P
3 N Hudson Bay - Hudson Strait- SE Baffin Isl. - N Labrador	6000	P	230	P	30##	330	?	120-300	Unknown	P
4 Western Greenland	500	F	46	P	30##	65	58	10-25	Declining	F
5 North Water (Baffin Bay - E Canadian Arctic)	3000	P	280	P	25	375	40	60-150	Declining?	P
6 Eastern Greenland	500-1000	P	20	P	23	25	5	10-50	Stable/incr.?	F
7 Svalbard - Franz Joseph Land	<2000	F	0**	F	0	0	0	-	Increasing	F
8 Kara Sea - Barents Sea - Novaya Zemlya	<500	P	?**	P	?	?	?	-	Increasing?	P

*: G = Good (minimal bias, acceptable precision)
F = Fair (problems with quality of data, precision uncertain)
P = Poor (considerable uncertainty, bias or few data)
**: These stocks have been protected since the 1950s, there are indications of some catch (see text).
#: Percentage lost of all struck
##: Where no stock-specific data were available, 30% was used (similarity with Foxe Basin in hunting methods).
SY: Sustainable yield is based on the stock size estimate (A), times the maximum net productivity of the population (2% to 5% of the stock).

summer and autumn in the vicinity of Cape Henrietta Maria. The reference to about 1000 walruses at Cape Henrietta Maria in 1955 (Loughrey 1959) is not particularly reliable, so no decline should be inferred from the maximal recent direct count of 310.

Available information suggests that the number of walruses in southern and eastern Hudson Bay is in the hundreds (perhaps about 500). The current removal of about 50 animals likely exceeds the sustainable yield (Table 1). Data for this region are, however, very limited.

Stock 3 – Northern Hudson Bay – Hudson Strait – Southeastern Baffin Island – Northern Labrador

In the absence of any direct evidence for stock identification (*e.g.* genetic analyses, tagging, morphometry), it may be inferred from the evidence on distribution and movements that the walruses in northern Hudson Bay, Hudson Strait and southeastern Baffin Island and off northern Labrador comprise a common stock. This stock may have some connection with southern and eastern Hudson Bay and with Central West Greenland. It cannot be ruled out that sub-units exist within the range of Stock 3.

Available information is insufficient for assessing the status of walruses along the Keewatin coast of western Hudson Bay, but all evidence indicates that they are now much less common there than they were earlier in the present century.

Crude comparisons of counts in 1954 (Loughrey 1959), 1961, and 1976-77 in areas around Southampton and Coats islands (Mansfield and St. Aubin 1991) could be interpreted as suggesting a decline, but the basis for comparing these counts and estimates is very weak.

Walruses are apparently much less abundant along both the Baffin Island and northern Québec coasts of Hudson Strait today than they were 50-100 years ago, as evidenced by the fact that hunters from Cape Dorset, Ivujivik, Salluit and other settlements travel long distances to hunt them on the offshore islands.

Walruses occur year-round along portions of the coast of eastern Baffin Island south of Clyde Inlet and in Hudson Strait. Although areas of summer concentration have been identified (*e.g.* outer parts of Cumberland and Hall peninsulas, Lady Franklin Island group, Loks Land) the walruses tend to occur in small, scattered groups in these areas. Some of these groups may undertake fairly long migrations while others are thought to move relatively short distances according to ice conditions and availability of food. Although connections have been suggested between the walruses in these areas and

those found year-round in Hudson Bay and during winter in Central West Greenland, the present distribution indicates that walruses along eastern Baffin Island and in Hudson Strait may have become more sedentary, or at least that the populations are now discontinuous rather than continuous.

Walruses have been eliminated from some areas where they were known to be present historically. For example, Soper (1928:9) reported that they had been common at one time around Bon Accord Harbour in upper Cumberland Sound but that none had been seen there for many years by the time of his visit in the mid 1920s (also see Stevenson 1993). Walruses may have declined in upper Cumberland Sound already by the 1870s (Kumlien 1879:63-64). They are said to have become "very rare" in the Clyde area due to commercial hunting during the 1930s and 1940s (Wenzel 1991:93). The availability of walruses has declined off Labrador since the "pre-settlement period" (before 1960) (Brice-Bennett 1977:129), but details are lacking. Nowadays the southern limit of walruses along northern Labrador appears to be in the Hebron-Okak Bay area.

Although commercial hunting driven by demand for hides, ivory and oil was stopped by governmental regulation in 1931, substantial catches continued to be made by Inuit, police, missionaries and traders in order to secure winter supplies of dog food. The availability of large boats made it possible to travel to offshore islands where walruses were still relatively abundant in the 1930s and 1940s. With the decline of dog teams in the 1960s, the urgency of obtaining large amounts of walrus meat abated. At some settlements much less effort was devoted to walrus hunting, and it is possible that stocks had a chance to make some recovery. We are unaware of any clear recent evidence of trends in the walrus population off eastern and southern Baffin Island.

We estimate that the population of walruses in northern Hudson Bay, including about 3000 around Southampton and Coats islands and at least 1000 in western Hudson Strait and southeastern Foxe Basin (Orr and Rebizant 1987, Richard and Campbell 1988, Richard 1990, Mansfield and St. Aubin 1991), totals about 4000 animals. Available information indicates that perhaps 2000 walruses are found along eastern Baffin Island, in Ungava Bay and in eastern Hudson Strait. The estimated current total removal rate of about 330 walruses per year may exceed the sustainable yield of the combined stock in area 3 (Fig. 3, Table 1).

Given the great amount of uncertainty about stock identity, population size, total removals (including hunting loss), and age/sex composition of the kill, however, any judgment about sustainability of the present harvest is highly speculative. It is important to bear in mind the possibility that the same population of walruses is hunted off Central West Greenland.



Fig. 4. Adult male walruses hauled out on Coats Island in mid-August 1967. Note the broken tusks and wrinkled skin, signs of old age, of the upper animal. Photo: F. Bruemmer.

Stock 4 – Western Greenland

Walruses winter off Central West Greenland. Apparently the walruses that winter along the western coast of Disko Island belong to a different stock than those found farther south off Aasiaat-Sisimiut. The northern group is thought to belong to the North Water stock (Stock 5), whereas the southern group perhaps is connected with walruses along eastern Baffin Island (Stock 3).

Vibe (1956) and Mansfield (1973) stated that the decline in the Greenland catches of walruses after 1940 reflected a decline in the walrus population. There is no evidence of a reduced hunting effort during the period of declining catches after approximately 1940. On the contrary, despite the difficulty of selling walrus hides on the European market (experienced already by the late 1930s; Anon. 1937), and despite the drop in international oil prices in 1930 (Anon. 1946), the trade of walrus hides and oil to the Royal Greenland Trade Department remained high in Central West Greenland (Born *et al.* 1994a). This supports the statements by Vibe (1956) and Mansfield (1973).

The shallow feeding banks off Central West Greenland provide important wintering habitat for walruses. A comparison between historical and recent information on occurrence, abundance and exploitation indicates clearly that the number of walruses in this area and the extent of undisturbed wintering habitat available to them have declined during the 20th century. Increased fishing activities since the 1960s in areas where walruses winter, and catches which remain high relative to the estimates of abundance, pose a threat to the survival of walruses in Central West Greenland.

The number of walruses on the Central West Greenland wintering grounds is estimated to be about 500 animals (Born *et al.* 1994a), or in the low hundreds (Heide-Jørgensen and Born 1995). The reported catch in Central West Greenland (from Uummannaq south) in the period 1980-1987 averaged about 46 walruses per year. This figure likely underestimates the actual landed catch. To the reported catch figure an overall loss of 30% is added (see Born *et al.* 1994a), resulting in an estimated total removal of about 65 walruses per year. We therefore believe that walruses in Central West Greenland are being harvested above their sustainable (= replacement) yield.



Fig. 5. A dog team is used for hauling a walrus onto the ice at Saunders Island (Avanersuaq/Thule area, NW Greenland) in May 1978. Photo: T. Kristensen.



Fig. 6. A group of adult male walruses at Tusenøyane, Svalbard. The majority of walruses in Svalbard are males. The females tend to occur further east, in Russian waters. Photo: I. Gjertz

Stock 5 – North Water (Baffin Bay – Eastern Canadian Arctic)

The walruses in the North Water (NOW) area probably belong to one population which has its main summering grounds along the southeast coast of Ellesmere Island, in Jones Sound and along the north shore of Lancaster Sound. Some, presumably few, walruses may summer farther north – in the Kane Basin region, and west – in the Canadian high arctic archipelago. The NOW population is thought to include walruses that winter in the eastern Canadian Arctic and along the west coast of Greenland as far south as Disko Island. The NOW population apparently no longer makes large-scale spring and fall migrations along either the northeast coast of Baffin Island or the west coast of Greenland.

No complete population estimate is available for the NOW stock but the available data suggest that it may contain no more than perhaps 3000 individuals.

During this century walruses have abandoned their uglit on the Greenland side of the NOW area and their summering range has diminished. Decreased access to two important ecological elements – undisturbed haul-out sites and summer feeding grounds – is thought to have had a negative impact on this population.

Historically, large catches of walruses in the NOW area were made by foreign commercial sealers and whalers. Since about the 1960s the effort devoted to walrus hunting by local Inuit has increased in the Avanersuaq (Thule) area (NW Greenland), where the bulk of the catch of walruses from this stock is normally made.

The actual catch of walruses in northern Baffin Bay is not well documented. However, we estimate that during the last two decades the annual removal rate (including loss) in the Avanersuaq and Upernavik areas (Greenland) and the eastern Canadian high Arctic has averaged about 375 walruses. To ensure sustainability an annual yield of 375 walruses necessitates the presence of a population of between about 7500 and about 19000 animals. Our estimate of the size of the walrus stock in the NOW area is only a few thousand. Thus the current exploitation appears to be unsustainable (Table 1).

Stock 6 – Eastern Greenland

Walruses occur along the east coast of Greenland north of about 63° N. Their main distribution is, however, north of about 70° N. Information on seasonal and geographical distribution indicates that walruses in eastern Greenland form a geographically separate unit. This stock apparently has some exchange, presumably infrequently, with walruses at Svalbard-Franz Joseph Land and in Davis Strait.

Large catches around the turn of the last century led to the disappearance of walruses at several of their uglit, and these catches presumably also caused a serious reduction in overall numbers. Recent surveys indicate that the recovery has been slow, perhaps reflecting the low productivity of these regions. It is estimated that the stock now numbers 500 to 1000 walruses. The estimated current removals from this stock are 20-30 animals per year, primarily males. This removal rate may approximate sustainable (= replacement) yield of the stock (Table 1).

Stock 7 – Svalbard – Franz Joseph Land

In Svalbard (Norway) and Franz Joseph Land (Russia), and possibly also in the other areas within Russian jurisdiction, stocks of Atlantic walruses are in an early phase of recovery from severe depletion. Their present numbers are, however, only a fraction of what they once were.

It has been demonstrated that Svalbard and Franz Joseph Land have a common walrus population. A possible connection with groups of walruses in other parts of the western Russian Arctic cannot be excluded. Walruses are in the process of repopulating the Svalbard archipelago from the east. The majority of animals summering in Svalbard are males; the rest of the population is distributed primarily east of Svalbard and in Franz Joseph Land. This stock of walruses is estimated to number at least 2000 animals. The stock probably has a very good food supply and is likely experiencing optimal feeding conditions (Table 1).

Stock 8 – Kara Sea – Southern Barents Sea – Novaya Zemlya

The situation for the stocks of Atlantic walruses in other parts of the eastern section of their range is less well known. The relationships between groups of walruses at Novaya Zemlya and in the southern Barents Sea, White Sea and Kara Sea areas are not well understood. Surveys to determine distribution and size of populations have not been conducted recently, and comprehensive population figures are not available. The limited available information indicates that some hundreds, or perhaps more than a thousand, walruses are now present in these regions. Presumably, walruses in these parts of their range have a more than adequate food supply, but recovery of their population(s) is probably being slowed or prevented by other limiting factors, such as the effects of marine nuclear waste, large-scale shipping and pollution. Some hunting occurs in these areas, but it is poorly documented. The available information is too limited to allow for an evaluation of the effects of hunting on the populations (Table 1).

Anthropogenic effects apart from those due to hunting

In response to the questions raised by the NAMMCO Council concerning the potential effects on walruses of recent environmental changes (*i.e.* disturbance, pollution), and changes in food supply, we reviewed the following topics:

1. Disturbance from different sources of noise
   1a: Aircraft and vessel traffic
   1b: Offshore hydrocarbon exploration and operational activities
   1c: Military activity
2. Pollution
   2a: Oil spills etc.
   2b: Heavy metals and chlorinated hydrocarbons (CHCs)
   2c: Radioactivity and nuclear activity
3. Changes in food abundance and interactions with fisheries

Our conclusions are summarized below.

1. Disturbance from different sources of noise

1a. Aircraft and vessel traffic

Although their reactions are variable, walruses usually flee into the water when an aircraft gets close. In some cases this can lead to stampeding, with the result that calves are crushed to death. Walruses also react to noise from boats and ships and they usually exhibit an escape response if a vessel gets too close. However, the degree of responsiveness is highly influenced by the type of noise and its source level, the social and behavioral situation of the walruses, and their previous experience with vessel noise, especially whether it was associated with more drastic effects such as hunting. Cases in which walruses have permanently abandoned uglit (*e.g.* western and eastern Greenland) have involved factors in addition to noise disturbance, such as hunting and the smell of humans, dogs, offal etc., that could have been as or more significant.

We are not in a position to evaluate whether walruses, like many other species, habituate to noise from aircraft, ships and boats. Nor do we have sufficient information for evaluating the long-term effects of such disturbance.

Because most walrus populations have been subjected to hunting pressure, in many cases intensive and over many years, and because various other human activities have modified walrus habitat through time, it will be very difficult to demonstrate long-term effects,



Fig. 7. Walruses are highly gregarious. When frightened by aircraft noise, they flee into the water. During such stampedes calves are sometimes crushed to death. Photo: I. Gjertz

at the population level, caused specifically by exposure to noise.

1b. Offshore hydrocarbon exploration and operational activities

Oil and gas exploration is now occurring in many offshore areas inhabited by Atlantic walruses. This activity is large-scale in some areas, for example around Svalbard and in the western Russian Arctic. In the latter the oil fields overlap the summer distribution of walruses and therefore large-scale petroleum activities pose a potential threat to walruses.

In a study of the effects on Pacific walruses of offshore drilling, the animals were found to exhibit only weak short-term behavioral responses to the drilling activities *per se*. They reacted more strongly to the icebreaking activities associated with these operations by moving away for a brief time. However we are not aware of any studies that support conclusions about the long-term effects of various exploration and operational activities on walruses.

1c. Military activity

We are not able to evaluate to what extent military activity (*e.g.* rocket launching, explosions) in different areas (*e.g.* southern Barents Sea) may have adversely affected walruses.

2. Pollution

2a. Oil spills etc.

Apparently no studies have specifically addressed the direct or indirect effects of oil on walruses.

Studies of seals have shown that surface contact with oil causes stress, and temporarily irritates the eyes, skin and lungs. Ingestion of oil leads to physiological and chemical changes, possibly affecting reproduction. Inhalation of aromatic hydrocarbons from an oil spill caused mental debilitation in harbor seals (*Phoca vitulina richardsi*) in Prince William Sound (Alaska). Most evidence of internal organ and tissue damage from oil ingestion by seals is, however, inconclusive for walruses. Walruses exposed to an oil spill are likely to show some of these reactions. However, walruses depend almost entirely on blubber to minimize heat loss. Their sparse pelage presumably is of little value as insulation, and their skin is thick and very tough. It is therefore unlikely that exposure of the skin to oil would have any appreciable thermal effect except perhaps in newborn walruses. Oiling of newborns that have not yet accumulated a thick insulating blubber layer could affect their ability to keep warm. Consequently, oil spills during the walrus calving season (late May-early June) in areas where females and young are present could, theoretically, have a greater adverse impact than spills at other times and in other areas.

We believe that some features in the ecology of walruses make them more vulnerable to the harmful

effects of spilled oil than are many other marine mammals:

1. Due to the high level of gregariousness in walruses, an oil spill that affected one would likely affect at least several individuals. Furthermore, the oil from a spill in one area could be transferred by individuals to other walruses on clean sites (for example oil-fouled walruses will rub oil onto the skin or into the eyes of other individuals during haul out).

2. Walruses tend to inhabit coastal areas and areas of relatively loose pack ice. Spilled oil is likely to accumulate in such areas. Walruses therefore have a high risk of being fouled not only in the water but also when they haul out on land.

3. Because they are benthic feeders, walruses may be more likely to ingest petroleum hydrocarbons than are most other pinnipeds. Benthic invertebrates are known to accumulate petroleum hydrocarbons from food, sediments and the surrounding water. The implications for walruses may be serious since contaminants in their food are certain to build up in their own tissue. Oil contamination may also reduce the biomass or productivity of the invertebrate communities that sustain walruses, forcing the animals to seek alternative food or feeding areas. It cannot be assumed that such alternatives are actually available, however.

2b. Heavy metals and chlorinated hydrocarbons (CHCs)

Two classes of pollutants are of particular concern in marine mammals: heavy metals and chlorinated hydrocarbons (CHCs). Few studies have been made of these pollutants in walruses, however.

The three metals of greatest concern are mercury (Hg), cadmium (Cd) and lead (Pb). Levels of heavy metals have been found to be very high in Pacific walruses; in certain organs they exceed the levels considered safe for human consumption. In Atlantic walruses, however, heavy metal levels have generally been found to be less than in Pacific walruses. High concentrations of some metals have been found in walruses from Foxe Basin (Cd), southern Hudson Bay (Pb and Hg) and northwestern Greenland (Hg).

CHCs are anthropogenic chemicals which accumulate mainly in blubber. They are of concern because of their potentially harmful effects on walrus reproduction, the walrus immune and hormone systems, and human health through consumption of contaminated walrus tissue. Walruses have generally low concentrations of CHCs. Especially high concentrations have been found, however, in eastern Hudson Bay compared with other parts of Canada, northwestern Greenland and Alaska. These high concentrations might be due to the fact that these individuals consumed significant amounts of ringed seal (*Phoca hispida*) blubber. It is worrisome that comparatively high levels of CHCs have been found in some Atlantic walruses, but the significance to walruses or people who consume them is unclear.

2c. Radioactivity and nuclear activity

Only a few studies have been made on radioactive elements in walruses. However, the levels of plutonium and other radionucleides such as ^{137}Cs reported so far from analyses of marine mammals are not considered high enough to pose a health risk to the animals.

No documentation is available concerning the effects on walruses of nuclear activities in the Novaya Zemlya region. Second-hand Russian sources indicate, however, that certain walrus haul-out sites in Novaya Zemlya were deserted in the 1960s due to the nuclear testing on this island.

3. Changes in food abundance and interactions with fisheries

Changes in the density and availability of food will likely influence the size of walrus stocks. Fluctuations in stocks of walrus prey might be caused by changes in both abiotic and biotic conditions driven, for example, by predator-prey relationships or anthropogenic factors. There is no information available to determine whether or to what extent such changes have influenced the stocks of Atlantic walruses. It is worth noting, however, that mere abundance of walrus prey does not necessarily trigger or sustain population growth. Despite the fact that walrus food must have been abundant in the Svalbard region for a long time, and that walruses have been completely protected there since 1952, they have only recently moved into the area. This may indicate that in the case of a walrus population which has been seriously reduced by hunting, factors other than prey density and availability govern the animals' ability or willingness to exploit a food resource. Walruses are conservative in their choice of food and selection of habitat. So factors such as the need to learn or inexperience may have played a role in the evident failure of the walruses at Svalbard to take full advantage of the rich feeding areas available to them.

Although the direct and indirect effects of fisheries on Atlantic walruses are basically unknown, some effects probably do occur. Fishing with

bottom draggers has destroyed potential walrus feeding habitat at Svalbard. The noise from fisheries in or near walrus habitat and the disturbance of the sea floor caused by trawling have probably contributed, perhaps synergistically, to the continued depletion of the stock of walruses wintering off Central West Greenland. Intensive fisheries along the coasts of Svalbard and elsewhere in the Barents Sea also may have prevented walruses from repopulating areas that, from a purely trophic perspective, appear still to be suitable walrus habitat.

DETAILED DESCRIPTIONS OF THE PUTATIVE STOCKS

1. Foxe Basin

Distribution and Stock Identity

Summer and winter distributions of walruses in Foxe Basin are shown in Figs 8-9, respectively. Places mentioned in the text and locations of uglit are shown in Fig. 10.

The shallow waters of northern Foxe Basin have always been known to support large numbers of walruses (Tremblay 1921, Loughrey 1959, Crowe 1969, Brody 1976). Walruses are present in northern Foxe Basin year-round and they are widely distributed in this area (Crowe 1969:7, Riewe 1992). Their movements are apparently local in response to changing ice conditions. Loughrey (1959) stated that walruses wintered from the northern tip of Melville Peninsula to Cape Wilson, and especially off the floe edge at Foster and Parry bays. In contrast to the situation at Southampton and Coats islands and at the islands in western Hudson Strait, walruses in northern Foxe Basin apparently haul out on land relatively infrequently, *e.g.* at South Ooglit Island in autumn (Mansfield 1958). On the east side of northern Foxe Basin, concentrations occur in summer off the Spicer Islands and around Koch, Rowley and Bray islands (Riewe 1992:195). Beaubier (1970) and Vestey (1973) provided some details on the seasonal distribution of walruses in northern Foxe Basin. The possible uglit shown on Fig. 10 are based on information supplied by H. Ivaluardjuk (pers. comm. 1995).

The distribution of walruses has changed since the 1950s when Hall Beach and Igloolik became major settlement sites (*cf.* Brody 1976). Large herds no longer occur along the east coast of Melville Peninsula, and walruses are much less common in the Foster Bay area than they were in the 1930s (Beaubier 1970). Crowe (1969:5) stated that boat traffic and hunting had "driven the walrus from



Fig. 8. Approximate summer distribution of walruses in Canada and Central West Greenland.

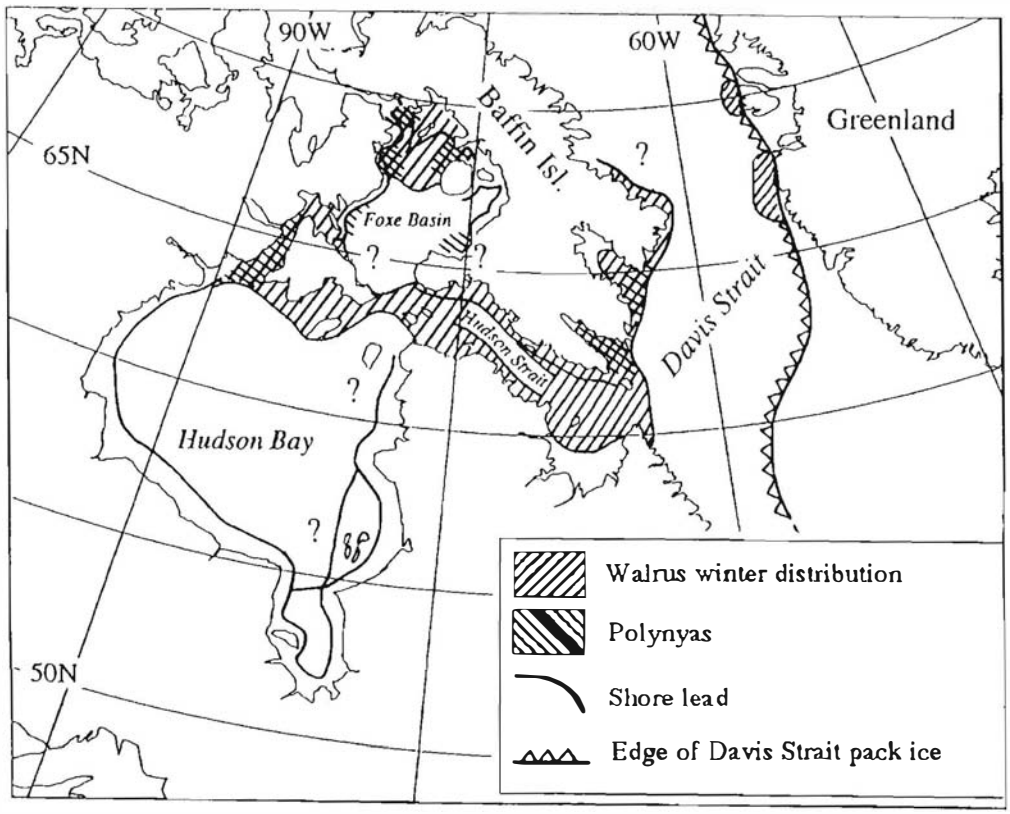


Fig. 9. Approximate winter distribution of walruses in Canada and Central West Greenland. The Davis Strait pack-ice limit is shown. An overlap between walrus wintering areas and locations of polynyas is indicated.

Richards Bay and other former haunts, eastward to the less accessible islands". He also noted that the walruses whose presence had once made boat crossings of Hooper Inlet dangerous had been "driven from there or exterminated by 1948" (Crowe 1969: 69). At the time of Mathiassen's (1928) visit in the early 1920s walruses were abundant in Hooper Inlet.

Mansfield (1958) proposed that the walruses in the northern half of Foxe Basin were effectively isolated from those at Southampton Island, arguing that deep water in the southern areas precluded their dispersal in that direction. Inuit knowledge indicates that there is a hiatus in walrus distribution in southern Foxe Basin (Riewe 1992), thus supporting the hypothesis of separate stocks. Garlich-Miller (1994) corroborated, with new specimen material collected at Igloolik and Hall Beach 1983-93, Mansfield's (1958) finding that walruses in northern Hudson Bay are smaller than those in northern Foxe Basin.

In the southeastern corner of Foxe Basin, walruses sometimes occur along the north coast of Foxe Peninsula and they haul out in summer and fall at capes Dorchester and Weston (Soper 1944, Riewe 1992:198). Soper (1944) claimed that there was no evidence that walruses were present along the west coast of Baffin Island from Bowman Bay to Murray Maxwell Bay, but Inuit told him that good catches had been made in the past (pre 1920s) on islands many miles north of Cape Dorchester. There is little evidence of movement by walruses through Fury and Hecla Strait (Riewe 1992), so the northern Foxe Basin population is also effectively separate from that in northern Prince Regent Inlet (which we assume to consist of migrants from the Lancaster Sound region). It should be noted, however, that at least small numbers of walruses were observed in Fury and Hecla Strait in the 1920s and early 1930s (Bethune 1934:79), so the apparent lack of movement through the strait may be a recent development.

Population Size

Crowe (1969:5) cited the guess of Mansfield (1973) that there were about 4000-5000 walruses in northern Foxe Basin during the 1960s. Helicopter surveys in August 1983 produced a count of 2722 walruses (Orr *et al.*1986), which accounts for Richard and Campbell's (1988) assignment of "2725+" to this area. Even though Orr *et al.*(1986) considered their helicopter survey to have been done under optimal conditions for detecting and counting walruses, they recognized that their count did not represent the entire northern Foxe Basin population.

Visual surveys using systematic strip transects flown in Foxe Basin resulted in estimates of 5200 (95% CI 900-30500) animals at the surface in 1988,

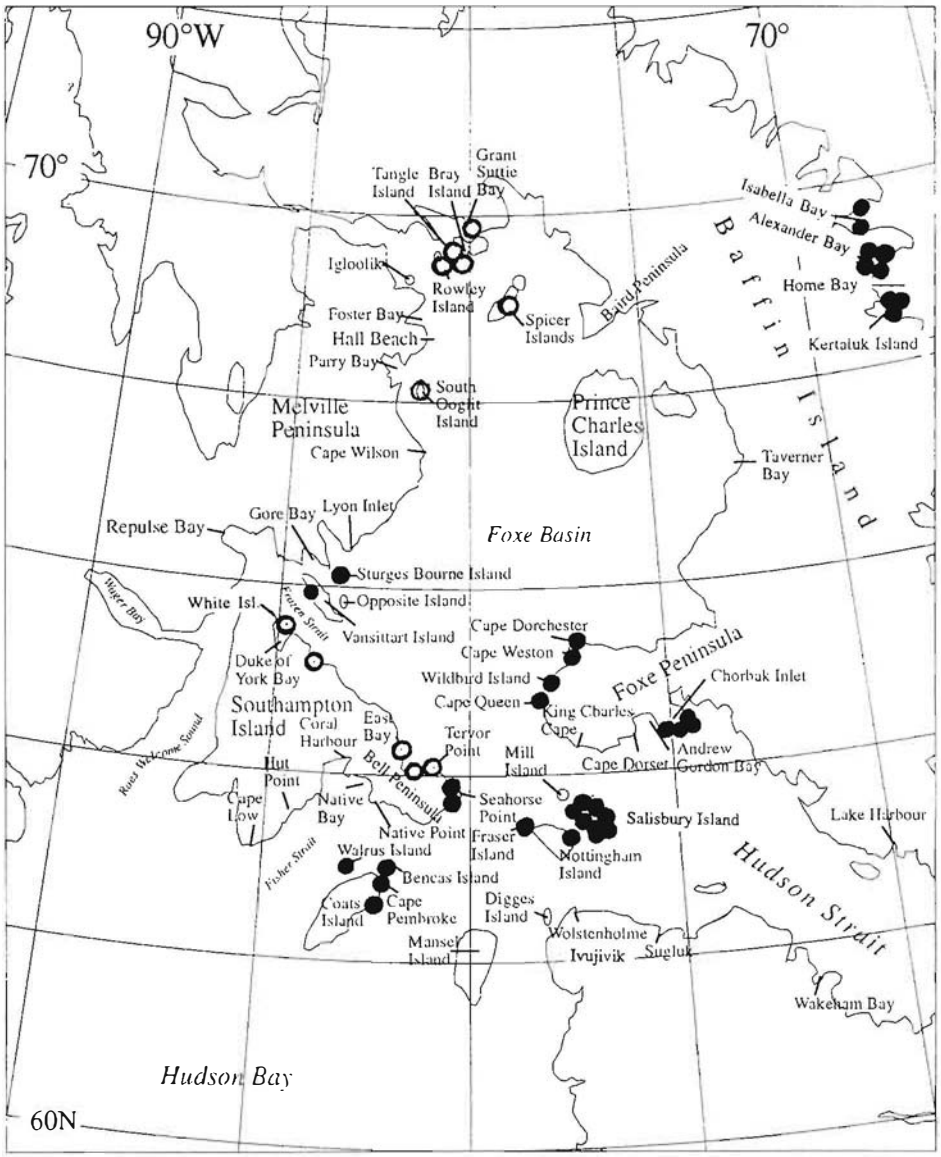


Fig.10. Locations of terrestrial haul-outs (uglit) in Foxe Basin, northern Hudson Bay, western Hudson Strait and parts of eastern Baffin Island (see also Figs. 12 and 16). Legend: Black dots = haul-outs still known or believed to be used by walruses. Open circles = historical haul-outs; present status unknown.

Note: Canadian haul-out sites in this and subsequent map figures are indentified and classified on the basis of information in Anon. (1981-87), Riewe (1992), and personal communications cited in the text.

and 5500 (95% CI 2700 – 11200) in 1989 (Cosens *et al.*1993). As the surveys did not cover the entire walrus distribution area and as no correction has been made to account for diving animals, these estimates are believed to be negatively biased (R.E.A. Stewart pers. comm. 1995).

Exploitation

Hunting methods: Descriptions of hunting methods for western Hudson Bay and Hudson Strait (see Manning 1944, Beaubier 1970, Vestey 1973) apply more or less equally to Foxe Basin. Brody (1976) referred to a major change in the pattern of walrus hunting in this area when whale boats were introduced during the 1920s. The hunting range expanded as hunters were then able to hunt walruses in open water. More recently (1940s-1950s?) the hunting shifted farther offshore, "away from the coastal areas around Jens Munk and Igloolik islands, and Foster and Parry bays, following changes in the animal's seasonal movements – fewer and fewer walruses were coming into the bays and along the coastal areas" (Brody 1976:164; also see Crowe 1969, Beaubier 1970). Whale boats and Peterheads were largely replaced by motorized freighter canoes in the 1960s (Beaubier 1970).

In the 1980s walrus hunting at Igloolik was done mainly from large canoes with outboard motors (20-90 hp) during July and August. Hunters hunted selectively for the larger tusked animals, and they preferred to hunt those hauled out on ice pans. When walruses were hunted in the water, an attempt was made to wound them with body shots and then to harpoon them before killing (Orr *et al.*1986).

The main products from contemporary walrus hunting in northern Foxe Basin are meat and organs for human consumption or dog food. The value of the tusks was high enough in the 1980s to approximately cover the costs of obtaining a walrus at Igloolik (Orr *et al.*1986). Nevertheless "head chopping" (*i.e.* saving only the head and discarding



Fig. 11. A whale boat with sail hunting walruses at Igloolik (northern Foxe Basin) probably at the middle of this century. Photo: Archives of Eskimo Museum, Churchill, Manitoba.

the rest of the carcass) was apparently a "rare practice" with Igloolik hunters (Orr *et al.*1986).

Catch levels: The annual landed catch in northern Foxe Basin was estimated as about 425 in the 1950s (Loughrey 1959) and was reported as 203 between 1973 and 1985 (Orr *et al.*1986). Assuming that about a third of the animals killed are lost, the average annual removals would appear to have declined from 637 in the 1950s to 305 in the 1970s and early 1980s. As pointed out by Orr *et al.*(1986), the crudeness and incompleteness of the catch data make the usefulness of such comparisons highly questionable. It should be noted that Beaubier (1970; also see Beaubier *et al.* 1970) summarized four years of data from the Royal Canadian Mountain Police (RCMP) from 1964-69 indicating catches at Igloolik ranging between 100 and 180 walruses. Moreover, Donaldson (1988:63), after analyzing the data obtained from a harvest study during the early 1980s, concluded that the official catch statistics for Igloolik and Hall Beach in the early 1980s were too high. The harvest study estimated the combined landed catch for these two settlements during 1981-83 as about 169 per year, while the official combined estimate from Department of Fisheries and Ocean (DFO) was somewhat more than 300 per year (Donaldson 1988:table 8).

The reported landed catches for Foxe Basin during 1988-93 (5 years) averaged about 200 (range: 124-319. Hall Beach: ca. 75; Igloolik: ca. 125) (Anon. 1991...94; R.E.A. Stewart *in litt.* 1995). Anderson and Garlich-Miller (1994 *fide* Garlich-Miller 1994) estimated the annual catch in 1992-93 in Foxe Basin as 215.

Hunting loss: A dead walrus with no air trapped in its lungs has a negative buoyancy. Consequently it easily sinks if it has not been harpooned or otherwise anchored to a float. Because walruses usually are not harpooned before being shot nowadays (except during the thin ice hunt in Avanersuaq, NW Greenland; see section Regulations), losses during walrus hunting are sometimes substantial.

Beaubier (1970) sampled the walrus hunt at Igloolik in 1968-69 and recorded that of 19 walruses shot, 3 were "wounded" and lost, while 3 more were "sunk" and lost. These data suggest a loss rate of 16-32%. During hunts observed at Igloolik in 1982-84, 40 out of 124 walruses shot were lost (32%; Orr *et al.*1986).

Catch composition: The sample of the catch at Igloolik examined by Orr *et al.* (1986) in 1982-84 consisted of 33% females.

2. Southern and Eastern Hudson Bay

Distribution and Stock Identity

Summer and winter distributions of walruses in southern and eastern Hudson Bay are shown in Figs 8-9, respectively. Places mentioned in the text and locations of uglit are shown in Fig. 12.

Walruses formerly hauled out on the Paint

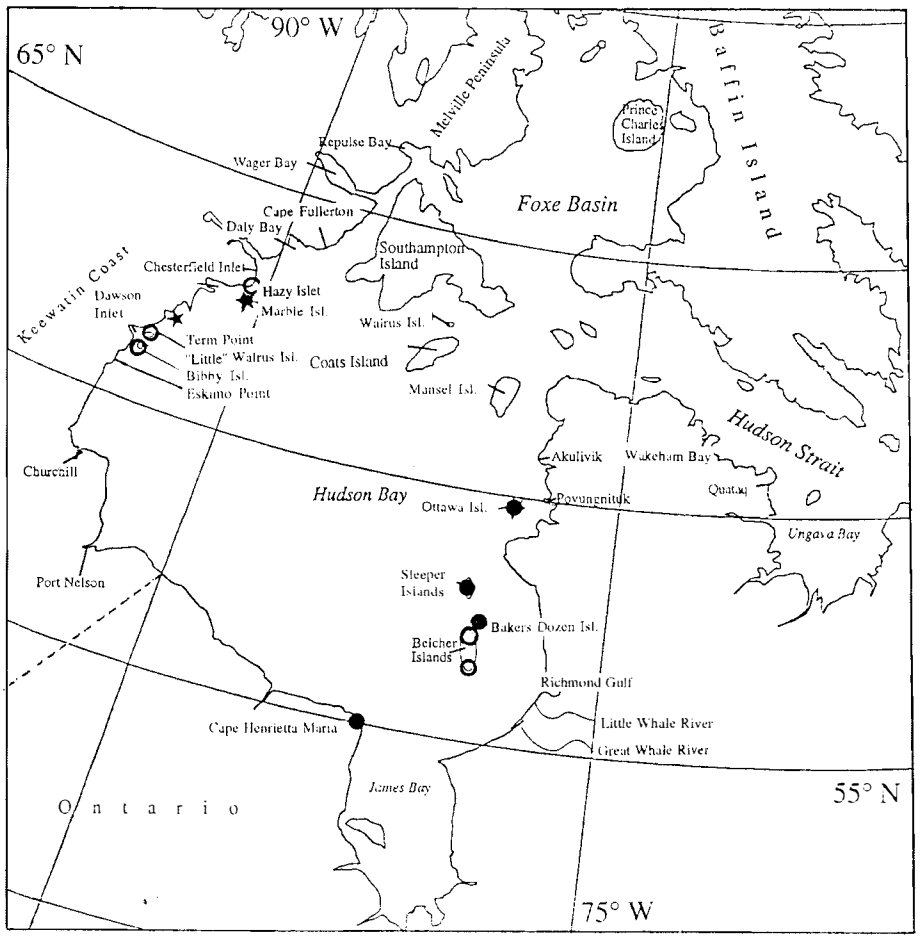


Fig. 12. Locations of terrestrial haul-outs (uglit) in southern, eastern and northwestern Hudson Bay. Legend: Black dots = haul-outs still known or believed to be used by walruses. Open circles = historical haul-outs; present status unknown. Stars = Abandoned haul-outs.

Islands in eastern James Bay but are now essentially absent south of about 57°N along the east coast of Hudson Bay (the Belcher Islands; Tremblay 1921:177).

We have found little evidence that walruses approached the mainland coast of eastern Hudson Bay (the Eastmain), although late 19th and early 20th century trade records occasionally refer to walrus catches or products in connection with Little Whale River, Richmond Gulf and Great Whale River (Francis and Morantz 1983:148, HBC Archives). Already by 1847 the mainland Inuit were said to travel to the "Sea Horse Islands" (Belcher Islands) to hunt walruses (Francis and Morantz 1983:142). Preble (1902) cited a report from 1879 indicating that walruses had formerly been seen "occasionally" as far south along the mainland coast as Little Whale River. They apparently have not been hunted by the Inuit south of Great Whale River in recent times (*cf.* Schwartz 1976).

Walruses were still plentiful on various islands off the Eastmain coast during the late 19th century (Bell 1885:14, Wakeham 1898:73) and probably until well into the 20th century. As elsewhere, in northeastern Hudson Bay walrus meat, blubber and skin were important sources of winter dog food. Thus much of the hunting by Inuit, trading companies, and police detachments was driven mainly by the need to secure their annual supply of dog food (*e.g.* May 1942). Loughrey (1959) speculated that the relocation of Inuit from the Sleeper Islands to the Québec mainland in 1954 could have had a beneficial effect on the walruses around the Sleepers.

Walruses were still sufficiently common at the Belcher Islands in the 1940s and 1950s for the Inuit from Port Harrison (Inukjuak) to come there (as well as to the Sleeper Islands) for walrus hunting (Manning 1946, Evans 1958). The main hunting areas were near the North Belcher Islands, south and east of Split Island, the south coast of Johnson Island, south of Kugong and Flaherty islands, and the Sleeper Islands (Twomey 1939, Twomey and Herrick 1942, Evans 1958, Schwartz 1976). At the Belcher Islands, the availability of walruses had become substantially reduced by the late 1950s/ early 1960s, and their importance in the local subsistence economy had become "almost negligible" (Freeman 1964:62). This change in availability was attributed by Freeman (1964) to a shift in walrus distribution: "It appears that very recently the herds shifted their location and now occur in the extreme southwest of the archipelago in the fall only. They are no longer found at other seasons on the Islands,

apart from the time they are migrating along the western coast en route to the southwestern hauling-out sites". According to Schwartz (1976) the hunting areas were reduced by the early 1970s "because some walruses have reinhabited the Sleeper Islands [?], and because people have moved to Sanikiluaq." The Belcher Islanders still hunted walruses in a small area at the southeastern extremity of Churchill Sound and another at the southern extremity of Robinson Bay, as well as at the north end of Moore Island, around the King George Islands, and most importantly at the southern and northern ends of the Sleeper Islands (Schwartz 1976, Freeman 1982).

The statement by Manning (1976), that Belcher Island hunters had to consider going to the Sleeper Islands for walruses because of a decline in local availability, was contradicted by Riewe (1992:161), who stated: "Good populations of walrus occur around the Belcher Islands and Bakers Dozen Islands [NE of the Belchers]. Frequent walrus haulouts occur on Bakers Dozen Islands." Riewe (1992:47) mapped walrus sites in the northern Belchers off northern Kugong, Flaherty, and Tukarak islands, in the northern and southern Bakers Dozen Islands, and at the King George and Sleeper islands. He also indicated that walruses were "particularly common" in the southern Belchers at the southeastern extremities of Churchill Sound and Robertson Bay (pp. 93, 203). The time scale of Riewe's (1992) observations is uncertain.

Walruses were traditionally hunted at the Ottawa Islands in the northeastern corner of Hudson Bay. Special expeditions were made in late summer or autumn (late August through October) from Povungnetuk and Port Harrison on the mainland (May 1942, Evans 1958:23).

Most walrus hunting at the offshore islands apparently was conducted in summer and autumn. Walruses of both sexes and various ages, including mothers with dependent calves, were present on the islands at this time (*e.g.* Twomey and Herrick 1942:334).

We have found no evidence to contradict Loughrey's (1959) speculation that the walruses occurring in summer and autumn on the chain of islands in eastern Hudson Bay overwinter in nearby leads and are thus basically non-migratory. It is reasonable to regard them, tentatively, as comprising a separate stock for management. We regard the walruses formerly found to the north of the Ottawas – at Digges and Mansel islands – as being part of a wider northern Hudson Bay-Hudson Strait population. The evidence for a separation of stocks in northeastern Hudson Bay is, however, not strong.

A few hundred walruses haul out in summer and fall on shoals off Brant River, Ontario, near Cape Henrietta Maria in southern Hudson Bay (Preble 1902, Loughrey 1959, Richard and Campbell 1988). This group of animals apparently includes females and young. Their stock affinities are entirely unknown. Mansfield (1958) considered them to be associated with eastern Hudson Bay (see above), while Loughrey (1959) mentioned them in connection with the population in western Hudson Bay. The group of walruses which occur near Cape Henrietta Maria may winter in the vicinity of the Belcher Islands and thus mix with the eastern Hudson Bay population (*cf.* Mansfield 1958).

Population Size

Virtually nothing is known about historical or current sizes of walrus populations in this area. Richard and Campbell (1988) assigned the number "100?" to the area. Twomey and Herrick (1942:334) estimated that the herd they observed and hunted at the northern Sleeper Islands in the late 1930s had at least 400 individuals (at least 50 are pictured in a scene at one ugli – Twomey 1939, Twomey and Herrick 1942). Manning (1976) reported seeing about 75 walruses hauled out on the Sleeper Islands and another 25 on Kidney Island, about halfway between the Sleeper and King George islands, in early August 1971.

The highest count of the Cape Henrietta Maria group was 310 walruses in October 1978 (from photographs taken during a goose survey; K.F. Abraham, Ontario Department of Natural Resources, *in litt.* to P. Richard 1985; N. Wilson, DNR, pers. comm. 1995).

Exploitation

Hunting methods: The hunt at the Sleeper Islands in the late 1930s described by Twomey (1939) and Twomey and Herrick (1942) involved the shooting and harpooning of animals in the water, from aboard an engine-powered boat. Although the Twomey expedition was mainly to obtain museum specimens, local Inuit and their equipment were used for the hunt. Another powered vessel from Port Harrison on the mainland, manned by an Inuit crew, was hunting at the same time in the same area using the same methods. Hunters at least occasionally went ashore on the offshore islands and stalked the walruses, shooting them at close range on shore (May 1942). The group of Inuit from Povungnetuk with whom May hunted apparently harpooned swimming walruses before shooting them.

Kayak, floe-edge, and on-land hunting of walruses at the Belcher Islands was described by Freeman (1964).

Catch levels: Information on historical catch levels is sketchy. As noted previously, no systematic compilation of walrus catch data has been attempted. For such a compilation, it would often be necessary to estimate catches from production data, including boatloads of walrus products, pounds of hide or ivory, gallons of oil etc. A Peterhead boat, fully loaded, could have on board the products (meat, hides, and tusks) of up to 32 walruses (Russell 1966:6 reported 65 walruses in two boats). A boatload of walruses obtained at the Sleeper Islands in 1939 included the remains of at least 23 walruses (Twomey and Herrick 1942:328). Freeman (1970:163) estimated that the hold of a Peterhead could carry the remains of about 20 adult walruses, while a whaleboat could carry only three or four. Mansfield (1966) gave 15 walruses as a full load for a Peterhead.

May (1942) reported securing a full boatload of meat during an autumn walrus hunt at the Ottawa Islands in 1939, suggesting a catch of perhaps 15-25 animals (May's account documents the capture of at least five). Such hunts were a regular feature of life at the trading posts in northwestern Québec, so it can be assumed that similar kills were made in most years.

Evans (1958:23-24) estimated annual catches during the 1950s as 20 at the Ottawa Islands, 20 at the Sleepers, and 30 at the Belchers for a total of about 70 from the region. This compares with the estimate of 60-80 given by Loughrey (1959:see p. 78 and appendix II) for this area. [Note that the figure of 169 per year cited from Loughrey by Reeves (1978), for "western Québec", includes the catches from settlements that hunt mainly in western Hudson Strait (Wakeham Bay, Sugluk, and Ivujivik).] Expeditions in August-September 1953 (3 from Povungnetuk and 3 from Port Harrison) accounted for 24 walruses at the Ottawas and 22 at the Sleepers (RCMP game report from Port Harrison 1953).

By the end of the 1950s the catch at the Belcher Islands had greatly declined (3 in fall 1959, 4 in fall 1960; Freeman 1964). The annual catch at the Belcher Islands was reported to be about 10 in the early 1970s (Reeves 1978), and it appears to have declined to about 5 since then (Richard and Campbell 1988; R.E.A. Stewart *in litt.* 1995). The combined average annual catch at Akulivik, Povungnetuk, and Inukjuak in the latter period was 35 (range 0-65) (Richard and Campbell 1988). The catch statistics for these areas are, however, of poor reliability (R.E.A. Stewart pers. comm. 1995).

Estimated annual landed catches of walruses during the mid 1970s are as follows (NHRC 1976): Great Whale 1, Inukjuak 6 and Akulivik 14. Data were not available for Povungnetuk and Ivujivik where the catches were probably greater.

Hunting loss: We have no recent information on hunting loss in these areas. Evans (1958:23) described walrus hunting in northern Québec as "extremely inefficient," with as many as two thirds of the shot animals sinking [also see Tremblay 1921:178].

Catch composition: We have been unable to locate any recent information on the catch composition for this area.

3. Northern Hudson Bay – Hudson Strait – Southeast Baffin Island – Northern Labrador

Distribution and Stock Identity

Summer and winter distributions of walruses in these areas are shown in Figs 8-9, respectively. Places mentioned in the text and locations of uglit are shown in Figs. 10, 12, 16 and 17.We describe the situation for Stock 3 going from west to east.

Keewatin coast: Along the west coast of Hudson Bay (Keewatin) walruses apparently have always been scarce south of Dawson Inlet. Only a few stragglers occurred as far south as Churchill (Preble 1902). For this reason it seems unlikely that there is (or perhaps has ever been) regular exchange with the eastern Hudson Bay population via a southern route. On the other hand, it seems likely that the groups of walruses along the west coast of Hudson Bay northward from Dawson Inlet would be continuous with the walruses of northern Hudson Bay (and possibly with those in at least southern Foxe Basin and western Hudson Strait as well).

Walruses were formerly common on Bibby Island, Term Point, "Little" Walrus Island, and Marble Island (Preble 1902, Loughrey 1959). They were formerly hunted during winter and spring along the floe edge of the Keewatin coast to the north of Dawson Inlet (Welland 1976). In summer they were hunted in the Rankin Inlet area and among the coastal islands, particularly "Little" Walrus Island, and occasionally as far south as Eskimo Point (Welland 1976:86). Farther north, they were hunted at uglit from Cape Jones in the south to just south of Karmarvik Harbour in the north, and in the Bury Cove area. Hunters were said to venture as much as 30 miles offshore in open boats to hunt walruses in this area (Welland

1976:88). Welland (1976:104,110) noted that walruses were formerly hunted from Bibby Island in the south to Baker Foreland and Cape Fullerton in the north, and seaward to a distance of 10 miles from Marble Island. Although they were scarce by the 1970s south of Chesterfield Inlet, they were still said to be common in the Daly Bay area (*Ibid.*:110). Hunting records reported in Ross (1984) demonstrate that walruses wintered near shore around the southern entrance of Roes Welcome Sound. They were also present in the sound, as well as in Wager Bay, in summer (Welland 1976:90).

According to Welland (1976:102) walruses have become "very scarce" in areas along the southern Keewatin coast, *e.g.* among the islands east of Bibby Island where they were formerly common (also see Loughrey 1959). People from the Rankin Inlet area must now travel in large boats to Roes Welcome Sound or to Walrus Island near Southampton Island to get walruses (Welland 1976:104).

Hazy Islet near Rankin Inlet (ca. 62°50'N) and "Little" Walrus and Bibby islands may still be used by a small number of walruses (Riewe 1992:63,81,175,191), but there is no evidence of significant numbers farther south along the Keewatin coast. Riewe (1992:145,256) indicated that a "small population" is present year-round between Eskimo Point and Wager Bay.

Northern Hudson Bay and western Hudson Strait: The area around Southampton Island has always had large numbers of walruses (Tremblay 1921:338, Mansfield 1958, Loughrey 1959). Major uglit were (and still are) on Coats, Bencas and Walrus (Akpatorardjuk; in Fisher Strait) islands and at Seahorse Point on the east coast of Southampton Island (Mansfield 1958, Freeman 1970, Riewe 1992). Other uglit were on the north side of Southampton Island, in Frozen Strait, and near the entrance of Lyon Inlet (Mansfield 1958:figure 1). Walruses were available in winter at the floe edge near Native Point and were hunted in winter at the floe edge in Smith, Native and Duke of York bays and between Hut Point and Cape Low (Welland 1976:95,112). Large numbers have been reported at the floe edge off Ruin Point and in South Bay, and groups of less than 100 are commonly observed in winter between Leyson and Hut points (Orr and Rebizant 1987). In spring and early summer walruses were hunted from Native Point to Ruin Point, in the Duke of York Bay area and along the coast of Bell Peninsula as far north as Terror and Gore points, as well as on Walrus, Bencas and Coats islands (Welland 1976:96,112). Walruses were also present in the water all the way across the channel between Southampton and Coats islands and in Duke of York Bay (*Ibid.*). Spring concentrations have been reported in recent years (mid 1980s) at the floe edge near Renny Point and at break-up near Leyson Point (Orr and Rebizant 1987). The recent summer and fall distribution was, according to Orr and Rebizant (1987), among the floating pack ice in Evans Strait, near the islands, along the coast of

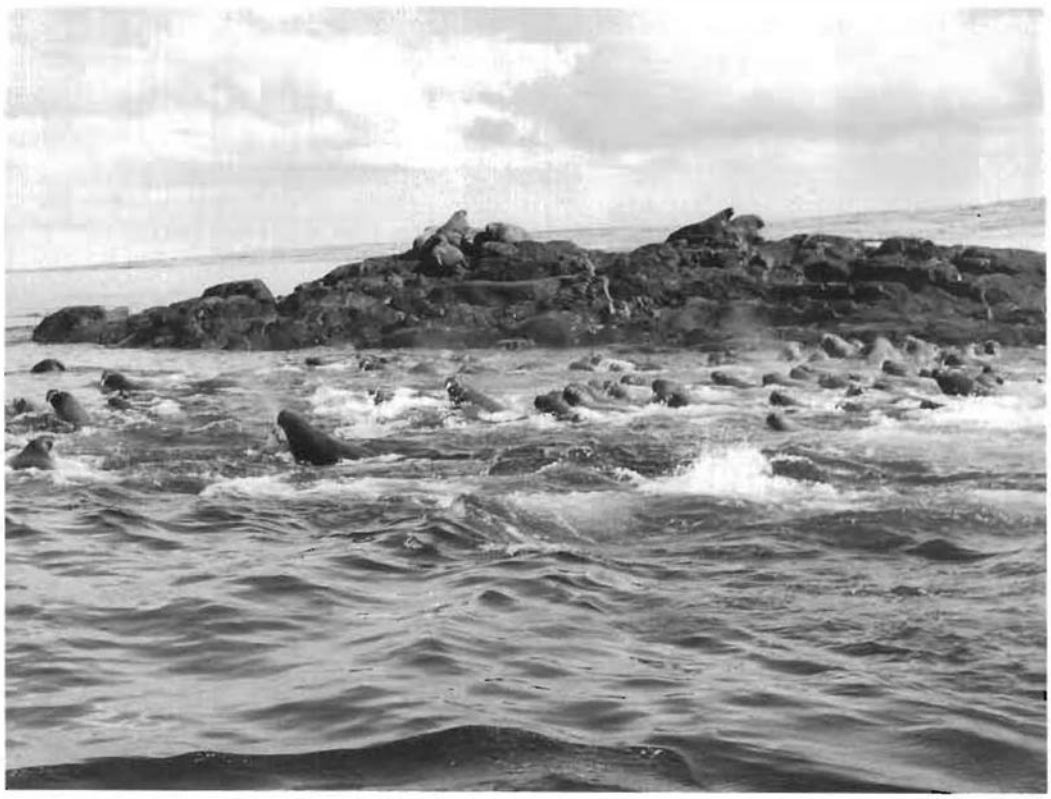


Fig. 13. Walruses at Coats Island, Hudson Bay, in mid-August 1967. Coats Island is still an important haul-out site (ugli). Photo: F. Bruemmer.



Fig. 14. Tagging walruses on Bencas Island, Hudson Bay, 1954. A harpoon-head metal tag was thrust through the tough skin of the walrus (see text). Photo: H. Norden-Andersen.

Southampton Island from Seahorse Point to Ruin Point, and in Duke of York Bay.

Brice-Bennett (1976) gave the following detailed information on where walruses were hunted by Repulse Bay Inuit (who, incidentally, were not known as major walrus hunters): Walruses were hunted at the spring floe edge and in open water off the west coast of Vansittart Island to Gore Bay, in Hurd Channel, Repulse Bay and the southwestern part of Roes Welcome Sound, off the south coast of Opposite Island, around the Sturges Islands, in Duke of York Bay and around the Savage Islands at the mouth of Wager Bay. They were "most intensively hunted" (pre-1962) around the Sturges Islands, Bluhme, October and Bushnan islands in Frozen Strait, and the Harbour Islands and Ubliardjuk area near Gibson Cove in Repulse Bay, and along the southwest coast of Roes Welcome Sound in the Ublialuk area north of Bury Cove. After 1962 most walruses were apparently taken around the Harbour Islands and near Gibson Cove in Repulse Bay (Brice-Bennett 1976:66).

To determine movement patterns and stock identity, tagging studies were conducted in the summers of 1954, 1955 and 1956 at Bencas, Coats and Southampton islands (Mansfield 1955, 1958, Loughrey 1959). However, these studies provided little information on movements. Of a total of 115 (Mansfield 1958) and 32 (Loughrey 1959) walruses tagged with harpoon-head tags (Figs 14-15), only three were recovered during the fall of 1954. The tag-recoveries revealed only local movements in the Southampton – Bencas islands area (Loughrey 1959).

The distribution of walruses in the northern Hudson Bay-western Hudson Strait region apparently has changed little during the past half-century. Donaldson (1988) claimed that the Baffin Island harvesting study of the 1980s led to discovery of "a previously unknown wintering area for walrus," by virtue of the relatively high catches at Cape Dorset during February-April. Walruses are believed to drift eastward on the ice from south-eastern Southampton Island during late summer and fall, passing Cape Dorset and dispersing into Hudson Strait where many overwinter (Riewe 1992: 198). They are also found along the floe edge of southern Foxe Peninsula throughout the winter.

Although walruses formerly occurred in East Bay, their continued use of this area has not been confirmed by recent surveys (Riewe 1992:243). In addition to the former hunting areas described above, Welland (1976:112) stated that walruses were still found along the shores of Bell Peninsula north to Terror Point, all around Coats Island and in the straits between Southampton and Coats islands. Some walruses ("a small population") are still present in Roes Welcome Sound year-round (Riewe 1992:244). They also remain year-round in Frozen Strait, hauling out on ice pans or rocky shores in summer and keeping in leads through the winter (Riewe 1992:244).

Researchers studying seabirds in the region of Digges Sound during 1979-82 (Gaston *et al.* 1985) observed no walruses (or even old walrus bones) on or near Digges Island; they were told by residents of Ivujivik that walruses are never seen there today (A.E. Gaston *in litt.* 1985), yet Roy (1971) indicated that walruses were hunted occasionally around



Fig. 15. A walrus being tagged off Seahorse Point (eastern Southhampton Island, Hudson Bay) in 1954. Photo: H. Norden-Andersen.

Digges Island and along the mainland coast in summer and fall as well as along the east coast of Mansel Island and among the Imiliit Islands in fall. Bell (1885:33) had found walruses "numerous" at Digges Island during late summer.

Historically walruses were always abundant and widespread in northern Hudson Bay and western Hudson Strait. Particular areas were noted as reliable sites for finding them at specific times. Mansfield (1958) suggested that there was a gap in walrus distribution along the north side of Hudson Strait, from about Amadjuak to the Middle Savage Islands.

Along the north shore of Hudson Strait walruses were fairly common off Amadjuak Bay at any season as long as the ice conditions were right (Soper 1928:48) as well as in Andrew Gordon Bay and Chorkbak Inlet (Soper 1944). They were even more common, however, at Mill and Salisbury islands and off King Charles Cape (Gordon 1885: 301, Soper 1928:48). The most reliable site for walruses near Salisbury Island was said to be 25-30 km east of the Island, "where a reef runs east and west, with part of it a rock about 400 yards long by 250 wide, called Nooshwetuk" (Russell 1966:4).

Walruses usually arrived at Nottingham Island on the ice in late August (Manning 1944:148), and this island, along with Salisbury Island, was a favorite hunting ground for communities in southwestern Baffin Island and northwestern Québec. Occasionally the animals were caught on land, but most of the hunting was done on the ice or in the water (Manning 1944:144). Bell (1885:30) reported seeing only a few walruses near Nottingham Island but many in the ice south of it on 20 September.

The walruses at Nottingham Island have continued to be relatively intensively exploited in recent years. People from Ivujivik carry out an annual walrus hunt there (Roy 1971), and people from Cape Dorset, Sugluk, Wakeham Bay and possibly Koartak also hunt them there (A.J. Gaston, *in litt.* 1985). In general it seems fair to conclude that the necessity of making long, costly trips to offshore islands for walruses demonstrates the unavailability of these animals along mainland shores. This is apparently the situation on both the north and south shores of western Hudson Strait today.

Orr and Rebizant (1987) reported that walruses were present in winter all along the floe edge near Foxe Peninsula, from Cape Dorchester to Chamberlain Island, with concentrations around Cape Dorchester and the offshore islands. The main seasonal change in distribution is apparently that walruses become less common in the vicinity of Cape Dorset during summer and fall, when they are particularly abundant along the west coast of Foxe Peninsula from Lloyd Point to the islands north of Cape Dorchester, as well as around the south, west, and north coasts of Salisbury Island and the southeast coast of Nottingham Island.

Ungava Bay, central and eastern Hudson Strait: Much information about the occurrence of walruses in the Ungava Bay – Hudson Strait – eastern Baffin Island – Labrador region was summarized by Loughrey (1959), Reeves (1978), Davis *et al.* (1980) and Richard and Campbell (1988). Few studies focusing on walruses have been carried out in this large area. Land use studies during the 1970s (Freeman 1976) and 1980s to early 1990s (Anon. 1981-87, Riewe 1992) have provided traditional knowledge and incorporated much of the survey data from consulting companies and government scientists. Systematic aerial surveys of marine mammals were conducted during the late 1970s and early 1980s in late winter (McLaren and Davis 1982) and in summer and fall (MacLaren Atlantic Ltd. 1978, MacLaren-Marex 1979, 1980a, 1980b) in Hudson Strait and Ungava Bay, along the southeast coast of Baffin Island and off northern Labrador. These surveys provided useful information on the recent distribution and relative abundance of walruses.

There is ample evidence that walruses were formerly common in parts of Ungava Bay, including Akpatok Island (winter: Elton 1942; summer: HBC Archives, see below) and the Gyrfalcon Islands (summer: Dunbar 1955). Except possibly at the Gyrfalcon Islands they have apparently always been rare in southern Ungava Bay (Mansfield 1959). Human communities living along the shores of Ungava Bay made annual walrus hunts at the offshore islands, especially Akpatok in June-September (HBC Archives, post journals from Diana Bay, Payne Bay, Leaf River, and Fort Chimo). Loughrey (1959) and Currie (1968) provided detailed speculations about walrus movements in Ungava Bay based on information obtained from local Inuit and long-time white residents of the area. It was suggested that walruses arrived at Akpatok from the east in late June and July, then swam westward or northwestward in late July and August. They supposedly passed Cape Hopes Advance and dispersed into Hudson Strait during August. Although Loughrey (1959) considered most of the

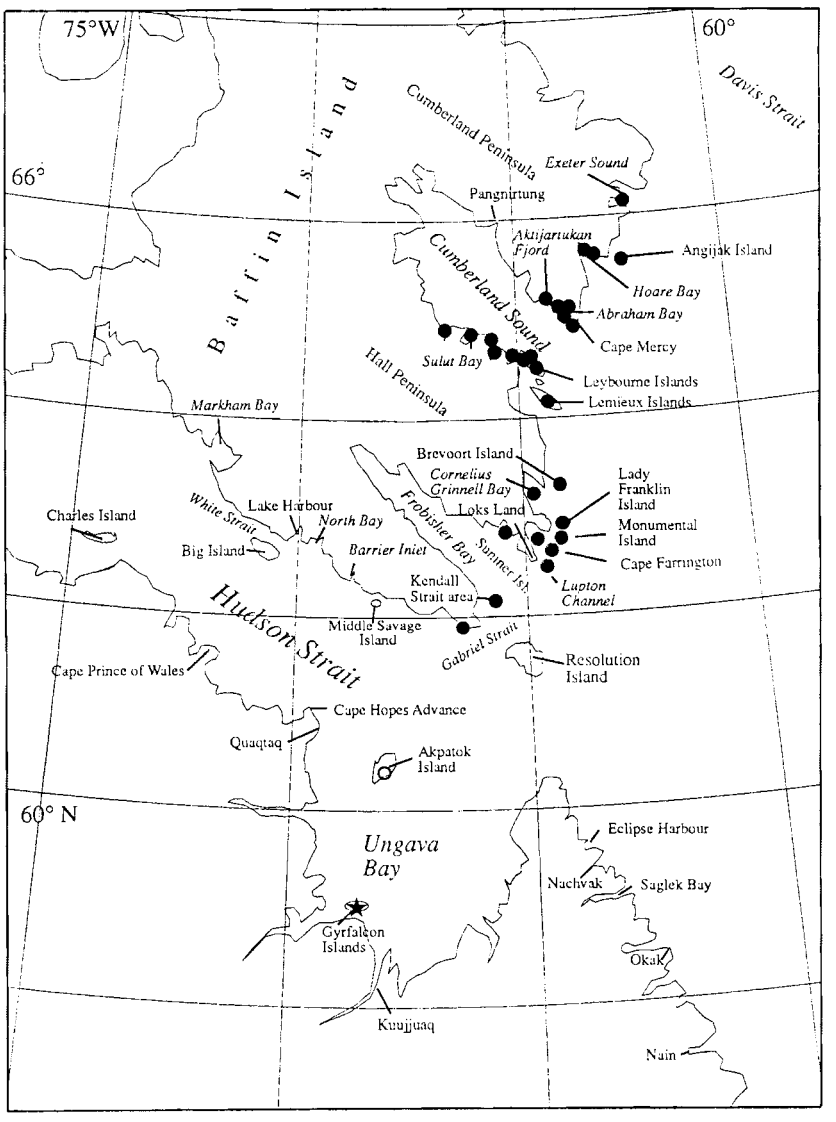


Fig. 16. Locations of terrestrial haul-outs (uglit) on southeastern Baffin Island (see also Fig. 10) and in Ungava Bay. Legend: Black dots = haul-outs still known or believed to be used by walruses. Open circles = historical haul-outs; present status unknown. Stars = Abandoned haul-outs.

eastward movement of walruses in autumn to be along the north shore of Hudson Strait, Currie (1968) referred to a southeasterly migration past Cape Hopes Advance in September-October, well offshore.

The historical distribution and movements of walruses along the south coast of Hudson Strait are poorly known. Bell (1885:27-28) was told by Inuit living at Cape Prince of Wales that it was a good site for walrus hunting "at most seasons of the year". He observed walruses there and in Ashe Inlet in mid August and was told that Ashe Inlet was also a good place for walrus hunting in winter (Bell 1885:25). Walruses were observed and hunted year-round in Stuparts Bay and Fisher Bay during the 1910s and 1920s, but by the 1930s the hunting from the Stuparts Bay HBC post seems to have been done mainly in late summer and fall at Nottingham Island (HBC Archives).

In the northeastern part of Hudson Strait, walruses were said to frequent Gabriel Strait from November to May but to be present between Gabriel Strait and Lake Harbour for only a short period during winter (Public Archives of Canada, RG85, Vol. 1045, file 540-3, part 3-C). In at least some years small groups were present off Pritzler Harbour through the winter. A small group of walruses was said to occur around the Middle Savage Islands between Resolution and Big islands, mainly from October until May (Mansfield 1958, Higgins 1968:150). Higgins believed that this group was separate from the walruses at Resolution Island and Loks Land at the entrance of Frobisher Bay. Rather, he believed that these walruses occasionally drifted on ice westward to North Bay, near Lake Harbour.

Inuit knowledge, as summarized by Kemp (1976), identified two sites in the Lake Harbour region as especially good for walrus hunting: 1) a narrow zone from Pritzler Harbour to Shaftesbury Inlet, especially in Pritzler Harbour and Observation Cove; and 2) at East Bluff on the southern tip of Meta Incognita Peninsula. Walruses were also hunted along the floe edge of Juet Island and at Fair Ness. They were also said to occupy uglit in North Bay and White Strait during summer and to be present in North Bay in winter (Kemp 1976).

The present distribution mapped by Riewe (1992:91,129) off southern Baffin Island is approximately as described by Kemp (1976) and others, with the suggestion that walruses migrate east and west along the south coast of Baffin Island. His descriptions of the current range (pp. 202-203, 237) indicate that they occur "in large numbers" around the Middle Savage Islands in spring and late fall, winter along the floe edge and throughout the offshore pack ice of Hudson Strait and in North Bay and White Strait, and occasionally enter Markham Bay in late summer after break-up. Riewe also refers to an ugli on Spicer Island, and to the fact that walruses occasionally drift westward on ice from the Middle Savage Islands to North Bay during winter.

Aerial surveys in March 1981 showed that walruses winter in Hudson Strait and Ungava Bay (McLaren and Davis 1982). The sightings reported by MacLaren-Atlantic (1978), MacLaren-Marex (1979), and McLaren and Davis (1982) indicate that walruses are still present at Akpatok Island and elsewhere in central and eastern Hudson Strait.

The almost complete lack of observations of walruses by Finley *et al.*(1982) during a shore-based survey of belugas, mid October to early December 1980, at Cape Hopes Advance (one eastbound walrus sighted on 3 December) is consistent with the widely held view that the eastward fall migration of walruses through Hudson Strait (assuming that it occurs) is either well offshore or along the north side of the strait.

Mansfield (1990) noted the absence of any recent information, other than that from the aerial surveys mentioned above, on the distribution of walruses in Hudson Strait and Ungava Bay.

Generally, information about migration and relationships among groups of walruses in these areas is difficult to interpret, and sometimes seems contradictory. Aerial surveys in March showed that walruses winter in Hudson Strait and Ungava Bay (McLaren and Davis 1982), which is consistent with Inuit knowledge and historical information. Inuit at Cape Dorset observe walruses during winter along the south coast of Foxe Peninsula, between Nottingham and Salisbury islands and at Chamberlain Island in western Hudson Strait (Orr and Rebizant 1987). According to Elton (1942) walruses wintered in Ungava Bay near Akpatok Island. Although walruses winter in Hudson Strait there apparently is also an eastward migration out of Hudson Strait in fall. This outmigration in October may be two pronged, with some groups moving south along the northern Labrador coast and others (probably the greater proportion) following the coast of Baffin Island (Loughrey 1959) and perhaps dispersing offshore. Walruses were seen off the northern tip of Labrador during aerial surveys in March (McLaren and Davis 1982). Local people of Labrador were of the opinion that the Akpatok Island summer population winters along north-eastern Labrador (Anon. 1978).

Apparently walruses in these areas winter in

small groups in cracks and leads among the ice, in the shore lead along southeastern Baffin Island, and in polynyas off northern Labrador, at the entrance to Frobisher Bay and off Hall Peninsula (and possibly Cumberland Peninsula).

Southeastern and eastern Baffin Island: Historically, walruses apparently occurred along the entire east coast of Baffin Island (Freuchen 1921, Vibe 1950, Loughrey 1959). This is also indicated by the location of walruses killed by British whalers along the east coast of Baffin Island. However, citing Inuit informants from the Pond Inlet area, Bisset (1968) stated that walruses very infrequently occurred along the northeast coast of Baffin Island between Cape Macculloch and Clyde Inlet. The current near-absence of walruses along this stretch of coast was confirmed during aerial surveys in both 1978 and 1979 and during coastal watches in the fall of 1978 (Koski and Davis 1979, Koski 1980).

Kills made by British whalers indicated that walruses were especially numerous in inshore areas in September and October in the Cape Searle-Home Bay area (Ross and MacIver 1982). Freuchen (1935) and Loughrey (1959) mentioned Clyde Inlet as an important haul-out area. Padloping Island had an important ugli. Hjort and Ruud (1929) observed "great numbers" of walruses in Exeter Sound on 24 July 1924.

The coastal areas to the north and south of the mouth of Cumberland Sound, Nuvuk Point to Cape Mercy and the Leybourne Islands to Abraham Bay, respectively, are important areas for walruses today (Schledermann 1975:27, Stevenson 1993). Kumlien (1879:63) reported that walruses had been much more common in the upper parts of the sound in the past. Judging by catch records of commercial whalers, the areas around Kekerton and Blacklead islands also had good numbers of walruses in the second half of the 19th century and early in the 20th. Although walruses have been mapped as occurring off and southeast of Bon Accord and in Kingnait Fiord, upper Cumberland Sound (Anon. 1981-87), they are no longer common in Cumberland Sound north of Nuvuk Point (Anders 1967); only occasional individuals are encountered towards the head of the sound, *e.g.* off Nettilling Fiord (Schledermann 1975:27, Stevenson 1993).

A hunter from Pangnirtung reported that walruses still occur all around Cape Mercy and westwards to Kingnait Fiord and northwards to Angijak Island (A. Papatsie pers. comm. 1995). Five uglit are still used by walruses in the Cumberland Sound area: 1) just west of the mouth of Ujuktuk Fiord, 2) on an island in Ujuktuk Fiord, 3) on an island between Angijak Island and Ingnit Fiord (north of Hoare Bay), 4) on a little island west of Kekertuk Island and near the mainland in the mouth of Exaluin Fiord, Hoare Bay, and 5) on an island on the east side of the mouth of Tonak Fiord, Hoare Bay (A. Papatsie, *op cit.*). The same hunter indicated that two uglit in this region were no longer used by walruses: one on Miliakdjuin Island (allegedly abandoned after 1947 because of disturbance by motorboats) and the other on a little island off Kekertukdjuak in the mouth of Kingnait Fiord. Walruses are said to winter in parts of Abraham Bay and to move into Ujuktuk Fiord with spring break-up. Those in the Hoare Bay area are said to winter off the coast between Muingmak and Angijak islands and to begin moving into the fiords in spring (A. Papatsie, *op cit.*).

Walruses are present throughout the Lemieux Islands from August to November, and perhaps year-round (Anon. 1981-87). The mouth of Winton Bay in outer Robinson Sound is an important walrus site (Anon. 1981-87). Walruses were hunted during the period 1928-62 along the south shore of Cumberland Sound, from near Iglootalik and all the way to the Leybourne Islands (Kemp 1976:138). Kipisa and Utusivik have been mapped as areas where Inuit from Pangnirtung go for walruses in this area (Anon. 1981-87). The general pattern was for the walruses to move close to shore in spring and summer and out into Cumberland Sound in winter (Kemp 1976:138). Some overwinter in outer Cumberland Sound (Anon. 1981-87). Hundreds of walruses are said to haul out at Cape Mercy, and there is another ugli on an island at the mouth of Ujuktuk Fiord (in Abraham Bay) (Anders 1967, Anon. 1981-87). The Leybourne Islands and Sulut Bay have been mapped as good walrus areas (Anders 1967, Anon. 1981-87). On the opposite side of Cumberland Sound, during the period 1928-82, walruses were hunted from the mouth of Kingnait Fiord all the way to Cape Mercy, with hunting especially good in Abraham Bay, Ujuktuk Fiord and the mouth of Aktijartukan Fiord (Kemp 1976). Along the east coast of Cumberland Peninsula they were hunted during summer in Hoare Bay and north to Clephane Bay and Exeter Sound (*Ibid.*). From 1962 to 1974 walruses were hunted in southern Cumberland Sound mainly near Kipisa, Utusivik, the mouth of Salut Bay and among the Leybourne Islands; along the eastern sound from the mouth of Iqalujuak Fiord to Kumlien Fiord and Wareham Island; and south of there from the mouth of Aktijartukan Fiord and near Kekertaluk Island in Hoare Bay (Kemp 1976:142). Broughton Island hunters hunted walruses during 1927-55 mainly in

the Alexander Bay area of Home Bay, northwest of Kekertaluk Island, in the mouth of Okoa Bay and the Nedlukseak Island area, between the northwestern headland of Kivitoo Peninsula and Nedlukseak Island, and among the islands in the southwest part of Kivitoo Bay (Kemp 1976:143). Important summer and fall walrus hunting sites were the southeast corner of Broughton Island, the islands directly south of Broughton Island, Duck and Padloping Islands, Cape Searle and Durban Island in Merchants Bay, as well as in a narrow zone southward from Cape Durban to Cape Dyer. Less important hunting areas were in the Totnes Road part of Exeter Sound, throughout Kairolik Fiord, near Kekertuk Island and in Hoare Bay (Kemp 1976:143).

Walruses are said to have become "much less plentiful" in the Padloping area during the late 1950s and early 1960s but to have increased in numbers there during the late 1960s and early 1970s (Kemp 1976:144). They were hunted during this latter period around Durban and Padloping islands, Cape Searle and occasionally just west of the islands in Canso Channel, near the southeastern corner of Broughton Island, and off the south shore of Kivitoo (*Ibid.*). In some years they were also taken around Nedlukseak Island and Brodie Bay, just north of Kekertaluk Island, in Nudlung Fiord and around some of the smaller islands in northwestern Home Bay (*Ibid.*).

Frobisher Bay was traditionally an important walrus hunting area. Besides hunting walruses intensively in the mouth of Hudson Strait (from the Middle Savage Islands southeast along the coast of the Meta Incognita Peninsula to the vicinity of Nanuk Harbour), the Inuit from this area also hunted them during 1925-55 in Ward Inlet and just south of Fletcher Island, both areas towards the head of Frobisher Bay, in a large area from Hamlen Bay, south along the east coast of Frobisher Bay, around Loks Land, and north to Beekman Peninsula, terminating at Cape St. David (Kemp 1976:134). Although walrus hunting remained intensive after 1955 in Hamlen Bay, Lupton Channel, and along Beekman Peninsula, the decline of dog teams during the 1960s and early 1970s made this activity less important. By the early 1970s most of the walrus hunting by the people of Frobisher Bay was limited mainly to areas along the east and west coasts of Blunt Peninsula, including Cyrus Field Bay (Kemp 1976:136). Records of the Hudson's Bay Company post in upper Frobisher Bay during the late 1920s to late 1930s indicate that walruses were hunted in summer and fall (July-November) as well as in winter (February-March) (HBC Archives, unpublished data).

A detailed report of a walrus hunt in September 1942 by the RCMP detachment at Lake Harbour (Public Archives of Canada, RG85, Vol. 1045, file 540-3, part 3-C) contains useful information on walrus distribution. The motorboat left Lake Harbour on 7 September and followed the coast east to Resolution Island, then north to Loks Land and finally Brevoort Island. Walruses were scarce when the vessel arrived (16 September) but began appearing from the north within several days. The total catch was 26 walruses, taken between 17 and 26 September at Brevoort Island, Loks Land, and in Robinson Sound. At least 8 animals were killed and lost due to poor weather. The meat, blubber, and skin were cached for dogfood on winter police patrols. All apparently were harpooned and killed in the water. A similar hunt in 1937 produced 21 walruses between 13 and 29 September in Jackman Sound (Frobisher Bay) and Cyrus Field Bay at Loks Land, and near the foot of the glacier on Grinnell Peninsula. RCMP records indicate that walruses were consistently "plentiful" in Cyrus Field Bay and Robinson Sound and along the coast from Robinson Sound to the Lemieux Islands during the 1930s and 1940s, especially in the autumn.

According to a local hunter, walruses are found today in spring at several sites along the west sides of Blunt Peninsula and Loks Land (E. Papatsie, pers. comm. 1995). In summer and fall they are present among islands off eastern Loks Land and in the mouth of Cyrus Field Bay (*Ibid.*). Land use maps call attention to many areas around the mouth of Frobisher Bay used by walruses (Anon. 1981-87, Riewe 1992). These essentially agree with previously published information, but there are some inconsistencies with the fine details. It is not possible to reconcile these inconsistencies here. Walruses may still occur during summer and fall in Ward Inlet, and there is a summer or fall ugli on some very small islands just southwest of Sumner Island (Riewe 1992).

According to Smith *et al.* (1979) walruses overwinter in the open areas of Frobisher Bay, where they are hunted along the floe edge in late winter and spring (Anon. 1981-87). During aerial surveys in March walruses were observed in this area, off Hall Peninsula and at northern Labrador(MacLaren-Marex 1979, McLaren and Davis 1982), and approximately 50 were seen along the floe edge just north of the western entrance of Chappell Inlet in January 1984 (Anon. 1981-87). Uglit on islands at the south end of Lupton Channel are occupied in autumn (*Ibid.*). Some of the walruses from these areas may move across Davis Strait to winter off central West Greenland at the edge of the Davis

Strait pack ice – the West Ice (Freuchen 1921, Dunbar 1956, Vibe 1967).

During aerial surveys walruses were observed in April and May at the entrance to Hudson Strait, and along the northern Labrador and Hall Peninsula coasts (MacLaren-Marex 1979). Between June and September, walruses occur along the outer coastline of southeastern Baffin Island, from Gabriel Strait north to Clyde Inlet (MacLaren Atlantic Ltd. 1978, MacLaren-Marex 1979, 1980a, 1980b, Smith *et al.*1979). They were observed in June at Akpatok Island in Ungava Bay (MacLaren Atlantic Ltd. 1978). During summer concentrations have been observed off Hall Peninsula, around Lady Franklin and Monumental islands (where they apparently feed), and near Brevoort Island and Cape Dyer (MacLaren- Marex 1980b). Walruses were present in the Loks Land and Lemieux Islands areas from early July. A large number of walruses, apparently coming from Hudson Strait, entered the Hall Peninsula area in mid-September (Smith *et al.*1979). Other terrestrial haul-out sites are found in the Lemieux Islands, on the west side of Brevoort Island, in Cyrus Field Bay, and in Hoare Bay (MacLaren Atlantic Ltd. 1978, MacLaren Marex 1979, 1980a, 1980b).

Uglit on eastern Baffin Island (see Figs 10 and 16): In the Hudson Strait-Ungava Bay area walruses are reported to have hauled out on Akpatok Island, the Eider Islands near Cape Hopes Advance, and several of the islands along the southern coast of Hudson Strait such as Wales, Weggs and Charles (Loughrey 1959). They were formerly found on islands near Sugluk, in Deception Bay and on Digges Island but apparently had been largely killed off at (or driven from?) these sites some time after 1909 (*Ibid.*). The most populated uglit in the Hudson Strait region are unquestionably those at Nottingham and Salisbury islands, which are discussed more fully under the section on Northern Hudson Bay and Western Hudson Strait.

In the early part of this century, the biggest ugli along the east Baffin coast may have been at Padlei, just south of Padloping Island (Mansfield 1958). Bethune (1934) mentioned a second-hand report that one company took over 4000 skins per year, but the catch locality (or localities), and the period or number of years involved, were not clearly stated. Mansfield (1958) and Reeves (1978) interpreted Bethune's text to mean that this very large number of walruses was taken annually at Padlei. However, without corroborating evidence of some kind, Bethune's statement, and the subsequent interpretations of it by other authors, need to be viewed with a degree of skepticism. Nevertheless it is certainly true that the Padloping Island area had a great many walruses at one time.

Recent information on uglit in the Padloping Island area and elsewhere along the east coast of Baffin Island is summarized in Figs 10 and 16. A relatively large number of sites are reported as still being used, at least sporadically by a few walruses. These are primarily on islands near the outer coasts of Hall and Cumberland peninsulas. Lady Franklin Island has one of the largest uglit at present.

Gulf of St. Lawrence and Nova Scotia: Walruses were historically abundant in Canadian east coast waters from Labrador south as far as Sable Island (approximately 43°N) and the Gulf of St. Lawrence (Fig. 17). It has been claimed, in fact, that the walrus herds on the Magdalen Islands, Gulf of St. Lawrence, represented "the greatest concentration of walruses in the world" before their discovery by Europeans in the 16th century (Bruemmer 1992). The crew of one ship reportedly killed 1500 walruses in one season at Sable Island in 1591, and kills of similar or greater magnitude were reported at the Magdalen Islands as recently as the 1770s (Allen 1880). Mowat (1984:304, 318) claimed that the Magdalen Islands had 100,000 walruses as late as the mid 18th century and that Sable Island had "at least that many". He referred to a catch of 25,000 walruses in one year (1760s), made from only three of the 11 uglit at the Magdalen Islands. Mowat is prone to exaggerate numbers and as a secondary source is not particularly reliable. Before trusting his account, it would be necessary to examine his primary sources, which we have not done. However regardless of whether Mowat's (and Bruemmer's) statements are literally true or not, the numbers of walruses in the Gulf of St. Lawrence and off the coast of Nova Scotia must have been very large, by any standard.

Walruses in southeastern Canada were said to haul out and give birth on islands between April and June (Allen 1880). Whether these large herds migrated over long distances, and whether their distribution was continuous northward along the Labrador coast, is uncertain. There is no evidence that walruses have begun to recolonize this part of their former range (Reeves 1978), and we accept the judgment of Richard and Campbell (1988) that the Atlantic walrus is now extinct in this part of its range.

Labrador: Walruses were formerly present along much of the Labrador coast and were regularly observed and hunted in winter and spring (mid February to June) to at least as far south as Okak Bay (Hawkes 1916:32, Hantzsch 1932, Taylor 1974, 1977, Taylor and Taylor 1977, Brice-Bennett 1977,

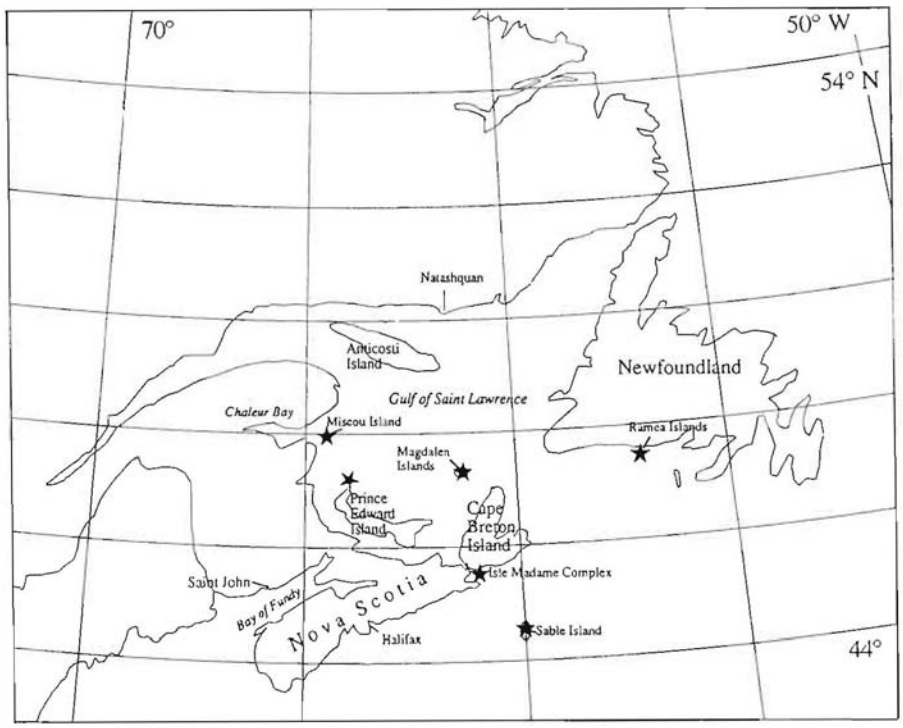


Fig. 17. Locations of abandoned terrestrial haul-outs (stars) in the Gulf of St.Lawrence and Nova Scotia region.

HBC Archives). The main hunting areas were in the northern Okak and Hebron districts (Brice-Bennett 1977:121). According to an archaeologist the traditional walrus hunting grounds were at the Galvano Islands and at Chance Rocks and Ashe Rocks off Mount Bache Point, both at the mouth of Eclipse Harbour (S. Loring, pers. comm.).

All accounts suggest that the animals were migratory and occurred off central Labrador only in winter and spring. It is not known how far south walruses migrated on the Labrador coast. Hawkes (1916:32) observed a large herd in heavy ice off Davis Inlet in 1914, and Freuchen (1935) claimed that females and young moved all the way south to Battle Harbour, near the Strait of Belle Isle. It appears, however, that by the 1920s and 1930s only stragglers reached as far south as Okak. Brice-Bennett (1977:173) concluded on the basis of interviews with Inuit elders that walruses had never been abundant as far south as Hopedale. Loughrey (1959) gave the normal southern limit as Hebron (= Nachvak). In February 1977 walruses were observed at 59°N, 62°W, about 50 km east of Saglek Bay (Anon. 1978).Although walruses were hunted "occasionally" near Port Burwell prior to 1960, they were no longer hunted there by the early 1970s (Val 1976).

Hunting methods: Taylor (1974:46) described the methods used for walrus hunting in the Okak area during the early 20th century. The animals were killed with harpoons and lances while hauled out on an ugli at the east end of the island Operngevik-soakh. They were also hunted at aglus (*i.e.* breathing holes in ice) by Inuit working cooperatively. Near Uvingayokh Island walruses were harpooned at the floe edge, sometimes by solitary or paired hunters. Kayak hunting of walruses occurred in the 19th century; for example the Inuit at Okak killed 10 walruses, apparently using this method, in spring 1844 (Taylor 1974:47).

Inuit in the area of Nachvak, Labrador, regularly hunted walruses during winter and spring in the early 1900s. HBC journals document catches of at least 11 walruses between 7 March and 5 May 1903, one in April 1904, two in February 1905, and eight between 26 February and 31 May 1906. Walrus hunting was clearly seasonal in this area, beginning in February and lasting into May most years (HBC Archives, unpubl. data).

Population Size

Western Hudson Bay: A report from the early 1930s at Chesterfield Inlet refers to at least 1500 walruses hauled out in early October on an unspecified island (Currie 1987:10). It is not clear which island is meant, and it could have been one of the large uglit in the Southampton – Coats Island area rather than along the west coast of Hudson Bay. As many as 40 walruses were seen at "Little" Walrus Island in late September 1956 (RCMP game report from Eskimo Point), and 400-500 were said to be present at Depot Island near the coast north of Chesterfield Inlet in spring 1961 (RCMP game report from Chesterfield).

We are not aware of any recent counts or estimates of walrus numbers from the Keewatin coast.

Northern Hudson Bay and western Hudson Strait: The Southampton Island area is one of the few in Canada where relatively intensive studies of walrus numbers have been attempted, beginning with the efforts of Mansfield (1958) and Loughrey (1959), followed most recently by those of Mansfield and St. Aubin (1991). Vessel surveys in 1953 and 1954 suggested a population of at least 3000 walruses on and around the major uglit at Southampton and Coats islands (Mansfield 1966). Aerial and boat surveys in 1961 resulted in an estimate for the population at Coats Island and Seahorse Point of 2650 walruses (Mansfield 1962), a figure close to the 3000 observed by Loughrey (1959) from an aerial survey in August 1954. These figures would not account, of course, for the walruses present elsewhere in the region at the time, including those in the water, on ice and at other uglit.

Aerial surveys of Fisher and Evans straits and the coasts of southeastern Southampton Island and Coats Island in 1976-77 (July-August) produced a maximal count of about 2400 animals (Mansfield and St. Aubin 1991). Miller (1982), whose purpose was to study behavior rather than to census walruses, counted more than 1500 hauled out on the northeast coast of Coats Island in early August 1978, and he counted about 500 at a different haul-out site (Cape Pembroke) on Coats Island at the end of July 1980 (Miller and Boness 1983). Numbers for the Southampton-Coats Island area summarized by Riewe (1992:244-45, 249) include: 29 in the entrance of Duke of York Bay and near Cape Deas in July 1982, 12 in the Peterson Bay area in August 1981, up to 1500 hauled out at Coats and Bencas islands in July and August 1981, as many as 2000 hauled out at Walrus and Bencas islands "in some years", and 2000 at Seahorse Point in 1954.

The number assigned to the southern Southampton-Coats Island area by Richard and Campbell (1988), "2350+", refers only to the animals counted during an aerial survey and is therefore negatively biased. Richard (1990) reported "total sightings" of about 1500 walruses during aerial surveys in both 1988 and 1989, indicating a "best estimate" that the population of walruses in northern Hudson Bay "may be as large as" 2600.

Richard and Campbell (1988) assigned numbers of "500-1000?" and "1000?" to the areas of western Hudson Strait and southwestern Foxe Basin, respectively. Their basis for these numbers was: 1) reported observations of about 200 walruses at Salisbury Island in fall of 1985 and 1986; 2) reports by hunters of seeing herds containing 500-1000+ walruses hauled out at Mill, Salisbury, and Nottingham islands in late summer and autumn (Orr and Rebizant 1987); and 3) other reports by hunters indicating that groups of 1000+ walruses had been seen in summer along the west coast of Foxe Peninsula, especially between Cape Dorchester and Cape Queen (Orr and Rebizant 1987).

During aerial surveys for seabirds along the west coast of Nottingham Island in the early 1980s, walrus counts in the "low hundreds" were recorded (A.J. Gaston, *in litt.* 1985). These seabird surveys covered only the northwest and southeast ends of Salisbury Island, and no walruses were sighted.

Ungava Bay and central and eastern Hudson Strait: Currie (1968) estimated that at least 1000 to 2000 walruses visited Akpatok Island each year. It is not known what proportion of the Hudson Strait population now uses Ungava Bay. From aerial surveys conducted in late winter it was estimated that a minimum of 850 animals wintered in Hudson Strait and Ungava Bay (McLaren and Davis 1982). According to Mansfield (1990) the number of walruses in Ungava Bay and most of Hudson Strait appears to be small at present.

Southeastern and eastern Baffin Island: On 15 August 1978 an estimated 600-700 walruses were hauled out on a small island in the Lady Franklin Island group directly east (but far offshore) of Cape Haven (MacLaren-Marex 1980b). This group of walruses is thought to make seasonal onshore-offshore movements (*e.g.* Anon. 1981-87) and thus may be related to the concentrations in the Loks Land, Cyrus Field Bay and Lemieux Islands areas. We have no reliable information on the age or sex composition of the walruses hauled out at Lady Franklin Island.

From aerial surveys conducted in late winter it was estimated that a minimum of 223 walruses were present in southwestern Davis Strait (McLaren and Davis 1982).

Richard and Campbell (1988) assigned the number "1000+" to the area of southeastern Baffin Island from Gabriel Strait north to Clyde Inlet, as a guess at the current population size. The apparent basis was the series of aerial surveys noted above.

We suggest that the aggregate population of walruses found during summer in northern Labrador, Ungava Bay and Hudson Strait and along the east coast of Baffin Island south of Clyde numbers between 1000 and 2000 walruses. The actual number is probably nearer the high than the low end of this range, and we emphasize that there could be considerably more than 2000 walruses in this large region. The basis for any estimate of walrus abundance is, in this instance, extremely weak. Moreover, it is possible that regular movement of walruses takes place through the entire length of Hudson

Strait, which could mean that the walruses in southeastern Baffin Island, northern Labrador and eastern Hudson Strait/Ungava Bay are part of a much larger and wide-ranging stock.

Exploitation

Hunting methods: Before the introduction of whaleboats and rifles, walruses were hunted cooperatively by harpoon and lance from the floe edge; by stalking them on shore, cutting off their access to water, and attacking them with lances; and by approaching them in kayaks and harpooning them while they were hauled out on ice pans or the floe edge (Ross 1975:105). Guns were introduced in northwestern Hudson Bay in the middle of the 19th century, whaleboats somewhat later. By the end of the century both were widely distributed in both northwestern Hudson Bay and along the north shore of Hudson Strait. They made walrus hunting "less dangerous and more productive" (Ross 1975:105; Fig. 18).

Kayaks had been entirely replaced by whaleboats and Peterhead boats in western Hudson Bay and on Melville Peninsula by the early 1940s (Manning 1944). Canvas freight canoes were used more at Repulse Bay than elsewhere, "perhaps because walrus are rarely hunted" (Manning 1944:140).

Freeman (1970, 1975) provided detailed information on the methods used by Inuit at Southampton Island to catch walruses. These included floe-edge hunting from canoes in spring and open-water hunting from larger boats in summer and autumn. In the open-water hunts if the walruses were encountered over deep water, the hunters tried to drive them into shallower water before killing them.

Walruses hunted in late September near the HBC post at Wolstenholme during the 1920s were shot in



Fig. 18. The "Agpa", a boat used at the Hudson's Bay Company post at Wolstenholme (near present-day Ivujivik, western Hudson Strait) for autumn walrus hunting at Nottingham Island during the 1920s. Photo: courtesy of Hudson's Bay Company Archives, Public Archives of Manitoba, A. 74/34, fo. 440, taken in 1924 by Ralph Parsons.

the water to wound them, then harpooned. Two or three animals were taken at a time, tied alongside the boat and cut up in the water (Lyall 1979:47- 48).

Inuit traditionally hunted walruses in Hudson Strait from kayaks, using harpoons, lances, and later rifles (Gordon 1887:64). The killing of walruses on land, by cordoning them off from the water with a row of hunters with rifles, took place in Hudson Strait as recently as the late 1940s and 1950s (Russell 1966:7). Manning (1944:140) noted that kayaks were still used by some Inuit living along the coasts of Hudson Strait. However they increasingly were obtaining Peterhead boats that could be used to reach the offshore walrus grounds, "undoubtedly contributing to destruction of the walrus at the more accessible places" (Manning 1944:149).

At Koartak (Diana Bay, near Cape Hopes Advance) the Inuit shot walruses from land and pursued them in kayaks as recently as the early 1960s (Currie 1968:19, 69). At this and other settlements in western Ungava Bay (Hopes Advance Bay, Payne Bay, and Koartak) the availability of Peterheads essentially determined whether walrus hunts took place at Akpatok Island (Currie 1968).

Loughrey (1959) described the walrus hunt in the Southampton Island region, and stated that similar hunting methods were used throughout the eastern Canadian Arctic. The bulk of walruses were taken during the open water season.

Communities on the east and south coasts of Baffin Island (to as far west as Lake Harbour and including the present-day settlements of Clyde River, Broughton Island, Iqaluit (Frobisher Bay) and Pangnirtung) may hunt walruses that belong to the same stock as those hunted by Inuit from Central West Greenland. The possibility that people from Cape Dorset in western Hudson Strait, as well as residents of northern Labrador, Ungava Bay and northern Québec also hunt from this stock cannot be entirely excluded.

During the days when dog teams provided the main means of winter transportation, police detachments, mission stations, and trading establishments depended, as did the Inuit, on walrus catches in the autumn to provide winter supplies of dog food and to a lesser extent fox bait. The use of walrus meat and organs as human food seems to have varied by locality. In some areas, such as northern Hudson Bay and Foxe Basin, walrus meat is reasonably popular as human food. On the other hand, Kemp (1976) reported that many Inuit at Lake Harbour had an aversion to walrus meat. As a consequence their interest in walrus hunting declined substantially with the introduction of snowmobiles to replace dog teams in the 1960s. By the early 1970s most walrus hunting at Lake Harbour was done in conjunction with hunts primarily for seals and ducks.

Catch levels – Walrus catch by commercial whalers: Walrus hunting became commercialized to some extent at the end of the whaling era (late 1800s and early 1900s). Ross (1975:109) noted that some 3000 walrus hides were obtained in trade by Scottish whalers/traders between 1900 and 1915, presumably mainly from northwestern Hudson Bay (as well as from stations along the north shore of Hudson Strait; see Lubbock 1937 for some returns). Commercial whalers, sealers, traders and explorers caught walruses, at least opportunistically (*e.g.* Wakeham 1898:72-73, Vollan 1951), along the east coast of Baffin Island (especially around the mouths of Cumberland Sound and Frobisher Bay; Ross and MacIver 1982) and in Hudson Strait. A "considerable number" of walruses were killed at the British trading and whaling stations (*e.g.* Low 1906), either by white employees or by Inuit hunters for credit in trade goods. For example catches of 150 in 1899, 138 in 1900, and 149 in 1901 walruses were reported for the Cumberland Sound stations (Lubbock 1937). To date, however, no attempt has been made to compile the commercial walrus catches from this and other areas of eastern Canada in a systematic and comprehensive manner.

The Hudson's Bay Company post at Churchill sent an expedition north along the west coast of Hudson Bay each spring to obtain walrus blubber, hides and ivory (Tuttle 1885:208). Walruses were also hunted by the commercial whalers in northwestern Hudson Bay, and Inuit catches contributed to the food supply of overwintering whalers during the late 19th and early 20th centuries (Ross 1975, 1984). Although plenty of data are available in archives and literature, no systematic effort has been made to compile historical catches of walruses for this area.

Inuit subsistence hunting: Inuit along the northern Keewatin coast hunted walruses for subsistence, depending on the meat for dog food and the blubber oil for heat and light (Welland 1976:88, 91).

Loughrey (1959:appendix II) gave the following averages and ranges of annual walrus catches along the Keewatin coast during the 1950s: 10 (2 to 15) at Eskimo Point, 6 at Tavani, 20 (4 to 26) at Chesterfield Inlet and 12 at Repulse Bay. These were based on sporadic RCMP, Canadian Wildlife Service and missionary reports. Catches at Chesterfield Inlet ranged to as high as 18 in the 1960s (RCMP Game Report from Chesterfield, 1960-61).

For settlements in western Hudson Bay the

following annual average catch levels have been reported officially: in 1973-75 (from D.H. Dowler *in litt.* 1976) no catch at Eskimo Point and Whale Cove, 10 at Repulse Bay, 4 at Chesterfield Inlet, and 2 at Rankin Inlet; in 1972-85 (Richard and Campbell 1988) no catch at Eskimo Point, 2 (0 to 6) at Whale Cove, 12 (0 to 35) at Repulse Bay, 4 (0 to 15) at Chesterfield Inlet, and 5 (0 to 15) at Rankin Inlet; in 1988-93 (Anon. 1991...94) no catch at Churchill, 2 in 1988-89 but otherwise none at Whale Cove, 3 in 1988-89 but otherwise none at Arviat (Eskimo Point), 13 (11 to 18) at Repulse Bay, 10 (9 to 11) at Chesterfield Inlet, and 4 (3 to 5) at Rankin Inlet. A harvest study based on hunter recall in 1983-85 (years expressed as, *e.g.* October 1983 to September 1984) gave the following estimates of landed catch (Gamble 1987a, 1987b): 0 in 1983-84 and 1 in 1984-85 at Eskimo Point, 0 at Whale Cove, 5 and 18 at Repulse Bay, 7 and 16 at Chesterfield Inlet, and 1 and 5 at Rankin Inlet. The months of catch reported in the harvest study were May at Eskimo Point, July-September at Repulse Bay, January-March and June at Chesterfield Inlet, and February, May and July at Rankin Inlet (Gamble 1987a, 1987b).There is little information on magnitude of the walrus catches by subsistence hunters before the 1950s.

Northern Hudson Bay and western Hudson Strait: The subsistence use of walruses by Inuit living on or near Southampton Island is especially well documented. "Large caches of walrus meat were stored along the coast of Southampton Island in areas where people expected to camp or trap during the winter" (Welland 1976:96). In more recent times, with the declining reliance upon dog traction for winter transportation, fewer walruses have been taken. They are important in the Southampton Island area mainly as human and dog food and for their ivory. Walrus meat was also traditionally important as fox bait (Welland 1976:112).

Loughrey's (1959:appendix II) estimate of the annual walrus catch at Southampton Island, 1950-54, was 204 (range: 101-261). The total subsistence catch during 1951-61, according to Freeman (1970), averaged 187 (range 101-172, excluding the 77 in 1957 when effort was reduced) (Freeman 1970). Calves, however, which constituted an estimated 20% of the catch, were not reported (or claimed against the quota?) (Freeman 1970). The quota of 7 animals per married hunter and 3 per unmarried hunter was apparently observed during the 1950s and early 1960s. Between 1961 and 1972, with the declining need for dog food as snowmobiles replaced dog sleds, the reported average annual catch of walruses at Southampton Island declined substantially (Freeman 1975).

Official statistics on the annual average landed catch at Southampton Island (Coral Harbour) in 1973-75 was 110 (D.H. Dowler *in litt.* 1976), and Richard and Campbell (1988) listed the average during 1972-85 as 46 (range: 11-103). Most recently (1988-93) the reported catch has averaged 48, ranging between 41 and 60 (Anon. 1991...94, R.E.A. Stewart *in litt.* 1995). Gamble (1987a, 1987b) estimated the landed catch at Coral Harbour (based on hunter recall surveys) in 1983-84 and 1984-85 as 44 and 29, respectively. Although the highest catches were in August and September, some walruses were taken in every other month except February, June, November and December.

The settlement quota for Coral Harbour under the Marine Mammal Regulations is 60 walruses per year (Richard and Campbell 1988).

Catches at the offshore islands in western Hudson Strait have not been compiled systematically or comprehensively, so it is difficult to make meaningful estimates of removals there during the first three quarters of the 20th century. We can present only some examples that may or may not be representative. Soper (1944) reported that one hunter near Cape Dorset killed 25 walruses one autumn (apparently in the 1920s), providing his family with enough meat for humans and dogs, and enough lamp oil, to last the winter. It is fair to say that subsistence hunting of walruses was intensive throughout much of the region. At Nottingham Island in 1953, 117 walruses were taken by people from Sugluk and Ivujivik in organized hunts using boats supplied by the RCMP and the Roman Catholic mission, respectively (RCMP game report from Port Harrison). The estimated annual catch at Ivujivik during the late 1960s was somewhat more than 30 walruses, taken principally at Nottingham and Salisbury islands (Roy 1971).

Donaldson (1988:62-63) noted that official statistics on the landed catch at Cape Dorset were negatively biased. For the years 1981-83 the official catches were reported as 10, 35 and 59, respectively, whereas the estimates made from hunter recall surveys were 89, 54 and 66, respectively. The hunters sampled during the harvest study actually reported catches of 40, 74, 33 and 57 for 1980-83, respectively (*Ibid.*).

Ungava Bay and central Hudson Strait: In addition to one exceptionally large pre-1950 catch of 800 walruses made in one year at Akpatok Island (Currie 1968), catches of 150-200 were made there during the 1950s when trips from coastal settlements were feasible (*i.e.* when seaworthy Peterhead boats were available). Without Akpatok trips, the

average annual total catch in western Ungava Bay during the early 1960s was only about 40 walruses (Currie 1968). A catch of 20 was made at Cape Hopes Advance in 1956 (Evans 1964:17).

We have scattered records from other areas along the south coast of Hudson Strait. In the 1970s annual estimated landings were (NHRC 1976): Sugluk 58, Wakeham Bay 4, Koartak 11, Payne Bay 13, Leaf Bay 0, Fort Chimo 0, George River 1 and Port Burwell 3. It should be noted that much or all of the large catch at Sugluk was probably made at Nottingham or Salisbury Island in western Hudson Strait.

Southeastern and eastern Baffin Island: Loughrey (1959) estimated the annual catch of walruses along the east and south coasts of Baffin Island (from Cape Christian to Lake Harbour) at about 219 per year during the 1950s. It is not clear whether this includes all commercial and subsistence catches (by Inuit, police, and trading companies). During the 1960s the RCMP post at Pangnirtung had a quota of 12 walruses per year, taken for dog food. Most of this catch was made at the Leybourne Islands (Anders 1967). It was noted at the time that the Inuit of Cumberland Sound did not find it "profitable" to hunt walruses because of the great distances to the areas where walruses were still found (Anders 1967:43).

Dowler (1976, *in litt.*) gave an estimate of 156-206 per year landed during 1973-75 at Lake Harbour, Iqaluit (Frobisher Bay), Pangnirtung and Broughton Island, combined. The combined estimate for these same settlements (plus Clyde River) given by Richard and Campbell (1988) was 108 per year for the period 1972 to 1985. Adding the "minimum" and "maximum" catches recorded during the latter period for these settlements, the lowest potential catch in one year would be 17, the highest 298 (Richard and Campbell 1988:table 1). The catches for 1981-83 estimated from hunter recall surveys agree reasonably well with the official figures although in a few cases there are substantial discrepancies – *e.g.* in 1981, 35 vs. 58 for Iqaluit and 36 vs. 62 for Pangnirtung (Donaldson 1988:62). In the period 1988-93 (5 years) the reported average catch in these areas totaled about 62 walruses per year (range: 29-110; Anon. 1991... 94, R.E.A. Stewart *in litt.* 1995). The reason for the apparent decline in the reported landed catch is not clear.

Hunting loss: Most observers of walrus hunting in Canada have commented on the high losses (*e.g.* Manning 1944, Dunbar 1949), with estimates ranging from as high as three or four animals killed for every one secured (Low 1906) to as "low" as one or less than one being lost out of every four killed (Loughrey 1959). Smith and Taylor (1977:7) described a hunt (locality not specified) in which 50-70% of the walruses shot [and killed?] were lost, with "further considerable wounding loss" likely.

Manning (1944) observed that less than 10% of the walruses taken in northern Hudson Bay were killed on land. Although some were still harpooned in the water before being killed, the proliferation of hunting from whaleboats and Peterhead boats meant that increasingly the animals were shot first, then harpooned if possible. Manning estimated that 75% of the walruses killed could be secured if the hunters worked in an organized and cooperative manner. Since they did not, the loss rate was high. Manning implied that this would not necessarily be the case at a place like Coats Island where the animals were usually shot in shallow water and retrieved at low tide.

At Southampton Island 40 of 50 walruses that were "hunted" during the summer open-water hunt in 1961 were "actually killed", and of these none were lost (Freeman 1970). In this hunting, walruses were harpooned after being wounded with body shots. In the same year 5 of 13 walruses killed in the spring hunt from canoes were lost (Freeman 1970).

Even when walruses were harpooned before being killed, there could be significant hunting loss. For example, during a hunt near Salisbury Island Russell (1966:6-7) and his crew were forced to abandon seven walruses that had been harpooned and were ready to be taken on board. Thus the catch actually delivered to the trading post was less than what was in fact secured.

In the absence of rigorously collected recent data from the area of interest, we consider the general average of 30% loss to be appropriate for estimating total removals.

Catch composition: Freeman's (1970) data from Southampton Island indicate a ratio in the annual catch of three adults to one subadult and one calf. However, since calves were not reported in the catch statistics, the pro-ration is not straightforward. Freeman (1970) also noted that the sexual dimorphism in body and tusk size is not as extreme in the walruses at Southampton Island as it is elsewhere. From this, one can infer that selectivity on the basis of sex may not have been a prominent feature of walrus hunting there. During the period of his study, walruses were hunted at Southampton Island for the meat which was needed as dog food. Freeman (1970:170) stated that the value of ivory and walrus meat and blubber for household consumption was "secondary if not negligible at the present time."

No useful information was available for

assessing the catch composition in a meaningful way in other areas within the range of Stock 3. Official catch statistics are reported in terms of numbers of animals killed. However assuming that the hunters are constrained by the Marine Mammal Regulations (*cf.* Richard and Campbell 1988) allowing each licensee to take no more than four walruses per year, it is reasonable to suppose that the catch in most areas of Stock 3 is selective for large animals with large tusks (*cf.* Orr *et al.* 1986).

4. Western Greenland

Distribution and Stock Identity

The approximate summer and winter distributions of walruses in western Greenland are shown in Figs 8 and 9, respectively. Places mentioned in the text are shown in Figs 19-21.

Based on a variety of sources, Born *et al.*(1994a) summarized the historical and current status of walruses in western Greenland south of 76°N (Melville Bay). The following description is based largely on Born *et al.*(1994 a). Only when it is judged particularly relevant is the original source cited.

Southwestern Greenland south of 65°30' N: Walruses are not known ever to have been common in southwestern Greenland but stragglers occasionally were reported in the past as well as in recent years. Apparently walruses sometimes hauled out on land in two places near Nuuk (Fig. 19-20).

Central West Greenland (65°30' N to 70°30'N): Historically, the coastal waters between Nordre Isortoq and Attu (Figs 19 and 20) comprised the most important area for walruses in West Greenland.

From fall until spring, walruses occurred at the entrance of Kangerlussuaq (Søndre Strømfjord), close to the town of Sisimiut (Holsteinsborg) and at the entrance to Nassuttooq (Nordre Strømfjord). Mainly mixed herds of adult females with young and subadults occurred in the shallow coastal waters of these areas. Adult males were reported to prefer offshore areas with deeper water.

Beginning in September, both male and female walruses hauled out on uglit situated on small islands and on the mainland coast between approximately 67° 25' N and 67° 47' N, an area devoid of humans between October and April-May (Fig. 20). Apparently the walruses left the uglit in November-December. According to Freuchen and Salomonsen

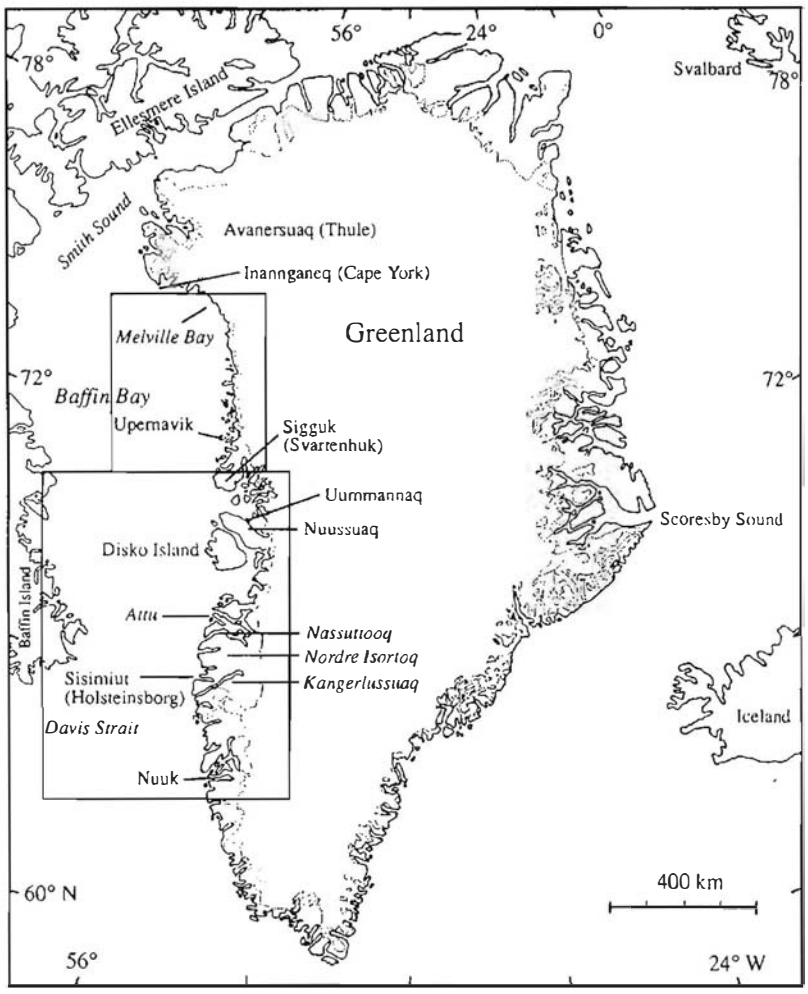


Fig. 19. Names of places in western Greenland (see also Figs. 20-21)

(1961) the number of walruses in this area increased in February, presumably due to immigration of animals from the Canadian side of Davis Strait.

Walruses rarely frequented the uglit after the late 1930s, and since the early 1950s no one has reported them as having hauled out on land in this region. Undoubtedly, the increased hunting at the uglit caused the walruses to abandon them. However, it cannot be determined with certainty whether the group of walruses that hauled out on land was extirpated or, instead, these animals learned to avoid the uglit and began wintering in the edge of the Baffin Bay-Davis Strait pack ice (the "West Ice").

In April the walruses retreated from the coastal regions to the eastern edge of the Davis Strait pack ice. Apparently they followed the westward retreat of the edge of the West Ice during spring. From around mid-June walruses were no longer found at the margins of the West Ice.

Information on the biology of walruses in these areas is scarce. In February males and females occurred together, whereas by late April adults were segregated by sex. By then the adult males occurred farther offshore and in denser ice than females with young.

Walruses were rarely seen near Aasiaat and in Disko Bay. They wintered, however, along the western coast of Disko Island. The walruses appeared in this area in October, and were reported to be abundant at the entrance to Kangerluk (Diskofjord) and were often observed near Kangersooq (Nordfjord) on the northwest coast of Disko. Since 1932, walruses have been caught from April until mid-June, 50-80 km west of Disko Island, at the margin of the pack ice. Large herds have been observed in June near Qeqertarssuatsiaq (Hare Island).

Occasionally, walruses hauled out on the small island of Saattut at the entrance to Kangerluk (Fig. 20). Apparently they no longer hauled out there after the 1950s. Walruses were also reported to haul out on land occasionally at Qeqertarssuatsiaq and on the north coast of Disko Island.

Systematic aerial surveys conducted in 1981, 1982, 1984, 1990, 1991, 1993 and 1994 (McLaren and Davis 1981, 1983, Born *et al.*1994a, Heide-Jørgensen and Born 1995) showed that walruses still occupy their former wintering range in the margin of the West Ice, between approximately 66° N and approximately 70°45' N. Apparently their occurence in this area is due to the availability of shallow feed-

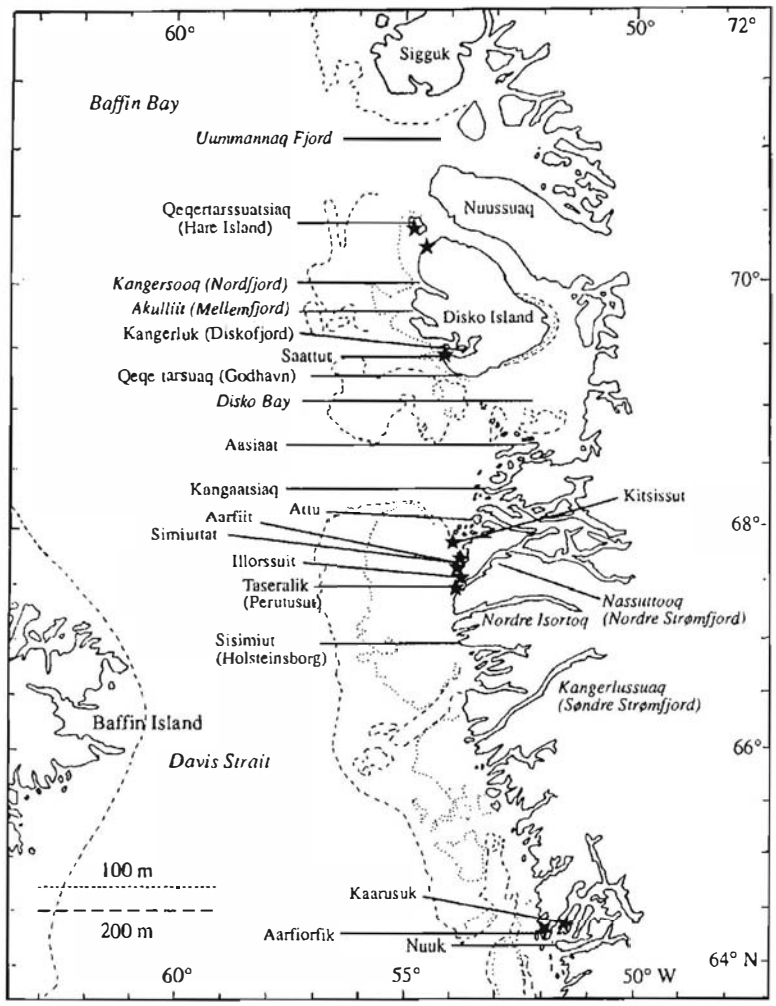


Fig. 20. Locations of abandoned terrestrial haul-outs (stars) in Central West Greenland.

ing grounds and suitable ice for hauling out. Walruses are absent from the entrance of Disko Bay where water depths exceed 200 m. Hence, their recent winter distribution off Central West Greenland is similar to that indicated by historical information. The major differences are their present absence from uglit, and the timing of migration.

From February until late May walruses are found in the pack ice about 30 to 100 km off the coast between Sisimiut and Kangaatsiaq (approx. 68°15' N).

Walruses are reported to arrive at the banks off the west coast of Disko in October-November. During winter they occur along the coast of northwestern Disko Island and around Qeqertarssuatsiaq (Hare Island). Subadults and females with young are generally reported to occur closer to the coast than males.

The walruses off Central West Greenland prefer areas with dense pack ice (usually more than 60% ice cover) in water that is less than 100 m deep. Several of the walrus's prey species inhabit these shallow banks. Most walruses observed during the aerial surveys were either single or in pairs. Larger congregations numbering one to two hundred have occasionally been reported from Central West Greenland.

Observations of newborn calves in this area are extremely rare. The walruses apparently have left these regions prior to the calving season. Recordings of underwater sounds indicate that walruses mate in these areas.

According to informants in Qeqertarsuaq (Godhavn) walruses are never observed moving southward south of the town of Qeqertarsuaq during fall, whereas those wintering near the northwest coast of Disko Island are believed to move north in May. Observations made during aerial reconnaissances flown along the coast between southwestern Disko and Sigguk (Svartenhuk) during spring 1982 indicated that the walruses wintering along the west coast of Disko progressively moved north in the shear zone between the fast ice and the pack ice. The timing of the catches in the Uummannaq and Upernavik areas, compared with that of catches farther south, supports this finding. However, scattered observations offshore in Davis Strait in March-July suggest that some walruses may migrate across Davis Strait from western Greenland to eastern Baffin Island during spring. The absence of walruses at the entrance to Disko Bay and in the bay proper, the information about migration and the differing response to exploitation indicate that the walruses that winter in Central West Greenland belong to two groups: one along the west coast of Disko representing the southern extreme of the North Water population (Stock 5), and a southern group off Attu-Sisimiut, presumably connected with Stock 3.

Northwestern Greenland (70°30' N to 76°N): Between Nuussuaq (70°45' N) and Inannganeq (Cape York) at the margin of the "North Water" polynya, the dense Baffin Bay pack ice lies close to the shorefast ice, leaving the walruses only limited space to overwinter in the Uummannaq and Upernavik areas.

Generally, the historical and present distribution of walruses in the Uummannaq and Upernavik areas appear similar. Walruses are not numerous in these areas and they appear to be mainly transient. A limited number can occur during winter in cracks and leads in the shear zone between the fast ice and the Baffin Bay pack ice. Northward migrating walruses are observed along the edge of the fast ice in the Uummannaq area during spring, but they rarely enter Uummannaq Fjord where the water is deep.

Farther north, migrants occur along the ice edge at the outer archipelago of the Upernavik area during spring (Fig. 21). Occasionally, walruses also are observed closer to the mainland coast. Walruses are more likely to be encountered in certain areas: Kiatassuup qeqertarsui (Ryders Islands, approx. 74°45' N), and between Kiatassuaq (Holms Island) and Nuussuaq (Kraulshavn), and at Kitsissorsuit (Ederfugle Islands).

Walruses were reported to haul out occasionally on the small islands near Eqqorleq.

According to Freuchen (1921) and Vibe (1950) the walruses crossed Melville Bay/Qimusseriarsuaq far offshore during their spring migration north into the Smith Sound region.

Although there are indications that some walruses move north in the shear zone between the shorefast ice and the Baffin Bay pack ice during spring, a "large scale" spring migration north along the western coast of Greenland as indicated in Freuchen (1921) is not witnessed nowadays.

The connection between walruses occurring in parts of the Baffin Bay and Davis Strait area is poorly known. However, in some areas walruses were caught with harpoon heads or rifle bullets that originated from other areas. This was interpreted to mean that a connection existed between walruses in different areas of northern Baffin Bay; for example between Avanersuaq (Thule) and the Ummannaq area in western Greenland, and between Pond Inlet in Canada and western Greenland (Freuchen 1921, 1935, Vibe 1950, Bisset 1968).

Freuchen (1921) and Vibe (1950, 1956) suggest-

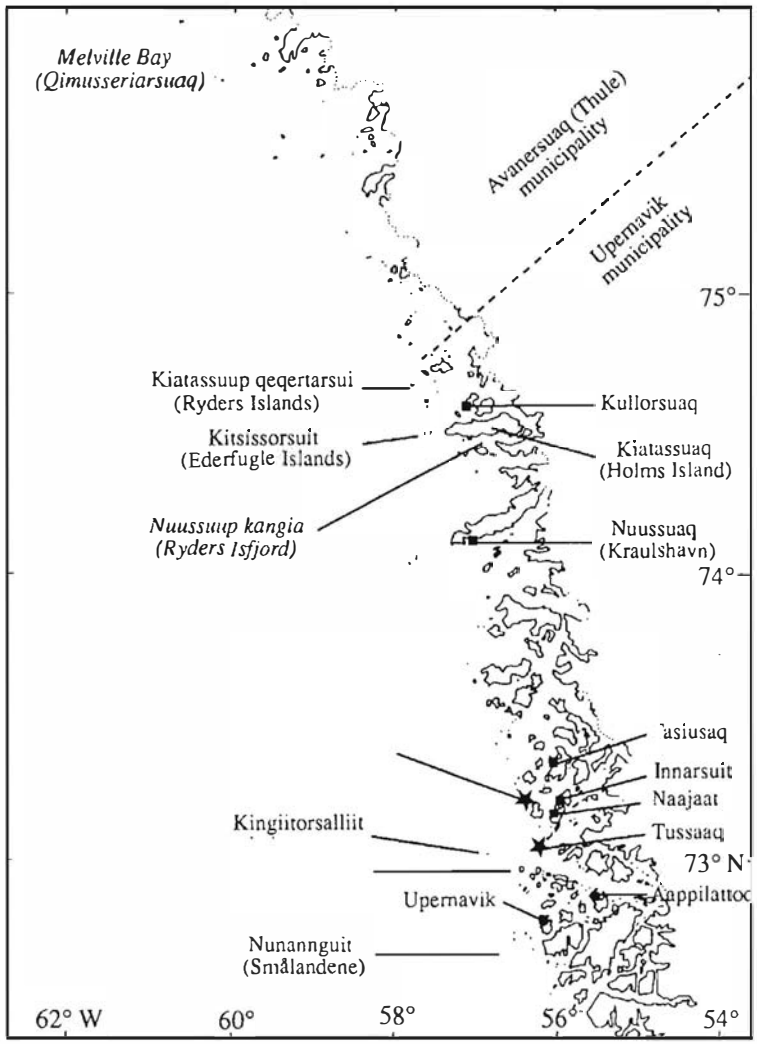


Fig. 21. Locations of abandoned terrestrial haul-outs (stars) in the Upernavik municipality in northwestern Greenland. Villages are shown as black squares.

ed that the walruses from Central West Greenland moved northward during May and June to join the walruses wintering in the northern Baffin Bay - Smith Sound region. In October there appeared to be a southward movement along the east coast of Baffin Island and the northwest coast of Greenland. From Baffin Island the animals were believed to move across Davis Strait to reappear in the central parts of West Greenland in the fall. Vibe (1967) assumed that the majority of the Baffin Bay summering population moved from the Avanersuaq (Thule) area in the fall to Lancaster Sound, and that from there some crossed Baffin Bay to western Greenland. Walruses off Central West Greenland were believed to stay in the Davis Strait pack ice or to cross the strait and join the population at south-eastern Baffin Island in severe winters (*Ibid.*).

Loughrey (1959) and Mansfield (1973) suggested that Atlantic walruses had more sedentary habits than Pacific walruses, and Mansfield (1973) questioned whether the large-scale, counter-clockwise migration cycle in the Baffin Bay-Davis Strait area suggested by Freuchen (1921) and Vibe (1950) actually occurred. Mansfield (1973) also indicated that walruses apparently had become scarce along the northeast coast of Baffin Island. In this area the Inuit did not witness any southward movement according to Bisset (1968). Nor did Koski and Davis (1979) and Koski (1980) during their systematic aerial surveys find any indication of a major southward fall movement along the northeast coast of Baffin Island. The absence of a substantial southward migration during fall along this coast was confirmed by the fact that there was only one sighting of walruses (seven on an ice floe on 5 October) during 260 h of observations for marine mammals conducted from Cape Adair between 13 September and 10 October 1978 (Koski and Davis 1979). We note with interest that according to Kemp (1976) the people of Clyde hunted walruses, mainly in fall, in five main areas during 1923-54: 1. the mouth of Alexander Bay and associated fiords; 2. central Isabella Bay and haulout sites off Henry Kater Peninsula; 3. Clyde Inlet and the mouth of Inugsuin Fiord; 4. the south side of Eglinton Fiord; 5. Scott Inlet.

From the dates when walruses appeared at various locations, Dunbar (1956) suggested that the

Hudson Bay, Hudson Strait and Frobisher Bay groups might comprise one large population. He suggested that the population moves into Hudson Strait in spring and out again in late fall, wintering perhaps in the neighborhood of the ice edge in Davis Strait, where they may well join the walruses occurring off Central West Greenland, as also suggested by Freuchen and Salomonsen (1961) and Mansfield (1973). It is still not clear, however, whether walruses from eastern Hudson Strait mix with walruses in Hudson Bay (Orr and Rebizant 1987).

Born *et al.*(1982) found indications of a northward movement in spring along the west coast of Disko Island. However, scattered observations of walruses in May-July in the middle of Davis Strait suggest that some walruses cross Davis Strait from Greenland to southeastern Baffin Island.

The finding of six haplotypes in analyses of mitochondrial-DNA from 10 walruses sampled during spring off Attu-Sisimiut in Central West Greenland (Cronin *et al.*1994) may reflect a mixing in this area during winter of walruses from different areas – for example northern Baffin Bay and southeastern Baffin Island.

Indications that walruses no longer migrate in any significant number southward in the fall along either the northeast coast of Baffin Island or the northwest coast of Greenland can be interpreted to mean that walruses occur in more sedentary groups nowadays, and that their numbers have decreased substantially.

Population Size

There are no historical estimates of abundance of walruses in western Greenland. Apparently several hundred used the uglit during fall. On 21 September 1897, about 300 animals were estimated to be present at the islands of Taseralik. In 1919 an estimated 600-800 walruses hauled out on the promontory of Illorssuit. In the fall of 1929, 600-700 animals were present on the islands south of Attu.

Catches during several decades of many hundreds of animals indicate, however, that several thousand walruses wintered in Central West Greenland at the beginning of this century.

The estimates of abundance based on aerial surveys between 66°N and 70°30' N from 1981-1982 and 1990-1991 revealed no trend since 1981 (Born *et al.*1994a). The line transect estimates in 1990 and 1991 produced a point estimate of the visible population wintering in Central West Greenland, between approximately 66°15' N and 70° 30' W, of about 500 animals (95% CI: 204-1512). Aerial surveys during late winter in 1993 and 1994 confirmed that the number of walruses wintering in Central West Greenland is in the low hundreds. These estimates are not corrected for animals which could have been submerged during the surveys. There were indications of a decline during the 1980s and early 1990s in numbers in the southern wintering area (Attu-Sisimiut) (Heide-Jørgensen and Born 1995).

Exploitation

Hunting methods – Central West Greenland (65° 30' N to 70° 30' N): The walruses were caught for their hide, blubber and tusks. In Greenland the meat was also used for human food and as food for sled dogs. Salted walrus hides, blubber and tusks were exported by the Greenland Trade Company (Vibe 1967, Born *et al.*1994a).

Traditionally, walruses were hunted from kayak, and often the skin-covered boats – umiat – were used for transportation. Some, presumably few, walruses were also taken during winter at their breathing holes in new ice – for example along the west coast of Disko Island, along ice edges, or when they hauled out on the shorefast ice.

However, of most significance were the walrus hunts by Greenlanders at the uglit in fall, and from 1932 the catch offshore during spring and early summer. Foreign whalers and sealers also caught walruses along the coast of western Greenland. These three types of hunting operations are described briefly in the following.

Traditionally, Greenlanders conducted co-operative walrus hunts during fall at the uglit at the entrance to Nassuttooq. Skin-covered boats and kayaks were used for transportation. However, in 1911 the Greenland Administration provided a motorized schooner which served as an auxiliary vessel during the walrus hunts at the uglit. This initiated an era of increased catches. For the period 1911-1937, a total catch of 1737 walruses was recorded for these hunts at the haul-out sites. This represents a minimum for the catches in these areas. Although these hunts were organized to some extent, many severely wounded walruses escaped into the sea, and losses could be high in some cases. Furthermore, in some years many walruses were killed but not reported. The annual catches were highly variable. For example, in 1898, 44 walruses were caught, and in this area more than 200 animals were killed in 1905. Despite the use of a larger vessels after 1911, the annual catch was still very variable due to the adverse weather conditions prevailing during fall.



Fig. 22. Greenlanders hunting walruses in the "West Ice" off the coast of Central West Greenland, presumably in the late 1930s. Photo: Archives of Arktisk Institut, Copenhagen. Photographer unknown.

A rapid increase in the population of Greenlanders led to an increased demand for hunting products and cash income. During the period 1911 to 1945, the human population in western Greenland almost doubled. During the same period the hunting technology changed dramatically. The number of motorized boats in western Greenland increased from one in 1925 to 390 in 1951. In 1939, 42% of the privately owned motorized vessels were registered in Sisimiut and Aasiaat, two of the most important walrus hunting communities. In 1949 this figure was 57.5%. A major reason for the relatively large number of motorized boats in these towns was that in these areas hunting, particularly of walruses, could be combined with fishing.

The Greenlanders began to use motorized vessels to take walruses offshore in 1932. In the beginning the Greenland Administration supplied the hunters with the vessels free of charge, but soon both vessels owned by the Greenland Administration and privately owned motorized vessels participated in the catch.

During cold winters the edge of the West Ice lies close to the coast (Vibe 1967). Apparently, the mild weather after about 1920 made ice conditions at the edge of this ice less severe during spring, thereby facilitating access by the vessels to walrus habitat. Hence, the combination of increased size of the fleet of motorized fishing vessels and lighter ice conditions during spring may have had a synergistic effect, causing the catch of walruses in Central West Greenland to increase rapidly during the 1920s.

Both British and Norwegian whalers and sealers caught walruses in the Davis Strait and Baffin Bay regions. Many of these walruses were taken along the coast of western Greenland off Sisimiut and Disko Island (Ross and MacIver 1982, Born *et al.* 1994a).

The British whaling operations in these areas ceased around 1910 (Ross and MacIver 1982). However, by that time Norwegian sealers and whalers commenced their walrus hunt in the West Ice between Sisimiut and Disko (*e.g.* Isachsen 1922, Isachsen and Isachsen 1932, Vollan 1951). The Norwegian offshore operations in western Greenland continued until World War I, and were resumed for the period 1919-1923 (Isachsen and Isachsen 1932, Vollan 1951). Prices of walrus hides dropped in 1921 and the Norwegian sealers discontinued



Fig. 23. Greenlanders butchering walruses in the "West Ice", presumably in the late 1930s. Photo: Archives of Arktisk Institut, Copenhagen. Photographer unknown.

their walrus hunt in Davis Strait until 1931, when two vessels again took walruses there (*Ibid.*).

The fact that foreign sealers made large catches of walruses close to the west coast of Greenland was used in Greenland as an argument for commencing the "rational" exploitation of walruses by Greenlanders, involving the use of motorized vessels (*e.g.* Müller 1906).

Northwestern Greenland (70°30' N to 76° N): In the Uummannaq and Upernavik areas walruses are either caught when they winter in the shear zone between the fast ice and the Baffin Bay pack ice, or when they move along the ice edge in spring. The seasonal distribution of the catch indicates that relatively many "late stragglers" are taken in the Uummannaq area. Walrus hunting practices in the Uummannaq and Upernavik area differ appreciably from those in the more southern districts. In the Uummannaq and Upernavik area, walruses were and are still caught by boat during fall, and from the ice edge during winter and spring; larger vessels are not used for walrus hunting.

Catch levels – Catches by Greenlanders in Central West Greenland: According to Rink (1877), the annual walrus catch in western Greenland hardly exceeded 200 animals in the first half of the 19th century. The catch in South Greenland (*i.e.* south of Maniitsoq) was estimated to be 10-20 per year at the beginning of this century (Müller 1906).

During the 1930s the offshore catch of walruses was intensified. According to the Hunters' Lists of Game (HLG) the highest landed catches were reported for 1938 (625 walruses) and 1940 (621 walruses), whereafter the catches decreased by an aver-



Fig. 24. A 20 ton fishing vessel during a walrus hunt in the "West Ice" off Sisimiut/-Holsteinsborg, Greenland, in April 1982. Photo: R. Dietz.

age of 3% per year until about 1965. According to the HLG, a total of 12306 walruses were landed by Greenlanders in western Greenland (Avanersuaq-Thule area not included) between 1900 and 1987 (last year of reporting). Due to loss of mortally wounded and killed walruses, and under-reporting of the landed catch, this figure represents an absolute minimum of the total removals of walruses during the period. Furthermore, the catch taken by foreign sealers and whalers should be added to these figures.

About 89% of the total catch was reported from the communities between Sisimiut and Nuussuaq in Central West Greenland (between 67°N and 70° 30' N); 74% were reported from Aasiaat, Attu and Sisimiut alone. About 7% of the total catch was reported from the Uummannaq and Upernavik areas, and only about 4% from areas south of Sisimiut.

Since about 1965 the reported catches of walruses have remained low. For the period 1965-1987 the annual catch in western Greenland, according to the HLG, averaged 56 animals (SD= 19.7, range: 19-101, n=23 annual reports). However, about 1975, the numbers of hunters reporting catches decreased. To compensate for this development, the catch figures reported for 1979-1985 in the published HLGs include estimates of unreported catches. Hence catch figures since about 1975 are not reliable. The numbers of reports received from Sisimiut – traditionally an important walrus hunting community – have been particularly insufficient in recent years. For example, in 1983 and 1984, when in each year an estimated 10 walruses were caught in Sisimiut according to the HLG, 40 and 74 walruses were taken, respectively, according to information obtained from residents in Sisimiut (Born *et al.* 1994a).

During the period of intensified exploitation in the 1930s and 1940s reproductive females were hunted selectively. The adult females occurred closer to land than males and were considered more valuable economically. The yield of blubber was relatively high in adult females and the ivory from their tusks was good for making tools and artifacts (Born *et al.* 1994a).

Catches by Greenlanders in northwestern Greenland: According to the HLG the annual catch of walruses in the Uummannaq and Upernavik areas decreased between 1940 and 1987. The average annual catch in the period 1940-1959 in the Upernavik and Uummannaq areas combined was around 22 walruses; between 1960 and 1987 the catch averaged 11 walruses per year. Over the entire period, the catch in the Uummannaq area amounted to about 20 % of the total catch of walruses in these two municipalities.

Catches by foreign whalers and sealers: Between 1859 and 1910, a minimum of 3734 walruses were taken in the Davis Strait and Baffin Bay regions by British whalers. The actual catch of walruses by British whalers probably was much higher. A substantial portion of these catches was taken off Central West Greenland during spring (Ross and MacIver 1982). In some years catches were high. For example, in 1906 a whaler took 300-400 walruses in the West Ice (Müller 1911).

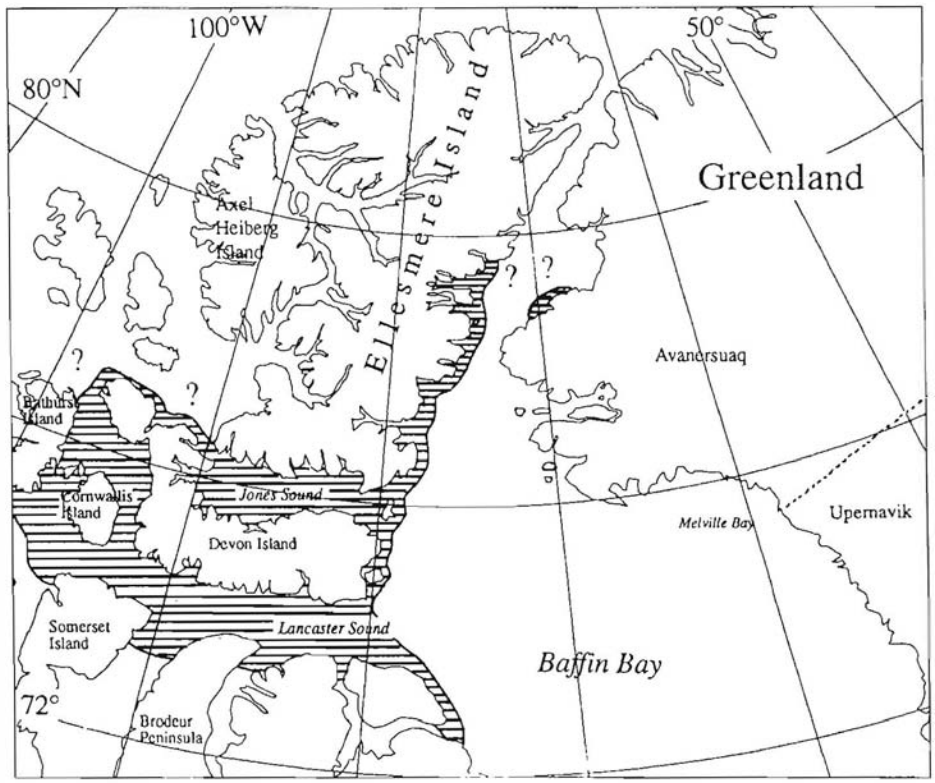


Fig. 25. Approximate summer distribution of walruses belonging to the North Water stock.

Information on the positions and the magnitude of the Norwegian catches of walruses at the beginning of this century is generally incomplete. However, in some years the Norwegian catch of walruses off western Greenland was high, sometimes several hundred animals (Born *et al.*1994a).

Hunting loss: No quantifiable data on hunting loss are available for western Greenland. An eyewitness account from 1937 from the hunt in the West Ice indicated that losses could be considerable. During those days the hunting practice was similar on board other vessels, and often the walruses were not harpooned before being shot (Born *et al.*1994a).

Due to the similarity in hunting practice between Greenland and Canada where losses from 20 to 50% have been reported (Mansfield 1973, Smith and Taylor 1977, Orr *et al.*1986), an overall loss rate (proportion of all animals killed or mortally wounded that are not retrieved) of 30 % is suggested for the kill in western Greenland.

Catch composition: A sample (n=26) taken offshore in the Sisimiut-Attu area (1982-1989) indicates that at present old and large walruses are hunted selectively. Sexually mature females (here, 5 years and older) constituted about 58% of the sample (Born *et al.*1994a).

5. North Water (Baffin Bay – Eastern Canadian Arctic)

The North Water (NOW) situated in northern Baffin Bay is the largest recurring polynya (*i.e.* area of open water surrounded by ice; Stirling and Cleator 1981) in the Canadian and West Greenland Arctic (*e.g.* Smith and Rigby 1981). Smaller persistent open (or semi-open) water areas exist at the entrance to Jones Sound off Coburg Island, in Hell Gate-Cardigan Strait in western Jones Sound and in Lancaster Sound off the southeast coast of Devon Island (*e.g.* Sverdrup 1903, Vibe 1950, Kiliaan and Stirling 1978, Smith and Rigby 1981, Fig. 26). Such open water areas are found in Greenland around Northumberland Island, and between Saunders Island and Wolstenholme Island (Vibe 1950).

For this report we include under the NOW area the entire eastern Canadian high Arctic, encompassing the Lancaster and Jones sound regions and their adjoining inlets and fiords.

Distribution and Stock Identity

Approximate summer and winter distributions of walruses in the NOW area are presented in Figs 25 and 26, respectively. Names of places mentioned in the text and terrestrial haul-out sites, are shown in Fig. 27.

Walruses winter in the NOW, in the polynyas connected with it, and in leads and holes in the

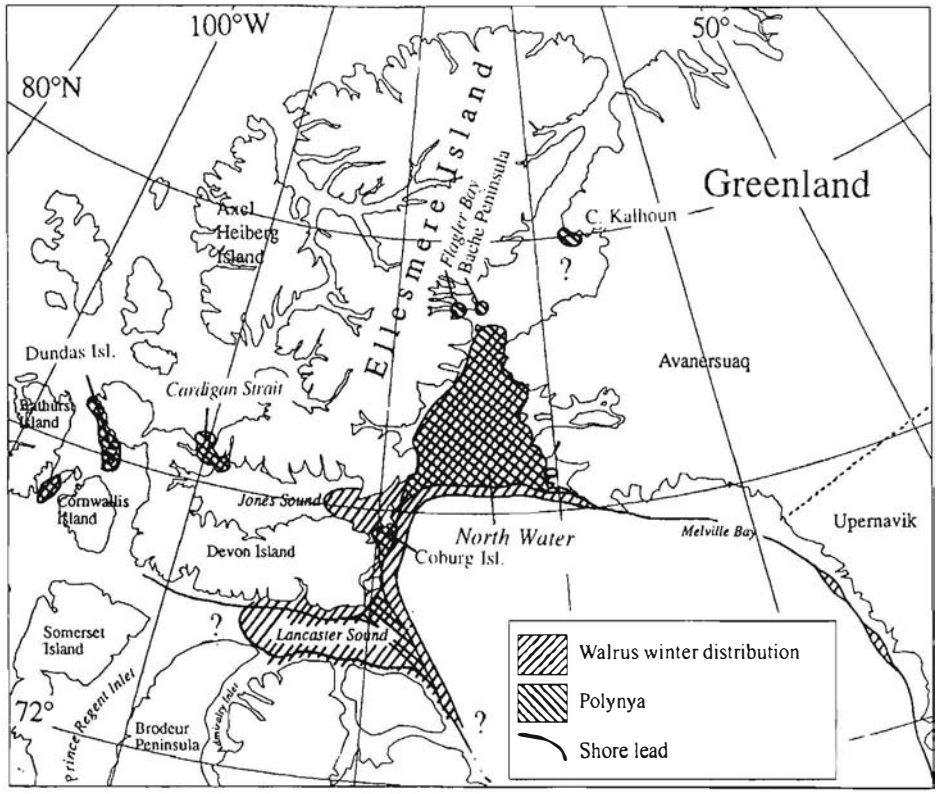


Fig. 26. Approximate winter distribution of walruses belonging to the North Water stock.

consolidated ice of adjacent areas (*e.g.* Kane 1892, Vibe 1950). It has been suggested that walruses might also winter in small polynyas in the Kane Basin region, for example in Flagler Bay (Schledermann 1980), off the tip of Bache Peninsula, and near Cape Kalhoun on Washington Land (Vibe 1950).

The following description of the distribution and movements of walruses in the NOW area proceeds from winter through fall.

In the eastern parts of the NOW area walruses winter in the Avanersuaq (Thule) area between Qeqertarsuaq (Wolstenholme Island) and Cape Inglefield (*e.g.* Kane 1856, Hayes 1867, Peary 1898, Freuchen 1921, Vibe 1950, Born 1987). The thin ice

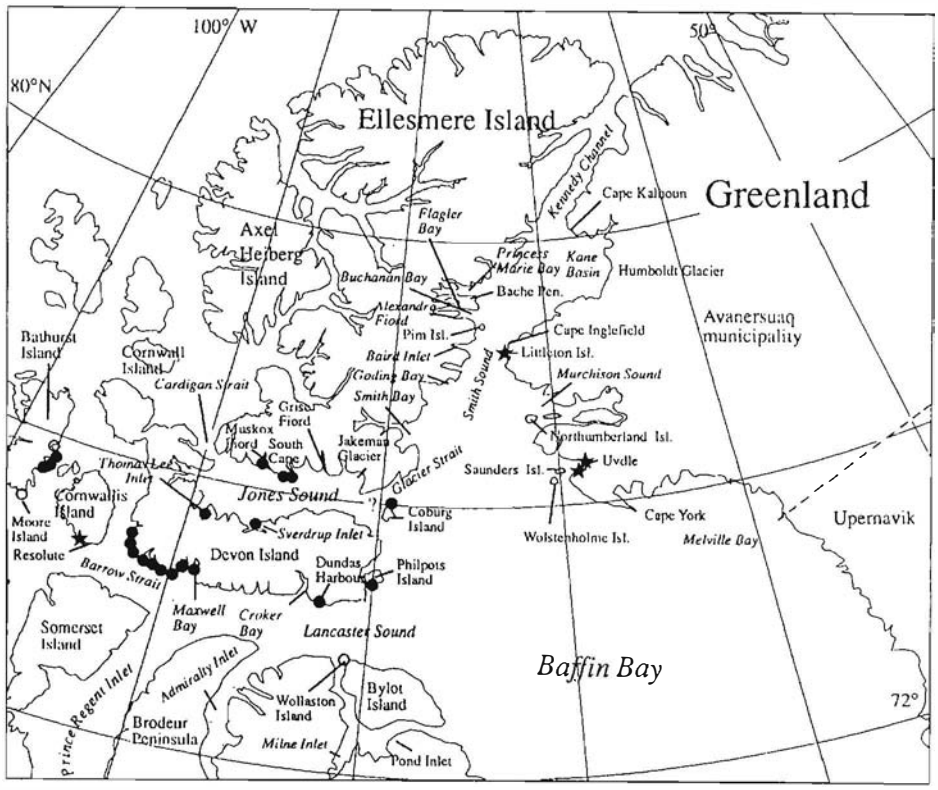


Fig. 27. Terrestrial haul-out sites used by the North Water stock of walruses. Legend: Black dots = haul-outs still used by walruses. Open circles = historical haul-outs; present status unknown. Stars = Abandoned haul-outs.



Fig. 28. In the Penny Strait-Queens Channel area (Canadian High Arctic), some walruses overwinter in heavy consolidated pack ice. They keep breathing holes open or surface in cracks and leads. Photo: E.W. Born.

there is frequently broken up by storms, giving the walruses access to shallow feeding banks (Vibe 1950, Born and Kristensen 1981). During winter walruses are hunted on the thin ice or from the edge of the fast ice. Walruses in the Avanersuaq area are segregated on the basis of sex and age class, with females and subadults generally occurring farther north than adult males (*e.g.* Peary 1917, Freuchen 1921, Vibe 1950, Born unpubl. data).

Walruses also winter in the outer half of Jones Sound (Freuchen 1921, Vibe 1950, Loughrey 1959, Riewe 1976, 1977), including Glacier Strait (Riewe 1992:180). Occasionally some individuals become stranded in Jones Sound by a quick freeze-up and are forced to maintain aglus in the ice throughout the winter (Riewe 1976, 1977, Riewe and Amsden 1979, Kiliaan and Stirling 1978). In May 1972 a hundred walruses were reported to be present in the Hell Gate-Cardigan Strait polynya in western Jones Sound (Kiliaan and Stirling 1978), where walruses are known to winter (Sverdrup 1903, Riewe and Amsden 1979, Stirling *et al.*1983). Walruses winter in the Cardigan Strait-Fram Sound and Penny Strait-Queens Channel areas (Stirling *et al.* 1983).

In connection with polar bear studies the Flagler Bay polynya and the open water at the eastern tip of Bache Peninsula were surveyed



Fig. 29. Hot-iron branding of a male walrus at the Dundas Island polynya (Canadian High Arctic) in April 1988. The animal, which was immobilized with Zoletil ® (Stirling and Sjare 1988), was unconscious during the branding. In the late 1980s a total of nine male walruses were branded and tagged in the Dundas Island polynya – Kerr Island area by Canadian Wildlife Service scientists. These animals have not been resighted outside the tagging area (I. Stirling ***in litt.*** 1995). Photo: E.W. Born.

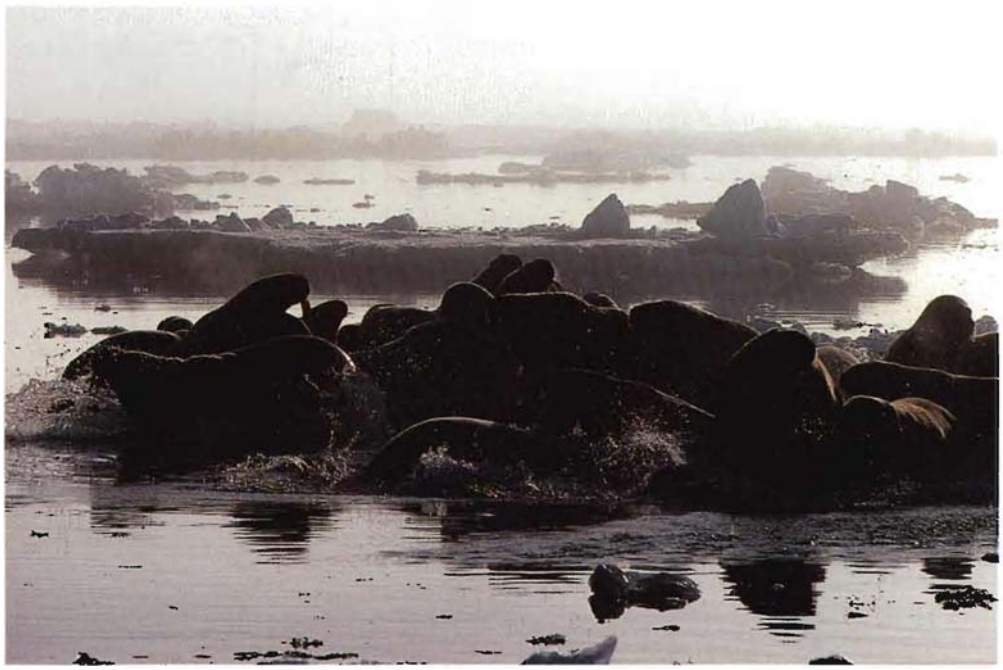


Fig. 30. A mixed herd of walruses hauled out on the pack ice in northern Smith Sound in July 1977 (see text). Photo: T. Kristensen.

between 29 April and 2 May 1994. No signs of walruses were detected in these areas. This was also true of the polynya off Cape Kalhoun (at southwestern Washington Land, *cf.* Vibe 1950) where open water was found at 80°08' N-67°30' W on 1 May 1994 (Born unpubl. data). It thus appears that walruses usually do not winter in these polynyas, which were separated during late April and early May 1994 by consolidated pack ice from the suitable walrus habitats farther south in the Smith Sound region.

In the past, walruses arrived in Avanersuaq (Thule) from the south during spring (Freuchen 1921, Vibe 1950). These migrants joined the animals that had overwintered there. Although information from local people indicates that some walruses still do come from the south during spring (Born unpubl. data), it appears that the pronounced influx during June and July, described by Freuchen (1921) and Vibe (1950), no longer takes place. During aerial surveys conducted in the periods 2 to 18 May 1992 and 4 to 8 May 1993 in the Melville Bay area (including the shore lead between 74° 30' N and 76°N) only two walruses were observed (Born *et al.*1992, Rosing-Asvid 1993). This supports the conclusion that there is no longer any substantial northbound spring migration of walruses along the west coast of Greenland.

Walruses are present at the floe edges of Pond Inlet and Lancaster Sound in spring (Riewe 1992); there is no strong evidence to suggest that these animals are from wintering areas along the east coast of Baffin Island. Aerial surveys during spring 1978 and 1979 revealed no major movement of walruses towards the NOW area from the south along the east Baffin coast (Koski and Davis 1979, Koski 1980). The westward movement of walruses as the ice breaks up makes them available to hunters all along the south side of Lancaster Sound and up to 15 km offshore (Schwartz 1982). According to Schwartz (1982), much of whose data came from interviews with hunters, walruses also penetrate well inside Pond Inlet, Milne Inlet and Admiralty Inlet during late spring and summer.

From April until sometime in June the walruses that wintered in Avanersuaq migrate north along the edge of the shore-fast ice (Freuchen 1921, Vibe 1950, Born 1987). Until about mid-July the ice dam in northern Smith Sound between Pim Island and Cape Inglefield prevents them from migrating farther north into the Kane Basin region. In June and July concentrations of walruses can occur along the edge of the pack ice in northern Smith Sound (*e.g.* Born 1987, Born and Knutsen 1988, Born and Knutsen 1990a) and along eastern Ellesmere Island south of Pim Island (Vibe 1950, Koski and Davis 1979). When the boat hunting is allowed to commence in Avanersuaq on 15 May, after which date thin ice usually does not form, the walruses retreat to the eastern coasts of Ellesmere Island, apparently as a reaction to the hunting (Born unpubl. data).

During aerial surveys conducted over the NOW area in 1978 walruses were observed in May-June along the edge of the shorefast ice off Ellesmere Island, the Lancaster Sound ice edge and the southeast coast of Devon Island. However, small numbers were also consistently sighted along eastern Devon Island, east of Coburg Island, and in Jones Sound (Koski and Davis 1979). During aerial surveys flown over the NOW area during the period 9 May-

2 July 1979 walruses were found in or north of Lancaster Sound. Other areas of importance to walruses were: 1. Coburg Island, 2. the Jones Sound ice edge, 3. southeastern Devon Island, and 4. the Navy Board Inlet ice edge (Koski 1980).

During summer (mid-June to mid-September) the central parts of the Avanersuaq area is devoid of walruses, except for a few stragglers (Born unpubl. data).

When cracks form in the consolidated pack ice in the Kane Basin – Nares Strait region walruses moved northward from Smith Sound; some were reported to penetrate the Kennedy Channel region (*e.g.* Kane 1856, Greely 1888, Rasmussen 1921, Freuchen 1921, Vibe 1950). According to the Inuit of the Avanersuaq area some walruses, predominantly males, still migrate via cracks and leads in the pack ice north along the coast of Inglefield Land to summer off the Humboldt Glacier (Born and Knutsen 1988). Presumably the number of walruses summering in the Kane Basin area varies a great deal from year to year, depending on ice conditions. However, there are no indications that in any year significant numbers summer there.

Officers stationed at an RCMP post in Alexandra Fiord during the 1950s and 1960s regularly reported large numbers of walruses, including a large proportion of females and calves, hauled out on the pack ice in Buchanan Bay and Hayes and Flagler fiords (RCMP game reports). The animals generally arrived in July or early August and left the area by mid September when new ice began forming in the embayments and along the coast. The occurrence of walruses in these areas and in Princess Marie Bay appears to be fairly regular (Freuchen 1921, Vibe 1950, Burton 1980, Schledermann 1980, Born and Knutsen 1988). A small recurring polynya in the Flagler Bay area is thought to attract walruses (Schledermann, 1980). Walruses reach this area in late June or early July (Schledermann 1978), following leads in the ice from the NOW (K. McCullough *in litt.* 1988).

Freuchen (1921) stated that according to Inuit, walruses migrate south along the east coast of Ellesmere Island, where they could meet those that spend the summer in or near Jones Sound (Vibe 1950). According to Greely (1888) Baird Inlet was a favorite feeding ground for walruses. On 7 August 1894 Ohlin (1895) found walruses in great numbers in Talbot Inlet west of Cape Faraday. At the end of July 1987 considerable numbers of walruses were seen at Cape Clarence Head; many females accompanied by calves were observed in Goding Bay (J. Schneller, pers. comm. 1989).

Walruses summer in Jones Sound, entering mainly from the east as the fast ice begins to break up in June or July (Riewe 1992:75,131,185,238). Females and young congregate along the lip of Jakeman Glacier, while males reportedly travel farther west towards the Hell Gate area (Riewe 1976, 1977, Riewe and Amsden 1979). This influx of walruses in late June and early July to Jones Sound was observed during aerial surveys of the NOW area. On 13-15 September relatively small congregations (<15) of walruses were observed along the coasts of Jones Sound west of South Cape, in Baad and Muskox fiords, along the ice edge at Hourglass Bay and off Viiks Fiord (Koski and Davis 1979). Riewe (1976) stated that walruses often haul out during the open-water season on the lowland west of South Cape and in Muskox Fiord. During this period mixed groups that are feeding are regularly observed off the settlement of Grise Fiord (D. Akeagok pers. comm. 1994 and 1995).

The walruses that congregate along the Lancaster Sound ice edge in May and June migrate westward following the receding ice edge (*e.g.* Degerbøl and Freuchen 1935, Bissett 1968, Johnson *et al.* 1976, Greendale and Brousseau-Greendale 1976, Davis *et al.* 1978). The main migration into Lancaster Sound apparently occurs between mid-June and mid-July from the northeast. During the open-water season walruses remain in considerable numbers along the south and southeast coasts of Devon Island (Koski and Davis 1979, Koski 1980, Renewable Resources Consulting Services Ltd. 1976). Along this coast, which has several terrestrial haul-out sites, they prefer Croker Bay, Dundas Harbour and the shallows north of Cape Sherard. The north and east coasts of Bylot Island seem to function primarily as a migration route (Renewable Resources Consulting Services Ltd. 1976). A few walruses may still haul out on the Wollaston Islands in the mouth of Navy Board Inlet, where they are hunted by the Inuit of Pond Inlet (Schwartz 1982).

Walruses were observed regularly from late September until early November off Dundas Harbour in the 1930s (Hudson's Bay Company Archives, Dundas post journals, unpubl. data). They were also present near the post in mid February and between Cape Warrender and Maxwell Bay from early March through July. In 1935 they were described as "exceptionally abundant" at the floe edge of this area on the first of May. They were hunted between Croker Bay and the southwest corner of Devon Island throughout July (*Ibid.*).

Resolute hunters report that walruses winter in the loose ice of Lancaster Sound, arriving at Resolute in late spring as the ice breaks up. In the past, westward migrating walruses entered Barrow

Strait through Resolute Passage, then moved into McDougall Sound, Queen Channel, and Penny Strait. They supposedly stopped going through Resolute Passage because of ship traffic, pollution, and other human disturbances associated with the development of Resolute. The walruses now migrate south of Griffin Island to reach the areas farther north. McDougall Sound, Queens Channel and Penny Strait were still considered walrus summering areas in the mid 1970s (Riewe 1976).

In years when the ice in Barrow Strait fails to clear, large numbers of walruses are said to move into Prince Regent and Admiralty inlets or into Wellington Channel. They are hunted relatively intensively in the vicinity of Cape Clarence and along the north coast of Somerset Island (Schwartz 1982). There was (and may still be) an ugli at Rapid Point on Bathurst Island. In the 1950s there were small uglit on one or two islands on the west side of Allen Bay, southwestern Cornwallis Island, where the Inuit from Resolute regularly hunted walruses (Manning and Macpherson 1961). These were no longer occupied by walruses in the 1960s "because of human disturbance" (Riewe 1976:178).

Manning and Macpherson (1961) reported that in August 1954 small groups of walruses, including calves, were present in western Barrow Strait around the western entrance of Baring Channel. They also claimed that walruses were killed occasionally in northern Peel Sound (Browne Bay). In fact, these authors surmised that the "scattered records" of walruses all the way west to Coronation Gulf and Amundsen Gulf probably involved mainly Atlantic walruses that had strayed westward, perhaps through Peel Sound or Bellot Strait (also see Bethune 1934, Harington 1966, Finley *et al.* 1974, Stewart and Burt 1994 for other "extralimital" records and interpretations).

Walruses have apparently always been rare in the waters near Pelly Bay (southwestern Gulf of Boothia) and Spence Bay (James Ross Strait) (Villiers 1970, Brice-Bennett 1976, Lyall 1979). Those that reach these areas are most likely wanderers from the Lancaster Sound/Barrow Strait region. The Pelly Bay people reportedly caught individual walruses in the 1960s or early 1970s at the mouth of the Kellett River and the southern end of St. Peter Bay (Brice-Bennett 1976).

Judging by the sparseness of records and the fact that walruses are not mentioned among the resources used by Inuit in Prince Regent Inlet and Gulf of Boothia (*cf.* Schwartz 1982), it can be assumed that these areas are unimportant as walrus habitat.

During fall walruses migrate eastward through Lancaster Sound to their wintering grounds in the northern Baffin Bay region. This migration is less conspicuous than the spring migration into Lancaster Sound. For example the eastward migration of walruses through Lancaster and Jones sounds was not even detected during studies in 1978. A southward migration from Lancaster Sound along northeastern Baffin Island was not observed during coastal watches until 10 October 1978 (Koski and Davis 1979). Neither were movements of walruses along the coast of northeastern Baffin Island observed in 1979 (Koski 1980).

Substantial numbers of walruses were present in Jones Sound in late summer and fall 1979 (Koski 1980). Prior to freeze-up walruses congregate in hundreds in the vicinity of Cape Sparbo in Jones Sound (Riewe 1977). Some migrate eastward (Schwartz 1982) and a few overwinter in cracks and aglus (Riewe 1977, Kiliaan and Stirling 1978). Walruses winter in leads and cracks in the eastern Canadian High Arctic as far west as Penny Strait (approx. 98° W; Kiliaan and Stirling 1978). They also winter near small areas of open water in Baird Fiord and Copes Bay as well as in the more extensive open water of Hell Gate (Riewe 1976). In October and November (the actual timing apparently being related to the formation of new shorefast ice) walruses of both sexes and all age groups reappear in the Avanersuaq area where they are hunted along the coast between Etah (Foulke Fiord) and Appat (Saunders Island; Born 1987).

There is no indication of any substantial southward migration along the west coast of Greenland from Avanersuaq to the Upernavik area. Some walruses are reportedly seen, however, migrating south in the Upernavik area during fall (Born *et al.* 1994a).

There are indications that the walruses occurring in the NOW area belong to a different group than those that occur along southeastern Baffin Island and on the southern wintering ground (Attu-Sisimiut) in western Greenland. A uniform haplotype was found in analyses of mt-DNA in a sample of 10 walruses from Avanersuaq (Cronin *et al.*1994). Using protein electrophoresis, walruses (n=93) from this area were also found to have low levels of genetic variation (Simonsen *et al.* 1982). An adult male walrus which was tagged on 18 June 1989 at Cape Inglefield was killed by a hunter on 17 May 1991 about 70 km south of the tagging site (Born 1991). The fact that walruses in Avanersuaq grow to a larger body length than walruses in Hudson Bay (Knutsen and Born 1994) indicates that there is no connection between walruses in these two areas.

Some connections exist, however, between the



Fig. 31. A walrus wearing a satellite-linked radio transmitter is given an additional drug dose by hand injection on Brooman Point, Bathurst Island (Canadian High Arctic), August 1993. One of the walruses tagged at this site was later shot at the entrance to Lancaster Sound (see text). Photo: E.W. Born

walruses in the NOW area and those that winter farther west in the eastern Canadian Arctic (*e.g.* Davis *et al.* 1978) and off the west coast of Disko Island, Central West Greenland (see section: Western Greenland). Walruses appear to winter annually in polynyas of the Cardigan Strait-Fram Sound and Penny Strait-Queens Channel areas (*e.g.* Stirling *et al.*1983). It cannot be excluded that walruses that move westward through Jones Sound and Lancaster Sound during late spring mix with this group of walruses, which probably hauls out on Bathurst Island during summer. This assumption was supported by the fact that one of ten walruses tagged in August 1993 at Bathurst Island was killed by Inuit off Bylot Island in June 1994 (R.E.A. Stewart information in NAMMCO 1995).

There are indications that some walruses move from Avanersuaq south along the coast of western Greenland as far south as Disko Island (Born *et al.* 1982, 1994a).

Uglit: Uglit identified in recent times in the NOW region are shown in Fig. 27. Terrestrial haul-out sites on the Greenland side of the NOW area are no longer used by walruses. Hence the walruses in this region now rely entirely upon access to uglit in Canada or haul out on floating ice. Until some time in the beginning of this century walruses hauled out on Littleton Island and on the Greenland coast opposite this island (Hayes 1867, Peary 1917, Freuchen 1921). According to information given by the Inuit in Avanersuaq to Vibe in 1939-40 (Vibe 1950), walruses also hauled out on land in two other places in the Avanersuaq area in the past (Fig. 27).

The available information indicates that there are no uglit along the east coast of Ellesmere island north of Jones Sound. However, this coast has not been visited frequently during summer, and the hunters from Grise Fiord do not go this far north during the open-water season (L. Audlaluk pers. comm. 1995).

Hundreds of walruses are said to haul out on Coburg Island in the entrance of Jones Sound (Riewe 1992:131,238). Along the north shore of Jones Sound, there are two uglit at and just west of South Cape, another (up to 50 animals) on the east side of Muskox Fiord, and one with "hundreds" of walruses at the base of Jakeman Glacier (Riewe 1992:71,180).

Information obtained from residents of the settlement of Grise Fiord (D. Akeagok and L. Audlaluk pers. comm. 1994, 1995) confirmed that walruses – primarily males – haul out west of South Cape at approximately 76°35' N, 85°15' W at a place called "Sannialuit" (*i.e.* the place with bones). After walruses had been killed on land at Sannialuit they abandoned this ugli. However, recently it has been re-occupied by a group of 50 to perhaps 100 walruses. Walruses still haul out on land in Muskox Fiord (76° 55' N, 87° 25' W). During the open-water season many walruses – primarily females with calves – congregate in the Anstead Point – Jakeman Glacier area east of Grise Fiord, but information conveyed to us (*Ibid.*) did not support the statements by Riewe (1992) that walruses haul out on land in this area, or on Coburg Island.

According to Koski and Davis (1979) there are uglit in Thomas Lee and Sverdrup inlets on the south coast of Jones Sound (*i.e.* north coast of Devon Island). During summer the Grise Fiord hunters usually do not go as far as to the southwest



Fig. 32. On 10 August 1993, 43 walruses were hauled out on Brooman Point. Eight others, including females with newborn calves, were in the water. Photo: E.W. Born

coast of Jones Sound and therefore less is known about uglit in this area. In connection with fishing for Arctic char (*Salvelinus alpinus*) walruses have, however, been seen hauling out on a small island at Cape Newman Smith (Sverdrup Inlet) on the south coast of Jones Sound (L. Audlaluk pers. comm. 1995).

Riewe (1992) identified several uglit along southern Devon Island – on the east side of the entrance to Dundas Harbour, at the southwest corner of Philpots Island, and along the southwestern part of Devon Island at Innes Point, Kearney Cove, Beechey Island, Cape Ricketts, and Cape Hurd and near the head of Maxwell Bay (<100 at each site). In the Queens Channel and McDougall Sound areas there are uglit at Brooman Point, Markham Point and occasionally Milne Island (Riewe 1992:157). Salter (1979) studied walrus behavior at the Brooman Point ugli on southeastern Bathurst Island that is occupied in July-August by as many as 194 walruses (Johnson *et al.* 1976).

Uglit on the Wollaston Islands in northern Navy Board Inlet and on the south coast of Devon Island were traditionally the main sites for walrus hunting by Inuit of the Pond Inlet region during the open-water season (Miller 1955, Ellis 1957, Brody 1976). According to Koski and Davis (1979), who cited Miller (1955) and Bisset (1968), the Inuit from Pond Inlet reported that the Wollaston Island haul-out was used by 200-300 walruses. During aerial surveys conducted in 1976 and 1978 walruses were not seen on the Wollaston uglit although small groups (30 animals) were present on ice pans near the site in late July 1976 (Johnson *et al.* 1976, Koski and Davis 1979).

Systematic surveys of all uglit used by walruses in the Canadian section of the NOW area have not been carried out. Information about the quantitative importance of the various uglit is fragmentary, but evidently the numbers using the different sites vary between years depending, among other things, on variable ice conditions (Koski and Davis 1979). Together, the uglit in Union Bay, Maxwell Bay, Thomas Lee Inlet and Sverdrup Inlet were used by at least 250 walruses in August 1977 (Davis *et al.* 1978). These four uglit were not occupied by walruses in mid September 1978 when they were surrounded by fast ice (Koski and Davis 1979).

Change in distribution: The absence of walruses from the Avanersuaq area during summer is in contrast to the situation earlier when walruses apparently were abundant in, for example, Murchison Sound during the open-water season (*e.g.* Sverdrup 1903, Peary 1917, Vibe 1950).

Apart from this decrease in the length of the period that walruses occur in the Avanersuaq area, their geographical range during summer has also decreased. They previously occurred farther east in Wolstenholme Sound and also penetrated McCormick Fiord (Vibe 1950).

Most likely, these changes have been caused by increased hunting. Between the mid 1950s and the mid 1970s the human population in Avanersuaq more than doubled to about 700 Inuit. This population increase was accompanied by an increased demand for hunting products and cash income. Since the 1960s there has been a substantial change in hunting technology, with an increased use of motorized boats with increased motor power (Born 1987, Born unpubl. data).



Fig. 33. A harpooned walrus surfaces in a lead near Dalrymple Rock/Iganaq, May 1975. Photo: T. Kristensen.

Population Size

Information about numbers of walruses in the NOW and adjacent areas has been collected at different seasons and in different years. Both aerial surveys and ship-borne surveys have been used and the entire range has not always been covered. Hence any numbers must be treated with caution.

Aerial surveys of the NOW during late winter 1978, 1979 and 1993 were intended to sample the entire wintering stock of walruses (Finley and Renaud 1980, Richard *et al.*1993). During the March-April 1978 survey only a few walruses were observed, but during the March 1979 survey approximately 700 were counted along the ice edge between Jones Sound and Talbot Inlet (Finley and Renaud 1980). A comparable aerial survey during 20-26 March 1993 resulted in a total count of only 10 walruses in the Glacier Strait-Cape Norton Shaw area (Richard *et al.* 1993).

Summer concentrations of walruses have been observed in several parts of the NOW area. On 12 July 1978 a minimum of 700 walruses of both sexes and all age classes were seen on the pack ice about 4 to 10 km west of Cape Inglefield (northern Smith Sound) (Born and Kristensen 1981). Between 18 June and 8 July 1989 a minimum of about 170 animals were observed along the ice edge across Smith Sound. Females, calves and subadults were found in the vicinity of Pim Island, while the only adult males observed were in the pack ice close to Cape Inglefield on the Greenland coast (Born and Knutsen 1990a).

Riewe (1992:39,154) indicated that "thousands" of walruses were found along the east coast of Bache Peninsula and also that the population scattered along the east coast of Ellesmere Island in summer represents the third greatest concentration of walruses in Canada (after the Southampton Island and northern Foxe Basin areas). The basis, however, for the statements by Riewe (1992) is not clear. RCMP game reports from Alexandra Fiord refer to a herd of 500-800 in Flagler Bay in summer 1956 and a group of 400, mainly females with calves, near Cape Sabine in early September 1962 (RCMP game reports). In July 1978 Schledermann (1978, 1980) saw about 300 walruses in the Flagler Bay polynya in western Buchanan Bay. The timing indicates that these animals were probably the same group as seen by Born and Kristensen (1981) in Smith Sound. In 1979 at least 250 walruses were observed in the Buchanan Bay area (Schledermann 1980). These estimates of numbers in Buchanan Bay were considered to be conservative (K. McCullough *in litt.* 1988). During an aerial reconnaissance on 31 August 1985 an estimated 300 walruses were observed in Buchanan Bay (Born unpubl. data) where on 21 August 1988 a minimum of 171 walruses were present (Born and Knutsen 1988).

The population estimate obtained from aerial surveys in July 1976 for Lancaster Sound was 309 walruses, the majority of which were along the south coast of Devon Island (Renewable Resources Consulting Services Ltd. 1976). Based on densities of walruses recorded between 9 and 15 July 1979 on coastal, nearshore and offshore transects, 468 walruses were estimated to have been present in parts of eastern Lancaster Sound (*i.e.* all non fast-ice



Fig. 34. A boat approaches a group of walruses in dense fog at Avanersuaq/Thule in June 1977. The hunters attempt to kill the hauled-out walruses instantly by firing a bullet at the head. Wounded animals that escape into the water are harpooned and shot. Photo: E.W. Born.

areas between 79° 30' W and 83° 30' W; Koski 1980).

Davis *et al.* (1978) estimated that 300-500 walruses move westward in the Canadian High Arctic via Lancaster Sound and an estimated 200-300 animals via Jones Sound. They concluded that a minimum of 1000 walruses summer between Devon Island and Bathurst Island. Riewe (1992:185) suggested that less than a thousand walruses remain in Lancaster Sound for the winter.

Based on these fragments of information we tentatively suggest that during summer the numbers of walruses in the NOW area are: 1) Avanersuaq (from Cape York to Cape Inglefield): 0; 2) Kane Basin region: 100; 3) Buchanan Bay and Princess Marie Bay: 300; 4) eastern Ellesmere Island south of Pim Island, and Jones Sound: 300-600; 5) southern Devon Island and Lancaster Sound: 1000.

Hence we conclude that approximately 1700-2000 (perhaps as many as 3000) walruses are present in the entire NOW area during the open-water season.

Exploitation

Hunting methods: The walrus hunt is very important in the subsistence harvest of the Inuit in Avanersuaq. On an annual basis walruses provide an estimated 25% of the meat and other edible products obtained from hunting (Born 1987). The majority of the tusks are sold to the Greenland Trade Company; some are sold directly to tourists.

During the first half of this century walruses were primarily taken from kayaks and on thin ice (Vibe 1950). According to Freuchen (1921) a few were taken during summer from a small schooner that operated from the trade station at Dundas in North Star Bay. Since the mid-1960s there has been an increased use of boats with outboard engines and small "Peterhead"-type boats.

There are two major hunting seasons: 1) The winter hunt takes place from November to mid May (peak March-April) on the walrus feeding banks. The animals are harpooned as they surface, then shot, in thin ice or at the ice edge. 2) The open-water season commences on 15 May when, according to a local rule, motorized vessels are allowed to be launched from the ice edge. This hunt has peaks in June-July and in fall, usually in October. It ends when the formation of new ice prevents navigation (Born 1987). Most of the walrus catch is made during the open-water season. Walruses are first hunted from boats until about mid-July, when the majority of animals have retreated to the east coast of Ellesmere Island, apparently as a reaction to the hunt. In the period September to November, with some variation from year to year, walruses reappear in the Avanersuaq area and are again hunted from boats.

According to local regulations, walruses must be harpooned before being shot (see section: Regulations). This only happens, however, during the thin-ice hunt. In order to secure a walrus during the open-water hunt, the hunter first wounds it with a body shot, sometimes from a long range. This makes it possible to approach the animal closely enough to harpoon it. After the harpoon is secure, the hunter dispatches the animal with head shots. When walruses are hauled out on ice floes, the hunters try to kill them instantly with head shots.

The harpoon is used afterwards to secure mortally wounded animals that have escaped into the water (Born pers. obs.).

We have little information about contemporary hunting methods in the Canadian parts of the NOW area. The Grise Fiord Inuit typically hunt walruses from motorized freighter canoes during summer and fall, approaching individuals and small groups that are either swimming or hauled out on ice floes (Riewe 1976, 1977, Riewe and Amsden 1979). The harpooning and killing methods appear to be similar to those described for Avanersuaq. In some cases walruses hauled out at aglus are stalked. In the past the Inuit used the entire carcass for various purposes. However today walruses are killed primarily for their ivory, and only a small portion of meat is brought back to the village for consumption by people and dogs. Since 1967, when snowmobiles were adopted by hunters, the walrus harvest has diminished at Grise Fiord (*Ibid.*). In recent years, however, there has been an increased interest in hunting walruses, partly because the demand for dog food has increased after the re-introduction of dog teams in Grise Fiord (D. Akeagok pers. comm. 1995).

Inuit of the Pond Inlet region traditionally made expeditions to the Wollaston Islands with the explicit purpose of hunting walruses (Bissett 1968, Brody 1976, RCMP game reports). However according to Treude (1977), whose field work was in 1972-73, "special walrus hunts" no longer occurred at Pond Inlet by the time of his visit. Walruses were, and still are, hunted by the people of Pond Inlet and Admiralty Inlet mainly at the floe edge during spring and early summer, and opportunistically during the open-water hunting directed primarily at phocid seals and monodontid whales (Brody 1976:164, Schwartz 1982, Reeves pers. obs.). This is at least partially due to the fact that large herds of walruses are not available. Hunting methods are presumably similar to those mentioned above for Grise Fiord.

The Resolute hunters hunt walruses in conjunction with seal and whale hunting just outside Resolute Bay in the spring, and also around Cunningham Inlet in the spring and fall (Riewe 1976). Other walrus hunting areas for the Resolute people are in Penny Strait, around Baring and Crozier islands, and along the south coast of Bathurst Island. According to Riewe (1976) the kill of walruses at Resolute declined sharply after the mid 1960s because of the reduced number of sled dogs needing food.

Catch levels – Catches by foreign whalers: In the late 19th century and until 1910 British whalers took numerous walruses in the NOW area. Particularly large kills were recorded for Smith Sound, around Coburg Island, at the entrances of Prince Regent Inlet and Navy Board Inlet, and in Croker and Maxwell bays (Ross and MacIver 1982). Walruses were killed on uglit at the Wollaston Islands at the entrance of Navy Board Inlet, and the large kills in Croker and Maxwell bays may also have been made on uglit. At around the turn of the century large catches of walruses were also sometimes made, by members of exploratory and scientific expeditions (*e.g.* Sverdrup 1903, Peary 1917; see summaries from Allen 1880 etc. in Reeves 1978). In 1949 and 1951, a Norwegian sealing vessel caught 623 and 1175 walruses, respectively,



Fig. 35. A pile of walrus skin, blubber and meat brought back to the settlement of Siorapaluk from a hunt in northern Smith Sound, July 1978. The small "Peterhead"- type boat can bring back the products of 5 to 10 walruses, depending on their size. Photo: E.W. Born.



Fig. 36. Walrus skulls are cleaned before they are sold to the Greenland Trade Company in Avanersuaq/Thule. Photo: T. Kristensen.

in the Davis Strait and Baffin Bay areas. Another vessel took some hundred walruses in 1951. Although the exact positions of the high catches in 1949 and 1951 are not well documented, there are indications that they were taken in the northern Baffin Bay region (Born *et al.*1994a). These latter catches led to a Norwegian hunting regulation in 1952 (Anon. 1952, Rasmussen 1952) which totally banned the hunting of walruses by Norwegians anywhere.

Catches by Greenlanders: The annual catch of walruses in the Thule area around 1940 was estimated at 200 (Vibe 1946, 1950). Bruemmer (1971) estimated the annual catch in the Thule area to range between 100 and 130 animals, to which figures an estimated 30 to 40 animals lost should be added (*i.e.* estimated loss 20-30%). According to Mansfield (1973) an annual average catch of 132 walruses was reported in the HLG for the period 1948 to 1965. Based on information obtained from the walrus hunters in the Thule area, Born and Kristensen (1981) estimated an annual catch of about 215 walruses for the late 1970s. Generally, the reporting in the HLG has been insufficient, and for some years is lacking entirely. The average annual catch during the 1970s and early 1980s was estimated at 250 animals (loss not included) by Born (1987), who pointed out that the walrus catch showed great annual fluctuations, determined mainly by variable ice conditions. In 1988 samples were obtained from 114 walruses, and according to a local informant a minimum of 150 walruses were taken that year (Born unpubl.). According to a new system of collecting catch statistics (introduced in 1993), a total of 217 walruses were landed in Avanersuaq in 1993 (Department of Fisheries, Nuuk).

In some years catches are high. According to the HLG, 290 and 440 walruses were reported for the years 1957/58 and 1961/62, respectively.

As stated earlier, walrus hunting was an important activity at the Hudson's Bay Company trading post at Dundas Harbour during 1934-36, when a total of at least 115 kills were recorded in the post journal (Hudson's Bay Company Archives unpubl. data).

Walruses were killed for dogfood by the RCMP stationed at Alexandra Fiord, Buchanan Bay, during the 1950s and 1960s. Smith and Taylor (1977:26) indicated that a total of 70 was taken in two years with records after 1962. From 1953 to 1962 the annual catch averaged about 16, of which less than 20% were females (7 years with records, RCMP game reports unpubl.).

Loughrey (1959:appendix II) estimated that Pond Inlet, Arctic Bay and Clyde accounted for about 42 walruses per year during the mid 1950s and that an additional 76 were taken each year in the areas of Resolute, Dundas Harbour, Craig Harbour and Alexandra Fiord, combined, during this same period. These totals certainly declined by the late 1960s as the need for dogfood diminished.

Recent reported catches in the Canadian parts of the NOW area (defined as including Resolute, Arctic Bay, Pond Inlet and Grise Fiord) averaged about 23 per year during the period 1972-1985 (Richard and Campbell 1988) and 21 for 1988-1993 (5 years; range: 13-30) (Anon. 1991...94, R.E.A. Stewart *in litt.* 1995).

We estimate that annual removals (including loss) from the NOW walrus population average approximately 375 animals. This estimate is derived in the following manner: annual landed catch in Avanersuaq = 250 walruses to which a loss rate of 25% is applied (see: Hunting Loss); Upernavik = about 10 walruses per year plus a loss rate of 25%; reported catches from the same population in Canada have averaged about 20 walruses per year,

subject to an overall loss rate of 30%. To these catches from the NOW walrus stock another 10 walruses landed in the Ummannaq municipality and in the Disko Island area may be added.

Hunting loss: In the Avanersuaq area losses during the open-water season ranged between 15% and 25% (based on 34 hunting trips, in which 112 animals were retrieved in 1977 and 1978). The highest figure includes animals that escaped during the hunt (newborn young and wounded animals) and whose fate was unknown (Born and Kristensen 1981). Presumably the majority of the injured animals eventually die from their wounds (Fay *et al.*1994). Although adoption in walruses may occur (Fay 1982:204) we consider it likely that many of the orphaned calves die. Hence, the loss rate tends to be closer to the upper end of the range. Hunting loss undoubtedly occurs in the Canadian sector of the NOW area even though there has been no systematic effort to estimate the loss rate from field observations. We assume that the rate is similar to those in other parts of Canada (*e.g.* Orr *et al.*1986) - about 30%.

Catch composition: Information on the age and sex composition of catches in Avanersuaq are available for a full hunting cycle ("a year") during 1977-78 and for two full hunting cycles during 1987-90. In all cases the samples presumably represent more than 50% of the actual take and can be considered representative for the total catch in the area (Born unpubl. data). Young and subadult animals are under-represented in the catch. Females are usually not recruited to the catch until 5-7 years of age, and males not until 7-9 years of age (*i.e.* age at sexual maturity). Similar age compositions showing that hunters select for larger animals with more yield of meat and larger tusks have been reported from Foxe Basin (Orr *et al.* 1986) and the Bering Strait region (*e.g.* Fay and Bowlby 1994).

Sexually mature females (5 years and older) represented 35% (1977-78), 37% (1988-89) and 48% (1989-90) of the Avanersuaq catch. Overall, 40 % of the catch consisted of females five years and older (Born unpubl. data).

We have no information about the catch composition in the Canadian parts of the NOW area. It would be reasonable to expect some selection of larger individuals, considering that the numbers of walruses that can be taken are restricted by quota and that ivory is a relatively valuable product of the hunting.

6. Eastern Greenland

Information about the occurrence of walruses in eastern Greenland was summarized by Dietz *et al.* (1985) and Born (1990). The following review is based mainly on these sources. When relevant, the original source is cited. Some additional recent information is also presented.

Distribution and Stock Identity

Summer and winter distributions of walruses in eastern Greenland are shown in Fig. 37-38 respectively. Places mentioned in the text and uglit are shown in Fig. 41.

The few historical observations of walruses along the coast of southeastern Greenland, between the Tasiilaq area (Ammassalik) and the entrance to Kangertiittivaq (Scoresby Sound), are concentrated around the fjord of Kangerlussuaq and at the shallow banks along the northern parts of the Blosseville Coast, just south of the entrance to Scoresby Sound. Walrus food items were reported by Thorson (1934) from the Kangerlussuaq area.

When the Inuit community at the entrance to Scoresby Sound was founded in 1924/25, walruses were common there; they also hauled out on land in this area (Rasmussen 1925, Pedersen 1926). They occurred only rarely in the inner parts of Scoresby Sound. Walruses wintered in the polynya at the entrance to this fjord system (Pedersen 1926). Walrus food items have been reported from the north coast of the entrance to Scoresby Sound and from Hurry Inlet.

In August 1924 about 30 walruses were observed in Hvalrosbugten close to where the settlement of Ittoqqortoormiit/Scoresbysund was founded. On 7 August 1924 a Norwegian sealer took "quite a few" walruses at the entrance to Scoresby Sound (Isachsen 1925). During 1925/26, 70 walruses were caught by the Inuit in this area, whereas during the following years only 10, 6 and 2 animals were secured (Pedersen 1931, Mikkelsen and Sveistrup 1944). After that time walruses were scarce in Scoresby Sound, and only old males were observed occasionally during summer hauled out on floes (Pedersen 1931). This indicates that a resident group of walruses probably had been exterminated.

Historical observations of walruses between Scoresby Sound and Clavering Island are few, presumably because there is little or no suitable walrus habitat in this area. The waters are deep in the fjords along this stretch of coast.

Walruses were common and used several uglit in

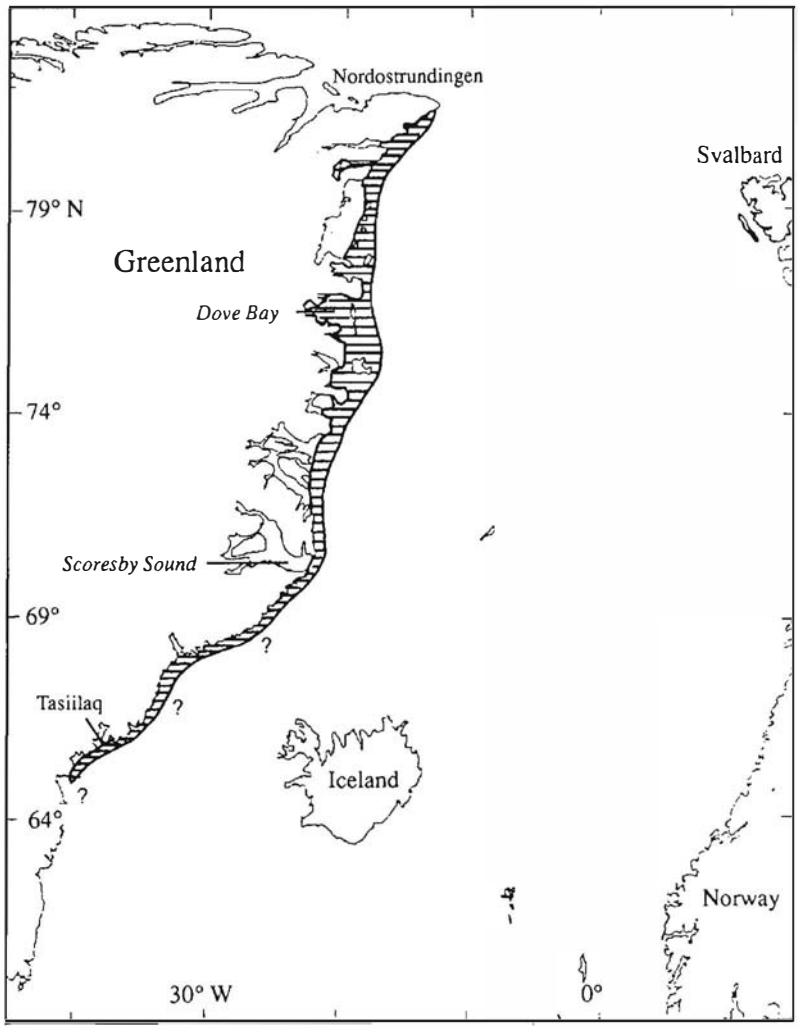


Fig. 37. Approximate summer distribution of walruses in eastern Greenland. Stragglers may occur south of the main concentration area.

the Clavering Island – Hochstetter Bay areas (Knudsen 1890, Giæver 1937). Sizeable concentrations were seen occasionally. For example, on 26 May 1932, 26 walruses were shot from a herd of about 200 at Cape Herschell according to Jennov (1945), who stated that the number of walruses around Clavering Island had decreased around 1940.

Several observations of walruses have been reported at Cape Borlase Warren, Cape Wynn, Sabine Island, Hvalros Island and Lille Pendulum Island at the promontory of Wollaston Forland. They also occurred in the Kuhn Island area and along the south coast of Shannon Island. In these areas there can be open water during winter, and a polynya is present along the south coast of Shannon Island (*e.g.* Koch 1945, Mikkelsen 1994).

Walruses were common in the Dove Bay area where they also hauled out on land (Friis 1909, 1925, Johansen 1910, Jennov 1945). Observations reported by Trolle (1908) and Johansen (1910) showed that walruses occurred along the coast from Dove Bay north to 81°10' N at Nordostrundingen (*i.e.* the northeastern cape of Greenland).

Recent observations indicate that the distribution of walruses in eastern Greenland is essentially similar to that described above.

A few walruses are occasionally caught in the Tasiilaq area (Dietz *et al.* 1985, Born 1990), and they are observed from time to time at the entrance to Kangerlussuaq (Glahder 1992). The seasonal distribution of catches for the period 1950-1983 indicates that walruses can occur in southeastern Greenland at all seasons (Dietz *et al.*1985, Born 1990). Stragglers that reach Iceland are likely to be from eastern Greenland (Born 1988).

At all times of the year, but particularly from February until late June, single walruses or groups of 2-3 animals of both sexes and all age groups (except newborn) may occur at the entrance to Scoresby Sound, where they feed along the north coast (Born 1983, Sandell and Sandell 1991). According to inhabitants of the area, the number of walruses frequenting this area has increased in recent years. The people ascribe this increase to the fact that walruses have been protected since the 1950s in the areas north of Scoresby Sound (Born 1983).

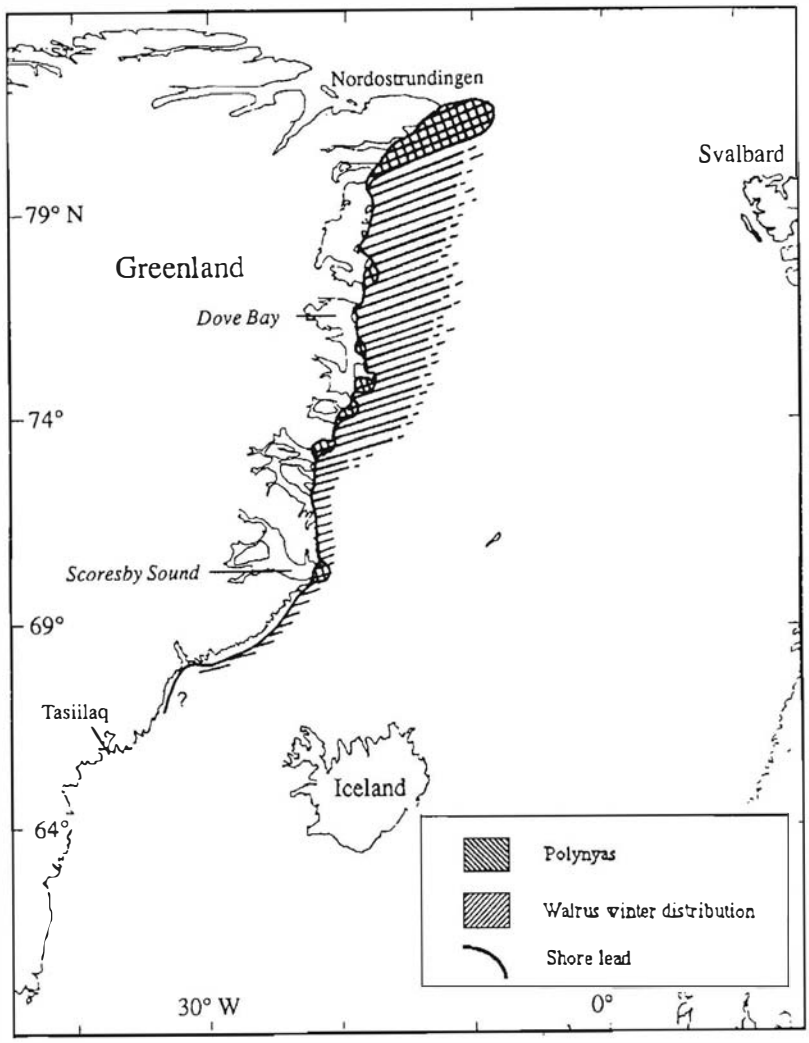


Fig. 38. Approximate winter distribution of walruses in eastern Greenland. Walruses can winter offshore in the moving pack ice over deep waters.

Small groups of walruses are observed along the coast between Hold with Hope and Dove Bay, and in the Dove Bay area. In these areas, regularly used uglit are found only on Sandøen (Young Sund) and Lille Snenæs (Dove Bay), although a few individuals have been observed while hauled out on land in other places.

North of Dove Bay walruses have been observed in several places along the coast between Skærfjorden (approx. 77°30' N) and Kilen (approx. 81° 14' N). Apparently they prefer the coastal areas between Dijmpha Sound (approx. 80° N) and Kilen (approx. 81°10' N) where the water is shallow. During aerial surveys of the coastal areas between Norske Islands and Nordostrundingen 26 May-18 June 1993 walruses were observed several times (Born and Thomassen 1994). Most notably, a total of 108 walruses were observed close to the coast between Kilen and Henrik Krøyer Holme on 3 June 1993 (Born *et al.*1994b). During a survey of the same area on 25 July, 93 walruses were seen, of which 17 were recorded as small calves (Tahon and Vens 1994).

Various sources indicate that walruses winter in the following areas of eastern Greenland: the entrance to Scoresby Sound, the Gael Hamkes Bay area, along Wollaston Forland and at Sabine Island, at Shannon Island and the southern tip of Store Koldewey Island, and farther north off Amdrup Land in the Eskimonæs and Antarctic Bay area. In these areas there are recurring polynyas with shallow water. Tracking of walruses instrumented with satellite-linked radios revealed that they can winter in the pack ice up to about 200 km offshore, between about 78°N and 81°N (Born and Knutsen 1992). The presence of polynyas at Île de France and at Hold with Hope (Pedersen 1942, Koch 1945) suggests that walruses may also winter there.

Observations of walruses between eastern Greenland and Svalbard suggest that some animals swim all the way across the Greenland Sea and Fram Strait (Dietz *et al.*1985, Born and Knutsen 1991). Such a connection was proven by the observation at Svalbard in 1992 of a walrus that had been tagged in eastern Greenland (77°N) in 1989 (Born and Gjertz 1993). Studies of the variation in mitochondrial DNA in a limited number of walruses showed the haplotype of those from the Scoresby



Fig. 39. Walruses at the ugli on Sandøen, Young Sound on 26 August 1994. Photo: E.W. Born.

Sund area to be different from that of walruses from Avanersuaq (Thule) in northwestern Greenland. However, three walruses in a sample of ten from Central West Greenland had a haplotype also found in walruses from eastern Greenland (Cronin *et al.* 1994). This indicates that some genetic mixing has occurred between eastern Greenland and Central West Greenland. In southwestern Greenland walruses are sporadically caught in the period January to August (Born 1990). These could be stragglers from either eastern Greenland or Central West Greenland.

Uglit: We are not aware of reports of uglit south of the entrance to Scoresby Sound. North of Scoresby Sound only two uglit are used regularly at present: Sandøen and Lille Snenæs (Figs 39, 40, 41). Both are used by males.

Around the mid-1920s walruses hauled out on Fame Islands in Hurry Inlet (Rasmussen 1925) and on the beach in Hvalrosbugten near the settlement of Scoresbysund (Pedersen 1926 Fig. 4). These uglit were soon abandoned due to hunting. Before the turn of the century other uglit were used by walruses in the Young Sound and Kuhn Island areas. For example, in 1889 more than 100 animals were killed on land at Cape Berghaus in Young Sound. Large kills were also made at an ugli situated somewhere in the Kuhn Ø area (Knudsen 1890, Giæver 1937, Jennov 1945). Due to hunting, these uglit were abandoned at the beginning of this century.



Fig. 40. The haul-out Lille Snenæs in northern Dove Bay in August 1990. Photo: E.W. Born.

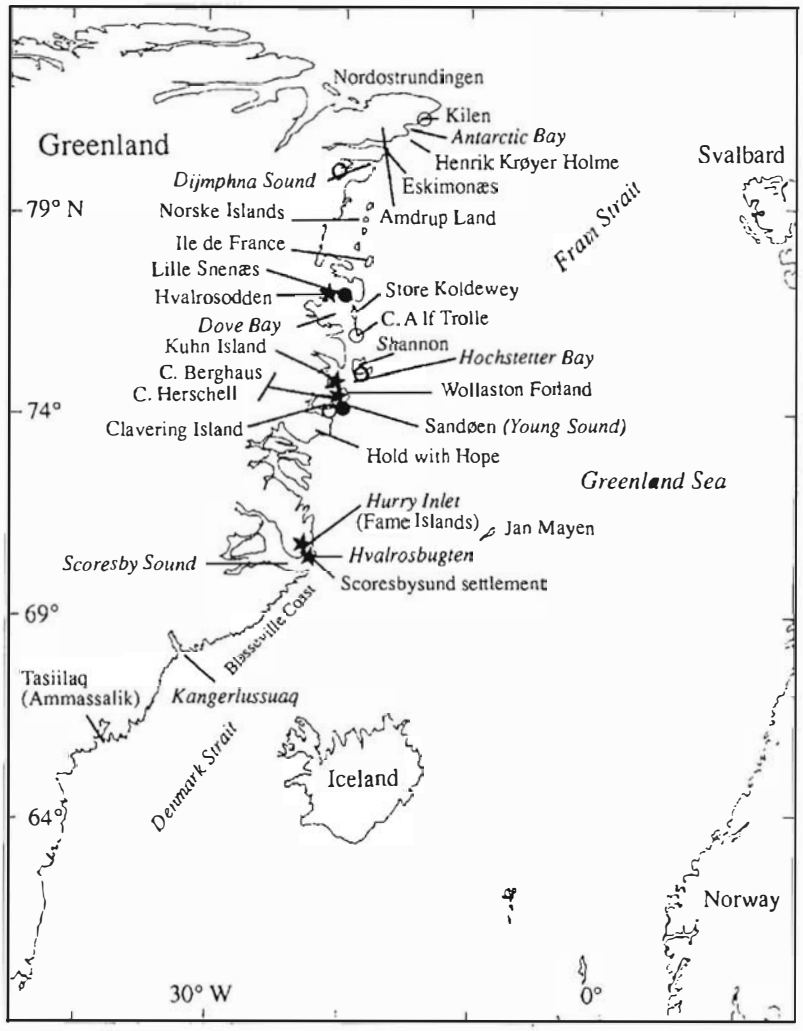


Fig. 41. Terrestrial haul-out sites used by walruses in eastern Greenland. Legend : Black dots = haul-outs still used by walruses. Open circles = places where walruses have been observed on land; present status unknown. Stars = Abandoned haul-outs.



Fig. 42. Walruses at the haul-out in Hvalrosbugten ("Walrus Bay") at the entrance to Scoresby Sound, East Greenland, in August 1924. It is apparent from the photo (bottom) that adult males, females and calves used this haul-out which was soon abandoned due to hunting (see text). Photo: A. Pedersen.

At present the Sandøen ugli is used regularly by a group of 20-30 up to perhaps as many as 50 walruses, primarily males. Walruses have also recently been observed on land at Cape Berghaus, on the southern coast of Clavering Island and on Shannon Island (Dietz *et al.* 1985, Born unpubl.).

Walruses formerly hauled out on land at Hvalrosodden ("walrus point") in northwestern Dove Bay. During the "Danmark Expedition" (1906-1908) about 30 walruses were shot in the northern Dove Bay area. Several of these were killed on the beach at Hvalrosodden. After this the walruses tended to avoid this ugli (Friis 1909, 1925, Johansen 1910, Jennov 1945, Dietz *et al.*1985). However, in 1933 they were observed on a new ugli at Lille Snenæs, about 10 km east of Hvalrosodden (Pedersen 1934). In July and August 1933 about 50 walruses were seen on this beach (Pedersen 1942, Jennov 1945).

Observations during the last decades have confirmed that Lille Snenæs is used as a haul-out site for adult males from late July until late September - early October (Dietz *et al.* 1985, Born and Knutsen 1992). A Petersen-estimate obtained from resightings of individually recognized walruses suggests that about 50 males used this haul-out site in 1989 and 1990 (Born and Knutsen 1990c).

Walruses have also been observed on land at Cape Alf Trolle (southern tip of the island of Store Koldewey) (Dietz *et al.*1985). Farther north, they have been observed on land in the Dijmphna Sound and Hanseraq Fiord areas (Dietz *et al.* 1985, Born unpubl. data).

Population Size

Andersen (1984), who was traveling along the coast in a kayak, recorded a total of 329 walruses between Nordostrundingen and Scoresby Sound. About 240 of these were observed between Kilen and Norske Islands. Based on aerial surveys in June 1993, Born *et al.* (1994b) tentatively concluded that not more than about 200 walruses were present between Eskimonæs and Nordostrundingen. This crude estimate is similar to that of Andersen (1984) and refers to those parts of the areas covered by Andersen (1984) where he found the highest concentrations of walruses. Various observations indicate that each of the two summering areas for males, Dove Bay (Lille Snenæs) and Young Sound (Sandøen), has about 50 adult males during the open-water season. Hence, about a hundred animals may tentatively be added to the 329 recorded by Andersen (1984). Consequently, a highly conservative estimate of the total population of walruses in eastern Greenland would be about 400. As this estimate is not corrected for walruses which may have been present in areas not covered by the surveys or for animals submerged and out of sight during the surveys, a rough estimate of 500 to 1000 animals in the eastern Greenland stock is tentatively suggested.

Exploitation

Hunting methods: Some, presumably few, walruses were traditionally taken by the Inuit of eastern Greenland (*e.g.* Sandell and Sandell 1991). Due to a general scarcity of walruses in southeastern Greenland, the catch in this region has been very small. Since 1966 walruses have been shot sporadically in Kangerlussuaq in the northern part of the municipality of Ammassalik (Siegstad 1989, Glahder 1992). The limited records available indicate that walruses may be caught in the Ammassalik area at any season, with a peak in August-Septem-

Fig. 43. Danish trappers ready to flense adult male walruses at Hvalrosodden (Dove Bay) in the summer of 1934 (year uncertain). Usually the walruses were towed into shallow water to be butchered at low tide. Photo: presumably P. Poulsen.



ber. We have no details about hunting methods but assume that they are similar to those described below for Scoresby Sund.

In the Scoresby Sound area walruses are usually taken between April and August at the entrance to the fjord complex (Born 1983, Sandell and Sandell 1991). According to Sølberg (1975) they are shot either from land or from the ice edge when they are observed during the hunt for ringed seals. Sometimes when walruses haul out on ice they are shot from dinghies powered by outboard engines. Rifles with calibres of 7.62 or larger are used to shoot the walruses either in the head, neck or spine (*Ibid.*). A harpoon is usually not used. Walruses that sink in shallow water are retrieved with a hook (J. Thygesen pers. comm. 1988).

Catch levels – Catches by foreign sealers etc.: During a period of 40 to 50 years beginning in 1889, more than 1000 walruses were killed by foreigners primarily Norwegian and Danish sealers and trappers mainly in the areas around Clavering Island and the island of Shannon and in Dove Bay. The majority were taken during the first half of this period (*e.g.* Jennov 1945; Fig. 43). Jennov (1945) believed that walruses had decreased in northeastern Greenland as a result of overexploitation. An unknown presumably limited number of walruses were also taken between the 1940s and 1960 by Danish and Norwegian trappers (Mikkelsen 1994).

Catches by Greenlanders: During the late 1920s an average of one walrus per year was taken in southeastern Greenland (Pedersen 1931). According to the Hunters' List of Game (HLG), the catch of walruses in the municipality of Ammassalik averaged 3.5 walruses per year (SD=4.4, range:1-10, four years of reporting) between 1980 and 1987 - the last year for which there was a record.

In the period 1980-1987 the catch in the Scoresby Sound area averaged 12.1 walruses (SD=7.0, range: 2-22, six years of reporting) according to the HLG.

The reporting in the HLG in eastern Greenland generally has been insufficient. We estimate that the annual landed catch of walruses in eastern Greenland ranges between 15 and 25 animals. With an overall loss rate of 23% (see below), the total annual kill would be approximately 20 to 30 walruses.

Hunting loss: Losses are not well documented. Dietz (pers. comm. 1986), who witnessed the kill of three walruses during the spring hunt, suggested that an overall loss rate of about 30% appeared likely. Three of nine walruses killed during April 1983 at Cape Swainson (entrance to Scoresby Sound) sank and were lost (Born 1983). Information about the fate of 23 walruses killed during the spring hunt in 1986-1988 (J. Thygesen pers. comm. 1988) indicates a loss rate of about 17% (four lost of 23 killed). Hence these observations, combined, indicate that the overall loss rate is about 23 %.

Catch composition: We have no information about the composition of the catch south of Scoresby Sund. The majority of the catch in the Scoresby Sund area consists of old males (J. Thygesen pers. comm. 1988, Born unpubl. data; but see Fig. 44). This catch composition presumably reflects the general distribution of walruses in

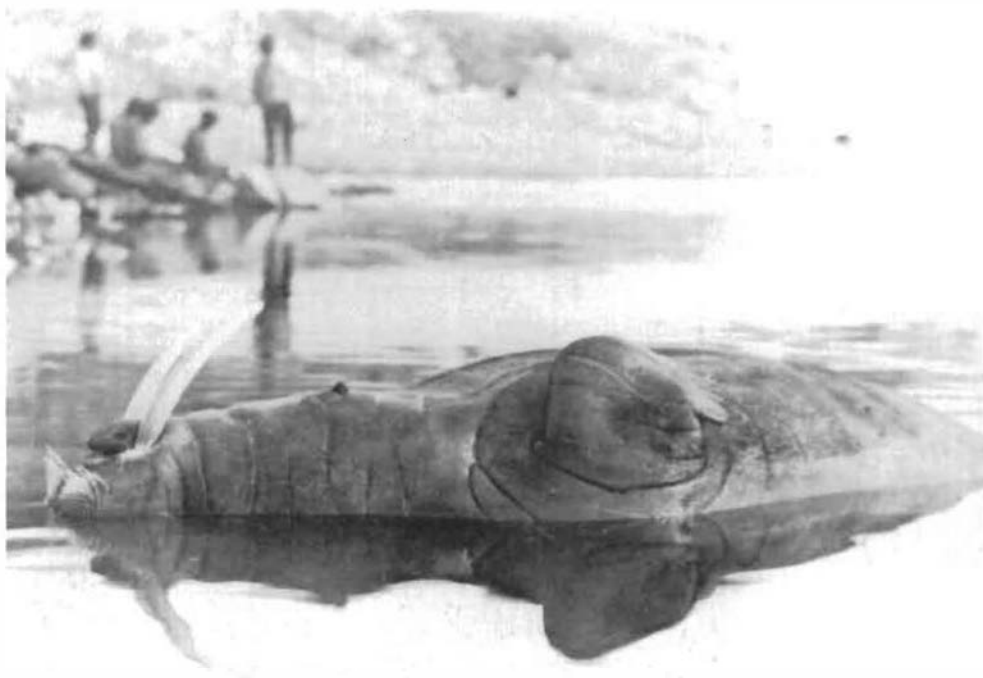


Fig. 44. Greenlanders waiting for low tide so that they can butcher an adult female walrus killed near the settlement of Scoresbysund in the mid-1920s. Note the plug in the throat. After the walruses were killed the Greenlanders would often inflate the carcasses, through a hole in to the lungs, to make them float. Thereafter the hole was plugged to prevent the air from escaping. Photo: A. Pedersen

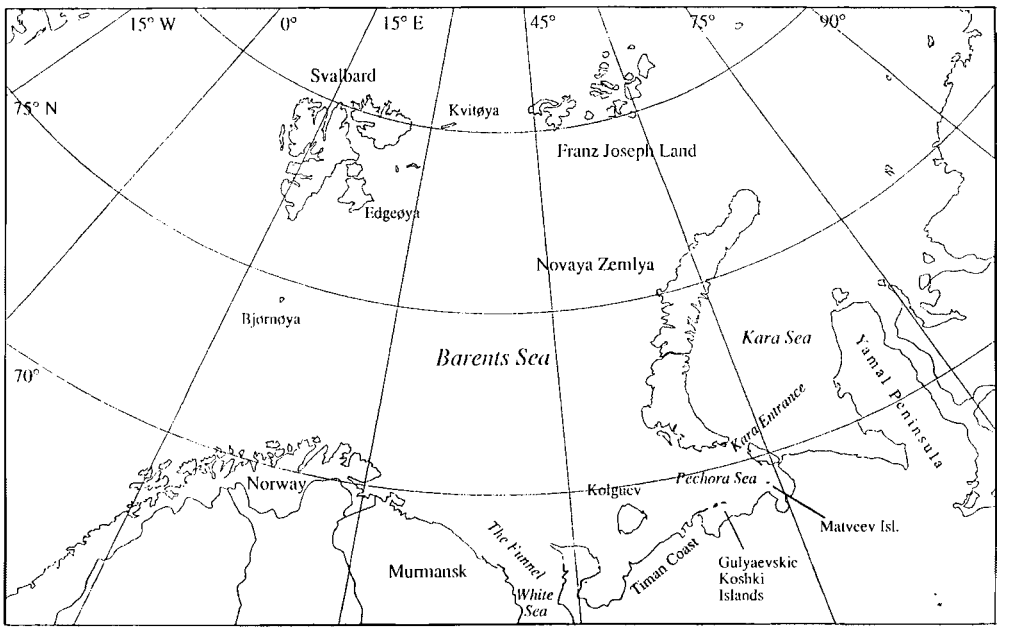


Fig. 45. The Barents Sea and Kara Sea region.

northeastern Greenland, with the males occurring farther south than the females.

7. Svalbard – Franz Joseph Land

Little is known about the walruses of the western European Arctic. Recent studies have been undertaken in Svalbard, and in parts of Franz Joseph Land, but recent scientific information on walruses from the Russian Arctic is largely non-existent. However it is clear that walruses in all areas of their European Arctic range were over-harvested up to the mid 1950s. The result was that they were virtually exterminated in several of these areas. In Svalbard they were more or less exterminated, but there were apparently still a few hundred left in Franz Joseph Land (Norderhaug 1969). The largest remaining groups were probably in the Franz Joseph Land – Kara Sea area. Today there are signs, at least in Svalbard and the White Sea area, that walruses are recolonizing their former distribution area.

Distribution and Stock Identity

Places mentioned in the text are shown in Fig. 45. Summer and winter distributions are shown in Figs 46-47, respectively. Locations of uglit are depicted in Figs. 48-49.

Walruses were once very abundant in the Svalbard archipelago. However three and a half centuries of commercial exploitation had caused the

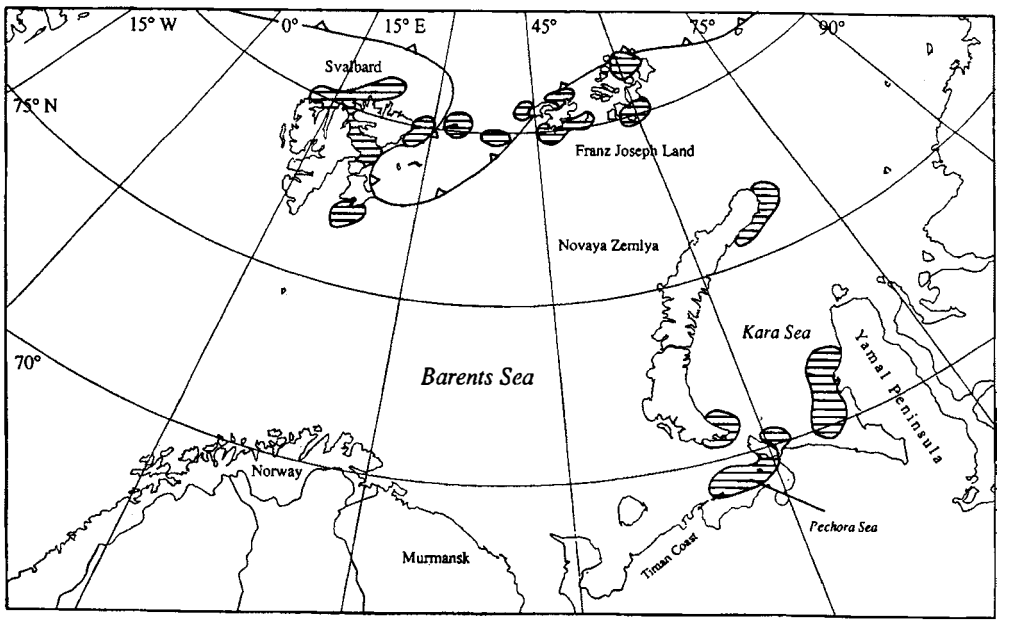


Fig.46. Approximate summer distribution of walruses in the Norwegian High Arctic and western Russian Arctic. A generalized picture of the extent of the polar pack ice is indicated.

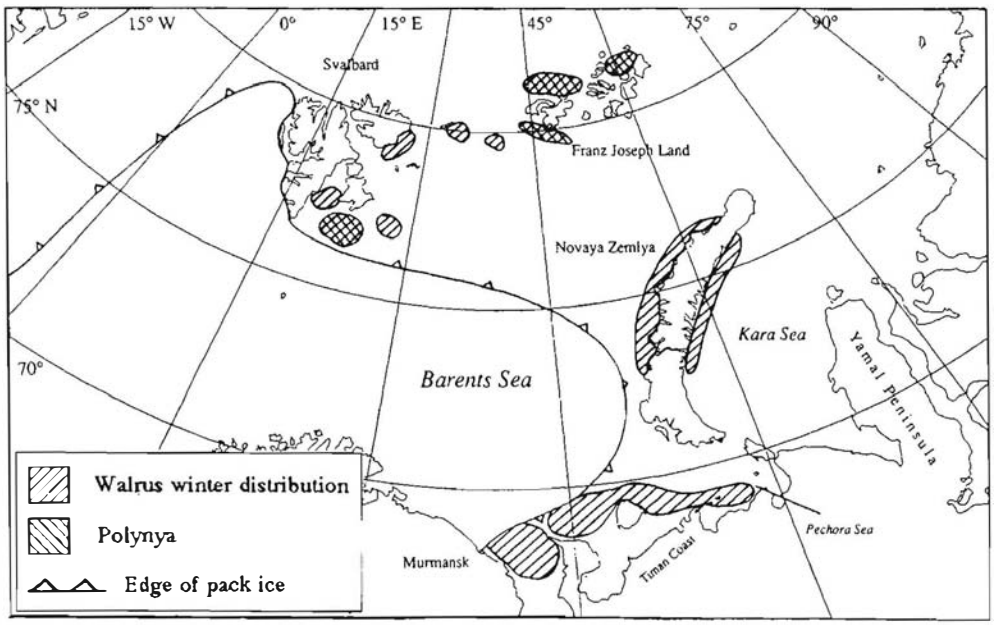


Fig. 47. Approximate winter distribution of walruses in the Norwegian High Arctic and western Russian Arctic. Several wind-driven polynyas exist in these parts of the Arctic. The walrus wintering areas are not well known, but walruses are thought to winter in these polynyas. The approximate position of the pack ice edge during winter is indicated.

walrus to be on the verge of extinction in this region when it finally was totally protected in 1952 (Norderhaug 1969). The hunting started in the most accessible parts of the archipelago, but as catches declined the hunters pushed further and further into the more remote parts of Svalbard (Lønø 1972). Lønø (1972) postulated, based on catch statistics, that the Svalbard stock must have consisted of partially stationary groups that had some contact with each other. This would explain why walruses still could be found in the more remote parts of the archipelago after they had been exterminated along the western coasts. Lønø (1972) found no indication of an annual migration between the northeastern parts of Svalbard and Franz Joseph Land.

In the 1970s walruses started reappearing in Svalbard. Born (1984) concluded, based on opportunistic observations and surveys between 1954 and 1982, that about 100 walruses, primarily bulls, summered in Svalbard. He suggested that the observations indicated that Svalbard was in the process of being repopulated by dispersal of the popul-

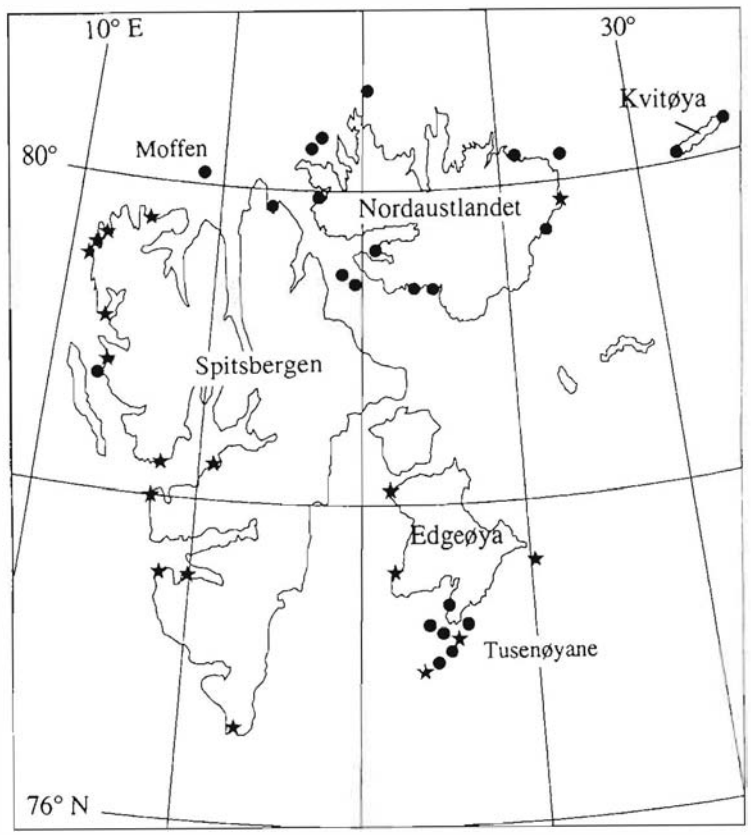


Fig. 48. Locations on Svalbard of walrus haul-outs still and formerly used. Little information was available to the authors concerning haul-outs in the Russian sector of the Atlantic walrus's range. Legend: Black dots = haul-outs still used by walruses. Stars = Abandoned.

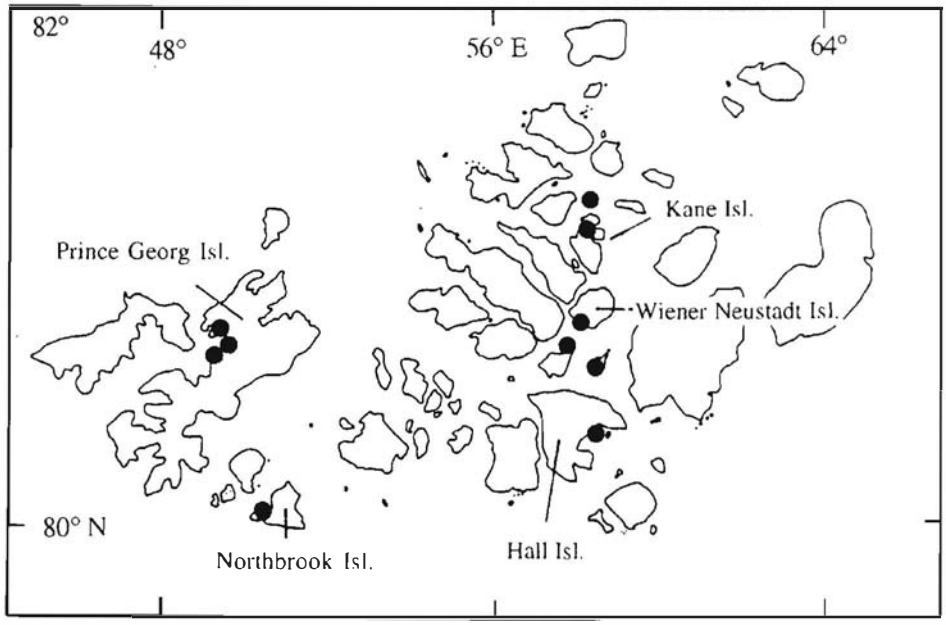


Fig. 49. Locations of haul-outs presently used by walruses on Franz Joseph Land.

ation centered at Franz Joseph Land.

Franz Joseph Land had a large walrus population when the archipelago was discovered in 1873. Because ice conditions were much more severe at Franz Joseph Land this group of islands was much less accessible than Svalbard. At Franz Joseph Land walrus hunting therefore first became significant around the turn of the century and it lasted until the early 1930s (Gjertz *et al.*1992). Harvests of walruses in Franz Joseph Land continued on a limited basis until 1953 (Lønø 1972). Atlantic walruses were totally protected in Russian waters in 1956 (Beloborodov and Timoshenko 1974). The distribution of walruses in Franz Joseph Land was described and mapped by Gjertz *et al.*(1992).

Based on ground and aerial surveys Gjertz and Wiig (1994) showed that walruses in Svalbard today are predominantly males (Fig. 50), although some females and calves are present in the northeasternmost part of the archipelago. Cows and calves were found to be abundant in the western part of Franz Joseph Land (*Ibid.*). It was therefore concluded, in concordance with Born (1984), that the majority of walruses in Svalbard in summer are males that probably belong to a common Svalbard – Franz Joseph Land stock.

In the period 1990 to 1993 thirty-four walruses (28 at Svalbard and six at Franz Joseph Land) were fitted with satellite-linked radio transmitters in order to study their movements. All of the instrumented animals were adult males except for one adult female caught at Franz Joseph Land (Gjertz



Fig. 50. In some parts of Svalbard, like here at Kalvøya, male walruses haul out as much as several hundred meters from shore.
Photo: I. Gjertz.



Fig. 51. More than 500 walruses hauled out on Kræmerpynten (Kvitøya, Svalbard) on 23 July 1984. Photo: L. Åby.

and Wiig 1993, Knutsen 1993, Wiig *et al.* in press). The results of the satellite trackings showed that male walruses move among most of the walrus areas in Svalbard and Franz Joseph Land. In particular, it seems that movement by males from southern Edgeøya to Kvitøya (Fig. 51), Victoria Island and Franz Joseph Land (Fig. 52) is common. The walruses winter in the southern parts of Svalbard as well as within the pack ice off north-eastern Svalbard. The only walrus at Franz Joseph Land that was followed until mid winter stayed in the same area. This observation supports the view that walruses also winter there. The results of the telemetry support the hypothesis of Born (1984) that the majority of walruses in Svalbard are males from a common Svalbard-Franz Joseph Land stock (Wiig *et al.* in press).

It is important to bear in mind, however, that walruses in both archipelagos, but especially in Svalbard, constitute a recovering population. The current distribution and behavior therefore very likely differ from that found in former times when walruses were abundant in these areas.

Population Size

The pre-exploitation size of the walrus population in the Barents and Kara seas is not known, but Fedoseev (1976) concluded that it could not have numbered less than 70 to 80 thousand animals.



Fig. 52. Walruses hauled out on the ice off the ugli on Appolonoff Island (Franz Joseph Land) in August 1992. Photo: L.Ø. Knutsen.

During the period 1989-1993 walrus haul-out sites in Svalbard were mapped, and age and sex composition at the haul-outs was determined (Gjertz and Wiig 1995). Aerial surveys were conducted in 1992 and 1993. The results of the surveys indicate that at least 723 males are present in Svalbard during summer. The bulk of the females and calves associated with these males are believed to be in Franz Joseph Land. Assuming a 1:1 sex ratio in the population, the Svalbard – Franz Joseph Land stock of walruses is therefore thought to number 2000 individuals. This is a conservative estimate, and the actual number is believed to be considerably higher. This is because undoubtedly some walruses in Svalbard were not counted, and because no survey has been conducted in Franz Joseph Land, where males, in addition to those counted in Svalbard, may be found.

In Svalbard three possible threats to the walrus population can be identified: conflicts with fishing interests, especially scallopers, disturbances by tourists, and planned petroleum development.

Exploitation

See under stock 8.

8. Kara Sea – Southern Barents Sea – Novaya Zemlya

Distribution and Stock Identity

Walruses are believed to have been more or less resident along parts of Finnmark (northern Norway) in former times (Lund 1954), but they were exterminated there. Today only stray individuals are encountered along the Norwegian coast and farther south in Europe, and these are believed to come from Russia or Svalbard (Lund 1954, Brun *et al.* 1968, Born 1988, Gjertz *et al.*1993).

Historically there was a large trade in walrus ivory between northern Russia and both Europe and the Muslim world. This ivory came predominantly from the White and Pechora seas (Chapskii 1939, Storå 1987).

Popov *et al.* (1990) reviewed information on the former distribution areas in the White Sea. Timoshenko and Popov (1990) indicated when and where walruses have been observed in the White Sea in recent years. Most observations have been in the Funnel, *i.e.* the northernmost part of the sea. Belkovich and Khuzin (1960) claimed that these animals usually have been young, with tusks of 20 cm length or longer (*sic!*). Popov *et al.* (1990) stated that the animals usually are encountered in pairs or as single individuals. They believed that the regular occurrence of walruses in the White Sea, though small in numbers, reflected the inclination of animals to return to their former habitat. Thus according to these authors there is good reason to believe that the Funnel of the White Sea is now a normal part of the walrus's range. Born (1988) suggested that an increase since about 1970 in the number of walrus stragglers appearing along the western coasts of Norway and the European continent perhaps reflected an expansion of the range of the population(s) in the western Russian Arctic.

According to Popov *et al.* (1990) walruses occur in the southeastern part of the Barents Sea throughout the year, though numbers are small. The most frequent occurrences are off the Timan coast near Gulyaevskie Koshki and near Kolguev and Matveev islands.

Beloborodov and Timoshenko (1974) mentioned several observations of herds of walruses in this area, also in mid winter. One of the herds (55 individuals) consisted of adults, subadults and calves. Lukin (1978) observed walruses on 4 January 1977 near Gulyaevskie Koshki islands in northern Pechora Bay. Quite remarkable was the observation of six adults with what were thought to be newborns. Lukin (1978) suggested that the period of birth in this area was late December-early January. The total number of walruses wintering in the southeastern Barents Sea was estimated not to exceed 100-120 animals. Haug and Nilssen (1995) reported observations between 5 and 17 February 1993 of a total of 138 walruses (including 21 mother-calf pairs) along the northeastern coasts of the Kanin Peninsula and in the western Pechora Sea. These observations suggest that the Pechora Sea is a wintering area for walruses from the Barents and Kara seas.

Walruses in the Kara Sea and Novaya Zemlya region are believed to belong to a stock that is distributed over a larger area; the animals presumably migrate into and out of the Kara Sea.

Arsenev (1976), based on Chapskii (1936), described in detail the supposed seasonal migrations of walruses in the Kara Sea as follows: Atlantic walruses inhabiting Russian waters in winter and spring are situated mainly in the southeastern part of the Barents Sea. In October they haul out on the coast in the vicinity of the Kara Entrance. With the formation of ice, the animals move onto the ice. Possibly in June the walruses abandon this area. They enter the Kara Sea via two routes – through the Kara Entrance and around the north end of Novaya Zemlya. The animals that pass through the Kara Entrance are found in the second half of July

and in August inhabiting the ice along the west coast of Yamal Peninsula. Under the influence of easterly winds in August, the ice goes out from there, and the walruses withdraw with it. In October these animals appear on the southern coast of Novaya Zemlya, near the Kara Entrance. There they congregate on coastal haul-out sites until freeze-up. The other walruses, which migrate northward with the ice, around the end of Novaya Zemlya, are found on the floating ice in nearshore waters in July and August. Toward September, when the drifting ice breaks away from the coast of Novaya Zemlya, these animals begin to concentrate very close to shore, usually at the northeast end of the island. There they form herds on shore in the area from Oransk Islands to Cape Sporyi Navolok. Probably new ice begins to form on the north coast of Novaya Zemlya by October. At this time the walruses vacate the nearshore waters, transfer to the drifting ice, and pass with it into the Barents Sea. There they proceed along the west coast of Novaya Zemlya, and by the end of the month reach their winter habitat in the southeastern Barents Sea.

Other authors have suggested that walruses in the Kara Sea – Novaya Zemlya area also migrate to other areas. Tsalkin (1937) suggested, based on differences in the sexual composition of groups of walruses in Franz Joseph Land and Novaya Zemlya, that they belong to a widely distributed population inhabiting the waters of the European Arctic. On the other hand Popov *et al.* (1990) suggested that walruses from the Pechora Sea move into the Kara Sea in summer.

The eastern distribution of walruses in the Kara Sea is somewhat unclear. According to Ivashin *et al.* (1972) walruses are observed on the drift ice in the region of the small arctic islands lying south and southeast of Franz Joseph Land (Vize, Ushakova and Schmidt islands). Further east at Severnaya Zemlya they are more rarely seen (*Ibid.*). Bychkov (1975) claimed that these were Atlantic walruses. According to Arsenev (1976) walruses at Severnaya Zemlya are mostly found on the east side of the archipelago; and in the Laptev Sea walruses are principally found in the western parts along the eastern Taimyr coast and near the Lena Delta. According to Chapskii (1936) walruses in the Laptev Sea form a subspecies (*O. r. laptevi*) which morphologically is intermediate between the Atlantic and Pacific subspecies. The taxonomy of the walruses in the Laptev Sea is, however, still disputed (see Fay 1981, 1982, 1985). Chapskii (1936) believed that the ranges of the Laptev and Atlantic walruses met at Severnaya Zemlya and western Taimyr, but that the animals near Vilkitski Strait (between Severnaya Zemlya and the mainland coast) were predominantly Laptev walruses. S. Belikov (pers. comm. 1994) confirmed that walruses in western Severnaya Zemlya are Atlantic walruses whereas those found in the eastern part of the archipelago and southward past Vilkitski Strait are Laptev walruses. Presently available information is, however, insufficient to determine whether these walruses have separate geographical distributions or are morphologically distinct.

Population Size

According to Lukin (1978) the total number of Atlantic walruses wintering in 1977 in the south-eastern Barents Sea apparently did not exceed 100-120. The number of walruses observed in the southern Barents Sea has increased in recent years (Popov *et al.* 1990, Haug and Nilssen 1995), and Lukin's (1978) figure is probably too low. Popov *et al.* (1990) referred to an observation of a herd of 100 animals, which can be interpreted as confirming that there are well over 120 walruses in the Barents and Pechora seas.

No new population figures are available for the Kara Sea – Novaya Zemlya region and all estimates are outdated. Chapskii (1936) estimated that there were no more than 1200-1300 walruses in the Barents and Kara seas in the mid-1930s. Popov (1960) estimated the stock to be 2000-2500 off the northern extremity of Novaya Zemlya and in Franz Joseph Land in 1952-55. According to Bychkov (1975) the Novaya Zemlya stock consisted of no more than 400 animals in 1969-1970. According to Popov *et al.* (1990) there are 1500-1700 walruses in the northern Novaya Zemlya – Franz Joseph Land area. This, however, is the same figure that has been presented previously (Nazarenko and Timoshenko 1983, Timoshenko 1984).

Bychkov (1975) and Popov *et al.* (1990) suggested that predation by polar bears may be one reason for the decrease in numbers and poor recovery of the walrus population in the western Russian Arctic. They also cited anthropogenic factors, such as industrial development in the haul-out areas, year-round shipping, petroleum and gas development and poaching as possibly contributing to the situation. One additional threat to the walrus population is the large amount of nuclear waste that has been dumped into the Kara Sea and west of Novaya Zemlya.

Exploitation (Stocks 7 and 8)

Walruses in Norwegian waters, including Svalbard, became totally protected in 1952 (Anon. 1952; see



Fig. 53. Numerous skulls and bones on the beach at Kapp Lee (Edgeøya, Svalbard) in 1982 bear witness to the massive slaughter of walruses by European hunters in former days. Photo: E.W. Born.

also section Regulations; Fig. 53). In Norwegian waters poaching is not very likely to occur since walruses are relatively scarce and are mostly found in inaccessible and uninhabited parts of the Svalbard archipelago. Moreover well-equipped law enforcement authorities patrol the main areas of walrus distribution on a regular basis. Walruses were given complete protection in the Northeast Atlantic Arctic in 1958 (see section: Regulations). Poaching may, however, be somewhat of a problem in Russia. Since the collapse of the Soviet Union law enforcement has been slack in the arctic areas, and Russian scientists admit that poaching, especially for polar bears and walruses, takes place. Frantzen (1992) documented one case of poaching in Franz Joseph Land, but other cases are also known. The size of this illegal hunt in Russia is not known.

One of the authors (Gjertz) has been contacted both by private persons and by foreign governmental agencies regarding offers from Russian sources in the Murmansk Region, Russia, to provide walrus calves for the international market. No such sales are known to have taken place, but the fact that offers have been made suggests that certain parties can and will provide illegally caught walruses. This can be viewed as a part of the large illegal trade in protected wildlife which has flourished in Russia since the collapse of the Soviet Union.

REGULATIONS

Uncontrolled hunting led to the depletion of Atlantic walruses in nearly all areas of their range. Regulations were introduced, belatedly, to control the hunting and to protect the walruses from extermination.

In Canada regulations intended to conserve the stocks of walruses have been in force since 1928 and have been amended numerous times (see Mansfield 1973, Reeves 1978, Richard and Campbell 1988). The regulations limit hunting mainly to indigenous people. Under the Marine Mammal Regulations only licensed hunting is permitted, but Indians and Inuit are allowed to take up to 4 walruses (per person per year) without a license "for food, social or ceremonial purposes" (Government of Canada 1993). In addition there is an annual quota system for four settlements: Coral Harbour, Sanikiluaq, Arctic Bay and Clyde River. These communities have annual quotas of 60, 10, 10 and 20, respectively (Government of Canada 1993).

As mentioned by Richard (1993) the Nunavut Land Claim agreement has changed some aspects of walrus management in Canada. The Nunavut Wildlife Management Board and its constituent Regional Wildlife Organizations, which consist of representatives of local Hunters and Trappers Associations, "will have considerable influence in shaping every aspect of management and conservation of Canadian walrus populations" (Richard 1993:18).

The Marine Mammal Regulations include a reporting requirement stating that a hunter must keep a record of his catch for two years and report this to a fishery officer "when requested to do so." The record is supposed to include the date and location of the catch, the animal's sex and its colour (!) (Government of Canada 1993). Catch data for settlements in northern Québec are supplied to the Department of Fisheries and Oceans through a contract with Makivik Corporation (S. Olpinski pers. comm. 1995).

Regulations for walrus hunting in Greenland were reviewed by Born (1990) and Born *et al.* (1994a). The latest amendments to the regulations were made in 1994 (Anon. 1994b).

The walrus hunt in the Avanersuaq (Thule) area has been regulated since the late 1920s (Rasmussen 1929). The present hunting regulations are essentially unchanged. It is permissible to hunt walruses at any time. While there is ice cover, shooting at walruses is not permitted before they have been harpooned. It is permitted, however, to shoot at walruses that appear in small leads or cracks in the ice, where they can then be harpooned. During the open-water season, it is not permitted to shoot more walruses than can be transported back to the hunter's home. Walruses are not allowed to be shot in the head before they have been harpooned. Hunters are permitted, however, to shoot at walruses before harpooning if the walruses are swimming along the ice edge, where they can be dangerous.

In Central West Greenland, changes in walrus hunting practices, and in particular the high catches in 1937, led to a discussion in the Local Political Council (Landsrådet) where it was proposed to regulate the walrus hunt. However, hunting regulations were not introduced until 1949 when walruses in the West Ice were protected between 20 May and 31 December. New hunting regulations came into force in 1956. Originally walruses were not allowed to be hunted at the uglit of Kitsissut and Aarfiit in Kangaatsiaq municipality between 15 October and 31 January. This paragraph was, however, canceled in 1959. The regulations were amended in 1978 and 1994 (see Born 1990 and Born *et al.* 1994a for reviews of regulations before 1994). According to the 1978 amendments, there was no quota for boats smaller than 40 tons, but after 1978 boats larger than 40 tons were permitted to catch five walruses per year. By the 1994 amendments boats above 40 tons are no longer allowed to catch walruses (Anon. 1994b). According to the latest regulations (*Ibid.*) the hunting of walruses in Greenland is only permitted to licensed persons resident in Greenland. Between 1 June and 31 December the take of walruses between 66°N and 75°N is prohibited. Between 1 April and 31 December females and young are protected in the same areas. All walruses are protected in western Greenland south of 66°N. Only vessels less than 40 tons and dog sleds can be used for hunting walruses. There are restrictions concerning the types of weapons and bullet types that can be used. It is stated explicitly that wounded walruses must be harpooned before they are killed. Municipal councils can, if they desire, place further restrictions on walrus hunting. It is now mandatory that hunters report the catch (number, sex, age, date etc.) (Anon. 1994b). According to a special regulation (Anon. 1990d) the hunting of walruses is allowed in the municipality of Kangaatsiaq between 1 February and 14 October. This regulation was not included in the recent amendment.

In 1938 hunting regulations were made for the Danish trappers working for the company "Nanok" in Northeast Greenland primarily north of 73°30' N. According to these regulations, the hunting of walruses at uglit or within 1 km of such sites was not allowed. Care was to be taken to ensure that

only walrus bulls were hunted. Females with calves were to be fully protected. All walruses became completely protected in 1956 in all areas of East Greenland north of the Scoresby Sound area (*i.e.* north of approx. 72° N; Anon. 1938, Born 1990).

In 1952 the walrus was given complete protection within Norwegian territory and walrus hunting by Norwegian citizens in other areas was prohibited (Anon. 1952, 1959, Øritsland 1973). In 1973 about half of Svalbard was included in nature reserves and national parks (*e.g.* Mehlum 1989). These areas include a major part of the walrus habitat.

Since 1921 various steps have been taken to regulate and minimize the harvest of Atlantic walruses in Russian territory (Bychkov 1973). In 1935 the harvest from sealing vessels run by the Soviet State ceased and in 1949 the killing of walruses by the fishing and sealing industry was prohibited. From 1956 hunting for Atlantic walruses was banned for all Soviet citizens, excluding a limited harvest by native peoples for subsistence purposes and by expeditions.

The Norwegian-Soviet Sealing Agreement of 1958 (Anon. 1959), which applies to northeast Atlantic waters east of Cape Farewell (*i.e.* southern tip of Greenland), also includes provision that the catching of walruses is forbidden throughout the year. This agreement thus confirms both the Soviet total prohibition of walrus hunting in the western Russian Arctic since 1956 and ship-borne hunting of Atlantic and Laptev walruses in 1935, and the Norwegian total protection since 1952 (Øritsland 1973).

In 1971 the Novaya Zemlya population of Atlantic walruses was included in the list of Rare Animals of the USSR (Bychkov 1971, 1973). In 1994 Franz Joseph Land became a national park (zapovednik), and most of the walrus habitat in this archipelago is therefore officially protected.

At Canada's request the walrus was included in Appendix III of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES), beginning in 1975. The walrus is included in Appendix II of the Convention on the Conservation of European Wildlife and Natural Habitats of 1979 (the Bern Convention; Born 1992).

ANTHROPOGENIC EFFECTS APART FROM THOSE DUE TO HUNTING

Like other wildlife, walruses are affected by many human activities other than those involving their deliberate killing. In this section we identify the human activities, apart from hunting, that are known or suspected to have negative impacts on walruses, and we review the available evidence concerning the nature and degree of these impacts on populations.

Disturbance from different sources of noise

Various sources of disturbance that might affect walruses and the potential consequences of such disturbance have been listed previously (*e.g.* Mansfield 1983, Anon. 1990c, 1993b, U.S. Fish and Wildlife Service 1993). In the present review we consider only the potential effects on walruses of in-air and underwater noise from aircraft, ships, off-shore drill-sites and seismic activities. Potential negative effects of noise on walruses include: 1) trampling of calves during stampedes, 2) insufficient rest, increased stress and energy expenditure, 3) insufficient suckling of calves, 4) interference with feeding, 5) masking of communication and 6) impaired thermoregulation in calves that spend too much time in water. Few studies have actually addressed questions about disturbance of walruses.

Walruses react to man-made disturbance by an escape response, presumably triggered by visual, auditory and olfactory cues (Loughrey 1959). The walrus's senses of smell and hearing are keen, whereas its vision is not particularly good (Loughrey 1959, Fay *et al.* 1984, Kastelein *et al.* 1993a, b). Walruses are highly vocal both in air and underwater (*e.g.* Ray and Watkins 1975, Miller and Bonness 1983). During the mating season in late winter and early spring, walruses use a complex array of vocalizations underwater. Displaying bulls produce sounds such as rasps, clicks, bell tones, strums etc. to attract females in estrous (*e.g.* Stirling *et al.* 1987). Most calls are within a frequency range of 50 Hz to 4 kHz. These sounds are transmitted underwater up to at least 10 km (*e.g.* Stirling *et al.* 1987, Anon. 1991). Underwater acoustic studies off Round Island (Alaska) indicate that walrus vocalizations can raise calm-water ambient noise levels by 11 dB (USFWS 1991 unpubl. data *fide* Anon. 1991). A study of the hearing ability of walruses in the wild indicated that they are sensitive to sounds between 250 Hz and 4 kHz. (Kastelein *et al.* 1993b).

The intensity of a walrus's reaction to human-made noise can be highly variable, and in some cases walruses may even be attracted by human presence (Fay *et al.* 1984, Anon. 1993b). Factors such as sex and age of the animal, the size and location of its group (on ice, in water, on land), distance from the disturbance, the type and intensity of the disturbing factor, the animal's previous experience with disturbance, the weather and the animal's behavioral state (*e.g.* hauled out in sunny weather and drowsy) can all affect its responsiveness. On ice or on shore, male walruses tend to be less shy than females, and solitary individuals tend to be less shy than groups. Females with calves appear to be most sensitive to disturbance (*e.g.* Salter 1979, Miller 1982, Fay *et al.* 1984).

Aircraft traffic: Richardson *et al.*(1989) and Davis *et al.*(1990) summarized information about marine mammal reactions to noise and concluded that seals and walruses were probably the most susceptible to disturbance by aircraft.

The sound and sight of an aircraft moving rapidly overhead appear to be particularly disturbing to walruses (*e.g.* Fay *et al.* 1984). Studies of walrus reactions to aircraft noise (Salter 1978, 1979, Fay 1981, Fay *et al.* 1984, Born and Knutsen 1990 c) have shown that the response varies with aircraft type, range, flight pattern, altitude and environmental factors such as, for example, wind speed and wind direction. The reactions of the walruses also depend on age and sex, group size and behavior (*e.g.* Salter 1978, 1979, Fay 1981, Orr *et al.*1986). Usually walruses that are hauled out react by lifting the head when the noise from a helicopter or other aircraft becomes audible to humans. An acute escape response, with animals fleeing into the water, is usually not observed until the aircraft is within 1-2 km of a group. However, there are exceptions to this, and in certain cases walruses can be scared by helicopter noise and escape into the water when the helicopter is even further away (Gjertz, unpubl. observation). Adult females, calves and subadults are more likely than adult males to enter the water during disturbance. This can result in a stampede, sometimes causing calves to be crushed to death. Tomilin and Kibal'chich (1975 *fide* Fay 1981) reported how an aircraft overflight caused Pacific walruses to stampede, leading to the trampling to death of some calves and the abortion of some fetuses. The passing of an aircraft at 800 m altitude over an ugli on Wrangel Island caused a stampede in which 102 walruses of all age and sex classes died. Many traumatized animals that were able to leave the ugli died later (Ovsyanikov *et al.*

1994). To reduce disturbance, overflights of most walrus haul-out sites in Russia are prohibited within 50 km except by special permit (U.S. Fish and Wildlife Service 1993).

Smith *et al.* (1979) noted that direct observations of walrus responses to aircraft flying over haul-out areas, disturbance by boats, and chronic disturbance by the construction of DEW (distant early warning) line sites and associated activities near haul-out areas all point to the sensitivity of walruses to any change in their environment. Chronic disturbance may lead to permanent abandonment of an ugli (Gol'tsev 1968, 1975 *fide* Fay *et al.* 1984). Richardson *et al.* (1989), however, stated that some walruses that were exposed to repeated aircraft disturbance at haul-out sites close to airstrips, *e.g.* at Cape Lisburne (Alaska), seemed to become more tolerant of the aircraft noise, *i.e.* they became partially habituated.

Vessel traffic: Walruses usually do not react to small boats with outboard engines before these are less than about 400 m away (Salter 1979, Fay 1981). However, drowsy walruses can sometimes be approached slowly to within about 10-20 m in small skiffs with outboard engines. In such cases the escape reaction often appears to be triggered by the sense of smell or sight. The reaction of the walruses is clearly related to their previous experience with skiffs. In hunted populations, *e.g.* that in Avanersuaq (Thule) in northwestern Greenland, walruses are much more skittish than they are in unhunted populations, *e.g.* at Svalbard (Born, unpubl. observations). According to Fay *et al.*(1984), Pacific walruses reacted to the icebreaking activities of a ship, starting when the ship was as much as 2 km away. These authors believed that the walruses reacted more to the sound of the ice breaking than to the sounds of the ship's engine. When the ship was 100-300 m away, male walruses on ice went into the water. Females with young usually went into the water when the ship was 500-1000 m away, apparently as a response to both the sight and the sound of the ship. Low-frequency diesel engines appear to cause less disturbance than high-frequency outboard engines (Fay *et al.* 1984). However, the opposite sometimes might be the case (Anon. 1991).

Haul-outs in Russia have been protected by regulations limiting access; the distance varies with the site but is usually 20 km (U.S. Fish and Wildlife Service 1993). It is, however, not clear from this source whether these regulations apply to all areas of Russia.

The reactions of walruses to drilling operations involving icebreaker activity were studied in the Chukchi Sea between late June and early October 1989 (Brueggeman *et al.* 1990, 1993). Walruses moved 20-25 km away from the ice-breaking operations deeper into the pack ice where noise levels approached ambient. Once the ice-breaking activities stopped or became more focused at the drill site, the walruses began returning to previously occupied areas. Under these circumstances, walruses displayed some behavioral responses which rapidly decreased at distances beyond 0.46 km from the ice breaker. They showed little response to other drilling operations. These studies demonstrated that walruses react to icebreaker activities, but responses varied according to the intensity of the ice management. According to Brueggeman *et al.*(1993) the variability of walrus responses to different activities offers opportunities to minimize disturbance to walruses during drilling and other industrial operations.

Intensive year-round ship traffic, including the use of large ice breakers in winter, reportedly has had a negative impact on walruses in the western Russian Arctic, particularly in the southern Barents Sea (Timoshenko 1984). In recent years, hunters from several villages along the northwest coast of Alaska have commented to the United States Fish and Wildlife Service that the abundance of walruses in the retreating spring pack ice declined at about the time when large ocean-going tugs arrived in the area, pulling barges of supplies destined for more northerly villages and industrial sites (U.S. Fish and Wildlife Service 1993).

See also section: Interactions with fisheries and changes in walrus food resources.

Offshore hydrocarbon exploration and operational activities: Sources of man-made underwater noise considered here include: 1) offshore drilling and production, 2) underwater "explosions" (high explosives, airguns, gas exploders and vibrators) associated with seismic activity (Davis *et al.* 1990). Seismic exploration usually involves the production of sounds with high source levels, making them audible many kilometers away. Vibroseis (use of vibration vehicles on the ice to project sounds into the water) creates low-frequency sounds with source levels greater than 185 dB (*Ibid.*).

In a study of the effects on walruses of offshore drilling, the animals were found to exhibit only weak short-term behavioral responses to the drilling activities *per se* (Brueggeman *et al.* 1990). According to Davis *et al.*(1990), detailed studies of how pinnipeds react to noise from seismic exploration have not been published, and there is little information on how they react to impulsive sounds generally. The available information is not conclusive, but

what there is suggests that, in some cases at least, seals will tolerate intense impulsive sounds, *e.g.* if they are strongly attracted to an area for feeding or reproduction.

Underwater noise could interfere with walrus mating activities in the wintering areas and thereby reduce their reproductive capacity. Fay *et al.* (1984) assumed that some inhibition of communication through garbling or "drowning out" of underwater vocalizations could take place if the noise level was high enough. Underwater noise might affect walruses in three ways: 1) by "masking" ordinary communication and thus preventing individuals from locating one another, 2) by "masking" vocalizations of displaying bulls and thereby preventing them from attracting females in estrus, and 3) by scaring walruses away from critical habitats, *e.g.* feeding banks (Anon. 1990 b,c).

Military activity : We are not able to evaluate to what extent military activity (rocket launching, explosions) in different areas (*e.g.* southern Barents Sea) may have adversely affected walruses.

Pollution

Oil spills etc.: Oil and gas exploration and development pose several potential risks to walruses and their habitat: 1) harassment, such as stampede induced by noise etc. from ships, seismic activities and installations, or crushing from direct contact with ships, 2) negative effects of noise (for example masking of communication), 3) contact with or ingestion of oil from oil spills etc., 4) damage or destruction of essential habitats, such as haul-out sites and feeding banks, from oil spills.

Potential risks associated with items 1 and 2 are discussed elsewhere in this report, and only items 3 and 4 are considered here.

Documented and hypothetical effects of oil spills on marine mammals have been reviewed by, for example, Griffiths *et al.* (1987), Richardson *et al.* (1989), and Boertmann *et al.* (1994). However, as far as we know, no studies have specifically addressed the direct or indirect effects of oil on walruses, and little specific information is available. Speculations and hypotheses about the potential impact of oil spills on walruses were given in Anon. (1990c).

Studies of seals have shown that surface contact with oil causes stress, and temporarily irritates the eyes and skin. Some studies have indicated that ingestion of oil leads to physiological and chemical changes, but most evidence of internal organ and tissue damage from oil ingestion by seals is inconclusive (see review by Richardson *et al.* 1989). Inhalation of aromatic hydrocarbons from an oil spill caused mental debilitation in harbor seals – *Phoca vitulina richardsi* (Frost and Lowry 1993). Walruses exposed to an oil spill are likely to show some of these reactions. However, walruses depend almost entirely on blubber to minimize heat loss. Their sparse pelage presumably is of little value as insulation, and their skin is thick and very tough (Fay 1982). It is therefore unlikely that exposure of the skin to oil would have any appreciable thermal effect except in newborn walruses. Perhaps the oiling of newborns that have not yet accumulated a thick insulating blubber layer would affect their ability to keep warm. Consequently, oil spills during the walrus calving season (May-June) in areas where females and young are present could, theoretically, have a greater adverse impact than spills at other times and in other areas.

Richardson *et al.* (1989) stated that hair seals (Phocidae) often do not actively avoid spilled oil, but Burns and Frost (1979 *fide* Richardson *et al.* 1989) mentioned circumstantial evidence that some bearded seals (*Erignathus barbatus*), ringed seals and walruses avoid waters that have been contaminated by fuel.

We believe that some features in the ecology of walruses make them more vulnerable to the harmful effects of spilled oil than are many other marine mammals:

1) Due to the high level of gregariousness in walruses, an oil spill that affects one would be likely to affect at least several individuals.
2) Their pronounced thigmotactic behavior on ice and on land makes it likely that oil-fouled walruses will rub oil onto the skin or into the eyes of other individuals.
3) Walruses tend to inhabit coastal areas and areas of relatively loose pack ice. Spilled oil is likely to accumulate in just such areas (Griffiths *et al.* 1987). Walruses therefore have a high risk of being fouled not only in the water but also when they haul out on land.
4) Because they are benthic feeders, walruses may be more likely to ingest petroleum hydrocarbons than are most other pinnipeds. Benthic invertebrates are known to accumulate petroleum hydrocarbons from food, sediments and the surrounding water (see Richardson *et al.* 1989, Anon. 1990c). Mortality of several species of benthic invertebrate, including bivalve mollusks, has been observed as a direct effect of oil spills (North 1967, Percy and Mullin 1975, both *fide* U.S. Fish and Wildlife Service 1993). Furthermore, sub-lethal effects on the behavior,



Fig. 54. A walrus devouring a ringed seal on the ice at Kong Karls Land (Svalbard) on 24 July 1991. It is suspected that the high levels of chlorinated hydrocarbons found in some walruses are related to their seal-eating habits. Photo: M. Forsberg.

physiology, and productivity of benthic mollusks may result from exposure to petroleum products (Clark and Finley 1977). The implications for walruses may be serious since contaminants in their food are certain to build up in their own tissue. Also, if oil contamination were to reduce the biomass or productivity of the invertebrate communities that sustain walruses, there would obviously be some secondary impact on the walruses themselves. However, information about population dynamics of marine mammals and the effects of oil on prey species is generally too incomplete to allow a meaningful assessment of the potential indirect long-term effects of oil spills (for a review see also Richardson *et al.* 1989).

5) Walruses are stenophagous (*i.e.* narrow feeding niche) and depend on access to mollusk banks in shallow water. Oil spills in certain feeding areas could force walruses to seek alternative food or relocate to other feeding areas. It cannot be assumed that alternative types of food or feeding areas are actually available, however, so such a scenario could prove detrimental to the walruses.

Activities associated with oil and gas exploration are now occurring in many areas inhabited by Atlantic walruses. In some areas these activities are large-scale. For example, around Svalbard there has been extensive offshore exploration for oil since the early 1980s (Moe 1994), and exploratory drilling is presently underway a little south of Bjørnøya. The feasibility of exploitation on the Spitsbergen Banke between Bjørnøya and the island of Hopen is being evaluated, and exploitation is expected to begin before the end of this century. One of the world's largest fields of liquified natural gas, the Stockmann Felt, is in the Barents Sea (Gjertz, unpubl. information).

In the western Russian Arctic there are large oil and gas fields in the southern Barents Sea from the White Sea northeast to southern Novaya Zemlya, and along the west coast of Novaya Zemlya. Furthermore, large fields in the Kara Sea stretch eastward to the Yamal Peninsula (Anon. 1992, Moe 1994). Seismic surveys started in 1971, and exploratory drilling in 1981. There are several drilling platforms along western Novaya Zemlya and in the Kara and Pechora seas, and oil is now produced on Kolgujev Island (*Ibid.*). These oil fields overlap the summer and winter distribution of walruses and therefore large-scale petroleum activities pose a potential threat to walruses in these areas.

Problems of oil spills or leaks on land in northwestern Russia are of concern for many reasons, among them the possibility that massive contamination will eventually reach marine waters and affect marine organisms. Of special interest in this regard are the walruses in outer Pechora Bay and the nearshore southern areas of the Pechora Sea (*cf.* Haug and Nilssen 1995).

At present, there is no exploitation of nonrenewable resources in Greenland. Since 1991, however, there has been marine seismic activity related to oil exploration along the coasts north to 79°N in eastern Greenland and 77°N in western Greenland (for a review see Born 1995).

We are not aware of any offshore petroleum development activity that is occurring in the eastern Canadian Arctic in areas presently occupied by walruses.

Heavy metals and chlorinated hydrocarbons (CHCs): Two classes of pollutants have given particular cause for concern in marine mammals: heavy metals and chlorinated hydrocarbons (CHCs) (for a review see Reijnders *et al.* 1993). Few studies have been made of heavy metals, PCBs and other CHCs in walruses.

Heavy metals: The three metals which give greatest cause for concern are mercury (Hg), cadmium (Cd) and lead (Pb) (Reijnders *et al.* 1993).

Concentrations, on a wet weight basis, of Hg in Atlantic walruses from northwestern Greenland, males and females combined, were 1.78 μg/g (SD = 1.54) for liver and 0.08 μg/g (SD = 0.05) for muscle (Born *et al.* 1981).

Wagemann *et al.*(1993) reported regional differences in heavy metal burdens in Atlantic walruses sampled between 1982 and 1990 in southeastern Hudson Bay, Foxe Basin and southeastern Baffin Island. Concentrations of Pb and Hg in Hudson Bay animals (8.0 and 0.58 μg/g dry weight Pb and Hg in the liver, respectively) were approximately twice as high as those in animals from Foxe Basin. Metal concentrations, except Cd, in walrus tissues appeared to parallel those found in clam tissues. Cd levels were relatively high in liver and kidney of walruses, and the spatial trend was opposite that for Hg and Pb, decreasing toward the south. The Cd concentration in liver of walruses from Foxe Basin (on average 38 μg/g dry weight) was twice as high as that in animals from southeastern Hudson Bay. Cd concentrations in tissues of walruses from Foxe Basin were also high compared with those in other marine mammals. The concentrations of Pb and Hg in animals from southeastern Hudson Bay were unexpectedly high compared with animals from the other locations.

Mean concentrations of mercury in liver of Pacific walruses (1981-1984) were as high as 1.85 μg/g (SD=2.59) in males and 4.00 (SD=8.41) in females. Cadmium in kidney reached 66.25 μg/g in males (SD=14.78) and 44.29 μg/g in females (SD=18.80) (Taylor *et al.* 1989). Further results of this study (1986-1989), which involved only adult animals, were presented in Warburton and Seagars (1991, 1993). Analyses were completed for 23 elements. All tissues had Pb, Cd, Ar, Zn and Hg in detectable quantities. Mean Cd concentrations were 27.6 μg/g (1.0-86.7 μg/g) in liver and 166.5 μg/g (3.6-457.6 μg/g) in kidney. In kidney and liver tissues, mean Hg concentrations were four times higher and Cd concentrations three times higher than reported previously. Mean Cd concentrations exceeded levels (13μg/g) considered by the EPA (Environmental Protection Agency) to interfere with organ function in some animals. Mean Hg concentration in liver exceeded the EPA standard (1 μg/g) considered safe for human consumption. Male and female tissues differed significantly in mean concentrations of Ar (liver and kidney) and Se (liver). Warburton and Seagars (1993) were unable to assess, conclusively, the meaning of their results with respect to the health of walruses.

CHCs, chlorinated hydrocarbons: PCBs are anthropogenic chemicals. They accumulate mainly in blubber and are of concern because of their potentially harmful effects on walrus reproduction, the walrus immune system, and human health through consumption of contaminated walrus tissue (Anon. 1993b). Norstrom and Muir (1994) identified 45 PCB congeners in walruses from the Canadian Arctic, but walruses typically contain low levels of CHCs (Anon. 1993b). These generally low burdens in walruses are likely explained by their diet. Walruses appear to be more efficient than ringed seals in metabolizing PCBs, but the difference could be diet-related (Norstrom and Muir 1994). It has been suggested that the comparatively high levels of PCBs found in some individual walruses in Canada were due to these walruses' seal-eating habit (Wagemann *et al.* 1993).

Concentrations of DDT in blubber from walruses in northwestern Greenland were 0.09 μg/g (wet weight; SD = 0.13) in males and 0.05 μg/g (SD = 0.05) in females (Born *et al.* 1981). Concentrations of total-PCB in blubber were 0.36 μg/g (SD = 0.31) and 0.18 μg/g (SD = 0.12) for males and females, respectively (Born *et al.* 1981). These values are relatively low compared with those reported for Pacific walruses (Norstrom and Muir 1994) and Atlantic walruses in eastern Hudson Bay (Segstro *et al.* 1993).

Blubber from walruses in eastern Hudson Bay, Foxe Basin and SE Baffin Island was analyzed for PCB congeners and other persistent CHCs (DDT, toxaphene, chlordanes, dieldrin, mirex) by Segstro *et al.* (1993) and Wagemann *et al.* (1993). Samples from 17 of 58 individuals had concentrations of total-PCB ranging from 1 to 20 μg/g; the remaining individuals had much lower concentrations (0.05-0.6 μg/g). Especially high concentrations were found in the sample from eastern Hudson Bay. Compared with previous studies from Greenland and Alaska these levels were unexpectedly high. Local contamination was ruled out, and Segstro *et al.* (1993) suggested that the high levels of the different CHCs found in some individuals in their study might have been caused by the fact that these animals had consumed ringed seals as a significant proportion of their diet (Fig. 54).

Compared with some other marine mammals, walruses have generally low concentrations of heavy metals in their tissues, and their concentrations generally are not significantly different from those reported for other pinnipeds (Wagemann and Muir 1984). This is also the case for CHCs (chlorinated hydrocarbons). The effect of CHCs on walrus physiology and reproduction is not known, but the comparatively high concentrations of these substances reported from some individuals give cause for concern. The contamination of walruses with CHCs warrants further study.

Radioactivity and nuclear activity: Only a few studies on radioactive elements in walruses have been made. In 1968 a USAF B-52 bomber crashed in the Avanersuaq area (Thule area, northwestern Greenland). In connection with this accident plutonium was released from the nuclear bombs to the surroundings (Anon. 1970a, b). Analyses of plutonium in sediment, bivalves (including walrus food items) and other benthic organisms collected at the crash site showed values elevated from background levels (Aarkrog 1970, 1971). Therefore, there is a risk that some walruses have become, and more will continue to become, contaminated with radioactive waste through their food. Aarkrog (1970) concluded that the animals at higher trophic levels such as birds, seals, and walruses showed plutonium levels hardly significantly different from the fall-out background.

In analyses of plutonium in liver and jaw tissues of 15 and five walruses sampled in northwestern Greenland (1977-78, 1989) and Central East Greenland (1989), respectively, very low values were detected in two jaws and seven livers. In the remainder of samples, values were below detection limit (Aarkrog, Nielsen and Born, unpubl. data). However, in this study, and in that reported by Aarkrog (1970, 1971), it was unclear to what extent the walruses analyzed had actually been feeding close to areas potentially contaminated by nuclear waste.

In general, nuclear weapon tests in different parts of the world caused widespread fall-out of plutonium. However, the levels of this element and other radionucleides, such as ^{137}Cs, reported so far from marine mammals are not considered high enough to pose a health risk to the animals (A. Aarkrog pers. comm. 1995).

No information is available about the effect on walruses of the nuclear activities in the Novaya Zemlya region. Thus we have no basis for determining if these large-scale activities, some of which were within or close to walrus habitat (see Stokke 1994: 147), have affected the walrus population by contaminating the walruses or their prey. If there has been an effect, it would most likely be in the form of direct killing by the shock waves, killing by acute nuclear "poisoning", or noise disturbance.

Second-hand information from Russian sources indicates that certain walrus haul-out sites in Novaya Zemlya were deserted in the 1960s due to the nuclear testing on this island. These walruses supposedly moved to Franz Joseph Land and have not returned (Gjertz, unpubl. information). This information may be connected to Bychkov's (1975) assumption that only 400 walruses remained of the Novaya Zemlya stock , and that their numbers were declining despite total protection. Although walrus population estimates in the Novaya Zemlya region are not very reliable, there are indications that both the population in this region, and the number of terrestrial haul-outs, have decreased since the 1950s (Bychkov 1975, Timoshenko 1984, Popov *et al.* 1990).

Interactions with fisheries and changes in walrus food resources

Walruses typically feed on bivalve mollusks in shallow continental shelf waters (*e.g.* Vibe 1950, Fay 1985). They have a narrow feeding niche and are therefore forced to inhabit specific areas for a major part of the year. Fishing activities in such areas may have direct or indirect negative effects on walrus populations.

Fishing activities may affect walrus populations in the following ways: 1) a fishery can compete directly with walruses for a food resource or damage their food supply by disturbing the ocean floor, 2) fishing activities produce noise and other forms of disturbance that can cause stress to walruses.

In none of the areas occupied by Atlantic walruses are the effects of interactions with fisheries understood, although major commercial fisheries have been developed during the present century in walrus habitats off western Greenland, around Svalbard and in the Barents Sea region. Sufficient information is available only for Svalbard and western Greenland to allow us to consider potential conflicts between fisheries and walruses.

In the Svalbard area concentrations of Icelandic scallops (*Chlamys islandica*) are found between 20 and 70 meters depth. From the mid-1980s there has been an intensive fishery for Icelandic scallops on the continental slope around Svalbard (J. Sundet pers comm. 1990). In 1986, 26 trawlers (all about 2000 GRT) took scallops (*Ibid.*); in 1987, 15-20 trawlers participated in the fishery (Anon 1990b). In

the period 1985-1990, the largest trawlers took 10-50 tons of living scallops per day, and during the operations the large ships had three dredges, each up to 5 m width, in operation at the same time (J. Sundet pers. comm. 1990). This fishery peaked in 1986 and 1987 when about 720 and 4000 tons, respectively, of scallop meat (adductor muscles) was processed. Thereafter the fishery collapsed (*Ibid.*). In Svalbard most of the important walrus habitat lies within protected areas (*i.e.* nature reserves and national parks). Apart from shrimp trawling at depths greater than 100 m, trawling and dredging in these areas are prohibited. One of the best-known terrestrial haul-outs for walruses in Svalbard, the island of Moffen, is located at the center of the richest scallop banks in Svalbard. In the mid-1980s this led to a siege of Moffen by a fleet of trawlers that, whenever given a chance, violated the protected area. This activity occurred in spite of increased surveillance by the coastguard and police (I. Gjertz unpubl. information).

It is not known to what extent walruses feed on scallops. In the Canadian Arctic, Mansfield (1958) found remains of scallops (*Pecten* sp.) in four walruses; scallops were the dominant prey in two of these animals. Scallop eating by walruses in the Svalbard area, has not been documented, but Gjertz and Wiig (1992) found some indications that Svalbard walruses do eat scallops. Walruses also feed on a large variety of other benthic organisms (*e.g.* Fay 1982). According to Anon. (1990c:133) the non-selective dredging technique that was used at Svalbard radically altered the sea floor. It is therefore reasonable to assume that the large-scale dredging in and around important walrus feeding grounds in Svalbard damaged benthic communities and reduced their biological diversity. Thus walruses presumably have been affected regardless of whether they feed on scallops.

In West Greenland a small-scale commercial fishery for Icelandic scallops began in 1983. Catches have ranged from 410 tons in 1984 to 1966 tons in 1991 (Pedersen 1994). The main fishing area is between Nuuk and Disko Island. The scallop beds are located close to the coast, and the fishery is confined to summer and autumn. Icelandic scallops are usually found on hard substrate (shell gravel, gravel, stones, rocks, sand and less frequently mud) in areas associated with strong tidal currents. These are not areas where typical walrus food items are found. The relatively small size of this fishery and its spatial and temporal location indicate that it probably has had no major effect on the stock of walruses wintering off western Greenland.

In contrast, the noise caused by another intensive fishery in walrus habitat off West Greenland may have had a negative impact on walruses. Since about 1920 fishing activities have increased in western Greenland, and the development of commercial fisheries has been especially rapid since the 1960s (*e.g.* Born *et al.* 1994a). At the beginning of the 1970s trawling for shrimp was initiated in offshore areas, including parts of Store Hellefiske Banke in the Sisimiut-Aasiaat area. Walruses occur in winter and spring on this bank in areas where water depths are less than 100 m. In spring 20-25 large trawlers and some smaller vessels operate close to the edge of the West Ice (Born 1990). As soon as ice conditions permit, the fishery commences on Store Hellefiske Banke. This may be as early as March, and during April and May fishing activity increases in this area. Similarly, the large trawlers operate along the west coast of Disko in or close to walrus habitat as early as May (P. Kanneworff pers. comm. 1995).

Most underwater sounds associated with fishing vessels are generated from propeller cavitation and are in relatively low frequencies (40 Hz-4 kHz). Measurements of a medium-sized trawler's underwater sounds showed source levels of 169 dB when transiting (at 10 knots) and 157 dB when trawling (at 5 knots) (Urick 1983). Small to medium sized ships operating at full power produce sound source levels of 165-175 dB (Malme *et al.* 1989). Underwater sounds produced by vessels are within the frequency range of those produced by walruses. It is therefore possible that intense vessel noise could mask the calls of walruses and impair the efficiency of signaling between individuals (Anon. 1991). In addition to the underwater sounds, airborne sounds of various kinds are associated with fishing activities (engines, generators, deck activities etc.)

Compelling circumstantial evidence indicated that yellowfin sole (*Limanda aspera*) fishery operations were causing airborne and submerged acoustic disturbance responsible for a significant decline (up to 60%) in the number of Pacific walruses reported hauling out at Round Island, the Twins, and Cape Pierce in Alaska. Many walruses from Round Island may have moved to other haul-out areas in Bristol Bay (U.S. Fish and Wildlife Service 1993). In order to reduce the negative impact of this fishery on the walruses, a 12-nautical-mile buffer zone has been established around the Walrus Island State Game Sanctuary and Cape Pierce (Anon. 1991, U.S. Fish and Wildlife Service 1993).

LIFE HISTORY AND VITAL PARAMETERS

In order to give the reader a background for evaluating the information presented in this report about the status of Atlantic walrus populations, the life history of walruses is briefly described. We emphasize aspects that are important for evaluating information about distribution, survey results, population recruitment and trends. Fay (1981, 1982) and Born (1992) gave more thorough reviews of the biology of walruses.

Taxonomy: The walrus genus, *Odobenus*, has only one species: *rosmarus*. Two subspecies are recognized (*e.g.* Heptner *et al.* 1976, Reeves 1978, Fay 1985): Atlantic walrus, *O. r. rosmarus* (Linnaeus 1758) and Pacific walrus, *O. r. divergens* (Illiger, 1815). On the basis of morphological variation and geographical isolation the existence of a third subspecies, *O. r. laptevi* , confined to the Laptev Sea, was suggested by Chapskii (1940). This taxon has generally been accepted by Russian scientists (*e.g.* Heptner *et al.* 1976, Belikov *et al.* 1984, Vishnevskaia and Bychov 1985), but was considered questionable by Fay (1981, 1982, 1985).

Only the Atlantic subspecies occurs in the northwestern and northeastern Atlantic Arctic.

Distribution: Today the walrus has a disjunct circumpolar distribution between the latitudes of approx. 55°N and 81°N (Heptner *et. al.* 1976, Reeves 1978, Fay 1985). The Atlantic walrus ranges from the eastern Canadian Arctic eastward to the Kara Sea (Reeves 1978). Several more or less well-defined subpopulations or stocks exist within this range (Fig. 3).

Body size: Walruses are the largest pinnipeds of the Arctic. Male Atlantic walruses reach a standard body length of about 300 cm and can weigh about 1200 -1500 kg. Females reach a body length of about 250 cm and a total body weight of 600-700 kg (Loughrey 1959, Mansfield 1958, Knutsen and Born 1994). Wiig and Gjertz (in press) have recently found that male walruses at Svalbard can reach a standard body length of about 380 cm corresponding to an estimated total body weight of nearly 2000 kg (Fig. 55). There are indications of differences in total body length in different stocks in the western Atlantic Arctic (Mansfield 1958, Knutsen and Born 1994). Chapskii (1936) reported body lengths of Atlantic walruses from the Kara Sea. However, in his study the methods of age determination and measuring differed from those of the authors cited above and his data are therefore not comparable.

Reproduction: On the basis of body and tusk size Chapskii (1936) estimated that male Atlantic walruses in the Kara Sea became sexually mature at 5 or 6 years of age. With more accurate methods of determining ages but on a relatively small sample, Mansfield (1958) judged that males in the eastern Canadian Arctic reached sexual maturity at 6 or 7 years of age. In *O.r.divergens* spermiogenesis commences between 7 and 10 years of age. The capa-



Fig. 55. Weighing an immobilized adult male walrus in Svalbard, where large males may weigh close to 2000 kg (Wiig and Gjertz in press). Photo: I. Gjertz



Fig. 56. Adult female with 1-year-old calf at Svalbard. Walruses give birth to a single calf at intervals of 2 or more years. Photo: I. Gjertz.

bility of fertilizing females is usually not achieved until later, when social or full physical maturity has been reached. Physical maturity is accompanied by a secondary growth spurt in males of *O. r. divergens* (Fay 1982); this growth pattern has not been observed in *O. r. rosmarus* (Mansfield 1958, Knutsen and Born 1994).

The majority of *O. r. rosmarus* females experience their first ovulation at 7 years of age (range: 5 to 10 years). According to Mansfield (1958) ovulations in 5-year-olds presumably usually do not result in successful pregnancies. However, Garlich-Miller and Stewart (1993) found one pregnant six-year-old in a sample of 71 females from Foxe Basin. In northwestern Greenland first ovulation occurs at five years of age. About 50% of the females experience their first ovulation at around the age of six and all have ovulated before the age of 10 (Born 1990). In *O. r. divergens* about 10% of females ovulate at 4 years, the majority of 6-year-olds have ovulated at least once and all have ovulated by the age of 10. The rates of reproductive failure in walruses appear to be high, and in any given year about 20% of the sexually mature females are resting. Females may experience reproductive senility. In *O. r. divergens* an onset of decline in productivity of females by age 16-18 has been observed (Fay 1982, Anon. 1990a).

In *O. r. rosmarus* potent bulls have been found between November and late May (Mansfield 1958) and the mating season is believed to be between late January and March-April (Mansfield 1966, Born 1990). In *O. r. divergens* spermiogenesis peaks in December-January for mature males and about 2 months later for adolescents (Fay 1982, 1985). Like in other pinnipeds, implantation is delayed in the walrus for 4-5 months (Fay 1982, Born 1990). Although unseasonal births have been reported (Vibe 1950, Lukin 1978), the main period of birth in *O. r. rosmarus* lasts about two months with a peak between mid-May and early June (Vibe 1950, Mansfield 1966, 1973). According to Fay (1985) calves of *O. r. divergens* are born mainly from mid-April to mid-June. Hence, pregnancy lasts about 15 to 16 months (Mansfield 1973, Fay 1985) and individual walruses therefore give birth to a calf at intervals of 2 or more years (Mansfield 1958, Fay 1982, 1985, Born 1990; Fig. 56).

Vital parameters: The segregation of different sex and age classes for most of the year, and the selective hunting pattern of the Inuit, make it very difficult to obtain unbiased samples for determining vital biological parameters (*e.g.* Fedoseev and Gol'tsev 1969, Fay 1982, DeMaster 1984). Sex ratio at birth is 1:1 with a slightly higher, but not significantly higher, proportion of males (Fay 1982, Fay *et al.* 1984). The sex ratio in the population is not well known. On the assumption that walruses are polygynous, an adult sex ratio of 1 male to 3 females has been suggested (Fay 1982, Fay *et al.* 1984, Sease and Chapman 1988). Generally, the low rate of reproduction (between 35 and 40% of fecund females give birth to a single calf in any given year; Mansfield 1958, Fay 1982, Born 1990) is believed to be balanced by a low rate of natural mortality, mainly secured by a prolonged period of parental care, and a higher recruitment to breeding age than in other pinnipeds (Fay 1982). Low reproductive capacity is probably also counterbalanced by the highly developed sociality

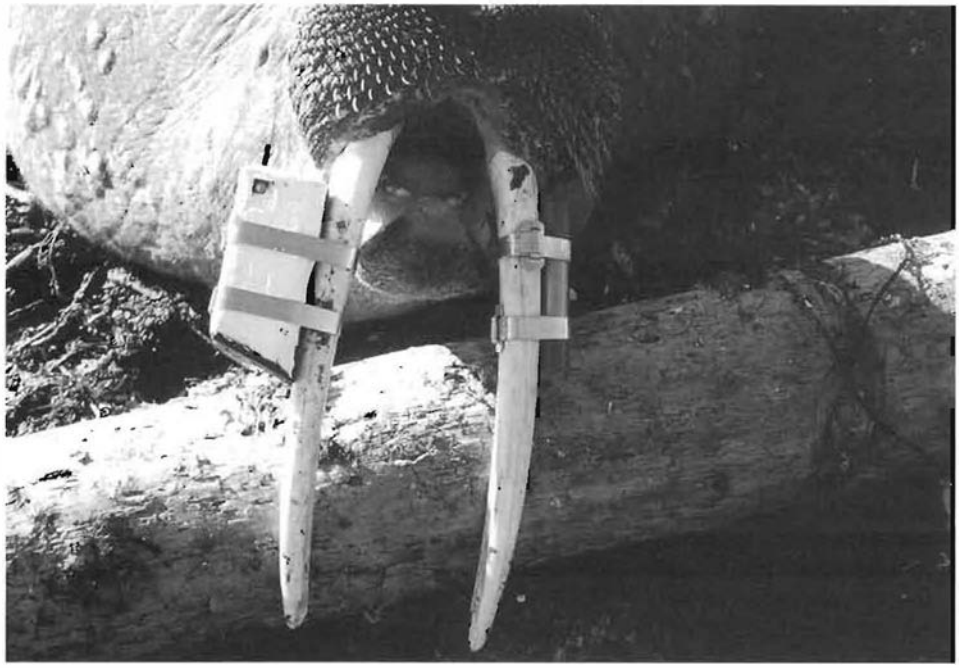


Fig. 57. A satellite-linked radio transmitter (the larger unit) and a time-depth recorder (TDR) attached to the tusks of an adult male walrus at Svalbard. The satellite-radios have been used for studies of movements (Born and Knutsen 1992, Wiig *et al.* in press). The TDR demonstrated a mean dive duration of 5.2 min (SD = 2.8 min, range = 0.2-12.7 min.) of which 81% of the time was spent at the bottom (Wiig *et al.* 1993). Photo: I. Gjertz

of walruses at all seasons (Fay 1985) and their long lifespan (up to about 40 years; Fedoseev and Gol'tsev 1969). The population birth rate (fraction of neonates in the total population) has been estimated at 0.07 (Mansfield 1966) or 0.11 (Mansfield 1973) in *O. r. rosmarus* and between 0.12 and 0.17 in *O. r. divergens* (Fedoseev and Gol'tsev 1969, Fay 1982). The differences in these estimates likely reflect sample variance rather than actual differences at the subspecies level. In *O. r. divergens* total annual mortality (A) for adult males has been estimated at 13% (Burns 1965). DeMaster (1984) suggested an A of about 9% for adult males and considered it likely that total annual mortality of adult females was much lower. Fedoseev and Gol'tsev (1969) estimated A for the entire population of *O. r. divergens* at 8-10%. The natural mortality rate is not known but has been estimated to be 3 to 5 % for the entire population of *O. r. divergens* (DeMaster 1984, Fay *et al.* 1989). An annual hunting mortality of 5 to 7% of the total population is therefore believed to be sustainable (Fay 1985). DeMaster (1984) estimated that maximum sustainable yield of adult females (4 years and older) would be 5.1% of the total population of females. He suggested that an adult female harvest of 1 to 5% could be sustained. Based on a variety of assumptions, maximum sustainable yield of a hypothetical walrus population has been estimated at 3 to 5% for a population between 59 and 91% of carrying capacity (*Ibid.*).

Instantaneous net growth rate of the population of Pacific walruses during the late 1950s to mid-1970s was estimated at 0.067 (Tavrovski 1971, Sease and Chapman 1988), indicating a finite growth rate of about 7% per year for a population in a phase of growth under favorable environmental conditions with no food limitations.

Estimates of abundance: Attainment of abundance estimates is hampered by the fact that the population usually occupies a very large area and has a clumped distribution. Furthermore the fraction of the population which is hauled out and visible at any given time is highly variable. In addition, walruses are "cryptically" colored and can be difficult to see in water (Estes and Gilbert 1978, Estes and Gol'tsev 1984, Gilbert 1989). During feeding, walruses are submerged and hence are not detectable for 80-85% of the time. (Fay 1982, Born and Knutsen 1992, Wiig *et al.* 1993; Fig. 57).

Ecology: As they feed mainly on bottom-dwelling bivalve mollusks, walruses are largely confined to continental shelves, where water depths are not greater than 80 to 100 m (Fay 1982, Wiig *et al.* 1993). Walruses are able to break through ice up to about 20 cm thick, but when the ice grows thicker than this walruses are forced to retreat to areas with drift ice. Hence, in winter walruses inhabit those regions of the drifting ice where leads and polynyas are numerous and where the ice is thick enough to support their weight (Burns *et al.* 1981, Fay 1982). They show a strong preference for hauling out on floes of first-year ice with a surface area between 50 m^2 and 400 m^2 (Wartzok and Ray 1980, 1981). Some walruses winter at high latitudes in polynyas (Vibe 1950, Finley and Renaud 1980, Stirling *et al.* 1981, Born 1984, Born and Knutsen 1992). In summer, males rest and molt while hauled out on land on traditional sites (uglit) often situated close to their feeding grounds (Tsalkin 1937, Mansfield

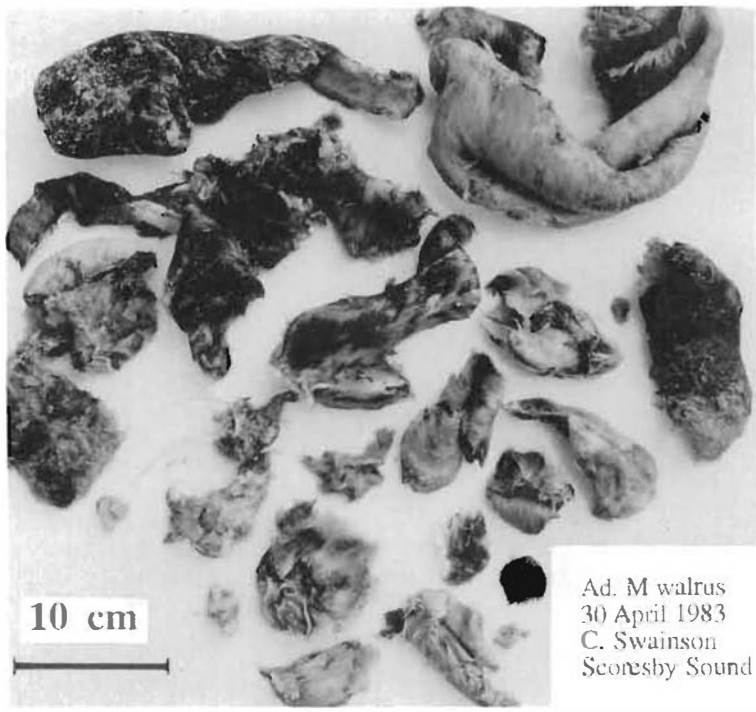


Fig. 58. Contents of the stomach of an adult male walrus killed at the entrance to Scoresby Sound (East Greenland) on 30 April 1983. The walrus had sucked out pieces of ringed seal skin and blubber. (See also Fig. 54). Photo: E.W. Born.

1958, Loughrey 1959, Fay 1982). Females and calves tend to occur farther off shore in association with the drifting ice (Fay 1982, 1985), although in some areas they also haul out on land (Miller 1982, Miller and Boness 1983).

Food and feeding: Walruses are stenophagous and depend on the soft parts (mainly feet and siphons) of bivalve mollusks for about 95% in numbers and weight of their food (Fay *et al.* 1977, Fay and Stoker 1982). This food is taken at water depths of less than about 80 m (Vibe 1950, Fay 1982). The principal food items are the bivalves *Mya truncata*, *Astarte borealis*, *Serripes groenlandicus* and *Hiatella arctica* (Vibe 1950, Heptner *et al.* 1976, Fay 1982, Gjertz and Wiig 1992). Other benthic invertebrates are also ingested to a varying extent (Fay 1982). Although reports of fish in walrus stomachs are rare (Fay 1982), piscivory may play a role in periods when other food is not available. Atlantic walruses have also been reported to prey on birds (Gjertz 1990). Walrus predation on seals is well documented (*e.g.* Johansen 1910, Fay 1982, Lowry and Fay 1984, Smith *et al.* 1979; Fig. 58). Apparently, the habit of seal-eating occurs in both sexes but apparently is confined largely to older subadults and adult walruses (Lowry and Fay 1984). In seasons and areas where the distribution of seals and walruses overlap considerably or when ice conditions make the mollusk feeding-banks inaccessible to walruses, seals may well be an important food source. This could be the case, for example, in northeastern Greenland. There is indirect evidence (trace metal and chlorinated hydrocarbon contaminant levels, ^{13}C analysis of tissues) that walruses in eastern Hudson Bay regularly prey on seals (Wagemann *et al.* 1993).

Natural enemies: Apart from man, the main predators of walruses are killer whales (Fig. 59) (*Orcinus orca*) and polar bears (*Ursus maritimus*) (Fay 1982). Interactions between killer whales and walruses occur in spring, summer and autumn, when the range of the two species may overlap (Fay 1982). Several instances of killer whales attacking and killing walruses, primarily young and calves, are summarized in Fay (1982). Several reports exist of polar bears attacking walruses. Apparently mainly calves and subadults are vulnerable to predation from bears (*e.g.* Parovschikov 1967, Fay *et al.* 1984, Calvert and Stirling 1990, Rugh 1993), although also adults are taken (Parovschikov 1967). A variety of other causes of natural mortality other than aging can be listed: adverse weather, freeze-out, disease, intraspecific interactions such as aggression during the breeding season, crushing of calves, and stampedes (Anon. 1990a). Although predation by bears and killer whales cannot be ruled out as a primary cause of natural mortality in regions where those predators are concentrated or seasonally abundant, the relative importance of the different causes of natural mortality is difficult to assess.

Behavior: Walruses are highly gregarious. They almost invariably occur in small groups and sometimes haul out on land in herds numbering thousands of individuals (Fay 1982, Miller and Boness 1983). The number of walruses hauled out at a given ugli can vary enormously from day to day (Salter 1979,



Fig. 59. An encounter in the ice near Svalbard between a polar bear and an adult walrus. Polar bears occasionally attack walruses but usually show respect toward adults (see text). Photo: L. Åby.

Miller 1982, Miller and Boness 1983). Walruses are polygynous; the sex ratio of adults in the breeding area is about one male per ten females. In the mating season, adult males fight intensively in the water, evidently in competition for display sites near females (Fay *et al.* 1984). During courtship displays the male walrus emits a stereotyped sequence of underwater sounds consisting of taps, knocks, pulses and "bells" (Schevill *et al.* 1966, Ray and Watkins 1975, Stirling *et al.* 1983, 1987, Fay *et al.* 1984). Probably, this acoustical display serves as an advertisement to females and as a warning to other males (Fay *et al.* 1984). Females choose a mate from among the displaying males and copulation occurs in the water. Hence, the mating system of the walruses is unique among pinnipeds. It resembles a lek in that: 1) dominant males display for females while congregated in a traditional location, 2) subdominant males take peripheral positions, and 3) the female appears to take the active role in consorting with the male of her choice within the "arena" (*e.g.* Fay *et al.* 1984, Le Boeuf 1986). However, Sjare (*e.g.* 1989, 1993), who studied the Atlantic walrus in the Canadian High Arctic, found no obvious indications that female choice was an important factor in determining which male was dominant. The mating behavior of Atlantic walruses may be more similar to female defense polygyny than to a mobile lek as described for the Pacific walrus.

ACKNOWLEDGMENTS

Publication of this report was funded by the North Atlantic Marine Mammal Commission (NAMMCO), Norwegian Polar Institute, and the Greenland Institute of Natural Resources. We are indebted to Pia Barner Neve, Cathleen Knötsch and René Søder for the great help that they provided during the preparation of this report. We also wish to thank Rob Stewart (DFO, Winnipeg) who provided us with, and helped us interpret, Canadian catch statistics. Thanks are due to the photographers who allowed us to use their photos in this publication. Finally we wish to thank all those who gave us information on walruses.

REFERENCES

Aarkrog, A. 1970: Radio-ecological investigations: Pp. 74-79 in: *Project crested ice. USAF Nuclear Safety. AFRP 122-1 Jan/Feb/Mar 1970 No. 1, Vol 65 (Part 2) Special Edition*. 93 pp.

Aarkrog, A. 1971: Radioecological investigations of plutonium in an arctic marine environment. *Health Physics* 2, 31-47

Allen, J.A. 1880: History of North American pinnipeds. A monograph of the walruses, sea-lions, sea-bears and seals of North America. *U.S. Geological and Geographical Survey of the Territories, Miscellaneous Publications 12*. Government Printing Office, Washington, D.C.. 785 pp.

Anders, G. (ed.): 1967. The east coast of Baffin Island: an area economic survey 1966. *Industrial Division, Department of Indian Affairs and Northern Development, Ottawa. A.E.S.R.* #66/4. 196 pp.

Andersen, J. 1984: *Zoologiske observationer fra Kajakekspeditionen Station Nord til Scoresby Sund*. (Zoological observations during a Kayak trip from Station Nord to Scoresby Sund). Unpublished field notes. Available at Department of Arctic Environment, Danish National Agency for the Environment, Tagensvej 135, DK-2200 Copenhagen, Denmark. (In Danish)

Anderson, L.E. & Garlich-Miller, J. 1994: Economic monitoring and analysis of the 1992 and 1993 summer walrus hunts in northern Foxe Basin, Northwest Territories. *Canadian Fisheries and Aquatic Sciences Technical Report 2011*. iv + 20 pp.

Anonymous 1938: Fredning af Dyrebestanden i Nordøstgrønland. (Protection of animal populations in Northeast Greenland). *Publikationer om Østgrønland* Nr. 6. 50 pp. (In Danish)

Anonymous 1946. 24: Afsnit. Indkøb af grønlandske produkter. (The purchase of products from Greenland). *Beretninger vedrørende Grønlands Styrelse, No.1. Sammendrag af statistiske oplysninger om Grønland* VI, 779-788 (In Danish).

Anonymous 1952: Fredning av hvalross. (Protection of the walrus). *Kongelig resolusjon (Royal decree) av 20. juni 1952*. Oslo, Norway. (In Norwegian)

Anonymous 1959: Norwegian-Soviet Sealing Agreement, 1958. *Polar Record* 9, 345-348

Anonymous 1966: Recent Norwegian laws relating to sealing. *Polar Record* 13, 209-211

Anonymous 1970a: The flight of Hobo 28. Pp. 2-3. In: Project crested ice. *USAF Nuclear Safety. AFRP 122-1 Jan/Feb/Mar 1970 No. 1, Vol 65 (Part 2) Special Edition*. 93 pp.

Anonymous 1970b: Radio-ecological investigations. Pp. 74-79 in: *Project crested ice. USAF Nuclear Safety. AFRP 122-1 Jan/Feb/Mar 1970 No. 1, Vol 65 (Part 2) Special Edition*. 93 pp.

Anonymous 1978: *Summary Environmental Impact Statement for Exploratory Drilling in the Davis Strait* Region Imperial Oil Ltd., Aquitaine Co. of Canada Ltd. Canada Cities Service Ltd., January 1978. 83 pp.

Anonymous. 1981-87: *Land use information series*. Lands Branch, Inland Waters/Lands Directorate, Environment Canada, Ottawa. Maps.

Anonymous 1983: Government of Canada, Fisheries and Oceans. *Walrus Protection Regulations made under the Fisheries Act, plus amendments*.

Anonymous 1990a: Reproduction, survival and recruitment. Report of working group 6. Pp. 45-48 in: F.H. Fay, B.P. Kelly and B.A. Fay (eds). *The ecology and management of walrus populations. Report of an international workshop, 26-30 March 1990, Seattle, Washington, U.S.A*. Final report to the U.S. Marine Mammal Commission in fulfillment of Contract T 68108850. 186 pp.

Anonymous 1990b: Environmental protection. Report of working group 11. Pp. 67-70 in: F.H. Fay, B.P. Kelly and B.A Fay (eds). *The ecology and management of walrus populations. Report of an international workshop, 26-30 March 1990, Seattle, Washington, U.S.A*. Final report to the U.S. Marine Mammal Commission in fulfillment of Contract T 68108850. 186 pp.

Anonymous 1990c: Walrus. Pp. 71-81 in: R. Hansson, P. Prestrud and N.A. Øritsland (eds). *Assessment system for the environment and industrial activities in Svalbard*. Norwegian Polar Institute. 267 pp.

Anonymous 1990d: *Summary of Fish and Wildlife Regulations in Greenland*. Greenland Home Rule, Wildlife Management, Nuuk, June 1990. 2 pp.

Anonymous 1991: *Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis for Amendment 17 to the Fishery Management Plan for the Groundfish Fishery of the Bering Sea and Aleutian Islands Area and Amendment 22 to the Fishery Management Plan for Groundfish of the Gulf of Alaska and for a Regulatory Amendment to Define Groundfish Pots*. Prepared by Members of the Plan Teams for Groundfish Fisheries of the Bering Sea and Aleutian Islands Area and the Gulf of Alaska, and by staffs of the North Pacific Fishery Management Council, National Marine Fisheries Service, Alaska Department of Fish and Game/U.S. Fish and Wildlife Service/LGL Research Associates, Anchorage, Alaska, May 14, 1991. 71 pp.

Anonymous 1991...94: *Annual Summary of Fish and Marine Mammal Harvest Data for the Northwest Territories, 1988-1993*, Vols. 1-5. Freshwater Institute, Department of Fisheries and Oceans, Winnipeg, Canada.

Anonymous 1992: *Ecology of the Novaya Zemlya region*. Map prepared by the Institute of Oceanology, Polish Academy of Science, Sopot, and Murmansk Marine Biological Institute, Russian Academy of Science, Murmansk. 1 p.

Anonymous 1993a: List of Priority Species. Prepared by the North Atlantic Marine Mammal Commission (NAMMCO) Scientific Committee and up-dated at its second meeting, Reykjavik, 23-26 November 1993. 24 pp.

Anonymous 1993b: Disturbances. Report of Working group 5. Pp. 33-38 in: R.E.A. Stewart, P.R. Richard and B.E. Stewart (eds). Report of the 2nd Walrus International Technical and Scientific (WITS) Workshop, 11-15 January 1993, Winnipeg, Manitoba, Canada. *Canadian Fisheries and Aquatic Sciences Technical Report* 1940. 91 pp.

Anonymous 1994a: *Report of the 4th Meeting of the Council of the North Atlantic Marine Mammal Commission (NAMMCO), Tromsø, 24-25 February 1994*. 142 pp.

Anonymous 1994b: *Hjemmestyrets bekendtgørelse nr. 19 af 11. maj 1994 om fangst af hvalros ved Grønland* (Greenland Home Rule's regulation of 11 May concerning the hunting of walrus in Greenland). Grønlands Hjemmestyre. 7 pp. (In Danish).

Arsenev, V.A. 1976: Walruses. Pp 25-51 in: V.G. Heptner, K.K. Chapskii, V.A. Arsenev and V.E. Sokolov (eds). Pinnipeds and toothed whales. *Mammals of the Soviet Union* Vol. 2 part 3. Vysshaia Shkola, Moscow. 718 pp. (In Russian) (Translated by F.H. Fay and B.A. Fay 1985)

Beaubier, P.H. 1970: *The hunting pattern of the Igluligmiut: with emphasis on the marine mammals*. Master thesis, Department of Geography, McGill University, Montreal. 248 pp.

Beaubier, P.H., Bradley, J.M. & Vestey, J.G. 1970: *Human ecological studies – Igloolik, N.W.T.* Final report, International Biological Programme, Human Adaptability Project, Department of Geography, McGill University, Montreal. 180 pp.

Belikov, S.E., Gorbunov, I.A. & Shil'nikov, V.I. 1984: Distribution and migrations of some pinnipeds, cetaceans, and the polar bear in the seas of the eastern region of the Arctic. Pp. 233-253 in: A.V. Iablokov (ed.). *Marine mammals*. Nauka, Moscow (In Russian) (Transl. F.H. and B.A. Fay 1986)

Belkovich, V.M. & Kuzin, R. Sh. 1960: To save and increase a valuable animal of the North. *Priroda* 1960 (2), 67-69 (In Russian) (Fisheries Research Board of Canada Translation Series 345)

Bell, R. 1885: *Observations on Labrador coast, Hudson's Strait and Bay*. Part DD in Report of progress 1882-83-84. Geological and Natural History Survey and Museum of Canada. Dawson Brothers, Montreal.

Beloborodov, A.G. & Timoshenko, Yu.K. 1974: In defence of the Atlantic walrus. *Priroda* 3, 97-99. (In Russian) (Fisheries Research Board of Canada Translation Series 3812, 1976).

Bethune, W.C. 1934: *Canada's Eastern Arctic. Its history, resources, population and administration*. Dept. of Interior, Lands, N.W.T. and Yukon Branch, Ottawa. 166 pp.

Bisset, D. 1968: *Northern Baffin Island: an area economic survey*. Vol. 2. Department of Indian Affairs and Northern Development, Ottawa. 131 pp.

Boertmann, D., Mosbech, A., Dietz, R. & Johansen, P. 1994: *Mapping of oil spill sensitive areas in eastern Baffin Bay*. A review of biological data in relation to oil spill sensitivity mapping and identification of data gaps. Report from Greenland Environmental Research Institute, Copenhagen. 57 pp. + appendices

Born, E.W. 1983: *Havpattedyr og havfugle i Scoresby Sund: fangst og forekomst 1983* (Marine mammals and sea birds in Scoresby Sound: catch and distribution 1983). Rapport til Råstofforvaltningen for Grønland og Grønlands Fiskeri-og Miljøundersøgelser fra Danbiu ApS. (biologiske konsulenter), December 1983. 112 pp. (In Danish with an English Summary).

Born, E.W. 1984: Status of the Atlantic walrus *Odobenus rosmarus rosmarus* in the Svalbard area. *Polar Research* 2, 27-45

Born, E.W. 1987: Aspects of present-day maritime subsistence hunting in the Thule area, Northwest Greenland: Pp. 109-132 in: L. Hacquebord and R. Vaughan (eds). Between Greenland and America. Cross-cultural contacts and the environment in the Baffin Bay area. *Works of the Arctic Centre No. 10*. University of Groningen, The Netherlands. 151 pp.

Born, E.W. 1988: Hvalrosstrejfere i Europa (Walrus stragglers in Europe). *Flora og Fauna (Århus)* 94, 9-14 (In Danish with English summary).

Born, E.W. 1990: *Distribution and numbers of Atlantic walruses (Odobenus rosmarus rosmarus) in Greenland*. Pp. 95-153 in: F.H. Fay, B.P. Kelly and B. Fay (eds). *The Ecology and Management of Walrus Populations. Report of an International Workshop. Seattle, Washington, USA, October 1990*. U.S. Marine Mammal Commission, Washington D.C.. 186 pp.

Born, E.W. 1991: Studies of walruses and polar bears. Pp. 31-49 in: I. Egede (ed.). *Conservation of nature in Greenland*. Atuakkiorlik. Greenland Publishers. Nuuk. 132pp.

Born, E.W. 1992: *Odobenus rosmarus* Linnaeus, 1758. Walross. Pp. 269-299 in: R. Duguy and D Robineau (eds). Band 6: Meeressäuger. Teil II: Robben – Pinnipedia. *Handbuch der Säugetiere Europas*. AULA -Verlag Wiesbaden. 309 pp (In German).

Born, E.W: 1995. Status of the polar bear in Greenland, 1993. Pp. 81-103 in: Ø. Wiig., E.W. Born and G. Garner (eds). Polar Bears. *Report of the 11th Working Meeting of IUCN/SSC Polar Bear Specialist Group. Occasional Paper of IUCN/SSC* (World Conservation Union Species Survival Commission) No. 10. 186 pp.

Born, E.W., Andriashek, D. & Rosing-Asvid, A. 1992: *Tagging of polar bears in NW Greenland, 2-19 May 1992*. Unpubl. report. Greenland Fisheries Research Institute, Copenhagen. 6 pp.

Born, E.W., Dietz, R. & Heide-Jørgensen, M.P. 1982: Catch and distribution of walrus (*Odobenus rosmarus*) in West Greenland. *I.C.E.S.* (International Council for Exploration of the Sea) *C.M. 1982/N:10*. 27 pp.

Born, E.W. & Gjertz, I. 1993: A link between walruses (*Odobenus rosmarus*) in northeast Greenland and Svalbard. *Polar Record* 29, 329

Born, E.W., Heide-Jørgensen, M.P. & Davis, R.A. 1994a: The Atlantic walrus (*Odobenus rosmarus rosmarus*) in West Greenland. *Meddelelser om Grønland, Bioscience*. 40. 33 pp.

Born, E.W., Joiris, C. & Bochert, A. 1994b: Aerial survey of walruses 14 June 1993. Pp. 125-128 in: H.-J. Hirche & G. Kattner (eds). The 1993 Northeast Water Expedition Scientific cruise report of RV "Polarstern" Arctic cruises ARK IX/2 and 3, USCG "Polar Sea" cruise NEWP and the NEWland expedition. – *Berichte zur Polarforschung 142*. 190 pp.

Born, E.W. & Knutsen, L.Ø. 1988: Observationer af hvalros (*Odobenus rosmarus* L.) i det nordlige Smith Sund, sydlige Kane Basin og Buchanan Bay, August 1988 (Observations of walruses in northern Smith Sound, southern Kane Basin and Buchanan Bay, August 1988). *Teknisk rapport – Grønlands Hjemmestyre, Miljø-og naturforvaltningen Nr. 2 – November 1988*. 10 pp. (In Danish with an English Summary).

Born, E.W. & Knutsen, L.Ø. 1990a: Hvalrosundersøgelser: rapport over feltarbejde 1989 (Walrus studies: report on field work in 1989 with preliminary results). *Teknisk rapport -Grønlands Hjemmestyre, Miljø-og Naturforvaltningen. Nr. 13 – Februar 1990*. 37 pp. (In Danish with an English summary).

Born, E.W. & Knutsen, L.Ø. 1990b: Immobilization of Atlantic walrus (*Odobenus rosmarus rosmarus*) by use of etorphine hydrochloride reversed by diprenorphine hydrochloride. *Teknisk rapport – Grønlands Hjemmestyre, Miljø-og naturforvaltningen. Nr. 14 – Februar 1990*. 15 pp.

Born, E.W. & Knutsen, L.Ø. 1990c: Satellite tracking and behavioural observations of Atlantic walrus (*Odobenus rosmarus rosmarus*) in NE Greenland in 1989. *Teknisk rapport – Grønlands Hjemmestyre, Miljø-og naturforvaltningen. Nr. 20 – Oktober 1990*. 68 pp.

Born, E.W. & Knutsen, L.Ø. 1991: Hvalrosundersøgelser i Nordøstgrønland. (Studies of walruses in Northeast Greenland) *Forskning i Grønland/ Tusaat* 91(4), 24-34 (In Danish)

Born, E.W. & Knutsen, L.Ø. 1992: Satellite-linked radio tracking of Atlantic walruses (*Odobenus rosmarus rosmarus*) in northeastern Greenland, 1989-1991. *Zeitschrift für Säugetierkunde* 57, 275 – 287

Born, E.W., Kraul, I. & Kristensen, T. 1981: Mercury, DDT and PCB in the Atlantic walrus (*Odobenus rosmarus rosmarus*) from the Thule District, North Greenland. *Arctic* 34, 255-260

Born,E.W. & Kristensen, T. 1981: Hvalrossen i Thule (The walrus in Thule). *Naturens verden* 4, 132-143 (In Danish).

Born, E.W. & Thomassen, J. 1994: *Polar bear studies*. Pp. 119-125 in: H.-J. Hirche and G. Kattner (eds). The 1993 Northeast Water Expedition Scientific cruise report of RV. "Polarstern" Arctic cruises ARK iX/2 and 3, USCG "Polar Sea" cruise NEWP and the NEWland expedition. – *Berichte zur Polarforschung* 142. 190 pp.

Brice-Bennett, C. 1976: Inuit land use in the east-central Canadian Arctic: Pp. 63-81 *in*: M.M.R. Freeman (ed.). *Report Inuit land use and occupancy project*, vol. 1. Department of Indian and Northern Affairs, Ottawa.

Brice-Bennett, C. 1977: Land use in the Nain and Hopedale regions. Pp. 97-203 in: C. Brice-Bennett (ed.). *Our footprints are everywhere: Inuit land use and occupancy in Labrador*. Labrador Inuit Association, Nain.

Brody, H. 1976: Inuit land use in north Baffin Island and northern Foxe Basin. Pp. 153-171 in: M.M.R. Freeman (ed.). *Report Inuit land use and occupancy project*, vol. 1. Department of Indian and Northern Affairs, Ottawa.

Brueggeman, J.J., Malme, C.I., Grotefendt, R.A., Volsen, D.P., Burns, J.J., Chapman, D.G., Ljungblad, D.K. & Green, G.A. 1990: Shell Western E and P Inc. *1989 Walrus Monitring Program: The Klondike, Burger, and Popcorn Prospects in the Chukchi Sea*. Report prepared by Ebasco Environmental for Shell Western E and P

Inc. P.O. Box 4320, Houston, Texas 77210, March 1990. 180 pp.

Brueggeman, J., Green, G.A., & Grotefendt, R.A. 1993. Walrus response to offshore drilling operations. P. 33 *in*: *Abstracts of Tenth Biennial Conference on the Biology of Marine Mammals, Galveston, Texas, USA, November 11-15, 1993*. 130 pp.

Bruemmer, F. 1971: *Notes on the sea mammals in Thule district, Greenland*. Unpublished manuscript, Montreal. 29 pp.

Bruemmer, F. 1992: And then there were none. *International Wildlife* 22, 20-23

Brun, E., Lid, G. & Lund, H.M.K. 1968: Hvalross, *Odobenus rosmarus*, på norskekysten. (Walruses along the Norwegian coast) *Fauna (Oslo)* 21, 7-20 (In Norwegian with English summary)

Burns, J.J. 1965: *The walrus in Alaska, its ecology and mangement*. Alaska Department Fish and Game, Juneau. 45 pp.

Burns, J.J. & Frost, K.J. 1979: *The natural history and ecology of the bearded seal, Erignathus barbatus*. Report from Alaska Department Fish and Game, Fairbanks, for Outer Continental Shelf Environmental Assessment Program, BLM/National Oceanographic Atmospheric Administration. 77 pp.

Burns, J.J., Shapiro, L.H., & Fay, F.H. 1981: Ice as marine mammal habitat in the Bering Sea: Pp. 781-797 in: D.W. Hood and J.A. Calder (eds). *The Eastern Bering Sea Shelf: Oceanography and Resources*. Vol. 2. Sect. 8. Mammals. Edited by F.H.Fay. Univ. Washington Press, Seattle.

Burton, R.W. 1980: Introduction, General Ornithology, Seabirds and Mammals. In: S. Williams (ed.). *Report of the Joint Services Expedition to Princess Marie Bay, Ellesmere Island*. Section 4 (A,B,C and F): 2,6,8 and 4 pp.

Bychkov, V.A. 1971: Review of the status of the pinniped fauna of the USSR. Pp. 59-74 in: *Scientific elements of nature conservation* No. 1. Central laboratory of Nature Conservation, Ministry for Agriculture of the USSR, Moscow. (In Russian)

Bychkov, V.A. 1973: The Atlantic walrus (*Odobenus rosmarus rosmarus*) – Novaya Zemlya population. Pp. 56-58 in: Seals. Proceedings of a Working Meeting of Seal Specialists on Threatened and Depleted Seals of the World, held under the auspices of the Survival Service Commission of IUCN (International Union for Conservation of Nature and Natural Resources). 18-19 August 1972 at the University of Guelph, Ontario. Canada. *IUCN Publications New Series, Supplementary Paper* 39. 176 pp.

Bychkov, V.A. 1975: Marine Mammals. Pp. 27-38 in: L.A. Zhirnov, A.A. Vinokurov and V.A. Bychkov (eds.). *Rare mammals, birds and their protection in the USSR*. Moscow, Ministry of Agriculture. 82 pp. (In Russian) (Translation F.H. Fay 1979)

Calvert, W. & Stirling, I. 1990: Interactions between polar bears and overwintering walruses in the central Canadian High Arctic. *International Conference on Bear Research and Management* 8, 351-356

Chapskii, K.K. 1936: The walrus of the Kara Sea. *Trudy Arkticheskogo Institute 67*. 124 pp (In Russian with English summary) (Translation by F.H. Fay and B.A. Fay)

Chapskii, K.K. 1939: A brief historical analysis of the contemporary state of the stocks of walrus in the Barents and Kara seas. *Problemy Arktiki* 3, 62-69 (In Russian) (Translation by P. Hagevold, Norwegian Polar Institute, 1994)

Chapskii, K.K. 1940: Distribution of walrus in the Laptev and East Siberian Seas. *Problemy Arktiki* 6, 80-94 (In Russian)(Transl. D. Wokruvcheff).

Clark, R.C. Jr. & Finley, J.S. 1977: Effects of oil spills in arctic and subarctic environments. Pp. 411-476 in D.C. Malins (ed). *Effects of petroleum on arctic and subarctic marine environments and organisms*. Vol. II. Biological effects. Academic Press, New York. 500 pp.

Cosens, S.E., Crawford, R., de March, B.G.E. & Short, T.A. 1993: Sub-arctic walrus. Pp. 12-13 in: Report of the Arctic Fisheries Scientific Advisory Committe for 1991/92 and 1992/93. *Canadian Fisheries and Aquatic Sciences Technical Report* 2224.

Cronin, M.A., Hills, S., Born, E.W. & Patton, J.C. 1994: Mitochondrial DNA variation in Atlantic and Pacific walruses. *Canadian Journal of Zoology* 72, 1035-1043

Crowe, K.J. 1969: *A cultural geography of northern Foxe Basin, N.W.T.* Ottawa: Northern Science Research Group, Department of Indian Affairs and Northern Development. 130 pp.

Currie, R.D. 1968: Western Ungava Bay: an area economic survey. *Industrial Division, Northern Administration Branch, Department of Indian Affairs and Northern Development, Ottawa. A.E.S.R. 62/2, Rep. 500-1968.*

Currie, B. 1987: Excerpts from a diary: Balfour Currie, Chesterfield Inlet, N.W.T., 1932-1933. *Musk-ox* 35, 9-22

Davis, R.A., Koski, W.R. & Finley, K.J. 1978: *Numbers and distribution of walruses in the central Canadian High Arctic*. Unpublished Report by LGL Ltd. for Polar Gas, Toronto. 50 pp.

Davis, R.A., Finley, K.J. & Richardson, W.J. 1980: *The present status and future management of Arctic*

marine mammals in Canada. Report by LGL Ltd. prepared for Science Advisory Board of the Northwest Territories, Yellowknife, N.W.T., January 1980. 93 pp.

Davis, R.A., Richardson, W.J., Thiele, L., Dietz, R. & Johansen, P. 1990: *State of the Arctic Environment. Report on Underwater Noise, November 9, 1990.* Report prepared by LGL Ltd. and Greenland Environmental Research Institute for the Finnish Initiative on Protection of the Arctic Environment. 151 pp.

Degerbøl, M. & Freuchen, P. 1935: Zoologi I, Mammals. *Report of the Fifth Thule Expedition 1921-1924*. The Danish Expedition to Arctric North America in Charge of Knud Rasmussen, Ph.D. Vol. II 4-5. 278 pp.

DeMaster, D.K. 1984: An analysis of a hypothetical population of walruses. Pp. 77-80 *in*: F.H. Fay and G. A. Fedoseev (eds). Soviet-American Cooperative Research on Marine Mammals. Vol. 1 – Pinnipeds. *National Oceanographic Atmospheric Administration Technical Report NMFS 12*. 104 pp.

Dietz, R., Heide-Jørgensen, M.P. & Born, E.W. 1985: *Havpattedyr i Østgrønland: en litteraturundersøgelse* (Marine mammals in eastern Greenland: a literature survey). Rapport til Råstofforvaltningen for Grønland og Grønlands Fiskeri-og Miljøundersøgelser fra Danbiu ApS. (biologiske konsulenter), januar 1985. 277 pp. (In Danish with an English summary).

Donaldson, J.L. 1988: *The economic ecology of hunting, a case study of the Canadian Inuit*. Ph.D. thesis, Department of Organismic and Evolutionary Biology, Harvard University, Cambridge, Massachusetts. 243 pp.

Dowler, D.H. 1976: *Average marine mammal harvest 1973-1975. Northwest-Territories*. (Unpublished tables received from H.R. Trudeau, Fish. and Marine Service, Yellowknife). 2 pp.

Dunbar, M.J. 1949: The Pinnipedia of the arctic and subarctic. *Fisheries Research Board of Canada Bulletin* 85, 1-22.

Dunbar, M.J. 1955: The status of the Atlantic walrus *Odobenus rosmarus* (L.) in Canada. *Arctic Circular* 8, 11-14

Dunbar, M.J. 1956: The status of the Atlantic walrus *Odobenus rosmarus* (L.) in Canada. Pp. 59-61 in: *Proceedings of the 5th Meeting, Copenhagen 1954. International Union for Protection of Nature.*

Ellis, D.V. 1957: Some observations on mammals in the area between Coppermine and Pond Inlet, N.W.T., during 1954 and 1955. *Canadian Field-Naturalist* 71, 1-6

Elton, C. 1942: *Voles, mice and lemmings*. Clarendon Press, Oxford. 496 pp.

Estes, J.A. 1978: Evaluation of an aerial survey of Pacific walruses (*Odobenus rosmarus divergens*). *Fisheries Research Board of Canada Journal* 35, 1130-1140

Estes, J.A. & Gol'tsev, V. 1984: Abundance and distribution of the Pacific walrus, *Odobenus rosmarus divergens*. Results of the first Soviet-American joint aerial survey, autumn 1975. Pp. 67-76 in: F.H. Fay and G.A. Fedoseev (eds). Soviet-American cooperative research on marine mammals. Vol. 1-Pinnipeds. *National Oceanographic Atmospheric Administration Technical Report NMFS* 12. 104 pp.

Evans, J. 1958: *Some aspects of economic development along the southern coast of Hudson Strait and the east coast of Hudson Bay (a pilot study)*. Department of Northern Affairs and National Resources, Arctic Division, Ottawa. (vi) + 52 pp. + 14 plates (maps).

Evans, J. 1964: *Ungava Bay. A resource survey 1958*. Department of Northern Affairs and National Resources, Northern Administration Branch, Industrial Division, Ottawa. (v) + 84 pp.

Fay, F.H. 1981: Modern populations, migrations, demography, trophics, and historical status of the Pacific walrus. Pp. 191-234 in: *Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the year ending March 1981*. Vol. 1. National Oceanographic Atmospheric Administration, Boulder, CO. 620 pp.

Fay, F.H. 1982: Ecology and Biology of the Pacific walrus, *Odobenus rosmarus divergens* Illiger. *North American Fauna No. 74*. U.S. Department of the Interior Fish and Wildlife Service. 279 pp.

Fay, F.H. 1985: *Odobenus rosmarus. Mammalian Species* No. 238. American Society of Mammalogists Lawrence, Kansas. 7 pp.

Fay, F.H. & Bowlby, C.E. 1994: The harvest of Pacific walrus, 1931-1989. *Marine Mammals Management, Fish and Wildlife Service Region 7, Alaska U.S. Department of the Interior. Technical Report MMM* 94-2. 44 pp.

Fay, F.H., Burns, J.J., Stoker, S.W. & Grundy, J. Scott. 1994: The struck-and-lost factor in Alaskan walrus harvest. *Arctic* 47, 368-373

Fay, F.H., Feder, H.M. & Stoker, S.W. 1977: An estimate of the impact of the Pacific walrus population on its food resources in the Bering Sea. *U.S. Department of Commerce, National Technical Information Service (Springfield, Va.) PB-273-505*. 38 pp.

Fay, F.H., Kelly, B.P. & Sease, J.L. 1989: Managing the exploitation of Pacific walruses: a tragedy of delayed response and poor communication. *Marine Mammal Science* 5, 1-16

Fay, F.H., Kelly, B.P. & Fay, B.A. (eds) 1990: *The ecology and management of walrus populations. Report of an international workshop, 26-30 March 1990, Seattle, Washington, USA.* Final report to the U.S. Marine Mammal Commission in fulfillment of Contract T 68108850. xii + 186 pp.

Fay, F.H., Ray, G.C. & Kibal'chich, A.A. 1984: Time and location of mating and associated behavior of the Pacific walrus, *Odobenus rosmarus divergens* Illiger. Pp. 81-88 in: F.H. Fay and G.A. Fedoseev (eds). Soviet-American cooperative research on marine mammals. Pinnipeds. *National Oceanographic Atmospheric Administration Technical Report NMFS 1.* 104 pp.

Fay, F.H. & Stoker, S.W. 1982: *Analysis of reproductive organs and stomach contents from walruses taken in the Alaskan native harvest, spring 1980.* Report presented to U.S. Fish and Wildlife Service, Anchorage Alaska. 86 pp.

Fedoseev, G.A. 1976: Giants of the polar seas. *Priroda* 1976 (8), 76-83 (In Russian) (Translation by F.H. Fay and B.A. Fay 1983)

Fedoseev, G.A. & Gol'tsev, V.N. 1969: Age-sex structure and reproductive capacity of the Pacific walrus population. *Zoologicheskij Zhurnal* 48, 407-413 (In Russian)

Finley, K.J., Davis, R.A. & Richardson, W.J. 1974: Walrus (*Odobenus rosmarus*). Pp. 45-51 *in:* K.J. Finley, R.A. Davis and W.J. Richardson. *Preliminary studies of the numbers and distribution of marine mammals in the Central Canadian Arctic – 1974.* Unpublished report by LGL Ltd, Toronto for Polar Gas Project, Toronto, Ontario.

Finley, K.J. & Renaud, W.E. 1980: Marine Mammals inhabiting the Baffin Bay North Water in Winter. *Arctic* 33, 724-738

Finley, K.J., Miller, G.W., Allard, M., Davis, R.A. & Evans, C.R. 1982: The belugas (*Delphinapterus leucas*) of northern Quebec: distribution, abundance, stock identity, catch history and management. *Canadian Fisheries and Aquatic Sciences Technical Report* 1123. 57pp.

Francis, D. & Morantz, T. 1983: *Partners in furs: a history of the fur trade in eastern James Bay 1600-1870.* McGill-Queen's University Press, Kingston, Ontario. 203 pp.

Frantzen, B. 1992: Russians violate the Agreement on the Conservation of Polar Bears. *Fauna (Oslo)* 45, 58-62 (In Norwegian with English summary)

Freeman, M.M.R. 1964: Observations on the kayak-complex, Belcher Islands, N.W.T. *National Museum of Canada Bulletin 194, Contributions to Anthropology* 1961-62 Pt. II, 56-85

Freeman, M.M.R. 1970: Studies in maritime hunting I. Ecological and technologic restraints on walrus hunting, Southampton Island N.W.T. *Folk* 11-12, 155-171

Freeman, M.M.R. 1975: Studies in maritime hunting II. An analysis of walrus hunting and utilisation: Southampton Island, N.W.T. 1970. *Folk* 16-17, 147-158

Freeman, M.M.R. (ed.) 1976: *Report Inuit land use and occupancy project.* 3 Vols. Department of Indian and Northern Affairs, Ottawa.

Freeman, M.M.R. 1982: An ecological perspective on man- environment research in the Hudson and James Bay region. *Naturaliste canadien* 109, 955-963

Freuchen, P. 1921: Om Hvalrossens Forekomst og Vandringer ved Grønlands Vestkyst (Distribution and migration of walruses along the western coast of Greenland). Videnskapelige *Meddelelser Dansk Naturhistorisk Forening København* 72, 237-249. (In Danish) (Translated: Fisheries Research Board of Canada Translation Series 2383. 14 pp.)

Freuchen, P. 1935: Mammals, Part II. Field notes and personal observations. *Report Fifth Thule Expedition*, 2 (2-5), 68-278

Freuchen, P. & Salomonsen, F. 1961: *Det arktiske år.* Gyldendal, København. 382 pp. (In Danish).

Friis, A. 1909: *Danmarks Ekspeditionen til Grønlands Nordøstkyst.* Gyldendal, København. 670 pp. (In Danish).

Friis, A. 1925: *Arktiske Jagter.* København, Gyldendalske Boghandel Nordisk Forlag. 206 pp. (In Danish).

Frost, K.J. & Lowry, L.F. 1993. Assessment of damages to harbor seals caused by Exxon Valdez oil spill. Pp. 300-302 in: *Exxon Valdez Oil Spill Symposium, February 2-5, 1993, Anchorage, AK, U.S.A.* Abstract book 356 pp.

Gamble, R.L. 1987a: Native harvest of wildlife in the Keewatin region, Northwest Territories for the period October 1983 to September 1984. *Canadian Fisheries and Aquatic Sciences Technical Report* 1543. 82 pp.

Gamble, R.L. 1987b: Native harvest of wildlife in the Keewatin region, Northwest Territories for the period October 1984 to September 1985. *Canadian Fisheries and Aquatic Sciences Technical Report* 1544. 59 pp

Garlich-Miller, J. 1994: *Growth and reproduction of Atlantic walruses (Odobenus rosmarus rosmarus) in Foxe Basin, Northwest Territories, Canada.* Master of Science thesis, University of Manitoba. 116 pp.

Garlich-Miller, J. & Stewart, R.E.A. 1993: Reproduction in the Atlantic walrus (*Odobenus rosmarus rosmarus*)

of Foxe Basin, Northwest Territories, Canada. Abstract p. 33, Abstract p. 51, *Tenth Biennial Conference on the Biology of Marine Mammals, Galveston, Texas, USA, November 11--15, 1993.* 130 pp.

Gjertz, I., Hansson, R. & Wiig, Ø. 1992: The historical distribution and catch of walrus in Franz Josef Land. *Norsk Polarinstitutt Meddelelser* 120, 67-81

Gjertz, I., Henriksen, G., Øritsland, T. & Wiig, Ø. 1993. Observations of walruses along the Norwegian coast 1969-1992. *Polar Research* 12, 27-31

Gjertz, I. & Wiig, Ø. 1993: Status of walrus research in Svalbard and Franz Joseph Land in 1992. A review. Pp. 68-84 in: R.E.A. Stewart, P.R. Richard and B.E. Stewart (eds). Report of the 2nd Walrus International Technical and Scientific (WITS) Workshop, 11-15 January 1993, Winnipeg, Manitoba, Canada. *Canadian Fisheries and Aquatic Sciences Technical Report* 1940. 91 pp.

Gjertz, I. & Wiig, Ø. 1994: Past and present distribution of walruses in Svalbard. *Arctic* 47, 34-42

Gjertz, I. & Wiig, Ø. 1995: The number of walrus (*Odobenus rosmarus rosmarus*) in Svalbard in summer. *Polar Biology* 15, 527-530

Glahder, C. 1992. Hunting in Kangerlussuaq, East Greenland 1951-1991. An Interview-investigation. – *Greenland Environmental Research Institute Report Series* 1. 201 pp.

Gol'tsev, V.N. 1968. Dynamics of coastal walrus herds in connection with the distribution and numbers of walruses. Pp. 205-215 in: V.A. Arsenev and K.I. Panin (eds). *Pinnipeds of the North Pacific.* Pishchevaya Promyshlennost', Moscow. (In Russian)

Gol'tsev, V.N. 1975. *Aerial survey of the Pacific walrus in the Soviet sector during autumn 1975.* Unpubl. report TINRO, Magadan. 22 pp. (In Russian)

Gordon, A.R. 1885: *Report of the Second Hudson's Bay Expedition under the Command of Lieut. A.R. Gordon, R.N.*. 112 pp.

Gordon, A.R. 1887: *Report of the Hudson's Bay Expedition of 1886 under the command of Lieut. A.R. Gordon, R.N.* Department of Marine, Ottawa. 133 pp.

Government of Canada. 1993: *Marine Mammal Regulations made under the Fisheries Act. Order in Council of February* 4, 1993. P.C. 1993-189 (SOR/DORS/1993-56, p. 930, 24/2/93

Greely, A.W. 1888: *Report of the proceedings of the U.S. Expedition to Lady Franklin Bay., Grinnell Land.* Government Printing Office Washington. Vol. 1. 545 pp. + Vol. 2. 738 pp.

Greendale, R.G. & Brousseau-Greendale, C. 1976: Observations of marine mammals at Cape Hay, Bylot Island during the summer of 1976. *Canadian Fisheries and Marine Services Technical Report* 680. 25 pp.

Griffiths, D.J., Øritsland, N.A. & Øritsland, T. 1987: Marine mammals and petroleum activities in Norwegian waters. *Fisken og Havet Serie B*, No. 1. 179 pp.

Hantzsch, B. 1932: Contributions to the knowledge of extreme north-eastern Labrador. *Canadian Field-Naturalist* 46, 7-12, 34-36

Harington, C.R. 1966: Extralimital occurrences of walruses in the Canadian Arctic. *Journal of Mammalogy* 47, 506-513

Haug, T. & Nilssen, K.T. 1995: Observations of walrus (*Odobenus rosmarus rosmarus*) in the southeastern Barents and Pechora seas in February 1993. *Polar Research 14*, 83-86

Hayes, E.E. 1867: *The Open Polar Sea. A Narrative of a Voyage of Discovery towards the North Pole, in the Schooner "United States".* Sampson Low, Son and Marson, London. 454 pp.

Hawkes, E.W. 1916: The Labrador Eskimo. Canada Department of Mines, *Geological Survey, Memoir 91, No. 14, Anthropological Series*, Goverment Printing Bureau, Ottawa (No. 1637). 235 pp.

Heide-Jørgensen, M.P. & Born, E.W. 1995: Monitoring walrus abundance off West Greenland. *Working paper SC/3/16 submitted to NAMMCO's Scientific Committee, Copenhagen 31 January – 2 February 1995.* 10 pp.

Heptner, V.G., Chapskii, K.K., Arsen'ev, V.A. & Sokolov, V.E. 1976: *Pinnipeds and toothed whales. Mammals of the Soviet Union.* Vysshaya Shkolo, Moscow, 2(3). 718 pp. (In Russian)

Higgins, G.M. 1968: The south coast of Baffin Island, an area economic survey. *Industrial Division, Department of Indian Affairs and Northern Development, Ottawa. A.E.S.R.* # 67/2, 1967. (xvi) + 235 pp.

Hjort, J. & Ruud, J.T. 1929: Whaling and Fishing in the North Atlantic,. *Rapports et Procès-verbaux des Reunion Conseil Permanent international pour L'Exploration de la Mer.* Vol. 56. 123 pp.

Isachsen, G. 1922: Norske fangstmænds ferder til Grønland. *Norske Geografiske Selskabs Aarbok* 1919-1921, 201-262 (In Norwegian)

Isachsen, G. 1925: *Grønland og Grønlandsisen.* J. W. Cappelens Forlag, Oslo. 248 pp. (In Norwegian)

Isachsen, G. & Isachsen, F. 1932: Norske fangstmenns og fiskeres ferder til Grønland 1922-1931. *Norges*

Svalbard-og ishavsundersøkelser Meddelelser 18, 60-61 (In Norwegian)

Ivashin, M.V., Popov, L.A., & Tsapko, A.S. 1972: *Marine mammals. Pinnipedia of the North Atlantic and Arctic Ocean. Moscow.* 294 pp. (In Russian) (Fisheries Research Board of Canada Translation Series # 2783, 1973)

Jennov, J. G. 1945: *Moskusoksebestanden i Nordøstgrønland og nogle spredte iagttagelser og betragtninger vedrørende dyrelivet i Nordøstgrønland.* (The population of Musk-oxen in Northeast Greenland and some observations of – and reflections on wildlife in Northeast Greenland). Østgrønlandsk Fangstkompagni Nanok A/S. 128 pp. (In Danish).

Johansen, F. 1910: Observations on seals (Pinnipedia) and whales (Cetacea) made on the Danmark-expedition 1906-08. *Meddelelser om Grønland* 45, 201-224

Johnson, S.R., Renaud, W.E., Davis, R.A. & Richardson, W.J. 1976: *Marine mammals recorded during aerial surveys of birds in eastern Lancaster Sound, 1976.* Unpublished report by LGL Ltd for Norland Petroleum Ltd, Calgary, Alberta, 25 December 1976. 180 pp.

Kane, E. K. 1856: *Arctic Exploration in the Years 1853, '54, '55.* Childs and Peterson, Philadelphia. Vol. 1. 464 pp. + Vol. 2. 467 pp.

Kane, E.K. 1892: *Arctic explorations in search of John Franklin.* T. Nelson and Sons, London.

Kastelein, R.A., Zweypfenning, R.C.V.J., Spekreijse, H., Dubbeldam, J.L. & Born, E.W. 1993a: The anatomy of the walrus head (*Odobenus rosmarus*). Part 3: The eyes and their function in walrus ecology. *Aquatic Mammals* 19, 61-92

Kastelein, R.A., van Lichtenberg, C.L., Gjertz, I. & Verboom, W.C. 1993b: Free field hearing tests on wild Atlantic walruses (*Odobenus rosmarus rosmarus*) in air. *Aquatic Mammals* 19, 143-148

Kemp, W.B. 1976: Inuit land use in south and east Baffin Island. Pp. 125-151 in: M.M.R. Freeman (ed.). *Report Inuit land use and occupancy project*, Vol. 1. Department of Indian and Northern Affairs, Ottawa.

Kiliaan, H.P.L. & Stirling, I. 1978: Observations of overwintering walruses in the eastern Canadian High Arctic. *Journal of Mammalogy* 59, 197-200

Knudsen, R. 1890: Kapt. R. Knudsens Fangstrejse til Østkysten af Grønland 1889, med det norske Sælfangerdampskib "Hekla". (Captain R. Knudsen's hunting trip to Eastern Greenland 1889, with the Norwegian sealer "Hekla"). *Geografisk Tidsskrift* 9-10, 143-148 (In Norwegian).

Knutsen, L.Ø. 1993: Walrus studies in Franz Joseph Land, 1992. Pp. 1-11 in: I. Gjertz and B. Mørkved (eds). Results of the scientific cruises to Franz Joseph Land. *Norsk Polarinstitutt Meddelelser* 126. 30 pp.

Knutsen, L.Ø. & Born, E.W. 1994: Body growth in Atlantic walruses (*Odobenus rosmarus rosmarus*) from Greenland. *Journal of Zoology (London)* 234, 371-385

Koch, L. 1945: The East Greenland ice. *Meddelelser om Grønland* 130(3). 373 pp.

Koski, W.R. 1980: *Distribution and migration of marine mammals in Baffin Bay and eastern Lancaster Sound, May – July 1979.* Report by LGL Ltd. for Petro-Canada Explorations, Calgary, Alberta, December 1980. 317 pp.

Koski, W.R. & Davis, R.A. 1979: *Distribution of marine mammals in northwest Baffin Bay and adjacent waters, May-October 1978.* Report by LGL Ltd. for Petro-Canada, Calgary, May 1979. 304 pp.

Kumlien, L. 1879: Contributions to the natural history of arctic America, made in connection with the Howgate polar expedition, 1877-1878. *U.S. National Museum Bulletin* 15, 1-179

Le Boeuf, B. 1986: Sexual strategies of seals and walruses. *New Scientist* 16 January 1986, 36-39

Loughrey, A.G. 1959: Preliminary investigation of the Atlantic walrus *Odobenus rosmarus rosmarus* (Linnaeus). *Canadian Wildlife Service, Wildlife Management Bulletin Series* 1. No. 14. 123 pp.

Low, A.P. 1906: *Report on the Dominion Government Expedition to Hudson Bay and the Arctic Islands on board the D.G.S. Neptune, 1903-1904.* Government Printing Bureau, Ottawa. 355 pp.

Lowry, L.F. & Fay, F.H. 1984: Seal eating by walruses in the Bering and Chukchi Seas. *Polar Biology* 3, 11-18

Lubbock, B. 1937: *The arctic whalers.* Brown, Son and Ferguson, LTD., Glasgow. 483 pp.

Lukin, L.R. 1978: Time and regions of whelping of the Atlantic walrus. *Ekologiya* 5, 100-101 (In Russian) (Transl. 1979. Soviet Journal of Ecology 9, 483-484)

Lund, H.M.K. 1954: The walrus (*Odobenus rosmarus* (L.)) off the coast of Norway in the past and after the year 1900, together with some observations on its migration and "cruising speed". *Astarte* 8, 1-12

Lyall, E. 1979: *An arctic man: sixty-five years in Canada's north.* Hurtig, Edmonton. 239 pp.

Lønø, O. 1972: The catch of walrus (*Odobenus rosmarus*) in the areas of Svalbard, Novaja Zemlja, and Franz Josef Land. *Norsk Polarinstitutt Årbok* 1970, 199-212.

MacLaren Atlantic Limited. 1978: *Report on aerial surveys 77-2,77-3,77-4: Studies of sea birds and marine mammals in Davis Strait, Hudson Strait and*

Ungava Bay. Report to Imperial Oil Ldt., Aquitaine Co. of Canada Ltd. and Canada Cities Services Ltd., Arctic Petroleum Operators Association. Project Nos. 134 and 138 February, 1978. Variously paginated.

MacLaren-Marex Inc. 1979: *Report on aerial surveys of birds and marine mammals in the southern Davis Strait between April and December 1978*. Report to ESSO Resources of Canada Ltd., Aquitaine Co. of Canada Ltd. and Canada Cities Service Ltd., Arctic Petroleum Operators' Association, Project Number 146, Vol III: Marine Mammals. February 1979. Variously paginated.

MacLaren-Marex Inc. 1980a: *Aerial monitoring of marine birds and mammals. The 1979 offshore drilling program near southeast Baffin Island*. Report to ESSO Resources of Canada Ltd. and Aquitaine Company of Canada Ltd., April 1980.

MacLaren-Marex Inc. 1980b: *Surveys for marine mammals along the outer coastline of southeast Baffin Island (August to October 1979)*. Report to ESSO Resources of Canada Ltd. and Aquitaine Company of Canada Ltd., April 1980.

Malme, C.I., Miles, P.R., Miller, G.W., Richardson, W.J., Thomson, D.H., Roseneau, D.G. & Green Jr., C.R. 1989: *Analysis and ranking of the acoustic disturbance potential of petroleum industry activities and other sources of noise in the environment of marine mammals in Alaska*. Final Report by BBN Systems and Technologies Corportion to U.S. Minerals Management Service, Anchorage, AK. BBN Report 6945. NTIS No PB90-188673

Manning, T.H. 1944: Hunting implements and methods of the present-day Eskimos of north-west Hudson Bay, Melville Peninsula, and south-west Baffin Island. *Geographical Journal* 104(4), 137-152

Manning, T.H. 1946: Bird and mammal notes from the east side of Hudson Bay. *Canadian Field-Naturalist* 60, 71-85

Manning, T.H. 1976: Birds and mammals of the Belcher, Sleeper, Ottawa and King George Islands, and Northwest Territories. *Canadian Wildlife Service Occasional Paper* 28. 42pp

Manning, T.H. & Macpherson, A.H. 1961: A biological investigation of Prince of Wales Island, N.W.T. *Transactions of the Royal Canadian Institute* 33, 116-239

Mansfield, A.W. 1955: Eastern Arctic Fisheries investigations, 1947-55. *Arctic* 8, 133-135

Mansfield, A.W. 1958: The biology of the Atlantic walrus, *Odobenus rosmarus rosmarus* (Linnaeus) in eastern Canadian arctic. *Fisheries Research Board of Canada Manuscript Report Series (Biology) No.* 653. 146 pp.

Mansfield, A.W. 1959: The walrus in the Canadian Arctic. Fisheries Research Board of Canada. *Arctic Unit. Circular* 2. 13 pp.

Mansfield, A.W. 1962: Present status of the walrus population at Southampton and Coats Islands. Report No. 16. Pp. 41-48 in: H.D. Fisher: *Annual report and investigors' summaries, April 1, 1961 to March 31, 1962. Fisheries Research Board of Canada, Arctic Unit, Montreal, Quebec.*

Mansfield, A.W. 1966: The walrus in Canada's arctic. *Canadian Geographic Journal* 72(3), 88-95

Mansfield, A.W. 1973: The Atlantic walrus *Odobenus rosmarus* in Canada and Greenland. Pp. 69-79 in: Seals. Proceedings of a Working Meeting of Seal Specialists on Threatened and Depleted Seals of the World, held under the auspices of the Survival Service Commission of IUCN (International Union for Conservation of Nature and Natural Resources). 18-19 August 1972 at the University of Guelph, Ontario. Canada. *IUCN Publications New Series, Supplementary Paper* 39. 176 pp.

Mansfield, A.W. 1983: The effects of vessel traffic on marine mammals and recommendations for future research. *Canadian Fisheries and Aquatic Sciences Technical Report No.* 1186. 97 pp.

Mansfield, A.W. 1990: Marine Mammals. Pp. 134-139 in: J.A. Percy (ed.). Proceedings of a Workshop: Marine Ecosystem Studies in Hudson Strait, November 9-10, 1989, Montreal, Quebec. *Canadian Fisheries and Aquatic Sciences Technical Report No.* 1770. 175 pp.

Mansfield, A.W. & St. Aubin, D.J. 1991: Distribution and abundance of the Atlantic walrus, *Odobenus rosmarus rosmarus*, in the Southampton Island - Coats Island region of northern Hudson Bay. *Canadian Field-Naturalist* 105, 95-100

Mathiassen, T. 1928: Material culture of the Iglulik Eskimos. *Report of the 5th Thule Expedition* 1921-1924 6(1). 242 pp.

May, B.M. 1942: Walrus hunt. *Beaver* 273, 38-40

McLaren, I.A. 1993: Growth in pinnipeds. *Biological Review* 68, 1-79

McLaren, P.L. & Davis. R. 1981: *Distribution of marine mammals in southern Baffin Bay and northern Davis Strait, March 1981*. Unpubl. Report by LGL Ltd, Toronto, for the Arctic Pilot Project, Calgary, October 1981. 85 pp. + 7 plates

McLaren, P.L. & Davis, R. 1982: *Winter distribution of arctic marine mammals in ice-covered waters of eastern North America*. Unpubl. Report by LGL Ltd. for Petro-Canada Exploration Inc., Calgary, Alberta, Canada. 151 pp.

McLaren, P.L. & Davis, R. 1983: *Distribution of wintering marine mammals off West Greenland and in southern Baffin Bay and northern Davis Strait, March 1982*. Unpubl. Report by LGL Ltd, Toronto, for the Arctic Pilot Project, Calgary, July 1983. 98 pp.

Mehlum, F. 1989: *Birds and mammals of Svalbard*. Polarhåndbok 5. Norsk Polarinstitutt, Oslo. 139 pp.

Mercer, M.C. 1967: Records of the Atlantic walrus, *Odobenus rosmarus rosmarus*, from Newfoundland. *Fisheries Research Board of Canada Journal* 24, 2631-2635.

Mikkelsen, E. & Sveistrup, P.P. 1944: The East Greenlanders Possibilities of Existence. Their Production and Consumption. *Meddelelser om Grønland* 134(2). 244 pp.

Mikkelsen, P.S. 1994: *Nordøstgrønland 1908-60 Fangstmandsperioden*. – Dansk Polarcenter, København.408 pp. (In Danish).

Miller, R.S. 1955: A survey of the mammals of Bylot Island. Northwest Territories. *Arctic* 8, 166-197.

Miller, E.H. 1982: Herd organisation and female threat behaviour in Atlantic walrus *Odobenus rosmarus rosmarus* (L.). *Mammalia* 46, 29-34.

Miller, E.H. & Boness, D.J. 1983: Summer behavior of Atlantic walruses, *Odobenus rosmarus rosmarus* (L) at Coats Island, N.W.T. (Canada). *Zeitschrift für Säugetierkunde* 48(5), 298-313.

Moe, A. 1994: Oil and Gas: Future role of the Barents region. Pp. 131-144 in: O.S. Stokke and O. Tunander (eds). *The Barents Region. Cooperation in Arctic Europe*. Sage Publishers. London, Thousand Oaks, New Dehli. 239 pp.

Mowat, F. 1984: *Sea of slaughter*. McClelland and Steward, Toronto.

Müller, R. 1906: *Vildtet og Jagten i Sydgrønland*. (Game and hunting in Southern Greenland). H. Hagerups Boghandel, København. 519 pp. (In Danish)

Müller, R. 1911: Om rationel hvalrosfangst. (On effective walrus hunting). *Det Grønlandske Selskabs Aarskrift* 1910-1911, 2. Hefte, 97-117, København. (In Danish).

NAMMCO 1995: *Report of the ad hoc working group on the Atlantic Walrus. Copenhagen, 31 January – 2 February, 1995*. 21 pp. Prepared for North Atlantic Marine Mammal Commission (NAMMCO), University of Tromsø, P.O.B. 9037 Tromsø, Norway.

Nazarenko, Iu. & Timoshenko, Iu. 1983: State of the coastal haul-out sites of the Atlantic Walrus in the western sector of the Soviet Arctic and measures of their protection. Pp. 143-144 in: *Rare species of mammals in the USSR and their conservation. Material of the III All-Union Conference on Rare Species of Mammals of the USSR, February 4-6 1982*, Moscow. (In Russian).

NHRC. 1976: *Research to establish present levels of harvesting by native people of northern Quebec. Part II. A report on the harvests by the Inuit of northern Quebec*. Final report. Native Harvesting Research Committee, Hunting, Fishing and Trapping Coordinating Committee, Montreal. 230 pp. + appendices.

Norderhaug, M. 1969: Hvalrossens (*Odobenus rosmarus*) forekomst i Svalbardområdet 1960-1967. (Observations of walruses in the Svalbard area 1960-1967) *Norsk Polarinstitutt Årbok* 1967, 146-150 (In Norwegian with English summary).

North, W.J. 1967: Tampico; a study of destruction and restoration. *Sea Front* 13, 212-217.

Norstrom, R.J. & Muir, D.C.G. 1994: Chlorinated hydrocarbon contaminants in arctic marine mammals. *Science of the Total Environment* 154, 107-128.

Ohlin, A. 1895: Zoological observations during Peary Auxiliary Expedition 1894, Mammals. *Biologisches Centralblatt* 15, 163-168.

Orr, J.R., Renooy, B. & Dahlke, L. 1986: Information from hunts and surveys of walrus (*Odobenus rosmarus*) in northern Foxe Basin, Northwest Territories, 1982-1984. *Canadian Fisheries and Aquatic Sciences Manuscript Report No*. 1899. 24 pp.

Orr, J.R. & Rebizant, T. 1987: A summary of information on the seasonal distribution and abundance of walrus (*Odobenus rosmarus*) in the area of northern Hudson Bay and western Hudson Strait, NWT, as collected from local hunters. *Canadian Fisheries and Aquatic Sciences Data Report No* 624. 16 pp.

Ovsyanikov, N.G., Bove, L.L. & Kochev, A.A. 1994: The factors causing mass death of walruses on coastal rookeries. *Zoologicheskij Zhurnal* 75(5), 80-87 (In Russian with English summary).

Øritsland, T. 1973: Walrus in the Svalbard area. Pp. 59-68 in: Seals. Proceedings of a Working Meeting of Seal Specialists on Threatened and Depleted Seals of the World, held under the auspices of the Survival Service Commission of IUCN (International Union for Conservation of Nature and Natural Resources). 18-19 August 1972 at the University of Guelph, Ontario. Canada. *IUCN Publications New Series, Supplementary Paper* 39. 176pp.

Parovschikov, V. Ja. 1967: The Polar Bear in Franz Josef Land. *Problemy Severa* 11, 149-159 (In Russian).

Peary, R. 1898: *Northward over the "Great Ice". A Narrative of the Life and Work along the Shores and upon the Interior Ice-Cap of Northern Greenland in the Years 1886- and 1891-1897.* Vol. I. 521 pp. Vol II. 625 pp.

Peary, R.E. 1917: *Secrets of Polar Travel.* The Century Co., New York. 313 pp.

Pedersen, A. 1926: Beiträge zur Kenntnis der Säugetier- und Vögelfauna der Ostküste Grönlands. (Information on the mammals and birds of Greenland's east coast). *Meddelelser om Grønland* 68(3), 149-249. (In German).

Pedersen, A. 1931: Fortgesetzte Beiträge zur Kenntnis der Säugetier- und Vögelfauna der Ostküste Grönlands (More information on the mammals and birds of Greenland's east coast). *Meddelelser om Grønland* 77(3), 344-506 (In German).

Pedersen, A. 1934: *Polardyr* (Polar Animals). København, Gyldendal. 54 pp. (In Danish).

Pedersen, A. 1942: Säugetiere und Vögel. (Mammals and birds) *Meddelelser om Grønland* 128 (2). 119 pp. (In German).

Pedersen, S.A. 1994: Population parameters of the Icelandic scallop (*Chlamys islandica* (Müller)) from West Greenland. *Journal of Northwest Atlantic Fishery Science* 16, 75-87.

Percy, J.A. & Mullin,T.C. 1975: Effects of crude oils on arctic marine invertebrates. *Beaufort Sea Technical Report* 11, Environment Canada, Victoria, British Columbia. 167 pp.

Polargas Environmental Program 1976: Walrus. Pp. 97-109 *in*: *Studies of the status of marine mammals in the Central District of Franklin, N.W.T. June - August, 1975.*

Popov, L. 1960: Status of the coastal herds of walruses in the Laptev Sea. *Okhrana Prirody i Ozelenie* 3, 95-104 (In Russian).

Popov, L., Timoshenko, Iu., & Wiig, Ø. 1990: Review of history and present status of world walrus stocks: Barents, Kara and White Seas. Pp. 6-14 in: F.H. Fay, B.P Kelly and B.A. Fay (eds). *The Ecology and management of Walrus Populations. Report of an international workshop 26-30 March 1990, Seattle, Washington, USA.* Marine Mammal Commission Report PB91-100479. 186 pp.

Preble, E.A. 1902: A biological investigation of the Hudson Bay region. *North American Fauna* 22. 140 pp.

Rasmussen, K. 1921: Thule Distrikt. Pp. 515-567 in: G.C. Amdrup, L. Bobé, Ad. S. Jensen and H.P. Steensby (eds). Grønland i Tohundredeaaret for Hans Egedes Landing. *Meddelelser om Grønland* 60(1). 567 pp. (In Danish)

Rasmussen, J. K. 1925: *Scoresby Sund Expeditionen 1924-25.* Unpublished diary Arktisk Institut, København. (In Danish)

Rasmussen, K. 1929: The regulations for the protection of Game and Wild fowl. *In: Laws of the Cape York Station, Thule 7 June 1929, given by Knud Rasmussen, Ph.D., and sanctioned by the Ministry for Shipping and Fisheries.*

Rasmussen, B. 1952: *Om beskyttelse av hvalross* (On the protection of the walrus). Upubl. rapport, 20. januar 1953, bearbejdet fra notat af 6. juni 1952. Archives of Marine Research Institute, Bergen. 6 pp. (In Norwegian).

Ray, G.E. & Watkins, W.A. 1975: Social function of underwater sounds in the walrus *Odobenus rosmarus. Rapports et Procès-verbaux des Reunion Conseil Permanent international pour L'Exploration de la Mer* 169, 524-526.

Reeves, R. 1978: Atlantic walrus (*Odobenus rosmarus rosmarus*): A literature survey and status report. *U.S. Department Interior. Fish and Wildlife Service, Wildlife Research Report* 10. 41 pp.

Reijnders, P., Brasseur, S., van der Toorn, J., van der Wolf, P., Boyd, I., Harwood, J., Lavigne, D. & Lowry, L. 1993: *Seals, Fur Seals, Sea Lions, and Walruses. Status Survey and Conservation Action Plan.* IUCN/SSC (World Conservation Union, Species Survival Commission) Seal Specialist Group. IUCN, Gland, Switzerland. 88 pp.

Renewable Resources Consulting Services Ltd. 1976: *Aerial surveys of marine mammals of Lancaster Sound, 1975-76.* 92 pp.

Richard, P.R. & Campbell, R.R. 1988: Status of the Atlantic walrus, *Odobenus rosmarus rosmarus*, in Canada. *Canadian Field-Naturalist* 102, 337-350.

Richard, P. 1990: Review of history and present status of world walrus stocks. Hudson Bay-Foxe Basin. Pp. 3-5 *in*: F.H. Fay, B.P. Kelly and B.A. Fay. (eds). *The ecology and management of walrus populations. Report of an international workshop, 26-30 March 1990, Seattle, Washington, USA.* Marine Mammal Commission Report PB91-100479. 186 pp.

Richard, P. 1993: Canada. Reports of Range State Representatives. Pp. 17-19 in: R.E.A. Stewart, P.R. Richard & B.E. Stewart. 1993 (eds). Report of the 2nd walrus International Technical and Scientific (WITS) workshop, 11-15 January 1993, Winnipeg, Manitoba, Canada. *Canadian Fisheries and Aquatic Sciences Technical Report* 1940. 91 pp.

Richard, P., Orr, J., Dietz, R. & Dueck, L. 1993: Preliminary report on an aerial survey of belugas in the North Water, 21-26 March 1993. *Working document for the 2nd Meeting of the Scientific Working Group of the Canada/Greenland Joint Commission on the*

Conservation and Management of Narwhals and Belugas. Copenhagen, 21-25 June 1993. 22 pp.

Richardson, W.J., Hickie, J.P., Davis, R.A. & Thomson, D.H. 1989: Effects of offshore petroleum operations on cold water marine mammals: A literature review. *American Petroleum Institute (API) Publication No.* 4485. Health and Environmental Sciences Department, February 1989. Report prepared by LGL Ltd., King City, Ontario, Canada. 385 pp.

Riewe, R. 1976: Inuit land use in the high Canadian Arctic. Pp. 173-184 in: M.M.R. Freeman (ed.). *Report Inuit land use and occupancy project*, vol. 1. Department of Indian and Northern Affairs, Ottawa.

Riewe, R.R. 1977: The utilization of wildlife in the Jones Sound region by the Grise Fjord Inuit. Pp. 623-644 in: L.C. Bliss (ed.). *Truelove Lowland, Devon Island, Canada: A High Arctic Ecosystem.* University of Alberta Press, Edmonton.

Riewe, R. (ed.). 1992: *Nunavut atlas*. Canadian Circumpolar Institute and Tungavik Federation of Nunavut, Edmonton, Alberta. 259 pp.

Riewe, R.R. & Amsden, C.W. 1979: Harvesting and utilization of pinnipeds by the Inuit hunters in Canada's eastern High Arctic. Pp. 324-348 *in*: A.P. McCartney (ed.). Thule Eskimo Culture: An anthropological retrospective. *National Museum of Man Mercury Series. Archaeological Survey of Canada Paper No.* 88

Rink, H. 1877: *Danish Greenland. Its People and Its Products*. Henry S. King and Co., London. 468 pp.

Rosing-Asvid, A. 1993: *Tagging of polar bears in NW Greenland 1993*. Unpubl. report. Greenland Fisheries Research Institute, Copenhagen. 8 pp.

Ross, W.G. 1975: Whaling and Eskimos: Hudson Bay 1860-1915. *National Museums of Canada, Publications in Ethnology* 10. 164 pp

Ross, W.G. (ed.). 1984: *An arctic whaling diary: the journal of Captain George Comer in Hudson Bay 1903-1905*. University of Toronto Press, Toronto. 271 pp.

Ross, W.G. & MacIver, A. 1982: *Distribution of the kills of Bowhead whales and other sea mammals by Davis Strait whalers 1829-1910.* Report for Arctic Pilot Project, January 1982. 75 pp.

Roy, C. 1971: La chasse des mammifères marins chez les Ivujivinumiut. (The Ivujivimmiut hunt for marine mammals). *Cahiers de Géographie de Québec* 15, 509-521 (In French)

Rugh, D.J. 1993: A polar bear kills a walrus calf. *Northwestern Naturalist* 74, 23-24

Russell, C. 1966: Walrus! Walrus! Walrus galore! *North* 13(2), 1-9

Salter, R.E. 1978: *Normal behavior and disturbance responses of walruses (Odobenus rosmarus L.) during terrestrial haul-out, eastern Bathurst Island, N.W.T., July-August 1977.* Rep. from LGL Ltd., Toronto, Ont. for Polar Gas project, Toronto, Ontario. 68 pp.

Salter, R.E. 1979: Site utilization, activity budgets, and disturbance responses of Atlantic walruses during terrestrial haul-out. *Canadian Journal of Zoology* 57, 1169-1180

Sandell, H.T. & Sandell, B. 1991: Archaeology and environment in the Scoresby Sund fjord. Ethnoarchaeological investigation of the last Thule culture of Northeast Greenland. – *Meddelelser om Grønland Man and Society* 14. 150 pp.

Schevill, W.E., Watkins, W.A. & Ray, G.C. 1966: Analysis of underwater *Odobenus* calls with remarks on the development and function of the pharyngeal pouches. *Zoologica* 51, 103-111

Schledermann, P. 1975: Thule Eskimo prehistory of Cumberland Sound, Baffin Island, Canada. *National Museum of Man Mercury Series, Archaeological Survey of Canada Paper No.* 38. 297 pp.

Schledermann, P. 1978: Preliminary results of archaeological investigations in the Bache Peninsula region, Ellesmere Island, N.W.T. *Arctic* 31, 459-474

Schledermann, P. 1980: Polynyas and prehistoric settlement patterns. *Arctic* 33, 292-302

Schwartz, F.H. 1976: Inuit land use in Hudson Bay and James Bay. Pp. 115-120 in: M.M.R. Freeman (ed.). *Report Inuit land use and occupancy project*, Vol. 1. Department of Indian and Northern Affairs, Ottawa.

Schwartz, F.H. 1982: Native land use in the Lancaster Sound area. Ottawa: *Department of Indian and Northern Affairs, Northern Affairs Program, Environmental Studies, No.* 27. 46 pp. + appendix.

Sease, J.L. & Chapman, D.G. 1988: Pacific walrus *Odobenus rosmarus divergens*: Pp. 17-38 *in*: J.W. Lentfer (ed.). *Selected Marine Mammals of Alaska. Species account with research and management recommendations*. Marine Mammal Commission, Washington DC. 275 pp.

Segstro, M., Muir, D., Hobson, K., Stewart, R. & Olpinski, S. 1993: Are unexpectedly high levels of PCBs and other organochlorines in walrus due to predation on seals? Abstract p. 98, Abstract p. 51, Abstract p. 33, *Tenth Biennial Conference on the Biology of Marine Mammals, Galveston, Texas, USA, November 11-15, 1993.* 130 pp.

Shuldham, M. 1775: Account of the sea-cow and the use made of it. *Philosophical Transactions of the Royal Society London* 65, 249-251

Siegstad, H. 1989: Kangerlussuaq – en aktiv fangstplads. (Kangerlussuaq – an active hunting community). *Tusaat/Forskning i Grønland* 1-2, 55-59 (In Danish)

Simonsen, V., Born, E.W. & Kristensen, T. 1982: Electrophoretic variation in large mammals. IV. The Atlantic walrus, *Odobenus rosmarus rosmarus* (L.). *Hereditas* 97, 91-94

Sjare, B. 1989. Observations on the breeding behavior of Atlantic walruses in the Central Canadian high Arctic. Abstract p. 63. In: *Eighth Biennial Conference on the Biology of Marine Mammals, Pacific Grove, California, December 7-11, 1989*. 81 pp.

Sjare, B. 1993. The breeding behavior and mating system of walruses. Abstract p. 10. In: *Tenth Biennial Conference on the Biology of Marine Mammals, Galveston, Texas, USA, November 11-15, 1993*. 130 pp.

Smith, T.G. & Taylor, D. 1977. Notes on marine mammals, fox and polar bear harvest in the Northwest Territories 1940 to 1972. *Fisheries and Marine Services Technical Report No.* 694. Environment Canada, Ottawa. 37 pp.

Smith, T.G., Hamill, M.O., Doidge, D.W., Cartier, T. & Sleno, G.A. 1979: Marine mammal studies in southeastern Baffin Island. *Canadian Fisheries and Aquatic Sciences Manuscript Report* 1552. 70 pp.

Smith, M. & Rigby, B. 1981: Distribution of polynyas in the Canadian Arctic. Pp. 7-28 in: I. Stirling and H. Cleator (eds). Polynyas in the Canadian Arctic. *Canadian Wildlife Service Occassional Paper* 45. 73 pp.

Soper, J.D. 1928: A faunal investigation of southern Baffin Island. *National Museum of Canada, Biology Series 15, Bulletin* 53, 1-143

Soper, J.D. 1944: The mammals of southern Baffin Island, Northwest Territories, Canada. *Journal of Mammalogy* 25, 221-254

Sølberg, F. 1975: *Beskrivelse af jagt og fangst i Scoresby Sund*. (Description of hunting and trapping in Scoresby Sund). Unpublished manuscript. 86 pp. (In Danish). Held by Erik W. Born.

Stevenson, M. 1993: *Central Inuit social structure: the view from Cumberland Sound, Baffin Island, Northwest Territories*. Ph.D. thesis, Department of Anthropology, University of Alberta, Edmonton.

Stewart, B.E. & Burt, P.M. 1994: Extralimital occurrences of beluga, *Delphinapterus leucas*, and walrus, *Odobenus rosmarus*, in Bathurst Inlet, Northwest Territories. *Canadian Field-Naturalist* 108, 488-490

Stewart, R.E.A., Richard, P.R. & Stewart B.E. 1993: Report of the 2nd walrus International Technical and Scientific (WITS) workshop, 11-15 January 1993, Winnipeg, Manitoba, Canada. *Canadian Fisheries and Aquatic Sciences Technical Report* 1940. 91 pp.

Stirling, I. & Cleator, H. 1981 (eds): Polynyas in the Canadian Arctic. *Canadian Wildlife Service Occassional Paper* 45. 73 pp.

Stirling, I., Cleator, H. & Smith, T.G. 1981: Marine mammals. Pp. 45-58 in: I. Stirling and H. Cleator (eds). Polynyas in the Canadian Arctic. *Canadian Wildlife Service Occassional Paper* 45. 73 pp.

Stirling, I., Calvert, W. & Cleator, H. 1983: Underwater vocalizations as a tool for studying the distribution and relative abundance of wintering pinnipeds in the High Arctic. *Arctic* 36, 262-274

Stirling, I., Calvert, W. & Spencer, C. 1987: Evidence of stereotyped underwater vocalization of male Atlantic walruses (*Odobenus rosmarus rosmarus*). *Canadian Journal of Zoology* 65, 2311-2321

Stirling, I. & Sjare, B. 1988: Preliminary observations on the immobilization of male Atlantic walruses (*Odobenus rosmarus rosmarus*) with Telazol. *Marine Mammal Science* 4, 163-168

Stokke, O.S. 1994: Environmental cooperation as a driving force in the Barents region. Pp. 145-158 in: O.S. Stokke and O. Tunander (eds). *The Barents Region. Cooperation in Arctic Europe*. Sage Publishers. London, Thousand Oaks, New Dehli. 239 pp.

Storå, N. 1987: Russian walrus hunting in Spitsbergen. *Etudes/Inuit/Studies* 11, 117-138

Sverdrup, O. 1903: *Nyt Land. Fire år i arktiske Egne*. (New Land. Four years in the Arctic). H Aschehoug & Co. (W. Nygaard). Kristiania. Vol. I. 505 pp. Vol. II. 523 pp. (In Norwegian, English version also available)

Tahon, J. & Vens, V. 1994: Marine mammals and birds ARK IX/3. Pp. 115-119 in: H.-J. Hirche and G. Kattner (eds). The 1993 Northeast Water Expedition Scientific cruise report of RV "Polarstern" Arctic cruises ARK IX/2 and 3, USCG "Polar Sea" cruise NEWP and the NEWland expedition. – *Berichte zur Polarforschung* 142. 190 pp.

Tavrovski, V.A. 1971: Pinnipedia – Lastonogie. Pp. 509-516 in: V.A. Tavrosvski (ed.). *Mammals of Yakutia*. Nauka, Moscow. 660 pp. (In Russian)(Translated by B.A. Fay and F.H. Fay).

Taylor, J.G. 1974: Labrador Eskimo settlements of the early contact period. Ottawa: *National Museums of Canada, National Museum of Man, Publications in Ethnology* 9.

Taylor, J.G. 1977: Traditional land use and occupancy by the Labrador Inuit. Pp. 49-58 *in*: C. Brice-Bennett (ed). *Our footprints are everywhere: Inuit land use and occupancy in Labrador*. Labrador Inuit Association, Nain.

Taylor, J.G. & Taylor, H.R. 1977: Inuit land use and occupancy in the Okak region: 1776-1830. Pp. 59-81 *in*: C. Brice-Bennett (ed.). *Our footprints are everywhere: Inuit land use and occupancy in Labrador*. Labrador Inuit Association, Nain.

Taylor, D.L., Schliebe, S. & Metsker, H. 1989: Contaminants in blubber, liver and kidney tissue of Pacific walruses. *Marine Pollution Bulletin* 20, 465-468

Thorson, G. 1934: Marine Mollusks. *Meddelelser om Grønland* 104(17), 1-8

Timoshenko, lu. K. 1984: Concerning the protection and restoration of the western Atlantic population of the walrus. Pp. 100-103 in: A.V. Yablokov (ed.). *Marine Mammals*. Nauka, Moscow (In Russian) (Translated by F.H. Fay, 4 pp.).

Timoshenko, lu. & Popov, L. 1990: On the predatory habits of Atlantic walrus. Manuscript presented at the International Workshop on the Ecology and Management of Walrus populations, 26 – 30 March 1990, Seattle, Washington, USA. 4 pp. (See also: Timoshenko, Iu. & Popov, L. 1990: On predatory habits of Atlantic walruses. Pp. 177-178 in: F.H. Fay, B.P. Kelly and B. Fay (eds). *The Ecology and Management of Walrus Populations. Report of an International Workshop. Seattle, Washington, USA, October 1990*. U.S. Marine Mammal Commission, Washington D.C.: Marine Mammal Commission Report PB91-100479: 186 pp.)

Tomilin, A.G. & Kibal'chich, A.A. 1975: (The walruses in the vicinity of Wrangel Island). *Zoologicheskij Zhurnal* 54, 266-272 (Canadian Fisheries and Marine Service Translation 3721, 1976. 15 pp.).

Tremblay, A. 1921: *Cruise of the Minnie Maud. Arctic seas and Hudson Bay 1910-11 and 1912-13*. Arctic Exchange and Publishing, Quebec. 583 pp.

Treude, E. 1977: Pond Inlet, northern Baffin Island: the structure of an Eskimo resource area. *Polar Geography* 1, 95-122

Trolle, A. 1908: Rapport over den nordgående slæderejse 1907 med Mylius Erichsens, Hagens og Brønlunds Rejse til Peary Kanalen og de Rejser, der dermed står i forbindelse. (Report from the northbound sledge journey 1907 with Mylius Erichsen's, Hagens and Brønlunds journey to the Peary Channel). Skrevet af Alf Trolle d. 11. august 1908 og afleveret til Danmark-Ekspeditionens Komite ved hjemkomsten. *Publikationer om Østgrønland* 1, 21-47 (In Danish).

Tsalkin, V.I. 1937: Materials on the biology of the walrus of the Franz Josef Archipelago. *Byulletin Moskovskogo Obschschestva Ispytatelei Prirody* (Bulletin Moscow Society Nature (sec. biol.) 46(1), 43-51 (In Russian with English summary)(Transl. by F.H. Fay, 1983).

Tuttle, R. 1885: *Our north land: being a full account of the Canadian North-west and Hudson's Bay route*. Toronto.

Twomey, A.C. 1939: Walrus off the Sleepers. *Beaver* 269(4), 6-10

Twomey, A.C. & Herrick, N. 1942: *Needle to the North. The story of an expedition to Ungava and the Belcher Islands*. Houghton Mifflin Co., Boston. 360 pp.

Urick, R.J. 1983: *Principles of Underwater Sound*. 3rd edition. McGraw Hill, New York, NY.

U.S. Fish and Wildlife Service. 1993: *Draft. A management plan for the Pacific Walrus in Alaska, January 1993*. U.S. Fish and Wildlife Service. Marine Mammals Management, 4230 University Drive, Suite 310. Anchorage, AK 99508. 76 pp.

Val, E. 1976: Inuit land use in the Port Burwell area. Pp. 121-123 in: M.M.R. Freeman (ed.). *Report Inuit land use and occupancy project*, vol. I. Department of Indian and Northern Affairs, Ottawa.

Vestey, J. 1973: *Igloolik Eskimo settlement and mobility 1900-1970*. Master's thesis, Department of Geography, McGill University, Montreal. 225 pp.

Vibe, C. 1946: Træk af hvalrossens of remmesælens biologi i Thule-districted (Aspects of the biology of the walrus and the bearded seal in the Thule area). *Grønlandsposten* Nr. 11-12, 282-286 (In Danish).

Vibe, C. 1950: The marine mammals and the marine fauna in the Thule Distrikt (Northwest Greenland) with observations on the ice conditions in 1939-41. *Meddelelser om Grønland* 150(6). 115 pp.

Vibe,C. 1956. The walrus west of Greenland. Pp. 79-84 in. *Proceedings 5th Meeting International Union for the Protection of Nature, Copenhagen 1954*.

Vibe, C. 1967: Arctic animals in relation to climatic fluctuations. *Meddelelser om Grønland* 170(5). 227 pp.

Villiers, D. 1970: The Central Arctic: an area economic survey 1968. *Industrial Division, Department of Indian Affairs and Northern Development, Ottawa. A.E.S.R. #68/1*. 189 pp.

Vishnevskaia, T.I. & Bychov, V.A. 1985: A mixed herd of the Laptev walrus in M. Pronchishchev Bay and prospects for its protection. Pp. 3-14 in: V.E. Flint (ed.). *Ecological aspects of protection of the animal world*. Ministry of Agriculture, Moscow. (In Russian) (Transl. by F.H. Fay 1986: 10 pp.).

Vollan, O. 1951: *Ishavsfart. Selfangsten fra Sunnmøre gjennom femti år*. (Fifty years of Arctic Ocean sealing and hunting from Sunnmøre). Alb. Cammermeyers Forlag, Oslo. 360 pp. (In Norwegian)

Wagemann, R. & Muir, D.C.G. 1984: Concentrations of heavy metals and organochlorines in marine mammals of northern waters: Overview and evaluation. *Canadian Fisheries and Aquatic Sciences Technical Report No.* 1279. 97 pp.

Wagemann, R., Muir, D.C.G. & Stewart, R.E.A. 1993: Trace metals and organic contaminants in walruses from the Canadian Arctic and northern Quebec. P. 67 *in*: R.E.A. Stewart, P.R. Richard and B.E. Stewart (eds). Report of the 2nd walrus International Technical and Scientific (WITS) workshop, 11-15 January 1993, Winnipeg, Manitoba, Canada. *Canadian Fisheries and Aquatic Sciences Technical Report* 1940. 91 pp.

Wakeham, W.C. 1898: *Report of the expedition to Hudson Bay and Cumberland Gulf in the steamship "Diana". Under the command of William Wakeham, Marine Fisheries Canada, in the year 1897*. Printed by S.E. Dawson, Printer to the Queen's Most Excellent Majesty, Ottawa. Frontis + (iv) + 83 pp. + 28 plates + 4 folding maps.

Warburton, J. & Seagers, D.J. 1991: Heavy metal concentrations in liver and kidney tissues of Pacific walrus: continuation of a baseline study. P. 71 in: *Abstracts from the Ninth Biennial Conference on the Biology of Marine Mammals, December 5-9, 1991, Chicago, Ill.* 76 pp.

Warburton, J. & Seagars, D.J. 1993: Heavy metal concentrations in liver and kidney tissues of Pacific walrus. Continuation of a baseline study. *US Fish and Wildlife Service Tecnical Report R7/MMM 93-1, April 1993*. 23 pp.

Wartzok, D. & Ray, G.C. 1980: *The hauling-out behavior of the Pacific walrus*. Final Report to U.S. Marine Mammal Commission, Contract MM5ACO28: 46 pp.

Wartzok, D. & Ray, G.C. 1981: Sea ice determinants of walrus hauling-out behavior. P. 122 in: *Abstract. 4th Biennial Conferance on the Biology of Marine Mammals, Dec. 14-18, 1981, San Francisco*.

Welland, T. 1976: Inuit land use in Keewatin District and Southampton Island. Pp. 83-114 in: M.M.R. Freeman (ed.). *Report Inuit land use and occupancy project*, vol. 1. Department of Indian and Northern Affairs, Ottawa.

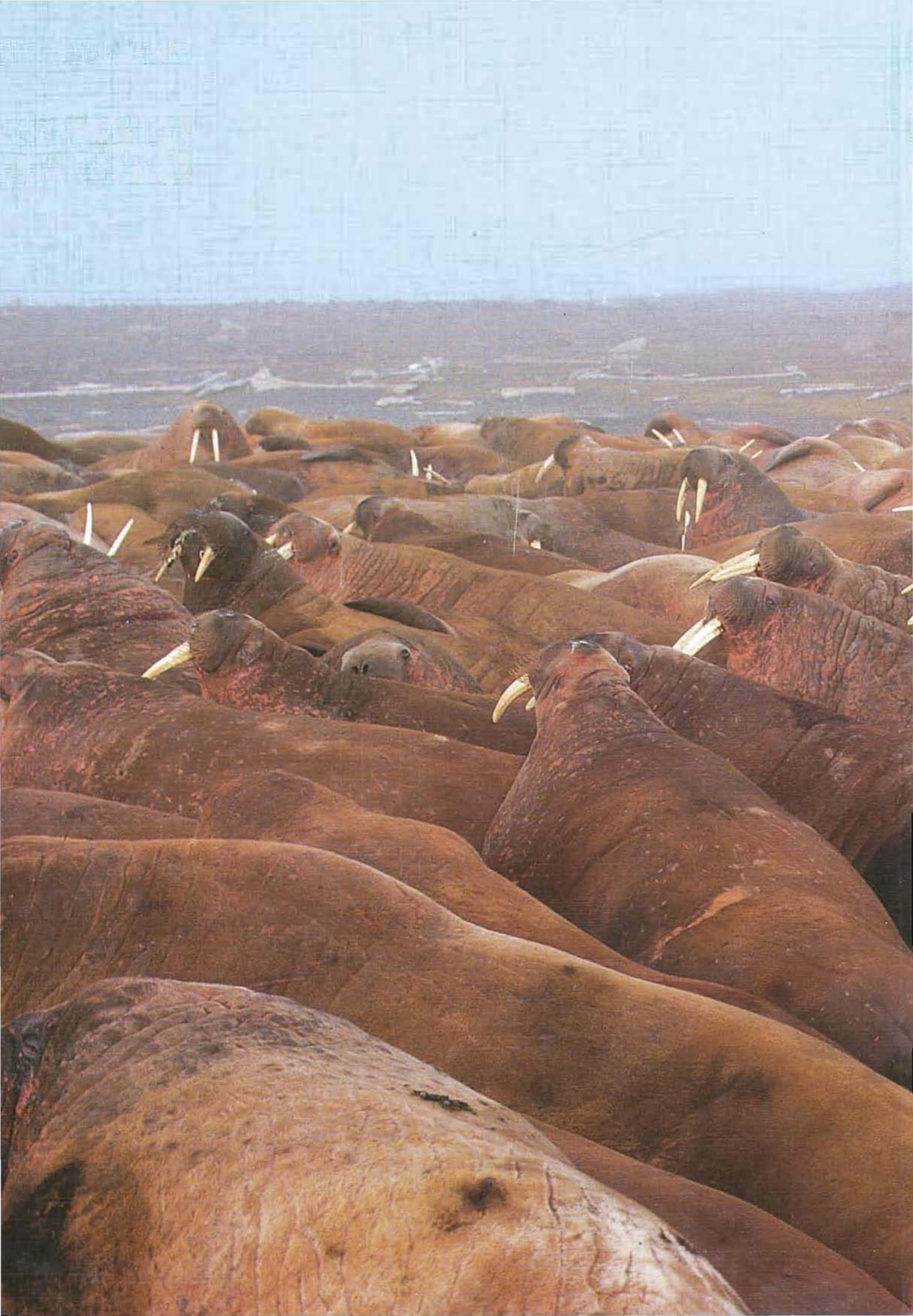
Wenzel, G. 1991: *Animal rights human rights. Ecology, economy and ideology in the Canadian Arctic*. University of Toronto Press, Toronto. 206 pp.

Wiig, Ø., Gjertz, I., Griffith, D. & Lydersen, C. 1993: Diving patterns of an Atlantic walrus *Odobenus rosmarus rosmarus* near Svalbard. *Polar Biology* 13, 71-72

Wiig, Ø. & Gjertz, I. Body size of male walruses (*Odobenus rosmarus*) from Svalbard. *Journal of Zoology (London)*. In press.

Wiig, Ø., Gjertz, I. & Griffiths, D. Migration of walruses (*Odobenus rosmarus*) in the Svalbard and Franz Josef Land area. *Journal of Zoology (London)*. In press

Woods, T.J. 1974: *Wildlife in the vicinity of Baffin Island National Park: an assessment of the impact of Inuit hunting and other factors on wildlife populations in southeastern Baffin Island*. Canadian Wildlife Service, Fredericton, N.B.. 35 pp. (Unpubl. manuscr.).



SCIENTIFIC REPORTS



OPEN

SUBJECT AREAS:
BEHAVIOURAL ECOLOGY
ZOOLOGY
ANIMAL BEHAVIOUR
ECOLOGY

Received
14 December 2012

Accepted
28 February 2013

Published
2 April 2013

Correspondence and requests for materials should be addressed to C.C. (cc201@st-andrews.ac.uk)

Responses of male sperm whales (*Physeter macrocephalus*) to killer whale sounds: implications for anti-predator strategies

Charlotte Curé[1], Ricardo Antunes[1], Ana Catarina Alves[1], Fleur Visser[2,3], Petter H. Kvadsheim[4] & Patrick J. O. Miller[1]

[1]Sea Mammal Research Unit, School of Biology, University of St. Andrews, Fife KY16 8LB, St. Andrews, UK, [2]Netherlands Organization for Applied Scientific Research (TNO), 2592 AK, The Hague, The Netherlands, [3]Kelp Marine Research, 1624 CJ, Hoorn, The Netherlands, [4]Norwegian Defence Research Establishment (FFI), N-3191, Horten, Norway.

Interactions between individuals of different cetacean species are often observed in the wild. Killer whales (*Orcinus orca*) can be potential predators of many other cetaceans, and the interception of their vocalizations by unintended cetacean receivers may trigger anti-predator behavior that could mediate predator-prey interactions. We explored the anti-predator behaviour of five typically-solitary male sperm whales (*Physeter macrocephalus*) in the Norwegian Sea by playing sounds of mammal-feeding killer whales and monitoring behavioural responses using multi-sensor tags. Our results suggest that, rather than taking advantage of their large aerobic capacities to dive away from the perceived predator, sperm whales responded to killer whale playbacks by interrupting their foraging or resting dives and returning to the surface, changing their vocal production, and initiating a surprising degree of social behaviour in these mostly solitary animals. Thus, the interception of predator vocalizations by male sperm whales disrupted functional behaviours and mediated previously unrecognized anti-predator responses.

Interspecific interactions across multiple scales (species, population, individual) remain a central question in understanding the organization of animal communities[1–3]. In predator-prey interactions, the importance of predation over evolutionary time (e.g. regulating prey population) has long been clear, but the influence of predation on phenotype (e.g. body size) and behaviour of prey has seen a growing recognition in the last decade. In fact, prey can be affected by predators in other ways than direct (lethal) predation, in the form of stress[4], changes in behaviour and anti-predator strategies[5]. Prey must search for food and reproduce while maintaining the capability to detect and avoid predators. There is thus a constant trade-off for prey between avoiding predation and continuing fitness-enhancing activities such as foraging or mating[5,6].

Cetaceans spend most of their time underwater and thus the effect of predator-prey interactions on the animals' behaviour is difficult to observe and rarely studied, especially in comparison to terrestrial animals[7]. However, the advanced multi-sensor tag developed by Johnson and Tyack (2003) contributed to a major advance in cetacean behavioural studies, enabling reliable monitoring and quantification of the animals' behaviour, even below the sea surface[8]. Using such technology, it becomes possible to study the effects of predation risk on cetaceans' behaviour.

The two main potential predators of cetaceans are killer whales and sharks[9]. Both of these predator types are widespread in the world's oceans and have been observed to feed on a large number of prey items including fishes, cephalopods, seabirds, seals and cetaceans. In general, small cetaceans such as dolphins and porpoises are likely more vulnerable to predation than larger cetaceans. Sharks seem not to pose a significant risk to large whales, though small calves of some species may be vulnerable to attacks occasionally[9]. Killer whales, however, clearly prey on large cetacean species including mysticetes and some odontocetes such as adult female and juvenile sperm whales[10–13]. In the last decade, there has been a growing interest in the role of killer whale predation in shaping marine ecosystems and regulating prey population[14,15]. However, the effect of predation pressure on behaviour and social organization of prey and especially of cetacean prey, remains to be experimentally tested[16]. Although various observations have reported interspecific predatory or non-predatory encounters between killer whale and

other cetaceans, there is a lack of consistency in these observations[10,13] and thus no prediction on how cetaceans' behaviour is altered by killer whale presence and how these interactions are mediated.

The sperm whale is the largest toothed whale. A considerable number of observations of lethal and non lethal attacks by killer whale on calves and adult female sperm whales have been reported[10,11]. Male and female sperm whales are geographically segregated outside of the breeding grounds. Females stay in tropical and subtropical areas in warm surface waters where they live in cohesive groups including adult females and immature males and females. Males leave their family unit at approximately 10 years of age and gradually move to higher latitudes into colder surface waters where they are usually seen solitary[17]. In their late twenties, males start to return periodically to the breeding grounds inhabited by females to mate[18]. In female sperm whales, grouping behaviour to defend themselves and their calves has been observed in response to killer whale attacks[10,15] and may be the primary function of their sociality[11,17,18].

Killer whales are a highly vocal species and their vocalizations can be heard underwater over long distances[19]. Specific avoidance responses to killer whale sounds have been demonstrated experimentally in fish[20,21], pinnipeds[22] and few cetacean species[23–25]. As sperm whales hear well at the frequencies of killer whale vocalizations[26], the unintended interception of killer whale sounds may inform the eavesdroppers about the presence of predators, enabling them to make adjustments of their behavior[27,28].

To our knowledge, no reports exist on how high-latitude male adult sperm whales might respond to predation risk, suggesting that male sperm whales are rarely attacked by killer whales. It's possible that anti-predator strategies exhibited by male sperm whales would be sufficiently powerful to actually discourage killer whales to attack such low benefit prey.

In natural conditions, sperm whales spend 80% of their time foraging and 20% of their time resting[29–31]. To meet their energy requirements, they predate mainly upon cephalopods and have developed a sophisticated and efficient foraging strategy, performing almost continuously long deep foraging dives and producing loud echolocation clicks to localize their prey[29,30]. If killer whales are perceived as a potential predation risk for male sperm whales, we expect that the detection of predator presence should induce significant changes in the foraging or resting behaviour of sperm whales. Alteration of foraging should be reflected in a change of diving behaviour along with a change in the production of sounds associated with foraging such as clicks and buzzes. Alteration of resting behaviour should be reflected in a change in the stereotypical resting dives pattern[31]. The solitary nature of adult males leads to the prediction that social defences would not be part of the response repertoire, while their large aerobic diving capacity would enable a diving escape strategy[15–17]. Grouping of male sperm whales is indeed rarely observed in natural conditions[15], but a male sperm whale could alert other males in the area to enrol them in a social defence. Such social behaviour should be indicated by the grouping of several whales and the emission of social sounds called 'codas'[32,33].

Our objectives were therefore to investigate whether the detection of mammal-feeding killer whale sounds 1) alters the behaviour (i.e. foraging or resting) of male sperm whales, and whether they respond by avoiding the sound source and diving deeper and longer, and 2) induces an initiation of social response as an anti-predator strategy. To test what anti-predator strategies are employed by adult male sperm whales, we conducted playback of killer whale vocalizations to five male sperm whales off Norway and monitored the behavioural responses of the animals using a high resolution depth-and-sound-recording tag[8].

Results

Overall, the five tested whales changed their behaviour in response to killer whale sounds playbacks (abbreviated as KW) (see Table 1).

Change in foraging/resting behaviour. *Change in the dive profile*. Four animals of the five tested whales (sw09_141a, sw09_160a, sw10_149a and sw10_140a) were conducting deep foraging dives before the start of KW sounds playback and 1 whale (sw09_142a) was in a resting mode, performing stereotypical resting dives (Table 1).

Playback of KW sounds resulted in significantly shorter and shallower dives compared to the baseline (Fig. 1a, b), and none of the whales extended the duration of their dives. For all whales except one (sw09_160a), KW sounds elicited a clear interruption in the descent phase of the dive and a return to the sea surface (Fig. 2a, b, d and e). Two of the four whales that were foraging were also exposed to a broadband noise as negative control (abbreviated as CTRL) (sw10_149a and sw10_150a) and performed apparent similar foraging dives during CTRL playback compared to the baseline (similar duration and max depth) (Fig. 1a, b and Fig. 2d, e). The foraging whale that did not interrupt its dive during KW playback (sw09_160a) performed an unusual foraging dive pattern showing multiple vertical wiggles (i.e. short ascents) during the descent phase of the dive (Fig. 2c). The tagged whale sw09_142a that was in a resting mode preceding the KW sounds exposure stopped resting in response to KW playback (Fig. 2b) and performed a spyhop (raising of the whale's head above the sea surface) just after coming up to the surface.

Change in regular click production. During baseline periods, the foraging sperm whales spent most of their dive clicking (mean 77 ± 9.4% s.e.m., range: 54.7–94.5%, $n = 4$). Buzzes were produced for all baseline foraging dives (Fig. 2a, c, d, e). For the whale that was resting

Table 1 | Behavioural changes of sperm whales in response to KW sound playbacks

		Pre-exposure behavioural mode and D-tag ID of tagged sperm whales				
		Foraging				Resting
		Sw09_141a	Sw09_160a	Sw10_149a	Sw10_150a	Sw_09_142a
Dive profile	Dive interruption and return to surface	X		X	X	X
	Unusual dive pattern (wiggles)		X			
Direction of horizontal movement	Change of direction compared to original course			X		X
	Clear avoidance response	X			X	
Foraging acoustic cues	lower clicking activity	X		X	X	
	lower prey capture attempts (less or no buzzing)	X	X	X	X	
Social behaviour cues	Association with other individuals	X			X	
	Production of social sounds (codas)	X		X		
Other	Spyhop					X

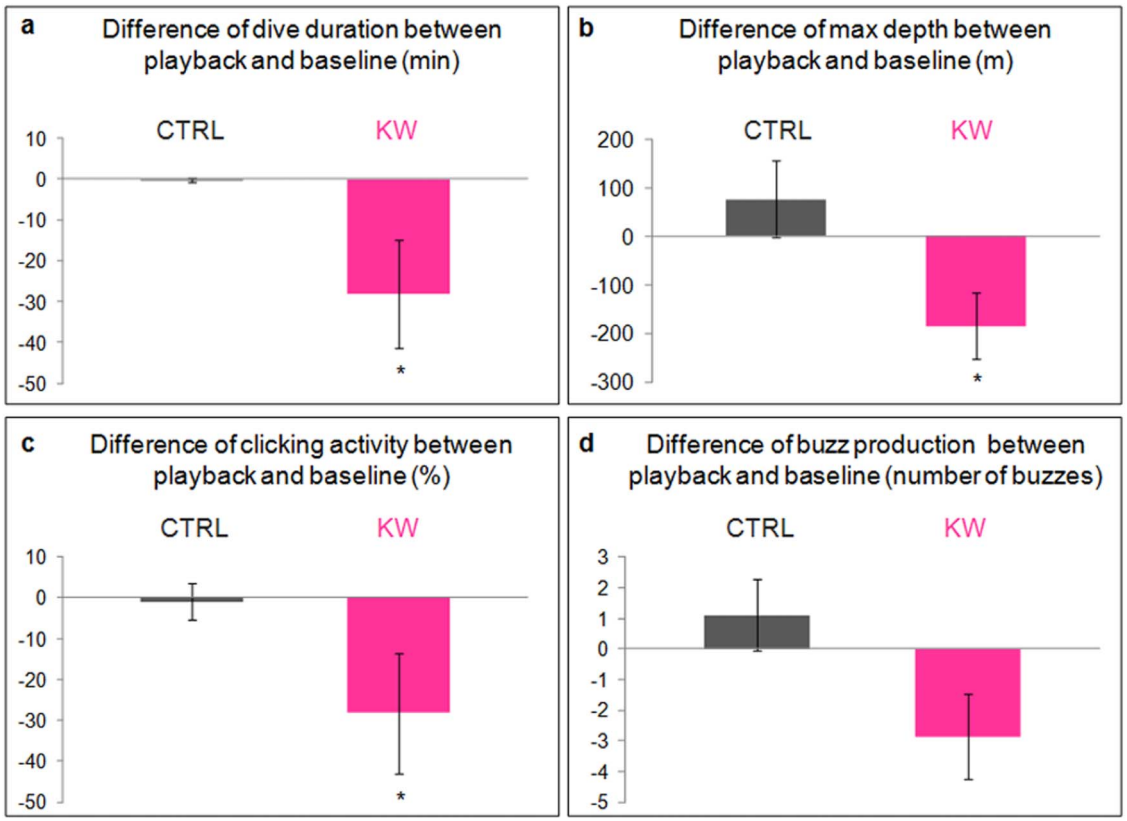


Figure 1 | Difference between baseline and playback (CTRL or KW) for dive duration (a), max depth (b), clicking activity (c) and production of buzzes (d). Values are given as mean ± s.e.m. A Wilcoxon matched-pair test was applied to assess difference between baseline and KW playback ($*P < 0.05$; $n = 5$).

during baseline, as expected, the clicking activity was close to zero and there was no buzz emitted during the dives (Fig. 2b).

Clicking activity was significantly lower during KW playback compared to baseline (Fig. 1c) ($P = 0.043$, $Z = 2.022$, $n = 5$) but appeared similar during CTRL playback compared to baseline. Buzz production was not significantly different between KW playback and baseline (Fig. 1d) although for two whales of four that interrupted their foraging dive to return to the surface in response to the KW playback, no buzz was produced during the dive (Fig. 2d, e).

Change in social behaviour (whale grouping and production of codas). Sperm whales were solitary during the baseline period preceding the playback experiments. During KW playbacks, we found evidence of a social response in three of the five tested whales (Fig. 2a, d, e and Table 1). Two tested whales appeared in association with other individuals at the first surfacing phase following KW playback (Fig. 2a, e). In addition, one of these 2 whales and another tested whale produced codas (Fig. 2a, d). We provide below a descriptive analysis of these behaviours along with Fig. 2 and Table 1.

For sperm whale sw09_141a, the tagged whale was observed solitary at the surface for the 3 h preceding the start of KW playback (group size: 1) (see Fig. 2a). During KW playback, the tagged animal interrupted its foraging dive and returned to the surface (group size: 1). At the first surfacing phase following the end of KW playback, three other whales appeared within 50 m apart from the tagged animal (group size: 1–4 whales). Simultaneously, twelve codas were produced by the group of individuals at the sea surface. At the next surfacing phase of the tagged whale, the animal was observed alone indicating that the group had spread out.

Sperm whale sw10_149a was solitary during the entire period preceding playback experiments. This whale produced one coda at the end of one single baseline dive, just before surfacing (3 h 30 before the start of KW playback) but did not produce any codas during the next baseline dives or during CTRL playback. Then, during KW playback, two codas were produced, one at the max depth of the dive and one when the animal returned to the surface (Fig. 2d). The animal was not observed with other whales and no more than one whale was acoustically detected by the passive acoustics equipment deployed in the water.

The tagged whale sw10_150a was observed as a single animal during baseline and CTRL playback (group size: 1) but then appeared with three more individuals at the first surfacing phase following the end of KW playbacks (group size: 3–4; distance of whales to the focal animal: 0–100 m) (see Fig. 2e). Then, at the next surfacing, the tagged whale appeared solitary again. No coda was recorded during baseline or during sound exposure.

Change in the direction of horizontal movement (avoidance or attraction). The visual tracks of the surfacing tagged whales indicated that four of the five tested whales (all except sw09_160a) changed their direction of horizontal movement in response to the KW playback. In two cases (sw09_141a and sw10_150a), the whales were originally moving towards the KW sound source but made a clear turn away from the source after they surfaced (avoidance). Sw09_160a did not show any apparent changes in direction of horizontal movement during the KW playback. This subject was moving towards the sound source before the playback started and kept this course during and after the KW playback. The two subjects that were exposed to CTRL playback (sw10_149a and sw10_150a) showed an avoidance response. Sw10_149a was moving towards the sound source before CTRL playback and made a clear turn away from the sound source during the playback. Sw10_150a slightly avoided the CTRL sound source during the playback and went back to its original course after the end of playback.

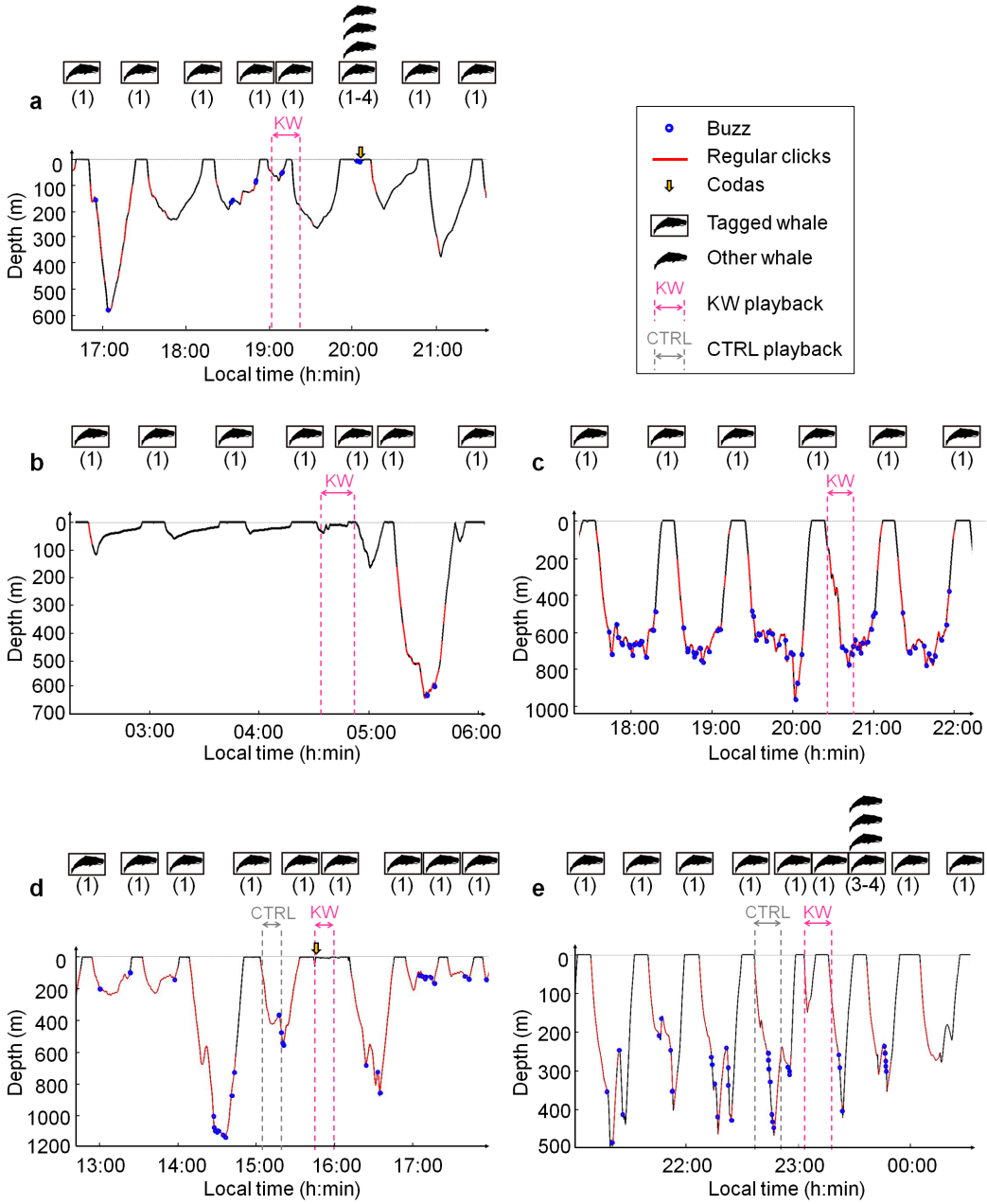


Figure 2 | Time-depth profile of tagged whales sw09_141a (a), sw09_142a (b), sw09_160a (c), sw10_149a (d) and sw10_150a (e) during baseline, CTRL and KW playbacks. The diving periods highlighted in red correspond to clicking activity, the blue circles represent emission of buzzes, and the yellow arrows indicate production of codas. For each surfacing phase, the range of group size is shown between brackets.

Responses to CTRL playbacks. The two individuals tested with CTRL playbacks (sw10_149a and sw10_150a) did not show any changes of behaviour except in the direction of horizontal movement (avoidance response). All the other behavioural parameters taken into account in our analyses had apparent similar values between CTRL playback and baseline period (Fig. 1 and Fig. 2d). Dive duration and maximum depth values during CTRL playback were essentially the same as those measured during baseline dives (Fig. 1a, b). Moreover, the rate of click production and number of buzzes indicating foraging activity appeared similar between CTRL playback and baseline (Fig. 1c, d). No indication of social behaviour, i.e., production of codas or association with other whales, was recorded during CTRL playback (Fig. 2d, e).

Discussion

Playbacks that simulated killer whale presence strongly changed the behaviour of five tested male sperm whales. This indicates that sperm whales have perceived the KW sounds in spite of the fact that the main frequencies of KW vocalizations are between 1–2 kHz which is outside the best hearing sensitivity (5–20 kHz) of sperm whales. Moreover, the fact that the two animals exposed to CTRL playback changed their direction of horizontal movement away from the sound source indicates that the whales also perceived the CTRL stimulus.

Animals that were initially foraging during the baseline exhibited significantly shorter and shallower dives compared to the baseline dives and produced less echolocation clicks and buzzes. In general, prey are predicted to alter their behaviour in response to the presence of predators by avoiding them or by reducing risk activities like feeding[5,6]. The best way for prey to avoid killer whales may be to keep quiet and hide from them by travelling to where the predator cannot follow. In offshore waters, deep diving species such as beaked whales or sperm whales may escape killer whales by going to great depths where killer whales cannot reach them[10]. Solitary male sperm

whales off Norway are not constrained by diving limitations of calves in their group so they could potentially use this strategy of escaping at depth. In contrast to this prediction, our results showed that during KW sounds playbacks, sperm whales interrupted their foraging or resting dive and returned to the surface. The animal's decision to reduce or stop foraging in response to KW playback represents a high energy cost and could be explained by the detection of a potential danger. A possible explanation for the behavioural response of the animals returning to the sea surface may be therefore that animals replenish their oxygen stores in preparation for a potential coming flight or deep avoidance dive if the predator approaches. At the surface, they might also search for additional cues of predator presence[34], a possible function of the spyhop observed by one of the tested whales.

In our study, all of the four sperm whales performing deep foraging dives at the start of exposure reduced vocal activity or silenced completely in response to the KW playback. In addition, three of these four whales and the initially resting whale interrupted their dive and returned to the surface, resulting in shorter and shallower dives compared to baseline. The two control experiments with the playback of a broad band noise (CTRL) showing the same frequency range than KW stimulus, verified that animals responded specifically to KW sounds and not to any unspecific acoustic stimuli.

On one hand, our findings are consistent with responses of six right whales (*Eubalaena glacialis*) exposed to experimental synthetic signals resembling to KW signals that interrupted their foraging dives and returned to the surface[35]. On the other hand, these results contrast with the typical straight avoidance responses reported in grey whales (*Eschrichtius robustus*) and belugas (*Delphinapterus leucas*) in response to KW playbacks[23,24]. Moreover, a Blainville's beaked whale (*Mesoplodon densirostris*), which is a deep diver like sperm whales, silenced and broke off the deep dive when exposed to a playback of KW sounds but returned to the sea surface only after an unusually slow ascent from depth[25]. Therefore, variations across cetacean species in their pattern of anti-predator responses to the detection of killer whale presence do not appear to be solely driven by physiological factors like diving capability.

We showed that in the feeding grounds off Norway, male sperm whales spend most of their time solitary and seldom produce codas, which is in agreement with the literature[15,36–38]. Indeed, male sperm whales were rarely observed socializing with other whales and when it happened, it was usually in cluster of two animals and for no more than few hours[15]. Moreover, codas, which play a major role in communication between conspecifics, have only rarely been recorded in the Norwegian Sea[36–38]. In contrast to females that live in cohesive groups, solitary males would not have the benefit of communal defence against predators. It has been suggested that as males are bigger than females, they would be less vulnerable to killer whale predation than females. Indeed, all documented predatory interactions between killer whales and sperm whales referred to attacks on group of female sperm whales with calves or wounded animals. However, in the present study, in three of five tested male sperm whales, KW playback induced a social response (clustering of animals at the sea surface and/or production of social/alerting sounds), indicating the initiation of anti-predator social strategy. This suggests that typically solitary males may also exhibit a social defence strategy in response to KW presence.

There have been observations of non-predatory interactions between killer whales and sperm whales or between killer whales and other species, where sometimes the prey ignores the predator[10,18]. A possible explanation for this absence of cetaceans' reaction facing their predator could be that animals can discriminate between vocalizations of different killer whale ecotypes and perceive as a potential predation risk only mammal-eating KW sounds. Thus, by intercepting KW sounds, prey would be able to assess food preference of killer whales and thus to evaluate the risk of predation. Here, we used unfamiliar mammal-eating KW sounds associated with foraging behaviour that may represent a higher threat for sperm whales compared to other sound types such as local fish-eating KW sounds that would likely pose no threat to them. Playback experiments using different KW sounds are needed to elucidate these questions, as has been explored in seals[22].

In summary, we found that the playback of unfamiliar mammal-eating KW sounds simulating potential predator presence modified the behaviour of five tested adult male sperm whale. Although, at the ecological scale, killer whale predation probably has a small role in regulating sperm whale populations[15], we show experimental evidence here that it must have at the individual scale a large impact on the behaviour and sociality of animals. Even if the predation risk might be lower for male sperm whales than for females with calves, it still induced a dramatic change in males' behaviour including the interruption of foraging or resting dives. Rather than taking advantage of their large aerobic capacities to dive away from the perceived predator, sperm whales returned quickly to the surface and initiated social responses, suggesting that high-latitude male sperm whales may have previously-unrecognized social interactions.

Methods

General protocol. Field work was conducted aboard a research vessel in the Northern Norwegian Sea during May/June 2009–2010[39,40]. The vessel had a dedicated observation platform from which visual data collection was conducted. A dedicated small motor boat was launched from the vessel for tagging operations and playback experiments. The protocol consisted of the following phases: 1) tagging, 2) start of visual tracking of the tagged animal, 3) collection of baseline behavioural data (before sound exposure), 4) collection of behavioural data during sound exposures, 5) end of visual tracking when the tag released, 6) tag recovery and data download for analysis.

Tagging and visual data collection. To monitor the behavioural response of sperm whales exposed to the playback sounds, we used an advanced miniature high-resolution movement-and-sound-recording tag called D-tag[8] (see Supplementary Material). We used the depth sensor and hydrophones on the tag to investigate potential changes in dive pattern and vocal production, respectively, in response to the playbacks. Using the VHF radio beacon on this tag, we were able to visually track the position of the animal at each surfacing event and to simultaneously assess whether the tagged whale was associated to other whales. At each surfacing phase, whale positions were determined at regular 2 min intervals (range: 3–8 recorded positions per surfacing phase) (see Supplementary Material).

Acoustic stimuli. Sperm whales were presented with playback of 'unfamiliar' mammal-eating KW sounds previously recorded in the North Pacific using D-tags[41] and corresponding to calls and clicks produced during eating activity. We expected these sounds to simulate a high risk of potential predation[22]. These KW sounds show a frequency range of 0.5–120 kHz with most energy distributed between 1 and 2 kHz which correspond to the fundamental frequency of the majority of the calls[42]. KW stimuli were transmitted through a speaker designed to broadcast in the 0.20–20 kHz frequency band. A large number of odontocetes are most sensitive in the 30–120 kHz[43,44] range whereas sperm whales show best hearing sensitivity between 5 kHz and 20 kHz[26] which matches with the frequency range covered by the speaker. Therefore, even if the frequencies of KW sounds above 20 kHz were transmitted by the speaker, sperm whales would probably hardly hear them. Our system of playback was thus appropriate to our species model. To control for sperm whales' reaction to any unspecific acoustic stimulus, two subjects were also exposed to a broad band noise (0.5–15 kHz) as a negative control (CTRL). CTRL stimuli were created from non-calling periods during the recordings from which KW stimuli were taken, amplified to get an average root mean square power equal to the KW stimuli. These CTRL stimuli had most energy between 1 and 2 kHz, like KW stimuli[42]. All stimuli had 15 min duration and were re-sampled at 44.1 kHz before being used for playback experiments. The average duration of the KW sounds within each 15 min KW stimulus was 7 min 21 sec ± 6 sec s.d. ($n = 3$). For each stimulus type (KW and CTRL), three different stimulus versions, i.e. collected from different acoustic recordings, were used among the tested whales to avoid pseudoreplication[45].

Playback experiments. We tested five male sperm whales encountered off Andenes, Norway. In 2009, three whales were tested with KW stimulus and in 2010, 2 whales were tested with both KW and CTRL stimuli. The baseline period was defined as the period preceding the start of the KW/CTRL playback experiments and had a duration of 5 h 12 min ± 1 h 49 min s.e.m. ($n = 5$). The three whales tested only with KW stimulus were previously exposed to sonar sounds as part of a parallel project[39]. For these whales, the baseline period was thus the period between the end of sonar exposure and the start of KW/CTRL playback experiments. Stimuli were transmitted using a M-Audio Microtrack II recorder and amplified by a Cadence Z8000 amplifier connected to a Lubell LL9642T underwater loudspeaker (frequency response: 0.2–20 kHz) submerged at a depth of 8 m[46]. To later measure the sound level of the source

and to ensure that sounds were faithfully played back by the system without distortion, playback stimuli were monitored using a calibrated hydrophone (Bruel & Kjaer 8105 amplified by a Bruel & Kjaer 2635 charge amplifier) placed 1 m from the source and recorded using a M-Audio Microtrack II recorder. The sound level of the KW stimuli ranged from 145 to 151 dBrms re 1 μPa (149 ± 1 dBrms re 1 μPa s.d., n = 3 stimuli) which corresponds to the source level of killer whale vocalizations observed in natural conditions[19]. The sound level of CTRL stimuli ranged from 145 to 150 dBrms re 1 μPa (147 ± 2 dBrms re 1 μPa s.d., n = 3 stimuli). After the baseline period during which we collected data on normal behavioural patterns, we waited until the tagged whale came up at the surface to then place the motor boat with the playback source at an approximate distance of 800 m from the tagged whale (713 ± 73 m s.e.m., n = 7 playback trials). At the end of a surfacing phase, the whale raises its flukes prior to diving[29,30]. We started to broadcast a sound stimulus at the end of a surfacing phase, just after fluking. For the two subjects that were first exposed to CTRL stimulus, the KW stimulus was played back after fluking of the next surfacing phase.

Measure of the behavioural response. *Quantification of the change in dive behaviour*. Vertical movements of the tagged animal were analysed using Matlab software (version 7.8.0). During the pre-exposure period (baseline), four sperm whales were conducting deep foraging dives interspersed with short surface periods and few shallow dives close to the surface[29]. For the analysis of the foraging dives, we excluded the shallow dives, i.e. dives with max depth <100 m. One whale was in a resting mode during baseline, performing characteristic resting dives (shallow dives <100 m, 20–30 min duration, no clicking[31]). For all dives performed during baseline and sounds exposure, we measured the dive duration (time from the fluke-up to the following surfacing) and the maximum depth. As an indication of what is a normal dive profile during foraging (n = 4 whales) or resting (n = 1 whale), we calculated for each whale the average of dive duration and max depth for all the dives performed during baseline (9 ± 3 s.d. baseline dives analysed/tagged whale, n = 5). Then, we compared the average baseline to the parameters measured for the dive performed during sound exposure (either KW or CTRL playback).

Quantification of the change in vocal production. Sound files recorded on the D-tags were viewed as spectrograms using Adobe Audition software (Blackman-Harris window; FFT length: 4096; time resolution: 21.3 ms). We identified on spectrograms the production of regular clicks and buzzes (associated with foraging) and codas (associated with socializing behaviour or alarm signalling). For each dive, we summed the duration of regular clicking periods to calculate the proportion of time clicking compared to the total duration of the dive, we scored the number of buzzes, and we monitored whether codas were produced.

Social behaviour. Simultaneously with visual recording of the tagged whales' positions, we scored the group size defined as the number of individuals within 200 m of the focal animal, and the group spacing defined as the distance between individuals in the group[47]. Group size and group spacing were compared between the baseline surfacing phases and the surfacing phase occurring right after the end of a stimulus playback (KW or CTRL).

Change in direction of horizontal movement. Potential changes of direction of horizontal movement were investigated using the visual tracks of the tagged whale recorded before, during and after the playbacks.

Statistical analyses. Statistical analyses were performed using Statistica software (version 6.0; StatSoft 2001). To test for differences in dive duration, max depth, proportion of clicking activity during the dive and number of buzzes between baseline (pre exposure) and KW playback exposure period, we used the non-parametric Wilcoxon matched-pair test suitable for small sample size. The sample size for CTRL playbacks was too small though (n = 2) to conduct the test comparison to baseline. A descriptive analysis was performed to assess production of codas and potential changes in direction of horizontal movement, group size and group spacing.

Ethical statement. All experiments comply with the current laws of the country where they were performed. Animal experiments were carried out with permission from the Norwegian Animal Research Authority (Permit No. S-2007/61201). Protocols were approved by the Animal Welfare and Ethics Committee of the University of St Andrews (AWEC, UK) and the Institutional Animal Care and Use Committee (IACUC) of the Woods Hole Oceanographic Institute (WHOI, USA).

1. Agrawal, A. A. *et al.* Filling key gaps in population and community ecology. *Front. Ecol. Environ.* **5**, 147–152 (2007).
2. Ings, T. C. *et al.* Review: Ecological networks - beyond food webs. *J. Anim. Ecol.* **78**, 253–269 (2009).
3. Golubski, A. J. & Abrams, P. A. Modifying modifiers: what happens when interspecific interactions interact? *J. Anim. Ecol.* **80**, 1097–1108 (2011).
4. Remage-Healey, L., Nowacek, D. P. & Bass, A. H. Dolphin foraging sounds suppress calling and elevate stress hormone levels in a prey species, the Gulf toadfish. *J. Exp. Biol.* **209**, 4444–4451 (2006).
5. Lima, S. L. & Dill, L. M. Behavioural decisions made under the risk of predation: a review and prospectus. *Can. J. Zool.* **68**, 619–640 (1990).
6. Frid, A. & Dill, L. M. Human-caused disturbance stimuli as a form of predation risk. *Cons. Ecol.* **6** (1), 11 (2002).
7. Wirsing, A. J., Heithaus, M. R., Frid, A. & Dill, L. M. Seascapes of fear: Evaluating sublethal predator effects experienced and generated by marine mammals. *Mar. Mamm. Sci.* **24**, 1–15 (2008).
8. Johnson, M. P. & Tyack, P. L. A digital acoustic recording tag for measuring the response of wild marine mammals to sound. *IEEE J. Ocean. Eng.* **28** (1), 3–12 (2003).
9. Weller, D. W. Predation on marine mammals. In *The Encyclopedia of Marine Mammals* (eds. Perrin, W. F., Würsig, B. & Thewissen, J. G. M.) 985–994 (Academic Press, San Diego, 2002).
10. Jefferson, T. A., Stacey, P. J. & Baird, R. W. A review of killer whale interactions with other marine mammals: predation to co-existence. *Mamm. Rev.* **21**, 151–180 (1991).
11. Pitman, R. L., Ballance, L. T., Mesnick, S. I. & Chivers, S. J. Killer whale predation on sperm whales: observations and implications. *Mar. Mamm. Sci.* **17**, 494–507 (2001).
12. Ford, J. K. B. *et al.* Killer whale attacks on minke whales: prey capture and anti-predator tactics. *Mar. Mamm. Sci.* **21**, 603–618 (2005).
13. Ford, J. K. B. & Reeves, R. R. Fight or flight: anti-predator strategies of baleen whales. *Mamm. Rev.* **38** (1), 50–86 (2008).
14. Barrett-Lennard, L. G. & Heise, K. A. The natural history and ecology of killer whales. In *Whales, Whaling and Ocean Ecosystems.* (eds. Estes, J. A., Demaster, D. P., Doak, D. F., Williams, T. M. & Brownell, R. I.) 163–173 (University of California Press, Berkeley, 2006).
15. Whitehead, H. Sperm whales in ocean ecosystems. In *Whales, Whaling and Ocean Ecosystems.* (eds. Estes, J. A., Demaster, D. P., Doak, D. F., Williams, T. M. & Brownell, R. I.) 324–334 (University of California Press, Berkeley, 2006).
16. Reeves, R. R., Berger, J. & Clapham, P. J. Killer whales as predators of large baleen whales and sperm whales. In *Whaling, Oceans and Food Webs.* (ed. Estes, J.) 172–186 (University of California Press, Berkeley, 2007).
17. Whitehead, H. In *Sperm Whales: Social Evolution in the Ocean.* (ed. Whitehead, University of Chicago Press, Chicago, 2003).
18. Whitehead, H. *et al.* Multilevel societies of female sperm whales (*Physeter macrocephalus*) in the Atlantic and Pacific: why are they so different? *Int. J. Primatol.* **33** (5), 993–1001 (2012).
19. Miller, P. J. O. Diversity in sound pressure levels and estimated active space of resident killer whale vocalizations. *J. Comp. Physiol. A.* **192**, 449–459 (2006).
20. Doksæter, L. *et al.* Behavioral responses of herring (*Clupea harengus*) to 1–2 kHz sonar signals and killer whale feeding sounds. *J. Acoust. Soc. Am.* **125**, 554–564 (2009).
21. Sivle, L. D. *et al.* Impact of naval sonar signals on herring (*Clupea harengus*) during summer feeding. *ICES. J. Mar. Sci.* **69** (6), 1–8 (2012).
22. Deecke, V. B., Slater, P. J. B. & Ford, J. K. B. Selective habituation shapes acoustic predator recognition in harbour seals. *Nature* **420**, 171–173 (2002).
23. Cummings, W. C. & Thompson, P. O. Gray whales, *Eschrichtius robustus*, avoid the underwater sounds of killer whales, *Orcinus orca*. *Fish. Bull.* **69**, 525–530 (1971).
24. Fish, J. F. & Vania, J. S. Killer whale, *Orcinus orca*, sounds repel white whales, *Delphinapterus leucas*. *Fish. Bull.* **69**, 531–535 (1971).
25. Tyack, P. L. *et al.* Beaked Whales Respond to Simulated and Actual Navy Sonar. *PLoS ONE* **6**, e17009 (2011).
26. Ridgway, S. H. & Carder, D. Assessing hearing and sound production in cetacean species not available for behavioral audiograms: experience with *Physeter*, *Kogia*, and *Eschrichtius*. *Aquat. Mamm.* **27**, 267–276 (2001).
27. Peake, T. Eavesdropping in communication network. In *Animal Communication Networks* (ed. McGregor, P. K.) 13–37 (Cambridge University Press, New York, 2005).
28. Blanchet, S., Clobert, J. & Danchin, E. The role of public information in ecology and conservation: an emphasis on inadvertent social information. *Ann. NY. Acad. Sci.* **1195**, 149–168 (2010).
29. Watwood, S. L., Miller, P. J. O., Johnson, M., Madsen, P. T. & Tyack, P. L. Deep-diving foraging behaviour of sperm whales (*Physeter macrocephalus*). *J. Anim. Ecol.* **75**, 814–825 (2006).
30. Miller, P. J. O., Johnson, M. P. & Tyack, P. L. Sperm whale behaviour indicates the use of of echolocation click buzzes 'creaks' in prey capture. *Proc. R. Soc. B.* **271**, 2239–2247 (2004).
31. Miller, P. J. O., Aoki, K., Rendell, L. E. & Amano, M. Stereotypical resting behavior of the sperm whale. *Curr. Biol.* **18** (1), R21–R23 (2008).
32. Madsen, P. T. *et al.* Sperm whale sound production studied with ultrasound time/depth-recording tags. *J. Exp. Biol.* **205**, 1899–1906 (2002).
33. Frantzis, A. & Alexiadou, P. Male sperm whale (*Physeter macrocephalus*) coda production and coda-type usage depend on the presence of conspecifics and the behavioural context. *Can. J. Zool.* **86**, 62–75 (2008).
34. Cresswell, W., Butler, S., Whittingham, M. J. & Quinn, J. L. Very short delays prior to escape from potential predators may function efficiently as adaptive risk-assessment periods. *Behaviour* **146**, 795–813 (2009).
35. Nowacek, D. P., Johnson, M. P. & Tyack, P. L. Right whales ignore ships but respond to alarm stimuli. *Proc. R. Soc. B.* **271**, 227–231 (2003).
36. Madsen, P. T. & Mohl, B. Sperm whales (*Physeter catodon*) do not react to sounds from detonators. *J. Acoust. Soc. Am.* **107**, 668–671 (2000).

37. Madsen, P. T., Wahlberg, M. & Møhl, B. Male sperm whale (*Physeter macrocephalus*) acoustics in a high-latitude habitat: implications for echolocation and communication. *Behav. Ecol. Sociobiol.* **53**, 31–41 (2002).
38. Wahlberg, M. The acoustic behaviour of diving sperm whales observed with a hydrophone array. *J. Exp. Mar. Biol. Ecol.* **281**, 53–62 (2002).
39. Kvadsheim, P. *et al.* Cetaceans and naval sonar – the 3S-2009 cruise report. FFI report 2009/01140 (2009). Available: http://rapporter.ffi.no/rapporter/2009/01140.pdf.
40. Miller, P. J. O. *et al.* 3S-2010 Baseline Cruise Report: baseline behavior of long-finned pilot whales and sperm whales (2010).
41. Miller, P. J. O., Shapiro, A. D. & Deecke, V. B. The diving behaviour of mammal eating killer whales (*Orcinus orca* L., 1758): variations with ecological not physiological factors. *Can. J. Zool.* **88**, 1103–1112 (2010).
42. Foote, A. D. & Nystuen, J. A. Variation in call pitch among killer whale ecotypes. *J. Acoust. Soc. Am.* **123**, 1747–1752 (2008).
43. Au, W. W. L. In *The Sonar of Dolphins.* (Springer Verlag, New York, 1993).
44. Au, W. W. L. Nachtigall, P. E. & Pawloski, J. L. Acoustic effects of the ATOC signal (75 Hz, 195 dB) on dolphins and whales. *J. Acoust. Soc. Am.* **101**, 2973–2977 (1997).
45. McGregor, P. K. *et al.* Design of playback experiments. In *Playback and Studies of Animal Communication.* (ed. McGregor, P. K.) 1–9 (Plenum Press, New York, 1992).
46. Curé, C. *et al.* Pilot whales attracted to killer whales sounds: acoustically-mediated interspecific interactions in cetaceans. *PLoS ONE* **7** (12), e52201 (2012).
47. Visser, F., Miller, P. J. O., Lam, F. P., Kvadsheim, P. & Tyack, P. Group behaviour sampling protocol for behavioural response studies. In Kvadsheim, P. *et al.* Behavioural Response Studies of Cetaceans to Naval Sonar Signals in Norwegian Waters - 3S-2011 Cruise Report. FFI-rapport 2011/01289. Available: http://rapporter.ffi.no/rapporter/2011/01289.pdf (2011).

Acknowledgments

Research funding was provided by the US Office of Naval Research, the Royal Norwegian Navy and Ministries of Defence of Norway and the Netherlands. RA was supported by WWF-Norway. CC was supported by Fondation Total and Fondation Bleustein-Blanchet. The authors are grateful to the many researchers and vessel crew members who helped to collect the data. The authors are also grateful to Volker Deecke for providing the D-tag acoustic recordings of killer whale sounds and for his thoughtful comments that improved the manuscript. The authors thank Marie Chalandre for offering her art skills on the whale drawing used in Figure 2.

Author contributions

All authors conducted the experiments and contributed extensively to the collection of the data. P.H.K. and P.J.O.M. are scientific project leaders. C.C. and P.J.O.M. were responsible for the protocol design of the playback experiments. F.V. elaborated the methodology for data collection on group size and group spacing. C.C. prepared the acoustic stimuli, performed the data analyzes and wrote the manuscript.

Additional information

Supplementary information accompanies this paper at http://www.nature.com/scientificreports

Competing financial interests: This study was mainly funded by three naval organizations: the US Office of Naval Research, the Norwegian Ministry of Defence and the Netherlands Ministry of Defence. In addition, WWF-Norway, Fondation TOTAL and the Fondation Bleustein-Blanchet also contributed financially. The funders had no role in study design, data analysis, or preparation of the manuscript. Authors are employed by government (Norwegian Defence Research Establishment), independent no-profit (Netherlands Organization for Applied Scientific Research and Kelp Marine Research), or academic (University of St. Andrews) research organizations. No authors are employed by naval organizations.

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How to cite this article: Curé, C. *et al.* Responses of male sperm whales (*Physeter macrocephalus*) to killer whale sounds: implications for anti-predator strategies. *Sci. Rep.* **3**, 1579; DOI:10.1038/srep01579 (2013).

Potential Impacts of Seismic Energy on Snow Crab

Background

On October 20, 2000, the Canada Nova Scotia Offshore Petroleum Board (CNSOPB) received a directive from the federal and provincial energy ministers to conduct a Public Review on the effects of potential oil and gas exploration and drilling activities off the coast of Cape Breton. In order to provide scientific information to the commissioner, DFO scientists reviewed a series of working papers at a meeting of the Maritimes Regional Advisory Process (RAP) in 2001 (DFO Maritime Provinces Regional Habitat Status Report 2001/001).

This meeting concluded that there was a lack of information on the potential impacts of seismic activities on snow crab, specifically:

- *Acute mortality of eggs, larvae, juveniles, adolescents and adult males and females.*
- *Physiological impacts including structural damage to hearing, digestive and reproductive organs, the respiratory system, digestive tracts and embryos and functional damage to hearing and communicating capacity and the capacity of molting, feeding and hatching.*
- *Abnormal behaviour during mating or molting.*
- *Movement and migration during all life stages.*
- *Impact on catch rate in the fishery.*

The RAP also concluded that the area of interest off the west coast of Cape Breton is the location of a large and economically important snow crab fishery and an important area for larval settlement. All benthic phases and size groups of snow crab inhabit the area of interest and there are high landings and catch per unit of effort in the fishery.

In March 2003, DFO organized a workshop to produce an inventory of ecological factors that should be considered when dealing with referrals for seismic surveys in Canadian waters (DFO National Capital Region Habitat Status Report 2004/002). Some highlights from this report include:

- *Information is lacking to evaluate the likelihood of sub-lethal or physiological effects on crustaceans during pre-molt, molting and post-molt periods.*
- *The ecological significance of the effects is expected to be low, except if effects of exposure to seismic sounds were to influence reproductive or growth activities.*
- *The potential for seismic sound to disrupt communication, orientation, detection of predator/prey, locomotion and other functional uses of sound has not been studied.*

In recognition of the stated lack of knowledge on the potential effects of seismic activities on the health of the resident snow crab populations in Atlantic Canada, the Environmental Studies Research Fund (ESRF) funded a scientific study on the effects of seismic energy on snow crab (Chionoecetes opilio). The results of this preliminary study suggested no obvious effects on adult crab behaviour, health or catch rates (Christian et al., 2003). However, some uncertainty remained as the eggs of one female showed significant effects on development when exposed to seismic signals at a very close range (2 m).

In November 2003, the CNSOPB granted a permit to industry to conduct a seismic survey off the western coast of Cape Breton Island, Nova Scotia. DFO formed a partnership with CNSOPB, NS Department of Energy, Area 19 Snow Crab Fishermen's Association and Corridor Resources Inc. to conduct a collaborative study on the potential impacts of seismic energy on the reproductive biology of female snow crab. DFO's role was 1) to augment industry's regulatory compliance monitoring program based on sound-field measurements and 2) to expand the crab studies beyond a repeat of the preliminary study parameters undertaken by Christian et al. (2003) by adding a comprehensive cage-study design. The sources of funding, including in-kind contributions, are provided below:

Corridor Resources	*$170,000*
(field support and sound propagation studies)	
NS Dept of Energy	*$42,500*
DFO	*$223,500*
(logistical support, salary and partnership contribution to St. Francis Xavier U.)	
ESRF	*$100,000*
(field support – spring program)	
Total	*$536,000*

Summary

1. There were three definitive observations:
   - This seismic survey did not cause any acute or mid-term mortality of the crab, nor was there any evidence of changes to feeding in the laboratory.
   - Survival of embryos being carried by female crabs, and locomotion of the resulting larvae after hatch, were unaffected by the seismic survey.
   - In the short term, gills, antennules and statocysts (balance organs) were soiled in the test group but they were found to be completely cleaned of sediment when sampled five months later.

2. There were several significant differences between experimental results of test and control groups, even after five months. It was not known if these differences were due to environmental differences between the test and control sites. As a consequence, nothing definitive could be said about the results until further work is done:
   - The hepatopancreas (similar function to a liver) was found to be bruised in the test site.
   - Ovaries from animals at the test site were found to be bruised and had dilated oocytes with detached chorions (the outer membrane).
   - In one test group, embryo hatch was delayed by 5 days on average and resulting larvae were slightly smaller than controls.
   - Orientation (turnover rate), as measured by the time an overturned crab needs to right itself, was different between the test and control groups.

3. This experiment was the first of its kind in the world to test the potential impact of seismic exposure on snow crabs and it demonstrated the importance of careful experimental design and the type of work required in conjunction with future seismic surveys.

Introduction

On September 29, 2004 a scientific peer review was completed on the results of experiments designed to study the potential impacts of seismic energy on snow crab. This review evaluated the results from a preliminary study on the potential impact of low-level seismic energy (132 hours of survey time, low-volume 1,310 in^3 air-gun array) on the reproductive biology of female snow crab. The study included caging and laboratory experiments conducted in winter 2003 and spring 2004. The caging experiment was conducted at the location of potential hydrocarbon deposits off the western coast of Cape Breton. It also bordered the site of one of the highest concentrations of snow crab in the world. The caging experiment examined short (12 days) and medium (5 months) term differences in the morphology and physiology of snow crab at test and control sites. Snow crabs from both groups were also observed under laboratory conditions for differences in mortality, morphology, physiology, feeding and orientation (turnover rate) over a five month period.

The study was organized on short notice to take advantage of an operational seismic survey in late 2003. It was developed by a partnership with Corridor Resources, Area 19 snow crab fishermen, CNSOPB, NS Dept. of Energy and DFO. The study was preliminary because it was designed to reveal observations or issues that would merit more detailed investigation. The study was designed to accompany a seismic survey in late 2003 and because of the short preparation time, there were constraints on its scope and the amount of resources available. As a result it was decided to focus the study entirely at one test and control site and because of concerns about reproduction, on the same type of mature female snow crab.

It is important to note that the test and control sites were quite different in temperature, substrate and food availability, which made it difficult to clearly interpret the results. The test site was colder, shallower and may have had sediments with elevated levels of organic

material when compared to the control site. Temperature is an important variable controlling metabolism and healing of marine animals. In addition, it appeared that snow crab placed at the control site were slightly larger than crab at the test site despite both groups originating from the same place and time.

Finally, animals in the short- and medium-term experiments received different exposures of seismic energy. Forty-two hours of seismic testing were done after retrieving animals for the short-term experiments.

Responses to the Questions

1. Is there evidence from this study that indicates irreversible harm (including death) to female snow crab caused by these seismic operations?

- There were no significant differences in mortality between the test and control groups.
- In one of the four laboratory studies, observations of greater leg loss within the seismic test group may be linked to other causes such as conditions of transport.

2. Is there evidence from this study that seismic energy produced mortality or morbidity in female snow crab carrying eggs?

- There was no evidence of mortality or morbidity in the test group.

3. Is there evidence from this study that seismic energy produced long-term effects on the behaviour of female snow crab?

- This study was unable to adequately address this question, except there was a trend towards faster turnover rates in seismic-exposed crab.
- Over several months of observations in the laboratory, there was no difference in food consumption between test and control animals.

4. Is there evidence from this study that seismic energy produced long-term effects on the characteristics and morphology of gills and internal organs of female snow crab?

- There were differences between test and control groups in the characteristics of antennules, statocysts, gills, hepatopancreas and ovaries.
- Animals at the test site were found to have sediment (associated with organic material) in the antennules, statocysts and gills but they were clean when examined five months later.
- In the test group, there were changes in the cellular structure of the hepatopancreas consistent with a response to stress in both short- (12 days) and medium- (5 months) term conditions. It is not known if the noted differences were related to dissimilarity of control and exposed samples and/or different holding conditions in the environment instead of seismic exposure per se.
- There were abnormalities and some hemorrhaging in the ovaries of the test group. In addition, the mean diameters of oocytes from this group were also larger due to dilation. The cause is not known: see statement above.
- In terms of metabolic indices, levels of enzymes in the haemolymph (blood) were comparable between the seismic and control groups, suggesting no major cellular damage to organs like the hepatopancreas for fed animals kept in laboratory conditions.

5. Is there evidence from this study that seismic energy produced effects on the hatch of embryos carried by exposed female snow crab and subsequent morphology and locomotion of larvae?

- The rates of embryo survival to hatch were similar between the two groups.
- Embryo development within animals recovered from the vicinity of the seismic site appeared to be delayed. Furthermore, the larvae from the seismic site were smaller and had proportionally (to body size) smaller spines and eyes than the control larvae. This observation may be caused by environmental factors, such as temperature differences. In addition, 45

crab retrieved after 12 days from test and control groups were observed in the laboratory for differences in time to hatch and none were noted. In fact larvae from the test group appeared two days before those from the control group.

- There were no differences observed in swimming behaviour of larvae hatched from the two sites.

6. What further research would be useful, if any?

There are a number of short-term research initiatives that would help clarify the results:

- Biomass surveys were conducted both before and after the seismic survey. These surveys should be examined for changes in abundance of different categories of snow crab to see if there was any evidence of elevated natural mortality or redistribution. In addition densities of caged animals and wild animals should be compared.
- It would be helpful to summarize observations of egg loss for laboratory studies where possible and this information needs to be corrected for parental size because larger females produce more eggs.
- There was some evidence of bruising in gills of test animals and these observations should be completed for all test and control animals.
- Measurements of background or ambient sound were taken prior to the seismic testing and this information should be summarized.
- Information on leg loss should be summarized for all laboratory studies.
- Sediment from the test and control sites should be compared.
- An additional study was conducted in May 2004 to examine the dragging of cages during their retrieval and its impact on sediment observed in gills, statocysts and antennules. This work should be summarized.
- There were concerns that some of the observations could be related to size of animals. Thus a smaller subset of comparisons could be done with the same-sized animals for test and control observations.

This experiment was the first of its kind in the world and revealed the importance of careful experimental design and the value of continuing this type of work in conjunction with future seismic surveys. Examples of the type of work that would be helpful are:

- Baseline animals should be examined at test and control sites before any experiments are done.
- Video monitoring of snow crab behaviour in the field would be very helpful. Note that there were limited behavioural observations in the current study.
- It would be helpful to examine different categories of animals. For example the multiparous females (females carrying eggs that are not their first batch) examined in this study may not necessarily be the most sensitive stage.
- Future field work should include multiple control and test sites.
- Laboratory studies should be conducted under blind or double-blind conditions to ensure that there is no bias or observation error.
- It would be useful to understand how sound affects animals, i.e. sound pressure or motion of particles. It remains to be determined if seismic noise causes stress and if snow crab can actually hear the seismic signals.
- It would be useful to examine expected worst-case scenarios under controlled conditions. The advantage of lab study is that signal and exposure can be controlled precisely and a whole range of behavioural and physiological questions could be asked that are difficult or impossible to address in the field.
- It would be useful to examine other parts of the benthic community for potential impacts.
- Future work should examine effects of exposure to seismic signals when animals are buried in the sediment because signal levels may be higher in the substrate than the water column. The caging experiments did not allow animals to bury themselves.

- Future work should ensure that animals receive the maximum exposure to seismic energy that they are likely to encounter and the experiment should measure ambient and cumulative exposure to sound, including peak sound levels (RMS) and sound exposure levels (SEL).
- Future field experiments should include observations for longer time periods, up to one year to assess if there are long-term effects and/or recovery.
- It would be useful to examine exposure-distance relationships for the effects on egg development.
- Finally, it is important that information on potential impacts of seismic energy be communicated to other scientists working on these questions in other parts of Canada and globally.

7. How applicable are the results and conclusions of this study to other crustacean species (e.g. other crab species and lobster)?

- This work is very helpful because snow crab is a species that lives closely associated with fine bottom sediments and there are very few studies on the potential impact of seismic energy on substrate dwelling animals.
- Observations on larvae may be applicable to other animals with this life-history stage, such as other crab species and lobster.
- The questions and experiments raised by this study will help to guide future work.

References

DFO, 2001. Description of the Southern Gulf pf St. Lawrence and Sydney Bight Marien Ecosystems in Relation to Oil and Gas Exploration. DFO Maritime Provinces Regional Habitat Status Report 2001/01.

DFO, 2004. Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. DFO Can. Sc. Advis. Sec. Habitat Status Report 2004/002.

Christian, J.R., A. Mathieu, D.H. Thompson, D. White, and R. Buchanan. 2003. Effect of Seismic Energy on Snow Crab (*Chionoecetes opilio*). Environmental Research Funds Project No. 144. Calgary, 106 p.

For more Information

Contact:

Michael Chadwick
Oceans and Science Branch
Fisheries and Oceans Canada
343 Université Avenue
Moncton, NB
E1C 9B6

Tel: (506) 851-6206
Fax: (506) 851-2387
E-mail: chadwickm@dfo-mpo.gc.ca

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Fisheries and Oceans Canada
P.O. Box 1006, Stn. B203
Dartmouth, Nova Scotia
Canada B2Y 4A2

Phone number: 902-426-7070
Fax Number: 902-326-5435
e-mail address: myrav@mar.dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

ISSN 1708-6272 (printed)
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La version française est disponible à l'adresse ci-dessus.

Correct citation for this publication

DFO, 2004. Potential Impacts of Seismic Energy on Snow Crab. DFO Can. Sci. Advis. Sec. Habitat Status Report 2004/003.

Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences

National Capital Region **Habitat Status Report 2004/002**

Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals

Background

A Workshop to develop a "Decision Framework for Seismic Survey Referrals" held in March 2003 produced an inventory of ecological factors that DFO should consider when dealing with referrals for seismic surveys in Canadian waters. The workshop also discussed the sources of uncertainty about effects of seismic sounds on those ecological factors, and ways that the uncertainty could be presented in science documents evaluating possible impacts. The workshop did not attempt to review critically the scientific literature on impacts of seismic sounds or effectiveness of mitigation options. Consequently the meeting did not address tolerances for ecological impacts, if any, or operational standards for respecting such tolerances.

Following that Workshop, teams of scientists prepared major literature reviews of the primary and secondary literature that reports on experimental studies and field monitoring of effects of sound, particularly seismic sound, on marine organisms. Reviews were also contracted of the standards and mitigation methods applied by other national and international bodies which regulate seismic surveys in marine ecosystems, and of the strengths and problems with various sound propagation models in marine environments. These papers were reviewed at a National Advisory Process meeting on Seismic Impact Evaluation Framework in May 2004, although time did not allow a detailed critical review of the paper on standards and mitigation methods.



Figure 1: Map of Canada

Summary

- From the evidence available, it can be concluded that seismic sounds in the marine environment are neither completely without consequences nor are they certain to result in serious and irreversible harm to the environment. In the huge range of effects between those extremes, however there are many *potential* detrimental consequences. In general risks of these consequences are poorly quantified, often unknown, and likely to be variable with both conditions of the environment and of the organisms exposed to the sounds. The long and widespread history of seismic surveys globally in marine environments with no documented fish or invertebrate kills, and only circumstantial evidence of associations with infrequent strandings of marine mammals and giant squid, suggest that seismic surveys with fairly routine mitigation measures in place are unlikely to pose high risk of mortality of marine organisms. However, this suggestion must be qualified, because sublethal or longer-term effects could have occurred and not have been detected by the monitoring programs typically in place.

- Immediate behavioral reactions to exposure to seismic sound have been widely documented in marine organisms, especially marine mammals; particularly behaviors which would result in avoiding the immediate area where the sounds are being produced, or reducing vocalisations. The possible longer-term consequences of these short-term behavioral changes are debated among experts. The debate is largely speculative and there is little empirical basis to determine the likelihood of the full chain of events which would lead to serious longer-term consequences of the short-term behavioral reactions. However, the risk to be managed would be the combined probability of all the events in the chain occurring.

- Whatever the absolute level of risk posed by seismic sounds, there are mitigation measures available which the evidence available suggests can reduce the risk by varying, but sometimes substantial, amounts. The effectiveness of specific mitigation measures was not reviewed in detail at the meeting, but was generally agreed likely to depend on the effect of concern and how the measures are implemented. The impact on the seismic operations of application of some mitigation methods, such as not conducting surveys in critical times and places, will also vary with many factors, but sometimes also could be large. Clearly much more research and monitoring are needed to better clarify and quantify the unknown risks and uncertain effects, if they occur, and the effectiveness of mitigation measures to a wider range of potential effects. Towards that end, some key research needs are listed below.

Introduction

Literature reviews of the primary and secondary literature that reports on experimental studies and field monitoring of effects of sound, particularly seismic sound, on marine organisms were evaluated in May 2004, by a group of scientists from DFO, other federal and international agencies, the hydrocarbon exploration industry and environmental groups. The review indicated that information was incomplete to varying degrees in essentially all areas related to impacts of seismic sound on marine ecosystems. Nonetheless, the background papers and scientific deliberations resulted in a body of information that allowed the following conclusions to be reached.

These conclusions provide a science basis for developing a regulatory framework for use of sound in aquatic environments, at least in the frequencies used for seismic surveys. Some of the conclusions based on the laboratory studies reviewed may generalise to higher frequencies as well, but the review focused on scientific studies directly applicable to seismic sound. The conclusions also contribute to the scientific basis for an integrated approach to managing human impacts on marine ecosystems, and for dealing with referrals of applications for seismic surveys at the regional to national level within DFO.

Habitat Concern

The issue of concern was the effects of sound, particularly seismic sound, on marine organisms. Advice was sought to provide a scientific basis for developing a regulatory framework for use of sound in aquatic environments, at least in the frequencies used for seismic surveys.

Management Considerations

Overall Considerations:

1) The following statements and conclusions are based on information available and presented at the time of the Seismic Impacts Evaluation Framework workshop. Additional research is needed in many areas, and a number of these are identified in the meeting proceedings. These statements and conclusions

should be re-evaluated as new information becomes available.

2) When considering the possible impacts of seismic sounds on the marine ecosystem, it makes sense to embed these considerations within the larger framework of the impact of all anthropogenic noise on the ecosystem. The major anthropogenic sources of noise that might be appropriate to consider in a holistic view would include seismic sounds, shipping, explosives, construction, and low-frequency SONAR. Moreover, the significance of impacts of sound in the environment, if any, should be evaluated in the context of other uses of ecosystem.

3) The dearth of scientific information, especially concerning field experiments on fish, invertebrates, and the larger marine mammals, makes it extremely difficult to evaluate the impact of a particular type of seismic sound, or more generally noise, on a particular species. Restricting our consideration to only seismic sound impacts would have reduced the already-sparse information base to one that would not have supported any conclusions with an acceptable level of confidence, so we have looked more widely for relevant information.

4) If was not just for convenience that we looked for information more widely than just considering publications on effects of seismic sound on marine species. Given the scarcity of hard information on so many facets of this multi-dimensional problem, it is likely that a meaningful appreciation of risk can only be obtained by taking an integrated view of all the sources of information available.

5) Many conclusions refer to the likelihood of various biological effects, if animals were exposed to seismic sound. Likelihood is used in a relative sense, and not as the product of quantitative risk assessments, which are not possible with the information available. Saying that an event has a "high likelihood" does not mean we necessarily expect to see it in nine out of every ten animals exposed to the sound, or even in nine out of ten replicates of the same experiment. Rather, it means that compared to the expectation of the event in the absence of seismic sound, the likelihood of the event has increased substantially, and it would be observed if sought with due diligence. However, it still may not be the typical event. Where quantification of the probability of an event is possible, we use the term "probability" rather than "likelihood".

6) The conclusions that follow often refer to "seismic sound" and "field operating conditions". These terms are used colloquially and are not defined prescriptively. In this document "seismic sound" refers generally to that produced by the types of airguns and arrays normally used at present in Canadian waters. "Field operating conditions" refers to 2-D and 3-D seismic surveys using measures such as ramp-up of sound level at onset, and ceasing sound emissions when cetaceans are known to be in the proximity of the operations.

7) Both the likelihood and severity of biological effects that may result from seismic surveys are likely to vary with local conditions of the environment (ice coverage, bottom topography, sea state, etc.) and conditions of the organisms (breeding state, nutritive condition, etc.). These conditions should not be ignored when evaluating risks and the potential for mitigation, however regulatory frameworks do not need complex rules to be effective.

Limitations for quantitative conclusions:

8) It was agreed that the biologically meaningful aspect of seismic sound is the "received sound" by the organism(s) potentially being affected. However, "received sound" is multi-dimensional. Seismic sound (or noise in general) can

be characterised by its frequency spectrum (acoustic energy or pressure as a function of acoustic frequencies), peak pressure (a time domain concept, referring to the maximum instantaneous amplitude of the pressure signal), rms pressure (mean pressure averages over a time interval), Sound Exposure Level (a measure of the "dosage" of sound energy received over a time interval), and in other ways.

9) The mechanisms by which exposure to seismic sound could result in biological impacts are sufficiently varied that no one metric may be sufficient to describe the risk of impact from a particular type of seismic sound. Some mechanisms may be well characterised by one or two of these metrics; others may not be well characterised by any of them. For example, peak pressure may be the most relevant parameter for risk of trauma, whereas rms pressure may be the most relevant parameter for non-trauma effects such as Temporary Threshold Shifts [TTS]. The frequency band, intensity, and duration of exposure all contribute to auditory effects, because although the impact must occur within the frequency band of exposure, we anticipate that auditory impact is greater within the hearing range of a species, and will decline towards the margins of its hearing threshold.

10) Many studies of the impacts of seismic sound on marine animals reduce the information about the sound used or received to a few numbers. This practice often discards important information, and makes inter-comparison of results across studies very difficult.

11) Although careful experimentation ought to be able to determine which feature(s) of the sound stimulus caused the observed reactions (when they occurred), the existing literature on experiments with marine fish and invertebrates rarely describes completely enough the characteristics of the sounds used to allow biological observations to be interpreted with confidence.

12) The literature on experiments and field observations of marine mammals exposed to sound stimuli is more extensive than the literature on effects on other types of marine organisms, and therefore likely to provide a more complete (but still partial) basis for setting thresholds. However the results, taken together, were complex and inconsistent and were an insufficient basis for agreement on quantitative thresholds for impacts on marine mammals, even from those studies where there were adequate descriptions of the sound characteristics. The major review by the NMFS Acoustic Criteria Panel is devoting much more time to this information, and may contain a quantitative synthesis of stimulus-response relationships from the information available at present. That review, when released, may comprise a useful source of information for defining regulatory tolerances. Where sensitivities of marine turtles, fish, or invertebrates are documented to be greater than sensitivities of marine mammals those factors should be taken into account in the Canada standards, guidelines and/or regulations. It was conjectured that sedentary species that cannot leave an area may experience higher levels of exposure to seismic sound than mobile animals, and this factor may be taken into account in management as well.

13) Ecological "significance" can be a value-laden term, although in these conclusions "significant" is used only in the context of DFO's areas of responsibility. Specifically, DFO has a responsibility for conservation of aquatic species (except birds) and ecosystems, and where detrimental population-scale impacts are considered likely, DFO must ensure that the impacts are mitigated or remediated. Likewise, for aquatic species protected under Schedule 1 of SARA, if deaths, harm or harassment of individuals is considered likely to occur, DFO must

either act to ensure the impacts are ameliorated, or issue permits under the provisions of Section 73 of SARA.

Other limitations:

14) A number of studies reported sub-lethal effects on marine organisms, such as elevated stress-related chemicals, and damage to ears or other morphological structures. The dearth of long-term studies of marine organisms exposed to seismic sounds means that the long-term consequences of these effects, when they occur, are unknown.

15) The severity of impact at the population level may be higher for an effect like auditory masking, if it occurs, because masking has the potential to affect a very large geographical area for low frequency sounds. Masking also may have few immediately observable signs that impacts are occurring, so mitigation may be less likely to be triggered than with individual mortalities due to trauma, (which have limited geographical extent and are more easily observable).

Conclusions Regarding Fish

Physical Effects

1) There are no documented cases of fish mortality upon exposure to seismic sound under field operating conditions. With regard to the detectability of fish kills, if they occurred, it was noted that in Canada seismic surveys have frequently, but not always, included follow-on vessels instructed to watch for fish kills, and none have been observed. It was also noted that fish kills are not necessarily cryptic events, and kills caused by anoxic events, toxic spills etc are often readily detected. However, it was also argued that the efficiency of detecting fish kills by the follow-on vessels was not tested independently, so the possibility of undetected fish kills cannot be eliminated.

2) Under experimental conditions one study found that some subjects from three of four species tested suffered lethal effects from low-frequency (<500 Hz) tonal sounds, under exposure levels of 24 h at >170 dB. Participants noted that the experimental regime differed greatly from field operating conditions of seismic surveys, so extrapolation of the results to seismic surveys was not warranted. However some participants argued that the result indicates that risk of direct fish mortality from sounds with some characteristics of seismic sound cannot be discounted completely.

3) One anecdotal report of fish mortality upon exposure to an airgun less than 2 m away was discussed and found to be inconclusive when considered relative to field operating conditions. Overall, exposure to seismic sound is considered *unlikely* to result in direct fish mortality.

4) Under experimental conditions, sub-lethal and/or physiological effects, including effects on hearing, have sometimes been observed in fish exposed to an airgun. The experimental design made it impossible to determine to the satisfaction of all experts what intensity of sound was responsible for the observed damage to ear structures, nor the biological significance of the damage that was observed. Simulated field experiments attempting to study such effects have been inconclusive. Currently, information is inadequate to evaluate the likelihood of sub-lethal or physiological effects under field operating conditions. The ecological significance of sub-lethal or physiological effects, were they occur, could range from trivial to important depending on their nature.

Behavioral Effects

5) There is high likelihood of obtaining the following effects in some fish exposed to seismic sound:

   - startle response,

- change in swimming patterns (potentially including change in swimming speed, and directional orientation), and
- change in vertical distribution.

6) These effects are expected to be short-term, with duration of effect less than or equal to the duration of exposure, are expected to vary between species and individuals, and be dependant on properties of received sound. The ecological significance of such effects is expected to be low, except where they influence reproductive activity.

7) Several scientific studies have investigated other behavioral effects on fish during seismic surveys. Some have found the effects listed below and some have not:

- Change in horizontal distribution of fish not closely associated with habitat structures such as a reefs or pinnacles,
- Change in catchability of fish possibly related to changes in behavior. Differences in experimental regimes and lack of adequate controls in some of the experiments means that the published results are an insufficient basis to predict the nature of any change that may occur, or even if a change will occur.

8) The duration of these effects may or may not extend beyond the duration of exposure, are expected to vary between species and individuals, and be dependant on the properties of received sound. The ecological significance of such effects is expected to be low, except when they may lead to a dispersion of spawning aggregations or deflection from migration paths. The magnitude of effect in these cases will depend on the biology of the species and the extent of the dispersion or deflection.

Functional Uses of Sound

9) The potential for seismic sound to disrupt communication, detection of predators/prey, navigation and other functional uses of sound by fish has not been studied. There is speculation that the discontinuous nature of seismic signals may allow these functions to occur between sound "pulses". There is also speculation that behavioral responses may include cessation of sound production by fish. If it were to occur, hearing damage would also be expected to impact these functions. Ecological significance of such effects is unknown.

Conclusions Regarding Invertebrates

Physical Effects

1) There are no documented cases of invertebrate mortality upon exposure to seismic sound under field operating conditions. An anecdotal report of beachings of giant squid on two occasions, which corresponded to periods of seismic activity, was discussed and found to be inconclusive.

2) Under experimental conditions, lethal and/or sub-lethal effects, including effects on external structure, have sometimes been observed in invertebrates exposed close to (less than 5 m) an airgun.

3) Therefore, exposure to seismic sound is considered *unlikely* to result in direct invertebrate mortality.

Physiological Effects

4) There is a series of publications showing effects of extended exposure to non-seismic sounds on the physiology of crustacean under experimental conditions. Effects include reduced growth and reproduction rates and behavioral changes, which indicate the

sensitivity of some invertebrates to noise. In a gastropod (mollusc) the physiological effects (sign of stress) were reported under field seismic operating conditions. In other species such effects were rarely present, except for some sign of excitation of ensonified crabs compared to control crabs.

5) Currently, information is lacking to evaluate the likelihood of sub-lethal or physiological effects on crustaceans during pre-molt, molting and post-molt periods.

6) The ecological significance of sub-lethal or physiological effects, were they occur, could range from trivial to important depending on their nature.

Behavioral Effects

7) There is high likelihood of obtaining the following effects in some invertebrates exposed to seismic sound:

   - startle response,
   - change in swimming/movement patterns (potentially including change in swimming/movement speed, and directional orientation).

8) Both increases and decreases in catch rates of commercially exploited species have been documented, but changes do not occur consistently.

9) These effects are expected to be short-term, with duration of effect often less than the duration of exposure, are expected to vary between species and individuals, and be dependent on properties of received sound.

10) Some invertebrates are sedentary or have limited locomotive capacity. Therefore their capacity to avoid seismic sound is extremely limited compared to many fish and marine mammals. This may increase their exposure to seismic sounds, but there is no basis on which to assume that increased exposure makes such species inherently more or less sensitive to those sounds.

11) The ecological significance of the effects is expected to be low, except if effects of exposure to seismic sounds were to influence reproductive or growth (molting) activities, or lead to a dispersion of spawning aggregations or deflection from migration paths. The magnitude of effect in these cases will depend on the biology of the species and the extent of the dispersion or deflection.

Functional Uses of Sound

12) The potential for seismic sound to disrupt communication, orientation, detection of predators/prey, locomotion and other functional uses of sound by invertebrates has not been studied. Loud sounds will reduce the efficiency of communication and other functional uses of sounds, but the severity and conditions under which this occurs with invertebrates are unknown. It is not known if invertebrates can communicate acoustically during the inter-pulse intervals that occur between seismic transmissions. Ecological significance of such effects, if they occur, is unknown.

Conclusions about Zooplankton, Eggs and Larvae of Fish and Invertebrates

1) Few studies of the effects of seismic sound on eggs and larvae or on zooplankton were found. A number of these provided inadequate description of experiment design, properties of the sound applied as treatments, or had methodological shortcomings.

2) Data are generally insufficient to evaluate the potential damage to eggs and larvae of fish and shellfish (or other planktonic organisms) that might be caused by seismic sound under field operating conditions.

3) From the experiments reported to date, results do show that exposure to sound may arrest development of eggs, and cause developmental anomalies in a small proportion of exposed eggs and/or larvae; however these results occurred at numbers of exposures much higher than are likely to occur during field operation conditions, and at sound intensities that only occur within a few meters of the sound source.

4) Effects of seismic sounds on behavioral functions and sensory perception of fish and invertebrate eggs and larvae are unknown;

5) In general, the magnitude of mortality of eggs or larvae that models predict could result from exposure to seismic sound would be far below that which would be expected to affect populations. However, special life history characteristics such as extreme patchiness in distribution and timing of key life history events in relation to the duration and coverage of seismic surveys may require case by case assessment.

6) No studies were found which specifically investigated the role of seismic sounds in recruitment variation of marine fish or invertebrates. There have been a large number of research studies on causes of variation in recruitment of marine fish or invertebrates, and none has considered that there are recruitment anomalies (positive or negative) which might be linked in space or time to seismic survey operations. This negative evidence applies at the scale of stocks, but does not provide information about the potential for effects on local-scale recruitment dynamics.

Conclusions Regarding Marine Turtles

1) Auditory studies suggest that sea turtles, specifically loggerhead and green turtles, are able to hear and respond to low frequency sound, but their hearing threshold appears to be high.

2) In three studies, the following behavioral responses of sea turtles in enclosures exposed to airgun sounds were sometimes observed:

   - increased swimming speed,
   - increased activity,
   - change in swimming direction, and
   - avoidance.

3) Sea turtles may become accustomed to seismic sound over time, but results of three studies were inconclusive on this matter.

4) Loss of hearing sensitivity and physiological stress response has also been considered as a possible consequence of exposure of sea turtles to seismic sound, but the one study reviewed was inconclusive.

5) The response, if any, of free-ranging sea turtles to seismic sound conducted under field operating conditions is unknown.

6) Based on studies that have been conducted to date, it is considered *unlikely* that sea turtles are more sensitive to seismic operations than cetaceans or some fish. Therefore, mitigation measures designed to reduce risk or severity of exposure of cetaceans to seismic sounds may be informative about measures to reduce risk or severity of exposure of sea turtles to seismic sounds. However sea turtles are harder to detect both visually and acoustically than are many species of cetaceans, so mitigation strategies based on sightings or acoustic detection of turtles, are expected to be less effective for turtles than for cetaceans.

Conclusions Regarding Marine Mammals

Mortality and Physical Effects

1. There are no documented cases of marine mammal mortality upon exposure to oil and gas exploration seismic surveys. There is one case of a stranding event involving two whales coincident in space and time with a research vessel conducting seismic operations. There is one stranding event involving the same vessel and whales, coincident in time but not space, with no obvious mechanism that could bridge the distance between the vessel and the stranding site. In both cases the research vessel was also operating mid-frequency airgun systems that produce sound significantly more similar in character to the tactical mid-frequency sonar implicated in whale mass stranding events, than is seismic sound. The role of the different sound sources in the stranding events could not be resolved by the study. Therefore, although whale strandings have been linked to exposure to anthropogenic sound, exposure to seismic sound is considered *unlikely* to cause direct marine mammal mortality.

2. Under experimental conditions, sub-lethal, temporary elevations in hearing thresholds (TTS) have sometimes been observed in captive marine mammals exposed to pulsed sounds. Currently, the likelihood of these effects have not been evaluated under field operating conditions; for some species of marine mammals the levels and types of sounds which may produce TTS can be predicted, so such evaluations may be possible. The significance of such TTS effects, were they occur, are likely to be unimportant, unless:

    a. the threshold was elevated repeatedly or for an extended period of time, which could result in a Permanent Threshold Shift [PTS]; or

    b. other threats were present at the same time as the temporary elevations in hearing thresholds, and the threats were ones normally avoided by acoustic means, such as predators or entanglements in fishing gear.

3. There are no documented cases of a marine mammal experiencing damage to non-auditory body tissues upon exposure to seismic surveys under field operating conditions. Therefore, exposure to seismic sound under field operating conditions is considered *unlikely* to result in such types of tissue damage to marine mammals, but the presence of other sound sources operating simultaneously with seismic operations should be taken into account when proposals are evaluated.

Direct Behavioral Effects

<u>Displacement and Migratory Diversion:</u>

4) There is documented displacement and migratory diversion in some marine mammal species exposed to seismic sound. The duration of these effects may or may not extend beyond the duration of exposure. The effects are expected to vary between contexts, species, gender and age class, and individuals, and be dependant on the properties of received sound. The ecological significance of such effects is expected to be low, but may be higher if they:

- displace feeding marine mammals from areas where there are no alternates,
- displace marine mammals from resting areas where there are no alternates,
- displace marine mammals from breeding or nursery areas, or
- divert migrating animals from routes for which their alternate routes either do not exist or would incur substantially greater costs to traverse.

5) The magnitude of effect in these cases will depend on the biology of the species and the extent and duration of the dispersion or deflection. Also, there is a risk that a seismic project occurring in another area could cause incursion of displaced competitors into the critical habitat or area of high biological productivity occupied by other species.

6) In summary, exposure to seismic sound can result in displacement and/or migratory diversion in some marine mammals, but this effect is species, individual, and contextually-related. The ecological significance of such effects is *unknown*, but there are conditions under which the worst-case scenarios could be high.

Changes in Dive and Respiratory Patterns

7) There are documented changes in dive and respiratory patterns in some marine mammal species (e.g., bowhead whales, harbour and grey seals) exposed to seismic sound. There are records of the duration of these effects extending beyond the duration of exposure. The effects are expected to vary between contexts, species and individuals, and be dependant on the properties of received sound. The ecological significance of such effects is expected to be low, except if such effects:

   - interfere with feeding, or
   - incur substantial energetic costs;

   The magnitude of effect in these cases will depend on the biology of the species and the extent and duration of the dispersion or deflection.

8) In summary, exposure to seismic sound can result in changes in dive and respiratory patterns in some marine mammals, but this effect is expected to vary with species, individual, and context. The ecological significance of such effects is *unknown*, but there are conditions under which the worst-case scenarios could be high.

Changes in Social Behavior

9) Social behavior can include a wide variety of activities such as mating, cooperative feeding, play, aggressive interactions, and communication (see below). Studies of behavioral changes in other subsections of this summary describe effects on some of the activities that could be considered "social". However, there have been no directed studies of the effects of seismic sounds on mating, cooperative feeding, play, or aggressive interactions.

10) In summary, it is *unknown* if exposure to seismic sound can result in changes in marine mammal social behavior, but if it were to occur there are conditions under which the worst-case consequences of such changes could be highly significant.

Changes in Vocalisation Patterns

11) There have been direct studies of the potential for anthropogenic sound to cause changes in the vocalisation patterns of marine mammals. For most cetacean species studied, there were measurable changes in vocalisation patterns, but these studies were not conducted during seismic operations. In the UK, Norway, and the Sable Gully, sperm whales did not stop calling when exposed to seismic sounds. A study off Heard Island, found that sperm whales did not call during distant (690-1070 km away) seismic transmissions in some parts of the study, but did call during seismic transmissions during another part of the study. Blue whales in the NE Pacific stopped calling for approximately one hour when within 10 kilometers of a small (1600 in^3) seismic array; they resumed calling as they swam away from the array.

12) There is evidence that exposure specifically to seismic sounds has sometimes caused changes in vocalisation patterns in marine mammals. However, it has not been possible to measure the functional consequences of

these changes (such as loss of contact between individuals or reduced ability to coordinate social behaviors), if any, nor the percent of time which they would occur.

13) In summary, it is *known* that exposure to seismic sound can result in changes in marine mammal vocal behavior, and when it occurs there are conditions under which the worst-case consequences could be highly significant.

Functional Consequences of Physical and Behavioral Effects

Reduced Communication Efficiency

14) Many species of marine mammals both produce and respond to sounds. Studies have shown these vocalisations to sometimes communicate information that is functionally important for feeding, breeding, parental care, predator avoidance, or maintenance of social groupings. Studies have also found vocalisations can occur when there are no observable functional consequences, although in such cases it is unclear if the vocalisations had no consequences, or if the effects were longer term or farther afield than the studies. Hence it is difficult for research to produce conclusive results about the frequency of occurrence and consequences of disruption of communication by anthropogenic activities, including seismic sounds.

15) There have been no published studies of the potential for seismic sound to reduce the efficiency of communication in marine mammals. Loud sounds will reduce the efficiency of communication but the severity and conditions under which this occurs with marine mammals are poorly known. When seismic sounds are produced there are inter-pulse intervals which present the opportunity for cetaceans to place vocal communication signals, but cetaceans have not been shown to use this mechanism in the field. Moreover, there is unpublished information that when multi-path echoes occur, such as in areas of complex bathymetry, the pulses of the seismic sound may smear over distance and time, such that the quieter inter-pulse intervals may be reduced or eliminated. This creates the potential for calls of cetaceans such as blue whales to be masked by seismic sounds although the distances over which the masking would be effective, if it were to occur, are unknown. It is unknown if whales could reduce the effects of masking through processes such as changes in their calling patterns, and the consequences of these changes (if they occur) are unknown. This facultative response has been documented in some other marine mammal species exposed to loud manmade sounds. Therefore, it is *unknown* if exposure to seismic sound can result in such reduced communication efficiency in marine mammals.

Reduced Echolocation Efficiency

16) There have been no direct studies of the potential for seismic sound to reduce the efficiency of echolocation in marine mammals. Therefore, it is *unknown* if exposure to seismic sound can result in reduced echolocation efficiency in marine mammals.

Hampered Passive Acoustic Detection of Prey

17) There have been no direct studies of the potential for seismic sound to hamper the passive acoustic detection of prey by marine mammals. In a published study on the effects of whale watching vessels on killer whale behavior, it was postulated that sounds from these vessels could reduce the ability of killer whales to detect their prey. It is not known if such an effect could result during exposure to seismic sounds, or even which species of marine mammals use passive acoustic detection of prey as an important feeding strategy. However the potential for an effect is greatest for mysticetes whose best hearing sensitivity is thought to be at lower frequencies than other marine mammals. Therefore, it is *unknown* whether exposure to seismic sound could hamper the passive acoustic detection of prey by marine mammals.

Hampered Passive Acoustic Detection of Predators

18) There have been no direct studies of the potential for seismic sound to hamper the passive acoustic detection of predators by marine mammals. The potential for an effect is greatest for mysticetes, whose best hearing sensitivity is thought to be at lower frequencies than other marine mammals. However it is not known if such an effect occurs during exposure to seismic sounds, and if so, to what extent. Therefore, it is *unknown* whether exposure to seismic sound could increase the vulnerability of marine mammals to predators.

Hampered Avoidance of Anthropogenic Threats (such as ship strikes, net entanglement)

19) There have been no direct studies of the potential for seismic sound to reduce the ability of marine mammals to avoid anthropogenic threats. There are published reports of other types of sounds interfering with the ability of individual whales to avoid anthropogenic threats such as ship strikes and net entanglements, but it is not known how widespread this response is. It is also not known if such an effect could result from exposure to seismic sounds. Therefore, it is a *concern* that exposure to seismic sound could reduce the ability of marine mammals to avoid anthropogenic threats, but the risk has not been demonstrated.

Hampered Parental Care or Bonding

20) There have been no direct studies of the potential for seismic sound to hamper parental care or bonding in marine mammals. Therefore, it is *unknown* if exposure to seismic sound can hamper parental care or bonding in marine mammals.

Chronic Effects (e.g., stress-related physiological changes, reduced fecundity)

21) There have been no studies of the potential for seismic sound to induce chronic effects, such as immunosuppression or reduced fecundity, in marine mammals. Therefore, it is *unknown* if exposure to seismic sound can result in such chronic effects on marine mammals.

Indirect Effects (e.g., reduced prey availability)

22) There have been no studies of the potential for seismic sound to reduce prey availability, through displacement or reduced catchability, for marine mammals. Therefore, it is *unknown* if exposure to seismic sound can result in such indirect effects on marine mammals.

Research Needs

In the review a large number of areas of future research were identified. Some emerged as particularly helpful in increasing the information available to those quantifying and those managing the risks of seismic surveys in marine ecosystems.

1) More work is required to determine the sound characteristics and environmental conditions under which seismic effects on behavior, physiology, and physical well-being of all types of marine species might occur.

2) The available information on the effectiveness of mitigation measures needs to be more fully evaluated, as a basis for both interim advice on appropriate operational requirements in the short term and additional research needs to increase our knowledge in the longer term.

3) In addition to targeted research, there is great value to linking a program of structured collection of information to the conduct of seismic surveys, to facilitate learning-by-doing. However, such information collection programs must be well coordinated, and accompanied by the resources to analyse, interpret, and apply the new information, as it is collected and submitted to scientific authorities.

4) A few representative studies on distance-effect relationships for all taxa, but particularly eggs and larvae, would greatly aid understanding of potential risks posed by seismic sound. The potential for effects stemming from sound exposure level (cumulative over a survey) as well as peak received sound pressure level should be considered, including under conditions of 3-D surveys.

5) Specific research is needed on the level of received sound experienced by sessile invertebrates, and the effects of seismic sounds on such organisms. The physics of the sound levels to which benthic organisms are exposed is complicated due to shear effects interacting with pressure effects, and the proximity to the bottom substrates. Hence results of generic sound propagation models are likely to be misleading with regard to exposure levels of sessile benthic species. However, the errors could be in any direction, and in sites of complex bathymetry there could be very patchy distributions of areas with higher intensities of exposure than predicted by sound propagation models and other areas with lower intensities.

6) There is a specific absence of information on the effects of seismic sounds on molting of invertebrates with hard exoskeletons.

7) There is a need to further clarify the best sound propagation models for the areas likely to host seismic exploration, and how habitat characters should influence model selection. Generic models also need to be evaluated relative to the sensitivity and precision of their predictions relative to requirements for evaluating potential impacts, although site-specific implementations of generic models will continue to be desirable.

8) Better data input is needed during modelling of the expected pattern of spread of seismic sounds during surveys. Near-and far-field sound measurements should be encouraged as part of seismic operations planned for an area that has not been surveyed previously, or if previous models have been shown to be inaccurate.

9) Further research on potential impacts of seismic sound on marine mammals is urgently needed. The issues in most need of attention through scientific research or further analysis of existing data include:

    a) An important scientific unknown limiting our ability to predict the effects of seismic surveys on marine mammal populations is knowledge of their spatio-temporal distribution, and physiological state and needs. Without knowledge about what species are present in which areas at what time of the year and for what purpose, there will always be risks of disturbance and injury to sensitive species. An effort should also be made to characterise the degree of

long-term natural variation in abundance and residency.

b) There is a need for significantly more information regarding the reactions of marine mammals (and their prey) to underwater sound from seismic arrays. Baseline studies prior to seismic operations, plus comparative reports during periods with and without seismic would contribute important new data.

c) There is a need for better and more accurate information on naturally-occurring and man-made noise in the ocean.

d) The effectiveness of all potential mitigation measures needs to be explored and documented more fully. In particular there is a need to document the extent to which passive and/or active acoustic monitoring of marine mammals from the source vessel is an effective mitigation strategy.

e) There is a particular need for directed studies of social behavior of marine mammals during seismic exposures, given the importance of these activities to marine mammals' biology.

f) The effects of anthropogenic sounds on the vocalisation patterns of marine mammals are well documented, but the effects of specifically seismic sounds are poor known, and warrant further study.

Many of these factors are also poorly known for many taxa of marine turtles, fish, and invertebrates. Research to fill in such knowledge gaps, particularly with regard to spatio-temporal distribution of important prey taxa and their reactions to seismic sound, would be valuable, although the topics listed above were given higher priority. A number of other topics requiring additional research were proposed by various individuals, and are recorded in the meeting proceedings.

References

DFO, 2003. A Framework to Assist DFO Consideration of Requests for Review of Seismic Testing Proposals. DFO Can. Sci. Advis. Sec. Habitat Status Report 2003/001.

LGL. 2004. Assessment of Regulatory Practices Governing the Limits of Sound Energy Produced during Seismic Operations (draft). LGL Limited, environmental research associates, Report TA4014-1. (Unpublished)

For more Information

Contact: Hugh Bain
Environmental Science
Fisheries and Oceans Canada
200 Kent Street
Ottawa, Ontario
K1A 0E6

Tel: (613) 990-0288
Fax: (613) 954-0807
E-Mail: bainh@dfo-mpo.gc.ca

This report is available from the:

Canadian Science Advisory Secretariat
200 Kent Street
Ottawa, Ontario
K1A 0E6

Telephone: (613) 990-0293
Fax: (613) 954-0807
E-Mail: CSAS@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

ISSN 1708-6272 (Print)
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La version française est disponible à l'adresse ci-dessus.

Correct citation for this publication

DFO, 2004. Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. DFO Can. Sci. Advis. Sec. Habitat Status Report 2004/002.

Development of a Closed Area in NAFO 0A to protect Narwhal Over-Wintering Grounds, including Deep-sea Corals

Context

This report provides background information on the development of effort restrictions for the Greenland halibut fishery in the southeast area of the Northwest Atlantic Fisheries Organization (NAFO) Div. 0A. The decision to close this area was taken by Fisheries Management in April 2006 and set out in the draft 2006-2008 Fisheries Management Plan for Greenland Halibut in NAFO SA0 that was circulated to stakeholders for comment in September 2006. A summary of narwhal life history and biology is included while more detailed information is available in the publications listed under Sources of Information. DFO policies related to this issue are under development. The material summarized here comes from published scientific literature and as additional research is undertaken, the advice provided in April 2006 may be modified to reflect the results.

Effort restrictions were first established in 1998 following consultation between DFO Fisheries Management, Science and the Nunavut Wildlife Management Board. There were concerns about the concentration of bottom trawl fishing effort in the southern narwhal over-wintering area and potential for habitat destruction and local depletion of Greenland halibut, a significant food resource of narwhal. These restrictions were subsequently included in the 2003-2005 Management Plan. During the consultation meeting for the 2006-2008 Management Plan, held February 7 and 8, 2006 in Iqaluit, there was general agreement that these restrictions would continue. With the introduction of gillnets to the fishery in 2004, the risk of narwhal entanglement in lost gillnets had increased. Gillnets were lost in both the 2004 and 2005 fishery. There was also new information provided in March 2006 on the potential ecosystem effects of the first few fishing events on sensitive habitat. Fisheries Management, following discussion with Science, decided in early April 2006 to close the area rather than continue with fishing effort restrictions. The draft 2006-2008 Management Plan defines the closed area as: Point A) 68° 15' N / 58° 30' W in the Northeast; Point B) 68° 15' N / 60° 30' W in the Northwest; Point C) 67° 15' N / 60° 30' W in the Southwest and Point D) 67° 15' N / 57° 50' W in the Southeast. This area corresponds to the core of the southern narwhal over-wintering ground and includes three of the four locations where deep-sea corals have been found.

Background

Prior to 1996, there had been very little fishing with otter trawl or any other gear in Div. 0A. The Greenland halibut fishery had been concentrated in Davis Strait on the Div. 0B fishing grounds with annual catches of approximately 5,500 t. An exploratory fishery for Greenland halibut began in 1996 with an allocation of effort rather than total allowable catch (TAC). Fishing was carried out by an otter trawl vessel. The effort for 1996 was set at 32 days (catch was 329 t). Div. 0A was also divided into four "sub-zones" with a minimum of six days to be fished in each sub-zone in an attempt to distribute fishing effort. In 1997, a similar approach was used with Div. 0A being further sub-divided into 18 sub-zones and three otter trawl vessels were licensed for a fixed number of days with catches totaling 241 t. These vessels were free to spend time

fishing where they chose but also had to fish a certain amount of time in specific sub-zones in order to distribute effort and allow assessment of Greenland halibut distribution within Div. 0A. In both years, a majority of the tows were conducted in sub-zone 2.1 in the south-east corner of Div. 0A (Appendix 1).

During this same period, marine mammal researchers were analyzing tracking data and dive behaviour data from narwhals tagged in Eclipse Sound, Baffin Island and Melville Bay, Greenland. Narwhals from these summering areas over-wintered in heavy pack ice (Heide-Jørgensen *et al.* 2002 and 2003) in the same area where the Greenland halibut fishery was concentrated in 1996 and 1997 (Appendix 2). The Greenland halibut fishery begins in late July and continues through to the middle of November. Narwhals arrive on their over-wintering grounds in late October or early November and leave the following April. Narwhals do not feed extensively on their summering grounds but are known to rely on Greenland halibut as a major food source during fall and winter (Laidre *et al.* 2004a). It was noted that during the time narwhals were on the southern over-wintering grounds they spent considerable time diving to depths over 800 m which corresponds to the depth where Greenland halibut are most abundant (Laidre *et al.* 2003 and 2004b, Treble *et al.* 2000 and 2001).

The closed area defined above corresponds very closely to the southern narwhal over-wintering grounds as shown in Laidre *et al.* 2004a which is based on satellite tracking data from three narwhals from Eclipse Sound and two from Melville Bay that spent time in the over-wintering area (Dietz *et al.* 2001 and Laidre *et al*. 2003). Additional whales were tagged and information on timing and direction of migration and dive behaviour were collected but the signal was lost before they reached the wintering ground. As new information becomes available the boundaries of the closed area could be adjusted.

Concern was expressed by Fisheries and Oceans Canada (DFO) as well as our co-management partner, the Nunavut Wildlife Management Board (NWMB), that narwhals could be impacted if the bottom habitat were damaged and their food supply depleted in the southern over-wintering area. The Greenland halibut fishery becomes concentrated in the southeast portion of Div. 0A late in the season because of encroaching sea ice. This increase in effort occurs immediately prior to the arrival of the narwhal. In 1998, fishing restrictions were put in place to limit fishing activities in sub-zone 2.1, which was found to correspond very well with the core of the narwhal's over-wintering grounds and later described by the points listed above. Three vessels were restricted to a combined total of 12 days of fishing in this area. This was approximately the level of effort observed in 1996 and 1997. This restriction has been maintained as policy for vessels fishing in the Greenland halibut fishery since 1998, although in some years, it was mistakenly omitted from certain exploratory licenses and compliance may not have been monitored.

Up to 2005, the harvest of Greenland halibut from the restricted area has comprised a relatively small portion of the overall harvest within Div. 0A based on a review of catch data from vessel daily hails and logbook data provided to the Eastern Arctic Area Office. In 2003, for example, 1.3% (55.4 t) of the trawl catch and 6.6% (272 t) of the overall catch came from the restricted area. In 2004, 3.0% (114 t) of the trawl catch and 5.0% (191 t) of the overall catch and in 2005 0.2% (8 t) of the trawl catch and 5.4% (233 t) of the overall catch came from the restricted area. During this period, there were effort restrictions in place but in each year there was at least one vessel that did not comply with these restrictions. Effort displaced by a complete closure of this area should be able to re-locate to other grounds within Div. 0A.

In 1999 and again in 2001, deep-sea coral species (including gorgonian species) were identified at several locations within the narwhal over-wintering grounds during multi-species trawl

surveys conducted by DFO. Division 0A has been surveyed several times (1999, 2001, 2004 and 2006) and gorgonian deep-sea corals have not been found anywhere else within Div. 0A.

Gillnet vessels were first introduced into the Div. 0A fishery late in 2004. In 2005, 26% of the catch came from gillnet vessels and in 2006 their share of the Div. 0A catch had increased to approximately 40%. The use of gillnets in the narwhal over-wintering area increases the risk of narwhals becoming entangled in lost nets. Bio-degradable mesh or similar technology is in development but it has not been used in this fishery. In 2004, there were 174 gillnets lost, approximately 16 km (each net is approximately 50 fathoms by 2 fathoms or 91.5 m by 3.7 m). DFO Science advised against the use of gillnets throughout Div. 0A in a briefing note submitted to the NWMB in March 2005. Rather than restricting their use however, an end date to the gill net season of Nov. 15th was established in an effort to reduce the risk of gear loss due to late season ice conditions. There were 291 (27 km) and 135 (12 km) gillnets reported lost in Div. 0A in 2005 and 2006, respectively.

Restrictions were not placed on vessels fishing for shrimp because they fish in shallow waters (<400 m). Dive behaviour showed that narwhals used depths >800m and deep-sea corals were found at depths >500 m.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) re-assessed the status of narwhal in Canada in 2004 and recommended the designation of “Special Concern” for all populations (COSEWIC 2004). COSEWIC cites uncertainty about numbers, trends, life history parameters, and levels of sustainable hunting as reasons for this designation. The developing fishery for Greenland halibut, one of the main prey species of narwhal, and the presence of lost gillnets in the narwhal over-wintering areas could be considered potential risks to the population that were not identified by COSEWIC.

At their April 2006 meeting the Canada/Greenland Joint Commission on the Conservation and Management of Narwhal and Beluga noted that “…under some scenarios of a high loss rate and/or a low rate of population increase, there is a risk that present catch levels are not sustainable in one of the small units (Admiralty Inlet sub-stock.” (JCNB 2006). Admiralty Inlet is one of three sub-populations of narwhals that are known to over-winter in southern Baffin Bay. On the interaction between Greenland halibut (turbot) and narwhal the JCNB noted that “… the Scientific Working Group indicated that turbot, an important commercial species, forms a significant part of the diet of narwhal. The Commission, at their May 2004 meeting noted that interactions between these two species may become a management concern.” (JCNB 2004).

Literature and Policy Review

Narwhal Life History and Biology

Research on narwhal in Baffin Bay beginning in 1997 has continued with tagging programs conducted in Eclipse Sound in 1997, 1998 and 1999, Creswell Bay, Somerset Island in 2000 and 2001 and in Admiralty Inlet, Baffin Island in 2003 and 2004. Narwhals from Eclipse Sound (n=3, Dietz *et al.* 2001, Heide-Jørgensen *et al.* 2002, Laidre *et al.* 2003), and Admiralty Inlet (n=18, unpublished data) off Baffin Island and from Melville Bay (n=2, Dietz *et al.* 2001, Laidre *et al.* 2003) off Greenland were observed to over-winter in the south-east area of Baffin Bay, identified as the “southern narwhal over-wintering area”. Narwhals from Creswell Bay, Baffin Island over-wintered further north, in the “northern narwhal over-wintering area” (Heide-Jørgensen *et al.* 2002, Heide-Jørgensen *et al.* 2003, Laidre *et al.* 2003). The northern over-

wintering area lies completely within Greenland waters, while the southern area lies primarily within Canadian waters (Appendix 2).

An examination of dive behaviour data showed that the number of surface dives (0 to 50 m) and time at the surface declined between summer and winter and clear differences were noted between the two over-wintering areas (Laidre *et al.* 2003) (Appendix 3). In the northern over-wintering area (Somerset sub-populations) narwhal spent most of their time diving to between 200 and 400 m while narwhal in the southern over-wintering area (Eclipse and Melville sub-populations) spent less time at shallow depths and most of their time diving to 800 m or deeper, spending over 3 hours at these depths per day and traveling 13 min. per round trip (Laidre *et al.* 2003) (Appendix 3).

Stomach contents of 94 narwhals harvested in the Eastern Canadian high Arctic and West Greenland were examined to assess feeding activity and prey selection (Laidre and Heide-Jørgensen 2004). Stomachs collected from summer harvests in Eclipse Sound, West Greenland near Inglefield Bredning and Melville Bay (n=21) contained Arctic cod, polar cod and squid but most were found to be empty (Laidre and Heide-Jørgensen 2004). Samples were collected in late fall from Uummannaq, West Greenland (n=51 stomachs from). Winter samples were collected 20 km offshore from Disko Island in approx. 800 m of water (n=22 stomachs) (Laidre and Heide-Jørgensen 2004). Greenland halibut, squid and shrimp were most common prey items in the fall and winter samples with Greenland halibut constituting a significant winter resource. Greenland halibut were found in 64% of the narwhal stomachs collected in winter and were the only prey species found in almost half of all stomachs sampled (Laidre and Heide-Jørgensen 2004 and Laidre 2003). There were no narwhals sampled from the over-wintering ground which is well off-shore with heavy ice conditions making sampling dangerous.

Laidre *et al.* 2004a investigated deep-ocean predation by narwhals using a bio-energetic model, narwhal satellite data and data on fish abundance, density and length frequencies. The bio-energetic model was used to estimate the biomass of Greenland halibut needed to sustain the sub-population(s) of narwhals for the five months that they spend on their winter grounds. The authors noted that energy budget models are not assumption-free and their model was no exception. They developed a “minimum realistic” model with results that compared well with one developed for beluga whale (Welch *et al.* 1993 in Laidre *et al.* 2004a). Estimates were made for varying levels of Greenland halibut in the narwhal diet, 25%, 50% and 75%. Assuming a diet comprised of 50% Greenland halibut Laidre *et al.* (2004a) estimated a daily consumption of 90 t and a mean consumption overall of 13,500 t (95% CI of 5,400 t – 28,300 t) for the southern narwhal over-wintering area that at the time was estimated to support 5,000 narwhal. They also found that the difference in Greenland halibut biomass between an area with high predation by narwhals and a comparable area without whales was approximately 19,000 t and corresponded well with the predicted biomass removed by the narwhal, assuming a diet of 50%-75% Greenland halibut (Laidre *et al.* 2004a).

The current narwhal population estimates for the Melville Bay and Eclipse Sound sub-populations that over-winter in the southern wintering ground is 20,000 and there is now evidence that approx. 5,000 narwhals from Admiralty Inlet also use this over-wintering area. Extrapolating to these new estimates of population size and assuming a diet of 50% Greenland halibut, the three sub-populations of narwhals may consume in the order of 67,500 t of Greenland halibut over the five months spent on their wintering ground. The most recent estimate for Greenland halibut biomass in southern Div. 0A is 86,176 t (S.E. 12,502) (Treble 2005) and for all of Baffin Bay it is 222,336 t (Jørgensen 2005). While the estimate for narwhal consumption on the southern over-wintering ground is higher than what was first reported by Laidre *et al.* (2004a) it still falls within the estimated biomass of Greenland halibut. Laidre *et al.*

(2004a) also found that mean densities and length distributions of Greenland halibut inside and outside of the narwhal wintering grounds correlated well with predicted whale predation levels based on diving behaviour (Appendix 4), which further supported their conclusions that narwhals were targeting Greenland halibut in the southern over-wintering grounds.

The TAC established for the Greenland halibut fishery in Baffin Bay (NAFO Div. 0A and 1A(offshore) and 1B) is lower than that set in other Greenland halibut fisheries. This approach was taken because of the difficulty in monitoring the Baffin Bay Greenland halibut stock, the possibility of reduced growth due to colder oceanographic conditions and predation of a significant amount of Greenland halibut by narwhals.

The northern over-wintering ground supports a larger number of whales (approx. 45,000 in 1996) and was estimated to require 700 t per day with a mean consumption over five months of 110,700 t (95% CI of 53,000 t - 310,300 t). This estimate for the northern over-wintering area was greater than the abundance of Greenland halibut estimated in a 2001 survey (36,416 t (Jørgensen 2005)). Laidre *et al*. 2004a suggest that Greenland halibut likely do not play the same role in the diet of narwhals in the northern area that they do in the southern area. An increase in the number of dives and time spent at mid-water for narwhals in the northern over-winter area compared to those in the southern over-winter area supports this conclusion (Laidre *et al.* 2003) (Appendix 3). Also, pelagic polar cod increase in abundance with increase in latitude (Laidre *et al.* 2004a) (Appendix 5) suggesting that schools of polar cod may be an alternative food source to Greenland halibut in the northern over-wintering ground (Laidre *et al.* 2004a).

Top predators are thought to congregate at predictable sites in response to elevated availability of prey resources driven by physical oceanographic processes (Guinet *et al.* 2001 and Thompson *et al.* 2003 in Laidre *et al.* 2004b). Also, marine trophic interactions are complex and are not easily measured so physical habitat features such as depth or bottom temperature are often used as proxies for the distribution of prey resources. Laidre *et al.* (2004b) found that bottom temperature was the strongest predictor of fall and winter movements and dive behaviour of narwhals. Bottom temperature on the west side of Baffin Bay rarely exceeded 1° C while bottom temperatures were much warmer on the east side, as high as 4.0 to 4.5^{o} C.

Greenland halibut are relatively abundant throughout Baffin Bay and Davis Strait (Appendix 4) so prey distribution alone would not account for the overwintering concentration of narwhals. Winter distribution of narwhals may result from a combination of prey abundance, oceanographic conditions such as sea-ice concentration and predator (killer whale) avoidance, so how readily narwhal would shift their over-wintering area in response to local depletion of prey is unknown.

Deep-sea Coral Locations in Baffin Bay

The distribution of coral in Atlantic Canada based on data from DFO groundfish trawl surveys (including those described below) and fisheries observer reports is reviewed in Gass (2002) and Gass and Willison (2005).

Scientific surveys were conducted using otter trawl gear in Baffin Bay in 1999, 2001, 2004 and 2006. During the 1999 survey, a large mound or reef of gorgonian coral (predominantly comprised of *Keratoisis ornata*) was encountered at 67° 58' N and 59° 30' W. The trawl filled with the heavy coral after only nine minutes and could not be brought back on board. The twine gave out due to the weight and only the doors and rigging lines were retrieved. This location fell within the southern narwhal over-wintering grounds and the restricted fishing zone (2.1)

described above (Appendix 1 and Appendix 6). In 2001, several cold-water coral species including two gorgonian species (*Acanella arbuscula, Paragorgia arborea*) and a *Flabellum* sp. were identified at three locations within the southeastern portion of Baffin Bay and within the narwhal over-wintering grounds (Appendix 6). Two of these locations fell within the restricted fishing zone and at one of these locations three different species were caught in a single 30 minute tow. No hard corals have been found in any other area of Div. 0A.

It could be argued that the entire area surrounding the locations where deep-sea coral were located should be protected from trawl gear. However, this would include most of the southeastern portion of Div. 0A, that area east of 60°W, and would create a significant problem for the fishery. The compromise was to close an area which corresponds to approximately 50% of the total area encompassed by locations where corals have been identified.

The bathymetry in the closed area is characterized by a very steep gradient between the 400 m and 1000 m depth contours, leveling off somewhat between 1000m and 1500 m. Given that coral was found at different randomly selected stations there is a good chance conditions would be suitable for coral growth in other locations as well. With the low level of fishing effort in the early years of the Greenland halibut fishery and the effort restrictions in place since 1998 it may be reasonable to assume that there is still habitat in this area that has not been impacted by bottom trawl gear. However, it is not possible to determine the actual status of any coral areas without conducting video or Remote Operated Vehicle surveys and there are no plans for this type of research in the near future.

In 2003, DFO drafted a national strategy for conserving deep-sea gorgonian corals which identified fishery closures as an interim management tool that could be implemented through fisheries management plans to protect known or newly discovered areas of significance. Since then, DFO conducted a National Advisory Process meeting in March 2006 to review impacts of trawls (DFO 2006) and a Policy for Managing the Impacts of Fishing on Sensitive Benthic Areas is under development (see below).

DFO Draft Policy for Managing the Impacts of Fishing on Sensitive Benthic Areas

DFO is developing policy to guide the management of impacts of fishing on sensitive benthic areas. Restrictions applied to the Greenland halibut fishery in 1998 were also established to minimize gear impacts from trawling on benthic organisms and physical structures that provide habitat for Greenland halibut and their prey. The decision to restrict fishing effort in a significant portion of the southern narwhal over-wintering area is consistent with the intent of the draft policy for protecting sensitive benthic areas. New information suggests the greatest damage to ecosystems that are most vulnerable to fishing activity occurs with the first few fishing events (DFO 2006). The area in question could have been considered a “frontier area” in 1998 (DFO 2006), and a decision to close the area completely to bottom trawl fishing at that time might have been more appropriate. Since then we have new information concerning deep-sea corals and although fishing has occurred in the area effort has been restricted and it is believed that a closure to bottom impacting gears would be in keeping with the precautionary approach to fisheries and ecosystem-based management.

DFO Draft Policy on Fisheries for Forage Species

DFO is developing policy as a guide for fisheries targeting forage species. The management decision taken in 1998 to restrict fishing effort in a significant portion of the southern narwhal

over-wintering area is consistent with the goals of this draft policy for forage species. While Greenland halibut might not be thought of as a typical forage species there are aspects of the policy that could apply. For example, Greenland halibut is a significant component of the diet for three sub-populations of narwhals that over-winter in southern Baffin Bay. Restrictions were also applied to the Greenland halibut fishery in 1998, in part, to ensure that local depletion of the narwhal food supply did not occur in the southern narwhal over-wintering area. In October and November, ice conditions in Baffin Bay force fishing effort to concentrate in the southern area of NAFO Div. 0A. If no restrictions were in place, the increased effort in this area could result in a depletion of Greenland halibut immediately prior to the narwhal's arrival in November. Greenland halibut are not a sedentary species so they would move in to re-occupy depleted areas but the rate at which this would occur is not known. If dispersal takes a number of days or weeks local depletion might not impact the narwhals but if it takes a number of months or up to a year then local depletion could be an important consideration. Given the uncertainties effort restrictions in this area are warranted.

Ecosystem-based Management

The Oceans Act, passed in 1997, requires the consideration of impacts of all human activities on an ecosystem level, not just impacts on a single species or stock. As a result DFO Science and Fisheries Management have been working towards an "ecosystem approach" to fisheries management by developing mechanisms with which to incorporate ecosystem considerations within single species assessment and management. The Fishery Management Plan for Greenland Halibut in NAFO SA0 includes several Biological Objectives one of which is to "Protect critical habitat, ecosystems and other species" (DFO 2006 in prep.). The management measure to restrict fishing in the narwhal over-wintering ground was implemented to help achieve this objective which is further enhanced by the decision to close the area entirely for all fishing gears.

Conclusions

Since 1998, the Greenland halibut fishery in NAFO Div. 0A has expanded to a level of 6,500 t TAC and a combination of otter trawl and gillnets is currently being used in this fishery. Since 1997, new information on narwhal migration, over-wintering areas and diet added further support to continue the 1998 decision to establish fishing effort controls in the southern narwhal over-wintering grounds. The introduction of gillnet gear into the fishery in 2004 and this fleet's concentration in the southern portion of Div. 0A introduced the potential for narwhal entanglement in lost gear. In addition, the identification of deep-sea coral and a greater understanding of fishing gear impacts on sensitive benthic habitat suggested that further steps should be taken to protect the area. In April 2006, DFO Fisheries Management, following discussions with DFO Science, decided that a significant portion of the southern narwhal over-wintering grounds that includes deep-water coral locations should be closed to all Greenland halibut fishing (fixed and mobile gears). A description of the closed area was included in the draft 2006-2008 Fisheries Management Plan for Greenland Halibut in SA0.

In summary, the rationale for closing an area of NAFO Div. 0A to the Greenland halibut fishery :

1) COSEWIC has assessed narwhal, including the high Arctic populations as "Special Concern". Important over-wintering habitat for three sub-populations is located in the southeast corner of NAFO Div. 0A where bottom temperatures are the warmest. The size of the closed area was based on tagging data from five narwhals from two of the sub-populations. The boundaries will be re-examined as more data becomes available.

2) Greenland halibut are an important forage species for narwhal, particularly the three sub-populations, Melville Bay, Eclipse Sound and Admiralty Inlet, that utilize the southern over-wintering area located in the southeast corner of NAFO Div. 0A. Continued research on narwhal diet and bio-energetic requirements is needed to further refine estimates of Greenland halibut consumption.
3) Narwhals feed primarily during the period spent on their over-wintering grounds. By closing a significant portion of the grounds to Greenland halibut fishing, we would ensure this important food resource does not become locally depleted prior to the narwhal's arrival on these grounds.
4) The only deep-sea corals found to date in Division 0A came from by-catch during scientific groundfish surveys conducted in 1999 and 2001 and were located within the southern narwhal over-wintering area. The role deep-sea coral plays in the ecosystem is still being investigated. Using a precautionary approach, measures should be taken to protect these areas from bottom impacting gears in the interim. The closed area covers approximately 50% of the total area encompassed by locations where corals were identified. It was recognized that this does not protect all the known coral locations but was a compromise in recognition of the developing fishery. The size of the closed area to protect coral habitat could be re-examined in the future.
5) While gillnets don't have the same degree of impact on benthic habitat as bottom trawls they can disturb habitat. However, in this case the risk of narwhal entanglement in lost gear, in an area where narwhals aggregate for several months at a time, is a concern and this risk is reduced by excluding gillnet gear in a significant portion of the over-wintering area.

The draft policies discussed above will undergo a consultation process prior to being adopted as policy. The advice provided in April 2006, summarized in this report, may be modified in the future as more information is gathered on benthic habitat, narwhals and coral in Southeast Baffin Bay. In the meantime, DFO is being guided by a broad ecosystem approach provided in part by these draft policies which includes the need to consider the impacts of fishing on forage species and on benthic habitat, with a view to determine ways of mitigating those impacts.

Contributors

Margaret Treble (Author)	DFO-Science, Stock Assessment Section
Pierre Richard	DFO-Science, Program Lead, Arctic Marine Mammals
Kathleen Martin	DFO-Science, Program Lead, Science Advisory Process
Stefan Romberg	DFO-Fisheries Management
Sam Stephenson	DFO-Fisheries Management
Patt Hall	DFO-Fisheries Management

The above contributors provided comment on earlier drafts of this report via electronic media and e-mail, no meeting or conference call was held.

Approved by

Michelle Wheatley, Director of Science, Central and Arctic Region

Martin Bergmann, Science Division Manager, Arctic Aquatic Research

Sources of information

COSEWIC, 2004. COSEWIC Assessment and update status report on the narwhal *Monodon monoceros* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Vii + 50 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

Dietz, R., M.P. Heide-Jørgensen, P.R. Richard and M. Acquarone. 2001. Summer and fall movements of narwhals (Monodon monoceros) from Northeastern Baffin Island towards Davis Strait. Arctic 54: 244-261.

DFO, 2006. Impacts of trawl gears and scallop dredges on benthic habitats, populations and communities. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/025.

DFO, 2006 in prep. Fishery Management Plan. Greenland Halibut NAFO Subarea 0 2006-2008. Fisheries and Oceans Canada, Central and Arctic Region, Resource Management and Aboriginal Affairs.

Gass, S.E. 2002. An assessment of the distribution and status of deep sea corals in Atlantic Canada by using both scientific and local forms of knowledge. Master of Environmental Studies Thesis, Dalhousie University, Halifax, Nova Scotia. 186 pp.

Gass, S.E. and J.H.M. Willison. 2005. An assessment of the distribution of deep-sea corals in Atlantic Canada by using both scientific and local forms of knowledge. In: *Cold-water Corals and Ecosystems*, A. Freiwald and J.M. Roberts (eds.). Springer-Verlag Berlin Heidelberg, pp 223-245.

Guinet, C., L. Dubroca, M.A. Lea, S. Goldsworthy, Y. Cherel, G. Duhamel, F. Bonadona, and J.-P. Donnay. 2001. Spatial distribution of foraging in female Antarctic fur seals *Arctocephalus gazelle* in relation to oceanographic variables: a scale-dependent approach using geographic information systems. Mar. Ecol. Prog. Ser. 219: 251-264.

Heide-Jørgensen, M.P., R. Dietz, K.L. Laidre, P. Richard. 2002. Autumn movements, home ranges, and winter density of narwhals (*Monodon monoceros*) tagged in Tremblay Sound, Baffin Island. Polar Biology 25: 331-341.

Heide-Jørgensen, M.P., R. Dietz, K.L. Laidre, P. Richard, J. Orr, H.C. Schmidt. 2003. The migratory behaviour of narwhals (*Monodon monoceros*). Canadian Journal of Zoology 81: 1298-1305.

JCNB 2004. Ninth meeting of the Canada/Greenland Joint Commission on the Conservation and Management of narwhal and beluga, Nuuk, Greenland, May 18-20, 2004. 62 pp.

JCNB 2006. Tenth meeting of the Canada/Greenland Joint Commission on the Conservation and Management of Narwhal and Beluga. http://www.nanoq.gl/English/Nyheder/JCNB.aspx

Jørgensen, O.A. 2005. Assessment of the Greenland halibut stock component in NAFO Subarea 0 + Division 1A Offshore + Division 1B-1F. NAFO SCR 05/51. 19 pp.

Laidre, K.L. 2003. Space-use patterns of narwhals (*Monodon monoceros*) in the high Arctic. PhD thesis, University of Washington, Seattle, WA. 166 pp.

Laidre, K.L., M.P. Heide-Jørgensen, R. Dietz, R.C. Hobbs, O.A. Jørgensen. 2003. Deep-diving by narwhals *Monodon monoceros*: differences in foraging behaviour between wintering areas? Marine Ecology Progress Series 261: 269-281.

Laidre, K.L. and M.P. Heide-Jørgensen. 2004. Seasonal feeding intensity of narwhals (*Monodon monoceros*). North Atlantic Marine Mammal Commission/SC/12-JCNB/SWG/2004-JWG/11. 20 pp.

Laidre, K.L., M.P. Heide-Jørgensen, O.A. Jørgensen, M.A. Treble. 2004a. Deep-ocean predation by a high Arctic cetacean. ICES Journal of Marine Science 61: 430-440.

Laidre, K.L., M.P. Heide-Jørgensen, M.L. Logdson, R.C. Hobbs, P. Heagerty, R. Dietz, O.A. Jørgensen, M.A. Treble. 2004b. Seasonal narwhal habitat associations in the high Arctic. Marine Biology 145: 821-831.

Thompson, D., S.E.W. Moss and P. Lovell. 2003. Foraging behaviour of South American fur seals *Arctocephalus australis*: extracting fine scale foraging behaviour from satellite tracks. Mar. Ecol. Prog. Ser. 260: 285-296.

Treble, M.A. 1999. Exploratory fishery results for Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Division 0A. 1996-1998.

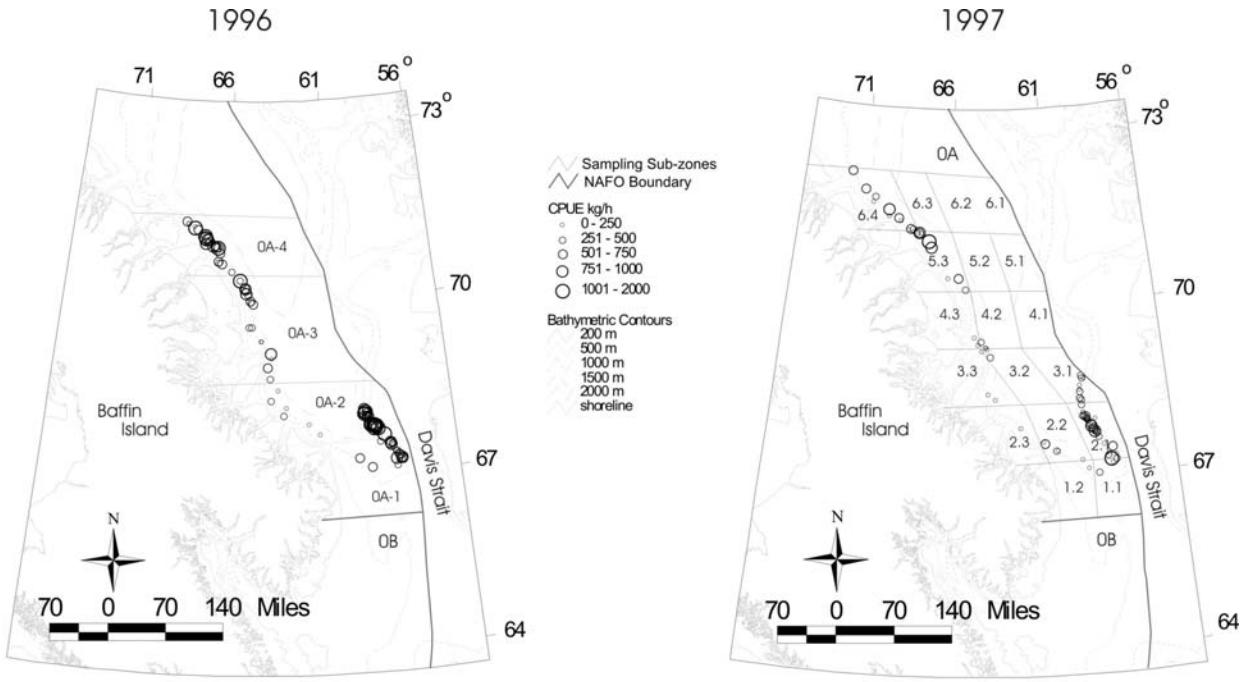
Treble, M.A. 2005. Analysis of data from the 2004 trawl surveys in NAFO Division 0A. NAFO SCR 05/56. 24 pp.

Treble, M.A., W.B. Brodie, W.R. Bowering and O.A. Jørgensen. 2000. Analysis of data from a trawl survey in NAFO Division 0A, 1999. NAFO SCR 00/31. 17 p.

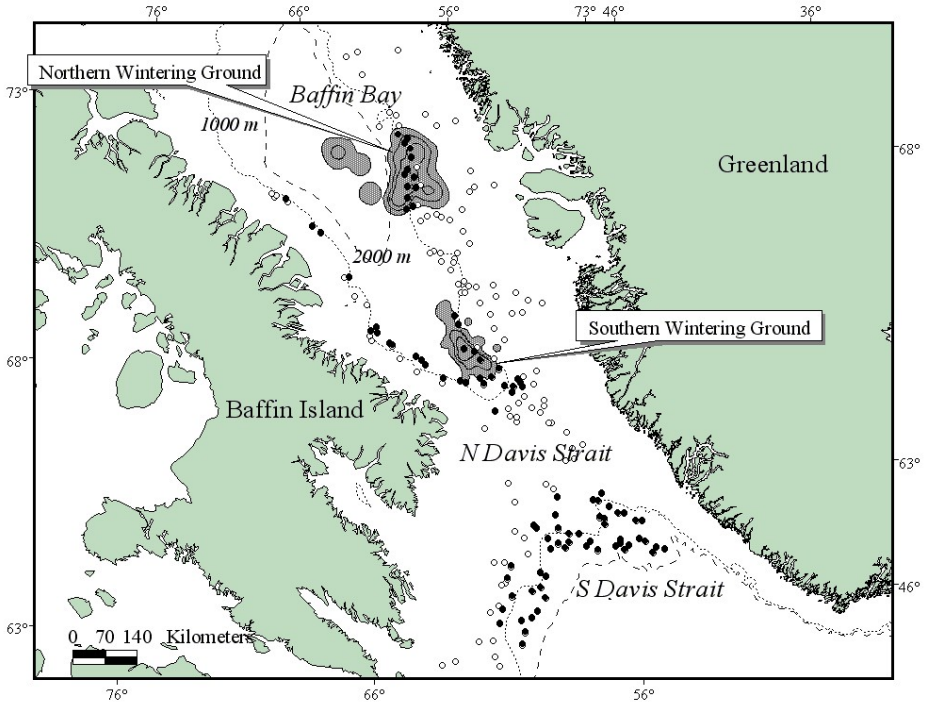
Treble, M.A., W.B. Brodie, W.R. Bowering and O.A. Jørgensen. 2001. Analysis of data from a trawl survey in NAFO Division 0B, 2000. NAFO SCR 01/42. 16 p.

Welch, H.E., R.E. Crawford, and H. Hop. 1993. Occurrence of Arctic cod (*Boreogadus saida*) schools and their vulnerability to predation in the Canadian high Arctic. Arctic, 46:331-339.

Appendices



Appendix 1. Distribution of fishing effort in NAFO Division 0A for 1996 and 1997 (from Treble 1999).



Appendix 2. Narwhal over-wintering areas and location of trawl tows from the 2001 Greenland halibut survey (from Laidre *et al.* 2004a).

Appendix 3. *Monodon monoceros.* Repeated-measures mixed model parameter estimates (with SE) based on an interaction model between season and locality for each of seven depth categories. A random effect of individual behaviour and an effect of linear temporal autocorrelation between days (without a nugget) were included in the models. Average number of dives per day and absolute time at depth (h) in three seasons for each of three narwhal sub-populations are reported (from Laidre *et al*. 2003).

Depth bin (m)	Summer			Migration			Winter		
	Eclipse	Melville	Somerset	Eclipse	Melville	Somerset	Eclipse	Melville	Somerset
Average number of dives per day									
0–50	159 (28)	167 (63)	149 (25)	147 (27)	165 (61)	101 (25)	116 (28)	151 (61)	59 (26)
50–100	8 (3)	11 (8)	15 (3)	7 (3)	6 (7)	10 (3)	10 (3)	13 (7)	11 (3)
100–200	4 (4)	7 (8)	8 (3)	5 (4)	4 (8)	14 (3)	10 (4)	5 (8)	19 (4)
200–400	11 (3)	14 (6)	9 (2)	7 (3)	12 (6)	20 (2)	5 (3)	3 (6)	25 (3)
400–600	11 (3)	5 (6)	6 (3)	12 (3)	6 (6)	10 (2)	3 (3)	2 (6)	12 (3)
600–800	4 (1)	10 (2)	0 (1)	7 (1)	10 (2)	2 (1)	2 (1)	4 (2)	2 (1)
>800	1 (1)	1 (2)	0 (1)	3 (1)	13 (2)	1 (1)	13 (1)	26 (3)	5 (1)
Average absolute time at depth per day (h)									
0–50	16.8 (0.8)	15.6 (1.9)	19.3 (0.7)	15.8 (0.8)	13.7 (1.8)	15.6 (0.7)	13.9 (0.8)	11.8 (1.8)	12.7 (0.8)
50–100	1.1 (0.2)	1.3 (0.4)	1.4 (0.1)	1.0 (0.2)	0.9 (0.4)	1.5 (0.1)	1.3 (0.2)	1.6 (0.4)	1.9 (0.2)
100–200	1.4 (0.2)	1.8 (0.6)	1.1 (0.2)	1.4 (0.2)	1.5 (0.5)	2.2 (0.2)	1.6 (0.2)	1.4 (0.5)	3.4 (0.2)
200–400	2.6 (0.5)	3.2 (1.3)	1.8 (0.5)	2.5 (0.5)	3.2 (1.2)	3.3 (0.5)	1.7 (0.5)	2.6 (1.2)	3.6 (0.5)
400–600	1.5 (0.2)	1.0 (0.6)	0.3 (0.2)	2.0 (0.2)	1.4 (0.6)	1.0 (0.2)	1.5 (0.3)	1.4 (0.6)	1.3 (0.3)
600–800	0.4 (0.1)	0.9 (0.3)	0 (0.1)	0.9 (0.1)	1.7 (0.2)	0.2 (0.1)	1.0 (0.1)	1.8 (0.2)	0.4 (0.1)
>800	0.1 (0.1)	0.1 (0.3)	0 (0.1)	0.4 (0.1)	1.5 (0.3)	0.1 (0.1)	3.0 (0.1)	3.3 (0.3)	0.7 (0.1)

Appendix 4.

Table 1. Summary information on survey tows for Greenland halibut (GHL) and "other" fish species in Baffin Bay and Davis Strait in 2001 (from Laidre *et al.* 2004a). Note: NWG is the Northern Wintering Ground and SWG is the Southern Wintering Ground.

Region	Number of tows	Number of GHL measured	Range of length categories for GHL (cm)	Mean density of GHL in kg/km^2 (SD)	Mean density of other fish in kg/km^2 (SD)
NWG	13	1,739	13-85	1,295 (667)	108 (77)
SWG	9	616	20-99	667 (974)	371 (454)
Baffin Bay	15	3,912	25-70	2,416 (2283)	130 (111)
North Davis Strait	7	1,255	18-104	1,762 (1085)	66 (32)
South Davis Strait	51	8,486	19-105	2,184 (1113)	436 (232)
TOTAL	95	16,008	13-105	1,664 (702)	302 (261)

Appendix 4 Continued.

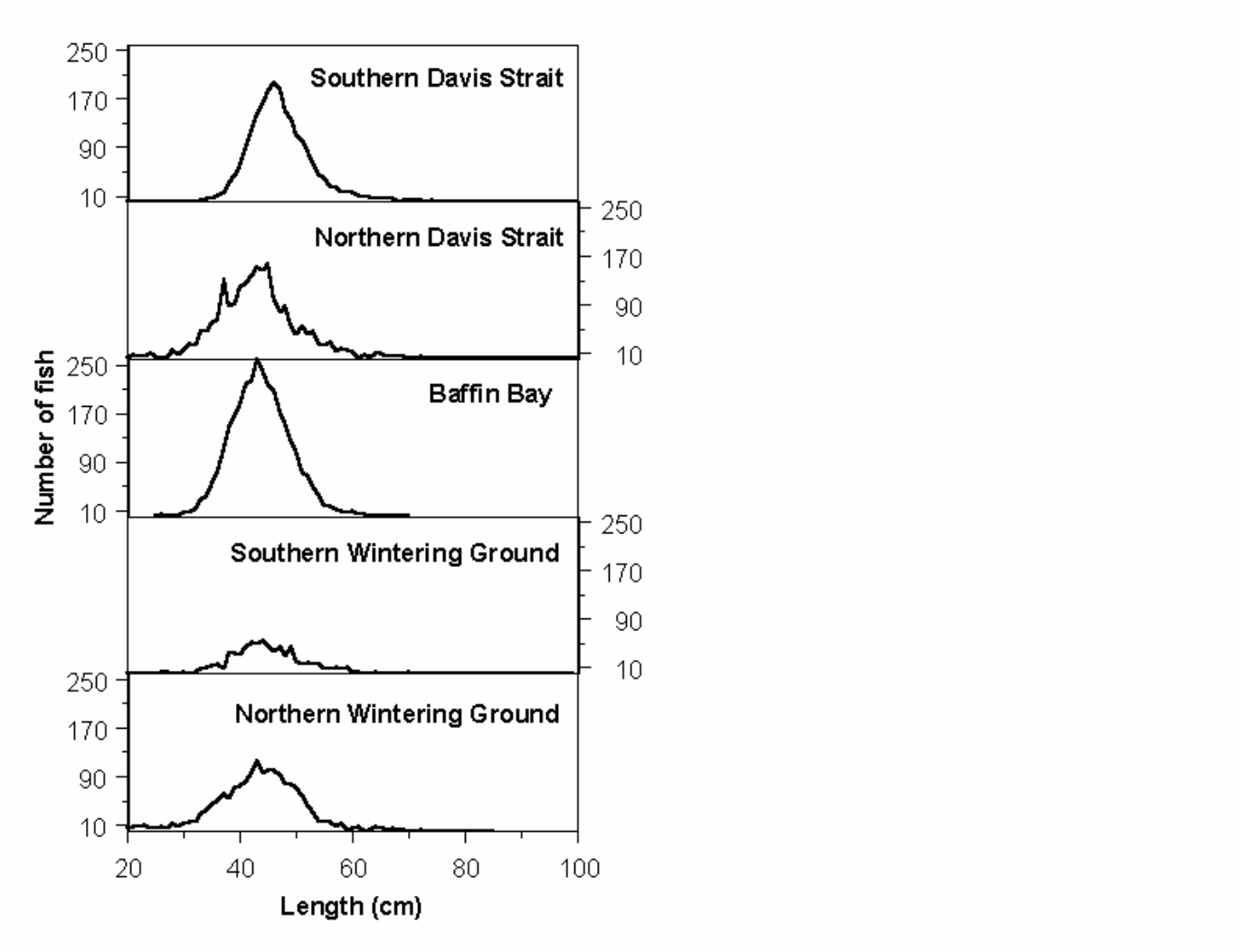
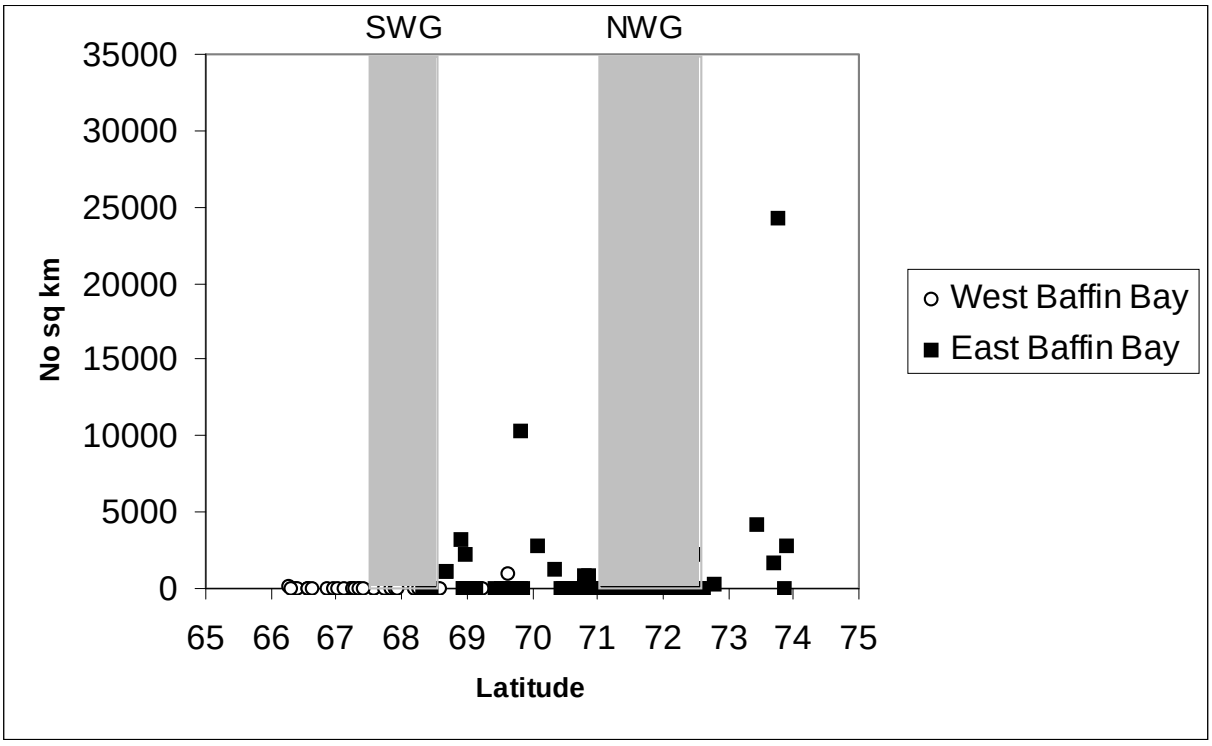


Figure 1. . Distribution of the number of Greenland halibut/km^2 by length class in the five regions. The Southern wintering ground is hypothesized to have high predation levels, Northern wintering ground is hypothesized to have low predation levels, and Northern Davis Strait, South Davis Strait and Baffin Bay are hypothesized to have no predation (from Laidre *et al*. 2004a).

Note: See the figure in Appendix two for location of the regions named in the above table and figure.



Appendix 5. Abundance of polar cod in West and East Baffin Bay, 2001, shown with latitude (degrees N) of each trawl location. The Northern Wintering Ground (NWG) and Southern Wintering Ground (SWG) are shaded. The large number of zero observations is due to the schooling behaviour of the pelagic species (from Laidre *et al*. 2004a).

Appendix 6

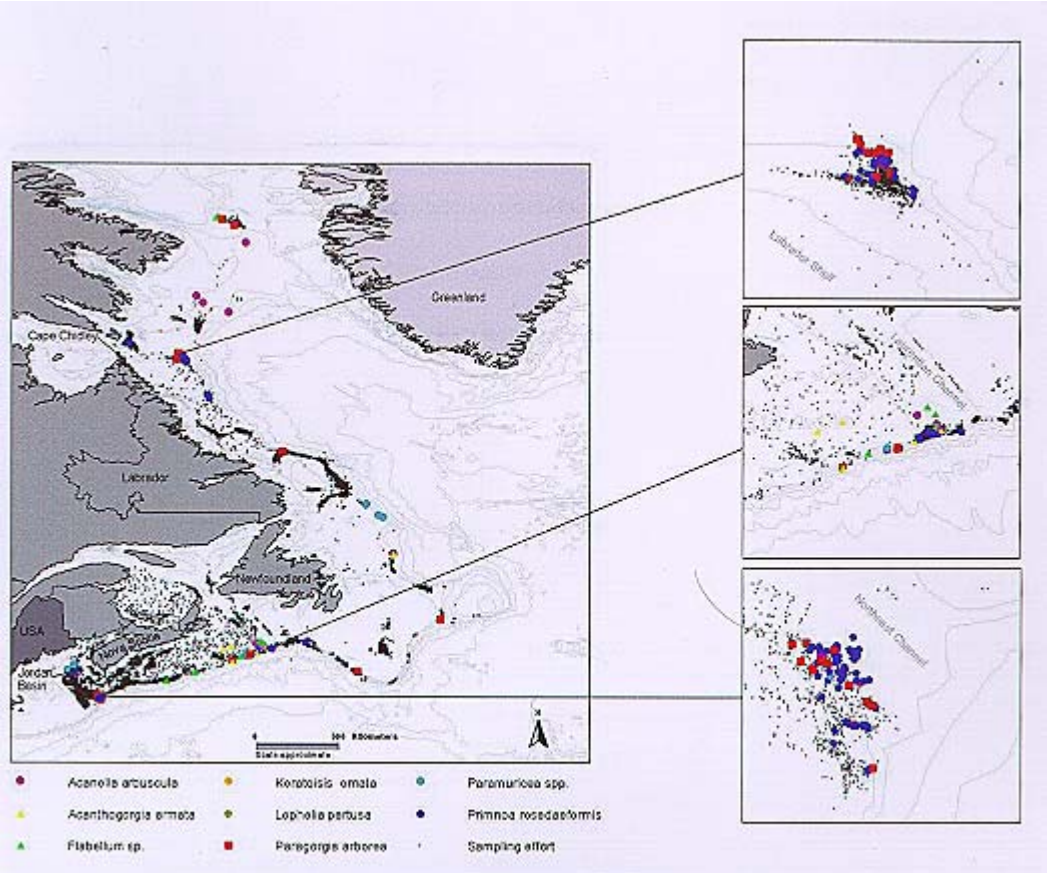


Figure 1. The distribution of deep sea corals based on DFO trawl surveys (1999-2001) and fisheries observer reports (2000 and 2001) (from Gass 2002). Note the cluster of samples that overlap with the southern narwhal over-wintering grounds.

Table 1. Locations of hard, deep-sea coral in NAFO Division 0A taken as by-catch in multi-species surveys (* locations within the restricted fishing zone).

Year	Trip	Set	Date	Start Latitude ˚N	Start Longitude ˚W	Mean Depth (m)	Temperature (˚C)	Species
1999	1	23*	Oct. 11	67 58.5’	59 30.8’	930	0.8	*Keratoisis ornata*
2001	6	7	Sept. 17	66 38.4’	57 50.6’	619	2.3	*Acanella arbusculla*
2001	6	13*	Sept. 18	67 34.2’	58 29.3’	556	3.8	*Paragorgia arborea*
2001	6	16*	Sept. 18	67 52.8’	59 09.9’	516	3.4	*Acanella arbusculla* *Paragorgia arborea* *Flabellum spp.*

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Center for Science Advice (CSA)
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Fax: (204) 984-2403
E-Mail: xcna-csa-cas@dfo-mpo.gc.ca
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Correct Citation for this Publication:

DFO, 2007. Development of a Closed Area in NAFO 0A to protect Narwhal Over-Wintering Grounds, including Deep-sea Corals. DFO Can. Sci. Advis. Sec. Sci. Resp. 2007/002.

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Science Advisory Report 2009/079

STOCK DEFINITION OF BELUGAS AND NARWHALS IN NUNAVUT



Beluga by G. Kuehl



Narwhal by R. Phillips.

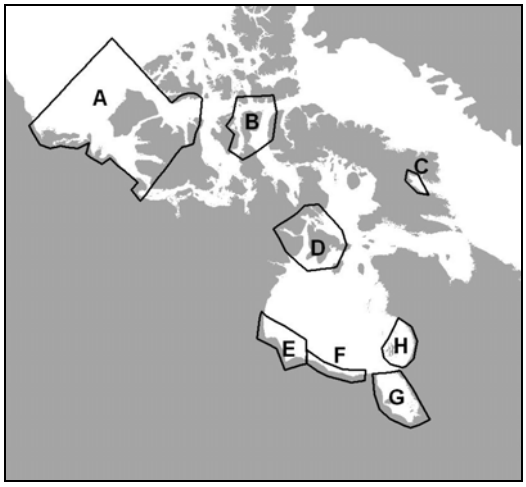

Figure 1: Summer aggregations of Nunavut beluga whales (A: Eastern Beaufort Sea; B: Eastern High Arctic-Baffin Bay; C: Cumberland Sound; E-D-F: Western-Northern-Southern Hudson Bay (Western Hudson Bay population); G: James Bay; H: Eastern Hudson Bay).

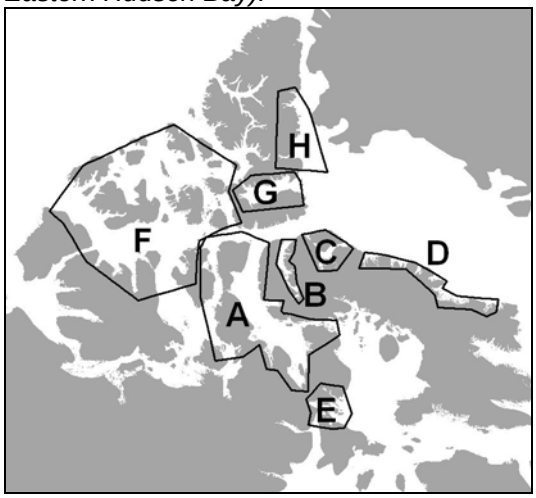

Figure 2: Summer aggregations of Nunavut narwhals (A: Somerset Island; B: Admiralty Inlet; C: Eclipse Sound; D: East Baffin Island; E: Northern Hudson Bay F: Parry Channel; G: Jones Sound; H: Smith Sound).

Context :

The Nunavut Wildlife Management Board (NWMB), in its review of advice provided by DFO Science on Total Allowable Harvest (TAH) for Nunavut beluga and narwhal stocks, has asked DFO to provide clarification on its rationale for providing science advice on the basis of known summering stock aggregations rather than at the population level. The NWMB also asked for clarification about various terms used (e.g., population, stock, sub-stock, management unit) and for an update on the current stock identity of belugas harvested by hunters from Iqaluit and Kimmirut.

In response to the request from the NWMB, this document provides the rationale to support previous science advice for harvest levels based on summering stock aggregations. It also provides information relevant to the definition of stocks of belugas and narwhals in Nunavut.

SUMMARY

- There is good evidence that Nunavut belugas are segregated geographically on a seasonal basis and, in many cases, year-round. There is also good evidence of genetic, contaminant and morphological differences between many of these beluga stocks.
- Six stocks of belugas potentially occur in Nunavut waters: Eastern Beaufort Sea, Eastern High Arctic-Baffin Bay, Cumberland Sound, Western-Northern-Southern Hudson Bay, James Bay and Eastern Hudson Bay.
- Evidence for narwhal segregation between stocks is largely based on tracking data, although some genetic and contaminant analyses also suggest some degree of geographical partitioning.
- Five stocks of narwhals occur in Nunavut waters: Somerset Island, Admiralty Inlet, Eclipse Sound, East Baffin Island, Northern Hudson Bay
- Managing harvest based on stocks reduces the potential for local depletions.
- Using current stock information is an appropriate and precautionary approach to co-management particularly for hunting communities that rely on a predictable seasonal occurrence of animals for their subsistence harvest.

INTRODUCTION

The term “stock” generally refers to a resource unit: a group of animals that are subject to hunting. The biological definition of a population is a reproductively-isolated group of animals. Stocks defined here may or may not be populations in that sense but they are geographically segregated groups subject to hunting. The term “sub-stock” was used by the Scientific Working Group of the Joint Commission on Conservation and Management of Narwhal and Beluga (JCNB) and the North Atlantic Marine Mammal Commission (NAMMCO) to subdivide the previously known “Baffin Bay Narwhal” stock into smaller management units to reflect information on the “sub-stocks” seasonal segregation. It essentially means “stock”. This analysis refers only to management “stocks”, keeping in mind that some of these stocks may or may not be “populations” in the biological sense.

Factors such as demographic and life history variability, habitat patchiness, environmental change, genetic sub-structuring and adaptability may result in temporally- or spatially-structured populations. It is possible to have localized depletions or extinctions if these factors are not considered when harvesting occurs. It is important to choose the definition of stock to suit the management goal. In this case, avoiding local depletion is one such goal, particularly for hunting

communities that rely on a predictable seasonal occurrence of animals for their subsistence. This goal also promotes the conservation of genetic diversity which may result from adaptation to local conditions. An example of the depletion of a local beluga stock is the Ungava Bay stock, which has been severely depleted, perhaps eradicated, by commercial whaling.

ANALYSIS

Methods

Stock definition of beluga and narwhal populations in Nunavut (Richard 2009) was derived from various sources of information:

1) studies of the seasonal range of the species in Nunavut and adjacent waters by documenting local and written reports of their occurrence,
2) appearance and behavioural differences of animals from different areas of Nunavut and adjacent waters,
3) studies of genetic and contaminant differences among animals from different parts of Nunavut and adjacent waters, and
4) tracking animals, using satellite-linked transmitters, to estimate their seasonal range and delimit areas of aggregations.

Results

Beluga Stocks

The combination of the above-mentioned data sources has allowed the identification of six beluga stocks (Fig. 1 A: Eastern Beaufort Sea; B: Eastern High Arctic-Baffin Bay; C: Cumberland Sound; E-D-F: Western-Northern-Southern Hudson Bay[1]; G: James Bay; H: Eastern Hudson Bay) in Nunavut.

The stock harvested by hunters from Iqaluit is not known for certain but is thought to be the Western-Northern-Southern (WNS) Hudson Bay beluga stock (Fig.1 E-D-F), to whom they are most similar genetically. This stock is very large (~63,000 animals) and winters in Hudson and Davis Straits. Most belugas caught around Kimmirut are taken in the autumn when the WNS Hudson Bay stock has moved into Hudson Strait (Smith 2008). Belugas found in Frobisher Bay and hunted by Iqaluit residents in summer are thought to be strays from this large stock.

Narwhal Stocks

Stock definition in Nunavut narwhals is not as clear as it is for belugas. Tracking results offer the best indication of geographic segregation in summer and, in the case of the Northern Hudson Bay stock, year-round. There is also some evidence from genetics and contaminants of stock partitioning in High Arctic narwhals. On that basis, five Nunavut narwhal stocks are identified (Fig. 2 A: Somerset Island; B: Admiralty Inlet; C: Eclipse Sound; D: East Baffin Island; E: Northern Hudson Bay) and three more (Fig. 2 F: Parry Channel; G: Jones Sound; H: Smith Sound) are hypothesized to exist based on the fact that narwhals have been sighted or hunted

[1] This corresponds to the Western Hudson Bay population of belugas assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

in these areas in summer and also because other stocks are sedentary during the same season.

Sources of Uncertainty

The stock definitions are provisional since they are based on an incomplete state of knowledge, particularly for narwhal stocks, for which information is equivocal in some cases and all but absent in others. There is uncertainty about the beluga stock present in Frobisher Bay during the summer months. These stock definitions can be altered if any new information changes these conclusions.

CONCLUSIONS AND ADVICE

The use of summering stocks as management units as we have done here is considered precautionary. As mentioned above, it is possible to have localized depletions or extinctions if this consideration is not taken into account when harvesting occurs. Even with information that is preliminary and based on small samples, by adopting as many stock units as are suggested by this information, co-managers reduce the risk of over-exploitation. For example, over-exploitation could occur if smaller stocks are assumed to be part of a larger- and wider-ranging stock, when in fact they are segregated for all or part of the year and have some annual site fidelity to specific areas.

SOURCES OF INFORMATION

Richard, P.R. 2010. Stock definition of belugas and narwhals in Nunavut. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/022. iv + 14 p.

FOR MORE INFORMATION

Contact: Pierre Richard
Fisheries and Oceans Canada
501 University Crescent
Winnipeg, MB
R3T 2N6
Tel: (204) 983-5130
Fax: (204) 984-2403
E-Mail: Pierre.Richard@dfo-mpo.gc.ca

This report is available from the:

Center for Science Advice (CSA)
Central and Arctic Region
Fisheries and Oceans Canada
501 University Crescent
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R3T 2N6

Telephone:(204) 983-5131
Fax: (204) 984-2403
E-Mail: xcna-csa-cas@dfo-mpo.gc.ca
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ISSN 1919-5079 (Print)
ISSN 1919-5087 (Online)
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La version française est disponible à l'adresse ci-dessus.

CORRECT CITATION FOR THIS PUBLICATION

DFO. 2010. Stock definition of Belugas and Narwhals in Nunavut. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/079.

Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment

Context

The Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment specifies the mitigation requirements that must be met during the planning and conduct of marine seismic surveys, in order to minimize impacts on life in the oceans. These requirements are set out as minimum standards, which will apply in all non-ice covered marine waters in Canada. The *Statement* complements existing environmental assessment processes, including those set out in settled land claims. The current regulatory system will continue to address protection of the health and safety of offshore workers and ensure that seismic activities are respectful of interactions with other ocean users.

Definitions

Cetacean: means a whale, dolphin or porpoise.

Critical habitat: means the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species.

Marine Mammal Observer: means an individual trained to identity different species of marine mammals and turtles that may reasonably be expected to be present in the area where the seismic survey will take place.

Marine mammals: means all cetaceans and pinnipeds.

Passive Acoustic Monitoring: means a technology that may be used to detect the subsea presence of vocalizing cetaceans.

Pinniped: means a seal, sea lion or walrus.

Ramp-up: means the gradual increase in emitted sound levels from a seismic air source array by systematically turning on the full complement of an array’s air sources over a period of time.

Seismic air source: means an air source that is used to generate acoustic waves in a seismic survey.

Seismic air source array(s): means one or a series of devices designed to release compressed air into the water column in order to create an acoustical energy pulse to penetrate the seafloor.

Seismic survey: means a geophysical operation that uses a seismic air source to generate acoustic waves that propagate through the earth, are reflected from or refracted along subsurface layers of the earth, and are subsequently recorded.

“Statement:” means the Statement of Canadian Practice for the Mitigation of Seismic Sound in the Marine Environment.

Whale: means a cetacean that is not a dolphin or porpoise.

Application

1. Unless otherwise provided, the mitigation measures set out in this Statement apply to all seismic surveys planned to be conducted in Canadian marine waters and which propose to use an air source array(s).

2. The mitigation measures set out in this Statement do not apply to seismic surveys conducted:
   a. on ice-covered marine waters; or
   b. in lakes or the non-estuarine portions of rivers.

Planning Seismic Surveys

Mitigation Measures

3. Each seismic survey must be planned to

   a. use the minimum amount of energy necessary to achieve operational objectives;

   b. minimize the proportion of the energy that propagates horizontally; and

   c. minimize the amount of energy at frequencies above those necessary for the purpose of the survey.

4. All seismic surveys must be planned to avoid:

   a. a significant adverse effect for an individual marine mammal or sea turtle of a species listed as endangered or threatened on Schedule 1 of the *Species at Risk Act*; and

   b. a significant adverse population-level effect for any other marine species.

5 Each seismic survey must be planned to avoid:

   a. displacing an individual marine mammal or sea turtle of a species listed as endangered or threatened on Schedule 1 of the *Species at Risk Act* from breeding, feeding or nursing;

   b. diverting an individual migrating marine mammal or sea turtle of a species listed as endangered or threatened on Schedule 1 of the *Species at Risk Act* from a known migration route or corridor;

   c. dispersing aggregations of spawning fish from a known spawning area;

   d. displacing a group of breeding, feeding or nursing marine mammals, if it is known there are no alternate areas available to those marine mammals for those activities, or that if by using those alternate areas, those marine mammals would incur significant adverse effects; and

   e. diverting aggregations of fish or groups of marine mammals from known migration routes or corridors if it is known there are no alternate migration routes or corridors, or that if by using those alternate migration routes or corridors, the group of marine mammals or aggregations of fish would incur significant adverse effects.

Safety Zone and Start-up

Mitigation Measures

6. Each seismic survey must:

   a. establish a safety zone which is a circle with a radius of at least 500 metres as measured from the centre of the air source array(s); and

   b. for all times the safety zone is visible,

      i. a qualified Marine Mammal Observer must continuously observe the safety zone for a minimum period of 30 minutes prior to the start up of the air source array(s), and

      ii. maintain a regular watch of the safety zone at all other times if the proposed seismic survey is of a power that it would meet a threshold requirement for an assessment under the *Canadian Environmental Assessment Act*, regardless of whether the Act applies.

7. If the full extent of the safety zone is visible, before starting or restarting an air source array(s) after they have been shut-down for more than 30 minutes, the following conditions and processes apply:

   a. none of the following have been observed by the Marine Mammal Observer within the safety zone for at least 30 minutes:

      i. a cetacean or sea turtle,

      ii. a marine mammal listed as endangered or threatened on Schedule 1 of the *Species at Risk Act*, or

      iii. based on the considerations set out in sub-section 4(b), any other marine mammal that has been identified in an environmental assessment process as a species for which there could be significant adverse effects; and

   b. a gradual ramp-up of the air source array(s) over a minimum of a 20 minute period beginning with the activation of a single source element of the air source array(s), preferably the smallest source element in terms of energy output and a gradual activation of additional source elements of the air source array(s) until the operating level is obtained.

Shut-down of Air Source Array(s)

Mitigation Measures

8. The air source array(s) must be shut down immediately if any of the following is observed by the Marine Mammal Observer in the safety zone:

   a. a marine mammal or sea turtle listed as endangered or threatened on Schedule 1 of the *Species at Risk Act*; or

   b. based on the considerations set out in sub-section 4(b), any other marine mammal or sea turtle that has been identified in an environmental assessment process as a species for which there could be significant adverse effects.

Line Changes and Maintenance Shut-downs

Mitigation Measures

9. When seismic surveying (data collection) ceases during line changes, for maintenance or for other operational reasons, the air source array(s) must be:
    a. shut down completely; or
    b. reduced to a single source element.

10. If the air source array(s) is reduced to a single source element as per subsection 9(b), then:
    a. visual monitoring of the safety zone as set out in section 6 and shut-down requirements as set out in section 8 must be maintained; but
    b. ramp-up procedures as set out in section 7 will not be required when seismic surveying resumes.

Operations in Low Visibility

Mitigation Measures

11. Under the conditions set out in this section, cetacean detection technology, such as Passive Acoustic Monitoring, must be used prior to ramp-up for the same time period as for visual monitoring set out in section 6. Those conditions are as follows:
    a. the full extent of the safety zone is not visible; and
    b. the seismic survey is in an area that
        i. has been identified as critical habitat for a vocalizing cetacean listed as endangered or threatened on Schedule 1 of the Species at Risk Act, or
        ii. in keeping with the considerations set out in sub-section 4(b), has been identified through an environmental assessment process as an area where a vocalising cetacean is expected to be encountered if that vocalizing cetacean has been identified through the environmental assessment process as a species for which there could be significant adverse effects.

12. If Passive Acoustic Monitoring or similar cetacean detection technology is used in accordance with the provision of section 11, unless the species can be identified by vocal signature or other recognition criteria:
    a. all non-identified cetacean vocalizations must be assumed to be those of whales named in sections 8(a) or (b); and
    b. unless it can be determined that the cetacean(s) is outside the safety zone, the ramp-up must not commence until non-identified cetacean vocalizations have not been detected for a period of at least 30 minutes.

Additional Mitigative Measures and Modifications

Mitigation Measures

13. Persons wishing to conduct seismic surveys in Canadian marine waters may be required to put in place additional or modified environmental mitigation measures, including modifications to the area of the safety zone and/or other measures as identified in the environmental assessment of the project to address:
    a. the potential for chronic or cumulative adverse environmental effects of
        i. multiple air source arrays (e.g., two vessels on one project; multiple projects), or
        ii. seismic surveys being carried out in combination with other activities adverse to marine environmental quality in the area affected by the proposed program or programs;
    b. variations in sound propagation levels within the water column, including factors such as seabed, geomorphologic, and oceanographic characteristics that affect sound propagation;
    c. sound levels from air source array(s) that are significantly lower or higher than average; and
    d. species identified in an environmental assessment process for which there is concern, including those described in sub-section 4b).

14. Variations to some or all of the measures set out in this Statement may be allowed provided the alternate mitigation or precautionary measures will achieve an equivalent or greater level of environmental protection to address the matters outlined in sections 6 through 13 inclusive. Where alternative methods or technologies are proposed, they should be evaluated as part of the environmental assessment of the project.

15. Where a single source element is used and the ramping up from an individual air source element to multiple elements is not applicable, the sound should still be introduced gradually whenever technically feasible.

Polar Biol (2008) 31:1295–1306
DOI 10.1007/s00300-008-0466-4

ORIGINAL PAPER

Movements of narwhals (*Monodon monoceros*) from Admiralty Inlet monitored by satellite telemetry

Rune Dietz · Mads Peter Heide-Jørgensen · Pierre Richard · Jack Orr · Kristin Laidre · Hans Christian Schmidt

Received: 19 July 2007 / Revised: 18 March 2008 / Accepted: 7 May 2008 / Published online: 20 June 2008
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Abstract Twenty-one narwhals tagged in 2003 and 2004 in Admiralty Inlet showed a different summer distributional pattern than previous narwhal-tracking studies from Somerset Island, Eclipse Sound and Melville Bay. The migration of the narwhals tracked from Admiralty Inlet moved out through Lancaster Sound 15 days earlier ($P < 0.0001$) than the narwhals summering around Eclipse Sound, whereas the Admiralty Inlet narwhals reached the mouths of Eclipse Sound 18 days later ($P < 0.0001$) than the Eclipse Sound summering population. The winter range of the Admiralty Inlet narwhals overlapped with the winter range of narwhals from Melville Bay and Eclipse Sound in central southern Baffin Bay and Northern Davis Strait, but not with the winter range of narwhals from Somerset Island that wintered further north. Distribution size of range, and population size did not appear to be related. An example of considerable year to year variation between area of summer and winter distribution in the 2 years was believed to be related to the sample size and number of pods of whales tagged, rather than to differences in sex or age classes.

Keywords Narwhal · Telemetry · Admiralty Inlet · Baffin Bay · Davis Strait · Migration

R. Dietz (✉) · H. C. Schmidt
National Environmental Research Institute,
University of Aarhus, Frederiksborgvej 399,
P·O. Box 358, 4000 Roskilde, Denmark
e-mail: rdi@dmu.dk

M. P. Heide-Jørgensen · K. Laidre · H. C. Schmidt
Greenland Institute of Natural Resources,
P·O. Box 570, 3900 Nuuk, Greenland

P. Richard · J. Orr
Department of Fisheries and Oceans, Freshwater Institute,
501 University Crescent, Winnipeg, MB R3T 2N6, Canada

Introduction

The narwhal (*Monodon monoceros*) is an Arctic odontocete that measures up to 5 m in lengh. Males have an ivory tusk that erupts from the upper left jaw (Hay and Mansfield 1989). The narwhal lacks a dorsal fin, but has a low irregular dorsal ridge along the posterior half of its back (Hay and Mansfield 1989). Narwhals occur in inshore areas of northeastern Canada and Greenland during the open-water season from July to September (Born et al. 1994; Dietz et al. 1994; Richard et al. 1994). The narwhal is also found on the east coast of Greenland and further east into the European Polar Basin, with most observations close to Svalbard and Franz Josef Land (Dietz et al. 1994). In the autumn, narwhals leave inshore areas of northeastern Canada and Greenland and make long-distance movements to their wintering grounds (Dietz and Heide-Jørgensen 1995; Dietz et al. 2001; Heide-Jørgensen et al. 2002, 2003a, b) which are covered with dense pack ice from November to July (Koski and Davis, 1994; Laidre et al. 2004b).

Narwhals are hunted in both Canada and Greenland, and therefore knowledge of stock discreteness or relatedness is important to provide advice on the management of these hunts. Understanding the degree of exchange between populations is also important in the design of comparative studies of contaminant loads in narwhals (Dietz et al. 2004). Finally the migration route and timing of their migration are of importance for impact assessments of human activities, such as shipping, commercial fishing and development of non-renewable resources (e.g. offshore oil and gas).

Although gross patterns of seasonal migrations have been inferred from statistics on Inuit catches of narwhals and from aerial surveys at different seasons (e.g. Born et al. 1994; Koski and Davis 1994; Richard et al. 1994), satellite

tracking methods have provided considerable detailed knowledge about narwhal seasonal range, migratory patterns and seasonal ecology (Martin et al. 1994; Dietz and Heide-Jørgensen 1995; Heide-Jørgensen and Dietz 1995; Dietz et al. 2001; Heide-Jørgensen et al. 2001, 2002, 2003a, b; Laidre et al. 2002, 2003, 2004a, b; Lydersen et al. 2007). Nevertheless, there is still much to learn from tagging as well as from other approaches. Little is known about the genetic exchange relative to the movements during the breeding season. A study of the population structure based on mtDNA revealed low nucleotide diversity, but significant levels of heterogeneity were detected between a number of combinations of three West Greenlandic sampling areas and a combined group from eastern Canada and northwestern Greenland (Palsbøll et al. 1997). The sample size from Canada was, however, too small ($N = 29$) to show conclusively any population structure. In areas where it has proven difficult to capture and tag narwhals (e.g. the Inglefield Bredning and Uummannaq area in Northwest Greenland), a combination of more indirect methods (genetics, contaminant and stable isotope analyses) has been used to elucidate stock connections (Palsbøll et al. 1997; Dietz et al. 2004).

The objectives of this study were to: (1) assess the degree of site tenacity of Admiralty Inlet narwhals during the open-water season, (2) to determine the migration routes and wintering range of this population, and (3) to examine the level of overlap in the winter range with the winter range of narwhals from other summer aggregations.

Materials and methods

The tagging area

The whales were tagged at Kakiak Point (72°41′00″N–86°41′20″W) in Admiralty Inlet, Baffin Island, Nunavut, Canada, a fjord which is approximately 250-km long and up to 35-km wide, with maximum depths of up to 700 m. The fjord is bordered by high (≥500 m) steep-sided cliffs of the Brodeur Peninsula Plateau to the west and Borden Peninsula to the east, but also by promontories of low bluffs or raised beaches with shores of sand and gravel. This fjord is a well-known narwhal summering area, where these whales are regularly hunted by Inuit of the hamlet of Arctic Bay/Ikpiarjuk.

According to local hunters, the fast ice usually clears the fjord at the end of July, although some years pack ice can remain throughout the summer. Little ice was present in the vicinity of Kakiak Point from 11 to 22 August of 2003 and 2004.

Local hunters hold Kakiak Point as one of the best spots in Admiralty Inlet to hunt narwhals because of the tendency of these whales to approach the coastline at that point. It also proved to be an excellent location for live-capture operations. In addition to narwhals, bowhead whales (*Balaena mysticetus*) and ringed seals (*Phoca hispida*) were regularly observed close to the campsite in both years.

Live-capture methods

Narwhals were captured in nets set close to the surface and perpendicular to the shoreline. Due to the large number of narwhals in the area, only one net section, 50-m long, was set approximately 50 m from shore. The net was black and 10 m deep with 40 × 40 cm mesh sizes. They were kept afloat with 40-cm white buoys along the top line. Larger (100 cm) white buoys marked both ends of the net. It was anchored to a large stone on the beach and several heavy stones on the bottom at the seaward end. The net was under constant surveillance day and night and the presence of narwhals anywhere close to the net triggered increased preparedness in the capture team. Soon after whales became entangled, two inflatable boats were paddled out to the captured animals. Both nets and narwhals were raised to the surface to ensure that the animals could breathe comfortably. Whales were then dragged to shore after releasing the net from the seaward anchor and secured by a tail rope. The net was cut off the whales and a hoop net was placed around its head to control it, unless it had a large tusk to hold on to. Both methods were used to keep the blowhole out of the water. Transmitters were attached to the back ($n = 21$) and, in some cases, also on the tusk ($n = 3$) of the animals. After instrumentation, the animals were pushed to deeper water and released. Average handling time was 30 minutes.

Instrumentation of narwhals

Thirteen narwhals were caught between 10 and 23 August 2003, and eight narwhals were caught between 10 and 23 August 2004. The sex, standard length, tusk length (for males) and fluke width were recorded and they were instrumented with backpack transmitters of type SPOT2 ($n = 7$), SPOT3 ($n = 6$) or SPOT4 ($n = 8$) (Table 1). All backpack transmitters were produced by Wildlife Computers (Redmond, WA, USA). Three of the animals were also instrumented with tusk tags (ST-10: Telonics Inc.; housing: Wildlife Computers). With their larger batteries (6 lithium C cells), tusk tags were programmed to provide 500 transmissions every day, while the backpack tags which had smaller batteries (2 AAA lithium batteries) were programmed to transmit 200 transmissions every third day. Further details on weight and size of transmitters and attachment methods are available from Dietz et al. (2001) and Heide-Jørgensen et al. (2003a). Data from the transmitters

Table 1 Information on 21 narwhals instrumented with satellite-linked transmitters in Admiralty Inlet in August 2003 and 2004

Admiralty tagging #/group	PTT ID No.	Sex	Length (cm)	Fluke width (cm)	Tusk length (cm)	Tag type	PTT ID	Tagging date (YeMoDa)	Date of last transmission	Duration (days)	Length of tracking (km)
1/A	3960	Female	416	?	–	Backpack	SPOT3	2003.08.16	2003.12.29	135	8,147
2/B	37236	Male	411	?	43	Backpack	SPOT2	2003.08.16	2003.10.31	76	3,279
3/C	3961	Female	385	91	–	Backpack	SPOT3	2003.08.16	2004.03.13	210	12,955
4/D	7928	Male	335	82	55	Backpack	SPOT3	2003.08.18	2004.04.11	237	13,118
5/D	37234	Male	442	112	174	Backpack	SPOT2	2003.08.18	2003.12.28	132	4,226
	3965					Tusk tag	ST-10	2003.08.18	2003.11.04	78	6,108
6/D	37235	Male	448	104	193	Backpack	SPOT2	2003.08.18	2003.12.22	126	4,885
	3962					Tusk tag	ST-10	2003.08.18	2003.10.18	61	4,545
7/E	7931	Male	349	90	68	Backpack	SPOT3	2003.08.19	2004.01.25	159	10,215
8/F	20165	Male	483	119	190	Backpack	SPOT3	2003.08.20	2003.09.14	25	520
	20157					Tusk tag	ST-10	2003.08.20	2003.09.13	24	2,357
9/F	37283	Male	434	107	184	Backpack	SPOT2	2003.08.20	2003.10.10	51	1,345
10/G	37282	Female	373	87	–	Backpack	SPOT2	2003.08.21	2003.10.01	41	1,828
11/G	21794	Female	367	89	–	Backpack	SPOT3	2003.08.21	2003.11.10	81	3,091
12/H	7927	Male	365	85	70	Backpack	SPOT2	2003.08.21	2003.12.13	114	4,049
13/I	3964	Female	380	88	–	Backpack	SPOT2	2003.08.21	2004.09.15	25	1,136
14/J	37232	Male	392	100	202	Backpack	SPOT4	2004.08.11	2004.09.16	36	1,670
15/K	37233	Male	415	105	165	Backpack	SPOT4	2004.08.13	2004.11.27	106	4,059
16/K	37286	Male	408	110	140	Backpack	SPOT4	2004.08.13	2005.05.20	280	7,506
17/L	37288	Female	365	82	–	Backpack	SPOT4	2004.08.14	2005.08.06	357	11,470
18/M	21803	Female	388	100	–	Backpack	SPOT4	2004.08.14	2004.09.06	23	192
19/N	27262	Female	410	95	–	Backpack	SPOT4	2004.08.22	2004.12.29	129	2,877
20/N	37228	Female	390	91	–	Backpack	SPOT4	2004.08.22	2005.03.08	198	5,733
21/N	37277	Female	390	91	–	Backpack	SPOT4	2004.08.22	2005.02.02	164	3,770
All										3234	119081

were relayed via the ARGOS DCLS system (Service Argos Inc. 1989; Harris et al. 1990).

Data collection and analysis

Data on location and transmitter status were collected via the Argos Location Service Plus system (Toulouse, France; Harris et al. 1990). The SAS program Argos_Filter (V6.0) (David Douglas, USGS, Alaska Science Center, Alaska, USA; http://alaska.usgs.gov/science/biology/spatial/douglas.html) was used to filter locations that passed plausibility criteria. The criteria used were a minimum angle threshold of 5° between movement vectors of consecutive locations and a maximum speed of 10 km/h calculated from distance travelled and time span between locations. Locations of quality class 3 were always retained. In addition the program calculated distances travelled and migration speeds. Excel 97 (SR2) and StatView (V5.0.1) were used for statistical analysis and graphs. Maps of narwhal movements were generated using ArcMap (V8.3). Bathymetric contours based on 1° resolution data were obtained from the International Bathymetry Chart of the Arctic Ocean (IBCAO, Jakobsson et al. 2000). ESRI ArcView (V3.2) with ArcView's Animal Movement (V2.0) (Hooge and Eichenlaub 2000) and Spatial Analyst extensions was used to generate tracklines and kernel home-range estimates. Single daily locations with the highest (best) location class were selected, using the PICKDAY = 1 function of the Argos_Filter. The Animal Movement extension was then used to generate 95% kernel home range contours with this subset. The purpose of this selection was to reduce problems associated with temporal auto-correlation. Average home range for both years was calculated using combined 2003 and 2004 daily "best" locations. Land was not subtracted in the home range calculations to make the calculated figures methodologically comparable between summer and winter situation.

Results from this study were compared and contrasted to previous tracking studies of narwhals including summer and winter home ranges, migration routes and distances. The previous studies include narwhals tagged in Melville

Bay, Greenland (1993: $n = 5$; 1994: $n = 4$), and from Canada in Eclipse Sound (1997: $n = 5$; 1998: $n = 5$; 1999: $n = 7$) and around Somerset Island (2000: $n = 10$; 2001: $n = 7$) (Dietz and Heide-Jørgensen 1995; Heide-Jørgensen and Dietz 1995; Dietz et al. 2001; Heide-Jørgensen et al. 2002; 2003).

Results

Duration of transmitter uplinks

The duration of the tags' uplinks ranged between 23 and 257 days. Average and maximum longevity increased in the latest produced transmitter model: ST-10 (mean = 54; range 24–78; $n = 3$), SPOT2 (mean = 81; range 25–132; $n = 7$), SPOT3 (mean = 141; range 25–237; $n = 6$) and SPOT4 (mean = 162; range 23–357; $n = 8$). Summer range was defined as release dates in (Table 1) to 10 September, the overall average date that tagged whales started to move in a directed manner out of Admiralty Inlet and the other compared summer populations (Dietz and Heide-Jørgensen 1995; Dietz et al. 2001; Heide-Jørgensen et al. 2002, 2003). Data on summer range for Admiratly Inlet was available for 13 narwhals in 2003 and 8 narwhals in 2004. Winter range was defined as 15 November to 25 April. This was based on the overall average date when all the whales had terminated their fall migration and switched from directed travel to more local movements. Nine Admiralty Inlet narwhals transmitted through the winter period in 2003–2004 and six in 2004–2005.

Movements

In summer of 2003, the tagged whales ranged over most of Admiralty Inlet (Figs. 1a, 2a), but in 2004 they concentrated in the central portion of the inlet (Figs. 1b, 2a). The estimated summer home range of the whales tagged in 2003 was therefore 4.8 times larger than the corresponding summer range in 2004 (Table 3; Fig. 2a). A similar pattern was observed on the wintering ground in southern Baffin Bay and northern Davis Strait. The winter home range of the whales tagged in 2003 was 6.7 times larger than the winter range for the 2004 deployment (Table 3). Four narwhals tagged of the 2003 sample went much further south than any of the narwhals tagged in 2004. One of the 2003 whales (#7928) reached latitude 63.0°N in February 2004 (Figs. 1a, 2b), while the southernmost winter latitude reached by a 2004 whale (#37228 in October 2004) was approximately 65.7°N, that is 300 km further north (Figs. 1a, 2b). The 2003 deployment was a larger sample size (13 animals in 9 groups: A–I) compared to the one in 2004 (eight animals in five groups: J–N). This could explain the differences in their ranges (Table 1). The winter home range of the whales tagged in 2003 was 21.3 times larger than the corresponding summer home range. Similarly, the following year, the winter range was 15.4 times larger than the summer distribution.

Seasonal distribution against latitude

A plot of latitude against Julian day (JDay) provides a summary of the seasonal movement patterns of narwhals in 2003 and 2004 (Fig. 3). Movement out of Admiralty Inlet (i.e. to latitudes north of 73.8°N) took place between 14 September and 11 October (JDay: 254–284). Most of the tagged whales used the southern coastline on their eastward migration out of Lancaster Sound. Their southbound movement along the east coast of Baffin Island took place between 29 September and 10 November (JDay: 272–314) and most of the narwhals migrated beyond the 500 m isobath (Figs. 1a, 1b). The tagged narwhals arrived at their wintering ground between approximately 17 October and 15 November (JDay: 290–319, Fig. 3). At first glance, there was no obvious pattern in winter latitudinal distribution between animals of different sex or age class, nor did it appear to be related to the timing of their departure from Admiralty Inlet. The first narwhal to leave Admiralty Inlet was an adult female (#3961; Fig. 3, red line) whose migration ended with an average winter latitude around 68°N, whereas the last departing animal was a juvenile male (#7928; Fig. 3, orange line) which moved to the southernmost latitude (63°N) reached by any of the tagged narwhals.

The two animals with transmitters functioning the longest (#37288 and 37286) started their northbound spring return migration around 25 April (JDay: 115) and continued transmitting for 2 months, until approximately 25 June (JDay: 176). This northward migration occurred in heavy pack ice. These whales took a less direct route than the autumn migration in open water and the duration of their migration took approximately three times as long.

Comparative results from double-tagged whales

Three males were equipped with both a backpack and a tusk transmitter. The tusk tags provided locations for 24–78 days (mean: 54 days), while backpack tags provided locations for 25–132 days (mean: 94 days) (Table 2). In two cases, tusk tags lasted only 48–59% (Mean: 53.5%) of the time from which positions were obtained from the backpack transmitters. It is unknown why the tusk tags failed earlier, but likely explanations are either that the tags came loose or that their electronics or antenna were damaged by contact with the seabed. Underwater footage has revealed that, when submerged, narwhals swim upside down and fairly close to the bottom (Dietz et al. 2007). In the third

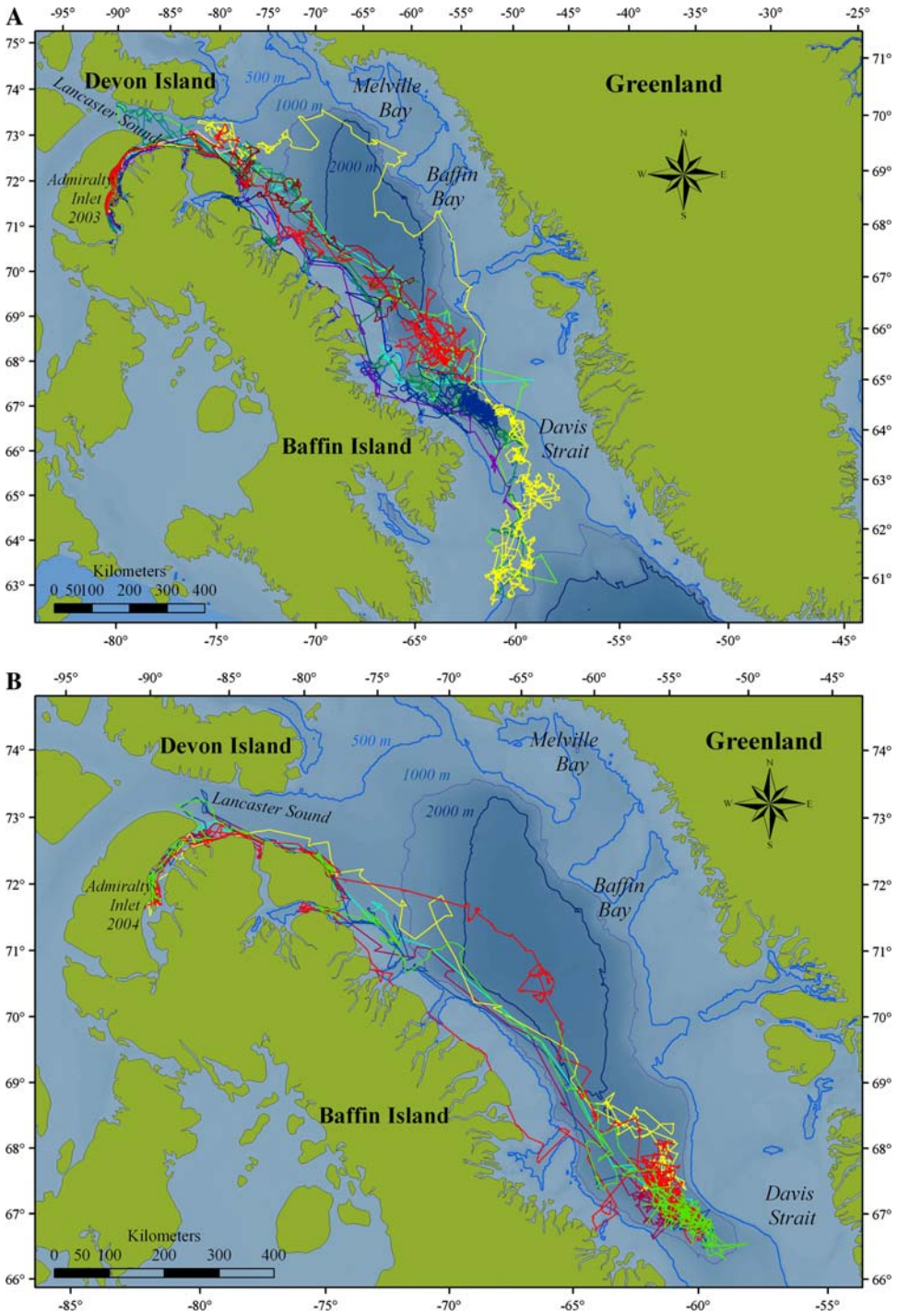

Fig. 1 **a** Tracklines from 13 narwhals tagged in August 2003 in Admiralty Inlet, Canada. Of these, nine transmitters lasted beyond 15 November where the whales reached their wintering ground in southern Baffin Bay and northern Davis Strait. The transmitters lasted from 25 to 237 days. **b** Tracklines from eight narwhals tagged in Admiralty Inlet in 2004. Of these six transmitters lasted beyond 15 November, where the whales reached their wintering ground in southern Baffin Bay and northern Davis Strait. The transmitters lasted from 23 to 357 days. See Table 1 for further information

case (#20165/20157), both tusk and backpack transmitters only lasted for a short period of time (24 and 25 days, respectively).

The backpack transmitters were programmed to transmit only 200 uplinks every third day, while tusk tags provided 500 uplinks every day. Therefore, the backpack transmitters gave only 22.6% (range 12.5–32.9%) of the number of uplinks obtained from the tusk tags over the same period of time. The reduced number of uplinks likewise resulted in shorter travel distances calculated from the backpack transmitters being only 33.1% (range 22.1–43.1) of the distances calculated from the tusk tag data (Table 2). If we correct for this bias (using the inverse of 33.1%), the narwhal equipped with backpack tag #37288 which migrated an estimated 11,470 km distance of the 357 days, could in fact have moved 34,653 km or more during that period, which, for the sake of comparison, is a good portion of the circumference of the earth (40,075 km).

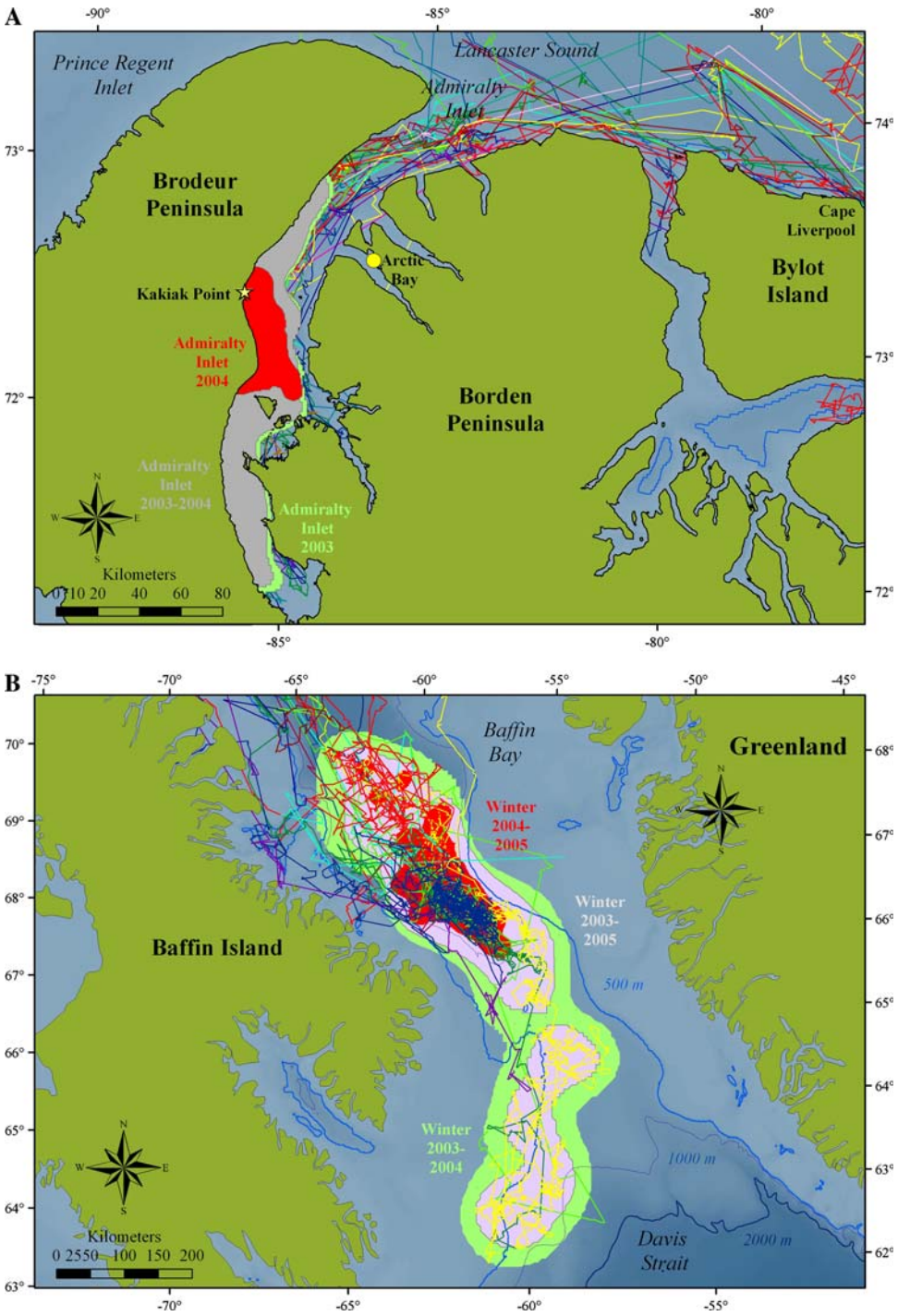

Fig. 2 **a** Close up of Admiralty Inlet with tracklines and 95% kernel home range polygons calculated for 21 narwhals tagged in August 2003 and 2004 The polygons shows the summer range of distribution of 2003 (*light green*) and 2004 (*red*) separately as well as the average of both years (*grey*). Summer was defined from tagging data in August to 15 September. **b** Tracklines for the 15 narwhals that were tracked to their wintering grounds in 2003 and 2004. The 95% kernel home range shows the winter range of the instrumented whales in 2003–2004 (*light green*) and 2004–2005 (*red*) separately as well as the average of both years (*grey*)

Year round tracking

An adult female (#37288) provided locations for almost an entire year (357 days). This animal spent the winter at latitudes between 68° and 69°N (Fig. 3). It entered Lancaster Sound on 25 June and moved westward towards the mouth of Admiralty Inlet reaching just north of Elwin Inlet (73°35′45″N, 84°01′55″W) by 13 July 2005. The female did not enter Admiralty Inlet, most likely because the fast ice had not left the fjord at that time and it was not possible to move south into the Inlet. It later turned eastward moving along the north coast of Borden Peninsula towards the mouth of Navy Board Inlet on 16 July 2005. The narwhal continued further east along the north coast of Bylot Island and finally turned back west towards Lancaster Sound on 28 July. Contact with this animal was lost on 6 August, when it was still near the mouth of Lancaster Sound, east of Cape Liverpool, Bylot Island (73°41′20″N, 78°27′06″W).

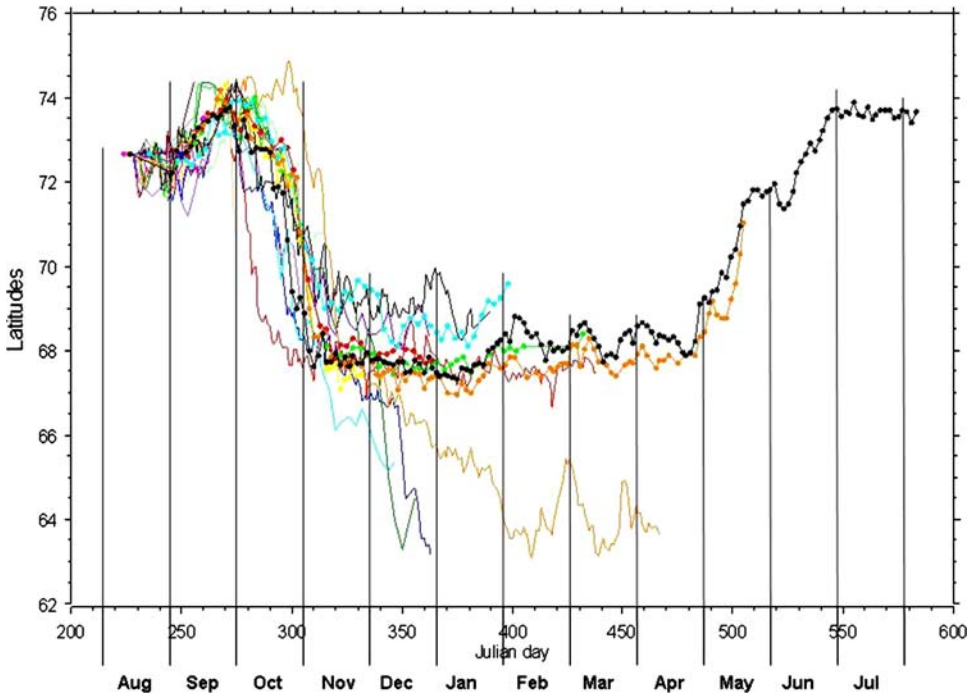

Fig. 3 The seasonal movements depicted as latitudinal presence as a function of Julian day of the 21 narwhals tagged in Admiralty Inlet in August 2003 and 2004. Julian days <220 are depicted as Julian Day +365 to obtain graphic continuity from the tagging date in August over the autumn and the following year

Table 2 Information for comparable periods from three narwhals instrumented with both backpack and tusk tag transmitters in Admiralty Inlet in August 2003

PTT ID No.	Tag type	Trms per day	Duty cycle	Duration (days)	Days with trms	Length of tracking (km)	Number of accepted positions	BP dist as % of TT dist	BP pos as % of TT loc
37234	Backpack	200	3rd day	78	26	2,089	173	34.2	22.3
3965	Tusk tag	500	Daily	78	78	6,108	776		
37235	Backpack	200	3rd day	62	21	1,958	194	43.1	32.9
3962	Tusk tag	500	Daily	61	61	4,545	589		
20165	Backpack	200	3rd day	25	9	520	59	22.1	12.5
20157	Tusk tag	500	Daily	24	8	2,357	473		
								33.1	22.6

BP backpack, *TT* tusk tag, *trms* transmissions, *dist* distance, *loc* locations

The transmitter did not last long enough to determine if the animal ever returned to Admiralty Inlet.

Discussion

Comparison with other tagged populations

During summer months, the home range of tagged whales from Admiralty Inlet did not overlap with any home ranges of the 9 Melville Bay narwhals tagged in 1993–1994, the 17 Eclipse Sound narwhals tagged in 1997–1999, or the 17 Somerset Island narwhals tagged in 2000–2001) (Fig. 4a, b; Dietz and Heide-Jørgensen 1995; Dietz et al. 2001; Heide-Jørgensen et al. 2002, 2003). The winter distribution of three of those four population samples overlapped. Based on their estimated winter home ranges, Admiralty Inlet, Eclipse Sound and Melville Bay tagged narwhals showed varying degrees of overlap in their wintering grounds as well as differences in home range size. Somerset Island narwhals, however, wintered further north than tagged animals from the three other populations. All three population's tagged animals stayed south of the 2,000-m abyss in central Baffin Bay and showed affinity for the slopes in southern Baffin Bay and northern Davis Strait over depths of about 500–1,000 m. The southern range of the distribution of Admiralty Inlet whales tagged in 2003 extended more than 300 km further south than any previously tracked winter locations.

The movement of tagged narwhals out of Admiralty Inlet was observed on average over 15 days earlier ($P < 0.0001$; T test) (Mean: 28 September, 95% CL:

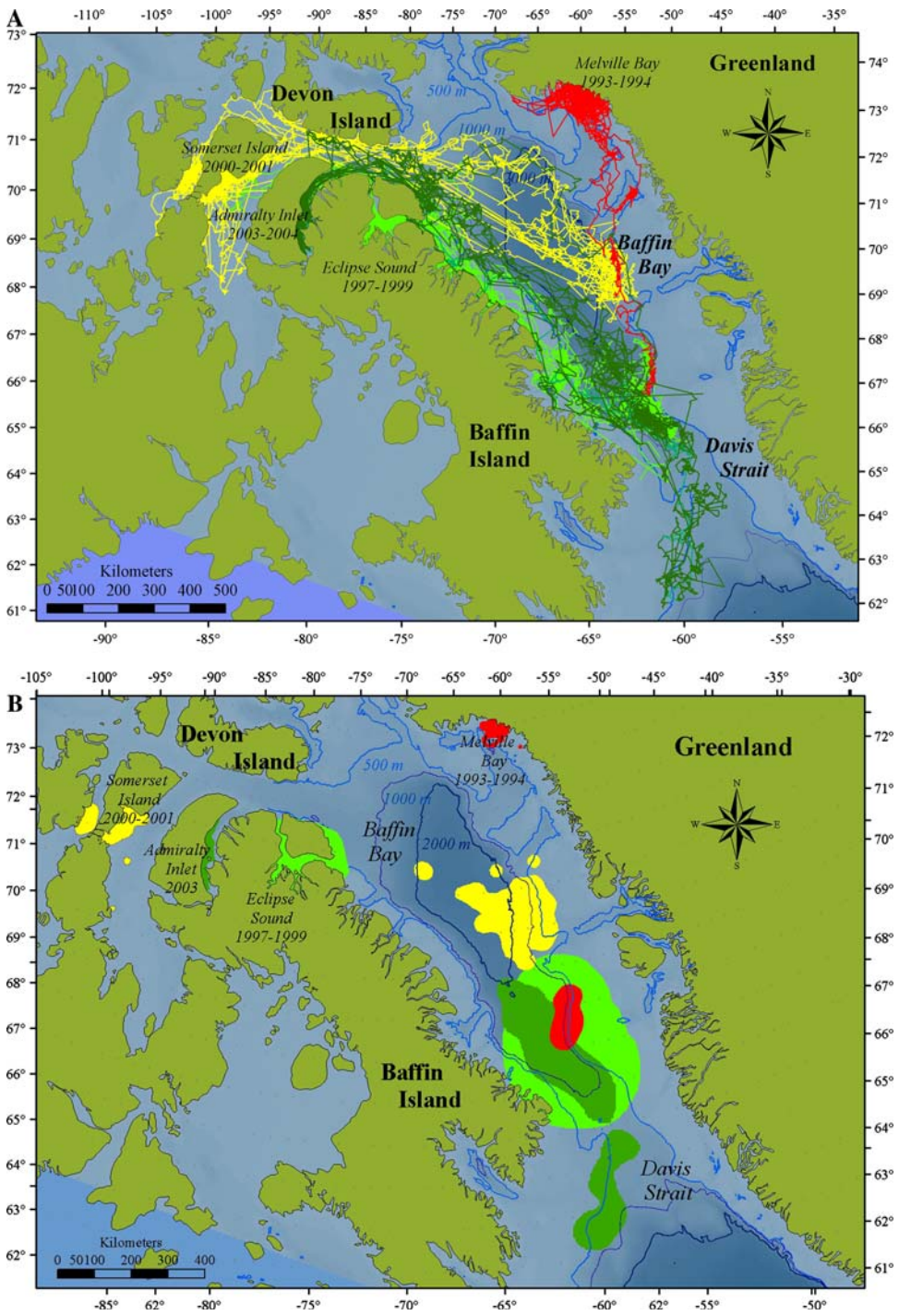

Fig. 4 **a** Tracklines; **b** kernel home range polygons for the narwhals tagged in 2003 and 2004 in Admiralty Inlet compared with previous tagging published by Dietz and Heide-Jørgensen (1995), Dietz et al. (2001), Heide-Jørgensen et al. (2002, 2003). *Dark green*, *yellow*, *light green* and *red* indicates narwhals tagged in Admiralty Inlet, Somerset Island, Eclipse Sound and Melville Bay, respectively

25 September–1 October) than the average date when tagged narwhals from Eclipse Sound (Mean: 13 October, CL: 8–18 October) passed the mouth of Admiralty Inlet on their eastward movement out of Lancaster Sound (Dietz et al. 2001; Heide-Jørgensen et al. 2003). In addition, most of the Admiralty Inlet narwhals used the southern coastline of Lancaster Sound, while the Somerset Island narwhals mainly moved out through Lancaster Sound along the northern side of the sound, along Devon Island, in a similar manner to migrating belugas from around Somerset Island (Richard et al. 1998a, b, 2001; Heide-Jørgensen et al. 2003). This suggests that during their migration out of Lancaster Sound, contact between the two narwhale populations is rather unlikely.

The tagged Admiralty Inlet narwhals ($n = 17$) reached eastward of Eclipse Sound on average 18 days later

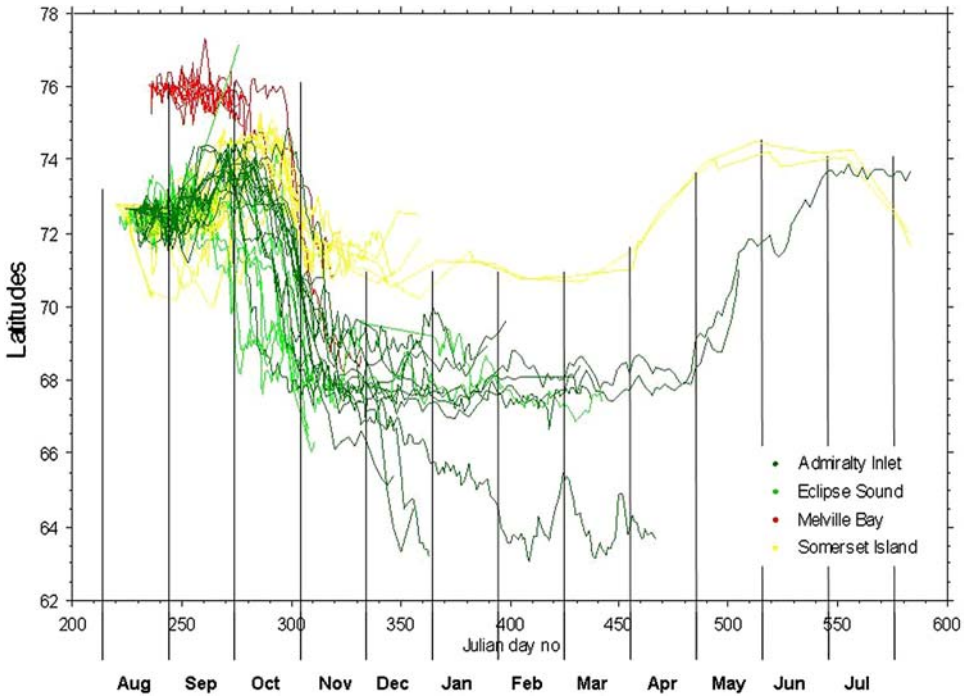

Fig. 5 The seasonal movements depicted as latitudinal presence and as a function of Julian day of the Admiralty Inlet narwhals compared to previously tagging conducted on the Melville Bay, Eclipse Sound and Somerset Island populations (Dietz and Heide-Jørgensen 1995; Dietz et al. 2001; Heide-Jørgensen et al. 2002, 2003). Julian days <220 are depicted as Julian day +365 days to obtain graphic continuity from the tagging date in August over the autumn and the following year

($P < 0.0001$; T test) in 2003 and 2004 (Mean: 12 October, CL: 8–15 October) than when the Eclipse Sound narwhals ($n = 11$) left their summering area in 1997, 1998 and 1999 (Mean: 24 September, CL: 15 September–3 October; Dietz et al. 2001; Heide-Jørgensen et al. 2002). This difference in timing could explain why Eclipse Sound narwhals had a longer migration, moving more closely along the coastline of eastern Baffin Island and sometimes (five out of nine monitored whales) entering fjords, while most of the Admiralty Inlet narwhals migrated 100 km or further offshore from the coastline on the 500 m depth contour or deeper water (Dietz et al. 2001; Heide-Jørgensen et al. 2002). The Somerset Island narwhals' southward migration took place even further offshore in Baffin Bay and ended farther north than tagged narwhals from the other areas. The Melville Bay narwhals started further east so their autumn migration was straight south, cutting through the eastern part of the Somerset Island narwhals wintering home range (Dietz and Heide-Jørgensen 1995; Laidre et al. 2003).

Two Somerset Island narwhals started their northward migration approximately a month earlier (late March) than the two Admiralty Inlet narwhals (late April; Fig. 5) and arrived in Lancaster Sound 1.5 month earlier (mid May) than the Admiralty Inlet narwhals (early July). When tagged Admiralty Inlet narwhals reached Lancaster Sound around the end of June, tagged Somerset Island narwhals had already moved 300 km westward into the sound. Even though based on a small sample size ($n = 3$), this migration pattern may suggests that the two narwhal populations, Admiralty Inlet and Somerset Island, may not enter into contact during their migration through Lancaster Sound. The Admiralty Inlet and Somerset Island narwhals therefore seem to be separated either in space or time making genetic exchange between these two stocks unlikely.

Year to year variability in range of distribution and migration

The 2003 sample of 13 narwhals tagged in Admiralty Inlet resulted in much larger summer home range compared to the 2004 sample of eight narwhals. Differences in the winter range of distribution could also be detected between 2 years as monitored by nine narwhals in the winter of 2003–2004 relative to six in the winter of 2004–2005. Differences in winter range of distribution can also be observed in tagging studies on other narwhal populations. It is therefore likely that the number of whales/pods tagged has an impact on the estimated home range and it is conceivable that it also affected our understanding of the routes and timing of migration.

The average size and age of the narwhals tagged in 2003 was larger than in 2004. Garde et al. (2007) found that the average length at physical maturity is 396 cm for females and 457 cm for males, respectively. Thus, females tagged in 2003 and 2004 and males tagged in 2004 are likely to all be adults, but three of 11 tagged males in 2003 (#7927, 7928 and 7931) measured between 335 and 365 cm and were probably sub-adults.

Nevertheless, the age or sex composition of the tagged whales does not clearly explain differences in home range between the 2 years. Juvenile males, adult males and adult

Table 3 Estimated 95% Kernel home range of narwhals at different seasons and from animals of different tagging locations and population estimates

Tagging location/year	Summer home range (km^2)	Winter home range (km^2)	Winter/summer home range	Population estimate	SE of estimate
Admiralty Inlet 2004/2004–2005	1,305	20,043	15.4	5,363[b]	2,688
Admiralty Inlet 2003/2003–2004	6,287	133,618	21.3	5,363[b]	2,688
Admiralty Inlet 2003–2004/2003–2005	5,503	82,411	15.0	5,363[b]	2,688
Somerset Island 2000–2001/2000–2002	15,399	44,183	2.9	45,358[a]	15,875
Eclipse Sound 1997–1999/1997–2000	57,702	131,772	2.3	20,216[b]	7,315
Melville Bay 1993–1994/1993–1995	4,586	14,747	3.2	4,676[c]	3,974

[a] Innes et al. (2002)

[b] DFO (unpublished)

[c] GINR (unpublished)

females all used the entire Admiralty Inlet home range in 2003. In winter, the four 2003 tagged whales that ranged farther south into Davis Strait were of mixed age–sex composition: an adult male, an adult female, and two juveniles. The two 2003 tagged juveniles (#7927 and 7928) wintered for the most part south of the 2004 winter range, while the third 2003 juvenile (#7931) spent the winter north of 68.2°N, in the northern part of the range. Only two adult animals, a 416-cm adult female (#3960) and a 448-cm adult male (#37235), both tagged in 2003, visited the area south of the 2004–2005 winter range. As only two adults out of six frequented this southern region during the winter 2003–2004, and none of the six adult narwhals monitored during the 2004–2005 winter went as far south, it is possible that this area is of lesser importance to Admiralty Inlet adult whales.

Comparison of home range size between narwhal populations and between seasons

The Admiralty Inlet animals had a smaller average winter home range than the Eclipse Sound animals, but the 2003 Admiralty Inlet home range was of comparable size (Table 3). Both of these home ranges were substantially larger than Somerset Island and Melville Bay winter home ranges. The Melville Bay tagged narwhals had the smallest home ranges both in summer and winter, although the data for winter only included two males for a short period of November and December 1993 and 1994. These home ranges do not seem to be related to the size of the population estimates. The Somerset Island population is estimated to number 45,358 narwhals while the other three populations are smaller in size (Table 3). For each population, the winter home range distribution of tagged narwhals was larger than the summer distribution, and in the case of Admiralty Inlet narwhals, that difference is particularly substantial (15 times). A likely explanation for this difference between summer and winter at least for three of the Canadian summering areas is that the fixed size of the fiords and bays they inhabit in summer limits their distribution while, in winter, their range is limited by suitable habitat in the large expanse of water of Baffin Bay and Davis Strait. Narwhals feed more during winter and may be competing for food (Greenland halibut, *Reinhardtius hippoglossoides*) and *Gonatus fabricii)* with other narwhal populations in Baffin Bay and Davis Strait, while in summer, they have a more limited food intake (Laidre and Heide-Jørgensen 2005). Finally, the dynamic pack ice in their winter range may force narwhals to move around more to find cracks in the ice to breathe. The overlap in winter range between several populations for several months suggests that there is some competition for available prey.

Year round tracking

One adult female narwhal almost provided locations for an entire year. On its return migration, this animal attempted to reach the entrance of Admiralty Inlet on July 12. However, the narwhal did not enter the fjord, probably because it was blocked by fast ice, and the transmitter did not last long enough to determine if the animal did in fact return later to Admiralty Inlet where it had been tagged the previous summer. Only two narwhals have previously been tracked longer than a year (Heide-Jørgensen et al. 2003). In that case, two narwhals instrumented in Creswell Bay, Somerset Island, in August 2000 returned to Peel Sound in August through September in the following year. Peel Sound is part of the summer home range of Somerset Island narwhals. These observations are suggestive of stock segregation and site fidelity in summer. Differences in migration routes and timing of migration noted above are also suggestive of stock segregation in the autumn and spring. In both cases, the sample sizes are small and the results could therefore be purely fortuitous.

More tracking data would be required to address this question.

Concluding remarks

This study provided information on the seasonal distribution of the Admiralty Inlet narwhal population, and added to a series of similar studies on neighboring narwhal populations. It suggests that this population's home range in summer is not likely to overlap with other narwhal populations in summer. In addition the autumn migration also seems to be separated in time and partly in space. The winter home range of the Admiralty Inlet narwhal population did not overlap with narwhals tagged around Somerset Island, but showed some overlap with narwhals from the Eclipse Sound and Melville Bay. One Admiralty Inlet animal's return migration together with previous long-term tracking of two Somerset Island narwhals provides some evidence of inter-annual site fidelity of narwhals to their summering areas. Consequently, these populations should be managed as separate stocks. This study has generated information on an additional summer population which together with previous information will be used in case-by-case advising and assessment to reduce potential conflicts with, e.g. oil and gas developments and fisheries.

Acknowledgments This study was funded by the Danish National Environmental Research Institute, the Greenland Institute of Natural Resources, Department of Fisheries and Oceans, Canada, the Nunavut Wildlife Research Trust Fund and the Danish Cooperation for the Environment in the Arctic (DANCEA). We wish to thank hunters from Arctic Bay for their participation in the live-capture of these narwhals. In addition, Mehdi Baktiari, Sandy Black, Greg O'Corry Crowe, Henrik Egede Lassen, Moe Keenainak, Martin Nweeia, Jim Orr, Ari Shapiro and Keith Yip participated in the capture and handling of the narwhals in 2003 and 2004. The Polar Continental Shelf Project provided important logistic support to the field camp during our stay in Admiralty Inlet. Software developed by David C. Douglas (Marine and Freshwater Ecology Branch, USGS Alaska Science Center, Alaska, USA) was used for filtering locations.

References

Born EW, Heide-Jørgensen MP, Larsen F, Martin AR (1994) Abundance and stock composition of narwhals (*Monodon monoceros*) in Inglefield Bredning (NW Greenland). Medd Groenl Biosci 39:51–68

Dietz R, Heide-Jørgensen MP (1995) Movements and swimming speed of narwhals (*Monodon monoceros*) instrumented with satellite transmitters in Melville Bay, Northwest Greenland. Can J Zool 73:2106–2119

Dietz R, Heide-Jørgensen MP, Born EW, Glahder CM (1994) Occurrence of narwhals (*Monodon monceros*) and white whales (*Delphinapterus leucas*) in West Greenland. Medd Groenl Biosci 39:69–86

Dietz R, Heide-Jørgensen MP, Richard PR, Acquarone M (2001) Summer and fall Movements of Narwhals (*Monodon monoceros*) from Northeastern Baffin Island towards Northern Davis Strait. Arctic 54(3):246–263

Dietz R, Rigét F, Hobson K, Heide-Jørgensen MP, Møller P, Cleemann M, de Boer J, Glacius M (2004) Regional and inter annual patterns of heavy metals, organochlorines and stable isotopes in narwhals (*Monodon monoceros*) from West Greenland. Sci Tot Environ 331(1–3):83–105

Dietz R, Shapiro A, Baktiary M, Orr J, Tyack P, Richard P, Eskesen IG, Marshall G (2007) First-ever observations of upside-down swimming behaviour of free-ranging narwhals. BMC Ecol 19(7):14

Garde E, Heide-Jørgensen MP, Hansen S, Nachman G, Forchhammer M (2007) Age-specific growth and high longevity in narwhals (*Monodon monoceros*) from West Greenland estimated via aspartic acid racemization. J Mammal 88(1):49–58

Hay KA, Mansfield AW (1989) Narwhal *Monodon monoceros* Linnaeus, 1758. In: Ridgway SH, Harrison R (eds) Handbook of marine mammals, pp 145–176

Harris RB, Fancy SG, Douglas DC, Garner GW, Amstrup SC, McCabe TR, Pank LF (1990) Tracking wildlife by satellite: Current systems and performance. United States Department of the Interior, Fish and Wildlife Service, Fish and Wildlife Technical Report 30, 52 pp

Heide-Jørgensen MP, Dietz R (1995) Some characteristics of narwhal, (*Monodon monoceros*), diving behaviour in Baffin Bay. Can J Zool 73:2120–2132

Heide-Jørgensen MP, Hammeken N, Dietz R, Orr J, Richard PR (2001) Surfacing Times and Dive Rates for Narwhals (*Monodon monoceros*) and Belugas (*Delphinapterus leucas*). Arctic 54(3):284–298

Heide-Jørgensen MP, Dietz R, Laidre K, Richard PR (2002) Autumn movements, home ranges and winter density of narwhals (*Monodon monoceros*) from Tremblay Sound, Baffin Island. Pol Biol 25:331–341

Heide-Jørgensen MP, Dietz R, Laidre KL, Richard PR, Orr J, Schmidt HC (2003a) The migratory behaviour of narwhals (*Monodon monoceros*). Can J Zool 81:1298–1305

Heide-Jørgensen MP, Richard PR, Dietz R, Laidre KL, Orr J (2003b) An estimate of the fraction of belugas (*Delphinapterus leucas*) in the Canadian High Arctic that winter in West Greenland. Pol Biol 26:318–326

Hooge PN, Eichenlaub B (2000) Animal movement extension to Arcview. Ver. 2.0. Alaska Science Center, Biological Science Office. US Geological Survey, Anchorage

Innes S, Heide-Jørgensen MP, Laake J, Laidre K, Cleator H, Richard P (2002) Surveys of belugas and narwhals in the Canadian high Arctic in 1996. In: Heide-Jørgensen MP, Wiig Ø (eds) Belugas in the North Atlantic and the Russian Arctic. NAMMCO Sci Publ 4:169–190

Jakobsson M, Cherkis N, Woodward J, Macnab R, Coakley B (2000) New grid of Arctic bathymetry aids scientists and mapmakers, Eos Trans. AGU 81(9):89–89. doi:10.1029/00EO00059

Koski WR, Davis RA (1994) Distribution and numbers of narwhals (*Monodon monoceros*) in Baffin Bay and Davis Strait. Medd Groenl Biosci 39:15–40

Laidre KL, Heide-Jørgensen MP (2005) Winter feeding intensity of narwhals (*Monodon monoceros*). Mar Mam Sci 21(1):45–57

Laidre KL, Heide-Jørgensen MP, Dietz R (2002) Diving behaviour of narwhals (*Monodon monoceros*) at two coastal localities in the Canadian Arctic. Can J Zool 80:624–635

Laidre KL, Heide-Jørgensen MP, Dietz R, Hobbs RC (2003) Deep-diving by narwhals, *Monodon monoceros*: differences in foraging behavior between wintering areas? Mar Ecol Prog Ser 261:269–281

Laidre KL, Heide-Jørgensen MP, Logsdon ML, Hobbs RC, Dietz R, Van Blaricom GR (2004a) Fractal analysis of narwhal space use patterns. Zoology 107:3–11

Laidre KL, Heide-Jørgensen MP, Logsdon ML, Hobbs RC, Heagerty CP, Jørgensen OA, Dietz R, Tremble MA (2004b) Seasonal narwhal habitat associations in the high Arctic. Mar Biol 145:821–831

Lydersen C, Martin AR, Gjertz I, Kovacs KM (2007) Satellite tracking and diving behaviour of sub-adult narwhals (*Monodon monoceros*) in Svalbard, Norway. Polar Biol 30:437–442

Martin AR, Kingsley MCS, Ramsay MA (1994) Diving behaviour of narwhals on their summer grounds. Can J Zool 72:118–125

Palsbøll P, Heide-Jørgensen MP, Dietz R (1997) Genetic studies of narwhals, *Monodon monoceros*, from West and East Greenland. Heredity 78:284–292

Richard PR, Weaver P, Dueck L, Barber D (1994) Distribution and numbers of Canadian High Arctic narwhals (*Monodon monoceros*) in August 1984. Medd Groenl Biosci 39:41–50

Richard PR, Heide-Jørensen MP, St Aubin D (1998a) Fall Movements of Belugas *(Delphinapterus leucas)* with Satellite-linked Transmitters in Lancaster Sound, Jones Sound, and Northern Baffin Bay. Arctic 51(1):5–16

Richard P, Orr J, Dietz R, Dueck L (1998b) Sighting of belugas, other marine mammals in the North Water, late March 1993. Arctic 51(1):1–4

Richard PR, Heide-Jørgensen MP, Orr JR, Dietz R, Smith TG (2001) Summer and autumn movements and habitat use by belugas in the Canadian high Arctic and adjacent areas. Arctic 54(3):207–222

Service Argos Inc (1989) Guide to ARGOS system, September 1989. Gls Argos, Toulouse

ARCTIC
VOL. 54, NO. 3 (SEPTEMBER 2001) P. 244–261

Summer and Fall Movements of Narwhals (*Monodon monoceros*) from Northeastern Baffin Island towards Northern Davis Strait

R. DIETZ,[1,2] M.P. HEIDE-JØRGENSEN,[3] P.R. RICHARD[4] and M. ACQUARONE[1]

(*Received 1 February 2000; accepted in revised form 2 November 2000*)

ABSTRACT. Ten narwhals (*Monodon monoceros*) were instrumented with satellite-linked radio transmitters in Tremblay Sound in August 1997 (N = 5) and August 1998 (N = 5). All whales stayed in the waters around Bylot Island until the end of September. On the basis of these animals and others tagged previously (total N = 24), it is believed that the Bylot Island summering population has limited or no contact with other summering populations in Canada or Greenland. Four whales were monitored during their southward movement along the east coast of Baffin Island. Three of them travelled close to the shore, visiting several fjords and bays, during September and October. The fourth whale started the southward migration at the same time as the other three, but it returned to the area east of Pond Inlet and made two trips northeast of Bylot Island. It headed south on 21 October 1998. South of Royal Society Fiord, it travelled offshore along the continental slope (1000 to 1500 m), probably because of ice formation in inshore areas. This narwhal and another male tagged in 1997 moved east toward the northern parts of the Davis Strait, reaching an area midway between Canada and Greenland in early November. Their winter movements were monitored until 30 January. The same wintering area in northern Davis Strait was previously documented for two male narwhals tracked from Melville Bay, NW Greenland, in 1993 and 1994. The whales showed a preference for deep areas, including deep fjords and the continental slope, where depths ranged between 500 and 1500 m. Even deeper areas, where maximum daily dives exceeded 1000 m, were also visited occasionally.

Key words: narwhal, *Monodon monoceros*, High Arctic, satellite telemetry, movements, migration, population, stock identity

RÉSUMÉ. On a équipé 10 narvals (*Monodon monoceros*) d'émetteurs radioélectriques en liaison avec un satellite dans le détroit de Tremblay en août 1997 (N = 5) et en août 1998 (N = 5). Toutes les baleines sont restées dans les eaux entourant l'île Bylot jusqu'à fin septembre. En considérant ces animaux et d'autres équipés précédemment (N total = 24), on pense que la population estivale de l'île Bylot n'a que peu, sinon pas de contact avec d'autres populations estivales du Canada ou du Groenland. Quatre baleines ont fait l'objet d'un suivi au cours de leur déplacement vers le sud le long de la côte est de l'île de Baffin. Durant les mois de septembre et d'octobre, trois d'entre elles longeaient la côte de près, effectuant des pauses dans divers fjords et baies. La quatrième a commencé sa migration vers le sud en même temps que les trois autres, mais elle est retournée dans la zone à l'est de Pond Inlet et s'est rendue par deux fois au nord-est de l'île Bylot. Elle a mis le cap vers le sud le 21 octobre 1998. Au sud du fjord Royal Society, elle s'est dirigée vers le large et a longé la pente continentale (à environ 1000 à 1500 m du rivage), probablement en raison de la formation de glace dans la zone côtière. Ce narval ainsi qu'un autre mâle équipé en 1997 se déplaçaient en direction de l'est vers la partie nord du détroit de Davis, atteignant début novembre une zone située à mi-chemin entre le Canada et le Groenland. En hiver, leurs déplacements ont été suivis jusqu'au 30 janvier. La même zone d'hivernage dans le nord du détroit de Davis a déjà été rapportée pour deux narvals mâles suivis en 1993 et 1994 depuis la baie Melville, au N.-O. du Groenland. Les baleines affichaient une préférence pour des zones profondes, y compris des fjords encaissés et la pente continentale, où la profondeur allait de 500 à 1500 m. De temps à autre, les baleines se rendaient aussi dans des zones encore plus profondes, où les plongées maximales quotidiennes dépassaient les 1000 m.

Mots clés: narval, *Monodon monoceros,* Extrême-Arctique, télémesure par satellite, déplacements, migration, population, identité des stocks

Traduit pour la revue *Arctic* par Nésida Loyer.

[1] Department of Arctic Environment, National Environmental Research Institute, Denmark, Frederiksborgvej 399, Post-box 358, DK-4000, Roskilde, Denmark

[2] Present address: Danmarks Akvarium, Kavalergården 1, 2920 Charlottenlund, Denmark: dietz@akvarium.dk

[3] Greenland Institute of Natural Resources, Boks 570, DK-3900 Nuuk, Greenland

[4] Department of Fisheries and Oceans, Arctic Research Division, Freshwater Institute Science Lab, 501 University Crescent, Winnipeg, Manitoba R3T 2N6, Canada

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INTRODUCTION

The narwhal (*Monodon monoceros*) occurs in inshore areas of northeastern Canada and Greenland during the open-water season, from July through September (Born et al., 1994; Dietz et al., 1994; Kingsley et al., 1994; Richard et al., 1994). By the time the Arctic fjords and bays freeze over in autumn, narwhals are leaving these areas. They apparently make long-distance movements between summering and wintering grounds (Dietz and Heide-Jørgensen, 1995). During winter and early spring (8–10 months), narwhals frequent areas covered with dense offshore pack ice (Koski and Davis, 1994). Although gross patterns of seasonal migration have been inferred from whaling records and various observational studies (e.g., Born et al., 1994; Koski and Davis, 1994; Richard et al., 1994), little is known about genetic exchange and movements of individual narwhals between summer and winter areas. Although a study of the population structure based on mtDNA revealed low nucleotide diversity, a significant level of heterogeneity was detected between a number of combinations of three West Greenlandic sampling areas and a combined group from eastern Canada and northwestern Greenland (Palsbøll et al., 1997). However, the sample size from Canada was too small (N = 29) to support conclusive analyses of population structures there.

Narwhals are hunted in both Canada and Greenland. Knowledge about stock discreteness is important for managing this exploitation. Other human activities such as shipping, commercial fishing, and development of nonrenewable resources (e.g., offshore oil and gas) may also have impacts on the feeding ecology and migrations of narwhal populations.

The remoteness and inaccessibility of areas inhabited by narwhals make these animals difficult to study in the field using traditional methods. Recent advances in satellite tracking have made it possible to monitor the movements of narwhals (Martin et al., 1994; Dietz and Heide-Jørgensen, 1995; Heide-Jørgensen and Dietz, 1995).

The objectives of the present study were to 1) assess site tenacity in coastal areas where narwhals congregate during the open-water season; 2) identify critical habitats, migration routes, and wintering grounds; and 3) examine the exchange among whales from different open-water aggregations.

MATERIALS AND METHODS

Study Area

The whales were all tagged off the Alpha River delta in Tremblay Sound (72°21.382′ N, 81°05.951′ W). Tremblay Sound is a narrow (down to 1.5 km wide) fjord about 45 km long with maximum depths of up to 275 m. The fjord is bordered with high (500 m or more) steep-sided mountains of the Lancaster Plateau (Sempels, 1982). The shores of Tremblay Sound are hence mainly steep-sided cliffs, but also promontories of low bluffs or raised beaches with shores of sand and gravel (Sempels, 1982). This fjord is a well-described narwhal habitat, and whales have previously been successfully captured and tagged there (Kingsley, 1993; Kingsley et al., 1994; Martin et al., 1994).

According to Inuit hunters camped in Tremblay Sound, the fast ice left the fjord in the middle of July 1998, and the first narwhals were seen on 28 July (J. Mucktar, pers. comm. 1998). No ice was present in the vicinity of the Alpha River during the tagging period (5 to 30 August) in either 1997 or 1998. Similar ice-free conditions were experienced in 1989 and 1991, whereas the fjord was packed with ice in 1993 and 1999 (Kingsley, 1993; Dietz and Heide-Jørgensen, pers. observation 1999).

In 1997, no hunting activities were observed close to the Alpha River, but a few boats travelled the sound, and two groups of hunters camped in Tremblay Sound during our stay. In addition to the narwhals, two bowhead whales (*Balaena mysticetus*), several ringed seals (*Phoca hispida*) and Greenland sharks (*Omnicephalus maximus*) were observed in the sound that year. Again in 1998, few boats were observed in the fjord. No bowheads were observed in 1998, but ringed seals, pods of harp seals (*Phoca groenlandica*), and Greenland sharks were observed in addition to the narwhals that year.

Capturing and Handling of the Whales

Five narwhals were caught in nets at the Alpha River delta between 8 and 24 August 1997 and tagged with satellite-linked transmitters. In 1998, five narwhals were likewise tagged at the same spot between 14 and 25 August. As in previous studies, the whales were captured in nets set close to the surface and perpendicular to the shoreline. The nets used in 1997 were deep, dark green and 5 m deep, with 20 × 20 cm mesh. Those used in 1998 were black and 10 m deep, with 40 × 40 cm mesh. The 1998 nets proved to be more effective, as almost no whales avoided them or became aware of their presence before entanglement.Three sections of net, each 50 m long, were kept afloat by white buoys. The nets were anchored at one end to a large stone on the beach and attached at the other end to a 200 L oil drum filled with stones, which served as an anchor in the water. The nets were kept under daily constant surveillance, and the presence of narwhals in the fjord was also monitored. Immediately after a whale became entangled, two inflatable boats were paddled or pulled towards the captured animal. Use of outboard engines was avoided as far as possible to minimize acoustic stress on the whales. The nets and narwhals were pulled to the surface to ensure that the animals could breathe and position them for the tagging operation. Oars (2.5 m) were placed between the boats through the nets to secure the animals during handling and to keep the boats separated. Ropes and transport belts were placed around the chest, tail, and tusk to secure the animal while the transmitters

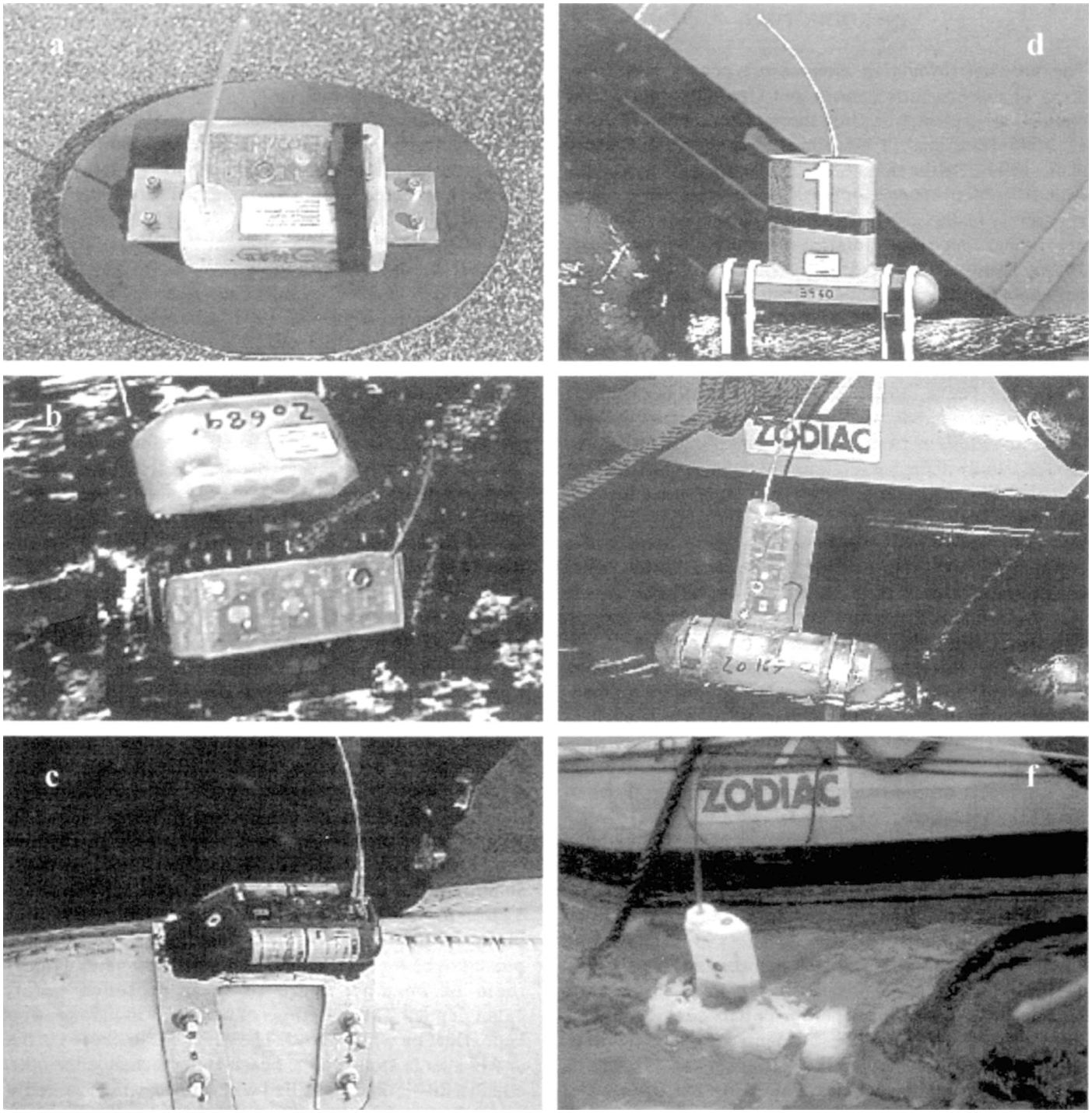

FIG. 1. Three first generations of narwhal (and beluga) backpack satellite transmitters (a–c) and three tusk transmitter generations (d–f).

were attached. After instrumentation, the nets were removed from the animals. Finally, the transport belts were detached at one end and the whales were released.

Instrumenting the Whales

Four whales, one female and one small male with a 40 cm tusk (external) in 1997 and two adult females in 1998, were instrumented with backpack transmitters that were pinned through the dorsal ridge. These transmitters had a power output of 0.5 W (ST-6, Telonics, Mesa, Arizona) and were programmed and cast in epoxy by Wildlife Computers (Woodinville, Washington). Three of the transmitters (#20682, #20691, and #20692) were of the second generation, each with two housings measuring $3 \times 4.5 \times 14$ cm, one covering the battery package and the other the ST-6 transmitter (see Fig. 1a-c). The unit weighed approximately 950 g in air and 150 g in water. The saddle, 20 cm

long and 24 cm wide, was made of a rubber material 5 mm thick (Ureol® polyurethane, composed of type XB 5073-1 and 6414 B in the proportion 100:18). Each transmitter, powered by four lithium C cells (3.5 V), was capable of 54 000 transmissions at 0°C. The third female (#20696) was instrumented with a fourth-generation transmitter with a single housing (3 × 4.5 × 14 cm) covering both the ST-10 transmitter and the battery package (four 3.5 V lithium C cells). This unit also weighed approximately 950 g in air and 150 g in water. The transmitter was glued to a saddle made of 1.5 mm thick belt material (Fig. 1c). The saddle was 20 cm long, with a belt in each end extending 15 cm to each side. Each belt was 5 cm wide and pre-punched with a row of holes. Excess belt material beyond the selected holes was cut off to minimize drag during swimming. The saddle was secured to the animal with two 8 mm pins of flexible polyethylene (PEHD 1000) held in place by washers and nuts. The ends of the pins were cut to a length of 1 cm and compressed with pliers to prevent the nuts from loosening.

Six male narwhals with tusks measuring between 0.6 and 2.1 m (external length) were fitted with 0.5 W satellite-linked UHF transmitters (ST-6, Telonics, Mesa, Arizona), also manufactured by Wildlife Computers (Redmond, Washington) (Fig. 1d-f). The housings of the second- and third-generation transmitters both measured 8 (3.5) × 21 (6.5) × 27 (8) cm (width × height × length; max (min) measures) and weighed approximately 1 kg in air and about 400 g in water. We deployed four second-generation transmitters with a pressure transducer maximum of 1000 m (cast in transparent epoxy) and two third-generation transmitters with a pressure transducer maximum of 1500 m (cast in yellow epoxy; see Fig. 1e-f). The transmitter housings were hydrodynamically designed to minimize both water resistance and reflection of sonar signals. These transmitters were powered by eight lithium C cells (expected capacity of 180 000 transmissions at 0°C).

The housing units were attached to the tusks by two 316-type stainless steel bands that were 19 mm wide (Band-it, Houdaille, Denver, Colorado). The tusk is assumed to rotate towards the left as it grows (e.g., Thompson, 1963; Kingsley and Ramsay, 1988); therefore, the transmitters were tilted slightly to the right side of the animal, so that the antennae would remain in an upright position for a longer time. None of the transmitters were duty-cycled. In 1997, a daily maximum of 500 transmissions was programmed to save battery power, but as this limit was seldom reached, no such upper limit was programmed in 1998. A saltwater switch triggered transmissions 0.2 s after the switch emerged from the water. The minimum time between transmissions (repetition rate) of the transmitters was 45 s. Each transmission contained 14 bytes of information. A status message was relayed every 15th transmission with information on sum of transmissions as well as the battery voltage. Data from the transmitters were relayed via the ARGOS DCLS system (Service Argos Inc., 1989; Harris et al., 1990).

Signal Monitoring in the Field

Before deploying the transmitters, we tested them in the field using a local uplink receiver (Telonics: TSUR-B Argos Uplink Receiver). The uplink receiver was connected to a PC to log and monitor signals within the fjord, evaluate whale behaviour after release, and determine how long the animals stayed in Tremblay Sound after the tagging. The uplinks also kept the team updated on the presence of whales nearby.

Maps

Only good-quality positions of Class 1 to 3 were used for the drawing of the maps. The Argos system predicts the accuracy of the best quality, Class 3, to be 150 m or less from the animal's real position for 68% of the locations The corresponding predictions are 350 m or less for Class 2 and 1 km or less for Class 1. Studies on seals have shown that the distances between predicted and observed positions are on average two to three times higher than ARGOS predicts. (e.g., Stewart et al., 1989; McConnell et al., 1992; Goulet et al., 1999). These positions were used to map the routes taken by 6 of the 10 tagged narwhals that had 24 or more "good" positions.

Maps were produced with ArcView GIS system for Windows NT by ESRI, using digital coastline and bathymetry derived from the GEBCO Digital Atlas (GEBCO 97 edition). Place names mentioned in the text and figures were extracted from Canadian Hydrographic Service nautical charts.

We included data from two of nine narwhals tagged in Greenland in 1993 and 1994 (Dietz and Heide-Jørgensen, 1995) to illustrate the common wintering area and the timing and rate of the southward migration.

RESULTS

Bylot Island Fjord Complex as a Summering Area

Table 1 gives information on the dates of capture, sex, and size of the 10 narwhals equipped with satellite-linked transmitters off the Alpha River delta during 8–24 August 1997 and 14–25 August 1998.

During the summer period of both years (10 August–22 September), the whales stayed within the Bylot Island area, including Tremblay Sound, Milne Inlet, Eclipse Sound, Navy Board Inlet, Oliver Sound, and Pond Inlet (see also Fig. 2 and Table 2). Only one position was obtained from Navy Board Inlet, suggesting limited use of this part of the fjord complex. No positions were obtained from Lancaster Sound or the more western summering areas of Admiralty Inlet and Prince Regent Inlet.

No good-quality positions were obtained from Tremblay Sound (or Milne Inlet) in 1997 even though the animals stayed for a considerable time (up to 12 hours after the

TABLE 1. Information on ten narwhals instrumented with satellite-linked transmitters.

Tag #	Type[1]	Date	Sex	Length (cm)	Tusk length (cm)
1997:					
20682	B	August 8	Female	400	–
3963	T	August 19	Male	375	83
20691	B	August 21	Male	306	40
3964	T	August 21	Male	370	63
6335	T	August 24	Male	440	137
1998:					
3960	T	August 14	Male	400+	148
20692	B	August 19	Female	380	–
20162	T	August 21	Male	475	190
3961	T	August 25	Male	500	210
20696	B	August 25	Female	380	–

[1] B = Backpack transmitter; T = Tusk transmitter.

tagging) in Tremblay Sound, as monitored in the field by a local uplink receiver (Fig. 3a, b). In contrast with the 1997 results, the 1998 tagging produced good-quality positions from both Tremblay Sound and Milne Inlet (including its offshoot, Koluktoo Bay) (Fig. 4a-d), indicating a connection between the whales that frequent these fjords. In both 1997 and 1998, the whales showed a preference for deep areas (500 to 750 m) in Eclipse Sound and Pond Inlet, whereas few or no positions were obtained from Navy Board Inlet and the narrow fjords east of Milne Inlet. The whales may have avoided some of these areas because they lack deep water (e.g., Assumption Harbour and Ragged Island Sound, both less than 170 m deep). However, even fjords with intermediate depths (up to 430 m) were not visited (e.g., Eskimo Inlet, White Bay, and Paquet Bay), and no visits were recorded in the rather deep Tay Sound (up to 640 m). Of the two fjords for which we have no information on depth (Oliver Sound and Stevenson Inlet), only Oliver Sound was visited, and that was only once by one animal (see Table 2).

Eastern Baffin Island and the Autumn Migration

In 1997, only one narwhal was monitored on its southward migration, whereas in 1998 three whales were tracked as they moved south along the east coast of Baffin Island (Fig. 5). In both years, the whales left the Bylot Island area between 20 and 29 September (Figs. 3b, 4b-d).

Narwhal #6335 was tracked for 76 days in 1997, over more than 4026 km (Figs. 3b, 6, 7). While moving south along the east coast of Baffin Island, this whale visited a number of fjords (Table 3). It showed a preference for deep areas at the mouths of Royal Society Fiord (400–550 m; north of Bergesen Island), Clark Fiord (500–700 m), and Sam Ford Fiord (550–660 m), as well as for the continental slope (500–1000 m) east of Home Bay and Kangeeak Point, all of which are deeper than the shallow (< 200 m) banks on the continental shelf (Figs. 3b and 6). Narwhal #6335 also clearly avoided the shallow (down to 14 m) Hecla and Griper Bank on its way south. It is uncertain whether it visited other fjords (e.g., Clyde Inlet), but the lack of positions and the rapidity of the southward migration suggest that it would have had little time for such visits. This animal travelled as far south as Broughton Island, and then moved northeast towards the deep southern part of Baffin Bay. It was tracked to the continental slope, where it transmitted the last position on 7 November at around 69°N, 59°W, in the very same area that had been frequented by two male narwhals from Melville Bay in early December of 1993 and 1994 (Dietz and Heide-Jørgensen, 1995). The last position of #6335 was only 3.5 km from the closest position of the narwhals tagged in Melville Bay.

Narwhal #20696, tagged in 1998, was the only female tracked on its southward migration. It covered more than 2742 km over the 49 days of tracking (Figs. 4b and 6). This female left the Bylot Island area on 28 September, one week later than the two males tracked the same autumn. Moving southward along the east coast of Baffin Island, female #20696 visited five of the nine fjords frequented by all four narwhals tracked along this route. When we lost contact with the transmitter on 13 October, the female had reached 69°N, 66°W east of Home Bay.

The two male narwhals tracked southward in 1998 (#20162 and #3961) left Bylot Island on the same date (20 September) and migrated from Coutts Inlet along Baffin Island, visiting deep fjords, e.g., Buchan Through (500–700 m), Buchan Gulf (200–800 m), and Royal Society Fiord (Figs. 5 and 6). Narwhal #20162 remained in this area for two days, whereas narwhal #3961 continued south along Baffin Island: following a route similar to that of narwhal #6335 in 1997, it visited Scott Inlet (250–700 m), Sam Ford Fiord (400–600 m), and the continental slope (500–1000 m) east of Home Bay and Kangeeak Point. As in 1997, the whales showed no interest in the shallow areas (less than 200 m) of the continental shelf along Baffin Island and the shallow Hecla and Griper Bank (only 14 m deep). Narwhal #3961 started to move east off Broughton Island but then decided to head farther south to Cape Dyer, where contact was lost on 4 November.

After the two days' stay in Royal Society Fiord, #20162 returned north on 22 September towards an area east of Pond Inlet, where it stayed from 26 September to 4 October (Figs. 4d, 6, 8). It then moved north to an area east of Bylot Island, at the north end of the deep, narrow basin. On 8 October, it returned to the mouth of Pond Inlet, then moved north again, this time to the deepwater areas farther east of Bylot Island, where it stayed until 21 October. Narwhal #20162 then moved southward towards Royal Society Fiord, taking essentially the same route that it had taken a month earlier in company with #3961. Thereafter, it moved farther east towards the 1500 m contour, which it followed, without visiting any of the Baffin Island fiords, until it reached the latitude of Broughton Island. It moved 6 latitudinal degrees south (more than 650 km) in 16 days (Fig. 8).

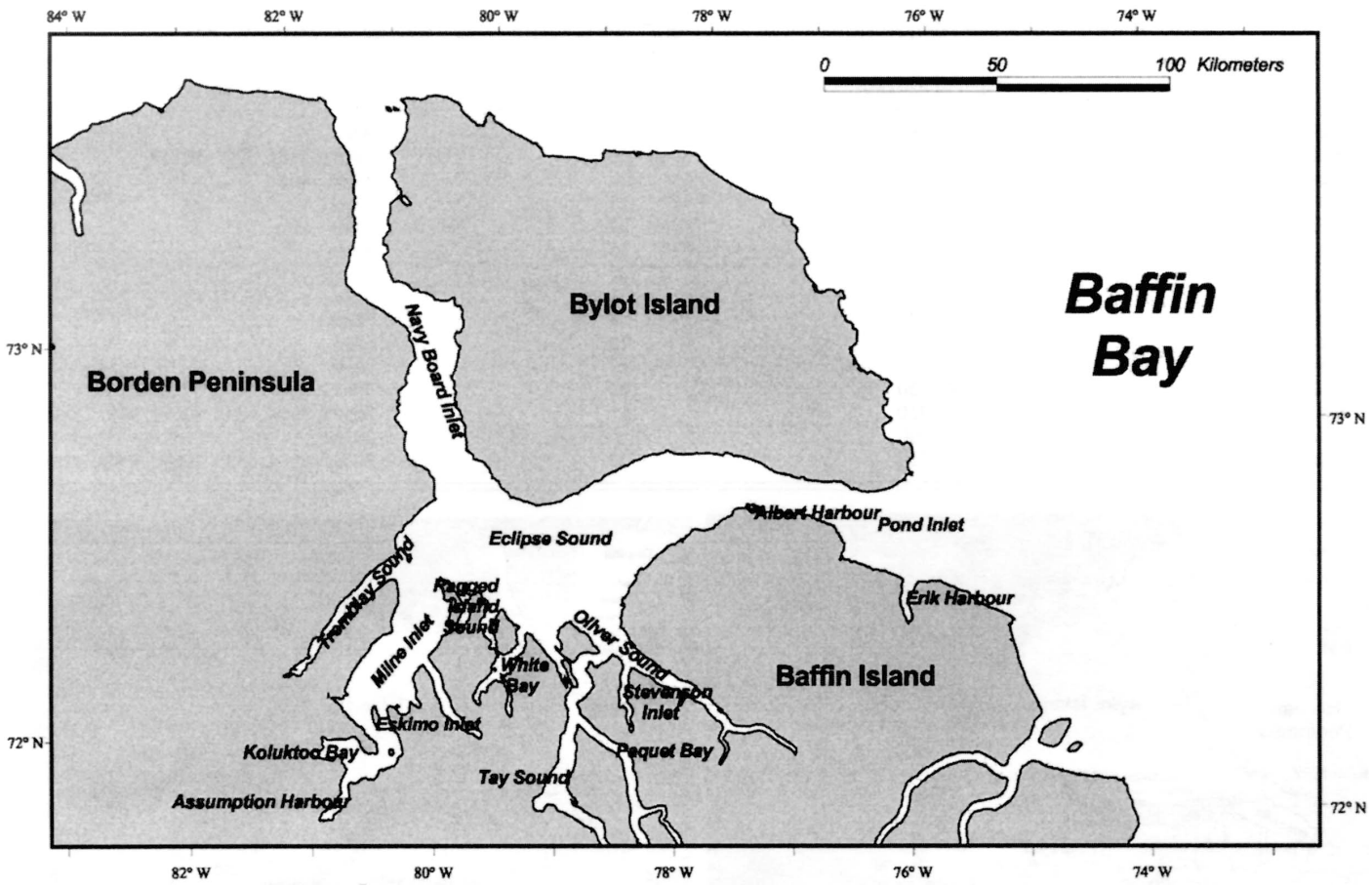

FIG. 2. Map showing place names in the Bylot Island area.

The whales that had time to visit the fjords of Baffin Island on their way south clearly preferred the deep fjords that extend close to the continental slope. Their rapid southward migration may have precluded visiting deep fjords situated or extending farther west (see Table 4).

Offshore Wintering Areas

After narwhal #6335 had reached its southern limit, it continued moving east until it reached the area used by the narwhals from Melville Bay. It arrived there, however, on 7 November, two weeks earlier than the Melville Bay narwhals. As the last contact with #6335 was on that date, it is impossible to conclude, from the 1997 data, whether it (and other narwhals) remained in the area for the winter.

Narwhal #20162 started moving east towards the 1000 m contour off Greenland on 5 November 1998, arriving there on 10 November (Figs. 6 and 7). This was the same area (69° N, 59° W) frequented by the "Canadian" narwhal (#6335) tagged in 1997 and by the two male narwhals from Melville Bay, and the arrival dates of all four whales were within a two-week period of November (Figs. 6 and 7). Narwhal #20162 stayed between 59° and 60° W and travelled south and north along the 1000 m contour between 67° and 70° N. It reached 68°18′N, 60° W on 10 November. From there it went south and arrived at its most southern latitude, 67°48′ N, on 15 November. Over the next two weeks, it went north to its most northern wintering latitude, 69°36′ N. Between 29 November and 7 January, narwhal #20162 went south and north twice between 68°30′ N and 69°30′ N. It then moved south to 68° N, perhaps because of severe ice conditions (NOAA satellite ice map from January 1999). It stayed at that latitude from 18 to 30 January, after which the transmitter stopped operating (Figs. 6 and 7).

Timing and Rate of the Southward Movement

The rate of southward movement by "Canadian" narwhals was similar to that of the narwhals from Greenland (Dietz and Heide-Jørgensen, 1995). However, the narwhals from the Bylot Island area started their southward movement approximately one month earlier (22–29 September) than the Melville Bay whales (ca. 22 October). One exception was male narwhal #20162, which went back north and stayed another month east of Bylot Island. As most narwhals from the Bylot Island area moved only 4.5° (500 km) south, compared with 7.5° (833 km) for the Melville Bay narwhals, the Bylot Island area animals took less time than the narwhals from Melville Bay (3 weeks vs. 4–5 weeks) to reach their southernmost positions (Fig. 8).

TABLE 2. The fjords of the Bylot Island area, showing depth and length characteristics and visits by narwhals in 1997 and 1998.

Fjord	Depth Range (m)	Length (km)	Visited by Narwhal No:
Tremblay Sound	90–260	41	All
Milne Inlet	150–850	52	3960, 20696, 3961, 20162
Koluktoo Bay	150–320	20	3960, 3961
Assumption Harbour	150–170	15	None
Eskimo Inlet	30–285	24	None
Ragged Island Sound	40–110	15	None
White Bay	40–410	26	None
Tay Sound	100–640	61	None
Paquet Bay	300–430	54	None
Oliver Sound	?	72	6335
Stevenson Inlet	?	19	None
Navy Board Inlet	100–550	120	3963
Eclipse Sound	100–750	111	20691, 3964, 6335, 20696, 3961, 20162
Albert Harbour	10–090	4	20162
Pond Inlet	100–750	52	20691, 3964, 6335, 20696, 3961, 20162

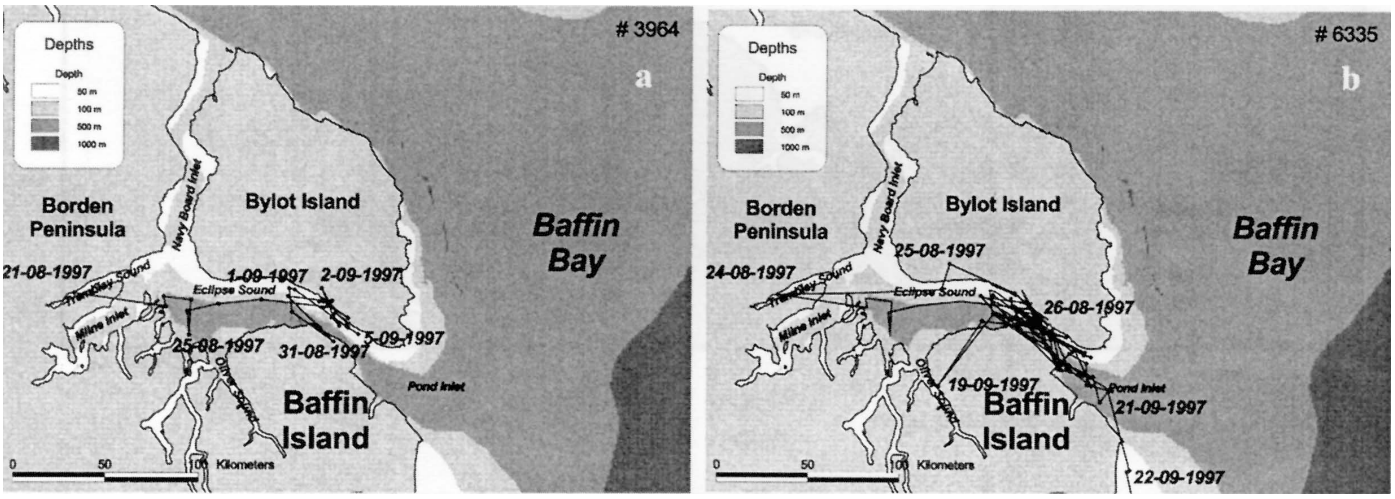

FIG. 3. a: Movements of adult male narwhal #3964 (length: 370 cm, tusk: 63 cm), tracked for 430 km from 21 August through 5 September 1997. b: Close-up of the Bylot Island area movement of adult male narwhal #6335 (length: 440 cm, tusk: 137 cm) from 24 August to 23 September 1997. See Figure 6 for the complete track of this whale. Only good-quality positions (Class 1–3) are shown.

Performance of the Backpack Transmitters

Three backpack transmitters of the second generation were deployed (on #20682 and #20691 in 1997 and on #20692 in 1998), and their average transmitter longevity was 41 days. Although 11 923 transmissions (on average) were sent from each of the three platform transmitter terminals (PTTs), only two Class 1–3 positions and 67 Class 0 positions were obtained in total from these three whales (Table 4).

However, the fourth-generation transmitter (#20696) deployed in 1998 provided three times as many uplinks (33261) on average, resulting in as many as 470 "good" positions (Class 1–3) and 473 positions with unknown accuracy (Class 0). This large difference must be ascribed to the design of the fourth-generation transmitters, which placed the PTT centrally on the saddle (see Fig. 1c). This placement elevated the antennae 3–4 cm higher than on the second-generation transmitters, which had the PTT unit and the battery package on opposite sides of the saddle. We therefore stopped using the second-generation design in subsequent studies on narwhals, as their lack of a protruding dorsal ridge leaves the antennae and saltwater switch too low in the water.

Performance of the Tusk-Mounted Transmitters

As the second- and third-generation transmitters had the same shape and PTT, differing only in the range of the pressure transducer and in colour, we did not compare their longevity. One tusk-mounted transmitter in 1997 (#6335) and two in 1998 (#3961 and #20162) showed fairly good longevity, ranging from 78 to 165 days. But three other tusk transmitters (#3963, #3960, and #3964) transmitted for only 6, 7, and 31 days, respectively: less time than the shortest lasting backpack transmitters. On the basis of the 1997 results, we believed that the small size of the tusks (63–83 cm external lengths) contributed to the premature failure of the tusk-mounted transmitters. However, the failure of #3960 in 1998, after only 7 days, showed that transmitters mounted on a large tusk (148 cm) could fail prematurely as well.

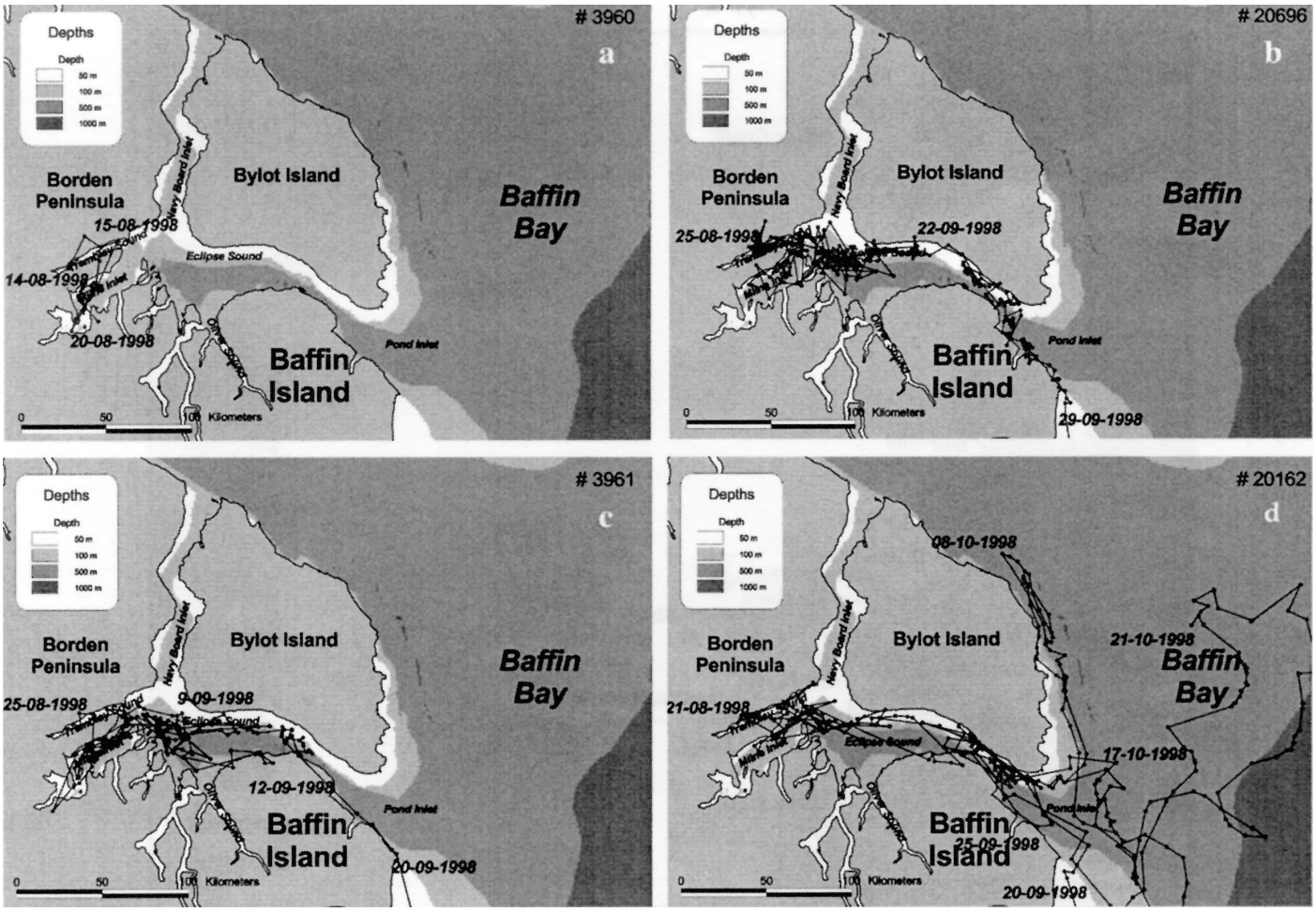

FIG. 4. a: Movements of adult male #3960 (length: 400+ cm, tusk: 148 cm), tracked for 228 km from 14 to 20 August 1998. b: Close-up of the Bylot Island area movement of adult female #20696 (length: 440 cm) from 25 August through 29 September 1998. c: Close-up of the Bylot Island area movement of adult male #3961 (length: 500 cm, tusk: 210 cm) from 25 August through 20 September 1998. d: Close-up of the Bylot Island area movement of adult male #20162 (length: 475 cm, tusk: 190 cm) from 21 August through 22 October 1998. See Figure 6 for complete tracks of whales #20696, #3961, and #20162 (b-d). Only good-quality positions (Class 1–3) are shown.

The fact that a transmitter operated for more than 18 months on a narwhal with a tusk 84 cm long (tagged in 1994) indicates considerable variability in the longevity of the tusk-mounted tags. This information also indicates that the mounting of a PTT on the tusk of a narwhal is not likely to affect the behaviour or survival of the animal. The cause of the transmission failure of the long-lasting transmitters #6335 (76 days), #3961 (78 days), and #20162 (162 days) is also unknown. The climatic conditions at the time of failure (November–February), with low temperatures and up to 10/10 of ice coverage, could have damaged the electronics, the antennae, or the attachment. As no reduction in the monitored voltage was observed, battery failure was not believed to be the cause of the transmission failure.

Backpack Transmitters vs. Tusk-Mounted Transmitters

The tusk-mounted transmitter had greater longevity than the backpack transmitters (61 vs. 43 days) and a larger number of days with good locations (57 vs. 25 days), but the differences were not significant ($p = 0.5869$ and $p = 0.3629$ respectively; unpaired T-test). However, the longevity of the six tusk-mounted transmitters showed greater variability (6–165 days) than that of the four backpack transmitters (32–49 days).

The number of good positions per day (Class 1–3 positions/Good position days) was very poor for the second generation of backpack transmitters (0–0.2 positions/day), intermediate for the tusk-mounted transmitters (0.2–5.4 positions/day) and best for the fourth generation of backpack transmitters (9.6 positions/day). However, data in these three groups were insufficient for a meaningful statistical test.

None of the transmitters showed battery drainage within the period monitored. All ten transmitters showed a higher battery voltage at the end of their operating period compared with the first measurements of voltage. We therefore concluded that none of the units stopped transmitting because of battery failure. It is likely that the backpack transmitters terminated because they fell off as the pins migrated out through the dorsal ridge.

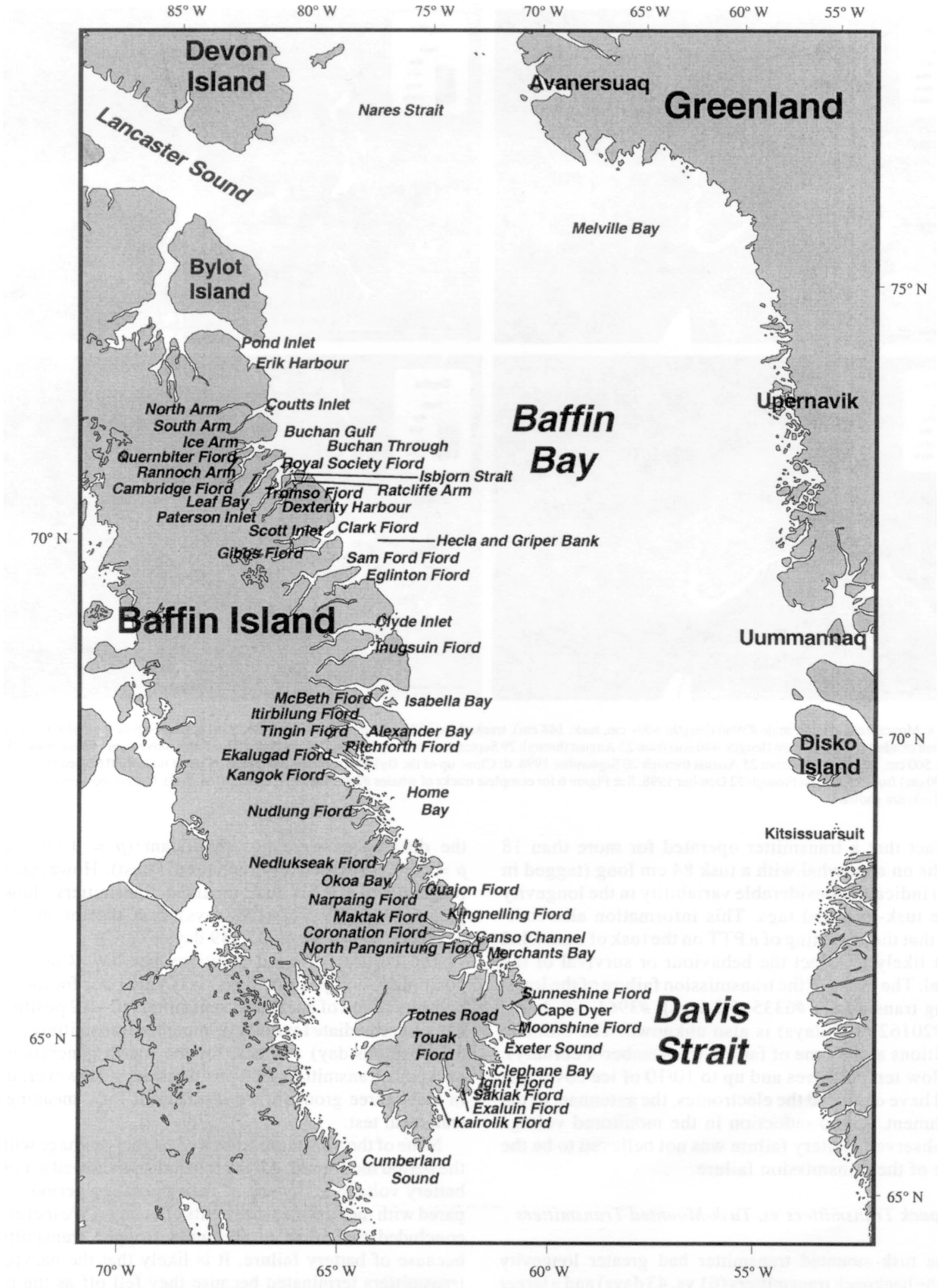

FIG. 3. Map showing place names along Baffin Island.

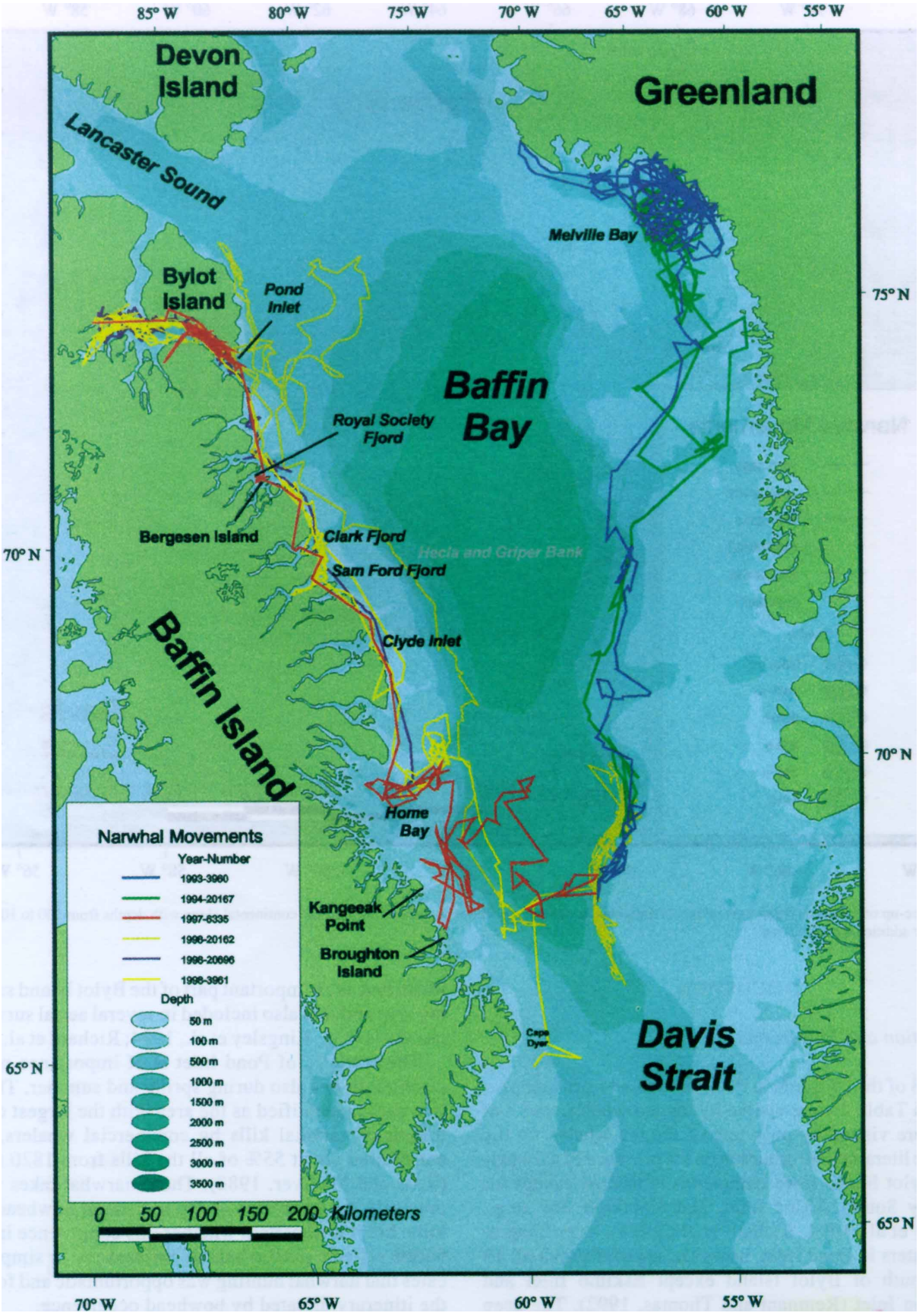

FIG. 6. Autumn movements of three adult narwhal males (#6335; #3961; #20162) and an adult female (#20696) tracked for 4062 km, 4516 km, 7017 km, and 2742 km, respectively, during 1997 and 1998. Also shown are the tracklines of two other male narwhals tracked from Melville Bay in West Greenland in 1993 (#3960) and 1994 (#20167); (see Dietz and Heide-Jørgensen, 1995). Only good-quality positions (Class 1–3) are shown.

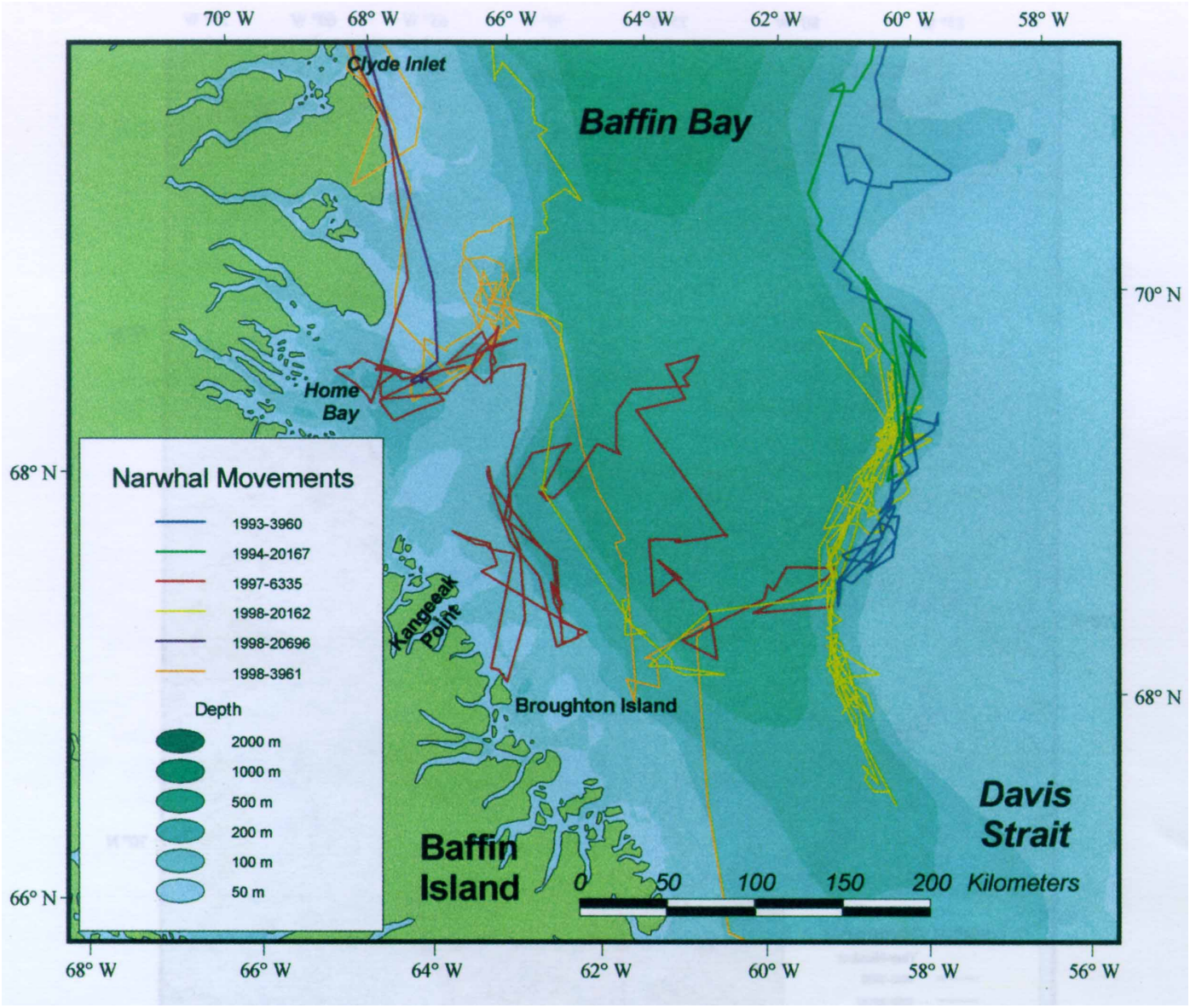

FIG. 7. Close-up of the Davis Strait movements of narwhals from Figure 6, showing their affinity for the continental slope with depths from 500 to 1000 m. See Figure 8 for additional information.

DISCUSSION

Distribution and Movements

Only 8 of the 15 fjords in the Bylot Island fjord complex shown in Table 2 were visited by tagged whales, and 3 of those were visited by only one of the ten whales. In the scientific literature, information on the presence of narwhals in the Bylot Island fjord complexes is limited except for Tremblay Sound, Milne Inlet, and Koluktoo Bay (e.g., Kingsley et al., 1994; Richard et al., 1994). According to Inuit hunters in Pond Inlet, however, narwhals visit all 15 fjords south of Bylot Island except Eskimo Inlet and Stevenson Inlet (Remnant and Thomas, 1992). The deep fjord Tay Sound (to 640 m) has been described as an important summering ground for narwhals (Miller, 1955; J. Mucktar, pers. comm. 1998). Eclipse Sound has also been identified as an important part of the Bylot Island summering area and was also included in several aerial surveys for narwhals (e.g., Kingsley et al., 1994; Richard et al., 1994).

The entrance of Pond Inlet is of importance not only during fall, but also during spring and summer. This area was earlier identified as the area with the largest concentration of narwhal kills by commercial whalers, which constituted about 55% of all the kills from 1820 to 1910 (Ross and MacIver, 1982). These narwhal takes were in precisely the same area as the registered bowhead whale kills, but it is uncertain whether this congruence in distribution reflects similar habitat preferences, or simply indicates that narwhal hunting was opportunistic and followed the itinerary dictated by bowhead occurrence.

In both 1997 and 1998, the tagged whales stayed within the Bylot Island area during the summer, without frequenting Lancaster Sound or the more western summering areas

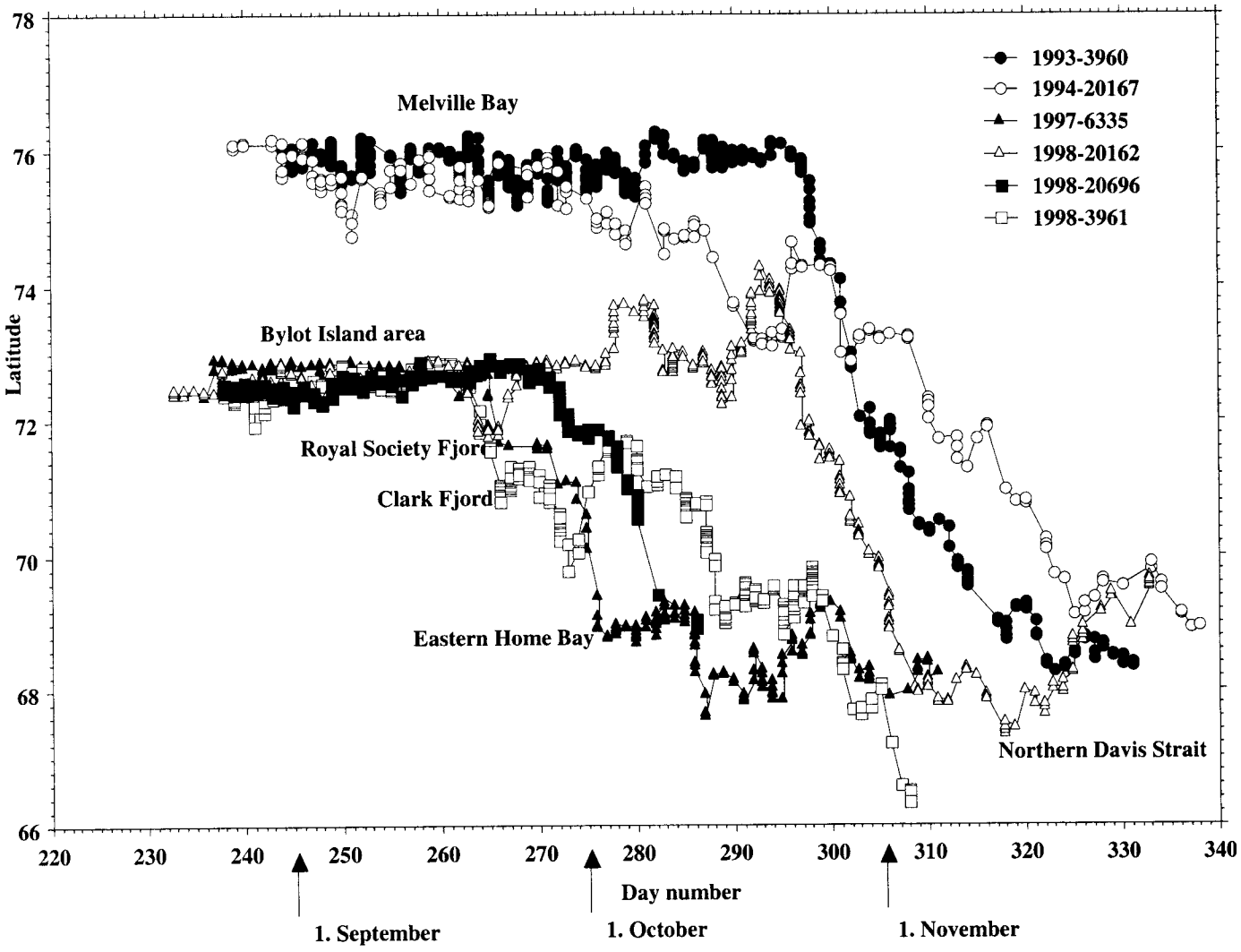

Fig. 8. Comparison of the change in latitudes over time for the narwhals from the Bylot Island area (#6335, #3961, #20162, and #20696) and for two whales from Melville Bay (#20167 and #3960) reported by Dietz and Heide-Jørgensen (1995).

in and around Admiralty Inlet, Prince Regent Inlet, Peel Sound, and the fjords south of Pond Inlet. Five narwhals previously tagged in Tremblay Sound and Milne Inlet also remained within the Bylot Island area without frequenting other summering areas during the monitored period (up to 26 days) in August and early September (Kingsley, 1993; Martin et al., 1994). Inuit hunters indicate that narwhals have a distribution within the Bylot Island area extending from the mouth of Navy Board Inlet to the mouth of Pond Inlet (Remnant and Thomas, 1992). Remnant and Thomas (1992) and Stewart et al. (1995) interviewed hunters from the other Canadian summering areas, but received no reports of summer observations in Lancaster Sound. In those studies, however, the hunters were not specifically asked about the connection between the summering populations. It is therefore not possible to conclude anything from the interview information about the connection between narwhals from the Bylot Island area and those from the other known summering areas around Admiralty Inlet, Resolute, Prince Regent Inlet, or Peel Sound (Remnant and Thomas, 1992; Stewart et al., 1995). Systematic aerial surveys carried out in Lancaster Sound in 1975, 1976, and 1981 likewise resulted in no observations of narwhals there during August and the first part of September (Johnson et al., 1976; Renewable Resources Consulting Services Ltd, 1976; Davis et al., 1978; Smith et al., 1985; Strong, 1988). However, some animals may move between the summering areas.

Even if there is some degree of separation among the summering stocks in and around Admiralty Inlet, Resolute, Prince Regent Inlet, and Peel Sound, most of the whales have to move through Lancaster Sound during their spring and autumn migrations. The exceptions are those narwhals that enter the Bylot Island area through Pond Inlet during the breakup of fast ice. It is possible that narwhals mingle at the entrance to Lancaster Sound in spring, but to what extent this mingling affects their choice of summering habitat and results in genetic exchange is uncertain.

TABLE 3. Eastern Baffin Island fjords, showing depth and length characteristics and visits by narwhals in 1997 and 1998. ? indicates that depth information is not available.

Fjord	Depth Range (m)	Length (km)	Visited by Narwhal No:
Erik Harbour	300	13	None
Coutts Inlet, Nonerth Arm	200–400	50	None
Coutts Inlet, South Arm	150–350	52	None
Buchan Through	500–700	0	6335, 3961, 20696, 20162
Buchan Gulf	200–800	41	6335, 3961, 20696, 20162
Buchan Gulf, Ice Arm	200–300	17	3961
Quernbiter Fiord	150–300	26	None
Cambridge Fiord, RanNonech Arm	100–450	15	None
Cambridge Fiord	200–700	56	None
Royal Society Fiord	150–500	48	6335
Royal Society Fiord, Leaf Bay	100–250	13	None
Paterson Inlet	100–500	52	6335
Tromso Fiord	200–300	39	None
Isbjorn Strait	200–400	20	None
Dexterity Harbour	020–100	19	None
Ratcliffe Arm	200–350	13	None
Dexterity Fiord	100–280	63	None
Scott Inlet	250–700	26	6335, 3961, 20696
Clark Fiord	100–700	54	6335
Gibbs Fiord	200–700	46+	None
Sam Ford Fiord	400–600	28+	6335, 3961, 20696
Eglinton Fiord	100–250	48	None
Clyde Inlet	200–500	83	None
Inugsuin Fiord	100–600	93	None
Isabella Bay	050–500	46	None
McBeth Fiord	150–500	67	None
Home Bay	200–800	52	6335, 3961, 20696
Alexander Bay	100–500	24	None
Itirbilung Fiord	?	43	None
Tingin Fiord	?	43	None
Pitchforth Fiord	?	4	None
Ekalugad Fiord	010–450	56	None
Kangok Fiord	?	28	None
Nudlung Fiord	?	37	None
Nedlukseak Fiord	100–200	37	None
Okoa Bay	200–300	44	None
Narpaing Fiord	?	44	None
Quajon Fiord	?	20	None
Kingnelling Fiord	?	19	None
Maktak Fiord	050–300	31	None
Coronation Fiord	050–300	28	None
Nonerth Pangnirtung Fiord	?	48	None
Canso Channel	100–200	19	None
Kangert Nonerth	?	33	None
Merchants Bay	?	20	None
Durban Harbour	050–100	9	None
Sunneshine Fiord	050–150	33	None
Moonshine Fiord	?	20	None
Totnes Road	?	31	None
Exeter Sound	?	19	None
Clephane Bay	?	35	None
Ignit Fiord	?	22	None
Sakiak Fiord	?	13	None
Exaluin Fiord	?	13	None
Touak Fiord	?	33	None
Kairolik Fiord	?	17	None
Cumberland Sound	?	315	None

Southeast of Pond Inlet, the hunters of Clyde River indicate the summer presence of narwhals in most of the fjords frequented during the autumn migration, including Scott Inlet, Clark Fiord, Gibbs Fiord, Sam Ford Fiord, Eglinton Fiord, Clyde Inlet, Inugsuin Fiord, McBeth Fiord, the Alexander Bay area, and Ekalugad Fiord (Fig. 5). Coutts Inlet and Buchan Bay were not listed by the 34 Pond Inlet residents interviewed as areas traditionally used by narwhals in summer and autumn (Remnant and Thomas, 1992). However, the Coutts Inlet area and farther south towards Clyde River were designated as "new" sighting areas, where narwhals had increased since the mid-1980s. According to J. Mucktar (pers. comm. 1998), both Buchan Gulf and Coutts Inlet are visited by a considerable number of narwhals in the summer. Buchan Gulf was surveyed between 11 and 15 August 1978, and 300 narwhals were

TABLE 4. Performance of satellite transmitters attached to narwhals in Tremblay Sound, NE Canada, in August 1997 and 1998.

Transmitter No./Type	Sex	Date of Instrumentation	Date of Last Good Position (Class 1–3)	Date of Last Uplink	Good Position Obtained (Days)	Transmitter Longevity (Days)	Class 1 Positions < 450 m	Class 2 Positions < 300 m	Class 3 Positions < 150 m	Class 1–3 Positions < 450 m	Class 0 Positions > 1000 m	Number of Uplinks
Backpack transmitters												
1997:												
20682/2. Gen.	Female	August 8	August 10	September 11	0	32	0	0	0	0	46	16165
20691/2. Gen.	Male	August 21	August 26	October 3	5	43	1	0	0	1	6	2875
1998:												
20692/2. Gen.	Female	August 19	October 3	October 5	46	48	1	0	0	1	15	16730
20696/4. Gen.	Female	August 25	October 10	October 13	49	49	276	149	45	470	473	33261
All backpack transmitters					100	172	278	149	45	472	540	69031
Average for backpack transmitters					25	43	70	37	11	118	135	17258
Tusk-mounted transmitters												
1997:												
3963/2. Gen.	Male	August 19	August 24	August 25	5	6	1	0	0	1	3	1078
3964/2. Gen.	Male	August 21	September 5	September 21	15	31	22	6	1	29	49	6995
6335/2. Gen.	Male	August 24	November 7	November 8	75	76	208	20	8	236	391	37029
1998:												
3960/3. Gen.	Male	August 14	August 20	August 21	6	7	15	5	4	24	82	4299
20162/2. Gen.	Male	August 21	January 30 '99	February 2 '99	162	165	362	129	45	536	541	62145
3961/3. Gen.	Male	August 25	November 4	November 4	78	78	291	103	30	424	320	32763
All tusk-mounted transmitters					341	363	899	263	88	1250	1386	144309
Average for tusk-mounted transmitters					57	61	150	44	15	208	231	24052
All transmitters in 1997–98					441	604	1177	412	133	1722	1926	213340
Average for all transmitters in 1997–98					44	60	118	41	13	172	193	21334

estimated to have been present there (Koski and Davis, 1994). A large group of narwhals was seen going up Coutts Inlet and moving along the glacier fronts in late August 1984 (R.R. Reeves, pers. comm. 2000). Haller (1967) stated that narwhals were common from Home Bay north to the Clyde River area, where they appeared from summer to early fall. Farther south, the Broughton Island hunters provided information on the summer presence of narwhals in Nudlung Fiord, the mouth of Nedlukseak Fiord, and Merchants Bay, all areas that were not visited by our tagged whales during autumn (Remnant and Thomas, 1992). On present evidence, we can not dismiss the possibility that the narwhals distributed during summer all the way from Peel Sound eastward and southward to Merchants Bay represent one large and widely distributed population. However, it is likely that there are several or many smaller population units, which, even if they mingle during other times of the year, return to specific inlets, embayments, or fjord complexes during the summer.

Exchange is less likely with other summering populations, such as those in Foxe Basin, because of the significant physical land barriers (Mansfield et al., 1975). In early papers, Sergeant (1979a, b) talks of a large northern narwhal component in the Lancaster Sound area and small southern component inhabiting northern Hudson Bay, but it is uncertain whether exchange may occur through Fury and Hecla Strait during summer and whether the segregation persists throughout winter. Small numbers of narwhals may, however, winter in Hudson Strait (McLaren and Davis, 1981; Strong, 1988).

Contact with the Greenland summer populations in Melville Bay and Inglefield Bredning, or with possible populations in the Nares Strait and its associated fjord complexes, is also uncertain. But since not one of the 24 narwhals tagged so far in Canada and Greenland has shown summer movements across country borders, such summer exchange seems unlikely (Kingsley, 1993; Martin et al., 1994; Dietz and Heide-Jørgensen, 1995). Additional tagging and increased tag longevity will certainly shed additional light on these questions.

All evidence points to a southward migration along the east coast of Baffin Island in late September (e.g., Strong, 1988; Remnant and Thomas, 1992). Whales in our study began moving south from the mouth of Pond Inlet around 22–29 September, which is consistent with the observations by Johnson et al. (1976) of eastward movements through Lancaster Sound around 26–28 September. Davis (1980, cited in Strong, 1988) claimed that the autumn migration starts in September or October. The timing of the southward migration at Pond Inlet is also in good accordance with the Inuit information from

this area (Remnant and Thomas, 1992). Koski and Davis (1994) reported departure periods from Admiralty Inlet to be 23–27 September in 1978 and 18–21 September in 1979. Many of the narwhals were reported to follow the coast of Baffin Island southeastward, but some continued moving offshore from SE Devon Island towards Baffin Bay (Koski and Davis, 1994).

Most of the areas visited by the tracked narwhals during their southward migration have also been described as summering areas. For example, Clyde River and Broughton Island residents reported the summer presence of narwhals in all fjords between Scott Island and Home Bay, as well as in the three fjord complexes west of Home Bay and in Merchants Bay south of Broughton Island (Remnant and Thomas, 1992). Wenzel (1991) states that narwhals may appear at any time from mid-August through September around Clyde River. As borders between spring, summer, and autumn are not well defined, at least some of the summer observations may represent late spring or early autumn observations. For example, Home Bay was described as a summering area by Koski and Davis (1994), who surveyed it on 18 September 1979, but this observation could represent an early portion of the southward migration. This "population" was estimated to be more than 95 animals (Koski and Davis, 1994).

According to Koski and Davis (1994), almost 5000 narwhals passed Cape Adair between 29 September and 2 October 1978. This timing agrees well with that of our four tagged narwhals as they moved southward along Baffin Island in 1997–98.

The few autumn kills of narwhal by commercial whalers along the eastern Baffin Island coast might reflect the fact that narwhals migrate southward somewhat later than bowheads (and thus, after the whalers have passed). According to Ross and MacIver (1982), the narwhals appeared after the whalers had cleared Cape Dyer.

The most southern position of our tagged narwhals was just south of Cape Dyer at about 66° N on 6 November 1998. This is consistent with the claim of Strong (1988) that narwhals are seldom seen south of 65° N in the Davis Strait.

The narwhals from Canada showed a preference for deep fjords and for the continental slope (1000–1500 m) along eastern Baffin Island. This same preference was shown by the narwhals from Melville Bay that moved south along the continental slope west of Disko Island (Dietz and Heide-Jørgensen, 1995). We find it remarkable that narwhals are so strongly linked to the narrow bathymetry corridors in Baffin Bay and Davis Strait, which constitute only a small proportion of the total water volume available between Canada and Greenland. A similar preference for a well-defined section (350–975 m isobath) of the continental slope was documented for Risso's dolphin (*Grampus griseus*), another cephalopod predator inhabiting the northern Gulf of Mexico (Baumgartner, 1997). This area constituted only 2% of the surface area of the entire gulf. It was argued that such shelf edges and upper continental slopes are frequently sites for increased biological activity. The upwelling in such areas introduces nutrients from deeper shelf or slope waters into the euphotic zone, stimulating increased primary production and thus supporting secondary production as well. Species with such a specialized distribution, including the narwhal, are particularly susceptible. Disturbance or intense fishing within these areas may force the whales to deeper and less favourable areas, which may negatively affect their foraging. Information on such critical areas can be used in their management and protection to avoid negative impacts from human activities.

The preferred wintering ground observed in this study, with its distinct pattern relative to the bathymetry, has been shown previously only for a few animals tracked from Melville Bay (Dietz and Heide-Jørgensen, 1995). Ours was the first study to document that populations summering in Canada and Greenland share a common wintering area. Our winter observations did not extend beyond 30 January and were restricted to the continental slope between 67°48′ N and 69°36′ N.

Few reliable winter observations of narwhals in Baffin Bay and Davis Strait have been published, but they suggest that wintering occurs in the offshore pack ice with a southern limit from 65° to 70° N. One published winter record is from the account of the North Polar Expedition during the southward drift of the U.S. *Polaris* from northern Baffin Bay to the Labrador Sea between October 1872 and April 1873 (Davis, 1876). Narwhals were seen on 7 February as the ship drifted south of 68°50′ N and then again on March 14 and 15 in latitudes from 64°32′ to 64°19′N, opposite the mouth of Cumberland Sound. No longitudes were given, as chronometers were not available at that time. However, the east coast of Baffin Island, probably Cape Dyer, was visible from the ship on 19 February, as it passed the Arctic Circle on approximately 66°30′N (Davis, 1876). Turl (1987) found large numbers of narwhals in the close pack ice in west and central Davis Strait (between 66°30′ and 68°15′N) in February–March 1976.

Information from aerial surveys in the late winter and early spring (mid-March to late May) suggests that narwhals winter throughout the close pack ice in Davis Strait and southern Baffin Bay down to 68° N, without any clear concentration areas (Heide-Jørgensen et al., 1993; Koski and Davis, 1994).

It is unclear whether this more scattered distribution of narwhals in late winter and early spring represents a reinvasion into the dense pack ice from the more southern winter quarter, or whether other narwhal stocks so far not tracked are using these areas outside the continental slopes as their wintering quarters. Tagging of other summering stocks with transmitters of increased longevity should help to answer these questions.

Stock Identity

The narwhals tracked in this study were almost stationary in the deepwater area of Eclipse Sound and adjacent

fjords for most of August. They moved east to the deep areas in Pond Inlet in early September and stayed there until their southward migration began in late September. From late September, they moved south along Baffin Island and visited a few fjords, possibly selected for their depth, productivity, or glacial activity. They made short stays in these fjords but continued their southward heading towards Davis Strait. The only exception was the individual that, after leaving Pond Inlet, first moved north to an abyss east of Bylot Island then headed south in early October along the continental slope. All of the whales moved east when they reached the southern end of the deep trough in Baffin Bay. They wintered on the eastern slope of the deep trough, together with narwhals that summered on the Greenland side of Baffin Bay.

With the ten animals tracked, we could not document an exchange with narwhals on other summering grounds (e.g., Admiralty Inlet or the eastern coast of Baffin Island) during August. Such an exchange may take place for some animals, in some years, earlier in the season, or between years (i.e., whales could visit different summering grounds in different years). Within the Bylot Island area, our whales seemed to be moving freely among the fjords known to be inhabited by narwhals in summer, so they apparently belong to a common stock. This may also be true of the narwhals in Pond Inlet in September.

During the summering period and the autumn southbound migration, the narwhals visited only 16% of the available fjords. The southbound migrating narwhals used a rather narrow corridor and a specific timing, either traveling along the coast between the few selected fjords or taking an offshore route along the slope of the Baffin Island continental shelf in water 1000–1500 m deep. The tagged animals did not visit the deepest part of Baffin Bay (> 2000 m deep) within the monitored period.

When on the wintering grounds, the narwhals made shorter trips within a restricted area along the north-south oriented slope of the Greenland continental shelf, the same area used by narwhals from Greenland.

These data suggest that some population structure may persist among Baffin Bay narwhals, with specific habitats for summering and wintering grounds and migrations that are well defined both spatially and temporally. In view of these restricted movements and the limited home range during stationary periods, the impact of harvest practices, competing fisheries, and habitat changes should be reviewed.

The mating season of narwhals is uncertain, but likely falls between May and July (Dietz et al., 1994). We have so far no tracking data from that period, but catch and survey data suggest that the narwhals are either still on their wintering grounds or moving towards their summering areas in those months. Large concentrations of narwhals are known to occur at fast-ice edges in both Greenland and Canada, just before the whales move into the summering areas, and this may allow opportunities for mating by animals from different areas. No thorough attempt has been made to investigate genetic differences between whales that use different summering habitats in Canada. Palsbøll et al. (1997) examined 427 narwhals, sampled in five regions, for mtDNA, but only 29 of these were from Canadian waters. The low nucleotide diversity and low number of Canadian samples did not permit internal Canadian comparisons, and no differences were found between the pooled Canadian sample and samples from the Avanersuaq district. However, the homogeneity tests identified five "entities": northern Baffin Bay, Melville Bay and Upernavik, Uummannaq, the 1994 "Sassat" at Kitsissuarsuit, and eastern Greenland (Palsbøll et al., 1997).

Independent of the question of genetic exchange, it is also important to know whether the whales return to the same summering grounds year after year, whether the site fidelity is equally strong for both sexes, and whether narwhals have the ability to re-inhabit localities that are locally depleted.

Performance of the Transmitters

For backpack transmitters, the average attachment period of 43 days for the two years was slightly longer than that obtained from five backpacks deployed on narwhals in Greenland waters in 1993–94, for which the average longevity was 38 days (range: 25–44 days; Dietz and Heide-Jørgensen, 1995). Two first-generation transmitters and three second-generation transmitters were used in the Greenland study. No statistical difference (unpaired t-test) on longevity, location classes, or number of uplinks could be found between first- and second-generation transmitters during the four years of investigation. The fourth-generation transmitter used in the present study certainly showed a considerable improvement on all measured categories; however, with a single unit, sample size was inadequate for a meaningful statistical comparison to previous transmitter generations.

The backpack transmitter longevity of the present study was longer than that for similar mountings on narwhals in Tremblay Sound in 1991 and at Svalbard in 1998 (Martin et al., 1994; Lydersen et al., 1999), but shorter than that for transmitters mounted on belugas (Richard et al., 1998, 2001; Lydersen et al., 1999). The larger dorsal ridge of the belugas—and possibly a stronger epidermis—can explain this difference.

For tusk-mounted transmitters, the average number of days providing good positions (57) in the Canadian study was similar to the average from the Greenland study (64 days; Dietz and Heide-Jørgensen, 1995). Only the transmitter on #20162 in the Canadian study lasted longer (162 days) than the longest-lasting tusk transmitters in the Greenland study, which provided good-quality positions for 87 days in 1993 and 100 days in 1994 (Dietz and Heide-Jørgensen, 1995). No significant differences (unpaired T-test) were found in the longevity, location classes, or number of uplinks between the first tusk-mounted generation used in Melville Bay in 1993 and generations 2 and 3,

used in Melville Bay in 1994 and in Tremblay Sound in 1997 and 1998. This result was due to the small total number (N = 10) in the comparison and to three short-performing transmitters in Tremblay Sound in 1997 and 1998.

Three tusk-mounted units in the Canadian study transmitted for 6, 7, and 31 days: less time than the shortest-performing tusk-mounted transmitter (32 days) in the Greenland study. It remains uncertain why these three Canadian transmitters stopped prematurely. Three of the four transmitters mounted in Greenland terminated because of battery drainage, which was monitored from status messages monitored every 15th uplink (Dietz and Heide-Jørgensen, 1995). None of the transmitters mounted on narwhals in Canada terminated because of battery failure.

In general, the narwhal tusk must be regarded as an ideal substratum for attachment compared to skin penetration. Brear et al. (1993) and Currey et al. (1994), who analyzed the mechanical properties of the narwhal tusk in detail, concluded that the tusk tissues are of low stiffness but very tough, suiting the tusk for loading on impact. The longest-lasting transmitter was on a male narwhal tagged during the Dietz and Heide-Jorgensen study. This transmitter provided scattered uplinks for more than 18 months, indicating that tusks have the potential for long-term attachment. However, the short performances of tusk-mounted transmitters indicate that tusk surface structure and variability of the stainless steel band tension may also produce short-term data series with even shorter longevity than the backpack transmitters.

The termination during winter of the longest-lasting tusk transmitters is likely to be caused by the severe ice conditions that narwhals inhabit at this time of the year. One possibility could be breakage of the antennae, as found on a retrieved walrus transmitter in 2000 in East Greenland (E. Born, pers. comm. 2000). To what extent the ice may cause loosening of the attachment or malfunction of the electronics still remains unknown.

ACKNOWLEDGEMENTS

Four Inuit hunters, Joanie Mucktar, Enookee Killiktee, Joshua Idlout, and Simon Qamarnirq, participated in the capturing and handling of the narwhals over the two years. Sylvain de Guise, Stephane Lair, Hans Christian Schmidt, Eydfinnur Steffanson, and Mehdi Bakhtiari were also part of the tagging teams. The Greenland Institute of Natural Resources, the National Environmental Research Institute, the Department of Fisheries and Oceans, the Nunavut Wildlife Management Board, the Commission for Scientific Research in Greenland, and the Arctic Environmental Program under the Danish Ministry of Environment funded the studies. The Polar Continental Shelf Project supplied logistical support for the fieldwork.

REFERENCES

BAUMGARTNER, M.F. 1997. The distribution of Risso's dolphin (*Grampus griseus*) with respect to the physiography of the northern Gulf of Mexico. Marine Mammal Science 13(4): 614–638.

BORN, E.W., HEIDE-JØRGENSEN, M.P., LARSEN, F., and MARTIN, A.R. 1994. Abundance and stock composition of narwhals (*Monodon monoceros*) in Inglefield Bredning (NW Greenland). Meddelelser om Grønland, Bioscience 39:51–68.

BREAR, K., CURREY, J.D., KINGSLEY, M.C.S., and RAMSAY, M. 1993. The mechanical design of the tusk of the narwhal (*Monodon monoceros*: Cetacea). Journal of Zoology, London 230:411–423.

CURREY, J.D., BREAR, K., and ZIOUPOS, P. 1994. Dependence of mechanical properties on fibre angle in narwhal tusk, a highly oriented biological composite. Journal of Biomechanics 27(7):885–897.

DAVIS, C.H. 1876. Narrative of the North Polar Expedition (U.S. Ship *Polaris*). Edited by G.M. Robeson. Washington, D.C.: U.S. Government Printing Office. 696 p.

DAVIS, R.A., RICHARDSON, W.J., JOHNSON, S.R., and RENAUD, W.E. 1978. Status of the Lancaster Sound narwhal population in 1976. Report to the International Whaling Commission 28. SC/29/Doc 22:209–215.

DIETZ, R., and HEIDE-JØRGENSEN, M.P. 1995. Movements and swimming speed of narwhals (*Monodon monoceros*) instrumented with satellite transmitters in Melville Bay, Northwest Greenland. Canadian Journal of Zoology 73:2106–2119.

DIETZ, R., HEIDE-JØRGENSEN, M.P., BORN, E.W., and GLAHDER, C. 1994. Occurrence of narwhals (*Monodon monceros*) and white whales (*Delphinapterus leucas*) in West Greenland. Meddelelser om Grønland, Bioscience 39:69–86.

GOULET, A.-M., HAMMILL, M.O., and BARRETTE, C. 1999. Quality of satellite telemetry locations of gray seals (*Halichoerus grypus*). Marine Mammal Science 15(2):589–594.

HALLER. A.A.1967. Baffin Island – East Coast: An area economic survey. Ottawa: Industrial Division, Department of Indian Affairs and Northern Development.

HARRIS, R.B., FANCY, S.G., DOUGLAS, D.C., GARNER, G.W., AMSTRUP, S.C., McCABE, T.R., and PANK, L.F. 1990. Tracking wildlife by satellite: Current systems and performance. United States Department of the Interior, Fish and Wildlife Service, Fish and Wildlife Technical Report 30. 52 p.

HEIDE-JØRGENSEN, M.P., and DIETZ, R. 1995. Some characteristics of narwhal, *Monodon monoceros*, diving behaviour in Baffin Bay. Canadian Journal of Zoology 73(11):2120–2132.

HEIDE-JØRGENSEN, M.P., LASSEN, H., TEILMANN, J., and DAVIS, R.A. 1993. An index of the relative abundance of wintering belugas, *Delphinapterus leucas*, and narwhals, *Monodon monoceros*, of West Greenland. Canadian Journal of Fisheries and Aquatic Sciences 50(11):2323–2335.

JOHNSON, S.R., RENAUD, W.E., DAVIS, R.A., and RICHARDSON, W.J. 1976. Marine mammals recorded during aerial surveys of birds in eastern Lancaster Sound, 1976. Toronto, Ontario: LGL Limited. 180 p.

KINGSLEY, M.C.S. 1993. Satellite radio tagging of narwhal in Koluktoo Bay, August 1993. Technical Report from Department of Fisheries and Oceans, Mont-Joli, Quebec, Canada. 6 p.

KINGSLEY, M.C.S., and RAMSAY, M.A. 1988. The spiral in the tusk of the narwhal. Arctic 41(3):236–238.

KINGSLEY, M.C.S., CLEATOR, H.J., and RAMSAY, M.A. 1994. Summer distribution and movements of narwhals (*Monodon monoceros*) in Eclipse Sound and adjacent waters, North Baffin Island, N.W.T. Meddelelser om Grønland, Bioscience 39: 163–174.

KOSKI, W.R., and DAVIS, R.A. 1994. Distribution and numbers of narwhals (*Monodon monoceros*) in Baffin Bay and Davis Strait. Meddelelser om Grønland, Bioscience 39:15–40.

LYDERSEN, C., KOVACS, K., and GJERTZ, I. 1999. Studies of white whales (*Delphinapterus leucas*) and narwhals (*Monodon monoceros*) in Svalbard. NAMMCO SC/7/BN/24. 27 p.

MANSFIELD, A.W., SMITH, T.G., and BECK, B. 1975. The narwhal, *Monodon monoceros*, in the eastern Canadian Waters. Journal of Fisheries Research Board Canada 32:1041–1046.

MARTIN, A.R., KINGSLEY, M.C.S., and RAMSAY, M.A. 1994. Diving behaviour of narwhals on their summer grounds. Canadian Journal of Zoology 72:118–125.

McCONNELL, B.J., CHAMBERS, C., NICHOLAS, K.S., and FEDAK, M.A. 1992. Satellite tracking of gray seals (*Halichoerus grypus*). Journal of Zoology 226:271–282.

McLAREN, P.L., and DAVIS, R.A. 1981. Distribution of wintering marine mammals in southern Baffin Bay and northern Davis Strait, March 1981. Unpubl. report by LGL Limited for the Arctic Pilot Project, Calgary, Alberta. 85 p.

MILLER, R.S. 1955. A survey of the mammals of Bylot Island, Northwest Territories. Arctic 8(3):167–176.

PALSBØLL, P., HEIDE-JØRGENSEN, M.P., and DIETZ, R. 1997. Genetic studies of narwhals, *Monodon monoceros*, from West and East Greenland. Heredity 78:284–292.

REMNANT, R.A., and THOMAS, M.L. 1992. Inuit traditional knowledge of the distribution and biology of High Arctic narwhal and beluga. North/South Consultants Inc., 202-1475 Chevrier Blvd, Winnipeg, Manitoba R3T 1Y7, Canada. 96 p.

RENEWABLE RESOURCES CONSULTING SERVICES LTD. 1976. Aerial surveys of marine mammals of Lancaster Sound, 1975–1976. Unpubl. report for Norland Petroleum Ltd., Calgary. 100 p.

RICHARD P., WEAVER, P., DUECK, L., and BARBER, D. 1994. Distribution and numbers of Canadian High Arctic narwhals (*Monodon monoceros*) in August 1984. Meddelelser om Grønland, Bioscience 39:41–50.

RICHARD, P.R., HEIDE-JØRGENSEN, M.P., and ST. AUBIN, D. 1998. Fall movements of belugas (*Delphinapterus leucas*) with satellite-linked transmitters in Lancaster Sound, Jones Sound, and Northern Baffin Bay. Arctic 51(1):5–16.

RICHARD P.R., HEIDE-JØRGENSEN, M.P., ORR, J.R., DIETZ, R., and SMITH, T.G. 2001. Summer and autumn movements and habitat use by belugas in the Canadian High Arctic and adjacent areas. Arctic 54(3):207–222.

ROSS, W.G., and MacIVER, A. 1982. Distribution of the kills of bowhead whales and other mammals by Davis Strait whalers, 1829 to 1910. Technical Report for Arctic Pilot Project. Unpubl. report available from the Dept. of Geography, Bishop's University, Lennoxville, Quebec J1M 1Z7. 75 p.

SEMPELS, J.-M. 1982. Coastlines of the eastern Arctic. Arctic 35(1):170–179.

SERGEANT, D.E. 1979a. Seasonal movements and numbers of cetaceans summering in Lancaster Sound, Arctic Canada. International Whaling Commission, Committee on Small Cetaceans Working Paper No. 11. 20 p.

———. 1979b. Summary of knowledge on populations of white whales (*Delphinapterus leucas*) and narwhals (*Monodon monoceros* L.) in Canadian waters. International Whaling Commission, Committee on Small Cetaceans Working Paper No. 8. 6 p.

SERVICE ARGOS INC. 1989. Guide to ARGOS system, September 1989. Toulouse, France: CLS ARGOS.

SMITH, T.G., HAMMILL, M.O., BURRAGE, D.J., and SLENO, G.A. 1985. Distribution and abundance of belugas, *Delphinapterus leucas*, and narwhals, *Monodon monoceros*, in the Canadian High Arctic. Canadian Journal of Fisheries and Aquatic Sciences 42:676–684.

STEWART, B.S., LEATHERWOOD, S., YOCHEM, P.K., and HEIDE-JØRGENSEN, M.P. 1989. Harbour seal tracking and telemetry by satellite. Marine Mammal Science 5:361–375.

STEWART, D.B, AKEEAGOK, A., AMARUALIK, R., PANIPAKUTSUK, S., and TAQTU, A. 1995. Local knowledge of beluga and narwhal from four communities in the Arctic. Canadian Technical Report of Fisheries and Aquatic Sciences 2065. 48 p.

STRONG, J.T. 1988. Status of the narwhal, *Monodon monoceros*, in Canada. Canadian Field-Naturalist 102(2):391–398.

THOMPSON, D.W. 1963. On growth and form. 2nd ed. Cambridge: Cambridge University Press. 1097 p.

TURL, C.W. 1987. Winter sightings of marine mammals in Arctic pack ice. Arctic 40(3):219–220.

WENZEL, G. 1991. Animal rights, human rights: Ecology, economy and ideology in the Canadian Arctic. Toronto: University of Toronto Press. 206 p.

Questions and Responses from June and October Community Information Sessions

TGS NOPEC Geophysical Company ASA, Petroleum GeoServices and Multi Klient Invest AS

Northeastern Canada 2D Seismic Exploration Survey

November 2012

Introduction

This document has been prepared to share information and to continue communication with the communities of Kimmirut, Iqaluit, Pangnirtung, Qikiqtarjuaq, Clyde River and Pond Inlet. The questions in this document were asked in information sessions held in the communities in June and October 2012. Some of the responses were provided during the community sessions, however a few required additional research. All responses are included in this document.

All sources referenced throughout the report will be available at the hamlet office, or provided by email, upon request.

The questions and responses have been grouped into three subject areas:

- The Proposed Project
- Marine Mammals
- Seismic Surveys

The Proposed Project

Question: Who are you? What is the company that is doing this?
Response: We work for a company called NEXUS Coastal Resource Management. Our company was hired by Multi Klient Invest to facilitate dialogue with the communities. Multi Klient Invest AS is the company that will be operating and conducting the proposed 2D Seismic Survey.

Question: How far (depth) is it from the air gun to the ocean floor?
Response: The distance between the air gun and the ocean floor depends on the ocean bathymetry. The project map illustrates the bathymetry of Baffin Bay and Davis Strait. Bathymetry tells us how far away the ocean floor is from the surface. Since the air gun will be relatively near the surface of water (approximately 9 metres, or 27 feet), we can use the bathymetry to tell us how far the air gun will be from the surface. On this map, the darker the colour, going from light purple to dark blue, the further the ocean floor is from the surface. In some areas (dark blue), the air gun will be as far as 5km, roughly 15,000 feet or as close as 500 metres, which is roughly 1500 feet from the ocean floor.

Question: How long will the project take to complete?
Response: The proposed project could be over a span of five years, based on the results of the first year. The survey vessel will only be in operation during the ice-free months.

Question: How much impact will it (the proposed project) have?
Response: The design of the 2D seismic survey includes mitigation measures to lessen the project's impact on the environment. These mitigation measures include a 20 minute ramp up procedure, marine mammal observers, fisheries liaison officers, pollution prevention protocols, and communicating with communities. Past projects have shown that 2D seismic surveys have caused little to no effect to the marine environment.

Question: If and when something goes wrong on the project, is the company held accountable? How?
Response: The Project Proponents are committed to protecting the environment. There are protocols in place to prevent and clean up environmental damage caused by a vessel. These protocols follow international standards and regulations. The Arctic Shipping Pollution Prevention Act (ASPPA) and the Arctic Shipping Pollution Prevention Regulators (ASPPR) develop the protocols for having a vessel in Arctic waters. In addition, the vessel will have contingency plans and safety management systems on board. Also, the vessel will avoid areas of ice, as the survey cannot be completed near ice. This will reduce the chance of collision with an iceberg or ice floe.

Question: Was it the company's strategy to do this last minute so not many people would show up to the meeting?
Response: No, as was explained during the sessions, and in prior communications with the Hamlet, this information session is the first step of the engagement process. It was not the company's intention to have the meeting at the last minute. The purpose of this meeting is to explain the project and to gather community members' questions, concerns and suggestions and bring those questions, concerns and suggestions to the company. Communication with your community will continue. This can be in the form of further meetings, newspaper ads, posters, radio announcements, mail and email. Due to feedback about the meeting time, all future meetings will take into consideration that this is not an ideal time for public meetings.

Question: What happens with the information? Who has access?
Response: The information collected from the 2D seismic survey will be collected and held by the Project Proponent.

Question: What if they notice a lot of algae in the water during the survey? What will happen? Will the survey stop?
Response: This has been researched in the past. Studies have shown that algae are not negatively affected by the sound produced from 2D Seismic Surveys. The survey will not stop.

Question: This information is for the benefit of an oil company? For oil exploration, correct?
Response: The data and information documented throughout the survey can be used in a number of ways. In addition to learning about what's below the ocean floor, information about whales, fish, and the marine environment will be collected. The information collected may influence decisions that are made in the community. For example, we can further our understanding about whale migratory paths. The information collected about what's below the ocean floor is property of the Project Proponent and as such, they can sell that information to other companies.

Question: What type of benefit could a seismic test have (to residents)?
Response: There will be opportunities for residents to work on the project. As we have discussed, Marine Mammal Observers and Fisheries Liaison Officers will be hired from Nunavut. Community members that are trained to be Marine Mammal Observers and Fisheries Liaison Officers will bring new skills and knowledge back to Nunavut.

Question: What will the negative impacts be (from the project)?
Response: The potential impacts from the project may vary but a number of mitigation measures will be implemented to avoid or diminish these impacts. Possible effects of the project

on whales include short term behavioural changes and temporary hearing loss. As we have mentioned, the Project Proponents will be taking precautionary steps to avoid the possible negative effect of the project. These measures include following the 'Canadian Statement of Practice with respect to the Mitigation of Seismic Sound in the Marine Environment', having a Fisheries Liaison Officer to communicate with the fishery, and following the protocols put in place by Arctic Shipping Pollution Prevention Act (ASPPA), safety management systems, contingency plans, and the Arctic Shipping Pollution Prevention Regulators (ASPPR).

Question: Is this not the same project as the other seismic survey in Lancaster Sound that got stopped in 2010?
Response: No, this is not the Lancaster Sound project from 2010. This is a different project in a different area that is funded and operated by a different company.

Question: Will I have a say?
Response: Yes, that is why we are here. We are here on behalf of the Project Proponents to discuss the project with your community and to document your questions, concerns and ideas about this project. The Project Proponents would like to work with communities to so that the project can be mutually beneficial.

Question: What is the research for?
Answer: The research is to better understand the ocean floor for potential resource development

Question: Who is funding the project?
Answer: Multi Klient Invest is funding this project. They are wholly owned subsidiary of Petroleum GeoServices.

Question: Who is buying the data collected?
Answer: At this point in time no one has purchased the data collected. However, potential buyers of such information may include commercial fishery organizations, the Government and industry.

Marine Mammals

Question: Will the sound impact marine mammal migration?
Response: Sound generated by humans has been shown to impact some marine mammal migration. Determining the nature of the impact is a complex subject and depends on a variety of factors including: species, sex, age, presence of offspring, prior experience, time of year, location of the survey, and many others.

Bowhead whales have been shown to alter their migratory route by twenty to thirty kilometers in order to avoid the noise from seismic testing (Richardson, Miller & Greene, 1999). Humpback whales, gray whales and harbour porpoises have shown similar changes in behaviour, while some other species, such as sperm whales, have been shown to be far less deterred by the noise (Weilgart, 2007). However, summering bowheads showed no detectable avoidance of seismic surveys, no change in general activities or call activities (Richardson et al., 2007 in Weilgart, 2007).

While whales seem to generally avoid seismic noise, it has also been shown that some species, such as the humpback whale, will return to follow their normal migration route once they have passed the area of disturbance (McCauley et al. 2000). Determining the effect of man-made noise on migrating marine mammals remains highly uncertain.

Question: Is there research from Greenland that says if whales were harmed?
Response: Currently there are no scientific studies from Greenland looking at the effect of recent seismic survey activity on whales. This year a study was released providing insight into the seasonal presence of background noise in the North Atlantic (Klink et al, 2012). Observed seasonal variations in background noise levels were caused by human activities (seismic surveys, commercial shipping), ocean surface wind and whales communicating. The study did not determine if a seismic survey affected blue, fin and sperm whales. However, sounds from blue, fin and sperm whales were recorded seasonally at both study locations (Klink et al, 2012).

The National Environmental Research Institute of Denmark has also released guidelines for Environmental Impact Assessments in Greenland (Boertmann et al, 2009), which lists beluga, narwhal and bowhead whales, as well as walrus, as species particularly sensitive to seismic surveys (p.22).

Question: Is there an impact on hearing to whales and seals?
Response: It is difficult to know if an animal is negatively impacted as a result of this project. It is not ethical to capture marine mammals and subject them to testing in captivity. The available information on the impact of man-made noise to marine mammals and seals have been from modeling and direct observations during seismic surveys. Several papers have used models to predict the impact of sound intensity, measured in decibels (dB), on the hearing of marine mammals. The 'Canadian Statement of Practice on the Mitigation of Seismic Noise in the Marine Environment' states that at 500m, or 1500 feet, the sound intensity is at a level where no permanent damage would occur to marine mammals (based on what is known about marine mammals).

Question: Will the narwhal conservation area be bothered after this project is completed?
Response: No survey activity will occur within the narwhal conservation area and proposed seismic survey activity surrounding the conservation area is minimal. However, to mitigate any potential effects of the project on narwhal and other marine mammals during the proposed project, the proposed project will adhere to the 'Canadian Statement of Practice on the Mitigation of Seismic Noise in the Marine Environment'. If additional projects were to occur after this proposed 2D Seismic Survey, then Environmental Assessments would need to be completed for each project.

Question: Will the survey impact narwhal?
Response: The potential impacts, if any, on narwhal and other marine mammals will vary. These impacts may include behavioral changes, loss of hearing and the potential for death (if a marine mammal is directly underneath the sound source). However, to our knowledge, no marine mammal deaths have been directly linked to seismic surveys. The effect of seismic surveys on marine mammals will vary depending on the species and individuals within a species.

To limit the potential effect of the proposed project on narwhal and other marine mammals, the project proponent will implement mitigation measures. These mitigation measures include a 20-

minute ramp up procedure, marine mammal observers and passive acoustic monitoring. In addition, the proposed project will adhere to the 'Canadian Statement of Practice on the Mitigation of Seismic Noise in the Marine Environment'.

Question: How can you determine if you have harmed a marine mammal?
Response: In the marine environment, it is difficult to determine if a project has an effect on marine mammals as marine mammals are constantly moving and there are other factors in the environment that can affect marine mammals. These other factors can include ships, earthquakes, and icebergs breaking apart. To limit the potential effect of this project on marine mammals, the project will follow the 'Canadian Statement of Practice with respect to the Mitigation of Seismic Sound in the Marine Environment'.

Question: How would you know that whales are there if they are under water?
Response: Some surveys use passive acoustic monitoring, which will allow the vessel to listen for the whales under water. Passive acoustic monitoring is a technique used to listen for whales under the water. A hydrophone, which is an underwater microphone, is placed in the water and people listen to the hydrophone for sounds that whales make. Passive acoustic monitoring is being researched as a possible option for this project

In addition, there will be Marine Mammal Observers on board the survey vessel looking for whales at the surface of the water.

Question: What will happen if the animals are negatively impacted?
Response: It is difficult to know if an animal is negatively impacted as a result of this project. As we have mentioned, the project will follow the "Canadian Statement of Practice with respect to the Mitigation of Seismic Sound in the Marine Environment". The Canadian Statement of Practice was developed to lessen the potential for seismic survey to effect the marine environment.

Seismic Surveys

Question: If I were beside the air gun in the water would I survive?
Response: Determining the effects of a seismic blast on living creatures is a complex task which is not well understood. This is due to the difference in characteristics of sound in air versus water, different methods of measuring sound intensity and the range of frequencies which are able to be heard by a given creature (Cummings, 2003). While it is not possible to say for certain if a person could survive the blast from an air gun, they would certainly experience negative effects. One report suggests that the lethal zone for marine mammals from a large seismic air gun array is 7 meters (approximately 21 feet) (Parvin, Nedwell & Harland, 2007). Despite the lack of conclusive scientific evidence, the blasts from air guns are still considered "potentially lethal" (Popper and Hastings, 2009). Organisms close to the blast risk organ damage from the potential rupture of gas-filled cavities, such as the lungs or ears (Weilgart, 2007).

Question: Have there been any differences in the sand/mud or microorganisms on the ocean floor from seismic surveys?
Response: Studies have shown that algae and other microorganisms are not negatively affected by the sound produced from 2D seismic surveys.

Question: How far is the after affect going to carry?
Answer: Sound travels further in the water than in the air. Noise from other boats, and natural phenomenon, like earthquakes can be heard throughout the oceans. This constant background noise is present throughout the oceans and whales have begun to adapt to this noise by communicating in higher frequencies.

The effect of the seismic survey in a distance, will contribute to this background noise, but only for a short period of time. It is impossible to determine how far such as 100km or 1000km the sound from the project will travel and be distinguishable from other noises in the environment.

Question: How far does the sound travel under water?
Answer: The sound source will be pointed at the bottom of the ocean. However, there will be some sound that travels outwards from the sound source and sound will bounce off the ocean floor to be reflected back to the survey equipment.

Sound travels further under water than in the air. Noise from other boats and natural occurrences like earthquakes can be heard throughout the oceans. This constant background noise is present throughout the oceans and whales have begun to adapt to this noise by communicating in higher frequencies. It would be difficult to determine how far outwards from the sound source that the sound will travel.

References

Boertmann, D., Tougaard, J., Johansen, K. & Mosbech, A. (2009). Guidelines to environmental impact assessment of seismic activities in Greenland waters. National Environmental Research Institute, Aarhus University, Denmark. NERI Technical Report no. 723.

Cummings, Jim. (2003). Seismic Surveys: What We Don't Know Can Hurt. (The Acoustic Ecology Institute and Greenpeace). Retrieved from: http://www.acousticecology.org/oceanairgunexecsumm.html

Klinck, H., Nieukirk, S.L., Mellinger, D.K., Klinck, K., Matsumoto, H., & Dziak R.P. (2012). Seasonal presence of cetaceans and ambient noise levels in polar waters of the North Atlantic. Journal of the Acoustical Society of America. 132 (3), p. EL176-EL181.

McCauley, R. D., Fewtrell, J., Duncan, A. J., Jenner, C., Jenner, M-N., Penrose, J., Prince, R. I. T., Adhitya, A., Murdoch, J., and McCabe, K. (2000). Marine seismic surveys – a study of environmental implications. *Australian Petroleum Production and Exploration Association Journal*, p. 692–705.

Parvin S J, Nedwell J R, Harland E. (2007) Lethal and physical injury of marine mammals, and requirements for Passive Acoustic Monitoring. Subacoustech Report Reference: 565R0212, February 2007, To UK Government Department of Business, Enterprise and Regulatory Reform. Retrieved from: http://www.atlanticdisarray.org.uk/wordpress/wp-content/uploads/2012/01/Lethal-physical-injury-of-marine-mammals.pdf

Popper A., & Hastings, M.C. (2009). The effects of human-generated sound on fish. *Integrative Zoology*, 4, p. 43-52.

Richardson WJ, Miller GW, Greene CR. (1999). Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea. *Journal of the Acoustical Society of America,* 106, p. 2281-2281.

Weilgart, L. (2007). The impacts of anthropogenic ocean noise on cetaceans and implications for management. Canadian Journal of Zoology, 85, p. 1091-1116.

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ᑐᓴᖅᑎᑦ ᑎᓯᒪᓕᕆᐊᖅᑐᑎᒃ ᑲᑎᒪᑎᑦ ᓯᓂᕐ ᒥ
ᐊᐱᖅᑯᓯᓇᔭᐅᖅᑲᑦ ᑕᓚᐅᖅᑐᓄᑦ ᑭᐅᔾ ᔪᑎᖕᒋ

TGS NOPEC Geophysical Company ASA, Petroleum GeoServices and Multi Klient Invest AS-ᑯᑦ

ᑲᓇᑕᐅᑉ ᑭᕙᒌᓂᐅᑭᐅᖅᑕᖅᑐᖕᒐᓂᒪᕐ ᕈᐃᓕᖕᒐᔪᑎᒍᑦ
ᑐᓴᖅᓴᐅᑎᑦ ᑎᓂᕐᑲᖅᑐᑎᒃ (ᐊᑭᐅᖅᑎᑦ ᑎᓪ ᓗᑎᒃ) ᖃᐅᔨᓴᕐ ᓂᐅᔪᑦ

ᓄᕕᐱᓇ 2012

ᓴᓇᓕᖅᑐᓄ

ᑖᒃ ᑯᐊᐃᑎᑎᕆᓴᒥᒃᓴᓪᓕᐊᓪ ᐊᑦᕿᑭᑲᒃ ᓴᐊᓚᕐᓇᖅ ᐅᓪᓗᕆᓂᖅᓴᓪ ᑐᑭᓯᓇᓚᐅᖅᑎᑦᑎᓂᒃ ᐊᒥᓱᓕᕆᔨᒃᑯᑦ ᑐᓴᕆᔭᐅᓂᖅ ᐊᑐᖅᑐᑦ ᐊᑐᖅᑐᑦ ᐊᑐᖅᑐᑦ

TGS NOPEC Geophysical Company ASA, Petroleum GeoServices and Multi Klient Invest AS-ᑯᑦ ᑲᓇᑕᒃᓴ ᑭᖑᓪᓕᐅᑭᐅᓂᖅᑕᖅᑐᑐᒃᓯᒪᓕᒫᑦ ᑭᐅᓂᖅᓯᒪᔪᑎᑦ ᑐᓴᕆᓂᐅᑦᑎᑎᓐ (ᐊᑭᐅᐅᖅᑎᑦ ᑎᑦ ᓄᓇᑎᓐ) ᖃᐅᔨᓴᖅ ᓂᐅᔾᔨᓴᖅ

ᑭᐅᑦ ᓴᐃᑎᐅᔾᔨᖅ: ᒪᖅ ᑭᐅᐃᓕᖓᔪᓂ ᓄᓕᐅᑐᓂᖅ ᑎᓂᐅ ᑯᑦ (ᐊᑭᐅᐅᖅᑎᑦ ᑎᓄᓇᑎᓐ) ᖃᐅᔨᓴᖅ ᓂᐅᔾᔨᓴᖅ ᐃᓕᓴᕐᕋᖅ >ᖅ ᖃᓄᐃᓕᓴᕐᕕᑎᑦ ᑎᑐᐃᓐᓇᐅᔾᔨᖏᑦ ᓂᓪ ᒧᑦ ᐊᑦᓴᑭᐅᓄ ᒥᐅᑭᐅᓂᖅᑐᓂᖅ ᐱᓕᕆᓂᖅᑐᑦ 20 Γᓂ ᓱᒥᓄ ᐊᑯᓂᐅᑎᓪᓗᒍ ᓄᓇᓕᒻᒥᐅᓂᑐᑦᓯᒪᓂᑦ ᓱᓂᐅᑦᑎᑎᓐ ᖃᐅᔨᓴᖅ ᓂᐅᔾᔨᓴᖅ ᐃᓕᓴᕐᕋᖅ ᑐᓴᕆᓂᐅᑦᑎᑎᓐ ᑐᓴᕆᓂᐅᑦᑎᑎᓐ ᑐᓴᕆᓂᐅᑦᑎᑎᓐ

ᐊᐱᖅᑯᑎᐅᔪᖅ: ᑕᒪᐃᒃ ᑯᐊ ᑐᓴᓱᒃ ᓴᓯᒥᐅᔪᓯ ᐅᖅᓱᓴᐊᓪᓚᒃ ᓴᒥᐅ ᖃᑭᙵᖅᑎᐅᔪᓂᒃ ᐃᑲᔪᕐᑕᑎᓴ ᓴᐅᑎᑕᐅᒪᓱ ᒪᑕᑭ? ᐅᖅᓱᓴᐊᓪᓚᒃ ᓴᒥᐅ ᖃᑭᙵᓂ ᓂᒥᙵᖅᑎᑦᑕ ᓄᑕᑦ , ᐃᓕᓐᐃ?
ᑭᐅᑦ ᔪᑎᐅᔪᖅ: ᑐᑭᓯᒋᐊᓂ ᓇᒃ ᓴᓯᒥᐅᔪᓯ ᑎᑎᖅᑲᐃᑦ ᐊᒪ ᒪᓪᑐᑐᓴᓱᒃ ᓴᓯᒥᐅᔪᓯ ᑎᑎᕆᖅᑕᐅᔭᓕᓐ ᓚᐊᓯᒪᔪᓯ ᖃᐅᔨᓴᓂ ᓂᒥᙵᖅᑎᑦᑕ ᐊᒥᓱᓂ ᑐᓂᓯᔪᓐᓇᖅᑐᖅ ᐅᓇᖅᑐᖅ ᑕᓂ ᑎᔪᓂ ᒪᒥᑕ. ᐃᓕᓴᖅᙵᖅᑎᑦᑕ ᓄᓇᕗᑦ ᐃᓕᓴᐅᔪᓂᒃ ᓚᐊᓯᒪᔪᓯ ᐊᒥᓱᓂ ᑐᓂᓯᔪᓐᓇᖅᑐᖅ ᐃᓐᓇᐅᑉ ᐊᑐᖅᑐᖅ, ᐃᓇᖅᑐᓂ , ᐊᒪᓂ ᒪᓪᑐᑐᓴᓱᒃ ᐊᐱᖅᑯᓴᕐᕕᖏᓐᓇᖅᑐᖅ ᐅᖃᓕᒫᓂᒃ ᑎᑎᕆᖅᑕᐅᔭᓕᓐ ᓚᐊᓯᒪᔪᓯ ᑎᑎᕆᖅᑕᐅᔭᓕᓐ ᓴᓯᒥᐅᔪᓯ ᒪᒥᑕ. ᐃᓐᓇᐅᑉ ᐊᑐᖅᑐᖅ ᐃᓐᓇᐅᑉ ᐊᑐᖅᑐᖅ ᐊᒪᓂ

ᑭᐅᑦ ᔪᑎᑎᔪᓕᖅ: ᖃᐅᔨᓴᓕᖅ ᓂᕆᓚᖅᑐᑦ ᑐᑭᓯᐅᒪᓕᕐᕕᒃᑯᑦ ᓕᕐᒪᓕᓂ ᓄᑎᒃ ᑕᓗᐅᑦ ᐃᓂ ᑎᖏᓐᓂᐅᔨᓴᕐᔪᐊᖅ ᓂᐊᒪᓴᒃ ᓴᓕᖏᓐᓂ ᐱᑕᖃᑦᑕᐃᓕᐅᖅ ᓚᐲᒃᑯ .

ᐊᐱᖅᑯᑎᐅᔪᓕᖅ: ᑭᒃ ᑯᑦ ᐱᑕᓚᐊᖓᒍᒃ ᑭᐃᓇᐅᔨᓴᕐᔪᐊᖅᑎᑎᓂ ᓯᓴᐅᑦᑕᑯᓪ ?
ᑭᐅᑦ ᔪᑎᑎᔪᓕᖅ: Multi Klient Invest-ᑯᑦ ᑕᐃᓴ ᓯᒥᖖᖏᓕᓚᐊᖓᒍᒃ ᑭᐃᓇᐅᔨᓴᕐᔪᐊᖅᑎᑎᓂ ᓯᓴᐅᑦᑕᑯᓪ . ᑭᐃᓇᐅᔨᓴᕐᔪᐊᖅ ᑎᑐᒧ ᐃᒃᓚᓂᕐᕕᒃᑯᑦ ᓄᑎᒃ ᓇᓐ ᒥᓂᔨᑎᑎᓂᒃ Petroleum GeoServices-ᑯᓐᓂ (ᐅᖃᓯᐊᓗᒃ ᓴᓂᓚᓴᐅᔪᓂ).

ᐊᐱᖅᑯᑎᐅᔪᓕᖅ: ᑭᒃ ᑯᑦ ᑐᑭᓯᐅᓂᐊᖅ ᓕᒫᔪᓐᓇᖅᑐᒥᑦ ᑲᑎᖅᓯᐊᓚᕆᐊᓯᒪᔪᓂᒃ ᓂᐅᓕᖅᑭᓴᖅ ᑕᖅ ᓂᐊᖅ ᒪᑕ?
ᑭᐅᑦ ᔪᑎᑎᔪᓕᖅ: ᑕᒪᑐᒍᓐᓇᐹᑦᑕ ᑐᒍ ᑐᑭᓯᐅᓂᐊᖅ ᓕᒫᔪᓐᓇᖅᑐᒥᑦ ᑲᑎᖅᓯᐊᓚᕆᐊᓯᒪᔪᓂᒃ ᓂᐅᓕᖅᑭᓴᖅ ᑕᖅ ᓂᐊᖅ ᒪᑕ . ᑭᐃᓇᐅᔨᓴᕐᔪᐊᖅᑎᑎᓂ ᑐᑭᓯᐅᓂᐊᖅ

ᑎᓪᓗᒍ ᓇᓱᖅ ᔪᐊᖏᓪᓕᐊᓂᒃᑯᓘᓐᓃᑦ ᓄᓇᑦ ᖃᐅᔨᓴᓂᖅᑎᑦ ᔪᐊᒃ ᑯᑦ ᓴᓇᓐᓂᒃ ᓴᓂᖅᑭᑦᓯᓚᕆᑐᐃᑦ ᒥᔪᔨᓐᓂᒃ ᓄᑭᒪᓂᖅ ᓄᓇᓕᖅᑐᓂ ᐊᓂᒍᓯᔪᓐᓇᖅᑐᖅ ᓄᓇᓕᖅᑐᓂ ᒥᔪᔨᓐᓂᒃ ᐊᓂᒍᓯᔪᓐᓇᖅᑐᖅ

ᑭᐅᐃᑦ ᔪᑎᑎᔪᖅ: ᑕᓂᐅᑦ ᐊᐅᖅᑎᑎᕆᔨᒃᑯ, ᖃᐅᔨᓕᓕᒫᒥᐅᑉ ᐱᓕᕆᔨᖅᑐᑎᓐ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ ᐊᔪᓂᖅ ᐊᔪᓂᖅ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ ᐃᓕᓴᕐᓂᐊᕐ

ᑭᐅᑦ ᓴᑎᐅᔪᖅ: ᑐᓴᖅᓴᐅᔪᖅ ᐅᖃᓗᐊᓂᒃ ᒥᖅᓴᖅᓴᐅᔪᑦ ᐃᓚᒋ ᕿᓚᒥ ᒪᑦ ᐃᒪᐅᑦ ᐃᓕᓴᐅᓂᓗᒍᑦ ᐱᓕᕆᔨᒃᑲᓪᓚᑦ ᐊᑐᖅᑐᑦᓯᓂᒃ ᐊᑐᖅᑐᑦᓯᓂᒃ ᐊᑐᖅᑐᑦᓯᓂᒃ

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Boertmann, D., Tougaard, J., Johansen, K. & Mosbech, A. (2009). Guidelines to environmental impact assessment of seismic activities in Greenland waters. National Environmental Research Institute, Aarhus University, Denmark. NERI Technical Report no. 723.

Cummings, Jim. (2003). Seismic Surveys: What We Don't Know Can Hurt. (The Acoustic Ecology Institute and Greenpeace). Retrieved from: http://www.acousticecology.org/oceanairgunexecsumm.html

Klinck, H., Nieukirk, S.L., Mellinger, D.K., Klinck, K., Matsumoto, H., & Dziak R.P. (2012). Seasonal presence of cetaceans and ambient noise levels in polar waters of the North Atlantic. Journal of the Acoustical Society of America. 132 (3), p. EL176-EL181.

McCauley, R. D., Fewtrell, J., Duncan, A. J., Jenner, C., Jenner, M-N., Penrose, J., Prince, R. I. T., Adhitya, A., Murdoch, J., and McCabe, K. (2000). Marine seismic surveys – a study of environmental implications. *Australian Petroleum Production and Exploration Association Journal*, p. 692–705.

Parvin S J, Nedwell J R, Harland E. (2007) Lethal and physical injury of marine mammals, and requirements for Passive Acoustic Monitoring. Subacoustech Report Reference: 565R0212, February 2007, To UK Government Department of Business, Enterprise and Regulatory Reform. Retrieved from: http://www.atlanticdisarray.org.uk/wordpress/wp-content/uploads/2012/01/Lethal-physical-injury-of-marine-mammals.pdf

Popper A., & Hastings, M.C. (2009). The effects of human-generated sound on fish. *Integrative Zoology*, 4, p. 43-52.

Richardson WJ, Miller GW, Greene CR. (1999). Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea. *Journal of the Acoustical Society of America,* 106, p. 2281-2281.

Weilgart, L. (2007). The impacts of anthropogenic ocean noise on cetaceans and implications for management. Canadian Journal of Zoology, 85, p. 1091-1116.

2010

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Fishery and Aquaculture Statistics

Capture production

Statistiques des pêches et de l'aquaculture

Captures

Estadísticas de pesca y acuicultura

Capturas

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Standard symbols		Signes conventionnels	Símbolos convencionales
...	Data not available; unobtainable; data not separately available but included in another category	Données non disponibles; données que l'on n'a pas pu obtenir; données non disponibles séparément, mais comprises dans une autre catégorie	No hay datos; no se han podido obtener datos; datos no disponibles por separado pero incluidos en otra partida estadística
–	None; magnitude known to be nil or zero	Néant; quantité que l'on sait égale à zéro	Ninguna; cantidad que se sabe es nula o cero
0	More than zero but less than half the unit used	Quantité supérieure à zéro, mais inférieure à la moitié de l'unité utilisée	Más de cero pero inferior a la mitad de la unidad empleada
F	FAO estimate from available sources of information or calculation based on specific assumptions	Estimations de la FAO d'après les sources d'informations disponibles ou calculées sur la base de suppositions spécifiques	Estimación de la FAO partiendo de fuentes de información disponibles o calculada sobre la base de suposiciones específicas
t	tonnes (=1000 kg)	tonnes (=1000 kg)	toneladas (=1000 kg)
kg	kilograms	kilogrammes	kilogramos
no	number	nombre	número
nei	not elsewhere included	**nca** non compris ailleurs	**nep** no especificado en otra partida
...**A**	FAO English name of the species item is not available	Le nom anglais de la FAO pour la catégorie d'espèces n'est pas disponible	El nombre de la FAO en inglés para la partida de especie no está disponible
...**B**	FAO French name of the species item is not available	Le nom français de la FAO pour la catégorie d'espèces n'est pas disponible	El nombre de la FAO en francés para la partida de especie no está disponible
...**C**	FAO Spanish name of the species item is not available	Le nom espagnol de la FAO pour la catégorie d'espèces n'est pas disponible	El nombre de la FAO en español para la partida de especie no está disponible
S	Summation of catches	Somme des captures	Suma de las capturas

Introduction

1. This section of the **FAO Yearbook of fishery and aquaculture statistics** presents the annual statistics, for a varying series of recent years ending in 2010, on a worldwide basis, on nominal catches of fish, crustaceans, molluscs and other aquatic animals, residues and plants, taken for all purposes (commercial, industrial, recreational and subsistence) by all types and classes of fishing units (fishermen, vessels, gear, etc.) operating both in inland, fresh and brackish water areas, and in inshore, offshore and high seas fishing areas. Beginning with Volume 82 statistics for mariculture, aquaculture and other kinds of fish farming, are excluded from all national, regional and global totals. **Beginning with Volume 90/1, the names and species composition of some groups of the FAO International Standard Statistical Classification of Aquatic Animals and Plants (ISSCAAP) have been revised. See paragraph 3 of the NOTES ON SPECIES ITEMS.**

2. The annual period used is the calendar year (1 January-31 December), with the exceptions of capture data in the Antarctic fishing areas and for some countries, mentioned in the NOTES ON INDIVIDUAL COUNTRIES OR AREAS, for which a split-year is used. Since Volume 94/1, the new fishing season (1 December–30 November) of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has been adopted. Split-year data are shown under the calendar year in which the split-year ends.

3. Catches are expressed in tonnes, except those for whales, seals and crocodiles which are given in numbers and corals, pearls and sponges which are given in kilograms.

4. Beginning with Volume 48 data on aquatic mammals (tables B-61, B-62 and B-63 expressed in numbers and B-64) and data on aquatic plants (A-6, B-91, B-92, B-93 and B-94) are excluded from all national, regional and global totals. For practice prior to Volume 48, see notes in respective Yearbook. Beginning with Volume 60, data on corals, expressed in kilograms given in table B-82 are also excluded from all national, regional and global totals. Beginning with Volume 62 data on pearls, expressed in kilograms in table B-81 and sponges expressed in kilograms in table B-83 are likewise excluded. Beginning with Volume 66 data on crocodiles expressed in numbers in table B-73 are excluded from all national, regional and global totals.

5. FAO has completed the separation of the aquaculture time series from the capture production time series dating back to 1950. This separation was based on national reporting, when available, and other sources of historical information.

6. Where necessary the data for 1950-2009 published in the preceding issues of the Yearbook of fishery and aquaculture statistics have been revised. Where figures in this issue differ from those previously published, the amended data represent the most recent version. Some statistics provided to FAO by national offices, in particular those for 2010, are provisional and may be amended in future editions, and in other FAO publications.

Introduction

Dans cette section de l'**Annuaire statistique des pêches et de l'aquaculture** figurent, pour diverses périodes récentes prenant fin en 2010, les statistiques établies sur une base mondiale des captures nominales de poissons, crustacés, mollusques et autres animaux aquatiques, résidus et plantes aquatiques, effectuées à toutes fins (commerciales, industrielles, récréatives et de subsistance) par tous les types et catégories d'unités de pêche (pêcheurs, bateaux, engins, etc.) opérant tant dans les eaux continentales, douces et saumâtres, que dans les zones de pêche du littoral, du large et de la haute mer. À partir du Volume 82, les statistiques ayant trait à la mariculture, à l'aquaculture et à d'autres types de pisciculture, sont exclues de toutes les données au niveau national, régional et global. **À partir du Volume 90/1, les dénominations et la composition par espèces de quelques groupes de la Classification statistique internationale type des animaux et des plantes aquatiques (CSITAPA) de la FAO ont subi des révisions. Voir le paragraphe 3 des NOTES SUR LES CATÉGORIES D'ESPÈCES.**

La période annuelle utilisée est l'année civile (1er janvier-31 décembre), sauf pour les données relatives aux captures effectuées dans les zones maritimes de l'Antarctique et pour quelques pays, mentionnés dans les NOTES SUR DIVERS PAYS OU ZONES, pour lesquels on utilise l'année fractionnée. À partir du volume 94/1 on utilise la nouvelle période de pêche (1er décembre-30 novembre) de la Commission pour la conservation de la faune et la flore marines de l'Antarctique (CCAMLR). Les données relatives aux années fractionnées figurent sous l'année civile durant laquelle se termine l'année fractionnée.

Les captures débarquées sont exprimées en tonnes, à l'exception des données relatives aux baleines, phoques et crocodiles qui sont indiquées numériquement et les données sur les coraux, les perles et les éponges qui sont indiquées en kilogrammes.

A partir du volume 48, les données sur les mammifères aquatiques (tableaux B-61, B-62 et B-63 exprimées en nombres et B-64) et les données sur les plantes aquatiques (A-6, B-91, B-92, B-93 et B-94) sont exclues de tous les totaux au niveau national, régional et global. Pour la méthode suivie avant le volume 48, se reporter aux notes de l'Annuaire en question. A partir du volume 60, les données sur les coraux exprimées en kilogrammes indiquées au tableau B-82 sont également exclues de tous les totaux au niveau national, régional et global. A partir du volume 62, les données sur les perles exprimées en kilogrammes indiquées au tableau B-81, et sur les éponges exprimées en kilogrammes indiquées au tableau B-83 sont, de même, exclues. A partir du volume 66, les données sur les crocodiles exprimées en nombre au tableau B-73 sont exclues de tous les totaux au niveau national, régional et global.

La FAO a complété la séparation des séries de production en aquaculture et capture à partir de 1950. Cette séparation a été basée sur des reportages nationaux, si disponibles, et d' autres sources d' information historique.

Le cas échéant, les données relatives aux années 1950-2009 publiées dans les éditions précédents de l'Annuaire statistique des pêches et de l'aquaculture ont été révisées. Lorsque les chiffres indiqués dans l'édition présente diffèrent de ceux déjà publiés, les données modifiées représentent la version la plus récente. Certaines statistiques communiquées à la FAO par les services nationaux sont provisoires, notamment pour 2010, et pourront être modifiées dans les éditions futures ainsi que dans d'autres publications de la FAO.

Introducción

En esta sección del **Anuario estadístico de pesca y acuicultura** se presentan las estadísticas mundiales, para diversas series de los últimos años que terminan en 2010, de las capturas nominales de peces, crustáceos, moluscos y demás animales, residuos y plantas acuáticos, hechas con cualquier fin (comercial, industrial, recreativo y de subsistencia), por unidades de pesca de todos los tipos y categorías (pescadores, barcos, artes, etc.) en aguas continentales, dulces y salobres y en áreas de pesca de bajura, media altura o altura. A partir del volumen 82 las estadísticas correspondientes a maricultura, acuicultura y otros tipos de pisicultura, están excluidas de las cantidades a nivel nacional, regional y global. **A partir del volumen 90/1, las denominaciones y la composición por especies de algunos de los grupos de especies de la Clasificación Estadística Internacional Uniforme de los Animales y Plantas Acuáticos (CEIUAPA) de la FAO fueron revisados. Véase el párrafo 3 en las NOTAS SOBRE LAS PARTIDAS DE ESPECIES.**

El período anual utilizado es el año civil (1 de enero-31 de diciembre), excepto en el caso de las capturas efectuadas en las áreas marítimas del Antártico y para algunos países, mencionados en las NOTAS SOBRE LOS DISTINTOS PAÍSES O ÁREAS, para los que se utiliza el año emergente. Desde el volumen 94/1 se utiliza el nuevo período de pesca (1 de diciembre-30 de noviembre) de la Comisión para la Conservación de los Recursos Vivos Marinos Antárticos (CCRVMA). Los datos correspondientes a los años emergentes se incluyen en el año civil en que termina el año emergente.

Las capturas se expresan en toneladas, excepto en el caso de ballenas, focas y cocodrilos que se dan en número y en el caso de corales, perlas y esponjas que se dan en kilogramos.

A partir del volumen 48 los datos relativos a los mamíferos acuáticos (cuadros B-61, B-62 y B-63 expresados en números y B-64) y los datos relativos a las plantas acuáticas (A-6, B-91, B-92, B-93 y B-94) están excluidos de las cantidades totales a nivel nacional, regional y global. Con respecto a la práctica seguida antes del volumen 48, véanse las notas en el Anuario respectivo. A partir del volumen 60 los datos relativos a los corales expresados en kilogramos que aparecen en el cuadro B-82 están también todos excluidos de las cantidades totales a nivel nacional, regional y global. A partir del volumen 62 los datos relativos a las perlas expresados en kilogramos que aparecen en el cuadro B-81 y a las esponjas expresados en kilogramos que aparecen en el cuadro B-83 están igualmente excluidos. A partir del volumen 66 los datos relativos a los cocodrilos, expresados en números, en el cuadro B-73 están excluidos de las cantidades totales a nivel nacional, regional y global.

La FAO ha completado la separación de las series cronológicas de acuicultura y de producción de captura a partir de 1950. Esta separación se basó en los informes nacionales, cuando eran disponibles, y en otras fuentes de información histórica.

Siempre que ha sido necesario se han revisado los datos correspondientes a 1950-2009 publicados en las ediciones anteriores del Anuario estadístico de pesca y acuicultura. Cuando las cifras que aparecen en esta edición difieren de las publicadas anteriormente, los nuevos datos representan la última versión disponible. Algunas estadísticas facilitadas a la FAO por las oficinas nacionales, en particular las correspondientes a 2010, son provisionales y podrán modificarse en ediciones futuras y en otras publicaciones de la FAO.

Introduction

7. National focal points for fishery statistics, in particular those of countries fishing in more than one major fishing area, report their annual catches to various fishery commissions, as well as to FAO. To eliminate duplication in requests to these national offices, FAO cooperates with regional fishery bodies, particularly through the Coordinating Working Party on Fishery Statistics (CWP), to standardize reporting forms, procedures, definitions, classifications and other related documentation. This system reduces discrepancies between the figures appearing in the Yearbook of Fishery Statistics and those published in the bulletins issued by the commissions. Some discrepancies may still exist, but effort is constantly being made to eliminate them.

8. For the time being, the flag of the vessel is used to assign its nationality unless the wording of chartering and joint operation contracts indicates otherwise.

9. To facilitate use of the Yearbook, a series of notes and lists are included.

10. As usual, government officers and staff of international organizations have made possible the timely publication of this Yearbook by their prompt attention to our requests, and the care they devoted to checking material submitted to them. FAO expresses its thanks to them and welcomes the support of national and international organizations, and of interested individuals, in improving the scope and accuracy of the Yearbook.

11. Great care is taken by FAO in ensuring as far as possible the quality of the data presented in this Yearbook, supplementing data reported by countries with information from other sources, where available, including regional fishery bodies, field projects and independent surveys, specialist literature and fishery-independent sources. However, the accuracy and reliability of world aggregations of fishery statistics ultimately depends upon the quality of national data sources, collection methods, periodicity of updating and reporting. Fishery data quality is known to be very uneven among countries. Although improvements to data quality are made by FAO on a continuing basis, it is clear that many more can be made. Any input from data users in this regard will be most welcome.

Introduction

Les centres nationaux des statistiques des pêches, notamment ceux des pays exploitant plus d'une principale zone de pêche, déclarent leurs captures annuelles aux diverses commissions des pêches, de même qu'à la FAO. Pour éviter que les demandes adressées à ces services nationaux ne fassent double emploi, la FAO coopère avec les organes régionaux des pêches, en particulier par l'entremise du Groupe de travail chargé de coordonner les statistiques des pêches (CWP), pour normaliser les formules de déclaration, les procédures, les définitions, les classifications et toute la documentation connexe. Ce système permet de réduire les divergences entre les chiffres figurant dans l'Annuaire statistique des pêches et ceux des bulletins publiés par les commissions. Certaines de ces divergences demeurent, mais on s'efforce toujours de les éliminer.

Pour le moment, le pavillon du navire est utilisé pour déterminer sa nationalité, à moins que le libellé des contrats d'affrètement et d'opérations conjointes ne l'indique autrement.

Pour faciliter l'emploi de l'Annuaire, on a introduit une série de notes et de listes.

Comme de coutume, c'est grâce à la rapidité et au soin avec lesquels les fonctionnaires des services publics et le personnel des organisations internationales ont répondu à nos demandes et vérifié les matériaux qui leur étaient soumis, que cet Annuaire a pu être publié en temps voulu. La FAO tient à les remercier et se félicite de l'aide que lui apportent les organisations tant nationales qu'internationales et les personnes intéressées, afin d'améliorer l'étendue et la précision de l'Annuaire.

La FAO essaie autant que possible, avec le plus grand soin, d'assurer la qualité des données présentées dans cet Annuaire, en complétant les données communiquées par les pays par des informations provenant d'autres sources telles que: organes régionaux des pêches, projets de terrain, enquêtes indépendantes, documents rédigés par des spécialistes et sources extérieures au secteur des pêches. Néanmoins, la précision et la fiabilité des agrégats mondiaux des statistiques des pêches dépendent en dernière analyse de la qualité des sources nationales de données, des méthodes de collecte, de la périodicité de leur mise à jour et de leur présentation. La qualité des données halieutiques peut être fort inégale d'un pays à l'autre. Même si la FAO s'engage à améliorer constamment la qualité des données, il ne fait pas de doute que nombre d'autres améliorations peuvent être apportées. Toute contribution des utilisateurs des données à cet égard sera la bienvenue.

Introducción

Los centros nacionales de estadísticas pesqueras, en particular los de aquellos países que pescan en más de una de las áreas principales de pesca, comunican sus datos sobre capturas anuales a las diversas comisiones de pesca y a la FAO. Para eliminar duplicaciones en la solicitud de datos a esas oficinas nacionales, la FAO colabora con los órganos regionales de pesca, particularmente mediante el Grupo Coordinador de Trabajo sobre Estadísticas de Pesca (CWP), para uniformar los formularios de comunicación de datos, y los procedimientos, definiciones, clasificaciones, etc. Esto permite además reducir las discrepancias entre las cifras que aparacen en el Anuario Estadístico de Pesca y las publicadas en los boletines preparados por las diversas comisiones. Pueden subsistir aún algunas discrepancias, pero siempre se intenta eliminarlas.

Por el momento, se entiende que el pabellón del barco determina su nacionalidad, a menos que en los contratos de fletes o de operación conjunta se indique otra cosa.

Para facilitar la consulta del Anuario se incluyen una serie de notas y listas.

Igual que en ocasiones anteriores, la pronta publicación de este Anuario ha sido posible gracias a la colaboración de funcionarios estatales y de organizaciones internacionales que han respondido con prontitud a nuestras peticiones y han controlado con atención el material que se les ha presentado. La FAO desea manifestar a todos ellos su reconocimiento y agradece ya desde ahora la ayuda que organizaciones nacionales e internacionales o personas privadas le presten para mejorar el alcance y exactitud de este Anuario.

La FAO presta gran atención a asegurar en la medida de lo posible la buena calidad de los datos que se presentan en este Anuario, complementando los datos comunicados por los países con información de otras procedencias, cuando se dispone, tales como los órganos regionales de pesca, los projectos de campo y encuestas independientes, bibliografía especializada y fuentes que no dependen de la pesca. Sin embargo, la exactitud y fiabilidad del acopio mundial de estadísticas de pesca se basan fundamentalmente en la calidad de las fuentes de datos nacionales, en los métodos de recopilación de los mismos, en la periodicidad de la actualización y la comunicación. Como se sabe, la calidad de los datos pesqueros nacionales puede variar mucho de un país a otro. Aunque la FAO está mejorando constantemente la calidad de los datos, es evidente que se puede mejorar todavía mucho. Cualquier aportación de los usuarios de los datos a este respecto será muy bien recibida.

Notes and lists

Notes et listes

Notas y listas

General notes

1. This section of the **Yearbook of fishery and aquaculture statistics** presents, for the most recent series of calendar years and split-years, annual statistics on NOMINAL CATCHES of freshwater, brackishwater and marine species of fish, crustaceans, molluscs and other aquatic animals and plants, killed, caught, trapped or collected for all commercial, industrial, recreational and subsistence purposes.

2. In view of the importance of recreational fishing regarding some stocks and for certain countries, and the difficulty of distinguishing in many cases between recreational and subsistence fishing (and in accordance with the recommendation of the 16th Session of the Coordinating Working Party on Fishery Statistics - CWP, Madrid, Spain, 20-25 March 1995), data should cover recreational fisheries. However, despite the importance of recreational fishing regarding some species and for certain countries, figures include recreational catches only where available.

3. The NOMINAL CATCHES concept refers to the landings converted to a *live weight* basis; the closely related concept LANDINGS refers to the quantities on a *landed weight* basis. In many fisheries the landed quantities (LANDINGS) are identical to the quantities caught (NOMINAL CATCHES).

4. There are many instances where the catches on board fishing vessels or factory ships are gutted, eviscerated, filleted, salted, dried, etc., or reduced to meals, oil, etc. The data on the LANDINGS of such species and products require conversion by accurate yield rates (conversion factors) to establish the live weight equivalents (nominal catches) at the time of their capture. See diagram on the following pages.

5. Many national statistical publications do not use the terms "landings" and "catches" with their precise meanings as described above. In such publications the term "catches" is used sometimes to refer to quantities on a landed weight basis, i.e. "landings" which might consist of gutted, eviscerated and filleted fish, as well as of meals and oils. However, only where the "primary production" (the phrase "primary production" is used in its economic and not in its biological sense) is landed whole is it correct to describe such landed quantities as "catches".

6. In some national statistics the following terms are in common use to refer to NOMINAL CATCHES, i.e. landings on a live weight basis:

   a) landings on a round, fresh basis;

   b) landings on a round, whole basis;

   c) landings on an ex-water weight basis.

7. For the "primary production" data on seaweeds, pearls, shells, corals, sponges, etc., it is preferable to use the term PRODUCTION which is more appropriate than NOMINAL CATCH. The term CATCH is also more suitable than NOMINAL CATCH in the case of whales and seals, where the "primary production" data for these species are not expressed in weight units but in numbers.

8. Data concerning the nominal catch of fish included within group 36 (tunas, bonitos and billfishes) are generally reviewed in collaboration with the regional agency concerned with tuna statistics (i.e. IATTC, ICCAT, IOTC, and WCPFC). Due to differences in the date by which these agencies require data to be submitted, figures for the most recent year are often subject to significant revision.

Notes générales

Dans cette section de l'**Annuaire statistique des pêches et de l'aquaculture** figurent, pour les plus récentes séries d'années civiles et d'années fractionnées, les statistiques annuelles des CAPTURES NOMINALES de poissons, crustacés, mollusques et autres animaux et plantes aquatiques d'eau douce, d'eau saumâtre et d'eau marine, tués, capturés, piégés ou ramassés à des fins commerciales, industrielles, récréative et de subsistance.

Étant donné que la pêche sportive a une grande incidence sur certains stocks et pour certains pays, qu'il est souvent difficile d'établir une distinction entre celle-ci et la pêche de subsistance (et en conformité avec la recommandation de la seizième session du Groupe de travail chargé de coordonner les statistiques de pêches - CWP, Madrid, Espagne, 20-25 mars 1995), les données doivent concerner la pêche sportive. Toutefois, malgré la grande incidence de la pêche récréative sur certaines espèces et pour certains pays, les chiffres indiqués comprennent les captures de la pêche récréative, seulement lorsque de telles données sont disponibles.

L'expression CAPTURES NOMINALES désigne l'équivalent en *poids vif* des quantités débarquées; l'expression, étroitement apparentée QUANTITÉS DÉBARQUÉES désigne le *poids mis à terre*. Dans de nombreuses pêcheries, les mises à terre (QUANTITÉS DÉBARQUÉES) sont identiques aux quantités capturées (CAPTURES NOMINALES).

Dans de nombreux cas, les captures sont vidées, éviscérées, filetées, salées, séchées, etc., ou réduites, en farine, en huile, etc., à bord des bateaux de pêche ou de navires-usines. Les données sur les QUANTITÉS DÉBARQUÉES de la sorte, à savoir après traitement, doivent être converties à l'aide de taux de rendement précis (coefficients de conversion) afin de déterminer les équivalents en poids vif (captures nominales) au moment de la prise. Voir le diagramme aux pages suivantes.

De nombreuses publications statistiques nationales n'emploient pas les expressions «quantités débarquées» et «captures» avec le sens précis indiqué ci-dessus. Le terme «captures» y sert parfois à désigner les quantités sur la base du poids mis à terre, c.-à-d. les «quantités débarquées» qui peuvent être des poissons vidés, éviscérés et filetés, ainsi que des farines et des huiles. Toutefois, c'est seulement lorsque la «production primaire» (au sens économique et non au sens biologique) est débarquée à l'état entier qu'il est correct de parler de «captures» pour ces mises à terre.

Dans certaines statistiques nationales, on utilise couramment les expressions suivantes pour désigner les CAPTURES NOMINALES, c.-à.-d. l'équivalent en poids vif des quantités débarquées:

a) quantités débarquées sur la base du poisson entier, frais;

b) quantités débarquées sur la base du poids du poisson entier;

c) quantités débarquées sur la base du poids du poisson à sa sortie de l'eau.

Pour les données sur la «production primaire» des algues, perles, coquillages, coraux, éponges, etc., il est préférable d'utiliser le terme PRODUCTION, qui est plus approprié que l'expression CAPTURES NOMINALES. Par ailleurs, le terme CAPTURES convient mieux que l'expression CAPTURES NOMINALES dans les cas des baleines et des phoques où la «production primaire» ne s'exprime pas en unités pondérales mais en nombres.

Les données concernant les captures nominales de poissons appartenant au groupe 36 (thonidés, bonites et marlins) sont en général révisées en collaboration avec l'organisation régionale chargée des statistiques des thonidés (CITT, CICTA, CTOI, et WCPFC). Comme les dates pour lesquelles ces organisations demandent les données ne correspondent pas toujours, les chiffres pour l'année la plus récente sont souvent sujets à des révisions significatives.

Notas generales

En esta sección del **Anuario estadístico de pesca y acuicultura** se presentan, para las más recientes series de años civiles y emergentes, estadísticas anuales de las CAPTURAS NOMINALES de especies de aguas dulces, salobres y marinas, de peces, crustáceos, moluscos y otros animales y plantas acuáticos, matados, capturados, entrampados o cobrados para todo fin de carácter comercial, industrial, pesca de recreo o de subsistencia.

Dada la importancia que la pesca de recreo tiene para algunas poblaciones de pescado y para ciertos países, y la dificultad de distinguir en muchos casos entre dicha pesca y la de subsistencia (y en conformidad con la recomendación de la decimosexta sesión del Grupo Coordinador de Trabajo sobre Estadísticas de Pesca - CWP, Madrid, España, 20-25 de marzo de 1995), los datos deberán incluir la pesca de recreo. Sin embargo, a pesar de la importancia que la pesca recreativa tiene para algunas especies de pescado y para ciertos países, las cifras incluyen las capturas de la pesca recreativa solamente cuando se hallan disponibles.

El concepto de CAPTURAS NOMINALES se refiere a los desembarques expresados en su *peso en vivo*; el concepto DESEMBARQUES íntimamente relacionado, se refiere al *peso descargado*. En muchas pesquerías las cantidades desembarcadas (DESEMBARQUES), son idénticas a las cantidades capturadas (CAPTURAS NOMINALES).

En muchos casos, las capturas a bordo de las embarcaciones de pesca o de los buques factoría se destripan, evisceran, filetean, salan, secan, etc., o se reducen en harina, en aceite, etc. Los datos sobre los DESEMBARQUES de estas especies y productos hay que convertirlos, mediante índices precisos de rendimiento (factores de conversión) para fijar su equivalente en peso en vivo (capturas nominales) en el momento de la captura. Véase el diagrama en las páginas siguientes.

Muchas publicaciones estadísticas nacionales no utilizan los términos «desembarques» y «capturas» con la significación precisa que se describe anteriormente. En tales publicaciones, el término «captura» se emplea algunas veces para referirse a cantidades basadas en el peso desembarcado, es decir «desembarques» que pueden consistir en pescado destripado, eviscerado y fileteado, así como en harinas y aceites. Sin embargo, sólo cuando la «producción primaria» (esta frase «producción primaria» se utiliza en su sentido económico y no en el biológico) se desembarca entera es correcto describir estas cantidades desembarcadas como «capturas».

En algunas estadísticas nacionales son de uso común las siguientes expresiones para referirse a las CAPTURAS NOMINALES, es decir, los desembarques expresados según su peso en vivo:

a) desembarques de pescado fresco, entero;

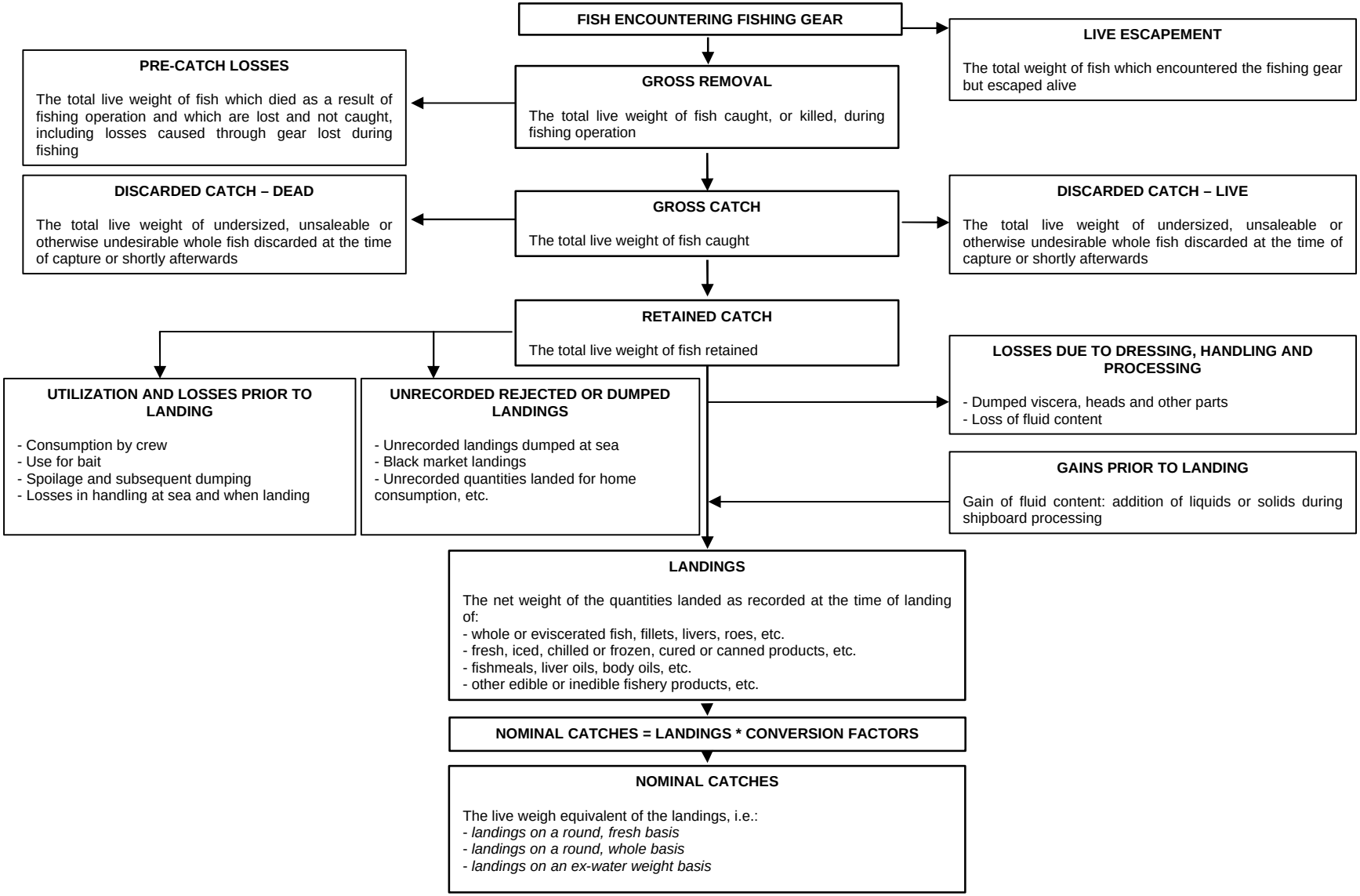
b) desembarques de pescado entero;

c) desembarques según el peso del pescado al sacarlo del agua.

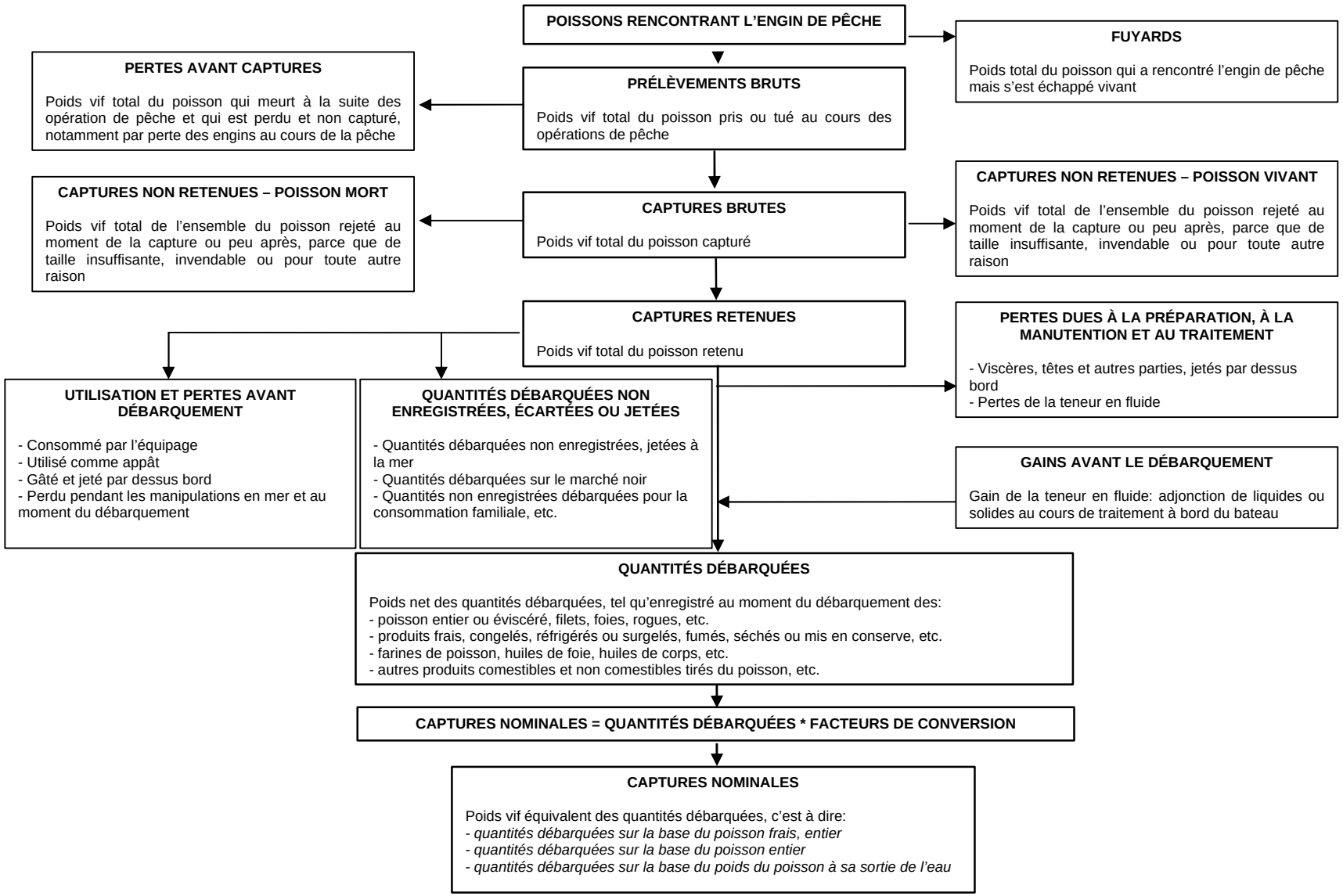
Para los datos de «producción primaria» de algas marinas, perlas, mariscos, corales, esponjas, etc., es preferible usar el término PRODUCCION, ya que es más apropiado que la expresión CAPTURA NOMINAL. El término CAPTURA también es más adecuado que la expresión CAPTURA NOMINAL en el caso de ballenas y focas donde los datos de «producción primaria» para estas especies no se expresan en unidades de peso sino en números.

Los datos relativos a la captura nominal de pescado incluido en el grupo 36 (atún, bonitos y agujas) se revisan generalmente en colaboración con los organismos regionales que se encargan de las estadísticas atuneras (CIAT, CICAA, CAOI, y WCPFC). Debido a las diferentes fechas en que esos organismos necesitan recibir los datos, es frecuente que las cifras correspondientes a los años más recientes se sometan a una considerable revisión.

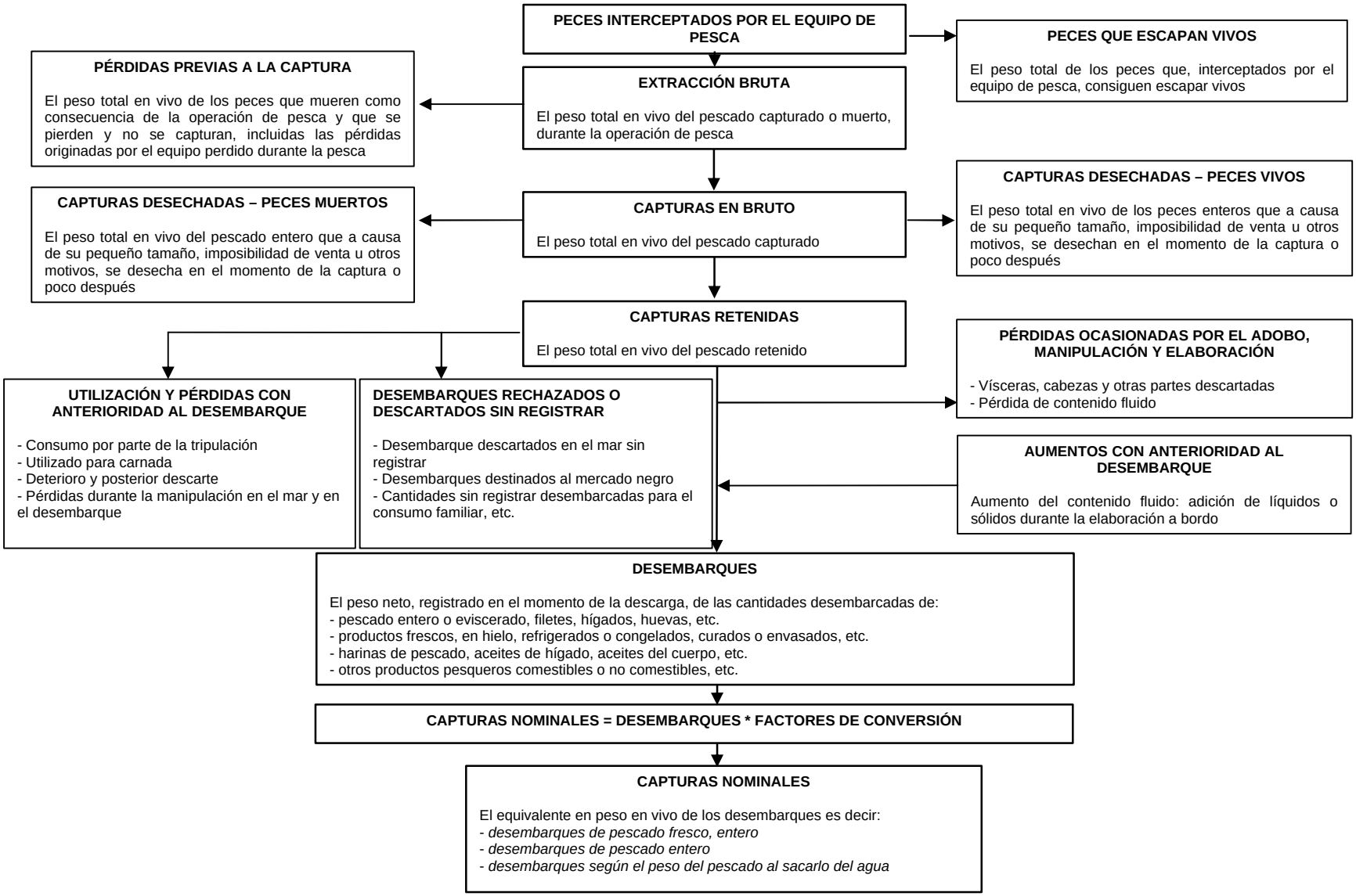
CATCH CONCEPTS: DIAGRAMMATIC PRESENTATION



CONCEPTS RELATIFS AUX CAPTURES: DIAGRAMME EXPLICATIF



CONCEPTOS DE CAPTURA: PRESENTACIÓN DIAGRAMÁTICA



Notes on species items

1. Data available world-wide on nominal catches of aquatic animals and plants, taken in inland and marine waters, for all kinds of commercial, industrial, recreational and subsistence purposes, are at present broken down at either the species, genus, family or higher taxonomic levels into 1875 statistical categories called *species items*.

2. These 1875 *species items* are arranged by FAO within the 50 *groups of species* constituting the nine *divisions* of the FAO "International Standard Statistical Classification of Aquatic Animals and Plants" (ISSCAAP). For these *groups of species* and *divisions* see the ISSCAAP list on the following page. The two-digit group codes shown in this list are reflected in the table numbers in Section B.

3. Following a recommendation of the 19th Session of the Coordinating Working Party on Fishery Statistics - CWP (Nouméa, New Caledonia, 10-13 July 2001) the names and composition of former groups 33, 34 and 37 of the FAO International Standard Statistical Classification of Aquatic Animals and Plants (ISSCAAP) were revised. The species items of the former group 33 "Redfishes, basses, congers" were classified as coastal or demersal fishes and accordingly assigned to the new groups 33 "Miscellaneous coastal fishes" and 34 "Miscellaneous demersal fishes". The species formerly included in group 34 "Jacks, mullets, sauries" were moved to group 37, which was renamed "Miscellaneous pelagic fishes".

4. Each *species item* is identified by means of the following descriptors (subject to constant review and improvement):
   a) FAO English name;
   b) FAO French name;
   c) FAO Spanish name;
   d) scientific name (at the species, genus, family or higher taxonomic levels);
   e) taxonomic code; and
   f) inter-agency 3-alpha code.

5. The taxonomic code descriptors are taken from FAO's **Aquatic Sciences and Fisheries Information System**. The following illustrates the meaning assigned to the different digits of this code:

Main grouping	Order or other taxonomic level	Family	Genus	Species
1,	75	(04)	003,	01

6. In all tables, except A-1(e) (where selected species items of significant commercial importance are listed in the order of 2010 catch size), the species items are arranged in order of their taxonomic codes within their respective ISSCAAP groups.

7. Several countries still report their catches by large groups of species. In these circumstances the catch data presented by individual species items are likely to be underestimated. Therefore, when examining the statistics for a particular species, it should be noted that an unknown proportion of the catches for that species might have been reported by the national office under the generic, family or order name of the species, or even more roughly as 'fishes not identified'. Consequently, **species item totals frequently underestimate the real catch of the individual species**.

Notes sur les catégories d'espèces

Les statistiques disponibles sur une base mondiale des captures nominales d'animaux et de plantes aquatiques effectuées dans les eaux continentales et dans les eaux marines à toutes fins commerciales, industrielles, récréatives et de subsistance sont, à l'heure actuelle, ventilées au niveau de l'espèce, du genre, de la famille ou des niveaux taxonomiques supérieurs dans 1875 catégories statistiques qui sont appelées des *catégories d'espèces*.

Ces 1875 *catégories d'espèces* sont rassemblées par la FAO en cinquante *groupes d'espèces* constituant les neuf *divisions* de la 'Classification statistique internationale type des animaux et des plantes aquatiques' (CSITAPA) de la FAO. Pour ces *groupes d'espèces* et ces *divisions*, on se reportera à la liste de la CSITAPA figurant à la page suivante. Les codes de groupe à deux chiffres indiqués sur la liste se retrouvent dans les numéros des tableaux de la section B.

Sur la base d'une recommandation de la 19ème session du Groupe de travail chargé de coordonner les statistiques des pêches - CWP (Nouméa, Nouvelle-Calédonie, 10-13 juillet 2001), la dénomination et la composition des anciens groupes 33, 34 et 37 de la Classification statistique internationale type des animaux et des plantes aquatiques (CSITAPA) de la FAO ont été révisées. Les catégories d'espèces de l'ancien groupe 33 "Rascasses, perches de mer, congres" ont été classifiées comme espèces côtières ou démersales et réparties sur cette base entre les nouveaux groupes 33 "Poissons côtiers divers" et 34 "Poissons démersaux divers". Les espèces auparavant incluses dans le groupe 34 "Chinchards, mulets, balaous" ont été classées dans le groupe 37 rebaptisé "Poissons pélagiques divers".

Chaque *catégorie d'espèces* est identifiée au moyen des descripteurs suivants (sous réserve de révision et d'amélioration constantes):
   a) nom anglais utilisé par la FAO;
   b) nom français utilisé par la FAO;
   c) nom espagnol utilisé par la FAO;
   d) nom scientifique (de l'espèce, du genre, de la famille ou des niveaux taxonomiques supérieurs);
   e) code taxonomique; et
   f) code interinstitutions alpha-3.

Les descripteurs de code taxonomique proviennent du **Système d'information sur les sciences aquatiques et la pêche** de la FAO. On trouvera ci-après la signification des divers chiffres constituant ce code taxonomique.

Groupe principal	Ordre ou autre niveau taxonomique	Famille	Genre	Espèce
1,	75	(04)	003,	01

Dans tous les tableaux, à l'exception de A-1(e) (où certaines catégories d'espèces ayant une importance commerciale notable sont énumérées selon le chiffre des captures de 2010), les catégories d'espèces sont disposées selon l'ordre du code taxonomique dans leurs groupes CSITAPA, respectifs.

Plusieurs pays continuent à communiquer leurs captures par grands groupes d'espèces. Dans ces circonstances les données des captures par catégories d'espèces individuelles sont donc probablement sous-estimées. Par conséquent, lorsqu'on examine les statistiques d'une espèce donnée, il convient de noter qu'une proportion inconnue des captures de cette espèce peut avoir été consignée par l'organisme national sous le nom du genre, de la famille ou de l'ordre de l'espèce, ou même, plus approximativement dans la catégorie 'poissons non identifiés'. C'est pourquoi **les totaux correspondant aux espèces données sous-estiment souvent la capture réelle de chacune des espèces**.

Notas sobre las partidas de especies

Los datos procedentes de todo el mundo sobre las capturas nominales de animales y plantas acuáticos capturados en aguas continentales y marinas con fines comerciales, industriales, de recreo o de subsistencia se desglosan en la actualidad en unas 1875 categorías estadísticas, denominadas *partidas de especies,* que corresponden a los niveles taxonómicos de especie, género, familia o superiores.

Utilizando esas 1875 *partidas de especies*, la FAO desglosa los cincuenta *grupos de especies* que constituyen las nueve *divisiones* de la Clasificación Estadística Internacional Uniforme de los Animales y Plantas Acuáticos (CEIUAPA) de la FAO. Estos *grupos de especies* y las nueve *divisiones* indicadas pueden verse en la lista de la CEIUAPA que aparece en la página siguiente. Los códigos de dos dígitos que en esa lista identifican a cada uno de los grupos se utilizan luego en los cuadros de la Sección B.

Sobre la base de una recomendación de la 19a sesión del Grupo Coordinador de Trabajo sobre Estadísticas de Pesca - CWP (Noumea, Nueva Caledonia, 10-13 de julio 2001) fue revisada la denominación y la composición de los antiguos grupos 33, 34, y 37 de la Clasificación Estadística Internacional Uniforme de los Animales y Plantas Acuáticos (CEIUAPA) de la FAO. Las partidas de especies del antiguo grupo 33 "Gallinetas, lubinas, congrios" fueron clasificadas como especies costeras o demersales y, de acuerdo con esto, distribuidas entre los nuevos grupos: 33 "Peces costeros diversos" y 34 "Peces demersales diversos". Las partidas de especies anteriormente comprendidas en el grupo 34 "Jureles, lisas, papardas" se incluyeron en el grupo 37, que pasó a denominarse "Peces pelágicos diversos".

Cada una de las *partidas de especies*, se identifica con los siguientes descriptores (que se revisan y mejoran continuamente):
   a) nombre inglés utilizado por la FAO;
   b) nombre francés utilizado por la FAO;
   c) nombre español utilizado por la FAO;
   d) nombre científico (de la especie, género, familia o niveles taxonómicos superiores);
   e) código taxonómico; e
   f) código interinstitucional alfa-3.

Los descriptores del código taxonómico se han tomado del **Sistema de información de las ciencias acuáticas y la pesca** de la FAO. El cuadro siguiente ilustra el significado de los distintos dígitos de dicho código:

Grupo principal	Orden u otro nivel taxonómico	Familia	Género	Especie
1,	75	(04)	003,	01

En todos los cuadros, excepto en el cuadro A-1(e) (en el cual algunas especies de gran importancia comercial aparecen ordenadas según el volumen de sus capturas en 2010), las partidas de especies aparecen por orden de su código taxonómico dentro de los respectivos grupos de la CEIUAPA.

Varios países siguen informando sobre sus capturas por grandes grupos de especies. En estos casos, es probable que aparezcan subestimados los datos sobre la captura de las partidas de especies. Por consiguiente, al examinar las estadísticas de una especie particular, debe tenerse en cuenta que una proporción desconocida de las capturas de esa especie puede haber sido ya comunicada por la oficina nacional con el nombre genérico, el de la familia o el del orden de la especie, o incluso más aproximativamente como 'peces no identificados'. En consecuencia, **los totales de las partidas de especies subestiman frecuentemente las capturas efectivas de la especie individual**.

ISSCAAP		CSITAPA	CEIUAPA
Code Code Código	DIVISION Group of species	DIVISION Groupe d'espèces	DIVISIÓN Grupo de especies
1	Freshwater fishes	Poissons d'eau douce	Peces de agua dulce
11	Carps, barbels and other cyprinids	Carpes, barbeaux et autres cyprinidés	Carpas, barbos y otros ciprínidos
12	Tilapias and other cichlids	Tilapias et autres cichlidés	Tilapias y otros cíclidos
13	Miscellaneous freshwater fishes	Poissons d'eau douce divers	Peces de agua dulce diversos
2	Diadromous fishes	Poissons diadromes	Peces diádromos
21	Sturgeons, paddlefishes	Esturgeons, spatules	Esturiones, sollos
22	River eels	Anguilles	Anguilas
23	Salmons, trouts, smelts	Saumons, truites, éperlans	Salmones, truchas, eperlanos
24	Shads	Aloses	Sábalos
25	Miscellaneous diadromous fishes	Poissons diadromes divers	Peces diádromos diversos
3	Marine fishes	Poissons marins	Peces marinos
31	Flounders, halibuts, soles	Flets, flétans, soles	Platijas, halibuts, lenguados
32	Cods, hakes, haddocks	Morues, merlus, églefins	Bacalaos, merluzas, eglefinos
33	Miscellaneous coastal fishes	Poissons côtiers divers	Peces costeros diversos
34	Miscellaneous demersal fishes	Poissons démersaux divers	Peces demersales diversos
35	Herrings, sardines, anchovies	Harengs, sardines, anchois	Arenques, sardinas, anchoas
36	Tunas, bonitos, billfishes	Thons, pélamides, marlins	Atunes, bonitos, agujas
37	Miscellaneous pelagic fishes	Poissons pélagiques divers	Peces pelágicos diversos
38	Sharks, rays, chimaeras	Squales, raies, chimères	Tiburones, rayas, quimeras
39	Marine fishes not identified	Poissons marins non identifiés	Peces marinos no identificados
4	Crustaceans	Crustacés	Crustáceos
41	Freshwater crustaceans	Crustacés d'eau douce	Crustáceos de agua dulce
42	Crabs, sea-spiders	Crabes, araignées de mer	Cangrejos, centollas
43	Lobsters, spiny-rock lobsters	Homards, langoustes	Bogavantes, langostas
44	King crabs, squat-lobsters	Crabes royaux, galatées	Cangrejos reales, galateidos
45	Shrimps, prawns	Crevettes	Gambas, camarones
46	Krill, planktonic crustaceans	Krill, crustacés planctoniques	Krill, crustáceos planctónicos
47	Miscellaneous marine crustaceans	Crustacés marins divers	Crustáceos marinos diversos
5	Molluscs	Mollusques	Moluscos
51	Freshwater molluscs	Mollusques d'eau douce	Moluscos de agua dulce
52	Abalones, winkles, conchs	Ormeaux, bigorneaux, strombes	Orejas de mar, bígaros, estrombos
53	Oysters	Huîtres	Ostras
54	Mussels	Moules	Mejillones
55	Scallops, pectens	Coquilles St-Jacques	Vieiras
56	Clams, cockles, arkshells	Clams, coques, arches	Almejas, berberechos, arcas
57	Squids, cuttlefishes, octopuses	Encornets, seiches, poulpes	Calamares, jibias, pulpos
58	Miscellaneous marine molluscs	Mollusques marins divers	Moluscos marinos diversos
* 6	Whales, seals and other aquatic mammals	Baleines, phoques et autres mammifères aquatiques	Ballenas, focas y otros mamíferos acuáticos
* 61	Blue-whales, fin-whales	Baleines bleues, rorquals communs	Ballenas azules, rorcuales
* 62	Sperm-whales, pilot-whales	Cachalots, globicéphales	Cachalotes, calderones
* 63	Eared seals, hair seals, walruses	Otaries, phoques, morses	Lobos marinos, focas, morsas
* 64	Miscellaneous aquatic mammals	Mammifères aquatiques divers	Mamíferos acuáticos diversos
7	Miscellaneous aquatic animals	Animaux aquatiques divers	Animales acuáticos diversos
71	Frogs and other amphibians	Grenouilles et autres amphibies	Ranas y otros anfibios
72	Turtles	Tortues	Tortugas
* 73	Crocodiles and alligators	Crocodiles et alligators	Cocodrilos y aligatores
74	Sea-squirts and other tunicates	Ascidiens et autres tuniciers	Ascidias y otros tunicados
75	Horseshoe crabs and other arachnoids	Limules et autres arachnoïdés	Límulos y otros arácnidos
76	Sea-urchins and other echinoderms	Oursins et autres échinodermes	Erizos de mar y otros equinodermos
77	Miscellaneous aquatic invertebrates	Invertébrés aquatiques divers	Invertebrados acuáticos diversos
* 8	Miscellaneous aquatic animal products	Produits divers d'animaux aquatiques	Diversos productos de animales acuáticos
* 81	Pearls, mother-of-pearl, shells	Perles, nacres, coquilles	Perlas, madreperlas, conchas
* 82	Corals	Coraux	Corales
* 83	Sponges	Éponges	Esponjas
* 9	Aquatic plants	Plantes aquatiques	Plantas acuáticas
* 91	Brown seaweeds	Algues brunes	Algas pardas
* 92	Red seaweeds	Algues rouges	Algas rojas
* 93	Green seaweeds	Algues vertes	Algas verdes
* 94	Miscellaneous aquatic plants	Plantes aquatiques diverses	Diversas plantas acuáticas

ISSCAAP = International Standard Statistical Classification of Aquatic Animals and Plants.

* In order to obtain the same aggregates presented in the Summary Tables for capture production, the ISSCAAP groups marked should be excluded.

CSITAPA = Classification statistique internationale type des animaux et des plantes aquatiques.

* Pour obtenir les mêmes agrégats que ceux qui sont présentés dans les Tableaux Résumés relatifs aux Captures, il faut exclure les groupes de la CSITAPA qui sont marqués d'un astérisque.

CEIUAPA = Clasificación Estadística Internacional Uniforme de los Animales y Plantas Acuáticos.

* Para obtener las mismas agregaciones que se presentan en los Cuadros Resúmenes para las Capturas, se deben excluir los grupos CEIUAPA que están marcados con un asterisco.

Notes on countries or areas

1. The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

2. The term *country or area* as used in the stubs and the column headings of the tables also covers territories, cities, land areas, as well as provinces, districts, enclaves, exclaves and other parts of territories or combinations of countries or areas such as economic or customs unions.

3. In all tables a country or area entry is designated by a multilingual code of not more than 12 characters. This code is keyed in the LIST OF COUNTRIES OR AREAS to the other descriptors for each country or area entry - the names in English, French and Spanish, the ISO's 3-alpha and 2-alpha codes, the UN's three-digit numerical code, etc.

4. Country or area names and designations are subject to nationally announced changes. Name changes announced after 31 December 2011 have not necessarily been incorporated in this issue but will be reflected in future ones.

5. The flag of the vessel performing the essential part of the fishing operation should be considered the paramount indication of the nationality assigned to the catches.

   The flag State of the vessel performing the essential part of the fishing operation should be responsible for the provision of catch data.

   Where a foreign flag vessel is fishing in the waters under the national jurisdiction of another State, the flag State of the vessel should have at all times the responsibility to provide relevant catch and landing data. The only exceptions to this shall be:

   (a) where the vessel undertakes fishing under a charter agreement or arrangement to augment the local fishing fleet, and the vessel has become for all practical purposes a local fishing vessel of the host country;

   (b) where the vessel undertakes fishing pursuant to a joint venture or similar arrangement in waters under the national jurisdiction of another State and the vessel is operating for all practical purposes as a local vessel, or its operation has become, or is intended to become, an integral part of the economy of the host country.

   In any situation where there is uncertainty as to the application of these criteria, any agreement, charter, joint venture or other similar arrangement should contain a provision setting out clearly the responsibility for reporting catch and landing data, which should be reported to the flag State and, where relevant, to any coastal State in whose waters fishing operations are to take place or competent subregional, regional or global fisheries organization or arrangement.

6. National data cover all quantities caught by fishing craft flying the flag of the reporting country and landed not only in the domestic harbours of the reporting country but also in foreign harbours. National catch excludes quantities caught by foreign fishing craft and landed in domestic ports.

7. Final data have been provided by many national offices; others submitted provisional figures only. Whenever national offices failed to report their annual catch statistics in time for publication, FAO has estimated the quantities to reflect more realistic catch data (F designated figures).

Notes sur les pays ou zones

Les appellations employées dans cette publication et la présentation des données qui y figurent n'impliquent de la part de l'Organisation des Nations Unies pour l'alimentation et l'agriculture aucune prise de position quant au statut juridique ou au stade de développement des pays, territoires, villes ou zones, ou de leurs autorités, ni quant au tracé de leurs frontières ou limites.

Le terme *pays ou zone* employé dans les talons et les têtes de colonne des tableaux, doit s'entendre également des territoires, villes, zones terrestres, ainsi que des provinces, districts, enclaves, parties détachées d'un État, autres parties de territoires ou regroupements de pays ou zones, tels qu'unions économiques ou douanières.

Dans tous les tableaux, les entrées des pays ou zones sont désignées par un code multilingue n'excédant pas douze espaces typographiques. Dans la LISTE DES PAYS OU ZONES ce code est associé aux autres descripteurs, c'est-à-dire aux noms en anglais, français et espagnol, aux codes ISO alpha-3 et alpha-2, au code numérique à trois chiffres des Nations Unies, etc.

La liste des appellations des pays ou zones est sujette de temps à autre à des modifications annoncées par les pays ou zones. Les modifications de noms survenues après le 31 décembre 2011 n'ont pas toujours été incorporées dans l'édition présente, mais il en sera tenu compte dans celles futures.

Le pavillon du navire effectuant la partie essentielle de l'opération de pêche devrait être considéré comme le facteur déterminant du pays ou zone auquel sont attribuées les captures.

L'État du pavillon du navire effectuant la partie essentielle de l'opération de pêche devrait fournir les données sur les captures.

Lorsqu'un navire battant pavillon étranger pêche dans des eaux placées sous la juridiction nationale d'un autre État, l'État du pavillon du navire devrait fournir à tout moment les données pertinentes sur les captures et les débarquements. Les seules exceptions à ce principe sont les suivantes:

(a) lorsque le navire pêche au titre d'un contrat ou d'un arrangement d'affrètement visant à compléter la flottille de pêche locale et que le navire est devenu à toutes fins utiles un navire de pêche local du pays d'accueil;

(b) lorsque le navire pêche dans le cadre d'une opération conjointe ou d'arrangements similaires dans des eaux placées sous la juridiction nationale d'un autre État et que le navire opère à toutes fins utiles en tant que navire local ou que ses activités font, ou sont appelées à faire, partie intégrante de l'économie du pays d'accueil.

Dans toute situation où il existe une incertitude quant à l'application de ces critères, l'accord, le contrat, l'opération conjointe ou tout autre arrangement similaire devrait contenir une disposition fixant clairement les responsabilités en matière de notification des données sur les captures et les débarquements. Celles-ci devraient être notifiées à l'État du pavillon et, le cas échéant, à tout État côtier dans les eaux duquel les opérations de pêche ont lieu ou à tout organisme ou accord de pêche sous-régional, régional ou mondial compétent.

Sont comprises dans les données nationales toutes les quantités capturées par les bateaux de pêche battant le pavillon du pays déclarant et débarquées non seulement dans les ports du pays déclarant, mais aussi dans des ports étrangers. Ne sont pas comprises dans les captures nationales, les quantités capturées par des bateaux étrangers et débarquées dans des ports nationaux.

De nombreux services nationaux ont communiqué des données définitives; d'autres n'ont fourni que des chiffres préliminaires. Chaque fois que les services nationaux n'ont pu déclarer leurs statistiques de captures annuelles en temps utile pour la publication, la FAO procédé à des estimations pour arriver à des chiffres de captures plus proches de la réalité (chiffres désignés par F).

Notas sobre los países o áreas

Las denominaciones empleadas en esta publicación y la forma en que aparecen presentados los datos que contiene no implican, da parte de la Organización de las Naciones Unidas para la Agricultura y la Alimentación, juicio alguno sobre la condición jurídica o nivel de desarrollo de países, territorios, ciudades o zonas, o de sus autoridades, ni respecto de la delimitación de sus fronteras o límites.

En los encabezamientos de las columnas o renglones de los cuadros, el término *país o área* puede referirse también a territorios, ciudades, zonas terrestres, provincias, distritos, enclaves, exclaves, otras partes de territorio o grupos de países o áreas, como uniones económicas o aduaneras.

En todos los cuadros, los países o áreas se indican con un código multilingue que no utiliza más de doce espacios. En la LISTA DE PAISES O AREAS dicho código aparece acompañado de otros descriptores - los nombres en inglés, francés y español, los códigos ISO alfa-3 y alfa-2, y el código numérico de tres dígitos de las Naciones Unidas, etc.

Los países o áreas anuncian en algunas ocasiones cambios de sus nombres y denominaciones. En la presente edición no se han incorporado todos los cambios de nombres anunciados después del 31 de diciembre de 2011, pero se tendrán presentes en las futuras.

El pabellón del barco que efectúa la parte principal de las operaciones de pesca debería considerarse como indicación decisiva para establecer a qué país o área hay que asignar las capturas.

El Estado del pabellón del barco que efectúa la parte principal de las operaciones de pesca debería ser el responsable de facilitar datos sobre capturas.

Cuando un barco de pabellón extranjero faene en aguas sometidas a la jurisdicción nacional de otro Estado, el Estado del pabellón de ese barco debería tener en todo momento la responsabilidad de facilitar datos pertinentes sobre capturas y desembarques. Las únicas excepciones a esto serán:

(a) cuando el barco faene con arreglo a un acuerdo de fletamento o como medida para aumentar la flota pesquera local, y el barco se ha convertido a todos los efectos prácticos en un barco pesquero local del país hospedante;

(b) cuando el barco emprenda las operaciones pesqueras en virtud de un acuerdo de empresa mixta o análogo en aguas sometidas a la jurisdicción nacional de otro Estado y faene a todos los efectos prácticos como un barco local, o sus operaciones se hayan convertido, o se tenga intención de que se conviertan, en parte integrante de la economía del país hospedante.

En cualquier situación en que haya incertidumbre respecto de la aplicación de estos criterios, cualquier acuerdo, fletamento, empresa mixta u otro acuerdo similar debería contener una disposición por la que se establezca claramente la responsabilidad de la presentación de datos sobre capturas y desembargues que deberían notificarse al Estado del pabellón y, según proceda, a cualquier Estado ribereño en cuyas aguas se vayan a realizar operaciones pesqueras o a cualquier organización o acuerdo pesquero subregional, regional o mundial competente.

Los datos nacionales incluyen todas las cantidades capturadas por embarcaciones pesqueras que enarbolan el pabellón del país que comunica los datos y desembarcadas en los puertos del país en cuestión o en puertos extranjeros. Las capturas nacionales no incluyen las cantidades capturadas por embarcaciones pesqueras extranjeras y desembarcadas en puertos del país al que se refieren los datos.

Muchas oficinas nacionales han facilitado datos difinitivos; otras, en cambio, sólo han presentado cifras provisionales. Cuando las oficinas nacionales no han comunicado a tiempo sus estadísticas nacionales de captura, la FAO ha estimado las cantidades para que reflejaran más objetivamente los datos de captura (cifras designadas F).

Notes on countries or areas

8. The NOTES ON INDIVIDUAL COUNTRIES OR AREAS list the few national exceptions to the standards described above and also to those standards specified in other NOTES in this Yearbook.

9. Users are reminded that, although data are shown to the nearest tonne, they are not necessarily of this degree of accuracy.

10. Countries included in the low-income food-deficit countries (LIFDCs) grouping are those classified (i) by the World Bank as low-income in terms of GNP per capita, and (ii) by FAO as having a trade deficit for food in terms of calorie content. Countries which have formally objected to being included in the grouping are excluded.

Notes sur les pays ou zones

Les quelques exceptions nationales à ces normes ainsi qu'aux normes indiquées dans les autres NOTES figurant dans le présent Annuaire sont indiquées dans les NOTES SUR DIVERS PAYS OU ZONES.

Il est rappelé aux utilisateurs que les chiffres sont arrondis à la tonne la plus proche, mais qu'ils n'ont pas nécessairement un tel degré de précision.

Les pays inclus dans le groupe pays à faible revenu et à déficit vivrier (PFRDV) sont ceux classifiés (i) par la Banque mondiale comme ayant un revenu par habitant bas en termes de PIB, et (ii) par la FAO comme ayant un déficit commercial alimentaire en termes de contenu en calories. Les pays qui se sont formellement opposés à leur inclusion dans ce groupe n'y figurent pas.

Notas sobre los países o áreas

En las NOTAS SOBRE LOS DISTINTOS PAISES O ÁREAS pueden verse algunas excepciones nacionales a estas normas; véanse también las que aparecen en otras NOTAS de este Anuario.

Se recuerda a los usarios que, si bien los datos están redondeados a la tonelada más próxima, no tienen necesariamente ese grado de precisión.

Los países incluidos en el grupo países de bajos ingresos y con déficit de alimentos (PBIDA) son aquellos clasificados (i) por el Banco Mundial como teniendo una renta per cápita baja en términos de PNL, y (ii) por la FAO como teniendo un déficit comercial alimentario en términos de contenido en calorías. Los países que se han formalmente opuesto a su inclusión en este grupo no están incluidos.

List of countries or areas included in this section | **Liste des pays ou zones inclus dans cette section** | **Lista de países o áreas incluidos en esta secciòn**

A	B	C	D	E	F	G	H
Afghanistan	AFG	AF	004	142	Afghanistan	Afghanistan	Afganistán
Albania	ALB	AL	008	150	Albania	Albanie	Albania
Algeria	DZA	DZ	012	002	Algeria	Algérie	Argelia
Amer Samoa	ASM	AS	016	009	American Samoa	Samoa américaines	Samoa Americana
Andorra	AND	AD	020	150	Andorra	Andorre	Andorra
Angola	AGO	AO	024	002	Angola	Angola	Angola
Anguilla	AIA	AI	660	019	Anguilla	Anguilla	Anguila
Antigua Barb	ATG	AG	028	019	Antigua and Barbuda	Antigua-et-Barbuda	Antigua y Barbuda
Argentina	ARG	AR	032	019	Argentina	Argentine	Argentina
Armenia	ARM	AM	051	142	Armenia	Arménie	Armenia
Aruba	ABW	AW	533	019	Aruba	Aruba	Aruba
Australia	AUS	AU	036	009	Australia	Australie	Australia
Austria	AUT	AT	040	150	Austria	Autriche	Austria
Azerbaijan	AZE	AZ	031	142	Azerbaijan	Azerbaïdjan	Azerbaiyán
Bahamas	BHS	BS	044	019	Bahamas	Bahamas	Bahamas
Bahrain	BHR	BH	048	142	Bahrain	Bahreïn	Bahrein
Bangladesh	BGD	BD	050	142	Bangladesh	Bangladesh	Bangladesh
Barbados	BRB	BB	052	019	Barbados	Barbade	Barbados
Belarus	BLR	BY	112	150	Belarus	Bélarus	Belarús
Belgium	BEL	BE	056	150	Belgium	Belgique	Bélgica
Belize	BLZ	BZ	084	019	Belize	Belize	Belice
Benin	BEN	BJ	204	002	Benin	Bénin	Benin
Bermuda	BMU	BM	060	019	Bermuda	Bermudes	Bermudas
Bhutan	BTN	BT	064	142	Bhutan	Bhoutan	Bhután
Bolivia	BOL	BO	068	019	Bolivia (Plurinat.State)	Bolivie (État plurinat.)	Bolivia (Estado Plurin.)
Bosnia Herzg	BIH	BA	070	150	Bosnia and Herzegovina	Bosnie-Herzégovine	Bosnia y Herzegovina
Botswana	BWA	BW	072	002	Botswana	Botswana	Botswana
Brazil	BRA	BR	076	019	Brazil	Brésil	Brasil
Br Ind Oc Tr	IOT	IO	086	002	British Indian Ocean Ter	Terr. brit. Océan Indien	Ter. Brit. Océano Índico
Br Virgin Is	VGB	VG	092	019	British Virgin Islands	Îles Vierges britanniq.	Islas Vírgenes Britán.
Brunei Darsm	BRN	BN	096	142	Brunei Darussalam	Brunéi Darussalam	Brunei Darussalam
Bulgaria	BGR	BG	100	150	Bulgaria	Bulgarie	Bulgaria
Burkina Faso	BFA	BF	854	002	Burkina Faso	Burkina Faso	Burkina Faso
Burundi	BDI	BI	108	002	Burundi	Burundi	Burundi
Cambodia	KHM	KH	116	142	Cambodia	Cambodge	Camboya
Cameroon	CMR	CM	120	002	Cameroon	Cameroun	Camerún
Canada	CAN	CA	124	019	Canada	Canada	Canadá
Cape Verde	CPV	CV	132	002	Cape Verde	Cap-Vert	Cabo Verde
Cayman Is	CYM	KY	136	019	Cayman Islands	Îles Caïmanes	Islas Caimán
Cent Afr Rep	CAF	CF	140	002	Central African Republic	Rép. centrafricaine	República Centroafricana
Chad	TCD	TD	148	002	Chad	Tchad	Chad
Channel Is	...	..	830	150	Channel Islands	Îles Anglo-Normandes	Islas Anglonormandas
Chile	CHL	CL	152	019	Chile	Chili	Chile
China	CHN	CN	156	142	China	Chine	China
China,H.Kong	HKG	HK	344	142	China, Hong Kong SAR	Hong Kong RAS de Chine	Hong Kong (RAE de China)
China, Macao	MAC	MO	446	142	China, Macao SAR	Chine, RAS de Macao	China, RAE de Macao
China,Taiwan	TWN	TW	158	142	Taiwan Province of China	Prov. chinoise de Taïwan	Prov. china de Taiwán
Colombia	COL	CO	170	019	Colombia	Colombie	Colombia
Comoros	COM	KM	174	002	Comoros	Comores	Comoras
Congo Dem R	COD	CD	180	002	Congo, Dem. Rep. of the	Rép. dém. du Congo	Rep. Dem. del Congo
Congo Rep	COG	CG	178	002	Congo, Republic of	République du Congo	República del Congo
Cook Is	COK	CK	184	009	Cook Islands	Îles Cook	Islas Cook
Costa Rica	CRI	CR	188	019	Costa Rica	Costa Rica	Costa Rica
Côte dIvoire	CIV	CI	384	002	Côte d'Ivoire	Côte d'Ivoire	Côte d'Ivoire
Croatia	HRV	HR	191	150	Croatia	Croatie	Croacia
Cuba	CUB	CU	192	019	Cuba	Cuba	Cuba
Cyprus	CYP	CY	196	142	Cyprus	Chypre	Chipre
Czech Rep	CZE	CZ	203	150	Czech Republic	République tchèque	República Checa
Denmark	DNK	DK	208	150	Denmark	Danemark	Dinamarca
Djibouti	DJI	DJ	262	002	Djibouti	Djibouti	Djibouti
Dominica	DMA	DM	212	019	Dominica	Dominique	Dominica
Dominican Rp	DOM	DO	214	019	Dominican Republic	République dominicaine	República Dominicana
Ecuador	ECU	EC	218	019	Ecuador	Équateur	Ecuador
Egypt	EGY	EG	818	002	Egypt	Égypte	Egipto
El Salvador	SLV	SV	222	019	El Salvador	El Salvador	El Salvador
Eq Guinea	GNQ	GQ	226	002	Equatorial Guinea	Guinée équatoriale	Guinea Ecuatorial
Eritrea	ERI	ER	232	002	Eritrea	Érythrée	Eritrea
Estonia	EST	EE	233	150	Estonia	Estonie	Estonia
Ethiopia	ETH	ET	231	002	Ethiopia	Éthiopie	Etiopía
Falkland Is	FLK	FK	238	019	Falkland Is.(Malvinas)	Îles Falkland(Malvinas)	Islas Malvinas(Falkland)
Faroe Is	FRO	FO	234	150	Faroe Islands	Îles Féroé	Islas Feroe
Fiji	FJI	FJ	242	009	Fiji, Republic of	République des Fidji	República de Fiji
Finland	FIN	FI	246	150	Finland	Finlande	Finlandia
FYRMacedonia	MKD	MK	807	150	Macedonia, Fmr Yug Rp of	Ex-Rép.youg.de Macédoine	Ex Rep.Yug. de Macedonia
France	FRA	FR	250	150	France	France	Francia
Fr Guiana	GUF	GF	254	019	French Guiana	Guyane française	Guayana Francesa
Fr Polynesia	PYF	PF	258	009	French Polynesia	Polynésie française	Polinesia Francesa
Fr South Tr	ATF	TF	260	002	French Southern Terr	Terres australes fr.	Tierras Australes Fr.
Gabon	GAB	GA	266	002	Gabon	Gabon	Gabón

List of countries or areas included in this section | **Liste des pays ou zones inclus dans cette section** | **Lista de países o áreas incluidos en esta secciòn**

A	B	C	D	E	F	G	H
Gambia	GMB	GM	270	002	Gambia	Gambie	Gambia
Georgia	GEO	GE	268	142	Georgia	Géorgie	Georgia
Germany	DEU	DE	276	150	Germany	Allemagne	Alemania
Ghana	GHA	GH	288	002	Ghana	Ghana	Ghana
Gibraltar	GIB	GI	292	150	Gibraltar	Gibraltar	Gibraltar
Greece	GRC	GR	300	150	Greece	Grèce	Grecia
Greenland	GRL	GL	304	019	Greenland	Groenland	Groenlandia
Grenada	GRD	GD	308	019	Grenada	Grenade	Granada
Guadeloupe	GLP	GP	312	019	Guadeloupe	Guadeloupe	Guadalupe
Guam	GUM	GU	316	009	Guam	Guam	Guam
Guatemala	GTM	GT	320	019	Guatemala	Guatemala	Guatemala
Guinea	GIN	GN	324	002	Guinea	Guinée	Guinea
GuineaBissau	GNB	GW	624	002	Guinea-Bissau	Guinée-Bissau	Guinea-Bissau
Guyana	GUY	GY	328	019	Guyana	Guyana	Guyana
Haiti	HTI	HT	332	019	Haiti	Haïti	Haití
Honduras	HND	HN	340	019	Honduras	Honduras	Honduras
Hungary	HUN	HU	348	150	Hungary	Hongrie	Hungría
Iceland	ISL	IS	352	150	Iceland	Islande	Islandia
India	IND	IN	356	142	India	Inde	India
Indonesia	IDN	ID	360	142	Indonesia	Indonésie	Indonesia
Iran	IRN	IR	364	142	Iran (Islamic Rep. of)	Iran (Rép. islamique d')	Irán (Rep. Islámica del)
Iraq	IRQ	IQ	368	142	Iraq	Iraq	Iraq
Ireland	IRL	IE	372	150	Ireland	Irlande	Irlanda
Isle of Man	IMN	IM	833	150	Isle of Man	Île de Man	Isla de Man
Israel	ISR	IL	376	142	Israel	Israël	Israel
Italy	ITA	IT	380	150	Italy	Italie	Italia
Jamaica	JAM	JM	388	019	Jamaica	Jamaïque	Jamaica
Japan	JPN	JP	392	142	Japan	Japon	Japón
Jordan	JOR	JO	400	142	Jordan	Jordanie	Jordania
Kazakhstan	KAZ	KZ	398	142	Kazakhstan	Kazakhstan	Kazajstán
Kenya	KEN	KE	404	002	Kenya	Kenya	Kenya
Kiribati	KIR	KI	296	009	Kiribati	Kiribati	Kiribati
Korea D P Rp	PRK	KP	408	142	Korea, Dem. People's Rep	Rép. pop. dém. de Corée	Rep. Pop. Dem. de Corea
Korea Rep	KOR	KR	410	142	Korea, Republic of	République de Corée	República de Corea
Kuwait	KWT	KW	414	142	Kuwait	Koweït	Kuwait
Kyrgyzstan	KGZ	KG	417	142	Kyrgyzstan	Kirghizistan	Kirguistán
Lao P.Dem.R.	LAO	LA	418	142	Lao People's Dem. Rep.	Rép. dém. pop. lao	Rep. Dem. Pop. Lao
Latvia	LVA	LV	428	150	Latvia	Lettonie	Letonia
Lebanon	LBN	LB	422	142	Lebanon	Liban	Líbano
Lesotho	LSO	LS	426	002	Lesotho	Lesotho	Lesotho
Liberia	LBR	LR	430	002	Liberia	Libéria	Liberia
Libya	LBY	LY	434	002	Libya	Libye	Libia
Liechtensten	LIE	LI	438	150	Liechtenstein	Liechtenstein	Liechtenstein
Lithuania	LTU	LT	440	150	Lithuania	Lituanie	Lituania
Luxembourg	LUX	LU	442	150	Luxembourg	Luxembourg	Luxemburgo
Madagascar	MDG	MG	450	002	Madagascar	Madagascar	Madagascar
Malawi	MWI	MW	454	002	Malawi	Malawi	Malawi
Malaysia	MYS	MY	458	142	Malaysia	Malaisie	Malasia
Maldives	MDV	MV	462	142	Maldives	Maldives	Maldivas
Mali	MLI	ML	466	002	Mali	Mali	Malí
Malta	MLT	MT	470	150	Malta	Malte	Malta
Marshall Is	MHL	MH	584	009	Marshall Islands	Îles Marshall	Islas Marshall
Martinique	MTQ	MQ	474	019	Martinique	Martinique	Martinica
Mauritania	MRT	MR	478	002	Mauritania	Mauritanie	Mauritania
Mauritius	MUS	MU	480	002	Mauritius	Maurice	Mauricio
Mayotte	MYT	YT	175	002	Mayotte	Mayotte	Mayotte
Mexico	MEX	MX	484	019	Mexico	Mexique	México
Micronesia	FSM	FM	583	009	Micronesia,Fed.States of	Micronésie(États féd.de)	Micronesia(Estados Fed.)
Moldova Rep	MDA	MD	498	150	Moldova, Republic of	République de Moldova	República de Moldova
Monaco	MCO	MC	492	150	Monaco	Monaco	Mónaco
Mongolia	MNG	MN	496	142	Mongolia	Mongolie	Mongolia
Montenegro	MNE	ME	499	150	Montenegro	Monténégro	Montenegro
Montserrat	MSR	MS	500	019	Montserrat	Montserrat	Montserrat
Morocco	MAR	MA	504	002	Morocco	Maroc	Marruecos
Mozambique	MOZ	MZ	508	002	Mozambique	Mozambique	Mozambique
Myanmar	MMR	MM	104	142	Myanmar	Myanmar	Myanmar
Namibia	NAM	NA	516	002	Namibia	Namibie	Namibia
Nauru	NRU	NR	520	009	Nauru	Nauru	Nauru
Nepal	NPL	NP	524	142	Nepal	Népal	Nepal
Netherlands	NLD	NL	528	150	Netherlands	Pays-Bas	Países Bajos
NethAntilles	ANT	AN	530	019	Netherlands Antilles	Antilles néerlandaises	Antillas Neerlandesas
NewCaledonia	NCL	NC	540	009	New Caledonia	Nouvelle-Calédonie	Nueva Caledonia
New Zealand	NZL	NZ	554	009	New Zealand	Nouvelle-Zélande	Nueva Zelandia
Nicaragua	NIC	NI	558	019	Nicaragua	Nicaragua	Nicaragua
Niger	NER	NE	562	002	Niger	Niger	Níger
Nigeria	NGA	NG	566	002	Nigeria	Nigéria	Nigeria
Niue	NIU	NU	570	009	Niue	Nioué	Niue
Norfolk Is	NFK	NF	574	009	Norfolk Island	Île Norfolk	Isla Norfolk
N Marianas	MNP	MP	580	009	Northern Mariana Is.	Îles Mariannes du Nord	Islas Marianas septent.

List of countries or areas included in this section | **Liste des pays ou zones inclus dans cette section** | **Lista de países o áreas incluidos en esta secciòn**

A	B	C	D	E	F	G	H
Norway	NOR	NO	578	150	Norway	Norvège	Noruega
Oman	OMN	OM	512	142	Oman	Oman	Omán
Pakistan	PAK	PK	586	142	Pakistan	Pakistan	Pakistán
Palau	PLW	PW	585	009	Palau	Palaos	Palau
Palest, O.T.	PSE	PS	275	142	Palestine, Occupied Tr.	Palestine, terr.occupé	Palestina, Terri.Ocupado
Panama	PAN	PA	591	019	Panama	Panama	Panamá
Papua N Guin	PNG	PG	598	009	Papua New Guinea	Papouasie-Nlle-Guinée	Papua Nueva Guinea
Paraguay	PRY	PY	600	019	Paraguay	Paraguay	Paraguay
Peru	PER	PE	604	019	Peru	Pérou	Perú
Philippines	PHL	PH	608	142	Philippines	Philippines	Filipinas
Pitcairn Is	PCN	PN	612	009	Pitcairn Islands	Îles Pitcairn	Islas Pitcairn
Poland	POL	PL	616	150	Poland	Pologne	Polonia
Portugal	PRT	PT	620	150	Portugal	Portugal	Portugal
Puerto Rico	PRI	PR	630	019	Puerto Rico	Porto Rico	Puerto Rico
Qatar	QAT	QA	634	142	Qatar	Qatar	Qatar
Réunion	REU	RE	638	002	Réunion	Réunion	Reunión
Romania	ROU	RO	642	150	Romania	Roumanie	Rumania
Russian Fed	RUS	RU	643	150	Russian Federation	Fédération de Russie	Federación de Rusia
Rwanda	RWA	RW	646	002	Rwanda	Rwanda	Rwanda
St Helena	SHN	SH	654	002	Saint Helena	Sainte-Hélène	Santa Elena
St Kitts Nev	KNA	KN	659	019	Saint Kitts and Nevis	Saint-Kitts-et-Nevis	Saint Kitts y Nevis
St Lucia	LCA	LC	662	019	Saint Lucia	Sainte-Lucie	Santa Lucía
St Pier Mq	SPM	PM	666	019	St. Pierre and Miquelon	Saint-Pierre-et-Miquelon	San Pedro y Miquelón
St Vincent	VCT	VC	670	019	Saint Vincent/Grenadines	Saint-Vincent/Grenadines	San Vicente/Grenadinas
Samoa	WSM	WS	882	009	Samoa	Samoa	Samoa
San Marino	SMR	SM	674	150	San Marino	Saint-Marin	San Marino
Sao Tome Prn	STP	ST	678	002	Sao Tome and Principe	Sao Tomé-et-Principe	Santo Tomé y Príncipe
Saudi Arabia	SAU	SA	682	142	Saudi Arabia	Arabie saoudite	Arabia Saudita
Senegal	SEN	SN	686	002	Senegal	Sénégal	Senegal
Serbia	SRB	RS	688	150	Serbia	Serbie	Serbia
Serbia-Monte	SCG	CS	891	150	Serbia and Montenegro	Serbie-et-Monténégro	Serbia y Montenegro
Seychelles	SYC	SC	690	002	Seychelles	Seychelles	Seychelles
Sierra Leone	SLE	SL	694	002	Sierra Leone	Sierra Leone	Sierra Leona
Singapore	SGP	SG	702	142	Singapore	Singapour	Singapur
Slovakia	SVK	SK	703	150	Slovakia	Slovaquie	Eslovaquia
Slovenia	SVN	SI	705	150	Slovenia	Slovénie	Eslovenia
Solomon Is	SLB	SB	090	009	Solomon Islands	Îles Salomon	Islas Salomón
Somalia	SOM	SO	706	002	Somalia	Somalie	Somalia
South Africa	ZAF	ZA	710	002	South Africa	Afrique du Sud	Sudáfrica
Spain	ESP	ES	724	150	Spain	Espagne	España
Sri Lanka	LKA	LK	144	142	Sri Lanka	Sri Lanka	Sri Lanka
Sudan	SDN	SD	736	002	Sudan	Soudan	Sudán
Suriname	SUR	SR	740	019	Suriname	Suriname	Suriname
Svalbard Is	SJM	SJ	744	150	Svalbard and Jan Mayen	Îles Svalbard/Jan Mayen	Islas Svalbard/Jan Mayen
Swaziland	SWZ	SZ	748	002	Swaziland	Swaziland	Swazilandia
Sweden	SWE	SE	752	150	Sweden	Suède	Suecia
Switzerland	CHE	CH	756	150	Switzerland	Suisse	Suiza
Syria	SYR	SY	760	142	Syrian Arab Republic	Rép. arabe syrienne	República Árabe Siria
Tajikistan	TJK	TJ	762	142	Tajikistan	Tadjikistan	Tayikistán
Tanzania	TZA	TZ	834	002	Tanzania, United Rep. of	Rép.-Unie de Tanzanie	Rep. Unida de Tanzanía
Thailand	THA	TH	764	142	Thaïland	Thaïlande	Tailandia
Timor-Leste	TLS	TL	626	142	Timor-Leste	Timor-Leste	Timor-Leste
Togo	TGO	TG	768	002	Togo	Togo	Togo
Tokelau	TKL	TK	772	009	Tokelau	Tokélaou	Tokelau
Tonga	TON	TO	776	009	Tonga	Tonga	Tonga
Trinidad Tob	TTO	TT	780	019	Trinidad and Tobago	Trinité-et-Tobago	Trinidad y Tabago
Tunisia	TUN	TN	788	002	Tunisia	Tunisie	Túnez
Turkey	TUR	TR	792	142	Turkey	Turquie	Turquía
Turkmenistan	TKM	TM	795	142	Turkménistan	Turkménistan	Turkmenistán
Turks Caicos	TCA	TC	796	019	Turks and Caicos Is.	Îles Turques et Caïques	Islas Turcas y Caicos
Tuvalu	TUV	TV	798	009	Tuvalu	Tuvalu	Tuvalu
Uganda	UGA	UG	800	002	Uganda	Ouganda	Uganda
Ukraine	UKR	UA	804	150	Ukraine	Ukraine	Ucrania
Untd Arab Em	ARE	AE	784	142	United Arab Emirates	Émirats arabes unis	Emiratos Árabes Unidos
UK	GBR	GB	826	150	United Kingdom	Royaume-Uni	Reino Unido
USA	USA	US	840	019	United States of America	États-Unis d'Amérique	EstadosUnidos de América
US Virgin Is	VIR	VI	850	019	US Virgin Islands	Îles Vierges américaines	Islas Vírgenes (EE.UU.)
Uruguay	URY	UY	858	019	Uruguay	Uruguay	Uruguay
Uzbekistan	UZB	UZ	860	142	Uzbekistan	Ouzbékistan	Uzbekistán
Vanuatu	VUT	VU	548	009	Vanuatu	Vanuatu	Vanuatu
Venezuela	VEN	VE	862	019	Venezuela, Boliv Rep of	Venezuela, Rép boliv du	Venezuela, Rep Boliv de
Viet Nam	VNM	VN	704	142	Viet Nam	Viet Nam	Viet Nam
Wallis Fut I	WLF	WF	876	009	Wallis and Futuna Is.	Îles Wallis et Futuna	Islas Wallis y Futuna
Yemen	YEM	YE	887	142	Yemen	Yémen	Yemen
Zambia	ZMB	ZM	894	002	Zambia	Zambie	Zambia

List of countries or areas included in this section

Liste des pays ou zones inclus dans cette section

Lista de países o áreas incluidos en esta secciòn

A	B	C	D	E	F	G	H
Zanzibar	...	..	...	002	Zanzibar	Zanzibar	Zanzíbar
Zimbabwe	ZWE	ZW	716	002	Zimbabwe	Zimbabwe	Zimbabwe
Other nei	...	..	896	...	Other nei	Autres nca	Otros nep

Column A = FAO multilingual country or area code (maximum 12 characters) used for statistical purposes.

Column B = Alpha-3 country or area code: ISO (International Organization for Standardization).

Column C = Alpha-2 country or area code: ISO (International Organization for Standardization).

Column D = Three-digit UN numerical country or area code as published in the "STANDARD COUNTRY OR AREA CODES FOR STATISTICAL USE" Statistical Papers, Series M., No. 49; United Nations, New York (http://unstats.un.org/unsd/methods/m49/m49.htm).

Column E = Continents:
- 002 = Africa
- 019 = Americas
- 142 = Asia
- 150 = Europe
- 009 = Oceania

Column F = Country or area names in English (maximum 24 characters).

Column G = Country or area names in French (maximum 24 characters).

Column H = Country or area names in Spanish (maximum 24 characters).

Colonne A = Noms de pays ou zone en code multilingue FAO (n'excédant pas 12 lettres) utilisés à des fins statistiques.

Colonne B = Code Alpha-3 des pays ou zones: ISO (Organisation internationale de normalisation).

Colonne C = Code Alpha-2 des pays ou zones: ISO (Organisation internationale de normalisation).

Colonne D = Code numérique à trois chiffres pour les pays ou zones des Nations Unies, tel que publié dans "STANDARD COUNTRY OR AREA CODES FOR STATISTICAL USE" (Code type pour les pays ou les zones des Nations Unies à des fins statistiques), Statistical Papers, Series M., No. 49; United Nations, New York (http://unstats.un.org/unsd/methods/m49/m49.htm).

Colonne E = Continents:
- 002 = Afrique
- 019 = Amériques
- 142 = Asie
- 150 = Europe
- 009 = Océanie

Colonne F = Noms de pays ou zone en anglais (n'excédant pas 24 espaces typographiques).

Colonne G = Noms des pays ou zone en français (n'excédant pas 24 espaces typographiques).

Colonne H = Noms de pays ou zone en espagnol (n'excédant pas 24 espaces typographiques).

Columna A = Nombres multilingües de los países o áreas utilizados por la FAO para fines estadísticos (máximo, 12 espacios).

Columna B = Código Alfa-3 de los países o áreas: ISO (Organización Internacional de Normalización).

Columna C = Código Alfa-2 de los países o áreas: ISO (Organización Internacional de Normalización).

Columna D = Código numérico de tres dígitos atribuido al país o área en cuestión por las Naciones Unidas, tal como aparece en la publicación "STANDARD COUNTRY OR AREA CODES FOR STATISTICAL USE" (Código estándar por los países o áreas de las Naciones Unidas para fines estadísticos), Statistical Papers, Series M., No. 49; United Nations, New York (http://unstats.un.org/unsd/methods/m49/m49.htm).

Columna E = Continentes:
- 002 = África
- 019 = Américas
- 142 = Asia
- 150 = Europa
- 009 = Oceanía

Columna F = Nombres de los países o áreas en inglés (máximo, 24 espacios).

Columna G = Nombres de los países o áreas en francés (máximo, 24 espacios).

Columna H = Nombres de los países o áreas en español (máximo, 24 espacios).

Notes on major fishing areas

1. The 26 *major fishing areas*, internationally established for fishery statistical purposes, consist of:

   a) seven major inland fishing areas, covering the inland waters of the continents;

   b) nineteen major marine fishing areas, covering the waters of the Atlantic, Indian, Pacific and Southern Oceans with their adjacent seas.

2. The list of these 26 areas appears on the following page facing the world map on which the boundaries of the various major fishing areas are shown together with their identifying two-digit codes. These two-digit area codes are reflected in the table numbers in Section C.

3. The major fishing areas, inland and marine, are identified in all tables by two kinds of descriptors: their FAO names and/or two-digit codes. Space restrictions require the use in column headings of the word *fishing area* when referring to *major fishing areas*.

4. Breakdown of catch statistics by subareas, divisions, subdivisions, etc., within these major fishing areas, are not given in this yearbook. These details appear in statistical bulletins issued regularly by various regional fishery organizations, councils, commissions, committees, etc., e.g. CECAF, GFCM, ICCAT, ICES, NAFO, etc.

5. Changes have been made in some of the boundaries between major fishing areas. The catch statistics for all areas and all years in this issue have been adjusted in accordance with the boundaries as now shown in the world map.

   The fishing area 07 ("Former USSR area – Inland waters") referred to the area that was formerly the Union of Soviet Socialist Republics. Since 1988, information for each new independent Republic is shown separately with the exception of capture data in the Antarctic fishing areas for which separate data begin in 1991. The new independent Republics are: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan (statistics now assigned to the fishing area "Asia – Inland waters") and Belarus, Estonia, Latvia, Lithuania, Republic of Moldova, Russian Federation, Ukraine (assigned to the fishing area "Europe – Inland waters").

   Since 1981, fishing area 41 includes the waters lying between 55° and 60° South latitude and between 50° and 60° West longitude which during the 1970-80 period were included in the fishing area 48.

   Division of catches between fishing areas 57 and 71 was estimated following boundary change in the Strait of Malacca in 1986.

   Beginning with the 1989 data, catches have been adjusted in accordance with the boundary change between fishing areas 87 and 81; and between 87 and 77.

   Boundary between fishing areas 51 and 57 was modified starting with the 1999 data. As a consequence data for Sri Lanka have been moved from area 51 to area 57.

   Boundary between fishing areas 57 and 71 in the Australian-Indonesian region was modified starting with the 2001 data.

6. Freshwater species are usually recorded as caught in inland waters. Small quantities of several freshwater species are caught regularly in parts of some seas with low salinities; these catches are included in the statistics of the appropriate marine area. Similarly, the catches of diadromous (anadromous and catadromous) species are shown in either the marine or inland area where caught.

Notes sur les principales zones de pêche

Les 26 *principales zones de pêche* établies au plan international à des fins statistiques, comprennent:

a) sept principales zones de pêche continentales, couvrant les eaux des continents;

b) dix-neuf principales zones de pêche maritimes, couvrant les eaux des océans Atlantique, Indien, Pacifique et Austral et leurs mers limitrophes.

La liste de ces 26 zones figure à la page suivante faisant face à la carte mondiale sur laquelle on a porté les limites des principales zones de pêche avec les codes à deux chiffres qui les identifient. Ces codes à deux chiffres se retrouvent dans les numéros des tableaux figurant à la Section C.

Les principales zones de pêche, tant continentales que maritimes, sont identifiées dans tous les tableaux par deux types de descripteurs: leur nom FAO et/ou leur code à deux chiffres. Faute d'espace, il a fallu utiliser le terme *zone de pêche* dans les têtes de colonne pour indiquer les *principales zones de pêche*.

Les ventilations des statistiques des captures par sous-zones, divisions, sous-divisions, etc., au sein de ces principales zones de pêche ne sont pas données dans cet annuaire. Ces détails figurent dans les bulletins statistiques qui sont publiés périodiquement par les divers organismes régionaux de pêche, conseils, commissions ou comités des pêches, par exemple, COPACE, CGPM, CICTA, CIEM, NAFO, etc.

Des modifications ont été apportées à certaines des limites tracées des principales zones de pêche. Les statistiques des captures relatives à toutes les zones de pêche et à toutes les années incluses dans l'édition présente ont été ajustées de manière à correspondre aux limites qui sont maintenant indiquées sur la carte mondiale.

La zone de pêche 07 (Zone de l'ex-URSS – Eaux continentales) correspondait au territoire de l'ancienne Union des Républiques socialistes soviétiques. Depuis 1988 les renseignements sont donnés séparément pour chaque république indépendante sauf pour les données relatives aux captures effectuées dans les zones maritimes de l'Antarctique pour lesquelles les données séparées commencent en 1991. Les nouvelles Républiques indépendantes sont: Arménie, Azerbaïdjan, Géorgie, Kazakhstan, Kirghizistan, Tadjikistan, Turkménistan, Ouzbékistan (statistiques maintenant attribuées à la zone de pêche Asie - Eaux continentales) et Bélarus, Estonie, Lettonie, Lituanie, République de Moldova, Fédération de Russie, Ukraine (statistiques attribuées à la zone de pêche "Europe - Eaux continentales").

Depuis 1981 la zone de pêche 41 comprend les eaux situées entre 55° et 60° de latitude sud et entre 50° et 60° de longitude ouest qui durant la période 1970-80 étaient incluses dans la zone de pêche 48.

La répartition des captures entre les zones de pêche 57 et 71 était estimée après changement apporté en 1986 à la limite relative au détroit de Malacca.

A partir des données de 1989 les captures ont été ajustées de manière à correspondre à la modification apportée aux limites entre les zones de pêche 87 et 81, et entre les zones 87 et 77.

La limite entre les zones de pêche 51 et 57 a été modifiée à partir des données de 1999. En conséquence les données pour le Sri Lanka ont été portées de la zone de pêche 51 à la zone de pêche 57.

La limite entre les zones de pêche 57 et 71 dans la région australien-indonésienne a été modifiée à partir des données de 2001.

Les poissons d'eau douce sont d'ordinaire enregistrés comme captures faites dans les eaux continentales. De petites quantités de poissons d'eau douce de plusieurs espèces sont couramment capturées dans certaines mers dont la salinité est faible; ces captures figurent dans les statistiques relatives à la zone maritime appropriée. De même, les captures de poissons d'espèces diadromes (anadromes et catadromes) apparaissent dans les statistiques ayant trait soit aux zones maritimes, soit aux zones continentales où elles ont été effectuées.

Notas sobre las áreas principales de pesca

Las 26 *áreas principales de pesca* establecidas internacionalmente con fines estadísticos se dividen en:

a) siete áreas principales de pesca continental, que cubren las aguas de los continentes;

b) diecinueve áreas principales de pesca marítimas, que cubren las aguas de los océanos Atlántico, Índico, Pacífico y Austral así como las de sus mares adyacentes.

La lista de estas 26 áreas de pesca puede verse en la página siguiente opuesta a la carta mundial, en la que se indican los límites de las distintas áreas principales de pesca con los códigos de dos dígitos correspondientes a cada área de pesca. Estos dos dígitos se utilizan luego en los números de los cuadros de la Sección C.

Las áreas principales de pesca, continentales y marinas, se identifican en todos los cuadros con dos tipos de descriptores: su nombre FAO y/o código de dos dígitos. Por razones de espacio, en los encabezamientos de las columnas se utiliza el término *área de pesca* para designar las *áreas principales de pesca*.

En esto anuario no se desglosan las estadísticas de captura por subáreas, divisiones, subdivisiones, etc., dentro de las áreas principales de pesca. Esos desgloses pueden verse en los boletines estadísticos publicados regularmente por las distintas organizaciones regionales de pesca, consejos, comisiones, comités, etc., como el CPACO, la CGPM, la CICAA, el CIEM, la NAFO, etc.

Los límites de algunas de las áreas principales de pesca han sido modificados en los años pasados. Las estadísticas de captura de todas las áreas y años que figuran en esta edición se han ajustado en consecuencia, teniendo en cuenta los límites que ahora aparecen en la carta mundial.

El área de pesca 07 (Área de la ex URSS – Aguas continentales) correspondía a la antigua Unión de Repúblicas Socialistas Soviéticas. A partir de 1988 la información de cada una de las nuevas repúblicas independientes se expone por separado excepto en el caso de las capturas efectuadas en las áreas marítimas del Antártico para las cuales los datos separados comienzan en 1991. Las nuevas repúblicas independientes de la ex URSS son: Armenia, Azerbaiyán, Georgia, Kazajstán, Kirguistán, Tayikistán, Turkmenistán, Uzbekistán (los datos han sido atribuidos al área de pesca Asia - Aguas continentales) y Belarús, Estonia, Letonia, Lituania, República de Moldova, Federación de Rusia, Ucrania (datos atribuidos al área de pesca "Europa – Aguas continentales").

Desde 1981 la área de pesca 41 incluye las aguas comprendidas entre 55° y 60° de latitud Sur y entre 50° y 60° de longitud Oeste que durante el período 1970-80 eran incluidas en la área de pesca 48.

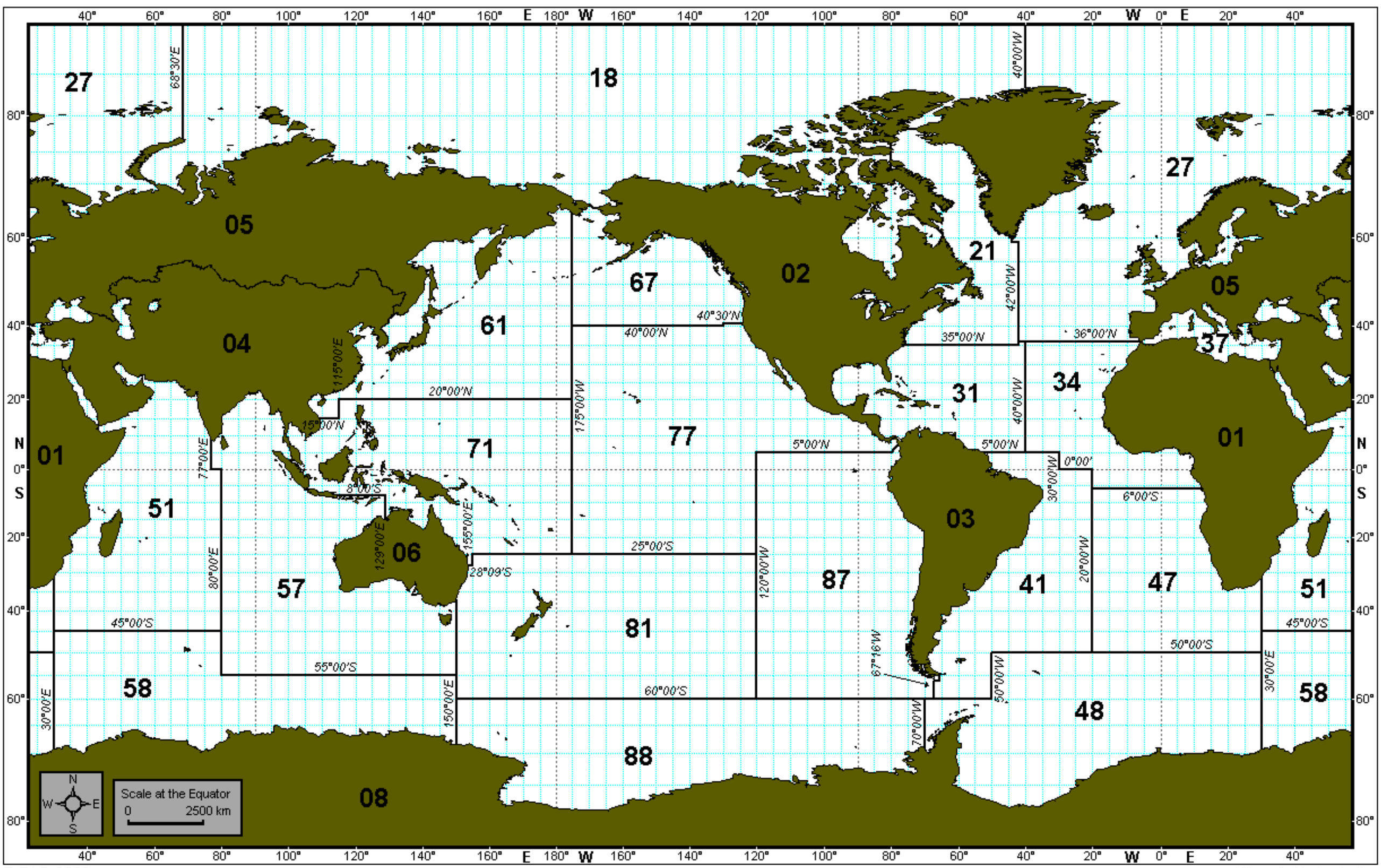
La distribución de las capturas entre las áreas de pesca 57 y 71 fue una estimación debida a la modificación hecha en 1986 al límite relativo al estrecho de Malaca.

A partir de datos de 1989 las capturas se han ajustado teniendo en cuenta las modificaciones hechas a los límites entre las áreas de pesca 87 y 81, y entre las áreas 87 y 77.

El límite entre las áreas de pesca 51 y 57 ha sido modificado a partir de datos de 1999. Consecuentemente se cambiaron los datos por Sri Lanka desde la área de pesca 51 a la 57.

El límite entre las áreas de pesca 57 y 71 en la región australiana-indonesia ha sido modificado a partir de datos de 2001.

Las especies de agua dulce se consignan de ordinario considerando que se han capturado en aguas continentales. Pequeñas cantidades de varias especies de agua dulce se capturan regularmente en algunas zonas marítimas de poca salinidad; dichas capturas se incluyen en las estadísticas correspondientes al área marítima en cuestión. De igual forma, las capturas de especies diadromas (anádromas y catádromas) se incluyen en el área marítima o continental en que se han capturadas.



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Miller cylindrical projection

A - Summaries

A - Résumés

A – Resúmenes

A-1 (a)

Fish, crustaceans, molluscs, etc — World capture production
Poissons, crustacés, mollusques, etc — Captures mondiales
Peces, crustáceos, moluscos, etc — Capturas mundiales

Division, fishing area, continent Division, zone de pêche, continent División, área de pesca, continente	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
World total **Total mondial** **Total mundial**	**92 604 414**	**92 329 279**	**90 023 515**	**90 305 150**	**89 698 988**	**89 630 210**	**88 603 826**
Capture production in inland waters ***Captures dans les eaux continentales*** ***Capturas en aguas continentales***	***8 642 262***	***9 413 139***	***9 796 525***	***9 955 448***	***10 194 565***	***10 382 865***	***11 211 200***
By ISSCAAP divisions	*Par divisions de la CSITAPA*				*Por divisiones de la CEIUAPA*		
1 Freshwater fishes Poissons d'eau douce Peces de agua dulce	7 454 413	8 153 730	8 504 904	8 629 682	8 861 055	8 972 906	9 749 414
2 Diadromous fishes Poissons diadromes Peces diádromos	310 625	350 796	332 807	338 635	305 081	360 412	358 789
3 Marine fishes Poissons marins Peces marinos	72 794	77 250	92 928	83 218	89 594	77 253	66 641
4 Crustaceans Crustacés Crustáceos	379 372	419 577	435 927	472 598	547 692	551 235	614 173
5 Molluscs Mollusques Moluscos	382 241	368 737	383 371	389 517	351 291	371 287	372 307
7 Miscellaneous aquatic animals Animaux aquatiques divers Animales acuáticos diversos	42 817	43 049	46 588	41 798	39 852	49 772	49 876
By inland fishing areas	*Par zones de pêche continentales*				*Por áreas de pesca continentales*		
01 Africa - Inland waters Afrique - Eaux continentales África - Aguas continentales	2 332 948	2 432 797	2 365 200	2 399 785	2 463 732	2 485 524	2 567 427
02 America, North - Inland waters Amérique du Nord - Eaux continentales América del Norte - Aguas continentales	186 399	184 907	180 759	189 380	181 240	180 384	178 344
03 America, South - Inland waters Amérique du Sud - Eaux continentales América del Sur - Aguas continentales	414 543	396 683	401 775	369 675	374 948	360 583	365 084
04 Asia - Inland waters Asie - Eaux continentales Asia - Aguas continentales	5 376 670	6 028 661	6 482 317	6 586 003	6 812 669	6 964 612	7 696 520
05 Europe - Inland waters Europe - Eaux continentales Europa - Aguas continentales	314 034	352 222	348 637	392 803	344 290	374 048	386 850
06 Oceania - Inland waters Océanie - Eaux continentales Oceanía - Aguas continentales	17 668	17 869	17 837	17 802	17 686	17 714	16 975
By continents	*Par continents*				*Por continentes*		
Africa Afrique África	2 332 948	2 432 797	2 365 200	2 399 785	2 463 732	2 485 524	2 567 427
Americas Amériques Américas	600 942	581 590	582 534	559 055	556 188	540 967	543 428
Asia Asie Asia	5 376 670	6 028 661	6 482 317	6 586 003	6 812 669	6 964 612	7 696 520
Europe Europe Europa	314 034	352 222	348 637	392 803	344 290	374 048	386 850
Oceania Océanie Oceanía	17 668	17 869	17 837	17 802	17 686	17 714	16 975
Capture production in marine fishing areas ***Captures dans les zones de pêche maritimes*** ***Capturas en áreas de pesca marítimas***	***83 962 152***	***82 916 140***	***80 226 990***	***80 349 702***	***79 504 423***	***79 247 345***	***77 392 626***
By ISSCAAP divisions	*Par divisions de la CSITAPA*				*Por divisiones de la CEIUAPA*		
1 Freshwater fishes Poissons d'eau douce Peces de agua dulce	21 203	22 059	23 234	22 733	19 138	19 198	19 551
2 Diadromous fishes Poissons diadromes Peces diádromos	1 205 257	1 353 941	1 287 729	1 463 897	1 213 899	1 556 279	1 392 053
3 Marine fishes Poissons marins Peces marinos	70 393 788	69 381 139	66 148 891	65 993 839	65 531 869	65 661 585	63 732 564
4 Crustaceans Crustacés Crustáceos	5 322 634	5 210 391	5 363 122	5 390 069	5 289 964	5 316 664	5 487 897
5 Molluscs Mollusques Moluscos	6 699 582	6 538 587	6 943 996	7 114 027	6 930 223	6 190 080	6 265 021
7 Miscellaneous aquatic animals Animaux aquatiques divers Animales acuáticos diversos	319 688	410 023	460 018	365 137	519 330	503 539	495 540

Fish, crustaceans, molluscs, etc **World capture production**
A-1 Poissons, crustacés, mollusques, etc Captures mondiales
(a) Peces, crustáceos, moluscos, etc Capturas mundiales

Division, fishing area, continent Division, zone de pêche, continent División, área de pesca, continente	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
By marine fishing areas	*Par zones de pêche maritimes*				*Por áreas de pesca marítimas*		
18 Arctic Sea Mer Arctique Mar Ártico	-	-	-	2	480	-	589
21 Atlantic, Northwest Atlantique, nord-ouest Atlántico, noroeste	2 353 367	2 201 025	2 198 570	2 153 251	2 063 538	2 047 435	2 052 389
27 Atlantic, Northeast Atlantique, nord-est Atlántico, nordeste	9 996 590	9 649 947	9 101 570	8 904 663	8 522 371	8 438 989	8 720 395
31 Atlantic, Western Central Atlantique, centre-ouest Atlántico, centro-occidental	1 746 583	1 399 179	1 389 754	1 407 073	1 267 745	1 345 255	1 264 622
34 Atlantic, Eastern Central Atlantique, centre-est Atlántico, centro-oriental	3 605 394	3 733 981	3 425 743	3 282 510	3 575 198	3 803 744	4 044 504
37 Mediterranean and Black Sea Méditerranée et mer Noire Mediterráneo y Mar Negro	1 510 187	1 442 302	1 618 243	1 686 058	1 488 723	1 468 537	1 429 143
41 Atlantic, Southwest Atlantique, sud-ouest Atlántico, sudoccidental	1 795 554	1 835 675	2 372 302	2 506 236	2 403 878	1 910 273	1 762 281
47 Atlantic, Southeast Atlantique, sud-est Atlántico, sudoriental	1 732 115	1 598 512	1 380 674	1 440 037	1 358 699	1 196 590	1 299 424
48 Atlantic, Antarctic Atlantique, Antarctique Atlántico, Antártico	125 469	132 531	112 686	112 845	163 235	131 658	215 216
51 Indian Ocean, Western Océan Indien, ouest Océano Índico, occidental	4 381 394	4 441 970	4 459 046	4 175 977	4 105 741	4 147 749	4 266 917
57 Indian Ocean, Eastern Océan Indien, est Océano Índico, oriental	5 576 152	5 455 177	5 889 863	5 941 605	6 347 188	6 764 362	6 950 343
58 Indian Ocean, Antarctic Océan Indien, Antarctique Océano Índico, Antártico	10 381	12 938	11 495	10 385	10 899	11 140	10 832
61 Pacific, Northwest Pacifique, nord-ouest Pacífico, noroeste	19 267 125	19 686 893	19 613 020	19 872 399	20 128 757	20 485 793	20 945 401
67 Pacific, Northeast Pacifique, nord-est Pacífico, nordeste	3 047 383	3 209 847	3 076 397	2 930 356	2 579 294	2 259 951	2 435 404
71 Pacific, Western Central Pacifique, centre-ouest Pacífico, centro-occidental	10 921 340	11 089 711	11 095 803	11 466 930	10 914 603	11 228 123	11 709 514
77 Pacific, Eastern Central Pacifique, centre-est Pacífico, centro-oriental	1 557 274	1 621 537	1 639 567	1 776 516	1 864 771	1 996 749	1 921 887
81 Pacific, Southwest Pacifique, sud-ouest Pacífico, sudoccidental	713 954	725 404	641 194	634 678	589 006	570 494	573 783
87 Pacific, Southeast Pacifique, sud-est Pacífico, sudoriental	15 618 861	14 675 496	12 197 381	12 044 446	12 117 471	11 437 296	7 786 834
88 Pacific, Antarctic Pacifique, Antarctique Pacífico, Antártico	3 029	4 015	3 682	3 735	2 826	3 207	3 148
By continents	*Par continents*				*Por continentes*		
Africa Afrique África	5 172 575	5 156 992	4 664 979	4 694 424	4 839 498	4 867 942	5 050 821
Americas Amériques Américas	25 051 684	24 191 853	21 828 983	21 399 900	21 011 079	20 112 170	16 673 318
Asia Asie Asia	38 407 676	38 429 565	39 158 849	39 776 995	39 653 851	39 935 120	41 016 562
Europe Europe Europa	13 583 082	13 473 963	13 082 796	12 974 174	12 667 383	12 965 590	13 406 828
Oceania Océanie Oceanía	1 446 961	1 479 585	1 346 575	1 369 227	1 213 161	1 197 769	1 185 955
Other nei Autres nca Otros nep	300 174	184 182	144 808	134 982	119 451	168 754	59 142

* See paragraph 5 of the INTRODUCTION.

* Voir le paragraphe 5 de l'INTRODUCTION.

* Véase el párrafo 5 en la INTRODUCCIÓN.

A-1 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by groupings of major fishing areas
Captures par groupes de principales zones de pêche
Capturas por grupos de áreas principales de pesca

Group of major fishing areas Groupe de principales zones de pêche Grupo de áreas principales de pesca		2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
World total **Total mondial** **Total mundial**		**92 604 414**	**92 329 279**	**90 023 515**	**90 305 150**	**89 698 988**	**89 630 210**	**88 603 826**
Inland waters ***Eaux continentales*** ***Aguas continentales***		***8 642 262***	***9 413 139***	***9 796 525***	***9 955 448***	***10 194 565***	***10 382 865***	***11 211 200***
Marine areas ***Zones maritimes*** ***Áreas marítimas***		***83 962 152***	***82 916 140***	***80 226 990***	***80 349 702***	***79 504 423***	***79 247 345***	***77 392 626***
Atlantic Ocean Océan Atlantique Océano Atlántico	18+21+27+31+34+37+41+47	22 739 790	21 860 621	21 486 856	21 379 830	20 680 632	20 210 823	20 573 347
Indian Ocean Océan Indien Océano Índico	51+57	9 957 546	9 897 147	10 348 909	10 117 582	10 452 929	10 912 111	11 217 260
Pacific Ocean Océan Pacifique Océano Pacífico	61+67+71+77+81+87	51 125 937	51 008 888	48 263 362	48 725 325	48 193 902	47 978 406	45 372 823
Southern Ocean Océan Austral Océano Austral	48+58+88	138 879	149 484	127 863	126 965	176 960	146 005	229 196
Atlantic, Northern Atlantique du Nord Atlántico del Norte	18+21+27	12 349 957	11 850 972	11 300 140	11 057 916	10 586 389	10 486 424	10 773 373
Atlantic, Central Atlantique central Atlántico central	31+34+37	6 862 164	6 575 462	6 433 740	6 375 641	6 331 666	6 617 536	6 738 269
Atlantic, Southern Atlantique du Sud Atlántico del Sur	41+47+48	3 653 138	3 566 718	3 865 662	4 059 118	3 925 812	3 238 521	3 276 921
Indian Ocean Océan Indien Océano Índico	51+57+58	9 967 927	9 910 085	10 360 404	10 127 967	10 463 828	10 923 251	11 228 092
Pacific, Northern Pacifique du Nord Pacífico del Norte	61+67	22 314 508	22 896 740	22 689 417	22 802 755	22 708 051	22 745 744	23 380 805
Pacific, Central Pacifique central Pacífico central	71+77	12 478 614	12 711 248	12 735 370	13 243 446	12 779 374	13 224 872	13 631 401
Pacific, Southern Pacifique du Sud Pacífico del Sur	81+87+88	16 335 844	15 404 915	12 842 257	12 682 859	12 709 303	12 010 997	8 363 765
Northern regions Régions septentrionales Regiones del Norte	18+21+27+61+67	34 664 465	34 747 712	33 989 557	33 860 671	33 294 440	33 232 168	34 154 178
Central regions Régions centrales Regiones centrales	31+34+37+51+57+71+77	29 298 324	29 183 857	29 518 019	29 736 669	29 563 969	30 754 519	31 586 930
Southern regions Régions méridionales Regiones del Sur	41+47+48+58+81+87+88	19 999 363	18 984 571	16 719 414	16 752 362	16 646 014	15 260 658	11 651 518

A-1 (c)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by principal producers in 2010
Captures par principaux producteurs en 2010
Capturas por productores principales en 2010

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
China (1)	14 176 195 F	14 173 776 F	14 347 274 F	14 464 803 F	14 588 940 F	14 631 018 F	14 659 036	14 791 163	14 919 596	15 418 967
Indonesia	4 259 343	4 322 764	4 583 771	4 605 435	4 695 977	4 800 621	5 050 340	4 997 199	5 103 603	5 380 266
India	3 777 092	3 736 603	3 712 149	3 391 009	3 691 362	3 844 837	3 859 293	4 099 227	4 066 756	4 694 968
USA	4 944 336	4 937 305	4 938 956	4 959 826	4 892 967	4 852 284	4 767 596	4 349 853	4 222 052	4 369 540
Peru	7 986 207	8 765 189	6 086 060	9 604 527	9 388 488	7 017 491	7 210 544	7 394 538	6 914 452	4 261 091
Russian Fed	3 628 683	3 232 351	3 281 510	2 941 595	3 197 686	3 284 306	3 475 883	3 383 724	3 826 129	4 069 624
Japan	4 713 773 F	4 373 723 F	4 680 360	4 330 029	4 312 430	4 328 134	4 277 691	4 302 264	4 116 263 F	4 044 185 F
Myanmar	1 187 880	1 284 340	1 343 860	1 586 600	1 732 250	2 006 790	2 235 580	2 493 750	2 766 940	3 063 210
Chile	3 797 546	4 271 417	3 612 048	4 926 808	4 328 321	4 160 732	3 819 285	3 554 808	3 453 786	2 679 736
Norway	2 686 942	2 740 475	2 548 803	2 524 377	2 392 594	2 256 448	2 380 425	2 431 371	2 524 437	2 675 292
Philippines	1 948 830	2 029 914	2 165 890	2 211 375	2 269 738	2 319 120	2 499 695	2 561 337	2 602 541	2 611 720
Viet Nam	1 724 758	1 802 598	1 856 105	1 940 034	1 987 900	2 027 700	2 074 600	2 136 300	2 280 500	2 420 800
Thailand	2 833 974	2 842 428	2 849 670	2 839 669	2 814 295	2 698 803	2 304 951	1 873 432	1 870 702	1 827 199
Korea Rep	1 993 946	1 693 924	1 656 600	1 580 542	1 646 158	1 757 508	1 869 884	1 956 566	1 858 572	1 732 928
Bangladesh	1 068 417	1 103 855	1 141 241	1 187 274	1 333 866	1 436 496	1 494 199	1 557 754	1 821 579	1 726 586
Mexico	1 398 576	1 450 747	1 357 303	1 259 056	1 319 936	1 357 195	1 472 533	1 581 272	1 611 175	1 523 889
Malaysia	1 234 733	1 275 555	1 287 084	1 335 764	1 214 183	1 286 478	1 385 703	1 398 885	1 397 683	1 433 427
Morocco	1 096 083	961 616	918 643	918 151	1 026 395	876 878	879 469	997 127	1 165 062	1 136 240
Iceland	1 983 574	2 134 546	1 986 539	1 733 702	1 664 657	1 327 079	1 399 190	1 284 034	1 141 869	1 060 640
Spain	1 093 896	890 509	894 976	810 293	853 156	961 300	820 195	918 136	918 124	968 662
Canada	1 041 682	1 063 702	1 107 991	1 172 578	1 103 853	1 079 415	1 025 604	950 370	950 498	927 622
China,Taiwan	1 005 199	1 042 756	1 135 359	980 106	1 017 243	967 578	1 174 393	1 016 390	769 907	851 384
Denmark	1 510 694	1 442 348	1 031 221	1 090 596	910 598	867 721	653 053	690 584	777 752	828 016
Argentina	931 081	946 185	910 200	944 846	929 937	1 171 980	985 409	995 083	861 973	811 749
Brazil	730 378	755 582	712 144	746 217	750 261	779 113	783 177	791 892	825 412	785 369
South Africa	750 502	766 941	822 935	888 104	817 666	618 616	678 878	644 659	512 284	623 920
Nigeria	452 146	481 056	475 162	465 251	523 182	552 323	530 420	601 368	598 210	616 981
UK	741 045	689 891	635 486	654 495	669 905	624 569	619 691	596 007	591 064	612 655
Cambodia	428 200	406 182	364 357	305 817	384 000	482 500	458 500	431 000	465 000	490 094
Turkey	527 733	566 682	507 772	550 482	426 496	533 048	632 450	494 126	464 233	485 939
Pakistan	543 166	532 134	491 834	480 340	434 850	489 421	440 056	451 414	446 362	453 264
Iran	351 140	324 873	350 195	370 011	410 569	445 879	403 690	407 842	419 903	443 650
Sri Lanka	291 581	297 173	328 319	333 360	190 856	274 025	307 280	327 404	355 694	436 355
New Zealand	569 811	588 635	550 900	545 991	545 309	476 572	494 500	452 326	439 378	436 232
France	612 209	629 449	638 678	599 931	574 877	574 934	513 391	460 372	420 776	426 514
Uganda	220 726	221 898	241 810	371 789	416 758	367 099	431 500 F	403 500 F	412 000 F	413 805
Senegal	428 117	397 328	466 842	434 770	400 120	366 992	412 835	425 853	442 295	409 578
Faroe Is	515 909	525 991	620 991	599 386	565 260	623 122	620 834	518 267	351 018	393 875
Ecuador	587 770	319 169	399 526	343 962	448 091	452 298	399 085	495 069	485 805	391 714
Netherlands	518 163	464 036	526 281	521 636	555 395	469 101	413 621	416 797	382 242	389 357
Egypt	428 633	425 162	431 123	393 494	349 553	375 894	372 491	373 815	387 398	385 209
Namibia	547 997	625 100	637 799	571 199	553 995	509 570	413 333	372 822	370 348	370 000 F
Ghana	447 180	371 242	390 770	399 388	391 866	375 087	330 486	359 831	321 815	351 205
Tanzania	336 551	324 232	351 294	363 688	376 700	335 437	329 835	326 811	316 204	342 481
Ireland	356 428	282 620	266 218	280 229	267 639	211 764	214 871	205 342	269 083	318 942
Mauritania	140 142 F	156 131 F	199 650 F	270 733	304 877	165 312	223 207	195 328	216 900	276 238
Venezuela	408 655	509 894	518 173	579 772	402 582	315 346	347 546	296 266	288 462	274 417 F
Angola	254 553	255 443	212 033	240 002	202 616	225 741	306 436	305 762	272 263	260 000 F
Congo Dem R	232 433	239 000	235 765	237 372	236 640	236 588	236 000	236 000 F	236 000 F	236 000 F
Italy	310 399	269 846	295 691	287 083	296 887	315 435	286 642	235 759	253 001	234 101
Papua N Guin	124 913 F	141 160	176 844	242 601	254 135	253 019	247 462	222 444	229 619	224 507
Portugal	193 266	202 853	212 442	222 303	220 459	229 072	256 181	224 246	198 813	222 944
Germany	209 142	221 772	257 647	258 343	281 368	293 037	290 511	274 282	244 045	222 771
Sweden	311 817	294 964	286 875	269 930	256 359	269 251	238 253	231 336	203 415	212 035
Greenland	158 485	195 624	175 321	225 088	234 864	252 959	233 754	227 665	197 878	209 446
Korea D P Rp	206 500	205 000 F	205 000 F	205 000 F	205 000 F	205 000 F	205 000 F	205 000 F	205 000 F	205 000 F
Sierra Leone	75 210	82 990	96 926	134 440	145 993	148 146	144 535	203 582	200 000 F	200 000 F
57 countries ***57 pays*** ***57 países***	***85 034 340***	***85 288 679***	***82 516 416***	***86 731 202***	***86 408 058***	***84 164 182***	***84 591 002***	***84 129 354***	***83 963 871***	***82 872 339***
Other countries ***Autres pays*** ***Otros países***	***5 746 627***	***5 672 524***	***5 783 128***	***5 873 212***	***5 921 221***	***5 859 333***	***5 714 148***	***5 569 634***	***5 666 339***	***5 731 487***
World total **Total mondial** **Total mundial**	**90 780 967**	**90 961 203**	**88 299 544**	**92 604 414**	**92 329 279**	**90 023 515**	**90 305 150**	**89 698 988**	**89 630 210**	**88 603 826**

These countries or areas are those with capture production of 200 000 tonnes or more in 2010.

(1) See note on China in NOTES ON INDIVIDUAL COUNTRIES OR AREAS.

Ces pays ou zones sont ceux dont les captures ont été de 200 000 tonnes ou plus en 2010.

(1) Voir la note sur la Chine dans les NOTES SUR DIVERS PAYS OU ZONES.

Estos países o áreas son referentes a los que totalizan unas capturas de 200 000 toneladas o más en 2010.

(1) Véase la nota sobre China en las NOTAS SOBRE LOS DISTINTOS PAÍSES O ÁREAS.

A-1 (d)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by groups of species
Captures par groupes d'espèces
Capturas por grupos de especies

Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
11 Carps, barbels and other cyprinids Carpes, barbeaux et autres cyprinidés Carpas, barbos y otros ciprínidos	612 452	775 147	756 657	811 025	902 869	911 130	1 371 685
12 Tilapias and other cichlids Tilapias et autres cichlidés Tilapias y otros cíclidos	755 280	738 894	717 837	743 351	764 765	764 593	801 542
13 Miscellaneous freshwater fishes Poissons d'eau douce divers Peces de agua dulce diversos	6 107 884	6 661 748	7 053 644	7 098 039	7 212 559	7 316 381	7 595 738
21 Sturgeons, paddlefishes Esturgeons, spatules Esturiones, sollos	1 446	1 330	1 057	841	891	710	547
22 River eels Anguilles Anguilas	11 791	9 578	13 643	10 917	8 845	8 938	8 440
23 Salmons, trouts, smelts Saumons, truites, éperlans Salmones, truchas, eperlanos	880 227	1 032 505	930 818	1 101 158	828 210	1 207 562	979 590
24 Shads Aloses Sábalos	554 620	580 656	578 813	584 443	589 202	591 562	644 388
25 Miscellaneous diadromous fishes Poissons diadromes divers Peces diádromos diversos	67 798	80 668	96 205	105 173	91 832	107 919	117 877
31 Flounders, halibuts, soles Flets, flétans, soles Platijas, halibuts, lenguados	862 674	900 497	875 355	916 106	945 937	924 564	955 350
32 Cods, hakes, haddocks Morues, merlus, églefins Bacalaos, merluzas, eglefinos	9 400 772	8 971 420	8 986 730	8 352 379	7 689 964	6 949 409	7 426 888
33 Miscellaneous coastal fishes Poissons côtiers divers Peces costeros diversos	6 727 393	6 476 815	6 997 601	6 579 644	6 984 404	7 231 685	7 237 005
34 Miscellaneous demersal fishes Poissons démersaux divers Peces demersales diversos	2 908 418	2 742 006	3 032 862	2 913 349	2 928 072	2 988 704	3 095 978
35 Herrings, sardines, anchovies Harengs, sardines, anchois Arenques, sardinas, anchoas	22 901 964	22 219 557	19 077 167	19 933 146	20 256 090	19 983 507	17 096 817
36 Tunas, bonitos, billfishes Thons, pélamides, marlins Atunes, bonitos, agujas	6 272 229	6 426 898	6 472 101	6 618 929	6 544 594	6 634 797	6 620 373
37 Miscellaneous pelagic fishes Poissons pélagiques divers Peces pelágicos diversos	11 195 063	11 223 756	10 856 612	10 970 875	10 588 197	10 133 512	10 020 718
38 Sharks, rays, chimaeras Squales, raies, chimères Tiburones, rayas, quimeras	847 982	781 000	760 623	800 132	733 583	749 458	738 924
39 Marine fishes not identified Poissons marins non identifiés Peces marinos no identificados	9 350 087	9 716 440	9 182 768	8 992 497	8 950 622	10 143 202	10 607 152
41 Freshwater crustaceans Crustacés d'eau douce Crustáceos de agua dulce	311 366	351 231	365 477	397 541	462 957	473 867	526 579
42 Crabs, sea-spiders Crabes, araignées de mer Cangrejos, centollas	1 254 214	1 235 077	1 304 357	1 306 841	1 330 522	1 341 696	1 424 867
43 Lobsters, spiny-rock lobsters Homards, langoustes Bogavantes, langostas	236 269	234 621	253 671	239 052	254 856	252 602	279 685
44 King crabs, squat-lobsters Crabes royaux, galatées Cangrejos reales, galateidos	36 458	52 102	57 288	62 132	56 874	55 566	44 971
45 Shrimps, prawns Crevettes Gambas, camarones	3 307 856	3 205 737	3 269 605	3 262 436	3 132 546	3 166 970	3 129 250

A-1 (d)

Fish, crustaceans, molluscs, etc | **Capture production by groups of species**
Poissons, crustacés, mollusques, etc | **Captures par groupes d'espèces**
Peces, crustáceos, moluscos, etc | **Capturas por grupos de especies**

Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
46 Krill, planktonic crustaceans Krill, crustacés planctoniques Krill, crustáceos planctónicos	118 165	129 026	106 591	104 586	156 521	125 864	215 175
47 Miscellaneous marine crustaceans Crustacés marins divers Crustáceos marinos diversos	437 678	422 174	442 060	490 079	443 380	451 334	481 543
51 Freshwater molluscs Mollusques d'eau douce Moluscos de agua dulce	382 241	368 807	383 441	389 840	351 376	371 217	372 673
52 Abalones, winkles, conchs Ormeaux, bigorneaux, strombes Orejas de mar, bígaros, estrombos	142 372	128 930	135 484	129 857	131 712	131 119	142 157
53 Oysters Huîtres Ostras	150 237	162 339	139 564	153 057	131 996	132 751	103 985
54 Mussels Moules Mejillones	189 340	136 491	114 263	114 742	90 778	99 369	88 943
55 Scallops, pectens Coquilles St-Jacques Vieiras	790 999	725 046	760 547	733 099	762 998	816 504	840 876
56 Clams, cockles, arkshells Clams, coques, arches Almejas, berberechos, arcas	856 039	703 442	757 598	795 541	762 631	714 464	669 169
57 Squids, cuttlefishes, octopuses Encornets, seiches, poulpes Calamares, jibias, pulpos	3 714 907	3 785 998	4 133 125	4 311 854	4 270 545	3 486 105	3 652 632
58 Miscellaneous marine molluscs Mollusques marins divers Moluscos marinos diversos	855 688	896 271	903 345	875 554	779 478	809 838	766 893
71 Frogs and other amphibians Grenouilles et autres amphibies Ranas y otros anfibios	2 836	2 489	8 167	2 691	2 407	2 533	3 033
72 Turtles Tortues Tortugas	399	394	347	353	380	539	189
74 Sea-squirts and other tunicates Ascidiens et autres tuniciers Ascidias y otros tunicados	2 497	2 735	2 349	2 340	2 624	2 388	2 128
75 Horseshoe crabs and other arachnoids Limules et autres arachnoïdés Límulos y otros arácnidos	519	753	711	920	787	1 034	609
76 Sea-urchins and other echinoderms Oursins et autres échinodermes Erizos de mar y otros equinodermos	115 084	105 064	100 338	98 359	101 291	107 583	101 207
77 Miscellaneous aquatic invertebrates Invertébrés aquatiques divers Invertebrados acuáticos diversos	241 170	341 637	394 694	302 272	451 693	439 234	438 250
World total **Total mondial** **Total mundial**	**92 604 414**	**92 329 279**	**90 023 515**	**90 305 150**	**89 698 988**	**89 630 210**	**88 603 826**

A-1 (e)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by principal species in 2010
Captures par principales espèces en 2010
Capturas por especies principales en 2010

3-alpha code Code alpha-3 Código alfa-3	English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	2006 t	2007 t	2008 t	2009 t	2010 t
VET	Anchoveta(=Peruvian anchovy)	*Engraulis ringens*	7 007 157	7 611 858	7 419 295	6 910 467	4 205 979
ALK	Alaska pollock(=Walleye poll.)	*Theragra chalcogramma*	2 860 487	2 909 213	2 649 155	2 502 661	2 829 704
SKJ	Skipjack tuna	*Katsuwonus pelamis*	2 567 615	2 478 199	2 459 107	2 619 117	2 523 001
HER	Atlantic herring	*Clupea harengus*	2 224 999	2 369 473	2 479 202	2 509 943	2 201 334
MAS	Chub mackerel	*Scomber japonicus*	1 978 327	1 719 137	1 905 005	1 631 676	1 601 867
LHT	Largehead hairtail	*Trichiurus lepturus*	1 368 467	1 324 202	1 358 205	1 345 500	1 343 571
PIL	European pilchard(=Sardine)	*Sardina pilchardus*	1 037 558	984 649	1 045 612	1 221 727	1 219 663
JAN	Japanese anchovy	*Engraulis japonicus*	1 509 170	1 390 596	1 265 763	1 068 334	1 202 212
YFT	Yellowfin tuna	*Thunnus albacares*	1 112 937	1 042 934	1 147 004	1 101 598	1 165 296
COD	Atlantic cod	*Gadus morhua*	834 412	783 553	769 316	865 377	950 950
MAC	Atlantic mackerel	*Scomber scombrus*	548 167	567 489	611 006	707 178	887 314
GIS	Jumbo flying squid	*Dosidicus gigas*	871 359	688 423	895 365	642 855	815 978
CKI	Araucanian herring	*Strangomera bentincki*	440 109	281 382	795 139	855 262	750 750
CJM	Chilean jack mackerel	*Trachurus murphyi*	1 992 783	1 992 410	1 468 293	1 287 178	728 301
CPI	California pilchard	*Sardinops caeruleus*	355 527	559 520	742 028	758 070	696 585
SPR	European sprat	*Sprattus sprattus*	592 909	575 258	562 223	667 224	630 311
AKS	Akiami paste shrimp	*Acetes japonicus*	619 691	620 649	558 124	602 420	573 613
WHB	Blue whiting(=Poutassou)	*Micromesistius poutassou*	2 038 723	1 684 853	1 283 536	640 957	551 551
ANE	European anchovy	*Engraulis encrasicolus*	539 564	614 701	508 272	480 264	529 615
CAP	Capelin	*Mallotus villosus*	269 146	422 893	254 452	364 293	505 297
SAP	Pacific saury	*Cololabis saira*	394 861	524 947	622 119	475 727	457 584
CRY	Yellow croaker	*Larimichthys polyactis*	316 866	373 249	388 018	407 081	438 837
MHG	Gulf menhaden	*Brevoortia patronus*	408 875	456 576	420 719	454 758	438 640
IOS	Indian oil sardine	*Sardinella longiceps*	377 693	385 082	428 529	429 781	420 440
HIL	Hilsa shad	*Tenualosa ilisha*	327 308	320 148	329 913	334 534	403 385
POK	Saithe(=Pollock)	*Pollachius virens*	495 616	444 509	455 941	410 216	400 920
HAD	Haddock	*Melanogrammus aeglefinus*	319 007	339 224	332 168	365 757	396 389
PCO	Pacific cod	*Gadus macrocephalus*	342 305	331 576	339 015	333 730	394 744
GAZ	Gazami crab	*Portunus trituberculatus*	355 018	367 223	370 847	366 446	385 281
PIN	Pink(=Humpback)salmon	*Oncorhynchus gorbuscha*	316 205	506 343	294 876	591 654	370 044
PRA	Northern prawn	*Pandalus borealis*	401 732	409 616	390 729	341 919	360 745
BET	Bigeye tuna	*Thunnus obesus*	429 782	443 264	427 815	403 539	358 682
SQJ	Japanese flying squid	*Todarodes pacificus*	388 087	429 162	403 722	408 188	357 590
DPC	Daggertooth pike conger	*Muraenesox cinereus*	353 888	312 712	331 953	351 229	349 617
SAA	Round sardinella	*Sardinella aurita*	375 141	371 660	376 914	313 868	348 792
HKP	Argentine hake	*Merluccius hubbsi*	406 876	346 832	315 516	331 302	345 685
RAB	Short mackerel	*Rastrelliger brachysoma*	305 770	308 952	300 424	310 311	331 818
HEP	Pacific herring	*Clupea pallasii*	343 765	269 318	283 915	306 104	331 094
JSC	Yesso scallop	*Patinopecten yessoensis*	274 459	260 353	313 793	323 485	330 740
TRV	Southern rough shrimp	*Trachypenaeus curvirostris*	333 453	349 355	314 984	286 279	293 722
NIP	Nile perch	*Lates niloticus*	332 856	319 466	311 716	315 928	291 117
TLN	Nile tilapia	*Oreochromis niloticus*	194 808	206 270	241 832	247 610	287 120
SCA	American sea scallop	*Placopecten magellanicus*	284 617	285 803	269 756	280 721	274 970
KAW	Kawakawa	*Euthynnus affinis*	306 979	314 538	318 072	283 822	270 282
RAG	Indian mackerel	*Rastrelliger kanagurta*	260 121	289 548	271 828	284 309	265 201
ALB	Albacore	*Thunnus alalunga*	236 870	256 978	229 512	246 390	255 290
COM	Narrow-barred Spanish mackerel	*Scomberomorus commerson*	208 596	222 878	235 686	225 256	249 873
LOT	Longtail tuna	*Thunnus tonggol*	247 774	277 784	222 641	214 705	235 400
PAS	Pacific sandlance	*Ammodytes personatus*	276 026	188 429	197 529	181 663	235 381
HMC	Cape horse mackerel	*Trachurus capensis*	334 928	233 400	223 156	233 505	231 396
MHA	Atlantic menhaden	*Brevoortia tyrannus*	183 868	215 506	187 742	182 210	228 966
BOA	Bonga shad	*Ethmalosa fimbriata*	197 123	191 350	225 172	221 376	225 360
BUC	Bombay-duck	*Harpadon nehereus*	189 681	217 679	280 396	261 822	225 286
ANC	Southern African anchovy	*Engraulis capensis*	135 463	252 997	266 105	174 493	217 192
KRI	Antarctic krill	*Euphausia superba*	106 591	104 586	156 521	125 824	215 175
NHA	North Pacific hake	*Merluccius productus*	356 651	281 055	316 354	172 003	210 409
GIT	Giant tiger prawn	*Penaeus monodon*	238 880	248 501	254 919	223 428	209 662
JAP	Japanese pilchard	*Sardinops melanostictus*	235 092	248 332	192 039	191 853	208 472
HOM	Atlantic horse mackerel	*Trachurus trachurus*	210 817	204 357	184 340	243 467	206 785
JJM	Japanese jack mackerel	*Trachurus japonicus*	328 781	380 178	260 265	216 586	206 210
BIS	Bigeye scad	*Selar crumenophthalmus*	138 518	137 386	184 330	189 304	205 242
SAG	Goldstripe sardinella	*Sardinella gibbosa*	170 522	169 823	174 356	180 010	196 067
TRY	Yellowstripe scad	*Selaroides leptolepis*	166 602	161 130	172 254	174 927	195 436
SQA	Argentine shortfin squid	*Illex argentinus*	703 804	955 044	837 935	261 227	189 967
SCD	Blue swimming crab	*Portunus pelagicus*	158 688	172 144	176 080	165 528	184 864
GRM	Patagonian grenadier	*Macruronus magellanicus*	218 885	180 108	201 900	213 439	177 466
SOC	Sockeye(=Red)salmon	*Oncorhynchus nerka*	151 523	164 609	138 896	150 040	170 972
SAE	Madeiran sardinella	*Sardinella maderensis*	138 997	139 591	124 045	123 288	163 151
THP	Pacific thread herring	*Opisthonema libertate*	227 649	247 207	176 093	185 497	163 047
ATK	Okhotsk atka mackerel	*Pleurogrammus azonus*	166 597	192 224	229 885	182 353	157 534
SOY	So-iny (redlip) mullet	*Chelon haematocheilus*	130 318	125 558	127 133	127 493	156 989
71 species ***71 espèces*** ***71 especies***			***45 274 439***	***45 755 952***	***45 006 500***	***42 808 086***	***40 137 923***
Other species ***Autres espèces*** ***Otras especies***			***44 749 076***	***44 549 198***	***44 692 488***	***46 822 124***	***48 465 903***
World total **Total mondial** **Total mundial**			**90 023 515**	**90 305 150**	**89 698 988**	**89 630 210**	**88 603 826**

These selected species are those with capture production of 150 000 tonnes or more in 2010.

Ces espèces sont celles dont les captures ont été de 150 000 tonnes ou plus en 2010.

Estas especies se refieren a las que totalizan unas capturas de 150 000 toneladas o más en 2010.

A-2

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

All fishing areas
Toutes les zones de pêche
Todas las áreas de pesca

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Afghanistan	800 F	900 F	900 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F
Albania	3 310	3 655	2 800 F	4 549	5 000	5 729	5 497	5 506	5 945	6 144
Algeria	133 623	134 320	140 957	113 462	126 259	145 762	147 362	138 861	127 513	93 607
Amer Samoa	3 667	6 939	5 089	4 041	4 019	5 349	6 512	4 423	4 943	5 261
Andorra	0	0	0	0	0	0	0	0	0	0
Angola	254 553	255 443	212 033	240 002	202 616	225 741	306 436	305 762	272 263	260 000 F
Anguilla	585 F	610 F	635 F	660 F	685 F	710 F	735 F	759	681	701
Antigua Barb	1 824	2 374	2 587	2 527	2 999	3 092	3 092	3 521	2 490	2 293
Argentina	931 081	946 185	910 200	944 846	929 937	1 171 980	985 409	995 083	861 973	811 749
Armenia	866	465	569	218	250	350	1 065	601	619 F	617 F
Aruba	163	163 F	160 F	162	162 F	145	159	151	163	153
Australia	191 372	197 184	215 259	230 679	236 484	197 108	188 076	181 517	171 637	171 410
Austria	362	350	372	400	370	360	350	350	350	350
Azerbaijan	10 893	11 188	6 435	9 258	9 001	4 061	2 949	1 524	1 206	1 081
Bahamas	9 290	12 192	12 611	11 347	11 064	10 598	8 382	9 117	9 018	11 611
Bahrain	11 230	11 204	13 638	14 489	11 854	15 594	15 014	14 175	16 358	13 490
Bangladesh	1 068 417	1 103 855	1 141 241	1 187 274	1 333 866	1 436 496	1 494 199	1 557 754	1 821 579	1 726 586
Barbados	2 721	2 520	2 838	2 148	2 182	1 975	2 224	3 551	3 496	3 269
Belarus	944	1 020	803	583	594	645	689	809	826	897
Belgium	30 209	29 028	26 831	26 735	24 567	23 019	24 541	22 609	21 722	22 418
Belize	33 362	59 015	11 857	7 557	31 806	19 022	23 902	50 949	11 114	114 292
Benin	38 415	40 663	41 648	39 988	31 497	41 507	36 386	37 495 F	38 928	39 791
Bermuda	309	397	363	386	399	380	424	399	416	382
Bhutan	260 F	240 F	240 F	220 F	220 F	200 F	200 F	180 F	180 F	160 F
Bolivia	5 940	6 300 F	6 599	6 436	6 360	6 080 F	5 770	6 750	7 568	6 946
Bosnia Herzg	2 005 F	2 005 F	2 005 F	2 005 F	2 005 F	2 005 F	2 005 F	2 005 F	2 005 F	2 005 F
Botswana	118	139	122	161	132	81	122	86	73 F	60
Brazil	730 378	755 582	712 144	746 217	750 261	779 113	783 177	791 892	825 412	785 369
Br Ind Oc Tr	0	28	28	28	28	21	24	34	43	40
Br Virgin Is	837	1 062	2 771	1 262	1 300 F	1 308 F	1 250 F	1 200 F	1 200 F	1 200 F
Brunei Darsm	1 597	2 058	1 789	1 923	2 709	2 279	2 550	2 357	1 766	2 272
Bulgaria	8 674	15 008	12 035	8 252	5 434	7 544	8 903	8 864	8 978	10 769
Burkina Faso	8 500	8 500	9 000	9 000 F	9 000	9 500	10 200	11 093	11 800	14 520
Burundi	8 964	11 000 F	14 697	13 855	14 800 F	15 750 F	16 700 F	17 766	17 700 F	17 700 F
Cambodia	428 200	406 182	364 357	305 817	384 000	482 500	458 500	431 000	465 000	490 094
Cameroon	121 031	130 135	117 801	129 000 F	142 345	137 232	138 612	139 200 F	140 000 F	140 000 F
Canada	1 041 682	1 063 702	1 107 991	1 172 578	1 103 853	1 079 415	1 025 604	950 370	950 498	927 622
Cape Verde	8 676	8 145	8 103	10 396	21 617	24 590	18 328	23 768	16 828	19 500 F
Cayman Is	125	125	125	125	125	125	125	125	125	125
Cent Afr Rep	17 000 F	19 000 F	21 000 F	23 000 F	25 000 F	27 000 F	29 000 F	31 000 F	33 000 F	35 000 F
Chad	75 000 F	70 000 F	65 000 F	60 000 F	55 000 F	50 000 F	45 000 F	40 000 F	40 000 F	40 000 F
Channel Is	3 927	3 449	3 526	3 201	3 505	3 468	3 566	3 228	2 649	3 373
Chile	3 797 546	4 271 417	3 612 048	4 926 808	4 328 321	4 160 732	3 819 285	3 554 808	3 453 786	2 679 736
China	14 176 195 F	14 173 776 F	14 347 274 F	14 464 803 F	14 588 940 F	14 631 018 F	14 659 036	14 791 163	14 919 596	15 418 967
China,H.Kong	173 972	169 790	157 444	167 544	161 964	154 536	154 147	158 126	158 965	168 010
China, Macao	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F
China,Taiwan	1 005 199	1 042 756	1 135 359	980 106	1 017 243	967 578	1 174 393	1 016 390	769 907	851 384
Colombia	146 042	124 722	129 792	111 860	121 000	107 527 F	124 133 F	113 632 F	106 321	79 027
Comoros	12 180	13 102	14 115	14 935	15 070	15 070 F	19 676	29 989 F	20 450 F	52 261 F
Congo Dem R	232 433	239 000	235 765	237 372	236 640	236 588	236 000	236 000 F	236 000 F	236 000 F
Congo Rep	48 830	51 927	53 865	57 024	54 616	59 082	59 216	54 104	61 218	65 186
Cook Is	800 F	1 400 F	3 297	4 069	3 994	3 913	4 302	3 753	2 695	10 019
Costa Rica	34 816	33 020	29 397	20 850	22 340	22 000 F	21 735	21 750 F	21 750 F	21 750 F
Côte dIvoire	76 005	69 870	68 903	54 401	42 665	54 830	47 289	50 000 F	44 198	71 812
Croatia	18 489	21 230	19 946	30 164	34 665	37 853	40 199	49 024	55 750	52 828
Cuba	54 657	32 532	34 031	32 143	28 192	27 543	29 447	28 561	28 843	23 951
Cyprus	81 058	1 968	1 790	1 568	1 916	2 155	2 446	2 011	1 405	1 420
Czech Rep	4 646	4 983	5 127	4 528	4 242	4 646	4 276	4 164	4 112	3 990
Denmark	1 510 694	1 442 348	1 031 221	1 090 596	910 598	867 721	653 053	690 584	777 752	828 016
Djibouti	900	1 000	1 100 F	1 200 F	1 571	1 299	1 229	1 206	1 058	1 058 F
Dominica	1 200 F	1 198	950 F	700 F	579	694	676	696	790	700 F
Dominican Rp	13 217	17 261	18 097	14 223	11 193	12 956	13 709	15 382	14 233	14 490
Ecuador	587 770	319 169	399 526	343 962	448 091	452 298	399 085	495 069	485 805	391 714
Egypt	428 633	425 162	431 123	393 494	349 553	375 894	372 491	373 815	387 398	385 209
El Salvador	19 010	34 455	35 410	42 415	41 114	43 218	48 639	32 325	30 527	36 000
Eq Guinea	3 600 F	3 550 F	3 550 F	3 500 F	3 750 F	4 000 F	4 533 F	5 400 F	7 669	7 376 F
Eritrea	8 820	7 832	6 689	7 404	4 027	8 813	1 932	1 665	3 030	3 286
Estonia	105 167	101 453	79 082	87 906	98 772	86 490	97 836	101 037	97 422	95 398
Ethiopia	15 390	12 300	9 213	10 005	9 450	9 890	13 253	16 770	17 047	18 058
Falkland Is	68 332	53 261	74 898	55 369	84 546	75 288	72 147	81 708	62 747	99 560
Faroe Is	515 909	525 991	620 991	599 386	565 260	623 122	620 834	518 267	351 018	393 875
Fiji	43 526	38 800	35 774	48 068	43 000 F	47 419	45 963	43 410 F	39 170 F	41 351 F
Finland	150 056	142 301	121 954	135 427	131 741	149 445	164 682	148 636	154 751	159 157
FYRMacedonia	128	148	162	213	246	89	122	122	141	177
France	612 209	629 449	638 678	599 931	574 877	574 934	513 391	460 372	420 776	426 514
Fr Guiana	4 599 F	4 782 F	5 565 F	5 514 F	5 285 F	4 442	4 857	3 958	4 140	4 000 F
Fr Polynesia	15 404	15 543	13 604 F	12 488 F	12 152	13 409	13 148	11 985	13 374	13 015
Fr South Tr	263 F	414 F	463 F	263 F	263 F	472 F	472 F	470 F	470 F	470 F
Gabon	42 871	41 570	45 479	46 072	43 863	41 521	38 500 F	42 500 F	32 000 F	32 000 F
Gambia	34 527	45 769	37 364	32 423	34 586	36 912	43 574	42 645	45 881	46 424
Georgia	1 636	1 811	3 306	11 988	9 974 F	9 709 F	18 197	26 512	25 050 F	30 594 F
Germany	209 142	221 772	257 647	258 343	281 368	293 037	290 511	274 282	244 045	222 771
Ghana	447 180	371 242	390 770	399 388	391 866	375 087	330 486	359 831	321 815	351 205
Gibraltar	0	0	0	0	0	0	0	0	0	0
Greece	94 190	96 343	93 383	93 886	92 422	98 236	96 093	89 424	83 328	83 000 F
Greenland	158 485	195 624	175 321	225 088	234 864	252 959	233 754	227 665	197 878	209 446
Grenada	2 250	2 171	2 544	2 039	2 053	2 169	2 407	2 386	2 615	2 452
Guadeloupe	10 100	10 100	10 100	10 100	10 100	10 100	10 100	10 100	10 000 F	10 000 F
Guam	801	557	527	682	370	604	640	322	488	291
Guatemala	29 704 F	23 427 F	23 696 F	10 012 F	18 361	17 173	17 685	22 826	19 994	21 859

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Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

All fishing areas
Toutes les zones de pêche
Todas las áreas de pesca

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Guinea	105 405	93 754	121 926	97 731	109 139	102 811	82 074	94 515	96 127 F	109 849 F
GuineaBissau	6 848 F	7 324 F	6 153 F	6 650 F	6 983 F	7 067 F	6 500 F	6 804 F	6 800 F	6 800 F
Guyana	53 405	48 017	59 695	56 719	53 370	53 763 F	47 448	42 168	43 605	45 186
Haiti	6 800 F	7 400 F	8 000 F	8 300	8 300 F	8 300 F	8 300 F	8 300 F	8 300 F	8 300 F
Honduras	21 044 F	14 377 F	16 224 F	14 586 F	18 817 F	20 877 F	15 155 F	12 904 F	11 302 F	11 107 F
Hungary	6 638	6 750	6 536	7 242	7 609	7 543	7 024	7 394	6 366	6 216
Iceland	1 983 574	2 134 546	1 986 539	1 733 702	1 664 657	1 327 079	1 399 190	1 284 034	1 141 869	1 060 640
India	3 777 092	3 736 603	3 712 149	3 391 009	3 691 362	3 844 837	3 859 293	4 099 227	4 066 756	4 694 968
Indonesia	4 259 343	4 322 764	4 583 771	4 605 435	4 695 977	4 800 621	5 050 340	4 997 199	5 103 603	5 380 266
Iran	351 140	324 873	350 195	370 011	410 569	445 879	403 690	407 842	419 903	443 650
Iraq	33 300	26 000	17 200	12 936	29 929	59 259	57 779	34 472	34 505	25 720
Ireland	356 428	282 620	266 218	280 229	267 639	211 764	214 871	205 342	269 083	318 942
Isle of Man	3 112	3 127	2 984	2 627	2 764	1 209	3 760	2 770	3 555	4 814
Israel	5 024	5 043	4 055	3 340	4 151	3 820	3 435	2 708 F	2 712	2 588
Italy	310 399	269 846	295 691	287 083	296 887	315 435	286 642	235 759	253 001	234 101
Jamaica	12 294	7 797	12 482	13 471	13 096	17 905 F	16 548	13 175	16 294	15 440
Japan	4 713 773 F	4 373 723 F	4 680 360	4 330 029	4 312 430	4 328 134	4 277 691	4 302 264	4 116 263 F	4 044 185 F
Jordan	520	526	481	494	510	497	506	500	569	486
Kazakhstan	22 960	24 668	25 195	33 306	37 621	34 724	41 366	55 706	35 028	42 953
Kenya	164 151	144 512	120 051	126 867	147 304	158 684	131 775	135 398	133 600	143 111
Kiribati	33 280	36 694	33 712	31 062 F	30 562 F	25 661 F	34 170	28 000	40 623	44 599
Korea D P Rp	206 500	205 000 F	205 000 F	205 000 F	205 000 F	205 000 F	205 000 F	205 000 F	205 000 F	205 000 F
Korea Rep	1 993 946	1 693 924	1 656 600	1 580 542	1 646 158	1 757 508	1 869 884	1 956 566	1 858 572	1 732 928
Kuwait	5 846	5 360	4 059	4 833	4 895	5 635	4 373	3 979	4 000 F	4 000 F
Kyrgyzstan	57	48	14	7	14 F	8 F	34	8	10 F	27
Lao P.Dem.R.	31 000 F	33 440	29 800	29 800 F	26 560	26 925	28 410	29 200	30 000	30 900
Latvia	128 176	113 677	114 543	125 391	150 618	140 389	155 276	157 934	163 213	164 819
Lebanon	3 670	3 970	3 898	3 866	3 798	3 811	3 811 F	3 811 F	3 811 F	3 811 F
Lesotho	24	40	42	45	45	45	48	50	45	45
Liberia	10 496	11 042	10 464	13 725	12 147	8 894	14 488	7 890	8 000 F	8 000 F
Libya	47 290 F	44 008 F	41 829 F	39 897	37 390 F	34 647 F	31 921	47 645	52 110	50 000 F
Liechtensten	0	0	0	0	0	0	0	0	0	0
Lithuania	150 831	150 146	157 205	161 988	139 785	154 548	187 513	182 760	172 692	149 851
Luxembourg	0	0	0	0	0	0	0	0	0	0
Madagascar	123 583	129 299	129 476	134 916	132 648	133 693	147 778	120 464	131 303	128 836
Malawi	40 619	41 329	53 543	56 463	59 595	72 787	66 500	70 019	69 325	98 299
Malaysia	1 234 733	1 275 555	1 287 084	1 335 764	1 214 183	1 286 478	1 385 703	1 398 885	1 397 683	1 433 427
Maldives	127 636	163 770	156 132	158 528	186 274	185 299	144 508	133 338	117 061	94 953
Mali	100 000 F	100 000 F	100 000 F	100 000 F	100 000 F	100 000 F	100 000	100 000 F	100 000 F	100 000
Malta	902	1 084	1 138	1 138	1 406	1 330	1 235	1 279	1 595	1 836
Marshall Is	36 581	39 859	38 886	47 887	57 583	43 974	61 229	35 102	46 246	59 730
Martinique	6 200	6 200 F	6 200	6 200	5 500	6 300	6 200	6 200	6 200 F	5 000 F
Mauritania	140 142 F	156 131 F	199 650 F	270 733	304 877	165 312	223 207	195 328	216 900	276 238
Mauritius	10 986	10 706	10 968	9 971	9 855	8 681	8 097	6 642	7 676	7 786
Mayotte	10 052	4 754	3 464	2 306	2 194	5 772	11 661	12 677	15 006	20 842
Mexico	1 398 576	1 450 747	1 357 303	1 259 056	1 319 936	1 357 195	1 472 533	1 581 272	1 611 175	1 523 889
Micronesia	19 321 F	22 776 F	33 603 F	31 823	32 212	15 292	20 723	25 295	27 706	30 871 F
Moldova Rep	387	565	343	487	531	612	1 160	1 407	1 607	1 633
Monaco	3 F	3 F	3 F	3 F	2 F	1 F	1 F	1 F	1 F	1 F
Mongolia	290	263	382	305	366	326	185	88	90	90 F
Montenegro	...	...	...	...	...	1 354	980	1 479	1 450	1 144
Montserrat	50 F	46	40 F	31	50	49	35	31	37	24
Morocco	1 096 083	961 616	918 643	918 151	1 026 395	876 878	879 469	997 127	1 165 062	1 136 240
Mozambique	36 416 F	40 552 F	99 282 F	99 589 F	93 995 F	101 900 F	92 270	119 646	148 049	150 634
Myanmar	1 187 880	1 284 340	1 343 860	1 586 600	1 732 250	2 006 790	2 235 580	2 493 750	2 766 940	3 063 210
Namibia	547 997	625 100	637 799	571 199	553 995	509 570	413 333	372 822	370 348	370 000 F
Nauru	360 F	342 F	344 F	298 F	300 F	280 F	260 F	240 F	220 F	200 F
Nepal	16 700	17 900	18 888	19 947	19 983	20 016	20 100	21 500	21 500	21 500
Netherlands	518 163	464 036	526 281	521 636	555 395	469 101	413 621	416 797	382 242	389 357
NethAntilles	22 805 F	12 901 F	20 149	17 286	650	6 247	4 018	16 698	18 874	18 455
NewCaledonia	3 309	3 380	3 453	3 733	3 314	3 146	3 507	3 720	3 554	3 771
New Zealand	569 811	588 635	550 900	545 991	545 309	476 572	494 500	452 326	439 378	436 232
Nicaragua	19 782	19 190	15 326	19 297	27 492	29 591	27 032	29 867	35 663	37 423
Niger	20 800	23 560	55 860	51 466	50 018	29 835	29 728	29 960	29 884	29 884 F
Nigeria	452 146	481 056	475 162	465 251	523 182	552 323	530 420	601 368	598 210	616 981
Niue	200 F	200 F	200 F	200 F	212 F	400	302 F	108 F	192	113
Norfolk Is	0	0	0	0	0	0	0	0	0	0
N Marianas	406	296	172	169	214	221	219	168	192	243
Norway	2 686 942	2 740 475	2 548 803	2 524 377	2 392 594	2 256 448	2 380 425	2 431 371	2 524 437	2 675 292
Oman	129 907	142 669	138 481	165 016	157 326	147 668	151 744	151 910	158 551	163 927
Pakistan	543 166	532 134	491 834	480 340	434 850	489 421	440 056	451 414	446 362	453 264
Palau	1 084	1 027	1 047	1 079	932	967	985	1 007	1 000 F	1 000 F
Palest, O.T.	1 950	2 379	1 507	2 951	1 814	2 323	2 702	2 843	1 525	1 699
Panama	275 569 F	241 573	227 646	208 840	245 018	258 108	221 567	223 406	222 516	163 488
Papua N Guin	124 913 F	141 160	176 844	242 601	254 135	253 019	247 462	222 444	229 619	224 507
Paraguay	25 000 F	21 500 F	18 000 F	14 500 F	11 000 F	8 000 F	5 000 F	1 708	1 700 F	1 700 F
Peru	7 986 207	8 765 189	6 086 060	9 604 527	9 388 488	7 017 491	7 210 544	7 394 538	6 914 452	4 261 091
Philippines	1 948 830	2 029 914	2 165 890	2 211 375	2 269 738	2 319 120	2 499 695	2 561 337	2 602 541	2 611 720
Pitcairn Is	5 F	5 F	5 F	3 F	3 F	3 F	3 F	3 F	3 F	3 F
Poland	225 064	223 440	180 399	192 108	155 247	145 479	151 820	142 496	223 893	189 721
Portugal	193 266	202 853	212 442	222 303	220 459	229 072	256 181	224 246	198 813	222 944
Puerto Rico	3 794	2 529	2 919	2 428	2 551	2 042	1 675	1 793	1 702	1 898
Qatar	8 864	7 155	11 295	11 134	13 935	16 376	15 190	17 688	14 064	13 760
Réunion	3 889	2 872	2 904	3 373	4 282	3 548	3 989	2 978	3 050	3 050 F
Romania	7 609	6 980	9 890	5 095	6 053	6 663	6 183	5 410	4 020	2 688
Russian Fed	3 628 683	3 232 351	3 281 510	2 941 595	3 197 686	3 284 306	3 475 883	3 383 724	3 826 129	4 069 624
Rwanda	6 828	7 000 F	7 400	7 826	7 800 F	8 400 F	9 050	9 050 F	9 050 F	9 050 F
St Helena	867	598	985	1 061	1 130	1 120	837	794	856	864
St Kitts Nev	555	355	400 F	484	470 F	455 F	440 F	425 F	410 F	21 099
St Lucia	1 983	1 637	1 462	1 508	1 409	1 496	1 555	1 728	1 920	1 844

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Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
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Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

All fishing areas
Toutes les zones de pêche
Todas las áreas de pesca

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
St Pier Mq	4 206	3 889	3 894	4 399	4 694	2 876	5 204	4 621	1 761	2 043
St Vincent	52 729	44 813	4 843	8 751	1 786	4 764	5 225	3 942	4 058	65 626
Samoa	8 613 F	10 881 F	9 703 F	9 456 F	9 836 F	12 435	14 091	13 899	13 279	13 000 F
San Marino	0	0	0	0	0	0	0	0	0	0
Sao Tome Prn	3 692 F	3 820 F	4 038	4 141	4 196 F	4 150 F	4 250 F	4 500 F	4 550 F	4 650 F
Saudi Arabia	55 331	57 211	55 440	55 418	60 421	65 485	66 221	68 898	67 664	65 142
Senegal	428 117	397 328	466 842	434 770	400 120	366 992	412 835	425 853	442 295	409 578
Serbia	...	...	...	...	...	2 632	2 535	3 153	3 846	4 807
Serbia-Monte	1 091	1 585	1 798	2 386	2 431	...	...	...	...	...
Seychelles	53 591	63 383	86 020	100 671	108 680	92 739	65 514	69 200	81 096	87 108
Sierra Leone	75 210	82 990	96 926	134 440	145 993	148 146	144 535	203 582	200 000 F	200 000 F
Singapore	3 342	2 769	2 085	2 173	1 920	3 103	3 522	1 623	2 121	1 732
Slovakia	1 531	1 746	1 646	1 603	1 693	1 718	1 994	1 655	1 761	1 608
Slovenia	1 827	1 686	1 281	1 022	1 223	1 131	1 111	869	1 032	932
Solomon Is	23 642 F	25 779 F	35 839 F	34 994 F	30 086 F	39 520 F	31 304 F	27 434 F	27 941 F	35 179 F
Somalia	31 900 F	29 000 F	30 000 F	30 000 F	25 000 F	30 000 F	30 000 F	30 000 F	30 000 F	30 000 F
South Africa	750 502	766 941	822 935	888 104	817 666	618 616	678 878	644 659	512 284	623 920
Spain	1 093 896	890 509	894 976	810 293	853 156	961 300	820 195	918 136	918 124	968 662
Sri Lanka	291 581	297 173	328 319	333 360	190 856	274 025	307 280	327 404	355 694	436 355
Sudan	58 000	57 000	59 000	63 000	59 000	57 000	65 509 F	68 595 F	71 690	71 700 F
Suriname	24 865	27 242 F	32 482	30 402	27 410	30 621	29 627	23 811	25 831	34 402
Svalbard Is	0	0	0	0	0	0	0	0	0	0
Swaziland	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F
Sweden	311 817	294 964	286 875	269 930	256 359	269 251	238 253	231 336	203 415	212 035
Switzerland	1 715	1 544	1 815	1 602	1 475	1 422	1 377	1 582	1 687	1 653
Syria	8 291	9 178	8 911	8 528	8 447	8 264	9 456	6 996	6 607	6 635
Tajikistan	137	181	158	184	146	146 F	146 F	150 F	150 F	160 F
Tanzania	336 551	324 232	351 294	363 688	376 700	335 437	329 835	326 811	316 204	342 481
Thailand	2 833 974	2 842 428	2 849 670	2 839 669	2 814 295	2 698 803	2 304 951	1 873 432	1 870 702	1 827 199
Timor-Leste	356	800 F	1 250 F	1 700 F	2 150 F	2 550 F	2 912	3 125	3 125 F	3 125 F
Togo	23 163	20 946	27 485	28 013	27 744	24 879	19 905	23 500 F	27 025	27 535
Tokelau	140 F	128 F	113 F	103 F	96 F	86 F	78 F	68 F	62 F	54 F
Tonga	4 774	4 853	4 435	1 645	2 200 F	2 750 F	3 103 F	2 593 F	2 036 F	2 150 F
Trinidad Tob	16 598	18 768	14 592	14 713	18 093	13 123	13 086	13 833	13 856	13 931
Tunisia	98 490	96 685	90 226	111 531	109 117	111 288	103 790	97 906	97 859	97 743
Turkey	527 733	566 682	507 772	550 482	426 496	533 048	632 450	494 126	464 233	485 939
Turkmenistan	12 749	12 812	14 543	14 992	15 000 F	15 000 F	15 000 F	15 000 F	15 000 F	15 000 F
Turks Caicos	6 419	5 767	5 100	5 685 F	5 505 F	6 040 F	4 860 F	6 133	6 803	5 446
Tuvalu	500 F	600 F	1 500	2 450	2 560	2 560 F	2 560 F	2 560 F	5 097	11 324 F
Uganda	220 726	221 898	241 810	371 789	416 758	367 099	431 500 F	403 500 F	412 000 F	413 805
Ukraine	310 978	265 599	222 349	202 676	244 945	238 734	213 508	195 449	213 173	186 021
Untd Arab Em	112 561	97 574	95 150	90 000 F	86 735	82 500 F	78 300 F	74 075	77 705	79 610
UK	741 045	689 891	635 486	654 495	669 905	624 569	619 691	596 007	591 064	612 655
USA	4 944 336	4 937 305	4 938 956	4 959 826	4 892 967	4 852 284	4 767 596	4 349 853	4 222 052	4 369 540
US Virgin Is	1 198 F	1 296 F	1 492	1 522	1 269	1 615	1 127	1 065	1 120	847
Uruguay	104 982	108 102	117 269	122 989	125 818	133 987	108 722	108 797	81 461	74 153
Uzbekistan	2 341	1 564	1 349	1 230	1 330 F	1 431	1 973	2 731	6 051	4 078
Vanuatu	36 103 F	44 901 F	113 815	210 708	227 381	219 124	213 242	169 770	145 278	97 807
Venezuela	408 655	509 894	518 173	579 772	402 582	315 346	347 546	296 266	288 462	274 417 F
Viet Nam	1 724 758	1 802 598	1 856 105	1 940 034	1 987 900	2 027 700	2 074 600	2 136 300	2 280 500	2 420 800
Wallis Fut I	300 F	300 F	300	400 F	500 F	600	650 F	700 F	750 F	800 F
Yemen	142 198	179 584	228 116	256 300	238 400	229 660	179 916	127 132	159 000 F	191 100
Zambia	63 000	63 000	66 332	67 725	65 927	60 236	73 542	79 403	84 716	76 396
Zanzibar	20 541	20 341	20 859	23 488	23 210	24 418	23 580	24 514	25 394	25 690
Zimbabwe	12 300 F	11 500 F	10 600 F	10 500 F	10 420 F	10 500 F	10 500 F	10 500 F	10 500 F	10 500 F
Other nei	244 551	313 742	365 180 F	300 174 F	184 182 F	144 808 F	134 982 F	119 451 F	168 754 F	59 142
World total **Total mondial** **Total mundial**	**90 780 967**	**90 961 203**	**88 299 544**	**92 604 414**	**92 329 279**	**90 023 515**	**90 305 150**	**89 698 988**	**89 630 210**	**88 603 826**
World excl. China **Monde excl. Chine** **Mundo excl. China**	**76 604 772**	**76 787 427**	**73 952 270**	**78 139 611**	**77 740 339**	**75 392 497**	**75 646 114**	**74 907 825**	**74 710 614**	**73 184 859**

A-3

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Inland waters
Eaux continentales
Aguas continentales

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Afghanistan	800 F	900 F	900 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F
Albania	1 373	1 167	1 265 F	1 807	2 210	2 442	2 591	2 144	2 251	3 041
Algeria	0	0	0	0	0	0	0	...	...	...
Amer Samoa	0	-	-	-	-	-	-	-	-	-
Andorra	0	0	0	0	0	0	0	0	0	0
Angola	8 000 F	9 000 F	10 000	10 000 F	10 000 F	10 500	9 000 F	7 500 F	5 848	10 000 F
Anguilla	0	0	-	-	-	-	-	-	-	-
Antigua Barb	0	0	-	-	-	-	-	-	-	-
Argentina	15 536	18 474	26 596	33 903	34 002	33 617	19 695	11 246	16 256	15 445
Armenia	866	465	569	218	250	350	1 065	601	619 F	617 F
Australia	185	156	303	317	501	335	1 238	1 275	1 576	844
Austria	362	350	372	400	370	360	350	350	350	350
Azerbaijan	10 893	11 188	6 435	9 258	9 001	4 061	2 949	1 524	1 206	1 081
Bahamas	0	0	0	0	0	0	0	-	-	-
Bangladesh	688 920	688 435	709 333	732 067	859 269	956 686	1 006 761	1 060 181	1 218 937	1 119 094
Belarus	944	1 020	803	583	594	645	689	809	826	897
Belgium	511	511	511	496	496	496	512	511	511	511
Belize	0	0	0	0	0	0	0	-	-	-
Benin	30 000	29 993	30 000 F	28 200	21 900	29 500	30 200	30 200 F	30 250	30 350
Bermuda	0	-	-	-	-	-	-	-	-	-
Bhutan	260 F	240 F	240 F	220 F	220 F	200 F	200 F	180 F	180 F	160 F
Bolivia	5 940	6 300 F	6 599	6 436	6 360	6 080 F	5 770	6 750	7 568	6 946
Bosnia Herzg	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F
Botswana	118	139	122	161	132	81	122	86	73 F	60
Brazil	220 432	239 415	227 551	246 101	243 435	251 241	243 210	261 280	239 493	248 122
Br Virgin Is	0	0	-	-	-	-	-	-	-	-
Brunei Darsm	19	14	5	11	-	-	-	-	-	-
Bulgaria	1 640	1 453	1 824	2 434	2 025	1 916	1 073	1 197	1 588	1 085
Burkina Faso	8 500	8 500	9 000	9 000 F	9 000	9 500	10 200	11 093	11 800	14 520
Burundi	8 964	11 000 F	14 697	13 855	14 800 F	15 750 F	16 700 F	17 766	17 700 F	17 700 F
Cambodia	385 000	360 300	308 750	250 000	324 000	422 000	395 000	365 000	390 000	405 000
Cameroon	52 500 F	65 000	55 000	65 000 F	75 000	75 000	74 380	74 700 F	75 000	75 000 F
Canada	38 140	39 999	37 383	36 116	32 269	32 234	32 303	31 063	33 023	27 293
Cape Verde	0	0	-	-	-	-	-	-	-	-
Cayman Is	0	0	0	-	-	-	-	-	-	-
Cent Afr Rep	17 000 F	19 000 F	21 000 F	23 000 F	25 000 F	27 000 F	29 000 F	31 000 F	33 000 F	35 000 F
Chad	75 000 F	70 000 F	65 000 F	60 000 F	55 000 F	50 000 F	45 000 F	40 000 F	40 000 F	40 000 F
Channel Is	0	0	-	-	-	-	-	-	-	-
Chile	0	0	0	0	0	0	0	...	...	...
China	1 871 295 F	1 951 889 F	2 135 086 F	2 097 167 F	2 210 103 F	2 203 316 F	2 256 403	2 248 177	2 183 859	2 289 343
China,H.Kong	0	0	0	0	0	0	0	...	...	...
China, Macao	0	0	-	-	-	-	-	-	-	-
China,Taiwan	591	599	475	245	197	149	242	198	159	77
Colombia	26 532	27 738	30 512	28 292	19 291	20 000 F	20 800 F	21 700 F	22 686	21 049
Comoros	0	0	-	-	-	-	-	-	-	-
Congo Dem R	227 433 F	233 800 F	230 365 F	231 772 F	230 840 F	230 588 F	230 000 F	230 000 F	230 000 F	230 000 F
Congo Rep	26 101	29 494	31 182	30 338	32 500	31 000	30 120	29 362	28 385	30 500
Cook Is	0	0	0	0	0	0	0	0	0	-
Costa Rica	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F
Côte dIvoire	10 502	22 000	22 000	4 856	13 145	6 565	3 178	4 400 F	5 679	7 063
Croatia	34	25	19	37	33	46	60	45	425	456
Cuba	1 994	2 023	2 698	2 513	1 561	1 449	3 058	2 764	2 526	2 028
Cyprus	70 F	60 F	50 F	40 F	30 F	20 F	20 F	20 F	20 F	20 F
Czech Rep	4 646	4 983	5 127	4 528	4 242	4 646	4 276	4 164	4 112	3 990
Denmark	99	77	129	123	60	54	44	40	45	41
Djibouti	0	0	0	-	-	-	-	-	-	-
Dominica	0	0	0	-	-	-	-	-	-	-
Dominican Rp	1 158	2 102	1 506	1 980	1 694	1 911	1 481	1 708	432	350
Ecuador	350 F	300 F	300 F	250 F	250 F	233	216 F	199	338	245
Egypt	295 450	292 662	313 742	282 099	242 100	256 288	241 743	237 572	259 577	263 847
El Salvador	1 692	2 663	2 673	2 205	2 051	2 034	2 422	3 980	3 000 F	2 326
Eq Guinea	1 000 F	950 F	900 F	850 F	850 F	900 F	900 F	900 F	1 000	1 000 F
Eritrea	0	-	-	-	-	-	-	-	-	-
Estonia	2 461	4 578	3 593	2 373	2 472	2 941	2 665	2 835	2 899	2 868
Ethiopia	15 390	12 300	9 213	10 005	9 450	9 890	13 253	16 770	17 047	18 058
Falkland Is	1	1	1	1	1	1	1	1	1	1
Faroe Is	0	0	0	-	-	-	-	-	-	-
Fiji	5 921	3 800 F	1 263	2 993	3 000 F	3 078	2 188	2 100 F	1 850 F	1 680
Finland	34 786	35 570	35 570	36 268	36 268	36 513	36 513	29 274	29 424	29 312
FYRMacedonia	128	148	162	213	246	89	122	122	141	177
France	2 641	2 600 F	2 600 F	2 600 F	2 600 F	2 600 F	2 600 F	2 600 F	2 500 F	2 500 F
Fr Guiana	0	0	-	-	-	-	-	-	-	-
Fr Polynesia	53	53	52 F	51 F	50	53	53	53	53	53
Fr South Tr	0	0	0	-	-	-	-	-	-	-
Gabon	9 850	9 400	9 507	8 293	9 700	9 359	9 500 F	10 000 F	10 000 F	10 000 F
Gambia	2 500 F	2 500 F	3 000 F	3 500 F	4 000 F	4 500 F	4 865	4 166	4 461	4 454 F
Georgia	8	10	39	51	51 F	50 F	50 F	50 F	50 F	50 F
Germany	20 678 F	20 118 F	19 391 F	18 851 F	17 100 F	16 642 F	16 162 F	16 262 F	15 502 F	15 010
Ghana	74 500	74 500	75 000	75 000 F	75 000	83 168	84 756	85 000	88 700 F	90 000 F
Greece	3 181	3 000	3 166	1 940	1 580	1 413	1 439	1 425	940	940 F
Greenland	0	0	0	-	-	-	-	-	-	-
Grenada	0	0	-	-	-	-	-	-	-	-
Guadeloupe	0	0	-	-	-	-	-	-	-	-
Guatemala	6 480 F	5 665 F	4 850 F	4 035 F	3 120 F	2 360	2 360 F	2 360 F	2 360 F	2 360 F
Guinea	4 000	5 000 F	6 000 F	7 000 F	8 000 F	9 000 F	10 000 F	12 000 F	14 000 F	16 000 F
GuineaBissau	150 F	150 F	150 F	150 F	150 F	150 F	150 F	150 F	150 F	150 F
Guyana	800	800	800	800	800	800 F	800	800	800 F	800
Haiti	400 F	400 F	400 F	300	300 F	300 F	300 F	300 F	300 F	300 F
Honduras	111	102 F	100 F	100 F	100 F	100 F	100 F	100 F	100 F	100 F
Hungary	6 638	6 750	6 536	7 242	7 609	7 543	7 024	7 394	6 366	6 216

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Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Inland waters
Eaux continentales
Aguas continentales

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Iceland	160	210	225	222	219	173	185	231	235	260
India	975 403	775 599	757 353	527 290	843 746	892 639	823 410	947 358	923 954	1 468 757
Indonesia	310 240	304 989	308 656	330 879	297 368	293 921	320 908	304 402	295 736	344 972
Iran	88 335	55 853	50 994	55 825	67 066	71 405	74 064	65 862	71 781	75 145
Iraq	14 100	11 900	13 200	10 581	23 570 F	46 300	45 460	29 986	22 259	12 230
Ireland	902	796	615	610	521	443	178	214	86	116
Isle of Man	0	0	-	-	-	-	-	-	-	-
Israel	1 286	1 569	1 064	1 137	1 396	1 600	840	224	401	402
Italy	5 527	4 242	4 379	5 099	3 823	3 915	3 944	3 552	4 988	3 852
Jamaica	400 F	400 F	400 F	400 F	400 F	400 F	400 F	400 F	400	400
Japan	61 819	61 725	60 334	60 402	54 327	41 700	39 039	32 626	41 694 F	39 911 F
Jordan	350	350	350	350	350	350	350	350	350	350
Kazakhstan	22 960	24 668	25 195	33 306	37 621	34 724	41 366	55 706	35 028	42 953
Kenya	156 763	137 792	113 221	119 093	140 199	151 729	124 327	127 097	128 036	134 847
Kiribati	0	0	0	-	-	-	-	-	-	-
Korea D P Rp	4 928	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F
Korea Rep	5 971	5 690	7 539	10 302	7 500	6 447	5 803	11 098	11 707	10 256
Kuwait	0	0	0	0	0	0	0	-	-	-
Kyrgyzstan	57	48	14	7	14 F	8 F	34	8	10 F	27
Lao P.Dem.R.	31 000 F	33 440	29 800	29 800 F	26 560	26 925	28 410	29 200	30 000	30 900
Latvia	581	581	565	360	356	328	310	349	326	330
Lebanon	20	297	285	265	275	270	270 F	270 F	270 F	270 F
Lesotho	24	40	42	45	45	45	48	50	45	45
Liberia	4 000	4 000 F	3 600 F	3 200 F	2 800 F	2 400 F	1 743	763	750 F	750 F
Libya	0	0	0	-	-	-	-	-	-	-
Liechtensten	0	0	0	0	0	0	0	0	0	0
Lithuania	1 854	758	1 959	1 766	1 547	1 437	1 874	1 600	1 315	1 310
Luxembourg	0	0	0	0	0	0	0	0	0	0
Madagascar	30 000	30 000	30 000	31 500	32 650	32 750	32 630	32 630	32 828	35 500
Malawi	40 619	41 329	53 543	56 463	59 595	72 787	66 500	70 019	69 325	98 299
Malaysia	3 446	3 450	3 828	4 119	4 582	4 165	4 280	4 353	4 469	4 545
Maldives	0	0	-	-	-	-	-	-	-	-
Mali	100 000 F	100 000 F	100 000 F	100 000 F	100 000 F	100 000 F	100 000	100 000 F	100 000 F	100 000
Malta	0	-	-	-	-	-	-	-	-	-
Marshall Is	0	0	-	-	-	-	-	-	-	-
Martinique	0	0	-	-	-	-	-	-	-	-
Mauritania	10 000 F	12 000 F	12 000 F	12 000 F	13 000 F	15 000 F	15 000 F	15 000 F	15 000 F	15 000 F
Mauritius	0	0	-	-	-	-	-	-	-	-
Mexico	91 952	82 648	99 604	107 203	113 578	116 268	116 591	108 853	111 792	116 410
Micronesia	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F
Moldova Rep	387	565	343	487	531	612	1 160	1 407	1 607	1 633
Mongolia	290	263	382	305	366	326	185	88	90	90 F
Montenegro	...	...	...	...	...	786	441	841	887	534
Montserrat	0	0	0	0	-	-	-	-	-	-
Morocco	1 660	2 112	1 655	850	2 930	3 350	4 020	4 440	6 020	7 226
Mozambique	15 076 F	20 037 F	19 831 F	27 760 F	22 991 F	26 017 F	24 081	28 386	33 666	31 741
Myanmar	238 210	254 880	290 140	454 260	503 540	631 120	717 640	814 740	899 430	1 002 430
Namibia	2 000 F	2 000 F	2 500 F	2 500 F	2 800 F	2 800 F	2 800	2 800 F	2 800 F	2 800 F
Nepal	16 700	17 900	18 888	19 947	19 983	20 016	20 100	21 500	21 500	21 500
Netherlands	2 200 F	2 578	2 150 F	2 100 F	2 100 F	2 100 F	2 000 F	2 000 F	2 000 F	2 051 F
NethAntilles	0	0	0	0	0	0	0	-	-	-
NewCaledonia	0	0	-	-	-	-	-	-	-	-
New Zealand	1 076	900	850	801	812	865	817	752	729	892
Nicaragua	700	487	405	866	1 042	412	853	988	868	943
Niger	20 800	23 560	55 860	51 466	50 018	29 835	29 728	29 960	29 884	29 884 F
Nigeria	154 175	187 242	174 968	182 264	238 051	223 395	227 107	304 413	285 771	293 382
Niue	0	0	-	-	-	-	-	-	-	-
Norfolk Is	0	0	0	0	0	0	0	0	0	0
N Marianas	0	-	-	-	-	-	-	-	-	-
Norway	550 F	500 F	450 F	405	507	679	851	874	662	705
Oman	0	0	-	-	-	-	-	-	-	-
Pakistan	122 468	114 030	92 794	93 687	94 644	140 000	100 000	108 000	112 355	115 348
Palau	0	0	0	-	-	-	-	-	-	-
Palest, O.T.	0	0	0	0	0	0	0	-	-	-
Panama	20 F	23 F	26	406	2 950	3 555	3 242	3 143	1 909	2 013
Papua N Guin	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F
Paraguay	25 000 F	21 500 F	18 000 F	14 500 F	11 000 F	8 000 F	5 000 F	1 708	1 700 F	1 700 F
Peru	35 757	29 968	32 940	37 688	40 196	37 466	42 633	45 412	45 720	44 368
Philippines	135 845	130 868	132 565	140 409	142 181	159 851	166 459	179 491	186 444	185 406
Pitcairn Is	0	0	-	-	-	-	-	-	-	-
Poland	17 789	18 947	19 994	20 330	19 469	19 183	19 059	18 937	18 798	18 508
Portugal	1	12	1	4	6	2	0	0	0	0
Puerto Rico	0	-	-	-	-	-	-	-	-	-
Qatar	0	0	0	-	-	-	-	-	-	-
Réunion	0	2	2	2	1	2	1	0	0	0
Romania	5 178	4 858	8 278	3 255	4 027	6 049	5 665	4 966	3 688	2 457
Russian Fed	206 430	208 522	190 712	178 403	219 237	209 376	250 248	216 841	246 137	262 983
Rwanda	6 828	7 000 F	7 400	7 826	7 800 F	8 400 F	9 050	9 050 F	9 050 F	9 050 F
St Kitts Nev	0	0	0	0	0	0	0	-	-	-
St Lucia	0	0	0	-	-	-	-	-	-	-
St Pier Mq	0	0	0	-	-	-	-	-	-	-
St Vincent	0	0	0	0	0	0	0	-	-	-
Samoa	1 F	1 F	1 F	1 F	1 F	1	1 F	1 F	1 F	1 F
San Marino	0	0	0	0	0	0	0	0	0	0
Sao Tome Prn	0	0	0	0	0	0	0	-	-	-
Saudi Arabia	0	0	0	0	0	0	0	-	-	-
Senegal	47 500 F	43 000 F	38 500 F	34 127	34 485	34 163	38 731	37 200	35 700 F	34 164 F
Serbia	...	...	...	...	...	2 632	2 535	3 153	3 846	4 807
Serbia-Monte	646	1 119	1 301	1 909	1 988	-	-	-	-	-
Seychelles	0	0	-	-	-	-	-	-	-	-

A-3 **Fish, crustaceans, molluscs, etc** | **Capture production by countries or areas** | **Inland waters**
Poissons, crustacés, mollusques, etc | **Captures par pays ou zones** | **Eaux continentales**
Peces, crustáceos, moluscos, etc | **Capturas por países o áreas** | **Aguas continentales**

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Sierra Leone	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F
Singapore	0	0	-	-	-	-	-	-	-	-
Slovakia	1 531	1 746	1 646	1 603	1 693	1 718	1 994	1 655	1 761	1 608
Slovenia	206	226	195	208	202	200	196	183	164	168
Solomon Is	0	0	0	0	0	0	0	-	-	-
Somalia	200 F	200 F	200 F	200 F	200 F	200 F	200 F	200 F	200 F	200 F
South Africa	900 F	900 F	900 F	900 F	900 F	900 F	900 F	900 F	900 F	900 F
Spain	7 300 F	6 600 F	6 000 F	6 000 F	6 000 F	6 000 F	6 000 F	6 000 F	6 000 F	6 000 F
Sri Lanka	26 330	25 570	26 920	30 780	31 560	35 290	38 380	44 500	46 560	52 410
Sudan	53 000	52 000	54 000 F	57 500 F	53 800 F	52 000 F	59 810	62 900 F	66 000	66 000 F
Suriname	200	200 F	222	242	218	200	350	350 F	420	560
Swaziland	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F
Sweden	1 234	1 436	1 491	1 393	1 417	1 644	1 546	1 614	1 564	1 368
Switzerland	1 715	1 544	1 815	1 602	1 475	1 422	1 377	1 582	1 687	1 653
Syria	5 969	6 355	5 851	5 451	4 770	4 869	6 075	3 784	3 500	3 679
Tajikistan	137	181	158	184	146	146 F	146 F	150 F	150 F	160 F
Tanzania	283 354	273 856	301 855	312 040	320 566	292 519	284 346	281 690	269 402	293 043
Thailand	202 500	198 700	198 447	203 700	198 730	214 000	225 600	228 600	206 856	209 800
Timor-Leste	0	0	0	0	-	-	-	-	-	-
Togo	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000 F	5 000	5 000
Tokelau	0	0	-	-	-	-	-	-	-	-
Tonga	0	0	0	0	0	0	0	-	-	-
Trinidad Tob	0	0	0	0	0	0	0	-	-	-
Tunisia	860	870	859	1 049	1 224	1 264	1 084	1 096	1 191	1 123
Turkey	43 323	43 938	44 698	45 585	46 115	44 082	43 321	41 011	39 187	40 259
Turkmenistan	12 749	12 812	14 543	14 992	15 000 F	15 000 F	15 000 F	15 000 F	15 000 F	15 000 F
Turks Caicos	0	0	-	-	-	-	-	-	-	-
Tuvalu	0	0	-	-	-	-	-	-	-	-
Uganda	220 726	221 898	241 810	371 789	416 758	367 099	431 500 F	403 500 F	412 000 F	413 805
Ukraine	4 343	3 823	15 144	5 263	6 027	7 171	12 603	4 590	5 855	4 640
Untd Arab Em	0	0	0	0	0	0	0	-	-	-
UK	3 142	3 431	3 875	1 120	1 172	2 421	2 517	2 529	2 562	2 473
USA	29 578	27 397	26 329	29 275	24 842	18 736	25 270	24 581	22 674	22 821
US Virgin Is	0	0	0	0	0	0	0	-	-	-
Uruguay	451	387	551	2 330	2 130	2 137	1 200	620	801	1 048
Uzbekistan	2 341	1 564	1 349	1 230	1 330 F	1 431	1 973	2 731	6 051	4 078
Vanuatu	0	0	0	0	0	0	0	-	-	-
Venezuela	24 326	40 776	49 090	44 000 F	39 000 F	42 000 F	30 000 F	24 882	24 800 F	24 800 F
Viet Nam	243 583	226 958	208 872	206 600	196 800	202 900	198 200	189 700	188 800	194 200
Wallis Fut I	0	0	-	-	-	-	-	-	-	-
Zambia	63 000	63 000	66 332	67 725	65 927	60 236	73 542	79 403	84 716	76 396
Zimbabwe	12 300 F	11 500 F	10 600 F	10 500 F	10 420 F	10 500 F	10 500 F	10 500 F	10 500 F	10 500 F
World total **Total mondial** **Total mundial**	**8 532 384**	**8 397 520**	**8 606 443**	**8 642 262**	**9 413 139**	**9 796 525**	**9 955 448**	**10 194 565**	**10 382 865**	**11 211 200**
World excl. China **Monde excl. Chine** **Mundo excl. China**	**6 661 089**	**6 445 631**	**6 471 357**	**6 545 095**	**7 203 036**	**7 593 209**	**7 699 045**	**7 946 388**	**8 199 006**	**8 921 857**

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Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Marine fishing areas
Zones de pêche maritimes
Areas de pesca marítimas

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Albania	1 937	2 488	1 535	2 742	2 790	3 287	2 906	3 362	3 694	3 103
Algeria	133 623	134 320	140 957	113 462	126 259	145 762	147 362	138 861	127 513	93 607
Amer Samoa	3 667	6 939	5 089	4 041	4 019	5 349	6 512	4 423	4 943	5 261
Angola	246 553	246 443	202 033	230 002	192 616	215 241	297 436	298 262	266 415	250 000 F
Anguilla	585 F	610 F	635 F	660 F	685 F	710 F	735 F	759	681	701
Antigua Barb	1 824	2 374	2 587	2 527	2 999	3 092	3 092	3 521	2 490	2 293
Argentina	915 545	927 711	883 604	910 943	895 935	1 138 363	965 714	983 837	845 717	796 304
Aruba	163	163 F	160 F	162	162 F	145	159	151	163	153
Australia	191 187	197 028	214 956	230 362	235 983	196 773	186 838	180 242	170 061	170 566
Bahamas	9 290	12 192	12 611	11 347	11 064	10 598	8 382	9 117	9 018	11 611
Bahrain	11 230	11 204	13 638	14 489	11 854	15 594	15 014	14 175	16 358	13 490
Bangladesh	379 497	415 420	431 908	455 207	474 597	479 810	487 438	497 573	602 642	607 492
Barbados	2 721	2 520	2 838	2 148	2 182	1 975	2 224	3 551	3 496	3 269
Belgium	29 698	28 517	26 320	26 239	24 071	22 523	24 029	22 098	21 211	21 907
Belize	33 362	59 015	11 857	7 557	31 806	19 022	23 902	50 949	11 114	114 292
Benin	8 415	10 670	11 648	11 788	9 597	12 007	6 186	7 295	8 678	9 441
Bermuda	309	397	363	386	399	380	424	399	416	382
Bosnia Herzg	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F
Brazil	509 946	516 167	484 593	500 116	506 826	527 872	539 967	530 612	585 919	537 247
Br Ind Oc Tr	0	28	28	28	28	21	24	34	43	40
Br Virgin Is	837	1 062	2 771	1 262	1 300 F	1 308 F	1 250 F	1 200 F	1 200 F	1 200 F
Brunei Darsm	1 578	2 044	1 784	1 912	2 709	2 279	2 550	2 357	1 766	2 272
Bulgaria	7 034	13 555	10 211	5 818	3 409	5 628	7 830	7 667	7 390	9 684
Cambodia	43 200	45 882	55 607	55 817	60 000	60 500	63 500	66 000	75 000	85 094
Cameroon	68 531	65 135	62 801	64 000 F	67 345	62 232	64 232	64 500 F	65 000 F	65 000 F
Canada	1 003 542	1 023 703	1 070 608	1 136 462	1 071 584	1 047 181	993 301	919 307	917 475	900 329
Cape Verde	8 676	8 145	8 103	10 396	21 617	24 590	18 328	23 768	16 828	19 500 F
Cayman Is	125	125	125	125	125	125	125	125	125	125
Channel Is	3 927	3 449	3 526	3 201	3 505	3 468	3 566	3 228	2 649	3 373
Chile	3 797 546	4 271 417	3 612 048	4 926 808	4 328 321	4 160 732	3 819 285	3 554 808	3 453 786	2 679 736
China	12 304 900 F	12 221 887 F	12 212 188 F	12 367 636 F	12 378 837 F	12 427 702 F	12 402 633	12 542 986	12 735 737	13 129 624
China,H.Kong	173 972	169 790	157 444	167 544	161 964	154 536	154 147	158 126	158 965	168 010
China, Macao	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F
China,Taiwan	1 004 608	1 042 157	1 134 884	979 861	1 017 046	967 429	1 174 151	1 016 192	769 748	851 307
Colombia	119 510	96 984	99 280	83 568	101 709	87 527 F	103 333 F	91 932 F	83 635	57 978
Comoros	12 180	13 102	14 115	14 935	15 070	15 070 F	19 676	29 989 F	20 450 F	52 261 F
Congo Dem R	5 000 F	5 200 F	5 400 F	5 600 F	5 800 F	6 000	6 000	6 000 F	6 000 F	6 000 F
Congo Rep	22 729	22 433	22 683	26 686	22 116	28 082	29 096	24 742	32 833	34 686
Cook Is	800 F	1 400 F	3 297	4 069	3 994	3 913	4 302	3 753	2 695	10 019
Costa Rica	33 816	32 020	28 397	19 850	21 340	21 000 F	20 735	20 750 F	20 750 F	20 750 F
Côte dIvoire	65 503	47 870	46 903	49 545	29 520	48 265	44 111	45 600 F	38 519	64 749
Croatia	18 455	21 205	19 927	30 127	34 632	37 807	40 139	48 979	55 325	52 372
Cuba	52 663	30 509	31 333	29 630	26 631	26 094	26 389	25 797	26 317	21 923
Cyprus	80 988	1 908	1 740	1 528	1 886	2 135	2 426	1 991	1 385	1 400
Denmark	1 510 595	1 442 271	1 031 092	1 090 473	910 538	867 667	653 009	690 544	777 707	827 975
Djibouti	900	1 000	1 100 F	1 200 F	1 571	1 299	1 229	1 206	1 058	1 058 F
Dominica	1 200 F	1 198	950 F	700 F	579	694	676	696	790	700 F
Dominican Rp	12 059	15 159	16 591	12 243	9 499	11 045	12 228	13 674	13 801	14 140
Ecuador	587 420	318 869	399 226	343 712	447 841	452 065	398 869	494 870	485 467	391 469
Egypt	133 183	132 500	117 381	111 395	107 453	119 606	130 748	136 243	127 821	121 362
El Salvador	17 318	31 792	32 737	40 210	39 063	41 184	46 217	28 345	27 527	33 674
Eq Guinea	2 600 F	2 600 F	2 650 F	2 650 F	2 900 F	3 100 F	3 633 F	4 500 F	6 669	6 376 F
Eritrea	8 820	7 832	6 689	7 404	4 027	8 813	1 932	1 665	3 030	3 286
Estonia	102 706	96 875	75 489	85 533	96 300	83 549	95 171	98 202	94 523	92 530
Falkland Is	68 331	53 260	74 897	55 368	84 545	75 287	72 146	81 707	62 746	99 559
Faroe Is	515 909	525 991	620 991	599 386	565 260	623 122	620 834	518 267	351 018	393 875
Fiji	37 605	35 000 F	34 511	45 075	40 000 F	44 341	43 775	41 310 F	37 320 F	39 671 F
Finland	115 270	106 731	86 384	99 159	95 473	112 932	128 169	119 362	125 327	129 845
France	609 568	626 849	636 078	597 331	572 277	572 334	510 791	457 772	418 276	424 014
Fr Guiana	4 599 F	4 782 F	5 565 F	5 514 F	5 285 F	4 442	4 857	3 958	4 140	4 000 F
Fr Polynesia	15 351	15 490	13 552 F	12 437 F	12 102	13 356	13 095	11 932	13 321	12 962
Fr South Tr	263 F	414 F	463 F	263 F	263 F	472 F	472 F	470 F	470 F	470 F
Gabon	33 021	32 170	35 972	37 779	34 163	32 162	29 000 F	32 500 F	22 000 F	22 000 F
Gambia	32 027	43 269	34 364	28 923	30 586	32 412	38 709	38 479	41 420	41 970
Georgia	1 628	1 801	3 267	11 937	9 923 F	9 659 F	18 147	26 462	25 000 F	30 544 F
Germany	188 464	201 654	238 256	239 492	264 268	276 395	274 349	258 020	228 543	207 761
Ghana	372 680	296 742	315 770	324 388	316 866	291 919	245 730	274 831	233 115	261 205
Gibraltar	0	0	0	0	0	0	0	0	0	0
Greece	91 009	93 343	90 217	91 946	90 842	96 823	94 654	87 999	82 388	82 060 F
Greenland	158 485	195 624	175 321	225 088	234 864	252 959	233 754	227 665	197 878	209 446
Grenada	2 250	2 171	2 544	2 039	2 053	2 169	2 407	2 386	2 615	2 452
Guadeloupe	10 100	10 100	10 100	10 100	10 100	10 100	10 100	10 100	10 000 F	10 000 F
Guam	801	557	527	682	370	604	640	322	488	291
Guatemala	23 224 F	17 762 F	18 846 F	5 977 F	15 241	14 813	15 325	20 466	17 634	19 499
Guinea	101 405	88 754	115 926	90 731	101 139	93 811	72 074	82 515	82 127 F	93 849 F
GuineaBissau	6 698 F	7 174 F	6 003 F	6 500 F	6 833 F	6 917 F	6 350 F	6 654 F	6 650 F	6 650 F
Guyana	52 605	47 217	58 895	55 919	52 570	52 963 F	46 648	41 368	42 805	44 386
Haiti	6 400 F	7 000 F	7 600 F	8 000	8 000 F	8 000 F	8 000 F	8 000 F	8 000 F	8 000 F
Honduras	20 933 F	14 275 F	16 124 F	14 486 F	18 717 F	20 777 F	15 055 F	12 804 F	11 202 F	11 007 F
Iceland	1 983 414	2 134 336	1 986 314	1 733 480	1 664 438	1 326 906	1 399 005	1 283 803	1 141 634	1 060 380
India	2 801 689	2 961 004	2 954 796	2 863 719	2 847 616	2 952 198	3 035 883	3 151 869	3 142 802	3 226 211
Indonesia	3 949 103	4 017 775	4 275 115	4 274 556	4 398 609	4 506 700	4 729 432	4 692 797	4 807 867	5 035 294
Iran	262 805	269 020	299 201	314 186	343 503	374 474	329 626	341 980	348 122	368 505
Iraq	19 200	14 100	4 000	2 355	6 359 F	12 959	12 319	4 486	12 246	13 490
Ireland	355 526	281 824	265 603	279 619	267 118	211 321	214 693	205 128	268 997	318 826
Isle of Man	3 112	3 127	2 984	2 627	2 764	1 209	3 760	2 770	3 555	4 814
Israel	3 738	3 474	2 991	2 203	2 755	2 220	2 595	2 484 F	2 311 F	2 186 F
Italy	304 872	265 604	291 312	281 984	293 064	311 520	282 698	232 207	248 013	230 249
Jamaica	11 894	7 397	12 082	13 071	12 696	17 505 F	16 148	12 775	15 894	15 040
Japan	4 651 954 F	4 311 998 F	4 620 026	4 269 627	4 258 103	4 286 434	4 238 652	4 269 638	4 074 569 F	4 004 274 F

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Marine fishing areas
Zones de pêche maritimes
Areas de pesca marítimas

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Jordan	170	176	131	144	160	147	156	150	219	136
Kenya	7 388	6 720	6 830	7 774	7 105	6 955	7 448	8 301	5 564	8 264
Kiribati	33 280	36 694	33 712	31 062 F	30 562 F	25 661 F	34 170	28 000	40 623	44 599
Korea D P Rp	201 572	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F
Korea Rep	1 987 975	1 688 234	1 649 061	1 570 240	1 638 658	1 751 061	1 864 081	1 945 468	1 846 865	1 722 672
Kuwait	5 846	5 360	4 059	4 833	4 895	5 635	4 373	3 979	4 000 F	4 000 F
Latvia	127 595	113 096	113 978	125 031	150 262	140 061	154 966	157 585	162 887	164 489
Lebanon	3 650	3 673	3 613	3 601	3 523	3 541	3 541 F	3 541 F	3 541 F	3 541 F
Liberia	6 496	7 042	6 864	10 525	9 347	6 494	12 745	7 127	7 250 F	7 250 F
Libya	47 290 F	44 008 F	41 829 F	39 897	37 390 F	34 647 F	31 921	47 645	52 110	50 000 F
Lithuania	148 977	149 388	155 246	160 222	138 238	153 111	185 639	181 160	171 377	148 541
Madagascar	93 583	99 299	99 476	103 416	99 998	100 943	115 148	87 834	98 475	93 336
Malaysia	1 231 287	1 272 105	1 283 256	1 331 645	1 209 601	1 282 313	1 381 423	1 394 532	1 393 214	1 428 882
Maldives	127 636	163 770	156 132	158 528	186 274	185 299	144 508	133 338	117 061	94 953
Malta	902	1 084	1 138	1 138	1 406	1 330	1 235	1 279	1 595	1 836
Marshall Is	36 581	39 859	38 886	47 887	57 583	43 974	61 229	35 102	46 246	59 730
Martinique	6 200	6 200 F	6 200	6 200	5 500	6 300	6 200	6 200	6 200 F	5 000 F
Mauritania	130 142 F	144 131 F	187 650 F	258 733	291 877	150 312	208 207	180 328	201 900	261 238
Mauritius	10 986	10 706	10 968	9 971	9 855	8 681	8 097	6 642	7 676	7 786
Mayotte	10 052	4 754	3 464	2 306	2 194	5 772	11 661	12 677	15 006	20 842
Mexico	1 306 624	1 368 099	1 257 699	1 151 853	1 206 358	1 240 927	1 355 942	1 472 419	1 499 383	1 407 479
Micronesia	19 316 F	22 771 F	33 598 F	31 818	32 207	15 287	20 718	25 290	27 701	30 866 F
Monaco	3 F	3 F	3 F	3 F	2 F	1 F	1 F	1 F	1 F	1 F
Montenegro	...	...	...	...	...	568	539	638	563	610
Montserrat	50 F	46	40 F	31	50	49	35	31	37	24
Morocco	1 094 423	959 504	916 988	917 301	1 023 465	873 528	875 449	992 687	1 159 042	1 129 014
Mozambique	21 340	20 515	79 451	71 829	71 004	75 883	68 189	91 260	114 383	118 893
Myanmar	949 670	1 029 460	1 053 720	1 132 340	1 228 710	1 375 670	1 517 940	1 679 010	1 867 510	2 060 780
Namibia	545 997	623 100	635 299	568 699	551 195	506 770	410 533	370 022	367 548	367 200 F
Nauru	360 F	342 F	344 F	298 F	300 F	280 F	260 F	240 F	220 F	200 F
Netherlands	515 963	461 458	524 131	519 536	553 295	467 001	411 621	414 797	380 242	387 306
NethAntilles	22 805 F	12 901 F	20 149	17 286	650	6 247	4 018	16 698	18 874	18 455
NewCaledonia	3 309	3 380	3 453	3 733	3 314	3 146	3 507	3 720	3 554	3 771
New Zealand	568 735	587 735	550 050	545 190	544 497	475 707	493 683	451 574	438 649	435 340
Nicaragua	19 082	18 703	14 921	18 431	26 450	29 179	26 179	28 879	34 795	36 480
Nigeria	297 971	293 814	300 194	282 987	285 131	328 928	303 313	296 955	312 439	323 599
Niue	200 F	200 F	200 F	200 F	212 F	400	302 F	108 F	192	113
Norfolk Is	0	0	0	0	0	0	0	0	0	0
N Marianas	406	296	172	169	214	221	219	168	192	243
Norway	2 686 392	2 739 975	2 548 353	2 523 972	2 392 087	2 255 769	2 379 574	2 430 497	2 523 775	2 674 587
Oman	129 907	142 669	138 481	165 016	157 326	147 668	151 744	151 910	158 551	163 927
Pakistan	420 698	418 104	399 040	386 653	340 206	349 421	340 056	343 414	334 007	337 916
Palau	1 084	1 027	1 047	1 079	932	967	985	1 007	1 000 F	1 000 F
Palest, O.T.	1 950	2 379	1 507	2 951	1 814	2 323	2 702	2 843	1 525	1 699
Panama	275 549	241 550	227 620	208 434	242 068	254 553	218 325	220 263	220 607	161 475
Papua N Guin	111 413	127 660	163 344	229 101	240 635	239 519	233 962	208 944	216 119	211 007
Peru	7 950 450	8 735 221	6 053 120	9 566 839	9 348 292	6 980 025	7 167 911	7 349 126	6 868 732	4 216 723
Philippines	1 812 985	1 899 046	2 033 325	2 070 966	2 127 557	2 159 269	2 333 236	2 381 846	2 416 097	2 426 314
Pitcairn Is	5 F	5 F	5 F	3 F	3 F	3 F	3 F	3 F	3 F	3 F
Poland	207 275	204 493	160 405	171 778	135 778	126 296	132 761	123 559	205 095	171 213
Portugal	193 265	202 841	212 441	222 299	220 453	229 070	256 181	224 246	198 813	222 944
Puerto Rico	3 794	2 529	2 919	2 428	2 551	2 042	1 675	1 793	1 702	1 898
Qatar	8 864	7 155	11 295	11 134	13 935	16 376	15 190	17 688	14 064	13 760
Réunion	3 889	2 870	2 902	3 371	4 281	3 546	3 988	2 978	3 050	3 050 F
Romania	2 431	2 122	1 612	1 840	2 026	614	518	444	332	231
Russian Fed	3 422 253	3 023 829	3 090 798	2 763 192	2 978 449	3 074 930	3 225 635	3 166 883	3 579 992	3 806 641
St Helena	867	598	985	1 061	1 130	1 120	837	794	856	864
St Kitts Nev	555	355	400 F	484	470 F	455 F	440 F	425 F	410 F	21 099
St Lucia	1 983	1 637	1 462	1 508	1 409	1 496	1 555	1 728	1 920	1 844
St Pier Mq	4 206	3 889	3 894	4 399	4 694	2 876	5 204	4 621	1 761	2 043
St Vincent	52 729	44 813	4 843	8 751	1 786	4 764	5 225	3 942	4 058	65 626
Samoa	8 612 F	10 880 F	9 702 F	9 455 F	9 835 F	12 434	14 090	13 898	13 278	12 999 F
Sao Tome Prn	3 692 F	3 820 F	4 038	4 141	4 196 F	4 150 F	4 250 F	4 500 F	4 550 F	4 650 F
Saudi Arabia	55 331	57 211	55 440	55 418	60 421	65 485	66 221	68 898	67 664	65 142
Senegal	380 617	354 328	428 342	400 643	365 635	332 829	374 104	388 653	406 595	375 414
Serbia-Monte	445	466	497	477	443	...	...	...	...	...
Seychelles	53 591	63 383	86 020	100 671	108 680	92 739	65 514	69 200	81 096	87 108
Sierra Leone	61 210	68 990	82 926	120 440	131 993	134 146	130 535	189 582	186 000 F	186 000 F
Singapore	3 342	2 769	2 085	2 173	1 920	3 103	3 522	1 623	2 121	1 732
Slovenia	1 621	1 460	1 086	814	1 021	931	915	686	868	764
Solomon Is	23 642 F	25 779 F	35 839 F	34 994 F	30 086 F	39 520 F	31 304 F	27 434 F	27 941 F	35 179 F
Somalia	31 700 F	28 800	29 800	29 800	24 800 F	29 800 F	29 800 F	29 800 F	29 800 F	29 800 F
South Africa	749 602	766 041	822 035	887 204	816 766	617 716	677 978	643 759	511 384	623 020
Spain	1 086 596	883 909	888 976	804 293	847 156	955 300	814 195	912 136	912 124	962 662
Sri Lanka	265 251	271 603	301 399	302 580	159 296	238 735	268 900	282 904	309 134	383 945
Sudan	5 000	5 000	5 000 F	5 500 F	5 200 F	5 000 F	5 699 F	5 695 F	5 690	5 700 F
Suriname	24 665	27 042 F	32 260	30 160	27 192	30 421	29 277	23 461	25 411	33 842
Svalbard Is	0	0	0	0	0	0	0	0	0	0
Sweden	310 583	293 528	285 384	268 537	254 942	267 607	236 707	229 722	201 851	210 667
Syria	2 322	2 823	3 060	3 077	3 677	3 395	3 381	3 212	3 107	2 956
Tanzania	53 197	50 376	49 439	51 648	56 134	42 918	45 489	45 121	46 802	49 438
Thailand	2 631 474	2 643 728	2 651 223	2 635 969	2 615 565	2 484 803	2 079 351	1 644 832	1 663 846	1 617 399
Timor-Leste	356	800 F	1 250 F	1 700 F	2 150 F	2 550 F	2 912	3 125	3 125 F	3 125 F
Togo	18 163	15 946	22 485	23 013	22 744	19 879	14 905	18 500 F	22 025	22 535
Tokelau	140 F	128 F	113 F	103 F	96 F	86 F	78 F	68 F	62 F	54 F
Tonga	4 774	4 853	4 435	1 645	2 200 F	2 750 F	3 103 F	2 593 F	2 036 F	2 150 F
Trinidad Tob	16 598	18 768	14 592	14 713	18 093	13 123	13 086	13 833	13 856	13 931
Tunisia	97 630	95 815	89 367	110 482	107 893	110 024	102 706	96 810	96 668	96 620
Turkey	484 410	522 744	463 074	504 897	380 381	488 966	589 129	453 115	425 046	445 680
Turks Caicos	6 419	5 767	5 100	5 685 F	5 505 F	6 040 F	4 860 F	6 133	6 803	5 446

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Zones de pêche maritimes
Areas de pesca marítimas

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Tuvalu	500 F	600 F	1 500	2 450	2 560	2 560 F	2 560 F	2 560 F	5 097	11 324 F
Ukraine	306 635	261 776	207 205	197 413	238 918	231 563	200 905	190 859	207 318	181 381
Untd Arab Em	112 561	97 574	95 150	90 000 F	86 735	82 500 F	78 300 F	74 075	77 705	79 610
UK	737 903	686 460	631 611	653 375	668 733	622 148	617 174	593 478	588 502	610 182
USA	4 914 758	4 909 908	4 912 627	4 930 551	4 868 125	4 833 548	4 742 326	4 325 272	4 199 378	4 346 719
US Virgin Is	1 198 F	1 296 F	1 492	1 522	1 269	1 615	1 127	1 065	1 120	847
Uruguay	104 531	107 715	116 718	120 659	123 688	131 850	107 522	108 177	80 660	73 105
Vanuatu	36 103 F	44 901 F	113 815	210 708	227 381	219 124	213 242	169 770	145 278	97 807
Venezuela	384 329	469 118	469 083	535 772 F	363 582 F	273 346 F	317 546 F	271 384	263 662 F	249 617 F
Viet Nam	1 481 175	1 575 640	1 647 233	1 733 434	1 791 100	1 824 800	1 876 400	1 946 600	2 091 700	2 226 600
Wallis Fut I	300 F	300 F	300	400 F	500 F	600	650 F	700 F	750 F	800 F
Yemen	142 198	179 584	228 116	256 300	238 400	229 660	179 916	127 132	159 000 F	191 100
Zanzibar	20 541	20 341	20 859	23 488	23 210	24 418	23 580	24 514	25 394	25 690
Other nei	244 551	313 742	365 180 F	300 174 F	184 182 F	144 808 F	134 982 F	119 451 F	168 754 F	59 142
World total **Total mondial** **Total mundial**	**82 248 583**	**82 563 683**	**79 693 101**	**83 962 152**	**82 916 140**	**80 226 990**	**80 349 702**	**79 504 423**	**79 247 345**	**77 392 626**
World excl. China **Monde excl. Chine** **Mundo excl. China**	**69 943 683**	**70 341 796**	**67 480 913**	**71 594 516**	**70 537 303**	**67 799 288**	**67 947 069**	**66 961 437**	**66 511 608**	**64 263 002**

A-5

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by low-income food-deficit countries (LIFDCs)
Captures par pays à faible revenu et à déficit vivrier (PFRDV)
Capturas por países de bajos ingresos y con déficit de alimentos (PBIDA)

Country or area Pays ou zone País o área	Population in 2010** Population en 2010** Población en 2010** '000	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Africa *Afrique* *África*	*857 619*	*4 445 305*	*4 520 487*	*4 325 062*	*4 380 873*	*4 533 829*	*4 591 190*	*4 807 572*
Benin	*8 850*	39 988	31 497	41 507	36 386	37 495 F	38 928	39 791
Burkina Faso	*16 469*	9 000 F	9 000	9 500	10 200	11 093	11 800	14 520
Burundi	*8 383*	13 855	14 800 F	15 750 F	16 700 F	17 766	17 700 F	17 700 F
Cameroon	*19 599*	129 000 F	142 345	137 232	138 612	139 200 F	140 000 F	140 000 F
Cent Afr Rep	*4 401*	23 000 F	25 000 F	27 000 F	29 000 F	31 000 F	33 000 F	35 000 F
Chad	*11 227*	60 000 F	55 000 F	50 000 F	45 000 F	40 000 F	40 000 F	40 000 F
Comoros	*735*	14 935	15 070	15 070 F	19 676	29 989 F	20 450 F	52 261 F
Congo Dem R	*65 966*	237 372	236 640	236 588	236 000	236 000 F	236 000 F	236 000 F
Congo Rep	*4 043*	57 024	54 616	59 082	59 216	54 104	61 218	65 186
Côte dIvoire	*19 738*	54 401	42 665	54 830	47 289	50 000 F	44 198	71 812
Djibouti	*889*	1 200 F	1 571	1 299	1 229	1 206	1 058	1 058 F
Egypt	*81 121*	393 494	349 553	375 894	372 491	373 815	387 398	385 209
Eritrea	*5 254*	7 404	4 027	8 813	1 932	1 665	3 030	3 286
Ethiopia	*82 950*	10 005	9 450	9 890	13 253	16 770	17 047	18 058
Gambia	*1 728*	32 423	34 586	36 912	43 574	42 645	45 881	46 424
Ghana	*24 392*	399 388	391 866	375 087	330 486	359 831	321 815	351 205
Guinea	*9 982*	97 731	109 139	102 811	82 074	94 515	96 127 F	109 849 F
GuineaBissau	*1 515*	6 650 F	6 983 F	7 067 F	6 500 F	6 804 F	6 800 F	6 800 F
Kenya	*40 513*	126 867	147 304	158 684	131 775	135 398	133 600	143 111
Lesotho	*2 171*	45	45	45	48	50	45	45
Liberia	*3 994*	13 725	12 147	8 894	14 488	7 890	8 000 F	8 000 F
Madagascar	*20 714*	134 916	132 648	133 693	147 778	120 464	131 303	128 836
Malawi	*14 901*	56 463	59 595	72 787	66 500	70 019	69 325	98 299
Mali	*15 370*	100 000 F	100 000 F	100 000 F	100 000	100 000 F	100 000 F	100 000
Mauritania	*3 460*	270 733	304 877	165 312	223 207	195 328	216 900	276 238
Mozambique	*23 391*	99 589 F	93 995 F	101 900 F	92 270	119 646	148 049	150 634
Niger	*15 512*	51 466	50 018	29 835	29 728	29 960	29 884	29 884 F
Nigeria	*158 423*	465 251	523 182	552 323	530 420	601 368	598 210	616 981
Rwanda	*10 624*	7 826	7 800 F	8 400 F	9 050	9 050 F	9 050 F	9 050 F
Sao Tome Prn	*165*	4 141	4 196 F	4 150 F	4 250 F	4 500 F	4 550 F	4 650 F
Senegal	*12 434*	434 770	400 120	366 992	412 835	425 853	442 295	409 578
Sierra Leone	*5 868*	134 440	145 993	148 146	144 535	203 582	200 000 F	200 000 F
Somalia	*9 331*	30 000 F	25 000 F	30 000 F	30 000 F	30 000 F	30 000 F	30 000 F
Sudan	*43 552*	63 000	59 000	57 000	65 509 F	68 595 F	71 690	71 700 F
Tanzania	*44 841*	363 688	376 700	335 437	329 835	326 811	316 204	342 481
Togo	*6 028*	28 013	27 744	24 879	19 905	23 500 F	27 025	27 535
Uganda	*33 425*	371 789	416 758	367 099	431 500 F	403 500 F	412 000 F	413 805
Zambia	*13 089*	67 725	65 927	60 236	73 542	79 403	84 716	76 396
Zanzibar	*0*	23 488	23 210	24 418	23 580	24 514	25 394	25 690
Zimbabwe	*12 571*	10 500 F	10 420 F	10 500 F	10 500 F	10 500 F	10 500 F	10 500 F
Americas *Amériques* *Américas*	*23 382*	*42 183*	*54 609*	*58 768*	*50 487*	*51 071*	*55 265*	*56 830*
Haiti	*9 993*	8 300	8 300 F	8 300 F	8 300 F	8 300 F	8 300 F	8 300 F
Honduras	*7 601*	14 586 F	18 817 F	20 877 F	15 155 F	12 904 F	11 302 F	11 107 F
Nicaragua	*5 788*	19 297	27 492	29 591	27 032	29 867	35 663	37 423
Asia *Asie* *Asia*	*1 958 106*	*12 583 415*	*13 109 318*	*13 722 093*	*14 194 615*	*14 432 015*	*14 907 441*	*15 860 078*
Afghanistan	*31 412*	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F
Bangladesh	*148 692*	1 187 274	1 333 866	1 436 496	1 494 199	1 557 754	1 821 579	1 726 586
Bhutan	*726*	220 F	220 F	200 F	200 F	180 F	180 F	160 F
Cambodia	*14 138*	305 817	384 000	482 500	458 500	431 000	465 000	490 094
Georgia	*4 352*	11 988	9 974 F	9 709 F	18 197	26 512	25 050 F	30 594 F
India	*1 224 614*	3 391 009	3 691 362	3 844 837	3 859 293	4 099 227	4 066 756	4 694 968
Indonesia	*239 871*	4 605 435	4 695 977	4 800 621	5 050 340	4 997 199	5 103 603	5 380 266
Iraq	*31 672*	12 936	29 929	59 259	57 779	34 472	34 505	25 720
Korea D P Rp	*24 346*	205 000 F	205 000 F	205 000 F	205 000 F	205 000 F	205 000 F	205 000 F
Kyrgyzstan	*5 334*	7	14 F	8 F	34	8	10 F	27
Lao P.Dem.R.	*6 201*	29 800 F	26 560	26 925	28 410	29 200	30 000	30 900
Mongolia	*2 756*	305	366	326	185	88	90	90 F
Nepal	*29 959*	19 947	19 983	20 016	20 100	21 500	21 500	21 500
Philippines	*93 261*	2 211 375	2 269 738	2 319 120	2 499 695	2 561 337	2 602 541	2 611 720
Sri Lanka	*20 860*	333 360	190 856	274 025	307 280	327 404	355 694	436 355
Syria	*20 411*	8 528	8 447	8 264	9 456	6 996	6 607	6 635
Tajikistan	*6 879*	184	146	146 F	146 F	150 F	150 F	160 F
Timor-Leste	*1 124*	1 700 F	2 150 F	2 550 F	2 912	3 125	3 125 F	3 125 F
Uzbekistan	*27 445*	1 230	1 330 F	1 431	1 973	2 731	6 051	4 078
Yemen	*24 053*	256 300	238 400	229 660	179 916	127 132	159 000 F	191 100
Europe *Europe* *Europa*	*3 573*	*487*	*531*	*612*	*1 160*	*1 407*	*1 607*	*1 633*
Moldova Rep	*3 573*	487	531	612	1 160	1 407	1 607	1 633
Oceania *Océanie* *Oceanía*	*7 496*	*308 657*	*314 783*	*318 200*	*312 936*	*277 878*	*298 183*	*304 285*
Kiribati	*100*	31 062 F	30 562 F	25 661 F	34 170	28 000	40 623	44 599
Papua N Guin	*6 858*	242 601	254 135	253 019	247 462	222 444	229 619	224 507
Solomon Is	*538*	34 994 F	30 086 F	39 520 F	31 304 F	27 434 F	27 941 F	35 179 F

A-5

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by low-income food-deficit countries (LIFDCs)
Captures par pays à faible revenu et à déficit vivrier (PFRDV)
Capturas por países de bajos ingresos y con déficit de alimentos (PBIDA)

Country or area Pays ou zone País o área	Population in 2010** Population en 2010** Población en 2010** '000	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
LIFDCs ***PFRDV*** ***PBIDA***	***2 850 176***	***17 380 047***	***17 999 728***	***18 424 735***	***18 940 071***	***19 296 200***	***19 853 686***	***21 030 398***
Other countries ***Autres pays*** ***Otros países***	***4 045 712***	***75 224 367***	***74 329 551***	***71 598 780***	***71 365 079***	***70 402 788***	***69 776 524***	***67 573 428***
World total **Total mondial** **Total mundial**	***6 895 888***	**92 604 414**	**92 329 279**	**90 023 515**	**90 305 150**	**89 698 988**	**89 630 210**	**88 603 826**

** Population (mid-2010) estimated by the Population Division of the United Nations, New York.

** Les données relatives à la population (mi-2010) ont été estimées par la Division de la population des Nations Unies, New York.

** Los datos relativos a la población (mitad-2010) están estimados por la División de Población de las Naciones Unidas, Nueva York.

A-6 Seaweeds and other aquatic plants / Algues et autres plantes aquatiques / Algas y otras plantas acuáticas

Capture production by countries or areas / Captures par pays ou zones / Capturas por países o áreas

All fishing areas / Toutes les zones de pêche / Todas las áreas de pesca

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Australia	13 547	9 916	8 879	12 570	14 167	15 504	2 223	1 923	1 923 F	1 923 F
Canada	35 242	42 139	45 797	41 069	41 771	43 191	19 382	17 715	43 300	37 632
Chile	234 253	244 020	309 055	390 577	409 850	301 115	313 551	384 563	368 032	368 580
China	227 680 F	252 820 F	251 660 F	321 440 F	261 790 F	274 820 F	328 600	366 100	276 170	246 620
China,H.Kong	0	0	-	-	-	-	-	-	-	-
China,Taiwan	91	148	308	244	221	190	177	108	213	106
Estonia	325	912	1 126	719	809	394	1 608	1 483	1 032	351
Fiji	470 F	435 F	406	358	300 F	250 F	200 F	150	150	75
France	66 289	73 654	69 867	64 723	23 054	19 160	39 757	39 757 F	18 907	22 597
Iceland	20 367	14 962	22 119	21 470	21 096	20 964	21 867	22 559	22 563	21 014
India	40 000 F	...	...	1	2	1	1	1	...	2
Indonesia	34 450	55 731	64 610	8 677	7 730	4 996	4 643	2 917	3 030	2 697
Ireland	36 100 F	36 100 F	35 000 F	30 000 F	29 500 F	29 500 F	29 500 F	29 500 F	29 500 F	29 500 F
Italy	2 000 F	2 000 F	2 000 F	1 850 F	1 600 F	1 400 F	1 400 F	1 400 F	1 400 F	1 400 F
Japan	122 145	127 897	111 467	113 836	104 893	113 665	103 602	104 668	104 103	96 600 F
Korea Rep	14 933	10 427 F	5 154	9 060	15 212	13 754	18 189	13 866	10 843	13 043
Latvia	0	0	0	-	-	-	-	-	-	-
Madagascar	800	800	1 000	1 000	1 000	1 000	800	800	800	800
Mexico	46 927	30 124	28 996	27 418	5 277	4 532	5 093	4 900	5 152	1 128
Morocco	10 015	7 919	11 131	13 126	12 812	14 870	12 373	9 037	10 368	7 405
Namibia	800	968	408	...	...	...	...	...	...	...
New Zealand	2	14	28	80	150	225	192	196	310	333
Norway	175 210	182 641	153 209	148 322	153 906	145 429	134 671	...	...	...
Peru	5 505	6 176	7 864	7 418	5 000	3 434	10 786	13 779	5 677	4 368
Philippines	551	811	496	433	299	314	351	388	434	473
Portugal	1 198	565	375	253	624	765	495	198	351	498
Russian Fed	10 144	11 713	9 714	11 564	10 138	11 614	8 342	10 242	5 828	5 917
Samoa	-	-	-	478	...	...	...	...	...	...
Senegal	223	232	-	-	-	-	-	-	-	-
South Africa	32 138	26 600 F	17 342	22 741	6 619	9 776	12 472	11 767	11 781	13 007
Spain	14 011	234	1	525	441	485	109	97	64	124
Tanzania	5 000 F	4 500	2 500 F	240	52	278	214	277	280 F	287
Timor-Leste	1	-	-	-	-	-	-	-	-	-
Tonga	173	407	319	1 707	420	356	107	0	16	1
Ukraine	...	147	233	255	522	1 121	1 892	1 947	2 179	142
USA	37 165	47 183	49 496	35 339	68 065	6 362	2 272	6 951	8 207	9 027
World total **Total mondial** **Total mundial**	**1 187 755**	**1 192 195**	**1 210 560**	**1 287 493**	**1 197 320**	**1 039 465**	**1 074 869**	**1 047 289**	**932 613**	**885 650**

The data in this A-6 table and in tables B-91, B-92, B-93 and B-94 refer to the annual production of seaweeds and other aquatic plants (expressed in tonnes and on a wet-weight basis) through harvesting of wild stocks.

See paragraph 5 of the INTRODUCTION.

Les données présentées dans les tableaux A-6 et B-91, B-92, B-93 et B-94 se rapportent à la production annuelle d'algues marines et autres plantes aquatiques (exprimée en tonnes et en poids vert) fournie par la récolte des espèces sauvages.

Voir le paragraphe 5 de l'INTRODUCTION.

Los datos de este cuadro A-6 y de los cuadros B-91, B-92, B-93 y B-94 se refieren a la producción anual de algas marinas y otras plantas acuáticas (expresada en toneladas y peso en húmedo) obtenida mediante la recolecciòn de plantas silvestres.

Véase el párrafo 5 en la INTRODUCCIÓN.

B - Capture production: by species groups

B - Captures: par groupes d'espèces

B - Captures: por grupos de especies

B-00 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species groups and fishing areas
Captures par groupes d'espèces et zones de pêche
Capturas por grupos de especies y áreas de pesca

Species group Groupe d'espèces Grupo de especies	Fishing area Zone de pêche Área de pesca	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
11 Carps, barbels and other cyprinids	01	112 205	134 608	138 980	162 625	162 491	188 650	222 504
Carpes, barbeaux et autres cyprinidés	02	25 270	24 186	25 288	24 144	25 441	29 289	34 695
Carpas, barbos y otros ciprínidos	03	441	447	440	440	470	430	448
	04	367 688	508 889	481 843	490 702	591 631	571 643	973 212
	05	98 978	99 506	102 564	125 338	115 522	113 435	133 498
	06	2	4	7	4	6	0	5
	27	7 410	6 897	7 043	7 329	6 845	7 377	6 999
	37	331	291	270	244	339	184	212
	61	127	319	222	199	124	122	112
	Group total	612 452	775 147	756 657	811 025	902 869	911 130	1 371 685
12 Tilapias and other cichlids	01	531 420	518 251	506 411	525 084	515 089	534 938	559 389
Tilapias et autres cichlidés	02	76 989	75 206	75 262	80 747	73 718	69 478	68 079
Tilapias y otros cíclidos	03	22 412	23 808	26 537	25 526	26 919	24 934	25 960
	04	119 958	115 541	105 175	107 000	144 295	130 754	143 438
	06	2 310	2 310	2 310	2 540	2 370	2 315	2 315
	34	2 191	3 778	2 142	2 454	2 374	2 174	2 361
	Group total	755 280	738 894	717 837	743 351	764 765	764 593	801 542
13 Miscellaneous freshwater fishes	01	1 635 039	1 731 463	1 652 344	1 654 767	1 730 778	1 715 978	1 733 384
Poissons d'eau douce divers	02	46 265	45 895	48 658	43 691	42 786	43 210	42 620
Peces de agua dulce diversos	03	370 760	352 859	355 827	323 492	326 887	316 067	331 623
	04	3 932 542	4 413 277	4 870 941	4 947 616	4 986 470	5 113 520	5 359 373
	05	102 980	98 112	103 111	105 863	105 840	107 709	109 088
	06	9 154	9 368	9 206	10 103	10 342	10 556	9 783
	27	9 899	9 594	12 727	12 260	9 298	9 222	9 737
	31	...	...	...	...	...	44	50
	37	1 245	1 180	830	247	158	75	80
	Group total	6 107 884	6 661 748	7 053 644	7 098 039	7 212 559	7 316 381	7 595 738
21 Sturgeons, paddlefishes	02	134	103	113	112	114	111	116
Esturgeons, spatules	04	832	735	598	397	413	196	104
Esturiones, sollos	05	286	284	180	181	196	223	171
	21	0	1	1	6	0	-	0
	27	-	-	-	-	0	24	36
	37	24	16	4	2	4	2	...
	67	170	191	161	143	164	154	120
	Group total	1 446	1 330	1 057	841	891	710	547
22 River eels	01	966	994	4 033	2 095	984	1 278	371
Anguilles	02	187	170	170	148	175	167	106
Anguilas	04	4 199	2 121	2 735	2 431	1 892	2 289	2 414
	05	2 776	2 808	2 840	2 716	2 679	2 489	2 748
	06	486	500	546	508	439	429	583
	21	606	615	798	724	508	554	585
	27	1 670	1 708	1 909	1 660	1 553	1 220	1 168
	31	47	17	11	13	13	27	52
	34	3	1	0	1	0	1	9
	37	524	270	306	344	366	320	360
	57	105	87	80	70	84	57	44
	81	222	287	215	207	152	107	...
	Group total	11 791	9 578	13 643	10 917	8 845	8 938	8 440
23 Salmons, trouts, smelts	01	34	36	33	47	49	51	122
Saumons, truites, éperlans	02	23 036	18 775	17 187	19 919	18 279	16 548	14 967
Salmones, truchas, eperlanos	03	457	361	352	369	267	284	292
	04	31 780	29 571	22 950	20 526	16 240	21 459	20 821
	05	80 279	116 846	110 891	131 140	97 622	132 559	126 969
	21	818	804	979	892	834	988	751
	27	8 443	7 618	7 453	7 489	7 285	8 303	7 134
	37	7	0	1	7	9	7	3
	61	376 901	424 667	447 615	499 667	384 990	688 309	426 915
	67	355 474	431 619	322 818	420 376	302 628	339 004	381 500
	77	2 997	2 206	538	725	0	0	116
	81	1	2	1	1	7	50	0
	Group total	880 227	1 032 505	930 818	1 101 158	828 210	1 207 562	979 590
24 Shads	01	226	212	395	434	396	313	336
Aloses	02	2 284	3 711	3 280	3 098	2 963	2 647	2 130
Sábalos	03	998	324	261	192	204	197	200
	04	137 845	141 844	138 063	129 240	144 493	158 013	167 896
	05	20 527	26 925	21 062	19 094	10 501	8 840	6 285
	06	480	480	480	480	480	480	480
	21	5 276	3 633	5 579	5 037	4 589	5 162	3 376

B-00 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species groups and fishing areas
Captures par groupes d'espèces et zones de pêche
Capturas por grupos de especies y áreas de pesca

Species group Groupe d'espèces Grupo de especies		Fishing area Zone de pêche Área de pesca	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
		27	111	138	62	259	259	222	332
		31	833	103	145	149	155	215	209
		34	12 385	11 804	10 574	13 382	15 314	14 837	14 870
		37	18 298	23 497	20 722	22 134	23 534	21 867	19 952
		47	...	...	...	15 217	17 616	8 930	8 600
		51	7 651	9 651	7 455	12 768	9 339	9 051	20 541
		57	232 379	239 665	243 946	232 637	231 400	232 147	273 913
		61	99 384	102 792	108 948	111 396	109 433	113 079	106 769
		67	120	234	82	82	19	2	14
		71	15 823	15 643	17 759	18 844	18 507	15 560	18 485
		Group total	554 620	580 656	578 813	584 443	589 202	591 562	644 388
25	Miscellaneous diadromous fishes	02	149	1 033	661	816	843	277	1 299
	Poissons diadromes divers	04	558	637	3 589	2 261	3 714	9 347	8 487
	Peces diádromos diversos	05	1 756	1 976	2 038	2 081	1 788	1 865	1 542
		06	350	350	350	350	350	350	350
		21	3 221	3 467	2 981	3 228	3 199	4 172	3 307
		27	596	525	528	467	479	701	465
		31	89	99	18	14	9	5	7
		37	1	-	2	-	-	-	-
		51	101	122	159	135	168	322	198
		57	11 523	11 316	12 316	12 809	12 791	15 274	12 756
		61	42	75	59	36	48	81	105
		71	49 409	61 054	73 489	82 554	68 374	75 460	89 293
		77	3	14	15	422	69	65	68
		Group total	67 798	80 668	96 205	105 173	91 832	107 919	117 877
31	Flounders, halibuts, soles	01	609	1 116	1 498	1 980	2 209	1 780	1 842
	Flets, flétans, soles	04	32	71	686	555	357	388	575
	Platijas, halibuts, lenguados	05	16	7	8	-	-	-	152
		18	-	-	-	-	17	-	-
		21	110 120	105 128	86 701	84 068	85 366	81 086	88 994
		27	270 505	247 946	238 224	229 020	217 549	230 754	241 107
		31	994	770	804	730	763	705	3 728
		34	28 677	42 924	36 454	34 153	32 646	30 122	28 267
		37	8 614	9 865	10 648	10 136	9 069	9 525	9 318
		41	8 749	9 874	10 530	10 330	10 840	10 157	10 155
		47	12 584	10 320	9 839	23 996	5 897	5 903	5 698
		48	-	-	-	0	0	0	0
		51	17 670	18 392	19 917	28 813	23 809	26 674	18 922
		57	27 496	25 870	30 277	34 705	31 458	30 907	39 051
		61	163 971	186 619	174 562	184 029	169 309	185 229	176 003
		67	184 268	214 185	230 221	249 272	329 176	283 659	303 879
		71	19 754	18 419	17 080	15 035	18 781	19 076	18 655
		77	4 935	4 412	3 904	4 789	4 857	4 784	5 186
		81	3 167	4 203	3 564	4 153	3 466	3 334	3 205
		87	513	376	438	342	368	481	613
		Group total	862 674	900 497	875 355	916 106	945 937	924 564	955 350
32	Cods, hakes, haddocks	02	-	0	-	-	-	-	-
	Morues, merlus, églefins	05	245	43	45	-	62	-	103
	Bacalaos, merluzas, eglefinos	18	-	-	-	2	463	-	589
		21	118 225	118 138	103 671	116 157	131 295	109 991	107 586
		27	4 184 525	3 824 213	3 861 635	3 371 273	2 973 626	2 482 133	2 587 462
		31	5	3	4	1	3	1	1
		34	30 251	23 219	20 187	21 636	16 879	26 268	15 605
		37	42 271	53 097	62 901	59 154	51 364	53 014	51 958
		41	729 124	632 039	625 032	530 108	513 317	530 530	495 400
		47	332 521	304 262	272 495	275 464	264 296	256 739	262 500
		48	74	154	188	183	214	174	111
		51	1 325	2 722	1 602	855	732	632	472
		57	9 560	7 069	5 141	3 744	5 958	4 636	6 515
		58	899	756	765	771	1 246	1 434	1 258
		61	1 363 271	1 429 342	1 504 556	1 717 875	1 787 005	1 848 982	2 155 069
		67	2 130 471	2 162 163	2 137 002	1 897 137	1 575 882	1 244 369	1 348 770
		71	60	89	95	51	42	50	151
		77	1 245	1 750	1 741	1 204	1 701	1 379	1 308
		81	214 279	194 073	178 755	160 827	154 638	164 160	176 998
		87	241 995	217 855	210 724	195 699	211 102	224 660	214 853
		88	426	433	191	238	139	257	179
		Group total	9 400 772	8 971 420	8 986 730	8 352 379	7 689 964	6 949 409	7 426 888
33	Miscellaneous coastal fishes	01	33 613	28 779	40 141	30 649	28 852	26 198	32 643
	Poissons côtiers divers	02	120	3 529	3 728	3 386	2 478	2 602	2 670
	Peces costeros diversos	03	12 270	12 792	12 244	12 030	13 132	12 037	...
		04	14 944	17 960	16 939	14 385	22 354	20 272	14 395
		05	409	507	633	365	365	1 061	517
		06	1 850	1 850	1 850	1 850	1 850	1 850	1 850

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Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species groups and fishing areas
Captures par groupes d'espèces et zones de pêche
Capturas por grupos de especies y áreas de pesca

Species group Groupe d'espèces Grupo de especies		Fishing area Zone de pêche Área de pesca	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
		21	21 653	20 152	17 122	18 211	15 470	16 283	14 816
		27	420 880	215 383	336 584	272 667	394 134	403 105	460 148
		31	181 852	149 696	123 926	121 332	115 934	112 485	108 108
		34	324 713	350 460	361 798	337 316	352 880	359 082	355 157
		37	162 374	177 203	178 577	172 393	165 268	172 634	174 541
		41	278 141	277 275	320 184	315 192	312 673	358 752	333 778
		47	76 501	72 570	83 957	79 412	111 119	108 725	104 847
		48	-	0	25	16	4	3	18
		51	795 242	806 041	819 190	869 549	901 474	876 228	816 659
		57	571 733	532 936	569 300	626 835	672 210	718 041	713 905
		58	3	2	5	10	20	26	50
		61	2 345 431	2 253 223	2 310 460	2 140 002	2 396 291	2 438 191	2 563 356
		67	53 163	62 542	62 725	61 813	62 423	75 595	69 996
		71	1 268 851	1 278 090	1 310 067	1 365 015	1 226 735	1 231 813	1 319 187
		77	25 791	51 933	51 296	55 858	51 567	48 947	51 414
		81	25 400	25 530	23 138	24 910	26 349	23 034	23 038
		87	112 459	138 362	353 712	56 448	110 820	224 721	75 912
		88	0	0	0	0	2	0	0
		Group total	6 727 393	6 476 815	6 997 601	6 579 644	6 984 404	7 231 685	7 237 005
34	Miscellaneous demersal fishes	04	807	1 163	728	289	353	434	493
	Poissons démersaux divers	21	79 400	87 730	72 169	51 875	45 179	47 677	52 827
	Peces demersales diversos	27	360 729	312 525	360 809	346 794	325 591	412 019	494 177
		31	26 595	17 151	11 316	13 598	15 375	16 264	16 796
		34	37 662	32 997	36 691	41 677	42 204	38 879	52 110
		37	15 863	21 185	24 299	23 640	23 196	24 589	25 361
		41	47 799	60 192	78 351	85 991	113 159	83 665	80 032
		47	64 672	62 789	51 656	44 053	42 118	34 740	35 183
		48	7 189	3 343	5 915	8 053	6 479	5 634	3 041
		51	152 371	160 128	174 807	152 125	138 994	156 425	217 395
		57	74 764	76 722	80 207	92 057	85 461	92 096	81 551
		58	8 894	11 494	10 337	9 203	9 169	9 187	8 979
		61	1 709 707	1 585 195	1 807 490	1 725 259	1 760 647	1 756 829	1 729 473
		67	78 621	77 019	82 949	86 657	83 267	79 997	85 859
		71	56 230	57 579	58 436	63 911	88 276	81 549	69 930
		77	3 989	4 686	4 915	4 537	4 726	5 286	5 810
		81	149 736	141 489	145 231	133 714	118 984	116 589	113 661
		87	30 815	25 100	23 069	26 459	22 214	23 903	20 338
		88	2 575	3 519	3 487	3 457	2 680	2 942	2 962
		Group total	2 908 418	2 742 006	3 032 862	2 913 349	2 928 072	2 988 704	3 095 978
35	Herrings, sardines, anchovies	01	1 600	1 250	1 100	900	2 440	1 300	416
	Harengs, sardines, anchois	05	-	-	3	-	-	-	-
	Arenques, sardinas, anchoas	21	456 394	449 325	437 704	456 298	405 782	438 403	443 511
		27	2 558 920	2 939 492	2 668 470	2 820 655	2 888 597	2 964 287	2 666 770
		31	634 198	493 897	505 346	569 044	473 776	506 324	489 202
		34	1 773 170	1 678 316	1 605 466	1 488 046	1 707 985	1 888 994	2 108 432
		37	767 695	591 194	757 333	854 858	706 053	711 695	704 238
		41	124 617	112 262	129 982	121 424	128 529	145 235	120 675
		47	705 231	632 927	453 097	549 250	513 712	397 346	503 152
		51	540 280	525 758	525 914	541 672	543 329	545 335	532 000
		57	373 219	346 328	441 101	495 675	555 358	569 872	553 591
		61	2 156 326	2 027 742	2 118 403	1 996 040	1 815 403	1 631 901	1 803 813
		67	102 058	120 750	100 005	89 799	79 051	81 732	91 837
		71	969 569	1 059 780	1 018 834	1 043 966	1 054 202	1 169 111	1 126 683
		77	625 666	651 291	722 058	861 424	978 444	1 013 363	858 456
		81	2 050	2 216	3 379	838	1 182	928	495
		87	11 110 971	10 587 029	7 588 972	8 043 257	8 402 247	7 917 681	5 093 546
		Group total	22 901 964	22 219 557	19 077 167	19 933 146	20 256 090	19 983 507	17 096 817
36	Tunas, bonitos, billfishes	21	6 095	6 323	5 747	5 475	4 881	4 562	5 043
	Thons, pélamides, marlins	27	34 817	48 393	51 896	38 127	32 767	26 556	37 387
	Atunes, bonitos, agujas	31	81 296	58 137	56 955	53 387	52 188	54 415	60 728
		34	304 684	298 686	267 837	270 612	298 477	316 472	347 378
		37	65 830	129 341	89 059	71 366	58 740	59 844	57 959
		41	62 078	60 491	56 439	54 305	62 540	70 646	59 343
		47	37 863	34 334	38 653	47 323	37 893	45 187	41 066
		51	1 164 211	1 215 345	1 221 453	961 497	898 579	857 277	847 839
		57	511 474	416 432	462 541	510 523	553 061	566 923	618 330
		58	-	2	-	-	-	-	-
		61	636 096	691 327	675 417	869 881	808 360	800 882	809 977
		67	19 110	12 438	17 518	16 441	14 471	16 442	15 978
		71	2 483 153	2 594 590	2 714 365	2 977 633	2 848 194	2 919 976	2 902 194
		77	480 561	458 814	414 088	421 785	406 254	487 238	509 112
		81	30 761	26 942	26 053	30 003	31 936	26 637	37 649
		87	354 200	375 303	374 080	290 571	436 253	381 740	270 390
		Group total	6 272 229	6 426 898	6 472 101	6 618 929	6 544 594	6 634 797	6 620 373

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Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species groups and fishing areas
Captures par groupes d'espèces et zones de pêche
Capturas por grupos de especies y áreas de pesca

Species group Groupe d'espèces Grupo de especies		Fishing area Zone de pêche Área de pesca	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
37	Miscellaneous pelagic fishes	01	2 246	1 985	5 290	7 987	5 459	73	5 661
	Poissons pélagiques divers	02	424	...	...	1 233	1 935	1 937	...
	Peces pelágicos diversos	03	888	850	880	919	963	1 000	750
		04	2 107	5 248	6 677	6 540	6 630	6 184	4 438
		05	614	100	478	150	155	137	136
		21	145 770	138 019	157 048	121 150	94 647	105 040	79 092
		27	1 478 884	1 458 008	972 814	1 182 395	1 070 195	1 270 464	1 584 587
		31	44 507	31 071	26 471	29 477	33 494	36 381	37 062
		34	573 738	616 864	515 489	501 808	563 572	554 428	657 427
		37	138 964	157 876	159 041	163 780	159 800	131 837	106 347
		41	41 302	50 104	47 947	57 104	57 811	62 274	74 706
		47	400 209	404 983	382 545	275 538	278 920	261 312	258 642
		51	438 410	431 760	450 469	454 577	404 297	435 940	454 789
		57	576 772	599 646	629 066	710 159	769 741	777 754	811 758
		58	-	0	-	-	-	0	-
		61	2 648 716	3 157 864	2 963 649	2 959 753	3 364 175	2 814 237	2 904 449
		67	292	402	675	717	39	23	13
		71	1 893 428	1 774 654	1 836 492	1 879 013	1 830 018	1 802 980	1 929 122
		77	28 784	55 253	34 531	34 060	25 308	26 781	32 309
		81	84 940	58 301	78 741	80 775	58 717	54 234	53 401
		87	2 694 068	2 280 768	2 588 309	2 503 740	1 862 321	1 790 496	1 026 029
		88	0	-	-	-	-	-	-
		Group total	11 195 063	11 223 756	10 856 612	10 970 875	10 588 197	10 133 512	10 020 718
38	Sharks, rays, chimaeras	21	34 056	27 064	32 446	35 131	37 786	32 203	39 250
	Squales, raies, chimères	27	75 175	63 469	57 067	62 382	59 444	57 717	49 027
	Tiburones, rayas, quimeras	31	39 619	30 702	26 275	25 042	23 493	24 062	26 913
		34	53 345	61 287	53 114	55 513	59 214	68 195	84 391
		37	8 845	9 821	12 390	11 121	11 182	20 073	19 992
		41	72 842	77 196	77 271	82 251	84 750	83 474	84 027
		47	15 099	18 078	20 913	28 608	15 643	15 839	17 070
		48	41	8	9	6	16	23	10
		51	118 303	118 805	113 746	124 333	111 214	97 304	96 195
		57	151 927	98 245	98 924	123 578	101 701	108 962	91 398
		58	573	645	384	399	447	489	539
		61	54 911	63 703	56 281	54 899	44 097	37 761	31 448
		67	19 193	18 198	13 214	14 101	14 466	15 560	12 968
		71	123 130	113 020	121 224	104 539	98 170	109 896	102 040
		77	41 659	42 296	39 836	39 016	35 151	38 582	40 558
		81	19 863	20 072	19 700	21 386	19 007	19 104	20 739
		87	19 375	18 330	17 825	17 789	17 798	20 207	22 352
		88	26	61	4	38	4	7	7
		Group total	847 982	781 000	760 623	800 132	733 583	749 458	738 924
39	Marine fishes not identified	21	5 018	4 951	4 163	3 755	4 592	7 047	6 728
	Poissons marins non identifiés	27	10 158	14 700	26 745	30 102	45 599	104 083	89 706
	Peces marinos no identificados	31	181 377	128 448	144 109	140 896	121 852	119 920	122 634
		34	311 213	405 660	319 570	341 412	297 794	295 648	204 892
		37	55 922	67 862	64 021	53 863	67 728	65 628	57 644
		41	78 968	79 149	77 667	70 556	48 455	55 626	48 419
		47	54 168	33 200	48 484	74 974	54 605	45 154	44 615
		51	683 186	665 583	645 370	575 840	640 403	705 679	846 353
		57	2 488 742	2 596 178	2 679 128	2 493 555	2 539 403	2 877 821	3 004 308
		58	0	1	-	-	-	0	-
		61	2 499 065	2 493 536	2 325 971	2 356 141	2 476 114	3 108 469	3 192 786
		67	8 713	16 578	3 643	1 543	6 960	11 524	14 646
		71	2 741 277	2 872 244	2 645 909	2 630 594	2 417 798	2 519 895	2 761 495
		77	108 225	108 340	112 171	88 798	90 800	78 781	94 061
		81	27 355	110 235	33 572	65 468	89 545	85 038	75 897
		87	96 698	119 775	52 245	64 999	48 974	62 889	42 968
		88	2	0	0	1	-	-	-
		Group total	9 350 087	9 716 440	9 182 768	8 992 497	8 950 622	10 143 202	10 607 152
41	Freshwater crustaceans	01	10 980	10 080	10 936	9 777	10 998	11 623	7 702
	Crustacés d'eau douce	02	6 905	10 652	4 689	10 379	10 229	11 719	9 287
	Crustáceos de agua dulce	03	6 317	5 242	5 233	6 707	6 106	5 634	5 811
		04	281 527	319 798	339 440	364 444	426 045	439 188	498 201
		05	5 128	4 951	4 621	5 763	9 224	5 466	5 468
		06	509	507	558	467	349	234	109
		37	-	1	-	1	3	3	1
		61	-	-	-	3	3	-	-
		Group total	311 366	351 231	365 477	397 541	462 957	473 867	526 579
42	Crabs, sea-spiders	02	...	2	2	...	...	...	4
	Crabes, araignées de mer	04	729	747	705	977	1 053	1 047	1 100
	Cangrejos, centollas	21	170 042	158 439	148 061	142 752	156 248	154 497	163 009
		27	58 238	43 073	60 019	68 683	54 614	52 836	58 885
		31	70 935	60 372	61 265	56 917	57 603	59 275	52 228

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Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species groups and fishing areas
Captures par groupes d'espèces et zones de pêche
Capturas por grupos de especies y áreas de pesca

Species group Groupe d'espèces Grupo de especies		Fishing area Zone de pêche Área de pesca	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
		34	5 260	6 335	9 279	4 479	6 829	6 610	6 797
		37	2 202	3 976	4 023	6 024	5 350	5 750	5 655
		41	15 076	17 568	13 096	10 701	11 950	13 201	12 717
		47	5 239	4 578	3 150	5 115	2 286	315	312
		51	19 714	20 097	21 585	22 146	22 256	25 814	25 514
		57	43 809	43 326	44 654	58 498	60 278	65 887	60 216
		61	616 640	639 370	668 709	673 409	669 157	674 761	739 129
		67	50 668	45 526	60 377	47 746	57 327	60 490	50 193
		71	174 025	169 401	186 842	183 580	195 808	194 660	212 717
		77	11 725	13 599	14 731	18 544	20 818	17 683	27 303
		81	588	580	511	247	318	330	205
		87	9 324	8 088	7 348	7 023	8 627	8 540	8 883
		Group total	1 254 214	1 235 077	1 304 357	1 306 841	1 330 522	1 341 696	1 424 867
43	Lobsters, spiny-rock lobsters Homards, langoustes Bogavantes, langostas	21	81 618	83 750	97 026	82 991	96 104	102 296	115 651
		27	57 220	54 829	68 445	74 200	71 613	71 014	66 314
		31	33 967	31 349	28 122	26 207	27 738	24 656	28 920
		34	2 836	3 372	3 949	2 563	3 368	4 332	6 446
		37	4 154	6 278	6 481	6 347	5 711	6 255	5 732
		41	8 689	6 927	6 724	6 490	6 589	7 268	6 866
		47	4 675	4 920	4 126	4 641	3 265	3 758	5 385
		51	2 832	2 810	3 233	3 195	2 949	2 798	3 677
		57	21 305	19 867	17 537	15 634	15 880	13 611	12 195
		61	3 485	3 612	3 611	3 554	3 430	3 058	11 417
		67	36	28	15	12	13	27	32
		71	10 048	10 807	8 420	7 612	12 007	7 814	9 727
		77	2 324	2 287	2 402	2 075	2 617	2 436	3 392
		81	3 021	3 550	3 489	3 478	3 514	3 219	3 856
		87	59	235	91	53	58	60	75
		Group total	236 269	234 621	253 671	239 052	254 856	252 602	279 685
44	King crabs, squat-lobsters Crabes royaux, galatées Cangrejos reales, galateidos	27	2 646	5 437	14 047	12 824	14 565	11 956	5 879
		41	1 337	1 037	1 195	936	769	325	715
		48	0	0	1	0	1	0	62
		58	7	34	-	-	0	0	0
		61	5 629	7 824	8 542	12 139	10 013	8 708	8 291
		67	10 013	10 859	9 816	11 767	12 341	10 156	10 905
		77	6 875	13 708	12 097	14 073	6 839	10 230	4 395
		87	9 951	13 203	11 590	10 393	12 346	14 191	14 724
		88	0	0	0	0	0	0	0
		Group total	36 458	52 102	57 288	62 132	56 874	55 566	44 971
45	Shrimps, prawns Crevettes Gambas, camarones	01	2 250	1 750	1 600	1 450	1 970	1 600	1 386
		04	61 846	65 848	68 143	72 634	81 718	74 724	85 103
		21	359 576	345 567	350 187	359 463	340 104	288 907	311 433
		27	123 820	113 864	91 124	90 511	88 145	96 136	90 717
		31	211 512	178 375	204 519	150 482	148 019	173 541	142 053
		34	58 285	66 260	64 491	64 550	48 922	51 500	49 548
		37	31 079	42 320	39 702	34 596	38 496	42 148	42 275
		41	59 919	46 233	82 988	91 683	85 317	94 584	110 563
		47	3 189	2 654	2 676	3 853	2 037	409	386
		51	301 498	317 837	307 374	300 524	293 624	290 508	220 948
		57	246 069	205 224	223 697	270 922	320 870	319 007	325 899
		61	1 328 020	1 332 361	1 330 147	1 288 509	1 191 454	1 233 706	1 207 195
		67	12 813	14 709	9 933	12 375	16 657	15 630	21 431
		71	438 689	400 577	415 095	425 746	383 007	392 042	422 466
		77	52 950	53 735	55 857	67 586	61 392	58 912	61 272
		81	1 831	877	1 360	1 471	1 832	1 690	1 199
		87	14 510	17 546	20 712	26 081	28 982	31 926	35 376
		Group total	3 307 856	3 205 737	3 269 605	3 262 436	3 132 546	3 166 970	3 129 250
46	Krill, planktonic crustaceans Krill, crustacés planctoniques Krill, crustáceos planctónicos	27	-	-	-	-	-	40	-
		41	-	-	43	-	-	-	10
		48	118 165	129 026	106 548	104 586	156 521	125 824	211 974
		57	-	-	-	-	-	-	3 191
		Group total	118 165	129 026	106 591	104 586	156 521	125 864	215 175
47	Miscellaneous marine crustaceans Crustacés marins divers Crustáceos marinos diversos	02	3 181	-	-	-	-	-	-
		05	-	-	-	-	-	-	2
		21	0	0	1	1	8	0	0
		27	558	660	813	1 084	899	635	818
		31	162	165	159	473	369	261	280
		34	64	353	421	452	363	394	316
		37	9 022	8 290	8 223	8 888	8 053	9 009	8 637
		41	356	511	460	509	1 045	1 160	1 094
		47	-	1	-	-	-	-	-

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Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species groups and fishing areas
Captures par groupes d'espèces et zones de pêche
Capturas por grupos de especies y áreas de pesca

Species group Groupe d'espèces Grupo de especies		Fishing area Zone de pêche Área de pesca	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
		51	18 383	20 414	21 326	14 694	11 376	9 825	7 330
		57	59 143	53 082	62 156	86 083	74 476	72 830	82 767
		61	334 094	325 038	337 220	363 229	338 587	350 227	373 173
		67	72	71	77	83	69	69	53
		71	8 593	8 333	6 174	6 853	6 477	5 323	5 461
		77	2 698	4 172	1 886	2 939	921	832	822
		81	535	480	491	473	381	292	356
		87	817	604	2 653	4 318	356	477	434
		Group total	437 678	422 174	442 060	490 079	443 380	451 334	481 543
51	Freshwater molluscs	01	1 760	2 273	2 439	1 990	2 017	1 742	1 671
	Mollusques d'eau douce	02	1 112	1 099	1 156	1 055	1 651	1 724	1 657
	Moluscos de agua dulce	04	376 672	362 790	377 003	384 749	345 926	365 756	367 400
		06	2 527	2 500	2 530	1 500	1 500	1 500	1 500
		61	170	145	313	546	282	495	445
		Group total	382 241	368 807	383 441	389 840	351 376	371 217	372 673
52	Abalones, winkles, conchs	21	4 844	6 422	9 010	8 378	10 706	11 204	14 012
	Ormeaux, bigorneaux, strombes	27	36 979	26 564	31 935	29 892	30 222	27 849	34 088
	Orejas de mar, bígaros, estrombos	31	25 558	25 400	27 886	23 718	21 655	25 170	25 030
		34	11 796	14 518	11 655	13 928	17 118	19 906	17 517
		37	3 302	6 515	9 021	10 120	7 599	7 251	9 718
		41	970	801	546	474	448	213	512
		47	258	228	212	123	61	-	128
		51	599	422	782	708	674	625	568
		57	6 224	6 293	5 814	4 880	4 713	4 858	4 538
		58	0	0	0	0	-	0	-
		61	22 544	20 562	19 012	19 346	19 740	19 287	19 258
		67	2	3	3	3	2	1	-
		71	439	371	969	761	358	314	881
		77	2 498	4 328	4 557	4 095	3 979	2 946	3 925
		81	1 251	1 239	1 081	1 255	1 050	1 083	1 211
		87	25 108	15 264	13 001	12 176	13 387	10 412	10 771
		Group total	142 372	128 930	135 484	129 857	131 712	131 119	142 157
53	Oysters	21	13 134	13 651	12 796	14 432	12 845	11 915	12 696
	Huîtres	27	2 764	1 801	2 194	2 977	4 350	5 020	7 647
	Ostras	31	103 249	113 417	80 594	96 498	79 750	85 756	48 171
		34	82	164	43	104	126	116	242
		37	171	131	141	213	54	37	29
		41	1 076	1 368	1 406	800	1 174	1 295	1 223
		47	30	24	...	20	16	17	17
		51	0	28	38	16	36	28	38
		57	64	178	370	338	1	23	22
		61	25 690	27 320	31 024	29 316	29 185	24 256	22 725
		67	43	160	234	72	307	238	6 391
		71	208	757	283	359	390	524	400
		77	3 248	2 788	9 915	7 396	3 325	3 399	3 390
		81	465	546	518	512	434	107	980
		87	13	6	8	4	3	20	14
		Group total	150 237	162 339	139 564	153 057	131 996	132 751	103 985
54	Mussels	21	10 572	9 836	8 547	7 646	8 678	12 841	15 014
	Moules	27	113 277	90 629	72 069	66 099	47 672	43 472	35 134
	Mejillones	31	4 280	2 300	1 360	1 660	1 900	1 830	1 830
		37	41 264	12 638	9 702	2 603	1 114	8 022	2 407
		41	1 531	2 739	2 419	1 368	5 846	6 227	2 201
		57	4	34	313	9	7	4	20
		61	3 076	4 191	6 630	9 555	7 987	10 808	13 555
		67	488	913	1 405	719	1 010	1 031	1 069
		71	31	32	1 234	440	35	55	457
		77	630	1 627	1 507	4 274	2 858	2 443	3 530
		81	1 353	486	403	200	182	152	153
		87	12 834	11 066	8 674	20 169	13 489	12 484	13 573
		Group total	189 340	136 491	114 263	114 742	90 778	99 369	88 943
55	Scallops, pectens	21	328 538	273 183	288 617	288 222	271 041	282 451	276 360
	Coquilles St-Jacques	27	64 137	67 445	67 082	75 749	67 600	73 327	91 218
	Vieiras	31	37	2	...	...	...	74	1
		37	1 586	1 134	914	693	298	496	397
		41	45 654	41 365	81 625	53 746	58 719	80 822	50 873
		57	7 279	12 336	7 278	7 161	7 326	4 939	4 620
		61	316 788	290 271	274 459	260 353	313 793	323 485	330 740
		67	1 274	808	...	...	1 477	1 092	1 818
		71	2 951	4 925	3 811	5 766	4 940	4 802	4 874
		77	5 151	15 348	16 027	14 761	16 522	16 284	16 499

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Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species groups and fishing areas
Captures par groupes d'espèces et zones de pêche
Capturas por grupos de especies y áreas de pesca

Species group Groupe d'espèces Grupo de especies		Fishing area Zone de pêche Área de pesca	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
		81	1 981	2 772	1 971	1 845	1 658	1 378	147
		87	15 623	15 457	18 763	24 803	19 624	27 354	63 329
		Group total	790 999	725 046	760 547	733 099	762 998	816 504	840 876
56	Clams, cockles, arkshells	04	170	75	243	223	197	565	79
	Clams, coques, arches	21	341 448	289 954	299 009	315 960	297 220	289 620	264 710
	Almejas, berberechos, arcas	27	51 376	40 285	40 343	39 826	46 630	30 905	29 526
		31	72 651	64 294	64 254	75 020	77 768	76 167	75 735
		34	132	171	81	252	354	534	640
		37	56 635	32 541	74 495	82 065	67 467	46 167	50 751
		41	1 586	1 467	2 790	2 739	2 722	1 754	2 025
		47	2	2	6	19	32	40	32
		51	...	...	...	252	273	626	655
		57	34 059	27 652	28 628	39 501	44 150	32 649	13 107
		61	149 015	126 425	112 743	121 743	116 642	117 930	106 156
		67	10 011	10 477	11 993	9 640	11 795	13 884	10 795
		71	82 073	57 831	65 548	53 943	47 436	54 328	51 715
		77	4 337	8 783	8 964	8 232	9 779	9 269	9 572
		81	2 358	2 291	2 585	1 734	1 431	1 439	1 423
		87	50 186	41 194	45 916	44 392	38 735	38 587	52 248
		Group total	856 039	703 442	757 598	795 541	762 631	714 464	669 169
57	Squids, cuttlefishes, octopuses	21	41 797	29 297	36 761	21 610	27 846	28 455	22 666
	Encornets, seiches, poulpes	27	62 095	53 945	48 918	59 041	60 892	45 757	60 755
	Calamares, jibias, pulpos	31	27 863	11 798	25 282	20 298	13 695	25 735	23 354
		34	73 561	114 854	105 364	87 071	107 766	124 208	91 101
		37	51 393	66 856	67 552	73 449	61 785	61 150	59 712
		41	212 447	352 266	751 277	1 004 114	895 749	301 922	261 625
		47	19 874	12 623	8 865	12 411	9 183	12 170	11 791
		48	-	-	-	-	0	-	...
		51	114 563	121 293	120 420	103 122	90 946	91 103	144 150
		57	115 244	92 179	101 052	110 671	100 400	125 447	114 021
		58	0	0	0	0	0	0	0
		61	1 471 729	1 456 688	1 319 070	1 461 267	1 382 484	1 330 517	1 295 802
		67	776	1 559	2 374	1 300	2 150	675	843
		71	488 993	492 338	495 386	500 134	497 338	515 374	549 711
		77	127 979	110 015	115 689	108 097	125 221	154 497	176 241
		81	142 155	128 272	115 543	100 311	73 353	66 796	58 327
		87	764 438	742 015	819 572	648 958	821 737	602 299	782 533
		88	0	0	0	0	0	0	0
		Group total	3 714 907	3 785 998	4 133 125	4 311 854	4 270 545	3 486 105	3 652 632
58	Miscellaneous marine molluscs	21	4 716	16 735	10 368	1 214	135	1 588	896
	Mollusques marins divers	27	163	122	62	217	147	95	75
	Moluscos marinos diversos	31	3 410	1 527	892	1 128	1 768	1 205	1 071
		34	1 312	1 910	1 099	1 087	1 004	1 039	981
		37	21 223	18 287	16 310	17 632	15 564	10 591	15 460
		41	3 293	4 811	4 330	5 415	1 476	1 143	5 322
		47	0	0	0	-	-	6	-
		51	3 078	2 809	2 262	5 060	9 403	10 336	2 442
		57	8 226	5 978	5 805	4 010	5 228	6 313	5 963
		58	0	-	-	0	-	-	-
		61	725 250	756 975	774 663	749 852	651 493	678 752	629 599
		67	3 102	3 471	3 961	4 592	3 502	4 413	2 861
		71	73 840	75 441	77 729	77 334	81 408	89 346	96 166
		77	5 059	2 176	2 500	3 129	2 776	2 453	2 427
		81	61	62	59	45	75	31	117
		87	2 955	5 967	3 305	4 839	5 499	2 527	3 513
		Group total	855 688	896 271	903 345	875 554	779 478	809 838	766 893
71	Frogs and other amphibians	02	135	174	181	183	219	221	231
	Grenouilles et autres amphibies	03	-	-	1	-	-	-	-
	Ranas y otros anfibios	04	2 701	2 315	7 970	2 508	2 188	2 312	2 802
		05	0	-	15	-	-	-	-
		Group total	2 836	2 489	8 167	2 691	2 407	2 533	3 033
72	Turtles	02	41	33	30	30	48	15	35
	Tortues	04	140	114	58	106	81	173	12
	Tortugas	31	24	28	21	9	2	0	0
		34	28	37	39	9	9	5	3
		57	137	125	134	139	4	120	96
		71	28	55	64	59	236	226	43
		87	1	2	1	1	...	...	...
		Group total	399	394	347	353	380	539	189

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Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species groups and fishing areas
Captures par groupes d'espèces et zones de pêche
Capturas por grupos de especies y áreas de pesca

Species group Groupe d'espèces Grupo de especies		Fishing area Zone de pêche Área de pesca	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
74	Sea-squirts and other tunicates	37	77	3	3	3	3	5	6
	Ascidiens et autres tuniciers	57	-	-	-	-	4	4	7
	Ascidias y otros tunicados	58	1	0	-	-	0	-	-
		61	1 336	1 548	1 113	1 135	1 591	1 128	1 238
		87	1 083	1 184	1 233	1 202	1 026	1 251	877
		88	0	-	-	-	-	-	-
		Group total	2 497	2 735	2 349	2 340	2 624	2 388	2 128
75	Horseshoe crabs and other arachnoids	21	518	749	706	917	779	1 027	602
	Limules et autres arachnoïdés	31	1	4	5	3	8	7	7
	Erizos de mar y otros equinodermos								
		Group total	519	753	711	920	787	1 034	609
76	Sea-urchins and other echinoderms	21	9 462	7 686	10 028	7 233	7 329	9 114	9 110
	Oursins et autres échinodermes	27	595	684	553	679	1 796	1 752	3 086
	Erizos de mar y otros equinodermos	31	10	10	15	306	205	730	452
		34	...	...	...	...	...	...	14
		37	175	22	86	3	3	39	109
		48	-	0	-	-	-	-	-
		51	1 665	1 595	1 901	2 337	1 541	1 878	2 235
		57	694	2 998	1 873	3 275	4 682	4 371	4 641
		58	3	2	3	1	3	3	5
		61	27 234	28 278	30 010	23 540	25 547	27 580	27 888
		67	6 432	4 944	5 196	3 966	4 098	4 184	3 433
		71	9 515	9 271	7 400	7 855	6 088	7 606	6 295
		77	7 871	7 928	7 311	7 608	7 699	9 174	9 730
		81	563	879	822	825	794	761	726
		87	50 865	40 767	35 140	40 730	41 505	40 390	33 483
		88	0	0	0	1	1	1	0
		Group total	115 084	105 064	100 338	98 359	101 291	107 583	101 207
77	Miscellaneous aquatic invertebrates	02	167	339	354	439	361	439	448
	Invertébrés aquatiques divers	04	39 593	39 917	37 831	38 420	36 619	46 348	46 177
	Invertebrados acuáticos diversos	05	40	157	148	112	336	264	171
		21	450	406	344	425	367	352	364
		27	0	0	0	2	5	8	11
		31	1 512	44	...	671	210	...	...
		34	6	11	-	5	-	-	-
		37	1 096	612	1 186	132	413	320	289
		47	-	19	...	20	...	...	...
		48	-	0	-	1	0	0	-
		51	312	358	43	1 759	325	3 341	7 997
		57	4 201	35 411	138 525	4 137	150 543	119 809	111 920
		58	1	2	1	1	14	1	1
		61	182 477	249 881	202 121	239 726	251 373	257 023	258 515
		71	11 223	14 410	13 098	15 333	9 978	10 343	11 366
		77	74	48	1 031	1 089	1 148	985	991
		81	18	20	12	...	1	1	0
		88	0	2	0	0	-	-	-
		Group total	241 170	341 637	394 694	302 272	451 693	439 234	438 250
World total **Total mondial** **Total mundial**			**92 604 414**	**92 329 279**	**90 023 515**	**90 305 150**	**89 698 988**	**89 630 210**	**88 603 826**

B-11

Carps, barbels and other cyprinids
Carpes, barbeaux et autres cyprinidés
Carpas, barbos y otros ciprínidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Buffalofishes nei	**Poissons-taureaux nca**		**...C**		***Ictiobus spp***				**1,40(01)011,XX**	**BUF**
02 USA	1 569	1 558	1 685	1 603	1 800	1 881	1 965	1 641	1 420	1 511
02 Fishing area total	*1 569*	*1 558*	*1 685*	*1 603*	*1 800*	*1 881*	*1 965*	*1 641*	*1 420*	*1 511*
Species total	*1 569*	*1 558*	*1 685*	*1 603*	*1 800*	*1 881*	*1 965*	*1 641*	*1 420*	*1 511*
Suckers nei	**Cyprins sucets nca**		**Chupadores nep**		***Catostomidae***				**1,40(01)XXX,XX**	**CTM**
02 USA	187	173	184	285	193	215	162	164	141	155
02 Fishing area total	*187*	*173*	*184*	*285*	*193*	*215*	*162*	*164*	*141*	*155*
Species total	*187*	*173*	*184*	*285*	*193*	*215*	*162*	*164*	*141*	*155*
Freshwater bream	**Brème d'eau douce**		**Brema común**		***Abramis brama***				**1,40(02)001,02**	**FBM**
04 Azerbaijan	127	48	50	43	63	66	75	76	72	56
Georgia	1	2	1	2	2 F	2 F	1 F	1 F	1 F	1 F
Kazakhstan	12 630	14 110	15 959	21 907	20 508	17 162	18 801	21 324	17 085	22 104
Kyrgyzstan	4	3	1	2	4 F	2 F	1	0	0	...
Tajikistan	37	25	24	28	22 F	20 F	10 F	5 F	5 F	...
Turkey	151	198	221	213	234	259	225	170	148	151
Turkmenistan	126	107	91	120	120 F	120 F	120 F	120 F	120 F	120 F
Uzbekistan	283	37	28	30	120 F	201	68	370	164	110 F
04 Fishing area total	*13 359*	*14 530*	*16 375*	*22 345*	*21 073 F*	*17 832 F*	*19 301 F*	*22 066 F*	*17 595 F*	*22 542 F*
05 Belarus	198	214	146	109	109	131	162	193	224	212
Belgium	60	60	60	60	60	60	60	60	60	60
Bulgaria	4	6	30	65	41	40	9	11	9	8
Croatia	-	-	-	-	-	-	-	-	63	68
Czech Rep	247	243	243	213	211	217	190	169	183	170
Denmark	28	26	49	6	5	5	3	3	2	1
Estonia	318	385	328	335	425	432	554	774	783	580
Finland	1 660	2 169	2 169	2 030	2 030	1 908	1 908	1 369	1 369	1 369
Germany	...	...	...	...	...	35	35	133	139	121
Greece	9	10	8	4	4	2	2	1	-	-
Latvia	152	141	134	82	55	63	54	54	67	71
Lithuania	470	86	453	460	382	366	455	366	323	400
Netherlands	300 F	282	280 F	280 F	280 F	280 F	280 F	280 F	280 F	280 F
Poland	1 859	1 797	1 962	1 776	1 240	1 068	1 051	1 004	861	766
Romania	800	911	1 828	615	581	1 278	1 090	988	705	339
Russian Fed	27 263	27 670	24 678	20 174	21 937	21 062	30 443	31 101	27 886	30 626
Serbia	...	...	...	...	...	359	479	431	528	399
Slovenia	10	9	8	9	7	6	9	6	6	6
Switzerland	9	10	10	9	11	17	15	11	8	13
Ukraine	942	502	2 678	330	691	819	2 686	298	314	245
UK	0	2	0	0	-	-	-	-	-	-
05 Fishing area total	*34 329 F*	*34 523*	*35 064 F*	*26 557 F*	*28 069 F*	*28 148 F*	*39 485 F*	*37 252 F*	*33 810 F*	*35 734 F*
27 Denmark	0	0	0	1	0	1	1	-	-	-
Estonia	10	16	15	12	7	6	9	8	5	4
Finland	987	636	617	462	450	555	531	778	796	1 206
Latvia	94	111	58	52	67	-	35	31	34	61
Lithuania	-	426	2	3	3	1	2	1	1	1
Netherlands	-	-	1	1	-	-	1	-	-	-
Poland	717	829	952	1 158	786	670	682	566	843	590
Sweden	4	5	5	4	9	7	10	2	12	2
27 Fishing area total	*1 812*	*2 023*	*1 650*	*1 693*	*1 322*	*1 240*	*1 271*	*1 386*	*1 691*	*1 864*
37 Russian Fed	108	47	7	10	4	3	3	5	5	2
Ukraine	-	-	0	...	0	-	-	-	1	1
37 Fishing area total	*108*	*47*	*7*	*10*	*4*	*3*	*3*	*5*	*6*	*3*
Species total	*49 608 F*	*51 123*	*53 096 F*	*50 605 F*	*50 468 F*	*47 223 F*	*60 060 F*	*60 709 F*	*53 102 F*	*60 143 F*
Freshwater breams nei	**Brèmes d'eau douce nca**		**Bremas nep**		***Abramis spp***				**1,40(02)001,XX**	**FBR**
04 Iran	10	38	33	27	92	13	11	9	1	8
04 Fishing area total	*10*	*38*	*33*	*27*	*92*	*13*	*11*	*9*	*1*	*8*
05 Bulgaria	-	-	2	2	3	2	1	2	1	0
Lithuania	24	-	-	-	-	-	-	-	-	-
Romania	-	7	190	-	-	-	-	-	-	-
Russian Fed	2 153	1 886	2 010	1 679	1 505	1 667	1 696	1 641	1 852	1 963
Slovakia	95	103	98	98	105	95	76	69	81	66
05 Fishing area total	*2 272*	*1 996*	*2 300*	*1 779*	*1 613*	*1 764*	*1 773*	*1 712*	*1 934*	*2 029*
27 Germany	174	107	54	69	173	268	241	278	327	204
Lithuania	2	9	-	-	-	-	-	-	-	-
Russian Fed	1 382	1 427	1 326	1 343	1 247	1 375	1 383	1 339	1 378	1 424
27 Fishing area total	*1 558*	*1 543*	*1 380*	*1 412*	*1 420*	*1 643*	*1 624*	*1 617*	*1 705*	*1 628*
Species total	*3 840*	*3 577*	*3 713*	*3 218*	*3 125*	*3 420*	*3 408*	*3 338*	*3 640*	*3 665*
Common carp	**Carpe commune**		**Carpa**		***Cyprinus carpio***				**1,40(02)002,01**	**FCP**
01 Ethiopia	74	79	39	63	57	36	284	313	293	182
Kenya	49	50	271	280	377	589	564	592	1 238	1 333
Lesotho	8	10	12	15	15	12	16	16	15	15

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Carps, barbels and other cyprinids
Carpes, barbeaux et autres cyprinidés
Carpas, barbos y otros ciprínidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
01 Fishing area total	*131*	*139*	*322*	*358*	*449*	*637*	*864*	*921*	*1 546*	*1 530*
02 Canada	506	878	507	480	502	431	362	259	305	33
Dominican Rp	397	585	377	580	494	424	372	489	28	118
Mexico	14 700	13 706	16 013	16 075	15 545	16 288	19 205	20 930	24 450	29 793
USA	704	656	553	430	394	546	617	550	487	521
02 Fishing area total	*16 307*	*15 825*	*17 450*	*17 565*	*16 935*	*17 689*	*20 556*	*22 228*	*25 270*	*30 465*
03 Venezuela	0	0	0	0	0	0	0	-	-	-
03 Fishing area total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*...*	*...*	*...*
04 Armenia	7	11	143	26	30 F	42 F	49 F	56 F	58 F	58 F
Azerbaijan	51	10	13	16	17	20	17	16	9	9
China,Taiwan	50	54	29	29	24	26	21	19	13	8
Georgia	5	5	1	3	2 F	...	...	...	...	...
Indonesia	8 228	9 460	8 917	9 951	9 012	9 013	9 096	8 183	6 361	8 941
Iran	7 220	3 643	5 170	5 600	6 210	6 292	9 769	8 091	7 700	8 775
Israel	97	98	98	115	88	108	50	30	59	59
Japan	3 558	3 359	2 883	1 843	1 484	579	528	468	434	398 F
Kazakhstan	710	23	99	78	1 625	160	184	191	152	146
Korea Rep	...	...	...	...	1 211	320	825	1 379	1 777	1 802
Kyrgyzstan	11	9	1	-	-	-	27	6	6 F	15
Tajikistan	24	51	52	45	36 F	30 F	30 F	25 F	20 F	20 F
Thailand	6 800	9 900	4 941	7 700	5 287	3 300	1 400	15 600	7 054	7 500
Turkey	12 265	12 965	13 820	13 451	13 718	12 116	12 286	11 625	10 964	12 058
Turkmenistan	93	75	53	31	30 F	30 F	30 F	30 F	30 F	30 F
Uzbekistan	514	382	397	238	330 F	424	405	630	1 636	1 100 F
04 Fishing area total	*39 633*	*40 045*	*36 617*	*39 126*	*39 104 F*	*32 460 F*	*34 717 F*	*46 349 F*	*36 273 F*	*40 919 F*
05 Albania	300	260	350 F	415	540	430	435	371	214	670
Belarus	15	44	44	34	30	39	38	42	41	42
Belgium	30	30	30	30	30	30	30	30	30	30
Bulgaria	880	521	752	999	736	723	540	464	804	502
Croatia	1	2	1	2	3	3	3	2	168	185
Czech Rep	3 560	3 909	4 015	3 462	3 260	3 656	3 341	3 257	3 214	3 161
Denmark	0	0	1	0	-	-	0	0	0	0
FYRMacedonia	6	22	24	10	14	1	2	2	3	6
Germany	386	386	386	386	139	108	108	114	84	76
Greece	198	263	265	275	262	260	265	259	202	202 F
Hungary	2 470	2 787	2 930	3 502	3 475	3 737	3 554	3 913	3 238	3 247
Latvia	5	5	4	2	2	1	1	2	1	1
Lithuania	16	18	18	10	3	1	2	1	2	2
Moldova Rep	212	274	125	128	160	239	538	580	715	738
Montenegro	...	...	...	...	...	410	82	452	350	234
Poland	50	54	48	62	112	41	51	43	44	33
Portugal	0	-	-	-	-	-	-	-	-	-
Romania	566	486	342	227	204	187	175	321	192	106
Russian Fed	2 698	2 614	2 525	1 917	2 257	2 302	3 564	2 643	2 436	3 430
Serbia	...	...	...	...	...	204	206	289	331	494
Serbia-Monte	96	111	140	170	139	-	-	-	-	-
Slovakia	967	1 166	1 046	1 015	1 112	1 184	1 430	1 178	1 241	1 159
Slovenia	75	83	82	83	76	80	74	89	72	69
Switzerland	1	2	2	1	3	3	3	3	3	2
Ukraine	39	40	36	311	33	46	68	39	48	45
UK	-	-	1	0	-	-	-	-	-	-
05 Fishing area total	*12 571*	*13 077*	*13 167 F*	*13 041*	*12 590*	*13 685*	*14 510*	*14 094*	*13 433*	*14 434 F*
06 New Zealand	6	7	6	2	4	6	3	5	0	4
06 Fishing area total	*6*	*7*	*6*	*2*	*4*	*6*	*3*	*5*	*0*	*4*
27 Denmark	-	10	0	-	-	0	-	-	-	-
Estonia	-	-	-	-	-	-	-	1	0	0
Germany	1	1	1	0	-	-	-	-	-	1
Latvia	-	-	3	2	-	-	-	-	-	0
27 Fishing area total	*1*	*11*	*4*	*2*	*-*	*0*	*-*	*1*	*0*	*1*
37 Russian Fed	1	-	-	-	-	2	2	4	-	2
Ukraine	1	3	4	4	6	6	-	-	-	-
37 Fishing area total	*2*	*3*	*4*	*4*	*6*	*8*	*2*	*4*	*-*	*2*
Species total	*68 651*	*69 107*	*67 570 F*	*70 098*	*69 088 F*	*64 485 F*	*70 652 F*	*83 602 F*	*76 522 F*	*87 355 F*

Tench **Tanche** **Tenca** ***Tinca tinca*** **1,40(02)007,01** **FTE**

04 Kazakhstan	-	183	150	207	...	...	...	...	95	88
Turkey	778	800	785	1 875	1 792	1 953	1 884	1 632	1 482	1 162
04 Fishing area total	*778*	*983*	*935*	*2 082*	*1 792*	*1 953*	*1 884*	*1 632*	*1 577*	*1 250*
05 Belarus	7	7	8	7	7	9	13	16	13	19
Belgium	15	15	15	...	...	...	15	15	15	15
Bulgaria	2	3	4	1	5	1	0	2	0	0
Croatia	-	-	-	-	-	-	-	-	5	5
Czech Rep	24	24	25	22	20	22	21	23	24	22
Denmark	0	0	0	0	-	-	0	0	-	-
Estonia	-	-	-	5	5	11	13	10	9	9
Germany	36	36	36	36	34	41	41	24	24	41
Greece	8	8	8	3	3	2	2	2	1	1 F
Latvia	35	40	47	28	29	42	27	37	38	47
Lithuania	15	16	16	9	3	2	2	3	3	4

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Carps, barbels and other cyprinids
Carpes, barbeaux et autres cyprinidés
Carpas, barbos y otros ciprínidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Poland	113	141	145	108	117	131	132	138	141	134
Portugal	-	-	-	-	-	1	-	-	-	-
Romania	31	19	29	10	22	51	27	7	11	13
Russian Fed	1 409	1 456	1 417	1 367	1 488	1 686	1 601	1 503	2 622	3 729
Serbia	...	...	...	...	...	12	58	7	101	-
Slovakia	5	5	4	3	5	4	6	3	3	4
Slovenia	1	1	1	1	-	1	1	1	1	1
Switzerland	3	4	5	5	5	5	4	5	5	5
05 Fishing area total	*1 704*	*1 775*	*1 760*	*1 605*	*1 743*	*2 021*	*1 963*	*1 796*	*3 016*	*4 049 F*
27 Denmark	0	0	-	0	-	-	-	-	-	-
Estonia	-	-	-	-	-	3	2	2	2	2
Germany	1	1	2	1	1	1	1	1	1	1
Poland	-	-	-	4	4	6	6	10	11	8
27 Fishing area total	*1*	*1*	*2*	*5*	*5*	*10*	*9*	*13*	*14*	*11*
Species total	*2 483*	*2 759*	*2 697*	*3 692*	*3 540*	*3 984*	*3 856*	*3 441*	*4 607*	*5 310 F*
Bleak	**Ablette**		**Alburno**		***Alburnus alburnus***				**1,40(02)012,01**	**ALR**
05 Albania	478	234	280 F	330	457	402	504	190	530	505
Belarus	...	12	...	...	...	...	...	...	...	...
Bulgaria	3	19	23	45	29	24	5	5	9	6
Estonia	-	-	-	-	-	0	-	-	-	4
Greece	9	5	30	35	30	30	30	25	5	5 F
Lithuania	4	6	4	1	-	1	0	0	0	-
Montenegro	...	...	...	...	...	30	88	112	100	1
Poland	-	-	-	-	-	-	2	2	4	8
Romania	60	27	0	0	11	15	10	35	30	13
Slovenia	-	3	1	2	2	2	6	2	2	2
Ukraine	-	2	3 503	...	-	-	-	-	-	-
05 Fishing area total	*554*	*308*	*3 841 F*	*413*	*529*	*504*	*645*	*371*	*680*	*544 F*
Species total	*554*	*308*	*3 841 F*	*413*	*529*	*504*	*645*	*371*	*680*	*544 F*
Barbel	**Barbeau fluviatile**		**Barbo común**		***Barbus barbus***				**1,40(02)013,01**	**PTB**
05 Bulgaria	3	4	1	47	34	33	10	11	10	12
Greece	9	9	7	3	3	2	2	2	1	1 F
Hungary	52	41	44	45	38	33	32	36	31	24
Poland	1	1	1	1	1	0	1	0	0	0
Romania	34	12	10	22	22	21	23	62	45	33
Serbia	...	...	...	...	...	90	69	271	191	101
Slovakia	19	15	20	20	18	15	13	15	14	15
Slovenia	11	11	10	10	9	8	11	7	8	9
05 Fishing area total	*129*	*93*	*93*	*148*	*125*	*202*	*161*	*404*	*300*	*195 F*
Species total	*129*	*93*	*93*	*148*	*125*	*202*	*161*	*404*	*300*	*195 F*
Mediterranean barbel	**...B**		**...C**		***Barbus meridionalis***				**1,40(02)013,02**	**BUD**
05 Bulgaria	...	10	5	1	1	0	0	0	0	0
05 Fishing area total	*...*	*10*	*5*	*1*	*1*	*0*	*0*	*0*	*0*	*0*
Species total	*...*	*10*	*5*	*1*	*1*	*0*	*0*	*0*	*0*	*0*
...A	**...B**		**...C**		***Barbus cyclolepis***				**1,40(02)013,45**	**BBZ**
05 Bulgaria	...	1	1	-	18	2	0	0	...	0
05 Fishing area total	*...*	*1*	*1*	-	*18*	*2*	*0*	*0*	*...*	*0*
Species total	*...*	*1*	*1*	-	*18*	*2*	*0*	*0*	*...*	*0*
Common nase	**Nase commun**		**Condrostoma común**		***Chondrostoma nasus***				**1,40(02)014,01**	**HON**
05 Bulgaria	7	17	14	17	20	13	2	3	3	2
Poland	-	-	0	-	0	0	0	0	0	1
Romania	...	...	...	...	20	20	9	10	5	7
Serbia	...	...	...	...	...	123	196	148	127	100
Slovakia	20	15	22	16	13	12	11	8	10	10
Slovenia	...	...	...	...	...	...	...	13	14	17
05 Fishing area total	*27*	*32*	*36*	*33*	*53*	*168*	*218*	*182*	*159*	*137*
Species total	*27*	*32*	*36*	*33*	*53*	*168*	*218*	*182*	*159*	*137*
Crucian carp	**Carassin(=Cyprin)**		**Carpín**		***Carassius carassius***				**1,40(02)016,01**	**FCC**
01 Ethiopia	108	103	119	119	119	48	16	151	179	100
01 Fishing area total	*108*	*103*	*119*	*119*	*119*	*48*	*16*	*151*	*179*	*100*
04 Armenia	32	54	63	40	45 F	63 F	73 F	83 F	85 F	85 F
Azerbaijan	17	6	8	7	3	9	10	20	19	12
China,Taiwan	37	26	12	7	10	-	-	-	-	-
Georgia	...	...	31	22	25 F	33 F	41	41 F	41 F	41 F
Japan	2 948	2 706	2 534	2 258	2 021	1 079	1 006	917	847	799 F
Kazakhstan	1 707	1 474	1 368	943	2 371	2 169	2 656	3 774	2 296	2 650
Tajikistan	...	17	11	8	6 F	5 F	5 F	...	...	...
Turkmenistan	154	141	87	62	70 F	70 F	70 F	70 F	70 F	70 F
Uzbekistan	201	249	216	191	70 F	...	3	10	289	200 F

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Carps, barbels and other cyprinids
Carpes, barbeaux et autres cyprinidés
Carpas, barbos y otros ciprínidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
04 Fishing area total	*5 096*	*4 673*	*4 330*	*3 538*	*4 621 F*	*3 428 F*	*3 864 F*	*4 915 F*	*3 647 F*	*3 857 F*
05 Albania	326	260	300 F	350	381	394	431	380	208	458
Bulgaria	...	...	...	...	...	...	6	35	23	13
Czech Rep	37	33	31	33	29	26	24	24	23	20
Estonia	-	-	-	1	1	2	4	3	3	2
Latvia	24	36	36	12	15	11	8	10	10	11
Moldova Rep	127	183	139	152	170	186	265	420	380	365
Poland	84	111	119	100	108	102	91	111	115	85
Portugal	0	0	-	-	-	-	-	-	-	-
Romania	97	87	0	0	-	-	-	-	4	-
Slovenia	0	2	1	1	4	3	3	0	0	0
05 Fishing area total	*695*	*712*	*626 F*	*649*	*708*	*724*	*832*	*983*	*766*	*954*
27 Denmark	0	0	-	-	-	-	-	-	-	-
Estonia	-	-	-	-	-	-	-	6	6	7
Germany	-	-	-	-	-	-	-	0	3	4
Latvia	...	...	...	...	...	...	4	2	1	5
Lithuania	-	15	-	-	-	-	-	-	-	-
Poland	3	4	6	9	8	8	10	18	15	16
Russian Fed	39	50	39	19	37	16	24	4	18	4
27 Fishing area total	*42*	*69*	*45*	*28*	*45*	*24*	*38*	*30*	*43*	*36*
Species total	*5 941*	*5 557*	*5 120 F*	*4 334*	*5 493 F*	*4 224 F*	*4 750 F*	*6 079 F*	*4 635 F*	*4 947 F*
Goldfish	**Poisson rouge(=Cyprin doré)**		**Pez rojo**		***Carassius auratus***			**1,40(02)016,02**		**CGO**
02 USA	10	12	7	14	9	52	57	31	53	69
02 Fishing area total	*10*	*12*	*7*	*14*	*9*	*52*	*57*	*31*	*53*	*69*
04 Kyrgyzstan	2	1	1	1	2 F	2 F	3	1	1 F	3
04 Fishing area total	*2*	*1*	*1*	*1*	*2 F*	*2 F*	*3*	*1*	*1 F*	*3*
05 Belarus	188	176	105	44	55	91	72	114	146	135
Bulgaria	138	247	307	304	208	135	100	127	132	129
Greece	415	350	348	450	400	300	330	318	210	210 F
Lithuania	38	33	44	34	19	20	25	27	19	20
Romania	1 149	1 097	2 348	1 447	1 917	2 507	2 907	1 642	1 246	851
Serbia	...	...	...	...	...	842	655	790	855	844
Slovakia	73	63	71	76	72	72	82	63	71	51
Slovenia	1	-	-	-	-	-	-	0	-	-
Ukraine	747	773	1 232	473	1 017	1 049	1 607	572	552	518
05 Fishing area total	*2 749*	*2 739*	*4 455*	*2 828*	*3 688*	*5 016*	*5 778*	*3 653*	*3 231*	*2 758 F*
06 New Zealand	-	-	-	-	-	1	1	1	-	1
06 Fishing area total	-	-	-	-	-	*1*	*1*	*1*	-	*1*
37 Ukraine	-	-	-	-	-	-	2	3	7	6
37 Fishing area total	-	-	-	-	-	-	*2*	*3*	*7*	*6*
Species total	*2 761*	*2 752*	*4 463*	*2 843*	*3 699 F*	*5 071 F*	*5 841*	*3 689*	*3 292 F*	*2 837 F*
Roach	**Gardon**		**Rutilo**		***Rutilus rutilus***			**1,40(02)018,01**		**FRO**
04 Azerbaijan	64	19	26	36	33	32	48	58	39	34
Turkmenistan	1	2	1	17	15 F	15 F	15 F	15 F	15 F	15 F
Uzbekistan	865	296	122	234	310 F	373	458	504	481	320 F
04 Fishing area total	*930*	*317*	*149*	*287*	*358 F*	*420 F*	*521 F*	*577 F*	*535 F*	*369 F*
05 Belarus	33	302	277	174	189	173	188	158	108	110
Belgium	160	160	160	160	160	160	160	160	160	160
Bulgaria	...	14	10	13	9	12	0	0	1	1
Denmark	19	12	30	6	4	8	2	0	1	3
Estonia	231	464	211	220	303	297	316	306	248	267
Finland	3 999	4 166	4 166	4 039	4 039	4 447	4 447	2 659	2 659	2 659
Latvia	49	47	38	33	18	15	16	14	17	17
Lithuania	643	229	763	734	545	484	561	492	354	323
Norway	-	-	-	-	-	1	...	...	...	-
Poland	837	800	830	680	518	489	416	374	412	349
Slovenia	4	4	4	4	2	3	3	2	1	2
Switzerland	137	159	162	167	163	166	168	176	170	149
Ukraine	519	314	3 047	143	522	534	2 569	100	114	90
UK	-	-	-	0	-	-	-	-	-	-
05 Fishing area total	*6 631*	*6 671*	*9 698*	*6 373*	*6 472*	*6 789*	*8 846*	*4 441*	*4 245*	*4 130*
27 Denmark	7	7	6	6	4	6	6	6	1	1
Estonia	272	303	160	187	85	81	63	54	61	71
Finland	1 459	1 077	1 198	881	920	1 309	1 449	945	948	946
Germany	320	347	453	406	494	449	421	507	492	329
Latvia	11	12	8	6	8	6	7	7	12	10
Lithuania	...	517	-	-	-	-	-	-	-	-
Poland	1 338	1 544	1 159	1 360	1 226	985	1 096	939	758	601
Russian Fed	653	585	646	611	590	570	518	475	685	765
Sweden	-	-	-	10	7	3	11	2	-	-
27 Fishing area total	*4 060*	*4 392*	*3 630*	*3 467*	*3 334*	*3 409*	*3 571*	*2 935*	*2 957*	*2 723*
37 Ukraine	7	11	12	5	6	13	18	5	22	16
37 Fishing area total	*7*	*11*	*12*	*5*	*6*	*13*	*18*	*5*	*22*	*16*

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Carps, barbels and other cyprinids
Carpes, barbeaux et autres cyprinidés
Carpas, barbos y otros ciprínidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*11 628*	*11 391*	*13 489*	*10 132*	*10 170 F*	*10 631 F*	*12 956 F*	*7 958 F*	*7 759 F*	*7 238 F*
Kutum	**...B**		**...C**		***Rutilus frisii***				**1,40(02)018,02**	**RFR**
04 Azerbaijan	...	16	31	16	18	20	46	50	41	54
Iran	7 199	6 417	8 984	7 036	9 631	16 118	17 196	14 835	12 495	11 573
04 Fishing area total	*7 199*	*6 433*	*9 015*	*7 052*	*9 649*	*16 138*	*17 242*	*14 885*	*12 536*	*11 627*
Species total	*7 199*	*6 433*	*9 015*	*7 052*	*9 649*	*16 138*	*17 242*	*14 885*	*12 536*	*11 627*
Roaches nei	**Gardons nca**		**Rutilos nep**		***Rutilus spp***				**1,40(02)018,XX**	**FRX**
04 Iran	1 316	787	215	129	92	49	57	60	49	134
Kazakhstan	579	1 682	1 235	1 571	1 445	2 039	2 326	4 788	4 162	4 980
04 Fishing area total	*1 895*	*2 469*	*1 450*	*1 700*	*1 537*	*2 088*	*2 383*	*4 848*	*4 211*	*5 114*
05 Albania	...	...	...	95	16	132	105	90	115	190
Germany	...	...	-	-	-	148	148	154	203	162
Greece	324	334	335	312	290	205	185	179	54	54 F
Netherlands	80 F	64	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F
Romania	278	276	579	159	177	250	354	360	265	174
Russian Fed	14 545	16 300	15 028	10 942	10 122	10 671	11 512	13 202	12 527	15 745
Slovenia	7	8	10	8	7	8	6	6	6	5
05 Fishing area total	*15 234 F*	*16 982*	*16 022 F*	*11 586 F*	*10 682 F*	*11 484 F*	*12 380 F*	*14 061 F*	*13 240 F*	*16 400 F*
37 Russian Fed	114	72	83	47	94	108	126	173	41	79
37 Fishing area total	*114*	*72*	*83*	*47*	*94*	*108*	*126*	*173*	*41*	*79*
Species total	*17 243 F*	*19 523*	*17 555 F*	*13 333 F*	*12 313 F*	*13 680 F*	*14 889 F*	*19 082 F*	*17 492 F*	*21 593 F*
Rudd	**Rotengle**		**Escardinio**		***Scardinius erythrophthalmus***				**1,40(02)019,01**	**SRE**
05 Bulgaria	3	45	35	41	33	19	7	17	19	4
Denmark	1	0	0	-	-	-	-	-	-	-
Estonia	-	-	-	-	-	0	0	0	1	1
Greece	45	50	46	34	20	10	8	9	5	5 F
Lithuania	20	23	21	13	1	-	1	2	2	2
Romania	...	...	...	...	2	3	1	8	23	14
Serbia	...	...	...	...	...	130	47	172	43	399
Slovenia	0	0	0	0	1	0	0	-	0	1
Ukraine	33	32	31	3	10	13	9	12	15	12
05 Fishing area total	*102*	*150*	*133*	*91*	*67*	*175*	*73*	*220*	*108*	*438 F*
27 Lithuania	...	2	1	-	-	-	-	-	-	-
27 Fishing area total	*...*	*2*	*1*	-	-	-	-	-	-	-
Species total	*102*	*152*	*134*	*91*	*67*	*175*	*73*	*220*	*108*	*438 F*
Orfe(=Ide)	**Ide mélanote**		**Cachuelo**		***Leuciscus idus***				**1,40(02)020,01**	**FID**
04 Kazakhstan	...	...	...	...	...	...	...	...	108	21
04 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*108*	*21*
05 Belarus	18	1	2	2	1	1	1	1	1	2
Bulgaria	0	0	1	5	7	11	0	0	0	0
Croatia	-	-	-	-	-	-	-	-	9	9
Czech Rep	0	1	1	...	...	...	...	...	...	...
Estonia	4	4	3	2	2	2	3	2	1	2
Finland	181	175	175	214	214	177	177	177	177	185
Latvia	1	1	1	1	-	-	0	0	0	0
Lithuania	1	1	2	1	0	-	0	-	0	-
Poland	7	7	7	7	8	5	6	5	7	8
Russian Fed	2 257	2 492	4 021	3 511	4 596	2 896	2 972	3 379	4 837	5 143
Slovenia	14	14	12	11	10	10	9	-	0	0
05 Fishing area total	*2 483*	*2 696*	*4 225*	*3 754*	*4 838*	*3 102*	*3 168*	*3 564*	*5 032*	*5 349*
27 Estonia	36	26	25	16	7	8	9	12	10	7
Finland	290	184	190	148	145	212	211	256	253	255
Latvia	2	1	1	-	-	-	-	-	-	0
27 Fishing area total	*328*	*211*	*216*	*164*	*152*	*220*	*220*	*268*	*263*	*262*
Species total	*2 811*	*2 907*	*4 441*	*3 918*	*4 990*	*3 322*	*3 388*	*3 832*	*5 403*	*5 632*
Common dace	**Vandoise**		**Leucisco**		***Leuciscus leuciscus***				**1,40(02)020,05**	**FIE**
04 Turkey	91	73	82	93	87	85	82	71	63	92
04 Fishing area total	*91*	*73*	*82*	*93*	*87*	*85*	*82*	*71*	*63*	*92*
05 Slovenia	0	0	0	-	-	-	-	0	-	-
05 Fishing area total	*0*	*0*	*0*	-	-	-	-	*0*	-	-
Species total	*91*	*73*	*82*	*93*	*87*	*85*	*82*	*71*	*63*	*92*
Chub	**...B**		**...C**		***Leuciscus cephalus***				**1,40(02)020,08**	**LUH**
05 Albania	-	-	-	-	-	-	8	8	4	...
Bulgaria	4	17	13	6	4	2	0	0	2	1
Czech Rep	-	-	-	30	19	19	19	20	17	10
Lithuania	3	10	3	3	0	-	0	0	0	0

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Carps, barbels and other cyprinids
Carpes, barbeaux et autres cyprinidés
Carpas, barbos y otros ciprínidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Poland	0	1	0	0	1	1	1	1	1	2
Romania	...	...	...	...	...	...	...	7	-	-
Serbia	...	...	...	...	...	12	14	32	20	13
05 Fishing area total	*7*	*28*	*16*	*39*	*24*	*34*	*42*	*68*	*44*	*26*
Species total	*7*	*28*	*16*	*39*	*24*	*34*	*42*	*68*	*44*	*26*
Chubs nei	**...B**		**...C**		***Leuciscus spp***				**1,40(02)020,XX**	**LEW**
05 Slovakia	31	24	27	21	16	16	17	14	14	12
05 Fishing area total	*31*	*24*	*27*	*21*	*16*	*16*	*17*	*14*	*14*	*12*
Species total	*31*	*24*	*27*	*21*	*16*	*16*	*17*	*14*	*14*	*12*
Rhinofishes nei	**Labéos nca**		**Labeos nep**		***Labeo spp***				**1,40(02)024,XX**	**RHI**
01 Ethiopia	3 387	2 303	668	100	267	...	...	...	...	...
Kenya	222	203	117	139	497	790	423	1 900	1 900	1 793
Senegal	...	...	...	...	...	...	...	1 522	940 F	357
01 Fishing area total	*3 609*	*2 506*	*785*	*239*	*764*	*790*	*423*	*3 422*	*2 840 F*	*2 150*
Species total	*3 609*	*2 506*	*785*	*239*	*764*	*790*	*423*	*3 422*	*2 840 F*	*2 150*
Mud carp	**Carpe de vase**		**Carpa de fango**		***Cirrhinus molitorella***				**1,40(02)025,02**	**MUC**
04 China,Taiwan	6	9	11	10	8	-	-	-	-	-
04 Fishing area total	*6*	*9*	*11*	*10*	*8*	-	-	-	-	-
Species total	*6*	*9*	*11*	*10*	*8*	-	-	-	-	-
Grass carp(=White amur)	**Carpe herbivore(=chinoise)**		**Carpa china**		***Ctenopharyngodon idellus***				**1,40(02)035,01**	**FCG**
01 Egypt	17 918	19 528	21 397	28 192	26 534	27 534	26 156	21 189	26 071	21 354
01 Fishing area total	*17 918*	*19 528*	*21 397*	*28 192*	*26 534*	*27 534*	*26 156*	*21 189*	*26 071*	*21 354*
02 USA	31	31	18	20	23	32	55	31	38	46
02 Fishing area total	*31*	*31*	*18*	*20*	*23*	*32*	*55*	*31*	*38*	*46*
04 China,Taiwan	132	160	91	34	16	1	12	11	10	8
Indonesia	...	...	...	369	802	814	901	1 005	12	0
Iran	2 579	1 301	1 846	2 000	2 218	2 497	3 489	2 890	2 750	3 134
Kazakhstan	...	...	...	...	...	...	...	...	31	31
Uzbekistan	4	8	22	55	30 F	...	15	309	607	400 F
04 Fishing area total	*2 715*	*1 469*	*1 959*	*2 458*	*3 066 F*	*3 312*	*4 417*	*4 215*	*3 410*	*3 573 F*
05 Albania	10	14	20 F	23	43	38	88	45	64	67
Bulgaria	18	23	30	40	47	51	23	27	21	19
Croatia	-	-	-	-	-	-	-	-	54	56
Czech Rep	60	69	113	89	80	92	96	86	89	89
Germany	5	3	10	10	20	23	23	26	53	10
Hungary	309	400	372	356	359	393	407	437	404	338
Poland	4	5	5	3	8	3	2	2	3	1
Romania	73	10	0	3	5	36	12	1	1	-
Russian Fed	-	-	-	-	-	-	-	-	1	1
Serbia	...	...	...	...	...	38	28	34	32	85
Slovakia	9	19	34	28	25	33	45	36	51	35
Slovenia	2	2	1	2	2	3	2	2	1	3
Ukraine	-	1	-	-	0	1	3	1	0	0
05 Fishing area total	*490*	*546*	*585 F*	*554*	*589*	*711*	*729*	*697*	*774*	*704*
Species total	*21 154*	*21 574*	*23 959 F*	*31 224*	*30 212 F*	*31 589*	*31 357*	*26 132*	*30 293*	*25 677 F*
Beardless barb	**...B**		**...C**		***Cyclocheilichthys apogon***				**1,40(02)036,02**	**YCA**
04 Indonesia	...	...	...	...	34	24	1 280	2 450	591	488
04 Fishing area total	...	...	...	...	*34*	*24*	*1 280*	*2 450*	*591*	*488*
Species total	...	...	...	...	*34*	*24*	*1 280*	*2 450*	*591*	*488*
...A	**...B**		**...C**		***Cyclocheilichthys armatus***				**1,40(02)036,04**	**YCQ**
04 Indonesia	...	...	...	...	...	...	...	...	2	9
04 Fishing area total	...	...	...	...	...	...	...	...	*2*	*9*
Species total	...	...	...	...	...	...	...	...	*2*	*9*
Hampala barb	**...B**		**...C**		***Hampala macrolepidota***				**1,40(02)042,02**	**HML**
04 Indonesia	...	...	...	75	181	124	404	160	1 630	805
04 Fishing area total	...	...	...	*75*	*181*	*124*	*404*	*160*	*1 630*	*805*
Species total	...	...	...	*75*	*181*	*124*	*404*	*160*	*1 630*	*805*
Silver carp	**Carpe argentée**		**Carpa plateada**		***Hypophthalmichthys molitrix***				**1,40(02)043,01**	**SVC**
04 China,Taiwan	11	18	19	35	12	-	-	-	-	-
Iran	8 509	4 293	6 092	6 600	7 319	8 240	11 513	9 536	9 075	10 342
Israel	16	31	23	60	114	167	119	32	79	79
Kazakhstan	...	...	...	...	...	...	...	...	171	198

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Carps, barbels and other cyprinids
Carpes, barbeaux et autres cyprinidés
Carpas, barbos y otros ciprínidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Kyrgyzstan	19	17	2	...	...	...	2	1	1 F	3
Tajikistan	...	16	12	14	11 F	20 F	30 F	35 F	40 F	50 F
Uzbekistan	270	305	348	106	140 F	...	298	219	1 982	1 340 F
04 Fishing area total	*8 825*	*4 680*	*6 496*	*6 815*	*7 596 F*	*8 427 F*	*11 962 F*	*9 823 F*	*11 348 F*	*12 012 F*
05 Albania	101	129	100 F	68	140	148	169	125	183	165
Belarus	...	9	...	...	...	...	...	...	...	...
Bulgaria	403	85	156	100	197	122	114	109	100	55
Croatia	-	-	-	-	-	-	-	-	3	2
Czech Rep	12	12	16	13	14	15	12	11	13	4
Germany	39	23	10	10	20	23	23	27	53	10
Hungary	997	525	534	767	1 143	754	583	578	367	350
Poland	120	198	203	115	154	87	83	58	83	66
Romania	644	411	3	16	39	29	29	129	88	74
Russian Fed	11	8	12	19	2	6	16	41	47	39
Serbia	...	...	...	...	...	225	121	206	244	265
Slovakia	8	8	4	5	6	4	7	3	5	3
Slovenia	0	0	0	0	-	0	0	-	-	-
Ukraine	267	152	152	810	264	364	1 225	224	244	244
05 Fishing area total	*2 602*	*1 560*	*1 190 F*	*1 923*	*1 979*	*1 777*	*2 382*	*1 511*	*1 430*	*1 277*
Species total	*11 427*	*6 240*	*7 686 F*	*8 738*	*9 575 F*	*10 204 F*	*14 344 F*	*11 334 F*	*12 778 F*	*13 289 F*
Bighead carp	**Carpe à grosse tête**		**Carpa cabezona**		***Hypophthalmichthys nobilis***				**1,40(02)043,02**	**BIC**
04 China,Taiwan	202	183	190	50	48	25	112	80	52	13
Iran	1 031	520	738	800	887	999	1 396	1 156	1 100	1 254
04 Fishing area total	*1 233*	*703*	*928*	*850*	*935*	*1 024*	*1 508*	*1 236*	*1 152*	*1 267*
05 Albania	-	-	-	-	-	-	24	24	5	...
Bulgaria	...	223	233	427	374	472	199	334	381	259
Croatia	-	-	-	-	-	-	-	-	1	1
Czech Rep	...	...	...	...	...	...	...	...	...	8
Germany	6	4	10	10	20	23	23	27	53	10
Romania	313	278	1	5	4	37	21	14	19	13
05 Fishing area total	*319*	*505*	*244*	*442*	*398*	*532*	*267*	*399*	*459*	*291*
Species total	*1 552*	*1 208*	*1 172*	*1 292*	*1 333*	*1 556*	*1 775*	*1 635*	*1 611*	*1 558*
Signal barb	**...B**		**...C**		***Labiobarbus festivus***				**1,40(02)044,03**	**LZF**
04 Indonesia	...	...	...	...	...	196	184	167	156	214
04 Fishing area total	*...*	*...*	*...*	*...*	*...*	*196*	*184*	*167*	*156*	*214*
Species total	*...*	*...*	*...*	*...*	*...*	*196*	*184*	*167*	*156*	*214*
Nilem carp	**...B**		**...C**		***Osteochilus hasselti***				**1,40(02)051,01**	**FCN**
04 Indonesia	...	...	...	3 986	3 918	4 829	6 082	5 833	4 878	5 328
04 Fishing area total	*...*	*...*	*...*	*3 986*	*3 918*	*4 829*	*6 082*	*5 833*	*4 878*	*5 328*
Species total	*...*	*...*	*...*	*3 986*	*3 918*	*4 829*	*6 082*	*5 833*	*4 878*	*5 328*
Silver rasbora	**...B**		**...C**		***Rasbora argyrotaenia***				**1,40(02)057,06**	**RSZ**
04 Indonesia	...	...	...	33	248	1 064	2 245	713	776	1 347
04 Fishing area total	*...*	*...*	*...*	*33*	*248*	*1 064*	*2 245*	*713*	*776*	*1 347*
Species total	*...*	*...*	*...*	*33*	*248*	*1 064*	*2 245*	*713*	*776*	*1 347*
...A	**...B**		**...C**		***Thynnichthys vaillanti***				**1,40(02)058,03**	**TWY**
04 Indonesia	...	...	...	157	204	263	453	594	564	1 727
04 Fishing area total	*...*	*...*	*...*	*157*	*204*	*263*	*453*	*594*	*564*	*1 727*
Species total	*...*	*...*	*...*	*157*	*204*	*263*	*453*	*594*	*564*	*1 727*
Semah mahseer	**...B**		**...C**		***Tor douronensis***				**1,40(02)059,06**	**TZD**
04 Indonesia	...	...	...	60	599	779	708	1 116	988	919
04 Fishing area total	*...*	*...*	*...*	*60*	*599*	*779*	*708*	*1 116*	*988*	*919*
Species total	*...*	*...*	*...*	*60*	*599*	*779*	*708*	*1 116*	*988*	*919*
Silver cyprinid	**...B**		**...C**		***Rastrineobola argentea***				**1,40(02)070,01**	**ENA**
01 Kenya	41 384	35 455	31 659	34 679	54 019	57 929	49 472	46 966	49 326	47 716
Uganda	12 163	11 981	8 248	22 902	25 672	22 618	30 800	33 000 F	47 000 F	63 560
01 Fishing area total	*53 547*	*47 436*	*39 907*	*57 581*	*79 691*	*80 547*	*80 272*	*79 966 F*	*96 326 F*	*111 276*
Species total	*53 547*	*47 436*	*39 907*	*57 581*	*79 691*	*80 547*	*80 272*	*79 966 F*	*96 326 F*	*111 276*
Kinneret bleak	**...B**		**...C**		***Acanthobrama terraesanctae***				**1,40(02)072,02**	**AHT**
04 Israel	811	1 123	641	422	558	847	439	88	98	98
04 Fishing area total	*811*	*1 123*	*641*	*422*	*558*	*847*	*439*	*88*	*98*	*98*
Species total	*811*	*1 123*	*641*	*422*	*558*	*847*	*439*	*88*	*98*	*98*

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Carps, barbels and other cyprinids
Carpes, barbeaux et autres cyprinidés
Carpas, barbos y otros ciprínidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Freshwater minnow	**...B**		**...C**		***Zacco platypus***				**1,40(02)079,01**	**ZAP**
04 Japan	1 190	1 037	941	792	674	...	...	...	...	...
04 Fishing area total	*1 190*	*1 037*	*941*	*792*	*674*	*...*	*...*	*...*	*...*	*...*
Species total	*1 190*	*1 037*	*941*	*792*	*674*	*...*	*...*	*...*	*...*	*...*
Vimba bream	**...B**		**...C**		***Vimba vimba***				**1,40(02)097,01**	**VIV**
04 Azerbaijan	-	-	-	1	2	4	7	9	5	6
04 Fishing area total	-	-	-	*1*	*2*	*4*	*7*	*9*	*5*	*6*
05 Bulgaria	1	2	2	23	19	13	3	2	4	5
Estonia	0	0	-	-	-	-	-	-	-	-
Latvia	20	15	17	7	9	2	2	3	2	3
Lithuania	40	-	-	55	76	82	178	161	73	61
Poland	2	1	0	2	2	0	1	2	1	1
Romania	2	2	1	-	4	14	9	13	7	6
Slovakia	10	11	20	16	12	9	10	8	8	6
Slovenia	2	1	3	2	2	2	2	1	1	1
Ukraine	20	15	11	6	4	5	6	10	11	9
05 Fishing area total	*97*	*47*	*54*	*111*	*128*	*127*	*211*	*200*	*107*	*92*
27 Estonia	83	115	73	60	40	27	35	35	25	32
Latvia	89	84	62	53	71	52	47	53	52	45
Lithuania	...	78	14	7	17	4	17	9	16	14
Poland	-	-	-	2	1	1	0	0	0	0
27 Fishing area total	*172*	*277*	*149*	*122*	*129*	*84*	*99*	*97*	*93*	*91*
Species total	*269*	*324*	*203*	*234*	*259*	*215*	*317*	*306*	*205*	*189*
Sichel	**...B**		**Peleco**		***Pelecus cultratus***				**1,40(02)100,01**	**FSC**
04 Kazakhstan	8	...	...	...	...	...	...	...	17	246
Tajikistan	8	4	2	10	8 F	6 F	6 F	...	...	...
04 Fishing area total	*16*	*4*	*2*	*10*	*8 F*	*6 F*	*6 F*	*...*	*17*	*246*
05 Bulgaria	...	...	1	1	1	0	0	0	-	0
Lithuania	12	-	-	9	5	8	15	14	11	2
Russian Fed	1 022	928	870	601	521	535	507	643	719	1 279
Ukraine	7	4	4	...	0	1	...	0	0	1
05 Fishing area total	*1 041*	*932*	*875*	*611*	*527*	*544*	*522*	*657*	*730*	*1 282*
27 Lithuania	...	4	-	-	-	-	-	-	-	-
Russian Fed	348	519	532	463	393	254	380	372	417	312
27 Fishing area total	*348*	*523*	*532*	*463*	*393*	*254*	*380*	*372*	*417*	*312*
37 Russian Fed	178	140	50	31	12	11	4	2	1	-
Ukraine	7	7	2	8	1	1	-	-	-	-
37 Fishing area total	*185*	*147*	*52*	*39*	*13*	*12*	*4*	*2*	*1*	-
Species total	*1 590*	*1 606*	*1 461*	*1 123*	*941 F*	*816 F*	*912 F*	*1 031*	*1 165*	*1 840*
Asp	**Aspe**		**Aspio**		***Aspius aspius***				**1,40(02)115,01**	**ASU**
04 Azerbaijan	5	1	4	3	2	2	4	4	1	3
Kazakhstan	476	673	956	852	1 326	1 011	1 009	5 219	1 417	1 560
Tajikistan	6	5	3	9	7 F	5 F	5 F	...	...	...
Turkmenistan	16	21	5	10	10 F	10 F	10 F	10 F	10 F	10 F
Uzbekistan	24	93	49	120	80 F	31	2	1	6	4 F
04 Fishing area total	*527*	*793*	*1 017*	*994*	*1 425 F*	*1 059 F*	*1 030 F*	*5 234 F*	*1 434 F*	*1 577 F*
05 Bulgaria	7	1	3	18	19	19	3	2	3	3
Croatia	-	-	-	-	-	-	-	-	11	12
Czech Rep	17	18	18	21	21	27	18	19	16	16
Germany	-	-	-	-	-	-	-	5	5	5
Hungary	21	20	38	43	44	44	45	45	37	33
Lithuania	5	2	11	8	5	4	5	4	3	2
Poland	5	6	6	11	13	10	10	10	11	10
Romania	4	7	2	3	4	10	10	22	27	23
Russian Fed	130	133	120	97	123	293	244	212	308	462
Serbia	...	...	...	...	...	66	84	63	61	86
Slovakia	8	9	11	11	12	11	11	9	12	12
Slovenia	0	-	-	-	-	-	-	-	-	-
Ukraine	7	7	13	3	4	4	6	8	9	9
05 Fishing area total	*204*	*203*	*222*	*215*	*245*	*488*	*436*	*399*	*503*	*673*
27 Lithuania	...	8	-	-	-	-	-	-	-	-
Poland	-	-	-	5	3	3	4	4	5	3
Russian Fed	9	15	23	15	14	24	22	-	26	-
27 Fishing area total	*9*	*23*	*23*	*20*	*17*	*27*	*26*	*4*	*31*	*3*
37 Russian Fed	-	-	-	-	-	-	1	1	-	1
37 Fishing area total	-	-	-	-	-	-	*1*	*1*	-	*1*
Species total	*740*	*1 019*	*1 262*	*1 229*	*1 687 F*	*1 574 F*	*1 493 F*	*5 638 F*	*1 968 F*	*2 254 F*

B-11

Carps, barbels and other cyprinids
Carpes, barbeaux et autres cyprinidés
Carpas, barbos y otros ciprínidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Danube bleak	**...B**		**...C**		***Chalcalburnus chalcoides***				**1,40(02)124,01**	**NUC**
05 Bulgaria	...	2	3	7	6	8	2	1	1	2
05 Fishing area total	*...*	*2*	*3*	*7*	*6*	*8*	*2*	*1*	*1*	*2*
Species total	*...*	*2*	*3*	*7*	*6*	*8*	*2*	*1*	*1*	*2*
Tarek	**...B**		**...C**		***Chalcalburnus tarichi***				**1,40(02)124,02**	**AWT**
04 Turkey	15 848	14 930	14 215	14 259	14 103	11 978	11 623	11 758	10 685	11 382
04 Fishing area total	*15 848*	*14 930*	*14 215*	*14 259*	*14 103*	*11 978*	*11 623*	*11 758*	*10 685*	*11 382*
Species total	*15 848*	*14 930*	*14 215*	*14 259*	*14 103*	*11 978*	*11 623*	*11 758*	*10 685*	*11 382*
...A	**...B**		**...C**		***Barbodes balleroides***				**1,40(02)129,02**	**BBR**
04 Indonesia	...	...	...	...	7	28	30	26	131	56
04 Fishing area total	*...*	*...*	*...*	*...*	*7*	*28*	*30*	*26*	*131*	*56*
Species total	*...*	*...*	*...*	*...*	*7*	*28*	*30*	*26*	*131*	*56*
Hoven's carp	**Barbus d'Hoven**		**Barbo de Hoven**		***Leptobarbus hoeveni***				**1,40(02)132,01**	**FCH**
04 Indonesia	2 362	3 980	3 341	2 682	2 862	3 199	3 257	3 662	4 062	4 902
04 Fishing area total	*2 362*	*3 980*	*3 341*	*2 682*	*2 862*	*3 199*	*3 257*	*3 662*	*4 062*	*4 902*
Species total	*2 362*	*3 980*	*3 341*	*2 682*	*2 862*	*3 199*	*3 257*	*3 662*	*4 062*	*4 902*
Black carp	**Carpe noire**		**Carpa negra**		***Mylopharyngodon piceus***				**1,40(02)144,01**	**BKC**
04 China,Taiwan	36	25	26	21	12	30	20	16	9	8
04 Fishing area total	*36*	*25*	*26*	*21*	*12*	*30*	*20*	*16*	*9*	*8*
05 Bulgaria	...	2	4	1	2	0	0	0	0	0
05 Fishing area total	*...*	*2*	*4*	*1*	*2*	*0*	*0*	*0*	*0*	*0*
Species total	*36*	*27*	*30*	*22*	*14*	*30*	*20*	*16*	*9*	*8*
Wuchang bream	**Carpe de Wuchang**		**Carpa de Wuchang**		***Megalobrama amblycephala***				**1,40(02)151,01**	**WUB**
05 Albania	-	3	...	...	2	4	3	3	12	...
05 Fishing area total	*-*	*3*	*...*	*...*	*2*	*4*	*3*	*3*	*12*	*...*
Species total	*-*	*3*	*...*	*...*	*2*	*4*	*3*	*3*	*12*	*...*
Spotted barb	**...B**		**...C**		***Puntius binotatus***				**1,40(02)161,03**	**PUI**
04 Indonesia	...	...	...	...	...	23	3	18	54	49
04 Fishing area total	*...*	*...*	*...*	*...*	*...*	*23*	*3*	*18*	*54*	*49*
Species total	*...*	*...*	*...*	*...*	*...*	*23*	*3*	*18*	*54*	*49*
Long pectoral-fin minnow	**...B**		**...C**		***Macrochirichthys macrochirus***				**1,40(02)214,01**	**MCO**
04 Indonesia	...	...	...	20	17	85	62	109	170	13
04 Fishing area total	*...*	*...*	*...*	*20*	*17*	*85*	*62*	*109*	*170*	*13*
Species total	*...*	*...*	*...*	*20*	*17*	*85*	*62*	*109*	*170*	*13*
...A	**...B**		**...C**		***Mystacoleucus padangensis***				**1,40(02)223,02**	**MZP**
04 Indonesia	...	...	...	34	136	19	1 036	1 960	13 121	19 205
04 Fishing area total	*...*	*...*	*...*	*34*	*136*	*19*	*1 036*	*1 960*	*13 121*	*19 205*
Species total	*...*	*...*	*...*	*34*	*136*	*19*	*1 036*	*1 960*	*13 121*	*19 205*
...A	**...B**		**...C**		***Puntioplites waandersi***				**1,40(02)291,02**	**WPU**
04 Indonesia	...	...	...	25	49	601	545	1 678	1 741	2 923
04 Fishing area total	*...*	*...*	*...*	*25*	*49*	*601*	*545*	*1 678*	*1 741*	*2 923*
Species total	*...*	*...*	*...*	*25*	*49*	*601*	*545*	*1 678*	*1 741*	*2 923*
White bream	**...B**		**...C**		***Blicca bjoerkna***				**1,40(02)333,01**	**ABK**
05 Belarus	...	147	...	...	...	...	...	...	...	...
Estonia	-	-	-	-	1	1	4	1	1	6
Lithuania	...	23	38	68	49	37	52	72	84	71
Poland	400	398	316	325	227	212	181	178	172	125
Romania	...	...	...	...	20	26	13	7	8	10
Slovenia	1	-	1	-	-	-	-	-	-	-
Ukraine	137	107	714	42	86	111	56	52	59	54
05 Fishing area total	*538*	*675*	*1 069*	*435*	*383*	*387*	*306*	*310*	*324*	*266*
27 Estonia	-	-	-	-	-	-	-	-	-	22
Latvia	-	-	-	-	-	-	0	1	1	1
27 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*0*	*1*	*1*	*23*
Species total	*538*	*675*	*1 069*	*435*	*383*	*387*	*306*	*311*	*325*	*289*

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Carps, barbels and other cyprinids — **Capture production by species, fishing areas and countries or areas**
Carpes, barbeaux et autres cyprinidés — **Captures par espèces, zones de pêche et pays ou zones**
Carpas, barbos y otros ciprínidos — **Capturas por especies, áreas de pesca y países o áreas**

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Silver barb	**Barbeau argenté**		**Barbo plateado**		***Barbonymus gonionotus***				**1,40(02)335,01**	**PTG**
04 Indonesia	17 425	18 346	17 695	20 413	13 896	14 426	12 881	7 576	10 972	9 962
Thailand	43 400	44 300	38 935	40 000	48 335	17 400	13 700	41 800	46 025	35 700
04 Fishing area total	*60 825*	*62 646*	*56 630*	*60 413*	*62 231*	*31 826*	*26 581*	*49 376*	*56 997*	*45 662*
Species total	*60 825*	*62 646*	*56 630*	*60 413*	*62 231*	*31 826*	*26 581*	*49 376*	*56 997*	*45 662*
Tinfoil barb	**...B**		**...C**		***Barbonymus schwanenfeldii***				**1,40(02)335,03**	**BFS**
04 Indonesia	11 649	14 300	9 095	6 847	6 043	7 452	6 296	4 540	3 488	699
04 Fishing area total	*11 649*	*14 300*	*9 095*	*6 847*	*6 043*	*7 452*	*6 296*	*4 540*	*3 488*	*699*
Species total	*11 649*	*14 300*	*9 095*	*6 847*	*6 043*	*7 452*	*6 296*	*4 540*	*3 488*	*699*
Cyprinids nei	**Cyprinidés nca**		**Ciprínidos nep**		***Cyprinidae***				**1,40(02)XXX,XX**	**FCY**
01 Egypt	5 040	4 385	6 938	5 978	2 747	4 280	4 795	2 537	3 599	2 740
Ethiopia	843	759	394	415	427	1 084	1 651	1 672	1 936	1 971
Kenya	0	0	-	-	-	-	-	-	-	-
Madagascar	4 000 F	4 000 F	4 000 F	4 200 F	4 350 F	4 350 F	4 350 F	4 350 F	4 370 F	4 750 F
Malawi	6 291	6 401	6 719	7 085	7 202	4 176	30 331	27 241	26 822	44 834
Morocco	900	1 100	850	600	2 400	2 800	3 400	3 800	5 200	6 200
Nigeria	5 901	6 004	7 430	7 401	9 883	12 697	10 317	15 242	14 261	15 949
Uganda	19	19	13	37	42	37	50	2 000 F	5 500 F	9 650
01 Fishing area total	*22 994 F*	*22 668 F*	*26 344 F*	*25 716 F*	*27 051 F*	*29 424 F*	*54 894 F*	*56 842 F*	*61 688 F*	*86 094 F*
02 Mexico	3 806	1 711	5 771	5 754	5 200	5 400	1 325	1 321	2 119	2 254
USA	33	27	28	29	26	19	24	25	248	195
02 Fishing area total	*3 839*	*1 738*	*5 799*	*5 783*	*5 226*	*5 419*	*1 349*	*1 346*	*2 367*	*2 449*
03 Brazil	390	406	430	441	447	440	440	470	430	448
03 Fishing area total	*390*	*406*	*430*	*441*	*447*	*440*	*440*	*470*	*430*	*448*
04 Armenia	15	9	10	6	7 F	10 F	12 F	14 F	15 F	14 F
China,H.Kong	0	0	0	0	0	0	0	-	-	-
India	148 622	195 300	201 215	159 633	293 916	296 145	284 274	339 610	326 547	731 052
Indonesia	...	...	...	45	7	15	88	58	550	705
Iran	6 446	3 253	4 615	5 230	5 545	6 242	8 722	7 224	6 878	7 835
Iraq	7 200	6 500	7 500	7 628	9 740	10 795	14 286	14 363	10 000	1 230
Israel	70	47	39	43	42	37	27	14	58	58
Japan	2 104	1 776	1 678	1 472	1 267	722	688	649	640	650 F
Korea Rep	...	...	...	...	...	745	1 342	2 560	2 718	2 893
Kyrgyzstan	8	7	5	1	2 F	2 F	-	-	2 F	6
Lao P.Dem.R.	4 650 F	5 000 F	4 500 F	4 500 F	4 000 F	4 100 F	4 300 F	4 400 F	4 500 F	4 900
Lebanon	10	25	20	20	25	25	25 F	25 F	25 F	25 F
Philippines	5 562	9 127	9 007	10 462	9 726	10 085	15 435	18 465	21 650	22 236
Tajikistan	31	27	23	32	26 F	-	-	-	-	-
Turkey	1 303	1 197	1 303	1 331	1 293	1 301	1 288	1 301	1 172	1 250
04 Fishing area total	*176 021 F*	*222 268 F*	*229 915 F*	*190 403 F*	*325 596 F*	*330 224 F*	*330 487 F*	*388 683 F*	*374 755 F*	*772 854 F*
05 Belarus	77	4	139	138	109	100	125	185	188	225
Belgium	50	50	50	50	50	50	50	50	50	50
Germany	1 653	1 653	1 653	1 653	1 182	1 083	1 083	1 058	952	1 232
Hungary	2 155	2 418	2 057	1 931	1 900	1 385	1 344	1 340	1 257	1 113
Italy	1 821	799	1 114	1 465	374	500	322	339	369	380
Lithuania	-	0	59	0	-	1	0	0	-	-
Poland	1	1	1	0	-	-	-	-	-	-
Romania	298	282	242	30	-	16	9	42	35	-
Russian Fed	18 082	19 855	19 708	20 428	20 324	20 945	27 585	25 467	26 192	38 688
Slovakia	12	29	31	33	35	30	36	22	22	17
Slovenia	25	24	4	19	21	17	18	6	7	7
Switzerland	13	13	23	14	15	23	17	21	11	10
05 Fishing area total	*24 187*	*25 128*	*25 081*	*25 761*	*24 010*	*24 150*	*30 589*	*28 530*	*29 083*	*41 722*
27 Estonia	-	-	-	-	-	-	-	96	76	-
Latvia	-	-	-	2	4	31	-	-	-	-
Lithuania	19	-	-	-	-	-	-	-	-	-
Russian Fed	49	63	59	32	76	101	91	25	86	45
27 Fishing area total	*68*	*63*	*59*	*34*	*80*	*132*	*91*	*121*	*162*	*45*
37 Russian Fed	159	95	141	226	168	126	88	146	107	105
37 Fishing area total	*159*	*95*	*141*	*226*	*168*	*126*	*88*	*146*	*107*	*105*
61 Russian Fed	52	38	3	127	319	222	199	124	122	112
61 Fishing area total	*52*	*38*	*3*	*127*	*319*	*222*	*199*	*124*	*122*	*112*
Species total	*227 710 F*	*272 404 F*	*287 772 F*	*248 491 F*	*382 897 F*	*390 137 F*	*418 137 F*	*476 262 F*	*468 714 F*	*903 829 F*
Pond loach	**Loche asiatique**		**Misgurno de Asia**		***Misgurnus anguillicaudatus***				**1,40(05)047,01**	**KUR**
04 Japan	115	84	69	68	59	...	...	...	...	...
04 Fishing area total	*115*	*84*	*69*	*68*	*59*	*...*	*...*	*...*	*...*	*...*
Species total	*115*	*84*	*69*	*68*	*59*	*...*	*...*	*...*	*...*	*...*
Weatherfish	**Loche d'étang**		**Misgurno**		***Misgurnus fossilis***				**1,40(05)047,02**	**MWT**
05 Ukraine	-	-	-	-	1	2	-	-	-	0
05 Fishing area total	*-*	*-*	*-*	*-*	*1*	*2*	*-*	*-*	*-*	*0*

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Carps, barbels and other cyprinids
Carpes, barbeaux et autres cyprinidés
Carpas, barbos y otros ciprínidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	-	-	-	-	*1*	*2*	-	-	-	*0*
Clown loach	**...B**		**...C**			***Chromobotia macracanthus***			**1,40(05)145,01**	**BMW**
04 Indonesia	...	...	...	2	3	1	29	2 814	2 834	41
04 Fishing area total	*...*	*...*	*...*	*2*	*3*	*1*	*29*	*2 814*	*2 834*	*41*
Species total	*...*	*...*	*...*	*2*	*3*	*1*	*29*	*2 814*	*2 834*	*41*
Group total	***589 840***	***630 714***	***637 515***	***612 452***	***775 147***	***756 657***	***811 025***	***902 869***	***911 130***	***1 371 685***

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Tilapias and other cichlids
Tilapias et autres cichlidés
Tilapias y otros cíclidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Mozambique tilapia	**Tilapia du Mozambique**		**Tilapia del Mozambique**		***Oreochromis mossambicus***			**1,70(59)051,01**		**TLM**
04 Indonesia	20 210	17 724	18 059	18 289	13 759	14 390	11 209	8 548	10 677	14 615
04 Fishing area total	*20 210*	*17 724*	*18 059*	*18 289*	*13 759*	*14 390*	*11 209*	*8 548*	*10 677*	*14 615*
06 Papua N Guin	2 310 F	2 310 F	2 310 F	2 310 F	2 310 F	2 310 F	2 310 F	2 310 F	2 310 F	2 310 F
06 Fishing area total	*2 310 F*	*2 310 F*	*2 310 F*	*2 310 F*	*2 310 F*	*2 310 F*	*2 310 F*	*2 310 F*	*2 310 F*	*2 310 F*
Species total	*22 520 F*	*20 034 F*	*20 369 F*	*20 599 F*	*16 069 F*	*16 700 F*	*13 519 F*	*10 858 F*	*12 987 F*	*16 925 F*
Nile tilapia	**Tilapia du Nil**		**Tilapia del Nilo**		***Oreochromis niloticus***			**1,70(59)051,02**		**TLN**
01 Burundi	120	100 F	...	200	190 F	170 F	150 F	131	130 F	130 F
Egypt	145 291	138 450	150 182	140 561	116 461	90 127	102 574	91 272	105 041	130 330
Kenya	7 292	16 252	15 982	17 507	22 231	19 038	10 125	12 732	17 274	26 118
Mali	30 000 F	30 000 F	30 000 F	30 000 F	30 000 F	30 000 F	30 000	30 000	30 000 F	30 000
Rwanda	2 650	2 750 F	2 800	3 120	3 100 F	3 500 F	3 950	3 950 F	3 950 F	3 950 F
Sudan	20 000	20 000	20 000 F	21 500 F	20 300 F	19 800 F	22 890	31 900 F	40 920	40 920 F
01 Fishing area total	*205 353 F*	*207 552 F*	*218 964 F*	*212 888 F*	*192 282 F*	*162 635 F*	*169 689 F*	*169 985 F*	*197 315 F*	*231 448 F*
02 El Salvador	560	1 169	1 160	867	1 050	609	767	3 977	...	...
02 Fishing area total	*560*	*1 169*	*1 160*	*867*	*1 050*	*609*	*767*	*3 977*	*...*	*...*
03 Ecuador	...	...	...	...	...	20	19 F	18	27	22
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*20*	*19 F*	*18*	*27*	*22*
04 Indonesia	...	...	...	4 343	6 678	8 344	11 865	15 492	12 765	17 345
Thailand	43 100	37 100	25 302	42 900	40 604	23 200	23 700	52 300	37 498	38 300
04 Fishing area total	*43 100*	*37 100*	*25 302*	*47 243*	*47 282*	*31 544*	*35 565*	*67 792*	*50 263*	*55 645*
06 Fiji	278	200 F	...	...	...	...	230	60	5	5
06 Fishing area total	*278*	*200 F*	*...*	*...*	*...*	*...*	*230*	*60*	*5*	*5*
Species total	*249 291 F*	*246 021 F*	*245 426 F*	*260 998 F*	*240 614 F*	*194 808 F*	*206 270 F*	*241 832 F*	*247 610 F*	*287 120 F*
Blue tilapia	**...B**		**Tilapia azul**		***Oreochromis aureus***			**1,70(59)051,03**		**OEA**
02 Cuba	1 948	2 002	2 692	2 513	1 561	1 449	3 058	2 764	2 526	2 028
02 Fishing area total	*1 948*	*2 002*	*2 692*	*2 513*	*1 561*	*1 449*	*3 058*	*2 764*	*2 526*	*2 028*
04 Israel	33	18	19	42	21	29	0	-	-	-
04 Fishing area total	*33*	*18*	*19*	*42*	*21*	*29*	*0*	-	-	-
Species total	*1 981*	*2 020*	*2 711*	*2 555*	*1 582*	*1 478*	*3 058*	*2 764*	*2 526*	*2 028*
Tilapias nei	**Tilapias nca**		**Tilapias nep**		***Oreochromis(=Tilapia) spp***			**1,70(59)051,XX**		**TLP**
01 Benin	10 900 F	10 900 F	10 900 F	10 200 F	7 950 F	12 100 F	12 750 F	12 750 F	13 400 F	13 700 F
Botswana	88	101	72	102	83	52	82	61	52 F	43
Burkina Faso	...	...	...	...	...	...	...	4 042	4 500 F	5 500 F
Ethiopia	6 870	4 603	4 653	5 590	3 604	4 928	5 425	7 180	7 554	12 110
Gabon	3 122	3 478	3 499	3 507	3 425	3 480	3 695	3 900 F	3 900 F	3 900 F
Gambia	1 050 F	1 050 F	1 000 F	950 F	900 F	850 F	719	1 077	1 153	1 154
Kenya	19 121	17 418	4 478	3 916	1 371	3 316	3 009	5 092	5 041	4 987
Malawi	5 154	5 244	5 717	6 029	5 973	9 693	14 307	11 055	12 367	11 214
Mauritius	0	0	-	-	-	-	-	-	-	-
Niger	...	...	...	...	...	...	...	...	8 965	8 965 F
Nigeria	18 332	17 218	31 205	22 910	31 756	30 476	38 878	47 571	54 241	56 632
Senegal	8 800 F	8 300 F	7 800 F	7 250 F	6 700 F	6 150 F	5 600 F	5 050	2 500 F	283
Tanzania	45 000	43 000	50 000	51 725	35 314	44 379	38 297	35 622	38 676	44 694
Togo	3 500	3 500	3 500	3 500	3 500	3 500	3 500	3 500 F	3 500	3 500
Uganda	96 172	98 000	97 330	138 789	155 575	137 006	178 350 F	150 000 F	123 000 F	83 541
Zimbabwe	850 F	900 F	950 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F
01 Fishing area total	*218 959 F*	*213 712 F*	*221 104 F*	*255 468 F*	*257 151 F*	*256 930 F*	*305 612 F*	*287 900 F*	*279 849 F*	*251 223 F*
02 Dominican Rp	529	1 056	675	887	804	762	757	744	298	139
Mexico	60 336	54 901	62 421	68 683	65 706	66 285	70 554	61 751	62 947	62 433
Nicaragua	...	...	...	...	...	...	200	57	180	113
Panama	12 F	10 F	8	394	2 942	3 545	3 236	3 124	1 886	2 002
USA	1 277	1 752	2 407	2 660	1	1	39	28	56	113
02 Fishing area total	*62 154 F*	*57 719 F*	*65 511*	*72 624*	*69 453*	*70 593*	*74 786*	*65 704*	*65 367*	*64 800*
03 Brazil	8 146	8 734	8 238	8 461	9 164	9 328	9 978	10 088	9 247	9 610
03 Fishing area total	*8 146*	*8 734*	*8 238*	*8 461*	*9 164*	*9 328*	*9 978*	*10 088*	*9 247*	*9 610*
04 China,Taiwan	98	97	63	33	36	6	11	12	8	8
Philippines	28 881	30 586	32 136	31 922	32 501	39 734	37 648	42 704	43 463	44 896
Sri Lanka	17 190	16 140	17 870	22 170	21 620	19 320	22 510	25 230	26 320	28 250
04 Fishing area total	*46 169*	*46 823*	*50 069*	*54 125*	*54 157*	*59 060*	*60 169*	*67 946*	*69 791*	*73 154*
34 Gabon	301	191	289	331	403	362	622	794	540 F	540 F
Gambia	27	67	41	81	32	...	...	...	...	...
Senegal	1 996	2 075	1 927	1 779	3 343	1 780	1 832	1 580	1 634	1 821
34 Fishing area total	*2 324*	*2 333*	*2 257*	*2 191*	*3 778*	*2 142*	*2 454*	*2 374*	*2 174 F*	*2 361 F*
Species total	*337 752 F*	*329 321 F*	*347 179 F*	*392 869 F*	*393 703 F*	*398 053 F*	*452 999 F*	*434 012 F*	*426 428 F*	*401 148 F*

B-12

Tilapias and other cichlids
Tilapias et autres cichlidés
Tilapias y otros cíclidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Mango tilapia	**...B**		**...C**		***Sarotherodon galilaeus***				**1,70(59)052,01**	**SAR**
04 Israel	110	93	91	237	316	151	51	8	20	21
04 Fishing area total	*110*	*93*	*91*	*237*	*316*	*151*	*51*	*8*	*20*	*21*
Species total	*110*	*93*	*91*	*237*	*316*	*151*	*51*	*8*	*20*	*21*
Blackchin tilapia	**...B**		**...C**		***Sarotherodon melanotheron***				**1,70(59)052,02**	**SAH**
01 Senegal	...	...	...	...	...	...	...	635	2 750 F	4 873
01 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*635*	*2 750 F*	*4 873*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*635*	*2 750 F*	*4 873*
Jaguar guapote	**...B**		**Guapote tigre**		***Cichlasoma managuense***				**1,70(59)053,06**	**CHL**
02 El Salvador	410	318	333	274	472	525	609	...	...	...
Nicaragua	...	...	...	...	111	126	94	73	96	64
02 Fishing area total	*410*	*318*	*333*	*274*	*583*	*651*	*703*	*73*	*96*	*64*
Species total	*410*	*318*	*333*	*274*	*583*	*651*	*703*	*73*	*96*	*64*
Peacock cichlid	**...B**		**Sargento**		***Cichla ocellaris***				**1,70(59)054,04**	**CLO**
02 Panama	8 F	13 F	18	12	8	10	6	19	23	11
02 Fishing area total	*8 F*	*13 F*	*18*	*12*	*8*	*10*	*6*	*19*	*23*	*11*
Species total	*8 F*	*13 F*	*18*	*12*	*8*	*10*	*6*	*19*	*23*	*11*
Banded jewelfish	**Hémichromis rayé**		**...C**		***Hemichromis fasciatus***				**1,70(59)275,02**	**HJF**
01 Senegal	...	...	...	...	...	...	...	1 150	630 F	101
01 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1 150*	*630 F*	*101*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1 150*	*630 F*	*101*
Oscar	**...B**		**...C**		***Astronotus ocellatus***				**1,70(59)313,02**	**TOC**
03 Brazil	...	...	...	...	...	...	...	2 040	1 870	1 943
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*2 040*	*1 870*	*1 943*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*2 040*	*1 870*	*1 943*
Velvety cichlids	**...B**		**Acarahuazu**		***Astronotus spp***				**1,70(59)313,XX**	**AST**
03 Peru	183	213	186	218	273	254	430	394	574	653
03 Fishing area total	*183*	*213*	*186*	*218*	*273*	*254*	*430*	*394*	*574*	*653*
Species total	*183*	*213*	*186*	*218*	*273*	*254*	*430*	*394*	*574*	*653*
Mouthbrooding cichlids	**...B**		**...C**		***Haplochromis spp***				**1,70(59)316,XX**	**CIM**
01 Kenya	1 195	1 259	1 020	1 066	4 832	5 198	5 687	5 423	822	840
Tanzania	8 500	7 500	7 600	8 000	7 000	8 000	8 103	4 570	9 835	12 146
01 Fishing area total	*9 695*	*8 759*	*8 620*	*9 066*	*11 832*	*13 198*	*13 790*	*9 993*	*10 657*	*12 986*
Species total	*9 695*	*8 759*	*8 620*	*9 066*	*11 832*	*13 198*	*13 790*	*9 993*	*10 657*	*12 986*
Green terror	**...B**		**Vieja azul**		***Aequidens rivulatus***				**1,70(59)354,01**	**AER**
03 Ecuador	...	...	...	...	...	14	14 F	14	48	39
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*14*	*14 F*	*14*	*48*	*39*
Species total	*...*	*...*	*...*	*...*	*...*	*14*	*14 F*	*14*	*48*	*39*
Cichlids nei	**Cichlidés nca**		**Cíclidos nep**		***Cichlidae***				**1,70(59)XXX,XX**	**CIX**
01 Madagascar	21 500 F	21 500 F	21 500 F	22 600 F	23 400 F	23 450 F	23 400 F	23 400 F	23 550 F	25 450 F
Malawi	20 533	20 892	29 774	31 398	33 586	50 198	12 593	22 026	20 187	33 308
01 Fishing area total	*42 033 F*	*42 392 F*	*51 274 F*	*53 998 F*	*56 986 F*	*73 648 F*	*35 993 F*	*45 426 F*	*43 737 F*	*58 758 F*
02 Guatemala	180 F	165 F	150 F	135 F	120 F	110 F	110 F	110 F	110 F	110 F
Mexico	...	...	...	...	1 625	1 698	987	721	955	502
Nicaragua	266	240	220	564	806	142	330	350	401	564
02 Fishing area total	*446 F*	*405 F*	*370 F*	*699 F*	*2 551 F*	*1 950 F*	*1 427 F*	*1 181 F*	*1 466 F*	*1 176 F*
03 Brazil	13 534	12 029	11 921	13 733	14 371	16 921	15 085	14 365	13 168	13 693
03 Fishing area total	*13 534*	*12 029*	*11 921*	*13 733*	*14 371*	*16 921*	*15 085*	*14 365*	*13 168*	*13 693*
04 Israel	24	23	13	22	6	1	6	1	3	3
04 Fishing area total	*24*	*23*	*13*	*22*	*6*	*1*	*6*	*1*	*3*	*3*
Species total	*56 037 F*	*54 849 F*	*63 578 F*	*68 452 F*	*73 914 F*	*92 520 F*	*52 511 F*	*60 973 F*	*58 374 F*	*73 630 F*
Group total	***677 987***	***661 641***	***688 511***	***755 280***	***738 894***	***717 837***	***743 351***	***764 765***	***764 593***	***801 542***

B-13

Miscellaneous freshwater fishes
Poissons d'eau douce divers
Peces de agua dulce diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
African lungfishes	**Protoptères d'Afrique**		**Protopteros africanos**		***Protopterus spp***				**1,16(02)002,XX**	**FLU**
01 Benin	110 F	110 F	110 F	100 F	80 F	120 F	130 F	130 F	140 F	143 F
Kenya	1 822	1 707	867	685	777	2 914	3 143	3 077	2 560	3 699
Nigeria	2 183	520	2 747	3 383	1 543	2 172	4 816	3 494	3 577	3 662
Uganda	5 796	5 000	4 566	12 938	14 503	12 778	17 400	13 000 F	10 000 F	6 279
01 Fishing area total	*9 911 F*	*7 337 F*	*8 290 F*	*17 106 F*	*16 903 F*	*17 984 F*	*25 489 F*	*19 701 F*	*16 277 F*	*13 783 F*
Species total	*9 911 F*	*7 337 F*	*8 290 F*	*17 106 F*	*16 903 F*	*17 984 F*	*25 489 F*	*19 701 F*	*16 277 F*	*13 783 F*
Tropical gar	**...B**		**Gaspar**		***Atractosteus tropicus***				**1,19(01)002,03**	**JTP**
02 Nicaragua	...	...	...	...	...	...	26	43	19	64
02 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*26*	*43*	*19*	*64*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*26*	*43*	*19*	*64*
...A	**Garpiques nca**		**...C**		***Atractosteus spp***				**1,19(01)002,XX**	**LKX**
02 Mexico	...	...	...	...	406	424	539	384	448	453
02 Fishing area total	*...*	*...*	*...*	*...*	*406*	*424*	*539*	*384*	*448*	*453*
Species total	*...*	*...*	*...*	*...*	*406*	*424*	*539*	*384*	*448*	*453*
Gars nei	**Lépisostés nca**		**Pejelagartos nep**		***Lepisosteidae***				**1,19(01)XXX,XX**	**LXS**
02 USA	287	337	400	340	246	280	368	320	280	230
02 Fishing area total	*287*	*337*	*400*	*340*	*246*	*280*	*368*	*320*	*280*	*230*
Species total	*287*	*337*	*400*	*340*	*246*	*280*	*368*	*320*	*280*	*230*
Dagaas	**Dagaas**		**Dagaas**		***Stolothrissa, Limnothrissa spp***				**1,21(05)XXX,XX**	**DAG**
01 Burundi	6 138	8 400 F	13 080	8 876	10 000 F	11 000 F	12 000 F	13 181	13 130 F	13 130 F
Mozambique	7 076	12 037	10 831	18 760	12 991	16 017	8 882	10 055	13 131	11 018
Tanzania	43 000	43 000	43 500	40 000	45 000	22 000	17 865	12 967	10 280	15 191
Zambia	8 500 F	8 000 F	7 481	6 574	6 251	7 659	9 476	7 860	9 993	7 821
Zimbabwe	9 700 F	8 900 F	8 000	7 900 F	7 820	7 900 F	7 900 F	7 900 F	7 900 F	7 900 F
01 Fishing area total	*74 414 F*	*80 337 F*	*82 892*	*82 110 F*	*82 062 F*	*64 576 F*	*56 123 F*	*51 963 F*	*54 434 F*	*55 060 F*
Species total	*74 414 F*	*80 337 F*	*82 892*	*82 110 F*	*82 062 F*	*64 576 F*	*56 123 F*	*51 963 F*	*54 434 F*	*55 060 F*
Northern pike	**Brochet du Nord**		**Lucio**		***Esox lucius***				**1,24(03)001,01**	**FPI**
02 Canada	2 464	2 684	2 323	1 938	1 417	1 572	1 697	1 951	1 955	1 890
02 Fishing area total	*2 464*	*2 684*	*2 323*	*1 938*	*1 417*	*1 572*	*1 697*	*1 951*	*1 955*	*1 890*
04 Azerbaijan	25	6	9	10	8	8	3	4	1	-
Kazakhstan	819	919	646	726	791	753	1 156	1 938	1 334	1 406
Turkey	192	217	237	253	249	279	242	213	197	228
Uzbekistan	33	26	17	36	45 F	49	...	...	10	6 F
04 Fishing area total	*1 069*	*1 168*	*909*	*1 025*	*1 093 F*	*1 089*	*1 401*	*2 155*	*1 542*	*1 640 F*
05 Belarus	171	28	25	28	48	39	45	49	52	59
Belgium	20	20	20	20	20	20	20	20	20	20
Bulgaria	2	6	7	13	20	25	8	8	8	8
Croatia	1	1	-	1	1	2	2	1	47	51
Czech Rep	176	172	167	162	148	156	152	166	154	122
Denmark	7	6	10	9	8	7	4	5	9	2
Estonia	180	199	169	138	134	194	184	98	111	95
Finland	7 887	8 023	8 023	8 272	8 272	7 887	7 887	7 030	7 030	7 030
Germany	205	205	205	205	166	165	165	212	194	206
Greece	9	10	12	8	14	20	18	17	8	8 F
Hungary	191	190	183	196	199	275	213	182	172	182
Latvia	73	88	71	48	39	45	36	48	44	39
Lithuania	68	66	70	47	17	17	20	18	14	13
Moldova Rep	36	62	53	106	100	92	184	195	230	207
Norway	...	...	...	...	...	11	...	...	...	-
Poland	302	345	354	316	264	252	322	319	281	255
Portugal	0	-	-	-	-	-	-	-	-	-
Romania	95	83	173	44	105	210	136	58	76	80
Russian Fed	8 387	9 741	10 167	8 606	7 978	8 693	9 396	9 278	15 988	10 348
Serbia	...	...	...	...	...	71	68	82	79	108
Serbia-Monte	24	25	33	28	24	-	-	-	-	-
Slovakia	73	64	56	61	68	61	58	54	51	52
Slovenia	9	9	9	10	9	10	9	8	8	8
Sweden	145	168	151	123	107	121	118	119	109	100
Switzerland	48	46	47	47	47	41	50	61	51	58
Ukraine	14	5	13	3	14	19	8	12	13	15
UK	5	4	8	4	4	5	5	6	5	4
05 Fishing area total	*18 128*	*19 566*	*20 026*	*18 495*	*17 806*	*18 438*	*19 108*	*18 046*	*24 754*	*19 070 F*
27 Denmark	3	4	8	3	3	3	8	8	9	8
Estonia	19	19	31	49	23	20	14	17	15	25
Finland	2 541	2 079	2 074	1 907	1 880	2 968	2 907	1 750	1 778	1 794
Germany	104	104	91	81	71	60	81	74	53	45
Latvia	-	-	1	1	1	1	1	1	1	1
Lithuania	...	8	-	-	-	-	-	-	-	-
Poland	9	9	8	8	7	8	8	9	6	6

B-13

Miscellaneous freshwater fishes
Poissons d'eau douce divers
Peces de agua dulce diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Russian Fed	17	18	20	10	20	18	16	16	12	18
Sweden	97	66	51	43	44	47	42	40	28	22
27 Fishing area total	*2 790*	*2 307*	*2 284*	*2 102*	*2 049*	*3 125*	*3 077*	*1 915*	*1 902*	*1 919*
37 Russian Fed	-	-	-	-	-	7	6	2	3	3
37 Fishing area total	-	-	-	-	-	*7*	*6*	*2*	*3*	*3*
Species total	*24 451*	*25 725*	*25 542*	*23 560*	*22 365 F*	*24 231*	*25 289*	*24 069*	*30 156*	*24 522 F*
Arapaima	**...B**		**Paiche**		***Arapaima gigas***				**1,28(01)001,01**	**ARP**
03 Brazil	...	427	411	413	1 228	1 237	1 249	1 315	1 206	1 253
Peru	204	155	225	169	171	374	246	232	326	258
03 Fishing area total	*204*	*582*	*636*	*582*	*1 399*	*1 611*	*1 495*	*1 547*	*1 532*	*1 511*
Species total	*204*	*582*	*636*	*582*	*1 399*	*1 611*	*1 495*	*1 547*	*1 532*	*1 511*
Arawana	**...B**		**...C**		***Osteoglossum bicirrhosum***				**1,28(01)002,01**	**OOB**
03 Brazil	...	1 791	1 621	1 644	1 622	1 679	1 817	1 813	1 662	1 727
03 Fishing area total	*...*	*1 791*	*1 621*	*1 644*	*1 622*	*1 679*	*1 817*	*1 813*	*1 662*	*1 727*
Species total	*...*	*1 791*	*1 621*	*1 644*	*1 622*	*1 679*	*1 817*	*1 813*	*1 662*	*1 727*
Asian bonytongue	**Scléropage d'Asie**		**Pez lengüihueso malayo**		***Scleropages formosus***				**1,28(01)003,02**	**OHB**
04 Indonesia	...	...	...	...	...	1	841	3	0	0
04 Fishing area total	*...*	*...*	*...*	*...*	*...*	*1*	*841*	*3*	*0*	*0*
Species total	*...*	*...*	*...*	*...*	*...*	*1*	*841*	*3*	*0*	*0*
African bonytongue	**...B**		**...C**		***Heterotis niloticus***				**1,28(01)004,01**	**HTN**
01 Benin	550 F	550 F	550 F	510 F	400 F	600 F	650 F	650 F	680 F	700 F
Mali	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000	1 000	1 000 F	1 148
Nigeria	8 577	6 832	10 118	10 314	11 884	11 233	10 554	16 451	14 889	15 392
Senegal	...	...	...	...	...	...	...	935	800 F	646
01 Fishing area total	*10 127 F*	*8 382 F*	*11 668 F*	*11 824 F*	*13 284 F*	*12 833 F*	*12 204 F*	*19 036 F*	*17 369 F*	*17 886 F*
Species total	*10 127 F*	*8 382 F*	*11 668 F*	*11 824 F*	*13 284 F*	*12 833 F*	*12 204 F*	*19 036 F*	*17 369 F*	*17 886 F*
Giant featherback	**...B**		**...C**		***Chitala lopis***				**1,28(02)002,02**	**NCG**
04 Indonesia	3 820	3 303	2 501	2 786	3 427	3 491	2 295	1 880	2 489	4 240
04 Fishing area total	*3 820*	*3 303*	*2 501*	*2 786*	*3 427*	*3 491*	*2 295*	*1 880*	*2 489*	*4 240*
Species total	*3 820*	*3 303*	*2 501*	*2 786*	*3 427*	*3 491*	*2 295*	*1 880*	*2 489*	*4 240*
Knifefishes	**...B**		**...C**		***Notopterus spp***				**1,28(02)003,XX**	**FKN**
01 Nigeria	22	19	34	18	169	69	203	136	242	239
01 Fishing area total	*22*	*19*	*34*	*18*	*169*	*69*	*203*	*136*	*242*	*239*
Species total	*22*	*19*	*34*	*18*	*169*	*69*	*203*	*136*	*242*	*239*
Elephantsnout fishes nei	**...B**		**...C**		***Mormyridae***				**1,28(06)XXX,XX**	**OEY**
01 Mali	7 000 F	7 000 F	7 000 F	7 000 F	7 000 F	7 000 F	7 000	7 000	7 000 F	7 000
Niger	...	...	...	...	...	...	...	...	5 977	5 977 F
Nigeria	17 509	5 567	15 400	19 494	18 617	18 710	26 141	22 380	22 564	22 976
Senegal	...	...	...	...	...	...	...	144	90 F	27
Uganda	...	...	1 210	1 487	1 667	1 469	2 000	1 300 F	700 F	144
01 Fishing area total	*24 509 F*	*12 567 F*	*23 610 F*	*27 981 F*	*27 284 F*	*27 179 F*	*35 141*	*30 824 F*	*36 331 F*	*36 124 F*
Species total	*24 509 F*	*12 567 F*	*23 610 F*	*27 981 F*	*27 284 F*	*27 179 F*	*35 141*	*30 824 F*	*36 331 F*	*36 124 F*
Aba	**...B**		**...C**		***Gymnarchus niloticus***				**1,28(07)001,01**	**OGN**
01 Nigeria	...	9 097	11 358	11 764	16 084	11 496	13 914	20 205	13 363	12 744
Senegal	...	...	...	...	...	...	...	538	330 F	120
01 Fishing area total	*...*	*9 097*	*11 358*	*11 764*	*16 084*	*11 496*	*13 914*	*20 743*	*13 693 F*	*12 864*
Species total	*...*	*9 097*	*11 358*	*11 764*	*16 084*	*11 496*	*13 914*	*20 743*	*13 693 F*	*12 864*
Banded astyanax	**...B**		**Colirroja**		***Astyanax fasciatus***				**1,38(01)009,01**	**AXF**
03 Brazil	...	427	461	901	1 032	953	938	1 153	1 056	1 098
03 Fishing area total	*...*	*427*	*461*	*901*	*1 032*	*953*	*938*	*1 153*	*1 056*	*1 098*
Species total	*...*	*427*	*461*	*901*	*1 032*	*953*	*938*	*1 153*	*1 056*	*1 098*
Machaca	**...B**		**Machaca**		***Brycon guatemalensis***				**1,38(01)013,20**	**BNV**
02 Nicaragua	...	...	...	...	...	52	52	102	95	71
02 Fishing area total	*...*	*...*	*...*	*...*	*...*	*52*	*52*	*102*	*95*	*71*
Species total	*...*	*...*	*...*	*...*	*...*	*52*	*52*	*102*	*95*	*71*

B-13

Miscellaneous freshwater fishes
Poissons d'eau douce divers
Peces de agua dulce diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
...A	**...B**		**...C**		***Brycon orbignyanus***				**1,38(01)013,24**	**BNO**
03 Brazil	...	9	10	9	9	9	8	9	8	8
03 Fishing area total	*...*	*9*	*10*	*9*	*9*	*9*	*8*	*9*	*8*	*8*
Species total	*...*	*9*	*10*	*9*	*9*	*9*	*8*	*9*	*8*	*8*
...A	**...B**		**Dama**		***Brycon dentex***				**1,38(01)013,28**	**BVD**
03 Ecuador	...	...	...	...	...	24	20 F	15	45	32
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*24*	*20 F*	*15*	*45*	*32*
Species total	*...*	*...*	*...*	*...*	*...*	*24*	*20 F*	*15*	*45*	*32*
Dorado	**...B**		**Pirayú**		***Salminus brasiliensis***				**1,38(01)023,04**	**SXU**
03 Brazil	...	...	...	...	...	...	...	3 319	3 042	3 162
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*3 319*	*3 042*	*3 162*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*3 319*	*3 042*	*3 162*
Cachama	**...B**		**Cachama**		***Colossoma macropomum***				**1,38(01)046,05**	**CSM**
03 Brazil	3 789	4 096	3 206	3 372	3 342	4 562	4 565	4 413	4 045	4 204
Peru	904	675	605	900	315	381	403	461	423	425
03 Fishing area total	*4 693*	*4 771*	*3 811*	*4 272*	*3 657*	*4 943*	*4 968*	*4 874*	*4 468*	*4 629*
Species total	*4 693*	*4 771*	*3 811*	*4 272*	*3 657*	*4 943*	*4 968*	*4 874*	*4 468*	*4 629*
Pirapatinga	**...B**		**Cachama blanca**		***Piaractus brachypomus***				**1,38(01)076,01**	**CSD**
03 Brazil	...	2 344	1 493	2 016	1 999	2 130	2 304	2 279	2 089	2 238
Peru	487	471	419	440	551	363	309	298	510	290
03 Fishing area total	*487*	*2 815*	*1 912*	*2 456*	*2 550*	*2 493*	*2 613*	*2 577*	*2 599*	*2 528*
Species total	*487*	*2 815*	*1 912*	*2 456*	*2 550*	*2 493*	*2 613*	*2 577*	*2 599*	*2 528*
...A	**...B**		**...C**		***Metynnis argenteus***				**1,38(01)096,01**	**MEY**
03 Brazil	...	11 661	11 485	11 153	10 858	10 766	11 090	11 591	10 624	11 042
03 Fishing area total	*...*	*11 661*	*11 485*	*11 153*	*10 858*	*10 766*	*11 090*	*11 591*	*10 624*	*11 042*
Species total	*...*	*11 661*	*11 485*	*11 153*	*10 858*	*10 766*	*11 090*	*11 591*	*10 624*	*11 042*
...A	**...B**		**...C**		***Triportheus angulatus***				**1,38(01)123,01**	**TPU**
03 Brazil	...	3 454	3 081	3 024	2 940	3 402	3 634	3 533	3 239	3 366
03 Fishing area total	*...*	*3 454*	*3 081*	*3 024*	*2 940*	*3 402*	*3 634*	*3 533*	*3 239*	*3 366*
Species total	*...*	*3 454*	*3 081*	*3 024*	*2 940*	*3 402*	*3 634*	*3 533*	*3 239*	*3 366*
Characins nei	**Characinidés nca**		**Carácidos nep**		***Characidae***				**1,38(01)XXX,XX**	**CHA**
01 Mali	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000	5 000	5 000 F	5 000
Nigeria	10 274	6 989	14 573	13 874	17 449	19 808	21 259	25 857	15 987	11 457
Uganda	10 331	7 100	9 491	20 002	22 422	19 754	26 900	42 000 F	74 000 F	113 401
01 Fishing area total	*25 605 F*	*19 089 F*	*29 064 F*	*38 876 F*	*44 871 F*	*44 562 F*	*53 159*	*72 857 F*	*94 987 F*	*129 858*
03 Argentina	1 557 F	1 000 F	1 515 F	1 737	3 927	5 258	3 349	713	388	311
Brazil	49 491	21 519	22 094	19 460	20 569	23 584	23 760	9 222	8 454	14 725
Colombia	8 667	13 435	14 779	13 704	6 847	7 400 F	8 000 F	8 700 F	9 426	6 664
Paraguay	9 000 F	7 700 F	6 400 F	5 200 F	3 900 F	2 900 F	1 800 F	600 F	600 F	600 F
Uruguay	107	260	318	1 760	1 600	444	241	503	...	...
Venezuela	2 978	4 014	6 198	5 500 F	4 900 F	5 280 F	3 600 F	3 000 F	3 000 F	3 000 F
03 Fishing area total	*71 800 F*	*47 928 F*	*51 304 F*	*47 361 F*	*41 743 F*	*44 866 F*	*40 750 F*	*22 738 F*	*21 868 F*	*25 300 F*
Species total	*97 405 F*	*67 017 F*	*80 368 F*	*86 237 F*	*86 614 F*	*89 428 F*	*93 909 F*	*95 595 F*	*116 855 F*	*155 158 F*
...A	**...B**		**...C**		***Leporellus vittatus***				**1,38(04)004,01**	**LPU**
03 Brazil	...	...	...	...	...	...	...	1 418	1 300	1 351
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1 418*	*1 300*	*1 351*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1 418*	*1 300*	*1 351*
...A	**...B**		**...C**		***Schizodon fasciatus***				**1,38(04)012,02**	**SZF**
03 Brazil	...	...	...	...	...	...	...	5 430	4 977	5 173
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*5 430*	*4 977*	*5 173*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*5 430*	*4 977*	*5 173*
Citharinus nei	**Citharinus nep**		**Citharinus nca**		***Citharinus spp***				**1,38(06)006,XX**	**CIV**
01 Nigeria	...	5 654	10 754	9 581	15 468	13 031	9 130	17 035	11 395	13 764
Senegal	...	...	...	...	...	...	...	788	530 F	272
01 Fishing area total	*...*	*5 654*	*10 754*	*9 581*	*15 468*	*13 031*	*9 130*	*17 823*	*11 925 F*	*14 036*
Species total	*...*	*5 654*	*10 754*	*9 581*	*15 468*	*13 031*	*9 130*	*17 823*	*11 925 F*	*14 036*

B-13

Miscellaneous freshwater fishes
Poissons d'eau douce divers
Peces de agua dulce diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Grass-eaters nei	**...B**		**...C**		***Distichodus spp***				**1,38(06)024,XX**	**DSE**
01 Nigeria	-	-	-	4 765	7 662	6 836	5 500	11 662	5 760	8 760
01 Fishing area total	-	-	-	*4 765*	*7 662*	*6 836*	*5 500*	*11 662*	*5 760*	*8 760*
Species total	-	-	-	*4 765*	*7 662*	*6 836*	*5 500*	*11 662*	*5 760*	*8 760*
...A	**...B**		**...C**		***Hoplias aimara***				**1,38(08)017,01**	**HOA**
03 Brazil	...	7 404	8 189	9 232	10 038	9 865	9 205	10 309	9 450	9 821
03 Fishing area total	...	*7 404*	*8 189*	*9 232*	*10 038*	*9 865*	*9 205*	*10 309*	*9 450*	*9 821*
Species total	...	*7 404*	*8 189*	*9 232*	*10 038*	*9 865*	*9 205*	*10 309*	*9 450*	*9 821*
...A	**...B**		**Guanchiche**		***Hoplias microlepis***				**1,38(08)017,02**	**HWM**
03 Ecuador	...	...	...	...	...	27	32 F	38	57	44
03 Fishing area total	...	...	...	...	...	*27*	*32 F*	*38*	*57*	*44*
Species total	...	...	...	...	...	*27*	*32 F*	*38*	*57*	*44*
Aimara	**...B**		**...C**		***Hoplerythrinus unitaeniatus***				**1,38(08)026,01**	**HPU**
03 Brazil	...	...	...	...	...	...	...	330	302	314
03 Fishing area total	...	...	...	...	...	...	...	*330*	*302*	*314*
Species total	...	...	...	...	...	...	...	*330*	*302*	*314*
Kafue pike	**...B**		**...C**		***Hepsetus odoe***				**1,38(10)001,01**	**HED**
01 Nigeria	...	1 288	2 345	1 009	2 090	2 284	2 372	7 837	1 941	2 634
01 Fishing area total	...	*1 288*	*2 345*	*1 009*	*2 090*	*2 284*	*2 372*	*7 837*	*1 941*	*2 634*
Species total	...	*1 288*	*2 345*	*1 009*	*2 090*	*2 284*	*2 372*	*7 837*	*1 941*	*2 634*
Netted prochilod	**Prochilode réticulé**		**Boquichico reticulado**		***Prochilodus reticulatus***				**1,38(12)001,20**	**PLR**
03 Peru	11 220	10 133	10 461	11 705	10 957	5 130	12 150	12 323	12 474	9 635
03 Fishing area total	*11 220*	*10 133*	*10 461*	*11 705*	*10 957*	*5 130*	*12 150*	*12 323*	*12 474*	*9 635*
Species total	*11 220*	*10 133*	*10 461*	*11 705*	*10 957*	*5 130*	*12 150*	*12 323*	*12 474*	*9 635*
Prochilods nei	**Prochilodes nca**		**Sábalos sudamericanos nep**		***Prochilodus spp***				**1,38(12)001,XX**	**PRL**
03 Argentina	13 687 F	17 096 F	24 876 F	31 879	29 396	27 522	15 602	10 084	14 839	13 999
Brazil	40 741	30 839	30 792	29 091	27 258	28 706	28 301	29 845	27 356	28 432
Venezuela	6 743	14 061	11 081	10 300 F	9 200 F	10 000 F	8 100 F	6 700 F	6 700 F	6 700 F
03 Fishing area total	*61 171 F*	*61 996 F*	*66 749 F*	*71 270 F*	*65 854 F*	*66 228 F*	*52 003 F*	*46 629 F*	*48 895 F*	*49 131 F*
Species total	*61 171 F*	*61 996 F*	*66 749 F*	*71 270 F*	*65 854 F*	*66 228 F*	*52 003 F*	*46 629 F*	*48 895 F*	*49 131 F*
...A	**...B**		**Dica**		***Pseudocurimata boulengeri***				**1,38(12)008,01**	**PDB**
03 Ecuador	...	...	...	...	...	42	36 F	30	47	34
03 Fishing area total	...	...	...	...	...	*42*	*36 F*	*30*	*47*	*34*
Species total	...	...	...	...	...	*42*	*36 F*	*30*	*47*	*34*
...A	**...B**		**...C**		***Semaprochilodus insignis***				**1,38(12)009,01**	**SKI**
03 Brazil	...	12 941	11 924	16 529	15 067	16 153	17 474	17 252	15 813	16 435
03 Fishing area total	...	*12 941*	*11 924*	*16 529*	*15 067*	*16 153*	*17 474*	*17 252*	*15 813*	*16 435*
Species total	...	*12 941*	*11 924*	*16 529*	*15 067*	*16 153*	*17 474*	*17 252*	*15 813*	*16 435*
...A	**...B**		**...C**		***Curimata cyprinoides***				**1,38(12)014,01**	**CUU**
03 Brazil	...	4 972	4 810	5 068	5 358	5 101	4 977	5 468	5 012	5 209
03 Fishing area total	...	*4 972*	*4 810*	*5 068*	*5 358*	*5 101*	*4 977*	*5 468*	*5 012*	*5 209*
Species total	...	*4 972*	*4 810*	*5 068*	*5 358*	*5 101*	*4 977*	*5 468*	*5 012*	*5 209*
...A	**...B**		**...C**		***Alestes baremoze***				**1,38(13)001,01**	**AEB**
01 Senegal	...	...	...	...	...	...	...	1 519	900 F	268
01 Fishing area total	...	...	...	...	...	...	...	*1 519*	*900 F*	*268*
Species total	...	...	...	...	...	...	...	*1 519*	*900 F*	*268*
Elongate tigerfish	**...B**		**...C**		***Hydrocynus forskahlii***				**1,38(13)011,01**	**HCF**
01 Senegal	...	...	...	...	...	...	...	1 404	900 F	418
01 Fishing area total	...	...	...	...	...	...	...	*1 404*	*900 F*	*418*
Species total	...	...	...	...	...	...	...	*1 404*	*900 F*	*418*
Raphael catfish	**...B**		**...C**		***Platydoras costatus***				**1,41(03)041,01**	**PYS**
03 Brazil	...	486	177	364	268	196	185	230	211	219

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Miscellaneous freshwater fishes
Poissons d'eau douce divers
Peces de agua dulce diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
03 Fishing area total	*...*	*486*	*177*	*364*	*268*	*196*	*185*	*230*	*211*	*219*
Species total	*...*	*486*	*177*	*364*	*268*	*196*	*185*	*230*	*211*	*219*
Wels(=Som)catfish	**Silure glane**		**Siluro**		***Silurus glanis***				**1,41(07)031,01**	**SOM**
04 Azerbaijan	8	4	8	8	4	3	4	7	8	4
Iran	1	21	16	20	311	21	32	3	2	7
Kazakhstan	780	607	1 086	911	1 835	1 902	2 218	3 376	2 527	2 429
Tajikistan	10	12	9	18	14 F	10 F	10 F	5 F	5 F	...
Turkey	813	987	912	897	804	1 245	1 293	1 275	1 193	1 178
Turkmenistan	3	2	1	8	8 F	8 F	8 F	8 F	8 F	8 F
Uzbekistan	4	12	3	5	5 F	...	2	2	113	78 F
04 Fishing area total	*1 619*	*1 645*	*2 035*	*1 867*	*2 981 F*	*3 189 F*	*3 567 F*	*4 676 F*	*3 856 F*	*3 704 F*
05 Belarus	1	1	1	0	0	2	2	0	0	8
Bulgaria	4	34	26	88	68	41	20	15	22	21
Croatia	1	2	1	3	2	2	3	2	37	40
Czech Rep	57	61	76	87	80	78	92	94	89	93
Germany	12	12	12	12	10	9	9	11	9	21
Greece	18	20	22	23	27	53	53	51	18	18 F
Hungary	120	134	136	155	160	163	164	169	167	170
Lithuania	0	0	1	0	0	-	0	0	0	0
Poland	4	4	7	5	9	9	9	8	9	9
Romania	116	120	277	103	103	233	236	212	144	131
Russian Fed	6 540	5 978	6 010	4 782	5 381	6 174	7 167	6 631	11 732	10 980
Serbia	...	...	...	...	...	174	201	256	269	295
Serbia-Monte	48	75	94	133	139	-	-	-	-	-
Slovakia	28	29	36	36	36	33	40	36	39	35
Slovenia	6	8	10	12	10	9	8	8	6	8
Switzerland	1	1	1	2	1	1	1	1	1	2
Ukraine	3	2	3	2	18	24	7	16	22	22
05 Fishing area total	*6 959*	*6 481*	*6 713*	*5 443*	*6 044*	*7 005*	*8 012*	*7 510*	*12 564*	*11 853 F*
27 Poland	-	-	-	0	0	1	1	1	2	3
27 Fishing area total	-	-	-	*0*	*0*	*1*	*1*	*1*	*2*	*3*
37 Russian Fed	-	-	-	-	-	-	-	1	-	1
37 Fishing area total	-	-	-	-	-	-	-	*1*	-	*1*
Species total	*8 578*	*8 126*	*8 748*	*7 310*	*9 025 F*	*10 195 F*	*11 580 F*	*12 188 F*	*16 422 F*	*15 561 F*
Glass catfishes	**...B**		**...C**		***Kryptopterus spp***				**1,41(07)050,XX**	**CAG**
04 Indonesia	13 522	12 271	13 433	11 815	11 952	12 666	14 296	13 318	13 035	13 592
04 Fishing area total	*13 522*	*12 271*	*13 433*	*11 815*	*11 952*	*12 666*	*14 296*	*13 318*	*13 035*	*13 592*
Species total	*13 522*	*12 271*	*13 433*	*11 815*	*11 952*	*12 666*	*14 296*	*13 318*	*13 035*	*13 592*
Butter catfish	**...B**		**...C**		***Ompok bimaculatus***				**1,41(07)057,01**	**OKB**
04 Indonesia	...	...	...	20	718	579	352	317	507	5 668
04 Fishing area total	*...*	*...*	*...*	*20*	*718*	*579*	*352*	*317*	*507*	*5 668*
Species total	*...*	*...*	*...*	*20*	*718*	*579*	*352*	*317*	*507*	*5 668*
Asian redtail catfish	**...B**		**...C**		***Mystus nemurus***				**1,41(08)054,05**	**MYN**
04 Indonesia	...	...	...	7 502	8 229	8 943	11 853	12 350	11 336	14 439
04 Fishing area total	*...*	*...*	*...*	*7 502*	*8 229*	*8 943*	*11 853*	*12 350*	*11 336*	*14 439*
Species total	*...*	*...*	*...*	*7 502*	*8 229*	*8 943*	*11 853*	*12 350*	*11 336*	*14 439*
...A	**...B**		**...C**		***Mystus nigriceps***				**1,41(08)054,11**	**BMZ**
04 Indonesia	...	...	...	172	148	708	449	571	1 016	1 121
04 Fishing area total	*...*	*...*	*...*	*172*	*148*	*708*	*449*	*571*	*1 016*	*1 121*
Species total	*...*	*...*	*...*	*172*	*148*	*708*	*449*	*571*	*1 016*	*1 121*
Bagrid catfish	**...B**		**...C**		***Chrysichthys nigrodigitatus***				**1,41(08)078,02**	**CSR**
01 Nigeria	12 413	5 678	12 537	10 859	12 519	13 161	16 287	11 110	17 541	18 795
01 Fishing area total	*12 413*	*5 678*	*12 537*	*10 859*	*12 519*	*13 161*	*16 287*	*11 110*	*17 541*	*18 795*
Species total	*12 413*	*5 678*	*12 537*	*10 859*	*12 519*	*13 161*	*16 287*	*11 110*	*17 541*	*18 795*
Black catfishes nei	**...B**		**...C**		***Chrysichthys spp***				**1,41(08)078,XX**	**CST**
01 Benin	1 500 F	1 500 F	1 500 F	1 400 F	1 100 F	1 650 F	1 750 F	1 750 F	1 850 F	1 900 F
Gabon	797	797	783	785	1 194	1 068	1 000 F	1 090 F	1 090 F	1 090 F
Mali	4 000 F	4 000 F	4 000 F	4 000 F	4 000 F	4 000 F	4 000	4 000	4 000 F	4 000
Senegal	1 400 F	1 600 F	1 800 F	2 000 F	2 200 F	2 400 F	2 600 F	2 804	1 400 F	75
01 Fishing area total	*7 697 F*	*7 897 F*	*8 083 F*	*8 185 F*	*8 494 F*	*9 118 F*	*9 350 F*	*9 644 F*	*8 340 F*	*7 065 F*
Species total	*7 697 F*	*7 897 F*	*8 083 F*	*8 185 F*	*8 494 F*	*9 118 F*	*9 350 F*	*9 644 F*	*8 340 F*	*7 065 F*

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Miscellaneous freshwater fishes
Poissons d'eau douce divers
Peces de agua dulce diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Bayad	**...B**		**...C**		***Bagrus bajad***				**1,41(08)111,01**	**BGJ**
01 Egypt	15 472	19 026	16 437	10 228	7 900	11 952	6 668	5 647	7 202	6 902
01 Fishing area total	*15 472*	*19 026*	*16 437*	*10 228*	*7 900*	*11 952*	*6 668*	*5 647*	*7 202*	*6 902*
Species total	*15 472*	*19 026*	*16 437*	*10 228*	*7 900*	*11 952*	*6 668*	*5 647*	*7 202*	*6 902*
Naked catfishes	**...B**		**...C**		***Bagrus spp***				**1,41(08)111,XX**	**CAN**
01 Ethiopia	119	98	407	163	163	...	...	10	11	57
Kenya	178	183	63	71	69	88	76	59	306	301
Niger	...	...	...	...	...	...	...	...	2 988	2 988 F
Nigeria	4 902	920	5 183	5 239	5 501	6 914	8 534	7 701	7 788	7 860
Senegal	...	...	...	...	...	...	...	1 210	1 900 F	2 588
Tanzania	2 000	2 000	1 500	1 000	2 100	900	520	442	551	1 821
Uganda	4 375	4 800	5 723	8 179	9 169	8 078	11 000	9 000 F	7 300 F	6 193
01 Fishing area total	*11 574*	*8 001*	*12 876*	*14 652*	*17 002*	*15 980*	*20 130*	*18 422 F*	*20 844 F*	*21 808 F*
Species total	*11 574*	*8 001*	*12 876*	*14 652*	*17 002*	*15 980*	*20 130*	*18 422 F*	*20 844 F*	*21 808 F*
Channel catfish	**Barbue de rivière**		**Bagre de canal**		***Ictalurus punctatus***				**1,41(10)002,02**	**ITP**
02 USA	-	6	7	758	516	510	318	262	527	1 172
02 Fishing area total	*-*	*6*	*7*	*758*	*516*	*510*	*318*	*262*	*527*	*1 172*
05 Bulgaria	26	18	11	18	8	57	0	2	1	1
05 Fishing area total	*26*	*18*	*11*	*18*	*8*	*57*	*0*	*2*	*1*	*1*
Species total	*26*	*24*	*18*	*776*	*524*	*567*	*318*	*264*	*528*	*1 173*
Blue catfish	**...B**		**Bagre azul**		***Ictalurus furcatus***				**1,41(10)002,04**	**ITF**
02 USA	-	6	16	1 472	1 552	1 580	1 829	1 490	1 242	1 491
02 Fishing area total	*-*	*6*	*16*	*1 472*	*1 552*	*1 580*	*1 829*	*1 490*	*1 242*	*1 491*
Species total	*-*	*6*	*16*	*1 472*	*1 552*	*1 580*	*1 829*	*1 490*	*1 242*	*1 491*
Catfishes nei	**Barbottes nca**		**Bagres nep**		***Ictalurus spp***				**1,41(10)002,XX**	**CAF**
02 Canada	344	338	342	297	297	327	327	326	337	291
El Salvador	169	125	126	113	169	168	134	...	...	...
Mexico	3 135	2 263	2 020	1 722	1 557	1 622	2 321	2 399	1 619	4 046
USA	7 478	6 289	5 204	3 946	1 683	1 567	1 484	1 836	1 529	440
02 Fishing area total	*11 126*	*9 015*	*7 692*	*6 078*	*3 706*	*3 684*	*4 266*	*4 561*	*3 485*	*4 777*
Species total	*11 126*	*9 015*	*7 692*	*6 078*	*3 706*	*3 684*	*4 266*	*4 561*	*3 485*	*4 777*
Brown bullhead	**Barbotte brune**		**...C**		***Ameiurus nebulosus***				**1,41(10)004,07**	**ITE**
02 USA	-	-	-	-	-	-	-	-	28	35
02 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*28*	*35*
06 New Zealand	8	7	13	13	8	12	5	7	0	4
06 Fishing area total	*8*	*7*	*13*	*13*	*8*	*12*	*5*	*7*	*0*	*4*
Species total	*8*	*7*	*13*	*13*	*8*	*12*	*5*	*7*	*28*	*39*
Flathead catfish	**...B**		**Bagre piltonte**		***Pylodictis olivaris***				**1,41(10)060,01**	**IPO**
02 USA	-	-	-	129	123	147	122	147	139	114
02 Fishing area total	*-*	*-*	*-*	*129*	*123*	*147*	*122*	*147*	*139*	*114*
Species total	*-*	*-*	*-*	*129*	*123*	*147*	*122*	*147*	*139*	*114*
Glass schilbid	**...B**		**...C**		***Parailia pellucida***				**1,41(16)007,01**	**ILP**
01 Nigeria	...	9	...	28	97	106	1 048	540	761	802
01 Fishing area total	*...*	*9*	*...*	*28*	*97*	*106*	*1 048*	*540*	*761*	*802*
Species total	*...*	*9*	*...*	*28*	*97*	*106*	*1 048*	*540*	*761*	*802*
North African catfish	**Poisson-chat nord-africain**		**Pez-gato**		***Clarias gariepinus***				**1,41(18)030,03**	**CLZ**
01 Ethiopia	3 926	4 318	2 662	2 532	2 366	2 252	2 823	3 384	3 143	2 050
Lesotho	2	4	5	5	5	3	2	2	5	5
Mali	25 000 F	25 000 F	25 000 F	25 000 F	25 000 F	25 000 F	25 000	25 000	25 000 F	25 000
Nigeria	10 419	7 375	11 363	10 988	18 938	14 027	15 813	10 836	23 146	22 879
Senegal	...	...	...	...	...	...	...	1 729	900 F	120
01 Fishing area total	*39 347 F*	*36 697 F*	*39 030 F*	*38 525 F*	*46 309 F*	*41 282 F*	*43 638*	*40 951*	*52 194 F*	*50 054*
04 Turkey	520	495	507	487	480	478	486	339	310	341
04 Fishing area total	*520*	*495*	*507*	*487*	*480*	*478*	*486*	*339*	*310*	*341*
Species total	*39 867 F*	*37 192 F*	*39 537 F*	*39 012 F*	*46 789 F*	*41 760 F*	*44 124*	*41 290*	*52 504 F*	*50 395*
Mudfish	**...B**		**...C**		***Clarias anguillaris***				**1,41(18)030,07**	**CLN**
01 Egypt	39 535	39 208	43 109	26 833	25 821	36 771	31 195	32 357	37 806	29 156
Senegal	...	...	...	...	...	...	...	1 142	1 750 F	2 337
01 Fishing area total	*39 535*	*39 208*	*43 109*	*26 833*	*25 821*	*36 771*	*31 195*	*33 499*	*39 556 F*	*31 493*

B-13

Miscellaneous freshwater fishes
Poissons d'eau douce divers
Peces de agua dulce diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*39 535*	*39 208*	*43 109*	*26 833*	*25 821*	*36 771*	*31 195*	*33 499*	*39 556 F*	*31 493*
Torpedo-shaped catfishes nei	**...B**		**...C**		***Clarias spp***				**1,41(18)030,XX**	**CTO**
01 Benin	1 500 F	1 500 F	1 500 F	1 400 F	1 100 F	1 650 F	1 750 F	1 750 F	1 850 F	1 900 F
Botswana	...	...	...	...	...	25	37	23	19 F	16
Kenya	1 611	1 581	1 525	1 442	1 353	4 387	1 632	2 269	2 736	4 181
Malawi	6 367	6 478	8 212	8 660	8 736	4 470	5 369	5 297	5 019	4 315
Niger	...	...	...	...	...	...	...	...	4 483	4 483 F
Nigeria	10 925	7 640	15 656	9 582	16 193	14 916	14 302	32 844	35 172	37 792
Tanzania	2 500	2 000	2 000	2 300	2 100	3 018	897	600	757	2 332
Uganda	2 987	2 500	1 697	3 718	4 168	3 672	5 000	5 200 F	5 500 F	5 878
01 Fishing area total	*25 890 F*	*21 699 F*	*30 590 F*	*27 102 F*	*33 650 F*	*32 138 F*	*28 987 F*	*47 983 F*	*55 536 F*	*60 897 F*
04 Indonesia	7 609	10 246	12 204	14 865	12 235	12 867	12 395	14 323	12 713	14 259
Philippines	2 366	2 601	2 629	3 205	3 314	3 687	4 607	5 517	5 685	5 137
Thailand	14 100	8 000	13 772	6 800	6 777	2 900	2 100	11 700	14 132	10 400
04 Fishing area total	*24 075*	*20 847*	*28 605*	*24 870*	*22 326*	*19 454*	*19 102*	*31 540*	*32 530*	*29 796*
Species total	*49 965 F*	*42 546 F*	*59 195 F*	*51 972 F*	*55 976 F*	*51 592 F*	*48 089 F*	*79 523 F*	*88 066 F*	*90 693 F*
Gilded catfish	**...B**		**...C**		***Brachyplatystoma flavicans***				**1,41(22)005,02**	**BPV**
03 Brazil	12 553	16 607	16 946	20 057	19 556	11 599	11 377	15 094	13 835	14 379
03 Fishing area total	*12 553*	*16 607*	*16 946*	*20 057*	*19 556*	*11 599*	*11 377*	*15 094*	*13 835*	*14 379*
Species total	*12 553*	*16 607*	*16 946*	*20 057*	*19 556*	*11 599*	*11 377*	*15 094*	*13 835*	*14 379*
Laulao catfish	**Bagre vaillant**		**Valentón**		***Brachyplatystoma vaillanti***				**1,41(22)005,04**	**BPT**
03 Brazil	23 126	24 149	19 698	22 547	21 284	28 195	23 557	25 830	23 676	24 607
03 Fishing area total	*23 126*	*24 149*	*19 698*	*22 547*	*21 284*	*28 195*	*23 557*	*25 830*	*23 676*	*24 607*
Species total	*23 126*	*24 149*	*19 698*	*22 547*	*21 284*	*28 195*	*23 557*	*25 830*	*23 676*	*24 607*
Porthole shovelnose catfish	**...B**		**...C**		***Hemisorubim platyrhynchos***				**1,41(22)012,01**	**HBY**
03 Brazil	...	16	16	15	14	12	11	13	12	12
03 Fishing area total	*...*	*16*	*16*	*15*	*14*	*12*	*11*	*13*	*12*	*12*
Species total	*...*	*16*	*16*	*15*	*14*	*12*	*11*	*13*	*12*	*12*
...A	**...B**		**...C**		***Lophiosilurus alexandri***				**1,41(22)018,01**	**LSX**
03 Brazil	...	...	...	...	...	...	...	599	549	571
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*599*	*549*	*571*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*599*	*549*	*571*
South American catfish	**...B**		**Juil descolorido**		***Rhamdia quelen***				**1,41(22)021,02**	**RMQ**
02 Mexico	...	...	...	...	10	10	17	13	16	18
02 Fishing area total	*...*	*...*	*...*	*...*	*10*	*10*	*17*	*13*	*16*	*18*
Species total	*...*	*...*	*...*	*...*	*10*	*10*	*17*	*13*	*16*	*18*
...A	**...B**		**...C**		***Pimelodus maculatus***				**1,41(22)022,09**	**MDM**
03 Brazil	...	...	...	...	...	...	...	32	29	30
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*32*	*29*	*30*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*32*	*29*	*30*
Duckbill catfish	**...B**		**...C**		***Sorubim lima***				**1,41(22)023,02**	**SBM**
03 Brazil	...	...	...	...	...	...	...	242	222	231
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*242*	*222*	*231*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*242*	*222*	*231*
Redtail catfish	**...B**		**...C**		***Phractocephalus hemioliopterus***				**1,41(22)026,01**	**PEH**
03 Brazil	...	...	...	...	...	...	...	758	695	723
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*758*	*695*	*723*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*758*	*695*	*723*
Spotted sorubim	**...B**		**Surubí**		***Pseudoplatystoma corruscans***				**1,41(22)090,01**	**UDC**
03 Brazil	...	...	...	...	...	...	...	2 145	1 966	8 688
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*2 145*	*1 966*	*8 688*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*2 145*	*1 966*	*8 688*
Barred sorubim	**...B**		**...C**		***Pseudoplatystoma fasciatum***				**1,41(22)090,02**	**UDF**
03 Brazil	...	...	...	...	...	...	...	1 090	999	1 038
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1 090*	*999*	*1 038*

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Miscellaneous freshwater fishes
Poissons d'eau douce divers
Peces de agua dulce diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	...	...	...	...	...	...	...	*1 090*	*999*	*1 038*
Pati	**...B**		**...C**		***Luciopimelodus pati***				**1,41(22)096,01**	**LPI**
03 Brazil	...	...	...	...	...	...	...	1	0	1
03 Fishing area total	...	...	...	...	...	...	...	*1*	*0*	*1*
Species total	...	...	...	...	...	...	...	*1*	*0*	*1*
Highwaterman catfish	**Bagre paysan**		**Bagre paisano**		***Hypophthalmus edentatus***				**1,41(22)148,01**	**HPN**
31 Fr Guiana	...	...	...	...	...	...	...	...	44	50 F
31 Fishing area total	...	...	...	...	...	...	...	...	*44*	*50 F*
Species total	...	...	...	...	...	...	...	...	*44*	*50 F*
...A	**...B**		**...C**		***Loricaria cataphracta***				**1,41(28)028,01**	**LCC**
03 Brazil	...	...	...	...	...	...	...	618	567	589
03 Fishing area total	...	...	...	...	...	...	...	*618*	*567*	*589*
Species total	...	...	...	...	...	...	...	*618*	*567*	*589*
...A	**...B**		**...C**		***Pangasius djambal***				**1,41(30)002,07**	**PQZ**
04 Indonesia	13 203	13 721	10 303	8 902	8 475	9 010	10 839	9 724	12 611	14 524
04 Fishing area total	*13 203*	*13 721*	*10 303*	*8 902*	*8 475*	*9 010*	*10 839*	*9 724*	*12 611*	*14 524*
Species total	*13 203*	*13 721*	*10 303*	*8 902*	*8 475*	*9 010*	*10 839*	*9 724*	*12 611*	*14 524*
Pangas catfishes nei	**...B**		**...C**		***Pangasius spp***				**1,41(30)002,XX**	**PGZ**
04 Thailand	1 100	1 700	2 858	3 000	9 880	12 100	6 800	6 400	4 429	4 700
04 Fishing area total	*1 100*	*1 700*	*2 858*	*3 000*	*9 880*	*12 100*	*6 800*	*6 400*	*4 429*	*4 700*
Species total	*1 100*	*1 700*	*2 858*	*3 000*	*9 880*	*12 100*	*6 800*	*6 400*	*4 429*	*4 700*
Upsidedown catfishes	**...B**		**...C**		***Synodontis spp***				**1,41(32)008,XX**	**CSY**
01 Benin	110 F	110 F	110 F	100 F	80 F	120 F	130 F	130 F	140 F	143 F
Egypt	3 937	5 520	6 037	1 929	1 454	2 038	1 843	1 903	2 297	1 871
Kenya	48	142	216	258	342	374	710	20	930	875
Mali	3 000 F	3 000 F	3 000 F	3 000 F	3 000 F	3 000 F	3 000	3 000	3 000 F	3 000
Nigeria	6 642	4 055	8 721	8 245	10 575	11 534	9 915	16 010	13 219	13 995
Senegal	...	...	...	...	...	...	...	2 347	1 500 F	687
Uganda	...	...	...	...	...	...	...	...	...	1 810
01 Fishing area total	*13 737 F*	*12 827 F*	*18 084 F*	*13 532 F*	*15 451 F*	*17 066 F*	*15 598 F*	*23 410 F*	*21 086 F*	*22 381 F*
Species total	*13 737 F*	*12 827 F*	*18 084 F*	*13 532 F*	*15 451 F*	*17 066 F*	*15 598 F*	*23 410 F*	*21 086 F*	*22 381 F*
Freshwater siluroids nei	**Silurides d'eau douce nca**		**Siluroideos de agua dulce nep**		***Siluroidei***				**1,41(XX)XXX,XX**	**FSI**
01 Burkina Faso	...	...	...	...	...	...	...	2 329	2 500 F	3 200 F
Togo	500	500	500	500	500	500	500	500 F	500	500
01 Fishing area total	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*2 829 F*	*3 000 F*	*3 700 F*
03 Argentina	292 F	276 F	205 F	287	498	485	684	342	294	502
Brazil	35 067	38 065	38 238	40 214	43 428	44 578	40 080	38 832	35 596	30 015
Colombia	10 545	8 304	9 134	8 469	7 224	8 300 F	9 400 F	10 500 F	11 530	11 303
Paraguay	12 000 F	10 000 F	8 400 F	6 700 F	5 100 F	3 700 F	2 300 F	800 F	800 F	800 F
Uruguay	81	83	115	421	400	104	58	80	...	...
Venezuela	8 967	8 675	15 451	13 700 F	12 100 F	13 000 F	9 000 F	7 400 F	7 400 F	7 400 F
03 Fishing area total	*66 952 F*	*65 403 F*	*71 543 F*	*69 791 F*	*68 750 F*	*70 167 F*	*61 522 F*	*57 954 F*	*55 620 F*	*50 020 F*
04 India	57 999	60 549	61 309	34 743	82 279	82 326	84 750	118 257	113 108	188 294
Iraq	900	800	700	531	4 830	3 958	1 374	2 046	2 709	3 000
Korea Rep	...	...	99	...	229	2 771	218	323	375	263
04 Fishing area total	*58 899*	*61 349*	*62 108*	*35 274*	*87 338*	*89 055*	*86 342*	*120 626*	*116 192*	*191 557*
Species total	*126 351 F*	*127 252 F*	*134 151 F*	*105 565 F*	*156 588 F*	*159 722 F*	*148 364 F*	*181 409 F*	*174 812 F*	*245 277 F*
Burbot	**Lotte de rivière**		**Lota**		***Lota lota***				**1,48(04)003,01**	**FBU**
02 USA	9	10	8	10	7	8	7	6	5	6
02 Fishing area total	*9*	*10*	*8*	*10*	*7*	*8*	*7*	*6*	*5*	*6*
04 Kazakhstan	...	...	...	...	...	...	...	...	11	3
04 Fishing area total	...	...	...	...	...	...	...	...	*11*	*3*
05 Belarus	29	0	0	-	0	-	0	0	0	0
Bulgaria	2	5	1	1	1	5	0	0	0	1
Denmark	0	0	-	-	-	-	-	-	-	-
Estonia	37	41	38	50	20	21	38	33	30	29
Finland	831	794	794	1 075	1 075	563	563	592	592	592
Germany	2	2	2	2	2	-	-	-	-	3
Lithuania	9	3	13	8	10	12	15	20	18	14
Poland	-	-	-	-	0	0	1	0	0	0
Russian Fed	1 628	1 683	2 422	2 034	2 112	2 455	1 740	1 572	2 300	2 373
Slovakia	4	4	2	3	2	2	4	3	3	2

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Miscellaneous freshwater fishes
Poissons d'eau douce divers
Peces de agua dulce diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Switzerland	8	10	11	11	10	12	10	6	12	11
05 Fishing area total	*2 550*	*2 542*	*3 283*	*3 184*	*3 232*	*3 070*	*2 371*	*2 226*	*2 955*	*3 025*
27 Estonia	1	1	1	1	1	3	3	1	1	1
Finland	337	277	257	188	162	225	215	87	109	114
Germany	2	2	3	2	2	1	-	1	-	2
Lithuania	...	12	-	-	-	-	-	-	-	-
Poland	26	38	21	12	9	12	11	12	9	8
Russian Fed	16	14	11	7	9	14	17	19	13	12
Sweden	3	2	2	1	2	2	1	1	2	1
27 Fishing area total	*385*	*346*	*295*	*211*	*185*	*257*	*247*	*121*	*134*	*138*
Species total	*2 944*	*2 898*	*3 586*	*3 405*	*3 424*	*3 335*	*2 625*	*2 353*	*3 105*	*3 172*
...A	**...B**		**Charales de agua dulce nep**		***Chirostoma spp***				**1,63(02)006,XX**	**KRW**
02 Mexico	...	...	...	...	590	617	2 005	1 936	2 372	3 552
02 Fishing area total	*...*	*...*	*...*	*...*	*590*	*617*	*2 005*	*1 936*	*2 372*	*3 552*
Species total	*...*	*...*	*...*	*...*	*590*	*617*	*2 005*	*1 936*	*2 372*	*3 552*
Asian swamp eel	**...B**		**...C**		***Monopterus albus***				**1,68(02)001,01**	**FLT**
04 Thailand	100	300	357	300	56	300	300	200	327	400
04 Fishing area total	*100*	*300*	*357*	*300*	*56*	*300*	*300*	*200*	*327*	*400*
Species total	*100*	*300*	*357*	*300*	*56*	*300*	*300*	*200*	*327*	*400*
Marbled swamp eel	**...B**		**...C**		***Synbranchus marmoratus***				**1,68(02)004,02**	**SXR**
03 Brazil	...	...	...	...	...	...	...	36	33	34
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*36*	*33*	*34*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*36*	*33*	*34*
Fire eel	**...B**		**...C**		***Mastacembelus erythrotaenia***				**1,68(04)005,02**	**MWY**
04 Indonesia	...	...	...	71	74	93	143	18	21	86
04 Fishing area total	*...*	*...*	*...*	*71*	*74*	*93*	*143*	*18*	*21*	*86*
Species total	*...*	*...*	*...*	*71*	*74*	*93*	*143*	*18*	*21*	*86*
Nile perch	**Perche du Nil**		**Perca del Nilo**		***Lates niloticus***				**1,70(01)167,07**	**NIP**
01 Egypt	5 328	5 775	9 985	10 341	6 548	9 666	6 860	5 039	15 735	12 294
Ethiopia	63	37	168	919	2 260	1 221	2 597	3 243	2 740	1 017
Kenya	78 534	58 432	55 175	57 235	52 368	55 706	47 558	45 026	43 650	39 375
Mali	6 000 F	6 000 F	6 000 F	6 000 F	6 000 F	6 000 F	6 000	6 000 F	6 000 F	6 000
Niger	...	...	...	...	...	...	...	...	2 988	2 988 F
Nigeria	6 139	3 030	6 442	7 760	9 336	8 223	8 941	16 705	11 542	11 800
Senegal	1 600 F	1 700 F	1 800 F	1 900 F	2 050 F	2 200 F	2 350 F	2 506	1 200 F	20
Tanzania	96 000	92 000	98 500	98 500	124 278	95 500	95 160	94 197	101 073	97 177
Uganda	88 881	90 698	112 804	156 301	175 205	154 340	150 000 F	139 000 F	131 000 F	120 446
01 Fishing area total	*282 545 F*	*257 672 F*	*290 874 F*	*338 956 F*	*378 045 F*	*332 856 F*	*319 466 F*	*311 716 F*	*315 928 F*	*291 117 F*
Species total	*282 545 F*	*257 672 F*	*290 874 F*	*338 956 F*	*378 045 F*	*332 856 F*	*319 466 F*	*311 716 F*	*315 928 F*	*291 117 F*
Freshwater perches nei	**Perches d'eau douce nca**		**Percas de agua dulce nep**		***Lates spp***				**1,70(01)167,XX**	**PEX**
01 Burundi	1 657	1 500 F	1 323	4 643	4 300 F	4 000 F	3 600 F	3 169	3 160 F	3 160 F
01 Fishing area total	*1 657*	*1 500 F*	*1 323*	*4 643*	*4 300 F*	*4 000 F*	*3 600 F*	*3 169*	*3 160 F*	*3 160 F*
Species total	*1 657*	*1 500 F*	*1 323*	*4 643*	*4 300 F*	*4 000 F*	*3 600 F*	*3 169*	*3 160 F*	*3 160 F*
White bass	**...B**		**...C**		***Morone chrysops***				**1,70(06)006,04**	**ROY**
02 USA	145	104	76	146	165	159	225	193	239	350
02 Fishing area total	*145*	*104*	*76*	*146*	*165*	*159*	*225*	*193*	*239*	*350*
Species total	*145*	*104*	*76*	*146*	*165*	*159*	*225*	*193*	*239*	*350*
Largemouth black bass	**Achigan à grande bouche**		**Perca atruchada**		***Micropterus salmoides***				**1,70(10)014,02**	**MPS**
02 Dominican Rp	...	...	240	303	272	229	42	165	88	24
Mexico	693	766	845	864	1 143	1 358	1 028	958	945	848
02 Fishing area total	*693*	*766*	*1 085*	*1 167*	*1 415*	*1 587*	*1 070*	*1 123*	*1 033*	*872*
Species total	*693*	*766*	*1 085*	*1 167*	*1 415*	*1 587*	*1 070*	*1 123*	*1 033*	*872*
European perch	**Perche européenne**		**Perca**		***Perca fluviatilis***				**1,70(14)002,01**	**FPE**
04 Kazakhstan	547	422	283	375	...	...	...	...	657	630
04 Fishing area total	*547*	*422*	*283*	*375*	*...*	*...*	*...*	*...*	*657*	*630*
05 Albania	-	-	-	-	-	-	64	111	58	136
Belarus	86	37	40	23	24	27	28	34	33	38
Belgium	25	25	25	25	25	25	25	25	25	25
Bulgaria	6	23	42	20	13	5	2	4	7	2
Czech Rep	34	30	30	30	26	24	20	17	18	14

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Miscellaneous freshwater fishes
Poissons d'eau douce divers
Peces de agua dulce diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Denmark	13	7	3	5	12	9	8	3	2	5
Estonia	300	246	621	408	411	563	379	766	826	1 237
Finland	9 599	9 389	9 389	9 687	9 687	10 407	10 407	7 431	7 431	7 431
France	65	60 F	60 F	60 F	60 F	60 F	60 F	60 F	60 F	60 F
Germany	215	215	215	215	120	96	96	181	138	122
Greece	23	20	35	30	30	20	20	21	17	17 F
Latvia	34	36	28	18	15	12	12	14	16	15
Lithuania	114	84	112	87	64	75	60	65	51	34
Netherlands	150 F	131	140 F	140 F	140 F	140 F	140 F	140 F	140 F	140 F
Norway	...	...	...	...	...	10	...	...	...	-
Poland	245	267	224	218	175	165	171	174	147	138
Romania	42	32	87	50	28	68	44	31	25	21
Russian Fed	3 824	6 649	7 702	6 370	4 913	6 158	7 183	7 658	8 565	11 351
Serbia	...	...	...	...	...	5	47	11	76	3
Slovakia	14	13	10	8	6	7	6	5	4	4
Slovenia	1	1	0	1	1	0	1	0	0	0
Sweden	135	169	172	118	114	122	141	142	99	103
Switzerland	262	288	485	359	281	267	242	292	342	285
Ukraine	74	64	40	6	25	32	32	28	31	26
05 Fishing area total	*15 261 F*	*17 786 F*	*19 460 F*	*17 878 F*	*16 170 F*	*18 297 F*	*19 188 F*	*17 213 F*	*18 111 F*	*21 207 F*
27 Denmark	60	72	74	57	43	55	70	32	34	30
Estonia	386	578	824	666	689	1 117	777	715	819	892
Finland	3 796	3 592	3 691	3 312	3 415	4 260	4 232	3 351	3 159	3 266
Germany	326	263	289	196	276	196	301	160	111	239
Latvia	49	59	42	36	39	84	68	34	37	37
Lithuania	1	48	-	1	-	-	-	1	2	1
Poland	874	790	757	719	654	702	855	737	691	837
Russian Fed	161	69	242	123	248	215	168	173	220	338
Sweden	66	81	93	103	96	108	92	83	73	73
27 Fishing area total	*5 719*	*5 552*	*6 012*	*5 213*	*5 460*	*6 737*	*6 563*	*5 286*	*5 146*	*5 713*
37 Russian Fed	1	1	-	-	-	1	-	-	-	1
37 Fishing area total	*1*	*1*	-	-	-	*1*	-	-	-	*1*
Species total	*21 528 F*	*23 761 F*	*25 755 F*	*23 466 F*	*21 630 F*	*25 035 F*	*25 751 F*	*22 499 F*	*23 914 F*	*27 551 F*
American yellow perch	**Perchaude**		**Perca canadiense**		***Perca flavescens***				**1,70(14)002,02**	**FPY**
02 Canada	2 524	3 622	3 507	3 588	4 034	5 307	4 188	3 713	2 813	3 322
USA	640	685	778	745	812	791	580	994	787	796
02 Fishing area total	*3 164*	*4 307*	*4 285*	*4 333*	*4 846*	*6 098*	*4 768*	*4 707*	*3 600*	*4 118*
Species total	*3 164*	*4 307*	*4 285*	*4 333*	*4 846*	*6 098*	*4 768*	*4 707*	*3 600*	*4 118*
Percarina	**Percarina**		**Percarina**		***Percarina demidoffi***				**1,70(14)007,01**	**PND**
37 Ukraine	-	18	15	202	14	11	8	1	-	-
37 Fishing area total	-	*18*	*15*	*202*	*14*	*11*	*8*	*1*	-	-
Species total	-	*18*	*15*	*202*	*14*	*11*	*8*	*1*	-	-
Ruffe	**Grémille**		**Acerina**		***Gymnocephalus cernuus***				**1,70(14)059,01**	**ACC**
05 Belarus	...	6	...	...	...	...	...	...	...	...
Denmark	1	1	6	-	-	0	-	-	-	-
Estonia	-	-	-	-	-	9	147	76	75	39
Lithuania	64	0	10	4	8	16	11	6	11	28
05 Fishing area total	*65*	*7*	*16*	*4*	*8*	*25*	*158*	*82*	*86*	*67*
27 Estonia	-	-	-	-	-	-	-	-	-	32
Lithuania	...	31	-	-	-	-	-	-	-	-
Poland	-	-	-	2	1	2	2	1	1	1
27 Fishing area total	...	*31*	-	*2*	*1*	*2*	*2*	*1*	*1*	*33*
Species total	*65*	*38*	*16*	*6*	*9*	*27*	*160*	*83*	*87*	*100*
Walleye	**Sandre américain**		**Lucioperca americana**		***Sander vitreus***				**1,70(14)361,01**	**STV**
02 Canada	6 949	7 007	7 352	6 945	8 855	10 245	8 984	8 288	7 660	7 725
USA	10	14	12	12	18	14	9	22	29	22
02 Fishing area total	*6 959*	*7 021*	*7 364*	*6 957*	*8 873*	*10 259*	*8 993*	*8 310*	*7 689*	*7 747*
Species total	*6 959*	*7 021*	*7 364*	*6 957*	*8 873*	*10 259*	*8 993*	*8 310*	*7 689*	*7 747*
Pike-perch	**Sandre**		**Lucioperca**		***Sander lucioperca***				**1,70(14)361,03**	**FPP**
04 Azerbaijan	19	17	35	33	41	39	25	27	27	20
Iran	26	32	33	23	309	115	82	114	92	278
Kazakhstan	1 628	1 718	1 449	2 669	2 940	3 515	4 876	9 811	4 099	5 525
Kyrgyzstan	1	2	1	2	4 F	1 F	...	...	...	...
Tajikistan	21	24	22	20	16 F	15 F	15 F	10 F	10 F	10 F
Turkey	1 644	1 850	1 751	1 852	1 768	1 656	1 586	1 346	1 234	1 476
Turkmenistan	42	34	19	54	50 F	50 F	50 F	50 F	50 F	50 F
Uzbekistan	61	81	54	107	50 F	...	...	...	...	...
04 Fishing area total	*3 442*	*3 758*	*3 364*	*4 760*	*5 178 F*	*5 391 F*	*6 634 F*	*11 358 F*	*5 512 F*	*7 359 F*
05 Albania	45	30	45 F	60	55	68	74	55	62	80
Belarus	24	19	3	5	4	7	5	6	8	15

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Miscellaneous freshwater fishes
Poissons d'eau douce divers
Peces de agua dulce diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Belgium	15	15	15	15	15	15	15	15	15	15
Bulgaria	5	18	25	48	31	25	5	11	14	18
Croatia	1	1	1	2	1	1	1	1	19	20
Czech Rep	139	144	133	165	145	147	121	106	107	106
Denmark	5	7	7	83	11	3	14	11	9	3
Estonia	484	938	1 786	924	717	1 131	932	671	729	537
Finland	759	1 575	1 575	1 981	1 981	2 309	2 309	1 928	1 928	1 928
Germany	251	251	251	251	131	158	158	126	137	102
Hungary	196	190	197	209	194	198	192	189	176	149
Latvia	38	44	41	26	24	21	22	32	26	31
Lithuania	87	11	121	125	112	104	101	92	75	83
Moldova Rep	12	19	21	43	50	58	106	140	186	219
Netherlands	250 F	295	300 F	300 F	300 F	300 F	300 F	300 F	300 F	300 F
Norway	...	...	...	...	...	3	...	...	...	-
Poland	162	214	201	162	126	136	145	138	102	95
Romania	92	118	141	79	114	203	252	227	219	169
Russian Fed	3 427	4 036	4 116	3 291	3 121	3 372	3 432	2 835	2 515	3 483
Serbia	...	...	...	...	...	137	143	186	189	225
Slovakia	62	79	78	78	83	65	68	63	62	62
Slovenia	4	4	3	3	4	4	5	4	4	3
Sweden	241	371	420	421	490	649	537	532	438	517
Switzerland	9	9	22	24	15	15	14	15	14	13
Ukraine	93	247	142	25	89	95	47	50	53	48
UK	1	-	0	-	-	-	-	-	-	-
05 Fishing area total	*6 402 F*	*8 635*	*9 644 F*	*8 320 F*	*7 813 F*	*9 224 F*	*8 998 F*	*7 733 F*	*7 387 F*	*8 221 F*
27 Denmark	4	2	8	3	1	0	1	-	-	-
Estonia	33	39	96	206	69	94	99	65	67	74
Finland	1 027	1 096	1 221	930	824	1 062	987	861	860	904
Germany	243	273	290	206	151	208	246	195	157	131
Latvia	21	34	9	7	8	9	63	7	5	6
Lithuania	28	162	25	5	12	6	13	14	7	9
Netherlands	4	7	1	10	2	3	5	1	3	5
Poland	316	295	318	280	231	191	287	190	189	151
Russian Fed	409	428	430	416	365	409	375	370	456	426
Sweden	26	27	31	30	35	35	41	27	24	16
27 Fishing area total	*2 111*	*2 363*	*2 429*	*2 093*	*1 698*	*2 017*	*2 117*	*1 730*	*1 768*	*1 722*
37 Russian Fed	1 875	1 577	1 170	540	587	586	128	99	40	11
Ukraine	1 629	1 716	927	503	319	225	105	43	29	10
37 Fishing area total	*3 504*	*3 293*	*2 097*	*1 043*	*906*	*811*	*233*	*142*	*69*	*21*
Species total	*15 459 F*	*18 049*	*17 534 F*	*16 216 F*	*15 595 F*	*17 443 F*	*17 982 F*	*20 963 F*	*14 736 F*	*17 323 F*
Freshwater drum	**Malachigan**		**Roncador de agua dulce**		***Aplodinotus grunniens***				**1,70(37)011,01**	**AGR**
02 Mexico	...	...	...	...	102	107	131	120	131	140
USA	506	502	429	372	401	440	456	435	526	562
02 Fishing area total	*506*	*502*	*429*	*372*	*503*	*547*	*587*	*555*	*657*	*702*
Species total	*506*	*502*	*429*	*372*	*503*	*547*	*587*	*555*	*657*	*702*
Smallscale archerfish	**...B**		**...C**		***Toxotes microlepis***				**1,70(44)246,03**	**TXM**
04 Indonesia	...	...	...	...	210	13	3	4	204	29
04 Fishing area total	*...*	*...*	*...*	*...*	*210*	*13*	*3*	*4*	*204*	*29*
Species total	*...*	*...*	*...*	*...*	*210*	*13*	*3*	*4*	*204*	*29*
Malayan leaffish	**...B**		**...C**		***Pristolepis fasciata***				**1,70(56)003,01**	**RIS**
04 Indonesia	...	...	...	1	-	33	258	320	162	141
04 Fishing area total	*...*	*...*	*...*	*1*	*-*	*33*	*258*	*320*	*162*	*141*
Species total	*...*	*...*	*...*	*1*	*-*	*33*	*258*	*320*	*162*	*141*
Fat sleeper	**...B**		**Naca**		***Dormitator maculatus***				**1,73(20)009,02**	**DMM**
02 Mexico	...	...	...	...	253	264	15	113	28	42
02 Fishing area total	*...*	*...*	*...*	*...*	*253*	*264*	*15*	*113*	*28*	*42*
Species total	*...*	*...*	*...*	*...*	*253*	*264*	*15*	*113*	*28*	*42*
Bigmouth sleeper	**...B**		**Guavina bocón**		***Gobiomorus dormitor***				**1,73(20)038,02**	**GBD**
02 Mexico	...	...	...	...	125	131	...	...	...	...
02 Fishing area total	*...*	*...*	*...*	*...*	*125*	*131*	*...*	*...*	*...*	*...*
Species total	*...*	*...*	*...*	*...*	*125*	*131*	*...*	*...*	*...*	*...*
Gudgeons, sleepers nei	**Gudgeons, dormeurs nca**		**Durmientes nep**		***Eleotridae***				**1,73(20)XXX,XX**	**FGB**
04 Indonesia	2 604	2 401	4 213	2 726	1 405	1 471	1 617	1 690	1 628	1 996
04 Fishing area total	*2 604*	*2 401*	*4 213*	*2 726*	*1 405*	*1 471*	*1 617*	*1 690*	*1 628*	*1 996*
06 Papua N Guin	1 850 F	1 850 F	1 850 F	1 850 F	1 850 F	1 850 F	1 850 F	1 850 F	1 850 F	1 850 F
06 Fishing area total	*1 850 F*	*1 850 F*	*1 850 F*	*1 850 F*	*1 850 F*	*1 850 F*	*1 850 F*	*1 850 F*	*1 850 F*	*1 850 F*
Species total	*4 454 F*	*4 251 F*	*6 063 F*	*4 576 F*	*3 255 F*	*3 321 F*	*3 467 F*	*3 540 F*	*3 478 F*	*3 846 F*

B-13

Miscellaneous freshwater fishes
Poissons d'eau douce divers
Peces de agua dulce diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Knout goby	**Gobie à tête plate**		**Gobio sapo**		***Mesogobius batrachocephalus***				**1,73(21)162,01**	**MBF**
37 Romania	-	-	-	-	-	-	-	1	1	0
37 Fishing area total	-	-	-	-	-	-	-	*1*	*1*	*0*
Species total	-	-	-	-	-	-	-	*1*	*1*	*0*
Bichique	**Sicyoptère à bec de lièvre**		**...C**		***Sicyopterus lagocephalus***				**1,73(21)227,02**	**IYL**
01 Réunion	...	2	2	2	1	2	1	0	0	0
01 Fishing area total	...	*2*	*2*	*2*	*1*	*2*	*1*	*0*	*0*	*0*
Species total	...	*2*	*2*	*2*	*1*	*2*	*1*	*0*	*0*	*0*
Freshwater gobies nei	**Gobies d'eau douce nca**		**Góbidos de agua dulce nep**		***Gobiidae***				**1,73(21)XXX,XX**	**FGX**
01 Benin	800 F	800 F	800 F	750 F	600 F	900 F	950 F	950 F	1 000 F	1 050 F
01 Fishing area total	*800 F*	*800 F*	*800 F*	*750 F*	*600 F*	*900 F*	*950 F*	*950 F*	*1 000 F*	*1 050 F*
04 Azerbaijan	-	6	7	8	5	5	10	16	18	14
Japan	520	493	341	694	629	339	383	265	202	172 F
Philippines	4 280	5 920	5 871	5 649	5 415	5 688	5 450	6 111	5 906	5 619
Turkey	116	85	73	79	105	101	70	57	51	47
04 Fishing area total	*4 916*	*6 504*	*6 292*	*6 430*	*6 154*	*6 133*	*5 913*	*6 449*	*6 177*	*5 852 F*
05 Albania	5	7	...	...	...	...	10	18	...	5
Bulgaria	-	-	2	1	-	0	-	-	-	-
Ukraine	...	70	69	52	56	41	50	59	21	17
05 Fishing area total	*5*	*77*	*71*	*53*	*56*	*41*	*60*	*77*	*21*	*22*
Species total	*5 721 F*	*7 381 F*	*7 163 F*	*7 233 F*	*6 810 F*	*7 074 F*	*6 923 F*	*7 476 F*	*7 198 F*	*6 924 F*
Climbing perch	**Anabas**		**Perca trepadora**		***Anabas testudineus***				**1,76(05)002,01**	**FPC**
04 Indonesia	...	...	...	6 175	9 545	9 719	11 054	11 372	11 116	14 234
Philippines	1 970	1 193	1 900	2 335	1 534	1 629	1 825	2 330	2 321	2 022
Thailand	5 800	7 200	10 081	7 800	13 197	9 100	6 800	12 300	16 019	10 200
04 Fishing area total	*7 770*	*8 393*	*11 981*	*16 310*	*24 276*	*20 448*	*19 679*	*26 002*	*29 456*	*26 456*
Species total	*7 770*	*8 393*	*11 981*	*16 310*	*24 276*	*20 448*	*19 679*	*26 002*	*29 456*	*26 456*
Giant gourami	**Gourami géant**		**Gurami gigante**		***Osphronemus goramy***				**1,76(09)007,01**	**FGG**
04 Indonesia	-	-	-	389	865	704	11 054	1 339	1 403	1 689
04 Fishing area total	-	-	-	*389*	*865*	*704*	*11 054*	*1 339*	*1 403*	*1 689*
Species total	-	-	-	*389*	*865*	*704*	*11 054*	*1 339*	*1 403*	*1 689*
Snakeskin gourami	**Gourami peau de serpent**		**Gurami piel de serpiente**		***Trichogaster pectoralis***				**1,76(10)013,02**	**FGS**
04 Indonesia	20 857	21 609	21 194	20 075	19 761	18 626	17 919	17 588	15 896	22 306
Philippines	3 536	2 830	3 279	4 831	3 832	5 063	5 343	6 108	6 352	6 153
Thailand	500	1 100	2 024	2 500	1 093	3 000	900	5 100	4 524	3 100
04 Fishing area total	*24 893*	*25 539*	*26 497*	*27 406*	*24 686*	*26 689*	*24 162*	*28 796*	*26 772*	*31 559*
Species total	*24 893*	*25 539*	*26 497*	*27 406*	*24 686*	*26 689*	*24 162*	*28 796*	*26 772*	*31 559*
Three spot gourami	**...B**		**...C**		***Trichogaster trichopterus***				**1,76(10)013,03**	**TGH**
04 Indonesia	...	...	...	6 466	6 867	6 793	7 104	12 350	7 483	12 716
04 Fishing area total	...	...	...	*6 466*	*6 867*	*6 793*	*7 104*	*12 350*	*7 483*	*12 716*
Species total	...	...	...	*6 466*	*6 867*	*6 793*	*7 104*	*12 350*	*7 483*	*12 716*
Kissing gourami	**Gourami embrasseur**		**Gurami besador**		***Helostoma temminckii***				**1,76(11)006,01**	**FGO**
04 Indonesia	19 429	18 980	14 741	19 734	14 816	13 052	13 011	12 703	11 615	12 914
04 Fishing area total	*19 429*	*18 980*	*14 741*	*19 734*	*14 816*	*13 052*	*13 011*	*12 703*	*11 615*	*12 914*
Species total	*19 429*	*18 980*	*14 741*	*19 734*	*14 816*	*13 052*	*13 011*	*12 703*	*11 615*	*12 914*
Snakehead	**Poisson tête de serpent**		**Cabeza de serpiente**		***Channa argus***				**1,77(19)001,01**	**CNA**
04 Korea Rep	...	...	6	...	13	287	28	46	42	50
04 Fishing area total	...	...	*6*	...	*13*	*287*	*28*	*46*	*42*	*50*
Species total	...	...	*6*	...	*13*	*287*	*28*	*46*	*42*	*50*
Striped snakehead	**Tête de serpent strié**		**Cabeza de serpiente cabrío**		***Channa striata***				**1,77(19)001,03**	**FSS**
04 Indonesia	31 274	29 423	30 627	41 014	32 784	31 194	30 300	29 842	27 930	34 017
Philippines	6 698	7 388	7 476	8 261	8 126	8 298	8 875	10 000	10 470	9 906
Thailand	18 300	18 300	24 052	19 600	12 620	7 900	6 600	20 300	25 494	18 100
04 Fishing area total	*56 272*	*55 111*	*62 155*	*68 875*	*53 530*	*47 392*	*45 775*	*60 142*	*63 894*	*62 023*
Species total	*56 272*	*55 111*	*62 155*	*68 875*	*53 530*	*47 392*	*45 775*	*60 142*	*63 894*	*62 023*

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Miscellaneous freshwater fishes
Poissons d'eau douce divers
Peces de agua dulce diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Indonesian snakehead	**Tête de serpent d'Indonésie**		**Cabeza de serpiente rojo**		***Channa micropeltes***				**1,77(19)001,04**	**FIS**
04 Indonesia	6 357	6 586	6 996	16 757	8 371	7 460	6 679	7 506	8 233	7 811
04 Fishing area total	*6 357*	*6 586*	*6 996*	*16 757*	*8 371*	*7 460*	*6 679*	*7 506*	*8 233*	*7 811*
Species total	*6 357*	*6 586*	*6 996*	*16 757*	*8 371*	*7 460*	*6 679*	*7 506*	*8 233*	*7 811*
Snakeheads(=Murrels) nei	**Poissons tête de serpent nca**		**Cabezas de serpiente nep**		***Channa spp***				**1,77(19)001,XX**	**FSN**
01 Nigeria	2 951	3 313	4 571	6 170	5 470	3 504	5 960	10 388	5 515	4 596
01 Fishing area total	*2 951*	*3 313*	*4 571*	*6 170*	*5 470*	*3 504*	*5 960*	*10 388*	*5 515*	*4 596*
04 India	58 856	35 966	40 375	37 632	60 521	60 767	58 428	81 674	82 924	81 056
Kazakhstan	12	8	17	33	...	...	...	...	32	6
Turkmenistan	1	-	2	6	6 F	6 F	6 F	6 F	6 F	6 F
Uzbekistan	55	75	93	108	50 F	...	34	32	141	100 F
04 Fishing area total	*58 924*	*36 049*	*40 487*	*37 779*	*60 577 F*	*60 773 F*	*58 468 F*	*81 712 F*	*83 103 F*	*81 168 F*
Species total	*61 875*	*39 362*	*45 058*	*43 949*	*66 047 F*	*64 277 F*	*64 428 F*	*92 100 F*	*88 618 F*	*85 764 F*
Freshwater fishes nei	**Poissons d'eau douce nca**		**Peces de agua dulce nep**		***Osteichthyes***				**1,99(XX)XXX,XX**	**FRF**
01 Algeria	0	0	0	0	0	0	0	-	-	-
Angola	8 000 F	9 000 F	10 000	10 000 F	10 000 F	10 500	9 000 F	7 500 F	5 848	10 000 F
Benin	3 440 F	3 433 F	3 440 F	3 220 F	2 400 F	3 750 F	4 000 F	4 000 F	4 200 F	4 300 F
Botswana	30	38	50	59	49	4	3	2	2 F	1
Burkina Faso	8 500	8 500	9 000	9 000 F	9 000	9 500	10 200	4 722	4 800	5 820
Burundi	1 049	1 000 F	294	136	310 F	580 F	950 F	1 285	1 280 F	1 280 F
Cameroon	52 500 F	65 000	55 000	65 000 F	75 000	75 000	74 380	74 700 F	75 000	75 000 F
Cape Verde	0	0	-	-	-	-	-	-	-	-
Cent Afr Rep	17 000 F	19 000 F	21 000 F	23 000 F	25 000 F	27 000 F	29 000 F	31 000 F	33 000 F	35 000 F
Chad	75 000 F	70 000 F	65 000 F	60 000 F	55 000 F	50 000 F	45 000 F	40 000 F	40 000 F	40 000 F
Comoros	0	0	-	-	-	-	-	-	-	-
Congo Dem R	227 433 F	233 800 F	230 365 F	231 772 F	230 840 F	230 588 F	230 000 F	230 000 F	230 000 F	230 000 F
Congo Rep	26 101	29 494	31 182	30 338	32 500	31 000	30 120	29 362	28 385	30 500
Côte dIvoire	10 116 F	20 157	21 000 F	4 856	13 145	6 499	3 178	4 400 F	5 649	6 763
Djibouti	0	0	0	-	-	-	-	-	-	-
Egypt	21 810	18 931	16 393	14 393	14 632	15 421	12 544	34 845	25 685	15 014
Eq Guinea	1 000 F	950 F	900 F	850 F	850 F	900 F	900 F	900 F	1 000	1 000 F
Eritrea	0	-	-	-	-	-	-	-	-	-
Ethiopia	-	-	103	104	187	321	457	817	1 191	571
Fr South Tr	0	0	0	-	-	-	-	-	-	-
Gabon	5 922	5 121	5 219	3 986	5 056	4 799	4 800 F	5 000 F	5 000 F	5 000 F
Gambia	1 450 F	1 450 F	2 000 F	2 550 F	3 100 F	3 650 F	4 146	3 089	3 308	3 300 F
Ghana	74 500	74 500	75 000	75 000 F	75 000	83 168	84 756	85 000	88 700 F	90 000 F
Guinea	4 000	5 000 F	6 000 F	7 000 F	8 000 F	9 000 F	10 000 F	12 000 F	14 000 F	16 000 F
GuineaBissau	150 F	150 F	150 F	150 F	150 F	150 F	150 F	150 F	150 F	150 F
Kenya	5 237	4 984	1 800	1 760	1 907	1 349	1 862	3 873	2 186	3 487
Lesotho	14	26	25	25	25	30	30	32	25	25
Liberia	4 000	4 000 F	3 600 F	3 200 F	2 800 F	2 400 F	1 743	763	750 F	750 F
Libya	0	0	0	-	-	-	-	-	-	-
Madagascar	4 500 F	4 500 F	4 500 F	4 700 F	4 900 F	4 950 F	4 880 F	4 880 F	4 908 F	5 300 F
Malawi	2 274	2 314	3 121	3 291	4 098	4 250	3 900	4 400	4 930	4 628
Mali	19 000 F	19 000 F	19 000 F	19 000 F	19 000 F	19 000 F	19 000	19 000 F	19 000 F	18 852
Mauritania	10 000 F	12 000 F	12 000 F	12 000 F	13 000 F	15 000 F	15 000 F	15 000 F	15 000 F	15 000 F
Morocco	600	800	700	200	460	500	580	600	780	1 000
Mozambique	8 000 F	8 000 F	9 000 F	9 000 F	10 000 F	10 000 F	15 199	18 331	20 535	20 723
Namibia	2 000 F	2 000 F	2 500 F	2 500 F	2 800 F	2 800 F	2 800	2 800 F	2 800 F	2 800 F
Niger	20 800	23 560	55 860	51 466	50 018	29 835	29 728	29 960	4 483	4 483 F
Nigeria	36 986	96 034	4 531	18 880	26 817	22 198	3 223	10 409	12 867	10 654
Réunion	0	...	...	...	...	...	...	...	...	...
Rwanda	4 178	4 250 F	4 600	4 706	4 700 F	4 900 F	5 100	5 100 F	5 100 F	5 100 F
Sao Tome Prn	0	0	0	0	0	0	0	-	-	-
Senegal	35 700 F	31 400 F	27 100 F	22 977 F	23 535 F	23 413 F	28 181 F	7 394	14 000 F	20 000 F
Seychelles	0	0	-	-	-	-	-	-	-	-
Sierra Leone	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F
Somalia	200 F	200 F	200 F	200 F	200 F	200 F	200 F	200 F	200 F	200 F
South Africa	900 F	900 F	900 F	900 F	900 F	900 F	900 F	900 F	900 F	900 F
Sudan	33 000	32 000	34 000 F	36 000 F	33 500 F	32 200 F	36 920	31 000 F	25 080	25 080 F
Swaziland	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F
Tanzania	86 354	84 356	98 755	110 515	104 774	118 722	123 504	133 292	108 230	119 682
Togo	1 000	1 000	1 000	1 000	1 000	1 000	1 000	1 000 F	1 000	1 000
Tunisia	860	870	859	1 049	1 093	1 087	1 084	1 096	1 191	1 123
Uganda	2	1 800	728	7 436	8 335	7 347	10 000	9 000 F	8 000 F	2 903
Zambia	54 500 F	55 000 F	58 851 F	61 151	59 676	52 577	64 066	71 543	74 723	68 575
Zimbabwe	1 750 F	1 700 F	1 650 F	1 600 F	1 600 F	1 600 F	1 600 F	1 600 F	1 600 F	1 600 F
01 Fishing area total	*883 926 F*	*970 288 F*	*911 446 F*	*929 040 F*	*949 427 F*	*932 158 F*	*938 154 F*	*955 015 F*	*909 556 F*	*917 634 F*
02 Anguilla	0	0	-	-	-	-	-	-	-	-
Antigua Barb	0	0	-	-	-	-	-	-	-	-
Bahamas	0	0	0	0	0	0	0	-	-	-
Belize	0	0	0	0	0	0	0	-	-	-
Bermuda	0	-	-	-	-	-	-	-	-	-
Br Virgin Is	0	0	-	-	-	-	-	-	-	-
Canada	8 247	10 568	7 998	6 125	4 657	4 031	3 568	4 344	7 516	4 852
Cayman Is	0	0	0	-	-	-	-	-	-	-
Costa Rica	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F
Dominica	0	0	0	-	-	-	-	-	-	-
Dominican Rp	183	390	44	45	37	354	195	189	...	42
El Salvador	535	1 022	1 026	928	356	692	895	...	3 000 F	2 326

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Miscellaneous freshwater fishes
Poissons d'eau douce divers
Peces de agua dulce diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Greenland	0	0	0	-	-	-	-	-	-	-
	Grenada	0	0	-	-	-	-	-	-	-	-
	Guadeloupe	0	0	-	-	-	-	-	-	-	-
	Guatemala	6 300 F	5 500 F	4 700 F	3 900 F	3 000 F	2 250 F	2 250 F	2 250	2 250 F	2 250 F
	Haiti	400 F	400 F	400 F	300	300 F	300 F	300 F	300 F	300 F	300 F
	Honduras	111	102 F	100 F	100 F	100 F	100 F	100 F	100 F	100 F	100 F
	Jamaica	400 F	400 F	400 F	400 F	400 F	400 F	400 F	400 F	400	400
	Martinique	0	0	-	-	-	-	-	-	-	-
	Mexico	3 911	4 280	7 454	9 278	11 021	11 482	7 964	7 506	4 681	3 534
	Montserrat	0	0	0	0	-	-	-	-	-	-
	NethAntilles	0	0	0	0	0	0	0	-	-	-
	Nicaragua	93	62	54	182	76	2	60	313	19	10
	Puerto Rico	0	-	-	-	-	-	-	-	-	-
	St Kitts Nev	0	0	0	0	0	0	0	-	-	-
	St Lucia	0	0	0	-	-	-	-	-	-	-
	St Pier Mq	0	0	0	-	-	-	-	-	-	-
	St Vincent	0	0	0	0	0	0	0	-	-	-
	Trinidad Tob	0	0	0	0	0	0	0	-	-	-
	Turks Caicos	0	0	-	-	-	-	-	-	-	-
	USA	350	242	270	307	195	118	55	168	87	102
	US Virgin Is	0	0	0	0	0	0	0	-	-	-
02	*Fishing area total*	*21 530 F*	*23 966 F*	*23 446 F*	*22 565 F*	*21 142 F*	*20 729 F*	*16 787 F*	*16 570 F*	*19 353 F*	*14 916 F*
03	Argentina	-	102 F	-	-	181	352	60	107	735	633
	Bolivia	4 900	5 303 F	5 615	5 548	5 510	5 200 F	4 851	5 787	6 568	6 196
	Brazil	18 852	20 152	17 964	19 022	15 425	14 413	14 491	20 870	19 129	25 926
	Chile	0	0	0	0	0	0	0	...	...	...
	Colombia	7 320	5 999	6 599	6 119	5 220	4 300 F	3 400 F	2 500 F	1 730	3 082
	Ecuador	350 F	300 F	300 F	250 F	250 F	...	...	...	...	...
	Fr Guiana	0	0	-	-	-	-	-	-	-	-
	Guyana	800	800	800	800	800	800 F	800	800	800 F	800
	Paraguay	4 000 F	3 800 F	3 200 F	2 600 F	2 000 F	1 400 F	900 F	308 F	300 F	300 F
	Peru	22 568	17 941	20 577	23 800	27 569	30 613	28 727	31 438	31 130	32 816
	Suriname	200	200 F	222	242	218	200	350	350 F	420	560
	Uruguay	254	39	114	149	130	1 588	901	37	801	1 048
	Venezuela	5 252	13 443	16 085	14 250 F	12 600 F	13 500 F	9 150 F	7 652 F	7 570 F	7 570 F
03	*Fishing area total*	*64 496 F*	*68 079 F*	*71 476 F*	*72 780 F*	*69 903 F*	*72 366 F*	*63 630 F*	*69 849 F*	*69 183 F*	*78 931 F*
04	Afghanistan	800 F	900 F	900 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F
	Armenia	...	22	81	49	56 F	80 F	73 F	69 F	71 F	70 F
	Azerbaijan	-	2	8	13	8	10	19	2	4	7
	Bangladesh	613 860	620 185	646 389	661 066	781 770	878 413	924 316	890 966	1 027 959	869 615
	Bhutan	260 F	240 F	240 F	220 F	220 F	200 F	200 F	180 F	180 F	160 F
	Brunei Darsm	3	1	0	3	-	-	-	-	-	-
	Cambodia	384 500	359 800	308 250	249 600	323 500	421 400	394 500	364 600	389 700	404 500
	China	899 384 F	802 492 F	1 501 030 F	1 494 274 F	1 586 017 F	1 549 587 F	1 574 051	1 615 339	1 526 285	1 614 675
	China, Macao	0	0	-	-	-	-	-	-	-	-
	China,Taiwan	19	15	22	14	19	43	48	43	54	22
	Cyprus	70 F	60 F	50 F	40 F	30 F	20 F	20 F	20 F	20 F	20 F
	Georgia	2	3	6	24	22 F	15 F	8 F	8 F	8 F	8 F
	India	598 798	343 742	308 152	225 711	334 503	372 803	317 211	313 344	317 532	389 021
	Indonesia	107 609	101 516	114 020	82 443	76 495	69 964	79 870	70 889	57 921	55 150
	Iran	2 060	1 091	2 108	3 518	5 524	3 302	1 528	1 699	1 625	1 095
	Iraq	6 000	4 600	5 000	2 422	9 000 F	31 547	29 800	13 577	9 550	8 000
	Japan	3 030	3 004	2 693	1 866	2 113	2 247	2 366	2 392	2 353 F	2 260 F
	Jordan	350	350	350	350	350	350	350	350	350	350
	Kazakhstan	2 740	2 444	1 660	2 720	4 429	5 103	7 427	4 635	...	...
	Korea D P Rp	4 928	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F
	Korea Rep	5 254	4 993	4 504	6 288	3 545	446	2 025	3 306	3 599	2 339
	Kuwait	0	0	0	0	0	0	0	-	-	-
	Lao P.Dem.R.	26 350 F	28 440 F	25 300 F	25 300 F	22 560 F	22 825 F	24 110 F	24 800 F	25 500 F	26 000
	Lebanon	10	272	265	245	250	245	245 F	245 F	245 F	245 F
	Malaysia	3 446	3 185	3 605	4 119	4 281	3 874	3 981	3 945	4 086	4 150
	Maldives	0	0	-	-	-	-	-	-	-	-
	Mongolia	290	263	382	305	366	326	185	88	90	90 F
	Myanmar	238 210	254 880	290 140	454 260	503 540	631 120	717 640	814 740	899 430	1 002 430
	Nepal	16 700	17 900	18 888	19 947	19 983	20 016	20 100	21 500	21 500	21 500
	Oman	0	0	-	-	-	-	-	-	-	-
	Pakistan	122 468	114 030	92 794	93 687	94 644	140 000	100 000	108 000	112 355	115 348
	Palest, O.T.	0	0	0	0	0	0	0	-	-	-
	Philippines	3 878	7 854	7 744	8 421	9 035	8 100	10 867	8 704	8 059	7 847
	Qatar	0	0	0	-	-	-	-	-	-	-
	Saudi Arabia	0	0	0	0	0	0	0	-	-	-
	Singapore	0	0	-	-	-	-	-	-	-	-
	Sri Lanka	9 140	9 430	9 050	8 610	9 940	15 970	15 870	19 270	20 240	24 160
	Syria	5 969	6 355	5 851	5 451	4 770	4 869	6 075	3 784	3 500	3 679
	Tajikistan	-	-	-	-	-	35 F	35 F	70 F	70 F	80 F
	Thailand	69 000	70 300	75 171	72 500	56 310	129 200	159 800	59 700	50 418	79 200
	Timor-Leste	0	0	0	0	-	-	-	-	-	-
	Turkey	2 613	2 521	2 852	2 352	1 367	1 378	952	312	236	223
	Turkmenistan	9	7	3	4	5 F	5 F	5 F	5 F	5 F	5 F
	Untd Arab Em	0	0	0	0	0	0	0	-	-	-
	Uzbekistan	27	-	-	-	100 F	353	688	654	622	420 F
	Viet Nam	188 542	163 615	148 959	194 621	188 400	193 300	187 800	178 700	177 400	182 500 F
04	*Fishing area total*	*3 316 319 F*	*2 929 512 F*	*3 581 467 F*	*3 626 443 F*	*4 049 152 F*	*4 513 146 F*	*4 588 165 F*	*4 531 936 F*	*4 666 967 F*	*4 821 169 F*
05	Albania	-	24	30 F	-	3	3	210	321	508	495
	Andorra	0	0	0	0	0	0	0	0	0	0
	Austria	362	350	372	400	370	360	350	350	350	350

B-13

Miscellaneous freshwater fishes
Poissons d'eau douce divers
Peces de agua dulce diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Belarus	-	0	4	3	5	17	1	1	3	1
Bosnia Herzg	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F
Bulgaria	74	5	-	16	12	11	6	2	3	-
Channel Is	0	0	-	-	-	-	-	-	-	-
Croatia	12	17	13	25	26	18	23	8	0	0
Czech Rep	131	126	128	74	65	59	51	55	55	50
Denmark	1	0	0	-	-	-	-	-	-	-
Estonia	209	28	184	186	198	126	0	1	0	1
Faroe Is	0	0	0	-	-	-	-	-	-	-
Finland	393	532	532	559	559	652	652	348	348	340
FYRMacedonia	7	6	8	78	84	87	90	84	94	100
France	1 071	1 050 F	1 050 F	1 050 F	1 050 F	1 050 F	1 050 F	1 050 F	1 050 F	1 050 F
Germany	16 868 F	16 328 F	15 788 F	15 248 F	14 500 F	14 000 F	13 500 F	13 000 F	12 500 F	12 000
Greece	1 663	1 451	1 539	280	263	250	250	264	177	177 F
Hungary	89	15	26	12	12	461	447	446	419	371
Iceland	0	0	0	0	0	0	0	0	-	-
Isle of Man	0	0	-	-	-	-	-	-	-	-
Italy	2 643	2 341	2 149	2 541	2 554	2 507	2 797	2 490	3 771	2 752
Latvia	40	38	27	17	20	11	7	8	10	8
Liechtensten	0	0	0	0	0	0	0	0	0	0
Lithuania	2	0	10	5	8	14	3	1	1	6
Luxembourg	0	0	0	0	0	0	0	0	0	0
Malta	0	-	-	-	-	-	-	-	-	-
Moldova Rep	-	27	5	58	51	37	67	72	96	104
Montenegro	...	...	...	...	...	87	70	64	168	83
Netherlands	150 F	134	140 F	140 F	140 F	140 F	140 F	140 F	140 F	140 F
Poland	13 035	14 035	15 038	16 039	16 045	16 059	16 030	16 014	16 024	16 022
Portugal	1	12	1	4	6	1	0	0	0	0
Romania	188	230	1 327	38	162	604	133	15	9	4
Russian Fed	3 887	5 078	11 291	6 602	4 520	5 640	7 353	13 440	791	5 551
San Marino	0	0	0	0	0	0	0	0	0	0
Serbia	...	...	...	...	...	109	85	126	661	1 365
Serbia-Monte	462	889	1 015	1 556	1 667	-	-	-	-	-
Slovenia	-	2	-	-	-	-	-	-	-	-
Spain	3 270 F	2 900 F	2 650 F	2 650 F	2 650 F	2 650 F	2 650 F	2 650 F	2 650 F	2 650 F
Sweden	155	179	-	-	-	-	-	-	-	-
Switzerland	1	2	3	4	5	1	3	1	2	2
Ukraine	7	-	7	-	-	-	-	-	-	-
05 Fishing area total	*46 721 F*	*47 799 F*	*55 337 F*	*49 585 F*	*46 975 F*	*46 954 F*	*47 968 F*	*52 951 F*	*41 830 F*	*45 622 F*
06 Amer Samoa	0	-	-	-	-	-	-	-	-	-
Australia	162	105	268	281	500	334	1 238	1 275	1 576	844
Cook Is	0	0	0	0	0	0	0	0	0	-
Fiji	...	...	...	...	...	...	...	200 F	120	75
Fr Polynesia	50	50	50 F	50 F	50	50	50	50	50	50
Kiribati	0	0	0	-	-	-	-	-	-	-
Marshall Is	0	0	-	-	-	-	-	-	-	-
Micronesia	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F
NewCaledonia	0	0	-	-	-	-	-	-	-	-
New Zealand	300	300	301	300	300	300	300	300	300	300
Niue	0	0	-	-	-	-	-	-	-	-
Norfolk Is	0	0	0	0	0	0	0	0	0	0
N Marianas	0	-	-	-	-	-	-	-	-	-
Palau	0	0	0	-	-	-	-	-	-	-
Papua N Guin	6 654 F	6 654 F	6 654 F	6 654 F	6 654 F	6 654 F	6 654 F	6 654 F	6 654 F	6 654 F
Pitcairn Is	0	0	-	-	-	-	-	-	-	-
Samoa	1 F	1 F	1 F	1 F	1 F	1	1 F	1 F	1 F	1 F
Solomon Is	0	0	0	0	0	0	0	-	-	-
Tokelau	0	0	-	-	-	-	-	-	-	-
Tonga	0	0	0	0	0	0	0	-	-	-
Tuvalu	0	0	-	-	-	-	-	-	-	-
Vanuatu	0	0	0	0	0	0	0	-	-	-
Wallis Fut I	0	0	-	-	-	-	-	-	-	-
06 Fishing area total	*7 172 F*	*7 115 F*	*7 279 F*	*7 291 F*	*7 510 F*	*7 344 F*	*8 248 F*	*8 485 F*	*8 706 F*	*7 929 F*
27 Estonia	-	-	-	-	-	-	115	-	-	-
Finland	203	249	289	210	152	124	130	235	193	191
Germany	1	3	2	1	2	-	1	1	2	2
Latvia	10	24	-	-	1	-	-	-	-	-
Lithuania	-	1	1	1	1	1	-	-	-	0
Poland	241	260	152	27	30	12	7	8	5	15
Russian Fed	-	2	20	31	15	450	-	-	69	-
Sweden	-	-	-	8	-	1	-	-	-	1
27 Fishing area total	*455*	*539*	*464*	*278*	*201*	*588*	*253*	*244*	*269*	*209*
37 Russian Fed	17	-	249	-	260	-	-	11	2	54
37 Fishing area total	*17*	-	*249*	-	*260*	-	-	*11*	*2*	*54*
Species total	*4 340 636 F*	*4 047 298 F*	*4 651 164 F*	*4 707 982 F*	*5 144 570 F*	*5 593 285 F*	*5 663 205 F*	*5 635 061 F*	*5 715 866 F*	*5 886 464 F*
Group total	***5 585 746***	***5 259 622***	***5 993 364***	***6 107 884***	***6 661 748***	***7 053 644***	***7 098 039***	***7 212 559***	***7 316 381***	***7 595 738***

B-21 **Sturgeons, paddlefishes**
Esturgeons, spatules
Esturiones, sollos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Danube sturgeon(=Osetr)	**Esturgeon du Danube**		**Esturión del Danube**		***Acipenser gueldenstaedtii***				**1,17(01)001,02**	**APG**
05 Bulgaria	1	1	1	0	1	1	0	0	-	0
Romania	17	4	2	0	-	-	-	-	-	-
Russian Fed	251	219	189	121	139	69	66	37	65	10
Ukraine	-	-	1	...	0	-	-	-	-	-
05 Fishing area total	*269*	*224*	*193*	*121*	*140*	*70*	*66*	*37*	*65*	*10*
37 Bulgaria	-	2	-	1	-	-	-	-	-	-
Ukraine	8	8	3	2	2	1	1	3	2	-
37 Fishing area total	*8*	*10*	*3*	*3*	*2*	*1*	*1*	*3*	*2*	-
Species total	*277*	*234*	*196*	*124*	*142*	*71*	*67*	*40*	*67*	*10*
Sterlet sturgeon	**Sterlet**		**Esterlete**		***Acipenser ruthenus***				**1,17(01)001,04**	**APR**
05 Bulgaria	1	3	5	3	5	4	0	0	0	0
Hungary	11	12	10	13	11	10	9	7	6	4
Russian Fed	1	2	1	2	1	1	1	-	1	1
Serbia	...	...	...	...	...	30	29	46	35	22
Slovakia	-	0	0	1	0	0	1	0	0	0
05 Fishing area total	*13*	*17*	*16*	*19*	*17*	*45*	*40*	*53*	*42*	*27*
Species total	*13*	*17*	*16*	*19*	*17*	*45*	*40*	*53*	*42*	*27*
Starry sturgeon	**Esturgeon étoilé**		**Esturión estrellado**		***Acipenser stellatus***				**1,17(01)001,05**	**APE**
04 Kazakhstan	...	99	58	4	4	84	37	83	10	1
04 Fishing area total	*...*	*99*	*58*	*4*	*4*	*84*	*37*	*83*	*10*	*1*
05 Bulgaria	1	2	1	0	1	0	-	-	-	0
Romania	20	13	4	2	2	-	-	-	-	-
Russian Fed	172	136	113	29	38	10	12	7	8	1
Ukraine	-	-	-	-	-	-	-	-	0	-
05 Fishing area total	*193*	*151*	*118*	*31*	*41*	*10*	*12*	*7*	*8*	*1*
37 Bulgaria	...	3	0	1	-	-	-	-	-	-
Romania	...	...	...	2	2	-	-	-	-	-
Ukraine	3	2	1	...	1	1	...	0	0	-
37 Fishing area total	*3*	*5*	*1*	*3*	*3*	*1*	*...*	*0*	*0*	-
Species total	*196*	*255*	*177*	*38*	*48*	*95*	*49*	*90*	*18*	*2*
Fringebarbel sturgeon	**Esturgeon barbillons frangés**		**Esturión barba de flecos**		***Acipenser nudiventris***				**1,17(01)001,06**	**AAN**
04 Kazakhstan	...	26	1	0	1	1	-	-	-	-
04 Fishing area total	*...*	*26*	*1*	*0*	*1*	*1*	-	-	-	-
Species total	*...*	*26*	*1*	*0*	*1*	*1*	-	-	-	-
White sturgeon	**Esturgeon blanc**		**Esturión blanco**		***Acipenser transmontanus***				**1,17(01)001,09**	**APN**
67 USA	185	200	163	167	188	158	143	164	154	120
67 Fishing area total	*185*	*200*	*163*	*167*	*188*	*158*	*143*	*164*	*154*	*120*
Species total	*185*	*200*	*163*	*167*	*188*	*158*	*143*	*164*	*154*	*120*
Green sturgeon	**Esturgeon vert**		**Esturión verde**		***Acipenser medirostris***				**1,17(01)001,15**	**AAM**
67 USA	10	7	3	3	3	3	0	0	0	0
67 Fishing area total	*10*	*7*	*3*	*3*	*3*	*3*	*0*	*0*	*0*	*0*
Species total	*10*	*7*	*3*	*3*	*3*	*3*	*0*	*0*	*0*	*0*
Beluga	**Béluga**		**Esturión beluga**		***Huso huso***				**1,17(01)005,01**	**HUH**
04 Kazakhstan	...	58	64	6	2	36	27	46	42	-
04 Fishing area total	*...*	*58*	*64*	*6*	*2*	*36*	*27*	*46*	*42*	-
05 Bulgaria	7	10	8	10	13	6	0	0	0	1
Romania	20	22	25	15	9	-	-	-	-	-
Russian Fed	40	32	24	13	17	8	6	4	4	-
Slovenia	1	0	0	-	-	-	-	-	-	-
05 Fishing area total	*68*	*64*	*57*	*38*	*39*	*14*	*6*	*4*	*4*	*1*
37 Bulgaria	0	4	1	3	1	-	-	-	-	-
Romania	...	...	...	7	4	-	-	-	-	-
37 Fishing area total	*0*	*4*	*1*	*10*	*5*	-	-	-	-	-
Species total	*68*	*126*	*122*	*54*	*46*	*50*	*33*	*50*	*46*	*1*
Sturgeons nei	**Esturgeons nca**		**Esturiones nep**		***Acipenseridae***				**1,17(01)XXX,XX**	**STU**
02 Canada	173	172	172	134	103	113	112	114	111	116
USA	-	-	-	-	-	-	0	-	-	-
02 Fishing area total	*173*	*172*	*172*	*134*	*103*	*113*	*112*	*114*	*111*	*116*
04 Azerbaijan	76	76	105	89	85	87	73	72	4	2
Iran	870	643	463	500	411	330	225	178	130	94

B-21

Sturgeons, paddlefishes
Esturgeons, spatules
Esturiones, sollos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Kazakhstan	282	61	91	228	227	55	30	29	5	2
Turkmenistan	3	5	4	5	5 F	5 F	5 F	5 F	5 F	5 F
04 Fishing area total	*1 231*	*785*	*663*	*822*	*728 F*	*477 F*	*333 F*	*284 F*	*144 F*	*103 F*
05 FYRMacedonia	-	-	-	-	6	0	0	0	-	5
Germany	0	0	0	0	0	-	-	-	-	-
Romania	1	1	-	-	-	-	-	-	-	-
Russian Fed	133	69	56	77	41	41	57	95	104	127
05 Fishing area total	*134*	*70*	*56*	*77*	*47*	*41*	*57*	*95*	*104*	*132*
21 Canada	4	0	0	0	1	1	6	0	-	0
21 Fishing area total	*4*	*0*	*0*	*0*	*1*	*1*	*6*	*0*	-	*0*
27 Germany	-	-	-	-	-	-	-	0	24	36
Spain	-	-	-	-	-	-	-	-	-	0
27 Fishing area total	-	-	-	-	-	-	-	*0*	*24*	*36*
37 Georgia	3	7	5	4	3 F	...	...	...	...	...
Romania	1	1	1	1	1	-	-	-	-	-
Russian Fed	18	15	8	3	2	2	1	1	-	-
37 Fishing area total	*22*	*23*	*14*	*8*	*6 F*	*2*	*1*	*1*	...	...
Species total	*1 564*	*1 050*	*905*	*1 041*	*885 F*	*634 F*	*509 F*	*494 F*	*383 F*	*387 F*
Group total	***2 313***	***1 915***	***1 583***	***1 446***	***1 330***	***1 057***	***841***	***891***	***710***	***547***

B-22 **River eels**
Anguilles
Anguilas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
European eel	**Anguille d'Europe**		**Anguila europea**		***Anguilla anguilla***				**1,43(02)002,01**	**ELE**
01 Egypt	1 979	1 802	781	916	924	3 983	2 055	944	1 238	345
Morocco	150	200	100	50	70	50	40	40	40	26
01 Fishing area total	*2 129*	*2 002*	*881*	*966*	*994*	*4 033*	*2 095*	*984*	*1 278*	*371*
04 Turkey	122	147	158	165	176	162	179	171	158	182
04 Fishing area total	*122*	*147*	*158*	*165*	*176*	*162*	*179*	*171*	*158*	*182*
05 Albania	...	23	...	50	102	190	116	93	66	114
Belarus	25	12	8	16	13	9	9	10	8	31
Belgium	30	30	30	30	30	30	30	30	30	30
Czech Rep	29	28	26	25	26	21	21	21	21	19
Denmark	23	18	17	14	14	14	10	9	13	13
Estonia	40	22	30	24	20	24	25	25	18	15
Finland	-	-	-	-	-	-	-	4	4	4
France	1 106	1 100 F	1 100 F	1 100 F	1 100 F	1 100 F	1 100 F	1 100 F	1 000 F	1 000 F
Germany	500	500	120	120	174	186	206	243	231	224
Greece	8	5	5	5	4	3	6	8	3	3 F
Hungary	27	18	9	13	74	90	34	52	92	235
Ireland	110	104	81	119	87	120	94	108	-	-
Italy	217	157	138	133	75	56	58	56	62	44
Latvia	17	9	9	9	13	6	9	12	4	7
Lithuania	12	2	12	16	22	16	15	13	9	19
Montenegro	...	...	...	...	...	6	1	1	6	-
Netherlands	340 F	353	350 F	300 F	300 F	300 F	250 F	250 F	250 F	301
Norway	...	...	...	...	...	3	...	...	...	-
Poland	263	235	203	188	144	131	132	111	110	115
Russian Fed	3	3	4	2	2	1	-	-	-	-
Slovakia	6	7	5	7	5	4	3	3	3	3
Slovenia	-	2	0	0	-	-	-	-	-	-
Spain	0	0	-	-	-	-	-	-	-	-
Sweden	118	102	96	106	111	125	111	113	96	108
Switzerland	2	2	2	2	2	2	2	2	1	2
Ukraine	-	5	-	-	-	-	-	-	-	-
UK	583	561	572	497	490	403	484	415	462	461
05 Fishing area total	*3 459 F*	*3 298 F*	*2 817 F*	*2 776 F*	*2 808 F*	*2 840 F*	*2 716 F*	*2 679 F*	*2 489 F*	*2 748 F*
27 Denmark	635	551	603	520	517	566	521	448	454	409
Estonia	27	28	19	16	9	9	6	5	4	4
Finland	-	-	...	...	...	...	...	14	15	15
France	180	167	176	96	74	117	127	119	59	97
Germany	138	136	131	123	111	117	88	85	74	74
Latvia	2	2	2	3	4	2	1	1	1	1
Lithuania	...	11	1	-	-	-	-	-	-	-
Netherlands	34	20	16	31	17	16	8	6	3	6
Norway	304	310	240	237	249	293	194	211	69	32
Poland	162	126	118	82	76	53	49	49	51	53
Portugal	37	36	13	11	9	12	12	10	11	14
Russian Fed	53	52	52	58	54	54	36	17	9	16
Spain	51	21	9	24	28	63	29	34	47	32
Sweden	462	532	469	462	557	605	587	553	422	415
UK	12	10	16	7	3	2	2	1	1	-
27 Fishing area total	*2 097*	*2 002*	*1 865*	*1 670*	*1 708*	*1 909*	*1 660*	*1 553*	*1 220*	*1 168*
34 Morocco	0	0	1	3	1	0	1	0	1	9
34 Fishing area total	*0*	*0*	*1*	*3*	*1*	*0*	*1*	*0*	*1*	*9*
37 Albania	98	2	0	2	3	3	3	5	4	6
Croatia	-	-	-	-	-	-	-	-	0	-
Cyprus	-	-	6	2	-	-	-	-	-	-
France	105	105	106	105	2	2	2	2	135	203
Greece	24	16	19	18	15	18	15	11	13	13 F
Italy	229	245	320	254	40	8	51	19	25	20
Montenegro	...	...	...	...	...	2	2	1	1	1
Serbia-Monte	...	4	4	2	2	-	-	-	-	-
Spain	11	72	31	33	27	23	21	26	34	32
Tunisia	135	202	166	108	181	250	250	302	108	85
37 Fishing area total	*602*	*646*	*652*	*524*	*270*	*306*	*344*	*366*	*320*	*360 F*
Species total	*8 409 F*	*8 095 F*	*6 374 F*	*6 104 F*	*5 957 F*	*9 250 F*	*6 995 F*	*5 753 F*	*5 466 F*	*4 838 F*
Japanese eel	**Anguille du Japon**		**Anguila japonesa**		***Anguilla japonica***				**1,43(02)002,04**	**ELJ**
04 Japan	677	610	589	614	484	302	289	270	263	245 F
Korea Rep	...	...	20	...	35	...	40	96	145	119
04 Fishing area total	*677*	*610*	*609*	*614*	*519*	*302*	*329*	*366*	*408*	*364 F*
Species total	*677*	*610*	*609*	*614*	*519*	*302*	*329*	*366*	*408*	*364 F*
American eel	**Anguille d'Amérique**		**Anguila americana**		***Anguilla rostrata***				**1,43(02)002,06**	**ELA**
02 Canada	254	241	240	175	156	146	146	158	158	96
Dominican Rp	1	37	23	9	14	24	2	17	9	10
USA	393	3	4	3	-	-	-	-	-	-
02 Fishing area total	*648*	*281*	*267*	*187*	*170*	*170*	*148*	*175*	*167*	*106*
21 Canada	220	231	393	328	226	458	401	253	251	253
USA	-	263	404	278	389	340	323	255	303	332

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River eels
Anguilles
Anguilas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
21 Fishing area total	*220*	*494*	*797*	*606*	*615*	*798*	*724*	*508*	*554*	*585*
31 Mexico	0	1	0	2	...	...	...	...	...	...
USA	-	11	55	45	17	11	13	13	27	52
31 Fishing area total	*0*	*12*	*55*	*47*	*17*	*11*	*13*	*13*	*27*	*52*
Species total	*868*	*787*	*1 119*	*840*	*802*	*979*	*885*	*696*	*748*	*743*
Short-finned eel	**Anguille d'Australie**		**Anguila australiana**		***Anguilla australis***				**1,43(02)002,07**	**ELU**
57 Australia	175	172	106	105	87	80	70	84	57	44
57 Fishing area total	*175*	*172*	*106*	*105*	*87*	*80*	*70*	*84*	*57*	*44*
81 Australia	38	28	27	13	10	5	...	...	...	...
81 Fishing area total	*38*	*28*	*27*	*13*	*10*	*5*	*...*	*...*	*...*	*...*
Species total	*213*	*200*	*133*	*118*	*97*	*85*	*70*	*84*	*57*	*44*
River eels nei	**Anguilles nca**		**Anguilas nep**		***Anguilla spp***				**1,43(02)002,XX**	**ELX**
04 Indonesia	1 907	1 623	2 171	2 881	929	1 659	1 235	645	888	1 149
Philippines	201	181	287	539	497	612	688	710	835	719
04 Fishing area total	*2 108*	*1 804*	*2 458*	*3 420*	*1 426*	*2 271*	*1 923*	*1 355*	*1 723*	*1 868*
06 New Zealand	762	586	530	486	500	546	508	439	429	583
06 Fishing area total	*762*	*586*	*530*	*486*	*500*	*546*	*508*	*439*	*429*	*583*
81 New Zealand	313	337	267	209	277	210	207	152	107	...
81 Fishing area total	*313*	*337*	*267*	*209*	*277*	*210*	*207*	*152*	*107*	*...*
Species total	*3 183*	*2 727*	*3 255*	*4 115*	*2 203*	*3 027*	*2 638*	*1 946*	*2 259*	*2 451*
Group total	***13 350***	***12 419***	***11 490***	***11 791***	***9 578***	***13 643***	***10 917***	***8 845***	***8 938***	***8 440***

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Salmons, trouts, smelts
Saumons, truites, éperlans
Salmones, truchas, eperlanos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Atlantic salmon	**Saumon de l'Atlantique**		**Salmón del Atlántico**		***Salmo salar***				**1,23(01)004,01**	**SAL**
05 Denmark	0	0	0	...	...	3	3	9	8	13
Estonia	-	-	-	0	1	1	1	1	1	1
Finland	221	181	181	238	238	222	222	255	255	255
Iceland	88	97	110	130	149	113	126	174	170	190
Ireland	792	674	515	474	418	308	71	89	68	99
Latvia	3	1	1	4	-	-	3	4	5	6
Lithuania	0	0	0	0	1	1	1	1	1	-
Norway	400 F	375 F	350 F	316	414	420	767	806	595	641
Poland	5	10	2	2	4	5	5	6	2	1
Russian Fed	52	57	52	31	13	15	25	66	64	70
Spain	30 F	50 F	50 F	50 F	50 F	50 F	50 F	50 F	50 F	50 F
Sweden	56	43	21	19	18	20	20	29	18	22
UK	482	481	364	452	407	324	305	313	227	175
05 Fishing area total	*2 129 F*	*1 969 F*	*1 646 F*	*1 716 F*	*1 713 F*	*1 482 F*	*1 599 F*	*1 803 F*	*1 464 F*	*1 523 F*
21 Canada	-	1	-	-	-	-	-	-	0	-
Denmark	0	0	-	-	-	-	-	-	-	-
Greenland	42	-	-	-	-	-	22	-	-	-
St Pier Mq	1	1	2	2	2	2	1	2	-	-
21 Fishing area total	*43*	*2*	*2*	*2*	*2*	*2*	*23*	*2*	*0*	*...*
27 Denmark	434	321	442	356	202	164	64	19	67	130
Estonia	14	16	10	7	8	6	6	8	8	6
Faroe Is	0	0	0	-	0	-	-	-	-	-
Finland	596	475	377	607	562	343	373	366	368	269
France	12	6	8	11	6	7	6	5	7	39
Germany	39	29	29	36	24	19	17	25	14	8
Latvia	135	110	49	31	20	16	20	5	9	4
Lithuania	4	11	3	2	2	1	1	1	1	1
Netherlands	0	0	-	-	-	-	-	-	-	-
Norway	708	602	606	477	475	525	434	388	3	3
Poland	156	188	176	82	110	107	91	43	49	48
Portugal	-	-	4	0	-	-	0	-	-	-
Russian Fed	109	91	80	75	85	72	55	79	62	32
Sweden	356	288	214	678	516	336	317	253	321	300
UK	37	31	2	2	2	7	8	5	0	0
27 Fishing area total	*2 600*	*2 168*	*2 000*	*2 364*	*2 012*	*1 603*	*1 392*	*1 197*	*909*	*840*
Species total	*4 772 F*	*4 139 F*	*3 648 F*	*4 082 F*	*3 727 F*	*3 087 F*	*3 014 F*	*3 002 F*	*2 373 F*	*2 363 F*
Sea trout	**Truite de mer**		**Trucha marina**		***Salmo trutta***				**1,23(01)004,02**	**TRS**
03 Falkland Is	1	1	1	1	1	1	1	1	1	1
03 Fishing area total	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
04 Turkey	364	352	393	352	376	374	550	630	557	738
04 Fishing area total	*364*	*352*	*393*	*352*	*376*	*374*	*550*	*630*	*557*	*738*
05 Belgium	100	100	100	100	100	100	100	100	100	100
Bulgaria	1	16	2	1	0	0	-	0	-	0
Croatia	-	-	-	-	-	-	-	-	6	3
Czech Rep	56	50	40	37	30	24	31	26	20	18
Denmark	0	0	1	...	1	3	0	0	-	-
Estonia	-	-	-	-	-	0	0	0	1	1
Finland	610	553	553	641	641	781	781	701	701	701
Germany	...	...	...	...	4	4	4	10	5	3
Iceland	...	63	64	54	46	38	41	38	45	47
Ireland	...	18	19	17	16	15	13	17	18	17
Latvia	-	-	-	-	1	-	0	0	0	0
Lithuania	1	0	1	0	1	1	1	2	2	-
Norway	-	-	-	79	83	69	77	64	64	60
Poland	48	55	32	14	10	12	34	43	28	30
Romania	48	15	13	-	4	11	7	85	195	-
Russian Fed	3	10	5	3	2	5	9	12	8	12
Serbia	...	...	...	...	...	3	3	2	2	2
Slovakia	38	33	26	25	20	15	22	16	14	14
Slovenia	7	9	7	6	6	6	4	5	4	3
Spain	2 000 F	1 900 F	1 800 F	1 800 F	1 800 F	1 800 F	1 800 F	1 800 F	1 800 F	1 800 F
Sweden	24	20	13	10	8	8	10	9	10	5
Switzerland	13	13	15	10	13	14	14	11	20	14
UK	560	139	119	114	93	89	87	84	106	162
05 Fishing area total	*3 509 F*	*2 994 F*	*2 810 F*	*2 911 F*	*2 879 F*	*2 998 F*	*3 038 F*	*3 025 F*	*3 149 F*	*2 992 F*
27 Denmark	52	35	38	45	14	50	28	20	13	8
Estonia	13	16	9	10	11	12	17	15	18	16
Finland	416	188	171	131	146	251	254	240	235	217
France	1	1	1	2	3	2	2	1	6	1
Germany	0	0	-	-	-	-	-	13	15	12
Latvia	11	13	6	7	7	8	8	8	10	5
Lithuania	2	3	1	-	1	-	-	-	-	0
Norway	11	11	11	14	12	11	10	6	0	-
Poland	529	811	752	716	567	513	488	128	364	372
Portugal	1	8	-	1	3	0	1	1	2	1
Russian Fed	1	-	1	1	1	-	-	-	-	-
Sweden	39	36	29	33	30	27	23	25	24	26
UK	11	9	3	2	2	6	6	5	1	1
27 Fishing area total	*1 087*	*1 131*	*1 022*	*962*	*797*	*880*	*837*	*462*	*688*	*659*

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Salmons, trouts, smelts
Saumons, truites, éperlans
Salmones, truchas, eperlanos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*4 961 F*	*4 478 F*	*4 226 F*	*4 226 F*	*4 053 F*	*4 253 F*	*4 426 F*	*4 118 F*	*4 395 F*	*4 390 F*
Trouts nei	**Truites nca**		**Truchas nep**		***Salmo spp***				**1,23(01)004,XX**	**TRO**
04 Armenia	180	167	151	62	72 F	100 F	91 F	78 F	80 F	80 F
Azerbaijan	5	-	-	-	-	-	-	-	-	-
Japan	1 053	1 022	967	774	732	316	295	215	332	...
Kazakhstan	35	41	39	44	46	48	64	58	-	-
04 Fishing area total	*1 273*	*1 230*	*1 157*	*880*	*850 F*	*464 F*	*450 F*	*351 F*	*412 F*	*80 F*
05 FYRMacedonia	115	120	130	125	142	1	30	36	44	66
Iceland	72	-	-	-	-	-	-	-	-	-
Montenegro	...	...	...	...	...	253	200	212	263	216
Norway	-	-	-	-	-	51	...	...	...	-
Russian Fed	-	-	-	3	-	4	-	2	532	-
Serbia-Monte	16	19	19	22	19	-	-	-	-	-
Slovenia	1	0	0	1	1	1	0	0	-	0
UK	254	426	496	24	151	173	272	250	248	150
05 Fishing area total	*458*	*565*	*645*	*175*	*313*	*483*	*502*	*500*	*1 087*	*432*
21 Canada	0	0	0	0	0	0	0	0	-	-
21 Fishing area total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	-	-
27 Finland	128	57	45	50	60	70	66	59	55	51
Germany	11	13	10	13	14	13	-	-	-	1
Norway	-	-	-	-	-	0	0	0	-	-
27 Fishing area total	*139*	*70*	*55*	*63*	*74*	*83*	*66*	*59*	*55*	*52*
61 Japan	-	-	-	-	-	-	-	-	-	14 900 F
61 Fishing area total	-	-	-	-	-	-	-	-	-	*14 900 F*
Species total	*1 870*	*1 865*	*1 857*	*1 118*	*1 237 F*	*1 030 F*	*1 018 F*	*910 F*	*1 554 F*	*15 464 F*
Pink(=Humpback)salmon	**Saumon rose**		**Salmón rosado**		***Oncorhynchus gorbuscha***				**1,23(01)009,02**	**PIN**
04 Japan	376	926	896	628	852	809	1 062	731	1 299	...
04 Fishing area total	*376*	*926*	*896*	*628*	*852*	*809*	*1 062*	*731*	*1 299*	...
05 Russian Fed	17 961	16 927	11 061	23 576	42 680	29 161	43 593	13 758	30 632	17 982
05 Fishing area total	*17 961*	*16 927*	*11 061*	*23 576*	*42 680*	*29 161*	*43 593*	*13 758*	*30 632*	*17 982*
27 Russian Fed	184	2	108	-	136	3	171	-	137	-
27 Fishing area total	*184*	*2*	*108*	-	*136*	*3*	*171*	-	*137*	-
61 Japan	9 389	25 382	21 727	12 360	16 220	10 791	23 125	11 452	17 159	...
Russian Fed	149 421	100 655	176 935	91 261	159 454	173 420	219 572	150 408	395 727	181 798
61 Fishing area total	*158 810*	*126 037*	*198 662*	*103 621*	*175 674*	*184 211*	*242 697*	*161 860*	*412 886*	*181 798*
67 Canada	10 575	8 609	15 456	3 575	12 588	1 430	11 196	353	13 414	1 273
Russian Fed	-	-	-	-	64	1	120	-	3	-
USA	173 067	116 043	151 566	135 154	224 356	100 590	207 504	118 174	133 283	168 991
67 Fishing area total	*183 642*	*124 652*	*167 022*	*138 729*	*237 008*	*102 021*	*218 820*	*118 527*	*146 700*	*170 264*
77 USA	0	-	-	-	-	-	-	-	-	-
77 Fishing area total	*0*	-	-	-	-	-	-	-	-	-
Species total	*360 973*	*268 544*	*377 749*	*266 554*	*456 350*	*316 205*	*506 343*	*294 876*	*591 654*	*370 044*
Chum(=Keta=Dog)salmon	**Saumon chien**		**Keta**		***Oncorhynchus keta***				**1,23(01)009,03**	**CHU**
02 USA	4	48	74	136	951	971	867	864	-	-
02 Fishing area total	*4*	*48*	*74*	*136*	*951*	*971*	*867*	*864*	-	-
04 Japan	9 599	10 458	13 858	19 103	16 269	14 899	13 524	9 525	12 727	...
04 Fishing area total	*9 599*	*10 458*	*13 858*	*19 103*	*16 269*	*14 899*	*13 524*	*9 525*	*12 727*	...
05 Russian Fed	14 127	13 864	11 668	11 019	20 250	27 834	28 561	27 347	41 913	46 874
05 Fishing area total	*14 127*	*13 864*	*11 668*	*11 019*	*20 250*	*27 834*	*28 561*	*27 347*	*41 913*	*46 874*
61 Japan	207 760	204 056	261 921	242 476	226 249	215 762	207 437	164 671	202 808	...
Russian Fed	17 940	22 698	15 953	13 816	8 117	23 997	26 469	35 488	48 240	43 396
61 Fishing area total	*225 700*	*226 754*	*277 874*	*256 292*	*234 366*	*239 759*	*233 906*	*200 159*	*251 048*	*43 396*
67 Canada	5 549	12 332	13 731	14 112	10 523	9 889	4 861	1 727	2 705	542
Russian Fed	-	-	-	-	409	546	909	-	536	711
USA	52 683	50 642	43 224	50 526	35 621	67 663	48 638	56 197	50 979	52 436
67 Fishing area total	*58 232*	*62 974*	*56 955*	*64 638*	*46 553*	*78 098*	*54 408*	*57 924*	*54 220*	*53 689*
Species total	*307 662*	*314 098*	*360 429*	*351 188*	*318 389*	*361 561*	*331 266*	*295 819*	*359 908*	*143 959*
Masu(=Cherry) salmon	**Saumon du Japon**		**Salmón japonés**		***Oncorhynchus masou***				**1,23(01)009,05**	**CHE**
04 Japan	826	765	757	667	629	14	10	15	17	...
Korea Rep	-	-	-	-	-	-	-	-	-	1
04 Fishing area total	*826*	*765*	*757*	*667*	*629*	*14*	*10*	*15*	*17*	*1*
05 Russian Fed	4	2	14	7	9	6	9	11	9	10
05 Fishing area total	*4*	*2*	*14*	*7*	*9*	*6*	*9*	*11*	*9*	*10*

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Salmons, trouts, smelts
Saumons, truites, éperlans
Salmones, truchas, eperlanos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
61 Japan	779	1 191	1 173	932	922	1 190	1 488	1 362	1 303	...
Russian Fed	1	1	-	2	3	8	1	4	2	4
61 Fishing area total	*780*	*1 192*	*1 173*	*934*	*925*	*1 198*	*1 489*	*1 366*	*1 305*	*4*
Species total	*1 610*	*1 959*	*1 944*	*1 608*	*1 563*	*1 218*	*1 508*	*1 392*	*1 331*	*15*
Sockeye(=Red)salmon	**Saumon rouge**		**Salmón rojo**		***Oncorhynchus nerka***				**1,23(01)009,06**	**SOC**
02 USA	0	-	-	29	-	-	-	48	-	-
02 Fishing area total	*0*	-	-	*29*	-	-	-	*48*	-	-
04 Japan	22	21	44	39	33	...	...	...	...	...
04 Fishing area total	*22*	*21*	*44*	*39*	*33*	...	...	...	...	...
05 Russian Fed	12 106	13 671	12 715	11 263	15 742	16 338	21 370	19 496	15 403	22 100
05 Fishing area total	*12 106*	*13 671*	*12 715*	*11 263*	*15 742*	*16 338*	*21 370*	*19 496*	*15 403*	*22 100*
61 Japan	2 718	3 229	2 020	2 587	2 744	2 840	2 727	2 585	2 733	...
Russian Fed	10 369	14 701	4 987	9 231	7 845	14 052	12 959	12 886	15 057	14 124
61 Fishing area total	*13 087*	*17 930*	*7 007*	*11 818*	*10 589*	*16 892*	*15 686*	*15 471*	*17 790*	*14 124*
67 Canada	6 231	10 050	6 357	4 323	933	10 048	1 758	1 958	661	19 993
Russian Fed	-	-	-	-	-	-	337	-	-	-
USA	77 172	61 653	83 699	114 913	119 854	108 245	125 458	101 923	116 186	114 755
67 Fishing area total	*83 403*	*71 703*	*90 056*	*119 236*	*120 787*	*118 293*	*127 553*	*103 881*	*116 847*	*134 748*
Species total	*108 618*	*103 325*	*109 822*	*142 385*	*147 151*	*151 523*	*164 609*	*138 896*	*150 040*	*170 972*
Chinook(=Spring=King)salmon	**Saumon royal**		**Salmón real**		***Oncorhynchus tshawytscha***				**1,23(01)009,07**	**CHI**
02 USA	236	214	383	531	298	403	271	75	63	87
02 Fishing area total	*236*	*214*	*383*	*531*	*298*	*403*	*271*	*75*	*63*	*87*
05 Russian Fed	163	179	95	105	205	264	254	764	288	99
05 Fishing area total	*163*	*179*	*95*	*105*	*205*	*264*	*254*	*764*	*288*	*99*
61 Japan	111	182	79	109	156	155	124	119	85	...
Russian Fed	336	486	136	263	395	578	575	166	451	689
61 Fishing area total	*447*	*668*	*215*	*372*	*551*	*733*	*699*	*285*	*536*	*689*
67 Canada	636	1 655	2 199	2 460	2 008	1 831	1 323	940	938	1 133
USA	6 095	8 779	8 872	9 438	8 302	6 727	5 628	4 372	4 428	5 845
67 Fishing area total	*6 731*	*10 434*	*11 071*	*11 898*	*10 310*	*8 558*	*6 951*	*5 312*	*5 366*	*6 978*
77 USA	1 193	2 416	3 278	2 992	2 205	538	724	-	0	115
77 Fishing area total	*1 193*	*2 416*	*3 278*	*2 992*	*2 205*	*538*	*724*	-	*0*	*115*
81 New Zealand	1	0	4	1	2	1	1	7	50	0
81 Fishing area total	*1*	*0*	*4*	*1*	*2*	*1*	*1*	*7*	*50*	*0*
Species total	*8 771*	*13 911*	*15 046*	*15 899*	*13 571*	*10 497*	*8 900*	*6 443*	*6 303*	*7 968*
Coho(=Silver)salmon	**Saumon argenté**		**Salmón plateado**		***Oncorhynchus kisutch***				**1,23(01)009,08**	**COH**
02 USA	659	161	107	1 478	735	769	690	581	1	1
02 Fishing area total	*659*	*161*	*107*	*1 478*	*735*	*769*	*690*	*581*	*1*	*1*
05 Russian Fed	1 090	1 233	976	797	442	671	2 303	2 418	2 260	1 183
05 Fishing area total	*1 090*	*1 233*	*976*	*797*	*442*	*671*	*2 303*	*2 418*	*2 260*	*1 183*
61 Japan	502	569	99	89	129	149	128	122	117	...
Russian Fed	944	1 027	440	1 510	679	1 052	1 650	1 403	1 648	3 911
61 Fishing area total	*1 446*	*1 596*	*539*	*1 599*	*808*	*1 201*	*1 778*	*1 525*	*1 765*	*3 911*
67 Canada	46	453	808	1 143	1 137	510	811	368	761	589
USA	16 764	17 314	14 565	19 529	15 669	15 124	11 646	16 388	14 938	15 086
67 Fishing area total	*16 810*	*17 767*	*15 373*	*20 672*	*16 806*	*15 634*	*12 457*	*16 756*	*15 699*	*15 675*
77 USA	1	-	-	-	-	-	-	-	-	-
77 Fishing area total	*1*	-	-	-	-	-	-	-	-	-
Species total	*20 006*	*20 757*	*16 995*	*24 546*	*18 791*	*18 275*	*17 228*	*21 280*	*19 725*	*20 770*
Rainbow trout	**Truite arc-en-ciel**		**Trucha arco iris**		***Oncorhynchus mykiss***				**1,23(01)009,09**	**TRR**
02 Mexico	223	174	251	183	283	123	45	85	66	67
USA	221	146	144	153	139	178	218	210	177	188
02 Fishing area total	*444*	*320*	*395*	*336*	*422*	*301*	*263*	*295*	*243*	*255*
03 Bolivia	280	197	124	...	...	...	...	...	...	...
Peru	191	380	467	456	360	351	368	266	283	291
Venezuela	186	400	...	...	...	...	...	...	...	...
03 Fishing area total	*657*	*977*	*591*	*456*	*360*	*351*	*368*	*266*	*283*	*291*
04 Japan	484	447	400	347	328	...	...	...	...	...
04 Fishing area total	*484*	*447*	*400*	*347*	*328*	...	...	...	...	...
05 Albania	-	67	...	...	...	...	...	...	...	...

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Salmons, trouts, smelts
Saumons, truites, éperlans
Salmones, truchas, eperlanos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Bulgaria	17	21	47	22	17	15	4	0	6	6
Croatia	18	2	3	4	-	20	28	31	2	4
Czech Rep	48	44	48	52	55	53	52	57	57	57
Denmark	0	0	5	0	0	0	-	0	-	-
Estonia	-	-	-	-	-	-	-	0	-	-
Finland	660	653	653	560	560	554	554	766	766	766
Poland	1	2	2	1	4	1	0	-	-	-
Romania	65	12	4	-	-	-	-	110	65	-
Serbia	...	...	...	...	...	1	2	1	1	1
Slovakia	30	31	32	32	33	36	39	40	46	43
Slovenia	21	25	24	22	23	23	21	19	19	21
Switzerland	0	0	-	-	-	-	-	-	-	-
UK	1 174	1 765	2 211	29	27	1 427	1 363	1 461	1 514	1 521
05 Fishing area total	*2 034*	*2 622*	*3 029*	*722*	*719*	*2 130*	*2 063*	*2 485*	*2 476*	*2 419*
27 Poland	11	11	6	4	3	0	0	0	1	0
Sweden	-	-	-	-	-	0	-	0	-	-
27 Fishing area total	*11*	*11*	*6*	*4*	*3*	*0*	*0*	*0*	*1*	*0*
67 Canada	-	-	-	-	-	1	1	2	-	-
67 Fishing area total	-	-	-	-	-	*1*	*1*	*2*	-	-
Species total	*3 630*	*4 377*	*4 421*	*1 865*	*1 832*	*2 783*	*2 695*	*3 048*	*3 003*	*2 965*
Pacific salmons nei	**Saumons du Pacifique nca**		**Salmones del Pacífico nep**		***Oncorhynchus spp***				**1,23(01)009,XX**	**ORC**
61 Japan	-	-	-	-	-	-	-	-	-	163 600 F
61 Fishing area total	-	-	-	-	-	-	-	-	-	*163 600 F*
67 USA	204	6	-	0	0	-	0	-	0	-
67 Fishing area total	*204*	*6*	-	*0*	*0*	-	*0*	-	*0*	-
Species total	*204*	*6*	-	*0*	*0*	-	*0*	-	*0*	*163 600 F*
Brook trout	**Saumon de fontaine**		**Trucha de arroyo**		***Salvelinus fontinalis***				**1,23(01)010,02**	**SVF**
05 Bulgaria	3	6	0	2	2	1	-	-	-	0
Czech Rep	3	5	6	5	6	5	10	8	7	8
Romania	-	-	-	-	-	-	-	6	10	-
Slovakia	1	0	0	0	0	1	3	0	1	0
Slovenia	0	0	0	0	4	0	-	0	-	-
05 Fishing area total	*7*	*11*	*6*	*7*	*12*	*7*	*13*	*14*	*18*	*8*
Species total	*7*	*11*	*6*	*7*	*12*	*7*	*13*	*14*	*18*	*8*
Arctic char	**Omble-chevalier**		**Trucha alpina**		***Salvelinus alpinus***				**1,23(01)010,05**	**ACH**
05 Finland	-	-	-	-	-	-	-	-	4	4
Germany	...	...	...	...	3	7	7	16	8	5
Iceland	...	50	51	38	24	22	18	19	20	23
Norway	100 F	80 F	60 F	10	10	35	7	4	3	4
Slovenia	1	2	3	-	-	2	2	2	2	1
Sweden	18	17	15	12	11	9	6	8	4	6
Switzerland	16	16	18	16	13	13	12	14	17	14
UK	1	1	0	0	0	0	0	0	0	-
05 Fishing area total	*136 F*	*166 F*	*147 F*	*76*	*61*	*88*	*52*	*63*	*58*	*57*
21 Greenland	20	20	0	18	35	50	16	17	19	44
21 Fishing area total	*20*	*20*	*0*	*18*	*35*	*50*	*16*	*17*	*19*	*44*
Species total	*156 F*	*186 F*	*147 F*	*94*	*96*	*138*	*68*	*80*	*77*	*101*
Lake trout(=Char)	**Touladi(=Omble du Canada)**		**Trucha lacustre**		***Salvelinus namaycush***				**1,23(01)010,07**	**LAT**
02 Canada	679	532	702	790	654	600	453	522	491	522
USA	451	346	253	186	188	219	266	302	350	389
02 Fishing area total	*1 130*	*878*	*955*	*976*	*842*	*819*	*719*	*824*	*841*	*911*
Species total	*1 130*	*878*	*955*	*976*	*842*	*819*	*719*	*824*	*841*	*911*
Chars nei	**Ombles nca**		**Salvelinos nep**		***Salvelinus spp***				**1,23(01)010,XX**	**CHR**
04 Japan	465	454	452	388	369	...	...	...	...	...
04 Fishing area total	*465*	*454*	*452*	*388*	*369*	...	...	...	...	...
21 Canada	34	19	17	-	5	-	30	18	15	11
21 Fishing area total	*34*	*19*	*17*	-	*5*	-	*30*	*18*	*15*	*11*
Species total	*499*	*473*	*469*	*388*	*374*	...	*30*	*18*	*15*	*11*
Huchen	**Huchon**		**Salmón del Danubio**		***Hucho hucho***				**1,23(01)020,02**	**HUC**
05 Serbia	...	...	...	...	...	0	0	0	1	0
Slovakia	1	1	1	1	1	1	0	1	0	0
05 Fishing area total	*1*	*1*	*1*	*1*	*1*	*1*	*0*	*1*	*1*	*0*
Species total	*1*	*1*	*1*	*1*	*1*	*1*	*0*	*1*	*1*	*0*

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Salmons, trouts, smelts
Saumons, truites, éperlans
Salmones, truchas, eperlanos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Grayling	**Ombre commun**		**Tímalo**		***Thymallus thymallus***				**1,23(02)005,01**	**TLV**
05 Belgium	5	5	5	5	5	5	5	5	5	5
Czech Rep	15	13	11	8	7	5	5	5	5	3
Finland	282	173	173	208	208	300	300	306	306	306
Lithuania	-	0	1	0	-	-	-	0	0	-
Norway	...	...	...	...	...	1	...	...	...	-
Serbia	...	...	...	...	...	1	0	0	-	0
Slovakia	17	18	12	9	8	8	6	6	6	3
Slovenia	2	2	1	1	1	1	1	1	1	1
UK	0	-	0	0	0	0	0	-	-	-
05 Fishing area total	*321*	*211*	*203*	*231*	*229*	*321*	*317*	*323*	*323*	*318*
Species total	*321*	*211*	*203*	*231*	*229*	*321*	*317*	*323*	*323*	*318*
Ayu sweetfish	**Ayu**		**Ayu**		***Plecoglossus altivelis***				**1,23(03)016,01**	**PCA**
04 Japan	11 148	10 663	8 420	7 312	7 149	3 014	3 284	3 438	3 625	3 406 F
04 Fishing area total	*11 148*	*10 663*	*8 420*	*7 312*	*7 149*	*3 014*	*3 284*	*3 438*	*3 625*	*3 406 F*
Species total	*11 148*	*10 663*	*8 420*	*7 312*	*7 149*	*3 014*	*3 284*	*3 438*	*3 625*	*3 406 F*
European smelt	**Éperlan européen**		**Eperlano europeo**		***Osmerus eperlanus***				**1,23(04)003,01**	**SME**
05 Denmark	-	-	-	-	5	1	0	-	-	-
Estonia	623	2 216	187	30	169	83	-	-	0	0
Finland	366	448	448	418	418	157	157	148	148	148
Latvia	1	1	1	1	6	3	0	0	1	0
Lithuania	178	139	165	61	206	169	329	196	221	170
Netherlands	930 F	868	870 F	870 F	870 F	870 F	820 F	820 F	820 F	820 F
Poland	1	41	33	10	18	30	7	9	29	40
05 Fishing area total	*2 099 F*	*3 713*	*1 704 F*	*1 390 F*	*1 692 F*	*1 313 F*	*1 313 F*	*1 173 F*	*1 219 F*	*1 178 F*
27 Denmark	25	10	6	10	5	7	23	15	3	2
Estonia	139	104	200	232	203	435	549	741	773	454
Finland	533	709	544	331	194	160	227	135	125	497
France	96	65	51	65	73	63	70	58	54	95
Germany	6	13	14	9	3	8	1	1	-	-
Latvia	127	13	75	277	187	314	862	1 745	1 979	1 128
Lithuania	182	148	210	285	165	134	55	65	107	17
Netherlands	111	258	198	19	143	211	22	177	364	401
Poland	19	16	5	9	2	-	1	1	2	0
Russian Fed	976	730	375	196	238	298	387	305	330	256
Sweden	-	-	-	-	-	-	4	-	0	-
UK	21	32	6	7	0	-	-	-	6	4
27 Fishing area total	*2 235*	*2 098*	*1 684*	*1 440*	*1 213*	*1 630*	*2 201*	*3 243*	*3 743*	*2 854*
Species total	*4 334 F*	*5 811*	*3 388 F*	*2 830 F*	*2 905 F*	*2 943 F*	*3 514 F*	*4 416 F*	*4 962 F*	*4 032 F*
Rainbow smelt	**Éperlan arc-en-ciel**		**Eperlano arco iris**		***Osmerus mordax***				**1,23(04)003,03**	**SMR**
02 USA	209	188	222	86	194	313	379	203	96	26
02 Fishing area total	*209*	*188*	*222*	*86*	*194*	*313*	*379*	*203*	*96*	*26*
05 Russian Fed	719	1 417	361	48	485	504	16	78	1 197	242
05 Fishing area total	*719*	*1 417*	*361*	*48*	*485*	*504*	*16*	*78*	*1 197*	*242*
21 Canada	308	314	1 115	797	761	927	822	797	954	696
USA	0	-	-	1	1	0	1	0	-	0
21 Fishing area total	*308*	*314*	*1 115*	*798*	*762*	*927*	*823*	*797*	*954*	*696*
27 Russian Fed	6	23	3	2	4	-	15	4	16	7
27 Fishing area total	*6*	*23*	*3*	*2*	*4*	-	*15*	*4*	*16*	*7*
37 Russian Fed	...	...	-	-	-	-	-	-	-	1
37 Fishing area total	*...*	*...*	-	-	-	-	-	-	-	*1*
Species total	*1 242*	*1 942*	*1 701*	*934*	*1 445*	*1 744*	*1 233*	*1 082*	*2 263*	*972*
Pond smelt	**Éperlan à petite bouche**		**Eperlano de estanque**		***Hypomesus olidus***				**1,23(04)008,01**	**PSM**
02 Canada	4 241	3 263	3 244	5 805	3 141	920	4 390	3 651	3 585	1 428
02 Fishing area total	*4 241*	*3 263*	*3 244*	*5 805*	*3 141*	*920*	*4 390*	*3 651*	*3 585*	*1 428*
Species total	*4 241*	*3 263*	*3 244*	*5 805*	*3 141*	*920*	*4 390*	*3 651*	*3 585*	*1 428*
Japanese smelt	**...B**		**...C**		***Hypomesus nipponensis***				**1,23(04)008,03**	**HVJ**
04 Japan	1 648	1 880	1 991	1 712	1 937	1 128	1 194	1 096	2 009 F	1 966 F
04 Fishing area total	*1 648*	*1 880*	*1 991*	*1 712*	*1 937*	*1 128*	*1 194*	*1 096*	*2 009 F*	*1 966 F*
Species total	*1 648*	*1 880*	*1 991*	*1 712*	*1 937*	*1 128*	*1 194*	*1 096*	*2 009 F*	*1 966 F*
Eulachon	**Eulakane**		**...C**		***Thaleichthys pacificus***				**1,23(04)012,01**	**EUL**
67 Canada	1	5	1	1	0	0	0	0	-	-
USA	142	324	491	104	0	7	4	8	8	2
67 Fishing area total	*143*	*329*	*492*	*105*	*0*	*7*	*4*	*8*	*8*	*2*
Species total	*143*	*329*	*492*	*105*	*0*	*7*	*4*	*8*	*8*	*2*

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Salmons, trouts, smelts
Saumons, truites, éperlans
Salmones, truchas, eperlanos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Smelts nei	**Éperlans nca**		**Eperlanos nep**		***Osmerus spp, Hypomesus spp***				**1,23(04)XXX,XX**	**SMX**
05 Russian Fed	3 568	3 965	4 160	3 879	4 644	3 935	4 565	4 109	5 871	4 999
05 Fishing area total	*3 568*	*3 965*	*4 160*	*3 879*	*4 644*	*3 935*	*4 565*	*4 109*	*5 871*	*4 999*
61 Russian Fed	612	1 032	1 037	1 546	1 492	2 240	2 083	2 286	1 675	2 000
61 Fishing area total	*612*	*1 032*	*1 037*	*1 546*	*1 492*	*2 240*	*2 083*	*2 286*	*1 675*	*2 000*
67 USA	218	261	207	196	153	206	182	218	164	144
67 Fishing area total	*218*	*261*	*207*	*196*	*153*	*206*	*182*	*218*	*164*	*144*
77 USA	12	8	4	5	1	0	1	0	0	1
77 Fishing area total	*12*	*8*	*4*	*5*	*1*	*0*	*1*	*0*	*0*	*1*
Species total	*4 410*	*5 266*	*5 408*	*5 626*	*6 290*	*6 381*	*6 831*	*6 613*	*7 710*	*7 144*
Japanese icefish	**...B**		**...C**		***Salangichthys microdon***				**1,23(09)025,02**	**SZM**
04 Japan	1 003	886	932	314	734	311	379	352	745 F	675 F
04 Fishing area total	*1 003*	*886*	*932*	*314*	*734*	*311*	*379*	*352*	*745 F*	*675 F*
Species total	*1 003*	*886*	*932*	*314*	*734*	*311*	*379*	*352*	*745 F*	*675 F*
Vendace	**Corégone blanc**		**Coregono blanco**		***Coregonus albula***				**1,23(12)001,01**	**FVE**
05 Estonia	-	-	-	-	-	-	1	0	0	1
Finland	4 837	5 137	5 137	4 422	4 422	3 955	3 955	4 102	4 102	4 102
Germany	...	...	...	...	...	54	54	73	82	74
Latvia	1	-	1	-	-	-	0	0	0	0
Lithuania	6	4	4	1	1	1	1	10	14	15
Norway	5 F	5 F	5 F	...	...	12	...	...	...	-
Poland	227	207	244	175	154	225	166	178	204	209
Sweden	182	194	270	291	220	276	221	262	204	174
05 Fishing area total	*5 258 F*	*5 547 F*	*5 661 F*	*4 889*	*4 797*	*4 523*	*4 398*	*4 625*	*4 606*	*4 575*
27 Finland	187	120	158	156	177	181	142	124	136	149
Sweden	698	1 003	1 581	1 821	1 652	1 195	915	626	973	1 038
27 Fishing area total	*885*	*1 123*	*1 739*	*1 977*	*1 829*	*1 376*	*1 057*	*750*	*1 109*	*1 187*
Species total	*6 143 F*	*6 670 F*	*7 400 F*	*6 866*	*6 626*	*5 899*	*5 455*	*5 375*	*5 715*	*5 762*
European whitefish	**Corégone lavaret**		**Lavareto**		***Coregonus lavaretus***				**1,23(12)001,02**	**PLN**
05 Czech Rep	1	1	-	-	-	-	-	-	-	-
Denmark	1	0	0	0	0	1	0	0	1	1
Estonia	-	-	-	-	-	-	-	1	3	1
Finland	2 421	1 446	1 446	1 781	1 781	1 855	1 855	1 190	1 190	1 190
France	280	280 F	280 F	280 F	280 F	280 F	280 F	280 F	280 F	280 F
Lithuania	1	0	1	0	1	-	1	0	1	0
Norway	45 F	40 F	35 F	...	...	63	...	...	...	-
Poland	13	11	11	10	7	9	9	9	7	5
Sweden	123	124	116	106	107	126	117	104	63	55
05 Fishing area total	*2 885 F*	*1 902 F*	*1 889 F*	*2 177 F*	*2 176 F*	*2 334 F*	*2 262 F*	*1 584 F*	*1 545 F*	*1 532 F*
27 Denmark	76	51	68	68	87	97	35	51	118	61
Estonia	33	47	30	28	19	28	31	37	28	20
Finland	1 826	1 206	1 200	1 181	1 122	1 490	1 458	1 289	1 313	1 267
Germany	63	34	36	30	43	34	27	13	12	11
Lithuania	3	2	1	-	-	-	-	-	-	-
Poland	-	-	-	18	17	13	19	12	19	22
Sweden	154	222	255	295	247	198	153	143	136	130
27 Fishing area total	*2 155*	*1 562*	*1 590*	*1 620*	*1 535*	*1 860*	*1 723*	*1 545*	*1 626*	*1 511*
Species total	*5 040 F*	*3 464 F*	*3 479 F*	*3 797 F*	*3 711 F*	*4 194 F*	*3 985 F*	*3 129 F*	*3 171 F*	*3 043 F*
Houting	**Bondelle**		**Coregono picudo**		***Coregonus oxyrinchus***				**1,23(12)001,03**	**HOU**
05 Estonia	9	11	6	2	2	1	2	-	-	-
05 Fishing area total	*9*	*11*	*6*	*2*	*2*	*1*	*2*	-	-	-
Species total	*9*	*11*	*6*	*2*	*2*	*1*	*2*	-	-	-
Lake(=Common)whitefish	**Corégone de lac**		**Coregono de lago**		***Coregonus clupeaformis***				**1,23(12)001,12**	**WHL**
02 Canada	9 624	8 623	9 017	8 537	7 158	7 098	6 648	6 497	6 822	6 674
USA	4 484	4 239	3 658	3 847	3 874	4 244	4 548	4 332	4 254	4 683
02 Fishing area total	*14 108*	*12 862*	*12 675*	*12 384*	*11 032*	*11 342*	*11 196*	*10 829*	*11 076*	*11 357*
Species total	*14 108*	*12 862*	*12 675*	*12 384*	*11 032*	*11 342*	*11 196*	*10 829*	*11 076*	*11 357*
Lake cisco	**Cisco de lac**		**Coregono de artedi**		***Coregonus artedi***				**1,23(12)001,13**	**CIS**
02 Canada	567	503	412	136	99	278	262	284	311	321
USA	303	285	298	248	229	221	330	287	329	564
02 Fishing area total	*870*	*788*	*710*	*384*	*328*	*499*	*592*	*571*	*640*	*885*
Species total	*870*	*788*	*710*	*384*	*328*	*499*	*592*	*571*	*640*	*885*

B-23

Salmons, trouts, smelts
Saumons, truites, éperlans
Salmones, truchas, eperlanos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Whitefishes nei	**Corégones nca**		**Coregonos nep**		***Coregonus spp***				**1,23(12)001,XX**	**WHF**
02 USA	768	841	954	891	832	850	552	338	3	8
02 Fishing area total	*768*	*841*	*954*	*891*	*832*	*850*	*552*	*338*	*3*	*8*
04 Armenia	632	202	121	35	40 F	55 F	50 F	43 F	44 F	44 F
Kyrgyzstan	12	9	3	1	2 F	1 F	1	...	...	...
04 Fishing area total	*644*	*211*	*124*	*36*	*42 F*	*56 F*	*51 F*	*43 F*	*44 F*	*44 F*
05 Belarus	31	0	0	0	0	0	-	0	-	-
Belgium	1	1	1	1	1	1	2	-	1	1
Germany	459	459	652	652	563	468	468	817	629	580
Russian Fed	9 053	13 170	14 119	11 745	14 694	12 985	11 565	10 722	13 381	14 455
Switzerland	1 174	946	986	912	865	822	801	956	1 020	1 056
05 Fishing area total	*10 718*	*14 576*	*15 758*	*13 310*	*16 123*	*14 276*	*12 836*	*12 495*	*15 031*	*16 092*
27 Latvia	4	3	3	5	4	4	3	3	3	2
Russian Fed	8	7	9	-	2	2	11	10	7	15
27 Fishing area total	*12*	*10*	*12*	*5*	*6*	*6*	*14*	*13*	*10*	*17*
Species total	*12 142*	*15 638*	*16 848*	*14 242*	*17 003 F*	*15 188 F*	*13 453 F*	*12 889 F*	*15 088 F*	*16 161 F*
Salmonoids nei	**Salmonoidés nca**		**Salmonoideos nep**		***Salmonoidei***				**1,23(XX)XXX,XX**	**SLX**
01 Kenya	67	112	29	34	36	33	47	49	51	122
01 Fishing area total	*67*	*112*	*29*	*34*	*36*	*33*	*47*	*49*	*51*	*122*
02 Canada	-	-	-	-	-	-	-	-	-	9
02 Fishing area total	-	-	-	-	-	-	-	-	-	*9*
04 Iran	2	9	14	2	3	3	2	5	3	6
Japan	-	-	-	-	-	-	-	-	-	13 875 F
Korea Rep	...	...	...	...	...	1 878	20	54	21	30
04 Fishing area total	*2*	*9*	*14*	*2*	*3*	*1 881*	*22*	*59*	*24*	*13 911 F*
05 Albania	56	43	50 F	66	27	41	58	58	49	29
Belgium	-	-	-	-	-	-	-	1	-	-
Germany	29	29	29	29	-	-	-	-	-	-
Greece	42	40	42	50	53	45	45	40	22	22 F
Italy	846	945	978	960	820	852	767	667	786	676
Russian Fed	783	1 191	1 223	873	772	1 282	1 203	783	3 151	1 627
Slovenia	-	-	-	-	-	1	1	1	1	0
05 Fishing area total	*1 756*	*2 248*	*2 322 F*	*1 978*	*1 672*	*2 221*	*2 074*	*1 550*	*4 009*	*2 354 F*
27 Finland	0	7	7	1	1	-	-	-	-	-
France	1	-	-	-	-	0	0	-	-	-
Spain	13	1 263	34	5	8	12	13	12	9	7
27 Fishing area total	*14*	*1 270*	*41*	*6*	*9*	*12*	*13*	*12*	*9*	*7*
37 Spain	0	-	-	7	0	1	7	9	7	2
37 Fishing area total	*0*	-	-	*7*	*0*	*1*	*7*	*9*	*7*	*2*
61 Korea Rep	19	33	42	16	15	37	102	186	25	177
Russian Fed	728	731	692	703	247	1 344	1 227	1 852	1 279	2 316
61 Fishing area total	*747*	*764*	*734*	*719*	*262*	*1 381*	*1 329*	*2 038*	*1 304*	*2 493*
67 Russian Fed	-	-	-	-	2	-	-	-	-	-
67 Fishing area total	-	-	-	-	*2*	-	-	-	-	-
Species total	*2 586*	*4 403*	*3 140 F*	*2 746*	*1 984*	*5 529*	*3 492*	*3 717*	*5 404*	*18 898 F*
Group total	***894 258***	***813 095***	***967 752***	***880 227***	***1 032 505***	***930 818***	***1 101 158***	***828 210***	***1 207 562***	***979 590***

B-24

Shads
Aloses
Sábalos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Pontic shad	**Alose de la mer Noire**		**Sábalo del Mar Negro**		***Alosa pontica***				**1,21(05)011,02**	**SHC**
05 Bulgaria	16	35	12	22	16	1	0	2	3	4
Romania	125	264	650	387	467	216	158	554	234	376
Russian Fed	-	2	2	4	6	7	9	9	36	-
Ukraine	146	206	167	211	365	229	301	458	408	470
05 Fishing area total	*287*	*507*	*831*	*624*	*854*	*453*	*468*	*1 023*	*681*	*850*
37 Bulgaria	16	106	56	78	38	18	26	27	37	59
Romania	3	2	1	16	51	4	9	47	63	46
Russian Fed	-	-	2	7	11	9	13	5	14	18
Ukraine	2	4	9	14	25	28	23	31	36	18
37 Fishing area total	*21*	*112*	*68*	*115*	*125*	*59*	*71*	*110*	*150*	*141*
Species total	*308*	*619*	*899*	*739*	*979*	*512*	*539*	*1 133*	*831*	*991*
American shad	**Alose savoureuse**		**Sábalo americano**		***Alosa sapidissima***				**1,21(05)011,03**	**SHA**
02 Canada	9	9	8	2	32	2	2	15	18	14
USA	768	24	47	42	33	23	20	23	28	11
02 Fishing area total	*777*	*33*	*55*	*44*	*65*	*25*	*22*	*38*	*46*	*25*
21 Canada	21	17	74	39	44	18	1	5	21	14
USA	505	340	236	331	212	131	221	65	87	106
21 Fishing area total	*526*	*357*	*310*	*370*	*256*	*149*	*222*	*70*	*108*	*120*
31 USA	171	286	230	202	103	145	149	155	148	169
31 Fishing area total	*171*	*286*	*230*	*202*	*103*	*145*	*149*	*155*	*148*	*169*
67 USA	178	66	210	120	234	82	82	19	2	14
67 Fishing area total	*178*	*66*	*210*	*120*	*234*	*82*	*82*	*19*	*2*	*14*
Species total	*1 652*	*742*	*805*	*736*	*658*	*401*	*475*	*282*	*304*	*328*
Allis shad	**Alose vraie(=Grande alose)**		**Sábalo común**		***Alosa alosa***				**1,21(05)011,04**	**ASD**
27 France	45	62	61	21	23	10	8	12	1	1
Portugal	18	16	30	35	21	18	38	40	58	19
27 Fishing area total	*63*	*78*	*91*	*56*	*44*	*28*	*46*	*52*	*59*	*20*
Species total	*63*	*78*	*91*	*56*	*44*	*28*	*46*	*52*	*59*	*20*
Twaite shad	**Alose feinte**		**Saboga(=Alosa)**		***Alosa fallax***				**1,21(05)011,05**	**TSD**
27 France	11	9	6	-	0	1	4	4	...	1
Latvia	-	-	-	-	-	-	-	1	-	0
Netherlands	5	8	8	10	8	-	-	1	1	-
Portugal	4	5	6	3	4	2	4	4	3	3
Russian Fed	-	5	3	-	21	-	42	36	-	-
27 Fishing area total	*20*	*27*	*23*	*13*	*33*	*3*	*50*	*46*	*4*	*4*
37 Malta	...	...	...	...	...	...	...	...	...	44
37 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*44*
Species total	*20*	*27*	*23*	*13*	*33*	*3*	*50*	*46*	*4*	*48*
Alewife	**Gaspareau**		**Pinchagua**		***Alosa pseudoharengus***				**1,21(05)011,06**	**ALE**
02 Canada	1 559	1 559	1 559	1 164	1 164	1 164	1 164	941	941	...
USA	21	48	90	44	28	19	13	9	14	2
02 Fishing area total	*1 580*	*1 607*	*1 649*	*1 208*	*1 192*	*1 183*	*1 177*	*950*	*955*	*2*
21 Canada	2 790	4 996	7 177	3 978	3 048	5 312	4 381	3 886	3 408	2 383
USA	691	886	232	595	329	118	434	633	733	873
21 Fishing area total	*3 481*	*5 882*	*7 409*	*4 573*	*3 377*	*5 430*	*4 815*	*4 519*	*4 141*	*3 256*
27 Spain	-	-	-	-	0	-	-	-	-	-
27 Fishing area total	-	-	-	-	*0*	-	-	-	-	-
31 USA	0	-	-	-	0	0	-	-	-	-
31 Fishing area total	*0*	-	-	-	*0*	*0*	-	-	-	-
Species total	*5 061*	*7 489*	*9 058*	*5 781*	*4 569*	*6 613*	*5 992*	*5 469*	*5 096*	*3 258*
Blueback shad	**Alose d'été du Canada**		**Sábalo del Canadá**		***Alosa aestivalis***				**1,21(05)011,07**	**BBH**
02 USA	-	-	-	-	8	6	8	7	-	9
02 Fishing area total	-	-	-	-	*8*	*6*	*8*	*7*	-	*9*
21 USA	-	-	10	9	-	-	-	-	10	-
21 Fishing area total	-	-	*10*	*9*	-	-	-	-	*10*	-
Species total	-	-	*10*	*9*	*8*	*6*	*8*	*7*	*10*	*9*
Hickory shad	**Alose américaine**		**...C**		***Alosa mediocris***				**1,21(05)011,08**	**SHH**
02 USA	90	-	-	-	106	39	32	40	-	60
02 Fishing area total	*90*	-	-	-	*106*	*39*	*32*	*40*	-	*60*

B-24 **Shads**
Aloses
Sábalos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
21 USA	...	39	31	79	-	-	-	-	44	-
21 Fishing area total	*...*	*39*	*31*	*79*	-	-	-	-	*44*	-
31 USA	...	3	9	38	-	-	-	-	22	-
31 Fishing area total	*...*	*3*	*9*	*38*	-	-	-	-	*22*	-
Species total	*90*	*42*	*40*	*117*	*106*	*39*	*32*	*40*	*66*	*60*
Shads nei	**Aloses nca**		**Sábalos nep**		***Alosa spp***				**1,21(05)011,XX**	**SHZ**
05 Albania	2	23	25 F	30	14	32	42	42	23	23
Greece	2	2	2	2	2	2	2	1	-	-
Lithuania	-	-	-	-	-	-	14	19	14	38
Switzerland	18	23	23	19	26	20	21	7	10	17
Ukraine	0	0	0	-	2	2	5	8	13	25
UK	0	-	-	-	-	-	-	-	-	-
05 Fishing area total	*22*	*48*	*50 F*	*51*	*44*	*56*	*84*	*77*	*60*	*103*
27 France	12	15	15	20	27	20	20	9	15	55
Lithuania	-	1	-	-	-	-	4	14	2	1
Portugal	-	-	-	-	-	2	15	21	21	50
Spain	61	41	11	20	32	7	123	116	119	198
UK	8	5	4	2	2	2	1	1	2	4
27 Fishing area total	*81*	*62*	*30*	*42*	*61*	*31*	*163*	*161*	*159*	*308*
34 Greece	-	6	26	-	-	-	-	-	-	-
Morocco	0	1	2	4	0	76	205	1	0	2
Netherlands	-	-	-	-	-	-	2	14	10	-
34 Fishing area total	*0*	*7*	*28*	*4*	*0*	*76*	*207*	*15*	*10*	*2*
37 France	2	4	5	4	4	0	1	1	2	2
Greece	2 215	2 733	1 502	2 462	1 803	2 581	2 783	2 758	1 721	1 715 F
Morocco	0	0	0	1	4	-	-	-	-	-
Romania	22	3	4	6	4	-	-	1	8	1
Spain	-	382	220	-	8	21	52	67	45	25
Turkey	690	862	1 100	1 172	2 176	1 738	2 252	2 289	3 070	2 574
Ukraine	-	-	-	-	-	-	-	-	1	1
37 Fishing area total	*2 929*	*3 984*	*2 831*	*3 645*	*3 999*	*4 340*	*5 088*	*5 116*	*4 847*	*4 318 F*
Species total	*3 032*	*4 101*	*2 939 F*	*3 742*	*4 104*	*4 503*	*5 542*	*5 369*	*5 076*	*4 731 F*
Caspian shads	**Aloses de la mer Caspienne**		**Sábalos del Mar Caspio**		***Caspialosa spp***				**1,21(05)014,XX**	**ASP**
04 Azerbaijan	52	24	48	64	60	68	96	108	79	90
Kazakhstan	...	...	...	...	...	...	...	...	69	53
04 Fishing area total	*52*	*24*	*48*	*64*	*60*	*68*	*96*	*108*	*148*	*143*
05 Russian Fed	176	239	24	24	46	85	118	84	41	116
05 Fishing area total	*176*	*239*	*24*	*24*	*46*	*85*	*118*	*84*	*41*	*116*
Species total	*228*	*263*	*72*	*88*	*106*	*153*	*214*	*192*	*189*	*259*
American gizzard shad	**Alose noyer**		**Sábalo molleja**		***Dorosoma cepedianum***				**1,21(05)018,01**	**SHG**
02 USA	1 781	1 223	1 351	1 032	1 081	711	615	996	669	1 092
02 Fishing area total	*1 781*	*1 223*	*1 351*	*1 032*	*1 081*	*711*	*615*	*996*	*669*	*1 092*
21 USA	...	721	392	245	...	...	...	...	859	...
21 Fishing area total	*...*	*721*	*392*	*245*	*...*	*...*	*...*	*...*	*859*	*...*
31 USA	...	836	578	593	...	...	...	...	10	...
31 Fishing area total	*...*	*836*	*578*	*593*	*...*	*...*	*...*	*...*	*10*	*...*
Species total	*1 781*	*2 780*	*2 321*	*1 870*	*1 081*	*711*	*615*	*996*	*1 538*	*1 092*
...A	**...B**		**Topotes nep**		***Dorosoma spp***				**1,21(05)018,XX**	**DQX**
02 Mexico	...	...	...	...	1 027	1 073	1 070	913	952	914
02 Fishing area total	*...*	*...*	*...*	*...*	*1 027*	*1 073*	*1 070*	*913*	*952*	*914*
Species total	*...*	*...*	*...*	*...*	*1 027*	*1 073*	*1 070*	*913*	*952*	*914*
Chacunda gizzard shad	**Alose chaconde**		**Sábalo chacunda**		***Anodontostoma chacunda***				**1,21(05)023,01**	**CHG**
57 Indonesia	...	...	...	591	687	734	1 228	947	920	1 601
Malaysia	2 769	2 350	2 446	2 252	3 430	4 131	4 385	2 645	2 252	3 501
57 Fishing area total	*2 769*	*2 350*	*2 446*	*2 843*	*4 117*	*4 865*	*5 613*	*3 592*	*3 172*	*5 102*
71 Indonesia	...	...	...	502	550	1 648	3 727	4 579	6 213	8 377
Malaysia	1 268	1 282	1 501	1 464	1 634	1 971	1 812	1 479	790	1 009
Philippines	1 346	1 003	1 101	914	874	804	933	1 150	1 127	1 197
71 Fishing area total	*2 614*	*2 285*	*2 602*	*2 880*	*3 058*	*4 423*	*6 472*	*7 208*	*8 130*	*10 583*
Species total	*5 383*	*4 635*	*5 048*	*5 723*	*7 175*	*9 288*	*12 085*	*10 800*	*11 302*	*15 685*
Hilsa shad	**Alose hilsa**		**Sábalo hilsa**		***Tenualosa ilisha***				**1,21(05)038,01**	**HIL**
04 Bangladesh	75 060	68 250	62 944	71 001	77 499	78 273	82 445	89 900	95 970	115 179
India	64 599	38 984	36 724	20 391	15 409	16 216	11 721	14 233	12 381	7 260

B-24 **Shads / Aloses / Sábalos**

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area / Espèce, Zone de pêche / Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
04 Fishing area total	*139 659*	*107 234*	*99 668*	*91 392*	*92 908*	*94 489*	*94 166*	*104 133*	*108 351*	*122 439*
51 India	4 277	5 525	2 306	3 534	3 513	4 151	5 227	3 765	3 216	12 880
Iran	3 339	5 702	7 896	2 790	5 321	2 776	5 441	4 179	4 672	6 431
Iraq	...	...	...	950	459	126	1 611	793	679	750
Kuwait	337	270 F	205	135	154	136	78	84	80 F	80 F
Pakistan	170	174	156	149	189	195	215	255	188	195
51 Fishing area total	*8 123*	*11 671 F*	*10 563*	*7 558*	*9 636*	*7 384*	*12 572*	*9 076*	*8 835 F*	*20 336 F*
57 Bangladesh	154 654	152 343	136 088	184 838	198 363	198 850	196 744	200 100	202 957	198 574
India	44 502	43 675	37 234	38 362	26 740	26 585	16 666	16 604	14 391	62 036
57 Fishing area total	*199 156*	*196 018*	*173 322*	*223 200*	*225 103*	*225 435*	*213 410*	*216 704*	*217 348*	*260 610*
Species total	*346 938*	*314 923 F*	*283 553*	*322 150*	*327 647*	*327 308*	*320 148*	*329 913*	*334 534 F*	*403 385 F*
Toli shad	**Alose toli**		**Sábalo toli**		***Tenualosa toli***				**1,21(05)038,04**	**TOL**
57 Indonesia	681	620	1 142	645	873	1 036	413	1 526	1 854	949
57 Fishing area total	*681*	*620*	*1 142*	*645*	*873*	*1 036*	*413*	*1 526*	*1 854*	*949*
71 Indonesia	4 576	2 793	4 917	4 708	4 265	4 483	2 812	3 115	2 564	2 135
71 Fishing area total	*4 576*	*2 793*	*4 917*	*4 708*	*4 265*	*4 483*	*2 812*	*3 115*	*2 564*	*2 135*
Species total	*5 257*	*3 413*	*6 059*	*5 353*	*5 138*	*5 519*	*3 225*	*4 641*	*4 418*	*3 084*
Bloch's gizzard shad	**Chardin gros nez**		**Machuelo narigón**		***Nematalosa nasus***				**1,21(05)040,01**	**CNS**
51 Bahrain	...	...	...	93	15	71	196	263	216	205
51 Fishing area total	*...*	*...*	*...*	*93*	*15*	*71*	*196*	*263*	*216*	*205*
Species total	*...*	*...*	*...*	*93*	*15*	*71*	*196*	*263*	*216*	*205*
Chinese gizzard shad	**Alose à museau court**		**Alosa chata**		***Clupanodon thrissa***				**1,21(05)058,03**	**DAS**
61 China,Taiwan	74	31	66	36	15	30	24	21	17	26
Korea Rep	9 120	4 717	6 518	4 313	6 721	8 225	10 757	7 772	7 668	13 500
61 Fishing area total	*9 194*	*4 748*	*6 584*	*4 349*	*6 736*	*8 255*	*10 781*	*7 793*	*7 685*	*13 526*
Species total	*9 194*	*4 748*	*6 584*	*4 349*	*6 736*	*8 255*	*10 781*	*7 793*	*7 685*	*13 526*
Black and Caspian Sea sprat	**Clupeonelle**		**Espadín del Mar Negro y Caspio**		***Clupeonella cultriventris***				**1,21(05)059,01**	**CLA**
04 Azerbaijan	10 389	10 950	6 073	8 897	8 637	3 667	2 450	1 020	839	708
Iran	45 180	26 000	15 497	19 610	22 626	22 303	15 411	16 743	25 483	27 110
Kazakhstan	...	...	...	...	...	...	...	...	274	...
Turkmenistan	12 300	12 418	14 276	14 674	14 680 F	14 680 F	14 680 F	14 680 F	14 680 F	14 680 F
04 Fishing area total	*67 869*	*49 368*	*35 846*	*43 181*	*45 943 F*	*40 650 F*	*32 541 F*	*32 443 F*	*41 276 F*	*42 498 F*
05 Russian Fed	46 036	31 683	17 066	17 303	23 310	17 169	14 630	6 970	4 379	2 588
Ukraine	904	1 181	3 176	2 525	2 671	3 299	3 794	2 347	3 679	2 628
05 Fishing area total	*46 940*	*32 864*	*20 242*	*19 828*	*25 981*	*20 468*	*18 424*	*9 317*	*8 058*	*5 216*
37 Romania	11	4	4	6	2	-	-	-	-	-
Russian Fed	9 681	15 064	9 852	8 523	7 448	7 877	7 873	8 572	8 245	8 069
Ukraine	18 085	12 171	7 887	6 009	11 923	8 446	9 102	9 736	8 625	7 380
37 Fishing area total	*27 777*	*27 239*	*17 743*	*14 538*	*19 373*	*16 323*	*16 975*	*18 308*	*16 870*	*15 449*
Species total	*142 586*	*109 471*	*73 831*	*77 547*	*91 297 F*	*77 441 F*	*67 940 F*	*60 068 F*	*66 204 F*	*63 163 F*
Dotted gizzard shad	**Alose tachetée**		**Alosa manchada**		***Konosirus punctatus***				**1,21(05)060,01**	**DOD**
61 Japan	17 210	13 402	10 031	14 331	11 566	8 510	11 815	7 448	6 737	6 500 F
61 Fishing area total	*17 210*	*13 402*	*10 031*	*14 331*	*11 566*	*8 510*	*11 815*	*7 448*	*6 737*	*6 500 F*
Species total	*17 210*	*13 402*	*10 031*	*14 331*	*11 566*	*8 510*	*11 815*	*7 448*	*6 737*	*6 500 F*
Elongate ilisha	**Alose gracile**		**Sardineta grácil**		***Ilisha elongata***				**1,21(12)001,03**	**EIL**
61 China	86 460 F	80 406 F	81 547 F	80 688 F	84 473 F	92 164 F	88 782	94 183	98 656	86 743
Korea Rep	40	19	11	16	17	19	18	9	1	-
61 Fishing area total	*86 500 F*	*80 425 F*	*81 558 F*	*80 704 F*	*84 490 F*	*92 183 F*	*88 800*	*94 192*	*98 657*	*86 743*
Species total	*86 500 F*	*80 425 F*	*81 558 F*	*80 704 F*	*84 490 F*	*92 183 F*	*88 800*	*94 192*	*98 657*	*86 743*
West African ilisha	**Alose rasoir**		**Sardineta africana**		***Ilisha africana***				**1,21(12)001,12**	**ILI**
34 Benin	923	692	795	1 058	841	870	696	375	889	1 516
Congo Rep	...	...	65	42	59	104	194	61	43	269
Côte dIvoire	50	417	94	531	512	398	501	400 F	350	170
Ghana	3 600	5 202	6 435	5 128	5 549	4 660	7 140	5 814	4 819	3 892
Liberia	198	200	200	242	24	4	182	57	60 F	60 F
Senegal	...	271	...	...	...	48	...	...	...	...
Sierra Leone	4	1 363	1 456	3 119	3 511	3 327	3 875	7 792	7 650 F	7 650 F
Togo	796	667	468	2 247	1 235	1 087	587	800 F	1 016	1 311
Ukraine	137	-	-	14	73	-	-	-	-	-
34 Fishing area total	*5 708*	*8 812*	*9 513*	*12 381*	*11 804*	*10 498*	*13 175*	*15 299 F*	*14 827 F*	*14 868 F*
47 Angola	...	...	...	...	...	...	15 217	17 616	8 930	8 600 F
47 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*15 217*	*17 616*	*8 930*	*8 600 F*

B-24 **Shads / Aloses / Sábalos**

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area / Espèce, Zone de pêche / Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*5 708*	*8 812*	*9 513*	*12 381*	*11 804*	*10 498*	*28 392*	*32 915 F*	*23 757 F*	*23 468 F*
Yellowfin river pellona	**Alose-écaille fluviale**		**Sardinata de río**		***Pellona flavipinnis***				**1,21(12)003,02**	**PEQ**
03 Brazil	746	456	556	748	124	41	42	74	67	70
03 Fishing area total	*746*	*456*	*556*	*748*	*124*	*41*	*42*	*74*	*67*	*70*
31 Fr Guiana	...	...	...	...	...	...	...	...	35	40 F
31 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*35*	*40 F*
Species total	*746*	*456*	*556*	*748*	*124*	*41*	*42*	*74*	*102*	*110 F*
Indian pellona	**Alose-écaille indienne**		**Sardineta índica**		***Pellona ditchela***				**1,21(12)003,03**	**PEO**
57 Malaysia	6 884	7 236	5 569	5 569	9 514	12 546	13 131	9 544	9 753	7 229
57 Fishing area total	*6 884*	*7 236*	*5 569*	*5 569*	*9 514*	*12 546*	*13 131*	*9 544*	*9 753*	*7 229*
71 Malaysia	5 780	4 822	4 872	5 948	6 282	6 632	7 484	6 161	2 548	3 027
Philippines	1 221	1 330	1 342	1 398	1 264	1 195	1 216	1 207	1 313	1 341
71 Fishing area total	*7 001*	*6 152*	*6 214*	*7 346*	*7 546*	*7 827*	*8 700*	*7 368*	*3 861*	*4 368*
Species total	*13 885*	*13 388*	*11 783*	*12 915*	*17 060*	*20 373*	*21 831*	*16 912*	*13 614*	*11 597*
Diadromous clupeoids nei	**Clupéoidés diadromes nca**		**Clupeoideos diádromos nep**		***Clupeoidei***				**1,21(XX)XXX,XX**	**DCX**
01 Benin	230 F	230 F	230 F	220 F	160 F	240 F	250 F	250 F	260 F	270 F
Egypt	28	8	41	6	52	155	184	146	53	66
01 Fishing area total	*258 F*	*238 F*	*271 F*	*226 F*	*212 F*	*395 F*	*434 F*	*396 F*	*313 F*	*336 F*
02 Mexico	...	...	...	...	232	243	174	19	25	28
02 Fishing area total	*...*	*...*	*...*	*...*	*232*	*243*	*174*	*19*	*25*	*28*
03 Venezuela	200	183	275	250 F	200 F	220 F	150 F	130 F	130 F	130 F
03 Fishing area total	*200*	*183*	*275*	*250 F*	*200 F*	*220 F*	*150 F*	*130 F*	*130 F*	*130 F*
04 India	2 090	2 090	2 906	2 906	2 562	2 669	2 120	7 193	7 287	1 966
Iran	623	932	480	302	371	187	317	539	905	818
Kazakhstan	-	3	-	0	-	-	-	77	46	32
04 Fishing area total	*2 713*	*3 025*	*3 386*	*3 208*	*2 933*	*2 856*	*2 437*	*7 809*	*8 238*	*2 816*
06 Papua N Guin	480 F	480 F	480 F	480 F	480 F	480 F	480 F	480 F	480 F	480 F
06 Fishing area total	*480 F*	*480 F*	*480 F*	*480 F*	*480 F*	*480 F*	*480 F*	*480 F*	*480 F*	*480 F*
57 Malaysia	50	305	75	122	58	64	70	34	20	23
57 Fishing area total	*50*	*305*	*75*	*122*	*58*	*64*	*70*	*34*	*20*	*23*
71 Malaysia	1 056	926	955	889	774	1 026	860	816	1 005	1 399
71 Fishing area total	*1 056*	*926*	*955*	*889*	*774*	*1 026*	*860*	*816*	*1 005*	*1 399*
Species total	*4 757 F*	*5 157 F*	*5 442 F*	*5 175 F*	*4 889 F*	*5 284 F*	*4 605 F*	*9 684 F*	*10 211 F*	*5 212 F*
Group total	***650 399***	***574 971***	***510 216***	***554 620***	***580 656***	***578 813***	***584 443***	***589 202***	***591 562***	***644 388***

B-25

Miscellaneous diadromous fishes
Poissons diadromes divers
Peces diádromos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Sea lamprey	**Lamproie marine**		**Lamprea marina**		***Petromyzon marinus***				**1,02(01)001,01**	**LAU**
27 Estonia	3	2	4	4	1	0	-	0	-	0
France	23	37	44	19	25	30	17	17	213	28
Portugal	6	13	27	20	26	26	25	24	57	37
27 Fishing area total	*32*	*52*	*75*	*43*	*52*	*56*	*42*	*41*	*270*	*65*
Species total	*32*	*52*	*75*	*43*	*52*	*56*	*42*	*41*	*270*	*65*
River lamprey	**Lamproie de rivière**		**Lamprea de río**		***Lampetra fluviatilis***				**1,02(01)002,01**	**LAR**
05 Estonia	25	23	30	48	62	43	62	67	59	40
Latvia	88	79	109	72	110	96	113	111	85	73
Lithuania	3	2	5	7	8	5	6	7	5	2
UK	2	2	3	-	-	-	-	-	-	-
05 Fishing area total	*118*	*106*	*147*	*127*	*180*	*144*	*181*	*185*	*149*	*115*
Species total	*118*	*106*	*147*	*127*	*180*	*144*	*181*	*185*	*149*	*115*
Lampreys nei	**Lamproies nca**		**Lampreas nep**		***Petromyzontidae***				**1,02(01)XXX,XX**	**LAS**
05 France	119	110 F	110 F	110 F	110 F	110 F	110 F	110 F	110 F	110 F
Russian Fed	21	96	44	48	61	4	4	5	-	24
05 Fishing area total	*140*	*206 F*	*154 F*	*158 F*	*171 F*	*114 F*	*114 F*	*115 F*	*110 F*	*134 F*
27 Poland	5	3	5	-	-	-	-	-	-	-
Russian Fed	28	21	4	3	10	24	30	32	35	32
27 Fishing area total	*33*	*24*	*9*	*3*	*10*	*24*	*30*	*32*	*35*	*32*
Species total	*173*	*230 F*	*163 F*	*161 F*	*181 F*	*138 F*	*144 F*	*147 F*	*145 F*	*166 F*
Milkfish	**Chano**		**Chano**		***Chanos chanos***				**1,22(02)001,01**	**MIL**
04 Philippines	201	329	1 114	558	637	3 589	2 261	3 714	9 347	8 487
04 Fishing area total	*201*	*329*	*1 114*	*558*	*637*	*3 589*	*2 261*	*3 714*	*9 347*	*8 487*
51 Bahrain	...	...	...	0	0	5	3	35	9	7
Eritrea	1	1	2	1	0	0	0	0	9	16
Saudi Arabia	93	51	49	40	61	89	62	56	46	46
Untd Arab Em	60 F	65	62	60 F	61	65 F	70 F	77	258	129
51 Fishing area total	*154 F*	*117*	*113*	*101 F*	*122*	*159 F*	*135 F*	*168*	*322*	*198*
61 China,Taiwan	1	-	22	0	-	2	1	5	13	14
61 Fishing area total	*1*	*-*	*22*	*0*	*-*	*2*	*1*	*5*	*13*	*14*
71 Fiji	32	20 F	1	20	23 F	26	22	120	20	20
Kiribati	58	57	376	290 F	200 F	110 F	45	3	2	1
Palau	1	0	0	1	0	0	0	1	1 F	1 F
Philippines	278	259	363	368	337	436	412	315	306	328
71 Fishing area total	*369*	*336 F*	*740*	*679 F*	*560 F*	*572 F*	*479*	*439*	*329 F*	*350 F*
77 Mexico	...	1	2	3	14	15	422	69	65	68
77 Fishing area total	*...*	*1*	*2*	*3*	*14*	*15*	*422*	*69*	*65*	*68*
Species total	*725 F*	*783 F*	*1 991*	*1 341 F*	*1 333 F*	*4 337 F*	*3 298 F*	*4 395*	*10 076 F*	*9 117 F*
Three-spined stickleback	**Épinoche à trois épines**		**Espinoso**		***Gasterosteus aculeatus***				**1,50(01)001,01**	**GTA**
05 Belarus	41	-	-	-	-	-	-	-	-	-
Lithuania	18	-	-	-	-	-	-	8	4	1
Russian Fed	906	1 676	1 320	1 343	1 489	1 716	1 655	1 359	1 247	1 191
Sweden	...	...	174	128	136	64	131	121	355	101
05 Fishing area total	*965*	*1 676*	*1 494*	*1 471*	*1 625*	*1 780*	*1 786*	*1 488*	*1 606*	*1 293*
27 Denmark	-	-	-	12	-	-	-	-	-	-
Estonia	-	-	-	-	-	-	-	0	-	-
Lithuania	-	6	-	-	-	-	-	-	-	-
Russian Fed	593	738	436	538	463	448	395	406	381	368
Sweden	-	-	-	-	-	-	-	-	15	-
27 Fishing area total	*593*	*744*	*436*	*550*	*463*	*448*	*395*	*406*	*396*	*368*
37 Russian Fed	8	4	6	1	-	2	-	-	-	-
37 Fishing area total	*8*	*4*	*6*	*1*	*-*	*2*	*-*	*-*	*-*	*-*
Species total	*1 566*	*2 424*	*1 936*	*2 022*	*2 088*	*2 230*	*2 181*	*1 894*	*2 002*	*1 661*
Barramundi(=Giant seaperch)	**Perche barramundi**		**Perca gigante**		***Lates calcarifer***				**1,70(01)167,01**	**GIP**
06 Papua N Guin	350 F	350 F	350 F	350 F	350 F	350 F	350 F	350 F	350 F	350 F
06 Fishing area total	*350 F*	*350 F*	*350 F*	*350 F*	*350 F*	*350 F*	*350 F*	*350 F*	*350 F*	*350 F*
51 Pakistan	-	-	-	-	-	0	0	0	-	-
51 Fishing area total	*-*	*-*	*-*	*-*	*-*	*0*	*0*	*0*	*-*	*-*
57 Indonesia	15 325	16 919	17 095	11 200	11 106	11 776	12 566	12 584	15 046	12 438
Malaysia	91	101	116	174	182	173	172	160	168	215
Thailand	119	130	122	149	28	367	71	47	60	103
57 Fishing area total	*15 535*	*17 150*	*17 333*	*11 523*	*11 316*	*12 316*	*12 809*	*12 791*	*15 274*	*12 756*

B-25

Miscellaneous diadromous fishes
Poissons diadromes divers
Peces diádromos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
61 China,Taiwan	80	73	54	42	75	57	35	43	68	91
61 Fishing area total	*80*	*73*	*54*	*42*	*75*	*57*	*35*	*43*	*68*	*91*
71 Australia	1 953	1 925	1 527	1 614	1 440	1 576	1 466	1 622	1 745	1 643
Indonesia	48 160	49 723	49 184	44 715	56 831	69 033	78 303	64 233	71 273	85 257
Malaysia	1 427	1 339	1 219	1 575	1 604	1 642	1 633	1 354	1 262	1 142
Papua N Guin	30	22	20	25	41	47	23	4	1	7
Philippines	751	929	922	729	504	531	585	644	807	856
Singapore	52	51	28	35	34	42	30	71	25	21
Thailand	378	426	68	37	40	46	35	7	18	17
71 Fishing area total	*52 751*	*54 415*	*52 968*	*48 730*	*60 494*	*72 917*	*82 075*	*67 935*	*75 131*	*88 943*
Species total	*68 716 F*	*71 988 F*	*70 705 F*	*60 645 F*	*72 235 F*	*85 640 F*	*95 269 F*	*81 119 F*	*90 823 F*	*102 140 F*
Striped bass	**Bar d'Amérique**		**Lubina estriada**		***Morone saxatilis***				**1,70(06)006,02**	**STB**
21 USA	2 934	2 847	3 193	2 776	3 467	2 981	3 228	3 199	3 367	3 307
21 Fishing area total	*2 934*	*2 847*	*3 193*	*2 776*	*3 467*	*2 981*	*3 228*	*3 199*	*3 367*	*3 307*
31 USA	15	17	21	88	99	18	14	9	4	7
31 Fishing area total	*15*	*17*	*21*	*88*	*99*	*18*	*14*	*9*	*4*	*7*
Species total	*2 949*	*2 864*	*3 214*	*2 864*	*3 566*	*2 999*	*3 242*	*3 208*	*3 371*	*3 314*
White perch	**Bar blanc d'Amérique**		**Lubina blanca**		***Morone americana***				**1,70(06)006,03**	**PEW**
02 USA	1 226	75	125	149	1 033	661	816	843	277	1 299
02 Fishing area total	*1 226*	*75*	*125*	*149*	*1 033*	*661*	*816*	*843*	*277*	*1 299*
21 USA	...	945	1 001	445	...	...	...	...	805	...
21 Fishing area total	*...*	*945*	*1 001*	*445*	*...*	*...*	*...*	*...*	*805*	*...*
31 USA	...	2	1	1	...	...	...	...	1	...
31 Fishing area total	*...*	*2*	*1*	*1*	*...*	*...*	*...*	*...*	*1*	*...*
Species total	*1 226*	*1 022*	*1 127*	*595*	*1 033*	*661*	*816*	*843*	*1 083*	*1 299*
Group total	***75 505***	***79 469***	***79 358***	***67 798***	***80 668***	***96 205***	***105 173***	***91 832***	***107 919***	***117 877***

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Flounders, halibuts, soles
Flets, flétans, soles
Platijas, halibuts, lenguados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Leopard flounder	**Rombou léopard**		**Lenguado leopardo**		***Bothus pantherinus***				**1,83(01)018,05**	**OUN**
51 Bahrain	...	...	...	3	5	0	0	2	2	0
Saudi Arabia	65	84	96	67	86	124	91	91	77	80
51 Fishing area total	*65*	*84*	*96*	*70*	*91*	*124*	*91*	*93*	*79*	*80*
Species total	*65*	*84*	*96*	*70*	*91*	*124*	*91*	*93*	*79*	*80*
Lefteye flounders nei	**Arnoglosses, rombous nca**		**Rodaballos, rombos, etc. nep**		***Bothidae***				**1,83(01)XXX,XX**	**LEF**
27 Germany	290	292	280	385	262	321	24	1	-	-
Portugal	107	106	162	224	202	189	117	106	136	103
Spain	...	...	...	49	92	68	63	106	134	116
27 Fishing area total	*397*	*398*	*442*	*658*	*556*	*578*	*204*	*213*	*270*	*219*
34 Korea Rep	-	-	-	-	5	-	-	-	-	-
Portugal	12	11	17	7	-	-	-	15	15	46
34 Fishing area total	*12*	*11*	*17*	*7*	*5*	-	-	*15*	*15*	*46*
41 Estonia	-	1	-	-	-	-	-	-	-	-
Korea Rep	20	-	-	-	-	-	-	-	-	-
41 Fishing area total	*20*	*1*	-	-	-	-	-	-	-	-
51 Eritrea	125	69	49	77	20	85	1	0	15	25
Korea Rep	-	19	24	1	-	-	-	1	-	-
51 Fishing area total	*125*	*88*	*73*	*78*	*20*	*85*	*1*	*1*	*15*	*25*
71 Korea Rep	10	1	-	-	-	-	-	-	-	-
71 Fishing area total	*10*	*1*	-	-	-	-	-	-	-	-
Species total	*564*	*499*	*532*	*743*	*581*	*663*	*205*	*229*	*300*	*290*
Atlantic halibut	**Flétan de l'Atlantique**		**Fletán del Atlántico**		***Hippoglossus hippoglossus***				**1,83(02)002,01**	**HAL**
21 Canada	1 647	1 649	1 829	1 850	1 746	1 832	2 022	2 093	2 387	2 462
Estonia	0	-	-	-	-	-	-	3	-	3
Faroe Is	-	-	-	-	0	-	-	-	-	6
Germany	-	-	-	-	-	-	-	8	-	-
Greenland	0	1	0	1	-	1	2	8	2	4
Japan	36	14	2	5	9	6	7	3	-	-
Lithuania	-	-	-	-	-	-	2	4	-	1
Norway	-	-	68	17	21	12	0	18	50	9
Poland	488	-	-	-	-	-	-	-	-	-
Portugal	44	46	89	59	20	46	35	24	469	55
Russian Fed	2	13	4	18	1	1	4	2	1	2
St Pier Mq	1	2	2	36	1	-	10	11	...	1
Spain	138	158	234	75	51	-	24	23	15	55
UK	-	-	-	-	-	-	-	1	3	-
USA	11	10	16	11	17	19	23	26	45	21
21 Fishing area total	*2 367*	*1 893*	*2 244*	*2 072*	*1 866*	*1 917*	*2 129*	*2 224*	*2 972*	*2 619*
27 Belgium	2	3	1	2	3	2	5	7	6	4
Denmark	53	82	113	120	147	140	118	129	110	77
Faroe Is	247	394	382	497	513	463	405	240	224	176
France	44	19	20	18	17	27	48	40	36	17
Germany	20	22	15	22	21	24	26	30	29	20
Greenland	19	47	12	10	12	10	8	17	19	24
Iceland	589	683	634	574	524	447	419	502	498	551
Ireland	17	23	14	9	2	4	9	3	2	2
Netherlands	-	0	-	1	2	3	6	11	2	2
Norway	869	676	796	1 034	1 076	1 362	1 607	1 747	1 538	1 868
Portugal	1	9	1	1	5	12	23	10	46	3
Russian Fed	-	-	-	-	3	5	2	1	2	-
Spain	14	1	8	-	0	0	0	4	-	4
Sweden	8	8	8	6	8	4	5	8	7	18
UK	159	222	296	251	290	228	269	324	264	189
27 Fishing area total	*2 042*	*2 189*	*2 300*	*2 545*	*2 623*	*2 731*	*2 950*	*3 073*	*2 783*	*2 955*
67 Russian Fed	-	-	-	-	-	-	-	-	-	1
67 Fishing area total	-	-	-	-	-	-	-	-	-	*1*
Species total	*4 409*	*4 082*	*4 544*	*4 617*	*4 489*	*4 648*	*5 079*	*5 297*	*5 755*	*5 575*
Pacific halibut	**Flétan du Pacifique**		**Fletán del Pacífico**		***Hippoglossus stenolepis***				**1,83(02)002,02**	**HAP**
61 Russian Fed	...	...	...	...	...	...	...	...	2 036	3 094
61 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*2 036*	*3 094*
67 Canada	4 766	6 487	7 139	7 395	6 609	7 277	5 970	7 641	4 071	4 124
Poland	4	-	-	-	-	-	-	-	-	-
USA	35 391	37 237	36 051	35 909	34 576	32 381	31 778	30 330	27 042	25 606
67 Fishing area total	*40 161*	*43 724*	*43 190*	*43 304*	*41 185*	*39 658*	*37 748*	*37 971*	*31 113*	*29 730*
77 USA	0	-	-	-	-	-	-	-	-	-
77 Fishing area total	*0*	-	-	-	-	-	-	-	-	-
Species total	*40 161*	*43 724*	*43 190*	*43 304*	*41 185*	*39 658*	*37 748*	*37 971*	*33 149*	*32 824*

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Flounders, halibuts, soles
Flets, flétans, soles
Platijas, halibuts, lenguados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
European plaice	**Plie d'Europe**		**Solla europea**		***Pleuronectes platessa***				**1,83(02)004,05**	**PLE**
27 Belgium	8 487	7 043	6 487	6 053	5 063	5 139	5 732	5 220	5 008	5 200
Channel Is	13	11	6	5	5	4	2	4	4	4
Denmark	26 849	22 998	22 379	20 705	18 377	21 185	16 780	17 580	16 056	18 095
Faroe Is	327	456	465	468	421	409	362	258	208	253
Finland	-	-	-	-	-	2	12	5	4	3
France	4 247	5 229	3 856	3 615	3 185	2 741	2 809	2 267	2 694	3 214
Germany	4 842	4 148	3 944	3 850	3 560	3 863	2 915	3 412	3 263	4 103
Iceland	4 905	5 126	5 257	5 707	5 807	6 370	5 816	6 724	6 316	5 984
Ireland	841	801	876	564	476	340	393	277	264	273
Isle of Man	1	0	1	0	...	...	0	1	1	0
Netherlands	33 835	29 083	28 867	25 123	23 101	23 947	23 099	20 757	23 476	28 291
Norway	2 772	2 945	3 227	2 886	2 671	2 619	2 085	1 818	1 690	1 670
Poland	-	-	-	45	28	56	60	29	43	38
Portugal	145	184	99	171	143	105	92	89	101	112
Russian Fed	1 250	1 133	593	976	1 160	1 445	1 938	2 233	4 245	7 514
Spain	41	13	12	13	33	7	16	6	8	12
Sweden	416	387	468	396	323	447	505	535	341	300
UK	21 936	19 647	16 495	17 402	12 272	14 521	13 242	12 963	14 793	16 416
27 Fishing area total	*110 907*	*99 204*	*93 032*	*87 979*	*76 625*	*83 200*	*75 858*	*74 178*	*78 515*	*91 482*
Species total	*110 907*	*99 204*	*93 032*	*87 979*	*76 625*	*83 200*	*75 858*	*74 178*	*78 515*	*91 482*
English sole	**Carlottin anglais**		**Soya inglesa**		***Pleuronectes vetulus***				**1,83(02)004,15**	**RFE**
67 USA	1 198	1 374	1 065	1 107	1 031	1 006	649	308	335	228
67 Fishing area total	*1 198*	*1 374*	*1 065*	*1 107*	*1 031*	*1 006*	*649*	*308*	*335*	*228*
77 USA	197	102	63	102	69	59	66	72	37	21
77 Fishing area total	*197*	*102*	*63*	*102*	*69*	*59*	*66*	*72*	*37*	*21*
Species total	*1 395*	*1 476*	*1 128*	*1 209*	*1 100*	*1 065*	*715*	*380*	*372*	*249*
Greenland halibut	**Flétan noir**		**Fletán negro**		***Reinhardtius hippoglossoides***				**1,83(02)005,01**	**GHL**
18 Russian Fed	-	-	-	-	-	-	-	17	-	-
18 Fishing area total	-	-	-	-	-	-	-	*17*	-	-
21 Canada	13 814	11 237	15 294	14 682	15 619	14 623	13 698	12 171	13 709	14 699
Denmark	0	0	-	-	-	-	-	-	-	-
Estonia	1 100	898	1 693	791	360	371	365	299	300	441
Faroe Is	647	385	253	505	304	603	390	549	479	492
Germany	537	536	541	534	550	544	1 517	1 516	1 511	1 818
Greenland	19 111	23 814	27 100	28 457	28 177	32 125	29 284	26 317	26 324	28 741
Iceland	14	-	-	-	-	-	-	-	-	-
Japan	2 815	2 782	2 519	1 416	1 279	1 405	1 222	1 218	-	-
Latvia	291	11	-	68	-	18	-	-	-	-
Lithuania	392	298	43	-	77	56	21	10	-	25
Norway	1 419	2 788	2 868	1 364	1 439	1 377	1 431	1 458	1 501	1 572
Portugal	5 026	4 319	4 611	1 882	2 256	2 327	1 873	1 973	2 075	2 284
Russian Fed	4 687	4 581	4 592	3 135	3 336	3 318	2 771	2 876	3 189	3 382
St Pier Mq	7	0	5	0	190	-	324	320	192	116
Spain	11 571	12 833	12 340	5 080	5 491	5 305	4 585	4 596	4 528	4 585
USA	-	-	-	-	1	0	-	-	-	0
21 Fishing area total	*61 431*	*64 482*	*71 859*	*57 914*	*59 079*	*62 072*	*57 481*	*53 303*	*53 808*	*58 155*
27 Denmark	1	1	1	1	1	2	2	1	2	1
Estonia	-	227	-	-	175	2	-	-	-	-
Faroe Is	3 744	2 631	2 991	2 389	1 486	1 058	1 662	2 819	2 567	1 681
France	230	353	246	185	94	116	64	64	140	215
Germany	2 865	2 093	2 967	5 177	5 158	4 308	4 937	4 852	5 021	5 301
Greenland	1 573	2 196	1 750	1 565	3 010	2 097	2 857	311	2 886	1 868
Iceland	16 628	19 229	20 366	15 486	13 030	11 796	9 582	11 699	15 780	13 310
Ireland	71	84	1	3	1	0	0	0	2	-
Lithuania	3	48	26	42	3	198	3	2	-	-
Norway	13 694	9 390	9 745	15 585	14 192	11 959	8 731	7 559	8 681	8 669
Poland	4	22	97	207	-	1 296	1 401	1 557	1 191	963
Portugal	40	145	19	52	25	27	47	46	237	11
Russian Fed	4 881	5 628	4 536	4 924	5 492	6 602	7 185	6 093	4 097	7 959
Spain	1 766	-	3 090	4 917	1 549	40	18	528	206	540
UK	1 690	1 346	2 215	2 475	672	114	549	470	778	652
27 Fishing area total	*47 190*	*43 393*	*48 050*	*53 008*	*44 888*	*39 615*	*37 038*	*36 001*	*41 588*	*41 170*
61 Russian Fed	...	...	...	...	...	...	...	...	9 049	11 610
61 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*9 049*	*11 610*
67 USA	4 391	2 937	2 558	1 879	2 368	1 775	1 692	2 041	4 054	3 910
67 Fishing area total	*4 391*	*2 937*	*2 558*	*1 879*	*2 368*	*1 775*	*1 692*	*2 041*	*4 054*	*3 910*
Species total	*113 012*	*110 812*	*122 467*	*112 801*	*106 335*	*103 462*	*96 211*	*91 362*	*108 499*	*114 845*
Arrow-tooth flounder	**Faux flétan du Pacifique**		**Halibut del Pacífico**		***Atheresthes stomias***				**1,83(02)008,01**	**ARF**
67 Canada	59	22	21	26	10	21	10	11	13	25
USA	14 342	16 588	19 569	13 016	21 353	24 060	22 586	39 172	40 857	49 555
67 Fishing area total	*14 401*	*16 610*	*19 590*	*13 042*	*21 363*	*24 081*	*22 596*	*39 183*	*40 870*	*49 580*
77 USA	0	1	5	2	3	2	3	1	0	0
77 Fishing area total	*0*	*1*	*5*	*2*	*3*	*2*	*3*	*1*	*0*	*0*

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Flounders, halibuts, soles
Flets, flétans, soles
Platijas, halibuts, lenguados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*14 401*	*16 611*	*19 595*	*13 044*	*21 366*	*24 083*	*22 599*	*39 184*	*40 870*	*49 580*
Kamchatka flounder	**Faux flétan du Japon**		**Halibut japonés**		***Atheresthes evermanni***				**1,83(02)008,02**	**KAF**
61 Russian Fed	19 049	17 609	17 301	16 703	16 625	16 256	14 170	14 719	166	376
61 Fishing area total	*19 049*	*17 609*	*17 301*	*16 703*	*16 625*	*16 256*	*14 170*	*14 719*	*166*	*376*
Species total	*19 049*	*17 609*	*17 301*	*16 703*	*16 625*	*16 256*	*14 170*	*14 719*	*166*	*376*
Petrale sole	**Charlottin pétrale**		**Limanda petrale**		***Eopsetta jordani***				**1,83(02)010,01**	**EOJ**
67 USA	1 554	1 569	1 781	1 690	2 363	2 236	1 657	1 659	1 431	655
67 Fishing area total	*1 554*	*1 569*	*1 781*	*1 690*	*2 363*	*2 236*	*1 657*	*1 659*	*1 431*	*655*
77 USA	268	224	220	266	371	372	575	549	330	146
77 Fishing area total	*268*	*224*	*220*	*266*	*371*	*372*	*575*	*549*	*330*	*146*
Species total	*1 822*	*1 793*	*2 001*	*1 956*	*2 734*	*2 608*	*2 232*	*2 208*	*1 761*	*801*
Witch flounder	**Plie cynoglosse**		**Mendo**		***Glyptocephalus cynoglossus***				**1,83(02)011,02**	**WIT**
21 Canada	2 128	2 399	2 276	1 939	2 168	1 746	1 579	1 476	1 281	1 145
Estonia	3	2	43	74	31	28	24	38	8	11
Japan	4	38	12	7	5	2	5	8	-	-
Lithuania	3	2	-	-	1	-	1	8	-	0
Portugal	579	433	501	589	150	141	122	219	129	81
Russian Fed	65	135	66	76	10	8	29	29	67	165
St Pier Mq	120	38	4	8	14	20	26	18	21	10
Spain	1 355	841	1 088	570	437	13	116	130	206	520
USA	3 020	3 189	3 124	2 919	2 652	1 863	1 075	1 000	948	759
21 Fishing area total	*7 277*	*7 077*	*7 114*	*6 182*	*5 468*	*3 821*	*2 977*	*2 926*	*2 660*	*2 691*
27 Denmark	2 046	1 907	1 808	1 812	1 722	1 290	1 149	827	943	788
Faroe Is	1	1	3	18	29	26	20	14	6	2
France	582	632	652	566	512	484	474	361	346	283
Germany	8	5	3	4	7	9	12	6	6	8
Iceland	1 132	1 147	1 948	2 122	2 325	2 030	1 805	1 428	1 789	1 325
Ireland	915	831	971	961	782	601	532	408	387	396
Netherlands	1	-	-	1	4	3	7	19	12	9
Norway	88	82	88	87	82	69	73	104	86	65
Portugal	20	21	17	10	14	13	6	8	11	12
Russian Fed	-	-	-	-	-	-	34	139	47	70
Spain	2 870	3 277	3 740	327	1 442	1 321	2 490	4 878	5 243	5 949
Sweden	576	584	548	552	559	371	290	279	157	125
UK	4 535	3 896	3 817	3 455	2 028	1 787	1 746	1 329	1 121	1 172
27 Fishing area total	*12 774*	*12 383*	*13 595*	*9 915*	*9 506*	*8 004*	*8 638*	*9 800*	*10 154*	*10 204*
Species total	*20 051*	*19 460*	*20 709*	*16 097*	*14 974*	*11 825*	*11 615*	*12 726*	*12 814*	*12 895*
Rex sole	**Plie cynoglosse royale**		**Platija rey**		***Glyptocephalus zachirus***				**1,83(02)011,03**	**GLZ**
67 USA	473	484	499	3 237	4 105	4 655	4 631	4 065	6 308	4 527
67 Fishing area total	*473*	*484*	*499*	*3 237*	*4 105*	*4 655*	*4 631*	*4 065*	*6 308*	*4 527*
77 USA	98	116	124	117	109	54	42	38	31	18
77 Fishing area total	*98*	*116*	*124*	*117*	*109*	*54*	*42*	*38*	*31*	*18*
Species total	*571*	*600*	*623*	*3 354*	*4 214*	*4 709*	*4 673*	*4 103*	*6 339*	*4 545*
Amer. plaice(=Long rough dab)	**Balai(=Plie canadienne)**		**Platija americana**		***Hippoglossoides platessoides***				**1,83(02)014,01**	**PLA**
21 Canada	4 466	3 714	3 514	2 753	2 919	1 431	1 626	1 685	1 903	1 906
Estonia	54	19	77	89	47	34	33	77	29	9
Faroe Is	3	1	-	-	-	-	-	-	12	-
Greenland	4	-	-	-	-	-	-	-	-	-
Japan	6	83	74	43	28	14	28	43	-	-
Lithuania	3	26	16	-	15	11	27	14	-	7
Poland	1	-	-	-	-	-	-	-	-	-
Portugal	633	631	901	512	371	380	440	355	296	160
Russian Fed	257	418	353	237	22	16	93	87	55	63
St Pier Mq	112	115	131	65	44	37	62	78	9	80
Spain	1 158	777	925	515	480	435	465	490	379	566
Ukraine	-	-	0	80	-	-	-	-	-	-
USA	4 425	3 420	2 430	1 708	1 350	1 107	995	1 106	1 392	1 413
21 Fishing area total	*11 122*	*9 204*	*8 421*	*6 002*	*5 276*	*3 465*	*3 769*	*3 935*	*4 075*	*4 204*
27 Denmark	31	0	3	1	4	7	7	7	5	4
Estonia	-	5	-	-	0	-	-	-	-	-
France	11	-	-	-	0	0	0	0	-	-
Germany	-	3	16	0	-	-	-	-	-	7
Iceland	3 473	3 579	2 835	2 024	877	744	358	278	290	220
Norway	15	-	-	59	27	5	-	-	0	10
Portugal	71	92	37	49	46	46	35	25	19	12
Russian Fed	3 497	2 641	1 293	2 249	2 643	3 090	1 991	1 271	1 212	933
Spain	254	138	153	-	-	3	-	16	8	6
UK	15	-	0	1	1	-	-	-	0	-
27 Fishing area total	*7 367*	*6 458*	*4 337*	*4 383*	*3 598*	*3 895*	*2 391*	*1 597*	*1 534*	*1 192*

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Flounders, halibuts, soles
Flets, flétans, soles
Platijas, halibuts, lenguados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*18 489*	*15 662*	*12 758*	*10 385*	*8 874*	*7 360*	*6 160*	*5 532*	*5 609*	*5 396*
Flathead sole	**Balai du Japon**		**Platija japonesa**		***Hippoglossoides elassodon***				**1,83(02)014,04**	**FTS**
67 USA	16 092	13 174	12 447	14 147	14 491	16 423	16 902	25 274	20 916	21 761
67 Fishing area total	*16 092*	*13 174*	*12 447*	*14 147*	*14 491*	*16 423*	*16 902*	*25 274*	*20 916*	*21 761*
Species total	*16 092*	*13 174*	*12 447*	*14 147*	*14 491*	*16 423*	*16 902*	*25 274*	*20 916*	*21 761*
Southern lemon sole	**...B**		**...C**		***Pelotretis flavilatus***				**1,83(02)018,01**	**EOL**
81 New Zealand	...	238	322	251	335	348	608	513	387	448
81 Fishing area total	*...*	*238*	*322*	*251*	*335*	*348*	*608*	*513*	*387*	*448*
Species total	*...*	*238*	*322*	*251*	*335*	*348*	*608*	*513*	*387*	*448*
Yellowfin sole	**Limande du Japon**		**Limanda japonesa**		***Limanda aspera***				**1,83(02)024,02**	**YES**
67 USA	54 918	63 625	68 825	62 896	85 324	90 571	109 059	141 237	100 644	113 246
67 Fishing area total	*54 918*	*63 625*	*68 825*	*62 896*	*85 324*	*90 571*	*109 059*	*141 237*	*100 644*	*113 246*
Species total	*54 918*	*63 625*	*68 825*	*62 896*	*85 324*	*90 571*	*109 059*	*141 237*	*100 644*	*113 246*
Yellowtail flounder	**Limande à queue jaune**		**Limanda**		***Limanda ferruginea***				**1,83(02)024,04**	**YEL**
21 Canada	15 648	13 001	15 013	12 907	13 513	534	3 896	10 433	5 561	8 302
Estonia	47	14	56	20	20	6	25	33	-	4
Lithuania	1	-	-	-	14	10	22	2	-	2
Portugal	351	122	287	68	188	134	281	144	71	26
Russian Fed	148	103	184	159	8	1	114	144	3	101
St Pier Mq	152	137	261	140	280	73	550	834	87	580
Spain	622	216	81	269	194	256	357	457	294	508
Ukraine	-	-	-	33	-	-	-	-	-	-
USA	7 304	5 355	5 565	7 207	4 118	1 939	1 753	1 668	1 603	1 318
21 Fishing area total	*24 273*	*18 948*	*21 447*	*20 803*	*18 335*	*2 953*	*6 998*	*13 715*	*7 619*	*10 841*
Species total	*24 273*	*18 948*	*21 447*	*20 803*	*18 335*	*2 953*	*6 998*	*13 715*	*7 619*	*10 841*
Common dab	**Limande**		**Lenguadina**		***Limanda limanda***				**1,83(02)024,05**	**DAB**
27 Belgium	850	752	681	591	558	605	624	559	570	553
Denmark	2 300	2 648	3 003	2 946	2 823	2 264	2 194	2 024	1 610	1 494
Faroe Is	75	34	12	20	54	97	80	69	77	84
France	950	1 195	1 115	1 065	1 111	1 080	1 101	942	1 119	1 203
Germany	1 074	762	1 153	1 536	1 641	1 698	1 106	927	884	786
Iceland	4 373	4 358	4 213	2 953	2 116	1 080	810	798	882	612
Ireland	34	32	40	55	9	4	1	0	3	0
Netherlands	5 969	4 955	5 138	5 162	5 478	5 210	6 472	5 638	4 650	5 349
Norway	54	55	91	56	131	125	127	63	30	16
Poland	-	-	-	2	-	-	-	-	-	-
Portugal	-	-	-	0	-	-	-	-	-	-
Russian Fed	-	-	-	-	68	68	46	3	55	182
Spain	24	70	58	45	36	15	-	2	-	-
Sweden	14	10	5	4	5	6	11	14	18	11
UK	1 530	1 355	1 380	1 291	1 304	1 537	1 296	964	800	875
27 Fishing area total	*17 247*	*16 226*	*16 889*	*15 726*	*15 334*	*13 789*	*13 868*	*12 003*	*10 698*	*11 165*
Species total	*17 247*	*16 226*	*16 889*	*15 726*	*15 334*	*13 789*	*13 868*	*12 003*	*10 698*	*11 165*
Rock sole	**Fausse limande du Pacifique**		**Lenguado del Pacífico**		***Lepidopsetta bilineata***				**1,83(02)043,01**	**ROS**
67 USA	24 206	29 258	23 475	29 326	28 240	34 241	34 476	52 977	50 039	53 425
67 Fishing area total	*24 206*	*29 258*	*23 475*	*29 326*	*28 240*	*34 241*	*34 476*	*52 977*	*50 039*	*53 425*
77 USA	7	13	15	13	13	6	5	2	2	2
77 Fishing area total	*7*	*13*	*15*	*13*	*13*	*6*	*5*	*2*	*2*	*2*
Species total	*24 213*	*29 271*	*23 490*	*29 339*	*28 253*	*34 247*	*34 481*	*52 979*	*50 041*	*53 427*
Dover sole	**Limande sole du Pacifique**		**Soya escurridiza**		***Microstomus pacificus***				**1,83(02)045,03**	**MIP**
67 USA	6 038	4 659	5 868	5 730	5 902	5 313	8 514	10 130	10 653	9 525
67 Fishing area total	*6 038*	*4 659*	*5 868*	*5 730*	*5 902*	*5 313*	*8 514*	*10 130*	*10 653*	*9 525*
77 USA	1 403	1 994	1 943	1 590	1 179	826	864	1 046	999	1 035
77 Fishing area total	*1 403*	*1 994*	*1 943*	*1 590*	*1 179*	*826*	*864*	*1 046*	*999*	*1 035*
Species total	*7 441*	*6 653*	*7 811*	*7 320*	*7 081*	*6 139*	*9 378*	*11 176*	*11 652*	*10 560*
Lemon sole	**Limande sole**		**Mendo limón**		***Microstomus kitt***				**1,83(02)045,04**	**LEM**
27 Belgium	1 076	1 089	1 027	1 341	1 155	925	888	885	679	663
Channel Is	1	1	0	0	-	0	-	0	0	-
Denmark	1 804	1 447	1 477	1 611	1 550	1 310	1 520	1 169	1 134	1 111
Faroe Is	729	1 221	1 131	907	661	778	649	380	314	276
France	1 366	1 442	1 473	1 309	1 169	1 026	992	731	1 039	851
Germany	77	121	143	86	91	191	148	127	67	105
Iceland	1 371	950	1 245	2 210	2 509	2 688	2 661	2 635	2 629	1 968
Ireland	440	482	521	519	401	341	337	250	281	261

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Flounders, halibuts, soles
Flets, flétans, soles
Platijas, halibuts, lenguados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Isle of Man	1	0	0	-	-	-	-	-	-	-
Netherlands	456	402	399	438	551	452	384	440	304	367
Norway	52	60	75	61	54	67	63	59	57	67
Portugal	-	-	3	0	0	1	1	-	-	2
Spain	4 040	408	285	1 071	1 795	2 141	2 569	3 054	3 846	3 135
Sweden	61	48	39	33	41	34	24	18	17	21
UK	4 005	2 719	2 604	2 406	2 262	2 394	2 473	2 074	2 256	2 238
27 Fishing area total	*15 479*	*10 390*	*10 422*	*11 992*	*12 239*	*12 348*	*12 709*	*11 822*	*12 623*	*11 065*
Species total	*15 479*	*10 390*	*10 422*	*11 992*	*12 239*	*12 348*	*12 709*	*11 822*	*12 623*	*11 065*
European flounder	**Flet d'Europe**		**Platija europea**		***Platichthys flesus***				**1,83(02)048,02**	**FLE**
05 Russian Fed	-	-	-	16	7	8	-	-	-	152
05 Fishing area total	-	-	-	*16*	*7*	*8*	-	-	-	*152*
27 Belgium	316	230	262	410	295	227	343	345	325	299
Denmark	6 026	5 143	3 562	4 525	3 852	3 372	2 650	2 047	1 653	1 664
Estonia	482	515	442	406	403	352	335	324	336	353
Finland	500	228	193	118	104	97	96	50	90	65
France	242	285	284	284	212	239	183	111	194	157
Germany	2 349	2 385	1 737	1 914	1 025	1 018	2 350	2 515	1 778	1 422
Ireland	18	19	43	41	5	7	5	2	1	2
Latvia	613	599	673	769	1 713	1 163	1 056	651	518	281
Lithuania	...	...	...	...	...	376	361	665	499	502
Netherlands	2 621	3 530	3 172	3 723	3 364	4 021	2 927	2 233	2 126	2 617
Norway	4	3	10	19	38	39	11	4	3	6
Poland	-	-	-	8 739	11 135	9 427	10 693	9 111	9 654	11 202
Portugal	-	6	30	17	16	14	13	8	9	11
Russian Fed	1 351	1 314	1 402	1 277	1 400	1 237	1 328	980	983	-
Spain	139	13	31	31	74	38	16	11	21	27
Sweden	467	357	270	211	310	181	193	225	222	183
UK	148	172	258	156	191	344	237	166	206	240
27 Fishing area total	*15 276*	*14 799*	*12 369*	*22 640*	*24 137*	*22 152*	*22 797*	*19 448*	*18 618*	*19 031*
37 Albania	15	3	...	37	20	27	15	17	17	34
Bulgaria	-	9	1	2	-	0	-	0	0	0
Croatia	...	...	...	...	...	...	...	...	...	2
France	8	9	6	6	7	6	4	1	1	3
Italy	...	...	...	...	284	182	121	58	79	74
Slovenia	3	2	3	3	5	2	8	4	3	6
Spain	-	8	6	0	5	3	3	2	2	1
Turkey	...	...	...	...	...	...	41	100	156	104
Ukraine	10	5	0	...	1	3	3	2	4	5
37 Fishing area total	*36*	*36*	*16*	*48*	*322*	*223*	*195*	*184*	*262*	*229*
Species total	*15 312*	*14 835*	*12 385*	*22 704*	*24 466*	*22 383*	*22 992*	*19 632*	*18 880*	*19 412*
Starry flounder	**Flet étoilé**		**...C**		***Platichthys stellatus***				**1,83(02)048,04**	**PWQ**
67 USA	45	33	41	85	102	91	37	8	58	23
67 Fishing area total	*45*	*33*	*41*	*85*	*102*	*91*	*37*	*8*	*58*	*23*
Species total	*45*	*33*	*41*	*85*	*102*	*91*	*37*	*8*	*58*	*23*
Pacific sand sole	**Plie à points noirs**		**...C**		***Psettichthys melanostictus***				**1,83(02)049,01**	**YSE**
67 USA	85	152	129	132	94	41	14	17	49	60
67 Fishing area total	*85*	*152*	*129*	*132*	*94*	*41*	*14*	*17*	*49*	*60*
77 USA	44	35	27	22	19	7	6	3	4	8
77 Fishing area total	*44*	*35*	*27*	*22*	*19*	*7*	*6*	*3*	*4*	*8*
Species total	*129*	*187*	*156*	*154*	*113*	*48*	*20*	*20*	*53*	*68*
Yellow striped flounder	**Limande-plie du Japon**		**Acedía del Japón**		***Pseudopleuronectes herzenst.***				**1,83(02)050,01**	**YFL**
61 Korea Rep	14 503	13 816	13 017	12 038	15 319	19 879	24 641	20 562	19 687	20 107
61 Fishing area total	*14 503*	*13 816*	*13 017*	*12 038*	*15 319*	*19 879*	*24 641*	*20 562*	*19 687*	*20 107*
Species total	*14 503*	*13 816*	*13 017*	*12 038*	*15 319*	*19 879*	*24 641*	*20 562*	*19 687*	*20 107*
Winter flounder	**Limande-plie rouge**		**Solla roja**		***Pseudopleuronectes americanus***				**1,83(02)050,03**	**FLW**
21 Canada	2 257	1 775	1 878	1 736	1 490	1 374	1 605	1 582	1 516	2 025
USA	6 930	5 890	5 890	4 917	3 667	2 746	2 664	2 355	2 211	1 584
21 Fishing area total	*9 187*	*7 665*	*7 768*	*6 653*	*5 157*	*4 120*	*4 269*	*3 937*	*3 727*	*3 609*
Species total	*9 187*	*7 665*	*7 768*	*6 653*	*5 157*	*4 120*	*4 269*	*3 937*	*3 727*	*3 609*
Sand flounders nei	**Rhombosoles nca**		**Sollas de arena nep**		***Rhombosolea spp***				**1,83(02)053,XX**	**FSA**
81 New Zealand	37	204	193	187	437	514	530	351	402	462
81 Fishing area total	*37*	*204*	*193*	*187*	*437*	*514*	*530*	*351*	*402*	*462*
Species total	*37*	*204*	*193*	*187*	*437*	*514*	*530*	*351*	*402*	*462*

B-31 Flounders, halibuts, soles / Flets, flétans, soles / Platijas, halibuts, lenguados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area / Espèce, Zone de pêche / Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Curlfin sole	**...B**		**Platija aleta de rizo**		***Pleuronichthys decurrens***				**1,83(02)059,02**	**NYD**
67 USA	5	4	1	1	1	0	0	0	0	0
67 Fishing area total	*5*	*4*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*0*
Species total	*5*	*4*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*0*
Righteye flounders nei	**Plies nca**		**Platijas nep**		***Pleuronectidae***				**1,83(02)XXX,XX**	**PLZ**
27 Norway	154	117	154	144	134	23	19	13	15	12
27 Fishing area total	*154*	*117*	*154*	*144*	*134*	*23*	*19*	*13*	*15*	*12*
Species total	*154*	*117*	*154*	*144*	*134*	*23*	*19*	*13*	*15*	*12*
Common sole	**Sole commune**		**Lenguado común**		***Solea solea***				**1,83(03)007,01**	**SOL**
01 Egypt	2 134	1 858	834	609	1 116	1 498	1 980	2 209	1 780	1 842
01 Fishing area total	*2 134*	*1 858*	*834*	*609*	*1 116*	*1 498*	*1 980*	*2 209*	*1 780*	*1 842*
27 Belgium	4 975	5 089	5 132	4 712	4 383	3 991	3 856	3 771	4 004	3 886
Channel Is	25	20	20	13	22	7	5	8	4	5
Denmark	1 313	1 210	1 001	1 224	1 648	1 362	982	1 109	1 049	872
France	7 644	7 115	8 656	7 973	8 152	7 914	7 852	6 918	8 951	8 053
Germany	959	771	767	967	790	519	500	549	582	563
Ireland	375	334	312	292	270	229	278	214	183	203
Isle of Man	1	0	0	0	...	...	0	0	-	-
Netherlands	13 737	12 120	12 469	12 883	10 926	8 304	10 368	9 459	9 606	8 773
Norway	88	53	129	190	89	45	13	22	5	5
Portugal	189	115	113	171	280	312	264	321	360	380
Spain	224	143	247	174	284	163	120	144	149	213
Sweden	20	15	10	16	31	38	45	36	37	46
UK	2 720	2 574	2 755	2 648	2 330	2 529	2 946	2 378	2 361	2 228
27 Fishing area total	*32 270*	*29 559*	*31 611*	*31 263*	*29 205*	*25 413*	*27 229*	*24 929*	*27 291*	*25 227*
34 Greece	82	185	117	59	25	43	42	6	3	3 F
Italy	749	384	626	567	259	206	278	167	103	108
Morocco	3 770	3 304	2 047	2 340	3 024	3 474	3 376	3 165	4 009	3 257
Portugal	12	-	11	0	-	-	0	13	25	19
34 Fishing area total	*4 613*	*3 873*	*2 801*	*2 966*	*3 308*	*3 723*	*3 696*	*3 351*	*4 140*	*3 387 F*
37 Albania	14	195	38	73	40	48	63	63	69	120
Algeria	271	377	585	271	255	213	201	241	245	116
Bulgaria	-	10	9	3	0	0	0	0	0	0
Croatia	...	...	...	...	...	...	...	...	301	238
Egypt	1 041	898	758	645	778	1 094	919	1 157	738	860
France	184	201	210	221	168	180	193	143	130	177
Greece	480	567	807	801	952	1 376	1 019	769	654	654 F
Italy	2 217	2 482	3 134	2 556	2 239	2 593	2 287	1 833	2 349	2 140
Libya	...	...	...	...	...	...	...	...	225	220 F
Malta	0	-	-	-	-	-	0	-	0	-
Morocco	18	27	45	92	50	95	89	125	98	65
Romania	9	6	13	13	9	-	-	-	-	-
Slovenia	3	4	8	7	6	6	9	7	11	8
Spain	284	327	180	220	251	248	211	240	223	245
Tunisia	456	454	486	438	498	550	521	469	448	463
Turkey	...	...	...	...	...	...	810	748	882	1 062
37 Fishing area total	*4 977*	*5 548*	*6 273*	*5 340*	*5 246*	*6 403*	*6 322*	*5 795*	*6 373*	*6 368 F*
Species total	*43 994*	*40 838*	*41 519*	*40 178*	*38 875*	*37 037*	*39 227*	*36 284*	*39 584*	*36 824 F*
Sand sole	**Sole-pole**		**Lenguado de arena**		***Solea lascaris***				**1,83(03)007,04**	**SOS**
27 Channel Is	1	1	1	2	2	1	1	2	2	1
France	153	184	181	168	200	226	370	170	237	213
Ireland	1	2	-	-	-	-	-	-	-	-
Netherlands	...	...	3	3	5	1	-	-	-	-
Portugal	142	97	98	120	139	90	53	79	138	161
UK	42	55	42	40	33	29	40	34	32	29
27 Fishing area total	*339*	*339*	*325*	*333*	*379*	*347*	*464*	*285*	*409*	*404*
Species total	*339*	*339*	*325*	*333*	*379*	*347*	*464*	*285*	*409*	*404*
Wedge sole	**Céteau**		**Acedía**		***Dicologlossa cuneata***				**1,83(03)017,01**	**CET**
27 France	579	608	877	779	545	558	624	417	506	543
Portugal	112	85	83	79	60	45	40	42	97	174
Spain	...	...	211	198	239	382	192	235	300	397
27 Fishing area total	*691*	*693*	*1 171*	*1 056*	*844*	*985*	*856*	*694*	*903*	*1 114*
34 Portugal	9	12	7	12	10	0	4	6	8	-
Spain	979	829	1 688	1 225	825	812	432	486	458	221
34 Fishing area total	*988*	*841*	*1 695*	*1 237*	*835*	*812*	*436*	*492*	*466*	*221*
37 Spain	...	...	...	7	2	3	5	3	2	1
37 Fishing area total	*...*	*...*	*...*	*7*	*2*	*3*	*5*	*3*	*2*	*1*
Species total	*1 679*	*1 534*	*2 866*	*2 300*	*1 681*	*1 800*	*1 297*	*1 189*	*1 371*	*1 336*
West coast sole	**Sole australe occidentale**		**Lenguado austral oeste**		***Austroglossus microlepis***				**1,83(03)057,01**	**SOW**
47 Angola	...	...	...	8 287	6 800 F	6 987	10 218	868	831	800 F

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Flounders, halibuts, soles
Flets, flétans, soles
Platijas, halibuts, lenguados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Namibia	589	644	746	514	586	632	839	578	765	700 F
47 Fishing area total	*589*	*644*	*746*	*8 801*	*7 386 F*	*7 619*	*11 057*	*1 446*	*1 596*	*1 500 F*
Species total	*589*	*644*	*746*	*8 801*	*7 386 F*	*7 619*	*11 057*	*1 446*	*1 596*	*1 500 F*
Mud sole	**Sole de vase**		**Lenguado de fango**		***Austroglossus pectoralis***				**1,83(03)057,02**	**SOE**
47 South Africa	844	702	754	612	485	429	332	455	569	570
47 Fishing area total	*844*	*702*	*754*	*612*	*485*	*429*	*332*	*455*	*569*	*570*
51 South Africa	-	-	-	-	-	-	-	19	-	-
51 Fishing area total	-	-	-	-	-	-	-	*19*	-	-
Species total	*844*	*702*	*754*	*612*	*485*	*429*	*332*	*474*	*569*	*570*
Southeast Atlantic soles nei	**Soles de l'Atl. sud-est nca**		**Lenguados del Atl. sudeste nep**		***Austroglossus spp***				**1,83(03)057,XX**	**SOA**
47 Korea Rep	650	492	375	493	415	432	319	225	255	260
Portugal	-	-	-	-	-	1	-	-	-	-
47 Fishing area total	*650*	*492*	*375*	*493*	*415*	*433*	*319*	*225*	*255*	*260*
Species total	*650*	*492*	*375*	*493*	*415*	*433*	*319*	*225*	*255*	*260*
Thickback soles nei	**Soles-perdix nca**		**Golletas nep**		***Microchirus spp***				**1,83(03)081,XX**	**THS**
27 France	80	139	114	198	170	125	89	47	78	65
Portugal	401	349	339	373	356	294	186	161	299	292
27 Fishing area total	*481*	*488*	*453*	*571*	*526*	*419*	*275*	*208*	*377*	*357*
Species total	*481*	*488*	*453*	*571*	*526*	*419*	*275*	*208*	*377*	*357*
Soles nei	**Soles nca**		**Lenguados nep**		***Soleidae***				**1,83(03)XXX,XX**	**SOX**
27 France	14	27	89	31	38	50	62	37	58	59
Netherlands	-	-	190	-	1	-	-	-	-	-
Norway	7	40	14	5	9	10	-	-	-	-
Portugal	430	367	428	501	412	203	97	93	79	98
27 Fishing area total	*451*	*434*	*721*	*537*	*460*	*263*	*159*	*130*	*137*	*157*
34 Congo Rep	30 F	20 F	...	...	...	...	...	-	-	-
Ghana	-	-	-	247	296	582	639	1 881	1 171	435
Korea Rep	-	-	-	-	362	647	803	788	117	-
Liberia	206	210	200	217	60	50	344	302	300 F	300 F
Mauritania	...	...	...	...	...	...	...	...	...	57
Nigeria	3 171	2 507	4 655	2 045	2 051	1 966	2 485	3 316	3 372	3 876
Portugal	73	78	74	187	199	307	14	56	244	62
Spain	4 297	-	-	310	584	651	576	470	590	484
Togo	19	13	7	23	30	14	9	20 F	28	49
34 Fishing area total	*7 796 F*	*2 828 F*	*4 936*	*3 029*	*3 582*	*4 217*	*4 870*	*6 833 F*	*5 822 F*	*5 263 F*
37 France	12	18	14	19	19	6	5	3	1	-
Italy	...	...	...	...	510	85	48	32	61	57
37 Fishing area total	*12*	*18*	*14*	*19*	*529*	*91*	*53*	*35*	*62*	*57*
Species total	*8 259 F*	*3 280 F*	*5 671*	*3 585*	*4 571*	*4 571*	*5 082*	*6 998 F*	*6 021 F*	*5 477 F*
Tonguefishes	**Cynoglossidés**		**Cinoglósidos**		***Cynoglossidae***				**1,83(04)XXX,XX**	**TOX**
31 Korea Rep	20	-	-	-	-	-	4	25	-	-
31 Fishing area total	*20*	-	-	-	-	-	*4*	*25*	-	-
34 Cameroon	439	788	750	500 F	155	135	135	225 F	315	315 F
Congo Dem R	100 F	100 F	100 F	110 F	110 F	120 F	120	120 F	120 F	120 F
Congo Rep	300 F	370 F	443	437	353	276	356	167	509	529
Côte dIvoire	197	237	165	75	80	74	40	30 F	25	118
Gabon	538	545	583	593	537	400	...	...	...	...
Gambia	2 262	586	614	842	2 001	1 372	1 294	866	879	...
Ghana	227	144	159	31	82	263	831	542	1 275	988
Korea Rep	1 956	1 279	1 125	1 058	712	549	344	168	1 029	1 373
Mauritania	...	...	...	...	...	...	...	...	...	104
Nigeria	6 655	7 493	6 931	6 187	8 790	7 971	8 961	7 375	6 290	8 193
Portugal	-	-	-	-	26	27	23	27	10	5
Sierra Leone	500	654	1 234	1 047	1 146	952	1 160	1 252	1 230 F	1 230 F
34 Fishing area total	*13 174 F*	*12 196 F*	*12 104 F*	*10 880 F*	*13 992 F*	*12 139 F*	*13 264*	*10 772 F*	*11 682 F*	*12 975 F*
41 Korea Rep	-	-	-	-	-	38	-	-	-	-
41 Fishing area total	-	-	-	-	-	*38*	-	-	-	-
47 South Africa	10	17	28	42	34	22	13	9	4	18
47 Fishing area total	*10*	*17*	*28*	*42*	*34*	*22*	*13*	*9*	*4*	*18*
51 Korea Rep	1	9	14	5	-	-	-	-	-	-
Pakistan	1 915	1 980	1 369	979	907	906	909	1 002	1 010	1 025
South Africa	7	...	...	0	0	1	-	-	1	-
51 Fishing area total	*1 923*	*1 989*	*1 383*	*984*	*907*	*907*	*909*	*1 002*	*1 011*	*1 025*
57 Malaysia	1 551	1 696	1 302	1 833	1 600	3 502	4 715	3 424	2 734	2 143
Thailand	9 776	11 998	6 775	6 621	3 276	3 687	3 526	2 357	2 273	2 315
57 Fishing area total	*11 327*	*13 694*	*8 077*	*8 454*	*4 876*	*7 189*	*8 241*	*5 781*	*5 007*	*4 458*

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Flounders, halibuts, soles
Flets, flétans, soles
Platijas, halibuts, lenguados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
61 China,H.Kong	1 100 F	1 050 F	1 000 F	1 050 F	1 020 F	970 F	970 F	1 000 F	1 010 F	1 065 F
Korea Rep	1 013	585	730	803	1 396	1 887	1 979	1 482	1 430	1 477
61 Fishing area total	*2 113 F*	*1 635 F*	*1 730 F*	*1 853 F*	*2 416 F*	*2 857 F*	*2 949 F*	*2 482 F*	*2 440 F*	*2 542 F*
71 Korea Rep	79	59	80	119	103	59	24	19	-	23
Malaysia	866	896	936	969	1 127	1 340	1 396	1 452	1 200	1 152
Thailand	4 966	6 638	5 997	3 944	3 920	3 561	2 463	1 989	2 049	2 019
71 Fishing area total	*5 911*	*7 593*	*7 013*	*5 032*	*5 150*	*4 960*	*3 883*	*3 460*	*3 249*	*3 194*
81 Korea Rep	-	3	-	-	-	-	-	-	-	-
81 Fishing area total	-	*3*	-	-	-	-	-	-	-	-
Species total	*34 478 F*	*37 127 F*	*30 335 F*	*27 245 F*	*27 375 F*	*28 112 F*	*29 263 F*	*23 531 F*	*23 393 F*	*24 212 F*
Megrim	**Cardine franche**		**Gallo del Norte**		***Lepidorhombus whiffiagonis***				**1,83(05)003,01**	**MEG**
27 Belgium	87	80	167	223	157	103	205	171	212	278
Channel Is	1	0	-	-	-	-	-	-	-	-
Denmark	55	8	11	7	2	6	12	31	54	24
France	4 000	3 227	3 244	2 656	2 968	2 850	2 873	2 342	3 223	3 707
Germany	1	0	5	2	4	7	4	1	-	-
Iceland	96	78	73	123	148	284	187	197	-	252
Ireland	3 713	2 848	2 679	2 612	2 417	2 071	2 028	1 757	2 167	2 719
Netherlands	11	8	7	11	19	22	20	3	1	8
Norway	-	-	-	-	-	1	1	4	6	2
Portugal	22	26	48	126	114	56	76	113	134	100
Spain	-	-	-	-	-	103	-	-	-	-
UK	4 672	4 418	4 088	3 711	3 329	3 534	3 972	4 350	4 959	4 854
27 Fishing area total	*12 658*	*10 693*	*10 322*	*9 471*	*9 158*	*9 037*	*9 378*	*8 969*	*10 756*	*11 944*
34 Spain	52	10	733	1	282	247	247	197	283	270
34 Fishing area total	*52*	*10*	*733*	*1*	*282*	*247*	*247*	*197*	*283*	*270*
37 Albania	1	6	0	2	7	5	11	29	28	15
Croatia	...	...	...	...	...	...	...	...	34	31
France	125	121	132	145	92	72	64	43	44	42
Spain	79	63	34	71	92	122	122	138	144	139
37 Fishing area total	*205*	*190*	*166*	*218*	*191*	*199*	*197*	*210*	*250*	*227*
Species total	*12 915*	*10 893*	*11 221*	*9 690*	*9 631*	*9 483*	*9 822*	*9 376*	*11 289*	*12 441*
Four-spot megrim	**Cardine à quatre taches**		**Gallo de cuatro manchas**		***Lepidorhombus boscii***				**1,83(05)003,02**	**LDB**
27 Portugal	5	6	12	8	14	16	40	43	45	23
Spain	-	-	-	-	-	38	-	-	-	-
UK	-	-	-	-	-	-	0	0	2	-
27 Fishing area total	*5*	*6*	*12*	*8*	*14*	*54*	*40*	*43*	*47*	*23*
Species total	*5*	*6*	*12*	*8*	*14*	*54*	*40*	*43*	*47*	*23*
Megrims nei	**Cardines nca**		**Gallos nep**		***Lepidorhombus spp***				**1,83(05)003,XX**	**LEZ**
27 Germany	-	-	-	-	-	-	12	5	4	4
Spain	8 161	6 277	8 557	8 831	7 911	6 905	5 071	6 525	6 095	5 230
27 Fishing area total	*8 161*	*6 277*	*8 557*	*8 831*	*7 911*	*6 905*	*5 083*	*6 530*	*6 099*	*5 234*
Species total	*8 161*	*6 277*	*8 557*	*8 831*	*7 911*	*6 905*	*5 083*	*6 530*	*6 099*	*5 234*
Brill	**Barbue**		**Rémol**		***Scophthalmus rhombus***				**1,83(05)064,01**	**BLL**
27 Belgium	491	448	478	419	391	390	419	360	335	350
Channel Is	17	16	14	15	21	15	11	13	10	11
Denmark	162	148	197	243	249	236	234	318	274	263
France	464	515	518	501	489	514	556	338	510	591
Germany	65	60	74	71	67	60	56	55	66	87
Ireland	95	99	112	130	125	109	85	73	67	72
Isle of Man	0	0	0	-	-	-	-	-	-	-
Netherlands	1 093	908	937	779	721	771	858	653	788	1 074
Norway	26	22	24	34	45	28	25	23	17	13
Portugal	57	47	40	51	50	35	19	26	33	50
Spain	23	9	10	20	13	25	19	23	26	27
Sweden	13	12	16	18	13	15	22	30	33	16
UK	535	475	506	485	392	393	429	359	333	405
27 Fishing area total	*3 041*	*2 759*	*2 926*	*2 766*	*2 576*	*2 591*	*2 733*	*2 271*	*2 492*	*2 959*
37 France	26	30	27	35	27	29	27	23	21	24
Spain	-	-	-	24	28	24	9	10	16	16
37 Fishing area total	*26*	*30*	*27*	*59*	*55*	*53*	*36*	*33*	*37*	*40*
Species total	*3 067*	*2 789*	*2 953*	*2 825*	*2 631*	*2 644*	*2 769*	*2 304*	*2 529*	*2 999*
Windowpane flounder	**Turbot de sable**		**Rodaballo arenero**		***Scophthalmus aquosus***				**1,83(05)064,02**	**FLD**
21 USA	177	98	64	86	89	103	200	121	81	54
21 Fishing area total	*177*	*98*	*64*	*86*	*89*	*103*	*200*	*121*	*81*	*54*
Species total	*177*	*98*	*64*	*86*	*89*	*103*	*200*	*121*	*81*	*54*

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Flounders, halibuts, soles
Flets, flétans, soles
Platijas, halibuts, lenguados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Turbot	**Turbot**		**Rodaballo**		***Psetta maxima***				**1,83(05)092,01**	**TUR**
27 Belgium	506	445	451	415	367	373	406	357	384	334
Channel Is	9	6	8	14	18	7	3	3	4	10
Denmark	864	994	700	737	647	522	543	700	800	676
Faroe Is	0	1	7	1	1	1	0	-	1	1
Finland	4	3	3	3	1	3	1	1	1	3
France	624	643	716	721	703	642	660	453	670	760
Germany	363	343	353	343	334	288	282	261	283	251
Iceland	0	0	0	-	-	-	-	-	-	-
Ireland	185	183	231	321	215	198	194	171	132	160
Isle of Man	0	-	4	-	-	-	-	-	0	0
Latvia	6	9	9	8	7	6	2	2	1	10
Lithuania	18	18	13	8	18	10	12	10	10	10
Netherlands	2 277	1 899	1 908	1 778	1 915	1 839	2 279	1 751	1 704	1 478
Norway	94	99	84	86	77	55	58	44	41	37
Poland	-	-	-	43	76	99	91	111	103	101
Portugal	83	69	62	67	73	53	31	29	44	72
Russian Fed	69	50	28	15	28	-	30	21	10	3
Spain	108	35	36	31	40	44	41	50	41	55
Sweden	64	55	41	33	41	40	40	55	50	46
UK	1 001	1 067	868	822	633	635	754	653	682	729
27 Fishing area total	*6 275*	*5 919*	*5 522*	*5 446*	*5 194*	*4 815*	*5 427*	*4 672*	*4 961*	*4 736*
34 Morocco	49	86	118	94	73	76	61	63	57	58
34 Fishing area total	*49*	*86*	*118*	*94*	*73*	*76*	*61*	*63*	*57*	*58*
37 Albania	...	...	3	2	3	3	10	7	12	...
Bulgaria	57	136	41	16	13	15	67	55	52	46
Croatia	...	...	...	...	...	...	...	...	14	15
France	15	17	18	23	15	12	8	4	7	8
Greece	77	75	75	54	71	48	81	106	91	91 F
Morocco	-	-	0	2	-	0	0	0	1	1
Romania	13	17	24	42	37	32	57	47	49	48
Slovenia	-	-	1	-	-	0	1	1	1	1
Spain	14	8	6	6	10	6	4	5	8	5
Turkey	2 455	459	300	376	649	807	769	528	383	295
Ukraine	171	157	199	168	188	245	279	261	272	215
37 Fishing area total	*2 802*	*869*	*667*	*689*	*986*	*1 168*	*1 276*	*1 014*	*890*	*725 F*
Species total	*9 126*	*6 874*	*6 307*	*6 229*	*6 253*	*6 059*	*6 764*	*5 749*	*5 908*	*5 519 F*
Turbots nei	**Turbots nca**		**Rodaballos nep**		***Scophthalmidae***				**1,83(05)XXX,XX**	**SCF**
37 Italy	622	482	610	561	445	749	1 179	916	794	848
37 Fishing area total	*622*	*482*	*610*	*561*	*445*	*749*	*1 179*	*916*	*794*	*848*
Species total	*622*	*482*	*610*	*561*	*445*	*749*	*1 179*	*916*	*794*	*848*
Citharids nei	**Feuilles nca**		**Solletas nep**		***Citharidae***				**1,83(06)XXX,XX**	**CIT**
34 Morocco	143	139	366	238	501	511	442	551	657	207
34 Fishing area total	*143*	*139*	*366*	*238*	*501*	*511*	*442*	*551*	*657*	*207*
37 Morocco	27	36	53	68	51	26	30	51	51	2
37 Fishing area total	*27*	*36*	*53*	*68*	*51*	*26*	*30*	*51*	*51*	*2*
Species total	*170*	*175*	*419*	*306*	*552*	*537*	*472*	*602*	*708*	*209*
Indian halibut	**Turbot épineux-indien**		**Lenguado espinudo-indio**		***Psettodes erumei***				**1,83(07)001,01**	**HAI**
51 Iran	1 932	1 858	1 715	2 243	3 180	2 536	3 671	3 942	2 871	2 943
Tanzania	75	60	50	50	52	955	629	603	507	727
Yemen	430 F	550 F	600 F	650 F	560 F	700 F	750 F	430 F	615 F	800 F
51 Fishing area total	*2 437 F*	*2 468 F*	*2 365 F*	*2 943 F*	*3 792 F*	*4 191 F*	*5 050 F*	*4 975 F*	*3 993 F*	*4 470 F*
57 Indonesia	7 012	7 705	8 162	6 056	7 384	8 469	7 140	7 195	5 967	6 075
Thailand	397	414	1 405	1 303	2 535	2 761	1 766	1 220	1 257	1 239
57 Fishing area total	*7 409*	*8 119*	*9 567*	*7 359*	*9 919*	*11 230*	*8 906*	*8 415*	*7 224*	*7 314*
71 Indonesia	4 361	5 133	8 082	8 753	7 473	6 839	5 909	10 983	11 284	10 623
Thailand	752	942	1 253	1 759	2 138	1 802	1 580	1 000	1 002	1 001
71 Fishing area total	*5 113*	*6 075*	*9 335*	*10 512*	*9 611*	*8 641*	*7 489*	*11 983*	*12 286*	*11 624*
Species total	*14 959 F*	*16 662 F*	*21 267 F*	*20 814 F*	*23 322 F*	*24 062 F*	*21 445 F*	*25 373 F*	*23 503 F*	*23 408 F*
Spottail spiny turbot	**Turbot épineux tacheté**		**Perro**		***Psettodes belcheri***				**1,83(07)001,02**	**SOT**
34 Togo	2	2	0	1	0	-	-	-	-	-
34 Fishing area total	*2*	*2*	*0*	*1*	*0*	-	-	-	-	-
Species total	*2*	*2*	*0*	*1*	*0*	-	-	-	-	-
Pacific sanddab	**Cardine de Californie**		**Lenguado moteado**		***Citharichthys sordidus***				**1,83(08)009,02**	**IYO**
67 USA	-	-	108	143	113	296	125	69	176	90
67 Fishing area total	-	-	*108*	*143*	*113*	*296*	*125*	*69*	*176*	*90*
Species total	-	-	*108*	*143*	*113*	*296*	*125*	*69*	*176*	*90*

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Flounders, halibuts, soles
Flets, flétans, soles
Platijas, halibuts, lenguados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Bastard halibut	**Cardeau hirame**		**Falso halibut del Japón**		***Paralichthys olivaceus***				**1,83(08)046,01**	**BAH**
61 Japan	6 729	6 680	6 446	5 917	6 095	7 388	8 136	7 500	7 218	7 700 F
Korea Rep	1 707	1 822	1 801	1 737	2 112	2 298	3 074	4 263	5 439	6 035
61 Fishing area total	*8 436*	*8 502*	*8 247*	*7 654*	*8 207*	*9 686*	*11 210*	*11 763*	*12 657*	*13 735 F*
Species total	*8 436*	*8 502*	*8 247*	*7 654*	*8 207*	*9 686*	*11 210*	*11 763*	*12 657*	*13 735 F*
California flounder	**Cardeau californien**		**Lenguado de California**		***Paralichthys californicus***				**1,83(08)046,03**	**YSF**
67 USA	4	4	0	0	0	0	0	1	0	-
67 Fishing area total	*4*	*4*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	-
77 USA	389	424	379	456	422	327	177	214	284	239
77 Fishing area total	*389*	*424*	*379*	*456*	*422*	*327*	*177*	*214*	*284*	*239*
Species total	*393*	*428*	*379*	*456*	*422*	*327*	*177*	*215*	*284*	*239*
Summer flounder	**Cardeau d'été**		**Falso halibut del Canadá**		***Paralichthys dentatus***				**1,83(08)046,06**	**FLS**
21 USA	5 350	6 776	6 399	8 701	8 347	7 000	5 026	4 860	5 648	6 337
21 Fishing area total	*5 350*	*6 776*	*6 399*	*8 701*	*8 347*	*7 000*	*5 026*	*4 860*	*5 648*	*6 337*
31 USA	1 204	639	653	8	8	9	8	7	4	-
31 Fishing area total	*1 204*	*639*	*653*	*8*	*8*	*9*	*8*	*7*	*4*	-
Species total	*6 554*	*7 415*	*7 052*	*8 709*	*8 355*	*7 009*	*5 034*	*4 867*	*5 652*	*6 337*
Fourspot flounder	**...B**		**...C**		***Paralichthys oblongus***				**1,83(08)046,07**	**YSO**
21 USA	...	...	...	...	...	...	7	10	6	8
21 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*7*	*10*	*6*	*8*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*7*	*10*	*6*	*8*
Bastard halibuts nei	**Cardeaux nca**		**Falsos halibuts nep**		***Paralichthys spp***				**1,83(08)046,XX**	**BAX**
31 USA	...	708	441	475	334	399	379	468	444	398
31 Fishing area total	*...*	*708*	*441*	*475*	*334*	*399*	*379*	*468*	*444*	*398*
41 Argentina	5 944	4 297	5 805	6 246	7 073	7 921	7 559	8 054	7 335	7 247
Brazil	2 317	3 300	2 798	2 173	2 594	2 411	2 566	2 550	2 813	2 658
Uruguay	307	400	278	291	190	160	205	236	...	248
41 Fishing area total	*8 568*	*7 997*	*8 881*	*8 710*	*9 857*	*10 492*	*10 330*	*10 840*	*10 148*	*10 153*
Species total	*8 568*	*8 705*	*9 322*	*9 185*	*10 191*	*10 891*	*10 709*	*11 308*	*10 592*	*10 551*
Antarctic armless flounder	**Mancoglosse antarctique**		**Mancolenguado antártico**		***Mancopsetta maculata***				**1,83(10)002,01**	**MMM**
48 UK	-	-	-	-	-	-	0	0	0	0
48 Fishing area total	-	-	-	-	-	-	*0*	*0*	*0*	*0*
Species total	-	-	-	-	-	-	*0*	*0*	*0*	*0*
Flatfishes nei	**Poissons plats nca**		**Peces planos nep**		***Pleuronectiformes***				**1,83(XX)XXX,XX**	**FLX**
04 Kazakhstan	...	117	34	32	71	686	555	357	388	575
04 Fishing area total	*...*	*117*	*34*	*32*	*71*	*686*	*555*	*357*	*388*	*575*
21 Canada	617	233	275	233	195	295	396	332	405	470
Faroe Is	-	-	-	-	-	-	-	2	85	4
Japan	268	2 920	2 603	1 468	1 311	940	815	-	-	-
Portugal	-	118	2	-	1	0	-	-	-	-
Russian Fed	-	-	-	-	-	-	-	-	-	2
Spain	-	-	-	-	-	5	-	-	-	-
USA	5	3	3	6	4	10	1	1	0	-
21 Fishing area total	*890*	*3 274*	*2 883*	*1 707*	*1 511*	*1 250*	*1 212*	*335*	*490*	*476*
27 Faroe Is	60	138	26	22	44	26	77	246	8	5
France	1 851	2 563	8	4	26	33	23	22	29	34
Germany	-	3	0	0	726	697	92	1	1	-
Iceland	2	1	1	-	-	1	0	-	-	-
Ireland	15	14	-	-	-	-	-	-	-	-
Lithuania	1 137	1 082	1 102	901	949	-	-	-	-	-
Poland	6 725	9 232	7 343	-	-	-	-	-	-	-
Portugal	-	-	-	-	-	-	0	0	-	-
Russian Fed	-	13	-	-	-	-	75	9	107	25
Spain	653	657	4 916	214	217	256	602	364	313	365
Sweden	-	-	-	1	2	1	1	1	0	-
UK	171	138	108	91	75	46	34	27	26	28
27 Fishing area total	*10 614*	*13 841*	*13 504*	*1 233*	*2 039*	*1 060*	*904*	*670*	*484*	*457*
31 Fr Guiana	...	...	...	...	...	...	...	...	3	3 F
Mexico	175	263	201	217	178	186	144	110	106	3 226
USA	296	312	283	294	250	210	195	153	148	101
31 Fishing area total	*471*	*575*	*484*	*511*	*428*	*396*	*339*	*263*	*257*	*3 330 F*
34 Benin	14	22	42	53	33	35	28	43	47	4

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Flounders, halibuts, soles
Flets, flétans, soles
Platijas, halibuts, lenguados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	China	...	1 881	963	...	460	465	1 873	674	...	...
	Comoros	-	-	-	-	-	-	-	94	...	...
	Eq Guinea	40 F	40 F	40 F	45 F	45 F	54 F	50	100	100	150
	Gabon	216	172	177	114	151	97	443	295	200 F	200 F
	Guinea	914	483	462	270	1 680	469	417	368	360 F	360 F
	GuineaBissau	38	117	156	150 F	138 F	135 F	130 F	145 F	145 F	145 F
	Italy	117	115	129	122	49	54	-	-	-	-
	Korea Rep	-	9	227	238	52	-	-	14	27	22
	Mauritania	300 F	250 F	120 F	170 F	190 F	100 F	130 F	120 F	130 F	34
	Morocco	5 832	4 960	6 873	5 133	5 518	4 646	3 771	4 332	5 605	3 796
	Portugal	1	2	2	2	1	-	0	-	-	1
	Russian Fed	-	190	-	-	-	-	-	-	-	-
	Senegal	9 059	7 262	8 382	3 865	3 563	3 433	3 781	...	...	822
	Spain	6 938	9 239	319	62	8 466	5 241	514	4 187	386	306
34	*Fishing area total*	*23 469 F*	*24 742 F*	*17 892 F*	*10 224 F*	*20 346 F*	*14 729 F*	*11 137 F*	*10 372 F*	*7 000 F*	*5 840 F*
37	Albania	-	-	29	2	2	4	-	-	-	-
	Croatia	111	106	169	153	210	192	274	133	-	-
	France	4	7	5	4	5	3	13	31	49	72
	Georgia	11	11	1	7	5 F	...	...	...	...	...
	Lebanon	15	8	8	8	8	9	9 F	9 F	9 F	9 F
	Morocco	12	9	9	30	12	8	6	15	13	77
	Palest, O.T.	10 F	6	5	5	7	4	1	1	1	0
	Russian Fed	25	15	15	2	15	10	7	5	22	35
	Serbia-Monte	11	10	10	9	...	-	-	-	-	-
	Spain	528	621	159	531	505	483	455	549	625	548
	Tunisia	205	194	316	230	79	83	78	85	85	80
	Turkey	1 250	585	410	624	1 190	937	-	-	-	-
37	*Fishing area total*	*2 182 F*	*1 572*	*1 136*	*1 605*	*2 038 F*	*1 733*	*843 F*	*828 F*	*804 F*	*821 F*
41	Korea Rep	-	-	-	39	17	-	-	-	-	-
	Spain	4	23	-	0	-	-	-	-	9	2
	UK	-	5	-	-	-	-	-	-	0	-
41	*Fishing area total*	*4*	*28*	-	*39*	*17*	-	-	-	*9*	*2*
47	Angola	1 928	3 463	3 069	2 636	2 000 F	1 336	12 275	3 762	3 479	3 350 F
	Russian Fed	-	2	-	-	-	-	-	-	-	-
47	*Fishing area total*	*1 928*	*3 465*	*3 069*	*2 636*	*2 000 F*	*1 336*	*12 275*	*3 762*	*3 479*	*3 350 F*
51	Egypt	-	-	-	-	-	-	-	22	21	-
	India	11 486	15 570	15 917	13 594	13 580	14 601	22 747	17 697	21 553	13 322
	Korea Rep	3	3	7	1	2	-	1	-	2	-
	UK	-	-	-	-	-	9	14	-	-	-
51	*Fishing area total*	*11 489*	*15 573*	*15 924*	*13 595*	*13 582*	*14 610*	*22 762*	*17 719*	*21 576*	*13 322*
57	Australia	-	-	-	1	2	3	1	1	1	1
	India	3 145	4 493	5 453	5 715	5 574	5 964	10 812	9 677	9 778	18 957
	Indonesia	3 300	3 462	4 352	5 624	4 942	4 836	5 837	6 413	6 939	6 564
	Malaysia	485	394	332	343	557	1 055	908	1 171	1 958	1 757
57	*Fishing area total*	*6 930*	*8 349*	*10 137*	*11 683*	*11 075*	*11 858*	*17 558*	*17 262*	*18 676*	*27 279*
61	China,Taiwan	198	172	206	288	280	370	395	382	449	277
	Japan	60 713	60 892	58 894	54 100	52 902	54 604	55 095	55 846	51 100 F	48 800 F
	Korea D P Rp	3 800 F	3 800 F	3 800 F	3 800 F	3 800 F	3 800 F	3 800 F	3 800 F	3 800 F	3 800 F
	Korea Rep	-	-	-	-	0	-	-	-	-	-
	Russian Fed	95 106	79 814	81 742	67 535	87 070	67 110	71 769	59 755	83 845	71 662
61	*Fishing area total*	*159 817 F*	*144 678 F*	*144 642 F*	*125 723 F*	*144 052 F*	*125 884 F*	*131 059 F*	*119 783 F*	*139 194 F*	*124 539 F*
67	Canada	5 459	6 711	6 114	6 111	5 868	5 400	5 323	4 188	5 940	4 437
	USA	4 703	5 531	877	1 438	1 635	4 434	5 849	10 048	11 073	12 681
67	*Fishing area total*	*10 162*	*12 242*	*6 991*	*7 549*	*7 503*	*9 834*	*11 172*	*14 236*	*17 013*	*17 118*
71	Indonesia	3 450	2 913	2 257	1 999	1 674	1 247	1 619	1 243	1 616	1 751
	Korea Rep	-	-	-	-	-	2	-	-	-	-
	Malaysia	1 227	1 198	1 272	1 389	1 200	1 375	1 149	1 112	1 005	1 225
	Philippines	756	836	878	822	784	855	895	983	920	861
71	*Fishing area total*	*5 433*	*4 947*	*4 407*	*4 210*	*3 658*	*3 479*	*3 663*	*3 338*	*3 541*	*3 837*
77	Guatemala	...	...	...	...	...	...	82	...	...	...
	Mexico	1 664	1 573	1 907	2 068	2 033	2 123	2 785	2 814	2 950	3 384
	Nicaragua	33	25	24	23	29	10	42	3	36	254
	USA	686	379	511	276	165	118	142	115	111	79
77	*Fishing area total*	*2 383*	*1 977*	*2 442*	*2 367*	*2 227*	*2 251*	*3 051*	*2 932*	*3 097*	*3 717*
81	Australia	14	8	9	9	14	9	0	-	-	-
	Korea Rep	-	-	-	-	-	-	-	-	-	5
	New Zealand	3 220	2 572	2 977	2 720	3 417	2 693	3 015	2 602	2 545	2 290
81	*Fishing area total*	*3 234*	*2 580*	*2 986*	*2 729*	*3 431*	*2 702*	*3 015*	*2 602*	*2 545*	*2 295*
87	Chile	76	12	51	93	101	76	48	95	102	55
	Colombia	171	79	82	7	32	60 F	90 F	120 F	145	270
	Peru	313	256	466	413	243	302	204	153	234	288
87	*Fishing area total*	*560*	*347*	*599*	*513*	*376*	*438 F*	*342 F*	*368 F*	*481*	*613*
Species total		*239 566 F*	*238 307 F*	*227 130 F*	*186 356 F*	*214 354 F*	*192 246 F*	*219 887 F*	*194 827 F*	*219 034 F*	*207 571 F*
Group total		***947 965***	***920 061***	***920 036***	***862 674***	***900 497***	***875 355***	***916 106***	***945 937***	***924 564***	***955 350***

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Cods, hakes, haddocks
Morues, merlus, églefins
Bacalaos, merluzas, eglefinos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Smalleye moray cod	**Gadomurène petit oeil**		**Gadimorena ojichica**		***Muraenolepis microps***				**1,48(01)001,01**	**MOY**
48 UK	-	0	-	-	-	-	0	0	0	0
48 Fishing area total	*-*	*0*	*-*	*-*	*-*	*-*	*0*	*0*	*0*	*0*
58 Australia	-	-	-	0	-	-	-	-	-	-
South Africa	0	-	-	0	0	-	-	-	-	-
58 Fishing area total	*0*	*-*	*-*	*0*	*0*	*-*	*-*	*-*	*-*	*-*
88 Korea Rep	-	-	-	0	-	-	0	0	0	...
New Zealand	...	1	1	1	1	0	0	0	0	-
South Africa	0	-	-	2	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	0	1
88 Fishing area total	*0*	*1*	*1*	*3*	*1*	*0*	*0*	*0*	*0*	*1*
Species total	*0*	*1*	*1*	*3*	*1*	*0*	*0*	*0*	*0*	*1*
Moray cods nei	**Gadomurènes nca**		**Gadimorenas nep**		***Muraenolepis spp***				**1,48(01)001,XX**	**MRL**
48 Chile	-	-	-	-	0	-	-	-	-	-
UK	-	-	-	-	-	-	0	0	0	0
48 Fishing area total	*-*	*-*	*-*	*-*	*0*	*-*	*0*	*0*	*0*	*0*
58 Namibia	-	-	-	-	-	-	0	-	-	-
South Africa	0	-	0	-	0	-	-	-	-	-
58 Fishing area total	*0*	*-*	*0*	*-*	*0*	*-*	*0*	*-*	*-*	*-*
88 Argentina	-	-	-	0	-	1	3	-	-	-
Chile	-	-	-	-	-	-	-	-	1	-
Korea Rep	-	-	-	0	-	-	0	-	0	...
New Zealand	3	5	1	2	2	1	3	2	3	3
Norway	-	-	-	7	2	-	13	-	-	-
South Africa	-	-	-	-	-	-	0	0	1	-
Ukraine	-	-	-	0	-	-	-	-	-	-
UK	-	-	-	0	-	-	1	5	2	4
Uruguay	-	-	-	0	2	3	1	0	2	-
88 Fishing area total	*3*	*5*	*1*	*9*	*6*	*5*	*21*	*7*	*9*	*7*
Species total	*3*	*5*	*1*	*9*	*6*	*5*	*21*	*7*	*9*	*7*
Common mora	**Moro commun**		**Mollera moranella**		***Mora moro***				**1,48(02)010,01**	**RIB**
27 France	1	39	58	33	40	116	84	76	89	90
Ireland	32	44	45	27	25	28	20	-	-	-
Portugal	-	99	125	87	70	92	90	53	68	55
27 Fishing area total	*33*	*182*	*228*	*147*	*135*	*236*	*194*	*129*	*157*	*145*
81 New Zealand	1 209	1 308	1 234	1 395	1 154	986	1 180	1 088	1 153	971
Ukraine	2	-	-	8	...	-	-	-	-	-
81 Fishing area total	*1 211*	*1 308*	*1 234*	*1 403*	*1 154*	*986*	*1 180*	*1 088*	*1 153*	*971*
Species total	*1 244*	*1 490*	*1 462*	*1 550*	*1 289*	*1 222*	*1 374*	*1 217*	*1 310*	*1 116*
Red codling	**Morue rouge**		**Brotolilla**		***Pseudophycis bachus***				**1,48(02)014,01**	**NEC**
81 Japan	22	20	38	-	-	-	-	-	-	-
New Zealand	4 454	4 414	8 161	9 515	8 165	5 854	5 854	6 122	4 636	5 554
Ukraine	50	9	66	25	...	-	-	-	-	-
81 Fishing area total	*4 526*	*4 443*	*8 265*	*9 540*	*8 165*	*5 854*	*5 854*	*6 122*	*4 636*	*5 554*
Species total	*4 526*	*4 443*	*8 265*	*9 540*	*8 165*	*5 854*	*5 854*	*6 122*	*4 636*	*5 554*
Grenadier cod	**...B**		**...C**		***Tripterophycis gilchristi***				**1,48(02)019,01**	**TPG**
81 New Zealand	2	7	10	13	13	43	29	26	0	0
81 Fishing area total	*2*	*7*	*10*	*13*	*13*	*43*	*29*	*26*	*0*	*0*
Species total	*2*	*7*	*10*	*13*	*13*	*43*	*29*	*26*	*0*	*0*
Blue antimora	**Antimora bleu**		**Mollera azul**		***Antimora rostrata***				**1,48(02)030,01**	**ANT**
21 Spain	-	0	7	12	10	-	4	2	-	-
21 Fishing area total	*-*	*0*	*7*	*12*	*10*	*-*	*4*	*2*	*-*	*-*
41 Falkland Is	-	-	-	24	18	12	7	14	10	12
Ukraine	-	-	-	-	-	-	2	21	-	-
41 Fishing area total	*-*	*-*	*-*	*24*	*18*	*12*	*9*	*35*	*10*	*12*
47 Japan	-	-	-	-	-	9	-	-	-	-
47 Fishing area total	*-*	*-*	*-*	*-*	*-*	*9*	*-*	*-*	*-*	*-*
48 Chile	-	-	-	-	1	1	1	1	0	0
Japan	-	-	-	-	-	3	1	0	1	0
Korea Rep	-	-	-	1	0	0	0	0	0	0
New Zealand	-	-	1	-	-	5	4	4	3	2
Russian Fed	0	-	-	-	-	-	-	-	-	-
South Africa	-	-	2	-	0	0	0	2	1	0
Spain	-	-	-	-	-	1	1	5	3	2
UK	-	-	1	6	18	25	19	25	24	12

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Cods, hakes, haddocks
Morues, merlus, églefins
Bacalaos, merluzas, eglefinos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Uruguay	-	-	-	1	-	2	2	0	2	0
48 Fishing area total	*0*	*-*	*4*	*8*	*19*	*37*	*28*	*37*	*34*	*16*
58 Australia	-	-	0	1	2	0	0	1	5	1
France	-	-	-	-	97	108	-	132	122	137
Japan	-	-	-	-	-	-	1	3	3	1
Namibia	-	-	-	-	-	-	0	0	-	-
South Africa	3	2	0	0	4	1	4	5	1	1
Spain	-	-	-	-	2	1	1	0	-	-
58 Fishing area total	*3*	*2*	*0*	*1*	*105*	*110*	*6*	*141*	*131*	*140*
88 Argentina	-	-	-	1	-	1	2	0	-	-
Korea Rep	-	-	-	0	-	-	0	0	0	0
New Zealand	3	3	7	9	4	2	2	2	1	1
Norway	-	-	-	2	1	-	2	-	-	-
Russian Fed	-	-	-	0	0	0	1	0	-	-
South Africa	1	-	0	0	-	-	-	0	4	-
Spain	-	-	-	-	-	-	-	0	0	1
Ukraine	-	-	-	1	-	-	-	-	-	-
UK	-	-	-	-	7	-	2	1	3	5
Uruguay	-	-	-	3	0	-	1	0	-	-
88 Fishing area total	*4*	*3*	*7*	*16*	*12*	*3*	*10*	*3*	*8*	*7*
Species total	*7*	*5*	*18*	*61*	*164*	*171*	*57*	*218*	*183*	*175*
Tadpole codling	**More têtard**		**Bacalao criollo**		***Salilota australis***				**1,48(02)040,01**	**SAO**
41 Argentina	4 449	3 129	5 689	4 664	3 186	2 952	4 610	8 010	6 963	6 808
Belize	42	-	-	-	-	-	-	-	-	-
Estonia	-	-	-	-	-	32	-	-	-	1
Falkland Is	1 379	959	970	1 032	748	1 049	1 127	901	1 308	802
Japan	-	-	-	-	-	-	1	-	-	-
Korea Rep	219	28	40	85	124	60	49	17	11	19
Namibia	-	-	-	7	-	-	-	-	-	-
St Vincent	14	-	-	-	-	-	-	-	-	-
Spain	2 250	545	927	560	1 579	2 250	3 997	3 140	3 778	2 267
UK	17	15	9	36	17	31	31	20	23	41
41 Fishing area total	*8 370*	*4 676*	*7 635*	*6 384*	*5 654*	*6 374*	*9 815*	*12 088*	*12 083*	*9 938*
87 Chile	641	360	1 141	2 855	3 131	1 751	685	698	3 356	1 400
87 Fishing area total	*641*	*360*	*1 141*	*2 855*	*3 131*	*1 751*	*685*	*698*	*3 356*	*1 400*
Species total	*9 011*	*5 036*	*8 776*	*9 239*	*8 785*	*8 125*	*10 500*	*12 786*	*15 439*	*11 338*
Moras nei	**Mores nca**		**Moras nep**		***Moridae***				**1,48(02)XXX,XX**	**MOR**
27 Faroe Is	-	-	6	2	1	5	4	10	10	13
France	73	12	4	-	33	41	11	11	-	-
Norway	278	97	216	4	1	0	-	-	1	1
UK	-	-	-	-	-	-	-	-	-	0
27 Fishing area total	*351*	*109*	*226*	*6*	*35*	*46*	*15*	*21*	*11*	*14*
61 Russian Fed	32 392	29 323	27 486	25 632	27 341	27 566	26 196	20 320	16 909	17 488
61 Fishing area total	*32 392*	*29 323*	*27 486*	*25 632*	*27 341*	*27 566*	*26 196*	*20 320*	*16 909*	*17 488*
88 Ukraine	-	-	-	0	-	-	-	-	-	-
88 Fishing area total	*-*	*-*	*-*	*0*	*-*	*-*	*-*	*-*	*-*	*-*
Species total	*32 743*	*29 432*	*27 712*	*25 638*	*27 376*	*27 612*	*26 211*	*20 341*	*16 920*	*17 502*
Unicorn cod	**Bregmacère de l'océan Indien**		**Bregmacero**		***Bregmaceros mcclellandi***				**1,48(03)018,01**	**UNC**
51 India	2 095	2 101	2 348	1 046	2 458	1 458	424	419	419	267
Mauritius	340	271	295	276	259	139	428	255	210	201
51 Fishing area total	*2 435*	*2 372*	*2 643*	*1 322*	*2 717*	*1 597*	*852*	*674*	*629*	*468*
57 India	92	181	138	769	505	814	1 496	2 491	2 485	3 088
57 Fishing area total	*92*	*181*	*138*	*769*	*505*	*814*	*1 496*	*2 491*	*2 485*	*3 088*
Species total	*2 527*	*2 553*	*2 781*	*2 091*	*3 222*	*2 411*	*2 348*	*3 165*	*3 114*	*3 556*
Tusk(=Cusk)	**Brosme**		**Brosmio**		***Brosme brosme***				**1,48(04)001,01**	**USK**
21 Canada	1 498	1 288	1 148	927	905	883	1 046	613	578	474
Greenland	-	-	-	-	-	-	-	0	2	-
Norway	-	-	5	1	1	5	0	30	30	9
USA	180	150	104	78	97	65	88	54	48	34
21 Fishing area total	*1 678*	*1 438*	*1 257*	*1 006*	*1 003*	*953*	*1 134*	*697*	*658*	*517*
27 Denmark	274	221	223	157	134	160	97	58	51	38
Faroe Is	3 056	2 307	2 369	3 150	3 059	4 025	3 638	4 345	4 244	5 890
France	282	185	151	193	248	298	328	298	349	287
Germany	10	10	7	5	7	6	5	2	1	3
Greenland	-	-	-	-	-	-	-	-	9	47
Iceland	3 425	3 935	4 031	3 127	3 539	5 053	5 984	6 933	6 950	6 919
Ireland	122	109	48	49	39	23	29	5	12	10
Norway	18 817	18 167	13 458	11 896	11 862	14 342	15 293	16 167	13 726	16 818
Portugal	-	-	-	0	4	0	-	-	-	-
Russian Fed	83	54	27	136	198	196	191	227	172	106

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Cods, hakes, haddocks
Morues, merlus, églefins
Bacalaos, merluzas, eglefinos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Spain	72	151	56	40	64	62	2	87	3	48
Sweden	6	4	5	6	6	4	2	4	3	4
UK	872	672	384	283	565	310	240	170	232	203
27 Fishing area total	*27 019*	*25 815*	*20 759*	*19 042*	*19 725*	*24 479*	*25 809*	*28 296*	*25 752*	*30 373*
Species total	*28 697*	*27 253*	*22 016*	*20 048*	*20 728*	*25 432*	*26 943*	*28 993*	*26 410*	*30 890*
Atlantic cod	**Morue de l'Atlantique**		**Bacalao del Atlántico**		***Gadus morhua***				**1,48(04)002,02**	**COD**
18 Russian Fed	-	-	-	-	-	-	-	390	-	517
18 Fishing area total	-	-	-	-	-	-	-	*390*	-	*517*
21 Canada	40 325	35 255	22 755	24 729	26 156	27 412	26 732	26 837	19 948	17 212
Estonia	44	8	23	29	17	52	25	73	128	93
Faroe Is	-	-	-	-	7	2	-	1	25	1 190
Germany	-	-	-	-	-	-	-	2 388	362	-
Greenland	1 680	3 891	3 954	4 706	5 734	8 312	14 134	20 067	9 865	9 419
Lithuania	-	-	1	-	1	13	12	10	-	63
Norway	-	-	457	3	70	243	32	633	745	822
Portugal	357	488	677	279	105	177	256	432	1 003	1 538
Russian Fed	254	348	180	98	5	1	46	97	102	408
St Pier Mq	2 350	2 219	2 385	2 371	3 096	1 958	2 013	1 908	542	459
Spain	-	-	-	0	42	151	268	255	351	1 428
UK	-	-	-	-	-	-	-	296	595	761
USA	15 064	13 128	10 698	7 290	6 314	5 724	7 687	8 652	8 940	8 035
21 Fishing area total	*60 074*	*55 337*	*41 130*	*39 505*	*41 547*	*44 045*	*51 205*	*61 649*	*42 606*	*41 428*
27 Belgium	3 207	3 506	1 856	1 930	2 075	1 551	1 268	1 140	1 087	797
Channel Is	6	9	4	3	4	1	2	2	1	4
Denmark	46 200	37 867	31 526	30 467	28 946	29 586	24 494	23 543	23 695	26 701
Estonia	755	51	560	1 278	604	702	946	973	822	797
Faroe Is	39 762	55 724	58 029	45 941	35 748	30 751	28 141	27 102	27 283	31 813
Finland	1 723	1 049	1 168	889	286	670	853	830	880	1 029
France	11 336	11 614	11 048	7 371	5 560	8 004	8 363	7 339	4 993	5 298
Germany	19 222	15 412	15 050	17 021	18 106	17 459	16 819	15 003	18 267	19 477
Greenland	3 934	32	2	5 252	5 377	6 812	5 237	4 268	5 744	8 129
Iceland	240 002	213 417	206 290	227 222	212 423	199 375	174 436	151 397	188 976	178 599
Ireland	2 653	2 503	1 694	1 247	1 330	1 511	1 791	1 526	1 207	1 272
Isle of Man	1	7	7	5	...	...	2	1	1	1
Latvia	6 298	4 867	4 634	5 027	3 996	4 567	4 269	4 019	4 611	5 160
Lithuania	3 852	2 964	2 900	3 382	2 993	3 301	2 935	2 614	2 818	3 212
Netherlands	3 656	4 714	2 372	1 764	1 691	1 644	1 603	1 939	2 689	2 731
Norway	208 977	228 096	216 905	230 743	225 705	221 056	217 757	214 810	242 052	282 516
Poland	23 310	17 209	17 291	16 541	13 846	15 947	11 785	11 254	12 364	14 841
Portugal	4 027	3 630	3 628	4 895	4 316	5 409	4 132	4 087	4 737	4 724
Russian Fed	188 630	187 865	185 982	204 937	203 733	207 529	189 867	194 123	233 963	271 847
Spain	20 283	8 409	9 086	21 648	9 753	405	4 754	9 660	11 473	12 661
Sweden	24 111	17 383	16 310	16 444	11 737	13 246	13 562	12 607	13 188	12 404
UK	32 840	31 548	21 543	21 210	20 001	20 841	19 332	19 040	21 920	24 992
27 Fishing area total	*884 785*	*847 876*	*807 885*	*865 217*	*808 230*	*790 367*	*732 348*	*707 277*	*822 771*	*909 005*
Species total	*944 859*	*903 213*	*849 015*	*904 722*	*849 777*	*834 412*	*783 553*	*769 316*	*865 377*	*950 950*
Pacific cod	**Morue du Pacifique**		**Bacalao del Pacífico**		***Gadus macrocephalus***				**1,48(04)002,11**	**PCO**
61 Japan	43 550	29 516	33 155	37 502	49 029	47 531	45 722	39 679	47 659	55 000 F
Korea Rep	13 110	9 240	4 421	5 444	6 915	9 459	10 181	8 060	9 556	11 768
Russian Fed	59 783	60 625	51 577	63 241	55 704	49 059	53 429	66 635	52 760	79 536
61 Fishing area total	*116 443*	*99 381*	*89 153*	*106 187*	*111 648*	*106 049*	*109 332*	*114 374*	*109 975*	*146 304 F*
67 Canada	474	694	809	1 322	1 535	960	531	362	964	2 019
Russian Fed	-	-	-	-	-	-	225	224	10	1 644
USA	213 967	232 617	257 436	266 108	248 910	235 296	221 488	224 055	222 781	244 777
67 Fishing area total	*214 441*	*233 311*	*258 245*	*267 430*	*250 445*	*236 256*	*222 244*	*224 641*	*223 755*	*248 440*
Species total	*330 884*	*332 692*	*347 398*	*373 617*	*362 093*	*342 305*	*331 576*	*339 015*	*333 730*	*394 744 F*
Greenland cod	**Morue ogac**		**Bacalao de Groenlandia**		***Gadus ogac***				**1,48(04)002,12**	**GRC**
21 Greenland	1 128	918	1 288	891	1 051	1 020	597	595	171	251
21 Fishing area total	*1 128*	*918*	*1 288*	*891*	*1 051*	*1 020*	*597*	*595*	*171*	*251*
27 Greenland	5	0	-	-	-	-	1	-	-	-
27 Fishing area total	*5*	*0*	-	-	-	-	*1*	-	-	-
Species total	*1 133*	*918*	*1 288*	*891*	*1 051*	*1 020*	*598*	*595*	*171*	*251*
Ling	**Lingue franche**		**Maruca**		***Molva molva***				**1,48(04)005,01**	**LIN**
21 Spain	-	-	-	4	-	1	-	-	-	-
21 Fishing area total	-	-	-	*4*	-	*1*	-	-	-	-
27 Belgium	88	91	67	97	94	57	71	71	42	48
Channel Is	3	2	1	0	5	4	4	2	2	2
Denmark	910	829	958	777	859	786	528	546	642	546
Faroe Is	2 859	3 447	3 341	4 513	4 387	5 040	4 359	5 322	5 194	6 643
France	2 987	2 561	2 664	2 306	2 309	2 162	2 360	1 843	1 963	2 093
Germany	110	114	133	75	104	78	119	118	67	89
Greenland	-	-	-	-	-	-	-	-	-	36

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Cods, hakes, haddocks
Morues, merlus, églefins
Bacalaos, merluzas, eglefinos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Iceland	2 864	2 833	3 855	3 722	4 311	6 277	6 592	7 737	9 610	...
Ireland	1 463	1 303	1 164	1 241	919	633	706	523	477	612
Isle of Man	0	-	0	-	-	-	-	-	-	-
Netherlands	4	3	1	1	-	-	-	-	2	2
Norway	13 633	15 340	13 995	14 259	14 852	16 828	18 582	19 479	16 716	18 246
Portugal	-	-	3	12	1	0	1	-	-	-
Russian Fed	2	11	12	196	358	17	105	255	52	-
Spain	4 276	6 506	9 140	3 500	2 374	2 505	643	1 387	1 477	1 032
Sweden	47	47	41	38	40	40	36	44	42	37
UK	8 095	8 465	5 033	4 645	3 693	3 542	3 337	3 267	4 253	4 471
27 Fishing area total	*37 341*	*41 552*	*40 408*	*35 382*	*34 306*	*37 969*	*37 443*	*40 594*	*40 539*	*33 857*
Species total	*37 341*	*41 552*	*40 408*	*35 386*	*34 306*	*37 970*	*37 443*	*40 594*	*40 539*	*33 857*
Blue ling	**Lingue bleue**		**Maruca azul**		***Molva dypterygia***				**1,48(04)005,02**	**BLI**
27 Denmark	27	13	25	25	54	48	5	2	1	1
Estonia	85	22	5	3	5	3	7	-	-	-
Faroe Is	1 751	1 132	2 519	1 542	1 729	2 051	2 080	1 168	1 214	2 238
France	3 666	3 342	3 781	3 974	3 133	3 131	3 137	3 065	2 656	2 530
Germany	26	10	16	10	26	22	-	1	-	3
Iceland	765	1 274	1 098	1 083	1 497	1 737	1 999	3 654	4 129	6 377
Ireland	827	583	31	20	11	4	3	0	-	-
Lithuania	16	29	37	42	16	9	9	4	-	-
Norway	1 026	902	552	295	281	367	467	407	392	517
Poland	19	8	85	3	1	-	-	-	-	-
Portugal	9	13	7	0	3	5	15	22	26	99
Russian Fed	-	3	2	19	22	21	37	122	16	47
Spain	4 472	2 041	2 384	67	1 138	190	128	1 096	621	539
Sweden	-	-	-	0	-	0	-	-	-	-
UK	5 980	3 166	631	704	3 819	498	299	228	365	386
27 Fishing area total	*18 669*	*12 538*	*11 173*	*7 787*	*11 735*	*8 086*	*8 186*	*9 769*	*9 420*	*12 737*
37 Spain	-	-	-	-	-	0	-	-	-	-
37 Fishing area total	-	-	-	-	-	*0*	-	-	-	-
Species total	*18 669*	*12 538*	*11 173*	*7 787*	*11 735*	*8 086*	*8 186*	*9 769*	*9 420*	*12 737*
Spanish ling	**Lingue espagnole**		**Maruca española**		***Molva macrophthalma***				**1,48(04)005,04**	**SLI**
27 Spain	...	-	-	-	-	-	-	-	104	2
27 Fishing area total	...	-	-	-	-	-	-	-	*104*	*2*
Species total	...	-	-	-	-	-	-	-	*104*	*2*
Lings nei	**Lingues nca**		**Marucas nep**		***Molva spp***				**1,48(04)005,XX**	**LNZ**
27 Ireland	-	-	136	17	4	-	-	-	-	-
Portugal	-	-	5	11	5	4	0	-	-	-
27 Fishing area total	-	-	*141*	*28*	*9*	*4*	*0*	-	-	-
Species total	-	-	*141*	*28*	*9*	*4*	*0*	-	-	-
Greater forkbeard	**Phycis de fond**		**Brótola de fango**		***Phycis blennoides***				**1,48(04)006,01**	**GFB**
27 Faroe Is	2	6	10	7	7	7	9	4	4	12
France	743	662	498	471	629	668	639	552	532	547
Germany	12	11	4	15	25	-	-	-	-	2
Iceland	-	6	3	-	-	-	1	-	0	1
Ireland	679	720	340	197	245	92	59	48	8	9
Norway	1 348	1 334	934	419	322	375	501	553	458	554
Portugal	89	63	57	48	37	25	29	28	30	23
Russian Fed	11	-	1	4	5	5	9	42	15	3
Spain	1 175	1 443	4 314	532	918	868	680	817	864	816
UK	1 204	985	911	707	575	419	369	239	222	253
27 Fishing area total	*5 263*	*5 230*	*7 072*	*2 400*	*2 763*	*2 459*	*2 296*	*2 283*	*2 133*	*2 220*
37 Algeria	19	39	16	26	42	55	48	79	13	4
France	3	5	3	7	4	4	4	2	6	6
Italy	...	...	...	...	104	58	42	57	59	57
Malta	0	-	-	-	2	3	-	-	2	6
Morocco	46	40	63	59	67	170	81	63	97	95
Spain	6	314	331	318	333	398	405	421	432	542
Turkey	35	8	4	8	27	17	23	11	21	9
37 Fishing area total	*109*	*406*	*417*	*418*	*579*	*705*	*603*	*633*	*630*	*719*
Species total	*5 372*	*5 636*	*7 489*	*2 818*	*3 342*	*3 164*	*2 899*	*2 916*	*2 763*	*2 939*
Forkbeard	**Phycis de roche**		**Brótola de roca**		***Phycis phycis***				**1,48(04)006,02**	**FOR**
27 France	-	-	-	-	-	-	0	0	5	6
Portugal	5	9	133	197	223	304	423	484	682	789
Spain	...	...	310	183	246	268	1 505	1 822	1 603	4 174
27 Fishing area total	*5*	*9*	*443*	*380*	*469*	*572*	*1 928*	*2 306*	*2 290*	*4 969*
37 Italy	...	...	...	...	105	280	295	245	369	407
37 Fishing area total	...	...	...	...	*105*	*280*	*295*	*245*	*369*	*407*
Species total	*5*	*9*	*443*	*380*	*574*	*852*	*2 223*	*2 551*	*2 659*	*5 376*

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Cods, hakes, haddocks
Morues, merlus, églefins
Bacalaos, merluzas, eglefinos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Longfin hake	**Merluche à longues nagerois**		**...C**		***Phycis chesteri***				**1,48(04)006,04**	**GPE**
21 Russian Fed	-	-	-	-	-	-	-	-	1	-
21 Fishing area total	-	-	-	-	-	-	-	-	*1*	-
Species total	-	-	-	-	-	-	-	-	*1*	-
Forkbeards nei	**Phycis nca**		**Brótolas nep**		***Phycis spp***				**1,48(04)006,XX**	**FOX**
27 Portugal	470	454	403	312	201	65	33	30	23	16
Spain	...	...	235	163	162	336	178	198	202	106
27 Fishing area total	*470*	*454*	*638*	*475*	*363*	*401*	*211*	*228*	*225*	*122*
34 Morocco	280	252	409	411	411	378	436	436	434	402
Portugal	12	5	15	14	19	18	1	3	2	12
Spain	-	-	26	572	214	196	764	146	259	205
34 Fishing area total	*292*	*257*	*450*	*997*	*644*	*592*	*1 201*	*585*	*695*	*619*
37 Spain	-	-	-	238	280	314	295	223	233	258
37 Fishing area total	-	-	-	*238*	*280*	*314*	*295*	*223*	*233*	*258*
Species total	*762*	*711*	*1 088*	*1 710*	*1 287*	*1 307*	*1 707*	*1 036*	*1 153*	*999*
Brazilian codling	**Phycis brésilien**		**Brótola brasileña**		***Urophycis brasiliensis***				**1,48(04)008,01**	**HKU**
41 Argentina	90	309	380	170	111	77	100	92	110	190
Brazil	6 334	8 207	5 664	3 863	4 869	4 825	6 579	5 312	5 859	5 532
Portugal	3	8	-	-	-	-	-	-	-	-
Russian Fed	-	70	118	8	-	-	-	-	-	-
Spain	-	-	-	-	-	-	557	-	717	954
Uruguay	361	382	685	711	380	358	480	364	749	359
41 Fishing area total	*6 788*	*8 976*	*6 847*	*4 752*	*5 360*	*5 260*	*7 716*	*5 768*	*7 435*	*7 035*
Species total	*6 788*	*8 976*	*6 847*	*4 752*	*5 360*	*5 260*	*7 716*	*5 768*	*7 435*	*7 035*
Red hake	**Merluche écureuil**		**Locha roja**		***Urophycis chuss***				**1,48(04)008,02**	**HKR**
21 Canada	130	115	204	171	165	147	230	263	184	174
Estonia	-	-	14	47	47	26	2	-	-	19
Lithuania	-	-	-	-	-	8	-	-	-	1
Portugal	273	1 969	2	12	18	5	2	3	1	2
Russian Fed	118	1 284	951	39	7	-	10	29	9	12
Spain	1 755	1 164	1 320	772	647	2	99	98	105	124
USA	1 732	911	807	676	430	453	512	587	613	602
21 Fishing area total	*4 008*	*5 443*	*3 298*	*1 717*	*1 314*	*641*	*855*	*980*	*912*	*934*
Species total	*4 008*	*5 443*	*3 298*	*1 717*	*1 314*	*641*	*855*	*980*	*912*	*934*
White hake	**Merluche blanche**		**Locha blanca**		***Urophycis tenuis***				**1,48(04)008,03**	**HKW**
21 Canada	4 140	4 585	3 790	3 726	4 485	3 910	3 070	2 930	2 091	2 198
Estonia	2	5	9	102	1	-	32	0	-	-
Lithuania	-	2	-	-	3	-	1	0	-	-
Portugal	-	1 678	3 919	1 264	157	103	61	55	26	17
Russian Fed	-	-	-	96	3	-	3	2	3	-
St Pier Mq	10	3	3	0	23	1	3	6	-	-
Spain	689	3 258	2 025	445	327	275	78	160	62	87
USA	3 482	3 268	4 435	3 506	2 680	1 701	1 530	1 324	1 691	1 808
21 Fishing area total	*8 323*	*12 799*	*14 181*	*9 139*	*7 679*	*5 990*	*4 778*	*4 477*	*3 873*	*4 110*
27 Estonia	-	1	-	1	-	-	-	-	-	-
Lithuania	-	-	-	-	-	-	1	2	-	-
Norway	-	-	-	-	-	-	-	-	20	117
Portugal	7	5	7	9	5	10	20	17	11	7
Spain	-	-	30	13	6	5	5	7	4	31
27 Fishing area total	*7*	*6*	*37*	*23*	*11*	*15*	*26*	*26*	*35*	*155*
31 USA	1	1	2	3	1	2	0	0	0	0
31 Fishing area total	*1*	*1*	*2*	*3*	*1*	*2*	*0*	*0*	*0*	*0*
Species total	*8 331*	*12 806*	*14 220*	*9 165*	*7 691*	*6 007*	*4 804*	*4 503*	*3 908*	*4 265*
Haddock	**Églefin**		**Eglefino**		***Melanogrammus aeglefinus***				**1,48(04)010,01**	**HAD**
18 Russian Fed	-	-	-	-	-	-	-	72	-	70
18 Fishing area total	-	-	-	-	-	-	-	*72*	-	*70*
21 Canada	15 594	14 947	15 772	16 489	20 432	16 960	19 238	20 539	23 395	22 400
Estonia	-	-	-	2	-	-	-	-	-	-
Faroe Is	-	-	-	-	-	3	-	-	-	13
Germany	-	-	-	-	-	-	-	56	4	-
Greenland	-	-	-	-	-	1	-	134	19	-
Norway	-	-	-	-	-	-	-	1	11	17
Portugal	23	78	131	23	6	1	2	1	3	1
Russian Fed	33	29	19	3	-	-	-	-	-	-
St Pier Mq	78	222	251	168	175	52	64	13	-	-
Spain	-	-	17	-	-	-	-	1	-	5
UK	-	-	-	-	-	-	-	-	4	-

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Cods, hakes, haddocks
Morues, merlus, églefins
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Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
USA	5 826	7 553	6 785	8 202	7 581	3 266	3 633	6 350	5 813	9 803
21 Fishing area total	*21 554*	*22 829*	*22 975*	*24 887*	*28 194*	*20 283*	*22 937*	*27 095*	*29 249*	*32 239*
27 Belgium	840	737	511	523	379	229	329	236	246	259
Channel Is	-	0	-	-	-	-	-	-	-	-
Denmark	4 001	8 920	4 780	3 194	1 898	1 783	1 724	1 575	1 818	1 865
Faroe Is	17 081	27 427	30 053	26 887	24 722	21 410	16 833	11 400	8 909	8 894
France	5 970	5 979	7 879	7 447	5 111	4 874	5 249	4 577	5 809	6 935
Germany	1 368	1 786	2 587	2 142	1 787	1 908	2 056	1 016	2 719	4 270
Greenland	547	596	847	992	1 129	1 124	901	1 028	1 421	1 989
Iceland	39 825	49 951	60 337	84 678	96 627	96 591	109 313	102 385	81 832	64 939
Ireland	5 404	3 509	2 788	2 256	2 486	2 688	3 596	3 724	4 023	3 507
Isle of Man	1	0	0	0	...	...	0	1	1	0
Netherlands	295	360	194	106	64	33	55	29	25	43
Norway	51 651	55 222	59 329	64 932	63 337	71 412	73 286	74 298	106 465	124 585
Poland	96	52	155	164	1	181	31	55	317	705
Portugal	105	153	265	377	442	559	987	611	643	488
Russian Fed	34 937	38 788	45 507	60 207	53 205	55 467	67 851	70 471	85 569	111 570
Spain	2 217	156	1 440	284	305	311	181	176	110	201
Sweden	1 087	965	642	345	315	347	408	359	307	216
UK	42 865	52 869	41 392	46 098	31 745	39 807	33 487	33 060	36 294	33 614
27 Fishing area total	*208 290*	*247 470*	*258 706*	*300 632*	*283 553*	*298 724*	*316 287*	*305 001*	*336 508*	*364 080*
Species total	*229 844*	*270 299*	*281 681*	*325 519*	*311 747*	*319 007*	*339 224*	*332 168*	*365 757*	*396 389*
Navaga(=Wachna cod)	**Morue arctique**		**Bacalao navaga**		***Eleginus navaga***				**1,48(04)012,01**	**COW**
05 Russian Fed	55	127	207	245	43	45	-	62	-	103
05 Fishing area total	*55*	*127*	*207*	*245*	*43*	*45*	*-*	*62*	*-*	*103*
27 Russian Fed	1 111	835	615	768	397	464	437	405	296	256
27 Fishing area total	*1 111*	*835*	*615*	*768*	*397*	*464*	*437*	*405*	*296*	*256*
Species total	*1 166*	*962*	*822*	*1 013*	*440*	*509*	*437*	*467*	*296*	*359*
Saffron cod	**Morne boréale**		**Bacalao del Artico**		***Eleginus gracilis***				**1,48(04)012,02**	**SAF**
61 Russian Fed	33 753	32 591	26 360	20 521	15 562	22 709	25 008	23 294	39 809	32 154
61 Fishing area total	*33 753*	*32 591*	*26 360*	*20 521*	*15 562*	*22 709*	*25 008*	*23 294*	*39 809*	*32 154*
Species total	*33 753*	*32 591*	*26 360*	*20 521*	*15 562*	*22 709*	*25 008*	*23 294*	*39 809*	*32 154*
Pacific tomcod	**Poulamon du Pacifique**		**...C**		***Microgadus proximus***				**1,48(04)013,01**	**MGX**
67 USA	0	-	1	0	-	-	-	-	-	-
67 Fishing area total	*0*	*-*	*1*	*0*	*-*	*-*	*-*	*-*	*-*	*-*
Species total	*0*	*-*	*1*	*0*	*-*	*-*	*-*	*-*	*-*	*-*
Atlantic tomcod	**Poulamon atlantique**		**Microgado**		***Microgadus tomcod***				**1,48(04)013,02**	**TOM**
02 Canada	-	-	0	-	0	-	-	-	-	-
02 Fishing area total	*-*	*-*	*0*	*-*	*0*	*-*	*-*	*-*	*-*	*-*
21 Canada	57	1	37	7	7	83	1	12	17	13
21 Fishing area total	*57*	*1*	*37*	*7*	*7*	*83*	*1*	*12*	*17*	*13*
Species total	*57*	*1*	*37*	*7*	*7*	*83*	*1*	*12*	*17*	*13*
Saithe(=Pollock)	**Lieu noir**		**Carbonero(=Colín)**		***Pollachius virens***				**1,48(04)015,01**	**POK**
21 Canada	7 190	7 617	8 562	8 777	8 081	4 896	6 943	5 800	5 518	5 372
Faroe Is	-	-	-	-	9	-	-	-	-	-
Greenland	-	-	-	8	2	-	6	1	-	-
Norway	-	-	-	-	-	-	-	0	-	-
Portugal	-	2	115	4	-	1	-	-	-	-
Russian Fed	-	-	13	-	-	-	-	-	-	-
St Pier Mq	13	135	225	335	35	12	20	3	-	-
Spain	-	-	30	-	-	-	-	-	-	-
USA	4 109	3 581	4 794	5 061	6 521	6 059	8 375	9 965	7 459	5 151
21 Fishing area total	*11 312*	*11 335*	*13 739*	*14 185*	*14 648*	*10 968*	*15 344*	*15 769*	*12 977*	*10 523*
27 Belgium	30	120	47	23	30	16	20	9	28	16
Denmark	3 593	5 686	6 959	7 988	7 498	7 540	5 455	8 076	8 818	8 019
Faroe Is	50 584	57 050	50 851	52 694	75 962	73 047	67 044	63 948	64 820	48 991
France	28 533	30 736	23 349	17 847	16 792	24 537	20 809	21 405	10 024	3 327
Germany	13 320	14 542	12 110	12 097	15 047	17 790	16 401	16 555	15 730	13 042
Greenland	1 526	1 580	2 036	2 094	1 843	1 803	1 643	1 401	1 630	954
Iceland	31 941	41 839	51 940	62 933	67 747	75 460	64 245	70 109	61 332	53 896
Ireland	2 048	1 354	924	724	562	667	607	453	671	823
Isle of Man	0	4	4	3	...	...	2	1	2	7
Lithuania	-	-	-	-	149	-	-	-	-	-
Netherlands	19	5	21	13	40	31	44	4	16	3
Norway	169 558	203 052	212 228	211 267	230 567	256 856	225 464	227 295	202 377	227 919
Poland	727	752	734	-	1 100	1 173	1 484	1 472	1 019	933
Portugal	86	130	155	143	368	380	477	350	187	95
Russian Fed	4 953	5 413	4 056	9 269	8 632	9 936	12 289	11 671	11 960	14 669
Spain	152	54	34	6	43	26	28	42	13	32
Sweden	1 628	1 868	1 880	2 248	2 133	1 747	1 380	1 640	1 363	1 545

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Cods, hakes, haddocks
Morues, merlus, églefins
Bacalaos, merluzas, eglefinos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
UK	10 585	12 310	9 876	9 774	15 612	13 639	11 773	15 741	17 249	16 126
27 Fishing area total	*319 283*	*376 495*	*377 204*	*389 123*	*444 125*	*484 648*	*429 165*	*440 172*	*397 239*	*390 397*
Species total	*330 595*	*387 830*	*390 943*	*403 308*	*458 773*	*495 616*	*444 509*	*455 941*	*410 216*	*400 920*
Pollack	**Lieu jaune**		**Abadejo**		***Pollachius pollachius***				**1,48(04)015,02**	**POL**
27 Belgium	137	143	125	132	124	96	107	90	53	47
Channel Is	57	40	41	55	63	48	50	69	83	77
Denmark	357	464	366	303	335	255	365	316	329	476
Faroe Is	0	0	0	1	0	3	6	7	11	11
France	3 649	3 964	3 541	3 066	3 534	3 637	3 596	2 778	3 196	3 147
Germany	41	116	85	59	133	89	147	118	57	137
Iceland	-	-	-	-	-	-	-	1	-	-
Ireland	1 382	1 334	1 238	1 119	755	834	804	758	833	982
Isle of Man	-	3	12	6	...	...	8	8	7	-
Netherlands	1	1	2	5	11	5	5	2	5	3
Norway	2 897	3 478	3 868	2 869	2 702	3 021	3 358	3 065	2 154	1 887
Portugal	41	45	31	55	6	7	5	31	3	2
Spain	436	222	193	312	454	386	303	407	289	359
Sweden	108	112	53	51	199	48	81	79	70	67
UK	2 839	2 765	2 682	2 291	2 136	2 248	2 693	2 461	2 179	2 003
27 Fishing area total	*11 945*	*12 687*	*12 237*	*10 324*	*10 452*	*10 677*	*11 528*	*10 190*	*9 269*	*9 198*
Species total	*11 945*	*12 687*	*12 237*	*10 324*	*10 452*	*10 677*	*11 528*	*10 190*	*9 269*	*9 198*
Alaska pollock(=Walleye poll.)	**Lieu de l'Alaska**		**Colín de Alaska**		***Theragra chalcogramma***				**1,48(04)016,01**	**ALK**
61 China	33 840 F	9 359 F	...	...	...	...	...	...	...	...
Japan	241 881	213 254	219 652	239 372	194 049	206 794	216 636	211 038	227 261	251 300 F
Korea D P Rp	60 000 F	60 000 F	60 000 F	60 000 F	60 000 F	60 000 F	60 000 F	60 000 F	60 000 F	60 000 F
Korea Rep	197 396	24 772	22 125	20 061	26 029	26 329	20 144	25 613	38 997	46 795
Poland	16 590	-	-	-	-	-	-	-	-	-
Russian Fed	1 145 016	826 706	1 055 886	849 646	961 659	1 021 652	1 217 556	1 316 100	1 326 532	1 580 516
61 Fishing area total	*1 694 723 F*	*1 134 091 F*	*1 357 663 F*	*1 169 079 F*	*1 241 737 F*	*1 314 775 F*	*1 514 336 F*	*1 612 751 F*	*1 652 790 F*	*1 938 611 F*
67 Canada	1 747	3 606	5 395	2 932	1 878	3 114	3 183	1 312	3 362	3 666
Russian Fed	-	1	-	-	-	-	897	2 640	5	4 011
USA	1 442 170	1 515 515	1 524 904	1 519 928	1 547 359	1 542 598	1 390 797	1 032 452	846 504	883 416
67 Fishing area total	*1 443 917*	*1 519 122*	*1 530 299*	*1 522 860*	*1 549 237*	*1 545 712*	*1 394 877*	*1 036 404*	*849 871*	*891 093*
Species total	*3 138 640 F*	*2 653 213 F*	*2 887 962 F*	*2 691 939 F*	*2 790 974 F*	*2 860 487 F*	*2 909 213 F*	*2 649 155 F*	*2 502 661 F*	*2 829 704 F*
Polar cod	**Morue polaire**		**Bacalao polar**		***Boreogadus saida***				**1,48(04)019,01**	**POC**
18 Russian Fed	-	-	-	-	-	-	-	-	-	1
18 Fishing area total	-	-	-	-	-	-	-	-	-	*1*
21 Greenland	-	58	5	18	45	18	50	6	-	-
21 Fishing area total	-	*58*	*5*	*18*	*45*	*18*	*50*	*6*	-	-
27 Norway	-	-	-	-	-	57	-	-	-	2
Russian Fed	39 445	37 191	39 451	1 637	22 447	16 310	26 870	8 221	17 167	27 426
27 Fishing area total	*39 445*	*37 191*	*39 451*	*1 637*	*22 447*	*16 367*	*26 870*	*8 221*	*17 167*	*27 428*
61 Russian Fed	-	-	10	-	-	-	-	-	-	-
61 Fishing area total	-	-	*10*	-	-	-	-	-	-	-
Species total	*39 445*	*37 249*	*39 466*	*1 655*	*22 492*	*16 385*	*26 920*	*8 227*	*17 167*	*27 429*
Silvery pout	**Merlan argenté**		**Faneca plateada**		***Gadiculus argenteus***				**1,48(04)025,07**	**GDG**
27 Norway	-	-	-	-	-	625	4 153	1 055	1 927	567
27 Fishing area total	-	-	-	-	-	*625*	*4 153*	*1 055*	*1 927*	*567*
Species total	-	-	-	-	-	*625*	*4 153*	*1 055*	*1 927*	*567*
Threadfin rockling	**Mustèle arctique à trois barb.**		**...C**		***Gaidropsarus ensis***				**1,48(04)028,01**	**GDE**
21 Estonia	-	-	-	-	-	-	-	19	-	-
21 Fishing area total	-	-	-	-	-	-	-	*19*	-	-
Species total	-	-	-	-	-	-	-	*19*	-	-
Rocklings nei	**Motelles nca**		**Barbadas nep**		***Gaidropsarus spp***				**1,48(04)028,XX**	**ROL**
21 Spain	-	-	-	-	-	-	-	23	-	-
21 Fishing area total	-	-	-	-	-	-	-	*23*	-	-
27 France	1	0	10	48	10	24	15	13	182	149
Portugal	-	-	1	28	9	10	8	5	5	10
UK	-	-	-	1	0	1	0	-	-	-
27 Fishing area total	*1*	*0*	*11*	*77*	*19*	*35*	*23*	*18*	*187*	*159*
37 Albania	-	-	-	-	-	-	12	15	10	-
Bulgaria	-	20	-	1	-	-	-	-	-	-
France	19	19	19	19	-	-	-	-	-	1
37 Fishing area total	*19*	*39*	*19*	*20*	-	-	*12*	*15*	*10*	*1*

B-32 Cods, hakes, haddocks / Morues, merlus, églefins / Bacalaos, merluzas, eglefinos

Capture production by species, fishing areas and countries or areas / Captures par espèces, zones de pêche et pays ou zones / Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area / Espèce, Zone de pêche / Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*20*	*39*	*30*	*97*	*19*	*35*	*35*	*56*	*197*	*160*
Norway pout	**Tacaud norvégien**		**Faneca noruega**		***Trisopterus esmarkii***				**1,48(04)032,01**	**NOP**
27 Denmark	62 652	78 243	23 045	13 646	-	39 974	83	32 558	19 829	71 312
Faroe Is	122	3 385	2 374	1 159	24	-	-	-	0	3
France	-	-	-	2	5	0	1	1	-	-
Germany	-	-	2	107	-	34	-	4	75	0
Iceland	160	253	-	-	-	-	-	-	41	39
Ireland	-	-	-	-	0	-	-	-	-	-
Netherlands	-	2	-	-	-	-	-	-	22	18
Norway	27 123	25 995	12 409	7 498	319	14 336	4 722	6 650	37 293	65 668
Sweden	780	-	-	88	0	-	-	10	-	10
UK	0	1	3	13	6	4	3	-	-	29
27 Fishing area total	*90 837*	*107 879*	*37 833*	*22 513*	*354*	*54 348*	*4 809*	*39 223*	*57 260*	*137 079*
Species total	*90 837*	*107 879*	*37 833*	*22 513*	*354*	*54 348*	*4 809*	*39 223*	*57 260*	*137 079*
Poor cod	**Capelan de Méditerranée**		**Capellán**		***Trisopterus minutus***				**1,48(04)032,02**	**POD**
27 France	-	-	-	-	1	-	1	-	8	13
Spain	-	0	0	11	25	28	22	13	8	10
27 Fishing area total	*-*	*0*	*0*	*11*	*26*	*28*	*23*	*13*	*16*	*23*
37 Albania	...	...	8	5	1	2	-	-	-	-
France	754	875	740	631	762	573	742	462	444	473
Italy	...	...	...	...	1 499	889	705	596	467	427
Slovenia	1	1	2	1	1	3	0	-	0	0
Spain	463	602	441	568	1 027	1 294	831	400	520	793
37 Fishing area total	*1 218*	*1 478*	*1 191*	*1 205*	*3 290*	*2 761*	*2 278*	*1 458*	*1 431*	*1 693*
Species total	*1 218*	*1 478*	*1 191*	*1 216*	*3 316*	*2 789*	*2 301*	*1 471*	*1 447*	*1 716*
Pouting(=Bib)	**Tacaud commun**		**Faneca**		***Trisopterus luscus***				**1,48(04)032,03**	**BIB**
27 Belgium	561	577	504	445	356	472	574	578	425	413
Channel Is	6	14	12	-	1	5	1	2	4	2
Denmark	3	2	0	0	1	0	-	-	-	-
France	7 293	7 078	6 490	5 056	5 879	6 060	4 903	3 897	5 889	5 667
Ireland	28	12	23	2	33	3	2	5	1	1
Netherlands	645	735	464	475	441	533	386	339	379	486
Portugal	4 511	3 103	3 854	4 074	3 109	2 583	3 822	3 333	3 463	2 842
Spain	2 587	3 429	2 776	1 886	1 889	2 458	1 408	2 134	1 993	2 287
UK	899	724	701	732	748	700	566	721	846	933
27 Fishing area total	*16 533*	*15 674*	*14 824*	*12 670*	*12 457*	*12 814*	*11 662*	*11 009*	*13 000*	*12 631*
34 Morocco	1 566	1 163	2 338	1 699	1 744	1 815	1 514	1 147	993	478
Portugal	-	-	-	-	1	-	-	-	-	-
34 Fishing area total	*1 566*	*1 163*	*2 338*	*1 699*	*1 745*	*1 815*	*1 514*	*1 147*	*993*	*478*
37 France	-	-	-	-	-	-	-	-	2	14
Libya	...	...	...	...	...	...	...	...	1 224	1 180 F
Morocco	0	0	82	95	63	22	24	73	63	33
Spain	190	58	60	64	92	124	101	32	50	107
37 Fishing area total	*190*	*58*	*142*	*159*	*155*	*146*	*125*	*105*	*1 339*	*1 334 F*
Species total	*18 289*	*16 895*	*17 304*	*14 528*	*14 357*	*14 775*	*13 301*	*12 261*	*15 332*	*14 443 F*
Blue whiting(=Poutassou)	**Merlan bleu**		**Bacaladilla**		***Micromesistius poutassou***				**1,48(04)033,01**	**WHB**
27 Denmark	65 067	51 040	87 966	89 523	39 107	58 183	52 656	17 997	247	142
Faroe Is	258 334	204 524	326 593	316 868	267 447	320 592	312 005	229 537	58 324	52 301
France	19 054	14 771	16 121	19 476	7 160	21 921	19 943	19 943	6 984	7 865
Germany	19 059	17 052	26 988	15 294	22 823	36 442	34 679	25 293	5 023	9 061
Greenland	-	-	-	-	-	6 517	5 389	5 215	60	2 435
Iceland	365 101	286 381	501 494	422 078	265 889	314 755	234 952	163 794	120 197	87 907
Ireland	29 910	17 825	22 586	58 426	69 650	54 910	31 092	22 852	9 250	8 324
Lithuania	-	-	-	-	-	4 636	9 812	5 365	-	-
Netherlands	63 625	35 624	57 257	77 183	128 368	96 607	80 730	78 781	35 758	34 966
Norway	573 686	557 684	851 395	958 768	738 599	642 452	539 589	418 289	225 996	194 319
Poland	-	38	297	345	-	3 891	7 573	-	-	-
Portugal	1 763	1 698	3 527	5 749	7 734	2 650	3 933	4 752	2 137	1 542
Russian Fed	315 586	298 367	360 160	346 762	332 240	329 400	252 277	225 163	149 649	127 961
Spain	28 822	25 522	23 825	29 021	50 095	48 355	31 078	21 980	15 182	11 231
Sweden	2 058	18 483	65 532	19 957	4 385	314	517	-	3	0
UK	51 889	28 679	29 386	59 841	126 131	82 141	56 466	38 151	6 350	7 971
27 Fishing area total	*1 793 954*	*1 557 688*	*2 373 127*	*2 419 291*	*2 059 628*	*2 023 766*	*1 672 691*	*1 277 112*	*635 160*	*546 025*
34 Spain	-	-	-	-	0	0	0	-	-	4
34 Fishing area total	*-*	*-*	*-*	*-*	*0*	*0*	*0*	*-*	*-*	*4*
37 Albania	-	6	...	1	5	8	-	-	-	-
Croatia	...	...	...	...	...	...	...	...	16	29
France	24	14	10	38	26	29	14	2	6	8
Greece	471	643	1 308	1 259	1 165	1 409	1 098	1 028	749	750 F
Italy	1 167	755	964	1 045	1 546	1 700	1 304	973	823	874
Malta	-	-	-	-	-	-	-	-	8	13
Slovenia	-	-	-	-	-	4	3	0	0	-
Spain	5 461	2 988	2 127	2 941	3 875	8 347	6 406	3 169	2 638	2 592

B-32 **Cods, hakes, haddocks**
Morues, merlus, églefins
Bacalaos, merluzas, eglefinos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Turkey	20 810	10 500	7 500	4 380	4 100	3 460	3 337	1 252	1 557	1 256
37 Fishing area total	*27 933*	*14 906*	*11 909*	*9 664*	*10 717*	*14 957*	*12 162*	*6 424*	*5 797*	*5 522 F*
Species total	*1 821 887*	*1 572 594*	*2 385 036*	*2 428 955*	*2 070 345*	*2 038 723*	*1 684 853*	*1 283 536*	*640 957*	*551 551 F*
Southern blue whiting	**Merlan bleu austral**		**Polaca austral**		***Micromesistius australis***				**1,48(04)033,02**	**POS**
41 Argentina	54 311	42 453	44 584	50 216	36 663	31 292	18 979	19 841	21 677	11 636
Belize	206	-	-	-	-	-	-	-	-	-
Chile	6 709	7 154	6 495	8 218	-	2 276	3 282	1 525	-	-
Estonia	-	-	-	13	-	-	-	-	-	-
Falkland Is	4 637	2 853	2 544	2 798	1 730	1 773	3 077	1 753	1 675	375
Japan	7 570	5 983	4 038	12 939	10 023	11 302	8 896	6 859	6 173	5 062
Korea Rep	-	-	-	-	-	-	96	237	1	24
Russian Fed	30	4	-	-	-	-	-	-	-	-
Spain	5 243	3 160	2 865	4 400	5 275	5 513	6 810	2 809	2 450	1 010
UK	30	181	20	230	36	47	69	25	100	1
Uruguay	0	5	-	50	0	0	0	0	0	0
41 Fishing area total	*78 736*	*61 793*	*60 546*	*78 864*	*53 727*	*52 203*	*41 209*	*33 049*	*32 076*	*18 108*
81 Japan	19 926	30 117	15 666	-	-	-	-	-	-	-
New Zealand	29 789	42 086	28 146	21 567	30 304	23 428	23 943	29 268	39 413	38 619
Ukraine	267	-	-	5 009	...	9 307	...	...	...	...
81 Fishing area total	*49 982*	*72 203*	*43 812*	*26 576*	*30 304*	*32 735*	*23 943*	*29 268*	*39 413*	*38 619*
87 Chile	22 046	22 255	25 673	24 951	25 425	26 839	23 419	25 561	22 221	23 301
87 Fishing area total	*22 046*	*22 255*	*25 673*	*24 951*	*25 425*	*26 839*	*23 419*	*25 561*	*22 221*	*23 301*
Species total	*150 764*	*156 251*	*130 031*	*130 391*	*109 456*	*111 777*	*88 571*	*87 878*	*93 710*	*80 028*
Whiting	**Merlan**		**Plegonero**		***Merlangius merlangus***				**1,48(04)034,01**	**WHG**
27 Belgium	732	500	456	381	381	300	254	309	324	345
Channel Is	3	1	3	0	-	-	1	1	0	4
Denmark	326	381	426	410	900	764	575	343	327	512
Estonia	-	-	-	-	-	-	1	0	0	-
Faroe Is	1 434	1 044	709	1 326	1 817	1 888	1 807	1 154	1 038	937
Finland	-	-	-	-	-	6	6	0	0	7
France	19 414	18 459	17 661	13 583	13 505	12 345	11 679	9 809	12 679	13 891
Germany	680	568	518	879	1 048	1 159	445	666	412	451
Iceland	1 179	1 295	1 026	1 048	797	1 051	1 259	1 688	2 308	...
Ireland	6 621	6 669	5 351	4 804	6 042	4 935	5 123	2 567	3 005	4 530
Isle of Man	1	1	1	1	...	...	1	1	1	0
Latvia	-	-	-	-	-	23	-	-	-	-
Netherlands	2 619	2 448	1 629	1 127	995	859	800	841	854	965
Norway	242	171	124	85	63	58	55	129	115	169
Poland	-	-	-	7	166	202	33	12	99	89
Portugal	38	42	59	91	86	174	113	98	114	114
Spain	299	248	256	357	490	523	318	199	54	109
Sweden	153	178	101	129	182	294	148	120	84	86
UK	15 287	11 538	8 287	7 481	6 755	12 361	13 192	11 490	10 238	9 216
27 Fishing area total	*49 028*	*43 543*	*36 607*	*31 709*	*33 227*	*36 942*	*35 810*	*29 427*	*31 652*	*31 425*
37 Algeria	...	...	...	...	...	...	758	966	510	539
Bulgaria	8	16	13	2	3	0	16	0	2	15
Croatia	...	...	...	...	...	...	...	...	46	50
France	2	2	2	2	-	0	1	-	51	109
Georgia	32	37	45	29	33 F	37 F	41	15	15 F	15 F
Greece	...	143	265	134	121	211	202	143	179	179 F
Italy	...	...	...	...	1 726	1 733	999	904	1 218	1 357
Romania	306	85	113	118	92	5	106	55	42	10
Russian Fed	642	656	93	55	78	60	99	96	49	30
Slovenia	37	19	57	28	51	33	35	51	53	69
Turkey	10 000	8 808	8 000	8 205	8 309	9 112	12 940	12 231	11 146	13 558
Ukraine	18	9	21	43	30	15	64	9	17	17
37 Fishing area total	*11 045*	*9 775*	*8 609*	*8 616*	*10 443 F*	*11 206 F*	*15 261*	*14 470*	*13 328 F*	*15 948 F*
Species total	*60 073*	*53 318*	*45 216*	*40 325*	*43 670 F*	*48 148 F*	*51 071*	*43 897*	*44 980 F*	*47 373 F*
Fourbeard rockling	**Motelle à quatre barbillons**		**...C**		***Enchelyopus cimbrius***				**1,48(04)041,01**	**ENC**
27 Poland	-	-	-	4	4	-	0	-	-	-
27 Fishing area total	-	-	-	*4*	*4*	-	*0*	-	-	-
Species total	-	-	-	*4*	*4*	-	*0*	-	-	-
European hake	**Merlu européen**		**Merluza europea**		***Merluccius merluccius***				**1,48(05)004,01**	**HKE**
27 Belgium	124	91	72	106	94	83	79	72	51	69
Denmark	1 043	1 163	1 199	1 357	1 254	1 360	1 224	1 668	2 179	2 189
Faroe Is	2	6	1	2	7	5	9	67	21	20
France	8 007	10 949	10 846	10 765	13 188	10 599	12 417	10 428	17 068	19 184
Germany	73	71	81	100	119	134	243	223	175	278
Iceland	-	-	-	-	-	-	-	-	-	110
Ireland	1 124	698	1 077	1 069	1 043	1 114	1 438	1 393	1 619	2 048
Isle of Man	1	-	0	0	...	...	0	0	-	-
Netherlands	72	18	24	24	40	37	95	157	193	251
Norway	635	534	608	642	882	1 179	1 294	1 608	1 693	1 634
Portugal	3 030	2 616	2 256	2 084	2 396	2 310	2 077	2 124	2 222	2 433

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Cods, hakes, haddocks
Morues, merlus, églefins
Bacalaos, merluzas, eglefinos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Spain	12 137	13 410	14 854	21 874	22 107	22 608	13 043	21 814	22 189	23 743
Sweden	63	51	55	72	71	61	61	182	75	70
UK	2 775	2 663	2 658	2 974	4 937	3 875	4 576	6 061	7 922	6 927
27 Fishing area total	*29 086*	*32 270*	*33 731*	*41 069*	*46 138*	*43 365*	*36 556*	*45 797*	*55 407*	*58 956*
34 Greece	-	349	2	-	1	-	-	-	-	-
Italy	539	1 459	1 398	717	17	10	5	6	2	-
Morocco	4 958	6 492	11 722	10 364	9 048	5 376	6 403	4 722	5 388	3 946
Portugal	2	264	371	210	1	28	128	-	11	66
Spain	7	3 989	4 380	6 937	6 347	5 148	4 168	3 240	3 825	5 315
34 Fishing area total	*5 506*	*12 553*	*17 873*	*18 228*	*15 414*	*10 562*	*10 704*	*7 968*	*9 226*	*9 327*
37 Albania	380	200	384	473	267	280	275	275	336	280
Algeria	196	209	31	22	12	44	193	96	307	288
Croatia	557	624	460	678	870	920	980	702	840	690
Cyprus	8	3	11	10	28	23	25	23	12	14
France	2 022	2 663	2 452	1 292	1 020	1 031	1 331	1 965	3 210	1 968
Greece	2 753	2 930	3 169	3 748	3 871	4 794	5 192	5 514	5 230	5 200 F
Israel	73	68	60	39	36	18	10	6 F	2	2
Italy	8 765	8 459	9 361	9 586	15 379	18 570	14 655	13 049	12 520	11 989
Malta	0	-	-	-	7	5	9	2	11	6
Montenegro	...	...	...	...	...	26	25	34	24	27
Morocco	197	197	187	202	157	547	194	132	197	146
Serbia-Monte	18	18	18	19	16	-	-	-	-	-
Slovenia	2	2	5	1	3	3	6	1	2	0
Spain	7 015	4 706	3 895	4 163	4 363	4 766	3 823	4 451	5 818	4 002
Syria	52	63	70	86	110	62	65	46	52	49
Tunisia	1 284	1 538	1 202	1 552	1 295	1 336	1 255	1 422	1 237	1 311
37 Fishing area total	*23 322*	*21 680*	*21 305*	*21 871*	*27 434*	*32 425*	*28 038*	*27 718 F*	*29 798*	*25 972 F*
Species total	*57 914*	*66 503*	*72 909*	*81 168*	*88 986*	*86 352*	*75 298*	*81 483 F*	*94 431*	*94 255 F*
Senegalese hake	**Merlu du Sénégal**		**Merluza del Senegal**		***Merluccius senegalensis***				**1,48(05)004,02**	**HKM**
34 GuineaBissau	...	...	...	...	...	...	...	47	47 F	47 F
Latvia	126	105	143	45	40	21	30	11	89	8
Poland	87	-	-	-	-	-	-	-	55	-
Portugal	-	-	128	67	-	620	345	25	-	-
Russian Fed	207	...	...	...	-	-	-	-	-	-
Senegal	98	221	480	16	10	152	155	57	92	72
Spain	16 716	6 978	5 589	5 400	2 244	2 792	4 607	4 384	13 206	3 125
Ukraine	6 350	182	53	-	-	-	24	-	-	-
34 Fishing area total	*23 584*	*7 486*	*6 393*	*5 528*	*2 294*	*3 585*	*5 161*	*4 524*	*13 489 F*	*3 252 F*
Species total	*23 584*	*7 486*	*6 393*	*5 528*	*2 294*	*3 585*	*5 161*	*4 524*	*13 489 F*	*3 252 F*
Southern hake	**Merlu austral**		**Merluza austral**		***Merluccius australis***				**1,48(05)004,03**	**HKN**
41 Argentina	4 742	5 301	6 693	5 923	3 865	3 418	2 871	3 172	3 212	2 755
Chile	1	-	-	1	-	-	-	-	-	-
Falkland Is	-	-	-	-	4	7	-	-	0	0
Spain	-	-	-	-	-	-	-	-	131	16
41 Fishing area total	*4 743*	*5 301*	*6 693*	*5 924*	*3 869*	*3 425*	*2 871*	*3 172*	*3 343*	*2 771*
81 Korea Rep	2 224	1 645	3 035	3 079	2 467	2 660	3 066	2 580	3 404	1 802
New Zealand	12 956	12 176	12 109	15 239	10 093	9 368	10 826	6 301	9 750	4 870
Spain	-	-	-	-	-	-	-	-	5	-
Ukraine	8	13	7 479	1 026	...	830	...	...	...	...
81 Fishing area total	*15 188*	*13 834*	*22 623*	*19 344*	*12 560*	*12 858*	*13 892*	*8 881*	*13 159*	*6 672*
87 Chile	28 806	23 431	22 948	31 700	31 458	31 493	30 589	28 050	26 272	25 361
87 Fishing area total	*28 806*	*23 431*	*22 948*	*31 700*	*31 458*	*31 493*	*30 589*	*28 050*	*26 272*	*25 361*
Species total	*48 737*	*42 566*	*52 264*	*56 968*	*47 887*	*47 776*	*47 352*	*40 103*	*42 774*	*34 804*
Silver hake	**Merlu argenté**		**Merluza norteamericana**		***Merluccius bilinearis***				**1,48(05)004,04**	**HKS**
21 Canada	17 929	13 725	11 133	13 388	11 365	12 357	12 062	12 464	10 669	8 270
Portugal	-	29	3	7	-	0	-	-	-	-
Russian Fed	2 055	2 525	457	544	-	-	-	-	-	-
Spain	9	27	10	-	40	13	-	-	-	-
USA	13 007	7 987	8 620	8 445	7 498	5 564	6 359	6 259	7 748	7 947
21 Fishing area total	*33 000*	*24 293*	*20 223*	*22 384*	*18 903*	*17 934*	*18 421*	*18 723*	*18 417*	*16 217*
Species total	*33 000*	*24 293*	*20 223*	*22 384*	*18 903*	*17 934*	*18 421*	*18 723*	*18 417*	*16 217*
South Pacific hake	**Merlu du Pacifique sud**		**Merluza del Pacífico sur**		***Merluccius gayi***				**1,48(05)004,05**	**PHA**
87 Chile	121 200	116 040	115 343	73 597	47 436	47 958	45 848	47 936	47 144	49 197
Ecuador	...	...	...	...	...	37	52	391	...	...
Peru	125 065	46 251	7 665	38 651	30 600	29 441	31 634	34 929	47 162	41 108
87 Fishing area total	*246 265*	*162 291*	*123 008*	*112 248*	*78 036*	*77 436*	*77 534*	*83 256*	*94 306*	*90 305*
Species total	*246 265*	*162 291*	*123 008*	*112 248*	*78 036*	*77 436*	*77 534*	*83 256*	*94 306*	*90 305*
Argentine hake	**Merlu d'Argentine**		**Merluza argentina**		***Merluccius hubbsi***				**1,48(05)004,06**	**HKP**
41 Argentina	249 443	358 819	334 098	416 739	361 971	353 109	301 691	263 323	280 679	281 757
Belize	4	0	-	-	-	-	-	-	-	-

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Cods, hakes, haddocks
Morues, merlus, églefins
Bacalaos, merluzas, eglefinos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Brazil	2 654	4 513	3 072	1 419	1 770	1 952	2 075	1 826	2 014	1 901
Estonia	-	-	-	575	700	700	-	-	-	1 125
Falkland Is	1 462	2 540	3 752	7 885	4 909	5 619	4 762	3 871	5 597	6 274
Japan	3	74	22	8	0	0	-	0	-	0
Namibia	-	-	-	0	-	-	-	-	-	-
Portugal	-	-	-	1	1	-	-	-	-	-
Russian Fed	197	86	186	34	-	-	-	-	-	-
St Vincent	5	-	-	-	-	-	-	-	-	-
Spain	25 302	13 572	3 810	12 131	11 248	14 162	7 604	11 973	13 759	20 347
UK	83	233	96	91	639	103	120	427	228	401
Uruguay	27 618	32 231	35 247	41 705	41 477	31 231	30 580	34 096	29 025	33 880
41 Fishing area total	*306 771*	*412 068*	*380 283*	*480 588*	*422 715*	*406 876*	*346 832*	*315 516*	*331 302*	*345 685*
Species total	*306 771*	*412 068*	*380 283*	*480 588*	*422 715*	*406 876*	*346 832*	*315 516*	*331 302*	*345 685*
North Pacific hake	**Merlu du Pacifique nord**		**Merluza del Pacífico norte**		***Merluccius productus***				**1,48(05)004,07**	**NHA**
67 Canada	61 016	56 872	69 057	124 872	104 189	96 198	73 448	73 750	55 885	48 013
USA	172 050	129 599	140 326	215 244	258 229	258 770	206 519	241 050	114 788	161 150
67 Fishing area total	*233 066*	*186 471*	*209 383*	*340 116*	*362 418*	*354 968*	*279 967*	*314 800*	*170 673*	*209 163*
77 Mexico	852	1 194	987	1 090	1 610	1 681	1 087	1 554	1 330	1 246
USA	1	0	1	1	41	2	1	0	0	0
77 Fishing area total	*853*	*1 194*	*988*	*1 091*	*1 651*	*1 683*	*1 088*	*1 554*	*1 330*	*1 246*
Species total	*233 919*	*187 665*	*210 371*	*341 207*	*364 069*	*356 651*	*281 055*	*316 354*	*172 003*	*210 409*
Benguela hake	**Merlu d'Afrique tropicale**		**Merluza de Benguela**		***Merluccius polli***				**1,48(05)004,08**	**HKB**
34 Cameroon	-	3	0	0	0	0	0	0	0	0
Ghana	-	-	1	-	-	-	-	1 005	...	...
Nigeria	-	1 714	2 551	2 503	2 536	3 023	2 657	1 461	1 801	1 363
Other nei	139	504	...	...	...	...	...	...	...	...
34 Fishing area total	*139*	*2 221*	*2 552*	*2 503*	*2 536*	*3 023*	*2 657*	*2 466*	*1 801*	*1 363*
47 Russian Fed	-	1	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	155	5 161	4 043
47 Fishing area total	*-*	*1*	*-*	*-*	*-*	*-*	*-*	*155*	*5 161*	*4 043*
Species total	*139*	*2 222*	*2 552*	*2 503*	*2 536*	*3 023*	*2 657*	*2 621*	*6 962*	*5 406*
Offshore silver hake	**Merlu argenté du large**		**Merluza blanca de altura**		***Merluccius albidus***				**1,48(05)004,12**	**HOF**
21 USA	2	6	10	23	14	37	12	21	22	10
21 Fishing area total	*2*	*6*	*10*	*23*	*14*	*37*	*12*	*21*	*22*	*10*
Species total	*2*	*6*	*10*	*23*	*14*	*37*	*12*	*21*	*22*	*10*
Panama hake	**Merlu du Panama**		**Merluza panameña**		***Merluccius angustimanus***				**1,48(05)004,14**	**MRG**
87 Colombia	391	...	54	61	85	60 F	40 F	20 F	...	...
87 Fishing area total	*391*	*...*	*54*	*61*	*85*	*60 F*	*40 F*	*20 F*	*...*	*...*
Species total	*391*	*...*	*54*	*61*	*85*	*60 F*	*40 F*	*20 F*	*...*	*...*
Shallow-water Cape hake	**Merlu côtier du Cap**		**Merluza del Cabo**		***Merluccius capensis***				**1,48(05)004,19**	**HKK**
47 Angola	1 863	3 225	1 457	1 799	1 600 F	1 800	5 876	2 565	2 146	2 070 F
47 Fishing area total	*1 863*	*3 225*	*1 457*	*1 799*	*1 600 F*	*1 800*	*5 876*	*2 565*	*2 146*	*2 070 F*
Species total	*1 863*	*3 225*	*1 457*	*1 799*	*1 600 F*	*1 800*	*5 876*	*2 565*	*2 146*	*2 070 F*
Cape hakes	**Merlus du Cap**		**Merluzas del Cabo**		***Merluccius capensis,M.paradox.***				**1,48(05)004,XX**	**HKC**
47 Namibia	173 277	156 499	192 275	173 902	158 060	135 879	125 534	126 284	136 920	140 000 F
Poland	-	-	-	39	5	-	-	-	-	-
Portugal	1	-	-	-	-	-	8	2	4	4
Russian Fed	49	2	3 307	-	-	-	-	-	-	-
South Africa	146 393	149 548	139 160	153 252	143 987	132 943	141 357	132 426	107 489	108 960
Spain	3 349	338	2 145	3 529	610	1 849	2 689	2 863	5 019	7 420
Ukraine	4	-	-	-	-	-	-	-	-	-
47 Fishing area total	*323 073*	*306 387*	*336 887*	*330 722*	*302 662*	*270 671*	*269 588*	*261 575*	*249 432*	*256 384 F*
51 South Africa	1	-	1	3	5	5	3	3	3	4
51 Fishing area total	*1*	*-*	*1*	*3*	*5*	*5*	*3*	*3*	*3*	*4*
Species total	*323 074*	*306 387*	*336 888*	*330 725*	*302 667*	*270 676*	*269 591*	*261 578*	*249 435*	*256 388 F*
Hakes nei	**Merlus nca**		**Merluzas nep**		***Merluccius spp***				**1,48(05)004,XX**	**HKX**
34 Belize	8	13	...	...	...	...	...	...	...	272
China	-	2	653	...	-	0	-	-	...	1
Comoros	-	-	-	-	-	-	...	...	...	22
Cyprus	115	-	-	-	-	-	-	-	-	-
Guinea	3	...	...	...	...	...	...	...	...	...
Honduras	-	-	-	-	-	42	-	-	-	-
Korea Rep	15	-	-	-	-	-	-	30	-	177
Lithuania	43	189	392	302	122	56	77	8	6	5
Mauritania	1 324	817	700 F	612	360	349	254	112	29	16

B-32 **Cods, hakes, haddocks**
Morues, merlus, églefins
Bacalaos, merluzas, eglefinos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Panama	-	5	-	-	-	-	-	-	...	...
Portugal	11	-	-	314	48	5	25	3	-	-
Russian Fed	-	647	309	22	-	9	5	2	6	35
St Kitts Nev	-	-	-	-	-	-	-	-	-	3
St Vincent	55	130	...	...	...	...	...	...	...	6
34 Fishing area total	*1 574*	*1 803*	*2 054 F*	*1 250*	*530*	*461*	*361*	*155*	*41*	*537*
41 Korea Rep	-	-	-	1 434	1 661	1 297	1 047	845	1 207	2 160
Portugal	354	186	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	254	100
41 Fishing area total	*354*	*186*	*-*	*1 434*	*1 661*	*1 297*	*1 047*	*845*	*1 461*	*2 260*
Species total	*1 928*	*1 989*	*2 054 F*	*2 684*	*2 191*	*1 758*	*1 408*	*1 000*	*1 502*	*2 797*
Patagonian grenadier	**Grenadier de Patagonie**		**Merluza de cola**		***Macruronus magellanicus***				**1,48(05)017,01**	**GRM**
41 Argentina	111 836	98 723	97 773	116 944	115 270	124 608	98 782	110 267	110 717	82 665
Belize	374	1	-	-	-	-	-	-	-	-
Chile	1 308	2 097	613	1 533	37	309	327	113	-	-
Estonia	108	-	-	189	-	73	-	-	-	135
Falkland Is	5 942	10 068	9 816	10 065	5 977	6 128	5 083	4 139	6 033	4 084
Japan	735	756	871	1 998	1 203	743	141	1 956	1 267	917
Korea Rep	1 553	1 584	947	1 303	2 603	171	600	249	792	667
Namibia	-	-	-	7	-	-	-	-	-	-
Panama	-	-	-	-	-	-	4	-	-	-
Poland	73	-	-	-	-	-	-	-	-	-
Russian Fed	173	2	35	93	-	-	-	-	-	-
Spain	13 599	12 949	11 343	11 840	9 008	12 129	10 350	9 386	15 176	13 511
UK	30	52	88	189	23	135	166	68	174	98
Uruguay	635	1 002	1 971	1 536	2 061	1 477	1 285	2 268	840	1 059
41 Fishing area total	*136 366*	*127 234*	*123 457*	*145 697*	*136 182*	*145 773*	*116 738*	*128 446*	*134 999*	*103 136*
87 Chile	160 774	131 321	85 283	69 644	79 718	73 112	63 370	73 454	78 440	74 330
87 Fishing area total	*160 774*	*131 321*	*85 283*	*69 644*	*79 718*	*73 112*	*63 370*	*73 454*	*78 440*	*74 330*
Species total	*297 140*	*258 555*	*208 740*	*215 341*	*215 900*	*218 885*	*180 108*	*201 900*	*213 439*	*177 466*
Blue grenadier	**Grenadier bleu**		**Cola de rata azul**		***Macruronus novaezelandiae***				**1,48(05)017,02**	**GRN**
57 Australia	7 313	9 014	8 760	8 773	6 562	4 313	2 237	3 458	2 146	3 420
57 Fishing area total	*7 313*	*9 014*	*8 760*	*8 773*	*6 562*	*4 313*	*2 237*	*3 458*	*2 146*	*3 420*
81 Australia	267	165	113	87	102	155	1 630	108	1 833	51
Japan	13 087	13 000	7 407	-	-	-	-	-	-	-
Korea Rep	9 484	9 627	10 155	6 241	6 399	6 726	6 048	6 827	6 289	9 235
New Zealand	223 703	192 482	181 110	134 435	127 644	104 973	101 859	96 011	91 465	109 969
Ukraine	1 300	28	10 629	6 269	...	7 475	...	...	...	...
81 Fishing area total	*247 841*	*215 302*	*209 414*	*147 032*	*134 145*	*119 329*	*109 537*	*102 946*	*99 587*	*119 255*
Species total	*255 154*	*224 316*	*218 174*	*155 805*	*140 707*	*123 642*	*111 774*	*106 404*	*101 733*	*122 675*
Roughhead grenadier	**Grenadier berglax**		**Granadero berglax**		***Macrourus berglax***				**1,48(06)001,03**	**RHG**
21 Estonia	-	-	94	217	102	95	69	132	41	93
Lithuania	28	3	8	-	-	-	-	2	-	5
Norway	1	8	36	7	8	2	2	2	4	7
Portugal	610	508	268	379	262	78	33	50	265	82
Russian Fed	-	-	-	-	58	39	143	126	34	20
Spain	1 103	905	1 196	559	687	312	166	188	80	550
21 Fishing area total	*1 742*	*1 424*	*1 602*	*1 162*	*1 117*	*526*	*413*	*500*	*424*	*757*
27 Estonia	-	-	-	-	1	-	-	-	-	-
France	4	7	19	14	14	43	25	20	6	1
Iceland	3	11	33	3	5	7	2	-	5	23
Ireland	-	-	138	276	345	138	18	-	-	-
Lithuania	-	-	-	-	-	-	48	74	-	-
Norway	181	89	87	141	132	81	45	55	60	41
Poland	-	-	-	-	-	1	1	5	0	4
Russian Fed	-	-	-	-	31	15	16	14	2	20
Spain	-	-	427	-	297	-	-	200	1 413	808
UK	16	7	3	19	2	1	-	-	0	1
27 Fishing area total	*204*	*114*	*707*	*453*	*827*	*286*	*155*	*368*	*1 486*	*898*
Species total	*1 946*	*1 538*	*2 309*	*1 615*	*1 944*	*812*	*568*	*868*	*1 910*	*1 655*
Whitson's grenadier	**...B**		**...C**		***Macrourus whitsoni***				**1,48(06)001,04**	**WGR**
48 Russian Fed	0	-	-	-	-	-	-	-	-	-
48 Fishing area total	*0*	-	-	-	-	-	-	-	-	-
58 Australia	-	-	-	0	36	1	3	67	0	1
Japan	-	-	-	-	-	-	8	-	-	-
Korea Rep	-	-	-	-	2	-	-	13	-	-
Namibia	-	-	-	-	-	-	2	5	-	-
New Zealand	-	-	-	-	4	0	-	-	-	-
South Africa	-	-	-	1	-	-	-	-	-	-
58 Fishing area total	-	-	-	*1*	*42*	*1*	*13*	*85*	*0*	*1*
88 Argentina	-	-	-	25	-	-	-	-	-	-

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Cods, hakes, haddocks
Morues, merlus, églefins
Bacalaos, merluzas, eglefinos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Korea Rep	-	-	-	-	-	-	-	0	-	2
New Zealand	49	158	71	140	195	73	51	61	73	78
Russian Fed	-	-	-	2	3	8	17	12	-	-
South Africa	-	-	1	9	-	-	-	-	-	-
Ukraine	-	-	-	3	-	-	-	-	-	-
88 Fishing area total	*49*	*158*	*72*	*179*	*198*	*81*	*68*	*73*	*73*	*80*
Species total	*49*	*158*	*72*	*180*	*240*	*82*	*81*	*158*	*73*	*81*
Ridge scaled rattail	**...B**		**...C**		***Macrourus carinatus***				**1,48(06)001,05**	**MCC**
41 Argentina	3 200	5 329	8 196	5 067	1 826	2 356	2 201	12 542	5 378	4 332
Falkland Is	-	-	-	...	9	4	31	20	5	25
41 Fishing area total	*3 200*	*5 329*	*8 196*	*5 067*	*1 835*	*2 360*	*2 232*	*12 562*	*5 383*	*4 357*
47 Japan	-	-	-	-	-	15	-	-	-	-
47 Fishing area total	-	-	-	-	-	*15*	-	-	-	-
58 Australia	-	-	1	15	0	17	-	0	-	-
France	-	-	-	-	-	-	-	951	1 167	997
58 Fishing area total	-	-	*1*	*15*	*0*	*17*	-	*951*	*1 167*	*997*
81 New Zealand	-	-	-	-	-	-	9	14	30	40
81 Fishing area total	-	-	-	-	-	-	*9*	*14*	*30*	*40*
88 New Zealand	-	0	-	0	-	-	-	-	-	-
88 Fishing area total	-	*0*	-	*0*	-	-	-	-	-	-
Species total	*3 200*	*5 329*	*8 197*	*5 082*	*1 835*	*2 392*	*2 241*	*13 527*	*6 580*	*5 394*
Bigeye grenadier	**Grenadier à gros yeux**		**Granadero ojisapo**		***Macrourus holotrachys***				**1,48(06)001,06**	**MCH**
41 Ukraine	-	-	-	-	-	2	11	53	-	-
41 Fishing area total	-	-	-	-	-	*2*	*11*	*53*	-	-
58 Australia	-	-	1	2	1	0	-	2	-	-
58 Fishing area total	-	-	*1*	*2*	*1*	*0*	-	*2*	-	-
Species total	-	-	*1*	*2*	*1*	*2*	*11*	*55*	-	-
Grenadiers nei	**Grenadiers nca**		**Granaderos nep**		***Macrourus spp***				**1,48(06)001,XX**	**GRV**
41 Falkland Is	-	-	-	133	247	158	108	126	94	168
Korea Rep	-	-	-	64	-	657	1 027	858	1 376	1 593
Portugal	1	19	-	-	-	-	-	-	-	-
Russian Fed	-	524	41	1	-	-	-	-	-	11
Spain	-	-	-	-	522	626	463	797	851	251
UK	-	-	-	-	-	7	19	-	1	0
Uruguay	8	180	16	-	-	1	9	1	...	...
41 Fishing area total	*9*	*723*	*57*	*198*	*769*	*1 449*	*1 626*	*1 782*	*2 322*	*2 023*
48 Chile	-	-	-	-	7	-	3	4	4	3
Japan	-	-	-	0	6	10	9	1	4	4
Korea Rep	-	-	7	5	-	1	2	0	1	6
New Zealand	-	-	13	-	-	36	48	40	30	17
Norway	-	-	-	-	-	-	3	-	-	-
Poland	3	-	-	-	-	-	-	-	-	-
Russian Fed	1	-	11	-	-	-	-	-	-	-
South Africa	-	-	11	2	12	6	11	9	4	3
Spain	-	-	1	-	6	4	5	19	18	12
UK	2	-	16	51	104	81	64	94	72	48
Uruguay	-	-	0	8	-	10	10	10	7	2
48 Fishing area total	*6*	-	*59*	*66*	*135*	*148*	*155*	*177*	*140*	*95*
58 Australia	-	-	15	29	34	9	62	19	119	102
Chile	-	-	-	-	24	1	-	-	-	-
France	159	635	818	834	514	591	620	-	-	-
Japan	-	-	-	-	-	-	-	10	4	8
Korea Rep	-	-	-	-	4	14	24	19	8	5
Namibia	-	-	-	-	-	-	-	1	-	-
New Zealand	-	-	-	-	13	-	-	-	-	-
South Africa	44	14	19	17	11	10	14	8	3	5
Spain	-	-	-	-	7	8	12	7	-	-
Uruguay	-	-	-	-	-	4	20	1	2	-
58 Fishing area total	*203*	*649*	*852*	*880*	*607*	*637*	*752*	*65*	*136*	*120*
88 Argentina	-	-	-	59	31	47	35	0	-	4
Chile	-	-	-	-	-	-	-	-	39	-
Korea Rep	-	-	-	2	-	-	8	5	6	5
Norway	-	-	-	69	93	-	48	-	-	-
Russian Fed	-	-	3	-	-	-	-	-	-	-
South Africa	6	-	-	-	-	-	1	3	21	-
Spain	-	-	-	9	-	-	-	0	3	13
UK	-	-	-	15	41	-	35	35	83	62
USA	-	-	-	39	-	-	-	-	-	-
Uruguay	-	-	-	26	51	55	12	13	15	-
88 Fishing area total	*6*	-	*3*	*219*	*216*	*102*	*139*	*56*	*167*	*84*
Species total	*224*	*1 372*	*971*	*1 363*	*1 727*	*2 336*	*2 672*	*2 080*	*2 765*	*2 322*

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Cods, hakes, haddocks
Morues, merlus, églefins
Bacalaos, merluzas, eglefinos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Roundnose grenadier	**Grenadier de roche**		**Granadero de roca**		***Coryphaenoides rupestris***				**1,48(06)004,01**	**RNG**
21 Canada	2	3	1	0	0	0	3	8	0	1
Estonia	21	24	49	170	55	43	-	-	-	-
Faroe Is	4	1	-	-	3	1	0	-	0	-
Germany	5	3	6	5	4	2	4	-	-	3
Greenland	22	21	37	-	1	17	13	7	1	-
Japan	124	88	186	123	54	-	-	-	-	-
Latvia	-	-	-	2	-	-	-	-	-	-
Lithuania	-	14	-	-	46	4	4	-	-	0
Norway	3	7	14	-	5	9	4	1	4	9
Poland	1	-	-	-	-	-	-	-	-	-
Portugal	-	-	26	-	-	56	36	31	197	27
Russian Fed	186	233	116	548	12	-	1	5	41	68
Spain	5 126	4 518	3 399	2 401	2 421	1 035	338	634	340	410
21 Fishing area total	*5 494*	*4 912*	*3 834*	*3 249*	*2 601*	*1 167*	*403*	*686*	*583*	*518*
27 Denmark	2 229	3 150	4 125	11 429	14 312	2 715	-	-	1	1
Estonia	680	824	52	26	99	61	140	-	-	-
Faroe Is	96	178	521	529	491	954	852	681	327	242
France	8 494	8 847	6 941	7 486	4 613	3 152	2 702	2 672	2 209	3 092
Germany	18	25	39	27	14	18	16	17	24	33
Greenland	5	5	6	-	1	1	3	0	1	-
Iceland	57	70	59	181	76	62	13	29	46	59
Ireland	-	-	60	52	72	141	30	0	-	-
Lithuania	137	1 835	970	1 081	105	118	39	28	-	-
Norway	76	52	10	138	20	26	15	10	10	28
Poland	178	933	483	34	-	-	-	-	-	-
Russian Fed	1 806	769	589	524	1 478	2	1	41	12	79
Spain	33 099	5 714	18 439	352	5 327	5 251	5 879	3 636	1 352	3 534
Sweden	258	262	82	0	1	0	-	-	-	-
UK	1 030	759	167	154	2 885	15	4	8	19	25
27 Fishing area total	*48 163*	*23 423*	*32 543*	*22 013*	*29 494*	*12 516*	*9 694*	*7 122*	*4 001*	*7 093*
48 Poland	-	9	-	-	-	-	-	-	-	-
48 Fishing area total	*-*	*9*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
Species total	*53 657*	*28 344*	*36 377*	*25 262*	*32 095*	*13 683*	*10 097*	*7 808*	*4 584*	*7 611*
Grenadiers, whiptails nei	**...B**		**...C**		***Coryphaenoides spp***				**1,48(06)004,XX**	**CVY**
88 New Zealand	-	0	-	-	-	-	-	-	-	-
88 Fishing area total	*-*	*0*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
Species total	*-*	*0*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
Chilean grenadier	**...B**		**Pejerrata**		***Caelorinchus chilensis***				**1,48(06)005,12**	**CQO**
87 Chile	...	...	...	11	2	33	62	63	65	156
87 Fishing area total	*...*	*...*	*...*	*11*	*2*	*33*	*62*	*63*	*65*	*156*
Species total	*...*	*...*	*...*	*11*	*2*	*33*	*62*	*63*	*65*	*156*
Roughsnout grenadier	**...B**		**...C**		***Trachyrincus scabrus***				**1,48(06)008,02**	**TSU**
27 Lithuania	-	-	-	-	272	573	543	99	-	-
27 Fishing area total	*-*	*-*	*-*	*-*	*272*	*573*	*543*	*99*	*-*	*-*
Species total	*-*	*-*	*-*	*-*	*272*	*573*	*543*	*99*	*-*	*-*
Dogtooth grenadier	**Grenadier denté**		**Granadero dentón**		***Cynomacrurus piriei***				**1,48(06)014,01**	**MNI**
58 Australia	...	...	0	0	1	-	-	-	0	-
58 Fishing area total	*...*	*...*	*0*	*0*	*1*	*-*	*-*	*-*	*0*	*-*
Species total	*...*	*...*	*0*	*0*	*1*	*-*	*-*	*-*	*0*	*-*
Common Atlantic grenadier	**Grenadier lisse**		**Granadero liso**		***Nezumia aequalis***				**1,48(06)021,02**	**NZA**
27 Ireland	-	-	28	39	8	-	-	-	-	-
27 Fishing area total	*-*	*-*	*28*	*39*	*8*	*-*	*-*	*-*	*-*	*-*
Species total	*-*	*-*	*28*	*39*	*8*	*-*	*-*	*-*	*-*	*-*
Thorntooth grenadier	**...B**		**...C**		***Lepidorhynchus denticulatus***				**1,48(06)030,01**	**LDE**
81 New Zealand	4 783	5 349	5 253	6 273	3 855	4 012	3 725	3 264	2 827	3 258
Ukraine	-	-	51	68	...	44	...	...	...	...
81 Fishing area total	*4 783*	*5 349*	*5 304*	*6 341*	*3 855*	*4 056*	*3 725*	*3 264*	*2 827*	*3 258*
Species total	*4 783*	*5 349*	*5 304*	*6 341*	*3 855*	*4 056*	*3 725*	*3 264*	*2 827*	*3 258*
Grenadiers, rattails nei	**...B**		**Granaderos, colas de ratón nep**		***Macrouridae***				**1,48(06)XXX,XX**	**RTX**
48 Chile	-	-	-	-	-	3	-	-	-	-
48 Fishing area total	*-*	*-*	*-*	*-*	*-*	*3*	*-*	*-*	*-*	*-*
58 Namibia	-	-	-	-	-	-	-	2	-	-

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Cods, hakes, haddocks
Morues, merlus, églefins
Bacalaos, merluzas, eglefinos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
58 Fishing area total	-	-	-	-	-	-	-	*2*	-	-
61 Korea Rep	-	-	-	2	-	-	-	-	-	-
Russian Fed	2 232	10 817	17 560	20 996	23 004	16 922	21 786	16 266	29 499	20 508
61 Fishing area total	*2 232*	*10 817*	*17 560*	*20 998*	*23 004*	*16 922*	*21 786*	*16 266*	*29 499*	*20 508*
67 Russian Fed	-	36	-	-	-	-	-	-	7	-
USA	160	120	185	65	63	66	49	37	63	74
67 Fishing area total	*160*	*156*	*185*	*65*	*63*	*66*	*49*	*37*	*70*	*74*
77 USA	145	156	130	114	99	58	82	85	49	62
77 Fishing area total	*145*	*156*	*130*	*114*	*99*	*58*	*82*	*85*	*49*	*62*
81 Korea Rep	-	-	15	67	-	162	-	-	-	-
New Zealand	3 094	3 866	4 223	3 636	2 660	2 668	1 891	2 143	2 015	2 206
Ukraine	-	11	15	29	...	18	...	...	...	...
81 Fishing area total	*3 094*	*3 877*	*4 253*	*3 732*	*2 660*	*2 848*	*1 891*	*2 143*	*2 015*	*2 206*
87 Belize	...	...	-	525	-	-	-	-	-	-
87 Fishing area total	*...*	*...*	-	*525*	-	-	-	-	-	-
Species total	*5 631*	*15 006*	*22 128*	*25 434*	*25 826*	*19 897*	*23 808*	*18 533*	*31 633*	*22 850*

Gadiformes nei	**Gadiformes nca**		**Gadiformes nep**		***Gadiformes***				**1,48(XX)XXX,XX**	**GAD**
18 Russian Fed	-	-	-	-	-	-	2	1	-	1
18 Fishing area total	-	-	-	-	-	-	*2*	*1*	-	*1*
21 Faroe Is	-	-	-	-	-	-	-	-	-	2
Norway	-	-	5	-	-	0	0	-	-	-
Portugal	-	24	-	2	1	-	-	-	-	-
USA	3	2	-	34	4	5	3	41	81	67
21 Fishing area total	*3*	*26*	*5*	*36*	*5*	*5*	*3*	*41*	*81*	*69*
27 Channel Is	-	-	-	-	-	-	-	-	-	1
Faroe Is	948	1 246	941	683	2 728	303	717	677	1 444	2 963
France	3 092	4 268	-	-	-	1	-	1	1	-
Iceland	-	-	-	-	-	-	-	4	-	-
Ireland	55	8	13	10	3	1	0	1	0	0
Norway	-	-	-	-	-	0	0	-	-	-
Portugal	1	-	1	-	-	17	2	1	1	26
Spain	25 971	8 310	32 208	612	273	501	1 691	6 781	16 675	4 658
Sweden	160	-	-	-	-	-	-	0	-	-
27 Fishing area total	*30 227*	*13 832*	*33 163*	*1 305*	*3 004*	*823*	*2 410*	*7 465*	*18 121*	*7 648*
31 USA	2	3	-	2	2	2	1	3	1	1
31 Fishing area total	*2*	*3*	-	*2*	*2*	*2*	*1*	*3*	*1*	*1*
34 Korea Rep	-	-	-	-	-	-	-	-	-	10
Netherlands	-	-	-	-	-	6	-	-	-	-
Portugal	-	1	3	-	-	-	28	18	15	3
Spain	25	57	160	46	56	143	10	16	8	12
34 Fishing area total	*25*	*58*	*163*	*46*	*56*	*149*	*38*	*34*	*23*	*25*
37 Croatia	...	...	...	...	...	...	...	...	7	9
France	-	-	-	-	1	0	-	-	1	4
Lebanon	30	28	27	25	26	25	25 F	25 F	25 F	25 F
Spain	1 067	289	368	55	67	82	60	48	46	66
37 Fishing area total	*1 097*	*317*	*395*	*80*	*94*	*107*	*85 F*	*73 F*	*79 F*	*104 F*
41 Korea Rep	538	154	24	192	249	-	-	-	116	75
Spain	2 601	-	-	-	-	1	2	1	-	-
UK	3	5	-	-	-	-	-	-	-	-
41 Fishing area total	*3 142*	*159*	*24*	*192*	*249*	*1*	*2*	*1*	*116*	*75*
47 Portugal	-	-	-	-	-	-	0	1	-	-
Spain	-	-	-	-	-	-	-	-	-	3
47 Fishing area total	-	-	-	-	-	-	*0*	*1*	-	*3*
51 Korea Rep	-	-	-	-	-	-	-	55	-	-
51 Fishing area total	-	-	-	-	-	-	-	*55*	-	-
57 Australia	5	9	5	18	2	14	11	9	5	7
Korea Rep	30	-	-	-	-	-	-	-	-	-
57 Fishing area total	*35*	*9*	*5*	*18*	*2*	*14*	*11*	*9*	*5*	*7*
61 China	-	-	23 823 F	20 853 F	10 050 F	16 535 F	21 216	...	...	...
Korea Rep	0	0	0	0	0	0	0	-	-	-
Russian Fed	1	13	6	1	-	-	1	-	-	4
61 Fishing area total	*1*	*13*	*23 829 F*	*20 854 F*	*10 050 F*	*16 535 F*	*21 217*	*...*	*...*	*4*
71 Australia	60	104	98	60	89	95	51	42	50	151
71 Fishing area total	*60*	*104*	*98*	*60*	*89*	*95*	*51*	*42*	*50*	*151*
77 Mexico	53	71	47	40	-	-	34	62	...	...
77 Fishing area total	*53*	*71*	*47*	*40*	-	-	*34*	*62*	*...*	*...*
81 Australia	3	2	3	5	2	1	0	0	0	1
Japan	1 960	2 981	2 940	-	-	-	-	-	-	-

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Cods, hakes, haddocks
Morues, merlus, églefins
Bacalaos, merluzas, eglefinos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Korea Rep	2 511	258	316	259	1 191	-	739	875	1 331	409
New Zealand	8	11	22	34	24	45	28	11	9	13
Ukraine	997	-	-	-	-	-	-	-	-	-
81 Fishing area total	*5 479*	*3 252*	*3 281*	*298*	*1 217*	*46*	*767*	*886*	*1 340*	*423*
Species total	*40 124*	*17 844*	*61 010 F*	*22 931 F*	*14 768 F*	*17 777 F*	*24 621 F*	*8 673 F*	*19 816 F*	*8 511 F*
Group total	***9 304 940***	***8 472 517***	***9 381 777***	***9 400 772***	***8 971 420***	***8 986 730***	***8 352 379***	***7 689 964***	***6 949 409***	***7 426 888***

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Broadgilled hagfish	**...B**		**...C**		***Eptatretus cirrhatus***				**1,03(03)006,03**	**MWC**
81 New Zealand	-	2	-	0	0	11	508	347	364	1 142
81 Fishing area total	*-*	*2*	*-*	*0*	*0*	*11*	*508*	*347*	*364*	*1 142*
Species total	*-*	*2*	*-*	*0*	*0*	*11*	*508*	*347*	*364*	*1 142*
Hagfishes nei	**Mixynes nca**		**Mixinos nep**		***Myxinidae***				**1,03(03)XXX,XX**	**MYX**
21 USA	687	1 362	1 055	1 339	809	383	992	1 954	1 853	925
21 Fishing area total	*687*	*1 362*	*1 055*	*1 339*	*809*	*383*	*992*	*1 954*	*1 853*	*925*
61 Korea Rep	3	0	63	58	11	15	29	37	18	15
61 Fishing area total	*3*	*0*	*63*	*58*	*11*	*15*	*29*	*37*	*18*	*15*
67 USA	53	313	431	236	617	446	990	1 481	1 184	1 725
67 Fishing area total	*53*	*313*	*431*	*236*	*617*	*446*	*990*	*1 481*	*1 184*	*1 725*
77 USA	-	-	-	1	54	68	302	416	497	198
77 Fishing area total	*-*	*-*	*-*	*1*	*54*	*68*	*302*	*416*	*497*	*198*
Species total	*743*	*1 675*	*1 549*	*1 634*	*1 491*	*912*	*2 313*	*3 888*	*3 552*	*2 863*
Ladyfish	**Guinée-machète**		**Malacho**		***Elops saurus***				**1,29(01)003,02**	**LAD**
21 USA	0	0	0	0	0	0	0	0	-	-
21 Fishing area total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	-	-
31 Colombia	...	398	...	15	0	5 F	10 F	16 F	22	30
Mexico	...	...	...	...	388	405	426	238	278	231
USA	460	655	726	434	871	814	538	406	271	712
31 Fishing area total	*460*	*1 053*	*726*	*449*	*1 259*	*1 224 F*	*974 F*	*660 F*	*571*	*973*
Species total	*460*	*1 053*	*726*	*449*	*1 259*	*1 224 F*	*974 F*	*660 F*	*571*	*973*
West African ladyfish	**Guinée d'Afrique occidentale**		**Malacho de Africa occidental**		***Elops lacerta***				**1,29(01)003,04**	**CEC**
34 Benin	15	16	25	19	...	23	19	15	23	12
Gambia	12	26	3	40	767	1 247	962	941	982	982
Nigeria	531	1 076	787	678	785	875	442	658	732	814
Senegal	...	...	148	147	41	16	137	170	844	307
Togo	...	...	...	...	1	23	24	12 F	1	-
34 Fishing area total	*558*	*1 118*	*963*	*884*	*1 594*	*2 184*	*1 584*	*1 796 F*	*2 582*	*2 115*
Species total	*558*	*1 118*	*963*	*884*	*1 594*	*2 184*	*1 584*	*1 796 F*	*2 582*	*2 115*
Tarpon	**Tarpon argenté**		**Tarpón**		***Megalops atlanticus***				**1,29(02)004,01**	**TAR**
31 Colombia	...	443	...	18	4	5 F	5 F	5 F	...	20
Dominican Rp	14	48	95	25	13	26	21	37	33	35
Fr Guiana	...	...	...	...	6	21	44	30	25	28 F
Mexico	1	1	4	4	1	1	1	1	1	...
Puerto Rico	1	2	2	1	0	0	0	-	0	-
Suriname	...	...	121	98	113	...	...	...	...	...
31 Fishing area total	*16*	*494*	*222*	*146*	*137*	*53 F*	*71 F*	*73 F*	*59*	*83 F*
41 Brazil	1 169	1 075	1 067	1 035	860	898	636	785	865	818
41 Fishing area total	*1 169*	*1 075*	*1 067*	*1 035*	*860*	*898*	*636*	*785*	*865*	*818*
Species total	*1 185*	*1 569*	*1 289*	*1 181*	*997*	*951 F*	*707 F*	*858 F*	*924*	*901 F*
Indo-Pacific tarpon	**Tarpon indo-pacifique**		**Tarpón del Indo-Pacífico**		***Megalops cyprinoides***				**1,29(02)004,02**	**TAI**
57 Malaysia	12	11	6	15	24	34	36	21	29	30
57 Fishing area total	*12*	*11*	*6*	*15*	*24*	*34*	*36*	*21*	*29*	*30*
71 Malaysia	92	51	129	124	302	294	192	512	62	107
Philippines	1 365	1 526	1 430	1 366	1 276	1 327	1 281	1 326	1 388	1 542
71 Fishing area total	*1 457*	*1 577*	*1 559*	*1 490*	*1 578*	*1 621*	*1 473*	*1 838*	*1 450*	*1 649*
Species total	*1 469*	*1 588*	*1 565*	*1 505*	*1 602*	*1 655*	*1 509*	*1 859*	*1 479*	*1 679*
Bonefish	**Banane de mer**		**Macabí**		***Albula vulpes***				**1,30(01)005,01**	**BOF**
31 Dominican Rp	11	...	92	23	16	51	40	35	32	34
31 Fishing area total	*11*	*...*	*92*	*23*	*16*	*51*	*40*	*35*	*32*	*34*
34 Benin	...	...	9	9	16	7	6	...	...	...
Côte dIvoire	13	32	7	37	32	30	32	25 F	20	10
Gabon	-	0	0	-	0	1	0	...	...	...
Liberia	6	10	10	104	252	80	13	2	2 F	2 F
Senegal	...	9	14	23	1	12	17	38	10	10
Sierra Leone	496	153	265	453	850	330	474	942	920 F	920 F
34 Fishing area total	*515*	*204*	*305*	*626*	*1 151*	*460*	*542*	*1 007 F*	*952 F*	*942 F*
Species total	*526*	*204*	*397*	*649*	*1 167*	*511*	*582*	*1 042 F*	*984 F*	*976 F*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Long snouted lancetfish	**Lancier longnez**		**Lanzón picudo**		***Alepisaurus ferox***				**1,31(07)022,01**	**ALX**
27 Spain	-	-	-	-	-	-	-	-	5	-
27 Fishing area total	-	-	-	-	-	-	-	-	*5*	-
Species total	-	-	-	-	-	-	-	-	*5*	-
Bombay-duck	**Scopelidé**		**Bumalo**		***Harpadon nehereus***				**1,31(16)001,02**	**BUC**
04 India	473	230	60	283	121	1 595	321	504	634	331
04 Fishing area total	*473*	*230*	*60*	*283*	*121*	*1 595*	*321*	*504*	*634*	*331*
51 India	141 027	100 302	101 869	135 285	158 778	152 788	185 043	218 590	176 421	133 970
Pakistan	55	64	67	55	51	50	45	49	44	44
51 Fishing area total	*141 082*	*100 366*	*101 936*	*135 340*	*158 829*	*152 838*	*185 088*	*218 639*	*176 465*	*134 014*
57 Bangladesh	...	...	...	...	...	...	...	36 980	58 263	59 374
India	34 920	35 382	40 640	35 981	29 486	29 528	26 520	15 513	17 090	21 941
Indonesia	454	1 003	1 281	1 458	1 386	1 012	980	1 268	845	918
Malaysia	...	...	...	574	...	...	...	485	661	515
57 Fishing area total	*35 374*	*36 385*	*41 921*	*38 013*	*30 872*	*30 540*	*27 500*	*54 246*	*76 859*	*82 748*
71 Indonesia	7 747	6 369	5 436	3 854	2 914	4 708	4 770	5 101	5 424	6 058
Malaysia	...	...	...	1 426	...	...	...	1 906	2 440	2 135
71 Fishing area total	*7 747*	*6 369*	*5 436*	*5 280*	*2 914*	*4 708*	*4 770*	*7 007*	*7 864*	*8 193*
Species total	*184 676*	*143 350*	*149 353*	*178 916*	*192 736*	*189 681*	*217 679*	*280 396*	*261 822*	*225 286*
Atlantic lizardfish	**...B**		**...C**		***Synodus saurus***				**1,31(16)010,03**	**SDR**
37 Malta	...	...	...	...	...	...	...	...	0	2
37 Fishing area total	...	...	...	...	...	...	...	...	*0*	*2*
Species total	...	...	...	...	...	...	...	...	*0*	*2*
Greater lizardfish	**Anoli tumbil**		**Lagarto tumbil**		***Saurida tumbil***				**1,31(16)068,01**	**LIG**
51 Iran	3 894	4 247	3 634	2 655	4 167	3 656	2 575	2 564	3 030	3 393
Qatar	0	0	0	-	-	-	-	-	-	-
51 Fishing area total	*3 894*	*4 247*	*3 634*	*2 655*	*4 167*	*3 656*	*2 575*	*2 564*	*3 030*	*3 393*
57 Indonesia	919	1 428	4 054	3 525	3 689	4 633	5 522	4 912	7 106	5 485
57 Fishing area total	*919*	*1 428*	*4 054*	*3 525*	*3 689*	*4 633*	*5 522*	*4 912*	*7 106*	*5 485*
61 China,Taiwan	2 248	1 520	1 833	1 949	2 301	1 810	1 885	1 328	1 457	1 186
Japan	6 094	5 652	5 798	5 216	4 444	4 246	...	...	...	...
61 Fishing area total	*8 342*	*7 172*	*7 631*	*7 165*	*6 745*	*6 056*	*1 885*	*1 328*	*1 457*	*1 186*
71 Indonesia	11 035	10 482	17 992	13 278	14 689	15 551	20 907	15 483	15 851	13 345
71 Fishing area total	*11 035*	*10 482*	*17 992*	*13 278*	*14 689*	*15 551*	*20 907*	*15 483*	*15 851*	*13 345*
Species total	*24 190*	*23 329*	*33 311*	*26 623*	*29 290*	*29 896*	*30 889*	*24 287*	*27 444*	*23 409*
Brushtooth lizardfish	**Anoli à grandes écailles**		**Lagarto escamoso**		***Saurida undosquamis***				**1,31(16)068,04**	**LIB**
37 Israel	24	24	20	154	119	76	49	66 F	83	141
37 Fishing area total	*24*	*24*	*20*	*154*	*119*	*76*	*49*	*66 F*	*83*	*141*
51 Kuwait	32	20 F	11	18	15	17	23	17	20 F	20 F
51 Fishing area total	*32*	*20 F*	*11*	*18*	*15*	*17*	*23*	*17*	*20 F*	*20 F*
61 Korea Rep	758	33	644	29	77	17	349	102	279	-
61 Fishing area total	*758*	*33*	*644*	*29*	*77*	*17*	*349*	*102*	*279*	-
Species total	*814*	*77 F*	*675*	*201*	*211*	*110*	*421*	*185 F*	*382 F*	*161 F*
Lizardfishes nei	**Anolis nca**		**Lagartos nep**		***Synodontidae***				**1,31(16)XXX,XX**	**LIX**
01 Egypt	28	17	57	71	26	-	-	-	-	-
01 Fishing area total	*28*	*17*	*57*	*71*	*26*	-	-	-	-	-
37 Egypt	1 037	900	675	645	1 112	1 746	1 971	1 862	1 600	1 960
Palest, O.T.	10 F	9	6	11	7	13	11	11	20	32
Syria	60	86	70	62	105	64	57	42	56	42
Turkey	55	97	160	140	206	289	409	348	487	565
37 Fishing area total	*1 162 F*	*1 092*	*911*	*858*	*1 430*	*2 112*	*2 448*	*2 263*	*2 163*	*2 599*
51 Bahrain	-	-	-	-	-	1	1	4	21	6
Egypt	7 913	5 736	5 700	4 892	2 188	4 162	3 151	4 116	4 381	3 915
Eritrea	2 574	3 274	1 688	3 886	2 364	3 717	...	...	540	801
India	1 768	3 308	3 157	4 929	5 515	5 266	7 821	2 426	10 308	11 323
Portugal	-	-	2	-	-	-	-	-	-	-
Saudi Arabia	178	129	168	179	126	130	229	111	166	166
51 Fishing area total	*12 433*	*12 447*	*10 715*	*13 886*	*10 193*	*13 276*	*11 202*	*6 657*	*15 416*	*16 211*
57 India	1 960	2 201	2 293	3 516	2 386	2 644	2 802	1 627	1 705	2 444
Malaysia	9 997	11 346	10 379	12 110	11 230	11 102	11 985	10 430	12 049	15 037
Thailand	6 097	5 725	6 314	9 823	3 649	3 330	5 185	13 232	12 881	13 057
57 Fishing area total	*18 054*	*19 272*	*18 986*	*25 449*	*17 265*	*17 076*	*19 972*	*25 289*	*26 635*	*30 538*
61 China,H.Kong	6 400 F	6 250 F	5 800 F	6 200 F	6 000 F	5 700 F	5 700 F	5 850 F	5 880 F	6 220 F

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
61 Fishing area total	*6 400 F*	*6 250 F*	*5 800 F*	*6 200 F*	*6 000 F*	*5 700 F*	*5 700 F*	*5 850 F*	*5 880 F*	*6 220 F*
71 Malaysia	7 627	7 858	7 285	9 808	9 028	13 395	16 108	12 766	13 709	11 961
Philippines	5 751	7 029	6 198	5 895	4 922	5 283	5 858	5 448	7 525	7 346
Singapore	6	4	3	5	4	18	28	3	7	1
Thailand	65 821	73 330	66 496	47 194	49 389	42 459	37 563	15 053	14 038	14 546
71 Fishing area total	*79 205*	*88 221*	*79 982*	*62 902*	*63 343*	*61 155*	*59 557*	*33 270*	*35 279*	*33 854*
Species total	*117 282 F*	*127 299 F*	*116 451 F*	*109 366 F*	*98 257 F*	*99 319 F*	*98 879 F*	*73 329 F*	*85 373 F*	*89 422 F*
Giant catfish	**Mâchoiron titan**		**Bagre titán**		***Arius thalassinus***				**1,41(02)006,06**	**AUX**
51 Bahrain	...	...	...	299	202	59	83	80	70	32
Saudi Arabia	480	470	574	597	603	562	903	934	1 132	1 153
51 Fishing area total	*480*	*470*	*574*	*896*	*805*	*621*	*986*	*1 014*	*1 202*	*1 185*
Species total	*480*	*470*	*574*	*896*	*805*	*621*	*986*	*1 014*	*1 202*	*1 185*
...A	**...B**		**...C**		***Arius spp***				**1,41(02)006,XX**	**AWX**
01 Senegal	...	...	...	...	...	...	...	500	250 F	5
01 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*500*	*250 F*	*5*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*500*	*250 F*	*5*
Sea catfishes nei	**Mâchoirons nca**		**Bagres marinos nep**		***Ariidae***				**1,41(02)XXX,XX**	**CAX**
04 Philippines	3 868	4 394	4 548	3 587	3 056	2 028	2 327	2 482	1 905	1 973
04 Fishing area total	*3 868*	*4 394*	*4 548*	*3 587*	*3 056*	*2 028*	*2 327*	*2 482*	*1 905*	*1 973*
06 Papua N Guin	1 850 F	1 850 F	1 850 F	1 850 F	1 850 F	1 850 F	1 850 F	1 850 F	1 850 F	1 850 F
06 Fishing area total	*1 850 F*	*1 850 F*	*1 850 F*	*1 850 F*	*1 850 F*	*1 850 F*	*1 850 F*	*1 850 F*	*1 850 F*	*1 850 F*
31 Colombia	...	443	5	14	17	40 F	65 F	90 F	111	127
Fr Guiana	...	...	...	...	124	397	456	390	421	450 F
Guatemala	...	...	...	...	27	...	90	...	87	109
Mexico	6 308	5 829	1 538	2 197	4 998	5 219	4 289	3 901	3 681	3 232
Nicaragua	...	...	...	...	...	173	97	86	40	53
Suriname	...	...	2 113	2 559	2 086	...	...	...	...	...
USA	3	1	-	0	1	4	-	-	-	-
Venezuela	11 929	15 148	15 490	24 470 F	13 100 F	7 800 F	9 520 F	2 148	2 070 F	2 070 F
31 Fishing area total	*18 240*	*21 421*	*19 146*	*29 240 F*	*20 353 F*	*13 633 F*	*14 517 F*	*6 615 F*	*6 410 F*	*6 041 F*
34 Belize	-	15	-	...	3 409	375	-	408	...	...
Benin	2	2	3	12	10	10	8	5	1	1
Cameroon	410	589	649	430 F	209	339	339	345 F	379 F	379 F
China	...	590	40	...	2 620	648	2 457	1 309	...	...
Congo Rep	600 F	800 F	1 000	822	679	1 592	1 590	665	1 545	1 522
Côte dIvoire	13	62	10	26	17	9	15	15 F	15	30
Gabon	1 140	1 171	1 031	894	714	561	546	176	120 F	120 F
Gambia	950	2 238	734	774	2 210	2 526	4 046	3 523	3 773	3 775
Ghana	0	6	3	11	1	4	154	64	...	6
Guinea	6 232	5 778	11 825	5 966	5 088	4 978	3 895	8 879	8 800 F	8 800 F
GuineaBissau	275	403	315	340 F	367 F	360 F	340 F	385 F	385 F	385 F
Liberia	210	210	200	31	394	106	187	61	60 F	60 F
Lithuania	-	113	359	135	25	74	25	25	8	87
Mauritania	500 F	500 F	900 F	1 300 F	1 700 F	1 340 F	1 860 F	1 610 F	1 800 F	2 704
Netherlands	-	-	-	-	57	67	-	27	29	-
Nigeria	16 537	21 155	18 349	20 544	21 198	23 486	18 165	20 826	18 388	17 236
Panama	37	50	26	...	343	309	147	-	...	...
Russian Fed	-	20	2	3	-	-	-	-	-	5
Senegal	9 279	9 205	8 588	18 762	18 771	11 700	11 344	10 163	13 268	8 826
Sierra Leone	748	774	2 058	2 347	2 706	3 236	2 283	6 508	6 400 F	6 400 F
Togo	...	...	...	...	...	...	1	1 F	...	...
Ukraine	1	9	21	5	13	17	-	2	-	-
UK	-	-	-	-	-	2	-	1	4	3
34 Fishing area total	*36 934 F*	*43 690 F*	*46 113 F*	*52 402 F*	*60 531 F*	*51 739 F*	*47 402 F*	*54 998 F*	*54 975 F*	*50 339 F*
41 Argentina	20	27	19	13	42	71	61	56	63	78
Brazil	41 349	36 601	29 553	33 235	29 503	30 349	28 781	30 073	33 170	31 330
Uruguay	42	96	75	186	93	149	124	141	114	148
41 Fishing area total	*41 411*	*36 724*	*29 647*	*33 434*	*29 638*	*30 569*	*28 966*	*30 270*	*33 347*	*31 556*
47 Angola	2 424	3 616	3 176	3 621	3 200 F	3 483	5 404	13 901	11 166	10 700 F
Namibia	11	0	22	3	10	7	...	...	...	...
47 Fishing area total	*2 435*	*3 616*	*3 198*	*3 624*	*3 210 F*	*3 490*	*5 404*	*13 901*	*11 166*	*10 700 F*
51 Egypt	-	-	103	107	98	17	79	89	79	35
Eritrea	436	273	207	217	57	241	15	15	42	128
India	40 933	42 719	36 687	37 627	40 814	42 404	55 342	72 755	61 675	50 247
Iran	3 559	2 963	4 937	4 194	4 810	3 248	2 493	3 200	2 667	3 468
Oman	2 238	1 163	870	796	1 278	939	1 112	1 667	1 121	1 799
Pakistan	38 215	38 500	30 339	30 390	26 341	28 696	28 150	28 246	23 926	32 318
Qatar	0	0	-	-	-	-	-	-	-	-
Tanzania	850	800	800	750	794	891	843	782	700	4 728
Untd Arab Em	877	723	1 198	1 200 F	1 250	1 100 F	1 000 F	850	1 217	1 150
UK	-	-	-	-	-	28	86	-	-	-
Yemen	1 000 F	1 300 F	1 360 F	1 490 F	1 400 F	1 750 F	1 850 F	1 050 F	1 500 F	1 950 F
51 Fishing area total	*88 108 F*	*88 441 F*	*76 501 F*	*76 771 F*	*76 842 F*	*79 314 F*	*90 970 F*	*108 654 F*	*92 927 F*	*95 823 F*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
57 Bangladesh	...	...	...	...	...	...	...	20 534	16 515	16 721
India	51 144	44 509	36 775	40 856	48 407	48 666	56 582	63 501	52 104	40 777
Indonesia	11 207	5 653	8 433	8 463	9 062	12 040	13 571	18 744	18 316	17 545
Malaysia	5 017	4 453	3 575	3 515	2 866	4 841	6 374	5 174	6 078	7 434
Thailand	4 642	5 751	6 470	6 378	2 748	2 580	1 591	2 269	1 873	2 071
57 Fishing area total	*72 010*	*60 366*	*55 253*	*59 212*	*63 083*	*68 127*	*78 118*	*110 222*	*94 886*	*84 548*
61 China,Taiwan	435	529	537	596	625	214	221	162	271	162
61 Fishing area total	*435*	*529*	*537*	*596*	*625*	*214*	*221*	*162*	*271*	*162*
71 Australia	-	-	1	0	-	-	-	-	-	-
Indonesia	63 236	64 974	66 370	66 309	60 074	66 078	68 720	79 207	64 985	74 796
Malaysia	9 059	6 653	6 797	10 148	7 350	6 636	6 283	9 223	10 374	11 987
Philippines	5 176	5 920	7 078	6 799	5 979	6 775	6 331	5 813	6 094	6 193
Singapore	76	55	45	54	63	82	81	36	89	51
Thailand	7 035	8 916	8 501	9 651	7 533	6 699	5 877	1 095	1 298	1 197
71 Fishing area total	*84 582*	*86 518*	*88 792*	*92 961*	*80 999*	*86 270*	*87 292*	*95 374*	*82 840*	*94 224*
77 El Salvador	192	716	665	670	931	1 016	951	...	...	...
Mexico	1 772	1 445	432	617	3 017	3 151	2 881	2 724	2 804	2 660
Nicaragua	...	...	...	...	...	7	5	11	16	17
77 Fishing area total	*1 964*	*2 161*	*1 097*	*1 287*	*3 948*	*4 174*	*3 837*	*2 735*	*2 820*	*2 677*
81 Australia	4	4	6	4	4	4	...	...	...	...
81 Fishing area total	*4*	*4*	*6*	*4*	*4*	*4*	...	...	...	...
87 Colombia	94	82	56	64	5	50 F	100 F	150 F	207	89
Ecuador	369	254	129	109	576	3 107	4 084	2 504	2 889	317
87 Fishing area total	*463*	*336*	*185*	*173*	*581*	*3 157 F*	*4 184 F*	*2 654 F*	*3 096*	*406*
Species total	*352 304 F*	*350 050 F*	*326 873 F*	*355 141 F*	*344 720 F*	*344 569 F*	*365 088 F*	*429 917 F*	*386 493 F*	*380 299 F*
Eeltail catfishes	**Balibots**		**Patunas**		***Plotosus spp***				**1,41(06)064,XX**	**CAE**
57 Malaysia	1 157	1 088	1 054	1 015	813	1 365	1 273	1 183	1 514	1 516
Thailand	62	42	158	48	173	101	179	59	118	124
57 Fishing area total	*1 219*	*1 130*	*1 212*	*1 063*	*986*	*1 466*	*1 452*	*1 242*	*1 632*	*1 640*
71 Malaysia	830	1 030	841	947	1 223	1 126	992	1 114	1 139	1 280
Thailand	1 084	1 029	148	209	159	176	137	103	216	160
71 Fishing area total	*1 914*	*2 059*	*989*	*1 156*	*1 382*	*1 302*	*1 129*	*1 217*	*1 355*	*1 440*
Species total	*3 133*	*3 189*	*2 201*	*2 219*	*2 368*	*2 768*	*2 581*	*2 459*	*2 987*	*3 080*
Morays	**Murènes**		**Morenas**		***Muraenidae***				**1,43(06)XXX,XX**	**MUI**
27 France	-	-	-	-	-	-	-	-	4	-
Portugal	142	128	189	183	130	151	184	163	120	138
Spain	-	-	-	22	12	12	13	16	12	12
27 Fishing area total	*142*	*128*	*189*	*205*	*142*	*163*	*197*	*179*	*136*	*150*
34 Mauritania	...	...	...	...	...	...	...	...	...	12
Morocco	15	267	362	500	263	82	131	113	88	107
Portugal	3	2	5	5	4	4	12	8	6	4
Senegal	209	229	173	184	179	235	169	203	376	324
Spain	-	-	-	12	34	45	60	74	85	84
34 Fishing area total	*227*	*498*	*540*	*701*	*480*	*366*	*372*	*398*	*555*	*531*
37 Cyprus	-	-	-	-	-	-	-	-	-	2
France	-	-	-	-	-	-	-	-	6	...
Malta	-	-	-	-	-	-	-	-	4	9
Spain	-	-	-	11	11	9	10	12	11	13
37 Fishing area total	-	-	-	*11*	*11*	*9*	*10*	*12*	*21*	*24*
41 Brazil	...	...	...	...	...	...	...	41	46	43
41 Fishing area total	...	...	...	...	...	...	...	*41*	*46*	*43*
Species total	*369*	*626*	*729*	*917*	*633*	*538*	*579*	*630*	*758*	*748*
Snake eels nei	**Serpentons nca**		**Tiesos, serpentones nep**		***Ophichthidae***				**1,43(15)XXX,XX**	**OWX**
87 Chile	270	41	61	188	201	71	50	74	60	38
87 Fishing area total	*270*	*41*	*61*	*188*	*201*	*71*	*50*	*74*	*60*	*38*
Species total	*270*	*41*	*61*	*188*	*201*	*71*	*50*	*74*	*60*	*38*
Korean sandlance	**...B**		**...C**		***Hypoptychus dybowskii***				**1,50(05)009,01**	**KLA**
61 Korea Rep	462	7	1 047	2 419	3 925	4 197	3 682	4 033	3 503	-
61 Fishing area total	*462*	*7*	*1 047*	*2 419*	*3 925*	*4 197*	*3 682*	*4 033*	*3 503*	-
Species total	*462*	*7*	*1 047*	*2 419*	*3 925*	*4 197*	*3 682*	*4 033*	*3 503*	-
Pacific cornetfish	**Cornette fluteau**		**Corneta flautera**		***Fistularia corneta***				**1,51(02)001,01**	**FUC**
87 Ecuador	...	...	...	...	...	12 260	364	2 497	6 396	6 443
87 Fishing area total	...	...	...	...	...	*12 260*	*364*	*2 497*	*6 396*	*6 443*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	...	...	...	...	...	*12 260*	*364*	*2 497*	*6 396*	*6 443*
Cornetfish	**Cornette tachetée**		**Corneta**		***Fistularia tabacaria***				**1,51(02)001,03**	**FUT**
34 Senegal	...	...	439	...	23	92	75	98	55	53
34 Fishing area total	...	...	*439*	...	*23*	*92*	*75*	*98*	*55*	*53*
Species total	...	...	*439*	...	*23*	*92*	*75*	*98*	*55*	*53*
Sabre squirrelfish	**Marignan sabre**		**Candil sable**		***Sargocentron spiniferum***				**1,61(11)011,02**	**HVS**
51 Saudi Arabia	97	96	135	114	160	146	67	53	54	54
51 Fishing area total	*97*	*96*	*135*	*114*	*160*	*146*	*67*	*53*	*54*	*54*
Species total	*97*	*96*	*135*	*114*	*160*	*146*	*67*	*53*	*54*	*54*
Squirrelfishes nei	**Marignons nca**		**Candiles nep**		***Holocentridae***				**1,61(11)XXX,XX**	**HCZ**
31 Antigua Barb	29	45	54	13	32	78	50	15	72	27
Dominican Rp	22	104	159	61	44	78	81	83	75	81
Grenada	3	2	2	12	15	9	5	3	1	0
Puerto Rico	12	8	9	5	5	4	3	3	3	3
St Kitts Nev	3	7	3 F	...	1 F	5 F	9 F	12 F	15 F	17
US Virgin Is	-	1	-	-	3	1	2	1	2	1
31 Fishing area total	*69*	*167*	*227 F*	*91*	*100 F*	*175 F*	*150 F*	*117 F*	*168 F*	*129*
71 Kiribati	...	...	...	...	...	...	...	...	...	41
71 Fishing area total	...	...	...	...	...	...	...	...	...	*41*
77 Amer Samoa	0	1	1	0	0	0	1	1	1	1
USA	...	23	21	18	15	12	15	26	23	40
77 Fishing area total	*0*	*24*	*22*	*18*	*15*	*12*	*16*	*27*	*24*	*41*
Species total	*69*	*191*	*249 F*	*109*	*115 F*	*187 F*	*166 F*	*144 F*	*192 F*	*211*
Flathead grey mullet	**Mulet à grosse tête**		**Pardete**		***Mugil cephalus***				**1,65(01)001,02**	**MUF**
01 Senegal	...	...	...	...	...	...	...	380	250 F	108
01 Fishing area total	...	...	...	...	...	...	...	*380*	*250 F*	*108*
05 Greece	46	8	40	61	60	55	50	52	62	62 F
05 Fishing area total	*46*	*8*	*40*	*61*	*60*	*55*	*50*	*52*	*62*	*62 F*
31 Mexico	4 838	3 545	1 179	1 685	3 807	3 976	3 002	3 201	2 712	2 558
USA	685	628	778	557	629	1 524	624	699	110	532
Venezuela	5 008	4 866	5 481	8 660 F	4 630 F	2 730 F	3 330 F	3 462	3 350 F	3 350 F
31 Fishing area total	*10 531*	*9 039*	*7 438*	*10 902 F*	*9 066 F*	*8 230 F*	*6 956 F*	*7 362*	*6 172 F*	*6 440 F*
37 Bulgaria	47	71	33	18	6	11	6	9	11	19
Cyprus	7	8	6	2	3	4	2	3	2	2
France	...	...	...	...	...	...	...	...	50	81
Greece	1 357	1 983	1 883	2 317	2 589	2 016	1 929	1 739	1 659	1 650 F
Libya	...	...	...	...	...	...	...	...	720	700 F
Montenegro	...	...	...	...	...	22	30	39	34	42
Serbia-Monte	25	27	26	26	26	-	-	-	-	-
Slovenia	-	-	-	-	1	0	0	0	1	0
Tunisia	229	952	205	1 010	1 051	1 160	1 085	912	890	258
37 Fishing area total	*1 665*	*3 041*	*2 153*	*3 373*	*3 676*	*3 213*	*3 052*	*2 702*	*3 367*	*2 752 F*
51 Kuwait	34	37 F	40	46	30	52	47	62	60 F	60 F
51 Fishing area total	*34*	*37 F*	*40*	*46*	*30*	*52*	*47*	*62*	*60 F*	*60 F*
61 China	101 734 F	96 886 F	112 195 F	143 150 F	94 216 F	75 562 F	61 686	74 758	90 160	91 499
China,Taiwan	1 559	934	324	1 216	622	193	111	159	260	185
Japan	3 457	2 993	2 686	2 317	2 199	2 109	...	...	...	...
Korea Rep	9 784	8 887	7 877	8 023	9 774	8 835	11 312	8 248	6 178	6 587
61 Fishing area total	*116 534 F*	*109 700 F*	*123 082 F*	*154 706 F*	*106 811 F*	*86 699 F*	*73 109*	*83 165*	*96 598*	*98 271*
77 Mexico	...	...	...	...	556	580	539	485	347	334
USA	-	3	4	4	4	4	5	4	3	3
77 Fishing area total	...	*3*	*4*	*4*	*560*	*584*	*544*	*489*	*350*	*337*
Species total	*128 810 F*	*121 828 F*	*132 757 F*	*169 092 F*	*120 203 F*	*98 833 F*	*83 758 F*	*94 212*	*106 859 F*	*108 030 F*
Lebranche mullet	**Mulet lebranche**		**Lebranche**		***Mugil liza***				**1,65(01)001,12**	**MUB**
31 Colombia	...	177	...	299	148	110 F	75 F	40 F	11	...
Venezuela	2 537	2 294	3 214	5 080 F	2 720 F	1 600 F	1 950 F	2 045	1 970 F	1 970 F
31 Fishing area total	*2 537*	*2 471*	*3 214*	*5 379 F*	*2 868 F*	*1 710 F*	*2 025 F*	*2 085 F*	*1 981 F*	*1 970 F*
Species total	*2 537*	*2 471*	*3 214*	*5 379 F*	*2 868 F*	*1 710 F*	*2 025 F*	*2 085 F*	*1 981 F*	*1 970 F*
White mullet	**Mulet blanc**		**Lisa blanca**		***Mugil curema***				**1,65(01)001,21**	**MGU**
31 Mexico	...	...	...	...	3 152	3 291	4 231	3 660	3 018	3 501
USA	-	-	-	-	-	-	-	-	-	54
31 Fishing area total	...	...	...	...	*3 152*	*3 291*	*4 231*	*3 660*	*3 018*	*3 555*
77 Mexico	...	...	...	...	554	578	584	250	274	159

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
77 Fishing area total	*...*	*...*	*...*	*...*	*554*	*578*	*584*	*250*	*274*	*159*
Species total	*...*	*...*	*...*	*...*	*3 706*	*3 869*	*4 815*	*3 910*	*3 292*	*3 714*
Parassi mullet	**Mulet parassi**		**Lisa rayada**		***Mugil incilis***				**1,65(01)001,22**	**MGI**
31 Fr Guiana	...	...	...	...	13	40	80	22	82	90 F
31 Fishing area total	*...*	*...*	*...*	*...*	*13*	*40*	*80*	*22*	*82*	*90 F*
Species total	*...*	*...*	*...*	*...*	*13*	*40*	*80*	*22*	*82*	*90 F*
So-iuy mullet	**Mulet so-iuy**		**Lisa so-iuy**		***Mugil soiuy***				**1,65(01)001,28**	**MYZ**
05 Ukraine	382	91	73	19	-	6	7	6	7	4
05 Fishing area total	*382*	*91*	*73*	*19*	*-*	*6*	*7*	*6*	*7*	*4*
37 Bulgaria	-	-	-	-	-	-	1	0	2	0
Ukraine	2 428	2 510	2 274	4 731	6 843	7 432	6 789	5 027	6 703	3 657
37 Fishing area total	*2 428*	*2 510*	*2 274*	*4 731*	*6 843*	*7 432*	*6 790*	*5 027*	*6 705*	*3 657*
Species total	*2 810*	*2 601*	*2 347*	*4 750*	*6 843*	*7 438*	*6 797*	*5 033*	*6 712*	*3 661*
Thicklip grey mullet	**Mulet lippu**		**...C**		***Chelon labrosus***				**1,65(01)002,02**	**MLR**
27 France	...	...	...	...	...	...	...	...	344	526
27 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*344*	*526*
37 France	...	...	...	...	...	...	...	...	111	122
37 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*111*	*122*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*455*	*648*
So-iny (redlip) mullet	**Mulet so-iny**		**Lisa so-iny**		***Chelon haematocheilus***				**1,65(01)002,04**	**SOY**
61 China	...	...	106 404 F	139 043 F	134 391 F	130 318 F	125 558	127 133	127 493	156 989
61 Fishing area total	*...*	*...*	*106 404 F*	*139 043 F*	*134 391 F*	*130 318 F*	*125 558*	*127 133*	*127 493*	*156 989*
Species total	*...*	*...*	*106 404 F*	*139 043 F*	*134 391 F*	*130 318 F*	*125 558*	*127 133*	*127 493*	*156 989*
Mountain mullet	**Mulet de fleuve**		**Lisa de río**		***Agonostomus monticola***				**1,65(01)006,02**	**AJW**
02 Dominican Rp	...	28	34	...	...	...	...	9	9	9
02 Fishing area total	*...*	*28*	*34*	*...*	*...*	*...*	*...*	*9*	*9*	*9*
Species total	*...*	*28*	*34*	*...*	*...*	*...*	*...*	*9*	*9*	*9*
Bobo mullet	**Mulet bobo**		**Bobo**		***Joturus pichardi***				**1,65(01)010,01**	**MUA**
31 Mexico	400	341	337	325	6	6	6	10	7	9
31 Fishing area total	*400*	*341*	*337*	*325*	*6*	*6*	*6*	*10*	*7*	*9*
77 Mexico	104	76	80	82	...	...	...	...	...	...
77 Fishing area total	*104*	*76*	*80*	*82*	*...*	*...*	*...*	*...*	*...*	*...*
Species total	*504*	*417*	*417*	*407*	*6*	*6*	*6*	*10*	*7*	*9*
Golden grey mullet	**Mulet doré**		**Galupe**		***Liza aurata***				**1,65(01)012,03**	**MGA**
37 Bulgaria	...	7	1	-	1	0	1	2	3	2
France	...	...	...	...	...	...	...	...	53	94
37 Fishing area total	*...*	*7*	*1*	*...*	*1*	*0*	*1*	*2*	*56*	*96*
Species total	*...*	*7*	*1*	*...*	*1*	*0*	*1*	*2*	*56*	*96*
Leaping mullet	**Mulet sauteur**		**Galúa**		***Liza saliens***				**1,65(01)012,06**	**LZS**
37 Bulgaria	10	18	16	8	1	2	15	4	7	9
37 Fishing area total	*10*	*18*	*16*	*8*	*1*	*2*	*15*	*4*	*7*	*9*
Species total	*10*	*18*	*16*	*8*	*1*	*2*	*15*	*4*	*7*	*9*
Klunzinger's mullet	**...B**		**...C**		***Liza klunzingeri***				**1,65(01)012,17**	**LZK**
51 Iran	11 252	9 000	7 743	2 900	710	6 127	4 936	7 284	4 943	1 199
51 Fishing area total	*11 252*	*9 000*	*7 743*	*2 900*	*710*	*6 127*	*4 936*	*7 284*	*4 943*	*1 199*
Species total	*11 252*	*9 000*	*7 743*	*2 900*	*710*	*6 127*	*4 936*	*7 284*	*4 943*	*1 199*
Bluespot mullet	**Mulet à tache bleue**		**Lisa de mancha azul**		***Valamugil seheli***				**1,65(01)043,02**	**VMH**
51 Iran	541	1 165	392	827	1 158	1 741	3 778	1 038	2 105	3 358
Saudi Arabia	414	372	344	322	334	283	519	464	338	197
51 Fishing area total	*955*	*1 537*	*736*	*1 149*	*1 492*	*2 024*	*4 297*	*1 502*	*2 443*	*3 555*
Species total	*955*	*1 537*	*736*	*1 149*	*1 492*	*2 024*	*4 297*	*1 502*	*2 443*	*3 555*
Mullets nei	**Mulets nca**		**Lizas nep**		***Mugilidae***				**1,65(01)XXX,XX**	**MUL**
01 Benin	2 050 F	2 050 F	2 050 F	2 050 F	1 600 F	2 450 F	2 560 F	2 560 F	2 700 F	2 770 F

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Egypt	20 688	21 708	29 298	28 861	24 269	31 791	22 023	18 771	16 575	26 513
	Senegal	...	...	...	...	...	...	...	1 128	750 F	384
01	*Fishing area total*	*22 738 F*	*23 758 F*	*31 348 F*	*30 911 F*	*25 869 F*	*34 241 F*	*24 583 F*	*22 459 F*	*20 025 F*	*29 667 F*
02	Mexico	...	...	...	...	707	743	...	...	...	...
02	*Fishing area total*	...	...	...	...	*707*	*743*	...	...	...	...
04	Azerbaijan	55	3	10	14	15	21	62	35	40	62
	India	12 613	2 326	3 160	3 006	4 200	4 784	3 933	9 617	7 532	4 324
	Iran	5 263	6 873	4 690	4 428	5 517	4 694	4 314	2 780	3 493	2 682
	Israel	125	136	140	196	251	260	148	51	84	84
	Japan	1 084	980	786	701	633	...	...	...	...	...
	Kazakhstan	7	...	...	...	...	...	...	...	...	267
	Korea Rep	...	...	536	...	1 001	...	331	1 552	1 152	933
	Philippines	667	474	526	562	696	831	789	865	910	1 013
	Turkey	710	659	738	820	830	948	927	1 023	970	1 512
	Turkmenistan	1	-	1	1	1 F	1 F	1 F	1 F	1 F	1 F
04	*Fishing area total*	*20 525*	*11 451*	*10 587*	*9 728*	*13 144 F*	*11 539 F*	*10 505 F*	*15 924 F*	*14 182 F*	*10 878 F*
05	Albania	50	50	65 F	320	430	560	250	210	150	104
	Russian Fed	11	291	9	9	17	12	58	97	842	346
05	*Fishing area total*	*61*	*341*	*74 F*	*329*	*447*	*572*	*308*	*307*	*992*	*450*
21	Portugal	-	30	-	-	-	-	-	-	-	-
	USA	412	545	353	301	401	305	298	323	365	387
21	*Fishing area total*	*412*	*575*	*353*	*301*	*401*	*305*	*298*	*323*	*365*	*387*
27	Channel Is	9	7	14	6	-	2	2	3	6	13
	Denmark	29	17	24	28	39	26	22	27	25	18
	France	974	834	963	1 097	1 288	1 253	1 411	887	1 353	832
	Germany	23	40	11	20	20	10	3	2	2	4
	Ireland	3	8	3	7	3	7	3	4	2	3
	Netherlands	184	113	105	147	110	119	168	128	109	126
	Norway	-	-	-	-	-	-	0	0	-	-
	Portugal	376	291	264	236	249	336	263	291	253	262
	Spain	75	42	27	52	99	144	106	161	152	282
	UK	65	35	73	79	85	137	154	171	187	214
27	*Fishing area total*	*1 738*	*1 387*	*1 484*	*1 672*	*1 893*	*2 034*	*2 132*	*1 674*	*2 089*	*1 754*
31	Colombia	...	929	...	10	88	90 F	95 F	100 F	104	150
	Cuba	114	125	77	47	40	57	52	60	108	249
	Dominican Rp	28	88	120	36	25	177	10	73	30	32
	Mexico	7 096	6 360	6 375	6 644	459	480	170	200	189	55
	Puerto Rico	41	30	35	20	14	11	6	7	7	5
	Suriname	...	...	45	39	51	...	...	...	...	...
	USA	5 463	4 759	4 131	4 423	3 836	5 470	4 307	4 949	5 425	5 227
31	*Fishing area total*	*12 742*	*12 291*	*10 783*	*11 219*	*4 513*	*6 285 F*	*4 640 F*	*5 389 F*	*5 863*	*5 718*
34	Benin	5	6	7	7	...	6	5	...	...	...
	Congo Rep	...	...	66	53	102	126	92	62	70	191
	Gabon	1 061	888	1 079	1 140	461	1 000	968	652	440 F	440 F
	Gambia	69	208	147	208	124	884	850	569	609	609
	Guinea	...	2 372	2 680	1 799	4 233	3 396	1 436	1 569	1 550 F	1 550 F
	GuineaBissau	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F
	Ireland	-	-	-	-	-	-	-	-	-	13
	Latvia	-	-	-	-	46	16	19	3	48	22
	Liberia	0	40	40	63	118	19	100	26	26 F	26 F
	Lithuania	-	102	109	71	6	17	2	13	28	34
	Mauritania	2 000 F	2 000 F	3 000 F	4 000 F	5 000 F	5 290 F	7 320 F	6 340 F	7 100 F	11 018
	Morocco	4 338	4 257	5 160	2 450	3 760	5 595	4 586	2 115	955	1 329
	Netherlands	-	-	-	20	118	26	35	17	8	-
	Nigeria	8 728	9 122	8 881	8 731	6 002	7 779	8 743	8 261	9 222	10 295
	Portugal	-	-	-	0	0	-	-	-	-	-
	Russian Fed	151	11	24	13	2	101	25	4	8	120
	Senegal	2 546	2 802	3 470	3 725	3 140	2 371	3 373	2 325	2 442	3 087
	Spain	-	-	-	1	9	28	5	14	7	16
	Togo	0	-	3	2	7	...	1	1 F	...	...
	Ukraine	27	183	80	99	20	10	23	10	-	-
	UK	-	-	-	-	-	2	2	-	-	7
34	*Fishing area total*	*20 425 F*	*23 491 F*	*26 246 F*	*23 882 F*	*24 648 F*	*28 166 F*	*29 085 F*	*23 481 F*	*24 013 F*	*30 257 F*
37	Albania	130	78	3	55	140	76	75	110	128	140
	Algeria	...	...	...	...	...	...	339	356	275	354
	Croatia	14	7	11	24	30	21	24	27	59	143
	Egypt	2 085	5 696	4 383	4 152	3 525	3 012	4 543	4 660	4 733	4 713
	France	511	414	352	359	347	402	250	269	58	132
	Georgia	28	73	80	68	44 F	20 F	0	1	1 F	1 F
	Israel	175	158	168	108	75	183	30	45 F	63	46
	Italy	5 023	5 716	4 134	4 252	3 805	2 415	2 596	2 066	1 786	2 759
	Lebanon	400	370	365	360	365	360	360 F	360 F	360 F	360 F
	Malta	0	-	-	-	-	-	1	0	0	0
	Morocco	9	2	59	36	21	21	9	14	23	17
	Palest, O.T.	15 F	17	11	6	8	8	7	16	24	3
	Romania	-	6	1	2	25	1	20	8	14	8
	Russian Fed	1 421	1 518	974	1 909	2 508	3 406	3 029	1 635	2 259	1 040
	Slovenia	49	19	50	29	10	9	14	20	21	10
	Spain	-	-	-	347	313	456	628	488	555	549
	Syria	80	136	122	113	179	157	92	98	90	140
	Tunisia	3 016	3 010	3 246	2 554	2 457	2 279	1 934	1 841	2 010	2 263

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Turkey	22 000	12 000	11 000	12 424	10 560	8 915	8 291	3 345	2 987	3 119
Ukraine	51	26	72	39	139	92	87	86	121	117
37 Fishing area total	*35 007 F*	*29 246*	*25 031*	*26 837*	*24 551 F*	*21 833 F*	*22 329 F*	*15 445 F*	*15 567 F*	*15 914 F*
41 Argentina	11	8	33	194	99	81	27	46	37	47
Brazil	11 075	11 143	13 204	13 929	16 554	14 130	21 864	17 153	18 919	17 866
Uruguay	219	282	223	226	267	208	250	327	363	417
41 Fishing area total	*11 305*	*11 433*	*13 460*	*14 349*	*16 920*	*14 419*	*22 141*	*17 526*	*19 319*	*18 330*
47 Namibia	117	122	159	120	95	104	113	7	11	8 F
South Africa	8	-	-	7	-	-	814	-	-	640
47 Fishing area total	*125*	*122*	*159*	*127*	*95*	*104*	*927*	*7*	*11*	*648 F*
51 Bahrain	39	29	26	33	15	19	28	103	46	1
Djibouti	0	0	0	0	-	-	-	-	-	-
Egypt	3 760	3 326	3 515	2 705	1 799	1 244	1 125	1 159	599	339
Eritrea	3	0	2	2	1	1	10	1	6	5
India	6 083	6 569	5 654	5 424	6 662	8 041	7 153	8 247	7 489	7 775
Iraq	...	...	...	725	...	...	2 371	1 347	5 762	6 780
Kenya	199	164	188	237	248	221	201	236	232	291
Kuwait	422	260 F	103	298	220	301	259	22	100 F	100 F
Mauritius	92	80	74	73	72	3	53	28	36	604
Oman	543	424	569	833	839	689	785	621	833	2 680
Pakistan	9 723	9 900	10 316	10 363	9 266	9 063	9 735	9 841	8 226	8 914
Qatar	5	4	6	4	7	12	10	8	4	8
Tanzania	250	200	200	200	291	291	202	228	250	321
Untd Arab Em	98	93	75	70 F	65	250 F	450 F	628	532	647
Yemen	250 F	338 F	350 F	380 F	340 F	420 F	446 F	254 F	365 F	475 F
Zanzibar	132	95	108	160	290	107	855	237	350	359
51 Fishing area total	*21 599 F*	*21 482 F*	*21 186 F*	*21 507 F*	*20 115 F*	*20 662 F*	*23 683 F*	*22 960 F*	*24 830 F*	*29 299 F*
57 Australia	536	444	610	652	573	501	461	564	312	544
India	12 054	9 888	10 762	17 114	18 824	19 608	34 385	17 823	22 827	24 037
Indonesia	10 937	11 582	11 230	7 840	8 432	9 834	10 463	10 522	9 486	7 909
Malaysia	2 669	1 863	1 491	1 534	623	689	1 301	1 033	1 375	1 340
Thailand	4 827	4 132	4 065	1 881	1 624	1 718	2 275	2 967	4 399	3 111
57 Fishing area total	*31 023*	*27 909*	*28 158*	*29 021*	*30 076*	*32 350*	*48 885*	*32 909*	*38 399*	*36 941*
61 Russian Fed	94	49	18	10	10	108	154	67	140	92
61 Fishing area total	*94*	*49*	*18*	*10*	*10*	*108*	*154*	*67*	*140*	*92*
71 Australia	2 631	1 909	2 088	2 322	1 749	1 803	1 590	1 840	1 864	1 801
Fiji	2 915	1 800 F	417	337	300 F	274	722	500	600	700
Indonesia	22 658	24 516	24 370	25 954	27 333	28 605	28 497	28 405	35 658	36 996
Kiribati	1 300	2 534	2 184	1 800 F	1 400 F	1 000 F	708	514	353	350 F
Malaysia	1 334	1 380	1 307	1 386	1 675	1 516	2 159	1 787	2 064	2 095
NewCaledonia	88	73	57	74	66	52	62	58	66	84
Palau	0	0	1	1	0	0	...	...	...	...
Philippines	15 336	14 596	13 635	13 768	15 823	16 315	16 194	16 525	12 763	14 261
Singapore	27	25	18	19	17	16	16	19	37	33
Thailand	4 312	2 867	2 384	2 267	2 956	2 345	2 216	3 560	3 790	2 883
71 Fishing area total	*50 601*	*49 700 F*	*46 461*	*47 928 F*	*51 319 F*	*51 926 F*	*52 164*	*53 208*	*57 195*	*59 203 F*
77 Cook Is	5 F	5 F	5 F	5	7 F	10	10 F	10 F	9 F	9 F
Mexico	3 166	4 206	2 845	2 965	3 090	3 227	3 112	3 192	2 386	2 463
USA	-	-	-	-	-	-	-	-	-	0
77 Fishing area total	*3 171 F*	*4 211 F*	*2 850 F*	*2 970*	*3 097 F*	*3 237*	*3 122 F*	*3 202 F*	*2 395 F*	*2 472 F*
81 Australia	3 916	4 482	3 729	3 237	4 005	3 980	3 550	3 722	1 767	3 183
New Zealand	910	748	890	898	946	882	889	851	782	766
81 Fishing area total	*4 826*	*5 230*	*4 619*	*4 135*	*4 951*	*4 862*	*4 439*	*4 573*	*2 549*	*3 949*
87 Chile	93	22	34	84	63	23	79	63	73	31
Colombia	22	28	...	43	1	2 F	3 F	4 F	5	11
Peru	24 189	19 472	19 137	12 121	6 975	4 233	10 549	16 185	18 595	10 779
87 Fishing area total	*24 304*	*19 522*	*19 171*	*12 248*	*7 039*	*4 258 F*	*10 631 F*	*16 252 F*	*18 673*	*10 821*
Species total	*260 696 F*	*242 198 F*	*241 988 F*	*237 174 F*	*229 795 F*	*237 644 F*	*260 026 F*	*235 706 F*	*246 607 F*	*256 780 F*

Fusiliers nei	**Fusiliers nca**		**Fusileros nep**		***Caesionidae***			**1,70(00)XXX,XX**		**CJX**
51 Jordan	15	12	13	12	14	11	13	13	15	9
Saudi Arabia	19	61	8	44	6	39	39	1	2	2
51 Fishing area total	*34*	*73*	*21*	*56*	*20*	*50*	*52*	*14*	*17*	*11*
57 Indonesia	6 040	4 690	6 309	4 878	5 884	6 180	8 336	7 386	7 200	10 023
Malaysia	14	1	64	39	19	11	15	23	62	32
57 Fishing area total	*6 054*	*4 691*	*6 373*	*4 917*	*5 903*	*6 191*	*8 351*	*7 409*	*7 262*	*10 055*
71 Indonesia	32 272	31 903	34 939	34 528	41 337	39 406	57 037	55 788	67 360	59 196
Malaysia	973	846	694	763	1 265	893	970	1 140	742	911
Philippines	13 677	12 162	12 698	12 586	15 281	15 457	19 230	20 834	20 540	24 134
Singapore	1	3	2	6	9	3	2	3	3	3
71 Fishing area total	*46 923*	*44 914*	*48 333*	*47 883*	*57 892*	*55 759*	*77 239*	*77 765*	*88 645*	*84 244*
Species total	*53 011*	*49 678*	*54 727*	*52 856*	*63 815*	*62 000*	*85 642*	*85 188*	*95 924*	*94 310*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Common snook	**Crossie blanc**		**Róbalo blanco**		***Centropomus undecimalis***				**1,70(01)025,10**	**SNO**
31 Mexico	4 000	5 951	6 268	5 425	20	21	39	16	17	25
Venezuela	1 903	1 437	2 615	4 130 F	2 210 F	1 300 F	1 600 F	1 479	1 430 F	1 430 F
31 Fishing area total	*5 903*	*7 388*	*8 883*	*9 555 F*	*2 230 F*	*1 321 F*	*1 639 F*	*1 495*	*1 447 F*	*1 455 F*
Species total	*5 903*	*7 388*	*8 883*	*9 555 F*	*2 230 F*	*1 321 F*	*1 639 F*	*1 495*	*1 447 F*	*1 455 F*
Snooks(=Robalos) nei	**Crossies nca**		**Róbalos nep**		***Centropomus spp***				**1,70(01)025,XX**	**ROB**
02 Mexico	...	...	...	...	2 773	2 895	3 296	2 420	2 544	2 604
Nicaragua	339	185	130	120	49	90	90	49	49	57
02 Fishing area total	*339*	*185*	*130*	*120*	*2 822*	*2 985*	*3 386*	*2 469*	*2 593*	*2 661*
31 Colombia	...	10	25	1	10	25 F	40 F	50 F	62	123
Dominican Rp	17	37	108	62	29	38	30	49	29	31
Fr Guiana	...	...	...	...	17	101	119	119	96	105 F
Grenada	0	0	0	0	1	1	1	0	0	0
Mexico	1 360	913	2 131	1 845	4 136	4 319	4 332	4 093	3 854	4 279
Nicaragua	1 090	1 222	1 322	949	937	1 007	1 008	936	392	772
Puerto Rico	8	24	30	14	7	8	7	9	7	7
Suriname	...	...	266	361	211	...	...	...	...	...
31 Fishing area total	*2 475*	*2 206*	*3 882*	*3 232*	*5 348*	*5 499 F*	*5 537 F*	*5 256 F*	*4 440*	*5 317 F*
41 Brazil	3 469	3 311	5 072	4 577	3 442	3 318	3 947	3 499	3 859	3 645
41 Fishing area total	*3 469*	*3 311*	*5 072*	*4 577*	*3 442*	*3 318*	*3 947*	*3 499*	*3 859*	*3 645*
77 Mexico	862	686	1 351	1 169	1 409	1 472	1 644	1 533	1 422	1 568
Nicaragua	...	...	...	...	...	39	45	75	56	55
77 Fishing area total	*862*	*686*	*1 351*	*1 169*	*1 409*	*1 511*	*1 689*	*1 608*	*1 478*	*1 623*
87 Colombia	37	37	1	44	6	10 F	15 F	20 F	25	6
Ecuador	...	...	...	...	...	2	15	3	...	92
87 Fishing area total	*37*	*37*	*1*	*44*	*6*	*12 F*	*30 F*	*23 F*	*25*	*98*
Species total	*7 182*	*6 425*	*10 436*	*9 142*	*13 027*	*13 325 F*	*14 589 F*	*12 855 F*	*12 395*	*13 344 F*
Redmouth grouper	**Vieille roga**		**Cherna roga**		***Aethaloperca rogaa***				**1,70(02)001,01**	**EHG**
51 Saudi Arabia	33	20	14	19	37	50	25	31	36	36
51 Fishing area total	*33*	*20*	*14*	*19*	*37*	*50*	*25*	*31*	*36*	*36*
Species total	*33*	*20*	*14*	*19*	*37*	*50*	*25*	*31*	*36*	*36*
Pink maomao	**...B**		**...C**		***Caprodon longimanus***				**1,70(02)009,01**	**RNL**
81 New Zealand	-	-	-	-	5	6	6	3	4	5
81 Fishing area total	-	-	-	-	*5*	*6*	*6*	*3*	*4*	*5*
Species total	-	-	-	-	*5*	*6*	*6*	*3*	*4*	*5*
Black grouper	**Badèche bonaci**		**Cuna bonací**		***Mycteroperca bonaci***				**1,70(02)040,01**	**MAB**
31 USA	7	6	...	5	-	-	-	-	-	-
31 Fishing area total	*7*	*6*	*...*	*5*	-	-	-	-	-	-
Species total	*7*	*6*	*...*	*5*	-	-	-	-	-	-
Gag	**Badèche baillou**		**Cuna aguají**		***Mycteroperca microlepis***				**1,70(02)040,04**	**MKM**
31 USA	10	13	...	11	12	8	13	9	9	3
31 Fishing area total	*10*	*13*	*...*	*11*	*12*	*8*	*13*	*9*	*9*	*3*
Species total	*10*	*13*	*...*	*11*	*12*	*8*	*13*	*9*	*9*	*3*
Scamp	**Badèche galopin**		**Cuna garopa**		***Mycteroperca phenax***				**1,70(02)040,06**	**MKH**
31 USA	17	26	...	28	23	18	23	28	25	16
31 Fishing area total	*17*	*26*	*...*	*28*	*23*	*18*	*23*	*28*	*25*	*16*
Species total	*17*	*26*	*...*	*28*	*23*	*18*	*23*	*28*	*25*	*16*
Yellowfin grouper	**Badèche de roche**		**Cuna de piedra**		***Mycteroperca venenosa***				**1,70(02)040,09**	**MKV**
31 Puerto Rico	-	4	4	2	1	1	1	1	1	1
USA	1	3	...	1	-	-	-	-	-	-
31 Fishing area total	*1*	*7*	*4*	*3*	*1*	*1*	*1*	*1*	*1*	*1*
Species total	*1*	*7*	*4*	*3*	*1*	*1*	*1*	*1*	*1*	*1*
Broomtail grouper	**Badèche balai**		**Garropa jaspeada**		***Mycteroperca xenarcha***				**1,70(02)040,10**	**GBS**
87 Colombia	66	106	32	55	54	70 F	85 F	100 F	120	14
87 Fishing area total	*66*	*106*	*32*	*55*	*54*	*70 F*	*85 F*	*100 F*	*120*	*14*
Species total	*66*	*106*	*32*	*55*	*54*	*70 F*	*85 F*	*100 F*	*120*	*14*
Brazilian groupers nei	**Badèches nca**		**Cunas nep**		***Mycteroperca spp***				**1,70(02)040,XX**	**GPB**
31 Mexico	...	...	...	...	23	24	24	30	36	37
31 Fishing area total	*...*	*...*	*...*	*...*	*23*	*24*	*24*	*30*	*36*	*37*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
41 Brazil	1 040	1 357	1 826	1 770	2 128	1 757	1 781	1 856	2 047	1 935
41 Fishing area total	*1 040*	*1 357*	*1 826*	*1 770*	*2 128*	*1 757*	*1 781*	*1 856*	*2 047*	*1 935*
Species total	*1 040*	*1 357*	*1 826*	*1 770*	*2 151*	*1 781*	*1 805*	*1 886*	*2 083*	*1 972*
Dusky grouper	**Mérou noir**		**Mero moreno**		***Epinephelus marginatus***				**1,70(02)042,01**	**GPD**
27 France	-	-	-	-	8	5	11	9	6	6
Portugal	-	-	26	0	3	2	1	1	1	24
Spain	51	40	28	31	28	56	115	67	29	31
UK	-	-	3	1	0	1	0	-	-	-
27 Fishing area total	*51*	*40*	*57*	*32*	*39*	*64*	*127*	*77*	*36*	*61*
34 Greece	2	1	29	-	-	-	-	-	-	-
Portugal	2	-	1	2	1	1	1	-	-	-
Senegal	...	...	149	177	54	108	184	114	63	106
Spain	...	...	6	5	11	11	17	16	18	21
34 Fishing area total	*4*	*1*	*185*	*184*	*66*	*120*	*202*	*130*	*81*	*127*
37 Greece	97	74	75	153	121	111	106	73	79	79 F
Israel	...	...	...	...	...	...	...	...	28	28
Italy	252	229	164	152	71	90	91	68	69	66
Libya	2 700 F	2 400 F	2 100 F	1 800 F	1 500 F	1 200 F	896	1 537	990	950 F
Malta	...	...	...	...	...	...	1	2	1	1
Spain	20	94	14	20	16	16	18	20	18	17
Turkey	80	71	107	97	151	97	95	25	83	63
37 Fishing area total	*3 149 F*	*2 868 F*	*2 460 F*	*2 222 F*	*1 859 F*	*1 514 F*	*1 207*	*1 725*	*1 268*	*1 204 F*
47 Portugal	-	-	41	-	29	-	-	-	-	-
47 Fishing area total	-	-	*41*	-	*29*	-	-	-	-	-
Species total	*3 204 F*	*2 909 F*	*2 743 F*	*2 438 F*	*1 993 F*	*1 698 F*	*1 536*	*1 932*	*1 385*	*1 392 F*
White grouper	**Mérou blanc**		**Cherna de ley**		***Epinephelus aeneus***				**1,70(02)042,02**	**GPW**
27 Portugal	0	0	-	0	1	3	15	3	1	1
27 Fishing area total	*0*	*0*	-	*0*	*1*	*3*	*15*	*3*	*1*	*1*
34 Côte dIvoire	3	121	...	8	...	...	...	...	...	906
Ghana	...	...	...	...	47	70	60	46	36	...
Greece	161	109	87	60	23	14	14	8	3	3 F
Mauritania	300 F	250 F	350 F	450 F	550 F	450 F	620 F	540 F	600 F	910
Portugal	1	0	2	1	8	11	7	6	12	5
Senegal	...	...	685	823	657	921	893	1 306	2 158	1 934
34 Fishing area total	*465 F*	*480 F*	*1 124 F*	*1 342 F*	*1 285 F*	*1 466 F*	*1 594 F*	*1 906 F*	*2 809 F*	*3 758 F*
37 Israel	...	...	...	...	...	...	...	...	30	14
Malta	...	...	...	...	...	...	...	...	...	11
Morocco	7	5	0	1	1	0	1	2	0	0
37 Fishing area total	*7*	*5*	*0*	*1*	*1*	*0*	*1*	*2*	*30*	*25*
47 Portugal	-	-	25	-	25	-	-	-	-	-
47 Fishing area total	-	-	*25*	-	*25*	-	-	-	-	-
Species total	*472 F*	*485 F*	*1 149 F*	*1 343 F*	*1 312 F*	*1 469 F*	*1 610 F*	*1 911 F*	*2 840 F*	*3 784 F*
Honeycomb grouper	**Mérou gâteau de cire**		**Mero panal**		***Epinephelus merra***				**1,70(02)042,11**	**EER**
57 Indonesia	...	...	...	1 307	1 677	1 929	3 750	2 737	1 552	1 834
57 Fishing area total	...	...	...	*1 307*	*1 677*	*1 929*	*3 750*	*2 737*	*1 552*	*1 834*
71 Indonesia	...	...	...	875	860	915	1 337	4 249	2 741	2 134
71 Fishing area total	...	...	...	*875*	*860*	*915*	*1 337*	*4 249*	*2 741*	*2 134*
Species total	...	...	...	*2 182*	*2 537*	*2 844*	*5 087*	*6 986*	*4 293*	*3 968*
Greasy grouper	**Mérou loutre**		**Mero lutria**		***Epinephelus tauvina***				**1,70(02)042,19**	**EPT**
51 Egypt	...	...	...	...	...	...	397	109	152	153
Saudi Arabia	1 113	1 173	1 992	786	902	738	671	859	768	940
51 Fishing area total	*1 113*	*1 173*	*1 992*	*786*	*902*	*738*	*1 068*	*968*	*920*	*1 093*
57 Indonesia	...	...	...	...	...	0	107	670	1 784	1 641
57 Fishing area total	...	...	...	...	...	*0*	*107*	*670*	*1 784*	*1 641*
71 Indonesia	...	...	...	...	...	1 020	1 010	4 242	3 878	1 964
71 Fishing area total	...	...	...	...	...	*1 020*	*1 010*	*4 242*	*3 878*	*1 964*
Species total	*1 113*	*1 173*	*1 992*	*786*	*902*	*1 758*	*2 185*	*5 880*	*6 582*	*4 698*
Nassau grouper	**Mérou rayé**		**Cherna criolla**		***Epinephelus striatus***				**1,70(02)042,20**	**GPN**
31 Bahamas	281	401	422	263	196	208	157	171	199	133
Colombia	1	8	1	3	154	120 F	80 F	40 F	3	4
Cuba	44	42	40	64	41	58	37	34	44	24
31 Fishing area total	*326*	*451*	*463*	*330*	*391*	*386 F*	*274 F*	*245 F*	*246*	*161*
Species total	*326*	*451*	*463*	*330*	*391*	*386 F*	*274 F*	*245 F*	*246*	*161*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Spotted grouper	**Mérou cabrilla**		**Mero moteado**		***Epinephelus analogus***				**1,70(02)042,22**	**GPS**
87 Colombia	139	47	8	43	2	34 F	65 F	95 F	131	143
87 Fishing area total	*139*	*47*	*8*	*43*	*2*	*34 F*	*65 F*	*95 F*	*131*	*143*
Species total	*139*	*47*	*8*	*43*	*2*	*34 F*	*65 F*	*95 F*	*131*	*143*
Yellowedge grouper	**Mérou aile jaune**		**Mero aleta amarilla**		***Epinephelus flavolimbatus***				**1,70(02)042,24**	**EEL**
31 USA	36	67	...	52	46	50	34	81	102	80
31 Fishing area total	*36*	*67*	*...*	*52*	*46*	*50*	*34*	*81*	*102*	*80*
Species total	*36*	*67*	*...*	*52*	*46*	*50*	*34*	*81*	*102*	*80*
Red hind	**Mérou couronné**		**Mero colorado**		***Epinephelus guttatus***				**1,70(02)042,25**	**EEU**
31 Grenada	88	159	203	192	181	201	177	165	148	175
Puerto Rico	46	43	39	32	26	20	13	15	16	19
St Vincent	...	...	...	...	...	...	...	...	55	61
31 Fishing area total	*134*	*202*	*242*	*224*	*207*	*221*	*190*	*180*	*219*	*255*
Species total	*134*	*202*	*242*	*224*	*207*	*221*	*190*	*180*	*219*	*255*
Red grouper	**Mérou rouge**		**Mero americano**		***Epinephelus morio***				**1,70(02)042,28**	**GPR**
31 Cuba	91	86	103	56	-	-	-	-	-	-
Dominican Rp	37	...	119	68	2	196	156	88	79	85
31 Fishing area total	*128*	*86*	*222*	*124*	*2*	*196*	*156*	*88*	*79*	*85*
41 Brazil	881	1 204	2 380	1 714	1 273	1 104	863	1 062	1 171	1 107
41 Fishing area total	*881*	*1 204*	*2 380*	*1 714*	*1 273*	*1 104*	*863*	*1 062*	*1 171*	*1 107*
Species total	*1 009*	*1 290*	*2 602*	*1 838*	*1 275*	*1 300*	*1 019*	*1 150*	*1 250*	*1 192*
Misty grouper	**Mérou brouillard**		**Mero listado**		***Epinephelus mystacinus***				**1,70(02)042,29**	**EEY**
31 Puerto Rico	3	3	3	4	6	5	5	7	4	7
31 Fishing area total	*3*	*3*	*3*	*4*	*6*	*5*	*5*	*7*	*4*	*7*
Species total	*3*	*3*	*3*	*4*	*6*	*5*	*5*	*7*	*4*	*7*
Snowy grouper	**Mérou neige**		**Cherna pintada**		***Epinephelus niveatus***				**1,70(02)042,30**	**EFV**
31 USA	4	9	...	6	8	7	8	12	9	8
31 Fishing area total	*4*	*9*	*...*	*6*	*8*	*7*	*8*	*12*	*9*	*8*
Species total	*4*	*9*	*...*	*6*	*8*	*7*	*8*	*12*	*9*	*8*
Dogtooth grouper	**Mérou gris**		**Mero dentón**		***Epinephelus caninus***				**1,70(02)042,32**	**EFJ**
37 Morocco	1	9	14	6	11	11	4	3	0	3
37 Fishing area total	*1*	*9*	*14*	*6*	*11*	*11*	*4*	*3*	*0*	*3*
Species total	*1*	*9*	*14*	*6*	*11*	*11*	*4*	*3*	*0*	*3*
Blacktip grouper	**Mérou oriflamme**		**Mero banderilla**		***Epinephelus fasciatus***				**1,70(02)042,33**	**EEA**
51 Réunion	2	2	2	2	5	6	1	0	0	0
51 Fishing area total	*2*	*2*	*2*	*2*	*5*	*6*	*1*	*0*	*0*	*0*
Species total	*2*	*2*	*2*	*2*	*5*	*6*	*1*	*0*	*0*	*0*
Dungat grouper	**Mérou de Gorée**		**Mero de Gorea**		***Epinephelus goreensis***				**1,70(02)042,34**	**EEG**
34 Sierra Leone	62	64	57	54	34	85	202	88	90 F	90 F
34 Fishing area total	*62*	*64*	*57*	*54*	*34*	*85*	*202*	*88*	*90 F*	*90 F*
Species total	*62*	*64*	*57*	*54*	*34*	*85*	*202*	*88*	*90 F*	*90 F*
Comet grouper	**Mérou comète**		**Mero cometa**		***Epinephelus morrhua***				**1,70(02)042,35**	**EEP**
51 Saudi Arabia	29	19	21	14	28	24	31	22	25	25
51 Fishing area total	*29*	*19*	*21*	*14*	*28*	*24*	*31*	*22*	*25*	*25*
Species total	*29*	*19*	*21*	*14*	*28*	*24*	*31*	*22*	*25*	*25*
Warsaw grouper	**Mérou Varsovie**		**Mero negro**		***Epinephelus nigritus***				**1,70(02)042,36**	**ELG**
31 USA	44	50	...	30	26	28	14	28	46	27
31 Fishing area total	*44*	*50*	*...*	*30*	*26*	*28*	*14*	*28*	*46*	*27*
Species total	*44*	*50*	*...*	*30*	*26*	*28*	*14*	*28*	*46*	*27*
Areolate grouper	**Mérou aréolé**		**Mero areolado**		***Epinephelus areolatus***				**1,70(02)042,40**	**EPR**
51 Saudi Arabia	245	289	309	349	346	347	336	291	377	491
51 Fishing area total	*245*	*289*	*309*	*349*	*346*	*347*	*336*	*291*	*377*	*491*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*245*	*289*	*309*	*349*	*346*	*347*	*336*	*291*	*377*	*491*
Brownspotted grouper	**Mérou pintade**		**Mero pintado**		***Epinephelus chlorostigma***				**1,70(02)042,55**	**EFH**
51 Saudi Arabia	35	22	13	6	26	28	29	56	60	60
51 Fishing area total	*35*	*22*	*13*	*6*	*26*	*28*	*29*	*56*	*60*	*60*
Species total	*35*	*22*	*13*	*6*	*26*	*28*	*29*	*56*	*60*	*60*
Orange-spotted grouper	**Mérou taches oranges**		**Mero de pintas naranjas**		***Epinephelus coioides***				**1,70(02)042,57**	**ENI**
51 Iran	2 542	2 187	2 343	2 626	2 207	2 520	3 268	3 499	2 092	3 260
Saudi Arabia	136	118	75	50	57	78	128	100	21	5
51 Fishing area total	*2 678*	*2 305*	*2 418*	*2 676*	*2 264*	*2 598*	*3 396*	*3 599*	*2 113*	*3 265*
Species total	*2 678*	*2 305*	*2 418*	*2 676*	*2 264*	*2 598*	*3 396*	*3 599*	*2 113*	*3 265*
Camouflage grouper	**Mérou camouflage**		**Mero disfrazado**		***Epinephelus polyphekadion***				**1,70(02)042,69**	**EEK**
51 Saudi Arabia	27	13	...	...	34	...	...	...	...	...
51 Fishing area total	*27*	*13*	*...*	*...*	*34*	*...*	*...*	*...*	*...*	*...*
Species total	*27*	*13*	*...*	*...*	*34*	*...*	*...*	*...*	*...*	*...*
Brown-marbled grouper	**Mérou marron**		**Mero manchado**		***Epinephelus fuscoguttatus***				**1,70(02)042,74**	**EWF**
51 Saudi Arabia	38	19	29	31	20	30	29	40	48	48
51 Fishing area total	*38*	*19*	*29*	*31*	*20*	*30*	*29*	*40*	*48*	*48*
Species total	*38*	*19*	*29*	*31*	*20*	*30*	*29*	*40*	*48*	*48*
White-blotched grouper	**Mérou plate grise**		**Mero de lunares**		***Epinephelus multinotatus***				**1,70(02)042,77**	**EWU**
51 Saudi Arabia	1 118	374	372	329	557	396	310	557	486	453
51 Fishing area total	*1 118*	*374*	*372*	*329*	*557*	*396*	*310*	*557*	*486*	*453*
Species total	*1 118*	*374*	*372*	*329*	*557*	*396*	*310*	*557*	*486*	*453*
Smallscaled grouper	**Mérou petites écailles**		**Mero escamoso**		***Epinephelus polylepis***				**1,70(02)042,84**	**EWY**
51 Saudi Arabia	447	310	286	150	220	223	279	346	358	417
51 Fishing area total	*447*	*310*	*286*	*150*	*220*	*223*	*279*	*346*	*358*	*417*
Species total	*447*	*310*	*286*	*150*	*220*	*223*	*279*	*346*	*358*	*417*
Summan grouper	**Mérou summan**		**Mero sumán**		***Epinephelus summana***				**1,70(02)042,85**	**EWS**
51 Saudi Arabia	54	22	26	18	26	31	33	80	35	35
51 Fishing area total	*54*	*22*	*26*	*18*	*26*	*31*	*33*	*80*	*35*	*35*
Species total	*54*	*22*	*26*	*18*	*26*	*31*	*33*	*80*	*35*	*35*
Groupers nei	**Mérous nca**		**Meros nep**		***Epinephelus spp***				**1,70(02)042,XX**	**GPX**
27 Portugal	42	44	51	79	71	45	28	41	25	1
27 Fishing area total	*42*	*44*	*51*	*79*	*71*	*45*	*28*	*41*	*25*	*1*
31 Aruba	15	15 F	16 F	17	17 F	15	19	16	16	15
Bahamas	177	170	172	239	107	126	59	102	74	105
Bermuda	45	50	33	35	48	54	61	54	48	45
Br Virgin Is	8	6	19	1	1 F	1 F	1 F	1 F	1 F	1 F
Cuba	22	61	52	22	-	-	-	-	-	-
Dominican Rp	942	1 332	565	436	399	...	634	653	1 393	1 498
Fr Guiana	...	...	...	...	5	27	45	17	31	35 F
Puerto Rico	62	44	44	27	20	18	14	11	10	10
St Kitts Nev	3	10	20 F	28	27 F	26 F	26 F	25 F	25 F	24
St Vincent	...	...	...	...	...	...	...	...	1	1
Suriname	...	...	125	149	102	...	...	...	...	...
USA	5 984	5 887	5 760	5 903	5 626	4 882	4 124	4 556	3 544	2 665
US Virgin Is	38	45	57	67	54	47	36	36	44	47
Venezuela	811	898	1 943	3 070 F	1 640 F	970 F	1 180 F	1 643	1 600 F	1 600 F
31 Fishing area total	*8 107*	*8 518 F*	*8 806 F*	*9 994 F*	*8 046 F*	*6 166 F*	*6 199 F*	*7 114 F*	*6 787 F*	*6 046 F*
34 Benin	16	1	58	67	9	38	30	500	688	538
Cameroon	1	1	1	15 F	54	3	3	19 F	35	35 F
Congo Rep	50 F	100 F	141	118	109	119	232	101	110	204
Gabon	40	113	459	315	272	216	137	16	11 F	11 F
Gambia	63	66	55	101	667	339	129	130	161	161
Ghana	138	233	206	231	579	609	689	665	986	705
Liberia	44	...	...	...	...	49	145	81	80 F	80 F
Morocco	33	46	76	43	35	39	47	31	65	63
Portugal	5	11	15	9	1	-	0	1	1	11
Sao Tome Prn	33 F	41 F	49	4	4 F	3 F	3 F	3 F	3 F	3 F
Spain	36	5	14	17	10	29	46	46	98	80
Togo	12	5	7	2	2	2	1	2 F	4	3
34 Fishing area total	*471 F*	*622 F*	*1 081*	*922 F*	*1 742 F*	*1 446 F*	*1 462 F*	*1 595 F*	*2 242 F*	*1 894 F*
37 Albania	-	3	2	5	1	7	16	23	21	...
Algeria	...	...	...	...	...	...	200	267	198	173

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Cyprus	24	24	15	9	18	19	9	8	8	8
Egypt	1 123	1 453	1 314	1 119	1 094	1 550	1 493	1 327	1 018	985
France	-	-	-	-	-	-	-	-	1	1
Greece	142	71	91	154	141	79	102	86	108	108 F
Israel	188	226	118	83	161	76	85	83 F	23	31
Malta	15	31	22	20	17	18	8	12	8	-
Palest, O.T.	25 F	23	25	24	30	12	10	26	12	19
Syria	39	54	37	40	55	20	32	32	37	37
Tunisia	539	474	423	445	424	601	480	626	444	518
Turkey	-	292	230	264	295	384	345	313	566	672
37 Fishing area total	*2 095 F*	*2 651*	*2 277*	*2 163*	*2 236*	*2 766*	*2 780*	*2 803 F*	*2 444*	*2 552 F*
41 Brazil	2 143	2 110	938	659	1 855	735	833	722	795	751
41 Fishing area total	*2 143*	*2 110*	*938*	*659*	*1 855*	*735*	*833*	*722*	*795*	*751*
47 St Helena	18	14	7	20	21	11	40	11	8	13
47 Fishing area total	*18*	*14*	*7*	*20*	*21*	*11*	*40*	*11*	*8*	*13*
51 Bahrain	794	725	811	649	358	462	440	307	176	134
Djibouti	200 F	225 F	245 F	265 F	289	195	182	126	133	133 F
Egypt	3 576	3 687	3 651	4 189	3 094	2 601	2 801	2 582	3 230	2 871
Eritrea	159	109	1	1	1	4	3	1	0	0
France	-	-	-	-	-	-	-	-	9	3
Korea Rep	227	230	267	300	341	273	80	112	77	-
Kuwait	268	235 F	202	171	152	148	169	129	140 F	140 F
Oman	3 799	3 292	4 203	5 911	4 777	4 613	4 676	5 536	6 019	5 246
Pakistan	15 928	16 000	14 415	13 023	12 609	14 053	14 411	14 562	14 300	13 989
Qatar	1 820	1 567	1 804	1 293	2 094	1 743	1 613	2 259	1 318	1 335
Tanzania	500	550	500	500	529	500	629	758	910	956
51 Fishing area total	*27 271 F*	*26 620 F*	*26 099 F*	*26 302 F*	*24 244*	*24 592*	*25 004*	*26 372*	*26 312 F*	*24 807 F*
57 Korea Rep	32	-	-	-	-	-	-	-	-	-
Malaysia	1 156	1 281	1 093	1 145	1 000	1 340	1 614	1 361	1 440	1 515
57 Fishing area total	*1 188*	*1 281*	*1 093*	*1 145*	*1 000*	*1 340*	*1 614*	*1 361*	*1 440*	*1 515*
61 China	38 370 F	38 666 F	55 461 F	57 626 F	58 897 F	72 839 F	82 984	80 007	86 021	93 999
China,Taiwan	1 610	933	1 201	707	434	480	452	301	454	442
Russian Fed	-	-	-	-	-	-	-	344	-	-
61 Fishing area total	*39 980 F*	*39 599 F*	*56 662 F*	*58 333 F*	*59 331 F*	*73 319 F*	*83 436*	*80 652*	*86 475*	*94 441*
71 Fiji	1 544	1 000 F	316	450	500 F	539	608	700	200	250
Guam	9	5	13	7	6	5	4	5	7	1
Korea Rep	-	-	-	-	-	-	-	-	-	5
Malaysia	9 320	7 556	7 356	8 188	6 551	6 683	6 376	6 543	7 347	7 993
N Marianas	3	2	2	2	1	1	1	1	0	0
Palau	10	6	9	9	6	10	14	22	20 F	20 F
Singapore	38	33	19	23	22	41	52	51	45	37
71 Fishing area total	*10 924*	*8 602 F*	*7 715*	*8 679*	*7 086 F*	*7 279*	*7 055*	*7 322*	*7 619 F*	*8 306 F*
77 Amer Samoa	1	1	1	1	1	0	1	2	2	1
Cook Is	60 F	60 F	50 F	50	50 F	50	50 F	50 F	45 F	45 F
77 Fishing area total	*61 F*	*61 F*	*51 F*	*51*	*51 F*	*50*	*51 F*	*52 F*	*47 F*	*46 F*
87 Peru	87	313	109	68	80	67	51	68	57	7
87 Fishing area total	*87*	*313*	*109*	*68*	*80*	*67*	*51*	*68*	*57*	*7*
Species total	*92 387 F*	*90 435 F*	*104 889 F*	*108 415 F*	*105 763 F*	*117 816 F*	*128 553 F*	*128 113 F*	*134 251 F*	*140 379 F*
Comber	**Serran-chèvre**		**Cabrilla**		***Serranus cabrilla***				**1,70(02)061,01**	**CBR**
27 Spain	-	-	42	224	292	36	1 149	323	280	369
27 Fishing area total	-	-	*42*	*224*	*292*	*36*	*1 149*	*323*	*280*	*369*
Species total	-	-	*42*	*224*	*292*	*36*	*1 149*	*323*	*280*	*369*
Orange perch	**...B**		**...C**		***Lepidoperca pulchella***				**1,70(02)072,01**	**LDP**
81 New Zealand	46	97	49	11	58	99	229	46	25	21
81 Fishing area total	*46*	*97*	*49*	*11*	*58*	*99*	*229*	*46*	*25*	*21*
Species total	*46*	*97*	*49*	*11*	*58*	*99*	*229*	*46*	*25*	*21*
Black seabass	**Fanfre noir**		**Serrano estriado**		***Centropristis striata***				**1,70(02)081,02**	**BSB**
21 USA	1 276	1 574	1 359	1 375	1 291	1 264	993	824	520	763
21 Fishing area total	*1 276*	*1 574*	*1 359*	*1 375*	*1 291*	*1 264*	*993*	*824*	*520*	*763*
31 USA	391	333	310	378	229	257	185	212	379	312
31 Fishing area total	*391*	*333*	*310*	*378*	*229*	*257*	*185*	*212*	*379*	*312*
Species total	*1 667*	*1 907*	*1 669*	*1 753*	*1 520*	*1 521*	*1 178*	*1 036*	*899*	*1 075*
Coney	**Coné ouatalibi**		**Cherna cabrilla**		***Cephalopholis fulva***				**1,70(02)115,02**	**CFJ**
31 Grenada	...	...	97	99	96	97	88	86	84	30
St Vincent	...	...	...	...	...	...	...	...	17	14
31 Fishing area total	*...*	*...*	*97*	*99*	*96*	*97*	*88*	*86*	*101*	*44*
Species total	*...*	*...*	*97*	*99*	*96*	*97*	*88*	*86*	*101*	*44*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Peacock hind	**Vieille la prude**		**Cherna pavo real**		***Cephalopholis argus***				**1,70(02)115,04**	**CFF**
51 Saudi Arabia	72	25	11	21	25	61	49	49	55	55
51 Fishing area total	*72*	*25*	*11*	*21*	*25*	*61*	*49*	*49*	*55*	*55*
Species total	*72*	*25*	*11*	*21*	*25*	*61*	*49*	*49*	*55*	*55*
Yellowfin hind	**Vieille d'Arabie**		**Cherna arábiga**		***Cephalopholis hemistiktos***				**1,70(02)115,09**	**CFH**
51 Saudi Arabia	324	289	149	187	185	243	229	288	231	229
51 Fishing area total	*324*	*289*	*149*	*187*	*185*	*243*	*229*	*288*	*231*	*229*
Species total	*324*	*289*	*149*	*187*	*185*	*243*	*229*	*288*	*231*	*229*
Coral hind	**Vieille de corail**		**Cherna estrellada**		***Cephalopholis miniata***				**1,70(02)115,11**	**CFI**
51 Saudi Arabia	256	302	203	172	323	400	401	459	345	252
51 Fishing area total	*256*	*302*	*203*	*172*	*323*	*400*	*401*	*459*	*345*	*252*
Species total	*256*	*302*	*203*	*172*	*323*	*400*	*401*	*459*	*345*	*252*
Chocolate hind	**Vielle chocolat**		**Cherna chocolate**		***Cephalopholis boenak***				**1,70(02)115,19**	**CVK**
57 Indonesia	15 190	20 230	18 617	5 174	10 327	10 470	11 807	10 830	13 757	14 250
57 Fishing area total	*15 190*	*20 230*	*18 617*	*5 174*	*10 327*	*10 470*	*11 807*	*10 830*	*13 757*	*14 250*
71 Indonesia	33 326	28 170	35 126	9 218	18 250	25 624	29 654	20 053	27 557	33 785
71 Fishing area total	*33 326*	*28 170*	*35 126*	*9 218*	*18 250*	*25 624*	*29 654*	*20 053*	*27 557*	*33 785*
Species total	*48 516*	*48 400*	*53 743*	*14 392*	*28 577*	*36 094*	*41 461*	*30 883*	*41 314*	*48 035*
Humpback grouper	**Mérou bossu**		**Mero jorobado**		***Cromileptes altivelis***				**1,70(02)125,01**	**MPV**
57 Indonesia	...	...	...	856	1 095	1 661	2 662	2 847	3 985	3 465
57 Fishing area total	*...*	*...*	*...*	*856*	*1 095*	*1 661*	*2 662*	*2 847*	*3 985*	*3 465*
71 Indonesia	...	...	...	4 951	4 981	2 928	3 609	3 146	4 189	3 975
71 Fishing area total	*...*	*...*	*...*	*4 951*	*4 981*	*2 928*	*3 609*	*3 146*	*4 189*	*3 975*
Species total	*...*	*...*	*...*	*5 807*	*6 076*	*4 589*	*6 271*	*5 993*	*8 174*	*7 440*
Squaretail coralgrouper	**Mérou queue carrée**		**Mero troncón**		***Plectropomus areolatus***				**1,70(02)208,02**	**EME**
51 Saudi Arabia	341	299	152	299	349	411	338	426	400	400
51 Fishing area total	*341*	*299*	*152*	*299*	*349*	*411*	*338*	*426*	*400*	*400*
Species total	*341*	*299*	*152*	*299*	*349*	*411*	*338*	*426*	*400*	*400*
Leopard coralgrouper	**Saumonée léopard**		**Mero celestial**		***Plectropomus leopardus***				**1,70(02)208,04**	**EMO**
57 Indonesia	...	...	...	4 427	886	1 008	2 728	1 516	1 857	1 779
57 Fishing area total	*...*	*...*	*...*	*4 427*	*886*	*1 008*	*2 728*	*1 516*	*1 857*	*1 779*
71 Indonesia	...	...	...	14 735	7 780	4 634	5 099	7 623	12 740	8 308
71 Fishing area total	*...*	*...*	*...*	*14 735*	*7 780*	*4 634*	*5 099*	*7 623*	*12 740*	*8 308*
Species total	*...*	*...*	*...*	*19 162*	*8 666*	*5 642*	*7 827*	*9 139*	*14 597*	*10 087*
Roving coralgrouper	**Mérou-loche vagabonde**		**Mero errante**		***Plectropomus pessuliferus***				**1,70(02)208,05**	**EMU**
51 Saudi Arabia	305	406	234	253	351	385	340	342	330	330
51 Fishing area total	*305*	*406*	*234*	*253*	*351*	*385*	*340*	*342*	*330*	*330*
Species total	*305*	*406*	*234*	*253*	*351*	*385*	*340*	*342*	*330*	*330*
Argentine seabass	**Serran argentin**		**Mero sureño**		***Acanthistius brasilianus***				**1,70(02)259,01**	**BSZ**
41 Argentina	4 881	3 622	4 029	5 034	5 982	4 343	4 455	4 562	4 672	4 198
Uruguay	9	2	3	77	1	126	17	8	7	...
41 Fishing area total	*4 890*	*3 624*	*4 032*	*5 111*	*5 983*	*4 469*	*4 472*	*4 570*	*4 679*	*4 198*
Species total	*4 890*	*3 624*	*4 032*	*5 111*	*5 983*	*4 469*	*4 472*	*4 570*	*4 679*	*4 198*
Peruvian rock seabass	**Serran cabrilla**		**Cabrilla loca**		***Paralabrax humeralis***				**1,70(02)405,05**	**BAP**
87 Peru	2 001	1 522	1 820	1 270	857	712	1 318	1 499	2 481	1 020
87 Fishing area total	*2 001*	*1 522*	*1 820*	*1 270*	*857*	*712*	*1 318*	*1 499*	*2 481*	*1 020*
Species total	*2 001*	*1 522*	*1 820*	*1 270*	*857*	*712*	*1 318*	*1 499*	*2 481*	*1 020*
...A	**...B**		**Verdillos nep**		***Paralabrax spp***				**1,70(02)405,XX**	**XBX**
77 Mexico	...	...	...	...	4 132	4 314	4 457	4 596	4 735	4 893
77 Fishing area total	*...*	*...*	*...*	*...*	*4 132*	*4 314*	*4 457*	*4 596*	*4 735*	*4 893*
Species total	*...*	*...*	*...*	*...*	*4 132*	*4 314*	*4 457*	*4 596*	*4 735*	*4 893*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Yellow-edged lyretail	**Croissant queue jaune**		**Mero luna creciente**		***Variola louti***				**1,70(02)557,01**	**VRL**
51 Egypt	...	...	...	...	...	...	785	1 283	859	989
Saudi Arabia	254	376	188	181	306	404	384	388	415	415
51 Fishing area total	*254*	*376*	*188*	*181*	*306*	*404*	*1 169*	*1 671*	*1 274*	*1 404*
Species total	*254*	*376*	*188*	*181*	*306*	*404*	*1 169*	*1 671*	*1 274*	*1 404*
Groupers, seabasses nei	**Serranidés nca**		**Meros, chernas, nep**		***Serranidae***				**1,70(02)XXX,XX**	**BSX**
21 USA	18	23	25	3	5	7	3	4	7	3
21 Fishing area total	*18*	*23*	*25*	*3*	*5*	*7*	*3*	*4*	*7*	*3*
27 Germany	1	-	-	-	-	-	-	-	-	-
Portugal	129	115	123	126	121	119	117	125	108	78
Spain	421	194	67	33	33	643	58	71	96	104
27 Fishing area total	*551*	*309*	*190*	*159*	*154*	*762*	*175*	*196*	*204*	*182*
31 Antigua Barb	217	364	352	398	455	463	454	258	301	243
Colombia	1	7	10	17	41	35 F	30 F	25 F	18	10
Costa Rica	0	1	0	0	0	0	0	-	-	-
Grenada	38	62	4	2	3	2	3	2	3	2
Mexico	10 572	10 220	6 806	6 582	11 906	11 852	13 490	12 730	11 069	9 946
Nicaragua	239	293	279	304	359	462	311	173	93	155
USA	16	...	...	2	-	-	-	-	-	-
Venezuela	123	137	587	930 F	500 F	300 F	370 F	410 F	400 F	400 F
31 Fishing area total	*11 206*	*11 084*	*8 038*	*8 235 F*	*13 264 F*	*13 114 F*	*14 658 F*	*13 598 F*	*11 884 F*	*10 756 F*
34 Greece	-	-	6	-	-	-	-	-	-	-
Korea Rep	351	181	481	653	275	45	194	22	106	167
Mauritania	200 F	160 F	130 F	100 F	70 F	40 F	60 F	50 F	55 F	86
Nigeria	2 487	2 354	3 914	2 276	2 182	2 828	2 294	2 518	3 442	4 652
Portugal	8	6	6	7	6	6	6	6	9	5
Sao Tome Prn	...	...	...	76	80 F	80 F	80 F	80 F	80 F	80 F
Senegal	3 685	2 903	1 064	591	659	1 528	1 365	2 482	3 563	2 891
Spain	82	4	16	13	32	25	23	26	42	30
34 Fishing area total	*6 813 F*	*5 608 F*	*5 617 F*	*3 716 F*	*3 304 F*	*4 552 F*	*4 022 F*	*5 184 F*	*7 297 F*	*7 911 F*
37 Algeria	0	0	0	...	...	0	0	-	-	-
Croatia	...	...	...	...	...	...	...	...	1	1
Cyprus	5	10	12	8	4	5	18	16	15	18
Greece	271	319	291	127	165	223	176	179	191	191 F
Italy	...	...	...	...	319	308	249	179	191	101
Lebanon	240	250	250	250	250	252	252 F	252 F	252 F	252 F
Malta	2	1	1	1	1	1	5	4	2	9
Spain	121	400	271	193	166	137	119	157	166	161
Tunisia	98	97	1 018	584	572	363	115	104	117	57
Turkey	410	100	94	127	93	90	103	229	51	23
37 Fishing area total	*1 147*	*1 177*	*1 937*	*1 290*	*1 570*	*1 379*	*1 037 F*	*1 120 F*	*986 F*	*813 F*
41 Portugal	1	1	-	-	-	-	-	-	-	-
Spain	-	9	-	-	-	-	-	-	-	-
41 Fishing area total	*1*	*10*	-	-	-	-	-	-	-	-
47 Angola	4 214	5 774	4 513	5 418	4 000 F	4 118	3 391	1 695	1 533	1 470 F
Portugal	-	-	-	-	-	-	-	2	-	-
South Africa	15	7	4	8	8	13	6	7	6	6
47 Fishing area total	*4 229*	*5 781*	*4 517*	*5 426*	*4 008 F*	*4 131*	*3 397*	*1 704*	*1 539*	*1 476 F*
51 Egypt	-	-	-	-	-	-	948	1 233	1 278	1 976
Eritrea	111	41	84	162	40	146	182	108	140	103
Mauritius	938	885	879	794	633	44	924	556	1 033	860
Réunion	9	6	6	6	...	...	...	...	...	...
Saudi Arabia	2 011	1 712	1 229	1 936	1 650	1 556	1 917	1 517	1 536	1 395
Seychelles	107	74	92	96	93	122	148	155	82	78
South Africa	...	20	18	28	28	29	26	35	27	26
Spain	-	93	-	108	85	51	5	3	-	-
Untd Arab Em	27 680	22 827	18 823	16 700 F	14 511	12 700 F	10 800 F	8 983	9 142	8 115
Yemen	1 070 F	1 400 F	1 500 F	1 650 F	1 450 F	1 800 F	1 950 F	1 104	1 580 F	2 050 F
Zanzibar	288	268	177	615	523	563	574	685	698	714
51 Fishing area total	*32 214 F*	*27 326 F*	*22 808 F*	*22 095 F*	*19 013 F*	*17 011 F*	*17 474 F*	*14 379*	*15 516 F*	*15 317 F*
57 Australia	84	51	66	106	125	153	121	118	82	67
Thailand	2 516	4 104	3 133	3 776	3 480	3 228	3 024	1 966	1 977	2 531
57 Fishing area total	*2 600*	*4 155*	*3 199*	*3 882*	*3 605*	*3 381*	*3 145*	*2 084*	*2 059*	*2 598*
61 China,H.Kong	1 200 F	1 150 F	1 050 F	1 150 F	1 100 F	1 000 F	1 000 F	1 030 F	1 040 F	1 050 F
Korea Rep	28	9	26	50	32	11	35	45	55	39
61 Fishing area total	*1 228 F*	*1 159 F*	*1 076 F*	*1 200 F*	*1 132 F*	*1 011 F*	*1 035 F*	*1 075 F*	*1 095 F*	*1 089 F*
71 Australia	0	1	8	12	13	2	8	6	2	2
Kiribati	...	...	...	...	...	...	...	...	...	3
Philippines	11 339	13 913	13 809	15 071	16 444	18 081	19 306	20 563	18 578	19 889
Thailand	5 112	5 841	4 993	3 733	3 880	3 172	3 175	1 829	2 022	1 926
71 Fishing area total	*16 451*	*19 755*	*18 810*	*18 816*	*20 337*	*21 255*	*22 489*	*22 398*	*20 602*	*21 820*
77 Costa Rica	103	103	143	145	112	130 F	147	150 F	150 F	150 F
Mexico	4 037	5 115	2 599	2 513	1 569	1 639	2 358	2 532	1 672	1 154
Nicaragua	187	136	200	173	48	100	127	172	51	59
USA	-	17	21	19	21	12	11	9	10	6

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
77 Fishing area total	*4 327*	*5 371*	*2 963*	*2 850*	*1 750*	*1 881 F*	*2 643*	*2 863 F*	*1 883 F*	*1 369 F*
81 Australia	8	59	24	24	27	6	4	4	6	4
Japan	11	3	13	-	-	-	-	-	-	-
81 Fishing area total	*19*	*62*	*37*	*24*	*27*	*6*	*4*	*4*	*6*	*4*
87 Chile	5	-	1	7	6	5	1	7	4	5
Ecuador	43	212	206	88	139	184	556	296	...	...
87 Fishing area total	*48*	*212*	*207*	*95*	*145*	*189*	*557*	*303*	*4*	*5*
Species total	*80 852 F*	*82 032 F*	*69 424 F*	*67 791 F*	*68 314 F*	*68 679 F*	*70 639 F*	*64 912 F*	*63 082 F*	*63 343 F*
Terapon perches nei	**...B**		**...C**		***Terapon spp***				**1,70(04)089,XX**	**THO**
51 Saudi Arabia	...	...	...	...	...	9	3	12	1	16
51 Fishing area total	*...*	*...*	*...*	*...*	*...*	*9*	*3*	*12*	*1*	*16*
57 Indonesia	...	...	...	651	646	686	1 467	659	2 308	3 288
57 Fishing area total	*...*	*...*	*...*	*651*	*646*	*686*	*1 467*	*659*	*2 308*	*3 288*
71 Indonesia	...	...	...	631	1 401	2 959	4 907	3 689	3 455	3 930
71 Fishing area total	*...*	*...*	*...*	*631*	*1 401*	*2 959*	*4 907*	*3 689*	*3 455*	*3 930*
Species total	*...*	*...*	*...*	*1 282*	*2 047*	*3 654*	*6 377*	*4 360*	*5 764*	*7 234*
Fourlined terapon	**Violon crépuscule**		**Baraonga aurora**		***Pelates quadrilineatus***				**1,70(04)201,01**	**PQD**
51 Bahrain	...	...	...	31	57	5	6	82	42	14
51 Fishing area total	*...*	*...*	*...*	*31*	*57*	*5*	*6*	*82*	*42*	*14*
Species total	*...*	*...*	*...*	*31*	*57*	*5*	*6*	*82*	*42*	*14*
Giant seabass	**Bar gigantesque**		**Lubina gigante**		***Stereolepis gigas***				**1,70(05)220,02**	**TEJ**
77 USA	3	2	4	4	3	3	4	3	3	6
77 Fishing area total	*3*	*2*	*4*	*4*	*3*	*3*	*4*	*3*	*3*	*6*
Species total	*3*	*2*	*4*	*4*	*3*	*3*	*4*	*3*	*3*	*6*
Spotted seabass	**Bar tacheté**		**Baila**		***Dicentrarchus punctatus***				**1,70(06)345,01**	**SPU**
27 France	79	56	83	76	62	59	84	32	107	97
Spain	-	27	20	30	12	18	17	13	9	18
27 Fishing area total	*79*	*83*	*103*	*106*	*74*	*77*	*101*	*45*	*116*	*115*
34 Mauritania	...	...	...	...	...	...	...	...	...	8
Senegal	125	193	190	376	83	129	153	133	86	125
34 Fishing area total	*125*	*193*	*190*	*376*	*83*	*129*	*153*	*133*	*86*	*133*
37 Egypt	238	556	751	472	640	1 070	759	933	586	587
Libya	...	...	...	...	...	...	...	...	153	150 F
37 Fishing area total	*238*	*556*	*751*	*472*	*640*	*1 070*	*759*	*933*	*739*	*737 F*
Species total	*442*	*832*	*1 044*	*954*	*797*	*1 276*	*1 013*	*1 111*	*941*	*985 F*
European seabass	**Bar européen**		**Lubina**		***Dicentrarchus labrax***				**1,70(06)345,03**	**BSS**
27 Belgium	...	...	153	159	207	211	179	187	174	216
Channel Is	80	73	84	159	220	193	160	143	103	144
Denmark	2	1	1	1	1	2	1	-	-	4
France	3 957	3 803	4 759	4 507	5 199	5 447	5 067	3 019	5 275	5 820
Ireland	-	-	-	0	0	-	-	-	1	-
Netherlands	79	96	164	191	327	308	376	380	395	399
Norway	-	-	-	-	-	0	0	1	0	-
Portugal	43	43	47	67	177	461	495	403	414	489
Spain	326	303	239	353	294	436	422	398	412	453
UK	457	640	589	621	516	576	715	790	698	737
27 Fishing area total	*4 944*	*4 959*	*6 036*	*6 058*	*6 941*	*7 634*	*7 415*	*5 321*	*7 472*	*8 262*
34 Greece	20	21	16	12	16	29	16	10	6	6 F
Netherlands	-	-	-	1	-	-	-	-	-	-
Spain	-	-	1	3	3	3	4	3	4	26
34 Fishing area total	*20*	*21*	*17*	*16*	*19*	*32*	*20*	*13*	*10*	*32 F*
37 Albania	70	64	2	13	43	135	200	258	208	170
Algeria	...	...	...	...	...	...	8	9	89	122
Bulgaria	-	11	0	1	-	0	0	-	0	-
Croatia	13	2	5	3	12	17	21	10	12	12
Egypt	800	1 336	1 404	942	1 112	1 516	1 550	1 125	1 336	1 326
France	251	261	239	285	251	277	279	228	194	214
Greece	280	448	551	669	812	1 260	796	472	308	308 F
Italy	2 735	3 428	3 412	3 318	156	138	205	186	163	159
Malta	0	-	-	-	-	-	0	-	-	-
Slovenia	5	4	7	2	1	1	1	4	7	4
Spain	258	240	147	174	183	158	206	162	222	208
37 Fishing area total	*4 412*	*5 794*	*5 767*	*5 407*	*2 570*	*3 502*	*3 266*	*2 454*	*2 539*	*2 523 F*
Species total	*9 376*	*10 774*	*11 820*	*11 481*	*9 530*	*11 168*	*10 701*	*7 788*	*10 021*	*10 817 F*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Seabasses nei	**Bars nca**		**Lubinas nep**		***Dicentrarchus spp***				**1,70(06)345,XX**	**BSE**
01 Egypt	3 789	3 310	1 184	1 741	2 215	4 402	4 307	3 965	4 208	2 060
01 Fishing area total	*3 789*	*3 310*	*1 184*	*1 741*	*2 215*	*4 402*	*4 307*	*3 965*	*4 208*	*2 060*
27 Portugal	367	357	318	328	318	209	111	83	46	35
27 Fishing area total	*367*	*357*	*318*	*328*	*318*	*209*	*111*	*83*	*46*	*35*
34 Morocco	164	188	274	286	176	174	131	95	74	176
Portugal	11	-	-	-	-	-	-	-	-	1
34 Fishing area total	*175*	*188*	*274*	*286*	*176*	*174*	*131*	*95*	*74*	*177*
37 Cyprus	3	3	6	3	2	-	22	1	-	-
Morocco	62	6	7	5	2	7	1	0	1	1
Serbia-Monte	7	7	8	6	...	-	-	-	-	-
Spain	1	14	14	0	3	1	1	1	1	1
Tunisia	317	949	750	746	940	854	387	322	214	249
Turkey	1 200	713	700	628	581	490	421	751	615	577
37 Fishing area total	*1 590*	*1 692*	*1 485*	*1 388*	*1 528*	*1 352*	*832*	*1 075*	*831*	*828*
Species total	*5 921*	*5 547*	*3 261*	*3 743*	*4 237*	*6 137*	*5 381*	*5 218*	*5 159*	*3 100*
Japanese seabass	**Bar du Japon**		**Serránido japonés**		***Lateolabrax japonicus***				**1,70(08)297,01**	**BAJ**
61 Japan	10 690	10 737	10 136	10 052	10 578	11 442	10 766	10 251	8 950	8 800 F
Korea Rep	1 566	1 479	1 564	1 382	1 173	1 173	1 007	938	1 114	1 154
61 Fishing area total	*12 256*	*12 216*	*11 700*	*11 434*	*11 751*	*12 615*	*11 773*	*11 189*	*10 064*	*9 954 F*
Species total	*12 256*	*12 216*	*11 700*	*11 434*	*11 751*	*12 615*	*11 773*	*11 189*	*10 064*	*9 954 F*
Red bigeye	**Beauclaire du Pacifique**		**Catalufa del Pacífico**		***Priacanthus macracanthus***				**1,70(11)026,05**	**BIR**
57 Indonesia	...	...	...	...	...	...	142	137	451	543
57 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*142*	*137*	*451*	*543*
61 China,Taiwan	3 079	2 142	2 256	1 965	1 841	1 569	1 523	1 256	1 580	1 066
61 Fishing area total	*3 079*	*2 142*	*2 256*	*1 965*	*1 841*	*1 569*	*1 523*	*1 256*	*1 580*	*1 066*
71 Indonesia	...	...	...	182	258	256	560	214	588	620
71 Fishing area total	*...*	*...*	*...*	*182*	*258*	*256*	*560*	*214*	*588*	*620*
Species total	*3 079*	*2 142*	*2 256*	*2 147*	*2 099*	*1 825*	*2 225*	*1 607*	*2 619*	*2 229*
Bigeyes nei	**Beauclaires nca**		**Catalufas nep**		***Priacanthus spp***				**1,70(11)026,XX**	**BIG**
31 USA	1	1	1	1	-	-	-	-	-	-
31 Fishing area total	*1*	*1*	*1*	*1*	-	-	-	-	-	-
34 Côte dIvoire	1	2	1	6	2	2	2	2 F	2	3
34 Fishing area total	*1*	*2*	*1*	*6*	*2*	*2*	*2*	*2 F*	*2*	*3*
41 Brazil	45	59	66	70	89	102	398	190	210	198
41 Fishing area total	*45*	*59*	*66*	*70*	*89*	*102*	*398*	*190*	*210*	*198*
47 St Helena	1	2	1	1	1	2	3	2	1	1
47 Fishing area total	*1*	*2*	*1*	*1*	*1*	*2*	*3*	*2*	*1*	*1*
51 France	-	-	-	-	-	-	-	-	38	24
Réunion	13	8	7	7	9	6	6	6	6 F	6 F
Saudi Arabia	-	-	-	-	-	0	0	-	-	-
51 Fishing area total	*13*	*8*	*7*	*7*	*9*	*6*	*6*	*6*	*44 F*	*30 F*
57 Indonesia	1 459	1 951	4 126	4 644	4 213	4 333	4 294	6 301	7 842	10 099
Malaysia	...	...	...	1 719	...	...	...	2 502	2 980	4 394
Thailand	33 771	39 722	40 281	47 077	36 188	37 755	33 712	12 617	11 780	12 199
57 Fishing area total	*35 230*	*41 673*	*44 407*	*53 440*	*40 401*	*42 088*	*38 006*	*21 420*	*22 602*	*26 692*
61 China,H.Kong	4 000 F	3 900 F	3 600 F	3 850 F	3 720 F	3 550 F	3 550 F	3 640 F	3 660 F	3 870 F
61 Fishing area total	*4 000 F*	*3 900 F*	*3 600 F*	*3 850 F*	*3 720 F*	*3 550 F*	*3 550 F*	*3 640 F*	*3 660 F*	*3 870 F*
71 Indonesia	3 885	7 640	6 617	8 431	12 227	15 292	17 472	14 248	10 283	31 152
Malaysia	...	...	...	10 366	...	...	...	10 523	15 756	16 358
Thailand	59 926	63 862	63 682	89 495	85 007	75 118	71 458	19 658	19 235	19 447
71 Fishing area total	*63 811*	*71 502*	*70 299*	*108 292*	*97 234*	*90 410*	*88 930*	*44 429*	*45 274*	*66 957*
Species total	*103 102 F*	*117 147 F*	*118 382 F*	*165 667 F*	*141 456 F*	*136 160 F*	*130 895 F*	*69 689 F*	*71 793 F*	*97 751 F*
Cardinalfishes, etc. nei	**Apogonidés nca**		**Peces cardenal, etc. nep**		***Apogonidae***				**1,70(12)XXX,XX**	**APO**
27 Germany	10	-	-	0	-	-	-	-	-	-
Ireland	5	55	952	699	627	315	212	-	-	-
27 Fishing area total	*15*	*55*	*952*	*699*	*627*	*315*	*212*	-	-	-
34 Portugal	-	-	-	-	-	0	-	-	-	-
34 Fishing area total	-	-	-	-	-	*0*	-	-	-	-
51 Yemen	262	293	301 F	330 F	310 F	382 F	400 F	226 F	320 F	420 F
51 Fishing area total	*262*	*293*	*301 F*	*330 F*	*310 F*	*382 F*	*400 F*	*226 F*	*320 F*	*420 F*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
71 Fiji	67	32 F	...	...	...	...	53	...	...	...
71 Fishing area total	*67*	*32 F*	*...*	*...*	*...*	*...*	*53*	*...*	*...*	*...*
Species total	*344*	*380 F*	*1 253 F*	*1 029 F*	*937 F*	*697 F*	*665 F*	*226 F*	*320 F*	*420 F*
Silver sillago	**Pêche-madame argenté**		**Silago plateado**		***Sillago sihama***				**1,70(15)233,04**	**ILS**
51 Saudi Arabia	18	65	22	132	53	75	84	176	96	65
51 Fishing area total	*18*	*65*	*22*	*132*	*53*	*75*	*84*	*176*	*96*	*65*
57 Indonesia	...	...	...	0	12	160	7	0	117	165
57 Fishing area total	*...*	*...*	*...*	*0*	*12*	*160*	*7*	*0*	*117*	*165*
71 Indonesia	...	...	...	160	163	301	376	423	97	878
71 Fishing area total	*...*	*...*	*...*	*160*	*163*	*301*	*376*	*423*	*97*	*878*
Species total	*18*	*65*	*22*	*292*	*228*	*536*	*467*	*599*	*310*	*1 108*
Sillago-whitings	**Sillaginidés**		**Sillagínidos**		***Sillaginidae***				**1,70(15)XXX,XX**	**WHS**
51 Bahrain	...	...	...	4	5	10	28	16	9	12
Pakistan	204	210	401	487	421	411	400	428	413	378
51 Fishing area total	*204*	*210*	*401*	*491*	*426*	*421*	*428*	*444*	*422*	*390*
57 Australia	1 696	1 544	1 713	1 383	1 224	1 257	1 342	1 250	1 243	1 207
Malaysia	1 275	913	1 027	1 343	961	1 195	766	650	702	1 135
Thailand	7 057	8 755	10 792	7 758	8 219	9 696	6 457	2 037	1 858	1 948
57 Fishing area total	*10 028*	*11 212*	*13 532*	*10 484*	*10 404*	*12 148*	*8 565*	*3 937*	*3 803*	*4 290*
61 China,Taiwan	132	231	141	241	144	100	95	86	61	61
Korea Rep	10	15	14	8	22	165	215	131	231	1
61 Fishing area total	*142*	*246*	*155*	*249*	*166*	*265*	*310*	*217*	*292*	*62*
71 Australia	814	1 197	956	900	1 283	1 485	1 357	1 014	1 049	1 333
Malaysia	782	694	776	1 023	1 247	1 413	1 376	1 096	1 008	1 363
Philippines	10 458	14 213	15 202	15 648	15 722	15 664	15 179	16 481	15 061	14 528
Singapore	14	8	8	8	12	25	50	9	16	5
Thailand	2 446	3 934	3 869	6 948	8 718	8 620	9 399	1 993	2 394	2 194
71 Fishing area total	*14 514*	*20 046*	*20 811*	*24 527*	*26 982*	*27 207*	*27 361*	*20 593*	*19 528*	*19 423*
81 Australia	1 443	1 594	2 126	1 866	1 469	1 615	1 467	1 397	1 059	967
81 Fishing area total	*1 443*	*1 594*	*2 126*	*1 866*	*1 469*	*1 615*	*1 467*	*1 397*	*1 059*	*967*
Species total	*26 331*	*33 308*	*37 025*	*37 617*	*39 447*	*41 656*	*38 131*	*26 588*	*25 104*	*25 132*
Sand tilefish	**Matajuel blanc**		**Matajuelo blanco**		***Malacanthus plumieri***				**1,70(17)357,02**	**MWP**
31 Grenada	-	-	-	-	-	-	-	6	3	3
31 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*6*	*3*	*3*
Species total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*6*	*3*	*3*
Moonfish	**Luneur**		**Lunero**		***Mene maculata***				**1,70(26)327,01**	**MOO**
61 China,Taiwan	1 582	1 110	956	2 223	1 512	1 665	2 225	1 681	1 194	1 622
61 Fishing area total	*1 582*	*1 110*	*956*	*2 223*	*1 512*	*1 665*	*2 225*	*1 681*	*1 194*	*1 622*
71 Philippines	13 268	15 413	15 084	14 396	14 604	14 926	16 354	17 609	16 753	17 302
Singapore	7	5	8	11	11	22	55	24	22	24
71 Fishing area total	*13 275*	*15 418*	*15 092*	*14 407*	*14 615*	*14 948*	*16 409*	*17 633*	*16 775*	*17 326*
Species total	*14 857*	*16 528*	*16 048*	*16 630*	*16 127*	*16 613*	*18 634*	*19 314*	*17 969*	*18 948*
Ruff	**Saumon rude**		**Salmón áspero**		***Arripis georgianus***				**1,70(29)051,01**	**RUF**
57 Australia	992	860	727	591	465	483	335	407	325	381
57 Fishing area total	*992*	*860*	*727*	*591*	*465*	*483*	*335*	*407*	*325*	*381*
Species total	*992*	*860*	*727*	*591*	*465*	*483*	*335*	*407*	*325*	*381*
Australian salmon	**Saumon australien**		**Salmón de Australia**		***Arripis trutta***				**1,70(29)051,02**	**ASA**
57 Australia	3 932	4 232	3 170	3 196	2 292	3 166	2 334	1 488	1 859	1 502
57 Fishing area total	*3 932*	*4 232*	*3 170*	*3 196*	*2 292*	*3 166*	*2 334*	*1 488*	*1 859*	*1 502*
81 Australia	815	810	1 347	2 132	1 135	659	1 068	1 449	1 531	542
New Zealand	2 934	3 637	3 987	1 533	2 549	1 547	2 938	2 495	1 749	2 400
Ukraine	-	-	-	-	-	11	...	...	...	...
81 Fishing area total	*3 749*	*4 447*	*5 334*	*3 665*	*3 684*	*2 217*	*4 006*	*3 944*	*3 280*	*2 942*
Species total	*7 681*	*8 679*	*8 504*	*6 861*	*5 976*	*5 383*	*6 340*	*5 432*	*5 139*	*4 444*
Mangrove red snapper	**Vivaneau des mangroves**		**Pargo de manglar**		***Lutjanus argentimaculatus***				**1,70(32)027,02**	**RES**
51 Pakistan	2 900	3 000	2 198	2 260	2 169	2 009	1 890	1 995	1 898	1 765
51 Fishing area total	*2 900*	*3 000*	*2 198*	*2 260*	*2 169*	*2 009*	*1 890*	*1 995*	*1 898*	*1 765*
57 Malaysia	608	627	732	772	736	719	794	687	1 083	924
57 Fishing area total	*608*	*627*	*732*	*772*	*736*	*719*	*794*	*687*	*1 083*	*924*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
71 Malaysia	10 436	10 635	10 499	12 420	9 163	9 115	9 114	8 288	8 102	7 388
71 Fishing area total	*10 436*	*10 635*	*10 499*	*12 420*	*9 163*	*9 115*	*9 114*	*8 288*	*8 102*	*7 388*
Species total	*13 944*	*14 262*	*13 429*	*15 452*	*12 068*	*11 843*	*11 798*	*10 970*	*11 083*	*10 077*
John's snapper	**Vivaneau ziebelo**		**Pargo jaspeado**		***Lutjanus johnii***				**1,70(32)027,07**	**LJH**
51 Iran	1 565	1 135	1 871	2 115	2 052	2 589	1 576	1 615	1 591	2 475
51 Fishing area total	*1 565*	*1 135*	*1 871*	*2 115*	*2 052*	*2 589*	*1 576*	*1 615*	*1 591*	*2 475*
Species total	*1 565*	*1 135*	*1 871*	*2 115*	*2 052*	*2 589*	*1 576*	*1 615*	*1 591*	*2 475*
Malabar blood snapper	**Vivaneau malabar**		**Pargo malabárico**		***Lutjanus malabaricus***				**1,70(32)027,13**	**MAL**
51 Iran	247	260	342	225	272	146	615	233	288	294
Qatar	204	90	250	...	231	305	207	201	136	128
51 Fishing area total	*451*	*350*	*592*	*225*	*503*	*451*	*822*	*434*	*424*	*422*
Species total	*451*	*350*	*592*	*225*	*503*	*451*	*822*	*434*	*424*	*422*
Mutton snapper	**Vivaneau sorbe**		**Pargo criollo**		***Lutjanus analis***				**1,70(32)027,17**	**LJN**
31 Puerto Rico	60	48	65	35	30	22	21	18	18	25
USA	...	...	...	...	...	...	...	70	53	57
31 Fishing area total	*60*	*48*	*65*	*35*	*30*	*22*	*21*	*88*	*71*	*82*
Species total	*60*	*48*	*65*	*35*	*30*	*22*	*21*	*88*	*71*	*82*
Yellow snapper	**Vivaneau jaune**		**Pargo amarillo(=Huachinango)**		***Lutjanus argentiventris***				**1,70(32)027,20**	**HUS**
77 Mexico	3 388	3 733	1 251	1 138	63	66	119	102	84	95
77 Fishing area total	*3 388*	*3 733*	*1 251*	*1 138*	*63*	*66*	*119*	*102*	*84*	*95*
87 Colombia	51	107	47	51	41	35 F	30 F	25 F	15	20
87 Fishing area total	*51*	*107*	*47*	*51*	*41*	*35 F*	*30 F*	*25 F*	*15*	*20*
Species total	*3 439*	*3 840*	*1 298*	*1 189*	*104*	*101 F*	*149 F*	*127 F*	*99*	*115*
Southern red snapper	**Vivaneau rouge**		**Pargo colorado**		***Lutjanus purpureus***				**1,70(32)027,22**	**SNC**
31 Colombia	41	102	41	102	10	13 F	16 F	20 F	23	7
Cuba	773	885	986	627	709	639	770	759	921	848
Dominican Rp	355	363	322	202	...	...	...	188	875	941
Guyana	524	423	612	539	399	650 F	976	897	789	1 037
St Vincent	...	...	...	...	...	...	...	...	20	11
31 Fishing area total	*1 693*	*1 773*	*1 961*	*1 470*	*1 118*	*1 302 F*	*1 762 F*	*1 864 F*	*2 628*	*2 844*
41 Brazil	6 209	6 923	5 912	5 994	7 793	6 587	3 694	5 943	6 555	6 199
41 Fishing area total	*6 209*	*6 923*	*5 912*	*5 994*	*7 793*	*6 587*	*3 694*	*5 943*	*6 555*	*6 199*
Species total	*7 902*	*8 696*	*7 873*	*7 464*	*8 911*	*7 889 F*	*5 456 F*	*7 807 F*	*9 183*	*9 043*
Blackfin snapper	**Vivaneau oreille noire**		**Pargo sesí**		***Lutjanus buccanella***				**1,70(32)027,24**	**LJU**
31 St Vincent	...	...	...	...	...	...	...	...	13	13
31 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*13*	*13*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*13*	*13*
Northern red snapper	**Vivaneau campèche**		**Pargo del Golfo**		***Lutjanus campechanus***				**1,70(32)027,25**	**SNR**
31 Mexico	2 717	2 566	1 003	912	3 195	3 337	2 893	2 574	2 251	1 055
USA	2 152	2 032	1 286	2 189	1 922	2 163	1 498	1 137	1 316	897
31 Fishing area total	*4 869*	*4 598*	*2 289*	*3 101*	*5 117*	*5 500*	*4 391*	*3 711*	*3 567*	*1 952*
Species total	*4 869*	*4 598*	*2 289*	*3 101*	*5 117*	*5 500*	*4 391*	*3 711*	*3 567*	*1 952*
Cubera snapper	**Vivaneau cubera**		**Pargo cubera**		***Lutjanus cyanopterus***				**1,70(32)027,27**	**LJY**
31 Mexico	...	...	...	...	344	359	350	261	172	115
31 Fishing area total	*...*	*...*	*...*	*...*	*344*	*359*	*350*	*261*	*172*	*115*
Species total	*...*	*...*	*...*	*...*	*344*	*359*	*350*	*261*	*172*	*115*
Grey snapper	**Vivaneau sarde grise**		**Pargo prieto**		***Lutjanus griseus***				**1,70(32)027,28**	**LJI**
31 Mexico	...	...	...	...	206	215	235	218	202	214
USA	12	19	-	23	23	14	10	12	17	2
31 Fishing area total	*12*	*19*	*...*	*23*	*229*	*229*	*245*	*230*	*219*	*216*
Species total	*12*	*19*	*...*	*23*	*229*	*229*	*245*	*230*	*219*	*216*
Spotted rose snapper	**Vivaneau rose**		**Pargo lunarejo**		***Lutjanus guttatus***				**1,70(32)027,29**	**LJS**
77 Mexico	...	...	...	...	448	468	638	520	402	485
Nicaragua	...	...	...	...	...	1 215	515	699	623	599
77 Fishing area total	*...*	*...*	*...*	*...*	*448*	*1 683*	*1 153*	*1 219*	*1 025*	*1 084*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*...*	*...*	*...*	*...*	*448*	*1 683*	*1 153*	*1 219*	*1 025*	*1 084*
Lane snapper	**Vivaneau gazou**		**Pargo biajaiba**		***Lutjanus synagris***				**1,70(32)027,33**	**SNL**
31 Colombia	...	20	33	48	9	15 F	20 F	30 F	36	34
Cuba	1 891	1 844	1 075	871	694	1 129	1 258	1 647	1 268	1 534
Mexico	693	280	256	233	392	410	258	250	241	172
Puerto Rico	124	97	100	74	80	76	62	54	56	68
31 Fishing area total	*2 708*	*2 241*	*1 464*	*1 226*	*1 175*	*1 630 F*	*1 598 F*	*1 981 F*	*1 601*	*1 808*
41 Brazil	1 437	1 392	1 631	1 306	1 778	1 863	2 036	1 855	2 046	1 933
41 Fishing area total	*1 437*	*1 392*	*1 631*	*1 306*	*1 778*	*1 863*	*2 036*	*1 855*	*2 046*	*1 933*
Species total	*4 145*	*3 633*	*3 095*	*2 532*	*2 953*	*3 493 F*	*3 634 F*	*3 836 F*	*3 647*	*3 741*
Silk snapper	**Vivaneau soie**		**Pargo de lo alto**		***Lutjanus vivanus***				**1,70(32)027,34**	**LTJ**
31 Puerto Rico	194	104	137	88	100	73	52	91	73	77
31 Fishing area total	*194*	*104*	*137*	*88*	*100*	*73*	*52*	*91*	*73*	*77*
Species total	*194*	*104*	*137*	*88*	*100*	*73*	*52*	*91*	*73*	*77*
Two-spot red snapper	**Vivaneau chien rouge**		**Pargo de dos manchas**		***Lutjanus bohar***				**1,70(32)027,42**	**LJB**
51 Saudi Arabia	351	345	355	348	236	314	308	319	340	341
51 Fishing area total	*351*	*345*	*355*	*348*	*236*	*314*	*308*	*319*	*340*	*341*
Species total	*351*	*345*	*355*	*348*	*236*	*314*	*308*	*319*	*340*	*341*
Humpback red snapper	**Vivaneau pagaie**		**Pargo jorobado**		***Lutjanus gibbus***				**1,70(32)027,45**	**LJG**
51 Saudi Arabia	607	873	539	539	356	340	291	381	284	330
51 Fishing area total	*607*	*873*	*539*	*539*	*356*	*340*	*291*	*381*	*284*	*330*
Species total	*607*	*873*	*539*	*539*	*356*	*340*	*291*	*381*	*284*	*330*
Common bluestripe snapper	**Vivaneau à raies bleues**		**Pargo de rayas azules**		***Lutjanus kasmira***				**1,70(32)027,50**	**LVK**
51 Saudi Arabia	24	296	19	14	4	29	25	16	18	18
51 Fishing area total	*24*	*296*	*19*	*14*	*4*	*29*	*25*	*16*	*18*	*18*
Species total	*24*	*296*	*19*	*14*	*4*	*29*	*25*	*16*	*18*	*18*
Five-lined snapper	**Vivaneau à cinq bandes**		**Pargo de cinco lineas**		***Lutjanus quinquelineatus***				**1,70(32)027,53**	**LWQ**
51 Saudi Arabia	177	10	294	315	360	340	459	439	299	305
51 Fishing area total	*177*	*10*	*294*	*315*	*360*	*340*	*459*	*439*	*299*	*305*
Species total	*177*	*10*	*294*	*315*	*360*	*340*	*459*	*439*	*299*	*305*
Pacific red snapper	**Vivaneau garance**		**Pargo gringo**		***Lutjanus peru***				**1,70(32)027,57**	**LWP**
77 Mexico	...	...	...	...	3 960	4 135	4 104	3 097	1 508	1 178
77 Fishing area total	*...*	*...*	*...*	*...*	*3 960*	*4 135*	*4 104*	*3 097*	*1 508*	*1 178*
Species total	*...*	*...*	*...*	*...*	*3 960*	*4 135*	*4 104*	*3 097*	*1 508*	*1 178*
Snappers nei	**Vivaneaux nca**		**Pargos tropicales nep**		***Lutjanus spp***				**1,70(32)027,XX**	**SNA**
31 Bahamas	777	798	700	648	585	830	568	936	596	643
Br Virgin Is	56	20	150	79	80 F	80 F	75 F	70 F	70 F	70 F
Nicaragua	503	561	566	630	671	104	565	388	720	266
St Kitts Nev	9	16	45 F	80	74 F	68 F	63 F	58 F	52 F	46
St Lucia	82	43	57	39	33	37	51	12	64	71
31 Fishing area total	*1 427*	*1 438*	*1 518 F*	*1 476*	*1 443 F*	*1 119 F*	*1 322 F*	*1 464 F*	*1 502 F*	*1 096 F*
34 Benin	32	51	64	68	66	58	46	486	8	6
Cameroon	293	297	280	400 F	480	485	485	480 F	487 F	487 F
Congo Rep	90 F	85 F	83	66	80	113	274	86	60	357
Côte dIvoire	...	...	...	...	...	...	5	5 F	5	6
Gabon	765	650	847	808	740	507	430 F	352	240 F	240 F
Gambia	126	122	60	96	85	406	133	600	643	543
Ghana	447	774	90	756	1 249	1 230	1 444	829	1 621	686
Korea Rep	601	369	265	139	-	-	-	-	-	-
Liberia	245	255	240	365	458	1 194	243	251	250 F	250 F
Nigeria	6 619	7 537	7 130	6 519	6 545	8 260	8 158	8 209	7 977	7 752
Senegal	499	360	393	348	254	1 200	452	490	747	851
Sierra Leone	381	314	528	1 019	888	1 098	1 158	159	160 F	160 F
Spain	-	-	2	5	20	6	2	-	-	1
Togo	16	30	13	18	35	23	23	35 F	48	44
Ukraine	-	-	-	9	4	3	2	1	-	-
34 Fishing area total	*10 114 F*	*10 844 F*	*9 995*	*10 616 F*	*10 904*	*14 583*	*12 855 F*	*11 983 F*	*12 246 F*	*11 383 F*
51 Eritrea	205	158	146	5	1	0	32	1	5	-
Kuwait	27	26 F	24	19	15	10	11	6	10 F	10 F
Qatar	26	12	20	214	87	137	99	136	105	112
Réunion	45	38	35	35	39	43	47	2	21 F	21 F
Seychelles	602	490	444	710	990	1 028	1 222	1 050	617	561
51 Fishing area total	*905*	*724 F*	*669*	*983*	*1 132*	*1 218*	*1 411*	*1 195*	*758 F*	*704 F*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
57 Indonesia	14 965	17 541	19 883	11 488	11 870	13 714	16 990	18 500	19 116	19 255
Malaysia	356	284	249	291	303	411	346	244	597	405
57 Fishing area total	*15 321*	*17 825*	*20 132*	*11 779*	*12 173*	*14 125*	*17 336*	*18 744*	*19 713*	*19 660*
71 Fiji	1 728	1 000 F	118	114	115 F	119	634	350	500	400
Indonesia	52 808	44 762	54 350	79 851	85 174	95 598	100 004	90 799	96 407	104 572
Malaysia	3 976	3 647	3 789	3 995	4 563	4 176	3 787	3 624	3 789	4 155
NewCaledonia	23	17	13	12	10	28	34	47	35	31
Singapore	80	63	59	56	62	132	179	94	129	76
71 Fishing area total	*58 615*	*49 489 F*	*58 329*	*84 028*	*89 924 F*	*100 053*	*104 638*	*94 914*	*100 860*	*109 234*
77 Cook Is	20 F	20 F	20 F	20	20 F	20	20 F	20 F	18 F	18 F
Nicaragua	1 367	1 591	1 621	1 792	2 897	577	1 993	1 251	958	1 022
USA	138	181	160	167	131	107	105	109	129	106
77 Fishing area total	*1 525 F*	*1 792 F*	*1 801 F*	*1 979*	*3 048 F*	*704*	*2 118 F*	*1 380 F*	*1 105 F*	*1 146 F*
87 Colombia	477	411	134	245	121	250 F	400 F	520 F	659	785
Ecuador	24	70	18	54	20	36	51	18	...	...
Peru	55	59	35	-	-	-	-	-	-	-
87 Fishing area total	*556*	*540*	*187*	*299*	*141*	*286 F*	*451 F*	*538 F*	*659*	*785*
Species total	*88 463 F*	*82 652 F*	*92 631 F*	*111 160 F*	*118 765 F*	*132 088 F*	*140 131 F*	*130 218 F*	*136 843 F*	*144 008 F*
Yellowtail snapper	**Vivaneau queue jaune**		**Rabirrubia**		***Ocyurus chrysurus***				**1,70(32)028,01**	**SNY**
31 Br Virgin Is	101	131	289	318	290 F	290 F	270 F	250 F	250 F	250 F
Colombia	-	-	3	...	...	20 F	40 F	60 F	81	16
Cuba	413	370	437	438	299	295	323	295	365	293
Dominican Rp	356	134	151	126	71	181	152	177	160	172
Mexico	1 600	1 702	591	537	1 640	1 713	1 707	2 057	2 106	1 227
Nicaragua	...	...	...	...	...	864	613	519	570	808
Puerto Rico	219	153	143	112	104	82	71	69	59	63
USA	0	-	-	0	-	-	-	619	878	768
Venezuela	158	213	585	928 F	497 F	299 F	360 F	407 F	390 F	390 F
31 Fishing area total	*2 847*	*2 703*	*2 199*	*2 459 F*	*2 901 F*	*3 744 F*	*3 536 F*	*4 453 F*	*4 859 F*	*3 987 F*
41 Brazil	2 002	2 106	2 656	2 667	5 376	5 371	3 717	4 745	5 233	4 945
41 Fishing area total	*2 002*	*2 106*	*2 656*	*2 667*	*5 376*	*5 371*	*3 717*	*4 745*	*5 233*	*4 945*
Species total	*4 849*	*4 809*	*4 855*	*5 126 F*	*8 277 F*	*9 115 F*	*7 253 F*	*9 198 F*	*10 092 F*	*8 932 F*
Rusty jobfish	**Vivaneau rouillé**		**Pargo bermellón**		***Aphareus rutilans***				**1,70(32)098,01**	**ARQ**
51 Saudi Arabia	209	199	110	138	114	129	195	195	205	205
51 Fishing area total	*209*	*199*	*110*	*138*	*114*	*129*	*195*	*195*	*205*	*205*
Species total	*209*	*199*	*110*	*138*	*114*	*129*	*195*	*195*	*205*	*205*
Green jobfish	**Vivaneau job**		**Pargo verde**		***Aprion virescens***				**1,70(32)100,01**	**AVR**
77 USA	-	51	64	66	66	65	68	62	49	49
77 Fishing area total	*-*	*51*	*64*	*66*	*66*	*65*	*68*	*62*	*49*	*49*
Species total	*-*	*51*	*64*	*66*	*66*	*65*	*68*	*62*	*49*	*49*
African forktail snapper	**Vivaneau fourche d'Afrique**		**Pargo tijera**		***Apsilus fuscus***				**1,70(32)101,02**	**AFK**
34 Togo	...	...	...	123	50	14	16	10 F	1	1
34 Fishing area total	*...*	*...*	*...*	*123*	*50*	*14*	*16*	*10 F*	*1*	*1*
Species total	*...*	*...*	*...*	*123*	*50*	*14*	*16*	*10 F*	*1*	*1*
Queen snapper	**Vivaneau royal**		**Pargo cachucho**		***Etelis oculatus***				**1,70(32)140,01**	**EEO**
31 Puerto Rico	72	58	103	59	142	90	85	114	96	155
31 Fishing area total	*72*	*58*	*103*	*59*	*142*	*90*	*85*	*114*	*96*	*155*
Species total	*72*	*58*	*103*	*59*	*142*	*90*	*85*	*114*	*96*	*155*
Jobfishes nei	**Colas nca**		**Panchito nep**		***Pristipomoides spp***				**1,70(32)217,XX**	**LWX**
57 Indonesia	...	...	...	265	290	366	1 220	853	816	1 077
57 Fishing area total	*...*	*...*	*...*	*265*	*290*	*366*	*1 220*	*853*	*816*	*1 077*
71 Indonesia	...	...	...	766	-	87	538	798	1 559	2 941
71 Fishing area total	*...*	*...*	*...*	*766*	*-*	*87*	*538*	*798*	*1 559*	*2 941*
Species total	*...*	*...*	*...*	*1 031*	*290*	*453*	*1 758*	*1 651*	*2 375*	*4 018*
Vermilion snapper	**Vivaneau ti-yeux**		**Pargo cunaro**		***Rhomboplites aurorubens***				**1,70(32)225,01**	**RPU**
31 Mexico	...	...	...	...	2 794	2 918	2 543	1 988	1 933	1 140
USA	1 057	980	452	990	1 256	657	994	1 691	1 926	1 389
31 Fishing area total	*1 057*	*980*	*452*	*990*	*4 050*	*3 575*	*3 537*	*3 679*	*3 859*	*2 529*
Species total	*1 057*	*980*	*452*	*990*	*4 050*	*3 575*	*3 537*	*3 679*	*3 859*	*2 529*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Mexican barred snapper	**Vivaneau mexicain**		**Pargo coconaco**		***Hoplopagrus guntherii***				**1,70(32)359,01**	**HLG**
77 Mexico	...	...	...	...	136	142	222	182	179	210
77 Fishing area total	*...*	*...*	*...*	*...*	*136*	*142*	*222*	*182*	*179*	*210*
Species total	*...*	*...*	*...*	*...*	*136*	*142*	*222*	*182*	*179*	*210*
Snappers, jobfishes nei	**Lutianidés nca**		**Lutjánidos nep**		***Lutjanidae***				**1,70(32)XXX,XX**	**SNX**
31 Antigua Barb	284	348	341	411	296	320	420	525	291	296
Aruba	45	45 F	45 F	50	50 F	40	43	40	50	45
Barbados	20	12	15	6	6	13	14	22	16	28
Bermuda	32	33	31	21	35	33	30	37	32	31
Colombia	-	-	-	3	1	20 F	40 F	55 F	78	43
Cuba	641	844	632	85	-	-	-	-	-	-
Dominican Rp	231	1 188	1 731	1 046	1 016	1 531	1 259	1 213	1 197	1 288
Grenada	56	80	92	95	119	142	130	122	104	118
Mexico	1 543	1 691	570	518	1 222	1 276	1 167	1 284	1 402	1 381
Puerto Rico	75	52	55	36	42	27	20	28	27	31
St Vincent	...	...	...	...	...	...	...	...	11	8
Suriname	...	...	1 113	1 149	1 145	...	...	...	...	...
USA	1 517	1 569	2 819	1 513	1 011	1 421	1 261	271	348	746
US Virgin Is	120 F	150 F	183	151	130	149	121	127	120	97
Venezuela	4 986	2 193	7 149	11 300 F	6 050 F	3 570 F	4 360 F	4 579	4 420 F	4 420 F
31 Fishing area total	*9 550 F*	*8 205 F*	*14 776 F*	*16 384 F*	*11 123 F*	*8 542 F*	*8 865 F*	*8 303 F*	*8 096 F*	*8 532 F*
41 Brazil	4 153	3 531	5 340	5 303	5 339	6 539	7 875	6 861	7 567	7 146
41 Fishing area total	*4 153*	*3 531*	*5 340*	*5 303*	*5 339*	*6 539*	*7 875*	*6 861*	*7 567*	*7 146*
47 South Africa	1	1	1	1	1	-	1	1	6	1
47 Fishing area total	*1*	*1*	*1*	*1*	*1*	-	*1*	*1*	*6*	*1*
51 Bahrain	103	142	44	62	45	122	76	66	44	27
China	-	-	-	-	-	2 852	-	-	-	-
Djibouti	140 F	150 F	160 F	170 F	177	110	98	172	179	179 F
Egypt	5 014	3 756	542	592	1 000	1 008	1 407	1 200	193	327
Eritrea	103	64	227	102	27	70	23	37	75	58
France	-	-	-	-	-	-	-	-	21	12
Kenya	177	177	118	137	171	193	220	244	254	298
Mauritius	2 184	2 113	1 806	1 595	2 584	1 674	816	404	430	739
Oman	380	337	446	405	376	377	356	1 042	733	948
Saudi Arabia	620	219	245	234	400	224	278	200	244	242
Seychelles	703	611	607	521	499	596	647	756	510	354
South Africa	-	-	0	0	0	-	-	-	-	-
Untd Arab Em	1 977	1 187	2 088	2 000 F	1 910	1 900 F	1 870 F	1 859	2 396	2 581
Yemen	900 F	1 160 F	1 200 F	1 300 F	1 230 F	1 530 F	1 650 F	940 F	1 350 F	1 750 F
Zanzibar	548	684	521	569	514	507	578	624	638	664
51 Fishing area total	*12 849 F*	*10 600 F*	*8 004 F*	*7 687 F*	*8 933 F*	*11 163 F*	*8 019 F*	*7 544 F*	*7 067 F*	*8 179 F*
57 Australia	2 943	3 235	3 213	3 388	3 736	3 681	3 270	3 256	3 193	3 211
Malaysia	196	312	459	485	816	770	822	612	1 062	1 038
Thailand	4 332	5 075	7 101	6 929	5 714	5 391	3 977	1 524	1 742	1 633
57 Fishing area total	*7 471*	*8 622*	*10 773*	*10 802*	*10 266*	*9 842*	*8 069*	*5 392*	*5 997*	*5 882*
61 China,H.Kong	330 F	300 F	280 F	300 F	290 F	270 F	270 F	277 F	280 F	295 F
China,Taiwan	385	409	292	208	160	167	199	30	30	29
61 Fishing area total	*715 F*	*709 F*	*572 F*	*508 F*	*450 F*	*437 F*	*469 F*	*307 F*	*310 F*	*324 F*
71 Australia	1 760	1 961	1 864	1 169	1 742	1 706	2 011	2 985	2 477	2 242
Guam	18	10	13	16	16	17	9	18	16	2
Kiribati	2 794	947	3 711	3 400 F	3 100 F	2 800 F	2 507	325	156	162 F
Malaysia	4 575	3 731	3 537	3 586	2 713	3 125	3 301	2 605	4 424	3 932
N Marianas	11	10	8	5	5	5	9	7	8	9
Palau	3	5	2	3	1	2	...	11	11 F	11 F
Philippines	14 371	13 630	11 839	12 841	12 547	14 840	15 842	18 246	19 666	21 232
Singapore	16	11	10	13	8	39	63	23	33	18
Thailand	4 104	6 577	6 394	11 201	10 723	6 422	5 443	974	1 070	1 022
71 Fishing area total	*27 652*	*26 882*	*27 378*	*32 234 F*	*30 855 F*	*28 956 F*	*29 185*	*25 194*	*27 861 F*	*28 630 F*
77 Amer Samoa	9	10	3	4	2	2	8	12	17	4
Costa Rica	347	382	304	218	188	150 F	115	120 F	120 F	120 F
El Salvador	481	530	521	514	1 035	1 590	1 071	...	...	...
Fr Polynesia	112	80	86 F	92 F	97	136	0	0	0	0
Mexico	1 581	1 537	584	531	2 122	2 216	2 775	2 393	2 111	2 368
Panama	22 322	26 642	13 111	4 990	10 987	8 785	6 665	6 464	6 913	6 263
Tonga	...	...	...	...	171	283	180	162	77	182
USA	125	2	3	5	3	1	2	-	-	-
77 Fishing area total	*24 977*	*29 183*	*14 612 F*	*6 354 F*	*14 605*	*13 163 F*	*10 816*	*9 151 F*	*9 238 F*	*8 937 F*
81 Australia	311	216	212	256	243	252	260	332	252	270
81 Fishing area total	*311*	*216*	*212*	*256*	*243*	*252*	*260*	*332*	*252*	*270*
Species total	*87 679 F*	*87 949 F*	*81 668 F*	*79 529 F*	*81 815 F*	*78 894 F*	*73 559 F*	*63 085 F*	*66 394 F*	*67 901 F*
Japanese threadfin bream	**Cohana japonaise**		**Baga japonesa**		***Nemipterus japonicus***				**1,70(33)184,04**	**NNJ**
51 Iran	4 857	6 047	5 128	5 459	6 748	7 912	5 535	4 313	5 444	6 127
51 Fishing area total	*4 857*	*6 047*	*5 128*	*5 459*	*6 748*	*7 912*	*5 535*	*4 313*	*5 444*	*6 127*
Species total	*4 857*	*6 047*	*5 128*	*5 459*	*6 748*	*7 912*	*5 535*	*4 313*	*5 444*	*6 127*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Golden threadfin bream	**Cohana doré**		**Baga dorada**		***Nemipterus virgatus***				**1,70(33)184,05**	**THG**
61 China,Taiwan	3 536	2 995	4 274	3 523	3 684	2 670	2 626	1 754	1 886	1 378
61 Fishing area total	*3 536*	*2 995*	*4 274*	*3 523*	*3 684*	*2 670*	*2 626*	*1 754*	*1 886*	*1 378*
Species total	*3 536*	*2 995*	*4 274*	*3 523*	*3 684*	*2 670*	*2 626*	*1 754*	*1 886*	*1 378*
Randall's threadfin bream	**...B**		**...C**		***Nemipterus randalli***				**1,70(33)184,16**	**NNZ**
37 Israel	-	-	-	-	-	-	-	-	126	147
37 Fishing area total	-	-	-	-	-	-	-	-	*126*	*147*
51 Saudi Arabia	-	6	26	25	...	6	6	...	...	...
51 Fishing area total	-	*6*	*26*	*25*	*...*	*6*	*6*	*...*	*...*	*...*
Species total	-	*6*	*26*	*25*	*...*	*6*	*6*	*...*	*126*	*147*
Threadfin breams nei	**Cohanas nca**		**Bagas nep**		***Nemipterus spp***				**1,70(33)184,XX**	**THB**
51 Egypt	4 974	3 050	4 205	4 454	4 027	3 417	2 278	3 456	4 135	2 894
Eritrea	1 115	675	525	819	615	1 019	2	0	62	165
Kuwait	24	24 F	24	43	31	34	33	45	40 F	40 F
Pakistan	8 466	8 600	8 363	7 299	7 592	7 198	7 324	7 411	1 676	1 654
Tanzania	400	600	650	750	794	616	880	1 002	900	1 126
Untd Arab Em	497	302	312	300 F	298	640 F	1 000 F	1 312	2 063	1 755
51 Fishing area total	*15 476*	*13 251 F*	*14 079*	*13 665 F*	*13 357*	*12 924 F*	*11 517 F*	*13 226*	*8 876 F*	*7 634 F*
57 Indonesia	7 678	8 002	7 674	5 958	9 590	10 311	12 605	10 155	15 627	16 043
Malaysia	6 891	7 209	7 437	8 167	9 071	10 392	11 774	11 608	12 493	13 210
Thailand	27 153	32 056	27 275	31 735	23 936	27 278	28 250	15 127	17 093	16 110
57 Fishing area total	*41 722*	*47 267*	*42 386*	*45 860*	*42 597*	*47 981*	*52 629*	*36 890*	*45 213*	*45 363*
61 China	245 181 F	260 676 F	368 311 F	265 300 F	224 834 F	258 605 F	144 403	311 559	306 456	314 922
China,H.Kong	18 800 F	18 300 F	17 000 F	18 100 F	17 500 F	16 700 F	16 600 F	17 030 F	17 120 F	18 120 F
61 Fishing area total	*263 981 F*	*278 976 F*	*385 311 F*	*283 400 F*	*242 334 F*	*275 305 F*	*161 003 F*	*328 589 F*	*323 576 F*	*333 042 F*
71 Indonesia	29 501	31 564	37 284	46 279	45 672	47 366	51 801	38 131	36 080	52 165
Malaysia	22 019	23 310	22 710	25 335	26 379	26 362	24 427	26 047	27 259	27 188
Philippines	27 079	49 257	40 514	41 161	45 253	51 252	55 564	51 432	47 238	45 827
Singapore	48	33	18	22	15	29	71	38	27	16
Thailand	79 505	89 320	85 226	74 160	80 700	69 305	64 211	25 024	25 799	25 412
71 Fishing area total	*158 152*	*193 484*	*185 752*	*186 957*	*198 019*	*194 314*	*196 074*	*140 672*	*136 403*	*150 608*
Species total	*479 331 F*	*532 978 F*	*627 528 F*	*529 882 F*	*496 307 F*	*530 524 F*	*421 223 F*	*519 377 F*	*514 068 F*	*536 647 F*
Black-streaked monocle bream	**Mamila dos noir**		**...C**		***Scolopsis taeniatus***				**1,70(33)230,10**	**NWS**
51 Saudi Arabia	41	93	150	161	240	724	854	732	751	898
51 Fishing area total	*41*	*93*	*150*	*161*	*240*	*724*	*854*	*732*	*751*	*898*
Species total	*41*	*93*	*150*	*161*	*240*	*724*	*854*	*732*	*751*	*898*
Monocle breams	**Mamilas**		**Besugatos**		***Scolopsis spp***				**1,70(33)230,XX**	**MOB**
57 Malaysia	88	121	7	95	7	4	6	178	235	71
Thailand	0	-	-	-	-	-	-	-	-	-
57 Fishing area total	*88*	*121*	*7*	*95*	*7*	*4*	*6*	*178*	*235*	*71*
71 Malaysia	1 554	1 321	2 269	2 113	2 363	2 008	1 864	1 718	1 889	1 941
Thailand	46	62	45	16	8	6	57	-	47	45
71 Fishing area total	*1 600*	*1 383*	*2 314*	*2 129*	*2 371*	*2 014*	*1 921*	*1 718*	*1 936*	*1 986*
Species total	*1 688*	*1 504*	*2 321*	*2 224*	*2 378*	*2 018*	*1 927*	*1 896*	*2 171*	*2 057*
Threadfin and dwarf breams nei	**Cohanas, mamilas nca**		**Bagas, besugatos nep**		***Nemipteridae***				**1,70(33)XXX,XX**	**THD**
51 Bahrain	...	...	...	317	132	174	154	136	86	56
Oman	1 206	2 865	657	390	815	603	603	1 837	2 812	1 395
Qatar	0	0	2	2	10	28	44	62	33	48
Saudi Arabia	60	-	-	-	193	-	-	-	-	-
Yemen	1 520 F	2 000 F	2 100 F	2 250 F	2 140 F	2 650 F	2 840 F	1 600 F	2 300 F	3 000 F
51 Fishing area total	*2 786 F*	*4 865 F*	*2 759 F*	*2 959 F*	*3 290 F*	*3 455 F*	*3 641 F*	*3 635 F*	*5 231 F*	*4 499 F*
Species total	*2 786 F*	*4 865 F*	*2 759 F*	*2 959 F*	*3 290 F*	*3 455 F*	*3 641 F*	*3 635 F*	*5 231 F*	*4 499 F*
Ponyfishes(=Slipmouths)	**Sapsap**		**Motambos**		***Leiognathus spp***				**1,70(35)169,XX**	**POY**
57 Malaysia	71	609	260	311	190	199	499	193	226	260
57 Fishing area total	*71*	*609*	*260*	*311*	*190*	*199*	*499*	*193*	*226*	*260*
71 Fiji	87	70 F	51	52	50 F	50	62	64 F	65 F	70
Malaysia	2 214	1 731	1 438	1 899	2 343	1 923	1 698	1 935	2 486	2 288
Singapore	23	9	10	5	10	47	42	11	20	25
71 Fishing area total	*2 324*	*1 810 F*	*1 499*	*1 956*	*2 403 F*	*2 020*	*1 802*	*2 010 F*	*2 571 F*	*2 383*
Species total	*2 395*	*2 419 F*	*1 759*	*2 267*	*2 593 F*	*2 219*	*2 301*	*2 203 F*	*2 797 F*	*2 643*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Ponyfishes(=Slipmouths) nei	**Sapsap nca**		**Motambos nep**		***Leiognathidae***				**1,70(35)XXX,XX**	**PON**
51 Eritrea	137	70	63	...	5	...	1	0	0	0
India	6 952	13 691	13 181	13 263	13 781	15 749	18 977	16 382	13 501	15 924
51 Fishing area total	*7 089*	*13 761*	*13 244*	*13 263*	*13 786*	*15 749*	*18 978*	*16 382*	*13 501*	*15 924*
57 India	45 610	42 872	42 994	44 828	47 690	50 358	42 866	42 199	42 171	45 081
Indonesia	18 906	19 363	23 279	15 812	15 796	18 041	23 134	17 330	20 149	20 497
57 Fishing area total	*64 516*	*62 235*	*66 273*	*60 640*	*63 486*	*68 399*	*66 000*	*59 529*	*62 320*	*65 578*
71 Indonesia	68 851	70 573	69 559	75 047	72 869	71 993	69 115	62 895	64 431	62 941
Philippines	65 007	65 816	69 841	68 768	67 654	67 573	62 613	59 053	60 899	64 138
71 Fishing area total	*133 858*	*136 389*	*139 400*	*143 815*	*140 523*	*139 566*	*131 728*	*121 948*	*125 330*	*127 079*
Species total	*205 463*	*212 385*	*218 917*	*217 718*	*217 795*	*223 714*	*216 706*	*197 859*	*201 151*	*208 581*
Painted sweetlips	**Diagramme voilier**		**Burro velero**		***Diagramma pictum***				**1,70(36)002,01**	**DGP**
51 Bahrain	...	...	...	2	5	0	4	2	0	-
Saudi Arabia	0	159	19	53	38	0	40	34	35	35
51 Fishing area total	*0*	*159*	*19*	*55*	*43*	*0*	*44*	*36*	*35*	*35*
Species total	*0*	*159*	*19*	*55*	*43*	*0*	*44*	*36*	*35*	*35*
White margate	**Gorette margate**		**Ronco jallao**		***Haemulon album***				**1,70(36)030,01**	**HLU**
31 USA	-	-	-	-	-	15	8	9	9	-
31 Fishing area total	-	-	-	-	-	*15*	*8*	*9*	*9*	-
Species total	-	-	-	-	-	*15*	*8*	*9*	*9*	-
White grunt	**Gorette blanche**		**Ronco margariteño**		***Haemulon plumierii***				**1,70(36)030,10**	**HLI**
31 Mexico	...	...	...	...	1 664	1 738	1 044	863	881	506
31 Fishing area total	...	...	...	...	*1 664*	*1 738*	*1 044*	*863*	*881*	*506*
Species total	...	...	...	...	*1 664*	*1 738*	*1 044*	*863*	*881*	*506*
Pigfish	**Goret mule**		**Corocoro burro**		***Orthopristis chrysoptera***				**1,70(36)032,01**	**PIG**
21 USA	0	0	1	0	0	1	1	0	0	-
21 Fishing area total	*0*	*0*	*1*	*0*	*0*	*1*	*1*	*0*	*0*	-
Species total	*0*	*0*	*1*	*0*	*0*	*1*	*1*	*0*	*0*	-
Cabinza grunt	**Cagna cabinza**		**Cabinza**		***Isacia conceptionis***				**1,70(36)163,01**	**GRP**
87 Chile	28	149	3 615	3 280	576	53	171	39	101	38
Peru	3 293	5 606	5 385	3 532	3 046	2 141	2 451	3 429	4 699	4 142
87 Fishing area total	*3 321*	*5 755*	*9 000*	*6 812*	*3 622*	*2 194*	*2 622*	*3 468*	*4 800*	*4 180*
Species total	*3 321*	*5 755*	*9 000*	*6 812*	*3 622*	*2 194*	*2 622*	*3 468*	*4 800*	*4 180*
Trout sweetlips	**Diagramme truité**		**Burro trucha**		***Plectorhinchus pictus***				**1,70(36)207,02**	**PKP**
51 Bahrain	...	...	...	85	17	17	18	19	6	1
Saudi Arabia	41	35	19	28	28	45	1	1	1	1
51 Fishing area total	*41*	*35*	*19*	*113*	*45*	*62*	*19*	*20*	*7*	*2*
Species total	*41*	*35*	*19*	*113*	*45*	*62*	*19*	*20*	*7*	*2*
Minstrel sweetlips	**Diagramme ménestrel**		**...C**		***Plectorhinchus schotaf***				**1,70(36)207,03**	**PKF**
51 Egypt	...	...	...	...	...	...	...	74	33	55
Eritrea	...	...	...	...	...	30	...	...	...	...
Saudi Arabia	140	152	155	176	164	195	216	188	151	80
51 Fishing area total	*140*	*152*	*155*	*176*	*164*	*225*	*216*	*262*	*184*	*135*
Species total	*140*	*152*	*155*	*176*	*164*	*225*	*216*	*262*	*184*	*135*
Biglip grunt	**Diagramme à grosses lèvres**		**Burro labiogrueso**		***Plectorhinchus macrolepis***				**1,70(36)207,04**	**GBL**
34 Senegal	...	...	37	...	...	...	...	...	...	...
34 Fishing area total	...	...	*37*	...	...	...	...	...	...	...
Species total	...	...	*37*	...	...	...	...	...	...	...
Rubberlip grunt	**Diagramme gris**		**Burro chiclero**		***Plectorhinchus mediterraneus***				**1,70(36)207,05**	**GBR**
27 Portugal	12	13	37	16	15	5	5	5	4	8
Spain	-	-	-	-	-	-	21	165	...	194
27 Fishing area total	*12*	*13*	*37*	*16*	*15*	*5*	*26*	*170*	*4*	*202*
34 Gambia	124	365	1 130	89	96	104	190	193	206	206
Mauritania	...	...	...	...	...	...	...	...	...	94
Morocco	2 503	2 335	3 264	3 610	4 567	5 208	4 038	4 231	4 732	4 625
Netherlands	-	-	-	-	-	-	-	10	3	-
Portugal	-	170	144	98	-	-	-	-	-	-
Spain	133	61	171	355	417	217	135	194	342	290
34 Fishing area total	*2 760*	*2 931*	*4 709*	*4 152*	*5 080*	*5 529*	*4 363*	*4 628*	*5 283*	*5 215*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
37 Morocco	0	0	131	42	25	22	20	15	37	50
Spain	2	13	13	19	15	15	12	12	17	18
37 Fishing area total	*2*	*13*	*144*	*61*	*40*	*37*	*32*	*27*	*54*	*68*
Species total	*2 774*	*2 957*	*4 890*	*4 229*	*5 135*	*5 571*	*4 421*	*4 825*	*5 341*	*5 485*
Blackspotted rubberlip	**Diagramme moucheté**		**...C**		***Plectorhinchus gaterinus***				**1,70(36)207,07**	**GQT**
51 Saudi Arabia	513	463	310	295	241	293	312	316	263	256
51 Fishing area total	*513*	*463*	*310*	*295*	*241*	*293*	*312*	*316*	*263*	*256*
Species total	*513*	*463*	*310*	*295*	*241*	*293*	*312*	*316*	*263*	*256*
Sordid rubberlip	**Diagramme à lèvres rouges**		**Burro boca colorada**		***Plectorhinchus sordidus***				**1,70(36)207,08**	**GQD**
51 Bahrain	...	...	...	132	102	220	90	74	77	60
51 Fishing area total	*...*	*...*	*...*	*132*	*102*	*220*	*90*	*74*	*77*	*60*
Species total	*...*	*...*	*...*	*132*	*102*	*220*	*90*	*74*	*77*	*60*
Sweetlips, rubberlips nei	**...B**		**...C**		***Plectorhinchus spp***				**1,70(36)207,XX**	**PBX**
57 Indonesia	...	...	...	0	31	44	290	369	223	209
57 Fishing area total	*...*	*...*	*...*	*0*	*31*	*44*	*290*	*369*	*223*	*209*
71 Indonesia	...	...	...	210	16	152	465	6 386	3 427	1 158
71 Fishing area total	*...*	*...*	*...*	*210*	*16*	*152*	*465*	*6 386*	*3 427*	*1 158*
Species total	*...*	*...*	*...*	*210*	*47*	*196*	*755*	*6 755*	*3 650*	*1 367*
Striped piggy	**Goret à trois bandes**		**Ronco de tres bandas**		***Pomadasys stridens***				**1,70(36)209,01**	**PKS**
51 Bahrain	...	...	...	21	-	0	5	3	8	1
Egypt	-	-	1 139	1 060	799	559	518	1 476	484	667
51 Fishing area total	*...*	*...*	*1 139*	*1 081*	*799*	*559*	*523*	*1 479*	*492*	*668*
Species total	*...*	*...*	*1 139*	*1 081*	*799*	*559*	*523*	*1 479*	*492*	*668*
Silver grunt	**Grondeur argenté**		**Corocoro plateado**		***Pomadasys argenteus***				**1,70(36)209,04**	**GRL**
51 Eritrea	199	152	50	159	41	115	0	0	46	55
Saudi Arabia	193	89	95	93	173	172	305	269	265	266
51 Fishing area total	*392*	*241*	*145*	*252*	*214*	*287*	*305*	*269*	*311*	*321*
57 Malaysia	507	639	522	640	656	737	716	669	870	850
57 Fishing area total	*507*	*639*	*522*	*640*	*656*	*737*	*716*	*669*	*870*	*850*
71 Malaysia	1 086	830	784	827	1 371	1 290	1 129	1 422	1 576	2 114
71 Fishing area total	*1 086*	*830*	*784*	*827*	*1 371*	*1 290*	*1 129*	*1 422*	*1 576*	*2 114*
Species total	*1 985*	*1 710*	*1 451*	*1 719*	*2 241*	*2 314*	*2 150*	*2 360*	*2 757*	*3 285*
Bastard grunt	**Grondeur métis**		**Ronco mestizo**		***Pomadasys incisus***				**1,70(36)209,18**	**BGR**
34 Portugal	0	-	0	0	-	0	0	-	-	-
Spain	-	-	12	5	4	3	3	2	5	38
34 Fishing area total	*0*	*-*	*12*	*5*	*4*	*3*	*3*	*2*	*5*	*38*
Species total	*0*	*-*	*12*	*5*	*4*	*3*	*3*	*2*	*5*	*38*
Sompat grunt	**Grondeur sompat**		**Ronco sompat**		***Pomadasys jubelini***				**1,70(36)209,19**	**BUR**
34 Cameroon	48	342	534	800 F	1 129	479	579	575 F	587 F	587 F
Congo Rep	130 F	270 F	404	250	365	401	688	458	901	466
Côte dIvoire	148	202	149	61	86	97	80	80 F	80	89
Gambia	423	439	888	271	516	739	1 190	1 541	1 650	1 651
Ghana	694	343	53	41	92	132	33	31	69	189
GuineaBissau	195	289	202	210 F	216 F	210 F	200 F	230 F	230 F	230 F
Liberia	...	...	...	...	...	...	188	160	160 F	160 F
Togo	1	5	15	108	1	2	-	-	1	-
34 Fishing area total	*1 639 F*	*1 890 F*	*2 245*	*1 741 F*	*2 405 F*	*2 060 F*	*2 958 F*	*3 075 F*	*3 678 F*	*3 372 F*
Species total	*1 639 F*	*1 890 F*	*2 245*	*1 741 F*	*2 405 F*	*2 060 F*	*2 958 F*	*3 075 F*	*3 678 F*	*3 372 F*
Javelin grunter	**Grondeur javelot**		**...C**		***Pomadasys kaakan***				**1,70(36)209,23**	**KAH**
51 Iran	2 626	2 953	4 260	4 164	4 003	4 577	4 010	4 643	4 402	5 704
51 Fishing area total	*2 626*	*2 953*	*4 260*	*4 164*	*4 003*	*4 577*	*4 010*	*4 643*	*4 402*	*5 704*
Species total	*2 626*	*2 953*	*4 260*	*4 164*	*4 003*	*4 577*	*4 010*	*4 643*	*4 402*	*5 704*
Bigeye grunt	**Lippu pelon**		**Burro ojón**		***Brachydeuterus auritus***				**1,70(36)263,03**	**GRB**
34 Congo Dem R	220 F	230 F	240 F	250 F	260 F	270 F	270	270 F	270 F	270 F
Congo Rep	450 F	480 F	499	245	386	636	1 077	393	699	1 102
Côte dIvoire	1 689	2 812	2 084	2 381	3 439	3 185	2 224	2 000 F	1 731	1 643
Ghana	13 845	9 267	7 732	26 456	16 827	19 729	21 930	17 709	17 436	13 660
Liberia	...	...	...	...	...	...	1 307	321	320 F	320 F

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Lithuania	-	78	-	-	-	-	-	-	-	-
Mauritania	...	...	...	...	...	...	...	...	...	147
Netherlands	-	-	-	-	-	-	-	2	-	-
Nigeria	275	849	1 908	835	637	1 248	569	909	1 029	1 165
Senegal	2 701	2 294	2 722	3 426	2 729	1 402	1 551	1 626	1 873	1 300
Sierra Leone	132	129	305	519	575	188	461	5 260	5 150 F	5 150 F
Togo	844	1 148	353	1 523	780	830	1 030	1 700 F	2 361	1 379
34 Fishing area total	*20 156 F*	*17 287 F*	*15 843 F*	*35 635 F*	*25 633 F*	*27 488 F*	*30 419*	*30 190 F*	*30 869 F*	*26 136 F*
47 Angola	1 176	4 078	3 662	3 484	3 000 F	3 075	3 168	4 157	6 097	5 880 F
Russian Fed	5	561	458	-	-	-	-	-	-	-
47 Fishing area total	*1 181*	*4 639*	*4 120*	*3 484*	*3 000 F*	*3 075*	*3 168*	*4 157*	*6 097*	*5 880 F*
Species total	*21 337 F*	*21 926 F*	*19 963 F*	*39 119 F*	*28 633 F*	*30 563 F*	*33 587*	*34 347 F*	*36 966 F*	*32 016 F*
Barred grunt	**Cagna rayée**		**Ronco canario**		***Conodon nobilis***				**1,70(36)395,01**	**BRG**
31 Mexico	...	...	...	...	187	195	165	238	301	299
31 Fishing area total	*...*	*...*	*...*	*...*	*187*	*195*	*165*	*238*	*301*	*299*
41 Brazil	56	106	177	133	137	154	161	147	163	154
41 Fishing area total	*56*	*106*	*177*	*133*	*137*	*154*	*161*	*147*	*163*	*154*
Species total	*56*	*106*	*177*	*133*	*324*	*349*	*326*	*385*	*464*	*453*
Grunts, sweetlips nei	**Grondeurs, diagrammes nca**		**Burros, roncos nep**		***Haemulidae(=Pomadasyidae)***				**1,70(36)XXX,XX**	**GRX**
27 Ireland	5	7	-	-	-	-	-	-	-	-
Portugal	9	9	6	16	22	27	22	10	8	8
Spain	163	67	121	161	155	154	171	36	181	37
27 Fishing area total	*177*	*83*	*127*	*177*	*177*	*181*	*193*	*46*	*189*	*45*
31 Antigua Barb	167	259	212	184	410	385	322	216	177	190
Bahamas	67	50	72	76	58	63	39	50	125	91
Colombia	24	26	37	15	129	100 F	70 F	40 F	13	174
Cuba	986	971	1 152	1 136	857	862	737	543	731	730
Dominican Rp	385	396	173	233	173	107	132	242	218	235
Grenada	1	2	4	17	14	18	13	5	4	2
Mexico	3 715	3 011	1 670	1 852	1 030	1 075	1 032	1 095	1 159	1 162
Nicaragua	...	...	...	...	...	...	...	48	45	24
Puerto Rico	104	77	87	66	49	45	27	27	32	26
St Kitts Nev	1	3	10 F	17	16 F	15 F	14 F	13 F	12 F	11
Suriname	...	...	645	635	378	...	...	...	...	...
USA	429	316	284	259	214	124	105	154	217	154
US Virgin Is	...	...	47	51	44	40	31	38	39	33
Venezuela	9 132	3 314	7 485	11 830 F	6 330 F	3 730 F	4 550 F	5 160 F	5 000 F	5 000 F
31 Fishing area total	*15 011*	*8 425*	*11 878 F*	*16 371 F*	*9 702 F*	*6 564 F*	*7 072 F*	*7 631 F*	*7 772 F*	*7 832 F*
34 Belize	-	18	-	...	534	93	-	242	...	...
Benin	222	365	374	268	455	473	200 F	22	...	...
China	...	242	5	...	407	357	472	539	...	...
Gabon	1 050	1 054	851	1 070	829	668	620 F	568	390 F	390 F
Ghana	153	197	201	144	176	144	195	2 825	3 095	1 198
Guinea	363	...	...	...	2 872	624	198	...	...	...
Korea Rep	538	510	1	-	-	-	-	-	-	-
Liberia	180	180	180	216	62	72	-	188	190 F	190 F
Lithuania	-	-	84	10	21	27	10	4	4	21
Mauritania	5 F	3 F	50 F	100 F	150 F	120 F	160 F	140 F	160 F	7
Morocco	655	744	1 719	1 737	2 408	2 921	2 858	3 636	2 972	2 902
Netherlands	-	-	-	-	10	10	-	1	19	-
Nigeria	4 804	3 352	5 132	4 275	8 559	4 473	4 278	4 375	4 631	4 902
Portugal	-	2	5	2	-	-	-	-	-	-
Russian Fed	-	-	8	-	-	3	-	-	-	-
Sao Tome Prn	3 F	6 F	9	7	7 F	7 F	7 F	7 F	7 F	7 F
Senegal	8 048	6 864	7 693	5 102	3 718	4 212	4 529	3 748	11 264	9 435
Sierra Leone	1 975	499	1 524	1 801	1 923	1 937	2 039	2 407	2 360 F	2 360 F
Ukraine	100	1 096	243	71	67	9	8	16	3	-
UK	-	-	-	-	-	-	-	-	1	4
34 Fishing area total	*18 096 F*	*15 132 F*	*18 079 F*	*14 803 F*	*22 198 F*	*16 150 F*	*15 574 F*	*18 718 F*	*25 096 F*	*21 416 F*
41 Brazil	3 380	3 228	2 581	2 459	2 811	3 254	3 792	3 219	3 550	3 298
41 Fishing area total	*3 380*	*3 228*	*2 581*	*2 459*	*2 811*	*3 254*	*3 792*	*3 219*	*3 550*	*3 298*
47 Angola	1 688	3 513	1 880	2 142	1 500 F	1 142	955	387	4 179	4 000 F
Portugal	18	-	25	-	54	-	-	1	1	-
Russian Fed	8	1	-	-	-	-	-	-	-	-
South Africa	1	0	0	0	-	-	-	11	-	-
47 Fishing area total	*1 715*	*3 514*	*1 905*	*2 142*	*1 554 F*	*1 142*	*955*	*399*	*4 180*	*4 000 F*
51 Bahrain	236	121	354	-	-	-	-	-	-	-
Eritrea	435	198	94	137	54	270	7	3	13	21
Kenya	85	90	79	112	65	88	94	135	110	149
Korea Rep	2	-	6	-	-	5	-	-	-	-
Kuwait	191	110 F	30	109	60	107	140	119	130 F	130 F
Oman	541	954	866	1 094	768	669	605	1 278	1 033	1 680
Pakistan	9 752	9 850	5 186	5 200	4 603	3 884	3 844	3 913	1 414	2 000
Qatar	900	673	755	785	761	1 031	1 041	1 035	746	772
Saudi Arabia	503	4	30	41	66	24	34	40	35	82
South Africa	3	3	1	2	2	1	-	5	-	-

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Untd Arab Em	4 828	4 541	3 766	3 750 F	3 715	2 900 F	2 100 F	1 301	2 501	2 059
Yemen	800 F	1 050 F	1 100 F	1 200 F	1 100 F	1 380 F	1 500 F	860 F	1 230 F	1 600 F
51 Fishing area total	*18 276 F*	*17 594 F*	*12 267 F*	*12 430 F*	*11 194 F*	*10 359 F*	*9 365 F*	*8 689 F*	*7 212 F*	*8 493 F*
57 Indonesia	3 840	3 216	3 510	3 753	3 290	3 594	4 659	4 328	3 786	3 297
Malaysia	81	72	64	64	25	35	46	28	63	33
57 Fishing area total	*3 921*	*3 288*	*3 574*	*3 817*	*3 315*	*3 629*	*4 705*	*4 356*	*3 849*	*3 330*
61 Japan	4 995	5 606	5 283	5 856	5 387	5 262	5 647	4 775	4 986	4 100 F
Russian Fed	-	-	-	-	224	-	-	-	-	-
61 Fishing area total	*4 995*	*5 606*	*5 283*	*5 856*	*5 611*	*5 262*	*5 647*	*4 775*	*4 986*	*4 100 F*
71 Indonesia	13 707	12 520	14 000	13 835	12 451	12 262	12 916	15 426	12 020	12 148
Malaysia	1 336	1 002	1 114	1 130	827	1 089	890	1 423	1 227	1 536
Singapore	18	16	12	15	16	37	58	21	33	25
71 Fishing area total	*15 061*	*13 538*	*15 126*	*14 980*	*13 294*	*13 388*	*13 864*	*16 870*	*13 280*	*13 709*
77 Guatemala	...	...	...	...	...	...	54	...	...	...
Mexico	506	634	227	252	2 570	2 683	3 278	2 286	2 295	2 338
Nicaragua	...	...	...	...	...	...	98	2	19	194
77 Fishing area total	*506*	*634*	*227*	*252*	*2 570*	*2 683*	*3 430*	*2 288*	*2 314*	*2 532*
87 Ecuador	410 F	350 F	300 F	250 F	200 F	136	780	6	1 222	488
Peru	307	-	32	271	274	212	214	114	154	87
87 Fishing area total	*717 F*	*350 F*	*332 F*	*521 F*	*474 F*	*348*	*994*	*120*	*1 376*	*575*
Species total	*81 855 F*	*71 392 F*	*71 379 F*	*73 808 F*	*72 900 F*	*62 960 F*	*65 591 F*	*67 111 F*	*73 804 F*	*69 330 F*
Brown meagre	**Corb commun**		**Corvallo**		***Sciaena umbra***			**1,70(37)009,21**		**CBM**
37 Cyprus	3	-	-	-	-	0	0	-	-	-
Libya	...	...	...	...	...	...	...	...	216	210 F
Malta	-	-	-	-	-	-	1	1	...	...
Tunisia	...	...	...	85	135	78	-	-	95	105
Turkey	20	39	30	17	26	54	73	41	32	20
37 Fishing area total	*23*	*39*	*30*	*102*	*161*	*132*	*74*	*42*	*343*	*335 F*
Species total	*23*	*39*	*30*	*102*	*161*	*132*	*74*	*42*	*343*	*335 F*
Acoupa weakfish	**Acoupa toeroe**		**Corvinata amarilla**		***Cynoscion acoupa***			**1,70(37)016,01**		**YNA**
41 Brazil	...	27 559	26 248	21 258	20 778	20 052	20 411	20 039	22 102	20 879
41 Fishing area total	*...*	*27 559*	*26 248*	*21 258*	*20 778*	*20 052*	*20 411*	*20 039*	*22 102*	*20 879*
Species total	*...*	*27 559*	*26 248*	*21 258*	*20 778*	*20 052*	*20 411*	*20 039*	*22 102*	*20 879*
Peruvian weakfish	**Acoupa du Pérou**		**Corvinata ayanque**		***Cynoscion analis***			**1,70(37)016,04**		**WEP**
87 Chile	14	30	25	52	53	3	5	-	-	1
Colombia	230	211	6	138	14	60 F	105 F	145 F	190	187
Peru	4 107	3 147	4 842	2 483	2 944	1 030	1 983	1 920	2 522	4 138
87 Fishing area total	*4 351*	*3 388*	*4 873*	*2 673*	*3 011*	*1 093 F*	*2 093 F*	*2 065 F*	*2 712*	*4 326*
Species total	*4 351*	*3 388*	*4 873*	*2 673*	*3 011*	*1 093 F*	*2 093 F*	*2 065 F*	*2 712*	*4 326*
Jamaica weakfish	**Acoupa mongolare**		**Corvinata goete**		***Cynoscion jamaicensis***			**1,70(37)016,06**		**YNJ**
41 Brazil	...	1 764	2 068	2 486	2 731	3 393	2 776	2 946	3 249	3 068
41 Fishing area total	*...*	*1 764*	*2 068*	*2 486*	*2 731*	*3 393*	*2 776*	*2 946*	*3 249*	*3 068*
Species total	*...*	*1 764*	*2 068*	*2 486*	*2 731*	*3 393*	*2 776*	*2 946*	*3 249*	*3 068*
Smooth weakfish	**...B**		**Corvinata blanca**		***Cynoscion leiarchus***			**1,70(37)016,07**		**YNE**
41 Brazil	...	974	884	694	1 002	1 080	692	910	1 003	948
41 Fishing area total	*...*	*974*	*884*	*694*	*1 002*	*1 080*	*692*	*910*	*1 003*	*948*
Species total	*...*	*974*	*884*	*694*	*1 002*	*1 080*	*692*	*910*	*1 003*	*948*
Spotted weakfish	**Acoupa pintade**		**Corvinata pintada**		***Cynoscion nebulosus***			**1,70(37)016,09**		**SWF**
21 USA	36	39	26	26	38	79	99	86	86	39
21 Fishing area total	*36*	*39*	*26*	*26*	*38*	*79*	*99*	*86*	*86*	*39*
31 Mexico	4 799	5 957	2 464	1 658	384	401	181	236	256	165
USA	116	131	111	87	91	122	136	101	131	110
31 Fishing area total	*4 915*	*6 088*	*2 575*	*1 745*	*475*	*523*	*317*	*337*	*387*	*275*
Species total	*4 951*	*6 127*	*2 601*	*1 771*	*513*	*602*	*416*	*423*	*473*	*314*
Squeteague(=Gray weakfish)	**Acoupa royal**		**Corvinata real**		***Cynoscion regalis***			**1,70(37)016,14**		**STG**
21 USA	2 119	2 054	771	535	491	379	340	151	122	99
21 Fishing area total	*2 119*	*2 054*	*771*	*535*	*491*	*379*	*340*	*151*	*122*	*99*
31 USA	154	108	136	183	96	103	50	57	50	24
31 Fishing area total	*154*	*108*	*136*	*183*	*96*	*103*	*50*	*57*	*50*	*24*
Species total	*2 273*	*2 162*	*907*	*718*	*587*	*482*	*390*	*208*	*172*	*123*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Striped weakfish	**Acoupa rayé**		**Corvinata pescadilla**		***Cynoscion striatus***				**1,70(37)016,17**	**WKS**
41 Argentina	11 844	11 412	6 597	15 603	10 133	15 312	15 670	15 158	13 255	12 772
Uruguay	10 890	8 958	7 122	10 980	8 559	9 954	8 909	11 033	6 354	5 480
41 Fishing area total	*22 734*	*20 370*	*13 719*	*26 583*	*18 692*	*25 266*	*24 579*	*26 191*	*19 609*	*18 252*
Species total	*22 734*	*20 370*	*13 719*	*26 583*	*18 692*	*25 266*	*24 579*	*26 191*	*19 609*	*18 252*
Green weakfish	**Acoupa cambucu**		**Corvinata cambucú**		***Cynoscion virescens***				**1,70(37)016,18**	**YNV**
41 Brazil	...	460	419	1 136	1 488	431	331	743	820	778
41 Fishing area total	*...*	*460*	*419*	*1 136*	*1 488*	*431*	*331*	*743*	*820*	*778*
Species total	*...*	*460*	*419*	*1 136*	*1 488*	*431*	*331*	*743*	*820*	*778*
Stripped weakfish	**...B**		**Corvinata listada**		***Cynoscion guatucupa***				**1,70(37)016,32**	**YGC**
41 Brazil	...	5 837	9 066	6 256	9 253	5 135	3 050	5 747	6 339	6 002
41 Fishing area total	*...*	*5 837*	*9 066*	*6 256*	*9 253*	*5 135*	*3 050*	*5 747*	*6 339*	*6 002*
Species total	*...*	*5 837*	*9 066*	*6 256*	*9 253*	*5 135*	*3 050*	*5 747*	*6 339*	*6 002*
Weakfishes nei	**Acoupas nca**		**Corvinatas nep**		***Cynoscion spp***				**1,70(37)016,XX**	**WKX**
31 Dominican Rp	10	71	83	34	...	24	...	34	30	33
Fr Guiana	...	...	...	...	467	1 283	1 366	1 542	1 805	1 950 F
Mexico	...	...	...	...	3 729	3 894	2 984	2 957	2 931	2 539
Nicaragua	46	56	83	93	112	84	113	51	26	59
USA	53	66	50	36	29	28	38	37	40	33
Venezuela	10 734	10 803	12 205	19 280 F	10 310 F	6 100 F	7 450 F	8 500 F	8 200 F	8 200 F
31 Fishing area total	*10 843*	*10 996*	*12 421*	*19 443 F*	*14 647 F*	*11 413 F*	*11 951 F*	*13 121 F*	*13 032 F*	*12 814 F*
41 Brazil	44 268	8 820	8 225	8 544	7 229	12 220	19 239	6 185	6 822	6 435
41 Fishing area total	*44 268*	*8 820*	*8 225*	*8 544*	*7 229*	*12 220*	*19 239*	*6 185*	*6 822*	*6 435*
77 Mexico	5 356	5 596	2 750	1 851	25	25	6 664	6 868	7 072	10 412
Nicaragua	97	77	61	53	34	47	145	117	139	112
77 Fishing area total	*5 453*	*5 673*	*2 811*	*1 904*	*59*	*72*	*6 809*	*6 985*	*7 211*	*10 524*
Species total	*60 564*	*25 489*	*23 457*	*29 891 F*	*21 935 F*	*23 705 F*	*37 999 F*	*26 291 F*	*27 065 F*	*29 773 F*
Mi-iuy (brown) croaker	**...B**		**...C**		***Miichthys miiuy***				**1,70(37)028,01**	**MIH**
61 China	...	...	36 671 F	28 693 F	17 943 F	28 779 F	37 509	34 659	35 726	41 677
61 Fishing area total	*...*	*...*	*36 671 F*	*28 693 F*	*17 943 F*	*28 779 F*	*37 509*	*34 659*	*35 726*	*41 677*
Species total	*...*	*...*	*36 671 F*	*28 693 F*	*17 943 F*	*28 779 F*	*37 509*	*34 659*	*35 726*	*41 677*
Whitemouth croaker	**Tambour rayé**		**Corvinón rayado**		***Micropogonias furnieri***				**1,70(37)038,02**	**CKM**
31 Venezuela	6 848	2 892	3 824	6 040 F	3 230 F	1 900 F	2 320 F	2 650 F	2 560 F	2 560 F
31 Fishing area total	*6 848*	*2 892*	*3 824*	*6 040 F*	*3 230 F*	*1 900 F*	*2 320 F*	*2 650 F*	*2 560 F*	*2 560 F*
41 Argentina	6 368	5 414	11 492	10 905	21 945	26 723	25 654	22 417	26 647	15 843
Brazil	40 306	43 085	39 789	37 006	30 572	45 612	44 374	41 480	45 750	43 191
Uruguay	27 322	26 665	30 668	29 390	27 805	28 928	27 670	27 207	23 728	15 358
41 Fishing area total	*73 996*	*75 164*	*81 949*	*77 301*	*80 322*	*101 263*	*97 698*	*91 104*	*96 125*	*74 392*
Species total	*80 844*	*78 056*	*85 773*	*83 341 F*	*83 552 F*	*103 163 F*	*100 018 F*	*93 754 F*	*98 685 F*	*76 952 F*
Atlantic croaker	**Tambour brésilien**		**Corvinón brasileño**		***Micropogonias undulatus***				**1,70(37)038,04**	**CKA**
21 USA	12 410	11 460	12 526	11 010	10 480	9 315	8 856	8 391	7 015	6 134
21 Fishing area total	*12 410*	*11 460*	*12 526*	*11 010*	*10 480*	*9 315*	*8 856*	*8 391*	*7 015*	*6 134*
31 USA	608	302	446	572	465	145	69	122	247	390
31 Fishing area total	*608*	*302*	*446*	*572*	*465*	*145*	*69*	*122*	*247*	*390*
Species total	*13 018*	*11 762*	*12 972*	*11 582*	*10 945*	*9 460*	*8 925*	*8 513*	*7 262*	*6 524*
Croakers nei	**Tambours nca**		**Corvinones nep**		***Micropogonias spp***				**1,70(37)038,XX**	**CRX**
77 Mexico	3 728	2 798	1 914	1 288	3 373	3 522	3 632	4 222	4 812	4 986
77 Fishing area total	*3 728*	*2 798*	*1 914*	*1 288*	*3 373*	*3 522*	*3 632*	*4 222*	*4 812*	*4 986*
87 Chile	7	5	9	23	37	28	4	3	4	9
Colombia	155	176	107	115	35	80 F	125 F	170 F	215	...
Peru	576	2	7	1 009	774	1 767	2 380	429	457	377
87 Fishing area total	*738*	*183*	*123*	*1 147*	*846*	*1 875 F*	*2 509 F*	*602 F*	*676*	*386*
Species total	*4 466*	*2 981*	*2 037*	*2 435*	*4 219*	*5 397 F*	*6 141 F*	*4 824 F*	*5 488*	*5 372*
Southern kingcroaker	**Bourrugue de crique**		**Lambe caletero**		***Menticirrhus americanus***				**1,70(37)039,01**	**KGB**
41 Argentina	-	-	-	-	-	-	-	-	1	0
41 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*1*	*0*
Species total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*1*	*0*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Northern kingfish	**Bourrugue renard**		**Lambe zorro**		***Menticirrhus saxatilis***				**1,70(37)039,07**	**KGF**
21 USA	39	8	12	179	129	14	16	20	39	24
21 Fishing area total	*39*	*8*	*12*	*179*	*129*	*14*	*16*	*20*	*39*	*24*
Species total	*39*	*8*	*12*	*179*	*129*	*14*	*16*	*20*	*39*	*24*
Gulf kingcroaker	**Bourrugue du Golfe**		**Lambe verrugato**		***Menticirrhus littoralis***				**1,70(37)039,08**	**KGG**
31 Mexico	484	630	248	167	460	480	199	101	102	103
USA	206	156	119	242	391	250	178	161	141	178
31 Fishing area total	*690*	*786*	*367*	*409*	*851*	*730*	*377*	*262*	*243*	*281*
Species total	*690*	*786*	*367*	*409*	*851*	*730*	*377*	*262*	*243*	*281*
Kingcroakers nei	**Bourrugues nca**		**Lambes nep**		***Menticirrhus spp***				**1,70(37)039,XX**	**KIX**
41 Brazil	2 055	2 048	2 037	1 649	2 175	2 114	1 948	1 935	2 134	2 015
Uruguay	6	5	15	6	11	12	13	18	...	21
41 Fishing area total	*2 061*	*2 053*	*2 052*	*1 655*	*2 186*	*2 126*	*1 961*	*1 953*	*2 134*	*2 036*
Species total	*2 061*	*2 053*	*2 052*	*1 655*	*2 186*	*2 126*	*1 961*	*1 953*	*2 134*	*2 036*
Shi drum	**Ombrine côtière**		**Verrugato fusco**		***Umbrina cirrosa***				**1,70(37)070,01**	**COB**
34 Benin	...	...	...	...	...	64	...	...	...	...
Greece	57	54	44	19	15	6	11	1	1	1 F
Portugal	...	...	...	...	-	-	-	-	-	2
34 Fishing area total	*57*	*54*	*44*	*19*	*15*	*70*	*11*	*1*	*1*	*3 F*
37 Albania	...	10	3	4	5	12	...	25	...	8
Cyprus	-	-	-	-	-	2	0	-	-	-
Greece	46	62	59	19	37	21	17	14	24	24 F
Slovenia	-	1	1	-	-	-	0	0	0	0
Tunisia	33	42	23	22	31	26	24	13	27	25
Turkey	55	70	77	63	52	29	19	22	24	41
37 Fishing area total	*134*	*185*	*163*	*108*	*125*	*90*	*60*	*74*	*75*	*98 F*
Species total	*191*	*239*	*207*	*127*	*140*	*160*	*71*	*75*	*76*	*101 F*
Argentine croaker	**Ombrine d'Argentine**		**Verrugato pargo**		***Umbrina canosai***				**1,70(37)070,03**	**CKY**
41 Argentina	2 083	1 539	1 668	1 889	2 548	4 702	3 859	2 483	3 085	3 094
Brazil	13 567	14 596	11 301	12 899	4 699	12 901	11 164	11 570	12 761	12 052
Uruguay	1 416	1 546	2 197	2 536	2 066	2 063	2 435	1 586	2 039	2 084
41 Fishing area total	*17 066*	*17 681*	*15 166*	*17 324*	*9 313*	*19 666*	*17 458*	*15 639*	*17 885*	*17 230*
Species total	*17 066*	*17 681*	*15 166*	*17 324*	*9 313*	*19 666*	*17 458*	*15 639*	*17 885*	*17 230*
Canary drum(=Baardman)	**Ombrine bronze**		**Verrugato de Canarias**		***Umbrina canariensis***				**1,70(37)070,09**	**UCA**
27 France	7	9	6	10	13	13	18	7	27	26
Spain	4	-	-	-	-	-	-	-	-	-
27 Fishing area total	*11*	*9*	*6*	*10*	*13*	*13*	*18*	*7*	*27*	*26*
34 Congo Rep	...	...	110	64	46	404	354	117	366	558
Mauritania	...	...	...	...	...	...	...	...	...	6
Morocco	554	968	522	858	761	745	728	709	514	549
34 Fishing area total	*554*	*968*	*632*	*922*	*807*	*1 149*	*1 082*	*826*	*880*	*1 113*
37 Morocco	3	2	12	19	4	2	1	4	2	6
37 Fishing area total	*3*	*2*	*12*	*19*	*4*	*2*	*1*	*4*	*2*	*6*
47 Angola	2 202	...	2 605	1 357	1 500 F	4 502	1 134	...	...	...
South Africa	5	13	12	9	4	3	4	9	15	13
47 Fishing area total	*2 207*	*13*	*2 617*	*1 366*	*1 504 F*	*4 505*	*1 138*	*9*	*15*	*13*
Species total	*2 775*	*992*	*3 267*	*2 317*	*2 328 F*	*5 669*	*2 239*	*846*	*924*	*1 158*
King weakfish	**Acoupa chasseur**		**Pescadilla real**		***Macrodon ancylodon***				**1,70(37)096,01**	**WKK**
41 Argentina	64	90	108	171	239	139	198	167	317	136
Brazil	2 641	4 220	3 278	2 942	3 048	3 613	3 651	10 099	11 139	10 507
Uruguay	1 486	2 008	1 146	2 648	1 189	1 919	1 272	2 487	3 229	1 932
41 Fishing area total	*4 191*	*6 318*	*4 532*	*5 761*	*4 476*	*5 671*	*5 121*	*12 753*	*14 685*	*12 575*
Species total	*4 191*	*6 318*	*4 532*	*5 761*	*4 476*	*5 671*	*5 121*	*12 753*	*14 685*	*12 575*
Meagre	**Maigre commun**		**Corvina**		***Argyrosomus regius***				**1,70(37)106,01**	**MGR**
01 Egypt	51	67	162	86	79	230	165	125	118	101
01 Fishing area total	*51*	*67*	*162*	*86*	*79*	*230*	*165*	*125*	*118*	*101*
27 France	162	156	101	525	1 263	1 356	1 204	855	965	779
Portugal	6	36	40	46	172	154	143	159	265	176
27 Fishing area total	*168*	*192*	*141*	*571*	*1 435*	*1 510*	*1 347*	*1 014*	*1 230*	*955*
34 Côte dIvoire	1	1	9	0	-	...	...	...	...	...

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Gambia	33	645	42	45	1	1	1	13	14	13
Ghana	...	...	...	...	...	...	233	2 042	118	115
Greece	...	...	...	5	...	...	...	...	...	...
GuineaBissau	372	730	337	310 F	277 F	260 F	240 F	240 F	240 F	240 F
Mauritania	600 F	600 F	1 000 F	1 400 F	1 800 F	1 560 F	2 170 F	1 880 F	2 100 F	3 227
Portugal	24	-	0	-	-	-	-	-	-	-
UK	-	-	-	-	-	-	-	-	13	-
34 Fishing area total	*1 030 F*	*1 976 F*	*1 388 F*	*1 760 F*	*2 078 F*	*1 821 F*	*2 644 F*	*4 175 F*	*2 485 F*	*3 595 F*
37 Egypt	987	1 305	1 252	2 325	1 153	1 877	1 437	977	1 031	896
France	-	-	-	-	-	-	-	-	5	16
Israel	223	273	249	144	6	2	22	18 F	13	8
Palest, O.T.	3 F	3	21	3	5	3	9	5	6	4
Tunisia	...	...	...	...	...	...	6	...	...	...
Turkey	50	63	75	62	96	-	60	56	23	101
37 Fishing area total	*1 263 F*	*1 644*	*1 597*	*2 534*	*1 260*	*1 882*	*1 534*	*1 056 F*	*1 078*	*1 025*
Species total	*2 512 F*	*3 879 F*	*3 288 F*	*4 951 F*	*4 852 F*	*5 443 F*	*5 690 F*	*6 370 F*	*4 911 F*	*5 676 F*
Southern meagre(=Mulloway)	**Maigre du Sud**		**Corvina del Sur**		***Argyrosomus hololepidotus***				**1,70(37)106,06**	**KOB**
34 Congo Rep	...	...	341	465	405	130	207	99	30	128
34 Fishing area total	*...*	*...*	*341*	*465*	*405*	*130*	*207*	*99*	*30*	*128*
47 Angola	2 540	...	3 787	4 758	4 400 F	4 758	12 878	26 765	17 313	16 600 F
Namibia	596	288	93	25	27	39	...	3	...	...
Portugal	1	-	-	-	-	-	-	-	-	-
South Africa	597	323	469	586	479	554	504	479	570	583
47 Fishing area total	*3 734*	*611*	*4 349*	*5 369*	*4 906 F*	*5 351*	*13 382*	*27 247*	*17 883*	*17 183 F*
51 South Africa	20	27	12	30	15	24	13	17	11	13
51 Fishing area total	*20*	*27*	*12*	*30*	*15*	*24*	*13*	*17*	*11*	*13*
57 Australia	363	368	305	272	268	254	211	151	90	109
57 Fishing area total	*363*	*368*	*305*	*272*	*268*	*254*	*211*	*151*	*90*	*109*
71 Australia	142	413	180	232	308	248	240	222	225	215
71 Fishing area total	*142*	*413*	*180*	*232*	*308*	*248*	*240*	*222*	*225*	*215*
81 Australia	73	70	74	102	54	58	46	48	36	40
81 Fishing area total	*73*	*70*	*74*	*102*	*54*	*58*	*46*	*48*	*36*	*40*
Species total	*4 332*	*1 489*	*5 261*	*6 470*	*5 956 F*	*6 065*	*14 099*	*27 784*	*18 275*	*17 688 F*
Geelbek croaker	**Téraglin**		**Corvinata prieta**		***Atractoscion aequidens***				**1,70(37)108,01**	**AWE**
47 South Africa	379	294	458	658	656	403	427	351	483	422
47 Fishing area total	*379*	*294*	*458*	*658*	*656*	*403*	*427*	*351*	*483*	*422*
51 South Africa	...	12	14	18	21	23	13	56	36	17
51 Fishing area total	*...*	*12*	*14*	*18*	*21*	*23*	*13*	*56*	*36*	*17*
81 Australia	37	17	19	13	11	7	...	...	...	...
81 Fishing area total	*37*	*17*	*19*	*13*	*11*	*7*	*...*	*...*	*...*	*...*
Species total	*416*	*323*	*491*	*689*	*688*	*433*	*440*	*407*	*519*	*439*
White weakfish	**Acoupa blanc**		**Corvina cabaicucho**		***Atractoscion nobilis***				**1,70(37)108,03**	**WEW**
77 USA	124	194	216	143	139	184	220	304	186	258
77 Fishing area total	*124*	*194*	*216*	*143*	*139*	*184*	*220*	*304*	*186*	*258*
Species total	*124*	*194*	*216*	*143*	*139*	*184*	*220*	*304*	*186*	*258*
White croaker	**Courbine blanche**		**Roncador blanco**		***Genyonemus lineatus***				**1,70(37)147,01**	**KIC**
77 USA	137	97	82	52	38	39	27	33	53	6
77 Fishing area total	*137*	*97*	*82*	*52*	*38*	*39*	*27*	*33*	*53*	*6*
Species total	*137*	*97*	*82*	*52*	*38*	*39*	*27*	*33*	*53*	*6*
Shorthead drum	**...B**		**...C**		***Larimus breviceps***				**1,70(37)166,03**	**LRJ**
41 Brazil	...	178	206	159	207	218	254	221	244	231
41 Fishing area total	*...*	*178*	*206*	*159*	*207*	*218*	*254*	*221*	*244*	*231*
Species total	*...*	*178*	*206*	*159*	*207*	*218*	*254*	*221*	*244*	*231*
Boe drum	**Courbine pélin**		**Bombache boe**		***Pteroscion peli***				**1,70(37)166,07**	**DRS**
34 Benin	115	137	169	244	200	192	100 F	...	...	...
Congo Rep	550 F	450 F	358	226	339	385	407	378	435	404
Portugal	0	17	15	6	-	0	1	-	-	-
Senegal	444	374	393	258	210	609	798	885	994	1 424
Sierra Leone	...	...	...	916	1 172	1 065	1 064	535	530 F	530 F
34 Fishing area total	*1 109 F*	*978 F*	*935*	*1 650*	*1 921*	*2 251*	*2 370 F*	*1 798*	*1 959 F*	*2 358 F*
47 Portugal	-	-	-	-	45	-	-	-	-	-
47 Fishing area total	*-*	*-*	*-*	*-*	*45*	*-*	*-*	*-*	*-*	*-*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*1 109 F*	*978 F*	*935*	*1 650*	*1 966*	*2 251*	*2 370 F*	*1 798*	*1 959 F*	*2 358 F*
Tigertooth croaker	**Grande verrue tigre**		**Bombache tigre mayor**		***Otolithes ruber***				**1,70(37)186,03**	**LKR**
51 Iran	5 057	4 053	5 933	6 461	6 140	8 598	8 778	9 253	5 513	5 602
51 Fishing area total	*5 057*	*4 053*	*5 933*	*6 461*	*6 140*	*8 598*	*8 778*	*9 253*	*5 513*	*5 602*
Species total	*5 057*	*4 053*	*5 933*	*6 461*	*6 140*	*8 598*	*8 778*	*9 253*	*5 513*	*5 602*
Peruvian banded croaker	**Bourrugue coco**		**Lambe coco**		***Paralonchurus peruanus***				**1,70(37)194,02**	**PDR**
87 Peru	4 167	1 886	1 591	2 395	854	880	1 353	1 234	1 091	2 159
87 Fishing area total	*4 167*	*1 886*	*1 591*	*2 395*	*854*	*880*	*1 353*	*1 234*	*1 091*	*2 159*
Species total	*4 167*	*1 886*	*1 591*	*2 395*	*854*	*880*	*1 353*	*1 234*	*1 091*	*2 159*
South American silver croaker	**Acoupa rivière**		**Curbinata**		***Plagioscion squamosissimus***				**1,70(37)205,06**	**LGQ**
03 Brazil	10 326	13 611	10 142	12 270	12 792	12 244	12 030	13 132	12 037	...
03 Fishing area total	*10 326*	*13 611*	*10 142*	*12 270*	*12 792*	*12 244*	*12 030*	*13 132*	*12 037*	*...*
Species total	*10 326*	*13 611*	*10 142*	*12 270*	*12 792*	*12 244*	*12 030*	*13 132*	*12 037*	*...*
Black drum	**Grand tambour**		**Corvinón negro**		***Pogonias cromis***				**1,70(37)210,02**	**BDM**
21 USA	39	23	59	49	50	35	54	27	54	56
21 Fishing area total	*39*	*23*	*59*	*49*	*50*	*35*	*54*	*27*	*54*	*56*
31 Mexico	143	165	73	49	88	92	44	33	21	23
USA	2 489	2 225	2 360	2 489	2 059	1 902	1 948	1 776	2 187	2 084
31 Fishing area total	*2 632*	*2 390*	*2 433*	*2 538*	*2 147*	*1 994*	*1 992*	*1 809*	*2 208*	*2 107*
41 Argentina	52	33	152	56	92	10	19	68	66	83
Uruguay	336	504	701	578	611	551	683	436	272	664
41 Fishing area total	*388*	*537*	*853*	*634*	*703*	*561*	*702*	*504*	*338*	*747*
77 Mexico	0	0	0	0	0	0	0	-	-	-
77 Fishing area total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	-	-	-
Species total	*3 059*	*2 950*	*3 345*	*3 221*	*2 900*	*2 590*	*2 748*	*2 340*	*2 600*	*2 910*
Honnibe croaker	**Tambour honnibe**		**Corvina honnibe**		***Nibea mitsukurii***				**1,70(37)298,05**	**HOC**
61 Korea Rep	2 156	1 148	1 299	974	1 302	2 002	3 030	-	-	-
61 Fishing area total	*2 156*	*1 148*	*1 299*	*974*	*1 302*	*2 002*	*3 030*	-	-	-
Species total	*2 156*	*1 148*	*1 299*	*974*	*1 302*	*2 002*	*3 030*	-	-	-
Large yellow croaker	**Tambour à gros yeux**		**Corvina japonesa**		***Larimichthys croceus***				**1,70(37)303,04**	**LYC**
61 China	65 086 F	70 689 F	86 370 F	75 739 F	64 119 F	66 667 F	69 392	55 922	62 807	63 358
Korea Rep	426	325	220	65	38	125	77	166	148	192
61 Fishing area total	*65 512 F*	*71 014 F*	*86 590 F*	*75 804 F*	*64 157 F*	*66 792 F*	*69 469*	*56 088*	*62 955*	*63 550*
Species total	*65 512 F*	*71 014 F*	*86 590 F*	*75 804 F*	*64 157 F*	*66 792 F*	*69 469*	*56 088*	*62 955*	*63 550*
Yellow croaker	**...B**		**Verrugato de Manchuria**		***Larimichthys polyactis***				**1,70(37)303,05**	**CRY**
61 China	209 298 F	221 591 F	237 724 F	266 982 F	277 968 F	295 150 F	338 843	354 665	372 895	406 868
China,Taiwan	903	742	560	384	434	288	185	153	153	38
Korea Rep	7 938	10 941	7 098	17 570	15 272	21 428	34 221	33 200	34 033	31 931
61 Fishing area total	*218 139 F*	*233 274 F*	*245 382 F*	*284 936 F*	*293 674 F*	*316 866 F*	*373 249*	*388 018*	*407 081*	*438 837*
Species total	*218 139 F*	*233 274 F*	*245 382 F*	*284 936 F*	*293 674 F*	*316 866 F*	*373 249*	*388 018*	*407 081*	*438 837*
Bigtooth corvina	**Acoupa aile-courte**		**Corvinata aletacorta**		***Isopisthus parvipinnis***				**1,70(37)314,02**	**ISA**
41 Brazil	...	2	2	2	104	131	16	83	91	86
41 Fishing area total	*...*	*2*	*2*	*2*	*104*	*131*	*16*	*83*	*91*	*86*
Species total	*...*	*2*	*2*	*2*	*104*	*131*	*16*	*83*	*91*	*86*
Spot croaker	**Tambour croca**		**Verrugato croca**		***Leiostomus xanthurus***				**1,70(37)363,01**	**SPT**
21 USA	1 877	1 784	2 001	2 299	1 880	1 023	2 113	1 041	2 090	1 489
21 Fishing area total	*1 877*	*1 784*	*2 001*	*2 299*	*1 880*	*1 023*	*2 113*	*1 041*	*2 090*	*1 489*
31 USA	1 214	703	670	779	441	432	333	269	396	186
31 Fishing area total	*1 214*	*703*	*670*	*779*	*441*	*432*	*333*	*269*	*396*	*186*
Species total	*3 091*	*2 487*	*2 671*	*3 078*	*2 321*	*1 455*	*2 446*	*1 310*	*2 486*	*1 675*
Red drum	**Tambour rouge**		**Corvinón ocelado**		***Sciaenops ocellatus***				**1,70(37)411,01**	**RDM**
21 USA	3	4	4	0	1	3	6	5	6	7
21 Fishing area total	*3*	*4*	*4*	*0*	*1*	*3*	*6*	*5*	*6*	*7*
31 USA	-	-	-	-	24	5	2	-	-	-

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
31 Fishing area total	*-*	*-*	*-*	*-*	*24*	*5*	*2*	*-*	*-*	*-*
Species total	*3*	*4*	*4*	*0*	*25*	*8*	*8*	*5*	*6*	*7*
Law croaker	**Otolithe gabo**		**Corvina reina**		***Pseudotolithus brachygnathus***				**1,70(37)457,01**	**CKL**
34 Gambia	856	794	897	355	...	79	48	73	75	...
Sierra Leone	227	61	526	1 189	888	1 491	1 156	2 386	2 350 F	2 350 F
34 Fishing area total	*1 083*	*855*	*1 423*	*1 544*	*888*	*1 570*	*1 204*	*2 459*	*2 425 F*	*2 350 F*
Species total	*1 083*	*855*	*1 423*	*1 544*	*888*	*1 570*	*1 204*	*2 459*	*2 425 F*	*2 350 F*
Cassava croaker	**Otolithe sénégalais**		**Corvina casava**		***Pseudotolithus senegalensis***				**1,70(37)457,02**	**PSS**
34 Cameroon	2 679	2 100	1 263	900 F	431	55	55	500 F	921	921 F
Côte dIvoire	39	26	17	6	6	6	19	17 F	15	...
Gambia	400	620	354	185	1 438	780	1 391	2 200	2 356	2 357
Liberia	100	150	90	490	95	369	381	229	220 F	220 F
Portugal	-	-	-	-	-	-	1	4	8	7
Senegal	1 682	1 159	3 270	2 831	2 110	2 430	2 269	2 481	3 246	2 495
34 Fishing area total	*4 900*	*4 055*	*4 994*	*4 412 F*	*4 080*	*3 640*	*4 116*	*5 431 F*	*6 766 F*	*6 000 F*
Species total	*4 900*	*4 055*	*4 994*	*4 412 F*	*4 080*	*3 640*	*4 116*	*5 431 F*	*6 766 F*	*6 000 F*
Bobo croaker	**Otolithe bobo**		**Corvina bobo**		***Pseudotolithus elongatus***				**1,70(37)457,05**	**PSE**
34 Cameroon	3 218	1 883	1 453	2 000 F	2 438	26	26	36 F	46	46 F
Côte dIvoire	4	1	2	2	4	1	7	6 F	5	...
Gabon	1 555	1 238	1 327	2 105	1 675	1 484	1 470 F	1 446	980 F	980 F
Gambia	120	494	255	274	182	405	861	396	425	424
Guinea	5 172	7 098	9 776	7 680	7 866	9 253	4 622	7 658	7 600 F	7 600 F
Liberia	110	70	130	535	107	300	201	260	260 F	260 F
Senegal	114	115	81	99	100	115	105	161	159	263
Sierra Leone	748	3 233	5 843	7 321	7 851	11 128	8 747	12 206	12 000 F	12 000 F
34 Fishing area total	*11 041*	*14 132*	*18 867*	*20 016 F*	*20 223*	*22 712*	*16 039 F*	*22 169 F*	*21 475 F*	*21 573 F*
Species total	*11 041*	*14 132*	*18 867*	*20 016 F*	*20 223*	*22 712*	*16 039 F*	*22 169 F*	*21 475 F*	*21 573 F*
West African croakers nei	**Otolithes nca**		**Corvinas africanas nep**		***Pseudotolithus spp***				**1,70(37)457,XX**	**CKW**
34 Benin	697	978	1 292	1 316	1 166	1 058	847	663	566	656
Congo Rep	800 F	1 900 F	3 049	2 283	2 765	2 911	2 762	2 318	3 177	3 827
Côte dIvoire	407	498	463	290	399	294	231	180 F	130	630
Gabon	2 197	2 554	3 389	5 108	4 482	3 436	2 270 F	1 110	750 F	750 F
Gambia	504	49	725	-	-	-	-	-	-	-
Ghana	1 070	1 067	593	1 126	1 837	1 336	1 504	1 229	1 441	1 958
Guinea	3 644	3 704	3 173	2 470	7 083	6 736	3 411	3 875	3 850 F	3 850 F
Lithuania	-	-	56	58	32	-	-	-	-	6
Mauritania	...	...	...	...	...	...	...	...	...	268
Nigeria	15 084	11 922	13 518	14 098	10 738	12 475	10 044	11 260	9 212	7 537
Portugal	25	31	18	27	27	9	5	-	-	-
Russian Fed	18	-	-	-	35	1	-	1	-	-
Sierra Leone	1 011	1 470	2 510	2 326	1 798	2 105	1 652	2 524	2 480 F	2 480 F
Togo	43	66	19	36	58	48	40	25 F	10	34
34 Fishing area total	*25 500 F*	*24 239 F*	*28 805*	*29 138*	*30 420*	*30 409*	*22 766 F*	*23 185 F*	*21 616 F*	*21 996 F*
47 Angola	8 725	25 946	18 896	18 289	17 000 F	19 280	15 268	21 887	19 141	18 400 F
Russian Fed	19	25	36	-	-	-	-	-	-	-
47 Fishing area total	*8 744*	*25 971*	*18 932*	*18 289*	*17 000 F*	*19 280*	*15 268*	*21 887*	*19 141*	*18 400 F*
Species total	*34 244 F*	*50 210 F*	*47 737*	*47 427*	*47 420 F*	*49 689*	*38 034 F*	*45 072 F*	*40 757 F*	*40 396 F*
Blackmouth croaker	**Maigre noire**		**Corvina negra**		***Atrobucca nibe***				**1,70(37)553,01**	**CRL**
61 China,Taiwan	644	535	465	287	335	370	403	386	501	364
61 Fishing area total	*644*	*535*	*465*	*287*	*335*	*370*	*403*	*386*	*501*	*364*
Species total	*644*	*535*	*465*	*287*	*335*	*370*	*403*	*386*	*501*	*364*
Silver croaker	**Maigre argenté**		**Corvina plateada**		***Pennahia argentata***				**1,70(37)561,01**	**CRV**
61 China	...	...	89 234 F	92 886 F	89 915 F	114 077 F	108 203	125 645	126 470	131 026
China,Taiwan	3 796	3 394	4 068	3 713	3 095	2 688	2 816	2 443	2 188	1 682
61 Fishing area total	*3 796*	*3 394*	*93 302 F*	*96 599 F*	*93 010 F*	*116 765 F*	*111 019*	*128 088*	*128 658*	*132 708*
Species total	*3 796*	*3 394*	*93 302 F*	*96 599 F*	*93 010 F*	*116 765 F*	*111 019*	*128 088*	*128 658*	*132 708*
Bigeye croaker	**Courbine grise**		**Corvina plomiza**		***Pennahia anea***				**1,70(37)561,05**	**NHK**
51 Iran	982	1 191	1 091	1 088	1 717	1 881	2 348	3 494	5 494	5 186
51 Fishing area total	*982*	*1 191*	*1 091*	*1 088*	*1 717*	*1 881*	*2 348*	*3 494*	*5 494*	*5 186*
Species total	*982*	*1 191*	*1 091*	*1 088*	*1 717*	*1 881*	*2 348*	*3 494*	*5 494*	*5 186*
Corvina drum	**Courbine blonde**		**Corvina pampera**		***Cilus gilberti***				**1,70(37)565,01**	**IAG**
87 Chile	1 033	733	594	916	772	544	574	743	1 189	626
Peru	3 295	5 242	6 244	4 736	6 001	4 200	6 530	9 399	9 204	9 945
87 Fishing area total	*4 328*	*5 975*	*6 838*	*5 652*	*6 773*	*4 744*	*7 104*	*10 142*	*10 393*	*10 571*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*4 328*	*5 975*	*6 838*	*5 652*	*6 773*	*4 744*	*7 104*	*10 142*	*10 393*	*10 571*
Croakers, drums nei	**Sciaenidés nca**		**Esciénidos nep**		***Sciaenidae***				**1,70(37)XXX,XX**	**CDX**
04 India	864	864	842	842	1 020	1 065	601	590	764	1 006
04 Fishing area total	*864*	*864*	*842*	*842*	*1 020*	*1 065*	*601*	*590*	*764*	*1 006*
21 Korea Rep	-	-	-	-	-	-	-	44	-	-
21 Fishing area total	-	-	-	-	-	-	-	*44*	-	-
27 Portugal	168	340	170	195	239	185	196	260	273	273
Spain	-	-	77	161	152	253	258	233	247	322
27 Fishing area total	*168*	*340*	*247*	*356*	*391*	*438*	*454*	*493*	*520*	*595*
31 Guatemala	...	...	...	...	36	...	74	...	...	...
Korea Rep	137	-	-	-	-	-	61	491	-	-
Mexico	663	114	340	229	2 606	2 721	1	5	9	13
Suriname	...	...	7 635	8 141	6 970	...	...	...	...	...
31 Fishing area total	*800*	*114*	*7 975*	*8 370*	*9 612*	*2 721*	*136*	*496*	*9*	*13*
34 Belize	1	-	6	...	5 189	6	56	8	...	...
Cameroon	2 399	1 946	1 564	800 F	40	24	24	24 F	24 F	24 F
China	2 061	1 144	1 391	...	3 988	455	2 014	894	...	...
Congo Dem R	180 F	200 F	220 F	230 F	250 F	260 F	270	270 F	270 F	270 F
Congo Rep	3 F	-	-	-	-	-	-	-	-	-
Ghana	-	-	-	1 126	54	1 337	2 388	267	187	-
GuineaBissau	...	121	7	20 F	36 F	35 F	30 F	30 F	30 F	30 F
Honduras	62	22	-	-	-	107	-	-	-	-
Korea Rep	14 750	15 152	16 401	14 794	14 816	11 728	12 729	8 783	10 248	12 980
Lithuania	-	61	-	-	-	-	-	-	-	-
Mauritania	300 F	300 F	290 F	280 F	270 F	140 F	190 F	160 F	184 F	7
Morocco	1 534	2 047	3 095	4 142	4 701	3 368	3 580	2 179	3 097	1 782
Nigeria	5 900	9 384	7 832	7 478	6 468	8 134	7 696	7 915	8 753	9 680
Panama	32	190	101	...	-	-	-	-	...	...
Portugal	6	36	90	30	-	-	-	-	-	9
Sao Tome Prn	35 F	40 F	45	158	165 F	165 F	165 F	165 F	165 F	170 F
Senegal	3 700	3 405	1 280	1 428	1 366	1 334	1 534	1 386	1 455	1 411
Spain	9	348	114	238	184	69	45	73	113	188
Ukraine	69	91	5	47	35	8	23	46	119	-
Other nei	12	...	...	...	...	...	...	...	...	...
34 Fishing area total	*31 053 F*	*34 487 F*	*32 441 F*	*30 771 F*	*37 562 F*	*27 170 F*	*30 744 F*	*22 200 F*	*24 645 F*	*26 551 F*
37 Albania	10	8	1	13	2	18	2	2	8	1
Italy	259	156	102	113	105	103	138	123	143	135
Malta	-	-	-	-	-	-	-	-	1	1
Morocco	-	-	28	16	21	19	19	11	20	35
Portugal	-	-	-	4	-	-	-	-	-	-
Spain	32	56	32	41	49	47	50	76	130	337
Tunisia	138	109	138	-	-	-	62	75	-	-
37 Fishing area total	*439*	*329*	*301*	*187*	*177*	*187*	*271*	*287*	*302*	*509*
41 Brazil	164	-	-	-	-	-	-	307	338	320
Korea Rep	270	-	-	312	146	407	-	-	-	-
Spain	-	8	-	-	-	-	-	-	-	-
41 Fishing area total	*434*	*8*	-	*312*	*146*	*407*	-	*307*	*338*	*320*
47 Angola	594	1 332	2 349	...	2 000 F	2 185	1 851	1 908	1 111	1 070 F
Korea Rep	1 965	2 217	2 843	1 931	1 875	1 779	1 299	1 127	1 377	1 365
Portugal	-	-	9	-	32	5	24	83	62	32
Russian Fed	59	4	-	-	-	-	-	-	-	-
Spain	17	13	-	-	0	0	-	-	36	6
47 Fishing area total	*2 635*	*3 566*	*5 201*	*1 931*	*3 907 F*	*3 969*	*3 174*	*3 118*	*2 586*	*2 473 F*
51 India	212 845	237 869	227 818	198 258	198 214	199 651	173 148	167 545	189 655	184 783
Iran	4 196	4 423	4 428	3 850	4 371	5 260	2 748	2 696	2 660	3 515
Korea Rep	361	423	744	329	48	294	183	180	916	920
Kuwait	853	740 F	625	865	674	35	45	649	300 F	300 F
Oman	1 873	4 152	4 117	4 696	4 136	3 996	4 261	2 673	3 016	4 493
Pakistan	21 725	22 886	19 737	16 910	15 858	14 686	14 618	14 697	13 557	19 981
Portugal	1	-	1	-	-	-	-	-	-	-
South Africa	0	-	-	-	-	-	-	-	-	-
51 Fishing area total	*241 854*	*270 493 F*	*257 470*	*224 908*	*223 301*	*223 922*	*195 003*	*188 440*	*210 104 F*	*213 992 F*
57 India	34 709	36 065	37 160	42 149	36 200	37 135	51 067	65 010	55 060	52 003
Indonesia	12 092	15 686	14 085	14 842	14 867	14 798	15 391	16 064	15 898	14 680
Korea Rep	202	14	47	-	-	-	-	-	-	-
Malaysia	10 507	11 593	11 650	12 019	10 723	14 313	15 266	14 847	17 710	20 676
Thailand	24 711	27 981	24 097	20 649	16 409	16 546	13 841	13 727	12 792	13 260
57 Fishing area total	*82 221*	*91 339*	*87 039*	*89 659*	*78 199*	*82 792*	*95 565*	*109 648*	*101 460*	*100 619*
61 China	-	-	265 117 F	278 776 F	287 804 F	289 184 F	285 382	302 757	314 061	320 516
China,H.Kong	3 900 F	3 800 F	3 500 F	3 750 F	3 630 F	3 450 F	3 440 F	3 530 F	3 550 F	3 750 F
China,Taiwan	3 841	8 428	2 115	2 706	2 664	1 548	1 015	1 015	881	745
Japan	4 362	4 112	3 580	3 381	3 272	3 373	...	...	...	...
Korea Rep	30 642	24 915	22 993	22 464	20 519	28 401	20 777	20 158	19 604	11 734
61 Fishing area total	*42 745 F*	*41 255 F*	*297 305 F*	*311 077 F*	*317 889 F*	*325 956 F*	*310 614 F*	*327 460 F*	*338 096 F*	*336 745 F*
71 Indonesia	37 555	44 475	41 811	42 711	45 310	39 187	42 097	49 239	41 184	52 347

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Korea Rep	4 072	6 223	7 003	7 104	7 391	6 354	8 940	8 052	3 449	6 001
Malaysia	18 253	10 744	11 592	12 718	13 187	13 118	11 748	10 799	9 694	12 111
Singapore	45	56	37	45	40	63	81	29	44	38
Thailand	20 221	23 683	24 165	30 202	33 308	31 485	29 989	13 355	14 259	13 807
71 Fishing area total	*80 146*	*85 181*	*84 608*	*92 780*	*99 236*	*90 207*	*92 855*	*81 474*	*68 630*	*84 304*
77 El Salvador	575	826	806	798	604	1 364	1 751	...	...	...
Korea Rep	441	174	66	284	-	-	-	-	-	-
Mexico	735	345	377	254	2 882	3 009	8	7	7	4
Panama	4 543	2 279	1 964	572	2 047	1 637	1 354	3 938	4 219	3 822
77 Fishing area total	*6 294*	*3 624*	*3 213*	*1 908*	*5 533*	*6 010*	*3 113*	*3 945*	*4 226*	*3 826*
81 Korea Rep	-	-	-	108	-	-	-	800	-	-
81 Fishing area total	-	-	-	*108*	-	-	-	*800*	-	-
87 Chile	15	5	29	61	35	114	31	37	82	112
Colombia	16	5	1	...	...	100 F	300 F	500 F	848	618
Ecuador	1 558	993	2 172	2 670	2 622	1 382	1 019	719	558	596
Korea Rep	105	92	-	-	-	-	-	-	-	-
87 Fishing area total	*1 694*	*1 095*	*2 202*	*2 731*	*2 657*	*1 596 F*	*1 350 F*	*1 256 F*	*1 488*	*1 326*
Species total	*491 347 F*	*532 695 F*	*778 844 F*	*765 940 F*	*779 630 F*	*766 440 F*	*733 880 F*	*740 558 F*	*753 168 F*	*772 279 F*
Largeeye breams	**...B**		**...C**		***Gymnocranius spp***				**1,70(38)155,XX**	**LBR**
61 China,H.Kong	130 F	120 F	110 F	120 F	116 F	107 F	107 F	110 F	115 F	120 F
61 Fishing area total	*130 F*	*120 F*	*110 F*	*120 F*	*116 F*	*107 F*	*107 F*	*110 F*	*115 F*	*120 F*
71 Fiji	30	50 F	76	110	108 F	106	75	80	75	100
71 Fishing area total	*30*	*50 F*	*76*	*110*	*108 F*	*106*	*75*	*80*	*75*	*100*
Species total	*160 F*	*170 F*	*186 F*	*230 F*	*224 F*	*213 F*	*182 F*	*190 F*	*190 F*	*220 F*
Spangled emperor	**Empereur moris**		**Emperador relámpago**		***Lethrinus nebulosus***				**1,70(38)172,02**	**LHN**
51 Bahrain	...	...	...	...	1 426	1 012	805	639	469	277
Iran	872	1 269	1 347	2 312	1 798	2 079	1 480	2 074	1 806	1 810
Saudi Arabia	261	201	144	91	192	280	245	340	246	246
51 Fishing area total	*1 133*	*1 470*	*1 491*	*2 403*	*3 416*	*3 371*	*2 530*	*3 053*	*2 521*	*2 333*
Species total	*1 133*	*1 470*	*1 491*	*2 403*	*3 416*	*3 371*	*2 530*	*3 053*	*2 521*	*2 333*
Atlantic emperor	**Empereur atlantique**		**Emperador atlántico**		***Lethrinus atlanticus***				**1,70(38)172,04**	**LTN**
34 Benin	...	...	...	...	49	38	31	3	...	...
Senegal	...	...	38	51	337	77	51	53	33	229
Togo	...	...	...	23	7	3	1	4 F	7	1
34 Fishing area total	*...*	*...*	*38*	*74*	*393*	*118*	*83*	*60 F*	*40*	*230*
Species total	*...*	*...*	*38*	*74*	*393*	*118*	*83*	*60 F*	*40*	*230*
Thumbprint emperor	**Empereur Saint Pierre**		**Emperador San Pedro**		***Lethrinus harak***				**1,70(38)172,06**	**LTK**
51 Saudi Arabia	30	10	21	18	15	33	70	41	42	42
51 Fishing area total	*30*	*10*	*21*	*18*	*15*	*33*	*70*	*41*	*42*	*42*
Species total	*30*	*10*	*21*	*18*	*15*	*33*	*70*	*41*	*42*	*42*
Sky emperor	**Empereur mahsena**		**Emperador mahsena**		***Lethrinus mahsena***				**1,70(38)172,07**	**LTQ**
51 Egypt	-	-	23	150	324	172	169	25	119	232
Saudi Arabia	435	411	428	275	446	462	391	477	427	427
51 Fishing area total	*435*	*411*	*451*	*425*	*770*	*634*	*560*	*502*	*546*	*659*
Species total	*435*	*411*	*451*	*425*	*770*	*634*	*560*	*502*	*546*	*659*
Pink ear emperor	**Empereur lentille**		**Emperador de lentejuelas**		***Lethrinus lentjan***				**1,70(38)172,15**	**LTS**
51 Bahrain	...	...	...	...	73	247	227	298	107	149
Saudi Arabia	2 660	2 395	2 526	2 238	2 443	2 574	2 683	2 297	2 990	2 460
51 Fishing area total	*2 660*	*2 395*	*2 526*	*2 238*	*2 516*	*2 821*	*2 910*	*2 595*	*3 097*	*2 609*
Species total	*2 660*	*2 395*	*2 526*	*2 238*	*2 516*	*2 821*	*2 910*	*2 595*	*3 097*	*2 609*
Smalltooth emperor	**Empereur tidents**		**Emperador boquidulce**		***Lethrinus microdon***				**1,70(38)172,16**	**LEN**
51 Bahrain	...	...	...	...	39	66	80	70	38	34
Saudi Arabia	59	88	87	36	70	46	59	141	172	142
51 Fishing area total	*59*	*88*	*87*	*36*	*109*	*112*	*139*	*211*	*210*	*176*
Species total	*59*	*88*	*87*	*36*	*109*	*112*	*139*	*211*	*210*	*176*
Orange-striped emperor	**Empereur à bandes oranges**		**Emperador de bandes**		***Lethrinus obsoletus***				**1,70(38)172,23**	**LWO**
51 Saudi Arabia	278	527	264	247	257	356	313	333	308	308
51 Fishing area total	*278*	*527*	*264*	*247*	*257*	*356*	*313*	*333*	*308*	*308*
Species total	*278*	*527*	*264*	*247*	*257*	*356*	*313*	*333*	*308*	*308*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Yellowlip emperor	**Empereur bec-de-cane**		**Emperador trompa amarilla**		***Lethrinus xanthochilus***				**1,70(38)172,25**	**LXN**
51 Saudi Arabia	98	19	23	82	32	17	34	23	35	35
51 Fishing area total	*98*	*19*	*23*	*82*	*32*	*17*	*34*	*23*	*35*	*35*
Species total	*98*	*19*	*23*	*82*	*32*	*17*	*34*	*23*	*35*	*35*
Snubnose emperor	**...B**		**...C**		***Lethrinus borbonicus***				**1,70(38)172,26**	**LBW**
51 Egypt	...	...	...	...	...	...	...	9	154	402
Saudi Arabia	722	908	686	729	651	723	482	420	598	618
51 Fishing area total	*722*	*908*	*686*	*729*	*651*	*723*	*482*	*429*	*752*	*1 020*
Species total	*722*	*908*	*686*	*729*	*651*	*723*	*482*	*429*	*752*	*1 020*
Humpnose big-eye bream	**Empereur bossu**		**Emperador jorobado**		***Monotaxis grandoculis***				**1,70(38)180,01**	**MXG**
51 Saudi Arabia	219	96	39	29	44	104	52	50	59	59
51 Fishing area total	*219*	*96*	*39*	*29*	*44*	*104*	*52*	*50*	*59*	*59*
Species total	*219*	*96*	*39*	*29*	*44*	*104*	*52*	*50*	*59*	*59*
Emperors(=Scavengers) nei	**Empereurs nca**		**Emperadores nep**		***Lethrinidae***				**1,70(38)XXX,XX**	**EMP**
47 South Africa	3	3	1	3	3	3	-	1	1	1
47 Fishing area total	*3*	*3*	*1*	*3*	*3*	*3*	-	*1*	*1*	*1*
51 Bahrain	1 377	1 675	2 169	1 821	146	502	291	251	159	212
Djibouti	70 F	80 F	90 F	100 F	109	126	139	112	126	126 F
Egypt	2 696	3 513	3 176	2 858	1 994	2 592	2 551	2 326	2 072	2 854
Eritrea	345	164	70	98	20	165	83	80	105	61
France	-	-	-	-	-	-	-	-	10	2
Jordan	2	1	1	1	2	1	2	3	9	7
Kenya	466	414	421	434	412	477	431	499	447	641
Korea Rep	459	-	-	-	-	-	-	-	-	-
Kuwait	78	77 F	76	94	107	95	92	58	70 F	70 F
Mauritius	4 008	4 078	3 955	3 374	2 534	2 969	2 962	3 022	3 454	3 032
Oman	6 526	7 179	8 010	10 300	9 235	8 149	8 577	8 954	11 306	10 791
Pakistan	5 044	5 100	2 626	1 941	1 849	1 623	1 457	1 467	1 546	1 584
Qatar	1 820	1 512	3 421	3 748	4 200	5 466	4 119	5 038	4 700	4 105
Saudi Arabia	4 139	4 187	4 260	4 459	4 396	4 011	4 503	4 113	4 386	4 224
Seychelles	483	336	234	258	227	168	189	340	218	97
South Africa	-	1	0	0	0	-	-	-	-	-
Tanzania	7 850	7 800	7 500	8 000	7 000	1 071	3 932	3 664	3 060	4 359
Untd Arab Em	22 619	21 056	20 310	20 200 F	20 110	20 750 F	21 400 F	22 040	24 806	22 750
Yemen	1 460 F	1 900 F	2 000 F	2 150 F	2 070 F	2 570 F	2 750 F	2 611	3 730 F	4 850 F
Zanzibar	2 178	1 958	1 411	1 698	1 814	1 816	2 496	2 565	2 667	2 684
51 Fishing area total	*61 620 F*	*61 031 F*	*59 730 F*	*61 534 F*	*56 225 F*	*52 551 F*	*55 974 F*	*57 143*	*62 871 F*	*62 449 F*
57 Indonesia	6 115	6 892	8 059	5 089	6 466	6 579	7 783	8 038	7 612	6 811
Malaysia	...	...	...	78	...	...	...	82	136	166
57 Fishing area total	*6 115*	*6 892*	*8 059*	*5 167*	*6 466*	*6 579*	*7 783*	*8 120*	*7 748*	*6 977*
71 Fiji	2 883	1 800 F	513	986	1 150 F	1 320	1 575	980	800	700
Guam	30	19	14	11	8	6	10	6	11	1
Indonesia	23 460	23 108	23 309	17 462	18 627	24 228	33 541	29 715	29 940	36 105
Kiribati	3 930	1 363	2 925	2 800 F	2 700 F	2 600 F	2 549	377	148	118 F
Malaysia	...	...	...	322	...	...	...	521	1 024	1 219
N Marianas	8	3	4	9	8	2	5	5	5	5
Palau	9	4	4	2	1	2	...	6	6 F	6 F
71 Fishing area total	*30 320*	*26 297 F*	*26 769*	*21 592 F*	*22 494 F*	*28 158 F*	*37 680*	*31 610*	*31 934 F*	*38 154 F*
77 Amer Samoa	6	6	2	2	0	0	3	6	9	2
USA	...	1	2	1	1	1	2	1	2	3
77 Fishing area total	*6*	*7*	*4*	*3*	*1*	*1*	*5*	*7*	*11*	*5*
Species total	*98 064 F*	*94 230 F*	*94 563 F*	*88 299 F*	*85 189 F*	*87 292 F*	*101 442 F*	*96 881*	*102 565 F*	*107 586 F*
Blackspot(=red) seabream	**Dorade rose**		**Besugo**		***Pagellus bogaraveo***				**1,70(39)008,01**	**SBR**
27 France	13	32	36	77	51	57	96	41	65	103
Germany	-	-	55	-	-	-	-	-	-	-
Ireland	-	-	-	-	-	-	0	0	-	-
Netherlands	2	4	5	15	32	34	17	21	15	-
Portugal	1 116	1 306	1 227	1 289	1 591	1 108	1 284	1 269	1 183	803
Spain	94	246	205	153	454	302	285	246	172	252
UK	38	41	20	16	2	-	4	13	13	14
27 Fishing area total	*1 263*	*1 629*	*1 548*	*1 550*	*2 130*	*1 501*	*1 686*	*1 590*	*1 448*	*1 172*
34 Netherlands	-	7	-	-	-	-	-	-	-	-
Portugal	12	6	4	7	4	2	5	2	1	1
Spain	...	...	...	...	109	-	-	-	-	-
34 Fishing area total	*12*	*13*	*4*	*7*	*113*	*2*	*5*	*2*	*1*	*1*
37 Cyprus	-	-	-	-	6	7	4	1	0	1
France	38	51	51	44	12	7	2	13	29	78
Malta	-	-	-	-	-	-	-	-	1	-
37 Fishing area total	*38*	*51*	*51*	*44*	*18*	*14*	*6*	*14*	*30*	*79*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*1 313*	*1 693*	*1 603*	*1 601*	*2 261*	*1 517*	*1 697*	*1 606*	*1 479*	*1 252*
Common pandora	**Pageot commun**		**Breca**		***Pagellus erythrinus***				**1,70(39)008,02**	**PAC**
27 France	3	2	1	-	18	10	9	3	14	5
Portugal	128	142	103	92	99	128	152	127	86	109
27 Fishing area total	*131*	*144*	*104*	*92*	*117*	*138*	*161*	*130*	*100*	*114*
34 Morocco	8 602	9 290	7 627	4 697	2 983	4 368	568	383	608	1 274
Portugal	-	-	-	0	-	0	-	-	-	-
34 Fishing area total	*8 602*	*9 290*	*7 627*	*4 697*	*2 983*	*4 368*	*568*	*383*	*608*	*1 274*
37 Algeria	1 339	1 515	2 082	1 361	1 494	1 206	973	951	588	547
Croatia	...	...	...	...	...	...	...	...	80	204
Cyprus	34	31	21	17	19	19	31	24	16	15
France	94	108	119	115	107	129	109	151	129	127
Israel	...	...	...	...	...	...	...	45 F	43	40
Libya	...	...	...	...	...	...	872	1 584	7 200	6 950 F
Malta	2	2	3	1	1	3	7	9	11	20
Morocco	71	72	164	216	197	96	97	128	176	624
Slovenia	7	8	3	4	4	4	5	6	5	6
Spain	229	514	535	607	625	748	802	865	913	917
Tunisia	3 219	2 687	2 823	2 937	2 779	2 439	2 517	2 857	3 312	3 861
37 Fishing area total	*4 995*	*4 937*	*5 750*	*5 258*	*5 226*	*4 644*	*5 413*	*6 620 F*	*12 473*	*13 311 F*
Species total	*13 728*	*14 371*	*13 481*	*10 047*	*8 326*	*9 150*	*6 142*	*7 133 F*	*13 181*	*14 699 F*
Axillary seabream	**Pageot acarne**		**Aligote**		***Pagellus acarne***				**1,70(39)008,03**	**SBA**
27 France	12	11	29	18	21	19	22	7	47	33
Portugal	1 201	1 129	1 129	846	710	1 051	1 166	787	977	1 041
27 Fishing area total	*1 213*	*1 140*	*1 158*	*864*	*731*	*1 070*	*1 188*	*794*	*1 024*	*1 074*
34 Morocco	...	...	...	...	...	...	...	...	...	1 315
Netherlands	-	-	-	-	-	-	-	11	-	-
Portugal	1	1	1	1	1	2	1	1	-	4
34 Fishing area total	*1*	*1*	*1*	*1*	*1*	*2*	*1*	*12*	*...*	*1 319*
37 Cyprus	20	19	25	14	4	5	10	24	15	16
France	186	238	203	149	121	126	85	127	179	128
Malta	-	-	-	-	2	3	4	2	2	7
37 Fishing area total	*206*	*257*	*228*	*163*	*127*	*134*	*99*	*153*	*196*	*151*
Species total	*1 420*	*1 398*	*1 387*	*1 028*	*859*	*1 206*	*1 288*	*959*	*1 220*	*2 544*
Red pandora	**Pageot à tache rouge**		**Breca chata**		***Pagellus bellottii***				**1,70(39)008,07**	**PAR**
34 Congo Rep	6 F	100 F	231	138	103	276	389	104	100	381
Ghana	3 206	3 132	3 458	4 922	8 729	7 820	9 106	6 429	3 899	4 832
Morocco	...	...	...	...	...	...	...	...	...	25
Portugal	-	-	-	-	-	-	-	-	2	-
Senegal	3 932	3 812	4 079	2 103	2 022	3 034	2 357	3 492	4 928	3 954
Togo	45	31	40	25	25	5	6	13 F	20	10
34 Fishing area total	*7 189 F*	*7 075 F*	*7 808*	*7 188*	*10 879*	*11 135*	*11 858*	*10 038 F*	*8 949*	*9 202*
Species total	*7 189 F*	*7 075 F*	*7 808*	*7 188*	*10 879*	*11 135*	*11 858*	*10 038 F*	*8 949*	*9 202*
Pandoras nei	**Pageots nca**		**Brecas nep**		***Pagellus spp***				**1,70(39)008,XX**	**PAX**
34 Benin	...	1	7	31	149	16	13	42	355	60
Côte dIvoire	697	819	705	536	456	288	134	120 F	105	197
Gabon	274	444	103	100	37	27	103	66	45 F	45 F
Gambia	...	8	...	234	84	...	457	12	12	...
Greece	602	196	99	46	10	56	45	7	5	5 F
Mauritania	...	...	...	...	...	...	...	...	...	74
Morocco	...	...	...	...	...	...	...	...	...	1 829
Sao Tome Prn	80 F	105 F	135	187	190 F	190 F	190 F	190 F	195 F	200 F
Spain	101	196	305	323	472	475	455	351	512	653
Togo	75	17	9	22	25	47	2	15 F	25	21
Ukraine	15	274	-	-	-	-	-	-	-	-
34 Fishing area total	*1 844 F*	*2 060 F*	*1 363*	*1 479*	*1 423 F*	*1 099 F*	*1 399 F*	*803 F*	*1 254 F*	*3 084 F*
37 Albania	15	26	13	20	3	30	25	54	39	23
Greece	335	367	473	384	491	592	543	529	572	572 F
Italy	949	800	743	964	2 198	2 291	2 234	1 562	1 477	1 369
Spain	1 955	1 772	1 129	997	825	791	813	780	1 375	1 189
Syria	85	100	91	110	109	131	85	74	65	84
37 Fishing area total	*3 339*	*3 065*	*2 449*	*2 475*	*3 626*	*3 835*	*3 700*	*2 999*	*3 528*	*3 237 F*
51 Spain	-	1	1	-	-	-	-	-	-	-
51 Fishing area total	*...*	*1*	*1*	*...*	*...*	*...*	*...*	*...*	*...*	*...*
Species total	*5 183 F*	*5 126 F*	*3 813*	*3 954*	*5 049 F*	*4 934 F*	*5 099 F*	*3 802 F*	*4 782 F*	*6 321 F*
South American silver porgy	**...B**		**Sargo de América del Sur**		***Diplodus argenteus***				**1,70(39)033,01**	**DIG**
41 Argentina	2	1	2	7	7	18	18	21	9	17
Uruguay	23	3	6	3	12	14	8	61	5	9
41 Fishing area total	*25*	*4*	*8*	*10*	*19*	*32*	*26*	*82*	*14*	*26*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*25*	*4*	*8*	*10*	*19*	*32*	*26*	*82*	*14*	*26*
Annular seabream	**Sparaillon commun**		**Raspallón**		***Diplodus annularis***				**1,70(39)033,02**	**ANN**
27 Portugal	17	19	20	35	49	47	23	56	45	31
27 Fishing area total	*17*	*19*	*20*	*35*	*49*	*47*	*23*	*56*	*45*	*31*
37 Egypt	...	...	25	854	384	882	1 431	1 792	1 479	1 937
37 Fishing area total	*...*	*...*	*25*	*854*	*384*	*882*	*1 431*	*1 792*	*1 479*	*1 937*
Species total	*17*	*19*	*45*	*889*	*433*	*929*	*1 454*	*1 848*	*1 524*	*1 968*
White seabream	**Sar commun**		**Sargo**		***Diplodus sargus***				**1,70(39)033,03**	**SWA**
27 France	51	79	85	139	131	147	236	136	193	333
Portugal	69	59	54	77	105	209	280	225	258	339
Spain	...	...	...	236	318	410	498	561	705	606
27 Fishing area total	*120*	*138*	*139*	*452*	*554*	*766*	*1 014*	*922*	*1 156*	*1 278*
34 Lithuania	...	...	...	...	...	...	...	...	...	9
Netherlands	-	-	-	-	-	-	-	3	1	-
34 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*3*	*1*	*9*
37 Algeria	...	...	...	...	...	...	22	35	94	30
Croatia	...	...	...	...	...	...	...	...	3	3
Egypt	793	447	455	536	699	974	740	874	845	875
Greece	347	285	294	253	389	256	202	185	204	204 F
Libya	...	...	...	...	...	...	...	...	900	870 F
Portugal	-	-	-	4	-	-	-	-	-	-
Spain	182	548	257	440	388	408	393	453	527	486
Syria	60	129	102	124	150	116	94	104	92	85
37 Fishing area total	*1 382*	*1 409*	*1 108*	*1 357*	*1 626*	*1 754*	*1 451*	*1 651*	*2 665*	*2 553 F*
47 Namibia	20	...	1	2	1	-	-	-	-	-
47 Fishing area total	*20*	*...*	*1*	*2*	*1*	-	-	-	-	-
Species total	*1 522*	*1 547*	*1 248*	*1 811*	*2 181*	*2 520*	*2 465*	*2 576*	*3 822*	*3 840 F*
Common two-banded seabream	**Sar à tête noire**		**Sargo mojarra**		***Diplodus vulgaris***				**1,70(39)033,05**	**CTB**
27 Portugal	479	562	625	530	440	450	435	417	490	457
27 Fishing area total	*479*	*562*	*625*	*530*	*440*	*450*	*435*	*417*	*490*	*457*
Species total	*479*	*562*	*625*	*530*	*440*	*450*	*435*	*417*	*490*	*457*
Sargo breams nei	**Sars, sparaillons nca**		**Sargos, raspallones nep**		***Diplodus spp***				**1,70(39)033,XX**	**SRG**
27 Portugal	228	255	250	253	214	179	182	128	90	73
Spain	-	-	-	113	132	350	142	136	176	175
27 Fishing area total	*228*	*255*	*250*	*366*	*346*	*529*	*324*	*264*	*266*	*248*
34 Greece	88	50	11	2	3	6	3	-	-	-
Latvia	176	135	163	8	27	263	138	-	1	-
Mauritania	278	286	270 F	250 F	230 F	120 F	160 F	140 F	160 F	237
Morocco	1 089	1 457	2 316	2 247	1 669	1 583	1 306	1 641	1 575	2 177
Portugal	2	4	6	2	12	15	4	-	-	5
Senegal	453	313	551	648	209	586	458	458	847	920
Spain	98	7	9	12	37	43	50	91	137	181
34 Fishing area total	*2 184*	*2 252*	*3 326 F*	*3 169 F*	*2 187 F*	*2 616 F*	*2 119 F*	*2 330 F*	*2 720 F*	*3 520*
37 Bulgaria	90	-	-	-	-	-	-	-	-	-
Croatia	...	...	...	...	...	...	...	...	25	31
Cyprus	...	...	44	26	33	57	42	48	22	25
France	83	84	96	72	81	100	80	79	81	114
Italy	462	475	414	446	1 644	1 484	879	703	807	754
Malta	2	3	4	2	2	3	11	10	8	12
Morocco	20	22	68	134	60	103	38	88	106	129
Palest, O.T.	15 F	16	22	12	22	10	7	14	10	13
Slovenia	2	3	1	2	3	2	2	2	-	-
Tunisia	3 241	3 226	409	437	373	334	344	347	352	371
Turkey	655	751	575	507	719	737	545	578	735	968
37 Fishing area total	*4 570 F*	*4 580*	*1 633*	*1 638*	*2 937*	*2 830*	*1 948*	*1 869*	*2 146*	*2 417*
47 Portugal	4	-	-	2	-	-	-	-	-	-
47 Fishing area total	*4*	-	-	*2*	-	-	-	-	-	-
Species total	*6 986 F*	*7 087*	*5 209 F*	*5 175 F*	*5 470 F*	*5 975 F*	*4 391 F*	*4 463 F*	*5 132 F*	*6 185*
Porgies	**Daubenets**		**Plumas**		***Calamus spp***				**1,70(39)034,XX**	**PRG**
31 Cuba	310	301	347	311	234	241	266	189	216	228
Dominican Rp	10	29	126	124	104	156	15	85	77	83
Mexico	214	121	228	223	179	187	135	65	68	24
31 Fishing area total	*534*	*451*	*701*	*658*	*517*	*584*	*416*	*339*	*361*	*335*
88 New Zealand	-	-	-	-	-	-	-	0	-	-
88 Fishing area total	-	-	-	-	-	-	-	*0*	-	-

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*534*	*451*	*701*	*658*	*517*	*584*	*416*	*339*	*361*	*335*
Large-eye dentex	**Denté à gros yeux**		**Cachucho**		***Dentex macrophthalmus***				**1,70(39)060,02**	**DEL**
27 Portugal	0	1	1	1	1	2	1	-	-	-
27 Fishing area total	*0*	*1*	*1*	*1*	*1*	*2*	*1*	-	-	-
34 Greece	12	14	-	4	-	-	-	-	-	-
Latvia	71	29	34	35	31	22	-	-	-	-
Portugal	0	-	0	15	7	-	-	-	13	55
Russian Fed	374	899	77	16	812	1 023	613	222	388	13
Senegal	499	249	219	108	157	187	286	496	813	898
Ukraine	165	46	50	5	-	-	-	-	24	-
34 Fishing area total	*1 121*	*1 237*	*380*	*183*	*1 007*	*1 232*	*899*	*718*	*1 238*	*966*
37 Greece	318	347	357	485	456	550	615	456	467	467 F
Turkey	...	...	...	...	...	...	97	143	98	91
37 Fishing area total	*318*	*347*	*357*	*485*	*456*	*550*	*712*	*599*	*565*	*558 F*
47 Namibia	182	171	104	61	48	106	29	...	...	...
Poland	-	-	-	18	2	-	-	-	-	-
Portugal	-	-	-	-	11	3	11	29	56	21
Russian Fed	807	66	461	-	-	-	-	-	-	-
Ukraine	55	-	-	-	-	-	-	-	-	-
47 Fishing area total	*1 044*	*237*	*565*	*79*	*61*	*109*	*40*	*29*	*56*	*21*
Species total	*2 483*	*1 822*	*1 303*	*748*	*1 525*	*1 893*	*1 652*	*1 346*	*1 859*	*1 545 F*
Common dentex	**Denté commun**		**Dentón**		***Dentex dentex***				**1,70(39)060,06**	**DEC**
27 Portugal	16	9	12	5	5	4	6	7	6	9
27 Fishing area total	*16*	*9*	*12*	*5*	*5*	*4*	*6*	*7*	*6*	*9*
34 Greece	317	444	278	230	92	172	131	26	11	11 F
Latvia	19	29	31	186	471	48	16	26	15	-
Portugal	-	1	0	-	-	-	-	-	-	-
34 Fishing area total	*336*	*474*	*309*	*416*	*563*	*220*	*147*	*52*	*26*	*11 F*
37 Albania	26	80	4	5	25	40	27	32	43	25
Croatia	10	7	16	6	6	12	13	...	16	20
Cyprus	19	16	16	12	10	8	7	12	7	11
France	1	0	-	1	0	0	1	1	20	20
Greece	163	170	203	254	251	234	258	243	261	261 F
Italy	201	207	251	232	261	220	288	195	189	186
Libya	...	...	...	...	...	...	783	1 373	585	570 F
Malta	1	2	1	1	1	1	5	4	4	7
Montenegro	...	...	...	...	...	8	9	10	4	5
Serbia-Monte	11	10	11	9	8	-	-	-	-	-
Spain	56	44	53	70	62	73	87	106	117	123
Tunisia	219	216	223	225	205	176	168	172	155	157
Turkey	60	79	90	106	136	242	106	146	165	170
37 Fishing area total	*767*	*831*	*868*	*921*	*965*	*1 014*	*1 752*	*2 294*	*1 566*	*1 555 F*
Species total	*1 119*	*1 314*	*1 189*	*1 342*	*1 533*	*1 238*	*1 905*	*2 353*	*1 598*	*1 575 F*
Angolan dentex	**Denté angolais**		**Dentón angoleño**		***Dentex angolensis***				**1,70(39)060,10**	**DEA**
34 Ghana	838	990	659	1 975	2 905	3 151	2 488	2 780	1 198	1 499
34 Fishing area total	*838*	*990*	*659*	*1 975*	*2 905*	*3 151*	*2 488*	*2 780*	*1 198*	*1 499*
Species total	*838*	*990*	*659*	*1 975*	*2 905*	*3 151*	*2 488*	*2 780*	*1 198*	*1 499*
Congo dentex	**Denté congolais**		**Dentón congolés**		***Dentex congoensis***				**1,70(39)060,11**	**DNC**
34 Ghana	571	445	287	...	1 080	664	559	538	123	73
34 Fishing area total	*571*	*445*	*287*	*...*	*1 080*	*664*	*559*	*538*	*123*	*73*
Species total	*571*	*445*	*287*	*...*	*1 080*	*664*	*559*	*538*	*123*	*73*
Dentex nei	**Dentés nca**		**Dentones, samas, etc. nep**		***Dentex spp***				**1,70(39)060,XX**	**DEX**
27 Portugal	1	1	1	1	1	5	7	8	10	7
Spain	182	231	193	113	85	64	104	101	108	171
27 Fishing area total	*183*	*232*	*194*	*114*	*86*	*69*	*111*	*109*	*118*	*178*
34 Benin	20	19	60	63	60	68	54	237	...	...
Bulgaria	10	-	-	-	-	-	-	-	-	-
Congo Rep	90 F	270 F	461	504	377	808	1 212	494	839	1 230
Gabon	498	556	570	660	591	463	646	161	110 F	110 F
Ghana	675	965	605	1 056	2 623	2 400	2 100	1 666	344	618
Liberia	...	...	...	...	...	...	1 260	481	480 F	480 F
Lithuania	-	121	104	111	1 016	684	105	131	433	65
Mauritania	...	...	...	...	...	...	...	...	...	366
Portugal	1	2	1	6	-	0	3	12	10	13
Senegal	833	884	1 081	198	135	157	159	299	219	265
Spain	687	937	1 891	690	853	1 286	780	927	1 014	1 237
Togo	...	...	...	...	0	18	6	20 F	30	40
34 Fishing area total	*2 814 F*	*3 754 F*	*4 773*	*3 288*	*5 655*	*5 884*	*6 325*	*4 428 F*	*3 479 F*	*4 424 F*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
47 Angola	16 080	8 948	18 186	17 879	18 000 F	22 660	22 098	26 156	33 802	32 000 F
Spain	-	-	-	-	-	-	-	-	96	211
47 Fishing area total	*16 080*	*8 948*	*18 186*	*17 879*	*18 000 F*	*22 660*	*22 098*	*26 156*	*33 898*	*32 211 F*
Species total	*19 077 F*	*12 934 F*	*23 153*	*21 281*	*23 741 F*	*28 613*	*28 534*	*30 693 F*	*37 495 F*	*36 813 F*
Black seabream	**Dorade grise**		**Chopa**		***Spondyliosoma cantharus***				**1,70(39)063,02**	**BRB**
27 France	2 784	3 192	3 038	3 083	3 139	3 628	4 510	2 235	4 253	4 314
Germany	-	-	-	-	-	5	-	-	-	-
Netherlands	-	1	6	189	121	140	462	547	453	-
Portugal	158	224	242	239	212	235	216	207	232	252
Spain	...	...	...	82	108	130	205	203	224	301
UK	202	294	245	388	182	211	285	211	377	365
27 Fishing area total	*3 144*	*3 711*	*3 531*	*3 981*	*3 762*	*4 349*	*5 678*	*3 403*	*5 539*	*5 232*
34 Benin	93	147	179	223	...	...	...	2	23	4
Greece	6	5	3	1	-	1	1	-	-	-
Liberia	10	10	10	12	37	18	...	0	0	0
Morocco	302	379	714	1 024	860	968	720	1 002	1 109	940
Netherlands	-	-	-	-	-	12	-	22	4	4
Portugal	0	1	0	0	-	0	-	-	4	17
Senegal	1 035	1 254	1 320	1 692	1 421	1 242	808	1 059	3 357	2 803
Spain	-	47	29	47	102	89	119	131	168	116
Togo	12	15	13	...	-	-	-	-	-	-
UK	-	-	-	-	-	-	-	-	5	-
34 Fishing area total	*1 458*	*1 858*	*2 268*	*2 999*	*2 420*	*2 330*	*1 648*	*2 216*	*4 670*	*3 884*
37 Croatia	5	3	2	2	5	6	10	...	9	8
France	15	21	15	16	12	7	9	10	11	12
Greece	132	195	208	118	96	109	98	92	118	118 F
Italy	...	...	...	...	334	425	179	118	116	73
Malta	...	...	...	...	...	...	0	0	0	2
Morocco	35	36	19	8	13	20	8	7	6	3
Serbia-Monte	4	4	4	4	...	-	-	-	-	-
Spain	23	129	57	19	45	47	54	52	60	40
Turkey	45	40	76	70	109	320	71	30	30	38
37 Fishing area total	*259*	*428*	*381*	*237*	*614*	*934*	*429*	*309*	*350*	*294 F*
47 Angola	494	13	1	1 065	300 F	...	211	195	26	25 F
UK	-	-	-	-	-	-	1	-	-	-
47 Fishing area total	*494*	*13*	*1*	*1 065*	*300 F*	*...*	*212*	*195*	*26*	*25 F*
Species total	*5 355*	*6 010*	*6 181*	*8 282*	*7 096 F*	*7 613*	*7 967*	*6 123*	*10 585*	*9 435 F*
Saddled seabream	**Oblade**		**Oblada**		***Oblada melanura***				**1,70(39)076,01**	**SBS**
01 Egypt	70	77	53	53	56	95	77	...	...	47
01 Fishing area total	*70*	*77*	*53*	*53*	*56*	*95*	*77*	*...*	*...*	*47*
27 France	2	-	-	6	18	24	1	1	9	10
Spain	...	...	...	66	75	494	192	194	181	233
27 Fishing area total	*2*	*...*	*...*	*72*	*93*	*518*	*193*	*195*	*190*	*243*
34 Portugal	0	0	2	1	-	0	1	1	-	-
34 Fishing area total	*0*	*0*	*2*	*1*	*-*	*0*	*1*	*1*	*-*	*-*
37 Algeria	...	...	...	...	...	...	3	13	46	20
Croatia	55	30	14	41	75	77	82	58	64	66
Cyprus	11	14	11	3	7	5	7	4	5	5
France	8	8	4	5	2	4	5	2	4	3
Greece	287	306	391	397	395	381	354	392	382	382 F
Italy	...	...	...	...	590	449	579	256	295	266
Libya	...	...	...	...	...	...	311	507	450	440 F
Malta	1	1	1	1	1	2	2	3	3	18
Serbia-Monte	6	6	6	4	...	-	-	-	-	-
Spain	81	56	75	62	92	52	59	94	110	69
Tunisia	51	53	58	32	144	53	48	42	61	57
Turkey	90	130	150	138	142	332	169	128	241	243
37 Fishing area total	*590*	*604*	*710*	*683*	*1 448*	*1 355*	*1 619*	*1 499*	*1 661*	*1 569 F*
Species total	*662*	*681*	*765*	*809*	*1 597*	*1 968*	*1 890*	*1 695*	*1 851*	*1 859 F*
Sheepshead	**Rondeau mouton**		**Sargo chopa**		***Archosargus probatocephalus***				**1,70(39)102,01**	**SPH**
21 USA	19	20	22	32	19	19	31	25	51	59
21 Fishing area total	*19*	*20*	*22*	*32*	*19*	*19*	*31*	*25*	*51*	*59*
31 USA	1 195	1 091	1 075	971	768	526	715	757	774	692
31 Fishing area total	*1 195*	*1 091*	*1 075*	*971*	*768*	*526*	*715*	*757*	*774*	*692*
Species total	*1 214*	*1 111*	*1 097*	*1 003*	*787*	*545*	*746*	*782*	*825*	*751*
Western Atlantic seabream	**Rondeau brème**		**Sargo amarillo**		***Archosargus rhomboidalis***				**1,70(39)102,02**	**AVB**
31 Dominican Rp	...	53	115	...	...	...	...	25	23	25
31 Fishing area total	*...*	*53*	*115*	*...*	*...*	*...*	*...*	*25*	*23*	*25*
Species total	*...*	*53*	*115*	*...*	*...*	*...*	*...*	*25*	*23*	*25*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
King soldier bream	**Spare royal**		**Sargo real**		***Argyrops spinifer***				**1,70(39)105,01**	**KBR**
51 Egypt	-	-	462	1 554	584	629	821	210	385	323
Qatar	426	327	560	619	626	1 030	1 158	1 171	631	535
Saudi Arabia	1 754	1 430	2 021	1 665	2 006	2 114	1 833	1 917	1 542	1 760
Untd Arab Em	4 149	4 797	5 906	5 850 F	5 810	5 000 F	4 240 F	3 443	3 598	3 121
51 Fishing area total	*6 329*	*6 554*	*8 949*	*9 688 F*	*9 026*	*8 773 F*	*8 052 F*	*6 741*	*6 156*	*5 739*
Species total	*6 329*	*6 554*	*8 949*	*9 688 F*	*9 026*	*8 773 F*	*8 052 F*	*6 741*	*6 156*	*5 739*
Carpenter seabream	**Denté charpentier**		**Dentón carpintero**		***Argyrozona argyrozona***				**1,70(39)107,01**	**SLF**
47 South Africa	287	249	253	272	276	204	294	250	323	345
47 Fishing area total	*287*	*249*	*253*	*272*	*276*	*204*	*294*	*250*	*323*	*345*
Species total	*287*	*249*	*253*	*272*	*276*	*204*	*294*	*250*	*323*	*345*
Santer seabream	**Denté nufar**		**Dentón nufar**		***Cheimerius nufar***				**1,70(39)118,02**	**SLD**
47 South Africa	25	15	17	29	28	21	34	33	19	28
47 Fishing area total	*25*	*15*	*17*	*29*	*28*	*21*	*34*	*33*	*19*	*28*
51 Bahrain	...	...	...	55	37	54	87	76	16	8
South Africa	...	31	28	56	56	55	42	50	42	43
51 Fishing area total	*...*	*31*	*28*	*111*	*93*	*109*	*129*	*126*	*58*	*51*
Species total	*25*	*46*	*45*	*140*	*121*	*130*	*163*	*159*	*77*	*79*
Black musselcracker	**Spare nasique**		**Sargo narigón**		***Cymatoceps nasutus***				**1,70(39)126,01**	**CYM**
47 South Africa	...	1	1	2	2	3	3	3	4	2
47 Fishing area total	*...*	*1*	*1*	*2*	*2*	*3*	*3*	*3*	*4*	*2*
51 South Africa	...	-	1	1	1	1	1	3	3	2
51 Fishing area total	*...*	*-*	*1*	*1*	*1*	*1*	*1*	*3*	*3*	*2*
Species total	*...*	*1*	*2*	*3*	*3*	*4*	*4*	*6*	*7*	*4*
Red porgy	**Pagre rouge**		**Pargo**		***Pagrus pagrus***				**1,70(39)191,03**	**RPG**
21 USA	-	-	-	0	2	0	0	0	0	4
21 Fishing area total	*-*	*-*	*-*	*0*	*2*	*0*	*0*	*0*	*0*	*4*
27 France	1	-	3	3	5	12	8	4	13	10
Portugal	243	113	228	186	120	155	192	186	167	172
Spain	100	87	90	173	114	116	103	109	90	114
27 Fishing area total	*344*	*200*	*321*	*362*	*239*	*283*	*303*	*299*	*270*	*296*
31 USA	4	5	-	5	6	6	9	11	255	208
31 Fishing area total	*4*	*5*	*-*	*5*	*6*	*6*	*9*	*11*	*255*	*208*
34 Greece	820	750	692	607	349	320	198	27	24	24 F
Portugal	26	22	22	20	21	19	19	16	14	13
34 Fishing area total	*846*	*772*	*714*	*627*	*370*	*339*	*217*	*43*	*38*	*37 F*
37 Algeria	...	...	...	...	...	...	518	529	409	237
Croatia	...	...	...	...	...	...	...	...	5	5
Cyprus	21	15	16	11	18	21	21	18	12	10
Egypt	575	1 231	758	906	1 553	2 058	2 072	2 738	2 801	3 183
Greece	319	249	251	262	312	368	411	447	479	479 F
Malta	4	4	7	7	6	9	9	8	9	15
Palest, O.T.	5 F	4	3	1	7	8	12	7	19	14
Spain	81	147	166	171	148	197	175	164	188	150
Tunisia	416	400	427	478	504	486	405	337	279	297
Turkey	320	403	550	551	541	1 021	689	634	724	742
37 Fishing area total	*1 741 F*	*2 453*	*2 178*	*2 387*	*3 089*	*4 168*	*4 312*	*4 882*	*4 925*	*5 132 F*
41 Argentina	935	904	1 822	2 298	2 802	4 747	4 302	6 574	7 102	5 869
Brazil	1 443	1 735	1 850	2 086	2 235	2 318	2 051	2 139	2 360	2 229
Uruguay	7	8	28	58	250	36	206	623	505	241
41 Fishing area total	*2 385*	*2 647*	*3 700*	*4 442*	*5 287*	*7 101*	*6 559*	*9 336*	*9 967*	*8 339*
Species total	*5 320 F*	*6 077*	*6 913*	*7 823*	*8 993*	*11 897*	*11 400*	*14 571*	*15 455*	*14 016 F*
Silver seabream	**Dorade**		**Dorada del Pacífico**		***Pagrus auratus***				**1,70(39)191,15**	**GSU**
57 Australia	3 391	3 453	3 987	3 379	2 673	2 748	2 563	1 869	1 602	1 119
57 Fishing area total	*3 391*	*3 453*	*3 987*	*3 379*	*2 673*	*2 748*	*2 563*	*1 869*	*1 602*	*1 119*
61 China,Taiwan	6 722	6 737	5 520	5 393	5 022	3 295	1 648	1 538	1 370	1 137
Japan	14 633	15 527	14 541	14 527	14 635	15 827	15 609	15 723	15 725	15 100 F
Korea Rep	913	1 084	756	518	513	502	686	-	-	-
61 Fishing area total	*22 268*	*23 348*	*20 817*	*20 438*	*20 170*	*19 624*	*17 943*	*17 261*	*17 095*	*16 237 F*
71 Australia	395	353	357	391	491	518	513	554	465	395
71 Fishing area total	*395*	*353*	*357*	*391*	*491*	*518*	*513*	*554*	*465*	*395*
81 Australia	811	573	492	328	413	296	215	145	201	234

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
New Zealand	6 209	6 571	6 515	6 348	7 062	6 372	5 919	6 469	6 300	6 240
Ukraine	-	3	30	64	...	11	...	...	...	...
81 Fishing area total	*7 020*	*7 147*	*7 037*	*6 740*	*7 475*	*6 679*	*6 134*	*6 614*	*6 501*	*6 474*
Species total	*33 074*	*34 301*	*32 198*	*30 948*	*30 809*	*29 569*	*27 153*	*26 298*	*25 663*	*24 225 F*
Pargo breams nei	**Dorades nca**		**Pargos nep**		***Pagrus spp***				**1,70(39)191,XX**	**SBP**
34 Benin	...	...	...	...	17	0	0	0	0	0
Ghana	2 189	2 624	2 266	461	556	169	650	3 742	458	769
Greece	-	7	1	-	-	-	-	-	-	-
Morocco	154	46	53	68	1 016	1 101	241	1 333	1 276	1 300
Portugal	23	11	129	20	1	3	0	-	-	-
Senegal	2 488	1 419	1 160	180	737	1 103	1 380	2 662	3 353	3 310
Spain	141	5	50	202	185	185	124	137	179	226
Togo	...	...	...	...	...	...	2	2 F	1	1
34 Fishing area total	*4 995*	*4 112*	*3 659*	*931*	*2 512*	*2 561*	*2 397*	*7 876 F*	*5 267*	*5 606*
37 Algeria	267	394	283	363	365	373	398	427	387	199
Greece	326	263	219	319	207	308	353	246	251	251 F
Israel	...	...	...	...	...	...	...	...	68	47
Morocco	1	1	1	0	0	1	0	24	32	34
Syria	77	112	75	60	58	36	36	62	52	24
37 Fishing area total	*671*	*770*	*578*	*742*	*630*	*718*	*787*	*759*	*790*	*555 F*
47 Angola	4 484	5 773	3 932	3 616	3 700 F	4 616	1 671	1 085	977	940 F
Portugal	122	-	79	-	247	-	0	2	-	-
47 Fishing area total	*4 606*	*5 773*	*4 011*	*3 616*	*3 947 F*	*4 616*	*1 671*	*1 087*	*977*	*940 F*
Species total	*10 272*	*10 655*	*8 248*	*5 289*	*7 089 F*	*7 895*	*4 855*	*9 722 F*	*7 034*	*7 101 F*
Red steenbras	**Denté du Cap**		**Dentón del Cabo**		***Petrus rupestris***				**1,70(39)203,01**	**RER**
47 South Africa	7	6	3	3	3	4	8	3	5	3
47 Fishing area total	*7*	*6*	*3*	*3*	*3*	*4*	*8*	*3*	*5*	*3*
51 South Africa	-	-	-	0	0	-	-	-	-	-
51 Fishing area total	*-*	*-*	*-*	*0*	*0*	*-*	*-*	*-*	*-*	*-*
Species total	*7*	*6*	*3*	*3*	*3*	*4*	*8*	*3*	*5*	*3*
Panga seabream	**Spare panga**		**Sargo panga**		***Pterogymnus laniarius***				**1,70(39)220,01**	**PGA**
47 Namibia	5 898	2 621	2 551	2 706	1 952	1 785	1 333	748	684	700 F
South Africa	1 058	1 177	1 350	1 257	1 096	971	972	1 132	1 499	1 549
47 Fishing area total	*6 956*	*3 798*	*3 901*	*3 963*	*3 048*	*2 756*	*2 305*	*1 880*	*2 183*	*2 249 F*
Species total	*6 956*	*3 798*	*3 901*	*3 963*	*3 048*	*2 756*	*2 305*	*1 880*	*2 183*	*2 249 F*
White stumpnose	**Sargue australe**		**Pargo ñato**		***Rhabdosargus globiceps***				**1,70(39)224,01**	**WSN**
47 South Africa	169	107	158	113	123	111	24	51	50	78
47 Fishing area total	*169*	*107*	*158*	*113*	*123*	*111*	*24*	*51*	*50*	*78*
Species total	*169*	*107*	*158*	*113*	*123*	*111*	*24*	*51*	*50*	*78*
Haffara seabream	**Sargue haffara**		**Sargo hafará**		***Rhabdosargus haffara***				**1,70(39)224,06**	**RXS**
51 Bahrain	...	...	...	181	96	188	233	266	243	172
Saudi Arabia	712	897	1 089	1 087	1 021	1 226	1 320	1 232	1 284	1 330
51 Fishing area total	*712*	*897*	*1 089*	*1 268*	*1 117*	*1 414*	*1 553*	*1 498*	*1 527*	*1 502*
Species total	*712*	*897*	*1 089*	*1 268*	*1 117*	*1 414*	*1 553*	*1 498*	*1 527*	*1 502*
Gilthead seabream	**Dorade royale**		**Dorada**		***Sparus aurata***				**1,70(39)235,08**	**SBG**
01 Egypt	1 711	1 506	459	751	534	1 173	1 517	1 383	1 317	641
01 Fishing area total	*1 711*	*1 506*	*459*	*751*	*534*	*1 173*	*1 517*	*1 383*	*1 317*	*641*
27 France	162	155	187	213	207	330	301	194	558	778
Portugal	213	268	94	137	137	150	240	186	194	219
Spain	152	203	100	263	152	243	131	154	116	139
UK	-	-	-	-	-	-	0	-	3	1
27 Fishing area total	*527*	*626*	*381*	*613*	*496*	*723*	*672*	*534*	*871*	*1 137*
34 Mauritania	...	...	...	...	...	...	...	...	...	711
Morocco	3	9	17	75	240	293	359	246	318	339
Portugal	-	0	0	38	-	-	-	3	6	1
Spain	1 263	417	301	167	102	90	40	44	42	44
34 Fishing area total	*1 266*	*426*	*318*	*280*	*342*	*383*	*399*	*293*	*366*	*1 095*
37 Albania	90	181	8	8	25	110	51	110	67	225
Bulgaria	-	-	-	-	-	-	2	-	-	-
Croatia	11	6	6	8	16	19	44	18	33	59
Cyprus	37	45	3	3	3	8	7	4	5	5
Egypt	601	974	914	602	800	1 396	1 367	1 322	1 481	1 431
France	207	319	431	535	360	345	248	302	393	437
Greece	176	199	172	131	357	138	166	208	194	194 F
Italy	2 675	3 004	2 999	3 349	265	303	424	339	293	341

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Libya	...	...	...	...	...	...	...	...	216	210 F
Malta	-	-	-	-	-	-	2	2	1	0
Morocco	0	1	1	3	8	27	30	29	22	29
Serbia-Monte	7	7	7	4	...	-	-	-	-	-
Slovenia	4	4	2	4	4	3	3	4	3	5
Spain	749	554	553	548	490	721	955	991	993	839
Syria	34	63	61	57	67	28	37	28	30	22
Tunisia	399	822	1 026	1 140	1 121	1 228	695	699	538	495
Turkey	1 070	700	794	879	1 215	867	759	1 526	1 186	1 164
37 Fishing area total	*6 060*	*6 879*	*6 977*	*7 271*	*4 731*	*5 193*	*4 790*	*5 582*	*5 455*	*5 456 F*
51 France	-	-	-	-	-	-	-	-	51	4
51 Fishing area total	-	-	-	-	-	-	-	-	*51*	*4*
Species total	*9 564*	*9 437*	*8 135*	*8 915*	*6 103*	*7 472*	*7 378*	*7 792*	*8 060*	*8 333 F*
Bogue	**Bogue**		**Boga**		***Boops boops***				**1,70(39)261,01**	**BOG**
27 France	71	42	49	78	52	118	142	80	133	54
Portugal	929	805	708	452	388	369	283	198	225	257
Spain	933	794	249	392	364	1 012	786	1 082	1 149	2 379
27 Fishing area total	*1 933*	*1 641*	*1 006*	*922*	*804*	*1 499*	*1 211*	*1 360*	*1 507*	*2 690*
34 Ghana	...	...	...	...	...	...	11	17	...	...
Morocco	785	1 102	894	1 899	1 606	4 429	3 476	3 773	5 513	2 605
Portugal	29	44	14	13	36	57	28	17	4	5
Sao Tome Prn	18 F	23 F	28	37	40 F	40 F	40 F	40 F	40 F	40 F
Senegal	14	98	59	13	12	17	16	15	120	16
Spain	30	32	12	11	7	5	7	13	31	26
Togo	99	4	1	-	-	-	-	-	-	-
34 Fishing area total	*975 F*	*1 303 F*	*1 008*	*1 973*	*1 701 F*	*4 548 F*	*3 578 F*	*3 875 F*	*5 708 F*	*2 692 F*
37 Albania	120	150	84	76	68	86	132	132	154	80
Algeria	4 135	4 697	6 951	5 819	6 597	5 677	4 972	7 661	6 618	6 545
Croatia	109	55	47	83	125	131	140	131	145	149
Cyprus	216	162	151	149	214	252	235	338	253	256
Egypt	1 222	1 541	1 288	1 622	3 039	3 980	3 677	3 597	2 711	3 230
France	258	259	203	214	140	135	126	126	159	263
Greece	3 674	3 792	4 026	3 906	4 185	4 059	3 954	3 760	4 018	4 000 F
Israel	37	38	68	51	120	123	112	100 F	85	49
Italy	3 537	3 129	2 358	2 195	3 961	3 164	2 857	2 431	2 072	2 080
Libya	2 900 F	2 800 F	2 700 F	2 700 F	2 700 F	2 700 F	2 708	4 009	2 250	2 180 F
Malta	27	16	18	15	21	17	23	18	16	39
Montenegro	...	...	...	...	...	28	23	27	30	28
Morocco	2 472	3 216	3 409	2 153	2 517	3 399	2 672	4 352	4 181	4 608
Palest, O.T.	50 F	32	33	29	27	21	26	27	10	25
Serbia-Monte	25	33	37	35	28	-	-	-	-	-
Slovenia	2	1	1	-	1	3	2	3	2	1
Spain	856	1 151	583	428	362	359	322	392	402	366
Syria	84	141	137	192	195	138	153	160	137	110
Tunisia	2 852	3 209	3 435	2 995	2 814	2 871	2 584	2 729	2 883	2 812
Turkey	1 000	1 126	1 540	1 463	3 062	3 601	3 851	2 580	2 919	2 761
37 Fishing area total	*23 576 F*	*25 548 F*	*27 069 F*	*24 125 F*	*30 176 F*	*30 744 F*	*28 569*	*32 573 F*	*29 045*	*29 582 F*
47 Portugal	-	-	-	-	-	-	-	1	-	-
47 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1*	*...*	*...*
Species total	*26 484 F*	*28 492 F*	*29 083 F*	*27 020 F*	*32 681 F*	*36 791 F*	*33 358 F*	*37 809 F*	*36 260 F*	*34 964 F*
Daggerhead breams nei	**Spares australs nca**		**Sargos australes nep**		***Chrysoblephus spp***				**1,70(39)264,XX**	**RSX**
47 South Africa	78	57	43	110	117	114	93	117	96	103
47 Fishing area total	*78*	*57*	*43*	*110*	*117*	*114*	*93*	*117*	*96*	*103*
51 South Africa	...	67	65	112	112	110	101	117	120	124
51 Fishing area total	*...*	*67*	*65*	*112*	*112*	*110*	*101*	*117*	*120*	*124*
Species total	*78*	*124*	*108*	*222*	*229*	*224*	*194*	*234*	*216*	*227*
Karanteen seabream	**Saupe de mer Rouge**		**Salema del Mar Rojo**		***Crenidens crenidens***				**1,70(39)266,01**	**CWC**
51 Saudi Arabia	-	638	-	100	-	0	78	37	48	35
51 Fishing area total	-	*638*	-	*100*	-	*0*	*78*	*37*	*48*	*35*
Species total	-	*638*	-	*100*	-	*0*	*78*	*37*	*48*	*35*
Sand steenbras	**Marbré**		**Herrera**		***Lithognathus mormyrus***				**1,70(39)277,02**	**SSB**
27 France	36	34	45	38	51	100	58	33	67	44
Portugal	109	145	85	114	73	65	51	51	46	43
Spain	...	...	...	99	176	383	296	208	266	140
27 Fishing area total	*145*	*179*	*130*	*251*	*300*	*548*	*405*	*292*	*379*	*227*
34 Morocco	339	321	271	525	795	600	367	265	328	239
Portugal	...	...	3	-	-	-	-	-	-	-
Senegal	77	32	35	49	14	19	15	11	45	25
Spain	...	...	...	47	67	64	18	16	28	29
34 Fishing area total	*416*	*353*	*309*	*621*	*876*	*683*	*400*	*292*	*401*	*293*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
37 Algeria	...	...	...	...	...	...	12	6	19	12
Croatia	...	...	...	...	...	...	...	...	1	2
Cyprus	-	-	-	-	-	4	3	2	2	2
France	61	56	55	49	49	82	54	55	61	72
Italy	...	...	...	...	725	681	520	322	609	574
Morocco	7	8	10	24	12	6	4	9	8	12
Slovenia	2	2	1	1	1	0	0	0	0	1
Spain	246	203	191	146	190	220	188	234	216	183
Syria	18	25	20	15	30	12	14	17	15	7
Tunisia	781	663	677	678	868	1 135	915	637	484	545
37 Fishing area total	*1 115*	*957*	*954*	*913*	*1 875*	*2 140*	*1 710*	*1 282*	*1 415*	*1 410*
47 Angola	1 735	2 802	3 217	3 334	3 000 F	3 353	223	772	2 031	1 950 F
47 Fishing area total	*1 735*	*2 802*	*3 217*	*3 334*	*3 000 F*	*3 353*	*223*	*772*	*2 031*	*1 950 F*
Species total	*3 411*	*4 291*	*4 610*	*5 119*	*6 051 F*	*6 724*	*2 738*	*2 638*	*4 226*	*3 880 F*
Steenbrasses nei	**Marbrés nca**		**Herreras nep**		***Lithognathus spp***				**1,70(39)277,XX**	**STW**
47 Namibia	20	4	3	1	0	4	3	...	...	...
47 Fishing area total	*20*	*4*	*3*	*1*	*0*	*4*	*3*	*...*	*...*	*...*
Species total	*20*	*4*	*3*	*1*	*0*	*4*	*3*	*...*	*...*	*...*
Salema	**Saupe**		**Salema**		***Sarpa salpa***				**1,70(39)293,01**	**SLM**
27 France	10	5	10	8	12	13	16	10	24	11
Portugal	320	239	252	225	245	266	324	274	226	172
Spain	...	...	...	56	88	217	257	234	353	1 059
27 Fishing area total	*330*	*244*	*262*	*289*	*345*	*496*	*597*	*518*	*603*	*1 242*
34 Morocco	50	143	54	38	44	54	41	56	55	78
Spain	...	...	...	13	27	45	65	70	73	65
34 Fishing area total	*50*	*143*	*54*	*51*	*71*	*99*	*106*	*126*	*128*	*143*
37 Albania	1	5	0	2	4	4	2	5	15	4
Algeria	...	...	...	...	...	...	22	46	239	125
Croatia	28	14	13	17	19	23	124	...	50	62
Cyprus	5	6	4	2	2	3	3	1	2	2
France	60	63	63	66	24	18	24	22	45	58
Greece	346	371	447	373	444	424	361	350	449	449 F
Italy	...	...	...	...	451	691	1 066	360	388	312
Libya	...	...	...	...	...	...	815	1 449	540	530 F
Malta	0	0	0	1	1	1	2	2	1	0
Montenegro	...	...	...	...	...	9	5	11	7	8
Morocco	4	4	4	2	2	8	6	10	12	12
Serbia-Monte	10	10	9	6	6	-	-	-	-	-
Slovenia	-	2	1	2	1	1	1	1	2	3
Spain	164	253	132	116	204	144	142	144	160	260
Tunisia	1 024	1 071	1 048	1 010	1 204	1 146	1 177	950	867	866
Turkey	160	243	230	198	391	599	321	190	348	305
37 Fishing area total	*1 802*	*2 042*	*1 951*	*1 795*	*2 753*	*3 071*	*4 071*	*3 541*	*3 125*	*2 996 F*
47 Russian Fed	1	-	-	-	-	-	-	-	-	-
47 Fishing area total	*1*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*
Species total	*2 183*	*2 429*	*2 267*	*2 135*	*3 169*	*3 666*	*4 774*	*4 185*	*3 856*	*4 381 F*
Sobaity seabream	**Spare sobaity**		**Sargo sobaito**		***Sparidentex hasta***				**1,70(39)300,01**	**SZH**
51 Bahrain	...	...	...	21	6	18	48	4	74	9
Saudi Arabia	72	107	82	65	104	65	70	122	100	210
51 Fishing area total	*72*	*107*	*82*	*86*	*110*	*83*	*118*	*126*	*174*	*219*
Species total	*72*	*107*	*82*	*86*	*110*	*83*	*118*	*126*	*174*	*219*
Goldsilk seabream	**Pagre berda**		**Sargo picnic**		***Acanthopagrus berda***				**1,70(39)330,01**	**MLB**
51 Bahrain	...	...	...	18	13	9	5	24	35	20
Saudi Arabia	27	40	14	14	27	19	63	48	35	26
51 Fishing area total	*27*	*40*	*14*	*32*	*40*	*28*	*68*	*72*	*70*	*46*
Species total	*27*	*40*	*14*	*32*	*40*	*28*	*68*	*72*	*70*	*46*
Blackhead seabream	**Pagre tête noire**		**...C**		***Acanthopagrus schlegeli***				**1,70(39)330,04**	**MLM**
61 China,Taiwan	878	784	806	826	717	637	602	632	469	365
61 Fishing area total	*878*	*784*	*806*	*826*	*717*	*637*	*602*	*632*	*469*	*365*
Species total	*878*	*784*	*806*	*826*	*717*	*637*	*602*	*632*	*469*	*365*
Yellowfin seabream	**Pagre à nageoires jaunes**		**Sargo aleta amarilla**		***Acanthopagrus latus***				**1,70(39)330,05**	**YWF**
51 Kuwait	271	220 F	164	269	280	320	305	299	300 F	300 F
Qatar	...	...	10	...	8	18	23	35	27	9
Saudi Arabia	79	129	149	126	131	139	152	210	249	344
Untd Arab Em	313	122	138	133 F	128	120 F	110 F	100	...	...
51 Fishing area total	*663*	*471 F*	*461*	*528 F*	*547*	*597 F*	*590 F*	*644*	*576 F*	*653 F*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*663*	*471 F*	*461*	*528 F*	*547*	*597 F*	*590 F*	*644*	*576 F*	*653 F*
Twobar seabream	**Pagre double bande**		**Sargo de dos bandas**		***Acanthopagrus bifasciatus***				**1,70(39)330,06**	**AAB**
51 Bahrain	...	...	...	80	92	134	155	214	76	90
Eritrea	...	...	...	28	...	...	...	...	...	...
Iran	1 603	2 135	2 131	2 114	1 934	2 248	2 545	2 716	2 437	2 733
Saudi Arabia	379	421	429	426	378	479	636	577	606	595
Untd Arab Em	1 586	332	489	475 F	450	460 F	470 F	472	506	478
51 Fishing area total	*3 568*	*2 888*	*3 049*	*3 123 F*	*2 854*	*3 321 F*	*3 806 F*	*3 979*	*3 625*	*3 896*
Species total	*3 568*	*2 888*	*3 049*	*3 123 F*	*2 854*	*3 321 F*	*3 806 F*	*3 979*	*3 625*	*3 896*
Scup	**Spare doré**		**Sargo de América del Norte**		***Stenotomus chrysops***				**1,70(39)353,01**	**SCP**
21 USA	1 845	3 312	4 489	4 309	4 375	4 109	4 212	2 375	3 879	4 659
21 Fishing area total	*1 845*	*3 312*	*4 489*	*4 309*	*4 375*	*4 109*	*4 212*	*2 375*	*3 879*	*4 659*
Species total	*1 845*	*3 312*	*4 489*	*4 309*	*4 375*	*4 109*	*4 212*	*2 375*	*3 879*	*4 659*
Porgies, seabreams nei	**Dentés, spares nca**		**Dentones, sargos nep**		***Sparidae***				**1,70(39)XXX,XX**	**SBX**
27 Channel Is	108	125	270	100	195	169	216	59	95	44
France	1	-	-	-	1	0	0	0	15	1
Ireland	11	7	-	-	-	-	2	2	2	2
Netherlands	-	-	-	-	-	1	5	4	5	-
Portugal	3	2	4	3	54	33	36	28	10	9
Russian Fed	-	-	3	-	-	-	-	-	-	-
Spain	1 950	693	624	481	681	660	802	884	727	794
UK	111	234	24	37	6	25	67	33	33	27
27 Fishing area total	*2 184*	*1 061*	*925*	*621*	*937*	*888*	*1 128*	*1 010*	*887*	*877*
31 Antigua Barb	9	15	35	16	40	30	28	40	4	15
Cuba	10	13	118	107	108	81	69	64	28	31
Korea Rep	-	-	-	-	-	-	-	39	-	-
Mexico	...	...	...	...	920	961	763	859	886	827
Puerto Rico	25	20	17	13	11	8	7	13	11	7
USA	215	204	238	199	188	235	292	297	127	67
US Virgin Is	...	...	18	16	15	13	12	13	12	12
31 Fishing area total	*259*	*252*	*426*	*351*	*1 282*	*1 328*	*1 171*	*1 325*	*1 068*	*959*
34 Belize	129	85	-	...	28	74	-	285	...	540
Cameroon	34	18	40	80 F	114	89	89	55 F	20	20 F
China	3 638	258	159	...	22	967	620	657	...	10
Comoros	-	-	-	-	-	-	...	...	...	10
Côte dIvoire	...	...	1	-	1	-	-	-	-	-
Cyprus	195	-	-	-	-	-	-	-	-	-
Germany	-	21	-	-	-	-	-	-	-	-
Ghana	532	969	356	1 121	6 380	5 449	5 100	4 922	4 527	3 497
Guinea	4 562	2 548	1 362	934	397	533	1 784	949	940 F	940 F
GuineaBissau	65	19	63	60 F	61 F	60 F	60 F	60 F	60 F	60 F
Honduras	438	-	-	-	2	1	-	-	-	-
Korea Rep	444	737	902	503	885	1 068	611	825	833	1 034
Latvia	-	-	-	-	-	-	-	5	6	8
Lithuania	40	137	139	33	4	283	316	465	517	64
Mauritania	550 F	500 F	440 F	399	542	258	173	110	850 F	159
Panama	78	142	24	...	239	1 214	135	-	...	...
Poland	-	-	-	-	-	-	-	-	2	18
Portugal	0	2	-	-	-	-	0	1	-	-
Russian Fed	860	2 097	80	97	290	317	172	25	12	-
St Kitts Nev	-	-	-	-	-	-	-	-	-	17
St Vincent	51	20	...	...	...	...	...	...	...	174
Sao Tome Prn	55 F	63 F	72	43	45 F	45 F	45 F	45 F	45 F	45 F
Senegal	295	79	-	1 338	70	88	174	545	473	430
Sierra Leone	1 189	1 007	1 954	1 077	1 122	962	1 870	2 882	2 830 F	2 830 F
Spain	163	36	59	3	10	4	9	6	15	25
Togo	-	-	-	-	0	-	-	-	-	-
Ukraine	1 371	913	750	944	23	52	229	32	39	-
Other nei	341	114	...	...	...	...	...	...	...	...
34 Fishing area total	*15 030 F*	*9 765 F*	*6 401 F*	*6 632 F*	*10 235 F*	*11 464 F*	*11 387 F*	*11 869 F*	*11 169 F*	*9 881 F*
37 Albania	1	2	2	4	3	7	-	-	-	3
Cyprus	46	55	-	-	-	-	6	1	-	-
Israel	562	494	368	537	229	185	205	180 F	151	131
Lebanon	400	370	370	365	370	371	371 F	371 F	371 F	371 F
Libya	4 300 F	4 000 F	3 700 F	3 400 F	3 200 F	3 000 F	-	-	-	-
Spain	232	62	53	22	23	0	1	3	5	4
Tunisia	2 825	2 818	2 806	2 193	2 109	2 266	2 154	2 378	2 359	2 764
Turkey	135	137	124	163	162	248	170	295	263	247
37 Fishing area total	*8 501 F*	*7 938 F*	*7 423 F*	*6 684 F*	*6 096 F*	*6 077 F*	*2 907 F*	*3 228 F*	*3 149 F*	*3 520 F*
41 Korea Rep	-	-	-	6	-	-	-	-	-	-
Spain	1 221	-	0	3	-	-	0	-	1	4
41 Fishing area total	*1 221*	-	*0*	*9*	-	-	*0*	-	*1*	*4*
47 Korea Rep	-	155	-	4	-	-	-	-	-	-
Portugal	0	-	10	-	13	-	0	-	-	-
Russian Fed	8	5	23	-	-	-	-	-	-	-
South Africa	151	109	114	288	282	107	148	144	214	179

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Spain	-	-	-	1	2	-	-	-	-	-
47 Fishing area total	*159*	*269*	*147*	*293*	*297*	*107*	*148*	*144*	*214*	*179*
51 Bahrain	401	488	573	4	7	13	8	18	17	23
Egypt	3 545	2 827	4 500	3 872	865	709	2 110	1 327	728	797
Eritrea	11	1	1	6	2	...	15	...	1	0
Korea Rep	1 218	4 647	3 218	4 909	4 165	2 473	2 145	2 257	3 111	1 375
Oman	3 976	8 776	5 913	8 200	6 842	6 185	6 473	7 408	10 282	9 864
Pakistan	4 411	4 430	2 687	2 392	2 115	2 465	2 625	2 745	2 101	2 099
Portugal	-	-	-	-	-	2	-	-	-	-
Qatar	288	209	233	215	567	527	407	612	418	379
Saudi Arabia	229	20	188	172	40	54	7	43	45	45
South Africa	...	4	2	2	0	5	4	3	2	1
51 Fishing area total	*14 079*	*21 402*	*17 315*	*19 772*	*14 603*	*12 433*	*13 794*	*14 413*	*16 705*	*14 583*
57 Australia	832	681	395	447	540	483	192	277	149	726
Korea Rep	677	791	12	-	-	-	-	53	-	-
57 Fishing area total	*1 509*	*1 472*	*407*	*447*	*540*	*483*	*192*	*330*	*149*	*726*
61 China	107 234 F	100 882 F	105 893 F	129 296 F	118 874 F	142 819 F	132 935	131 330	153 316	165 428
China,H.Kong	780 F	750 F	700 F	740 F	720 F	680 F	680 F	700 F	710 F	750 F
China,Taiwan	9 953	7 370	7 870	7 319	8 301	8 062	4 149	6 607	4 588	2 453
Japan	9 545	10 983	10 947	11 633	10 335	10 355	10 162	10 531	10 176	10 100 F
Korea Rep	1 425	1 848	1 622	1 338	1 630	1 557	1 633	2 449	3 286	5 415
61 Fishing area total	*128 937 F*	*121 833 F*	*127 032 F*	*150 326 F*	*139 860 F*	*163 473 F*	*149 559 F*	*151 617 F*	*172 076 F*	*184 146 F*
71 Australia	197	169	147	223	217	229	197	279	173	167
Korea Rep	70	291	6	11	214	1	37	588	21	64
Philippines	11 432	13 097	13 905	13 008	12 741	12 806	14 171	16 830	13 497	14 036
71 Fishing area total	*11 699*	*13 557*	*14 058*	*13 242*	*13 172*	*13 036*	*14 405*	*17 697*	*13 691*	*14 267*
77 Korea Rep	-	1	-	-	-	-	195	-	7	-
77 Fishing area total	*-*	*1*	*-*	*-*	*-*	*-*	*195*	*-*	*7*	*-*
81 Australia	340	336	390	335	393	382	477	354	230	232
Korea Rep	2 427	2 302	2 466	1 889	2 363	2 669	2 832	3 182	3 972	2 509
81 Fishing area total	*2 767*	*2 638*	*2 856*	*2 224*	*2 756*	*3 051*	*3 309*	*3 536*	*4 202*	*2 741*
87 Spain	-	-	-	-	-	-	-	-	9	-
87 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*9*	*-*
Species total	*186 345 F*	*180 188 F*	*176 990 F*	*200 601 F*	*189 778 F*	*212 340 F*	*198 195 F*	*205 169 F*	*223 327 F*	*231 883 F*
Blotched picarel	**Mendole**		**Chucla**		***Spicara maena***				**1,70(40)075,01**	**BPI**
37 Cyprus	...	...	...	...	...	36	39	46	22	24
Greece	...	294	385	304	419	280	443	366	493	493 F
Russian Fed	1	1	3	4	4	4	-	2	7	7
Tunisia	381	593	241	418	401	393	413	394	151	321
37 Fishing area total	*382*	*888*	*629*	*726*	*824*	*713*	*895*	*808*	*673*	*845 F*
Species total	*382*	*888*	*629*	*726*	*824*	*713*	*895*	*808*	*673*	*845 F*
Picarels nei	**Mendoles, picarels nca**		**Chuclas, carameles nep**		***Spicara spp***				**1,70(40)075,XX**	**PIC**
27 France	-	-	-	-	-	-	-	-	27	15
Portugal	25	36	32	30	45	55	41	35	37	51
Spain	-	-	-	8	23	14	11	17	17	12
27 Fishing area total	*25*	*36*	*32*	*38*	*68*	*69*	*52*	*52*	*81*	*78*
34 Greece	-	16	3	-	-	-	-	-	-	-
34 Fishing area total	*-*	*16*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
37 Albania	5	11	59	47	53	4	2	10	...	53
Bulgaria	-	-	10	-	-	-	-	1	0	1
Croatia	189	72	55	116	145	160	115	136	156	200
Cyprus	671	486	580	313	250	258	281	244	211	183
France	5	7	11	9	8	7	7	10	17	20
Greece	4 031	3 588	3 447	3 584	3 216	3 355	3 127	3 139	3 083	3 060 F
Israel	-	-	-	-	-	-	-	-	28	31
Italy	313	287	272	313	2 966	1 779	1 644	1 529	1 262	1 347
Lebanon	95	93	90	90	85	84	84 F	84 F	84 F	84 F
Malta	6	3	1	1	2	0	6	5	7	9
Montenegro	...	...	...	...	...	18	14	16	15	17
Serbia-Monte	27	38	40	36	19	-	-	-	-	-
Slovenia	5	6	6	4	3	4	8	4	5	3
Spain	759	346	295	399	339	329	316	316	309	272
Tunisia	572	858	1 025	1 002	878	776	720	572	372	348
Turkey	2 250	1 105	1 200	1 020	1 869	1 321	1 044	742	1 116	1 243
37 Fishing area total	*8 928*	*6 900*	*7 091*	*6 934*	*9 833*	*8 095*	*7 368 F*	*6 808 F*	*6 665 F*	*6 871 F*
47 Angola	744	674	454	...	400 F	484	...	...	...	...
47 Fishing area total	*744*	*674*	*454*	*...*	*400 F*	*484*	*...*	*...*	*...*	*...*
Species total	*9 697*	*7 626*	*7 580*	*6 972*	*10 301 F*	*8 648*	*7 420 F*	*6 860 F*	*6 746 F*	*6 949 F*
Surmullet	**Rouget de roche**		**Salmonete de roca**		***Mullus surmuletus***				**1,70(41)007,01**	**MUR**
27 Belgium	...	...	19	44	49	45	56	42	33	83

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Channel Is	19	15	11	45	9	8	9	9	5	5
Denmark	5	12	13	24	16	20	6	4	-	-
France	2 969	2 648	4 267	5 749	3 716	2 975	5 402	4 635	2 282	2 626
Ireland	-	-	4	5	12	15	17	17	9	7
Isle of Man	4	-	-	-	-	-	-	-	-	-
Netherlands	560	337	421	863	703	408	1 054	1 038	672	695
Portugal	92	83	64	62	108	184	263	192	220	294
Spain	352	198	316	408	285	379	390	379	490	465
UK	310	217	261	301	248	239	354	476	391	442
27 Fishing area total	*4 311*	*3 510*	*5 376*	*7 501*	*5 146*	*4 273*	*7 551*	*6 792*	*4 102*	*4 617*
37 Bulgaria	-	-	-	-	-	-	2	2	24	38
Croatia	480	294	299	894	911	805	950	826	31	22
Cyprus	132	125	130	94	106	78	154	119	70	90
Greece	1 238	976	1 245	1 208	1 227	1 398	1 515	1 389	1 424	1 420 F
Italy	...	...	...	...	3 903	4 255	4 046	2 919	2 451	2 606
Malta	...	...	...	...	...	...	9	10	13	53
Spain	473	738	632	572	634	755	732	495	438	469
Tunisia	2 163	1 803	1 948	2 095	1 893	1 666	1 640	1 577	1 412	1 447
Turkey	1 570	1 450	1 050	961	1 207	1 256	1 732	1 978	2 818	4 455
37 Fishing area total	*6 056*	*5 386*	*5 304*	*5 824*	*9 881*	*10 213*	*10 780*	*9 315*	*8 681*	*10 600 F*
Species total	*10 367*	*8 896*	*10 680*	*13 325*	*15 027*	*14 486*	*18 331*	*16 107*	*12 783*	*15 217 F*
Red mullet	**Rouget de vase**		**Salmonete de fango**		***Mullus barbatus***				**1,70(41)007,02**	**MUT**
37 Bulgaria	26	33	36	17	1	6	13	17	48	72
Croatia	...	...	...	...	...	...	...	...	844	792
Cyprus	91	84	84	53	50	41	58	53	26	31
Greece	1 541	1 559	1 547	1 797	1 833	2 158	2 091	1 905	1 867	1 860 F
Italy	...	...	...	...	9 430	9 231	9 463	7 415	6 329	5 132
Malta	...	...	...	...	...	...	0	4	...	12
Spain	262	560	899	453	623	902	811	642	635	639
Tunisia	2 632	2 045	2 908	2 732	2 335	2 236	2 807	3 194	3 657	3 633
Turkey	2 455	2 395	1 400	1 848	2 825	2 617	2 390	2 035	2 778	2 797
Ukraine	201	42	64	46	24	72	76	60	85	93
37 Fishing area total	*7 208*	*6 718*	*6 938*	*6 946*	*17 121*	*17 263*	*17 709*	*15 325*	*16 269*	*15 061 F*
Species total	*7 208*	*6 718*	*6 938*	*6 946*	*17 121*	*17 263*	*17 709*	*15 325*	*16 269*	*15 061 F*
Argentine goatfish	**Rouget-barbet argentin**		**Trilla**		***Mullus argentinae***				**1,70(41)007,03**	**MWU**
41 Argentina	225	78	88	178	238	416	350	304	447	357
41 Fishing area total	*225*	*78*	*88*	*178*	*238*	*416*	*350*	*304*	*447*	*357*
Species total	*225*	*78*	*88*	*178*	*238*	*416*	*350*	*304*	*447*	*357*
Surmullets(=Red mullets) nei	**Rougets nca**		**Salmonetes nep**		***Mullus spp***				**1,70(41)007,XX**	**MUX**
27 Germany	10	9	14	27	25	17	4	17	10	6
Portugal	99	84	75	70	42	29	23	9	5	30
Spain	-	-	-	450	572	1 580	824	696	759	775
27 Fishing area total	*109*	*93*	*89*	*547*	*639*	*1 626*	*851*	*722*	*774*	*811*
34 Greece	-	-	2	-	-	-	-	-	-	-
Mauritania	25 F	25 F	40 F	35 F	30 F	25 F	20 F	15 F	10 F	...
Morocco	1 062	993	561	420	424	486	352	534	848	958
Netherlands	-	-	-	-	14	-	-	-	-	-
Portugal	-	-	-	-	-	-	-	-	-	3
Spain	28	7	105	214	160	58	37	80	79	530
34 Fishing area total	*1 115 F*	*1 025 F*	*708 F*	*669 F*	*628 F*	*569 F*	*409 F*	*629 F*	*937 F*	*1 491*
37 Albania	170	97	141	158	113	185	154	162	187	113
Algeria	2 081	2 140	1 775	1 665	1 625	1 795	1 862	1 624	933	817
Cyprus	-	-	-	-	-	56	-	-	-	-
Egypt	1 717	1 957	1 133	1 200	1 478	3 428	4 396	2 939	3 058	3 577
France	206	189	267	322	208	229	218	136	189	319
Georgia	22	67	50	35	3	3 F	4	0	0	0
Israel	401	368	324	17	257	182	143	100 F	48	49
Italy	7 121	6 111	6 491	7 857	-	-	-	-	-	-
Lebanon	200	200	200	200	190	190	190 F	190 F	190 F	190 F
Libya	3 900 F	3 400	2 900	2 400	1 900	1 400 F	889	1 519	6 246	6 000 F
Malta	5	4	3	4	3	5	23	40	33	-
Montenegro	...	...	...	...	...	16	17	21	14	17
Morocco	360	309	502	438	335	279	331	389	424	442
Palest, O.T.	40 F	35	23	18	24	31	23	33	14	13
Romania	3	2	3	40	30	0	1	-	0	2
Russian Fed	118	46	174	95	147	136	84	115	235	201
Serbia-Monte	11	11	11	9	9	...	...	...	...	...
Slovenia	4	1	3	3	4	2	6	2	3	1
Spain	1 750	1 192	864	980	1 096	1 395	1 350	1 171	1 066	864
Syria	125	147	105	98	105	85	67	72	65	84
37 Fishing area total	*18 234 F*	*16 276*	*14 969*	*15 539*	*7 527*	*9 417 F*	*9 758 F*	*8 513 F*	*12 705 F*	*12 689 F*
Species total	*19 458 F*	*17 394 F*	*15 766 F*	*16 755 F*	*8 794 F*	*11 612 F*	*11 018 F*	*9 864 F*	*14 416 F*	*14 991 F*
Yellowstripe goatfish	**Capucin à bande jaune**		**...C**		***Mulloidichthys flavolineatus***				**1,70(41)181,01**	**MUV**
51 Saudi Arabia	88	110	97	121	180	261	197	142	158	144

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
51 Fishing area total	*88*	*110*	*97*	*121*	*180*	*261*	*197*	*142*	*158*	*144*
Species total	*88*	*110*	*97*	*121*	*180*	*261*	*197*	*142*	*158*	*144*
Goatfishes	**Rougets-souris**		**Salmonetes**		***Upeneus spp***				**1,70(41)251,XX**	**GOX**
37 Israel	-	-	-	-	-	-	-	-	55	66
37 Fishing area total	-	-	-	-	-	-	-	-	*55*	*66*
51 Eritrea	9	9	1	11	3	20	1	0	7	0
India	14 748	15 457	18 895	8 116	10 063	11 452	13 816	11 978	11 988	11 188
Mauritius	556	501	537	425	456	204	138	100	497	268
51 Fishing area total	*15 313*	*15 967*	*19 433*	*8 552*	*10 522*	*11 676*	*13 955*	*12 078*	*12 492*	*11 456*
57 India	1 988	3 088	3 028	4 749	3 488	3 507	4 877	19 735	22 028	19 106
Indonesia	16 622	16 047	22 153	14 322	14 493	15 217	17 127	22 408	15 878	18 448
Malaysia	6 488	6 413	6 360	7 285	8 032	8 528	9 383	9 091	8 912	7 015
57 Fishing area total	*25 098*	*25 548*	*31 541*	*26 356*	*26 013*	*27 252*	*31 387*	*51 234*	*46 818*	*44 569*
61 China,H.Kong	400 F	390 F	350 F	380 F	370 F	340 F	340 F	350 F	355 F	375 F
China,Taiwan	300	344	254	302	315	269	261	90	129	68
61 Fishing area total	*700 F*	*734 F*	*604 F*	*682 F*	*685 F*	*609 F*	*601 F*	*440 F*	*484 F*	*443 F*
71 Fiji	157	120 F	65	37	30 F	22	79	100	85	100
Indonesia	12 038	14 518	11 899	19 658	20 064	27 172	22 204	38 562	27 945	47 171
Kiribati	1 609	404	376	360 F	340 F	320 F	310	613	174	170 F
Malaysia	6 472	7 119	8 190	10 013	9 373	9 336	8 497	9 573	8 239	7 472
Singapore	15	1	1	2	2	4	7	0	0	1
71 Fishing area total	*20 291*	*22 162 F*	*20 531*	*30 070 F*	*29 809 F*	*36 854 F*	*31 097*	*48 848*	*36 443*	*54 914 F*
Species total	*61 402 F*	*64 411 F*	*72 109 F*	*65 660 F*	*67 029 F*	*76 391 F*	*77 040 F*	*112 600 F*	*96 292 F*	*111 448 F*
West African goatfish	**Rouget du Sénégal**		**Salmonete barbudo**		***Pseudupeneus prayensis***				**1,70(41)499,03**	**GOA**
34 Benin	...	...	11	3	1	1	1	0	...	...
China	...	164	18	...	4	367	493	261	...	...
Côte dIvoire	40	35	50	59	45	26	21	20 F	21	5
Gabon	311	392	260	241	139	39	80	18	12 F	12 F
Ghana	285	278	194	427	151	673	1 007	1 836	1 933	1 055
Greece	1 081	675	367	173	66	384	378	115	62	62 F
Korea Rep	-	-	-	-	-	-	-	2	-	-
Liberia	-	-	-	-	-	-	-	26	25 F	25 F
Portugal	-	-	5	3	-	-	0	2	4	9
Senegal	1 846	1 855	1 133	260	213	308	165	132	200	76
Sierra Leone	119	130	189	213	309	333	720	275	270 F	270 F
Spain	-	-	19	39	45	171	212	246	205	...
Togo	-	-	-	-	1	-	-	-	-	-
34 Fishing area total	*3 682*	*3 529*	*2 246*	*1 418*	*974*	*2 302*	*3 077*	*2 933 F*	*2 732 F*	*1 514 F*
Species total	*3 682*	*3 529*	*2 246*	*1 418*	*974*	*2 302*	*3 077*	*2 933 F*	*2 732 F*	*1 514 F*
Goatfishes, red mullets nei	**Rougets, etc. nca**		**Salmonetes, etc. nep**		***Mullidae***				**1,70(41)XXX,XX**	**MUM**
31 Dominican Rp	161	41	101	56	81	116	43	91	82	230
Grenada	0	0	0	0	0	0	0	-	-	-
Puerto Rico	15	10	10	6	5	4	2	2	3	3
St Kitts Nev	0	0	20 F	85	60 F	47 F	34 F	22 F	12 F	2
USA	36	6	2	2	-	-	9	18	12	-
US Virgin Is	...	...	4	3	2	3	1	1	1	1
31 Fishing area total	*212*	*57*	*137 F*	*152*	*148 F*	*170 F*	*89 F*	*134 F*	*110 F*	*236*
41 Brazil	2 044	2 218	1 981	2 102	1 442	1 394	1 388	1 382	1 524	1 440
41 Fishing area total	*2 044*	*2 218*	*1 981*	*2 102*	*1 442*	*1 394*	*1 388*	*1 382*	*1 524*	*1 440*
51 Bahrain	192	17	75	5	7	2	1	5	171	6
Egypt	2 590	1 684	1 947	1 836	713	990	988	1 237	925	806
Qatar	0	0	2	3	37	79	27	9	13	10
Réunion	3	4	3	3	3	3	1	0	0	0
Russian Fed	-	28	10	-	-	-	-	-	-	-
Untd Arab Em	180 F	200	255	200 F	157	120 F	80 F	46	167	142
Zanzibar	1 739	707	363	628	561	690	834	657	864	881
51 Fishing area total	*4 704 F*	*2 640*	*2 655*	*2 675 F*	*1 478*	*1 884 F*	*1 931 F*	*1 954*	*2 140*	*1 845*
71 N Marianas	1	0	1	1	0	0	0	0	0	0
Palau	1	0	0	1	0	0	...	0	0	0
Philippines	14 291	24 440	25 244	23 407	23 381	25 302	28 220	24 787	29 136	30 192
71 Fishing area total	*14 293*	*24 440*	*25 245*	*23 409*	*23 381*	*25 302*	*28 220*	*24 787*	*29 136*	*30 192*
77 USA	-	27	22	22	16	14	12	17	21	28
77 Fishing area total	-	*27*	*22*	*22*	*16*	*14*	*12*	*17*	*21*	*28*
81 Korea Rep	-	-	-	-	-	-	-	-	-	7
81 Fishing area total	-	-	-	-	-	-	-	-	-	*7*
Species total	*21 253 F*	*29 382*	*30 040 F*	*28 360 F*	*26 465 F*	*28 764 F*	*31 640 F*	*28 274 F*	*32 931 F*	*33 748*
Common silver-biddy	**Blanche commune**		**Mojarra común**		***Gerres oyena***				**1,70(46)036,11**	**GEJ**
51 Egypt	...	...	...	...	...	...	516	735	57	50

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Saudi Arabia	484	268	348	402	530	625	623	567	496	545
51 Fishing area total	*484*	*268*	*348*	*402*	*530*	*625*	*1 139*	*1 302*	*553*	*595*
Species total	*484*	*268*	*348*	*402*	*530*	*625*	*1 139*	*1 302*	*553*	*595*
Slender silver-biddy	**Blanche élégante**		**Mojarra elegante**		***Gerres oblongus***				**1,70(46)036,12**	**GEO**
51 Saudi Arabia	178	35	98	2	...	46	46	58	61	61
51 Fishing area total	*178*	*35*	*98*	*2*	*...*	*46*	*46*	*58*	*61*	*61*
Species total	*178*	*35*	*98*	*2*	*...*	*46*	*46*	*58*	*61*	*61*
Guinean striped mojarra	**Friture rayée**		**Mojarra guineana**		***Gerres nigri***				**1,70(46)036,13**	**GEZ**
34 Senegal	...	...	1 253	1 811	868	3 872	3 567	2 580	2 815	1 775
34 Fishing area total	*...*	*...*	*1 253*	*1 811*	*868*	*3 872*	*3 567*	*2 580*	*2 815*	*1 775*
Species total	*...*	*...*	*1 253*	*1 811*	*868*	*3 872*	*3 567*	*2 580*	*2 815*	*1 775*
Mojarras(=Silver-biddies) nei	**Blanches nca**		**Mojarras nep**		***Gerres spp***				**1,70(46)036,XX**	**MOJ**
31 USA	180	211	274	241	196	251	233	296	270	247
31 Fishing area total	*180*	*211*	*274*	*241*	*196*	*251*	*233*	*296*	*270*	*247*
51 Bahrain	372	172	151	175	63	133	145	128	119	35
Qatar	82	52	75	71	70	77	136	123	87	44
Saudi Arabia	-	182	68	18	...	0	20	25	27	27
Untd Arab Em	1 900	371	318	300 F	275	360 F	450 F	543	691	692
51 Fishing area total	*2 354*	*777*	*612*	*564 F*	*408*	*570 F*	*751 F*	*819*	*924*	*798*
57 Malaysia	...	...	...	83	...	...	...	105	152	114
57 Fishing area total	*...*	*...*	*...*	*83*	*...*	*...*	*...*	*105*	*152*	*114*
71 Fiji	11	12 F	13	13	13 F	13	12	10 F	10 F	10
Kiribati	1 455	847	1 034	1 000 F	970 F	930 F	909	1 066	143	140 F
Malaysia	...	...	...	1 152	...	...	...	1 071	771	868
Palau	0	0	0	1	0	1	...	0	0	0
Philippines	5 525	6 630	6 957	6 613	6 395	6 880	6 877	7 259	6 731	6 384
71 Fishing area total	*6 991*	*7 489 F*	*8 004*	*8 779 F*	*7 378 F*	*7 824 F*	*7 798*	*9 406 F*	*7 655 F*	*7 402 F*
Species total	*9 525*	*8 477 F*	*8 890*	*9 667 F*	*7 982 F*	*8 645 F*	*8 782 F*	*10 626 F*	*9 001 F*	*8 561 F*
Irish mojarra	**Blanche cabuche**		**Mojarra cagüicha**		***Diapterus auratus***				**1,70(46)037,01**	**DUT**
41 Brazil	...	1 603	2 573	2 592	1 708	2 087	2 074	1 918	2 115	1 997
41 Fishing area total	*...*	*1 603*	*2 573*	*2 592*	*1 708*	*2 087*	*2 074*	*1 918*	*2 115*	*1 997*
Species total	*...*	*1 603*	*2 573*	*2 592*	*1 708*	*2 087*	*2 074*	*1 918*	*2 115*	*1 997*
Mojarras, etc. nei	**Blanches, etc. nca**		**Mojarras, etc. nep**		***Gerreidae***				**1,70(46)XXX,XX**	**GDJ**
31 Colombia	0	447	0	1	53	55 F	57 F	59 F	61	21
Cuba	1 104	858	805	729	765	697	730	863	1 095	1 320
Dominican Rp	15	7	104	59	55	69	11	49	44	123
Mexico	2 800	2 108	2 897	3 187	1 173	1 225	1 041	980	918	841
Puerto Rico	13	11	14	5	3	2	2	5	3	2
Venezuela	0	-	-	-	-	-	-	-	-	-
31 Fishing area total	*3 932*	*3 431*	*3 820*	*3 981*	*2 049*	*2 048 F*	*1 841 F*	*1 956 F*	*2 121*	*2 307*
77 Mexico	1 800	1 692	1 862	2 049	953	995	818	971	1 023	1 256
77 Fishing area total	*1 800*	*1 692*	*1 862*	*2 049*	*953*	*995*	*818*	*971*	*1 023*	*1 256*
87 Colombia	58	91	...	40	...	35 F	30 F	25 F	22	31
87 Fishing area total	*58*	*91*	*...*	*40*	*...*	*35 F*	*30 F*	*25 F*	*22*	*31*
Species total	*5 790*	*5 214*	*5 682*	*6 070*	*3 002*	*3 078 F*	*2 689 F*	*2 952 F*	*3 166*	*3 594*
Parore	**...B**		**...C**		***Girella tricuspidata***				**1,70(47)003,02**	**GIY**
57 Australia	-	-	-	20	16	21	0	0	1	0
57 Fishing area total	*-*	*-*	*-*	*20*	*16*	*21*	*0*	*0*	*1*	*0*
81 Australia	559	525	485	390	326	372	435	391	302	262
New Zealand	71	78	63	52	58	67	59	65	83	89
81 Fishing area total	*630*	*603*	*548*	*442*	*384*	*439*	*494*	*456*	*385*	*351*
Species total	*630*	*603*	*548*	*462*	*400*	*460*	*494*	*456*	*386*	*351*
Opaleye	**Calicagère verte**		**Chopa verde**		***Girella nigricans***				**1,70(47)003,03**	**GIQ**
77 USA	2	1	1	8	5	0	1	0	0	0
77 Fishing area total	*2*	*1*	*1*	*8*	*5*	*0*	*1*	*0*	*0*	*0*
Species total	*2*	*1*	*1*	*8*	*5*	*0*	*1*	*0*	*0*	*0*
Sea chubs nei	**Calicagères nca**		**Chopas nep**		***Kyphosidae***				**1,70(47)XXX,XX**	**KYX**
31 Antigua Barb	8	4	10	6	9	3	9	20	7	6
31 Fishing area total	*8*	*4*	*10*	*6*	*9*	*3*	*9*	*20*	*7*	*6*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
41 Brazil	...	132	60	47	57	54	44	51	56	53
Estonia	-	37	-	-	-	-	-	-	-	-
41 Fishing area total	*...*	*169*	*60*	*47*	*57*	*54*	*44*	*51*	*56*	*53*
71 Palau	1	1	1	1	1	0	...	...	...	...
71 Fishing area total	*1*	*1*	*1*	*1*	*1*	*0*	*...*	*...*	*...*	*...*
77 USA	-	12	9	10	9	16	14	17	8	13
77 Fishing area total	*-*	*12*	*9*	*10*	*9*	*16*	*14*	*17*	*8*	*13*
87 Chile	49	1	4	70	89	43	43	38	34	28
87 Fishing area total	*49*	*1*	*4*	*70*	*89*	*43*	*43*	*38*	*34*	*28*
Species total	*58*	*187*	*84*	*134*	*165*	*116*	*110*	*126*	*105*	*100*
Spotted sicklefish	**Forgeron tacheté**		**Catemo manchado**		***Drepane punctata***				**1,70(50)132,01**	**SPS**
51 Iran	626	750	1 075	1 416	1 196	893	886	793	736	862
51 Fishing area total	*626*	*750*	*1 075*	*1 416*	*1 196*	*893*	*886*	*793*	*736*	*862*
57 Malaysia	26	59	125	143	146	155	169	173	247	257
57 Fishing area total	*26*	*59*	*125*	*143*	*146*	*155*	*169*	*173*	*247*	*257*
71 Malaysia	663	730	1 323	1 022	981	1 307	1 226	1 134	787	814
Philippines	135	122	136	139	90	129	111	95	124	126
71 Fishing area total	*798*	*852*	*1 459*	*1 161*	*1 071*	*1 436*	*1 337*	*1 229*	*911*	*940*
Species total	*1 450*	*1 661*	*2 659*	*2 720*	*2 413*	*2 484*	*2 392*	*2 195*	*1 894*	*2 059*
African sicklefish	**Forgeron ailé**		**Catemo africano**		***Drepane africana***				**1,70(50)132,02**	**SIC**
34 Belize	-	-	-	...	330	1 418	-	690	...	...
Benin	6	4	24	24	22	14	11	16	6	8
Bulgaria	57	-	-	-	-	-	-	-	-	-
Cameroon	70	30	42	30 F	13	24	24	24 F	24 F	24 F
China	...	52	44	...	254	944	271	159	...	...
Comoros	-	-	-	-	-	-	122	206	...	...
Congo Rep	30 F	35 F	43	65	65	104	155	87	44	255
Côte dIvoire	20	24	10	9	14	10	15	15 F	15	17
Gabon	71	107	148	309	256	215	...	...	...	...
Gambia	85	186	206	93	108	140	347	257	275	275
Ghana	8	30	27	7	15	7	9	6 740	59	...
Guinea	...	...	...	...	52	...	...	...	...	...
GuineaBissau	132	299	124	125 F	128 F	125 F	120 F	120 F	120 F	120 F
Liberia	104	110	110	256	573	98	150	185	180 F	180 F
Mauritania	...	...	...	...	...	...	...	...	...	16
Nigeria	1 429	1 511	1 419	1 425	949	2 142	1 066	1 604	1 459	1 327
Panama	432	175	0	...	462	2 306	225	-	...	...
Sao Tome Prn	18 F	28 F	39	27	30 F	30 F	30 F	30 F	30 F	30 F
Senegal	421	244	450	293	322	330	405	577	584	546
Sierra Leone	416	244	332	404	215	423	540	588	580 F	580 F
Togo	-	0	0	-	1	-	6	6 F	...	...
34 Fishing area total	*3 299 F*	*3 079 F*	*3 018*	*3 067 F*	*3 809 F*	*8 330 F*	*3 496 F*	*11 304 F*	*3 376 F*	*3 378 F*
Species total	*3 299 F*	*3 079 F*	*3 018*	*3 067 F*	*3 809 F*	*8 330 F*	*3 496 F*	*11 304 F*	*3 376 F*	*3 378 F*
Ballan wrasse	**Vieille commune**		**Maragota**		***Labrus bergylta***				**1,70(63)005,01**	**USB**
27 Channel Is	-	-	-	-	-	7	4	6	9	8
Norway	...	2	7	7	6	4	4	6	96	145
Portugal	...	...	5	6	8	15	17	15	16	13
27 Fishing area total	*...*	*2*	*12*	*13*	*14*	*26*	*25*	*27*	*121*	*166*
Species total	*...*	*2*	*12*	*13*	*14*	*26*	*25*	*27*	*121*	*166*
Rock cook	**...B**		**...C**		***Centrolabrus exoletus***				**1,70(63)065,01**	**ENX**
27 Portugal	...	...	...	...	...	...	...	50	59	69
27 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*50*	*59*	*69*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*50*	*59*	*69*
Mediterranean rainbow wrasse	**...B**		**...C**		***Coris julis***				**1,70(63)066,01**	**COU**
27 Portugal	...	...	0	0	1	1	6	5	5	3
27 Fishing area total	*...*	*...*	*0*	*0*	*1*	*1*	*6*	*5*	*5*	*3*
Species total	*...*	*...*	*0*	*0*	*1*	*1*	*6*	*5*	*5*	*3*
Goldsinny-wrasse	**Rouquié**		**Tabernero**		***Ctenolabrus rupestris***				**1,70(63)069,01**	**TBR**
27 Norway	...	...	2	3	2	3	2	2	8	159
27 Fishing area total	*...*	*...*	*2*	*3*	*2*	*3*	*2*	*2*	*8*	*159*
Species total	*...*	*...*	*2*	*3*	*2*	*3*	*2*	*2*	*8*	*159*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Pearly razorfish	**Donzelle lame**		**Rao**		***Xyrichtys novacula***				**1,70(63)079,01**	**XYN**
37 Italy	...	...	...	...	79	181	98	163	274	155
37 Fishing area total	*...*	*...*	*...*	*...*	*79*	*181*	*98*	*163*	*274*	*155*
Species total	*...*	*...*	*...*	*...*	*79*	*181*	*98*	*163*	*274*	*155*
Humphead wrasse	**Napoléon**		**Napoleón**		***Cheilinus undulatus***				**1,70(63)117,03**	**HVM**
57 Indonesia	...	...	...	79	89	93	97	970	790	663
57 Fishing area total	*...*	*...*	*...*	*79*	*89*	*93*	*97*	*970*	*790*	*663*
71 Indonesia	...	...	...	36	55	577	663	3 266	3 804	1 354
71 Fishing area total	*...*	*...*	*...*	*36*	*55*	*577*	*663*	*3 266*	*3 804*	*1 354*
Species total	*...*	*...*	*...*	*115*	*144*	*670*	*760*	*4 236*	*4 594*	*2 017*
Hogfish	**Labre capitaine**		**Doncella de pluma**		***Lachnolaimus maximus***				**1,70(63)164,01**	**LCX**
31 Mexico	...	...	...	...	276	288	625	645	664	840
USA	-	-	-	-	-	10	11	19	18	-
US Virgin Is	...	...	...	...	0	1	1	1	0	1
31 Fishing area total	*...*	*...*	*...*	*...*	*276*	*299*	*637*	*665*	*682*	*841*
Species total	*...*	*...*	*...*	*...*	*276*	*299*	*637*	*665*	*682*	*841*
Tautog	**Tautogue noir**		**...C**		***Tautoga onitis***				**1,70(63)243,01**	**TAU**
21 USA	138	160	155	142	131	159	153	140	105	109
21 Fishing area total	*138*	*160*	*155*	*142*	*131*	*159*	*153*	*140*	*105*	*109*
Species total	*138*	*160*	*155*	*142*	*131*	*159*	*153*	*140*	*105*	*109*
Cunner	**Tanche-tautogue**		**...C**		***Tautogolabrus adspersus***				**1,70(63)250,02**	**CUN**
21 USA	9	13	7	2	3	2	3	4	3	2
21 Fishing area total	*9*	*13*	*7*	*2*	*3*	*2*	*3*	*4*	*3*	*2*
Species total	*9*	*13*	*7*	*2*	*3*	*2*	*3*	*4*	*3*	*2*
California sheephead	**Labre californien**		**Vieja de California**		***Semicossyphus pulcher***				**1,70(63)331,02**	**YFH**
77 USA	68	52	48	34	40	39	31	37	33	31
77 Fishing area total	*68*	*52*	*48*	*34*	*40*	*39*	*31*	*37*	*33*	*31*
Species total	*68*	*52*	*48*	*34*	*40*	*39*	*31*	*37*	*33*	*31*
Corkwing wrasse	**Crénilabre mélops**		**Porredana**		***Symphodus melops***				**1,70(63)387,02**	**YFM**
27 Norway	...	...	4	1	1	-	-	1	6	163
27 Fishing area total	*...*	*...*	*4*	*1*	*1*	*-*	*-*	*1*	*6*	*163*
Species total	*...*	*...*	*4*	*1*	*1*	*-*	*-*	*1*	*6*	*163*
Wrasses, hogfishes, etc. nei	**Pourceaux, donzelles, etc. nca**		**Lábridos(=Tordos,maragotas)nep**		***Labridae***				**1,70(63)XXX,XX**	**WRA**
27 France	250	224	255	241	247	220	228	108	263	302
Norway	6	4	4	3	2	37	32	41	96	2
Portugal	39	54	51	58	58	43	37	2	2	2
Spain	-	-	-	136	230	275	317	365	313	339
UK	25	20	16	16	10	14	18	14	18	15
27 Fishing area total	*320*	*302*	*326*	*454*	*547*	*589*	*632*	*530*	*692*	*660*
31 Dominican Rp	22	557	141	41	65	...	...	125	113	317
Puerto Rico	46	36	45	30	23	25	24	25	26	25
31 Fishing area total	*68*	*593*	*186*	*71*	*88*	*25*	*24*	*150*	*139*	*342*
34 Portugal	1	1	1	1	-	0	-	-	-	-
Senegal	...	...	21	...	...	...	...	...	...	...
34 Fishing area total	*1*	*1*	*22*	*1*	*...*	*0*	*...*	*...*	*...*	*...*
37 Malta	-	-	-	-	-	-	-	-	2	8
Spain	-	-	-	7	7	8	7	6	19	8
37 Fishing area total	*-*	*-*	*-*	*7*	*7*	*8*	*7*	*6*	*21*	*16*
51 Eritrea	...	...	...	...	...	...	1	0	0	0
Saudi Arabia	153	111	82	78	69	69	72	72	85	85
Tanzania	3 500	3 000	2 800	2 800	2 080	633	1 271	1 158	1 308	1 624
51 Fishing area total	*3 653*	*3 111*	*2 882*	*2 878*	*2 149*	*702*	*1 344*	*1 230*	*1 393*	*1 709*
57 Australia	88	90	72	141	164	148	189	104	90	89
Malaysia	-	1	12	12	23	219	149	15	57	112
57 Fishing area total	*88*	*91*	*84*	*153*	*187*	*367*	*338*	*119*	*147*	*201*
71 Australia	1	0	0	1	22	16	0	1	0	24
Fiji	400	320 F	236	11	20 F	25	190	130 F	70 F	10
Guam	3	2	4	2	2	1	1	0	2	1
Malaysia	1 948	292	285	317	368	2 313	264	630	1 313	972
Palau	7	12	1	1	2	0	...	...	...	...
Philippines	12 664	7 106	8 549	8 743	9 655	11 349	13 920	14 019	14 983	16 404
71 Fishing area total	*15 023*	*7 732 F*	*9 075*	*9 075*	*10 069 F*	*13 704*	*14 375*	*14 780 F*	*16 368 F*	*17 411*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
81 Australia	13	11	10	13	12	7	...	...	...	...
New Zealand	2	3	1	3	4	5	5	5	2	4
81 Fishing area total	*15*	*14*	*11*	*16*	*16*	*12*	*5*	*5*	*2*	*4*
Species total	*19 168*	*11 844 F*	*12 586*	*12 655*	*13 063 F*	*15 407*	*16 725*	*16 820 F*	*18 762 F*	*20 343*
Parrotfish	**Perroquet vieillard**		**Loro viejo**		***Sparisoma cretense***				**1,70(65)055,06**	**PRR**
27 Portugal	161	153	158	164	161	208	249	284	297	209
27 Fishing area total	*161*	*153*	*158*	*164*	*161*	*208*	*249*	*284*	*297*	*209*
34 Portugal	1	0	0	0	-	1	1	1	-	-
34 Fishing area total	*1*	*0*	*0*	*0*	*-*	*1*	*1*	*1*	*-*	*-*
Species total	*162*	*153*	*158*	*164*	*161*	*209*	*250*	*285*	*297*	*209*
Gulf parrotfish	**Perroquet du Golfe**		**Loro del Golfo**		***Scarus persicus***				**1,70(65)056,09**	**USW**
51 Iran	38	48	78	57	43	163	49	74	114	317
51 Fishing area total	*38*	*48*	*78*	*57*	*43*	*163*	*49*	*74*	*114*	*317*
Species total	*38*	*48*	*78*	*57*	*43*	*163*	*49*	*74*	*114*	*317*
Blue-barred parrotfish	**Perroquet barbe bleue**		**Loro barba azul**		***Scarus ghobban***				**1,70(65)056,11**	**USY**
51 Saudi Arabia	54	62	46	64	76	47	87	59	100	96
51 Fishing area total	*54*	*62*	*46*	*64*	*76*	*47*	*87*	*59*	*100*	*96*
Species total	*54*	*62*	*46*	*64*	*76*	*47*	*87*	*59*	*100*	*96*
Green humphead parrotfish	**Perroquet bossu vert**		**Loro cototo verde**		***Bolbometopon muricatum***				**1,70(65)437,01**	**BMK**
51 Saudi Arabia	253	251	161	210	89	134	254	102	168	142
51 Fishing area total	*253*	*251*	*161*	*210*	*89*	*134*	*254*	*102*	*168*	*142*
Species total	*253*	*251*	*161*	*210*	*89*	*134*	*254*	*102*	*168*	*142*
Parrotfishes nei	**Perroquets nca**		**Loros nep**		***Scaridae***				**1,70(65)XXX,XX**	**PWT**
31 Antigua Barb	173	252	254	225	202	278	285	259	271	169
Dominican Rp	19	85	181	42	28	8	173	81	73	206
Grenada	41	113	178	133	161	157	131	114	107	130
Nicaragua	...	...	...	...	...	27	...	...	0	0
Puerto Rico	66	57	56	38	28	28	26	24	25	-
St Kitts Nev	7	8	25 F	47	43 F	39 F	35 F	31 F	26 F	22
St Vincent	...	...	...	...	...	...	...	...	12	12
US Virgin Is	...	...	197	195	181	206	176	170	196	104
31 Fishing area total	*306*	*515*	*891 F*	*680*	*643 F*	*743 F*	*826 F*	*679 F*	*710 F*	*643*
34 Gambia	1	17	-	-	-	-	-	1	0	1
34 Fishing area total	*1*	*17*	*-*	*-*	*-*	*-*	*-*	*1*	*0*	*1*
37 Cyprus	42	55	26	31	22	63	43	37	50	52
Libya	...	...	...	...	...	...	...	...	306	300 F
Malta	-	-	-	-	-	-	-	-	6	12
37 Fishing area total	*42*	*55*	*26*	*31*	*22*	*63*	*43*	*37*	*362*	*364 F*
41 Brazil	162	137	140	364	280	357	135	254	280	264
41 Fishing area total	*162*	*137*	*140*	*364*	*280*	*357*	*135*	*254*	*280*	*264*
51 Bahrain	21	27	20	15	5	6	4	8	8	6
Egypt	...	...	2 040	1 334	1 481	2 038	1 947	1 844	1 370	1 090
Eritrea	2	1	0	0	0	0	0	0	2	6
Qatar	79	27	116	...	119	334	192	84	60	50
Saudi Arabia	541	359	248	241	259	322	310	348	360	360
Untd Arab Em	383	712	589	580 F	575	430 F	300 F	150	141	108
Zanzibar	1 056	828	801	1 082	1 043	1 052	1 226	1 295	1 378	1 395
51 Fishing area total	*2 082*	*1 954*	*3 814*	*3 252 F*	*3 482*	*4 182 F*	*3 979 F*	*3 729*	*3 319*	*3 015*
61 China,Taiwan	27	46	39	78	75	81	55	54	64	58
61 Fishing area total	*27*	*46*	*39*	*78*	*75*	*81*	*55*	*54*	*64*	*58*
71 Guam	16	10	14	11	6	4	5	6	22	22
N Marianas	13	2	1	1	3	7	12	12	11	10
Palau	26	13	10	1	4	1	...	2	2 F	2 F
71 Fishing area total	*55*	*25*	*25*	*13*	*13*	*12*	*17*	*20*	*35 F*	*34 F*
77 Amer Samoa	3	1	2	2	3	3	3	2	2	4
Nicaragua	...	...	...	...	...	21	5	...	21	7
USA	-	22	30	13	14	12	20	20	22	29
77 Fishing area total	*3*	*23*	*32*	*15*	*17*	*36*	*28*	*22*	*45*	*40*
Species total	*2 678*	*2 772*	*4 967 F*	*4 433 F*	*4 532 F*	*5 474 F*	*5 083 F*	*4 796 F*	*4 815 F*	*4 419 F*
Yellowbar angelfish	**...B**		**...C**		***Pomacanthus maculosus***				**1,70(66)007,04**	**OAZ**
51 Bahrain	...	...	...	299	168	1 411	763	283	283	230
Saudi Arabia	9	8	25	52	52	52	18	49	59	117

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
51 Fishing area total	*9*	*8*	*25*	*351*	*220*	*1 463*	*781*	*332*	*342*	*347*
Species total	*9*	*8*	*25*	*351*	*220*	*1 463*	*781*	*332*	*342*	*347*
Angelfishes nei	**Demoiselles nca**		**Angeles nep**		***Pomacanthidae***				**1,70(66)XXX,XX**	**ANW**
31 Antigua Barb	...	28	12	4	12	15	17	8	1	6
31 Fishing area total	*...*	*28*	*12*	*4*	*12*	*15*	*17*	*8*	*1*	*6*
51 Eritrea	0	0	0	0	0	0	0	-	-	-
51 Fishing area total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	-	-	-
Species total	*0*	*28*	*12*	*4*	*12*	*15*	*17*	*8*	*1*	*6*
...A	**...B**		**Jerguilla**		***Aplodactylus punctatus***				**1,70(69)021,02**	**FPJ**
87 Chile	...	...	...	13	6	8	12	22	32	13
87 Fishing area total	*...*	*...*	*...*	*13*	*6*	*8*	*12*	*22*	*32*	*13*
Species total	*...*	*...*	*...*	*13*	*6*	*8*	*12*	*22*	*32*	*13*
Giant African threadfin	**Gros capitaine**		**Barbudo gigante africano**		***Polydactylus quadrifilis***				**1,70(77)001,09**	**TGA**
01 Senegal	...	...	...	...	...	...	...	40	30 F	14
01 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*40*	*30 F*	*14*
34 Benin	...	...	21	21	26	12	10	2	19	24
Cameroon	170	75	106	160 F	216	109	109	75 F	42	42 F
Congo Rep	...	...	110	97	68	36	103	92	85	82
Gabon	...	630	1 980	3 177	1 714	1 127	1 460	1 169	800 F	800 F
Gambia	141	206	307	82	248	602	722	1 036	1 110	1 110
Guinea	...	...	929	1 298	1 794	1 854	619	727	720 F	720 F
GuineaBissau	159	56	19	20 F	22 F	20 F	20 F	20 F	20 F	20 F
Nigeria	11 645	14 052	15 675	9 571	11 370	14 077	15 146	14 612	16 149	17 848
Senegal	...	650	945	664	340	367	400	313	412	330
Sierra Leone	445	469	802	1 985	2 283	2 424	2 259	3 236	3 170 F	3 170 F
Togo	6	1	0	1	0	3	7	7 F	...	1
34 Fishing area total	*12 566*	*16 139*	*20 894*	*17 076 F*	*18 081 F*	*20 631 F*	*20 855 F*	*21 289 F*	*22 527 F*	*24 147 F*
Species total	*12 566*	*16 139*	*20 894*	*17 076 F*	*18 081 F*	*20 631 F*	*20 855 F*	*21 329 F*	*22 557 F*	*24 161 F*
Fourfinger threadfin	**Barbure à quatre doigts**		**Barbudo de cuatro dedos**		***Eleutheronema tetradactylum***				**1,70(77)002,01**	**FOT**
51 Iran	220	237	611	580	753	1 060	962	590	465	717
Pakistan	55	60	69	1 329	540	494	545	561	509	568
51 Fishing area total	*275*	*297*	*680*	*1 909*	*1 293*	*1 554*	*1 507*	*1 151*	*974*	*1 285*
57 Indonesia	...	...	...	200	237	272	265	488	100	558
57 Fishing area total	*...*	*...*	*...*	*200*	*237*	*272*	*265*	*488*	*100*	*558*
61 China,Taiwan	1 715	1 236	1 204	1 233	1 533	1 256	1 548	1 161	923	942
61 Fishing area total	*1 715*	*1 236*	*1 204*	*1 233*	*1 533*	*1 256*	*1 548*	*1 161*	*923*	*942*
71 Indonesia	...	...	...	5 416	6 729	7 177	6 219	8 465	7 621	8 195
71 Fishing area total	*...*	*...*	*...*	*5 416*	*6 729*	*7 177*	*6 219*	*8 465*	*7 621*	*8 195*
Species total	*1 990*	*1 533*	*1 884*	*8 758*	*9 792*	*10 259*	*9 539*	*11 265*	*9 618*	*10 980*
Lesser African threadfin	**Petit capitaine**		**Barbudo enano africano**		***Galeoides decadactylus***				**1,70(77)003,02**	**GAL**
34 Benin	...	...	528	568	455	472	378	377	406	542
Cameroon	462	134	341	180 F	67	227	227	220 F	214	214 F
Congo Rep	200 F	400 F	589	279	316	561	706	609	977	820
Côte dIvoire	168	246	145	60	80	80	108	90 F	85	390
Gabon	3 101	2 072	820	733	1 722	1 545	1 217	750	500 F	500 F
Gambia	116	120	132	78	210	454	608	425	455	455
Ghana	2 892	2 204	1 976	3 098	2 242	3 135	3 416	2 318	1 197	1 786
Guinea	62	47	130	141	...	132	79	73	70 F	70 F
GuineaBissau	173	599	498	465 F	428 F	400 F	370 F	420 F	420 F	420 F
Liberia	...	...	...	...	...	...	464	599	600 F	600 F
Nigeria	5 131	4 819	6 338	4 746	3 871	6 112	4 529	5 320	5 053	4 799
Senegal	3 849	3 037	3 281	1 526	1 166	2 071	1 336	2 290	6 051	3 485
Sierra Leone	914	753	1 382	1 990	2 461	3 376	3 944	3 000	2 950 F	2 950 F
Spain	-	-	-	-	-	-	-	-	15	-
Togo	98	88	12	57	17	3	60	130 F	198	103
34 Fishing area total	*17 166 F*	*14 519 F*	*16 172*	*13 921 F*	*13 035 F*	*18 568 F*	*17 442 F*	*16 621 F*	*19 191 F*	*17 134 F*
Species total	*17 166 F*	*14 519 F*	*16 172*	*13 921 F*	*13 035 F*	*18 568 F*	*17 442 F*	*16 621 F*	*19 191 F*	*17 134 F*
Royal threadfin	**Capitaine royal**		**Barbudo real**		***Pentanemus quinquarius***				**1,70(77)004,01**	**PET**
34 Benin	...	...	99	114	90	93	75	10	33	151
Cameroon	3 276	832	1 698	800 F	5	131	131	333 F	535	535 F
Congo Rep	240 F	280 F	317	288	339	316	500	305	429	636
Gabon	389	210	152	147	176	156	420 F	749	500 F	500 F
Gambia	...	...	...	...	...	...	767	152	163	163
Liberia	102	110	110	118	217	61	63	30	30 F	30 F
Sierra Leone	...	107	88	163	267	51	120	469	460 F	460 F
34 Fishing area total	*4 007 F*	*1 539 F*	*2 464*	*1 630 F*	*1 094*	*808*	*2 076 F*	*2 048 F*	*2 150 F*	*2 475 F*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*4 007 F*	*1 539 F*	*2 464*	*1 630 F*	*1 094*	*808*	*2 076 F*	*2 048 F*	*2 150 F*	*2 475 F*
Indian threadfin	**Barbure indien**		**Barbudo indio**		***Leptomelanosoma indicum***				**1,70(77)006,01**	**OYD**
57 Bangladesh	...	...	...	...	...	...	...	1 040	7 733	7 732
57 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1 040*	*7 733*	*7 732*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1 040*	*7 733*	*7 732*
Threadfins, tasselfishes nei	**Barbures, capitaines nca**		**Barbudos nep**		***Polynemidae***				**1,70(77)XXX,XX**	**THF**
04 India	345	345	449	449	537	561	420	2 615	2 541	...
04 Fishing area total	*345*	*345*	*449*	*449*	*537*	*561*	*420*	*2 615*	*2 541*	*...*
34 Benin	324	463	-	-	-	-	-	10	-	-
China	...	1 060	176	...	1 072	1 406	1 727	1 612	...	...
Congo Dem R	130 F	160 F	190 F	220 F	250 F	280 F	300	300 F	300 F	300 F
Korea Rep	-	-	-	223	-	-	-	-	-	-
Panama	12	64	95	...	291	173	21	-	...	...
Sao Tome Prn	80 F	90 F	102	125	130 F	130 F	130 F	130 F	130 F	130 F
34 Fishing area total	*546 F*	*1 837 F*	*563 F*	*568 F*	*1 743 F*	*1 989 F*	*2 178 F*	*2 052 F*	*430 F*	*430 F*
47 Angola	1 834	2 664	3 082	3 297	3 000 F	3 945	4 972	7 603	5 724	5 500 F
47 Fishing area total	*1 834*	*2 664*	*3 082*	*3 297*	*3 000 F*	*3 945*	*4 972*	*7 603*	*5 724*	*5 500 F*
51 India	2 313	2 379	1 529	1 825	1 954	2 785	2 948	2 626	2 901	6 600
Réunion	10	7	6	6	5	8	3	1	1 F	1 F
51 Fishing area total	*2 323*	*2 386*	*1 535*	*1 831*	*1 959*	*2 793*	*2 951*	*2 627*	*2 902 F*	*6 601 F*
57 India	3 094	3 848	4 038	10 092	11 108	11 405	10 595	13 288	14 975	10 418
Indonesia	7 973	7 205	8 014	7 840	7 228	9 822	10 312	10 320	10 652	10 015
Malaysia	1 951	1 341	1 492	1 748	1 484	1 681	1 651	1 775	7 296	6 298
Thailand	27	31	378	99	694	185	117	51	67	59
57 Fishing area total	*13 045*	*12 425*	*13 922*	*19 779*	*20 514*	*23 093*	*22 675*	*25 434*	*32 990*	*26 790*
71 Australia	1 116	1 122	931	1 151	1 039	958	1 057	1 053	1 045	1 012
Indonesia	27 390	25 691	31 454	29 926	29 235	30 282	30 448	28 585	27 057	26 438
Malaysia	2 377	1 523	1 656	2 250	1 771	1 472	2 216	2 890	4 010	4 609
Philippines	2 804	3 940	4 282	4 252	3 941	4 060	3 757	3 774	3 897	4 035
Singapore	11	11	13	15	18	28	55	32	46	33
Thailand	306	644	400	511	524	837	443	240	238	408
71 Fishing area total	*34 004*	*32 931*	*38 736*	*38 105*	*36 528*	*37 637*	*37 976*	*36 574*	*36 293*	*36 535*
87 Colombia	...	...	1	3	8	7 F	7 F	6 F	5	6
87 Fishing area total	*...*	*...*	*1*	*3*	*8*	*7 F*	*7 F*	*6 F*	*5*	*6*
Species total	*52 097 F*	*52 588 F*	*58 288 F*	*64 032 F*	*64 289 F*	*70 025 F*	*71 179 F*	*76 911 F*	*80 885 F*	*75 862 F*
Channel bull blenny	**Toreau de Patagonie**		**Torito de los canales**		***Cottoperca gobio***				**1,70(91)003,01**	**BVG**
41 Falkland Is	-	-	-	-	-	4	19	9	15	8
Spain	-	-	-	-	-	1	11	16	1	5
UK	-	-	-	-	-	-	-	-	1	-
41 Fishing area total	*-*	*-*	*-*	*-*	*-*	*5*	*30*	*25*	*17*	*13*
Species total	*-*	*-*	*-*	*-*	*-*	*5*	*30*	*25*	*17*	*13*
Patagonian blennie	**Guite de Patagonie**		**Róbalo patagónico**		***Eleginops maclovinus***				**1,70(92)007,02**	**BLP**
41 Argentina	233	50	60	56	53	47	7	15	25	66
Falkland Is	61	47	17	17	6	10	9	6	3	4
41 Fishing area total	*294*	*97*	*77*	*73*	*59*	*57*	*16*	*21*	*28*	*70*
87 Chile	109	240	164	312	150	148	124	139	205	151
87 Fishing area total	*109*	*240*	*164*	*312*	*150*	*148*	*124*	*139*	*205*	*151*
Species total	*403*	*337*	*241*	*385*	*209*	*205*	*140*	*160*	*233*	*221*
Marbled rockcod	**Bocasse marbrée**		**Trama jaspeada**		***Notothenia rossii***				**1,70(92)019,02**	**NOR**
48 Germany	-	-	-	-	-	-	6	-	-	-
Japan	-	0	-	-	-	-	-	-	-	-
Ukraine	-	-	-	-	-	1	...	-	-	-
UK	-	5	-	-	0	1	1	3	2	16
USA	0	-	-	-	-	0	-	-	-	-
48 Fishing area total	*0*	*5*	*-*	*-*	*0*	*2*	*7*	*3*	*2*	*16*
58 Australia	-	0	0	0	0	-	-	-	-	-
58 Fishing area total	*-*	*0*	*0*	*0*	*0*	*-*	*-*	*-*	*-*	*-*
Species total	*0*	*5*	*0*	*0*	*0*	*2*	*7*	*3*	*2*	*16*
Humped rockcod	**Bocasse bossue**		**Trama jorobada**		***Notothenia gibberifrons***				**1,70(92)019,03**	**NOG**
48 France	0	-	-	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	3	-	-	-
UK	0	1	-	-	-	-	1	1	1	2
USA	2	-	-	-	-	1	-	-	-	-

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
48 Fishing area total	*2*	*1*	*-*	*-*	*-*	*1*	*4*	*1*	*1*	*2*
Species total	*2*	*1*	*-*	*-*	*-*	*1*	*4*	*1*	*1*	*2*
Yellowbelly rockcod	**Bocasse jaune**		**Trama amarilla**		***Notothenia neglecta***				**1,70(92)019,04**	**NON**
48 USA	2	-	-	-	-	-	-	-	-	-
48 Fishing area total	*2*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
Species total	*2*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
Grey rockcod	**Bocasse grise**		**Trama gris**		***Notothenia squamifrons***				**1,70(92)019,06**	**NOS**
48 UK	-	0	-	-	-	-	1	0	0	0
USA	0	-	-	-	-	0	-	-	-	-
48 Fishing area total	*0*	*0*	*-*	*-*	*-*	*0*	*1*	*0*	*0*	*0*
57 Australia	297	290	297	415	463	460	426	354	331	316
57 Fishing area total	*297*	*290*	*297*	*415*	*463*	*460*	*426*	*354*	*331*	*316*
58 Australia	0	1	0	3	2	5	10	20	26	48
Japan	-	-	-	-	-	-	0	-	0	-
Namibia	-	-	-	-	-	-	0	-	-	-
58 Fishing area total	*0*	*1*	*0*	*3*	*2*	*5*	*10*	*20*	*26*	*48*
88 Korea Rep	-	-	-	0	-	-	0	-	-	-
88 Fishing area total	*-*	*-*	*-*	*0*	*-*	*-*	*0*	*-*	*-*	*-*
Species total	*297*	*291*	*297*	*418*	*465*	*465*	*437*	*374*	*357*	*364*
Black rockcod	**Bocasse noire**		**Trama negra**		***Notothenia coriiceps***				**1,70(92)019,09**	**NOC**
48 Germany	-	-	-	-	-	-	4	-	-	-
48 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*4*	*-*	*-*	*-*
Species total	*-*	*-*	*-*	*-*	*-*	*-*	*4*	*-*	*-*	*-*
Striped-eyed rockcod	**Bocasse aux yeux rayés**		**Trama ojirayada**		***Notothenia kempi***				**1,70(92)019,10**	**NOK**
58 South Africa	-	0	-	0	-	-	-	-	-	-
58 Fishing area total	*-*	*0*	*-*	*0*	*-*	*-*	*-*	*-*	*-*	*-*
88 Ukraine	-	-	-	0	-	-	-	-	-	-
88 Fishing area total	*-*	*-*	*-*	*0*	*-*	*-*	*-*	*-*	*-*	*-*
Species total	*-*	*0*	*-*	*0*	*-*	*-*	*-*	*-*	*-*	*-*
Triangular rockcod	**Bocasse triangulaire**		**Trama triangular**		***Notothenia acuta***				**1,70(92)019,11**	**NOA**
58 Australia	-	-	0	0	0	-	-	-	0	2
58 Fishing area total	*-*	*-*	*0*	*0*	*0*	*-*	*-*	*-*	*0*	*2*
Species total	*-*	*-*	*0*	*0*	*0*	*-*	*-*	*-*	*0*	*2*
Painted notie	**Bocassette écrivain**		**Doradillo escribano**		***Nototheniops larseni***				**1,70(92)430,01**	**NOL**
48 UK	-	0	-	-	-	-	0	0	0	0
48 Fishing area total	*-*	*0*	*-*	*-*	*-*	*-*	*0*	*0*	*0*	*0*
Species total	*-*	*0*	*-*	*-*	*-*	*-*	*0*	*0*	*0*	*0*
Yellowfin notie	**Bocassette dégarnie**		**Doradillo pobre**		***Nototheniops nudifrons***				**1,70(92)430,02**	**NOD**
48 Germany	-	-	-	-	-	-	0	-	-	-
UK	-	-	-	-	-	-	0	0	0	0
USA	0	-	-	-	-	0	-	-	-	-
48 Fishing area total	*0*	*-*	*-*	*-*	*-*	*0*	*0*	*0*	*0*	*0*
Species total	*0*	*-*	*-*	*-*	*-*	*0*	*0*	*0*	*0*	*0*
Toad notie	**Bocassette crapaud**		**Ojo de sapo**		***Nototheniops mizops***				**1,70(92)430,03**	**NOZ**
58 Australia	-	-	0	0	0	-	-	-	0	-
58 Fishing area total	*-*	*-*	*0*	*0*	*0*	*-*	*-*	*-*	*0*	*-*
Species total	*-*	*-*	*0*	*0*	*0*	*-*	*-*	*-*	*0*	*-*
...A	**...B**		**...C**		***Nototheniops nybelini***				**1,70(92)430,04**	**NNY**
48 Ukraine	-	-	-	-	-	8	...	-	-	-
48 Fishing area total	*-*	*-*	*-*	*-*	*-*	*8*	*...*	*-*	*-*	*-*
Species total	*-*	*-*	*-*	*-*	*-*	*8*	*...*	*-*	*-*	*-*
Trematomus nei	**Trematomus nca**		**Trematomus nep**		***Trematomus spp***				**1,70(92)448,XX**	**TRT**
48 USA	0	-	-	-	-	-	-	-	-	-
48 Fishing area total	*0*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*0*	-	-	-	-	-	-	-	-	...
Striped rockcod	**Bocasson rayé**		**Austrobacalao rayado**		***Pagothenia hansoni***				**1,70(92)529,01**	**TRH**
48 UK	-	-	-	-	-	-	0	0	0	-
48 Fishing area total	-	-	-	-	-	-	*0*	*0*	*0*	...
Species total	-	-	-	-	-	-	*0*	*0*	*0*	...
Antarctic silverfish	**Calandre antarctique**		**Diablillo antártico**		***Pleuragramma antarcticum***				**1,70(92)535,01**	**ANS**
48 Germany	-	-	-	-	-	-	0	-	-	-
Ukraine	-	-	-	-	0	14	...	-	-	-
USA	0	-	-	-	-	0	-	-	-	-
48 Fishing area total	*0*	-	-	-	*0*	*14*	*0*	-	-	-
88 New Zealand	-	-	-	-	-	-	-	1	-	-
88 Fishing area total	-	-	-	-	-	-	-	*1*	-	-
Species total	*0*	-	-	-	*0*	*14*	*0*	*1*	...	...
Antarctic rockcods, noties nei	**Bocasses, bocassons nca**		**Tramas, doradillos nep**		***Nototheniidae***				**1,70(92)XXX,XX**	**NOX**
41 Argentina	182	180	259	469	4 170	9 842	8 355	12 433	16 645	9 448
Estonia	-	-	-	-	56	127	-	-	-	58
Falkland Is	-	-	-	-	-	-	-	-	11 672	18 300
Korea Rep	-	-	-	-	-	-	-	-	42	145
Spain	-	-	-	-	-	-	-	-	13 978	25 604
Uruguay	-	-	-	99	10	544	8	28	91	17
41 Fishing area total	*182*	*180*	*259*	*568*	*4 236*	*10 513*	*8 363*	*12 461*	*42 428*	*53 572*
48 Chile	-	-	-	-	0	-	-	-	-	-
UK	0	10	0	-	0	-	0	0	0	0
USA	0	-	-	-	-	-	-	-	-	-
48 Fishing area total	*0*	*10*	*0*	-	*0*	-	*0*	*0*	*0*	*0*
58 Australia	0	-	0	-	0	0	0	0	-	-
Japan	-	-	-	-	-	-	-	0	-	0
58 Fishing area total	*0*	-	*0*	-	*0*	*0*	*0*	*0*	-	*0*
81 New Zealand	15	42	42	1	0	0	40	63	77	-
81 Fishing area total	*15*	*42*	*42*	*1*	*0*	*0*	*40*	*63*	*77*	-
88 New Zealand	0	0	1	0	0	0	0	0	0	0
Norway	-	-	-	0	0	-	-	-	-	-
South Africa	0	-	-	-	-	-	-	0	-	-
UK	-	-	-	-	-	-	-	1	0	0
Uruguay	-	-	-	0	0	-	0	0	-	-
88 Fishing area total	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*1*	*0*	*0*
Species total	*197*	*232*	*302*	*569*	*4 236*	*10 513*	*8 403*	*12 525*	*42 505*	*53 572*
Glassfishes	**...B**		**...C**		***Ambassidae***				**1,70(95)XXX,XX**	**AIB**
71 Philippines	1 876	2 198	2 225	2 016	1 650	1 552	1 492	1 619	1 832	1 882
71 Fishing area total	*1 876*	*2 198*	*2 225*	*2 016*	*1 650*	*1 552*	*1 492*	*1 619*	*1 832*	*1 882*
Species total	*1 876*	*2 198*	*2 225*	*2 016*	*1 650*	*1 552*	*1 492*	*1 619*	*1 832*	*1 882*
Percoids nei	**Percoides nca**		**Percoideos nep**		***Percoidei***				**1,70(XX)XXX,XX**	**PRC**
41 Brazil	2 099	-	-	-	-	-	-	-	-	-
41 Fishing area total	*2 099*	-	-	-	-	-	-	-	-	-
51 India	39 928	53 778	38 853	42 436	48 600	52 154	82 884	79 090	84 065	50 104
Mauritius	152	135	140	134	126	...	68	74	100	100
Tanzania	200	100	100	100	145	637	629	621	603	797
51 Fishing area total	*40 280*	*54 013*	*39 093*	*42 670*	*48 871*	*52 791*	*83 581*	*79 785*	*84 768*	*51 001*
57 India	38 142	28 548	32 473	37 440	31 251	33 602	39 998	51 810	60 026	57 713
57 Fishing area total	*38 142*	*28 548*	*32 473*	*37 440*	*31 251*	*33 602*	*39 998*	*51 810*	*60 026*	*57 713*
71 Kiribati	1 069	1 198	1 394	1 380 F	1 350 F	1 320 F	1 300 F	1 300 F	1 200 F	1 100 F
Philippines	9 775	11 194	10 556	9 375	7 407	8 448	9 050	9 640	15 849	15 931
71 Fishing area total	*10 844*	*12 392*	*11 950*	*10 755 F*	*8 757 F*	*9 768 F*	*10 350 F*	*10 940 F*	*17 049 F*	*17 031 F*
81 Australia	42	54	59	65	65	62	-	-	-	-
81 Fishing area total	*42*	*54*	*59*	*65*	*65*	*62*	-	-	-	-
Species total	*91 407*	*95 007*	*83 575*	*90 930 F*	*88 944 F*	*96 223 F*	*133 929 F*	*142 535 F*	*161 843 F*	*125 745 F*
Eelpout	**Loquette d'Europe**		**Viruela**		***Zoarces viviparus***				**1,71(15)004,01**	**ELP**
27 Denmark	5	4	4	3	5	3	1	2	2	3
Estonia	1	1	0	0	0	0	2	1	0	1
Germany	5	1	2	1	1	2	1	2	3	2
Latvia	26	37	24	29	75	50	38	30	54	38
Poland	-	-	-	16	7	3	3	1	0	0
27 Fishing area total	*37*	*43*	*30*	*49*	*88*	*58*	*45*	*36*	*59*	*44*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*37*	*43*	*30*	*49*	*88*	*58*	*45*	*36*	*59*	*44*
Ocean pout	**Loquette d'Amérique**		**...C**		***Macrozoarces americanus***				**1,71(15)012,02**	**OPT**
21 USA	18	12	26	6	4	5	4	7	3	0
21 Fishing area total	*18*	*12*	*26*	*6*	*4*	*5*	*4*	*7*	*3*	*0*
Species total	*18*	*12*	*26*	*6*	*4*	*5*	*4*	*7*	*3*	*0*
Pacific sandlance	**Lançon du Pacifique**		**Lanzón del Pacífico**		***Ammodytes personatus***				**1,72(04)002,04**	**PAS**
61 China	...	...	220 766 F	191 962 F	197 247 F	162 720 F	139 866	128 684	146 525	153 599
Japan	88 164	67 564	60 076	66 770	67 591	110 925	46 921	62 116	32 753	68 200 F
Korea Rep	4 803	5 145	2 419	223	1 160	1 546	1 631	6 702	2 380	13 557
Russian Fed	-	192	360	306	445	835	11	27	5	25
61 Fishing area total	*92 967*	*72 901*	*283 621 F*	*259 261 F*	*266 443 F*	*276 026 F*	*188 429*	*197 529*	*181 663*	*235 381 F*
Species total	*92 967*	*72 901*	*283 621 F*	*259 261 F*	*266 443 F*	*276 026 F*	*188 429*	*197 529*	*181 663*	*235 381 F*
Sandeels(=Sandlances) nei	**Lançons nca**		**Lanzones nep**		***Ammodytes spp***				**1,72(04)002,XX**	**SAN**
21 Canada	-	-	-	2	8	5	3	5	0	-
USA	0	0	-	-	7	2	3	4	3	2
21 Fishing area total	*0*	*0*	*-*	*2*	*15*	*7*	*6*	*9*	*3*	*2*
27 Channel Is	41	40	38	1	56	45	60	46	52	57
Denmark	666 295	662 402	283 158	299 606	157 124	256 763	167 271	255 645	305 561	292 516
Faroe Is	-	18 549	5 168	3 476	-	-	2 448	2 385	1 390	1 327
France	50	86	165	162	184	118	116	102	139	109
Germany	-	-	534	2 658	1	3 605	1 989	4 383	12 234	13 000
Iceland	8	-	-	-	-	-	-	-	-	1
Ireland	-	10	-	-	-	-	-	-	-	-
Isle of Man	-	-	-	1	...	0	1	1	1	-
Lithuania	-	-	-	-	-	-	-	-	2 941	593
Netherlands	-	-	-	-	-	-	-	-	1 422	-
Norway	187 459	175 985	29 641	48 668	17 342	5 815	51 134	81 553	27 418	78 013
Poland	-	-	-	1	2	2	1	0	0	2
Portugal	40	34	12	34	18	8	4	2	2	3
Russian Fed	-	-	-	-	1	-	-	-	-	-
Spain	584	280	267	24	399	347	478	157	153	95
Sweden	50 559	55 953	21 998	34 607	8 799	32 767	8 049	12 515	12 650	32 741
UK	1 264	3 691	303	595	0	703	1 669	6 272	3 616	3 966
27 Fishing area total	*906 300*	*917 030*	*341 284*	*389 833*	*183 926*	*300 173*	*233 220*	*363 061*	*367 579*	*422 423*
37 France	1	0	-	-	-	-	-	-	-	-
Italy	...	...	...	...	266	229	299	43	108	180
Spain	105	428	238	403	247	104	192	928	444	604
37 Fishing area total	*106*	*428*	*238*	*403*	*513*	*333*	*491*	*971*	*552*	*784*
Species total	*906 406*	*917 458*	*341 522*	*390 238*	*184 454*	*300 513*	*233 717*	*364 041*	*368 134*	*423 209*
Brazilian flathead	**Platête brésilien**		**Pez palo**		***Percophis brasiliensis***				**1,72(08)202,01**	**FLA**
41 Argentina	8 324	5 433	6 268	6 101	7 741	8 546	7 636	8 076	8 068	7 784
Brazil	633	747	714	696	738	593	941	741	818	772
Uruguay	0	0	0	0	0	0	0	-	-	-
41 Fishing area total	*8 957*	*6 180*	*6 982*	*6 797*	*8 479*	*9 139*	*8 577*	*8 817*	*8 886*	*8 556*
Species total	*8 957*	*6 180*	*6 982*	*6 797*	*8 479*	*9 139*	*8 577*	*8 817*	*8 886*	*8 556*
Pacific sandperch	**Tile blanquille**		**Blanquillo**		***Prolatilus jugularis***				**1,72(09)005,01**	**ROJ**
87 Chile	53	52	27	62	40	27	35	55	60	32
87 Fishing area total	*53*	*52*	*27*	*62*	*40*	*27*	*35*	*55*	*60*	*32*
Species total	*53*	*52*	*27*	*62*	*40*	*27*	*35*	*55*	*60*	*32*
Argentinian sandperch	**...B**		**Salmón de mar**		***Pseudopercis semifasciata***				**1,72(09)006,02**	**UPR**
41 Argentina	2 007	1 778	2 232	2 237	2 902	2 724	2 627	2 602	2 258	1 759
Brazil	...	460	461	510	704	665	687	610	673	635
Uruguay	0	0	1	156	162	73	10	12	...	1
41 Fishing area total	*2 007*	*2 238*	*2 694*	*2 903*	*3 768*	*3 462*	*3 324*	*3 224*	*2 931*	*2 395*
Species total	*2 007*	*2 238*	*2 694*	*2 903*	*3 768*	*3 462*	*3 324*	*3 224*	*2 931*	*2 395*
New Zealand blue cod	**...B**		**...C**		***Parapercis colias***				**1,72(09)196,02**	**NEB**
81 New Zealand	2 441	2 376	2 463	2 469	2 572	2 126	2 413	2 292	2 349	2 271
81 Fishing area total	*2 441*	*2 376*	*2 463*	*2 469*	*2 572*	*2 126*	*2 413*	*2 292*	*2 349*	*2 271*
Species total	*2 441*	*2 376*	*2 463*	*2 469*	*2 572*	*2 126*	*2 413*	*2 292*	*2 349*	*2 271*
Brazilian sandperch	**Pinge brésilien**		**Chanchito**		***Pinguipes brasilianus***				**1,72(09)288,01**	**PJR**
41 Argentina	-	-	-	-	-	-	1	2	6	15
41 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*1*	*2*	*6*	*15*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	-	-	-	-	-	-	*1*	*2*	*6*	*15*
Chilean sandperch	**Pinge chilien**		**Rollizo**		***Pinguipes chilensis***				**1,72(09)288,02**	**JPC**
87 Chile	...	...	...	34	56	27	25	51	76	37
87 Fishing area total	*...*	*...*	*...*	*34*	*56*	*27*	*25*	*51*	*76*	*37*
Species total	*...*	*...*	*...*	*34*	*56*	*27*	*25*	*51*	*76*	*37*
Greater weever	**Grande vive**		**Escorpión**		***Trachinus draco***				**1,72(12)010,02**	**WEG**
27 Denmark	48	98	84	88	196	1 721	379	41	38	46
France	203	210	195	194	194	247	346	148	385	314
Ireland	691	616	-	-	-	-	-	-	-	-
Netherlands	6	0	1	-	1	-	3	9	13	4
Portugal	11	22	60	49	36	13	11	11	15	12
Spain	-	-	-	3	13	52	31	32	15	39
Sweden	26	9	7	8	8	19	213	555	960	92
UK	-	-	1	1	1	-	0	-	1	8
27 Fishing area total	*985*	*955*	*348*	*343*	*449*	*2 052*	*983*	*796*	*1 427*	*515*
37 Albania	...	...	...	48	51	118	-	-	-	-
Algeria	...	...	...	...	...	...	3	8	8	5
Croatia	...	...	...	...	...	...	...	...	1	1
France	3	5	5	5	5	11	14	7	8	14
Malta	0	-	-	-	-	-	-	-	1	0
Slovenia	-	-	-	-	-	0	0	1	0	0
Spain	57	67	72	90	95	88	74	79	99	120
Tunisia	20	13	13	30	9	9	11	9	17	18
37 Fishing area total	*80*	*85*	*90*	*173*	*160*	*226*	*102*	*104*	*134*	*158*
Species total	*1 065*	*1 040*	*438*	*516*	*609*	*2 278*	*1 085*	*900*	*1 561*	*673*
Weevers nei	**Vives nca**		**Arañas nep**		***Trachinus spp***				**1,72(12)010,XX**	**WEX**
34 Morocco	1 593	1 633	2 001	1 287	1 353	1 088	1 234	1 026	764	643
34 Fishing area total	*1 593*	*1 633*	*2 001*	*1 287*	*1 353*	*1 088*	*1 234*	*1 026*	*764*	*643*
37 Morocco	19	1	8	13	16	16	14	12	10	22
37 Fishing area total	*19*	*1*	*8*	*13*	*16*	*16*	*14*	*12*	*10*	*22*
Species total	*1 612*	*1 634*	*2 009*	*1 300*	*1 369*	*1 104*	*1 248*	*1 038*	*774*	*665*
Weeverfishes nei	**Vives, etc. nca**		**Arañas, escorpiones nep**		***Trachinidae***				**1,72(12)XXX,XX**	**TRA**
37 Italy	...	...	...	...	95	336	355	267	225	208
37 Fishing area total	*...*	*...*	*...*	*...*	*95*	*336*	*355*	*267*	*225*	*208*
Species total	*...*	*...*	*...*	*...*	*95*	*336*	*355*	*267*	*225*	*208*
Black goby	**Gobie noir**		**Chaparrudo**		***Gobius niger***				**1,73(21)003,03**	**GBN**
37 Slovenia	1	1	1	6	3	2	3	1	2	0
37 Fishing area total	*1*	*1*	*1*	*6*	*3*	*2*	*3*	*1*	*2*	*0*
Species total	*1*	*1*	*1*	*6*	*3*	*2*	*3*	*1*	*2*	*0*
Transparent goby	**Nonnat**		**Chanquete**		***Aphia minuta***				**1,73(21)004,01**	**FIM**
37 Italy	...	...	...	...	365	239	224	236	200	204
Malta	...	...	...	...	...	2	3	2	1	0
37 Fishing area total	*...*	*...*	*...*	*...*	*365*	*241*	*227*	*238*	*201*	*204*
Species total	*...*	*...*	*...*	*...*	*365*	*241*	*227*	*238*	*201*	*204*
Common goby	**Gobie commun**		**...C**		***Pomatoschistus microps***				**1,73(21)017,02**	**OBD**
05 Latvia	-	-	-	-	-	-	-	-	-	1
05 Fishing area total	-	-	-	-	-	-	-	-	-	*1*
Species total	-	-	-	-	-	-	-	-	-	*1*
Gobies nei	**Gobies nca**		**Góbidos nep**		***Gobiidae***				**1,73(21)XXX,XX**	**GPA**
27 Poland	-	-	-	8	19	7	4	2	0	1
Portugal	-	-	-	-	-	-	1	1	-	-
Spain	-	-	-	1	1	3	1	0	1	1
27 Fishing area total	-	-	-	*9*	*20*	*10*	*6*	*3*	*1*	*2*
37 Bulgaria	142	142	125	79	49	31	74	26	37	44
France	1	3	3	4	5	4	1	4	5	18
Georgia	5	32	4	2	3	2 F	0	0	0	0
Italy	665	695	647	526	442	469	701	603	584	514
Romania	24	46	47	74	95	23	19	12	16	13
Russian Fed	25	44	395	1 289	1 418	477	1 675	1 977	1 405	1 919
Spain	378	294	265	310	282	241	228	241	161	123
Turkey	335	201	170	210	141	113	136	164	124	130
Ukraine	1 510	3 582	6 577	12 411	11 697	9 947	7 650	8 720	7 698	8 823
37 Fishing area total	*3 085*	*5 039*	*8 233*	*14 905*	*14 132*	*11 307 F*	*10 484*	*11 747*	*10 030*	*11 584*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
47 Namibia	-	-	-	-	2	-	0	...	2	2 F
47 Fishing area total	*-*	*-*	*-*	*-*	*2*	*-*	*0*	*...*	*2*	*2 F*
61 Korea Rep	703	388	789	1 105	7 486	2 081	1 661	909	1 058	688
Russian Fed	27 321	22 099	17 169	16 007	21 874	12 313	7 221	6 830	8 524	21 066
61 Fishing area total	*28 024*	*22 487*	*17 958*	*17 112*	*29 360*	*14 394*	*8 882*	*7 739*	*9 582*	*21 754*
71 Philippines	9 032	9 979	12 121	12 290	10 729	12 791	11 988	10 653	11 635	12 214
71 Fishing area total	*9 032*	*9 979*	*12 121*	*12 290*	*10 729*	*12 791*	*11 988*	*10 653*	*11 635*	*12 214*
Species total	*40 141*	*37 505*	*38 312*	*44 316*	*54 243*	*38 502 F*	*31 360*	*30 142*	*31 250*	*45 556 F*
Sohal surgeonfish	**...B**		**...C**		***Acanthurus sohal***				**1,74(02)004,16**	**AVQ**
51 Saudi Arabia	24	26	56	42	62	17	12	43	50	50
51 Fishing area total	*24*	*26*	*56*	*42*	*62*	*17*	*12*	*43*	*50*	*50*
Species total	*24*	*26*	*56*	*42*	*62*	*17*	*12*	*43*	*50*	*50*
Bluespine unicornfish	**Nason à éperons bleus**		**Berbero de aguijon azul**		***Naso unicornis***				**1,74(02)008,02**	**NAS**
51 Saudi Arabia	191	133	145	113	138	182	179	163	210	210
51 Fishing area total	*191*	*133*	*145*	*113*	*138*	*182*	*179*	*163*	*210*	*210*
Species total	*191*	*133*	*145*	*113*	*138*	*182*	*179*	*163*	*210*	*210*
Surgeonfishes nei	**Chirurgiens nca**		**Navajones nep**		***Acanthuridae***				**1,74(02)XXX,XX**	**SUR**
31 Antigua Barb	158	237	196	141	254	289	259	236	189	119
Grenada	2	2	1	3	2	3	5	4	3	2
St Kitts Nev	0	4	20 F	40	36 F	32 F	29 F	25 F	21 F	17
US Virgin Is	...	...	53	47	46	39	33	36	34	-
31 Fishing area total	*160*	*243*	*270 F*	*231*	*338 F*	*363 F*	*326 F*	*301 F*	*247 F*	*138*
34 Senegal	...	...	183	1 093	661	183	181	163	311	253
34 Fishing area total	*...*	*...*	*183*	*1 093*	*661*	*183*	*181*	*163*	*311*	*253*
51 Eritrea	...	...	...	...	...	...	1	0	0	0
Saudi Arabia	149	29	13	12	4	3	7	13	17	17
51 Fishing area total	*149*	*29*	*13*	*12*	*4*	*3*	*8*	*13*	*17*	*17*
71 Fiji	196	170 F	146	255	260 F	268	212	400	70	100
Guam	31	17	23	32	15	16	16	23	17	2
N Marianas	10	2	0	0	1	3	1	1	2	2
Palau	46	40	47	35	33	30	23	21	21 F	21 F
Philippines	6 211	9 171	8 317	7 340	5 960	5 688	6 608	6 421	6 889	7 639
71 Fishing area total	*6 494*	*9 400 F*	*8 533*	*7 662*	*6 269 F*	*6 005*	*6 860*	*6 866*	*6 999 F*	*7 764 F*
77 Amer Samoa	3	2	5	2	4	2	6	4	6	7
USA	-	60	50	32	37	30	39	35	38	51
77 Fishing area total	*3*	*62*	*55*	*34*	*41*	*32*	*45*	*39*	*44*	*58*
Species total	*6 806*	*9 734 F*	*9 054 F*	*9 032*	*7 313 F*	*6 586 F*	*7 420 F*	*7 382 F*	*7 618 F*	*8 230 F*
Batfishes	**Poules d'eau**		**Dalapuganos**		***Platax spp***				**1,74(05)206,XX**	**BAT**
51 Bahrain	...	...	...	5	5	18	29	16	9	5
Eritrea	0	0	0	0	0	0	...	...	...	...
51 Fishing area total	*0*	*0*	*0*	*5*	*5*	*18*	*29*	*16*	*9*	*5*
71 Philippines	2 830	3 191	3 303	3 204	2 525	2 893	2 798	3 246	3 277	3 040
71 Fishing area total	*2 830*	*3 191*	*3 303*	*3 204*	*2 525*	*2 893*	*2 798*	*3 246*	*3 277*	*3 040*
Species total	*2 830*	*3 191*	*3 303*	*3 209*	*2 530*	*2 911*	*2 827*	*3 262*	*3 286*	*3 045*
Pacific spadefish	**Disque du Pacifique**		**Paguala peluquero**		***Chaetodipterus zonatus***				**1,74(05)267,02**	**HTZ**
87 Ecuador	...	...	...	...	...	42	29	16	...	...
87 Fishing area total	*...*	*...*	*...*	*...*	*...*	*42*	*29*	*16*	*...*	*...*
Species total	*...*	*...*	*...*	*...*	*...*	*42*	*29*	*16*	*...*	*...*
Spadefishes nei	**Chèvres, disques nca**		**Pagualas nep**		***Ephippidae***				**1,74(05)XXX,XX**	**SPA**
21 USA	20	10	5	6	11	4	15	6	4	15
21 Fishing area total	*20*	*10*	*5*	*6*	*11*	*4*	*15*	*6*	*4*	*15*
31 USA	1	6	-	7	20	7	6	26	10	-
31 Fishing area total	*1*	*6*	*-*	*7*	*20*	*7*	*6*	*26*	*10*	*-*
34 Benin	2	1	4	7	17	9	7	3	9	3
Mauritania	...	...	...	...	...	...	...	...	...	33
Togo	-	-	1	-	-	-	-	-	-	-
34 Fishing area total	*2*	*1*	*5*	*7*	*17*	*9*	*7*	*3*	*9*	*36*
41 Brazil	409	208	170	265	315	250	198	246	271	256
41 Fishing area total	*409*	*208*	*170*	*265*	*315*	*250*	*198*	*246*	*271*	*256*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
51 Eritrea	...	...	...	...	...	1	...	...	...	...
Saudi Arabia	...	...	...	...	8	...	1	5	2	8
51 Fishing area total	*...*	*...*	*...*	*...*	*8*	*1*	*1*	*5*	*2*	*8*
Species total	*432*	*225*	*180*	*285*	*371*	*271*	*227*	*286*	*296*	*315*
Scats	**Pavillons**		**Pingos**		***Scatophagus spp***				**1,74(06)330,XX**	**SCT**
04 Philippines	55	30	40	55	82	151	211	239	246	207
04 Fishing area total	*55*	*30*	*40*	*55*	*82*	*151*	*211*	*239*	*246*	*207*
71 Philippines	3 162	3 313	3 005	2 370	2 166	2 414	2 805	3 288	2 766	3 005
71 Fishing area total	*3 162*	*3 313*	*3 005*	*2 370*	*2 166*	*2 414*	*2 805*	*3 288*	*2 766*	*3 005*
Species total	*3 217*	*3 343*	*3 045*	*2 425*	*2 248*	*2 565*	*3 016*	*3 527*	*3 012*	*3 212*
Spinefeet(=Rabbitfishes) nei	**Sigans nca**		**Síganos nep**		***Siganus spp***				**1,74(07)001,XX**	**SPI**
37 Cyprus	31	57	44	30	19	19	55	53	45	47
Egypt	904	923	717	610	745	1 248	1 146	1 102	945	1 008
Israel	...	...	...	...	...	34	6	6 F	...	...
Libya	...	...	...	...	...	...	415	721	540	530 F
Palest, O.T.	5 F	3	1	0	1	4	2	2	37	13
Syria	84	118	120	112	153	97	103	117	103	98
37 Fishing area total	*1 024 F*	*1 101*	*882*	*752*	*918*	*1 402*	*1 727*	*2 001 F*	*1 670*	*1 696 F*
51 Bahrain	1 899	2 009	2 273	1 836	1 802	2 602	1 695	1 607	1 366	1 700
Egypt	1 402	665	335	391	593	243	860	1 298	478	710
Eritrea	0	0	0	0	0	0	0	-	-	-
Iran	682	983	634	556	957	986	620	622	793	1 202
Jordan	11	8	-	5	6	4	4	3	10	6
Kenya	403	469	382	388	423	412	420	484	504	675
Mauritius	450	365	404	319	345	90	200	111	274	372
Oman	363	559	709	815	1 155	669	843	749	893	513
Qatar	451	400	469	432	658	527	516	445	422	542
Saudi Arabia	1 998	1 972	2 151	2 276	2 402	2 393	1 984	1 890	2 075	2 170
Seychelles	91	203	255	317	241	279	215	191	222	255
Tanzania	3 000	3 200	3 250	3 000	3 600	1 481	1 792	1 902	2 100	2 494
Untd Arab Em	2 100	1 234	1 355	1 330 F	1 315	1 330 F	1 350 F	1 357	1 558	1 711
Zanzibar	1 109	1 186	710	1 101	1 060	1 266	932	1 003	1 012	1 023
51 Fishing area total	*13 959*	*13 253*	*12 927*	*12 766 F*	*14 557*	*12 282 F*	*11 431 F*	*11 662*	*11 707*	*13 373*
57 Indonesia	...	...	...	146	1 087	1 325	2 513	2 083	2 786	2 453
Malaysia	87	49	12	85	19	156	80	134	109	234
57 Fishing area total	*87*	*49*	*12*	*231*	*1 106*	*1 481*	*2 593*	*2 217*	*2 895*	*2 687*
71 Fiji	96	110 F	122	156	155 F	157	127	145	100	100
Guam	11	9	7	5	3	6	6	5	3	-
Indonesia	...	...	...	3 574	5 493	12 448	13 973	15 090	26 359	17 593
Malaysia	1 407	1 683	1 595	1 454	1 254	1 695	1 419	2 013	1 845	1 879
N Marianas	4	4	3	2	1	3	3	1	1	1
Palau	11	6	5	4	4	8	...	0	0	0
Philippines	20 336	17 581	18 527	19 125	22 352	25 826	31 866	29 810	26 494	25 882
Singapore	8	12	10	6	11	11	12	17	12	6
71 Fishing area total	*21 873*	*19 405 F*	*20 269*	*24 326*	*29 273 F*	*40 154*	*47 406*	*47 081*	*54 814*	*45 461*
Species total	*36 943 F*	*33 808 F*	*34 090*	*38 075 F*	*45 854 F*	*55 319 F*	*63 157 F*	*62 961 F*	*71 086*	*63 217 F*
Lingcod	**Morue-lingue**		**Bacalao largo(=Lorcha)**		***Ophiodon elongatus***				**1,78(07)005,01**	**CLI**
67 Canada	2 511	2 673	2 765	2 842	2 798	2 416	2 555	2 321	2 029	1 610
USA	153	208	147	130	162	225	220	241	192	370
67 Fishing area total	*2 664*	*2 881*	*2 912*	*2 972*	*2 960*	*2 641*	*2 775*	*2 562*	*2 221*	*1 980*
77 USA	34	44	37	48	43	36	50	42	41	38
77 Fishing area total	*34*	*44*	*37*	*48*	*43*	*36*	*50*	*42*	*41*	*38*
Species total	*2 698*	*2 925*	*2 949*	*3 020*	*3 003*	*2 677*	*2 825*	*2 604*	*2 262*	*2 018*
Okhotsk atka mackerel	**Terpuga arabesque de Okhotsk**		**Lorcha de Okhotsk**		***Pleurogrammus azonus***				**1,78(07)014,02**	**ATK**
61 Japan	161 160	154 736	167 989	175 544	140 450	116 391	139 154	169 807	119 325	84 200 F
Korea D P Rp	3 000 F	3 000 F	3 000 F	3 000 F	3 000 F	3 000 F	3 000 F	3 000 F	3 000 F	3 000 F
Korea Rep	1 261	627	3 083	772	1 048	1 294	1 266	758	191	1 470
Russian Fed	49 171	55 570	60 787	49 305	44 451	45 912	48 804	56 320	59 837	68 864
61 Fishing area total	*214 592 F*	*213 933 F*	*234 859 F*	*228 621 F*	*188 949 F*	*166 597 F*	*192 224 F*	*229 885 F*	*182 353 F*	*157 534 F*
Species total	*214 592 F*	*213 933 F*	*234 859 F*	*228 621 F*	*188 949 F*	*166 597 F*	*192 224 F*	*229 885 F*	*182 353 F*	*157 534 F*
Atka mackerel	**Terpuga atka**		**Lorcha de atka**		***Pleurogrammus monopterygius***				**1,78(07)014,03**	**HUM**
67 USA	57 096	37 759	45 152	49 508	58 733	59 337	57 422	57 620	71 164	65 865
67 Fishing area total	*57 096*	*37 759*	*45 152*	*49 508*	*58 733*	*59 337*	*57 422*	*57 620*	*71 164*	*65 865*
Species total	*57 096*	*37 759*	*45 152*	*49 508*	*58 733*	*59 337*	*57 422*	*57 620*	*71 164*	*65 865*
Kelp greenling	**...B**		**...C**		***Hexagrammos decagrammus***				**1,78(07)029,02**	**HXQ**
67 USA	-	-	-	-	-	15	18	22	21	18

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
67 Fishing area total	-	-	-	-	-	*15*	*18*	*22*	*21*	*18*
Species total	-	-	-	-	-	*15*	*18*	*22*	*21*	*18*
Spotfin flathead	**Platycéphale épée**		**...C**			***Grammoplites suppositus***			**1,78(09)003,02**	**GMK**
51 Saudi Arabia	4	13	16	37	41	48	19	98	50	49
51 Fishing area total	*4*	*13*	*16*	*37*	*41*	*48*	*19*	*98*	*50*	*49*
Species total	*4*	*13*	*16*	*37*	*41*	*48*	*19*	*98*	*50*	*49*
Bartail flathead	**Platycéphale indien**		**Chato índico**			***Platycephalus indicus***			**1,78(09)018,01**	**FLI**
51 Iran	961	1 083	1 252	1 160	1 359	1 183	1 114	1 291	1 370	1 339
51 Fishing area total	*961*	*1 083*	*1 252*	*1 160*	*1 359*	*1 183*	*1 114*	*1 291*	*1 370*	*1 339*
61 Korea Rep	1 699	1 199	1 495	1 477	1 738	1 948	1 790	2 082	2 220	2 215
61 Fishing area total	*1 699*	*1 199*	*1 495*	*1 477*	*1 738*	*1 948*	*1 790*	*2 082*	*2 220*	*2 215*
Species total	*2 660*	*2 282*	*2 747*	*2 637*	*3 097*	*3 131*	*2 904*	*3 373*	*3 590*	*3 554*
Flatheads nei	**Platycéphalidés nca**		**Platicefálidos nep**			***Platycephalidae***			**1,78(09)XXX,XX**	**FLH**
51 Bahrain	...	...	...	11	5	29	1	1	5	4
Eritrea	11	1	0	1	0	0	...	...	...	...
51 Fishing area total	*11*	*1*	*0*	*12*	*5*	*29*	*1*	*1*	*5*	*4*
57 Australia	2 432	2 876	3 781	5 173	5 064	3 678	3 071	3 380	2 896	3 011
Malaysia	...	...	...	147	...	...	...	...	...	...
57 Fishing area total	*2 432*	*2 876*	*3 781*	*5 320*	*5 064*	*3 678*	*3 071*	*3 380*	*2 896*	*3 011*
71 Australia	...	0	57	83	88	77	1	0	-	60
Malaysia	...	...	...	35	...	...	...	...	...	...
71 Fishing area total	*...*	*0*	*57*	*118*	*88*	*77*	*1*	*0*	*...*	*60*
81 Australia	1 671	1 527	1 849	1 800	921	850	855	985	916	794
New Zealand	19	51	46	59	63	44	30	21	17	13
81 Fishing area total	*1 690*	*1 578*	*1 895*	*1 859*	*984*	*894*	*885*	*1 006*	*933*	*807*
Species total	*4 133*	*4 455*	*5 733*	*7 309*	*6 141*	*4 678*	*3 958*	*4 387*	*3 834*	*3 882*
Cabezon	**...B**		**Cabezón**			***Scorpaenichthys marmoratus***			**1,78(13)030,01**	**SMQ**
67 USA	50	49	29	30	32	25	25	27	32	25
67 Fishing area total	*50*	*49*	*29*	*30*	*32*	*25*	*25*	*27*	*32*	*25*
77 USA	69	48	38	46	28	26	23	21	17	21
77 Fishing area total	*69*	*48*	*38*	*46*	*28*	*26*	*23*	*21*	*17*	*21*
Species total	*119*	*97*	*67*	*76*	*60*	*51*	*48*	*48*	*49*	*46*
Sculpins nei	**Chabots nca**		**Cótidos nep**			***Cottidae***			**1,78(13)XXX,XX**	**SWU**
21 USA	1	0	1	0	0	0	2	0	0	0
21 Fishing area total	*1*	*0*	*1*	*0*	*0*	*0*	*2*	*0*	*0*	*0*
67 USA	71	158	363	417	200	261	583	711	973	383
67 Fishing area total	*71*	*158*	*363*	*417*	*200*	*261*	*583*	*711*	*973*	*383*
77 USA	3	3	2	2	1	1	1	2	2	1
77 Fishing area total	*3*	*3*	*2*	*2*	*1*	*1*	*1*	*2*	*2*	*1*
Species total	*75*	*161*	*366*	*419*	*201*	*262*	*586*	*713*	*975*	*384*
Mote sculpin	**Mote**		**Mote camotillo**			***Normanichthys crockeri***			**1,78(16)022,05**	**NRC**
87 Chile	223	4 371	9 319	70 465	110 383	319 476	20 302	67 409	170 025	32 291
87 Fishing area total	*223*	*4 371*	*9 319*	*70 465*	*110 383*	*319 476*	*20 302*	*67 409*	*170 025*	*32 291*
Species total	*223*	*4 371*	*9 319*	*70 465*	*110 383*	*319 476*	*20 302*	*67 409*	*170 025*	*32 291*
Flying gurnard	**Grondin volant**		**Alón volador**			***Dactylopterus volitans***			**1,78(24)002,01**	**DYL**
37 Spain	-	-	-	5	4	3	4	5	4	4
37 Fishing area total	-	-	-	*5*	*4*	*3*	*4*	*5*	*4*	*4*
Species total	-	-	-	*5*	*4*	*3*	*4*	*5*	*4*	*4*
Boxfishes nei	**Coffres nca**		**Toritos nep**			***Ostraciidae***			**1,90(01)XXX,XX**	**BXF**
31 Antigua Barb	66	38	40	66	81	101	81	76	70	50
Br Virgin Is	12	29	105	34	35 F	35 F	35 F	30 F	30 F	30 F
Puerto Rico	52	42	47	39	40	35	24	26	27	27
US Virgin Is	...	...	24	-	-	-	17	17	19	-
31 Fishing area total	*130*	*109*	*216*	*139*	*156 F*	*171 F*	*157 F*	*149 F*	*146 F*	*107 F*
Species total	*130*	*109*	*216*	*139*	*156 F*	*171 F*	*157 F*	*149 F*	*146 F*	*107 F*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Northern puffer	**Compère bigaré**		**Tamboril norteño**		***Sphoeroides maculatus***				**1,90(02)006,12**	**PUF**
21 Spain	-	-	-	6	-	-	-	-	-	-
USA	35	57	36	27	12	5	5	17	51	22
21 Fishing area total	*35*	*57*	*36*	*33*	*12*	*5*	*5*	*17*	*51*	*22*
Species total	*35*	*57*	*36*	*33*	*12*	*5*	*5*	*17*	*51*	*22*
Puffers nei	**Compères nca**		**Tamboriles nep**		***Tetraodontidae***				**1,90(02)XXX,XX**	**PUX**
34 Benin	2	5	1	5	...	...	...	38	...	...
Gambia	33	81	3	1 222	190	423	687	166	177	177
Ghana	...	...	...	...	...	...	...	149	...	...
Korea Rep	-	-	4	29	29	25	47	28	33	52
Mauritania	...	...	...	...	...	...	...	...	...	18
Senegal	...	...	375	1 084	342	2 111	1 108	991	664	503
34 Fishing area total	*35*	*86*	*383*	*2 340*	*561*	*2 559*	*1 842*	*1 372*	*874*	*750*
37 Cyprus	-	-	-	-	-	-	-	-	-	23
37 Fishing area total	-	-	-	-	-	-	-	-	-	*23*
41 Brazil	34	201	143	297	682	724	409	596	657	621
41 Fishing area total	*34*	*201*	*143*	*297*	*682*	*724*	*409*	*596*	*657*	*621*
51 Korea Rep	-	-	-	1	-	-	3	-	29	-
51 Fishing area total	-	-	-	*1*	-	-	*3*	-	*29*	-
57 Australia	432	534	456	905	960	731	475	342	282	442
57 Fishing area total	*432*	*534*	*456*	*905*	*960*	*731*	*475*	*342*	*282*	*442*
61 Japan	7 820	7 869	6 340	6 704	6 266	5 693	5 052	5 207	4 184	4 900 F
Korea Rep	3 735	3 110	2 486	3 971	2 226	3 368	2 512	2 820	4 368	3 194
61 Fishing area total	*11 555*	*10 979*	*8 826*	*10 675*	*8 492*	*9 061*	*7 564*	*8 027*	*8 552*	*8 094 F*
71 Korea Rep	-	-	189	1 783	941	630	2 621	188	-	397
71 Fishing area total	-	-	*189*	*1 783*	*941*	*630*	*2 621*	*188*	-	*397*
81 Australia	232	429	548	719	353	291	231	347	335	371
Korea Rep	-	-	-	14	-	-	-	18	-	-
81 Fishing area total	*232*	*429*	*548*	*733*	*353*	*291*	*231*	*365*	*335*	*371*
Species total	*12 288*	*12 229*	*10 545*	*16 734*	*11 989*	*13 996*	*13 145*	*10 890*	*10 729*	*10 698 F*
Longspine burrfish	**...B**		**...C**		***Tragulichthys jaculiferus***				**1,90(03)006,01**	**ALJ**
81 New Zealand	-	10	5	5	3	4	7	3	5	6
81 Fishing area total	-	*10*	*5*	*5*	*3*	*4*	*7*	*3*	*5*	*6*
Species total	-	*10*	*5*	*5*	*3*	*4*	*7*	*3*	*5*	*6*
Filefishes nei	**Bourses nca**		**Cachúas nep**		***Cantherhines(=Navodon) spp***				**1,90(09)004,XX**	**FLF**
61 China	172 108 F	134 985 F	156 142 F	168 773 F	211 098 F	185 041 F	176 753	184 114	209 716	204 541
China,Taiwan	959	1 322	3 157	3 405	4 495	2 013	1 370	1 297	825	287
61 Fishing area total	*173 067 F*	*136 307 F*	*159 299 F*	*172 178 F*	*215 593 F*	*187 054 F*	*178 123*	*185 411*	*210 541*	*204 828*
Species total	*173 067 F*	*136 307 F*	*159 299 F*	*172 178 F*	*215 593 F*	*187 054 F*	*178 123*	*185 411*	*210 541*	*204 828*
Threadsail filefish	**...B**		**...C**		***Stephanolepis cirrhifer***				**1,90(09)010,01**	**FIL**
61 Korea Rep	1 578	933	1 429	1 267	1 055	1 071	2 998	2 632	8 280	3 475
61 Fishing area total	*1 578*	*933*	*1 429*	*1 267*	*1 055*	*1 071*	*2 998*	*2 632*	*8 280*	*3 475*
Species total	*1 578*	*933*	*1 429*	*1 267*	*1 055*	*1 071*	*2 998*	*2 632*	*8 280*	*3 475*
Velvet leatherjacket	**Bourse lisse**		**...C**		***Parika scaber***				**1,90(09)018,01**	**PKB**
81 New Zealand	1 142	1 012	811	662	416	443	427	515	670	666
Ukraine	-	-	2	-	-	-	-	-	-	-
81 Fishing area total	*1 142*	*1 012*	*813*	*662*	*416*	*443*	*427*	*515*	*670*	*666*
Species total	*1 142*	*1 012*	*813*	*662*	*416*	*443*	*427*	*515*	*670*	*666*
Filefishes, leatherjackets nei	**Poissons-bourses nca**		**Cachúas, lijas nep**		***Monacanthidae***				**1,90(09)XXX,XX**	**FFX**
31 Antigua Barb	...	15	23	2	2	2	11	2	11	3
31 Fishing area total	*...*	*15*	*23*	*2*	*2*	*2*	*11*	*2*	*11*	*3*
87 Chile	5 307	8 487	3 500	4 995	246	18	-	44	-	-
87 Fishing area total	*5 307*	*8 487*	*3 500*	*4 995*	*246*	*18*	-	*44*	-	-
Species total	*5 307*	*8 502*	*3 523*	*4 997*	*248*	*20*	*11*	*46*	*11*	*3*
Grey triggerfish	**Baliste cabri**		**Pejepuerco blanco**		***Balistes carolinensis***				**1,90(10)002,01**	**TRG**
27 France	4	-	2	2	1	1	21	6	7	7
Portugal	21	32	60	52	37	50	110	116	169	332
Spain	-	-	-	7	6	7	22	23	41	50
UK	-	-	-	-	2	-	1	-	1	0
27 Fishing area total	*25*	*32*	*62*	*61*	*46*	*58*	*154*	*145*	*218*	*389*

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Miscellaneous coastal fishes
Poissons côtiers divers
Peces costeros diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
37 Albania	...	...	...	1	1	1	-	-	-	-
Libya	...	...	...	...	...	...	...	...	432	420 F
Spain	-	-	-	1	2	2	4	5	-	6
Syria	4	5	12	10	35	12	19	7	15	11
Tunisia	62	96	114	134	74	85	47	163	187	246
37 Fishing area total	*66*	*101*	*126*	*146*	*112*	*100*	*70*	*175*	*634*	*683 F*
Species total	*91*	*133*	*188*	*207*	*158*	*158*	*224*	*320*	*852*	*1 072 F*
Triggerfishes, durgons nei	**Balistes nca**		**Peces-ballesta nep**		***Balistidae***				**1,90(10)XXX,XX**	**TRI**
21 USA	2	8	5	4	3	2	5	3	9	5
21 Fishing area total	*2*	*8*	*5*	*4*	*3*	*2*	*5*	*3*	*9*	*5*
31 Antigua Barb	18	83	143	89	61	124	102	72	82	44
Bermuda	14	14	10	7	9	8	13	14	24	23
Dominican Rp	21	90	133	75	41	232	73	101	91	255
Grenada	0	0	0	1	1	1	1	0	1	0
Mexico	122	53	...	...	22	23	38	21	23	25
Puerto Rico	41	28	34	32	29	24	16	20	23	25
St Kitts Nev	1	8	15 F	21	19 F	16 F	14 F	12 F	10 F	7
USA	178	191	209	216	199	153	211	195	211	233
US Virgin Is	50 F	60 F	73	66	51	45	39	49	54	53
31 Fishing area total	*445 F*	*527 F*	*617 F*	*507*	*432 F*	*626 F*	*507 F*	*484 F*	*519 F*	*665*
34 Gambia	3	1	-	-	-	1	1	0	1	0
Ghana	2	12	1	1	2	-	1	0	27	7
Liberia	0	0	0	0	4	...	5	0	0	0
Portugal	0	-	1	1	-	-	0	-	-	19
Sao Tome Prn	35 F	45 F	54	35	40 F	40 F	40 F	40 F	40 F	40 F
Senegal	52	18	22	21	25	78	21	19	35	19
Sierra Leone	...	17	8	3	9	1	29	138	135 F	135 F
Spain	-	-	-	0	28	60	51	50	61	77
Togo	0	1	0	2	1	48	-	-	-	0
34 Fishing area total	*92 F*	*94 F*	*86*	*63*	*109 F*	*228 F*	*148 F*	*247 F*	*299 F*	*297 F*
37 Israel	-	-	-	-	-	-	-	-	7	7
37 Fishing area total	-	-	-	-	-	-	-	-	*7*	*7*
41 Brazil	6 594	12 828	7 970	6 590	6 349	5 494	3 787	5 026	5 543	5 240
41 Fishing area total	*6 594*	*12 828*	*7 970*	*6 590*	*6 349*	*5 494*	*3 787*	*5 026*	*5 543*	*5 240*
51 Eritrea	0	0	0	0	0	11	...	...	...	...
Saudi Arabia	...	...	...	...	55	...	...	...	...	...
51 Fishing area total	*0*	*0*	*0*	*0*	*55*	*11*	*...*	*...*	*...*	*...*
57 Malaysia	193	221	476	336	289	257	258	223	332	170
57 Fishing area total	*193*	*221*	*476*	*336*	*289*	*257*	*258*	*223*	*332*	*170*
71 Fiji	...	30 F	59	90	100 F	111	67	100	100	150
Malaysia	2 002	1 705	1 539	1 152	2 747	1 893	1 319	2 346	1 628	922
71 Fishing area total	*2 002*	*1 735 F*	*1 598*	*1 242*	*2 847 F*	*2 004*	*1 386*	*2 446*	*1 728*	*1 072*
77 Mexico	833	901	...	...	1 167	1 219	1 555	1 181	1 198	1 271
USA	-	-	-	-	1	1	0	0	1	0
77 Fishing area total	*833*	*901*	*...*	*...*	*1 168*	*1 220*	*1 555*	*1 181*	*1 199*	*1 271*
Species total	*10 161 F*	*16 314 F*	*10 752 F*	*8 742*	*11 252 F*	*9 842 F*	*7 646 F*	*9 610 F*	*9 636 F*	*8 727 F*
Bocon toadfish	**Crapaud goulu**		**Sapo bocón**		***Amphichthys cryptocentrus***				**1,93(01)001,01**	**BAY**
41 Brazil	...	105	239	218	304	340	311	312	344	325
41 Fishing area total	*...*	*105*	*239*	*218*	*304*	*340*	*311*	*312*	*344*	*325*
Species total	*...*	*105*	*239*	*218*	*304*	*340*	*311*	*312*	*344*	*325*
Lusitanian toadfish	**Crapaud-lusitanien**		**Sapo lusitánico**		***Halobatrachus didactylus***				**1,93(01)006,01**	**BHD**
34 Morocco	-	-	1	1	0	1	-	-	-	-
34 Fishing area total	-	-	*1*	*1*	*0*	*1*	-	-	-	-
Species total	-	-	*1*	*1*	*0*	*1*	-	-	-	-
Toadfishes, etc. nei	**Crapauds, etc. nca**		**Sapos, etc. nep**		***Batrachoididae***				**1,93(01)XXX,XX**	**TFD**
21 USA	27	22	8	1	2	2	4	14	18	13
21 Fishing area total	*27*	*22*	*8*	*1*	*2*	*2*	*4*	*14*	*18*	*13*
27 Portugal	75	86	63	52	257	69	55	56	53	56
27 Fishing area total	*75*	*86*	*63*	*52*	*257*	*69*	*55*	*56*	*53*	*56*
Species total	*102*	*108*	*71*	*53*	*259*	*71*	*59*	*70*	*71*	*69*
Group total	***6 143 935***	***6 157 314***	***6 484 809***	***6 727 393***	***6 476 815***	***6 997 601***	***6 579 644***	***6 984 404***	***7 231 685***	***7 237 005***

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Greater argentine	**Grande argentine**		**...C**		***Argentina silus***				**1,23(05)015,03**	**ARU**
27 Germany	-	-	-	-	-	-	177	-	30	-
Netherlands	...	...	2 611	10 662	3 637	1 062	3 866	3 026	...	2 903
Norway	...	...	...	...	...	1 821	2 204	986	864	665
27 Fishing area total	*...*	*...*	*2 611*	*10 662*	*3 637*	*2 883*	*6 247*	*4 012*	*894*	*3 568*
Species total	*...*	*...*	*2 611*	*10 662*	*3 637*	*2 883*	*6 247*	*4 012*	*894*	*3 568*
Argentine	**Petite argentine**		**Pez plata**		***Argentina sphyraena***				**1,23(05)015,04**	**ARY**
27 Germany	-	-	-	-	-	-	412	10	85	-
Netherlands	...	...	-	-	2 232	3 566	3 103	1 130	698	248
Norway	...	...	...	...	...	2 584	1 651	593	784	671
27 Fishing area total	*...*	*...*	*...*	*...*	*2 232*	*6 150*	*5 166*	*1 733*	*1 567*	*919*
Species total	*...*	*...*	*...*	*...*	*2 232*	*6 150*	*5 166*	*1 733*	*1 567*	*919*
Argentines	**Argentines**		**Argentinas**		***Argentina spp***				**1,23(05)015,XX**	**ARG**
21 Canada	17	20	12	1	3	2	0	0	0	2
21 Fishing area total	*17*	*20*	*12*	*1*	*3*	*2*	*0*	*0*	*0*	*2*
27 Denmark	916	614	918	910	470	335	-	-	-	-
Faroe Is	9 572	7 058	6 264	3 441	7 055	12 576	14 339	15 921	18 193	18 627
France	41	1	-	147	11	-	0	0	13	10
Germany	189	150	164	1 086	181	219	-	-	-	-
Iceland	2 478	4 357	2 680	3 645	-	4 776	4 246	9 038	11 644	16 569
Ireland	7 505	7 592	96	82	20	-	-	-	0	0
Netherlands	3 659	4 213	-	-	-	-	-	-	1 790	-
Norway	14 876	7 406	8 351	11 578	17 073	20 744	12 552	11 849	11 930	11 536
Portugal	-	-	-	-	-	0	1	-	2	2
Russian Fed	496	293	154	721	79	39	9	20	64	13
Spain	34	3	7	18	19	50	40	27	7	16
Sweden	1 010	484	42	0	-	0	-	0	-	-
UK	7 955	4 862	109	579	75	5	-	-	6	95
27 Fishing area total	*48 731*	*37 033*	*18 785*	*22 207*	*24 983*	*38 744*	*31 187*	*36 855*	*43 649*	*46 868*
34 Morocco	107	144	139	229	296	509	555	286	521	57
34 Fishing area total	*107*	*144*	*139*	*229*	*296*	*509*	*555*	*286*	*521*	*57*
37 France	4	7	5	7	6	5	2	3	4	9
Morocco	8	9	75	72	33	50	41	37	31	5
Spain	65	50	52	68	70	73	50	49	38	41
37 Fishing area total	*77*	*66*	*132*	*147*	*109*	*128*	*93*	*89*	*73*	*55*
81 New Zealand	56	101	131	74	36	136	306	48	69	71
Ukraine	-	1	7	4	...	-	-	-	-	-
81 Fishing area total	*56*	*102*	*138*	*78*	*36*	*136*	*306*	*48*	*69*	*71*
Species total	*48 988*	*37 365*	*19 206*	*22 662*	*25 427*	*39 519*	*32 141*	*37 278*	*44 312*	*47 053*
Deep-sea smelt	**Argentina du Pacifique**		**Argentina del Pacífico**		***Glossanodon semifasciatus***				**1,23(05)029,01**	**DES**
61 Japan	5 414	4 926	4 495	5 223	4 180	4 570	4 689	4 921	4 357	4 000 F
61 Fishing area total	*5 414*	*4 926*	*4 495*	*5 223*	*4 180*	*4 570*	*4 689*	*4 921*	*4 357*	*4 000 F*
Species total	*5 414*	*4 926*	*4 495*	*5 223*	*4 180*	*4 570*	*4 689*	*4 921*	*4 357*	*4 000 F*
Baird's slickhead	**Alépocéphale de Baird**		**Talismán celindra**		***Alepocephalus bairdii***				**1,23(14)007,01**	**ALC**
21 Spain	-	-	1	-	39	162	-	0	-	1
21 Fishing area total	*-*	*-*	*1*	*-*	*39*	*162*	*-*	*0*	*-*	*1*
27 Estonia	153	259	43	22	64	158	9	-	-	-
Germany	1	-	-	-	-	-	-	-	-	-
Iceland	2	-	1	-	-	-	-	-	-	-
Ireland	-	-	2	-	2	-	-	-	-	-
Lithuania	460	-	242	546	737	328	206	25	-	-
Poland	-	-	118	-	-	-	-	-	-	-
Russian Fed	-	-	-	-	-	-	-	9	-	-
Spain	-	-	9 257	6 924	156	316	-	1 845	1 516	1 567
UK	-	-	-	-	-	70	-	-	-	-
27 Fishing area total	*616*	*259*	*9 663*	*7 492*	*959*	*872*	*215*	*1 879*	*1 516*	*1 567*
Species total	*616*	*259*	*9 664*	*7 492*	*998*	*1 034*	*215*	*1 879*	*1 516*	*1 568*
Slickheads nei	**...B**		**Talismanes**		***Alepocephalus spp***				**1,23(14)007,XX**	**ALH**
58 Australia	-	-	-	0	0	-	-	-	0	-
58 Fishing area total	*-*	*-*	*-*	*0*	*0*	*-*	*-*	*-*	*0*	*-*
81 New Zealand	-	-	1	7	0	9	22	82	76	57
81 Fishing area total	*-*	*-*	*1*	*7*	*0*	*9*	*22*	*82*	*76*	*57*
Species total	*-*	*-*	*1*	*7*	*0*	*9*	*22*	*82*	*76*	*57*

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Silvery lightfish	**...B**		**...C**		***Maurolicus muelleri***				**1,25(02)030,01**	**MAV**
27 Faroe Is	-	-	-	-	-	-	-	1 482	422	-
Iceland	-	-	-	-	-	-	-	-	-	17 894
27 Fishing area total	-	-	-	-	-	-	-	*1 482*	*422*	*17 894*
Species total	-	-	-	-	-	-	-	*1 482*	*422*	*17 894*
Snaggletooth	**...B**		**...C**		***Borostomias antarcticus***				**1,25(03)008,01**	**BRT**
51 Cook Is	-	-	-	-	-	-	-	-	-	1
51 Fishing area total	-	-	-	-	-	-	-	-	-	*1*
Species total	-	-	-	-	-	-	-	-	-	*1*
Duckbill barracudina	**...B**		**...C**		***Magnisudis atlantica***				**1,31(11)007,01**	**MNL**
27 Iceland	-	-	-	-	-	-	-	-	-	4
27 Fishing area total	-	-	-	-	-	-	-	-	-	*4*
Species total	-	-	-	-	-	-	-	-	-	*4*
...A	**...B**		**...C**		***Notolepis spp***				**1,31(11)008,XX**	**NOE**
48 Ukraine	-	-	-	-	-	1	...	-	-	-
48 Fishing area total	-	-	-	-	-	*1*	...	-	-	-
Species total	-	-	-	-	-	*1*	...	-	-	-
Hector's lanternfish	**Lanternule de Hector**		**Linternillas de Hector**		***Lampanyctodes hectoris***				**1,32(08)017,01**	**LAN**
47 South Africa	...	...	...	0	-	-	-	-	-	-
47 Fishing area total	*...*	*...*	*...*	*0*	-	-	-	-	-	-
Species total	*...*	*...*	*...*	*0*	-	-	-	-	-	-
Skinnycheek lanternfish	**...B**		**...C**		***Benthosema pterotum***				**1,32(08)024,03**	**BHQ**
51 Iran	335	37	10	-	-	-	-	5 137	7 753	9 897
51 Fishing area total	*335*	*37*	*10*	-	-	-	-	*5 137*	*7 753*	*9 897*
Species total	*335*	*37*	*10*	-	-	-	-	*5 137*	*7 753*	*9 897*
Nichol's lanternfish	**...B**		**...C**		***Gymnoscopelus nicholsi***				**1,32(08)032,01**	**GYN**
48 UK	-	0	-	-	-	-	0	0	0	0
48 Fishing area total	-	*0*	-	-	-	-	*0*	*0*	*0*	*0*
Species total	-	*0*	-	-	-	-	*0*	*0*	*0*	*0*
Lanternfishes nei	**Lanternules nca**		**Peces linterna nep**		***Myctophidae***				**1,32(08)XXX,XX**	**LXX**
27 Faroe Is	-	-	-	-	-	-	-	-	34	-
Russian Fed	3 215	10 172	886	175	190	1	24	25	-	-
27 Fishing area total	*3 215*	*10 172*	*886*	*175*	*190*	*1*	*24*	*25*	*34*	-
34 Russian Fed	-	-	-	-	-	13	-	-	-	6 912
Ukraine	-	46	-	-	-	-	-	-	-	-
34 Fishing area total	-	*46*	-	-	-	*13*	-	-	-	*6 912*
48 Korea Rep	-	-	-	-	1	-	-	-	0	...
UK	-	-	-	-	-	-	-	-	0	0
48 Fishing area total	-	-	-	-	*1*	-	-	-	*0*	*0*
51 South Africa	-	-	-	1	-	-	-	-	-	-
51 Fishing area total	-	-	-	*1*	-	-	-	-	-	-
58 Australia	-	-	-	0	0	-	-	-	0	...
58 Fishing area total	-	-	-	*0*	*0*	-	-	-	*0*	...
81 New Zealand	-	0	0	1	2	1	3	5	18	11
81 Fishing area total	-	*0*	*0*	*1*	*2*	*1*	*3*	*5*	*18*	*11*
Species total	*3 215*	*10 218*	*886*	*177*	*193*	*15*	*27*	*30*	*52*	*6 923*
Daggertooth pike conger	**Murénésoce-dague**		**Morenocio dentón**		***Muraenesox cinereus***				**1,43(09)011,02**	**DPC**
57 Malaysia	2 083	1 329	1 277	1 355	1 209	2 194	1 925	2 277	1 779	1 483
Thailand	929	939	1 011	919	1 143	966	868	709	937	823
57 Fishing area total	*3 012*	*2 268*	*2 288*	*2 274*	*2 352*	*3 160*	*2 793*	*2 986*	*2 716*	*2 306*
61 China	208 072 F	219 210 F	248 328 F	271 359 F	249 281 F	337 048 F	300 259	320 968	340 564	340 105
China,Taiwan	5 084	2 827	4 091	3 911	3 852	2 937	3 154	1 879	2 042	1 545
Japan	2 738	2 843	2 720	3 070	2 904	3 927	...	...	...	...
Korea Rep	1 080	833	800	766	810	672	1 071	1 306	1 650	1 358
61 Fishing area total	*216 974 F*	*225 713 F*	*255 939 F*	*279 106 F*	*256 847 F*	*344 584 F*	*304 484*	*324 153*	*344 256*	*343 008*
71 Malaysia	2 936	4 044	4 449	4 140	3 655	4 538	3 770	3 484	2 752	2 885
Thailand	1 160	1 205	1 221	1 882	1 819	1 606	1 665	1 330	1 505	1 418
71 Fishing area total	*4 096*	*5 249*	*5 670*	*6 022*	*5 474*	*6 144*	*5 435*	*4 814*	*4 257*	*4 303*

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*224 082 F*	*233 230 F*	*263 897 F*	*287 402 F*	*264 673 F*	*353 888 F*	*312 712*	*331 953*	*351 229*	*349 617*
Pike-congers nei	**Murénésoces nca**		**Morenocios nep**		***Muraenesox spp***				**1,43(09)011,XX**	**PCX**
04 India	620	337	307	807	1 163	728	289	353	434	493
04 Fishing area total	*620*	*337*	*307*	*807*	*1 163*	*728*	*289*	*353*	*434*	*493*
51 India	5 058	4 969	4 851	4 262	8 435	7 346	14 797	20 200	12 905	12 355
Pakistan	5 834	5 940	4 545	4 743	4 271	2 954	2 817	2 841	5 404	3 648
South Africa	5	...	...	...	...	-	-	-	-	-
51 Fishing area total	*10 897*	*10 909*	*9 396*	*9 005*	*12 706*	*10 300*	*17 614*	*23 041*	*18 309*	*16 003*
57 India	6 441	3 576	4 126	5 783	5 287	5 300	6 638	8 887	9 355	7 590
57 Fishing area total	*6 441*	*3 576*	*4 126*	*5 783*	*5 287*	*5 300*	*6 638*	*8 887*	*9 355*	*7 590*
61 China,H.Kong	2 300 F	2 250 F	2 100 F	2 200 F	2 130 F	2 060 F	2 050 F	2 100 F	2 110 F	2 230 F
61 Fishing area total	*2 300 F*	*2 250 F*	*2 100 F*	*2 200 F*	*2 130 F*	*2 060 F*	*2 050 F*	*2 100 F*	*2 110 F*	*2 230 F*
71 Brunei Darsm	...	...	...	...	...	404	...	...	...	...
71 Fishing area total	*...*	*...*	*...*	*...*	*...*	*404*	*...*	*...*	*...*	*...*
Species total	*20 258 F*	*17 072 F*	*15 929 F*	*17 795 F*	*21 286 F*	*18 792 F*	*26 591 F*	*34 381 F*	*30 208 F*	*26 316 F*
Red pike conger	**Morénesoce bio-bio**		**Morenocio bío-bío**		***Cynoponticus coniceps***				**1,43(09)021,02**	**CXP**
77 Nicaragua	...	...	...	...	...	254	26	86	33	35
77 Fishing area total	*...*	*...*	*...*	*...*	*...*	*254*	*26*	*86*	*33*	*35*
Species total	*...*	*...*	*...*	*...*	*...*	*254*	*26*	*86*	*33*	*35*
European conger	**Congre d'Europe**		**Congrio común**		***Conger conger***				**1,43(13)001,01**	**COE**
27 Belgium	56	66	69	62	64	58	81	65	31	27
Channel Is	25	17	50	34	73	129	55	46	33	15
France	4 651	4 816	4 992	5 195	4 815	4 982	5 538	4 184	4 934	4 943
Ireland	253	277	387	455	271	174	95	57	48	53
Isle of Man	-	-	0	-	-	-	-	-	-	-
Netherlands	1	0	-	1	1	2	2	2	-	-
Norway	1	1	0	0	0	0	0	-	-	4
Portugal	1 888	1 522	1 648	1 671	1 608	1 723	1 871	1 515	1 720	1 646
Russian Fed	-	-	-	-	-	-	1	3	1	-
Spain	2 537	2 425	3 182	3 002	2 364	3 993	4 380	5 272	5 495	6 968
UK	1 255	1 301	1 586	1 193	896	679	574	491	315	346
27 Fishing area total	*10 667*	*10 425*	*11 914*	*11 613*	*10 092*	*11 740*	*12 597*	*11 635*	*12 577*	*14 002*
34 Morocco	1 091	1 289	2 052	2 176	1 697	1 468	1 571	1 379	1 432	1 433
Portugal	8	5	15	9	5	18	101	54	32	22
Spain	66	6	16	19	37	23	42	39	57	49
Togo	0	-	-	1	-	-	-	-	-	-
34 Fishing area total	*1 165*	*1 300*	*2 083*	*2 205*	*1 739*	*1 509*	*1 714*	*1 472*	*1 521*	*1 504*
37 Albania	-	10	7	5	3	3	61	47	41	...
Algeria	...	...	...	...	...	...	5	16	36	18
Croatia	25	9	13	11	25	22	31	26	34	45
France	574	529	393	406	317	324	318	217	127	167
Greece	1 062	811	687	786	755	720	1 044	1 168	1 158	1 150 F
Italy	...	...	...	...	845	1 152	961	844	958	860
Lebanon	10	9	8	8	9	8	8 F	8 F	8 F	8 F
Malta	3	3	2	2	2	2	2	2	2	5
Morocco	2	0	0	0	0	0	1	4	1	2
Serbia-Monte	14	12	11	8	...	-	-	-	-	-
Slovenia	1	0	1	-	0	0	0	0	0	0
Spain	708	762	528	537	494	472	512	518	540	417
Tunisia	7	5	8	2	5	5	3	8	13	13
Turkey	340	300	290	239	233	283	257	426	393	289
37 Fishing area total	*2 746*	*2 450*	*1 948*	*2 004*	*2 688*	*2 991*	*3 203 F*	*3 284 F*	*3 311 F*	*2 974 F*
Species total	*14 578*	*14 175*	*15 945*	*15 822*	*14 519*	*16 240*	*17 514 F*	*16 391 F*	*17 409 F*	*18 480 F*
Argentine conger	**Congre argentin**		**Congrio argentino**		***Conger orbignyanus***				**1,43(13)001,02**	**COS**
41 Argentina	95	43	34	23	18	32	4	15	12	31
Brazil	144	173	43	100	117	83	12	117	128	35
Uruguay	3	57	9	179	121	89	3	1	...	3
41 Fishing area total	*242*	*273*	*86*	*302*	*256*	*204*	*19*	*133*	*140*	*69*
Species total	*242*	*273*	*86*	*302*	*256*	*204*	*19*	*133*	*140*	*69*
American conger	**Congre d'Amérique**		**Congrio americano**		***Conger oceanicus***				**1,43(13)001,04**	**COA**
21 USA	40	61	61	37	31	35	42	35	24	28
21 Fishing area total	*40*	*61*	*61*	*37*	*31*	*35*	*42*	*35*	*24*	*28*
Species total	*40*	*61*	*61*	*37*	*31*	*35*	*42*	*35*	*24*	*28*
Whitespotted conger	**Congre du Pacifique nord-ouest**		**Congrio del Pacífico**		***Conger myriaster***				**1,43(13)001,05**	**ELS**
61 Korea Rep	7 676	17 210	17 451	16 506	14 739	15 242	19 399	18 441	13 507	13 757
61 Fishing area total	*7 676*	*17 210*	*17 451*	*16 506*	*14 739*	*15 242*	*19 399*	*18 441*	*13 507*	*13 757*

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*7 676*	*17 210*	*17 451*	*16 506*	*14 739*	*15 242*	*19 399*	*18 441*	*13 507*	*13 757*
Conger eels, etc. nei	**Congres, etc. nca**		**Congrios, etc. nep**		***Congridae***				**1,43(13)XXX,XX**	**COX**
34 Cameroon	7	11	16	10 F	1	1	1	1 F	0	0
Congo Dem R	100 F	100 F	100 F	110 F	110 F	120 F	120	120 F	120 F	120 F
Congo Rep	590 F	580 F	572	956	1 154	1 474	959	237	1 207	752
Côte dIvoire	17	12	13	3	3	4	11	10 F	10	11
Liberia	76	80	80	128	92	33	194	45	50 F	50 F
Senegal	112	140	205	161	52	73	100	65	74	42
34 Fishing area total	*902 F*	*923 F*	*986 F*	*1 368 F*	*1 412 F*	*1 705 F*	*1 385*	*478 F*	*1 461 F*	*975 F*
41 Argentina	-	-	-	-	-	27	5	5	12	0
Russian Fed	-	1 192	3	-	-	-	-	-	-	-
41 Fishing area total	*-*	*1 192*	*3*	*-*	*-*	*27*	*5*	*5*	*12*	*0*
47 Angola	...	...	1 511	...	1 300 F	1 466	...	...	...	...
Portugal	1	-	-	-	-	-	-	-	1	-
St Helena	5	2	1	3	2	2	4	3	3	5
47 Fishing area total	*6*	*2*	*1 512*	*3*	*1 302 F*	*1 468*	*4*	*3*	*4*	*5*
51 Korea Rep	-	-	6	20	-	-	2	13	82	-
51 Fishing area total	*-*	*-*	*6*	*20*	*-*	*-*	*2*	*13*	*82*	*-*
61 Japan	7 999	8 921	8 683	7 937	6 860	7 917	6 991	6 339	5 959	5 400 F
61 Fishing area total	*7 999*	*8 921*	*8 683*	*7 937*	*6 860*	*7 917*	*6 991*	*6 339*	*5 959*	*5 400 F*
71 Korea Rep	78	6	9	60	75	141	32	-	-	51
Philippines	2 663	2 493	2 418	2 336	2 364	2 589	2 576	2 702	3 068	3 048
71 Fishing area total	*2 741*	*2 499*	*2 427*	*2 396*	*2 439*	*2 730*	*2 608*	*2 702*	*3 068*	*3 099*
81 Korea Rep	-	-	-	-	-	-	-	9	-	-
New Zealand	106	144	154	152	138	119	137	148	165	163
81 Fishing area total	*106*	*144*	*154*	*152*	*138*	*119*	*137*	*157*	*165*	*163*
Species total	*11 754 F*	*13 681 F*	*13 771 F*	*11 876 F*	*12 151 F*	*13 966 F*	*11 132*	*9 697 F*	*10 751 F*	*9 642 F*
Basketwork eel	**...B**		**...C**		***Diastobranchus capensis***				**1,43(18)045,01**	**SDC**
81 New Zealand	0	1	3	1	2	0	3	25	34	20
81 Fishing area total	*0*	*1*	*3*	*1*	*2*	*0*	*3*	*25*	*34*	*20*
Species total	*0*	*1*	*3*	*1*	*2*	*0*	*3*	*25*	*34*	*20*
Longspine snipefish	**Bécasse de mer**		**Trompetero**		***Macroramphosus scolopax***				**1,51(03)004,01**	**SNS**
27 Portugal	-	0	-	-	-	0	1	-	-	11
27 Fishing area total	*-*	*0*	*-*	*-*	*-*	*0*	*1*	*-*	*-*	*11*
34 Russian Fed	44	-	-	-	80	39	-	-	-	-
34 Fishing area total	*44*	*-*	*-*	*-*	*80*	*39*	*-*	*-*	*-*	*-*
61 Russian Fed	-	-	-	544	-	-	-	-	-	-
61 Fishing area total	*-*	*-*	*-*	*544*	*-*	*-*	*-*	*-*	*-*	*-*
81 New Zealand	-	1	15	18	1	1	14	1	8	2
81 Fishing area total	*-*	*1*	*15*	*18*	*1*	*1*	*14*	*1*	*8*	*2*
Species total	*44*	*1*	*15*	*562*	*81*	*40*	*15*	*1*	*8*	*13*
Crested bellowfish	**...B**		**...C**		***Notopogon lilliei***				**1,51(03)022,04**	**NLD**
81 New Zealand	-	0	0	0	8	3	7	24	14	0
81 Fishing area total	*-*	*0*	*0*	*0*	*8*	*3*	*7*	*24*	*14*	*0*
Species total	*-*	*0*	*0*	*0*	*8*	*3*	*7*	*24*	*14*	*0*
Banded yellowfish	**...B**		**...C**		***Centriscops humerosus***				**1,51(04)021,01**	**CUQ**
81 New Zealand	52	24	79	57	34	84	63	43	23	29
Ukraine	-	1	16	-	-	-	-	-	-	-
81 Fishing area total	*52*	*25*	*95*	*57*	*34*	*84*	*63*	*43*	*23*	*29*
Species total	*52*	*25*	*95*	*57*	*34*	*84*	*63*	*43*	*23*	*29*
Pink cusk-eel	**Abadèche rosé**		**Congribadejo rosado**		***Genypterus blacodes***				**1,58(02)001,01**	**CUS**
41 Argentina	19 633	17 794	14 601	17 101	18 605	20 580	20 609	17 558	16 694	16 357
Belize	8	0	-	-	-	-	-	-	-	-
Estonia	-	-	-	27	17	22	-	-	-	144
Falkland Is	472	531	606	784	669	1 058	783	489	762	770
Japan	-	-	-	-	-	-	2	0	1	0
Korea Rep	327	325	185	325	606	395	334	184	409	604
Namibia	-	-	-	0	-	-	-	-	-	-
Portugal	89	98	-	-	-	-	-	-	-	-
Spain	1 408	388	840	787	1 183	1 702	2 735	1 691	2 619	2 835
UK	9	7	3	12	15	31	22	26	11	26
Uruguay	756	569	215	257	189	101	153	107	42	119

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
41 Fishing area total	*22 702*	*19 712*	*16 450*	*19 293*	*21 284*	*23 889*	*24 638*	*20 055*	*20 538*	*20 855*
57 Australia	1 153	1 217	1 229	1 265	1 384	980	840	947	846	716
57 Fishing area total	*1 153*	*1 217*	*1 229*	*1 265*	*1 384*	*980*	*840*	*947*	*846*	*716*
81 Australia	561	435	384	422	418	345	218	204	200	156
Korea Rep	1 277	1 539	1 444	1 479	996	1 703	2 149	1 403	1 182	1 389
New Zealand	18 620	20 295	19 543	18 676	16 019	14 846	17 169	14 156	11 527	13 045
Spain	-	-	-	-	-	-	-	17	21	-
Ukraine	35	-	601	599	...	337	...	...	...	...
81 Fishing area total	*20 493*	*22 269*	*21 972*	*21 176*	*17 433*	*17 231*	*19 536*	*15 780*	*12 930*	*14 590*
87 Chile	7 522	4 518	4 767	5 801	3 870	5 225	4 585	3 346	3 690	3 253
87 Fishing area total	*7 522*	*4 518*	*4 767*	*5 801*	*3 870*	*5 225*	*4 585*	*3 346*	*3 690*	*3 253*
Species total	*51 870*	*47 716*	*44 418*	*47 535*	*43 971*	*47 325*	*49 599*	*40 128*	*38 004*	*39 414*
Red cusk-eel	**Abadèche rouge**		**Congribadejo colorado**		***Genypterus chilensis***				**1,58(02)001,02**	**CUC**
87 Chile	730	213	100	548	389	377	395	619	654	467
87 Fishing area total	*730*	*213*	*100*	*548*	*389*	*377*	*395*	*619*	*654*	*467*
Species total	*730*	*213*	*100*	*548*	*389*	*377*	*395*	*619*	*654*	*467*
Black cusk-eel	**Abadèche noir**		**Congribadejo negro**		***Genypterus maculatus***				**1,58(02)001,03**	**CUB**
87 Chile	3 889	1 558	1 560	1 469	867	514	259	294	309	196
87 Fishing area total	*3 889*	*1 558*	*1 560*	*1 469*	*867*	*514*	*259*	*294*	*309*	*196*
Species total	*3 889*	*1 558*	*1 560*	*1 469*	*867*	*514*	*259*	*294*	*309*	*196*
Kingklip	**Abadèche du Cap**		**Congribadejo(=Rosada)del Cabo**		***Genypterus capensis***				**1,58(02)001,05**	**KCP**
47 Namibia	6 607	7 926	7 238	7 538	5 620	4 747	5 298	3 677	4 524	4 400 F
Russian Fed	5	1	17	-	-	-	-	-	-	-
South Africa	4 848	5 491	4 030	4 772	3 928	3 163	2 674	2 709	2 341	2 685
Spain	-	-	87	-	-	-	-	-	-	-
47 Fishing area total	*11 460*	*13 418*	*11 372*	*12 310*	*9 548*	*7 910*	*7 972*	*6 386*	*6 865*	*7 085 F*
Species total	*11 460*	*13 418*	*11 372*	*12 310*	*9 548*	*7 910*	*7 972*	*6 386*	*6 865*	*7 085 F*
Cusk-eels nei	**Abadèches nca**		**Congribadejos nep**		***Genypterus spp***				**1,58(02)001,XX**	**CEX**
87 Peru	552	1 033	512	563	1 037	813	424	398	444	232
87 Fishing area total	*552*	*1 033*	*512*	*563*	*1 037*	*813*	*424*	*398*	*444*	*232*
Species total	*552*	*1 033*	*512*	*563*	*1 037*	*813*	*424*	*398*	*444*	*232*
Bearded brotula	**Brotule barbée**		**Brótula de barbas**		***Brotula barbata***				**1,58(02)005,02**	**BRD**
31 USA	0	0	-	0	-	-	-	-	-	-
31 Fishing area total	*0*	*0*	-	*0*	-	-	-	-	-	-
34 Congo Rep	47 F	250 F	467	342	390	96	366	271	626	428
Côte dIvoire	156	186	112	125	101	156	67	60 F	55	118
Korea Rep	-	-	-	71	-	2	-	-	-	57
Liberia	0	40	40	48	57	20	69	43	40 F	40 F
Senegal	1 669	1 124	698	98	285	1 081	619	1 534	2 303	2 123
Spain	61	-	-	-	-	-	-	-	-	-
34 Fishing area total	*1 933 F*	*1 600 F*	*1 317*	*684*	*833*	*1 355*	*1 121*	*1 908 F*	*3 024 F*	*2 766 F*
Species total	*1 933 F*	*1 600 F*	*1 317*	*684*	*833*	*1 355*	*1 121*	*1 908 F*	*3 024 F*	*2 766 F*
Cusk-eels, brotulas nei	**Abadèches, brotules nca**		**Brótulas, congribadejos nep**		***Ophidiidae***				**1,58(02)XXX,XX**	**OPH**
31 Cuba	17	11	4	3	4	1	1	-	-	-
31 Fishing area total	*17*	*11*	*4*	*3*	*4*	*1*	*1*	-	-	-
41 Brazil	711	808	824	577	642	576	626	583	643	608
Russian Fed	18	-	-	-	-	-	-	-	-	-
41 Fishing area total	*729*	*808*	*824*	*577*	*642*	*576*	*626*	*583*	*643*	*608*
87 Ecuador	191	416	570	383	328	166	609	374	...	...
87 Fishing area total	*191*	*416*	*570*	*383*	*328*	*166*	*609*	*374*	...	...
Species total	*937*	*1 235*	*1 398*	*963*	*974*	*743*	*1 236*	*957*	*643*	*608*
Velvet whalefish	**...B**		**...C**		***Barbourisia rufa***				**1,60(02)001,01**	**BBF**
51 Cook Is	-	-	-	-	-	-	-	-	-	210
51 Fishing area total	-	-	-	-	-	-	-	-	-	*210*
Species total	-	-	-	-	-	-	-	-	-	*210*
Stout beardfish	**Poisson chèvre robuste**		**Chivato de fondo**		***Polymixia nobilis***				**1,61(01)001,02**	**PXV**
34 Portugal	-	-	-	-	-	0	1	-	-	-
Spain	-	-	-	-	-	-	-	-	1	-
34 Fishing area total	-	-	-	-	-	*0*	*1*	-	*1*	-

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	-	-	-	-	-	*0*	*1*	-	*1*	-
Alfonsino	**Béryx commun**		**Alfonsino palometón**		***Beryx decadactylus***				**1,61(02)003,01**	**BXD**
27 Portugal	...	...	13	29	361	50	56	54	69	60
Spain	...	...	61	112	187	180	227	102	117	138
27 Fishing area total	*...*	*...*	*74*	*141*	*548*	*230*	*283*	*156*	*186*	*198*
Species total	*...*	*...*	*74*	*141*	*548*	*230*	*283*	*156*	*186*	*198*
Splendid alfonsino	**Béryx long**		**Alfonsino besugo**		***Beryx splendens***				**1,61(02)003,02**	**BYS**
27 Portugal	15	28	10	15	146	161	163	153	218	172
Spain	...	122	267	353	378	258	187	93	44	112
27 Fishing area total	*15*	*150*	*277*	*368*	*524*	*419*	*350*	*246*	*262*	*284*
Species total	*15*	*150*	*277*	*368*	*524*	*419*	*350*	*246*	*262*	*284*
Alfonsinos nei	**Béryx nca**		**Alfonsinos nep**		***Beryx spp***				**1,61(02)003,XX**	**ALF**
21 Spain	-	-	-	-	576	69	-	-	-	53
21 Fishing area total	-	-	-	-	*576*	*69*	-	-	-	*53*
27 Faroe Is	2	0	-	-	7	-	-	0	1	-
France	52	42	22	33	25	36	27	23	19	19
Ireland	-	-	242	258	66	2	54	3	1	1
Portugal	44	52	45	44	32	8	6	3	3	-
Russian Fed	-	-	-	-	-	-	-	-	-	5
Spain	-	-	284	271	80	82	81	75	61	69
UK	16	29	6	4	0	5	1	1	1	1
27 Fishing area total	*114*	*123*	*599*	*610*	*210*	*133*	*169*	*105*	*86*	*95*
34 Lithuania	-	98	18	40	11	2	38	3	46	33
Portugal	-	1	-	0	-	3	37	67	6	37
Russian Fed	6	52	7	70	2	21	-	10	-	30
Spain	243	310	69	150	96	64	44	85	112	108
34 Fishing area total	*249*	*461*	*94*	*260*	*109*	*90*	*119*	*165*	*164*	*208*
37 Spain	-	-	-	-	-	-	-	-	1	0
37 Fishing area total	-	-	-	-	-	-	-	-	*1*	*0*
41 Russian Fed	-	749	-	-	-	-	-	-	-	-
41 Fishing area total	-	*749*	-	-	-	-	-	-	-	-
47 Korea Rep	-	-	-	-	-	-	-	-	-	187
Namibia	300	232	196	258	316	644	357	...	297	300 F
Portugal	7	1	5	-	4	2	6	4	6	7
Russian Fed	1	3	-	-	-	-	-	-	-	-
South Africa	10	-	26	66	190	134	19	119	21	39
Spain	2	2	3	4	72	-	-	-	-	-
47 Fishing area total	*320*	*238*	*230*	*328*	*582*	*780*	*382*	*123*	*324*	*533 F*
51 China	-	7	-	-	-	-	-	-	-	-
Cook Is	-	-	-	-	-	-	-	-	-	4 023
Korea Rep	-	-	-	-	-	-	-	-	-	50
Russian Fed	210	-	-	-	-	-	-	-	-	-
Spain	4	3	-	6	12	13	1	-	-	-
Ukraine	371	-	-	-	-	-	-	-	-	-
51 Fishing area total	*585*	*10*	-	*6*	*12*	*13*	*1*	-	-	*4 073*
57 Cook Is	-	-	-	-	-	-	-	-	-	2
57 Fishing area total	-	-	-	-	-	-	-	-	-	*2*
61 Korea Rep	-	-	-	-	-	-	-	-	-	86
Russian Fed	14	12	44	1	296	-	-	-	-	-
61 Fishing area total	*14*	*12*	*44*	*1*	*296*	-	-	-	-	*86*
71 Korea Rep	-	-	-	-	464	-	237	105	-	-
NewCaledonia	0	0	-	-	-	-	-	-	-	-
71 Fishing area total	*0*	*0*	-	-	*464*	-	*237*	*105*	-	-
81 Australia	-	3	2	1	81	209	86	-	-	-
China	-	152	-	-	-	-	-	-	-	-
Korea Rep	-	1	-	-	194	-	-	-	-	-
New Zealand	3 044	2 888	3 272	2 631	3 858	2 555	2 881	2 615	2 690	3 331
Ukraine	9	-	11	-	-	-	-	-	-	-
81 Fishing area total	*3 053*	*3 044*	*3 285*	*2 632*	*4 133*	*2 764*	*2 967*	*2 615*	*2 690*	*3 331*
87 Belize	-	-	73	229	102	101	61	-	-	-
Chile	5 182	8 166	9 951	2 860	2 951	2 377	2 648	2 622	1 109	948
Lithuania	-	-	-	-	-	-	447	1 497	-	-
87 Fishing area total	*5 182*	*8 166*	*10 024*	*3 089*	*3 053*	*2 478*	*3 156*	*4 119*	*1 109*	*948*
Species total	*9 517*	*12 803*	*14 276*	*6 926*	*9 435*	*6 327*	*7 031*	*7 232*	*4 374*	*9 329 F*
Redfish	**Béryx australien**		**...C**		***Centroberyx affinis***				**1,61(02)012,01**	**CXF**
57 Australia	408	237	383	968	1 015	802	1 038	820	697	482

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
57 Fishing area total	*408*	*237*	*383*	*968*	*1 015*	*802*	*1 038*	*820*	*697*	*482*
71 Australia	5	5	0	0	0	0	4	0	0	1
71 Fishing area total	*5*	*5*	*0*	*0*	*0*	*0*	*4*	*0*	*0*	*1*
81 Australia	802	913	846	693	507	488	216	222	190	181
New Zealand	202	117	162	49	56	51	53	90	39	32
81 Fishing area total	*1 004*	*1 030*	*1 008*	*742*	*563*	*539*	*269*	*312*	*229*	*213*
Species total	*1 417*	*1 272*	*1 391*	*1 710*	*1 578*	*1 341*	*1 311*	*1 132*	*926*	*696*
Mediterranean slimehead	**Hoplostète argenté**		**Reloj mediterráneo**		***Hoplostethus mediterraneus***				**1,61(05)002,01**	**HPR**
21 Spain	-	-	-	-	2	-	-	-	-	-
21 Fishing area total	-	-	-	-	*2*	-	-	-	-	-
27 Portugal	-	-	-	-	-	1	-	-	-	14
27 Fishing area total	-	-	-	-	-	*1*	-	-	-	*14*
47 Portugal	-	-	-	-	1	1	1	2	16	-
47 Fishing area total	-	-	-	-	*1*	*1*	*1*	*2*	*16*	-
Species total	-	-	-	-	*3*	*2*	*1*	*2*	*16*	*14*
Orange roughy	**Hoplostète orange**		**Reloj anaranjado**		***Hoplostethus atlanticus***				**1,61(05)002,02**	**ORY**
27 Faroe Is	430	35	1	466	290	89	20	108	61	74
France	1 254	499	548	511	285	540	188	178	69	13
Germany	-	-	-	4	-	-	1	0	-	1
Iceland	18	10	0	28	8	2	-	-	-	-
Ireland	2 759	4 647	310	209	96	38	200	-	-	-
Portugal	161	122	0	0	-	-	-	-	-	-
Spain	15	55	12	21	11	2	0	1	-	0
UK	35	70	1	1	78	-	-	-	-	-
27 Fishing area total	*4 672*	*5 438*	*872*	*1 240*	*768*	*671*	*409*	*287*	*130*	*88*
47 Namibia	857	2 169	2 109	1 820	317	550	273	...	5	5 F
Portugal	-	-	-	-	-	-	0	2	3	1
South Africa	-	-	-	25	63	18	2	4	-	2
47 Fishing area total	*857*	*2 169*	*2 109*	*1 845*	*380*	*568*	*275*	*6*	*8*	*8 F*
51 China	710	38	-	-	-	-	-	-	-	-
Cook Is	-	-	-	-	-	-	-	-	-	607
South Africa	-	-	-	-	2	-	-	-	-	-
Spain	1	-	-	-	-	-	-	-	-	-
51 Fishing area total	*711*	*38*	-	-	*2*	-	-	-	-	*607*
57 Australia	5 197	3 961	4 455	2 558	3 250	2 373	1 120	288	659	652
57 Fishing area total	*5 197*	*3 961*	*4 455*	*2 558*	*3 250*	*2 373*	*1 120*	*288*	*659*	*652*
81 Australia	17	14	54	56	144	8	9	0	2	1
China	520	597	562	592	710	570	336	-	-	-
Korea Rep	93	208	243	138	-	77	44	-	-	-
New Zealand	14 044	17 954	17 778	17 829	18 451	15 920	14 276	13 310	12 446	10 843
Ukraine	195	-	176	272	...	249	...	...	...	...
81 Fishing area total	*14 869*	*18 773*	*18 813*	*18 887*	*19 305*	*16 824*	*14 665*	*13 310*	*12 448*	*10 844*
87 Belize	-	-	9	914	506	200	332	-	-	-
Chile	1 868	1 514	1 249	1 262	783	259	5	1	-	-
87 Fishing area total	*1 868*	*1 514*	*1 258*	*2 176*	*1 289*	*459*	*337*	*1*	-	-
Species total	*28 174*	*31 893*	*27 507*	*26 706*	*24 994*	*20 895*	*16 806*	*13 892*	*13 245*	*12 199 F*
Sandpaper fish	**...B**		**...C**		***Paratrachichthys trailli***				**1,61(05)013,01**	**TPT**
81 Ukraine	-	-	1	1	...	-	-	-	-	-
81 Fishing area total	-	-	*1*	*1*	...	-	-	-	-	-
Species total	-	-	*1*	*1*	...	-	-	-	-	-
Slimeheads nei	**Poissons-montres nca**		**Relojes nep**		***Trachichthyidae***				**1,61(05)XXX,XX**	**TRC**
27 Portugal	235	-	-	-	-	-	-	-	-	-
Spain	6	2	3	46	5	78	13	2	3	18
27 Fishing area total	*241*	*2*	*3*	*46*	*5*	*78*	*13*	*2*	*3*	*18*
34 Portugal	235	-	-	-	-	-	-	-	-	-
34 Fishing area total	*235*	-	-	-	-	-	-	-	-	-
81 New Zealand	2	12	10	14	12	7	2	7	7	10
81 Fishing area total	*2*	*12*	*10*	*14*	*12*	*7*	*2*	*7*	*7*	*10*
Species total	*478*	*14*	*13*	*60*	*17*	*85*	*15*	*9*	*10*	*28*
John dory	**Saint Pierre**		**Pez de San Pedro**		***Zeus faber***				**1,62(01)001,01**	**JOD**
27 Channel Is	1	1	1	1	0	1	1	0	1	0
France	1 355	1 228	1 700	1 696	1 725	1 640	1 573	1 227	1 661	1 814
Ireland	169	153	266	327	546	251	249	192	177	178

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Netherlands	-	-	-	-	-	-	-	-	1	1
Portugal	408	395	389	310	269	284	352	238	304	379
Spain	899	784	1 261	1 368	1 218	1 354	1 536	2 643	2 293	2 438
UK	267	269	321	294	287	269	289	306	302	332
27 Fishing area total	*3 099*	*2 830*	*3 938*	*3 996*	*4 045*	*3 799*	*4 000*	*4 606*	*4 739*	*5 142*
34 Greece	28	7	2	4	-	-	-	-	-	-
Latvia	...	-	-	-	-	-	-	-	12	5
Lithuania	-	1	8	47	11	37	25	15	8	22
Morocco	509	733	703	1 524	965	1 067	1 113	1 237	1 284	1 345
Portugal	0	0	1	0	-	0	-	-	3	14
Russian Fed	-	-	69	1	-	-	-	-	-	13
Senegal	161	151	204	42	27	52	37	48	251	234
Spain	-	-	-	1	93	314	238	53	201	147
Ukraine	27	8	-	-	-	-	-	-	-	-
34 Fishing area total	*725*	*900*	*987*	*1 619*	*1 096*	*1 470*	*1 413*	*1 353*	*1 759*	*1 780*
37 Albania	-	5	3	2	2	4	12	12	22	...
Algeria	...	...	...	...	...	...	1	...	2	2
Croatia	...	...	...	...	...	...	...	...	25	32
Cyprus	-	-	-	-	-	-	-	-	1	1
France	9	7	7	8	7	11	18	9	13	23
Greece	268	204	187	172	192	413	411	500	413	413 F
Italy	...	...	...	...	199	227	283	252	358	307
Malta	0	-	-	-	-	-	2	3	5	3
Morocco	2	3	3	4	6	14	16	18	15	13
Slovenia	-	-	-	-	1	0	0	0	1	1
Spain	50	62	67	82	85	125	147	171	213	142
Tunisia	43	61	39	44	41	25	26	29	31	29
Turkey	130	55	24	24	76	95	101	72	104	90
37 Fishing area total	*502*	*397*	*330*	*336*	*609*	*914*	*1 017*	*1 066*	*1 203*	*1 056 F*
47 Angola	1 303	2 061	2 681	2 792	2 000 F	1 493	1 473	541	866	830 F
Namibia	138	208	105	117	28	50	26	...	25	25 F
Portugal	-	-	-	-	-	-	0	2	1	-
South Africa	1 177	1 313	1 266	1 323	1 159	1 103	1 147	947	1 028	993
47 Fishing area total	*2 618*	*3 582*	*4 052*	*4 232*	*3 187 F*	*2 646*	*2 646*	*1 490*	*1 920*	*1 848 F*
51 Korea Rep	-	-	-	-	-	-	-	3	-	-
South Africa	6	...	0	4	2	4	2	2	2	-
51 Fishing area total	*6*	*...*	*0*	*4*	*2*	*4*	*2*	*5*	*2*	-
57 Australia	22	32	33	44	48	41	29	31	37	30
Korea Rep	216	-	-	-	-	-	-	-	-	-
57 Fishing area total	*238*	*32*	*33*	*44*	*48*	*41*	*29*	*31*	*37*	*30*
81 Australia	157	131	153	171	100	62	38	71	100	62
Japan	38	54	37	-	-	-	-	-	-	-
Korea Rep	9	-	-	-	127	-	-	-	-	-
New Zealand	914	1 141	1 367	1 582	1 360	1 117	1 104	974	1 013	623
Ukraine	-	-	8	12	...	-	-	-	-	-
81 Fishing area total	*1 118*	*1 326*	*1 565*	*1 765*	*1 587*	*1 179*	*1 142*	*1 045*	*1 113*	*685*
Species total	*8 306*	*9 067*	*10 905*	*11 996*	*10 574 F*	*10 053*	*10 249*	*9 596*	*10 773*	*10 541 F*
Silvery John dory	**Saint Pierre argenté**		**San Pedro plateado**		***Zenopsis conchifer***				**1,62(01)004,01**	**JOS**
21 USA	62	66	64	45	51	23	29	28	22	65
21 Fishing area total	*62*	*66*	*64*	*45*	*51*	*23*	*29*	*28*	*22*	*65*
27 Portugal	49	22	24	21	18	28	35	35	44	51
27 Fishing area total	*49*	*22*	*24*	*21*	*18*	*28*	*35*	*35*	*44*	*51*
34 Portugal	0	-	3	-	-	-	-	-	3	11
34 Fishing area total	*0*	-	*3*	-	-	-	-	-	*3*	*11*
41 Brazil	...	...	...	...	...	...	...	46	51	48
41 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*46*	*51*	*48*
Species total	*111*	*88*	*91*	*66*	*69*	*51*	*64*	*109*	*120*	*175*
Mirror dory	**...B**		**...C**		***Zenopsis nebulosus***				**1,62(01)004,02**	**ZNE**
57 Australia	111	279	325	277	188	171	104	202	176	256
57 Fishing area total	*111*	*279*	*325*	*277*	*188*	*171*	*104*	*202*	*176*	*256*
81 Australia	146	144	325	445	390	327	198	241	271	279
New Zealand	48	52	53	62	58	58	82	63	76	107
81 Fishing area total	*194*	*196*	*378*	*507*	*448*	*385*	*280*	*304*	*347*	*386*
Species total	*305*	*475*	*703*	*784*	*636*	*556*	*384*	*506*	*523*	*642*
Capro dory	**...B**		**...C**		***Capromimus abbreviatus***				**1,62(01)008,01**	**ZCA**
81 Ukraine	-	24	10	17	...	-	-	-	-	-
81 Fishing area total	-	*24*	*10*	*17*	*...*	-	-	-	-	-
Species total	-	*24*	*10*	*17*	*...*	-	-	-	-	-

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
New Zealand dory	**...B**		**...C**		***Cyttus novaezealandiae***				**1,62(01)011,01**	**ZCN**
81 Ukraine	2	50	332	452	...	114	...	...	...	...
81 Fishing area total	*2*	*50*	*332*	*452*	*...*	*114*	*...*	*...*	*...*	*...*
Species total	*2*	*50*	*332*	*452*	*...*	*114*	*...*	*...*	*...*	*...*
King dory	**...B**		**...C**		***Cyttus traversi***				**1,62(01)011,02**	**ZCT**
81 New Zealand	585	879	724	489	375	450	410	475	454	426
Ukraine	-	-	56	5	...	-	-	-	-	-
81 Fishing area total	*585*	*879*	*780*	*494*	*375*	*450*	*410*	*475*	*454*	*426*
Species total	*585*	*879*	*780*	*494*	*375*	*450*	*410*	*475*	*454*	*426*
Dories nei	**Saint Pierres nca**		**Peces de San Pedro nep**		***Zeidae***				**1,62(01)XXX,XX**	**ZEX**
81 New Zealand	52	81	56	38	47	38	11	49	16	10
81 Fishing area total	*52*	*81*	*56*	*38*	*47*	*38*	*11*	*49*	*16*	*10*
Species total	*52*	*81*	*56*	*38*	*47*	*38*	*11*	*49*	*16*	*10*
Boarfish	**Sanglier**		**Ochavo**		***Capros aper***				**1,62(03)002,01**	**BOC**
27 Denmark	-	-	-	-	-	-	-	3 119	15 079	39 805
Ireland	120	91	460	674	242	2 772	17 615	21 584	68 629	88 457
Norway	-	-	-	-	-	-	-	-	1	-
UK	-	-	-	-	-	-	772	-	-	9 414
27 Fishing area total	*120*	*91*	*460*	*674*	*242*	*2 772*	*18 387*	*24 703*	*83 709*	*137 676*
34 Ukraine	7	-	-	-	-	-	-	-	-	-
34 Fishing area total	*7*	-	-	-	-	-	-	-	-	-
Species total	*127*	*91*	*460*	*674*	*242*	*2 772*	*18 387*	*24 703*	*83 709*	*137 676*
Boarfishes nei	**Sangliers nca**		**Ochavos nep**		***Caproidae***				**1,62(03)XXX,XX**	**BOR**
47 Korea Rep	-	-	-	-	-	-	-	-	-	112
Namibia	20	0	11	73	0	15	-	-	-	-
Russian Fed	-	-	-	0	-	-	-	-	-	-
Spain	-	-	-	71	-	-	-	-	-	-
47 Fishing area total	*20*	*0*	*11*	*144*	*0*	*15*	-	-	-	*112*
51 Cook Is	-	-	-	-	-	-	-	-	-	562
Spain	7	-	-	-	-	-	-	-	-	-
51 Fishing area total	*7*	-	-	-	-	-	-	-	-	*562*
61 Russian Fed	-	-	-	-	1	-	-	-	-	-
61 Fishing area total	-	-	-	-	*1*	-	-	-	-	-
87 Belize	...	...	-	-	-	-	28	-	-	-
87 Fishing area total	*...*	*...*	-	-	-	-	*28*	-	-	-
Species total	*27*	*0*	*11*	*144*	*1*	*15*	*28*	-	-	*674*
Spiky oreo	**...B**		**...C**		***Neocyttus rhomboidalis***				**1,62(04)001,02**	**ONV**
51 Cook Is	-	-	-	-	-	-	-	-	-	72
51 Fishing area total	-	-	-	-	-	-	-	-	-	*72*
81 Australia	31	35	32	9	1	-	1	-	-	-
New Zealand	28	149	156	159	123	49	96	104	85	95
Ukraine	-	-	-	16	...	-	-	-	-	-
81 Fishing area total	*59*	*184*	*188*	*184*	*124*	*49*	*97*	*104*	*85*	*95*
Species total	*59*	*184*	*188*	*184*	*124*	*49*	*97*	*104*	*85*	*167*
Smooth oreo dory	**...B**		**...C**		***Pseudocyttus maculatus***				**1,62(04)002,01**	**SSO**
51 Cook Is	-	-	-	-	-	-	-	-	-	23
51 Fishing area total	-	-	-	-	-	-	-	-	-	*23*
81 Australia	13	4	3	16	74	-	-	-	-	-
New Zealand	6 492	12 888	10 653	14 192	12 387	10 685	12 089	9 735	10 876	12 636
Ukraine	-	-	1	368	...	97	...	...	...	...
81 Fishing area total	*6 505*	*12 892*	*10 657*	*14 576*	*12 461*	*10 782*	*12 089*	*9 735*	*10 876*	*12 636*
Species total	*6 505*	*12 892*	*10 657*	*14 576*	*12 461*	*10 782*	*12 089*	*9 735*	*10 876*	*12 659*
Black oreo	**...B**		**...C**		***Allocyttus niger***				**1,62(04)007,01**	**BOE**
51 Cook Is	-	-	-	-	-	-	-	-	-	64
51 Fishing area total	-	-	-	-	-	-	-	-	-	*64*
81 New Zealand	1 999	4 586	4 452	5 226	4 856	6 136	5 652	5 762	4 997	6 496
Ukraine	-	-	3	233	...	57	...	...	...	...
81 Fishing area total	*1 999*	*4 586*	*4 455*	*5 459*	*4 856*	*6 193*	*5 652*	*5 762*	*4 997*	*6 496*
Species total	*1 999*	*4 586*	*4 455*	*5 459*	*4 856*	*6 193*	*5 652*	*5 762*	*4 997*	*6 560*

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Oreo dories nei	**Oréos nca**		**Oreós nep**		***Oreosomatidae***				**1,62(04)XXX,XX**	**ORD**
47 Namibia	54	335	331	497	83	19	7	...	1	1 F
47 Fishing area total	*54*	*335*	*331*	*497*	*83*	*19*	*7*	*...*	*1*	*1 F*
51 China	180	97	-	-	-	-	-	-	-	-
Cook Is	-	-	-	-	-	-	-	-	-	13
51 Fishing area total	*180*	*97*	-	-	-	-	-	-	-	*13*
61 Russian Fed	14	8	3	-	48	-	-	-	-	-
61 Fishing area total	*14*	*8*	*3*	-	*48*	-	-	-	-	-
81 China	-	10	-	-	-	-	-	-	-	-
New Zealand	15 646	2	2	0	0	0	0	4	2	2
Ukraine	-	-	-	210	...	283	...	...	...	...
81 Fishing area total	*15 646*	*12*	*2*	*210*	*0*	*283*	*0*	*4*	*2*	*2*
Species total	*15 894*	*452*	*336*	*707*	*131*	*302*	*7*	*4*	*3*	*16 F*
Wreckfish	**Cernier commun**		**Cherna**		***Polyprion americanus***				**1,70(05)058,01**	**WRF**
21 Spain	-	-	-	-	21	-	-	-	-	-
21 Fishing area total	-	-	-	-	*21*	-	-	-	-	-
27 Channel Is	-	-	-	0	-	-	-	-	-	-
France	22	15	4	8	13	26	21	8	21	8
Ireland	1	-	0	-	-	-	-	-	-	-
Portugal	306	381	484	305	474	836	1 408	818	610	342
Spain	84	36	33	45	72	143	399	406	427	604
UK	1	-	0	0	0	-	4	3	9	17
27 Fishing area total	*414*	*432*	*521*	*358*	*559*	*1 005*	*1 832*	*1 235*	*1 067*	*971*
31 USA	-	-	-	7	420	...	3	-	8	63
31 Fishing area total	-	-	-	*7*	*420*	*...*	*3*	-	*8*	*63*
34 Portugal	4	3	15	5	5	31	137	64	49	15
Spain	9	8	16	40	42	19	28	29	49	36
34 Fishing area total	*13*	*11*	*31*	*45*	*47*	*50*	*165*	*93*	*98*	*51*
37 Albania	-	10	1	1	1	4	-	-	-	-
France	-	-	-	-	-	0	-	-	1	-
Greece	...	...	...	171	67	66	67	70	97	97 F
Malta	8	16	11	11	7	4	5	2	3	7
Spain	4	37	5	6	12	6	3	14	11	14
37 Fishing area total	*12*	*63*	*17*	*189*	*87*	*80*	*75*	*86*	*112*	*118 F*
41 Argentina	109	69	61	47	39	116	52	64	76	44
Spain	35	-	-	-	-	-	-	-	-	-
Uruguay	-	-	-	-	-	-	139	82	...	56
41 Fishing area total	*144*	*69*	*61*	*47*	*39*	*116*	*191*	*146*	*76*	*100*
47 Portugal	-	2	6	1	6	6	30	-	-	-
47 Fishing area total	-	*2*	*6*	*1*	*6*	*6*	*30*	-	-	-
51 Portugal	-	-	-	2	-	1	-	-	-	-
Spain	1	-	-	-	-	-	-	-	-	-
51 Fishing area total	*1*	-	-	*2*	-	*1*	-	-	-	-
Species total	*584*	*577*	*636*	*649*	*1 179*	*1 258*	*2 296*	*1 560*	*1 361*	*1 303 F*
Hapuku wreckfish	**Cernier de Nouvelle-Zélande**		**Cherna hapuku**		***Polyprion oxygeneios***				**1,70(05)058,02**	**WHA**
81 New Zealand	1 579	1 610	1 706	1 511	1 881	1 684	1 786	1 674	1 646	1 697
Ukraine	14	-	5	13	...	-	-	-	-	-
81 Fishing area total	*1 593*	*1 610*	*1 711*	*1 524*	*1 881*	*1 684*	*1 786*	*1 674*	*1 646*	*1 697*
87 Chile	10	2	-	16	2	0	0	3	1	1
87 Fishing area total	*10*	*2*	-	*16*	*2*	*0*	*0*	*3*	*1*	*1*
Species total	*1 603*	*1 612*	*1 711*	*1 540*	*1 883*	*1 684*	*1 786*	*1 677*	*1 647*	*1 698*
Grey tilefish	**Tile gris**		**Blanquillo lucio**		***Caulolatilus microps***				**1,70(16)001,02**	**ULM**
21 USA	-	-	3	3	1	1	9	3	4	4
21 Fishing area total	-	-	*3*	*3*	*1*	*1*	*9*	*3*	*4*	*4*
Species total	-	-	*3*	*3*	*1*	*1*	*9*	*3*	*4*	*4*
Ocean whitefish	**Tile fin**		**Blanquillo fino**		***Caulolatilus princeps***				**1,70(16)001,03**	**ULP**
77 Mexico	979	927	1 170	1 284	2 244	2 343	2 524	2 336	2 148	2 259
USA	5	2	2	2	2	1	2	2	1	2
77 Fishing area total	*984*	*929*	*1 172*	*1 286*	*2 246*	*2 344*	*2 526*	*2 338*	*2 149*	*2 261*
Species total	*984*	*929*	*1 172*	*1 286*	*2 246*	*2 344*	*2 526*	*2 338*	*2 149*	*2 261*

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Atlantic goldeneye tilefish	**Tile oeil doré**		**Blanquillo ojo amarillo**		***Caulolatilus chrysops***				**1,70(16)001,04**	**CKZ**
21 USA	790	847	-	-	-	-	-	-	-	-
21 Fishing area total	*790*	*847*	-	-	-	-	-	-	-	-
31 USA	16	10	...	41	-	-	-	-	12	28
31 Fishing area total	*16*	*10*	*...*	*41*	-	-	-	-	*12*	*28*
Species total	*806*	*857*	*...*	*41*	-	-	-	-	*12*	*28*
Great Northern tilefish	**Tile chameau**		**Blanquillo camello**		***Lopholatilus chamaeleonticeps***				**1,70(16)400,02**	**TIL**
21 USA	117	98	1 127	1 149	674	954	752	905	1 055	1 089
21 Fishing area total	*117*	*98*	*1 127*	*1 149*	*674*	*954*	*752*	*905*	*1 055*	*1 089*
31 USA	168	197	181	189	171	433	381	405	416	284
31 Fishing area total	*168*	*197*	*181*	*189*	*171*	*433*	*381*	*405*	*416*	*284*
Species total	*285*	*295*	*1 308*	*1 338*	*845*	*1 387*	*1 133*	*1 310*	*1 471*	*1 373*
Tilefishes nei	**Tiles nca**		**Blanquillos, paletas nep**		***Branchiostegidae***				**1,70(16)XXX,XX**	**TIS**
31 Mexico	28	18	37	37	...	...	...	...	...	...
USA	314	268	245	235	319	13	11	23	42	32
31 Fishing area total	*342*	*286*	*282*	*272*	*319*	*13*	*11*	*23*	*42*	*32*
34 Côte dIvoire	15	16	12	10	12	7	1	3 F	5	5
Senegal	...	...	338	142	229	302	266	310	447	210
Spain	-	-	-	-	-	-	27	8	8	18
34 Fishing area total	*15*	*16*	*350*	*152*	*241*	*309*	*294*	*321 F*	*460*	*233*
41 Brazil	755	638	639	614	790	782	924	766	845	798
Uruguay	...	...	...	...	...	...	15	7	...	...
41 Fishing area total	*755*	*638*	*639*	*614*	*790*	*782*	*939*	*773*	*845*	*798*
61 China	...	...	45 019 F	55 182 F	57 446 F	47 692 F	52 477	40 795	40 437	37 263
China,H.Kong	4 750 F	4 650 F	4 300 F	4 600 F	4 450 F	4 250 F	4 250 F	4 360 F	4 380 F	4 630 F
China,Taiwan	512	306	385	127	146	85	70	47	130	48
Japan	1 781	1 804	1 716	1 661	1 350	1 415	1 565	1 392	1 421	1 300 F
Korea Rep	1 049	1 341	1 303	1 405	1 186	1 537	1 570	1 073	1 215	1 549
61 Fishing area total	*8 092 F*	*8 101 F*	*52 723 F*	*62 975 F*	*64 578 F*	*54 979 F*	*59 932 F*	*47 667 F*	*47 583 F*	*44 790 F*
87 Ecuador	...	...	...	...	...	74	103	139	...	...
Peru	1 485	2 507	1 381	53	...	14	-	-	-	-
87 Fishing area total	*1 485*	*2 507*	*1 381*	*53*	*...*	*88*	*103*	*139*	*...*	*...*
Species total	*10 689 F*	*11 548 F*	*55 375 F*	*64 066 F*	*65 928 F*	*56 171 F*	*61 279 F*	*48 923 F*	*48 930 F*	*45 853 F*
Cape bonnetmouth	**Andorrève du Cap**		**Andorrero del Cabo**		***Emmelichthys nitidus***				**1,70(30)010,01**	**EMM**
47 South Africa	37	-	102	156	266	226	183	-	-	367
47 Fishing area total	*37*	-	*102*	*156*	*266*	*226*	*183*	-	-	*367*
81 New Zealand	1 881	2 825	4 178	3 248	2 163	4 168	2 237	3 068	3 217	971
Ukraine	-	1 410	3 782	2 393	...	2 420	...	...	...	...
81 Fishing area total	*1 881*	*4 235*	*7 960*	*5 641*	*2 163*	*6 588*	*2 237*	*3 068*	*3 217*	*971*
Species total	*1 918*	*4 235*	*8 062*	*5 797*	*2 429*	*6 814*	*2 420*	*3 068*	*3 217*	*1 338*
Rubyfish	**...B**		**...C**		***Plagiogeneion rubiginosum***				**1,70(30)286,02**	**RYG**
81 New Zealand	434	403	195	419	489	464	504	714	635	602
Ukraine	-	-	4	-	-	19	...	...	...	...
81 Fishing area total	*434*	*403*	*199*	*419*	*489*	*483*	*504*	*714*	*635*	*602*
Species total	*434*	*403*	*199*	*419*	*489*	*483*	*504*	*714*	*635*	*602*
Bonnetmouths, rubyfishes nei	**Andorrèves, poissons rubis nca**		**Andorreros, peces rubí nep**		***Emmelichthyidae***				**1,70(30)XXX,XX**	**EMT**
34 Lithuania	-	8	19	6	6	1	-	-	-	-
34 Fishing area total	-	*8*	*19*	*6*	*6*	*1*	-	-	-	-
47 Russian Fed	6	-	-	-	-	-	-	-	-	-
47 Fishing area total	*6*	-	-	-	-	-	-	-	-	-
51 Ukraine	121	-	-	-	-	-	-	-	-	-
51 Fishing area total	*121*	-	-	-	-	-	-	-	-	-
61 Russian Fed	-	-	3	-	-	-	-	-	-	-
61 Fishing area total	-	-	*3*	-	-	-	-	-	-	-
Species total	*127*	*8*	*22*	*6*	*6*	*1*	-	-	-	-
Tripletail	**Croupia roche**		**Dormilona**		***Lobotes surinamensis***				**1,70(34)029,01**	**LOB**
31 Fr Guiana	...	...	...	...	17	101	128	93	110	120 F
Suriname	...	...	54	55	52	...	...	...	...	...
USA	1	1	1	1	0	2	-	-	3	-
31 Fishing area total	*1*	*1*	*55*	*56*	*69*	*103*	*128*	*93*	*113*	*120 F*
41 Brazil	...	14	16	24	21	21	14	18	20	19

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
41 Fishing area total	*...*	*14*	*16*	*24*	*21*	*21*	*14*	*18*	*20*	*19*
Species total	*1*	*15*	*71*	*80*	*90*	*124*	*142*	*111*	*133*	*139 F*
Pacific tripletail	**Croupia roche du Pacifique**		**Dormilona del Pacífico**		***Lobotes pacificus***				**1,70(34)029,02**	**LOZ**
87 Ecuador	...	...	...	...	...	4	21	25	...	...
87 Fishing area total	*...*	*...*	*...*	*...*	*...*	*4*	*21*	*25*	*...*	*...*
Species total	*...*	*...*	*...*	*...*	*...*	*4*	*21*	*25*	*...*	*...*
Giant boarfish	**...B**		**...C**		***Paristiopterus labiosus***				**1,70(57)004,02**	**SWH**
81 New Zealand	3	9	103	7	10	7	5	6	16	7
81 Fishing area total	*3*	*9*	*103*	*7*	*10*	*7*	*5*	*6*	*16*	*7*
Species total	*3*	*9*	*103*	*7*	*10*	*7*	*5*	*6*	*16*	*7*
Bigspined boarfish	**...B**		**...C**		***Pentaceros decacanthus***				**1,70(57)006,02**	**EMV**
81 New Zealand	0	0	35	0	1	1	0	0	0	0
81 Fishing area total	*0*	*0*	*35*	*0*	*1*	*1*	*0*	*0*	*0*	*0*
Species total	*0*	*0*	*35*	*0*	*1*	*1*	*0*	*0*	*0*	*0*
Pelagic armourhead	**Tête casquée pélagique**		**...C**		***Pseudopentaceros richardsoni***				**1,70(57)007,01**	**EDR**
47 Spain	0	-	3	3	-	-	-	-	-	-
47 Fishing area total	*0*	*-*	*3*	*3*	*-*	*-*	*-*	*-*	*-*	*-*
51 Ukraine	12	-	-	-	-	-	-	-	-	-
51 Fishing area total	*12*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
81 China	-	26	-	-	-	-	-	-	-	-
New Zealand	7	37	53	106	119	69	29	42	42	98
Ukraine	-	-	-	1	...	-	-	-	-	-
81 Fishing area total	*7*	*63*	*53*	*107*	*119*	*69*	*29*	*42*	*42*	*98*
Species total	*19*	*63*	*56*	*110*	*119*	*69*	*29*	*42*	*42*	*98*
Red bandfish	**Cépole commune**		**Cepola**		***Cepola macrophthalma***				**1,70(60)083,01**	**CBC**
27 Portugal	-	-	-	-	-	-	8	1	5	2
Spain	-	17	5	7	8	12	11	19	51	41
27 Fishing area total	*-*	*17*	*5*	*7*	*8*	*12*	*19*	*20*	*56*	*43*
37 France	26	26	18	30	37	35	33	...	2	9
Slovenia	-	-	1	4	3	1	1	0	0	0
Spain	-	-	-	190	287	293	260	196	154	125
37 Fishing area total	*26*	*26*	*19*	*224*	*327*	*329*	*294*	*196*	*156*	*134*
Species total	*26*	*43*	*24*	*231*	*335*	*341*	*313*	*216*	*212*	*177*
Castaneta	**Castanette pontude**		**Castañeta**		***Cheilodactylus bergi***				**1,70(70)270,02**	**CTA**
41 Argentina	98	149	146	682	3 048	605	1 291	1 372	1 071	869
Uruguay	1 269	349	384	501	966	3 892	982	4 445	997	589
41 Fishing area total	*1 367*	*498*	*530*	*1 183*	*4 014*	*4 497*	*2 273*	*5 817*	*2 068*	*1 458*
Species total	*1 367*	*498*	*530*	*1 183*	*4 014*	*4 497*	*2 273*	*5 817*	*2 068*	*1 458*
Peruvian morwong	**Castanette pintadille**		**Pintadilla**		***Cheilodactylus variegatus***				**1,70(70)270,03**	**HAW**
87 Chile	46	4	6	65	62	49	75	102	77	62
Peru	260	356	303	429	371	316	889	278	380	260
87 Fishing area total	*306*	*360*	*309*	*494*	*433*	*365*	*964*	*380*	*457*	*322*
Species total	*306*	*360*	*309*	*494*	*433*	*365*	*964*	*380*	*457*	*322*
Tarakihi	**...B**		**...C**		***Nemadactylus macropterus***				**1,70(70)305,04**	**TAK**
81 New Zealand	6 129	6 149	5 853	5 440	5 947	5 945	5 608	5 481	5 885	5 536
Ukraine	-	-	-	1	...	-	-	-	-	-
81 Fishing area total	*6 129*	*6 149*	*5 853*	*5 441*	*5 947*	*5 945*	*5 608*	*5 481*	*5 885*	*5 536*
Species total	*6 129*	*6 149*	*5 853*	*5 441*	*5 947*	*5 945*	*5 608*	*5 481*	*5 885*	*5 536*
Morwongs	**...B**		**...C**		***Nemadactylus spp***				**1,70(70)305,XX**	**MOW**
57 Australia	776	716	768	733	772	763	625	616	490	391
57 Fishing area total	*776*	*716*	*768*	*733*	*772*	*763*	*625*	*616*	*490*	*391*
81 Australia	425	319	375	334	335	339	273	323	267	217
New Zealand	92	91	80	89	91	49	75	53	63	67
81 Fishing area total	*517*	*410*	*455*	*423*	*426*	*388*	*348*	*376*	*330*	*284*
Species total	*1 293*	*1 126*	*1 223*	*1 156*	*1 198*	*1 151*	*973*	*992*	*820*	*675*

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Trumpeters nei	**...B**		**Tromperos nep**		***Latridae***				**1,70(71)XXX,XX**	**TRU**
57 Australia	77	70	65	66	47	49	63	39	31	23
57 Fishing area total	*77*	*70*	*65*	*66*	*47*	*49*	*63*	*39*	*31*	*23*
81 Australia	13	8	6	9	1	1	0	1	1	0
New Zealand	505	493	527	466	615	569	616	645	601	615
81 Fishing area total	*518*	*501*	*533*	*475*	*616*	*570*	*616*	*646*	*602*	*615*
Species total	*595*	*571*	*598*	*541*	*663*	*619*	*679*	*685*	*633*	*638*
Plunderfish	**...B**		**...C**		***Pogonophryne permitini***				**1,70(88)001,01**	**PGR**
88 Korea Rep	-	-	-	0	-	-	-	-	-	0
New Zealand	0	0	0	0	0	0	0	0	0	-
88 Fishing area total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Species total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Antarctic toothfish	**Légine antarctique**		**Austromerluza antártica**		***Dissostichus mawsoni***				**1,70(92)015,01**	**TOA**
48 Germany	-	-	-	-	-	-	0	-	-	-
Japan	-	-	-	-	-	63	23	11	93	184
Korea Rep	-	-	-	-	2	-	4	-	173	159
New Zealand	-	-	-	-	-	0	0	0	27	31
Norway	-	-	-	-	-	-	7	-	-	-
UK	-	-	-	-	-	-	-	-	32	26
USA	0	-	-	-	-	0	-	-	-	-
48 Fishing area total	*0*	-	-	-	*2*	*63*	*34*	*11*	*325*	*400*
58 Australia	-	-	117	26	0	0	0	3	-	-
Chile	-	-	-	-	211	73	-	-	-	-
Japan	-	-	-	-	-	-	73	72	44	98
Korea Rep	-	-	-	-	235	280	318	356	218	201
Namibia	-	-	-	-	-	-	108	214	-	-
New Zealand	-	-	-	-	59	-	-	-	-	-
Spain	-	-	-	-	405	543	315	66	-	-
Uruguay	-	-	-	-	-	6	27	15	115	-
58 Fishing area total	-	-	*117*	*26*	*910*	*902*	*841*	*726*	*377*	*299*
88 Argentina	-	-	-	162	253	213	194	0	-	38
Chile	-	-	-	-	-	-	-	-	103	-
Korea Rep	-	-	-	105	-	-	453	420	654	789
New Zealand	582	1 354	1 060	1 157	1 769	1 402	1 159	1 063	828	1 310
Norway	-	-	-	98	192	385	260	-	-	-
Russian Fed	-	-	703	261	666	707	586	276	-	-
South Africa	21	-	149	110	-	-	51	120	118	-
Spain	-	-	-	114	-	-	-	44	384	352
Ukraine	-	-	-	154	-	-	-	-	-	-
UK	-	-	-	16	260	407	474	672	740	459
USA	-	-	-	194	-	-	-	-	-	-
Uruguay	23	-	-	187	370	367	248	70	90	-
88 Fishing area total	*626*	*1 354*	*1 912*	*2 558*	*3 510*	*3 481*	*3 425*	*2 665*	*2 917*	*2 948*
Species total	*626*	*1 354*	*2 029*	*2 584*	*4 422*	*4 446*	*4 300*	*3 402*	*3 619*	*3 647*
Patagonian toothfish	**Légine australe**		**Austromerluza negra**		***Dissostichus eleginoides***				**1,70(92)015,02**	**TOP**
41 Argentina	6 410	8 164	5 652	2 348	1 219	1 411	1 873	2 171	2 434	3 015
Belize	11	0	-	-	-	-	-	-	-	-
Chile	831	207	17	65	145	202	145	-	-	-
Falkland Is	1 468	1 243	971	1 643	1 598	1 264	1 123	1 391	1 211	1 031
Japan	...	2	-	-	-	-	-	-	-	-
Korea Rep	686	1 476	720	1 095	1 034	1 375	1 118	958	1 081	802
New Zealand	-	-	43	-	-	-	-	-	-	-
Russian Fed	1	3	9	245	-	-	-	-	-	109
Seychelles	3 800	-	-	-	-	-	-	-	-	-
Spain	277	215	180	...	73	39	35	37	203	366
Ukraine	-	-	-	-	-	376	365	333	96	198
UK	3	8	1	5	0	1	1	1	5	3
Uruguay	336	1 170	1 278	1 270	848	1 231	2 911	569	366	464
41 Fishing area total	*13 823*	*12 488*	*8 871*	*6 671*	*4 917*	*5 899*	*7 571*	*5 460*	*5 396*	*5 988*
47 Chile	5	-	-	-	-	-	-	-	-	-
Japan	-	-	47	124	158	155	166	122	86	14
Korea Rep	-	-	245	-	10	5	26	76	65	-
Spain	-	18	101	202	-	12	-	-	-	28
Uruguay	-	906	2 045	402	-	-	-	-	-	-
47 Fishing area total	*5*	*924*	*2 438*	*728*	*168*	*172*	*192*	*198*	*151*	*42*
48 Chile	534	1 545	2 881	1 542	738	440	345	388	370	351
Japan	-	1	262	7	49	100	75	12	17	10
Korea Rep	787	300	296	325	-	225	205	53	176	39
New Zealand	-	-	399	-	-	394	441	506	436	363
Russian Fed	224	313	606	-	-	-	-	-	-	-
South Africa	359	332	382	232	303	304	341	316	149	175
Spain	643	832	880	660	367	373	369	814	810	648
Ukraine	149	-	-	-	-	-	-	-	-	-
UK	924	1 728	1 475	1 392	1 654	1 569	1 664	1 634	1 359	894
Uruguay	428	693	347	346	-	249	232	251	156	145

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
48 Fishing area total	*4 048*	*5 744*	*7 528*	*4 504*	*3 111*	*3 654*	*3 672*	*3 974*	*3 473*	*2 625*
51 Korea Rep	122	-	-	-	420	-	-	-	44	136
Seychelles	-	2 870	-	-	-	-	-	-	-	-
Uruguay	7 002	1 928	1 112	86	-	-	31	101	26	-
51 Fishing area total	*7 124*	*4 798*	*1 112*	*86*	*420*	*-*	*31*	*101*	*70*	*136*
57 Korea Rep	450	836	1 100	-	-	-	-	-	-	-
Ukraine	-	-	-	13	-	-	-	-	-	-
Uruguay	-	1 847	83	-	-	-	-	-	-	-
57 Fishing area total	*450*	*2 683*	*1 183*	*13*	*-*	*-*	*-*	*-*	*-*	*-*
58 Australia	2 981	2 756	2 844	2 864	2 745	2 528	2 387	2 281	2 464	2 459
France	5 838	5 312	5 822	5 708	5 633	5 931	5 611	5 673	6 123	5 575
Japan	-	-	-	-	-	-	37	113	46	63
Korea Rep	-	-	-	-	10	-	0	0	-	-
Namibia	-	-	-	-	-	-	5	1	-	-
New Zealand	-	-	-	-	1	-	-	-	-	-
South Africa	271	165	259	204	221	150	175	124	43	150
Spain	-	-	-	-	87	88	1	0	-	-
Ukraine	8	-	-	-	-	-	-	-	-	-
Uruguay	-	-	-	-	-	44	129	13	0	-
58 Fishing area total	*9 098*	*8 233*	*8 925*	*8 776*	*8 697*	*8 741*	*8 345*	*8 205*	*8 676*	*8 247*
81 New Zealand	14	...	...	3	...	...	90	308	746	-
81 Fishing area total	*14*	*...*	*...*	*3*	*...*	*...*	*90*	*308*	*746*	*-*
87 Chile	6 521	6 787	5 376	4 864	5 251	4 469	4 383	4 752	4 851	4 946
Spain	11	-	-	-	-	-	-	-	-	-
87 Fishing area total	*6 532*	*6 787*	*5 376*	*4 864*	*5 251*	*4 469*	*4 383*	*4 752*	*4 851*	*4 946*
88 Argentina	-	-	-	1	-	-	-	0	-	-
Korea Rep	-	-	-	-	-	-	11	5	16	-
New Zealand	30	12	26	1	1	1	1	1	0	0
Norway	-	-	-	0	-	-	-	-	-	-
Russian Fed	-	-	-	0	5	0	-	0	-	-
South Africa	4	-	0	0	-	-	-	0	0	-
Spain	-	-	-	-	-	-	-	2	0	-
Ukraine	-	-	-	9	-	-	-	-	-	-
USA	-	-	-	1	-	-	-	-	-	-
Uruguay	0	-	-	0	1	-	0	0	-	-
88 Fishing area total	*34*	*12*	*26*	*12*	*7*	*1*	*12*	*8*	*16*	*0*
Species total	*41 128*	*41 669*	*35 459*	*25 657*	*22 571*	*22 936*	*24 296*	*23 006*	*23 379*	*21 984*
Patagonian rockcod	**Bocasse de Patagonie**		**Trama patagónica**		***Patagonotothen brevicauda***				**1,70(92)440,01**	**NOT**
41 Russian Fed	-	4	49	43	-	-	-	-	-	-
Spain	-	5	7	83	-	-	-	-	-	-
41 Fishing area total	*-*	*9*	*56*	*126*	*-*	*-*	*-*	*-*	*-*	*-*
48 UK	-	0	-	-	-	-	0	0	1	1
48 Fishing area total	*-*	*0*	*-*	*-*	*-*	*-*	*0*	*0*	*1*	*1*
Species total	*-*	*9*	*56*	*126*	*-*	*-*	*0*	*0*	*1*	*1*
Longtail Southern cod	**Notothénia queue longue**		**Nototenia coluda**		***Patagonotothen ramsayi***				**1,70(92)440,02**	**PAT**
41 Falkland Is	-	-	-	52	4 297	11 226	11 319	18 710	3 475	4 918
Korea Rep	-	-	-	-	-	1	7	62	68	190
Panama	-	-	-	-	-	-	104	-	-	-
Spain	-	10	191	1 036	4 238	11 234	18 831	41 222	28 601	27 252
UK	-	-	-	-	446	568	716	824	937	857
41 Fishing area total	*-*	*10*	*191*	*1 088*	*8 981*	*23 029*	*30 977*	*60 818*	*33 081*	*33 217*
Species total	*-*	*10*	*191*	*1 088*	*8 981*	*23 029*	*30 977*	*60 818*	*33 081*	*33 217*
...A	**...B**		**...C**		***Parachaenichthys georgianus***				**1,70(93)452,01**	**PGE**
48 UK	-	-	-	-	-	-	0	0	0	0
48 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*0*	*0*	*0*	*0*
Species total	*-*	*-*	*-*	*-*	*-*	*-*	*0*	*0*	*0*	*0*
...A	**...B**		**...C**		***Chionobathyscus dewitti***				**1,70(94)001,01**	**CHW**
58 Namibia	-	-	-	-	-	-	-	1	-	-
58 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*1*	*-*	*-*
88 Korea Rep	-	-	-	0	-	-	1	0	0	0
Spain	-	-	-	-	-	-	-	-	0	3
88 Fishing area total	*-*	*-*	*-*	*0*	*-*	*-*	*1*	*0*	*0*	*3*
Species total	*-*	*-*	*-*	*0*	*-*	*-*	*1*	*1*	*0*	*3*
Blackfin icefish	**Grande-gueule antarctique**		**Draco antártico**		***Chaenocephalus aceratus***				**1,70(94)416,01**	**SSI**
48 Chile	-	-	-	-	0	-	-	-	-	-
Germany	-	-	-	-	-	-	0	-	-	-

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Japan	-	-	-	-	-	-	0	-	-	-
Korea Rep	-	1	1	0	2	0	0	-	-	-
Ukraine	-	-	-	-	0	3	...	-	-	-
UK	-	4	-	0	0	0	0	1	0	1
USA	1	-	-	-	-	0	-	-	-	-
48 Fishing area total	*1*	*5*	*1*	*0*	*2*	*3*	*0*	*1*	*0*	*1*
58 Australia	-	-	-	0	-	-	-	-	-	-
Chile	-	-	-	-	1	-	-	-	-	-
Korea Rep	-	-	-	-	0	1	1	1	0	-
58 Fishing area total	-	-	-	*0*	*1*	*1*	*1*	*1*	*0*	-
88 Korea Rep	-	-	-	0	-	-	-	-	0	-
88 Fishing area total	-	-	-	*0*	-	-	-	-	*0*	-
Species total	*1*	*5*	*1*	*0*	*3*	*4*	*1*	*2*	*0*	*1*
Mackerel icefish	**Poisson des glaces antarctique**		**Draco rayado**		***Champsocephalus gunnari***				**1,70(94)417,01**	**ANI**
41 Chile	447	192	7	75	-	4	17	5	-	-
Falkland Is	-	-	-	-	-	1	-	-	-	-
41 Fishing area total	*447*	*192*	*7*	*75*	-	*5*	*17*	*5*	-	-
48 Chile	365	-	834	972	2	1 187	1 502	503	-	1
France	386	-	-	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	1	-	-	-
Japan	-	-	-	-	-	-	-	1	-	-
Korea Rep	-	602	494	1 034	179	646	1 248	249	499	-
Poland	-	296	-	-	-	-	-	-	-	-
Russian Fed	0	1 373	-	-	-	-	-	-	-	-
Ukraine	-	-	-	-	1	16	...	0	-	-
UK	208	396	658	678	20	336	1 595	1 739	1 334	11
USA	1	-	-	-	-	0	-	-	-	-
48 Fishing area total	*960*	*2 667*	*1 986*	*2 684*	*202*	*2 185*	*4 346*	*2 492*	*1 833*	*12*
58 Australia	1 136	865	2 345	78	1 851	660	1	199	83	352
58 Fishing area total	*1 136*	*865*	*2 345*	*78*	*1 851*	*660*	*1*	*199*	*83*	*352*
Species total	*2 543*	*3 724*	*4 338*	*2 837*	*2 053*	*2 850*	*4 364*	*2 696*	*1 916*	*364*
Pike icefish	**...B**		**...C**		***Champsocephalus esox***				**1,70(94)417,02**	**CES**
41 Falkland Is	-	-	-	-	0	22	2	88	1	5
UK	-	-	-	-	-	-	-	2	-	0
41 Fishing area total	-	-	-	-	*0*	*22*	*2*	*90*	*1*	*5*
Species total	-	-	-	-	*0*	*22*	*2*	*90*	*1*	*5*
South Georgia icefish	**Crocodile de Géorgie**		**Draco cocodrilo**		***Pseudochaenichthys georgianus***				**1,70(94)418,01**	**SGI**
48 Chile	-	-	-	-	0	-	-	1	-	-
France	0	-	-	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	0	-	-	-
Korea Rep	-	1	5	1	17	4	0	-	-	-
Norway	-	-	-	-	-	-	-	-	1	-
Ukraine	-	-	-	-	0	3	...	-	-	-
UK	6	5	-	0	8	1	1	0	1	2
USA	0	-	-	-	-	-	-	-	-	-
48 Fishing area total	*6*	*6*	*5*	*1*	*25*	*8*	*1*	*1*	*2*	*2*
58 Australia	-	-	-	0	-	-	-	-	-	-
58 Fishing area total	-	-	-	*0*	-	-	-	-	-	-
Species total	*6*	*6*	*5*	*1*	*25*	*8*	*1*	*1*	*2*	*2*
Ocellated icefish	**Grande-gueule ocellée**		**Draco ocelado**		***Chionodraco rastrospinosus***				**1,70(94)466,01**	**KIF**
48 Germany	-	-	-	-	-	-	0	-	-	-
USA	1	-	-	-	-	0	-	-	-	-
48 Fishing area total	*1*	-	-	-	-	*0*	*0*	-	-	-
Species total	*1*	-	-	-	-	*0*	*0*	-	-	-
...A	**...B**		**...C**		***Chionodraco hamatus***				**1,70(94)466,02**	**TIC**
88 Ukraine	-	-	-	0	-	-	-	-	-	-
88 Fishing area total	-	-	-	*0*	-	-	-	-	-	-
Species total	-	-	-	*0*	-	-	-	-	-	-
Myers' icefish	**...B**		**...C**		***Chionodraco myersi***				**1,70(94)466,03**	**MIC**
88 Argentina	-	-	-	0	-	-	-	-	-	-
88 Fishing area total	-	-	-	*0*	-	-	-	-	-	-
Species total	-	-	-	*0*	-	-	-	-	-	-

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Unicorn icefish	**Grande-gueule à long nez**		**Draco rinoceronte**		***Channichthys rhinoceratus***				**1,70(94)470,01**	**LIC**
58 Australia	1	3	21	14	34	33	15	37	51	81
58 Fishing area total	*1*	*3*	*21*	*14*	*34*	*33*	*15*	*37*	*51*	*81*
Species total	*1*	*3*	*21*	*14*	*34*	*33*	*15*	*37*	*51*	*81*
Spiny icefish	**Grande-gueule épineuse**		**Draco espinudo**		***Chaenodraco wilsoni***				**1,70(94)480,01**	**WIC**
48 Germany	-	-	-	-	-	-	0	-	-	-
USA	0	-	-	-	-	0	-	-	-	-
48 Fishing area total	*0*	-	-	-	-	*0*	*0*	-	-	-
58 Australia	11	-	-	-	-	-	-	-	-	-
58 Fishing area total	*11*	-	-	-	-	-	-	-	-	-
Species total	*11*	-	-	-	-	*0*	*0*	-	-	-
Crocodile icefishes nei	**Poissons des glaces nca**		**Dracos nep**		***Channichthyidae***				**1,70(94)XXX,XX**	**ICX**
48 Chile	-	-	-	-	0	-	-	-	-	-
France	0	-	-	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	0	-	-	-
UK	-	0	-	-	-	-	-	0	0	-
USA	0	-	-	-	-	-	-	-	-	-
Uruguay	-	-	-	-	-	1	-	-	-	-
48 Fishing area total	*0*	*0*	-	-	*0*	*1*	*0*	*0*	*0*	-
58 Australia	-	-	0	-	-	0	-	0	0	-
Namibia	-	-	-	-	-	-	0	-	-	-
New Zealand	-	-	-	-	1	0	0	-	-	-
58 Fishing area total	-	-	*0*	-	*1*	*0*	*0*	*0*	*0*	-
88 Argentina	-	-	-	0	-	1	4	-	-	-
New Zealand	2	2	9	3	2	4	5	4	4	3
Norway	-	-	-	1	0	-	4	-	-	-
Russian Fed	-	-	-	0	0	-	1	-	-	-
South Africa	0	-	0	0	-	-	0	0	3	-
Ukraine	-	-	-	0	-	-	-	-	-	-
UK	-	-	-	0	0	-	4	3	2	8
Uruguay	-	-	-	1	0	0	1	0	0	-
88 Fishing area total	*2*	*2*	*9*	*5*	*2*	*5*	*19*	*7*	*9*	*11*
Species total	*2*	*2*	*9*	*5*	*3*	*6*	*19*	*7*	*9*	*11*
Black cardinal fish	**Poisson cardinal**		**Boca negra(Pez del diablo)**		***Epigonus telescopus***				**1,70(96)373,01**	**EPI**
21 Spain	-	-	-	-	-	-	-	-	-	3
21 Fishing area total	-	-	-	-	-	-	-	-	-	*3*
27 France	153	72	88	63	64	76	15	11	14	14
Ireland	-	-	36	127	32	12	1	-	-	-
Portugal	4	18	18	9	8	18	12	11	11	7
Spain	-	70	7	19	8	23	35	14	39	32
UK	22	-	0	-	-	-	-	-	-	-
27 Fishing area total	*179*	*160*	*149*	*218*	*112*	*129*	*63*	*36*	*64*	*53*
37 Spain	-	-	-	-	-	-	-	-	2	-
37 Fishing area total	-	-	-	-	-	-	-	-	*2*	-
47 Namibia	...	...	103	30	28	16	9	...	11	10 F
47 Fishing area total	*...*	*...*	*103*	*30*	*28*	*16*	*9*	*...*	*11*	*10 F*
81 Australia	-	-	-	-	-	-	2	-	-	-
New Zealand	1 957	2 741	2 879	2 063	1 525	3 115	1 804	1 302	1 279	1 151
Ukraine	-	-	-	4	...	-	-	-	-	-
81 Fishing area total	*1 957*	*2 741*	*2 879*	*2 067*	*1 525*	*3 115*	*1 806*	*1 302*	*1 279*	*1 151*
Species total	*2 136*	*2 901*	*3 131*	*2 315*	*1 665*	*3 260*	*1 878*	*1 338*	*1 356*	*1 217 F*
Cardinal fishes nei	**Poissons-cardinaux nca**		**Peces cardenal nep**		***Epigonus spp***				**1,70(96)373,XX**	**CDL**
51 China	-	3	-	-	-	-	-	-	-	-
Cook Is	-	-	-	-	-	-	-	-	-	123
Réunion	9	6	6	6	9	9	9	0	5 F	5 F
51 Fishing area total	*9*	*9*	*6*	*6*	*9*	*9*	*9*	*0*	*5 F*	*128 F*
87 Chile	4 648	1 595	3 276	2 070	2 229	1 536	801	351	184	93
87 Fishing area total	*4 648*	*1 595*	*3 276*	*2 070*	*2 229*	*1 536*	*801*	*351*	*184*	*93*
Species total	*4 657*	*1 604*	*3 282*	*2 076*	*2 238*	*1 545*	*810*	*351*	*189 F*	*221 F*
Atlantic wolffish	**Loup atlantique**		**Perro del Norte**		***Anarhichas lupus***				**1,71(02)001,01**	**CAA**
21 Estonia	-	-	-	-	-	-	-	12	5	-
Spain	7	0	5	3	-	-	-	-	-	-
21 Fishing area total	*7*	*0*	*5*	*3*	-	-	-	*12*	*5*	-
27 Belgium	175	188	69	96	130	67	74	70	52	34
Denmark	223	248	176	164	131	111	128	140	180	235
Faroe Is	272	253	440	433	360	362	282	171	175	128

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
France	7	8	2	2	2	16	47	46	5	...
Germany	66	-	-	-	-	-	-	-	-	-
Greenland	16	27	7	21	10	12	2	24	10	1
Iceland	17 953	14 303	16 453	13 194	15 233	16 408	16 192	14 648	15 129	12 608
Ireland	27	50	27	4	5	36	41	5	10	0
Norway	1 113	871	753	667	521	766	857	715	1 213	942
Poland	8	12	7	8	-	2	6	0	16	-
Portugal	...	...	...	...	...	1	1	-	-	-
Russian Fed	...	...	...	...	...	...	...	...	619	1 063
Sweden	95	74	67	67	63	38	31	48	19	17
UK	140	151	131	84	76	82	66	33	24	16
27 Fishing area total	*20 095*	*16 185*	*18 132*	*14 740*	*16 531*	*17 901*	*17 727*	*15 900*	*17 452*	*15 044*
Species total	*20 102*	*16 185*	*18 137*	*14 743*	*16 531*	*17 901*	*17 727*	*15 912*	*17 457*	*15 044*
Northern wolffish	**Loup gélatineux**		**Lobo**		***Anarhichas denticulatus***				**1,71(02)001,02**	**CAB**
27 Norway	8 640	3 115	2 674	3 533	2 382	1 417	880	901	818	365
Russian Fed	...	...	...	...	...	...	...	...	7 216	6 261
27 Fishing area total	*8 640*	*3 115*	*2 674*	*3 533*	*2 382*	*1 417*	*880*	*901*	*8 034*	*6 626*
Species total	*8 640*	*3 115*	*2 674*	*3 533*	*2 382*	*1 417*	*880*	*901*	*8 034*	*6 626*
Spotted wolffish	**Loup tacheté**		**Perro pintado**		***Anarhichas minor***				**1,71(02)001,03**	**CAS**
21 Norway	...	-	...	0	24	11	1	7	10	8
Portugal	-	-	-	-	-	-	-	2	0	2
Spain	...	...	...	...	...	...	...	33	-	-
21 Fishing area total	*...*	*...*	*...*	*0*	*24*	*11*	*1*	*42*	*10*	*10*
27 Germany	-	10	35	20	11	8	-	-	-	-
Iceland	2 126	2 128	2 414	3 346	3 264	3 644	2 726	2 100	2 314	1 903
Norway	1 114	1 394	1 943	1 959	1 826	2 309	2 323	2 381	3 717	2 269
Portugal	20	-	-	172	-	2	4	1	-	-
Russian Fed	...	...	...	...	...	...	...	...	4 924	5 080
27 Fishing area total	*3 260*	*3 532*	*4 392*	*5 497*	*5 101*	*5 963*	*5 053*	*4 482*	*10 955*	*9 252*
Species total	*3 260*	*3 532*	*4 392*	*5 497*	*5 125*	*5 974*	*5 054*	*4 524*	*10 965*	*9 262*
Wolffishes(=Catfishes) nei	**Loups nca**		**Perritos del Norte nep**		***Anarhichas spp***				**1,71(02)001,XX**	**CAT**
21 Canada	578	-	-	0	44	69	78	44	57	45
Estonia	5	1	28	108	71	63	10	2	-	-
Faroe Is	-	-	-	-	6	-	-	-	-	10
Germany	-	-	-	-	-	-	-	4	2	-
Greenland	58	128	393	313	491	752	879	1 186	1 157	1 198
Japan	45	30	26	6	2	-	1	1	-	-
Lithuania	-	-	-	-	1	-	1	-	-	-
Norway	1	-	11	-	-	-	-	-	-	-
Portugal	141	87	106	46	32	31	16	24	43	13
Russian Fed	23	56	57	21	10	-	27	14	2	3
St Pier Mq	1	1	1	0	-	-	2	-	-	-
Spain	785	532	585	290	285	-	51	165	155	182
Ukraine	-	-	1	1	-	-	-	-	-	-
UK	-	-	-	-	-	-	-	6	15	-
USA	250	155	129	119	121	81	65	50	34	3
21 Fishing area total	*1 887*	*990*	*1 337*	*904*	*1 063*	*996*	*1 130*	*1 496*	*1 465*	*1 454*
27 Estonia	-	1	-	-	3	-	-	-	-	-
Faroe Is	99	78	159	175	281	267	260	342	260	340
Germany	-	86	54	52	43	36	63	56	56	87
Iceland	-	-	-	-	-	-	-	-	-	17
Ireland	-	-	2	5	15	12	13	12	6	2
Netherlands	2	3	1	1	2	2	2	2	4	6
Norway	3 597	316	673	1 409	1 040	897	606	745	1 251	374
Portugal	163	627	459	108	77	72	109	70	133	32
Russian Fed	19 087	20 190	12 199	12 691	13 538	10 898	8 962	7 478	-	-
Spain	98	109	70	-	-	0	0	16	5	8
UK	600	437	475	346	268	279	214	207	304	263
27 Fishing area total	*23 646*	*21 847*	*14 092*	*14 787*	*15 267*	*12 463*	*10 229*	*8 928*	*2 019*	*1 129*
61 Russian Fed	33	22	11	-	-	-	-	-	-	-
61 Fishing area total	*33*	*22*	*11*	-	-	-	-	-	-	-
Species total	*25 566*	*22 859*	*15 440*	*15 691*	*16 330*	*13 459*	*11 359*	*10 424*	*3 484*	*2 583*
Eelpouts	**Loquettes**		**Viruelas**		***Lycodes spp***				**1,71(15)024,XX**	**ELZ**
21 Spain	-	-	-	1	-	-	-	-	-	-
21 Fishing area total	-	-	-	*1*	-	-	-	-	-	-
27 Russian Fed	1	2	-	-	-	-	-	-	-	-
27 Fishing area total	*1*	*2*	-	-	-	-	-	-	-	-
61 Russian Fed	47	60	513	587	377	73	51	86	21	371
61 Fishing area total	*47*	*60*	*513*	*587*	*377*	*73*	*51*	*86*	*21*	*371*
Species total	*48*	*62*	*513*	*588*	*377*	*73*	*51*	*86*	*21*	*371*

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Stargazer	**Uranoscope**		**Rata**		***Uranoscopus scaber***				**1,72(13)352,02**	**UUC**
27 Portugal	46	104	91	127	33	36	89	31	56	35
27 Fishing area total	*46*	*104*	*91*	*127*	*33*	*36*	*89*	*31*	*56*	*35*
37 France	-	-	-	-	-	-	-	-	5	7
Italy	...	...	...	...	38	232	262	207	148	162
Malta	-	-	-	-	-	-	-	-	1	3
37 Fishing area total	*...*	*...*	*...*	*...*	*38*	*232*	*262*	*207*	*154*	*172*
Species total	*46*	*104*	*91*	*127*	*71*	*268*	*351*	*238*	*210*	*207*
Giant stargazer	**Uranoscope géant**		**Miracielo gigante**		***Kathetostoma giganteum***				**1,72(13)484,01**	**STZ**
81 New Zealand	4 233	3 272	2 859	3 179	3 895	3 206	3 473	3 107	3 165	3 321
81 Fishing area total	*4 233*	*3 272*	*2 859*	*3 179*	*3 895*	*3 206*	*3 473*	*3 107*	*3 165*	*3 321*
Species total	*4 233*	*3 272*	*2 859*	*3 179*	*3 895*	*3 206*	*3 473*	*3 107*	*3 165*	*3 321*
Japanese sandfish	**Toroumoque japonais**		**...C**		***Arctoscopus japonicus***				**1,72(72)103,01**	**JAS**
61 Japan	8 753	9 249	15 395	12 804	14 358	13 217	7 823	14 959	9 752	8 800 F
Korea Rep	1 286	3 381	1 928	2 472	2 401	2 647	3 769	2 720	3 939	4 236
61 Fishing area total	*10 039*	*12 630*	*17 323*	*15 276*	*16 759*	*15 864*	*11 592*	*17 679*	*13 691*	*13 036 F*
Species total	*10 039*	*12 630*	*17 323*	*15 276*	*16 759*	*15 864*	*11 592*	*17 679*	*13 691*	*13 036 F*
Snoek	**Escolier**		**Sierra**		***Thyrsites atun***				**1,75(05)001,01**	**SNK**
41 Argentina	-	-	-	-	-	2	-	-	-	-
41 Fishing area total	-	-	-	-	-	*2*	-	-	-	-
47 Namibia	1 699	1 890	2 083	2 195	2 736	1 695	4 194	702	2 570	1 800 F
South Africa	10 328	11 079	9 476	15 188	13 245	6 766	6 799	10 209	9 613	10 221
Spain	-	-	-	56	43	31	35	10	25	59
47 Fishing area total	*12 027*	*12 969*	*11 559*	*17 439*	*16 024*	*8 492*	*11 028*	*10 921*	*12 208*	*12 080 F*
51 France	-	-	-	-	-	-	-	-	1	1
51 Fishing area total	-	-	-	-	-	-	-	-	*1*	*1*
57 Australia	154	161	110	98	110	415	70	63	66	50
57 Fishing area total	*154*	*161*	*110*	*98*	*110*	*415*	*70*	*63*	*66*	*50*
81 Australia	29	9	19	40	43	27	19	14	11	8
Japan	157	81	213	-	-	-	-	-	-	-
New Zealand	25 222	23 121	21 738	22 473	31 122	25 902	28 616	27 356	27 832	26 416
Ukraine	2 970	3 846	7 480	7 386	...	9 198	...	...	...	...
81 Fishing area total	*28 378*	*27 057*	*29 450*	*29 899*	*31 165*	*35 127*	*28 635*	*27 370*	*27 843*	*26 424*
87 Chile	830	934	469	734	1 236	673	1 025	838	1 348	2 156
87 Fishing area total	*830*	*934*	*469*	*734*	*1 236*	*673*	*1 025*	*838*	*1 348*	*2 156*
Species total	*41 389*	*41 121*	*41 588*	*48 170*	*48 535*	*44 709*	*40 758*	*39 192*	*41 466*	*40 711 F*
Escolar	**Escolier noir**		**Escolar negro**		***Lepidocybium flavobrunneum***				**1,75(05)005,01**	**LEC**
21 Spain	-	-	-	-	9	4	-	8	-	2
USA	4	1	3	1	1	0	1	1	1	0
21 Fishing area total	*4*	*1*	*3*	*1*	*10*	*4*	*1*	*9*	*1*	*2*
27 Portugal	-	-	-	-	-	-	-	1	2	15
Spain	-	-	-	35	19	14	28	20	38	43
27 Fishing area total	-	-	-	*35*	*19*	*14*	*28*	*21*	*40*	*58*
31 USA	40	57	76	67	43	39	56	45	60	34
31 Fishing area total	*40*	*57*	*76*	*67*	*43*	*39*	*56*	*45*	*60*	*34*
34 UK	-	-	-	-	-	-	-	-	1	-
34 Fishing area total	-	-	-	-	-	-	-	-	*1*	-
41 Portugal	-	-	-	-	-	-	-	-	1	14
UK	-	-	-	-	-	-	-	6	-	-
Uruguay	10	21	28	30	40	21	8	33	...	...
41 Fishing area total	*10*	*21*	*28*	*30*	*40*	*21*	*8*	*39*	*1*	*14*
47 Portugal	-	-	-	-	-	-	-	-	1	1
UK	-	-	-	-	-	-	-	6	1	-
47 Fishing area total	-	-	-	-	-	-	-	*6*	*2*	*1*
51 Portugal	-	-	-	-	-	-	-	-	-	5
UK	-	-	-	-	-	-	-	-	-	4
Uruguay	-	-	-	-	-	10	-	-	-	-
51 Fishing area total	-	-	-	-	-	*10*	-	-	-	*9*
77 Fr Polynesia	...	...	...	...	30	27	28	23	35	50
USA	3	3	4	3	2	2	3	6	5	7
77 Fishing area total	*3*	*3*	*4*	*3*	*32*	*29*	*31*	*29*	*40*	*57*
81 New Zealand	87	76	53	33	21	25	18	15	21	17

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
81 Fishing area total	*87*	*76*	*53*	*33*	*21*	*25*	*18*	*15*	*21*	*17*
87 Portugal	-	-	-	-	-	-	-	-	-	7
Uruguay	-	-	-	-	7	-	-	-	-	-
87 Fishing area total	-	-	-	-	*7*	-	-	-	-	*7*
Species total	*144*	*158*	*164*	*169*	*172*	*142*	*142*	*164*	*166*	*199*
Oilfish	**Rouvet**		**Escolar clavo**		***Ruvettus pretiosus***				**1,75(05)007,01**	**OIL**
21 Portugal	-	-	-	-	-	0	1	-	1	1
Spain	-	-	-	-	2	4	-	1	-	1
21 Fishing area total	-	-	-	-	*2*	*4*	*1*	*1*	*1*	*2*
27 Portugal	9	9	12	69	130	190	360	228	198	212
27 Fishing area total	*9*	*9*	*12*	*69*	*130*	*190*	*360*	*228*	*198*	*212*
31 USA	30	25	18	19	9	3	4	4	3	-
31 Fishing area total	*30*	*25*	*18*	*19*	*9*	*3*	*4*	*4*	*3*	-
34 Portugal	2	8	13	19	44	26	28	48	48	90
34 Fishing area total	*2*	*8*	*13*	*19*	*44*	*26*	*28*	*48*	*48*	*90*
37 Cyprus	-	-	-	-	-	-	-	-	-	1
Malta	-	-	-	-	-	-	-	-	1	2
Portugal	-	-	-	7	2	-	-	-	-	-
37 Fishing area total	-	-	-	*7*	*2*	-	-	-	*1*	*3*
41 Portugal	-	-	-	-	17	32	72	111	62	65
41 Fishing area total	-	-	-	-	*17*	*32*	*72*	*111*	*62*	*65*
47 Namibia	-	-	21	11	-	141	88	...	99	100 F
Portugal	-	-	-	-	-	20	39	21	61	30
South Africa	-	-	-	17	27	8	117	114	3	36
47 Fishing area total	-	-	*21*	*28*	*27*	*169*	*244*	*135*	*163*	*166 F*
51 Portugal	-	-	-	17	7	58	40	3	14	24
South Africa	-	-	-	-	-	-	1	2	-	-
UK	-	-	-	-	-	-	-	-	28	3
51 Fishing area total	-	-	-	*17*	*7*	*58*	*41*	*5*	*42*	*27*
57 Portugal	-	-	-	1	2	-	21	4	-	6
57 Fishing area total	-	-	-	*1*	*2*	-	*21*	*4*	-	*6*
61 China,Taiwan	3 678	4 190	5 166	5 404	12 449	35 910	41 920	15 189	17 869	12 971
61 Fishing area total	*3 678*	*4 190*	*5 166*	*5 404*	*12 449*	*35 910*	*41 920*	*15 189*	*17 869*	*12 971*
77 Fr Polynesia	...	...	...	36	...	5	5	5	5	12
USA	-	92	126	157	175	189	208	223	247	263
77 Fishing area total	*...*	*92*	*126*	*193*	*175*	*194*	*213*	*228*	*252*	*275*
81 New Zealand	86	131	107	62	29	18	11	12	13	13
81 Fishing area total	*86*	*131*	*107*	*62*	*29*	*18*	*11*	*12*	*13*	*13*
87 Portugal	-	-	-	-	-	-	8	-	-	-
87 Fishing area total	-	-	-	-	-	-	*8*	-	-	-
Species total	*3 805*	*4 455*	*5 463*	*5 819*	*12 893*	*36 604*	*42 923*	*15 965*	*18 652*	*13 830 F*
Silver gemfish	**Escolier tifiati**		**Escolar plateado**		***Rexea solandri***				**1,75(05)009,01**	**GEM**
57 Australia	482	224	294	503	430	469	500	441	180	178
57 Fishing area total	*482*	*224*	*294*	*503*	*430*	*469*	*500*	*441*	*180*	*178*
71 Australia	-	11	2	13	3	0	14	-	-	-
71 Fishing area total	-	*11*	*2*	*13*	*3*	*0*	*14*	-	-	-
81 Australia	89	70	59	71	60	61	39	66	96	52
New Zealand	827	688	919	1 171	1 092	818	670	655	594	680
Ukraine	-	-	1	7	...	-	-	-	-	-
81 Fishing area total	*916*	*758*	*979*	*1 249*	*1 152*	*879*	*709*	*721*	*690*	*732*
Species total	*1 398*	*993*	*1 275*	*1 765*	*1 585*	*1 348*	*1 223*	*1 162*	*870*	*910*
Roudi escolar	**Escolier clair**		**Escolar prometeo**		***Promethichthys prometheus***				**1,75(05)017,01**	**PRP**
34 Portugal	6	7	6	4	5	5	5	3	3	2
34 Fishing area total	*6*	*7*	*6*	*4*	*5*	*5*	*5*	*3*	*3*	*2*
77 Fr Polynesia	...	...	...	...	6	7	2	2	3	7
77 Fishing area total	*...*	*...*	*...*	*...*	*6*	*7*	*2*	*2*	*3*	*7*
Species total	*6*	*7*	*6*	*4*	*11*	*12*	*7*	*5*	*6*	*9*
Snake mackerels, escolars nei	**Escoliers, rouvets nca**		**Escolares, sierras nep**		***Gempylidae***				**1,75(05)XXX,XX**	**GEP**
27 Spain	-	-	-	22	4	15	14	7	6	24
27 Fishing area total	-	-	-	*22*	*4*	*15*	*14*	*7*	*6*	*24*

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
31 Spain	-	-	4	-	9	5	6	2	7	7
31 Fishing area total	-	-	*4*	-	*9*	*5*	*6*	*2*	*7*	*7*
34 Portugal	-	-	-	-	-	-	-	-	6	28
Spain	-	-	-	71	105	80	50	56	68	57
34 Fishing area total	-	-	-	*71*	*105*	*80*	*50*	*56*	*74*	*85*
41 Spain	-	-	-	74	-	-	29	-	164	122
41 Fishing area total	-	-	-	*74*	-	-	*29*	-	*164*	*122*
51 Spain	-	-	-	69	94	177	229	42	57	64
51 Fishing area total	-	-	-	*69*	*94*	*177*	*229*	*42*	*57*	*64*
57 Spain	-	-	24	61	38	24	12	17	4	7
57 Fishing area total	-	-	*24*	*61*	*38*	*24*	*12*	*17*	*4*	*7*
87 Ecuador	212	28	642	770	448	1 826	1 884	822	193	661
87 Fishing area total	*212*	*28*	*642*	*770*	*448*	*1 826*	*1 884*	*822*	*193*	*661*
Species total	*212*	*28*	*670*	*1 067*	*698*	*2 127*	*2 224*	*946*	*505*	*970*
Frostfishes	**...B**		**...C**		***Benthodesmus spp***				**1,75(06)002,XX**	**BEH**
81 New Zealand	1	80	95	124	126	92	31	36	54	28
Ukraine	-	-	26	34	...	39	...	...	...	...
81 Fishing area total	*1*	*80*	*121*	*158*	*126*	*131*	*31*	*36*	*54*	*28*
Species total	*1*	*80*	*121*	*158*	*126*	*131*	*31*	*36*	*54*	*28*
Largehead hairtail	**Poisson-sabre commun**		**Pez sable**		***Trichiurus lepturus***				**1,75(06)003,02**	**LHT**
21 USA	1	2	0	0	1	2	2	3	26	9
21 Fishing area total	*1*	*2*	*0*	*0*	*1*	*2*	*2*	*3*	*26*	*9*
27 Ireland	523	831	-	-	-	-	-	-	-	-
Netherlands	-	-	1	-	-	1	-	13	9	-
Portugal	0	0	-	0	-	1	1	1	-	1
27 Fishing area total	*523*	*831*	*1*	*0*	-	*2*	*1*	*14*	*9*	*1*
31 Suriname	...	...	357	378	276	...	...	...	...	...
USA	6	14	8	21	9	15	22	22	37	4
Venezuela	8 793	6 484	9 332	14 740 F	7 900 F	5 000 F	6 100 F	6 900 F	6 660 F	6 660 F
31 Fishing area total	*8 799*	*6 498*	*9 697*	*15 139 F*	*8 185 F*	*5 015 F*	*6 122 F*	*6 922 F*	*6 697 F*	*6 664 F*
34 Belize	7	56	...	...	...	...	...	...	...	1 353
Benin	584	579	662	548	436	451	200 F	20	55	71
Cameroon	59	6	7	400 F	889	815	815	770 F	722 F	722 F
Comoros	-	-	-	-	-	-	...	...	...	130
Congo Rep	30 F	38 F	45	78	43	179	699	93	237	800
Côte dIvoire	200	171	269	93	212	133	208	150 F	103	820
Cyprus	3 949	-	-	-	-	-	-	-	-	-
Germany	-	-	-	2	-	15	58	-	-	-
Ghana	1 849	3 154	3 717	1 760	2 894	3 262	7 303	1 331	574	1 483
Guinea	...	...	...	...	...	...	976	...	...	94
GuineaBissau	...	4	1	5 F	5 F	5 F	5 F	5 F	5 F	5 F
Ireland	253	75	84	-	-	-	-	-	60	19
Latvia	13	46	-	-	-	-	-	-	-	-
Liberia	169	160	160	33	192	53	208	30	30 F	30 F
Lithuania	167	8 120	4 590	601	556	...	...	28	19	149
Mauritania	590 F	700 F	800 F	944	1 047	807 F	677 F	598	180 F	275
Morocco	5 124	3 793	2 700	4 051	4 872	4 842	4 091	4 245	5 243	5 716
Netherlands	697	547	356	630	360	-	-	19	-	6
Nigeria	1 156	1 927	2 396	3 054	1 734	1 041	727	884	977	1 080
Russian Fed	1 146	66	22	90	536	1 426	28	-	10	72
St Kitts Nev	-	-	-	-	-	-	-	-	-	59
St Vincent	716	1 441	...	...	...	...	...	...	...	73
Senegal	1 083	886	1 102	819	714	691	1 316	2 410	2 883	8 461
Sierra Leone	48	66	49	54	116	333	694	1 357	1 330 F	1 330 F
Spain	5	36	10	39	67	64	538	264	383	597
Togo	4	14	6	378	18	16	18	20 F	24	7
Ukraine	40	1 005	-	-	-	-	-	-	-	-
Other nei	660	301	...	...	...	...	...	...	...	...
34 Fishing area total	*18 549 F*	*23 191 F*	*16 976 F*	*13 579 F*	*14 691 F*	*14 133 F*	*18 561 F*	*12 224 F*	*12 835 F*	*23 352 F*
37 Egypt	1 107	1 096	694	588	782	1 294	1 235	1 749	1 549	1 812
Morocco	0	0	0	0	0	54	2	1	4	3
37 Fishing area total	*1 107*	*1 096*	*694*	*588*	*782*	*1 348*	*1 237*	*1 750*	*1 553*	*1 815*
41 Argentina	37	75	90	77	435	273	399	258	308	458
Brazil	2 886	2 863	1 459	1 706	1 846	1 999	3 390	2 424	2 673	2 523
Uruguay	0	0	153	553	55	21	64	91	...	105
41 Fishing area total	*2 923*	*2 938*	*1 702*	*2 336*	*2 336*	*2 293*	*3 853*	*2 773*	*2 981*	*3 086*
47 Namibia	691	...	491	399	994	742	...	...	...	...
Portugal	-	-	-	-	-	-	-	22	-	-
Russian Fed	1 180	208	167	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	39	-
47 Fishing area total	*1 871*	*208*	*658*	*399*	*994*	*742*	*...*	*22*	*39*	*...*

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
51 Egypt	-	-	-	-	41	2	-	4	3	-
Iran	2 766	3 530	2 709	1 815	3 417	3 338	2 281	5 162	7 056	8 650
Pakistan	27 355	28 440	25 660	25 592	23 163	23 494	22 605	22 733	20 375	20 940
51 Fishing area total	*30 121*	*31 970*	*28 369*	*27 407*	*26 621*	*26 834*	*24 886*	*27 899*	*27 434*	*29 590*
57 Malaysia	1 681	1 617	2 315	3 825	4 410	4 260	5 686	4 934	4 523	4 565
Thailand	8 263	9 719	8 123	7 359	6 799	7 372	6 060	3 189	3 489	3 339
57 Fishing area total	*9 944*	*11 336*	*10 438*	*11 184*	*11 209*	*11 632*	*11 746*	*8 123*	*8 012*	*7 904*
61 China	1 094 329 F	1 095 629 F	1 074 614 F	1 191 085 F	1 090 220 F	1 204 857 F	1 152 001	1 192 721	1 172 440	1 186 841
China,Taiwan	8 834	8 390	8 710	8 697	8 474	9 138	8 536	7 988	8 373	6 679
Japan	16 615	14 405	12 949	16 439	16 332	16 099	17 894	16 399	11 891	10 100 F
Korea Rep	79 898	60 172	62 861	66 291	60 086	63 739	66 029	72 934	85 450	59 242
Russian Fed	-	-	-	-	2	-	-	-	-	-
61 Fishing area total	*1 199 676 F*	*1 178 596 F*	*1 159 134 F*	*1 282 512 F*	*1 175 114 F*	*1 293 833 F*	*1 244 460*	*1 290 042*	*1 278 154*	*1 262 862 F*
71 Malaysia	8 030	3 806	4 144	5 133	4 925	5 325	6 066	5 122	4 634	5 067
Singapore	50	61	45	40	31	74	79	24	34	31
Thailand	8 021	10 154	9 474	10 037	8 652	7 234	7 189	3 287	3 092	3 190
71 Fishing area total	*16 101*	*14 021*	*13 663*	*15 210*	*13 608*	*12 633*	*13 334*	*8 433*	*7 760*	*8 288*
Species total	*1 289 615 F*	*1 270 687 F*	*1 241 332 F*	*1 368 354 F*	*1 253 541 F*	*1 368 467 F*	*1 324 202 F*	*1 358 205 F*	*1 345 500 F*	*1 343 571 F*
Silver scabbardfish	**Sabre argenté**		**Pez cinto**		***Lepidopus caudatus***				**1,75(06)006,01**	**SFS**
27 France	16	24	12	16	36	42	16	4	7	9
Germany	-	-	-	-	3	-	-	-	-	-
Ireland	-	-	1	-	-	342	67	-	-	-
Lithuania	-	-	-	-	12	30	23	2	-	-
Portugal	82	82	50	114	52	48	68	76	143	84
Russian Fed	2	-	-	-	-	-	-	6	-	-
Spain	256	1 863	936	676	381	499	736	928	808	1 000
UK	5	1	1	0	0	4	0	-	-	-
27 Fishing area total	*361*	*1 970*	*1 000*	*806*	*484*	*965*	*910*	*1 016*	*958*	*1 093*
34 Liberia	-	-	-	-	9	-	-	-	-	-
Portugal	4	-	-	-	-	-	0	-	-	1
Ukraine	-	183	-	-	-	-	-	-	-	-
UK	-	-	-	-	-	-	-	-	13	8
34 Fishing area total	*4*	*183*	-	-	*9*	-	*0*	-	*13*	*9*
37 Albania	0	0	3	1	1	23	2	2	...	...
France	15	11	7	8	7	7	5	1	2	15
Italy	...	...	...	...	1 951	2 284	2 233	2 150	2 614	2 812
Malta	-	-	-	-	-	-	2	2	1	2
Spain	3 031	779	632	192	125	179	163	176	472	167
Tunisia	375	263	559	323	279	393	440	542	320	491
37 Fishing area total	*3 421*	*1 053*	*1 201*	*524*	*2 363*	*2 886*	*2 845*	*2 873*	*3 409*	*3 487*
47 Angola	...	6 579	6 773	...	...	...	...	...	...	...
South Africa	2 316	4 523	4 600	6 463	8 732	8 506	6 673	4 478	4 263	3 462
47 Fishing area total	*2 316*	*11 102*	*11 373*	*6 463*	*8 732*	*8 506*	*6 673*	*4 478*	*4 263*	*3 462*
51 South Africa	-	-	-	-	-	1	-	2	-	2
51 Fishing area total	-	-	-	-	-	*1*	-	*2*	-	*2*
81 New Zealand	2 876	2 435	2 200	1 959	3 150	1 781	1 804	1 737	1 529	1 110
Ukraine	11	40	774	932	...	934	...	...	...	...
81 Fishing area total	*2 887*	*2 475*	*2 974*	*2 891*	*3 150*	*2 715*	*1 804*	*1 737*	*1 529*	*1 110*
Species total	*8 989*	*16 783*	*16 548*	*10 684*	*14 738*	*15 073*	*12 232*	*10 106*	*10 172*	*9 163*
Black scabbardfish	**Sabre noir**		**Sable negro**		***Aphanopus carbo***				**1,75(06)012,01**	**BSF**
21 Spain	-	-	-	-	8	98	-	-	-	-
21 Fishing area total	-	-	-	-	*8*	*98*	-	-	-	-
27 Estonia	224	-	7	5	11	5	7	-	-	-
Faroe Is	407	1 364	1 496	973	649	769	719	994	1 317	969
France	5 070	4 958	3 420	3 089	3 054	2 250	2 392	2 287	2 899	1 886
Iceland	8	15	14	19	19	23	1	...	...	109
Ireland	299	259	160	151	79	73	121	-	-	-
Lithuania	3	9	13	86	5	1	-	-	-	-
Netherlands	-	21	-	-	-	-	-	14	-	-
Poland	-	2	2	1	-	-	-	-	-	-
Portugal	2 745	2 692	2 813	3 306	3 572	2 796	3 497	3 613	3 483	3 386
Spain	1 323	992	189	266	222	187	177	203	221	438
UK	742	1 065	101	196	1 669	65	58	26	82	104
27 Fishing area total	*10 821*	*11 377*	*8 215*	*8 092*	*9 280*	*6 169*	*6 972*	*7 137*	*8 002*	*6 892*
34 Ireland	-	-	-	148	121	-	-	-	-	-
Portugal	4 008	3 873	3 665	3 747	3 195	2 640	3 087	3 119	2 429	1 860
34 Fishing area total	*4 008*	*3 873*	*3 665*	*3 895*	*3 316*	*2 640*	*3 087*	*3 119*	*2 429*	*1 860*
Species total	*14 829*	*15 250*	*11 880*	*11 987*	*12 604*	*8 907*	*10 059*	*10 256*	*10 431*	*8 752*
Hairtails, scabbardfishes nei	**Poissons-sabres, sabres nca**		**Peces sable, cintos nep**		***Trichiuridae***				**1,75(06)XXX,XX**	**CUT**
27 Ireland	-	-	-	0	2	-	-	-	0	-

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Spain	13	-	-	86	68	133	188	171	115	81
27 Fishing area total	*13*	-	-	*86*	*70*	*133*	*188*	*171*	*115*	*81*
31 Korea Rep	6	-	-	-	-	-	-	-	-	-
Mexico	5 085	3 872	...	...	2 386	2 492	3 229	4 071	4 913	5 408
31 Fishing area total	*5 091*	*3 872*	...	...	*2 386*	*2 492*	*3 229*	*4 071*	*4 913*	*5 408*
34 China	-	-	-	-	-	-	-	-	-	14
Gambia	28	8	0	4 022	1	...	39	570	610	610
Korea Rep	1 001	571	538	388	215	251	207	221	369	247
Netherlands	-	-	-	-	209	33	-	111	38	-
Nigeria	...	...	...	...	...	789	613	701	896	945
34 Fishing area total	*1 029*	*579*	*538*	*4 410*	*425*	*1 073*	*859*	*1 603*	*1 913*	*1 816*
41 Korea Rep	155	-	-	43	21	14	-	-	-	-
41 Fishing area total	*155*	-	-	*43*	*21*	*14*	-	-	-	-
51 India	86 652	118 633	90 668	91 346	95 109	110 204	80 848	62 736	74 786	125 293
Korea Rep	1 663	2 592	2 153	2 031	1 490	1 291	1 432	1 182	1 974	241
Oman	2 617	6 600	8 809	3 492	4 869	5 571	5 483	3 757	5 710	6 749
Untd Arab Em	80 F	82	95	70 F	50	30 F	10 F	...	...	...
51 Fishing area total	*91 012 F*	*127 907*	*101 725*	*96 939 F*	*101 518*	*117 096 F*	*87 773 F*	*67 675*	*82 470*	*132 283*
57 India	15 046	14 914	10 213	13 373	19 859	20 281	25 568	24 724	25 997	19 629
Indonesia	14 278	18 047	22 839	14 051	16 744	19 191	23 939	22 250	24 845	19 599
Korea Rep	90	-	152	-	-	-	-	31	-	-
57 Fishing area total	*29 414*	*32 961*	*33 204*	*27 424*	*36 603*	*39 472*	*49 507*	*47 005*	*50 842*	*39 228*
61 China,H.Kong	1 650 F	1 600 F	1 500 F	1 600 F	1 550 F	1 470 F	1 470 F	1 510 F	1 520 F	1 610 F
61 Fishing area total	*1 650 F*	*1 600 F*	*1 500 F*	*1 600 F*	*1 550 F*	*1 470 F*	*1 470 F*	*1 510 F*	*1 520 F*	*1 610 F*
71 Indonesia	24 224	26 627	21 409	21 550	22 049	21 633	23 475	51 457	49 003	37 466
Korea Rep	361	532	351	213	292	483	833	628	-	63
Philippines	8 315	9 187	10 177	10 826	13 250	14 409	17 971	20 137	17 461	16 710
71 Fishing area total	*32 900*	*36 346*	*31 937*	*32 589*	*35 591*	*36 525*	*42 279*	*72 222*	*66 464*	*54 239*
77 Korea Rep	-	9	-	-	-	-	-	-	-	-
Mexico	4	7	7	7	...	...	...	...	...	...
77 Fishing area total	*4*	*16*	*7*	*7*	*...*	*...*	*...*	*...*	*...*	*...*
81 Korea Rep	227	152	70	127	47	10	11	96	22	29
81 Fishing area total	*227*	*152*	*70*	*127*	*47*	*10*	*11*	*96*	*22*	*29*
87 Ecuador	3 382	3 000 F	2 000 F	1 000 F	500 F	464	514	...	3 501	2 464
Korea Rep	-	1	-	-	-	-	-	-	-	-
87 Fishing area total	*3 382*	*3 001 F*	*2 000 F*	*1 000 F*	*500 F*	*464*	*514*	*...*	*3 501*	*2 464*
Species total	*164 877 F*	*206 434 F*	*170 981 F*	*164 225 F*	*178 711 F*	*198 749 F*	*185 830 F*	*194 353 F*	*211 760 F*	*237 158 F*
Indian driftfish	**Ariomme indienne**		**Arioma índica**		***Ariomma indica***			**1,76(04)012,01**		**DRI**
51 Bahrain	...	...	...	29	11	24	128	39	26	62
51 Fishing area total	*...*	*...*	*...*	*29*	*11*	*24*	*128*	*39*	*26*	*62*
61 China,H.Kong	45 F	40 F	37 F	39 F	38 F	37 F	37 F	38 F	40 F	42 F
61 Fishing area total	*45 F*	*40 F*	*37 F*	*39 F*	*38 F*	*37 F*	*37 F*	*38 F*	*40 F*	*42 F*
Species total	*45 F*	*40 F*	*37 F*	*68 F*	*49 F*	*61 F*	*165 F*	*77 F*	*66 F*	*104 F*
Rudderfish	**Centrolophe noir**		**Romerillo**		***Centrolophus niger***			**1,76(08)001,01**		**CEO**
58 Australia	-	-	-	0	-	-	-	-	-	-
58 Fishing area total	-	-	-	*0*	-	-	-	-	-	-
81 Ukraine	-	-	2	1	...	-	-	-	-	-
81 Fishing area total	-	-	*2*	*1*	*...*	-	-	-	-	-
Species total	-	-	*2*	*1*	*...*	-	-	-	-	-
Imperial blackfish	**Rouffe impérial**		**Rufo imperial**		***Schedophilus ovalis***			**1,76(08)003,02**		**HDV**
27 Portugal	-	-	1	2	2	2	3	3	3	2
Spain	-	-	-	...	...	...	...	...	6	-
27 Fishing area total	-	-	*1*	*2*	*2*	*2*	*3*	*3*	*9*	*2*
Species total	-	-	*1*	*2*	*2*	*2*	*3*	*3*	*9*	*2*
Violet warehou	**...B**		**...C**		***Schedophilus velaini***			**1,76(08)003,09**		**SEY**
34 Mauritania	...	...	...	...	...	...	...	...	...	406
34 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*406*
47 Portugal	-	-	3	1	30	20	33	36	26	-
Spain	-	-	2	7	-	-	-	-	-	-
47 Fishing area total	-	-	*5*	*8*	*30*	*20*	*33*	*36*	*26*	-
Species total	*...*	*...*	*5*	*8*	*30*	*20*	*33*	*36*	*26*	*406*

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Pemarco blackfish	**Rouffe rayé**		**Rufo pemarco**		***Schedophilus pemarco***				**1,76(08)003,10**	**HDW**
34 Senegal	...	...	405	466	278	235	618	275	70	63
34 Fishing area total	*...*	*...*	*405*	*466*	*278*	*235*	*618*	*275*	*70*	*63*
47 Angola	...	...	...	...	...	...	4 683	487	91	87 F
47 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*4 683*	*487*	*91*	*87 F*
Species total	*...*	*...*	*405*	*466*	*278*	*235*	*5 301*	*762*	*161*	*150 F*
Choicy ruff	**Sériolelle argentine**		**Cojinoba savorín**		***Seriolella porosa***				**1,76(08)010,01**	**SEO**
41 Argentina	4 059	5 360	5 917	5 971	3 785	6 160	4 691	6 241	6 479	2 834
41 Fishing area total	*4 059*	*5 360*	*5 917*	*5 971*	*3 785*	*6 160*	*4 691*	*6 241*	*6 479*	*2 834*
Species total	*4 059*	*5 360*	*5 917*	*5 971*	*3 785*	*6 160*	*4 691*	*6 241*	*6 479*	*2 834*
Common warehou	**...B**		**...C**		***Seriolella brama***				**1,76(08)010,02**	**SEM**
81 New Zealand	4 101	4 005	4 906	4 713	4 605	3 637	3 498	2 874	3 314	2 805
Ukraine	-	169	552	606	...	429	...	...	...	...
81 Fishing area total	*4 101*	*4 174*	*5 458*	*5 319*	*4 605*	*4 066*	*3 498*	*2 874*	*3 314*	*2 805*
Species total	*4 101*	*4 174*	*5 458*	*5 319*	*4 605*	*4 066*	*3 498*	*2 874*	*3 314*	*2 805*
Silver warehou	**...B**		**Cojinoba moteada**		***Seriolella punctata***				**1,76(08)010,04**	**SEP**
81 New Zealand	11 268	8 778	9 015	10 755	10 582	11 572	12 296	9 045	8 501	7 728
Ukraine	-	397	633	539	...	356	...	...	...	...
81 Fishing area total	*11 268*	*9 175*	*9 648*	*11 294*	*10 582*	*11 928*	*12 296*	*9 045*	*8 501*	*7 728*
Species total	*11 268*	*9 175*	*9 648*	*11 294*	*10 582*	*11 928*	*12 296*	*9 045*	*8 501*	*7 728*
White warehou	**...B**		**Cojinoba del sur**		***Seriolella caerulea***				**1,76(08)010,05**	**SEU**
81 New Zealand	1 962	1 975	3 642	2 328	2 669	2 489	3 287	1 771	2 060	1 875
Ukraine	-	-	4	2	...	-	-	-	-	-
81 Fishing area total	*1 962*	*1 975*	*3 646*	*2 330*	*2 669*	*2 489*	*3 287*	*1 771*	*2 060*	*1 875*
Species total	*1 962*	*1 975*	*3 646*	*2 330*	*2 669*	*2 489*	*3 287*	*1 771*	*2 060*	*1 875*
Warehou nei	**Sériolelles nca**		**Cojinobas nep**		***Seriolella spp***				**1,76(08)010,XX**	**BSP**
34 Russian Fed	-	-	-	-	-	-	-	-	-	3
34 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*
57 Australia	4 192	4 008	4 465	3 673	3 055	2 984	2 699	1 978	1 794	1 346
57 Fishing area total	*4 192*	*4 008*	*4 465*	*3 673*	*3 055*	*2 984*	*2 699*	*1 978*	*1 794*	*1 346*
81 Ukraine	666	34	-	-	-	-	-	-	-	-
81 Fishing area total	*666*	*34*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
87 Chile	3 336	3 587	2 567	3 644	2 952	3 121	3 339	3 254	4 618	3 603
Colombia	8	...	...	7	...	...	...	...	...	...
Peru	3 192	2 192	1 472	2 361	867	261	630	764	453	314
87 Fishing area total	*6 536*	*5 779*	*4 039*	*6 012*	*3 819*	*3 382*	*3 969*	*4 018*	*5 071*	*3 917*
Species total	*11 394*	*9 821*	*8 504*	*9 685*	*6 874*	*6 366*	*6 668*	*5 996*	*6 865*	*5 266*
Bluenose warehou	**Rouffe antarctique**		**Rufo antártico**		***Hyperoglyphe antarctica***				**1,76(08)015,02**	**BWA**
47 Spain	0	-	-	1	-	-	-	-	-	-
Uruguay	-	-	-	-	56	-	-	-	-	-
47 Fishing area total	*0*	*-*	*-*	*1*	*56*	*-*	*-*	*-*	*-*	*-*
51 Cook Is	-	-	-	-	-	-	-	-	-	384
51 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*384*
81 New Zealand	2 954	3 001	3 043	3 178	2 977	2 553	2 627	2 516	2 066	2 254
81 Fishing area total	*2 954*	*3 001*	*3 043*	*3 178*	*2 977*	*2 553*	*2 627*	*2 516*	*2 066*	*2 254*
Species total	*2 954*	*3 001*	*3 043*	*3 179*	*3 033*	*2 553*	*2 627*	*2 516*	*2 066*	*2 638*
Black driftfish	**...B**		**...C**		***Hyperoglyphe bythites***				**1,76(08)015,03**	**HGY**
31 USA	5	6	...	11	2	2	4	2	1	1
31 Fishing area total	*5*	*6*	*...*	*11*	*2*	*2*	*4*	*2*	*1*	*1*
Species total	*5*	*6*	*...*	*11*	*2*	*2*	*4*	*2*	*1*	*1*
Barrelfish	**...B**		**...C**		***Hyperoglyphe perciformis***				**1,76(08)015,04**	**HYW**
31 USA	-	-	-	-	-	-	11	7	12	-
31 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*11*	*7*	*12*	*-*
Species total	*-*	*-*	*-*	*-*	*-*	*-*	*11*	*7*	*12*	*-*
Pacific rudderfish	**Stromaté du Japon**		**Pámpano del Pacífico**		***Psenopsis anomala***				**1,76(08)020,01**	**BUP**
61 China,H.Kong	1 100 F	1 050 F	1 000 F	1 050 F	1 020 F	970 F	970 F	1 000 F	1 010 F	1 065 F

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
China,Taiwan	5 646	5 154	4 488	5 000	4 821	3 933	3 861	4 484	3 947	3 170
Japan	4 196	3 695	3 969	3 895	3 767	4 510	...	...	...	...
61 Fishing area total	*10 942 F*	*9 899 F*	*9 457 F*	*9 945 F*	*9 608 F*	*9 413 F*	*4 831 F*	*5 484 F*	*4 957 F*	*4 235 F*
Species total	*10 942 F*	*9 899 F*	*9 457 F*	*9 945 F*	*9 608 F*	*9 413 F*	*4 831 F*	*5 484 F*	*4 957 F*	*4 235 F*
Ruffs, barrelfishes nei	**Centrolophes nca**		**Rufos, romerillos nep**		***Centrolophidae***			**1,76(08)XXX,XX**		**CEN**
27 Spain	-	-	-	6	1	2	1	136	-	8
27 Fishing area total	-	-	-	*6*	*1*	*2*	*1*	*136*	-	*8*
34 Korea Rep	-	-	-	-	37	-	-	-	-	-
Lithuania	-	51	73	51	1	21	32	-	-	-
Spain	-	-	-	-	5	31	9	-	4	6
34 Fishing area total	-	*51*	*73*	*51*	*43*	*52*	*41*	-	*4*	*6*
37 Spain	-	-	-	8	12	24	26	17	16	13
37 Fishing area total	-	-	-	*8*	*12*	*24*	*26*	*17*	*16*	*13*
41 Korea Rep	-	-	-	1	53	41	-	-	41	2
41 Fishing area total	-	-	-	*1*	*53*	*41*	-	-	*41*	*2*
51 Spain	-	-	-	18	47	28	4	-	-	-
Ukraine	299	-	-	-	-	-	-	-	-	-
51 Fishing area total	*299*	-	-	*18*	*47*	*28*	*4*	-	-	-
71 NewCaledonia	0	0	-	-	-	-	-	-	-	-
71 Fishing area total	*0*	*0*	-	-	-	-	-	-	-	-
81 Korea Rep	209	636	787	453	560	1 017	1 011	1 003	1 291	829
New Zealand	211	169	195	198	178	152	143	137	155	129
81 Fishing area total	*420*	*805*	*982*	*651*	*738*	*1 169*	*1 154*	*1 140*	*1 446*	*958*
Species total	*719*	*856*	*1 055*	*735*	*894*	*1 316*	*1 226*	*1 293*	*1 507*	*987*
Golden redfish	**Sébaste doré**		**Gallineta dorada**		***Sebastes marinus***			**1,78(01)001,01**		**REG**
21 Greenland	-	-	-	3	-	-	2	0	2	0
Norway	-	-	4	3	3	4	-	10	18	6
Portugal	-	-	-	-	-	-	74	-	-	-
Russian Fed	...	...	...	...	725	-	-	-	-	-
21 Fishing area total	...	...	*4*	*6*	*728*	*4*	*76*	*10*	*20*	*6*
27 Denmark	11	1	2	0	3	2	10	1	19	3
Greenland	13	228	97	132	146	260	123	94	922	4 740
Iceland	38 762	54 766	41 296	35 518	44 447	46 780	42 993	50 268	42 804	39 316
Ireland	...	...	4	0	-	-	-	-	-	-
Norway	13 721	9 436	8 204	8 583	7 122	9 570	7 007	6 303	6 359	12 290
Portugal	2	5	4	4	-	0	-	-	-	1
Russian Fed	978	832	479	725	614	911	890	749	703	563
Spain	8	3	1	-	-	-	-	-	-	-
27 Fishing area total	*53 495*	*65 271*	*50 087*	*44 962*	*52 332*	*57 523*	*51 023*	*57 415*	*50 807*	*56 913*
Species total	*53 495*	*65 271*	*50 091*	*44 968*	*53 060*	*57 527*	*51 099*	*57 425*	*50 827*	*56 919*
Norway redfish	**Petit sébaste**		**...C**		***Sebastes viviparus***			**1,78(01)001,02**		**SFV**
27 Iceland	...	...	...	...	...	...	...	...	...	2 601
Ireland	...	...	7	2	...	13	7	-	-	-
27 Fishing area total	...	...	*7*	*2*	...	*13*	*7*	...	...	*2 601*
Species total	...	...	*7*	*2*	...	*13*	*7*	...	...	*2 601*
Widow rockfish	**Sébaste rocote**		**Rocote**		***Sebastes entomelas***			**1,78(01)001,03**		**WRO**
67 USA	2 481	435	91	151	135	129	159	178	152	137
67 Fishing area total	*2 481*	*435*	*91*	*151*	*135*	*129*	*159*	*178*	*152*	*137*
77 USA	128	7	4	1	1	4	7	1	2	1
77 Fishing area total	*128*	*7*	*4*	*1*	*1*	*4*	*7*	*1*	*2*	*1*
Species total	*2 609*	*442*	*95*	*152*	*136*	*133*	*166*	*179*	*154*	*138*
Yellowtail rockfish	**Sébaste à queue jaune**		**Chancharro cola amarilla**		***Sebastes flavidus***			**1,78(01)001,04**		**YRO**
67 USA	2 073	1 204	455	612	824	429	320	387	655	861
67 Fishing area total	*2 073*	*1 204*	*455*	*612*	*824*	*429*	*320*	*387*	*655*	*861*
77 USA	4	2	1	1	5	5	7	2	1	1
77 Fishing area total	*4*	*2*	*1*	*1*	*5*	*5*	*7*	*2*	*1*	*1*
Species total	*2 077*	*1 206*	*456*	*613*	*829*	*434*	*327*	*389*	*656*	*862*
Pacific ocean perch	**Sébaste du Pacifique**		**Gallineta del Pacífico**		***Sebastes alutus***			**1,78(01)001,09**		**OPP**
61 Japan	668	754	488	314	212	443	...	...	...	...
Russian Fed	793	1 194	963	878	1 217	1 205	948	739	970	1 700
61 Fishing area total	*1 461*	*1 948*	*1 451*	*1 192*	*1 429*	*1 648*	*948*	*739*	*970*	*1 700*

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
67 Canada	5 832	5 897	6 228	5 971	5 152	5 348	4 689	4 311	4 414	5 341
Russian Fed	-	38	17	-	-	-	-	-	15	-
USA	17 696	20 602	21 445	20 606	19 488	23 199	28 124	28 987	26 634	32 471
67 Fishing area total	*23 528*	*26 537*	*27 690*	*26 577*	*24 640*	*28 547*	*32 813*	*33 298*	*31 063*	*37 812*
77 USA	12	18	20	29	14	11	3	3	4	2
77 Fishing area total	*12*	*18*	*20*	*29*	*14*	*11*	*3*	*3*	*4*	*2*
Species total	*25 001*	*28 503*	*29 161*	*27 798*	*26 083*	*30 206*	*33 764*	*34 040*	*32 037*	*39 514*
Bocaccio rockfish	**Sébaste bocace**		**Chancharro bocacio**		***Sebastes paucispinis***				**1,78(01)001,10**	**SBC**
67 USA	0	1	0	0	0	0	1	1	1	1
67 Fishing area total	*0*	*1*	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*1*
77 USA	33	21	1	12	5	5	6	6	6	4
77 Fishing area total	*33*	*21*	*1*	*12*	*5*	*5*	*6*	*6*	*6*	*4*
Species total	*33*	*22*	*1*	*12*	*5*	*5*	*7*	*7*	*7*	*5*
Beaked redfish	**Sébaste du Nord**		**Gallineta nórdica**		***Sebastes mentella***				**1,78(01)001,12**	**REB**
21 Denmark	0	0	-	-	-	-	-	-	-	-
Greenland	124	124	-	278	-	22	-	-	-	-
Norway	-	-	12	0	527	-	1	-	-	4
Poland	4	428	776	897	697	624	189	-	-	-
Portugal	-	-	-	-	-	-	-	-	1	363
Russian Fed	...	...	...	12 083	13 098	6 604	4 890	2 895	1 354	2 346
Spain	-	-	-	11	821	1 612	143	-	-	10
21 Fishing area total	*128*	*552*	*788*	*13 269*	*15 143*	*8 862*	*5 223*	*2 895*	*1 355*	*2 723*
27 Denmark	89	42	70	44	31	48	17	3	16	3
Estonia	...	...	...	...	...	396	684	-	-	-
Faroe Is	...	...	...	...	2 877	...	...	...	...	...
Greenland	3 258	3 951	3 453	1 070	778	2 413	2 008	1 106	1 518	2 992
Iceland	42 440	44 504	46 454	32 905	13 231	11 169	12 461	19 385	15 529	28 242
Ireland	...	...	45	2	0	-	-	-	-	-
Norway	14 959	6 883	8 570	8 165	5 307	7 762	6 713	1 803	1 919	1 029
Poland	5	9	147	2 052	1 413	3 832	1 715	219	516	4
Portugal	-	-	-	-	-	-	80	1 993	2 345	2 460
Russian Fed	32 208	35 303	32 163	35 072	24 551	35 241	27 499	22 258	29 796	29 592
Spain	5 575	1 652	3 787	4 670	0	3	1	981	2 088	4 454
27 Fishing area total	*98 534*	*92 344*	*94 689*	*83 980*	*48 188*	*60 864*	*51 178*	*47 748*	*53 727*	*68 776*
Species total	*98 662*	*92 896*	*95 477*	*97 249*	*63 331*	*69 726*	*56 401*	*50 643*	*55 082*	*71 499*
Canary rockfish	**Sébaste citron**		**Chancharro flioma**		***Sebastes pinniger***				**1,78(01)001,15**	**SPG**
67 USA	45	51	15	18	11	14	5	11	11	16
67 Fishing area total	*45*	*51*	*15*	*18*	*11*	*14*	*5*	*11*	*11*	*16*
77 USA	4	3	0	0	1	1	2	1	1	0
77 Fishing area total	*4*	*3*	*0*	*0*	*1*	*1*	*2*	*1*	*1*	*0*
Species total	*49*	*54*	*15*	*18*	*12*	*15*	*7*	*12*	*12*	*16*
Chilipepper rockfish	**Sébaste piment**		**Chancharro pimienta**		***Sebastes goodei***				**1,78(01)001,16**	**SGO**
67 USA	9	5	11	24	29	13	6	5	4	21
67 Fishing area total	*9*	*5*	*11*	*24*	*29*	*13*	*6*	*5*	*4*	*21*
77 USA	609	156	7	42	41	26	39	95	237	331
77 Fishing area total	*609*	*156*	*7*	*42*	*41*	*26*	*39*	*95*	*237*	*331*
Species total	*618*	*161*	*18*	*66*	*70*	*39*	*45*	*100*	*241*	*352*
Splitnose rockfish	**...B**		**...C**		***Sebastes diploproa***				**1,78(01)001,22**	**SFD**
67 USA	-	-	-	-	-	-	-	-	-	18
67 Fishing area total	-	-	-	-	-	-	-	-	-	*18*
Species total	-	-	-	-	-	-	-	-	-	*18*
Black rockfish	**...B**		**...C**		***Sebastes melanops***				**1,78(01)001,32**	**RMG**
67 USA	148	127	118	119	102	97	105	100	134	102
67 Fishing area total	*148*	*127*	*118*	*119*	*102*	*97*	*105*	*100*	*134*	*102*
Species total	*148*	*127*	*118*	*119*	*102*	*97*	*105*	*100*	*134*	*102*
Darkblotched rockfish	**...B**		**...C**		***Sebastes crameri***				**1,78(01)001,47**	**RFC**
67 USA	76	59	68	146	77	78	95	80	91	158
67 Fishing area total	*76*	*59*	*68*	*146*	*77*	*78*	*95*	*80*	*91*	*158*
Species total	*76*	*59*	*68*	*146*	*77*	*78*	*95*	*80*	*91*	*158*

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Patagonian redfish	**...B**		**Chancharro cabrilla**		***Sebastes oculatus***				**1,78(01)001,48**	**REQ**
41 Argentina	...	...	...	...	...	...	...	32	...	2
41 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*32*	*...*	*2*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*32*	*...*	*2*
Atlantic redfishes nei	**Sébastes de l'Atlantique nca**		**Gallinetas del Atlántico nep**		***Sebastes spp***				**1,78(01)001,XX**	**RED**
21 Canada	19 710	16 745	15 239	12 930	16 008	14 248	9 214	7 829	12 117	13 244
Estonia	186	26	65	122	1 106	1 260	830	1 003	1 748	1 340
Faroe Is	38	69	1 460	436	2 152	229	-	315	1	304
Germany	817	2 322	3 003	1 048	1 038	995	-	-	-	-
Greenland	305	523	477	171	210	386	257	169	160	164
Iceland	-	-	2 378	3 917	2 660	1 870	-	-	-	-
Japan	188	213	183	272	548	419	703	633	-	-
Latvia	11	780	898	707	450	592	186	227	138	-
Lithuania	4 396	7 196	7 310	3 698	1 332	863	995	449	-	995
Norway	-	7	-	-	-	-	-	-	-	-
Portugal	5 625	6 344	9 068	6 634	8 832	9 152	7 683	7 771	9 359	10 607
Russian Fed	14 152	20 397	23 911	335	-	-	-	-	-	-
St Pier Mq	129	319	219	14	19	22	218	177	16	15
Spain	3 709	1 277	2 437	942	2 966	3 600	2 188	1 962	2 613	2 702
Ukraine	-	-	6	7	-	3	-	-	-	-
UK	-	-	-	-	-	-	-	-	0	1
USA	363	368	363	398	564	500	788	1 190	1 439	1 644
21 Fishing area total	*49 629*	*56 586*	*67 017*	*31 631*	*37 885*	*34 139*	*23 062*	*21 725*	*27 591*	*31 016*
27 Belgium	6	3	2	1	2	1	0	0	0	0
Estonia	599	15	-	1	5	-	209	-	-	-
Faroe Is	13 879	8 372	7 860	10 573	4 551	10 829	7 163	6 429	6 541	7 118
France	1 076	585	524	421	465	518	683	666	344	510
Germany	11 973	13 229	8 897	3 351	2 876	4 890	1 719	54	111	58
Greenland	94	28	71	13	-	158	-	-	1	0
Iceland	11 325	11 606	21 484	12 256	17 159	22 776	19 942	6 804	15 054	-
Ireland	433	297	31	25	172	92	6	0	-	-
Latvia	-	1 061	371	410	517	1 211	1 148	908	1 468	2 212
Lithuania	15 786	14 657	14 321	3 438	1 027	2 139	2 010	379	5 544	2 838
Netherlands	8	15	89	33	48	21	20	15	4	-
Norway	1	1	1	1	1	1	1	1	1	1
Poland	-	-	-	-	-	26	8	10	-	-
Portugal	2 694	3 374	2 680	4 034	3 251	3 654	4 007	504	139	80
Russian Fed	-	19	-	43	138	48	45	46	1	2
Spain	935	2 827	4 077	5 978	2 790	69	540	2 089	2 337	2 289
Sweden	-	-	-	-	-	-	-	1	0	0
UK	2 875	2 117	3 371	2 377	1 782	1 656	753	302	295	492
27 Fishing area total	*61 684*	*58 206*	*63 779*	*42 955*	*34 784*	*48 089*	*38 254*	*18 208*	*31 840*	*15 600*
Species total	*111 313*	*114 792*	*130 796*	*74 586*	*72 669*	*82 228*	*61 316*	*39 933*	*59 431*	*46 616*
Red scorpionfish	**Rascasse rouge**		**Cabracho**		***Scorpaena scrofa***				**1,78(01)009,02**	**RSE**
27 Portugal	28	28	36	47	38	30	32	39	41	33
UK	2	5	3	0	0	-	4	-	-	0
27 Fishing area total	*30*	*33*	*39*	*47*	*38*	*30*	*36*	*39*	*41*	*33*
Species total	*30*	*33*	*39*	*47*	*38*	*30*	*36*	*39*	*41*	*33*
Blackbelly rosefish	**Sébaste chèvre**		**Gallineta**		***Helicolenus dactylopterus***				**1,78(01)017,03**	**BRF**
21 USA	0	0	0	1	0	1	1	0	1	0
21 Fishing area total	*0*	*0*	*0*	*1*	*0*	*1*	*1*	*0*	*1*	*0*
27 France	125	50	34	74	152	222	169	135	160	173
Ireland	...	...	1	8	29	14	23	9	10	11
Norway	-	-	-	-	-	7	-	-	-	-
Portugal	313	297	357	309	251	356	674	466	488	350
Spain	...	...	...	835	567	875	2 298	1 436	1 765	3 361
UK	186	106	96	113	163	98	60	83	20	66
27 Fishing area total	*624*	*453*	*488*	*1 339*	*1 162*	*1 572*	*3 224*	*2 129*	*2 443*	*3 961*
34 Portugal	2	1	2	1	1	4	28	10	15	5
Spain	-	-	-	73	82	123	122	69	98	44
34 Fishing area total	*2*	*1*	*2*	*74*	*83*	*127*	*150*	*79*	*113*	*49*
37 Malta	-	-	-	-	-	-	-	-	1	2
Spain	...	...	...	175	147	154	165	154	163	162
37 Fishing area total	*...*	*...*	*...*	*175*	*147*	*154*	*165*	*154*	*164*	*164*
41 Argentina	1 176	494	549	960	946	1 523	1 070	1 007	2 231	1 686
Spain	6	-	-	1	-	-	2	-	36	31
Uruguay	1 830	1 544	856	1 188	1 863	1 021	1 235	1 240	227	905
41 Fishing area total	*3 012*	*2 038*	*1 405*	*2 149*	*2 809*	*2 544*	*2 307*	*2 247*	*2 494*	*2 622*
47 Namibia	891	...	933	695	603	677	...	...	...	...
South Africa	782	821	888	1 220	1 150	1 074	948	959	780	679
Spain	...	...	1	3	-	-	21	-	-	-
Uruguay	-	-	-	-	10	-	-	-	-	-
47 Fishing area total	*1 673*	*821*	*1 822*	*1 918*	*1 763*	*1 751*	*969*	*959*	*780*	*679*
51 Spain	1	-	-	4	-	2	-	-	-	-

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
51 Fishing area total	*1*	-	-	*4*	-	*2*	-	-	-	-
Species total	*5 312*	*3 313*	*3 717*	*5 660*	*5 964*	*6 151*	*6 816*	*5 568*	*5 995*	*7 475*
Offshore rockfish	**Rascasse du large**		**Rascacio de fuera**		***Pontinus kuhlii***				**1,78(01)019,02**	**POI**
27 Portugal	36	37	66	81	52	43	59	57	56	78
27 Fishing area total	*36*	*37*	*66*	*81*	*52*	*43*	*59*	*57*	*56*	*78*
Species total	*36*	*37*	*66*	*81*	*52*	*43*	*59*	*57*	*56*	*78*
Shortspine thornyhead	**...B**		**Chancharro alacrán**		***Sebastolobus alascanus***				**1,78(01)079,01**	**SJU**
61 Russian Fed	-	-	-	-	52	227	101	139	29	375
61 Fishing area total	-	-	-	-	*52*	*227*	*101*	*139*	*29*	*375*
67 USA	268	295	335	333	307	348	641	961	1 027	840
67 Fishing area total	*268*	*295*	*335*	*333*	*307*	*348*	*641*	*961*	*1 027*	*840*
Species total	*268*	*295*	*335*	*333*	*359*	*575*	*742*	*1 100*	*1 056*	*1 215*
Spiny scorpionfish	**Rascasse épineuse**		**Rascacio espinoso**		***Trachyscorpia echinata***				**1,78(01)080,03**	**TZY**
27 France	-	-	41	40	31	31	18	8	8	...
UK	-	-	-	2	-	26	2	-	-	1
27 Fishing area total	-	-	*41*	*42*	*31*	*57*	*20*	*8*	*8*	*1*
Species total	-	-	*41*	*42*	*31*	*57*	*20*	*8*	*8*	*1*
Scorpionfishes nei	**Rascasses, etc. nca**		**Rascacios, gallinetas nep**		***Scorpaenidae***				**1,78(01)XXX,XX**	**SCO**
27 France	18	49	2	14	20	19	10	12	60	77
Portugal	299	149	419	199	147	83	73	47	26	32
Russian Fed	-	-	6	23	16	-	-	-	-	-
Spain	653	818	1 106	280	374	457	369	371	396	445
27 Fishing area total	*970*	*1 016*	*1 533*	*516*	*557*	*559*	*452*	*430*	*482*	*554*
31 Portugal	-	-	-	-	-	-	282	-	-	-
31 Fishing area total	-	-	-	-	-	-	*282*	-	-	-
34 Greece	42	21	18	8	7	4	2	1	1	1 F
Italy	14	-	5	7	-	-	-	-	0	-
Morocco	386	828	554	1 254	873	754	626	515	568	639
Nigeria	2 568	600	3 137	2 444	1 809	4 829	6 536	5 682	5 350	5 037
Portugal	7	4	10	17	6	8	18	12	10	4
Senegal	471	451	423	261	281	218	115	336	580	336
Spain	-	-	-	100	70	103	99	66	66	87
34 Fishing area total	*3 488*	*1 904*	*4 147*	*4 091*	*3 046*	*5 916*	*7 396*	*6 612*	*6 575*	*6 104 F*
37 Albania	-	-	4	-	-	-	-	-	-	-
Algeria	...	...	...	...	...	...	192	361	272	109
Croatia	39	22	18	22	22	22	28	...	48	50
Cyprus	11	8	11	5	11	15	20	27	22	22
France	24	27	25	25	9	9	8	11	43	47
Greece	684	485	644	476	397	605	532	487	489	489 F
Italy	...	...	...	...	1 386	1 361	1 441	1 010	1 199	1 136
Lebanon	100	125	125	125	110	115	115 F	115 F	115 F	115 F
Libya	...	...	...	...	...	...	...	...	396	380 F
Malta	0	-	-	-	5	5	28	26	28	44
Morocco	9	18	17	30	31	37	18	16	24	31
Russian Fed	2	3	8	6	1	-	2	4	15	219
Serbia-Monte	7	7	6	5	...	-	-	-	-	-
Spain	332	1 272	803	735	751	725	702	717	691	681
Syria	36	38	39	43	110	60	29	23	30	25
Tunisia	444	453	438	469	537	504	464	381	379	408
Turkey	640	296	267	366	397	386	239	397	446	334
37 Fishing area total	*2 328*	*2 754*	*2 405*	*2 307*	*3 767*	*3 844*	*3 818 F*	*3 575 F*	*4 197 F*	*4 090 F*
41 Korea Rep	4	2	-	1	-	-	-	4	-	-
Russian Fed	-	-	8	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	2	33
41 Fishing area total	*4*	*2*	*8*	*1*	-	-	-	*4*	*2*	*33*
47 Portugal	-	6	-	0	-	0	1	2	1	-
Spain	-	-	-	-	4	-	-	-	-	-
47 Fishing area total	-	*6*	-	*0*	*4*	*0*	*1*	*2*	*1*	-
51 South Africa	2	...	0	1	1	1	1	3	6	-
51 Fishing area total	*2*	...	*0*	*1*	*1*	*1*	*1*	*3*	*6*	-
57 Australia	8	20	141	-	10	7	5	1	0	2
57 Fishing area total	*8*	*20*	*141*	-	*10*	*7*	*5*	*1*	*0*	*2*
61 Japan	1 132	1 323	1 330	1 227	1 426	1 271	1 141	1 187	1 462	1 100 F
Korea Rep	5 152	5 007	6 156	5 188	4 854	5 256	5 995	5 818	4 467	3 806
Russian Fed	54	57	271	30	31	8	3	9	8	1
61 Fishing area total	*6 338*	*6 387*	*7 757*	*6 445*	*6 311*	*6 535*	*7 139*	*7 014*	*5 937*	*4 907 F*
67 Canada	16 351	16 248	14 769	13 569	13 095	13 046	14 027	13 396	13 684	12 576

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Russian Fed	-	1	-	-	-	-	-	-	-	-
USA	12 360	12 141	13 561	11 275	11 032	11 421	12 250	13 082	12 755	14 510
67 Fishing area total	*28 711*	*28 390*	*28 330*	*24 844*	*24 127*	*24 467*	*26 277*	*26 478*	*26 439*	*27 086*
77 USA	1 679	1 839	1 436	1 358	1 036	1 004	800	973	944	950
77 Fishing area total	*1 679*	*1 839*	*1 436*	*1 358*	*1 036*	*1 004*	*800*	*973*	*944*	*950*
81 Australia	29	36	265	0	1	1	1	0	0	0
Korea Rep	198	428	611	286	106	-	229	315	137	1
New Zealand	1 897	2 331	2 534	1 711	1 436	1 187	1 263	1 292	909	1 301
Ukraine	-	-	-	1	...	-	-	-	-	-
81 Fishing area total	*2 124*	*2 795*	*3 410*	*1 998*	*1 543*	*1 188*	*1 493*	*1 607*	*1 046*	*1 302*
87 Chile	264	88	69	303	242	229	256	149	295	271
87 Fishing area total	*264*	*88*	*69*	*303*	*242*	*229*	*256*	*149*	*295*	*271*
Species total	*45 916*	*45 201*	*49 236*	*41 864*	*40 644*	*43 750*	*47 920 F*	*46 848 F*	*45 924 F*	*45 299 F*
Bluefin gurnard	**Grondin aile bleue**		**Testolín de aleta azul**		***Chelidonichthys kumu***				**1,78(02)003,01**	**KUG**
57 Australia	163	143	76	162	145	150	188	203	124	136
57 Fishing area total	*163*	*143*	*76*	*162*	*145*	*150*	*188*	*203*	*124*	*136*
61 Korea Rep	140	260	225	302	375	888	729	1 135	728	979
61 Fishing area total	*140*	*260*	*225*	*302*	*375*	*888*	*729*	*1 135*	*728*	*979*
81 Australia	277	233	37	58	60	48	33	34	44	30
New Zealand	3 670	3 447	3 822	3 606	3 891	3 512	3 820	3 256	3 621	3 807
Ukraine	-	2	5	2	...	6	...	...	...	...
81 Fishing area total	*3 947*	*3 682*	*3 864*	*3 666*	*3 951*	*3 566*	*3 853*	*3 290*	*3 665*	*3 837*
Species total	*4 250*	*4 085*	*4 165*	*4 130*	*4 471*	*4 604*	*4 770*	*4 628*	*4 517*	*4 952*
Tub gurnard	**Grondin perlon**		**Begel**		***Chelidonichthys lucerna***				**1,78(02)003,02**	**GUU**
27 Belgium	...	...	...	559	504	568	688	553	436	448
Denmark	12	63	37	47	76	39	79	74	39	39
France	1 134	1 233	1 093	1 039	1 248	1 269	1 328	909	940	906
Netherlands	-	1 438	1 210	1 467	1 547	1 726	2 088	1 543	1 668	-
Portugal	3	8	-	-	-	-	47	61	59	59
27 Fishing area total	*1 149*	*2 742*	*2 340*	*3 112*	*3 375*	*3 602*	*4 230*	*3 140*	*3 142*	*1 452*
37 France	68	27	35	35	30	25	25	21	22	21
37 Fishing area total	*68*	*27*	*35*	*35*	*30*	*25*	*25*	*21*	*22*	*21*
Species total	*1 217*	*2 769*	*2 375*	*3 147*	*3 405*	*3 627*	*4 255*	*3 161*	*3 164*	*1 473*
Streaked gurnard	**...B**		**...C**		***Chelidonichthys lastoviza***				**1,78(02)003,04**	**CTZ**
27 France	51	67	57	66	82	74	72	4	89	88
27 Fishing area total	*51*	*67*	*57*	*66*	*82*	*74*	*72*	*4*	*89*	*88*
Species total	*51*	*67*	*57*	*66*	*82*	*74*	*72*	*4*	*89*	*88*
Cape gurnard	**Grondin du Cap**		**Rubio del Cabo**		***Chelidonichthys capensis***				**1,78(02)003,07**	**GUC**
47 Namibia	144	234	169	184	245	232	...	...	412	400 F
South Africa	465	462	500	401	476	500	570	452	414	461
47 Fishing area total	*609*	*696*	*669*	*585*	*721*	*732*	*570*	*452*	*826*	*861 F*
Species total	*609*	*696*	*669*	*585*	*721*	*732*	*570*	*452*	*826*	*861 F*
Red gurnard	**Grondin rouge**		**Arete**		***Aspitrigla cuculus***				**1,78(02)004,03**	**GUR**
27 Belgium	493	500	525	318	280	313	328	352	227	237
Channel Is	-	15	4	15	1	12	4	8	6	2
France	4 707	5 017	4 669	4 586	5 089	4 552	4 495	4 045	3 310	3 437
Netherlands	1 724	53	46	62	60	57	66	92	160	251
Portugal	-	1	3	4	48	125	137	112	150	115
UK	207	281	311	262	108	115	156	166	263	362
27 Fishing area total	*7 131*	*5 867*	*5 558*	*5 247*	*5 586*	*5 174*	*5 186*	*4 775*	*4 116*	*4 404*
37 France	162	313	279	363	434	272	226	226	151	283
37 Fishing area total	*162*	*313*	*279*	*363*	*434*	*272*	*226*	*226*	*151*	*283*
Species total	*7 293*	*6 180*	*5 837*	*5 610*	*6 020*	*5 446*	*5 412*	*5 001*	*4 267*	*4 687*
Scaly gurnard	**...B**		**...C**		***Lepidotrigla brachyoptera***				**1,78(02)008,03**	**LDY**
81 New Zealand	-	-	1	6	16	16	10	9	10	8
Ukraine	-	-	-	-	-	5	...	...	...	...
81 Fishing area total	-	-	*1*	*6*	*16*	*21*	*10*	*9*	*10*	*8*
Species total	-	-	*1*	*6*	*16*	*21*	*10*	*9*	*10*	*8*
Atlantic searobins	**Grondins**		**Rubios americanos**		***Prionotus spp***				**1,78(02)020,XX**	**SRA**
21 USA	39	66	63	37	29	17	32	43	37	51
21 Fishing area total	*39*	*66*	*63*	*37*	*29*	*17*	*32*	*43*	*37*	*51*

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
41 Argentina	-	-	-	-	-	0	5	2	10	2
Brazil	4 560	6 057	3 189	4 419	7 637	5 660	5 246	5 273	5 816	5 493
41 Fishing area total	*4 560*	*6 057*	*3 189*	*4 419*	*7 637*	*5 660*	*5 251*	*5 275*	*5 826*	*5 495*
Species total	*4 599*	*6 123*	*3 252*	*4 456*	*7 666*	*5 677*	*5 283*	*5 318*	*5 863*	*5 546*
Latchet(=Sharpbeak gurnard)	**Grondin pointu**		**Cabete picudo**		***Pterygotrigla polyommata***				**1,78(02)025,01**	**BEG**
57 Australia	78	88	117	137	207	245	199	140	107	96
57 Fishing area total	*78*	*88*	*117*	*137*	*207*	*245*	*199*	*140*	*107*	*96*
81 Australia	73	54	65	67	37	32	33	33	47	66
81 Fishing area total	*73*	*54*	*65*	*67*	*37*	*32*	*33*	*33*	*47*	*66*
Species total	*151*	*142*	*182*	*204*	*244*	*277*	*232*	*173*	*154*	*162*
Spotted gurnard	**...B**		**...C**		***Pterygotrigla picta***				**1,78(02)025,02**	**JGU**
81 New Zealand	65	49	51	53	44	67	67	101	98	116
81 Fishing area total	*65*	*49*	*51*	*53*	*44*	*67*	*67*	*101*	*98*	*116*
Species total	*65*	*49*	*51*	*53*	*44*	*67*	*67*	*101*	*98*	*116*
Grey gurnard	**Grondin gris**		**Borracho**		***Eutrigla gurnardus***				**1,78(02)070,01**	**GUG**
27 Belgium	33	63	37	40	38	25	21	21	30	43
Denmark	289	65	92	84	74	65	38	48	21	19
Faroe Is	0	1	0	0	0	0	12	15	7	2
France	218	179	159	132	125	104	95	10	132	206
Iceland	-	0	0	-	-	-	-	1	-	10
Netherlands	295	286	320	304	246	165	166	123	158	263
Norway	-	-	-	-	-	2	5	5	1	1
Russian Fed	3 155	60	263	1 401	2 456	138	-	-	-	-
Sweden	5	2	7	5	9	2	3	7	3	2
UK	46	41	25	21	22	27	54	79	91	89
27 Fishing area total	*4 041*	*697*	*903*	*1 987*	*2 970*	*528*	*394*	*309*	*443*	*635*
37 Egypt	778	611	379	508	612	1 207	1 104	1 540	1 211	1 383
France	4	16	11	18	20	17	14	9	13	23
37 Fishing area total	*782*	*627*	*390*	*526*	*632*	*1 224*	*1 118*	*1 549*	*1 224*	*1 406*
Species total	*4 823*	*1 324*	*1 293*	*2 513*	*3 602*	*1 752*	*1 512*	*1 858*	*1 667*	*2 041*
Gurnards, searobins nei	**Grondins, cavillones nca**		**Cabetes, rubios nep**		***Triglidae***				**1,78(02)XXX,XX**	**GUX**
27 Belgium	177	183	276	-	-	-	-	-	-	-
Channel Is	41	7	15	3	6	-	-	-	-	-
France	87	70	66	44	6	5	3	1	81	55
Germany	150	198	198	224	215	185	121	61	80	89
Ireland	97	101	90	119	77	75	48	169	48	63
Isle of Man	1	-	1	-	-	-	-	-	1	2
Portugal	616	643	676	657	565	496	409	296	277	234
Spain	506	409	562	581	603	968	650	790	799	925
UK	1 131	1 154	1 689	1 203	1 106	923	898	943	1 107	1 239
27 Fishing area total	*2 806*	*2 765*	*3 573*	*2 831*	*2 578*	*2 652*	*2 129*	*2 260*	*2 393*	*2 607*
34 Benin	...	...	1	4	...	...	...	19	...	...
Côte dIvoire	...	...	248	500	365	209	64	50 F	40	20
Ghana	37	...	35	32	45	64	13	7 858	53	45
Greece	-	-	10	-	-	-	-	-	-	-
Italy	129	80	21	39	26	22	-	-	0	-
Morocco	4 163	3 554	2 469	1 718	2 538	2 801	2 349	2 340	3 223	1 302
Portugal	-	-	1	7	-	-	1	-	5	17
Senegal	94	67	102	117	74	53	27	19	52	21
Spain	-	-	3	3	0	1	4	6	2	2
34 Fishing area total	*4 423*	*3 701*	*2 890*	*2 420*	*3 048*	*3 150*	*2 458*	*10 292 F*	*3 375*	*1 407*
37 Albania	34	72	25	7	20	26	41	39	36	16
Croatia	...	...	...	...	...	...	...	...	44	45
Cyprus	-	-	-	-	-	-	-	-	-	1
France	105	14	74	112	77	56	49	27	96	243
Greece	169	212	166	147	116	134	157	134	111	111 F
Italy	2 135	1 861	2 084	2 033	1 642	1 900	1 447	1 401	1 395	1 474
Malta	1	1	1	0	1	1	6	7	3	2
Morocco	9	21	81	85	55	53	41	50	32	31
Slovenia	1	1	-	-	-	1	1	1	1	0
Spain	346	674	512	663	510	488	481	504	509	451
Syria	32	38	42	63	88	45	46	37	40	38
Tunisia	198	346	344	359	308	258	242	204	156	136
Turkey	200	271	230	241	313	560	655	400	379	422
37 Fishing area total	*3 230*	*3 511*	*3 559*	*3 710*	*3 130*	*3 522*	*3 166*	*2 804*	*2 802*	*2 970 F*
47 Portugal	-	-	-	1	-	-	-	1	-	-
47 Fishing area total	-	-	-	*1*	-	-	-	*1*	-	-
51 South Africa	0	...	0	0	1	-	-	-	-	-
51 Fishing area total	*0*	*...*	*0*	*0*	*1*	-	-	-	-	-

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
87 Ecuador	1 428	1 050 F	700 F	400 F	100 F	1	2 738	1 586	1 796	404
87 Fishing area total	*1 428*	*1 050 F*	*700 F*	*400 F*	*100 F*	*1*	*2 738*	*1 586*	*1 796*	*404*
Species total	*11 887*	*11 027 F*	*10 722 F*	*9 362 F*	*8 857 F*	*9 325*	*10 491*	*16 943 F*	*10 366*	*7 388 F*
Skilfish	**...B**		**...C**		***Erilepis zonifer***				**1,78(08)001,01**	**ESZ**
61 Russian Fed	-	-	-	-	-	-	-	-	165	-
61 Fishing area total	-	-	-	-	-	-	-	-	*165*	-
Species total	-	-	-	-	-	-	-	-	*165*	-
Sablefish	**Morue charbonnière**		**Bacalao negro**		***Anoplopoma fimbria***				**1,78(08)004,01**	**SAB**
61 Russian Fed	6	19	46	28	6	14	19	27	15	10
61 Fishing area total	*6*	*19*	*46*	*28*	*6*	*14*	*19*	*27*	*15*	*10*
67 Canada	2 967	1 449	2 555	3 024	4 719	8 434	7 211	3 095	2 615	2 412
Russian Fed	-	31	-	-	-	-	-	-	2	-
USA	19 017	17 659	20 629	22 773	22 048	20 393	19 024	18 673	17 803	16 395
67 Fishing area total	*21 984*	*19 139*	*23 184*	*25 797*	*26 767*	*28 827*	*26 235*	*21 768*	*20 420*	*18 807*
77 USA	958	897	1 077	1 057	1 124	1 031	875	962	1 614	1 886
77 Fishing area total	*958*	*897*	*1 077*	*1 057*	*1 124*	*1 031*	*875*	*962*	*1 614*	*1 886*
Species total	*22 948*	*20 055*	*24 307*	*26 882*	*27 897*	*29 872*	*27 129*	*22 757*	*22 049*	*20 703*
Antarctic horsefish	**Cacique antarctique**		**Cacique antártico**		***Zanclorhynchus spinifer***				**1,78(11)030,01**	**ZSP**
58 Australia	-	-	-	-	-	-	-	-	0	-
58 Fishing area total	-	-	-	-	-	-	-	-	*0*	-
Species total	-	-	-	-	-	-	-	-	*0*	-
Lumpfish(=Lumpsucker)	**Lompe**		**Liebre de mar**		***Cyclopterus lumpus***				**1,78(20)003,01**	**LUM**
21 Canada	0	0	0	0	6	1	1	56	...	...
Greenland	3 216	5 848	6 578	8 233	9 702	9 973	8 801	6 436	6 930	8 623
St Pier Mq	146	3	36	531	232	301	23	-	-	-
21 Fishing area total	*3 362*	*5 851*	*6 614*	*8 764*	*9 940*	*10 275*	*8 825*	*6 492*	*6 930*	*8 623*
27 Denmark	422	756	863	429	186	131	254	192	92	231
Faroe Is	-	-	-	-	-	1	-	30	-	-
Germany	3	2	6	6	3	18	8	3	1	6
Greenland	-	-	-	0	0	3	0	-	-	-
Iceland	3 271	5 047	6 230	5 782	3 731	4 026	3 319	-	5 614	8 477
Norway	5 185	6 050	4 725	4 416	3 145	2 304	2 210	4 625	2 844	2 540
Russian Fed	28	28	-	2	58	48	5	2	1	1
Sweden	83	213	255	198	42	181	125	143	78	138
UK	-	-	0	0	0	0	-	-	-	-
27 Fishing area total	*8 992*	*12 096*	*12 079*	*10 833*	*7 165*	*6 712*	*5 921*	*4 995*	*8 630*	*11 393*
Species total	*12 354*	*17 947*	*18 693*	*19 597*	*17 105*	*16 987*	*14 746*	*11 487*	*15 560*	*20 016*
Angler(=Monk)	**Baudroie commune**		**Rape**		***Lophius piscatorius***				**1,95(01)001,01**	**MON**
27 Channel Is	5	2	3	2	3	2	2	2	1	1
Denmark	1 917	1 932	1 929	2 121	1 898	1 814	1 389	1 596	1 725	1 607
Faroe Is	2 314	1 901	2 753	3 723	5 001	5 201	4 010	2 315	2 156	2 486
Iceland	1 353	965	1 685	2 224	2 852	2 587	2 777	2 947	4 069	3 283
Ireland	3 112	2 523	2 121	2 250	2 921	3 384	3 477	2 838	3 261	4 144
Isle of Man	2	1	0	3	...	...	0	0	0	0
Netherlands	168	86	67	79	65	60	87	77	50	66
Norway	4 996	3 185	3 386	4 069	3 661	5 422	5 474	5 034	5 324	6 290
Portugal	76	83	253	198	217	104	98	111	150	177
Russian Fed	1	-	-	3	5	1	1	36	-	-
Spain	...	...	...	...	...	422	-	-	-	-
Sweden	92	119	80	81	88	64	70	127	-	-
UK	16 249	14 289	11 208	11 815	12 126	13 936	15 867	15 433	15 072	14 392
27 Fishing area total	*30 285*	*25 086*	*23 485*	*26 568*	*28 837*	*32 997*	*33 252*	*30 516*	*31 808*	*32 446*
34 Portugal	2	1	...	...	1	15	7	-	1	1
34 Fishing area total	*2*	*1*	*...*	*...*	*1*	*15*	*7*	-	*1*	*1*
Species total	*30 287*	*25 087*	*23 485*	*26 568*	*28 838*	*33 012*	*33 259*	*30 516*	*31 809*	*32 447*
Blackbellied angler	**Baudroie rousse**		**Rape negro**		***Lophius budegassa***				**1,95(01)001,02**	**ANK**
27 Portugal	1	1	11	10	16	3	15	43	25	20
27 Fishing area total	*1*	*1*	*11*	*10*	*16*	*3*	*15*	*43*	*25*	*20*
34 Portugal	-	...	6	3	2	3	5	-	-	-
34 Fishing area total	-	*...*	*6*	*3*	*2*	*3*	*5*	-	-	-
Species total	*1*	*1*	*17*	*13*	*18*	*6*	*20*	*43*	*25*	*20*
American angler	**Baudroie d'Amérique**		**Rape americano**		***Lophius americanus***				**1,95(01)001,03**	**ANG**
21 Canada	1 900	3 634	4 397	2 270	2 387	1 895	501	499	562	404

B-34 **Miscellaneous demersal fishes** | **Poissons démersaux divers** | **Peces demersales diversos**

Capture production by species, fishing areas and countries or areas | **Captures par espèces, zones de pêche et pays ou zones** | **Capturas por especies, áreas de pesca y países o áreas**

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Lithuania	-	-	-	-	-	-	-	2	-	-
Portugal	-	134	157	75	6	34	36	12	5	11
Russian Fed	-	-	38	-	-	-	1	-	-	-
St Pier Mq	1	2	1	0	-	-	3	-	-	-
Spain	9	93	70	10	5	1	10	30	-	21
USA	23 256	22 878	26 044	21 193	19 101	14 580	12 138	10 937	8 563	7 250
21 Fishing area total	*25 166*	*26 741*	*30 707*	*23 548*	*21 499*	*16 510*	*12 689*	*11 480*	*9 130*	*7 686*
31 USA	12	15	14	6	2	2	3	0	0	0
31 Fishing area total	*12*	*15*	*14*	*6*	*2*	*2*	*3*	*0*	*0*	*0*
Species total	*25 178*	*26 756*	*30 721*	*23 554*	*21 501*	*16 512*	*12 692*	*11 480*	*9 130*	*7 686*
Shortspine African angler	**Baudroie africaine**		**Rape africano**		***Lophius vaillanti***				**1,95(01)001,05**	**MVA**
34 Congo Rep	9 F	10 F	...	...	...	...	...	-	-	-
Portugal	...	...	...	...	...	...	9	-	-	-
Spain	2	...	...	...	-	-	-	-	-	-
34 Fishing area total	*11 F*	*10 F*	*...*	*...*	*...*	*...*	*9*	-	-	-
Species total	*11 F*	*10 F*	*...*	*...*	*...*	*...*	*9*	-	-	-
Devil anglerfish	**Baudroie diable**		**Rape diablo**		***Lophius vomerinus***				**1,95(01)001,06**	**MVO**
47 Namibia	12 390	15 174	12 867	8 991	11 087	9 831	...	8 555	...	...
South Africa	9 554	8 492	6 359	8 554	7 722	7 399	7 771	7 809	7 020	7 816
Spain	52	55	120	8	78	187	380	47	21	20
47 Fishing area total	*21 996*	*23 721*	*19 346*	*17 553*	*18 887*	*17 417*	*8 151*	*16 411*	*7 041*	*7 836*
Species total	*21 996*	*23 721*	*19 346*	*17 553*	*18 887*	*17 417*	*8 151*	*16 411*	*7 041*	*7 836*
Blackfin goosefish	**Baudroie pêcheuse**		**Rape pescador**		***Lophius gastrophysus***				**1,95(01)001,07**	**MVJ**
41 Brazil	7 094	5 143	2 665	2 434	2 550	2 517	2 508	2 488	2 744	2 592
Spain	3	-	-	-	-	-	-	-	-	-
UK	2 105	1 199	-	-	-	-	-	-	-	-
41 Fishing area total	*9 202*	*6 342*	*2 665*	*2 434*	*2 550*	*2 517*	*2 508*	*2 488*	*2 744*	*2 592*
Species total	*9 202*	*6 342*	*2 665*	*2 434*	*2 550*	*2 517*	*2 508*	*2 488*	*2 744*	*2 592*
Monkfishes nei	**Baudroies nca**		**Rapes nep**		***Lophius spp***				**1,95(01)001,XX**	**MNZ**
27 Belgium	1 354	1 312	1 250	1 495	1 302	1 193	1 363	964	853	1 031
France	13 072	15 454	20 945	20 778	20 286	19 455	22 172	18 558	17 022	16 475
Germany	364	362	376	413	407	298	632	738	625	641
Portugal	540	428	477	257	289	213	285	207	207	86
Spain	5 245	4 559	4 564	5 578	4 052	4 219	3 438	5 021	4 404	4 459
27 Fishing area total	*20 575*	*22 115*	*27 612*	*28 521*	*26 336*	*25 378*	*27 890*	*25 488*	*23 111*	*22 692*
34 Belize	-	2	...	...	...	...	...	...	...	...
Greece	19	18	14	7	1	-	-	-	-	-
Mauritania	28	36	28 F	13	7	2	-	0	1	0
Morocco	310	327	536	518	434	394	375	325	332	356
Portugal	-	5	4	2	-	18	18	58	-	-
Spain	367	491	602	385	427	532	211	235	332	253
UK	-	-	-	-	-	51	-	-	-	-
34 Fishing area total	*724*	*879*	*1 184 F*	*925*	*869*	*997*	*604*	*618*	*665*	*609*
37 Albania	...	14	25	22	12	18	21	18	39	...
Algeria	...	...	...	...	...	...	25	119	161	119
Croatia	...	...	...	...	...	...	...	...	96	99
Cyprus	-	-	-	-	-	-	-	-	-	1
France	494	325	343	599	558	355	254	172	575	873
Greece	694	729	844	1 049	1 216	1 303	1 277	910	1 070	1 060 F
Italy	1 244	1 083	1 281	1 272	2 239	2 222	1 991	1 711	1 876	1 976
Malta	-	-	-	-	-	-	1	2	4	2
Morocco	126	186	192	234	251	332	175	171	187	177
Spain	1 492	1 187	994	1 269	1 480	1 649	1 531	1 268	1 318	1 613
Tunisia	35	43	42	11	7	36	31	32	24	35
Turkey	...	...	...	...	...	...	204	360	317	219
37 Fishing area total	*4 085*	*3 567*	*3 721*	*4 456*	*5 763*	*5 915*	*5 510*	*4 763*	*5 667*	*6 174 F*
Species total	*25 384*	*26 561*	*32 517 F*	*33 902*	*32 968*	*32 290*	*34 004*	*30 869*	*29 443*	*29 475 F*
Anglerfishes nei	**Baudroies, etc. nca**		**Rapes, etc. nep**		***Lophiidae***				**1,95(01)XXX,XX**	**ANF**
51 Spain	-	-	-	-	-	-	-	4	-	-
51 Fishing area total	-	-	-	-	-	-	-	*4*	-	-
61 Korea Rep	5 813	9 500	10 486	11 885	11 448	12 226	14 417	17 944	14 961	13 104
61 Fishing area total	*5 813*	*9 500*	*10 486*	*11 885*	*11 448*	*12 226*	*14 417*	*17 944*	*14 961*	*13 104*
Species total	*5 813*	*9 500*	*10 486*	*11 885*	*11 448*	*12 226*	*14 417*	*17 948*	*14 961*	*13 104*
Demersal percomorphs nei	**Percomorphes démersaux nca**		**Percomorfos demersales nep**		***Perciformes***				**1,99(XX)XXX,XX**	**DPX**
31 Colombia	5	9	9	...	...	...	...	...	...	...
Mexico	3 046	3 573	4 100	4 227	-	-	...	...	...	...
Trinidad Tob	2 860	3 116	2 631	2 358	3 282	1 878	1 737	1 951	2 190	2 365

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Miscellaneous demersal fishes
Poissons démersaux divers
Peces demersales diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Venezuela	1 687	2 084	2 666	4 200 F	2 250 F	1 330 F	1 620 F	1 850 F	1 790 F	1 790 F
31 Fishing area total	*7 598*	*8 782*	*9 406*	*10 785 F*	*5 532 F*	*3 208 F*	*3 357 F*	*3 801 F*	*3 980 F*	*4 155 F*
34 Cape Verde	1 116	960	1 016	976	1 058	1 084	928	998	1 445	1 400 F
Eq Guinea	110 F	110 F	110 F	110 F	110 F	105 F	100	200	300	350
Spain	-	-	3	0	5	0	4	1	3	1
34 Fishing area total	*1 226 F*	*1 070 F*	*1 129 F*	*1 086 F*	*1 173 F*	*1 189 F*	*1 032*	*1 199*	*1 748*	*1 751 F*
37 Spain	758	3 954	321	264	265	311	377	365	256	201
Syria	95	-	-	-	-	100	183	171	115	225
37 Fishing area total	*853*	*3 954*	*321*	*264*	*265*	*411*	*560*	*536*	*371*	*426*
41 Brazil	38	-	-	-	-	-	-	-	-	-
Japan	-	5	23	7	-	-	-	-	-	-
Uruguay	-	-	1 394	334	-	-	-	-	-	-
41 Fishing area total	*38*	*5*	*1 417*	*341*	-	-	-	-	-	-
51 Japan	3 748	412	-	-	-	-	-	-	-	-
Kenya	2 060	1 450	1 099	1 103	1 211	1 286	2 196	2 514	845	1 680
Oman	2 421	11 273	5 935	6 499	6 449	5 635	4 906	4 250	7 597	6 296
Seychelles	153	181	133	155	117	128	102	164	126	108
Yemen	7 400 F	9 600 F	10 400 F	11 000 F	10 900 F	13 200 F	14 200 F	8 100 F	11 600 F	15 100 F
51 Fishing area total	*15 782 F*	*22 916 F*	*17 567 F*	*18 757 F*	*18 677 F*	*20 249 F*	*21 404 F*	*15 028 F*	*20 168 F*	*23 184 F*
57 Sri Lanka	14 490	16 320	19 980	17 540	10 570	11 170	13 860	12 670	15 960	20 150
57 Fishing area total	*14 490*	*16 320*	*19 980*	*17 540*	*10 570*	*11 170*	*13 860*	*12 670*	*15 960*	*20 150*
77 Mexico	0	0	0	0	0	0	0	-	-	-
77 Fishing area total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	-	-	-
81 Japan	1 724	3 034	3 508	-	-	-	-	-	-	-
81 Fishing area total	*1 724*	*3 034*	*3 508*	-	-	-	-	-	-	-
87 Colombia	282	213	62	70	...	...	...	...	...	...
87 Fishing area total	*282*	*213*	*62*	*70*	*...*	*...*	*...*	*...*	*...*	*...*
Species total	*41 993 F*	*56 294 F*	*53 390 F*	*48 843 F*	*36 217 F*	*36 227 F*	*40 213 F*	*33 234 F*	*42 227 F*	*49 666 F*
Group total	***2 780 922***	***2 830 103***	***2 825 741***	***2 908 418***	***2 742 006***	***3 032 862***	***2 913 349***	***2 928 072***	***2 988 704***	***3 095 978***

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Herrings, sardines, anchovies
Harengs, sardines, anchois
Arenques, sardinas, anchoas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Atlantic herring	**Hareng de l'Atlantique**		**Arenque del Atlántico**		***Clupea harengus***				**1,21(05)001,05**	**HER**
21 Canada	199 295	191 097	200 299	183 432	163 263	160 101	167 782	140 237	155 178	149 764
Russian Fed	1 664	-	25	33	-	-	-	-	-	-
St Pier Mq	0	0	0	0	-	-	-	-	-	-
Spain	-	-	-	-	-	-	11	-	-	-
USA	106 561	67 652	97 200	81 528	97 398	93 934	73 330	77 912	101 133	65 138
21 Fishing area total	*307 520*	*258 749*	*297 524*	*264 993*	*260 661*	*254 035*	*241 123*	*218 149*	*256 311*	*214 902*
27 Belgium	11	23	5	8	6	3	1	0	0	1
Channel Is	-	-	-	-	-	-	-	1	1	1
Denmark	141 508	112 582	114 806	136 809	167 456	139 660	120 660	105 450	92 049	77 445
Estonia	41 738	36 250	27 359	27 358	22 098	23 192	26 108	31 843	33 168	28 866
Faroe Is	34 516	34 663	28 370	50 106	71 878	71 840	63 332	78 317	94 538	87 575
Finland	82 867	76 242	64 020	71 072	66 978	79 887	89 393	83 716	90 833	92 979
France	27 577	26 627	33 736	36 558	40 960	39 607	22 115	22 122	3 752	4 421
Germany	50 680	56 701	74 818	70 586	92 581	80 552	49 966	46 660	37 453	37 038
Greenland	-	2 370	2 895	4 430	3 360	18 130	4 898	4 245	3 730	4 764
Iceland	178 950	223 842	250 039	224 580	261 445	291 380	319 894	370 814	331 200	254 476
Ireland	40 640	30 606	28 839	26 234	29 341	30 780	30 827	28 058	26 254	26 662
Isle of Man	35	-	4	3	...	...	1	2	1	0
Latvia	26 652	25 284	24 187	23 559	22 202	21 762	22 404	22 527	21 557	21 373
Lithuania	1 639	1 539	2 109	1 845	748	1 172	3 592	1 793	3 807	2 042
Netherlands	66 357	78 557	95 085	129 643	128 038	95 915	103 120	56 709	56 934	55 782
Norway	581 202	573 777	563 049	616 221	748 220	710 591	884 593	1 027 873	1 070 438	921 285
Poland	37 611	36 778	30 703	27 914	22 850	22 069	25 175	16 848	22 232	24 897
Portugal	2	0	-	0	-	1	-	-	-	-
Russian Fed	125 756	128 129	144 224	123 242	140 106	131 112	171 527	202 161	222 283	208 729
Spain	232	266	203	...	50	347	159	145	55	88
Sweden	125 749	97 625	86 626	89 032	105 614	103 352	99 487	94 656	76 234	71 117
UK	81 363	72 893	90 327	96 298	130 839	109 612	91 098	67 113	67 113	66 891
27 Fishing area total	*1 645 085*	*1 614 754*	*1 661 404*	*1 755 498*	*2 054 770*	*1 970 964*	*2 128 350*	*2 261 053*	*2 253 632*	*1 986 432*
Species total	*1 952 605*	*1 873 503*	*1 958 928*	*2 020 491*	*2 315 431*	*2 224 999*	*2 369 473*	*2 479 202*	*2 509 943*	*2 201 334*
Pacific herring	**Hareng du Pacifique**		**Arenque del Pacífico**		***Clupea pallasii***				**1,21(05)001,07**	**HEP**
05 Russian Fed	-	-	-	-	-	3	-	-	-	-
05 Fishing area total	-	-	-	-	-	*3*	-	-	-	-
61 China	44 321 F	41 427 F	38 237 F	32 009 F	33 245 F	45 096 F	21 702	26 207	21 668	21 637
Japan	2 385	1 366	3 350	4 716	8 933	3 343	6 278	3 461	3 374	3 500 F
Korea Rep	8 491	1 941	3 571	5 113	7 592	12 524	28 356	45 505	37 617	25 005
Russian Fed	278 511	203 411	190 786	194 363	205 448	222 264	169 553	158 099	190 875	222 041
61 Fishing area total	*333 708 F*	*248 145 F*	*235 944 F*	*236 201 F*	*255 218 F*	*283 227 F*	*225 889*	*233 272*	*253 534*	*272 183 F*
67 Canada	24 189	29 321	28 847	24 255	29 445	23 370	11 993	11 530	12 326	9 528
Russian Fed	-	-	-	-	-	-	-	5	-	1
USA	38 891	32 284	31 876	32 508	39 242	36 434	30 839	38 351	39 710	49 381
67 Fishing area total	*63 080*	*61 605*	*60 723*	*56 763*	*68 687*	*59 804*	*42 832*	*49 886*	*52 036*	*58 910*
77 USA	2 521	3 282	1 843	1 638	354	731	597	757	534	1
77 Fishing area total	*2 521*	*3 282*	*1 843*	*1 638*	*354*	*731*	*597*	*757*	*534*	*1*
Species total	*399 309 F*	*313 032 F*	*298 510 F*	*294 602 F*	*324 259 F*	*343 765 F*	*269 318*	*283 915*	*306 104*	*331 094 F*
Spotted sardinella	**Sardinelle tachetée**		**Sardinela manchada**		***Amblygaster sirm***				**1,21(05)005,03**	**AGS**
57 Indonesia	...	...	...	408	414	516	1 030	826	1 225	628
57 Fishing area total	*...*	*...*	*...*	*408*	*414*	*516*	*1 030*	*826*	*1 225*	*628*
71 Indonesia	...	...	...	669	887	12 069	8 877	4 792	3 668	3 690
71 Fishing area total	*...*	*...*	*...*	*669*	*887*	*12 069*	*8 877*	*4 792*	*3 668*	*3 690*
Species total	*...*	*...*	*...*	*1 077*	*1 301*	*12 585*	*9 907*	*5 618*	*4 893*	*4 318*
Goldstripe sardinella	**Sardinelle dorée**		**Sardinela dorada**		***Sardinella gibbosa***				**1,21(05)012,03**	**SAG**
57 Indonesia	40 375	34 669	31 513	29 453	39 365	29 696	45 903	45 862	44 652	48 880
57 Fishing area total	*40 375*	*34 669*	*31 513*	*29 453*	*39 365*	*29 696*	*45 903*	*45 862*	*44 652*	*48 880*
71 Indonesia	145 537	147 357	122 258	115 975	137 937	140 826	123 920	128 494	135 358	147 187
71 Fishing area total	*145 537*	*147 357*	*122 258*	*115 975*	*137 937*	*140 826*	*123 920*	*128 494*	*135 358*	*147 187*
Species total	*185 912*	*182 026*	*153 771*	*145 428*	*177 302*	*170 522*	*169 823*	*174 356*	*180 010*	*196 067*
Indian oil sardine	**Sardinelle indienne**		**Sardinela aceitera**		***Sardinella longiceps***				**1,21(05)012,04**	**IOS**
51 India	287 628	249 601	263 948	248 011	235 852	246 526	249 801	254 856	261 605	262 761
Iran	17 453	12 865	14 237	18 403	15 704	17 638	22 295	27 244	21 187	20 838
Oman	58 960	37 931	31 964	34 865	32 091	36 187	34 281	33 466	36 602	32 070
Pakistan	31 201	31 600	32 939	34 336	31 532	30 955	31 282	31 474	26 937	20 127
Yemen	6 800 F	11 400 F	18 300 F	21 300 F	19 000 F	19 300 F	18 000 F	17 731	21 100 F	24 500 F
51 Fishing area total	*402 042 F*	*343 397 F*	*361 388 F*	*356 915 F*	*334 179 F*	*350 606 F*	*355 659 F*	*364 771*	*367 431 F*	*360 296 F*
57 India	55 448	18 210	12 584	25 271	26 802	27 087	29 423	63 758	62 350	60 144
57 Fishing area total	*55 448*	*18 210*	*12 584*	*25 271*	*26 802*	*27 087*	*29 423*	*63 758*	*62 350*	*60 144*
Species total	*457 490 F*	*361 607 F*	*373 972 F*	*382 186 F*	*360 981 F*	*377 693 F*	*385 082 F*	*428 529*	*429 781 F*	*420 440 F*

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Herrings, sardines, anchovies
Harengs, sardines, anchois
Arenques, sardinas, anchoas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Round sardinella	**Allache**		**Alacha**		***Sardinella aurita***				**1,21(05)012,10**	**SAA**
31 Mexico	373	332	291	250	...	...	...	...	...	...
USA	623	653	721	921	456	1 021	625	983	635	915
Venezuela	71 168	158 125	141 901	120 000 F	100 000 F	80 000 F	97 600 F	36 157	34 900 F	34 900 F
31 Fishing area total	*72 164*	*159 110*	*142 913*	*121 171 F*	*100 456 F*	*81 021 F*	*98 225 F*	*37 140*	*35 535 F*	*35 815 F*
34 Congo Rep	...	...	3 073	3 828	4 541	4 308	4 166	4 637	7 400	4 050
Côte dIvoire	18 864	7 288	8 279	10 583	7 174	8 617	8 410	6 000 F	4 201	9 554
Cuba	1 575	-	-	-	-	-	-	-	-	-
Georgia	...	...	...	...	...	...	...	...	...	920
Ghana	67 321	64 300	78 840	82 396	64 389	70 672	40 759	24 904	19 479	36 724
Ireland	52 980	24 552	20 764	19 651	24 084	-	-	1 905	9 241	17 961
Lithuania	30 800	22 205	29 517	35 372	19 328	24 846	21 116	23 021	16 781	16 611
Morocco	...	...	...	...	...	...	...	...	...	710
Netherlands	134 490	93 032	101 963	55 571	70 933	45 414	5 251	67 491	42 385	56 964
Russian Fed	22 557	18 800	7 116	4 615	8 050	23 097	39 146	17 838	14 200	15 257
Senegal	112 120	78 244	107 559	137 583	113 975	101 858	127 194	165 126	142 968	126 040
Spain	...	...	0	1	17	63	49	32	277	229
Togo	3 123	1 807	4 018	4 700	9 394	2 498	1 173	1 780 F	2 376	2 651
UK	-	-	-	-	-	...	10 925	6 524	8 763	15 019
34 Fishing area total	*443 830*	*310 228*	*361 129*	*354 300*	*321 885*	*281 373*	*258 189*	*319 258 F*	*268 071*	*302 690*
37 Albania	...	...	54	42	15	25	-	-	-	6
Croatia	37	42	60	71	102	114	131	75	...	...
France	17	7	3	5	2	1	1	1	1	3
Israel	117	143	118	86	168	64	182	150 F	162	91
Italy	...	...	...	...	576	542	1 375	768	645	987
Libya	9 500 F	10 000 F	10 500 F	11 000 F	11 500 F	12 000 F	13 554	19 518	9 450	9 200 F
Serbia-Monte	16	13	14	27	...	-	-	-	-	-
Slovenia	-	-	-	-	-	1	3	4	4	-
37 Fishing area total	*9 687 F*	*10 205 F*	*10 749 F*	*11 231 F*	*12 363 F*	*12 747 F*	*15 246*	*20 516 F*	*10 262*	*10 287 F*
Species total	*525 681 F*	*479 543 F*	*514 791 F*	*486 702 F*	*434 704 F*	*375 141 F*	*371 660 F*	*376 914 F*	*313 868 F*	*348 792 F*
Madeiran sardinella	**Grande allache**		**Machuelo**		***Sardinella maderensis***				**1,21(05)012,17**	**SAE**
34 Congo Rep	...	...	4 315	7 217	2 451	3 204	2 182	3 946	4 723	4 780
Côte dIvoire	716	2 421	362	6 007	962	377	1 324	1 000 F	721	865
Ghana	15 906	13 755	15 578	27 052	14 241	21 384	10 218	15 772	6 269	11 311
Lithuania	...	...	...	...	...	...	...	...	...	981
Morocco	...	...	...	...	...	...	...	...	...	45 498
Netherlands	...	...	...	...	3 852	3 216	275	2 215	3 000	1 813
Nigeria	11 931	12 132	11 407	10 921	10 880	13 903	15 716	14 809	14 439	14 078
Portugal	3	1	2	5	4	3	5	4	4	1
Senegal	99 944	105 773	149 012	115 299	118 371	95 588	109 429	85 976	93 481	82 951
Spain	49	5	38	13	4	6	100	91	127	157
Togo	445	353	208	542	204	1 316	188	100 F	20	3
UK	-	-	-	-	-	...	154	132	504	713
34 Fishing area total	*128 994*	*134 440*	*180 922*	*167 056*	*150 969*	*138 997*	*139 591*	*124 045 F*	*123 288*	*163 151*
Species total	*128 994*	*134 440*	*180 922*	*167 056*	*150 969*	*138 997*	*139 591*	*124 045 F*	*123 288*	*163 151*
Japanese sardinella	**Sardinelle japonaise**		**Sardinela del Japón**		***Sardinella zunasi***				**1,21(05)012,22**	**JSS**
61 Korea Rep	766	796	885	755	1 756	953	795	4 893	5 983	1 787
61 Fishing area total	*766*	*796*	*885*	*755*	*1 756*	*953*	*795*	*4 893*	*5 983*	*1 787*
Species total	*766*	*796*	*885*	*755*	*1 756*	*953*	*795*	*4 893*	*5 983*	*1 787*
Bali sardinella	**Sardinelle de Bali**		**Sardinela de Balí**		***Sardinella lemuru***				**1,21(05)012,23**	**SAM**
57 Indonesia	37 810	70 818	76 088	58 430	47 642	114 125	95 122	89 061	103 564	83 558
57 Fishing area total	*37 810*	*70 818*	*76 088*	*58 430*	*47 642*	*114 125*	*95 122*	*89 061*	*103 564*	*83 558*
71 Indonesia	65 900	61 352	60 348	44 932	49 352	49 004	81 543	50 289	62 288	47 579
71 Fishing area total	*65 900*	*61 352*	*60 348*	*44 932*	*49 352*	*49 004*	*81 543*	*50 289*	*62 288*	*47 579*
Species total	*103 710*	*132 170*	*136 436*	*103 362*	*96 994*	*163 129*	*176 665*	*139 350*	*165 852*	*131 137*
Brazilian sardinella	**Sardinelle de Brésil**		**Sardinela del Brasil**		***Sardinella brasiliensis***				**1,21(05)012,24**	**BSR**
31 Grenada	0	3	0	-	-	-	0	-	0	-
31 Fishing area total	*0*	*3*	*0*	-	-	-	*0*	-	*0*	-
41 Brazil	39 847	22 054	25 266	53 421	42 657	54 201	55 940	74 631	83 286	62 134
41 Fishing area total	*39 847*	*22 054*	*25 266*	*53 421*	*42 657*	*54 201*	*55 940*	*74 631*	*83 286*	*62 134*
Species total	*39 847*	*22 057*	*25 266*	*53 421*	*42 657*	*54 201*	*55 940*	*74 631*	*83 286*	*62 134*
Sardinellas nei	**Sardinelles nca**		**Sardinelas nep**		***Sardinella spp***				**1,21(05)012,XX**	**SIX**
27 Spain	1	-	6	3	0	2	1	-	-	0
27 Fishing area total	*1*	-	*6*	*3*	*0*	*2*	*1*	-	-	*0*
34 Belize	1 365	5 168	-	...	197	5 487	-	8 430	...	62 028
Benin	1 434	1 496	1 806	1 559	1 240	1 283	500 F	449	837	1 263
Bulgaria	115	-	-	-	-	-	-	-	-	-

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Herrings, sardines, anchovies
Harengs, sardines, anchois
Arenques, sardinas, anchoas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Cameroon	21 645	22 540	21 760	11 800 F	1 805	2 103	2 103	2 100 F	2 100 F	2 100 F
China	-	-	-	-	-	-	-	-	-	14
Comoros	-	-	-	-	-	-	933	2 797	...	4 379
Congo Dem R	1 800 F	1 700 F	1 600 F	1 500 F	1 400 F	1 300 F	1 200	1 200 F	1 200 F	1 200 F
Congo Rep	8 500 F	7 500 F	97	639	383	614	554	981	100	462
Cyprus	9 455	-	-	-	-	-	-	-	-	-
France	1 220	-	-	-	-	-	-	-	-	-
Gabon	1 083	1 270	1 762	1 789	2 398	1 856	1 148	5	4 F	4 F
Gambia	81	1 711	1 488	1 266	564	4 941	4 417	7 064	7 576	7 581
Germany	1 683	1 518	-	153	-	14 782	12 093	-	-	2
Ghana	8 345	1 553	2 819	4 245	445	416	443	-	409	1 827
Guinea	8 027	6 281	3 664	1 397	631	1 921	2 490	1 651	1 650 F	4 887 F
GuineaBissau	...	...	...	...	46 F	45 F	45 F	45 F	45 F	45 F
Latvia	7 689	6 132	8 714	6 986	9 726	15 589	13 225	11 455	11 716	14 228
Liberia	1 358	1 350	1 350	1 355	386	508	1 599	626	630 F	630 F
Mauritania	14 000 F	15 000 F	16 000 F	19 231	30 523	14 604	28 785	21 849	89 000 F	147 651
Morocco	631	191	16	13	31	13	22	139	8	-
Netherlands	-	5 131	-	-	-	-	-	-	-	-
Nigeria	61 927	59 400	67 648	71 416	65 818	72 749	65 897	63 509	67 503	67 621
Panama	804	1 828	-	...	5 677	2 175	2 161	-	...	...
Poland	3 463	4 824	-	-	-	-	-	607	6 771	3 646
Portugal	-	-	-	-	-	-	172	53	1	-
St Kitts Nev	-	-	-	-	-	-	-	-	-	4 197
St Vincent	7 716	7 053	...	...	...	...	...	...	...	11 911
Sierra Leone	9 845	13 251	15 447	18 210	22 061	15 173	16 575	20 176	19 800 F	19 800 F
Spain	-	-	-	-	-	-	-	2	-	2
Ukraine	19 497	16 440	6 409	3 775	4 967	12 949	12 038	5 895	32 808	4 225
UK	-	-	-	-	-	7 701	-	-	-	-
Other nei	38 577	31 211	30 000 F	24 000 F	22 000 F	22 000 F	23 000 F	19 400 F	26 000 F	...
34 Fishing area total	*230 260 F*	*212 548 F*	*180 580 F*	*169 334 F*	*170 298 F*	*198 209 F*	*189 400 F*	*168 433 F*	*268 158 F*	*359 703 F*
37 Algeria	33 748	24 480	26 397	22 516	22 942	23 527	16 853	22 826	16 176	11 124
Egypt	20 037	12 106	10 270	12 268	14 976	14 764	20 191	17 389	11 917	8 971
Morocco	839	1 732	1 232	1 260	655	766	635	540	453	838
Palest, O.T.	950 F	1 299	620	2 080	928	1 516	1 953	1 983	337	702
Spain	13 555	7 368	5 968	3 289	1 636	3 951	4 081	4 254	2 742	4 194
Syria	197	334	305	320	518	426	352	360	340	362
Tunisia	12 942	12 465	11 824	13 531	12 849	13 619	16 612	16 610	14 198	15 066
37 Fishing area total	*82 268 F*	*59 784*	*56 616*	*55 264*	*54 504*	*58 569*	*60 677*	*63 962*	*46 163*	*41 257*
47 Angola	57 896	28 513	44 955	58 569	46 000 F	50 000 F	66 837	68 049	74 184	71 000 F
Lithuania	-	-	1 815	-	-	-	-	-	-	-
Namibia	-	-	-	-	-	406	...	...	...	...
Russian Fed	443	1 513	553	-	-	-	-	-	-	-
47 Fishing area total	*58 339*	*30 026*	*47 323*	*58 569*	*46 000 F*	*50 406 F*	*66 837*	*68 049*	*74 184*	*71 000 F*
51 Bahrain	...	...	...	64	-	35	0	5	6	44
Comoros	1 000	1 000	1 000	1 150	1 000	1 000 F	1 150 F	1 150 F	1 150 F	1 150 F
Egypt	4 343	5 431	4 779	3 704	2 887	2 367	2 193	3 281	7 295	4 701
Eritrea	0	0	0	0	0	293	...	...	...	...
Qatar	0	0	-	-	-	-	-	-	-	-
Tanzania	15 500	14 000	14 200	15 000	15 500	3 095	12 221	11 832	14 300	8 015
Untd Arab Em	4 200	3 500	4 140	4 700 F	5 180	4 800 F	4 500 F	4 074	839	819
Zanzibar	572	899	711	1 133	956	1 511	973	1 166	1 172	1 199
51 Fishing area total	*25 615*	*24 830*	*24 830*	*25 751 F*	*25 523*	*13 101 F*	*21 037 F*	*21 508 F*	*24 762 F*	*15 928 F*
57 Thailand	33 894	20 648	15 520	16 598	16 964	19 258	15 886	17 596	16 415	17 006
57 Fishing area total	*33 894*	*20 648*	*15 520*	*16 598*	*16 964*	*19 258*	*15 886*	*17 596*	*16 415*	*17 006*
61 China,H.Kong	6 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F
61 Fishing area total	*6 F*	*5 F*	*5 F*	*5 F*	*5 F*	*5 F*	*5 F*	*5 F*	*5 F*	*5 F*
71 Brunei Darsm	...	...	...	...	...	401	...	...	...	...
Philippines	282 617	245 054	242 968	270 227	336 304	303 766	313 082	369 199	467 853	448 556
Thailand	111 138	108 229	109 399	103 303	110 463	90 250	81 562	78 859	83 612	81 236
71 Fishing area total	*393 755*	*353 283*	*352 367*	*373 530*	*446 767*	*394 417*	*394 644*	*448 058*	*551 465*	*529 792*
Species total	*824 138 F*	*701 124 F*	*677 247 F*	*699 054 F*	*760 061 F*	*733 967 F*	*748 487 F*	*787 611 F*	*981 152 F*	*1 034 691 F*

Japanese pilchard	**Pilchard du Japon**		**Sardina japonesa**		***Sardinops melanostictus***			**1,21(05)013,01**		**JAP**
61 China	137 207 F	158 484 F	139 287 F	153 122 F	157 517 F	182 589 F	169 127	157 074	134 377	135 011
Japan	178 423	50 313	52 050	50 153	27 601	52 503	79 099	34 857	57 429	73 400 F
Korea Rep	129	8	18	215	46	0	106	108	47	61
61 Fishing area total	*315 759 F*	*208 805 F*	*191 355 F*	*203 490 F*	*185 164 F*	*235 092 F*	*248 332*	*192 039*	*191 853*	*208 472 F*
Species total	*315 759 F*	*208 805 F*	*191 355 F*	*203 490 F*	*185 164 F*	*235 092 F*	*248 332*	*192 039*	*191 853*	*208 472 F*

California pilchard	**Pilchard de Californie**		**Sardina monterrey**		***Sardinops caeruleus***			**1,21(05)013,02**		**CPI**
67 USA	23 908	38 958	37 192	45 069	51 831	40 031	46 809	28 797	28 847	32 676
67 Fishing area total	*23 908*	*38 958*	*37 192*	*45 069*	*51 831*	*40 031*	*46 809*	*28 797*	*28 847*	*32 676*
77 Mexico	609 777	624 817	561 929	475 657	252 747	268 919	431 760	655 431	691 680	630 221
USA	51 812	58 296	34 433	44 554	34 552	46 577	80 951	57 800	37 543	33 688
77 Fishing area total	*661 589*	*683 113*	*596 362*	*520 211*	*287 299*	*315 496*	*512 711*	*713 231*	*729 223*	*663 909*
Species total	*685 497*	*722 071*	*633 554*	*565 280*	*339 130*	*355 527*	*559 520*	*742 028*	*758 070*	*696 585*

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Herrings, sardines, anchovies
Harengs, sardines, anchois
Arenques, sardinas, anchoas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
South American pilchard	**Pilchard sudaméricain**		**Sardina sudamericana**		***Sardinops sagax***				**1,21(05)013,03**	**CHP**
87 Chile	33 271	18 561	10 679	4 813	3 665	1 170	979	395	179	88
Ecuador	42 143	1 924	632	544	4	9	-	-	-	-
Peru	60 298	6 853	8 726	1 541	838	89	56	5	26	17
87 Fishing area total	*135 712*	*27 338*	*20 037*	*6 898*	*4 507*	*1 268*	*1 035*	*400*	*205*	*105*
Species total	*135 712*	*27 338*	*20 037*	*6 898*	*4 507*	*1 268*	*1 035*	*400*	*205*	*105*
Southern African pilchard	**Pilchard de l'Afrique australe**		**Sardina de Africa austral**		***Sardinops ocellatus***				**1,21(05)013,05**	**PIA**
47 Angola	...	...	...	...	...	...	13 771	2 389	-	-
Namibia	7 940	4 176	22 255	28 605	27 266	2 314	23 522	20 699	13 675	14 000 F
South Africa	192 160	260 710	289 994	373 827	246 777	217 328	139 489	90 969	94 362	112 386
47 Fishing area total	*200 100*	*264 886*	*312 249*	*402 432*	*274 043*	*219 642*	*176 782*	*114 057*	*108 037*	*126 386 F*
51 South Africa	0	-	0	3	-	-	-	-	12	-
51 Fishing area total	*0*	-	*0*	*3*	-	-	-	-	*12*	-
Species total	*200 100*	*264 886*	*312 249*	*402 435*	*274 043*	*219 642*	*176 782*	*114 057*	*108 049*	*126 386 F*
Australian pilchard	**...B**		**...C**		***Sardinops neopilchardus***				**1,21(05)013,09**	**SRP**
81 New Zealand	1 399	920	768	1 399	760	1 120	837	656	779	495
Ukraine	-	72	20	12	...	74	...	...	...	...
81 Fishing area total	*1 399*	*992*	*788*	*1 411*	*760*	*1 194*	*837*	*656*	*779*	*495*
Species total	*1 399*	*992*	*788*	*1 411*	*760*	*1 194*	*837*	*656*	*779*	*495*
Brazilian menhaden	**Menhaden du Brésil**		**Savela**		***Brevoortia aurea***				**1,21(05)024,01**	**MHS**
41 Argentina	265	94	151	275	324	251	480	223	262	170
Brazil	344	734	879	876	712	735	1 078	823	908	857
41 Fishing area total	*609*	*828*	*1 030*	*1 151*	*1 036*	*986*	*1 558*	*1 046*	*1 170*	*1 027*
Species total	*609*	*828*	*1 030*	*1 151*	*1 036*	*986*	*1 558*	*1 046*	*1 170*	*1 027*
Argentine menhaden	**Menhaden d'Argentine**		**Lacha**		***Brevoortia pectinata***				**1,21(05)024,02**	**MHP**
41 Uruguay	103	47	76	116	110	9	31	61	81	97
41 Fishing area total	*103*	*47*	*76*	*116*	*110*	*9*	*31*	*61*	*81*	*97*
Species total	*103*	*47*	*76*	*116*	*110*	*9*	*31*	*61*	*81*	*97*
Atlantic menhaden	**Menhaden tyran**		**Lacha tirana**		***Brevoortia tyrannus***				**1,21(05)024,03**	**MHA**
21 USA	236 246	180 506	181 529	191 401	188 661	183 669	215 175	187 633	182 092	228 609
21 Fishing area total	*236 246*	*180 506*	*181 529*	*191 401*	*188 661*	*183 669*	*215 175*	*187 633*	*182 092*	*228 609*
31 USA	25 155	31 068	21 734	23 762	5 582	199	331	109	118	357
31 Fishing area total	*25 155*	*31 068*	*21 734*	*23 762*	*5 582*	*199*	*331*	*109*	*118*	*357*
Species total	*261 401*	*211 574*	*203 263*	*215 163*	*194 243*	*183 868*	*215 506*	*187 742*	*182 210*	*228 966*
Gulf menhaden	**Menhaden écailleux**		**Lacha escamuda**		***Brevoortia patronus***				**1,21(05)024,04**	**MHG**
31 USA	528 506	582 497	522 195	464 148	369 906	408 875	456 576	420 719	454 758	438 640
31 Fishing area total	*528 506*	*582 497*	*522 195*	*464 148*	*369 906*	*408 875*	*456 576*	*420 719*	*454 758*	*438 640*
Species total	*528 506*	*582 497*	*522 195*	*464 148*	*369 906*	*408 875*	*456 576*	*420 719*	*454 758*	*438 640*
Rainbow sardine	**Sardine arc-en-ciel**		**Sardina arco iris**		***Dussumieria acuta***				**1,21(05)029,01**	**RAS**
57 Indonesia	4 951	3 740	3 431	3 601	4 492	5 763	4 749	3 438	4 192	3 342
57 Fishing area total	*4 951*	*3 740*	*3 431*	*3 601*	*4 492*	*5 763*	*4 749*	*3 438*	*4 192*	*3 342*
71 Indonesia	15 450	14 934	15 768	17 017	22 653	19 117	19 514	15 775	16 378	17 448
Philippines	16 902	8 501	10 488	10 742	11 169	10 231	10 895	11 426	10 614	10 178
71 Fishing area total	*32 352*	*23 435*	*26 256*	*27 759*	*33 822*	*29 348*	*30 409*	*27 201*	*26 992*	*27 626*
Species total	*37 303*	*27 175*	*29 687*	*31 360*	*38 314*	*35 111*	*35 158*	*30 639*	*31 184*	*30 968*
Slender rainbow sardine	**Sardine arc-en-ciel gracile**		**Sardina arco iris grácil**		***Dussumieria elopsoides***				**1,21(05)029,02**	**RAL**
61 China,H.Kong	17 F	15 F	14 F	15 F	15 F	14 F	14 F	14 F	15 F	16 F
61 Fishing area total	*17 F*	*15 F*	*14 F*	*15 F*	*15 F*	*14 F*	*14 F*	*14 F*	*15 F*	*16 F*
Species total	*17 F*	*15 F*	*14 F*	*15 F*	*15 F*	*14 F*	*14 F*	*14 F*	*15 F*	*16 F*
Bonga shad	**Ethmalose d'Afrique**		**Sábalo africano**		***Ethmalosa fimbriata***				**1,21(05)030,02**	**BOA**
01 Benin	1 700 F	1 700 F	1 700 F	1 600 F	1 250 F	1 100 F	900 F	900 F	500 F	341
Senegal	...	...	...	...	...	...	...	1 540	800 F	75
01 Fishing area total	*1 700 F*	*1 700 F*	*1 700 F*	*1 600 F*	*1 250 F*	*1 100 F*	*900 F*	*2 440 F*	*1 300 F*	*416*
34 Benin	8	17	14	22	12	12	10	0	...	...
Cameroon	21 645	21 782	20 226	30 800 F	41 699	41 593	41 493	41 400 F	41 400 F	41 400 F
Congo Rep	2 000 F	2 000 F	989	1 208	987	801	716	1 402	1 436	1 586
Côte dIvoire	10 200 F	9 370	7 000 F	4 500 F	46	26	38	40 F	45	454

B-35 **Herrings, sardines, anchovies**
Harengs, sardines, anchois
Arenques, sardinas, anchoas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Gabon	12 733	11 428	11 964	10 560	8 570	10 577	11 321	8 313	5 610 F	5 610 F
Gambia	18 516	22 786	22 118	16 815	14 978	13 187	13 876	11 744	12 577	12 585
Ghana	282	295	128	303	1 373	723	198	1 805	5 468	643
Guinea	38 454	36 451	52 788	32 438	12 577	26 726	27 870	32 935	32 900 F	32 900 F
Liberia	123	120	120	123	23	67	102	33	30 F	30 F
Lithuania	-	-	-	17	-	-	-	-	-	-
Mauritania	805 F	801 F	830 F	1 150 F	1 320 F	690 F	950 F	810 F	900 F	1 416
Netherlands	-	-	-	-	-	2	-	-	5	8
Nigeria	19 049	21 987	21 621	14 733	19 758	22 589	21 688	22 138	23 411	24 757
Senegal	31 675	26 240	23 630	21 839	19 211	18 896	19 473	16 074	11 894	19 155
Sierra Leone	24 790	31 492	28 516	51 049	52 717	60 134	52 715	86 038	84 400 F	84 400 F
34 Fishing area total	*180 280 F*	*184 769 F*	*189 944 F*	*185 557 F*	*173 271 F*	*196 023 F*	*190 450 F*	*222 732 F*	*220 076 F*	*224 944 F*
Species total	*181 980 F*	*186 469 F*	*191 644 F*	*187 157 F*	*174 521 F*	*197 123 F*	*191 350 F*	*225 172 F*	*221 376 F*	*225 360 F*
Red-eye round herring	**Shadine ronde**		**Sardineta canalera**		***Etrumeus teres***				**1,21(05)031,01**	**RRH**
61 China,Taiwan	1 306	1 553	1 023	1 852	890	332	271	301	200	243
Japan	31 525	26 355	30 647	31 655	35 418	38 196	60 233	48 255	53 642	48 900 F
61 Fishing area total	*32 831*	*27 908*	*31 670*	*33 507*	*36 308*	*38 528*	*60 504*	*48 556*	*53 842*	*49 143 F*
77 Mexico	...	...	...	...	7 065	7 377	3 605	1 025	1 098	1 024
USA	2	-	-	-	-	-	-	-	-	-
77 Fishing area total	*2*	*...*	*...*	*...*	*7 065*	*7 377*	*3 605*	*1 025*	*1 098*	*1 024*
87 Ecuador	28	613	1 068	4 901	4 629	433	520	2 632	1 154	1 903
87 Fishing area total	*28*	*613*	*1 068*	*4 901*	*4 629*	*433*	*520*	*2 632*	*1 154*	*1 903*
Species total	*32 861*	*28 521*	*32 738*	*38 408*	*48 002*	*46 338*	*64 629*	*52 213*	*56 094*	*52 070 F*
Whitehead's round herring	**Shadine de Angola**		**Sardina angoleña**		***Etrumeus whiteheadi***				**1,21(05)031,04**	**WRR**
47 Namibia	1 432	9 650	1 490	4 689	542	4 926	4 526	800	...	...
South Africa	55 330	54 800	42 529	47 236	28 896	42 660	48 108	64 701	40 632	88 574
47 Fishing area total	*56 762*	*64 450*	*44 019*	*51 925*	*29 438*	*47 586*	*52 634*	*65 501*	*40 632*	*88 574*
Species total	*56 762*	*64 450*	*44 019*	*51 925*	*29 438*	*47 586*	*52 634*	*65 501*	*40 632*	*88 574*
Pacific flatiron herring	**Harengule pacifique**		**Sardineta plumilla**		***Harengula thrissina***				**1,21(05)033,07**	**HCT**
77 Mexico	...	...	...	...	162	169	...	...	...	...
77 Fishing area total	*...*	*...*	*...*	*...*	*162*	*169*	*...*	*...*	*...*	*...*
Species total	*...*	*...*	*...*	*...*	*162*	*169*	*...*	*...*	*...*	*...*
Scaled sardines	**Harengules**		**Sardinetas**		***Harengula spp***				**1,21(05)033,XX**	**SAS**
31 Cuba	1 770	506	719	751	677	735	874	839	1 015	1 083
Dominican Rp	21	...	147	126	127	36	28	74	66	186
Grenada	0	0	-	-	-	-	-	-	-	-
Mexico	...	...	...	...	458	478	296	230	246	140
31 Fishing area total	*1 791*	*506*	*866*	*877*	*1 262*	*1 249*	*1 198*	*1 143*	*1 327*	*1 409*
41 Brazil	210	326	358	335	296	298	226	268	296	280
41 Fishing area total	*210*	*326*	*358*	*335*	*296*	*298*	*226*	*268*	*296*	*280*
Species total	*2 001*	*832*	*1 224*	*1 212*	*1 558*	*1 547*	*1 424*	*1 411*	*1 623*	*1 689*
Pacific thread herring	**Chardin du Pacifique**		**Machuelo hebra pinchagua**		***Opisthonema libertate***				**1,21(05)042,01**	**THP**
77 Mexico	...	...	...	...	170 010	180 525	215 329	114 022	134 068	98 174
Panama	32 709	58 850	50 935	45 515	32 036	30 273	17 725	36 808	28 902	35 351
77 Fishing area total	*32 709*	*58 850*	*50 935*	*45 515*	*202 046*	*210 798*	*233 054*	*150 830*	*162 970*	*133 525*
87 Colombia	...	...	...	...	...	...	...	...	...	153
Ecuador	19 886	10 951	6 895	8 590	8 282	16 851	14 153	25 263	22 527	29 369
87 Fishing area total	*19 886*	*10 951*	*6 895*	*8 590*	*8 282*	*16 851*	*14 153*	*25 263*	*22 527*	*29 522*
Species total	*52 595*	*69 801*	*57 830*	*54 105*	*210 328*	*227 649*	*247 207*	*176 093*	*185 497*	*163 047*
Atlantic thread herring	**Chardin fil**		**Machuelo hebra atlántico**		***Opisthonema oglinum***				**1,21(05)042,02**	**THA**
21 USA	-	-	-	-	3	0	0	-	-	-
21 Fishing area total	*-*	*-*	*-*	*-*	*3*	*0*	*0*	*-*	*-*	*-*
31 Cuba	1 676	1 799	1 740	1 740	1 195	1 964	1 359	1 666	1 799	1 524
Dominican Rp	106	1	110	99	87	92	77	87	78	220
Grenada	0	0	-	-	-	-	-	-	-	-
USA	1 256	2 607	909	1 339	908	233	51	414	392	533
Venezuela	3 650	106	9 218	14 560 F	7 800 F	4 600 F	5 600 F	6 400 F	6 180 F	6 180 F
31 Fishing area total	*6 688*	*4 513*	*11 977*	*17 738 F*	*9 990 F*	*6 889 F*	*7 087 F*	*8 567 F*	*8 449 F*	*8 457 F*
41 Brazil	4 520	4 581	7 752	5 754	4 853	7 673	13 252	8 375	9 237	8 710
41 Fishing area total	*4 520*	*4 581*	*7 752*	*5 754*	*4 853*	*7 673*	*13 252*	*8 375*	*9 237*	*8 710*
Species total	*11 208*	*9 094*	*19 729*	*23 492 F*	*14 846 F*	*14 562 F*	*20 339 F*	*16 942 F*	*17 686 F*	*17 167 F*

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Herrings, sardines, anchovies
Harengs, sardines, anchois
Arenques, sardinas, anchoas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Silver-stripe round herring	**Hareng gracile**		**Arenquillo de banda**		***Spratelloides gracilis***				**1,21(05)049,01**	**SRH**
61 China,Taiwan	505	1 033	376	380	199	455	352	47	338	22
61 Fishing area total	*505*	*1 033*	*376*	*380*	*199*	*455*	*352*	*47*	*338*	*22*
Species total	*505*	*1 033*	*376*	*380*	*199*	*455*	*352*	*47*	*338*	*22*
Pacific piquitinga	**Harengule piquitinge pacifique**		**Sardineta piquitinga pelada**		***Lile stolifera***				**1,21(05)063,02**	**LCS**
77 Mexico	...	...	...	...	141	147	229	203	218	251
77 Fishing area total	*...*	*...*	*...*	*...*	*141*	*147*	*229*	*203*	*218*	*251*
Species total	*...*	*...*	*...*	*...*	*141*	*147*	*229*	*203*	*218*	*251*
European pilchard(=Sardine)	**Sardine commune**		**Sardina europea**		***Sardina pilchardus***				**1,21(05)064,01**	**PIL**
27 Denmark	1 399	3 523	158	742	78	12	52	92	-	48
France	13 536	21 643	23 214	18 902	27 317	28 040	25 470	22 880	35 748	25 026
Germany	463	133	13	60	194	324	-	43	-	62
Ireland	2 475	5 824	3 973	2 455	1 448	1 281	82	236	486	25
Lithuania	-	-	-	-	-	23	-	-	-	-
Netherlands	807	2 572	7 587	2 315	2 115	2 291	1 202	2 400	3 426	4 904
Norway	-	-	-	-	-	-	40	0	-	-
Portugal	71 907	68 740	66 605	75 918	74 361	74 113	91 178	71 055	60 924	63 759
Spain	28 846	31 872	30 353	36 391	36 842	32 826	29 220	34 391	27 628	29 647
Sweden	1 031	142	-	56	-	-	-	-	-	-
UK	10 427	9 401	5 137	2 682	3 630	1 925	2 691	3 471	2 540	2 526
27 Fishing area total	*130 891*	*143 850*	*137 040*	*139 521*	*145 985*	*140 835*	*149 935*	*134 568*	*130 752*	*125 997*
34 Belize	127	1 975	...	...	...	...	...	...	...	...
China	2	...	...	...	...	...	...	...	...	2 551
Comoros	-	-	-	-	-	-	...	...	...	4 222
Cyprus	29	-	-	-	-	-	-	-	-	-
Georgia	...	...	...	...	...	...	...	...	...	1 819
Germany	37	2 918	-	1 338	-	338	348	-	-	0
Guinea	...	...	...	...	...	...	...	...	...	4 375
Ireland	5 380	6 335	5 180	10 542	6 775	-	-	-	2 401	14 118
Latvia	54	362	-	-	5 528	8 281	6 282	6 454	8 229	9 756
Lithuania	22	206	...	15	920	8 688	4 073	9 123	15 017	27 159
Mauritania	3 000 F	4 500 F	6 000 F	8 092	14 779	9 120	22 319	15 276	13 409	16 674
Morocco	752 262	674 120	648 536	632 159	614 759	526 709	505 469	639 042	775 650	759 368
Netherlands	10 979	25 009	39 850	44 455	29 710	17 968	5 000	7 208	30 507	22 586
Poland	-	14 244	-	-	-	-	-	3 006	6 151	1 639
Portugal	40	23	18	10	13	20	467	110	3	6
Russian Fed	1 829	6 450	7 004	7 851	13 330	35 103	40 175	15 802	16 164	42 026
St Kitts Nev	-	-	-	-	-	-	-	-	-	3 083
St Vincent	41	192	...	...	...	...	...	...	...	4 266
Spain	1 118	242	1 137	192	355	332	483	562	717	303
Ukraine	29 349	20 093	21 150	30 675	38 024	51 464	29 450	27 565	13 606	14 425
UK	-	-	-	-	-	266	982	24 868	3 782	5 697
Other nei	3 949	7 677	9 000 F	7 300 F	6 700 F	6 700 F	6 700 F	5 600 F	7 500 F	...
34 Fishing area total	*808 218 F*	*764 346 F*	*737 875 F*	*742 629 F*	*730 893 F*	*664 989 F*	*621 748 F*	*754 616 F*	*893 136 F*	*934 073*
37 Albania	123	90	70	32	104	115	95	110	120	104
Algeria	58 966	72 547	70 258	63 796	69 512	83 928	73 703	40 047	55 289	31 219
Bulgaria	-	-	-	-	-	-	1	0	3	8
Croatia	9 097	12 626	12 271	16 357	16 521	16 950	16 900	21 194	32 191	29 600
Cyprus	1	2	7	3	3	5	13	13	3	3
France	15 539	13 122	12 091	12 548	10 407	12 255	13 188	6 777	4 032	1 207
Greece	14 395	16 331	8 669	9 217	11 258	11 321	9 410	10 544	10 072	10 000 F
Italy	23 980	18 049	15 969	11 891	12 038	14 215	14 134	12 025	15 637	16 274
Montenegro	...	...	...	...	...	21	23	32	30	35
Morocco	11 426	10 862	10 672	12 584	15 241	15 293	13 824	7 937	14 982	12 179
Russian Fed	-	-	-	-	-	-	-	-	-	1
Serbia-Monte	28	25	24	24	43	-	-	-	-	-
Slovenia	1 219	1 223	771	374	327	298	249	306	429	403
Spain	41 180	22 256	24 325	27 770	28 835	36 945	30 614	21 526	15 936	16 562
Tunisia	13 988	13 311	12 051	14 256	18 612	24 802	19 871	18 386	19 024	14 359
Turkey	10 000	8 684	12 000	12 883	20 656	15 586	20 941	17 531	30 091	27 639
37 Fishing area total	*199 942*	*189 128*	*179 178*	*181 735*	*203 557*	*231 734*	*212 966*	*156 428*	*197 839*	*159 593 F*
Species total	*1 139 051 F*	*1 097 324 F*	*1 054 093 F*	*1 063 885 F*	*1 080 435 F*	*1 037 558 F*	*984 649 F*	*1 045 612 F*	*1 221 727 F*	*1 219 663 F*
European sprat	**Sprat**		**Espadín**		***Sprattus sprattus***				**1,21(05)066,01**	**SPR**
27 Belgium	2	1	1	1	0	1	0	0	0	1
Denmark	256 778	237 466	262 084	274 129	329 802	183 793	140 892	126 693	195 174	187 021
Estonia	40 777	40 717	29 366	37 306	55 285	46 689	51 007	48 582	47 299	47 862
Faroe Is	44	67	1 675	-	2 125	1 538	1 901	-	-	7 326
Finland	15 850	17 257	8 961	16 582	17 894	19 057	24 626	24 270	23 176	24 618
France	9	2	5	195	4	11	0	0	5	206
Germany	791	950	18 023	26 353	28 974	30 797	30 974	30 973	29 223	21 092
Ireland	455	1 729	4 947	4 096	5 928	1 522	3 744	2 353	3 772	3 201
Latvia	42 769	47 540	41 743	52 399	64 647	54 638	60 454	57 301	49 550	45 851
Lithuania	3 135	2 800	3 032	6 185	8 635	10 814	19 745	18 296	19 515	10 223
Netherlands	136	169	508	118	3	106	124	5	4	1 722
Norway	12 420	2 609	3 113	1 526	1 957	11 470	12 933	4 453	11 469	14 648
Poland	85 757	81 243	84 098	95 798	74 328	55 891	60 202	55 557	83 416	59 277
Portugal	-	-	-	-	-	0	0	-	-	-
Russian Fed	31 959	32 854	28 663	25 109	29 749	28 324	24 808	21 337	25 512	25 647
Spain	17	28	4	1	-	2	14	-	-	2

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Herrings, sardines, anchovies
Harengs, sardines, anchois
Arenques, sardinas, anchoas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Sweden	88 562	78 365	76 689	90 724	109 435	102 748	100 440	95 571	81 826	82 604
UK	5 091	5 792	5 863	3 883	3 854	2 707	3 050	3 601	5 448	6 822
27 Fishing area total	*584 552*	*549 589*	*568 775*	*634 405*	*732 620*	*550 108*	*534 914*	*488 992*	*575 389*	*538 123*
37 Albania	...	...	...	2	1	2	3	8	5	...
Bulgaria	695	11 595	9 155	2 889	2 575	2 655	2 985	4 310	4 551	4 041
Croatia	...	...	...	...	...	...	...	...	89	111
Georgia	30	43	2	4	0	0	0	0	0	0
Greece	474	166	304	138	90	254	204	262	201	201 F
Italy	...	...	...	...	148	90	105	122	124	163
Montenegro	...	...	...	...	...	30	49	48	38	38
Romania	1 792	1 617	1 219	1 350	1 487	491	228	234	92	29
Russian Fed	11 122	11 218	20 974	14 324	13 889	10 616	6 815	7 814	8 733	5 911
Serbia-Monte	...	13	14	57	35	...	...	...	...	...
Slovenia	8	14	13	18	36	38	18	17	13	19
Spain	-	13	2	-	0	5	3	2	-	0
Turkey	1 000	2 050	6 025	5 411	5 500	7 311	11 921	39 303	53 385	57 023
Ukraine	49 004	45 503	31 379	30 894	35 707	21 309	18 013	21 111	24 604	24 652
37 Fishing area total	*64 125*	*72 232*	*69 087*	*55 087*	*59 468*	*42 801*	*40 344*	*73 231*	*91 835*	*92 188 F*
Species total	*648 677*	*621 821*	*637 862*	*689 492*	*792 088*	*592 909*	*575 258*	*562 223*	*667 224*	*630 311 F*
Falkland sprat	**Sprat des îles Falkland**		**Espadín de las Malvinas**		***Sprattus fuegensis***				**1,21(05)066,02**	**FAS**
41 Argentina	-	-	-	-	-	9	2	-	1	0
Falkland Is	1	1	-	-	-	0	9	-	-	-
41 Fishing area total	*1*	*1*	-	-	-	*9*	*11*	-	*1*	*0*
87 Chile	-	-	-	-	-	39 545	50 705	45 089	52 602	20 173
87 Fishing area total	-	-	-	-	-	*39 545*	*50 705*	*45 089*	*52 602*	*20 173*
Species total	*1*	*1*	-	-	-	*39 554*	*50 716*	*45 089*	*52 603*	*20 173*
Pacific menhaden	**Menhaden du Pacifique**		**Machete**		***Ethmidium maculatum***				**1,21(05)067,02**	**MES**
87 Chile	4 931	18 399	14 296	19 316	10 994	24 449	19 550	23 207	25 998	10 599
Peru	9 085	8 929	8 018	5 527	9 856	3 483	4 984	7 037	10 008	4 878
87 Fishing area total	*14 016*	*27 328*	*22 314*	*24 843*	*20 850*	*27 932*	*24 534*	*30 244*	*36 006*	*15 477*
Species total	*14 016*	*27 328*	*22 314*	*24 843*	*20 850*	*27 932*	*24 534*	*30 244*	*36 006*	*15 477*
Bluestripe herring	**Hareng à bande bleue**		**Arenque banda azul**		***Herklotsichthys quadrimaculat.***				**1,21(05)072,01**	**HES**
71 Fiji	...	30 F	33	34	35 F	35	37	30	25 F	15
71 Fishing area total	*...*	*30 F*	*33*	*34*	*35 F*	*35*	*37*	*30*	*25 F*	*15*
Species total	*...*	*30 F*	*33*	*34*	*35 F*	*35*	*37*	*30*	*25 F*	*15*
Araucanian herring	**Hareng araucian**		**Sardina araucana**		***Strangomera bentincki***				**1,21(05)078,01**	**CKI**
87 Chile	324 617	347 368	304 048	356 090	289 534	440 109	281 382	795 139	855 262	750 750
87 Fishing area total	*324 617*	*347 368*	*304 048*	*356 090*	*289 534*	*440 109*	*281 382*	*795 139*	*855 262*	*750 750*
Species total	*324 617*	*347 368*	*304 048*	*356 090*	*289 534*	*440 109*	*281 382*	*795 139*	*855 262*	*750 750*
European anchovy	**Anchois**		**Boquerón**		***Engraulis encrasicolus***				**1,21(06)002,01**	**ANE**
27 Denmark	0	-	997	6 936	-	158	156	-	-	20
France	16 339	11 435	7 134	8 869	997	914	148	10	900	5 934
Germany	-	-	274	-	454	31	38	0	16	200
Netherlands	3	4	4	3	3	4	9	9	1	1
Norway	-	-	-	-	-	-	136	-	-	-
Portugal	855	934	522	664	128	111	874	335	72	130
Spain	25 094	11 504	8 013	12 404	4 519	4 805	4 541	2 575	2 205	8 761
UK	274	0	24	68	8	-	940	176	354	320
27 Fishing area total	*42 565*	*23 877*	*16 968*	*28 944*	*6 109*	*6 023*	*6 842*	*3 105*	*3 548*	*15 366*
34 Belize	2 359	5 099	...	...	...	...	...	...	...	...
Benin	852	1 381	1 472	1 099	874	904	450 F	...	...	...
Comoros	-	-	-	-	-	-	...	...	...	4 098
Cyprus	13 975	-	-	-	-	-	-	-	-	-
Georgia	...	...	...	...	...	...	...	...	...	962
Germany	42	-	-	-	-	6	-	-	-	-
Ghana	68 175	57 639	82 930	52 629	36 400	44 854	10 081	40 612	54 408	45 051
Latvia	9 143	6 872	-	-	-	-	-	5 964	7 879	8 395
Lithuania	9 492	14 064	22 000	27 548	20 500	25 791	18 072	20 610	5 946	...
Mauritania	16 000 F	19 000 F	25 000 F	33 411	37 429	16 292	17 742	12 567	6 979	5 031
Morocco	47 049	20 757	16 991	7 071	6 935	9 752	18 168	18 776	15 629	29 541
Poland	-	-	-	-	-	-	-	60	-	901
Portugal	-	0	-	-	-	-	-	-	-	-
Russian Fed	12 344	11 593	8 289	7 550	9 040	8 023	8 106	5 228	6 626	4 062
St Kitts Nev	-	-	-	-	-	-	-	-	-	3 077
St Vincent	7 139	9 757	...	...	...	...	...	...	...	13 367
Senegal	1 015	435	1 522	1 619	321	48	166	218	700	242
Sierra Leone	...	43	3	38	41	151	22	82	80 F	80 F
Spain	60	-	5	-	39	18	98	419	544	813
Togo	6 660	6 932	11 479	6 940	6 479	6 981	2 691	2 700 F	2 714	5 098
Ukraine	274	1 690	534	-	-	-	-	-	-	-
Other nei	4 068	9 931	14 000 F	10 500 F	10 000 F	10 000 F	9 000 F	8 500 F	11 500 F	...

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Herrings, sardines, anchovies
Harengs, sardines, anchois
Arenques, sardinas, anchoas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
34 Fishing area total	*198 647 F*	*165 193 F*	*184 225 F*	*148 405 F*	*128 058 F*	*122 820 F*	*84 596 F*	*115 736 F*	*113 005 F*	*120 718 F*
37 Albania	4	3	1	1	1	1	10	7	5	3
Algeria	6 085	2 182	1 711	1 374	3 119	1 542	1 382	2 216	3 184	2 015
Bulgaria	102	237	131	88	14	6	60	28	42	65
Croatia	2 850	3 187	3 341	5 044	9 504	11 850	13 200	13 054	15 456	15 224
Cyprus	-	-	-	1	0	-	-	-	0	0
Egypt	...	...	...	...	...	...	5 256	4 865	3 167	2 988
France	7 360	9 834	10 699	7 346	2 433	2 228	4 184	4 138	2 568	3 166
Georgia	941	927	2 665	11 607	9 587	9 222	17 447	25 938	24 500 F	24 500 F
Greece	10 770	9 976	13 786	13 404	11 324	14 156	16 020	16 278	14 539	14 500 F
Israel	-	-	-	-	22	16	77	60 F	...	...
Italy	53 047	42 068	44 296	58 261	63 361	81 174	61 216	45 039	54 388	54 095
Malta	-	-	-	-	-	-	-	-	8	5
Montenegro	...	...	...	...	...	23	15	15	19	13
Morocco	317	212	161	390	661	119	225	266	445	679
Romania	186	296	160	135	154	10	39	15	21	48
Russian Fed	7 766	9 271	7 999	7 323	6 706	8 097	6 636	9 492	11 261	12 786
Serbia-Monte	10	9	11	9	2	-	-	-	-	-
Slovenia	97	72	58	238	438	410	407	184	210	144
Spain	11 908	16 853	7 155	8 213	7 031	3 370	2 684	3 754	12 735	11 150
Tunisia	269	258	361	961	771	796	605	1 378	1 822	704
Turkey	320 000	373 000	295 000	340 000	138 569	270 000	385 000	251 675	204 699	229 023
Ukraine	16 668	12 941	13 101	9 383	6 930	7 701	8 800	11 029	14 642	22 423
37 Fishing area total	*438 380*	*481 326*	*400 636*	*463 778*	*260 627*	*410 721*	*523 263*	*389 431 F*	*363 711 F*	*393 531 F*
Species total	*679 592 F*	*670 396 F*	*601 829 F*	*641 127 F*	*394 794 F*	*539 564 F*	*614 701 F*	*508 272 F*	*480 264 F*	*529 615 F*
Japanese anchovy	**Anchois japonais**		**Anchoíta japonesa**		***Engraulis japonicus***				**1,21(06)002,02**	**JAN**
61 China	1 075 571 F	998 129 F	1 106 500 F	935 358 F	882 551 F	826 834 F	806 528	658 721	521 897	598 110
China,Taiwan	695	1 267	1 331	1 687	1 243	1 493	498	521	775	766
Japan	301 168	443 158	534 919	495 795	348 647	415 497	362 460	344 989	341 934	353 700 F
Korea Rep	273 927	236 315	250 106	196 646	249 001	265 346	221 110	261 532	203 728	249 636
61 Fishing area total	*1 651 361 F*	*1 678 869 F*	*1 892 856 F*	*1 629 486 F*	*1 481 442 F*	*1 509 170 F*	*1 390 596*	*1 265 763*	*1 068 334*	*1 202 212 F*
Species total	*1 651 361 F*	*1 678 869 F*	*1 892 856 F*	*1 629 486 F*	*1 481 442 F*	*1 509 170 F*	*1 390 596*	*1 265 763*	*1 068 334*	*1 202 212 F*
Argentine anchovy	**Anchois d'Argentine**		**Anchoíta**		***Engraulis anchoita***				**1,21(06)002,06**	**ANA**
41 Argentina	12 815	21 324	28 428	37 266	34 403	31 385	27 824	22 887	27 754	26 323
Uruguay	318	11	142	2 101	9 631	12 890	...	...	...	...
41 Fishing area total	*13 133*	*21 335*	*28 570*	*39 367*	*44 034*	*44 275*	*27 824*	*22 887*	*27 754*	*26 323*
Species total	*13 133*	*21 335*	*28 570*	*39 367*	*44 034*	*44 275*	*27 824*	*22 887*	*27 754*	*26 323*
Californian anchovy	**Anchois de Californie**		**Anchoa de California**		***Engraulis mordax***				**1,21(06)002,07**	**NPA**
67 USA	70	232	253	226	232	170	158	368	849	251
67 Fishing area total	*70*	*232*	*253*	*226*	*232*	*170*	*158*	*368*	*849*	*251*
77 Mexico	418	4 145	2 607	2 156	15 037	47 972	8 021	9 243	9 895	3 330
USA	19 189	4 650	1 567	6 877	11 182	12 791	10 390	14 285	2 668	1 026
77 Fishing area total	*19 607*	*8 795*	*4 174*	*9 033*	*26 219*	*60 763*	*18 411*	*23 528*	*12 563*	*4 356*
Species total	*19 677*	*9 027*	*4 427*	*9 259*	*26 451*	*60 933*	*18 569*	*23 896*	*13 412*	*4 607*
Anchoveta(=Peruvian anchovy)	**Anchois du Pérou**		**Anchoveta**		***Engraulis ringens***				**1,21(06)002,08**	**VET**
87 Chile	852 789	1 526 872	823 180	1 859 571	1 548 797	995 249	1 393 747	1 116 748	955 150	755 370
Ecuador	2 071	71 013	33 384	11 273	39 908	76 606	58 309	44 566	20 152	...
Peru	6 358 217	8 104 729	5 347 187	8 808 494	8 655 461	5 935 302	6 159 802	6 257 981	5 935 165	3 450 609
87 Fishing area total	*7 213 077*	*9 702 614*	*6 203 751*	*10 679 338*	*10 244 166*	*7 007 157*	*7 611 858*	*7 419 295*	*6 910 467*	*4 205 979*
Species total	*7 213 077*	*9 702 614*	*6 203 751*	*10 679 338*	*10 244 166*	*7 007 157*	*7 611 858*	*7 419 295*	*6 910 467*	*4 205 979*
Southern African anchovy	**Anchois de l'Afrique australe**		**Anchoa de Africa austral**		***Engraulis capensis***				**1,21(06)002,12**	**ANC**
47 Namibia	2 133	41 203	1 649	2 212	718	1 103	215	282	28	150 F
South Africa	287 190	213 440	258 876	190 093	282 728	134 360	252 782	265 823	174 465	217 042
47 Fishing area total	*289 323*	*254 643*	*260 525*	*192 305*	*283 446*	*135 463*	*252 997*	*266 105*	*174 493*	*217 192 F*
Species total	*289 323*	*254 643*	*260 525*	*192 305*	*283 446*	*135 463*	*252 997*	*266 105*	*174 493*	*217 192 F*
Buccaneer anchovy	**Anchois boucanier**		**Boquerón bucanero**		***Encrasicholina punctifer***				**1,21(06)007,03**	**STL**
51 Egypt	-	-	4 205	527	2 375	3 358	3 667	5 336	4 230	3 775
51 Fishing area total	-	-	*4 205*	*527*	*2 375*	*3 358*	*3 667*	*5 336*	*4 230*	*3 775*
Species total	-	-	*4 205*	*527*	*2 375*	*3 358*	*3 667*	*5 336*	*4 230*	*3 775*
Atlantic anchoveta	**Anchois queue jaune**		**Anchoveta rabo amarillo**		***Cetengraulis edentulus***				**1,21(06)015,01**	**AVA**
31 Venezuela	2	0	500	790 F	420 F	250 F	310 F	350 F	340 F	340 F
31 Fishing area total	*2*	*0*	*500*	*790 F*	*420 F*	*250 F*	*310 F*	*350 F*	*340 F*	*340 F*
Species total	*2*	*0*	*500*	*790 F*	*420 F*	*250 F*	*310 F*	*350 F*	*340 F*	*340 F*

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Herrings, sardines, anchovies
Harengs, sardines, anchois
Arenques, sardinas, anchoas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Pacific anchoveta	**Anchois chuchueco**		**Anchoveta chuchueco**		***Cetengraulis mysticetus***				**1,21(06)015,03**	**VEP**
77 Mexico	...	...	...	...	48 721	50 874	27 407	37 578	40 230	31 879
Panama	134 149	74 206	76 540	46 972	59 472	53 403	62 188	47 445	62 523	19 365
77 Fishing area total	*134 149*	*74 206*	*76 540*	*46 972*	*108 193*	*104 277*	*89 595*	*85 023*	*102 753*	*51 244*
87 Colombia	25 028	28 879	25 269	21 170	5 081	16 380 F	21 144 F	22 144 F	5 704	8 169
Ecuador	73 537	18 290	19 492	5 061	9 672	12 332	1 079	26 925	7 586	741
87 Fishing area total	*98 565*	*47 169*	*44 761*	*26 231*	*14 753*	*28 712 F*	*22 223 F*	*49 069 F*	*13 290*	*8 910*
Species total	*232 714*	*121 375*	*121 301*	*73 203*	*122 946*	*132 989 F*	*111 818 F*	*134 092 F*	*116 043*	*60 154*
Marini's anchovy	**...B**		**Aliche**		***Anchoa marinii***				**1,21(06)020,03**	**EAM**
41 Uruguay	...	...	...	...	...	...	18	36	...	...
41 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*18*	*36*	*...*	*...*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*18*	*36*	*...*	*...*
Longnose anchovy	**Anchois samase**		**Anchoa samasa**		***Anchoa nasus***				**1,21(06)020,05**	**EAN**
87 Ecuador	...	...	...	...	...	26 965	36 840	35 108	26 162	33 975
Peru	137 098	6 022	5 914	4 080	308	-	7	8	6	26 752
87 Fishing area total	*137 098*	*6 022*	*5 914*	*4 080*	*308*	*26 965*	*36 847*	*35 116*	*26 168*	*60 727*
Species total	*137 098*	*6 022*	*5 914*	*4 080*	*308*	*26 965*	*36 847*	*35 116*	*26 168*	*60 727*
Broad-striped anchovy	**Anchois rayé**		**Anchoa legítima**		***Anchoa hepsetus***				**1,21(06)020,11**	**ENP**
31 Grenada	0	0	-	-	-	-	-	-	-	-
31 Fishing area total	*0*	*0*	-	-	-	-	-	-	-	-
Species total	*0*	*0*	-	-	-	-	-	-	-	-
Stolephorus anchovies nei	**Anchois Stolephorus nca**		**Boquerones Stolephorus nep**		***Stolephorus spp***				**1,21(06)050,XX**	**STO**
51 Untd Arab Em	4 030	6 400	3 450	4 100 F	4 810	2 000 F	500 F	...	...	...
51 Fishing area total	*4 030*	*6 400*	*3 450*	*4 100 F*	*4 810*	*2 000 F*	*500 F*	*...*	*...*	*...*
57 Indonesia	70 424	60 169	60 188	41 562	42 811	48 542	50 656	64 728	57 902	53 347
Malaysia	7 881	14 963	10 334	14 615	9 990	10 417	10 114	9 164	6 514	7 064
57 Fishing area total	*78 305*	*75 132*	*70 522*	*56 177*	*52 801*	*58 959*	*60 770*	*73 892*	*64 416*	*60 411*
61 China,H.Kong	17 F	15 F	14 F	15 F	15 F	14 F	14 F	14 F	15 F	16 F
61 Fishing area total	*17 F*	*15 F*	*14 F*	*15 F*	*15 F*	*14 F*	*14 F*	*14 F*	*15 F*	*16 F*
71 Indonesia	119 758	108 790	100 953	113 249	109 115	116 482	124 866	134 947	135 064	122 379
Malaysia	9 842	8 720	9 985	8 834	6 897	9 008	13 861	10 436	14 221	11 541
Philippines	100 899	74 095	71 101	71 498	68 947	70 569	76 042	73 235	81 842	80 183
71 Fishing area total	*230 499*	*191 605*	*182 039*	*193 581*	*184 959*	*196 059*	*214 769*	*218 618*	*231 127*	*214 103*
Species total	*312 851 F*	*273 152 F*	*256 025 F*	*253 873 F*	*242 585 F*	*257 032 F*	*276 053 F*	*292 524 F*	*295 558 F*	*274 530 F*
Anchovies, etc. nei	**Anchois, etc. nca**		**Anchoas, etc. nep**		***Engraulidae***				**1,21(06)XXX,XX**	**ANX**
31 Mexico	1 328	1 075	1 199	1 166	2 050	2 140	777	1 019	1 091	504
31 Fishing area total	*1 328*	*1 075*	*1 199*	*1 166*	*2 050*	*2 140*	*777*	*1 019*	*1 091*	*504*
41 Brazil	4 197	3 766	4 398	4 676	3 353	5 181	4 374	4 445	4 902	4 627
41 Fishing area total	*4 197*	*3 766*	*4 398*	*4 676*	*3 353*	*5 181*	*4 374*	*4 445*	*4 902*	*4 627*
51 Comoros	850	850	900	950	950	950 F	1 100 F	1 100 F	1 100 F	1 100 F
India	62 023	61 992	78 619	68 389	66 221	66 821	69 546	66 112	67 242	65 913
Oman	970	2 571	860	3 205	1 856	2 006	2 349	1 596	889	5 898
Pakistan	15 001	15 400	16 029	8 972	7 155	6 937	6 007	6 016	6 053	6 112
Zanzibar	1 506	1 357	1 726	1 036	1 268	1 449	1 164	1 235	1 247	1 257
51 Fishing area total	*80 350*	*82 170*	*98 134*	*82 552*	*77 450*	*78 163 F*	*80 166 F*	*76 059 F*	*76 531 F*	*80 280 F*
57 India	14 274	7 785	13 675	19 228	11 494	14 251	28 570	41 917	38 669	37 825
Thailand	24 436	27 890	21 110	23 911	24 545	31 865	26 701	24 110	34 322	29 216
57 Fishing area total	*38 710*	*35 675*	*34 785*	*43 139*	*36 039*	*46 116*	*55 271*	*66 027*	*72 991*	*67 041*
61 Russian Fed	114	260	184	117	602	155	11	21	4	26
61 Fishing area total	*114*	*260*	*184*	*117*	*602*	*155*	*11*	*21*	*4*	*26*
71 Thailand	121 065	123 841	132 550	139 326	135 140	125 919	118 886	119 964	110 410	107 944
71 Fishing area total	*121 065*	*123 841*	*132 550*	*139 326*	*135 140*	*125 919*	*118 886*	*119 964*	*110 410*	*107 944*
81 Australia	22	82	9	2	50	2	...	...	...	...
81 Fishing area total	*22*	*82*	*9*	*2*	*50*	*2*	*...*	*...*	*...*	*...*
Species total	*245 786*	*246 869*	*271 259*	*270 978*	*254 684*	*257 676 F*	*259 485 F*	*267 535 F*	*265 929 F*	*260 422 F*
Dorab wolf-herring	**Chirocentre dorab**		**Arencón dorab**		***Chirocentrus dorab***				**1,21(11)002,01**	**DOB**
51 Pakistan	2 604	2 720	2 118	2 218	1 279	1 157	1 203	1 288	1 151	1 228
Qatar	0	0	-	-	-	-	-	-	-	-
51 Fishing area total	*2 604*	*2 720*	*2 118*	*2 218*	*1 279*	*1 157*	*1 203*	*1 288*	*1 151*	*1 228*
57 Thailand	6 663	7 864	6 258	6 707	5 082	4 806	4 099	2 459	2 525	2 492

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Herrings, sardines, anchovies
Harengs, sardines, anchois
Arenques, sardinas, anchoas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
57 Fishing area total	*6 663*	*7 864*	*6 258*	*6 707*	*5 082*	*4 806*	*4 099*	*2 459*	*2 525*	*2 492*
61 China,Taiwan	-	15	1	-	-	-	-	-	-	-
61 Fishing area total	*-*	*15*	*1*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
71 Thailand	5 928	6 739	7 371	6 203	5 188	4 711	3 533	2 742	2 523	2 633
71 Fishing area total	*5 928*	*6 739*	*7 371*	*6 203*	*5 188*	*4 711*	*3 533*	*2 742*	*2 523*	*2 633*
Species total	*15 195*	*17 338*	*15 748*	*15 128*	*11 549*	*10 674*	*8 835*	*6 489*	*6 199*	*6 353*
Whitefin wolf-herring	**Chirocentre sabre**		**Arencón de aleta blanca**		***Chirocentrus nudus***				**1,21(11)002,02**	**CNU**
51 Iran	4 200	4 313	5 137	5 058	6 302	3 824	4 737	5 168	5 920	8 014
Saudi Arabia	23	21	48	40	37	70	21	43	29	19
51 Fishing area total	*4 223*	*4 334*	*5 185*	*5 098*	*6 339*	*3 894*	*4 758*	*5 211*	*5 949*	*8 033*
Species total	*4 223*	*4 334*	*5 185*	*5 098*	*6 339*	*3 894*	*4 758*	*5 211*	*5 949*	*8 033*
Wolf-herrings nei	**Chirocentres nca**		**Arencones nep**		***Chirocentrus spp***				**1,21(11)002,XX**	**DOS**
51 India	7 646	12 834	6 902	6 503	8 829	10 523	12 898	9 403	9 443	9 329
51 Fishing area total	*7 646*	*12 834*	*6 902*	*6 503*	*8 829*	*10 523*	*12 898*	*9 403*	*9 443*	*9 329*
57 India	9 536	9 037	9 441	10 147	10 258	10 411	28 256	28 067	27 948	28 944
Indonesia	6 851	5 695	8 350	4 791	6 234	8 178	8 319	7 968	7 643	5 654
Malaysia	1 382	1 003	1 005	1 003	954	1 390	1 273	1 222	1 563	1 047
57 Fishing area total	*17 769*	*15 735*	*18 796*	*15 941*	*17 446*	*19 979*	*37 848*	*37 257*	*37 154*	*35 645*
71 Indonesia	22 946	30 051	33 482	25 234	24 678	14 146	22 532	12 774	9 291	10 600
Malaysia	2 607	2 820	3 402	3 850	3 272	3 684	3 591	4 159	3 738	4 696
Philippines	443	508	548	436	338	340	327	383	430	444
Singapore	30	28	22	22	20	48	61	17	43	37
71 Fishing area total	*26 026*	*33 407*	*37 454*	*29 542*	*28 308*	*18 218*	*26 511*	*17 333*	*13 502*	*15 777*
Species total	*51 441*	*61 976*	*63 152*	*51 986*	*54 583*	*48 720*	*77 257*	*63 993*	*60 099*	*60 751*
Clupeoids nei	**Clupéoidés nca**		**Clupeoideos nep**		***Clupeoidei***				**1,21(XX)XXX,XX**	**CLU**
27 France	1 086	1 337	-	-	-	-	-	-	5	-
Ireland	-	-	112	543	-	-	0	0	-	-
Portugal	-	-	-	-	6	6	-	-	-	-
Spain	19 986	8 464	169	6	2	532	613	879	961	852
27 Fishing area total	*21 072*	*9 801*	*281*	*549*	*8*	*538*	*613*	*879*	*966*	*852*
31 Bermuda	21	42	40	37	40	39	39	36	37	26
Martinique	4 000	4 000	4 000	4 000	3 500 F	4 000	4 000	4 000	4 000 F	3 230 F
Mexico	6	91	7	71	288	300	-	-	-	-
Puerto Rico	17	15	14	11	10	5	5	7	6	7
Trinidad Tob	178	47	22	12	11	4	4	2	41	5
USA	13	13	327	415	382	375	492	684	622	412
31 Fishing area total	*4 235*	*4 208*	*4 410*	*4 546*	*4 231 F*	*4 723*	*4 540*	*4 729*	*4 706 F*	*3 680 F*
34 Eq Guinea	2 000 F	2 000 F	2 000 F	2 000 F	2 250 F	2 500 F	2 750 F	3 000	3 000	3 050
Ghana	1 824	2 126	2 774	49	445	76	443	-	-	-
Latvia	-	-	8 040	3 433	-	-	-	-	-	-
Liberia	208	210	210	386	216	364	...	1	1 F	1 F
Sao Tome Prn	23 F	22 F	21	19	20 F	20 F	20 F	20 F	20 F	20 F
Spain	-	1	0	2	11	-	859	144	239	82
Togo	0	-	-	-	-	-	-	-	-	-
Ukraine	-	-	-	-	-	95	-	-	-	-
34 Fishing area total	*4 055 F*	*4 359 F*	*13 045 F*	*5 889 F*	*2 942 F*	*3 055 F*	*4 072 F*	*3 165 F*	*3 260 F*	*3 153 F*
37 Algeria	1 074	1 541	2 006	-	-	-	1 449	1 623	1 107	6 689
Lebanon	500	650	600	600	580	580	580 F	580 F	580 F	580 F
Malta	-	-	-	-	-	-	3	7	5	1
Spain	195	975	822	-	95	181	330	275	193	112
37 Fishing area total	*1 769*	*3 166*	*3 428*	*600*	*675*	*761*	*2 362 F*	*2 485 F*	*1 885 F*	*7 382 F*
41 Brazil	26 978	25 930	18 357	19 797	15 923	17 350	18 190	16 780	18 508	17 477
41 Fishing area total	*26 978*	*25 930*	*18 357*	*19 797*	*15 923*	*17 350*	*18 190*	*16 780*	*18 508*	*17 477*
51 India	34 325	39 217	35 733	32 250	42 603	42 387	42 102	40 310	37 137	32 409
Iran	1 207	801	709	567	440	469	674	310	903	586
Kenya	164	101	119	108	112	138	147	142	121	139
Pakistan	24 306	24 500	23 700	19 470	16 382	16 854	16 234	16 254	14 818	17 323
Réunion	4	9	8	8	5	8	10	0	5 F	5 F
Saudi Arabia	267	210	159	155	165	146	243	332	396	196
Zanzibar	3 202	3 772	4 882	4 055	5 267	3 110	2 374	2 405	2 446	2 473
51 Fishing area total	*63 475*	*68 610*	*65 310*	*56 613*	*64 974*	*63 112*	*61 784*	*59 753*	*55 826 F*	*53 131 F*
57 Australia	8 525	14 460	25 005	36 065	48 918	31 484	32 952	33 121	31 510	40 736
India	34 618	30 959	22 323	22 502	19 984	20 231	45 436	51 018	52 500	55 726
Malaysia	4 275	4 238	3 866	4 517	5 509	6 851	3 666	4 153	4 798	3 672
Sri Lanka	49 270	52 310	56 390	54 410	24 870	56 230	63 520	66 890	71 580	74 310
57 Fishing area total	*96 688*	*101 967*	*107 584*	*117 494*	*99 281*	*114 796*	*145 574*	*155 182*	*160 388*	*174 444*
61 China,Taiwan	4 393	4 581	5 516	5 030	4 511	2 679	4 213	1 025	1 016	731
Japan	58 286	62 694	67 621	47 325	62 507	48 111	65 315	69 754	56 962	69 200 F
61 Fishing area total	*62 679*	*67 275*	*73 137*	*52 355*	*67 018*	*50 790*	*69 528*	*70 779*	*57 978*	*69 931 F*

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Herrings, sardines, anchovies
Harengs, sardines, anchois
Arenques, sardinas, anchoas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
71 Australia	-	-	-	-	6	2	-	-	-	-
Kiribati	2 079	3 619	375	310 F	245 F	175 F	108	13	1	...
Malaysia	36 475	36 373	36 964	37 140	36 734	47 569	40 223	36 162	31 159	29 735
Philippines	736	750	776	554	393	469	504	505	592	601
Singapore	73	63	25	14	7	13	2	1	1	1
71 Fishing area total	*39 363*	*40 805*	*38 140*	*38 018 F*	*37 385 F*	*48 228 F*	*40 837*	*36 681*	*31 753*	*30 337*
77 Costa Rica	2 207	4 170	2 624	2 096	2 184	2 190 F	2 201	2 200 F	2 200 F	2 200 F
Mexico	15	318	189	201	17 628	20 022	980	1 576	1 688	1 721
Nicaragua	...	...	...	...	...	88	41	71	116	225
77 Fishing area total	*2 222*	*4 488*	*2 813*	*2 297*	*19 812*	*22 300 F*	*3 222*	*3 847 F*	*4 004 F*	*4 146 F*
81 Australia	40	42	290	607	1 392	2 181	...	525	148	0
New Zealand	11	3	14	21	14	2	1	1	1	-
Ukraine	-	-	-	9	...	-	-	-	-	-
81 Fishing area total	*51*	*45*	*304*	*637*	*1 406*	*2 183*	*1*	*526*	*149*	*0*
87 Colombia	2 708	454	-	-	-	-	-	-	-	-
Ghana	4 320	-	-	-	-	-	-	-	-	-
87 Fishing area total	*7 028*	*454*	-	-	-	-	-	-	-	-
Species total	*329 615 F*	*331 108 F*	*326 809 F*	*298 795 F*	*313 655 F*	*327 836 F*	*350 723 F*	*354 806 F*	*339 423 F*	*364 533 F*
Group total	***20 444 220***	***22 099 656***	***18 662 942***	***22 901 964***	***22 219 557***	***19 077 167***	***19 933 146***	***20 256 090***	***19 983 507***	***17 096 817***

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Atlantic bonito	**Bonite à dos rayé**		**Bonito del Atlántico**		***Sarda sarda***				**1,75(01)001,01**	**BON**
21 USA	38	16	22	29	40	19	45	19	35	22
21 Fishing area total	*38*	*16*	*22*	*29*	*40*	*19*	*45*	*19*	*35*	*22*
27 France	42	18	17	28	34	48	121	58	25	208
Portugal	47	55	40	53	37	310	277	191	124	511
27 Fishing area total	*89*	*73*	*57*	*81*	*71*	*358*	*398*	*249*	*149*	*719*
31 Br Virgin Is	2	2	1	3	2 F	0	-	-	-	-
Dominica	-	-	-	-	6	16	15	9	4	...
Grenada	10	10	3	15	3	9	8	7	6	4
Martinique	530 F	530 F	...	...	...	...	...	...	...	...
Mexico	1 506	1 401	1 509	1 500	1 251	1 306	1 067	1 072	1 469	1 294
NethAntilles	...	...	...	...	...	...	...	...	...	524
St Lucia	0	0	0	-	-	-	-	-	-	-
St Vincent	-	-	15	18	-	16	23	27	15	6
Trinidad Tob	56	452	188	280	80	7	16	38	68	69
USA	10	5	5	3	5	4	7	8	4	6
Venezuela	...	61	13	13 F	16	18	19	12	38	10
31 Fishing area total	*2 114 F*	*2 461 F*	*1 734*	*1 832 F*	*1 363 F*	*1 376*	*1 155*	*1 173*	*1 604*	*1 913*
34 Congo Rep	...	...	34	42	50	198	223	...	156	178
Côte dIvoire	...	...	31	16	88	16	119	110 F	80	755
Germany	51	38	-	-	-	7	-	-	-	-
Greece	-	-	1	-	-	-	-	-	-	-
Ireland	-	-	188	48	-	-	-	-	56	125
Latvia	396	639	462	218	382	621	641	730	1 502	1 019
Lithuania	-	793	625	571	149	505	247	232	923	3 998
Morocco	1 700	2 063	937	1 024	1 431	1 671	1 053	1 419	2 523	3 421
Netherlands	1 791	1 793	530	742	429	336	344	538	539	612
NethAntilles	...	...	...	...	...	...	...	...	...	15
Poland	521	79	-	-	-	-	-	-	23	16
Portugal	-	6	0	0	-	0	3	-	-	-
Russian Fed	538	1 431	445	16	79	319	259	106	368	1 042
Senegal	545	621	195	183	483	729	1 020	1 155	2 545	1 768
Sierra Leone	245	44	102	1 151	671	192	150	156	150 F	150 F
Spain	10	5	22	9	1	15	13	13	36	45
Togo	663	846	1 733	1 583	1 216	2 298	350	1 170 F	2 000	329
Ukraine	274	913	45	48	45	66	128	23	146	-
UK	-	-	-	-	-	35	60	7	30	71
34 Fishing area total	*6 734*	*9 271*	*5 350*	*5 651*	*5 024*	*7 008*	*4 610*	*5 659 F*	*11 077 F*	*13 544 F*
37 Albania	30	24	4	2	23	30	19	27	21	23
Algeria	350	597	839	609	575	684	910	1 042	976	1 010
Bulgaria	49	-	23	18	56	8	1	16	5	16
Croatia	54	28	30	32	102	78	85	27	41	59
Cyprus	-	-	-	-	-	-	6	5	4	6
France	28	27	22	15	6	9	15	34	24	24
Greece	1 550	1 420	1 538	1 321	1 390	845	1 123	587	476	531
Italy	1 006	944	2 091	2 009	1 356	1 544	1 665	1 371	1 302	1 350
Malta	1	0	0	1	-	-	2	7	5	6
Morocco	19	61	85	78	38	89	87	142	131	57
Romania	-	-	-	-	-	0	0	-	-	-
Serbia-Monte	17	16	18	16	...	-	-	-	-	-
Slovenia	-	1	1	-	0	1	1	0	2	1
Spain	349	461	544	272	215	429	531	459	247	517
Tunisia	1 183	1 112	848	1 251	1 666	1 970	1 961	1 532	1 451	1 779
Turkey	13 460	6 286	5 999	5 701	70 797	29 690	5 965	6 448	7 036	9 401
37 Fishing area total	*18 096*	*10 977*	*12 042*	*11 325*	*76 224*	*35 377*	*12 371*	*11 697*	*11 721*	*14 780*
41 Argentina	235	1	129	269	110	180	34	7	220	59
Brazil	...	...	...	...	90	353	334	333	367	347
Portugal	-	-	-	-	-	-	37	20	-	-
Uruguay	23	15	0	0	0	0	0	0	-	-
41 Fishing area total	*258*	*16*	*129*	*269*	*200*	*533*	*405*	*360*	*587*	*406*
47 Angola	1 157	118	762	...	138	900	931	...	1 979	990
Portugal	-	-	-	-	-	-	3	3	-	-
Russian Fed	36	10	16	-	-	-	-	-	-	-
47 Fishing area total	*1 193*	*128*	*778*	*...*	*138*	*900*	*934*	*3*	*1 979*	*990*
Species total	*28 522 F*	*22 942 F*	*20 112*	*19 187 F*	*83 060 F*	*45 571*	*19 918*	*19 160 F*	*27 152 F*	*32 374 F*
Striped bonito	**Bonite oriental**		**Bonito mono**		***Sarda orientalis***				**1,75(01)001,02**	**BIP**
51 Oman	287	378	587	869	620	679	693	582	162	181
Réunion	-	-	25	25	-	-	-	-	-	-
51 Fishing area total	*287*	*378*	*612*	*894*	*620*	*679*	*693*	*582*	*162*	*181*
57 Indonesia	...	...	...	...	18	47	98	175	117	97
57 Fishing area total	*...*	*...*	*...*	*...*	*18*	*47*	*98*	*175*	*117*	*97*
71 Indonesia	...	...	...	7	...	7	68	187	348	323
71 Fishing area total	*...*	*...*	*...*	*7*	*...*	*7*	*68*	*187*	*348*	*323*
87 Ecuador	...	...	...	...	...	49	13	437	11	10
87 Fishing area total	*...*	*...*	*...*	*...*	*...*	*49*	*13*	*437*	*11*	*10*

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*287*	*378*	*612*	*901*	*638*	*782*	*872*	*1 381*	*638*	*611*
Eastern Pacific bonito	**Bonite du Pacifique oriental**		**Bonito del Pacífico oriental**		***Sarda chiliensis***				**1,75(01)001,04**	**BEP**
77 Mexico	146	250	146	145	171	179	18 196	7 380	7 699	13 402
USA	6	33	22	354	10	2 491	222	803	2 133	18
77 Fishing area total	*152*	*283*	*168*	*499*	*181*	*2 670*	*18 418*	*8 183*	*9 832*	*13 420*
87 Chile	19	0	24	8	11	3	4	10	36	8
Colombia	13	...	...	...	...	...	...	...	...	...
Peru	1 287	865	2 191	1 488	3 093	13 365	9 706	42 871	30 648	13 144
Venezuela	-	-	-	-	-	261	4	33	-	-
87 Fishing area total	*1 319*	*865*	*2 215*	*1 496*	*3 104*	*13 629*	*9 714*	*42 914*	*30 684*	*13 152*
Species total	*1 471*	*1 148*	*2 383*	*1 995*	*3 285*	*16 299*	*28 132*	*51 097*	*40 516*	*26 572*
Plain bonito	**Palomette**		**Tasarte**		***Orcynopsis unicolor***				**1,75(01)006,01**	**BOP**
27 Portugal	-	2	6	9	5	3	1	2	4	3
27 Fishing area total	*-*	*2*	*6*	*9*	*5*	*3*	*1*	*2*	*4*	*3*
34 Ireland	-	-	-	-	24	-	-	-	-	-
Morocco	838	803	708	503	644	1 232	804	391	273	199
Portugal	-	1	1	65	-	-	-	-	7	19
Senegal	28	5	6	70	78	28	240	33	158	53
34 Fishing area total	*866*	*809*	*715*	*638*	*746*	*1 260*	*1 044*	*424*	*438*	*271*
37 Algeria	145	128	...	...	...	...	...	...	27	7
Morocco	9	9	20	10	3	1	172	107	6	14
Portugal	-	-	-	-	1	-	-	-	-	-
Tunisia	-	-	3	1	3	2	-	-	2	8
37 Fishing area total	*154*	*137*	*23*	*11*	*7*	*3*	*172*	*107*	*35*	*29*
Species total	*1 020*	*948*	*744*	*658*	*758*	*1 266*	*1 217*	*533*	*477*	*303*
Wahoo	**Thazard-bâtard**		**Peto**		***Acanthocybium solandri***				**1,75(01)010,01**	**WAH**
21 USA	1	1	1	2	2	1	3	2	1	1
21 Fishing area total	*1*	*1*	*1*	*2*	*2*	*1*	*3*	*2*	*1*	*1*
31 Aruba	60	60 F	55 F	50	50 F	50	50	50	45	45
Barbados	26	44	34	45	26	41	36	34	17	30
Bermuda	56	91	87	88	83	86	124	117	101	81
Dominica	11	37	10	6	12	16	15	16	11	13
Dominican Rp	37	...	193	51	148	75	63	86	77	218
Grenada	71	59	44	60	42	59	70	56	80	61
NethAntilles	230 F	230 F	...	...	...	...	...	...	...	...
Panama	-	-	-	-	-	91	240	120	86	111
Puerto Rico	6	1	2	3	3	4	2	2	4	7
St Kitts Nev	...	...	7	6	7	6 F	5 F	3 F	1 F	0
St Lucia	213	243	169	238	169	187	211	180	195	199
St Vincent	311	17	40	60	...	241	28	24	31	40
Spain	-	-	-	253	6	10	-	-	1	-
Trinidad Tob	1	9	7	7	5	6	6	6	5	5
USA	56	63	73	80	64	68	65	53	63	18
US Virgin Is	...	...	30	12	15	10	5	7	5	8
Venezuela	17	13	9	7	15	13	33	9	25	28
31 Fishing area total	*1 095 F*	*867 F*	*760 F*	*966*	*645 F*	*963 F*	*953 F*	*763 F*	*747 F*	*864*
34 Cape Verde	578	500	343	458	45	537	454	811	273	470
Eq Guinea	-	-	-	-	-	-	-	-	1	...
Mauritania	...	...	...	...	...	...	...	...	...	52
Morocco	-	-	-	-	-	-	-	-	-	71
Portugal	-	-	-	1	-	2	0	-	2	9
St Vincent	-	-	-	-	-	-	1	-	-	-
Sao Tome Prn	52	52	52	94	88	76	76 F	131	235	241
Senegal	-	-	5	0	0	1	0	-	2	6
Spain	38	46	48	47	214	55	65	38	72	48
Ukraine	14	18	-	-	-	-	-	-	-	-
34 Fishing area total	*682*	*616*	*448*	*600*	*347*	*671*	*596 F*	*980*	*585*	*897*
37 Morocco	-	-	-	-	-	-	-	-	-	5
37 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*5*
41 Brazil	...	0	403	519	449	113	76	77	70	19
41 Fishing area total	*...*	*0*	*403*	*519*	*449*	*113*	*76*	*77*	*70*	*19*
47 St Helena	20	25	18	17	11	20	13	18	29	19
Spain	-	-	-	5	17	44	1	-	-	4
47 Fishing area total	*20*	*25*	*18*	*22*	*28*	*64*	*14*	*18*	*29*	*23*
51 Belize	-	-	-	-	3	-	-	-	11	6
Br Ind Oc Tr	-	-	-	-	-	-	-	6	-	17
France	-	-	-	-	-	-	-	-	3	1
India	389	434	432	350	349	431	441	444	412	354
Mayotte	65	88	133	71	...	...	...	...	...	...
Réunion	60	73	68	46	49	38	41	42	36	36 F
Seychelles	1	3	3	5	4	3	5	3	1	2
Spain	-	0	0	-	0	2	1	1	1	1

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Other nei	-	0	0	0	4	0	0	-	0	0
51 Fishing area total	*515*	*598*	*636*	*472*	*409*	*474*	*488*	*496*	*464*	*417 F*
57 Australia	9	6	3	0	0	0	1	0	0	0
Belize	-	-	-	-	1	-	-	-	-	-
India	250	279	278	225	225	279	288	287	267	232
Indonesia	12	13	84	101	53	88	48	2	2	2
Sri Lanka	196	261	246	114	156	357	163	157	178	560
Other nei	-	0	0	0	1	0	0	-	0	0
57 Fishing area total	*467*	*559*	*611*	*440*	*436*	*724*	*500*	*446*	*447*	*794*
71 Australia	9	13	29	16	9	26	67	36	42	35
Fiji	167	100 F	10	72	85 F	97	71	180	200	500
Guam	60	36	32	60	22	53	22	49	65	16
N Marianas	2	4	4	3	1	1	1	1	2	1
Palau	2	1	11	0	0	...	...	0	0	0
71 Fishing area total	*240*	*154 F*	*86*	*151*	*117 F*	*177*	*161*	*266*	*309*	*552*
77 Amer Samoa	47	108	166	203	207	278	198	135	136	125
Fr Polynesia	259	291	260 F	231	397	377	384	265	214	351
USA	1	298	445	384	371	406	325	385	276	273
77 Fishing area total	*307*	*697*	*871 F*	*818*	*975*	*1 061*	*907*	*785*	*626*	*749*
81 Australia	1	2	3	2	2	2	1	0	1	0
New Zealand	-	-	1	0	0	-	-	-	0	-
81 Fishing area total	*1*	*2*	*4*	*2*	*2*	*2*	*1*	*0*	*1*	*0*
87 Ecuador	...	...	...	...	...	99	211	95	115	1
87 Fishing area total	*...*	*...*	*...*	*...*	*...*	*99*	*211*	*95*	*115*	*1*
Species total	*3 328 F*	*3 519 F*	*3 838 F*	*3 992*	*3 410 F*	*4 349 F*	*3 910 F*	*3 928 F*	*3 394 F*	*4 322 F*
Dogtooth tuna	**Bonite à gros yeux**		**Casarte ojón**		***Gymnosarda unicolor***				**1,75(01)012,02**	**DOT**
51 France	-	-	-	-	-	-	-	-	-	2
Maldives	647	789	746	615	542	512	499	571	633	636
Réunion	-	-	16	12	11	10	3	0	2 F	2 F
Saudi Arabia	82	31	46	80	70	131	72	89	92	92
51 Fishing area total	*729*	*820*	*808*	*707*	*623*	*653*	*574*	*660*	*727 F*	*732 F*
Species total	*729*	*820*	*808*	*707*	*623*	*653*	*574*	*660*	*727 F*	*732 F*
Narrow-barred Spanish mackerel	**Thazard rayé indo-pacifique**		**Carite estriado Indo-Pacífico**		***Scomberomorus commerson***				**1,75(01)015,03**	**COM**
37 Israel	...	...	...	...	...	...	...	...	89	47
37 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*89*	*47*
51 Bahrain	109	121	130	170	80	77	54	169	84	45
Egypt	374	418	449	4 931	721	294	405	181	174	349
Eritrea	280	177	95	134	27	88	399	496	573	414
France	-	-	-	-	-	-	-	-	-	1
India	19 869	22 173	22 086	17 901	17 850	22 052	22 492	22 602	21 012	18 072
Iran	6 071	8 557	8 145	7 079	6 164	8 778	9 658	10 292	7 690	10 884
Jordan	1	1	1	1	2	2	2	2	7	7
Kenya	136	150	215	151	124	145	197	212	268	419
Kuwait	204	136	66	136	90	88	73	48	60 F	60 F
Madagascar	6 523	6 066	7 052	5 834	6 254	6 984	6 241	6 577	6 577	6 577
Oman	2 785	2 088	2 764	3 198	3 372	2 932	3 158	3 760	3 766	4 060
Pakistan	8 455	7 922	8 543	8 754	7 218	7 049	7 411	7 432	7 577	8 430
Qatar	1 019	963	1 945	1 511	1 882	2 037	1 811	2 563	1 750	2 107
Saudi Arabia	6 399	5 381	6 023	5 365	5 547	5 386	4 961	4 356	4 802	3 728
South Africa	49	7	10	2	3	9	12	9	9	3
Sudan	34	34	34 F	34 F	34 F	34 F	34 F	34 F	34	34 F
Untd Arab Em	7 650	3 824	5 655	5 093	4 610	4 600	4 000 F	3 303	4 872	8 745
Yemen	2 006	1 925	1 844	1 764	1 800	1 671	1 543	2 822	3 050 F	3 300 F
51 Fishing area total	*61 964*	*59 943*	*65 057 F*	*62 058 F*	*55 778 F*	*62 226 F*	*62 451 F*	*64 858 F*	*62 305 F*	*67 235 F*
57 Australia	490	468	491	432	312	261	325	323	284	284
India	11 693	13 049	12 998	10 536	10 504	12 978	13 237	13 302	12 365	10 636
Indonesia	19 942	17 603	18 361	21 990	19 435	21 993	24 367	30 379	29 359	29 359
Sri Lanka	2 880	2 863	2 842	2 512	1 234	2 462	2 537	2 752	3 016	4 042
57 Fishing area total	*35 005*	*33 983*	*34 692*	*35 470*	*31 485*	*37 694*	*40 466*	*46 756*	*45 024*	*44 321*
61 China,Taiwan	4 153	6 613	6 421	3 382	2 533	1 255	1 385	1 471	1 059	1 196
61 Fishing area total	*4 153*	*6 613*	*6 421*	*3 382*	*2 533*	*1 255*	*1 385*	*1 471*	*1 059*	*1 196*
71 Australia	251	-	-	-	0	208	161	109	70	82
Fiji	2 120	1 200 F	159	306	350 F	396	469	300	250	300
Indonesia	59 625	68 015	77 307	92 494	106 723	89 811	96 032	103 187	99 267	117 700
Palau	1	0	0	7	0	...	...	...	...	...
Philippines	9 085	9 030	9 431	9 793	14 302	17 006	21 914	19 005	17 192	18 992
71 Fishing area total	*71 082*	*78 245 F*	*86 897*	*102 600*	*121 375 F*	*107 421*	*118 576*	*122 601*	*116 779*	*137 074*
Species total	*172 204*	*178 784 F*	*193 067 F*	*203 510 F*	*211 171 F*	*208 596 F*	*222 878 F*	*235 686 F*	*225 256 F*	*249 873 F*
Indo-Pacific king mackerel	**Thazard ponctué indo-pacifique**		**Carite del Indo-Pacífico**		***Scomberomorus guttatus***				**1,75(01)015,04**	**GUT**
51 India	10 272	11 464	11 419	9 255	9 228	11 401	11 628	11 687	10 864	9 343
Iran	2 474	4 031	3 695	4 279	3 087	4 050	3 797	4 078	2 669	3 170

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Kuwait	134	175	101	125	97	73	58	57	55 F	55 F
Madagascar	78	77	48	77	83	71	131	173	173	173
Saudi Arabia	320	505	437	422	824	1 310	1 106	963	1 009	750
Yemen	329	316	303	289	300	150	149	85 F	92 F	100 F
51 Fishing area total	*13 607*	*16 568*	*16 003*	*14 447*	*13 619*	*17 055*	*16 869*	*17 043 F*	*14 862 F*	*13 591 F*
57 India	6 312	7 044	7 017	5 687	5 670	7 005	7 145	7 180	6 675	5 742
Indonesia	4 719	4 741	5 531	7 308	7 049	8 629	9 560	11 918	11 519	11 519
57 Fishing area total	*11 031*	*11 785*	*12 548*	*12 995*	*12 719*	*15 634*	*16 705*	*19 098*	*18 194*	*17 261*
61 China,Taiwan	1 395	992	1 003	1 171	1 054	509	433	355	257	336
61 Fishing area total	*1 395*	*992*	*1 003*	*1 171*	*1 054*	*509*	*433*	*355*	*257*	*336*
71 Indonesia	13 705	14 056	14 606	16 439	13 449	13 521	14 126	11 251	12 655	12 295
71 Fishing area total	*13 705*	*14 056*	*14 606*	*16 439*	*13 449*	*13 521*	*14 126*	*11 251*	*12 655*	*12 295*
Species total	*39 738*	*43 401*	*44 160*	*45 052*	*40 841*	*46 719*	*48 133*	*47 747 F*	*45 968 F*	*43 483 F*
Streaked seerfish	**Thazard cirrus**		**Carite rayado**		***Scomberomorus lineolatus***				**1,75(01)015,05**	**STS**
51 India	1 896	2 115	2 107	1 707	1 702	2 103	2 145	2 156	2 004	1 724
51 Fishing area total	*1 896*	*2 115*	*2 107*	*1 707*	*1 702*	*2 103*	*2 145*	*2 156*	*2 004*	*1 724*
57 India	1 132	1 263	1 257	1 019	1 016	1 256	1 280	1 288	1 197	1 029
57 Fishing area total	*1 132*	*1 263*	*1 257*	*1 019*	*1 016*	*1 256*	*1 280*	*1 288*	*1 197*	*1 029*
Species total	*3 028*	*3 378*	*3 364*	*2 726*	*2 718*	*3 359*	*3 425*	*3 444*	*3 201*	*2 753*
King mackerel	**Thazard barré**		**Carite lucio**		***Scomberomorus cavalla***				**1,75(01)015,06**	**KGM**
21 USA	232	163	145	21	47	26	141	30	29	4
21 Fishing area total	*232*	*163*	*145*	*21*	*47*	*26*	*141*	*30*	*29*	*4*
31 Dominica	2	...	...	...	1	1	0	0	0	...
Dominican Rp	261	653	452	225	173	180	145	317	285	802
Grenada	4	6	4	9	6	6	4	4	2	5
Guyana	239	267	390	312	245	168	326	174	91	132
Mexico	5 119	5 720	4 369	6 634	4 616	4 821	4 048	4 921	3 473	4 720
Puerto Rico	68	62	65	39	43	32	23	23	26	30
St Vincent	...	...	...	...	...	...	...	...	7	9
Trinidad Tob	410	1 457	801	577	747	660	567	1 043	1 001	815
USA	1 962	1 865	2 209	2 468	2 460	2 810	2 621	2 981	3 512	2 982
Venezuela	1 861	2 324	3 052	4 820 F	2 580 F	1 520 F	1 850 F	2 193 F	2 120 F	2 120 F
31 Fishing area total	*9 926*	*12 354*	*11 342*	*15 084 F*	*10 871 F*	*10 198 F*	*9 584 F*	*11 656 F*	*10 517 F*	*11 615 F*
41 Brazil	1 251	2 316	3 311	247	202	316	33	4 232	4 683	4 473
41 Fishing area total	*1 251*	*2 316*	*3 311*	*247*	*202*	*316*	*33*	*4 232*	*4 683*	*4 473*
Species total	*11 409*	*14 833*	*14 798*	*15 352 F*	*11 120 F*	*10 540 F*	*9 758 F*	*15 918 F*	*15 229 F*	*16 092 F*
Atlantic Spanish mackerel	**Thazard atlantique**		**Carite atlántico**		***Scomberomorus maculatus***				**1,75(01)015,07**	**SSM**
21 USA	363	337	245	124	178	123	133	165	342	356
21 Fishing area total	*363*	*337*	*245*	*124*	*178*	*123*	*133*	*165*	*342*	*356*
31 Mexico	5 320	6 123	5 242	6 895	6 450	5 735	5 424	6 870	4 543	6 001
USA	1 553	1 238	2 029	2 040	2 239	2 309	2 006	1 715	2 188	2 270
31 Fishing area total	*6 873*	*7 361*	*7 271*	*8 935*	*8 689*	*8 044*	*7 430*	*8 585*	*6 731*	*8 271*
Species total	*7 236*	*7 698*	*7 516*	*9 059*	*8 867*	*8 167*	*7 563*	*8 750*	*7 073*	*8 627*
Cero	**Thazard franc**		**Carite chinigua**		***Scomberomorus regalis***				**1,75(01)015,08**	**CER**
31 Dominican Rp	147	...	...	...	145	...	...	44	39	42
Puerto Rico	56	28	29	15	27	21	12	9	8	10
31 Fishing area total	*203*	*28*	*29*	*15*	*172*	*21*	*12*	*53*	*47*	*52*
Species total	*203*	*28*	*29*	*15*	*172*	*21*	*12*	*53*	*47*	*52*
Pacific sierra	**Thazard sierra (Pacifique)**		**Carite sierra**		***Scomberomorus sierra***				**1,75(01)015,09**	**SIE**
77 Korea Rep	-	-	-	-	2	-	-	-	-	-
Mexico	5 959	4 815	5 020	7 723	6 861	6 072	7 192	7 200	5 776	7 230
Nicaragua	36	77	56	104	56	19	62	58	40	58
Panama	971	1 027	5 545	511	1 399	1 119	1 339	3 038	3 239	2 935
77 Fishing area total	*6 966*	*5 919*	*10 621*	*8 338*	*8 318*	*7 210*	*8 593*	*10 296*	*9 055*	*10 223*
87 Colombia	379	361	...	232	179	370 F	560 F	750 F	947	851
Ecuador	...	...	...	...	...	754	145	103	25	17
Peru	181	288	341	191	138	155	91	219	326	407
87 Fishing area total	*560*	*649*	*341*	*423*	*317*	*1 279 F*	*796 F*	*1 072 F*	*1 298*	*1 275*
Species total	*7 526*	*6 568*	*10 962*	*8 761*	*8 635*	*8 489 F*	*9 389 F*	*11 368 F*	*10 353*	*11 498*
West African Spanish mackerel	**Thazard blanc**		**Carite lusitánico**		***Scomberomorus tritor***				**1,75(01)015,11**	**MAW**
34 Benin	203	185	506	462	370	378	302	183	686	605
Côte dIvoire	...	...	...	...	...	232	123	110 F	95	2
Gabon	-	265	-	-	0	0	...	...	...	...

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
GuineaBissau	4	39	30	30 F	31 F	30 F	30 F	30 F	30 F	30 F
Korea Rep	-	-	-	1	2	-	-	-	-	-
Lithuania	-	298	762	78	-	-	8	10	11	8
Mauritania	...	...	...	...	...	...	...	...	...	187
Netherlands	-	-	-	-	2	3	-	1	1	-
Panama	51	0	-	...	64	354	1	-	...	...
Russian Fed	4	-	15	-	-	1	-	-	-	-
Sao Tome Prn	6	6	6	21	12	13	13 F	91	94	96
Senegal	1 024	1 376	1 053	507	812	374	845	189	304	239
Togo	-	-	-	-	-	643	694	870 F	1 040	200
Ukraine	...	46	27	24	12	14	25	14	-	-
34 Fishing area total	*1 292*	*2 215*	*2 399*	*1 123 F*	*1 305 F*	*2 042 F*	*2 041 F*	*1 498 F*	*2 261 F*	*1 367 F*
Species total	*1 292*	*2 215*	*2 399*	*1 123 F*	*1 305 F*	*2 042 F*	*2 041 F*	*1 498 F*	*2 261 F*	*1 367 F*
Japanese Spanish mackerel	**Thazard oriental**		**Carite oriental**		***Scomberomorus niphonius***				**1,75(01)015,12**	**NPH**
61 China,Taiwan	11 497	12 565	14 509	11 166	9 315	10 474	15 465	2 017	2 491	3 576
Japan	9 056	8 936	8 488	9 568	10 412	13 727	18 095	15 718	13 925	14 200 F
Korea Rep	25 513	25 956	22 608	26 622	33 794	36 484	42 199	40 809	39 793	35 778
61 Fishing area total	*46 066*	*47 457*	*45 605*	*47 356*	*53 521*	*60 685*	*75 759*	*58 544*	*56 209*	*53 554 F*
Species total	*46 066*	*47 457*	*45 605*	*47 356*	*53 521*	*60 685*	*75 759*	*58 544*	*56 209*	*53 554 F*
Serra Spanish mackerel	**Thazard serra**		**Serra**		***Scomberomorus brasiliensis***				**1,75(01)015,15**	**BRS**
31 Grenada	0	...	1	2	5	1	1	1	2	1
Guyana	329	441	389	494	521	377	277	312	141	226
Trinidad Tob	2 207	2 472	1 867	2 102	2 720	1 778	1 414	1 472	1 498	1 220
Venezuela	3 062	2 337	3 372	5 330 F	2 850 F	1 700 F	2 070 F	2 460 F	2 370 F	2 370 F
31 Fishing area total	*5 598*	*5 250*	*5 629*	*7 928 F*	*6 096 F*	*3 856 F*	*3 762 F*	*4 245 F*	*4 011 F*	*3 817 F*
41 Brazil	251	3 071	2 881	814	471	1 432	563	407	449	424
41 Fishing area total	*251*	*3 071*	*2 881*	*814*	*471*	*1 432*	*563*	*407*	*449*	*424*
Species total	*5 849*	*8 321*	*8 510*	*8 742 F*	*6 567 F*	*5 288 F*	*4 325 F*	*4 652 F*	*4 460 F*	*4 241 F*
Seerfishes nei	**Thazards nca**		**Carites nep**		***Scomberomorus spp***				**1,75(01)015,XX**	**KGX**
31 Br Virgin Is	1	1	1	1	1 F	0	-	-	-	-
Colombia	0	26	1 110	139	34	60 F	85 F	120 F	140	116
Cuba	184	263	197	103	88	139	167	185	227	169
Fr Guiana	...	...	...	...	3	20	20	22	14	15 F
Nicaragua	154	116	136	79	34	17	47	9	4	11
St Lucia	7	29	2	1	2	1	2	0	1	3
St Vincent	0	0	0	0	-	0	0	-	-	-
Suriname	...	...	385	365	601	...	...	...	...	...
US Virgin Is	...	...	10	13	15	15	11	3	2	3
31 Fishing area total	*346*	*435*	*1 841*	*701*	*778 F*	*252 F*	*332 F*	*339 F*	*388*	*317 F*
41 Brazil	...	...	...	...	...	...	...	9 187	10 133	9 573
41 Fishing area total	...	...	...	...	...	...	...	*9 187*	*10 133*	*9 573*
51 Comoros	250	350	500	500	600	600 F	600 F	799	799 F	799 F
Djibouti	60 F	60 F	60 F	60 F	42	299	271	99	82	82 F
Korea Rep	17	8	19	-	14	5	-	-	3	-
Réunion	-	-	2	2	2	2	2	0	1 F	1 F
South Africa	2	4	-	-	-	-	-	-	-	-
Tanzania	711	1 014	450	652	757	783	1 002	1 156	1 164	1 190
Untd Arab Em	2 870	...	...	...	...	...	...	...	...	...
Zanzibar	711	1 014	450	652	757	783	1 002	1 156	1 164	1 171
51 Fishing area total	*4 621 F*	*2 450 F*	*1 481 F*	*1 866 F*	*2 172*	*2 472 F*	*2 877 F*	*3 210*	*3 213 F*	*3 243 F*
57 Australia	55	3	0	6	508	1 897	...	...	...	972
Bangladesh	500 F	1 000 F	1 500 F	1 932	1 143	2 738	2 316	1 559	1 548	2 350
Malaysia	3 259	4 150	4 115	3 653	2 814	3 349	3 028	2 980	3 035	4 353
Sri Lanka	3	1	-	-	-	-	-	-	190	220
Thailand	4 861	6 275	6 343	6 429	7 114	8 120	6 508	4 753	3 853	3 925
57 Fishing area total	*8 678 F*	*11 429 F*	*11 958 F*	*12 020*	*11 579*	*16 104*	*11 852*	*9 292*	*8 626*	*11 820*
61 China	406 686 F	430 659 F	334 576 F	323 159 F	356 493 F	333 650 F	455 135	434 179	429 057	476 208
China,H.Kong	1 650 F	1 600 F	1 500 F	1 600 F	1 550 F	1 470 F	1 470 F	1 510 F	1 520 F	1 610 F
China,Taiwan	1 433	2 022	1 979	2 850	2 944	3 279	2 337	1 686	1 401	1 589
61 Fishing area total	*409 769 F*	*434 281 F*	*338 055 F*	*327 609 F*	*360 987 F*	*338 399 F*	*458 942 F*	*437 375 F*	*431 978 F*	*479 407 F*
71 Korea Rep	1	2	-	-	9	-	-	-	-	-
Malaysia	11 647	10 438	14 790	12 548	9 258	10 473	10 216	11 530	9 010	12 142
NewCaledonia	3	24	14	3	3	13	42	25	57	20
Singapore	46	38	37	32	30	61	83	62	48	39
Thailand	8 684	10 418	12 712	19 806	20 828	18 137	15 501	6 449	6 964	6 707
71 Fishing area total	*20 381*	*20 920*	*27 553*	*32 389*	*30 128*	*28 684*	*25 842*	*18 066*	*16 079*	*18 908*
81 Korea Rep	2 079	1 327	897	647	1 298	860	4 315	5 828	5 414	3 768
81 Fishing area total	*2 079*	*1 327*	*897*	*647*	*1 298*	*860*	*4 315*	*5 828*	*5 414*	*3 768*
Species total	*445 874 F*	*470 842 F*	*381 785 F*	*375 232 F*	*406 942 F*	*386 771 F*	*504 160 F*	*483 297 F*	*475 831 F*	*527 036 F*

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Butterfly kingfish	**Thon papillon**		**Atún chauchera**		***Gasterochisma melampus***				**1,75(01)018,01**	**BUK**
81 New Zealand	47	30	17	11	9	14	13	6	16	13
81 Fishing area total	*47*	*30*	*17*	*11*	*9*	*14*	*13*	*6*	*16*	*13*
Species total	*47*	*30*	*17*	*11*	*9*	*14*	*13*	*6*	*16*	*13*
Frigate tuna	**Auxide**		**Melva**		***Auxis thazard***				**1,75(01)023,01**	**FRI**
31 NethAntilles	202	432	...	...	...	...	...	...	...	...
31 Fishing area total	*202*	*432*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*
34 Côte dIvoire	-	-	-	-	4	170	135	...	65	60
Eq Guinea	-	-	-	-	-	-	-	-	20	119
Guatemala	-	-	-	-	-	-	98	74	81	78
NethAntilles	787	278	505	474	...	150	106	485	364	...
Panama	-	-	-	394	975	970	1 349	411	439	425
Other nei	9 523	7 934	1 694	1 902	1 824	1 888	1 212	614	1 131	873
34 Fishing area total	*10 310*	*8 212*	*2 199*	*2 770*	*2 803*	*3 178*	*2 900*	*1 584*	*2 100*	*1 555*
71 Indonesia	...	...	...	14 970	43 003	34 271	90 708	79 763	97 700	80 844
71 Fishing area total	*...*	*...*	*...*	*14 970*	*43 003*	*34 271*	*90 708*	*79 763*	*97 700*	*80 844*
Species total	*10 512*	*8 644*	*2 199*	*17 740*	*45 806*	*37 449*	*93 608*	*81 347*	*99 800*	*82 399*
Bullet tuna	**Bonitou**		**Melva(=Melvera)**		***Auxis rochei***				**1,75(01)023,03**	**BLT**
71 Indonesia	...	...	...	...	9	539	361	582	460	191
71 Fishing area total	*...*	*...*	*...*	*...*	*9*	*539*	*361*	*582*	*460*	*191*
Species total	*...*	*...*	*...*	*...*	*9*	*539*	*361*	*582*	*460*	*191*
Frigate and bullet tunas	**Auxide et bonitou**		**Melva y melvera**		***Auxis thazard, A. rochei***				**1,75(01)023,XX**	**FRZ**
21 USA	3	1	2	-	0	0	0	1	1	0
21 Fishing area total	*3*	*1*	*2*	-	*0*	*0*	*0*	*1*	*1*	*0*
27 France	-	-	-	-	-	-	3	3	0	3
Portugal	208	166	231	683	790	863	829	385	436	656
Spain	13	1	24	29	42	...	11	629	1 070	925
27 Fishing area total	*221*	*167*	*255*	*712*	*832*	*863*	*843*	*1 017*	*1 506*	*1 584*
31 Grenada	1	0	0	1	2	1	1	0	0	1
Trinidad Tob	...	...	...	414	...	...	...	0	-	-
Venezuela	444	32	113	182	42	165	52	48	54	215
31 Fishing area total	*445*	*32*	*113*	*597*	*44*	*166*	*53*	*48*	*54*	*216*
34 Cape Verde	171	278	264	344	168	404	197	832	940	743
France	127	91	...	168	47	6	98	22	24	88
Ghana	-	-	-	-	-	151	-	-	-	-
Ireland	-	-	-	-	-	-	-	-	17	13
Lithuania	-	-	-	-	-	-	-	-	27	70
Morocco	418	441	184	553	61	48	135	179	9	19
Netherlands	-	-	-	-	63	115	9	150	90	30
Portugal	28	10	4	6	-	3	3	1	-	1
Russian Fed	1 028	760	172	156	202	28	6	36	161	337
Sao Tome Prn	200	200	200	234	215	290	290 F	275	282	290
Senegal	3	0	13	288	151	83	118	315	15	177
Spain	709	437	610	5	124	72	267	2	25	50
Togo	-	-	-	-	-	...	300	470 F	645	220
Ukraine	69	45	-	-	-	-	-	-	-	-
UK	-	-	-	-	-	-	-	6	6	0
34 Fishing area total	*2 753*	*2 262*	*1 447*	*1 754*	*1 031*	*1 200*	*1 423 F*	*2 288 F*	*2 241*	*2 038*
37 Algeria	230	481	588	391	547	586	477	1 134	805	969
Croatia	-	-	-	-	-	-	-	-	2	8
Greece	125	120	246	226	180	274	157	620	506	169
Italy	375	251	1 463	1 819	865	385	393	356	770	798
Malta	1	0	2	8	4	1	4	12	7	11
Morocco	256	621	246	326	50	199	35	83	336	525
Serbia-Monte	9	8	9	9	...	-	-	-	-	-
Spain	861	493	495	1 009	845	1 101	3 083	3 389	727	3 787
Syria	-	-	-	-	-	-	99	139	162	111
Tunisia	2 300	932	989	1 760	1	1	0	1 021	1 011	2 370
Turkey	...	...	...	284	1 020	1 031	993	836	1 873	1 081
37 Fishing area total	*4 157*	*2 906*	*4 038*	*5 832*	*3 512*	*3 578*	*5 241*	*7 590*	*6 199*	*9 829*
41 Brazil	98	1 117	860	413	532	604	203	149	313	204
41 Fishing area total	*98*	*1 117*	*860*	*413*	*532*	*604*	*203*	*149*	*313*	*204*
47 Angola	206	114	35	...	...	...	95	4	46	23
Russian Fed	25	8	6	-	-	-	-	-	-	-
47 Fishing area total	*231*	*122*	*41*	*...*	*...*	*...*	*95*	*4*	*46*	*23*
51 France	174	116	31	39	-	41	-	10	-	11
India	7 931	8 850	8 816	7 144	7 124	8 801	8 978	9 022	8 387	7 212
Iran	562	611	1 144	1 459	1 616	2 444	5 308	7 163	5 179	6 172
Jordan	5	5	4	4	5	4	5	6	9	6
Madagascar	1 032	1 057	594	1 249	887	694	754	628	628	628
Maldives	3 981	4 187	4 357	3 638	5 057	3 532	3 802	4 056	5 201	2 908
Oman	638	170	121	194	217	171	194	1 113	737	1 314

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Pakistan	52	31	35	42	58	45	52	56	62	75
Seychelles	10	7	37	94	208	231	131	168	22	12
Spain	201	406	132	192	377	344	77	57	31	23
Untd Arab Em	380	320	350	250	216	200	165 F	134	148	279
Yemen	38	41	44	47	50	52	53	30 F	32 F	35 F
Other nei	110	513	144	1	-	-	-	-	-	-
51 Fishing area total	*15 114*	*16 314*	*15 809*	*14 353*	*15 815*	*16 559*	*19 519 F*	*22 443 F*	*20 436 F*	*18 675 F*
57 India	3 136	3 500	3 485	2 825	2 817	3 480	3 550	3 568	3 315	2 852
Indonesia	28 030	24 842	26 014	31 271	27 740	31 420	34 810	43 400	41 941	41 941
Malaysia	...	...	...	...	...	...	...	...	...	1
Sri Lanka	1 960	4 595	3 183	3 234	1 702	2 260	3 015	2 427	3 038	9 064
Thailand	1 018	814	1 160	1 159	1 593	1 470	1 149	1 267	1 571	1 626
57 Fishing area total	*34 144*	*33 751*	*33 842*	*38 489*	*33 852*	*38 630*	*42 524*	*50 662*	*49 865*	*55 484*
61 China,Taiwan	2 089	2 298	3 539	5 259	5 462	4 095	2 378	5 039	7 334	4 745
Japan	37 234	37 234 F	264	323	23	2	5	9	10	5
61 Fishing area total	*39 323*	*39 532 F*	*3 803*	*5 582*	*5 485*	*4 097*	*2 383*	*5 048*	*7 344*	*4 750*
71 China,Taiwan	0	-	-	-	-	-	-	-	-	-
Japan	13	13 F	-	-	-	-	-	-	-	-
Malaysia	...	...	...	3 225	...	...	...	...	...	3 505
Philippines	111 719	163 132	179 086	208 108	173 960	175 348	191 472	156 341	152 338	149 567
Thailand	15 400	18 300	14 600	18 700	18 700	16 800	15 600	6 050	5 650	5 850
71 Fishing area total	*127 132*	*181 445 F*	*193 686*	*230 033*	*192 660*	*192 148*	*207 072*	*162 391*	*157 988*	*158 922*
81 New Zealand	5	5	1	3	12	0	1	0	0	0
81 Fishing area total	*5*	*5*	*1*	*3*	*12*	*0*	*1*	*0*	*0*	*0*
87 Ecuador	5 738	9 806	36 297	19 710	6 544	13 023	21 829	19 338	34 956	37 670
87 Fishing area total	*5 738*	*9 806*	*36 297*	*19 710*	*6 544*	*13 023*	*21 829*	*19 338*	*34 956*	*37 670*
Species total	*229 364*	*287 460 F*	*290 194*	*317 478*	*260 319*	*270 868*	*301 186 F*	*270 979 F*	*280 949 F*	*289 395 F*
Little tunny(=Atl.black skipj)	**Thonine commune**		**Bacoreta**		***Euthynnus alletteratus***				**1,75(01)024,01**	**LTA**
21 USA	121	138	100	26	22	28	56	65	32	17
21 Fishing area total	*121*	*138*	*100*	*26*	*22*	*28*	*56*	*65*	*32*	*17*
27 France	-	-	-	-	-	-	-	-	92	4
Portugal	-	2	16	16	4	24	41	10	6	5
Spain	22	8	-	-	33	16	-	38	35	31
27 Fishing area total	*22*	*10*	*16*	*16*	*37*	*40*	*41*	*48*	*133*	*40*
31 Bermuda	1	5	4	5	7	5	5	4	3	4
Cuba	1	3	5	8	8	3	4	7	4	14
Grenada	-	-	-	-	-	-	-	-	0	1
NethAntilles	...	...	...	...	...	...	...	...	...	38
Puerto Rico	14	8	9	10	7	8	5	9	5	6
St Lucia	1	10	1	1	1	1	1	10	0	0
St Vincent	-	-	-	-	-	-	-	-	67	11
USA	236	279	561	195	188	266	275	187	322	482
Venezuela	1 948	2 254	50	50 F	50 F	40 F	40 F	30	...	2
31 Fishing area total	*2 201*	*2 559*	*630*	*269 F*	*261 F*	*323 F*	*330 F*	*247*	*401*	*558*
34 Benin	69	69	259	331	260	270	216	183	...	...
Cape Verde	178	262	143	137	39	160	348	518	498	402
Côte dIvoire	...	...	...	...	270	298	404	1 677	1 041	1 359
France	...	3	...	10	27	12	-	1	50	30
Gabon	213	57	173	221	1	...	...	81	55 F	55 F
Germany	-	-	-	-	-	6	-	-	-	-
Ghana	730	4 768	8 541	7 060	5 738	216	4 449	3 188	1 497	2 343
Ireland	-	-	-	14	3	-	-	-	8	6
Lithuania	-	-	-	-	-	-	-	-	1	64
Morocco	87	308	76	91	33	198	40	20	63	5
Netherlands	-	-	-	-	8	58	14	69	8	-
NethAntilles	-	-	9	...	...	...	...	...	...	...
Portugal	-	-	-	-	17	-	-	-	-	-
Russian Fed	-	74	13	-	-	-	-	-	-	268
Sao Tome Prn	33	33	33	178	182	179	179 F	183	188	193
Senegal	1 856	1 805	1 431	3 508	2 694	3 825	3 885	2 972	1 691	6 180
Spain	-	-	1	489	17	0	-	-	-	105
Togo	-	-	-	-	-	-	-	-	-	1 500
UK	-	-	-	-	-	-	-	3	7	15
Other nei	4 238	3 367	1 084	1 148	1 040	1 159	715	410	1 181	795
34 Fishing area total	*7 404*	*10 746*	*11 763*	*13 187*	*10 329*	*6 381*	*10 250 F*	*9 305*	*6 288 F*	*13 320 F*
37 Algeria	407	148	7	158	116	187	96	142	119	130
Croatia	-	-	-	-	-	-	-	-	38	8
Cyprus	13	10	10	6	4	3	-	-	-	-
Egypt	1 072	1 416	784	706	963	895	1 061	1 587	1 939	1 302
France	-	-	-	-	-	-	-	-	1	1
Greece	-	132	-	-	112	69	72	183	148	165
Israel	70	40	76	189	89	136	130	100 F	77	52
Italy	-	16	24	38	34	513	615	486	868	596
Libya	4	4	...	...	...	...	...	...	819	800 F
Malta	5	4	3	0	1	2	1	5	8	7
Morocco	2	3	1	10	9	...	59	19	24	1
Palest, O.T.	70 F	129	38	57	93	45	107	42	176	91

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Serbia-Monte	16	16	20	17	...	-	-	-	-	-
Spain	82	32	0	40	262	115	203	211	86	299
Syria	370	330	280	114	114	278	193	190	200	270
Tunisia	1 036	960	657	633	496	568	1 056	834	872	805
Turkey	...	...	...	568	507	1 230	785	1 074	1 309	1 046
37 Fishing area total	*3 147 F*	*3 240*	*1 900*	*2 536*	*2 800*	*4 041*	*4 378*	*4 873 F*	*6 684*	*5 573 F*
41 Brazil	615	615	...	320	280	454	397	444	490	463
Portugal	-	-	-	4	-	-	2	-	-	-
41 Fishing area total	*615*	*615*	*...*	*324*	*280*	*454*	*399*	*444*	*490*	*463*
47 Angola	231	155	1 813	...	2	1 654	4 365	1 373	1 644	822
47 Fishing area total	*231*	*155*	*1 813*	*...*	*2*	*1 654*	*4 365*	*1 373*	*1 644*	*822*
Species total	*13 741 F*	*17 463*	*16 222*	*16 358 F*	*13 731 F*	*12 921 F*	*19 819 F*	*16 355 F*	*15 672 F*	*20 793 F*
Black skipjack	**Thonine noire**		**Barrilete negro**		***Euthynnus lineatus***				**1,75(01)024,04**	**BKJ**
77 Colombia	-	-	-	-	-	2	-	-	-	10
Ecuador	2	66	-	1	5	...	7	45	52	2
Mexico	...	...	...	...	50	53	1 334	3 523	1 782	1 229
Nicaragua	-	-	-	-	6	2	...	3	...	...
Panama	-	7	2	5	5	4	12	45	30	191
USA	0	-	-	-	-	-	1	0	-	-
Vanuatu	-	-	2	-	-	-	-	-	-	-
Venezuela	1	63	11	25	49	12	104	109	7	12
Other nei	10	1	-	-	-	-	-	-	-	-
77 Fishing area total	*13*	*137*	*15*	*31*	*115*	*73*	*1 458*	*3 725*	*1 871*	*1 444*
87 Colombia	120	...	...	...	...	...	25	2	-	1
Ecuador	1 824	1 060	35	106	245	73	118	224	259	656
Nicaragua	-	-	-	-	-	-	-	-	-	70
Panama	-	-	2	20	7	7	80	71	-	-
Vanuatu	-	19	10	-	17	-	2	-	-	7
Venezuela	-	-	-	-	-	-	1	-	-	6
Other nei	22	4	-	-	-	-	-	-	-	97
87 Fishing area total	*1 966*	*1 083*	*47*	*126*	*269*	*80*	*226*	*297*	*259*	*837*
Species total	*1 979*	*1 220*	*62*	*157*	*384*	*153*	*1 684*	*4 022*	*2 130*	*2 281*
Kawakawa	**Thonine orientale**		**Bacoreta oriental**		***Euthynnus affinis***				**1,75(01)024,06**	**KAW**
51 Bahrain	...	...	...	1	28	3	10	3	4	0
Br Ind Oc Tr	-	1	1	1	1	2	2	0	0	1
Comoros	160	160	200	200	200	200 F	220 F	293	293 F	293 F
Egypt	209	313	537	356	135	375	638	160	167	272
Eritrea	36	0	0	0	0	0	0	0	-	-
India	17 349	19 361	19 284	15 630	15 586	19 255	19 639	19 736	18 347	15 780
Iran	12 474	16 361	14 066	11 645	11 803	12 595	15 720	20 439	17 827	16 336
Jordan	40	40	33	35	40	44	45	42	46	34
Madagascar	2 001	2 211	1 763	2 345	2 297	1 869	1 944	1 882	1 882	1 882
Maldives	2 150	2 241	2 406	2 290	2 702	1 674	2 790	2 075	3 042	2 817
Mozambique	-	-	-	-	-	-	-	-	1	0
Oman	1 961	1 493	2 903	2 140	2 217	2 443	2 261	4 077	2 336	2 214
Pakistan	1 817	1 210	1 400	1 753	1 922	2 136	2 243	2 281	2 385	4 487
Réunion	23	30	21	25	18	10	1	-	-	-
Saudi Arabia	357	194	1 015	740	1 147	1 566	1 201	1 529	2 189	2 257
Seychelles	48	58	118	64	71	62	76	131	135	38
South Africa	0	0	0	-	0	-	0	-	-	-
Untd Arab Em	1 000	850	845	676	719	700	450 F	219	289	332
Yemen	2 335	2 524	1 419	2 901	2 758	2 366	2 639	5 228	5 650 F	6 100 F
51 Fishing area total	*41 960*	*47 047*	*46 011*	*40 802*	*41 644*	*45 300 F*	*49 879 F*	*58 095*	*54 593 F*	*52 843 F*
57 Australia	0	1	1	1	0	0	0	0	-	0
India	4 213	4 702	4 683	3 796	3 785	4 677	4 769	4 793	4 456	3 832
Indonesia	29 229	26 229	27 794	33 797	30 308	34 782	38 536	48 044	46 431	46 431
Malaysia	6 084	10 236	8 860	8 633	8 005	11 717	13 125	10 615	13 061	13 675
Sri Lanka	1 244	875	622	1 291	1 620	2 191	3 010	2 089	2 814	1 938
Thailand	6 232	4 984	7 089	7 097	9 764	9 011	7 028	7 519	9 433	9 721
57 Fishing area total	*47 002*	*47 027*	*49 049*	*54 615*	*53 482*	*62 378*	*66 468*	*73 060*	*76 195*	*75 597*
61 China,Taiwan	0	0	-	-	-	-	-	-	-	-
61 Fishing area total	*0*	*0*	-	-	-	-	-	-	-	-
71 China,Taiwan	2 136	1 722	2 295	2 220	2 674	2 178	1 818	-	-	-
Indonesia	133 122	163 573	163 159	84 134	56 148	79 894	88 892	103 530	78 849	80 805
Malaysia	47 133	49 149	12 256	6 202	8 003	13 578	10 897	19 383	15 717	14 004
Palau	1	0	2	2	12	...	13	14	15 F	15 F
Philippines	27 280	34 681	38 675	44 875	77 674	78 377	73 094	54 907	49 973	38 237
Thailand	23 000	27 391	22 016	27 931	27 947	25 273	23 476	9 082	8 478	8 780
71 Fishing area total	*232 672*	*276 516*	*238 403*	*165 364*	*172 458*	*199 300*	*198 190*	*186 916*	*153 032 F*	*141 841 F*
77 USA	-	4	2	1	2	1	1	1	2	1
77 Fishing area total	*-*	*4*	*2*	*1*	*2*	*1*	*1*	*1*	*2*	*1*
Species total	*321 634*	*370 594*	*333 465*	*260 782*	*267 586*	*306 979 F*	*314 538 F*	*318 072*	*283 822 F*	*270 282 F*

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Skipjack tuna	**Listao**		**Listado**		***Katsuwonus pelamis***				**1,75(01)025,01**	**SKJ**
21 Canada	-	-	-	0	-	-	-	-	-	-
Portugal	-	-	-	-	-	0	1	-	-	-
USA	4	0	4	14	2	2	1	1	5	2
21 Fishing area total	*4*	*0*	*4*	*14*	*2*	*2*	*2*	*1*	*5*	*2*
27 France	-	12	9	11	5	10	0	0	1	5
Portugal	1 611	2 159	3 618	4 326	2 013	8 767	8 404	5 150	943	11 586
Spain	-	2	-	0	7	1	-	-	-	0
27 Fishing area total	*1 611*	*2 173*	*3 627*	*4 337*	*2 025*	*8 778*	*8 404*	*5 150*	*944*	*11 591*
31 Barbados	1	2	2	2	2	2	-	-	-	-
Bermuda	0	0	0	1	1	0	0	0	1	0
Cuba	443	462	634	545	515	536	417	409	404	318
Dominica	45	55	51	30	38	30	35	45	28	...
Dominican Rp	32	48	173	...	71	...	...	49	44	48
Grenada	15	14	16	21	22	15	29	20	8	11
Mexico	91	108	77	118	155	161	81	17	24	32
Puerto Rico	26	20	25	17	23	20	23	32	18	14
St Lucia	151	106	132	137	159	120	89	168	142	153
St Vincent	97	357	92	251	251	354	90	83	54	46
Spain	-	-	-	-	-	-	5	11	-	0
USA	0	-	-	-	0	0	0	-	0	0
Venezuela	6 870	2 554	3 247	3 270	1 093	2 007	921	757	2 250	2 119
31 Fishing area total	*7 771*	*3 726*	*4 449*	*4 392*	*2 330*	*3 245*	*1 690*	*1 591*	*2 973*	*2 741*
34 Belize	-	-	-	...	-	-	-	2 126	...	2 051
Cape Verde	794	398	343	1 096	7 504	7 931	6 026	6 010	4 766	6 032
China,Taiwan	2	2	14	12	9	3	2	1	-	-
Côte dIvoire	259	292	143	559	1 259	1 565	1 817	2 328	2 840	2 620
Eq Guinea	-	-	-	-	-	-	-	-	1 224	1 224
France	16 593	16 603	19 899	21 879	14 844	7 034	4 168	4 439	7 788	14 736
Gabon	101	...	...	...	0	0	...	2	1 F	1 F
Ghana	42 489	30 499	24 597	25 726	44 671	30 236	34 572	37 387	36 064	53 812
Guatemala	-	-	-	-	6 389	4 959	5 546	6 319	4 036	2 951
GuineaBissau	20	10	1	...	...	...	...	...	...	...
Ireland	-	-	-	-	10	-	-	-	-	-
Korea Rep	-	-	-	-	-	-	-	-	-	694
Lithuania	-	-	129	320	277	156	20	253	339	1 408
Mauritania	...	...	...	...	...	...	...	...	...	10
Morocco	335	280	523	807	1 893	3 779	1 570	1 291	2 575	2 317
Netherlands	-	-	-	-	20	35	4	9	-	-
NethAntilles	13 370	5 427	10 092	8 708	...	3 042	1 587	6 436	9 143	9 179
Panama	281	342	-	7 126	11 490	13 468	18 821	8 253	8 518	9 590
Portugal	496	785	689	2 475	1 469	2 357	553	979	130	688
Russian Fed	-	-	-	-	-	392	1 130	386	260	-
St Vincent	-	1	-	-	-	1	0	-	-	-
Sao Tome Prn	179	179	179	117	166	143	143 F	229	235	241
Senegal	1 271	1 053	733	1 333	4 874	3 534	2 278	3 661	4 573	2 447
Spain	30 954	25 432	44 832	38 721	28 124	22 171	23 670	35 105	36 694	41 186
Togo	-	-	-	-	-	...	633	1 800 F	3 000	40
Other nei	15 259	11 545	14 647	16 399	7 539	5 942	3 275	3 128	2 969	4 163
34 Fishing area total	*122 403*	*92 848*	*116 821*	*125 278*	*130 538*	*106 748*	*105 815 F*	*120 142 F*	*125 155 F*	*155 390 F*
37 Algeria	77	...	...	...	...	...	...	...	...	...
France	-	22	25	20	2	2	4	2	0	8
Greece	-	-	102	99	...	...	...	...	...	...
Italy	-	4	29	34	17	-	-	-	-	-
Morocco	16	1	1	2	1	6	22	18	5	26
Spain	-	10	-	26	10	15	44	13	0	5
Syria	-	-	-	-	-	-	38	47	50	27
37 Fishing area total	*93*	*37*	*157*	*181*	*30*	*23*	*108*	*80*	*55*	*66*
41 Argentina	-	-	-	30	-	0	0	-	3	12
Belize	...	...	-	-	-	-	-	-	-	663
Brazil	24 146	18 339	20 416	23 037	26 388	23 269	24 191	20 845	23 307	20 640
China,Taiwan	9	6	9	8	13	28	3	21	5	5
Portugal	-	-	3	3	4	21	11	-	-	-
41 Fishing area total	*24 155*	*18 345*	*20 428*	*23 078*	*26 405*	*23 318*	*24 205*	*20 866*	*23 315*	*21 320*
47 Angola	687	14	14	10	...	...	...	...	...	...
China,Taiwan	49	38	9	5	13	0	1	5	1	8
Japan	1	-	-	-	-	-	-	1	1	2
Namibia	8	0	-	0	-	0	1	-	71	2
Portugal	61	15	-	0	-	4	0	-	17	16
St Helena	205	63	178	317	321	88	110	45	152	250
South Africa	1	1	2	2	1	1	-	3	4	2
Spain	-	22	5	4	8	35	-	-	-	-
47 Fishing area total	*1 012*	*153*	*208*	*338*	*343*	*128*	*112*	*54*	*246*	*280*
51 Belize	1 894	14 039	-	-	4	23	-	-	-	-
Br Ind Oc Tr	-	1	1	1	1	0	0	0	16	0
China,Taiwan	64	48	5	27	74	59	13	40	9	4
Comoros	2 000	2 400	2 700	3 200	3 200	3 200 F	3 400 F	4 532	4 532 F	4 532 F
France	36 261	54 357	38 902	37 972	43 171	47 490	30 420	29 702	29 035	20 962
Guinea	-	-	0	-	0	1	1	0	0	1
India	8 856	10 567	9 393	10 604	10 502	12 824	12 360	15 623	14 010	15 971
Iran	26 058	29 850	36 032	53 646	80 651	102 669	68 057	42 412	44 819	22 285
Italy	1 681	2 660	3 722	3 521	4 046	5 077	2 393	4 189	3 491	-
Japan	245	762	573	56	392	209	315	79	42	17

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Jordan	52	52	43	45	55	50	44	43	45	28
	Kenya	183	116	267	307	337	233	185	320	295	221
	Korea Rep	-	-	-	4	-	-	-	-	-	-
	Madagascar	8 489	9 147	9 132	9 895	9 580	9 711	10 666	8 452	8 452	8 452
	Maldives	88 043	115 321	108 329	109 749	132 061	138 458	96 860	87 073	66 189	58 482
	Mauritius	8	8	8	7	7	8	4	25	25	50
	Mayotte	4 020	707	379	510	472	2 431	4 943	5 112	6 621	9 082
	Oman	1	2	111	149	63	106	102	18	11	80
	Pakistan	3 405	3 102	3 062	3 318	3 579	4 680	4 702	4 882	5 102	8 345
	Portugal	-	-	-	20	-	0	14	0	0	2
	Réunion	79	69	72	70	81	59	29	26	15	15 F
	Senegal	-	-	-	-	-	1	-	-	-	-
	Seychelles	26 219	29 891	36 802	29 884	46 038	47 515	29 721	30 021	40 101	43 782
	South Africa	0	0	0	0	1	0	0	1	1	-
	Spain	68 455	91 327	88 037	64 389	94 317	118 865	65 014	65 041	65 590	75 141
	Tanzania	-	-	-	-	1	1	1	0	0	1
	Thailand	-	-	-	0	7 971	16 395	7 304	5 923	6 452	...
	Yemen	29	31	33	35	35	77	119	68 F	74 F	80 F
	Other nei	43 154	35 917	41 617	19 031	11 243	1 773	-	-	156	4
51	*Fishing area total*	*319 196*	*400 374*	*379 220*	*346 440*	*447 882*	*511 915 F*	*336 667 F*	*303 582 F*	*295 083 F*	*267 537 F*
57	Australia	1 040	1 145	2	30	3	446	90	847	855	...
	Belize	75	259	-	-	0	-	-	-	-	-
	China,Taiwan	13	7	6	7	11	12	2	1	7	5
	France	-	-	-	-	-	584	6	-	353	72
	India	246	562	587	847	648	1 321	1 350	1 647	1 653	1 938
	Indonesia	49 846	41 998	42 352	48 054	40 386	43 327	48 136	59 855	57 792	57 828
	Japan	1 465	1 176	1 871	1 407	2 760	1 786	4 060	3 089	3 436	1 729
	Malaysia	-	-	-	-	-	6	-	293	293	293
	Seychelles	-	-	-	76	-	-	6	15	55	48
	Spain	-	-	2	4	2	1	1	60	991	1
	Sri Lanka	66 692	64 425	75 146	75 795	44 938	54 341	73 240	78 860	82 127	99 799
	Thailand	460	-	-	-	0	441	1 124	215	1 080	2 369
	Other nei	773	122	29	3	1	445	10	1	1	1
57	*Fishing area total*	*120 610*	*109 694*	*119 995*	*126 223*	*88 749*	*102 710*	*128 025*	*144 883*	*148 643*	*164 083*
61	China	...	1 582	17 839	...	...	...	...	...	...	...
	China,Taiwan	16 159	3 042	2 358	5 693	4 460	6 557	4 868	29	267	176
	Japan	140 171	140 171 F	178 184	86 375	132 479	91 752	114 180	133 890	80 920	114 636
	Russian Fed	33	-	-	-	-	-	1	-	-	-
61	*Fishing area total*	*156 363*	*144 795 F*	*198 381*	*92 068*	*136 939*	*98 309*	*119 049*	*133 919*	*81 187*	*114 812*
67	USA	1	-	-	-	0	0	-	-	0	-
67	*Fishing area total*	*1*	-	-	-	*0*	*0*	-	-	*0*	-
71	Australia	1	1	1	1	0	9	65	8	22	7
	Belize	-	-	-	22	20	1	-	-	-	-
	China	2 750	7 713	20 284	20 104	38 928	47 776	48 745	43 406	67 635	42 255
	China,Taiwan	182 531	229 415	177 926	182 942	163 992	184 931	208 841	165 007	173 817	166 265
	Cook Is	-	-	-	-	0	5	5	7	1	-
	Fiji	509	560	517	519	576	583	535	536	500	300
	Guam	151	80	83	73	65	67	71	134	150	146
	Indonesia	166 309	161 831	158 228	182 476	203 564	226 869	255 745	245 669	268 228	261 483
	Japan	133 980	133 980 F	154 563	158 746	178 272	182 125	182 517	174 742	183 003	184 389
	Kiribati	3 816	6 744	4 565	4 758	5 930	4 307	8 223	8 238	8 580	8 438
	Korea Rep	134 766	170 988	153 323	162 114	171 617	205 975	214 933	187 277	257 481	216 026
	Malaysia	...	...	...	...	...	...	...	329	4 460	5 145
	Marshall Is	32 583	37 745	35 234	42 078	47 565	38 881	53 915	26 803	39 647	50 000 F
	Micronesia	10 689	14 574	24 054	23 641	23 612	9 215	11 853	15 933	16 785	18 000 F
	Nauru	...	2	4	5	13	13 F	12 F	11 F	10 F	10 F
	NewCaledonia	0	0	0	0	0	0	0	-	-	-
	New Zealand	6 721	24 382	16 991	15 325	13 374	14 422	22 267	16 051	19 527	...
	N Marianas	261	177	77	66	108	124	108	77	109	147
	Papua N Guin	64 901	91 671	118 678	192 100	176 813	184 087	181 475	146 954	160 782	160 500 F
	Philippines	105 484	109 977	138 319	143 143	143 064	164 326	185 864	222 010	251 524	228 179
	Singapore	10	6	4	2	4	1	0	2	2	0
	Solomon Is	11 943	13 998	18 653	14 198	12 605	18 557	13 743	7 564	9 557	245
	Spain	1 201	-	-	3 479	2 293	8 796	13 290	24 977	19 770	21 579
	Tuvalu	300 F	400 F	800	1 000	1 200	1 200 F	1 200 F	1 200 F	3 135	7 480 F
	USA	86 441	86 743	28 469	22 833	19 779	26 307	28 852	43 371	77 988	96 063
	Vanuatu	8 725	17 722	19 199	48 243	63 700	55 050	62 631	30 512	35 454	18 206
71	*Fishing area total*	*954 072 F*	*1 108 709 F*	*1 069 972*	*1 217 868*	*1 267 094*	*1 373 627 F*	*1 494 890 F*	*1 360 818 F*	*1 598 167 F*	*1 484 863 F*
77	Amer Samoa	71	134	216	234	147	195	168	172	156	121
	Belize	14	...	...	...	...	...	...	...	...	...
	China	1 130	-	-	-	-	-	-	-	-	-
	China,Taiwan	5	8	201	1 101	1 748	2 724	228	124	118	39
	Colombia	58	204	282	232	1 393	300	478	591	677	1 233
	Cook Is	8 F	16	34	62	32	69	41	54	89	124
	Ecuador	10 941	5 252	13 587	11 101	17 724	28 496	21 632	20 275	26 085	30 381
	El Salvador	4 476	6 804	4 545	6 897	4 712	7 301	11 129	13 538	12 645	12 076
	Fr Polynesia	1 557	1 470	1 029	1 093	1 123	1 479	895	1 004	1 306	1 154
	Guatemala	6 060	10 138	9 880	476	630	87	2	640	73	1 936
	Honduras	185	...	...	...	31	110	172	...	10	35
	Japan	299	299 F	108	144	172	27	346	70	360	351
	Korea Rep	138	2 225	5	82	24	491	1	1	-	-
	Mexico	7 520	9 534	6 335	9 746	40 988	19 462	31 837	24 906	19 394	15 994
	Nicaragua	5	1	-	308	1 842	1 436	490	1 114	958	2 750
	Niue	...	...	...	2	4	8	7	1	6	1

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Panama	1 375	4 308	6 668	7 955	7 918	12 610	7 985	6 850	5 218	9 292
Samoa	389	198	288	186	100	59	40	31	77	67
Spain	9 821	12 659	16 854	10 549	9 987	16 583	3 471	4 000	10 025	2 948
Tokelau	...	5	2	2	5	4	6	6	8	4
Tonga	15	5	3	3	2	1	1	0	0	0
USA	2 583	1 939	30 140	24 990	22 068	28 641	29 620	48 097	78 315	96 201
Vanuatu	1 187	519	6 597	2 153	895	894	1 143	1 608	1 386	3 058
Venezuela	679	2 581	5 491	6 225	8 689	3 406	3 584	3 671	3 735	2 055
Other nei	189	6 354	11 351	43	-	1	-	-	-	-
77 Fishing area total	*48 705 F*	*64 653 F*	*113 616*	*83 584*	*120 234*	*124 384*	*113 276*	*126 753*	*160 641*	*179 820*
81 Australia	1 091	221	16	780	1	48	4	1	8	3
China,Taiwan	7	24	75	-	-	59	23	39	76	24
Cook Is	-	0	-	0	-	1	-	0	-	67
Japan	512	512 F	224	964	1 006	134	3	10	12	5
New Zealand	3 691	3 344	3 002	9 043	8 029	7 247	11 391	10 034	5 617	12 425
81 Fishing area total	*5 301*	*4 101 F*	*3 317*	*10 787*	*9 036*	*7 489*	*11 421*	*10 084*	*5 713*	*12 524*
87 Belize	783	...	...	...	...	...	...	...	...	...
Chile	57	1	18	37	6	2	3	-	-	-
China,Taiwan	-	-	-	-	-	-	-	-	-	1
Colombia	1 813	2 080	12 334	5 866	11 093	21 042	17 430	21 763	13 436	10 890
Ecuador	58 799	72 974	119 556	77 936	125 118	114 204	78 324	122 639	104 401	67 593
Guatemala	4 613	...	...	836	429	885	1 958	3 540	3 495	2 150
Honduras	1 989	...	...	3 340	5 085	6 221	2 959	3 568	3 257	1 408
Japan	7	7 F	2	27	143	6	4	6	28	7
Korea Rep	2 665	480	-	-	-	-	-	-	-	-
Mexico	610	517	514	791	1 122	222	...	...	...	...
Nicaragua	3	...	-	47	824	3 859	1 924	4 985	3 468	1 575
Panama	4 140	2 957	4 806	10 803	19 821	30 601	13 010	35 703	22 977	11 728
Peru	81	1 339	495	918	157	396	331	1 740	3 238	2 810
Spain	12 950	10 849	5 633	4 808	5 167	2 700	460	1 936	1 283	104
USA	9	1 276	2 381	1 364	1 329	820	432	4 311	1 618	...
Vanuatu	5 719	5 710	10 120	5 147	3 605	4 569	1 607	6 742	3 978	2 779
Venezuela	1 089	1 597	5 027	6 914	6 781	21 233	15 866	24 251	15 597	6 617
Other nei	2 079	18 277	19 649	5 315	219	179	227	-	214	310
87 Fishing area total	*97 406*	*118 064 F*	*180 535*	*124 149*	*180 899*	*206 939*	*134 535*	*231 184*	*176 990*	*107 972*
Species total	*1 858 703 F*	*2 067 672 F*	*2 210 730*	*2 158 737*	*2 412 506*	*2 567 615 F*	*2 478 199 F*	*2 459 107 F*	*2 619 117 F*	*2 523 001 F*

Atlantic bluefin tuna — **Thon rouge de l'Atlantique** — **Atún rojo del Atlántico** — ***Thunnus thynnus*** — **1,75(01)026,01** — **BFT**

21 Canada	537	641	571	552	604	735	491	576	533	530
Japan	1 056	575	176	487	289	175	191	393	61	127
St Pier Mq	0	3	1	10	5	-	4	3	2	8
USA	1 175	1 141	842	369	397	164	162	239	374	577
21 Fishing area total	*2 768*	*2 360*	*1 590*	*1 418*	*1 295*	*1 074*	*848*	*1 211*	*970*	*1 242*
27 China	-	-	-	41	24	42	72	118	41	38
China,Taiwan	100	98	-	-	-	-	-	-	-	-
Faroe Is	1	2	0	-	2	-	-	-	-	-
France	629	755	648	561	818	1 218	630	252	366	228
Iceland	-	1	-	-	-	-	-	-	-	-
Ireland	7	15	3	1	1	2	0	1	1	2
Japan	1 361	2 200	2 502	2 282	2 309	1 072	1 387	1 808	1 886	1 140
Libya	-	-	-	-	-	47	-	-	-	-
Netherlands	-	-	-	1	-	-	-	-	-	-
Norway	-	-	-	-	-	-	-	0	-	-
Portugal	402	55	27	25	41	35	29	36	46	58
Spain	3 578	4 083	2 136	2 796	3 066	1 959	3 162	2 930	2 406	1 535
UK	-	-	0	-	-	0	0	-	-	-
27 Fishing area total	*6 078*	*7 209*	*5 316*	*5 707*	*6 261*	*4 375*	*5 280*	*5 145*	*4 746*	*3 001*
31 Bermuda	1	1	0	0	0	0	0	0	0	0
Cuba	-	74	11	18	27	19	-	-	-	-
Dominican Rp	...	342	...	...	...	34	131	77	56	48
Japan	-	-	8	20	89	201	86	99	101	226
Mexico	10	15	22	21	31	33	26	61	65	72
USA	57	71	115	203	129	90	83	90	90	49
Other nei	49	-	-	-	-	-	-	-	-	-
31 Fishing area total	*117*	*503*	*156*	*262*	*276*	*377*	*326*	*327*	*312*	*395*
34 China	68	39	19	-	-	-	-	-	-	-
China,Taiwan	101	123	23	-	-	0	-	-	-	-
Japan	211	336	458	93	289	824	225	543	18	15
Morocco	2 497	2 565	1 797	1 961	2 405	2 196	2 418	1 947	1 909	1 348
Portugal	2	124	34	7	39	47	-	-	1	-
Sierra Leone	118	...	...	...	...	...	...	...	...	...
Spain	55	5	2	5	35	73	113	9	2	14
Togo	-	-	-	-	-	-	-	-	-	23
34 Fishing area total	*3 052*	*3 192*	*2 333*	*2 066*	*2 768*	*3 140*	*2 756*	*2 499*	*1 930*	*1 400*
37 Algeria	2 012	1 710	1 015	1 208	950	1 038	833	889	223	19
China,Taiwan	196	131	421	51	277	8	-	-	-	-
Croatia	903	977	1 139	827	1 017	1 022	825	833	619	388
Cyprus	90	91	79	105	149	110	1	132	2	3
France	6 167	5 832	5 859	6 471	8 637	7 664	10 157	2 670	3 087	1 754
Greece	361	438	422	389	318	254	285	350	373	224
Italy	4 379	4 628	4 971	4 685	4 839	4 693	4 621	2 236	2 734	1 052

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Japan	187	390	486	199	265	556	466	80	18	-
Korea Rep	-	-	-	700	987	68	276	335	102	-
Libya	1 941	638	753	1 299	1 090	1 280	1 358	1 318	1 081	645
Malta	219	240	255	264	346	263	334	296	263	153
Morocco	511	421	760	819	92	190	641	531	369	205
Portugal	64	-	2	0	-	11	-	-	-	-
Serbia-Monte	5	6	9	7	...	-	-	-	-	-
Spain	2 235	2 215	2 513	2 353	2 758	2 690	2 414	2 465	1 769	1 057
Syria	-	-	225	263	98	108	49	42	0	32
Tunisia	2 493	2 528	791	2 376	3 249	2 545	2 622	2 679	1 932	1 043
Turkey	2 100	2 300	3 300	1 075	990	806	918	887	981	423
Other nei	571	508	610	709	-	-	-	-	-	-
37 Fishing area total	*24 434*	*23 053*	*23 610*	*23 800*	*26 062*	*23 306*	*25 800*	*15 743*	*13 553*	*6 998*
41 Portugal	-	-	-	-	-	12	0	-	-	-
41 Fishing area total	-	-	-	-	-	*12*	*0*	-	-	-
47 Portugal	-	-	-	-	-	2	-	-	-	-
Seychelles	-	2	-	-	-	-	-	-	-	-
47 Fishing area total	-	*2*	-	-	-	*2*	-	-	-	-
Species total	*36 449*	*36 319*	*33 005*	*33 253*	*36 662*	*32 286*	*35 010*	*24 925*	*21 511*	*13 036*
Pacific bluefin tuna	**Thon bleu du Pacifique**		**Atún aleta azul del Pacífico**		***Thunnus orientalis***				**1,75(01)026,02**	**PBF**
61 China,Taiwan	580	487	500	1 595	1 302	1 164	1 400	979	877	373
Japan	14 063	14 370	10 829	12 981	20 055	12 193	13 526	16 959	14 831	7 892
61 Fishing area total	*14 643*	*14 857*	*11 329*	*14 576*	*21 357*	*13 357*	*14 926*	*17 938*	*15 708*	*8 265*
67 Japan	0	0	0	1	0	0	0	0	-	-
USA	0	0	0	0	-	-	-	-	-	-
67 Fishing area total	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	-	-
71 China,Taiwan	1 504	1 354	1 385	119	66	105	0	0	0	-
Japan	5	1	4	8	2	14	15	9	10	2
Palau	-	-	3	2	...	...	...	...	...	...
Solomon Is	-	-	-	-	6	...	...	...	...	...
71 Fishing area total	*1 509*	*1 355*	*1 392*	*129*	*74*	*119*	*15*	*9*	*10*	*2*
77 Cook Is	-	2	3	2	1	-	0	-	-	0
Japan	2	2	6	3	2	-	-	-	-	-
Mexico	860	1 326	1 221	1 108	5 858	6 116	5 202	4 423	4 470	3 873
USA	317	41	35	38	207	1	45	1	415	1
77 Fishing area total	*1 179*	*1 371*	*1 265*	*1 151*	*6 068*	*6 117*	*5 247*	*4 424*	*4 885*	*3 874*
81 China,Taiwan	-	-	-	-	-	-	1	-	-	-
Japan	4	4	10	7	12	7	5	5	4	2
New Zealand	50	55	41	67	30	22	14	13	16	13
81 Fishing area total	*54*	*59*	*51*	*74*	*42*	*29*	*20*	*18*	*20*	*15*
87 Japan	0	-	-	-	0	0	-	-	-	-
87 Fishing area total	*0*	-	-	-	*0*	*0*	-	-	-	-
Species total	*17 385*	*17 642*	*14 037*	*15 931*	*27 541*	*19 622*	*20 208*	*22 389*	*20 623*	*12 156*
Longtail tuna	**Thon mignon**		**Atún tongol**		***Thunnus tonggol***				**1,75(01)026,03**	**LOT**
51 India	4 656	5 196	5 175	4 195	4 183	5 168	5 270	5 297	4 924	4 235
Iran	34 896	29 853	30 284	19 528	18 528	25 142	29 530	34 110	49 463	64 450
Jordan	3	3	2	3	2	2	4	5	11	10
Madagascar	833	1 007	1 145	964	898	838	1 584	1 266	1 266	1 266
Oman	6 011	6 854	8 024	7 791	7 646	7 883	7 754	7 753	8 052	8 564
Pakistan	4 735	4 466	5 454	4 722	4 356	4 690	4 819	4 832	6 105	9 205
Saudi Arabia	190	210	358	288	233	190	272	242	222	222
Seychelles	-	-	22	-	-	-	-	-	-	-
Untd Arab Em	1 720	2 238	3 364	2 360	2 270	2 250	1 300 F	328	707	805
Yemen	4 198	4 537	3 528	5 215	6 124	7 414	6 808	3 029	3 250 F	3 550 F
51 Fishing area total	*57 242*	*54 364*	*57 356*	*45 066*	*44 240*	*53 577*	*57 341 F*	*56 862*	*74 000 F*	*92 307 F*
57 Australia	58	23	28	17	19	4	0	1	0	0
India	658	734	731	593	591	730	745	748	696	598
Indonesia	28 101	24 570	25 395	30 137	26 397	29 609	32 804	40 898	39 525	39 525
Malaysia	2 773	4 752	4 026	3 930	3 690	5 255	6 119	4 963	5 892	6 473
Thailand	1 726	3 536	3 907	2 864	1 819	2 567	6 217	4 376	4 578	4 732
57 Fishing area total	*33 316*	*33 615*	*34 087*	*37 541*	*32 516*	*38 165*	*45 885*	*50 986*	*50 691*	*51 328*
61 China,Taiwan	14 321	859	823	-	-	-	-	-	2 980	-
61 Fishing area total	*14 321*	*859*	*823*	-	-	-	-	-	*2 980*	-
71 Australia	7	6	4	5	2	2	3	6	0	1
China,Taiwan	4 300	3 452	3 310	-	-	-	-	-	-	-
Indonesia	...	...	...	70 735	62 340	62 177	92 268	76 486	60 920	65 193
Malaysia	...	...	28 570	23 084	21 616	22 640	20 215	27 801	13 805	15 165
Thailand	55 533	59 052	68 147	78 657	79 095	71 213	62 072	10 500	12 309	11 405
71 Fishing area total	*59 840*	*62 510*	*100 031*	*172 481*	*163 053*	*156 032*	*174 558*	*114 793*	*87 034*	*91 764*
81 Australia	6	5	3	10	1	0	-	0	0	1
81 Fishing area total	*6*	*5*	*3*	*10*	*1*	*0*	-	*0*	*0*	*1*

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*164 725*	*151 353*	*192 300*	*255 098*	*239 810*	*247 774*	*277 784 F*	*222 641*	*214 705 F*	*235 400 F*
Blackfin tuna	**Thon à nageoires noires**		**Atún aleta negra**		***Thunnus atlanticus***				**1,75(01)026,04**	**BLF**
21 USA	2	1	2	1	1	1	2	3	5	2
21 Fishing area total	*2*	*1*	*2*	*1*	*1*	*1*	*2*	*3*	*5*	*2*
31 Bermuda	4	5	9	4	5	8	7	6	7	9
Cuba	299	209	322	435	450	527	492	499	731	445
Dominica	54	78	42	20	64	52	32	37	50	41
Dominican Rp	517	651	290	137	130	...	...	261	916	985
Grenada	223	255	335	277	306	372	321	290	187	159
Guadeloupe	500	500	...	...	...	...	...	...	...	...
Martinique	470 F	470 F	...	...	...	...	...	...	...	...
Mexico	12	...	10	9	10	10	12	6	7	6
NethAntilles	45 F	45 F	...	...	...	...	...	...	...	...
Puerto Rico	17	14	28	22	10	18	17	21	23	32
St Lucia	108	96	169	96	126	182	151	179	215	203
St Vincent	24	24	-	-	-	-	-	-	15	6
Trinidad Tob	-	-	5	5	5	5	5	5	5	5
USA	33	31	26	21	23	15	6	3	9	5
Venezuela	1 902	1 210	319	732	225	237	777	231	292	331
31 Fishing area total	*4 208 F*	*3 588 F*	*1 555*	*1 758*	*1 354*	*1 426*	*1 820*	*1 538*	*2 457*	*2 227*
34 Senegal	-	-	-	-	-	-	-	124	62	93
34 Fishing area total	-	-	-	-	-	-	-	*124*	*62*	*93*
41 Brazil	148	1 669	1	118	90	243	233	315	348	329
41 Fishing area total	*148*	*1 669*	*1*	*118*	*90*	*243*	*233*	*315*	*348*	*329*
Species total	*4 358 F*	*5 258 F*	*1 558*	*1 877*	*1 445*	*1 670*	*2 055*	*1 980*	*2 872*	*2 651*
Albacore	**Germon**		**Atún blanco**		***Thunnus alalunga***				**1,75(01)026,05**	**ALB**
21 Canada	51	113	56	27	54	27	25	33	10	14
China,Taiwan	465	451	143	353	344	122	4	9	10	-
Japan	492	558	20	98	267	158	75	123	20	24
St Pier Mq	-	4	-	7	2	-	3	0	-	0
USA	121	91	37	83	71	63	81	66	81	82
21 Fishing area total	*1 129*	*1 217*	*256*	*568*	*738*	*370*	*188*	*231*	*121*	*120*
27 China	-	-	-	0	5	15	9	-	-	-
China,Taiwan	423	395	176	209	476	-	29	5	-	-
France	6 006	4 346	3 455	2 448	7 232	6 584	3 179	3 009	1 123	1 299
Ireland	2 092	1 100	755	175	305	522	596	1 517	1 997	789
Japan	117	140	10	235	320	184	105	50	7	2
Portugal	411	30	10	137	125	44	39	488	53	61
Spain	7 668	7 838	11 217	14 700	19 717	24 213	14 326	12 020	9 567	12 580
UK	2	-	-	-	6	18	30	50	66	118
27 Fishing area total	*16 719*	*13 849*	*15 623*	*17 904*	*28 186*	*31 580*	*18 313*	*17 139*	*12 813*	*14 849*
31 Barbados	8	6	8	9	13	9	7	7	4	6
Belize	-	-	-	-	-	-	22	26	39	416
Bermuda	2	0	0	1	1	0	0	0	0	0
China	-	-	-	-	-	-	-	-	1	-
China,Taiwan	9 240	9 455	3 663	3 756	1 514	1 230	979	689	634	999
Dominican Rp	...	...	...	...	...	...	...	...	426	458
Grenada	21	23	46	25	29	19	22	15	19	17
Japan	281	...	461	372	616	344	64	161	145	325
Korea Rep	-	-	-	-	-	-	-	-	15	-
Panama	-	-	-	-	-	96	297	118	51	154
Philippines	-	-	-	-	9	-	8	19	54	22
St Lucia	3	2	10	5	2	2	2	2	8	13
St Vincent	1 370	300	1 555	89	802	141	423	201	185	207
Trinidad Tob	11	9	12	12	9	12	18	16	17	17
USA	8	12	8	10	16	10	21	16	38	24
Vanuatu	-	-	-	414	507	235	95	6	60	187
Venezuela	349	162	424	457	176	321	375	221	398	288
31 Fishing area total	*11 293*	*9 969*	*6 187*	*5 150*	*3 694*	*2 419*	*2 333*	*1 497*	*2 094*	*3 133*
34 Cape Verde	-	-	-	-	-	-	-	-	5	-
China	57	196	155	91	124	226	58	25	35	146
China,Taiwan	849	860	523	241	1 395	920	288	158	103	247
Côte dIvoire	-	-	-	-	-	-	-	-	72	96
France	11	18	63	16	478	347	12	50	60	109
Guatemala	-	-	-	-	-	40	-	-	-	-
Japan	275	...	187	173	205	131	48	72	134	187
Korea Rep	-	-	-	-	54	31	12	10	67	201
Morocco	-	55	81	120	178	98	96	99	130	0
NethAntilles	...	...	...	...	...	...	...	...	21	4
Panama	-	-	-	-	17	-	87	-	-	1
Portugal	765	1 924	543	166	88	76	113	155	58	51
St Vincent	4 292	44	-	-	-	-	-	-	-	-
Sierra Leone	91	...	...	...	...	...	...	...	...	...
Spain	1 509	1 114	1 312	680	731	325	256	730	49	408
Togo	-	-	-	-	-	-	-	-	-	28
UK	-	-	-	-	-	-	-	-	1	-
Vanuatu	-	-	-	-	684	1 400	96	13	80	104
34 Fishing area total	*7 849*	*4 211*	*2 864*	*1 487*	*3 954*	*3 594*	*1 066*	*1 312*	*815*	*1 582*

B-36

Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
37 Croatia	-	-	-	-	-	-	-	-	0	2
Cyprus	-	12	29	256	425	507	712	240	223	231
France	-	1	-	1	0	0	2	1	-	-
Greece	1 840	1 352	950	773	622	401	448	191	116	125
Italy	2 826	4 032	6 912	3 671	2 249	4 584	4 017	2 103	2 724	1 110
Korea Rep	-	-	-	-	-	-	-	-	2	-
Malta	-	2	-	10	15	15	1	5	1	2
Morocco	-	-	-	-	-	-	-	-	120	0
Spain	200	209	1	138	189	382	516	238	205	277
Syria	-	-	15	38	248	115	19	14	12	20
Tunisia	-	-	-	-	-	-	-	-	711	683
Turkey	-	-	-	27	30	73	852	208	631	402
37 Fishing area total	*4 866*	*5 608*	*7 907*	*4 914*	*3 778*	*6 077*	*6 567*	*3 000*	*4 745*	*2 852*
41 Argentina	-	0	12	18	0	0	0	0	0	130
Belize	-	-	-	-	-	54	32	31	213	302
Brazil	6 863	3 226	2 649	521	556	360	534	487	202	271
China	-	-	-	32	3	18	18	22	76	92
China,Taiwan	4 644	8 172	10 370	9 935	7 335	7 281	5 029	4 867	3 785	2 648
Japan	64	...	63	38	31	12	7	13	712	503
Korea Rep	-	-	-	-	-	-	-	8	19	-
Philippines	-	-	-	-	34	-	3	59	45	73
Portugal	-	-	-	-	13	6	7	42	165	116
UK	-	-	-	-	-	2	1	3	-	-
Uruguay	135	111	108	120	32	93	34	53	685	24
Vanuatu	-	-	-	-	-	-	-	131	64	-
41 Fishing area total	*11 706*	*11 509*	*13 202*	*10 664*	*8 004*	*7 826*	*5 665*	*5 716*	*5 966*	*4 159*
47 China	26	30	26	21	75	42	10	2	4	1
China,Taiwan	3 685	3 511	7 034	3 072	2 206	5 097	8 115	5 345	5 009	8 668
Japan	456	209	195	724	812	1 294	678	1 872	397	645
Korea Rep	-	-	-	37	47	81	56	129	355	39
Namibia	3 419	2 963	3 153	3 329	2 344	5 100	1 196	1 958	4 936	1 320
Philippines	-	-	-	-	18	-	10	19	-	-
Portugal	41	433	415	-	16	2	6	13	87	27
St Helena	12	2	3	2	35	62	46	94	81	3
South Africa	7 236	6 507	3 469	4 502	3 198	3 735	3 797	3 469	5 043	4 147
Spain	572	836	376	81	285	367	758	908	1 061	266
UK	-	-	-	-	-	-	4	4	1	-
Other nei	10	14	53	-	15	46	15	-	-	-
47 Fishing area total	*15 457*	*14 505*	*14 724*	*11 768*	*9 051*	*15 826*	*14 691*	*13 813*	*16 974*	*15 116*
51 Belize	1 358	550	74	44	412	704	874	287	161	141
China	1	19	25	56	50	53	84	87	205	957
China,Taiwan	4 795	7 798	7 969	12 451	7 060	8 132	15 757	14 241	10 957	10 815
France	660	264	608	77	86	850	305	952	295	29
Guinea	1	58	3	8	17	58	68	32	28	48
India	-	-	-	289	198	220	235	67	295	332
Italy	56	39	61	28	14	19	3	45	35	-
Japan	1 590	1 254	1 923	2 878	3 181	4 638	3 542	2 219	1 410	925
Korea Rep	31	7	-	126	135	237	102	98	293	152
Madagascar	-	9	9	-	67	26	33	25	24	24
Mauritius	18	8	28	39	40	52	73	215	200	100
Mayotte	13	69	0	0	13	...	30	28	...	34
Philippines	68	-	-	1	11	-	148	125	36	-
Portugal	-	-	-	-	-	9	22	6	2	18
Réunion	706	368	364	431	768	516	793	560	600	600 F
Senegal	-	-	-	-	-	58	-	-	-	-
Seychelles	716	1 173	1 263	125	166	138	442	433	180	225
South Africa	23	86	69	10	5	63	15	33	29	23
Spain	503	439	551	113	674	960	814	535	492	544
Tanzania	-	-	-	-	82	67	75	39	34	35
Thailand	4	-	16	166	122	380	115	23	24	18
UK	-	-	-	-	2	6	11	10	9	2
Uruguay	-	-	-	-	-	4	-	-	-	-
Other nei	5 580	3 635	794	328	991	574	161	104	257	249
51 Fishing area total	*16 123*	*15 776*	*13 757*	*17 170*	*14 094*	*17 764*	*23 702*	*20 164*	*15 566*	*15 271 F*
57 Australia	137	72	112	32	12	8	11	13	20	20
Belize	82	34	78	47	278	-	12	9	-	-
China	19	21	6	5	1	27	33	71	184	1 839
China,Taiwan	290	300	3 087	4 331	3 369	1 412	1 125	1 077	3 242	4 926
Guinea	...	-	-	7	-	9	7	7	6	5
India	-	-	-	305	209	233	248	71	311	350
Indonesia	3 240	2 790	5 870	12 644	11 575	7 792	13 434	17 135	14 111	16 079
Japan	1 172	1 978	523	590	421	810	1 270	2 073	1 953	2 734
Korea Rep	-	3	-	224	48	-	13	21	32	192
Madagascar	-	-	-	-	9	-	-	-	-	-
Malaysia	-	...	...	...	10	193	350	285	202	4
Philippines	-	-	-	0	-	-	4	25	35	81
Portugal	-	-	-	-	-	0	7	-	-	-
Senegal	-	-	-	-	-	9	-	-	-	-
Seychelles	157	65	66	1	1	6	67	495	177	560
Spain	...	19	24	35	196	79	56	49	47	45
Sri Lanka	-	-	-	-	-	-	1	-	-	-
Thailand	2	-	47	29	21	14	-	-	24	263
UK	-	-	-	-	0	-	3	-	0	3
Vanuatu	-	-	-	-	-	-	-	-	91	54

B-36

Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Other nei	337	220	712	336	789	317	67	120	186	265
57	*Fishing area total*	*5 436*	*5 502*	*10 525*	*18 586*	*16 939*	*10 909*	*16 708*	*21 451*	*20 621*	*27 420*
58	Japan	-	-	-	-	2	-	-	-	-	-
58	*Fishing area total*	-	-	-	-	*2*	-	-	-	-	-
61	China	528	210	396	...	...	...	...	...	...	...
	China,Taiwan	713	854	149	722	1 407	2 594	4 423	1 174	2 657	2 230
	Japan	49 507	49 507 F	52 068	48 649	28 500	30 370	58 318	35 379	51 333	38 406
	Korea Rep	-	-	-	-	97	52	68	23	-	-
61	*Fishing area total*	*50 748*	*50 571 F*	*52 613*	*49 371*	*30 004*	*33 016*	*62 809*	*36 576*	*53 990*	*40 636*
67	Canada	3 061	3 495	2 489	5 304	3 717	4 755	5 170	3 620	4 362	4 626
	China,Taiwan	310	210	37	73	57	39	0	32	-	-
	Japan	-	-	-	-	-	3	-	-	-	1
	Korea Rep	-	-	-	-	-	-	-	-	-	1
	USA	8 762	8 499	15 405	13 731	8 652	12 611	11 269	10 814	12 047	11 254
67	*Fishing area total*	*12 133*	*12 204*	*17 931*	*19 108*	*12 426*	*17 408*	*16 439*	*14 466*	*16 409*	*15 882*
71	Australia	173	345	246	220	274	1 081	2 720	1 194	1 297	1 016
	Belize	4 864	1 853	972	416	313	271	164	7	26	10
	China	2 711	2 710	5 827	4 522	3 307	5 437	4 746	14 827	19 860	10 739
	China,Taiwan	6 958	9 148	2 602	6 176	3 752	4 924	5 165	4 994	7 861	12 874
	Cook Is	-	-	-	0	22	216	146	159	67	37
	Fiji	7 971	8 026	6 881	11 290	8 901	11 802	7 145	7 650	7 166	8 221
	Indonesia	...	...	...	17 489	22 888	17 910	21 922	27 513	19 564	17 104
	Japan	8 678	8 678 F	3 018	2 265	4 332	4 929	4 024	4 375	4 505	5 755
	Kiribati	-	-	-	-	-	-	-	-	-	66
	Korea Rep	332	687	543	606	1 046	1 032	914	852	1 096	757
	Marshall Is	-	-	-	-	-	-	-	15	10	17
	Micronesia	3	0	1	0	0	0	0	0	40	49
	Nauru	...	...	2	0	...	...	...	...	...	...
	NewCaledonia	1 020	1 165	1 111	1 468	1 590	1 358	1 324	1 506	1 649	1 939
	Palau	0	0	0	0	-	-	-	-	-	-
	Papua N Guin	124	142	857	1 681	2 256	1 811	1 598	464	906	883
	Solomon Is	54	121	95	207	...	...	...	...	...	7 966
	Vanuatu	655	6 756	4 903	9 566	9 339	8 804	8 388	5 582	7 992	12 293
	Viet Nam	...	...	...	...	...	...	...	...	...	4
71	*Fishing area total*	*33 543*	*39 631 F*	*27 058*	*55 906*	*58 020*	*59 575*	*58 256*	*69 138*	*72 039*	*79 730*
77	Amer Samoa	3 233	5 951	3 931	2 462	2 936	4 078	5 183	3 550	3 885	3 947
	China	1 624	1 327	915	2 130	1 354	1 575	653	398	360	1 478
	China,Taiwan	6 729	6 675	5 978	10 324	8 004	3 129	3 709	3 073	2 566	3 894
	Cook Is	204	693	2 046	2 245	2 460	2 344	2 697	2 224	1 551	2 423
	Ecuador	-	-	-	-	-	-	-	-	3	-
	Fr Polynesia	4 432	4 678	3 930	2 361	2 524	3 091	3 984	3 241	3 792	3 687
	Japan	3 285	3 285 F	1 916	1 094	1 940	1 010	1 350	1 146	397	962
	Korea Rep	1 557	1 791	1 252	742	1 436	573	654	542	540	734
	Mexico	40	68	92	102	4	50	25	49	49	60
	Niue	...	...	...	...	55	213	137	7	147	97
	Samoa	4 820	4 223	2 253	1 233	1 263	2 113	3 113	2 342	2 816	2 529
	Tonga	1 268	1 189	611	182	283	414	390	220	124	57
	USA	3 814	2 251	1 828	1 124	717	466	849	638	478	722
77	*Fishing area total*	*31 006*	*32 131 F*	*24 752*	*23 999*	*22 976*	*19 056*	*22 744*	*17 430*	*16 708*	*20 590*
81	Australia	222	332	248	330	353	217	94	190	224	190
	Canada	206	144	-	63	72	135	27	-	-	-
	China	-	-	-	-	108	492	112	-	-	5 366
	China,Taiwan	5 491	9 710	8 052	2 024	1 568	4 373	2 623	1 548	2 054	3 687
	Cook Is	-	1	2	1	-	18	55	13	-	63
	Japan	2 415	2 415 F	1 877	3 058	2 979	1 233	1 146	908	1 087	896
	Korea Rep	-	-	-	-	-	-	-	54	32	68
	New Zealand	5 356	5 558	6 693	4 461	3 460	2 542	2 093	3 734	2 217	2 319
	Spain	-	-	-	5	4	-	-	66	70	7
	USA	5 942	6 735	-	-	-	-	-	-	-	-
81	*Fishing area total*	*19 632*	*24 895 F*	*16 872*	*9 942*	*8 544*	*9 010*	*6 150*	*6 513*	*5 684*	*12 596*
87	Chile	5	40	1	8	7	5	0	2	3	-
	China	-	-	-	43	230	35	2	4	12	29
	China,Taiwan	866	987	153	1 876	1 454	831	300	159	402	640
	Cook Is	-	-	-	-	-	-	20	-	-	-
	Japan	864	864 F	629	1 622	1 540	1 569	1 011	787	1 422	675
	Korea Rep	-	-	-	-	14	-	14	-	1	10
	Spain	-	-	-	-	-	-	-	114	5	-
	Other nei	-	-	2	-	-	-	-	-	-	-
87	*Fishing area total*	*1 735*	*1 891 F*	*785*	*3 549*	*3 245*	*2 440*	*1 347*	*1 066*	*1 845*	*1 354*
Species total		*239 375*	*243 469 F*	*225 056*	*250 086*	*223 655*	*236 870*	*256 978*	*229 512*	*246 390*	*255 290 F*

Southern bluefin tuna — **Thon rouge du Sud** — **Atún rojo del Sur** — ***Thunnus maccoyii*** — **1,75(01)026,08** — **SBF**

41	China,Taiwan	-	-	7	-	-	-	-	-	-	-
	Japan	-	-	-	-	-	-	-	-	1	1
	Portugal	-	-	-	-	-	-	8	-	-	-
	Uruguay	1	1	0	-	-	-	-	-	-	-
41	*Fishing area total*	*1*	*1*	*7*	-	-	-	*8*	-	*1*	*1*
47	China,Taiwan	76	95	108	18	2	-	-	4	3	5
	Japan	2 421	1 246	2 162	924	1 914	928	273	1 220	696	584

B-36 **Tunas, bonitos, billfishes**
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Korea Rep	19	-	-	-	1	37	42	229	277	1
Namibia	-	0	-	-	1	-	-	-	-	-
Portugal	-	-	-	-	-	-	2	-	-	-
South Africa	1	17	14	10	1	2	4	28	1	30
Vanuatu	-	-	-	-	-	1	-	-	-	-
47 Fishing area total	*2 517*	*1 358*	*2 284*	*952*	*1 919*	*968*	*321*	*1 481*	*977*	*620*
51 Belize	123	98	-	-	-	-	-	-	-	-
China,Taiwan	1 473	740	550	1 279	169	174	152	157	280	396
Japan	1 232	760	704	2 148	1 657	1 490	888	192	155	503
Korea Rep	363	513	215	75	32	93	376	432	595	367
Philippines	43	79	57	51	53	50	45	44	-	-
Portugal	-	-	-	-	8	77	3	-	-	-
Seychelles	169	185	-	-	-	-	-	0	121	0
South Africa	0	2	0	6	3	8	12	-	17	5
Spain	-	-	2	17	2	13	-	-	-	-
Thailand	-	-	-	-	-	-	82	27	-	-
UK	-	-	-	22	-	-	-	174	-	-
Other nei	122	-	-	-	-	-	-	-	-	-
51 Fishing area total	*3 525*	*2 377*	*1 528*	*3 598*	*1 924*	*1 905*	*1 558*	*1 026*	*1 168*	*1 271*
57 Australia	5 463	4 929	5 618	5 180	5 332	5 852	4 822	4 431	4 321	3 660
Belize	37	30	-	-	-	-	-	-	-	-
China	-	-	14	-	-	-	-	-	-	-
China,Taiwan	106	254	461	980	768	788	689	714	623	820
Indonesia	1 472	1 778	564	633	1 724	598	1 079	1 128	641	736
Japan	1 907	2 279	701	1 648	2 243	1 848	1 615	1 123	1 287	519
Korea Rep	347	136	6	39	-	-	35	325	99	311
Philippines	0	-	8	7	-	-	1	1	-	-
Seychelles	69	56	-	-	-	-	-	-	-	-
Spain	-	-	2	5	1	2	-	-	-	-
Thailand	-	-	-	-	1	-	-	-	-	-
Other nei	37	-	-	-	-	-	-	-	-	-
57 Fishing area total	*9 438*	*9 462*	*7 374*	*8 492*	*10 069*	*9 088*	*8 241*	*7 722*	*6 971*	*6 046*
71 Australia	-	1	0	-	2	-	-	-	0	8
Japan	-	-	-	-	-	-	-	-	-	1
71 Fishing area total	*-*	*1*	*0*	*-*	*2*	*-*	*-*	*-*	*0*	*9*
81 Australia	98	41	27	55	201	30	8	15	44	184
China,Taiwan	-	-	2	2	1	1	1	1	6	5
Japan	1 680	1 680 F	1 916	1 110	827	549	326	420	561	617
New Zealand	358	450	389	395	264	238	378	318	419	500
81 Fishing area total	*2 136*	*2 171 F*	*2 334*	*1 562*	*1 293*	*818*	*713*	*754*	*1 030*	*1 306*
87 Japan	-	-	-	-	1	-	-	-	-	-
87 Fishing area total	*-*	*-*	*-*	*-*	*1*	*-*	*-*	*-*	*-*	*-*
Species total	*17 617*	*15 370 F*	*13 527*	*14 604*	*15 208*	*12 779*	*10 841*	*10 983*	*10 147*	*9 253*

Yellowfin tuna	**Albacore**		**Rabil**		***Thunnus albacares***				**1,75(01)026,10**	**YFT**
21 Canada	125	70	73	304	240	292	276	170	53	166
China,Taiwan	143	95	10	11	-	-	1	-	-	-
Japan	12	...	0	25	64	60	20	1	1	25
USA	740	420	354	697	442	751	858	397	345	482
21 Fishing area total	*1 020*	*585*	*437*	*1 037*	*746*	*1 103*	*1 155*	*568*	*399*	*673*
27 China	-	-	-	8	878	9	2	-	-	-
China,Taiwan	11	40	4	2	1	-	6	-	-	-
France	-	-	-	-	-	-	-	-	-	7
Ireland	3	-	0	-	-	-	0	-	-	-
Japan	2	...	0	6	-	-	-	-	-	-
Portugal	2	2	0	0	52	156	697	360	845	291
Spain	101	54	128	5	8	81	17	12	23	30
UK	-	-	-	-	-	-	-	-	-	23
27 Fishing area total	*119*	*96*	*132*	*21*	*939*	*246*	*722*	*372*	*868*	*351*
31 Barbados	166	125	178	211	292	197	154	156	79	129
Belize	-	-	-	-	-	-	637	482	725	1 480
Bermuda	37	48	47	82	61	31	30	15	42	37
Br Virgin Is	4	3	3	2	2 F	1	1 F	0	0	0
China	-	-	-	-	-	-	-	2	4	-
China,Taiwan	995	527	502	500	43	376	468	42	30	3
Colombia	46	46	1 228	335	150	180 F	210 F	240 F	264	941
Cuba	156	65	71	19	19	19	36	2	2	8
Dominica	120	169	119	81	119	71	113	124	112	110
Dominican Rp	263	50	515	204	110	381	191	260	586	630
Grenada	759	593	749	460	493	502	698	756	630	956
Japan	860	545	547	831	792	140	281	786	873	1 053
Korea Rep	-	-	-	-	-	-	-	-	30	24
Mexico	1 084	1 380	1 552	1 624	1 240	1 295	1 063	1 075	1 183	1 071
Panama	-	-	-	-	-	2 804	228	152	288	2 134
Philippines	2	49	58	222	80	39	40	29	59	22
Portugal	-	-	-	-	2	4	-	-	1	-
Puerto Rico	24	10	19	12	19	18	15	7	6	4
St Lucia	145	97	139	147	172	103	82	106	109	223
St Vincent	1 365	1 160	568	4 251	...	2 680	2 990	2 547	2 275	854
Spain	-	-	-	-	-	1	40	28	9	27

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Trinidad Tob	122	125	186	224	295	459	615	520	629	788
	Turks Caicos	-	-	-	0	...	0	1	0	...	...
	USA	1 443	1 856	1 781	1 818	1 287	1 207	1 451	806	1 245	463
	Vanuatu	-	-	-	681	689	547	555	169	275	406
	Venezuela	18 651	11 421	7 411	5 773	5 097	6 515	3 911	3 272	3 199	4 784
	Other nei	791	41	112	-	-	-	-	-	-	-
31	*Fishing area total*	*27 033*	*18 310*	*15 785*	*17 477*	*10 962 F*	*17 570 F*	*13 810 F*	*11 576 F*	*12 655*	*16 147*
34	Belize	...	...	-	-	-	-	-	-	-	273
	Benin	1	...	...	5	...	...	...	...	...	...
	Cape Verde	1 684	1 802	1 868	3 236	7 154	8 112	4 057	8 413	3 274	4 492
	China	586	262	1 033	902	275	817	828	462	267	299
	China,Taiwan	2 072	1 671	2 660	3 352	1 958	509	878	767	902	547
	Côte dIvoire	213	99	302	565	175	482	216	626	410	470
	Cuba	32	-	-	-	-	-	-	-	-	-
	Eq Guinea	-	-	-	-	-	-	-	-	892	892
	France	32 211	32 735	32 429	23 949	22 671	18 940	11 331	16 115	18 923	20 272
	Gabon	270	245	44	6	2	0	...	...	...	...
	Gambia	1	26	55	1	-	1	-	-	-	-
	Ghana	33 546	23 675	18 457	15 054	17 493	11 931	15 463	14 250	18 355	12 511
	Guatemala	-	-	-	-	2 906	5 265	3 461	3 736	2 603	3 124
	Guinea	-	-	-	-	-	-	-	-	-	730
	Italy	-	-	-	-	-	-	410	-	-	-
	Japan	1 136	753	1 439	4 475	2 995	3 800	6 567	3 971	2 510	1 908
	Korea Rep	-	-	26	-	32	212	307	684	307	463
	Latvia	72	334	182	604	648	109	73	621	649	200
	Liberia	166	170	140	369	119	107	290	25	25 F	25 F
	Libya	208	73	73	-	-	-	-	-	-	-
	Morocco	-	79	108	95	183	95	102	110	110	44
	Netherlands	-	-	-	-	-	-	-	-	1	1
	NethAntilles	4 793	4 035	6 185	4 161	...	1 939	1 368	7 351	6 293	5 302
	Panama	574	1 022	-	1 887	6 170	8 557	9 363	6 175	5 813	5 048
	Philippines	0	43	-	24	-	6	16	-	-	11
	Portugal	2	4	3	4	57	111	113	94	182	201
	Russian Fed	-	-	-	-	3	42	211	42	33	-
	St Vincent	-	5	-	14	-	101	209	83	74	28
	Sao Tome Prn	122	122	122	134	144	137	137 F	160	165	169
	Senegal	295	447	279	681	1 301	1 262	819	588	1 279	1 212
	Spain	30 937	31 261	24 709	21 378	11 777	11 381	13 535	24 342	32 735	25 400
	Togo	-	-	-	-	-	-	-	-	-	2
	Vanuatu	-	-	-	-	24	145	483	450	331	23
	Other nei	13 724	8 942	6 852	5 345	2 714	1 281	655	626	459	533
34	*Fishing area total*	*122 645*	*107 805*	*96 966*	*86 241*	*78 801*	*75 342*	*70 892 F*	*89 691*	*96 592 F*	*84 180 F*
41	Argentina	-	-	-	-	-	-	-	-	5	0
	Belize	-	-	-	-	-	143	527	679	264	305
	Brazil	6 238	6 173	3 502	6 985	7 223	3 790	5 468	2 750	3 313	3 669
	China	470	435	17	300	-	107	173	130	181	127
	China,Taiwan	642	775	1 890	663	675	214	167	130	183	69
	Japan	192	...	127	191	185	96	75	133	321	298
	Korea Rep	-	-	-	-	-	-	-	10	22	32
	Philippines	10	30	86	77	150	195	110	138	82	45
	Portugal	-	-	-	-	58	56	88	181	218	98
	Spain	-	-	-	-	-	-	44	53	60	18
	Uruguay	90	91	95	204	644	218	35	66	76	122
	Vanuatu	-	-	-	-	-	114	-	704	541	314
41	*Fishing area total*	*7 642*	*7 504*	*5 717*	*8 420*	*8 935*	*4 933*	*6 687*	*4 974*	*5 266*	*5 097*
47	Angola	34	34	34	34	111	669	405	...	3 914	98
	China	-	-	-	96	32	152	122	56	10	2
	China,Taiwan	1 140	1 058	1 420	1 298	919	162	427	183	276	205
	Japan	1 117	753	715	1 072	796	1 096	2 171	1 447	1 340	1 518
	Korea Rep	21	-	183	871	565	38	200	299	68	71
	Namibia	165	88	139	86	135	59	28	11	1	9
	Philippines	0	8	9	44	13	25	72	53	10	10
	Portugal	0	-	-	-	-	8	37	1	4	2
	St Helena	72	90	158	226	255	363	177	97	104	65
	Seychelles	-	11	-	-	-	-	-	-	-	-
	South Africa	342	152	298	402	1 156	1 208	1 064	351	303	234
	Spain	66	155	47	32	10	143	32	55	36	129
	UK	-	-	-	-	-	-	1	-	-	-
47	*Fishing area total*	*2 957*	*2 349*	*3 003*	*4 161*	*3 992*	*3 923*	*4 736*	*2 553*	*6 066*	*2 343*
51	Belize	2 350	5 188	271	339	155	143	114	91	51	14
	Br Ind Oc Tr	-	26	26	26	26	10	11	1	2	8
	China	483	878	2 182	3 572	4 166	3 806	2 676	858	425	210
	China,Taiwan	18 064	21 747	22 783	42 312	52 341	23 271	16 502	6 261	3 515	2 361
	Comoros	5 200	5 600	5 800	5 900	5 900	5 900 F	6 000 F	7 997	7 997 F	7 997 F
	France	34 077	36 399	63 281	63 521	57 218	44 128	32 731	37 514	22 580	22 486
	Guinea	1	47	13	1	13	15	9	12	11	9
	India	3 686	5 982	5 742	5 986	7 718	8 009	12 492	8 692	9 251	10 284
	Iran	20 153	24 070	37 722	51 601	43 572	40 722	16 283	19 482	22 596	31 485
	Italy	1 332	1 746	5 930	8 085	4 959	4 337	1 886	2 900	1 523	-
	Japan	10 767	13 022	18 428	15 104	21 261	22 260	17 809	9 896	4 386	3 054
	Jordan	5	5	4	3	3	4	3	4	10	8
	Korea Rep	1 240	242	1 679	2 744	2 446	3 209	3 220	995	894	656
	Madagascar	6 869	7 410	7 400	8 008	7 936	7 891	8 657	6 855	6 855	6 855
	Maldives	13 656	20 603	18 825	21 394	20 512	21 772	20 661	22 609	19 611	12 412
	Mauritius	125	110	131	128	151	208	193	180	125	100

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Mayotte	3 558	1 645	220	392	302	1 188	4 098	4 895	5 483	8 532
	Mozambique	-	-	-	-	0	1	0	1	1	0
	Oman	7 945	7 114	10 236	24 310	21 969	17 524	19 848	7 046	7 021	3 202
	Pakistan	3 603	2 940	3 122	2 944	4 853	4 545	4 489	4 697	5 243	9 232
	Philippines	261	282	1 579	920	2 775	1 778	676	721	78	158
	Portugal	19	29	50	12	19	21	16	0	40	84
	Réunion	610	544	586	751	935	827	706	473	475	475 F
	Senegal	-	-	1	2	-	15	-	-	-	-
	Seychelles	13 355	17 104	34 633	52 763	44 784	31 003	18 272	21 204	21 811	25 911
	South Africa	149	181	677	53	65	177	136	118	86	134
	Spain	47 734	53 524	78 968	80 815	77 540	71 056	37 841	46 126	33 120	45 278
	Tanzania	800	700	650	650	545	622	120	125	121	127
	Thailand	208	6	2	148	2 348	2 507	1 083	1 023	1 117	48
	UK	-	-	-	-	-	-	-	-	118	22
	Uruguay	-	-	-	-	-	13	-	-	-	-
	Yemen	25 168	27 201	25 309	31 268	26 360	19 200	15 797	13 667	14 800 F	15 900 F
	Other nei	30 089	23 403	36 204	19 856	12 681	1 885	2 721	3 776	6 016	4 857
51	*Fishing area total*	*251 507*	*277 748*	*382 454*	*443 608*	*423 553*	*338 047 F*	*245 050 F*	*228 219*	*195 362 F*	*211 899 F*
57	Australia	572	362	196	154	37	46	33	17	13	25
	Belize	103	235	71	89	24	-	1	0	-	-
	China	1 288	447	97	208	94	50	149	39	28	287
	China,Taiwan	4 636	6 113	2 043	14 391	15 268	11 406	9 207	10 310	9 956	11 439
	France	-	-	-	-	-	192	2	-	53	13
	Guinea	...	-	-	1	-	2	1	3	2	1
	India	476	1 172	1 033	1 980	2 783	4 882	8 845	6 334	6 543	10 539
	Indonesia	32 936	28 604	24 395	20 837	17 563	13 414	13 663	12 945	11 081	12 045
	Japan	2 821	1 445	1 087	785	1 113	821	1 668	1 573	998	678
	Korea Rep	161	90	421	1 324	849	1	232	15	9	46
	Madagascar	-	-	-	-	34	-	-	-	-	-
	Malaysia	-	202	526	592	2 229	1 090	1 229	1 242	1 000	576
	Philippines	26	24	60	1 084	105	67	435	78	247	143
	Senegal	-	-	-	-	1	2	-	-	-	-
	Seychelles	37	37	100	83	36	36	79	141	89	91
	Spain	-	9	-	6	6	20	8	35	487	21
	Sri Lanka	26 522	28 085	34 425	35 512	24 887	35 842	32 998	32 933	38 703	48 759
	Thailand	242	63	66	3	0	86	278	60	72	...
	Timor-Leste	3	3 F	3 F	3 F	3 F	3 F	3 F	3 F	3 F	3 F
	UK	-	-	-	-	-	-	-	-	2	28
	Vanuatu	-	-	-	-	-	-	-	-	103	94
	Other nei	587	1 425	685	2 746	1 350	770	296	127	175	207
57	*Fishing area total*	*70 410*	*68 316 F*	*65 208 F*	*79 798 F*	*66 382 F*	*68 730 F*	*69 127 F*	*65 855 F*	*69 564 F*	*84 995 F*
61	China	1 079	1 020	4 022	...	...	...	...	...	...	...
	China,Taiwan	1 568	2 906	2 622	3 766	8 380	11 688	13 741	12 542	13 133	13 683
	Japan	12 698	12 698 F	11 440	4 147	4 786	4 385	4 807	14 419	13 600	14 046
	Korea Rep	-	-	-	-	14	54	25	16	3	1
61	*Fishing area total*	*15 345*	*16 624 F*	*18 084*	*7 913*	*13 180*	*16 127*	*18 573*	*26 977*	*26 736*	*27 730*
67	Korea Rep	-	-	-	-	-	-	-	-	-	8
	USA	13	-	-	0	0	-	-	-	-	-
67	*Fishing area total*	*13*	-	-	*0*	*0*	-	-	-	-	*8*
71	Australia	1 031	1 356	1 679	1 004	958	781	1 227	717	1 029	878
	Belize	957	720	943	208	298	106	273	129	121	28
	China	2 359	1 371	2 713	2 384	11 065	7 194	8 086	14 920	12 545	11 311
	China,Taiwan	78 374	61 452	57 262	26 813	34 299	26 887	23 871	37 986	19 898	35 196
	Cook Is	-	-	-	-	7	65	85	88	34	40
	Fiji	2 167	2 112	2 567	4 249	2 074	2 316	1 806	2 807	2 564	2 777
	Guam	27	20	31	46	17	13	22	9	23	11
	Indonesia	98 543	106 292	93 362	52 042	47 675	63 822	73 980	78 574	80 091	82 496
	Japan	52 710	52 710 F	32 713	28 076	33 433	35 631	33 828	39 764	41 613	49 552
	Kiribati	1 411	2 943	2 218	1 778	2 997	2 277	4 347	4 336	4 539	4 533
	Korea Rep	40 428	34 728	43 738	28 964	43 568	47 551	46 437	65 971	31 998	63 490
	Malaysia	-	-	-	-	146	-	-	...	749	1 557
	Marshall Is	2 930	1 049	2 129	3 719	7 628	1 436	3 372	4 247	1 697	6 951 F
	Micronesia	5 552	4 651	5 618	3 599	3 959	1 228	1 996	2 227	2 390	2 903 F
	Nauru	5	10	18	6	12	12 F	11 F	10 F	9 F	8 F
	NewCaledonia	570	572	754	631	448	414	393	424	487	505
	New Zealand	917	4 469	3 301	3 639	2 485	2 146	2 329	3 201	1 264	...
	N Marianas	16	7	12	12	22	20	16	8	11	15
	Palau	41	3	19	28	0	-	-	-	-	-
	Papua N Guin	24 234	27 197	35 889	27 170	49 813	41 363	42 581	53 298	44 690	41 500 F
	Philippines	75 919	90 669	115 606	117 705	114 027	113 397	134 492	168 411	152 437	147 276
	Solomon Is	4 410	3 529	6 431	8 840	6 630	9 550	6 546	7 749	8 133	3 197
	Spain	467	-	-	1 219	322	2 107	4 146	4 769	3 138	3 500
	Tuvalu	20 F	20 F	100	1 000	1 000	900 F	800 F	700 F	399	950 F
	USA	27 217	22 528	9 959	8 404	4 343	4 031	3 609	6 426	8 183	11 358
	Vanuatu	2 432	778	1 315	1 322	936	799	967	539	514	788
	Viet Nam	...	...	...	...	...	...	...	...	...	9 513
71	*Fishing area total*	*422 737 F*	*419 186 F*	*418 377*	*322 858*	*368 162*	*364 046 F*	*395 220 F*	*497 310 F*	*418 556 F*	*480 333 F*
77	Amer Samoa	191	490	500	891	529	517	644	342	399	469
	Belize	10	...	...	...	...	...	...	...	...	...
	China	1 994	1 457	1 425	3 015	1 548	2 072	1 548	1 218	1 461	1 142
	China,Taiwan	1 750	685	5 104	8 789	7 858	2 560	2 253	1 727	3 147	2 737
	Colombia	9 394	14 773	5 421	2 122	1 692	970	4 803	3 842	7 398	8 299
	Cook Is	1	45	178	506	413	262	290	247	197	319
	Ecuador	3 963	5 607	8 506	4 808	3 367	6 216	4 772	4 603	5 458	5 136

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
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Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	El Salvador	2 165	3 434	6 618	12 931	6 673	7 539	4 396	5 910	5 735	2 612
	Fr Polynesia	1 514	1 163	909	1 620	1 387	1 484	1 089	939	1 193	974
	Guatemala	2 149	2 387	3 041	838	1 293	526	916	1 061	574	1 215
	Honduras	72	...	...	145	9	94	99	...	52	13
	Japan	10 392	10 392 F	6 876	6 354	3 146	3 166	3 441	3 407	3 587	3 516
	Korea Rep	15 208	13 702	6 130	6 316	4 993	4 749	3 574	2 413	3 140	1 992
	Mexico	127 000	144 383	130 778	124 158	98 173	75 929	77 303	81 696	104 651	93 100
	Nicaragua	1 119	2 768	-	3 853	6 927	6 626	4 953	4 149	5 499	8 418
	Niue	...	...	...	4	36	43	30	8	20	8
	Panama	6 267	15 441	19 962	17 812	18 936	17 871	18 926	12 648	16 465	16 956
	Samoa	470	369	293	444	199	264	305	317	412	386
	Spain	3 007	2 838	3 315	2 985	1 880	3 393	897	795	1 511	611
	Tokelau	...	2	1	1	1	2	2	2	3	...
	Tonga	259	263	263	163	219	227	341	291	109	47
	USA	5 188	7 531	11 137	11 257	7 050	5 846	5 608	8 695	9 352	12 449
	Vanuatu	4 523	2 158	1 493	776	319	233	393	360	293	508
	Venezuela	54 497	91 881	60 944	33 038	32 400	12 633	16 775	11 340	20 196	21 440
	Other nei	9 756	20 057	13 465	930	35	2	-	-	-	-
77	*Fishing area total*	*260 889*	*341 826 F*	*286 359*	*243 756*	*199 083*	*153 224*	*153 358*	*146 010*	*190 852*	*182 347*
81	Australia	896	1 111	1 716	1 432	997	601	573	547	629	569
	China	-	-	-	-	13	19	11	-	-	240
	China,Taiwan	174	128	329	69	49	272	61	53	119	93
	Cook Is	-	0	0	0	-	1	0	0	-	2
	Japan	567	567 F	1 040	897	443	321	236	136	93	104
	Korea Rep	419	16	-	-	-	-	-	348	327	288
	New Zealand	137	27	39	36	40	14	25	12	84	165
81	*Fishing area total*	*2 193*	*1 849 F*	*3 124*	*2 434*	*1 542*	*1 228*	*906*	*1 096*	*1 252*	*1 461*
87	Belize	394	...	...	...	...	...	...	...	...	...
	Chile	66	15	73	86	110	79	76	74	47	30
	China	-	-	-	42	155	18	9	40	14	48
	China,Taiwan	5	-	218	293	210	336	78	2	8	50
	Colombia	16 085	15 975	41 824	19 603	21 916	12 989	15 798	17 506	23 614	13 520
	Ecuador	47 973	30 775	32 292	40 241	40 221	22 542	17 558	16 432	18 238	21 429
	Guatemala	3 725	...	...	8	952	374	244	853	2 765	1 270
	Honduras	2 568	...	...	1 370	2 758	1 866	898	770	427	409
	Japan	5 192	5 192 F	3 366	3 301	1 791	918	2 415	2 673	1 128	705
	Korea Rep	1 480	-	15	-	7	17	45	-	8	67
	Mexico	7 410	2 820	1 770	6 360	2 699	535	...	...	...	...
	Nicaragua	2 616	...	-	33	384	987	923	1 353	2 813	1 504
	Panama	5 409	3 938	8 732	14 114	11 023	8 746	11 166	15 369	16 277	10 729
	Peru	4 175	5 967	9 592	4 628	12 080	11 429	4 080	3 840	2 520	12 512
	Portugal	-	-	-	-	-	-	11	-	-	-
	Spain	8 430	2 033	1 141	1 208	1 084	704	67	340	202	37
	USA	9	496	539	965	965	283	232	752	628	...
	Vanuatu	6 408	3 543	3 303	1 403	1 077	530	279	725	626	462
	Venezuela	49 241	23 883	29 783	23 365	11 082	5 734	8 655	11 073	8 114	4 560
	Other nei	10 191	17 418	24 369	11 694	161	331	164	1	1	400
87	*Fishing area total*	*171 377*	*112 055 F*	*157 017*	*128 714*	*108 675*	*68 418*	*62 698*	*71 803*	*77 430*	*67 732*
Species total		*1 355 887 F*	*1 374 253 F*	*1 452 663 F*	*1 346 438 F*	*1 284 952 F*	*1 112 937 F*	*1 042 934 F*	*1 147 004 F*	*1 101 598 F*	*1 165 296 F*

Bigeye tuna **Thon obèse(=Patudo)** **Patudo** ***Thunnus obesus*** **1,75(01)026,12** **BET**

21	Canada	241	279	182	143	193	197	144	134	112	103
	China,Taiwan	2	-	4	18	15	-	1	1	1	-
	Japan	342	...	21	147	304	142	46	20	136	96
	Portugal	-	-	-	-	-	-	0	2	0	-
	St Pier Mq	-	21	-	28	6	-	2	3	-	2
	USA	453	267	132	192	226	398	268	248	212	225
21	*Fishing area total*	*1 038*	*567*	*339*	*528*	*744*	*737*	*461*	*408*	*461*	*426*
27	China	-	-	-	10	4 673	58	5	-	-	-
	China,Taiwan	20	45	10	3	13	-	8	-	-	-
	France	28	44	3	3	306	11	237	-	1	0
	Ireland	10	-	-	0	33	-	3	-	-	-
	Japan	339	...	42	159	98	21	12	12	2	1
	Portugal	425	1 467	251	911	1 058	1 185	1 358	1 450	2 745	2 651
	Spain	559	427	295	228	609	15	149	90	112	146
27	*Fishing area total*	*1 381*	*1 983*	*601*	*1 314*	*6 790*	*1 290*	*1 772*	*1 552*	*2 860*	*2 798*
31	Barbados	15	12	16	19	27	18	14	14	7	12
	Belize	-	-	-	-	-	-	36	44	46	162
	Bermuda	0	0	0	1	1	0	0	0	0	0
	China	-	-	-	-	-	-	-	9	37	-
	China,Taiwan	114	379	567	1 443	115	573	356	150	337	28
	Dominica	5	...	...	-	-	-	0	0	-	-
	Grenada	-	-	1	2	2	4	11	31	0	0
	Japan	2 719	1 021	2 581	2 700	2 088	1 189	637	659	527	456
	Korea Rep	-	-	-	-	-	-	-	-	178	97
	Mexico	2	7	4	5	4	3	3	1	1	3
	Philippines	34	638	267	820	530	183	325	432	419	340
	Portugal	-	-	-	-	1	4	-	-	1	-
	St Lucia	1	2	2	0	2	2	0	0	1	0
	St Vincent	506	13	103	18	...	114	567	171	291	396
	Spain	-	-	-	-	-	-	164	121	143	175
	Trinidad Tob	11	30	6	5	9	12	27	69	56	40
	USA	67	63	62	39	45	68	85	118	154	20

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Vanuatu	-	-	-	104	96	21	4	1	1	11
Venezuela	708	629	516	1 060	243	261	318	122	229	85
31 Fishing area total	*4 182*	*2 794*	*4 125*	*6 216*	*3 163*	*2 452*	*2 547*	*1 942*	*2 428*	*1 825*
34 Benin	...	...	5	...	4	19	15	58	25	9
Cape Verde	-	1	1	1	1 092	1 437	1 147	1 069	827	1 164
China	2 897	3 044	5 503	4 060	1 287	4 842	4 349	3 134	2 171	3 853
China,Taiwan	8 279	6 240	9 029	6 778	5 742	950	5 673	4 913	4 821	5 679
Côte dIvoire	-	-	-	-	-	-	-	-	790	576
Cuba	1	-	-	-	-	-	-	-	-	-
Eq Guinea	-	-	-	-	-	-	-	-	50	...
France	4 948	4 249	3 940	2 926	2 510	2 973	1 391	1 130	2 312	3 329
Gabon	121	...	...	...	0	0	...	21	14 F	14 F
Ghana	12 041	7 106	13 557	14 901	13 916	9 141	13 267	9 269	10 554	6 769
Guatemala	-	-	-	-	998	949	836	998	913	1 011
Japan	8 625	6 000	7 407	6 839	7 656	8 563	9 710	8 613	9 983	8 264
Korea Rep	-	-	27	-	416	1 574	1 862	2 063	1 378	1 749
Liberia	175	175	145	112	32	29	377	144	140 F	140 F
Libya	31	593	593	-	-	4	-	-	-	-
Morocco	857	913	889	929	519	887	700	802	795	276
NethAntilles	2 803	1 879	2 758	3 343	...	416	252	1 721	2 348	2 688
Panama	89	63	-	1 521	2 310	2 415	2 922	2 263	2 405	3 047
Philippines	-	51	-	232	-	35	143	-	-	49
Portugal	1 181	1 123	1 071	2 034	1 942	3 744	3 859	1 534	2 574	1 301
Russian Fed	-	-	-	-	1	1	26	-	43	-
St Vincent	-	1	-	-	-	-	-	-	-	-
Sao Tome Prn	4	4	4	11	6	4	4 F	92	94	97
Senegal	1 308	565	474	561	721	1 267	805	926	1 042	858
Sierra Leone	2	...	...	...	...	...	...	...	...	...
Spain	9 364	9 813	10 398	7 721	6 905	7 437	6 263	7 222	11 623	10 513
Togo	26	66	100	97	16	45	3	100 F	213	30
UK	-	-	-	-	-	3	-	14	32	-
Vanuatu	-	-	-	-	13	14	128	3	1	31
Other nei	12 016	2 997	2 865	1 770	633	466	238	228	381	-
34 Fishing area total	*64 768*	*44 883*	*58 766*	*53 836*	*46 719*	*47 215*	*53 970 F*	*46 317 F*	*55 529 F*	*51 447 F*
41 Belize	-	-	-	-	-	4	24	27	14	86
Brazil	2 660	2 583	2 456	1 493	1 081	1 478	1 595	958	1 175	1 151
China	-	-	-	1 844	-	831	1 642	1 250	2 579	1 586
China,Taiwan	3 732	5 417	2 627	1 011	1 298	600	672	1 144	1 254	1 384
Japan	1 133	1 814	2 008	2 256	1 647	1 057	631	1 560	1 597	1 300
Korea Rep	-	-	-	-	-	-	-	51	211	259
Philippines	314	141	541	513	1 089	1 409	1 203	1 247	1 108	785
Portugal	-	-	45	30	100	95	231	376	242	191
Spain	150	149	427	149	80	1	69	11	78	-
UK	-	-	-	-	-	4	2	21	-	-
Uruguay	51	67	59	40	62	83	22	27	201	23
Vanuatu	-	-	-	-	-	17	-	87	33	0
41 Fishing area total	*8 040*	*10 171*	*8 163*	*7 336*	*5 357*	*5 579*	*6 091*	*6 759*	*8 492*	*6 765*
47 Angola	-	-	-	476	75	...	...	...	...	...
China	4 313	2 795	2 387	642	241	1 468	1 403	1 293	187	50
China,Taiwan	8 895	9 436	6 445	7 146	4 801	841	5 406	4 210	6 839	6 098
Japan	4 926	6 600	8 102	5 347	3 479	5 777	7 114	6 067	4 230	5 206
Korea Rep	4	-	116	557	265	255	274	485	360	552
Namibia	639	273	215	177	307	283	41	146	108	181
Philippines	29	8	47	290	123	190	698	195	353	226
Portugal	-	-	288	25	46	41	123	61	41	19
St Helena	5	5	4	7	18	25	18	28	17	11
Seychelles	-	162	-	-	-	-	-	-	-	-
South Africa	239	340	112	270	222	99	170	224	159	145
Spain	60	184	-	267	24	...	31	50	9	438
UK	-	-	-	-	-	16	61	23	3	-
47 Fishing area total	*19 110*	*19 803*	*17 716*	*15 204*	*9 601*	*8 995*	*15 339*	*12 782*	*12 306*	*12 926*
51 Belize	2 114	2 538	525	447	108	34	150	118	16	31
China	890	1 917	4 258	7 237	8 070	8 289	6 511	4 636	2 261	2 910
China,Taiwan	48 908	42 737	48 151	51 807	30 892	29 027	29 058	16 377	19 152	8 633
Comoros	30	32	35	35	35	35 F	35 F	47	47 F	47 F
France	5 453	7 325	5 335	5 813	6 481	5 039	6 069	6 742	5 757	3 575
Guinea	0	26	25	65	1	26	11	15	14	7
India	0	0	-	2 917	2 076	3 726	4 019	1 871	3 704	3 365
Iran	430	127	-	-	-	1	55	23	0	0
Italy	57	315	300	669	307	361	240	511	413	-
Japan	4 953	7 485	7 463	7 441	10 335	9 443	13 049	8 412	3 681	973
Korea Rep	1 145	178	854	1 778	1 787	2 945	1 218	466	467	145
Madagascar	271	294	293	316	446	341	372	293	292	292
Maldives	923	1 323	1 284	1 190	1 047	1 111	932	1 102	1 004	725
Mauritius	6	3	8	23	50	40	11	76	156	56
Mayotte	465	110	0	...	23	128	815	867	1 127	1 419
Philippines	775	519	1 220	573	1 329	1 602	1 610	1 431	282	158
Portugal	-	-	-	-	-	37	35	1	-	22
Réunion	79	54	71	133	612	564	718	503	507	507 F
Senegal	-	-	-	-	-	26	-	-	-	-
Seychelles	3 677	5 636	6 757	10 976	10 780	7 407	9 020	8 845	10 013	10 105
South Africa	34	280	252	73	75	60	80	166	196	178
Spain	7 907	10 985	8 788	8 936	10 313	10 188	9 849	12 595	11 621	10 081
Tanzania	-	-	-	-	3	30	12	18	17	5
Thailand	40	10	31	78	1 710	4 103	1 521	2 332	2 309	113

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	UK	-	-	-	-	16	-	-	-	-	4
	Uruguay	-	-	-	-	-	22	-	-	-	-
	Other nei	13 124	11 691	9 170	7 154	5 555	3 803	2 170	1 834	1 887	1 343
51	*Fishing area total*	*91 281*	*93 585*	*94 820*	*107 661*	*92 051*	*88 388 F*	*87 560 F*	*69 281*	*64 923 F*	*44 694 F*
57	Australia	386	419	206	91	31	57	69	45	62	78
	Belize	195	256	90	77	21	-	0	0	-	-
	China	2 105	875	310	1 085	797	414	656	327	401	441
	China,Taiwan	4 780	6 986	8 627	12 920	9 320	6 788	7 086	7 971	11 032	9 122
	France	-	-	-	-	-	275	3	-	106	26
	Guinea	...	-	-	61	-	4	1	3	3	1
	India	0	0	-	660	473	740	1 015	569	798	630
	Indonesia	23 177	28 008	14 259	12 921	10 786	9 773	12 481	10 574	9 370	10 386
	Japan	8 137	6 726	3 978	3 506	2 499	4 825	5 950	6 282	6 803	4 022
	Korea Rep	256	8	267	688	694	-	73	39	28	152
	Madagascar	-	-	-	-	15	-	-	-	-	-
	Malaysia	-	145	355	109	655	512	893	1 322	1 180	592
	Philippines	119	258	136	351	148	179	493	445	252	85
	Senegal	-	-	-	-	-	4	-	-	-	-
	Seychelles	72	191	331	377	103	220	484	916	1 272	566
	Spain	...	9	196	288	11	36	9	32	231	6
	Sri Lanka	98	15	137	106	57	270	426	256	346	636
	Thailand	154	9	65	33	31	83	342	36	153	172
	UK	-	-	-	-	2	-	-	-	-	-
	Vanuatu	-	-	-	-	-	-	-	-	100	87
	Other nei	899	1 090	883	1 723	701	739	381	313	362	349
57	*Fishing area total*	*40 378*	*44 995*	*29 840*	*34 996*	*26 344*	*24 919*	*30 362*	*29 130*	*32 499*	*27 351*
61	China	2 003	1 573	2 367	...	...	...	...	...	...	...
	China,Taiwan	316	1 452	725	649	3 577	1 908	5 344	6 162	3 949	2 041
	Japan	6 254	6 254 F	10 809	10 900	8 028	13 866	13 277	9 423	8 676	10 023
	Korea Rep	-	-	-	-	71	72	92	68	8	12
	Russian Fed	-	-	-	-	-	-	87	-	-	-
61	*Fishing area total*	*8 573*	*9 279 F*	*13 901*	*11 549*	*11 676*	*15 846*	*18 800*	*15 653*	*12 633*	*12 076*
67	Korea Rep	-	-	-	-	-	-	-	-	-	44
	USA	1	-	-	-	-	-	-	5	-	-
67	*Fishing area total*	*1*	-	-	-	-	-	-	*5*	-	*44*
71	Australia	628	568	577	408	515	326	586	944	559	576
	Belize	1 322	812	782	297	425	254	158	89	43	89
	China	2 227	739	6 598	1 230	1 324	2 385	2 114	3 235	5 660	4 850
	China,Taiwan	5 914	31 335	15 927	4 738	4 260	8 073	4 015	3 755	3 555	7 231
	Cook Is	-	-	-	0	1	14	31	30	10	18
	Fiji	662	853	889	1 254	423	771	556	671	689	657
	Indonesia	9 604	10 359	9 100	31 160	29 183	29 711	31 776	37 853	39 722	27 996
	Japan	25 629	25 629 F	15 850	17 248	13 921	13 297	10 664	12 948	11 024	8 679
	Kiribati	174	143	115	126	238	139	103	44	8	3
	Korea Rep	2 370	4 316	9 564	10 634	9 719	7 137	8 412	6 619	8 852	11 673
	Malaysia	...	...	...	...	...	...	...	...	412	411
	Marshall Is	261	158	513	879	971	2 032	2 121	1 947	2 619	257
	Micronesia	1 402	1 382	1 156	1 232	732	331	1 591	1 264	1 940	2 850 F
	Nauru	6	3	10	2	3	3 F	3 F	3 F	3 F	2 F
	NewCaledonia	128	189	142	90	76	35	53	63	51	44
	New Zealand	230	593	383	1 196	352	861	646	710	200	...
	Palau	21	1	1	7	...	...	...	...	...	...
	Papua N Guin	3 547	5 695	4 198	4 490	6 557	5 909	4 361	4 966	6 640	5 370 F
	Philippines	7 641	9 125	11 634	11 848	21 686	29 471	34 216	35 140	5 736	11 646
	Solomon Is	810	889	1 185	1 659	788	1 355	955	869	193	412
	Spain	734	-	-	884	834	750	3 102	5 824	3 911	4 400
	Tuvalu	-	-	-	-	-	-	-	-	24	...
	USA	-	4 818	1 715	2 106	2 120	2 024	1 961	1 820	2 317	2 091
	Vanuatu	105	396	841	1 862	1 558	1 651	2 122	860	1 300	2 060
	Viet Nam	...	...	...	...	...	...	...	...	...	2 441
71	*Fishing area total*	*63 415*	*98 003 F*	*81 180*	*93 350*	*95 686*	*106 529 F*	*109 546 F*	*119 654 F*	*95 468 F*	*93 756 F*
77	Amer Samoa	75	196	242	227	134	181	218	132	249	491
	Belize	31	...	...	...	...	...	...	...	...	...
	China	3 074	7 614	4 388	10 494	6 495	9 277	7 956	8 822	8 038	7 749
	China,Taiwan	169	216	15 202	19 891	13 273	8 998	11 504	9 634	10 467	8 987
	Colombia	-	-	-	135	171	99	275	37	297	288
	Cook Is	1	59	204	394	220	166	238	292	217	192
	Ecuador	3 152	3 513	4 344	5 203	6 855	9 321	10 074	6 760	11 473	14 730
	El Salvador	2 059	4 590	1 147	971	756	415	2 313	3 157	3 914	2 899
	Fr Polynesia	746	651	441	496	606	498	478	490	587	436
	Guatemala	2 175	2 624	1 659	165	-	-	-	393	17	936
	Honduras	35	...	...	...	16	165	133	...	3	2
	Japan	32 366	32 366 F	26 853	23 663	20 753	19 435	18 650	15 961	14 348	15 409
	Korea Rep	26 868	27 438	11 011	12 695	11 112	12 067	10 505	8 644	7 669	8 637
	Mexico	90	61	61	60	17	...	31	761	89	...
	Nicaragua	-	-	-	...	9	310	118	3	637	1 207
	Niue	...	...	...	...	10	22	18	1	10	4
	Panama	503	794	2 210	5 713	3 860	6 176	4 599	3 563	3 468	4 368
	Samoa	185	137	110	104	64	128	101	106	117	108
	Spain	2 884	5 006	3 569	4 338	5 707	4 125	1 242	1 171	2 827	288
	Tokelau	...	1	-	-	-	-	-	-	1	...
	Tonga	191	215	94	40	125	117	129	81	38	24
	USA	5 378	6 932	6 384	8 153	8 444	7 322	8 278	8 121	7 206	8 047
	Vanuatu	910	309	3 257	1 976	1 047	345	1 284	459	937	1 331

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Venezuela	-	35	22	63	-	345	757	736	1 248	222
Other nei	-	3 796	2 453	8	-	-	-	-	-	-
77 Fishing area total	*80 892*	*96 553 F*	*83 651*	*94 789*	*79 674*	*79 512*	*78 901*	*69 324*	*73 857*	*76 355*
81 Australia	367	450	358	381	343	189	57	308	154	107
China	-	-	-	-	24	29	10	-	-	158
China,Taiwan	107	17	448	21	14	399	316	88	237	348
Cook Is	-	-	0	1	-	1	1	0	-	1
Japan	1 108	1 108 F	973	1 111	952	288	483	761	554	287
Korea Rep	692	22	-	-	-	-	-	1 566	2 719	1 881
New Zealand	481	201	204	186	177	177	218	136	267	133
81 Fishing area total	*2 755*	*1 798 F*	*1 983*	*1 700*	*1 510*	*1 083*	*1 085*	*2 859*	*3 931*	*2 915*
87 Belize	272	...	...	...	...	...	...	...	...	...
Chile	5	7	15	9	24	36	37	28	15	2
China	-	-	-	235	660	162	75	83	127	164
China,Taiwan	8	-	663	640	417	926	487	8	37	122
Colombia	103	159	1 458	978	2 999	5 236	2 940	4 036	975	1 677
Ecuador	19 503	17 339	15 861	21 338	18 073	22 460	20 595	32 939	22 134	14 307
Guatemala	2 392	...	...	204	-	-	228	855	1 540	1 759
Honduras	1 747	...	...	1 132	2 386	2 171	2 355	1 408	243	146
Japan	7 716	7 716 F	2 842	4 614	3 715	2 889	2 789	3 012	3 030	2 001
Korea Rep	-	-	-	-	114	283	391	-	44	33
Mexico	-	8	60	-	-	35	...	...	...	...
Nicaragua	-	-	-	10	24	1 188	619	602	405	550
Panama	1 678	812	1 669	3 212	5 257	3 369	3 295	5 154	5 607	3 432
Portugal	-	-	-	-	-	-	11	-	-	-
Spain	4 580	3 336	1 499	1 238	1 687	2 574	65	915	685	158
USA	-	443	1 124	1 527	1 354	624	464	213	117	...
Vanuatu	3 374	2 128	2 702	2 138	843	1 360	980	981	1 328	756
Venezuela	84	382	819	1 233	125	3 924	1 499	1 915	1 862	194
Other nei	220	5 368	3 379	1 048	-	-	-	-	3	3
87 Fishing area total	*41 682*	*37 698 F*	*32 091*	*39 556*	*37 678*	*47 237*	*36 830*	*52 149*	*38 152*	*25 304*
Species total	*427 496*	*462 112 F*	*427 176*	*468 035*	*416 993*	*429 782 F*	*443 264 F*	*427 815 F*	*403 539 F*	*358 682 F*
Slender tuna	**Thon élégant**		**Atún lanzón**		***Allothunnus fallai***				**1,75(01)027,01**	**SLT**
41 Falkland Is	0	0	-	-	-	-	-	0	-	-
41 Fishing area total	*0*	*0*	-	-	-	-	-	*0*	-	-
81 New Zealand	41	66	18	30	150	28	16	17	53	44
Ukraine	-	15	6	11	...	6	...	...	...	...
81 Fishing area total	*41*	*81*	*24*	*41*	*150*	*34*	*16*	*17*	*53*	*44*
Species total	*41*	*81*	*24*	*41*	*150*	*34*	*16*	*17*	*53*	*44*
Indo-Pacific sailfish	**Voilier indo-pacifique**		**Pez vela del Indo-Pacífico**		***Istiophorus platypterus***				**1,75(03)004,02**	**SFA**
51 Belize	-	-	-	-	10	3	-	-	-	-
China,Taiwan	1 602	2 051	866	1 665	1 283	1 228	961	879	768	115
Comoros	200	200	300	300	300	300 F	320 F	427	427 F	427 F
Eritrea	-	-	-	-	1	-	1	0	0	0
France	-	-	-	-	-	-	-	-	9	5
Guinea	-	3	7	8	31	10	14	12	11	8
India	651	724	722	583	580	720	733	735	685	971
Iran	3 160	4 257	7 299	12 050	12 578	10 578	6 242	5 633	7 976	9 209
Japan	98	11	110	148	200	511	633	561	223	167
Korea Rep	-	-	-	1	-	2	24	5	-	-
Madagascar	1 533	1 583	1 398	1 532	1 583	1 545	1 348	1 474	1 474	1 474
Mauritius	0	0	-	-	-	-	2	...	...	...
Mayotte	9	8	11	7	7	7	7	7	7	7
Oman	177	121	162	335	139	305	358	1 937	992	1 807
Portugal	-	-	-	-	7	-	-	-	2	6
Réunion	19	13	18	21	38	26	29	28	32	32 F
Saudi Arabia	22	7	25	12	9	18	3	3	2	2
Senegal	-	-	0	0	-	10	-	-	-	-
Seychelles	18	9	0	9	9	6	3	7	21	17
South Africa	0	0	1	0	0	0	0	-	13	-
Spain	-	8	27	37	89	87	117	88	70	65
Tanzania	-	-	-	-	12	11	15	15	13	6
Thailand	1	0	-	6	1	-	-	-	-	-
UK	-	-	-	-	3	-	-	-	1	-
Yemen	-	-	-	-	642	612	583	330 F	360 F	385 F
Other nei	-	1	7	21	41	6	35	62	128	113
51 Fishing area total	*7 490*	*8 996*	*10 953*	*16 735*	*17 563*	*15 985 F*	*11 428 F*	*12 203 F*	*13 214 F*	*14 816 F*
57 Australia	-	0	-	-	0	0	0	-	-	-
China,Taiwan	202	579	276	1 252	500	358	318	276	342	378
Guinea	...	-	-	8	-	1	1	3	2	1
Honduras	205	-	-	-	-	-	-	-	-	-
India	873	974	971	789	785	972	991	994	923	1 311
Indonesia	908	1 040	1 824	795	819	693	1 195	1 264	1 137	1 193
Japan	36	91	10	6	3	25	20	20	31	23
Korea Rep	-	-	-	1	-	-	-	-	-	-
Malaysia	-	...	...	...	134	48	81	162	68	38
Portugal	-	-	-	-	-	-	-	-	-	1
Senegal	-	-	0	0	0	1	-	-	-	-
Seychelles	-	-	-	-	-	-	-	-	7	1

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Spain	-	1	21	35	29	13	11	18	7	7
	Sri Lanka	3 913	4 587	4 831	9 055	4 001	4 321	2 267	2 077	2 489	5 812
	Thailand	0	1	-	0	0	0	-	-	-	-
	Other nei	-	1	3	19	8	1	1	-	1	1
57	*Fishing area total*	*6 137*	*7 274*	*7 936*	*11 960*	*6 279*	*6 433*	*4 885*	*4 814*	*5 007*	*8 766*
61	China,Taiwan	201	266	2 164	380	4 251	2 523	4 220	918	372	960
	Japan	382	382 F	12	13	12	22	16	61	511	526
61	*Fishing area total*	*583*	*648 F*	*2 176*	*393*	*4 263*	*2 545*	*4 236*	*979*	*883*	*1 486*
71	Australia	...	5	6	1	1	2	3	1	1	1
	China,Taiwan	63	47	2 517	1 733	503	405	938	541	304	370
	Cook Is	-	-	-	-	0	1	1	1	0	0
	Guam	1	1	1	1	1	1	1	0	1	0
	Indonesia	...	...	...	653	994	1 266	1 977	2 296	3 789	1 824
	Japan	40	40 F	80	51	111	115	94	67	92	197
71	*Fishing area total*	*104*	*93 F*	*2 604*	*2 439*	*1 610*	*1 790*	*3 014*	*2 906*	*4 187*	*2 392*
77	Amer Samoa	1	1	1	1	1	1	1	1	1	2
	China,Taiwan	112	20	24	86	68	118	41	39	64	40
	Cook Is	-	2	3	3	1	0	1	1	0	0
	Costa Rica	1 289	1 399	1 012	1 244	767	850 F	924	924 F	924 F	924 F
	Fr Polynesia	...	...	...	...	7	8	6	3	3	11
	Japan	295	295 F	304	224	275	275	259	270	397	410
	Korea Rep	33	128	111	1	-	-	-	-	-	-
	USA	-	5	2	3	3	8	12	5	10	15
77	*Fishing area total*	*1 730*	*1 850 F*	*1 457*	*1 562*	*1 122*	*1 260 F*	*1 244*	*1 243 F*	*1 399 F*	*1 402 F*
81	Australia	...	2	1	1	1	0	1	-	1	0
	China,Taiwan	36	26	9	4	15	19	20	18	1	23
	Japan	10	10 F	13	7	8	12	4	9	8	11
81	*Fishing area total*	*46*	*38 F*	*23*	*12*	*24*	*31*	*25*	*27*	*10*	*34*
87	Ecuador	...	...	...	...	...	211	359	245	41	...
	Japan	35	35 F	23	15	13	33	9	17	45	22
	Korea Rep	-	-	20	-	-	-	1	-	-	-
87	*Fishing area total*	*35*	*35 F*	*43*	*15*	*13*	*244*	*369*	*262*	*86*	*22*
Species total		*16 125*	*18 934 F*	*25 192*	*33 116*	*30 874*	*28 288 F*	*25 201 F*	*22 434 F*	*24 786 F*	*28 918 F*

Atlantic sailfish	**Voilier de l'Atlantique**	**Pez vela del Atlántico**	***Istiophorus albicans***				**1,75(03)004,04**	**SAI**
21 Japan	-	-	-	-	-	-	-	1
21 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*1*
27 China	-	-	-	1	-	-	-	-
Portugal	3	7	5	15	30	40	20	20	26	47
27 Fishing area total	*3*	*7*	*5*	*15*	*31*	*40*	*20*	*20*	*26*	*47*
31 Barbados	42	26	26	26	42	58	42	...	...	18
Belize	-	-	-	-	-	-	6	-	-	55
China,Taiwan	-	-	7	-	6	41	-	-	-	-
Cuba	68	32	18	50	72	47	56	19	19	26
Dominica	5	3	...	1	0	3	4	4	2	...
Dominican Rp	81	260	91	68	135	95	100	111	100	107
Grenada	187	151	171	112	147	159	192	216	162	178
Japan	2	3	43	-	75	56	22	69	57	87
Mexico	36	34	45	51	55	41	46	45	48	34
Portugal	-	-	-	-	1	1	-	-	-	-
St Lucia	-	-	-	-	-	-	-	4	-	2
St Vincent	2	164	3	86	73	60	18	13	7	8
Spain	69	75	30	57	68	40	35	33	39	31
Trinidad Tob	7	6	7	10	9	17	13	16	16	21
Venezuela	126	159	133	158	178	184	248	154	161	178
Other nei	290	1	1	9	4	4	87	59	17	-
31 Fishing area total	*915*	*914*	*575*	*628*	*865*	*806*	*869*	*743*	*628*	*745*
34 Benin	12	2	2	5	3	3	4	...	...	...
China	5	11	4	2	4	7	1	-	3	1
China,Taiwan	-	128	29	-	2	12	...	45	13	15
Côte dIvoire	47	65	121	73	93	78	52	448	236	670
Ghana	568	592	566	521	542	282	420	342	358	417
Japan	11	17	31	80	77	65	132	189	115	104
Liberia	56	133	127	106	122	118	115	...	...	...
Morocco	-	-	-	-	15	-	-	-	-	-
Portugal	...	3	7	10	41	20	20	38	62	91
Russian Fed	-	-	-	-	1	-	-	-	-	-
St Vincent	-	4	-	-	-	1	4	-	-	-
Sao Tome Prn	136	136	136	515	346	292	384	114	119	121
Senegal	953	240	674	566	463	255	740	446	630	485
Spain	73	96	61	80	89	35	43	95	112	52
Other nei	52	81	92	41	35	99	63	17	8	-
34 Fishing area total	*1 913*	*1 508*	*1 850*	*1 999*	*1 833*	*1 267*	*1 978*	*1 734*	*1 656*	*1 956*
37 Portugal	-	1	-	3	-	-	-	-	-	-
37 Fishing area total	*-*	*1*	*-*	*3*	*-*	*-*	*-*	*-*	*-*	*-*
41 Belize	-	-	-	-	5	-	6	-	-	21
Brazil	414	546	582	531	414	138	123	221	432	71

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
China	3	1	0	1	1	2	5	1	2	4
China,Taiwan	-	4	27	-	16	22	...	42	19	10
Japan	4	...	6	5	9	5	4	9	12	5
Portugal	-	-	12	3	30	18	56	118	43	14
Spain	284	374	167	125	45	108	149	361	412	123
Other nei	1	-	-	-	-	68	-	193	-	-
41 Fishing area total	*706*	*925*	*794*	*665*	*520*	*361*	*343*	*945*	*920*	*248*
47 China	-	-	-	1	3	7	2	1	1	0
China,Taiwan	-	66	36	-	49	20	-	45	65	23
Japan	16	...	14	25	20	22	48	63	39	60
Portugal	-	-	0	2	19	77	14	3	21	16
Spain	77	113	123	68	89	166	214	111	167	275
Other nei	7	0	3	2	1	38	15	4	3	-
47 Fishing area total	*100*	*179*	*176*	*98*	*181*	*330*	*293*	*227*	*296*	*374*
Species total	*3 637*	*3 534*	*3 400*	*3 408*	*3 430*	*2 804*	*3 503*	*3 669*	*3 526*	*3 371*

Blue marlin **Makaire bleu** **Aguja azul** ***Makaira nigricans*** **1,75(03)005,05** **BUM**

21 Japan	-	-	-	1	2	1	-	-	1	2
Portugal	-	-	1	-	-	-	1	-	-	-
21 Fishing area total	-	-	*1*	*1*	*2*	*1*	*1*	-	*1*	*2*
27 France	-	-	-	-	-	-	-	1	-	0
Portugal	16	1	28	10	8	8	23	6	7	3
Spain	5	0	2	23	-	-	3	8	4	10
27 Fishing area total	*21*	*1*	*30*	*33*	*8*	*8*	*26*	*15*	*11*	*13*
31 Barbados	18	11	11	...	...	25	...	...	...	9
Belize	...	...	-	-	-	-	0	-	-	1
Bermuda	2	2	2	2	2	2	2	2	2	1
China	-	-	-	-	-	-	-	-	1	-
China,Taiwan	-	-	9	16	-	18	31	2	1	-
Cuba	56	34	3	4	7	7	2	4	6	3
Dominica	64	69	75	36	44	55	58	107	84	76
Dominican Rp	23	...	207	142	30	38	47	67	60	65
Grenada	104	69	72	45	42	34	54	54	32	69
Japan	39	...	93	48	72	64	84	322	267	320
Mexico	37	50	70	90	86	64	91	81	93	89
Philippines	-	-	-	-	-	-	-	1	-	-
Portugal	-	-	-	-	-	-	-	-	1	-
St Lucia	5	...	18	17	21	53	46	70	72	58
St Vincent	-	19	-	-	-	-	1	3	2	1
Spain	3	1	4	5	12	23	11	15	2	4
Trinidad Tob	17	16	9	11	7	14	21	41	20	22
Turks Caicos	-	-	-	0	...	2	...	0	...	...
Vanuatu	-	-	-	2	1	-	-	-	-	6
Venezuela	72	76	84	83	139	131	206	120	107	136
Other nei	-	-	-	-	-	-	8	13	4	-
31 Fishing area total	*440*	*347*	*657*	*501*	*463*	*530*	*662*	*902*	*754*	*860*
34 China	31	15	17	23	59	39	10	1	29	54
China,Taiwan	249	92	148	118	58	28	79	63	50	74
Côte dIvoire	196	78	109	115	107	178	150	991	463	450
France	-	-	-	-	776	-	-	752	434	498
Ghana	795	999	415	470	759	405	683	191	140	116
Japan	131	123	199	341	306	290	538	403	323	241
Liberia	235	158	115	37	9	16	143	...	...	...
Lithuania	-	-	-	-	-	-	-	-	-	3
Morocco	-	-	-	-	12	-	-	-	-	-
Portugal	1	0	2	3	14	29	50	49	33	30
Russian Fed	-	-	-	-	1	-	-	-	-	-
St Vincent	-	1	-	-	-	-	-	-	-	-
Sao Tome Prn	32	32	32	9	21	26	26 F	68	70	72
Senegal	11	24	32	11	1	5	91	114	61	42
Spain	16	25	-	-	7	68	15	6	5	151
Other nei	438	271	174	87	6	49	116	101	154	-
34 Fishing area total	*2 135*	*1 818*	*1 243*	*1 214*	*2 136*	*1 133*	*1 901 F*	*2 739*	*1 762*	*1 731*
41 Belize	-	-	-	-	-	-	4	-	-	2
Brazil	781	387	579	195	610	300	261	160	149	130
China	-	-	-	18	1	16	39	5	41	46
China,Taiwan	106	143	63	38	35	41	49	28	31	23
Japan	46	...	30	13	25	19	30	66	64	30
Philippines	-	-	-	-	-	-	-	7	-	-
Portugal	-	3	1	0	20	22	18	72	43	51
Spain	70	2	6	24	5	...	9	26	48	-
Uruguay	...	1	5	3	2	8	5	...	6	...
Vanuatu	-	-	-	-	-	2	-	-	-	1
Other nei	1	-	-	-	-	62	-	62	-	-
41 Fishing area total	*1 004*	*536*	*684*	*291*	*698*	*470*	*415*	*426*	*382*	*283*
47 China	61	73	72	17	36	44	17	6	6	1
China,Taiwan	323	210	98	142	57	12	74	55	113	56
Japan	115	156	162	129	58	139	269	237	167	140
Namibia	-	-	-	-	-	-	-	-	-	23
Portugal	1	3	-	-	4	47	52	28	21	16
St Helena	...	...	...	...	...	...	...	...	...	2

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
South Africa	1	4	1	1	0	1	2	7	2	3
Other nei	20	4	8	2	1	48	85	28	19	-
47 Fishing area total	*521*	*450*	*341*	*291*	*156*	*291*	*499*	*361*	*328*	*241*
51 Belize	110	59	30	18	11	4	10	4	0	-
China	...	...	...	...	...	...	...	...	66	27
China,Taiwan	4 085	3 712	2 411	2 737	1 402	1 604	1 587	1 304	1 282	1 057
France	-	-	-	-	-	-	-	-	9	10
Guinea	-	-	0	1	1	2	1	2	2	1
India	0	0	-	125	88	186	214	70	189	181
Japan	372	105	331	405	438	677	676	492	312	169
Korea Rep	16	-	11	43	20	-	-	-	9	6
Madagascar	-	-	-	-	4	-	-	-	-	-
Philippines	18	13	-	-	-	-	-	-	-	-
Portugal	-	-	-	-	3	3	15	17	0	21
Senegal	-	-	3	3	-	2	-	-	-	-
Seychelles	-	-	0	-	1	0	1	1	3	18
South Africa	-	-	3	1	0	2	1	2	1	4
Spain	20	-	1	2	2	18	11	16	8	7
Tanzania	-	-	-	-	0	2	1	2	2	1
Thailand	1	0	2	20	4	3	-	-	-	-
Other nei	486	395	254	126	159	131	55	70	86	75
51 Fishing area total	*5 108*	*4 284*	*3 046*	*3 481*	*2 133*	*2 634*	*2 572*	*1 980*	*1 969*	*1 577*
57 Australia	-	0	-	-	-	-	-	-	-	-
Belize	7	8	9	5	0	-	0	0	-	-
China	...	...	...	...	...	...	...	...	9	78
China,Taiwan	282	678	472	1 551	998	803	644	782	1 837	1 976
India	0	0	-	54	37	75	150	48	60	61
Indonesia	1 338	2 498	2 660	2 949	1 940	1 563	1 028	1 120	988	1 097
Japan	142	404	57	50	20	85	93	92	104	73
Korea Rep	-	-	-	1	-	-	-	-	-	-
Madagascar	-	-	-	-	1	-	-	-	-	-
Philippines	0	1	-	-	-	-	-	-	-	-
Seychelles	-	-	-	-	-	-	-	-	2	1
Spain	-	-	1	2	1	3	1	3	1	1
Sri Lanka	4 661	2 159	2 059	1 891	3 112	3 758	1 975	1 805	2 164	5 054
Thailand	1	0	11	2	0	2	0	-	-	-
Other nei	32	52	90	57	45	41	16	22	26	33
57 Fishing area total	*6 463*	*5 800*	*5 359*	*6 562*	*6 154*	*6 330*	*3 907*	*3 872*	*5 191*	*8 374*
61 China,Taiwan	2 016	2 525	5 255	5 836	11 502	11 703	12 838	14 265	4 407	4 544
Japan	1 152	1 152 F	974	775	723	674	775	821	1 267	1 485
61 Fishing area total	*3 168*	*3 677 F*	*6 229*	*6 611*	*12 225*	*12 377*	*13 613*	*15 086*	*5 674*	*6 029*
71 Belize	-	-	-	-	-	-	52	13	10	29
China	-	-	-	-	-	-	-	842	1 029	815
China,Taiwan	6 442	5 866	9 035	6 374	4 769	1 954	485	305	448	1 519
Cook Is	-	-	-	0	1	2	2	6	1	1
Ecuador	-	-	-	-	-	-	-	-	2	1
Fiji	186	192	181	295	199	237	165	154	101	244
Guam	15	24	30	22	6	13	9	4	15	14
Indonesia	...	...	...	25	37	66	51	42	73	89
Japan	1 969	1 969 F	1 407	1 515	1 531	1 527	1 404	1 542	1 394	1 750
Kiribati	2	2	1	0	1	0	1	3	3	7
Korea Rep	164	221	134	191	291	-	172	35	25	65
Marshall Is	2	2	3	3	18	17	19	78	62	84
Micronesia	66	62	65	53	20	38	124	194	249	190
NewCaledonia	62	70	73	79	21	9	11	9	9	11
N Marianas	1	1	1	1	1	1	0	1	0	0
Papua N Guin	96	101	135	196	195	173	203	143	95	244
Philippines	3 752	2 350	1 742	1 101	949	1 066	1 408	1 797	1 499	2 251
Solomon Is	19	39	39	39	4	5	8	5	5	238
Tuvalu	-	-	-	-	-	-	-	-	1	1
Vanuatu	0	217	193	417	537	90	135	84	110	182
Viet Nam	...	...	...	...	...	...	...	...	...	230
71 Fishing area total	*12 776*	*11 116 F*	*13 039*	*10 311*	*8 580*	*5 198*	*4 249*	*5 257*	*5 131*	*7 965*
77 Amer Samoa	5	20	4	1	23	25	38	34	40	49
China	-	-	-	-	-	-	-	195	107	599
China,Taiwan	871	990	967	1 103	1 103	1 204	1 021	862	1 212	1 016
Cook Is	...	13	48	116	135	25	35	26	16	43
Fr Polynesia	...	365	430	481	444	436	663	400	418	491
Japan	2 407	2 407 F	2 507	2 186	1 719	1 292	1 002	755	782	879
Korea Rep	170	175	185	206	301	-	138	259	341	361
Niue	...	...	...	...	1	5	9	0	0	1
Samoa	55	41	19	9	15	20	21	16	9	6
Tonga	36	35	20	8	17	18	27	12	8	6
USA	...	394	432	404	440	443	339	418	468	398
77 Fishing area total	*3 544*	*4 440 F*	*4 612*	*4 514*	*4 198*	*3 468*	*3 293*	*2 977*	*3 401*	*3 849*
81 China	-	-	-	-	-	-	-	-	-	14
China,Taiwan	26	17	70	4	4	29	16	7	14	8
Cook Is	-	0	0	0	-	1	0	0	-	-
Japan	15	15 F	7	23	10	8	12	4	8	9
Korea Rep	-	-	-	-	-	-	-	42	140	121
New Zealand	1	3	2	2	6	4	8	4	22	3
Spain	-	-	-	-	1	85	87	3	8	23
81 Fishing area total	*42*	*35 F*	*79*	*29*	*21*	*127*	*123*	*60*	*192*	*178*

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
87 China	-	-	-	-	-	-	-	5	2	6
China,Taiwan	1	-	20	55	57	49	19	7	13	50
Ecuador	...	...	...	...	...	315	1 236	1 222	594	...
Japan	163	163 F	106	134	83	61	70	29	52	53
Portugal	-	-	-	-	-	-	2	-	-	-
Uruguay	-	-	-	-	10	-	-	-	-	-
87 Fishing area total	*164*	*163 F*	*126*	*189*	*150*	*425*	*1 327*	*1 263*	*661*	*109*
Species total	*35 386*	*32 667 F*	*35 446*	*34 028*	*36 924*	*32 992*	*32 588 F*	*34 938*	*25 457*	*31 211*
Black marlin	**Makaire noir**		**Aguja negra**		***Makaira indica***				**1,75(03)005,07**	**BLM**
27 UK	-	-	-	-	-	-	-	-	-	1
27 Fishing area total	-	-	-	-	-	-	-	-	-	*1*
34 China,Taiwan	-	1	4	4	2	1	2	6	6	2
Japan	-	-	-	-	-	-	-	-	2	-
Korea Rep	-	-	2	55	4	8	-	-	-	-
Portugal	-	-	-	-	1	-	-	-	-	-
UK	-	-	-	-	-	-	-	28	47	-
Vanuatu	-	-	-	-	1	2	1	-	-	-
34 Fishing area total	*...*	*1*	*6*	*59*	*8*	*11*	*3*	*34*	*55*	*2*
47 China,Taiwan	618	318	4	4	11	-	6	1	2	6
Japan	-	-	-	3	3	3	2	4	2	4
Korea Rep	-	-	-	40	1	-	-	-	-	11
Portugal	-	-	-	-	-	-	-	1	58	1
South Africa	-	3	9	1	0	1	-	9	4	6
Spain	-	-	-	-	-	-	-	-	229	-
UK	-	-	-	-	-	5	16	14	1	-
47 Fishing area total	*618*	*321*	*13*	*48*	*15*	*9*	*24*	*29*	*296*	*28*
51 Belize	12	7	3	1	0	0	7	4	1	2
China	...	...	...	...	...	...	...	...	28	7
China,Taiwan	94	127	334	140	152	215	171	346	111	60
Guinea	-	-	0	0	0	0	0	1	1	0
India	118	131	131	113	116	153	167	139	159	186
Iran	-	3	-	-	-	-	-	-	-	-
Japan	...	29	78	75	83	181	175	105	71	42
Korea Rep	10	4	16	-	55	109	69	36	58	23
Mauritius	2	2	3	39	36	...	30	38	36	...
Oman	41	26	66	128	95	153	185	184	240	226
Portugal	-	-	-	-	-	2	6	21	-	-
Senegal	-	-	-	-	-	0	-	-	-	-
Seychelles	-	2	-	13	1	1	1	2	27	124
South Africa	-	-	0	0	1	2	-	4	2	13
Spain	-	-	0	0	1	2	2	5	1	1
Tanzania	-	-	-	-	0	0	0	1	1	0
Thailand	11	1	-	4	1	-	2	-	-	-
Other nei	48	47	29	6	14	7	59	113	199	194
51 Fishing area total	*336*	*379*	*660*	*519*	*555*	*825*	*874*	*999*	*935*	*878*
57 Belize	2	3	2	0	0	-	-	-	-	-
China	...	...	...	...	...	...	...	...	5	10
China,Taiwan	-	36	60	375	434	445	53	60	686	271
India	146	162	162	139	142	183	228	184	176	227
Indonesia	885	1 072	1 556	1 465	1 099	999	1 028	1 288	1 200	1 218
Japan	...	47	18	11	6	21	27	31	35	18
Korea Rep	13	2	20	59	51	-	7	3	2	-
Portugal	-	-	-	-	-	-	1	2	-	-
Senegal	-	-	-	-	1	-	-	-	-	-
Seychelles	-	-	-	-	-	-	-	-	15	25
Spain	-	-	-	-	-	-	-	1	0	0
Sri Lanka	1 606	744	710	652	1 073	1 230	646	591	709	1 654
Thailand	5	2	-	0	0	1	2	-	-	-
Other nei	7	22	17	3	8	4	1	7	2	3
57 Fishing area total	*2 664*	*2 090*	*2 545*	*2 704*	*2 814*	*2 883*	*1 993*	*2 167*	*2 830*	*3 426*
61 China,Taiwan	193	355	875	495	1 343	1 917	1 735	249	298	383
Japan	-	-	-	16	11	10	8	18	16	16
Korea Rep	-	-	-	-	5	12	4	7	3	1
61 Fishing area total	*193*	*355*	*875*	*511*	*1 359*	*1 939*	*1 747*	*274*	*317*	*400*
67 Japan	-	-	-	-	6	-	-	-	-	-
Korea Rep	-	-	-	-	-	-	-	-	-	3
67 Fishing area total	-	-	-	-	*6*	-	-	-	-	*3*
71 Belize	-	-	-	-	-	-	27	37	10	-
China	...	...	...	...	...	...	...	...	27	24
China,Taiwan	59	20	806	1 181	298	587	49	52	60	138
Cook Is	-	-	-	-	0	1	5	8	1	0
Ecuador	-	-	-	-	-	-	-	-	1	-
Fiji	46	66	62	102	69	82	64	62	44	34
Indonesia	...	...	...	48	1 143	301	380	302	423	957
Japan	-	-	-	134	69	68	76	65	68	64
Kiribati	1	1	1	1	1	1	1	1	2	3
Korea Rep	115	147	458	918	930	804	917	1 003	1 457	1 004
Marshall Is	5	5	7	8	1	8	2	4	7	16

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Micronesia	25	25	27	23	30	15	42	6	26	14
NewCaledonia	28	31	33	...	28	24	35	39	33	41
Papua N Guin	29	31	42	62	83	83	70	43	125	116
Solomon Is	4	5	6	6	3	3	2	1	3	33
Tuvalu	-	-	-	-	-	-	-	-	-	1
Vanuatu	1	82	73	9	33	42	36	29	35	58
Viet Nam	...	...	...	...	...	...	...	...	...	179
71 Fishing area total	*313*	*413*	*1 515*	*2 492*	*2 688*	*2 019*	*1 706*	*1 652*	*2 322*	*2 682*
77 China	...	...	...	...	...	...	...	...	29	31
China,Taiwan	-	-	7	6	44	14	6	4	10	52
Cook Is	...	1	6	10	8	8	23	19	6	19
Japan	-	-	-	34	30	30	18	23	16	23
Korea Rep	1 153	997	1 115	863	1 241	1 083	829	587	611	493
Niue	...	...	...	...	2	4	3	1	0	0
Samoa	27	16	3	2	9	3	13	15	13	15
Tonga	39	38	22	9	7	7	4	6	3	2
USA	...	4	2	3	1	4	2	3	0	-
77 Fishing area total	*1 219*	*1 056*	*1 155*	*927*	*1 342*	*1 153*	*898*	*658*	*688*	*635*
81 China	-	-	-	-	-	-	-	-	-	5
China,Taiwan	-	-	1	-	-	1	-	1	-	4
Japan	-	-	-	4	4	6	4	3	3	7
Korea Rep	-	-	-	-	-	-	-	74	28	-
New Zealand	-	2	2	1	6	2	2	5	10	1
Spain	-	-	-	2	1	-	-	4	3	3
81 Fishing area total	*-*	*2*	*3*	*7*	*11*	*9*	*6*	*87*	*44*	*20*
87 China	...	-	-	...	...	...	...	...	2	2
China,Taiwan	-	-	0	-	2	-	-	-	-	-
Ecuador	...	...	...	...	...	509	841	217	59	...
Japan	-	-	-	-	-	-	-	3	3	4
Korea Rep	-	-	5	-	5	13	20	-	3	1
Portugal	-	-	-	-	-	-	0	-	-	-
87 Fishing area total	*...*	*...*	*5*	*...*	*7*	*522*	*861*	*220*	*67*	*7*
Species total	*5 343*	*4 617*	*6 777*	*7 267*	*8 805*	*9 370*	*8 112*	*6 120*	*7 554*	*8 082*

Mediterranean spearfish **Marlin de la Méditerranée** **Marlín del Mediterráneo** ***Tetrapturus belone*** **1,75(03)009,01** **MSP**

37 Italy	...	...	103	87	...	...	...	266	388	...
Malta	-	-	-	-	-	-	-	-	2	1
37 Fishing area total	*...*	*...*	*103*	*87*	*...*	*...*	*...*	*266*	*390*	*1*
Species total	*...*	*...*	*103*	*87*	*...*	*...*	*...*	*266*	*390*	*1*

Striped marlin **Marlin rayé** **Marlín rayado** ***Tetrapturus audax*** **1,75(03)009,03** **MLS**

51 Belize	63	32	14	14	9	3	2	2	0	-
China	...	...	...	...	...	...	...	...	80	27
China,Taiwan	1 602	-	1 171	2 032	726	862	688	471	311	282
France	-	-	-	-	-	-	-	-	15	24
Guinea	-	5	2	2	1	2	2	3	3	1
India	-	-	-	92	41	90	100	33	76	40
Japan	63	62	48	63	44	84	64	124	30	183
Korea Rep	2	-	3	17	11	39	6	8	7	8
Madagascar	-	-	-	-	2	-	-	-	-	-
Mauritius	1	2	...	2	2	-	-	-	-	-
Philippines	5	11	-	-	-	-	-	-	-	2
Senegal	-	-	-	-	-	2	-	-	-	-
Seychelles	-	-	-	-	1	-	0	0	7	77
South Africa	-	-	-	-	0	-	-	-	-	-
Spain	-	15	7	8	2	15	19	24	13	12
Tanzania	-	-	-	-	0	2	2	4	4	1
Thailand	-	-	-	3	1	0	-	-	-	-
Other nei	265	221	122	102	88	94	29	28	22	22
51 Fishing area total	*2 001*	*348*	*1 367*	*2 335*	*928*	*1 193*	*912*	*697*	*568*	*679*
57 Australia	-	1	0	0	4	6	4	2	0	0
Belize	8	8	6	6	1	-	-	-	-	-
China	...	...	...	...	...	...	...	...	8	64
China,Taiwan	202	-	340	514	508	699	182	240	441	740
Guinea	...	-	-	2	-	0	0	1	1	0
India	0	0	0	45	22	46	76	25	35	20
Indonesia	242	386	256	341	319	292	256	232	204	217
Japan	71	70	22	18	31	34	14	35	25	21
Korea Rep	1	-	3	11	11	-	-	-	-	-
Madagascar	-	-	-	-	1	-	-	-	-	-
Philippines	1	2	-	-	-	-	-	-	-	1
Senegal	-	-	-	-	-	0	-	-	-	-
Seychelles	-	-	-	-	-	-	-	-	5	7
Spain	-	1	6	8	1	2	2	5	1	1
Sri Lanka	38	18	17	15	26	30	18	15	17	41
Thailand	-	-	-	1	0	1	1	-	-	-
Other nei	35	55	57	63	35	43	12	13	9	11
57 Fishing area total	*598*	*541*	*707*	*1 024*	*959*	*1 153*	*565*	*568*	*746*	*1 123*
61 China,Taiwan	1	-	445	145	548	660	567	186	238	196
Japan	2 875	2 875 F	1 220	1 094	730	601	887	2 219	1 599	1 786

B-36 **Tunas, bonitos, billfishes**
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Korea Rep	-	-	-	-	7	4	-	1	-	-
61	*Fishing area total*	*2 876*	*2 875 F*	*1 665*	*1 239*	*1 285*	*1 265*	*1 454*	*2 406*	*1 837*	*1 982*
67	Japan	-	-	-	-	-	2	-	-	-	-
67	*Fishing area total*	-	-	-	-	-	*2*	-	-	-	-
71	Australia	354	416	275	226	176	214	267	248	273	200
	Belize	-	-	-	-	-	-	3	-	-	3
	China	-	-	-	-	-	-	-	421	192	21
	China,Taiwan	64	-	47	138	359	347	108	59	128	206
	Cook Is	-	-	-	-	0	-	1	1	0	0
	Fiji	88	120	112	183	124	147	62	27	34	62
	Indonesia	...	...	...	1	4	38	14	290	908	373
	Japan	186	186 F	131	108	66	52	50	64	55	81
	Korea Rep	3	9	19	34	100	15	13	15	-	4
	Marshall Is	-	-	-	-	-	-	-	1	0	0
	Micronesia	5	5	5	4	1	2	10	1	0	0
	NewCaledonia	165	185	193	211	74	54	63	103	71	65
	Papua N Guin	13	13	18	14	11	15	14	4	17	11
	Solomon Is	0	1	1	1	0	0	0	0	0	10
	Vanuatu	0	137	122	235	178	83	111	75	57	77
71	*Fishing area total*	*878*	*1 072 F*	*923*	*1 155*	*1 093*	*967*	*716*	*1 309*	*1 735*	*1 113*
77	Amer Samoa	-	-	-	-	3	4	1	1	6	8
	China	-	-	-	-	-	-	-	97	120	312
	China,Taiwan	112	-	559	734	535	506	338	228	205	197
	Cook Is	...	14	43	36	41	18	16	10	11	24
	Fr Polynesia	...	92	118	110	91	124	139	142	104	153
	Japan	656	656 F	834	561	686	669	373	393	176	280
	Korea Rep	343	266	188	59	109	64	49	28	13	17
	Niue	...	...	...	...	3	3	6	0	0	0
	Samoa	22	5	24	5	4	7	21	7	7	16
	Tonga	82	79	46	18	6	24	18	11	8	4
	USA	...	278	622	423	552	676	283	464	292	155
77	*Fishing area total*	*1 215*	*1 390 F*	*2 434*	*1 946*	*2 030*	*2 095*	*1 244*	*1 381*	*942*	*1 166*
81	Australia	363	353	357	348	234	267	111	114	142	129
	China	-	-	-	-	-	-	-	-	-	6
	China,Taiwan	36	-	177	9	6	71	54	35	49	90
	Cook Is	-	-	-	-	-	-	-	-	-	1
	Japan	266	266 F	330	216	123	128	94	103	130	157
	Korea Rep	-	-	-	-	-	-	-	8	10	14
	New Zealand	-	1	2	0	3	3	1	1	1	0
	Spain	-	-	-	-	-	1	1	63	63	6
81	*Fishing area total*	*665*	*620 F*	*866*	*573*	*366*	*470*	*261*	*324*	*395*	*403*
87	Chile	1	14	4	9	7	7	15	4	11	20
	China	-	-	-	-	-	-	-	2	6	9
	China,Taiwan	-	-	16	103	69	84	62	2	9	63
	Ecuador	...	...	...	...	...	373	481	364	189	...
	Japan	666	666 F	371	310	221	295	250	117	222	182
	Korea Rep	-	-	20	-	1	5	4	-	-	1
87	*Fishing area total*	*667*	*680 F*	*411*	*422*	*298*	*764*	*812*	*489*	*437*	*275*
Species total		*8 900*	*7 526 F*	*8 373*	*8 694*	*6 959*	*7 909*	*5 964*	*7 174*	*6 660*	*6 741*

Atlantic white marlin **Makaire blanc de l'Atlantique** **Aguja blanca del Atlántico** ***Tetrapturus albidus*** **1,75(03)009,04** **WHM**

21	Canada	3	2	1	2	5	3	2	2	1	2
21	*Fishing area total*	*3*	*2*	*1*	*2*	*5*	*3*	*2*	*2*	*1*	*2*
27	China,Taiwan	1	-	-	-	-	-	-	-	-	-
	France	-	-	-	-	0	-	-	1	0	0
	Portugal	-	1	5	9	11	2	1	-	1	-
27	*Fishing area total*	*1*	*1*	*5*	*9*	*11*	*2*	*1*	*1*	*1*	*0*
31	Barbados	24	15	15	...	...	33	...	...	...	6
	Bermuda	0	0	0	1	1	1	1	1	0	0
	China,Taiwan	11	-	2	12	2	17	18	-	-	-
	Costa Rica	-	-	1	2	1	1 F	1	1 F	1 F	1 F
	Grenada	15	8	14	8	10	12	13	17	15	9
	Japan	7	11	16	8	13	12	4	14	12	18
	Mexico	44	15	15	28	25	16	13	14	19	20
	Philippines	-	-	-	-	-	-	-	1	-	-
	St Vincent	-	0	44	-	-	-	-	-	-	0
	Spain	20	4	7	8	24	28	17	4	5	11
	Trinidad Tob	2	5	12	6	6	5	12	10	11	15
	Venezuela	72	110	55	54	60	27	52	26	71	54
	Other nei	108	2	2	-	26	7	11	17	20	-
31	*Fishing area total*	*303*	*170*	*183*	*127*	*168*	*159 F*	*142*	*105 F*	*154 F*	*134 F*
34	China	7	4	2	3	5	3	2	1	5	4
	China,Taiwan	-	-	30	48	6	5	3	2	1	3
	Côte dIvoire	2	2	3	1	1	1	1	3	2	4
	Ghana	21	2	1	1	1	-	-	4	4	-
	Japan	11	...	12	17	18	20	8	10	16	14
	Korea Rep	-	-	-	-	-	2	-	-	8	-
	Liberia	3	4	3	...	...	...	...	...	...	...
	Portugal	-	-	-	2	20	0	0	-	-	-

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Sao Tome Prn	37	37	37	21	33	28	28 F	36	37	38
Spain	24	-	12	11	24	...	15	7	3	39
Other nei	1	4	8	-	-	2	3	1	1	-
34 Fishing area total	*106*	*53*	*108*	*104*	*108*	*61*	*60 F*	*64*	*77*	*102*
37 Spain	0	0	-	0	0	-	-	0	-	-
37 Fishing area total	*0*	*0*	-	*0*	*0*	-	-	*0*	-	-
41 Brazil	172	407	263	79	245	92	70	47	52	35
China	-	-	-	2	0	1	6	2	3	4
China,Taiwan	6	-	41	46	12	20	25	29	26	6
Japan	14	...	3	2	3	2	2	3	10	2
Philippines	-	-	-	-	-	-	-	1	-	-
Portugal	-	-	-	-	-	8	0	17	3	1
Spain	18	-	2	45	5	23	4	21	8	-
Uruguay	...	1	9	2	5	9	3	...	5	...
Other nei	144	9	26	126	12	17	111	94	166	-
41 Fishing area total	*354*	*417*	*344*	*302*	*282*	*172*	*221*	*214*	*273*	*48*
47 China	13	19	6	2	3	2	3	2	1	0
China,Taiwan	17	-	31	65	36	2	8	7	1	11
Japan	28	6	5	5	2	6	8	6	5	9
Portugal	-	-	-	7	-	10	-	18	36	6
Spain	-	2	1	-	6	0	10	-	-	44
Other nei	5	0	2	8	4	10	46	92	13	-
47 Fishing area total	*63*	*27*	*45*	*87*	*51*	*30*	*75*	*125*	*56*	*70*
Species total	*830*	*670*	*686*	*631*	*625*	*427 F*	*501 F*	*511 F*	*562 F*	*356 F*

Shortbill spearfish	**Makaire à rostre court**		**Marlín trompa corta**		***Tetrapturus angustirostris***				**1,75(03)009,05**	**SSP**
51 France	-	-	-	-	-	-	-	-	3	4
Guinea	...	7	0	1	3	1	1	1	1	-
Japan	...	7	-	-	-	-	-	-	-	-
Madagascar	-	0	0	-	-	-	0	1	1	1
Réunion	2	1	5	-	-	-	11	13	13	13 F
Senegal	-	-	-	-	-	1	-	-	-	-
Spain	12	21	0	7	8	6	9	5	-	-
Tanzania	-	-	-	-	1	1	1	1	1	-
Thailand	-	-	-	1	0	-	-	-	-	-
Other nei	-	3	0	0	0	0	1	-	-	-
51 Fishing area total	*14*	*39*	*5*	*9*	*12*	*9*	*23*	*21*	*19*	*18 F*
57 Australia	0	0	0	-	0	0	0	-	-	-
Guinea	...	-	-	1	-	0	0	0	0	-
Indonesia	-	0	49	-	0	3	6	10	8	9
Japan	...	25	-	-	-	-	-	-	-	-
Spain	-	2	0	7	2	1	1	1	-	-
57 Fishing area total	*0*	*27*	*49*	*8*	*2*	*4*	*7*	*11*	*8*	*9*
71 Australia	...	10	12	6	10	14	29	13	14	15
Cook Is	-	-	-	-	1	1	0	0	0	0
71 Fishing area total	*...*	*10*	*12*	*6*	*11*	*15*	*29*	*13*	*14*	*15*
77 Amer Samoa	-	-	-	-	-	-	-	-	-	1
Cook Is	-	3	10	8	2	3	3	2	1	2
Fr Polynesia	...	...	...	...	11	17	10	13	13	41
77 Fishing area total	*...*	*3*	*10*	*8*	*13*	*20*	*13*	*15*	*14*	*44*
81 Australia	0	6	11	8	8	4	5	2	2	2
New Zealand	-	0	0	0	-	-	-	-	-	-
81 Fishing area total	*0*	*6*	*11*	*8*	*8*	*4*	*5*	*2*	*2*	*2*
Species total	*14*	*85*	*87*	*39*	*46*	*52*	*77*	*62*	*57*	*88 F*

Longbill spearfish	**Makaire bécune**		**Aguja picuda**		***Tetrapturus pfluegeri***				**1,75(03)009,06**	**SPF**
27 Portugal	-	-	-	-	0	-	1	1	-	1
27 Fishing area total	-	-	-	-	*0*	-	*1*	*1*	-	*1*
31 Belize	...	...	-	-	-	-	-	-	-	6
Japan	...	14	-	-	-	-	-	-	-	-
St Vincent	-	-	-	82	-	134	24	13	7	8
Spain	3	0	4	-	-	-	-	2	3	3
Venezuela	4	0	3	3	17	5	15	3	14	24
31 Fishing area total	*7*	*14*	*7*	*85*	*17*	*139*	*39*	*18*	*24*	*41*
34 Japan	...	14	-	-	-	-	-	-	-	-
Portugal	-	-	-	-	1	10	3	1	15	24
Senegal	-	-	-	-	-	-	-	-	-	6
Spain	1	2	-	-	-	1	-	2	7	4
34 Fishing area total	*1*	*16*	-	-	*1*	*11*	*3*	*3*	*22*	*34*
41 Belize	...	...	-	-	-	-	-	-	-	5
Brazil	55	38	2	...	0	6	4	-	-	0
Portugal	-	-	-	-	44	26	15	43	1	10
Spain	20	5	21	-	5	16	-	-	3	-
41 Fishing area total	*75*	*43*	*23*	*...*	*49*	*48*	*19*	*43*	*4*	*15*

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
47 Portugal	-	-	-	-	-	5	5	-	-	-
Spain	7	5	-	-	3	2	-	-	-	24
47 Fishing area total	*7*	*5*	*-*	*-*	*3*	*7*	*5*	*-*	*-*	*24*
Species total	*90*	*78*	*30*	*85*	*70*	*205*	*67*	*65*	*50*	*115*
Roundscale spearfish	**Makaire épée**		**Marlín peto**		***Tetrapturus georgii***			**1,75(03)009,07**		**RSP**
27 Spain	-	-	-	-	-	-	-	1	-	1
27 Fishing area total	-	-	-	-	-	-	-	*1*	-	*1*
34 Spain	-	-	-	-	-	-	-	3	-	0
34 Fishing area total	-	-	-	-	-	-	-	*3*	-	*0*
Species total	-	-	-	-	-	-	-	*4*	-	*1*
Marlins,sailfishes,etc. nei	**Makaires,marlins,voiliers nca**		**Agujas,marlines,peces vela nep**		***Istiophoridae***			**1,75(03)XXX,XX**		**BIL**
27 Portugal	408	626	311	127	23	2	3	1	9	1
27 Fishing area total	*408*	*626*	*311*	*127*	*23*	*2*	*3*	*1*	*9*	*1*
31 Barbados	1	1	30	48	115	-	69	100	36	-
Belize	-	-	-	-	-	-	-	-	3	-
China,Taiwan	-	-	7	-	-	-	6	-	-	-
Costa Rica	-	-	0	1	0	1 F	2	2 F	2 F	2 F
Korea Rep	-	-	-	-	-	-	-	-	12	6
Portugal	-	-	-	-	-	1	-	-	-	-
St Lucia	-	9	-	-	-	-	-	-	-	-
St Vincent	339	-	25	-	-	1	-	-	-	-
Spain	-	-	3	-	-	-	-	-	2	-
Trinidad Tob	-	-	5	3	7	0	0	-	8	2
Turks Caicos	-	-	-	-	-	-	1	...	...	...
Venezuela	8	-	-	-	-	-	-	-	-	-
31 Fishing area total	*348*	*10*	*70*	*52*	*122*	*3 F*	*78*	*102 F*	*63 F*	*10 F*
34 China,Taiwan	-	-	-	11	20	12	54	-	-	-
Gabon	1	...	7	4	1	0	...	...	...	...
Korea Rep	-	-	-	-	1	6	88	67	45	38
Liberia	-	-	-	407	-	-	459	180	180 F	180 F
Netherlands	-	-	-	-	2	-	-	-	-	-
Portugal	6	62	45	15	78	31	24	29	46	52
Spain	-	1	1	-	-	-	3	6	8	5
Togo	205	158	872	135	73	80	71	40 F	13	16
34 Fishing area total	*212*	*221*	*925*	*572*	*175*	*129*	*699*	*322 F*	*292 F*	*291 F*
37 Italy	...	...	...	...	49	231	194	11	28	164
Korea Rep	-	-	-	-	-	-	-	-	1	-
Malta	-	-	-	-	-	-	5	3	-	-
Portugal	25	1	-	9	1	-	-	-	-	-
37 Fishing area total	*25*	*1*	*...*	*9*	*50*	*231*	*199*	*14*	*29*	*164*
41 Brazil	2	0	4	29	...	19	3	76	2	11
China,Taiwan	8	-	2	-	-	-	33	-	-	-
Korea Rep	-	-	-	-	-	-	-	12	10	11
Portugal	-	-	12	19	8	5	44	102	54	9
Spain	-	-	-	-	-	-	-	-	7	-
UK	-	-	-	-	-	-	1	21	-	-
Uruguay	-	-	5	-	4	2	-	2	-	1
41 Fishing area total	*10*	*0*	*23*	*48*	*12*	*26*	*81*	*213*	*73*	*32*
47 Korea Rep	-	-	28	121	30	15	-	-	296	34
Namibia	-	3	-	5	9	57	109	50	32	...
Portugal	30	1	7	3	1	2	36	-	4	6
St Helena	3	4	1	1	2	2	3	4	3	-
South Africa	-	13	-	2	7	1	5	11	2	5
47 Fishing area total	*33*	*21*	*36*	*132*	*49*	*77*	*153*	*65*	*337*	*45*
51 Belize	31	16	6	1	1	0	-	-	-	-
China	121	218	130	184	255	262	77	143	-	-
China,Taiwan	57	-	-	-	-	-	-	-	-	-
Comoros	120	120	130	130	135	135 F	135 F	180	180 F	180 F
France	-	-	-	-	-	-	-	-	14	25
India	7	1 427	1 807	3 616	929	1 711	2 462	2 850	5 244	4 083
Kenya	78	55	44	75	111	148	83	105	160	165
Korea Rep	74	38	30	42	6	132	166	115	321	307
Madagascar	-	1	2	-	10	5	5	3	3	3
Mauritius	287	287	299	308	292	288	291	251	650	650
Mayotte	2	4	7	...	7	7	7	7	7	7
Pakistan	1 122	995	1 001	985	3 107	3 095	3 350	3 375	3 050	3 133
Portugal	1	-	4	-	1	12	6	2	8	8
Réunion	129	79	81	104	113	103	142	128	99	99 F
Seychelles	66	125	222	298	229	155	162	208	104	12
South Africa	4	12	12	2	1	1	4	4	0	6
Tanzania	734	685	650	535	786	861	1 041	1 295	1 326	1 334
Untd Arab Em	273	145	184	132	122	119	125 F	131	195	492
UK	-	-	-	14	1	20	21	49	19	15
Uruguay	-	-	-	-	-	3	-	-	-	-
Zanzibar	734	685	2 013	535	786	861	1 041	1 295	1 326	1 334
Other nei	125	110	51	10	63	20	64	132	206	14

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
51 Fishing area total	*3 965*	*5 002*	*6 673*	*6 971*	*6 955*	*7 938 F*	*9 182 F*	*10 273*	*12 912 F*	*11 867 F*
57 Belize	2	1	9	2	0	-	-	-	-	-
China	258	37	19	34	16	4	3	8	-	-
China,Taiwan	700	-	-	-	-	-	-	-	-	-
Honduras	182	-	-	-	-	-	-	-	-	-
India	650	508	639	1 294	378	702	977	1 047	1 956	1 490
Indonesia	9	14	130	55	201	325	358	204	163	166
Korea Rep	4	4	36	74	96	-	21	116	48	295
Madagascar	-	-	-	-	3	-	-	-	-	-
Malaysia	0	14	40	21	126	102	146	138	69	70
Portugal	-	-	-	-	-	-	23	2	-	2
Seychelles	4	6	13	14	5	7	8	13	10	-
Spain	-	-	0	-	0	0	-	-	-	-
Sri Lanka	-	-	-	-	-	-	3	-	-	-
UK	-	-	-	-	0	19	16	-	3	14
Other nei	8	7	83	17	105	29	40	48	27	21
57 Fishing area total	*1 817*	*591*	*969*	*1 511*	*930*	*1 188*	*1 595*	*1 576*	*2 276*	*2 058*
61 China	146	123	258	...	...	...	...	...	...	...
Korea Rep	-	-	-	-	30	34	20	46	4	-
61 Fishing area total	*146*	*123*	*258*	*...*	*30*	*34*	*20*	*46*	*4*	*...*
71 Australia	4	-	-	-	-	-	-	-	-	-
China	171	61	785	157	217	479	580	140	-	-
China,Taiwan	42	-	-	-	-	-	-	-	-	-
Korea Rep	100	104	354	601	551	154	316	479	-	1 764
Malaysia	154	205	192	209	297	385	565	385	411	455
Nauru	...	...	2	0	1	1 F	1 F	1 F	1 F	1 F
Palau	4	0	42	65	...	1	...	...	...	...
Philippines	6 037	6 378	5 178	3 853	2 969	3 329	3 721	3 825	4 090	4 578
71 Fishing area total	*6 512*	*6 748*	*6 553*	*4 885*	*4 035*	*4 349 F*	*5 183 F*	*4 830 F*	*4 502 F*	*6 798 F*
77 China	103	532	662	716	398	391	200	32	-	-
Cook Is	10 F	-	-	-	-	-	-	-	-	-
Costa Rica	917	874	1 009	650	1 149	1 030 F	912	912 F	912 F	912 F
Fr Polynesia	551	70	2	-	-	37	-	-	-	11
Guatemala	...	...	...	...	4	4	3	-	-	-
Korea Rep	1 479	1 673	1 212	789	585	331	299	395	482	821
Mexico	250	196	180	154	197	206	332	307	283	347
Spain	-	-	-	2	1	1	28	-	11	-
USA	250	142	235	201	212	165	144	230	118	123
77 Fishing area total	*3 560 F*	*3 487*	*3 300*	*2 512*	*2 546*	*2 165 F*	*1 918*	*1 876 F*	*1 806 F*	*2 214 F*
81 China	-	-	-	-	3	9	-	-	-	-
Korea Rep	-	-	-	-	-	-	-	-	-	75
81 Fishing area total	-	-	-	-	*3*	*9*	-	-	-	*75*
87 China	-	-	-	24	83	8	2	1	-	-
Ecuador	2 385	1 773	1 612	1 730	965	696	235	235	84	1 702
Korea Rep	-	-	-	-	-	-	-	-	1	13
Portugal	-	-	-	-	-	-	-	-	-	1
Spain	-	6	62	198	140	77	66	43	159	29
87 Fishing area total	*2 385*	*1 779*	*1 674*	*1 952*	*1 188*	*781*	*303*	*279*	*244*	*1 745*
Species total	*19 421 F*	*18 609*	*20 792*	*18 771*	*16 118*	*16 932 F*	*19 414 F*	*19 597 F*	*22 547 F*	*25 300 F*

Swordfish	**Espadon**		**Pez espada**		***Xiphias gladius***				**1,75(04)003,01**	**SWO**
21 Canada	1 105	992	1 363	1 248	1 664	1 441	1 409	1 383	1 309	1 360
China,Taiwan	-	10	-	-	-	-	-	-	-	-
Japan	1	...	...	44	43	37	17	23	67	92
Portugal	-	-	2	-	-	2	10	2	10	-
St Pier Mq	-	10	3	36	48	-	82	48	17	90
Spain	-	-	-	-	-	-	-	33	-	-
USA	948	1 075	1 031	992	739	775	916	685	755	629
21 Fishing area total	*2 054*	*2 087*	*2 399*	*2 320*	*2 494*	*2 255*	*2 434*	*2 174*	*2 158*	*2 171*
27 China	-	-	-	1	-	1	1	-	-	-
China,Taiwan	1	26	-	-	1	-	1	-	-	-
France	101	74	170	102	178	92	46	14	16	35
Ireland	17	5	12	1	1	3	2	2	1	2
Japan	1	...	...	108	94	44	52	49	5	3
Libya	-	-	-	-	-	2	-	-	-	-
Portugal	665	485	790	1 126	585	719	448	609	726	721
Spain	2 274	2 041	1 866	2 261	1 734	3 170	1 695	1 362	1 712	1 604
UK	-	-	-	221	-	-	0	-	-	0
27 Fishing area total	*3 059*	*2 631*	*2 838*	*3 820*	*2 593*	*4 031*	*2 245*	*2 036*	*2 460*	*2 365*
31 Barbados	19	10	21	26	44	39	27	39	20	13
Belize	-	-	-	-	-	-	9	1	112	107
Bermuda	2	0	0	1	1	0	3	4	3	3
Br Virgin Is	10	16	4	4	4	7	5 F	3	3 F	3 F
China	-	-	-	-	-	-	-	1	4	-
China,Taiwan	10	63	27	39	1	75	25	12	1	1
Costa Rica	-	-	1	3	2	2 F	3	3 F	3 F	3 F
Cuba	3	10	3	3	3	2	1	-	-	-
Dominica	1	...	...	0	0	0	0	0	-	-
Grenada	73	54	88	73	56	30	29	43	31	20

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Japan	8	...	547	157	187	170	122	207	140	200
	Mexico	27	34	32	44	41	31	35	34	32	35
	Philippines	1	4	44	0	-	8	-	22	28	-
	Portugal	-	39	-	-	0	0	-	2	1	-
	St Lucia	-	1	0	2	3	0	1	2	0	0
	St Vincent	22	22	7	7	7	...	61	14	50	17
	Spain	1 694	1 913	2 718	3 113	3 777	966	3 868	2 970	3 237	2 543
	Trinidad Tob	75	92	78	83	91	19	29	48	29	21
	USA	816	834	1 000	874	759	634	832	799	1 101	1 083
	Vanuatu	-	-	-	35	29	14	-	-	-	10
	Venezuela	21	34	45	53	55	22	30	11	13	23
31	*Fishing area total*	*2 782*	*3 126*	*4 615*	*4 517*	*5 060*	*2 019 F*	*5 080 F*	*4 215 F*	*4 808 F*	*4 082 F*
34	Angola	-	-	54	-	-	-	-	-	-	-
	Belize	...	-	-	...	346	-	-	212	...	...
	Benin	41	68	71	95	75	78	62	41	55	18
	Bulgaria	9	-	-	-	-	-	-	-	-	-
	China	102	90	316	206	136	225	167	103	158	206
	China,Taiwan	1 986	512	730	249	184	149	237	374	278	218
	Comoros	-	-	-	-	-	-	48	17	...	...
	Côte dIvoire	19	19	43	29	31	39	17	159	125	144
	Gabon	-	-	9	...	...	...	...	1	1 F	1 F
	Ghana	531	372	734	343	55	32	65	177	132	116
	Greece	-	3	0	-	-	-	-	-	-	-
	GuineaBissau	4	...	...	...	...	...	...	...	...	...
	Honduras	-	-	-	-	-	10	-	-	-	-
	Japan	262	239	1 439	521	653	1 113	2 130	1 427	1 144	1 363
	Korea Rep	-	-	7	-	19	21	180	58	3	-
	Liberia	34	35	30	39	85	0	...	71	70 F	70 F
	Morocco	523	223	329	335	334	341	237	430	724	963
	Nigeria	-	133	78	59	82	102	78	88	64	72
	Panama	0	48	0	...	225	-	125	-	...	...
	Philippines	-	-	-	4	-	-	-	-	-	-
	Portugal	69	400	342	247	201	245	252	198	253	355
	Russian Fed	-	-	-	-	1	-	-	-	-	-
	Sao Tome Prn	120	120	120	126	147	138	138 F	183	188	193
	Senegal	35	61	468	108	4	102	180	138	223	191
	Sierra Leone	2	...	...	...	...	...	...	...	...	...
	Spain	1	3	1	3	10	2	0	0	0	0
	Togo	17	21	37	9	10	2	2	2 F	2	3
	UK	-	-	-	1	-	49	-	2	5	-
	Vanuatu	-	-	-	-	11	26	6	-	-	1
34	*Fishing area total*	*3 755*	*2 347*	*4 808*	*2 374*	*2 609*	*2 674*	*3 924 F*	*3 681 F*	*3 425 F*	*3 914 F*
37	Albania	2	15	...	5	12	23	20	28	12	17
	Algeria	1 081	814	665	564	635	702	602	802	468	624
	China,Taiwan	1	-	-	-	-	-	-	-	-	-
	Croatia	-	-	-	-	-	-	-	4	3	6
	Cyprus	135	104	47	49	53	43	67	56	38	32
	France	12	27	31	19	9	4	14	14	16	79
	Greece	1 730	1 680	1 230	1 129	1 424	1 374	1 906	989	1 132	1 494
	Israel	-	-	-	2	-	-	-	-	-	-
	Italy	6 388	3 539	8 394	6 942	7 460	7 627	6 779	4 715	5 325	6 274
	Japan	1	-	0	3	4	-	3	2	1	-
	Korea Rep	-	-	-	-	-	-	-	2	1	-
	Libya	6	...	10	2	...	14	...	...	...	...
	Malta	102	257	163	195	362	239	213	260	266	423
	Morocco	3 026	3 379	3 300	3 253	2 523	2 058	1 722	1 957	1 587	1 610
	Portugal	115	8	1	146	15	16	-	-	-	-
	Spain	1 483	1 497	1 226	950	910	1 461	1 698	2 095	2 001	1 793
	Syria	-	-	-	-	-	-	37	40	35	37
	Tunisia	567	1 138	1 172	791	1 074	949	1 024	1 011	1 012	1 041
	Turkey	360	370	350	386	425	410	423	386	301	334
37	*Fishing area total*	*15 009*	*12 828*	*16 589*	*14 436*	*14 906*	*14 920*	*14 508*	*12 361*	*12 198*	*13 764*
41	Argentina	5	10	8	0	-	-	0	3	0	1
	Belize	-	-	-	-	-	-	120	32	112	121
	Brazil	4 084	2 910	2 920	2 999	3 783	4 429	4 243	3 407	3 386	2 926
	China	-	-	-	83	8	56	191	147	192	159
	China,Taiwan	430	712	285	140	52	225	161	115	70	45
	Japan	166	55	199	112	122	114	108	212	387	351
	Korea Rep	-	-	-	-	-	-	-	11	-	-
	Philippines	6	1	8	1	1	4	15	41	39	14
	Portugal	63	47	93	208	290	224	167	196	179	186
	Spain	3 770	4 247	2 468	3 329	2 698	3 970	2 927	1 381	3 044	-
	UK	-	-	-	-	-	193	47	87	-	-
	Uruguay	789	768	850	1 105	843	620	464	370	501	222
	Vanuatu	-	-	-	-	-	-	-	3	-	2
41	*Fishing area total*	*9 313*	*8 750*	*6 831*	*7 977*	*7 797*	*9 835*	*8 443*	*6 005*	*7 910*	*4 027*
47	Angola	...	...	...	...	3	...	...	...	...	...
	China	200	423	353	44	56	89	198	313	29	5
	China,Taiwan	747	635	468	346	278	100	350	308	352	234
	Japan	353	845	310	318	244	398	651	649	386	389
	Korea Rep	-	-	-	61	46	98	84	72	10	-
	Namibia	751	504	191	549	832	1 118	1 038	518	394	417
	Philippines	-	-	-	-	-	-	43	-	10	-
	Portugal	330	174	161	101	178	201	388	128	101	49
	Seychelles	-	6	-	-	-	-	-	-	-	-

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
South Africa	547	649	293	295	199	193	206	142	170	144
Spain	2 019	1 494	2 059	2 154	2 704	2 640	2 357	2 692	2 139	5 801
UK	-	-	-	-	-	263	267	70	3	-
47 Fishing area total	*4 947*	*4 730*	*3 835*	*3 868*	*4 540*	*5 100*	*5 582*	*4 892*	*3 594*	*7 039*
51 Belize	603	322	151	93	39	32	64	75	22	7
China	93	327	705	614	589	741	393	405	226	205
China,Taiwan	11 528	12 746	11 748	11 294	5 827	5 825	5 187	3 342	3 247	1 221
France	-	-	-	-	-	-	-	-	443	521
Guinea	28	446	322	519	809	498	524	443	388	324
India	155	171	170	743	506	871	926	476	852	818
Iran	-	27	73	21	11	26	-	-	-	-
Japan	650	406	881	967	1 271	1 512	1 710	1 181	565	258
Korea Rep	18	9	50	120	210	176	100	34	72	17
Madagascar	-	24	24	-	116	50	48	43	41	41
Mauritius	37	189	441	727	608	705	520	308	75	27
Mayotte	4	3	6	4	80	...	...	...	...	...
Philippines	79	133	271	96	67	103	146	331	11	34
Portugal	567	785	855	794	826	2 165	1 325	452	542	967
Réunion	1 653	801	784	957	1 205	908	1 107	942	942	942 F
Senegal	-	-	216	127	-	498	-	-	-	-
Seychelles	600	532	1 270	1 293	1 268	867	923	631	652	584
South Africa	321	922	804	175	161	216	266	259	186	396
Spain	1 860	3 222	2 315	2 423	3 828	4 481	4 369	3 249	2 990	2 812
Tanzania	-	-	-	-	494	573	575	535	469	239
Thailand	8	0	3	17	4	-	6	59	55	41
UK	-	-	-	352	495	386	397	858	842	221
Uruguay	-	-	-	-	-	134	-	-	-	-
Other nei	2 560	2 717	1 955	3 138	4 136	1 406	806	314	877	822
51 Fishing area total	*20 764*	*23 782*	*23 044*	*24 474*	*22 550*	*22 173*	*19 392*	*13 937*	*13 497*	*10 497 F*
57 Australia	2 900	1 344	1 766	370	301	335	301	221	349	420
Belize	73	46	34	21	3	-	0	0	-	-
China	170	70	48	74	36	34	56	13	15	587
China,Taiwan	2 620	3 776	1 726	2 649	1 719	1 022	772	1 362	3 068	3 228
Guinea	...	-	-	491	-	75	51	92	81	35
Honduras	165	-	-	-	-	-	-	-	-	-
India	52	33	34	183	126	213	257	142	218	178
Indonesia	1 001	1 608	3 085	2 896	2 002	1 799	1 691	1 212	1 144	1 258
Japan	497	841	4 595	236	140	267	452	361	450	355
Korea Rep	19	3	35	135	106	-	6	5	7	9
Madagascar	-	-	-	-	4	-	-	-	-	-
Malaysia	-	4	26	12	162	132	217	142	182	46
Philippines	9	34	34	38	8	13	59	3	6	-
Portugal	-	-	-	109	241	40	632	62	11	48
Senegal	-	-	-	-	86	75	-	-	-	-
Seychelles	21	46	145	67	9	16	44	68	135	81
Spain	-	280	1 974	2 290	1 250	674	428	675	317	304
Sri Lanka	2 095	2 109	2 260	2 133	824	1 628	848	779	934	2 188
Thailand	6	1	10	2	1	2	2	-	-	-
UK	-	-	-	-	75	620	472	-	40	377
Vanuatu	-	-	-	-	-	-	-	-	4	4
Other nei	313	393	654	2 265	1 226	246	121	58	127	148
57 Fishing area total	*9 941*	*10 588*	*16 426*	*13 971*	*8 319*	*7 191*	*6 409*	*5 195*	*7 088*	*9 266*
61 China	104	174	272	...	...	...	...	...	...	...
China,Taiwan	1 710	1 504	1 941	1 802	4 301	6 857	7 689	3 416	3 129	2 290
Japan	5 506	5 506 F	547	4 755	5 893	6 101	6 871	6 157	5 809	5 163
Korea Rep	-	-	-	-	9	6	6	8	-	1
Russian Fed	-	2	-	-	-	-	-	-	-	-
Spain	-	-	-	-	43	-	-	-	-	-
61 Fishing area total	*7 320*	*7 186 F*	*2 760*	*6 557*	*10 246*	*12 964*	*14 566*	*9 581*	*8 938*	*7 454*
67 Japan	-	-	-	-	6	108	2	-	33	38
Korea Rep	-	-	-	-	-	-	-	-	-	3
USA	14	0	0	1	-	-	-	0	-	-
67 Fishing area total	*14*	*0*	*0*	*1*	*6*	*108*	*2*	*0*	*33*	*41*
71 Australia	1 064	1 170	779	577	698	771	1 144	1 138	1 133	1 136
Belize	128	10	417	117	44	23	7	4	2	7
China	95	47	896	127	159	310	1 240	527	882	301
China,Taiwan	17	2 143	3 966	3 130	2 548	668	342	253	205	621
Cook Is	-	-	-	-	0	1	2	2	0	1
Fiji	115	170	160	261	177	210	86	82	97	104
Indonesia	...	...	...	58	63	74	40	1 122	675	429
Japan	589	589 F	361	364	369	492	500	436	548	451
Korea Rep	100	185	144	358	517	160	220	280	489	339
Malaysia	-	-	-	-	-	-	-	373	343	234
Marshall Is	-	-	-	-	-	-	-	7	4	5
Micronesia	29	27	27	21	8	13	57	20	26	15
NewCaledonia	41	46	48	17	12	10	19	15	7	8
Palau	2	...	4	18	...	...	...	...	...	...
Papua N Guin	22	22	30	73	98	80	82	81	79	93
Philippines	3 158	4 706	5 236	4 907	4 350	4 874	4 805	4 605	5 530	5 528
Solomon Is	2	3	3	3	0	0	0	0	0	63
Vanuatu	-	174	155	805	466	188	222	125	130	281
Viet Nam	...	...	...	...	...	...	...	...	...	820
71 Fishing area total	*5 362*	*9 292 F*	*12 226*	*10 836*	*9 509*	*7 874*	*8 766*	*9 070*	*10 150*	*10 436*

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
77 Amer Samoa	1	1	4	4	8	38	13	7	11	19
China	319	852	718	1 347	672	1 485	1 040	2 106	1 137	1 305
China,Taiwan	592	27	2 093	2 501	1 303	1 226	1 323	1 352	1 675	1 653
Cook Is	10 F	14	164	170	97	98	36	17	11	78
Costa Rica	653	638	286	179	191	230 F	279	279 F	279 F	279 F
Fr Polynesia	79	70	117	84	79	83	67	80	71	80
Guatemala	...	...	...	...	...	1	0	-	-	-
Japan	3 029	3 029 F	2 667	2 465	1 821	1 684	1 470	1 868	2 041	2 600
Korea Rep	894	954	627	642	569	722	666	716	758	674
Mexico	753	443	405	367	770	804	750	744	738	724
Niue	...	...	...	...	1	2	2	0	0	1
Samoa	27	14	12	4	1	3	5	6	5	7
Spain	-	-	-	48	51	23	193	29	225	-
Tonga	44	42	25	10	18	21	31	28	22	26
USA	2 490	2 012	2 249	1 422	1 860	1 720	2 195	2 266	2 165	1 797
77 Fishing area total	*8 891 F*	*8 096 F*	*9 367*	*9 243*	*7 441*	*8 140 F*	*8 070*	*9 498 F*	*9 138 F*	*9 243 F*
81 Australia	789	1 167	1 397	1 091	938	633	73	95	159	124
China	-	-	-	-	5	8	12	-	-	36
China,Taiwan	17	121	179	10	5	152	106	50	48	188
Cook Is	-	-	0	0	-	8	2	0	0	0
Japan	488	488 F	347	350	253	162	140	148	167	192
Korea Rep	-	-	-	-	-	-	-	149	366	224
New Zealand	1 027	920	635	538	348	581	392	347	419	536
Spain	-	-	-	730	1 358	3 107	4 217	3 410	1 721	994
Ukraine	-	-	1	-	-	-	-	-	-	-
81 Fishing area total	*2 321*	*2 696 F*	*2 559*	*2 719*	*2 907*	*4 651*	*4 942*	*4 199*	*2 880*	*2 294*
87 Chile	3 262	3 523	3 848	3 268	3 979	3 147	3 741	2 792	3 514	4 363
China	-	-	-	56	140	28	4	14	28	35
China,Taiwan	2	9	117	263	130	168	133	6	14	31
Colombia	1	...	...	1	...	...	...	...	0	0
Ecuador	617	508	263	1	127	718	586	1 257	802	490
Japan	1 267	1 267 F	878	869	650	607	568	740	629	942
Korea Rep	-	-	-	-	9	34	45	-	10	5
Peru	356	278	80	28	27	93	57	112	629	418
Portugal	-	-	-	-	-	-	495	-	-	241
Spain	828	6 322	5 674	5 605	2 599	2 636	1 339	1 627	9 232	3 126
Uruguay	-	-	-	343	494	-	-	-	-	-
87 Fishing area total	*6 333*	*11 907 F*	*10 860*	*10 434*	*8 155*	*7 431*	*6 968*	*6 548*	*14 858*	*9 651*
Species total	*101 865 F*	*110 046 F*	*119 157*	*117 547*	*109 132*	*111 366 F*	*111 331 F*	*93 392 F*	*103 135 F*	*96 244 F*

Tuna-like fishes nei	Poissons type thon nca		Peces parec. a los atunes nep		*Scombroidei*			1,75(XX)XXX,XX		TUX
21 Canada	-	0	0	0	1	2	2	0	0	0
Portugal	-	-	10	-	-	-	1	-	-	-
USA	13	4	4	4	6	2	1	1	1	2
21 Fishing area total	*13*	*4*	*14*	*4*	*7*	*4*	*4*	*1*	*1*	*2*
27 China	-	-	-	1	6	12	8	-	-	2
France	-	26	2	1	5	4	10	1	22	-
Ireland	-	-	-	343	15	-	0	-	0	0
Portugal	61	43	69	116	355	97	39	15	3	20
Russian Fed	-	-	-	-	-	-	-	2	-	-
Spain	206	588	126	231	200	167	-	-	-	-
UK	-	-	-	20	0	-	-	0	1	-
27 Fishing area total	*267*	*657*	*197*	*712*	*581*	*280*	*57*	*18*	*26*	*22*
31 Antigua Barb	28	12	13	5	59	22	28	41	11	15
Br Virgin Is	-	-	-	-	-	9	5 F	5 F	5 F	5 F
Colombia	7 846	19 522	53	...	...	...	...	...	...	...
Costa Rica	3	2	5	1	2	5 F	10	10 F	10 F	10 F
Dominica	12	-	-	8	7	-	-	2	7	-
Dominican Rp	-	-	351	437	-	-	2	120	108	128
Jamaica	86	48	...	...	...	...	...	...	...	...
Philippines	-	-	1	-	-	-	-	-	-	-
Portugal	-	-	-	-	-	-	-	-	4	-
Puerto Rico	17	6	12	7	5	5	4	2	1	2
St Kitts Nev	23	13	22	11	2	3 F	4 F	5 F	6 F	7
St Vincent	49	-	1 701	3 110	-	287	42	123	109	71
Spain	-	-	-	-	-	-	0	1	-	-
Trinidad Tob	405	482	233	28	482	130	133	184	242	326
USA	47	20	31	12	1	1	5	7	14	189
US Virgin Is	...	...	61	20	25	26	10	12	12	12
Vanuatu	-	-	-	165	161	106	97	5	-	-
Venezuela	13	-	-	-	-	17	40	6	36	-
31 Fishing area total	*8 529*	*20 105*	*2 483*	*3 804*	*744*	*611 F*	*380 F*	*523 F*	*565 F*	*765 F*
34 Belize	125	172	-	...	97	657	-	1 128	...	...
Benin	-	-	-	-	-	-	-	8	595	328
Bulgaria	55	-	-	-	-	-	-	-	-	-
Cameroon	...	59	36	22 F	5	5	5	5 F	5 F	5 F
China	187	80	100	114	898	637	290	32	22	21
Comoros	-	-	-	-	-	-	173	258	...	383
Congo Rep	-	-	36	55	114	41	24	...	52	45
Côte dIvoire	-	-	-	-	-	-	-	3 398	120	2 295
Cyprus	268	-	-	-	-	-	-	-	-	-
Eq Guinea	50 F	50 F	50 F	60 F	60 F	65 F	70	135 F	-	12

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
France	-	27	-	-	-	2	-	37	-	-
Gabon	-	58	-	-	-	91	93	...	...	...
Georgia	...	...	...	...	...	...	...	...	...	14
Germany	-	-	-	-	-	12	1	-	-	-
Ghana	-	-	-	-	-	-	-	-	-	4 785
Greece	3	-	-	-	-	-	-	-	-	-
Guinea	...	...	...	...	1 691	...	...	...	...	...
Ireland	-	-	-	-	122	-	-	23	-	-
Liberia	-	-	-	-	-	-	45	-	-	-
Lithuania	154	216	-	-	-	-	-	-	-	-
Mauritania	1 000 F	900 F	800 F	724	522	143	86	122	159	68
Morocco	-	108	48	89	-	-	-	-	-	-
Nigeria	5	1	22	42	570	327	90	208	501	497
Panama	135	174	-	...	1 237	1 338	599	-	...	...
Poland	-	-	-	-	-	-	-	-	-	4
Portugal	16	55	78	79	118	34	10	-	6	-
St Kitts Nev	-	-	-	-	-	-	-	-	-	773
St Vincent	-	-	-	-	-	-	1	-	-	-
Senegal	6	-	-	1	2	3	61	-	-	-
Sierra Leone	6 638	498	848	2 480	1 964	1 217	2 113	2 704	2 650 F	2 650 F
Spain	322	16	-	-	-	-	-	-	-	-
Togo	-	-	-	18	-	-	224	-	-	-
Ukraine	206	37	5	47	-	1	-	5	-	384
Vanuatu	-	-	-	-	51	199	796	11	-	-
Other nei	-	1	-	-	-	-	-	-	-	-
34 Fishing area total	*9 170 F*	*2 452 F*	*2 023 F*	*3 731 F*	*7 451 F*	*4 772 F*	*4 681*	*8 074 F*	*4 110 F*	*12 264 F*
37 Cyprus	-	8	-	-	-	-	-	-	-	-
Egypt	778	1 301	903	986	426	1 087	1 564	1 810	1 689	1 578
France	-	-	-	-	-	6	10	-	1	-
Greece	125	-	-	-	-	-	-	-	-	-
Italy	-	56	44	59	1 109	-	-	-	-	-
Korea Rep	-	-	-	-	-	-	-	-	13	-
Lebanon	450	400	400	400	385	389	389 F	389 F	389 F	389 F
Libya	-	-	-	-	-	-	-	-	305	300 F
Montenegro	...	...	...	...	...	4	1	9	14	14
Morocco	-	-	22	-	-	-	-	-	-	-
Palest, O.T.	50 F	54	27	48	41	17	58	80	121	45
Portugal	-	1	2	16	4	-	-	-	-	-
Serbia-Monte	-	-	-	-	7	...	...	...	...	...
Tunisia	989	4	-	1 187	-	-	-	721	1 614	1 525
37 Fishing area total	*2 392 F*	*1 824*	*1 398*	*2 696*	*1 972*	*1 503*	*2 022 F*	*3 009 F*	*4 146 F*	*3 851 F*
41 Argentina	-	-	-	83	3	16	0	0	1	121
Brazil	5	467	2 259	358	60	-	22	651	864	1 315
China	-	-	-	41	33	60	57	10	26	19
Korea Rep	-	-	-	-	-	-	-	-	1	-
Portugal	4	13	2	53	4	37	88	29	24	-
Russian Fed	-	-	-	2	-	-	-	-	-	-
Spain	-	-	2	-	9	-	13	14	55	-
Uruguay	3	51	80	56	99	51	35	11	-	2
Vanuatu	-	-	-	-	-	-	-	493	-	-
41 Fishing area total	*12*	*531*	*2 343*	*593*	*208*	*164*	*215*	*1 208*	*971*	*1 457*
47 Angola	-	-	206	330	3 518	-	-	-	-	-
China	346	510	37	17	104	76	51	1	2	0
Korea Rep	3	-	13	2	-	-	-	106	-	-
Lithuania	-	-	5	-	-	-	-	-	-	-
Portugal	42	23	13	4	52	9	12	3	-	-
South Africa	1	506	391	411	451	99	-	-	-	102
Spain	61	130	73	130	140	165	22	3	11	-
47 Fishing area total	*453*	*1 169*	*738*	*894*	*4 265*	*349*	*85*	*113*	*13*	*102*
51 Belize	0	600	-	0	-	-	-	-	-	-
Br Ind Oc Tr	-	0	0	0	0	9	11	0	2	0
China	125	89	66	-	-	-	-	-	-	-
Comoros	450	450	500	500	500	500 F	550 F	733	733 F	733 F
Djibouti	35 F	45 F	60 F	75 F	92	107	129	193	100	100 F
Eritrea	96	136	149	129	67	152	529	589	640	423
France	-	-	-	-	-	-	-	-	9	20
India	-	-	1	-	-	-	-	-	-	-
Italy	8	-	-	-	-	-	-	-	-	-
Jordan	4	14	-	5	4	3	4	3	10	7
Korea Rep	294	22	99	168	400	426	172	45	29	26
Maldives	-	24	21	24	-	-	-	-	-	-
Mauritius	745	745	745	736	730	706	164	200	100	360
Mayotte	97	79	83	171	254	-	-	-	-	-
Oman	188	7	69	1 216	49	449	568	418	55	369
Pakistan	2 775	2 480	2 505	2 215	3 156	3 300	3 196	3 285	3 504	9 558
Portugal	55	45	43	38	26	102	17	11	9	23
Qatar	-	-	36	-	62	216	257	368	232	335
Réunion	-	-	1	-	-	14	6	-	-	-
Saudi Arabia	1 098	1 331	125	79	81	71	89	131	135	135
Seychelles	134	32	28	17	19	8	25	10	13	17
South Africa	7	12	9	22	3	1	17	4	1	3
Tanzania	417	402	419	1 040	901	2 046	1 371	1 513	1 529	1 644
Thailand	-	-	-	-	-	58	254	180	118	-
UK	-	-	-	-	-	72	140	84	-	-
Yemen	571	618	664	710	730	772	814	460 F	500 F	550 F

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Tunas, bonitos, billfishes
Thons, pélamides, marlins
Atunes, bonitos, agujas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Zanzibar	1 217	1 102	1 069	1 690	1 443	2 556	1 428	1 565	1 576	1 584
	Other nei	...	-	-	3	6	11	0	-	-	-
51	*Fishing area total*	*8 316 F*	*8 233 F*	*6 692 F*	*8 838 F*	*8 523*	*11 579 F*	*9 741 F*	*9 792 F*	*9 295 F*	*15 887 F*
57	Australia	12	83	15	0	3	13	39	31	1	4
	Belize	0	-	-	0	-	-	-	-	-	-
	China	167	23	12	-	-	-	-	-	-	-
	India	-	-	1	-	-	-	-	-	-	-
	Indonesia	-	3	116	-	-	-	-	-	-	-
	Japan	236	2	-	-	-	-	-	-	-	-
	Korea Rep	29	-	-	4	-	-	3	4	-	-
	Portugal	-	-	-	3	5	3	80	3	1	4
	Sri Lanka	14 143	14 886	13 831	13 040	5 376	10 305	12 755	14 013	15 118	17 671
	Timor-Leste	3	3 F	3 F	3 F	3 F	3 F	3 F	3 F	3 F	3 F
	UK	-	-	-	-	0	47	41	-	-	-
	Other nei	0	-	-	0	2	0	-	-	-	-
57	*Fishing area total*	*14 590*	*15 000 F*	*13 978 F*	*13 050 F*	*5 389 F*	*10 371 F*	*12 921 F*	*14 054 F*	*15 123 F*	*17 682 F*
61	China	259 F	152 F	59 400 F	57 614 F	20 945 F	59 977 F	57 052	37 745	31 369	38 848
	China,H.Kong	0	0	0	0	0	0	0	-	-	-
	Japan	8 096	8 096 F	438	785	433	1	-	1 469	1 103	1 103
	Korea Rep	3 295	2 344	3 739	1 755	3 324	2 715	4 134	6 918	60 676	9 913
	Russian Fed	18	3	-	54	375	-	-	-	-	-
	Spain	-	-	-	-	106	-	-	-	-	-
61	*Fishing area total*	*11 668 F*	*10 595 F*	*63 577 F*	*60 208 F*	*25 183 F*	*62 693 F*	*61 186*	*46 132*	*93 148*	*49 864*
67	USA	0	1	-	-	-	-	-	-	-	-
67	*Fishing area total*	*0*	*1*	-	-	-	-	-	-	-	-
71	Australia	13	6	7	8	13	12	10	10	4	6
	Ecuador	1 057	427	1 562	3 051	5 193	9 523	9 187	25 415	4 429	8 451
	Guam	2	2	1	2	1	1	0	1	1	1
	Japan	621	621 F	...	5	1	45	-	-	-	-
	Kiribati	-	-	-	-	-	-	5 347	5 756	20 877	25 747
	Korea Rep	256	869	3 203	756	1 298	1 500	955	592	-	715
	Malaysia	-	-	-	-	-	-	-	-	45	-
	NewCaledonia	14	-	18	86	197	187	210	213	228	236
	New Zealand	-	-	-	-	-	-	-	-	1 441	11 897
	N Marianas	3	5	4	6	6	4	2	3	2	2
	Palau	2	51	3	9	3	11	...	...	...	...
	Philippines	3 809	-	-	-	-	-	-	-	-	-
	Solomon Is	-	-	-	-	-	-	-	1 196	...	12 965
	Tuvalu	20 F	20 F	20	...	30	20 F	20 F	20 F	898	2 152 F
	Vanuatu	...	2 379	2 185	4 061	11 032	6 854	8 650	8 206	2 386	5 514
	Viet Nam	18 700 F	20 900 F	17 500	18 500 F	24 000 F	38 000 F	42 000 F	38 000 F	35 000 F	21 700 F
71	*Fishing area total*	*24 497 F*	*25 280 F*	*24 503*	*26 484 F*	*41 774 F*	*56 157 F*	*66 381 F*	*79 412 F*	*65 311 F*	*89 386 F*
77	Amer Samoa	1	-	-	-	-	-	-	-	-	-
	Costa Rica	1 160	1 583	1 436	1 723	1 814	1 620 F	1 418	1 418 F	1 418 F	1 418 F
	Fr Polynesia	0	4	-	-	-	-	2	-	-	12
	Honduras	-	-	-	-	-	-	226	-	10	-
	Korea Rep	3 408	4 122	1 480	933	539	635	249	117	-	249
	Niue	100 F	100 F	100 F	94 F	-	-	-	-	6	-
	Samoa	-	-	-	-	-	25	34	-	-	-
	Spain	10	-	-	19	5	2	39	-	5	-
	Tokelau	10 F	-	-	-	-	-	-	-	-	-
	Tonga	-	-	42	84	133	196	232	137	82	48
	USA	5	2	7	30	5	1	2	3	0	9
77	*Fishing area total*	*4 694 F*	*5 811 F*	*3 065 F*	*2 883 F*	*2 496*	*2 479 F*	*2 202*	*1 675 F*	*1 521 F*	*1 736 F*
81	Australia	159	116	138	199	162	185	0	-	-	-
	Japan	-	-	-	-	1	-	-	-	-	-
	Korea Rep	228	14	-	-	-	-	-	62	-	-
	Ukraine	-	-	-	1	...	-	-	-	-	-
81	*Fishing area total*	*387*	*130*	*138*	*200*	*163*	*185*	*0*	*62*	-	-
87	Colombia	43 840	-	-	21 995	22 933	10 320 F	9 000 F	3 000 F	700	340
	Ecuador	-	-	-	1 078	1 401	190	2 118	3 822	2 714	1 846
	Guatemala	-	-	-	-	-	-	-	15	-	-
	Honduras	-	-	-	-	-	2	15	-	-	23
	Portugal	-	-	-	-	-	-	-	-	-	11
	Spain	-	10	154	285	353	208	482	...	233	984
	USA	-	-	-	20	-	-	-	-	-	-
	Uruguay	-	-	-	87	73	-	-	-	-	-
	Other nei	-	-	-	-	-	-	117	-	-	70
87	*Fishing area total*	*43 840*	*10*	*154*	*23 465*	*24 760*	*10 720 F*	*11 732 F*	*6 837 F*	*3 647*	*3 274*
Species total		*128 828 F*	*91 802 F*	*121 303 F*	*147 562 F*	*123 516 F*	*161 867 F*	*171 607 F*	*170 910 F*	*197 877 F*	*196 292 F*
Group total		***5 795 534***	***6 160 788***	***6 294 273***	***6 272 229***	***6 426 898***	***6 472 101***	***6 618 929***	***6 544 594***	***6 634 797***	***6 620 373***

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Capelin	**Capelan**		**Capelán**		***Mallotus villosus***				**1,23(04)002,01**	**CAP**
21 Canada	19 747	13 559	22 392	33 630	36 704	42 194	37 599	39 175	35 359	26 294
Greenland	3	83	42	263	24	24	33	139	184	90
St Pier Mq	1	4	21	0	2	-	9	2	-	-
Spain	-	-	-	10	-	-	-	-	-	-
21 Fishing area total	*19 751*	*13 646*	*22 455*	*33 903*	*36 730*	*42 218*	*37 641*	*39 316*	*35 543*	*26 384*
27 Denmark	17 588	23 165	14 352	-	-	-	-	-	-	-
Faroe Is	28 907	54 059	50 468	33 078	19 752	31 610	19 059	10 211	-	7 353
France	1	4	13	-	1	-	0	0	...	2
Germany	-	95	-	-	-	-	-	-	-	-
Greenland	18 638	30 258	29 521	21 225	21 192	6 676	12 608	6 650	-	4 948
Iceland	918 417	1 078 818	680 291	524 516	604 509	184 431	307 447	149 031	21 526	115 515
Norway	482 834	522 349	249 497	49 054	67 339	2 047	41 098	40 907	232 569	272 415
Russian Fed	180 098	247 039	94 030	4	411	-	1 999	7 000	73 151	77 446
Sweden	-	7 570	1 350	-	-	-	-	-	-	-
UK	-	-	-	-	-	0	0	-	-	-
27 Fishing area total	*1 646 483*	*1 963 357*	*1 119 522*	*627 877*	*713 204*	*224 764*	*382 211*	*213 799*	*327 246*	*477 679*
61 Russian Fed	1 468	3 882	1 994	1 753	1 971	2 164	3 041	1 337	1 504	1 234
61 Fishing area total	*1 468*	*3 882*	*1 994*	*1 753*	*1 971*	*2 164*	*3 041*	*1 337*	*1 504*	*1 234*
Species total	*1 667 702*	*1 980 885*	*1 143 971*	*663 533*	*751 905*	*269 146*	*422 893*	*254 452*	*364 293*	*505 297*
Garfish	**Orphie**		**Aguja**		***Belone belone***				**1,47(01)001,01**	**GAR**
27 Channel Is	2	1	2	2	-	-	-	-	1	1
Denmark	558	580	540	515	410	347	263	193	354	300
Estonia	111	148	96	168	156	191	110	82	72	86
France	53	102	60	61	76	51	58	14	59	68
Germany	73	113	138	110	100	78	110	71	98	76
Ireland	-	-	1	-	-	-	-	-	-	-
Latvia	11	-	18	23	27	25	26	40	30	26
Lithuania	-	-	-	-	-	-	6	4	7	2
Netherlands	2	2	-	1	-	88	-	-	1	1
Norway	0	0	0	0	0	1	1	0	0	-
Poland	-	-	-	56	71	30	50	24	12	23
Portugal	57	30	27	34	28	23	26	15	21	22
Spain	152	198	146	128	157	83	73	69	89	93
Sweden	9	8	11	47	2	2	1	2	2	2
UK	2	3	5	4	1	-	1	1	2	1
27 Fishing area total	*1 030*	*1 185*	*1 044*	*1 149*	*1 028*	*919*	*725*	*515*	*748*	*701*
37 Albania	...	...	5	5	...	4	-	-	-	-
Bulgaria	16	37	8	4	2	0	3	4	5	4
Croatia	11	4	3	10	55	18	27	...	16	9
France	2	3	-	1	1	0	2	...	2	1
Greece	126	103	103	106	97	70	82	84	100	100 F
Italy	139	139	179	84	214	247	192	48	18	94
Romania	-	-	-	-	-	0	0	-	-	-
Russian Fed	1	1	1	1	8	2	1	-	3	2
Serbia-Monte	6	6	5	2	...	-	-	-	-	-
Slovenia	1	0	-	-	1	1	2	1	2	0
Spain	228	1 015	50	54	133	60	69	111	163	51
Tunisia	307	349	308	267	259	190	152	161	155	166
Turkey	640	482	450	491	577	375	400	335	346	661
Ukraine	-	-	1	...	4	3	3	2	7	4
37 Fishing area total	*1 477*	*2 139*	*1 113*	*1 025*	*1 351*	*970*	*933*	*746*	*817*	*1 092 F*
Species total	*2 507*	*3 324*	*2 157*	*2 174*	*2 379*	*1 889*	*1 658*	*1 261*	*1 565*	*1 793 F*
Flat needlefish	**Orphie plate**		**Agujón sable**		***Ablennes hians***				**1,47(01)008,01**	**BAF**
51 Qatar	2	1	4	5	6	22	42	18	12	26
51 Fishing area total	*2*	*1*	*4*	*5*	*6*	*22*	*42*	*18*	*12*	*26*
Species total	*2*	*1*	*4*	*5*	*6*	*22*	*42*	*18*	*12*	*26*
Hound needlefish	**Aiguille crocodile**		**Marao lisero**		***Tylosurus crocodilus***				**1,47(01)013,08**	**BTS**
51 Saudi Arabia	136	244	183	180	192	242	258	169	195	145
51 Fishing area total	*136*	*244*	*183*	*180*	*192*	*242*	*258*	*169*	*195*	*145*
Species total	*136*	*244*	*183*	*180*	*192*	*242*	*258*	*169*	*195*	*145*
Needlefishes nei	**Aiguilles nca**		**Maraos nep**		***Tylosurus spp***				**1,47(01)013,XX**	**NED**
51 Egypt	28	-	121	141	662	435	375	141	208	284
Oman	130	541	137	28	269	146	145	472	297	455
51 Fishing area total	*158*	*541*	*258*	*169*	*931*	*581*	*520*	*613*	*505*	*739*
57 Indonesia	...	...	...	382	529	870	3 245	3 655	3 424	3 243
Malaysia	...	...	...	37	...	...	...	...	...	...
57 Fishing area total	*...*	*...*	*...*	*419*	*529*	*870*	*3 245*	*3 655*	*3 424*	*3 243*
71 Indonesia	...	...	...	1 278	1 506	1 887	2 663	2 397	3 515	4 568
Malaysia	...	...	...	36	...	...	...	...	...	...
Philippines	11 819	11 672	13 524	12 797	11 296	14 408	14 020	10 962	11 580	12 915

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
71 Fishing area total	*11 819*	*11 672*	*13 524*	*14 111*	*12 802*	*16 295*	*16 683*	*13 359*	*15 095*	*17 483*
Species total	*11 977*	*12 213*	*13 782*	*14 699*	*14 262*	*17 746*	*20 448*	*17 627*	*19 024*	*21 465*
Needlefishes, etc. nei	**Aiguilles, orphies nca**		**Agujones, maraos nep**		***Belonidae***				**1,47(01)XXX,XX**	**BEN**
31 Dominican Rp	45	48	65	26	21	...	...	31	28	30
Grenada	0	0	0	1	4	4	3	1	1	0
St Kitts Nev	37	34	15 F	...	7 F	15 F	23 F	31 F	39 F	47
31 Fishing area total	*82*	*82*	*80 F*	*27*	*32 F*	*19 F*	*26 F*	*63 F*	*68 F*	*77*
34 Benin	38	32	25	27	21	22	18	48	60	55
Côte dIvoire	3	2	...	...	...	0	0	0	0	-
Liberia	31	35	35	90	175	...	5	1	1 F	1 F
Nigeria	431	301	422	371	118	160	348	254	468	381
Portugal	-	-	-	-	4	-	-	-	-	-
Senegal	0	...	16	20	40	70	5	10	11	49
Spain	-	3	6	2	3	1	2	3	3	2
Togo	153	69	85	82	130	249	82	130 F	175	133
34 Fishing area total	*656*	*442*	*589*	*592*	*491*	*502*	*460*	*446 F*	*718 F*	*621 F*
51 Bahrain	53	...	27	132	41	79	44	77	160	96
Eritrea	...	...	...	...	...	...	15	7	7	3
51 Fishing area total	*53*	*...*	*27*	*132*	*41*	*79*	*59*	*84*	*167*	*99*
Species total	*791*	*524*	*696 F*	*751*	*564 F*	*600 F*	*545 F*	*593 F*	*953 F*	*797 F*
Atlantic saury	**Balaou atlantique**		**Paparda del Atlántico**		***Scomberesox saurus***				**1,47(02)002,01**	**SAU**
27 Portugal	1	-	-	0	-	0	2	-	-	-
Spain	992	589	598	352	1 280	682	2 260	281	344	159
27 Fishing area total	*993*	*589*	*598*	*352*	*1 280*	*682*	*2 262*	*281*	*344*	*159*
37 Spain	-	-	-	0	29	26	528	2 204	383	264
37 Fishing area total	-	-	-	*0*	*29*	*26*	*528*	*2 204*	*383*	*264*
87 Chile	4 178	1 492	10 339	1 490	756	633	558	1 093	5 979	7 013
87 Fishing area total	*4 178*	*1 492*	*10 339*	*1 490*	*756*	*633*	*558*	*1 093*	*5 979*	*7 013*
Species total	*5 171*	*2 081*	*10 937*	*1 842*	*2 065*	*1 341*	*3 348*	*3 578*	*6 706*	*7 436*
Pacific saury	**Balaou du Japon**		**Paparda del Pacífico**		***Cololabis saira***				**1,47(02)007,01**	**SAP**
61 China,Taiwan	39 764	51 295	91 515	44 262	111 491	60 649	87 277	139 514	104 219	165 692
Japan	269 797	205 282	264 804	204 371	234 451	244 586	296 521	354 727	310 744	232 700 F
Korea Rep	25 782	26 953	32 643	25 585	44 828	12 706	21 716	34 201	25 551	23 924
Russian Fed	40 407	51 709	57 104	81 572	87 456	76 920	119 433	93 677	35 213	35 268
61 Fishing area total	*375 750*	*335 239*	*446 066*	*355 790*	*478 226*	*394 861*	*524 947*	*622 119*	*475 727*	*457 584 F*
77 Korea Rep	423	234	-	-	-	-	-	-	-	-
77 Fishing area total	*423*	*234*	-	-	-	-	-	-	-	-
Species total	*376 173*	*335 473*	*446 066*	*355 790*	*478 226*	*394 861*	*524 947*	*622 119*	*475 727*	*457 584 F*
Japanese halfbeak	**Demi-bec du Japon**		**Agujeta del Japón**		***Hyporhamphus sajori***				**1,47(03)003,11**	**HAJ**
61 Korea Rep	613	670	411	1 137	607	369	293	462	518	-
61 Fishing area total	*613*	*670*	*411*	*1 137*	*607*	*369*	*293*	*462*	*518*	-
Species total	*613*	*670*	*411*	*1 137*	*607*	*369*	*293*	*462*	*518*	-
Ballyhoo halfbeak	**Demi-bec brésilien**		**Agujeta brasileña**		***Hemiramphus brasiliensis***				**1,47(03)004,06**	**BAL**
31 Puerto Rico	41	36	33	20	16	14	14	19	23	17
USA	354	393	460	288	285	466	430	345	469	502
31 Fishing area total	*395*	*429*	*493*	*308*	*301*	*480*	*444*	*364*	*492*	*519*
41 Brazil	3 342	3 651	1 735	1 761	429	867	2 081	1 093	1 205	1 136
41 Fishing area total	*3 342*	*3 651*	*1 735*	*1 761*	*429*	*867*	*2 081*	*1 093*	*1 205*	*1 136*
Species total	*3 737*	*4 080*	*2 228*	*2 069*	*730*	*1 347*	*2 525*	*1 457*	*1 697*	*1 655*
Balao halfbeak	**Demi-bec balaou**		**Agujeta balaju**		***Hemiramphus balao***				**1,47(03)004,13**	**BHA**
31 St Vincent	...	...	...	...	...	...	...	...	59	71
31 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*59*	*71*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*59*	*71*
Halfbeaks nei	**Demi-becs nca**		**Agujetas nep**		***Hemiramphus spp***				**1,47(03)004,XX**	**HAX**
31 Grenada	1	1	1	0	1	6	9	2	3	1
Nicaragua	...	...	...	...	...	59	...	...	...	61
31 Fishing area total	*1*	*1*	*1*	*0*	*1*	*65*	*9*	*2*	*3*	*62*
34 Benin	...	...	...	...	8	8	7	8	17	30
Ghana	...	...	...	...	...	...	1 544	1 476	1 020	1 420
Liberia	97	100	100	85	63	13	198	47	50 F	50 F
Sao Tome Prn	125 F	137 F	156	30	35 F	35 F	35 F	35 F	35 F	35 F

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Senegal	14	48	37	62	35	235	152	108	120	148
Togo	18	18	21	14	33	49	19	10 F	3	6
34 Fishing area total	*254 F*	*303 F*	*314*	*191*	*174 F*	*340 F*	*1 955 F*	*1 684 F*	*1 245 F*	*1 689 F*
51 Bahrain	59	28	175	52	60	134	101	84	126	103
India	1 318	3 110	2 337	2 246	3 835	5 385	5 804	933	705	896
Saudi Arabia	...	...	...	...	...	...	...	67	45	29
Tanzania	1 300	1 200	1 125	1 200	1 751	1 751	716	728	647	987
Untd Arab Em	50 F	55	70	60 F	51	30 F	10 F	...	...	...
51 Fishing area total	*2 727 F*	*4 393*	*3 707*	*3 558 F*	*5 697*	*7 300 F*	*6 631 F*	*1 812*	*1 523*	*2 015*
57 Australia	746	678	510	470	554	531	457	393	421	383
India	4 695	5 000	5 175	4 884	4 650	4 839	3 519	25 346	4 291	26 719
Indonesia	8 141	6 136	7 558	7 615	6 802	7 032	5 867	4 669	8 054	6 740
57 Fishing area total	*13 582*	*11 814*	*13 243*	*12 969*	*12 006*	*12 402*	*9 843*	*30 408*	*12 766*	*33 842*
71 Australia	143	182	179	...	210	193	-	0	-	-
Fiji	56	45 F	36	58	60 F	62	52	50 F	50 F	50
Indonesia	19 179	20 895	14 477	15 575	18 900	19 606	18 342	18 274	19 578	18 971
Philippines	2 820	3 286	3 053	2 848	2 655	2 833	3 101	2 713	2 786	2 738
71 Fishing area total	*22 198*	*24 408 F*	*17 745*	*18 481*	*21 825 F*	*22 694*	*21 495*	*21 037 F*	*22 414 F*	*21 759*
81 Australia	66	52	29	23	48	38	...	...	...	...
New Zealand	13	11	6	14	13	9	11	7	12	12
81 Fishing area total	*79*	*63*	*35*	*37*	*61*	*47*	*11*	*7*	*12*	*12*
Species total	*38 841 F*	*40 982 F*	*35 045*	*35 236 F*	*39 764 F*	*42 848 F*	*39 944 F*	*54 950 F*	*37 963 F*	*59 379 F*
Japanese flyingfish	**Poisson-volant du Japon**		**Volador japonés**		***Cypselurus agoo***			**1,47(04)010,02**		**JFL**
61 Japan	8 286	6 909	5 973	6 130	7 722	8 101	...	...	...	...
61 Fishing area total	*8 286*	*6 909*	*5 973*	*6 130*	*7 722*	*8 101*	*...*	*...*	*...*	*...*
Species total	*8 286*	*6 909*	*5 973*	*6 130*	*7 722*	*8 101*	*...*	*...*	*...*	*...*
Flyingfishes nei	**Exocets nca**		**Voladores nep**		***Exocoetidae***			**1,47(04)XXX,XX**		**FLY**
31 Barbados	1 673	1 590	1 912	1 186	1 112	922	1 288	2 354	2 292	2 424
Grenada	10	5	4	3	9	3	1	15	17	8
Martinique	0	0	-	-	-	-	-	-	-	-
St Kitts Nev	48	42	20 F	...	10 F	15 F	20 F	25 F	30 F	35
St Lucia	323	193	75	11	72	30	46	249	220	109
31 Fishing area total	*2 054*	*1 830*	*2 011 F*	*1 200*	*1 203 F*	*970 F*	*1 355 F*	*2 643 F*	*2 559 F*	*2 576*
34 Benin	96	92	122	125	99	102	82	1 164	1 362	877
Congo Rep	-	-	109	104	116	195	114	102	246	601
Ghana	...	...	...	...	...	...	2 348	2 200	1 053	196
Liberia	19	20	20	0	112	11	246	99	100 F	100 F
Nigeria	55	1 837	647	509	479	146	257	202	450	387
Sao Tome Prn	850 F	820 F	800	774	785 F	785 F	790 F	790 F	810 F	830 F
Togo	186	190	99	113	345	707	94	150 F	198	142
34 Fishing area total	*1 206 F*	*2 959 F*	*1 797*	*1 625*	*1 936 F*	*1 946 F*	*3 931 F*	*4 707 F*	*4 219 F*	*3 133 F*
41 Brazil	217	708	698	1 289	726	1 063	1 256	1 014	1 119	1 056
41 Fishing area total	*217*	*708*	*698*	*1 289*	*726*	*1 063*	*1 256*	*1 014*	*1 119*	*1 056*
51 India	47	79	79	79	63	75	140	134	170	209
51 Fishing area total	*47*	*79*	*79*	*79*	*63*	*75*	*140*	*134*	*170*	*209*
57 India	2 467	2 704	2 685	2 322	2 211	2 436	4 201	3 582	5 092	4 948
Indonesia	4 471	4 049	9 162	7 504	4 145	3 911	5 832	4 049	3 927	2 188
57 Fishing area total	*6 938*	*6 753*	*11 847*	*9 826*	*6 356*	*6 347*	*10 033*	*7 631*	*9 019*	*7 136*
61 China,Taiwan	366	502	460	1 096	532	147	71	85	296	84
61 Fishing area total	*366*	*502*	*460*	*1 096*	*532*	*147*	*71*	*85*	*296*	*84*
71 Indonesia	11 996	7 808	8 204	10 298	9 401	10 307	12 260	10 405	10 203	9 201
Kiribati	1 594	1 617	471	500 F	530 F	560 F	588	270 F	2	5
Philippines	33 212	34 650	37 571	33 577	27 937	30 981	30 198	31 474	26 546	25 887
71 Fishing area total	*46 802*	*44 075*	*46 246*	*44 375 F*	*37 868 F*	*41 848 F*	*43 046*	*42 149 F*	*36 751*	*35 093*
77 Cook Is	30 F	30 F	30 F	30	40 F	50	50 F	50 F	45 F	45 F
Fr Polynesia	82	79	70 F	60 F	52	57	20	23	22	33
77 Fishing area total	*112 F*	*109 F*	*100 F*	*90 F*	*92 F*	*107*	*70 F*	*73 F*	*67 F*	*78 F*
81 New Zealand	1	7	2	5	3	0	1	1	0	3
81 Fishing area total	*1*	*7*	*2*	*5*	*3*	*0*	*1*	*1*	*0*	*3*
87 Peru	5 035	3 198	433	550	85	146	331	295	987	2 676
87 Fishing area total	*5 035*	*3 198*	*433*	*550*	*85*	*146*	*331*	*295*	*987*	*2 676*
Species total	*62 778 F*	*60 220 F*	*63 673 F*	*60 135 F*	*48 864 F*	*52 649 F*	*60 234 F*	*58 732 F*	*55 187 F*	*52 044 F*
Opah	**Opah**		**Opa**		***Lampris guttatus***			**1,52(01)001,02**		**LAG**
21 USA	1	0	0	0	0	0	0	1	0	0
21 Fishing area total	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*
27 Portugal	-	-	-	-	-	1	0	-	-	1

B-37 **Miscellaneous pelagic fishes** / **Poissons pélagiques divers** / **Peces pelágicos diversos**

Capture production by species, fishing areas and countries or areas / **Captures par espèces, zones de pêche et pays ou zones** / **Capturas por especies, áreas de pesca y países o áreas**

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
27 Fishing area total	-	-	-	-	-	*1*	*0*	-	-	*1*
31 USA	1	0	-	0	-	-	-	-	-	-
31 Fishing area total	*1*	*0*	-	*0*	-	-	-	-	-	-
34 Portugal	0	0	1	0	-	-	-	-	-	-
34 Fishing area total	*0*	*0*	*1*	*0*	-	-	-	-	-	-
41 Uruguay	-	-	12	12	0	16	0	0	-	-
41 Fishing area total	-	-	*12*	*12*	*0*	*16*	*0*	*0*	-	-
77 Amer Samoa	1	-	2	0	0	-	-	-	-	-
Fr Polynesia	148	140	144 F	148	118	108	122	120	82	115
USA	47	446	530	376	508	552	616	655	934	869
77 Fishing area total	*196*	*586*	*676 F*	*524*	*626*	*660*	*738*	*775*	*1 016*	*984*
81 New Zealand	340	329	213	136	112	84	80	48	91	113
Ukraine	-	-	4	-	-	-	-	-	-	-
81 Fishing area total	*340*	*329*	*217*	*136*	*112*	*84*	*80*	*48*	*91*	*113*
Species total	*538*	*915*	*906 F*	*672*	*738*	*761*	*818*	*824*	*1 107*	*1 098*
Southern opah	**...B**		**...C**		***Lampris immaculatus***				**1,52(01)001,03**	**LAI**
58 Australia	-	0	-	-	0	-	-	-	0	-
58 Fishing area total	-	*0*	-	-	*0*	-	-	-	*0*	-
88 Ukraine	-	-	-	0	-	-	-	-	-	-
88 Fishing area total	-	-	-	*0*	-	-	-	-	-	-
Species total	-	*0*	-	*0*	*0*	-	-	-	*0*	-
Mediterranean dealfish	**Poisson ruban**		**Traquíptero**		***Trachipterus trachipterus***				**1,52(04)002,02**	**TRQ**
27 Spain	-	-	-	-	-	-	-	-	83	-
27 Fishing area total	-	-	-	-	-	-	-	-	*83*	-
Species total	-	-	-	-	-	-	-	-	*83*	-
Dealfish	**Trachyptère atlantique**		**Cardenal atlántico**		***Trachipterus arcticus***				**1,52(04)002,03**	**TPA**
21 USA	2	1	-	2	5	0	4	12	3	20
21 Fishing area total	*2*	*1*	-	*2*	*5*	*0*	*4*	*12*	*3*	*20*
27 Faroe Is	-	-	-	-	-	-	-	798	1 940	134
Iceland	-	-	-	-	-	-	-	-	-	11
Portugal	25	16	-	-	-	-	-	-	-	-
27 Fishing area total	*25*	*16*	-	-	-	-	-	*798*	*1 940*	*145*
Species total	*27*	*17*	-	*2*	*5*	*0*	*4*	*810*	*1 943*	*165*
Dealfishes	**...B**		**...C**		***Trachipterus spp***				**1,52(04)002,XX**	**TRP**
81 New Zealand	103	63	85	67	25	12	7	8	5	3
Ukraine	-	1	10	1	...	-	-	-	-	-
81 Fishing area total	*103*	*64*	*95*	*68*	*25*	*12*	*7*	*8*	*5*	*3*
Species total	*103*	*64*	*95*	*68*	*25*	*12*	*7*	*8*	*5*	*3*
King of herrings	**Roi des harengs**		**Rey de los arenques**		***Regalecus glesne***				**1,52(05)001,01**	**REL**
81 New Zealand	1	0	0	-	-	-	0	0	0	-
81 Fishing area total	*1*	*0*	*0*	-	-	-	*0*	*0*	*0*	-
Species total	*1*	*0*	*0*	-	-	-	*0*	*0*	*0*	-
Chilean silverside	**Athérine chilienne**		**Pejerrey de mar**		***Odontesthes regia***				**1,63(02)002,01**	**ODR**
87 Chile	833	1 396	2 136	1 212	706	1 370	1 421	1 411	1 429	397
87 Fishing area total	*833*	*1 396*	*2 136*	*1 212*	*706*	*1 370*	*1 421*	*1 411*	*1 429*	*397*
Species total	*833*	*1 396*	*2 136*	*1 212*	*706*	*1 370*	*1 421*	*1 411*	*1 429*	*397*
...A	**...B**		**Pejerrey de aleta amarilla**		***Odontesthes smitti***				**1,63(02)002,04**	**OWM**
41 Argentina	...	...	...	...	...	...	...	...	3	0
41 Fishing area total	...	...	...	...	...	...	...	...	*3*	*0*
Species total	...	...	...	...	...	...	...	...	*3*	*0*
Big-scale sand smelt	**Joël**		**Pejerrey mediterráneo**		***Atherina boyeri***				**1,63(02)003,01**	**ATB**
05 Greece	326	390	400	350	100	150	150	155	134	134 F
Ukraine	-	-	-	264	-	328	-	-	3	2
05 Fishing area total	*326*	*390*	*400*	*614*	*100*	*478*	*150*	*155*	*137*	*136 F*
37 Bulgaria	2	0	0	1	1	1	9	2	14	27
Russian Fed	95	99	183	53	19	7	8	7	36	21
Ukraine	332	540	430	239	657	504	1 169	690	1 326	1 048

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
37 Fishing area total	*429*	*639*	*613*	*293*	*677*	*512*	*1 186*	*699*	*1 376*	*1 096*
Species total	*755*	*1 029*	*1 013*	*907*	*777*	*990*	*1 336*	*854*	*1 513*	*1 232 F*
Atlantic silverside	**Capucette**		**Pejerrey del Atlántico**		***Menidia menidia***				**1,63(02)013,02**	**SSA**
21 Canada	646	135	467	294	268	551	495	444	488	580
USA	15	15	37	2	1	4	2	16	2	13
21 Fishing area total	*661*	*150*	*504*	*296*	*269*	*555*	*497*	*460*	*490*	*593*
Species total	*661*	*150*	*504*	*296*	*269*	*555*	*497*	*460*	*490*	*593*
Silversides(=Sand smelts) nei	**Athérinidés nca**		**Pejerreyes nep**		***Atherinidae***				**1,63(02)XXX,XX**	**SIL**
01 Egypt	5 154	5 941	4 407	2 246	1 985	5 290	7 987	5 459	73	5 661
01 Fishing area total	*5 154*	*5 941*	*4 407*	*2 246*	*1 985*	*5 290*	*7 987*	*5 459*	*73*	*5 661*
02 Mexico	558	379	430	424	...	...	1 233	1 935	1 937	...
02 Fishing area total	*558*	*379*	*430*	*424*	*...*	*...*	*1 233*	*1 935*	*1 937*	*...*
03 Bolivia	760	800 F	860	888	850	880 F	919 F	963 F	1 000	750
03 Fishing area total	*760*	*800 F*	*860*	*888*	*850*	*880 F*	*919 F*	*963 F*	*1 000*	*750*
04 Turkey	1 685	1 733	1 826	2 107	5 248	6 677	6 540	6 630	6 184	4 438
04 Fishing area total	*1 685*	*1 733*	*1 826*	*2 107*	*5 248*	*6 677*	*6 540*	*6 630*	*6 184*	*4 438*
27 France	52	30	34	46	39	46	77	36	57	86
Portugal	0	1	-	1	1	5	8	2	2	2
Spain	192	260	126	236	253	533	239	312	219	194
UK	1	-	4	6	10	8	1	-	-	-
27 Fishing area total	*245*	*291*	*164*	*289*	*303*	*592*	*325*	*350*	*278*	*282*
37 Albania	10	16	...	2	4	3	5	10	8	4
Croatia	20	8	8	13	10	15	9	...	10	14
Egypt	3 490	3 267	3 560	3 681	5 056	-	-	-	-	-
France	44	38	84	61	11	9	20	27	23	29
Italy	736	772	879	812	1 067	1 245	953	1 052	1 232	709
Lebanon	50	50	50	50	45	48	48 F	48 F	48 F	48 F
Romania	29	8	7	6	6	-	-	1	-	-
Serbia-Monte	14	22	34	28	...	-	-	-	-	-
Slovenia	2	5	4	5	5	2	2	1	2	1
Spain	20	80	32	57	79	126	90	81	118	79
Tunisia	309	122	60	...	...	...	92	14	139	94
Turkey	575	518	664	1 037	1 479	993	999	1 142	1 721	1 442
37 Fishing area total	*5 299*	*4 906*	*5 382*	*5 752*	*7 762*	*2 441*	*2 218 F*	*2 376 F*	*3 301 F*	*2 420 F*
41 Argentina	363	206	129	38	32	255	396	525	379	564
Brazil	5	5	5	2	14	1	1	1	1	1
Falkland Is	4	2	1	1	0	1	0	-	-	-
41 Fishing area total	*372*	*213*	*135*	*41*	*46*	*257*	*397*	*526*	*380*	*565*
51 Bahrain	-	-	-	-	-	-	-	-	-	4
51 Fishing area total	-	-	-	-	-	-	-	-	-	*4*
71 Fiji	86	40 F	0	0	0	0	0	0	0	-
Philippines	625	530	506	484	316	444	407	443	581	617
71 Fishing area total	*711*	*570 F*	*506*	*484*	*316*	*444*	*407*	*443*	*581*	*617*
77 Mexico	704	986	1 021	1 117	...	...	...	...	...	...
USA	34	37	9	17	4	3	9	9	15	2
77 Fishing area total	*738*	*1 023*	*1 030*	*1 134*	*4*	*3*	*9*	*9*	*15*	*2*
87 Peru	7 528	11 220	8 235	10 992	9 964	10 464	14 867	9 946	12 618	7 406
87 Fishing area total	*7 528*	*11 220*	*8 235*	*10 992*	*9 964*	*10 464*	*14 867*	*9 946*	*12 618*	*7 406*
Species total	*23 050*	*27 076 F*	*22 975*	*24 357*	*26 478*	*27 048 F*	*34 902 F*	*28 637 F*	*26 367 F*	*22 145 F*
False trevally	**Péliau chanos**		**Pagapa**		***Lactarius lactarius***				**1,70(19)165,02**	**TRF**
51 India	5 992	5 882	4 687	8 387	6 562	7 404	9 188	12 146	6 205	10 151
51 Fishing area total	*5 992*	*5 882*	*4 687*	*8 387*	*6 562*	*7 404*	*9 188*	*12 146*	*6 205*	*10 151*
57 India	992	970	964	2 930	2 574	2 717	3 118	1 962	3 523	3 339
Indonesia	...	...	...	694	1 123	1 474	3 790	6 608	6 615	8 567
Malaysia	2	1	0	0	0	0	0	...	3	...
57 Fishing area total	*994*	*971*	*964*	*3 624*	*3 697*	*4 191*	*6 908*	*8 570*	*10 141*	*11 906*
71 Indonesia	...	...	...	2 030	1 977	6 451	1 953	10 641	19 466	25 318
Malaysia	437	362	515	279	164	29	207	361	581	302
Philippines	285	158	197	195	204	241	220	153	541	454
71 Fishing area total	*722*	*520*	*712*	*2 504*	*2 345*	*6 721*	*2 380*	*11 155*	*20 588*	*26 074*
Species total	*7 708*	*7 373*	*6 363*	*14 515*	*12 604*	*18 316*	*18 476*	*31 871*	*36 934*	*48 131*
Bluefish	**Tassergal**		**Anjova**		***Pomatomus saltatrix***				**1,70(20)213,01**	**BLU**
21 USA	3 825	3 011	3 246	3 418	3 014	3 030	3 181	2 580	2 911	2 955
21 Fishing area total	*3 825*	*3 011*	*3 246*	*3 418*	*3 014*	*3 030*	*3 181*	*2 580*	*2 911*	*2 955*

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
27 Portugal	15	14	12	19	16	15	20	19	21	17
Spain	38	19	43	111	116	194	143	112	64	34
27 Fishing area total	*53*	*33*	*55*	*130*	*132*	*209*	*163*	*131*	*85*	*51*
31 Suriname	...	...	28	33	46	...	...	...	...	...
USA	168	152	159	312	246	197	239	209	290	395
Venezuela	1 158	813	617	970 F	520 F	310 F	380 F	430 F	410 F	410 F
31 Fishing area total	*1 326*	*965*	*804*	*1 315 F*	*812 F*	*507 F*	*619 F*	*639 F*	*700 F*	*805 F*
34 Gambia	70	60	92	-	-	-	-	-	-	-
Germany	-	-	-	6	-	-	-	-	-	-
Latvia	17	48	53	10	125	32	5	33	-	-
Lithuania	-	742	623	370	117	47	10	33	1	-
Mauritania	...	...	...	...	...	...	...	...	...	67
Morocco	193	135	366	206	343	270	120	121	117	233
Netherlands	-	-	-	-	107	8	-	9	-	-
Portugal	0	1	0	0	-	0	1	-	-	-
Russian Fed	157	168	27	26	67	8	-	5	-	5
Senegal	1 149	5 417	3 207	1 133	1 206	971	221	218	79	49
Spain	-	-	0	0	2	2	2	3	4	6
Ukraine	137	822	107	56	39	24	2	14	60	-
UK	-	-	-	-	-	-	1	0	-	43
34 Fishing area total	*1 723*	*7 393*	*4 475*	*1 807*	*2 006*	*1 362*	*362*	*436*	*261*	*403*
37 Albania	...	...	...	2	6	9	-	-	-	-
Bulgaria	2	102	18	5	83	8	8	25	53	63
Egypt	468	549	420	393	343	638	653	862	560	776
Greece	511	513	291	117	277	219	121	134	111	111 F
Morocco	5	59	3	8	5	2	2	6	2	4
Palest, O.T.	5 F	5	7	2	5	2	1	1	1	2
Romania	10	2	2	3	1	0	-	-	-	-
Spain	168	113	132	154	202	334	234	249	239	132
Tunisia	1 037	1 285	1 018	...	1 000	298	138	167	182	157
Turkey	13 060	25 000	22 000	19 901	18 357	8 399	6 858	4 048	5 999	4 744
37 Fishing area total	*15 266 F*	*27 628*	*23 891*	*20 585*	*20 279*	*9 909*	*8 015*	*5 492*	*7 147*	*5 989 F*
41 Argentina	181	701	404	525	392	463	69	199	174	629
Brazil	3 435	3 924	4 127	3 160	2 213	4 344	3 926	3 585	3 954	3 731
Uruguay	93	56	182	267	251	201	8	0	-	69
41 Fishing area total	*3 709*	*4 681*	*4 713*	*3 952*	*2 856*	*5 008*	*4 003*	*3 784*	*4 128*	*4 429*
47 Angola	167	...	...	...	...	720	...	...	6	6 F
Russian Fed	-	-	1	-	-	-	-	-	-	-
South Africa	3	2	4	15	14	12	28	21	6	6
47 Fishing area total	*170*	*2*	*5*	*15*	*14*	*732*	*28*	*21*	*12*	*12 F*
51 South Africa	-	-	-	-	-	-	-	8	-	-
51 Fishing area total	-	-	-	-	-	-	-	*8*	-	-
57 Australia	...	...	...	62	40	15	-	0	-	-
57 Fishing area total	*...*	*...*	*...*	*62*	*40*	*15*	-	*0*	-	-
71 Australia	267	224	111	127	150	117	82	...	...	118
71 Fishing area total	*267*	*224*	*111*	*127*	*150*	*117*	*82*	*...*	*...*	*118*
81 Australia	114	73	55	61	54	119	...	0	0	0
81 Fishing area total	*114*	*73*	*55*	*61*	*54*	*119*	*...*	*0*	*0*	*0*
Species total	*26 453 F*	*44 010*	*37 355*	*31 472 F*	*29 357 F*	*21 008 F*	*16 453 F*	*13 091 F*	*15 244 F*	*14 762 F*

Cobia **Mafou** **Cobia** ***Rachycentron canadum*** **1,70(22)221,01** **CBA**

21 USA	13	13	9	6	5	7	7	7	8	6
21 Fishing area total	*13*	*13*	*9*	*6*	*5*	*7*	*7*	*7*	*8*	*6*
31 Mexico	298	180	209	157	151	158	308	373	394	487
USA	84	87	95	89	70	77	73	69	73	106
31 Fishing area total	*382*	*267*	*304*	*246*	*221*	*235*	*381*	*442*	*467*	*593*
34 Benin	...	...	...	...	...	...	...	25	...	...
Gambia	-	-	23	22	-	-	-	-	-	-
Mauritania	...	...	...	...	...	...	...	...	...	16
Senegal	...	...	225	128	375	173	163	238	137	0
34 Fishing area total	*...*	*...*	*248*	*150*	*375*	*173*	*163*	*263*	*137*	*16*
41 Brazil	1 036	1 375	1 146	919	1 161	898	635	885	976	923
41 Fishing area total	*1 036*	*1 375*	*1 146*	*919*	*1 161*	*898*	*635*	*885*	*976*	*923*
51 Bahrain	20	11	5	22	7	5	4	11	3	3
Eritrea	31	41	45	30	10	0	19	15	16	14
Iran	729	1 028	1 365	1 478	1 390	1 574	1 528	1 385	1 196	1 661
Kuwait	38	33 F	28	36	28	35	38	22	30 F	30 F
Oman	54	202	141	82	134	117	109	153	141	228
Pakistan	2 797	2 808	2 225	1 997	1 868	1 937	2 253	2 274	2 581	2 623
Qatar	95	89	120	99	233	223	224	254	197	224
Saudi Arabia	188	279	282	190	237	264	258	279	180	161
Untd Arab Em	800 F	954	509	510 F	518	570 F	620 F	675	701	504
Yemen	...	...	...	...	...	...	...	189	225 F	260 F
51 Fishing area total	*4 752 F*	*5 445 F*	*4 720*	*4 444 F*	*4 425*	*4 725 F*	*5 053 F*	*5 257*	*5 270 F*	*5 708 F*

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
57 Malaysia	150	152	166	164	134	218	246	147	305	236
57 Fishing area total	*150*	*152*	*166*	*164*	*134*	*218*	*246*	*147*	*305*	*236*
61 China,Taiwan	486	457	643	643	405	468	546	246	92	322
61 Fishing area total	*486*	*457*	*643*	*643*	*405*	*468*	*546*	*246*	*92*	*322*
71 Malaysia	407	367	391	505	811	654	1 473	559	830	1 107
Philippines	1 124	2 491	2 120	1 399	1 598	1 637	2 236	1 547	2 014	3 033
71 Fishing area total	*1 531*	*2 858*	*2 511*	*1 904*	*2 409*	*2 291*	*3 709*	*2 106*	*2 844*	*4 140*
Species total	*8 350 F*	*10 567 F*	*9 747*	*8 476 F*	*9 135*	*9 015 F*	*10 740 F*	*9 353*	*10 099 F*	*11 944 F*
Shrimp scad	**Sélar subari**		**Jurel subarí**		***Alepes djedaba***				**1,70(23)001,01**	**LSJ**
37 Israel	-	-	-	-	-	-	-	-	61	34
37 Fishing area total	-	-	-	-	-	-	-	-	*61*	*34*
51 Saudi Arabia	214	233	146	147	196	203	267	211	200	200
51 Fishing area total	*214*	*233*	*146*	*147*	*196*	*203*	*267*	*211*	*200*	*200*
Species total	*214*	*233*	*146*	*147*	*196*	*203*	*267*	*211*	*261*	*234*
Yellowtail scad	**Sélar queue jaune**		**Jurel rabo amarillo**		***Atule mate***				**1,70(23)002,01**	**TUM**
51 Saudi Arabia	933	26	775	1 069	938	1 397	581	864	1 158	969
51 Fishing area total	*933*	*26*	*775*	*1 069*	*938*	*1 397*	*581*	*864*	*1 158*	*969*
Species total	*933*	*26*	*775*	*1 069*	*938*	*1 397*	*581*	*864*	*1 158*	*969*
Atlantic horse mackerel	**Chinchard d'Europe**		**Jurel**		***Trachurus trachurus***				**1,70(23)004,01**	**HOM**
27 Belgium	20	30	5	4	6	4	6	3	5	22
Channel Is	8	9	8	1	1	1	1	0	4	1
Denmark	23 631	11 611	16 310	23 955	13 378	8 808	7 813	5 277	6 015	5 903
Faroe Is	-	458	693	3 867	3 476	1 313	385	800	10	212
France	19 852	21 518	11 909	10 964	15 801	15 715	15 603	15 591	3 177	6 267
Germany	12 464	15 926	18 763	22 938	19 413	12 454	5 815	12 957	16 511	21 381
Iceland	-	-	-	-	-	-	36 518	-	-	-
Ireland	54 975	33 072	35 854	26 432	33 925	28 856	29 952	36 588	40 715	44 489
Lithuania	344	-	-	-	-	9 195	5 703	4 874	3 690	-
Netherlands	84 011	56 575	68 071	66 678	67 810	63 599	61 369	62 966	61 538	79 220
Norway	7 988	36 686	20 514	10 748	25 113	27 224	5 425	12 244	72 619	12 504
Portugal	13 796	15 009	14 730	16 685	15 970	17 314	11 549	11 026	11 840	12 420
Russian Fed	16	3	5	-	-	4	25	-	-	-
Sweden	119	575	1 073	800	312	1 074	505	45	660	2
UK	19 581	12 332	8 287	12 244	8 780	12 676	13 839	11 177	17 633	17 118
27 Fishing area total	*236 805*	*203 804*	*196 222*	*195 316*	*203 985*	*198 237*	*194 508*	*173 548*	*234 417*	*199 539*
34 Bulgaria	1 601	-	-	-	-	-	-	-	-	-
Portugal	-	-	-	-	-	-	111	26	1	-
34 Fishing area total	*1 601*	-	-	-	-	-	*111*	*26*	*1*	-
37 France	...	...	...	...	...	...	...	...	562	589
Greece	747	753	778	609	710	536	534	555	428	428 F
Israel	90	129	101	80	125	110	61	60 F	57	93
Montenegro	...	...	...	...	...	20	13	17	13	12
Serbia-Monte	15	16	16	11	12	...	...	...	...	...
Slovenia	4	2	2	3	8	9	5	3	4	3
Syria	56	66	91	78	139	105	95	88	90	66
Turkey	10 635	6 982	11 600	9 337	13 978	11 800	9 030	10 043	7 895	6 055
37 Fishing area total	*11 547*	*7 948*	*12 588*	*10 118*	*14 972*	*12 580*	*9 738*	*10 766 F*	*9 049*	*7 246 F*
Species total	*249 953*	*211 752*	*208 810*	*205 434*	*218 957*	*210 817*	*204 357*	*184 340 F*	*243 467*	*206 785 F*
Blue jack mackerel	**Chinchard du large**		**Jurel de altura(=Chicharro)**		***Trachurus picturatus***				**1,70(23)004,02**	**JAA**
27 Portugal	1 509	5 675	4 013	4 076	2 303	4 177	5 502	5 692	5 698	4 707
27 Fishing area total	*1 509*	*5 675*	*4 013*	*4 076*	*2 303*	*4 177*	*5 502*	*5 692*	*5 698*	*4 707*
Species total	*1 509*	*5 675*	*4 013*	*4 076*	*2 303*	*4 177*	*5 502*	*5 692*	*5 698*	*4 707*
Japanese jack mackerel	**Chinchard du Japon**		**Jurel japonés**		***Trachurus japonicus***				**1,70(23)004,03**	**JJM**
61 China	...	...	47 016 F	21 991 F	165 065 F	135 281 F	186 411	59 028	25 311	26 251
China,Taiwan	3 903	7 458	7 942	6 407	4 340	2 779	4 289	6 163	4 022	5 654
Japan	214 434	196 044	241 920	254 287	191 335	167 494	170 389	172 322	165 166	155 000 F
Korea Rep	17 537	26 037	20 454	25 513	42 608	23 227	19 089	22 752	22 087	19 305
61 Fishing area total	*235 874*	*229 539*	*317 332 F*	*308 198 F*	*403 348 F*	*328 781 F*	*380 178*	*260 265*	*216 586*	*206 210 F*
Species total	*235 874*	*229 539*	*317 332 F*	*308 198 F*	*403 348 F*	*328 781 F*	*380 178*	*260 265*	*216 586*	*206 210 F*
Chilean jack mackerel	**Chinchard du Chili**		**Jurel chileno**		***Trachurus murphyi***				**1,70(23)004,05**	**CJM**
87 Belize	-	-	-	-	867	481	12 585	15 245	5 681	2 240
Chile	1 649 933	1 518 994	1 421 296	1 451 599	1 430 438	1 379 941	1 302 784	896 189	834 927	464 808
China	20 090	76 261	94 690	131 020	143 000	160 000	140 582	143 182	117 963	63 606
Ecuador	134 011	604	-	-	-	-	927	-	19 834	4 613
Faroe Is	-	-	-	-	-	-	38 700	22 919	20 213	11 643

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Germany	-	-	-	-	-	-	43 587	48 505	32 093	13 028
Ghana	1 157	-	-	-	-	-	-	-	-	-
Korea Rep	-	-	2 196	9 227	9 444	11 492	11 138	12 600	14 080	8 547
Lithuania	-	-	-	-	-	-	33 433	21 046	20 113	10 135
Netherlands	-	-	-	-	6 187	33 766	41 747	36 854	37 632	11 148
Peru	723 733	154 219	217 734	187 369	80 663	277 568	254 426	169 537	74 694	17 559
Poland	-	-	-	-	-	-	-	-	20 893	33 172
Russian Fed	-	-	132	-	-	-	-	2 150	381	-
Vanuatu	-	-	53 959	94 685	77 356	129 535	112 501	100 066	79 942	46 487
Other nei	-	-	7 408	62 300	7 040	-	-	...	8 732	41 315
87 Fishing area total	*2 528 924*	*1 750 078*	*1 797 415*	*1 936 200*	*1 754 995*	*1 992 783*	*1 992 410*	*1 468 293*	*1 287 178*	*728 301*
Species total	*2 528 924*	*1 750 078*	*1 797 415*	*1 936 200*	*1 754 995*	*1 992 783*	*1 992 410*	*1 468 293*	*1 287 178*	*728 301*
Pacific jack mackerel	**Chinchard gros yeux**		**Chicharro ojotón**		***Trachurus symmetricus***				**1,70(23)004,06**	**PJM**
67 Russian Fed	-	-	1	-	-	-	-	-	-	-
USA	215	21	75	185	84	8	15	9	1	1
67 Fishing area total	*215*	*21*	*76*	*185*	*84*	*8*	*15*	*9*	*1*	*1*
77 Korea Rep	-	-	-	1 090	-	-	-	-	-	-
Mexico	...	...	...	...	311	325	1 796	143	150	394
USA	3 624	1 005	155	1 027	213	1 167	632	274	119	310
77 Fishing area total	*3 624*	*1 005*	*155*	*2 117*	*524*	*1 492*	*2 428*	*417*	*269*	*704*
Species total	*3 839*	*1 026*	*231*	*2 302*	*608*	*1 500*	*2 443*	*426*	*270*	*705*
Mediterranean horse mackerel	**Chinchard à queue jaune**		**Jurel mediterráneo**		***Trachurus mediterraneus***				**1,70(23)004,08**	**HMM**
27 France	-	-	2 634	1 864	1 306	511	535	64	461	210
Portugal	-	-	-	-	-	1	1	22	10	15
27 Fishing area total	-	-	*2 634*	*1 864*	*1 306*	*512*	*536*	*86*	*471*	*225*
37 Bulgaria	130	142	142	74	29	63	116	180	177	165
Egypt	1 351	1 122	823	848	697	1 101	1 376	1 113	874	854
France	...	...	...	...	...	...	...	...	9	17
Georgia	7	19	70	56	55 F	55 F	53	8	8 F	8 F
Greece	3 408	3 086	2 499	2 574	2 809	3 338	2 830	2 866	2 738	2 730 F
Romania	17	21	10	15	12	8	7	11	17	7
Turkey	15 545	19 500	16 400	18 068	13 540	14 127	22 991	22 134	20 373	14 392
Ukraine	1	34	748	280	334	483	220	375	262	197
37 Fishing area total	*20 459*	*23 924*	*20 692*	*21 915*	*17 476 F*	*19 175 F*	*27 593*	*26 687*	*24 458 F*	*18 370 F*
Species total	*20 459*	*23 924*	*23 326*	*23 779*	*18 782 F*	*19 687 F*	*28 129*	*26 773*	*24 929 F*	*18 595 F*
Rough scad	**Chinchard frappeur**		**Chicharro garretón**		***Trachurus lathami***				**1,70(23)004,11**	**RSC**
21 USA	-	-	-	-	-	-	25	145	-	-
21 Fishing area total	-	-	-	-	-	-	*25*	*145*	-	-
41 Argentina	117	127	103	110	181	243	293	265	282	161
Brazil	295	331	939	660	1 275	1 047	2 291	1 502	1 656	1 563
41 Fishing area total	*412*	*458*	*1 042*	*770*	*1 456*	*1 290*	*2 584*	*1 767*	*1 938*	*1 724*
Species total	*412*	*458*	*1 042*	*770*	*1 456*	*1 290*	*2 609*	*1 912*	*1 938*	*1 724*
Cape horse mackerel	**Chinchard du Cap**		**Jurel del Cabo**		***Trachurus capensis***				**1,70(23)004,13**	**HMC**
47 Namibia	309 381	359 183	366 912	314 538	324 486	307 912	201 660	192 654	198 282	198 000 F
Poland	3 098	3 557	4 097	4 062	798	-	-	-	-	-
Russian Fed	28 215	1 738	5 636	234	-	-	-	-	-	-
South Africa	9 659	21 883	28 285	34 131	35 105	27 016	31 740	30 502	35 219	33 394
Spain	-	-	-	-	-	-	-	-	4	2
Ukraine	3 693	-	-	-	-	-	-	-	-	-
47 Fishing area total	*354 046*	*386 361*	*404 930*	*352 965*	*360 389*	*334 928*	*233 400*	*223 156*	*233 505*	*231 396 F*
Species total	*354 046*	*386 361*	*404 930*	*352 965*	*360 389*	*334 928*	*233 400*	*223 156*	*233 505*	*231 396 F*
Cunene horse mackerel	**Chinchard du Cunène**		**Jurel de Cunene**		***Trachurus trecae***				**1,70(23)004,14**	**HMZ**
34 Congo Rep	50 F	100 F	141	156	118	100	104	41	22	252
Ghana	1 540	...	...	...	14	-	-	-	-	-
Liberia	-	-	-	-	-	100	100	78	80 F	80 F
Lithuania	...	...	...	...	...	...	4 299	...	...	...
Sierra Leone	434	134	330	442	1 302	339	1 114	2 323	2 280 F	2 280 F
Ukraine	32 915	20 477	8 545	2 360	-	-	-	-	-	-
34 Fishing area total	*34 939 F*	*20 711 F*	*9 016*	*2 958*	*1 434*	*539*	*5 617*	*2 442*	*2 382 F*	*2 612 F*
47 Angola	40 898	43 292	28 123	34 863	30 000 F	33 563	31 659	44 395	13 826	13 300 F
Russian Fed	5 934	1 934	2 016	-	-	-	-	-	-	-
47 Fishing area total	*46 832*	*45 226*	*30 139*	*34 863*	*30 000 F*	*33 563*	*31 659*	*44 395*	*13 826*	*13 300 F*
Species total	*81 771 F*	*65 937 F*	*39 155*	*37 821*	*31 434 F*	*34 102*	*37 276*	*46 837*	*16 208 F*	*15 912 F*
Greenback horse mackerel	**Chinchard dos vert**		**Jurel verde**		***Trachurus declivis***				**1,70(23)004,15**	**HMG**
57 Australia	82	594	2 250	3 403	1 923	889	608	363	450	262
57 Fishing area total	*82*	*594*	*2 250*	*3 403*	*1 923*	*889*	*608*	*363*	*450*	*262*

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
81 Australia	71	40	112	92	68	50	64	48	19	22
Russian Fed	-	-	-	-	-	-	647	-	-	-
Ukraine	7 577	5 667	25 016	22 600	...	20 627	22 067	...	...	...
81 Fishing area total	*7 648*	*5 707*	*25 128*	*22 692*	*68*	*20 677*	*22 778*	*48*	*19*	*22*
Species total	*7 730*	*6 301*	*27 378*	*26 095*	*1 991*	*21 566*	*23 386*	*411*	*469*	*284*
Jack and horse mackerels nei	**Chinchards noirs nca**		**Jureles nep**		***Trachurus spp***				**1,70(23)004,XX**	**JAX**
27 Spain	39 824	33 429	32 821	35 871	30 193	32 132	30 471	34 260	34 984	32 497
27 Fishing area total	*39 824*	*33 429*	*32 821*	*35 871*	*30 193*	*32 132*	*30 471*	*34 260*	*34 984*	*32 497*
34 Belize	3 731	5 419	1 399	...	6 881	1 300	-	12 709	...	...
Benin	...	...	...	...	24	17	14	2	...	...
China	3	115	1 369	...	5 288	107	68	45	...	223
Comoros	-	-	-	-	-	-	1 749	4 918	...	15 506
Congo Dem R	1 620 F	1 480 F	1 320 F	1 180 F	1 020 F	850 F	660	660 F	660 F	660 F
Cyprus	42 691	-	-	-	-	-	-	-	-	-
Gambia	246	417	145	140	766	318	211	407	350	349
Georgia	...	...	...	...	...	...	...	...	...	1 314
Germany	708	278	-	727	-	161	475	-	-	3
Ghana	2 109	504	2 417	2 714	893	134	400	116	293	194
Greece	-	2	-	-	-	-	-	-	-	-
Guinea	5 171	2 516	...	...	...	...	...	...	...	2 322
Honduras	-	-	-	-	-	9	-	-	-	-
Ireland	8 522	3 411	1 106	1 680	1 402	-	-	44	326	561
Korea Rep	-	-	42	13	6	-	-	-	-	-
Latvia	18 522	7 768	8 674	13 838	25 689	17 758	22 507	31 302	35 134	40 169
Lithuania	57 200	46 282	30 498	49 312	55 831	47 064	41 349	50 321	53 671	50 850
Mauritania	30 000 F	32 000 F	37 000 F	51 543	79 377	28 162	24 810	34 207	24 413	33 710
Morocco	10 013	9 159	14 385	14 233	17 135	18 664	15 340	15 117	15 531	18 049
Netherlands	14 476	11 003	6 118	18 754	8 039	7 318	217	1 640	1 737	2 631
Panama	7 415	1 837	7 938	...	12 593	17 311	7 390	-	...	...
Poland	1 449	1 638	-	-	-	-	-	11 135	24 553	6 532
Portugal	386	358	572	653	483	481	522	487	588	378
Russian Fed	56 229	41 338	12 339	70 885	88 436	67 786	28 160	53 380	74 037	96 997
St Kitts Nev	-	-	-	-	-	-	-	-	-	6 719
St Vincent	19 564	18 098	...	...	...	...	...	...	...	27 211
Senegal	1 877	3 886	2 788	2 932	1 432	3 903	4 092	6 059	3 754	7 246
Spain	215	432	287	123	869	1 091	696	1 019	1 391	982
Togo	501	154	575	916	451	716	718	500 F	...	7
Ukraine	10 150	3 653	2 100	944	457	3 942	9 183	534	8 131	26 848
UK	-	-	-	-	-	-	72	184	478	308
Other nei	12 012	58 030	42 000 F	35 000 F	32 000 F	32 000 F	32 000 F	28 000 F	37 000 F	...
34 Fishing area total	*304 810 F*	*249 778 F*	*173 072 F*	*265 587 F*	*339 072 F*	*249 092 F*	*190 633 F*	*252 786 F*	*282 047 F*	*339 769 F*
37 Albania	21	65	66	94	75	118	130	139	182	90
Algeria	8 174	7 088	7 867	5 975	10 590	18 695	27 607	31 990	18 541	11 145
Croatia	192	84	112	264	569	590	550	371	357	442
Cyprus	-	-	-	-	15	7	14	4	3	3
France	1 038	709	608	572	503	461	616	433	-	-
Italy	3 927	2 913	2 540	2 744	5 370	5 689	5 307	4 194	4 387	4 390
Libya	4 900 F	4 800 F	4 700 F	4 700 F	4 700 F	4 700 F	4 691	6 855	2 817	2 720 F
Malta	0	-	1	2	4	3	8	2	12	13
Morocco	2 255	1 851	2 415	2 323	8 607	15 304	13 611	11 185	7 873	5 164
Palest, O.T.	90 F	125	75	82	88	44	28	44	57	82
Russian Fed	6	28	77	105	179	239	185	154	90	113
Slovenia	-	-	-	-	-	13	8	2	6	4
Spain	6 957	4 400	3 901	3 885	7 411	11 179	11 879	9 415	8 022	7 305
Tunisia	4 204	4 746	4 096	6 998	5 540	7 839	9 462	8 934	8 221	9 371
37 Fishing area total	*31 764 F*	*26 809 F*	*26 458 F*	*27 744 F*	*43 651 F*	*64 881 F*	*74 096*	*73 722*	*50 568*	*40 842 F*
47 Lithuania	-	-	1 941	-	-	-	-	-	-	-
Portugal	-	-	-	-	-	0	2	7	9	-
47 Fishing area total	-	-	*1 941*	-	-	*0*	*2*	*7*	*9*	-
51 Bahrain	...	...	...	152	541	204	61	73	34	3
Korea Rep	6	3	26	19	26	87	93	98	198	-
Russian Fed	-	57	79	-	-	-	-	-	-	-
South Africa	-	-	0	7	-	-	-	-	-	4
Ukraine	7	-	-	-	-	-	-	-	-	-
Yemen	2 200 F	3 550 F	5 600 F	6 500 F	6 300 F	6 600 F	4 800 F	2 750 F	3 280 F	3 800 F
51 Fishing area total	*2 213 F*	*3 610 F*	*5 705 F*	*6 678 F*	*6 867 F*	*6 891 F*	*4 954 F*	*2 921 F*	*3 512 F*	*3 807 F*
81 Japan	545	26	209	-	-	-	-	-	-	-
Korea Rep	307	11	261	16	96	93	386	715	440	300
New Zealand	28 507	32 285	37 661	43 152	45 709	36 332	46 355	47 342	40 162	40 988
81 Fishing area total	*29 359*	*32 322*	*38 131*	*43 168*	*45 805*	*36 425*	*46 741*	*48 057*	*40 602*	*41 288*
Species total	*407 970 F*	*345 948 F*	*278 128 F*	*379 048 F*	*465 588 F*	*389 421 F*	*346 897 F*	*411 753 F*	*411 722 F*	*458 203 F*
White trevally	**Carangue dentue**		**Jurel dentón**		***Pseudocaranx dentex***				**1,70(23)011,27**	**TRZ**
57 Australia	26	19	14	81	114	115	48	65	51	53
57 Fishing area total	*26*	*19*	*14*	*81*	*114*	*115*	*48*	*65*	*51*	*53*
71 Australia	-	-	-	-	1	1	4	1	0	0
71 Fishing area total	-	-	-	-	*1*	*1*	*4*	*1*	*0*	*0*

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
81 Australia	413	459	493	706	606	390	324	220	213	287
New Zealand	3 116	3 280	3 389	3 232	3 390	3 111	2 752	3 284	2 839	3 311
Ukraine	-	5	13	2	...	5	...	...	...	...
81 Fishing area total	*3 529*	*3 744*	*3 895*	*3 940*	*3 996*	*3 506*	*3 076*	*3 504*	*3 052*	*3 598*
Species total	*3 555*	*3 763*	*3 909*	*4 021*	*4 111*	*3 622*	*3 128*	*3 570*	*3 103*	*3 651*
Shortfin scad	**Comète fine**		**Macarela alicorta**		***Decapterus macrosoma***				**1,70(23)043,03**	**DCC**
87 Ecuador	...	...	...	...	...	5 168	9 240	28 782	50 719	21 097
87 Fishing area total	*...*	*...*	*...*	*...*	*...*	*5 168*	*9 240*	*28 782*	*50 719*	*21 097*
Species total	*...*	*...*	*...*	*...*	*...*	*5 168*	*9 240*	*28 782*	*50 719*	*21 097*
Japanese scad	**Comète japonaise**		**Macarela japonesa**		***Decapterus maruadsi***				**1,70(23)043,07**	**RSA**
61 China,Taiwan	6 224	7 755	8 378	7 682	5 974	3 535	3 510	5 506	8 056	9 244
Japan	41 236	41 831	37 830	26 181	22 899	23 671	25 652	34 711	26 956	25 100 F
61 Fishing area total	*47 460*	*49 586*	*46 208*	*33 863*	*28 873*	*27 206*	*29 162*	*40 217*	*35 012*	*34 344 F*
Species total	*47 460*	*49 586*	*46 208*	*33 863*	*28 873*	*27 206*	*29 162*	*40 217*	*35 012*	*34 344 F*
Indian scad	**Comète indienne**		**Macarela índica**		***Decapterus russelli***				**1,70(23)043,08**	**RUS**
51 Saudi Arabia	1 301	1 079	1 128	938	1 124	1 398	1 169	1 003	828	1 076
51 Fishing area total	*1 301*	*1 079*	*1 128*	*938*	*1 124*	*1 398*	*1 169*	*1 003*	*828*	*1 076*
57 Malaysia	5 811	15 474	22 287	23 477	26 331	33 311	34 466	37 492	27 829	31 344
Thailand	25 264	32 576	30 118	31 836	33 663	28 879	23 265	22 514	24 304	23 409
57 Fishing area total	*31 075*	*48 050*	*52 405*	*55 313*	*59 994*	*62 190*	*57 731*	*60 006*	*52 133*	*54 753*
61 China,Taiwan	598	58	40	41	41	152	130	379	36	154
61 Fishing area total	*598*	*58*	*40*	*41*	*41*	*152*	*130*	*379*	*36*	*154*
71 Malaysia	71 583	74 827	56 811	43 814	54 619	65 826	55 492	59 457	64 187	51 458
Thailand	67 144	71 408	68 627	68 519	52 197	46 204	45 347	3 731	4 186	3 959
71 Fishing area total	*138 727*	*146 235*	*125 438*	*112 333*	*106 816*	*112 030*	*100 839*	*63 188*	*68 373*	*55 417*
Species total	*171 701*	*195 422*	*179 011*	*168 625*	*167 975*	*175 770*	*159 869*	*124 576*	*121 370*	*111 400*
Scads nei	**Comètes nca**		**Macarelas nep**		***Decapterus spp***				**1,70(23)043,XX**	**SDX**
31 Grenada	52	75	54	26	10	19	25	31	61	76
St Vincent	...	...	...	...	...	...	...	...	241	206
USA	-	-	-	-	-	-	-	232	195	296
31 Fishing area total	*52*	*75*	*54*	*26*	*10*	*19*	*25*	*263*	*497*	*578*
34 Benin	...	...	...	...	...	41	...	17	...	...
Côte dIvoire	...	...	1 717	905	620	303	207	180 F	150	592
Gabon	101	84	78	75	93	89	...	...	...	...
Ghana	2 466	2 944	962	1 435	861	333	458	367	2 715	374
Mauritania	...	...	...	...	...	...	...	...	...	508
Sao Tome Prn	45 F	55 F	69	80	85 F	85 F	85 F	85 F	85 F	85 F
Senegal	4 209	7 416	6 894	4 409	5 494	3 924	3 383	2 800	2 937	1 064
34 Fishing area total	*6 821 F*	*10 499 F*	*9 720*	*6 904*	*7 153 F*	*4 775 F*	*4 133 F*	*3 449 F*	*5 887 F*	*2 623 F*
51 Egypt	-	-	11 230	10 401	7 935	5 938	6 522	4 909	7 932	6 151
Jordan	26	25	22	20	17	15	20	16	27	8
Pakistan	4 355	4 400	3 561	3 794	4 765	6 134	5 841	5 914	5 498	4 316
Qatar	0	0	-	-	-	-	-	-	-	-
Untd Arab Em	565 F	550	480	390 F	300	250 F	200 F	150	...	...
51 Fishing area total	*4 946 F*	*4 975*	*15 293*	*14 605 F*	*13 017*	*12 337 F*	*12 583 F*	*10 989*	*13 457*	*10 475*
57 Indonesia	43 133	49 450	36 932	33 112	35 757	44 835	47 703	49 624	54 768	47 723
57 Fishing area total	*43 133*	*49 450*	*36 932*	*33 112*	*35 757*	*44 835*	*47 703*	*49 624*	*54 768*	*47 723*
61 China	464 733 F	513 032 F	571 023 F	524 431 F	531 151 F	532 373 F	570 716	595 280	539 943	562 982
China,H.Kong	2 900 F	2 800 F	2 600 F	2 750 F	2 660 F	2 555 F	2 550 F	2 620 F	2 630 F	2 780 F
China,Taiwan	2 670	2 486	3 744	4 106	2 689	2 057	1 959	2 409	3 302	1 231
61 Fishing area total	*470 303 F*	*518 318 F*	*577 367 F*	*531 287 F*	*536 500 F*	*536 985 F*	*575 225 F*	*600 309 F*	*545 875 F*	*566 993 F*
71 Brunei Darsm	...	...	...	...	...	188	...	...	...	...
Guam	5	2	1	1	0	0	0	1	2	1
Indonesia	215 260	251 665	261 005	292 075	254 852	259 904	257 782	277 743	275 919	303 493
N Marianas	13	10	7	4	3	5	12	17	11	11
Philippines	291 774	279 728	312 738	295 952	283 756	263 651	323 922	297 892	251 072	274 994
Singapore	106	74	65	61	55	70	77	43	53	40
71 Fishing area total	*507 158*	*531 479*	*573 816*	*588 093*	*538 666*	*523 818*	*581 793*	*575 696*	*527 057*	*578 539*
77 El Salvador	270	295	284	284	357	561	1 147	...	485	...
USA	-	111	111	77	70	89	87	74	93	93
77 Fishing area total	*270*	*406*	*395*	*361*	*427*	*650*	*1 234*	*74*	*578*	*93*
81 New Zealand	87	70	98	85	45	89	19	32	33	46
81 Fishing area total	*87*	*70*	*98*	*85*	*45*	*89*	*19*	*32*	*33*	*46*
Species total	*1 032 770 F*	*1 115 272 F*	*1 213 675 F*	*1 174 473 F*	*1 131 575 F*	*1 123 508 F*	*1 222 715 F*	*1 240 436 F*	*1 148 152 F*	*1 207 070 F*

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Giant trevally	**Carangue têtue**		**Jurel gigante**		***Caranx ignobilis***				**1,70(23)044,05**	**NXI**
51 Iran	4 815	5 527	6 143	6 621	9 224	9 285	9 194	9 980	8 099	10 144
Qatar	388	318	351	303	435	565	478	611	375	344
Saudi Arabia	116	88	55	31	114	35	47	64	69	69
51 Fishing area total	*5 319*	*5 933*	*6 549*	*6 955*	*9 773*	*9 885*	*9 719*	*10 655*	*8 543*	*10 557*
Species total	*5 319*	*5 933*	*6 549*	*6 955*	*9 773*	*9 885*	*9 719*	*10 655*	*8 543*	*10 557*
Bluefin trevally	**Carangue aîle bleue**		**Jurel de aleta azul**		***Caranx melampygus***				**1,70(23)044,08**	**NXM**
51 Saudi Arabia	50	29	2	6	2	12	11	34	38	38
51 Fishing area total	*50*	*29*	*2*	*6*	*2*	*12*	*11*	*34*	*38*	*38*
Species total	*50*	*29*	*2*	*6*	*2*	*12*	*11*	*34*	*38*	*38*
Bigeye trevally	**Carangue vorace**		**Jurel voráz**		***Caranx sexfasciatus***				**1,70(23)044,11**	**CXS**
51 Saudi Arabia	52	34	21	115	11	85	97	141	150	150
51 Fishing area total	*52*	*34*	*21*	*115*	*11*	*85*	*97*	*141*	*150*	*150*
Species total	*52*	*34*	*21*	*115*	*11*	*85*	*97*	*141*	*150*	*150*
Blue runner	**Carangue coubali**		**Cojinúa negra**		***Caranx crysos***				**1,70(23)044,26**	**RUB**
21 USA	0	1	1	0	0	0	0	0	0	1
21 Fishing area total	*0*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*1*
31 Dominican Rp	68	124	380	...	120	...	...	105	94	102
Mexico	...	...	...	...	4 645	4 850	4 507	4 589	4 671	4 590
USA	157	170	186	270	156	129	170	156	151	120
31 Fishing area total	*225*	*294*	*566*	*270*	*4 921*	*4 979*	*4 677*	*4 850*	*4 916*	*4 812*
41 Brazil	680	688	930	854	1 592	1 813	1 384	1 568	1 730	1 634
41 Fishing area total	*680*	*688*	*930*	*854*	*1 592*	*1 813*	*1 384*	*1 568*	*1 730*	*1 634*
Species total	*905*	*983*	*1 497*	*1 124*	*6 513*	*6 792*	*6 061*	*6 418*	*6 646*	*6 447*
Crevalle jack	**Carangue crevalle**		**Jurel común**		***Caranx hippos***				**1,70(23)044,29**	**CVJ**
21 USA	1	4	1	0	1	0	0	4	5	1
21 Fishing area total	*1*	*4*	*1*	*0*	*1*	*0*	*0*	*4*	*5*	*1*
31 USA	304	217	293	216	190	259	205	234	261	279
31 Fishing area total	*304*	*217*	*293*	*216*	*190*	*259*	*205*	*234*	*261*	*279*
34 Ghana	2 525	2 872	4 578	9 111	8 195	6 057	6 678	12 255	2 191	6 196
Sao Tome Prn	45 F	55 F	68	144	150 F	150 F	150 F	150 F	150 F	155 F
Togo	...	...	...	...	...	...	...	...	...	2 000
34 Fishing area total	*2 570 F*	*2 927 F*	*4 646*	*9 255*	*8 345 F*	*6 207 F*	*6 828 F*	*12 405 F*	*2 341 F*	*8 351 F*
47 Angola	674	271	992	943	700 F	643	...	14	...	...
47 Fishing area total	*674*	*271*	*992*	*943*	*700 F*	*643*	*...*	*14*	*...*	*...*
Species total	*3 549 F*	*3 419 F*	*5 932*	*10 414*	*9 236 F*	*7 109 F*	*7 033 F*	*12 657 F*	*2 607 F*	*8 631 F*
Bar jack	**Carangue comade**		**Cojinúa carbonera**		***Caranx ruber***				**1,70(23)044,31**	**CXR**
31 Puerto Rico	34	33	30	25	21	15	11	16	18	13
USA	7	13	-	14	7	6	12	17	13	9
31 Fishing area total	*41*	*46*	*30*	*39*	*28*	*21*	*23*	*33*	*31*	*22*
Species total	*41*	*46*	*30*	*39*	*28*	*21*	*23*	*33*	*31*	*22*
False scad	**Comète coussut**		**Macarela real**		***Caranx rhonchus***				**1,70(23)044,42**	**HMY**
34 Gambia	...	...	126	69	54	55	118	404	433	433
Ghana	147	1 605	3 200	2 016	1 585	3 518	1 071	958	772	473
Liberia	134	140	140	435	369	54	...	...	...	...
34 Fishing area total	*281*	*1 745*	*3 466*	*2 520*	*2 008*	*3 627*	*1 189*	*1 362*	*1 205*	*906*
47 Portugal	-	-	-	-	-	-	2	6	3	3
47 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*2*	*6*	*3*	*3*
Species total	*281*	*1 745*	*3 466*	*2 520*	*2 008*	*3 627*	*1 191*	*1 368*	*1 208*	*909*
Jacks, crevalles nei	**Chinchards, carangues nca**		**Jureles, pámpanos nep**		***Caranx spp***				**1,70(23)044,XX**	**TRE**
31 Br Virgin Is	10	17	12	37	25 F	25 F	25 F	25 F	25 F	25 F
Colombia	1	7	1 190	55	49	85 F	120 F	150 F	189	342
Cuba	2 138	180	165	74	68	48	72	61	101	41
Dominican Rp	43	182	351	342	82	57	206	191	172	185
Fr Guiana	...	...	...	...	5	18	23	20	13	14 F
Mexico	6 002	6 328	8 035	7 941	2 876	3 003	2 801	2 623	2 726	6 102
Trinidad Tob	263	451	249	327	298	258	330	427	292	270
USA	-	103	124	81	25	63	96	116	156	151
Venezuela	2 115	2 161	2 274	3 590 F	1 920 F	1 130 F	1 380 F	1 730	1 670 F	1 670 F
31 Fishing area total	*10 572*	*9 429*	*12 400*	*12 447 F*	*5 348 F*	*4 687 F*	*5 053 F*	*5 343 F*	*5 344 F*	*8 800 F*
34 Congo Rep	50 F	95 F	138	92	104	236	361	100	125	394

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Côte dIvoire	119	690	123	69	166	13	135	130 F	130	577
Gabon	31	39	41	85	36	11	18	12	8 F	8 F
Gambia	288	899	306	111	796	484	590	640	402	402
GuineaBissau	98	10	38	100 F	152 F	150 F	140 F	260 F	260 F	260 F
Lithuania	-	-	-	15	-	-	-	-	-	1
Nigeria	317	277	818	162	207	1 284	392	838	677	747
Portugal	1	0	0	0	2	0	0	-	-	-
Sao Tome Prn	125 F	135 F	152	162	170 F	170 F	170 F	170 F	175 F	180 F
Sierra Leone	327	726	201	842	1 320	1 533	1 218	1 887	1 850 F	1 850 F
Togo	2 482	1 489	723	1 247	1 035	650	2 856	3 300 F	3 722	4 358
Ukraine	12 303	10 960	4 195	1 893	1	1	-	-	-	-
34 Fishing area total	*16 141 F*	*15 320 F*	*6 735*	*4 778 F*	*3 989 F*	*4 532 F*	*5 880 F*	*7 337 F*	*7 349 F*	*8 777 F*
37 Syria	17	36	30	13	35	23	19	34	25	18
37 Fishing area total	*17*	*36*	*30*	*13*	*35*	*23*	*19*	*34*	*25*	*18*
41 Brazil	5 397	4 923	5 763	5 649	5 669	5 451	6 971	5 716	6 304	5 952
Spain	-	-	-	-	-	-	-	-	2	-
41 Fishing area total	*5 397*	*4 923*	*5 763*	*5 649*	*5 669*	*5 451*	*6 971*	*5 716*	*6 306*	*5 952*
47 Russian Fed	1	-	1	-	-	-	-	-	-	-
47 Fishing area total	*1*	-	*1*	-	-	-	-	-	-	-
51 Egypt	...	...	1 049	1 014	1 288	2 251	2 269	1 332	1 402	1 775
India	30 894	24 613	31 373	31 319	32 531	37 296	35 026	41 480	43 201	60 127
Oman	1 218	1 666	2 170	2 667	4 387	3 376	2 515	3 433	3 256	4 266
Pakistan	8 928	9 200	31 126	6 008	3 322	4 930	5 005	5 012	9 072	7 572
Untd Arab Em	2 762	4 759	1 593	1 600 F	1 612	1 600 F	1 600 F	1 600	1 517	1 049
Yemen	689 F	1 127 F	1 814 F	2 135 F	1 948 F	2 028 F	2 200 F	2 389	2 850 F	3 300 F
51 Fishing area total	*44 491 F*	*41 365 F*	*69 125 F*	*44 743 F*	*45 088 F*	*51 481 F*	*48 615 F*	*55 246*	*61 298 F*	*78 089 F*
57 India	16 461	15 461	15 859	16 845	16 180	16 106	17 627	9 219	18 494	5 724
Indonesia	11 007	15 134	13 344	7 919	11 508	16 201	18 309	25 918	21 257	22 986
57 Fishing area total	*27 468*	*30 595*	*29 203*	*24 764*	*27 688*	*32 307*	*35 936*	*35 137*	*39 751*	*28 710*
61 China,H.Kong	17 F	15 F	14 F	15 F	15 F	14 F	14 F	14 F	15 F	16 F
China,Taiwan	3 273	4 614	2 716	2 651	974	1 125	977	465	330	340
61 Fishing area total	*3 290 F*	*4 629 F*	*2 730 F*	*2 666 F*	*989 F*	*1 139 F*	*991 F*	*479 F*	*345 F*	*356 F*
71 Fiji	709	470 F	229	330	360 F	397	221	250	280	250
Indonesia	26 981	25 101	27 826	33 432	35 273	31 109	32 945	46 852	45 877	47 331
Kiribati	2 858	3 702	2 733	2 350 F	2 000 F	1 600 F	1 176	364	114	102 F
Singapore	66	69	56	47	31	70	62	57	48	40
71 Fishing area total	*30 614*	*29 342 F*	*30 844*	*36 159 F*	*37 664 F*	*33 176 F*	*34 404*	*47 523*	*46 319*	*47 723 F*
77 Cook Is	40 F	40 F	40 F	40	40 F	40	40 F	40 F	36 F	36 F
Mexico	2 868	2 729	3 840	3 795	3 909	4 081	4 452	4 599	4 537	12 772
USA	-	28	23	23	16	11	14	14	13	15
77 Fishing area total	*2 908 F*	*2 797 F*	*3 903 F*	*3 858*	*3 965 F*	*4 132*	*4 506 F*	*4 653 F*	*4 586 F*	*12 823 F*
87 Colombia	217	223	129	229	58	70 F	90 F	105 F	119	350
Peru	11	62	...	...	...	...	...	...	...	...
87 Fishing area total	*228*	*285*	*129*	*229*	*58*	*70 F*	*90 F*	*105 F*	*119*	*350*
Species total	*141 127 F*	*138 721 F*	*160 863 F*	*135 306 F*	*130 493 F*	*136 998 F*	*142 465 F*	*161 573 F*	*171 442 F*	*191 598 F*

Atlantic moonfish	**Musso atlantique**		**Jorobado lamparosa**		***Selene setapinnis***			**1,70(23)046,04**		**MOA**
31 Grenada	0	0	-	-	-	-	-	-	-	-
USA	-	-	-	-	-	24	29	24	16	-
Venezuela	3 443	1 345	2 405	3 800 F	2 030 F	1 200 F	1 460 F	1 650 F	1 600 F	1 600 F
31 Fishing area total	*3 443*	*1 345*	*2 405*	*3 800 F*	*2 030 F*	*1 224 F*	*1 489 F*	*1 674 F*	*1 616 F*	*1 600 F*
41 Brazil	1 085	1 857	2 093	1 909	1 689	31	23	1 965	2 168	2 046
41 Fishing area total	*1 085*	*1 857*	*2 093*	*1 909*	*1 689*	*31*	*23*	*1 965*	*2 168*	*2 046*
Species total	*4 528*	*3 202*	*4 498*	*5 709 F*	*3 719 F*	*1 255 F*	*1 512 F*	*3 639 F*	*3 784 F*	*3 646 F*

African moonfish	**Musso africain**		**Jorobado africano**		***Selene dorsalis***			**1,70(23)046,05**		**LUK**
34 Benin	121	144	176	271	216	247	198	238	...	...
Congo Rep	80 F	90 F	111	108	77	83	389	98	276	279
Ghana	1 100	690	1 319	1 479	3 180	2 066	2 038	684	868	450
Liberia	-	-	-	-	22	...	599	250	250 F	250 F
Russian Fed	-	-	-	-	-	1	-	0	-	-
Senegal	326	469	343	612	220	430	270	227	217	170
Sierra Leone	319	260	116	120	40	178	138	256	250 F	250 F
Togo	-	13	0	3	3	-	11	10 F	...	4
Ukraine	2	18	26	23	80	66	21	76	19	-
34 Fishing area total	*1 948 F*	*1 684 F*	*2 091*	*2 616*	*3 838*	*3 071*	*3 664*	*1 839 F*	*1 880 F*	*1 403 F*
Species total	*1 948 F*	*1 684 F*	*2 091*	*2 616*	*3 838*	*3 071*	*3 664*	*1 839 F*	*1 880 F*	*1 403 F*

Peruvian moonfish	**Musso pacifique**		**Jorobado espejo**		***Selene peruviana***			**1,70(23)046,09**		**LNP**
87 Ecuador	...	...	...	...	...	5 287	6 289	3 915	3 923	676
87 Fishing area total	*...*	*...*	*...*	*...*	*...*	*5 287*	*6 289*	*3 915*	*3 923*	*676*
Species total	*...*	*...*	*...*	*...*	*...*	*5 287*	*6 289*	*3 915*	*3 923*	*676*

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Lookdown	**Musso panache**		**Jorobado de penacho**		***Selene vomer***				**1,70(23)046,10**	**LNM**
31 USA	-	-	-	-	-	-	-	19	15	-
31 Fishing area total	-	-	-	-	-	-	-	*19*	*15*	-
Species total	-	-	-	-	-	-	-	*19*	*15*	-
Snubnose pompano	**Pompaneau lune**		**Pámpano lunero**		***Trachinotus blochii***				**1,70(23)047,01**	**POO**
51 Saudi Arabia	44	33	30	59	32	59	39	64	131	92
51 Fishing area total	*44*	*33*	*30*	*59*	*32*	*59*	*39*	*64*	*131*	*92*
Species total	*44*	*33*	*30*	*59*	*32*	*59*	*39*	*64*	*131*	*92*
Florida pompano	**Pompaneau sole**		**Pámpano amarillo**		***Trachinotus carolinus***				**1,70(23)047,03**	**POM**
21 USA	0	1	1	1	0	0	0	0	0	0
21 Fishing area total	*0*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*
31 USA	181	158	157	168	154	221	197	196	187	118
31 Fishing area total	*181*	*158*	*157*	*168*	*154*	*221*	*197*	*196*	*187*	*118*
Species total	*181*	*159*	*158*	*169*	*154*	*221*	*197*	*196*	*187*	*118*
Pompano	**Palomine**		**Pámpano blanco**		***Trachinotus ovatus***				**1,70(23)047,06**	**POP**
34 Lithuania	-	-	-	-	-	-	-	-	3	13
34 Fishing area total	-	-	-	-	-	-	-	-	*3*	*13*
47 Angola	...	...	...	484	...	...	...	...	...	...
47 Fishing area total	...	...	...	*484*	...	...	...	...	...	...
Species total	...	...	...	*484*	...	...	...	...	*3*	*13*
Indian pompano	**Pompaneau indien**		**Pámpano índico**		***Trachinotus mookalee***				**1,70(23)047,21**	**TUK**
51 Iran	63	91	122	125	284	54	45	58	66	304
51 Fishing area total	*63*	*91*	*122*	*125*	*284*	*54*	*45*	*58*	*66*	*304*
Species total	*63*	*91*	*122*	*125*	*284*	*54*	*45*	*58*	*66*	*304*
Pompanos nei	**Pompaneaux nca**		**Pámpanos(=Palometas) nep**		***Trachinotus spp***				**1,70(23)047,XX**	**POX**
31 Dominican Rp	7	118	126	...	61	...	...	47	43	46
Mexico	333	605	247	220	540	563	419	410	425	755
Venezuela	117	174	74	120 F	54 F	40 F	50 F	52 F	52 F	52 F
31 Fishing area total	*457*	*897*	*447*	*340 F*	*655 F*	*603 F*	*469 F*	*509 F*	*520 F*	*853 F*
34 Gambia	22	...	...	-	-	-	-	2	1	...
Netherlands	-	-	-	-	1	12	-	13	24	-
Portugal	-	0	-	27	-	-	1	-	-	-
Senegal	158	110	84	48	80	82	154	78	136	111
Spain	7	85	350	789	248	170	1 071	285	367	339
UK	-	-	-	-	-	-	-	7	2	-
34 Fishing area total	*187*	*195*	*434*	*864*	*329*	*264*	*1 226*	*385*	*530*	*450*
37 Spain	-	-	-	63	89	57	46	68	78	89
37 Fishing area total	-	-	-	*63*	*89*	*57*	*46*	*68*	*78*	*89*
41 Brazil	273	211	191	536	649	453	152	1 048	1 155	1 094
Estonia	-	3	-	-	-	-	-	-	-	-
41 Fishing area total	*273*	*214*	*191*	*536*	*649*	*453*	*152*	*1 048*	*1 155*	*1 094*
51 India	11	12	15	12	29	31	31	31	17	52
51 Fishing area total	*11*	*12*	*15*	*12*	*29*	*31*	*31*	*31*	*17*	*52*
57 India	-	-	-	2 028	1 526	2 538	1 737	12 819	2 194	13 493
57 Fishing area total	-	-	-	*2 028*	*1 526*	*2 538*	*1 737*	*12 819*	*2 194*	*13 493*
77 Mexico	222	258	164	147	549	574	268	307	310	301
77 Fishing area total	*222*	*258*	*164*	*147*	*549*	*574*	*268*	*307*	*310*	*301*
87 Peru	632	878	464	1 509	157	931	159	97	177	202
87 Fishing area total	*632*	*878*	*464*	*1 509*	*157*	*931*	*159*	*97*	*177*	*202*
Species total	*1 782*	*2 454*	*1 715*	*5 499 F*	*3 983 F*	*5 451 F*	*4 088 F*	*15 264 F*	*4 981 F*	*16 534 F*
Greater amberjack	**Sériole couronnée**		**Pez de limón**		***Seriola dumerili***				**1,70(23)048,01**	**AMB**
21 Spain	-	-	-	-	-	-	-	12	-	-
21 Fishing area total	-	-	-	-	-	-	-	*12*	-	-
27 France	-	-	-	-	-	-	-	-	6	2
Portugal	20	37	26	34	43	75	90	65	60	38
Spain	-	-	5	5	14	3	12	6	2	4
27 Fishing area total	*20*	*37*	*31*	*39*	*57*	*78*	*102*	*71*	*68*	*44*
31 USA	452	448	637	738	678	467	445	471	589	637

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
31 Fishing area total	*452*	*448*	*637*	*738*	*678*	*467*	*445*	*471*	*589*	*637*
37 Albania	2	19	1	7	5	8	2	5	10	2
Algeria	341	542	686	719	441	255	231	...	67	220
Croatia	19	38	10	20	38	30	35	...	73	24
Cyprus	14	15	13	3	6	4	7	5	5	5
France	-	-	-	-	-	-	-	-	4	1
Greece	396	322	259	297	418	441	413	405	449	449 F
Israel	223	201	119	76	276	120	431	200 F	60	38
Italy	...	...	...	...	918	831	775	457	470	536
Libya	...	...	...	...	...	...	...	...	846	820 F
Malta	2	3	4	5	5	3	5	7	6	11
Serbia-Monte	13	12	12	8	...	-	-	-	-	-
Spain	430	283	378	531	253	296	196	369	458	262
Syria	96	53	90	67	85	75	65	51	60	37
Tunisia	122	93	267	237	213	136	171	167	116	124
37 Fishing area total	*1 658*	*1 581*	*1 839*	*1 970*	*2 658*	*2 199*	*2 331*	*1 666 F*	*2 624*	*2 529 F*
Species total	*2 130*	*2 066*	*2 507*	*2 747*	*3 393*	*2 744*	*2 878*	*2 220 F*	*3 281*	*3 210 F*
Yellowtail amberjack	**Sériole chicard**		**Medregal rabo amarillo**		***Seriola lalandi***				**1,70(23)048,06**	**YTC**
41 Argentina	33	8	3	2	4	13	6	6	16	9
Brazil	159	165	206	81	158	373	279	333	367	347
41 Fishing area total	*192*	*173*	*209*	*83*	*162*	*386*	*285*	*339*	*383*	*356*
47 Portugal	-	-	-	-	-	-	6	-	-	-
Russian Fed	-	3	-	-	-	-	-	-	-	-
South Africa	315	213	288	878	876	310	559	311	348	246
47 Fishing area total	*315*	*216*	*288*	*878*	*876*	*310*	*565*	*311*	*348*	*246*
51 South Africa	...	...	0	0	0	-	-	-	-	-
UK	-	-	-	-	-	-	-	-	3	6
51 Fishing area total	*...*	*...*	*0*	*0*	*0*	-	-	-	*3*	*6*
77 USA	39	34	14	22	10	18	11	6	4	7
77 Fishing area total	*39*	*34*	*14*	*22*	*10*	*18*	*11*	*6*	*4*	*7*
81 Spain	-	-	-	-	-	-	-	1	4	-
Ukraine	-	17	104	22	...	6	...	...	...	...
81 Fishing area total	-	*17*	*104*	*22*	*...*	*6*	*...*	*1*	*4*	*...*
Species total	*546*	*440*	*615*	*1 005*	*1 048*	*720*	*861*	*657*	*742*	*615*
Amberjacks nei	**Sérioles nca**		**Medregales nep**		***Seriola spp***				**1,70(23)048,XX**	**AMX**
21 USA	3	2	2	1	1	0	1	1	1	0
21 Fishing area total	*3*	*2*	*2*	*1*	*1*	*0*	*1*	*1*	*1*	*0*
31 Dominican Rp	18	39	164	44	36	66	53	64	57	62
Mexico	1 405	1 293	1 532	1 385	1 175	1 227	1 137	1 104	1 056	1 032
USA	383	208	188	184	149	127	161	158	194	159
Venezuela	399	538	282	450 F	240 F	140 F	170 F	195 F	190 F	190 F
31 Fishing area total	*2 205*	*2 078*	*2 166*	*2 063 F*	*1 600 F*	*1 560 F*	*1 521 F*	*1 521 F*	*1 497 F*	*1 443 F*
34 Lithuania	-	-	-	-	-	-	-	-	-	1
Portugal	7	8	5	10	4	9	13	12	12	7
Senegal	165	103	157	96	27	47	107	114	97	93
Spain	116	26	16	9	24	36	82	59	84	84
34 Fishing area total	*288*	*137*	*178*	*115*	*55*	*92*	*202*	*185*	*193*	*185*
41 Brazil	588	631	792	833	627	940	904	806	889	839
Portugal	-	-	-	-	-	-	-	-	4	-
Spain	-	-	-	-	-	-	-	-	5	3
41 Fishing area total	*588*	*631*	*792*	*833*	*627*	*940*	*904*	*806*	*898*	*842*
51 Bahrain	...	...	...	38	18	40	21	25	5	9
Kenya	92	31	61	107	111	81	21	18	71	63
Korea Rep	-	-	34	26	36	3	-	-	-	-
Tanzania	60	50	50	50	52	880	913	946	720	642
51 Fishing area total	*152*	*81*	*145*	*221*	*217*	*1 004*	*955*	*989*	*796*	*714*
57 Australia	2	1	3	6	-	-	-	2	1	1
57 Fishing area total	*2*	*1*	*3*	*6*	-	-	-	*2*	*1*	*1*
61 Japan	66 925	51 194	60 787	66 345	54 890	69 353	72 470	75 964	78 334	104 700 F
Korea Rep	6 475	5 374	3 671	5 321	2 876	5 073	6 524	12 643	14 080	19 468
61 Fishing area total	*73 400*	*56 568*	*64 458*	*71 666*	*57 766*	*74 426*	*78 994*	*88 607*	*92 414*	*124 168 F*
71 Australia	0	0	1	3	1	1	0	2	0	0
Korea Rep	-	-	-	3	3	3	-	3	-	1
71 Fishing area total	*0*	*0*	*1*	*6*	*4*	*4*	*0*	*5*	*0*	*1*
77 Mexico	28	20	31	28	15	16	30	25	25	31
Panama	510	1 433	1 436	297	597	477	1 586	1 640	1 345	...
USA	-	-	1	0	0	0	-	0	0	1
77 Fishing area total	*538*	*1 453*	*1 468*	*325*	*612*	*493*	*1 616*	*1 665*	*1 370*	*32*
81 Australia	0	1	1	1	1	0	...	...	...	...

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
New Zealand	278	242	295	166	193	166	159	164	151	168
81 Fishing area total	*278*	*243*	*296*	*167*	*194*	*166*	*159*	*164*	*151*	*168*
87 Colombia	91	...	...	70	4	50 F	100 F	150 F	202	213
Lithuania	-	-	-	-	-	-	-	4	-	-
Peru	28 025	29 787	35 651	31 456	37 078	33 755	35 333	49 473	57 153	53 359
87 Fishing area total	*28 116*	*29 787*	*35 651*	*31 526*	*37 082*	*33 805 F*	*35 433 F*	*49 627 F*	*57 355*	*53 572*
Species total	*105 570*	*90 981*	*105 160*	*106 929 F*	*98 158 F*	*112 490 F*	*119 785 F*	*143 572 F*	*154 676 F*	*181 126 F*
Shortjaw leatherjacket	**Sapater violine**		**Zapatero raspa balsa**		***Oligoplites refulgens***				**1,70(23)049,03**	**OLG**
77 Mexico	...	...	...	...	3 547	3 704	1 286	9	0	0
77 Fishing area total	*...*	*...*	*...*	*...*	*3 547*	*3 704*	*1 286*	*9*	*0*	*0*
Species total	*...*	*...*	*...*	*...*	*3 547*	*3 704*	*1 286*	*9*	*0*	*0*
Pilotfish	**Poisson pilote**		**Pez piloto**		***Naucrates ductor***				**1,70(23)050,01**	**NAU**
37 Italy	...	...	...	...	152	130	126	172	396	68
Malta	-	-	-	-	-	-	-	-	7	2
37 Fishing area total	*...*	*...*	*...*	*...*	*152*	*130*	*126*	*172*	*403*	*70*
Species total	*...*	*...*	*...*	*...*	*152*	*130*	*126*	*172*	*403*	*70*
Leerfish	**Liche**		**Palometón**		***Lichia amia***				**1,70(23)072,02**	**LEE**
27 Portugal	0	-	-	0	-	0	0	0	-	-
Spain	10	6	5	2	3	3	1	-	1	1
27 Fishing area total	*10*	*6*	*5*	*2*	*3*	*3*	*1*	*0*	*1*	*1*
34 Bulgaria	40	-	-	-	-	-	-	-	-	-
Côte dIvoire	3	4	1	27	26	11	8	10 F	10	24
Latvia	96	454	230	75	167	97	148	153	104	93
Lithuania	-	386	475	427	142	46	21	64	95	417
Netherlands	-	-	-	-	86	28	2	51	26	12
Portugal	-	-	-	-	-	-	-	11	-	-
Russian Fed	83	333	106	10	43	32	66	27	45	49
Sao Tome Prn	35 F	45 F	60	38	40 F	40 F	40 F	40 F	40 F	40 F
Senegal	341	270	303	67	60	112	76	38	98	172
Spain	-	38	5	34	2	-	5	4	4	9
Ukraine	130	457	37	76	27	12	101	23	41	-
UK	-	-	-	-	-	-	-	2	-	2
34 Fishing area total	*728 F*	*1 987 F*	*1 217*	*754*	*593 F*	*378 F*	*467 F*	*423 F*	*463 F*	*818 F*
37 Albania	...	1	1	1	4	2	37	42	13	32
Croatia	...	...	...	...	...	...	...	...	1	1
Italy	183	223	247	268	11	19	44	22	33	26
Spain	35	88	80	92	114	87	99	142	151	154
Tunisia	134	138	190	155	104	96	67	65	35	40
Turkey	255	330	262	352	505	606	549	513	1 167	883
37 Fishing area total	*607*	*780*	*780*	*868*	*738*	*810*	*796*	*784*	*1 400*	*1 136*
47 Russian Fed	1	21	5	-	-	-	-	-	-	-
47 Fishing area total	*1*	*21*	*5*	-	-	-	-	-	-	-
Species total	*1 346 F*	*2 794 F*	*2 007*	*1 624*	*1 334 F*	*1 191 F*	*1 264 F*	*1 207 F*	*1 864 F*	*1 955 F*
Alexandria pompano	**Cordonnier bossu**		**Jurel de Alejandría**		***Alectis alexandrinus***				**1,70(23)090,03**	**ALA**
34 Benin	...	...	...	...	...	25	...	37	...	...
Gambia	-	-	2	1	3	4	-	424	455	455
Mauritania	...	...	...	...	...	...	...	...	...	138
Senegal	862	611	403	292	372	445	310	348	596	499
34 Fishing area total	*862*	*611*	*405*	*293*	*375*	*474*	*310*	*809*	*1 051*	*1 092*
Species total	*862*	*611*	*405*	*293*	*375*	*474*	*310*	*809*	*1 051*	*1 092*
Black pomfret	**Castagnoline noire**		**Palometa negra**		***Parastromateus niger***				**1,70(23)099,01**	**POB**
51 Iran	2 772	2 483	3 775	3 565	3 138	3 377	2 904	4 559	4 875	6 157
Pakistan	1 975	2 002	2 880	1 990	1 675	1 987	1 805	1 901	2 781	4 914
Saudi Arabia	4	2	8	...	...	...	...	...	...	...
51 Fishing area total	*4 751*	*4 487*	*6 663*	*5 555*	*4 813*	*5 364*	*4 709*	*6 460*	*7 656*	*11 071*
57 Indonesia	7 758	9 973	8 718	7 203	8 474	11 060	10 590	13 956	12 268	12 656
Malaysia	2 612	2 767	1 516	1 561	1 290	1 576	1 453	1 232	2 395	1 952
Thailand	399	455	922	922	1 073	934	832	907	849	880
57 Fishing area total	*10 769*	*13 195*	*11 156*	*9 686*	*10 837*	*13 570*	*12 875*	*16 095*	*15 512*	*15 488*
61 China,Taiwan	2 129	1 779	2 269	1 288	1 161	1 159	1 808	834	548	744
61 Fishing area total	*2 129*	*1 779*	*2 269*	*1 288*	*1 161*	*1 159*	*1 808*	*834*	*548*	*744*
71 Indonesia	35 927	38 180	35 988	37 873	41 492	49 971	46 418	40 886	40 850	48 381
Malaysia	1 199	1 617	19 626	3 456	2 677	2 445	2 703	3 005	2 973	4 335
Thailand	3 801	4 003	3 665	3 216	2 884	2 451	2 800	1 750	1 863	1 807
71 Fishing area total	*40 927*	*43 800*	*59 279*	*44 545*	*47 053*	*54 867*	*51 921*	*45 641*	*45 686*	*54 523*
Species total	*58 576*	*63 261*	*79 367*	*61 074*	*63 864*	*74 960*	*71 313*	*69 030*	*69 402*	*81 826*

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Orangespotted trevally	**Carangue lentigine**		**Jurel lentejuela**		***Carangoides bajad***				**1,70(23)114,02**	**NGJ**
51 Saudi Arabia	686	762	356	538	617	553	558	979	1 150	1 150
51 Fishing area total	*686*	*762*	*356*	*538*	*617*	*553*	*558*	*979*	*1 150*	*1 150*
Species total	*686*	*762*	*356*	*538*	*617*	*553*	*558*	*979*	*1 150*	*1 150*
Yellowspotted trevally	**Carangue pailletée**		**Jurel centellante**		***Carangoides fulvoguttatus***				**1,70(23)114,08**	**NGU**
51 Saudi Arabia	128	324	182	156	268	185	175	189	190	190
51 Fishing area total	*128*	*324*	*182*	*156*	*268*	*185*	*175*	*189*	*190*	*190*
Species total	*128*	*324*	*182*	*156*	*268*	*185*	*175*	*189*	*190*	*190*
Malabar trevally	**Carangue monique**		**Jurel malabárico**		***Carangoides malabaricus***				**1,70(23)114,12**	**NGS**
51 Qatar	266	151	202	...	408	416	360	376	242	261
Saudi Arabia	12	169	63	69	65	78	67	91	74	98
51 Fishing area total	*278*	*320*	*265*	*69*	*473*	*494*	*427*	*467*	*316*	*359*
Species total	*278*	*320*	*265*	*69*	*473*	*494*	*427*	*467*	*316*	*359*
Rainbow runner	**Comète saumon**		**Macarela salmón**		***Elagatis bipinnulata***				**1,70(23)134,01**	**RRU**
31 Grenada	15	20	10	12	11	13	8	16	13	18
31 Fishing area total	*15*	*20*	*10*	*12*	*11*	*13*	*8*	*16*	*13*	*18*
34 Sao Tome Prn	...	...	...	102	110 F	110 F	110 F	110 F	110 F	110 F
Togo	1	1	1	21	7	27	-	-	-	-
34 Fishing area total	*1*	*1*	*1*	*123*	*117 F*	*137 F*	*110 F*	*110 F*	*110 F*	*110 F*
51 Saudi Arabia	...	...	...	...	20	...	...	67	...	...
51 Fishing area total	*...*	*...*	*...*	*...*	*20*	*...*	*...*	*67*	*...*	*...*
57 Indonesia	2 117	1 575	5 522	3 099	3 137	4 229	2 284	3 042	4 106	3 582
Malaysia	75	28	180	79	73	86	134	18	167	90
57 Fishing area total	*2 192*	*1 603*	*5 702*	*3 178*	*3 210*	*4 315*	*2 418*	*3 060*	*4 273*	*3 672*
71 Guam	2	3	3	5	2	4	2	1	1	1
Indonesia	7 842	4 516	4 935	7 003	7 409	6 118	5 046	5 426	6 056	8 657
Malaysia	120	32	43	192	367	272	484	805	608	784
Nauru	...	3	4	1	2	2 F	2 F	2 F	2 F	2 F
Philippines	4 755	6 061	6 428	6 085	5 746	6 217	6 774	7 331	6 820	7 509
71 Fishing area total	*12 719*	*10 615*	*11 413*	*13 286*	*13 526*	*12 613 F*	*12 308 F*	*13 565 F*	*13 487 F*	*16 953 F*
77 USA	-	2	2	2	2	1	0	1	1	1
77 Fishing area total	*-*	*2*	*2*	*2*	*2*	*1*	*0*	*1*	*1*	*1*
Species total	*14 927*	*12 241*	*17 128*	*16 601*	*16 886 F*	*17 079 F*	*14 844 F*	*16 819 F*	*17 884 F*	*20 754 F*
Golden trevally	**Carangue royale**		**Jurel dorado**		***Gnathanodon speciosus***				**1,70(23)151,01**	**GLT**
51 Bahrain	...	...	...	35	36	59	44	34	26	23
Qatar	204	173	183	204	391	345	256	224	242	255
Saudi Arabia	585	831	756	651	807	1 021	707	910	571	488
Untd Arab Em	1 082	2 471	1 073	1 150 F	1 215	960 F	700 F	444	558	421
51 Fishing area total	*1 871*	*3 475*	*2 012*	*2 040 F*	*2 449*	*2 385 F*	*1 707 F*	*1 612*	*1 397*	*1 187*
Species total	*1 871*	*3 475*	*2 012*	*2 040 F*	*2 449*	*2 385 F*	*1 707 F*	*1 612*	*1 397*	*1 187*
Torpedo scad	**Comète torpille**		**Macarela torpedo**		***Megalaspis cordyla***				**1,70(23)179,01**	**HAS**
51 Bahrain	-	-	-	-	-	12	0	5	4	2
Pakistan	1 825	1 950	2 070	3 455	3 278	3 143	5 819	5 924	5 498	3 321
Saudi Arabia	1 046	916	...	...	34	47	47	...	5	5
51 Fishing area total	*2 871*	*2 866*	*2 070*	*3 455*	*3 312*	*3 202*	*5 866*	*5 929*	*5 507*	*3 328*
57 Indonesia	6 555	5 864	6 822	6 468	11 131	13 324	12 963	12 008	13 103	20 060
Malaysia	2 929	4 950	5 085	5 586	6 420	8 693	11 105	11 260	19 835	21 514
Thailand	15 356	16 511	9 837	10 036	19 103	15 147	12 169	11 657	12 721	12 189
57 Fishing area total	*24 840*	*27 325*	*21 744*	*22 090*	*36 654*	*37 164*	*36 237*	*34 925*	*45 659*	*53 763*
61 China,Taiwan	198	229	125	140	158	105	250	99	181	77
61 Fishing area total	*198*	*229*	*125*	*140*	*158*	*105*	*250*	*99*	*181*	*77*
71 Indonesia	15 041	14 032	15 807	14 276	15 665	27 179	26 640	17 442	18 892	27 909
Malaysia	11 023	17 555	16 768	16 835	8 750	10 253	11 004	11 701	7 371	7 896
Philippines	19 590	17 697	19 619	19 140	17 608	19 940	18 351	18 979	20 609	18 914
Thailand	3 388	2 557	9 644	7 041	2 186	1 838	2 701	4 260	3 178	3 719
71 Fishing area total	*49 042*	*51 841*	*61 838*	*57 292*	*44 209*	*59 210*	*58 696*	*52 382*	*50 050*	*58 438*
Species total	*76 951*	*82 261*	*85 777*	*82 977*	*84 333*	*99 681*	*101 049*	*93 335*	*101 397*	*115 606*
Talang queenfish	**Sauteur talang**		**Jurel saltador**		***Scomberoides commersonnianus***				**1,70(23)231,01**	**OBM**
51 Bahrain	...	...	...	46	57	25	66	54	82	38
Iran	4 543	5 687	7 540	7 389	7 077	10 042	9 961	12 371	8 773	11 012
Saudi Arabia	451	393	51	659	494	729	479	570	485	324

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
51 Fishing area total	*4 994*	*6 080*	*7 591*	*8 094*	*7 628*	*10 796*	*10 506*	*12 995*	*9 340*	*11 374*
Species total	*4 994*	*6 080*	*7 591*	*8 094*	*7 628*	*10 796*	*10 506*	*12 995*	*9 340*	*11 374*
Doublespotted queenfish	**Sauteur sabre**		**Jurel sable**		***Scomberoides lysan***				**1,70(23)231,02**	**OBY**
51 Saudi Arabia	28	-	209	-	-	5	31	28	26	26
51 Fishing area total	*28*	*-*	*209*	*-*	*-*	*5*	*31*	*28*	*26*	*26*
Species total	*28*	*-*	*209*	*-*	*-*	*5*	*31*	*28*	*26*	*26*
Needlescaled queenfish	**Sauteur leurre**		**Jurel saltarín**		***Scomberoides tol***				**1,70(23)231,04**	**OBJ**
51 Saudi Arabia	13	623	431	184	215	212	232	252	262	262
51 Fishing area total	*13*	*623*	*431*	*184*	*215*	*212*	*232*	*252*	*262*	*262*
Species total	*13*	*623*	*431*	*184*	*215*	*212*	*232*	*252*	*262*	*262*
Queenfishes	**Sauteurs**		**Jureles saltadores**		***Scomberoides spp***				**1,70(23)231,XX**	**QUE**
51 Eritrea	257	229	387	212	38	252	177	53	185	176
Oman	528	420	1 084	977	887	977	943	1 378	1 706	2 833
Qatar	78	54	35	44	104	162	171	229	221	188
Untd Arab Em	701	453	580	600 F	612	540 F	470 F	390	551	575
51 Fishing area total	*1 564*	*1 156*	*2 086*	*1 833 F*	*1 641*	*1 931 F*	*1 761 F*	*2 050*	*2 663*	*3 772*
57 Indonesia	2 433	2 603	2 865	2 206	3 520	4 189	5 365	4 382	4 652	3 428
Malaysia	357	460	486	525	459	640	654	632	855	703
57 Fishing area total	*2 790*	*3 063*	*3 351*	*2 731*	*3 979*	*4 829*	*6 019*	*5 014*	*5 507*	*4 131*
71 Indonesia	14 852	12 945	13 361	12 568	9 475	10 765	12 414	9 030	10 259	10 893
Malaysia	3 170	2 236	2 647	3 118	2 550	2 690	2 737	2 690	1 917	2 660
Philippines	5 242	4 910	6 954	6 990	6 786	7 677	7 777	7 334	6 959	7 274
71 Fishing area total	*23 264*	*20 091*	*22 962*	*22 676*	*18 811*	*21 132*	*22 928*	*19 054*	*19 135*	*20 827*
Species total	*27 618*	*24 310*	*28 399*	*27 240 F*	*24 431*	*27 892 F*	*30 708 F*	*26 118*	*27 305*	*28 730*
Atlantic bumper	**Sapater**		**Casabe**		***Chloroscombrus chrysurus***				**1,70(23)268,01**	**BUA**
34 Benin	853	1 022	1 131	984	822	813	400 F	78	224	343
Congo Rep	...	...	74	62	49	176	557	102	176	847
Côte dIvoire	2 364	2 047	714	365	493	606	726	725 F	725	430
Ghana	6 418	5 670	7 259	5 747	8 056	9 388	9 943	9 888	2 613	7 455
Liberia	...	...	...	...	...	...	...	654	650 F	650 F
Lithuania	-	-	-	-	2	14	3	73	76	510
Mauritania	...	...	...	...	...	...	...	...	...	50
Netherlands	-	-	-	-	40	20	-	24	33	54
Russian Fed	-	-	-	17	-	-	-	-	-	-
Senegal	2 045	5 871	5 836	4 926	2 425	4 182	4 603	7 799	6 497	3 300
Sierra Leone	227	...	320	254	124	211	140	289	280 F	280 F
Togo	...	...	...	...	...	...	...	...	...	832
Ukraine	41	639	-	-	-	-	-	-	-	-
34 Fishing area total	*11 948*	*15 249*	*15 334*	*12 355*	*12 011*	*15 410*	*16 372 F*	*19 632 F*	*11 274 F*	*14 751 F*
41 Brazil	5 488	3 574	2 149	2 982	3 060	2 869	2 868	2 694	2 971	2 806
41 Fishing area total	*5 488*	*3 574*	*2 149*	*2 982*	*3 060*	*2 869*	*2 868*	*2 694*	*2 971*	*2 806*
Species total	*17 436*	*18 823*	*17 483*	*15 337*	*15 071*	*18 279*	*19 240 F*	*22 326 F*	*14 245 F*	*17 557 F*
Pacific bumper	**Sapater du Pacifique**		**Casabe orqueta**		***Chloroscombrus orqueta***				**1,70(23)268,02**	**HSO**
87 Ecuador	1 008	2 000 F	3 000 F	4 000 F	5 000 F	6 958	9 178	7 067	12 825	585
87 Fishing area total	*1 008*	*2 000 F*	*3 000 F*	*4 000 F*	*5 000 F*	*6 958*	*9 178*	*7 067*	*12 825*	*585*
Species total	*1 008*	*2 000 F*	*3 000 F*	*4 000 F*	*5 000 F*	*6 958*	*9 178*	*7 067*	*12 825*	*585*
Parona leatherjacket	**Sauteur parone**		**Parona**		***Parona signata***				**1,70(23)283,01**	**PAO**
41 Argentina	933	868	1 314	2 489	1 192	1 446	1 235	935	797	526
Uruguay	618	446	712	612	431	568	317	561	286	271
41 Fishing area total	*1 551*	*1 314*	*2 026*	*3 101*	*1 623*	*2 014*	*1 552*	*1 496*	*1 083*	*797*
Species total	*1 551*	*1 314*	*2 026*	*3 101*	*1 623*	*2 014*	*1 552*	*1 496*	*1 083*	*797*
Bigeye scad	**Sélar coulisou**		**Chicharro ojón**		***Selar crumenophthalmus***				**1,70(23)291,01**	**BIS**
31 Grenada	97	67	55	36	40	17	16	35	542	109
St Kitts Nev	25	41	20 F	...	10 F	12 F	14 F	16 F	18 F	18
St Vincent	...	...	...	...	...	...	...	...	137	115
USA	-	-	-	-	-	-	-	77	68	53
Venezuela	1 774	2 267	2 345	3 700 F	2 000 F	1 180 F	1 450 F	1 650 F	1 600 F	1 600 F
31 Fishing area total	*1 896*	*2 375*	*2 420 F*	*3 736 F*	*2 050 F*	*1 209 F*	*1 480 F*	*1 778 F*	*2 365 F*	*1 895 F*
41 Brazil	...	764	240	441	1 151	458	262	618	682	646
41 Fishing area total	*...*	*764*	*240*	*441*	*1 151*	*458*	*262*	*618*	*682*	*646*
57 Indonesia	...	...	...	1	21	289	948	1 366	3 123	1 790
Malaysia	...	...	...	4 637	...	...	...	15 121	15 473	18 813
Thailand	1 506	2 984	7 938	3 721	7 991	8 288	6 924	6 138	6 294	6 216

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
57 Fishing area total	*1 506*	*2 984*	*7 938*	*8 359*	*8 012*	*8 577*	*7 872*	*22 625*	*24 890*	*26 819*
71 Indonesia	...	...	...	4 891	5 111	5 560	4 694	6 561	4 900	4 625
Malaysia	...	...	...	17 694	...	...	...	40 517	31 685	33 329
Philippines	80 858	100 786	103 975	103 358	91 533	93 921	95 028	97 149	107 335	121 523
Thailand	31 089	31 715	36 650	37 020	33 293	28 585	27 808	14 798	17 356	16 077
71 Fishing area total	*111 947*	*132 501*	*140 625*	*162 963*	*129 937*	*128 066*	*127 530*	*159 025*	*161 276*	*175 554*
77 Mexico	...	...	...	...	97	101	120	214	...	212
USA	-	128	148	132	112	107	122	70	91	116
77 Fishing area total	*...*	*128*	*148*	*132*	*209*	*208*	*242*	*284*	*91*	*328*
Species total	*115 349*	*138 752*	*151 371 F*	*175 631 F*	*141 359 F*	*138 518 F*	*137 386 F*	*184 330 F*	*189 304 F*	*205 242 F*
Yellowstripe scad	**Sélar à bande dorée**		**Chicharro banda dorada**		***Selaroides leptolepis***				**1,70(23)422,01**	**TRY**
51 Untd Arab Em	3 034	5 320	4 251	3 900 F	3 512	2 740 F	2 000 F	1 200	...	...
51 Fishing area total	*3 034*	*5 320*	*4 251*	*3 900 F*	*3 512*	*2 740 F*	*2 000 F*	*1 200*	*...*	*...*
57 Indonesia	30 690	30 520	37 760	27 153	38 284	41 604	39 996	46 811	51 680	64 947
Malaysia	3 693	5 861	5 634	4 760	1 291	1 240	877	887	1 639	1 614
57 Fishing area total	*34 383*	*36 381*	*43 394*	*31 913*	*39 575*	*42 844*	*40 873*	*47 698*	*53 319*	*66 561*
71 Indonesia	102 308	118 673	117 106	111 770	104 821	103 606	102 710	104 019	105 030	114 993
Malaysia	36 165	35 145	27 833	29 671	18 085	17 412	15 547	19 337	16 578	13 882
71 Fishing area total	*138 473*	*153 818*	*144 939*	*141 441*	*122 906*	*121 018*	*118 257*	*123 356*	*121 608*	*128 875*
Species total	*175 890*	*195 519*	*192 584*	*177 254 F*	*165 993*	*166 602 F*	*161 130 F*	*172 254*	*174 927*	*195 436*
Blackbanded trevally	**Sériole amourez**		**...C**		***Seriolina nigrofasciata***				**1,70(23)425,01**	**RNJ**
57 Thailand	1 970	2 852	2 171	2 936	1 795	2 425	1 653	1 394	1 483	1 439
57 Fishing area total	*1 970*	*2 852*	*2 171*	*2 936*	*1 795*	*2 425*	*1 653*	*1 394*	*1 483*	*1 439*
71 Thailand	2 562	6 532	6 750	2 386	2 747	2 326	1 927	1 253	1 151	1 202
71 Fishing area total	*2 562*	*6 532*	*6 750*	*2 386*	*2 747*	*2 326*	*1 927*	*1 253*	*1 151*	*1 202*
Species total	*4 532*	*9 384*	*8 921*	*5 322*	*4 542*	*4 751*	*3 580*	*2 647*	*2 634*	*2 641*
Vadigo	**Liche lirio**		**Lirio**		***Campogramma glaycos***				**1,70(23)526,01**	**VAD**
34 Lithuania	-	-	-	-	-	-	-	-	4	12
Mauritania	...	...	...	...	...	...	...	...	...	55
Morocco	809	584	438	314	444	416	256	290	...	766
34 Fishing area total	*809*	*584*	*438*	*314*	*444*	*416*	*256*	*290*	*4*	*833*
37 Morocco	-	1	4	2	1	0	-	0	0	0
37 Fishing area total	*-*	*1*	*4*	*2*	*1*	*0*	*-*	*0*	*0*	*0*
Species total	*809*	*585*	*442*	*316*	*445*	*416*	*256*	*290*	*4*	*833*
Carangids nei	**Carangidés nca**		**Carángidos nep**		***Carangidae***				**1,70(23)XXX,XX**	**CGX**
27 Portugal	28	19	31	37	48	27	26	34	50	101
Spain	-	-	-	7	26	55	53	17	19	168
27 Fishing area total	*28*	*19*	*31*	*44*	*74*	*82*	*79*	*51*	*69*	*269*
31 Antigua Barb	33	34	85	65	98	43	72	38	66	87
Bahamas	101	86	92	97	65	79	83	40	84	39
Barbados	11	10	10	10	15	20	16	8	9	20
Bermuda	41	52	41	49	46	53	51	49	50	56
Dominican Rp	28	1	111	180	...	139	284	113	101	109
Grenada	14	26	18	22	22	23	1	16	16	49
Mexico	470	157	348	311	19	20	12	18	17	15
Nicaragua	...	...	...	...	...	19	...	5	1	5
Puerto Rico	32	20	23	14	9	7	5	5	8	5
St Vincent	...	...	...	...	...	...	...	...	12	15
Suriname	...	...	306	409	288	...	...	...	...	...
US Virgin Is	...	...	41	41	23	25	38	33	34	28
Venezuela	5	26	1 003	1 580 F	850 F	500 F	610 F	700 F	680 F	680 F
31 Fishing area total	*735*	*412*	*2 078*	*2 778 F*	*1 435 F*	*928 F*	*1 172 F*	*1 025 F*	*1 078 F*	*1 108 F*
34 Belize	-	99	-	...	122	1 062	-	907	...	...
Benin	475	428	492	585	468	481	385	486	540	676
Bulgaria	24	-	-	-	-	-	-	-	-	-
Cameroon	5	7	10	40 F	74	74	74	50 F	26	26 F
Comoros	-	-	-	-	-	-	89	226	...	...
Greece	1	1	2	4	-	-	2	-	-	-
Guinea	2 559	670	276	261	1 192	583	1 290	...	1 000 F	1 000 F
Liberia	271	280	280	394	317	284	289	67	70 F	70 F
Mauritania	275 F	420 F	470 F	640 F	730 F	380 F	530 F	450 F	500 F	13
Nigeria	833	630	1 728	680	350	277	440	359	393	431
Panama	87	143	3	...	876	2 733	440	-	...	...
Portugal	2	1	-	-	-	-	-	-	-	-
Russian Fed	-	-	-	-	-	-	-	695	-	-
Senegal	2 616	2 097	3 154	2 492	2 542	2 199	2 661	2 599	2 691	2 880
Sierra Leone	-	-	198	360	398	275	704	2 188	2 150 F	2 150 F
Spain	-	-	-	44	33	38	24	39	28	101
34 Fishing area total	*7 148 F*	*4 776 F*	*6 613 F*	*5 500 F*	*7 102 F*	*8 386 F*	*6 928 F*	*8 066 F*	*7 398 F*	*7 347 F*

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
37 Israel	-	-	-	-	-	-	-	20 F	19	16
Lebanon	400	400	400	400	380	383	383 F	383 F	383 F	383 F
Malta	8	8	16	4	10	13	6	17	0	1
Russian Fed	-	-	-	-	-	-	-	-	17	-
Spain	393	14	21	87	83	98	99	298	290	160
37 Fishing area total	*801*	*422*	*437*	*491*	*473*	*494*	*488 F*	*718 F*	*709 F*	*560 F*
41 Brazil	1 022	638	782	806	683	956	1 203	1 781	1 964	1 856
41 Fishing area total	*1 022*	*638*	*782*	*806*	*683*	*956*	*1 203*	*1 781*	*1 964*	*1 856*
47 Russian Fed	805	583	137	-	-	-	-	-	-	-
St Helena	1	1	1	1	1	1	2	3	2	3
47 Fishing area total	*806*	*584*	*138*	*1*	*1*	*1*	*2*	*3*	*2*	*3*
51 Bahrain	450	470	570	320	63	167	106	78	35	45
Comoros	500	500	500	500	600	600 F	650 F	650 F	650 F	650 F
Djibouti	110 F	125 F	140 F	155 F	173	163	210	206	204	204 F
Eritrea	1 014	730	343	301	120	311	67	46	79	109
India	5 909	23 637	37 402	35 507	30 754	37 215	43 671	34 520	47 247	57 575
Kenya	119	144	163	189	187	157	176	181	138	266
Kuwait	242	170 F	93	121	100	124	92	39	60 F	60 F
Mauritius	51	37	48	45	41	25	18	21	29	19
Oman	1 302	7 839	2 567	3 175	2 909	2 406	2 359	5 702	6 203	6 001
Pakistan	15 988	16 400	11 047	5 050	4 978	6 459	8 549	8 624	8 769	8 754
Qatar	286	213	254	461	381	379	397	616	394	352
Réunion	131	154	143	143	98	84	47	7	7 F	7 F
Saudi Arabia	1 212	999	1 790	1 393	1 609	1 571	1 608	1 394	1 300	1 300
Seychelles	1 285	2 042	1 293	1 177	1 103	767	786	1 234	541	679
South Africa	-	-	0	-	-	-	-	-	-	-
Tanzania	2 000	1 880	1 900	1 800	1 600	1 600	1 711	1 642	1 698	2 013
Untd Arab Em	4 107	1 164	3 291	2 700 F	2 150	4 000 F	6 000 F	7 866	8 960	8 688
Zanzibar	511	742	472	1 256	990	1 303	1 185	1 295	1 297	1 312
51 Fishing area total	*35 217 F*	*57 246 F*	*62 016 F*	*54 293 F*	*47 856*	*57 331 F*	*67 632 F*	*64 121 F*	*77 611 F*	*88 034 F*
57 India	7 061	7 926	9 598	15 308	13 078	16 449	21 839	16 218	23 127	22 996
Malaysia	5 807	6 024	1 934	3 387	6 931	6 940	19 397	447	675	795
Sri Lanka	9 950	10 760	14 940	13 580	5 950	9 570	11 380	11 160	13 020	17 240
Thailand	9 236	9 170	11 013	11 017	12 242	10 656	10 397	9 519	10 209	9 864
57 Fishing area total	*32 054*	*33 880*	*37 485*	*43 292*	*38 201*	*43 615*	*63 013*	*37 344*	*47 031*	*50 895*
61 Russian Fed	-	-	22	-	-	-	-	-	-	28
61 Fishing area total	-	-	*22*	-	-	-	-	-	-	*28*
71 Guam	1	2	1	3	2	24	12	1	19	1
Malaysia	31 318	32 245	19 208	21 813	10 896	11 569	43 395	10 411	10 864	10 578
Nauru	...	...	...	...	5	5 F	4 F	4 F	4 F	4 F
N Marianas	3	2	4	3	6	1	2	2	2	2
Palau	3	1	0	0	0	0	...	...	...	...
Philippines	42 442	54 019	56 093	52 147	55 343	62 629	64 992	72 916	71 011	76 207
Singapore	12	16	16	29	28	35	44	30	48	45
Thailand	41 716	38 647	37 526	39 850	35 882	29 772	28 021	24 230	*22 724*	23 477
71 Fishing area total	*115 495*	*124 932*	*112 848*	*113 845*	*102 162*	*104 035 F*	*136 470 F*	*107 594 F*	*104 672 F*	*110 314 F*
77 Amer Samoa	1	1	0	0	0	1	2	2	2	1
Mexico	166	330	123	110	115	120	142	154	157	173
77 Fishing area total	*167*	*331*	*123*	*110*	*115*	*121*	*144*	*156*	*159*	*174*
87 Chile	150	65	66	58	26	25	46	77	29	12
Ecuador	68	164 F	260 F	300 F	357 F	462	772	1 421	1 145	3 943
Spain	-	-	-	7	-	-	-	-	-	-
87 Fishing area total	*218*	*229 F*	*326 F*	*365 F*	*383 F*	*487*	*818*	*1 498*	*1 174*	*3 955*
Species total	*193 691 F*	*223 469 F*	*222 899 F*	*221 525 F*	*198 485 F*	*216 436 F*	*277 949 F*	*222 357 F*	*241 867 F*	*264 543 F*

Atlantic pomfret	**Grande castagnole**		**Japuta**		***Brama brama***				**1,70(27)003,01**	**POA**
27 Denmark	0	0	-	0	0	0	0	-	-	-
France	-	-	-	2	3	11	64	62	103	715
Iceland	-	-	-	-	-	-	-	2	-	-
Ireland	184	404	-	0	-	2	4	1	0	-
Netherlands	-	-	-	-	-	-	-	5	1	2
Norway	-	-	-	-	-	-	3	8	1	-
Portugal	7	76	4	4	717	473	244	608	96	149
Russian Fed	-	-	-	-	-	-	-	2	-	-
Spain	244	30	50	667	2 983	7 089	4 417	3 724	4 934	7 733
UK	-	-	-	-	-	11	108	94	574	700
27 Fishing area total	*435*	*510*	*54*	*673*	*3 703*	*7 586*	*4 840*	*4 506*	*5 709*	*9 299*
34 Latvia	-	-	-	-	-	-	151	87	29	36
Lithuania	-	-	3	19	20	468	66	24	187	176
Netherlands	-	-	-	-	-	-	-	8	4	-
Poland	-	-	-	-	-	-	-	-	47	5
Portugal	3	4	2	2	3	2	5	38	7	2
Russian Fed	-	29	77	4	21	82	12	187	342	347
Spain	-	-	-	376	1	363	1 029	1 333	1 153	2 004
Ukraine	-	10	-	-	-	-	-	-	-	-
34 Fishing area total	*3*	*43*	*82*	*401*	*45*	*915*	*1 263*	*1 677*	*1 769*	*2 570*

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
37 France	5	5	5	5	0	0	-	-	1	1
Spain	104	47	36	32	20	40	17	41	27	35
37 Fishing area total	*109*	*52*	*41*	*37*	*20*	*40*	*17*	*41*	*28*	*36*
47 Namibia	684	486	609	874	789	985	95	233	4	50 F
Poland	-	-	-	4	-	-	-	-	-	-
South Africa	437	404	410	685	999	815	1 132	836	806	876
47 Fishing area total	*1 121*	*890*	*1 019*	*1 563*	*1 788*	*1 800*	*1 227*	*1 069*	*810*	*926 F*
58 South Africa	0	0	-	-	-	-	-	-	-	-
58 Fishing area total	*0*	*0*	-	-	-	-	-	-	-	-
81 New Zealand	903	552	322	139	253	206	152	157	173	117
Ukraine	-	3	11	15	...	15	...	...	...	...
81 Fishing area total	*903*	*555*	*333*	*154*	*253*	*221*	*152*	*157*	*173*	*117*
Species total	*2 571*	*2 050*	*1 529*	*2 828*	*5 809*	*10 562*	*7 499*	*7 450*	*8 489*	*12 948 F*
Southern rays bream	**...B**		**Reineta**		***Brama australis***				**1,70(27)003,02**	**BRU**
87 Chile	15 156	4 430	2 647	3 795	12 761	2 642	3 896	6 210	15 199	16 977
Lithuania	-	-	-	-	-	-	-	-	89	51
Netherlands	-	-	-	-	-	-	-	-	76	76
Poland	-	-	-	-	-	-	-	-	78	305
87 Fishing area total	*15 156*	*4 430*	*2 647*	*3 795*	*12 761*	*2 642*	*3 896*	*6 210*	*15 442*	*17 409*
Species total	*15 156*	*4 430*	*2 647*	*3 795*	*12 761*	*2 642*	*3 896*	*6 210*	*15 442*	*17 409*
Sickle pomfret	**...B**		**Tristón segador**		***Taractichthys steindachneri***				**1,70(27)004,04**	**TST**
77 Fr Polynesia	...	...	...	25	22	16	14	17	14	20
77 Fishing area total	*...*	*...*	*...*	*25*	*22*	*16*	*14*	*17*	*14*	*20*
Species total	*...*	*...*	*...*	*25*	*22*	*16*	*14*	*17*	*14*	*20*
Pomfrets, ocean breams nei	**Castagnoles nca**		**Japutas nep**		***Bramidae***				**1,70(27)XXX,XX**	**BRZ**
51 Réunion	-	-	-	-	3	4	4	0	2 F	2 F
51 Fishing area total	-	-	-	-	*3*	*4*	*4*	*0*	*2 F*	*2 F*
61 Russian Fed	-	-	5	-	-	-	-	-	-	-
61 Fishing area total	-	-	*5*	-	-	-	-	-	-	-
77 Amer Samoa	1	0	-	-	0	-	-	-	-	-
USA	4	222	208	348	293	265	269	304	285	269
77 Fishing area total	*5*	*222*	*208*	*348*	*293*	*265*	*269*	*304*	*285*	*269*
Species total	*5*	*222*	*213*	*348*	*296*	*269*	*273*	*304*	*287 F*	*271 F*
Common dolphinfish	**Coryphène commune**		**Lampuga**		***Coryphaena hippurus***				**1,70(28)071,01**	**DOL**
21 USA	82	108	70	71	30	44	113	51	180	65
21 Fishing area total	*82*	*108*	*70*	*71*	*30*	*44*	*113*	*51*	*180*	*65*
27 Portugal	3	4	3	7	5	7	9	8	4	21
27 Fishing area total	*3*	*4*	*3*	*7*	*5*	*7*	*9*	*8*	*4*	*21*
31 Antigua Barb	4	7	7	10	13	9	10	62	3	2
Barbados	574	553	458	455	357	476	428	693	870	465
Br Virgin Is	3	1	2	1	1 F	1 F	1 F	1 F	1 F	1 F
Costa Rica	-	0	1	1	1	1 F	2	2 F	2 F	2 F
Cuba	335	416	331	339	339	30	23	16	28	32
Dominica	...	211	153 F	118 F	53	177	170	125	201	190 F
Dominican Rp	232	570	197	221	163	...	1 009	363	241	259
Grenada	221	178	130	164	86	134	225	146	195	132
Guadeloupe	700 F	700 F	700 F	700 F	700 F	700 F	700 F	700 F	700 F	700 F
Martinique	220 F	220 F	220 F	220 F	200 F	220 F	210 F	210 F	210 F	170 F
Mexico	315	350	283	227	205	214	75	2	2	2
Puerto Rico	74	53	52	57	39	41	40	50	49	44
St Kitts Nev	26	40	25 F	8	9 F	9 F	10 F	10 F	11 F	11
St Lucia	427	402	286	376	198	382	512	341	465	352
St Vincent	-	-	-	-	-	-	154	56	118	71
USA	329	281	311	380	257	279	434	435	544	266
US Virgin Is	...	...	16	31	23	31	19	34	31	32
Venezuela	...	...	55	...	14	16	...	1 471	1 420 F	1 420 F
31 Fishing area total	*3 460 F*	*3 982 F*	*3 227 F*	*3 308 F*	*2 658 F*	*2 720 F*	*4 022 F*	*4 717 F*	*5 091 F*	*4 151 F*
34 Benin	48	28	24	31	25	26	21	11	12	5
Liberia	22	25	25	48	2	1	-	-	-	-
Portugal	1	0	1	0	2	1	1	-	-	1
Senegal	258	198	247	262	214	253	365	329	361	304
Spain	-	14	8	1	2	7	2	2	4	13
Togo	148	147	41	58	20	64	17	14 F	10	19
UK	-	-	-	-	-	-	-	-	1	-
34 Fishing area total	*477*	*412*	*346*	*400*	*265*	*352*	*406*	*356 F*	*388*	*342*
37 Italy	...	...	...	...	2 288	2 400	2 322	2 302	2 106	1 843
Libya	...	...	...	...	...	...	21	55	342	330 F
Malta	303	347	507	473	447	559	276	237	395	530

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Spain	70	156	225	271	169	258	175	128	156	184
Tunisia	784	678	1 726	1 285	865	1 829	612	740	1 179	1 097
37 Fishing area total	*1 157*	*1 181*	*2 458*	*2 029*	*3 769*	*5 046*	*3 406*	*3 462*	*4 178*	*3 984 F*
41 Brazil	4 326	4 956	7 266	6 393	13 199	8 149	8 873	7 786	8 588	7 999
Portugal	-	-	-	-	-	-	-	18	1	4
Spain	-	-	-	-	-	-	-	-	3	-
Uruguay	3	4	1	2	2	7	2	2	...	...
41 Fishing area total	*4 329*	*4 960*	*7 267*	*6 395*	*13 201*	*8 156*	*8 875*	*7 806*	*8 592*	*8 003*
47 Portugal	-	-	-	-	-	-	-	-	4	4
St Helena	0	1	1	0	0	2	1	0	1	2
South Africa	1	1	3	1	2	3	4	3	8	6
47 Fishing area total	*1*	*2*	*4*	*1*	*2*	*5*	*5*	*3*	*13*	*12*
51 France	-	-	-	-	-	-	-	-	37	43
Iran	...	2 113	4 852	3 424	2 600	2 262	1 568	1 185	1 577	1 158
Pakistan	1 869	1 875	3 742	2 949	2 705	2 453	2 536	2 612	2 072	2 268
Portugal	-	-	-	-	-	2	1	-	6	10
Réunion	141	145	150	149	146	153	139	60	60 F	60 F
South Africa	...	1	11	5	5	4	4	2	9	1
51 Fishing area total	*2 010*	*4 134*	*8 755*	*6 527*	*5 456*	*4 874*	*4 248*	*3 859*	*3 761 F*	*3 540 F*
57 Indonesia	...	...	...	776	487	1 070	3 043	4 882	2 800	2 163
Japan	-	2	1	2	2	1	-	-	-	-
Portugal	-	-	-	-	-	-	3	0	-	-
57 Fishing area total	*...*	*2*	*1*	*778*	*489*	*1 071*	*3 046*	*4 882*	*2 800*	*2 163*
61 China,Taiwan	7 427	7 014	9 435	13 638	14 351	13 566	14 755	9 307	6 950	9 115
Japan	9 129	9 345	9 869	9 250	7 192	8 808	...	...	...	...
61 Fishing area total	*16 556*	*16 359*	*19 304*	*22 888*	*21 543*	*22 374*	*14 755*	*9 307*	*6 950*	*9 115*
71 Guam	83	78	38	88	48	67	117	16	70	48
Indonesia	...	...	...	722	1 691	2 253	2 236	3 363	5 947	4 768
Japan	21	37	19	4	2	4	...	...	...	...
N Marianas	6	9	3	16	10	6	13	5	9	10
Palau	-	0	0	0	1	0	...	...	...	...
Philippines	258	286	232	161	104	115	130	154	182	184
71 Fishing area total	*368*	*410*	*292*	*991*	*1 856*	*2 445*	*2 496*	*3 538*	*6 208*	*5 010*
77 Amer Samoa	16	14	8	4	16	14	10	8	11	6
Costa Rica	11 221	7 832	3 974	2 320	3 161	2 900 F	2 713	2 710 F	2 710 F	2 710 F
Fr Polynesia	651	610	500 F	357	456	644	429	527	417	711
Guatemala	...	...	...	...	8	27	5	...	13	1
Japan	-	2	6	5	2	3	...	...	...	...
Mexico	208	345	322	362	504	526	712	1 074	1 044	1 260
Nicaragua	1 408	1 445	745	404	292	200	187	423	500	185
USA	7	621	601	1 006	653	609	632	569	584	692
77 Fishing area total	*13 511*	*10 869*	*6 156 F*	*4 458*	*5 092*	*4 923 F*	*4 688*	*5 311 F*	*5 279 F*	*5 565 F*
81 New Zealand	15	7	2	1	1	3	1	2	1	2
81 Fishing area total	*15*	*7*	*2*	*1*	*1*	*3*	*1*	*2*	*1*	*2*
87 Chile	349	819	459	594	383	517	347	250	240	402
Ecuador	5 266	5 473	4 756	4 838	2 300	3 638	3 865	13 491	6 920	6 728
Uruguay	-	-	-	-	1	-	-	-	-	-
87 Fishing area total	*5 615*	*6 292*	*5 215*	*5 432*	*2 684*	*4 155*	*4 212*	*13 741*	*7 160*	*7 130*
Species total	*47 584 F*	*48 722 F*	*53 100 F*	*53 286 F*	*57 051 F*	*56 175 F*	*50 282 F*	*57 043 F*	*50 605 F*	*49 103 F*
Live sharksucker	**Rémora commun**		**Pegatimón**		***Echeneis naucrates***				**1,70(42)001,01**	**EHN**
51 Bahrain	...	...	...	3	3	2	2	1	0	0
51 Fishing area total	*...*	*...*	*...*	*3*	*3*	*2*	*2*	*1*	*0*	*0*
Species total	*...*	*...*	*...*	*3*	*3*	*2*	*2*	*1*	*0*	*0*
Suckerfishes, remoras nei	**Rémoras nca**		**Remoras, pegas nep**		***Echeneidae***				**1,70(42)XXX,XX**	**ECN**
34 Liberia	0	0	0	1	513	-	-	-	-	-
34 Fishing area total	*0*	*0*	*0*	*1*	*513*	-	-	-	-	-
Species total	*0*	*0*	*0*	*1*	*513*	-	-	-	-	-
Chub mackerel	**Maquereau espagnol**		**Estornino**		***Scomber japonicus***				**1,75(01)002,01**	**MAS**
27 France	110	408	65	978	614	2 651	1 558	161	168	240
Germany	-	-	-	-	-	-	-	1	-	-
Portugal	4 492	5 516	8 666	14 749	15 288	17 503	26 134	23 837	14 619	24 458
27 Fishing area total	*4 602*	*5 924*	*8 731*	*15 727*	*15 902*	*20 154*	*27 692*	*23 999*	*14 787*	*24 698*
31 Mexico	0	0	1 255	1 222	...	...	...	...	1 222	...
USA	13	-	221	-	-	-	-	3	-	0
Venezuela	514	664	352	560 F	300 F	180 F	220 F	250 F	240 F	240 F
31 Fishing area total	*527*	*664*	*1 828*	*1 782 F*	*300 F*	*180 F*	*220 F*	*253 F*	*1 462 F*	*240 F*
34 Belize	1 041	3 698	-	...	422	203	-	1 559	...	36 226
Benin	314	452	20	...	...	...	...	488	...	...
Bulgaria	135	-	-	-	-	-	-	-	-	-

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
China	36	18	-	...	325	-	-	-	...	103
Comoros	-	-	-	-	-	-	277	413	...	2 551
Congo Rep	...	...	27	34	25	18	26	27	30	164
Côte dIvoire	110	878	1 192	1 030	656	441	38	40 F	40	441
Cuba	11 383	-	-	-	-	-	-	-	-	-
Cyprus	7 305	-	-	-	-	-	-	-	-	-
Eq Guinea	50 F	50 F	50 F	50 F	50 F	54 F	50	100	50	...
Gambia	-	-	121	128	110	131	407	19	21	...
Georgia	...	...	...	...	...	...	...	...	...	423
Germany	20	318	-	113	-	62	201	-	-	16
Ghana	14 338	7 018	6 764	6 010	5 921	2 895	4 079	4 133	3 525	4 055
Guinea	...	...	...	...	...	...	...	...	...	1 734
Ireland	6 135	4 473	5 860	804	322	-	-	-	64	478
Korea Rep	26	281	-	32	13	-	-	-	-	-
Latvia	9 924	7 079	10 537	8 999	4 620	3 595	8 943	8 112	10 495	8 148
Liberia	34	40	40	218	48	99	934	323	320 F	320 F
Lithuania	9 900	12 119	20 956	15 868	14 962	6 681	9 884	16 275	16 826	14 028
Mauritania	14 000 F	16 000 F	18 000 F	23 653	14 320	2 889	7 617	6 299	5 096	4 631
Morocco	25 683	23 564	32 801	68 649	78 414	69 700	104 258	105 788	82 201	75 222
Netherlands	12 708	23 254	25 171	7 537	3 486	1 186	60	1 145	1 682	7 613
Panama	452	463	-	...	462	516	973	-	...	...
Poland	1 666	5 958	-	-	-	-	-	1 719	3 414	1 829
Portugal	446	289	227	430	568	317	448	904	339	172
Russian Fed	29 619	35 688	19 904	65 784	47 582	64 554	51 462	40 687	41 806	38 622
St Kitts Nev	-	-	-	-	-	-	-	-	-	2 214
St Vincent	5 384	4 071	...	...	...	...	...	...	...	5 208
Senegal	2 710	6 577	8 748	5 330	1 995	2 973	3 793	4 081	2 882	6 459
Spain	1 138	643	539	254	689	556	459	519	1 080	746
Togo	204	419	176	614	322	...	5	4 F	2	133
Ukraine	19 475	8 220	6 350	3 304	510	4 751	9 530	257	1 064	-
Other nei	4 845	15 193	15 000 F	12 200 F	11 300 F	11 300 F	11 300 F	10 500 F	14 000 F	...
34 Fishing area total	*179 081 F*	*176 763 F*	*172 483 F*	*221 041 F*	*187 122 F*	*172 921 F*	*214 744 F*	*203 392 F*	*184 937 F*	*211 536 F*
37 Croatia	...	...	...	...	...	...	...	...	552	809
Cyprus	3	5	1	1	-	2	1	-	5	5
France	77	66	63	68	31	31	106	49	93	90
Greece	1 829	3 188	2 786	2 937	3 473	3 277	3 017	1 980	2 097	2 100 F
Israel	4	0	4	3	22	7	107	100 F	83	102
Italy	...	...	...	...	1 937	1 363	1 138	975	841	971
Libya	3 900 F	3 800 F	3 800 F	3 800 F	3 800 F	3 800 F	3 895	6 029	...	...
Malta	32	3	0	4	12	6	14	17	226	61
Montenegro	...	...	...	...	...	6	12	21	12	14
Morocco	213	722	5 860	10 304	4 534	2 324	641	701	1 586	668
Palest, O.T.	190 F	160	124	113	82	94	77	109	15	39
Serbia-Monte	...	4	1	1	4	...	...	...	...	...
Slovenia	3	1	3	-	2	2	4	0	2	0
Tunisia	3 727	2 480	4 457	9 367	9 026	4 873	2 786	3 528	3 091	3 416
Turkey	4 500	1 500	1 480	1 402	2 001	2 760	2 263	1 818	2 952	2 004
37 Fishing area total	*14 478 F*	*11 929 F*	*18 579 F*	*28 000 F*	*24 924 F*	*18 545 F*	*14 061*	*15 327 F*	*11 555*	*10 279 F*
41 Argentina	4 602	11 616	5 036	5 008	2 388	6 081	10 631	13 354	12 830	27 433
Brazil	1 580	5 012	2 171	3 442	10 030	3 361	8 262	4 862	5 363	5 059
Uruguay	0	0	0	0	43	3 486	22	0	...	40
41 Fishing area total	*6 182*	*16 628*	*7 207*	*8 450*	*12 461*	*12 928*	*18 915*	*18 216*	*18 193*	*32 532*
47 Angola	...	...	9 703	6 574	6 000 F	6 573	6 435	7 555	10 054	9 700 F
Korea Rep	-	35	-	-	-	-	-	-	-	-
Lithuania	-	-	308	-	-	-	-	-	-	-
Namibia	6 329	3 530	4 650	55	2 562	2 854	1 236	...	1 558	1 600 F
Poland	-	675	61	-	-	-	-	-	-	-
Portugal	-	-	-	-	-	0	2	-	3	2
Russian Fed	2 090	1 813	922	-	-	-	-	-	-	-
St Helena	11	7	3	1	0	2	1	1	1	8
South Africa	1 620	876	1 328	1 844	2 487	864	824	2 370	1 100	1 404
Spain	-	-	5	-	-	-	-	-	-	-
Ukraine	29	-	-	-	-	-	-	-	-	-
47 Fishing area total	*10 079*	*6 936*	*16 980*	*8 474*	*11 049 F*	*10 293*	*8 498*	*9 926*	*12 716*	*12 714 F*
51 Egypt	2 747	1 614	2 741	1 083	553	645	1 047	647	382	119
Korea Rep	-	1	22	239	117	-	-	-	-	-
Russian Fed	-	-	2	-	-	-	-	-	-	-
South Africa	...	...	...	1	0	-	-	-	2	2
51 Fishing area total	*2 747*	*1 615*	*2 765*	*1 323*	*670*	*645*	*1 047*	*647*	*384*	*121*
61 China	325 527 F	353 382 F	370 747 F	382 927 F	418 677 F	403 510 F	343 821	592 637	397 010	492 005
China,Taiwan	24 298	34 950	53 834	60 618	77 789	54 768	49 919	56 015	70 174	62 109
Japan	375 273	279 633	329 273	338 098	620 393	652 397	456 552	520 326	470 904	477 900 F
Korea Rep	203 717	141 751	122 044	184 592	135 596	101 427	143 776	187 240	117 960	94 331
Russian Fed	1	-	4	-	2	-	-	-	-	-
61 Fishing area total	*928 816 F*	*809 716 F*	*875 902 F*	*966 235 F*	*1 252 457 F*	*1 212 102 F*	*994 068*	*1 356 218*	*1 056 048*	*1 126 345 F*
67 USA	322	127	160	107	318	667	702	30	22	12
67 Fishing area total	*322*	*127*	*160*	*107*	*318*	*667*	*702*	*30*	*22*	*12*
71 Philippines	1 664	2 064	1 556	847	853	862	1 362	1 255	1 866	2 380
71 Fishing area total	*1 664*	*2 064*	*1 556*	*847*	*853*	*862*	*1 362*	*1 255*	*1 866*	*2 380*
77 Korea Rep	-	-	-	204	-	-	-	-	-	-
Mexico	17 156	10 433	11 292	10 996	35 390	10 716	11 078	7 367	7 217	8 532

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
USA	6 925	3 368	3 999	3 579	3 244	5 904	5 018	3 535	5 080	2 053
77 Fishing area total	*24 081*	*13 801*	*15 291*	*14 779*	*38 634*	*16 620*	*16 096*	*10 902*	*12 297*	*10 585*
87 Belize	-	-	-	-	-	-	966	1 104	295	21
Chile	365 031	343 371	572 052	577 336	280 756	368 786	297 189	133 018	158 452	95 659
Ecuador	85 378	17 073	33 273	51 806	115 406	37 665	43 171	21 758	36 679	52 751
Faroe Is	-	-	-	-	-	-	...	...	...	102
Germany	-	-	-	-	-	-	3 449	2 055	1 257	135
Ghana	855	-	-	-	-	-	-	-	-	-
Korea Rep	-	-	-	581	-	285	1 240	968	997	71
Lithuania	-	-	-	-	-	-	2 009	1 493	1 077	109
Netherlands	-	-	-	-	-	-	3 616	2 337	1 693	115
Peru	176 202	32 698	94 384	62 255	52 895	102 322	62 387	92 989	110 605	20 467
Poland	-	-	-	-	-	-	-	-	918	319
Russian Fed	-	-	5	-	-	-	-	173	18	-
Vanuatu	-	-	1 553	3 137	1 819	3 352	7 705	8 945	4 901	676
Other nei	-	-	-	-	-	-	-	...	517	-
87 Fishing area total	*627 466*	*393 142*	*701 267*	*695 115*	*450 876*	*512 410*	*421 732*	*264 840*	*317 409*	*170 425*
Species total	*1 800 045 F*	*1 439 309 F*	*1 822 749 F*	*1 961 880 F*	*1 995 566 F*	*1 978 327 F*	*1 719 137 F*	*1 905 005 F*	*1 631 676 F*	*1 601 867 F*
Atlantic mackerel	**Maquereau commun**		**Caballa del Atlántico**		***Scomber scombrus***				**1,75(01)002,05**	**MAC**
21 Canada	24 488	43 092	44 824	53 612	55 282	53 959	53 394	29 671	42 231	38 488
Russian Fed	3	-	3	14	-	-	-	-	-	-
St Pier Mq	7	7	6	3	2	4	17	4	-	-
USA	12 339	27 364	34 296	53 901	42 209	56 641	25 547	21 761	23 144	9 959
21 Fishing area total	*36 837*	*70 463*	*79 129*	*107 530*	*97 493*	*110 604*	*78 958*	*51 436*	*65 375*	*48 447*
27 Belgium	98	23	4	5	1	4	1	2	4	29
Channel Is	14	12	15	16	19	18	12	14	16	13
Denmark	31 395	33 046	26 425	26 250	23 214	24 234	24 888	26 730	23 230	41 055
Estonia	218	-	-	-	-	-	-	-	-	-
Faroe Is	22 790	20 356	12 299	14 203	10 310	12 082	14 124	11 920	14 469	71 539
France	20 958	22 070	27 463	23 315	18 297	17 366	15 730	13 471	12 001	13 340
Germany	25 325	26 536	24 061	23 376	19 120	16 601	18 574	15 422	22 408	18 880
Iceland	1	53	122	-	363	4 222	-	112 352	116 101	122 033
Ireland	70 451	72 189	67 481	60 753	44 981	41 227	48 789	44 906	61 424	58 246
Isle of Man	8	6	7	7	...	...	7	6	10	14
Latvia	-	-	-	-	-	-	-	7	-	-
Lithuania	1 949	1 600	582	-	-	92	7	-	111	-
Netherlands	33 109	43 460	29 167	28 006	23 457	22 068	24 773	20 395	23 419	24 906
Norway	180 750	184 382	163 535	157 432	119 878	122 011	131 698	121 496	121 229	233 957
Poland	-	-	-	0	570	1 368	978	2	0	3
Portugal	3 121	3 090	2 902	2 779	3 064	2 856	3 031	2 954	2 733	3 294
Russian Fed	41 568	45 811	40 026	49 489	40 506	33 580	35 674	32 728	41 428	59 309
Spain	24 382	26 558	18 930	22 139	14 020	16 735	18 678	16 512	13 952	21 417
Sweden	5 098	5 232	4 449	4 574	3 205	3 386	3 936	3 662	7 303	3 429
UK	198 953	200 405	183 021	174 730	126 603	103 027	133 700	124 927	171 984	160 428
27 Fishing area total	*660 188*	*684 829*	*600 489*	*587 074*	*447 608*	*420 877*	*474 600*	*547 506*	*631 822*	*831 892*
34 Russian Fed	-	-	-	-	-	-	-	-	-	76
34 Fishing area total	-	-	-	-	-	-	-	-	-	*76*
37 Algeria	1 167	567	3 403	1 688	817	791	932	3 108	761	435
Bulgaria	...	...	1	-	-	-	1	0	0	0
Croatia	...	...	...	...	...	...	...	...	15	15
France	1 342	1 198	864	989	933	1 314	1 659	696	413	365
Greece	155	315	318	398	310	766	550	327	292	292 F
Italy	...	...	...	...	2 737	2 127	1 556	1 251	1 222	1 390
Montenegro	...	...	...	...	...	10	11	12	10	12
Serbia-Monte	...	13	13	11	8	...	...	...	...	...
Slovenia	16	4	3	4	4	7	10	3	7	2
Spain	2 958	3 214	4 700	7 474	9 150	10 558	7 725	5 792	6 426	3 924
Syria	162	264	336	355	205	330	411	359	330	238
Turkey	550	486	350	568	781	783	1 076	516	505	226
37 Fishing area total	*6 350*	*6 061*	*9 988*	*11 487*	*14 945*	*16 686*	*13 931*	*12 064*	*9 981*	*6 899 F*
Species total	*703 375*	*761 353*	*689 606*	*706 091*	*560 046*	*548 167*	*567 489*	*611 006*	*707 178*	*887 314 F*
Blue mackerel	**Maquereau tacheté**		**Caballa pintoja**		***Scomber australasicus***				**1,75(01)002,07**	**MAA**
57 Indonesia	...	...	...	205	134	672	152	211	124	146
57 Fishing area total	*...*	*...*	*...*	*205*	*134*	*672*	*152*	*211*	*124*	*146*
71 Indonesia	...	...	...	9	45	657	445	244	275	447
71 Fishing area total	*...*	*...*	*...*	*9*	*45*	*657*	*445*	*244*	*275*	*447*
81 Korea Rep	-	-	-	-	-	-	-	6	-	-
New Zealand	9 761	13 287	10 347	11 150	7 224	15 432	7 685	6 633	10 087	8 026
Russian Fed	-	-	-	-	-	-	50	-	-	-
Ukraine	2 040	1 849	2 843	2 165	...	1 877	...	...	...	...
81 Fishing area total	*11 801*	*15 136*	*13 190*	*13 315*	*7 224*	*17 309*	*7 735*	*6 639*	*10 087*	*8 026*
Species total	*11 801*	*15 136*	*13 190*	*13 529*	*7 403*	*18 638*	*8 332*	*7 094*	*10 486*	*8 619*
Scomber mackerels nei	**Maquereaux scomber nca**		**Caballas scomber nep**		***Scomber spp***				**1,75(01)002,XX**	**MAZ**
37 Albania	11	11	20	51	38	47	84	84	92	80

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Croatia	490	420	738	598	721	1 551	1 127	14	-	-
Italy	6 033	5 041	4 115	3 052	-	-	-	-	-	-
Serbia-Monte	13	-	-	-	-	-	-	-	-	-
Syria	25	41	60	42	66	44	37	52	60	46
37 Fishing area total	*6 572*	*5 513*	*4 933*	*3 743*	*825*	*1 642*	*1 248*	*150*	*152*	*126*
Species total	*6 572*	*5 513*	*4 933*	*3 743*	*825*	*1 642*	*1 248*	*150*	*152*	*126*
Short mackerel	**Maquereau trapu**		**Caballa rechoncha**		***Rastrelliger brachysoma***				**1,75(01)014,01**	**RAB**
57 Indonesia	76 984	72 166	65 787	56 630	65 330	69 137	78 291	80 137	67 604	72 467
57 Fishing area total	*76 984*	*72 166*	*65 787*	*56 630*	*65 330*	*69 137*	*78 291*	*80 137*	*67 604*	*72 467*
71 Indonesia	137 403	149 468	128 640	145 252	156 702	185 823	181 167	169 301	193 229	203 643
Philippines	28 091	32 657	38 294	42 760	46 810	50 810	49 494	50 986	49 478	55 708
71 Fishing area total	*165 494*	*182 125*	*166 934*	*188 012*	*203 512*	*236 633*	*230 661*	*220 287*	*242 707*	*259 351*
Species total	*242 478*	*254 291*	*232 721*	*244 642*	*268 842*	*305 770*	*308 952*	*300 424*	*310 311*	*331 818*
Indian mackerel	**Maquereau des Indes**		**Caballa de la India**		***Rastrelliger kanagurta***				**1,75(01)014,03**	**RAG**
51 Egypt	1 442	2 782	2 269	1 899	1 467	1 139	878	1 080	1 383	1 492
Eritrea	100	13	5	8	4	269	...	...	...	1
India	32 410	38 041	28 380	36 242	39 233	33 047	64 996	33 421	44 967	34 107
Iran	893	1 484	2 311	2 930	2 240	2 077	2 250	1 008	1 539	1 116
Oman	3 223	3 459	4 107	5 783	7 776	4 364	6 995	9 016	10 986	10 092
Pakistan	...	...	...	34 552	28 129	38 504	37 079	37 165	34 906	23 015
Saudi Arabia	1 921	3 491	3 297	3 111	3 003	3 226	4 081	3 914	3 950	3 950
Seychelles	182	281	206	410	650	184	330	292	90	174
Tanzania	5 000	5 250	5 000	5 000	5 500	5 600	3 895	3 735	3 850	1 328
Untd Arab Em	2 000	2 104	2 930	3 100 F	3 221	2 350 F	1 480 F	607	569	1 505
Yemen	1 250 F	2 000 F	3 100 F	3 700 F	3 400 F	3 500 F	7 000 F	11 746	14 000 F	16 230 F
51 Fishing area total	*48 421 F*	*58 905 F*	*51 605 F*	*96 735 F*	*94 623 F*	*94 260 F*	*128 984 F*	*101 984*	*116 240 F*	*93 010 F*
57 India	13 748	14 819	13 602	24 711	21 279	21 384	25 348	29 460	32 499	30 130
Indonesia	...	...	...	922	843	1 418	1 012	1 106	3 209	2 817
Thailand	17 329	15 488	17 364	16 410	27 848	23 715	18 820	16 899	17 122	17 011
57 Fishing area total	*31 077*	*30 307*	*30 966*	*42 043*	*49 970*	*46 517*	*45 180*	*47 465*	*52 830*	*49 958*
71 Brunei Darsm	...	...	...	...	...	194	...	...	...	...
Fiji	722	400 F	95	179	200 F	236	185	150	130 F	100
Indonesia	...	...	...	9 635	9 230	11 822	12 033	15 743	15 356	14 982
Palau	0	0	0	0	0	...	...	...	...	...
Philippines	62 484	72 592	79 084	77 294	85 648	90 334	89 582	91 272	87 449	93 392
Thailand	14 620	17 273	16 826	18 479	17 857	16 758	13 584	15 214	12 304	13 759
71 Fishing area total	*77 826*	*90 265 F*	*96 005*	*105 587*	*112 935 F*	*119 344*	*115 384*	*122 379*	*115 239 F*	*122 233*
Species total	*157 324 F*	*179 477 F*	*178 576 F*	*244 365 F*	*257 528 F*	*260 121 F*	*289 548 F*	*271 828*	*284 309 F*	*265 201 F*
Indian mackerels nei	**Maquereaux indo-pacifique nca**		**Caballas del Indo-Pacífico nep**		***Rastrelliger spp***				**1,75(01)014,XX**	**RAX**
51 Comoros	220	220	230	250	230	230 F	250 F	250 F	250 F	250 F
Seychelles	83	62	15	51	33	70	71	85	219	29
51 Fishing area total	*303*	*282*	*245*	*301*	*263*	*300 F*	*321 F*	*335 F*	*469 F*	*279 F*
57 Malaysia	65 971	55 527	87 995	105 156	97 435	86 010	132 771	139 597	157 450	154 194
Thailand	34 625	30 780	43 744	38 328	49 548	47 114	41 171	27 297	33 823	30 560
57 Fishing area total	*100 596*	*86 307*	*131 739*	*143 484*	*146 983*	*133 124*	*173 942*	*166 894*	*191 273*	*184 754*
71 Malaysia	33 498	32 383	36 863	36 476	33 837	31 465	23 916	30 724	28 040	32 031
Singapore	68	35	27	44	31	21	40	25	46	58
Thailand	106 690	115 642	112 479	122 070	117 218	111 865	95 668	85 260	81 555	83 408
71 Fishing area total	*140 256*	*148 060*	*149 369*	*158 590*	*151 086*	*143 351*	*119 624*	*116 009*	*109 641*	*115 497*
Species total	*241 155*	*234 649*	*281 353*	*302 375*	*298 332*	*276 775 F*	*293 887 F*	*283 238 F*	*301 383 F*	*300 530 F*
Mackerels nei	**Maquereaux nca**		**Caballas nep**		***Scombridae***				**1,75(01)XXX,XX**	**MAX**
27 France	2 642	-	...	...	...	...	...	...	...	...
Spain	22 949	19 936	15 704	8 239	36 832	61 696	58 212	64 434	11 570	2 286
27 Fishing area total	*25 591*	*19 936*	*15 704*	*8 239*	*36 832*	*61 696*	*58 212*	*64 434*	*11 570*	*2 286*
31 Guadeloupe	1 600 F	1 600 F	1 600 F	1 600 F	1 600 F	1 600 F	1 600 F	1 600 F	1 600 F	1 600 F
31 Fishing area total	*1 600 F*	*1 600 F*	*1 600 F*	*1 600 F*	*1 600 F*	*1 600 F*	*1 600 F*	*1 600 F*	*1 600 F*	*1 600 F*
34 Gabon	201	267	197	95	112	69	67	62	42 F	42 F
Nigeria	3 759	3 500	4 403	2 695	2 529	3 506	2 840	3 173	3 043	2 918
UK	-	-	-	-	-	122	120	3 317	318	241
34 Fishing area total	*3 960*	*3 767*	*4 600*	*2 790*	*2 641*	*3 697*	*3 027*	*6 552*	*3 403 F*	*3 201 F*
37 France	7	-	-	-	-	-	-	-	-	-
Lebanon	350	350	300	300	320	322	322 F	322 F	322 F	322 F
Spain	-	-	-	1	1	2	167	143	212	44
37 Fishing area total	*357*	*350*	*300*	*301*	*321*	*324*	*489 F*	*465 F*	*534 F*	*366 F*
41 Brazil	...	...	...	...	...	...	...	1 835	2 023	1 911
Spain	-	-	-	1	-	-	0	-	-	0
41 Fishing area total	*...*	*...*	*...*	*1*	*...*	*...*	*0*	*1 835*	*2 023*	*1 911*

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
51 Mauritius	13	11	12	11	11	-	-	-	-	-
South Africa	0	-	-	-	-	-	-	-	-	-
51 Fishing area total	*13*	*11*	*12*	*11*	*11*	-	-	-	-	-
57 Australia	445	465	844	609	551	1 821	1 795	1 240	2 411	1 379
Sri Lanka	16 760	17 250	17 760	18 440	9 680	15 570	16 290	18 260	19 380	24 890
57 Fishing area total	*17 205*	*17 715*	*18 604*	*19 049*	*10 231*	*17 391*	*18 085*	*19 500*	*21 791*	*26 269*
71 Australia	2 286	1 750	3 380	2 716	2 604	2 353	2 317	2 071	2 267	2 378
NewCaledonia	30	33	51	35	42	91	67	88	106	44
71 Fishing area total	*2 316*	*1 783*	*3 431*	*2 751*	*2 646*	*2 444*	*2 384*	*2 159*	*2 373*	*2 422*
81 Australia	412	847	1 144	777	87	77	15	49	4	3
81 Fishing area total	*412*	*847*	*1 144*	*777*	*87*	*77*	*15*	*49*	*4*	*3*
Species total	*51 454 F*	*46 009 F*	*45 395 F*	*35 519 F*	*54 369 F*	*87 229 F*	*83 812 F*	*96 594 F*	*43 298 F*	*38 058 F*
Blue butterfish	**Fiatole**		**Palometa fiatola**		***Stromateus fiatola***				**1,76(03)004,01**	**BLB**
34 Congo Rep	1 F	40 F	104	86	99	169	101	...	196	300
Côte dIvoire	27	21	3	12	14	15	12	10 F	10	9
Liberia	183	190	190	573	138	159	-	-	-	-
Lithuania	-	4	24	2	-	3	4	-	-	1
Nigeria	4 106	1 000	4 057	4 100	7 767	7 134	7 249	7 191	6 033	5 987
Portugal	-	-	1	5	-	0	0	-	3	4
Senegal	57	190	43	...	...	73	-	-	-	-
Spain	58	50	53	90	51	19	6	9	9	23
Ukraine	-	11	5	4	-	-	1	-	4	-
34 Fishing area total	*4 432 F*	*1 506 F*	*4 480*	*4 872*	*8 069*	*7 572*	*7 373*	*7 210 F*	*6 255*	*6 324*
47 Portugal	-	70	27	2	158	230	131	6	36	-
Russian Fed	-	13	-	-	-	-	-	-	-	-
47 Fishing area total	*-*	*83*	*27*	*2*	*158*	*230*	*131*	*6*	*36*	*...*
Species total	*4 432 F*	*1 589 F*	*4 507*	*4 874*	*8 227*	*7 802*	*7 504*	*7 216 F*	*6 291*	*6 324*
Southwest Atlantic butterfish	**...B**		**Pampanito**		***Stromateus brasiliensis***				**1,76(03)004,05**	**TMB**
41 Argentina	...	...	...	...	...	1 035	1 162	1 171	2 480	2 489
41 Fishing area total	*...*	*...*	*...*	*...*	*...*	*1 035*	*1 162*	*1 171*	*2 480*	*2 489*
Species total	*...*	*...*	*...*	*...*	*...*	*1 035*	*1 162*	*1 171*	*2 480*	*2 489*
Silver pomfret	**Aileron argenté**		**Palometón platero**		***Pampus argenteus***				**1,76(03)009,01**	**SIP**
51 Iran	2 447	1 904	1 963	2 169	2 551	2 620	1 906	1 548	1 826	1 857
Kuwait	133	110 F	94	117	168	175	101	115	110 F	110 F
Saudi Arabia	21	22	5	5	5	2	3	8	9	10
51 Fishing area total	*2 601*	*2 036 F*	*2 062*	*2 291*	*2 724*	*2 797*	*2 010*	*1 671*	*1 945 F*	*1 977 F*
57 Indonesia	6 330	7 414	7 498	5 398	4 827	5 525	8 158	13 793	13 770	12 142
Malaysia	1 400	1 067	2 067	1 503	1 324	1 676	1 864	1 680	2 303	2 335
Thailand	135	97	386	409	879	911	586	685	802	744
57 Fishing area total	*7 865*	*8 578*	*9 951*	*7 310*	*7 030*	*8 112*	*10 608*	*16 158*	*16 875*	*15 221*
61 China,Taiwan	4 245	4 182	1 948	1 600	1 531	919	498	716	565	436
Korea Rep	-	2 247	3 718	1 888	-	-	-	-	-	-
61 Fishing area total	*4 245*	*6 429*	*5 666*	*3 488*	*1 531*	*919*	*498*	*716*	*565*	*436*
71 Indonesia	23 955	24 160	22 592	30 661	28 641	32 416	38 133	31 069	31 307	33 579
Malaysia	2 714	2 633	790	800	1 445	1 298	2 132	1 628	1 330	1 819
Thailand	299	621	955	596	542	670	2 587	457	476	467
71 Fishing area total	*26 968*	*27 414*	*24 337*	*32 057*	*30 628*	*34 384*	*42 852*	*33 154*	*33 113*	*35 865*
Species total	*41 679*	*44 457 F*	*42 016*	*45 146*	*41 913*	*46 212*	*55 968*	*51 699*	*52 498 F*	*53 499 F*
Silver pomfrets nei	**Ailerons nca**		**Palometones nep**		***Pampus spp***				**1,76(03)009,XX**	**XPO**
61 China	300 728 F	328 670 F	315 314 F	328 102 F	349 793 F	335 639 F	342 747	372 042	373 145	364 776
61 Fishing area total	*300 728 F*	*328 670 F*	*315 314 F*	*328 102 F*	*349 793 F*	*335 639 F*	*342 747*	*372 042*	*373 145*	*364 776*
Species total	*300 728 F*	*328 670 F*	*315 314 F*	*328 102 F*	*349 793 F*	*335 639 F*	*342 747*	*372 042*	*373 145*	*364 776*
American harvestfish	**Stromaté lune**		**Palometa pámpano**		***Peprilus paru***				**1,76(03)011,02**	**ERP**
21 USA	18	22	20	21	20	18	15	47	78	32
21 Fishing area total	*18*	*22*	*20*	*21*	*20*	*18*	*15*	*47*	*78*	*32*
31 Suriname	...	...	55	66	76	...	...	...	...	...
31 Fishing area total	*...*	*...*	*55*	*66*	*76*	*...*	*...*	*...*	*...*	*...*
41 Argentina	137	67	149	118	423	709	1 210	1 202	1 364	1 463
41 Fishing area total	*137*	*67*	*149*	*118*	*423*	*709*	*1 210*	*1 202*	*1 364*	*1 463*
Species total	*155*	*89*	*224*	*205*	*519*	*727*	*1 225*	*1 249*	*1 442*	*1 495*
Atlantic butterfish	**Stromaté fossette**		**Palometa pintada**		***Peprilus triacanthus***				**1,76(03)011,04**	**BUT**
21 Spain	-	-	-	-	-	-	-	0	-	-

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
21 Fishing area total	-	-	-	-	-	-	-	*0*	-	-
Species total	-	-	-	-	-	-	-	*0*	-	-
Gulf butterfishes, etc. nei	**Stromatés du Golfe, etc. nca**		**Pámpanos del Golfo, etc. nep**		***Peprilus spp***				**1,76(03)011,XX**	**BTG**
31 Venezuela	742	872	1 281	2 020 F	1 080 F	640 F	780 F	1 440	1 390 F	1 390 F
31 Fishing area total	*742*	*872*	*1 281*	*2 020 F*	*1 080 F*	*640 F*	*780 F*	*1 440*	*1 390 F*	*1 390 F*
Species total	*742*	*872*	*1 281*	*2 020 F*	*1 080 F*	*640 F*	*780 F*	*1 440*	*1 390 F*	*1 390 F*
Butterfishes, pomfrets nei	**Stromatés, ailerons nca**		**Pámpanos, palometónes nep**		***Stromateidae***				**1,76(03)XXX,XX**	**BUX**
21 USA	4 416	889	537	521	451	572	708	575	446	588
21 Fishing area total	*4 416*	*889*	*537*	*521*	*451*	*572*	*708*	*575*	*446*	*588*
27 Portugal	74	61	69	80	39	47	84	68	70	-
Russian Fed	-	-	-	-	-	-	-	17	-	-
Spain	7	-	-	34	8	15	31	24	2	11
27 Fishing area total	*81*	*61*	*69*	*114*	*47*	*62*	*115*	*109*	*72*	*11*
31 USA	539	613	740	561	232	567	833	638	751	156
31 Fishing area total	*539*	*613*	*740*	*561*	*232*	*567*	*833*	*638*	*751*	*156*
41 Falkland Is	-	-	-	4	20	2	2	3	79	19
Portugal	20	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	1	5	100	35	16
UK	-	-	-	-	-	-	-	-	2	-
41 Fishing area total	*20*	-	-	*4*	*20*	*3*	*7*	*103*	*116*	*35*
51 India	9 112	19 009	11 850	9 461	24 280	18 388	22 280	22 763	24 295	21 422
Kuwait	...	70 F	43	122	86	114	41	27	35 F	35 F
Pakistan	3 454	3 500	4 531	4 800	3 928	3 958	3 796	3 805	3 471	1 742
Spain	-	24	-	-	-	-	-	-	-	-
51 Fishing area total	*12 566*	*22 603 F*	*16 424*	*14 383*	*28 294*	*22 460*	*26 117*	*26 595*	*27 801 F*	*23 199 F*
57 India	15 545	16 526	15 819	21 507	15 170	16 020	24 945	22 807	19 912	18 081
Malaysia	109	118	387	856	936	1 073	1 060	1 199	1 769	1 538
57 Fishing area total	*15 654*	*16 644*	*16 206*	*22 363*	*16 106*	*17 093*	*26 005*	*24 006*	*21 681*	*19 619*
61 China,H.Kong	2 100 F	2 050 F	1 900 F	2 000 F	1 930 F	1 860 F	1 850 F	1 900 F	1 910 F	2 020 F
China,Taiwan	146	210	167	471	301	163	130	100	61	157
Korea Rep	6 819	6 191	7 496	9 286	11 448	13 873	9 489	8 121	5 929	8 871
61 Fishing area total	*9 065 F*	*8 451 F*	*9 563 F*	*11 757 F*	*13 679 F*	*15 896 F*	*11 469 F*	*10 121 F*	*7 900 F*	*11 048 F*
71 Malaysia	268	370	0	277	222	1 135	75	739	1 502	1 512
Philippines	1 759	1 485	1 403	1 212	1 094	1 190	1 313	1 595	1 502	2 035
Singapore	48	44	39	46	40	94	180	82	90	72
71 Fishing area total	*2 075*	*1 899*	*1 442*	*1 535*	*1 356*	*2 419*	*1 568*	*2 416*	*3 094*	*3 619*
77 USA	7	23	11	6	3	4	5	2	1	2
77 Fishing area total	*7*	*23*	*11*	*6*	*3*	*4*	*5*	*2*	*1*	*2*
81 Japan	1 839	1 491	1 768	-	-	-	-	-	-	-
81 Fishing area total	*1 839*	*1 491*	*1 768*	-	-	-	-	-	-	-
87 Chile	11	141	1 579	1 653	5 261	7 520	3 010	4 887	3 325	2 061
Ecuador	...	...	...	...	...	3 451	52	63	12 633	2 774
87 Fishing area total	*11*	*141*	*1 579*	*1 653*	*5 261*	*10 971*	*3 062*	*4 950*	*15 958*	*4 835*
Species total	*46 273 F*	*52 815 F*	*48 339 F*	*52 897 F*	*65 449 F*	*70 047 F*	*69 889 F*	*69 515 F*	*77 820 F*	*63 112 F*
European barracuda	**Bécune européenne**		**Espetón**		***Sphyraena sphyraena***				**1,77(10)001,01**	**YRS**
37 France	-	-	-	-	-	-	-	-	2	2
Italy	...	...	...	...	57	398	275	265	367	281
Malta	-	-	-	-	-	-	9	9	6	15
Spain	130	160	138	161	169	174	179	162	146	142
37 Fishing area total	*130*	*160*	*138*	*161*	*226*	*572*	*463*	*436*	*521*	*440*
Species total	*130*	*160*	*138*	*161*	*226*	*572*	*463*	*436*	*521*	*440*
Pickhandle barracuda	**Bécune jello**		**Picuda serpentina**		***Sphyraena jello***				**1,77(10)001,03**	**BAC**
51 Saudi Arabia	416	75	35	54	55	82	91	76	68	68
51 Fishing area total	*416*	*75*	*35*	*54*	*55*	*82*	*91*	*76*	*68*	*68*
57 Indonesia	...	...	...	...	...	4	14	0	0	94
57 Fishing area total	*...*	*...*	*...*	*...*	*...*	*4*	*14*	*0*	*0*	*94*
71 Indonesia	...	...	...	61	44	32	20	28	591	700
71 Fishing area total	*...*	*...*	*...*	*61*	*44*	*32*	*20*	*28*	*591*	*700*
Species total	*416*	*75*	*35*	*115*	*99*	*118*	*125*	*104*	*659*	*862*
Obtuse barracuda	**Bécune obtuse**		**Picuda obtusa**		***Sphyraena obtusata***				**1,77(10)001,04**	**YRB**
51 Saudi Arabia	29	71	102	97	59	73	137	168	192	142
51 Fishing area total	*29*	*71*	*102*	*97*	*59*	*73*	*137*	*168*	*192*	*142*

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Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*29*	*71*	*102*	*97*	*59*	*73*	*137*	*168*	*192*	*142*
Great barracuda	**Barracuda**		**Picuda barracuda**		***Sphyraena barracuda***				**1,77(10)001,07**	**GBA**
51 Saudi Arabia	642	744	384	798	1 011	1 526	1 195	1 077	1 546	1 262
51 Fishing area total	*642*	*744*	*384*	*798*	*1 011*	*1 526*	*1 195*	*1 077*	*1 546*	*1 262*
57 Indonesia	7 740	7 665	4 965	1 079	1 622	1 407	2 952	4 294	4 989	2 579
57 Fishing area total	*7 740*	*7 665*	*4 965*	*1 079*	*1 622*	*1 407*	*2 952*	*4 294*	*4 989*	*2 579*
71 Indonesia	11 330	9 110	6 124	3 265	3 498	9 159	4 883	8 249	7 418	5 061
71 Fishing area total	*11 330*	*9 110*	*6 124*	*3 265*	*3 498*	*9 159*	*4 883*	*8 249*	*7 418*	*5 061*
Species total	*19 712*	*17 519*	*11 473*	*5 142*	*6 131*	*12 092*	*9 030*	*13 620*	*13 953*	*8 902*
Mexican barracuda	**Bécune mexicaine**		**Picuda picúa**		***Sphyraena ensis***				**1,77(10)001,08**	**YRE**
87 Ecuador	...	...	...	...	...	29	44	451	44	...
87 Fishing area total	*...*	*...*	*...*	*...*	*...*	*29*	*44*	*451*	*44*	*...*
Species total	*...*	*...*	*...*	*...*	*...*	*29*	*44*	*451*	*44*	*...*
Barracudas nei	**Bécunes nca**		**Picudas nep**		***Sphyraena spp***				**1,77(10)001,XX**	**BAR**
27 France	-	-	-	-	-	-	-	-	5	3
Portugal	33	37	51	38	41	42	41	49	59	63
Spain	-	-	-	3	2	1	1	1	3	10
27 Fishing area total	*33*	*37*	*51*	*41*	*43*	*43*	*42*	*50*	*67*	*76*
31 Antigua Barb	6	8	26	33	13	12	20	23	8	6
Bermuda	6	4	5	5	6	8	9	8	8	9
Dominican Rp	7	195	159	...	...	56	...	63	57	61
Grenada	43	52	58	39	46	54	45	68	71	71
Mexico	708	532	531	474	675	705	562	339	455	305
Puerto Rico	13	13	9	5	5	4	2	1	2	2
St Vincent	...	...	...	...	...	...	...	...	8	5
Suriname	...	...	285	364	260	...	...	...	...	...
USA	55	51	52	50	43	42	50	41	56	57
US Virgin Is	...	...	13	11	7	7	6	7	5	3
Venezuela	1 165	1 311	1 321	2 090 F	1 120 F	660 F	810 F	1 181	1 140 F	1 140 F
31 Fishing area total	*2 003*	*2 166*	*2 459*	*3 071 F*	*2 175 F*	*1 548 F*	*1 504 F*	*1 731*	*1 810 F*	*1 659 F*
34 Belize	-	-	-	...	45	133	-	201	...	...
Benin	262	365	409	412	338	326	261	172	271	268
Cameroon	293	340	583	580 F	580	580	580	580 F	586 F	586 F
Congo Rep	40 F	150 F	260	207	185	408	533	179	207	902
Côte dIvoire	75	218	97	249	293	285	313	310 F	305	489
Gabon	1 636	1 379	1 536	1 601	1 004	599	542	392	270 F	270 F
Gambia	631	2 573	1 012	153	464	438	762	334	358	358
Ghana	1 156	1 193	1 242	3 541	3 185	5 146	55	101	717	8 385
Guinea	1 043	577	...	...	1 200	553	...	453	440 F	440 F
Liberia	272	302	384	432	372	419	356	126	130 F	130 F
Lithuania	-	40	4	7	1	2	-	-	-	2
Nigeria	10 947	11 085	10 944	9 254	9 813	11 156	12 103	11 629	13 415	15 475
Panama	76	12	-	...	354	275	71	-	...	...
Portugal	9	2	2	2	1	3	10	3	3	2
Russian Fed	-	2	8	-	-	-	-	-	-	-
Sao Tome Prn	60 F	70 F	80	47	50 F	50 F	50 F	50 F	50 F	50 F
Senegal	1 519	1 483	2 003	1 325	1 546	1 110	1 266	2 012	1 211	2 056
Sierra Leone	2 757	2 063	1 207	3 161	2 466	1 817	1 702	2 971	2 900 F	2 900 F
Spain	37	9	4	3	16	33	31	36	40	44
Togo	54	76	64	174	317	595	724	1 200 F	1 668	983
Ukraine	-	9	-	-	-	-	-	-	-	-
34 Fishing area total	*20 867 F*	*21 948 F*	*19 839*	*21 148 F*	*22 230 F*	*23 928 F*	*19 359 F*	*20 749 F*	*22 571 F*	*33 340 F*
37 Albania	...	...	...	2	4	7	...	...	...	7
Algeria	392	447	721	618	546	398	302	301	251	300
Croatia	-	-	-	-	-	-	-	-	-	1
Cyprus	-	-	5	2	2	2	9	2	2	2
Egypt	1 085	995	889	763	994	782	671	529	919	615
Israel	55	54	77	184	162	130	185	140 F	104	36
Lebanon	250	200	250	250	240	240	240 F	240 F	240 F	240 F
Libya	...	...	...	...	...	...	...	...	531	510 F
Palest, O.T.	55 F	52	21	60	22	27	26	53	20	55
Syria	77	60	91	120	142	90	118	108	115	77
Tunisia	96	122	157	113	110	69	84	130	129	160
Turkey	130	206	250	255	281	234	417	218	178	459
37 Fishing area total	*2 140 F*	*2 136*	*2 461*	*2 367*	*2 503*	*1 979*	*2 052 F*	*1 721 F*	*2 489 F*	*2 462 F*
41 Brazil	338	371	389	396	419	346	375	373	412	389
Estonia	-	1	-	-	-	-	-	-	-	-
41 Fishing area total	*338*	*372*	*389*	*396*	*419*	*346*	*375*	*373*	*412*	*389*
47 Angola	...	...	...	...	...	...	16	3	32	30 F
Russian Fed	1	3	-	-	-	-	-	-	-	-
47 Fishing area total	*1*	*3*	*...*	*...*	*...*	*...*	*16*	*3*	*32*	*30 F*
51 Bahrain	7	6	11	52	116	69	57	180	63	49

B-37

Miscellaneous pelagic fishes
Poissons pélagiques divers
Peces pelágicos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Djibouti	95 F	115 F	130 F	145 F	163	148	116	170	120	120 F
Egypt	485	260	288	319	275	438	881	485	650	873
Eritrea	2	455	1 845	411	208	602	94	58	78	69
India	148	3 306	2 054	1 662	1 724	1 760	1 925	2 546	2 663	5 045
Iran	2 253	2 919	3 905	5 023	5 654	5 308	5 186	7 829	5 750	6 587
Kenya	99	88	158	125	171	246	248	325	292	281
Oman	1 781	3 215	2 366	1 914	3 033	2 410	2 370	3 659	3 951	5 724
Pakistan	3 889	3 900	3 869	3 586	3 464	3 979	4 951	5 001	7 235	6 030
Qatar	86	91	131	102	257	220	322	496	752	694
Réunion	5	7	7	7	5	4	1	0	0	0
Russian Fed	-	-	36	-	-	-	-	-	-	-
Saudi Arabia	406	438	1 057	484	591	585	611	603	600	600
Seychelles	253	300	231	190	189	210	188	200	91	55
Spain	-	-	-	-	-	-	-	-	1	-
Tanzania	25	25	25	50	52	1 373	1 037	1 057	890	1 451
Untd Arab Em	625	487	626	670 F	720	1 100 F	1 500 F	1 905	1 981	2 737
Yemen	2 900 F	4 500 F	6 800 F	7 300 F	6 750 F	6 900 F	5 000 F	2 850 F	3 400 F	3 940 F
Zanzibar	685	672	649	813	659	543	1 254	1 296	1 329	1 344
51 Fishing area total	*13 744 F*	*20 784 F*	*24 188 F*	*22 853 F*	*24 031 F*	*25 895 F*	*25 741 F*	*28 660 F*	*29 846 F*	*35 599 F*
57 India	4 717	4 767	5 256	5 959	3 961	4 438	1 907	22 893	8 958	7 717
Malaysia	554	716	669	720	883	938	1 263	1 183	1 578	1 590
Thailand	8 202	9 767	6 526	7 196	4 880	4 906	3 716	5 536	4 574	5 055
57 Fishing area total	*13 473*	*15 250*	*12 451*	*13 875*	*9 724*	*10 282*	*6 886*	*29 612*	*15 110*	*14 362*
61 China,Taiwan	439	311	464	548	562	656	580	333	495	431
61 Fishing area total	*439*	*311*	*464*	*548*	*562*	*656*	*580*	*333*	*495*	*431*
71 Fiji	2 809	1 500 F	168	357	415 F	474	350	500	480	400
Guam	4	2	1	2	1	4	4	0	4	1
Kiribati	732	1 360	1 291	1 100 F	900 F	700 F	456	96	13	11 F
Malaysia	6 057	5 247	4 939	5 470	5 259	5 673	5 592	6 797	6 407	6 081
Palau	0	0	0	0	0	0	0	-	-	-
Philippines	9 128	9 720	9 990	8 613	6 978	7 537	7 946	7 956	10 261	10 083
Singapore	86	65	59	55	52	68	74	26	45	35
Thailand	7 625	8 451	10 072	7 115	10 373	7 600	8 033	6 393	6 158	6 276
71 Fishing area total	*26 441*	*26 345 F*	*26 520*	*22 712 F*	*23 978 F*	*22 056 F*	*22 455*	*21 768*	*23 368*	*22 887 F*
77 Amer Samoa	0	1	1	1	0	1	1	1	2	0
Fr Polynesia	...	...	...	...	13	15	13	7	13	20
Mexico	224	415	298	300	463	484	370	310	367	289
USA	72	48	48	45	51	40	52	25	57	32
77 Fishing area total	*296*	*464*	*347*	*346*	*527*	*540*	*436*	*343*	*439*	*341*
81 Korea Rep	512	585	-	312	373	-	-	-	-	-
81 Fishing area total	*512*	*585*	-	*312*	*373*	-	-	-	-	-
Species total	*80 287 F*	*90 401 F*	*89 169 F*	*87 669 F*	*86 565 F*	*87 273 F*	*79 446 F*	*105 343 F*	*96 639 F*	*111 576 F*
Ocean sunfish	**Poisson lune**		**Pez luna**		***Mola mola***				**1,90(08)002,01**	**MOX**
27 France	-	-	-	-	-	-	-	-	-	4
Ireland	13	-	-	-	-	-	-	-	-	-
Portugal	-	-	0	0	-	1	0	1	1	-
27 Fishing area total	*13*	-	*0*	*0*	-	*1*	*0*	*1*	*1*	*4*
41 Argentina	-	-	-	-	-	-	0	5	5	22
41 Fishing area total	-	-	-	-	-	-	*0*	*5*	*5*	*22*
47 Namibia	2	1	3	20	6	40	3	...	...	...
47 Fishing area total	*2*	*1*	*3*	*20*	*6*	*40*	*3*	...	...	...
Species total	*15*	*1*	*3*	*20*	*6*	*41*	*3*	*6*	*6*	*26*
Pelagic percomorphs nei	**Percomorphes pélagiques nca**		**Percomorfos pelágicos nep**		***Perciformes***				**1,99(XX)XXX,XX**	**PPX**
31 Venezuela	109	74	1 502	2 370 F	1 270 F	750 F	920 F	1 030 F	1 000 F	1 000 F
31 Fishing area total	*109*	*74*	*1 502*	*2 370 F*	*1 270 F*	*750 F*	*920 F*	*1 030 F*	*1 000 F*	*1 000 F*
34 Cape Verde	3 583	3 450	3 604	3 734	4 072	4 296	4 759	4 454	4 107	4 100 F
Eq Guinea	20 F	30 F	40 F	50 F	60 F	85 F	80	100	300	36
Spain	2	-	-	-	-	-	-	-	-	-
34 Fishing area total	*3 605 F*	*3 480 F*	*3 644 F*	*3 784 F*	*4 132 F*	*4 381 F*	*4 839*	*4 554*	*4 407*	*4 136 F*
41 Uruguay	-	-	15	-	1	0	0	0	-	-
41 Fishing area total	-	-	*15*	-	*1*	*0*	*0*	*0*	-	-
51 Kenya	1 003	982	793	897	875	792	937	1 011	243	914
Oman	3 391	5 467	4 974	4 393	3 383	4 796	4 182	4 417	2 681	1 398
Yemen	60 000 F	83 000 F	113 000 F	115 000 F	102 000 F	101 500 F	63 000 F	34 000 F	40 400 F	46 900 F
51 Fishing area total	*64 394 F*	*89 449 F*	*118 767 F*	*120 290 F*	*106 258 F*	*107 088 F*	*68 119 F*	*39 428 F*	*43 324 F*	*49 212 F*
87 Peru	371	684	503	-	-	-	-	-	-	-
87 Fishing area total	*371*	*684*	*503*	-	-	-	-	-	-	-
Species total	*68 479 F*	*93 687 F*	*124 431 F*	*126 444 F*	*111 661 F*	*112 219 F*	*73 878 F*	*45 012 F*	*48 731 F*	*54 348 F*
Group total	***12 205 570***	***11 591 999***	***11 432 859***	***11 195 063***	***11 223 756***	***10 856 612***	***10 970 875***	***10 588 197***	***10 133 512***	***10 020 718***

B-38

Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Bluntnose sixgill shark	**Requin griset**		**Cañabota gris**		***Hexanchus griseus***				**1,05(02)002,01**	**SBL**
21 Spain	-	-	-	-	4	-	-	1	-	-
21 Fishing area total	-	-	-	-	*4*	-	-	*1*	-	-
27 France	...	...	...	...	2	1	1	0	8	-
Portugal	1	7	2	30	12	15	5	-	1	1
27 Fishing area total	*1*	*7*	*2*	*30*	*14*	*16*	*6*	*0*	*9*	*1*
34 Portugal	-	-	-	-	-	-	0	1	-	-
34 Fishing area total	-	-	-	-	-	-	*0*	*1*	-	-
37 Malta	...	...	...	...	...	...	...	...	0	4
37 Fishing area total	...	...	...	...	...	...	...	...	*0*	*4*
41 Argentina	...	...	...	...	...	...	...	...	21	8
41 Fishing area total	...	...	...	...	...	...	...	...	*21*	*8*
47 Portugal	-	-	-	-	1	-	-	-	-	-
47 Fishing area total	-	-	-	-	*1*	-	-	-	-	-
51 France	-	-	-	-	-	-	-	-	3	3
51 Fishing area total	-	-	-	-	-	-	-	-	*3*	*3*
Species total	*1*	*7*	*2*	*30*	*19*	*16*	*6*	*2*	*33*	*16*
Sharpnose sevengill shark	**Requin perlon**		**Cañabota bocadulce**		***Heptranchias perlo***				**1,05(02)003,01**	**HXT**
37 Malta	...	...	...	...	...	...	...	2	2	2
37 Fishing area total	...	...	...	...	...	...	...	*2*	*2*	*2*
Species total	...	...	...	...	...	...	...	*2*	*2*	*2*
Broadnose sevengill shark	**Platnez**		**Cañabota gata**		***Notorynchus cepedianus***				**1,05(02)005,02**	**NTC**
41 Argentina	-	-	-	-	-	-	-	6	3	1
41 Fishing area total	-	-	-	-	-	-	-	*6*	*3*	*1*
47 South Africa	-	-	-	-	-	-	4	12	12	10
47 Fishing area total	-	-	-	-	-	-	*4*	*12*	*12*	*10*
81 New Zealand	5	4	5	2	2	2	7	5	12	14
81 Fishing area total	*5*	*4*	*5*	*2*	*2*	*2*	*7*	*5*	*12*	*14*
Species total	*5*	*4*	*5*	*2*	*2*	*2*	*11*	*23*	*27*	*25*
Basking shark	**Pèlerin**		**Peregrino**		***Cetorhinus maximus***				**1,06(01)003,01**	**BSK**
27 France	-	-	-	-	2	1	0	0	6	-
Norway	200	54	128	72	87	6	26	4	-	-
Portugal	3	1	1	27	5	0	13	2	-	-
27 Fishing area total	*203*	*55*	*129*	*99*	*94*	*7*	*39*	*6*	*6*	-
34 Spain	-	-	-	-	-	3	-	-	-	-
34 Fishing area total	-	-	-	-	-	*3*	-	-	-	-
37 Spain	-	4	10	5	4	4	6	1	-	-
37 Fishing area total	-	*4*	*10*	*5*	*4*	*4*	*6*	*1*	-	-
81 New Zealand	84	40	139	26	62	1	7	5	1	0
Ukraine	-	-	36	-	-	-	-	-	-	-
81 Fishing area total	*84*	*40*	*175*	*26*	*62*	*1*	*7*	*5*	*1*	*0*
Species total	*287*	*99*	*314*	*130*	*160*	*15*	*52*	*12*	*7*	*0*
Sand tiger shark	**Requin taureau**		**Toro bacota**		***Carcharias taurus***				**1,06(02)005,01**	**CCT**
21 USA	-	-	-	1	1	1	-	-	15	-
21 Fishing area total	-	-	-	*1*	*1*	*1*	-	-	*15*	-
41 Argentina	...	...	...	...	...	...	...	...	5	1
Uruguay	8	8	3	3	4	0	0	0	-	-
41 Fishing area total	*8*	*8*	*3*	*3*	*4*	*0*	*0*	*0*	*5*	*1*
Species total	*8*	*8*	*3*	*4*	*5*	*1*	*0*	*0*	*20*	*1*
Crocodile shark	**Requin crocodile**		**Tiburón cocodrilo**		***Pseudocarcharias kamoharai***				**1,06(04)036,01**	**PSK**
34 Portugal	-	-	-	-	-	-	14	-	-	-
34 Fishing area total	-	-	-	-	-	-	*14*	-	-	-
Species total	-	-	-	-	-	-	*14*	-	-	-
Thresher	**Renard**		**Zorro**		***Alopias vulpinus***				**1,06(06)006,01**	**ALV**
21 Spain	-	-	-	-	1	2	-	1	-	-
USA	11	11	10	4	2	10	20	12	9	17
21 Fishing area total	*11*	*11*	*10*	*4*	*3*	*12*	*20*	*13*	*9*	*17*

B-38

Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
27 France	113	11	11	13	18	23	31	1	35	24
Portugal	27	21	17	33	80	106	93	62	64	15
Spain	...	...	...	84	54	59	54	39	37	0
27 Fishing area total	*140*	*32*	*28*	*130*	*152*	*188*	*178*	*102*	*136*	*39*
34 Korea Rep	-	-	-	-	-	-	-	-	-	24
Portugal	7	1	0	0	5	2	3	-	6	-
Spain	...	...	1	5	10	5	6	9	2	0
34 Fishing area total	*7*	*1*	*1*	*5*	*15*	*7*	*9*	*9*	*8*	*24*
37 France	19	13	17	10	12	10	6	10	8	2
Italy	...	...	...	...	...	...	8	6	14	4
Portugal	2	1	-	1	-	-	-	-	-	-
Spain	...	...	...	3	3	4	2	4	3	0
37 Fishing area total	*21*	*14*	*17*	*14*	*15*	*14*	*16*	*20*	*25*	*6*
41 Portugal	3	-	-	-	-	-	-	-	-	5
Uruguay	...	...	45	9	20	4	1	3	...	...
41 Fishing area total	*3*	*...*	*45*	*9*	*20*	*4*	*1*	*3*	*...*	*5*
47 South Africa	2	...	...	...	4	1	3	5	2	3
47 Fishing area total	*2*	*...*	*...*	*...*	*4*	*1*	*3*	*5*	*2*	*3*
51 France	-	-	-	-	-	-	-	-	1	-
Portugal	-	-	-	-	-	1	1	-	-	-
51 Fishing area total	-	-	-	-	-	*1*	*1*	-	*1*	-
57 Portugal	-	-	-	-	-	-	1	-	-	-
57 Fishing area total	-	-	-	-	-	-	*1*	-	-	-
67 USA	76	73	28	5	1	1	1	0	-	0
67 Fishing area total	*76*	*73*	*28*	*5*	*1*	*1*	*1*	*0*	-	*0*
77 USA	299	242	267	111	179	159	200	144	105	94
77 Fishing area total	*299*	*242*	*267*	*111*	*179*	*159*	*200*	*144*	*105*	*94*
81 New Zealand	57	53	69	40	33	25	35	32	25	19
Ukraine	-	1	2	1	...	-	-	-	-	-
81 Fishing area total	*57*	*54*	*71*	*41*	*33*	*25*	*35*	*32*	*25*	*19*
87 Spain	...	...	1	2	-	3	-	-	-	-
87 Fishing area total	*...*	*...*	*1*	*2*	-	*3*	-	-	-	-
Species total	*616*	*427*	*468*	*321*	*422*	*415*	*465*	*328*	*311*	*207*

Pelagic thresher **Renard pélagique** **Zorro pelágico** ***Alopias pelagicus*** **1,06(06)006,02** **PTH**

87 Ecuador	...	...	...	...	...	280	2 556	4 583	...	...
87 Fishing area total	*...*	*...*	*...*	*...*	*...*	*280*	*2 556*	*4 583*	*...*	*...*
Species total	*...*	*...*	*...*	*...*	*...*	*280*	*2 556*	*4 583*	*...*	*...*

Bigeye thresher **Renard à gros yeux** **Zorro ojón** ***Alopias superciliosus*** **1,06(06)006,03** **BTH**

27 Portugal	-	-	-	-	-	-	0	1	-	-
Spain	...	...	...	74	51	1	16	18	62	...
27 Fishing area total	*...*	*...*	*...*	*74*	*51*	*1*	*16*	*19*	*62*	*...*
31 Mexico	...	...	...	...	119	124	52	4	4	4
31 Fishing area total	*...*	*...*	*...*	*...*	*119*	*124*	*52*	*4*	*4*	*4*
34 Portugal	-	-	-	-	-	-	3	-	-	-
Spain	...	...	0	2	7	4	1	6	11	0
34 Fishing area total	*...*	*...*	*0*	*2*	*7*	*4*	*4*	*6*	*11*	*0*
37 Spain	...	-	-	-	-	-	-	-	1	-
37 Fishing area total	*...*	-	-	-	-	-	-	-	*1*	-
41 Brazil	47	72	111	83	113	83	69	85	17	22
Portugal	-	-	-	-	1	-	1	-	-	-
41 Fishing area total	*47*	*72*	*111*	*83*	*114*	*83*	*70*	*85*	*17*	*22*
47 Portugal	-	-	-	-	-	-	-	2	-	-
47 Fishing area total	-	-	-	-	-	-	-	*2*	-	-
77 USA	2	-	5	5	10	4	5	6	7	1
77 Fishing area total	*2*	-	*5*	*5*	*10*	*4*	*5*	*6*	*7*	*1*
81 New Zealand	-	-	-	-	-	-	1	-	0	0
81 Fishing area total	-	-	-	-	-	-	*1*	-	*0*	*0*
87 Ecuador	...	...	...	...	...	7	94	105	...	...
Portugal	-	-	-	-	-	-	1	-	-	-
Spain	-	-	-	-	-	-	-	-	2	-
87 Fishing area total	*...*	*...*	*...*	*...*	*...*	*7*	*95*	*105*	*2*	*...*
Species total	*49*	*72*	*116*	*164*	*301*	*223*	*243*	*227*	*104*	*27*

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Thresher sharks nei	**Renards de mer nca**		**Zorros nep**		***Alopias spp***				**1,06(06)006,XX**	**THR**
21 USA	-	-	-	10	6	2	2	1	3	4
21 Fishing area total	-	-	-	*10*	*6*	*2*	*2*	*1*	*3*	*4*
27 Spain	-	-	-	-	-	-	-	8	4	0
UK	-	-	-	-	-	-	-	1	1	2
27 Fishing area total	-	-	-	-	-	-	-	*9*	*5*	*2*
31 Trinidad Tob	...	10	5	3	2	1	1	1	0	1
31 Fishing area total	...	*10*	*5*	*3*	*2*	*1*	*1*	*1*	*0*	*1*
34 Spain	...	...	...	1	0	0	-	-	-	-
34 Fishing area total	...	...	...	*1*	*0*	*0*	-	-	-	-
47 Namibia	...	2	...	18	17	6	25	3	20	9
47 Fishing area total	...	*2*	...	*18*	*17*	*6*	*25*	*3*	*20*	*9*
57 Indonesia	...	...	...	...	5 795	773	1 785	6 752	2 526	2 833
57 Fishing area total	...	...	...	...	*5 795*	*773*	*1 785*	*6 752*	*2 526*	*2 833*
71 Indonesia	...	...	...	...	7 479	13 701	11 982	2 633	5 684	10 057
71 Fishing area total	...	...	...	...	*7 479*	*13 701*	*11 982*	*2 633*	*5 684*	*10 057*
77 USA	-	37	44	47	29	33	45	41	28	18
77 Fishing area total	-	*37*	*44*	*47*	*29*	*33*	*45*	*41*	*28*	*18*
87 Ecuador	599	454	714	487	675	893	304	-	1 766	3 358
87 Fishing area total	*599*	*454*	*714*	*487*	*675*	*893*	*304*	-	*1 766*	*3 358*
Species total	*599*	*503*	*763*	*566*	*14 003*	*15 409*	*14 144*	*9 440*	*10 032*	*16 282*
Shortfin mako	**Taupe bleue**		**Marrajo dientuso**		***Isurus oxyrinchus***				**1,06(08)002,01**	**SMA**
21 Canada	69	78	73	80	92	70	73	43	53	50
Portugal	-	-	9	-	1	0	30	5	19	28
St Pier Mq	-	-	-	-	-	-	1	2	-	4
Spain	-	-	-	-	212	212	...	503	...	507
USA	19	20	16	33	14	10	52	24	31	53
21 Fishing area total	*88*	*98*	*98*	*113*	*319*	*292*	*156*	*577*	*103*	*642*
27 Portugal	186	107	541	328	603	729	1 407	1 063	974	937
Spain	637	876	1 205	2 632	1 017	1 098	1 281	714	1 338	390
UK	2	1	1	1	0	-	-	1	2	-
27 Fishing area total	*825*	*984*	*1 747*	*2 961*	*1 620*	*1 827*	*2 688*	*1 778*	*2 314*	*1 327*
31 Belize	-	-	-	-	-	-	-	-	23	28
Mexico	16	...	10	6	9	5	8	6	7	8
Philippines	-	-	-	-	-	-	-	1	-	-
Portugal	-	-	-	-	-	-	0	1	3	2
Spain	...	134	63	-	94	105	127	79	213	278
Trinidad Tob	1	2	3	1	2	1	1	1	1	1
USA	5	-	-	5	-	-	-	-	-	-
Venezuela	...	...	...	58	20	6	11	2	35	22
31 Fishing area total	*22*	*136*	*76*	*70*	*125*	*117*	*147*	*90*	*282*	*339*
34 Benin	1	...	...	...	1	...	...	...	...	...
China	22	208	260	...	...	...	99	16	25	41
Côte dIvoire	15	15	30	15	14	22	25	25	25	27
Panama	-	-	-	-	-	0	49	42	39	...
Portugal	42	68	151	42	216	225	169	178	196	344
Senegal	-	-	-	-	-	-	8	17	21	...
Spain	1 048	1 036	800	771	428	503	407	597	663	794
Togo	...	...	...	...	...	...	...	...	...	5
UK	-	-	-	-	-	5	-	-	11	-
Vanuatu	-	-	-	52	12	63	1	-	-	-
34 Fishing area total	*1 128*	*1 327*	*1 241*	*880*	*671*	*818*	*758*	*875*	*980*	*1 211*
37 Libya	...	...	...	...	...	...	...	...	27	25 F
Portugal	6	-	0	31	15	5	-	-	-	-
Spain	2	2	2	2	2	4	1	2	2	8
37 Fishing area total	*8*	*2*	*2*	*33*	*17*	*9*	*1*	*2*	*29*	*33 F*
41 Belize	-	-	-	-	38	...	17	2	-	31
Brazil	410	226	285	239	426	210	157	202	97	128
China	...	...	...	...	...	...	30	5	14	20
Philippines	-	-	-	-	-	-	-	1	-	-
Portugal	26	22	39	3	110	84	239	300	373	308
Spain	461	381	561	441	308	416	307	369	488	114
UK	...	...	...	...	...	...	...	51	-	-
Uruguay	70	58	188	249	185	77	38	41	106	23
41 Fishing area total	*967*	*687*	*1 073*	*932*	*1 067*	*787*	*788*	*971*	*1 078*	*624*
47 China	-	-	-	-	-	-	28	-	4	1
Namibia	...	1 587	1 998	509	1 415	1 243	1 002	295	120	306
Portugal	158	0	256	4	128	407	212	65	99	73
South Africa	79	24	138	658	687	451	546	45	489	542
Spain	774	429	598	262	276	249	347	259	450	1 192
UK	-	-	-	-	-	5	...	16	-	-
47 Fishing area total	*1 011*	*2 040*	*2 990*	*1 433*	*2 506*	*2 355*	*2 135*	*680*	*1 162*	*2 114*

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
51 China	-	-	-	-	-	-	31	63	50	46
France	-	-	-	-	-	-	-	-	9	14
Portugal	95	66	152	65	102	229	135	20	44	117
South Africa	...	7	9	1	2	2	2	3	2	4
Spain	-	308	26	5	13	130	165	45	65	59
UK	-	-	-	...	...	...	...	91	17	11
Uruguay	-	-	-	-	-	15	-	-	-	-
51 Fishing area total	*95*	*381*	*187*	*71*	*117*	*376*	*333*	*222*	*187*	*251*
57 China	-	-	-	-	-	-	3	2	25	77
Portugal	-	-	-	-	-	6	41	15	2	5
UK	-	-	-	-	-	31	-	-	-	-
57 Fishing area total	-	-	-	-	-	*37*	*44*	*17*	*27*	*82*
67 USA	0	0	0	0	-	-	-	0	0	-
67 Fishing area total	*0*	*0*	*0*	*0*	-	-	-	*0*	*0*	-
71 China	-	-	-	-	-	-	-	260	364	62
NewCaledonia	...	...	38	34	26	14	13	13	10	10
71 Fishing area total	*...*	*...*	*38*	*34*	*26*	*14*	*13*	*273*	*374*	*72*
77 China	-	-	-	-	-	-	-	117	100	105
Costa Rica	10	13	10	6	19	20 F	22	20 F	20 F	20 F
Fr Polynesia	53	41	38 F	36	26	27	18	10	12	21
USA	46	81	68	53	33	46	44	35	29	21
77 Fishing area total	*109*	*135*	*116 F*	*95*	*78*	*93 F*	*84*	*182 F*	*161 F*	*167 F*
81 China	-	-	-	-	-	-	-	-	-	13
New Zealand	327	238	204	107	119	84	79	73	85	65
Spain	-	-	-	3	-	-	103	-	56	0
Ukraine	-	1	-	-	-	-	-	-	-	-
81 Fishing area total	*327*	*239*	*204*	*110*	*119*	*84*	*182*	*73*	*141*	*78*
87 Chile	964	425	426	439	519	509	405	225	312	367
China	-	-	-	-	-	-	-	7	3	3
Ecuador	47	55	48	61	12	57	48	77	25	72
Portugal	-	-	-	-	-	-	104	-	-	17
Spain	...	1 006	...	29	-	13	57	10	118	113
Uruguay	-	-	-	27	22	-	-	-	-	-
87 Fishing area total	*1 011*	*1 486*	*474*	*556*	*553*	*579*	*614*	*319*	*458*	*572*
Species total	*5 591*	*7 515*	*8 246 F*	*7 288*	*7 218*	*7 388 F*	*7 943*	*6 059 F*	*7 296 F*	*7 512 F*

Longfin mako	**Petite taupe**		**Marrajo carite**		***Isurus paucus***			**1,06(08)002,03**		**LMA**
21 Spain	-	-	-	-	2	1	-	1	-	-
USA	0	1	0	1	0	1	1	1	16	0
21 Fishing area total	*0*	*1*	*0*	*1*	*2*	*2*	*1*	*2*	*16*	*0*
31 Trinidad Tob	...	2	1	0	0	1	1	1	0	1
USA	3	-	-	-	-	-	-	-	-	-
31 Fishing area total	*3*	*2*	*1*	*0*	*0*	*1*	*1*	*1*	*0*	*1*
34 Portugal	...	...	-	-	-	-	-	-	-	1
34 Fishing area total	*...*	*...*	-	-	-	-	-	-	-	*1*
Species total	*3*	*3*	*1*	*1*	*2*	*3*	*2*	*3*	*16*	*2*

Mako sharks	**Taupes**		**Marrajos**		***Isurus spp***			**1,06(08)002,XX**		**MAK**
21 Spain	-	-	-	-	-	2	-	-	-	-
USA	47	37	21	33	31	40	33	36	10	0
21 Fishing area total	*47*	*37*	*21*	*33*	*31*	*42*	*33*	*36*	*10*	*0*
31 Trinidad Tob	-	-	-	-	-	-	-	0	1	1
31 Fishing area total	-	-	-	-	-	-	-	*0*	*1*	*1*
34 UK	-	-	-	-	...	...	-	13	13	-
34 Fishing area total	-	-	-	-	*...*	*...*	-	*13*	*13*	-
47 UK	-	-	-	-	-	-	-	-	11	-
47 Fishing area total	-	-	-	-	-	-	-	-	*11*	-
77 USA	-	80	86	57	92	90	120	113	106	84
77 Fishing area total	-	*80*	*86*	*57*	*92*	*90*	*120*	*113*	*106*	*84*
Species total	*47*	*117*	*107*	*90*	*123*	*132*	*153*	*162*	*141*	*85*

Porbeagle	**Requin-taupe commun**		**Marrajo sardinero**		***Lamna nasus***			**1,06(08)003,01**		**POR**
21 Canada	499	238	143	232	203	192	94	125	63	83
Portugal	-	8	-	-	-	-	-	-	-	-
St Pier Mq	2	1	2	0	-	-	-	1	...	...
USA	1	1	1	4	2	2	2	3	2	2
21 Fishing area total	*502*	*248*	*146*	*236*	*205*	*194*	*96*	*129*	*65*	*85*
27 Channel Is	2	2	2	1	1	1	1	1	0	0
Denmark	76	42	22	20	4	4	3	2	4	-

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Faroe Is	8	10	14	5	18	21	14	10	13	14
France	368	463	434	410	276	213	356	239	305	9
Germany	1	3	5	4	5	-	2	2	-	-
Iceland	3	2	1	2	-	1	-	1	1	1
Ireland	6	3	13	19	3	4	8	7	3	0
Norway	16	19	19	21	12	27	10	12	10	12
Portugal	2	-	0	50	4	0	-	-	-	-
Spain	3	5	2	5	7	9	6	143	73	60
Sweden	1	0	-	5	0	-	-	0	-	-
UK	10	7	25	24	24	13	26	14	11	-
27 Fishing area total	*496*	*556*	*537*	*566*	*354*	*293*	*426*	*431*	*420*	*96*
31 Spain	...	...	...	...	...	...	...	...	13	-
31 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*13*	*-*
34 Portugal	3	8	4	3	5	6	2	1	17	-
Spain	22	49	24	6	7	25	2	118	151	8
34 Fishing area total	*25*	*57*	*28*	*9*	*12*	*31*	*4*	*119*	*168*	*8*
37 Albania	...	...	...	1	2	4	...	...	...	...
Italy	...	...	...	2	1	1	...	2	0	0
Malta	1	0	0	0	1	...	0	0	1	0
Spain	1	-	1	0	0	0	0	-	-	0
37 Fishing area total	*2*	*0*	*1*	*3*	*4*	*5*	*0*	*2*	*1*	*0*
41 Argentina	...	...	...	...	...	...	...	...	1	0
Portugal	...	...	...	4	1	-	-	-	-	-
Spain	0	1	0	0	0	3	5	3	-	-
Uruguay	1	8	34	8	28	34	3	40	14	6
41 Fishing area total	*1*	*9*	*34*	*12*	*29*	*37*	*8*	*43*	*15*	*6*
47 Spain	1	1	9	3	0	0	0	4	2	1
47 Fishing area total	*1*	*1*	*9*	*3*	*0*	*0*	*0*	*4*	*2*	*1*
48 UK	-	-	-	-	-	-	-	1	-	-
48 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*1*	*-*	*-*
51 Portugal	...	...	...	6	-	-	-	-	-	-
Spain	1	-	-	25	-	-	9	-	-	-
51 Fishing area total	*1*	*...*	*...*	*31*	*-*	*-*	*9*	*-*	*-*	*-*
58 Australia	-	-	-	-	-	-	-	-	-	1
58 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*1*
81 New Zealand	127	130	102	65	58	49	52	42	63	56
Ukraine	-	8	6	3	...	-	-	-	-	-
81 Fishing area total	*127*	*138*	*108*	*68*	*58*	*49*	*52*	*42*	*63*	*56*
87 Spain	...	65	67	57	26	2	18	47	-	-
87 Fishing area total	*...*	*65*	*67*	*57*	*26*	*2*	*18*	*47*	*-*	*-*
Species total	*1 155*	*1 074*	*930*	*985*	*688*	*611*	*613*	*818*	*747*	*253*
Great white shark	**Grand requin blanc**		**Jaquetón blanco**		***Carcharodon carcharias***				**1,06(08)007,01**	**WSH**
21 USA	0	-	-	0	0	0	-	0	-	-
21 Fishing area total	*0*	*-*	*-*	*0*	*0*	*0*	*-*	*0*	*-*	*-*
34 Portugal	-	-	-	-	7	-	-	-	-	-
Senegal	...	...	...	...	...	...	...	...	...	18
34 Fishing area total	*...*	*...*	*...*	*...*	*7*	*...*	*...*	*...*	*...*	*18*
41 Portugal	-	-	-	-	1	-	-	-	-	-
41 Fishing area total	*-*	*-*	*-*	*-*	*1*	*-*	*-*	*-*	*-*	*-*
77 USA	0	-	-	0	0	0	0	0	1	1
77 Fishing area total	*0*	*-*	*-*	*0*	*0*	*0*	*0*	*0*	*1*	*1*
81 New Zealand	0	0	4	-	-	-	-	-	-	-
81 Fishing area total	*0*	*0*	*4*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
Species total	*0*	*0*	*4*	*0*	*8*	*0*	*0*	*0*	*1*	*19*
Mackerel sharks,porbeagles nei	**Requins taupe nca**		**Jaquetones,marrajos nep**		***Lamnidae***				**1,06(08)XXX,XX**	**MSK**
57 Indonesia	...	...	...	250	272	259	296	90	444	537
57 Fishing area total	*...*	*...*	*...*	*250*	*272*	*259*	*296*	*90*	*444*	*537*
71 Indonesia	...	...	...	...	...	1 104	201	371	386	196
71 Fishing area total	*...*	*...*	*...*	*...*	*...*	*1 104*	*201*	*371*	*386*	*196*
Species total	*...*	*...*	*...*	*250*	*272*	*1 363*	*497*	*461*	*830*	*733*
Nurse shark	**Requin-nourrice**		**Gata nodriza**		***Ginglymostoma cirratum***				**1,07(03)009,01**	**GNC**
21 USA	-	0	-	-	-	-	-	-	-	-
21 Fishing area total	*-*	*0*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
31 Dominican Rp	89	24	113	79	43	...	612	146	131	141

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Mexico	...	...	...	...	17	18	30	21	21	25
St Lucia	-	-	1	1	-	3	2	1	1	2
Trinidad Tob	0	...	1	1	2	0	1	0	2	2
31 Fishing area total	*89*	*24*	*115*	*81*	*62*	*21*	*645*	*168*	*155*	*170*
34 Mauritania	...	...	...	...	...	...	...	...	...	18
34 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*18*
77 Nicaragua	...	...	...	...	...	1	...	...	...	...
77 Fishing area total	*...*	*...*	*...*	*...*	*...*	*1*	*...*	*...*	*...*	*...*
Species total	*89*	*24*	*115*	*81*	*62*	*22*	*645*	*168*	*155*	*188*
Blackmouth catshark	**Chien espagnol**		**Pintarroja bocanegra**		***Galeus melastomus***				**1,08(01)001,04**	**SHO**
27 France	...	...	...	...	1	1	2	2	5	1
Ireland	...	...	5	8	6	7	3	2	3	3
Norway	-	-	-	-	-	-	-	-	-	13
Portugal	34	50	30	64	50	31	20	12	16	4
Spain	...	230	183	86	118	189	133	129	71	0
27 Fishing area total	*34*	*280*	*218*	*158*	*175*	*228*	*158*	*145*	*95*	*21*
34 Portugal	-	-	-	-	-	-	5	3	2	-
34 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*5*	*3*	*2*	*-*
37 Spain	...	58	49	90	52	55	77	81	109	117
37 Fishing area total	*...*	*58*	*49*	*90*	*52*	*55*	*77*	*81*	*109*	*117*
Species total	*34*	*338*	*267*	*248*	*227*	*283*	*240*	*229*	*206*	*138*
Mouse catshark	**Chien islandais**		**Pintarroja islándica**		***Galeus murinus***				**1,08(01)001,06**	**GAM**
27 France	-	-	-	-	-	-	-	-	7	5
Spain	-	-	-	-	-	5	...	...	...	...
27 Fishing area total	*-*	*-*	*-*	*-*	*-*	*5*	*...*	*...*	*7*	*5*
Species total	*-*	*-*	*-*	*-*	*-*	*5*	*...*	*...*	*7*	*5*
Small-spotted catshark	**Petite roussette**		**Pintarroja**		***Scyliorhinus canicula***				**1,08(01)003,01**	**SYC**
27 Channel Is	-	-	-	-	-	12	...	...	0	-
France	6 253	5 714	5 477	5 574	5 791	5 465	5 713	5 108	5 351	5 533
Ireland	633	564	297	133	121	40	130	256	211	297
Netherlands	-	-	-	-	-	-	-	-	-	2
Spain	...	6	9	69	90	112	136	128	186	245
UK	155	162	102	102	218	143	218	285	343	256
27 Fishing area total	*7 041*	*6 446*	*5 885*	*5 878*	*6 220*	*5 772*	*6 197*	*5 777*	*6 091*	*6 333*
37 France	31	33	32	37	28	21	29	28	32	39
Italy	...	...	...	...	...	...	212	...	...	90
Malta	-	-	-	-	-	-	-	-	1	1
37 Fishing area total	*31*	*33*	*32*	*37*	*28*	*21*	*241*	*28*	*33*	*130*
Species total	*7 072*	*6 479*	*5 917*	*5 915*	*6 248*	*5 793*	*6 438*	*5 805*	*6 124*	*6 463*
Nursehound	**Grande roussette**		**Alitán**		***Scyliorhinus stellaris***				**1,08(01)003,02**	**SYT**
27 France	180	168	171	178	196	158	182	81	258	261
Portugal	...	...	33	30	210	420	444	431	454	447
UK	84	39	62	0	9	-	-	-	-	-
27 Fishing area total	*264*	*207*	*266*	*208*	*415*	*578*	*626*	*512*	*712*	*708*
34 Portugal	-	-	-	-	-	-	-	1	1	1
34 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*1*	*1*	*1*
Species total	*264*	*207*	*266*	*208*	*415*	*578*	*626*	*513*	*713*	*709*
Catsharks, nursehounds nei	**Roussettes nca**		**Alitanes, pintarrojas nep**		***Scyliorhinus spp***				**1,08(01)003,XX**	**SCL**
27 France	7	15	21	49	65	104	144	144	404	446
Spain	-	-	-	678	502	147	140	90	99	93
UK	-	-	-	41	66	-	-	-	-	-
27 Fishing area total	*7*	*15*	*21*	*768*	*633*	*251*	*284*	*234*	*503*	*539*
37 Albania	...	...	...	1	2	4	...	...	...	...
Algeria	...	...	...	...	...	...	49	139	197	113
Croatia	...	...	...	...	...	...	...	...	8	12
Malta	-	-	-	-	-	-	3	3	1	1
Montenegro	...	...	...	...	...	2	4	10	5	7
Serbia-Monte	...	2	2	1	1	...	...	...	...	...
Spain	379	185	274	316	240	261	260	265	287	264
Tunisia	122	139	140	117	103	145	124	217	237	280
37 Fishing area total	*501*	*326*	*416*	*435*	*346*	*412*	*440*	*634*	*735*	*677*
Species total	*508*	*341*	*437*	*1 203*	*979*	*663*	*724*	*868*	*1 238*	*1 216*
Dusky catshark	**Holbiche sombre**		**Pejegato oscuro**		***Halaelurus canescens***				**1,08(01)030,04**	**HAN**
48 UK	-	0	-	-	-	-	-	-	-	-

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
48 Fishing area total	-	*0*	-	-	-	-	-	-	-	-
Species total	-	*0*	-	-	-	-	-	-	-	-
Draughtsboard shark	**Holbiche damier**		**Pejegato ajedrezado**		***Cephaloscyllium isabellum***				**1,08(01)034,02**	**CPS**
81 New Zealand	5	31	46	40	47	50	47	36	48	64
81 Fishing area total	*5*	*31*	*46*	*40*	*47*	*50*	*47*	*36*	*48*	*64*
Species total	*5*	*31*	*46*	*40*	*47*	*50*	*47*	*36*	*48*	*64*
Catsharks, etc. nei	**Chiens,holbiches,rousset. nca**		**Alitanes,pejegatos,pintar. nep**		***Scyliorhinidae***				**1,08(01)XXX,XX**	**SYX**
27 Spain	-	-	-	-	-	-	372	481	464	399
UK	-	-	-	10	4	3	11	2	9	3
27 Fishing area total	-	-	-	*10*	*4*	*3*	*383*	*483*	*473*	*402*
47 Portugal	-	-	-	-	-	-	-	-	11	-
47 Fishing area total	-	-	-	-	-	-	-	-	*11*	-
Species total	-	-	-	*10*	*4*	*3*	*383*	*483*	*484*	*402*
Blue shark	**Peau bleue**		**Tiburón azul**		***Prionace glauca***				**1,08(02)004,01**	**BSH**
21 Canada	581	836	346	965	1 134	977	843	...	...	...
Portugal	-	-	48	-	-	11	71	70	70	-
St Pier Mq	-	-	-	-	-	-	-	-	1	-
Spain	-	-	-	-	1 150	1 387	...	2 214	...	7 604
21 Fishing area total	*581*	*836*	*394*	*965*	*2 284*	*2 375*	*914*	*2 284*	*71*	*7 604*
27 Channel Is	-	-	-	1	-	-	-	1	0	-
China	-	-	-	-	-	-	-	-	-	2
Denmark	1	13	6	1	0	1	1	-	-	-
France	205	112	134	103	120	134	167	109	118	122
Ireland	66	11	2	0	0	-	0	0	0	0
Netherlands	-	-	-	-	-	-	1	-	1	-
Portugal	1 006	1 209	2 169	1 514	1 990	2 627	3 283	2 746	3 433	3 615
Spain	9 404	8 507	8 185	7 359	5 408	6 069	10 684	13 100	12 422	6 038
UK	9	6	4	6	5	3	6	5	5	8
27 Fishing area total	*10 691*	*9 858*	*10 500*	*8 984*	*7 523*	*8 834*	*14 142*	*15 961*	*15 979*	*9 785*
31 Belize	-	-	-	-	-	-	-	-	114	461
China	-	-	-	-	-	-	-	1	1	-
Portugal	-	8	-	-	3	1	2	32	33	59
Spain	...	...	...	...	1 310	1 972	2 034	842	2 140	4 898
Trinidad Tob	...	6	3	2	1	1	0	2	8	9
Venezuela	...	...	...	9	26	10	18	7	71	74
31 Fishing area total	*...*	*14*	*3*	*11*	*1 340*	*1 984*	*2 054*	*884*	*2 367*	*5 501*
34 Benin	...	...	9	7	6	6	5	...	...	...
China	750	420	600	...	...	...	472	111	105	61
Ghana	...	...	...	...	...	...	...	21	...	...
Liberia	...	...	...	25	...	...	...	...	...	...
Panama	-	-	-	-	-	254	891	1 134	1 574	...
Portugal	557	668	1 292	661	1 440	1 754	2 212	3 479	4 075	4 659
Russian Fed	-	-	-	-	1	-	-	-	-	-
Senegal	...	456	...	...	...	...	43	134	255	56
Spain	7 958	7 159	7 789	9 955	7 138	6 036	4 320	4 625	9 903	21 945
UK	-	-	-	-	...	239	-	62	91	-
34 Fishing area total	*9 265*	*8 703*	*9 690*	*10 648*	*8 585*	*8 289*	*7 943*	*9 566*	*16 003*	*26 721*
37 France	2	0	-	-	1	0	-	-	-	1
Italy	...	...	...	113	1	95	46	75	176	165
Malta	-	-	-	-	1	-	2	2	2	1
Portugal	40	14	3	128	56	22	-	-	-	2
Spain	6	3	3	4	8	61	3	9	7	39
37 Fishing area total	*48*	*17*	*6*	*245*	*67*	*178*	*51*	*86*	*185*	*208*
41 Belize	-	-	-	37	259	...	236	109	-	273
Brazil	2 173	1 971	2 168	1 669	2 523	2 591	2 318	1 986	1 274	1 500
China	-	-	-	-	-	-	278	34	86	30
Portugal	988	1 015	199	910	1 907	1 100	2 781	4 118	2 657	4 025
Spain	3 448	2 140	2 875	4 283	2 983	4 579	4 310	5 157	6 273	8 397
UK	...	...	...	...	...	...	...	168	-	-
Uruguay	66	159	480	462	376	232	337	359	942	208
41 Fishing area total	*6 675*	*5 285*	*5 722*	*7 361*	*8 048*	*8 502*	*10 260*	*11 931*	*11 232*	*14 433*
47 China	-	-	-	-	-	-	202	3	5	1
Namibia	...	794	117	1 906	2 757	4 410	3 948	1 829	1 359	2 352
Portugal	949	513	616	864	1 192	1 600	2 069	1 001	1 333	1 184
South Africa	83	73	232	159	207	112	190	131	250	287
Spain	4 295	3 228	3 751	3 084	3 427	4 145	4 632	4 459	6 826	5 210
UK	-	-	-	-	-	515	474	132	14	-
47 Fishing area total	*5 327*	*4 608*	*4 716*	*6 013*	*7 583*	*10 782*	*11 515*	*7 555*	*9 787*	*9 034*
51 China	-	-	-	-	-	-	104	333	227	72
France	-	-	-	-	-	-	-	-	1	1
Portugal	1 123	1 148	1 281	1 046	1 725	2 283	1 043	329	365	646
South Africa	...	21	33	10	5	5	9	9	7	12

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Spain	-	2 135	2 189	1 801	1 527	1 283	1 967	624	1 090	1 518
UK	-	-	-	-	-	136	63	461	423	170
Uruguay	-	-	-	-	-	32	-	-	-	-
51 Fishing area total	*1 123*	*3 304*	*3 503*	*2 857*	*3 257*	*3 739*	*3 186*	*1 756*	*2 113*	*2 419*
57 China	-	-	-	-	-	-	8	8	14	30
Portugal	-	-	-	30	59	18	433	85	10	16
Spain	-	-	1 699	2 269	596	649	305	411	32	72
UK	-	-	-	-	-	375	-	-	-	-
57 Fishing area total	-	-	*1 699*	*2 299*	*655*	*1 042*	*746*	*504*	*56*	*118*
67 USA	2	0	1	1	1	0	1	0	0	0
67 Fishing area total	*2*	*0*	*1*	*1*	*1*	*0*	*1*	*0*	*0*	*0*
71 China	-	-	-	-	-	-	-	1 039	410	432
71 Fishing area total	-	-	-	-	-	-	-	*1 039*	*410*	*432*
77 China	-	-	-	-	-	-	-	462	713	172
Mexico	...	...	...	...	1 121	1 170	2 073	3 531	3 427	4 356
USA	0	1	0	0	-	-	9	0	1	0
77 Fishing area total	*0*	*1*	*0*	*0*	*1 121*	*1 170*	*2 082*	*3 993*	*4 141*	*4 528*
81 China	-	-	-	-	-	-	-	-	-	38
New Zealand	1 328	1 186	844	651	833	619	806	712	799	688
Spain	-	-	-	372	112	516	1 684	428	630	775
81 Fishing area total	*1 328*	*1 186*	*844*	*1 023*	*945*	*1 135*	*2 490*	*1 140*	*1 429*	*1 501*
87 Chile	445	605	448	420	387	468	474	197	268	850
China	-	-	-	-	-	-	-	27	14	8
Ecuador	...	...	...	...	...	496	646	832	...	...
Portugal	-	-	-	-	-	-	140	-	-	45
Spain	11	1 886	1 270	1 560	1 058	1 081	601	456	1 160	1 491
Uruguay	-	-	-	80	85	-	-	-	-	-
87 Fishing area total	*456*	*2 491*	*1 718*	*2 060*	*1 530*	*2 045*	*1 861*	*1 512*	*1 442*	*2 394*
Species total	*35 496*	*36 303*	*38 796*	*42 467*	*42 939*	*50 075*	*57 245*	*58 211*	*65 215*	*84 678*

Sandbar shark	**Requin gris**		**Tiburón trozo**		***Carcharhinus plumbeus***				**1,08(02)010,01**	**CCP**
21 USA	24	28	21	34	58	102	142	31	0	0
21 Fishing area total	*24*	*28*	*21*	*34*	*58*	*102*	*142*	*31*	*0*	*0*
Species total	*24*	*28*	*21*	*34*	*58*	*102*	*142*	*31*	*0*	*0*

Blacktip shark	**Requin bordé**		**Tiburón macuira**		***Carcharhinus limbatus***				**1,08(02)010,03**	**CCL**
21 USA	1	11	4	33	11	37	11	31	1	16
21 Fishing area total	*1*	*11*	*4*	*33*	*11*	*37*	*11*	*31*	*1*	*16*
31 Guyana	14	86	20	7	547	15	...	...	...	...
Nicaragua	...	...	...	...	...	123	...	...	...	...
St Lucia	-	-	2	2	-	-	0	16	3	2
Trinidad Tob	10	...	17	9	12	11	20	16	3	1
USA	520	-	-	420	-	-	-	-	-	-
31 Fishing area total	*544*	*86*	*39*	*438*	*559*	*149*	*20*	*32*	*6*	*3*
34 Panama	-	-	-	-	-	8	10	13	17	...
34 Fishing area total	-	-	-	-	-	*8*	*10*	*13*	*17*	...
Species total	*545*	*97*	*43*	*471*	*570*	*194*	*41*	*76*	*24*	*19*

Oceanic whitetip shark	**Requin océanique**		**Tiburón oceánico**		***Carcharhinus longimanus***				**1,08(02)010,11**	**OCS**
41 Brazil	534	203	174	187	78	76	14	240	...	...
Portugal	-	-	-	-	-	-	0	2	-	-
41 Fishing area total	*534*	*203*	*174*	*187*	*78*	*76*	*14*	*242*	...	...
51 China	-	-	-	-	-	-	-	-	49	56
51 Fishing area total	-	-	-	-	-	-	-	-	*49*	*56*
57 China	-	-	-	-	-	-	-	-	7	104
57 Fishing area total	-	-	-	-	-	-	-	-	*7*	*104*
71 China	-	-	-	-	-	-	-	-	578	401
71 Fishing area total	-	-	-	-	-	-	-	-	*578*	*401*
77 China	-	-	-	-	-	-	-	-	177	148
77 Fishing area total	-	-	-	-	-	-	-	-	*177*	*148*
81 China	-	-	-	-	-	-	-	-	-	7
81 Fishing area total	-	-	-	-	-	-	-	-	-	*7*
87 China	-	-	-	-	-	-	-	-	7	2
87 Fishing area total	-	-	-	-	-	-	-	-	*7*	*2*
Species total	*534*	*203*	*174*	*187*	*78*	*76*	*14*	*242*	*818*	*718*

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Smalltail shark	**Requin tiqueue**		**Tiburón poroso**		***Carcharhinus porosus***				**1,08(02)010,12**	**CCR**
31 Guyana	114	306	...	...	130	10	...	...	...	...
31 Fishing area total	*114*	*306*	*...*	*...*	*130*	*10*	*...*	*...*	*...*	*...*
Species total	*114*	*306*	*...*	*...*	*130*	*10*	*...*	*...*	*...*	*...*
Dusky shark	**Requin de sable**		**Tiburón arenero**		***Carcharhinus obscurus***				**1,08(02)010,16**	**DUS**
21 USA	0	3	10	0	0	0	0	-	0	-
21 Fishing area total	*0*	*3*	*10*	*0*	*0*	*0*	*0*	-	*0*	-
Species total	*0*	*3*	*10*	*0*	*0*	*0*	*0*	*...*	*0*	*...*
Silky shark	**Requin soyeux**		**Tiburón jaquetón**		***Carcharhinus falciformis***				**1,08(02)010,17**	**FAL**
21 USA	-	-	-	0	0	0	2	-	0	-
21 Fishing area total	-	-	-	*0*	*0*	*0*	*2*	-	*0*	-
31 Costa Rica	59	39	27	30	28	25 F	21	20 F	20 F	20 F
Spain	-	17	0	-	4	1	1	0	-	2
31 Fishing area total	*59*	*56*	*27*	*30*	*32*	*26 F*	*22*	*20 F*	*20 F*	*22 F*
34 Liberia	...	...	...	40	...	...	...	...	...	...
Portugal	-	-	-	-	1	2	6	-	6	-
Spain	...	14	4	16	23	23	38	21	23	95
Togo	...	...	...	...	...	...	...	...	...	5
34 Fishing area total	*...*	*14*	*4*	*56*	*24*	*25*	*44*	*21*	*29*	*100*
41 Brazil	...	328	307	286	20	0	...	-	-	...
Portugal	-	-	-	-	-	-	1	2	4	1
41 Fishing area total	*...*	*328*	*307*	*286*	*20*	*0*	*1*	*2*	*4*	*1*
51 Portugal	-	-	-	-	-	2	2	-	44	34
51 Fishing area total	-	-	-	-	-	*2*	*2*	-	*44*	*34*
57 Sri Lanka	8 240	6 830	3 650	3 140	2 340	1 960	980	520	530	670
57 Fishing area total	*8 240*	*6 830*	*3 650*	*3 140*	*2 340*	*1 960*	*980*	*520*	*530*	*670*
77 Costa Rica	1 031	1 484	1 287	846	838	950 F	1 049	1 050 F	1 050 F	1 050 F
Guatemala	...	...	...	...	...	...	11	...	...	...
Spain	-	-	-	-	-	-	-	-	1	-
77 Fishing area total	*1 031*	*1 484*	*1 287*	*846*	*838*	*950 F*	*1 060*	*1 050 F*	*1 051 F*	*1 050 F*
87 Ecuador	...	...	...	...	...	...	373	500	...	...
87 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*373*	*500*	*...*	*...*
Species total	*9 330*	*8 712*	*5 275*	*4 358*	*3 254*	*2 963 F*	*2 484*	*2 113 F*	*1 678 F*	*1 877 F*
Bull shark	**Requin bouledogue**		**Tiburón sarda**		***Carcharhinus leucas***				**1,08(02)010,18**	**CCE**
21 USA	-	-	-	0	0	-	1	-	-	1
21 Fishing area total	-	-	-	*0*	*0*	-	*1*	-	-	*1*
31 Trinidad Tob	-	-	-	-	1	...	0	10	0	-
31 Fishing area total	-	-	-	-	*1*	*...*	*0*	*10*	*0*	-
Species total	-	-	-	*0*	*1*	*...*	*1*	*10*	*0*	*1*
Copper shark	**Requin cuivre**		**Tiburón cobrizo**		***Carcharhinus brachyurus***				**1,08(02)010,20**	**BRO**
41 Argentina	-	-	-	-	-	-	0	1	8	1
41 Fishing area total	-	-	-	-	-	-	*0*	*1*	*8*	*1*
47 South Africa	1	-	-	-	1	2	20	29	64	88
47 Fishing area total	*1*	-	-	-	*1*	*2*	*20*	*29*	*64*	*88*
81 New Zealand	38	38	27	25	16	14	16	11	14	12
81 Fishing area total	*38*	*38*	*27*	*25*	*16*	*14*	*16*	*11*	*14*	*12*
Species total	*39*	*38*	*27*	*25*	*17*	*16*	*36*	*41*	*86*	*101*
Finetooth shark	**Requin à petits dents**		**Tiburón dentiliso**		***Carcharhinus isodon***				**1,08(02)010,25**	**CCO**
21 USA	-	-	-	-	-	-	-	-	-	24
21 Fishing area total	-	-	-	-	-	-	-	-	-	*24*
Species total	-	-	-	-	-	-	-	-	-	*24*
Spot-tail shark	**Requin à queue tachetée**		**Tiburón rabo manchado**		***Carcharhinus sorrah***				**1,08(02)010,31**	**CCQ**
51 Iran	8 976	8 071	11 689	13 298	14 086	13 516	11 821	10 451	10 122	9 698
51 Fishing area total	*8 976*	*8 071*	*11 689*	*13 298*	*14 086*	*13 516*	*11 821*	*10 451*	*10 122*	*9 698*
Species total	*8 976*	*8 071*	*11 689*	*13 298*	*14 086*	*13 516*	*11 821*	*10 451*	*10 122*	*9 698*
Tiger shark	**Requin tigre commun**		**Tintorera tigre**		***Galeocerdo cuvier***				**1,08(02)017,03**	**TIG**
21 USA	1	0	0	-	0	1	0	-	0	-
21 Fishing area total	*1*	*0*	*0*	-	*0*	*1*	*0*	-	*0*	-

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Sharks, rays, chimaeras
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Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
27 Netherlands	-	13	48	48	64	54	38	32	39	-
Spain	-	-	-	2	4	5	3	2	-	0
27 Fishing area total	*-*	*13*	*48*	*50*	*68*	*59*	*41*	*34*	*39*	*0*
31 Bermuda	...	...	...	...	...	1	1	2	0	2
Mexico	...	...	...	...	18	19	5	12	12	8
St Lucia	-	-	0	10	-	1	0	2	2	1
Trinidad Tob	1	...	0	0	1	2	2	1	0	0
31 Fishing area total	*1*	*...*	*0*	*10*	*19*	*23*	*8*	*17*	*14*	*11*
41 Brazil	-	-	-	0	0	3	6	7	10	10
41 Fishing area total	*-*	*-*	*-*	*0*	*0*	*3*	*6*	*7*	*10*	*10*
Species total	*2*	*13*	*48*	*60*	*87*	*86*	*55*	*58*	*63*	*21*
Lemon shark	**Requin citron**		**Tiburón galano**		***Negaprion brevirostris***				**1,08(02)027,01**	**NGB**
21 USA	-	-	-	1	-	-	0	-	-	-
21 Fishing area total	*-*	*-*	*-*	*1*	*-*	*-*	*0*	*-*	*-*	*-*
Species total	*-*	*-*	*-*	*1*	*-*	*-*	*0*	*-*	*-*	*-*
Atlantic sharpnose shark	**Requin aiguille gussi**		**Cazón picudo atlántico**		***Rhizoprionodon terraenovae***				**1,08(02)040,01**	**RHT**
21 USA	-	-	-	-	0	0	33	89	-	4
21 Fishing area total	*-*	*-*	*-*	*-*	*0*	*0*	*33*	*89*	*-*	*4*
31 Mexico	...	...	...	...	139	146	72	164	159	153
31 Fishing area total	*...*	*...*	*...*	*...*	*139*	*146*	*72*	*164*	*159*	*153*
Species total	*...*	*...*	*...*	*...*	*139*	*146*	*105*	*253*	*159*	*157*
Milk shark	**Requin à museau pointu**		**Cazón lechoso**		***Rhizoprionodon acutus***				**1,08(02)040,02**	**RHA**
34 Mauritania	...	...	...	...	...	...	...	...	...	516
34 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*516*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*516*
Requiem sharks nei	**Requins nca**		**Cazones picudos,tintoreras nep**		***Carcharhinidae***				**1,08(02)XXX,XX**	**RSK**
31 Mexico	3 196	3 022	3 354	3 653	3 325	3 471	1 911	1 843	2 360	1 515
Nicaragua	87	23	20	11	129	136	236	145	87	123
Venezuela	2 536	5 663	9 052	14 300 F	7 650 F	4 550 F	5 550 F	6 300 F	6 100 F	6 100 F
31 Fishing area total	*5 819*	*8 708*	*12 426*	*17 964 F*	*11 104 F*	*8 157 F*	*7 697 F*	*8 288 F*	*8 547 F*	*7 738 F*
34 Congo Rep	490 F	500 F	555	587	655	593	636	363	391	605
Côte dIvoire	3	0	0	0	27	5	11	10 F	3	934
Portugal	11	34	50	25	54	-	-	-	-	-
34 Fishing area total	*504 F*	*534 F*	*605*	*612*	*736*	*598*	*647*	*373 F*	*394*	*1 539*
41 Brazil	-	-	1 999	-	157	463	1 414	383	138	126
Portugal	36	32	4	44	48	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	22	25
Uruguay	8	58	305	213	123	39	13	67	41	-
41 Fishing area total	*44*	*90*	*2 308*	*257*	*328*	*502*	*1 427*	*450*	*201*	*151*
47 Portugal	237	143	77	124	167	7	-	-	1	-
Spain	-	-	-	-	-	-	-	-	2	102
47 Fishing area total	*237*	*143*	*77*	*124*	*167*	*7*	*-*	*-*	*3*	*102*
51 Bahrain	...	...	...	97	19	42	21	43	36	14
Eritrea	110	144	123	16	25	232	117	115	165	307
Pakistan	27 118	27 000	18 697	18 857	12 250	10 681	8 489	8 496	5 917	4 754
Portugal	...	...	...	88	72	71	10	-	19	10
Qatar	0	0	-	-	-	-	-	-	-	-
Spain	8	57	1	10	20	38	15	12	14	14
51 Fishing area total	*27 236*	*27 201*	*18 821*	*19 068*	*12 386*	*11 064*	*8 652*	*8 666*	*6 151*	*5 099*
57 Indonesia	...	...	...	...	7 815	10 382	12 220	2 811	6 881	7 485
57 Fishing area total	*...*	*...*	*...*	*...*	*7 815*	*10 382*	*12 220*	*2 811*	*6 881*	*7 485*
71 Indonesia	...	...	...	...	5 156	15 148	17 467	23 189	21 497	18 969
71 Fishing area total	*...*	*...*	*...*	*...*	*5 156*	*15 148*	*17 467*	*23 189*	*21 497*	*18 969*
77 Mexico	2 859	2 450	3 000	3 268	3 040	3 174	3 170	2 224	3 258	2 819
Nicaragua	124	268	182	226	110	11	23	94	13	76
77 Fishing area total	*2 983*	*2 718*	*3 182*	*3 494*	*3 150*	*3 185*	*3 193*	*2 318*	*3 271*	*2 895*
87 Ecuador	1 944	1 499	541	430	289	121	31	26	573	1 780
Spain	-	-	-	-	1	8	1	-	-	-
87 Fishing area total	*1 944*	*1 499*	*541*	*430*	*290*	*129*	*32*	*26*	*573*	*1 780*
Species total	*38 767 F*	*40 893 F*	*37 960*	*41 949 F*	*41 132 F*	*49 172 F*	*51 335 F*	*46 121 F*	*47 518 F*	*45 758 F*
Smooth hammerhead	**Requin-marteau commun**		**Cornuda cruz(=Pez martillo)**		***Sphyrna zygaena***				**1,08(03)005,01**	**SPZ**
21 USA	-	-	-	0	0	0	-	0	2	4
21 Fishing area total	*-*	*-*	*-*	*0*	*0*	*0*	*-*	*0*	*2*	*4*

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
27 Portugal	4	5	7	20	3	13	9	7	5	4
Spain	-	-	-	5	10	0	3	2	1	0
27 Fishing area total	*4*	*5*	*7*	*25*	*13*	*13*	*12*	*9*	*6*	*4*
34 Portugal	1	13	5	7	40	13	23	17	27	49
Spain	-	9	67	123	215	93	69	37	73	0
34 Fishing area total	*1*	*22*	*72*	*130*	*255*	*106*	*92*	*54*	*100*	*49*
41 Portugal	-	-	5	-	-	5	5	7	2	-
Spain	-	-	15	17	...	...	16	-	7	-
41 Fishing area total	-	-	*20*	*17*	*...*	*5*	*21*	*7*	*9*	-
47 Portugal	5	3	1	-	-	8	2	1	1	1
Spain	-	-	6	22	21	24	56	27	4	-
47 Fishing area total	*5*	*3*	*7*	*22*	*21*	*32*	*58*	*28*	*5*	*1*
81 New Zealand	17	10	13	11	5	9	8	11	12	7
81 Fishing area total	*17*	*10*	*13*	*11*	*5*	*9*	*8*	*11*	*12*	*7*
87 Ecuador	...	...	...	...	...	11	130	271	...	...
87 Fishing area total	*...*	*...*	*...*	*...*	*...*	*11*	*130*	*271*	*...*	*...*
Species total	*27*	*40*	*119*	*205*	*294*	*176*	*321*	*380*	*134*	*65*

Scalloped hammerhead **Requin-marteau halicorne** **Cornuda común** ***Sphyrna lewini*** **1,08(03)005,06** **SPL**

31 Venezuela	...	...	...	...	...	...	...	1	5	...
31 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1*	*5*	*...*
34 GuineaBissau	8	...	...	5 F	5 F	5 F	5 F	5 F	5 F	5 F
Mauritania	...	...	...	...	...	...	...	...	...	257
Spain	-	257	109	310	148	31	25	-	-	-
UK	-	-	-	-	...	...	-	2	12	-
34 Fishing area total	*8*	*257*	*109*	*315 F*	*153 F*	*36 F*	*30 F*	*7 F*	*17 F*	*262 F*
41 Brazil	507	508	286	170	175	177	120	122	87	74
Spain	-	33	30	7	...	...	0	-	-	-
UK	...	...	...	...	...	...	...	1	-	-
41 Fishing area total	*507*	*541*	*316*	*177*	*175*	*177*	*120*	*123*	*87*	*74*
47 UK	-	-	-	-	-	...	...	1	0	-
47 Fishing area total	-	-	-	-	-	*...*	*...*	*1*	*0*	-
87 Ecuador	...	...	...	...	...	11	52	26	...	...
87 Fishing area total	*...*	*...*	*...*	*...*	*...*	*11*	*52*	*26*	*...*	*...*
Species total	*515*	*798*	*425*	*492 F*	*328 F*	*224 F*	*202 F*	*158 F*	*109 F*	*336 F*

Hammerhead sharks, etc. nei **Requins marteau, etc. nca** **Cornudas, etc. nep** ***Sphyrnidae*** **1,08(03)XXX,XX** **SPY**

31 Guyana	...	4	0	3	5	301	...	...	...	...
Mexico	...	...	...	...	169	177	90	41	40	41
Spain	...	...	3	-	15	5	9	2	2	-
Trinidad Tob	16	...	8	6	9	2	8	37	32	58
31 Fishing area total	*16*	*4*	*11*	*9*	*198*	*485*	*107*	*80*	*74*	*99*
34 Benin	...	...	15	15	12	12	10	...	268	153
Congo Rep	700 F	550 F	432	538	1 059	594	375	513	302	401
Côte dIvoire	49	48	71	32	32	57	40	40 F	40	15
Ghana	...	...	...	...	...	...	...	105	...	...
Liberia	...	...	...	23	802	100	332	...	100 F	100 F
Mauritania	...	...	...	...	...	...	...	...	...	17
Senegal	1 451	1 428	1 100	...	318	1 794	2 259	1 123	38	1 031
Spain	...	...	...	214	207	155	184	67	77	-
Togo	...	...	...	...	...	...	...	...	...	10
34 Fishing area total	*2 200 F*	*2 026 F*	*1 618*	*822*	*2 430*	*2 712*	*3 200*	*1 848 F*	*825 F*	*1 727 F*
41 Spain	-	-	-	-	-	-	-	-	9	-
Uruguay	...	13	65	47	24	27	1	12	11	...
41 Fishing area total	*...*	*13*	*65*	*47*	*24*	*27*	*1*	*12*	*20*	*...*
47 Namibia	...	...	...	1	22	55	31	25	...	...
47 Fishing area total	*...*	*...*	*...*	*1*	*22*	*55*	*31*	*25*	*...*	*...*
51 Portugal	-	-	-	-	-	3	1	2	1	2
Spain	...	...	2	9	27	4	15	0	5	-
51 Fishing area total	*...*	*...*	*2*	*9*	*27*	*7*	*16*	*2*	*6*	*2*
57 Indonesia	...	...	...	...	...	88	66	956	1 355	1 358
Portugal	-	-	-	-	-	-	1	-	-	-
Spain	...	...	1	1	2	1	0	-	-	-
57 Fishing area total	*...*	*...*	*1*	*1*	*2*	*89*	*67*	*956*	*1 355*	*1 358*
71 Indonesia	...	...	...	...	253	11	1 357	1 410	1 757	2 080
71 Fishing area total	*...*	*...*	*...*	*...*	*253*	*11*	*1 357*	*1 410*	*1 757*	*2 080*
77 Mexico	...	...	...	...	77	80	137	178	173	216
USA	-	-	0	-	0	0	0	-	-	-

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
77 Fishing area total	*...*	*...*	*0*	*...*	*77*	*80*	*137*	*178*	*173*	*216*
87 Ecuador	66	56	76	149	98	108	47	30	96	304
Spain	...	2	-	-	-	-	-	-	-	-
87 Fishing area total	*66*	*58*	*76*	*149*	*98*	*108*	*47*	*30*	*96*	*304*
Species total	*2 282 F*	*2 101 F*	*1 773*	*1 038*	*3 131*	*3 574*	*4 963*	*4 541 F*	*4 306 F*	*5 786 F*
Dusky smooth-hound	**Émissole douce**		**Boca dulce**		***Mustelus canis***				**1,08(04)007,03**	**CTI**
21 USA	321	493	498	517	257	239	328	324	651	933
21 Fishing area total	*321*	*493*	*498*	*517*	*257*	*239*	*328*	*324*	*651*	*933*
Species total	*321*	*493*	*498*	*517*	*257*	*239*	*328*	*324*	*651*	*933*
Brown smooth-hound	**Émissole brune**		**Musola parda**		***Mustelus henlei***				**1,08(04)007,07**	**CTK**
77 USA	4	3	2	2	4	3	1	1	0	0
77 Fishing area total	*4*	*3*	*2*	*2*	*4*	*3*	*1*	*1*	*0*	*0*
87 Ecuador	...	...	...	...	...	...	...	8	2	3
87 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*8*	*2*	*3*
Species total	*4*	*3*	*2*	*2*	*4*	*3*	*1*	*9*	*2*	*3*
Spotted estuary smooth-hound	**Émissole grivelée**		**Musola manchada**		***Mustelus lenticulatus***				**1,08(04)007,09**	**MTL**
81 New Zealand	1 563	1 403	1 484	1 344	1 467	1 373	1 335	1 225	1 244	1 318
Ukraine	-	-	4	-	-	-	-	-	-	-
81 Fishing area total	*1 563*	*1 403*	*1 488*	*1 344*	*1 467*	*1 373*	*1 335*	*1 225*	*1 244*	*1 318*
Species total	*1 563*	*1 403*	*1 488*	*1 344*	*1 467*	*1 373*	*1 335*	*1 225*	*1 244*	*1 318*
Narrownose smooth-hound	**Émissole gatuso**		**Gatuso**		***Mustelus schmitti***				**1,08(04)007,12**	**SDP**
41 Argentina	9 613	7 019	7 899	7 715	7 744	9 378	9 142	10 362	9 028	7 948
Uruguay	1 153	1 121	996	1 033	892	888	731	531	448	316
41 Fishing area total	*10 766*	*8 140*	*8 895*	*8 748*	*8 636*	*10 266*	*9 873*	*10 893*	*9 476*	*8 264*
Species total	*10 766*	*8 140*	*8 895*	*8 748*	*8 636*	*10 266*	*9 873*	*10 893*	*9 476*	*8 264*
Smooth-hound	**Émissole lisse**		**Musola**		***Mustelus mustelus***				**1,08(04)007,13**	**SMD**
27 Spain	-	-	-	63	29	32	51	26	33	36
UK	76	56	85	76	171	131	154	172	196	274
27 Fishing area total	*76*	*56*	*85*	*139*	*200*	*163*	*205*	*198*	*229*	*310*
34 Mauritania	...	...	...	...	...	...	...	...	...	100
Portugal	-	-	-	-	-	-	1	-	-	-
34 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*1*	*...*	*...*	*100*
47 South Africa	4	2	1	24	81	81	90	76	85	102
47 Fishing area total	*4*	*2*	*1*	*24*	*81*	*81*	*90*	*76*	*85*	*102*
Species total	*80*	*58*	*86*	*163*	*281*	*244*	*296*	*274*	*314*	*512*
Starry smooth-hound	**Émissole tachetée**		**Musola dentuda**		***Mustelus asterias***				**1,08(04)007,15**	**SDS**
27 Portugal	0	2	5	8	10	22	24	8	14	7
UK	-	-	-	-	-	-	1	-	1	-
27 Fishing area total	*0*	*2*	*5*	*8*	*10*	*22*	*25*	*8*	*15*	*7*
Species total	*0*	*2*	*5*	*8*	*10*	*22*	*25*	*8*	*15*	*7*
Smooth-hounds nei	**Émissoles nca**		**Tollos nep**		***Mustelus spp***				**1,08(04)007,XX**	**SDV**
27 France	1 249	1 590	1 882	2 197	2 361	2 416	2 640	2 986	3 266	3 388
Ireland	...	...	2	1	-	-	-	-	-	0
Portugal	43	40	49	43	36	38	38	38	31	31
Spain	-	-	-	26	24	40	40	27	55	24
27 Fishing area total	*1 292*	*1 630*	*1 933*	*2 267*	*2 421*	*2 494*	*2 718*	*3 051*	*3 352*	*3 443*
31 Colombia	14	37	12	160	28	60 F	90 F	125 F	160	...
Trinidad Tob	74	...	71	273	201	419	645	363	210	201
31 Fishing area total	*88*	*37*	*83*	*433*	*229*	*479 F*	*735 F*	*488 F*	*370*	*201*
34 Greece	21	29	22	14	6	5	11	3	2	2 F
Portugal	-	6	7	9	6	-	-	2	-	-
Senegal	1 908	2 064	2 155	2 261	1 255	2 307	1 752	1 491	1 738	1 324
Spain	-	-	-	-	2	18	54	32	37	18
34 Fishing area total	*1 929*	*2 099*	*2 184*	*2 284*	*1 269*	*2 330*	*1 817*	*1 528*	*1 777*	*1 344 F*
37 Albania	5	23	10	12	2	8	15	21	40	10
France	-	-	-	-	-	0	-	-	-	2
Greece	351	383	281	241	205	240	318	289	312	312 F
Italy	369	325	423	483	981	728	567	432	495	310
Libya	...	...	...	...	...	...	...	...	1 188	1 150 F
Malta	-	-	-	-	-	-	3	26	17	3
Montenegro	...	...	...	...	...	6	9	7	5	7

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Palest, O.T.	5 F	2	2	4	3	2	1	4	0	2
Serbia-Monte	...	6	6	4	4	...	...	...	...	...
Slovenia	4	2	5	4	2	2	1	2	1	-
Spain	19	12	21	18	22	24	20	22	34	21
Tunisia	192	186	156	150	192	166	110	149	204	258
Turkey	1 000	686	400	458	734	668	496	413	618	285
37 Fishing area total	*1 945 F*	*1 625*	*1 304*	*1 374*	*2 145*	*1 844*	*1 540*	*1 365*	*2 914*	*2 360 F*
41 Portugal	...	...	...	3	-	-	-	-	-	-
41 Fishing area total	*...*	*...*	*...*	*3*	-	-	-	-	-	-
57 Australia	2 485	2 414	2 817	2 945	2 951	2 704	2 612	3 216	2 925	2 641
57 Fishing area total	*2 485*	*2 414*	*2 817*	*2 945*	*2 951*	*2 704*	*2 612*	*3 216*	*2 925*	*2 641*
81 Australia	110	118	78	78	24	16	19	33	41	32
81 Fishing area total	*110*	*118*	*78*	*78*	*24*	*16*	*19*	*33*	*41*	*32*
87 Chile	128	57	87	197	293	162	184	203	160	36
Colombia	520	357	1	368	339	355 F	370 F	385 F	406	112
Ecuador	134	56	21	17	160	23	12	5	2	2
Peru	4 648	7 015	1 309	3 712	4 806	1 794	3 086	3 265	4 281	5 181
87 Fishing area total	*5 430*	*7 485*	*1 418*	*4 294*	*5 598*	*2 334 F*	*3 652 F*	*3 858 F*	*4 849*	*5 331*
Species total	*13 279 F*	*15 408*	*9 817*	*13 678*	*14 637*	*12 201 F*	*13 093 F*	*13 539 F*	*16 228*	*15 352 F*
Tope shark	**Requin-hâ**		**Cazón**		***Galeorhinus galeus***				**1,08(04)011,03**	**GAG**
27 Denmark	4	4	5	5	8	6	3	4	3	2
France	469	379	384	310	290	333	273	148	340	345
Ireland	4	2	...	...	...	...	...	...	...	...
Portugal	-	-	69	51	45	45	43	47	34	41
Spain	-	-	-	571	434	539	484	524	542	328
UK	82	73	68	80	81	91	49	42	24	17
27 Fishing area total	*559*	*458*	*526*	*1 017*	*858*	*1 014*	*852*	*765*	*943*	*733*
34 Portugal	1	2	98	1	-	0	87	99	110	117
Spain	-	-	-	6	17	17	8	17	8	44
34 Fishing area total	*1*	*2*	*98*	*7*	*17*	*17*	*95*	*116*	*118*	*161*
37 France	-	-	-	-	-	-	-	-	1	5
Spain	-	-	-	23	15	36	21	32	26	33
37 Fishing area total	-	-	-	*23*	*15*	*36*	*21*	*32*	*27*	*38*
41 Argentina	50	29	58	79	138	143	128	91	170	128
Spain	37	6	-	-	-	-	-	-	-	-
Uruguay	194	123	376	304	255	225	78	68	105	105
41 Fishing area total	*281*	*158*	*434*	*383*	*393*	*368*	*206*	*159*	*275*	*233*
47 South Africa	16	19	26	219	163	204	297	290	257	302
Spain	-	-	-	-	-	-	-	29	-	-
47 Fishing area total	*16*	*19*	*26*	*219*	*163*	*204*	*297*	*319*	*257*	*302*
57 Australia	325	350	329	349	287	329	276	399	355	305
57 Fishing area total	*325*	*350*	*329*	*349*	*287*	*329*	*276*	*399*	*355*	*305*
67 USA	1	0	0	1	0	2	-	0	0	0
67 Fishing area total	*1*	*0*	*0*	*1*	*0*	*2*	-	*0*	*0*	*0*
77 USA	44	32	34	26	26	28	17	8	4	3
77 Fishing area total	*44*	*32*	*34*	*26*	*26*	*28*	*17*	*8*	*4*	*3*
81 New Zealand	3 091	3 315	3 119	3 093	3 602	3 053	3 330	3 327	3 351	3 569
Ukraine	-	1	2	5	...	-	-	-	-	-
81 Fishing area total	*3 091*	*3 316*	*3 121*	*3 098*	*3 602*	*3 053*	*3 330*	*3 327*	*3 351*	*3 569*
Species total	*4 318*	*4 335*	*4 568*	*5 123*	*5 361*	*5 051*	*5 094*	*5 125*	*5 330*	*5 344*
Sharptooth houndshark	**Virli dentu**		**Tollo dentudo**		***Triakis megalopterus***				**1,08(04)023,04**	**TTE**
47 South Africa	-	-	-	-	-	-	6	-	2	-
47 Fishing area total	-	-	-	-	-	-	*6*	-	*2*	-
Species total	-	-	-	-	-	-	*6*	-	*2*	-
Atlantic weasel shark	**Milandre jaune**		**Tiburón comadiza**		***Paragaleus pectoralis***				**1,08(06)003,02**	**HEI**
34 Mauritania	...	...	...	...	...	...	...	...	...	14
34 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*14*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*14*
Barbeled houndshark	**Émissole barbue**		**Tiburón barbudo**		***Leptocharias smithii***				**1,08(07)020,01**	**CLL**
34 Mauritania	...	...	...	...	...	...	...	...	...	111
34 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*111*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*111*

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Greenland shark	**Laimargue du Groenland**		**Tollo de Groenlandia**		***Somniosus microcephalus***				**1,09(01)002,01**	**GSK**
21 Greenland	-	0	2	-	1	-	-	-	-	-
Portugal	-	-	-	-	-	8	0	3	6	6
Spain	-	-	2	1	-	-	-	-	-	-
21 Fishing area total	*-*	*0*	*4*	*1*	*1*	*8*	*0*	*3*	*6*	*6*
27 Estonia	-	-	-	-	9	-	-	-	-	-
Greenland	-	-	-	-	-	-	17	-	-	-
Iceland	57	56	61	66	50	24	2	42	25	43
Portugal	1	0	-	0	-	1	1	1	-	-
27 Fishing area total	*58*	*56*	*61*	*66*	*59*	*25*	*20*	*43*	*25*	*43*
58 South Africa	-	1	-	-	-	-	-	-	-	-
58 Fishing area total	*-*	*1*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
Species total	*58*	*57*	*65*	*67*	*60*	*33*	*20*	*46*	*31*	*49*
Little sleeper shark	**Laimargue de la Méditerranée**		**Tollo boreal**		***Somniosus rostratus***				**1,09(01)002,02**	**SOR**
27 Spain	...	2	1	1	0	3	3	-	-	0
27 Fishing area total	*...*	*2*	*1*	*1*	*0*	*3*	*3*	*-*	*-*	*0*
Species total	*...*	*2*	*1*	*1*	*0*	*3*	*3*	*-*	*-*	*0*
Pacific sleeper shark	**Laimargue dormeur**		**Tollo negro dormilón**		***Somniosus pacificus***				**1,09(01)002,03**	**SON**
58 Australia	-	3	3	8	2	0	2	-	1	1
58 Fishing area total	*-*	*3*	*3*	*8*	*2*	*0*	*2*	*-*	*1*	*1*
Species total	*-*	*3*	*3*	*8*	*2*	*0*	*2*	*-*	*1*	*1*
Longnose spurdog	**Aiguillat coq**		**Galludo**		***Squalus blainville***				**1,09(01)007,01**	**QUB**
27 France	-	-	-	-	-	-	-	-	1	-
27 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*1*	*-*
37 Malta	-	-	-	-	-	-	14	...	...	21
37 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*14*	*...*	*...*	*21*
Species total	*-*	*-*	*-*	*-*	*-*	*-*	*14*	*...*	*1*	*21*
Picked dogfish	**Aiguillat commun**		**Mielga**		***Squalus acanthias***				**1,09(01)007,04**	**DGS**
21 Canada	3 760	3 589	1 324	2 371	2 270	2 440	2 384	1 576	154	6
St Pier Mq	0	0	0	7	3	...	...	...	...	...
Spain	1	0	31	8	-	-	-	-	-	-
USA	2 234	2 108	1 067	785	1 127	2 365	2 881	4 008	4 774	5 081
21 Fishing area total	*5 995*	*5 697*	*2 422*	*3 171*	*3 400*	*4 805*	*5 265*	*5 584*	*4 928*	*5 087*
27 Belgium	13	23	12	13	21	17	10	11	7	1
Denmark	156	256	233	219	151	122	76	77	83	15
France	1 333	1 138	1 110	1 129	1 096	847	659	580	508	291
Germany	303	119	98	140	140	7	3	5	2	1
Iceland	136	276	231	141	82	74	34	68	95	62
Ireland	1 301	1 293	...	...	...	...	-	-	-	-
Netherlands	39	27	9	25	30	24	25	19	4	8
Norway	1 425	1 130	1 119	1 053	1 010	790	615	711	543	513
Portugal	3	4	4	9	6	10	14	3	3	2
Spain	363	359	201	17	96	102	115	79	53	19
Sweden	238	270	275	244	170	148	95	76	80	5
UK	7 306	5 170	6 817	5 030	3 132	1 211	808	278	546	64
27 Fishing area total	*12 616*	*10 065*	*10 109*	*8 020*	*5 934*	*3 352*	*2 454*	*1 907*	*1 924*	*981*
37 Algeria	...	...	...	...	...	...	13	14	15	6
Bulgaria	126	100	51	47	15	6	24	23	9	77
France	2	2	3	3	2	3	2	2	2	3
Georgia	1	3	9	...	0	...	2	...	...	...
Malta	17	24	17	20	19	20	-	-	-	-
Romania	-	-	-	-	5	8	13	10	4	3
Slovenia	-	-	-	-	-	-	-	0	-	-
Spain	8	8	2	3	5	2	2	3	7	7
Ukraine	134	97	172	93	75	67	45	79	47	27
37 Fishing area total	*288*	*234*	*254*	*166*	*121*	*106*	*101*	*131*	*84*	*123*
41 Argentina	-	-	-	-	-	113	119	148	232	268
41 Fishing area total	*-*	*-*	*-*	*-*	*-*	*113*	*119*	*148*	*232*	*268*
47 Portugal	-	-	-	-	-	-	11	17	19	10
Spain	-	-	-	-	-	-	-	56	-	-
47 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*11*	*73*	*19*	*10*
67 Canada	4 543	4 701	5 617	5 490	5 432	2 417	4 093	2 152	4 301	1 841
USA	638	990	651	493	577	547	612	834	245	101
67 Fishing area total	*5 181*	*5 691*	*6 268*	*5 983*	*6 009*	*2 964*	*4 705*	*2 986*	*4 546*	*1 942*
77 USA	3	17	11	28	8	14	11	44	46	6
77 Fishing area total	*3*	*17*	*11*	*28*	*8*	*14*	*11*	*44*	*46*	*6*
81 New Zealand	4 192	6 024	3 073	3 088	3 866	4 638	3 967	2 911	3 129	4 015

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Ukraine	-	162	160	153	...	160	...	...	...	...
81 Fishing area total	*4 192*	*6 186*	*3 233*	*3 241*	*3 866*	*4 798*	*3 967*	*2 911*	*3 129*	*4 015*
87 Chile	-	-	-	-	-	-	-	-	0	99
87 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*0*	*99*
Species total	*28 275*	*27 890*	*22 297*	*20 609*	*19 338*	*16 152*	*16 633*	*13 784*	*14 908*	*12 531*
Gulper shark	**Squale-chagrin commun**		**Quelvacho**		***Centrophorus granulosus***				**1,09(01)008,01**	**GUP**
27 France	-	-	-	-	-	-	-	-	1	-
Ireland	...	...	2	0	14	-	-	-	-	-
Portugal	248	393	276	182	108	121	94	61	20	4
Spain	-	8	4	9	5	1	0	-	-	0
UK	-	-	637	481	40	133	3	2	-	-
27 Fishing area total	*248*	*401*	*919*	*672*	*167*	*255*	*97*	*63*	*21*	*4*
34 Portugal	-	-	10	0	2	5	40	56	4	-
34 Fishing area total	*-*	*-*	*10*	*0*	*2*	*5*	*40*	*56*	*4*	*-*
37 Malta	3	2	0	0	1	0	1	0	1	0
Spain	...	1	1	2	2	1	1	11	10	2
37 Fishing area total	*3*	*3*	*1*	*2*	*3*	*1*	*2*	*11*	*11*	*2*
51 Portugal	-	-	-	-	-	1	-	-	-	-
51 Fishing area total	*-*	*-*	*-*	*-*	*-*	*1*	*-*	*-*	*-*	*-*
Species total	*251*	*404*	*930*	*674*	*172*	*262*	*139*	*130*	*36*	*6*
Leafscale gulper shark	**Squale-chagrin de l'Atlantique**		**Quelvacho negro**		***Centrophorus squamosus***				**1,09(01)008,03**	**GUQ**
27 Faroe Is	0	1	7	-	0	-	3	-	-	-
France	-	48	61	109	26	43	60	48	142	147
Germany	-	-	-	15	35	-	-	-	-	-
Norway	1	-	-	-	-	-	-	-	-	-
Portugal	1 894	2 498	720	529	513	549	174	87	26	2
Spain	-	495	739	443	176	18	7	9	1	-
UK	-	-	1 420	1 460	310	150	16	-	-	-
27 Fishing area total	*1 895*	*3 042*	*2 947*	*2 556*	*1 060*	*760*	*260*	*144*	*169*	*149*
34 Portugal	27	29	75	102	79	91	236	338	185	212
34 Fishing area total	*27*	*29*	*75*	*102*	*79*	*91*	*236*	*338*	*185*	*212*
81 New Zealand	0	1	1	3	0	0	2	37	12	21
81 Fishing area total	*0*	*1*	*1*	*3*	*0*	*0*	*2*	*37*	*12*	*21*
Species total	*1 922*	*3 072*	*3 023*	*2 661*	*1 139*	*851*	*498*	*519*	*366*	*382*
Lowfin gulper shark	**Squale-chagrin longue dorsale**		**Quelvacho lusitánico**		***Centrophorus lusitanicus***				**1,09(01)008,04**	**CPL**
27 Portugal	-	-	-	-	-	0	180	243	423	271
27 Fishing area total	*-*	*-*	*-*	*-*	*-*	*0*	*180*	*243*	*423*	*271*
34 Portugal	-	-	-	-	-	-	-	59	15	-
34 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*59*	*15*	*-*
Species total	*-*	*-*	*-*	*-*	*-*	*0*	*180*	*302*	*438*	*271*
Velvet belly	**Sagre commun**		**Negrito**		***Etmopterus spinax***				**1,09(01)010,01**	**ETX**
27 Norway	-	-	-	-	-	-	-	-	-	9
UK	-	-	5	10	50	-	8	...	-	-
27 Fishing area total	*-*	*-*	*5*	*10*	*50*	*-*	*8*	*...*	*-*	*9*
37 Spain	...	3	5	1	1	5	8	5	5	7
37 Fishing area total	*...*	*3*	*5*	*1*	*1*	*5*	*8*	*5*	*5*	*7*
Species total	*...*	*3*	*10*	*11*	*51*	*5*	*16*	*5*	*5*	*16*
Great lanternshark	**Sagre rude**		**Tollo lucero raspa**		***Etmopterus princeps***				**1,09(01)010,05**	**ETR**
27 UK	-	-	-	-	-	-	-	20	-	-
27 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*20*	*-*	*-*
Species total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*20*	*-*	*-*
Lanternsharks nei	**Sagres nca**		**Tollos lucero nep**		***Etmopterus spp***				**1,09(01)010,XX**	**SHL**
27 Spain	...	99	76	63	60	44	120	14	19	1
27 Fishing area total	*...*	*99*	*76*	*63*	*60*	*44*	*120*	*14*	*19*	*1*
58 Australia	-	-	-	0	-	-	-	-	0	0
58 Fishing area total	*-*	*-*	*-*	*0*	*-*	*-*	*-*	*-*	*0*	*0*
81 New Zealand	4	25	23	10	15	6	13	20	46	62
81 Fishing area total	*4*	*25*	*23*	*10*	*15*	*6*	*13*	*20*	*46*	*62*
Species total	*4*	*124*	*99*	*73*	*75*	*50*	*133*	*34*	*65*	*63*

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Birdbeak dogfish	**Squale savate**		**Tollo pajarito**		***Deania calcea***				**1,09(01)014,01**	**DCA**
27 France	-	-	-	-	-	-	1	1	12	2
Portugal	50	90	76	160	154	80	31	60	23	2
Spain	-	12	42	80	64	30	26	9	-	-
UK	1	-	22	83	46	21	-	-	-	-
27 Fishing area total	*51*	*102*	*140*	*323*	*264*	*131*	*58*	*70*	*35*	*4*
34 Portugal	-	-	-	-	-	0	3	15	4	-
34 Fishing area total	-	-	-	-	-	*0*	*3*	*15*	*4*	-
81 New Zealand	66	86	49	93	122	143	105	148	168	142
Ukraine	-	-	-	1	...	-	-	-	-	-
81 Fishing area total	*66*	*86*	*49*	*94*	*122*	*143*	*105*	*148*	*168*	*142*
Species total	*117*	*188*	*189*	*417*	*386*	*274*	*166*	*233*	*207*	*146*
Arrowhead dogfish	**Squale-savate lutin**		**Tollo flecha**		***Deania profundorum***				**1,09(01)014,03**	**SDU**
27 Portugal	...	...	...	...	...	...	...	...	0	3
27 Fishing area total	...	...	...	...	...	...	...	...	*0*	*3*
Species total	...	...	...	...	...	...	...	...	*0*	*3*
Portuguese dogfish	**Pailona commun**		**Pailona**		***Centroscymnus coelolepis***				**1,09(01)016,01**	**CYO**
21 Spain	-	-	-	-	0	11	-	-	-	-
21 Fishing area total	-	-	-	-	*0*	*11*	-	-	-	-
27 Estonia	-	-	-	-	7	3	-	-	-	-
Faroe Is	6	4	6	1	7	-	2	3	-	-
France	-	456	579	707	219	187	231	228	434	96
Germany	...	...	...	...	23	-	-	-	-	-
Ireland	216	368	728	485	203	104	7	-	-	-
Lithuania	-	-	7	17	3	5	2	0	-	-
Netherlands	-	-	-	-	-	-	-	-	-	1
Norway	13	-	-	-	-	-	-	-	-	-
Portugal	1 327	1 295	768	687	533	482	190	74	33	1
Spain	-	135	211	290	159	220	36	49	5	0
UK	1 663	1 456	1 933	1 834	1 142	273	89	44	15	21
27 Fishing area total	*3 225*	*3 714*	*4 232*	*4 021*	*2 296*	*1 274*	*557*	*398*	*487*	*119*
34 Portugal	-	-	-	-	1	-	102	289	56	-
34 Fishing area total	-	-	-	-	*1*	-	*102*	*289*	*56*	-
37 Portugal	23	2	-	-	-	-	0	-	-	-
37 Fishing area total	*23*	*2*	-	-	-	-	*0*	-	-	-
Species total	*3 248*	*3 716*	*4 232*	*4 021*	*2 297*	*1 285*	*659*	*687*	*543*	*119*
Longnose velvet dogfish	**Pailona à long nez**		**Sapata negra**		***Centroscymnus crepidater***				**1,09(01)016,02**	**CYP**
27 Estonia	-	-	-	-	-	-	3	-	-	-
France	-	12	6	7	6	3	3	1	6	3
Ireland	-	-	-	-	-	-	2	-	-	-
Portugal	3	4	2	1	3	8	21	34	27	-
UK	-	-	501	293	152	411	109	-	-	-
27 Fishing area total	*3*	*16*	*509*	*301*	*161*	*422*	*138*	*35*	*33*	*3*
34 Portugal	-	-	-	-	-	-	1	3	-	-
34 Fishing area total	-	-	-	-	-	-	*1*	*3*	-	-
81 New Zealand	0	1	5	1	0	0	0	1	0	3
81 Fishing area total	*0*	*1*	*5*	*1*	*0*	*0*	*0*	*1*	*0*	*3*
Species total	*3*	*17*	*514*	*302*	*161*	*422*	*139*	*39*	*33*	*6*
Knifetooth dogfish	**Squale-grogneur commun**		**Bruja**		***Scymnodon ringens***				**1,09(01)017,02**	**SYR**
27 Ireland	-	-	-	2	-	-	28	-	-	-
Portugal	-	-	-	-	-	-	86	113	84	115
Spain	-	-	-	9	9	124	127	127	77	101
UK	-	-	-	-	39	-	51	-	-	-
27 Fishing area total	-	-	-	*11*	*48*	*124*	*292*	*240*	*161*	*216*
34 Portugal	-	-	-	-	-	-	-	13	7	-
34 Fishing area total	-	-	-	-	-	-	-	*13*	*7*	-
Species total	-	-	-	*11*	*48*	*124*	*292*	*253*	*168*	*216*
Kitefin shark	**Squale liche**		**Carocho**		***Dalatias licha***				**1,09(01)018,01**	**SCK**
27 France	...	...	...	...	1	3	1	0	...	5
Germany	...	...	...	...	21	-	-	-	-	-
Ireland	...	...	33	4	8	9	-	-	-	-
Portugal	189	40	145	278	365	16	9	11	7	1
UK	-	-	557	321	77	34	5	-	-	-
27 Fishing area total	*189*	*40*	*735*	*603*	*472*	*62*	*15*	*11*	*7*	*6*

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Sharks, rays, chimaeras
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Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
34 Liberia	...	...	...	54	...	...	...	...	...	...
Portugal	-	-	-	-	-	-	1	15	-	-
34 Fishing area total	*...*	*...*	*...*	*54*	*...*	*...*	*1*	*15*	*...*	*...*
81 New Zealand	375	520	478	479	455	413	333	363	239	276
Spain	-	-	-	-	-	-	-	899	11	-
Ukraine	-	-	-	1	...	-	-	-	-	-
81 Fishing area total	*375*	*520*	*478*	*480*	*455*	*413*	*333*	*1 262*	*250*	*276*
Species total	*564*	*560*	*1 213*	*1 137*	*927*	*475*	*349*	*1 288*	*257*	*282*

Black dogfish **Aiguillat noir** **Tollo negro merga** ***Centroscyllium fabricii*** **1,09(01)019,01** **CFB**

21 Estonia	-	-	-	-	-	-	6	-	-	-
21 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*6*	*-*	*-*	*-*
27 Estonia	-	-	-	-	-	4	-	-	-	-
France	271	27	53	56	4	2	6	5	94	70
Iceland	-	-	-	-	-	-	-	-	1	10
27 Fishing area total	*271*	*27*	*53*	*56*	*4*	*6*	*6*	*5*	*95*	*80*
Species total	*271*	*27*	*53*	*56*	*4*	*6*	*12*	*5*	*95*	*80*

Dogfishes and hounds nei **Squales et émissoles nca** **Galludos, tollos y musolas nep** ***Squalidae, Scyliorhinidae*** **1,09(01)XXX,XX** **DGH**

27 Belgium	396	448	444	465	488	503	478	521	502	484
Channel Is	51	53	61	78	93	55	66	46	60	31
Norway	-	-	-	-	-	0	0	0	-	-
Portugal	776	712	781	750	460	259	468	132	98	90
UK	1 443	1 795	186	198	215	312	300	222	161	299
27 Fishing area total	*2 666*	*3 008*	*1 472*	*1 491*	*1 256*	*1 129*	*1 312*	*921*	*821*	*904*
Species total	*2 666*	*3 008*	*1 472*	*1 491*	*1 256*	*1 129*	*1 312*	*921*	*821*	*904*

Dogfish sharks nei **Squales nca** **Galludos, tollos, nep** ***Squalidae*** **1,09(01)XXX,XX** **DGX**

21 Estonia	-	-	-	44	6	-	-	3	-	0
Lithuania	-	-	-	-	2	-	1	-	-	-
Russian Fed	-	-	-	-	2	-	2	2	2	2
Spain	692	475	612	323	167	-	30	130	80	125
USA	287	243	272	157	128	154	259	189	825	391
21 Fishing area total	*979*	*718*	*884*	*524*	*305*	*154*	*292*	*324*	*907*	*518*
27 Faroe Is	622	322	248	333	251	310	260	143	462	179
France	4 194	1 992	860	700	844	600	687	644	71	48
Germany	433	519	642	634	53	1	1	0	1	6
Ireland	30	14	2 210	1 685	1 139	968	532	146	219	60
Isle of Man	3	1	2	-	-	-	-	-	7	8
Lithuania	14	40	22	56	6	6	2	-	-	-
Netherlands	-	-	-	-	-	-	-	-	-	4
Norway	314	10	58	19	6	-	-	-	-	-
Spain	365	171	340	542	127	313	104	107	49	0
UK	477	752	158	227	31	27	86	104	159	211
27 Fishing area total	*6 452*	*3 821*	*4 540*	*4 196*	*2 457*	*2 225*	*1 672*	*1 144*	*968*	*516*
31 Fr Guiana	...	...	...	...	52	133	127	109	76	85 F
USA	8	8	6	380	201	129	186	257	463	1 117
31 Fishing area total	*8*	*8*	*6*	*380*	*253*	*262*	*313*	*366*	*539*	*1 202 F*
34 Greece	-	14	-	-	-	-	-	-	-	-
Liberia	...	...	...	75	...	...	...	...	...	...
Portugal	-	-	-	-	-	-	0	-	-	-
34 Fishing area total	*...*	*14*	*...*	*75*	*...*	*...*	*0*	*...*	*...*	*...*
37 Albania	10	77	1	7	56	73	30	36	48	31
Algeria	...	...	...	...	...	...	98	117	68	32
Croatia	74	34	33	37	91	82	77	39	51	73
France	17	14	6	5	1	1	3	4	1	2
Greece	224	143	171	169	140	102	75	67	87	87 F
Italy	...	...	...	...	157	157	99	70	72	45
Libya	...	...	...	...	...	...	...	...	7 596	7 300 F
Serbia-Monte	7	-	-	-	-	-	-	-	-	-
Spain	20	19	16	12	10	14	15	13	17	19
Tunisia	883	945	977	983	800	984	913	841	734	816
37 Fishing area total	*1 235*	*1 232*	*1 204*	*1 213*	*1 255*	*1 413*	*1 310*	*1 187*	*8 674*	*8 405 F*
41 Uruguay	0	0	0	26	2	9	13	17	...	1
41 Fishing area total	*0*	*0*	*0*	*26*	*2*	*9*	*13*	*17*	*...*	*1*
57 Indonesia	...	...	...	...	6 717	9 866	10 324	2 503	2 067	1 875
57 Fishing area total	*...*	*...*	*...*	*...*	*6 717*	*9 866*	*10 324*	*2 503*	*2 067*	*1 875*
71 Indonesia	...	...	...	...	9 819	4 606	1 742	2 910	3 235	710
71 Fishing area total	*...*	*...*	*...*	*...*	*9 819*	*4 606*	*1 742*	*2 910*	*3 235*	*710*
81 New Zealand	700	294	374	395	224	303	515	522	579	565
Spain	-	-	-	-	-	-	-	-	235	-
81 Fishing area total	*700*	*294*	*374*	*395*	*224*	*303*	*515*	*522*	*814*	*565*

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*9 374*	*6 087*	*7 008*	*6 809*	*21 032*	*18 838*	*16 181*	*8 973*	*17 204*	*13 792 F*
Sawsharks nei	**Requins scies nca**		**Tiburónes sierra nep**		***Pristiophorus spp***				**1,09(02)004,XX**	**PWS**
57 Australia	423	371	459	519	511	499	386	384	372	264
57 Fishing area total	*423*	*371*	*459*	*519*	*511*	*499*	*386*	*384*	*372*	*264*
Species total	*423*	*371*	*459*	*519*	*511*	*499*	*386*	*384*	*372*	*264*
Angelshark	**Ange de mer commun**		**Angelote**		***Squatina squatina***				**1,09(03)004,01**	**AGN**
27 Estonia	-	3	-	-	-	-	-	-	-	-
France	1	-	0	0	2	-	0	0	2	2
Spain	...	...	...	...	...	...	1	0	0	9
27 Fishing area total	*1*	*3*	*0*	*0*	*2*	*...*	*1*	*0*	*2*	*11*
37 Tunisia	22	13	41	10	14	36	15	52	74	86
37 Fishing area total	*22*	*13*	*41*	*10*	*14*	*36*	*15*	*52*	*74*	*86*
Species total	*23*	*16*	*41*	*10*	*16*	*36*	*16*	*52*	*76*	*97*
Argentine angelshark	**Ange de mer argentin**		**Angelote argentino**		***Squatina argentina***				**1,09(03)004,04**	**SUG**
41 Argentina	3 840	2 812	3 555	3 767	3 863	4 218	4 293	5 214	5 065	5 252
Uruguay	231	377	201	329	234	298	231	239	211	282
41 Fishing area total	*4 071*	*3 189*	*3 756*	*4 096*	*4 097*	*4 516*	*4 524*	*5 453*	*5 276*	*5 534*
Species total	*4 071*	*3 189*	*3 756*	*4 096*	*4 097*	*4 516*	*4 524*	*5 453*	*5 276*	*5 534*
Pacific angelshark	**Ange de mer du Pacifique**		**Pez ángel del Pacífico**		***Squatina californica***				**1,09(03)004,06**	**SUC**
77 Mexico	...	...	...	...	763	797	1 914	834	809	1 062
77 Fishing area total	*...*	*...*	*...*	*...*	*763*	*797*	*1 914*	*834*	*809*	*1 062*
87 Ecuador	-	-	-	81	14	4	6	16	...	...
Peru	510	477	294	187	154	36	62	68	61	45
87 Fishing area total	*510*	*477*	*294*	*268*	*168*	*40*	*68*	*84*	*61*	*45*
Species total	*510*	*477*	*294*	*268*	*931*	*837*	*1 982*	*918*	*870*	*1 107*
Angelsharks, sand devils nei	**Anges de mer nca**		**Angelotes, peces ángel nep**		***Squatinidae***				**1,09(03)XXX,XX**	**ASK**
27 Portugal	-	-	1	-	1	1	1	1	1	-
27 Fishing area total	*-*	*-*	*1*	*-*	*1*	*1*	*1*	*1*	*1*	*-*
37 Albania	16	79	1	4	68	55	12	23	14	78
Malta	0	-	-	-	-	-	-	-	-	-
Turkey	20	18	25	28	38	51	15	34	20	19
37 Fishing area total	*36*	*97*	*26*	*32*	*106*	*106*	*27*	*57*	*34*	*97*
47 Portugal	...	...	...	...	9	4	7	9	2	3
47 Fishing area total	*...*	*...*	*...*	*...*	*9*	*4*	*7*	*9*	*2*	*3*
57 Australia	71	118	184	246	319	336	278	221	141	...
57 Fishing area total	*71*	*118*	*184*	*246*	*319*	*336*	*278*	*221*	*141*	*...*
Species total	*107*	*215*	*211*	*278*	*435*	*447*	*313*	*288*	*178*	*100*
Angular roughshark	**Centrine commune**		**Cerdo marino**		***Oxynotus centrina***				**1,09(05)006,01**	**OXY**
27 Portugal	63	86	144	79	38	54	96	63	76	50
27 Fishing area total	*63*	*86*	*144*	*79*	*38*	*54*	*96*	*63*	*76*	*50*
Species total	*63*	*86*	*144*	*79*	*38*	*54*	*96*	*63*	*76*	*50*
Sailfin roughshark	**Humantin**		**Cerdo marino velero**		***Oxynotus paradoxus***				**1,09(05)006,02**	**OXN**
27 Ireland	-	-	-	1	-	-	1	-	-	-
Spain	...	1	-	-	-	-	-	-	-	-
UK	-	-	-	-	-	-	1	-	-	-
27 Fishing area total	*...*	*1*	*-*	*1*	*-*	*-*	*2*	*-*	*-*	*-*
Species total	*...*	*1*	*-*	*1*	*-*	*-*	*2*	*-*	*-*	*-*
Bramble shark	**Squale bouclé**		**Tiburón de clavos**		***Echinorhinus brucus***				**1,09(06)009,01**	**SHB**
27 Portugal	1	-	-	3	1	0	2	-	2	1
27 Fishing area total	*1*	*-*	*-*	*3*	*1*	*0*	*2*	*-*	*2*	*1*
Species total	*1*	*-*	*-*	*3*	*1*	*0*	*2*	*-*	*2*	*1*
Whitespotted wedgefish	**...B**		**...C**		***Rhynchobatus australiae***				**1,10(01)004,01**	**RCA**
57 Indonesia	...	...	...	...	2 304	2 677	716	1 786	625	23
57 Fishing area total	*...*	*...*	*...*	*...*	*2 304*	*2 677*	*716*	*1 786*	*625*	*23*
71 Indonesia	...	...	...	...	26 188	15 268	8 881	1 859	8 390	3 475
71 Fishing area total	*...*	*...*	*...*	*...*	*26 188*	*15 268*	*8 881*	*1 859*	*8 390*	*3 475*

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*...*	*...*	*...*	*...*	*28 492*	*17 945*	*9 597*	*3 645*	*9 015*	*3 498*
Giant guitarfish	**Poisson paille à pois**		**Pez cuna manchado**		***Rhynchobatus djiddensis***				**1,10(01)004,02**	**RCD**
51 Iran	56	44	134	157	125	72	29	60	104	98
51 Fishing area total	*56*	*44*	*134*	*157*	*125*	*72*	*29*	*60*	*104*	*98*
Species total	*56*	*44*	*134*	*157*	*125*	*72*	*29*	*60*	*104*	*98*
Blackchin guitarfish	**...B**		**...C**		***Rhinobatos cemiculus***				**1,10(01)005,07**	**RBC**
34 Mauritania	...	...	...	...	...	...	...	...	...	161
34 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*161*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*161*
Chola guitarfish	**Poisson-guitare chola**		**Guitarra chola**		***Rhinobatos percellens***				**1,10(01)005,09**	**GUD**
41 Uruguay	0	2	3	1	5	16	1	4	...	26
41 Fishing area total	*0*	*2*	*3*	*1*	*5*	*16*	*1*	*4*	*...*	*26*
Species total	*0*	*2*	*3*	*1*	*5*	*16*	*1*	*4*	*...*	*26*
Pacific guitarfish	**Poisson-guitare du Pacifique**		**Guitarra del Pacífico**		***Rhinobatos planiceps***				**1,10(01)005,10**	**GUF**
87 Peru	1 060	822	260	28	184	173	112	114	79	47
87 Fishing area total	*1 060*	*822*	*260*	*28*	*184*	*173*	*112*	*114*	*79*	*47*
Species total	*1 060*	*822*	*260*	*28*	*184*	*173*	*112*	*114*	*79*	*47*
Common guitarfish	**...B**		**...C**		***Rhinobatos rhinobatos***				**1,10(01)005,24**	**RBX**
37 Israel	...	...	...	...	...	...	...	...	90	69
37 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*90*	*69*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*90*	*69*
Guitarfishes, etc. nei	**Guitares, etc. nca**		**Guitarras, etc. nep**		***Rhinobatidae***				**1,10(01)XXX,XX**	**GTF**
34 Benin	...	...	32	42	39	35	28	6	6	93
Côte dIvoire	...	...	12	5	5	9	6	6 F	6	7
Liberia	0	0	0	175	50	65	...	...	...	...
Senegal	1 772	1 062	994	1 039	920	1 369	1 247	989	1 390	1 002
34 Fishing area total	*1 772*	*1 062*	*1 038*	*1 261*	*1 014*	*1 478*	*1 281*	*1 001 F*	*1 402*	*1 102*
37 Albania	-	2	0	-	1	8	3	3	-	-
Greece	89	52	32	41	24	34	32	43	38	38 F
Libya	...	...	...	...	...	...	...	...	126	120 F
Palest, O.T.	2 F	1	4	1	1	2	8	6	1	3
37 Fishing area total	*91 F*	*55*	*36*	*42*	*26*	*44*	*43*	*52*	*165*	*161 F*
51 Eritrea	1	7	0	0	0	0	0	0	0	-
Pakistan	1 944	2 004	840	765	697	554	516	527	484	450
51 Fishing area total	*1 945*	*2 011*	*840*	*765*	*697*	*554*	*516*	*527*	*484*	*450*
71 Indonesia	...	...	...	...	120	12	2	0	210	189
71 Fishing area total	*...*	*...*	*...*	*...*	*120*	*12*	*2*	*0*	*210*	*189*
Species total	*3 808 F*	*3 128*	*1 914*	*2 068*	*1 857*	*2 088*	*1 842*	*1 580 F*	*2 261*	*1 902 F*
Sawfishes	**Poissons-scies**		**Peces sierra**		***Pristidae***				**1,10(02)XXX,XX**	**SAW**
34 Liberia	...	...	...	8	...	...	...	...	...	...
Senegal	-	-	...	...	...	...	...	...	...	268
34 Fishing area total	*...*	*...*	*...*	*8*	*...*	*...*	*...*	*...*	*...*	*268*
51 Iran	45	27	73	21	11	26	11	37	38	142
51 Fishing area total	*45*	*27*	*73*	*21*	*11*	*26*	*11*	*37*	*38*	*142*
57 Indonesia	...	...	...	...	...	1	6	11	163	20
57 Fishing area total	*...*	*...*	*...*	*...*	*...*	*1*	*6*	*11*	*163*	*20*
71 Indonesia	...	...	...	...	...	5	16	2	0	33
71 Fishing area total	*...*	*...*	*...*	*...*	*...*	*5*	*16*	*2*	*0*	*33*
Species total	*45*	*27*	*73*	*29*	*11*	*32*	*33*	*50*	*201*	*463*
Blue skate	**Pocheteau gris**		**Noriega**		***Raja batis***				**1,10(04)001,01**	**RJB**
27 Denmark	0	0	0	0	0	-	-	-	-	-
France	667	449	443	472	302	258	238	14	31	2
Iceland	85	59	120	145	167	134	117	127	113	117
Norway	65	53	31	44	33	29	32	30	35	27
Spain	...	...	...	...	...	...	...	...	9	3
UK	...	...	...	...	...	...	...	25	17	6
27 Fishing area total	*817*	*561*	*594*	*661*	*502*	*421*	*387*	*196*	*205*	*155*
Species total	*817*	*561*	*594*	*661*	*502*	*421*	*387*	*196*	*205*	*155*

B-38

Sharks, rays, chimaeras
Squales, raies, chimères
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Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Thornback ray	**Raie bouclée**		**Raya de clavos**		***Raja clavata***				**1,10(04)001,02**	**RJC**
27 Belgium	...	...	...	...	...	...	...	571	399	384
Denmark	-	-	-	-	-	-	-	0	0	1
France	1 214	1 163	1 329	1 081	958	829	687	47	952	1 077
Ireland	-	-	0	-	-	-	0	-	29	195
Netherlands	...	...	...	...	...	...	...	192	162	-
Norway	0	0	0	2	1	-	-	0	-	5
Portugal	...	2	48	87	220	363	434	502	588	869
Spain	...	...	...	...	...	...	...	...	252	714
UK	...	...	...	...	...	...	...	447	796	993
27 Fishing area total	*1 214*	*1 165*	*1 377*	*1 170*	*1 179*	*1 192*	*1 121*	*1 759*	*3 178*	*4 238*
34 Portugal	...	...	...	...	...	0	8	18	7	1
34 Fishing area total	*...*	*...*	*...*	*...*	*...*	*0*	*8*	*18*	*7*	*1*
37 Bulgaria	-	-	-	-	-	-	4	26	47	72
France	17	19	27	25	15	18	13	11	11	12
Greece	...	...	351	298	315	371	323	331	295	295 F
Malta	...	...	...	...	...	...	...	...	...	8
Ukraine	65	79	108	76	60	75	47	55	50	45
37 Fishing area total	*82*	*98*	*486*	*399*	*390*	*464*	*387*	*423*	*403*	*432 F*
Species total	*1 296*	*1 263*	*1 863*	*1 569*	*1 569*	*1 656*	*1 516*	*2 200*	*3 588*	*4 671 F*
Starry ray	**Raie radiée**		**Raya radiante**		***Raja radiata***				**1,10(04)001,03**	**RJR**
27 Belgium	...	...	...	...	...	...	...	2	-	0
France	...	...	...	...	...	...	...	...	...	2
Iceland	1 211	1 781	1 491	1 015	660	512	473	636	710	1 029
Ireland	...	-	1	-	-	-	-	-	0	7
UK	...	...	...	...	...	...	...	1	1	1
27 Fishing area total	*1 211*	*1 781*	*1 492*	*1 015*	*660*	*512*	*473*	*639*	*711*	*1 039*
Species total	*1 211*	*1 781*	*1 492*	*1 015*	*660*	*512*	*473*	*639*	*711*	*1 039*
Spotted ray	**Raie douce**		**Raya pintada**		***Raja montagui***				**1,10(04)001,04**	**RJM**
27 Belgium	...	...	...	...	...	...	...	122	105	88
France	1 563	1 451	1 434	1 312	1 156	1 017	934	42	957	1 003
Ireland	...	...	1	-	-	-	-	-	2	39
Netherlands	...	...	...	...	...	...	...	277	216	-
Portugal	...	...	...	...	64	81	145	158	135	89
Spain	...	...	...	...	...	...	...	...	28	91
UK	...	...	...	...	...	...	...	26	84	187
27 Fishing area total	*1 563*	*1 451*	*1 435*	*1 312*	*1 220*	*1 098*	*1 079*	*625*	*1 527*	*1 497*
Species total	*1 563*	*1 451*	*1 435*	*1 312*	*1 220*	*1 098*	*1 079*	*625*	*1 527*	*1 497*
Blonde ray	**Raie lisse**		**Raya boca de rosa**		***Raja brachyura***				**1,10(04)001,05**	**RJH**
27 Belgium	...	...	...	...	...	...	...	307	296	280
Channel Is	...	...	...	...	...	...	...	...	102	143
France	-	-	...	...	...	...	...	...	138	269
Ireland	...	...	1	-	3	6	-	-	11	440
Netherlands	...	...	...	...	...	...	...	3	2	11
Portugal	...	...	...	...	120	378	376	347	412	377
Spain	...	...	...	...	...	...	...	...	13	9
UK	...	...	...	...	...	...	...	164	349	499
27 Fishing area total	*...*	*...*	*1*	*...*	*123*	*384*	*376*	*821*	*1 323*	*2 028*
Species total	*...*	*...*	*1*	*...*	*123*	*384*	*376*	*821*	*1 323*	*2 028*
Sandy ray	**Raie circulaire**		**Raya falsa vela**		***Raja circularis***				**1,10(04)001,06**	**RJI**
27 Belgium	...	...	...	...	...	...	...	...	...	40
Channel Is	...	...	...	...	...	...	...	...	5	-
France	330	302	281	258	295	221	249	1	84	79
Portugal	...	...	18	24	56	80	49	32	38	39
Spain	...	...	...	...	...	...	...	...	23	67
UK	...	...	...	...	...	...	...	13	15	15
27 Fishing area total	*330*	*302*	*299*	*282*	*351*	*301*	*298*	*46*	*165*	*240*
Species total	*330*	*302*	*299*	*282*	*351*	*301*	*298*	*46*	*165*	*240*
Shagreen ray	**Raie chardon**		**Raya cardadora**		***Raja fullonica***				**1,10(04)001,07**	**RJF**
27 France	68	70	46	33	33	25	32	2	188	191
Iceland	37	32	17	23	16	18	25	4	45	19
Ireland	-	-	-	-	-	-	-	-	-	4
Spain	...	...	...	...	...	...	...	...	50	128
UK	...	...	...	...	...	...	...	13	38	92
27 Fishing area total	*105*	*102*	*63*	*56*	*49*	*43*	*57*	*19*	*321*	*434*
Species total	*105*	*102*	*63*	*56*	*49*	*43*	*57*	*19*	*321*	*434*
Small-eyed ray	**Raie mêlée**		**Raya colorada**		***Raja microocellata***				**1,10(04)001,09**	**RJE**
27 Channel Is	...	...	...	...	...	...	...	...	6	10

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
France	-	-	13	16	23	19	20	0	48	66
Spain	...	...	...	...	...	...	...	...	2	11
UK	...	...	...	...	...	...	...	88	168	247
27 Fishing area total	*...*	*...*	*13*	*16*	*23*	*19*	*20*	*88*	*224*	*334*
Species total	*...*	*...*	*13*	*16*	*23*	*19*	*20*	*88*	*224*	*334*
Cuckoo ray	**Raie fleurie**		**Raya santiguesa**		***Raja naevus***				**1,10(04)001,10**	**RJN**
27 Belgium	...	...	...	...	...	...	...	86	80	74
France	2 885	2 742	2 843	2 759	3 057	2 528	2 471	103	3 215	3 061
Ireland	-	-	-	-	-	-	-	-	12	58
Portugal	-	-	-	-	-	-	24	19	17	10
Spain	...	...	...	...	...	...	...	1	662	1 703
UK	...	...	...	...	...	...	...	227	322	506
27 Fishing area total	*2 885*	*2 742*	*2 843*	*2 759*	*3 057*	*2 528*	*2 495*	*436*	*4 308*	*5 412*
37 France	...	...	...	...	...	...	...	...	1	7
37 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1*	*7*
Species total	*2 885*	*2 742*	*2 843*	*2 759*	*3 057*	*2 528*	*2 495*	*436*	*4 309*	*5 419*
Longnosed skate	**Pocheteau noir**		**Raya picuda**		***Raja oxyrinchus***				**1,10(04)001,11**	**RJO**
27 France	89	210	198	43	49	50	68	12	32	13
Ireland	-	-	0	-	-	-	-	-	2	4
Portugal	-	-	-	-	-	2	6	-	-	-
Spain	...	...	...	...	...	...	...	2	39	1
UK	...	...	...	...	...	...	...	21	11	2
27 Fishing area total	*89*	*210*	*198*	*43*	*49*	*52*	*74*	*35*	*84*	*20*
Species total	*89*	*210*	*198*	*43*	*49*	*52*	*74*	*35*	*84*	*20*
Undulate ray	**Raie brunette**		**Raya mosaica**		***Raja undulata***				**1,10(04)001,12**	**RJU**
27 Channel Is	...	...	...	...	...	...	...	...	4	2
France	-	-	-	-	-	-	-	-	20	10
UK	...	...	...	...	...	...	...	3	2	-
27 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*3*	*26*	*12*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*3*	*26*	*12*
...A	**...B**		**...C**		***Raja taaf***				**1,10(04)001,18**	**RFA**
58 Australia	-	-	-	-	-	-	-	1	-	-
France	-	-	-	-	-	-	-	53	187	176
Uruguay	-	-	-	-	-	-	-	2	-	-
58 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*56*	*187*	*176*
Species total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*56*	*187*	*176*
White skate	**Raie blanche**		**Raya bramante**		***Raja alba***				**1,10(04)001,25**	**RJA**
27 France	...	...	...	...	...	...	0	0	73	23
Iceland	-	-	-	-	-	-	-	-	-	12
Spain	...	...	...	...	...	...	...	...	0	1
UK	...	...	...	...	...	...	...	1	14	41
27 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*0*	*1*	*87*	*77*
37 France	...	...	...	...	...	...	...	...	...	6
37 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*6*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*0*	*1*	*87*	*83*
Round ray	**Raie ronde**		**Raya redonda**		***Raja fyllae***				**1,10(04)001,31**	**RJY**
27 Ireland	-	-	-	-	-	-	-	-	1	1
UK	...	...	...	...	...	...	...	1	-	-
27 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1*	*1*	*1*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1*	*1*	*1*
Antarctic starry skate	**Raie étoilée antarctique**		**Raya estrellada antártica**		***Raja georgiana***				**1,10(04)001,32**	**SRR**
48 New Zealand	-	-	1	-	-	-	-	-	1	-
UK	-	-	0	-	0	-	0	0	0	0
48 Fishing area total	*-*	*-*	*1*	*-*	*0*	*-*	*0*	*0*	*1*	*0*
58 Australia	-	-	-	-	-	-	5	-	-	-
South Africa	-	0	-	-	-	-	-	-	-	-
Spain	-	-	-	-	19	0	-	-	-	-
58 Fishing area total	*-*	*0*	*-*	*-*	*19*	*0*	*5*	*-*	*-*	*-*
88 Argentina	-	-	-	4	-	-	-	-	-	-
Korea Rep	-	-	-	-	-	-	3	-	0	0
New Zealand	7	24	13	3	2	1	2	4	5	4
Russian Fed	-	-	4	1	-	0	1	-	-	-
Spain	-	-	-	2	-	-	-	-	0	1
Ukraine	-	-	-	1	-	-	-	-	-	-

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Uruguay	-	-	-	2	33	-	5	0	-	-
88 Fishing area total	*7*	*24*	*17*	*13*	*35*	*1*	*11*	*4*	*5*	*5*
Species total	*7*	*24*	*18*	*13*	*54*	*1*	*16*	*4*	*6*	*5*
Mediterranean starry ray	**Raie étoilée**		**Raya estrellada**		***Raja asterias***				**1,10(04)001,37**	**JRS**
27 France	...	...	...	...	...	...	...	...	1	...
27 Fishing area total	...	...	...	...	...	...	...	...	*1*	...
37 France	...	...	...	...	...	...	...	...	2	6
37 Fishing area total	...	...	...	...	...	...	...	...	*2*	*6*
Species total	...	...	...	...	...	...	...	...	*3*	*6*
Spotback skate	**...B**		**Raya a lunares**		***Raja castelnaui***				**1,10(04)001,46**	**JRT**
41 Argentina	...	...	...	...	...	...	...	...	25	60
41 Fishing area total	...	...	...	...	...	...	...	...	*25*	*60*
Species total	...	...	...	...	...	...	...	...	*25*	*60*
Eyespot skate	**...B**		**Raya de círculos**		***Raja cyclophora***				**1,10(04)001,54**	**JRY**
41 Argentina	...	...	...	...	...	...	...	...	73	288
41 Fishing area total	...	...	...	...	...	...	...	...	*73*	*288*
Species total	...	...	...	...	...	...	...	...	*73*	*288*
Little skate	**Raie hérisson**		**...C**		***Raja erinacea***				**1,10(04)001,60**	**RJD**
21 USA	...	...	...	...	...	...	...	4 131	3 947	4 207
21 Fishing area total	...	...	...	...	...	...	...	*4 131*	*3 947*	*4 207*
Species total	...	...	...	...	...	...	...	*4 131*	*3 947*	*4 207*
Arctic skate	**Raie arctique**		**Raya ártica**		***Raja hyperborea***				**1,10(04)001,68**	**RJG**
27 Ireland	...	...	5	0	-	-	2	-	-	-
Spain	...	...	...	...	...	...	...	...	...	1
UK	...	...	...	...	...	...	...	...	1	2
27 Fishing area total	...	...	*5*	*0*	...	...	*2*	...	*1*	*3*
Species total	...	...	*5*	*0*	...	...	*2*	...	*1*	*3*
Sailray	**Raie voile**		**Raya vela**		***Raja lintea***				**1,10(04)001,81**	**RJK**
27 Iceland	-	-	10	8	20	-	-	-	-	-
27 Fishing area total	-	-	*10*	*8*	*20*	-	-	-	-	-
Species total	-	-	*10*	*8*	*20*	-	-	-	-	-
Madeiran ray	**Raie de Madère**		**Raya de Madeira**		***Raja maderensis***				**1,10(04)001,83**	**JFY**
34 Spain	-	-	-	-	-	-	-	-	1	-
34 Fishing area total	-	-	-	-	-	-	-	-	*1*	-
Species total	-	-	-	-	-	-	-	-	*1*	-
Brown ray	**Raie miroir**		**Raya de espejos**		***Raja miraletus***				**1,10(04)001,86**	**JAI**
47 Portugal	-	-	-	-	-	1	-	-	-	-
47 Fishing area total	-	-	-	-	-	*1*	-	-	-	-
Species total	-	-	-	-	-	*1*	-	-	-	-
Norwegian skate	**Pocheteau de Norvège**		**Raya noruega**		***Raja nidarosiensis***				**1,10(04)001,88**	**JAD**
27 UK	...	...	...	...	...	...	...	52	5	-
27 Fishing area total	...	...	...	...	...	...	...	*52*	*5*	-
Species total	...	...	...	...	...	...	...	*52*	*5*	-
Raja rays nei	**Pocheteaux et raies raja nca**		**Rayas raja nep**		***Raja spp***				**1,10(04)001,XX**	**SKA**
21 Canada	2 625	2 969	2 606	1 931	1 789	1 274	1 544	1 063	1 130	431
Estonia	1 023	328	882	857	537	258	366	123	29	169
Faroe Is	2	0	-	-	-	268	-	49	36	-
Greenland	-	6	11	-	-	-	-	-	-	-
Lithuania	4	18	406	-	50	136	110	29	-	1
Norway	-	0	10	-	-	-	-	0	0	-
Poland	2	-	-	-	-	-	-	-	-	-
Portugal	880	1 361	1 817	1 543	576	1 004	1 055	1 253	1 048	300
Russian Fed	2 575	3 168	3 278	3 594	82	21	732	544	27	101
St Pier Mq	38	238	82	1	125	77	510	769	6	...
Spain	10 547	6 172	7 516	5 800	1 874	4 023	3 908	4 971	4 623	4 994
USA	13 122	13 010	14 554	14 248	14 113	16 158	19 230	14 468	14 090	13 663
21 Fishing area total	*30 818*	*27 270*	*31 162*	*27 974*	*19 146*	*23 219*	*27 455*	*23 269*	*20 989*	*19 659*

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
27 Belgium	1 527	1 734	1 849	2 012	2 029	1 861	1 901	613	554	458
Channel Is	241	235	251	169	198	177	125	227	19	10
Denmark	122	60	69	156	90	55	37	29	42	41
Estonia	56	6	-	-	3	-	-	-	-	-
Faroe Is	78	26	100	292	298	268	202	203	164	199
France	3 195	3 196	3 462	3 059	3 127	2 713	2 838	5 756	1 256	962
Germany	27	26	42	66	69	24	44	90	-	1
Iceland	-	-	-	-	-	-	-	10	436	-
Ireland	2 140	2 501	2 885	2 704	2 113	1 746	1 571	1 283	986	426
Isle of Man	1	0	0	-	-	-	-	-	-	-
Lithuania	-	-	-	2	12	8	-	-	-	-
Netherlands	748	793	676	558	565	606	733	58	2	-
Norway	727	484	430	368	346	397	351	508	494	500
Portugal	1 685	1 636	1 805	1 861	1 439	920	941	624	477	160
Russian Fed	339	211	44	141	115	67	44	13	10	3
Spain	9 198	3 692	2 276	2 906	5 378	4 980	4 952	6 135	2 133	594
Sweden	12	8	13	20	8	17	11	6	2	10
UK	6 392	6 059	6 543	5 102	3 474	3 385	3 303	2 161	862	400
27 Fishing area total	*26 488*	*20 667*	*20 445*	*19 416*	*19 264*	*17 224*	*17 053*	*17 716*	*7 437*	*3 764*
31 Fr Guiana	...	...	...	...	12	30	24	25	18	20 F
31 Fishing area total	*...*	*...*	*...*	*...*	*12*	*30*	*24*	*25*	*18*	*20 F*
37 Greece	579	536	150	162	165	216	221	211	232	232 F
Syria	...	...	...	...	...	...	...	35	39	43
37 Fishing area total	*579*	*536*	*150*	*162*	*165*	*216*	*221*	*246*	*271*	*275 F*
41 Estonia	-	10	-	18	1	-	-	-	-	59
41 Fishing area total	*-*	*10*	*-*	*18*	*1*	*-*	*-*	*-*	*-*	*59*
Species total	*57 885*	*48 483*	*51 757*	*47 570*	*38 588*	*40 689*	*44 753*	*41 256*	*28 715*	*23 777 F*
Eaton's skate	**Raie d'Eaton**		**Raya de Eaton**		***Bathyraja eatonii***				**1,10(04)002,01**	**BEA**
48 Russian Fed	0	-	-	-	-	-	-	-	-	-
48 Fishing area total	*0*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
58 Australia	-	-	24	8	6	0	7	8	6	13
Korea Rep	-	-	-	-	1	-	0	0	-	-
South Africa	-	0	-	-	-	-	-	-	-	-
58 Fishing area total	*-*	*0*	*24*	*8*	*7*	*0*	*7*	*8*	*6*	*13*
88 Argentina	-	-	-	1	-	0	-	-	-	-
Korea Rep	-	-	-	-	-	-	0	-	1	0
New Zealand	0	1	0	0	0	0	0	-	1	1
Ukraine	-	-	-	0	-	-	-	-	-	-
88 Fishing area total	*0*	*1*	*0*	*1*	*0*	*0*	*0*	*-*	*2*	*1*
Species total	*0*	*1*	*24*	*9*	*7*	*0*	*7*	*8*	*8*	*14*
McCain's skate	**Raie de McCain**		**Raya de McCain**		***Bathyraja maccaini***				**1,10(04)002,02**	**BAM**
58 Australia	-	-	0	0	-	-	-	-	-	-
Korea Rep	-	-	-	-	1	-	-	-	-	-
58 Fishing area total	*-*	*-*	*0*	*0*	*1*	*-*	*-*	*-*	*-*	*-*
88 Argentina	-	-	-	0	-	-	-	-	-	...
New Zealand	-	-	-	0	-	-	0	0	0	-
Ukraine	-	-	-	0	-	-	-	-	-	-
88 Fishing area total	*-*	*-*	*-*	*0*	*-*	*-*	*0*	*0*	*0*	*...*
Species total	*-*	*-*	*0*	*0*	*1*	*-*	*0*	*0*	*0*	*...*
Murray's skate	**Raie de Murray**		**Raya de Murray**		***Bathyraja murrayi***				**1,10(04)002,03**	**BMU**
58 Australia	-	-	1	0	2	-	1	1	2	1
South Africa	-	-	-	-	0	-	-	-	-	-
58 Fishing area total	*-*	*-*	*1*	*0*	*2*	*-*	*1*	*1*	*2*	*1*
88 Korea Rep	-	-	-	0	-	-	-	-	-	-
88 Fishing area total	*-*	*-*	*-*	*0*	*-*	*-*	*-*	*-*	*-*	*-*
Species total	*-*	*-*	*1*	*0*	*2*	*-*	*1*	*1*	*2*	*1*
Kerguelen sandpaper skate	**Raie rugueuse**		**Raya rugosa**		***Bathyraja irrasa***				**1,10(04)002,12**	**BYR**
58 Australia	-	-	2	2	1	8	2	10	1	0
58 Fishing area total	*-*	*-*	*2*	*2*	*1*	*8*	*2*	*10*	*1*	*0*
88 Korea Rep	-	-	-	1	-	-	-	-	-	-
UK	-	-	-	1	-	-	-	-	-	-
88 Fishing area total	*-*	*-*	*-*	*2*	*-*	*-*	*-*	*-*	*-*	*-*
Species total	*-*	*-*	*2*	*4*	*1*	*8*	*2*	*10*	*1*	*0*
Dark-belly skate	**...B**		**...C**		***Bathyraja meridionalis***				**1,10(04)002,16**	**BYE**
48 UK	-	-	0	-	-	-	-	-	-	-
48 Fishing area total	*-*	*-*	*0*	*-*	*-*	*-*	*-*	*-*	*-*	*-*

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	-	-	*0*	-	-	-	-	-	-	-
Broadnose skate	**...B**		**Raya de los canales**		***Bathyraja brachyurops***				**1,10(04)002,33**	**BZB**
41 Argentina	...	...	...	...	...	...	...	...	182	0
41 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*182*	*0*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*182*	*0*
Patagonian skate	**...B**		**Raya espinosa**		***Bathyraja macloviana***				**1,10(04)002,34**	**BZM**
41 Argentina	...	...	...	...	...	...	...	...	20	12
41 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*20*	*12*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*20*	*12*
Bathyraja rays nei	**Raies Bathyraja nca**		**Rayas Bathyraja nep**		***Bathyraja spp***				**1,10(04)002,XX**	**BHY**
58 Australia	-	-	14	-	-	-	-	-	-	-
South Africa	-	-	-	0	-	-	-	-	-	-
Uruguay	-	-	-	-	-	-	1	-	-	-
58 Fishing area total	*-*	*-*	*14*	*0*	*-*	*-*	*1*	*-*	*-*	*-*
88 New Zealand	-	-	-	-	-	-	0	-	-	-
Uruguay	-	-	-	-	3	0	-	-	-	-
88 Fishing area total	*-*	*-*	*-*	*-*	*3*	*0*	*0*	*-*	*-*	*-*
Species total	*-*	*-*	*14*	*0*	*3*	*0*	*1*	*-*	*-*	*-*
New Zealand smooth skate	**...B**		**...C**		***Dipturus innominatus***				**1,10(04)020,01**	**DPQ**
81 New Zealand	707	673	820	594	689	667	644	681	525	573
81 Fishing area total	*707*	*673*	*820*	*594*	*689*	*667*	*644*	*681*	*525*	*573*
Species total	*707*	*673*	*820*	*594*	*689*	*667*	*644*	*681*	*525*	*573*
Yellownose skate	**...B**		**Raya hocicuda**		***Dipturus chilensis***				**1,10(04)020,02**	**DPV**
41 Argentina	...	...	...	...	...	...	...	...	1 331	1 459
41 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1 331*	*1 459*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1 331*	*1 459*
New Zealand rough skate	**...B**		**...C**		***Zearaja nasuta***				**1,10(04)030,01**	**ZRN**
81 New Zealand	979	867	1 311	1 911	1 982	1 674	1 710	1 641	1 922	1 962
81 Fishing area total	*979*	*867*	*1 311*	*1 911*	*1 982*	*1 674*	*1 710*	*1 641*	*1 922*	*1 962*
Species total	*979*	*867*	*1 311*	*1 911*	*1 982*	*1 674*	*1 710*	*1 641*	*1 922*	*1 962*
Rio skate	**...B**		**Raya lisa**		***Rioraja agassizi***				**1,10(04)032,01**	**RRW**
41 Argentina	...	...	...	...	...	...	...	...	237	417
41 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*237*	*417*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*237*	*417*
Smallnose fanskate	**...B**		**Raya marmorada**		***Sympterygia bonapartii***				**1,10(04)036,01**	**YBQ**
41 Argentina	...	...	...	...	...	...	...	...	187	424
41 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*187*	*424*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*187*	*424*
Bignose fanskate	**...B**		**Raya marrón oscuro**		***Sympterygia acuta***				**1,10(04)036,02**	**YAW**
41 Argentina	...	...	...	...	...	...	...	...	53	39
41 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*53*	*39*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*53*	*39*
Rays and skates nei	**Rajidés nca**		**Rayidos nep**		***Rajidae***				**1,10(04)XXX,XX**	**RAJ**
58 France	-	-	-	-	-	-	-	369	273	335
South Africa	-	-	-	0	-	-	-	-	-	-
58 Fishing area total	*-*	*-*	*-*	*0*	*-*	*-*	*-*	*369*	*273*	*335*
88 Argentina	-	-	-	-	-	-	23	-	-	-
Uruguay	-	-	-	-	1	0	3	-	-	-
88 Fishing area total	*-*	*-*	*-*	*-*	*1*	*0*	*26*	*-*	*-*	*-*
Species total	*-*	*-*	*-*	*0*	*1*	*0*	*26*	*369*	*273*	*335*
Whip stingray	**Pastenague du Pacifique**		**Raya látigo del Pacífico**		***Dasyatis akajei***				**1,10(05)003,01**	**WST**
61 Japan	4 312	4 512	4 842	4 700	5 207	5 235	...	...	...	...
61 Fishing area total	*4 312*	*4 512*	*4 842*	*4 700*	*5 207*	*5 235*	*...*	*...*	*...*	*...*

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*4 312*	*4 512*	*4 842*	*4 700*	*5 207*	*5 235*	*...*	*...*	*...*	*...*
Southern stingray	**Pastenague américaine**		**Raya látigo americana**		***Dasyatis americana***				**1,10(05)003,02**	**RDA**
31 Mexico	...	...	...	...	101	105	68	26	25	26
31 Fishing area total	*...*	*...*	*...*	*...*	*101*	*105*	*68*	*26*	*25*	*26*
Species total	*...*	*...*	*...*	*...*	*101*	*105*	*68*	*26*	*25*	*26*
Longtail stingray	**Pastenague queue longue**		**Raya látigo coluda**		***Dasyatis longa***				**1,10(05)003,20**	**RDL**
87 Ecuador	...	...	...	...	...	39	135	45	...	...
87 Fishing area total	*...*	*...*	*...*	*...*	*...*	*39*	*135*	*45*	*...*	*...*
Species total	*...*	*...*	*...*	*...*	*...*	*39*	*135*	*45*	*...*	*...*
Common stingray	**Pastenague commune**		**Raya látigo común**		***Dasyatis pastinaca***				**1,10(05)003,26**	**JDP**
27 France	...	...	11	14	20	13	8	1	4	4
27 Fishing area total	*...*	*...*	*11*	*14*	*20*	*13*	*8*	*1*	*4*	*4*
37 Bulgaria	-	-	-	-	-	-	2	2	2	7
Ukraine	11	-	-	-	-	-	-	-	-	-
37 Fishing area total	*11*	*-*	*-*	*-*	*-*	*-*	*2*	*2*	*2*	*7*
Species total	*11*	*...*	*11*	*14*	*20*	*13*	*10*	*3*	*6*	*11*
Stingrays nei	**Pastenagues nca**		**Pastinacas nep**		***Dasyatis spp***				**1,10(05)003,XX**	**STI**
27 France	7	10	...	...	...	...	...	...	...	...
27 Fishing area total	*7*	*10*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*
Species total	*7*	*10*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*
Sharpnose stingray	**...B**		**...C**		***Himantura gerrardi***				**1,10(05)034,07**	**DHG**
51 Saudi Arabia	37	22	68	25	20	39	38	29	36	37
51 Fishing area total	*37*	*22*	*68*	*25*	*20*	*39*	*38*	*29*	*36*	*37*
Species total	*37*	*22*	*68*	*25*	*20*	*39*	*38*	*29*	*36*	*37*
Stingrays, butterfly rays nei	**Pastenagues, etc. nca**		**Pastinacas, etc. nep**		***Dasyatidae***				**1,10(05)XXX,XX**	**STT**
27 Portugal	2	2	5	2	1	2	1	1	-	-
Spain	...	...	-	-	-	-	-	0	0	1
27 Fishing area total	*2*	*2*	*5*	*2*	*1*	*2*	*1*	*1*	*0*	*1*
37 Malta	-	-	-	-	-	-	-	-	1	1
Spain	-	-	-	2	2	1	3	2	4	3
37 Fishing area total	*-*	*-*	*-*	*2*	*2*	*1*	*3*	*2*	*5*	*4*
51 Bahrain	...	...	...	51	1	1	5	5	12	3
51 Fishing area total	*...*	*...*	*...*	*51*	*1*	*1*	*5*	*5*	*12*	*3*
57 Indonesia	...	...	...	...	7 738	9 657	9 876	11 567	14 588	7 722
57 Fishing area total	*...*	*...*	*...*	*...*	*7 738*	*9 657*	*9 876*	*11 567*	*14 588*	*7 722*
71 Indonesia	...	...	...	...	19 206	19 412	25 774	24 217	30 677	30 077
71 Fishing area total	*...*	*...*	*...*	*...*	*19 206*	*19 412*	*25 774*	*24 217*	*30 677*	*30 077*
Species total	*2*	*2*	*5*	*55*	*26 948*	*29 073*	*35 659*	*35 792*	*45 282*	*37 807*
Common eagle ray	**Aigle commun**		**Aguila marina**		***Myliobatis aquila***				**1,10(07)008,01**	**MYL**
27 France	2	-	2	1	2	2	1	0	26	1
Portugal	9	12	16	10	16	23	21	15	11	18
27 Fishing area total	*11*	*12*	*18*	*11*	*18*	*25*	*22*	*15*	*37*	*19*
37 Malta	...	...	...	...	...	...	...	...	...	2
Slovenia	-	-	-	1	0	-	0	-	0	0
37 Fishing area total	*...*	*...*	*...*	*1*	*0*	*...*	*0*	*...*	*0*	*2*
Species total	*11*	*12*	*18*	*12*	*18*	*25*	*22*	*15*	*37*	*21*
Cownose ray	**...B**		**...C**		***Rhinoptera bonasus***				**1,10(07)024,02**	**MRB**
21 USA	-	-	-	-	-	-	-	176	102	63
21 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*176*	*102*	*63*
Species total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*176*	*102*	*63*
Lusitanian cownose ray	**...B**		**...C**		***Rhinoptera marginata***				**1,10(07)024,06**	**MRM**
34 Mauritania	...	...	...	...	...	...	...	...	...	1 166
34 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1 166*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1 166*

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Eagle rays nei	**Aigles de mer nca**		**Aguilas de mar nep**		***Myliobatidae***				**1,10(07)XXX,XX**	**EAG**
27 Spain	-	-	-	4	5	2	6	5	10	10
27 Fishing area total	-	-	-	*4*	*5*	*2*	*6*	*5*	*10*	*10*
37 Spain	-	-	-	9	45	39	33	34	27	18
37 Fishing area total	-	-	-	*9*	*45*	*39*	*33*	*34*	*27*	*18*
41 Argentina	-	-	-	-	-	4	11	4	15	1
41 Fishing area total	-	-	-	-	-	*4*	*11*	*4*	*15*	*1*
57 Indonesia	...	...	...	...	531	91	2 865	1 114	1 678	2 817
57 Fishing area total	...	...	...	...	*531*	*91*	*2 865*	*1 114*	*1 678*	*2 817*
71 Indonesia	...	...	...	...	444	4 699	943	2 757	3 081	1 415
71 Fishing area total	...	...	...	...	*444*	*4 699*	*943*	*2 757*	*3 081*	*1 415*
81 New Zealand	5	9	13	27	26	33	41	39	38	53
81 Fishing area total	*5*	*9*	*13*	*27*	*26*	*33*	*41*	*39*	*38*	*53*
Species total	*5*	*9*	*13*	*40*	*1 051*	*4 868*	*3 899*	*3 953*	*4 849*	*4 314*
Giant manta	**Mante géante**		**Manta gigante**		***Manta birostris***				**1,10(08)007,02**	**RMB**
87 Ecuador	...	...	...	...	...	...	5	10	...	...
87 Fishing area total	...	...	...	...	...	...	*5*	*10*	...	...
Species total	...	...	...	...	...	...	*5*	*10*	...	...
Devil fish	**...B**		**Manta mobula**		***Mobula mobular***				**1,10(08)010,07**	**RMM**
27 Spain	-	-	-	1	3	3	2	1	3	4
27 Fishing area total	-	-	-	*1*	*3*	*3*	*2*	*1*	*3*	*4*
Species total	-	-	-	*1*	*3*	*3*	*2*	*1*	*3*	*4*
Mantas, devil rays nei	**Mantes, diables de mer nca**		**Mantas, diablos nep**		***Mobulidae***				**1,10(08)XXX,XX**	**MAN**
34 Liberia	106	110	100	802	435	23	...	...	...	...
34 Fishing area total	*106*	*110*	*100*	*802*	*435*	*23*	...	...	...	...
57 Indonesia	...	...	...	...	...	...	761	136	118	265
57 Fishing area total	...	...	...	...	...	...	*761*	*136*	*118*	*265*
71 Indonesia	...	...	...	...	200	2 768	1 259	4 173	2 296	2 182
71 Fishing area total	...	...	...	...	*200*	*2 768*	*1 259*	*4 173*	*2 296*	*2 182*
Species total	*106*	*110*	*100*	*802*	*635*	*2 791*	*2 020*	*4 309*	*2 414*	*2 447*
Spiny butterfly ray	**Raie-papillon épineuse**		**Raya mariposa**		***Gymnura altavela***				**1,10(10)015,01**	**RGL**
27 Portugal	2	4	6	4	6	9	26	7	9	8
27 Fishing area total	*2*	*4*	*6*	*4*	*6*	*9*	*26*	*7*	*9*	*8*
34 Mauritania	...	...	...	...	...	...	...	...	...	144
34 Fishing area total	...	...	...	...	...	...	...	...	...	*144*
Species total	*2*	*4*	*6*	*4*	*6*	*9*	*26*	*7*	*9*	*152*
California butterfly ray	**Raie-papillon californienne**		**Raya mariposa californiana**		***Gymnura marmorata***				**1,10(10)015,05**	**RGM**
87 Ecuador	...	...	...	...	...	20	20	35	...	...
87 Fishing area total	...	...	...	...	...	*20*	*20*	*35*	...	...
Species total	...	...	...	...	...	*20*	*20*	*35*	...	...
Rays, stingrays, mantas nei	**Raies, pastenagues, mantes nca**		**Rayas, pastinacas, mantas nep**		***Rajiformes***				**1,10(XX)XXX,XX**	**SRX**
31 Cuba	1 119	1 278	1 330	1 421	1 533	1 527	1 854	1 926	2 027	1 599
Dominican Rp	123	12	123	51	37	169	102	94	84	91
Korea Rep	3	-	-	-	-	-	1	1	-	-
Martinique	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	4 F
Mexico	2 618	2 407	2 915	2 967	2 876	2 212	2 915	2 402	2 331	3 277
Nicaragua	...	...	...	...	...	1	118	97	163	65
Venezuela	2 182	1 956	2 242	3 540 F	1 900 F	1 120 F	1 370 F	2 018	1 950 F	1 950 F
31 Fishing area total	*6 050 F*	*5 658 F*	*6 615 F*	*7 984 F*	*6 351 F*	*5 034 F*	*6 365 F*	*6 543 F*	*6 560 F*	*6 986 F*
34 Benin	38	32	349	150	155	47	38	33	19	0
Cameroon	130	133	139	400 F	721	721	721	440 F	162	162 F
Congo Rep	100 F	120 F	136	97	162	288	390	99	263	252
Côte dIvoire	168	240	170	81	85	51	41	45 F	45	202
Gabon	88	46	49	83	78	109	90 F	76	50 F	50 F
Ghana	814	969	35	409	707	752	19	600	1 051	21
Italy	12	23	6	1	-	-	-	-	-	-
Korea Rep	334	399	390	276	135	183	259	131	184	238
Liberia	29	30	30	111	29	55	152	40	40 F	40 F
Lithuania	-	-	-	-	-	-	-	-	-	3
Mauritania	300 F	300 F	700 F	1 100 F	1 500 F	760 F	1 050 F	900 F	1 000 F	45
Morocco	1 487	1 867	1 648	1 817	2 595	2 504	2 169	2 408	1 975	2 142
Nigeria	7 352	6 262	6 618	7 195	4 544	6 532	6 101	6 381	7 266	8 330

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Sharks, rays, chimaeras
Squales, raies, chimères
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Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Portugal	-	-	1	1	2	1	5	4	8	-
	Senegal	1 667	917	1 200	1 478	1 365	2 136	2 414	1 027	1 523	70
	Sierra Leone	...	1	...	...	...	...	...	1 797	1 760 F	1 760 F
	Spain	-	-	58	738	138	233	165	36	87	80
	Togo	5	2	55	13	14	11	33	20 F	6	7
34	*Fishing area total*	*12 524 F*	*11 341 F*	*11 584 F*	*13 950 F*	*12 230 F*	*14 383 F*	*13 647 F*	*14 037 F*	*15 439 F*	*13 402 F*
37	Albania	14	28	16	28	44	51	27	50	32	6
	Algeria	298	491	641	330	344	359	399	383	255	173
	Croatia	42	34	31	30	65	57	68	39	41	48
	Cyprus	-	-	-	-	-	-	-	4	8	10
	France	64	75	71	78	65	52	43	33	39	51
	Israel	...	...	...	...	...	...	...	...	31	66
	Italy	543	498	541	577	1 276	958	972	701	822	838
	Korea Rep	-	-	-	-	-	-	-	3	-	-
	Malta	0	...	5	6	6	7	10	13	12	4
	Montenegro	...	...	...	...	...	13	6	13	9	13
	Morocco	24	34	39	49	50	49	40	47	54	53
	Palest, O.T.	25 F	28	28	49	17	3	7	4	3	4
	Russian Fed	30	14	22	14	17	24	12	11	23	20
	Serbia-Monte	11	10	9	8	10	-	-	-	-	-
	Spain	375	835	206	315	287	342	384	418	430	416
	Tunisia	1 113	1 092	917	793	651	630	642	686	715	802
	Turkey	555	369	541	532	763	813	974	591	707	668
	Ukraine	-	-	0	-	-	-	-	-	-	-
37	*Fishing area total*	*3 094 F*	*3 508*	*3 067*	*2 809*	*3 595*	*3 358*	*3 584*	*2 996*	*3 181*	*3 172*
41	Argentina	17 026	14 722	17 469	18 170	22 455	23 618	28 038	26 958	19 941	20 326
	Belize	201	10	-	-	-	-	-	-	-	-
	Brazil	5 100	7 634	6 497	7 505	8 996	7 240	5 279	6 784	7 482	7 073
	Falkland Is	469	575	410	710	658	894	738	444	1 006	1 044
	Korea Rep	6 382	4 430	6 364	6 599	3 377	2 797	3 203	1 981	4 026	2 394
	New Zealand	-	-	4	-	-	-	-	-	-	-
	Portugal	82	54	-	-	-	-	-	-	1	-
	Russian Fed	203	-	105	-	-	-	-	-	-	9
	Seychelles	-	-	30	-	-	-	-	-	-	-
	Spain	428	555	411	716	634	1 163	1 138	1 522	3 357	2 513
	Ukraine	-	-	-	-	-	-	-	5	...	0
	UK	32	24	5	9	16	11	34	25	44	71
	Uruguay	989	1 998	3 324	3 383	2 952	2 831	3 616	1 896	1 259	1 104
41	*Fishing area total*	*30 912*	*30 002*	*34 619*	*37 092*	*39 088*	*38 554*	*42 046*	*39 615*	*37 116*	*34 534*
47	Angola	1 430	2 696	1 641	1 876	1 700 F	1 876	5 686	172	822	800 F
	Korea Rep	323	268	213	272	287	325	266	209	269	398
	Namibia	1 204	...	887	236	...	114	...	...	...	...
	Portugal	-	-	-	-	2	0	-	-	3	-
	South Africa	1 151	1 300	1 495	1 646	...	1 220	1 021	-	-	8
47	*Fishing area total*	*4 108*	*4 264*	*4 236*	*4 030*	*1 989 F*	*3 535*	*6 973*	*381*	*1 094*	*1 206 F*
48	Chile	-	-	-	-	-	-	-	0	0	1
	Korea Rep	7	-	-	0	-	-	0	-	2	-
	New Zealand	-	-	0	-	-	5	4	7	2	2
	Russian Fed	0	-	-	-	-	-	-	-	-	-
	South Africa	-	-	10	1	0	-	0	-	1	0
	Spain	-	-	1	-	0	0	0	0	2	4
	UK	6	-	6	32	8	4	2	8	15	3
	USA	0	-	-	-	-	-	-	-	-	-
	Uruguay	-	-	-	2	-	-	0	0	0	0
48	*Fishing area total*	*13*	*-*	*17*	*35*	*8*	*9*	*6*	*15*	*22*	*10*
51	Iran	2 558	2 477	4 067	4 842	3 221	1 401	1 326	1 130	3 078	3 677
	Korea Rep	23	36	79	12	1	-	-	-	-	-
	Mauritius	2	2	2	2	2	...	2	5	...	...
	Oman	198	199	162	143	176	160	157	967	726	667
	Pakistan	20 801	20 900	13 711	11 065	9 930	8 892	7 279	7 312	6 618	6 196
	Tanzania	3 500	2 500	2 500	2 300	2 350	1 170	2 005	2 004	2 050	2 707
51	*Fishing area total*	*27 082*	*26 114*	*20 521*	*18 364*	*15 680*	*11 623*	*10 769*	*11 418*	*12 472*	*13 247*
57	Australia	24	36	46	87	105	90	48	53	53	54
	Indonesia	11 978	12 275	12 329	11 452	-	-	-	-	-	-
	Malaysia	5 176	5 058	5 230	5 024	3 679	4 750	5 157	5 913	4 663	4 173
	Thailand	5 085	5 256	4 394	6 454	7 858	5 209	4 002	3 173	3 039	3 106
57	*Fishing area total*	*22 263*	*22 625*	*21 999*	*23 017*	*11 642*	*10 049*	*9 207*	*9 139*	*7 755*	*7 333*
58	Australia	-	-	0	59	70	8	4	3	16	11
	Chile	-	-	-	-	3	-	-	-	-	-
	France	119	599	856	494	538	360	376	-	-	-
	Japan	-	-	-	-	-	-	0	0	2	1
	Namibia	-	-	-	-	-	-	1	-	-	-
	South Africa	1	0	2	2	-	-	-	-	0	-
	Spain	-	-	-	-	1	8	0	-	-	-
	Uruguay	-	-	-	-	-	0	-	0	1	-
58	*Fishing area total*	*120*	*599*	*858*	*555*	*612*	*376*	*381*	*3*	*19*	*12*
61	China,Taiwan	851	1 143	2 706	1 126	797	230	131	167	378	182
	Korea Rep	3 091	2 583	2 788	2 825	3 297	4 116	5 168	4 465	6 645	6 773
	Russian Fed	1 602	1 358	1 054	1 569	2 291	1 623	1 667	977	2 484	3 479
61	*Fishing area total*	*5 544*	*5 084*	*6 548*	*5 520*	*6 385*	*5 969*	*6 966*	*5 609*	*9 507*	*10 434*

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
67 Canada	1 618	1 540	2 235	1 723	1 780	1 429	1 192	933	915	1 064
USA	1 399	3 112	14 088	10 793	10 328	8 722	8 156	10 534	10 079	9 870
67 Fishing area total	*3 017*	*4 652*	*16 323*	*12 516*	*12 108*	*10 151*	*9 348*	*11 467*	*10 994*	*10 934*
71 Australia	0	-	-	-	-	-	-	-	-	-
Indonesia	32 473	37 217	47 130	46 525	-	-	-	-	-	-
Korea Rep	1 526	1 861	1 295	1 486	1 698	1 136	704	887	203	631
Malaysia	11 356	10 883	14 023	11 729	12 250	10 079	8 924	9 729	10 427	9 597
Philippines	2 733	2 986	3 156	2 799	2 307	2 545	2 559	2 370	2 591	2 713
Singapore	187	162	140	154	164	195	180	117	143	105
Thailand	8 047	11 034	13 737	11 037	5 136	4 924	4 114	3 072	2 893	2 983
71 Fishing area total	*56 322*	*64 143*	*79 481*	*73 730*	*21 555*	*18 879*	*16 481*	*16 175*	*16 257*	*16 029*
77 Korea Rep	106	75	58	22	-	-	-	4	-	-
Mexico	4 405	4 098	4 904	4 993	5 997	4 614	5 114	4 199	4 075	3 922
Nicaragua	...	...	...	...	...	17	94	76	36	125
USA	101	27	29	22	25	20	27	54	37	72
77 Fishing area total	*4 612*	*4 200*	*4 991*	*5 037*	*6 022*	*4 651*	*5 235*	*4 333*	*4 148*	*4 119*
81 Australia	46	42	74	84	61	23	24	37	40	29
Korea Rep	168	121	162	212	137	115	198	146	119	85
New Zealand	1 098	1 120	722	10	6	4	6	8	6	7
Ukraine	-	-	4	-	-	-	-	-	-	-
81 Fishing area total	*1 312*	*1 283*	*962*	*306*	*204*	*142*	*228*	*191*	*165*	*121*
87 Chile	2 974	2 992	5 193	3 268	3 011	3 116	2 802	1 742	1 834	1 803
Colombia	1	...	...	3	...	10 F	15 F	20 F	25	-
Ecuador	...	...	...	...	...	159	234	62	223	...
Korea Rep	38	2	-	-	-	-	-	-	-	-
Peru	2 034	2 502	2 292	983	672	1 386	974	1 185	1 509	1 440
87 Fishing area total	*5 047*	*5 496*	*7 485*	*4 254*	*3 683*	*4 671 F*	*4 025 F*	*3 009 F*	*3 591*	*3 243*
88 Argentina	-	-	-	0	-	-	-	-	-	-
Korea Rep	-	-	-	1	-	-	-	-	0	-
New Zealand	-	-	-	-	0	0	-	-	-	1
Norway	-	-	-	5	5	-	1	-	-	-
South Africa	-	-	-	4	-	-	0	0	-	-
UK	-	-	-	-	17	-	0	0	0	0
Uruguay	-	-	-	0	-	3	-	-	-	-
88 Fishing area total	-	-	-	*10*	*22*	*3*	*1*	*0*	*0*	*1*
Species total	*182 020 F*	*188 969 F*	*219 306 F*	*209 209 F*	*141 174 F*	*131 387 F*	*135 262 F*	*124 931 F*	*128 320 F*	*124 783 F*

Torpedo rays	**Torpilles**		**Tremolinas**		***Torpedo spp***			**1,11(01)002,XX**		**TOE**
27 France	43	34	31	33	22	23	21	6	26	22
Portugal	35	34	45	45	47	59	57	52	44	58
Spain	-	-	-	14	13	21	20	23	26	26
27 Fishing area total	*78*	*68*	*76*	*92*	*82*	*103*	*98*	*81*	*96*	*106*
Species total	*78*	*68*	*76*	*92*	*82*	*103*	*98*	*81*	*96*	*106*

Rabbit fish	**Chimère commune**		**Quimera**		***Chimaera monstrosa***			**1,12(01)003,01**		**CMO**
21 Norway	-	-	-	-	-	-	-	1	-	-
21 Fishing area total	-	-	-	-	-	-	-	*1*	-	-
27 Denmark	1	0	0	1	11	1	1	0	1	1
Estonia	-	-	-	-	4	2	-	-	-	-
Iceland	1	-	1	-	-	-	-	1	1	7
Ireland	15	16	2	1	-	1	10	10	0	1
Norway	69	146	131	130	84	65	108	114	156	247
Russian Fed	-	-	-	36	2	-	-	2	-	-
Spain	-	-	3	449	5	0	24	6	31	31
UK	36	7	33	1	240	18	9	-	-	0
27 Fishing area total	*122*	*169*	*170*	*618*	*346*	*87*	*152*	*133*	*189*	*287*
Species total	*122*	*169*	*170*	*618*	*346*	*87*	*152*	*134*	*189*	*287*

Spotted ratfish	**Chimère d'Amérique**		**Quimera americana**		***Hydrolagus colliei***			**1,12(01)004,01**		**RAT**
67 USA	-	-	-	-	-	-	-	-	-	1
67 Fishing area total	-	-	-	-	-	-	-	-	-	*1*
77 USA	-	2	-	-	0	0	0	0	0	0
77 Fishing area total	-	*2*	-	-	*0*	*0*	*0*	*0*	*0*	*0*
Species total	-	*2*	-	-	*0*	*0*	*0*	*0*	*0*	*1*

Dark ghost shark	**...B**		**...C**		***Hydrolagus novaezealandiae***			**1,12(01)004,11**		**CYV**
81 New Zealand	1 572	2 055	2 554	1 793	2 170	1 669	2 154	1 779	1 993	2 229
81 Fishing area total	*1 572*	*2 055*	*2 554*	*1 793*	*2 170*	*1 669*	*2 154*	*1 779*	*1 993*	*2 229*
Species total	*1 572*	*2 055*	*2 554*	*1 793*	*2 170*	*1 669*	*2 154*	*1 779*	*1 993*	*2 229*

Ratfishes nei	**Chimères nca**		**Quimeras nep**		***Hydrolagus spp***			**1,12(01)004,XX**		**HYD**
27 France	822	629	467	525	450	385	421	431	363	404

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Ireland	5	-	-	-	-	-	-	-	-	-
Lithuania	-	-	4	26	64	57	86	7	-	-
Norway	19	23	-	-	-	-	-	-	-	-
UK	2	-	-	-	-	-	-	-	-	-
27 Fishing area total	*848*	*652*	*471*	*551*	*514*	*442*	*507*	*438*	*363*	*404*
81 New Zealand	2 184	1 901	1 802	1 451	840	684	742	849	823	737
Ukraine	-	-	-	1	...	-	-	-	-	-
81 Fishing area total	*2 184*	*1 901*	*1 802*	*1 452*	*840*	*684*	*742*	*849*	*823*	*737*
Species total	*3 032*	*2 553*	*2 273*	*2 003*	*1 354*	*1 126*	*1 249*	*1 287*	*1 186*	*1 141*
Straightnose rabbitfish	**Chimère à nez mou**		**Narigón sierra**		***Rhinochimaera atlantica***				**1,12(02)001,01**	**RCT**
27 UK	2	1	-	-	-	-	-	-	-	-
27 Fishing area total	*2*	*1*	-	-	-	-	-	-	-	-
Species total	*2*	*1*	-	-	-	-	-	-	-	-
Ghost shark	**Masca laboureur**		**...C**		***Callorhinchus milii***				**1,12(03)001,01**	**CHB**
57 Australia	105	102	141	112	115	146	118	130	146	160
57 Fishing area total	*105*	*102*	*141*	*112*	*115*	*146*	*118*	*130*	*146*	*160*
81 New Zealand	1 189	1 085	1 004	1 191	1 239	1 161	1 353	1 380	1 506	1 448
Ukraine	-	1	1	-	-	-	-	-	-	-
81 Fishing area total	*1 189*	*1 086*	*1 005*	*1 191*	*1 239*	*1 161*	*1 353*	*1 380*	*1 506*	*1 448*
Species total	*1 294*	*1 188*	*1 146*	*1 303*	*1 354*	*1 307*	*1 471*	*1 510*	*1 652*	*1 608*
Plownose chimaera	**Masca**		**Pejegallo**		***Callorhinchus callorynchus***				**1,12(03)001,02**	**CHJ**
41 Argentina	457	568	1 712	1 619	1 873	1 512	1 688	2 688	2 782	2 138
Uruguay	4	0	3	27	2	2	4	5	...	1
41 Fishing area total	*461*	*568*	*1 715*	*1 646*	*1 875*	*1 514*	*1 692*	*2 693*	*2 782*	*2 139*
87 Chile	1 125	312	815	1 297	672	386	650	966	1 023	561
87 Fishing area total	*1 125*	*312*	*815*	*1 297*	*672*	*386*	*650*	*966*	*1 023*	*561*
Species total	*1 586*	*880*	*2 530*	*2 943*	*2 547*	*1 900*	*2 342*	*3 659*	*3 805*	*2 700*
Cape elephantfish	**Masca du Cap**		**Pejegallo del Cabo**		***Callorhinchus capensis***				**1,12(03)001,03**	**CHM**
47 South Africa	405	422	524	559	645	749	702	585	623	859
47 Fishing area total	*405*	*422*	*524*	*559*	*645*	*749*	*702*	*585*	*623*	*859*
Species total	*405*	*422*	*524*	*559*	*645*	*749*	*702*	*585*	*623*	*859*
Elephantfishes, etc. nei	**Mascas, etc. nca**		**Pejegallos, etc. nep**		***Callorhinchidae***				**1,12(03)XXX,XX**	**CAH**
48 Chile	-	-	-	6	-	-	-	-	-	-
48 Fishing area total	-	-	-	*6*	-	-	-	-	-	-
Species total	-	-	-	*6*	-	-	-	-	-	-
Chimaeras, etc. nei	**Chimères, etc. nca**		**Quimeras, etc. nep**		***Chimaeriformes***				**1,12(XX)XXX,XX**	**HOL**
27 Spain	-	-	-	-	-	-	-	-	26	0
27 Fishing area total	-	-	-	-	-	-	-	-	*26*	*0*
34 Spain	-	-	-	-	1	6	-	-	-	-
34 Fishing area total	-	-	-	-	*1*	*6*	-	-	-	-
81 New Zealand	76	103	156	193	152	101	93	95	96	104
81 Fishing area total	*76*	*103*	*156*	*193*	*152*	*101*	*93*	*95*	*96*	*104*
Species total	*76*	*103*	*156*	*193*	*153*	*107*	*93*	*95*	*122*	*104*
Various sharks nei	**Requins divers nca**		**Escualos diversos nep**		***Selachimorpha(Pleurotremata)***				**1,99(XX)XXX,XX**	**SKH**
27 Belgium	18	12	12	15	16	12	12	15	9	10
Estonia	-	53	4	3	-	-	-	-	-	-
Ireland	455	468	1	-	-	-	1	1	1	0
Netherlands	3	-	-	-	-	-	-	-	3	7
Norway	72	-	1	-	-	0	2	3	1	-
Russian Fed	-	-	-	73	40	130	438	469	101	-
Spain	17 729	5 033	136	-	-	-	-	-	-	1 382
UK	1 564	1 198	411	644	67	31	161	43	42	7
27 Fishing area total	*19 841*	*6 764*	*565*	*735*	*123*	*173*	*614*	*531*	*157*	*1 406*
41 Argentina	798	1 101	998	684	1 088	1 337	917	989	820	936
41 Fishing area total	*798*	*1 101*	*998*	*684*	*1 088*	*1 337*	*917*	*989*	*820*	*936*
Species total	*20 639*	*7 865*	*1 563*	*1 419*	*1 211*	*1 510*	*1 531*	*1 520*	*977*	*2 342*
Sharks, rays, skates, etc. nei	**Requins, raies, etc. nca**		**Tiburones, rayas, etc. nep**		***Elasmobranchii***				**1,99(XX)XXX,XX**	**SKX**
21 Canada	23	29	22	14	33	8	10	11	6	-
China,Taiwan	8	14	4	5	-	3	1	-	-	-

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Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Japan	93	104	23	90	129	142	179	526	233	217
	Portugal	-	7	9	-	-	193	-	-	-	-
	Spain	-	-	-	-	438	393	1	90	-	1
	USA	784	940	737	329	431	211	183	153	139	158
21	*Fishing area total*	*908*	*1 094*	*795*	*438*	*1 031*	*950*	*374*	*780*	*378*	*376*
27	China,Taiwan	8	20	18	4	-	-	2	-	-	-
	Faroe Is	13	54	87	56	98	69	50	54	23	18
	France	-	-	-	-	-	-	0	1	55	29
	Japan	131	2	210	395	514	633	1 149	891	471	351
	Poland	11	8	8	1	-	-	-	-	-	-
	Portugal	213	342	221	88	79	84	20	4	4	-
	Sweden	-	-	-	16	8	13	-	-	0	-
27	*Fishing area total*	*376*	*426*	*544*	*560*	*699*	*799*	*1 221*	*950*	*553*	*398*
31	Antigua Barb	8	17	36	29	17	44	30	91	47	28
	Bahamas	0	0	0	2	0	0	0	0	0	0
	Barbados	14	14	12	13	18	15	13	15	9	11
	Belize	...	5	...	...	10	8	6	6	7	6
	Bermuda	5	5	7	6	7	5	6	5	5	3
	Br Virgin Is	0	0	0	0	0	0	0	-	-	-
	China,Taiwan	195	107	80	315	3	451	182	8	1	-
	Costa Rica	49	27	43	54	49	35 F	18	18 F	18 F	18 F
	Cuba	2 396	2 344	1 225	572	550	888	895	901	883	619
	Grenada	29	12	17	15	18	16	25	24	12	10
	Guyana	670	842	1 791	3 054	2 360	1 681	988	1 662	370	383
	Japan	75	323	194	190	251	202	57	222	107	159
	Korea Rep	-	-	-	-	-	-	-	-	4	1
	Martinique	40 F	40 F	40 F	40 F	35 F	35 F	35 F	35 F	35 F	28 F
	Mexico	3 970	3 100	4 101	4 593	2 415	2 526	2 425	1 801	1 747	1 509
	Portugal	-	2	-	-	1	0	1	-	-	-
	Puerto Rico	32	20	20	11	16	20	16	18	8	11
	St Lucia	5	10	3	7	12	3	3	5	3	4
	St Vincent	5	3	2	2	...	3	9	4	5	8
	Spain	-	205	255	-	2	10	5	-	32	26
	Suriname	...	...	267	291	155	...	...	...	...	...
	Trinidad Tob	884	1 295	925	1 059	1 991	387	391	341	326	415
	USA	1 846	2 426	2 730	1 952	2 011	2 785	1 606	1 129	1 284	1 188
	Vanuatu	-	-	-	1	5	7	-	-	-	8
31	*Fishing area total*	*10 223 F*	*10 797 F*	*11 748 F*	*12 206 F*	*9 926 F*	*9 121 F*	*6 711 F*	*6 285 F*	*4 903 F*	*4 435 F*
34	Benin	87	86	97	88	73	71	57	168	...	...
	Cameroon	146	85	95	500 F	1 091	1 091	1 091	1 090 F	952 F	952 F
	China,Taiwan	116	69	261	75	133	300	725	498	243	284
	Congo Dem R	450 F	830 F	1 230 F	1 600 F	2 000 F	2 400 F	2 760	2 760 F	2 760 F	2 760 F
	Côte dIvoire	-	69	-	-	50	...	...	200 F	200	350
	Eq Guinea	100 F	100 F	100 F	100 F	100 F	105 F	100	200	150 F	3
	Gabon	375	360	536	553	562	602	554	63	44 F	44 F
	Gambia	3 982	6 128	1 085	494	1 738	324	361	471	504	504
	Ghana	2 092	2 451	1 308	1 170	4 292	974	1 129	4 345	5 403	5 243
	Guinea	681	592	...	...	1 728	...	451	430	420 F	420 F
	Japan	265	873	361	569	625	798	1 004	1 596	1 713	1 578
	Korea Rep	-	-	-	-	1	-	-	11	20	67
	Liberia	169	512	520	303	256	349	504	108	100 F	100 F
	Mauritania	500 F	500 F	700 F	900 F	1 100 F	530 F	730 F	630 F	700 F	10
	Morocco	2 189	2 131	2 925	2 996	3 501	2 710	2 951	4 231	2 618	2 354
	Netherlands	-	-	-	-	-	-	19	49	48	-
	Nigeria	7 274	7 187	8 561	6 365	9 338	7 912	9 191	8 750	10 704	13 295
	Portugal	10	91	26	8	23	46	26	13	19	15
	Russian Fed	-	-	-	-	17	-	-	-	-	-
	Sao Tome Prn	178	178	165	171	143	132	132 F	238	100	102
	Senegal	3 260	2 648	2 367	3 976	4 357	2 371	2 208	1 149	2 133	3 989
	Sierra Leone	164	403	1 250	1 314	1 281	1 291	1 483	1 776	1 740 F	1 740 F
	Spain	-	-	3 017	-	-	-	-	-	-	194
	Togo	130	254	700	140	83	100	41	41 F	41	6
	UK	-	-	-	-	834	25	-	-	-	-
	Vanuatu	-	-	-	-	18	13	4	-	-	-
34	*Fishing area total*	*22 168 F*	*25 547 F*	*25 304 F*	*21 322 F*	*33 344 F*	*22 144 F*	*25 521 F*	*28 817 F*	*30 612 F*	*34 010 F*
37	Algeria	679	519	25	12	30	11	11	34	59	41
	China,Taiwan	-	-	-	-	-	1	-	-	-	-
	Cyprus	28	22	13	13	21	25	17	3	2	3
	Egypt	2 143	2 020	1 395	1 251	577	3 450	2 388	3 039	2 468	3 056
	France	-	-	-	-	-	-	1	-	-	-
	Georgia	26	62	31	31	20 F	10 F	...	0	0	0
	Israel	35	32	28	89	280	179	169	170 F	57	46
	Italy	-	-	-	-	196	35	138	229	117	85
	Japan	-	-	1	1	2	-	3	2	-	-
	Lebanon	55	60	60	60	55	58	58 F	58 F	58 F	58 F
	Malta	6	10	6	4	4	7	8	0	1	0
	Morocco	11	30	27	17	41	33	23	53	87	120
	Portugal	1	1	-	4	3	-	1	-	-	-
	Russian Fed	27	19	29	34	19	17	32	59	12	9
	Spain	369	28	34	32	22	1	26	29	42	37
	Syria	150	182	184	190	135	196	103	55	80	62
37	*Fishing area total*	*3 530*	*2 985*	*1 833*	*1 738*	*1 405 F*	*4 023 F*	*2 978 F*	*3 731 F*	*2 983 F*	*3 517 F*
41	Brazil	11 637	10 795	9 022	9 907	11 265	7 549	7 862	9 848	11 904	12 337
	China,Taiwan	142	221	967	846	787	1 681	954	943	558	410

B-38

Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Estonia	-	188	-	-	-	11	-	-	-	-
	Falkland Is	...	...	...	...	13	1	1	2	3	1
	Japan	46	302	64	20	6	19	49	82	193	194
	Korea Rep	...	...	...	...	...	818	1 233	14	5	824
	Portugal	5	-	4	1	14	2	3	2	1	1
	Spain	-	-	-	-	-	-	-	-	-	182
	UK	4	26	...	...	3	290	30	-	-	4
	Uruguay	286	323	-	-	15	-	-	-	-	40
	Vanuatu	-	-	-	-	-	-	-	1	-	3
41	*Fishing area total*	*12 120*	*11 855*	*10 057*	*10 774*	*12 103*	*10 371*	*10 132*	*10 892*	*12 664*	*13 996*
47	Angola	3 354	3 236	1 438	1 746	1 600 F	1 746	2 855	895	106	100 F
	China,Taiwan	568	703	473	134	532	242	1 027	762	824	1 210
	Japan	205	235	236	347	874	575	806	1 698	801	1 009
	Korea Rep	-	-	-	-	-	-	-	12	3	7
	Namibia	1 875	-	576	-	181	72	1 718	1 620	130	...
	Portugal	2	7	-	3	3	-	3	7	3	-
	St Helena	6	4	2	0	1	0	0	1	1	0
	Seychelles	-	1	-	-	-	-	-	-	-	-
	South Africa	132	350	207	423	1 678	418	292	861	810	863
	Spain	-	-	-	-	-	-	-	-	-	37
	UK	-	-	-	-	-	46	30	-	-	-
47	*Fishing area total*	*6 142*	*4 536*	*2 932*	*2 653*	*4 869 F*	*3 099*	*6 731*	*5 856*	*2 678*	*3 226 F*
48	UK	-	-	-	0	0	0	0	-	-	-
48	*Fishing area total*	-	-	-	*0*	*0*	*0*	*0*	-	-	-
51	Belize	-	4 243	-	-	15	37	21	0	-	-
	China,Taiwan	1 826	1 979	2 626	2 073	1 441	1 204	4 111	3 749	2 694	2 879
	Comoros	140	150	160	170	175	175 F	183	244	244 F	244 F
	Egypt	263	202	209	127	51	126	115	80	81	23
	France	-	-	-	-	-	-	-	-	1	1
	Guinea	148	804	709	487	1 697	417	455	506	437	350
	India	28 933	33 310	31 127	24 393	29 237	32 254	42 708	42 176	29 816	25 199
	Japan	158	526	435	304	343	300	388	626	634	379
	Kenya	175	134	208	197	253	189	165	183	232	274
	Korea Rep	49	59	96	73	105	119	112	108	325	179
	Madagascar	5 735	5 730	5 728	5 725	5 725	5 717	5 668	5 617	5 617	5 617
	Maldives	11 935	11 498	11 522	947	896	856	782	537	457	128
	Mauritius	12	48	309	282	242	161	500	70	40	28
	Mayotte	1	2	2	...	6	11	11	11	11	11
	Mozambique	...	...	429	268	893	776	746	181	906	791
	Oman	3 632	3 803	5 927	5 564	5 455	5 962	5 341	5 209	4 752	5 277
	Philippines	28	66	-	-	-	-	-	-	-	1
	Portugal	728	94	2 756	1	-	7	33	39	6	2
	Réunion	76	68	59	66	80	63	81	64	54	54 F
	Saudi Arabia	1 027	1 241	1 330	1 191	1 394	1 261	1 533	1 360	923	875
	Senegal	-	-	88	133	-	417	-	-	-	-
	Seychelles	95	90	243	213	237	163	420	208	246	263
	South Africa	35	7	2	12	2	1	1	3	1	2
	Spain	8 491	12 223	8 361	611	1 921	2 302	5 738	3 027	2 054	1 445
	Sudan	79	79	79 F	79 F	79 F	79 F	79 F	79 F	79	79 F
	Tanzania	1 500	1 500	1 550	1 841	1 690	1 923	1 839	2 686	2 580	3 964
	Untd Arab Em	1 762	2 541	3 060	2 631	3 520	3 480 F	3 450 F	3 405	982	1 433
	UK	-	-	-	166	134	30	24	270	271	15
	Uruguay	-	-	-	-	-	2	-	-	-	-
	Yemen	7 100 F	8 600 F	11 000 F	12 000 F	12 800	12 593	12 387	5 544	8 750 F	12 000
	Zanzibar	641	870	1 245	1 841	1 236	1 443	1 339	1 395	1 400	1 418
	Other nei	344	650	885	2 191	2 771	657	715	664	1 889	1 725
51	*Fishing area total*	*74 913 F*	*90 517 F*	*90 145 F*	*63 586 F*	*72 398 F*	*72 725 F*	*88 945 F*	*78 041 F*	*65 482 F*	*64 656 F*
57	Australia	2 508	2 936	2 616	2 671	3 054	1 994	1 629	1 667	1 592	1 459
	Bangladesh	...	...	...	...	...	...	...	4 767	3 933	4 033
	Belize	-	913	-	-	0	-	-	-	-	-
	China,Taiwan	345	626	429	2 230	1 990	1 996	756	932	2 005	2 337
	Guinea	...	-	-	461	-	63	45	105	91	38
	Honduras	85	-	-	-	-	-	-	-	-	-
	India	39 038	33 613	32 644	55 432	31 819	34 113	60 538	45 078	49 931	36 672
	Indonesia	32 620	26 176	31 049	27 006	-	-	-	-	-	-
	Japan	271	419	141	70	85	90	147	706	849	420
	Korea Rep	-	-	-	1	-	-	-	5	-	-
	Madagascar	-	-	-	-	1	-	-	-	-	-
	Malaysia	1 119	1 216	994	947	728	1 096	1 088	789	1 432	1 181
	Philippines	0	-	-	-	-	-	-	-	-	1
	Portugal	-	-	-	6	17	-	-	-	-	-
	Senegal	-	-	-	-	42	63	-	-	-	-
	Seychelles	5	5	40	2	1	2	6	8	47	48
	Spain	-	1 279	4 287	428	538	235	66	360	635	256
	Sri Lanka	21 160	25 923	29 188	23 419	5 270	5 740	3 268	3 890	4 331	6 837
	Thailand	4 361	4 800	3 917	4 287	3 836	2 506	2 042	1 112	1 229	1 171
	UK	-	-	-	-	20	22	371	-	6	207
	Other nei	61	83	426	2 089	850	107	58	26	122	126
57	*Fishing area total*	*101 573*	*97 989*	*105 731*	*119 049*	*48 251*	*48 027*	*70 014*	*59 445*	*66 203*	*54 786*
58	Australia	-	-	-	-	1	-	-	-	-	-
58	*Fishing area total*	-	-	-	-	*1*	-	-	-	-	-
61	China,H.Kong	370 F	350 F	320 F	345 F	330 F	310 F	310 F	320 F	325 F	340 F
	China,Taiwan	8 230	9 482	14 842	30 797	35 257	32 023	36 723	28 987	19 346	12 642

B-38

Sharks, rays, chimaeras
Squales, raies, chimères
Tiburones, rayas, quimeras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Japan	19 905	21 338	15 691	13 376	15 983	12 534	10 649	8 936	8 242	7 495
	Korea Rep	389	243	213	172	259	208	227	245	341	525
	Russian Fed	100	-	6	1	-	2	24	-	-	12
	Spain	-	-	-	-	282	-	-	-	-	-
61	*Fishing area total*	*28 994 F*	*31 413 F*	*31 072 F*	*44 691 F*	*52 111 F*	*45 077 F*	*47 933 F*	*38 488 F*	*28 254 F*	*21 014 F*
67	Japan	-	-	-	578	24	40	2	-	19	90
	USA	36	4	81	109	55	56	44	13	1	1
67	*Fishing area total*	*36*	*4*	*81*	*687*	*79*	*96*	*46*	*13*	*20*	*91*
71	Australia	2 223	2 279	2 730	3 198	3 032	2 623	2 585	2 481	2 641	1 739
	China,Taiwan	29 961	29 952	44 699	4 891	3 771	9 521	3 041	3 582	1 610	3 144
	Cook Is	-	-	-	-	-	13	5	29	4	4
	Guam	0	0	-	-	-	-	-	-	-	-
	Indonesia	33 240	30 730	27 051	23 711	-	-	-	-	-	-
	Japan	155	325	163	163	72	136	138	174	143	293
	Kiribati	1 273	2 769	1 334	1 150 F	850 F	600 F	408	209	344	252 F
	Korea Rep	8	10	1	14	24	-	-	-	28	95
	Malaysia	7 558	7 010	7 701	7 353	8 437	6 315	6 595	6 557	5 820	5 612
	Nauru	...	0	2	0	1	1 F	1 F	1 F	1 F	1 F
	Philippines	2 542	2 682	3 021	2 977	2 439	2 764	2 638	2 380	2 635	2 798
	Singapore	32	30	17	31	23	38	42	17	20	10
	Solomon Is	10	5	2	9	10 F	10 F	10 F	10 F	10 F	10 F
	Spain	-	-	-	1	-	-	-	-	-	-
	Thailand	6 785	9 118	10 492	5 868	3 915	3 576	2 958	1 722	1 808	1 765
71	*Fishing area total*	*83 787*	*84 910*	*97 213*	*49 366 F*	*22 574 F*	*25 597 F*	*18 421 F*	*17 162 F*	*15 064 F*	*15 723 F*
77	China,Taiwan	105	96	327	1 301	1 234	1 723	1 054	1 148	1 651	1 201
	Cook Is	20 F	6 F	45 F	28	29 F	4	5 F	1	3	1
	Costa Rica	8 510	7 444	10 191	3 801	4 380	4 100 F	3 853	3 850 F	3 850 F	3 850 F
	El Salvador	759	951	964	906	1 202	804	715	28	44	44
	Fr Polynesia	705	1 063	700 F	309	227	139	148	119	165	0
	Guatemala	250 F	359	11	187	203	104	129	122	247	273
	Japan	956	2 121	2 485	1 934	1 250	1 715	1 055	746	1 104	1 243
	Korea Rep	703	239	122	3	-	-	-	-	-	74
	Mexico	15 654	15 811	16 145	18 060	15 646	16 338	15 096	12 217	11 857	18 721
	Panama	5 855	6 127	3 901	5 109	5 577	3 579	2 777	3 655	5 403	744
	Samoa	250 F	250 F	250 F	170 F	100 F	33	6	...	...	...
	Spain	-	-	-	71	19	7	52	4	14	-
	USA	187	35	30	32	32	32	22	16	16	15
77	*Fishing area total*	*33 954 F*	*34 502 F*	*35 171 F*	*31 911 F*	*29 899 F*	*28 578 F*	*24 912 F*	*21 906 F*	*24 354 F*	*26 166 F*
81	Australia	918	905	1 001	1 149	496	400	273	250	316	253
	Cook Is	-	-	-	-	-	1	0	0	-	-
	Japan	476	1 004	402	390	289	188	161	207	155	182
	Korea Rep	861	1 635	783	537	787	1 024	836	748	589	1 011
	New Zealand	-	1	0	1	0	2	2	1	0	5
	Spain	-	-	-	227	136	480	685	305	176	300
	Ukraine	1	-	1	2	...	-	-	-	-	-
81	*Fishing area total*	*2 256*	*3 545*	*2 187*	*2 306*	*1 708*	*2 095*	*1 957*	*1 511*	*1 236*	*1 751*
87	China,Taiwan	-	-	-	-	-	-	-	-	-	63
	Ecuador	-	-	-	1	6	-	-	1	2 481	-
	Japan	648	795	289	348	276	188	425	445	626	548
	Korea Rep	-	-	3	-	-	-	-	-	-	-
	Peru	3 618	3 433	4 458	3 730	3 894	5 231	2 393	1 606	2 762	4 002
	Portugal	-	-	-	-	-	-	1	-	-	-
	Spain	2	945	846	1 414	677	675	221	198	389	-
87	*Fishing area total*	*4 268*	*5 173*	*5 596*	*5 493*	*4 853*	*6 094*	*3 040*	*2 250*	*6 258*	*4 613*
Species total		*385 248 F*	*405 293 F*	*420 409 F*	*366 780 F*	*295 251 F*	*278 796 F*	*308 936 F*	*276 127 F*	*261 642 F*	*248 758 F*
Group total		***868 676***	***870 942***	***906 657***	***847 982***	***781 000***	***760 623***	***800 132***	***733 583***	***749 458***	***738 924***

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Marine fishes not identified
Poissons marins non identifiés
Peces marinos no identificados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Groundfishes nei	**Poissons de fond nca**		**Peces de fondo nep**		***Osteichthyes***				**1,99(XX)XXX,XX**	**GRO**
21 Canada	831	-	1 660	2 349	2 435	1 592	1 552	2 754	5 064	5 101
Japan	5	65	31	18	8	-	-	-	-	-
Spain	-	-	196	-	29	-	-	-	-	-
USA	0	0	-	-	-	-	-	-	-	-
21 Fishing area total	*836*	*65*	*1 887*	*2 367*	*2 472*	*1 592*	*1 552*	*2 754*	*5 064*	*5 101*
27 Belgium	501	509	350	387	389	366	342	273	276	254
Faroe Is	-	0	37	66	-	-	-	-	-	-
Iceland	45	49	28	100	-	-	62	-	10	0
Spain	828	743	526	71	3 265	15 495	19 203	30 936	17 193	8 108
UK	977	893	647	500	411	498	406	296	189	132
27 Fishing area total	*2 351*	*2 194*	*1 588*	*1 124*	*4 065*	*16 359*	*20 013*	*31 505*	*17 668*	*8 494*
Species total	*3 187*	*2 259*	*3 475*	*3 491*	*6 537*	*17 951*	*21 565*	*34 259*	*22 732*	*13 595*
Pelagic fishes nei	**Poissons pélagiques nca**		**Peces pelágicos nep**		***Osteichthyes***				**1,99(XX)XXX,XX**	**PEL**
21 Canada	208	-	17	24	28	152	200	96	169	81
21 Fishing area total	*208*	*-*	*17*	*24*	*28*	*152*	*200*	*96*	*169*	*81*
27 Belgium	4	30	20	1	0	-	1	1	1	4
Iceland	-	-	-	-	-	58	-	49	46 203	-
Spain	100	4 701	73	1	30	1	1	5 619	30 264	53 567
UK	-	-	-	186	45	167	743	202	-	9
27 Fishing area total	*104*	*4 731*	*93*	*188*	*75*	*226*	*745*	*5 871*	*76 468*	*53 580*
Species total	*312*	*4 731*	*110*	*212*	*103*	*378*	*945*	*5 967*	*76 637*	*53 661*
Finfishes nei	**Poissons téléostéens nca**		**Peces de escama nep**		***Osteichthyes***				**1,99(XX)XXX,XX**	**FIN**
21 Estonia	-	-	-	-	-	13	4	-	-	15
Greenland	589	584	474	2	2	392	2	5	6	-
Lithuania	1	1	1	-	2	-	-	-	-	-
Poland	1	-	-	-	1	-	-	-	-	-
Portugal	41	95	21	12	3	9	1	0	1	1
Russian Fed	162	153	109	425	18	9	2	-	-	-
Spain	74	175	-	12	23	81	-	14	-	-
Ukraine	-	-	1	1	-	-	-	-	-	-
USA	1 877	1 991	2 116	2 172	2 388	1 901	1 986	1 713	1 630	1 433
21 Fishing area total	*2 745*	*2 999*	*2 722*	*2 624*	*2 437*	*2 405*	*1 995*	*1 732*	*1 637*	*1 449*
27 Denmark	107	209	109	189	-	-	-	-	58	194
Estonia	91	125	59	88	60	63	1	20	27	53
France	12 661	5 302	1 170	1 692	2 828	2 297	2 149	1 877	3 948	4 247
Germany	37	36	26	20	23	18	22	196	150	56
Isle of Man	-	-	1	-	29	25	3	5	0	0
Lithuania	2	563	30	10	3	1	-	1	1	-
Norway	1 910	1 186	645	1 136	763	870	743	508	146	98
Poland	306	339	108	3	-	-	-	0	-	1
Portugal	1 529	615	1 179	1 136	965	766	637	207	112	413
Russian Fed	536	3 233	-	1 879	398	176	-	219	12	187
Spain	12 572	13 932	6 756	1 023	5 202	5 574	5 112	4 705	5 004	22 090
Sweden	508	300	199	388	69	165	163	148	61	35
UK	-	-	-	0	0	-	-	-	-	-
27 Fishing area total	*30 259*	*25 840*	*10 282*	*7 564*	*10 340*	*9 955*	*8 830*	*7 886*	*9 519*	*27 374*
Species total	*33 004*	*28 839*	*13 004*	*10 188*	*12 777*	*12 360*	*10 825*	*9 618*	*11 156*	*28 823*
Marine fishes nei	**Poissons marins nca**		**Peces marinos nep**		***Osteichthyes***				**1,99(XX)XXX,XX**	**MZZ**
21 Japan	17	14	42	3	14	14	8	10	7	8
St Pier Mq	-	-	-	-	-	-	-	-	170	89
21 Fishing area total	*17*	*14*	*42*	*3*	*14*	*14*	*8*	*10*	*177*	*97*
27 Faroe Is	-	-	0	1	26	4	44	63	32	38
Greenland	264	41	71	43	11	21	154	46	35	-
Ireland	284	575	192	1 192	137	133	176	166	149	161
Japan	4	2	4	14	23	14	15	19	1	1
Latvia	-	-	-	-	-	-	-	1	-	-
Netherlands	-	83	12	32	23	33	125	42	211	58
Svalbard Is	0	0	0	0	0	0	0	0	0	0
27 Fishing area total	*552*	*701*	*279*	*1 282*	*220*	*205*	*514*	*337*	*428*	*258*
31 Anguilla	350 F	365 F	380 F	395 F	410 F	425 F	440 F	460	333	309
Antigua Barb	66	13	36	31	108	62	59	17	16	47
Aruba	43	43 F	44 F	45	45 F	40	47	45	52	48
Bahamas	133	100	105	72	57	86	88	40	48	88
Barbados	109	89	90	92	113	107	116	109	137	98
Belize	66	83	60	44	54	70	93	52	19	74
Bermuda	15	15	12	10	13	13	9	11	11	11
Br Virgin Is	494	658	2 036	726	800 F	800 F	780 F	770 F	770 F	770 F
Cayman Is	125	125	125	125	125	125	125	125	125	125
China,Taiwan	32	46	103	54	27	150	119	205	3	2
Colombia	149	1 244	2 625	2 361	2 821	2 650 F	2 500 F	2 350 F	2 144	872
Costa Rica	583	427	405	362	413	400 F	360	360 F	360 F	360 F
Cuba	11 055	5 022	10 342	8 240	8 235	8 298	8 829	7 174	8 131	4 012
Dominica	881 F	576	500 F	400 F	235	273	234	227	291	270 F

B-39

Marine fishes not identified
Poissons marins non identifiés
Peces marinos no identificados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Dominican Rp	4 391	1 238	4 569	4 484	2 913	4 401	3 717	4 129	1 437	1 632
Fr Guiana	1 900 F	1 700 F	2 000 F	2 150 F	1 600 F	32	46	38	21	25 F
Grenada	10	3	3	3	3	6	0	1	23	3
Guadeloupe	6 600 F	6 600 F	7 100 F	7 100 F	7 100 F	7 100 F	7 100 F	7 100 F	7 000 F	7 000 F
Guatemala	190 F	170 F	150 F	130 F	43	115	73	239	155	319
Guyana	23 864	24 284	33 109	32 905	29 972	30 298 F	24 981	21 683	23 911	23 542
Haiti	5 100 F	5 350 F	5 650 F	5 700	5 700 F	5 700 F	5 700 F	5 700 F	5 700 F	5 700 F
Honduras	1 620 F	1 890 F	1 991 F	2 006 F	2 193 F	2 220 F	2 236 F	785	549	548
Jamaica	4 314	6 952	7 972	8 646	7 158	12 330	11 048	9 475	12 544	11 390
Japan	5	11	19	16	24	30	13	55	58	66
Korea Rep	1	-	-	-	-	-	59	394	-	-
Martinique	35 F	35 F	1 035 F	1 035 F	1 000 F	1 140 F	1 050 F	1 050 F	1 050 F	850 F
Mexico	52 427	52 796	56 567	60 967	29 808	30 701	31 438	27 167	25 015	24 886
Montserrat	50 F	46	40 F	31	50	49	35	31	37	24
NethAntilles	570 F	570 F	595 F	595 F	645 F	695 F	700 F	700 F	700 F	700 F
Nicaragua	286	220	405	522	479	159	497	425	251	142
Portugal	-	-	-	-	-	-	9	-	1	-
Puerto Rico	173	126	104	41	25	21	15	11	10	23
St Kitts Nev	268	83	40 F	...	10 F	10 F	5 F	5 F	2 F	1
St Lucia	435	324	325	361	380	345	302	330	375	402
St Vincent	653	650 F	620	643	600 F	600 F	550 F	550 F	19	20
Spain	-	111	1	-	43	22	7	8	2	2
Suriname	11 300	13 500 F	2 130	2 571	3 736	19 061	20 049	17 179	16 037	25 717
Trinidad Tob	8 045	7 731	6 430	6 184	7 008	6 124	6 248	6 282	6 310	6 180
Turks Caicos	1	4	3	8 F	14 F	22 F	30 F	60	31	6
USA	3 621	3 791	3 551	2 988	2 260	2 100	2 362	2 229	2 116	2 016
US Virgin Is	673 F	613 F	33	34	28	29	27	31	26	29
Venezuela	18 241	28 824	14 440	29 300 F	12 200 F	7 300 F	8 800 F	4 250 F	4 100 F	4 325 F
31 Fishing area total	*158 874 F*	*166 428 F*	*165 745 F*	*181 377 F*	*128 448 F*	*144 109 F*	*140 896 F*	*121 852 F*	*119 920 F*	*122 634 F*
34 Angola	-	144	165	-	-	83	-	-	-	-
Belize	829	1 090	2	...	5 943	2 424	109	746	...	1 408
Benin	370	1 192	-	548	256	2 635	235	406	563	1 105
Bulgaria	2	-	-	-	-	-	-	-	-	-
Cameroon	907	830	674	1 800 F	2 869	2 869	2 869	3 150 F	3 570 F	3 570 F
Cape Verde	497	426	467	354	449	593	412	593	693	697 F
China	10 031	1 812	488	...	3 654	3 790	4 760	11 938	...	29
China,Taiwan	23	63	244	174	239	205	209	263	116	310
Comoros	-	-	-	-	-	-	285	610	...	510
Congo Dem R	400 F	400 F	400 F	400 F	400 F	400 F	300	300 F	300 F	300 F
Congo Rep	5 800 F	4 000 F	1 644	2 957	1 443	3 319	3 264	3 626	2 816	1 626
Côte dIvoire	27 869	17 579	21 300	19 000	10 325 F	28 480	25 249	23 000 F	22 012	34 440
Cyprus	757	-	-	-	-	-	-	-	-	-
Eq Guinea	159 F	169 F	219 F	203 F	198 F	115	400	600 F	500	518 F
France	1	-	-	-	-	2	166	-	-	-
Gabon	...	226	116	1 061	3 319	2 913	2 600 F	14 606 F	9 900 F	9 900 F
Gambia	6	204	11	211	9	282	58	396	1 113	3 310
Georgia	...	...	...	...	...	...	...	...	...	92
Germany	132	77	-	-	-	18	23	-	-	0
Ghana	40 993	26 234	722	4 542	18 380	6 460	11 313	10 409	6 390	5 456
Greece	1 273	967	1 128	1 196	685	934	951	431	567	567 F
Guinea	23 306	18 225	27 780	33 896	48 482	34 823	21 285	21 673	20 700 F	20 208 F
GuineaBissau	2 483 F	2 654 F	2 466 F	2 900 F	3 128 F	2 657 F	2 650 F	2 866 F	2 862 F	2 862 F
Honduras	620	45	-	-	11	295	-	-	-	-
Ireland	425	505	256	850	202	-	-	32	-	5
Italy	2 183	1 805	1 990	1 602	1 203	1 244	1 271	628	525	290
Japan	46	85	52	101	143	130	160	214	333	489
Korea Rep	5 303	6 399	7 655	8 502	7 410	7 073	8 478	6 508	8 921	9 131
Latvia	996	407	-	3 909	6 351	7 453	9 837	3 454	5 375	5 151
Liberia	752	690	660	353	580	735	-	757	800 F	800 F
Lithuania	2 182	-	-	90	816	175	-	-	42	39
Mauritania	21 342 F	30 531 F	56 701 F	90 983 F	78 661 F	50 210 F	73 514 F	65 580 F	30 000 F	7 051
Morocco	48 173	48 054	45 722	48 369	108 754	50 767	66 658	31 870	65 965	43 819
Netherlands	1 781	1 367	1 120	1 003	320	27	-	81	3	245
Nigeria	49 205	28 152	13 271	25 321	19 770	29 385	28 855	28 521	28 100	27 303
Panama	454	579	132	...	1 725	2 448	764	-	...	...
Poland	5 999	1 969	-	-	-	-	-	-	5	14
Portugal	52	73	235	107	23	44	99	47	99	75
Russian Fed	2 242	857	950	2 298	281	1 594	793	131	21	15
St Kitts Nev	-	-	-	-	-	-	-	-	-	564
St Vincent	926	966	...	...	...	...	...	...	...	682
Sao Tome Prn	900 F	900 F	956	401	500 F	500 F	500 F	500 F	513 F	527 F
Senegal	14 409	8 020	9 429	4 892	5 486	4 623	3 527	4 741	13 454	9 203
Sierra Leone	3 609	3 547	6 716	8 175	12 412	12 966	14 572	9 709	9 500 F	9 322 F
Spain	9 750	2 445	2 412	255	983	1 492	1 217	867	4 752	1 342
Togo	1 027	807	521	990	287	631	2 130	1 250 F	381	722
Ukraine	4 000	2 740	2 670	2 770	21 963	16 776	13 764	13 450	10 730	798
UK	-	-	-	-	-	-	135	546	27	397
Other nei	648	1 012	50 000 F	41 000 F	38 000 F	38 000 F	38 000 F	33 295 F	44 000 F	...
34 Fishing area total	*292 862 F*	*218 247 F*	*259 274 F*	*311 213 F*	*405 660 F*	*319 570 F*	*341 412 F*	*297 794 F*	*295 648 F*	*204 892 F*
37 Albania	312	323	4	720	944	900	772	852	1 030	850
Algeria	6 010	6 749	8 271	-	-	-	6 452	14 419	13 560	13 871
Bosnia Herzg	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F
Bulgaria	2	-	-	-	-	15	-	1	0	3
Croatia	863	1 625	257	3 643	1 924	1 689	2 064	9 805	979	841
Cyprus	238	183	129	130	161	183	220	237	167	136
Egypt	3 637	4 035	2 846	1 993	4 136	10 487	6 137	7 432	7 550	6 513
France	1 748	2 685	7 639	556	278	295	381	126	120	453

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Marine fishes not identified
Poissons marins non identifiés
Peces marinos no identificados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Georgia	5	17	10	29	20 F	10 F	0	...	...	...
	Gibraltar	0	0	0	0	0	0	0	0	0	0
	Greece	10 055	10 041	11 775	13 351	11 466	9 029	8 501	8 361	6 599	6 600 F
	Israel	958	848	756	150	230	124	151	450 F	112	171
	Italy	24 946	19 714	15 893	14 335	17 173	10 557	8 778	10 663	17 419	11 925
	Korea Rep	-	-	-	-	-	-	-	-	3	-
	Libya	13 000 F	11 500 F	10 000 F	8 796 F	7 000 F	4 500 F	-	-	-	-
	Malta	82	59	40	44	46	63	44	53	17	7
	Monaco	3 F	3 F	3 F	3 F	2 F	1 F	1 F	1 F	1 F	1 F
	Montenegro	...	...	...	...	...	203	173	171	206	206
	Morocco	3 809	5 769	5 750	3 001	6 782	6 255	3 036	2 625	3 257	2 494
	Palest, O.T.	100 F	132	132	103	79	103	59	62	304	121
	Portugal	12	-	-	6	1	-	0	-	-	-
	Romania	5	6	3	4	9	32	5	2	2	15
	Russian Fed	-	-	-	645	6	-	14	14	39	-
	Serbia-Monte	29	8	15	6	142	-	-	-	-	-
	Slovenia	-	-	-	-	2	1	2	1	4	5
	Spain	6 200	9 893	10 714	2 095	11 214	12 768	11 748	10 220	9 894	9 874
	Syria	75	-	-	-	-	190	358	285	265	247
	Tunisia	4 259	2 222	-	5 879	5 550	5 405	4 135	1 461	3 410	2 558
	Turkey	230	330	483	417	671	1 182	811	396	582	699
	Ukraine	20	6	10	11	21	24	16	86	103	49
37	*Fishing area total*	*76 603 F*	*76 153 F*	*74 735 F*	*55 922 F*	*67 862 F*	*64 021 F*	*53 863 F*	*67 728 F*	*65 628 F*	*57 644 F*
41	Argentina	7 218	3 765	3 520	4 360	6 735	2 929	2 064	3 428	2 723	1 219
	Belize	43	0	-	-	-	-	-	-	-	-
	Brazil	59 003	63 312	57 578	57 506	54 440	65 263	60 823	38 196	42 129	39 935
	Chile	-	-	-	-	342	99	-	10	-	-
	Estonia	-	4	-	178	-	7	-	-	-	-
	Falkland Is	716	486	805	3 669	2 492	343	264	10	20	179
	Japan	145	559	852	7	2	11	10	33	168	145
	Korea Rep	10 402	10 452	5 472	11 006	12 546	5 287	5 566	3 994	7 598	5 513
	Namibia	-	-	-	25	-	-	-	-	-	-
	New Zealand	-	-	22	-	-	-	-	-	-	-
	Portugal	7	-	10	86	80	19	17	52	126	71
	Russian Fed	14	199	13	6	-	-	-	-	-	-
	Spain	370	434	14	101	350	155	127	241	-	-
	Ukraine	-	-	-	-	-	0	0	-	-	2
	UK	19	23	15	-	-	-	-	-	-	-
	Uruguay	2 681	3 070	4 078	2 024	2 162	3 554	1 685	2 491	2 862	1 355
41	*Fishing area total*	*80 618*	*82 304*	*72 379*	*78 968*	*79 149*	*77 667*	*70 556*	*48 455*	*55 626*	*48 419*
47	Angola	80 741	78 416	20 302	34 510	20 119 F	22 785 F	38 053	39 703	37 710	36 300 F
	China,Taiwan	-	-	-	-	-	276	747	458	496	756
	Japan	441	477	545	237	662	431	86	586	327	440
	Korea Rep	2 041	2 816	2 425	1 907	1 935	2 698	1 971	2 034	1 142	1 929
	Lithuania	-	-	617	-	-	-	-	-	-	-
	Namibia	2 009	4 125	4 343	6 320	781	12 805	26 480	5 746	...	...
	Poland	2	86	310	-	-	-	-	-	-	-
	Portugal	74	19	21	15	41	20	44	25	22	8
	Russian Fed	146	92	646	89	-	-	-	-	-	-
	St Helena	67	65	64	64	62	62	63	63	62	64
	South Africa	4 505	4 573	9 162	10 920	9 542	9 260	7 299	5 916	5 120	4 901
	Spain	442	91	54	106	53	146	228	74	275	217
	Ukraine	531	-	-	-	-	-	-	-	-	-
	UK	-	-	-	-	-	1	3	-	-	-
	Uruguay	-	-	-	-	5	-	-	-	-	-
47	*Fishing area total*	*90 999*	*90 760*	*38 489*	*54 168*	*33 200 F*	*48 484 F*	*74 974*	*54 605*	*45 154*	*44 615 F*
48	Chile	-	-	0	-	-	-	-	-	-	-
	Korea Rep	-	0	-	-	-	-	-	-	-	-
	Poland	-	1	-	-	-	-	-	-	-	-
	USA	0	-	-	-	-	-	-	-	-	-
48	*Fishing area total*	*0*	*1*	*0*	-	-	-	-	-	-	-
51	Bahrain	1 077	803	948	770	928	1 087	557	582	519	456
	Belize	-	327	-	-	-	-	224	5	18	-
	Br Ind Oc Tr	0	0	0	0	0	0	0	27	23	14
	China	169	...	...	226	225	4 528	99	101	188	23
	China,Taiwan	905	1 421	263	589	5 948	18 887	3 806	4 649	3 693	1 988
	Comoros	1 040	1 050	1 140	1 130	1 225	1 225 F	1 387 F	2 020 F	2 020 F	2 020 F
	Djibouti	190 F	200 F	215 F	230 F	526	151	84	128	114	114 F
	Egypt	23 885	28 274	3 227	3 786	9 082	6 433	2 033	1 104	1 409	1 119
	Eritrea	1	100	-	12	6	3	1	2	0	0
	France	-	-	-	-	-	192	1	-	67	68
	Fr South Tr	80 F	80 F	80 F	80 F	80 F	80 F	80 F	80 F	80 F	80 F
	Guinea	-	-	-	29	-	40	54	28	37	17
	India	410 981	418 590	454 347	434 089	408 823	356 115	322 977	379 247	397 127	565 491
	Iran	34 204	32 622	20 301	17 336	19 670	19 458	26 874	30 857	31 465	22 970
	Iraq	19 200	14 100	4 000	650	5 900 F	12 774	7 949	2 281	5 753	5 900
	Israel	120	30	30	100	75	75	50	50 F	50 F	50 F
	Japan	862	328	336	598	650	996	795	880	585	497
	Jordan	6	10	8	10	10	7	10	10	20	6
	Kenya	667	874	1 418	1 646	1 401	1 297	678	619	514	606
	Korea Rep	1 426	3 353	4 082	5 137	4 989	2 978	2 675	3 317	3 705	1 977
	Kuwait	581	955 F	754	443	698	1 526	1 228	374	700 F	700 F
	Madagascar	44 237	48 115	48 029	52 526	50 683	51 449	57 123	44 142	52 778	49 216
	Maldives	5 610	7 211	7 925	18 135	23 106	17 100	17 843	15 063	20 765	16 218
	Mauritius	568	442	471	285	302	931 F	9	500	6	16

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Marine fishes not identified
Poissons marins non identifiés
Peces marinos no identificados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Mayotte	1 818	2 039	2 623	1 151	1 030	2 000	1 750	1 750	1 750	1 750
Mozambique	8 784	8 019	62 744	57 709	54 389	61 775	55 042	78 457	101 134	105 092
Oman	1 273	502	3 519	5 854	4 543	3 945	4 539	6 051	4 410	3 491
Pakistan	34 856	31 769	35 685	36 385	32 547	28 772	21 142	21 245	27 834	17 383
Philippines	7	-	12	46	15	80	15	80	30	-
Portugal	4	18	17	42	39	88	7	9	6	17
Qatar	257	184	239	921	155	324	1 090	479	743	736
Réunion	66	90	84	84	34	70	50	123	167 F	167 F
Russian Fed	11	7	17	-	-	-	-	-	-	-
Saudi Arabia	947	625	600	1 293	698	801	971	1 278	908	1 091
Senegal	-	-	2	4	-	40	-	-	-	-
Seychelles	228	253	130	116	135	836	1 136	673	2 193	1 238
Somalia	30 530 F	27 740 F	28 700 F	28 700 F	23 900 F	28 700 F	28 700 F	28 700 F	28 700 F	28 700 F
South Africa	85	55	23	12	12	9	26	52	16	40
Spain	69	359	163	148	161	143	214	161	215	82
Sudan	4 887	4 887	4 887 F	5 387 F	5 087 F	4 887 F	5 586	5 582 F	5 577	5 587 F
Tanzania	2 035	1 995	1 595	2 470	5 624	10 949	3 591	3 199	2 911	3 837
Ukraine	35	-	-	-	-	-	-	-	-	-
Untd Arab Em	1 189	237	2 285	1 500 F	-	1 200 F	2 500 F	3 288	4 152	4 292
UK	-	-	-	8	17	11	4	33	15	1
Uruguay	-	-	-	-	-	2	-	-	-	-
Zanzibar	2 606	2 492	2 786	3 549	2 870	3 406	2 940	3 177	3 282	3 303
51 Fishing area total	*635 496 F*	*640 156 F*	*693 685 F*	*683 186 F*	*665 583 F*	*645 370 F*	*575 840 F*	*640 403 F*	*705 679 F*	*846 353 F*
57 Australia	827	11 955	8 576	11 766	11 964	9 213	8 612	6 543	5 745	3 904
Bangladesh	193 306	230 101	262 389	231 949	230 830	230 103	236 509	179 387	259 476	266 116
Belize	-	89	-	-	-	-	-	-	-	-
China	-	-	-	28	9	9	7	2	8	17
China,Taiwan	132	29	36	247	1 019	1 064	517	506	406	2 657
Guinea	...	-	-	28	-	6	5	6	8	2
India	286 632	411 561	412 353	273 879	276 853	344 524	173 167	153 401	193 880	120 365
Indonesia	67 217	71 210	60 278	235 581	300 354	188 445	91 460	113 525	162 529	151 002
Japan	920	771	440	559	541	565	844	869	912	475
Korea Rep	1 443	1 723	65	-	-	-	-	48	-	-
Malaysia	197 608	211 830	213 936	222 251	196 958	234 458	230 899	229 400	206 434	220 140
Myanmar	926 070	1 006 160	1 030 720	1 109 640	1 206 330	1 345 370	1 485 740	1 643 600	1 827 500	2 016 600
Philippines	0	-	1	28	2	9	0	20	57	-
Portugal	-	-	-	2	3	-	2	-	-	1
Senegal	-	-	-	-	5	6	-	-	-	-
Seychelles	3	17	7	3	0	1	18	46	61	74
Spain	-	20	78	174	59	31	32	26	53	9
Sri Lanka	14 470	8 467	4 832	10 471	6 170	10 820	11 230	12 850	13 630	19 580
Thailand	306 996	321 107	352 288	390 471	362 971	311 955	251 651	196 114	203 589	199 875
Timor-Leste	344	780 F	1 222 F	1 665 F	2 107 F	2 500 F	2 855 F	3 060 F	3 060 F	3 060 F
UK	-	-	-	-	3	49	7	-	2	48
Vanuatu	-	-	-	-	-	-	-	-	471	383
57 Fishing area total	*1 995 968*	*2 275 820 F*	*2 347 221 F*	*2 488 742 F*	*2 596 178 F*	*2 679 128 F*	*2 493 555 F*	*2 539 403 F*	*2 877 821 F*	*3 004 308 F*
58 Australia	-	-	-	0	1	-	-	-	0	-
58 Fishing area total	-	-	-	*0*	*1*	-	-	-	*0*	-
61 China	2 967 377 F	2 889 899 F	2 003 516 F	1 998 174 F	1 988 809 F	1 843 952 F	1 781 091	1 925 241	2 599 237	2 660 617
China,H.Kong	104 550 F	102 250 F	94 800 F	100 800 F	97 400 F	93 000 F	92 746 F	95 100 F	95 550 F	101 020 F
China, Macao	1 020 F	1 020 F	1 020 F	1 020 F	1 020 F	1 020 F	1 020 F	1 020 F	1 020 F	1 020 F
China,Taiwan	74 853	75 602	32 220	61 566	72 760	44 850	64 809	51 415	32 015	59 111
Japan	247 551	214 251	246 017	208 249	192 718	205 530	277 992	262 443	246 241 F	227 800 F
Korea D P Rp	108 991 F	107 600 F	107 600 F	107 600 F	107 600 F	107 600 F	107 600 F	107 600 F	107 600 F	107 600 F
Korea Rep	97 648	76 431	36 944	21 217	33 058	30 008	30 838	33 157	26 790	35 589
Russian Fed	43 018	15 174	8	439	65	11	45	138	16	29
Spain	-	-	-	-	106	-	-	-	-	-
61 Fishing area total	*3 645 008 F*	*3 482 227 F*	*2 522 125 F*	*2 499 065 F*	*2 493 536 F*	*2 325 971 F*	*2 356 141 F*	*2 476 114 F*	*3 108 469 F*	*3 192 786 F*
67 Canada	8 566	5 353	5 182	8 632	16 510	3 568	1 489	6 874	11 468	14 573
Japan	-	-	-	11	-	3	-	-	-	-
Russian Fed	-	2	-	-	-	-	-	-	-	-
USA	4 710	4 548	11 325	70	68	72	54	86	56	73
67 Fishing area total	*13 276*	*9 903*	*16 507*	*8 713*	*16 578*	*3 643*	*1 543*	*6 960*	*11 524*	*14 646*
71 Australia	5 765	6 321	5 652	6 298	3 846	3 554	4 762	4 426	4 622	4 140
Brunei Darsm	1 186	1 528	1 421	1 680	2 513	894	2 286	2 173	1 609	2 154
Cambodia	26 500 F	28 550 F	33 747 F	34 330 F	37 000 F	37 400 F	41 500 F	45 345	55 460	62 700 F
China	825	283	991	679	773	2 300	261	151	1 107	559
China,Taiwan	-	45	160	272	200	818	1 056	1 834	651	2 301
Fiji	1 113	8 182 F	19 603	21 261	21 261 F	21 352	25 761	23 000 F	21 000 F	22 000 F
Guam	329	232	214	293	146	296	323	42	51	20
Indonesia	521 270	455 956	698 045	542 690	614 742	496 101	456 347	347 149	331 098	463 437
Japan	230	247	241	83	133	191	142	193	227	347
Kiribati	3 198	3 130	2 863	2 600 F	1 750 F	1 500 F	527	530 F	500 F	40
Korea Rep	3 177	1 811	2 618	3 204	2 246	1 958	2 006	814	3 114	529
Malaysia	215 813	233 783	232 205	215 740	244 005	194 044	212 031	174 435	161 371	174 701
Marshall Is	800 F	900 F	1 000 F	1 200 F	1 400 F	1 600 F	1 800 F	2 000 F	2 200 F	2 400 F
Micronesia	1 500 F	2 000 F	2 600 F	3 200 F	3 800 F	4 400 F	5 000 F	5 600 F	6 200 F	6 800 F
Nauru	349 F	324 F	302 F	284 F	263 F	243 F	226 F	208 F	190 F	172 F
NewCaledonia	618	602 F	370	145	197	245	213	288	284	347
N Marianas	49	55	40	36	35	36	32	25	19	28
Palau	883	876	877	877	861	896	920	926	920 F	920 F
Papua N Guin	15 232	1 523	1 998	1 647	2 975	4 547	2 087	1 927	1 967	1 689
Philippines	14 656	15 267	14 725	14 024	12 559	12 001	13 207	13 080	13 608	15 856
Singapore	1 325	1 031	707	651	507	769	849	350	440	400

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Marine fishes not identified
Poissons marins non identifiés
Peces marinos no identificados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Solomon Is	6 000 F	7 000 F	9 000 F	10 000 F	10 000 F	10 000 F	10 000 F	10 000 F	10 000 F	10 000 F
	Thailand	677 494	616 741	611 861	562 426	565 206	489 728	455 575	342 669	369 874	356 272
	Tuvalu	160 F	160 F	580	450 F	330	440 F	540 F	640 F	640 F	740 F
	Vanuatu	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500	150
	Viet Nam	1 101 761	1 168 691	1 210 025	1 315 311	1 343 500	1 358 500	1 391 000	1 437 800	1 530 500	1 632 000 F
	Wallis Fut I	296 F	296 F	296	396 F	496 F	596	643 F	693 F	743 F	793 F
71	*Fishing area total*	*2 602 029 F*	*2 557 034 F*	*2 853 641 F*	*2 741 277 F*	*2 872 244 F*	*2 645 909 F*	*2 630 594 F*	*2 417 798 F*	*2 519 895 F*	*2 761 495 F*
77	Amer Samoa	0	1	0	2	3	6	10	9	7	1
	China	303	712	710	854	610	904	557	172	58	273
	China,Taiwan	16	-	82	332	1 184	903	1 323	1 322	1 143	1 067
	Cook Is	311 F	319 F	326 F	300	322 F	350	340 F	300 F	280 F	280 F
	Costa Rica	3 544	3 440	3 255	3 513	3 410	3 750 F	4 090	4 100 F	4 100 F	4 100 F
	El Salvador	1 678	3 385	3 276	3 135	4 551	6 805	7 833	362	575	14 938
	Fr Polynesia	4 362	4 526	4 680 F	4 800 F	4 293	4 315	4 353	4 276	4 575	4 243
	Guatemala	400 F	418	295	278	63	72	64	252	443	357
	Honduras	1 704 F	2 409 F	2 000 F	1 800 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F
	Japan	861	653	769	621	947	747	679	590	716	835
	Korea Rep	744	56	19	1	2	18	93	3	203	-
	Mexico	71 432	74 800	72 603	59 766	72 231	75 397	51 974	59 222	46 688	48 924
	Nicaragua	593	1 066	1 061	737	1 691	1 358	265	62	85	137
	Niue	100 F	100 F	100 F	100 F	100 F	60	50 F	50 F	3	1
	Panama	32 455	27 473	12 805	25 946	10 884	8 702	7 681	10 344	11 078	10 037
	Samoa	754	4 216	4 700 F	5 200 F	5 700 F	6 232	6 645	7 049	6 239	6 280 F
	Spain	-	-	-	15	7	5	14	-	1	-
	Tokelau	130 F	120 F	110 F	100 F	90 F	80 F	70 F	60 F	50 F	50 F
	Tonga	2 548	2 612	2 874	668	719 F	942 F	1 200 F	1 100 F	1 008 F	1 000 F
	USA	3 004	43	35	28	24	24	25	27	28	27
	Venezuela	-	-	-	29	9	1	32	-	1	11
77	*Fishing area total*	*124 939 F*	*126 349 F*	*109 700 F*	*108 225 F*	*108 340 F*	*112 171 F*	*88 798 F*	*90 800 F*	*78 781 F*	*94 061 F*
81	Australia	2 309	2 179	1 975	2 294	4 297	3 088	6 472	5 729	6 423	6 065
	China	-	17	-	-	38	91	6	-	-	108
	China,Taiwan	7	-	35	1	4	386	546	540	337	547
	Japan	335	4 159	5 604	19 627	26 257	23 459	125	144	150	143
	Korea Rep	2 880	6 721	6 430	5 316	4 776	6 462	7 350	6 870	3 581	4 058
	New Zealand	66	78	28	42	42	23	21	145	23	238
	Norfolk Is	0	0	0	0	0	0	0	0	0	0
	Pitcairn Is	5 F	5 F	5 F	3 F	3 F	3 F	3 F	3 F	3 F	3 F
	Spain	-	-	-	67	36	60	185	58	-	44
	Ukraine	34 141	33 696	41	5	74 782	-	50 760	76 056	74 521	64 691
81	*Fishing area total*	*39 743 F*	*46 855 F*	*14 118 F*	*27 355 F*	*110 235 F*	*33 572 F*	*65 468 F*	*89 545 F*	*85 038 F*	*75 897 F*
87	Chile	146	174	305	617	656	148	396	998	157	1 045
	China	-	-	-	27	271	54	2	7	4	4
	Colombia	4 135	4 412	1 053	1 340	26 930	11 600 F	21 600 F	8 056 F	18 532	3 880
	Ecuador	54 709	30 000	51 350	55 900	27 000	1 564	1 289	3 049	1 150	731
	Germany	-	-	-	-	-	-	11	21	176	83
	Japan	771	615	437	416	460	428	271	392	702	625
	Korea Rep	12	12	-	-	62	209	0	3 983	59	-
	Lithuania	-	-	-	-	-	-	-	13	-	-
	Netherlands	-	-	-	-	-	-	-	1	-	6
	Nicaragua	-	-	-	-	-	-	-	-	1	1
	Peru	125 959	68 489	27 873	37 733	64 266	38 074	41 269	32 327	41 844	36 524
	Poland	-	-	-	-	-	-	-	-	33	0
	Portugal	-	-	-	-	-	-	21	-	-	2
	Spain	3	186	141	665	130	165	137	122	229	67
	Venezuela	-	-	-	-	-	3	3	5	2	-
87	*Fishing area total*	*185 735*	*103 888*	*81 159*	*96 698*	*119 775*	*52 245 F*	*64 999 F*	*48 974 F*	*62 889*	*42 968*
88	Russian Fed	-	-	2	0	0	0	1	-	-	-
	Spain	-	-	-	2	-	-	-	-	-	-
	Uruguay	-	-	-	0	-	-	0	-	-	-
88	*Fishing area total*	*-*	*-*	*2*	*2*	*0*	*0*	*1*	*-*	*-*	*-*
Species total		*9 942 719 F*	*9 876 840 F*	*9 249 101 F*	*9 336 196 F*	*9 697 023 F*	*9 152 079 F*	*8 959 162 F*	*8 900 778 F*	*10 032 677 F*	*10 511 073 F*
Group total		***9 979 222***	***9 912 669***	***9 265 690***	***9 350 087***	***9 716 440***	***9 182 768***	***8 992 497***	***8 950 622***	***10 143 202***	***10 607 152***

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Freshwater crustaceans
Crustacés d'eau douce
Crustáceos de agua dulce

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Siberian prawn	**Bouquet sibérien**		**Camarón siberiano**		***Exopalaemon modestus***				**2,28(12)001,04**	**EXO**
04 China	...	...	123 332 F	117 288 F	130 471 F	142 523 F	151 477	141 412	137 659	144 744
04 Fishing area total	*...*	*...*	*123 332 F*	*117 288 F*	*130 471 F*	*142 523 F*	*151 477*	*141 412*	*137 659*	*144 744*
Species total	*...*	*...*	*123 332 F*	*117 288 F*	*130 471 F*	*142 523 F*	*151 477*	*141 412*	*137 659*	*144 744*
Oriental river prawn	**Bouquet nippon**		**Camarón nipón**		***Macrobrachium nipponense***				**2,28(12)023,04**	**MNX**
04 China	...	...	123 332 F	117 288 F	130 471 F	142 523 F	151 478	141 413	137 659	144 744
04 Fishing area total	*...*	*...*	*123 332 F*	*117 288 F*	*130 471 F*	*142 523 F*	*151 478*	*141 413*	*137 659*	*144 744*
Species total	*...*	*...*	*123 332 F*	*117 288 F*	*130 471 F*	*142 523 F*	*151 478*	*141 413*	*137 659*	*144 744*
Giant river prawn	**Bouquet géant**		**Langostino de río**		***Macrobrachium rosenbergii***				**2,28(12)023,07**	**PRF**
04 Brunei Darsm	16	13	5	8	-	-	-	-	-	-
Indonesia	5 185	4 685	4 947	4 646	8 408	4 906	5 130	6 860	8 643	9 398
Philippines	262	291	414	688	836	877	1 456	1 440	1 544	1 400
04 Fishing area total	*5 463*	*4 989*	*5 366*	*5 342*	*9 244*	*5 783*	*6 586*	*8 300*	*10 187*	*10 798*
06 Fr Polynesia	3	3	2 F	1 F	0	3	3	3	3	3
06 Fishing area total	*3*	*3*	*2 F*	*1 F*	*0*	*3*	*3*	*3*	*3*	*3*
Species total	*5 466*	*4 992*	*5 368 F*	*5 343 F*	*9 244*	*5 786*	*6 589*	*8 303*	*10 190*	*10 801*
River prawns nei	**Bouquets d'eau douce nca**		**Camarones de agua dulce nep**		***Macrobrachium spp***				**2,28(12)023,XX**	**PPF**
01 Benin	110 F	110 F	110 F	100 F	80 F	120 F	130 F	130 F	130 F	133 F
01 Fishing area total	*110 F*	*110 F*	*110 F*	*100 F*	*80 F*	*120 F*	*130 F*	*130 F*	*130 F*	*133 F*
02 Mexico	3 112	3 051	2 936	2 782	3 595	3 754	2 967	3 025	3 083	2 759
Nicaragua	2	0	1	0	...	0	1	1	9	0
02 Fishing area total	*3 114*	*3 051*	*2 937*	*2 782*	*3 595*	*3 754*	*2 968*	*3 026*	*3 092*	*2 759*
03 Brazil	3 671	2 820	3 648	6 317	5 242	5 127	6 612	6 022	5 520	5 737
03 Fishing area total	*3 671*	*2 820*	*3 648*	*6 317*	*5 242*	*5 127*	*6 612*	*6 022*	*5 520*	*5 737*
06 Papua N Guin	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F
06 Fishing area total	*5 F*	*5 F*	*5 F*	*5 F*	*5 F*	*5 F*	*5 F*	*5 F*	*5 F*	*5 F*
Species total	*6 900 F*	*5 986 F*	*6 700 F*	*9 204 F*	*8 922 F*	*9 006 F*	*9 715 F*	*9 183 F*	*8 747 F*	*8 634 F*
Freshwater prawns, shrimps nei	**Crevettes d'eau douce nca**		**Gambas,camaron.(agua dulce)nep**		***Palaemonidae***				**2,28(12)XXX,XX**	**PPZ**
01 Egypt	2 450	2 326	2 674	5 089	4 464	5 029	4 792	5 409	6 176	3 023
Morocco	4	5	3	-	-	-	-	-	-	-
01 Fishing area total	*2 454*	*2 331*	*2 677*	*5 089*	*4 464*	*5 029*	*4 792*	*5 409*	*6 176*	*3 023*
04 Indonesia	3 898	5 115	4 013	3 790	2 892	2 915	3 162	2 256	1 812	4 088
Japan	1 158	1 002	793	1 157	1 035	928	976	761	555	676 F
Malaysia	-	265	223	...	301	291	299	408	383	395
Thailand	300	500	418	400	1 431	2 300	3 000	3 000	686	1 400
04 Fishing area total	*5 356*	*6 882*	*5 447*	*5 347*	*5 659*	*6 434*	*7 437*	*6 425*	*3 436*	*6 559 F*
Species total	*7 810*	*9 213*	*8 124*	*10 436*	*10 123*	*11 463*	*12 229*	*11 834*	*9 612*	*9 582 F*
Danube crayfish	**Écrevisse à pattes grêles**		**Cangrejo de patas punteadas**		***Astacus leptodactylus***				**2,29(03)027,01**	**CRD**
04 Armenia	...	...	...	...	...	...	717 F	258 F	266 F	266 F
04 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*717 F*	*258 F*	*266 F*	*266 F*
05 Belarus	-	1	1	...	...	...	...	...	1	-
05 Fishing area total	*-*	*1*	*1*	*...*	*...*	*...*	*...*	*...*	*1*	*-*
Species total	*...*	*1*	*1*	*...*	*...*	*...*	*717 F*	*258 F*	*267 F*	*266 F*
Noble crayfish	**Écrevisse à pieds rouges**		**Cangrejo de río de patas rojas**		***Astacus astacus***				**2,29(03)027,02**	**AAS**
05 Finland	...	...	...	...	...	80	80	65	80	76
Norway	...	...	...	...	...	0	0	...	...	...
05 Fishing area total	*...*	*...*	*...*	*...*	*...*	*80*	*80*	*65*	*80*	*76*
Species total	*...*	*...*	*...*	*...*	*...*	*80*	*80*	*65*	*80*	*76*
Signal crayfish	**Écrevisse signal**		**...C**		***Pacifastacus leniusculus***				**2,29(03)076,01**	**PCL**
05 Finland	...	...	...	...	...	259	259	203	334	226
UK	80	50	101	-	-	-	1	-	-	-
05 Fishing area total	*80*	*50*	*101*	*...*	*...*	*259*	*260*	*203*	*334*	*226*
Species total	*80*	*50*	*101*	*...*	*...*	*259*	*260*	*203*	*334*	*226*
White-clawed crayfish	**Écrevisse à pattes blanches**		**Cangrejo a pinzas blancas**		***Austropotamobius pallipes***				**2,29(03)139,01**	**AUP**
05 Spain	0	0	-	-	-	-	-	-	-	-
05 Fishing area total	*0*	*0*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
Species total	*0*	*0*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*

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Freshwater crustaceans
Crustacés d'eau douce
Crustáceos de agua dulce

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Red swamp crawfish	**Écrevisse rouge de marais**		**Cangrejo de las marismas**		***Procambarus clarkii***				**2,29(04)001,01**	**RCW**
01 Kenya	3	14	19	21	20	18	19	19	16	20
01 Fishing area total	*3*	*14*	*19*	*21*	*20*	*18*	*19*	*19*	*16*	*20*
05 Spain	2 000 F	1 750 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F
05 Fishing area total	*2 000 F*	*1 750 F*	*1 500 F*	*1 500 F*	*1 500 F*	*1 500 F*	*1 500 F*	*1 500 F*	*1 500 F*	*1 500 F*
Species total	*2 003 F*	*1 764 F*	*1 519 F*	*1 521 F*	*1 520 F*	*1 518 F*	*1 519 F*	*1 519 F*	*1 516 F*	*1 520 F*
Australian crayfish	**Écrevisse d'Australie**		**Cangrejo de río de Australia**		***Euastacus armatus***				**2,29(05)158,01**	**AYA**
06 Australia	23	51	35	36	1	1	...	...	...	...
06 Fishing area total	*23*	*51*	*35*	*36*	*1*	*1*	*...*	*...*	*...*	*...*
Species total	*23*	*51*	*35*	*36*	*1*	*1*	*...*	*...*	*...*	*...*
Red claw crayfish	**...B**		**...C**		***Cherax quadricarinatus***				**2,29(05)173,03**	**CRP**
03 Ecuador	...	...	...	...	...	106	95 F	84	114	74
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*106*	*95 F*	*84*	*114*	*74*
Species total	*...*	*...*	*...*	*...*	*...*	*106*	*95 F*	*84*	*114*	*74*
Oceanian crayfishes nei	**Écrevisses océaniennes nca**		**Cangrejos río de Oceanía nep**		***Parastacidae***				**2,29(05)XXX,XX**	**CJF**
06 Papua N Guin	1	1 F	1 F	1 F	1 F	1 F	1 F	1 F	1 F	1 F
06 Fishing area total	*1*	*1 F*	*1 F*	*1 F*	*1 F*	*1 F*	*1 F*	*1 F*	*1 F*	*1 F*
Species total	*1*	*1 F*	*1 F*	*1 F*	*1 F*	*1 F*	*1 F*	*1 F*	*1 F*	*1 F*
Euro-American crayfishes nei	**Écrevisses euro-américain. nca**		**Cangrejos de río nep**		***Astacidae, Cambaridae***				**2,29(XX)XXX,XX**	**AYS**
02 Mexico	17	94	44	27	64	66	55	73	91	88
USA	4 676	7 125	3 748	3 920	6 916	719	7 243	7 032	8 536	6 432
02 Fishing area total	*4 693*	*7 219*	*3 792*	*3 947*	*6 980*	*785*	*7 298*	*7 105*	*8 627*	*6 520*
04 Turkey	1 634	1 894	2 183	2 317	809	797	816	783	734	1 030
04 Fishing area total	*1 634*	*1 894*	*2 183*	*2 317*	*809*	*797*	*816*	*783*	*734*	*1 030*
05 Bulgaria	1	8	4	6	4	5	4	1	1	2
Denmark	0	0	-	-	-	-	-	-	-	-
Estonia	1	1	-	-	1	0	-	-	-	-
Finland	80	156	156	143	143	-	-	-	-	-
Greece	27	25	22	15	15	4	21	21	21	21 F
Lithuania	0	0	1	-	0	0	-	0	-	-
Romania	...	3	0	0	1	1	-	-	-	-
Sweden	37	49	43	59	95	124	134	175	168	177
Ukraine	-	-	-	-	-	-	-	-	-	1
05 Fishing area total	*146*	*242*	*226*	*223*	*259*	*134*	*159*	*197*	*190*	*201 F*
Species total	*6 473*	*9 355*	*6 201*	*6 487*	*8 048*	*1 716*	*8 273*	*8 085*	*9 551*	*7 751 F*
Chinese mitten crab	**Crabe chinois**		**Cangrejo chino**		***Eriocheir sinensis***				**2,31(13)028,03**	**ERS**
04 China	...	...	34 540 F	32 603 F	38 564 F	36 711 F	44 119	46 323	52 495	53 832
04 Fishing area total	*...*	*...*	*34 540 F*	*32 603 F*	*38 564 F*	*36 711 F*	*44 119*	*46 323*	*52 495*	*53 832*
61 Russian Fed	-	-	-	-	-	-	3	3	-	-
61 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*-*	*-*
Species total	*...*	*...*	*34 540 F*	*32 603 F*	*38 564 F*	*36 711 F*	*44 122*	*46 326*	*52 495*	*53 832*
Freshwater crustaceans nei	**Crustacés d'eau douce nca**		**Crustáceos de agua dulce nep**		***Crustacea***				**2,99(XX)XXX,XX**	**FCX**
01 Benin	4 600 F	4 600 F	4 600 F	4 300 F	3 350 F	3 100 F	2 800 F	2 800 F	2 250 F	2 000 F
Côte dIvoire	386 F	1 843	1 000 F	...	...	66	...	...	30	300
Egypt	2 192	2 029	1 469	1 455	2 141	2 591	2 031	2 425	2 911	2 216
Gabon	9	4	6	15	25	12	5 F	10 F	10 F	10 F
Senegal	...	...	...	...	...	...	...	205	100 F	...
01 Fishing area total	*7 187 F*	*8 476 F*	*7 075 F*	*5 770 F*	*5 516 F*	*5 769 F*	*4 836 F*	*5 440 F*	*5 301 F*	*4 526 F*
02 Dominican Rp	48	6	113	156	73	118	113	95	...	8
El Salvador	16	22	24	20	4	32	0	3	...	...
02 Fishing area total	*64*	*28*	*137*	*176*	*77*	*150*	*113*	*98*	*...*	*8*
04 Bangladesh	...	...	...	...	...	...	...	79 315	95 008	134 300
Cambodia	500 F	500 F	500 F	400 F	500 F	600 F	500 F	400	300	500 F
China	510 910 F	670 942 F	-	-	-	-	-	-	-	-
India	183	202	381	376	508	356	456	364	354	...
Indonesia	337	194	737	334	366	413	213	138	355	312
Korea Rep	48	61	111	32	66	...	145	714	485	316
Thailand	-	-	536	200	3 140	3 300	500	200	250	800
04 Fishing area total	*511 978 F*	*671 899 F*	*2 265 F*	*1 342 F*	*4 580 F*	*4 669 F*	*1 814 F*	*81 131*	*96 752*	*136 228 F*
05 Germany	12	12	12	12	12	11	11	5	3	3
Russian Fed	1 733	1 754	3 107	3 392	3 175	2 631	3 748	7 254	3 349	3 459
Ukraine	2	3	16	1	5	6	5	-	9	3

B-41

Freshwater crustaceans
Crustacés d'eau douce
Crustáceos de agua dulce

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
05 Fishing area total	*1 747*	*1 769*	*3 135*	*3 405*	*3 192*	*2 648*	*3 764*	*7 259*	*3 361*	*3 465*
06 Fiji	343	300 F	211	466	500 F	548	458	340 F	225 F	100
06 Fishing area total	*343*	*300 F*	*211*	*466*	*500 F*	*548*	*458*	*340 F*	*225 F*	*100*
37 Russian Fed	-	-	-	-	1	-	1	3	3	1
37 Fishing area total	-	-	-	-	*1*	-	*1*	*3*	*3*	*1*
Species total	*521 319 F*	*682 472 F*	*12 823 F*	*11 159 F*	*13 866 F*	*13 784 F*	*10 986 F*	*94 271 F*	*105 642 F*	*144 328 F*
Group total	***550 075***	***713 885***	***322 077***	***311 366***	***351 231***	***365 477***	***397 541***	***462 957***	***473 867***	***526 579***

B-42

Crabs, sea-spiders
Crabes, araignées de mer
Cangrejos, centollas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Mangrove ghost crab	**Crabe mantou vert**		**Capuco verde**		***Ucides occidentalis***				**2,31(03)003,02**	**UCD**
87 Ecuador	...	...	...	517	438	...	...	...	608	1 978
87 Fishing area total	*...*	*...*	*...*	*517*	*438*	*...*	*...*	*...*	*608*	*1 978*
Species total	*...*	*...*	*...*	*517*	*438*	*...*	*...*	*...*	*608*	*1 978*
Atlantic rock crab	**Tourteau poïnclos**		**Jaiba de roca amarilla**		***Cancer irroratus***				**2,31(09)010,03**	**CRK**
21 Canada	7 968	7 829	6 803	7 485	7 961	9 151	9 304	8 138	7 042	6 717
USA	326	502	1 385	1 335	1 748	1 681	1 942	2 118	1 891	1 099
21 Fishing area total	*8 294*	*8 331*	*8 188*	*8 820*	*9 709*	*10 832*	*11 246*	*10 256*	*8 933*	*7 816*
Species total	*8 294*	*8 331*	*8 188*	*8 820*	*9 709*	*10 832*	*11 246*	*10 256*	*8 933*	*7 816*
Dungeness crab	**Dormeur du Pacifique**		**Buey del Pacífico**		***Cancer magister***				**2,31(09)010,04**	**DUN**
67 Canada	5 685	4 090	7 075	9 462	5 403	3 871	6 219	6 445	5 088	4 510
USA	15 685	20 177	35 876	29 559	27 246	37 216	24 154	20 908	27 490	22 784
67 Fishing area total	*21 370*	*24 267*	*42 951*	*39 021*	*32 649*	*41 087*	*30 373*	*27 353*	*32 578*	*27 294*
77 USA	840	2 008	2 205	3 193	2 538	3 114	1 622	1 733	1 251	6 852
77 Fishing area total	*840*	*2 008*	*2 205*	*3 193*	*2 538*	*3 114*	*1 622*	*1 733*	*1 251*	*6 852*
Species total	*22 210*	*26 275*	*45 156*	*42 214*	*35 187*	*44 201*	*31 995*	*29 086*	*33 829*	*34 146*
Edible crab	**Tourteau**		**Buey de mar**		***Cancer pagurus***				**2,31(09)010,06**	**CRE**
27 Belgium	108	126	142	140	143	112	130	115	45	95
Channel Is	1 560	1 423	1 435	1 440	1 258	1 104	1 345	1 281	980	1 179
Denmark	53	67	62	94	89	122	232	157	69	61
France	6 602	5 543	5 892	5 515	5 076	4 804	5 743	5 135	5 206	5 916
Germany	44	74	84	142	191	172	156	143	159	135
Ireland	9 738	10 099	11 462	13 690	5 690	9 808	11 525	7 122	5 665	8 210
Isle of Man	170	387	352	415	333	402	245	200	292	459
Netherlands	300	506	312	444	362	317	479	435	244	394
Norway	3 477	4 344	4 944	5 248	5 671	6 205	8 515	5 295	4 970	5 714
Portugal	13	12	15	14	12	7	6	6	8	1
Spain	35	64	56	83	88	98	117	103	66	61
Sweden	133	146	158	170	165	135	153	150	178	213
UK	21 909	20 760	21 589	19 230	14 591	22 897	31 079	22 745	22 256	24 457
27 Fishing area total	*44 142*	*43 551*	*46 503*	*46 625*	*33 669*	*46 183*	*59 725*	*42 887*	*40 138*	*46 895*
Species total	*44 142*	*43 551*	*46 503*	*46 625*	*33 669*	*46 183*	*59 725*	*42 887*	*40 138*	*46 895*
Jonah crab	**Tourteau jona**		**Jaiba de roca jonás**		***Cancer borealis***				**2,31(09)010,07**	**CRJ**
21 USA	1 245	1 190	1 457	2 017	3 257	3 037	4 289	3 918	3 980	4 935
21 Fishing area total	*1 245*	*1 190*	*1 457*	*2 017*	*3 257*	*3 037*	*4 289*	*3 918*	*3 980*	*4 935*
Species total	*1 245*	*1 190*	*1 457*	*2 017*	*3 257*	*3 037*	*4 289*	*3 918*	*3 980*	*4 935*
Pacific rock crab	**Tourteau du Pacifique**		**Jaiba del Pacífico**		***Cancer productus***				**2,31(09)010,08**	**ROC**
67 USA	5	6	2	3	2	3	7	1	2	2
67 Fishing area total	*5*	*6*	*2*	*3*	*2*	*3*	*7*	*1*	*2*	*2*
77 USA	532	546	411	361	482	522	578	490	585	561
77 Fishing area total	*532*	*546*	*411*	*361*	*482*	*522*	*578*	*490*	*585*	*561*
Species total	*537*	*552*	*413*	*364*	*484*	*525*	*585*	*491*	*587*	*563*
Mola rock crab	**Tourteau mola**		**Jaiba marmola**		***Cancer edwardsi***				**2,31(09)010,10**	**CWE**
87 Chile	5 758	6 974	4 917	5 331	4 562	5 109	4 150	5 449	4 222	4 279
87 Fishing area total	*5 758*	*6 974*	*4 917*	*5 331*	*4 562*	*5 109*	*4 150*	*5 449*	*4 222*	*4 279*
Species total	*5 758*	*6 974*	*4 917*	*5 331*	*4 562*	*5 109*	*4 150*	*5 449*	*4 222*	*4 279*
Batwing coral crab	**Crabe moro**		**Cangrejo moro**		***Carpilius corallinus***				**2,31(10)002,01**	**KPC**
31 Antigua Barb	-	-	-	-	-	-	-	-	1	1
31 Fishing area total	-	-	-	-	-	-	-	-	*1*	*1*
Species total	-	-	-	-	-	-	-	-	*1*	*1*
Giant stone crab	**Crabe caillou moré**		**Jaiba mora**		***Homalaspis plana***				**2,31(10)010,01**	**HWP**
87 Chile	202	106	22	95	118	134	186	312	301	195
87 Fishing area total	*202*	*106*	*22*	*95*	*118*	*134*	*186*	*312*	*301*	*195*
Species total	*202*	*106*	*22*	*95*	*118*	*134*	*186*	*312*	*301*	*195*
Black stone crab	**Crabe caillou noir**		**Cangrejo de piedra negro**		***Menippe mercenaria***				**2,31(10)050,01**	**STC**
31 Bahamas	47	50	49	51	34	57	31	23	30	57
Belize	8	4	2	13	16	13	4	6	6	6
Cuba	76	48	50	132	114	77	95	90	...	...
Mexico	205	378	201	155	364	380	311	161	172	97

B-42

Crabs, sea-spiders
Crabes, araignées de mer
Cangrejos, centollas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
USA	2 996	2 942	2 345	2 743	2 108	2 216	2 520	2 729	2 399	2 407
31 Fishing area total	*3 332*	*3 422*	*2 647*	*3 094*	*2 636*	*2 743*	*2 961*	*3 009*	*2 607*	*2 567*
Species total	*3 332*	*3 422*	*2 647*	*3 094*	*2 636*	*2 743*	*2 961*	*3 009*	*2 607*	*2 567*
Charybdis crabs nei	**Crabes Charybdis nca**		**Jaibas Charybdis nep**		***Charybdis spp***				**2,31(11)003,XX**	**YBX**
61 China	...	...	61 460 F	49 286 F	60 400 F	57 363 F	64 829	64 927	39 779	62 851
61 Fishing area total	*...*	*...*	*61 460 F*	*49 286 F*	*60 400 F*	*57 363 F*	*64 829*	*64 927*	*39 779*	*62 851*
Species total	*...*	*...*	*61 460 F*	*49 286 F*	*60 400 F*	*57 363 F*	*64 829*	*64 927*	*39 779*	*62 851*
Blue swimming crab	**Étrille bleue**		**Jaiba azul**		***Portunus pelagicus***				**2,31(11)004,01**	**SCD**
04 Philippines	67	69	216	353	264	226	258	286	259	279
04 Fishing area total	*67*	*69*	*216*	*353*	*264*	*226*	*258*	*286*	*259*	*279*
37 Israel	-	-	-	-	-	-	...	...	126	115
37 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*126*	*115*
51 Bahrain	2 556	2 828	3 522	4 169	3 246	3 695	3 248	4 656	4 142	3 912
Iran	1 144	938	722	679	1 504	900	1 791	955	2 807	1 399
Saudi Arabia	1 212	1 318	1 569	1 745	2 729	2 977	3 839	3 810	3 840	3 695
51 Fishing area total	*4 912*	*5 084*	*5 813*	*6 593*	*7 479*	*7 572*	*8 878*	*9 421*	*10 789*	*9 006*
57 Australia	1 007	1 027	1 255	1 211	1 305	1 146	1 230	1 156	1 033	1 256
Indonesia	3 694	3 157	3 747	3 760	3 808	3 909	5 187	4 018	3 662	4 504
Thailand	7 171	7 467	9 549	7 411	9 304	7 972	7 583	7 417	8 630	8 276
57 Fishing area total	*11 872*	*11 651*	*14 551*	*12 382*	*14 417*	*13 027*	*14 000*	*12 591*	*13 325*	*14 036*
61 China	50 691 F	52 732 F	67 703 F	65 004 F	53 966 F	54 865 F	68 588	64 059	60 704	67 151
China,Taiwan	1 703	1 030	1 377	1 509	1 459	1 460	1 452	1 365	603	7 467
61 Fishing area total	*52 394 F*	*53 762 F*	*69 080 F*	*66 513 F*	*55 425 F*	*56 325 F*	*70 040*	*65 424*	*61 307*	*74 618*
71 Australia	5 482	4 935	4 372	4 744	4 063	3 668	3 560	3 664	3 222	2 917
Indonesia	18 346	16 831	26 783	18 094	14 952	22 777	25 234	34 820	31 348	38 498
Philippines	38 083	32 947	33 020	34 345	34 377	31 051	33 536	33 718	30 020	29 751
Thailand	29 134	21 407	22 825	22 113	18 567	23 860	16 638	16 156	15 132	15 644
71 Fishing area total	*91 045*	*76 120*	*87 000*	*79 296*	*71 959*	*81 356*	*78 968*	*88 358*	*79 722*	*86 810*
81 Australia	318	272	396	198	160	182	...	...	...	...
81 Fishing area total	*318*	*272*	*396*	*198*	*160*	*182*	*...*	*...*	*...*	*...*
Species total	*160 608 F*	*146 958 F*	*177 056 F*	*165 335 F*	*149 704 F*	*158 688 F*	*172 144*	*176 080*	*165 528*	*184 864*
Gazami crab	**Crabe gazami**		**Jaiba gazami**		***Portunus trituberculatus***				**2,31(11)004,04**	**GAZ**
61 China	284 572 F	295 307 F	263 494 F	289 463 F	317 522 F	345 109 F	350 631	350 199	332 825	349 488
Japan	3 596	3 485	2 627	3 354	3 201	3 015	2 986	2 802	2 319	2 600 F
Korea Rep	13 016	18 659	9 478	2 683	3 714	6 894	13 606	17 846	31 302	33 193
61 Fishing area total	*301 184 F*	*317 451 F*	*275 599 F*	*295 500 F*	*324 437 F*	*355 018 F*	*367 223*	*370 847*	*366 446*	*385 281 F*
Species total	*301 184 F*	*317 451 F*	*275 599 F*	*295 500 F*	*324 437 F*	*355 018 F*	*367 223*	*370 847*	*366 446*	*385 281 F*
Portunus swimcrabs nei	**Étrilles Portunus nca**		**Jaibas Portunus nep**		***Portunus spp***				**2,31(11)004,XX**	**CRS**
27 Ireland	214	...	...	...	...	...	-	-	-	-
Portugal	67	123	188	63	22	4	4	5	3	1
Spain	-	-	0	-	-	0	0	-	-	0
UK	2 418	2 397	1 911	2 558	1 479	3 765	...	3 296	3 180	2 811
27 Fishing area total	*2 699*	*2 520*	*2 099*	*2 621*	*1 501*	*3 769*	*4*	*3 301*	*3 183*	*2 812*
31 Trinidad Tob	0	0	4	5	15	28	38	45	52	112
31 Fishing area total	*0*	*0*	*4*	*5*	*15*	*28*	*38*	*45*	*52*	*112*
51 Eritrea	1	4	...	...	...	15	...	...	...	...
51 Fishing area total	*1*	*4*	*...*	*...*	*...*	*15*	*...*	*...*	*...*	*...*
Species total	*2 700*	*2 524*	*2 103*	*2 626*	*1 516*	*3 812*	*42*	*3 346*	*3 235*	*2 924*
Blue crab	**Crabe bleu**		**Cangrejo azul**		***Callinectes sapidus***				**2,31(11)012,02**	**CRB**
02 USA	-	-	-	-	-	-	-	-	-	4
02 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*4*
21 USA	39 511	42 997	40 750	42 755	40 618	37 398	30 746	43 131	39 078	59 887
21 Fishing area total	*39 511*	*42 997*	*40 750*	*42 755*	*40 618*	*37 398*	*30 746*	*43 131*	*39 078*	*59 887*
31 Cuba	528	410	780	430	225	349	330	340	306	345
Mexico	7 291	8 063	6 023	4 752	10 275	10 729	10 183	9 729	9 275	9 138
Nicaragua	69	0	0	0	1	1	1	1	1	176
USA	32 356	37 609	39 818	34 725	31 597	37 731	32 232	28 242	31 539	24 039
Venezuela	4 001	8 459	15 650	24 730 F	13 230 F	7 800 F	9 500 F	14 499	14 000 F	14 000 F
31 Fishing area total	*44 245*	*54 541*	*62 271*	*64 637 F*	*55 328 F*	*56 610 F*	*52 246 F*	*52 811*	*55 121 F*	*47 698 F*
Species total	*83 756*	*97 538*	*103 021*	*107 392 F*	*95 946 F*	*94 008 F*	*82 992 F*	*95 942*	*94 199 F*	*107 589 F*

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Crabs, sea-spiders
Crabes, araignées de mer
Cangrejos, centollas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Dana swimcrab	**Crabe lénée**		**Cangrejo sirí**		***Callinectes danae***				**2,31(11)012,05**	**CRZ**
41 Brazil	1 062	1 224	940	1 345	2 761	2 415	1 461	2 181	2 405	2 274
41 Fishing area total	*1 062*	*1 224*	*940*	*1 345*	*2 761*	*2 415*	*1 461*	*2 181*	*2 405*	*2 274*
Species total	*1 062*	*1 224*	*940*	*1 345*	*2 761*	*2 415*	*1 461*	*2 181*	*2 405*	*2 274*
Green crab	**Crabe vert**		**Cangrejo verde**		***Carcinus maenas***				**2,31(11)090,01**	**CRG**
21 USA	67	39	6	6	6	17	97	75	75	69
21 Fishing area total	*67*	*39*	*6*	*6*	*6*	*17*	*97*	*75*	*75*	*69*
27 France	566	522	492	188	168	339	403	403	397	392
Ireland	68	...	428	268	-	46	91	72	226	129
Portugal	125	335	248	263	351	219	222	140	338	407
Spain	12	11	5	9	12	6	10	12	8	8
UK	331	402	219	232	157	389	283	271	327	383
27 Fishing area total	*1 102*	*1 270*	*1 392*	*960*	*688*	*999*	*1 009*	*898*	*1 296*	*1 319*
Species total	*1 169*	*1 309*	*1 398*	*966*	*694*	*1 016*	*1 106*	*973*	*1 371*	*1 388*
Mediterranean shore crab	**Crabe vert de la Méditerranée**		**Cangrejo verde mediterráneo**		***Carcinus aestuarii***				**2,31(11)090,02**	**CMR**
37 Albania	...	...	...	1	4	9	...	...	...	...
France	9	9	11	8	5	4	11	12	8	3
Greece	17	117	109	33	47	24	58	56	76	76 F
Spain	-	36	4	2	17	23	25	24	31	31
Tunisia	11	12	-	-	-	-	-	-	-	-
37 Fishing area total	*37*	*174*	*124*	*44*	*73*	*60*	*94*	*92*	*115*	*110 F*
Species total	*37*	*174*	*124*	*44*	*73*	*60*	*94*	*92*	*115*	*110 F*
Indo-Pacific swamp crab	**Crabe de palétuviers**		**Cangrejo de manglares**		***Scylla serrata***				**2,31(11)140,01**	**MUD**
04 China,Taiwan	0	-	-	-	-	-	-	-	-	-
Philippines	150	219	421	376	483	479	719	767	788	821
04 Fishing area total	*150*	*219*	*421*	*376*	*483*	*479*	*719*	*767*	*788*	*821*
51 Mauritius	24	22	24	21	20	2	3	4	5	3
51 Fishing area total	*24*	*22*	*24*	*21*	*20*	*2*	*3*	*4*	*5*	*3*
57 Indonesia	3 938	3 891	4 023	4 867	3 808	3 948	4 613	4 166	4 466	4 256
Thailand	2 462	3 120	663	808	447	2 691	1 410	539	919	842
57 Fishing area total	*6 400*	*7 011*	*4 686*	*5 675*	*4 255*	*6 639*	*6 023*	*4 705*	*5 385*	*5 098*
61 China,Taiwan	230	337	293	9	717	521	647	409	211	150
61 Fishing area total	*230*	*337*	*293*	*9*	*717*	*521*	*647*	*409*	*211*	*150*
71 Fiji	268	180 F	82	324	370 F	427	339	150	80	70
Indonesia	7 815	7 349	10 779	15 262	15 290	19 508	21 028	22 462	24 356	26 324
Marshall Is	0	0	-	-	-	-	-	-	-	-
Micronesia	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F
Palau	8	6	4	4	3	4	12	3	3 F	3 F
Papua N Guin	4	1	15	6	9	17	21	12	8	2
Philippines	1 454	1 239	1 242	1 090	949	1 023	1 084	1 158	1 221	1 537
Singapore	9	8	11	14	28	36	23	22	32	30
Thailand	2 955	703	596	2 051	1 297	4 327	1 936	1 205	1 063	1 632
71 Fishing area total	*12 518 F*	*9 491 F*	*12 734 F*	*18 756 F*	*17 951 F*	*25 347 F*	*24 448 F*	*25 017 F*	*26 768 F*	*29 603 F*
77 Fr Polynesia	2	3	3 F	3 F	3	6	6	6	6	6
77 Fishing area total	*2*	*3*	*3 F*	*3 F*	*3*	*6*	*6*	*6*	*6*	*6*
Species total	*19 324 F*	*17 083 F*	*18 161 F*	*24 840 F*	*23 429 F*	*32 994 F*	*31 846 F*	*30 908 F*	*33 163 F*	*35 681 F*
Velvet swimcrab	**Étrille commune**		**Nécora**		***Necora puber***				**2,31(11)195,01**	**LIO**
27 France	258	377	386	329	192	214	273	244	198	210
Ireland	-	-	328	291	36	280	127	267	193	342
Isle of Man	-	-	1	-	3	-	-	-	0	-
Portugal	...	...	29	42	29	43	42	30	31	30
27 Fishing area total	*258*	*377*	*744*	*662*	*260*	*537*	*442*	*541*	*422*	*582*
Species total	*258*	*377*	*744*	*662*	*260*	*537*	*442*	*541*	*422*	*582*
Harbour spidercrab	**Araignée portuaire**		**Araña porteña**		***Mithrax armatus***				**2,31(21)001,02**	**MXT**
31 Nicaragua	35	23	78	67	47	59	27	21	3	3
31 Fishing area total	*35*	*23*	*78*	*67*	*47*	*59*	*27*	*21*	*3*	*3*
Species total	*35*	*23*	*78*	*67*	*47*	*59*	*27*	*21*	*3*	*3*
Spinous spider crab	**Araignée européenne**		**Centolla europea**		***Maja squinado***				**2,31(21)005,01**	**SCR**
27 Channel Is	428	406	379	323	242	194	165	265	257	246
Denmark	2	2	2	1	2	1	1	-	1	-
France	4 807	4 134	4 440	4 017	3 917	4 542	4 695	4 166	4 965	4 537
Ireland	264	330	222	180	25	153	60	153	443	415
Portugal	51	49	59	53	48	67	56	26	37	37
Spain	108	114	128	196	298	379	288	333	375	295
UK	1 199	1 171	1 027	623	498	1 568	1 441	1 023	865	769
27 Fishing area total	*6 859*	*6 206*	*6 257*	*5 393*	*5 030*	*6 904*	*6 706*	*5 966*	*6 943*	*6 299*

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Crabs, sea-spiders
Crabes, araignées de mer
Cangrejos, centollas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
34 Morocco	0	168	175	108	18	1	1	0	1	4
Portugal	...	...	...	...	...	...	1	-	-	-
34 Fishing area total	*0*	*168*	*175*	*108*	*18*	*1*	*2*	*0*	*1*	*4*
37 Croatia	21	61	54	113	110	69	244	246	19	22
France	1	2	2	2	3	2	-	-	2	8
Morocco	-	-	5	4	3	0	0	0	1	0
Serbia-Monte	0	1	0	2	...	-	-	-	-	-
Spain	5	3	2	2	4	6	5	2	5	5
37 Fishing area total	*27*	*67*	*63*	*123*	*120*	*77*	*249*	*248*	*27*	*35*
Species total	*6 886*	*6 441*	*6 495*	*5 624*	*5 168*	*6 982*	*6 957*	*6 214*	*6 971*	*6 338*
Queen crab	**Crabe des neiges**		**Cangrejo de las nieves**		***Chionoecetes opilio***				**2,31(21)145,01**	**CRQ**
21 Canada	95 299	106 766	96 897	103 354	95 347	89 646	90 672	93 868	97 308	84 414
Greenland	14 247	9 841	6 862	5 837	4 454	3 146	2 189	2 169	2 991	3 096
St Pier Mq	498	150	85	161	151	191	153	137	169	250
Spain	-	-	-	-	292	-	-	-	-	-
21 Fishing area total	*110 044*	*116 757*	*103 844*	*109 352*	*100 244*	*92 983*	*93 014*	*96 174*	*100 468*	*87 760*
Species total	*110 044*	*116 757*	*103 844*	*109 352*	*100 244*	*92 983*	*93 014*	*96 174*	*100 468*	*87 760*
Red snow crab	**...B**		**...C**		***Chionoecetes japonicus***				**2,31(21)145,03**	**CWJ**
61 Japan	21 197 F	19 252	18 041	17 794	19 833	21 456	20 228	20 200	20 300 F	19 200 F
61 Fishing area total	*21 197 F*	*19 252*	*18 041*	*17 794*	*19 833*	*21 456*	*20 228*	*20 200*	*20 300 F*	*19 200 F*
Species total	*21 197 F*	*19 252*	*18 041*	*17 794*	*19 833*	*21 456*	*20 228*	*20 200*	*20 300 F*	*19 200 F*
Tanner crabs nei	**Crabes des neiges du Pac. nca**		**Cangrejos Pacíf. de las nieves**		***Chionoecetes spp***				**2,31(21)145,XX**	**PCR**
61 Japan	5 355	5 016	5 454	5 959	4 849	5 996	5 970	5 308	4 717	4 800 F
Korea Rep	13 974	10 062	21 151	25 718	25 166	27 952	30 205	31 312	32 365	33 355
Russian Fed	24 493	23 759	27 987	25 406	21 014	20 404	22 706	22 797	22 505	27 646
61 Fishing area total	*43 822*	*38 837*	*54 592*	*57 083*	*51 029*	*54 352*	*58 881*	*59 417*	*59 587*	*65 801 F*
67 USA	12 177	15 078	13 169	11 644	12 875	19 287	17 365	29 973	27 910	22 895
67 Fishing area total	*12 177*	*15 078*	*13 169*	*11 644*	*12 875*	*19 287*	*17 365*	*29 973*	*27 910*	*22 895*
Species total	*55 999*	*53 915*	*67 761*	*68 727*	*63 904*	*73 639*	*76 246*	*89 390*	*87 497*	*88 696 F*
Hair crab	**Crabe velu**		**Cangrejo peludo**		***Erimacrus isenbeckii***				**2,31(23)001,01**	**HBZ**
61 Russian Fed	162	117	134	5	16	45	96	136	6	1
61 Fishing area total	*162*	*117*	*134*	*5*	*16*	*45*	*96*	*136*	*6*	*1*
Species total	*162*	*117*	*134*	*5*	*16*	*45*	*96*	*136*	*6*	*1*
Portly spider crab	**...B**		**...C**		***Libinia emarginata***				**2,31(24)001,01**	**KEM**
31 Bahamas	-	-	-	-	-	-	-	-	-	6
31 Fishing area total	-	-	-	-	-	-	-	-	-	*6*
Species total	-	-	-	-	-	-	-	-	-	*6*
West African geryon	**Géryon ouest-africain**		**Gerión de Guinea**		***Chaceon maritae***				**2,31(43)001,02**	**CGE**
34 Mauritania	16	5	25 F	48	4	1	-	-	-	-
Portugal	-	-	-	-	-	-	2	158	9	-
UK	31	-	-	-	-	-	-	-	-	-
34 Fishing area total	*47*	*5*	*25 F*	*48*	*4*	*1*	*2*	*158*	*9*	-
47 Japan	1 650	1 427	1 096	1 152	1 198	572	770	39	196	200
Namibia	2 343	2 471	2 128	2 467	2 413	2 237	4 101	2 100	...	...
Portugal	-	-	-	-	-	-	35	-	-	-
Spain	168	-	5	24	-	-	-	-	-	-
47 Fishing area total	*4 161*	*3 898*	*3 229*	*3 643*	*3 611*	*2 809*	*4 906*	*2 139*	*196*	*200*
Species total	*4 208*	*3 903*	*3 254 F*	*3 691*	*3 615*	*2 810*	*4 908*	*2 297*	*205*	*200*
Deep-sea red crab	**Crabe rouge de profondeur**		**Cangrejo rey**		***Chaceon affinis***				**2,31(43)001,09**	**KEF**
27 Germany	...	...	...	...	...	446	369	263	309	440
Ireland	-	-	-	79	128	10	-	-	-	4
UK	382	1 041	1 309	628	927	623	-	209	13	10
27 Fishing area total	*382*	*1 041*	*1 309*	*707*	*1 055*	*1 079*	*369*	*472*	*322*	*454*
Species total	*382*	*1 041*	*1 309*	*707*	*1 055*	*1 079*	*369*	*472*	*322*	*454*
Red crab	**Gériocrabe rouge**		**Geriocangrejo rojo**		***Chaceon quinquedens***				**2,31(43)001,12**	**CRR**
21 USA	4 004	2 169	1 920	1 793	1 667	1 562	1 284	1 414	1 013	1 416
21 Fishing area total	*4 004*	*2 169*	*1 920*	*1 793*	*1 667*	*1 562*	*1 284*	*1 414*	*1 013*	*1 416*
31 USA	-	-	116	24	-	-	-	-	-	-
31 Fishing area total	-	-	*116*	*24*	-	-	-	-	-	-

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Crabs, sea-spiders
Crabes, araignées de mer
Cangrejos, centollas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*4 004*	*2 169*	*2 036*	*1 817*	*1 667*	*1 562*	*1 284*	*1 414*	*1 013*	*1 416*
Southwest Atlantic red crab	**Géryon de Atlantique sud-ouest**		**Gerión atlántico sudoccidental**		***Chaceon notialis***				**2,31(43)001,13**	**HBN**
41 Brazil	-	2 163	2 209	1 750	1 465	292	1	...	...	...
UK	596	417	-	-	444	557	-	-	-	-
Uruguay	2 089	2 004	2 987	2 653	2 726	1 791	2 358	1 504	1 712	1 760
41 Fishing area total	*2 685*	*4 584*	*5 196*	*4 403*	*4 635*	*2 640*	*2 359*	*1 504*	*1 712*	*1 760*
Species total	*2 685*	*4 584*	*5 196*	*4 403*	*4 635*	*2 640*	*2 359*	*1 504*	*1 712*	*1 760*
Golden deepsea crab	**...B**		**...C**		***Chaceon fenneri***				**2,31(43)001,14**	**HFB**
31 USA	346	239	145	129	171	222	197	178	223	253
31 Fishing area total	*346*	*239*	*145*	*129*	*171*	*222*	*197*	*178*	*223*	*253*
Species total	*346*	*239*	*145*	*129*	*171*	*222*	*197*	*178*	*223*	*253*
Chaceon geryons nei	**Géryons Chaceon nca**		**Geriones Chaceon nep**		***Chaceon spp***				**2,31(43)001,XX**	**GER**
51 Mozambique	47	40	81	184	158	107	125	74	57	40
South Africa	53	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	4	-	-
51 Fishing area total	*100*	*40*	*81*	*184*	*158*	*107*	*125*	*78*	*57*	*40*
Species total	*100*	*40*	*81*	*184*	*158*	*107*	*125*	*78*	*57*	*40*
Mediterranean geryon	**Géryon de la Méditerranée**		**Gerión mediterráneo**		***Geryon longipes***				**2,31(43)088,02**	**GRQ**
37 Spain	-	-	-	67	57	60	88	125	119	141
37 Fishing area total	-	-	-	*67*	*57*	*60*	*88*	*125*	*119*	*141*
Species total	-	-	-	*67*	*57*	*60*	*88*	*125*	*119*	*141*
Marine crabs nei	**Crabes de mer nca**		**Cangrejos de mar nep**		***Brachyura***				**2,31(XX)XXX,XX**	**CRA**
02 Mexico	...	...	...	...	2	2	...	...	...	...
02 Fishing area total	*...*	*...*	*...*	*...*	*2*	*2*	*...*	*...*	*...*	*...*
21 Canada	4 306	4 373	3 730	3 029	2 465	1 889	1 736	1 068	619	700
Spain	-	-	-	-	-	14	-	-	-	-
USA	6 020	6 352	3 652	2 270	473	329	340	212	331	426
21 Fishing area total	*10 326*	*10 725*	*7 382*	*5 299*	*2 938*	*2 232*	*2 076*	*1 280*	*950*	*1 126*
27 Channel Is	-	0	-	-	-	2	-	-	0	-
Denmark	189	245	218	233	194	194	146	209	228	166
Faroe Is	1	0	11	-	0	89	102	169	154	188
France	2	6	2	11	15	13	34	32	-	3
Germany	-	141	498	576	452	2	-	-	-	-
Iceland	1	0	-	1	-	52	-	1	-	2
Ireland	-	505	-	-	-	-	-	1	-	-
Norway	2	0	-	-	-	-	-	-	1	1
Portugal	45	32	7	125	29	2	1	-	-	13
Spain	74	41	74	100	127	172	139	136	143	149
UK	60	132	69	224	53	22	6	1	6	2
27 Fishing area total	*374*	*1 102*	*879*	*1 270*	*870*	*548*	*428*	*549*	*532*	*524*
31 Colombia	2	658	5	780	596	450 F	300 F	150 F	3	4
Cuba	865	257	160	188	272	186	124	246	208	311
Dominican Rp	52	168	186	80	67	75	51	103	49	276
Haiti	150 F	200 F	250 F	300 F	300 F	300 F	300 F	300 F	300 F	300 F
Honduras	20 F	20 F	20 F	20 F	20 F	20 F	20 F	...	...	...
Jamaica	51	...	...	...	...	...	...	...	...	...
Korea Rep	2	-	-	-	-	-	-	-	-	-
Mexico	...	...	...	...	46	48	25	25	25	14
Puerto Rico	6	3	1	1	4	4	3	3	3	3
Suriname	25	20 F	...	30	20	20	15	12	...	...
USA	-	-	3	-	-	-	-	-	-	-
Venezuela	155	2	1 000	1 580 F	850 F	500 F	610 F	700 F	680 F	680 F
31 Fishing area total	*1 328 F*	*1 328 F*	*1 625 F*	*2 979 F*	*2 175 F*	*1 603 F*	*1 448 F*	*1 539 F*	*1 268 F*	*1 588 F*
34 Benin	9	22	47	29	23	24	19	28	8	10
Cameroon	26	20	1	1 F	1	1	1	1 F	1 F	1 F
China	...	111	1	...	0	58	202	52	...	...
Congo Rep	48 F	50 F	...	...	...	...	...	...	...	...
Côte dIvoire	2 F	2	2 F	2 F	2 F	1 F	2 F	2 F	2	10
Gabon	142	136	206	156	171	219	89	23	15 F	15 F
Gambia	2	...	...	...	...	22	120	44	45	46
Ghana	155	156	337	...	2 466	1 445	868	570	650	848
Greece	54	63	54	17	8	4	9	8	1	1 F
GuineaBissau	15	3	1	10 F	10 F	10 F	10 F	10 F	10 F	10 F
Italy	-	-	3	-	-	-	-	-	-	-
Korea Rep	-	-	-	-	-	-	-	-	-	1
Liberia	122	223	150	151	8	131	50	47	50 F	50 F
Morocco	371	79	15	15	26	59	254	138	170	540
Nigeria	4 374	5 029	4 218	3 694	2 917	6 570	1 963	4 467	3 946	3 593
Portugal	193	12	10	9	12	11	29	140	5	15
Senegal	389	243	368	73	47	21	29	16	53	87
Sierra Leone	269	168	208	602	368	312	332	950	930 F	930 F

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Crabs, sea-spiders
Crabes, araignées de mer
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Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Spain	516	611	574	335	248	354	447	160	693	623
	Togo	23	17	7	10	6	28	5	15 F	21	13
	UK	-	-	-	-	-	7	46	-	-	-
34	*Fishing area total*	*6 710 F*	*6 945 F*	*6 202 F*	*5 104 F*	*6 313 F*	*9 277 F*	*4 475 F*	*6 671 F*	*6 600 F*	*6 793 F*
37	Egypt	1 160	2 222	1 456	950	2 307	2 306	4 095	3 525	3 949	3 792
	France	...	-	-	-	-	-	-	-	12	13
	Italy	...	...	...	...	315	323	630	538	466	441
	Palest, O.T.	60 F	73	83	83	102	177	94	99	132	226
	Spain	1 031	834	942	767	842	871	748	698	720	733
	Turkey	273	215	173	168	160	149	26	25	84	49
37	*Fishing area total*	*2 524 F*	*3 344*	*2 654*	*1 968*	*3 726*	*3 826*	*5 593*	*4 885*	*5 363*	*5 254*
41	Argentina	44	34	23	19	21	62	63	79	57	148
	Brazil	12 695	10 536	10 531	9 308	10 151	7 977	6 818	8 185	9 027	8 535
	Portugal	-	-	-	-	-	2	-	-	-	-
	Spain	-	7	-	1	-	-	-	-	-	-
	Ukraine	-	-	-	-	-	-	-	1	...	0
	UK	36	360	-	-	-	-	-	-	-	-
41	*Fishing area total*	*12 775*	*10 937*	*10 554*	*9 328*	*10 172*	*8 041*	*6 881*	*8 265*	*9 084*	*8 683*
47	Angola	836	1 400	1 111	1 596	900 F	296	172	103	117	112 F
	Portugal	-	-	-	-	-	-	1	-	-	-
	Spain	254	179	116	-	67	45	36	44	2	-
47	*Fishing area total*	*1 090*	*1 579*	*1 227*	*1 596*	*967 F*	*341*	*209*	*147*	*119*	*112 F*
51	Egypt	744	678	1 998	833	371	331	311	201	297	267
	France	-	-	-	-	-	-	-	-	1	-
	India	1 841	4 393	4 497	4 405	5 067	6 571	6 210	5 580	5 641	7 542
	Kenya	134	122	142	148	124	110	137	148	117	167
	Korea Rep	5	3	5	-	-	-	-	-	-	-
	Madagascar	1 347	1 400	1 509	1 500	1 525	1 600	1 370	1 370	2 580	2 019
	Mozambique	582	850	356	202	161	175	121	254	574	626
	Pakistan	5 099	6 060	4 619	5 079	4 439	4 218	4 048	4 098	4 840	4 695
	Portugal	5	-	3	42	-	-	-	-	-	-
	Qatar	21	17	35	56	74	65	128	159	140	83
	Réunion	11	13	12	12	6	6	1	0	0	0
	Seychelles	26	24	17	23	18	48	15	4	0	15
	South Africa	2	30	3	26	33	31	16	17	12	23
	Spain	188	-	-	-	-	5	4	6	1	-
	Untd Arab Em	1 969	353	437	470 F	512	630 F	750 F	870	712	978
	Yemen	37	89	108	120 F	110 F	99	29	46	48 F	50 F
51	*Fishing area total*	*12 011*	*14 032*	*13 741*	*12 916 F*	*12 440 F*	*13 889 F*	*13 140 F*	*12 753*	*14 963 F*	*16 465 F*
57	India	16 164	15 591	15 621	15 151	16 619	16 619	29 707	34 213	37 229	32 272
	Malaysia	4 434	4 003	4 193	4 307	3 886	4 793	5 614	5 747	6 509	5 605
	Spain	-	-	-	-	-	4	-	-	-	-
	Thailand	7 048	8 011	7 538	6 288	4 142	3 564	3 145	3 012	3 429	3 195
	Timor-Leste	1	3 F	5 F	6 F	7 F	8 F	9 F	10 F	10 F	10 F
57	*Fishing area total*	*27 647*	*27 608 F*	*27 357 F*	*25 752 F*	*24 654 F*	*24 988 F*	*38 475 F*	*42 982 F*	*47 177 F*	*41 082 F*
61	China	...	...	97 357 F	107 232 F	104 569 F	103 150 F	72 988	69 596	110 190	113 832
	China,H.Kong	1 100 F	1 050 F	1 000 F	1 050 F	1 020 F	970 F	970 F	1 000 F	1 010 F	1 065 F
	China,Taiwan	7 373	8 253	15 293	7 737	5 439	3 201	2 836	2 812	1 482	2 349
	Japan	7 806	7 940	7 440	6 321	6 102	6 124	6 248	4 935	4 800 F	5 100 F
	Korea Rep	9 001	6 753	6 798	8 110	10 383	10 184	8 423	9 454	9 643	8 881
	Russian Fed	194	856	-	-	-	-	-	-	-	-
61	*Fishing area total*	*25 474 F*	*24 852 F*	*127 888 F*	*130 450 F*	*127 513 F*	*123 629 F*	*91 465 F*	*87 797 F*	*127 125 F*	*131 227 F*
67	Russian Fed	-	-	50	-	-	-	-	-	-	-
	USA	42	2	0	-	-	0	1	-	0	2
67	*Fishing area total*	*42*	*2*	*50*	-	-	*0*	*1*	-	*0*	*2*
71	Cambodia	3 500 F	3 800 F	4 600 F	4 700 F	5 100 F	5 100 F	4 800 F	4 580	5 013	5 700 F
	Fiji	290	200 F	112	153	160 F	176	198	150 F	100 F	50
	Korea Rep	23	1	96	176	82	32	95	6	4	2
	Malaysia	7 864	7 232	8 373	8 770	7 696	6 466	6 423	6 383	5 651	6 899
	NewCaledonia	14	8	8	22	9	22	25	47	54	77
	Singapore	203	173	110	100	95	92	96	81	88	98
	Thailand	1 003	1 413	2 459	3 551	4 148	4 950	4 425	2 184	2 458	3 476
	Viet Nam	47 000 F	52 000 F	63 000 F	58 500 F	62 200 F	63 300 F	64 100	69 000 F	74 800 F	80 000 F
	Wallis Fut I	1 F	1 F	1	1 F	1 F	1 F	2 F	2 F	2 F	2 F
71	*Fishing area total*	*59 898 F*	*64 828 F*	*78 759 F*	*75 973 F*	*79 491 F*	*80 139 F*	*80 164 F*	*82 433 F*	*88 170 F*	*96 304 F*
77	Amer Samoa	-	0	-	-	0	0	0	0	0	0
	Costa Rica	3	3	1	8	7	6 F	4	5 F	5 F	5 F
	Honduras	40 F	40 F	40 F	40 F	40 F	40 F	40 F	40 F	40 F	40 F
	Mexico	11 204	7 896	7 680	8 047	10 481	10 944	16 240	18 489	15 737	19 795
	Nicaragua	-	-	-	-	-	-	-	1	...	...
	Panama	20	3	28	17	9	54	10	16	12	...
	USA	54	52	64	56	39	45	44	38	47	44
77	*Fishing area total*	*11 321 F*	*7 994 F*	*7 813 F*	*8 168 F*	*10 576 F*	*11 089 F*	*16 338 F*	*18 589 F*	*15 841 F*	*19 884 F*
81	Korea Rep	-	1	-	-	-	-	-	-	-	-
	New Zealand	360	292	329	384	420	307	247	318	330	205
	Ukraine	-	6	24	6	...	22	...	...	...	...
81	*Fishing area total*	*360*	*299*	*353*	*390*	*420*	*329*	*247*	*318*	*330*	*205*
87	Chile	810	212	161	770	547	519	809	976	1 463	777

B-42

Crabs, sea-spiders
Crabes, araignées de mer
Cangrejos, centollas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Colombia	74	596	114	551	417	330 F	250 F	140 F	52	76
Ecuador	550 F	570 F	430 F	...	...	...	...	...	...	...
Peru	1 568	2 838	2 631	2 060	2 006	1 256	1 628	1 750	1 894	1 578
87 Fishing area total	*3 002 F*	*4 216 F*	*3 336 F*	*3 381*	*2 970*	*2 105 F*	*2 687 F*	*2 866 F*	*3 409*	*2 431*
Species total	*174 882 F*	*179 791 F*	*289 820 F*	*284 574 F*	*285 227 F*	*282 038 F*	*263 627 F*	*271 074 F*	*320 931 F*	*331 680 F*
Group total	***1 036 748***	***1 063 311***	***1 248 103***	***1 254 214***	***1 235 077***	***1 304 357***	***1 306 841***	***1 330 522***	***1 341 696***	***1 424 867***

B-43 **Lobsters, spiny-rock lobsters**
Homards, langoustes
Bogavantes, langostas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Longlegged spiny lobster	**Langouste diablotin**		**Langosta duende**		***Panulirus longipes***				**2,29(01)001,01**	**LOJ**
61 China,Taiwan	23	13	217	23	18	17	7	8	13	10
Japan	1 486	1 378	1 472	1 271	1 299	1 252	1 300	1 401	1 335	1 200 F
Korea Rep	415	391	393	595	742	772	734	554	1 111	1 093
61 Fishing area total	*1 924*	*1 782*	*2 082*	*1 889*	*2 059*	*2 041*	*2 041*	*1 963*	*2 459*	*2 303 F*
Species total	*1 924*	*1 782*	*2 082*	*1 889*	*2 059*	*2 041*	*2 041*	*1 963*	*2 459*	*2 303 F*
Caribbean spiny lobster	**Langouste blanche**		**Langosta común del Caribe**		***Panulirus argus***				**2,29(01)001,08**	**SLC**
31 Anguilla	160 F	170 F	180 F	190 F	200 F	210 F	220 F	232	131	115
Antigua Barb	272	276	243	245	309	318	318	165	103	175
Bahamas	7 042	10 012	10 378	9 317	9 278	8 294	6 977	6 896	7 138	9 692
Belize	394	525	541	555	439	573	630	642	624	672
Bermuda	21	26	31	27	30	32	31	31	38	39
Br Virgin Is	125	168	138	47	50 F	50 F	45 F	40 F	40 F	40 F
Colombia	356	339	271	272	289	282 F	275 F	268 F	261	45
Costa Rica	39	57	28	81	34	45 F	59	59 F	59 F	59 F
Cuba	6 776	7 972	5 265	7 601	5 834	4 401	4 778	5 725	4 124	4 458
Dominican Rp	1 209	2 451	803	1 007	958	886	1 076	1 272	1 411	1 001
Grenada	32	24	26	19	23	15	11	10	23	19
Guatemala	...	...	...	...	...	1	...	...	...	...
Haiti	480 F	630 F	800 F	950 F	950 F	950 F	950 F	950 F	950 F	950 F
Honduras	1 839	2 319	3 066	2 853	3 321	2 877	2 763	3 039	2 145	3 150
Jamaica	309	359	330	300	738	300	300	300	350	350
Martinique	190	190	190	190	150 F	190	190	190	190 F	150 F
Mexico	782	1 070	926	795	767	800	611	531	469	370
Nicaragua	3 858	4 326	3 851	4 257	3 787	3 625	3 654	4 186	3 419	3 690
Puerto Rico	190	158	196	158	157	148	123	142	139	148
St Kitts Nev	33	10	25 F	40	39 F	38 F	37 F	35 F	34 F	33
St Vincent	...	...	...	...	...	...	...	...	13	15
Trinidad Tob	1	3	2	12	6	3	7	13	12	60
Turks Caicos	291	323	182	278	388	427	436	380	203	154
USA	1 527	2 047	1 887	2 266	1 534	2 165	1 638	1 569	1 827	2 570
US Virgin Is	110 F	120 F	130	150	106	124	106	121	125	111
Venezuela	78	88	1 060	1 670 F	900 F	530 F	650 F	740 F	710 F	710 F
31 Fishing area total	*26 114 F*	*33 663 F*	*30 549 F*	*33 280 F*	*30 287 F*	*27 284 F*	*25 885 F*	*27 536 F*	*24 538 F*	*28 776 F*
41 Brazil	7 139	6 807	6 320	8 689	6 927	6 724	6 479	6 589	7 268	6 866
41 Fishing area total	*7 139*	*6 807*	*6 320*	*8 689*	*6 927*	*6 724*	*6 479*	*6 589*	*7 268*	*6 866*
Species total	*33 253 F*	*40 470 F*	*36 869 F*	*41 969 F*	*37 214 F*	*34 008 F*	*32 364 F*	*34 125 F*	*31 806 F*	*35 642 F*
Scalloped spiny lobster	**Langouste festonnée**		**Langosta festoneada**		***Panulirus homarus***				**2,29(01)001,13**	**LOK**
51 Yemen	202	328	437	216	238	237	112	98	105 F	110
51 Fishing area total	*202*	*328*	*437*	*216*	*238*	*237*	*112*	*98*	*105 F*	*110*
Species total	*202*	*328*	*437*	*216*	*238*	*237*	*112*	*98*	*105 F*	*110*
Australian spiny lobster	**Langouste d'Australie**		**Langosta de Australia**		***Panulirus cygnus***				**2,29(01)001,15**	**LOA**
57 Australia	11 353	9 050	11 477	13 745	12 304	10 441	8 676	8 990	7 635	5 502
57 Fishing area total	*11 353*	*9 050*	*11 477*	*13 745*	*12 304*	*10 441*	*8 676*	*8 990*	*7 635*	*5 502*
Species total	*11 353*	*9 050*	*11 477*	*13 745*	*12 304*	*10 441*	*8 676*	*8 990*	*7 635*	*5 502*
Green spiny lobster	**Langouste verte**		**Langosta barbona**		***Panulirus gracilis***				**2,29(01)001,16**	**NUG**
77 Nicaragua	337	167	71	118	126	101	98	151	224	110
77 Fishing area total	*337*	*167*	*71*	*118*	*126*	*101*	*98*	*151*	*224*	*110*
87 Colombia	9	3	-	0	...	1 F	1 F	1 F	1	1
Ecuador	33 F	38 F	25 F	6 F	6 F	2	-	-	-	-
Peru	62	20	24	6	175	43	2	-	1	2
87 Fishing area total	*104 F*	*61 F*	*49 F*	*12 F*	*181 F*	*46 F*	*3 F*	*1 F*	*2*	*3*
Species total	*441 F*	*228 F*	*120 F*	*130 F*	*307 F*	*147 F*	*101 F*	*152 F*	*226*	*113*
Tropical spiny lobsters nei	**Langoustes tropicales nca**		**Langostas tropicales nep**		***Panulirus spp***				**2,29(01)001,XX**	**SLV**
31 Bermuda	4	4	4	3	2	1	2	3	4	2
Panama	845	687	624	684	1 053	837	320	199	113	142
31 Fishing area total	*849*	*691*	*628*	*687*	*1 055*	*838*	*322*	*202*	*117*	*144*
34 Benin	2	7	7	10	6	9	7	8	2	7
Cameroon	0	1	1	1 F	1	1	1	1 F	1 F	1 F
Cape Verde	8	9	9	12	12	12	...	8	...	...
Congo Rep	50 F	90 F	123	138	130	103	92	101	134	269
Côte dIvoire	2	18	20 F	15 F	10 F	9 F	12 F	12 F	11	20
Gabon	57	121	75	85	80	53	43	8	5 F	5 F
Ghana	342	97	28	127	49	3	5	25	128	64
Liberia	36	40	40	4	39	95	-	-	-	-
Mauritania	...	...	...	...	...	...	...	...	...	14
Nigeria	1 699	193	1 904	1 943	2 456	2 881	1 610	2 265	3 147	4 398
Sierra Leone	30	43	40	122	75	100	55	234	230 F	230 F
Togo	0	0	0	1	3	1	1	1 F	0	1
34 Fishing area total	*2 226 F*	*619 F*	*2 247 F*	*2 458 F*	*2 861 F*	*3 267 F*	*1 826 F*	*2 663 F*	*3 658 F*	*5 009 F*

B-43 **Lobsters, spiny-rock lobsters**
Homards, langoustes
Bogavantes, langostas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
51 Comoros	20	20	20	20	20	20 F	20 F	28 F	28 F	28 F
Djibouti	0	0	0	0	-	-	-	-	-	-
Egypt	-	-	14	41	27	2	45	12	25	1
Iran	20	20	33	17	11	11	13	10	7	13
Kenya	76	119	171	162	97	93	94	112	84	100
Madagascar	359	400	436	450	500	550	380	450	432	367
Maldives	13	...	...	...	...	20	...	...	...	...
Mauritius	19	26	21	18	18	8	...	12	6	8
Oman	379	449	473	233	428	373	332	157	19	407
Pakistan	756	802	749	716	576	601	591	603	511	1 029
Seychelles	5	6	0	-	4	6	4	-	0	-
Somalia	530 F	480 F	500 F	500 F	400 F	500 F	500 F	500 F	500 F	500 F
Zanzibar	68	30	64	81	65	218	463	395	393	396
51 Fishing area total	*2 245 F*	*2 352 F*	*2 481 F*	*2 238 F*	*2 146 F*	*2 402 F*	*2 442 F*	*2 279 F*	*2 005 F*	*2 849 F*
57 Indonesia	1 777	1 907	2 437	2 384	2 486	2 115	2 156	2 623	2 184	2 081
Malaysia	104	20	23	18	51	29	25	24	80	26
Timor-Leste	2	4 F	6 F	7 F	9 F	10 F	11 F	12 F	12 F	12 F
57 Fishing area total	*1 883*	*1 931 F*	*2 466 F*	*2 409 F*	*2 546 F*	*2 154 F*	*2 192 F*	*2 659 F*	*2 276 F*	*2 119 F*
61 China,H.Kong	0	0	0	0	0	0	0	-	-	-
61 Fishing area total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	-	-	-
71 Australia	274	330	1 211	1 471	1 061	768	675	655	444	429
Fiji	224	110 F	1	277	330 F	385	219	190	200	100
Guam	1	1	1	1	1	2	1	0	1	1
Indonesia	2 713	2 851	2 911	3 055	4 162	3 139	2 549	7 273	3 708	5 570
Malaysia	1 508	2 039	2 087	1 566	1 812	1 010	885	1 088	731	704
Micronesia	20 F	20 F	20 F	20 F	20 F	20 F	20 F	20 F	20 F	20 F
NewCaledonia	9	9 F	6	7	6	13	14	9	25	35
N Marianas	2	2	0	1	2	1	1	1	0	0
Palau	1	1	1	0	0	1	3	1	1 F	1 F
Papua N Guin	131	111	98	92	117	72	86	49	63	53
Philippines	309	328	236	161	145	148	181	177	211	205
Singapore	7	2	6	4	6	11	10	2	6	5
Wallis Fut I	1 F	1 F	1	1 F	1 F	1 F	2 F	2 F	2 F	2 F
71 Fishing area total	*5 200 F*	*5 805 F*	*6 579 F*	*6 656 F*	*7 663 F*	*5 571 F*	*4 646 F*	*9 467 F*	*5 412 F*	*7 125 F*
77 Amer Samoa	1	0	0	0	2	2	1	1	1	2
Costa Rica	17	11	9	10	8	10 F	11	11 F	11 F	11 F
El Salvador	2	5	4	5	3	4	2	4	5	...
Fr Polynesia	58	54	55 F	55 F	50	55	55	55	55	55
Guatemala	2 F	1	0	0	0	...	2	...	...	...
Honduras	1 F	1 F	1 F	1 F	1 F	1 F	1 F	1 F	1 F	1 F
Mexico	1 727	1 923	2 044	1 757	1 746	1 823	1 601	2 056	1 816	2 890
USA	324	306	306	378	351	406	304	338	323	323
77 Fishing area total	*2 132 F*	*2 301 F*	*2 419 F*	*2 206 F*	*2 161 F*	*2 301 F*	*1 977 F*	*2 466 F*	*2 212 F*	*3 282 F*
Species total	*14 535 F*	*13 699 F*	*16 820 F*	*16 654 F*	*18 432 F*	*16 533 F*	*13 405 F*	*19 736 F*	*15 680 F*	*20 528 F*
Cape rock lobster	**Langouste du Cap**		**Langosta del Cabo**		***Jasus lalandii***				**2,29(01)002,01**	**LBC**
47 Namibia	363	358	250	214	248	285	165	196	50	50 F
South Africa	1 611	2 671	2 594	2 888	2 937	2 162	2 894	1 945	2 100	3 368
47 Fishing area total	*1 974*	*3 029*	*2 844*	*3 102*	*3 185*	*2 447*	*3 059*	*2 141*	*2 150*	*3 418 F*
Species total	*1 974*	*3 029*	*2 844*	*3 102*	*3 185*	*2 447*	*3 059*	*2 141*	*2 150*	*3 418 F*
Juan Fernandez rock lobster	**Langouste Juan Fernandez**		**Langosta de Juan Fernández**		***Jasus frontalis***				**2,29(01)002,02**	**LOF**
87 Chile	21	9	1	47	54	45	50	57	58	72
87 Fishing area total	*21*	*9*	*1*	*47*	*54*	*45*	*50*	*57*	*58*	*72*
Species total	*21*	*9*	*1*	*47*	*54*	*45*	*50*	*57*	*58*	*72*
Green rock lobster	**Langouste d'Océanie**		**Langosta de Oceanía**		***Jasus verreauxi***				**2,29(01)002,03**	**LOG**
81 Australia	103	103	122	108	99	101	110	122	122	122
New Zealand	10	8	16	19	19	29	29	32	36	35
81 Fishing area total	*113*	*111*	*138*	*127*	*118*	*130*	*139*	*154*	*158*	*157*
Species total	*113*	*111*	*138*	*127*	*118*	*130*	*139*	*154*	*158*	*157*
Tristan da Cunha rock lobster	**Langouste de Tristan da Cunha**		**Langosta de Tristán da Cunha**		***Jasus tristani***				**2,29(01)002,05**	**LBT**
47 St Helena	425	301	534	377	373	464	351	406	380	403
47 Fishing area total	*425*	*301*	*534*	*377*	*373*	*464*	*351*	*406*	*380*	*403*
Species total	*425*	*301*	*534*	*377*	*373*	*464*	*351*	*406*	*380*	*403*
Red rock lobster	**...B**		**Langosta roja**		***Jasus edwardsii***				**2,29(01)002,06**	**LOR**
81 New Zealand	2 551	2 485	2 553	2 348	2 573	2 542	2 451	2 749	2 493	2 871
81 Fishing area total	*2 551*	*2 485*	*2 553*	*2 348*	*2 573*	*2 542*	*2 451*	*2 749*	*2 493*	*2 871*
Species total	*2 551*	*2 485*	*2 553*	*2 348*	*2 573*	*2 542*	*2 451*	*2 749*	*2 493*	*2 871*

B-43

Lobsters, spiny-rock lobsters
Homards, langoustes
Bogavantes, langostas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Southern rock lobster	**...B**		**...C**		***Jasus novaehollandiae***				**2,29(01)002,07**	**JSN**
57 Australia	4 677	4 403	4 271	4 500	4 426	4 258	4 294	4 099	3 497	4 368
57 Fishing area total	*4 677*	*4 403*	*4 271*	*4 500*	*4 426*	*4 258*	*4 294*	*4 099*	*3 497*	*4 368*
Species total	*4 677*	*4 403*	*4 271*	*4 500*	*4 426*	*4 258*	*4 294*	*4 099*	*3 497*	*4 368*
St.Paul rock lobster	**Langouste de St.Paul**		**Langosta de St.Paul**		***Jasus paulensis***				**2,29(01)002,08**	**JSP**
51 Fr South Tr	183	334	383	183	183	392	392	390 F	390 F	390 F
51 Fishing area total	*183*	*334*	*383*	*183*	*183*	*392*	*392*	*390 F*	*390 F*	*390 F*
Species total	*183*	*334*	*383*	*183*	*183*	*392*	*392*	*390 F*	*390 F*	*390 F*
Pink spiny lobster	**Langouste rose**		**Langosta mora**		***Palinurus mauritanicus***				**2,29(01)008,02**	**PSL**
27 France	5	1	-	-	3	3	6	6	2	1
27 Fishing area total	*5*	*1*	-	-	*3*	*3*	*6*	*6*	*2*	*1*
37 France	-	-	-	-	-	0	-	-	-	-
37 Fishing area total	-	-	-	-	-	*0*	-	-	-	-
Species total	*5*	*1*	-	-	*3*	*3*	*6*	*6*	*2*	*1*
Common spiny lobster	**Langouste rouge**		**Langosta común**		***Palinurus elephas***				**2,29(01)008,04**	**SLO**
27 France	65	45	42	31	27	25	28	17	77	65
27 Fishing area total	*65*	*45*	*42*	*31*	*27*	*25*	*28*	*17*	*77*	*65*
37 Albania	1	2	1	2	2	1	4	3	1	...
Croatia	...	...	...	...	...	...	...	...	15	17
France	3	3	3	3	0	0	-	-	20	32
Italy	166	152	184	179	312	297	294	254	330	250
Spain	44	103	143	44	40	43	41	51	57	59
Turkey	18	19	11	22	30	42	14	20	26	26
37 Fishing area total	*232*	*279*	*342*	*250*	*384*	*383*	*353*	*328*	*449*	*384*
Species total	*297*	*324*	*384*	*281*	*411*	*408*	*381*	*345*	*526*	*449*
Natal spiny lobster	**Langouste du Natal**		**Langosta del Natal**		***Palinurus delagoae***				**2,29(01)008,05**	**SLN**
51 South Africa	10	7	90	4	4	5	2	5	7	19
51 Fishing area total	*10*	*7*	*90*	*4*	*4*	*5*	*2*	*5*	*7*	*19*
Species total	*10*	*7*	*90*	*4*	*4*	*5*	*2*	*5*	*7*	*19*
Southern spiny lobster	**Langouste du Sud**		**Langosta del Sur**		***Palinurus gilchristi***				**2,29(01)008,06**	**SLS**
47 South Africa	1 053	651	89	399	843	723	734	425	366	734
47 Fishing area total	*1 053*	*651*	*89*	*399*	*843*	*723*	*734*	*425*	*366*	*734*
Species total	*1 053*	*651*	*89*	*399*	*843*	*723*	*734*	*425*	*366*	*734*
Palinurid spiny lobsters nei	**Langoustes Palinurus nca**		**Langostas Palinurus nep**		***Palinurus spp***				**2,29(01)008,XX**	**CRW**
27 Channel Is	3	2	2	1	1	1	1	1	1	0
Ireland	35	36	57	81	6	34	16	18	27	30
Portugal	11	9	12	16	9	11	8	8	12	13
Spain	21	6	3	4	4	5	4	3	3	3
UK	15	15	14	9	12	15	15	14	13	15
27 Fishing area total	*85*	*68*	*88*	*111*	*32*	*66*	*44*	*44*	*56*	*61*
34 Belize	...	...	-	-	-	-	-	-	-	2
Cape Verde	18	19	19	23	24	24	...	0	...	...
Cyprus	1	-	-	-	-	-	-	-	-	-
Gambia	75	98	118	23	24	35	4	38	41	40
GuineaBissau	3	0	0	0	0	0	0	0	-	-
Latvia	-	10	-	-	-	-	-	-	-	-
Mauritania	...	...	...	...	...	...	...	...	...	635
Morocco	39	163	108	171	123	131	292	254	195	259
Portugal	5	-	-	1	-	11	17	-	-	-
Senegal	53	50	59	58	47	51	49	39	43	48
Spain	46	54	-	-	3	-	-	-	-	0
34 Fishing area total	*240*	*394*	*304*	*276*	*221*	*252*	*362*	*331*	*279*	*984*
37 Algeria	34	46	74	123	46	31	51	131	93	34
Morocco	7	3	3	8	2	18	5	2	4	10
Tunisia	41	45	58	58	52	51	57	48	38	43
37 Fishing area total	*82*	*94*	*135*	*189*	*100*	*100*	*113*	*181*	*135*	*87*
Species total	*407*	*556*	*527*	*576*	*353*	*418*	*519*	*556*	*470*	*1 132*
Spiny lobsters nei	**Langoustes diverses nca**		**Langostas diversas nep**		***Palinuridae***				**2,29(01)XXX,XX**	**VLO**
34 Mauritania	25 F	15 F	8 F	1	...	0	2	0	75 F	103
34 Fishing area total	*25 F*	*15 F*	*8 F*	*1*	*...*	*0*	*2*	*0*	*75 F*	*103*
51 Eritrea	0	0	1	0	0	0	2	0	0	0
Mozambique	199	276	243	2	1	13	41	5	145	203
Portugal	-	-	-	-	-	1	-	-	-	-

B-43

Lobsters, spiny-rock lobsters
Homards, langoustes
Bogavantes, langostas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
51 Fishing area total	*199*	*276*	*244*	*2*	*1*	*14*	*43*	*5*	*145*	*203*
Species total	*224 F*	*291 F*	*252 F*	*3*	*1*	*14*	*45*	*5*	*220 F*	*306*
Japanese fan lobster	**Cigale japonaise**		**Cigarra japonesa**		***Ibacus ciliatus***				**2,29(15)001,04**	**IBC**
61 China,Taiwan	1 607	1 005	1 637	1 596	1 553	1 570	1 513	1 467	599	9 114
61 Fishing area total	*1 607*	*1 005*	*1 637*	*1 596*	*1 553*	*1 570*	*1 513*	*1 467*	*599*	*9 114*
Species total	*1 607*	*1 005*	*1 637*	*1 596*	*1 553*	*1 570*	*1 513*	*1 467*	*599*	*9 114*
Flathead lobster	**Cigale raquette**		**Cigarra chata**		***Thenus orientalis***				**2,29(15)005,01**	**THQ**
51 Bahrain	2	3	1	2	10	2	3	6	3	3
Qatar	20	17	13	21	36	30	11	19	20	9
Saudi Arabia	15	41	17	29	43	57	37	47	3	...
51 Fishing area total	*37*	*61*	*31*	*52*	*89*	*89*	*51*	*72*	*26*	*12*
57 Thailand	58	282	629	588	503	620	414	97	150	124
57 Fishing area total	*58*	*282*	*629*	*588*	*503*	*620*	*414*	*97*	*150*	*124*
71 Thailand	1 797	2 035	2 474	2 179	1 837	1 619	1 457	908	664	786
71 Fishing area total	*1 797*	*2 035*	*2 474*	*2 179*	*1 837*	*1 619*	*1 457*	*908*	*664*	*786*
Species total	*1 892*	*2 378*	*3 134*	*2 819*	*2 429*	*2 328*	*1 922*	*1 077*	*840*	*922*
Mediterranean slipper lobster	**Grande cigale**		**Cigarra**		***Scyllarides latus***				**2,29(15)041,01**	**YLL**
27 Portugal	1	1	-	1	1	1	1	1	1	1
27 Fishing area total	*1*	*1*	*-*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Species total	*1*	*1*	*-*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Spanish slipper lobster	**Cigale marie-carogne**		**Cigarro español**		***Scyllarides aequinoctialis***				**2,29(15)041,02**	**YLA**
31 Antigua Barb	-	-	-	-	-	-	-	-	1	0
31 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*1*	*0*
Species total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*1*	*0*
Slipper lobsters nei	**Cigales nca**		**Cigarros nep**		***Scyllaridae***				**2,29(15)XXX,XX**	**LOS**
31 USA	-	-	-	-	7	-	-	-	-	-
31 Fishing area total	*-*	*-*	*-*	*-*	*7*	*-*	*-*	*-*	*-*	*-*
34 Morocco	4	33	30	65	79	87	32	62	16	31
Senegal	6	1	2	4	8	9	6	10	19	25
34 Fishing area total	*10*	*34*	*32*	*69*	*87*	*96*	*38*	*72*	*35*	*56*
37 Israel	-	-	-	-	-	-	...	...	3	2
Morocco	27	58	103	90	65	46	24	62	82	78
37 Fishing area total	*27*	*58*	*103*	*90*	*65*	*46*	*24*	*62*	*85*	*80*
47 St Helena	0	-	0	0	1	-	-	-	-	-
47 Fishing area total	*0*	*-*	*0*	*0*	*1*	*-*	*-*	*-*	*-*	*-*
51 South Africa	4	...	...	...	-	-	-	-	-	-
51 Fishing area total	*4*	*...*	*...*	*...*	*-*	*-*	*-*	*-*	*-*	*-*
57 Australia	-	-	-	-	27	22	15	20	16	31
57 Fishing area total	*-*	*-*	*-*	*-*	*27*	*22*	*15*	*20*	*16*	*31*
71 Australia	...	...	...	...	56	56	36	33	22	12
Philippines	121	107	129	74	36	37	41	59	82	86
Singapore	7	4	5	3	5	19	24	16	5	5
71 Fishing area total	*128*	*111*	*134*	*77*	*97*	*112*	*101*	*108*	*109*	*103*
81 Australia	0	0	0	0	9	6	2	2	3	3
New Zealand	4	2	0	0	1	-	-	0	-	-
81 Fishing area total	*4*	*2*	*0*	*0*	*10*	*6*	*2*	*2*	*3*	*3*
Species total	*173*	*205*	*269*	*236*	*294*	*282*	*180*	*264*	*248*	*273*
Mozambique lobster	**Langoustine du Mozambique**		**Cigala del Mozambique**		***Metanephrops mozambicus***				**2,29(42)005,02**	**NEM**
51 Mozambique	69	80	124	132	149	94	153	100	120	94
South Africa	72	55	-	-	-	-	-	-	-	-
51 Fishing area total	*141*	*135*	*124*	*132*	*149*	*94*	*153*	*100*	*120*	*94*
Species total	*141*	*135*	*124*	*132*	*149*	*94*	*153*	*100*	*120*	*94*
New Zealand lobster	**Langoustine de N.lle-Zélande**		**Cigala de Nueva Zelandia**		***Metanephrops challengeri***				**2,29(42)005,04**	**MEC**
81 New Zealand	1 093	1 020	829	546	849	811	886	609	565	825
81 Fishing area total	*1 093*	*1 020*	*829*	*546*	*849*	*811*	*886*	*609*	*565*	*825*
Species total	*1 093*	*1 020*	*829*	*546*	*849*	*811*	*886*	*609*	*565*	*825*

B-43 **Lobsters, spiny-rock lobsters**
Homards, langoustes
Bogavantes, langostas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Metanephrops lobsters nei	**Langoustine Metanephrops nca**		**Cigalas Metanephrops nep**		***Metanephrops spp***				**2,29(42)005,XX**	**MWF**
57 Australia	105	88	-	63	61	42	43	15	37	51
57 Fishing area total	*105*	*88*	-	*63*	*61*	*42*	*43*	*15*	*37*	*51*
71 Australia	-	9	-	16	10	18	8	24	29	...
71 Fishing area total	*-*	*9*	*-*	*16*	*10*	*18*	*8*	*24*	*29*	*...*
Species total	*105*	*97*	*-*	*79*	*71*	*60*	*51*	*39*	*66*	*51*
Norway lobster	**Langoustine**		**Cigala**		***Nephrops norvegicus***				**2,29(42)006,02**	**NEP**
27 Belgium	284	287	231	226	190	228	215	212	282	134
Denmark	4 815	5 439	4 893	5 209	5 303	4 498	4 325	4 290	4 466	4 341
Faroe Is	56	41	30	32	42	42	43	54	56	56
France	6 992	7 588	7 598	6 314	6 764	6 206	5 504	4 497	5 599	4 759
Germany	141	132	62	62	110	294	616	286	426	403
Iceland	1 420	1 548	1 666	1 437	2 031	1 876	2 007	2 070	2 463	2 541
Ireland	7 074	6 983	6 808	6 791	7 097	6 337	9 294	9 226	7 155	7 758
Isle of Man	2	-	1	13	12	4	-	52	1	2
Netherlands	853	966	940	919	1 019	982	1 147	737	882	701
Norway	281	280	240	223	245	206	266	331	315	291
Portugal	282	365	458	443	638	316	278	244	184	152
Spain	907	854	985	886	984	1 081	547	480	679	507
Sweden	1 067	1 046	898	906	1 051	1 152	1 472	1 538	1 339	1 253
UK	28 536	28 502	27 767	30 550	27 079	41 346	44 519	43 518	42 900	38 652
27 Fishing area total	*52 710*	*54 031*	*52 577*	*54 011*	*52 565*	*64 568*	*70 233*	*67 535*	*66 747*	*61 550*
34 Morocco	19	14	17	8	13	21	62	27	14	2
Portugal	88	60	23	-	6	2	17	3	-	-
Spain	3	7	48	-	3	16	3	8	-	0
34 Fishing area total	*110*	*81*	*88*	*8*	*22*	*39*	*82*	*38*	*14*	*2*
37 Albania	10	5	2	2	2	4	...	1	...	...
Algeria	45	56	119	69	60	25	14	53	84	99
Croatia	274	140	128	158	141	223	198	201	371	328
France	-	-	-	1	0	0	1	3	10	28
Greece	242	215	304	390	369	464	555	499	491	491 F
Italy	2 287	2 051	2 550	2 355	4 493	4 564	4 325	3 551	3 719	3 350
Malta	-	-	-	-	-	-	1	1	2	3
Morocco	1	1	1	21	18	0	0	0	1	2
Serbia-Monte	9	10	11	7	...	-	-	-	-	-
Spain	630	636	539	511	480	502	579	603	678	666
Tunisia	4	4	-	-	1	1	4	4	4	6
Turkey	...	...	...	...	...	...	7	35	43	19
37 Fishing area total	*3 502*	*3 118*	*3 654*	*3 514*	*5 564*	*5 783*	*5 684*	*4 951*	*5 403*	*4 992 F*
Species total	*56 322*	*57 230*	*56 319*	*57 533*	*58 151*	*70 390*	*75 999*	*72 524*	*72 164*	*66 544 F*
American lobster	**Homard américain**		**Bogavante americano**		***Homarus americanus***				**2,29(42)007,01**	**LBA**
21 Canada	51 412	45 111	48 772	47 446	43 819	55 008	48 870	58 984	58 347	63 291
St Pier Mq	2	2	4	3	-	8	14	...	...	...
USA	32 389	37 309	32 539	34 169	39 931	42 010	34 107	37 120	43 949	52 360
21 Fishing area total	*83 803*	*82 422*	*81 315*	*81 618*	*83 750*	*97 026*	*82 991*	*96 104*	*102 296*	*115 651*
Species total	*83 803*	*82 422*	*81 315*	*81 618*	*83 750*	*97 026*	*82 991*	*96 104*	*102 296*	*115 651*
European lobster	**Homard européen**		**Bogavante**		***Homarus gammarus***				**2,29(42)007,18**	**LBE**
27 Belgium	6	1	1	1	2	2	2	4	10	11
Channel Is	178	200	216	230	202	190	227	230	245	305
Denmark	11	11	9	8	8	9	7	9	16	31
France	329	299	319	283	282	330	420	365	447	871
Germany	0	0	0	1	-	1	1	1	1	1
Ireland	781	740	657	853	157	631	207	499	399	476
Isle of Man	12	23	27	29	43	32	38	44	38	47
Netherlands	33	11	19	18	18	16	19	22	26	24
Norway	40	42	52	52	58	62	57	44	50	57
Portugal	2	2	3	3	2	4	3	3	4	3
Spain	8	6	9	11	11	11	11	12	12	10
Sweden	18	19	30	31	27	22	25	33	36	31
UK	1 086	1 188	1 325	1 379	1 212	2 368	2 786	2 689	2 782	2 739
27 Fishing area total	*2 504*	*2 542*	*2 667*	*2 899*	*2 022*	*3 678*	*3 803*	*3 955*	*4 066*	*4 606*
34 Greece	12	15	7	8	166	286	243	255	261	261 F
Morocco	11	55	24	16	15	9	10	9	10	31
34 Fishing area total	*23*	*70*	*31*	*24*	*181*	*295*	*253*	*264*	*271*	*292 F*
37 Albania	...	...	...	1	3	6	...	...	...	...
Algeria	-	-	-	-	-	-	0	-	-	-
Croatia	13	3	2	3	7	6	9	14	2	2
France	-	-	-	1	1	0	-	-	1	4
Greece	221	97	83	81	120	124	139	138	149	149 F
Italy	...	...	...	...	15	11	11	16	17	20
Morocco	-	0	0	0	0	0	0	-	-	-
Serbia-Monte	7	5	6	5	...	-	-	-	-	-
Spain	3	1	3	3	3	3	3	3	4	3
Tunisia	0	0	1	1	2	-	1	1	0	...
Turkey	10	9	25	15	13	18	8	15	8	7

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Lobsters, spiny-rock lobsters
Homards, langoustes
Bogavantes, langostas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
37 Fishing area total	*254*	*115*	*120*	*110*	*164*	*168*	*171*	*187*	*181*	*185 F*
Species total	*2 781*	*2 727*	*2 818*	*3 033*	*2 367*	*4 141*	*4 227*	*4 406*	*4 518*	*5 083 F*
Southern lobsterette	**Langoustine du Sud**		**Cigala del Sur**		***Thymops birsteini***				**2,29(42)009,01**	**TQB**
41 Falkland Is	-	-	-	-	-	-	11	-	-	-
41 Fishing area total	-	-	-	-	-	-	*11*	-	-	-
Species total	-	-	-	-	-	-	*11*	-	-	-
Blue mud shrimp	**...B**		**...C**		***Upogebia pugettensis***				**2,29(49)001,03**	**UOP**
67 USA	4	4	3	2	1	1	1	1	1	1
67 Fishing area total	*4*	*4*	*3*	*2*	*1*	*1*	*1*	*1*	*1*	*1*
Species total	*4*	*4*	*3*	*2*	*1*	*1*	*1*	*1*	*1*	*1*
Ghost shrimps nei	**Machottes nca**		**Topos de mar nep**		***Callianassa spp***				**2,29(59)001,XX**	**CZP**
67 USA	14	14	27	34	27	14	11	12	26	31
67 Fishing area total	*14*	*14*	*27*	*34*	*27*	*14*	*11*	*12*	*26*	*31*
Species total	*14*	*14*	*27*	*34*	*27*	*14*	*11*	*12*	*26*	*31*
Lobsters nei	**Langoustes, homards nca**		**Langostas nep**		***Reptantia***				**2,29(XX)XXX,XX**	**LOX**
27 France	-	-	-	-	-	-	-	-	1	-
Spain	-	-	215	167	179	104	85	55	64	30
27 Fishing area total	-	-	*215*	*167*	*179*	*104*	*85*	*55*	*65*	*30*
37 Cyprus	5	5	3	1	1	1	1	1	1	2
France	2	-	-	-	-	0	-	-	-	-
Malta	-	-	-	-	-	-	1	1	1	2
37 Fishing area total	*7*	*5*	*3*	*1*	*1*	*1*	*2*	*2*	*2*	*4*
47 Angola	1 062	1 000	655	783	500 F	483	487	290	862	830 F
Portugal	-	6	6	13	17	4	9	-	-	-
Spain	-	2	15	1	1	5	1	3	-	-
47 Fishing area total	*1 062*	*1 008*	*676*	*797*	*518 F*	*492*	*497*	*293*	*862*	*830 F*
51 Portugal	2	-	1	5	-	-	-	-	-	-
51 Fishing area total	*2*	-	*1*	*5*	-	-	-	-	-	-
71 Viet Nam	1 000 F	1 127	1 200 F	1 120 F	1 200 F	1 100 F	1 400	1 500 F	1 600 F	1 713 F
71 Fishing area total	*1 000 F*	*1 127*	*1 200 F*	*1 120 F*	*1 200 F*	*1 100 F*	*1 400*	*1 500 F*	*1 600 F*	*1 713 F*
Species total	*2 071 F*	*2 140*	*2 095 F*	*2 090 F*	*1 898 F*	*1 697 F*	*1 984*	*1 850 F*	*2 529 F*	*2 577 F*
Group total	***223 655***	***227 437***	***228 441***	***236 269***	***234 621***	***253 671***	***239 052***	***254 856***	***252 602***	***279 685***

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King crabs, squat-lobsters
Crabes royaux, galatées
Cangrejos reales, galateidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Pelagic red crab	**Galathée pélagique**		**Langostino pelágico**		***Pleuroncodes planipes***				**2,30(19)001,01**	**LQL**
77 El Salvador	1 263	3 156	7 451	6 838	13 708	11 754	11 377	3 971	3 034	...
77 Fishing area total	*1 263*	*3 156*	*7 451*	*6 838*	*13 708*	*11 754*	*11 377*	*3 971*	*3 034*	*...*
Species total	*1 263*	*3 156*	*7 451*	*6 838*	*13 708*	*11 754*	*11 377*	*3 971*	*3 034*	*...*
Carrot squat lobster	**Galathée orange**		**Langostino colorado**		***Pleuroncodes monodon***				**2,30(19)001,02**	**PQG**
87 Chile	1 754	2 499	1 254	809	1 085	1 031	1 545	1 336	3 327	2 786
87 Fishing area total	*1 754*	*2 499*	*1 254*	*809*	*1 085*	*1 031*	*1 545*	*1 336*	*3 327*	*2 786*
Species total	*1 754*	*2 499*	*1 254*	*809*	*1 085*	*1 031*	*1 545*	*1 336*	*3 327*	*2 786*
Swarming squat lobster	**Galathée naine**		**Langostino enano**		***Munida gregaria***				**2,30(19)002,06**	**UDQ**
41 Falkland Is	-	-	-	-	17	4	264	-	0	5
Panama	-	-	-	-	-	-	63	-	-	-
UK	-	-	-	-	-	-	22	-	0	0
41 Fishing area total	*-*	*-*	*-*	*-*	*17*	*4*	*349*	*-*	*0*	*5*
Species total	*-*	*-*	*-*	*-*	*17*	*4*	*349*	*-*	*0*	*5*
Blue squat lobster	**Galathée bleue**		**Langostino amarillo**		***Cervimunida johni***				**2,30(19)003,01**	**CZJ**
87 Chile	2 178	925	2 197	1 929	3 002	4 188	4 197	5 552	5 391	5 128
87 Fishing area total	*2 178*	*925*	*2 197*	*1 929*	*3 002*	*4 188*	*4 197*	*5 552*	*5 391*	*5 128*
Species total	*2 178*	*925*	*2 197*	*1 929*	*3 002*	*4 188*	*4 197*	*5 552*	*5 391*	*5 128*
Craylets, squat lobsters	**Galathées**		**Camaroncillos,langostinos,etc.**		***Galatheidae***				**2,30(19)XXX,XX**	**LOQ**
27 France	84	84	65	69	54	66	51	24	40	32
UK	-	-	-	-	-	-	4	1	2	1
27 Fishing area total	*84*	*84*	*65*	*69*	*54*	*66*	*55*	*25*	*42*	*33*
77 Nicaragua	-	-	61	37	...	343	2 696	2 868	7 196	4 395
77 Fishing area total	*-*	*-*	*61*	*37*	*...*	*343*	*2 696*	*2 868*	*7 196*	*4 395*
87 Chile	-	724	209	509	140	2	12	139	306	1 417
87 Fishing area total	*-*	*724*	*209*	*509*	*140*	*2*	*12*	*139*	*306*	*1 417*
Species total	*84*	*808*	*335*	*615*	*194*	*411*	*2 763*	*3 032*	*7 544*	*5 845*
Red king crab	**Crabe royal du Kamtchatka**		**Cangrejo real rojo**		***Paralithodes camtschaticus***				**2,30(20)018,01**	**KCD**
27 Norway	434	414	823	1 294	1 223	1 041	1 267	5 199	5 602	1 906
Russian Fed	252	1 217	1 914	1 165	4 132	12 938	11 502	9 339	6 308	3 939
UK	44	87	64	118	28	2	-	2	4	1
27 Fishing area total	*730*	*1 718*	*2 801*	*2 577*	*5 383*	*13 981*	*12 769*	*14 540*	*11 914*	*5 846*
61 Japan	181	...	...	...	...	...	...	...	...	...
Russian Fed	16 064	9 691	6 499	2 101	1 317	1 882	4 729	2 084	2 206	1 606
61 Fishing area total	*16 245*	*9 691*	*6 499*	*2 101*	*1 317*	*1 882*	*4 729*	*2 084*	*2 206*	*1 606*
Species total	*16 975*	*11 409*	*9 300*	*4 678*	*6 700*	*15 863*	*17 498*	*16 624*	*14 120*	*7 452*
Blue king crab	**Crabe royal bleu**		**Cangrejo real azul**		***Paralithodes platypus***				**2,30(20)018,02**	**KCI**
61 Russian Fed	4 500	4 598	3 504	2 391	4 024	4 587	4 831	4 774	3 267	2 915
61 Fishing area total	*4 500*	*4 598*	*3 504*	*2 391*	*4 024*	*4 587*	*4 831*	*4 774*	*3 267*	*2 915*
Species total	*4 500*	*4 598*	*3 504*	*2 391*	*4 024*	*4 587*	*4 831*	*4 774*	*3 267*	*2 915*
Brown king crab	**Crabe royal brun**		**Cangrejo real marrón**		***Paralithodes brevipes***				**2,30(20)018,03**	**KCY**
61 Russian Fed	254	350	249	155	225	363	302	269	329	763
61 Fishing area total	*254*	*350*	*249*	*155*	*225*	*363*	*302*	*269*	*329*	*763*
Species total	*254*	*350*	*249*	*155*	*225*	*363*	*302*	*269*	*329*	*763*
King crabs	**Crabes royaux**		**Cangrejos rusos**		***Paralithodes spp***				**2,30(20)018,XX**	**KCS**
61 Japan	181	...	...	...	...	...	...	...	...	...
61 Fishing area total	*181*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*
67 USA	7 281	7 616	10 381	10 013	10 859	9 816	11 767	12 341	10 156	10 905
67 Fishing area total	*7 281*	*7 616*	*10 381*	*10 013*	*10 859*	*9 816*	*11 767*	*12 341*	*10 156*	*10 905*
77 USA	2	1	0	0	0	0	0	0	0	-
77 Fishing area total	*2*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*-*
Species total	*7 464*	*7 617*	*10 381*	*10 013*	*10 859*	*9 816*	*11 767*	*12 341*	*10 156*	*10 905*
Southern king crab	**Crabe royal de Patagonie**		**Centolla patagónica**		***Lithodes santolla***				**2,30(20)070,01**	**KCR**
41 Argentina	88	385	1 506	1 162	961	845	533	769	325	682
Russian Fed	...	...	-	-	-	-	-	-	-	28
Uruguay	0	-	-	-	-	-	-	-	-	-

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King crabs, squat-lobsters
Crabes royaux, galatées
Cangrejos reales, galateidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
41 Fishing area total	*88*	*385*	*1 506*	*1 162*	*961*	*845*	*533*	*769*	*325*	*710*
87 Chile	2 937	2 869	2 980	3 062	3 243	4 094	2 865	3 241	3 022	3 441
87 Fishing area total	*2 937*	*2 869*	*2 980*	*3 062*	*3 243*	*4 094*	*2 865*	*3 241*	*3 022*	*3 441*
Species total	*3 025*	*3 254*	*4 486*	*4 224*	*4 204*	*4 939*	*3 398*	*4 010*	*3 347*	*4 151*
Subantarctic stone crab	**Crabe royal subantarctique**		**Centolla subantártica**		***Lithodes murrayi***				**2,30(20)070,02**	**KCM**
48 Uruguay	-	-	-	-	-	-	-	-	-	0
48 Fishing area total	-	-	-	-	-	-	-	-	-	*0*
58 South Africa	0	0	-	1	3	-	-	-	-	-
58 Fishing area total	*0*	*0*	-	*1*	*3*	-	-	-	-	-
88 New Zealand	-	0	-	0	-	-	-	0	-	-
88 Fishing area total	-	*0*	-	*0*	-	-	-	*0*	-	-
Species total	*0*	*0*	-	*1*	*3*	-	-	*0*	-	*0*
Golden king crab	**Crabe royal doré**		**Centolla dorada**		***Lithodes aequispina***				**2,30(20)070,05**	**KAQ**
61 Russian Fed	2 245	2 291	1 789	982	2 220	1 710	2 232	2 886	2 906	3 007
61 Fishing area total	*2 245*	*2 291*	*1 789*	*982*	*2 220*	*1 710*	*2 232*	*2 886*	*2 906*	*3 007*
Species total	*2 245*	*2 291*	*1 789*	*982*	*2 220*	*1 710*	*2 232*	*2 886*	*2 906*	*3 007*
King crabs nei	**Crabes royaux nca**		**Centollas nep**		***Lithodes spp***				**2,30(20)070,XX**	**KCZ**
58 South Africa	-	-	-	0	0	-	-	-	-	-
58 Fishing area total	-	-	-	*0*	*0*	-	-	-	-	-
Species total	-	-	-	*0*	*0*	-	-	-	-	-
Softshell red crab	**Crabe royal hérisson**		**Centollón**		***Paralomis granulosa***				**2,30(20)123,01**	**PAG**
41 Argentina	213	129	175	167	52	344	29	-	-	-
Falkland Is	5	1	2	8	6	0	25	0	0	0
41 Fishing area total	*218*	*130*	*177*	*175*	*58*	*344*	*54*	*0*	*0*	*0*
87 Chile	6 527	4 631	2 868	3 632	5 731	2 275	1 773	2 078	2 145	1 952
87 Fishing area total	*6 527*	*4 631*	*2 868*	*3 632*	*5 731*	*2 275*	*1 773*	*2 078*	*2 145*	*1 952*
Species total	*6 745*	*4 761*	*3 045*	*3 807*	*5 789*	*2 619*	*1 827*	*2 078*	*2 145*	*1 952*
Red stone crab	**Crabe royal rouge**		**Centolla colorada**		***Paralomis aculeata***				**2,30(20)123,02**	**KCU**
48 UK	-	-	0	0	-	-	-	-	-	-
48 Fishing area total	-	-	*0*	*0*	-	-	-	-	-	-
58 South Africa	0	-	0	0	-	-	-	-	-	-
58 Fishing area total	*0*	-	*0*	*0*	-	-	-	-	-	-
Species total	*0*	-	*0*	*0*	-	-	-	-	-	-
Antarctic stone crab	**Crabe royal de l'Antarctique**		**Centolla antártica**		***Paralomis spinosissima***				**2,30(20)123,03**	**KCV**
48 Japan	-	55	-	-	-	-	-	-	-	-
Russian Fed	-	-	-	-	-	-	-	-	-	53
UK	4	0	0	-	0	-	0	1	0	0
48 Fishing area total	*4*	*55*	*0*	-	*0*	-	*0*	*1*	*0*	*53*
58 South Africa	-	-	-	1	-	-	-	-	-	-
58 Fishing area total	-	-	-	*1*	-	-	-	-	-	-
Species total	*4*	*55*	*0*	*1*	*0*	-	*0*	*1*	*0*	*53*
Globose king crab	**Crabe royal sphérique**		**Centolla redonda**		***Paralomis formosa***				**2,30(20)123,04**	**KCF**
48 Japan	-	56	-	-	-	-	-	-	-	-
Russian Fed	-	-	-	-	-	-	-	-	-	9
UK	11	-	0	0	-	-	0	0	0	0
48 Fishing area total	*11*	*56*	*0*	*0*	-	-	*0*	*0*	*0*	*9*
Species total	*11*	*56*	*0*	*0*	-	-	*0*	*0*	*0*	*9*
Red vermillion crab	**Crabe royal vermillon**		**Centolla rojo bermellón**		***Paralomis verrilli***				**2,30(20)123,06**	**KVV**
61 Russian Fed	-	-	-	-	38	-	45	-	-	-
61 Fishing area total	-	-	-	-	*38*	-	*45*	-	-	-
Species total	-	-	-	-	*38*	-	*45*	-	-	-
...A	**...B**		**...C**		***Paralomis spp***				**2,30(20)123,XX**	**PAI**
58 South Africa	-	-	0	0	15	-	-	-	-	-
58 Fishing area total	-	-	*0*	*0*	*15*	-	-	-	-	-
Species total	-	-	*0*	*0*	*15*	-	-	-	-	-

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King crabs, squat-lobsters
Crabes royaux, galatées
Cangrejos reales, galateidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
King crabs, stone crabs nei	**Crabes royaux, etc. nca**		**Centollas, centollones nep**		***Lithodidae***				**2,30(20)XXX,XX**	**KCX**
41 UK	4	2	1	0	1	2	-	-	-	-
41 Fishing area total	*4*	*2*	*1*	*0*	*1*	*2*	-	-	-	-
48 Korea Rep	-	-	-	-	-	0	0	-	0	-
South Africa	-	-	-	-	0	0	0	-	-	-
UK	-	-	1	0	0	1	0	0	0	0
48 Fishing area total	*-*	*-*	*1*	*0*	*0*	*1*	*0*	*0*	*0*	*0*
58 Australia	-	-	-	-	-	-	-	0	0	-
South Africa	0	0	-	5	16	-	-	-	-	0
58 Fishing area total	*0*	*0*	*-*	*5*	*16*	*-*	*-*	*0*	*0*	*0*
87 Chile	60	70	-	10	2	-	1	-	-	-
87 Fishing area total	*60*	*70*	*-*	*10*	*2*	*-*	*1*	*-*	*-*	*-*
88 New Zealand	-	-	0	0	0	0	0	0	0	0
Ukraine	-	-	-	0	-	-	-	-	-	-
88 Fishing area total	*-*	*-*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Species total	*64*	*72*	*2*	*15*	*19*	*3*	*1*	*0*	*0*	*0*
Group total	***46 566***	***41 851***	***43 993***	***36 458***	***52 102***	***57 288***	***62 132***	***56 874***	***55 566***	***44 971***

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Shrimps, prawns
Crevettes
Gambas, camarones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Northern brown shrimp	**Crevette royale grise**		**Camarón café norteño**		***Penaeus aztecus***				**2,28(01)001,01**	**ABS**
21 USA	458	856	373	289	141	247	598	1 167	730	860
21 Fishing area total	*458*	*856*	*373*	*289*	*141*	*247*	*598*	*1 167*	*730*	*860*
31 Mexico	...	...	...	...	897	937	979	1 943	1 583	1 381
USA	68 411	57 335	64 853	56 326	44 418	60 744	46 330	37 821	55 898	35 420
31 Fishing area total	*68 411*	*57 335*	*64 853*	*56 326*	*45 315*	*61 681*	*47 309*	*39 764*	*57 481*	*36 801*
Species total	*68 869*	*58 191*	*65 226*	*56 615*	*45 456*	*61 928*	*47 907*	*40 931*	*58 211*	*37 661*
Banana prawn	**Crevette banane**		**Langostino banana**		***Penaeus merguiensis***				**2,28(01)001,03**	**PBA**
57 Australia	281	345	509	470	293	473	112	244	4 064	5 021
Indonesia	10 021	13 859	12 627	12 336	12 567	13 432	17 039	23 058	25 307	21 469
Thailand	6 479	9 288	11 792	6 136	5 749	5 522	3 382	3 126	3 096	3 428
57 Fishing area total	*16 781*	*23 492*	*24 928*	*18 942*	*18 609*	*19 427*	*20 533*	*26 428*	*32 467*	*29 918*
71 Australia	6 368	5 493	3 294	4 057	3 034	3 162	2 972	5 744	2 086	1 570
Indonesia	55 248	55 649	53 874	56 363	49 383	46 406	64 154	50 812	46 686	54 950
Papua N Guin	1 017	453	506	601	665	387	335	302	126	289
Solomon Is	10 F	10 F	10 F	10 F	15 F	15 F	15 F	15 F	15 F	15 F
Thailand	10 453	8 953	7 458	9 284	11 381	9 294	7 972	6 924	5 785	6 355
71 Fishing area total	*73 096 F*	*70 558 F*	*65 142 F*	*70 315 F*	*64 478 F*	*59 264 F*	*75 448 F*	*63 797 F*	*54 698 F*	*63 179 F*
Species total	*89 877 F*	*94 050 F*	*90 070 F*	*89 257 F*	*83 087 F*	*78 691 F*	*95 981 F*	*90 225 F*	*87 165 F*	*93 097 F*
Yellowleg shrimp	**Crevette pattes jaunes**		**Camarón patiamarillo**		***Penaeus californiensis***				**2,28(01)001,04**	**YPS**
77 Costa Rica	2	2	1	2	9	9 F	10	10 F	10 F	10 F
Guatemala	100 F	273	330	191	121	0	...	...	...	...
Mexico	...	...	...	...	6 818	7 120	8 694	7 897	7 467	8 222
77 Fishing area total	*102 F*	*275*	*331*	*193*	*6 948*	*7 129 F*	*8 704*	*7 907 F*	*7 477 F*	*8 232 F*
87 Ecuador	...	...	...	372	714	793	274	241	...	360
87 Fishing area total	*...*	*...*	*...*	*372*	*714*	*793*	*274*	*241*	*...*	*360*
Species total	*102 F*	*275*	*331*	*565*	*7 662*	*7 922 F*	*8 978*	*8 148 F*	*7 477 F*	*8 592 F*
Northern pink shrimp	**Crevette rose du Nord**		**Camarón rosado norteño**		***Penaeus duorarum***				**2,28(01)001,05**	**APS**
21 USA	1	29	0	2	0	0	0	40	28	1
21 Fishing area total	*1*	*29*	*0*	*2*	*0*	*0*	*0*	*40*	*28*	*1*
31 Cuba	1 483	1 308	1 447	1 451	1 582	1 518	464	530	595	738
Mexico	...	...	...	...	646	674	1 338	755	615	811
USA	7 143	8 045	6 504	7 176	6 138	6 084	2 383	3 746	2 889	4 183
31 Fishing area total	*8 626*	*9 353*	*7 951*	*8 627*	*8 366*	*8 276*	*4 185*	*5 031*	*4 099*	*5 732*
Species total	*8 627*	*9 382*	*7 951*	*8 629*	*8 366*	*8 276*	*4 185*	*5 071*	*4 127*	*5 733*
Kuruma prawn	**Crevette kuruma**		**Langostino japonés**		***Penaeus japonicus***				**2,28(01)001,09**	**KUP**
37 France	-	-	0	2	1	2	2	1	-	1
Israel	121	111	98	8	104	32	59	100 F	141	228
37 Fishing area total	*121*	*111*	*98*	*10*	*105*	*34*	*61*	*101 F*	*141*	*229*
61 China,Taiwan	4 179	1 590	1 874	1 737	1 664	1 620	1 564	1 440	893	1 750
Japan	1 271	1 123	1 033	1 044	956	874	863	726	584	600 F
Korea Rep	513	217	240	132	282	215	315	254	297	123
61 Fishing area total	*5 963*	*2 930*	*3 147*	*2 913*	*2 902*	*2 709*	*2 742*	*2 420*	*1 774*	*2 473 F*
Species total	*6 084*	*3 041*	*3 245*	*2 923*	*3 007*	*2 743*	*2 803*	*2 521 F*	*1 915*	*2 702 F*
Blue shrimp	**Crevette bleue**		**Camarón azul**		***Penaeus stylirostris***				**2,28(01)001,10**	**PNS**
77 Guatemala	...	38	62	20	5	5	...	...	...	...
Mexico	...	...	...	...	4 099	4 280	5 894	12 057	11 825	14 600
77 Fishing area total	*...*	*38*	*62*	*20*	*4 104*	*4 285*	*5 894*	*12 057*	*11 825*	*14 600*
87 Ecuador	...	...	...	188	253	134	5	...	...	...
87 Fishing area total	*...*	*...*	*...*	*188*	*253*	*134*	*5*	*...*	*...*	*...*
Species total	*...*	*38*	*62*	*208*	*4 357*	*4 419*	*5 899*	*12 057*	*11 825*	*14 600*
Whiteleg shrimp	**Crevette pattes blanches**		**Camarón patiblanco**		***Penaeus vannamei***				**2,28(01)001,11**	**PNV**
77 El Salvador	460	926	869	833	760	472	717	435	221	216
Guatemala	...	373	586	303	248	278	...	...	...	...
Mexico	...	...	...	...	601	627	857	508	414	452
77 Fishing area total	*460*	*1 299*	*1 455*	*1 136*	*1 609*	*1 377*	*1 574*	*943*	*635*	*668*
87 Ecuador	...	...	...	1 171	982	880	21	32	...	...
87 Fishing area total	*...*	*...*	*...*	*1 171*	*982*	*880*	*21*	*32*	*...*	*...*
Species total	*460*	*1 299*	*1 455*	*2 307*	*2 591*	*2 257*	*1 595*	*975*	*635*	*668*

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Shrimps, prawns
Crevettes
Gambas, camarones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Giant tiger prawn	**Crevette géante tigrée**		**Langostino jumbo**		***Penaeus monodon***				**2,28(01)001,12**	**GIT**
51 India	100 155	123 266	129 750	109 552	126 525	132 202	125 304	128 024	122 015	115 534
Pakistan	140	155	171	160	147	150	140	154	160	175
51 Fishing area total	*100 295*	*123 421*	*129 921*	*109 712*	*126 672*	*132 352*	*125 444*	*128 178*	*122 175*	*115 709*
57 Australia	14	23	75	49	29	16	1	9	19	1 064
India	57 868	44 532	47 376	67 623	59 945	60 720	73 902	93 460	70 276	58 501
Indonesia	9 099	9 221	9 482	9 392	8 474	9 046	9 855	7 783	10 687	5 914
Thailand	725	1 205	2 297	570	1 103	1 329	996	1 021	871	963
57 Fishing area total	*67 706*	*54 981*	*59 230*	*77 634*	*69 551*	*71 111*	*84 754*	*102 273*	*81 853*	*66 442*
61 China,Taiwan	91	54	51	50	38	8	11	13	13	7
61 Fishing area total	*91*	*54*	*51*	*50*	*38*	*8*	*11*	*13*	*13*	*7*
71 Australia	4 247	4 168	4 420	5 059	4 320	4 212	3 622	2 433	2 707	1 704
Indonesia	34 660	28 867	24 708	25 141	21 906	28 414	32 181	18 709	13 950	22 405
Papua N Guin	117	135	138	148	202	118	103	106	42	110
Philippines	328	354	485	816	709	646	704	1 091	949	891
Thailand	989	660	580	1 666	1 999	2 013	1 682	2 116	1 739	1 928
71 Fishing area total	*40 341*	*34 184*	*30 331*	*32 830*	*29 136*	*35 403*	*38 292*	*24 455*	*19 387*	*27 038*
81 Australia	5	4	4	4	5	6	...	...	...	466
81 Fishing area total	*5*	*4*	*4*	*4*	*5*	*6*	...	...	...	*466*
Species total	*208 438*	*212 644*	*219 537*	*220 230*	*225 402*	*238 880*	*248 501*	*254 919*	*223 428*	*209 662*
Fleshy prawn	**Crevette charnue**		**Langostino carnoso**		***Penaeus chinensis***				**2,28(01)001,16**	**FLP**
61 China	82 757 F	84 625 F	80 897 F	83 851 F	89 403 F	104 421 F	111 299	89 678	107 618	107 522
Korea Rep	581	222	148	848	989	1 261	704	275	219	252
61 Fishing area total	*83 338 F*	*84 847 F*	*81 045 F*	*84 699 F*	*90 392 F*	*105 682 F*	*112 003*	*89 953*	*107 837*	*107 774*
Species total	*83 338 F*	*84 847 F*	*81 045 F*	*84 699 F*	*90 392 F*	*105 682 F*	*112 003*	*89 953*	*107 837*	*107 774*
Caramote prawn	**Caramote**		**Langostino**		***Penaeus kerathurus***				**2,28(01)001,17**	**TGS**
34 Greece	1	41	8	1	6	18	3	2	1	1 F
Portugal	...	...	...	16	11	25	12	31	21	-
34 Fishing area total	*1*	*41*	*8*	*17*	*17*	*43*	*15*	*33*	*22*	*1 F*
37 Albania	23	84	178	285	150	102	18	23	20	228
France	6	7	6	3	3	1	1	3	2	3
Greece	1 502	1 299	1 955	2 581	3 120	3 263	3 056	2 215	1 987	1 970 F
Italy	...	...	...	...	351	546	863	637	790	852
Libya	...	...	...	...	...	...	...	...	783	760 F
Spain	64	250	281	168	229	202	316	248	168	135
Tunisia	3 356	2 539	2 264	2 864	2 809	2 303	1 962	1 285	1 230	1 358
Turkey	...	...	...	...	...	...	372	449	442	951
37 Fishing area total	*4 951*	*4 179*	*4 684*	*5 901*	*6 662*	*6 417*	*6 588*	*4 860*	*5 422*	*6 257 F*
Species total	*4 952*	*4 220*	*4 692*	*5 918*	*6 679*	*6 460*	*6 603*	*4 893*	*5 444*	*6 258 F*
Redspotted shrimp	**Crevette royale rose**		**Camarón rosado con manchas**		***Penaeus brasiliensis***				**2,28(01)001,19**	**PNB**
41 Brazil	5 029	6 730	5 175	6 355	9 390	12 382	8 238	9 829	10 841	10 237
41 Fishing area total	*5 029*	*6 730*	*5 175*	*6 355*	*9 390*	*12 382*	*8 238*	*9 829*	*10 841*	*10 237*
Species total	*5 029*	*6 730*	*5 175*	*6 355*	*9 390*	*12 382*	*8 238*	*9 829*	*10 841*	*10 237*
Green tiger prawn	**Crevette tigrée verte**		**Langostino tigre verde**		***Penaeus semisulcatus***				**2,28(01)001,20**	**TIP**
51 Bahrain	1 359	1 401	1 602	1 585	1 107	1 951	2 790	2 403	3 432	4 599
Qatar	0	0	-	-	-	-	-	-	-	-
Saudi Arabia	3 050	6 420	4 487	6 568	7 399	7 488	8 643	10 551	9 083	7 571
51 Fishing area total	*4 409*	*7 821*	*6 089*	*8 153*	*8 506*	*9 439*	*11 433*	*12 954*	*12 515*	*12 170*
57 Thailand	1 404	702	798	805	967	841	665	771	634	690
57 Fishing area total	*1 404*	*702*	*798*	*805*	*967*	*841*	*665*	*771*	*634*	*690*
71 Thailand	611	911	1 591	1 751	2 065	2 028	1 718	1 929	1 427	1 678
71 Fishing area total	*611*	*911*	*1 591*	*1 751*	*2 065*	*2 028*	*1 718*	*1 929*	*1 427*	*1 678*
Species total	*6 424*	*9 434*	*8 478*	*10 709*	*11 538*	*12 308*	*13 816*	*15 654*	*14 576*	*14 538*
Northern white shrimp	**Crevette ligubam du Nord**		**Camarón blanco norteño**		***Penaeus setiferus***				**2,28(01)001,22**	**PST**
21 USA	28	171	3	121	0	363	1 083	281	183	123
21 Fishing area total	*28*	*171*	*3*	*121*	*0*	*363*	*1 083*	*281*	*183*	*123*
31 Mexico	...	...	...	...	2 148	2 243	891	739	602	62
USA	40 696	43 015	47 134	56 818	50 258	62 274	36 499	49 551	54 995	46 692
31 Fishing area total	*40 696*	*43 015*	*47 134*	*56 818*	*52 406*	*64 517*	*37 390*	*50 290*	*55 597*	*46 754*
Species total	*40 724*	*43 186*	*47 137*	*56 939*	*52 406*	*64 880*	*38 473*	*50 571*	*55 780*	*46 877*
Crystal shrimp	**Crevette cristal**		**Camarón cristal**		***Penaeus brevirostris***				**2,28(01)001,23**	**CSP**
77 Costa Rica	456	343	289	342	314	330 F	340	340 F	340 F	340 F
El Salvador	153	93	105	119	95	48	58	4	11	11
Guatemala	8 F	8	298	76	16	2	...	...	...	...

B-45 **Shrimps, prawns** **Crevettes** **Gambas, camarones**

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Panama	2 286	1 636	1 604	1 648	450	744	1 183	2 302	2 976	1 836
77 Fishing area total	*2 903 F*	*2 080*	*2 296*	*2 185*	*875*	*1 124 F*	*1 581*	*2 646 F*	*3 327 F*	*2 187 F*
87 Ecuador	...	...	...	261	286	648	72	98	...	...
87 Fishing area total	*...*	*...*	*...*	*261*	*286*	*648*	*72*	*98*	*...*	*...*
Species total	*2 903 F*	*2 080*	*2 296*	*2 446*	*1 161*	*1 772 F*	*1 653*	*2 744 F*	*3 327 F*	*2 187 F*
Indian white prawn	**Crevette blanche des Indes**		**Langostino blanco de la India**		***Penaeus indicus***				**2,28(01)001,25**	**PNI**
51 Portugal	-	-	-	-	72	-	35	-	-	-
51 Fishing area total	-	-	-	-	*72*	-	*35*	-	-	-
Species total	-	-	-	-	*72*	-	*35*	-	-	-
Western king prawn	**Crevette royale occidentale**		**Langostino marfil**		***Penaeus latisulcatus***				**2,28(01)001,28**	**WKP**
57 Thailand	351	694	1 711	1 353	1 865	1 817	1 769	1 412	1 100	1 427
57 Fishing area total	*351*	*694*	*1 711*	*1 353*	*1 865*	*1 817*	*1 769*	*1 412*	*1 100*	*1 427*
71 Australia	71	169	124	86	61	66	74	62	26	9
Thailand	2 353	2 616	1 884	2 081	1 965	2 023	1 940	1 503	1 448	1 476
71 Fishing area total	*2 424*	*2 785*	*2 008*	*2 167*	*2 026*	*2 089*	*2 014*	*1 565*	*1 474*	*1 485*
Species total	*2 775*	*3 479*	*3 719*	*3 520*	*3 891*	*3 906*	*3 783*	*2 977*	*2 574*	*2 912*
Western white shrimp	**Crevette royale blanche**		**Camarón blanco del Pacífico**		***Penaeus occidentalis***				**2,28(01)001,29**	**WWP**
87 Colombia	979	561	846	350	325	430 F	560 F	670 F	789	810
Ecuador	...	...	...	6	212	96	0	1	...	42
87 Fishing area total	*979*	*561*	*846*	*356*	*537*	*526 F*	*560 F*	*671 F*	*789*	*852*
Species total	*979*	*561*	*846*	*356*	*537*	*526 F*	*560 F*	*671 F*	*789*	*852*
Redtail prawn	**Crevette queue rouge**		**Camarón rabo colorado**		***Penaeus penicillatus***				**2,28(01)001,30**	**REP**
61 China,Taiwan	312	509	1 020	429	756	1 077	1 073	717	178	60
61 Fishing area total	*312*	*509*	*1 020*	*429*	*756*	*1 077*	*1 073*	*717*	*178*	*60*
Species total	*312*	*509*	*1 020*	*429*	*756*	*1 077*	*1 073*	*717*	*178*	*60*
Southern pink shrimp	**Crevette rose du Sud**		**Camarón rosado sureño**		***Penaeus notialis***				**2,28(01)001,31**	**SOP**
34 Gabon	...	...	202	114	...	77	25	2	1 F	1 F
Gambia	211	324	98	76	112	230	1 549	1 633	1 748	1 749
Nigeria	18 805	13 413	13 201	11 410	12 397	11 928	10 852	11 390	9 369	7 707
Portugal	...	...	...	192	166	208	138	149	117	63
Senegal	4 643	3 539	3 371	1 820	1 985	1 083	1 400	1 157	1 640	1 495
34 Fishing area total	*23 659*	*17 276*	*16 872*	*13 612*	*14 660*	*13 526*	*13 964*	*14 331*	*12 875 F*	*11 015 F*
Species total	*23 659*	*17 276*	*16 872*	*13 612*	*14 660*	*13 526*	*13 964*	*14 331*	*12 875 F*	*11 015 F*
Sao Paulo shrimp	**Crevette de Sao Paulo**		**Langostino de Sao Paulo**		***Penaeus paulensis***				**2,28(01)001,32**	**PPS**
41 Uruguay	23	7	5	109	38	0	0	54	11	...
41 Fishing area total	*23*	*7*	*5*	*109*	*38*	*0*	*0*	*54*	*11*	*...*
Species total	*23*	*7*	*5*	*109*	*38*	*0*	*0*	*54*	*11*	*...*
Southern brown shrimp	**Crevette grise du Sud**		**Camarón café sureño**		***Penaeus subtilis***				**2,28(01)001,33**	**PNU**
31 Suriname	...	...	1 689	1 475	1 219	...	...	...	...	...
31 Fishing area total	*...*	*...*	*1 689*	*1 475*	*1 219*	*...*	*...*	*...*	*...*	*...*
Species total	*...*	*...*	*1 689*	*1 475*	*1 219*	*...*	*...*	*...*	*...*	*...*
Penaeus shrimps nei	**Crevettes Penaeus nca**		**Langostinos Penaeus nep**		***Penaeus spp***				**2,28(01)001,XX**	**PEN**
01 Benin	2 400 F	2 400 F	2 400 F	2 250 F	1 750 F	1 600 F	1 450 F	1 450 F	1 150 F	1 000 F
Senegal	...	...	...	...	...	...	...	520	450 F	386
01 Fishing area total	*2 400 F*	*2 400 F*	*2 400 F*	*2 250 F*	*1 750 F*	*1 600 F*	*1 450 F*	*1 970 F*	*1 600 F*	*1 386 F*
04 India	14 772	4 150	9 242	12 793	15 913	15 908	15 259	20 397	15 107	17 074
04 Fishing area total	*14 772*	*4 150*	*9 242*	*12 793*	*15 913*	*15 908*	*15 259*	*20 397*	*15 107*	*17 074*
27 Netherlands	3	5	-	-	-	-	-	-	-	-
Portugal	-	-	-	-	2	-	-	-	-	-
Spain	267	104	0	112	146	155	171	117	155	208
27 Fishing area total	*270*	*109*	*0*	*112*	*148*	*155*	*171*	*117*	*155*	*208*
31 Belize	69	81	104	147	52	33	19	26	22	4
Colombia	1 208	206	1 313	790	245	340 F	440 F	540 F	630	...
Costa Rica	166	164	140	66	75	100 F	148	150 F	150 F	150 F
Cuba	1	-	-	-	-	-	-	-	-	-
Dominican Rp	32	47	125	45	55	122	97	79	34	126
Fr Guiana	2 699	3 082	3 565	3 364	2 943	2 223	2 362	1 497	1 332	944
Guatemala	170 F	175 F	180 F	185 F	191	130	232	283	176	210
Guyana	1 698	1 505	1 161	1 293	1 021	1 663	657	931	747	854
Honduras	1 184	897	1 032	652	853	968	744	1 234	934	1 698

B-45 **Shrimps, prawns** **Crevettes** **Gambas, camarones**

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Jamaica	39	38	...	...	...	...	...	...	...	...
Mexico	21 847	18 533	29 650	23 924	18 851	19 684	14 456	12 748	11 887	9 216
Nicaragua	3 412	3 527	3 240	2 694	3 498	2 189	2 418	1 638	2 211	2 383
Suriname	2 840	2 664	685	401	461	1 000	980	247	240	525
Trinidad Tob	856	852	729	617	701	789	697	782	693	879
Venezuela	12 128	9 981	11 480	18 140 F	9 700 F	5 750 F	7 020 F	5 769	5 570 F	5 570 F
31 Fishing area total	*48 349 F*	*41 752 F*	*53 404 F*	*52 318 F*	*38 646 F*	*34 991 F*	*30 270 F*	*25 924 F*	*24 626 F*	*22 559 F*
34 Belize	41	9	56	...	-	111	871	42	...	...
Bulgaria	106	-	-	-	-	-	-	-	-	-
Cameroon	168	280	531	550 F	557	501	651	500 F	345	345 F
China	2 087	184	1 244	...	...	146	204	144	...	...
Congo Rep	565 F	700 F	852	688	800	1 503	923	1 200	1 216	1 682
Côte dIvoire	1	484	490 F	470 F	325 F	350 F	370 F	370 F	370	133
Gabon	1 892	1 785	2 784	1 839	1 376	1 378	400 F	108	70 F	70 F
Guinea	701	16	...	...	...	...	...	...	...	...
Honduras	-	-	-	-	1	-	-	-	-	-
Sierra Leone	1 280	1 237	1 552	1 481	1 409	1 365	1 408	1 035	1 020 F	1 020 F
Togo	0	0	0	1	1	1	-	-	-	-
Other nei	-	-	-	-	-	-	-	56	...	...
34 Fishing area total	*6 841 F*	*4 695 F*	*7 509 F*	*5 029 F*	*4 469 F*	*5 355 F*	*4 827 F*	*3 455 F*	*3 021 F*	*3 250 F*
41 Brazil	10 841	10 584	17 456	13 964	13 319	12 137	12 244	12 342	13 612	12 861
41 Fishing area total	*10 841*	*10 584*	*17 456*	*13 964*	*13 319*	*12 137*	*12 244*	*12 342*	*13 612*	*12 861*
51 Eritrea	790	508	451	413	235	547	112	38	219	323
Iraq	...	...	...	30	...	59	388	65	52	60
Mozambique	9 479	9 222	13 525	11 889	13 075	8 760	7 884	7 482	7 349	7 313
Pakistan	5 974	5 600	5 100	4 301	3 240	3 552	3 457	3 574	3 425	4 184
Saudi Arabia	496	37	217	60	92	10	51	28	460	30
Tanzania	2 000	2 000	1 700	1 300	1 800	1 800	1 656	1 041	1 016	1 463
Yemen	1 654	2 541	2 247	1 210	1 285	1 378	1 000	864	930 F	1 000
51 Fishing area total	*20 393*	*19 908*	*23 240*	*19 203*	*19 727*	*16 106*	*14 548*	*13 092*	*13 451 F*	*14 373*
57 Australia	6 322	6 319	5 994	6 024	5 839	5 485	4 888	5 105	5 056	5 603
Thailand	14 100	7 552	7 855	7 666	6 828	6 361	5 483	4 207	5 229	4 973
57 Fishing area total	*20 422*	*13 871*	*13 849*	*13 690*	*12 667*	*11 846*	*10 371*	*9 312*	*10 285*	*10 576*
71 Australia	3 660	3 904	4 326	4 015	3 511	3 282	2 829	3 221	3 424	4 449
Philippines	13 632	14 153	13 030	12 849	13 443	13 484	14 076	12 294	14 551	13 370
Thailand	33 128	34 182	28 228	23 292	21 170	21 327	18 056	13 486	14 346	13 916
71 Fishing area total	*50 420*	*52 239*	*45 584*	*40 156*	*38 124*	*38 093*	*34 961*	*29 001*	*32 321*	*31 735*
77 Costa Rica	634	813	1 019	902	672	620 F	568	570 F	570 F	570 F
El Salvador	19	30	34	-	3	4	3	-	-	-
Guatemala	650	689	544	653	430	300	407	211	299	498
Honduras	500 F	550 F	450 F	450 F	450 F	450 F	450 F	450 F	450 F	450 F
Mexico	35 662	36 100	48 398	39 052	32 261	33 687	38 773	28 256	27 814	27 023
Nicaragua	771	510	406	344	372	104	118	131	105	235
Panama	2 576	2 487	2 431	2 449	1 667	1 850	2 263	3 285	2 200	2 194
77 Fishing area total	*40 812 F*	*41 179 F*	*53 282 F*	*43 850 F*	*35 855 F*	*37 015 F*	*42 582 F*	*32 903 F*	*31 438 F*	*30 970 F*
81 Australia	3 024	2 292	2 233	1 827	869	1 352	1 468	1 830	1 689	733
81 Fishing area total	*3 024*	*2 292*	*2 233*	*1 827*	*869*	*1 352*	*1 468*	*1 830*	*1 689*	*733*
87 Ecuador	2 211	2 383	2 349	64	2	...	...	...	...	198
Peru	5 988	4 129	4 471	6 514	9 881	12 032	14 496	15 562	17 519	20 337
87 Fishing area total	*8 199*	*6 512*	*6 820*	*6 578*	*9 883*	*12 032*	*14 496*	*15 562*	*17 519*	*20 535*
Species total	*226 743 F*	*199 691 F*	*235 019 F*	*211 770 F*	*191 370 F*	*186 590 F*	*182 647 F*	*165 905 F*	*164 824 F*	*166 260 F*
Titi shrimp	**Crevette titi**		**Camarón tití**		***Protrachypene precipua***				**2,28(01)003,01**	**RRJ**
87 Ecuador	...	...	...	...	...	...	4 645	6 094	7 012	7 064
87 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*4 645*	*6 094*	*7 012*	*7 064*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*4 645*	*6 094*	*7 012*	*7 064*
Speckled shrimp	**Crevette mouchetée**		**Gamba moteada**		***Metapenaeus monoceros***				**2,28(01)016,01**	**MPN**
37 Tunisia	757	1 607	2 078	2 582	1 564	1 325	1 111	69	477	258
37 Fishing area total	*757*	*1 607*	*2 078*	*2 582*	*1 564*	*1 325*	*1 111*	*69*	*477*	*258*
51 Portugal	-	-	-	24	47	-	13	-	-	-
Saudi Arabia	448	561	1 235	651	825	1 123	994	1 614	545	2 505
51 Fishing area total	*448*	*561*	*1 235*	*675*	*872*	*1 123*	*1 007*	*1 614*	*545*	*2 505*
Species total	*1 205*	*2 168*	*3 313*	*3 257*	*2 436*	*2 448*	*2 118*	*1 683*	*1 022*	*2 763*
Endeavour shrimp	**Crevette devo**		**Camarón devo**		***Metapenaeus endeavouri***				**2,28(01)016,06**	**ENS**
57 Australia	23	28	9	13	36	5	1	5	8	287
57 Fishing area total	*23*	*28*	*9*	*13*	*36*	*5*	*1*	*5*	*8*	*287*
71 Australia	3 314	2 925	2 102	2 248	1 862	1 947	1 523	1 104	1 129	747
Philippines	174	192	237	794	917	897	1 114	1 095	1 105	1 015
71 Fishing area total	*3 488*	*3 117*	*2 339*	*3 042*	*2 779*	*2 844*	*2 637*	*2 199*	*2 234*	*1 762*
Species total	*3 511*	*3 145*	*2 348*	*3 055*	*2 815*	*2 849*	*2 638*	*2 204*	*2 242*	*2 049*

B-45

Shrimps, prawns
Crevettes
Gambas, camarones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Shiba shrimp	**Crevette siba**		**Camarón siba**		***Metapenaeus joyneri***				**2,28(01)016,07**	**SHI**
61 Korea Rep	2 385	1 736	325	414	834	980	1 010	1 646	1 048	652
61 Fishing area total	*2 385*	*1 736*	*325*	*414*	*834*	*980*	*1 010*	*1 646*	*1 048*	*652*
Species total	*2 385*	*1 736*	*325*	*414*	*834*	*980*	*1 010*	*1 646*	*1 048*	*652*
Metapenaeus shrimps nei	**Crevettes Metapenaeus nca**		**Camarones Metapenaeus nep**		***Metapenaeus spp***				**2,28(01)016,XX**	**MET**
51 Pakistan	7 246	6 555	7 121	7 955	5 124	5 004	4 670	4 742	7 121	6 950
51 Fishing area total	*7 246*	*6 555*	*7 121*	*7 955*	*5 124*	*5 004*	*4 670*	*4 742*	*7 121*	*6 950*
57 Indonesia	10 572	10 606	9 941	10 913	10 238	11 064	15 654	15 741	20 273	17 832
Thailand	2 011	1 720	3 060	3 207	3 783	4 333	2 968	2 225	2 467	2 553
57 Fishing area total	*12 583*	*12 326*	*13 001*	*14 120*	*14 021*	*15 397*	*18 622*	*17 966*	*22 740*	*20 385*
61 China,Taiwan	241	227	249	207	145	122	125	16	18	22
61 Fishing area total	*241*	*227*	*249*	*207*	*145*	*122*	*125*	*16*	*18*	*22*
71 Indonesia	25 786	22 964	24 237	27 525	21 268	15 795	17 801	18 977	26 467	21 773
Papua N Guin	346	145	138	173	105	85	79	57	22	53
Philippines	7 059	9 632	10 501	10 857	10 601	10 417	9 864	10 066	9 657	9 592
Thailand	8 504	7 900	6 895	8 344	8 409	8 022	7 173	6 143	5 940	6 042
71 Fishing area total	*41 695*	*40 641*	*41 771*	*46 899*	*40 383*	*34 319*	*34 917*	*35 243*	*42 086*	*37 460*
Species total	*61 765*	*59 749*	*62 142*	*69 181*	*59 673*	*54 842*	*58 334*	*57 967*	*71 965*	*64 817*
Deep-water rose shrimp	**Crevette rose du large**		**Gamba de altura**		***Parapenaeus longirostris***				**2,28(01)017,01**	**DPS**
27 France	...	4	58	107	66	78	31	15	38	25
Portugal	1 080	620	1 603	159	193	411	451	802	1 546	918
Spain	...	...	...	277	354	374	476	1 643	3 088	1 217
27 Fishing area total	*1 080*	*624*	*1 661*	*543*	*613*	*863*	*958*	*2 460*	*4 672*	*2 160*
34 Estonia	6	4	-	-	-	-	-	-	-	-
Gabon	55	48	102	114	108	65	15	1	1 F	1 F
GuineaBissau	912	254	1	50 F	116 F	682 F	281 F	1 F	1 F	1 F
Liberia	7	10	10	50	218	20	39	10	10 F	10 F
Mauritania	500 F	600 F	800 F	990	457	346	650	208	...	5
Portugal	424	104	356	15	248	205	178	441	310	152
Senegal	2 199	2 578	3 156	30	13	82	8	4	38	25
Spain	4 867	1 071	376	267	463	489	1 133	556	170	100
34 Fishing area total	*8 970 F*	*4 669 F*	*4 801 F*	*1 516 F*	*1 623 F*	*1 889 F*	*2 304 F*	*1 221 F*	*530 F*	*294 F*
37 Albania	52	57	1	8	78	65	198	187	262	7
Algeria	2 107	1 654	1 384	1 134	1 152	850	639	760	1 204	719
Croatia	...	...	...	...	...	...	...	...	139	175
Cyprus	2	3	4	3	3	5	2	4	...	...
France	1	0	1	1	1	0	-	-	1	5
Italy	6 980	6 378	6 058	4 496	13 364	13 441	8 668	8 574	9 936	10 675
Malta	...	...	...	...	...	...	8	22	18	7
Spain	504	505	393	302	156	158	170	216	378	245
Tunisia	1 454	1 536	1 648	1 758	1 572	1 932	1 037	1 200	1 558	1 932
Turkey	...	...	...	...	...	...	2 761	2 623	2 073	1 413
37 Fishing area total	*11 100*	*10 133*	*9 489*	*7 702*	*16 326*	*16 451*	*13 483*	*13 586*	*15 569*	*15 178*
47 Angola	1 660	2 200	1 500	1 677	1 350 F	1 200 F	1 069	275	124	120 F
Spain	3 966	-	170	-	-	-	1	3	32	26
47 Fishing area total	*5 626*	*2 200*	*1 670*	*1 677*	*1 350 F*	*1 200 F*	*1 070*	*278*	*156*	*146 F*
Species total	*26 776 F*	*17 626 F*	*17 621 F*	*11 438 F*	*19 912 F*	*20 403 F*	*17 815 F*	*17 545 F*	*20 927 F*	*17 778 F*
Guinea shrimp	**Crevette guinéenne**		**Camarón guineo**		***Parapenaeopsis atlantica***				**2,28(01)019,02**	**GUS**
34 Gabon	-	-	456	324	431	686	109	7	5 F	5 F
34 Fishing area total	-	-	*456*	*324*	*431*	*686*	*109*	*7*	*5 F*	*5 F*
Species total	-	-	*456*	*324*	*431*	*686*	*109*	*7*	*5 F*	*5 F*
Parapenaeopsis shrimps nei	**Crevettes Parapenaeopsis nca**		**Camarones Parapenaeopsis nep**		***Parapenaeopsis spp***				**2,28(01)019,XX**	**NPP**
51 Pakistan	11 576	10 222	12 019	12 358	10 412	9 727	9 441	9 534	9 438	10 581
51 Fishing area total	*11 576*	*10 222*	*12 019*	*12 358*	*10 412*	*9 727*	*9 441*	*9 534*	*9 438*	*10 581*
Species total	*11 576*	*10 222*	*12 019*	*12 358*	*10 412*	*9 727*	*9 441*	*9 534*	*9 438*	*10 581*
Atlantic seabob	**Crevette seabob atlantique**		**Camarón siete barbas**		***Xiphopenaeus kroyeri***				**2,28(01)022,01**	**BOB**
31 Fr Guiana	...	...	...	...	21	16	17	34	14	26
Guyana	23 771	17 659	19 205	14 842	14 863	16 000 F	17 404	14 420	15 427	17 686
Mexico	...	...	...	...	1 937	2 023	1 243	1 186	967	638
Suriname	10 500	10 858	13 937	10 567	8 926	10 340	8 233	6 023	9 134	7 600
Trinidad Tob	79	88	70	69	78	88	77	87	77	-
USA	3 951	3 514	1 731	1 728	1 073	729	363	605	214	490
31 Fishing area total	*38 301*	*32 119*	*34 943*	*27 206*	*26 898*	*29 196 F*	*27 337*	*22 355*	*25 833*	*26 440*
41 Brazil	12 155	11 786	11 382	12 185	15 788	13 943	15 060	14 659	16 168	15 276
41 Fishing area total	*12 155*	*11 786*	*11 382*	*12 185*	*15 788*	*13 943*	*15 060*	*14 659*	*16 168*	*15 276*

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Shrimps, prawns
Crevettes
Gambas, camarones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*50 456*	*43 905*	*46 325*	*39 391*	*42 686*	*43 139 F*	*42 397*	*37 014*	*42 001*	*41 716*
Pacific seabob	**Crevette seabob**		**Camarón botalón**		***Xiphopenaeus riveti***				**2,28(01)022,02**	**TIT**
87 Colombia	716	561	846	511	413	730 F	1 050 F	1 350 F	1 683	1 590
87 Fishing area total	*716*	*561*	*846*	*511*	*413*	*730 F*	*1 050 F*	*1 350 F*	*1 683*	*1 590*
Species total	*716*	*561*	*846*	*511*	*413*	*730 F*	*1 050 F*	*1 350 F*	*1 683*	*1 590*
Southern rough shrimp	**Crevette-archer**		**Camarón fijador arquero**		***Trachypenaeus curvirostris***				**2,28(01)043,02**	**TRV**
61 China	208 340 F	198 857 F	363 508 F	251 427 F	361 245 F	328 668 F	344 978	312 272	282 554	290 761
China,Taiwan	593	366	391	403	598	513	492	215	273	374
Korea Rep	3 145	4 132	3 988	2 575	3 364	4 272	3 885	2 497	3 452	2 587
61 Fishing area total	*212 078 F*	*203 355 F*	*367 887 F*	*254 405 F*	*365 207 F*	*333 453 F*	*349 355*	*314 984*	*286 279*	*293 722*
Species total	*212 078 F*	*203 355 F*	*367 887 F*	*254 405 F*	*365 207 F*	*333 453 F*	*349 355*	*314 984*	*286 279*	*293 722*
Argentine stiletto shrimp	**Crevette stylet d'Argentine**		**Camarón estilete argentino**		***Artemesia longinaris***				**2,28(01)067,01**	**ASH**
41 Argentina	283	298	414	166	181	121	104	367	221	104
41 Fishing area total	*283*	*298*	*414*	*166*	*181*	*121*	*104*	*367*	*221*	*104*
Species total	*283*	*298*	*414*	*166*	*181*	*121*	*104*	*367*	*221*	*104*
Pacific seabobs	**Crevettes seabob du Pacifique**		**Camaroncillos**		***Xiphopenaeus,Trachypenaeus spp***				**2,28(01)XXX,XX**	**BOS**
77 Costa Rica	228	125	105	130	195	175 F	156	160 F	160 F	160 F
El Salvador	1 525	918	1 094	798	511	610	581	896	820	858
Guatemala	200 F	64	1 774	1 412	238	671	774	844	92	1 278
Panama	3 002	1 675	2 661	1 510	1 363	1 748	4 127	1 337	1 469	831
77 Fishing area total	*4 955 F*	*2 782*	*5 634*	*3 850*	*2 307*	*3 204 F*	*5 638*	*3 237 F*	*2 541 F*	*3 127 F*
Species total	*4 955 F*	*2 782*	*5 634*	*3 850*	*2 307*	*3 204 F*	*5 638*	*3 237 F*	*2 541 F*	*3 127 F*
Scarlet shrimp	**Gambon écarlate**		**Gamba carabinero**		***Plesiopenaeus edwardsianus***				**2,28(02)021,01**	**SSH**
27 Portugal	1	18	33	37	16	42	59	103	118	73
27 Fishing area total	*1*	*18*	*33*	*37*	*16*	*42*	*59*	*103*	*118*	*73*
34 Portugal	...	...	...	...	...	0	1	2	-	-
Spain	39	2	2	3	3	28	18	2	1	1
34 Fishing area total	*39*	*2*	*2*	*3*	*3*	*28*	*19*	*4*	*1*	*1*
47 Spain	-	-	-	-	76	24	55	32	-	-
47 Fishing area total	-	-	-	-	*76*	*24*	*55*	*32*	-	-
Species total	*40*	*20*	*35*	*40*	*95*	*94*	*133*	*139*	*119*	*74*
Giant red shrimp	**Gambon rouge**		**Gamba española**		***Aristaeomorpha foliacea***				**2,28(02)030,01**	**ARS**
34 Portugal	-	-	-	-	-	9	-	-	-	-
34 Fishing area total	-	-	-	-	-	*9*	-	-	-	-
37 Malta	...	...	...	...	...	...	...	27	42	27
Spain	-	33	37	65	45	36	23	46	37	52
37 Fishing area total	...	*33*	*37*	*65*	*45*	*36*	*23*	*73*	*79*	*79*
Species total	...	*33*	*37*	*65*	*45*	*45*	*23*	*73*	*79*	*79*
Blue and red shrimp	**Crevette rouge**		**Gamba rosada**		***Aristeus antennatus***				**2,28(02)031,01**	**ARA**
27 Portugal	182	97	117	39	17	31	61	28	25	40
27 Fishing area total	*182*	*97*	*117*	*39*	*17*	*31*	*61*	*28*	*25*	*40*
34 Portugal	...	51	93	0	12	46	90	44	29	-
34 Fishing area total	...	*51*	*93*	*0*	*12*	*46*	*90*	*44*	*29*	-
37 Albania	-	34	22	15	12	18	...	...	...	...
Algeria	740	893	1 027	1 310	1 542	1 423	1 137	1 244	1 175	895
Malta	...	...	...	...	...	...	...	...	...	2
Spain	1 418	1 033	990	1 025	696	1 004	1 056	1 178	1 150	1 058
Tunisia	51	51	24	43	163	9	17	183	38	32
37 Fishing area total	*2 209*	*2 011*	*2 063*	*2 393*	*2 413*	*2 454*	*2 210*	*2 605*	*2 363*	*1 987*
Species total	*2 391*	*2 159*	*2 273*	*2 432*	*2 442*	*2 531*	*2 361*	*2 677*	*2 417*	*2 027*
Striped red shrimp	**Gambon rayé**		**Gamba listada**		***Aristeus varidens***				**2,28(02)031,02**	**ARV**
34 Spain	-	-	-	745	760	658	612	660	-	2
34 Fishing area total	-	-	-	*745*	*760*	*658*	*612*	*660*	-	*2*
47 Angola	1 200	1 553	1 133	...	...	...	913	299	253	240 F
Spain	2 205	546	588	255	365	317	303	317	-	-
47 Fishing area total	*3 405*	*2 099*	*1 721*	*255*	*365*	*317*	*1 216*	*616*	*253*	*240 F*
Species total	*3 405*	*2 099*	*1 721*	*1 000*	*1 125*	*975*	*1 828*	*1 276*	*253*	*242 F*

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Shrimps, prawns
Crevettes
Gambas, camarones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Aristeid shrimps nei	**Gambons,crevet. aristeidés nca**		**Gambas aristeidos nep**		***Aristeidae***				**2,28(02)XXX,XX**	**ARI**
37 Italy	1 833	1 768	2 409	1 546	3 174	3 623	3 207	2 423	2 957	3 231
37 Fishing area total	*1 833*	*1 768*	*2 409*	*1 546*	*3 174*	*3 623*	*3 207*	*2 423*	*2 957*	*3 231*
Species total	*1 833*	*1 768*	*2 409*	*1 546*	*3 174*	*3 623*	*3 207*	*2 423*	*2 957*	*3 231*
Coonstripe shrimp	**Crevette à front rayé**		**Camarón malacho**		***Pandalus hypsinotus***				**2,28(04)002,01**	**PYX**
61 Russian Fed	359	231	98	234	213	376	339	457	586	649
61 Fishing area total	*359*	*231*	*98*	*234*	*213*	*376*	*339*	*457*	*586*	*649*
Species total	*359*	*231*	*98*	*234*	*213*	*376*	*339*	*457*	*586*	*649*
Northern prawn	**Crevette nordique**		**Camarón norteño**		***Pandalus borealis***				**2,28(04)002,03**	**PRA**
21 Canada	94 328	102 097	141 137	173 697	165 066	175 617	182 868	164 968	136 557	161 954
Denmark	93	359	1 006	2 754	3 696	3 632	3 520	3 803	5 072	5 130
Estonia	9 917	13 697	12 966	13 586	12 290	6 133	11 538	11 269	3 685	2 131
Faroe Is	12 028	7 806	12 673	6 002	3 512	2 623	4 099	3 463	4 296	2 998
Greenland	81 398	103 216	79 652	131 380	142 791	146 818	136 531	145 234	130 210	123 897
Iceland	5 065	6 877	4 848	3 671	4 154	2 184	-	-	-	185
Japan	126	89	67	-	-	-	-	-	-	-
Latvia	3 028	1 951	3 677	3 202	2 356	1 574	2 249	1 563	1 532	994
Lithuania	2 768	3 388	3 886	4 946	3 940	1 730	2 295	763	-	442
Norway	12 970	11 625	21 302	11 738	352	714	2 008	606	672	315
Poland	263	-	145	1 302	588	469	247	-	-	-
Portugal	420	15	-	50	-	-	-	-	332	15
Russian Fed	5 754	1 243	3	795	426	294	185	299	355	35
St Pier Mq	404	197	144	-	-	-	986	278	527	334
Spain	885	671	1 013	1 274	1 537	1 127	960	654	913	853
Ukraine	405	-	381	460	-	401	-	-	-	-
UK	-	-	547	-	-	-	-	-	-	2 843
USA	1 309	682	1 100	1 317	1 883	2 072	3 662	4 097	2 357	6 053
21 Fishing area total	*231 161*	*253 913*	*284 547*	*356 174*	*342 591*	*345 388*	*351 148*	*336 997*	*286 508*	*308 179*
27 Denmark	5 238	5 156	5 945	5 314	3 736	4 297	3 484	3 201	2 957	1 779
Estonia	1 318	539	-	-	91	-	538	1 473	4 903	6 906
Faroe Is	3 902	5 335	1 410	3 312	3 671	1 443	2 962	5 442	3 882	2 826
France	-	-	-	-	-	-	-	-	4	-
Greenland	4 444	2 730	4 187	4 581	3 375	626	1 735	14	1 284	600
Iceland	25 725	29 280	23 939	16 377	4 505	860	2 027	2 198	5 512	7 577
Lithuania	2 645	3 319	1 653	2 111	1 920	1 352	1 219	734	-	388
Norway	52 255	57 523	44 263	47 223	47 959	37 996	35 393	30 135	26 620	21 807
Portugal	220	1	0	24	1	0	1	2	-	-
Russian Fed	5 846	3 790	2 776	2 410	435	4	192	417	-	-
Spain	798	267	352	-	92	13	0	-	-	4
Sweden	2 113	2 188	2 244	2 312	2 145	2 394	2 324	2 377	2 324	1 649
UK	996	68	-	0	-	-	0	-	-	0
27 Fishing area total	*105 500*	*110 196*	*86 769*	*83 664*	*67 930*	*48 985*	*49 875*	*45 993*	*47 486*	*43 536*
61 Russian Fed	8 457	7 596	8 185	7 586	7 797	7 359	8 593	7 739	7 925	9 030
61 Fishing area total	*8 457*	*7 596*	*8 185*	*7 586*	*7 797*	*7 359*	*8 593*	*7 739*	*7 925*	*9 030*
Species total	*345 118*	*371 705*	*379 501*	*447 424*	*418 318*	*401 732*	*409 616*	*390 729*	*341 919*	*360 745*
Ocean shrimp	**Crevette océanique**		**Camarón oceánico**		***Pandalus jordani***				**2,28(04)002,04**	**PJK**
67 USA	17 710	25 150	13 653	8 990	10 908	8 493	11 182	15 570	14 431	20 318
67 Fishing area total	*17 710*	*25 150*	*13 653*	*8 990*	*10 908*	*8 493*	*11 182*	*15 570*	*14 431*	*20 318*
77 USA	113	373	414	265	174	29	0	-	0	-
77 Fishing area total	*113*	*373*	*414*	*265*	*174*	*29*	*0*	-	*0*	-
Species total	*17 823*	*25 523*	*14 067*	*9 255*	*11 082*	*8 522*	*11 182*	*15 570*	*14 431*	*20 318*
Aesop shrimp	**Crevette ésope**		**Camarón esópico**		***Pandalus montagui***				**2,28(04)002,05**	**AES**
21 Greenland	609	-	925	605	509	1 421	1 959	89	53	-
21 Fishing area total	*609*	-	*925*	*605*	*509*	*1 421*	*1 959*	*89*	*53*	-
Species total	*609*	-	*925*	*605*	*509*	*1 421*	*1 959*	*89*	*53*	-
Humpy shrimp	**Crevette gibbeuse**		**Camarón jiboso**		***Pandalus goniurus***				**2,28(04)002,07**	**DUJ**
61 Russian Fed	247	32	352	398	119	41	100	-	187	26
61 Fishing area total	*247*	*32*	*352*	*398*	*119*	*41*	*100*	-	*187*	*26*
Species total	*247*	*32*	*352*	*398*	*119*	*41*	*100*	-	*187*	*26*
Hokkai shrimp	**Crevette hokkai**		**Camarón de Hokkai**		***Pandalus kessleri***				**2,28(04)002,08**	**DUK**
61 Russian Fed	94	81	37	24	32	24	36	27	26	26
61 Fishing area total	*94*	*81*	*37*	*24*	*32*	*24*	*36*	*27*	*26*	*26*
Species total	*94*	*81*	*37*	*24*	*32*	*24*	*36*	*27*	*26*	*26*

B-45 **Shrimps, prawns**
Crevettes
Gambas, camarones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Pandalus shrimps nei	**Crevettes Pandalus nca**		**Camarones Pandalus nep**		***Pandalus spp***				**2,28(04)002,XX**	**PAN**
21 Canada	31 234	33 342	1 410	2 381	2 320	2 766	4 673	1 528	1 400	2 264
21 Fishing area total	*31 234*	*33 342*	*1 410*	*2 381*	*2 320*	*2 766*	*4 673*	*1 528*	*1 400*	*2 264*
27 Sweden	-	-	-	-	-	-	-	-	1	9
UK	74	290	27	26	23	19	10	13	25	23
27 Fishing area total	*74*	*290*	*27*	*26*	*23*	*19*	*10*	*13*	*26*	*32*
Species total	*31 308*	*33 632*	*1 437*	*2 407*	*2 343*	*2 785*	*4 683*	*1 541*	*1 426*	*2 296*
Chilean nylon shrimp	**Crevette nylon chilienne**		**Camarón nailon**		***Heterocarpus reedi***				**2,28(04)005,01**	**CHS**
87 Chile	4 863	4 112	3 590	3 663	3 880	4 475	4 481	4 556	4 640	4 795
87 Fishing area total	*4 863*	*4 112*	*3 590*	*3 663*	*3 880*	*4 475*	*4 481*	*4 556*	*4 640*	*4 795*
Species total	*4 863*	*4 112*	*3 590*	*3 663*	*3 880*	*4 475*	*4 481*	*4 556*	*4 640*	*4 795*
Northern nylon shrimp	**Crevette nylon nordique**		**Camarón nailon norteño**		***Heterocarpus vicarius***				**2,28(04)005,08**	**HUV**
77 Nicaragua	131	0	41	150	73	0	...	...	...	...
77 Fishing area total	*131*	*0*	*41*	*150*	*73*	*0*	*...*	*...*	*...*	*...*
Species total	*131*	*0*	*41*	*150*	*73*	*0*	*...*	*...*	*...*	*...*
Morotoge shrimp	**Crevette morotoge**		**Camarón morotoje**		***Pandalopsis japonica***				**2,28(04)037,02**	**NDJ**
61 Russian Fed	36	22	5	8	13	2	80	3	1	4
61 Fishing area total	*36*	*22*	*5*	*8*	*13*	*2*	*80*	*3*	*1*	*4*
Species total	*36*	*22*	*5*	*8*	*13*	*2*	*80*	*3*	*1*	*4*
Tsivakihini paste shrimp	**Chevrette tsivakihini**		**Camaroncillo tsivakihini**		***Acetes erythraeus***				**2,28(07)009,01**	**EKR**
51 Mozambique	...	...	...	...	...	2 018	2 022	2 443	1 892	2 358
51 Fishing area total	*...*	*...*	*...*	*...*	*...*	*2 018*	*2 022*	*2 443*	*1 892*	*2 358*
Species total	*...*	*...*	*...*	*...*	*...*	*2 018*	*2 022*	*2 443*	*1 892*	*2 358*
Akiami paste shrimp	**Chevrette akiami**		**Camaroncillo akiami**		***Acetes japonicus***				**2,28(07)009,03**	**AKS**
61 China	482 703 F	492 289 F	530 089 F	571 789 F	557 908 F	611 881 F	608 096	543 190	588 698	554 752
Korea Rep	11 705	7 013	12 885	7 889	7 352	7 810	12 553	14 934	13 722	18 861
61 Fishing area total	*494 408 F*	*499 302 F*	*542 974 F*	*579 678 F*	*565 260 F*	*619 691 F*	*620 649*	*558 124*	*602 420*	*573 613*
Species total	*494 408 F*	*499 302 F*	*542 974 F*	*579 678 F*	*565 260 F*	*619 691 F*	*620 649*	*558 124*	*602 420*	*573 613*
Sergestid shrimps nei	**Crevettes sergestid nca**		**Camarones sergéstidos nep**		***Sergestidae***				**2,28(07)XXX,XX**	**SHS**
57 Malaysia	7 026	6 362	6 182	5 032	3 531	4 708	11 636	25 774	26 014	47 306
Thailand	632	865	690	585	1 154	95	63	153	2 060	903
57 Fishing area total	*7 658*	*7 227*	*6 872*	*5 617*	*4 685*	*4 803*	*11 699*	*25 927*	*28 074*	*48 209*
71 Malaysia	1 341	2 198	2 088	2 496	1 397	1 495	2 162	681	3 250	5 460
Philippines	22 960	17 131	16 995	15 403	14 002	15 706	12 914	16 287	15 249	15 228
Thailand	3 375	3 748	4 243	5 149	8 778	6 785	6 310	7 124	7 210	7 167
71 Fishing area total	*27 676*	*23 077*	*23 326*	*23 048*	*24 177*	*23 986*	*21 386*	*24 092*	*25 709*	*27 855*
Species total	*35 334*	*30 304*	*30 198*	*28 665*	*28 862*	*28 789*	*33 085*	*50 019*	*53 783*	*76 064*
West African estuarine prawn	**Bouquet étier**		**Camarón estuarino africano**		***Nematopalaemon hastatus***				**2,28(12)003,01**	**NLH**
34 Cameroon	10 000	10 000 F	10 000 F	10 000 F	11 700	9 750	11 600	11 500 F	11 500 F	11 500 F
34 Fishing area total	*10 000*	*10 000 F*	*10 000 F*	*10 000 F*	*11 700*	*9 750*	*11 600*	*11 500 F*	*11 500 F*	*11 500 F*
Species total	*10 000*	*10 000 F*	*10 000 F*	*10 000 F*	*11 700*	*9 750*	*11 600*	*11 500 F*	*11 500 F*	*11 500 F*
Whitebelly prawn	**Bouquet covac**		**Camarón cuac**		***Nematopalaemon schmitti***				**2,28(12)003,02**	**NLC**
31 Guyana	1 382	1 400	2 218	2 470	2 507	1 800 F	1 039	1 289	1 329	526
Suriname	...	...	19	24	20	...	...	...	...	...
31 Fishing area total	*1 382*	*1 400*	*2 237*	*2 494*	*2 527*	*1 800 F*	*1 039*	*1 289*	*1 329*	*526*
Species total	*1 382*	*1 400*	*2 237*	*2 494*	*2 527*	*1 800 F*	*1 039*	*1 289*	*1 329*	*526*
Baltic prawn	**Bouquet balte**		**Camarón báltico**		***Palaemon adspersus***				**2,28(12)018,01**	**PAA**
37 Ukraine	...	...	...	...	...	...	...	...	...	33
37 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*33*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*33*
Delta prawn	**Bouquet delta**		**Camarón delta**		***Palaemon longirostris***				**2,28(12)018,06**	**PIQ**
27 France	26	21	30	13	7	8	9	9	-	3
27 Fishing area total	*26*	*21*	*30*	*13*	*7*	*8*	*9*	*9*	-	*3*
Species total	*26*	*21*	*30*	*13*	*7*	*8*	*9*	*9*	-	*3*

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Shrimps, prawns
Crevettes
Gambas, camarones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Common prawn	**Bouquet commun**		**Camarón común**		***Palaemon serratus***				**2,28(12)018,10**	**CPR**
27 Denmark	141	144	131	99	80	63	47	86	78	58
France	326	287	255	196	126	194	175	151	185	245
Spain	41	13	20	32	56	69	69	81	84	87
UK	24	13	15	5	5	29	36	33	28	14
27 Fishing area total	*532*	*457*	*421*	*332*	*267*	*355*	*327*	*351*	*375*	*404*
37 France	-	-	-	-	-	-	-	-	2	4
Spain	...	97	26	-	23	15	11	31	20	12
37 Fishing area total	*...*	*97*	*26*	*...*	*23*	*15*	*11*	*31*	*22*	*16*
Species total	*532*	*554*	*447*	*332*	*290*	*370*	*338*	*382*	*397*	*420*
Palaemonid shrimps nei	**Crevettes palémonides nca**		**Camarones palemónidos nep**		***Palaemonidae***				**2,28(12)XXX,XX**	**PAL**
27 Ireland	268	208	99	268	79	322	277	157	115	107
Portugal	13	7	9	10	3	2	3	-	57	3
27 Fishing area total	*281*	*215*	*108*	*278*	*82*	*324*	*280*	*157*	*172*	*110*
Species total	*281*	*215*	*108*	*278*	*82*	*324*	*280*	*157*	*172*	*110*
Common shrimp	**Crevette grise**		**Quisquilla**		***Crangon crangon***				**2,28(23)003,03**	**CSH**
27 Belgium	988	538	1 136	749	976	866	637	1 024	1 585	2 078
Denmark	1 826	3 197	3 693	3 349	4 197	4 239	3 975	3 391	3 099	3 140
France	389	289	265	238	196	319	311	291	439	445
Germany	12 571	15 966	16 269	19 222	22 616	18 819	15 904	17 902	17 315	18 380
Ireland	...	...	104	145	4	1	6	24	103	27
Netherlands	14 081	11 453	14 834	14 502	16 227	15 620	16 491	15 375	19 416	18 939
Norway	-	-	-	-	-	-	-	-	-	3
Portugal	0	-	-	0	1	-	-	-	-	1
Spain	1	4	12	2	1	1	3	1	1	2
UK	2 290	1 430	628	506	515	460	1 392	873	1 064	921
27 Fishing area total	*32 146*	*32 877*	*36 941*	*38 713*	*44 733*	*40 325*	*38 719*	*38 881*	*43 022*	*43 936*
37 Algeria	2	3	1	1	6	3	1	1	12	11
France	2	2	2	2	-	0	-	-	2	6
Italy	...	...	...	...	81	46	27	37	59	84
Spain	...	134	85	36	33	64	71	44	55	34
37 Fishing area total	*4*	*139*	*88*	*39*	*120*	*113*	*99*	*82*	*128*	*135*
Species total	*32 150*	*33 016*	*37 029*	*38 752*	*44 853*	*40 438*	*38 818*	*38 963*	*43 150*	*44 071*
Sculptured shrimps nei	**Crevettes sculptées nca**		**Camarones esculpidos nep**		***Sclerocrangon spp***				**2,28(23)006,XX**	**CVL**
61 Russian Fed	45	41	26	49	32	30	29	29	1	2
61 Fishing area total	*45*	*41*	*26*	*49*	*32*	*30*	*29*	*29*	*1*	*2*
Species total	*45*	*41*	*26*	*49*	*32*	*30*	*29*	*29*	*1*	*2*
Crangonid shrimps nei	**Crevettes crangonidés nca**		**Camarones crangónidos nep**		***Crangonidae***				**2,28(23)XXX,XX**	**CRN**
77 USA	45	38	40	30	24	18	23	21	32	24
77 Fishing area total	*45*	*38*	*40*	*30*	*24*	*18*	*23*	*21*	*32*	*24*
Species total	*45*	*38*	*40*	*30*	*24*	*18*	*23*	*21*	*32*	*24*
Rock shrimp	**Boucot ovetgernade**		**Camarón de piedra**		***Sicyonia brevirostris***				**2,28(28)028,01**	**RSH**
31 USA	2 909	890	3 243	3 753	724	1 628	314	1 013	1 974	805
31 Fishing area total	*2 909*	*890*	*3 243*	*3 753*	*724*	*1 628*	*314*	*1 013*	*1 974*	*805*
Species total	*2 909*	*890*	*3 243*	*3 753*	*724*	*1 628*	*314*	*1 013*	*1 974*	*805*
Pacific rock shrimp	**Boucot du Pacifique**		**Camarón de piedra del Pacífico**		***Sicyonia ingentis***				**2,28(28)028,06**	**YII**
77 USA	165	215	225	27	28	73	93	233	235	92
77 Fishing area total	*165*	*215*	*225*	*27*	*28*	*73*	*93*	*233*	*235*	*92*
Species total	*165*	*215*	*225*	*27*	*28*	*73*	*93*	*233*	*235*	*92*
Argentine red shrimp	**Salicoque rouge d'Argentine**		**Camarón langostín argentino**		***Pleoticus muelleri***				**2,28(29)006,01**	**LAA**
41 Argentina	78 843	51 410	52 896	27 127	7 473	44 405	47 619	47 406	53 731	72 085
Uruguay	0	2	0	0	37	0	0	0	-	-
41 Fishing area total	*78 843*	*51 412*	*52 896*	*27 127*	*7 510*	*44 405*	*47 619*	*47 406*	*53 731*	*72 085*
Species total	*78 843*	*51 412*	*52 896*	*27 127*	*7 510*	*44 405*	*47 619*	*47 406*	*53 731*	*72 085*
Royal red shrimp	**Salicoque royale rouge**		**Camarón rojo real**		***Pleoticus robustus***				**2,28(29)006,03**	**RRS**
21 USA	24	23	16	4	6	2	2	2	5	6
21 Fishing area total	*24*	*23*	*16*	*4*	*6*	*2*	*2*	*2*	*5*	*6*
31 USA	281	418	358	268	196	201	419	243	230	323
31 Fishing area total	*281*	*418*	*358*	*268*	*196*	*201*	*419*	*243*	*230*	*323*
Species total	*305*	*441*	*374*	*272*	*202*	*203*	*421*	*245*	*235*	*329*

B-45 **Shrimps, prawns**
Crevettes
Gambas, camarones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Kolibri shrimp	**Salicoque colibrí**		**Camarón chupaflor**		***Solenocera agassizii***				**2,28(29)072,01**	**SOK**
87 Colombia	522	1	688	208	339	300 F	260 F	220 F	189	94
87 Fishing area total	*522*	*1*	*688*	*208*	*339*	*300 F*	*260 F*	*220 F*	*189*	*94*
Species total	*522*	*1*	*688*	*208*	*339*	*300 F*	*260 F*	*220 F*	*189*	*94*
Knife shrimp	**Salicoque couteau**		**Camarón navaja**		***Haliporoides triarthrus***				**2,28(29)073,01**	**KNS**
51 Mozambique	1 738	1 441	1 425	993	1 774	1 803	1 366	1 448	1 163	1 243
South Africa	249	160	15	127	216	133	121	6	30	16
51 Fishing area total	*1 987*	*1 601*	*1 440*	*1 120*	*1 990*	*1 936*	*1 487*	*1 454*	*1 193*	*1 259*
Species total	*1 987*	*1 601*	*1 440*	*1 120*	*1 990*	*1 936*	*1 487*	*1 454*	*1 193*	*1 259*
Chilean knife shrimp	**Salicoque couteau du Chili**		**Camarón cuchilla**		***Haliporoides diomedeae***				**2,28(29)073,03**	**HJD**
87 Chile	309	482	705	292	252	189	214	157	94	86
87 Fishing area total	*309*	*482*	*705*	*292*	*252*	*189*	*214*	*157*	*94*	*86*
Species total	*309*	*482*	*705*	*292*	*252*	*189*	*214*	*157*	*94*	*86*
Natantian decapods nei	**Décapodes natantia nca**		**Decápodos natantia nep**		***Natantia***				**2,28(XX)XXX,XX**	**DCP**
04 China,Taiwan	-	12	12	12	12	18	18	17	13	10
India	14 569	90 514	90 621	26 108	31 094	31 124	34 712	37 938	36 317	45 988
Indonesia	7 721	5 611	5 653	5 540	5 000	6 033	6 320	6 098	5 905	4 538
Philippines	4 245	4 811	5 125	5 414	5 429	5 460	5 925	6 268	5 982	5 793
Viet Nam	8 626	9 128	10 989	11 979	8 400	9 600	10 400	11 000	11 400	11 700 F
04 Fishing area total	*35 161*	*110 076*	*112 400*	*49 053*	*49 935*	*52 235*	*57 375*	*61 321*	*59 617*	*68 029 F*
27 France	-	-	-	-	1	1	0	0	41	100
Portugal	83	105	120	60	22	14	34	17	18	74
Spain	1 842	3 910	1 554	3	5	2	8	13	22	40
UK	-	-	-	-	-	-	0	3	4	1
27 Fishing area total	*1 925*	*4 015*	*1 674*	*63*	*28*	*17*	*42*	*33*	*85*	*215*
31 Colombia	129	2	5	...	...	...	...	...	...	...
Haiti	370 F	470 F	600 F	750 F	750 F	750 F	750 F	750 F	750 F	750 F
Korea Rep	68	45	-	-	8	26	26	3	-	-
USA	2 663	1 556	1 410	1 477	1 320	1 453	1 443	1 357	1 622	1 363
31 Fishing area total	*3 230 F*	*2 073 F*	*2 015 F*	*2 227 F*	*2 078 F*	*2 229 F*	*2 219 F*	*2 110 F*	*2 372 F*	*2 113 F*
34 Angola	-	58	70	-	-	6	-	-	-	-
Belize	11	-	29	...	381	15	-	6	...	...
Benin	3	55	88	63	43	71	50 F	57	...	...
China	-	0	1 257	...	293	-	44	4	...	...
Ghana	1 361	973	1 108	1 180	1 695	1 327	1 167	868	2 065	1 323
Greece	511	517	391	166	439	608	402	265	257	257 F
GuineaBissau	237	63	1	10 F	19 F	88 F	39 F	50 F	50 F	50 F
Italy	686	473	795	674	715	536	675	301	695	454
Korea Rep	916	4	-	-	1	5	-	4	5	99
Latvia	19	7	-	-	-	-	-	-	-	-
Liberia	24	30	30	252	31	35	41	33	30 F	30 F
Mauritania	1 546	1 226	1 200 F	763	748	1 108	421	45	293	205
Morocco	11 852	10 561	10 311	8 515	8 702	8 131	11 372	10 343	8 427	7 136
Nigeria	909	17 076	15 004	11 505	16 152	16 085	11 418	1 941	11 496	13 465
Panama	-	-	0	...	137	-	28	-	...	...
Portugal	255	242	314	108	96	181	173	105	54	111
Senegal	19	18	-	-	-	-	-	-	-	1
Spain	5 661	5 831	6 037	3 803	3 133	4 305	5 180	3 645	145	349
34 Fishing area total	*24 010*	*37 134*	*36 635 F*	*27 039 F*	*32 585 F*	*32 501 F*	*31 010 F*	*17 667 F*	*23 517 F*	*23 480 F*
37 Bulgaria	0	1	0	0	0	0	-	-	-	-
Cyprus	-	-	-	-	-	-	-	-	7	2
Egypt	3 668	4 685	2 473	3 278	2 950	3 272	4 806	10 746	10 632	10 563
France	1	1	-	1	2	1	1	-	2	1
Greece	844	933	891	1 125	1 432	1 223	1 216	1 211	1 011	1 000 F
Israel	116	110	97	51	143	113	210	110 F	15	13
Malta	36	29	37	26	30	32	34	5	3	5
Morocco	965	767	704	514	472	199	183	366	592	389
Palest, O.T.	70 F	60	65	45	57	66	75	122	92	118
Portugal	-	-	-	-	-	-	23	37	58	83
Russian Fed	3	-	-	-	-	-	-	-	-	-
Spain	8	734	651	508	454	456	460	453	463	357
Turkey	3 000	4 000	6 000	5 279	6 339	3 856	784	1 596	2 099	2 341
Ukraine	0	4	2	14	9	16	11	20	16	-
37 Fishing area total	*8 711 F*	*11 324*	*10 920*	*10 841*	*11 888*	*9 234*	*7 803*	*14 666 F*	*14 990*	*14 872 F*
41 Korea Rep	2 750	12 965	5 488	-	-	-	8 414	660	-	-
Portugal	-	-	-	13	7	-	-	-	-	-
Spain	66	57	-	-	-	-	4	-	-	-
41 Fishing area total	*2 816*	*13 022*	*5 488*	*13*	*7*	-	*8 418*	*660*	-	-
47 Spain	4 298	1 798	1 654	1 257	863	1 135	1 512	1 111	-	-
47 Fishing area total	*4 298*	*1 798*	*1 654*	*1 257*	*863*	*1 135*	*1 512*	*1 111*	-	-
51 Egypt	1 704	1 366	1 761	2 014	1 957	1 604	918	961	774	683
France	-	-	-	-	-	-	-	-	6	4
India	119 114	122 072	123 639	119 859	121 039	109 848	103 102	100 877	102 796	38 835

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Shrimps, prawns
Crevettes
Gambas, camarones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Iran	6 940	5 726	7 100	5 939	9 128	5 951	7 450	8 686	8 769	6 204
	Kenya	690	581	383	393	162	158	307	219	153	251
	Korea Rep	279	172	22	7	-	12	20	14	3	3
	Kuwait	1 977	1 692	1 376	1 666	1 890	2 245	1 540	1 807	1 700 F	1 700 F
	Madagascar	11 776	13 268	13 314	11 195	9 334	9 382	16 604	6 683	7 330	6 509
	Mauritius	1	1	1	1	1	...	...	...	...	...
	Oman	627	467	416	496	515	469	493	366	647	854
	Portugal	735	-	295	511	252	-	3	0	-	-
	Réunion	1	0	0	0	0	-	-	-	-	-
	Russian Fed	-	31	61	-	-	-	-	-	-	-
	Spain	175	152	-	241	184	-	-	-	-	-
51	*Fishing area total*	*144 019*	*145 528*	*148 368*	*142 322*	*144 462*	*129 669*	*130 437*	*119 613*	*122 178 F*	*55 043 F*
57	India	22 463	16 244	16 411	33 218	20 551	20 638	37 386	44 475	33 944	55 396
	Indonesia	17 761	16 718	20 411	20 500	19 641	20 992	21 699	29 965	32 436	12 547
	Korea Rep	1	-	-	-	-	-	-	-	-	-
	Malaysia	39 730	37 887	39 747	39 169	22 216	28 506	33 406	29 316	38 146	39 002
	Myanmar	22 500 F	22 000 F	21 500 F	21 000 F	20 404	28 300	30 000 F	33 000 F	37 300 F	41 000 F
	Timor-Leste	1	3 F	5 F	8 F	11 F	14 F	17 F	20 F	20 F	20 F
57	*Fishing area total*	*102 456 F*	*92 852 F*	*98 074 F*	*113 895 F*	*82 823 F*	*98 450 F*	*122 508 F*	*136 776 F*	*141 846 F*	*147 965 F*
61	China	...	...	259 107 F	350 669 F	240 377 F	208 164 F	142 024	171 978	193 554	181 597
	China,H.Kong	5 100 F	5 000 F	4 600 F	4 900 F	4 740 F	4 550 F	4 550 F	4 670 F	4 700 F	4 950 F
	China, Macao	230 F	230 F	230 F	230 F	230 F	230 F	230 F	230 F	230 F	230 F
	China,Taiwan	11 987	10 787	13 178	11 577	23 084	11 627	10 722	9 744	2 686	7 342
	Japan	24 280	24 527	23 115	22 025	21 845	21 669	22 297	20 345	18 300 F	16 900 F
	Korea Rep	8 077	7 206	7 875	7 383	8 269	12 353	12 541	8 339	5 936	8 099
	Russian Fed	80	232	1	142	76	-	-	20	7	17
61	*Fishing area total*	*49 754 F*	*47 982 F*	*308 106 F*	*396 926 F*	*298 621 F*	*258 593 F*	*192 364 F*	*215 326 F*	*225 413 F*	*219 135 F*
67	Canada	4 212	3 622	3 497	2 690	2 882	766	675	575	592	513
	USA	1 030	1 201	1 122	1 133	919	674	518	512	607	600
67	*Fishing area total*	*5 242*	*4 823*	*4 619*	*3 823*	*3 801*	*1 440*	*1 193*	*1 087*	*1 199*	*1 113*
71	Brunei Darsm	0	0	-	-	-	-	-	-	-	-
	Cambodia	8 800 F	10 000 F	12 300 F	12 600 F	13 500 F	13 600 F	12 400 F	11 040	7 060	8 000 F
	Guam	0	0	-	-	-	-	-	-	-	-
	Indonesia	95 400	78 843	79 810	78 304	58 414	76 761	75 888	61 981	55 172	62 785
	Korea Rep	380	52	146	97	17	-	7	1	-	2
	Malaysia	29 371	29 573	25 180	32 006	25 644	27 189	24 525	25 238	22 908	24 211
	Micronesia	0	0	-	-	-	-	-	-	-	-
	N Marianas	-	0	-	-	-	-	-	-	-	-
	Papua N Guin	117	72	92	139	83	59	48	34	22	87
	Singapore	250	222	220	245	251	460	505	132	244	189
	Viet Nam	85 656	85 849	91 850	95 090	99 500	99 000	101 000	102 300	127 300	135 000 F
71	*Fishing area total*	*219 974 F*	*204 611 F*	*209 598 F*	*218 481 F*	*197 409 F*	*217 069 F*	*214 373 F*	*200 726*	*212 706*	*230 274 F*
77	Costa Rica	508	561	705	984	1 240	1 250 F	1 254	1 250 F	1 250 F	1 250 F
	Korea Rep	-	2	-	-	-	-	-	-	-	-
	Panama	1 147	346	237	154	372	207	124	63	15	7
	USA	196	183	82	106	126	146	119	132	137	115
77	*Fishing area total*	*1 851*	*1 092*	*1 024*	*1 244*	*1 738*	*1 603 F*	*1 497*	*1 445 F*	*1 402 F*	*1 372 F*
81	Japan	5	12	50	-	-	-	-	-	-	-
	New Zealand	0	-	1	0	3	2	3	2	1	-
81	*Fishing area total*	*5*	*12*	*51*	*0*	*3*	*2*	*3*	*2*	*1*	-
87	Colombia	4	13	-	910	7	5 F	3 F	1 F	...	...
87	*Fishing area total*	*4*	*13*	-	*910*	*7*	*5 F*	*3 F*	*1 F*	...	...
Species total		*603 456 F*	*676 355 F*	*940 626 F*	*968 094 F*	*826 248 F*	*804 182 F*	*770 757 F*	*772 544 F*	*805 326 F*	*763 611 F*
Group total		***2 826 980***	***2 844 192***	***3 345 014***	***3 307 856***	***3 205 737***	***3 269 605***	***3 262 436***	***3 132 546***	***3 166 970***	***3 129 250***

B-46

Krill, planktonic crustaceans
Krill, crustacés planctoniques
Krill, crustáceos planctónicos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Antarctic krill	**Krill antarctique**		**Krill antártico**		***Euphausia superba***				**2,26(01)005,01**	**KRI**
41 China	-	-	-	-	-	-	-	-	-	10
Norway	-	-	-	-	-	43	-	-	-	-
41 Fishing area total	-	-	-	-	-	*43*	-	-	-	*10*
48 Chile	-	-	-	-	-	-	-	2	-	-
China	-	-	-	-	-	-	-	-	-	1 946
Japan	67 377	51 079	59 682	33 583	22 793	32 711	24 301	38 803	21 020	29 919
Korea Rep	7 525	14 353	21 276	24 522	28 910	43 031	33 088	38 033	42 827	45 648
Norway	-	-	-	-	-	9 185	39 783	63 293	44 174	119 401
Poland	13 696	16 365	8 905	8 967	4 335	6 413	7 414	8 035	8 149	6 995
Russian Fed	-	-	-	775	-	-	-	222	9 654	8 065
Ukraine	14 023	32 015	17 715	12 261	22 440	15 206	...	8 133	-	-
UK	-	-	-	16	0	2	-	0	0	-
USA	1 561	12 175	10 150	8 550	2 159	-	-	-	-	-
Vanuatu	-	-	-	29 491	48 389	-	-	-	-	-
48 Fishing area total	*104 182*	*125 987*	*117 728*	*118 165*	*129 026*	*106 548*	*104 586*	*156 521*	*125 824*	*211 974*
57 India	...	...	-	-	-	-	-	-	-	3 191
57 Fishing area total	*...*	*...*	-	-	-	-	-	-	-	*3 191*
Species total	*104 182*	*125 987*	*117 728*	*118 165*	*129 026*	*106 591*	*104 586*	*156 521*	*125 824*	*215 175*
Norwegian krill	**Krill norvégien**		**Krill de Noruega**		***Meganyctiphanes norvegica***				**2,26(01)011,01**	**NKR**
27 Denmark	36	-	254	-	-	-	-	-	-	-
Norway	-	-	-	-	-	-	-	-	40	-
27 Fishing area total	*36*	-	*254*	-	-	-	-	-	*40*	-
Species total	*36*	-	*254*	-	-	-	-	-	*40*	-
Group total	***104 218***	***125 987***	***117 982***	***118 165***	***129 026***	***106 591***	***104 586***	***156 521***	***125 864***	***215 175***

B-47

Miscellaneous marine crustaceans
Crustacés marins divers
Crustáceos marinos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Brine shrimp	**Crevette de salines**		**Artemia**		***Artemia salina***				**2,02(02)001,01**	**AMS**
02 USA	...	...	2 720	3 181	-	-	-	-	-	-
02 Fishing area total	*...*	*...*	*2 720*	*3 181*	-	-	-	-	-	-
05 Ukraine	-	-	-	-	-	-	-	-	-	2
05 Fishing area total	-	-	-	-	-	-	-	-	-	*2*
67 USA	63	58	71	72	71	77	83	69	69	53
67 Fishing area total	*63*	*58*	*71*	*72*	*71*	*77*	*83*	*69*	*69*	*53*
77 USA	475	320	237	381	273	228	343	-	-	-
77 Fishing area total	*475*	*320*	*237*	*381*	*273*	*228*	*343*	-	-	-
Species total	*538*	*378*	*3 028*	*3 634*	*344*	*305*	*426*	*69*	*69*	*55*
Goose barnacles nei	**Balanes nca**		**Bellotas de mar nep**		***Lepas spp***				**2,13(02)007,XX**	**GOO**
27 Portugal	-	-	-	-	-	0	-	-	-	-
27 Fishing area total	-	-	-	-	-	*0*	-	-	-	-
Species total	-	-	-	-	-	*0*	-	-	-	-
Giant barnacle	**Balane géante**		**Picoroco gigante**		***Austromegabalanus psittacus***				**2,13(03)012,01**	**MBZ**
87 Chile	685	199	192	278	290	184	158	176	312	96
87 Fishing area total	*685*	*199*	*192*	*278*	*290*	*184*	*158*	*176*	*312*	*96*
Species total	*685*	*199*	*192*	*278*	*290*	*184*	*158*	*176*	*312*	*96*
Barnacle	**Pouce-pied**		**Percebe**		***Pollicipes pollicipes***				**2,13(05)001,01**	**PCB**
27 Portugal	-	-	-	-	-	12	59	77	79	94
27 Fishing area total	-	-	-	-	-	*12*	*59*	*77*	*79*	*94*
Species total	-	-	-	-	-	*12*	*59*	*77*	*79*	*94*
Spottail mantis squillid	**Squille ocellée**		**Galera ocelada**		***Squilla mantis***				**2,25(01)001,02**	**MTS**
27 Spain	-	-	-	176	240	347	233	221	145	231
27 Fishing area total	-	-	-	*176*	*240*	*347*	*233*	*221*	*145*	*231*
37 Croatia	...	...	...	...	...	...	...	...	1	1
France	33	44	48	48	38	40	27	26	24	25
Italy	5 570	5 374	5 460	6 176	6 628	6 621	7 091	6 212	6 723	6 466
Slovenia	3	4	6	6	5	2	7	6	4	5
Spain	1 000	810	908	947	862	814	883	872	1 037	976
37 Fishing area total	*6 606*	*6 232*	*6 422*	*7 177*	*7 533*	*7 477*	*8 008*	*7 116*	*7 789*	*7 473*
Species total	*6 606*	*6 232*	*6 422*	*7 353*	*7 773*	*7 824*	*8 241*	*7 337*	*7 934*	*7 704*
Red sea mantis shrimp	**Squille de la mer rouge**		**Galera del mar Rojo**		***Erugosquilla massavensis***				**2,25(01)004,02**	**OQM**
37 Egypt	-	-	-	-	-	-	-	-	300	295
37 Fishing area total	-	-	-	-	-	-	-	-	*300*	*295*
Species total	-	-	-	-	-	-	-	-	*300*	*295*
Squillids nei	**Squilles nca**		**Galeras nep**		***Squillidae***				**2,25(01)XXX,XX**	**SQY**
61 China	...	...	246 961 F	270 452 F	261 806 F	282 761 F	306 969	279 873	303 002	315 360
61 Fishing area total	*...*	*...*	*246 961 F*	*270 452 F*	*261 806 F*	*282 761 F*	*306 969*	*279 873*	*303 002*	*315 360*
71 Philippines	2 612	3 134	3 305	3 789	3 185	2 653	3 657	3 216	2 588	2 276
71 Fishing area total	*2 612*	*3 134*	*3 305*	*3 789*	*3 185*	*2 653*	*3 657*	*3 216*	*2 588*	*2 276*
Species total	*2 612*	*3 134*	*250 266 F*	*274 241 F*	*264 991 F*	*285 414 F*	*310 626*	*283 089*	*305 590*	*317 636*
Stomatopods nei	**Stomatopodes nca**		**Estomatopodos nep**		***Stomatopoda***				**2,25(XX)XXX,XX**	**SVX**
21 USA	1	1	0	0	0	1	1	8	0	0
21 Fishing area total	*1*	*1*	*0*	*0*	*0*	*1*	*1*	*8*	*0*	*0*
57 Thailand	243	811	661	654	375	227	139	1	11	6
57 Fishing area total	*243*	*811*	*661*	*654*	*375*	*227*	*139*	*1*	*11*	*6*
71 Thailand	1 634	1 474	1 856	1 994	1 638	1 526	1 014	845	505	675
71 Fishing area total	*1 634*	*1 474*	*1 856*	*1 994*	*1 638*	*1 526*	*1 014*	*845*	*505*	*675*
Species total	*1 878*	*2 286*	*2 517*	*2 648*	*2 013*	*1 754*	*1 154*	*854*	*516*	*681*
Marine crustaceans nei	**Crustacés marins nca**		**Crustáceos marinos nep**		***Crustacea***				**2,99(XX)XXX,XX**	**CRU**
27 Belgium	-	-	1	2	3	2	2	1	0	1
France	689	14	19	7	24	46	70	68	13	16
Ireland	401	595	-	-	-	-	-	-	-	-
Norway	-	-	-	6	51	98	70	88	-	27
Portugal	25	20	75	160	20	4	3	3	5	6
Spain	545	575	318	205	319	300	645	439	393	443

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Miscellaneous marine crustaceans
Crustacés marins divers
Crustáceos marinos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Sweden	-	-	-	1	2	2	1	1	-	-
UK	12	7	4	1	1	2	1	1	0	-
27 Fishing area total	*1 672*	*1 211*	*417*	*382*	*420*	*454*	*792*	*601*	*411*	*493*
31 Barbados	0	0	0	0	0	0	0	-	-	-
Cuba	-	3	1	1	-	-	310	208	101	111
Guadeloupe	150	150	150	150	150	150	150	150	150 F	150 F
Puerto Rico	-	-	-	-	-	-	-	-	0	-
St Lucia	36	10	23	11	15	9	13	11	10	19
31 Fishing area total	*186*	*163*	*174*	*162*	*165*	*159*	*473*	*369*	*261 F*	*280 F*
34 Côte dIvoire	-	-	-	-	300 F	300 F	320 F	310 F	300	283
Eq Guinea	50 F	40 F	30 F	25 F	20 F	15	20	40 F	60	2
Italy	77	40	10	9	18	70	82	-	4	2
Korea Rep	-	-	-	2	-	3	-	-	-	1
Mauritania	20	5	8 F	10	1	16	20	-	25	1
Portugal	3	1	1	-	1	-	0	-	-	-
Sao Tome Prn	6 F	9 F	12	3	4 F	4 F	5 F	5 F	5 F	5 F
Spain	375	-	7	15	9	13	5	8	-	22
Togo	0	-	-	-	-	-	-	-	-	-
34 Fishing area total	*531 F*	*95 F*	*68 F*	*64 F*	*353 F*	*421 F*	*452 F*	*363 F*	*394 F*	*316 F*
37 Algeria	222	297	49	-	-	-	4	10	44	108
France	-	-	-	-	-	0	-	-	-	5
Israel	-	-	-	-	-	-	5	5 F	-	-
Italy	1 707	1 655	1 606	1 590	429	478	519	494	570	496
Lebanon	55	60	60	60	55	57	57 F	57 F	57 F	57 F
Libya	...	...	...	...	...	...	65	133	...	...
Montenegro	...	...	...	...	...	29	25	41	21	27
Romania	-	-	0	-	-	-	-	-	-	-
Serbia-Monte	-	-	-	-	16	...	...	...	...	...
Spain	1 349	373	73	47	41	45	57	49	35	40
Syria	57	66	128	146	215	137	148	148	160	117
Tunisia	0	-	-	2	1	-	-	-	2	-
Ukraine	-	-	-	-	-	-	-	-	31	19
37 Fishing area total	*3 390*	*2 451*	*1 916*	*1 845*	*757*	*746*	*880 F*	*937 F*	*920 F*	*869 F*
41 Argentina	-	-	-	0	-	-	-	-	7	1
Brazil	223	377	390	354	492	431	484	1 045	1 153	1 093
Korea Rep	1 155	-	-	-	-	27	25	-	-	-
Portugal	-	-	-	2	19	2	-	-	-	-
Uruguay	-	-	2	-	-	-	-	-	-	-
41 Fishing area total	*1 378*	*377*	*392*	*356*	*511*	*460*	*509*	*1 045*	*1 160*	*1 094*
47 Portugal	-	-	-	-	1	-	-	-	-	-
47 Fishing area total	-	-	-	-	*1*	-	-	-	-	-
51 India	26 503	11 271	10 261	17 687	20 304	21 158	14 549	11 220	9 561	7 107
Italy	65	-	-	-	-	-	-	-	-	-
Kenya	136	108	60	504	58	57	81	75	53	59
Korea Rep	361	412	241	153	52	48	28	53	180	106
Portugal	-	-	124	-	-	-	-	-	-	-
South Africa	-	-	-	39	-	63	36	28	31	58
Spain	-	-	-	0	-	-	-	-	-	0
51 Fishing area total	*27 065*	*11 791*	*10 686*	*18 383*	*20 414*	*21 326*	*14 694*	*11 376*	*9 825*	*7 330*
57 Australia	1 062	1 062	1 063	950	965	840	813	834	883	-
Bangladesh	31 037	31 976	31 931	36 488	44 261	48 119	51 869	53 206	52 217	52 592
India	4 420	3 793	3 906	4 296	4 123	4 862	22 346	7 906	6 248	14 168
Indonesia	219	547	1 887	1 435	748	1 018	466	749	271	141
Korea Rep	155	-	-	-	-	-	-	-	-	-
Sri Lanka	4 450	7 530	13 650	15 320	2 610	7 090	10 450	11 780	13 200	15 860
57 Fishing area total	*41 343*	*44 908*	*52 437*	*58 489*	*52 707*	*61 929*	*85 944*	*74 475*	*72 819*	*82 761*
61 China	1 079 209 F	1 033 492 F	-	-	-	-	-	-	-	-
China, Macao	210 F	210 F	210 F	210 F	210 F	210 F	210 F	210 F	210 F	210 F
Japan	49 619	41 199	50 915	46 669	46 042	37 227	38 729	41 563	29 984	40 500 F
Korea D P Rp	16 181	16 000 F	16 000 F	16 000 F	16 000 F	16 000 F	16 000 F	16 000 F	16 000 F	16 000 F
Korea Rep	4 257	936	2 721	763	980	1 022	1 321	941	1 031	1 103
61 Fishing area total	*1 149 476 F*	*1 091 837 F*	*69 846 F*	*63 642 F*	*63 232 F*	*54 459 F*	*56 260 F*	*58 714 F*	*47 225 F*	*57 813 F*
71 Australia	614	567	78	11	633	681	561	468	514	563
Brunei Darsm	368	485	228	175	149	167	191	131	106	36
Fiji	87	60 F	16	52	60 F	73	61	70 F	75	100
Indonesia	414	252	1 347	2 171	2 238	620	887	1 497	1 284	1 358
Kiribati	418	174	135	150 F	175 F	200 F	232	...	...	203 F
Korea Rep	30	6	6	1	4	4	-	-	-	-
NewCaledonia	0	0	0	0	1	0	0	0	1	0
Vanuatu	250 F	250 F	250 F	250 F	250 F	250 F	250 F	250 F	250	250
71 Fishing area total	*2 181 F*	*1 794 F*	*2 060 F*	*2 810 F*	*3 510 F*	*1 995 F*	*2 182 F*	*2 416 F*	*2 230*	*2 510 F*
77 Cook Is	5 F	5 F	5 F	5	5 F	5	5 F	5 F	5 F	5 F
El Salvador	409	4 370	3 706	1 608	3 087	801	1 664	8	14	...
Guatemala	20 F	27	4	1	1	...	0	2	7	7
Mexico	-	-	2	1	-	-	...	...	...	...
Panama	2	3	5	2	6	2	1	5	1	1
Samoa	203 F	203 F	250 F	300 F	350 F	400	426	451	402	408 F
Tonga	270	337	386	400	450 F	450 F	500 F	450 F	403 F	401 F
77 Fishing area total	*909 F*	*4 945 F*	*4 358 F*	*2 317 F*	*3 899 F*	*1 658 F*	*2 596 F*	*921 F*	*832 F*	*822 F*

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Miscellaneous marine crustaceans
Crustacés marins divers
Crustáceos marinos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
81 Australia	295	260	299	535	480	491	473	381	292	356
81 Fishing area total	*295*	*260*	*299*	*535*	*480*	*491*	*473*	*381*	*292*	*356*
87 Chile	5	-	-	59	10	10	12	8	9	9
Peru	758	1 367	458	480	304	2 398	4 148	172	156	266
Spain	2	16	-	-	-	61	-	-	-	63
87 Fishing area total	*765*	*1 383*	*458*	*539*	*314*	*2 469*	*4 160*	*180*	*165*	*338*
Species total	*1 229 191 F*	*1 161 215 F*	*143 111 F*	*149 524 F*	*146 763 F*	*146 567 F*	*169 415 F*	*151 778 F*	*136 534 F*	*154 982 F*
Group total	***1 241 510***	***1 173 444***	***405 536***	***437 678***	***422 174***	***442 060***	***490 079***	***443 380***	***451 334***	***481 543***

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Freshwater molluscs
Mollusques d'eau douce
Moluscos de agua dulce

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Japanese corbicula	**Cyrène japonaise**		**Corbicula japonesa**		***Corbicula japonica***				**3,16(21)025,02**	**CMJ**
04 Japan	17 295	17 779	16 940	16 234	13 455	13 412	10 942	9 831	10 432	11 189 F
Korea Rep	-	-	798	...	626	...	141	292	362	704
04 Fishing area total	*17 295*	*17 779*	*17 738*	*16 234*	*14 081*	*13 412*	*11 083*	*10 123*	*10 794*	*11 893 F*
61 Russian Fed	74	209	50	170	145	313	546	282	495	445
61 Fishing area total	*74*	*209*	*50*	*170*	*145*	*313*	*546*	*282*	*495*	*445*
Species total	*17 369*	*17 988*	*17 788*	*16 404*	*14 226*	*13 725*	*11 629*	*10 405*	*11 289*	*12 338 F*
Freshwater molluscs nei	**Mollusques d'eau douce nca**		**Moluscos de agua dulce nep**		***Mollusca***				**3,99(XX)XXX,XX**	**MOF**
01 Egypt	845	1 190	1 845	1 760	2 142	2 262	1 990	1 947	1 692	1 671
Morocco	6	7	2	-	-	-	-	-	-	-
Senegal	...	...	...	...	...	...	...	70	50 F	...
Tunisia	-	-	-	-	131	177	...	...	...	...
01 Fishing area total	*851*	*1 197*	*1 847*	*1 760*	*2 273*	*2 439*	*1 990*	*2 017*	*1 742 F*	*1 671*
02 El Salvador	2	7	4	3	0	8	17	...	...	...
Mexico	1 027	1 045	1 145	1 109	1 099	1 148	1 038	1 651	1 723	1 657
USA	-	-	-	-	-	-	0	0	1	-
02 Fishing area total	*1 029*	*1 052*	*1 149*	*1 112*	*1 099*	*1 156*	*1 055*	*1 651*	*1 724*	*1 657*
04 China	461 001 F	478 455 F	310 241 F	297 681 F	287 548 F	295 364 F	298 518	268 267	284 331	286 980
India	-	-	1 610	1 610	-	-	8 915	669	492	892
Indonesia	2 312	1 120	1 029	1 533	1 056	2 249	885	967	1 461	674
Japan	583	338	444	563	740	1 202	1 488	1 336	4 698	3 266 F
Korea Rep	669	636	1 465	3 981	774	...	688	776	1 031	806
Philippines	68 958	52 571	49 832	53 191	56 718	63 314	61 775	62 781	60 722	60 898
Turkey	1 601	1 937	1 850	1 879	1 873	1 462	1 397	1 007	2 227	1 991
04 Fishing area total	*535 124 F*	*535 057 F*	*366 471 F*	*360 438 F*	*348 709 F*	*363 591 F*	*373 666*	*335 803*	*354 962*	*355 507 F*
05 Netherlands	-	451	...	...	-	-	-	-	-	-
05 Fishing area total	-	*451*	...	...	-	-	-	-	-	-
06 Fiji	5 300	3 300 F	1 052	2 527	2 500 F	2 530	1 500	1 500 F	1 500	1 500
06 Fishing area total	*5 300*	*3 300 F*	*1 052*	*2 527*	*2 500 F*	*2 530*	*1 500*	*1 500 F*	*1 500*	*1 500*
Species total	*542 304 F*	*541 057 F*	*370 519 F*	*365 837 F*	*354 581 F*	*369 716 F*	*378 211*	*340 971 F*	*359 928 F*	*360 335 F*
Group total	***559 673***	***559 045***	***388 307***	***382 241***	***368 807***	***383 441***	***389 840***	***351 376***	***371 217***	***372 673***

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Abalones, winkles, conchs
Ormeaux, bigorneaux, strombes
Orejas de mar, bígaros, estrombos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Common periwinkle	**Bigorneau**		**Bígaro**		***Littorina littorea***				**3,07(01)001,01**	**PEE**
27 Ireland	2 781	2 287	1 838	1 683	182	1 232	97	1 141	1 027	1 280
Portugal	-	-	-	-	-	2	88	69	69	60
27 Fishing area total	*2 781*	*2 287*	*1 838*	*1 683*	*182*	*1 234*	*185*	*1 210*	*1 096*	*1 340*
37 Spain	...	28	13	...	4	4	1	8	15	10
Tunisia	...	...	...	...	...	...	19	2	18	5
37 Fishing area total	*...*	*28*	*13*	*...*	*4*	*4*	*20*	*10*	*33*	*15*
Species total	*2 781*	*2 315*	*1 851*	*1 683*	*186*	*1 238*	*205*	*1 220*	*1 129*	*1 355*
Periwinkles nei	**Bigorneaux nca**		**Bígaros nep**		***Littorina spp***				**3,07(01)001,XX**	**PER**
21 Canada	92	24	79	114	130	115	21	12	14	13
St Pier Mq	-	1	0	0	-	-	-	-	-	-
USA	649	1 061	223	38	113	95	225	476	743	754
21 Fishing area total	*741*	*1 086*	*302*	*152*	*243*	*210*	*246*	*488*	*757*	*767*
27 Denmark	1	0	1	1	2	2	-	-	-	-
France	-	-	-	-	-	-	0	0	-	-
Norway	-	-	-	-	4	7	0	-	-	1
Spain	5	3	2	7	8	11	15	21	59	86
UK	760	271	288	36	113	185	78	65	81	104
27 Fishing area total	*766*	*274*	*291*	*44*	*127*	*205*	*93*	*86*	*140*	*191*
Species total	*1 507*	*1 360*	*593*	*196*	*370*	*415*	*339*	*574*	*897*	*958*
Murex	**Rochers**		**Murices**		***Murex spp***				**3,07(02)002,XX**	**MUE**
27 Portugal	87	71	44	47	45	53	40	31	33	36
27 Fishing area total	*87*	*71*	*44*	*47*	*45*	*53*	*40*	*31*	*33*	*36*
34 Senegal	2 080	1 617	2 083	3 090	5 628	2 035	3 020	3 657	2 364	1 415
34 Fishing area total	*2 080*	*1 617*	*2 083*	*3 090*	*5 628*	*2 035*	*3 020*	*3 657*	*2 364*	*1 415*
37 France	52	64	92	110	83	97	71	66	81	110
Spain	26	215	118	107	77	65	67	95	75	52
37 Fishing area total	*78*	*279*	*210*	*217*	*160*	*162*	*138*	*161*	*156*	*162*
Species total	*2 245*	*1 967*	*2 337*	*3 354*	*5 833*	*2 250*	*3 198*	*3 849*	*2 553*	*1 613*
Sea snails	**Escargots de mer**		**Caracoles de mar**		***Rapana spp***				**3,07(02)018,XX**	**RPN**
37 Bulgaria	3 353	698	325	2 428	511	2 773	4 310	2 872	2 214	4 831
Georgia	517	503	295	65	150 F	300 F	600	500 F	476 F	476 F
Romania	-	-	-	-	-	-	-	-	2	0
Russian Fed	224	56	62	62	122	21	2	3	2	2
Ukraine	400	93	154	182	171	201	251	138	191	230
37 Fishing area total	*4 494*	*1 350*	*836*	*2 737*	*954 F*	*3 295 F*	*5 163*	*3 513 F*	*2 885 F*	*5 539 F*
Species total	*4 494*	*1 350*	*836*	*2 737*	*954 F*	*3 295 F*	*5 163*	*3 513 F*	*2 885 F*	*5 539 F*
False abalone	**Rocher loco**		**Loco**		***Concholepas concholepas***				**3,07(02)023,01**	**SNE**
87 Chile	828	1 622	2 963	3 601	3 270	3 902	2 939	3 210	3 641	3 009
Peru	522	686	658	2 906	3 529	2 359	2 535	2 757	274	2 237
87 Fishing area total	*1 350*	*2 308*	*3 621*	*6 507*	*6 799*	*6 261*	*5 474*	*5 967*	*3 915*	*5 246*
Species total	*1 350*	*2 308*	*3 621*	*6 507*	*6 799*	*6 261*	*5 474*	*5 967*	*3 915*	*5 246*
Giant abalone	**Ormeau géant**		**Abulón gigante**		***Haliotis gigantea***				**3,07(03)001,09**	**ABG**
61 Japan	1 982	2 223	2 182	1 996	1 768	1 976	2 063	1 687	1 855	1 500 F
61 Fishing area total	*1 982*	*2 223*	*2 182*	*1 996*	*1 768*	*1 976*	*2 063*	*1 687*	*1 855*	*1 500 F*
Species total	*1 982*	*2 223*	*2 182*	*1 996*	*1 768*	*1 976*	*2 063*	*1 687*	*1 855*	*1 500 F*
Perlemoen abalone	**Ormeau de Mida**		**Oreja de mar**		***Haliotis midae***				**3,07(03)001,11**	**ABP**
47 South Africa	527	516	406	258	228	212	123	61	-	128
47 Fishing area total	*527*	*516*	*406*	*258*	*228*	*212*	*123*	*61*	-	*128*
Species total	*527*	*516*	*406*	*258*	*228*	*212*	*123*	*61*	-	*128*
Blacklip abalone	**Ormeau à lèvres noires**		**Oreja de mar de labios negros**		***Haliotis rubra***				**3,07(03)001,13**	**ABR**
57 Australia	5 304	5 524	4 830	5 336	5 405	4 882	4 880	4 713	4 858	4 452
57 Fishing area total	*5 304*	*5 524*	*4 830*	*5 336*	*5 405*	*4 882*	*4 880*	*4 713*	*4 858*	*4 452*
81 Australia	311	285	276	252	189	129	122	109	103	73
81 Fishing area total	*311*	*285*	*276*	*252*	*189*	*129*	*122*	*109*	*103*	*73*
Species total	*5 615*	*5 809*	*5 106*	*5 588*	*5 594*	*5 011*	*5 002*	*4 822*	*4 961*	*4 525*
Tuberculate abalone	**Ormeau tuberculeux**		**Oreja marina tuberculosa**		***Haliotis tuberculata***				**3,07(03)001,14**	**HLT**
27 Channel Is	2	3	2	-	-	1	1	-	1	1
France	60	19	22	28	39	24	30	27	29	42

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Abalones, winkles, conchs
Ormeaux, bigorneaux, strombes
Orejas de mar, bígaros, estrombos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
27 Fishing area total	*62*	*22*	*24*	*28*	*39*	*25*	*31*	*27*	*30*	*43*
Species total	*62*	*22*	*24*	*28*	*39*	*25*	*31*	*27*	*30*	*43*
Abalones nei	**Ormeaux nca**		**Orejas de mar nep**		***Haliotis spp***				**3,07(03)001,XX**	**ABX**
27 Ireland	-	-	-	-	-	5	-	-	-	-
27 Fishing area total	-	-	-	-	-	*5*	-	-	-	-
51 Oman	51	50	56	44	45	51	46	0	0	0
51 Fishing area total	*51*	*50*	*56*	*44*	*45*	*51*	*46*	*0*	*0*	*0*
61 China,Taiwan	1	-	4	-	-	-	-	-	-	-
Korea Rep	104	75	94	101	202	170	259	172	226	235
61 Fishing area total	*105*	*75*	*98*	*101*	*202*	*170*	*259*	*172*	*226*	*235*
67 USA	3	3	3	2	3	3	3	2	-	-
67 Fishing area total	*3*	*3*	*3*	*2*	*3*	*3*	*3*	*2*	-	-
71 Philippines	288	201	198	168	146	175	196	247	202	354
71 Fishing area total	*288*	*201*	*198*	*168*	*146*	*175*	*196*	*247*	*202*	*354*
77 Mexico	482	494	386	371	622	649	687	715	743	756
77 Fishing area total	*482*	*494*	*386*	*371*	*622*	*649*	*687*	*715*	*743*	*756*
81 New Zealand	1 064	1 090	1 051	996	1 043	952	1 132	932	979	1 115
81 Fishing area total	*1 064*	*1 090*	*1 051*	*996*	*1 043*	*952*	*1 132*	*932*	*979*	*1 115*
Species total	*1 993*	*1 913*	*1 792*	*1 682*	*2 061*	*2 005*	*2 323*	*2 068*	*2 150*	*2 460*
Commercial top	**Trocha nacrier**		**...C**		***Trochus niloticus***				**3,07(04)006,03**	**RQN**
57 Indonesia	...	...	...	888	888	932	0	0	0	86
57 Fishing area total	...	...	...	*888*	*888*	*932*	*0*	*0*	*0*	*86*
71 Indonesia	...	...	...	271	225	794	565	111	112	527
71 Fishing area total	...	...	...	*271*	*225*	*794*	*565*	*111*	*112*	*527*
Species total	...	...	...	*1 159*	*1 113*	*1 726*	*565*	*111*	*112*	*613*
Horned turban	**Troque**		**Peonza cornuda**		***Turbo cornutus***				**3,07(05)002,02**	**TOS**
61 Japan	10 241	9 504	8 656	8 822	8 384	7 911	8 456	7 880	7 556	7 200 F
Korea Rep	6 274	7 193	14 065	9 507	8 498	7 496	6 909	3 055	2 534	3 018
61 Fishing area total	*16 515*	*16 697*	*22 721*	*18 329*	*16 882*	*15 407*	*15 365*	*10 935*	*10 090*	*10 218 F*
Species total	*16 515*	*16 697*	*22 721*	*18 329*	*16 882*	*15 407*	*15 365*	*10 935*	*10 090*	*10 218 F*
Stromboid conchs nei	**Strombes nca**		**Cobos nep**		***Strombus spp***				**3,07(06)002,XX**	**CON**
31 Anguilla	75 F	75 F	75 F	75 F	75 F	75 F	75 F	67	217	277
Antigua Barb	278	319	469	554	528	494	517	1 357	758	764
Bahamas	661	523	620	578	682	851	379	858	724	703
Belize	1 980	1 380	1 770	2 101	2 136	2 336	1 969	1 861	2 303	2 205
Br Virgin Is	11	10	11	9	9 F	9 F	7 F	5 F	5 F	5 F
Colombia	555	563	360	195	38	180 F	330 F	480 F	638	15
Cuba	1 172	997	372	552	644	326	574	401	534	506
Dominican Rp	1 437	2 685	1 654	1 207	1 473	996	1 328	1 634	2 278	256
Grenada	2	32	35	29	16	2	28	3	2	1
Guadeloupe	550	550	550	550	550	550	550	550	550 F	550 F
Guatemala	...	...	...	...	...	1	...	...	...	...
Haiti	300 F	350 F	300 F	300	300 F	300 F	300 F	300 F	300 F	300 F
Honduras	5 550	6 000	7 515	668	-	1 575	435	...	1 572	1 575
Jamaica	7 095	-	3 780	4 125	4 800	4 875 F	4 800	3 000	3 000	3 300
Mexico	8 730	6 293	6 994	6 726	6 342	6 622	...	...	...	...
NethAntilles	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F
Nicaragua	476	200	407	395	598	1 043	580	1 076	1 894	3 108
Puerto Rico	1 643	931	1 141	1 203	1 329	1 005	829	829	803	915
St Kitts Nev	71	36	68 F	101	100 F	99 F	98 F	97 F	96 F	95
St Lucia	41	60	48	46	42	35	41	40	34	28
St Vincent	278	300	68	120	53	30	30	30	128	293
Turks Caicos	6 127	5 440	4 915	5 399	5 103	5 589	4 392	5 693	6 569	5 286
US Virgin Is	200 F	300 F	493	589	480	787	436	327	359	254
31 Fishing area total	*37 237 F*	*27 049 F*	*31 650 F*	*25 527 F*	*25 303 F*	*27 785 F*	*17 703 F*	*18 613 F*	*22 769 F*	*20 441 F*
77 Costa Rica	-	-	-	4	0	0	0	-	-	-
Mexico	2 667	2 732	2 137	2 055	1 906	1 991	...	...	...	...
Nicaragua	-	-	-	-	-	3	0	...	...	...
Panama	1	12	7	1	1	-	3	...	5	...
77 Fishing area total	*2 668*	*2 744*	*2 144*	*2 060*	*1 907*	*1 994*	*3*	*...*	*5*	*...*
87 Ecuador	10	...	...	...	...	...	...	...	...	...
87 Fishing area total	*10*	...	...	...	...	...	...	...	...	...
Species total	*39 915 F*	*29 793 F*	*33 794 F*	*27 587 F*	*27 210 F*	*29 779 F*	*17 706 F*	*18 613 F*	*22 774 F*	*20 441 F*
Whelk	**Buccin**		**Bocina**		***Buccinum undatum***				**3,07(08)001,01**	**WHE**
27 Belgium	119	92	111	128	142	122	99	103	101	118

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Abalones, winkles, conchs
Ormeaux, bigorneaux, strombes
Orejas de mar, bígaros, estrombos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Channel Is	519	204	134	147	442	621	545	298	107	500
Denmark	-	1	1	0	1	33	-	0	-	-
Faroe Is	-	-	-	133	391	494	180	-	-	91
France	11 030	11 985	12 767	13 642	11 395	12 449	12 536	12 066	10 631	13 839
Iceland	678	-	248	863	991	832	554	398	116	142
Ireland	6 364	7 901	8 752	7 560	717	3 124	2 093	1 871	2 198	2 976
Isle of Man	2	62	60	176	195	146	275	136	140	140
Netherlands	163	178	268	255	325	255	142	96	107	87
Norway	-	-	-	-	72	50	23	73	41	16
Spain	-	4	2	16	8	1	0	-	-	-
UK	11 270	8 669	9 441	12 222	11 463	12 254	13 062	13 786	13 058	14 515
27 Fishing area total	*30 145*	*29 096*	*31 784*	*35 142*	*26 142*	*30 381*	*29 509*	*28 827*	*26 499*	*32 424*
Species total	*30 145*	*29 096*	*31 784*	*35 142*	*26 142*	*30 381*	*29 509*	*28 827*	*26 499*	*32 424*
Spiral babylon	**Buccin spiral**		**...C**		***Babylonia spirata***				**3,07(08)006,03**	**YJS**
51 Pakistan	...	...	...	555	377	731	662	674	625	568
51 Fishing area total	*...*	*...*	*...*	*555*	*377*	*731*	*662*	*674*	*625*	*568*
Species total	*...*	*...*	*...*	*555*	*377*	*731*	*662*	*674*	*625*	*568*
Whelks	**Busycons**		**Busicones**		***Busycon spp***				**3,07(09)003,XX**	**WHX**
21 Canada	2 041	2 218	2 579	2 805	3 780	5 792	5 290	7 219	6 501	7 013
USA	3 557	2 917	3 458	1 887	2 399	3 008	2 842	2 999	3 946	6 232
21 Fishing area total	*5 598*	*5 135*	*6 037*	*4 692*	*6 179*	*8 800*	*8 132*	*10 218*	*10 447*	*13 245*
Species total	*5 598*	*5 135*	*6 037*	*4 692*	*6 179*	*8 800*	*8 132*	*10 218*	*10 447*	*13 245*
Helmet ton	**Tonne cannelée**		**Caracol tonel**		***Tonna galea***				**3,07(23)002,01**	**TOQ**
41 Uruguay	...	...	475	0	0	0	0	0	109	...
41 Fishing area total	*...*	*...*	*475*	*0*	*0*	*0*	*0*	*0*	*109*	*...*
Species total	*...*	*...*	*475*	*0*	*0*	*0*	*0*	*0*	*109*	*...*
Pig's snout volute	**Volute trompe de cochon**		**Voluta trompa de cerdo**		***Cymbium cymbium***				**3,07(42)004,01**	**YBC**
34 Mauritania	...	...	...	...	...	...	...	...	...	1 007
34 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1 007*
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*1 007*
Volutes nei	**Volutes nca**		**Volutas nep**		***Cymbium spp***				**3,07(42)004,XX**	**CXY**
34 Senegal	5 422	4 347	3 609	5 730	5 975	6 938	7 353	10 184	13 849	11 602
34 Fishing area total	*5 422*	*4 347*	*3 609*	*5 730*	*5 975*	*6 938*	*7 353*	*10 184*	*13 849*	*11 602*
Species total	*5 422*	*4 347*	*3 609*	*5 730*	*5 975*	*6 938*	*7 353*	*10 184*	*13 849*	*11 602*
Angulate volute	**Volute angulée**		**Voluta angulosa**		***Zidona dufresnei***				**3,07(42)007,01**	**ZDF**
41 Argentina	694	414	496	401	352	401	238	215	104	257
Uruguay	825	900	794	569	449	145	236	233	0	255
41 Fishing area total	*1 519*	*1 314*	*1 290*	*970*	*801*	*546*	*474*	*448*	*104*	*512*
Species total	*1 519*	*1 314*	*1 290*	*970*	*801*	*546*	*474*	*448*	*104*	*512*
Gastropods nei	**Gastropodes nca**		**Gasterópodos nep**		***Gastropoda***				**3,07(XX)XXX,XX**	**GAS**
27 France	-	-	-	-	-	-	0	0	3	6
Portugal	59	48	34	35	29	32	34	41	48	48
27 Fishing area total	*59*	*48*	*34*	*35*	*29*	*32*	*34*	*41*	*51*	*54*
31 Mexico	...	...	...	...	67	70	5 994	3 014	2 326	4 533
USA	480	153	146	31	30	31	21	28	75	56
31 Fishing area total	*480*	*153*	*146*	*31*	*97*	*101*	*6 015*	*3 042*	*2 401*	*4 589*
34 Gambia	20	1	14	...	15	106	685	592	633	...
Nigeria	2 084	2 426	2 741	2 913	2 822	2 475	2 866	2 671	3 020	3 415
Portugal	42	61	54	58	72	88	0	-	19	-
Senegal	11	4	4	5	6	12	0	0	0	61
Spain	-	115	-	0	-	1	4	14	21	17
34 Fishing area total	*2 157*	*2 607*	*2 813*	*2 976*	*2 915*	*2 682*	*3 555*	*3 277*	*3 693*	*3 493*
37 France	19	26	22	57	33	25	34	37	70	72
Italy	...	...	...	...	5 068	5 242	4 501	3 609	3 826	3 653
Spain	825	559	367	291	296	293	264	269	281	277
37 Fishing area total	*844*	*585*	*389*	*348*	*5 397*	*5 560*	*4 799*	*3 915*	*4 177*	*4 002*
58 Australia	-	-	-	0	0	0	0	-	0	-
58 Fishing area total	*-*	*-*	*-*	*0*	*0*	*0*	*0*	*-*	*0*	*-*
61 China,Taiwan	53	-	2	17	14	25	20	10	14	13
Korea Rep	730	1 555	2 600	2 101	1 696	1 434	1 639	6 936	7 102	7 242
Russian Fed	-	-	-	-	-	-	-	-	-	50
61 Fishing area total	*783*	*1 555*	*2 602*	*2 118*	*1 710*	*1 459*	*1 659*	*6 946*	*7 116*	*7 305*

B-52

Abalones, winkles, conchs
Ormeaux, bigorneaux, strombes
Orejas de mar, bígaros, estrombos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
67 USA	1	4	-	-	-	-	-	-	1	-
67 Fishing area total	*1*	*4*	-	-	-	-	-	-	*1*	-
77 Mexico	...	...	...	...	1 717	1 793	3 297	3 168	2 038	3 008
Panama	55	83	84	18	17	12	7	...	32	53
USA	25	47	63	49	65	109	101	96	128	108
77 Fishing area total	*80*	*130*	*147*	*67*	*1 799*	*1 914*	*3 405*	*3 264*	*2 198*	*3 169*
81 New Zealand	1	15	20	3	7	0	1	9	1	23
81 Fishing area total	*1*	*15*	*20*	*3*	*7*	*0*	*1*	*9*	*1*	*23*
87 Chile	5 429	5 122	5 335	16 090	5 340	3 042	3 859	3 352	3 180	3 136
Colombia	5	9	1	4	1	3 F	5 F	7 F	9	...
Peru	4 995	2 349	2 369	2 507	3 124	3 695	2 838	4 061	3 308	2 389
87 Fishing area total	*10 429*	*7 480*	*7 705*	*18 601*	*8 465*	*6 740 F*	*6 702 F*	*7 420 F*	*6 497*	*5 525*
Species total	*14 834*	*12 577*	*13 856*	*24 179*	*20 419*	*18 488 F*	*26 170 F*	*27 914 F*	*26 135*	*28 160*
Group total	***136 504***	***118 742***	***132 314***	***142 372***	***128 930***	***135 484***	***129 857***	***131 712***	***131 119***	***142 157***

B-53 **Oysters** **Huîtres** **Ostras**

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Chilean flat oyster	**Huître plate chilienne**		**Ostra chilena**		***Ostrea chilensis***				**3,16(07)002,03**	**OCH**
87 Chile	202	7	2	13	6	8	4	3	20	14
87 Fishing area total	*202*	*7*	*2*	*13*	*6*	*8*	*4*	*3*	*20*	*14*
Species total	*202*	*7*	*2*	*13*	*6*	*8*	*4*	*3*	*20*	*14*
European flat oyster	**Huître plate européenne**		**Ostra europea**		***Ostrea edulis***				**3,16(07)002,05**	**OYF**
27 Denmark	23	528	877	896	942	911	1 212	1 490	1 172	1 050
France	130	192	94	97	79	112	163	119	374	217
Ireland	...	...	548	1 225	...	433	641	138	87	169
Norway	5	-	-	1	-	-	-	-	-	-
Portugal	-	-	-	-	2	1	0	-	-	-
Spain	37	59	10	11	25	38	8	12	20	12
Sweden	1	2	6	2	2	0	1	16	13	10
UK	611	586	653	523	734	661	656	323	218	206
27 Fishing area total	*807*	*1 367*	*2 188*	*2 755*	*1 784*	*2 156*	*2 681*	*2 098*	*1 884*	*1 664*
37 Croatia	24	5	12	9	8	62	55	16	7	8
France	2	1	-	1	-	0	-	-	-	-
Greece	120	72	41	23	8	46	122	13	20	20 F
Serbia-Monte	0	0	0	0	...	-	-	-	-	-
Slovenia	0	0	-	-	-	-	-	0	-	-
Spain	-	-	-	-	0	0	0	-	-	0
Tunisia	1	8	8	8	10	2	5	12	10	...
Turkey	10	70	120	130	105	31	31	13	-	1
37 Fishing area total	*157*	*156*	*181*	*171*	*131*	*141*	*213*	*54*	*37*	*29 F*
Species total	*964*	*1 523*	*2 369*	*2 926*	*1 915*	*2 297*	*2 894*	*2 152*	*1 921*	*1 693 F*
New Zealand dredge oyster	**Huître plate néo-zélandaise**		**Ostra de Nueva Zelandia**		***Ostrea lutaria***				**3,16(07)002,20**	**DRY**
81 New Zealand	832	816	852	465	546	518	512	434	107	980
81 Fishing area total	*832*	*816*	*852*	*465*	*546*	*518*	*512*	*434*	*107*	*980*
Species total	*832*	*816*	*852*	*465*	*546*	*518*	*512*	*434*	*107*	*980*
Pacific cupped oyster	**Huître creuse du Pacifique**		**Ostión japonés**		***Crassostrea gigas***				**3,16(07)008,01**	**OYG**
27 France	63	10	23	4	6	30	63	65	41	37
Portugal	-	-	2	-	9	-	21	49	38	68
Spain	9	-	-	-	-	-	-	-	-	60
UK	20	5	95	5	2	8	20	20	50	42
27 Fishing area total	*92*	*15*	*120*	*9*	*17*	*38*	*104*	*134*	*129*	*207*
61 China,Taiwan	4	-	-	-	-	-	-	-	-	-
Korea Rep	10 056	7 950	20 201	25 690	27 320	31 016	29 316	29 185	24 254	22 686
61 Fishing area total	*10 060*	*7 950*	*20 201*	*25 690*	*27 320*	*31 016*	*29 316*	*29 185*	*24 254*	*22 686*
67 USA	...	...	...	...	...	...	...	...	...	6 326
67 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*6 326*
77 USA	1 083	1 083	1 225	1 527	1 283	8 344	5 187	2 235	2 370	1 233
77 Fishing area total	*1 083*	*1 083*	*1 225*	*1 527*	*1 283*	*8 344*	*5 187*	*2 235*	*2 370*	*1 233*
81 New Zealand	0	-	-	0	0	-	-	...	...	...
81 Fishing area total	*0*	-	-	*0*	*0*	-	-	*...*	*...*	*...*
87 Ecuador	5	...	...	...	...	...	...	...	...	...
87 Fishing area total	*5*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*
Species total	*11 240*	*9 048*	*21 546*	*27 226*	*28 620*	*39 398*	*34 607*	*31 554*	*26 753*	*30 452*
Mangrove cupped oyster	**Huître creuse des Caraïbes**		**Ostión de mangle**		***Crassostrea rhizophorae***				**3,16(07)008,02**	**OYM**
31 Colombia	-	15	12	20	59	50 F	35 F	20 F	7	7
Dominican Rp	8	129	40	13	12	35	...	36	20	...
Venezuela	3 754	800	2 252	3 560 F	1 900 F	1 120 F	1 370 F	1 550 F	1 500 F	1 500 F
31 Fishing area total	*3 762*	*944*	*2 304*	*3 593 F*	*1 971 F*	*1 205 F*	*1 405 F*	*1 606 F*	*1 527 F*	*1 507 F*
Species total	*3 762*	*944*	*2 304*	*3 593 F*	*1 971 F*	*1 205 F*	*1 405 F*	*1 606 F*	*1 527 F*	*1 507 F*
American cupped oyster	**Huître creuse américaine**		**Ostión virgínico**		***Crassostrea virginica***				**3,16(07)008,03**	**OYA**
21 Canada	3 009	2 410	1 470	4 255	3 245	2 405	2 355	1 684	2 168	1 789
USA	15 548	10 807	9 760	8 878	10 406	10 390	12 069	11 119	9 744	10 906
21 Fishing area total	*18 557*	*13 217*	*11 230*	*13 133*	*13 651*	*12 795*	*14 424*	*12 803*	*11 912*	*12 695*
31 Mexico	48 570	47 570	45 330	45 041	39 894	42 902	45 948	40 472	36 858	46 664
USA	107 915	98 381	108 548	54 615	71 552	36 487	49 145	37 672	47 371	...
31 Fishing area total	*156 485*	*145 951*	*153 878*	*99 656*	*111 446*	*79 389*	*95 093*	*78 144*	*84 229*	*46 664*
Species total	*175 042*	*159 168*	*165 108*	*112 789*	*125 097*	*92 184*	*109 517*	*90 947*	*96 141*	*59 359*
Slipper cupped oyster	**Huître creuse chausson**		**...C**		***Crassostrea iredalei***				**3,16(07)008,11**	**CSI**
71 Philippines	96	86	86	78	74	84	88	101	85	119
71 Fishing area total	*96*	*86*	*86*	*78*	*74*	*84*	*88*	*101*	*85*	*119*

B-53 **Oysters**
Huîtres
Ostras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*96*	*86*	*86*	*78*	*74*	*84*	*88*	*101*	*85*	*119*
Cupped oysters nei	**Huîtres creuses nca**		**Ostiones nep**			***Crassostrea spp***			**3,16(07)008,XX**	**OYC**
21 USA	14	19	2	1	0	1	8	42	3	1
21 Fishing area total	*14*	*19*	*2*	*1*	*0*	*1*	*8*	*42*	*3*	*1*
27 Ireland	-	-	-	-	-	-	192	2 118	3 005	5 776
UK	-	-	-	-	-	-	-	-	2	-
27 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*192*	*2 118*	*3 007*	*5 776*
34 Senegal	151	120	129	82	164	43	104	126	116	242
34 Fishing area total	*151*	*120*	*129*	*82*	*164*	*43*	*104*	*126*	*116*	*242*
41 Brazil	895	874	647	1 076	1 368	1 406	800	1 174	1 295	1 223
41 Fishing area total	*895*	*874*	*647*	*1 076*	*1 368*	*1 406*	*800*	*1 174*	*1 295*	*1 223*
47 South Africa	-	36	...	30	24	...	20	16	17	17
47 Fishing area total	*-*	*36*	*...*	*30*	*24*	*...*	*20*	*16*	*17*	*17*
51 Kenya	1	1	1	0	28	38	11	33	23	33
South Africa	-	-	-	-	-	-	5	3	5	5
51 Fishing area total	*1*	*1*	*1*	*0*	*28*	*38*	*16*	*36*	*28*	*38*
57 Indonesia	298	82	127	64	178	370	338	1	23	22
57 Fishing area total	*298*	*82*	*127*	*64*	*178*	*370*	*338*	*1*	*23*	*22*
61 Russian Fed	3	1	-	-	-	8	-	-	2	39
61 Fishing area total	*3*	*1*	*-*	*-*	*-*	*8*	*-*	*-*	*2*	*39*
67 USA	12	8	17	36	131	163	71	307	234	65
67 Fishing area total	*12*	*8*	*17*	*36*	*131*	*163*	*71*	*307*	*234*	*65*
71 Indonesia	896	116	118	130	683	199	271	289	439	281
71 Fishing area total	*896*	*116*	*118*	*130*	*683*	*199*	*271*	*289*	*439*	*281*
77 Mexico	2 234	2 218	1 790	1 721	1 505	1 571	2 209	1 090	1 029	2 157
77 Fishing area total	*2 234*	*2 218*	*1 790*	*1 721*	*1 505*	*1 571*	*2 209*	*1 090*	*1 029*	*2 157*
Species total	*4 504*	*3 475*	*2 831*	*3 140*	*4 081*	*3 799*	*4 029*	*5 199*	*6 193*	*9 861*
Olympia oyster	**Huître plate Olympie**		**Ostra Olimpia**			***Ostreola conchaphila***			**3,16(07)011,02**	**OYH**
67 USA	8	11	8	7	29	71	1	0	4	0
67 Fishing area total	*8*	*11*	*8*	*7*	*29*	*71*	*1*	*0*	*4*	*0*
Species total	*8*	*11*	*8*	*7*	*29*	*71*	*1*	*0*	*4*	*0*
Group total	***196 650***	***175 078***	***195 106***	***150 237***	***162 339***	***139 564***	***153 057***	***131 996***	***132 751***	***103 985***

B-54 **Mussels**
Moules
Mejillones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Korean mussel	**Moule coréenne**		**Mejillón coreano**		***Mytilus coruscus***				**3,16(10)001,01**	**MUK**
61 Korea Rep	1 085	946	817	588	724	1 184	1 620	2 448	3 399	3 271
61 Fishing area total	*1 085*	*946*	*817*	*588*	*724*	*1 184*	*1 620*	*2 448*	*3 399*	*3 271*
Species total	*1 085*	*946*	*817*	*588*	*724*	*1 184*	*1 620*	*2 448*	*3 399*	*3 271*
Chilean mussel	**Moule chilienne**		**Chorito**		***Mytilus chilensis***				**3,16(10)001,03**	**MYC**
41 Falkland Is	-	-	-	-	1	0	1	0	-	-
41 Fishing area total	-	-	-	-	*1*	*0*	*1*	*0*	-	-
87 Chile	6 758	1 416	2 899	1 046	335	217	8 048	476	293	354
87 Fishing area total	*6 758*	*1 416*	*2 899*	*1 046*	*335*	*217*	*8 048*	*476*	*293*	*354*
Species total	*6 758*	*1 416*	*2 899*	*1 046*	*336*	*217*	*8 049*	*476*	*293*	*354*
Blue mussel	**Moule commune**		**Mejillón común**		***Mytilus edulis***				**3,16(10)001,05**	**MUS**
21 Canada	348	344	205	213	218	151	318	127	34	33
St Pier Mq	0	0	0	0	-	-	-	-	-	-
USA	6 524	9 862	9 091	10 359	9 618	8 396	7 328	8 551	12 807	14 981
21 Fishing area total	*6 872*	*10 206*	*9 296*	*10 572*	*9 836*	*8 547*	*7 646*	*8 678*	*12 841*	*15 014*
27 Denmark	122 487	110 873	92 523	99 500	69 155	54 808	57 335	35 082	37 447	27 872
France	7 497	4 299	1 396	1 443	5 071	6 025	3 238	3 137	2 402	1 083
Iceland	-	-	-	-	-	-	-	3	-	79
Ireland	-	-	813	...	5 092	733	733	740	...	765
Norway	-	-	-	-	-	-	0	-	-	-
Portugal	74	165	1 422	104	9	12	21	53	37	32
Spain	33	66	12	19	27	7	38	8	124	58
Sweden	51	86	70	101	112	107	51	13	11	52
UK	14 905	16 738	3 103	12 102	11 158	10 376	4 649	8 602	3 451	5 193
27 Fishing area total	*145 047*	*132 227*	*99 339*	*113 269*	*90 624*	*72 068*	*66 065*	*47 638*	*43 472*	*35 134*
Species total	*151 919*	*142 433*	*108 635*	*123 841*	*100 460*	*80 615*	*73 711*	*56 316*	*56 313*	*50 148*
River Plata mussel	**Moule de la Plata**		**Mejillón del Plata**		***Mytilus platensis***				**3,16(10)001,08**	**MSR**
41 Argentina	217	344	-	5	1	0	1	110	0	35
Uruguay	306	96	58	126	83	81	18	32	33	46
41 Fishing area total	*523*	*440*	*58*	*131*	*84*	*81*	*19*	*142*	*33*	*81*
Species total	*523*	*440*	*58*	*131*	*84*	*81*	*19*	*142*	*33*	*81*
Mediterranean mussel	**Moule méditerranéenne**		**Mejillón mediterráneo**		***Mytilus galloprovincialis***				**3,16(10)001,12**	**MSM**
37 Albania	-	50	...	...	...	...	...	...	...	...
Bulgaria	7	55	15	34	10	10	83	35	45	0
Croatia	32	45	36	56	12	15	13	19	26	27
France	12	4	4	4	-	-	-	-	10	77
Greece	254	182	77	300	165	223	474	289	708	708 F
Italy	44 160 F	46 030	42 736	35 065	...	...	...	...	...	...
Romania	-	-	-	-	-	-	14	0	1	1
Russian Fed	-	-	1	9	2	-	-	-	-	-
Slovenia	0	0	-	-	-	-	-	-	-	-
Spain	24	11	4	-	3	3	0	-	129	165
Tunisia	...	...	...	...	...	...	217	117	142	...
Turkey	1 500	5 000	8 100	5 734	12 362	9 234	1 566	343	6 272	989
Ukraine	71	75	71	62	84	217	236	311	689	440
37 Fishing area total	*46 060 F*	*51 452*	*51 044*	*41 264*	*12 638*	*9 702*	*2 603*	*1 114*	*8 022*	*2 407 F*
Species total	*46 060 F*	*51 452*	*51 044*	*41 264*	*12 638*	*9 702*	*2 603*	*1 114*	*8 022*	*2 407 F*
Australian mussel	**Moule d'Australie**		**Mejillón de Australia**		***Mytilus planulatus***				**3,16(10)001,17**	**MYA**
81 Australia	3	2	1	0	0	0	-	-	-	-
81 Fishing area total	*3*	*2*	*1*	*0*	*0*	*0*	-	-	-	-
Species total	*3*	*2*	*1*	*0*	*0*	*0*	-	-	-	-
Choro mussel	**Moule choro**		**Choro**		***Choromytilus chorus***				**3,16(10)026,01**	**CHC**
87 Chile	166	91	126	142	47	66	67	152	212	559
87 Fishing area total	*166*	*91*	*126*	*142*	*47*	*66*	*67*	*152*	*212*	*559*
Species total	*166*	*91*	*126*	*142*	*47*	*66*	*67*	*152*	*212*	*559*
Horse mussels nei	**Modioles nca**		**Mejillónes Modiolus nep**		***Modiolus spp***				**3,16(10)028,XX**	**MOD**
27 Norway	2	12	7	8	5	0	-	0	0	-
27 Fishing area total	*2*	*12*	*7*	*8*	*5*	*0*	-	*0*	*0*	-
57 Thailand	293	267	24	0	30	-	-	-	-	-
57 Fishing area total	*293*	*267*	*24*	*0*	*30*	-	-	-	-	-
71 Thailand	94	-	-	-	-	-	-	-	-	1
71 Fishing area total	*94*	-	-	-	-	-	-	-	-	*1*

B-54

Mussels
Moules
Mejillones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*389*	*279*	*31*	*8*	*35*	*0*	-	*0*	*0*	*1*
South American rock mussel	**Moule de roche sudaméricaine**		**Mejillón de roca sudamericano**		***Perna perna***				**3,16(10)032,01**	**MSL**
31 Venezuela	1 081	1 272	2 712	4 280 F	2 300 F	1 360 F	1 660 F	1 900 F	1 830 F	1 830 F
31 Fishing area total	*1 081*	*1 272*	*2 712*	*4 280 F*	*2 300 F*	*1 360 F*	*1 660 F*	*1 900 F*	*1 830 F*	*1 830 F*
Species total	*1 081*	*1 272*	*2 712*	*4 280 F*	*2 300 F*	*1 360 F*	*1 660 F*	*1 900 F*	*1 830 F*	*1 830 F*
Green mussel	**Moule verte asiatique**		**Mejillón verde**		***Perna viridis***				**3,16(10)032,02**	**MSV**
57 Indonesia	...	...	...	4	4	313	9	7	4	20
57 Fishing area total	*...*	*...*	*...*	*4*	*4*	*313*	*9*	*7*	*4*	*20*
71 Indonesia	...	...	...	...	1	1 202	411	7	26	427
Philippines	20	27	30	31	31	32	29	28	29	29
71 Fishing area total	*20*	*27*	*30*	*31*	*32*	*1 234*	*440*	*35*	*55*	*456*
Species total	*20*	*27*	*30*	*35*	*36*	*1 547*	*449*	*42*	*59*	*476*
Cholga mussel	**Moule cholga**		**Cholga**		***Aulacomya ater***				**3,16(10)038,01**	**MSC**
41 Argentina	-	-	-	-	-	-	-	88	...	4
41 Fishing area total	-	-	-	-	-	-	-	*88*	*...*	*4*
87 Chile	7 884	3 775	3 188	2 027	1 678	3 138	3 285	3 967	907	3 638
Peru	14 700	15 658	10 408	9 619	9 006	5 253	8 769	8 894	11 072	9 022
87 Fishing area total	*22 584*	*19 433*	*13 596*	*11 646*	*10 684*	*8 391*	*12 054*	*12 861*	*11 979*	*12 660*
Species total	*22 584*	*19 433*	*13 596*	*11 646*	*10 684*	*8 391*	*12 054*	*12 949*	*11 979*	*12 664*
Sea mussels nei	**Moules nca**		**Mejillones nep**		***Mytilidae***				**3,16(10)XXX,XX**	**MSX**
27 France	1 110	-	-	-	-	1	34	34	-	-
Russian Fed	26	2	-	-	-	-	-	-	-	-
27 Fishing area total	*1 136*	*2*	-	-	-	*1*	*34*	*34*	-	-
41 Brazil	926	651	1 137	1 400	2 654	2 338	1 348	5 616	6 194	2 116
41 Fishing area total	*926*	*651*	*1 137*	*1 400*	*2 654*	*2 338*	*1 348*	*5 616*	*6 194*	*2 116*
61 Korea Rep	3 828	3 500	2 443	2 471	3 453	5 409	7 897	5 489	7 368	10 224
Russian Fed	42	33	15	17	14	37	38	50	41	60
61 Fishing area total	*3 870*	*3 533*	*2 458*	*2 488*	*3 467*	*5 446*	*7 935*	*5 539*	*7 409*	*10 284*
67 USA	448	251	252	488	913	1 405	719	1 010	1 031	1 069
67 Fishing area total	*448*	*251*	*252*	*488*	*913*	*1 405*	*719*	*1 010*	*1 031*	*1 069*
77 Mexico	733	691	562	445	1 442	1 506	4 274	2 858	2 443	3 511
USA	90	91	88	185	185	1	0	0	0	19
77 Fishing area total	*823*	*782*	*650*	*630*	*1 627*	*1 507*	*4 274*	*2 858*	*2 443*	*3 530*
81 New Zealand	2 270	1 725	2 147	1 353	486	403	200	182	152	153
81 Fishing area total	*2 270*	*1 725*	*2 147*	*1 353*	*486*	*403*	*200*	*182*	*152*	*153*
87 Ecuador	5	...	...	...	...	...	...	...	...	...
87 Fishing area total	*5*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*
Species total	*9 478*	*6 944*	*6 644*	*6 359*	*9 147*	*11 100*	*14 510*	*15 239*	*17 229*	*17 152*
Group total	***240 066***	***224 735***	***186 593***	***189 340***	***136 491***	***114 263***	***114 742***	***90 778***	***99 369***	***88 943***

B-55 **Scallops, pectens**
Coquilles St-Jacques
Vieiras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Queen scallop	**Vanneau**		**Volandeira**		***Aequipecten opercularis***				**3,16(08)001,05**	**QSC**
27 Faroe Is	4 053	2 366	3 659	4 055	4 512	5 237	4 970	2 851	3 115	4 771
France	5 989	4 260	4 275	2 978	4 058	4 614	5 905	3 282	1 266	3 937
Ireland	13	58	39	110	75	172	26	4	3	0
Isle of Man	1 749	1 655	1 426	859	1 133	448	2 028	858	1 473	2 817
Portugal	-	1	-	-	-	0	-	-	-	-
UK	8 660	10 774	7 317	5 094	3 856	5 056	5 661	4 659	6 843	13 082
27 Fishing area total	*20 464*	*19 114*	*16 716*	*13 096*	*13 634*	*15 527*	*18 590*	*11 654*	*12 700*	*24 607*
Species total	*20 464*	*19 114*	*16 716*	*13 096*	*13 634*	*15 527*	*18 590*	*11 654*	*12 700*	*24 607*
Great Atlantic scallop	**Coquille St-Jacques atlantique**		**Vieira(=Concha de Santiago)**		***Pecten maximus***				**3,16(08)003,09**	**SCE**
27 Belgium	340	432	521	530	485	534	634	674	886	1 037
Channel Is	439	463	399	306	337	427	480	431	413	516
France	16 454	20 103	18 990	23 328	26 944	26 874	26 628	24 104	25 078	26 887
Ireland	1 413	1 140	1 719	1 715	1 196	694	901	1 117	2 641	1 975
Isle of Man	1 115	977	1 073	1 106	1 016	152	1 149	1 453	1 578	1 316
Netherlands	274	473	536	612	702	781	757	781	754	315
Norway	670	575	504	679	681	799	866	899	748	748
Portugal	1	-	-	-	-	0	-	-	-	-
Spain	84	223	176	151	135	105	226	150	124	150
UK	9 796	9 171	10 056	20 843	17 794	19 294	20 822	23 143	27 606	30 780
27 Fishing area total	*30 586*	*33 557*	*33 974*	*49 270*	*49 290*	*49 660*	*52 463*	*52 752*	*59 828*	*63 724*
37 France	4	6	2	7	8	2	3	...	3	1
37 Fishing area total	*4*	*6*	*2*	*7*	*8*	*2*	*3*	*...*	*3*	*1*
Species total	*30 590*	*33 563*	*33 976*	*49 277*	*49 298*	*49 662*	*52 466*	*52 752*	*59 831*	*63 725*
Great Mediterranean scallop	**Coquille St-Jacques méditerr.**		**Concha de peregrino**		***Pecten jacobaeus***				**3,16(08)003,11**	**SJA**
37 Croatia	...	...	...	...	...	...	...	...	20	17
France	-	-	-	-	-	-	-	-	-	1
Italy	...	...	...	...	78	94	49	47	136	71
Turkey	150	470	1 300	1 576	259	30	-	-	-	4
37 Fishing area total	*150*	*470*	*1 300*	*1 576*	*337*	*124*	*49*	*47*	*156*	*93*
Species total	*150*	*470*	*1 300*	*1 576*	*337*	*124*	*49*	*47*	*156*	*93*
New Zealand scallop	**Pecten de Nouvelle-Zélande**		**Vieira de Nueva Zelandia**		***Pecten novaezelandiae***				**3,16(08)003,13**	**SCZ**
81 New Zealand	6 792	4 408	2 456	1 896	2 746	1 952	1 840	1 624	1 355	122
81 Fishing area total	*6 792*	*4 408*	*2 456*	*1 896*	*2 746*	*1 952*	*1 840*	*1 624*	*1 355*	*122*
Species total	*6 792*	*4 408*	*2 456*	*1 896*	*2 746*	*1 952*	*1 840*	*1 624*	*1 355*	*122*
Delicate scallop	**...B**		**...C**		***Zygochlamis delicatula***				**3,16(08)012,01**	**ZYE**
81 New Zealand	222	118	134	85	26	19	5	34	23	25
81 Fishing area total	*222*	*118*	*134*	*85*	*26*	*19*	*5*	*34*	*23*	*25*
Species total	*222*	*118*	*134*	*85*	*26*	*19*	*5*	*34*	*23*	*25*
Patagonian scallop	**Peigne de Patagonie**		**Pecten patagónico**		***Zygochlamis patagonica***				**3,16(08)012,02**	**ZYP**
41 Argentina	42 960	51 200	50 650	43 920	39 483	80 045	53 732	58 713	80 810	50 870
Falkland Is	-	-	-	-	12	7	13	6	12	3
Panama	-	-	-	-	-	-	1	-	-	-
UK	-	-	-	-	1	3	-	-	0	0
Uruguay	3 638	215	3 421	1 734	1 869	1 570	0	0	-	-
41 Fishing area total	*46 598*	*51 415*	*54 071*	*45 654*	*41 365*	*81 625*	*53 746*	*58 719*	*80 822*	*50 873*
Species total	*46 598*	*51 415*	*54 071*	*45 654*	*41 365*	*81 625*	*53 746*	*58 719*	*80 822*	*50 873*
American sea scallop	**Pecten d'Amérique**		**Vieira americana**		***Placopecten magellanicus***				**3,16(08)014,04**	**SCA**
21 Canada	89 196	93 971	92 520	81 260	53 684	61 559	65 007	67 491	62 657	59 700
St Pier Mq	2	1	0	404	197	110	45	...	...	...
USA	164 762	186 336	200 279	243 424	214 245	222 948	220 751	202 265	218 064	215 270
21 Fishing area total	*253 960*	*280 308*	*292 799*	*325 088*	*268 126*	*284 617*	*285 803*	*269 756*	*280 721*	*274 970*
31 USA	236	264	215	37	2	-	-	-	-	-
31 Fishing area total	*236*	*264*	*215*	*37*	*2*	-	-	-	-	-
Species total	*254 196*	*280 572*	*293 014*	*325 125*	*268 128*	*284 617*	*285 803*	*269 756*	*280 721*	*274 970*
Atlantic bay scallop	**Peigne baie**		**Peine caletero**		***Argopecten irradians***				**3,16(08)030,02**	**SCB**
21 USA	13	8	12	62	367	349	696	488	954	485
21 Fishing area total	*13*	*8*	*12*	*62*	*367*	*349*	*696*	*488*	*954*	*485*
31 USA	17	127	96	0	0	-	-	-	74	1
31 Fishing area total	*17*	*127*	*96*	*0*	*0*	-	-	-	*74*	*1*
Species total	*30*	*135*	*108*	*62*	*367*	*349*	*696*	*488*	*1 028*	*486*

B-55 **Scallops, pectens**
Coquilles St-Jacques
Vieiras

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Peruvian calico scallop	**Pétoncle éventail**		**Ostión abanico**		***Argopecten purpuratus***				**3,16(08)030,03**	**SCQ**
87 Chile	272	55	20	120	43	-	-	-	189	-
Peru	2 359	7 732	14 653	15 476	15 185	18 763	24 768	19 618	26 478	62 827
87 Fishing area total	*2 631*	*7 787*	*14 673*	*15 596*	*15 228*	*18 763*	*24 768*	*19 618*	*26 667*	*62 827*
Species total	*2 631*	*7 787*	*14 673*	*15 596*	*15 228*	*18 763*	*24 768*	*19 618*	*26 667*	*62 827*
Pacific calico scallop	**Pétoncle volant**		**Peine volador**		***Argopecten ventricosus***				**3,16(08)030,04**	**SCH**
77 Mexico	3 100	9 875	5 763	5 151	15 348	16 027	14 761	16 522	16 284	16 499
77 Fishing area total	*3 100*	*9 875*	*5 763*	*5 151*	*15 348*	*16 027*	*14 761*	*16 522*	*16 284*	*16 499*
Species total	*3 100*	*9 875*	*5 763*	*5 151*	*15 348*	*16 027*	*14 761*	*16 522*	*16 284*	*16 499*
Iceland scallop	**Peigne islandais**		**Peine islándico**		***Chlamys islandica***				**3,16(08)036,03**	**ISC**
21 Canada	1 347	989	895	898	3 299	1 830	330	130	264	508
Greenland	1 593	2 457	2 566	2 476	1 391	1 818	1 393	667	512	392
St Pier Mq	16	9	19	14	-	3	-	-	-	5
21 Fishing area total	*2 956*	*3 455*	*3 480*	*3 388*	*4 690*	*3 651*	*1 723*	*797*	*776*	*905*
27 Greenland	-	2	-	-	-	-	-	-	-	-
Iceland	6 499	5 192	789	-	-	-	-	-	-	-
Norway	14	16	15	14	9	-	-	5	-	-
27 Fishing area total	*6 513*	*5 210*	*804*	*14*	*9*	-	-	*5*	-	-
Species total	*9 469*	*8 665*	*4 284*	*3 402*	*4 699*	*3 651*	*1 723*	*802*	*776*	*905*
Weathervane scallop	**Pecten géant du Pacifique**		**Vieira gigante del Pacífico**		***Patinopecten caurinus***				**3,16(08)066,01**	**SCG**
67 USA	1 052	1 264	1 352	1 274	808	...	...	1 477	1 092	1 818
67 Fishing area total	*1 052*	*1 264*	*1 352*	*1 274*	*808*	*...*	*...*	*1 477*	*1 092*	*1 818*
Species total	*1 052*	*1 264*	*1 352*	*1 274*	*808*	*...*	*...*	*1 477*	*1 092*	*1 818*
Yesso scallop	**Pétoncle du Japon**		**Vieira japonesa**		***Patinopecten yessoensis***				**3,16(08)066,07**	**JSC**
61 China,Taiwan	47	25	37	33	-	14	-	-	-	-
Japan	290 974	306 666	344 150	313 800	287 486	271 928	258 303	310 205	319 638	327 100 F
Korea Rep	11	-	32	18	13	23	278	15	50	132
Russian Fed	2 236	3 612	2 852	2 937	2 772	2 494	1 772	3 573	3 797	3 508
61 Fishing area total	*293 268*	*310 303*	*347 071*	*316 788*	*290 271*	*274 459*	*260 353*	*313 793*	*323 485*	*330 740 F*
Species total	*293 268*	*310 303*	*347 071*	*316 788*	*290 271*	*274 459*	*260 353*	*313 793*	*323 485*	*330 740 F*
Scallops nei	**Peignes nca**		**Peines nep**		***Pectinidae***				**3,16(08)XXX,XX**	**SCX**
27 Denmark	0	0	0	2	2	2	1	1	-	-
France	430	276	303	382	1 116	706	1 422	1 363	428	599
Germany	-	-	-	-	2	1	-	-	-	-
Lithuania	-	-	-	-	-	1	-	-	-	-
Norway	13	37	48	55	17	1	-	-	0	1
Russian Fed	13 598	5 751	3 818	1 218	3 287	900	2 874	1 409	-	1 881
Spain	35	32	15	100	88	284	399	416	371	406
UK	9 722	9 553	9 102	-	-	-	-	-	-	-
27 Fishing area total	*23 798*	*15 649*	*13 286*	*1 757*	*4 512*	*1 895*	*4 696*	*3 189*	*799*	*2 887*
31 USA	-	-	5 167	-	-	-	-	-	-	-
31 Fishing area total	-	-	*5 167*	-	-	-	-	-	-	-
37 Croatia	...	...	...	...	...	...	...	...	...	9
Italy	...	...	...	...	784	787	640	250	336	293
Spain	-	-	-	3	5	1	1	1	1	1
37 Fishing area total	*...*	*...*	*...*	*3*	*789*	*788*	*641*	*251*	*337*	*303*
57 Australia	4 421	2 525	8 012	7 257	12 315	7 255	7 149	7 325	4 938	4 618
Indonesia	-	60	11	22	21	23	12	1	1	2
57 Fishing area total	*4 421*	*2 585*	*8 023*	*7 279*	*12 336*	*7 278*	*7 161*	*7 326*	*4 939*	*4 620*
71 Australia	4 752	3 082	1 550	2 054	3 228	1 803	3 500	2 974	2 661	2 920
Indonesia	419	888	997	709	1 383	1 705	1 992	1 753	1 966	1 759
Philippines	54	65	48	32	28	31	37	42	43	43
Thailand	234	124	180	156	286	272	237	171	132	152
71 Fishing area total	*5 459*	*4 159*	*2 775*	*2 951*	*4 925*	*3 811*	*5 766*	*4 940*	*4 802*	*4 874*
81 Australia	1	-	0	-	0	0	-	-	-	-
81 Fishing area total	*1*	-	*0*	-	*0*	*0*	-	-	-	-
87 Chile	141	373	180	27	229	-	35	6	687	502
87 Fishing area total	*141*	*373*	*180*	*27*	*229*	-	*35*	*6*	*687*	*502*
Species total	*33 820*	*22 766*	*29 431*	*12 017*	*22 791*	*13 772*	*18 299*	*15 712*	*11 564*	*13 186*
Group total	***702 382***	***750 455***	***804 349***	***790 999***	***725 046***	***760 547***	***733 099***	***762 998***	***816 504***	***840 876***

B-56

Clams, cockles, arkshells
Clams, coques, arches
Almejas, berberechos, arcas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Ark clams nei	**Arches nca**		**Arcas nep**		***Arca spp***				**3,16(04)001,XX**	**ARK**
31 Venezuela	43 675	44 725	45 850	63 000 F	56 000 F	52 000 F	63 450 F	70 964	68 500 F	68 500 F
31 Fishing area total	*43 675*	*44 725*	*45 850*	*63 000 F*	*56 000 F*	*52 000 F*	*63 450 F*	*70 964*	*68 500 F*	*68 500 F*
61 Korea Rep	923	790	5 267	2 571	1 827	4 366	481	1 320	3 865	3 959
61 Fishing area total	*923*	*790*	*5 267*	*2 571*	*1 827*	*4 366*	*481*	*1 320*	*3 865*	*3 959*
77 Costa Rica	0	18	46	49	51	40 F	20	20 F	20 F	20 F
Mexico	600	328	330	208	605	632	598	648	698	697
77 Fishing area total	*600*	*346*	*376*	*257*	*656*	*672 F*	*618*	*668 F*	*718 F*	*717 F*
Species total	*45 198*	*45 861*	*51 493*	*65 828 F*	*58 483 F*	*57 038 F*	*64 549 F*	*72 952 F*	*73 083 F*	*73 176 F*
Half-crenated ark	**Arche crénelée**		**Arca japonesa**		***Scapharca subcrenata***				**3,16(04)005,08**	**MCL**
61 Japan	4 899	9 828	7 454	7 036	10 319	2 175	...	...	...	...
61 Fishing area total	*4 899*	*9 828*	*7 454*	*7 036*	*10 319*	*2 175*	*...*	*...*	*...*	*...*
Species total	*4 899*	*9 828*	*7 454*	*7 036*	*10 319*	*2 175*	*...*	*...*	*...*	*...*
Blood cockle	**Arche granuleuse**		**Arca del Pacífico occidental**		***Anadara granosa***				**3,16(04)071,01**	**BLC**
57 Indonesia	10 167	15 321	11 492	20 992	21 049	22 486	30 303	27 659	5 444	7 295
Thailand	34	32	35	44	13	-	-	-	-	-
57 Fishing area total	*10 201*	*15 353*	*11 527*	*21 036*	*21 062*	*22 486*	*30 303*	*27 659*	*5 444*	*7 295*
61 Korea Rep	153	228	509	257	230	148	152	1 228	5 638	5 720
Russian Fed	100	650	280	343	219	141	198	295	280	294
61 Fishing area total	*253*	*878*	*789*	*600*	*449*	*289*	*350*	*1 523*	*5 918*	*6 014*
71 Indonesia	54 141	56 107	36 013	43 506	36 115	30 431	34 338	19 778	25 719	27 187
Thailand	1 248	1 174	2 427	2 523	1 966	1 417	1 204	1 219	1 416	1 337
71 Fishing area total	*55 389*	*57 281*	*38 440*	*46 029*	*38 081*	*31 848*	*35 542*	*20 997*	*27 135*	*28 524*
Species total	*65 843*	*73 512*	*50 756*	*67 665*	*59 592*	*54 623*	*66 195*	*50 179*	*38 497*	*41 833*
Blood ark	**Arche ovale**		**...C**		***Anadara ovalis***				**3,16(04)071,16**	**NDZ**
21 USA	16	19	5	13	3	6	4	47	51	85
21 Fishing area total	*16*	*19*	*5*	*13*	*3*	*6*	*4*	*47*	*51*	*85*
Species total	*16*	*19*	*5*	*13*	*3*	*6*	*4*	*47*	*51*	*85*
Anadara clams nei	**Arches Anadara nca**		**Arcas Anadara nep**		***Anadara spp***				**3,16(04)071,XX**	**BLS**
71 Fiji	2 884	1 600 F	135	286	300 F	339	135	170 F	210 F	250
Philippines	3	3	2	1	1	1	1	1	1	1
71 Fishing area total	*2 887*	*1 603 F*	*137*	*287*	*301 F*	*340*	*136*	*171 F*	*211 F*	*251*
87 Ecuador	...	...	...	522	215	...	...	370	371	336
87 Fishing area total	*...*	*...*	*...*	*522*	*215*	*...*	*...*	*370*	*371*	*336*
Species total	*2 887*	*1 603 F*	*137*	*809*	*516 F*	*340*	*136*	*541 F*	*582 F*	*587*
Ocean quahog	**Cyprine d'Islande**		**Almeja de Islandia**		***Arctica islandica***				**3,16(09)045,01**	**CLQ**
21 Canada	164	92	14	20	36	0	12	2	0	9
USA	142 662	149 767	156 552	152 010	113 793	119 307	129 771	128 552	130 634	132 224
21 Fishing area total	*142 826*	*149 859*	*156 566*	*152 030*	*113 829*	*119 307*	*129 783*	*128 554*	*130 634*	*132 233*
27 Iceland	7 434	12 353	14 558	10 376	2 357	328	4 620	7 629	-	-
27 Fishing area total	*7 434*	*12 353*	*14 558*	*10 376*	*2 357*	*328*	*4 620*	*7 629*	-	-
Species total	*150 260*	*162 212*	*171 124*	*162 406*	*116 186*	*119 635*	*134 403*	*136 183*	*130 634*	*132 233*
Striped venus	**Petite praire**		**Chirla**		***Chamelea gallina***				**3,16(11)001,05**	**SVE**
27 France	627	789	767	829	1 016	1 165	801	666	712	609
Portugal	48	865	717	210	840	692	253	83	53	20
Spain	4 881	2 789	2 690	3 686	3 939	3 394	3 520	2 967	3 162	2 360
27 Fishing area total	*5 556*	*4 443*	*4 174*	*4 725*	*5 795*	*5 251*	*4 574*	*3 716*	*3 927*	*2 989*
37 Greece	...	...	...	215	248	273	324	304	262	262 F
Italy	34 916	25 971	41 784	37 438	14 946	19 510	28 802	24 940	17 328	19 748
Slovenia	1	1	1	1	3	-	-	-	-	-
Spain	240	105	46	65	148	133	78	111	55	53
Turkey	7 500	10 000	19 700	16 899	10 847	48 344	47 215	36 896	24 574	26 931
37 Fishing area total	*42 657*	*36 077*	*61 531*	*54 618*	*26 192*	*68 260*	*76 419*	*62 251*	*42 219*	*46 994 F*
Species total	*48 213*	*40 520*	*65 705*	*59 343*	*31 987*	*73 511*	*80 993*	*65 967*	*46 146*	*49 983 F*
Pullet carpet shell	**Palourde bleue**		**Almeja babosa**		***Venerupis pullastra***				**3,16(11)003,01**	**CTS**
27 France	1 595	1 729	2 045	1 159	486	49	74	74	730	712
Portugal	81	73	99	133	120	184	230	212	257	260
Spain	744	1 034	239	324	571	509	635	772	1 172	1 184
27 Fishing area total	*2 420*	*2 836*	*2 383*	*1 616*	*1 177*	*742*	*939*	*1 058*	*2 159*	*2 156*

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Clams, cockles, arkshells
Clams, coques, arches
Almejas, berberechos, arcas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
37 Spain	...	3	-	-	0	0	0	-	-	0
37 Fishing area total	*...*	*3*	*-*	*-*	*0*	*0*	*0*	*-*	*-*	*0*
Species total	*2 420*	*2 839*	*2 383*	*1 616*	*1 177*	*742*	*939*	*1 058*	*2 159*	*2 156*
Banded carpet shell	**Palourde rose**		**Almeja rubia**		***Venerupis rhomboides***				**3,16(11)003,03**	**VNR**
27 Portugal	...	...	2	0	-	5	-	1	16	109
27 Fishing area total	*...*	*...*	*2*	*0*	*-*	*5*	*-*	*1*	*16*	*109*
Species total	*...*	*...*	*2*	*0*	*-*	*5*	*-*	*1*	*16*	*109*
Smooth callista	**Vernis fauve**		**Almejon**		***Callista chione***				**3,16(11)006,01**	**KLK**
27 France	63	53	34	3	22	36	34	34	22	62
Portugal	...	...	378	332	271	252	310	204	284	319
27 Fishing area total	*63*	*53*	*412*	*335*	*293*	*288*	*344*	*238*	*306*	*381*
37 Italy	...	...	...	...	2 956	2 190	1 853	1 669	1 955	1 679
37 Fishing area total	*...*	*...*	*...*	*...*	*2 956*	*2 190*	*1 853*	*1 669*	*1 955*	*1 679*
Species total	*63*	*53*	*412*	*335*	*3 249*	*2 478*	*2 197*	*1 907*	*2 261*	*2 060*
Stutchbury's venus	**...B**		**...C**		***Chione stutchburyi***				**3,16(11)007,04**	**KNU**
81 New Zealand	1 748	1 687	1 589	1 446	1 477	1 450	1 398	1 148	1 202	1 202
81 Fishing area total	*1 748*	*1 687*	*1 589*	*1 446*	*1 477*	*1 450*	*1 398*	*1 148*	*1 202*	*1 202*
Species total	*1 748*	*1 687*	*1 589*	*1 446*	*1 477*	*1 450*	*1 398*	*1 148*	*1 202*	*1 202*
Japanese hard clam	**Cythérée du Japon**		**Mercenaria japonesa**		***Meretrix lusoria***				**3,16(11)017,01**	**HCJ**
61 Japan	1 245	1 300	1 171	977	971	867	...	...	...	...
Korea Rep	1 044	1 704	6 918	6 860	3 135	4 490	2 662	1 415	1 396	1 146
61 Fishing area total	*2 289*	*3 004*	*8 089*	*7 837*	*4 106*	*5 357*	*2 662*	*1 415*	*1 396*	*1 146*
Species total	*2 289*	*3 004*	*8 089*	*7 837*	*4 106*	*5 357*	*2 662*	*1 415*	*1 396*	*1 146*
Hard clams nei	**...B**		**...C**		***Meretrix spp***				**3,16(11)017,XX**	**HCX**
57 Indonesia	2 383	2 585	1 854	3 776	3 664	3 835	3 892	7 762	1 692	2 170
57 Fishing area total	*2 383*	*2 585*	*1 854*	*3 776*	*3 664*	*3 835*	*3 892*	*7 762*	*1 692*	*2 170*
71 Indonesia	10 992	13 093	11 408	5 725	129	10 180	3 991	10 029	10 152	9 948
71 Fishing area total	*10 992*	*13 093*	*11 408*	*5 725*	*129*	*10 180*	*3 991*	*10 029*	*10 152*	*9 948*
Species total	*13 375*	*15 678*	*13 262*	*9 501*	*3 793*	*14 015*	*7 883*	*17 791*	*11 844*	*12 118*
Grooved carpet shell	**Palourde croisée d'Europe**		**Almeja fina**		***Ruditapes decussatus***				**3,16(11)020,01**	**CTG**
27 France	282	9	25	15	56	383	471	470	13	8
Ireland	130	-	102	215	-	-	-	-	-	-
Portugal	21	18	15	20	15	72	64	54	118	90
Spain	270	627	55	105	124	153	206	275	820	804
UK	29	-	0	0	1	-	-	-	-	-
27 Fishing area total	*732*	*654*	*197*	*355*	*196*	*608*	*741*	*799*	*951*	*902*
37 Croatia	...	...	...	...	...	...	...	...	1	1
France	6	6	-	-	-	-	-	-	19	10
Spain	19	18	6	4	1	0	1	1	7	3
Tunisia	544	1 002	513	527	621	487	615	537	481	433
37 Fishing area total	*569*	*1 026*	*519*	*531*	*622*	*487*	*616*	*538*	*508*	*447*
Species total	*1 301*	*1 680*	*716*	*886*	*818*	*1 095*	*1 357*	*1 337*	*1 459*	*1 349*
Japanese carpet shell	**Palourde japonaise**		**Almeja japonesa**		***Ruditapes philippinarum***				**3,16(11)020,02**	**CLJ**
27 France	29	45	401	3	28	26	15	13	4	...
Ireland	...	...	...	...	...	...	...	158	-	120
Portugal	-	-	-	-	-	-	-	-	9	105
27 Fishing area total	*29*	*45*	*401*	*3*	*28*	*26*	*15*	*171*	*13*	*225*
61 Japan	31 022	34 494	37 370	36 179	34 261	34 984	35 822	39 217	31 655	27 000 F
Korea Rep	20 004	14 758	13 148	12 902	14 447	7 559	8 640	20 761	22 488	12 818
Russian Fed	-	-	-	-	-	-	-	-	-	22
61 Fishing area total	*51 026*	*49 252*	*50 518*	*49 081*	*48 708*	*42 543*	*44 462*	*59 978*	*54 143*	*39 840 F*
Species total	*51 055*	*49 297*	*50 919*	*49 084*	*48 736*	*42 569*	*44 477*	*60 149*	*54 156*	*40 065 F*
Carpet shells nei	**Clovisses nca**		**Almejas nep**		***Ruditapes spp***				**3,16(11)020,XX**	**TPS**
27 France	224	311	453	189	4	663	1 063	1 063	395	461
27 Fishing area total	*224*	*311*	*453*	*189*	*4*	*663*	*1 063*	*1 063*	*395*	*461*
41 Argentina	...	...	...	...	...	...	...	620	0	346
41 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*620*	*0*	*346*
Species total	*224*	*311*	*453*	*189*	*4*	*663*	*1 063*	*1 683*	*395*	*807*

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Clams, cockles, arkshells
Clams, coques, arches
Almejas, berberechos, arcas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Rostrate pitar	**...B**		**Almeja corazón**		***Pitar rostratus***				**3,16(11)021,04**	**ITT**
41 Uruguay	...	...	1 808	833	852	328	865	0	-	25
41 Fishing area total	*...*	*...*	*1 808*	*833*	*852*	*328*	*865*	*0*	*-*	*25*
Species total	*...*	*...*	*1 808*	*833*	*852*	*328*	*865*	*0*	*-*	*25*
Gay's little venus	**...B**		**Juliana**		***Tawera gayi***				**3,16(11)024,01**	**TWG**
87 Chile	291	271	2 554	2 910	2 925	6 342	6 644	3 251	7 725	9 608
87 Fishing area total	*291*	*271*	*2 554*	*2 910*	*2 925*	*6 342*	*6 644*	*3 251*	*7 725*	*9 608*
Species total	*291*	*271*	*2 554*	*2 910*	*2 925*	*6 342*	*6 644*	*3 251*	*7 725*	*9 608*
Triangular tivela	**...B**		**...C**		***Tivela mactroides***				**3,16(11)025,02**	**TVM**
41 Brazil	280	835	957	753	604	2 461	1 820	1 590	1 754	1 652
41 Fishing area total	*280*	*835*	*957*	*753*	*604*	*2 461*	*1 820*	*1 590*	*1 754*	*1 652*
Species total	*280*	*835*	*957*	*753*	*604*	*2 461*	*1 820*	*1 590*	*1 754*	*1 652*
Butter clam	**Coque jaune**		**Almeja amarilla**		***Saxidomus giganteus***				**3,16(11)037,02**	**BCL**
67 Canada	1 111	1 370	1 226	1 213	1 140	827	629	696	612	551
USA	48	58	68	31	21	29	31	30	109	27
67 Fishing area total	*1 159*	*1 428*	*1 294*	*1 244*	*1 161*	*856*	*660*	*726*	*721*	*578*
Species total	*1 159*	*1 428*	*1 294*	*1 244*	*1 161*	*856*	*660*	*726*	*721*	*578*
Short neck clams nei	**...B**		**...C**		***Paphia spp***				**3,16(11)041,XX**	**NCL**
57 Thailand	18 788	-	270	230	...	...	...	1 800	2 025	1 798
57 Fishing area total	*18 788*	*-*	*270*	*230*	*...*	*...*	*...*	*1 800*	*2 025*	*1 798*
71 Philippines	2	1	3	3	3	5	4	3	3	3
Thailand	33 736	31 737	50 282	28 646	18 079	22 097	13 205	14 134	15 738	11 709
71 Fishing area total	*33 738*	*31 738*	*50 285*	*28 649*	*18 082*	*22 102*	*13 209*	*14 137*	*15 741*	*11 712*
81 New Zealand	202	212	228	258	151	176	137	146	153	120
81 Fishing area total	*202*	*212*	*228*	*258*	*151*	*176*	*137*	*146*	*153*	*120*
Species total	*52 728*	*31 950*	*50 783*	*29 137*	*18 233*	*22 278*	*13 346*	*16 083*	*17 919*	*13 630*
Pacific littleneck clam	**Palourde commune**		**Almejuela común**		***Protothaca staminea***				**3,16(11)055,02**	**PTS**
67 USA	102	146	77	47	64	64	54	51	57	49
67 Fishing area total	*102*	*146*	*77*	*47*	*64*	*64*	*54*	*51*	*57*	*49*
Species total	*102*	*146*	*77*	*47*	*64*	*64*	*54*	*51*	*57*	*49*
Taca clam	**Palourde taca**		**Taca**		***Protothaca thaca***				**3,16(11)055,03**	**TCL**
87 Chile	26 483	5 360	8 345	18 914	14 113	13 868	9 400	15 725	15 739	21 591
87 Fishing area total	*26 483*	*5 360*	*8 345*	*18 914*	*14 113*	*13 868*	*9 400*	*15 725*	*15 739*	*21 591*
Species total	*26 483*	*5 360*	*8 345*	*18 914*	*14 113*	*13 868*	*9 400*	*15 725*	*15 739*	*21 591*
Northern quahog(=Hard clam)	**Praire**		**Chirla mercenaria**		***Mercenaria mercenaria***				**3,16(11)075,01**	**CLH**
21 Canada	1 657	2 519	3 984	3 189	1 307	739	458	722	839	818
USA	5 023	12 045	...	...	...	241	3 798	...	...	...
21 Fishing area total	*6 680*	*14 564*	*3 984*	*3 189*	*1 307*	*980*	*4 256*	*722*	*839*	*818*
27 France	-	-	-	-	-	-	-	-	147	184
UK	-	-	1	0	-	7	-	15	4	11
27 Fishing area total	*-*	*-*	*1*	*0*	*-*	*7*	*-*	*15*	*151*	*195*
31 USA	5 113	4 441	6 529	5 143	4 733	8 975	7 912	3 361	4 086	3 615
31 Fishing area total	*5 113*	*4 441*	*6 529*	*5 143*	*4 733*	*8 975*	*7 912*	*3 361*	*4 086*	*3 615*
Species total	*11 793*	*19 005*	*10 514*	*8 332*	*6 040*	*9 962*	*12 168*	*4 098*	*5 076*	*4 628*
Venus clams nei	**Petites praires nca**		**Almejas(=Veneridos) nep**		***Veneridae***				**3,16(11)XXX,XX**	**CLV**
27 France	-	-	2	-	3	1	0	0	...	...
UK	-	-	-	-	-	-	-	47	93	91
27 Fishing area total	*-*	*-*	*2*	*-*	*3*	*1*	*0*	*47*	*93*	*91*
31 Mexico	1 834	646	1 337	1 412	1 514	1 581	1 798	1 768	1 739	1 871
Venezuela	388	262	1 224	1 930 F	1 030 F	610 F	740 F	830 F	800 F	800 F
31 Fishing area total	*2 222*	*908*	*2 561*	*3 342 F*	*2 544 F*	*2 191 F*	*2 538 F*	*2 598 F*	*2 539 F*	*2 671 F*
37 France	22	12	13	12	-	-	-	-	2	2
Turkey	...	...	...	...	...	1 266	1 334	1 255	68	56
37 Fishing area total	*22*	*12*	*13*	*12*	*...*	*1 266*	*1 334*	*1 255*	*70*	*58*
77 Mexico	3 582	2 930	3 233	3 026	6 694	6 990	6 399	7 539	7 678	7 815
77 Fishing area total	*3 582*	*2 930*	*3 233*	*3 026*	*6 694*	*6 990*	*6 399*	*7 539*	*7 678*	*7 815*

B-56 **Clams, cockles, arkshells**
Clams, coques, arches
Almejas, berberechos, arcas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
87 Ecuador	0	-	-	-	-	-	-	-	-	-
87 Fishing area total	*0*	-	-	-	-	-	-	-	-	-
Species total	*5 826*	*3 850*	*5 809*	*6 380 F*	*9 241 F*	*10 448 F*	*10 271 F*	*11 439 F*	*10 380 F*	*10 635 F*
Imperial surf clam	**Clam**		**Almeja**		***Pseudocardium sybillae***				**3,16(12)001,02**	**HCL**
61 Japan	8 914	8 861	8 097	8 039	7 872	8 006	...	...	...	...
Korea Rep	3 409	3 464	5 694	3 363	128	612	606	146	331	248
61 Fishing area total	*12 323*	*12 325*	*13 791*	*11 402*	*8 000*	*8 618*	*606*	*146*	*331*	*248*
Species total	*12 323*	*12 325*	*13 791*	*11 402*	*8 000*	*8 618*	*606*	*146*	*331*	*248*
Pacific horse clams nei	**...B**		**...C**		***Tresus spp***				**3,16(12)005,XX**	**TQZ**
67 USA	2	9	13	11	6	4	4	9	6	11
67 Fishing area total	*2*	*9*	*13*	*11*	*6*	*4*	*4*	*9*	*6*	*11*
Species total	*2*	*9*	*13*	*11*	*6*	*4*	*4*	*9*	*6*	*11*
Atlantic surf clam	**Mactre solide**		**Almeja blanca**		***Spisula solidissima***				**3,16(12)020,01**	**CLB**
21 Canada	602	613	1 165	896	789	789	567	509	819	932
USA	165 708	175 709	167 838	149 483	143 160	144 981	151 534	138 586	122 305	98 398
21 Fishing area total	*166 310*	*176 322*	*169 003*	*150 379*	*143 949*	*145 770*	*152 101*	*139 095*	*123 124*	*99 330*
Species total	*166 310*	*176 322*	*169 003*	*150 379*	*143 949*	*145 770*	*152 101*	*139 095*	*123 124*	*99 330*
Stimpson's surf clam	**Douceron de Stimpson**		**Coquina antártica**		***Spisula polynyma***				**3,16(12)020,02**	**CLT**
21 Canada	20 257	19 960	27 339	24 038	19 286	21 922	18 823	20 014	25 594	23 765
21 Fishing area total	*20 257*	*19 960*	*27 339*	*24 038*	*19 286*	*21 922*	*18 823*	*20 014*	*25 594*	*23 765*
Species total	*20 257*	*19 960*	*27 339*	*24 038*	*19 286*	*21 922*	*18 823*	*20 014*	*25 594*	*23 765*
Solid surf clam	**Spisule épaisse**		**...C**		***Spisula solida***				**3,16(12)020,05**	**ULO**
27 Denmark	214	1 709	566	1 018	31	6	6	41	-	-
France	101	116	1 255	486	511	207	22	21	101	97
Ireland	-	-	1	-	-	103	-	-	-	-
Netherlands	-	-	9 460	203	1	-	2	-	-	-
Portugal	1 125	1 220	3 150	3 007	1 581	1 193	550	405	678	666
UK	-	-	-	-	-	-	-	101	94	-
27 Fishing area total	*1 440*	*3 045*	*14 432*	*4 714*	*2 124*	*1 509*	*580*	*568*	*873*	*763*
Species total	*1 440*	*3 045*	*14 432*	*4 714*	*2 124*	*1 509*	*580*	*568*	*873*	*763*
Surf clams nei	**Spisules nca**		**...C**		***Spisula spp***				**3,16(12)020,XX**	**SSD**
61 Russian Fed	-	22	303	527	714	524	501	433	594	595
61 Fishing area total	*-*	*22*	*303*	*527*	*714*	*524*	*501*	*433*	*594*	*595*
Species total	*-*	*22*	*303*	*527*	*714*	*524*	*501*	*433*	*594*	*595*
Taquilla clams	**Mactres taquille**		**Taquillas**		***Mulinia spp***				**3,16(12)040,XX**	**MUN**
87 Chile	1 699	7 034	7 401	4 329	6 971	5 307	7 870	3 843	2 650	3 290
87 Fishing area total	*1 699*	*7 034*	*7 401*	*4 329*	*6 971*	*5 307*	*7 870*	*3 843*	*2 650*	*3 290*
Species total	*1 699*	*7 034*	*7 401*	*4 329*	*6 971*	*5 307*	*7 870*	*3 843*	*2 650*	*3 290*
Common European bittersweet	**Amande commune**		**Almendra de mar**		***Glycymeris glycymeris***				**3,16(13)001,02**	**GKL**
27 France	3 893	4 561	6 340	4 433	5 649	7 591	4 984	4 463	2 771	3 877
Portugal	-	-	-	-	-	-	-	83	16	25
27 Fishing area total	*3 893*	*4 561*	*6 340*	*4 433*	*5 649*	*7 591*	*4 984*	*4 546*	*2 787*	*3 902*
Species total	*3 893*	*4 561*	*6 340*	*4 433*	*5 649*	*7 591*	*4 984*	*4 546*	*2 787*	*3 902*
Donax clams	**Olives de mer**		**Coquinas**		***Donax spp***				**3,16(15)002,XX**	**DON**
27 France	88	-	-	-	0	0	-	-	120	-
Portugal	540	347	492	734	775	561	609	588	379	340
Spain	-	12	-	8	10	8	1	8	32	29
27 Fishing area total	*628*	*359*	*492*	*742*	*785*	*569*	*610*	*596*	*531*	*369*
37 Italy	...	...	...	...	311	454	308	195	176	66
Spain	174	176	209	228	257	201	83	152	183	146
37 Fishing area total	*174*	*176*	*209*	*228*	*568*	*655*	*391*	*347*	*359*	*212*
41 Uruguay	0	-	-	-	-	-	-	-	-	-
41 Fishing area total	*0*	-	-	-	-	-	-	-	-	-
47 South Africa	-	1	...	2	2	6	19	32	40	32
47 Fishing area total	*-*	*1*	*...*	*2*	*2*	*6*	*19*	*32*	*40*	*32*
Species total	*802*	*536*	*701*	*972*	*1 355*	*1 230*	*1 020*	*975*	*930*	*613*

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Clams, cockles, arkshells
Clams, coques, arches
Almejas, berberechos, arcas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Solen razor clams nei	**Couteaux Solen nca**		**Navajas Solen nep**		***Solen spp***				**3,16(16)003,XX**	**RAZ**
27 Ireland	201	167	276	180	10	87	208	181	231	363
Netherlands	-	-	719	1 131	1 090	1 873	2 314	2 217	2 218	2 903
Portugal	214	195	231	23	-	-	-	-	-	-
Spain	129	-	55	72	135	182	219	256	342	400
UK	59	37	29	97	146	107	257	553	723	695
27 Fishing area total	*603*	*399*	*1 310*	*1 503*	*1 381*	*2 249*	*2 998*	*3 207*	*3 514*	*4 361*
37 France	5	5	5	5	-	-	-	-	-	-
37 Fishing area total	*5*	*5*	*5*	*5*	-	-	-	-	-	-
Species total	*608*	*404*	*1 315*	*1 508*	*1 381*	*2 249*	*2 998*	*3 207*	*3 514*	*4 361*
Atl.jackknife(=Atl.razor clam)	**Couteau de l'Atlantique**		**Navaja del Atlántico**		***Ensis directus***				**3,16(16)005,02**	**CLR**
21 USA	36	90	30	56	173	254	133	93	105	91
21 Fishing area total	*36*	*90*	*30*	*56*	*173*	*254*	*133*	*93*	*105*	*91*
Species total	*36*	*90*	*30*	*56*	*173*	*254*	*133*	*93*	*105*	*91*
Pod razor shell	**Couteau-sabre**		**Navaja**		***Ensis ensis***				**3,16(16)005,03**	**EQE**
27 Ireland	...	...	2	220	5	456	16	-	-	48
27 Fishing area total	*...*	*...*	*2*	*220*	*5*	*456*	*16*	-	-	*48*
Species total	*...*	*...*	*2*	*220*	*5*	*456*	*16*	-	-	*48*
Sword razor shell	**Couteau-silique**		**Muergo**		***Ensis siliqua***				**3,16(16)005,05**	**EQI**
27 Ireland	...	...	...	...	...	3	-	284	...	82
27 Fishing area total	*...*	*...*	*...*	*...*	*...*	*3*	-	*284*	*...*	*82*
Species total	*...*	*...*	*...*	*...*	*...*	*3*	-	*284*	*...*	*82*
Pacific razor clam	**Couteau du Pacifique**		**Navaja del Pacífico**		***Siliqua patula***				**3,16(16)007,01**	**RAP**
67 USA	61	146	26	180	97	131	127	174	244	240
67 Fishing area total	*61*	*146*	*26*	*180*	*97*	*131*	*127*	*174*	*244*	*240*
Species total	*61*	*146*	*26*	*180*	*97*	*131*	*127*	*174*	*244*	*240*
Razor clams, knife clams nei	**Couteaux, etc. nca**		**Navajas, solénidos nep**		***Solenidae***				**3,16(16)XXX,XX**	**SOI**
37 Italy	...	...	...	...	471	304	182	210	364	356
Spain	-	-	-	-	-	-	-	-	-	2
37 Fishing area total	*...*	*...*	*...*	*...*	*471*	*304*	*182*	*210*	*364*	*358*
51 Pakistan	...	...	...	...	...	...	12	18	148	190
51 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*12*	*18*	*148*	*190*
Species total	*...*	*...*	*...*	*...*	*471*	*304*	*194*	*228*	*512*	*548*
Sand gaper	**Mye des sables**		**Almeja de can**		***Mya arenaria***				**3,16(17)006,01**	**CLS**
21 Canada	3 152	3 073	3 424	3 600	2 509	1 725	1 026	841	1 693	940
USA	6 794	5 662	5 122	6 161	6 572	7 636	7 997	7 241	7 050	7 404
21 Fishing area total	*9 946*	*8 735*	*8 546*	*9 761*	*9 081*	*9 361*	*9 023*	*8 082*	*8 743*	*8 344*
67 USA	123	516	783	427	741	691	410	1 017	1 236	1 666
67 Fishing area total	*123*	*516*	*783*	*427*	*741*	*691*	*410*	*1 017*	*1 236*	*1 666*
Species total	*10 069*	*9 251*	*9 329*	*10 188*	*9 822*	*10 052*	*9 433*	*9 099*	*9 979*	*10 010*
Pacific geoduck	**Panopée du Pacifique**		**Panopea del Pacífico**		***Panopea abrupta***				**3,16(18)089,01**	**GEC**
67 Canada	1 413	1 706	1 725	1 797	1 560	1 278	1 178	1 332	1 367	1 330
USA	2 481	3 061	3 537	4 282	4 493	5 159	4 963	6 412	7 982	5 040
67 Fishing area total	*3 894*	*4 767*	*5 262*	*6 079*	*6 053*	*6 437*	*6 141*	*7 744*	*9 349*	*6 370*
Species total	*3 894*	*4 767*	*5 262*	*6 079*	*6 053*	*6 437*	*6 141*	*7 744*	*9 349*	*6 370*
Common edible cockle	**Coque commune**		**Berberecho común**		***Cerastoderma edule***				**3,16(23)002,03**	**COC**
27 Denmark	2 392	78	258	4 163	1 002	679	39	52	892	187
France	11	40	53	63	15	686	703	703	576	577
Ireland	6	112	320	207	-	7	105	9	63	2
Norway	33	19	32	18	14	8	10	14	27	18
Portugal	683	3 518	1 242	1 963	2 390	4 374	1 769	2 293	3 878	2 890
Spain	1 486	737	450	1 047	2 037	1 409	2 729	2 760	3 269	3 729
Sweden	-	-	-	-	-	-	14	21	22	16
UK	19 048	14 268	26 832	12 889	13 151	11 324	11 317	14 035	2 637	1 257
27 Fishing area total	*23 659*	*18 772*	*29 187*	*20 350*	*18 609*	*18 487*	*16 686*	*19 887*	*11 364*	*8 676*
34 Senegal	105	152	244	128	168	80	252	354	534	640
34 Fishing area total	*105*	*152*	*244*	*128*	*168*	*80*	*252*	*354*	*534*	*640*
Species total	*23 764*	*18 924*	*29 431*	*20 478*	*18 777*	*18 567*	*16 938*	*20 241*	*11 898*	*9 316*

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Clams, cockles, arkshells
Clams, coques, arches
Almejas, berberechos, arcas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Basket cockle	**...B**		**...C**		***Clinocardium nuttallii***				**3,16(23)004,02**	**KCL**
67 USA	67	80	61	92	65	79	98	104	125	179
67 Fishing area total	*67*	*80*	*61*	*92*	*65*	*79*	*98*	*104*	*125*	*179*
Species total	*67*	*80*	*61*	*92*	*65*	*79*	*98*	*104*	*125*	*179*
American yellow cockle	**Bucarde jaune**		**Berberecho amarillo**		***Trachycardium muricatum***				**3,16(23)010,04**	**TIX**
41 Argentina	-	-	-	-	11	1	54	-	0	2
41 Fishing area total	-	-	-	-	*11*	*1*	*54*	-	*0*	*2*
Species total	-	-	-	-	*11*	*1*	*54*	-	*0*	*2*
Cockles nei	**Coques nca**		**Berberechos(=Cárdidos) nep**		***Cardiidae***				**3,16(23)XXX,XX**	**COZ**
37 France	-	-	-	-	-	-	-	-	10	23
Italy	...	...	...	...	166	72	28	48	21	9
37 Fishing area total	...	...	...	...	*166*	*72*	*28*	*48*	*31*	*32*
61 Korea Rep	2 002	810	1 288	2 846	945	272	1 817	364	3 504	949
61 Fishing area total	*2 002*	*810*	*1 288*	*2 846*	*945*	*272*	*1 817*	*364*	*3 504*	*949*
Species total	*2 002*	*810*	*1 288*	*2 846*	*1 111*	*344*	*1 845*	*412*	*3 535*	*981*
Pipi wedge clam	**...B**		**...C**		***Paphies australis***				**3,16(24)002,01**	**AFQ**
57 Australia	1 251	1 085	1 187	1 073	1 103	1 025	994	607	469	300
57 Fishing area total	*1 251*	*1 085*	*1 187*	*1 073*	*1 103*	*1 025*	*994*	*607*	*469*	*300*
81 Australia	660	479	301	571	568	299	118	73	32	16
81 Fishing area total	*660*	*479*	*301*	*571*	*568*	*299*	*118*	*73*	*32*	*16*
Species total	*1 911*	*1 564*	*1 488*	*1 644*	*1 671*	*1 324*	*1 112*	*680*	*501*	*316*
Macha clam	**Mesodème chilienne**		**Macha**		***Mesodesma donacium***				**3,16(24)039,01**	**CLM**
87 Chile	1 396	1 303	2 349	1 927	1 528	2 593	2 882	2 108	2 906	4 056
Peru	-	85	-	-	2	-	-	-	31	-
87 Fishing area total	*1 396*	*1 388*	*2 349*	*1 927*	*1 530*	*2 593*	*2 882*	*2 108*	*2 937*	*4 056*
Species total	*1 396*	*1 388*	*2 349*	*1 927*	*1 530*	*2 593*	*2 882*	*2 108*	*2 937*	*4 056*
Chilean semele	**Sémèle chilienne**		**Almeja blanca chilena**		***Semele solida***				**3,16(39)001,03**	**TUW**
87 Chile	3 054	2 162	2 402	3 046	2 640	1 685	1 853	1 143	689	1 752
87 Fishing area total	*3 054*	*2 162*	*2 402*	*3 046*	*2 640*	*1 685*	*1 853*	*1 143*	*689*	*1 752*
Species total	*3 054*	*2 162*	*2 402*	*3 046*	*2 640*	*1 685*	*1 853*	*1 143*	*689*	*1 752*
Bean solen	**Cératisole-gousse**		**Navallon**		***Pharus legumen***				**3,16(40)005,01**	**FRL**
27 Portugal	...	...	224	200	196	178	256	116	82	72
27 Fishing area total	...	...	*224*	*200*	*196*	*178*	*256*	*116*	*82*	*72*
Species total	...	...	*224*	*200*	*196*	*178*	*256*	*116*	*82*	*72*
Tellins nei	**Tellines nca**		**Telinas nep**		***Tellina spp***				**3,16(42)002,XX**	**TWL**
37 France	...	...	...	...	...	...	...	...	31	30
37 Fishing area total	...	...	...	...	...	...	...	...	*31*	*30*
Species total	...	...	...	...	...	...	...	...	*31*	*30*
Clams, etc. nei	**Clams, etc. nca**		**Almejas, etc. nep**		***Bivalvia***				**3,16(XX)XXX,XX**	**CLX**
04 Indonesia	792	220	148	170	75	243	223	197	565	79
04 Fishing area total	*792*	*220*	*148*	*170*	*75*	*243*	*223*	*197*	*565*	*79*
21 Canada	1 078	2 459	3 294	1 981	2 324	1 385	1 621	610	527	44
USA	51	66	0	1	2	24	216	3	3	-
21 Fishing area total	*1 129*	*2 525*	*3 294*	*1 982*	*2 326*	*1 409*	*1 837*	*613*	*530*	*44*
27 France	112	25	7	26	4	16	18	14	3	1
Ireland	126	83	18	28	-	30	14	55	26	25
Portugal	398	322	166	24	63	35	103	212	210	126
Spain	1 850	2 494	620	1 385	1 493	1 223	1 069	1 788	2 952	2 803
UK	91	43	909	152	123	78	196	620	552	789
27 Fishing area total	*2 577*	*2 967*	*1 720*	*1 615*	*1 683*	*1 382*	*1 400*	*2 689*	*3 743*	*3 744*
31 Cuba	633	375	290	443	403	374	385	95	296	304
Martinique	700	700	700	700	600 F	700	700	700	700 F	560 F
USA	2 096	2 002	30	23	14	14	35	50	46	85
31 Fishing area total	*3 429*	*3 077*	*1 020*	*1 166*	*1 017 F*	*1 088*	*1 120*	*845*	*1 042 F*	*949 F*
34 Portugal	-	-	-	4	1	-	-	-	-	-
Spain	7	19	1	-	2	1	0	-	-	0
34 Fishing area total	*7*	*19*	*1*	*4*	*3*	*1*	*0*	-	-	*0*
37 Croatia	69	33	46	56	70	55	65	45	38	46

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Clams, cockles, arkshells
Clams, coques, arches
Almejas, berberechos, arcas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
France	691	556	553	504	191	524	156	96	1	1
Slovenia	-	-	-	-	-	-	1	6	5	7
Spain	811	1 107	733	681	1 305	682	1 020	1 002	586	887
37 Fishing area total	*1 571*	*1 696*	*1 332*	*1 241*	*1 566*	*1 261*	*1 242*	*1 149*	*630*	*941*
41 Uruguay	17	240	67	-	-	-	-	512	...	...
41 Fishing area total	*17*	*240*	*67*	-	-	-	-	*512*	*...*	*...*
51 Mozambique	11	19	...	...	...	...	...	...	...	...
Pakistan	...	...	...	...	...	...	240	255	478	465
51 Fishing area total	*11*	*19*	*...*	*...*	*...*	*...*	*240*	*255*	*478*	*465*
57 Malaysia	2 983	2 606	6 832	7 944	1 823	1 282	4 312	6 322	23 019	1 544
57 Fishing area total	*2 983*	*2 606*	*6 832*	*7 944*	*1 823*	*1 282*	*4 312*	*6 322*	*23 019*	*1 544*
61 Japan	30 133	28 198	32 199	33 566	29 355	26 929	51 315	42 032	40 141	44 300 F
Korea Rep	19 533	17 863	39 245	33 376	21 847	21 664	19 335	8 865	8 037	8 732
Russian Fed	317	178	15	173	155	6	214	566	1	373
61 Fishing area total	*49 983*	*46 239*	*71 459*	*67 115*	*51 357*	*48 599*	*70 864*	*51 463*	*48 179*	*53 405 F*
67 USA	1 250	1 892	1 803	1 931	2 290	3 731	2 146	1 970	2 146	1 702
67 Fishing area total	*1 250*	*1 892*	*1 803*	*1 931*	*2 290*	*3 731*	*2 146*	*1 970*	*2 146*	*1 702*
71 Fiji	43	30 F	5	58	70 F	83	47	48	40	45
Malaysia	966	648	665	945	816	640	705	1 730	727	915
Philippines	223	330	354	375	347	350	308	319	317	315
Solomon Is	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F
71 Fishing area total	*1 237 F*	*1 013 F*	*1 029 F*	*1 383 F*	*1 238 F*	*1 078 F*	*1 065 F*	*2 102 F*	*1 089 F*	*1 280 F*
77 Panama	1 661	1 124	1 243	1 047	1 426	1 302	1 214	1 565	865	660
USA	5	4	5	7	7	-	1	7	8	380
77 Fishing area total	*1 666*	*1 128*	*1 248*	*1 054*	*1 433*	*1 302*	*1 215*	*1 572*	*873*	*1 040*
81 New Zealand	-	-	23	83	95	660	81	64	52	85
81 Fishing area total	-	-	*23*	*83*	*95*	*660*	*81*	*64*	*52*	*85*
87 Chile	16 775	12 719	11 778	17 429	10 807	13 152	12 830	10 239	7 952	10 746
Colombia	1	4	1	2	31	70 F	120 F	150 F	198	104
Ecuador	10	75 F	115 F	...	...	...	...	...	...	...
Peru	949	978	407	1 107	1 962	2 899	2 793	1 906	326	765
87 Fishing area total	*17 735*	*13 776 F*	*12 301 F*	*18 538*	*12 800*	*16 121 F*	*15 743 F*	*12 295 F*	*8 476*	*11 615*
Species total	*84 387 F*	*77 417 F*	*102 277 F*	*104 226 F*	*77 706 F*	*78 157 F*	*101 488 F*	*82 048 F*	*90 822 F*	*76 893 F*
Group total	***826 428***	***811 766***	***901 447***	***856 039***	***703 442***	***757 598***	***795 541***	***762 631***	***714 464***	***669 169***

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Squids, cuttlefishes, octopuses
Encornets, seiches, poulpes
Calamares, jibias, pulpos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Common cuttlefish	**Seiche commune**		**Sepia común**		***Sepia officinalis***				**3,21(02)002,02**	**CTC**
27 Belgium	370	741	569	818	598	730	1 395	872	321	454
Channel Is	8	11	16	12	7	3	2	3	1	4
France	11	206	604	820	569	535	1 071	1 555	8 076	11 922
Netherlands	162	380	249	388	174	310	216	164	100	237
Portugal	1 348	1 368	1 304	1 727	1 857	1 862	1 554	1 457	1 268	2 027
Spain	833	712	1 053	1 072	1 318	1 491	1 476	1 715	1 512	1 650
27 Fishing area total	*2 732*	*3 418*	*3 795*	*4 837*	*4 523*	*4 931*	*5 714*	*5 766*	*11 278*	*16 294*
34 Cyprus	0	-	-	-	-	-	-	-	-	-
Greece	615	1 210	980	447	385	433	164	125	94	94 F
Portugal	115	110	64	82	50	47	30	74	95	59
34 Fishing area total	*730*	*1 320*	*1 044*	*529*	*435*	*480*	*194*	*199*	*189*	*153 F*
37 Albania	22	52	43	70	75	86	47	62	126	98
Algeria	340	318	586	455	476	344	453	449	317	291
Croatia	85	45	70	39	80	71	91	38	68	86
Cyprus	106	105	85	73	42	66	57	46	35	37
France	83	96	168	119	63	128	121	67	54	120
Greece	1 623	2 782	2 816	1 855	1 630	1 968	1 874	1 443	1 493	1 490 F
Israel	...	...	...	...	...	...	...	...	23	13
Libya	...	...	...	...	...	...	200	288	1 800	1 750 F
Malta	0	-	-	-	2	3	12	16	19	29
Slovenia	72	22	25	29	33	24	41	15	14	7
Tunisia	7 148	7 995	7 188	6 008	6 204	6 404	6 717	4 913	3 924	4 722
Turkey	465	909	785	1 570	1 221	1 199	1 288	1 502	1 258	1 597
37 Fishing area total	*9 944*	*12 324*	*11 766*	*10 218*	*9 826*	*10 293*	*10 901*	*8 839*	*9 131*	*10 240 F*
Species total	*13 406*	*17 062*	*16 605*	*15 584*	*14 784*	*15 704*	*16 809*	*14 804*	*20 598*	*26 687 F*
Pharaoh cuttlefish	**Seiche pharaon**		**Sepia faraón**		***Sepia pharaonis***				**3,21(02)002,29**	**IAH**
51 Bahrain	104	128	151	130	176	229	224	217	208	362
Iran	6 517	2 877	3 003	2 230	2 820	2 087	1 704	3 105	1 500	2 479
Oman	5 673	8 061	11 411	11 832	11 513	9 183	10 787	9 208	6 558	9 795
Qatar	41	11	24	21	36	58	51	58	44	69
Saudi Arabia	406	649	993	938	1 231	2 301	1 314	1 985	1 799	1 372
Untd Arab Em	465	205	198	190 F	185	226 F	280 F	325	396	518
51 Fishing area total	*13 206*	*11 931*	*15 780*	*15 341 F*	*15 961*	*14 084 F*	*14 360 F*	*14 898*	*10 505*	*14 595*
Species total	*13 206*	*11 931*	*15 780*	*15 341 F*	*15 961*	*14 084 F*	*14 360 F*	*14 898*	*10 505*	*14 595*
Cuttlefish, bobtail squids nei	**Seiches, sépioles nca**		**Sepias,choquitos,globitos nep**		***Sepiidae, Sepiolidae***				**3,21(02)XXX,XX**	**CTL**
27 Denmark	5	22	60	67	49	91	85	70	74	65
France	13 745	16 176	18 745	20 691	13 572	13 972	16 732	12 495	268	117
Ireland	-	-	-	-	3	1	0	1	0	0
Spain	65	305	31	28	33	29	37	33	44	42
Sweden	-	-	-	-	-	-	10	10	-	1
UK	2 705	3 535	5 110	5 044	3 010	3 594	4 436	3 575	2 243	3 885
27 Fishing area total	*16 520*	*20 038*	*23 946*	*25 830*	*16 667*	*17 687*	*21 300*	*16 184*	*2 629*	*4 110*
34 Angola	-	225	55	-	-	114	-	-	-	-
Belize	19	-	7	...	64	10	46	1	...	...
Benin	1	5	33	90	5	33	26	5	...	...
Cameroon	1	1	1	1 F	1	1	1	1 F	1 F	1 F
China	8 238	1 208	846	...	49	532	1 047	658	...	...
Congo Rep	10 F	10 F	11	19	20	46	34	20	52	50
Côte dIvoire	140	...	...	...	...	217	3	5 F	10	200
Gabon	166	512	449	1 140	887	426	449	387	260 F	260 F
Gambia	1 499	696	957	321	1 993	1 345	826	603	587	646
Ghana	2 866	3 649	5 500	3 687	2 218	2 763	2 544	2 526	1 878	3 131
Guinea	236	...	...	...	...	...	...	...	...	...
GuineaBissau	2	4	158	140 F	126 F	120 F	115 F	165 F	165 F	165 F
Honduras	-	-	-	-	7	19	-	-	-	-
Italy	1 239	919	1 547	2 255	1 467	983	827	412	185	168
Korea Rep	487	17	-	39	27	4	-	1	-	-
Latvia	-	17	-	-	-	-	-	-	-	-
Liberia	29	30	30	8	535	11	61	15	15 F	15 F
Mauritania	4 981 F	2 342 F	2 500 F	2 682	3 097	2 038	2 512	1 294	2 916	2 070
Morocco	16 966	13 263	7 541	8 612	17 300	16 317	15 464	15 554	22 571	18 779
Nigeria	189	419	328	290	140	319	250	285	261	241
Panama	-	-	10	...	-	-	-	-	...	...
St Vincent	2	...	...	...	...	...	...	...	...	70
Senegal	3 941	3 986	3 948	2 812	2 377	2 220	3 164	2 715	3 553	3 577
Sierra Leone	574	1 138	1 610	1 369	1 336	982	716	215	210 F	210 F
Spain	2 761	461	-	764	745	747	775	1 116	866	705
Togo	20	0	3	0	1	1	-	-	0	1
Other nei	148	-	-	-	-	-	-	304	...	...
34 Fishing area total	*44 515 F*	*28 902 F*	*25 534 F*	*24 229 F*	*32 395 F*	*29 248 F*	*28 860 F*	*26 282 F*	*33 530 F*	*30 289 F*
37 Croatia	-	-	-	-	-	-	-	-	3	4
Egypt	1 554	1 734	1 516	1 441	1 697	2 561	3 224	3 301	2 473	2 957
Italy	6 131	4 076	4 691	4 221	9 052	10 689	14 014	10 177	10 082	7 412
Lebanon	25	25	25	25	25	26	26 F	26 F	26 F	26 F
Montenegro	...	...	...	...	...	15	18	15	7	9
Morocco	195	220	264	307	233	256	238	252	219	196
Palest, O.T.	50 F	55	80	66	73	38	23	18	17	8

B-57 **Squids, cuttlefishes, octopuses**
Encornets, seiches, poulpes
Calamares, jibias, pulpos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Serbia-Monte	10	10	10	10	8	-	-	-	-	-
Spain	1 142	972	456	870	967	1 123	1 341	1 228	1 056	1 025
37 Fishing area total	*9 107 F*	*7 092*	*7 042*	*6 940*	*12 055*	*14 708*	*18 884 F*	*15 017 F*	*13 883 F*	*11 637 F*
47 Angola	-	1 500	1 066	1 007	700 F	678	694	322	844	820 F
Russian Fed	5	-	-	-	-	-	-	-	-	-
South Africa	-	-	-	-	72	-	-	-	-	-
Spain	26	101	15	-	20	13	9	2	-	-
47 Fishing area total	*31*	*1 601*	*1 081*	*1 007*	*792 F*	*691*	*703*	*324*	*844*	*820 F*
51 Egypt	1 365	854	2 536	1 751	1 139	666	880	1 387	613	276
Eritrea	35	9	15	5	11	66	22	...	...	...
Korea Rep	840	721	3 600	2 810	1 839	931	1 257	1 305	1 992	1 277
Pakistan	5 256	5 302	5 105	4 005	3 310	3 255	2 817	2 901	3 428	4 184
South Africa	16	19	1	21	10	9	-	4	4	7
Spain	-	2	-	-	-	-	-	-	-	-
Yemen	9 566	5 649	11 269	21 900	24 100	16 791	9 531	6 017	11 500 F	17 000
51 Fishing area total	*17 078*	*12 556*	*22 526*	*30 492*	*30 409*	*21 718*	*14 507*	*11 614*	*17 537 F*	*22 744*
57 Australia	48	46	29	46	99	89	63	58	60	33
Indonesia	7 477	6 707	8 170	5 456	5 591	5 798	7 836	5 693	28 082	10 853
Korea Rep	189	352	24	-	-	-	-	1	-	-
Malaysia	9 810	9 778	9 831	11 106	8 252	11 442	11 062	10 526	11 179	10 455
Sri Lanka	290	380	420	380	190	120	430	480	510	780
Thailand	17 916	20 350	16 153	21 758	15 278	14 602	14 962	8 554	8 191	8 373
57 Fishing area total	*35 730*	*37 613*	*34 627*	*38 746*	*29 410*	*32 051*	*34 353*	*25 312*	*48 022*	*30 494*
61 China	264 585 F	252 541 F	137 048 F	149 292 F	141 145 F	164 534 F	152 754	116 587	119 681	115 826
China,H.Kong	500 F	490 F	450 F	480 F	470 F	440 F	440 F	450 F	460 F	490 F
China,Taiwan	4 546	2 405	3 112	3 966	1 636	837	760	576	571	488
Japan	8 297	7 873	6 883	7 920	8 225	7 065	...	...	...	...
Korea Rep	1 443	1 920	872	905	1 325	1 988	1 938	3 038	3 396	4 105
61 Fishing area total	*279 371 F*	*265 229 F*	*148 365 F*	*162 563 F*	*152 801 F*	*174 864 F*	*155 892 F*	*120 651 F*	*124 108 F*	*120 909 F*
71 Australia	7	6	5	7	7	10	5	4	4	1
Indonesia	8 312	9 180	15 071	13 795	10 803	12 299	13 821	16 326	10 614	14 680
Korea Rep	7	9	9	33	42	10	58	3	1	5
Malaysia	11 657	13 823	13 899	13 894	11 400	12 309	12 319	10 697	11 372	12 858
NewCaledonia	0	0	1	1	1	0	0	0	0	0
Philippines	2 320	2 398	1 892	1 369	982	1 180	1 368	1 599	1 674	1 699
Singapore	56	57	38	58	34	65	61	24	33	36
Thailand	38 754	41 963	43 386	39 224	42 484	34 850	30 101	13 873	15 854	14 864
71 Fishing area total	*61 113*	*67 436*	*74 301*	*68 381*	*65 753*	*60 723*	*57 733*	*42 526*	*39 552*	*44 143*
81 Australia	249	267	308	382	296	203	115	127	84	110
81 Fishing area total	*249*	*267*	*308*	*382*	*296*	*203*	*115*	*127*	*84*	*110*
Species total	*463 714 F*	*440 734 F*	*337 730 F*	*358 570 F*	*340 578 F*	*351 893 F*	*332 347 F*	*258 037 F*	*280 189 F*	*265 256 F*
Patagonian squid	**Calmar de Patagonie**		**Calamar patagónico**		***Loligo gahi***			**3,21(04)001,02**		**SQP**
41 Argentina	251	64	325	221	608	280	238	234	255	374
Estonia	-	-	-	...	-	-	-	-	-	44
Falkland Is	43 055	23 479	44 896	24 330	54 319	40 293	38 154	45 744	27 341	58 129
Japan	-	-	-	1	-	-	2	1	-	0
Namibia	-	-	-	1 141	-	-	-	-	-	-
Panama	-	-	-	-	-	-	325	-	-	-
St Vincent	1 795	-	-	-	-	-	-	-	-	-
Spain	9 011	3 673	778	2 039	1 003	75	3 236	4 397	4 718	3 723
UK	4 015	2 705	3 306	1 967	4 586	2 791	2 681	3 515	2 535	4 770
41 Fishing area total	*58 127*	*29 921*	*49 305*	*29 699*	*60 516*	*43 439*	*44 636*	*53 891*	*34 849*	*67 040*
87 Peru	18 738	6 490	27 441	12 481	10 205	9 093	14 769	4 654	13 178	4 798
87 Fishing area total	*18 738*	*6 490*	*27 441*	*12 481*	*10 205*	*9 093*	*14 769*	*4 654*	*13 178*	*4 798*
Species total	*76 865*	*36 411*	*76 746*	*42 180*	*70 721*	*52 532*	*59 405*	*58 545*	*48 027*	*71 838*
Opalescent inshore squid	**Calmar opale**		**Calamar opalescente**		***Loligo opalescens***			**3,21(04)001,03**		**SQO**
67 USA	-	-	-	-	0	27	1	-	-	-
67 Fishing area total	-	-	-	-	*0*	*27*	*1*	-	-	-
77 Mexico	...	...	...	...	24	25	8	3	4	35
USA	85 829	72 879	39 330	39 596	55 708	49 153	49 438	36 596	92 372	129 901
77 Fishing area total	*85 829*	*72 879*	*39 330*	*39 596*	*55 732*	*49 178*	*49 446*	*36 599*	*92 376*	*129 936*
Species total	*85 829*	*72 879*	*39 330*	*39 596*	*55 732*	*49 205*	*49 447*	*36 599*	*92 376*	*129 936*
Longfin squid	**Calmar totam**		**Calamar pálido**		***Loligo pealeii***			**3,21(04)001,05**		**SQL**
21 USA	14 211	16 684	11 929	13 537	16 967	15 899	12 327	11 400	9 293	6 689
21 Fishing area total	*14 211*	*16 684*	*11 929*	*13 537*	*16 967*	*15 899*	*12 327*	*11 400*	*9 293*	*6 689*
Species total	*14 211*	*16 684*	*11 929*	*13 537*	*16 967*	*15 899*	*12 327*	*11 400*	*9 293*	*6 689*
European squid	**Encornet**		**Calamar**		***Loligo vulgaris***			**3,21(04)001,09**		**SQR**
37 Malta	2	2	2	1	3	5	7	7	6	22
37 Fishing area total	*2*	*2*	*2*	*1*	*3*	*5*	*7*	*7*	*6*	*22*

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Squids, cuttlefishes, octopuses
Encornets, seiches, poulpes
Calamares, jibias, pulpos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*2*	*2*	*2*	*1*	*3*	*5*	*7*	*7*	*6*	*22*
Cape Hope squid	**Calmar du Cap**		**Calamar del Cabo**		***Loligo reynaudi***				**3,21(04)001,12**	**CHO**
47 South Africa	3 373	7 405	7 616	7 306	10 362	6 777	9 948	8 329	10 107	10 068
47 Fishing area total	*3 373*	*7 405*	*7 616*	*7 306*	*10 362*	*6 777*	*9 948*	*8 329*	*10 107*	*10 068*
51 Spain	-	1	-	-	-	-	-	-	-	-
51 Fishing area total	*-*	*1*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
Species total	*3 373*	*7 406*	*7 616*	*7 306*	*10 362*	*6 777*	*9 948*	*8 329*	*10 107*	*10 068*
Veined squid	**Encornet veiné**		**Calamar veteado**		***Loligo forbesi***				**3,21(04)001,13**	**SQF**
27 Portugal	70	140	536	261	272	472	721	664	455	554
27 Fishing area total	*70*	*140*	*536*	*261*	*272*	*472*	*721*	*664*	*455*	*554*
Species total	*70*	*140*	*536*	*261*	*272*	*472*	*721*	*664*	*455*	*554*
Common squids nei	**Calmars Loligo nca**		**Calamares Loligo nep**		***Loligo spp***				**3,21(04)001,XX**	**SQC**
21 Portugal	-	-	-	1	-	2	1	-	-	-
21 Fishing area total	*-*	*-*	*-*	*1*	*-*	*2*	*1*	*-*	*-*	*-*
27 Belgium	51	137	131	106	72	81	145	101	83	100
Channel Is	1	2	1	1	-	1	2	1	1	0
Ireland	14	40	119	156	101	52	67	171	47	54
Isle of Man	1	0	0	-	-	-	-	-	-	-
Portugal	-	-	-	-	-	-	-	402	253	272
Spain	1 473	505	552	855	924	623	961	1 088	1 091	1 441
UK	850	1 002	866	879	761	1 409	1 909	2 098	2 702	3 798
27 Fishing area total	*2 390*	*1 686*	*1 669*	*1 997*	*1 858*	*2 166*	*3 084*	*3 861*	*4 177*	*5 665*
31 Dominican Rp	51	26	68	50	41	49	39	49	1	95
Mexico	92	58	121	109	25	26	220	41	38	82
Venezuela	1 261	637	905	1 430 F	770 F	450 F	550 F	620 F	600 F	600 F
31 Fishing area total	*1 404*	*721*	*1 094*	*1 589 F*	*836 F*	*525 F*	*809 F*	*710 F*	*639 F*	*777 F*
34 Italy	151	9	4	38	66	89	95	91	86	60
Portugal	1	2	3	0	7	4	1	34	47	14
34 Fishing area total	*152*	*11*	*7*	*38*	*73*	*93*	*96*	*125*	*133*	*74*
37 Albania	65	85	45	73	64	103	81	107	60	64
Algeria	224	172	210	201	183	270	219	236	227	121
Cyprus	-	-	-	-	51	36	35	20	18	18
France	177	179	133	254	319	444	141	215	289	117
Greece	405	405	571	605	650	821	766	667	725	720 F
Israel	...	...	...	...	...	...	...	...	87	56
Italy	2 201	1 776	1 711	1 742	2 437	2 115	2 233	1 984	1 910	2 241
Libya	...	...	...	...	...	...	300	503	810	780 F
Montenegro	...	...	...	...	...	15	17	19	10	14
Palest, O.T.	50 F	56	51	49	85	73	77	74	96	65
Serbia-Monte	14	12	13	12	17	-	-	-	-	-
Spain	806	900	284	731	808	927	482	651	631	497
Tunisia	327	510	409	482	449	263	296	454	339	495
Turkey	230	330	450	506	711	972	844	537	576	528
37 Fishing area total	*4 499 F*	*4 425*	*3 877*	*4 655*	*5 774*	*6 039*	*5 491*	*5 467*	*5 778*	*5 716 F*
41 Brazil	1 201	4 828	1 418	2 134	2 252	1 393	2 160	1 899	2 095	1 608
41 Fishing area total	*1 201*	*4 828*	*1 418*	*2 134*	*2 252*	*1 393*	*2 160*	*1 899*	*2 095*	*1 608*
51 Egypt	-	-	157	167	138	79	120	172	234	280
51 Fishing area total	*-*	*-*	*157*	*167*	*138*	*79*	*120*	*172*	*234*	*280*
57 Indonesia	11 056	9 267	9 090	8 454	10 334	10 751	14 936	15 807	13 319	22 124
Thailand	16 937	19 445	14 884	16 738	11 860	12 825	13 396	14 198	14 723	14 461
57 Fishing area total	*27 993*	*28 712*	*23 974*	*25 192*	*22 194*	*23 576*	*28 332*	*30 005*	*28 042*	*36 585*
61 China,Taiwan	5 791	...	68 506	...	4 333	487	503	549	...	...
Korea Rep	-	-	-	-	-	-	-	864	1 564	1 416
61 Fishing area total	*5 791*	*...*	*68 506*	*...*	*4 333*	*487*	*503*	*1 413*	*1 564*	*1 416*
71 China,Taiwan	3 308	4 445	-	-	-	-	-	-	-	-
Indonesia	49 473	52 866	42 392	60 903	48 099	47 070	48 489	49 565	57 917	72 043
Philippines	41 964	50 612	53 100	56 181	59 801	57 585	64 139	57 223	61 112	55 957
Singapore	186	185	135	181	124	224	148	12	64	43
Thailand	60 532	70 060	65 578	56 856	63 628	63 377	53 489	57 766	54 903	56 335
71 Fishing area total	*155 463*	*178 168*	*161 205*	*174 121*	*171 652*	*168 256*	*166 265*	*164 566*	*173 996*	*184 378*
Species total	*198 893 F*	*218 551*	*261 907*	*209 894 F*	*209 110 F*	*202 616 F*	*206 861 F*	*208 218 F*	*216 658 F*	*236 499 F*
Bigfin reef squid	**Calmar tonnelet**		**Calamar manopla**		***Sepioteuthis lessoniana***				**3,21(04)007,02**	**UHL**
57 Thailand	3 345	5 073	2 335	2 173	2 330	2 171	2 465	3 271	2 431	2 851
57 Fishing area total	*3 345*	*5 073*	*2 335*	*2 173*	*2 330*	*2 171*	*2 465*	*3 271*	*2 431*	*2 851*
71 Thailand	5 574	5 826	6 333	5 500	3 811	3 584	3 646	4 528	4 523	4 526
71 Fishing area total	*5 574*	*5 826*	*6 333*	*5 500*	*3 811*	*3 584*	*3 646*	*4 528*	*4 523*	*4 526*

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Squids, cuttlefishes, octopuses
Encornets, seiches, poulpes
Calamares, jibias, pulpos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*8 919*	*10 899*	*8 668*	*7 673*	*6 141*	*5 755*	*6 111*	*7 799*	*6 954*	*7 377*
Neon flying squid	**Encornet volant**		**Pota saltadora**		***Ommastrephes bartrami***				**3,21(05)003,01**	**OFJ**
61 Japan	21 578	14 082	18 429	9 926	13 095	9 251	21 900	24 400	36 000 F	16 800 F
Russian Fed	100	483	531	1 420	1 327	46	256	-	-	-
61 Fishing area total	*21 678*	*14 565*	*18 960*	*11 346*	*14 422*	*9 297*	*22 156*	*24 400*	*36 000 F*	*16 800 F*
67 Japan	2 061	382	4	132	8	104	-	-	-	-
67 Fishing area total	*2 061*	*382*	*4*	*132*	*8*	*104*	-	-	-	-
77 Japan	131	...	...	-	-	-	-	-	-	-
77 Fishing area total	*131*	...	...	-	-	-	-	-	-	-
Species total	*23 870*	*14 947*	*18 964*	*11 478*	*14 430*	*9 401*	*22 156*	*24 400*	*36 000 F*	*16 800 F*
Northern shortfin squid	**Encornet rouge nordique**		**Pota norteña**		***Illex illecebrosus***				**3,21(05)010,01**	**SQI**
21 Canada	65	253	1 135	2 568	554	6 923	244	527	687	117
Estonia	-	-	-	3	-	24	-	-	5	-
Portugal	-	-	-	11	-	16	1	5	29	2
Russian Fed	-	-	5	1	-	-	-	-	-	-
St Pier Mq	-	2	0	0	-	4	-	4	2	-
Spain	-	-	-	1	0	31	-	-	-	-
USA	4 009	2 750	6 466	25 393	11 701	13 837	9 022	15 898	18 419	15 823
21 Fishing area total	*4 074*	*3 005*	*7 606*	*27 977*	*12 255*	*20 835*	*9 267*	*16 434*	*19 142*	*15 942*
27 Faroe Is	1	2	16	17	1	-	0	291	208	72
Germany	-	-	-	-	-	-	-	-	-	13
Ireland	121	114	70	61	33	17	14	22	18	51
Portugal	-	-	-	3	-	1	1	5	2	4
Spain	1 503	2 406	2 891	45	1 548	766	1 197	3 338	3 542	4 578
27 Fishing area total	*1 625*	*2 522*	*2 977*	*126*	*1 582*	*784*	*1 212*	*3 656*	*3 770*	*4 718*
31 USA	0	0	-	-	-	0	-	-	-	-
31 Fishing area total	*0*	*0*	-	-	-	*0*	-	-	-	-
Species total	*5 699*	*5 527*	*10 583*	*28 103*	*13 837*	*21 619*	*10 479*	*20 090*	*22 912*	*20 660*
Broadtail shortfin squid	**Encornet rouge**		**Pota voladora**		***Illex coindetii***				**3,21(05)010,02**	**SQM**
27 France	219	446	217	235	372	236	204	70	123	118
27 Fishing area total	*219*	*446*	*217*	*235*	*372*	*236*	*204*	*70*	*123*	*118*
37 France	31	79	30	30	44	24	78	169	...	94
Italy	2 346	2 034	1 759	1 999	5 117	4 390	3 850	4 334	4 223	3 675
Malta	-	-	-	-	-	-	-	-	3	2
37 Fishing area total	*2 377*	*2 113*	*1 789*	*2 029*	*5 161*	*4 414*	*3 928*	*4 503*	*4 226*	*3 771*
Species total	*2 596*	*2 559*	*2 006*	*2 264*	*5 533*	*4 650*	*4 132*	*4 573*	*4 349*	*3 889*
Argentine shortfin squid	**Encornet rouge argentin**		**Pota argentina**		***Illex argentinus***				**3,21(05)010,03**	**SQA**
41 Argentina	230 272	177 314	140 938	76 485	146 097	292 070	233 062	255 531	72 604	85 989
Belize	1 692	124	2 768	47	61	-	2 285	-	-	-
Cambodia	1 200	32	857	17	-	-	-	-	-	94
China	93 500	85 436	96 000	13 400	41 000	104 000	207 626	197 187	61 400	35 000
China,Taiwan	146 783	110 887	123 688	49 272	35 725	125 929	284 707	208 641	56 092	30 543
Estonia	1 833	533	-	109	581	499	-	-	-	42
Falkland Is	8 660	10 475	10 073	2 178	6 756	5 394	5 188	3 975	2 393	3 403
Ghana	-	-	-	-	-	1 244	-	-	-	-
Japan	70 883	26 792	23 424	10 198	6 278	9 592	-	-	-	-
Korea Rep	142 585	98 649	91 445	20 440	42 939	138 751	193 673	157 816	56 967	24 985
Latvia	...	...	162	-	-	-	-	-	-	-
Panama	-	-	-	95	194	585	750	-	-	-
Poland	683	2 754	-	-	-	-	-	-	-	-
Portugal	1 049	2 355	-	-	1	-	-	-	-	-
Russian Fed	2 578	5 453	2 848	554	-	-	-	-	-	-
St Vincent	4	-	-	-	-	-	-	-	-	-
Sierra Leone	...	...	-	-	-	-	-	-	-	178
Spain	41 318	7 750	5 059	1 451	95	9 448	11 818	3 197	10 185	7 216
UK	21	-	-	-	-	15	35	691	0	-
Uruguay	7 373	11 811	6 363	4 728	7 743	16 277	15 900	10 897	1 586	2 375
Vanuatu	-	-	-	-	120	-	-	-	-	142
41 Fishing area total	*750 434*	*540 365*	*503 625*	*178 974*	*287 590*	*703 804*	*955 044*	*837 935*	*261 227*	*189 967*
48 Poland	18	49	-	-	-	-	-	-	-	-
48 Fishing area total	*18*	*49*	-	-	-	-	-	-	-	-
Species total	*750 452*	*540 414*	*503 625*	*178 974*	*287 590*	*703 804*	*955 044*	*837 935*	*261 227*	*189 967*
Jumbo flying squid	**Encornet géant**		**Jibia gigante**		***Dosidicus gigas***				**3,21(05)023,01**	**GIS**
77 Japan	691	-	2	-	-	-	-	-	-	-
Mexico	73 741	115 896	97 332	87 228	53 437	65 611	57 476	84 437	57 894	42 893
USA	0	4	4	0	2	24	74	36	8	10
77 Fishing area total	*74 432*	*115 900*	*97 338*	*87 228*	*53 439*	*65 635*	*57 550*	*84 473*	*57 902*	*42 903*

B-57 **Squids, cuttlefishes, octopuses**
Encornets, seiches, poulpes
Calamares, jibias, pulpos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
87 Chile	3 476	5 589	15 191	175 134	296 954	250 989	124 389	145 667	56 337	200 428
China	17 770	50 483	81 000	205 600	86 000	62 000	49 963	79 064	70 000	142 000
China,Taiwan	-	12 064	23 009	39 450	15 976	18 349	14 750	31 161	12 319	29 206
Ecuador	...	...	...	...	...	212	121	668	...	...
Japan	71 646	60 246	27 058	46 187	33 652	37 428	14 059	14 143	27 271	17 113
Korea Rep	5 797	21 759	4 722	10 787	2 519	2 485	-	6 775	7 221	14 506
Peru	71 834	146 390	153 727	270 368	291 140	434 261	427 591	533 414	411 805	369 822
87 Fishing area total	*170 523*	*296 531*	*304 707*	*747 526*	*726 241*	*805 724*	*630 873*	*810 892*	*584 953*	*773 075*
Species total	*244 955*	*412 431*	*402 045*	*834 754*	*779 680*	*871 359*	*688 423*	*895 365*	*642 855*	*815 978*
European flying squid	**Toutenon commun**		**Pota europea**		***Todarodes sagittatus***				**3,21(05)058,01**	**SQE**
27 Iceland	-	0	-	-	-	-	-	7	2	2
Ireland	14	40	27	8	3	6	1	7	0	1
Norway	-	-	0	1	0	0	0	2	1	4
Spain	1 588	1 735	697	373	376	388	981	540	724	632
UK	193	171	116	92	20	10	17	8	38	6
27 Fishing area total	*1 795*	*1 946*	*840*	*474*	*399*	*404*	*999*	*564*	*765*	*645*
37 Malta	0	-	-	-	-	-	-	-	-	-
Slovenia	...	...	...	...	...	...	11	8	11	24
Spain	120	1 217	114	120	175	122	102	202	204	304
37 Fishing area total	*120*	*1 217*	*114*	*120*	*175*	*122*	*113*	*210*	*215*	*328*
Species total	*1 915*	*3 163*	*954*	*594*	*574*	*526*	*1 112*	*774*	*980*	*973*
Japanese flying squid	**Toutenon japonais**		**Pota japonesa**		***Todarodes pacificus***				**3,21(05)058,03**	**SQJ**
61 China,Taiwan	4 716	4 215	482	...	-	-	-	-	-	-
Japan	298 191	273 567	253 840	234 603	222 360	190 317	253 494	217 472	218 658	198 100 F
Korea Rep	225 616	226 656	233 254	212 760	189 126	197 084	174 479	186 160	189 160	159 130
Russian Fed	-	-	-	457	158	686	1 189	90	370	360
61 Fishing area total	*528 523*	*504 438*	*487 576*	*447 820*	*411 644*	*388 087*	*429 162*	*403 722*	*408 188*	*357 590 F*
Species total	*528 523*	*504 438*	*487 576*	*447 820*	*411 644*	*388 087*	*429 162*	*403 722*	*408 188*	*357 590 F*
Wellington flying squid	**Encornet minami**		**Pota neozelandesa**		***Nototodarus sloanii***				**3,21(05)059,01**	**TSQ**
81 China,Taiwan	-	-	-	-	3 831	3 304	-	-	-	-
Japan	1 139	1 850	3 274	3 906	4 757	3 951	3 081	1 359	761	856
New Zealand	35 100	50 016	43 730	84 409	87 810	69 213	70 840	55 627	46 257	32 557
Ukraine	8 623	11 230	10 379	20 122	...	12 935	...	...	...	...
81 Fishing area total	*44 862*	*63 096*	*57 383*	*108 437*	*96 398*	*89 403*	*73 921*	*56 986*	*47 018*	*33 413*
Species total	*44 862*	*63 096*	*57 383*	*108 437*	*96 398*	*89 403*	*73 921*	*56 986*	*47 018*	*33 413*
Sevenstar flying squid	**Encornet étoile**		**Pota festoneada**		***Martialia hyadesi***				**3,21(05)060,01**	**SQS**
41 Argentina	113	-	1	1	3	-	-	0	4	0
Falkland Is	-	0	34	35	-	0	1	0	0	0
Japan	2	2	-	-	-	-	-	-	-	-
Spain	-	-	2	23	-	-	3	-	-	-
41 Fishing area total	*115*	*2*	*37*	*59*	*3*	*0*	*4*	*0*	*4*	*0*
48 Korea Rep	2	-	-	-	-	-	-	-	-	-
UK	-	-	-	-	-	-	-	0	-	-
48 Fishing area total	*2*	-	-	-	-	-	-	*0*	-	-
58 South Africa	-	-	-	0	-	-	-	-	-	-
58 Fishing area total	-	-	-	*0*	-	-	-	-	-	-
Species total	*117*	*2*	*37*	*59*	*3*	*0*	*4*	*0*	*4*	*0*
Various squids nei	**Calmars, encornets nca**		**Calamares, jibias, potas nep**		***Loliginidae, Ommastrephidae***				**3,21(05)XXX,XX**	**SQU**
21 Korea Rep	-	-	-	-	11	-	-	-	-	-
Spain	-	-	-	0	0	2	-	-	-	-
USA	124	196	14	282	64	23	15	12	20	35
21 Fishing area total	*124*	*196*	*14*	*282*	*75*	*25*	*15*	*12*	*20*	*35*
27 France	4 690	6 244	7 797	6 292	5 249	4 882	5 464	4 306	5 789	6 212
Germany	3	17	62	38	24	16	24	14	10	11
Iceland	-	-	-	1	-	-	-	-	-	-
Ireland	228	316	241	97	166	66	77	125	71	85
Isle of Man	...	...	-	-	-	-	-	-	-	1
Netherlands	172	312	193	238	176	168	281	323	316	343
Portugal	1 203	950	495	1 583	601	95	67	44	57	72
Russian Fed	-	-	-	-	-	-	-	1	-	-
Spain	307	234	1 060	2 992	3 579	3 639	4 226	4 340	3 298	3 522
Sweden	0	1	1	5	3	10	-	-	2	9
UK	815	1 346	2 312	2 202	752	-	0	-	8	9
27 Fishing area total	*7 418*	*9 420*	*12 161*	*13 448*	*10 550*	*8 876*	*10 139*	*9 153*	*9 551*	*10 264*
31 Belize	-	-	0	0	0	0	0	-	-	-
Colombia	29	0	29	8	2	10 F	20 F	25 F	30	34
Grenada	5	3	-	0	0	-	0	-	4	1
Guatemala	...	...	...	...	7	12	14	14	10	9
Trinidad Tob	6	10	5	8	-	2	2	3	1	4

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Squids, cuttlefishes, octopuses
Encornets, seiches, poulpes
Calamares, jibias, pulpos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca		2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	USA	74	51	67	51	35	56	33	41	38	34
31	*Fishing area total*	*114*	*64*	*101*	*67*	*44*	*80 F*	*69 F*	*83 F*	*83*	*82*
34	Belize	1	-	-	...	-	-	-	-	...	19
	China	290	16	-	...	-	-	-	-	-	-
	Gabon	10	10	3	1	0	1	0	4	3 F	3 F
	Greece	11	13	2	2	7	559	179	14	4	4 F
	Italy	11	105	11	-	-	-	-	-	-	-
	Korea Rep	55	48	1	191	13	-	-	40	-	44
	Latvia	-	12	-	-	-	-	-	-	-	-
	Mauritania	1 100 F	800 F	580 F	464	593	203	1 047	624	758	480
	Morocco	10 605	4 788	1 395	1 141	7 829	3 045	1 034	4 555	5 879	3 559
	Panama	4	-	-	-	-	-	-	-	...	...
	Portugal	2	-	2	-	-	-	4	2	2	-
	St Vincent	4	...	...	...	...	...	...	...	...	11
	Senegal	107	125	116	384	30	28	272	216	56	117
	Sierra Leone	...	...	72	...	...	...	...	3	3 F	3 F
	Spain	2 548	1 863	790	665	797	2 438	555	1 024	833	902
	Other nei	77	-	-	-	-	-	-	-	-	-
34	*Fishing area total*	*14 825 F*	*7 780 F*	*2 972 F*	*2 848*	*9 269*	*6 274*	*3 091*	*6 482*	*7 538 F*	*5 142 F*
37	Croatia	162	53	32	69	243	212	315	238	180	214
	France	-	-	-	-	-	-	-	-	1	-
	Greece	739	943	1 152	1 192	934	1 114	1 235	1 244	1 290	1 280 F
	Morocco	11	4	24	25	34	42	33	27	19	19
	Slovenia	8	3	5	5	11	8	0	0	-	-
	Spain	302	237	254	414	394	220	217	688	804	1 144
37	*Fishing area total*	*1 222*	*1 240*	*1 467*	*1 705*	*1 616*	*1 596*	*1 800*	*2 197*	*2 294*	*2 657 F*
41	Estonia	-	-	-	4	-	-	-	-	-	1
	Korea Rep	-	-	-	-	-	-	-	-	642	588
	Spain	-	-	-	-	-	-	-	-	826	316
41	*Fishing area total*	-	-	-	*4*	-	-	-	-	*1 468*	*905*
47	Angola	292	1 000	825	750	500 F	480	19	65	38	37 F
	Korea Rep	-	-	906	-	-	-	-	-	-	-
	Namibia	775	993	984	567	507	471	704	79	454	280 F
	Russian Fed	-	1	4	-	-	-	-	-	-	-
	South Africa	53	40	75	10 085	72	86	109	72	65	42
	Spain	1	-	12	14	4	5	13	30	39	17
47	*Fishing area total*	*1 121*	*2 034*	*2 806*	*11 416*	*1 083 F*	*1 042*	*845*	*246*	*596*	*376 F*
51	China	-	-	-	-	-	6 400	1 200	800	-	-
	Djibouti	0	0	0	0	-	-	-	-	-	-
	Eritrea	85	19	20	21	24	88	...	...	0	3
	Kenya	78	74	99	77	207	191	180	162	140	142
	Korea Rep	612	749	2 569	3 382	2 633	2 942	3 908	1 878	1 184	1 525
	Mozambique	385	534	...	...	...	...	...	...	...	...
	Pakistan	4 024	3 200	2 130	3 430	2 504	2 176	2 340	2 431	2 523	3 200
	Portugal	3	-	3	5	1	-	-	-	-	-
	Saudi Arabia	341	360	271	520	476	352	414	352	350	350
	South Africa	...	5	-	11	2	4	-	3	3	5
	Spain	-	-	-	-	636	-	-	-	-	-
51	*Fishing area total*	*5 528*	*4 941*	*5 092*	*7 446*	*6 483*	*12 153*	*8 042*	*5 626*	*4 200*	*5 225*
57	Australia	3 272	1 728	2 841	3 693	2 907	1 749	2 878	1 231	1 310	1 073
	Korea Rep	235	277	18	-	-	-	-	3	-	-
	Malaysia	20 128	20 779	19 392	20 294	16 665	23 655	25 365	21 950	26 403	22 321
57	*Fishing area total*	*23 635*	*22 784*	*22 251*	*23 987*	*19 572*	*25 404*	*28 243*	*23 184*	*27 713*	*23 394*
58	Australia	-	-	0	0	-	-	-	-	-	-
58	*Fishing area total*	-	-	*0*	*0*	-	-	-	-	-	-
61	China	81 000	87 056	372 761 F	491 360 F	509 215 F	385 875 F	466 374	462 981	392 478	431 433
	China,H.Kong	8 100 F	7 900 F	7 300 F	7 800 F	7 540 F	7 200 F	7 200 F	7 390 F	7 430 F	7 850 F
	Japan	46 451	49 250	52 830	39 934	50 496	38 229	47 340	46 110	41 200 F	43 600 F
	Korea D P Rp	9 500 F	9 500 F	9 500 F	9 500 F	9 500 F	9 500 F	9 500 F	9 500 F	9 500 F	9 500 F
	Korea Rep	898	836	758	793	1 304	1 354	1 657	2 379	2 280	2 203
	Russian Fed	44 249	72 537	58 094	67 136	73 397	82 306	8 136	903	2 724	5 578
61	*Fishing area total*	*190 198 F*	*227 079 F*	*501 243 F*	*616 523 F*	*651 452 F*	*524 464 F*	*540 207 F*	*529 263 F*	*455 612 F*	*500 164 F*
67	USA	852	665	685	561	1 487	2 189	1 261	2 129	639	469
67	*Fishing area total*	*852*	*665*	*685*	*561*	*1 487*	*2 189*	*1 261*	*2 129*	*639*	*469*
71	Australia	622	414	244	220	264	185	295	69	103	143
	Korea Rep	1 535	1 888	2 869	1 487	2 614	1 388	2 645	1 306	587	788
	Malaysia	25 149	31 704	30 510	31 914	27 670	36 874	34 365	34 405	29 961	27 800
71	*Fishing area total*	*27 306*	*34 006*	*33 623*	*33 621*	*30 548*	*38 447*	*37 305*	*35 780*	*30 651*	*28 731*
77	China	6 000	-	-	-	-	-	-	-	-	-
	Costa Rica	11	30	20	23	8	7 F	6	6 F	6 F	6 F
	El Salvador	9	13	15	12	11	12	13	24	17	14
	Guatemala	120 F	18	32	14	3	...	12	...	...	7
	Korea Rep	-	377	-	-	-	-	-	2 877	1 957	1 176
	Nicaragua	-	2	2	6	2	2	3	2	1	2
	USA	...	1	1	0	1	1	1	1	1	3
77	*Fishing area total*	*6 140 F*	*441*	*70*	*55*	*25*	*22 F*	*35*	*2 910 F*	*1 982 F*	*1 208 F*
81	Australia	392	207	342	557	459	478	315	281	296	267

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Squids, cuttlefishes, octopuses
Encornets, seiches, poulpes
Calamares, jibias, pulpos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Korea Rep	11 380	16 991	17 779	32 079	30 634	25 092	25 643	15 611	19 116	24 145
New Zealand	45	41	21	54	36	48	51	75	91	100
81 Fishing area total	*11 817*	*17 239*	*18 142*	*32 690*	*31 129*	*25 618*	*26 009*	*15 967*	*19 503*	*24 512*
87 Belize	453	588	479	681	825	-	-	-	-	-
Chile	118	72	59	24	934	-	120	317	91	18
Colombia	76	68	42	25	9	7 F	6 F	5 F	3	2
Ecuador	100	90 F	130 F	123 F	135 F	145 F	155 F	165 F	175	199
87 Fishing area total	*747*	*818 F*	*710 F*	*853 F*	*1 903 F*	*152 F*	*281 F*	*487 F*	*269*	*219*
Species total	*291 047 F*	*328 707 F*	*601 337 F*	*745 506 F*	*765 236 F*	*646 342 F*	*657 342 F*	*633 519 F*	*562 119 F*	*603 383 F*
Greater hooked squid	**Cornet commun**		**Lurión común**		***Moroteuthis ingens***				**3,21(06)033,01**	**OIJ**
41 Falkland Is	-	-	-	-	39	13	25	6	31	0
Japan	-	-	-	-	-	2	-	4	-	36
Panama	-	-	-	-	-	-	8	-	-	-
Spain	-	-	-	-	70	7	33	24	51	0
UK	-	-	-	-	-	-	2	-	5	-
41 Fishing area total	-	-	-	-	*109*	*22*	*68*	*34*	*87*	*36*
Species total	-	-	-	-	*109*	*22*	*68*	*34*	*87*	*36*
Robust clubhook squid	**Cornet mange-piquants**		**Lurión máximo**		***Moroteuthis robustus***				**3,21(06)033,05**	**UHB**
67 USA	-	-	-	-	5	13	6	-	-	-
67 Fishing area total	-	-	-	-	*5*	*13*	*6*	-	-	-
Species total	-	-	-	-	*5*	*13*	*6*	-	-	-
Common octopus	**Pieuvre**		**Pulpo común**		***Octopus vulgaris***				**3,21(09)005,07**	**OCC**
27 France	...	...	...	...	...	...	20	3	38	37
Portugal	823	659	1 310	692	3 487	3 953	5 283	9 160	6 720	10 454
27 Fishing area total	*823*	*659*	*1 310*	*692*	*3 487*	*3 953*	*5 303*	*9 163*	*6 758*	*10 491*
31 Dominican Rp	57	86	66	45	84	73	7	63	57	24
Mexico	20 596	16 018	16 103	24 447	6 753	16 372	11 802	8 959	16 636	15 325
31 Fishing area total	*20 653*	*16 104*	*16 169*	*24 492*	*6 837*	*16 445*	*11 809*	*9 022*	*16 693*	*15 349*
34 Congo Rep	-	-	28	6	5	38	10	8	25	20
GuineaBissau	3	0	85	50 F	22 F	20 F	20 F	20 F	20 F	20 F
Italy	1 388	784	1 499	1 350	1 534	1 612	1 277	1 305	1 387	727
Spain	14 913	8 483	12 640	8 142	9 894	9 948	5 134	5 792	6 752	4 759
34 Fishing area total	*16 304*	*9 267*	*14 252*	*9 548 F*	*11 455 F*	*11 618 F*	*6 441 F*	*7 125 F*	*8 184 F*	*5 526 F*
37 Albania	24	105	137	135	47	82	82	82	109	47
Croatia	...	...	...	...	...	...	...	...	146	141
France	1 406	2 128	1 284	1 166	1 569	1 576	1 389	1 223	1 153	1 584
Greece	2 058	2 263	2 697	3 061	2 496	2 212	2 146	1 601	1 580	1 570 F
Italy	8 648	7 373	6 615	5 473	3 897	4 117	3 895	3 018	3 454	3 336
Lebanon	25	25	25	25	25	24	24 F	24 F	24 F	24 F
Libya	...	...	...	...	...	...	148	247	...	...
Montenegro	...	...	...	...	...	20	19	23	15	16
Serbia-Monte	12	11	10	7	9	-	-	-	-	-
Slovenia	53	25	32	24	37	28	34	14	25	20
Tunisia	1 752	2 535	2 710	4 638	3 901	2 542	2 297	1 280	1 819	3 064
Turkey	1 400	1 502	750	1 185	876	1 114	664	681	649	509
37 Fishing area total	*15 378*	*15 967*	*14 260*	*15 714*	*12 857*	*11 715*	*10 698 F*	*8 193 F*	*8 974 F*	*10 311 F*
Species total	*53 158*	*41 997*	*45 991*	*50 446 F*	*34 636 F*	*43 731 F*	*34 251 F*	*33 503 F*	*40 609 F*	*41 677 F*
Mexican four-eyed octopus	**Poulpe mexicain**		**Pulpo mexicano**		***Octopus maya***				**3,21(09)005,19**	**OQY**
31 Mexico	...	...	...	...	3 166	7 675	6 928	2 396	6 879	5 713
31 Fishing area total	*...*	*...*	*...*	*...*	*3 166*	*7 675*	*6 928*	*2 396*	*6 879*	*5 713*
Species total	*...*	*...*	*...*	*...*	*3 166*	*7 675*	*6 928*	*2 396*	*6 879*	*5 713*
Horned octopus	**Élédone commune**		**Pulpo blanco**		***Eledone cirrosa***				**3,21(09)024,01**	**EOI**
27 Ireland	...	...	17	9	20	5	1	1	0	17
Portugal	56	216	273	356	319	248	571	174	187	252
27 Fishing area total	*56*	*216*	*290*	*365*	*339*	*253*	*572*	*175*	*187*	*269*
Species total	*56*	*216*	*290*	*365*	*339*	*253*	*572*	*175*	*187*	*269*
Musky octopus	**Élédone musquée**		**Pulpo almizclado**		***Eledone moschata***				**3,21(09)024,02**	**EDT**
27 Portugal	...	...	...	...	...	1	-	-	-	-
27 Fishing area total	*...*	*...*	*...*	*...*	*...*	*1*	-	-	-	-
Species total	*...*	*...*	*...*	*...*	*...*	*1*	-	-	-	-
Horned and musky octopuses	**Élédones communes et musquées**		**Pulpos blancos y almizclados**		***Eledone spp***				**3,21(09)024,XX**	**OCM**
37 Croatia	...	...	...	...	...	...	...	...	707	464
Italy	1 661	1 309	1 248	1 353	7 445	7 435	8 536	6 872	6 950	5 821
Montenegro	...	...	...	...	...	18	13	21	15	22

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Squids, cuttlefishes, octopuses
Encornets, seiches, poulpes
Calamares, jibias, pulpos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Serbia-Monte	...	5	4	3	4	...	...	...	...	...
Tunisia	696	878	668	876	844	657	1 049	797	634	700
37 Fishing area total	*2 357*	*2 192*	*1 920*	*2 232*	*8 293*	*8 110*	*9 598*	*7 690*	*8 306*	*7 007*
Species total	*2 357*	*2 192*	*1 920*	*2 232*	*8 293*	*8 110*	*9 598*	*7 690*	*8 306*	*7 007*
Octopuses, etc. nei	**Pieuvres, poulpes nca**		**Pulpitos, pulpos nep**		***Octopodidae***			**3,21(09)XXX,XX**		**OCT**
21 USA	0	5	1	0	-	-	0	0	0	-
21 Fishing area total	*0*	*5*	*1*	*0*	-	-	*0*	*0*	*0*	-
27 Belgium	29	70	51	50	21	35	48	31	45	69
France	388	109	105	221	153	130	161	74	127	123
Ireland	14	13	10	3	11	7	3	7	3	1
Netherlands	7	2	1	-	1	1	-	-	-	-
Portugal	7 273	7 358	8 569	7 792	7 722	3 441	3 834	4 417	1 128	100
Spain	2 895	3 902	4 422	5 572	5 772	5 360	5 469	6 835	4 530	6 998
UK	164	179	160	187	184	147	233	233	231	336
27 Fishing area total	*10 770*	*11 633*	*13 318*	*13 825*	*13 864*	*9 121*	*9 748*	*11 597*	*6 064*	*7 627*
31 Colombia	4	4	3	...	...	...	1 F	1 F	1	0
Nicaragua	-	-	-	-	-	-	-	2	1	...
Portugal	-	-	-	-	-	-	3	-	-	-
Puerto Rico	23	15	21	15	9	17	19	14	13	13
USA	-	-	-	-	6	-	-	-	6	-
Venezuela	1 064	1 226	1 075	1 700 F	900 F	540 F	660 F	1 467	1 420 F	1 420 F
31 Fishing area total	*1 091*	*1 245*	*1 099*	*1 715 F*	*915 F*	*557 F*	*683 F*	*1 484 F*	*1 441 F*	*1 433 F*
34 Angola	-	43	150	-	-	89	-	-	-	-
Belize	-	-	65	...	253	-	3	-	...	...
China	5 130	741	1 876	...	195	36	442	284	...	...
Côte dIvoire	88	...	...	...	...	...	...	...	...	...
Cyprus	3	-	-	-	-	-	-	-	-	-
Gabon	0	4	11	3	1	1	0	...	...	...
Gambia	1	-	-	-	-	7	2	-	-	-
Ghana	94	...	...	313	290	5	7	8	...	...
Greece	133	180	327	112	238	399	491	660	477	477 F
Guinea	97	...	...	...	...	...	...	...	...	...
Honduras	-	-	-	-	24	5	-	-	-	-
Korea Rep	32	18	6	18	19	4	-	-	2	4
Latvia	2	6	-	-	-	-	-	-	-	-
Liberia	41	45	40	23	490	0	5	15	15 F	15 F
Mauritania	13 576 F	12 500 F	12 000 F	12 104	14 634	12 093	11 525	7 605	12 313	15 801
Morocco	79 232	56 834	28 895	18 562	43 108	41 864	30 573	53 411	57 738	30 137
Panama	-	-	18	...	-	-	-	-	...	...
Portugal	2	5	7	2	4	14	18	299	221	128
Senegal	2 985	12 795	10 861	5 023	1 816	2 981	5 196	3 679	3 845	3 317
Sierra Leone	11	1	19	3	1	0	6	1	2 F	2 F
Other nei	264	-	-	-	-	-	-	276	...	...
34 Fishing area total	*101 691 F*	*83 172 F*	*54 275 F*	*36 163*	*61 073*	*57 498*	*48 268*	*66 238*	*74 613 F*	*49 881 F*
37 Algeria	343	366	639	684	1 240	750	823	895	735	672
Cyprus	173	117	93	85	121	128	162	112	39	34
Greece	680	649	852	672	923	1 018	985	625	629	629 F
Israel	...	...	...	...	...	...	...	...	11	11
Malta	5	7	5	4	5	4	29	33	23	52
Morocco	46	796	13	596	1 832	1 829	2 906	2 973	2 469	1 869
Spain	6 634	5 087	-	5 026	6 048	5 885	4 906	4 194	4 403	4 703
37 Fishing area total	*7 881*	*7 022*	*1 602*	*7 067*	*10 169*	*9 614*	*9 811*	*8 832*	*8 309*	*7 970 F*
41 Argentina	13	3	6	2	7	3	7	3	0	0
Brazil	1 193	914	1 028	1 518	1 783	2 104	2 195	1 987	2 192	2 069
Korea Rep	2	-	-	57	6	512	-	-	-	-
41 Fishing area total	*1 208*	*917*	*1 034*	*1 577*	*1 796*	*2 619*	*2 202*	*1 990*	*2 192*	*2 069*
47 Angola	-	...	...	...	...	...	8	6	411	400 F
Namibia	-	-	-	-	-	-	450	...	...	...
Portugal	-	133	37	22	186	113	174	-	-	-
St Helena	16	12	9	24	26	14	5	18	11	15
South Africa	93	68	90	98	112	199	228	215	201	112
Spain	20	78	73	1	62	29	50	45	-	-
47 Fishing area total	*129*	*291*	*209*	*145*	*386*	*355*	*915*	*284*	*623*	*527 F*
51 Kenya	154	208	214	249	198	187	222	291	257	408
Korea Rep	11	4	4	5	28	2	1	2	-	-
Mauritius	347	335	327	307	293	84	68	92	89	93
Mozambique	35	24	...	...	...	...	...	...	...	...
Portugal	1	-	1	5	-	-	-	-	-	-
Réunion	3	281	260	260	2	2	0	0	0	0
Seychelles	54	32	27	34	34	29	17	41	17	10
South Africa	14	7	0	15	5	7	13	5	6	11
Tanzania	650	800	1 700	1 600	1 334	703	882	829	1 121	1 316
Yemen	21	2	50	60 F	40 F	6	5	3 F	4 F	5 F
51 Fishing area total	*1 290*	*1 693*	*2 583*	*2 535 F*	*1 934 F*	*1 020*	*1 208*	*1 263 F*	*1 494 F*	*1 843 F*
57 Australia	158	147	124	361	274	246	313	403	324	367
Indonesia	430	332	352	424	323	352	520	573	1 006	982
Malaysia	804	934	750	766	523	727	707	1 057	1 325	971
Thailand	14 267	13 644	10 249	11 028	5 960	4 983	4 750	4 766	4 007	4 387

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Squids, cuttlefishes, octopuses
Encornets, seiches, poulpes
Calamares, jibias, pulpos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
57 Fishing area total	*15 659*	*15 057*	*11 475*	*12 579*	*7 080*	*6 308*	*6 290*	*6 799*	*6 662*	*6 707*
58 Australia	-	-	0	0	0	0	0	0	0	0
South Africa	-	0	-	0	-	-	-	-	-	-
58 Fishing area total	-	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
61 China	...	...	99 736 F	115 653 F	97 470 F	120 607 F	139 416	120 602	118 345	125 776
China,Taiwan	374	481	816	561	159	83	87	77	138	71
Japan	45 200	57 482	61 091	54 655	55 306	50 779	52 564	48 821	45 723	41 700 F
Korea Rep	19 873	21 616	17 569	18 024	19 685	19 323	27 486	23 794	26 684	20 744
Russian Fed	64	77	182	133	197	37	96	25	65	52
61 Fishing area total	*65 511*	*79 656*	*179 394 F*	*189 026 F*	*172 817 F*	*190 829 F*	*219 649*	*193 319*	*190 955*	*188 343 F*
67 Canada	61	125	122	75	48	36	27	19	32	41
USA	23	52	50	8	11	5	5	2	4	333
67 Fishing area total	*84*	*177*	*172*	*83*	*59*	*41*	*32*	*21*	*36*	*374*
71 Australia	1	1	2	1	1	1	1	0	0	0
Fiji	57	45 F	32	40	42 F	45	44	24	25	20
Guam	2	2	2	1	2	4	5	1	7	1
Indonesia	2 797	2 653	6 147	4 081	2 673	6 063	6 454	7 806	5 007	9 878
Kiribati	69	23	70	89 F	105 F	122 F	144	5	1	2
Korea Rep	47	59	207	477	27	32	7	16	-	11
Malaysia	676	597	569	603	926	911	1 454	1 423	1 146	965
Micronesia	20 F	20 F	20 F	20 F	20 F	20 F	20 F	20 F	20 F	20 F
N Marianas	0	1	1	1	1	1	1	1	0	0
Philippines	6 945	6 477	6 205	3 978	2 776	3 052	3 496	3 997	4 987	5 506
Thailand	8 065	8 469	9 449	10 228	14 000	11 124	8 957	6 013	5 842	5 928
Wallis Fut I	1 F	1 F	1	1 F	1 F	1 F	2 F	2 F	2 F	2 F
71 Fishing area total	*18 680 F*	*18 348 F*	*22 705 F*	*19 520 F*	*20 574 F*	*21 376 F*	*20 585 F*	*19 308 F*	*17 037 F*	*22 333 F*
77 Amer Samoa	0	0	0	0	0	1	1	1	0	0
Cook Is	30 F	30 F	30 F	30	30 F	30	30 F	30 F	27 F	27 F
Costa Rica	66	35	20	54	18	18 F	19	20 F	20 F	20 F
Korea Rep	-	6	-	-	-	-	-	-	-	-
Mexico	837	676	654	994	758	791	1 004	1 166	2 165	2 134
Nicaragua	-	3	3	12	1	4	3	12	14	2
USA	3	20	14	10	12	10	9	10	11	11
77 Fishing area total	*936 F*	*770 F*	*721 F*	*1 100*	*819 F*	*854 F*	*1 066 F*	*1 239 F*	*2 237 F*	*2 194 F*
81 Australia	578	470	573	542	345	220	164	176	105	181
New Zealand	140	100	103	104	104	99	102	97	86	111
81 Fishing area total	*718*	*570*	*676*	*646*	*449*	*319*	*266*	*273*	*191*	*292*
87 Chile	2 008	1 354	2 020	2 308	2 589	2 786	1 340	2 783	2 153	1 895
Ecuador	5	...	...	...	...	...	...	...	...	...
Korea Rep	-	-	-	-	-	-	-	-	716	-
Peru	635	1 415	1 429	1 270	1 077	1 817	1 695	2 921	1 030	2 546
87 Fishing area total	*2 648*	*2 769*	*3 449*	*3 578*	*3 666*	*4 603*	*3 035*	*5 704*	*3 899*	*4 441*
88 New Zealand	-	0	0	0	0	0	0	0	0	0
88 Fishing area total	-	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Species total	*228 296 F*	*223 325 F*	*292 713 F*	*289 559 F*	*295 601 F*	*305 114 F*	*323 758 F*	*318 351 F*	*315 753 F*	*296 034 F*

Schoolmaster gonate squid	**Encornet suçoir**		**Gonalura magister**		***Berryteuthis magister***				**3,21(14)001,02**	**YTT**
61 Russian Fed	-	-	-	1 132	1 068	1 084	48 981	54 868	60 639	59 306
61 Fishing area total	-	-	-	*1 132*	*1 068*	*1 084*	*48 981*	*54 868*	*60 639*	*59 306*
Species total	-	-	-	*1 132*	*1 068*	*1 084*	*48 981*	*54 868*	*60 639*	*59 306*

Cephalopods nei	**Céphalopodes nca**		**Cefalópodos nep**		***Cephalopoda***				**3,21(XX)XXX,XX**	**CEP**
27 France	58	55	12	5	32	34	45	39	-	-
27 Fishing area total	*58*	*55*	*12*	*5*	*32*	*34*	*45*	*39*	-	-
34 China	...	-	-	-	-	-	-	1 214	...	...
Mauritania	150	236	200 F	189	136	121	95	44	5	16
Spain	129	335	994	17	18	32	26	57	16	20
34 Fishing area total	*279*	*571*	*1 194 F*	*206*	*154*	*153*	*121*	*1 315*	*21*	*36*
37 Algeria	22	113	45	-	-	-	824	29	19	38
Croatia	885	403	351	562	771	621	1 215	640	-	-
France	48	56	36	59	46	35	17	2	-	1
Israel	146	127	112	52	56	235	116	120 F	-	-
Spain	61	...	1 992	39	54	45	46	39	9	14
37 Fishing area total	*1 162*	*699*	*2 536*	*712*	*927*	*936*	*2 218*	*830 F*	*28*	*53*
51 India	44 021	76 149	75 693	56 732	64 564	69 405	62 596	55 108	54 562	96 860
Madagascar	600 F	600 F	700 F	800 F	900 F	1 000	1 000 F	850 F	930 F	870 F
Mozambique	-	-	520	450	404	361	689	815	1 041	1 133
Somalia	640 F	580 F	600 F	600 F	500 F	600 F	600 F	600 F	600 F	600 F
51 Fishing area total	*45 261 F*	*77 329 F*	*77 513 F*	*58 582 F*	*66 368 F*	*71 366 F*	*64 885 F*	*57 373 F*	*57 133 F*	*99 463 F*
57 India	9 250	11 195	13 842	12 560	11 584	11 531	10 975	11 813	12 561	13 974
Timor-Leste	1	3 F	5 F	7 F	9 F	11 F	13 F	16 F	16 F	16 F
57 Fishing area total	*9 251*	*11 198 F*	*13 847 F*	*12 567 F*	*11 593 F*	*11 542 F*	*10 988 F*	*11 829 F*	*12 577 F*	*13 990 F*

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Squids, cuttlefishes, octopuses
Encornets, seiches, poulpes
Calamares, jibias, pulpos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
58 Australia	-	-	-	0	0	-	-	-	-	-
58 Fishing area total	-	-	-	*0*	*0*	-	-	-	-	-
61 China	-	-	20 194 F	43 319 F	33 963 F	21 028 F	37 343	49 786	53 451	51 274
China,Taiwan	3	2	3	-	14 188	8 930	7 374	5 062	-	-
61 Fishing area total	*3*	*2*	*20 197 F*	*43 319 F*	*48 151 F*	*29 958 F*	*44 717*	*54 848*	*53 451*	*51 274*
71 Cambodia	2 200 F	2 400 F	2 800 F	2 850 F	3 000 F	3 000 F	3 000 F	2 930	3 115	3 600 F
Viet Nam	172 000 F	189 681	198 998 F	185 000 F	197 000 F	200 000 F	211 600	227 700 F	246 500 F	262 000 F
71 Fishing area total	*174 200 F*	*192 081 F*	*201 798 F*	*187 850 F*	*200 000 F*	*203 000 F*	*214 600 F*	*230 630 F*	*249 615 F*	*265 600 F*
Species total	*230 214 F*	*281 935 F*	*317 097 F*	*303 241 F*	*327 225 F*	*316 989 F*	*337 574 F*	*356 864 F*	*372 825 F*	*430 416 F*
Group total	***3 286 605***	***3 257 648***	***3 519 370***	***3 714 907***	***3 785 998***	***4 133 125***	***4 311 854***	***4 270 545***	***3 486 105***	***3 652 632***

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Miscellaneous marine molluscs
Mollusques marins divers
Moluscos marinos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Marine molluscs nei	**Mollusques marins nca**		**Moluscos marinos nep**		***Mollusca***				**3,99(XX)XXX,XX**	**MOL**
21 Canada	1 262	3 165	5 267	4 660	16 686	10 365	1 148	130	1 587	894
St Pier Mq	115	42	1	55	42	1	59	-	-	-
Spain	-	-	-	1	-	1	-	-	-	-
USA	7	3	0	0	7	1	7	5	1	2
21 Fishing area total	*1 384*	*3 210*	*5 268*	*4 716*	*16 735*	*10 368*	*1 214*	*135*	*1 588*	*896*
27 Belgium	10	1	0	1	2	-	0	0	-	0
Channel Is	-	-	3	-	-	-	-	-	0	-
France	-	-	-	-	6	0	93	93	-	-
Norway	10	43	12	17	50	3	0	0	84	59
Portugal	118	52	45	68	1	0	0	-	-	-
Spain	286	79	39	58	57	50	124	54	11	15
Sweden	-	-	-	1	6	7	-	-	-	1
UK	1	21	11	18	-	2	0	-	0	-
27 Fishing area total	*425*	*196*	*110*	*163*	*122*	*62*	*217*	*147*	*95*	*75*
31 Barbados	0	0	0	0	0	0	0	-	-	-
Colombia	3	...	...	2	0	...	1 F	1 F	1	...
Dominican Rp	18	388	143	131	15	...	33	110	11	3
Guatemala	...	...	...	...	...	5	...	...	...	...
Puerto Rico	9	6	7	4	9	7	4	4	2	6
USA	815	1 721	884	898	232	123	190	612	191	44
US Virgin Is	7 F	7 F	9	25	21	17	-	1	0	18
Venezuela	1 056	186	1 492	2 350 F	1 250 F	740 F	900 F	1 040 F	1 000 F	1 000 F
31 Fishing area total	*1 908 F*	*2 308 F*	*2 535*	*3 410 F*	*1 527 F*	*892 F*	*1 128 F*	*1 768 F*	*1 205 F*	*1 071 F*
34 Cameroon	0	2	0	0	0	0	0	0	0	0
Cape Verde	49	40	26	25	...	...	...	62	...	...
Côte dIvoire	-	1	2	2 F	1 F	2 F	2 F	2 F	2	4
Eq Guinea	20 F	10 F	10 F	5 F	5 F	0	10	20 F	20	20 F
Italy	64	6	0	-	-	-	-	-	-	-
Mauritania	6	23	10 F	2	-	5	8	3	0	0
Portugal	3	8	2	-	-	-	0	-	-	-
Sao Tome Prn	22 F	32 F	45	11	13 F	13 F	15 F	15 F	15 F	15 F
Senegal	75	19	3	-	8	14	127	114	232	172
Sierra Leone	63	2 434	3 061	1 267	1 883	1 065	925	788	770 F	770 F
Spain	-	-	-	0	-	0	-	-	-	-
Togo	0	-	-	-	-	-	-	-	-	-
34 Fishing area total	*302 F*	*2 575 F*	*3 159 F*	*1 312 F*	*1 910 F*	*1 099 F*	*1 087 F*	*1 004 F*	*1 039 F*	*981 F*
37 Algeria	-	-	-	-	-	-	43	17	6	96
Egypt	4 173	3 243	2 738	1 197	2 093	2 991	2 500	2 990	3 231	3 365
France	-	-	-	-	-	-	1	-	-	-
Greece	2 169	887	591	122	141	184	271	205	240	240 F
Italy	6 260	5 879	5 590	5 677	3 249	1 267	669	809	773	1 084
Montenegro	...	...	...	...	...	4	6	5	5	6
Serbia-Monte	1	3	3	3	7	-	-	-	-	-
Slovenia	1	-	2	1	1	-	0	0	-	-
Spain	1	17	7	0	1	0	0	-	8	1
Syria	75	136	122	146	128	115	128	75	90	65
Tunisia	1	10	8	16	1	-	-	-	-	-
Turkey	2 674	6 274	5 534	14 061	12 666	11 749	14 014	11 463	6 238	10 603
Ukraine	-	2	-	-	-	-	-	-	-	-
37 Fishing area total	*15 355*	*16 451*	*14 595*	*21 223*	*18 287*	*16 310*	*17 632*	*15 564*	*10 591*	*15 460 F*
41 Argentina	3	1	-	-	-	2	-	21	0	73
Brazil	1 431	1 991	2 260	3 125	4 793	3 797	5 389	1 036	1 143	5 189
Korea Rep	769	448	585	168	18	531	26	419	-	60
Uruguay	-	91	-	-	-	-	-	-	-	-
41 Fishing area total	*2 203*	*2 531*	*2 845*	*3 293*	*4 811*	*4 330*	*5 415*	*1 476*	*1 143*	*5 322*
47 South Africa	-	-	-	-	-	-	-	-	6	-
Spain	-	-	-	0	0	0	-	-	-	-
47 Fishing area total	-	-	-	*0*	*0*	*0*	-	-	*6*	-
51 Egypt	361	135	973	811	64	70	238	69	40	49
India	1 675	1 240	748	873	1 237	558	3 500	7 916	8 748	854
Korea Rep	-	-	87	-	-	-	-	-	5	-
Madagascar	400 F	400 F	400 F	400 F	400 F	400 F	400 F	350 F	380 F	360 F
South Africa	-	-	-	-	-	-	-	-	8	-
Zanzibar	1 038	980	701	994	1 108	1 234	922	1 068	1 155	1 179
51 Fishing area total	*3 474 F*	*2 755 F*	*2 909 F*	*3 078 F*	*2 809 F*	*2 262 F*	*5 060 F*	*9 403 F*	*10 336 F*	*2 442 F*
57 Australia	862	913	877	797	817	763	698	532	447	355
India	922	-	-	6 361	4 375	4 375	2 083	2 578	1 076	2 994
Indonesia	106	458	269	774	486	479	518	697	3 530	673
Sri Lanka	30	60	110	250	300	120	710	1 420	1 260	1 940
Thailand	46	-	9	44	-	68	1	1	-	1
57 Fishing area total	*1 966*	*1 431*	*1 265*	*8 226*	*5 978*	*5 805*	*4 010*	*5 228*	*6 313*	*5 963*
58 Australia	-	-	-	0	-	-	0	-	-	-
58 Fishing area total	-	-	-	*0*	-	-	*0*	-	-	-
61 China	1 194 242 F	1 170 484 F	684 911 F	718 992 F	751 281 F	766 819 F	743 617	643 759	669 742	622 104
China,H.Kong	660 F	650 F	600 F	640 F	620 F	580 F	580 F	594 F	600 F	640 F
China, Macao	40 F	40 F	40 F	40 F	40 F	40 F	40 F	40 F	40 F	40 F

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Miscellaneous marine molluscs
Mollusques marins divers
Moluscos marinos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
China,Taiwan	118	209	116	1 930	78	1 358	1 198	1 170	1 856	650
Korea Rep	501	383	171	106	77	43	51	68	148	179
Russian Fed	4 809	4 679	3 995	3 542	4 879	5 823	4 366	5 862	6 366	5 986
61 Fishing area total	*1 200 370 F*	*1 176 445 F*	*689 833 F*	*725 250 F*	*756 975 F*	*774 663 F*	*749 852 F*	*651 493 F*	*678 752 F*	*629 599 F*
67 Canada	919	1 184	1 749	1 452	1 353	2 562	2 878	2 028	2 821	1 817
USA	730	910	975	1 650	2 118	1 399	1 714	1 474	1 592	1 044
67 Fishing area total	*1 649*	*2 094*	*2 724*	*3 102*	*3 471*	*3 961*	*4 592*	*3 502*	*4 413*	*2 861*
71 Australia	201	118	301	92	146	60	239	35	19	21
Brunei Darsm	24	31	135	57	47	31	73	53	51	82
Cambodia	1 000 F	1 100 F	1 300 F	1 320 F	1 400 F	1 400 F	1 800 F	2 105	4 352	5 000 F
Fiji	3 150	1 600 F	0	0	0	0	0	0	0	-
Indonesia	2 627	2 182	4 268	2 710	1 773	3 324	2 691	2 265	2 322	2 534
Kiribati	3 260	2 337	5 378	4 800 F	4 300 F	3 800 F	3 375	3 400 F	3 300 F	3 004 F
Korea Rep	-	-	1	12	3	2	29	117	54	-
NewCaledonia	7	6	6	7	7	12	10	7	17	17
Thailand	1 389	896	1 864	4 893	4 029	4 155	3 762	3 096	3 227	4 495
Vanuatu	200 F	100 F	8	36	36	45 F	55	30 F	4	13
Viet Nam	55 058 F	57 392	64 660	59 913 F	63 700 F	64 900 F	65 300	70 300 F	76 000 F	81 000 F
71 Fishing area total	*66 916 F*	*65 762 F*	*77 921 F*	*73 840 F*	*75 441 F*	*77 729 F*	*77 334 F*	*81 408 F*	*89 346 F*	*96 166 F*
77 Amer Samoa	-	-	-	0	0	0	1	0	-	-
Cook Is	40 F	20 F	5	5	7 F	10	10 F	10 F	9 F	9 F
El Salvador	823	750	633	2 891	64	84	496	8	7	6
Fr Polynesia	25	25	25 F	25 F	25	150	150	150	150	150
Guatemala	...	...	...	...	...	...	10	15	8	1
Honduras	122 F	82 F	9 F	9 F	9 F	9 F	9 F	9 F	9 F	9 F
Panama	19	22	28	309	14	13	73	59	10	7
Samoa	1 410 F	1 208 F	1 500 F	1 750 F	2 000 F	2 177	2 318	2 458	2 204	2 200 F
Tonga	22	38	49	60	50 F	50 F	50 F	50 F	46 F	42 F
USA	341	428	2	10	7	7	12	17	10	3
77 Fishing area total	*2 802 F*	*2 573 F*	*2 251 F*	*5 059 F*	*2 176 F*	*2 500 F*	*3 129 F*	*2 776 F*	*2 453 F*	*2 427 F*
81 Australia	62	66	53	61	62	58	44	75	30	117
New Zealand	-	-	-	-	-	1	1	0	1	-
81 Fishing area total	*62*	*66*	*53*	*61*	*62*	*59*	*45*	*75*	*31*	*117*
87 Chile	17	2	48	39	5	7	11	33	1	4
Colombia	7	10	-	14	...	5 F	5 F	1 F	1	...
Peru	2 138	2 239	4 939	2 902	5 962	3 293	4 823	5 465	2 525	3 509
87 Fishing area total	*2 162*	*2 251*	*4 987*	*2 955*	*5 967*	*3 305 F*	*4 839 F*	*5 499 F*	*2 527*	*3 513*
Species total	*1 300 978 F*	*1 280 648 F*	*810 455 F*	*855 688 F*	*896 271 F*	*903 345 F*	*875 554 F*	*779 478 F*	*809 838 F*	*766 893 F*
Group total	***1 300 978***	***1 280 648***	***810 455***	***855 688***	***896 271***	***903 345***	***875 554***	***779 478***	***809 838***	***766 893***

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Blue-whales, fin-whales
Baleines bleues, rorquals communs
Ballenas azules, rorcuales

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
Minke whale	**Petit rorqual**		**Rorcual enano**		***Balaenoptera acutorostrata***				**4,23(02)001,01**	**MIW**
21 USA	...	-	-	-	-	-	1	4	-	-
21 Fishing area total	*...*	-	-	-	-	-	*1*	*4*	-	-
98 Japan	440	440	441	443	440	853	505	551	679	170
98 Fishing area total	*440*	*440*	*441*	*443*	*440*	*853*	*505*	*551*	*679*	*170*
99 Argentina	-	-	-	-	-	-	-	1	-	-
Australia	-	-	1	-	-	-	-	-	-	-
Belgium	-	-	-	1	-	-	-	-	-	-
Chile	-	-	-	1	-	-	-	-	1	-
France	-	-	-	1	-	-	-	-	-	-
Greenland	153	149	198	190	180	181	167	152	168	195
Iceland	-	2	36	25	41	62	45	39	81	60
Japan	179	259	275	274	349	342	362	302	280	243
Korea Rep	149	84	92	70	107	82	101	87	70	70
Norway	552	634	647	544	639	545	597	535	484	468
Portugal	-	-	-	1	1	1	-	-	-	-
Spain	-	-	2	-	4	-	-	2	-	-
UK	1	2	-	1	1	2	1	2	-	-
USA	3	4	5	3	6	1	-	-	-	-
99 Fishing area total	*1 037*	*1 134*	*1 256*	*1 111*	*1 328*	*1 216*	*1 273*	*1 120*	*1 084*	*1 036*
Species total	*1 477*	*1 574*	*1 697*	*1 554*	*1 768*	*2 069*	*1 779*	*1 675*	*1 763*	*1 206*
Bryde's whale	**Rorqual de Bryde**		**Rorcual tropical**		***Balaenoptera edeni***				**4,23(02)001,02**	**BRW**
99 Brazil	-	-	1	-	1	1	-	-	-	-
Japan	50	50	51	52	50	50	50	50	50	51
Korea Rep	-	-	-	-	-	-	1	-	-	1
New Zealand	-	-	-	-	-	1	-	-	-	-
St Vincent	-	-	-	-	1	-	-	-	-	-
USA	-	-	-	-	1	-	1	-	-	-
99 Fishing area total	*50*	*50*	*52*	*52*	*53*	*52*	*52*	*50*	*50*	*52*
Species total	*50*	*50*	*52*	*52*	*53*	*52*	*52*	*50*	*50*	*52*
Sei whale	**Rorqual de Rudolphi**		**Rorcual del Norte**		***Balaenoptera borealis***				**4,23(02)001,03**	**SIW**
21 USA	-	-	-	-	-	-	-	1	-	-
21 Fishing area total	-	-	-	-	-	-	-	*1*	-	-
98 Argentina	...	...	-	1	-	-	-	-	-	-
98 Fishing area total	*...*	*...*	-	*1*	-	-	-	-	-	-
99 Greenland	-	-	-	-	-	1	-	-	-	0
Japan	1	39	50	100	100	100	100	100	100	100
USA	1	-	1	-	1	-	-	-	-	-
99 Fishing area total	*2*	*39*	*51*	*100*	*101*	*101*	*100*	*100*	*100*	*100*
Species total	*2*	*39*	*51*	*101*	*101*	*101*	*100*	*101*	*100*	*100*
Blue whale	**Rorqual bleu**		**Ballena azul**		***Balaenoptera musculus***				**4,23(02)001,04**	**BLW**
98 Spain	-	-	-	1	-	-	-	-	-	-
98 Fishing area total	-	-	-	*1*	-	-	-	-	-	-
99 Australia	2	-	-	-	-	1	-	-	-	-
New Zealand	-	-	-	-	-	-	-	-	1	1
USA	-	-	-	1	-	-	-	-	-	-
99 Fishing area total	*2*	-	-	*1*	-	*1*	-	-	*1*	*1*
Species total	*2*	-	-	*2*	-	*1*	-	-	*1*	*1*
Fin whale	**Rorqual commun**		**Rorcual común**		***Balaenoptera physalus***				**4,23(02)001,06**	**FIW**
61 USA	...	-	-	-	-	-	1	-	-	-
61 Fishing area total	*...*	-	-	-	-	-	*1*	-	-	-
67 USA	-	-	-	-	-	-	2	-	-	-
67 Fishing area total	-	-	-	-	-	-	*2*	-	-	-
98 UK	-	-	-	-	-	-	1	-	-	-
98 Fishing area total	-	-	-	-	-	-	*1*	-	-	-
99 France	-	-	-	-	-	2	4	-	-	-
Greenland	8	13	9	13	14	10	12	14	10	5
Iceland	-	-	-	-	-	7	-	-	125	148
Italy	-	-	-	1	3	-	-	-	-	-
Japan	1	-	-	-	-	-	1	1	1	2
Korea Rep	-	1	-	1	1	1	-	-	-	-
Spain	-	-	1	1	2	-	-	-	-	-
USA	4	1	-	5	4	5	-	-	-	-
99 Fishing area total	*13*	*15*	*10*	*21*	*24*	*25*	*17*	*15*	*136*	*155*
Species total	*13*	*15*	*10*	*21*	*24*	*25*	*21*	*15*	*136*	*155*

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Blue-whales, fin-whales
Baleines bleues, rorquals communs
Ballenas azules, rorcuales

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
Humpback whale	**Baleine à bosse**		**Rorcual jorobado**		***Megaptera novaeangliae***				**4,23(02)003,01**	**HUW**
21 USA	-	-	-	-	-	4	1	2	-	-
21 Fishing area total	-	-	-	-	-	*4*	*1*	*2*	-	-
98 UK	-	-	-	-	-	-	1	-	-	-
98 Fishing area total	...	...	...	...	...	...	*1*	...	...	...
99 Australia	5	1	-	1	5	3	1	2	2	-
Belgium	-	-	-	-	-	1	-	-	-	-
Brazil	-	2	-	3	-	-	1	-	-	-
France	-	-	-	-	-	-	-	-	1	-
Greenland	2	5	2	-	-	-	-	-	-	9
Iceland	-	2	3	1	-	-	-	-	-	2
Ireland	-	-	-	1	-	-	-	-	-	-
Japan	3	3	3	5	4	3	1	2	4	8
Korea Rep	-	-	1	1	1	-	-	-	-	1
New Zealand	-	-	-	-	-	-	-	-	1	-
Peru	-	-	1	-	-	-	-	-	-	-
St Vincent	2	2	1	-	1	1	1	-	-	-
South Africa	-	-	-	1	-	-	-	-	-	-
USA	6	9	6	3	4	-	-	-	-	-
99 Fishing area total	*18*	*24*	*17*	*16*	*15*	*8*	*4*	*4*	*8*	*20*
Species total	*18*	*24*	*17*	*16*	*15*	*12*	*6*	*6*	*8*	*20*
Northern right whale	**Baleine de Biscaye**		**Ballena franca**		***Eubalaena glacialis***				**4,23(03)001,01**	**EUG**
21 USA	3	7	1	3	3	1	1	-	-	-
21 Fishing area total	*3*	*7*	*1*	*3*	*3*	*1*	*1*	-	-	-
67 USA	-	-	-	-	-	-	-	1	-	-
67 Fishing area total	-	-	-	-	-	-	-	*1*	-	-
99 Japan	-	-	1	-	-	-	-	-	-	-
99 Fishing area total	-	-	*1*	-	-	-	-	-	-	-
Species total	*3*	*7*	*2*	*3*	*3*	*1*	*1*	*1*	-	-
Southern right whale	**Baleine australe**		**Ballena franca austral**		***Eubalaena australis***				**4,23(03)001,02**	**EUA**
99 Argentina	-	-	1	-	-	-	-	-	-	-
Australia	4	-	-	-	-	-	-	-	-	-
Brazil	-	-	1	-	-	-	-	-	-	-
99 Fishing area total	*4*	-	*2*	-	-	-	-	-	-	-
Species total	*4*	-	*2*	-	-	-	-	-	-	-
Bowhead whale	**Baleine du Groenland**		**Ballena de cabeza arqueada**		***Balaena mysticetus***				**4,23(03)002,01**	**BMY**
61 Russian Fed	1	2	3	1	2	-	-	-	8	-
61 Fishing area total	*1*	*2*	*3*	*1*	*2*	-	-	-	*8*	-
67 Russian Fed	-	-	-	-	-	-	-	2	-	-
USA	49	39	35	36	55	32	63	50	-	-
67 Fishing area total	*49*	*39*	*35*	*36*	*55*	*32*	*63*	*52*	-	-
99 Greenland	-	-	-	-	-	-	1	-	3	3
99 Fishing area total	-	-	-	-	-	-	*1*	-	*3*	*3*
Species total	*50*	*41*	*38*	*37*	*57*	*32*	*64*	*52*	*11*	*3*
Gray whale	**Baleine grise**		**Ballena gris**		***Eschrichtius robustus***				**4,23(04)001,01**	**GRW**
61 Russian Fed	112	131	-	78	71	92	90	25	-	-
61 Fishing area total	*112*	*131*	-	*78*	*71*	*92*	*90*	*25*	-	-
67 Russian Fed	-	-	126	29	46	34	36	102	102	-
67 Fishing area total	-	-	*126*	*29*	*46*	*34*	*36*	*102*	*102*	-
99 Japan	-	-	-	-	-	-	1	-	-	-
Mexico	-	-	-	-	-	1	-	-	-	-
99 Fishing area total	-	-	-	-	-	*1*	*1*	-	-	-
Species total	*112*	*131*	*126*	*107*	*117*	*127*	*127*	*127*	*102*	-
Baleen whales nei	**Baleines mysticètes nca**		**Ballenas mysticetas nep**		***Mysticeti***				**4,23(XX)XXX,XX**	**MYS**
99 Argentina	-	-	1	-	-	-	-	-	-	-
Australia	-	-	-	-	-	-	-	-	-	1
Chile	-	-	-	-	1	-	-	-	-	-
Japan	1	-	-	-	-	-	-	-	-	-
New Zealand	-	1	-	-	-	-	-	-	-	-
Oman	1	1	-	-	-	-	-	-	-	-
USA	-	-	-	1	-	-	-	-	-	-
99 Fishing area total	*2*	*2*	*1*	*1*	*1*	-	-	-	-	*1*

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Blue-whales, fin-whales
Baleines bleues, rorquals communs
Ballenas azules, rorcuales

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
Species total	*2*	*2*	*1*	*1*	*1*	*-*	*-*	*-*	*-*	*1*
Group total	***1 733***	***1 883***	***1 996***	***1 894***	***2 139***	***2 420***	***2 150***	***2 027***	***2 171***	***1 538***

Fishing area 98: Antarctic areas nei. Split-year data shown under the calendar year in which the split-year ends.

Fishing area 99: Marine areas outside the Antarctic. Calendar year data.

Data are derived mainly from sources of the International Whaling Commission (IWC).

See paragraph 5 of the INTRODUCTION.

Zone de pêche 98: Zones antarctiques nca. Données relatives à des années fractionnées figurant sous l'année civile durant laquelle se termine l'année fractionnée.

Zone de pêche 99: Zones maritimes hors de l'Antarctique. Données relatives à l'année civile.

Données provenant principalement des sources de la Commission baleinière internationale.

Voir le paragraphe 5 de l'INTRODUCTION.

Área de pesca 98: Áreas antárticas nep. Datos correspondientes a los años emergentes que figuran en la columna del año civil en que finaliza el año emergente.

Área de pesca 99: Áreas marítimas fuera del Antártico. Datos relativos al año civil.

Datos obtenidos por la mayoría desde fuentes de la Comisión Ballenera Internacional.

Véase el párrafo 5 en la INTRODUCCIÓN.

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Sperm-whales, pilot-whales
Cachalots, globicéphales
Cachalotes, calderones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
Cuvier's beaked whale	**Ziphius**		**Zifio de Cuvier**		***Ziphius cavirostris***				**4,22(02)001,01**	**BCW**
99 Italy	...	...	-	-	1	-	-	-	-	-
Korea Rep	-	-	-	-	-	-	-	-	-	1
Spain	-	10	-	2	-	-	1	-	-	-
99 Fishing area total	*...*	*10*	*-*	*2*	*1*	*-*	*1*	*-*	*-*	*1*
Species total	*...*	*10*	*-*	*2*	*1*	*-*	*1*	*-*	*-*	*1*
Blainville's beaked whale	**Baleine à bec de Blainville**		**Zifio de Blainville**		***Mesoplodon densirostris***				**4,22(02)003,01**	**BBW**
99 Spain	-	1	-	-	-	-	-	-	-	-
USA	-	-	-	-	1	-	-	-	-	-
99 Fishing area total	*-*	*1*	*-*	*-*	*1*	*-*	*-*	*-*	*-*	*-*
Species total	*-*	*1*	*-*	*-*	*1*	*-*	*-*	*-*	*-*	*-*
Gervais' beaked whale	**Baleine à bec de Gervais**		**Zifio de Gervais**		***Mesoplodon europaeus***				**4,22(02)003,08**	**BGW**
99 Spain	-	1	-	-	-	-	-	-	-	-
99 Fishing area total	*-*	*1*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
Species total	*-*	*1*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
Strap-toothed whale	**Baleine à bec de Layard**		**Zifio de Layard**		***Mesoplodon layardii***				**4,22(02)003,10**	**TSW**
99 Australia	-	-	-	-	-	-	-	1	-	-
Chile	...	...	-	-	-	1	-	-	-	-
99 Fishing area total	*...*	*...*	*-*	*-*	*-*	*1*	*-*	*1*	*-*	*-*
Species total	*...*	*...*	*-*	*-*	*-*	*1*	*-*	*1*	*-*	*-*
Stejneger's beaked whale	**Baleine à bec de Stejneger**		**Zifio de Stejneger**		***Mesoplodon stejnegeri***				**4,22(02)003,13**	**BJW**
99 Korea Rep	-	2	2	-	-	-	-	1	-	1
99 Fishing area total	*-*	*2*	*2*	*-*	*-*	*-*	*-*	*1*	*-*	*1*
Species total	*-*	*2*	*2*	*-*	*-*	*-*	*-*	*1*	*-*	*1*
Beaked whales nei	**...B**		**...C**		***Mesoplodon spp***				**4,22(02)003,XX**	**MEP**
99 Spain	-	1	-	-	-	-	-	-	-	-
99 Fishing area total	*-*	*1*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
Species total	*-*	*1*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
Northern bottlenose whale	**Hyperoodon boréal**		**Ballena nariz de botella norte**		***Hyperoodon ampullatus***				**4,22(02)005,01**	**BOW**
99 Faroe Is	2	6	-	-	-	-	-	7	-	-
99 Fishing area total	*2*	*6*	*-*	*-*	*-*	*-*	*-*	*7*	*-*	*-*
Species total	*2*	*6*	*-*	*-*	*-*	*-*	*-*	*7*	*-*	*-*
Baird's beaked whale	**Baleine à bec de Baird**		**Zifio de Baird**		***Berardius bairdii***				**4,22(02)019,02**	**BEW**
99 Japan	62	62	62	62	66	63	67	64	67	66
Korea Rep	1	1	1	-	1	-	-	-	-	-
99 Fishing area total	*63*	*63*	*63*	*62*	*67*	*63*	*67*	*64*	*67*	*66*
Species total	*63*	*63*	*63*	*62*	*67*	*63*	*67*	*64*	*67*	*66*
Sperm whale	**Cachalot**		**Cachalote**		***Physeter macrocephalus***				**4,22(03)001,01**	**SPW**
67 USA	-	-	-	-	-	3	-	2	-	-
67 Fishing area total	*-*	*-*	*-*	*-*	*-*	*3*	*-*	*2*	*-*	*-*
98 UK	-	-	-	-	1	-	-	-	-	-
98 Fishing area total	*...*	*...*	*...*	*...*	*1*	*...*	*...*	*...*	*...*	*...*
99 Australia	-	-	-	-	1	1	3	-	-	-
Belgium	-	-	-	1	-	-	-	-	-	-
Chile	-	-	-	-	-	1	-	-	-	-
France	-	-	-	-	-	1	1	-	1	1
Greenland	-	-	-	-	1	-	-	-	-	0
Italy	-	-	-	-	-	-	-	-	-	1
Japan	8	5	10	3	5	7	3	2	1	3
Oman	1	1	-	-	-	-	-	-	-	-
Peru	-	-	1	-	9	-	-	-	-	-
Spain	3	-	2	3	2	3	-	-	1	1
USA	-	-	-	1	-	-	-	-	-	-
99 Fishing area total	*12*	*6*	*13*	*8*	*18*	*13*	*7*	*2*	*3*	*6*
Species total	*12*	*6*	*13*	*8*	*19*	*16*	*7*	*4*	*3*	*6*
Irrawaddy dolphin	**Orcelle**		**Delfín del Irawaddy**		***Orcaella brevirostris***				**4,22(04)001,01**	**IRD**
99 Australia	-	-	-	-	1	-	2	-	-	-
99 Fishing area total	*-*	*-*	*-*	*-*	*1*	*-*	*2*	*-*	*-*	*-*

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Sperm-whales, pilot-whales
Cachalots, globicéphales
Cachalotes, calderones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
Species total	-	-	-	-	*1*	-	*2*	-	-	-
Australian snubfin dolphin	**Dauphin australien de Heinsohn**		**Delfín de Heinsohn**		***Orcaella heinsohni***				**4,22(04)001,02**	**IDB**
99 Australia	-	-	-	-	-	2	-	1	-	-
99 Fishing area total	-	-	-	-	-	*2*	-	*1*	-	-
Species total	-	-	-	-	-	*2*	-	*1*	-	-
False killer whale	**Faux-orque**		**Orca falsa**		***Pseudorca crassidens***				**4,22(04)003,01**	**FAW**
99 Australia	1	-	-	-	-	-	1	-	-	-
Japan	37	7	21	7	1	35	4	5	1	-
Korea Rep	-	-	-	-	1	1	-	1	-	1
Oman	1	-	-	-	-	-	-	-	-	-
Spain	-	-	1	-	-	-	-	-	-	-
USA	...	...	-	1	2	-	-	-	-	-
99 Fishing area total	*39*	*7*	*22*	*8*	*4*	*36*	*5*	*6*	*1*	*1*
Species total	*39*	*7*	*22*	*8*	*4*	*36*	*5*	*6*	*1*	*1*
Long-finned pilot whale	**Globicéphale commun**		**Calderón común**		***Globicephala melas***				**4,22(04)004,02**	**PIW**
21 USA	94	54	-	7	5	2	4	11	-	-
21 Fishing area total	*94*	*54*	-	*7*	*5*	*2*	*4*	*11*	-	-
99 Chile	-	-	-	-	-	12	-	-	-	-
Faroe Is	918	626	503	1 010	302	-	-	-	99	-
France	2	2	1	1	1	-	1	4	-	1
Greenland	62	38	195	265	345	46	287	182	443	216
New Zealand	-	1	-	6	-	-	-	2	1	-
Spain	-	4	-	1	-	-	-	1	-	-
99 Fishing area total	*982*	*671*	*699*	*1 283*	*648*	*58*	*288*	*189*	*543*	*217*
Species total	*1 076*	*725*	*699*	*1 290*	*653*	*60*	*292*	*200*	*543*	*217*
Short-finned pilot whale	**Globicéphale tropical**		**Calderón de aletas cortas**		***Globicephala macrorhynchus***				**4,22(04)004,03**	**SHW**
99 Japan	391	181	160	205	177	271	338	181	295	44
Spain	-	1	-	-	-	-	-	-	-	-
USA	-	-	5	-	-	-	-	-	-	-
Other nei	-	1	2	-	-	-	-	-	-	-
99 Fishing area total	*391*	*183*	*167*	*205*	*177*	*271*	*338*	*181*	*295*	*44*
Species total	*391*	*183*	*167*	*205*	*177*	*271*	*338*	*181*	*295*	*44*
Pilot whales nei	**...B**		**...C**		***Globicephala spp***				**4,22(04)004,XX**	**GLO**
99 Spain	-	-	-	-	-	-	-	-	-	1
99 Fishing area total	-	-	-	-	-	-	-	-	-	*1*
Species total	-	-	-	-	-	-	-	-	-	*1*
Common dolphin	**Dauphin commun**		**Delfín común**		***Delphinus delphis***				**4,22(04)006,01**	**DCO**
21 USA	126	1	1	12	-	15	5	4	-	-
21 Fishing area total	*126*	*1*	*1*	*12*	-	*15*	*5*	*4*	-	-
67 USA	25	52	84	9	30	7	9	8	-	-
67 Fishing area total	*25*	*52*	*84*	*9*	*30*	*7*	*9*	*8*	-	-
77 Other nei	343	228	372	481	-	-	-	-	-	-
77 Fishing area total	*343*	*228*	*372*	*481*	-	-	-	-	-	-
81 New Zealand	-	-	-	-	-	-	-	-	-	15
81 Fishing area total	-	-	-	-	-	-	-	-	-	*15*
99 Argentina	-	-	-	-	-	-	1	-	-	-
Australia	7	15	11	12	20	22	22	25	21	26
France	118	207	62	94	70	52	16	22	145	-
Ireland	1	16	7	5	-	7	-	-	-	-
Italy	-	-	-	-	7	-	-	4	-	-
Korea Rep	62	79	113	92	204	345	368	244	254	-
Netherlands	...	...	-	-	-	1	-	-	-	-
New Zealand	3	2	33	23	1	3	27	1	13	-
Oman	1	-	-	-	-	-	-	-	-	-
Peru	7	162	-	2	5	1	-	-	-	-
Portugal	...	...	2	5	-	-	-	28	-	-
Spain	4	8	151	102	-	9	-	4	-	-
UK	72	37	120	411	-	32	35	4	-	-
99 Fishing area total	*275*	*526*	*499*	*746*	*307*	*472*	*469*	*332*	*433*	*26*
Species total	*769*	*807*	*956*	*1 248*	*337*	*494*	*483*	*344*	*433*	*41*
Long-beaked common dolphin	**Dauphin commun a bec large**		**Delfín común a pico largo**		***Delphinus capensis***				**4,22(04)006,02**	**DCZ**
67 USA	-	-	-	-	-	-	-	1	-	-
67 Fishing area total	-	-	-	-	-	-	-	*1*	-	-

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Sperm-whales, pilot-whales
Cachalots, globicéphales
Cachalotes, calderones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
77 USA	-	15	-	11	5	-	-	-	-	-
77 Fishing area total	-	*15*	-	*11*	*5*	-	-	-	-	-
99 Australia	-	-	-	2	-	-	-	-	-	6
Korea Rep	-	-	-	-	-	-	-	-	-	198
Peru	7	161	-	-	-	-	-	-	-	-
South Africa	13	32	31	40	39	-	-	-	-	-
99 Fishing area total	*20*	*193*	*31*	*42*	*39*	-	-	-	-	*204*
Species total	*20*	*208*	*31*	*53*	*44*	-	-	*1*	-	*204*
Risso's dolphin	**Grampus**		**Delfín de Risso**		***Grampus griseus***				**4,22(04)012,01**	**DRR**
21 USA	26	-	-	2	-	-	-	1	-	-
21 Fishing area total	*26*	-	-	*2*	-	-	-	*1*	-	-
67 USA	-	-	20	-	2	1	1	2	-	-
67 Fishing area total	-	-	*20*	-	*2*	*1*	*1*	*2*	-	-
99 Australia	-	-	-	-	1	-	-	-	-	-
Ireland	-	-	1	-	-	-	-	-	-	-
Italy	-	1	-	1	-	-	-	-	-	-
Japan	478	388	379	504	394	344	497	338	430	397
Korea Rep	25	2	2	3	3	-	1	2	-	-
Spain	-	-	3	5	-	-	-	-	-	-
Tanzania	11	-	1	1	-	-	-	-	-	-
UK	-	-	-	1	-	-	-	-	-	-
99 Fishing area total	*514*	*391*	*386*	*515*	*398*	*344*	*498*	*340*	*430*	*397*
Species total	*540*	*391*	*406*	*517*	*400*	*345*	*499*	*343*	*430*	*397*
Melon-headed whale	**Péponocéphale**		**Calderón pequeño**		***Peponocephala electra***				**4,22(04)013,01**	**MEW**
99 Australia	-	-	-	-	-	-	-	1	-	1
99 Fishing area total	-	-	-	-	-	-	-	*1*	-	*1*
Species total	-	-	-	-	-	-	-	*1*	-	*1*
Tucuxi	**Sotalia**		**Bufeo negro**		***Sotalia fluviatilis***				**4,22(04)014,01**	**TUC**
03 Brazil	4	18	87	61	15	16	21	-	-	-
Fr Guiana	-	1	3	1	-	-	-	-	-	-
03 Fishing area total	*4*	*19*	*90*	*62*	*15*	*16*	*21*	-	-	-
Species total	*4*	*19*	*90*	*62*	*15*	*16*	*21*	-	-	-
Guyana dolphin	**Dauphin de Guyane**		**Delfín costero**		***Sotalia guianensis***				**4,22(04)014,02**	**TZG**
41 Brazil	-	-	-	-	-	-	114	22	22	60
41 Fishing area total	-	-	-	-	-	-	*114*	*22*	*22*	*60*
Species total	-	-	-	-	-	-	*114*	*22*	*22*	*60*
Indo-Pac. hump-backed dolphin	**Dauphin à bosse indo-pacifique**		**Delfín jorobado del Pacífico**		***Sousa chinensis***				**4,22(04)015,02**	**DHI**
99 Australia	2	6	6	1	1	-	1	-	-	1
Oman	6	1	1	-	-	-	-	-	-	-
South Africa	2	9	3	10	9	-	-	-	-	-
Tanzania	5	1	4	1	-	-	-	-	-	-
99 Fishing area total	*15*	*17*	*14*	*12*	*10*	-	*1*	-	-	*1*
Species total	*15*	*17*	*14*	*12*	*10*	-	*1*	-	-	*1*
Rough-toothed dolphin	**Sténo**		**Esteno**		***Steno bredanensis***				**4,22(04)016,01**	**RTD**
77 Other nei	-	5	-	1	-	-	-	-	-	-
77 Fishing area total	-	*5*	-	*1*	-	-	-	-	-	-
99 Brazil	-	1	1	-	-	-	-	-	-	-
99 Fishing area total	-	*1*	*1*	-	-	-	-	-	-	-
Species total	-	*6*	*1*	*1*	-	-	-	-	-	-
Killer whale	**Orque**		**Orca**		***Orcinus orca***				**4,22(04)022,01**	**KIW**
99 Greenland	2	21	5	14	2	-	3	23	13	7
Korea Rep	-	3	-	1	1	-	-	3	2	-
New Zealand	-	1	-	-	-	-	-	-	-	-
Spain	-	1	-	-	-	-	-	-	-	-
USA	2	1	-	1	-	-	-	1	-	-
99 Fishing area total	*4*	*27*	*5*	*16*	*3*	-	*3*	*27*	*15*	*7*
Species total	*4*	*27*	*5*	*16*	*3*	-	*3*	*27*	*15*	*7*
Northern right whale dolphin	**Dauphin à dos lisse boréal**		**Delfín liso del Norte**		***Lissodelphis borealis***				**4,22(04)026,01**	**RNW**
67 USA	-	-	-	-	-	-	1	-	-	-
67 Fishing area total	-	-	-	-	-	-	*1*	-	-	-

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Sperm-whales, pilot-whales
Cachalots, globicéphales
Cachalotes, calderones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
99 USA	9	15	5	-	-	-	-	-	-	-
99 Fishing area total	*9*	*15*	*5*	-	-	-	-	-	-	-
Species total	*9*	*15*	*5*	-	-	-	*1*	-	-	-
Commerson's dolphin	**Dauphin de Commerson**		**Tonina overa**		***Cephalorhynchus commersonii***				**4,22(04)027,01**	**CMD**
99 Argentina	37	40	16	12	24	14	-	-	21	21
99 Fishing area total	*37*	*40*	*16*	*12*	*24*	*14*	-	-	*21*	*21*
Species total	*37*	*40*	*16*	*12*	*24*	*14*	-	-	*21*	*21*
Hector's dolphin	**Dauphin d'Hector**		**Delfín de Hector**		***Cephalorhynchus hectori***				**4,22(04)027,03**	**HCD**
81 New Zealand	-	-	-	-	-	-	-	-	-	2
81 Fishing area total	-	-	-	-	-	-	-	-	-	*2*
99 New Zealand	13	8	-	2	11	4	1	1	2	-
99 Fishing area total	*13*	*8*	-	*2*	*11*	*4*	*1*	*1*	*2*	-
Species total	*13*	*8*	-	*2*	*11*	*4*	*1*	*1*	*2*	*2*
Pacific white-sided dolphin	**Dauphin à flancs blancs Pacif.**		**Delfín costados blancos Pacíf.**		***Lagenorhynchus obliquidens***				**4,22(04)028,01**	**DWP**
67 USA	-	-	-	-	-	-	1	5	-	-
67 Fishing area total	-	-	-	-	-	-	*1*	*5*	-	-
99 Japan	6	9	9	-	-	-	-	21	21	27
Korea Rep	41	53	18	20	47	29	60	21	25	17
USA	6	5	-	1	-	-	-	-	-	-
99 Fishing area total	*53*	*67*	*27*	*21*	*47*	*29*	*60*	*42*	*46*	*44*
Species total	*53*	*67*	*27*	*21*	*47*	*29*	*61*	*47*	*46*	*44*
Dusky dolphin	**Dauphin sombre**		**Delfín obscuro**		***Lagenorhynchus obscurus***				**4,22(04)028,02**	**DDU**
81 New Zealand	-	-	-	-	-	-	-	-	-	3
81 Fishing area total	-	-	-	-	-	-	-	-	-	*3*
99 New Zealand	3	-	-	-	-	2	-	-	1	-
Peru	2	-	-	-	-	-	-	-	-	-
99 Fishing area total	*5*	-	-	-	-	*2*	-	-	*1*	-
Species total	*5*	-	-	-	-	*2*	-	-	*1*	*3*
White-beaked dolphin	**Dauphin à bec blanc**		**Delfín de hocico blanco**		***Lagenorhynchus albirostris***				**4,22(04)028,03**	**BWD**
99 Belgium	...	...	-	-	1	1	-	-	-	-
99 Fishing area total	*...*	*...*	-	-	*1*	*1*	-	-	-	-
Species total	*...*	*...*	-	-	*1*	*1*	-	-	-	-
Atlantic white-sided dolphin	**Dauphin à flancs blancs Atlan.**		**Delfín de flancos blancos**		***Lagenorhynchus acutus***				**4,22(04)028,04**	**DWH**
21 USA	-	-	-	-	-	-	4	10	-	-
21 Fishing area total	-	-	-	-	-	-	*4*	*10*	-	-
99 Faroe Is	546	774	186	333	310	-	-	1	-	-
Ireland	-	-	-	1	-	-	-	-	-	-
Netherlands	...	...	-	-	-	1	-	-	-	-
Spain	1	-	1	-	-	1	-	-	-	-
USA	28	31	-	21	68	11	-	-	-	-
99 Fishing area total	*575*	*805*	*187*	*355*	*378*	*13*	-	*1*	-	-
Species total	*575*	*805*	*187*	*355*	*378*	*13*	*4*	*11*	-	-
Peale's dolphin	**Dauphin de Peale**		**Delfín austral**		***Lagenorhynchus australis***				**4,22(04)028,06**	**PLD**
99 Argentina	-	-	1	2	-	-	-	-	-	-
Chile	-	-	-	-	2	-	-	-	-	-
99 Fishing area total	-	-	*1*	*2*	*2*	-	-	-	-	-
Species total	-	-	*1*	*2*	*2*	-	-	-	-	-
Bottlenose dolphin	**Grand dauphin**		**Tursion**		***Tursiops truncatus***				**4,22(04)029,01**	**DBO**
21 USA	...	...	-	1	2	-	-	-	-	-
21 Fishing area total	*...*	*...*	-	*1*	*2*	-	-	-	-	-
31 Mexico	-	-	-	-	-	-	1	9	-	-
31 Fishing area total	-	-	-	-	-	-	*1*	*9*	-	-
37 Croatia	-	2	1	-	1	-	3	5	2	-
37 Fishing area total	-	*2*	*1*	-	*1*	-	*3*	*5*	*2*	-
67 USA	...	...	-	1	-	-	-	-	-	-
67 Fishing area total	*...*	*...*	-	*1*	-	-	-	-	-	-
77 Mexico	16	2	-	-	-	-	-	-	-	-

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Sperm-whales, pilot-whales
Cachalots, globicéphales
Cachalotes, calderones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
Other nei	1	10	4	-	-	-	-	-	-	-
77 Fishing area total	*17*	*12*	*4*	-	-	-	-	-	-	-
81 New Zealand	-	-	-	-	-	-	-	-	-	1
81 Fishing area total	-	-	-	-	-	-	-	-	-	*1*
99 Argentina	-	-	-	-	1	-	-	-	-	-
Australia	9	9	-	4	15	75	26	9	4	2
Brazil	-	-	2	6	-	1	-	1	1	-
Faroe Is	6	18	3	-	1	-	-	-	-	-
France	10	13	13	8	11	-	4	1	1	-
Ireland	-	1	-	-	-	-	-	-	-	-
Italy	-	1	3	3	7	1	6	-	-	2
Japan	259	801	181	653	363	372	401	391	433	434
Korea Rep	3	4	1	4	15	-	18	4	3	4
New Zealand	-	-	-	-	-	-	-	1	-	-
Oman	8	1	-	-	-	-	-	-	-	-
Peru	1	-	-	-	-	-	-	-	-	-
Portugal	-	-	-	-	-	-	-	1	-	-
South Africa	22	35	36	27	29	-	-	-	-	-
Spain	2	7	12	16	-	2	-	-	-	-
Tanzania	-	1	1	-	-	-	-	-	-	-
UK	-	-	-	1	-	-	1	1	-	-
USA	-	83	-	-	-	-	-	-	-	-
99 Fishing area total	*320*	*974*	*252*	*722*	*442*	*451*	*456*	*409*	*442*	*442*
Species total	*337*	*988*	*257*	*724*	*445*	*451*	*460*	*423*	*444*	*443*

Indo-Pacif. bottlenose dolphin **Grand dauphin indo-pacifique** **Delfín mular del Indo-Pacífico** ***Tursiops aduncus*** **4,22(04)029,02** **DBZ**

99 Australia	...	1	5	3	4	1	4	-	2	1
Korea Rep	-	-	-	-	-	-	-	2	5	6
Tanzania	12	11	15	6	-	-	-	-	-	-
99 Fishing area total	*12*	*12*	*20*	*9*	*4*	*1*	*4*	*2*	*7*	*7*
Species total	*12*	*12*	*20*	*9*	*4*	*1*	*4*	*2*	*7*	*7*

Pantropical spotted dolphin **Dauphin tacheté pantropical** **Estenela moteada** ***Stenella attenuata*** **4,22(04)032,01** **DPN**

67 USA	-	-	-	-	-	-	-	1	-	-
67 Fishing area total	-	-	-	-	-	-	-	*1*	-	-
99 Australia	-	-	-	-	-	-	-	3	3	-
Brazil	-	1	-	-	-	1	-	-	-	-
Japan	10	419	132	2	13	405	16	329	3	132
Tanzania	4	-	2	1	-	-	-	-	-	-
Other nei	903	646	631	507	-	-	-	-	-	-
99 Fishing area total	*917*	*1 066*	*765*	*510*	*13*	*406*	*16*	*332*	*6*	*132*
Species total	*917*	*1 066*	*765*	*510*	*13*	*406*	*16*	*333*	*6*	*132*

Spinner dolphin **Dauphin longirostre** **Estenela giradora** ***Stenella longirostris*** **4,22(04)032,02** **DSI**

77 Other nei	841	594	460	441	-	-	-	-	-	-
77 Fishing area total	*841*	*594*	*460*	*441*	-	-	-	-	-	-
99 Australia	-	-	4	-	-	1	1	-	2	-
Oman	1	-	-	-	-	-	-	-	-	-
Tanzania	18	1	10	3	-	-	-	-	-	-
99 Fishing area total	*19*	*1*	*14*	*3*	-	*1*	*1*	-	*2*	-
Species total	*860*	*595*	*474*	*444*	-	*1*	*1*	-	*2*	-

Striped dolphin **Dauphin bleu et blanc** **Estenela listada** ***Stenella coeruleoalba*** **4,22(04)032,03** **DST**

37 Croatia	-	2	-	-	1	-	-	1	-	-
37 Fishing area total	-	*2*	-	-	*1*	-	-	*1*	-	-
67 USA	-	-	-	-	-	1	-	-	-	-
67 Fishing area total	-	-	-	-	-	*1*	-	-	-	-
77 Other nei	3	2	11	5	-	-	-	-	-	-
77 Fishing area total	*3*	*2*	*11*	*5*	-	-	-	-	-	-
99 Brazil	-	-	1	-	-	-	-	-	-	-
France	15	23	21	9	25	-	3	4	8	6
Ireland	-	-	-	-	-	1	-	-	-	-
Italy	-	8	7	1	4	-	1	4	-	-
Japan	484	642	450	637	457	515	470	598	419	558
Spain	1	12	67	60	-	1	1	1	-	-
UK	3	-	-	-	-	-	-	-	-	-
99 Fishing area total	*503*	*685*	*546*	*707*	*486*	*517*	*475*	*607*	*427*	*564*
Species total	*506*	*689*	*557*	*712*	*487*	*518*	*475*	*608*	*427*	*564*

Atlantic spotted dolphin **Dauphin tacheté de l'Atlantiq.** **Delfín pintado** ***Stenella frontalis*** **4,22(04)032,04** **DSA**

99 Spain	1	-	-	2	-	-	2	-	-	-
99 Fishing area total	*1*	-	-	*2*	-	-	*2*	-	-	-

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Sperm-whales, pilot-whales
Cachalots, globicéphales
Cachalotes, calderones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
Species total	*1*	-	-	*2*	-	-	*2*	-	-	-
Clymene dolphin	**Dauphin de Clyméné**		**Delfín clymene**		***Stenella clymene***				**4,22(04)032,05**	**DCL**
99 Brazil	-	1	6	2	-	2	-	-	-	-
99 Fishing area total	-	*1*	*6*	*2*	-	*2*	-	-	-	-
Species total	-	*1*	*6*	*2*	-	*2*	-	-	-	-
Spotted dolphins nei	**Dauphins tachetés nca**		**Estenelas nep**		***Stenella spp***				**4,22(04)032,XX**	**DSP**
99 France	1	-	-	-	-	-	-	-	-	-
99 Fishing area total	*1*	-	-	-	-	-	-	-	-	-
Species total	*1*	-	-	-	-	-	-	-	-	-
Dolphins nei	**Dauphins nca**		**Delfínidos nep**		***Delphinidae***				**4,22(04)XXX,XX**	**DLP**
21 USA	...	...	-	7	2	4	-	-	-	-
21 Fishing area total	...	...	-	*7*	*2*	*4*	-	-	-	-
77 Other nei	40	29	22	34	-	-	-	-	-	-
77 Fishing area total	*40*	*29*	*22*	*34*	-	-	-	-	-	-
99 Australia	2	-	1	19	1	2	5	5	1	-
France	15	18	8	3	7	-	-	-	-	-
Greenland	...	...	7	-	26	70	39	96	300	208
Iceland	-	6	-	3	14	-	-	3	-	-
Italy	-	1	-	-	-	-	-	-	-	-
Japan	1	1	1	-	-	-	-	-	-	-
Korea Rep	-	4	7	1	5	1	-	-	-	-
Oman	1	1	-	-	-	-	-	-	-	-
Peru	-	17	-	-	-	-	-	-	-	-
South Africa	-	2	-	-	-	-	-	-	-	-
Spain	1	1	52	59	-	2	-	-	-	-
99 Fishing area total	*20*	*51*	*76*	*85*	*53*	*75*	*44*	*104*	*301*	*208*
Species total	*60*	*80*	*98*	*126*	*55*	*79*	*44*	*104*	*301*	*208*
Harbour porpoise	**Marsouin commun**		**Marsopa común**		***Phocoena phocoena***				**4,22(05)002,01**	**PHR**
21 USA	79	483	-	29	40	55	36	40	-	-
21 Fishing area total	*79*	*483*	-	*29*	*40*	*55*	*36*	*40*	-	-
67 USA	5	16	-	5	-	-	1	-	-	-
67 Fishing area total	*5*	*16*	-	*5*	-	-	*1*	-	-	-
99 Belgium	-	-	-	17	18	27	-	-	15	-
Denmark	3 887	-	-	-	-	-	-	-	-	-
France	12	9	16	32	25	21	19	10	4	2
Germany	8	8	10	5	4	9	27	8	8	4
Greenland	2 216	2 132	2 325	2 963	3 214	2 923	2 901	1 764	3 654	1 661
Iceland	-	128	-	362	206	-	-	84	-	-
Ireland	1	5	-	1	-	3	2	-	-	-
Japan	1	5	-	-	-	-	-	-	-	-
Korea Rep	87	34	104	22	105	55	5	15	36	31
Netherlands	-	-	-	100	150	250	173	-	-	38
Norway	-	-	-	-	-	149	-	-	-	0
Portugal	...	...	2	1	3	-	-	6	-	-
Spain	1	-	5	8	-	-	-	-	-	-
Sweden	3	3	5	1	-	2	3	1	1	-
Turkey	-	20	-	-	-	-	-	-	-	-
UK	11	29	22	53	-	20	16	21	-	-
99 Fishing area total	*6 227*	*2 373*	*2 489*	*3 565*	*3 725*	*3 459*	*3 146*	*1 909*	*3 718*	*1 736*
Species total	*6 311*	*2 872*	*2 489*	*3 599*	*3 765*	*3 514*	*3 183*	*1 949*	*3 718*	*1 736*
Burmeister's porpoise	**Marsouin de Burmeister**		**Marsopa espinosa**		***Phocoena spinipinnis***				**4,22(05)002,02**	**BRP**
99 Argentina	-	-	-	-	-	1	-	-	-	-
Chile	-	-	-	-	-	-	2	-	-	-
Peru	14	125	-	-	-	-	-	-	-	-
99 Fishing area total	*14*	*125*	-	-	-	*1*	*2*	-	-	-
Species total	*14*	*125*	-	-	-	*1*	*2*	-	-	-
Vaquita	**Marsouin du golfe de Californi**		**Vaquita**		***Phocoena sinus***				**4,22(05)002,03**	**VAQ**
77 Mexico	2	1	-	-	-	-	-	1	-	3
77 Fishing area total	*2*	*1*	-	-	-	-	-	*1*	-	*3*
Species total	*2*	*1*	-	-	-	-	-	*1*	-	*3*
Spectacled porpoise	**Marsouin de Lahille**		**Marsopa de anteojos**		***Phocaena dioptrica***				**4,22(05)002,04**	**SPP**
99 Argentina	4	5	6	1	4	6	-	-	-	4
99 Fishing area total	*4*	*5*	*6*	*1*	*4*	*6*	-	-	-	*4*

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Sperm-whales, pilot-whales
Cachalots, globicéphales
Cachalotes, calderones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
Species total	*4*	*5*	*6*	*1*	*4*	*6*	-	-	-	*4*
Finless porpoise	**Marsouin aptère**		**Marsopa lisa o sin aleta**		***Neophocaena phocaenoides***				**4,22(05)003,01**	**PFI**
99 Japan	9	8	9	-	-	-	-	-	-	-
Korea Rep	107	67	132	37	57	30	56	347	161	246
99 Fishing area total	*116*	*75*	*141*	*37*	*57*	*30*	*56*	*347*	*161*	*246*
Species total	*116*	*75*	*141*	*37*	*57*	*30*	*56*	*347*	*161*	*246*
Dall's porpoise	**Marsouin de Dall**		**Marsopa de Dall**		***Phocoenoides dalli***				**4,22(05)033,01**	**PDA**
67 USA	-	-	-	-	-	1	-	-	-	-
67 Fishing area total	-	-	-	-	-	*1*	-	-	-	-
99 Japan	16 650	15 949	15 720	13 789	14 664	12 014	11 357	7 226	9 540	4 919
Korea Rep	2	1	-	1	1	-	-	1	-	-
USA	3	1	-	1	2	-	-	-	-	-
99 Fishing area total	*16 655*	*15 951*	*15 720*	*13 791*	*14 667*	*12 014*	*11 357*	*7 227*	*9 540*	*4 919*
Species total	*16 655*	*15 951*	*15 720*	*13 791*	*14 667*	*12 015*	*11 357*	*7 227*	*9 540*	*4 919*
White whale	**Bélouga**		**Beluga**		***Delphinapterus leucas***				**4,22(06)014,01**	**BEL**
27 Russian Fed	-	5	-	-	1	-	-	-	-	-
27 Fishing area total	-	*5*	-	-	*1*	-	-	-	-	-
61 Russian Fed	7	15	39	17	2	3	-	-	-	-
61 Fishing area total	*7*	*15*	*39*	*17*	*2*	*3*	-	-	-	-
67 Russian Fed	-	-	27	14	9	10	-	18	6	8
67 Fishing area total	-	-	*27*	*14*	*9*	*10*	-	*18*	*6*	*8*
99 Canada	375	-	-	-	-	-	-	-	-	-
Greenland	456	424	423	247	157	137	120	185	279	109
USA	412	364	271	262	216	234	562	261	270	-
99 Fishing area total	*1 243*	*788*	*694*	*509*	*373*	*371*	*682*	*446*	*549*	*109*
Species total	*1 250*	*808*	*760*	*540*	*385*	*384*	*682*	*464*	*555*	*117*
Narwhal	**Narval**		**Narval**		***Monodon monoceros***				**4,22(06)018,01**	**NAR**
99 Canada	559	-	-	-	-	-	-	-	-	-
Greenland	657	672	647	595	466	411	331	454	653	228
99 Fishing area total	*1 216*	*672*	*647*	*595*	*466*	*411*	*331*	*454*	*653*	*228*
Species total	*1 216*	*672*	*647*	*595*	*466*	*411*	*331*	*454*	*653*	*228*
Pygmy sperm whale	**Cachalot pygmée**		**Cachalote pigmeo**		***Kogia breviceps***				**4,22(07)001,01**	**PYW**
99 Australia	-	-	2	-	-	-	1	-	-	-
Brazil	-	-	-	-	1	-	-	-	-	-
New Zealand	-	-	-	-	-	1	-	-	-	-
Spain	1	1	-	1	-	-	-	-	-	-
99 Fishing area total	*1*	*1*	*2*	*1*	*1*	*1*	*1*	-	-	-
Species total	*1*	*1*	*2*	*1*	*1*	*1*	*1*	-	-	-
Dwarf sperm whale	**Cachalot nain**		**Cachalote enano**		***Kogia sima***				**4,22(07)001,02**	**DWW**
99 Japan	1	-	-	-	-	-	-	-	-	-
Oman	2	-	-	-	-	-	-	-	-	-
Spain	-	1	-	-	-	-	-	-	-	-
99 Fishing area total	*3*	*1*	-	-	-	-	-	-	-	-
Species total	*3*	*1*	-	-	-	-	-	-	-	-
Boto	**Inia**		**Bufeo**		***Inia geoffrensis***				**4,22(08)001,01**	**BOT**
03 Brazil	-	50	150	154	-	-	1 652	-	-	-
03 Fishing area total	-	*50*	*150*	*154*	-	-	*1 652*	-	-	-
Species total	-	*50*	*150*	*154*	-	-	*1 652*	-	-	-
Franciscana	**Dauphin de la Plata**		**Franciscana**		***Pontoporia blainvillei***				**4,22(09)002,01**	**FRA**
99 Argentina	160	215	893	900	-	80	-	27	91	96
Brazil	19	60	109	73	1	235	11	4	2	10
99 Fishing area total	*179*	*275*	*1 002*	*973*	*1*	*315*	*11*	*31*	*93*	*106*
Species total	*179*	*275*	*1 002*	*973*	*1*	*315*	*11*	*31*	*93*	*106*
Toothed whales nei	**Baleines odontocètes nca**		**Ballenas odontocetas nep**		***Odontoceti***				**4,22(XX)XXX,XX**	**ODN**
21 USA	...	...	-	3	-	3	-	-	-	-
21 Fishing area total	...	...	-	*3*	-	*3*	-	-	-	-
99 Chile	-	-	-	-	1	-	-	-	-	-
Italy	-	-	-	-	-	-	-	1	-	-

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Sperm-whales, pilot-whales
Cachalots, globicéphales
Cachalotes, calderones

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
Korea Rep	-	4	7	1	2	-	-	-	-	-
New Zealand	-	-	-	-	-	-	-	-	2	-
Peru	24	140	-	-	-	13	2	-	-	-
Turkey	-	80	-	-	-	-	-	-	-	-
USA	2	-	-	-	-	-	-	-	-	-
99 Fishing area total	*26*	*224*	*7*	*1*	*3*	*13*	*2*	*1*	*2*	-
Species total	*26*	*224*	*7*	*4*	*3*	*16*	*2*	*1*	*2*	-
Group total	***32 098***	***27 906***	***25 806***	***26 100***	***22 548***	***19 518***	***20 179***	***13 206***	***17 788***	***9 831***

Fishing area 98: Antarctic areas nei. Split-year data shown under the calendar year in which the split-year ends.

Fishing area 99: Marine areas outside the Antarctic. Calendar year data.

Data are derived mainly from sources of the International Whaling Commission (IWC).

See paragraph 5 of the INTRODUCTION.

Zone de pêche 98: Zones antarctiques nca. Données relatives à des années fractionnées figurant sous l'année civile durant laquelle se termine l'année fractionnée.

Zone de pêche 99: Zones maritimes hors de l'Antarctique. Données relatives à l'année civile.

Données provenant principalement des sources de la Commission baleinière internationale.

Voir le paragraphe 5 de l'INTRODUCTION.

Área de pesca 98: Áreas antárticas nep. Datos correspondientes a los años emergentes que figuran en la columna del año civil en que finaliza el año emergente.

Área de pesca 99: Áreas marítimas fuera del Antártico. Datos relativos al año civil.

Datos obtenidos por la mayoría desde fuentes de la Comisión Ballenera Internacional.

Véase el párrafo 5 en la INTRODUCCIÓN.

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Eared seals, hair seals, walruses
Otaries, phoques, morses
Lobos marinos, focas, morsas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
Steller sea lion	**Lion de mer de Steller**		**Lobo marino de Steller**		***Eumetopias jubatus***				**4,06(01)001,01**	**SSL**
67 USA	198	185	212	216	218	186	217	146	...	...
67 Fishing area total	*198*	*185*	*212*	*216*	*218*	*186*	*217*	*146*	*...*	*...*
Species total	*198*	*185*	*212*	*216*	*218*	*186*	*217*	*146*	*...*	*...*
Northern fur seal	**Otarie des Pribilofs**		**Lobo fino del Norte**		***Callorhinus ursinus***				**4,06(01)002,01**	**SEN**
61 Russian Fed	1 602	2 895	691	3 476	2 060	4 214	239	4 988	532	1 000
61 Fishing area total	*1 602*	*2 895*	*691*	*3 476*	*2 060*	*4 214*	*239*	*4 988*	*532*	*1 000*
Species total	*1 602*	*2 895*	*691*	*3 476*	*2 060*	*4 214*	*239*	*4 988*	*532*	*1 000*
New Zealand sea lion	**Lion de mer de N.lle-Zélande**		**Léon marino de Nueva Zelandia**		***Phocarctos hookeri***				**4,06(01)005,01**	**NSL**
81 New Zealand	-	-	-	-	-	-	-	8	5	14
81 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*8*	*5*	*14*
Species total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*8*	*5*	*14*
South American fur seal	**Otarie d'Amérique du Sud**		**Lobo fino austral**		***Arctocephalus australis***				**4,06(01)006,01**	**SEF**
41 Uruguay	7	16	37	30	36	24	66	61	82	80
41 Fishing area total	*7*	*16*	*37*	*30*	*36*	*24*	*66*	*61*	*82*	*80*
Species total	*7*	*16*	*37*	*30*	*36*	*24*	*66*	*61*	*82*	*80*
South African fur seal	**Otarie du Cap**		**Lobo marino de dos pelos**		***Arctocephalus pusillus***				**4,06(01)006,03**	**SEK**
47 Namibia	44 223	37 670	34 000	31 971	64 167	83 045	34 728	47 115	47 403	...
47 Fishing area total	*44 223*	*37 670*	*34 000*	*31 971*	*64 167*	*83 045*	*34 728*	*47 115*	*47 403*	*...*
Species total	*44 223*	*37 670*	*34 000*	*31 971*	*64 167*	*83 045*	*34 728*	*47 115*	*47 403*	*...*
New Zealand fur seal	**Otarie de Nouvelle-Zélande**		**Lobo fino de Nueva Zelandia**		***Arctocephalus forsteri***				**4,06(01)006,07**	**SNZ**
81 New Zealand	-	-	-	-	-	-	227	98	226	120
81 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*227*	*98*	*226*	*120*
Species total	*-*	*-*	*-*	*-*	*-*	*-*	*227*	*98*	*226*	*120*
South American sea lion	**Lion de mer d'Amérique du Sud**		**Lobo común**		***Otaria flavescens***				**4,06(01)016,01**	**SEL**
41 Uruguay	71	48	42	63	18	11	16	2	-	-
41 Fishing area total	*71*	*48*	*42*	*63*	*18*	*11*	*16*	*2*	*-*	*-*
Species total	*71*	*48*	*42*	*63*	*18*	*11*	*16*	*2*	*-*	*-*
Walrus	**Morse**		**Morsa**		***Odobenus rosmarus***				**4,06(02)004,01**	**WAL**
21 Greenland	333	297	273	153	198	141	135	82	163	67
21 Fishing area total	*333*	*297*	*273*	*153*	*198*	*141*	*135*	*82*	*163*	*67*
27 Greenland	10	34	11	3	16	5	9	10	14	7
27 Fishing area total	*10*	*34*	*11*	*3*	*16*	*5*	*9*	*10*	*14*	*7*
61 Russian Fed	738	1 369	-	572	651	486	548	165	158	43
61 Fishing area total	*738*	*1 369*	*-*	*572*	*651*	*486*	*548*	*165*	*158*	*43*
67 Russian Fed	-	-	1 283	523	783	559	617	623	927	296
67 Fishing area total	*-*	*-*	*1 283*	*523*	*783*	*559*	*617*	*623*	*927*	*296*
Species total	*1 081*	*1 700*	*1 567*	*1 251*	*1 648*	*1 191*	*1 309*	*880*	*1 262*	*413*
Harp seal	**Phoque du Groenland**		**Foca de Groenlandia**		***Phoca groenlandica***				**4,06(03)005,01**	**SEH**
21 Canada	193 366	285 510	262 048	325 346	289 908	296 595	223 443	215 382	53 496	67 001
Greenland	84 165	65 810	64 735	63 763	84 317	92 612	81 010	77 600	128 296	58 029
21 Fishing area total	*277 531*	*351 320*	*326 783*	*389 109*	*374 225*	*389 207*	*304 453*	*292 982*	*181 792*	*125 030*
27 Greenland	2 598	1 915	2 872	2 612	2 739	2 101	2 852	3 435	4 070	1 219
Norway	8 192	3 580	7 575	9 895	17 771	13 390	13 981	1 263	8 035	4 793
Russian Fed	39 116	34 187	37 939	-	14 277	7 107	5 476	5 333	-	10
27 Fishing area total	*49 906*	*39 682*	*48 386*	*12 507*	*34 787*	*22 598*	*22 309*	*10 031*	*12 105*	*6 022*
Species total	*327 437*	*391 002*	*375 169*	*401 616*	*409 012*	*411 805*	*326 762*	*303 013*	*193 897*	*131 052*
Harbour seal	**Phoque veau marin**		**Foca común**		***Phoca vitulina***				**4,06(03)005,02**	**SEC**
21 Greenland	75	181	643	567	287	81	51	38	47	19
21 Fishing area total	*75*	*181*	*643*	*567*	*287*	*81*	*51*	*38*	*47*	*19*
27 Greenland	5	6	81	88	75	1	33	42	7	2
27 Fishing area total	*5*	*6*	*81*	*88*	*75*	*1*	*33*	*42*	*7*	*2*
67 USA	2 031	1 834	2 030	1 822	1 696	1 644	1 428	1 462	...	...
67 Fishing area total	*2 031*	*1 834*	*2 030*	*1 822*	*1 696*	*1 644*	*1 428*	*1 462*	*...*	*...*

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Eared seals, hair seals, walruses
Otaries, phoques, morses
Lobos marinos, focas, morsas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
Species total	*2 111*	*2 021*	*2 754*	*2 477*	*2 058*	*1 726*	*1 512*	*1 542*	*54*	*21*
Ringed seal	**Phoque annelé ou marbré**		**Foca marbreada**		***Phoca hispida***				**4,06(03)005,03**	**SER**
18 Russian Fed	-	-	-	-	170	327	146	-	-	-
18 Fishing area total	-	-	-	-	*170*	*327*	*146*	-	-	-
21 Canada	2 035	1 340	850	290	306	77	113	49	21	6
Greenland	65 865	68 736	67 229	56 935	71 232	73 191	60 835	61 354	97 158	39 954
21 Fishing area total	*67 900*	*70 076*	*68 079*	*57 225*	*71 538*	*73 268*	*60 948*	*61 403*	*97 179*	*39 960*
27 Greenland	12 572	13 768	13 417	12 841	11 958	11 140	10 742	8 241	12 077	4 308
Russian Fed	687	581	423	281	303	305	-	128	85	-
27 Fishing area total	*13 259*	*14 349*	*13 840*	*13 122*	*12 261*	*11 445*	*10 742*	*8 369*	*12 162*	*4 308*
61 Russian Fed	2 030	1 580	266	2 407	1 970	1 084	1 353	382	239	42
61 Fishing area total	*2 030*	*1 580*	*266*	*2 407*	*1 970*	*1 084*	*1 353*	*382*	*239*	*42*
67 Russian Fed	-	2 453	4 928	2 740	3 017	1 485	1 972	2 630	2 290	98
67 Fishing area total	-	*2 453*	*4 928*	*2 740*	*3 017*	*1 485*	*1 972*	*2 630*	*2 290*	*98*
Species total	*83 189*	*88 458*	*87 113*	*75 494*	*88 956*	*87 609*	*75 161*	*72 784*	*111 870*	*44 408*
Ribbon seal	**Phoque à rubans**		**Foca fajada**		***Phoca fasciata***				**4,06(03)005,04**	**SLR**
61 Russian Fed	-	1	8	65	10	48	7	12	42	28
61 Fishing area total	-	*1*	*8*	*65*	*10*	*48*	*7*	*12*	*42*	*28*
67 Russian Fed	-	-	1	-	-	-	-	-	-	-
67 Fishing area total	-	-	*1*	-	-	-	-	-	-	-
Species total	-	*1*	*9*	*65*	*10*	*48*	*7*	*12*	*42*	*28*
Caspian seal	**Phoque de la Mer Caspienne**		**Foca del Caspio**		***Phoca caspica***				**4,06(03)005,05**	**SAC**
05 Russian Fed	9	195	21	28	145	3 900	911	795	20	19
05 Fishing area total	*9*	*195*	*21*	*28*	*145*	*3 900*	*911*	*795*	*20*	*19*
Species total	*9*	*195*	*21*	*28*	*145*	*3 900*	*911*	*795*	*20*	*19*
Baikal seal	**Phoque du lac Baikal**		**Foca de Baikal**		***Phoca sibirica***				**4,06(03)005,06**	**SBK**
05 Russian Fed	2 817	729	1 034	1 891	2 116	2 092	-	682	1 090	2 050
05 Fishing area total	*2 817*	*729*	*1 034*	*1 891*	*2 116*	*2 092*	-	*682*	*1 090*	*2 050*
Species total	*2 817*	*729*	*1 034*	*1 891*	*2 116*	*2 092*	-	*682*	*1 090*	*2 050*
Larga seal	**Veau marin du Pacifique**		**Foca largha**		***Phoca largha***				**4,06(03)005,07**	**SST**
61 Russian Fed	179	1 824	260	1 087	824	491	621	288	288	55
61 Fishing area total	*179*	*1 824*	*260*	*1 087*	*824*	*491*	*621*	*288*	*288*	*55*
67 Russian Fed	-	159	479	150	155	130	137	304	45	9
67 Fishing area total	-	*159*	*479*	*150*	*155*	*130*	*137*	*304*	*45*	*9*
Species total	*179*	*1 983*	*739*	*1 237*	*979*	*621*	*758*	*592*	*333*	*64*
Bearded seal	**Phoque barbu**		**Foca barbuda**		***Erignathus barbatus***				**4,06(03)008,01**	**SEB**
21 Canada	170	70	-	-	1	-	14	-	-	-
Greenland	2 016	1 652	1 361	985	954	1 458	1 181	1 077	1 880	899
21 Fishing area total	*2 186*	*1 722*	*1 361*	*985*	*955*	*1 458*	*1 195*	*1 077*	*1 880*	*899*
27 Greenland	334	313	355	263	366	305	379	264	414	156
Russian Fed	26	19	23	8	-	1	-	-	-	-
27 Fishing area total	*360*	*332*	*378*	*271*	*366*	*306*	*379*	*264*	*414*	*156*
61 Russian Fed	340	501	113	1 063	1 211	705	660	183	43	104
61 Fishing area total	*340*	*501*	*113*	*1 063*	*1 211*	*705*	*660*	*183*	*43*	*104*
67 Russian Fed	-	326	943	564	687	242	208	1 110	713	1 534
67 Fishing area total	-	*326*	*943*	*564*	*687*	*242*	*208*	*1 110*	*713*	*1 534*
Species total	*2 886*	*2 881*	*2 795*	*2 883*	*3 219*	*2 711*	*2 442*	*2 634*	*3 050*	*2 693*
Hooded seal	**Phoque à crete**		**Foca capuchina**		***Cystophora cristata***				**4,06(03)010,01**	**SEZ**
21 Canada	257	11	6	389	20	40	5	3	10	-
Greenland	5 010	3 606	4 351	3 766	2 924	4 229	2 496	2 087	3 101	1 461
21 Fishing area total	*5 267*	*3 617*	*4 357*	*4 155*	*2 944*	*4 269*	*2 501*	*2 090*	*3 111*	*1 461*
27 Greenland	1 504	1 200	2 002	1 640	1 015	555	762	476	559	233
Norway	3 820	7 116	5 295	4 851	3 826	3 647	62	-	402	178
27 Fishing area total	*5 324*	*8 316*	*7 297*	*6 491*	*4 841*	*4 202*	*824*	*476*	*961*	*411*
Species total	*10 591*	*11 933*	*11 654*	*10 646*	*7 785*	*8 471*	*3 325*	*2 566*	*4 072*	*1 872*

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Eared seals, hair seals, walruses
Otaries, phoques, morses
Lobos marinos, focas, morsas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
Grey seal	**Phoque gris**		**Foca de gris**		***Halichoerus grypus***				**4,06(03)011,01**	**SEG**
27 Finland	90	130	233	291	312	157	218	360	475	328
27 Fishing area total	*90*	*130*	*233*	*291*	*312*	*157*	*218*	*360*	*475*	*328*
Species total	*90*	*130*	*233*	*291*	*312*	*157*	*218*	*360*	*475*	*328*
Seals nei	**Phoques nca**		**Focas nep**		***Otariidae, Phocidae***				**4,06(XX)XXX,XX**	**SXX**
21 Canada	39	1 005	22	40	7	37	66	6	4	-
21 Fishing area total	*39*	*1 005*	*22*	*40*	*7*	*37*	*66*	*6*	*4*	-
81 New Zealand	-	-	-	-	-	-	-	-	19	9
81 Fishing area total	-	-	-	-	-	-	-	-	*19*	*9*
Species total	*39*	*1 005*	*22*	*40*	*7*	*37*	*66*	*6*	*23*	*9*
Group total	***476 530***	***542 852***	***518 092***	***533 675***	***582 746***	***607 848***	***447 964***	***438 284***	***364 436***	***184 171***

See paragraph 5 of the INTRODUCTION. Voir le paragraphe 5 de l'INTRODUCTION. Véase el párrafo 5 en la INTRODUCCIÓN.

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Miscellaneous aquatic mammals
Mammifères aquatiques divers
Mamíferos acuáticos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Aquatic mammals nei	**Mammifères aquatiques nca**		**Mamíferos acuáticos nep**		***Mammalia***				**4,99(XX)XXX,XX**	**MAM**
61 Japan	1 874	1 997	1 800	2 039	1 652	1 599	1 573	1 154	1 404	500
61 Fishing area total	*1 874*	*1 997*	*1 800*	*2 039*	*1 652*	*1 599*	*1 573*	*1 154*	*1 404*	*500*
Species total	*1 874*	*1 997*	*1 800*	*2 039*	*1 652*	*1 599*	*1 573*	*1 154*	*1 404*	*500*
Group total	***1 874***	***1 997***	***1 800***	***2 039***	***1 652***	***1 599***	***1 573***	***1 154***	***1 404***	***500***

See paragraph 5 of the INTRODUCTION. Voir le paragraphe 5 de l'INTRODUCTION. Véase el párrafo 5 en la INTRODUCCIÓN.

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Frogs and other amphibians
Grenouilles et autres amphibies
Ranas y otros anfibios

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Frogs	**Grenouilles**		**Ranas**		***Rana spp***				**5,12(01)001,XX**	**FRG**
02 Cuba	45	21	6	0	-	-	-	-	-	-
Mexico	315	125	115	135	174	181	183	219	221	230
USA	1	-	0	0	0	0	-	-	-	1
02 Fishing area total	*361*	*146*	*121*	*135*	*174*	*181*	*183*	*219*	*221*	*231*
03 Uruguay	9	5	4	-	-	1	-	-	-	-
03 Fishing area total	*9*	*5*	*4*	-	-	*1*	-	-	-	-
04 India	...	...	...	...	...	5 592	...	...	...	...
Indonesia	1 243	1 385	2 000	1 898	1 512	1 545	1 613	1 520	1 690	2 022
Turkey	873	898	792	803	803	833	895	668	622	780
04 Fishing area total	*2 116*	*2 283*	*2 792*	*2 701*	*2 315*	*7 970*	*2 508*	*2 188*	*2 312*	*2 802*
05 Bulgaria	-	-	-	-	-	12	-	-	-	-
Romania	...	29	0	0	-	3	-	-	-	-
05 Fishing area total	*...*	*29*	*0*	*0*	-	*15*	-	-	-	-
Species total	*2 486*	*2 463*	*2 917*	*2 836*	*2 489*	*8 167*	*2 691*	*2 407*	*2 533*	*3 033*
Group total	***2 486***	***2 463***	***2 917***	***2 836***	***2 489***	***8 167***	***2 691***	***2 407***	***2 533***	***3 033***

B-72 **Turtles**
Tortues
Tortugas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Diamond back terrapins	**Tortues diamantées**		**Tortugas comestibles**		***Malaclemys spp***				**5,31(06)021,XX**	**TTG**
02 USA	-	-	-	-	0	2	-	-	-	-
02 Fishing area total	-	-	-	-	*0*	*2*	-	-	-	-
Species total	-	-	-	-	*0*	*2*	-	-	-	-
Green turtle	**Tortue verte**		**Tortuga verde**		***Chelonia mydas***				**5,31(07)005,02**	**TUG**
31 Cuba	5	6	6	1	5	2	-	-	-	-
Grenada	7	8	8	6	6	3	3	1	0	0
31 Fishing area total	*12*	*14*	*14*	*7*	*11*	*5*	*3*	*1*	*0*	*0*
71 Fiji	3	1 F	0	0	0	0	0	0	0	-
71 Fishing area total	*3*	*1 F*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	-
Species total	*15*	*15 F*	*14*	*7*	*11*	*5*	*3*	*1*	*0*	*0*
Hawksbill turtle	**Tortue caret**		**Tortuga carey**		***Eretmochelys imbricata***				**5,31(07)017,01**	**TTH**
31 Cuba	11	17	10	7	8	9	-	-	-	-
31 Fishing area total	*11*	*17*	*10*	*7*	*8*	*9*	-	-	-	-
Species total	*11*	*17*	*10*	*7*	*8*	*9*	-	-	-	-
Loggerhead turtle	**Caouane**		**Caguama**		***Caretta caretta***				**5,31(07)018,01**	**TTL**
31 Cuba	7	8	8	6	7	3	3	-	-	-
31 Fishing area total	*7*	*8*	*8*	*6*	*7*	*3*	*3*	-	-	-
Species total	*7*	*8*	*8*	*6*	*7*	*3*	*3*	-	-	-
River and lake turtles nei	**Tortues d'eau douce nca**		**Galápagos nep**		***Testudinata***				**5,31(XX)XXX,XX**	**TUL**
02 Cuba	1	-	-	-	-	-	-	-	-	-
USA	51	27	69	41	33	28	30	48	15	35
02 Fishing area total	*52*	*27*	*69*	*41*	*33*	*28*	*30*	*48*	*15*	*35*
04 Indonesia	42	389	130	140	114	58	106	81	173	12
04 Fishing area total	*42*	*389*	*130*	*140*	*114*	*58*	*106*	*81*	*173*	*12*
Species total	*94*	*416*	*199*	*181*	*147*	*86*	*136*	*129*	*188*	*47*
Marine turtles nei	**Tortues de mer nca**		**Tortugas de mar nep**		***Testudinata***				**5,31(XX)XXX,XX**	**TTX**
31 Bahamas	4	2	1	4	2	4	1	1	0	0
Cuba	-	-	-	-	-	-	2	-	-	-
31 Fishing area total	*4*	*2*	*1*	*4*	*2*	*4*	*3*	*1*	*0*	*0*
34 Benin	5	1	2	1	1	1	1	...	...	...
Côte dIvoire	71	...	...	...	...	...	...	...	...	...
Eq Guinea	1 F	1 F	1 F	2 F	2 F	2 F	3	5	2	...
Gabon	238	843	1 107	25	34	36	5	4	3 F	3 F
34 Fishing area total	*315 F*	*845 F*	*1 110 F*	*28 F*	*37 F*	*39 F*	*9*	*9*	*5 F*	*3 F*
57 Indonesia	44	68	59	136	124	133	138	3	119	95
Timor-Leste	1	1 F	1 F	1 F	1 F	1 F	1 F	1 F	1 F	1 F
57 Fishing area total	*45*	*69 F*	*60 F*	*137 F*	*125 F*	*134 F*	*139 F*	*4 F*	*120 F*	*96 F*
71 Fiji	7	4 F	0	0	0	0	0	0	0	-
Indonesia	306	54	81	27	54	63	58	235	225	42
Micronesia	0	0	-	-	-	-	-	-	-	-
Philippines	1	-	1	-	-	-	-	-	-	-
Wallis Fut I	1 F	1 F	1	1 F	1 F	1 F	1 F	1 F	1 F	1 F
71 Fishing area total	*315 F*	*59 F*	*83*	*28 F*	*55 F*	*64 F*	*59 F*	*236 F*	*226 F*	*43 F*
87 Ecuador	10	...	...	...	...	...	...	...	...	...
Peru	2	2	4	1	2	1	1	-	-	-
87 Fishing area total	*12*	*2*	*4*	*1*	*2*	*1*	*1*	...	...	...
Species total	*691 F*	*977 F*	*1 258 F*	*198 F*	*221 F*	*242 F*	*211 F*	*250 F*	*351 F*	*142 F*
Group total	***818***	***1 433***	***1 489***	***399***	***394***	***347***	***353***	***380***	***539***	***189***

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Crocodiles and alligators
Crocodiles et alligators
Cocodrilos y aligatores

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
Broad-nosed caiman	**...B**		**...C**		***Caiman latirostris***				**5,36(01)001,01**	**IMO**
03 Argentina	-	90	165	215	2 752	1 652	1 125	987	342	1 684
Brazil	-	-	-	10	...	50	-	-	-	5
03 Fishing area total	*-*	*90*	*165*	*225*	*2 752*	*1 702*	*1 125*	*987*	*342*	*1 689*
Species total	*-*	*90*	*165*	*225*	*2 752*	*1 702*	*1 125*	*987*	*342*	*1 689*
Spectacled caiman	**Caïman à lunettes**		**Caimán de anteojos**		***Caiman crocodilus***				**5,36(01)001,03**	**CAI**
02 Cuba	-	-	-	1	1	-	-	-	-	-
Nicaragua	...	...	...	...	...	...	...	134	...	...
Panama	11 700	13 298	14 694	15 850	4 696	2 210	2 752	2 205	995	9 902
02 Fishing area total	*11 700*	*13 298*	*14 694*	*15 851*	*4 697*	*2 210*	*2 752*	*2 339*	*995*	*9 902*
03 Argentina	-	-	-	1	1 291	2 883	6 083	3 851	10 204	4 318
Bolivia	28 170	31 018	43 528	36 299	51 330	44 443	49 115	54 588	27 885	20 349
Brazil	1 253	6 048	12 851	7 004	620	673	10 254	7 016	9 114	35
Colombia	704 313	540 579	555 719	612 041	601 958	974 721	673 062	532 394	405 386	568 170
Guyana	5 917	8 222	3 124	3 310	2 301	3 720	16 707	23 700	28 000	19 749
Paraguay	3 793	8 373	4 409	-	-	-	-	-	-	-
Venezuela	19 215	20 349	33 942	63 902	58 346	60 864	23 201	15 489	16 246	10 989
03 Fishing area total	*762 661*	*614 589*	*653 573*	*722 557*	*715 846*	*1 087 304*	*778 422*	*637 038*	*496 835*	*623 610*
Species total	*774 361*	*627 887*	*668 267*	*738 408*	*720 543*	*1 089 514*	*781 174*	*639 377*	*497 830*	*633 512*
American alligator	**Alligator américain**		**Caimán americano**		***Alligator mississippiensis***				**5,36(01)002,01**	**AGM**
02 USA	265 470	325 291	355 789	368 409	356 398	421 220	387 203	230 464	297 187	369 731
02 Fishing area total	*265 470*	*325 291*	*355 789*	*368 409*	*356 398*	*421 220*	*387 203*	*230 464*	*297 187*	*369 731*
04 China,Taiwan	-	-	36	47	82	34	38	34	27	30
Israel	6	-	-	-	-	-	-	-	2	...
04 Fishing area total	*6*	*-*	*36*	*47*	*82*	*34*	*38*	*34*	*29*	*30*
Species total	*265 476*	*325 291*	*355 825*	*368 456*	*356 480*	*421 254*	*387 241*	*230 498*	*297 216*	*369 761*
Estuarine crocodile	**Crocodile d'estuaires**		**Cocodrilo estuarino**		***Crocodylus porosus***				**5,36(01)003,01**	**CDP**
04 Cambodia	36 000	50 850	78 008	74 820	120 000	137 642	128 945	156 500	185 000	100 000 F
Indonesia	3 456	3 277	2 732	3 986	4 717	3 825	5 151	5 718	4 996	4 302
Malaysia	375	122	307	1 450	1 058	1 790	540	1 043	587	861
Philippines	-	-	-	-	-	-	34	20	892	...
Singapore	1 041	1 058	1 074	1 136	1 330	1 712	1 653	1 877	1 086	1 217
Thailand	...	-	-	300	500	600	3 149	2 560	1 229	1 704
04 Fishing area total	*40 872*	*55 307*	*82 121*	*81 692*	*127 605*	*145 569*	*139 472*	*167 718*	*193 790*	*108 084 F*
06 Australia	11 849	10 423	15 325	12 232	22 733	16 123	21 314	28 626	20 929	32 984
Papua N Guin	10 677	9 332	8 000	11 043	10 750	10 208	12 675	14 074	11 910	5 519
06 Fishing area total	*22 526*	*19 755*	*23 325*	*23 275*	*33 483*	*26 331*	*33 989*	*42 700*	*32 839*	*38 503*
Species total	*63 398*	*75 062*	*105 446*	*104 967*	*161 088*	*171 900*	*173 461*	*210 418*	*226 629*	*146 587 F*
Siamese crocodile	**Crocodile siamois**		**Cocodrilo del Siam**		***Crocodylus siamensis***				**5,36(01)003,02**	**CDS**
04 Cambodia	30	-	-	-	-	-	100	1 300	300	...
Thailand	2 399	3 580	10 982	20 105	28 141	31 847	37 041	39 109	24 890	29 809
Viet Nam	-	-	-	831	3 376	16 125	17 190	23 062	9 483	3 285
04 Fishing area total	*2 429*	*3 580*	*10 982*	*20 936*	*31 517*	*47 972*	*54 331*	*63 471*	*34 673*	*33 094*
Species total	*2 429*	*3 580*	*10 982*	*20 936*	*31 517*	*47 972*	*54 331*	*63 471*	*34 673*	*33 094*
Australian crocodile	**Crocodile australien**		**Cocodrilo de Australia**		***Crocodylus johnstoni***				**5,36(01)003,03**	**CRH**
06 Australia	-	2	184	-	65	-	-	-	-	-
06 Fishing area total	*-*	*2*	*184*	*-*	*65*	*-*	*-*	*-*	*-*	*-*
Species total	*-*	*2*	*184*	*-*	*65*	*-*	*-*	*-*	*-*	*-*
Nile crocodile	**Crocodile du Nil**		**Cocodrilo del Nilo**		***Crocodylus niloticus***				**5,36(01)003,04**	**CRI**
01 Botswana	152	-	9	...	...	...	320	374	1 626	1 500
Ethiopia	42	220	900	446	347	727	540	492	3	4
Kenya	4 250	3 967	3 811	3 862	10 950	8 710	6 354	4 504	6 906	5 259
Madagascar	9 408	6 936	7 300	4 760	4 850	6 660	5 550	2 640	2 450	...
Malawi	1 256	60	301	20	637	698	1 287	3 370	3 105	3 250
Mauritius	-	-	118	400	150	...	180	...	100	...
Mozambique	477	7 322	5 130	...	1 323	2 021	179	566	...	2 448
Namibia	...	...	...	...	400	305	...	...	600	2
Senegal	-	-	-	-	-	2	-	1	-	-
South Africa	33 174	45 787	31 321	35 760	25 526	24 089	34 837	40 197	24 988	70 208
Tanzania	1 589	1 369	1 469	1 560	1 427	1 100	1 556	1 784	790	1 796
Uganda	900	...	2	600	300	...	...	290	...	...
Zambia	20 900	22 259	28 019	26 353	28 490	39 804	37 305	28 197	43 655	23 717
Zimbabwe	76 157	79 932	73 707	60 185	69 374	80 873	64 490	81 554	62 101	104 731
01 Fishing area total	*148 305*	*167 852*	*152 087*	*133 946*	*143 774*	*164 989*	*152 598*	*163 969*	*146 324*	*212 915*
03 Brazil	50	-	1	44	-	-	-	-	-	-
03 Fishing area total	*50*	*-*	*1*	*44*	*-*	*-*	*-*	*-*	*-*	*-*

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Crocodiles and alligators
Crocodiles et alligators
Cocodrilos y aligatores

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 no	2002 no	2003 no	2004 no	2005 no	2006 no	2007 no	2008 no	2009 no	2010 no
04 Israel	2 289	699	-	-	-	-	-	-	-	-
04 Fishing area total	*2 289*	*699*	-	-	-	-	-	-	-	-
Species total	*150 644*	*168 551*	*152 088*	*133 990*	*143 774*	*164 989*	*152 598*	*163 969*	*146 324*	*212 915*
New Guinea crocodile	**Crocodile de Nouvelle-Guinée**		**Cocodrilo de Nueva Guinea**		***Crocodylus novaeguineae***				**5,36(01)003,05**	**CNG**
04 Indonesia	9 946	11 951	8 826	10 481	13 585	16 575	12 759	10 588	7 255	7 450
04 Fishing area total	*9 946*	*11 951*	*8 826*	*10 481*	*13 585*	*16 575*	*12 759*	*10 588*	*7 255*	*7 450*
06 Papua N Guin	20 668	18 798	18 482	40 358	20 082	22 070	15 904	16 955	18 840	10 821
06 Fishing area total	*20 668*	*18 798*	*18 482*	*40 358*	*20 082*	*22 070*	*15 904*	*16 955*	*18 840*	*10 821*
Species total	*30 614*	*30 749*	*27 308*	*50 839*	*33 667*	*38 645*	*28 663*	*27 543*	*26 095*	*18 271*
Cuban crocodile	**Crocodile cubain**		**Cocodrilo de Cuba**		***Crocodylus rhombifer***				**5,36(01)003,06**	**CMB**
02 Cuba	3	1	-	-	-	-	-	1	-	-
02 Fishing area total	*3*	*1*	-	-	-	-	-	*1*	-	-
Species total	*3*	*1*	-	-	-	-	-	*1*	-	-
Morelet's crocodile	**Crocodile de Morelet**		**...C**		***Crocodylus moreletii***				**5,36(01)003,07**	**CME**
02 Mexico	3 643	1 588	1 037	609	855	158	11	724	485	...
02 Fishing area total	*3 643*	*1 588*	*1 037*	*609*	*855*	*158*	*11*	*724*	*485*	...
Species total	*3 643*	*1 588*	*1 037*	*609*	*855*	*158*	*11*	*724*	*485*	...
American crocodile	**...B**		**...C**		***Crocodylus acutus***				**5,36(01)003,08**	**YUU**
02 Honduras	-	-	-	197	76	111	54	1 944	1 090	3
02 Fishing area total	-	-	-	*197*	*76*	*111*	*54*	*1 944*	*1 090*	*3*
03 Colombia	100	...	130	30	128	9	250	367	10	200
03 Fishing area total	*100*	*...*	*130*	*30*	*128*	*9*	*250*	*367*	*10*	*200*
Species total	*100*	*...*	*130*	*227*	*204*	*120*	*304*	*2 311*	*1 100*	*203*
Black caiman	**...B**		**...C**		***Melanosuchus niger***				**5,36(01)007,01**	**MHW**
03 Brazil	...	...	...	...	...	...	...	8	2	-
03 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*8*	*2*	-
Species total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*8*	*2*	-
Cuvier's Dwarf caiman	**...B**		**...C**		***Paleosuchus palpebrosus***				**5,36(01)008,01**	**UCB**
03 Guyana	476	486	370	369	383	377	384	443	409	392
03 Fishing area total	*476*	*486*	*370*	*369*	*383*	*377*	*384*	*443*	*409*	*392*
Species total	*476*	*486*	*370*	*369*	*383*	*377*	*384*	*443*	*409*	*392*
Smooth-fronted caiman	**...B**		**...C**		***Paleosuchus trigonatus***				**5,36(01)008,02**	**UCI**
03 Guyana	423	500	312	269	395	428	570	357	322	541
03 Fishing area total	*423*	*500*	*312*	*269*	*395*	*428*	*570*	*357*	*322*	*541*
Species total	*423*	*500*	*312*	*269*	*395*	*428*	*570*	*357*	*322*	*541*
Group total	***1 291 567***	***1 233 787***	***1 322 114***	***1 419 295***	***1 451 723***	***1 937 059***	***1 579 862***	***1 340 107***	***1 231 427***	***1 416 965***

The data, derived mainly from sources of the UNEP World Conservation Monitoring Centre, refer to captive breeding, ranching and wild harvest.

See paragraph 5 of the INTRODUCTION.

Les données, provenant principalement des sources du Centre mondial de surveillance de la conservation du PNUE, ont trait à l'élevage en captivité, au 'ranching' et à la récolte sauvage.

Voir le paragraphe 5 de l'INTRODUCTION.

Los datos, obtenidos por la mayoría desde fuentes del Centro Mundial de Vigilancia de la Conservación del PNUMA, se refieren a la cría en cautividad, las grandes explotaciones y las capturas en libertad.

Véase el párrafo 5 en la INTRODUCCIÓN.

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Sea-squirts and other tunicates
Ascidiens et autres tuniciers
Ascidias y otros tunicados

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Red sea squirt	**Violet chilien**		**Piure chileno**		***Pyura chilensis***				**6,96(09)005,02**	**SSE**
87 Chile	1 298	1 217	1 043	1 083	1 184	1 233	1 202	1 026	1 251	877
87 Fishing area total	*1 298*	*1 217*	*1 043*	*1 083*	*1 184*	*1 233*	*1 202*	*1 026*	*1 251*	*877*
Species total	*1 298*	*1 217*	*1 043*	*1 083*	*1 184*	*1 233*	*1 202*	*1 026*	*1 251*	*877*
Grooved sea squirt	**Violet**		**Provecho**		***Microcosmus sulcatus***				**6,96(09)037,01**	**SSG**
37 France	76	78	77	77	3	3	3	3	5	6
37 Fishing area total	*76*	*78*	*77*	*77*	*3*	*3*	*3*	*3*	*5*	*6*
Species total	*76*	*78*	*77*	*77*	*3*	*3*	*3*	*3*	*5*	*6*
Sea squirts nei	**Ascidiens nca**		**Ascidias nep**		***Ascidiacea***				**6,96(XX)XXX,XX**	**SSX**
57 India	-	-	-	-	-	-	-	4	4	7
57 Fishing area total	-	-	-	-	-	-	-	*4*	*4*	*7*
61 Korea Rep	1 053	1 025	1 830	1 326	1 547	1 113	1 128	1 589	1 122	1 237
Russian Fed	-	-	1	10	1	-	7	2	6	1
61 Fishing area total	*1 053*	*1 025*	*1 831*	*1 336*	*1 548*	*1 113*	*1 135*	*1 591*	*1 128*	*1 238*
88 Ukraine	-	-	-	0	-	-	-	-	-	-
88 Fishing area total	-	-	-	*0*	-	-	-	-	-	-
Species total	*1 053*	*1 025*	*1 831*	*1 336*	*1 548*	*1 113*	*1 135*	*1 595*	*1 132*	*1 245*
Salps	**Salpes**		**...C**		***Salpidae***				**6,97(01)XXX,XX**	**SPX**
58 Australia	-	-	-	1	0	-	-	0	-	-
58 Fishing area total	-	-	-	*1*	*0*	-	-	*0*	-	-
Species total	-	-	-	*1*	*0*	-	-	*0*	-	-
Group total	***2 427***	***2 320***	***2 951***	***2 497***	***2 735***	***2 349***	***2 340***	***2 624***	***2 388***	***2 128***

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Horseshoe crabs and other arachnoids
Limules et autres arachnoïdés
Límulos y otros arácnidos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Horseshoe crab	**Limule**		**Límulo(=Cangrejo cacerola)**		***Limulus polyphemus***				**6,56(01)001,02**	**HSC**
21 USA	1 071	1 257	1 190	518	749	706	917	779	1 027	602
21 Fishing area total	*1 071*	*1 257*	*1 190*	*518*	*749*	*706*	*917*	*779*	*1 027*	*602*
31 USA	228	130	-	1	4	5	3	8	7	7
31 Fishing area total	*228*	*130*	*-*	*1*	*4*	*5*	*3*	*8*	*7*	*7*
Species total	*1 299*	*1 387*	*1 190*	*519*	*753*	*711*	*920*	*787*	*1 034*	*609*
Group total	***1 299***	***1 387***	***1 190***	***519***	***753***	***711***	***920***	***787***	***1 034***	***609***

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Sea-urchins and other echinoderms
Oursins et autres échinodermes
Erizos de mar y otros equinodermos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Echinoderms	**Oursins, bèches-de-mer**		**Erizos, cohombros de mar**		***Echinodermata***				**6,89(XX)XXX,XX**	**ECH**
27 Norway	-	-	-	-	-	-	4	0	-	-
Spain	304	603	13	530	445	471	531	615	436	677
27 Fishing area total	*304*	*603*	*13*	*530*	*445*	*471*	*535*	*615*	*436*	*677*
31 Mexico	0	-	-	-	-	-	-	-	-	-
31 Fishing area total	*0*	-	-	-	-	-	-	-	-	-
37 Spain	2	-	-	-	-	-	-	-	-	-
37 Fishing area total	*2*	-	-	-	-	-	-	-	-	-
58 Australia	-	-	0	0	0	0	-	0	-	0
58 Fishing area total	-	-	*0*	*0*	*0*	*0*	-	*0*	-	*0*
61 Korea Rep	1 454	1 459	1 607	1 301	2 035	2 596	2 651	3 555	2 846	2 868
61 Fishing area total	*1 454*	*1 459*	*1 607*	*1 301*	*2 035*	*2 596*	*2 651*	*3 555*	*2 846*	*2 868*
77 Fr Polynesia	15	15	15 F	15 F	15	15	15	15	66	118
Mexico	2 278	2 068	1 829	1 916	83	87	58	74	88	157
Samoa	...	...	...	...	5	4	13	8	7	7 F
77 Fishing area total	*2 293*	*2 083*	*1 844 F*	*1 931 F*	*103*	*106*	*86*	*97*	*161*	*282 F*
81 New Zealand	853	738	586	555	854	812	811	762	741	703
81 Fishing area total	*853*	*738*	*586*	*555*	*854*	*812*	*811*	*762*	*741*	*703*
87 Peru	2 114	2 245	2 066	1 388	3 033	281	1 932	2 438	1 866	1 314
87 Fishing area total	*2 114*	*2 245*	*2 066*	*1 388*	*3 033*	*281*	*1 932*	*2 438*	*1 866*	*1 314*
Species total	*7 020*	*7 128*	*6 116 F*	*5 705 F*	*6 470*	*4 266*	*6 015*	*7 467*	*6 050*	*5 844 F*
Starfishes nei	**Astéridés nca**		**Estrellas nep**		***Asteroidea***				**6,91(XX)XXX,XX**	**STF**
21 USA	-	-	-	0	0	-	-	2	0	-
21 Fishing area total	-	-	-	*0*	*0*	-	-	*2*	*0*	-
27 Denmark	0	0	-	0	-	-	-	-	-	-
27 Fishing area total	*0*	*0*	-	*0*	-	-	-	-	-	-
48 Chile	-	-	-	-	0	-	-	-	-	-
48 Fishing area total	-	-	-	-	*0*	-	-	-	-	-
58 Australia	-	-	1	2	2	3	1	3	3	5
58 Fishing area total	-	-	*1*	*2*	*2*	*3*	*1*	*3*	*3*	*5*
77 USA	0	1	1	7	2	0	4	0	0	0
77 Fishing area total	*0*	*1*	*1*	*7*	*2*	*0*	*4*	*0*	*0*	*0*
81 New Zealand	9	39	15	7	11	6	4	19	14	16
81 Fishing area total	*9*	*39*	*15*	*7*	*11*	*6*	*4*	*19*	*14*	*16*
88 New Zealand	2	0	0	0	0	0	1	0	1	0
Ukraine	-	-	-	0	-	-	-	-	-	-
UK	-	-	-	-	-	-	-	1	...	-
88 Fishing area total	*2*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*0*
Species total	*11*	*40*	*17*	*16*	*15*	*9*	*10*	*25*	*18*	*21*
Sea urchins nei	**Oursins nca**		**Erizos nep**		***Strongylocentrotus spp***				**6,93(02)004,XX**	**URC**
21 Canada	2 775	2 295	2 584	2 318	2 191	2 246	2 244	2 232	1 699	2 025
St Pier Mq	0	-	0	0	0	0	0	-	-	-
USA	4 499	2 412	2 709	2 605	1 609	1 312	558	1 278	1 597	1 190
21 Fishing area total	*7 274*	*4 707*	*5 293*	*4 923*	*3 800*	*3 558*	*2 802*	*3 510*	*3 296*	*3 215*
27 Norway	1	0	1	0	0	3	2	1	0	-
Russian Fed	151	38	1	-	-	25	4	-	6	7
UK	-	-	-	-	-	-	-	-	0	-
27 Fishing area total	*152*	*38*	*2*	*0*	*0*	*28*	*6*	*1*	*6*	*7*
31 Martinique	10	10	10	10	10 F	10	10	10	10 F	8 F
31 Fishing area total	*10*	*10*	*10*	*10*	*10 F*	*10*	*10*	*10*	*10 F*	*8 F*
61 China	171 F	170 F	170 F	170 F	170 F	170 F	170	170	170	180
China,Taiwan	50	63	78	71	40	45	46	8	7	8
Japan	11 208	12 733	12 574	12 716	11 990	10 820	11 679	10 867	11 061	10 200 F
Korea D P Rp	100 F	100 F	100 F	100 F	100 F	100 F	100 F	100 F	100 F	100 F
Russian Fed	1 612	2 582	2 206	2 454	3 435	4 321	5 958	8 587	10 607	10 660
61 Fishing area total	*13 141 F*	*15 648 F*	*15 128 F*	*15 511 F*	*15 735 F*	*15 456 F*	*17 953 F*	*19 732 F*	*21 945 F*	*21 148 F*
67 Canada	4 288	4 146	4 413	4 552	4 135	3 136	2 191	1 925	2 177	1 363
USA	2 090	2 053	241	1 618	419	802	406	416	461	222
67 Fishing area total	*6 378*	*6 199*	*4 654*	*6 170*	*4 554*	*3 938*	*2 597*	*2 341*	*2 638*	*1 585*
71 Fiji	96	70 F	31	100	115 F	133	91	120	35	12
Philippines	127	112	104	98	85	102	108	122	126	145
71 Fishing area total	*223*	*182 F*	*135*	*198*	*200 F*	*235*	*199*	*242*	*161*	*157*
77 Cook Is	5 F	2 F	0	2	2 F	1	1 F	1 F	1 F	1 F

B-76 **Sea-urchins and other echinoderms** | **Capture production by species, fishing areas and countries or areas**
Oursins et autres échinodermes | **Captures par espèces, zones de pêche et pays ou zones**
Erizos de mar y otros equinodermos | **Capturas por especies, áreas de pesca y países o áreas**

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Mexico	...	...	...	...	1 967	1 627	1 774	2 046	2 598	3 215
USA	5 871	6 162	4 781	5 666	5 387	5 050	5 262	5 020	5 507	5 012
77 Fishing area total	*5 876 F*	*6 164 F*	*4 781*	*5 668*	*7 356 F*	*6 678*	*7 037 F*	*7 067 F*	*8 106 F*	*8 228 F*
87 Ecuador	0	-	-	-	-	-	-	-	-	-
87 Fishing area total	*0*	-	-	-	-	-	-	-	-	-
Species total	*33 054 F*	*32 948 F*	*30 003 F*	*32 480 F*	*31 655 F*	*29 903 F*	*30 604 F*	*32 903 F*	*36 162 F*	*34 348 F*
Stony sea urchin	**Oursin-pierre**		**Erizo de mar**		***Paracentrotus lividus***				**6,93(04)007,01**	**URM**
27 France	3	-	1	-	1	3	4	3	3	7
Portugal	15	1	26	15	-	-	-	-	-	3
27 Fishing area total	*18*	*1*	*27*	*15*	*1*	*3*	*4*	*3*	*3*	*10*
37 Albania	...	...	...	35	18	23	...	...	...	...
France	98	180	181	138	-	59	-	-	34	106
37 Fishing area total	*98*	*180*	*181*	*173*	*18*	*82*	*...*	*...*	*34*	*106*
Species total	*116*	*181*	*208*	*188*	*19*	*85*	*4*	*3*	*37*	*116*
European edible sea urchin	**Oursin d'Europe**		**Erizo europeo**		***Echinus esculentus***				**6,93(04)014,01**	**URS**
27 Denmark	0	0	-	0	1	0	-	-	-	-
Iceland	-	-	-	50	29	1	134	126	140	146
Ireland	5	-	-	-	-	-	-	-	-	-
27 Fishing area total	*5*	*0*	*-*	*50*	*30*	*1*	*134*	*126*	*140*	*146*
Species total	*5*	*0*	*-*	*50*	*30*	*1*	*134*	*126*	*140*	*146*
Chilean sea urchin	**Oursin chilien**		**Erizo blanco**		***Loxechinus albus***				**6,93(04)017,01**	**UCH**
87 Chile	46 794	60 166	42 650	49 228	37 566	34 826	38 526	38 922	37 866	32 060
87 Fishing area total	*46 794*	*60 166*	*42 650*	*49 228*	*37 566*	*34 826*	*38 526*	*38 922*	*37 866*	*32 060*
Species total	*46 794*	*60 166*	*42 650*	*49 228*	*37 566*	*34 826*	*38 526*	*38 922*	*37 866*	*32 060*
Sea urchins, etc. nei	**Oursins, etc. nca**		**Erizos, etc. nep**		***Echinoidea***				**6,93(XX)XXX,XX**	**URX**
58 Australia	-	-	-	0	0	-	0	-	0	-
58 Fishing area total	-	-	-	*0*	*0*	-	*0*	-	*0*	-
Species total	-	-	-	*0*	*0*	-	*0*	-	*0*	-
Sand fish	**...B**		**...C**		***Holothuria scabra***				**6,94(01)003,02**	**HFC**
51 Seychelles	10	1	0	1	-	2	1	2	0	2
51 Fishing area total	*10*	*1*	*0*	*1*	*-*	*2*	*1*	*2*	*0*	*2*
Species total	*10*	*1*	*0*	*1*	*-*	*2*	*1*	*2*	*0*	*2*
Black teatfish	**Holothurie noire à mamelles**		**...C**		***Holothuria nobilis***				**6,94(01)003,03**	**HFN**
51 Seychelles	9	9	8	12	14	11	10	7	8	36
51 Fishing area total	*9*	*9*	*8*	*12*	*14*	*11*	*10*	*7*	*8*	*36*
Species total	*9*	*9*	*8*	*12*	*14*	*11*	*10*	*7*	*8*	*36*
White teatfish	**Holothurie blanche à mamelles**		**...C**		***Holothuria fuscogilva***				**6,94(01)003,05**	**HFF**
51 Seychelles	29	66	36	65	76	54	98	94	230	197
51 Fishing area total	*29*	*66*	*36*	*65*	*76*	*54*	*98*	*94*	*230*	*197*
Species total	*29*	*66*	*36*	*65*	*76*	*54*	*98*	*94*	*230*	*197*
Prickly redfish	**Holothurie ananas**		**...C**		***Thelenota ananas***				**6,94(14)002,01**	**TFQ**
51 Seychelles	6	28	31	29	43	35	49	53	113	83
51 Fishing area total	*6*	*28*	*31*	*29*	*43*	*35*	*49*	*53*	*113*	*83*
Species total	*6*	*28*	*31*	*29*	*43*	*35*	*49*	*53*	*113*	*83*
Japanese sea cucumber	**Bèche-de-mer japonaise**		**Cohombro de mar japonés**		***Stichopus japonicus***				**6,94(14)004,01**	**CUJ**
61 Japan	7 229	7 259	8 517	9 268	9 373	10 344	...	...	...	...
Korea Rep	900	833	1 281	1 154	1 135	1 614	2 936	2 260	2 789	3 872
61 Fishing area total	*8 129*	*8 092*	*9 798*	*10 422*	*10 508*	*11 958*	*2 936*	*2 260*	*2 789*	*3 872*
Species total	*8 129*	*8 092*	*9 798*	*10 422*	*10 508*	*11 958*	*2 936*	*2 260*	*2 789*	*3 872*
Sea cucumbers nei	**Bèches-de-mer nca**		**Cohombros de mar nep**		***Holothuroidea***				**6,94(XX)XXX,XX**	**CUX**
21 Canada	...	...	...	...	...	2 492	1 991	3 039	3 872	4 300
USA	1 504	4 656	9 102	4 539	3 886	3 978	2 440	778	1 946	1 595
21 Fishing area total	*1 504*	*4 656*	*9 102*	*4 539*	*3 886*	*6 470*	*4 431*	*3 817*	*5 818*	*5 895*
27 Iceland	-	-	27	-	208	50	-	1 051	1 167	2 246
Spain	-	8	-	-	-	0	-	-	-	-
27 Fishing area total	-	*8*	*27*	-	*208*	*50*	-	*1 051*	*1 167*	*2 246*

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Sea-urchins and other echinoderms
Oursins et autres échinodermes
Erizos de mar y otros equinodermos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
31 Bahamas	-	-	-	-	-	-	-	-	-	54
Mexico	39	-	-	-	-	-	113	...	...	...
Nicaragua	-	-	-	-	-	5	183	195	720	390
31 Fishing area total	*39*	-	-	-	-	*5*	*296*	*195*	*720*	*444*
34 Mauritania	...	...	...	...	...	...	...	...	...	14
34 Fishing area total	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*14*
37 Spain	4	2	2	2	4	4	3	3	5	3
37 Fishing area total	*4*	*2*	*2*	*2*	*4*	*4*	*3*	*3*	*5*	*3*
51 Egypt	139	2 310	527	15	5	6	-	9	-	-
Kenya	13	68	27	28	19	18	17	33	11	22
Madagascar	1 500	500	500 F	600 F	700 F	820	820 F	700 F	760 F	710 F
Maldives	678	573	717	546	351	264	339	252	159	627
Mauritius	...	...	...	...	...	340	620	95	100	100
Mozambique	11	10	4	0	0	...	...	...	...	...
Seychelles	6	62	131	129	243	319	372	285	487	448
Tanzania	340	65	75	10	14	0	0	0	0	0
Yemen	13	14	336	230 F	130 F	32	11	11	10 F	10 F
51 Fishing area total	*2 700*	*3 602*	*2 317 F*	*1 558 F*	*1 462 F*	*1 799*	*2 179 F*	*1 385 F*	*1 527 F*	*1 917 F*
57 Indonesia	697	649	334	414	658	523	395	452	481	391
Sri Lanka	90	150	170	280	2 340	1 350	2 880	4 230	3 890	4 250
57 Fishing area total	*787*	*799*	*504*	*694*	*2 998*	*1 873*	*3 275*	*4 682*	*4 371*	*4 641*
58 Australia	-	-	0	1	0	-	-	0	-	-
58 Fishing area total	-	-	*0*	*1*	*0*	-	-	*0*	-	-
67 Canada	...	...	...	...	...	967	1 161	1 477	1 270	1 351
USA	300	249	199	262	390	291	208	280	276	497
67 Fishing area total	*300*	*249*	*199*	*262*	*390*	*1 258*	*1 369*	*1 757*	*1 546*	*1 848*
71 Cambodia	...	...	3	...	...	...	...	...	...	...
Fiji	824	500 F	21	121	150 F	186	372	60	50	200
Indonesia	2 820	2 408	2 680	6 516	6 520	4 255	3 878	3 171	5 380	4 584
Kiribati	180	780	162	320 F	480 F	600 F	806	537	163	98
NewCaledonia	489	350	517	811	500	565	919	766	364	257
Papua N Guin	1 453	326	492	484	612	666	796	500	534	-
Philippines	791	954	979	1 006	762	849	850	777	934	979
Solomon Is	375	174	409	17	20 F	20 F	20 F	20 F	20 F	20 F
Vanuatu	114	24	75	42	27	24	15	15 F	...	...
Wallis Fut I	0	-	0	0	0	0	0	-	-	-
71 Fishing area total	*7 046*	*5 516 F*	*5 338*	*9 317 F*	*9 071 F*	*7 165 F*	*7 656 F*	*5 846 F*	*7 445 F*	*6 138 F*
77 Mexico	442	290	285	265	416	434	388	391	461	432
Nicaragua	-	-	-	-	51	93	93	99	91	207
Tonga	-	-	-	-	-	-	-	45	108	311
USA	-	-	-	0	-	-	-	0	247	270
77 Fishing area total	*442*	*290*	*285*	*265*	*467*	*527*	*481*	*535*	*907*	*1 220*
81 New Zealand	0	1	-	1	14	4	10	13	6	7
81 Fishing area total	*0*	*1*	-	*1*	*14*	*4*	*10*	*13*	*6*	*7*
87 Chile	107	106	307	234	153	18	257	130	658	109
Ecuador	15	15 F	15 F	15 F	15 F	15 F	15 F	15 F	...	...
87 Fishing area total	*122*	*121 F*	*322 F*	*249 F*	*168 F*	*33 F*	*272 F*	*145 F*	*658*	*109*
88 Ukraine	-	-	-	0	-	-	-	-	-	-
88 Fishing area total	-	-	-	*0*	-	-	-	-	-	-
Species total	*12 944*	*15 244 F*	*18 096 F*	*16 888 F*	*18 668 F*	*19 188 F*	*19 972 F*	*19 429 F*	*24 170 F*	*24 482 F*
Group total	***108 127***	***123 903***	***106 963***	***115 084***	***105 064***	***100 338***	***98 359***	***101 291***	***107 583***	***101 207***

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Miscellaneous aquatic invertebrates
Invertébrés aquatiques divers
Invertebrados acuáticos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Jellyfishes nei	**Méduses nca**		**Medusas nep**		***Rhopilema spp***				**6,18(41)007,XX**	**JEL**
31 Nicaragua	-	-	-	-	-	-	-	205	...	...
USA	-	-	500	1 512	44	...	671	5	-	-
31 Fishing area total	-	-	*500*	*1 512*	*44*	...	*671*	*210*	...	...
37 Turkey	2 000	500	4 000	1 000	544	1 017	-	-	-	-
37 Fishing area total	*2 000*	*500*	*4 000*	*1 000*	*544*	*1 017*	-	-	-	-
47 Namibia	44	2 193	139	-	19	...	20	...	...	...
47 Fishing area total	*44*	*2 193*	*139*	-	*19*	...	*20*	...	...	...
48 Chile	-	-	-	-	0	-	-	-	-	-
UK	-	0	-	-	-	-	1	0	0	-
48 Fishing area total	-	*0*	-	-	*0*	-	*1*	*0*	*0*	-
51 Bahrain	...	...	...	312	358	43	1 759	325	3 341	79
Iran	-	-	-	-	-	-	-	-	-	7 918
51 Fishing area total	...	...	...	*312*	*358*	*43*	*1 759*	*325*	*3 341*	*7 997*
57 Indonesia	16 159	46 511	76 024	535	1 303	8	37	71	1 197	106
Malaysia	6 367	2 607	2 196	926	1 432	681	589	481	571	342
Myanmar	1 100 F	1 300 F	1 500 F	1 700 F	1 976	2 000 F	2 200 F	2 410 F	2 710 F	3 180 F
Thailand	799	-	-	-	29 882	134 616	31	147 109	114 481	107 256
57 Fishing area total	*24 425 F*	*50 418 F*	*79 720 F*	*3 161 F*	*34 593*	*137 305 F*	*2 857 F*	*150 071 F*	*118 959 F*	*110 884 F*
58 Australia	-	-	2	1	2	1	1	14	1	1
58 Fishing area total	-	-	*2*	*1*	*2*	*1*	*1*	*14*	*1*	*1*
61 China	282 645 F	245 120 F	253 930 F	174 653 F	244 175 F	196 570 F	223 868	236 626	223 151	216 056
Russian Fed	142	-	44	53	67	79	105	81	237	312
61 Fishing area total	*282 787 F*	*245 120 F*	*253 974 F*	*174 706 F*	*244 242 F*	*196 649 F*	*223 973*	*236 707*	*223 388*	*216 368*
71 Indonesia	5 306	13 585	14 625	5 575	1 849	2 492	2 535	2 136	875	1 421
Malaysia	3 932	4 041	3 667	3 115	3 853	4 228	3 479	4 658	3 442	4 907
Philippines	12	11	21	23	21	30	27	17	17	19
Thailand	46 735	28 947	8 791	1 528	3 524	3 659	7 274	2 264	3 335	2 744
71 Fishing area total	*55 985*	*46 584*	*27 104*	*10 241*	*9 247*	*10 409*	*13 315*	*9 075*	*7 669*	*9 091*
Species total	*365 241 F*	*344 815 F*	*365 439 F*	*190 933 F*	*289 049 F*	*345 424 F*	*242 597 F*	*396 402 F*	*353 358 F*	*344 341 F*
Marine worms	**Vers marins**		**Poliquetos**		***Polychaeta***				**6,49(XX)XXX,XX**	**WOR**
02 Mexico	26	27	26	29	8	8	35	37	41	54
02 Fishing area total	*26*	*27*	*26*	*29*	*8*	*8*	*35*	*37*	*41*	*54*
21 USA	481	507	454	450	406	344	425	367	352	364
21 Fishing area total	*481*	*507*	*454*	*450*	*406*	*344*	*425*	*367*	*352*	*364*
27 Portugal	-	-	-	-	-	-	1	3	7	7
27 Fishing area total	-	-	-	-	-	-	*1*	*3*	*7*	*7*
77 Panama	36	41	33	26	23	25	20	16	15	21
77 Fishing area total	*36*	*41*	*33*	*26*	*23*	*25*	*20*	*16*	*15*	*21*
Species total	*543*	*575*	*513*	*505*	*437*	*377*	*481*	*423*	*415*	*446*
Aquatic invertebrates nei	**Invertébrés aquatiques nca**		**Invertebrados acuáticos nep**		***Invertebrata***				**6,99(XX)XXX,XX**	**INV**
02 Mexico	93	126	133	138	331	346	404	324	398	394
02 Fishing area total	*93*	*126*	*133*	*138*	*331*	*346*	*404*	*324*	*398*	*394*
04 China	...	...	42 611 F	38 033 F	37 032 F	36 608 F	36 760	35 423	45 430	44 368
Indonesia	645	781	489	703	2 184	824	1 035	831	402	1 475
Japan	933	1 035	926	856	701	399	625	365	516	334 F
Korea Rep	-	-	-	1	-	-	-	-	-	-
Viet Nam	46 415 F	54 215 F	48 924 F	...	...	...	...	...	...	...
04 Fishing area total	*47 993 F*	*56 031 F*	*92 950 F*	*39 593 F*	*39 917 F*	*37 831 F*	*38 420*	*36 619*	*46 348*	*46 177 F*
05 Russian Fed	-	-	-	6	7	7	-	46	34	21
Ukraine	-	-	16	34	150	141	112	290	230	150
05 Fishing area total	-	-	*16*	*40*	*157*	*148*	*112*	*336*	*264*	*171*
27 Spain	-	-	-	-	-	0	1	2	1	4
UK	24	4	20	0	0	-	-	-	-	-
27 Fishing area total	*24*	*4*	*20*	*0*	*0*	*0*	*1*	*2*	*1*	*4*
34 Spain	-	-	8	6	11	-	5	-	-	-
34 Fishing area total	-	-	*8*	*6*	*11*	-	*5*	-	-	-
37 Croatia	592	59	35	58	...	...	...	...	...	...
France	-	-	-	-	-	1	1	1	-	-
Spain	-	11	7	8	4	3	1	1	4	5
Ukraine	3	9	1	30	64	165	130	411	316	284
37 Fishing area total	*595*	*79*	*43*	*96*	*68*	*169*	*132*	*413*	*320*	*289*
47 Spain	-	19	-	-	-	-	-	-	-	-
47 Fishing area total	-	*19*	-	-	-	-	-	-	-	-

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Miscellaneous aquatic invertebrates
Invertébrés aquatiques divers
Invertebrados acuáticos diversos

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
57 Australia	96	72	125	87	91	66	88	271	196	173
Indonesia	661	842	1 851	953	724	1 154	1 192	198	654	862
Thailand	-	-	-	-	3	-	-	3	-	1
57 Fishing area total	*757*	*914*	*1 976*	*1 040*	*818*	*1 220*	*1 280*	*472*	*850*	*1 036*
58 Australia	-	-	-	-	-	-	-	0	0	0
58 Fishing area total	-	-	-	-	-	-	-	*0*	*0*	*0*
61 Japan	7 406	6 314	6 197	6 030	5 078	4 723	14 950	14 226	33 300 F	42 000 F
Korea Rep	1 302	1 936	1 622	1 741	561	749	803	436	334	147
Russian Fed	-	-	-	-	-	-	-	4	1	-
61 Fishing area total	*8 708*	*8 250*	*7 819*	*7 771*	*5 639*	*5 472*	*15 753*	*14 666*	*33 635 F*	*42 147 F*
71 Australia	44	14	10	0	3	5	4	3	3	1
Fiji	...	...	241	283	270 F	267	266	200	200	100
Indonesia	612	389	700	425	1 632	832	699	91	2 045	1 750
Palau	0	0	0	0	0	...	...	...	...	...
Thailand	1 749	339	489	274	3 258	1 585	1 049	609	426	424
71 Fishing area total	*2 405*	*742*	*1 440*	*982*	*5 163 F*	*2 689*	*2 018*	*903*	*2 674*	*2 275*
77 Niue	...	...	...	...	...	40	40 F	40 F	...	...
Samoa	...	...	...	48	25	966	1 029	1 092	970	970 F
77 Fishing area total	*...*	*...*	*...*	*48*	*25*	*1 006*	*1 069 F*	*1 132 F*	*970*	*970 F*
81 Australia	31	22	17	16	20	12	...	1	1	0
New Zealand	-	1	-	2	-	-	-	0	0	-
81 Fishing area total	*31*	*23*	*17*	*18*	*20*	*12*	*...*	*1*	*1*	*0*
88 Uruguay	-	-	-	0	2	0	0	-	-	-
88 Fishing area total	-	-	-	*0*	*2*	*0*	*0*	-	-	-
Species total	*60 606 F*	*66 188 F*	*104 422 F*	*49 732 F*	*52 151 F*	*48 893 F*	*59 194 F*	*54 868 F*	*85 461 F*	*93 463 F*
Group total	***426 390***	***411 578***	***470 374***	***241 170***	***341 637***	***394 694***	***302 272***	***451 693***	***439 234***	***438 250***

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Pearls, mother-of-pearl, shells
Perles, nacres, coquilles
Perlas, madreperlas, conchas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 kg	2002 kg	2003 kg	2004 kg	2005 kg	2006 kg	2007 kg	2008 kg	2009 kg	2010 kg
Trochus shells	**Troques**		**Tróquidos**		***Ex Trochus spp***				**3,07(04)006,XX**	**TSH**
51 Eritrea	60 000 F	20 000 F	-	-	-	-	-	-	-	-
51 Fishing area total	*60 000 F*	*20 000 F*	-	-	-	-	-	-	-	-
71 Australia	0	-	-	-	-	-	-	-	-	-
Fiji	110 000 F	85 000 F	57 800	106 660	90 000 F	64 000	84 000	70 000	15 000	10 000
Marshall Is	0	0	0	0	-	-	-	-	-	-
Micronesia	150 000 F	150 000 F	150 000 F	150 000 F	150 000 F	150 000 F	150 000 F	150 000 F	150 000 F	150 000 F
NewCaledonia	190 000	77 900	99 500	120 000	153 000	187 000	197 700	199 000	277 000	228 000
Palau	-	-	-	-	498 900	0	144 820	0	0	0
Papua N Guin	345 062	437 705	466 784	349 320	401 596	515 791	425 958	359 518	277 445	274 345
Solomon Is	146 301	126 465	43 120	17 551	18 000 F	18 000 F	18 000 F	18 000 F	18 000 F	18 000 F
Vanuatu	73 000	67 000	52 000	35 630	36 000	36 000	55 200	54 000 F	52 300	24 500
Wallis Fut I	35 000 F	40 000 F	59 100	15 200	29 750	29 200	29 000 F	29 000 F	29 000 F	29 000 F
71 Fishing area total	*1 049 363 F*	*984 070 F*	*928 304 F*	*794 361 F*	*1 377 246 F*	*999 991 F*	*1 104 678 F*	*879 518 F*	*818 745 F*	*733 845 F*
77 Cook Is	27 000	11 000	8 000	-	-	-	-	-	-	-
Fr Polynesia	...	9 891	...	...	...	...	...	...	...	...
77 Fishing area total	*27 000*	*20 891*	*8 000*	*...*	*...*	*...*	*...*	*...*	*...*	*...*
Species total	*1 136 363 F*	*1 024 961 F*	*936 304 F*	*794 361 F*	*1 377 246 F*	*999 991 F*	*1 104 678 F*	*879 518 F*	*818 745 F*	*733 845 F*
Turban shells nei	**Coquilles turbo nca**		**Turbinas nep**		***Ex Turbo spp***				**3,07(05)002,XX**	**GSH**
71 Malaysia	80 000 F	80 000 F	80 000 F	80 000 F	80 000 F	80 000 F	80 000 F	80 000 F	80 000 F	80 000 F
71 Fishing area total	*80 000 F*	*80 000 F*	*80 000 F*	*80 000 F*	*80 000 F*	*80 000 F*	*80 000 F*	*80 000 F*	*80 000 F*	*80 000 F*
Species total	*80 000 F*	*80 000 F*	*80 000 F*	*80 000 F*	*80 000 F*	*80 000 F*	*80 000 F*	*80 000 F*	*80 000 F*	*80 000 F*
Freshwater mussel shells	**Coquilles des moules eau douce**		**Conchas de mejillón agua dulce**		***Ex Unionidae***				**3,16(05)XXX,XX**	**FSH**
02 USA	...	...	...	-	0	5 706	34 511	-	-	-
02 Fishing area total	*...*	*...*	*...*	*-*	*0*	*5 706*	*34 511*	*-*	*-*	*-*
Species total	*...*	*...*	*...*	*-*	*0*	*5 706*	*34 511*	*-*	*-*	*-*
Pearl oyster shells nei	**Coquilles d'huîtres perl. nca**		**Conchas de ostras perleras nep**		***Ex Pinctada spp***				**3,16(06)006,XX**	**OSH**
04 Japan	178	198	...	76	113	99	190	102	113	113 F
04 Fishing area total	*178*	*198*	*...*	*76*	*113*	*99*	*190*	*102*	*113*	*113 F*
51 Sudan	7 500	7 500	7 500 F	7 500 F	7 500 F	7 500 F	7 500	7 500 F	8 000	8 000 F
51 Fishing area total	*7 500*	*7 500*	*7 500 F*	*7 500 F*	*7 500 F*	*7 500 F*	*7 500*	*7 500 F*	*8 000*	*8 000 F*
57 Australia	190 000 F	220 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F
Indonesia	...	...	...	0	0	96 000	0	1 000	0	523 000
57 Fishing area total	*190 000 F*	*220 000 F*	*200 000 F*	*200 000 F*	*200 000 F*	*296 000 F*	*200 000 F*	*201 000 F*	*200 000 F*	*723 000 F*
61 China,Taiwan	1 251	1 518	1 579	1 923	1 502	-	-	-	-	-
Japan	34 516	31 910	31 557	29 210	28 846	27 355	27 225	23 813	22 016	22 016 F
61 Fishing area total	*35 767*	*33 428*	*33 136*	*31 133*	*30 348*	*27 355*	*27 225*	*23 813*	*22 016*	*22 016 F*
71 Indonesia	65 000 F	60 000 F	55 000 F	51 000	212 000	399 000	205 000	550 000	1 338 000	932 000
Papua N Guin	4 819	2 712	18 781	49 051	36 888	13 908	3 194	22 988	8 284	3 133
71 Fishing area total	*69 819 F*	*62 712 F*	*73 781 F*	*100 051*	*248 888*	*412 908*	*208 194*	*572 988*	*1 346 284*	*935 133*
Species total	*303 264 F*	*323 838 F*	*314 417 F*	*338 760 F*	*486 849 F*	*743 862 F*	*443 109 F*	*805 403 F*	*1 576 413 F*	*1 688 262 F*
Marine shells nei	**Coquilles marines nca**		**Conchas marinas nep**		***Ex Mollusca***				**3,99(XX)XXX,XX**	**MSH**
27 France	-	-	-	-	-	-	-	-	763 000	763 000 F
27 Fishing area total	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*763 000*	*763 000 F*
31 Bahamas	13 000	22 000	28 000	18 000	27 000	62 000	33 000	71 000	52 750	104 440
Mexico	33 000 F	21 580	14 170	16 770	93 665	97 451	47 048	27 998	89 368	134 000
31 Fishing area total	*46 000 F*	*43 580*	*42 170*	*34 770*	*120 665*	*159 451*	*80 048*	*98 998*	*142 118*	*238 440*
37 Croatia	3 125	2 539	2 036	3 121	3 090	4 132	3 633	3 080	...	...
Serbia-Monte	2 285	3 075	3 060	3 000	...	-	-	-	-	-
Slovenia	-	-	1 000	1 000	4 000	169	1 454	5 714	5 259	7 000
37 Fishing area total	*5 410*	*5 614*	*6 096*	*7 121*	*7 090*	*4 301*	*5 087*	*8 794*	*5 259*	*7 000*
51 Kenya	260 324	271 334	265 000	198 074	207 000	211 000	198 000	208 000	161 000	174 000
Madagascar	32 000	26 000	194 000	...	...	...	...	...	...	...
Tanzania	436 743	325 000	895 747	316 680	300 000 F	277 000	270 000 F	331 000	330 000 F	330 000 F
51 Fishing area total	*729 067*	*622 334*	*1 354 747*	*514 754*	*507 000 F*	*488 000*	*468 000 F*	*539 000*	*491 000 F*	*504 000 F*
57 Sri Lanka	498 000	324 000	683 200	588 400	846 000	557 000	1 277 000	1 953 000	692 000	1 113 000
57 Fishing area total	*498 000*	*324 000*	*683 200*	*588 400*	*846 000*	*557 000*	*1 277 000*	*1 953 000*	*692 000*	*1 113 000*
71 Philippines	2 713 000	2 792 000	2 825 000	2 754 000	2 541 000	2 731 550	2 692 000	3 030 000	2 845 000	3 553 000
Solomon Is	20 F	20 F	20 F	20 F	20 F	20 F	20 F	20 F	20 F	20 F
71 Fishing area total	*2 713 020 F*	*2 792 020 F*	*2 825 020 F*	*2 754 020 F*	*2 541 020 F*	*2 731 570 F*	*2 692 020 F*	*3 030 020 F*	*2 845 020 F*	*3 553 020 F*
77 Mexico	330 000 F	243 930	155 289	166 488	463 414	479 405	205 906	297 421	339 178	513 000
77 Fishing area total	*330 000 F*	*243 930*	*155 289*	*166 488*	*463 414*	*479 405*	*205 906*	*297 421*	*339 178*	*513 000*
Species total	*4 321 497 F*	*4 031 478 F*	*5 066 522 F*	*4 065 553 F*	*4 485 189 F*	*4 419 727 F*	*4 728 061 F*	*5 927 233 F*	*5 277 575 F*	*6 691 460 F*
Group total	***5 841 124***	***5 460 277***	***6 397 243***	***5 278 674***	***6 429 284***	***6 249 286***	***6 390 359***	***7 692 154***	***7 752 733***	***9 193 567***

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Pearls, mother-of-pearl, shells
Perles, nacres, coquilles
Perlas, madreperlas, conchas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 kg	2002 kg	2003 kg	2004 kg	2005 kg	2006 kg	2007 kg	2008 kg	2009 kg	2010 kg

Data of "Pearl oyster shells nei" include aquaculture production.

Data by Japan for "Pearl oyster shells nei" refer only to production of pearls.

See paragraph 5 of the INTRODUCTION.

Les données de "Coquilles d'huîtres perlières nca" comprennent les quantités provenant de l'aquaculture.

Les données du Japon concernant les "Coquilles d'huîtres perlières nca" se rapportent à la production des perles.

Voir le paragraphe 5 de l'INTRODUCTION.

Los datos correspondientes a "Conchas de ostras perleras nep" incluyen las cantidades procedentes de la acuicultura.

Los datos de Japón referidos a "Conchas de ostras perleras nep" se refieren solamente a la producción de perlas.

Véase el párrafo 5 en la INTRODUCCIÓN.

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Corals
Coraux
Corales

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 kg	2002 kg	2003 kg	2004 kg	2005 kg	2006 kg	2007 kg	2008 kg	2009 kg	2010 kg
Cnidarians nei	**Cnidaires nca**		**Cnidarios nep**		***Cnidaria***				**6,16(XX)XXX,XX**	**CNI**
58 Australia	-	-	2 491	49	705	-	-	-	-	-
Chile	-	-	-	-	-	1	-	-	-	-
Japan	-	-	-	-	-	-	-	14	-	-
New Zealand	-	-	-	-	0	-	-	-	-	-
58 Fishing area total	-	-	*2 491*	*49*	*705*	*1*	-	*14*	-	-
81 New Zealand	-	-	-	-	-	-	-	-	-	10 600
81 Fishing area total	-	-	-	-	-	-	-	-	-	*10 600*
88 New Zealand	-	-	-	-	5	-	-	0	-	-
Uruguay	-	-	-	-	53	-	197	-	-	-
88 Fishing area total	-	-	-	-	*58*	-	*197*	*0*	-	-
Species total	-	-	*2 491*	*49*	*763*	*1*	*197*	*14*	-	*10 600*
Sardinia coral	**Corail Sardaigne**		**Coral Cerdeña**		***Corallium rubrum***				**6,19(01)003,01**	**COL**
27 Spain	1 600	2 300	800	500	400	400	-	-	-	-
27 Fishing area total	*1 600*	*2 300*	*800*	*500*	*400*	*400*	-	-	-	-
34 Morocco	600	800	3 600	3 000	2 100	2 500	2 300	1 900	3 500	3 600
34 Fishing area total	*600*	*800*	*3 600*	*3 000*	*2 100*	*2 500*	*2 300*	*1 900*	*3 500*	*3 600*
37 Albania	1 200	1 800	1 600	500	...	300	400	1 000	1 000	1 200
Algeria	5 000	4 800	2 000	2 200	1 300	1 800	1 131	1 430	...	...
Croatia	1 900	2 000	1 000	1 000	6 500	6 400	2 100	4 000	4 500	6 500
France	3 700	5 600	4 500	4 200	11 000	9 300	8 200	8 400	9 000	9 300
Greece	1 400	1 900	1 900	1 700	1 500	1 700	800	800	900	2 800
Italy	4 700	5 100	8 800	6 300	4 700	5 400	6 250	7 300	9 800	10 300
Montenegro	...	...	...	...	...	800	1 000	1 000	1 200	1 400
Morocco	3 300	3 800	1 000	700	900	1 100	1 200	1 800	3 000	3 513
Spain	5 000	5 500	8 100	7 800	6 200	5 300	4 800	4 700	5 100	5 400
Tunisia	2 005	2 371	1 670	3 092	3 523	5 703	10 669	8 106	5 309	10 100
37 Fishing area total	*28 205*	*32 871*	*30 570*	*27 492*	*35 623*	*37 803*	*36 550*	*38 536*	*39 809*	*50 513*
Species total	*30 405*	*35 971*	*34 970*	*30 992*	*38 123*	*40 703*	*38 850*	*40 436*	*43 309*	*54 113*
Aka coral	**Corail aka**		**Coral aka**		***Corallium japonicum***				**6,19(01)003,02**	**COJ**
61 China,Taiwan	350	250	300	1 100	...	...	...	...	3	1 000
Japan	1 200	680	450	2 080	1 826	1 920	1 950	1 950	2 000	2 200
61 Fishing area total	*1 550*	*930*	*750*	*3 180*	*1 826*	*1 920*	*1 950*	*1 950*	*2 003*	*3 200*
Species total	*1 550*	*930*	*750*	*3 180*	*1 826*	*1 920*	*1 950*	*1 950*	*2 003*	*3 200*
Momo, boke magai, misu coral	**Corail momo**		**Coral momo**		***Corallium elatius***				**6,19(01)003,03**	**CEL**
61 China,Taiwan	4 500	8 500	15 000	9 000	5 500	6 300	7 720	11 500	9 500	12 900
Japan	2 300	3 240	2 029	2 200	2 000	2 100	2 300	2 350	2 650	2 800
61 Fishing area total	*6 800*	*11 740*	*17 029*	*11 200*	*7 500*	*8 400*	*10 020*	*13 850*	*12 150*	*15 700*
Species total	*6 800*	*11 740*	*17 029*	*11 200*	*7 500*	*8 400*	*10 020*	*13 850*	*12 150*	*15 700*
Shiro, white coral	**Corail blanc**		**Coral blanco**		***Corallium konojoi***				**6,19(01)003,04**	**COK**
61 China,Taiwan	-	100	250	150	200	210	195	215	220	1 000
Japan	-	320	265	430	370	320	300	300	-	300
61 Fishing area total	-	*420*	*515*	*580*	*570*	*530*	*495*	*515*	*220*	*1 300*
Species total	-	*420*	*515*	*580*	*570*	*530*	*495*	*515*	*220*	*1 300*
Sea plume	**...B**		**...C**		***Pseudopterogorgia elisabethae***				**6,19(27)001,01**	**QAE**
31 Bahamas	-	-	-	-	-	-	-	-	2 040	-
31 Fishing area total	-	-	-	-	-	-	-	-	*2 040*	-
Species total	-	-	-	-	-	-	-	-	*2 040*	-
Gorgonians	**...B**		**...C**		***Gorgoniidae***				**6,19(27)XXX,XX**	**GGW**
58 Australia	-	-	-	0	0	-	-	0	0	-
58 Fishing area total	-	-	-	*0*	*0*	-	-	*0*	*0*	-
Species total	-	-	-	*0*	*0*	-	-	*0*	*0*	-
Hard corals, madrepores nei	**Madrépores nca**		**Madréporas nep**		***Scleractinia***				**6,19(XX)XXX,XX**	**CSS**
31 Haiti	10 000 F	10 000 F	10 000 F	10 000 F	10 000 F	10 000 F	10 000 F	10 000 F	10 000 F	10 000 F
Mexico	500 F	370	593	168	435	453	525	240	280	1 000
31 Fishing area total	*10 500 F*	*10 370 F*	*10 593 F*	*10 168 F*	*10 435 F*	*10 453 F*	*10 525 F*	*10 240 F*	*10 280 F*	*11 000 F*
57 India	...	8 750 000	8 750 000	-	-	-	-	-	-	-
57 Fishing area total	*...*	*8 750 000*	*8 750 000*	-	-	-	-	-	-	-
58 Australia	-	-	-	-	-	-	-	0	-	-
58 Fishing area total	-	-	-	-	-	-	-	*0*	-	-

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Corals
Coraux
Corales

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 kg	2002 kg	2003 kg	2004 kg	2005 kg	2006 kg	2007 kg	2008 kg	2009 kg	2010 kg
71 Fiji	1 000 000 F	1 000 000 F	1 000 000 F	1 100 000 F	1 000 000 F	1 000 000	1 000 000	1 000 000	1 000 000	70 000
Indonesia	600 000 F	500 000 F	...	13 000	8 000	0	0	...	...	...
Malaysia	4 000 000 F	4 000 000 F	4 000 000 F	4 000 000 F	4 000 000 F	4 000 000 F	4 000 000 F	4 000 000 F	4 000 000 F	4 000 000 F
Wallis Fut I	-	-	23	-	-	-	-	-	-	-
71 Fishing area total	*5 600 000 F*	*5 500 000 F*	*5 000 023 F*	*5 113 000 F*	*5 008 000 F*	*5 000 000 F*	*5 000 000 F*	*5 000 000 F*	*5 000 000 F*	*4 070 000 F*
77 USA	8 533	...	1 946	-	-	-	-	-	-	-
77 Fishing area total	*8 533*	*...*	*1 946*	-	-	-	-	-	-	-
81 New Zealand	-	-	-	-	-	-	-	-	-	2 000
81 Fishing area total	-	-	-	-	-	-	-	-	-	*2 000*
88 New Zealand	-	-	-	-	1	0	0	190	0	-
88 Fishing area total	-	-	-	-	*1*	*0*	*0*	*190*	*0*	-
Species total	*5 619 033 F*	*14 260 370 F*	*13 762 562 F*	*5 123 168 F*	*5 018 436 F*	*5 010 453 F*	*5 010 525 F*	*5 010 430 F*	*5 010 280 F*	*4 083 000 F*
Black corals and thorny corals	**...B**		**...C**		***Antipatharia***				**6,19(XX)XXX,XX**	**AQZ**
81 New Zealand	-	-	-	-	-	-	-	-	45	46
81 Fishing area total	-	-	-	-	-	-	-	-	*45*	*46*
Species total	-	-	-	-	-	-	-	-	*45*	*46*
Sea anemones	**Actinies**		**Anémonas de mar**		***Actiniaria***				**6,19(XX)XXX,XX**	**ATX**
58 Australia	-	-	-	1 000	0	-	0	0	0	3 000
58 Fishing area total	-	-	-	*1 000*	*0*	-	*0*	*0*	*0*	*3 000*
81 New Zealand	-	-	-	1 000	1 000	...	...	...	18 000	...
81 Fishing area total	-	-	-	*1 000*	*1 000*	*...*	*...*	*...*	*18 000*	*...*
88 New Zealand	-	-	-	-	0	0	0	0	-	-
Uruguay	-	-	-	-	0	-	-	-	-	-
88 Fishing area total	-	-	-	-	*0*	*0*	*0*	*0*	-	-
Species total	-	-	-	*2 000*	*1 000*	*0*	*0*	*0*	*18 000*	*3 000*
Group total	***5 657 788***	***14 309 431***	***13 818 317***	***5 171 169***	***5 068 218***	***5 062 007***	***5 062 037***	***5 067 195***	***5 088 047***	***4 170 959***

See paragraph 5 of the INTRODUCTION. Voir le paragraphe 5 de l'INTRODUCTION. Véase el párrafo 5 en la INTRODUCCIÓN.

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Sponges
Éponges
Esponjas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 kg	2002 kg	2003 kg	2004 kg	2005 kg	2006 kg	2007 kg	2008 kg	2009 kg	2010 kg
Sponges	**Éponges**		**Esponjas**		***Spongiidae***				**6,15(01)XXX,XX**	**SPO**
31 Bahamas	71 000	61 000	55 000	42 000	31 000	50 000	33 000	48 000	31 040	57 000
Colombia	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F
Cuba	51 000	54 000	57 000	51 000	42 000	44 000	38 000	46 000	46 000	45 000
USA	291 326	260 688	237 106	253 475	234 671	153 733	266 690	210 136	121 086	116 734
31 Fishing area total	*415 326 F*	*377 688 F*	*351 106 F*	*348 475 F*	*309 671 F*	*249 733 F*	*339 690 F*	*306 136 F*	*200 126 F*	*220 734 F*
37 Croatia	57 100	1 000	8 000	4 000	18 500	12 600	20 900	31 000	35 000	31 800
Egypt	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F
France	2 000 F	1 400 F	1 200 F	1 000 F	800 F	600 F	500 F	400 F	300 F	200 F
Greece	5 000	2 000	2 500	2 700	3 000	3 000	3 000 F	3 500	4 900	4 000 F
Italy	1 000 F	1 000 F	1 000 F	500 F	400 F	300 F	200 F	200 F	200 F	200 F
Lebanon	0	-	-	-	-	-	-	-	-	-
Libya	6 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	6 300	6 000 F
Spain	700 F	700 F	500	500 F	500 F	400 F	300 F	200 F	200 F	200 F
Tunisia	23 092	44 200	34 451	24 580	32 791	100 839	20 522	17 643	10 500	9 700
Turkey	3 000	-	-	-	-	-	-	-	-	-
37 Fishing area total	*98 892 F*	*56 300 F*	*53 651 F*	*39 280 F*	*61 991 F*	*123 739 F*	*51 422 F*	*58 943 F*	*58 400 F*	*53 100 F*
48 UK	-	-	2	-	-	-	-	-	...	-
48 Fishing area total	-	-	*2*	-	-	-	-	-	...	-
58 Australia	-	-	1 739	-	1 584	-	295	2 302	1 387	8 836
Japan	-	-	-	-	-	-	-	1	-	...
58 Fishing area total	-	-	*1 739*	-	*1 584*	-	*295*	*2 303*	*1 387*	*8 836*
71 Philippines	8 000	8 000	8 000	7 000	5 000	5 940	6 000	5 000	6 000	7 000
71 Fishing area total	*8 000*	*8 000*	*8 000*	*7 000*	*5 000*	*5 940*	*6 000*	*5 000*	*6 000*	*7 000*
81 New Zealand	23 000	...	...	...	...	...	...	...	56 357	62 716
81 Fishing area total	*23 000*	*...*	*...*	*...*	*...*	*...*	*...*	*...*	*56 357*	*62 716*
88 New Zealand	-	-	-	-	1	1	-	117	-	-
Ukraine	-	-	-	8	-	-	-	-	-	-
Uruguay	-	-	-	-	-	-	1	-	-	-
88 Fishing area total	-	-	-	*8*	*1*	*1*	*1*	*117*	-	-
Species total	*545 218 F*	*441 988 F*	*414 498 F*	*394 763 F*	*378 247 F*	*379 413 F*	*397 408 F*	*372 499 F*	*322 270 F*	*352 386 F*
Group total	***545 218***	***441 988***	***414 498***	***394 763***	***378 247***	***379 413***	***397 408***	***372 499***	***322 270***	***352 386***

See paragraph 5 of the INTRODUCTION. Voir le paragraphe 5 de l'INTRODUCTION. Véase el párrafo 5 en la INTRODUCCIÓN.

B-91

Brown seaweeds
Algues brunes
Algas pardas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Tangle	**Laminaire digitée**		**...C**		***Laminaria digitata***				**7,71(02)002,01**	**LQD**
27 France	48 520	51 251	52 402	52 402	15 635	12 856	24 196	24 196 F	17 139	21 320
Iceland	4 679	3	4 072	3 734	2 910	3 135	4 753	3 995	3 575	2 454
27 Fishing area total	*53 199*	*51 254*	*56 474*	*56 136*	*18 545*	*15 991*	*28 949*	*28 191 F*	*20 714*	*23 774*
Species total	*53 199*	*51 254*	*56 474*	*56 136*	*18 545*	*15 991*	*28 949*	*28 191 F*	*20 714*	*23 774*
Japanese kelp	**Laminaire du Japon**		**Laminaria del Japón**		***Laminaria japonica***				**7,71(02)002,02**	**LNJ**
61 Japan	97 261	104 402	84 274	91 122	78 575	84 665	72 767	73 244	80 115	73 800 F
Korea Rep	...	...	37	0	9	12	28	2	354	180
61 Fishing area total	*97 261*	*104 402*	*84 311*	*91 122*	*78 584*	*84 677*	*72 795*	*73 246*	*80 469*	*73 980 F*
Species total	*97 261*	*104 402*	*84 311*	*91 122*	*78 584*	*84 677*	*72 795*	*73 246*	*80 469*	*73 980 F*
North European kelp	**...B**		**...C**		***Laminaria hyperborea***				**7,71(02)002,04**	**LAH**
27 France	2 638	3 249	4 548	4 548	464	1 491	6 714	6 714 F	1 406	1 277
Ireland	2 000 F	2 000 F	1 900 F	1 700 F	1 400 F	1 400 F	1 400 F	1 400 F	1 400 F	1 400 F
27 Fishing area total	*4 638 F*	*5 249 F*	*6 448 F*	*6 248 F*	*1 864 F*	*2 891 F*	*8 114 F*	*8 114 F*	*2 806 F*	*2 677 F*
Species total	*4 638 F*	*5 249 F*	*6 448 F*	*6 248 F*	*1 864 F*	*2 891 F*	*8 114 F*	*8 114 F*	*2 806 F*	*2 677 F*
Wakame	**Wakamé**		**Abeto marino**		***Undaria pinnatifida***				**7,71(04)003,01**	**UDP**
61 Japan	3 034	3 179	3 680	3 673	3 613	3 575	...	...	...	...
Korea Rep	...	...	942	719	4 740	3 569	6 384	3 114	3 882	4 783
61 Fishing area total	*3 034*	*3 179*	*4 622*	*4 392*	*8 353*	*7 144*	*6 384*	*3 114*	*3 882*	*4 783*
Species total	*3 034*	*3 179*	*4 622*	*4 392*	*8 353*	*7 144*	*6 384*	*3 114*	*3 882*	*4 783*
Chilean kelp	**...B**		**Chascón**		***Lessonia nigrescens***				**7,71(05)001,01**	**LJX**
87 Chile	87 508	96 428	108 899	151 752	203 897	161 834	136 766	202 262	222 628	190 746
87 Fishing area total	*87 508*	*96 428*	*108 899*	*151 752*	*203 897*	*161 834*	*136 766*	*202 262*	*222 628*	*190 746*
Species total	*87 508*	*96 428*	*108 899*	*151 752*	*203 897*	*161 834*	*136 766*	*202 262*	*222 628*	*190 746*
...A	**...B**		**Huiro palo**		***Lessonia trabeculata***				**7,71(05)001,02**	**LJZ**
87 Chile	18 457	25 956	69 272	65 290	46 923	27 552	31 010	33 754	54 120	62 734
87 Fishing area total	*18 457*	*25 956*	*69 272*	*65 290*	*46 923*	*27 552*	*31 010*	*33 754*	*54 120*	*62 734*
Species total	*18 457*	*25 956*	*69 272*	*65 290*	*46 923*	*27 552*	*31 010*	*33 754*	*54 120*	*62 734*
...A	**...B**		**Chascón nep**		***Lessonia spp***				**7,71(05)001,XX**	**EOZ**
81 New Zealand	0	3	1	0	-	-	-	-	-	1
81 Fishing area total	*0*	*3*	*1*	*0*	-	-	-	-	-	*1*
Species total	*0*	*3*	*1*	*0*	-	-	-	-	-	*1*
Kelp nei	**Kelps nca**		**Huiros nep**		***Macrocystis spp***				**7,71(05)002,XX**	**GQO**
67 USA	2	-	-	-	-	-	-	-	-	-
67 Fishing area total	*2*	-	-	-	-	-	-	-	-	-
77 USA	34 544	47 104	47 654	33 724	65 868	3 046	4	3 719	4 203	3 602
77 Fishing area total	*34 544*	*47 104*	*47 654*	*33 724*	*65 868*	*3 046*	*4*	*3 719*	*4 203*	*3 602*
81 New Zealand	0	1	5	27	8	12	6	35	45	45
81 Fishing area total	*0*	*1*	*5*	*27*	*8*	*12*	*6*	*35*	*45*	*45*
87 Chile	9 672	9 774	11 501	9 543	8 786	9 319	10 950	17 060	14 092	11 723
87 Fishing area total	*9 672*	*9 774*	*11 501*	*9 543*	*8 786*	*9 319*	*10 950*	*17 060*	*14 092*	*11 723*
Species total	*44 218*	*56 879*	*59 160*	*43 294*	*74 662*	*12 377*	*10 960*	*20 814*	*18 340*	*15 370*
North Atlantic rockweed	**...B**		**...C**		***Ascophyllum nodosum***				**7,71(06)006,01**	**ASN**
21 Canada	28 810	34 159	10 076	7 741	7 531	8 145	4 404	2 740	2 798	1 666
USA	2 394	59	1 745	1 388	1 946	3 155	2 218	3 204	3 978	5 366
21 Fishing area total	*31 204*	*34 218*	*11 821*	*9 129*	*9 477*	*11 300*	*6 622*	*5 944*	*6 776*	*7 032*
27 France	6 372	7 914	4 429	4 429	1 376	4 261	...	...	...	...
Iceland	15 688	14 959	18 047	17 736	18 186	17 829	17 114	18 564	18 988	18 560
Ireland	34 000 F	34 000 F	33 000 F	28 200	28 000 F	28 000 F	28 000 F	28 000 F	28 000 F	28 000 F
27 Fishing area total	*56 060 F*	*56 873 F*	*55 476 F*	*50 365*	*47 562 F*	*50 090 F*	*45 114 F*	*46 564 F*	*46 988 F*	*46 560 F*
Species total	*87 264 F*	*91 091 F*	*67 297 F*	*59 494*	*57 039 F*	*61 390 F*	*51 736 F*	*52 508 F*	*53 764 F*	*53 592 F*
Bull kelp	**Durvillée antarctique**		**Cochayuyo**		***Durvillaea antartica***				**7,71(08)001,01**	**DVA**
81 New Zealand	0	3	-	-	-	-	-	-	-	-
81 Fishing area total	*0*	*3*	-	-	-	-	-	-	-	-
87 Chile	2 098	2 312	1 764	2 733	2 562	2 292	4 274	4 872	5 872	6 048
87 Fishing area total	*2 098*	*2 312*	*1 764*	*2 733*	*2 562*	*2 292*	*4 274*	*4 872*	*5 872*	*6 048*

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Brown seaweeds
Algues brunes
Algas pardas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*2 098*	*2 315*	*1 764*	*2 733*	*2 562*	*2 292*	*4 274*	*4 872*	*5 872*	*6 048*
Golden Cystoseira	**Cystoseire dorée**		**Cistosira barbuda**		***Cystoseira barbata***				**7,71(09)001,01**	**YQT**
37 Ukraine	...	36	36	...	...	4	31	-	14	5
37 Fishing area total	*...*	*36*	*36*	*...*	*...*	*4*	*31*	*-*	*14*	*5*
Species total	*...*	*36*	*36*	*...*	*...*	*4*	*31*	*-*	*14*	*5*
Brown seaweeds	**Algues brunes**		**Algas pardas**		***Phaeophyceae***				**7,71(XX)XXX,XX**	**SWB**
21 USA	225	17	94	222	246	158	48	25	23	57
21 Fishing area total	*225*	*17*	*94*	*222*	*246*	*158*	*48*	*25*	*23*	*57*
27 France	6 989	9 958	6 789	1 890	3 724	382	...	...	352	...
Norway	175 210	182 641	153 209	148 322	153 906	145 429	134 671	...	...	...
Russian Fed	6 572	4 046	3 426	2 639	2 756	2 153	4 573	4 616	1 812	1 748
Spain	239	233	0	129	109	46	61	75	...	49
27 Fishing area total	*189 010*	*196 878*	*163 424*	*152 980*	*160 495*	*148 010*	*139 305*	*4 691*	*2 164*	*1 797*
37 Spain	-	1	1	-	-	-	1	...	...	2
37 Fishing area total	*-*	*1*	*1*	*-*	*-*	*-*	*1*	*...*	*...*	*2*
47 South Africa	30 518	25 000 F	15 693	20 531	5 884	8 531	11 694	10 767	10 849	12 176
47 Fishing area total	*30 518*	*25 000 F*	*15 693*	*20 531*	*5 884*	*8 531*	*11 694*	*10 767*	*10 849*	*12 176*
51 India	7 000 F	-	-	-	-	-	-	-	-	-
51 Fishing area total	*7 000 F*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
57 Australia	13 547	9 916	8 879	12 570	14 167	15 504	2 223	1 923	1 923 F	1 923 F
57 Fishing area total	*13 547*	*9 916*	*8 879*	*12 570*	*14 167*	*15 504*	*2 223*	*1 923*	*1 923 F*	*1 923 F*
61 Japan	7 238	6 973	7 207	6 375	6 881	8 209	...	...	...	...
Korea Rep	10 067	7 000 F	2 744	5 284	3 522	2 934	2 685	2 981	2 971	2 622
Russian Fed	2 453	6 210	2 486	8 490	6 674	8 720	2 977	5 531	4 006	4 168
61 Fishing area total	*19 758*	*20 183 F*	*12 437*	*20 149*	*17 077*	*19 863*	*5 662*	*8 512*	*6 977*	*6 790*
77 Mexico	38 233	24 923	22 092	22 275	31	124	229	294	258	409
Tonga	173	407	319	1 707	420	356	107	0	16	1
USA	...	3	3	3	3	3	2	3	3	2
77 Fishing area total	*38 406*	*25 333*	*22 414*	*23 985*	*454*	*483*	*338*	*297*	*277*	*412*
Species total	*298 464 F*	*277 328 F*	*222 942*	*230 437*	*198 323*	*192 549*	*159 271*	*26 215*	*22 213 F*	*23 157 F*
Group total	***696 141***	***714 120***	***681 226***	***710 898***	***690 752***	***568 701***	***510 290***	***453 090***	***484 822***	***456 867***

See paragraph 5 of the INTRODUCTION. Voir le paragraphe 5 de l'INTRODUCTION. Véase el párrafo 5 en la INTRODUCCIÓN.

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Red seaweeds
Algues rouges
Algas rojas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
...A	**...B**		**Liquen gomoso**		***Gymnogongrus furcellatus***				**7,87(02)002,04**	**GKF**
87 Chile	-	-	-	93	187	215	0	2	0	0
87 Fishing area total	-	-	-	*93*	*187*	*215*	*0*	*2*	*0*	*0*
Species total	-	-	-	*93*	*187*	*215*	*0*	*2*	*0*	*0*
Gracilaria seaweeds	**Algues gracilaires**		**Gracilarias**		***Gracilaria spp***				**7,87(12)004,XX**	**GLS**
47 Namibia	800	968	408	...	...	...	...	...	...	...
South Africa	...	...	738	1 257	104	403	5	-	-	-
47 Fishing area total	*800*	*968*	*1 146*	*1 257*	*104*	*403*	*5*	*...*	*...*	*...*
87 Chile	52 431	54 536	53 856	98 396	72 860	43 750	69 734	63 967	1 169	45 089
87 Fishing area total	*52 431*	*54 536*	*53 856*	*98 396*	*72 860*	*43 750*	*69 734*	*63 967*	*1 169*	*45 089*
Species total	*53 231*	*55 504*	*55 002*	*99 653*	*72 964*	*44 153*	*69 739*	*63 967*	*1 169*	*45 089*
Carragheen (Irish) moss	**Mousse perle**		**...C**		***Chondrus crispus***				**7,87(16)001,04**	**IMS**
21 USA	-	-	-	2	2	0	0	-	-	-
21 Fishing area total	-	-	-	*2*	*2*	*0*	*0*	-	-	-
Species total	-	-	-	*2*	*2*	*0*	*0*	-	-	-
Skottsberg's gigartina	**Gigartine de Skottsberg**		**Gigartina de Skottsberg**		***Gigartina skottsbergii***				**7,87(16)002,03**	**GJK**
87 Chile	22 717	21 301	30 952	33 308	42 541	33 331	41 879	41 896	29 159	19 725
87 Fishing area total	*22 717*	*21 301*	*30 952*	*33 308*	*42 541*	*33 331*	*41 879*	*41 896*	*29 159*	*19 725*
Species total	*22 717*	*21 301*	*30 952*	*33 308*	*42 541*	*33 331*	*41 879*	*41 896*	*29 159*	*19 725*
...A	**...B**		**Chicorea de mar**		***Chondracanthus chamissoi***				**7,87(16)004,03**	**KDM**
87 Chile	3 325	5 677	4 986	4 642	1 517	1 590	980	1 031	2 001	914
87 Fishing area total	*3 325*	*5 677*	*4 986*	*4 642*	*1 517*	*1 590*	*980*	*1 031*	*2 001*	*914*
Species total	*3 325*	*5 677*	*4 986*	*4 642*	*1 517*	*1 590*	*980*	*1 031*	*2 001*	*914*
...A	**...B**		**Luga negra o crespa**		***Sarcothalia crispata***				**7,87(16)005,01**	**SBQ**
87 Chile	-	20 047	21 135	18 414	24 942	17 135	12 297	14 941	34 289	30 194
87 Fishing area total	-	*20 047*	*21 135*	*18 414*	*24 942*	*17 135*	*12 297*	*14 941*	*34 289*	*30 194*
Species total	-	*20 047*	*21 135*	*18 414*	*24 942*	*17 135*	*12 297*	*14 941*	*34 289*	*30 194*
...A	**...B**		**Luga cuchara o corta**		***Mazzaella laminarioides***				**7,87(16)006,01**	**MZL**
87 Chile	-	7 329	6 247	5 954	4 930	3 731	5 108	4 372	4 225	1 172
87 Fishing area total	-	*7 329*	*6 247*	*5 954*	*4 930*	*3 731*	*5 108*	*4 372*	*4 225*	*1 172*
Species total	-	*7 329*	*6 247*	*5 954*	*4 930*	*3 731*	*5 108*	*4 372*	*4 225*	*1 172*
Gigartina seaweeds nei	**Gigartines nca**		**Lugas nep**		***Gigartinaceae***				**7,87(16)XXX,XX**	**GHG**
87 Chile	37 606	99	9	24	13	8	-	-	-	-
87 Fishing area total	*37 606*	*99*	*9*	*24*	*13*	*8*	-	-	-	-
Species total	*37 606*	*99*	*9*	*24*	*13*	*8*	*...*	*...*	*...*	*...*
Laver (Nori)	**Algue nori**		**Lechuga nori**		***Porphyra tenera***				**7,87(20)002,08**	**PRT**
61 China,Taiwan	-	8	3	2	3	7	3	0	11	1
Korea Rep	...	...	122	3	13	2	24	1	23	8
61 Fishing area total	*...*	*8*	*125*	*5*	*16*	*9*	*27*	*1*	*34*	*9*
Species total	*...*	*8*	*125*	*5*	*16*	*9*	*27*	*1*	*34*	*9*
Nori nei	**Nori nca**		**Luche**		***Porphyra spp***				**7,87(20)002,XX**	**FYS**
81 New Zealand	...	...	3	-	-	-	4	...	5	...
81 Fishing area total	*...*	*...*	*3*	-	-	-	*4*	*...*	*5*	*...*
87 Chile	-	8	31	16	9	4	33	87	102	16
87 Fishing area total	-	*8*	*31*	*16*	*9*	*4*	*33*	*87*	*102*	*16*
Species total	*...*	*8*	*34*	*16*	*9*	*4*	*37*	*87*	*107*	*16*
Gelidium seaweeds	**Algues gélidium**		**Gelidios**		***Gelidium spp***				**7,87(26)002,XX**	**GEL**
47 South Africa	...	...	911	953	631	836	765	962	924	831
47 Fishing area total	*...*	*...*	*911*	*953*	*631*	*836*	*765*	*962*	*924*	*831*
61 China,Taiwan	26	25	165	80	29	33	31	14	96	25
61 Fishing area total	*26*	*25*	*165*	*80*	*29*	*33*	*31*	*14*	*96*	*25*
87 Chile	402	533	392	402	683	310	494	292	375	219
87 Fishing area total	*402*	*533*	*392*	*402*	*683*	*310*	*494*	*292*	*375*	*219*

B-92 Red seaweeds / Algues rouges / Algas rojas

Capture production by species, fishing areas and countries or areas
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Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Species total	*428*	*558*	*1 468*	*1 435*	*1 343*	*1 179*	*1 290*	*1 268*	*1 395*	*1 075*
Manifold callophyllis	**Callophyllis variable**		**Calofila variable**		***Callophyllis variegata***				**7,87(27)001,01**	**KFV**
87 Chile	5	12	5	10	-	17	13	0	0	0
87 Fishing area total	*5*	*12*	*5*	*10*	*-*	*17*	*13*	*0*	*0*	*0*
Species total	*5*	*12*	*5*	*10*	*-*	*17*	*13*	*0*	*0*	*0*
Red seaweeds	**Algues rouges**		**Algas rojas**		***Rhodophyceae***				**7,87(XX)XXX,XX**	**SWR**
21 Canada	6 432	7 980	35 721	33 328	34 240	35 046	14 978	14 975	40 502	35 966
21 Fishing area total	*6 432*	*7 980*	*35 721*	*33 328*	*34 240*	*35 046*	*14 978*	*14 975*	*40 502*	*35 966*
27 Estonia	325	912	1 126	719	809	394	1 608	1 483	1 032	351
France	1 653	1 179	1 620	1 374	1 770	-	0	0	-	-
Ireland	100 F	100 F	100 F	100 F	100 F	100 F	100 F	100 F	100 F	100 F
Latvia	0	0	0	-	-	-	-	-	-	-
Portugal	1 198	565	375	253	624	765	495	198	351	498
Russian Fed	135	33	60	40	150	41	17	-	-	-
Spain	13 772	...	...	396	332	439	47	22	64	73
27 Fishing area total	*17 183 F*	*2 789 F*	*3 281 F*	*2 882 F*	*3 785 F*	*1 739 F*	*2 267 F*	*1 803 F*	*1 547 F*	*1 022 F*
34 Morocco	10 015	7 919	11 131	13 126	12 812	14 870	12 373	9 037	10 368	7 405
34 Fishing area total	*10 015*	*7 919*	*11 131*	*13 126*	*12 812*	*14 870*	*12 373*	*9 037*	*10 368*	*7 405*
37 Italy	750 F	750 F	750 F	750 F	600 F	500 F	500 F	500 F	500 F	500 F
37 Fishing area total	*750 F*	*750 F*	*750 F*	*750 F*	*600 F*	*500 F*	*500 F*	*500 F*	*500 F*	*500 F*
47 South Africa	1 620	1 600 F	-	-	-	-	-	-	-	-
47 Fishing area total	*1 620*	*1 600 F*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
51 India	9 000 F	...	...	1	2	1	1	1	...	2
Madagascar	800	800	1 000	1 000	1 000	1 000	800	800	800	800
Tanzania	5 000 F	4 500	2 500 F	240	52	278	214	277	280 F	287
51 Fishing area total	*14 800 F*	*5 300*	*3 500 F*	*1 241*	*1 054*	*1 279*	*1 015*	*1 078*	*1 080 F*	*1 089*
57 Indonesia	4 990	3 052	4 549	3 352	2 990	924	686	482	2 234	1 810
Timor-Leste	1	-	-	-	-	-	-	-	-	-
57 Fishing area total	*4 991*	*3 052*	*4 549*	*3 352*	*2 990*	*924*	*686*	*482*	*2 234*	*1 810*
61 Japan	3 218	2 614	2 173	2 120	3 187	3 808	...	...	...	...
Korea Rep	3 779	2 500 F	-	-	-	-	-	-	-	-
Russian Fed	984	1 424	3 715	355	558	700	754	95	1	1
61 Fishing area total	*7 981*	*6 538 F*	*5 888*	*2 475*	*3 745*	*4 508*	*754*	*95*	*1*	*1*
71 Fiji	10 F	5 F	0	0	...	...	...	...	...	...
Indonesia	29 460	52 679	60 061	5 325	4 740	4 072	3 957	2 435	796	887
Philippines	551	581	491	433	299	314	351	388	434	473
71 Fishing area total	*30 021 F*	*53 265 F*	*60 552*	*5 758*	*5 039*	*4 386*	*4 308*	*2 823*	*1 230*	*1 360*
77 Mexico	8 694	5 201	6 904	5 143	5 246	4 408	4 864	4 606	4 894	719
77 Fishing area total	*8 694*	*5 201*	*6 904*	*5 143*	*5 246*	*4 408*	*4 864*	*4 606*	*4 894*	*719*
81 New Zealand	2	7	19	53	142	213	182	161	260	287
81 Fishing area total	*2*	*7*	*19*	*53*	*142*	*213*	*182*	*161*	*260*	*287*
87 Peru	5 505	6 176	7 864	7 418	5 000	3 434	10 786	13 779	5 677	4 368
87 Fishing area total	*5 505*	*6 176*	*7 864*	*7 418*	*5 000*	*3 434*	*10 786*	*13 779*	*5 677*	*4 368*
Species total	*107 994 F*	*100 577 F*	*140 159 F*	*75 526 F*	*74 653 F*	*71 307 F*	*52 713 F*	*49 339 F*	*68 293 F*	*54 527 F*
Group total	***225 306***	***211 120***	***260 122***	***239 082***	***223 117***	***172 679***	***184 083***	***176 904***	***140 672***	***152 721***

See paragraph 5 of the INTRODUCTION. Voir le paragraphe 5 de l'INTRODUCTION. Véase el párrafo 5 en la INTRODUCCIÓN.

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Green seaweeds
Algues vertes
Algas verdes

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
...A	**...B**		**...C**		***Dunaliella salina***				**7,41(02)001,01**	**UNI**
37 Ukraine	...	-	-	-	-	1	-	-	-	-
37 Fishing area total	...	-	-	-	-	*1*	-	-	-	-
Species total	...	-	-	-	-	*1*	-	-	-	-
Fragile codium	**Codium orvet**		**Codio fragil**		***Codium fragile***				**7,41(04)001,06**	**KII**
61 Korea Rep	...	...	27	616	3 083	2 875	3 950	1 400	553	451
61 Fishing area total	...	...	*27*	*616*	*3 083*	*2 875*	*3 950*	*1 400*	*553*	*451*
Species total	...	...	*27*	*616*	*3 083*	*2 875*	*3 950*	*1 400*	*553*	*451*
Green laver	**Laitue brillante**		**Lechuga brillante**		***Monostroma nitidum***				**7,41(07)001,02**	**MTN**
61 Korea Rep	...	...	182	71	246	164	167	295	297	368
61 Fishing area total	...	...	*182*	*71*	*246*	*164*	*167*	*295*	*297*	*368*
Species total	...	...	*182*	*71*	*246*	*164*	*167*	*295*	*297*	*368*
Lacy sea lettuce	**...B**		**...C**		***Ulva pertusa***				**7,41(08)002,04**	**UVP**
61 China,Taiwan	46	99	119	155	166	131	126	76	5	65
61 Fishing area total	*46*	*99*	*119*	*155*	*166*	*131*	*126*	*76*	*5*	*65*
Species total	*46*	*99*	*119*	*155*	*166*	*131*	*126*	*76*	*5*	*65*
Green seaweeds	**Algues vertes**		**Algas verdes**		***Chlorophyceae***				**7,41(XX)XXX,XX**	**SWG**
04 Japan	145	119	70	97	105	...	...	...	...	...
04 Fishing area total	*145*	*119*	*70*	*97*	*105*	...	...	...	...	...
27 France	114	93	79	80	85	-	-	-	-	-
27 Fishing area total	*114*	*93*	*79*	*80*	*85*	-	-	-	-	-
37 Italy	1 250 F	1 250 F	1 250 F	1 100 F	1 000 F	900 F	900 F	900 F	900 F	900 F
37 Fishing area total	*1 250 F*	*1 250 F*	*1 250 F*	*1 100 F*	*1 000 F*	*900 F*	*900 F*	*900 F*	*900 F*	*900 F*
51 India	24 000 F	-	-	-	-	-	-	-	-	-
51 Fishing area total	*24 000 F*	-	-	-	-	-	-	-	-	-
61 Korea Rep	444	400 F	-	-	-	-	-	-	-	-
61 Fishing area total	*444*	*400 F*	-	-	-	-	-	-	-	-
71 Fiji	460 F	430 F	406	358	300 F	250 F	200 F	150	150	75
71 Fishing area total	*460 F*	*430 F*	*406*	*358*	*300 F*	*250 F*	*200 F*	*150*	*150*	*75*
Species total	*26 413 F*	*2 292 F*	*1 805 F*	*1 635 F*	*1 490 F*	*1 150 F*	*1 100 F*	*1 050 F*	*1 050 F*	*975 F*
Group total	***26 459***	***2 391***	***2 133***	***2 477***	***4 985***	***4 321***	***5 343***	***2 821***	***1 905***	***1 859***

See paragraph 5 of the INTRODUCTION. Voir le paragraphe 5 de l'INTRODUCTION. Véase el párrafo 5 en la INTRODUCCIÓN.

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Miscellaneous aquatic plants
Plantes aquatiques diverses
Diversas plantas acuáticas

Capture production by species, fishing areas and countries or areas
Captures par espèces, zones de pêche et pays ou zones
Capturas por especies, áreas de pesca y países o áreas

Species, Fishing area Espèce, Zone de pêche Especie, Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Eel-grass	**Grande zostère**		**Gran zostera**		***Zostera marina***				**7,92(02)001,01**	**ZOM**
37 Ukraine	...	111	197	255	522	1 116	1 861	1 947	2 165	137
37 Fishing area total	*...*	*111*	*197*	*255*	*522*	*1 116*	*1 861*	*1 947*	*2 165*	*137*
Species total	*...*	*111*	*197*	*255*	*522*	*1 116*	*1 861*	*1 947*	*2 165*	*137*
Seaweeds nei	**Algues nca**		**Algas nep**		***Algae***				**7,99(XX)XXX,XX**	**SWX**
27 France	3	10	-	-	-	170	8 847	8 847 F	-	-
27 Fishing area total	*3*	*10*	-	-	-	*170*	*8 847*	*8 847 F*	-	-
37 France	-	-	-	-	-	-	-	-	10	-
37 Fishing area total	-	-	-	-	-	-	-	-	*10*	-
47 South Africa	-	-	-	-	-	6	8	38	8	-
47 Fishing area total	-	-	-	-	-	*6*	*8*	*38*	*8*	-
Species total	*3*	*10*	-	-	-	*176*	*8 855*	*8 885 F*	*18*	-
Aquatic plants nei	**Plantes aquatiques nca**		**Plantas acuáticas nep**		***Plantae aquaticae***				**7,99(XX)XXX,XX**	**APL**
04 China	...	...	2 410 F	1 610 F	3 200 F	4 840 F	130	170	190	260
Philippines	-	230	5	-	-	-	-	-	-	-
04 Fishing area total	*...*	*230*	*2 415 F*	*1 610 F*	*3 200 F*	*4 840 F*	*130*	*170*	*190*	*260*
34 Senegal	223	232	-	-	-	-	-	-	-	-
34 Fishing area total	*223*	*232*	-	-	-	-	-	-	-	-
61 China	227 680 F	252 820 F	249 250 F	319 830 F	258 590 F	269 980 F	328 470	365 930	275 980	246 360
China,H.Kong	0	0	-	-	-	-	-	-	-	-
China,Taiwan	19	16	21	7	23	19	17	18	101	15
Japan	11 249	10 610	14 063	10 449	12 532	13 408	30 835	31 424	23 988	22 800 F
Korea Rep	643	527 F	1 100	2 367	3 599	4 198	4 951	6 073	2 763	4 631
Russian Fed	-	-	27	40	-	-	21	-	9	-
61 Fishing area total	*239 591 F*	*263 973 F*	*264 461 F*	*332 693 F*	*274 744 F*	*287 605 F*	*364 294*	*403 445*	*302 841*	*273 806 F*
77 Samoa	-	-	-	478	...	...	...	...	...	...
77 Fishing area total	-	-	-	*478*	*...*	*...*	*...*	*...*	*...*	*...*
87 Chile	32	8	6	-	-	27	13	27	0	0
87 Fishing area total	*32*	*8*	*6*	-	-	*27*	*13*	*27*	*0*	*0*
Species total	*239 846 F*	*264 443 F*	*266 882 F*	*334 781 F*	*277 944 F*	*292 472 F*	*364 437*	*403 642*	*303 031*	*274 066 F*
Group total	***239 849***	***264 564***	***267 079***	***335 036***	***278 466***	***293 764***	***375 153***	***414 474***	***305 214***	***274 203***

See paragraph 5 of the INTRODUCTION. Voir le paragraphe 5 de l'INTRODUCTION. Véase el párrafo 5 en la INTRODUCCIÓN.

C - Capture production: by fishing areas

C - Captures: par zones de pêche

C - Capturas: por áreas de pesca

C-00

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by fishing areas and species groups
Captures par zones de pêche et groupes d'espèces
Capturas por áreas de pesca y grupos de especies

Fishing area Zone de pêche Área de pesca	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
01 Africa - Inland waters	11	112 205	134 608	138 980	162 625	162 491	188 650	222 504
Afrique - Eaux continentales	12	531 420	518 251	506 411	525 084	515 089	534 938	559 389
África - Aguas continentales	13	1 635 039	1 731 463	1 652 344	1 654 767	1 730 778	1 715 978	1 733 384
	22	966	994	4 033	2 095	984	1 278	371
	23	34	36	33	47	49	51	122
	24	226	212	395	434	396	313	336
	31	609	1 116	1 498	1 980	2 209	1 780	1 842
	33	33 613	28 779	40 141	30 649	28 852	26 198	32 643
	35	1 600	1 250	1 100	900	2 440	1 300	416
	37	2 246	1 985	5 290	7 987	5 459	73	5 661
	41	10 980	10 080	10 936	9 777	10 998	11 623	7 702
	45	2 250	1 750	1 600	1 450	1 970	1 600	1 386
	51	1 760	2 273	2 439	1 990	2 017	1 742	1 671
	Area total	2 332 948	2 432 797	2 365 200	2 399 785	2 463 732	2 485 524	2 567 427
02 America, North - Inland waters	11	25 270	24 186	25 288	24 144	25 441	29 289	34 695
Amérique du Nord - Eaux continentales	12	76 989	75 206	75 262	80 747	73 718	69 478	68 079
América del Norte - Aguas continentales	13	46 265	45 895	48 658	43 691	42 786	43 210	42 620
	21	134	103	113	112	114	111	116
	22	187	170	170	148	175	167	106
	23	23 036	18 775	17 187	19 919	18 279	16 548	14 967
	24	2 284	3 711	3 280	3 098	2 963	2 647	2 130
	25	149	1 033	661	816	843	277	1 299
	32	-	0	-	-	-	-	-
	33	120	3 529	3 728	3 386	2 478	2 602	2 670
	37	424	...	...	1 233	1 935	1 937	...
	41	6 905	10 652	4 689	10 379	10 229	11 719	9 287
	42	...	2	2	...	...	...	4
	47	3 181	-	-	-	-	-	-
	51	1 112	1 099	1 156	1 055	1 651	1 724	1 657
	71	135	174	181	183	219	221	231
	72	41	33	30	30	48	15	35
	77	167	339	354	439	361	439	448
	Area total	186 399	184 907	180 759	189 380	181 240	180 384	178 344
03 America, South - Inland waters	11	441	447	440	440	470	430	448
Amérique du Sud - Eaux continentales	12	22 412	23 808	26 537	25 526	26 919	24 934	25 960
América del Sur - Aguas continentales	13	370 760	352 859	355 827	323 492	326 887	316 067	331 623
	23	457	361	352	369	267	284	292
	24	998	324	261	192	204	197	200
	33	12 270	12 792	12 244	12 030	13 132	12 037	...
	37	888	850	880	919	963	1 000	750
	41	6 317	5 242	5 233	6 707	6 106	5 634	5 811
	71	-	-	1	-	-	-	-
	Area total	414 543	396 683	401 775	369 675	374 948	360 583	365 084
04 Asia - Inland waters	11	367 688	508 889	481 843	490 702	591 631	571 643	973 212
Asie - Eaux continentales	12	119 958	115 541	105 175	107 000	144 295	130 754	143 438
Asia - Aguas continentales	13	3 932 542	4 413 277	4 870 941	4 947 616	4 986 470	5 113 520	5 359 373
	21	832	735	598	397	413	196	104
	22	4 199	2 121	2 735	2 431	1 892	2 289	2 414
	23	31 780	29 571	22 950	20 526	16 240	21 459	20 821
	24	137 845	141 844	138 063	129 240	144 493	158 013	167 896
	25	558	637	3 589	2 261	3 714	9 347	8 487
	31	32	71	686	555	357	388	575
	33	14 944	17 960	16 939	14 385	22 354	20 272	14 395
	34	807	1 163	728	289	353	434	493
	37	2 107	5 248	6 677	6 540	6 630	6 184	4 438
	41	281 527	319 798	339 440	364 444	426 045	439 188	498 201
	42	729	747	705	977	1 053	1 047	1 100
	45	61 846	65 848	68 143	72 634	81 718	74 724	85 103
	51	376 672	362 790	377 003	384 749	345 926	365 756	367 400
	56	170	75	243	223	197	565	79
	71	2 701	2 315	7 970	2 508	2 188	2 312	2 802
	72	140	114	58	106	81	173	12
	77	39 593	39 917	37 831	38 420	36 619	46 348	46 177
	Area total	5 376 670	6 028 661	6 482 317	6 586 003	6 812 669	6 964 612	7 696 520
05 Europe - Inland waters	11	98 978	99 506	102 564	125 338	115 522	113 435	133 498
Europe - Eaux continentales	13	102 980	98 112	103 111	105 863	105 840	107 709	109 088
Europa - Aguas continentales	21	286	284	180	181	196	223	171
	22	2 776	2 808	2 840	2 716	2 679	2 489	2 748
	23	80 279	116 846	110 891	131 140	97 622	132 559	126 969
	24	20 527	26 925	21 062	19 094	10 501	8 840	6 285
	25	1 756	1 976	2 038	2 081	1 788	1 865	1 542
	31	16	7	8	-	-	-	152
	32	245	43	45	-	62	-	103
	33	409	507	633	365	365	1 061	517
	35	-	-	3	-	-	-	-
	37	614	100	478	150	155	137	136

C-00

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by fishing areas and species groups
Captures par zones de pêche et groupes d'espèces
Capturas por áreas de pesca y grupos de especies

Fishing area Zone de pêche Área de pesca	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	41	5 128	4 951	4 621	5 763	9 224	5 466	5 468
	47	-	-	-	-	-	-	2
	71	0	-	15	-	-	-	-
	77	40	157	148	112	336	264	171
	Area total	314 034	352 222	348 637	392 803	344 290	374 048	386 850
06 Oceania - Inland waters	11	2	4	7	4	6	0	5
Océanie - Eaux continentales	12	2 310	2 310	2 310	2 540	2 370	2 315	2 315
Oceanía - Aguas continentales	13	9 154	9 368	9 206	10 103	10 342	10 556	9 783
	22	486	500	546	508	439	429	583
	24	480	480	480	480	480	480	480
	25	350	350	350	350	350	350	350
	33	1 850	1 850	1 850	1 850	1 850	1 850	1 850
	41	509	507	558	467	349	234	109
	51	2 527	2 500	2 530	1 500	1 500	1 500	1 500
	Area total	17 668	17 869	17 837	17 802	17 686	17 714	16 975
18 Arctic Sea	31	-	-	-	-	17	-	-
Mer Arctique	32	-	-	-	2	463	-	589
Atlántico, noroeste								
	Area total	-	-	-	2	480	-	589
21 Atlantic, Northwest	21	0	1	1	6	0	-	0
Atlantique, nord-ouest	22	606	615	798	724	508	554	585
Atlántico, noroeste	23	818	804	979	892	834	988	751
	24	5 276	3 633	5 579	5 037	4 589	5 162	3 376
	25	3 221	3 467	2 981	3 228	3 199	4 172	3 307
	31	110 120	105 128	86 701	84 068	85 366	81 086	88 994
	32	118 225	118 138	103 671	116 157	131 295	109 991	107 586
	33	21 653	20 152	17 122	18 211	15 470	16 283	14 816
	34	79 400	87 730	72 169	51 875	45 179	47 677	52 827
	35	456 394	449 325	437 704	456 298	405 782	438 403	443 511
	36	6 095	6 323	5 747	5 475	4 881	4 562	5 043
	37	145 770	138 019	157 048	121 150	94 647	105 040	79 092
	38	34 056	27 064	32 446	35 131	37 786	32 203	39 250
	39	5 018	4 951	4 163	3 755	4 592	7 047	6 728
	42	170 042	158 439	148 061	142 752	156 248	154 497	163 009
	43	81 618	83 750	97 026	82 991	96 104	102 296	115 651
	45	359 576	345 567	350 187	359 463	340 104	288 907	311 433
	47	0	0	1	1	8	0	0
	52	4 844	6 422	9 010	8 378	10 706	11 204	14 012
	53	13 134	13 651	12 796	14 432	12 845	11 915	12 696
	54	10 572	9 836	8 547	7 646	8 678	12 841	15 014
	55	328 538	273 183	288 617	288 222	271 041	282 451	276 360
	56	341 448	289 954	299 009	315 960	297 220	289 620	264 710
	57	41 797	29 297	36 761	21 610	27 846	28 455	22 666
	58	4 716	16 735	10 368	1 214	135	1 588	896
	75	518	749	706	917	779	1 027	602
	76	9 462	7 686	10 028	7 233	7 329	9 114	9 110
	77	450	406	344	425	367	352	364
	Area total	2 353 367	2 201 025	2 198 570	2 153 251	2 063 538	2 047 435	2 052 389
27 Atlantic, Northeast	11	7 410	6 897	7 043	7 329	6 845	7 377	6 999
Atlantique, nord-est	13	9 899	9 594	12 727	12 260	9 298	9 222	9 737
Atlántico, nordeste	21	-	-	-	-	0	24	36
	22	1 670	1 708	1 909	1 660	1 553	1 220	1 168
	23	8 443	7 618	7 453	7 489	7 285	8 303	7 134
	24	111	138	62	259	259	222	332
	25	596	525	528	467	479	701	465
	31	270 505	247 946	238 224	229 020	217 549	230 754	241 107
	32	4 184 525	3 824 213	3 861 635	3 371 273	2 973 626	2 482 133	2 587 462
	33	420 880	215 383	336 584	272 667	394 134	403 105	460 148
	34	360 729	312 525	360 809	346 794	325 591	412 019	494 177
	35	2 558 920	2 939 492	2 668 470	2 820 655	2 888 597	2 964 287	2 666 770
	36	34 817	48 393	51 896	38 127	32 767	26 556	37 387
	37	1 478 884	1 458 008	972 814	1 182 395	1 070 195	1 270 464	1 584 587
	38	75 175	63 469	57 067	62 382	59 444	57 717	49 027
	39	10 158	14 700	26 745	30 102	45 599	104 083	89 706
	42	58 238	43 073	60 019	68 683	54 614	52 836	58 885
	43	57 220	54 829	68 445	74 200	71 613	71 014	66 314
	44	2 646	5 437	14 047	12 824	14 565	11 956	5 879
	45	123 820	113 864	91 124	90 511	88 145	96 136	90 717
	46	-	-	-	-	-	40	-
	47	558	660	813	1 084	899	635	818
	52	36 979	26 564	31 935	29 892	30 222	27 849	34 088
	53	2 764	1 801	2 194	2 977	4 350	5 020	7 647
	54	113 277	90 629	72 069	66 099	47 672	43 472	35 134
	55	64 137	67 445	67 082	75 749	67 600	73 327	91 218
	56	51 376	40 285	40 343	39 826	46 630	30 905	29 526
	57	62 095	53 945	48 918	59 041	60 892	45 757	60 755

C-00 **Fish, crustaceans, molluscs, etc** **Capture production by fishing areas and species groups**
Poissons, crustacés, mollusques, etc **Captures par zones de pêche et groupes d'espèces**
Peces, crustáceos, moluscos, etc **Capturas por áreas de pesca y grupos de especies**

Fishing area Zone de pêche Área de pesca	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	58	163	122	62	217	147	95	75
	76	595	684	553	679	1 796	1 752	3 086
	77	0	0	0	2	5	8	11
	Area total	9 996 590	9 649 947	9 101 570	8 904 663	8 522 371	8 438 989	8 720 395
31 Atlantic, Western Central	13	...	...	...	...	...	44	50
Atlantique, centre-ouest	22	47	17	11	13	13	27	52
Atlántico, centro-occidental	24	833	103	145	149	155	215	209
	25	89	99	18	14	9	5	7
	31	994	770	804	730	763	705	3 728
	32	5	3	4	1	3	1	1
	33	181 852	149 696	123 926	121 332	115 934	112 485	108 108
	34	26 595	17 151	11 316	13 598	15 375	16 264	16 796
	35	634 198	493 897	505 346	569 044	473 776	506 324	489 202
	36	81 296	58 137	56 955	53 387	52 188	54 415	60 728
	37	44 507	31 071	26 471	29 477	33 494	36 381	37 062
	38	39 619	30 702	26 275	25 042	23 493	24 062	26 913
	39	181 377	128 448	144 109	140 896	121 852	119 920	122 634
	42	70 935	60 372	61 265	56 917	57 603	59 275	52 228
	43	33 967	31 349	28 122	26 207	27 738	24 656	28 920
	45	211 512	178 375	204 519	150 482	148 019	173 541	142 053
	47	162	165	159	473	369	261	280
	52	25 558	25 400	27 886	23 718	21 655	25 170	25 030
	53	103 249	113 417	80 594	96 498	79 750	85 756	48 171
	54	4 280	2 300	1 360	1 660	1 900	1 830	1 830
	55	37	2	...	...	...	74	1
	56	72 651	64 294	64 254	75 020	77 768	76 167	75 735
	57	27 863	11 798	25 282	20 298	13 695	25 735	23 354
	58	3 410	1 527	892	1 128	1 768	1 205	1 071
	72	24	28	21	9	2	0	0
	75	1	4	5	3	8	7	7
	76	10	10	15	306	205	730	452
	77	1 512	44	...	671	210	...	...
	Area total	1 746 583	1 399 179	1 389 754	1 407 073	1 267 745	1 345 255	1 264 622
34 Atlantic, Eastern Central	12	2 191	3 778	2 142	2 454	2 374	2 174	2 361
Atlantique, centre-est	22	3	1	0	1	0	1	9
Atlántico, centro-oriental	24	12 385	11 804	10 574	13 382	15 314	14 837	14 870
	31	28 677	42 924	36 454	34 153	32 646	30 122	28 267
	32	30 251	23 219	20 187	21 636	16 879	26 268	15 605
	33	324 713	350 460	361 798	337 316	352 880	359 082	355 157
	34	37 662	32 997	36 691	41 677	42 204	38 879	52 110
	35	1 773 170	1 678 316	1 605 466	1 488 046	1 707 985	1 888 994	2 108 432
	36	304 684	298 686	267 837	270 612	298 477	316 472	347 378
	37	573 738	616 864	515 489	501 808	563 572	554 428	657 427
	38	53 345	61 287	53 114	55 513	59 214	68 195	84 391
	39	311 213	405 660	319 570	341 412	297 794	295 648	204 892
	42	5 260	6 335	9 279	4 479	6 829	6 610	6 797
	43	2 836	3 372	3 949	2 563	3 368	4 332	6 446
	45	58 285	66 260	64 491	64 550	48 922	51 500	49 548
	47	64	353	421	452	363	394	316
	52	11 796	14 518	11 655	13 928	17 118	19 906	17 517
	53	82	164	43	104	126	116	242
	56	132	171	81	252	354	534	640
	57	73 561	114 854	105 364	87 071	107 766	124 208	91 101
	58	1 312	1 910	1 099	1 087	1 004	1 039	981
	72	28	37	39	9	9	5	3
	76	...	...	...	...	...	...	14
	77	6	11	-	5	-	-	-
	Area total	3 605 394	3 733 981	3 425 743	3 282 510	3 575 198	3 803 744	4 044 504
37 Mediterranean and Black Sea	11	331	291	270	244	339	184	212
Méditerranée et mer Noire	13	1 245	1 180	830	247	158	75	80
Mediterráneo y Mar Negro	21	24	16	4	2	4	2	...
	22	524	270	306	344	366	320	360
	23	7	0	1	7	9	7	3
	24	18 298	23 497	20 722	22 134	23 534	21 867	19 952
	25	1	-	2	-	-	-	-
	31	8 614	9 865	10 648	10 136	9 069	9 525	9 318
	32	42 271	53 097	62 901	59 154	51 364	53 014	51 958
	33	162 374	177 203	178 577	172 393	165 268	172 634	174 541
	34	15 863	21 185	24 299	23 640	23 196	24 589	25 361
	35	767 695	591 194	757 333	854 858	706 053	711 695	704 238
	36	65 830	129 341	89 059	71 366	58 740	59 844	57 959
	37	138 964	157 876	159 041	163 780	159 800	131 837	106 347
	38	8 845	9 821	12 390	11 121	11 182	20 073	19 992
	39	55 922	67 862	64 021	53 863	67 728	65 628	57 644
	41	-	1	-	1	3	3	1
	42	2 202	3 976	4 023	6 024	5 350	5 750	5 655
	43	4 154	6 278	6 481	6 347	5 711	6 255	5 732
	45	31 079	42 320	39 702	34 596	38 496	42 148	42 275
	47	9 022	8 290	8 223	8 888	8 053	9 009	8 637

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Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by fishing areas and species groups
Captures par zones de pêche et groupes d'espèces
Capturas por áreas de pesca y grupos de especies

Fishing area Zone de pêche Área de pesca	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	52	3 302	6 515	9 021	10 120	7 599	7 251	9 718
	53	171	131	141	213	54	37	29
	54	41 264	12 638	9 702	2 603	1 114	8 022	2 407
	55	1 586	1 134	914	693	298	496	397
	56	56 635	32 541	74 495	82 065	67 467	46 167	50 751
	57	51 393	66 856	67 552	73 449	61 785	61 150	59 712
	58	21 223	18 287	16 310	17 632	15 564	10 591	15 460
	74	77	3	3	3	3	5	6
	76	175	22	86	3	3	39	109
	77	1 096	612	1 186	132	413	320	289
	Area total	1 510 187	1 442 302	1 618 243	1 686 058	1 488 723	1 468 537	1 429 143
41 Atlantic, Southwest	31	8 749	9 874	10 530	10 330	10 840	10 157	10 155
Atlantique, sud-ouest	32	729 124	632 039	625 032	530 108	513 317	530 530	495 400
Atlántico, sudoccidental	33	278 141	277 275	320 184	315 192	312 673	358 752	333 778
	34	47 799	60 192	78 351	85 991	113 159	83 665	80 032
	35	124 617	112 262	129 982	121 424	128 529	145 235	120 675
	36	62 078	60 491	56 439	54 305	62 540	70 646	59 343
	37	41 302	50 104	47 947	57 104	57 811	62 274	74 706
	38	72 842	77 196	77 271	82 251	84 750	83 474	84 027
	39	78 968	79 149	77 667	70 556	48 455	55 626	48 419
	42	15 076	17 568	13 096	10 701	11 950	13 201	12 717
	43	8 689	6 927	6 724	6 490	6 589	7 268	6 866
	44	1 337	1 037	1 195	936	769	325	715
	45	59 919	46 233	82 988	91 683	85 317	94 584	110 563
	46	-	-	43	-	-	-	10
	47	356	511	460	509	1 045	1 160	1 094
	52	970	801	546	474	448	213	512
	53	1 076	1 368	1 406	800	1 174	1 295	1 223
	54	1 531	2 739	2 419	1 368	5 846	6 227	2 201
	55	45 654	41 365	81 625	53 746	58 719	80 822	50 873
	56	1 586	1 467	2 790	2 739	2 722	1 754	2 025
	57	212 447	352 266	751 277	1 004 114	895 749	301 922	261 625
	58	3 293	4 811	4 330	5 415	1 476	1 143	5 322
	Area total	1 795 554	1 835 675	2 372 302	2 506 236	2 403 878	1 910 273	1 762 281
47 Atlantic, Southeast	24	...	...	...	15 217	17 616	8 930	8 600
Atlantique, sud-est	31	12 584	10 320	9 839	23 996	5 897	5 903	5 698
Atlántico, sudoriental	32	332 521	304 262	272 495	275 464	264 296	256 739	262 500
	33	76 501	72 570	83 957	79 412	111 119	108 725	104 847
	34	64 672	62 789	51 656	44 053	42 118	34 740	35 183
	35	705 231	632 927	453 097	549 250	513 712	397 346	503 152
	36	37 863	34 334	38 653	47 323	37 893	45 187	41 066
	37	400 209	404 983	382 545	275 538	278 920	261 312	258 642
	38	15 099	18 078	20 913	28 608	15 643	15 839	17 070
	39	54 168	33 200	48 484	74 974	54 605	45 154	44 615
	42	5 239	4 578	3 150	5 115	2 286	315	312
	43	4 675	4 920	4 126	4 641	3 265	3 758	5 385
	45	3 189	2 654	2 676	3 853	2 037	409	386
	47	-	1	-	-	-	-	-
	52	258	228	212	123	61	-	128
	53	30	24	...	20	16	17	17
	56	2	2	6	19	32	40	32
	57	19 874	12 623	8 865	12 411	9 183	12 170	11 791
	58	0	0	0	-	-	6	-
	77	-	19	...	20	...	...	...
	Area total	1 732 115	1 598 512	1 380 674	1 440 037	1 358 699	1 196 590	1 299 424
48 Atlantic, Antarctic	31	-	-	-	0	0	0	0
Atlantique, Antarctique	32	74	154	188	183	214	174	111
Atlántico, Antártico	33	-	0	25	16	4	3	18
	34	7 189	3 343	5 915	8 053	6 479	5 634	3 041
	38	41	8	9	6	16	23	10
	44	0	0	1	0	1	0	62
	46	118 165	129 026	106 548	104 586	156 521	125 824	211 974
	57	-	-	-	-	0	-	...
	76	-	0	-	-	-	-	-
	77	-	0	-	1	0	0	-
	Area total	125 469	132 531	112 686	112 845	163 235	131 658	215 216
51 Indian Ocean, Western	24	7 651	9 651	7 455	12 768	9 339	9 051	20 541
Océan Indien, ouest	25	101	122	159	135	168	322	198
Océano Índico, occidental	31	17 670	18 392	19 917	28 813	23 809	26 674	18 922
	32	1 325	2 722	1 602	855	732	632	472
	33	795 242	806 041	819 190	869 549	901 474	876 228	816 659
	34	152 371	160 128	174 807	152 125	138 994	156 425	217 395
	35	540 280	525 758	525 914	541 672	543 329	545 335	532 000
	36	1 164 211	1 215 345	1 221 453	961 497	898 579	857 277	847 839
	37	438 410	431 760	450 469	454 577	404 297	435 940	454 789
	38	118 303	118 805	113 746	124 333	111 214	97 304	96 195

C-00 **Fish, crustaceans, molluscs, etc** **Capture production by fishing areas and species groups**
Poissons, crustacés, mollusques, etc **Captures par zones de pêche et groupes d'espèces**
Peces, crustáceos, moluscos, etc **Capturas por áreas de pesca y grupos de especies**

Fishing area Zone de pêche Área de pesca	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	39	683 186	665 583	645 370	575 840	640 403	705 679	846 353
	42	19 714	20 097	21 585	22 146	22 256	25 814	25 514
	43	2 832	2 810	3 233	3 195	2 949	2 798	3 677
	45	301 498	317 837	307 374	300 524	293 624	290 508	220 948
	47	18 383	20 414	21 326	14 694	11 376	9 825	7 330
	52	599	422	782	708	674	625	568
	53	0	28	38	16	36	28	38
	56	...	...	...	252	273	626	655
	57	114 563	121 293	120 420	103 122	90 946	91 103	144 150
	58	3 078	2 809	2 262	5 060	9 403	10 336	2 442
	76	1 665	1 595	1 901	2 337	1 541	1 878	2 235
	77	312	358	43	1 759	325	3 341	7 997
	Area total	4 381 394	4 441 970	4 459 046	4 175 977	4 105 741	4 147 749	4 266 917
57 Indian Ocean, Eastern Océan Indien, est Océano Índico, oriental	22	105	87	80	70	84	57	44
	24	232 379	239 665	243 946	232 637	231 400	232 147	273 913
	25	11 523	11 316	12 316	12 809	12 791	15 274	12 756
	31	27 496	25 870	30 277	34 705	31 458	30 907	39 051
	32	9 560	7 069	5 141	3 744	5 958	4 636	6 515
	33	571 733	532 936	569 300	626 835	672 210	718 041	713 905
	34	74 764	76 722	80 207	92 057	85 461	92 096	81 551
	35	373 219	346 328	441 101	495 675	555 358	569 872	553 591
	36	511 474	416 432	462 541	510 523	553 061	566 923	618 330
	37	576 772	599 646	629 066	710 159	769 741	777 754	811 758
	38	151 927	98 245	98 924	123 578	101 701	108 962	91 398
	39	2 488 742	2 596 178	2 679 128	2 493 555	2 539 403	2 877 821	3 004 308
	42	43 809	43 326	44 654	58 498	60 278	65 887	60 216
	43	21 305	19 867	17 537	15 634	15 880	13 611	12 195
	45	246 069	205 224	223 697	270 922	320 870	319 007	325 899
	46	-	-	-	-	-	-	3 191
	47	59 143	53 082	62 156	86 083	74 476	72 830	82 767
	52	6 224	6 293	5 814	4 880	4 713	4 858	4 538
	53	64	178	370	338	1	23	22
	54	4	34	313	9	7	4	20
	55	7 279	12 336	7 278	7 161	7 326	4 939	4 620
	56	34 059	27 652	28 628	39 501	44 150	32 649	13 107
	57	115 244	92 179	101 052	110 671	100 400	125 447	114 021
	58	8 226	5 978	5 805	4 010	5 228	6 313	5 963
	72	137	125	134	139	4	120	96
	74	-	-	-	-	4	4	7
	76	694	2 998	1 873	3 275	4 682	4 371	4 641
	77	4 201	35 411	138 525	4 137	150 543	119 809	111 920
	Area total	5 576 152	5 455 177	5 889 863	5 941 605	6 347 188	6 764 362	6 950 343
58 Indian Ocean, Antarctic Océan Indien, Antarctique Océano Índico, Antártico	32	899	756	765	771	1 246	1 434	1 258
	33	3	2	5	10	20	26	50
	34	8 894	11 494	10 337	9 203	9 169	9 187	8 979
	36	-	2	-	-	-	-	-
	37	-	0	-	-	-	0	-
	38	573	645	384	399	447	489	539
	39	0	1	-	-	-	0	-
	44	7	34	-	-	0	0	0
	52	0	0	0	0	-	0	-
	57	0	0	0	0	0	0	0
	58	0	-	-	0	-	-	-
	74	1	0	-	-	0	-	-
	76	3	2	3	1	3	3	5
	77	1	2	1	1	14	1	1
	Area total	10 381	12 938	11 495	10 385	10 899	11 140	10 832
61 Pacific, Northwest Pacifique, nord-ouest Pacífico, noroeste	11	127	319	222	199	124	122	112
	23	376 901	424 667	447 615	499 667	384 990	688 309	426 915
	24	99 384	102 792	108 948	111 396	109 433	113 079	106 769
	25	42	75	59	36	48	81	105
	31	163 971	186 619	174 562	184 029	169 309	185 229	176 003
	32	1 363 271	1 429 342	1 504 556	1 717 875	1 787 005	1 848 982	2 155 069
	33	2 345 431	2 253 223	2 310 460	2 140 002	2 396 291	2 438 191	2 563 356
	34	1 709 707	1 585 195	1 807 490	1 725 259	1 760 647	1 756 829	1 729 473
	35	2 156 326	2 027 742	2 118 403	1 996 040	1 815 403	1 631 901	1 803 813
	36	636 096	691 327	675 417	869 881	808 360	800 882	809 977
	37	2 648 716	3 157 864	2 963 649	2 959 753	3 364 175	2 814 237	2 904 449
	38	54 911	63 703	56 281	54 899	44 097	37 761	31 448
	39	2 499 065	2 493 536	2 325 971	2 356 141	2 476 114	3 108 469	3 192 786
	41	-	-	-	3	3	-	-
	42	616 640	639 370	668 709	673 409	669 157	674 761	739 129
	43	3 485	3 612	3 611	3 554	3 430	3 058	11 417
	44	5 629	7 824	8 542	12 139	10 013	8 708	8 291
	45	1 328 020	1 332 361	1 330 147	1 288 509	1 191 454	1 233 706	1 207 195
	47	334 094	325 038	337 220	363 229	338 587	350 227	373 173
	51	170	145	313	546	282	495	445
	52	22 544	20 562	19 012	19 346	19 740	19 287	19 258
	53	25 690	27 320	31 024	29 316	29 185	24 256	22 725

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Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by fishing areas and species groups
Captures par zones de pêche et groupes d'espèces
Capturas por áreas de pesca y grupos de especies

Fishing area Zone de pêche Área de pesca	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	54	3 076	4 191	6 630	9 555	7 987	10 808	13 555
	55	316 788	290 271	274 459	260 353	313 793	323 485	330 740
	56	149 015	126 425	112 743	121 743	116 642	117 930	106 156
	57	1 471 729	1 456 688	1 319 070	1 461 267	1 382 484	1 330 517	1 295 802
	58	725 250	756 975	774 663	749 852	651 493	678 752	629 599
	74	1 336	1 548	1 113	1 135	1 591	1 128	1 238
	76	27 234	28 278	30 010	23 540	25 547	27 580	27 888
	77	182 477	249 881	202 121	239 726	251 373	257 023	258 515
	Area total	19 267 125	19 686 893	19 613 020	19 872 399	20 128 757	20 485 793	20 945 401
67 Pacific, Northeast	21	170	191	161	143	164	154	120
Pacifique, nord-est	23	355 474	431 619	322 818	420 376	302 628	339 004	381 500
Pacífico, nordeste	24	120	234	82	82	19	2	14
	31	184 268	214 185	230 221	249 272	329 176	283 659	303 879
	32	2 130 471	2 162 163	2 137 002	1 897 137	1 575 882	1 244 369	1 348 770
	33	53 163	62 542	62 725	61 813	62 423	75 595	69 996
	34	78 621	77 019	82 949	86 657	83 267	79 997	85 859
	35	102 058	120 750	100 005	89 799	79 051	81 732	91 837
	36	19 110	12 438	17 518	16 441	14 471	16 442	15 978
	37	292	402	675	717	39	23	13
	38	19 193	18 198	13 214	14 101	14 466	15 560	12 968
	39	8 713	16 578	3 643	1 543	6 960	11 524	14 646
	42	50 668	45 526	60 377	47 746	57 327	60 490	50 193
	43	36	28	15	12	13	27	32
	44	10 013	10 859	9 816	11 767	12 341	10 156	10 905
	45	12 813	14 709	9 933	12 375	16 657	15 630	21 431
	47	72	71	77	83	69	69	53
	52	2	3	3	3	2	1	-
	53	43	160	234	72	307	238	6 391
	54	488	913	1 405	719	1 010	1 031	1 069
	55	1 274	808	...	...	1 477	1 092	1 818
	56	10 011	10 477	11 993	9 640	11 795	13 884	10 795
	57	776	1 559	2 374	1 300	2 150	675	843
	58	3 102	3 471	3 961	4 592	3 502	4 413	2 861
	76	6 432	4 944	5 196	3 966	4 098	4 184	3 433
	Area total	3 047 383	3 209 847	3 076 397	2 930 356	2 579 294	2 259 951	2 435 404
71 Pacific, Western Central	24	15 823	15 643	17 759	18 844	18 507	15 560	18 485
Pacifique, centre-ouest	25	49 409	61 054	73 489	82 554	68 374	75 460	89 293
Pacífico, centro-occidental	31	19 754	18 419	17 080	15 035	18 781	19 076	18 655
	32	60	89	95	51	42	50	151
	33	1 268 851	1 278 090	1 310 067	1 365 015	1 226 735	1 231 813	1 319 187
	34	56 230	57 579	58 436	63 911	88 276	81 549	69 930
	35	969 569	1 059 780	1 018 834	1 043 966	1 054 202	1 169 111	1 126 683
	36	2 483 153	2 594 590	2 714 365	2 977 633	2 848 194	2 919 976	2 902 194
	37	1 893 428	1 774 654	1 836 492	1 879 013	1 830 018	1 802 980	1 929 122
	38	123 130	113 020	121 224	104 539	98 170	109 896	102 040
	39	2 741 277	2 872 244	2 645 909	2 630 594	2 417 798	2 519 895	2 761 495
	42	174 025	169 401	186 842	183 580	195 808	194 660	212 717
	43	10 048	10 807	8 420	7 612	12 007	7 814	9 727
	45	438 689	400 577	415 095	425 746	383 007	392 042	422 466
	47	8 593	8 333	6 174	6 853	6 477	5 323	5 461
	52	439	371	969	761	358	314	881
	53	208	757	283	359	390	524	400
	54	31	32	1 234	440	35	55	457
	55	2 951	4 925	3 811	5 766	4 940	4 802	4 874
	56	82 073	57 831	65 548	53 943	47 436	54 328	51 715
	57	488 993	492 338	495 386	500 134	497 338	515 374	549 711
	58	73 840	75 441	77 729	77 334	81 408	89 346	96 166
	72	28	55	64	59	236	226	43
	76	9 515	9 271	7 400	7 855	6 088	7 606	6 295
	77	11 223	14 410	13 098	15 333	9 978	10 343	11 366
	Area total	10 921 340	11 089 711	11 095 803	11 466 930	10 914 603	11 228 123	11 709 514
77 Pacific, Eastern Central	23	2 997	2 206	538	725	0	0	116
Pacifique, centre-est	25	3	14	15	422	69	65	68
Pacífico, centro-oriental	31	4 935	4 412	3 904	4 789	4 857	4 784	5 186
	32	1 245	1 750	1 741	1 204	1 701	1 379	1 308
	33	25 791	51 933	51 296	55 858	51 567	48 947	51 414
	34	3 989	4 686	4 915	4 537	4 726	5 286	5 810
	35	625 666	651 291	722 058	861 424	978 444	1 013 363	858 456
	36	480 561	458 814	414 088	421 785	406 254	487 238	509 112
	37	28 784	55 253	34 531	34 060	25 308	26 781	32 309
	38	41 659	42 296	39 836	39 016	35 151	38 582	40 558
	39	108 225	108 340	112 171	88 798	90 800	78 781	94 061
	42	11 725	13 599	14 731	18 544	20 818	17 683	27 303
	43	2 324	2 287	2 402	2 075	2 617	2 436	3 392
	44	6 875	13 708	12 097	14 073	6 839	10 230	4 395
	45	52 950	53 735	55 857	67 586	61 392	58 912	61 272
	47	2 698	4 172	1 886	2 939	921	832	822
	52	2 498	4 328	4 557	4 095	3 979	2 946	3 925
	53	3 248	2 788	9 915	7 396	3 325	3 399	3 390

C-00

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by fishing areas and species groups
Captures par zones de pêche et groupes d'espèces
Capturas por áreas de pesca y grupos de especies

Fishing area Zone de pêche Área de pesca	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	54	630	1 627	1 507	4 274	2 858	2 443	3 530
	55	5 151	15 348	16 027	14 761	16 522	16 284	16 499
	56	4 337	8 783	8 964	8 232	9 779	9 269	9 572
	57	127 979	110 015	115 689	108 097	125 221	154 497	176 241
	58	5 059	2 176	2 500	3 129	2 776	2 453	2 427
	76	7 871	7 928	7 311	7 608	7 699	9 174	9 730
	77	74	48	1 031	1 089	1 148	985	991
	Area total	1 557 274	1 621 537	1 639 567	1 776 516	1 864 771	1 996 749	1 921 887
81 Pacific, Southwest	22	222	287	215	207	152	107	...
Pacifique, sud-ouest	23	1	2	1	1	7	50	0
Pacífico, sudoccidental	31	3 167	4 203	3 564	4 153	3 466	3 334	3 205
	32	214 279	194 073	178 755	160 827	154 638	164 160	176 998
	33	25 400	25 530	23 138	24 910	26 349	23 034	23 038
	34	149 736	141 489	145 231	133 714	118 984	116 589	113 661
	35	2 050	2 216	3 379	838	1 182	928	495
	36	30 761	26 942	26 053	30 003	31 936	26 637	37 649
	37	84 940	58 301	78 741	80 775	58 717	54 234	53 401
	38	19 863	20 072	19 700	21 386	19 007	19 104	20 739
	39	27 355	110 235	33 572	65 468	89 545	85 038	75 897
	42	588	580	511	247	318	330	205
	43	3 021	3 550	3 489	3 478	3 514	3 219	3 856
	45	1 831	877	1 360	1 471	1 832	1 690	1 199
	47	535	480	491	473	381	292	356
	52	1 251	1 239	1 081	1 255	1 050	1 083	1 211
	53	465	546	518	512	434	107	980
	54	1 353	486	403	200	182	152	153
	55	1 981	2 772	1 971	1 845	1 658	1 378	147
	56	2 358	2 291	2 585	1 734	1 431	1 439	1 423
	57	142 155	128 272	115 543	100 311	73 353	66 796	58 327
	58	61	62	59	45	75	31	117
	76	563	879	822	825	794	761	726
	77	18	20	12	...	1	1	0
	Area total	713 954	725 404	641 194	634 678	589 006	570 494	573 783
87 Pacific, Southeast	31	513	376	438	342	368	481	613
Pacifique, sud-est	32	241 995	217 855	210 724	195 699	211 102	224 660	214 853
Pacífico, sudoriental	33	112 459	138 362	353 712	56 448	110 820	224 721	75 912
	34	30 815	25 100	23 069	26 459	22 214	23 903	20 338
	35	11 110 971	10 587 029	7 588 972	8 043 257	8 402 247	7 917 681	5 093 546
	36	354 200	375 303	374 080	290 571	436 253	381 740	270 390
	37	2 694 068	2 280 768	2 588 309	2 503 740	1 862 321	1 790 496	1 026 029
	38	19 375	18 330	17 825	17 789	17 798	20 207	22 352
	39	96 698	119 775	52 245	64 999	48 974	62 889	42 968
	42	9 324	8 088	7 348	7 023	8 627	8 540	8 883
	43	59	235	91	53	58	60	75
	44	9 951	13 203	11 590	10 393	12 346	14 191	14 724
	45	14 510	17 546	20 712	26 081	28 982	31 926	35 376
	47	817	604	2 653	4 318	356	477	434
	52	25 108	15 264	13 001	12 176	13 387	10 412	10 771
	53	13	6	8	4	3	20	14
	54	12 834	11 066	8 674	20 169	13 489	12 484	13 573
	55	15 623	15 457	18 763	24 803	19 624	27 354	63 329
	56	50 186	41 194	45 916	44 392	38 735	38 587	52 248
	57	764 438	742 015	819 572	648 958	821 737	602 299	782 533
	58	2 955	5 967	3 305	4 839	5 499	2 527	3 513
	72	1	2	1	1	...	...	...
	74	1 083	1 184	1 233	1 202	1 026	1 251	877
	76	50 865	40 767	35 140	40 730	41 505	40 390	33 483
	Area total	15 618 861	14 675 496	12 197 381	12 044 446	12 117 471	11 437 296	7 786 834
88 Pacific, Antarctic	32	426	433	191	238	139	257	179
Pacifique, Antarctique	33	0	0	0	0	2	0	0
Pacífico, Antártico	34	2 575	3 519	3 487	3 457	2 680	2 942	2 962
	37	0	-	-	-	-	-	-
	38	26	61	4	38	4	7	7
	39	2	0	0	1	-	-	-
	44	0	0	0	0	0	0	0
	57	0	0	0	0	0	0	0
	74	0	-	-	-	-	-	-
	76	0	0	0	1	1	1	0
	77	0	2	0	0	-	-	-
	Area total	3 029	4 015	3 682	3 735	2 826	3 207	3 148
World total ***Total mondial*** ***Total mundial***		***92 604 414***	***92 329 279***	***90 023 515***	***90 305 150***	***89 698 988***	***89 630 210***	***88 603 826***

C-01 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Africa - Inland waters
Afrique - Eaux continentales
África - Aguas continentales

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Common carp	*Cyprinus carpio*	11	358	449	637	864	921	1 546	1 530
Crucian carp	*Carassius carassius*	11	119	119	48	16	151	179	100
Rhinofishes nei	*Labeo spp*	11	239	764	790	423	3 422	2 840	2 150
Grass carp(=White amur)	*Ctenopharyngodon idellus*	11	28 192	26 534	27 534	26 156	21 189	26 071	21 354
Silver cyprinid	*Rastrineobola argentea*	11	57 581	79 691	80 547	80 272	79 966	96 326	111 276
Cyprinids nei	*Cyprinidae*	11	25 716	27 051	29 424	54 894	56 842	61 688	86 094
Nile tilapia	*Oreochromis niloticus*	12	212 888	192 282	162 635	169 689	169 985	197 315	231 448
Tilapias nei	*Oreochromis(=Tilapia) spp*	12	255 468	257 151	256 930	305 612	287 900	279 849	251 223
Blackchin tilapia	*Sarotherodon melanotheron*	12	...	...	...	...	635	2 750	4 873
Banded jewelfish	*Hemichromis fasciatus*	12	...	...	...	...	1 150	630	101
Mouthbrooding cichlids	*Haplochromis spp*	12	9 066	11 832	13 198	13 790	9 993	10 657	12 986
Cichlids nei	*Cichlidae*	12	53 998	56 986	73 648	35 993	45 426	43 737	58 758
African lungfishes	*Protopterus spp*	13	17 106	16 903	17 984	25 489	19 701	16 277	13 783
Dagaas	*Stolothrissa, Limnothrissa spp*	13	82 110	82 062	64 576	56 123	51 963	54 434	55 060
African bonytongue	*Heterotis niloticus*	13	11 824	13 284	12 833	12 204	19 036	17 369	17 886
Knifefishes	*Notopterus spp*	13	18	169	69	203	136	242	239
Elephantsnout fishes nei	*Mormyridae*	13	27 981	27 284	27 179	35 141	30 824	36 331	36 124
Aba	*Gymnarchus niloticus*	13	11 764	16 084	11 496	13 914	20 743	13 693	12 864
Characins nei	*Characidae*	13	38 876	44 871	44 562	53 159	72 857	94 987	129 858
Citharinus nei	*Citharinus spp*	13	9 581	15 468	13 031	9 130	17 823	11 925	14 036
Grass-eaters nei	*Distichodus spp*	13	4 765	7 662	6 836	5 500	11 662	5 760	8 760
Kafue pike	*Hepsetus odoe*	13	1 009	2 090	2 284	2 372	7 837	1 941	2 634
...A	*Alestes baremoze*	13	...	...	...	...	1 519	900	268
Elongate tigerfish	*Hydrocynus forskahlii*	13	...	...	...	...	1 404	900	418
Bagrid catfish	*Chrysichthys nigrodigitatus*	13	10 859	12 519	13 161	16 287	11 110	17 541	18 795
Black catfishes nei	*Chrysichthys spp*	13	8 185	8 494	9 118	9 350	9 644	8 340	7 065
Bayad	*Bagrus bajad*	13	10 228	7 900	11 952	6 668	5 647	7 202	6 902
Naked catfishes	*Bagrus spp*	13	14 652	17 002	15 980	20 130	18 422	20 844	21 808
Glass schilbid	*Parailia pellucida*	13	28	97	106	1 048	540	761	802
North African catfish	*Clarias gariepinus*	13	38 525	46 309	41 282	43 638	40 951	52 194	50 054
Mudfish	*Clarias anguillaris*	13	26 833	25 821	36 771	31 195	33 499	39 556	31 493
Torpedo-shaped catfishes nei	*Clarias spp*	13	27 102	33 650	32 138	28 987	47 983	55 536	60 897
Upsidedown catfishes	*Synodontis spp*	13	13 532	15 451	17 066	15 598	23 410	21 086	22 381
Freshwater siluroids nei	*Siluroidei*	13	500	500	500	500	2 829	3 000	3 700
Nile perch	*Lates niloticus*	13	338 956	378 045	332 856	319 466	311 716	315 928	291 117
Freshwater perches nei	*Lates spp*	13	4 643	4 300	4 000	3 600	3 169	3 160	3 160
Bichique	*Sicyopterus lagocephalus*	13	2	1	2	1	0	0	0
Freshwater gobies nei	*Gobiidae*	13	750	600	900	950	950	1 000	1 050
Snakeheads(=Murrels) nei	*Channa spp*	13	6 170	5 470	3 504	5 960	10 388	5 515	4 596
Freshwater fishes nei	*Osteichthyes*	13	929 040	949 427	932 158	938 154	955 015	909 556	917 634
European eel	*Anguilla anguilla*	22	966	994	4 033	2 095	984	1 278	371
Salmonoids nei	*Salmonoidei*	23	34	36	33	47	49	51	122
Diadromous clupeoids nei	*Clupeoidei*	24	226	212	395	434	396	313	336
Common sole	*Solea solea*	31	609	1 116	1 498	1 980	2 209	1 780	1 842
Lizardfishes nei	*Synodontidae*	33	71	26	-	-	-	-	-
...A	*Arius spp*	33	...	...	...	...	500	250	5
Flathead grey mullet	*Mugil cephalus*	33	...	...	...	...	380	250	108
Mullets nei	*Mugilidae*	33	30 911	25 869	34 241	24 583	22 459	20 025	29 667
Seabasses nei	*Dicentrarchus spp*	33	1 741	2 215	4 402	4 307	3 965	4 208	2 060
Meagre	*Argyrosomus regius*	33	86	79	230	165	125	118	101
Saddled seabream	*Oblada melanura*	33	53	56	95	77	...	...	47
Gilthead seabream	*Sparus aurata*	33	751	534	1 173	1 517	1 383	1 317	641
Giant African threadfin	*Polydactylus quadrifilis*	33	...	...	...	...	40	30	14
Bonga shad	*Ethmalosa fimbriata*	35	1 600	1 250	1 100	900	2 440	1 300	416
Silversides(=Sand smelts) nei	*Atherinidae*	37	2 246	1 985	5 290	7 987	5 459	73	5 661
River prawns nei	*Macrobrachium spp*	41	100	80	120	130	130	130	133
Freshwater prawns, shrimps nei	*Palaemonidae*	41	5 089	4 464	5 029	4 792	5 409	6 176	3 023
Red swamp crawfish	*Procambarus clarkii*	41	21	20	18	19	19	16	20
Freshwater crustaceans nei	*Crustacea*	41	5 770	5 516	5 769	4 836	5 440	5 301	4 526
Penaeus shrimps nei	*Penaeus spp*	45	2 250	1 750	1 600	1 450	1 970	1 600	1 386
Freshwater molluscs nei	*Mollusca*	51	1 760	2 273	2 439	1 990	2 017	1 742	1 671
Total			***2 332 948***	***2 432 797***	***2 365 200***	***2 399 785***	***2 463 732***	***2 485 524***	***2 567 427***

C-01 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Africa - Inland waters
Afrique - Eaux continentales
África - Aguas continentales

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Algeria	0	0	0	0	0	0	0	...	...	...
Angola	8 000 F	9 000 F	10 000	10 000 F	10 000 F	10 500	9 000 F	7 500 F	5 848	10 000 F
Benin	30 000	29 993	30 000 F	28 200	21 900	29 500	30 200	30 200 F	30 250	30 350
Botswana	118	139	122	161	132	81	122	86	73 F	60
Burkina Faso	8 500	8 500	9 000	9 000 F	9 000	9 500	10 200	11 093	11 800	14 520
Burundi	8 964	11 000 F	14 697	13 855	14 800 F	15 750 F	16 700 F	17 766	17 700 F	17 700 F
Cameroon	52 500 F	65 000	55 000	65 000 F	75 000	75 000	74 380	74 700 F	75 000	75 000 F
Cape Verde	0	0	-	-	-	-	-	-	-	-
Cent Afr Rep	17 000 F	19 000 F	21 000 F	23 000 F	25 000 F	27 000 F	29 000 F	31 000 F	33 000 F	35 000 F
Chad	75 000 F	70 000 F	65 000 F	60 000 F	55 000 F	50 000 F	45 000 F	40 000 F	40 000 F	40 000 F
Comoros	0	0	-	-	-	-	-	-	-	-
Congo Dem R	227 433 F	233 800 F	230 365 F	231 772 F	230 840 F	230 588 F	230 000 F	230 000 F	230 000 F	230 000 F
Congo Rep	26 101	29 494	31 182	30 338	32 500	31 000	30 120	29 362	28 385	30 500
Côte dIvoire	10 502	22 000	22 000	4 856	13 145	6 565	3 178	4 400 F	5 679	7 063
Djibouti	0	0	0	-	-	-	-	-	-	-
Egypt	295 450	292 662	313 742	282 099	242 100	256 288	241 743	237 572	259 577	263 847
Eq Guinea	1 000 F	950 F	900 F	850 F	850 F	900 F	900 F	900 F	1 000	1 000 F
Eritrea	0	-	-	-	-	-	-	-	-	-
Ethiopia	15 390	12 300	9 213	10 005	9 450	9 890	13 253	16 770	17 047	18 058
Fr South Tr	0	0	0	-	-	-	-	-	-	-
Gabon	9 850	9 400	9 507	8 293	9 700	9 359	9 500 F	10 000 F	10 000 F	10 000 F
Gambia	2 500 F	2 500 F	3 000 F	3 500 F	4 000 F	4 500 F	4 865	4 166	4 461	4 454 F
Ghana	74 500	74 500	75 000	75 000 F	75 000	83 168	84 756	85 000	88 700 F	90 000 F
Guinea	4 000	5 000 F	6 000 F	7 000 F	8 000 F	9 000 F	10 000 F	12 000 F	14 000 F	16 000 F
GuineaBissau	150 F	150 F	150 F	150 F	150 F	150 F	150 F	150 F	150 F	150 F
Kenya	156 763	137 792	113 221	119 093	140 199	151 729	124 327	127 097	128 036	134 847
Lesotho	24	40	42	45	45	45	48	50	45	45
Liberia	4 000	4 000 F	3 600 F	3 200 F	2 800 F	2 400 F	1 743	763	750 F	750 F
Libya	0	0	0	-	-	-	-	-	-	-
Madagascar	30 000	30 000	30 000	31 500	32 650	32 750	32 630	32 630	32 828	35 500
Malawi	40 619	41 329	53 543	56 463	59 595	72 787	66 500	70 019	69 325	98 299
Mali	100 000 F	100 000 F	100 000 F	100 000 F	100 000 F	100 000 F	100 000	100 000 F	100 000 F	100 000
Mauritania	10 000 F	12 000 F	12 000 F	12 000 F	13 000 F	15 000 F	15 000 F	15 000 F	15 000 F	15 000 F
Mauritius	0	0	-	-	-	-	-	-	-	-
Morocco	1 660	2 112	1 655	850	2 930	3 350	4 020	4 440	6 020	7 226
Mozambique	15 076 F	20 037 F	19 831 F	27 760 F	22 991 F	26 017 F	24 081	28 386	33 666	31 741
Namibia	2 000 F	2 000 F	2 500 F	2 500 F	2 800 F	2 800 F	2 800	2 800 F	2 800 F	2 800 F
Niger	20 800	23 560	55 860	51 466	50 018	29 835	29 728	29 960	29 884	29 884 F
Nigeria	154 175	187 242	174 968	182 264	238 051	223 395	227 107	304 413	285 771	293 382
Réunion	0	2	2	2	1	2	1	0	0	0
Rwanda	6 828	7 000 F	7 400	7 826	7 800 F	8 400 F	9 050	9 050 F	9 050 F	9 050 F
Sao Tome Prn	0	0	0	0	0	0	0	-	-	-
Senegal	47 500 F	43 000 F	38 500 F	34 127	34 485	34 163	38 731	37 200	35 700 F	34 164 F
Seychelles	0	0	-	-	-	-	-	-	-	-
Sierra Leone	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F
Somalia	200 F	200 F	200 F	200 F	200 F	200 F	200 F	200 F	200 F	200 F
South Africa	900 F	900 F	900 F	900 F	900 F	900 F	900 F	900 F	900 F	900 F
Sudan	53 000	52 000	54 000 F	57 500 F	53 800 F	52 000 F	59 810	62 900 F	66 000	66 000 F
Swaziland	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F
Tanzania	283 354	273 856	301 855	312 040	320 566	292 519	284 346	281 690	269 402	293 043
Togo	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000 F	5 000	5 000
Tunisia	860	870	859	1 049	1 224	1 264	1 084	1 096	1 191	1 123
Uganda	220 726	221 898	241 810	371 789	416 758	367 099	431 500 F	403 500 F	412 000 F	413 805
Zambia	63 000	63 000	66 332	67 725	65 927	60 236	73 542	79 403	84 716	76 396
Zimbabwe	12 300 F	11 500 F	10 600 F	10 500 F	10 420 F	10 500 F	10 500 F	10 500 F	10 500 F	10 500 F
Total	***2 109 813***	***2 148 796***	***2 214 626***	***2 332 948***	***2 432 797***	***2 365 200***	***2 399 785***	***2 463 732***	***2 485 524***	***2 567 427***

C-02 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

America, North - Inland waters
Amérique du Nord - Eaux continentales
América del Norte - Aguas continentales

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Buffalofishes nei	*Ictiobus spp*	11	1 603	1 800	1 881	1 965	1 641	1 420	1 511
Suckers nei	*Catostomidae*	11	285	193	215	162	164	141	155
Common carp	*Cyprinus carpio*	11	17 565	16 935	17 689	20 556	22 228	25 270	30 465
Goldfish	*Carassius auratus*	11	14	9	52	57	31	53	69
Grass carp(=White amur)	*Ctenopharyngodon idellus*	11	20	23	32	55	31	38	46
Cyprinids nei	*Cyprinidae*	11	5 783	5 226	5 419	1 349	1 346	2 367	2 449
Nile tilapia	*Oreochromis niloticus*	12	867	1 050	609	767	3 977	...	...
Blue tilapia	*Oreochromis aureus*	12	2 513	1 561	1 449	3 058	2 764	2 526	2 028
Tilapias nei	*Oreochromis(=Tilapia) spp*	12	72 624	69 453	70 593	74 786	65 704	65 367	64 800
Jaguar guapote	*Cichlasoma managuense*	12	274	583	651	703	73	96	64
Peacock cichlid	*Cichla ocellaris*	12	12	8	10	6	19	23	11
Cichlids nei	*Cichlidae*	12	699	2 551	1 950	1 427	1 181	1 466	1 176
Tropical gar	*Atractosteus tropicus*	13	...	...	...	26	43	19	64
...A	*Atractosteus spp*	13	...	406	424	539	384	448	453
Gars nei	*Lepisosteidae*	13	340	246	280	368	320	280	230
Northern pike	*Esox lucius*	13	1 938	1 417	1 572	1 697	1 951	1 955	1 890
Machaca	*Brycon guatemalensis*	13	...	...	52	52	102	95	71
Channel catfish	*Ictalurus punctatus*	13	758	516	510	318	262	527	1 172
Blue catfish	*Ictalurus furcatus*	13	1 472	1 552	1 580	1 829	1 490	1 242	1 491
Catfishes nei	*Ictalurus spp*	13	6 078	3 706	3 684	4 266	4 561	3 485	4 777
Brown bullhead	*Ameiurus nebulosus*	13	-	-	-	-	-	28	35
Flathead catfish	*Pylodictis olivaris*	13	129	123	147	122	147	139	114
South American catfish	*Rhamdia quelen*	13	...	10	10	17	13	16	18
Burbot	*Lota lota*	13	10	7	8	7	6	5	6
...A	*Chirostoma spp*	13	...	590	617	2 005	1 936	2 372	3 552
White bass	*Morone chrysops*	13	146	165	159	225	193	239	350
Largemouth black bass	*Micropterus salmoides*	13	1 167	1 415	1 587	1 070	1 123	1 033	872
American yellow perch	*Perca flavescens*	13	4 333	4 846	6 098	4 768	4 707	3 600	4 118
Walleye	*Sander vitreus*	13	6 957	8 873	10 259	8 993	8 310	7 689	7 747
Freshwater drum	*Aplodinotus grunniens*	13	372	503	547	587	555	657	702
Fat sleeper	*Dormitator maculatus*	13	...	253	264	15	113	28	42
Bigmouth sleeper	*Gobiomorus dormitor*	13	...	125	131	...	...	...	...
Freshwater fishes nei	*Osteichthyes*	13	22 565	21 142	20 729	16 787	16 570	19 353	14 916
Sturgeons nei	*Acipenseridae*	21	134	103	113	112	114	111	116
American eel	*Anguilla rostrata*	22	187	170	170	148	175	167	106
Chum(=Keta=Dog)salmon	*Oncorhynchus keta*	23	136	951	971	867	864	-	-
Sockeye(=Red)salmon	*Oncorhynchus nerka*	23	29	-	-	-	48	-	-
Chinook(=Spring=King)salmon	*Oncorhynchus tshawytscha*	23	531	298	403	271	75	63	87
Coho(=Silver)salmon	*Oncorhynchus kisutch*	23	1 478	735	769	690	581	1	1
Rainbow trout	*Oncorhynchus mykiss*	23	336	422	301	263	295	243	255
Lake trout(=Char)	*Salvelinus namaycush*	23	976	842	819	719	824	841	911
Rainbow smelt	*Osmerus mordax*	23	86	194	313	379	203	96	26
Pond smelt	*Hypomesus olidus*	23	5 805	3 141	920	4 390	3 651	3 585	1 428
Lake(=Common)whitefish	*Coregonus clupeaformis*	23	12 384	11 032	11 342	11 196	10 829	11 076	11 357
Lake cisco	*Coregonus artedi*	23	384	328	499	592	571	640	885
Whitefishes nei	*Coregonus spp*	23	891	832	850	552	338	3	8
Salmonoids nei	*Salmonoidei*	23	-	-	-	-	-	-	9
American shad	*Alosa sapidissima*	24	44	65	25	22	38	46	25
Alewife	*Alosa pseudoharengus*	24	1 208	1 192	1 183	1 177	950	955	2
Blueback shad	*Alosa aestivalis*	24	-	8	6	8	7	-	9
Hickory shad	*Alosa mediocris*	24	-	106	39	32	40	-	60
American gizzard shad	*Dorosoma cepedianum*	24	1 032	1 081	711	615	996	669	1 092
...A	*Dorosoma spp*	24	...	1 027	1 073	1 070	913	952	914
Diadromous clupeoids nei	*Clupeoidei*	24	...	232	243	174	19	25	28
White perch	*Morone americana*	25	149	1 033	661	816	843	277	1 299
Atlantic tomcod	*Microgadus tomcod*	32	-	0	-	-	-	-	-
Mountain mullet	*Agonostomus monticola*	33	...	...	...	...	9	9	9
Mullets nei	*Mugilidae*	33	...	707	743	...	...	...	...
Snooks(=Robalos) nei	*Centropomus spp*	33	120	2 822	2 985	3 386	2 469	2 593	2 661
Silversides(=Sand smelts) nei	*Atherinidae*	37	424	...	...	1 233	1 935	1 937	...
River prawns nei	*Macrobrachium spp*	41	2 782	3 595	3 754	2 968	3 026	3 092	2 759
Euro-American crayfishes nei	*Astacidae, Cambaridae*	41	3 947	6 980	785	7 298	7 105	8 627	6 520
Freshwater crustaceans nei	*Crustacea*	41	176	77	150	113	98	...	8
Blue crab	*Callinectes sapidus*	42	-	-	-	-	-	-	4
Marine crabs nei	*Brachyura*	42	...	2	2	...	...	...	...
Brine shrimp	*Artemia salina*	47	3 181	-	-	-	-	-	-
Freshwater molluscs nei	*Mollusca*	51	1 112	1 099	1 156	1 055	1 651	1 724	1 657
Frogs	*Rana spp*	71	135	174	181	183	219	221	231
Diamond back terrapins	*Malaclemys spp*	72	-	0	2	-	-	-	-
River and lake turtles nei	*Testudinata*	72	41	33	28	30	48	15	35
Marine worms	*Polychaeta*	77	29	8	8	35	37	41	54
Aquatic invertebrates nei	*Invertebrata*	77	138	331	346	404	324	398	394
Total			***186 399***	***184 907***	***180 759***	***189 380***	***181 240***	***180 384***	***178 344***

C-02 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

America, North - Inland waters
Amérique du Nord - Eaux continentales
América del Norte - Aguas continentales

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Anguilla	0	0	-	-	-	-	-	-	-	-
Antigua Barb	0	0	-	-	-	-	-	-	-	-
Bahamas	0	0	0	0	0	0	0	-	-	-
Belize	0	0	0	0	0	0	0	-	-	-
Bermuda	0	-	-	-	-	-	-	-	-	-
Br Virgin Is	0	0	-	-	-	-	-	-	-	-
Canada	38 140	39 999	37 383	36 116	32 269	32 234	32 303	31 063	33 023	27 293
Cayman Is	0	0	0	-	-	-	-	-	-	-
Costa Rica	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F
Cuba	1 994	2 023	2 698	2 513	1 561	1 449	3 058	2 764	2 526	2 028
Dominica	0	0	0	-	-	-	-	-	-	-
Dominican Rp	1 158	2 102	1 506	1 980	1 694	1 911	1 481	1 708	432	350
El Salvador	1 692	2 663	2 673	2 205	2 051	2 034	2 422	3 980	3 000 F	2 326
Greenland	0	0	0	-	-	-	-	-	-	-
Grenada	0	0	-	-	-	-	-	-	-	-
Guadeloupe	0	0	-	-	-	-	-	-	-	-
Guatemala	6 480 F	5 665 F	4 850 F	4 035 F	3 120 F	2 360	2 360 F	2 360 F	2 360 F	2 360 F
Haiti	400 F	400 F	400 F	300	300 F	300 F	300 F	300 F	300 F	300 F
Honduras	111	102 F	100 F	100 F	100 F	100 F	100 F	100 F	100 F	100 F
Jamaica	400 F	400 F	400 F	400 F	400 F	400 F	400 F	400 F	400	400
Martinique	0	0	-	-	-	-	-	-	-	-
Mexico	91 952	82 648	99 604	107 203	113 578	116 268	116 591	108 853	111 792	116 410
Montserrat	0	0	0	0	-	-	-	-	-	-
NethAntilles	0	0	0	0	0	0	0	-	-	-
Nicaragua	700	487	405	866	1 042	412	853	988	868	943
Panama	20 F	23 F	26	406	2 950	3 555	3 242	3 143	1 909	2 013
Puerto Rico	0	-	-	-	-	-	-	-	-	-
St Kitts Nev	0	0	0	0	0	0	0	-	-	-
St Lucia	0	0	0	-	-	-	-	-	-	-
St Pier Mq	0	0	0	-	-	-	-	-	-	-
St Vincent	0	0	0	0	0	0	0	-	-	-
Trinidad Tob	0	0	0	0	0	0	0	-	-	-
Turks Caicos	0	0	-	-	-	-	-	-	-	-
USA	29 578	27 397	26 329	29 275	24 842	18 736	25 270	24 581	22 674	22 821
US Virgin Is	0	0	0	0	0	0	0	-	-	-
Total	***173 625***	***164 909***	***177 374***	***186 399***	***184 907***	***180 759***	***189 380***	***181 240***	***180 384***	***178 344***

C-03 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

America, South - Inland waters
Amérique du Sud - Eaux continentales
América del Sur - Aguas continentales

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Common carp	*Cyprinus carpio*	11	0	0	0	0	...	...	...
Cyprinids nei	*Cyprinidae*	11	441	447	440	440	470	430	448
Nile tilapia	*Oreochromis niloticus*	12	...	...	20	19	18	27	22
Tilapias nei	*Oreochromis(=Tilapia) spp*	12	8 461	9 164	9 328	9 978	10 088	9 247	9 610
Oscar	*Astronotus ocellatus*	12	...	...	...	...	2 040	1 870	1 943
Velvety cichlids	*Astronotus spp*	12	218	273	254	430	394	574	653
Green terror	*Aequidens rivulatus*	12	...	...	14	14	14	48	39
Cichlids nei	*Cichlidae*	12	13 733	14 371	16 921	15 085	14 365	13 168	13 693
Arapaima	*Arapaima gigas*	13	582	1 399	1 611	1 495	1 547	1 532	1 511
Arawana	*Osteoglossum bicirrhosum*	13	1 644	1 622	1 679	1 817	1 813	1 662	1 727
Banded astyanax	*Astyanax fasciatus*	13	901	1 032	953	938	1 153	1 056	1 098
...A	*Brycon orbignyanus*	13	9	9	9	8	9	8	8
...A	*Brycon dentex*	13	...	...	24	20	15	45	32
Dorado	*Salminus brasiliensis*	13	...	...	...	...	3 319	3 042	3 162
Cachama	*Colossoma macropomum*	13	4 272	3 657	4 943	4 968	4 874	4 468	4 629
Pirapatinga	*Piaractus brachypomus*	13	2 456	2 550	2 493	2 613	2 577	2 599	2 528
...A	*Metynnis argenteus*	13	11 153	10 858	10 766	11 090	11 591	10 624	11 042
...A	*Triportheus angulatus*	13	3 024	2 940	3 402	3 634	3 533	3 239	3 366
Characins nei	*Characidae*	13	47 361	41 743	44 866	40 750	22 738	21 868	25 300
...A	*Leporellus vittatus*	13	...	...	...	...	1 418	1 300	1 351
...A	*Schizodon fasciatus*	13	...	...	...	...	5 430	4 977	5 173
...A	*Hoplias aimara*	13	9 232	10 038	9 865	9 205	10 309	9 450	9 821
...A	*Hoplias microlepis*	13	...	...	27	32	38	57	44
Aimara	*Hoplerythrinus unitaeniatus*	13	...	...	...	...	330	302	314
Netted prochilod	*Prochilodus reticulatus*	13	11 705	10 957	5 130	12 150	12 323	12 474	9 635
Prochilods nei	*Prochilodus spp*	13	71 270	65 854	66 228	52 003	46 629	48 895	49 131
...A	*Pseudocurimata boulengeri*	13	...	...	42	36	30	47	34
...A	*Semaprochilodus insignis*	13	16 529	15 067	16 153	17 474	17 252	15 813	16 435
...A	*Curimata cyprinoides*	13	5 068	5 358	5 101	4 977	5 468	5 012	5 209
Raphael catfish	*Platydoras costatus*	13	364	268	196	185	230	211	219
Gilded catfish	*Brachyplatystoma flavicans*	13	20 057	19 556	11 599	11 377	15 094	13 835	14 379
Laulao catfish	*Brachyplatystoma vaillanti*	13	22 547	21 284	28 195	23 557	25 830	23 676	24 607
Porthole shovelnose catfish	*Hemisorubim platyrhynchos*	13	15	14	12	11	13	12	12
...A	*Lophiosilurus alexandri*	13	...	...	...	...	599	549	571
...A	*Pimelodus maculatus*	13	...	...	...	...	32	29	30
Duckbill catfish	*Sorubim lima*	13	...	...	...	...	242	222	231
Redtail catfish	*Phractocephalus hemioliopterus*	13	...	...	...	...	758	695	723
Spotted sorubim	*Pseudoplatystoma corruscans*	13	...	...	...	...	2 145	1 966	8 688
Barred sorubim	*Pseudoplatystoma fasciatum*	13	...	...	...	...	1 090	999	1 038
Pati	*Luciopimelodus pati*	13	...	...	...	...	1	0	1
...A	*Loricaria cataphracta*	13	...	...	...	...	618	567	589
Freshwater siluroids nei	*Siluroidei*	13	69 791	68 750	70 167	61 522	57 954	55 620	50 020
Marbled swamp eel	*Synbranchus marmoratus*	13	...	...	...	...	36	33	34
Freshwater fishes nei	*Osteichthyes*	13	72 780	69 903	72 366	63 630	69 849	69 183	78 931
Sea trout	*Salmo trutta*	23	1	1	1	1	1	1	1
Rainbow trout	*Oncorhynchus mykiss*	23	456	360	351	368	266	283	291
Yellowfin river pellona	*Pellona flavipinnis*	24	748	124	41	42	74	67	70
Diadromous clupeoids nei	*Clupeoidei*	24	250	200	220	150	130	130	130
South American silver croaker	*Plagioscion squamosissimus*	33	12 270	12 792	12 244	12 030	13 132	12 037	...
Silversides(=Sand smelts) nei	*Atherinidae*	37	888	850	880	919	963	1 000	750
River prawns nei	*Macrobrachium spp*	41	6 317	5 242	5 127	6 612	6 022	5 520	5 737
Red claw crayfish	*Cherax quadricarinatus*	41	...	...	106	95	84	114	74
Frogs	*Rana spp*	71	-	-	1	-	-	-	-
Total			***414 543***	***396 683***	***401 775***	***369 675***	***374 948***	***360 583***	***365 084***

C-03 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

America, South - Inland waters
Amérique du Sud - Eaux continentales
América del Sur - Aguas continentales

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Argentina	15 536	18 474	26 596	33 903	34 002	33 617	19 695	11 246	16 256	15 445
Bolivia	5 940	6 300 F	6 599	6 436	6 360	6 080 F	5 770	6 750	7 568	6 946
Brazil	220 432	239 415	227 551	246 101	243 435	251 241	243 210	261 280	239 493	248 122
Chile	0	0	0	0	0	0	0	...	...	...
Colombia	26 532	27 738	30 512	28 292	19 291	20 000 F	20 800 F	21 700 F	22 686	21 049
Ecuador	350 F	300 F	300 F	250 F	250 F	233	216 F	199	338	245
Falkland Is	1	1	1	1	1	1	1	1	1	1
Fr Guiana	0	0	-	-	-	-	-	-	-	-
Guyana	800	800	800	800	800	800 F	800	800	800 F	800
Paraguay	25 000 F	21 500 F	18 000 F	14 500 F	11 000 F	8 000 F	5 000 F	1 708	1 700 F	1 700 F
Peru	35 757	29 968	32 940	37 688	40 196	37 466	42 633	45 412	45 720	44 368
Suriname	200	200 F	222	242	218	200	350	350 F	420	560
Uruguay	451	387	551	2 330	2 130	2 137	1 200	620	801	1 048
Venezuela	24 326	40 776	49 090	44 000 F	39 000 F	42 000 F	30 000 F	24 882	24 800 F	24 800 F
Total	***355 325***	***385 859***	***393 162***	***414 543***	***396 683***	***401 775***	***369 675***	***374 948***	***360 583***	***365 084***

C-04 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Asia - Inland waters
Asie - Eaux continentales
Asia - Aguas continentales

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Freshwater bream	*Abramis brama*	11	22 345	21 073	17 832	19 301	22 066	17 595	22 542
Freshwater breams nei	*Abramis spp*	11	27	92	13	11	9	1	8
Common carp	*Cyprinus carpio*	11	39 126	39 104	32 460	34 717	46 349	36 273	40 919
Tench	*Tinca tinca*	11	2 082	1 792	1 953	1 884	1 632	1 577	1 250
Crucian carp	*Carassius carassius*	11	3 538	4 621	3 428	3 864	4 915	3 647	3 857
Goldfish	*Carassius auratus*	11	1	2	2	3	1	1	3
Roach	*Rutilus rutilus*	11	287	358	420	521	577	535	369
Kutum	*Rutilus frisii*	11	7 052	9 649	16 138	17 242	14 885	12 536	11 627
Roaches nei	*Rutilus spp*	11	1 700	1 537	2 088	2 383	4 848	4 211	5 114
Orfe(=Ide)	*Leuciscus idus*	11	...	...	...	...	...	108	21
Common dace	*Leuciscus leuciscus*	11	93	87	85	82	71	63	92
Mud carp	*Cirrhinus molitorella*	11	10	8	-	-	-	-	-
Grass carp(=White amur)	*Ctenopharyngodon idellus*	11	2 458	3 066	3 312	4 417	4 215	3 410	3 573
Beardless barb	*Cyclocheilichthys apogon*	11	...	34	24	1 280	2 450	591	488
...A	*Cyclocheilichthys armatus*	11	...	...	...	...	...	2	9
Hampala barb	*Hampala macrolepidota*	11	75	181	124	404	160	1 630	805
Silver carp	*Hypophthalmichthys molitrix*	11	6 815	7 596	8 427	11 962	9 823	11 348	12 012
Bighead carp	*Hypophthalmichthys nobilis*	11	850	935	1 024	1 508	1 236	1 152	1 267
Signal barb	*Labiobarbus festivus*	11	...	...	196	184	167	156	214
Nilem carp	*Osteochilus hasselti*	11	3 986	3 918	4 829	6 082	5 833	4 878	5 328
Silver rasbora	*Rasbora argyrotaenia*	11	33	248	1 064	2 245	713	776	1 347
...A	*Thynnichthys vaillanti*	11	157	204	263	453	594	564	1 727
Semah mahseer	*Tor douronensis*	11	60	599	779	708	1 116	988	919
Kinneret bleak	*Acanthobrama terraesanctae*	11	422	558	847	439	88	98	98
Freshwater minnow	*Zacco platypus*	11	792	674	...	...	...	...	...
Vimba bream	*Vimba vimba*	11	1	2	4	7	9	5	6
Sichel	*Pelecus cultratus*	11	10	8	6	6	...	17	246
Asp	*Aspius aspius*	11	994	1 425	1 059	1 030	5 234	1 434	1 577
Tarek	*Chalcalburnus tarichi*	11	14 259	14 103	11 978	11 623	11 758	10 685	11 382
...A	*Barbodes balleroides*	11	...	7	28	30	26	131	56
Hoven's carp	*Leptobarbus hoeveni*	11	2 682	2 862	3 199	3 257	3 662	4 062	4 902
Black carp	*Mylopharyngodon piceus*	11	21	12	30	20	16	9	8
Spotted barb	*Puntius binotatus*	11	...	...	23	3	18	54	49
Long pectoral-fin minnow	*Macrochirichthys macrochirus*	11	20	17	85	62	109	170	13
...A	*Mystacoleucus padangensis*	11	34	136	19	1 036	1 960	13 121	19 205
...A	*Puntioplites waandersi*	11	25	49	601	545	1 678	1 741	2 923
Silver barb	*Barbonymus gonionotus*	11	60 413	62 231	31 826	26 581	49 376	56 997	45 662
Tinfoil barb	*Barbonymus schwanenfeldii*	11	6 847	6 043	7 452	6 296	4 540	3 488	699
Cyprinids nei	*Cyprinidae*	11	190 403	325 596	330 224	330 487	388 683	374 755	772 854
Pond loach	*Misgurnus anguillicaudatus*	11	68	59	...	...	...	...	...
Clown loach	*Chromobotia macracanthus*	11	2	3	1	29	2 814	2 834	41
Mozambique tilapia	*Oreochromis mossambicus*	12	18 289	13 759	14 390	11 209	8 548	10 677	14 615
Nile tilapia	*Oreochromis niloticus*	12	47 243	47 282	31 544	35 565	67 792	50 263	55 645
Blue tilapia	*Oreochromis aureus*	12	42	21	29	0	-	-	-
Tilapias nei	*Oreochromis(=Tilapia) spp*	12	54 125	54 157	59 060	60 169	67 946	69 791	73 154
Mango tilapia	*Sarotherodon galilaeus*	12	237	316	151	51	8	20	21
Cichlids nei	*Cichlidae*	12	22	6	1	6	1	3	3
Northern pike	*Esox lucius*	13	1 025	1 093	1 089	1 401	2 155	1 542	1 640
Asian bonytongue	*Scleropages formosus*	13	...	...	1	841	3	0	0
Giant featherback	*Chitala lopis*	13	2 786	3 427	3 491	2 295	1 880	2 489	4 240
Wels(=Som)catfish	*Silurus glanis*	13	1 867	2 981	3 189	3 567	4 676	3 856	3 704
Glass catfishes	*Kryptopterus spp*	13	11 815	11 952	12 666	14 296	13 318	13 035	13 592
Butter catfish	*Ompok bimaculatus*	13	20	718	579	352	317	507	5 668
Asian redtail catfish	*Mystus nemurus*	13	7 502	8 229	8 943	11 853	12 350	11 336	14 439
...A	*Mystus nigriceps*	13	172	148	708	449	571	1 016	1 121
North African catfish	*Clarias gariepinus*	13	487	480	478	486	339	310	341
Torpedo-shaped catfishes nei	*Clarias spp*	13	24 870	22 326	19 454	19 102	31 540	32 530	29 796
...A	*Pangasius djambal*	13	8 902	8 475	9 010	10 839	9 724	12 611	14 524
Pangas catfishes nei	*Pangasius spp*	13	3 000	9 880	12 100	6 800	6 400	4 429	4 700
Freshwater siluroids nei	*Siluroidei*	13	35 274	87 338	89 055	86 342	120 626	116 192	191 557
Burbot	*Lota lota*	13	...	...	...	...	...	11	3
Asian swamp eel	*Monopterus albus*	13	300	56	300	300	200	327	400
Fire eel	*Mastacembelus erythrotaenia*	13	71	74	93	143	18	21	86
European perch	*Perca fluviatilis*	13	375	...	...	...	...	657	630
Pike-perch	*Sander lucioperca*	13	4 760	5 178	5 391	6 634	11 358	5 512	7 359
Smallscale archerfish	*Toxotes microlepis*	13	...	210	13	3	4	204	29
Malayan leaffish	*Pristolepis fasciata*	13	1	-	33	258	320	162	141
Gudgeons, sleepers nei	*Eleotridae*	13	2 726	1 405	1 471	1 617	1 690	1 628	1 996
Freshwater gobies nei	*Gobiidae*	13	6 430	6 154	6 133	5 913	6 449	6 177	5 852
Climbing perch	*Anabas testudineus*	13	16 310	24 276	20 448	19 679	26 002	29 456	26 456
Giant gourami	*Osphronemus goramy*	13	389	865	704	11 054	1 339	1 403	1 689
Snakeskin gourami	*Trichogaster pectoralis*	13	27 406	24 686	26 689	24 162	28 796	26 772	31 559
Three spot gourami	*Trichogaster trichopterus*	13	6 466	6 867	6 793	7 104	12 350	7 483	12 716
Kissing gourami	*Helostoma temminckii*	13	19 734	14 816	13 052	13 011	12 703	11 615	12 914
Snakehead	*Channa argus*	13	...	13	287	28	46	42	50
Striped snakehead	*Channa striata*	13	68 875	53 530	47 392	45 775	60 142	63 894	62 023
Indonesian snakehead	*Channa micropeltes*	13	16 757	8 371	7 460	6 679	7 506	8 233	7 811
Snakeheads(=Murrels) nei	*Channa spp*	13	37 779	60 577	60 773	58 468	81 712	83 103	81 168
Freshwater fishes nei	*Osteichthyes*	13	3 626 443	4 049 152	4 513 146	4 588 165	4 531 936	4 666 967	4 821 169
Starry sturgeon	*Acipenser stellatus*	21	4	4	84	37	83	10	1
Fringebarbel sturgeon	*Acipenser nudiventris*	21	0	1	1	-	-	-	-
Beluga	*Huso huso*	21	6	2	36	27	46	42	-
Sturgeons nei	*Acipenseridae*	21	822	728	477	333	284	144	103
European eel	*Anguilla anguilla*	22	165	176	162	179	171	158	182
Japanese eel	*Anguilla japonica*	22	614	519	302	329	366	408	364
River eels nei	*Anguilla spp*	22	3 420	1 426	2 271	1 923	1 355	1 723	1 868

C-04 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Asia - Inland waters
Asie - Eaux continentales
Asia - Aguas continentales

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Sea trout	*Salmo trutta*	23	352	376	374	550	630	557	738
Trouts nei	*Salmo spp*	23	880	850	464	450	351	412	80
Pink(=Humpback)salmon	*Oncorhynchus gorbuscha*	23	628	852	809	1 062	731	1 299	...
Chum(=Keta=Dog)salmon	*Oncorhynchus keta*	23	19 103	16 269	14 899	13 524	9 525	12 727	...
Masu(=Cherry) salmon	*Oncorhynchus masou*	23	667	629	14	10	15	17	1
Sockeye(=Red)salmon	*Oncorhynchus nerka*	23	39	33	...	...	...	...	...
Rainbow trout	*Oncorhynchus mykiss*	23	347	328	...	...	...	...	...
Chars nei	*Salvelinus spp*	23	388	369	...	...	...	...	...
Ayu sweetfish	*Plecoglossus altivelis*	23	7 312	7 149	3 014	3 284	3 438	3 625	3 406
Japanese smelt	*Hypomesus nipponensis*	23	1 712	1 937	1 128	1 194	1 096	2 009	1 966
Japanese icefish	*Salangichthys microdon*	23	314	734	311	379	352	745	675
Whitefishes nei	*Coregonus spp*	23	36	42	56	51	43	44	44
Salmonoids nei	*Salmonoidei*	23	2	3	1 881	22	59	24	13 911
Caspian shads	*Caspialosa spp*	24	64	60	68	96	108	148	143
Hilsa shad	*Tenualosa ilisha*	24	91 392	92 908	94 489	94 166	104 133	108 351	122 439
Black and Caspian Sea sprat	*Clupeonella cultriventris*	24	43 181	45 943	40 650	32 541	32 443	41 276	42 498
Diadromous clupeoids nei	*Clupeoidei*	24	3 208	2 933	2 856	2 437	7 809	8 238	2 816
Milkfish	*Chanos chanos*	25	558	637	3 589	2 261	3 714	9 347	8 487
Flatfishes nei	*Pleuronectiformes*	31	32	71	686	555	357	388	575
Bombay-duck	*Harpadon nehereus*	33	283	121	1 595	321	504	634	331
Sea catfishes nei	*Ariidae*	33	3 587	3 056	2 028	2 327	2 482	1 905	1 973
Mullets nei	*Mugilidae*	33	9 728	13 144	11 539	10 505	15 924	14 182	10 878
Croakers, drums nei	*Sciaenidae*	33	842	1 020	1 065	601	590	764	1 006
Threadfins, tasselfishes nei	*Polynemidae*	33	449	537	561	420	2 615	2 541	...
Scats	*Scatophagus spp*	33	55	82	151	211	239	246	207
Pike-congers nei	*Muraenesox spp*	34	807	1 163	728	289	353	434	493
Silversides(=Sand smelts) nei	*Atherinidae*	37	2 107	5 248	6 677	6 540	6 630	6 184	4 438
Siberian prawn	*Exopalaemon modestus*	41	117 288	130 471	142 523	151 477	141 412	137 659	144 744
Oriental river prawn	*Macrobrachium nipponense*	41	117 288	130 471	142 523	151 478	141 413	137 659	144 744
Giant river prawn	*Macrobrachium rosenbergii*	41	5 342	9 244	5 783	6 586	8 300	10 187	10 798
Freshwater prawns, shrimps nei	*Palaemonidae*	41	5 347	5 659	6 434	7 437	6 425	3 436	6 559
Danube crayfish	*Astacus leptodactylus*	41	...	...	...	717	258	266	266
Euro-American crayfishes nei	*Astacidae, Cambaridae*	41	2 317	809	797	816	783	734	1 030
Chinese mitten crab	*Eriocheir sinensis*	41	32 603	38 564	36 711	44 119	46 323	52 495	53 832
Freshwater crustaceans nei	*Crustacea*	41	1 342	4 580	4 669	1 814	81 131	96 752	136 228
Blue swimming crab	*Portunus pelagicus*	42	353	264	226	258	286	259	279
Indo-Pacific swamp crab	*Scylla serrata*	42	376	483	479	719	767	788	821
Penaeus shrimps nei	*Penaeus spp*	45	12 793	15 913	15 908	15 259	20 397	15 107	17 074
Natantian decapods nei	*Natantia*	45	49 053	49 935	52 235	57 375	61 321	59 617	68 029
Japanese corbicula	*Corbicula japonica*	51	16 234	14 081	13 412	11 083	10 123	10 794	11 893
Freshwater molluscs nei	*Mollusca*	51	360 438	348 709	363 591	373 666	335 803	354 962	355 507
Clams, etc. nei	*Bivalvia*	56	170	75	243	223	197	565	79
Frogs	*Rana spp*	71	2 701	2 315	7 970	2 508	2 188	2 312	2 802
River and lake turtles nei	*Testudinata*	72	140	114	58	106	81	173	12
Aquatic invertebrates nei	*Invertebrata*	77	39 593	39 917	37 831	38 420	36 619	46 348	46 177
Total			***5 376 670***	***6 028 661***	***6 482 317***	***6 586 003***	***6 812 669***	***6 964 612***	***7 696 520***

C-04 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Asia - Inland waters
Asie - Eaux continentales
Asia - Aguas continentales

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Afghanistan	800 F	900 F	900 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F
Armenia	866	465	569	218	250	350	1 065	601	619 F	617 F
Azerbaijan	10 893	11 188	6 435	9 258	9 001	4 061	2 949	1 524	1 206	1 081
Bangladesh	688 920	688 435	709 333	732 067	859 269	956 686	1 006 761	1 060 181	1 218 937	1 119 094
Bhutan	260 F	240 F	240 F	220 F	220 F	200 F	200 F	180 F	180 F	160 F
Brunei Darsm	19	14	5	11	-	-	-	-	-	-
Cambodia	385 000	360 300	308 750	250 000	324 000	422 000	395 000	365 000	390 000	405 000
China	1 871 295 F	1 951 889 F	2 135 086 F	2 097 167 F	2 210 103 F	2 203 316 F	2 256 403	2 248 177	2 183 859	2 289 343
China,H.Kong	0	0	0	0	0	0	0	...	...	...
China, Macao	0	0	-	-	-	-	-	-	-	-
China,Taiwan	591	599	475	245	197	149	242	198	159	77
Cyprus	70 F	60 F	50 F	40 F	30 F	20 F	20 F	20 F	20 F	20 F
Georgia	8	10	39	51	51 F	50 F	50 F	50 F	50 F	50 F
India	975 403	775 599	757 353	527 290	843 746	892 639	823 410	947 358	923 954	1 468 757
Indonesia	310 240	304 989	308 656	330 879	297 368	293 921	320 908	304 402	295 736	344 972
Iran	88 335	55 853	50 994	55 825	67 066	71 405	74 064	65 862	71 781	75 145
Iraq	14 100	11 900	13 200	10 581	23 570 F	46 300	45 460	29 986	22 259	12 230
Israel	1 286	1 569	1 064	1 137	1 396	1 600	840	224	401	402
Japan	61 819	61 725	60 334	60 402	54 327	41 700	39 039	32 626	41 694 F	39 911 F
Jordan	350	350	350	350	350	350	350	350	350	350
Kazakhstan	22 960	24 668	25 195	33 306	37 621	34 724	41 366	55 706	35 028	42 953
Korea D P Rp	4 928	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F
Korea Rep	5 971	5 690	7 539	10 302	7 500	6 447	5 803	11 098	11 707	10 256
Kuwait	0	0	0	0	0	0	0	-	-	-
Kyrgyzstan	57	48	14	7	14 F	8 F	34	8	10 F	27
Lao P.Dem.R.	31 000 F	33 440	29 800	29 800 F	26 560	26 925	28 410	29 200	30 000	30 900
Lebanon	20	297	285	265	275	270	270 F	270 F	270 F	270 F
Malaysia	3 446	3 450	3 828	4 119	4 582	4 165	4 280	4 353	4 469	4 545
Maldives	0	0	-	-	-	-	-	-	-	-
Mongolia	290	263	382	305	366	326	185	88	90	90 F
Myanmar	238 210	254 880	290 140	454 260	503 540	631 120	717 640	814 740	899 430	1 002 430
Nepal	16 700	17 900	18 888	19 947	19 983	20 016	20 100	21 500	21 500	21 500
Oman	0	0	-	-	-	-	-	-	-	-
Pakistan	122 468	114 030	92 794	93 687	94 644	140 000	100 000	108 000	112 355	115 348
Palest, O.T.	0	0	0	0	0	0	0	-	-	-
Philippines	135 845	130 868	132 565	140 409	142 181	159 851	166 459	179 491	186 444	185 406
Qatar	0	0	0	-	-	-	-	-	-	-
Saudi Arabia	0	0	0	0	0	0	0	-	-	-
Singapore	0	0	-	-	-	-	-	-	-	-
Sri Lanka	26 330	25 570	26 920	30 780	31 560	35 290	38 380	44 500	46 560	52 410
Syria	5 969	6 355	5 851	5 451	4 770	4 869	6 075	3 784	3 500	3 679
Tajikistan	137	181	158	184	146	146 F	146 F	150 F	150 F	160 F
Thailand	202 500	198 700	198 447	203 700	198 730	214 000	225 600	228 600	206 856	209 800
Timor-Leste	0	0	0	0	-	-	-	-	-	-
Turkey	43 323	43 938	44 698	45 585	46 115	44 082	43 321	41 011	39 187	40 259
Turkmenistan	12 749	12 812	14 543	14 992	15 000 F	15 000 F	15 000 F	15 000 F	15 000 F	15 000 F
Untd Arab Em	0	0	0	0	0	0	0	-	-	-
Uzbekistan	2 341	1 564	1 349	1 230	1 330 F	1 431	1 973	2 731	6 051	4 078
Viet Nam	243 583	226 958	208 872	206 600	196 800	202 900	198 200	189 700	188 800	194 200
Total	***5 529 082***	***5 332 697***	***5 461 101***	***5 376 670***	***6 028 661***	***6 482 317***	***6 586 003***	***6 812 669***	***6 964 612***	***7 696 520***

C-05 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Europe - Inland waters
Europe - Eaux continentales
Europa - Aguas continentales

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Freshwater bream	*Abramis brama*	11	26 557	28 069	28 148	39 485	37 252	33 810	35 734
Freshwater breams nei	*Abramis spp*	11	1 779	1 613	1 764	1 773	1 712	1 934	2 029
Common carp	*Cyprinus carpio*	11	13 041	12 590	13 685	14 510	14 094	13 433	14 434
Tench	*Tinca tinca*	11	1 605	1 743	2 021	1 963	1 796	3 016	4 049
Bleak	*Alburnus alburnus*	11	413	529	504	645	371	680	544
Barbel	*Barbus barbus*	11	148	125	202	161	404	300	195
Mediterranean barbel	*Barbus meridionalis*	11	1	1	0	0	0	0	0
...A	*Barbus cyclolepis*	11	-	18	2	0	0	...	0
Common nase	*Chondrostoma nasus*	11	33	53	168	218	182	159	137
Crucian carp	*Carassius carassius*	11	649	708	724	832	983	766	954
Goldfish	*Carassius auratus*	11	2 828	3 688	5 016	5 778	3 653	3 231	2 758
Roach	*Rutilus rutilus*	11	6 373	6 472	6 789	8 846	4 441	4 245	4 130
Roaches nei	*Rutilus spp*	11	11 586	10 682	11 484	12 380	14 061	13 240	16 400
Rudd	*Scardinius erythrophthalmus*	11	91	67	175	73	220	108	438
Orfe(=Ide)	*Leuciscus idus*	11	3 754	4 838	3 102	3 168	3 564	5 032	5 349
Common dace	*Leuciscus leuciscus*	11	-	-	-	-	0	-	-
Chub	*Leuciscus cephalus*	11	39	24	34	42	68	44	26
Chubs nei	*Leuciscus spp*	11	21	16	16	17	14	14	12
Grass carp(=White amur)	*Ctenopharyngodon idellus*	11	554	589	711	729	697	774	704
Silver carp	*Hypophthalmichthys molitrix*	11	1 923	1 979	1 777	2 382	1 511	1 430	1 277
Bighead carp	*Hypophthalmichthys nobilis*	11	442	398	532	267	399	459	291
Vimba bream	*Vimba vimba*	11	111	128	127	211	200	107	92
Sichel	*Pelecus cultratus*	11	611	527	544	522	657	730	1 282
Asp	*Aspius aspius*	11	215	245	488	436	399	503	673
Danube bleak	*Chalcalburnus chalcoides*	11	7	6	8	2	1	1	2
Black carp	*Mylopharyngodon piceus*	11	1	2	0	0	0	0	0
Wuchang bream	*Megalobrama amblycephala*	11	...	2	4	3	3	12	...
White bream	*Blicca bjoerkna*	11	435	383	387	306	310	324	266
Cyprinids nei	*Cyprinidae*	11	25 761	24 010	24 150	30 589	28 530	29 083	41 722
Weatherfish	*Misgurnus fossilis*	11	-	1	2	-	-	-	0
Northern pike	*Esox lucius*	13	18 495	17 806	18 438	19 108	18 046	24 754	19 070
Wels(=Som)catfish	*Silurus glanis*	13	5 443	6 044	7 005	8 012	7 510	12 564	11 853
Channel catfish	*Ictalurus punctatus*	13	18	8	57	0	2	1	1
Burbot	*Lota lota*	13	3 184	3 232	3 070	2 371	2 226	2 955	3 025
European perch	*Perca fluviatilis*	13	17 878	16 170	18 297	19 188	17 213	18 111	21 207
Ruffe	*Gymnocephalus cernuus*	13	4	8	25	158	82	86	67
Pike-perch	*Sander lucioperca*	13	8 320	7 813	9 224	8 998	7 733	7 387	8 221
Freshwater gobies nei	*Gobiidae*	13	53	56	41	60	77	21	22
Freshwater fishes nei	*Osteichthyes*	13	49 585	46 975	46 954	47 968	52 951	41 830	45 622
Danube sturgeon(=Osetr)	*Acipenser gueldenstaedtii*	21	121	140	70	66	37	65	10
Sterlet sturgeon	*Acipenser ruthenus*	21	19	17	45	40	53	42	27
Starry sturgeon	*Acipenser stellatus*	21	31	41	10	12	7	8	1
Beluga	*Huso huso*	21	38	39	14	6	4	4	1
Sturgeons nei	*Acipenseridae*	21	77	47	41	57	95	104	132
European eel	*Anguilla anguilla*	22	2 776	2 808	2 840	2 716	2 679	2 489	2 748
Atlantic salmon	*Salmo salar*	23	1 716	1 713	1 482	1 599	1 803	1 464	1 523
Sea trout	*Salmo trutta*	23	2 911	2 879	2 998	3 038	3 025	3 149	2 992
Trouts nei	*Salmo spp*	23	175	313	483	502	500	1 087	432
Pink(=Humpback)salmon	*Oncorhynchus gorbuscha*	23	23 576	42 680	29 161	43 593	13 758	30 632	17 982
Chum(=Keta=Dog)salmon	*Oncorhynchus keta*	23	11 019	20 250	27 834	28 561	27 347	41 913	46 874
Masu(=Cherry) salmon	*Oncorhynchus masou*	23	7	9	6	9	11	9	10
Sockeye(=Red)salmon	*Oncorhynchus nerka*	23	11 263	15 742	16 338	21 370	19 496	15 403	22 100
Chinook(=Spring=King)salmon	*Oncorhynchus tshawytscha*	23	105	205	264	254	764	288	99
Coho(=Silver)salmon	*Oncorhynchus kisutch*	23	797	442	671	2 303	2 418	2 260	1 183
Rainbow trout	*Oncorhynchus mykiss*	23	722	719	2 130	2 063	2 485	2 476	2 419
Brook trout	*Salvelinus fontinalis*	23	7	12	7	13	14	18	8
Arctic char	*Salvelinus alpinus*	23	76	61	88	52	63	58	57
Huchen	*Hucho hucho*	23	1	1	1	0	1	1	0
Grayling	*Thymallus thymallus*	23	231	229	321	317	323	323	318
European smelt	*Osmerus eperlanus*	23	1 390	1 692	1 313	1 313	1 173	1 219	1 178
Rainbow smelt	*Osmerus mordax*	23	48	485	504	16	78	1 197	242
Smelts nei	*Osmerus spp, Hypomesus spp*	23	3 879	4 644	3 935	4 565	4 109	5 871	4 999
Vendace	*Coregonus albula*	23	4 889	4 797	4 523	4 398	4 625	4 606	4 575
European whitefish	*Coregonus lavaretus*	23	2 177	2 176	2 334	2 262	1 584	1 545	1 532
Houting	*Coregonus oxyrinchus*	23	2	2	1	2	-	-	-
Whitefishes nei	*Coregonus spp*	23	13 310	16 123	14 276	12 836	12 495	15 031	16 092
Salmonoids nei	*Salmonoidei*	23	1 978	1 672	2 221	2 074	1 550	4 009	2 354
Pontic shad	*Alosa pontica*	24	624	854	453	468	1 023	681	850
Shads nei	*Alosa spp*	24	51	44	56	84	77	60	103
Caspian shads	*Caspialosa spp*	24	24	46	85	118	84	41	116
Black and Caspian Sea sprat	*Clupeonella cultriventris*	24	19 828	25 981	20 468	18 424	9 317	8 058	5 216
River lamprey	*Lampetra fluviatilis*	25	127	180	144	181	185	149	115
Lampreys nei	*Petromyzontidae*	25	158	171	114	114	115	110	134
Three-spined stickleback	*Gasterosteus aculeatus*	25	1 471	1 625	1 780	1 786	1 488	1 606	1 293
European flounder	*Platichthys flesus*	31	16	7	8	-	-	-	152
Navaga(=Wachna cod)	*Eleginus navaga*	32	245	43	45	-	62	-	103
Flathead grey mullet	*Mugil cephalus*	33	61	60	55	50	52	62	62
So-iuy mullet	*Mugil soiuy*	33	19	-	6	7	6	7	4
Mullets nei	*Mugilidae*	33	329	447	572	308	307	992	450
Common goby	*Pomatoschistus microps*	33	-	-	-	-	-	-	1
Pacific herring	*Clupea pallasii*	35	-	-	3	-	-	-	-

C-05 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Europe - Inland waters
Europe - Eaux continentales
Europa - Aguas continentales

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Big-scale sand smelt	*Atherina boyeri*	37	614	100	478	150	155	137	136
Danube crayfish	*Astacus leptodactylus*	41	...	...	...	...	...	1	-
Noble crayfish	*Astacus astacus*	41	...	...	80	80	65	80	76
Signal crayfish	*Pacifastacus leniusculus*	41	...	...	259	260	203	334	226
Red swamp crawfish	*Procambarus clarkii*	41	1 500	1 500	1 500	1 500	1 500	1 500	1 500
Euro-American crayfishes nei	*Astacidae, Cambaridae*	41	223	259	134	159	197	190	201
Freshwater crustaceans nei	*Crustacea*	41	3 405	3 192	2 648	3 764	7 259	3 361	3 465
Brine shrimp	*Artemia salina*	47	-	-	-	-	-	-	2
Frogs	*Rana spp*	71	0	-	15	-	-	-	-
Aquatic invertebrates nei	*Invertebrata*	77	40	157	148	112	336	264	171
Total			***314 034***	***352 222***	***348 637***	***392 803***	***344 290***	***374 048***	***386 850***

C-05 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Europe - Inland waters
Europe - Eaux continentales
Europa - Aguas continentales

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Albania	1 373	1 167	1 265 F	1 807	2 210	2 442	2 591	2 144	2 251	3 041
Andorra	0	0	0	0	0	0	0	0	0	0
Austria	362	350	372	400	370	360	350	350	350	350
Belarus	944	1 020	803	583	594	645	689	809	826	897
Belgium	511	511	511	496	496	496	512	511	511	511
Bosnia Herzg	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F
Bulgaria	1 640	1 453	1 824	2 434	2 025	1 916	1 073	1 197	1 588	1 085
Channel Is	0	0	-	-	-	-	-	-	-	-
Croatia	34	25	19	37	33	46	60	45	425	456
Czech Rep	4 646	4 983	5 127	4 528	4 242	4 646	4 276	4 164	4 112	3 990
Denmark	99	77	129	123	60	54	44	40	45	41
Estonia	2 461	4 578	3 593	2 373	2 472	2 941	2 665	2 835	2 899	2 868
Faroe Is	0	0	0	-	-	-	-	-	-	-
Finland	34 786	35 570	35 570	36 268	36 268	36 513	36 513	29 274	29 424	29 312
FYRMacedonia	128	148	162	213	246	89	122	122	141	177
France	2 641	2 600 F	2 600 F	2 600 F	2 600 F	2 600 F	2 600 F	2 600 F	2 500 F	2 500 F
Germany	20 678 F	20 118 F	19 391 F	18 851 F	17 100 F	16 642 F	16 162 F	16 262 F	15 502 F	15 010
Greece	3 181	3 000	3 166	1 940	1 580	1 413	1 439	1 425	940	940 F
Hungary	6 638	6 750	6 536	7 242	7 609	7 543	7 024	7 394	6 366	6 216
Iceland	160	210	225	222	219	173	185	231	235	260
Ireland	902	796	615	610	521	443	178	214	86	116
Isle of Man	0	0	-	-	-	-	-	-	-	-
Italy	5 527	4 242	4 379	5 099	3 823	3 915	3 944	3 552	4 988	3 852
Latvia	581	581	565	360	356	328	310	349	326	330
Liechtensten	0	0	0	0	0	0	0	0	0	0
Lithuania	1 854	758	1 959	1 766	1 547	1 437	1 874	1 600	1 315	1 310
Luxembourg	0	0	0	0	0	0	0	0	0	0
Malta	0	-	-	-	-	-	-	-	-	-
Moldova Rep	387	565	343	487	531	612	1 160	1 407	1 607	1 633
Montenegro	...	...	...	...	...	786	441	841	887	534
Netherlands	2 200 F	2 578	2 150 F	2 100 F	2 100 F	2 100 F	2 000 F	2 000 F	2 000 F	2 051 F
Norway	550 F	500 F	450 F	405	507	679	851	874	662	705
Poland	17 789	18 947	19 994	20 330	19 469	19 183	19 059	18 937	18 798	18 508
Portugal	1	12	1	4	6	2	0	0	0	0
Romania	5 178	4 858	8 278	3 255	4 027	6 049	5 665	4 966	3 688	2 457
Russian Fed	206 430	208 522	190 712	178 403	219 237	209 376	250 248	216 841	246 137	262 983
San Marino	0	0	0	0	0	0	0	0	0	0
Serbia	...	...	...	...	...	2 632	2 535	3 153	3 846	4 807
Serbia-Monte	646	1 119	1 301	1 909	1 988	-	-	-	-	-
Slovakia	1 531	1 746	1 646	1 603	1 693	1 718	1 994	1 655	1 761	1 608
Slovenia	206	226	195	208	202	200	196	183	164	168
Spain	7 300 F	6 600 F	6 000 F	6 000 F	6 000 F	6 000 F	6 000 F	6 000 F	6 000 F	6 000 F
Sweden	1 234	1 436	1 491	1 393	1 417	1 644	1 546	1 614	1 564	1 368
Switzerland	1 715	1 544	1 815	1 602	1 475	1 422	1 377	1 582	1 687	1 653
Ukraine	4 343	3 823	15 144	5 263	6 027	7 171	12 603	4 590	5 855	4 640
UK	3 142	3 431	3 875	1 120	1 172	2 421	2 517	2 529	2 562	2 473
Total	***343 798***	***346 844***	***344 206***	***314 034***	***352 222***	***348 637***	***392 803***	***344 290***	***374 048***	***386 850***

C-06 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Oceania - Inland waters
Océanie - Eaux continentales
Oceanía - Aguas continentales

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Common carp	*Cyprinus carpio*	11	2	4	6	3	5	0	4
Goldfish	*Carassius auratus*	11	-	-	1	1	1	-	1
Mozambique tilapia	*Oreochromis mossambicus*	12	2 310	2 310	2 310	2 310	2 310	2 310	2 310
Nile tilapia	*Oreochromis niloticus*	12	...	...	...	230	60	5	5
Brown bullhead	*Ameiurus nebulosus*	13	13	8	12	5	7	0	4
Gudgeons, sleepers nei	*Eleotridae*	13	1 850	1 850	1 850	1 850	1 850	1 850	1 850
Freshwater fishes nei	*Osteichthyes*	13	7 291	7 510	7 344	8 248	8 485	8 706	7 929
River eels nei	*Anguilla spp*	22	486	500	546	508	439	429	583
Diadromous clupeoids nei	*Clupeoidei*	24	480	480	480	480	480	480	480
Barramundi(=Giant seaperch)	*Lates calcarifer*	25	350	350	350	350	350	350	350
Sea catfishes nei	*Ariidae*	33	1 850	1 850	1 850	1 850	1 850	1 850	1 850
Giant river prawn	*Macrobrachium rosenbergii*	41	1	0	3	3	3	3	3
River prawns nei	*Macrobrachium spp*	41	5	5	5	5	5	5	5
Australian crayfish	*Euastacus armatus*	41	36	1	1	...	...	...	...
Oceanian crayfishes nei	*Parastacidae*	41	1	1	1	1	1	1	1
Freshwater crustaceans nei	*Crustacea*	41	466	500	548	458	340	225	100
Freshwater molluscs nei	*Mollusca*	51	2 527	2 500	2 530	1 500	1 500	1 500	1 500
Total			***17 668***	***17 869***	***17 837***	***17 802***	***17 686***	***17 714***	***16 975***

C-06 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Oceania - Inland waters
Océanie - Eaux continentales
Oceanía - Aguas continentales

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Amer Samoa	0	-	-	-	-	-	-	-	-	-
Australia	185	156	303	317	501	335	1 238	1 275	1 576	844
Cook Is	0	0	0	0	0	0	0	0	0	-
Fiji	5 921	3 800 F	1 263	2 993	3 000 F	3 078	2 188	2 100 F	1 850 F	1 680
Fr Polynesia	53	53	52 F	51 F	50	53	53	53	53	53
Kiribati	0	0	0	-	-	-	-	-	-	-
Marshall Is	0	0	-	-	-	-	-	-	-	-
Micronesia	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F
NewCaledonia	0	0	-	-	-	-	-	-	-	-
New Zealand	1 076	900	850	801	812	865	817	752	729	892
Niue	0	0	-	-	-	-	-	-	-	-
Norfolk Is	0	0	0	0	0	0	0	0	0	0
N Marianas	0	-	-	-	-	-	-	-	-	-
Palau	0	0	0	-	-	-	-	-	-	-
Papua N Guin	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F
Pitcairn Is	0	0	-	-	-	-	-	-	-	-
Samoa	1 F	1 F	1 F	1 F	1 F	1	1 F	1 F	1 F	1 F
Solomon Is	0	0	0	0	0	0	0	-	-	-
Tokelau	0	0	-	-	-	-	-	-	-	-
Tonga	0	0	0	0	0	0	0	-	-	-
Tuvalu	0	0	-	-	-	-	-	-	-	-
Vanuatu	0	0	0	0	0	0	0	-	-	-
Wallis Fut I	0	0	-	-	-	-	-	-	-	-
Total	***20 741***	***18 415***	***15 974***	***17 668***	***17 869***	***17 837***	***17 802***	***17 686***	***17 714***	***16 975***

C-21 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Northwest
Atlantique, nord-ouest
Atlántico, noroeste

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Sturgeons nei	*Acipenseridae*	21	0	1	1	6	0	-	0
American eel	*Anguilla rostrata*	22	606	615	798	724	508	554	585
Atlantic salmon	*Salmo salar*	23	2	2	2	23	2	0	...
Trouts nei	*Salmo spp*	23	0	0	0	0	0	-	-
Arctic char	*Salvelinus alpinus*	23	18	35	50	16	17	19	44
Chars nei	*Salvelinus spp*	23	-	5	-	30	18	15	11
Rainbow smelt	*Osmerus mordax*	23	798	762	927	823	797	954	696
American shad	*Alosa sapidissima*	24	370	256	149	222	70	108	120
Alewife	*Alosa pseudoharengus*	24	4 573	3 377	5 430	4 815	4 519	4 141	3 256
Blueback shad	*Alosa aestivalis*	24	9	-	-	-	-	10	-
Hickory shad	*Alosa mediocris*	24	79	-	-	-	-	44	-
American gizzard shad	*Dorosoma cepedianum*	24	245	...	...	...	...	859	...
Striped bass	*Morone saxatilis*	25	2 776	3 467	2 981	3 228	3 199	3 367	3 307
White perch	*Morone americana*	25	445	...	...	...	...	805	...
Atlantic halibut	*Hippoglossus hippoglossus*	31	2 072	1 866	1 917	2 129	2 224	2 972	2 619
Greenland halibut	*Reinhardtius hippoglossoides*	31	57 914	59 079	62 072	57 481	53 303	53 808	58 155
Witch flounder	*Glyptocephalus cynoglossus*	31	6 182	5 468	3 821	2 977	2 926	2 660	2 691
Amer. plaice(=Long rough dab)	*Hippoglossoides platessoides*	31	6 002	5 276	3 465	3 769	3 935	4 075	4 204
Yellowtail flounder	*Limanda ferruginea*	31	20 803	18 335	2 953	6 998	13 715	7 619	10 841
Winter flounder	*Pseudopleuronectes americanus*	31	6 653	5 157	4 120	4 269	3 937	3 727	3 609
Windowpane flounder	*Scophthalmus aquosus*	31	86	89	103	200	121	81	54
Summer flounder	*Paralichthys dentatus*	31	8 701	8 347	7 000	5 026	4 860	5 648	6 337
Fourspot flounder	*Paralichthys oblongus*	31	...	...	...	7	10	6	8
Flatfishes nei	*Pleuronectiformes*	31	1 707	1 511	1 250	1 212	335	490	476
Blue antimora	*Antimora rostrata*	32	12	10	-	4	2	-	-
Tusk(=Cusk)	*Brosme brosme*	32	1 006	1 003	953	1 134	697	658	517
Atlantic cod	*Gadus morhua*	32	39 505	41 547	44 045	51 205	61 649	42 606	41 428
Greenland cod	*Gadus ogac*	32	891	1 051	1 020	597	595	171	251
Ling	*Molva molva*	32	4	-	1	-	-	-	-
Longfin hake	*Phycis chesteri*	32	-	-	-	-	-	1	-
Red hake	*Urophycis chuss*	32	1 717	1 314	641	855	980	912	934
White hake	*Urophycis tenuis*	32	9 139	7 679	5 990	4 778	4 477	3 873	4 110
Haddock	*Melanogrammus aeglefinus*	32	24 887	28 194	20 283	22 937	27 095	29 249	32 239
Atlantic tomcod	*Microgadus tomcod*	32	7	7	83	1	12	17	13
Saithe(=Pollock)	*Pollachius virens*	32	14 185	14 648	10 968	15 344	15 769	12 977	10 523
Polar cod	*Boreogadus saida*	32	18	45	18	50	6	-	-
Threadfin rockling	*Gaidropsarus ensis*	32	-	-	-	-	19	-	-
Rocklings nei	*Gaidropsarus spp*	32	-	-	-	-	23	-	-
Silver hake	*Merluccius bilinearis*	32	22 384	18 903	17 934	18 421	18 723	18 417	16 217
Offshore silver hake	*Merluccius albidus*	32	23	14	37	12	21	22	10
Roughhead grenadier	*Macrourus berglax*	32	1 162	1 117	526	413	500	424	757
Roundnose grenadier	*Coryphaenoides rupestris*	32	3 249	2 601	1 167	403	686	583	518
Gadiformes nei	*Gadiformes*	32	36	5	5	3	41	81	69
Hagfishes nei	*Myxinidae*	33	1 339	809	383	992	1 954	1 853	925
Ladyfish	*Elops saurus*	33	0	0	0	0	0	-	-
Mullets nei	*Mugilidae*	33	301	401	305	298	323	365	387
Black seabass	*Centropristis striata*	33	1 375	1 291	1 264	993	824	520	763
Groupers, seabasses nei	*Serranidae*	33	3	5	7	3	4	7	3
Pigfish	*Orthopristis chrysoptera*	33	0	0	1	1	0	0	-
Spotted weakfish	*Cynoscion nebulosus*	33	26	38	79	99	86	86	39
Squeteague(=Gray weakfish)	*Cynoscion regalis*	33	535	491	379	340	151	122	99
Atlantic croaker	*Micropogonias undulatus*	33	11 010	10 480	9 315	8 856	8 391	7 015	6 134
Northern kingfish	*Menticirrhus saxatilis*	33	179	129	14	16	20	39	24
Black drum	*Pogonias cromis*	33	49	50	35	54	27	54	56
Spot croaker	*Leiostomus xanthurus*	33	2 299	1 880	1 023	2 113	1 041	2 090	1 489
Red drum	*Sciaenops ocellatus*	33	0	1	3	6	5	6	7
Croakers, drums nei	*Sciaenidae*	33	-	-	-	-	44	-	-
Sheepshead	*Archosargus probatocephalus*	33	32	19	19	31	25	51	59
Red porgy	*Pagrus pagrus*	33	0	2	0	0	0	0	4
Scup	*Stenotomus chrysops*	33	4 309	4 375	4 109	4 212	2 375	3 879	4 659
Tautog	*Tautoga onitis*	33	142	131	159	153	140	105	109
Cunner	*Tautogolabrus adspersus*	33	2	3	2	3	4	3	2
Ocean pout	*Macrozoarces americanus*	33	6	4	5	4	7	3	0
Sandeels(=Sandlances) nei	*Ammodytes spp*	33	2	15	7	6	9	3	2
Spadefishes nei	*Ephippidae*	33	6	11	4	15	6	4	15
Sculpins nei	*Cottidae*	33	0	0	0	2	0	0	0
Northern puffer	*Sphoeroides maculatus*	33	33	12	5	5	17	51	22
Triggerfishes, durgons nei	*Balistidae*	33	4	3	2	5	3	9	5
Toadfishes, etc. nei	*Batrachoididae*	33	1	2	2	4	14	18	13
Argentines	*Argentina spp*	34	1	3	2	0	0	0	2
Baird's slickhead	*Alepocephalus bairdii*	34	-	39	162	-	0	-	1
American conger	*Conger oceanicus*	34	37	31	35	42	35	24	28
Alfonsinos nei	*Beryx spp*	34	-	576	69	-	-	-	53
Mediterranean slimehead	*Hoplostethus mediterraneus*	34	-	2	-	-	-	-	-
Silvery John dory	*Zenopsis conchifer*	34	45	51	23	29	28	22	65
Wreckfish	*Polyprion americanus*	34	-	21	-	-	-	-	-
Grey tilefish	*Caulolatilus microps*	34	3	1	1	9	3	4	4
Great Northern tilefish	*Lopholatilus chamaeleonticeps*	34	1 149	674	954	752	905	1 055	1 089
Black cardinal fish	*Epigonus telescopus*	34	-	-	-	-	-	-	3
Atlantic wolffish	*Anarhichas lupus*	34	3	-	-	-	12	5	-
Spotted wolffish	*Anarhichas minor*	34	0	24	11	1	42	10	10
Wolffishes(=Catfishes) nei	*Anarhichas spp*	34	904	1 063	996	1 130	1 496	1 465	1 454
Eelpouts	*Lycodes spp*	34	1	-	-	-	-	-	-

C-21 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Northwest
Atlantique, nord-ouest
Atlántico, noroeste

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Escolar	*Lepidocybium flavobrunneum*	34	1	10	4	1	9	1	2
Oilfish	*Ruvettus pretiosus*	34	-	2	4	1	1	1	2
Largehead hairtail	*Trichiurus lepturus*	34	0	1	2	2	3	26	9
Black scabbardfish	*Aphanopus carbo*	34	-	8	98	-	-	-	-
Golden redfish	*Sebastes marinus*	34	6	728	4	76	10	20	6
Beaked redfish	*Sebastes mentella*	34	13 269	15 143	8 862	5 223	2 895	1 355	2 723
Atlantic redfishes nei	*Sebastes spp*	34	31 631	37 885	34 139	23 062	21 725	27 591	31 016
Blackbelly rosefish	*Helicolenus dactylopterus*	34	1	0	1	1	0	1	0
Atlantic searobins	*Prionotus spp*	34	37	29	17	32	43	37	51
Lumpfish(=Lumpsucker)	*Cyclopterus lumpus*	34	8 764	9 940	10 275	8 825	6 492	6 930	8 623
American angler	*Lophius americanus*	34	23 548	21 499	16 510	12 689	11 480	9 130	7 686
Atlantic herring	*Clupea harengus*	35	264 993	260 661	254 035	241 123	218 149	256 311	214 902
Atlantic menhaden	*Brevoortia tyrannus*	35	191 401	188 661	183 669	215 175	187 633	182 092	228 609
Atlantic thread herring	*Opisthonema oglinum*	35	-	3	0	0	-	-	-
Atlantic bonito	*Sarda sarda*	36	29	40	19	45	19	35	22
Wahoo	*Acanthocybium solandri*	36	2	2	1	3	2	1	1
King mackerel	*Scomberomorus cavalla*	36	21	47	26	141	30	29	4
Atlantic Spanish mackerel	*Scomberomorus maculatus*	36	124	178	123	133	165	342	356
Frigate and bullet tunas	*Auxis thazard, A. rochei*	36	-	0	0	0	1	1	0
Little tunny(=Atl.black skipj)	*Euthynnus alletteratus*	36	26	22	28	56	65	32	17
Skipjack tuna	*Katsuwonus pelamis*	36	14	2	2	2	1	5	2
Atlantic bluefin tuna	*Thunnus thynnus*	36	1 418	1 295	1 074	848	1 211	970	1 242
Blackfin tuna	*Thunnus atlanticus*	36	1	1	1	2	3	5	2
Albacore	*Thunnus alalunga*	36	568	738	370	188	231	121	120
Yellowfin tuna	*Thunnus albacares*	36	1 037	746	1 103	1 155	568	399	673
Bigeye tuna	*Thunnus obesus*	36	528	744	737	461	408	461	426
Atlantic sailfish	*Istiophorus albicans*	36	-	-	-	-	-	-	1
Blue marlin	*Makaira nigricans*	36	1	2	1	1	-	1	2
Atlantic white marlin	*Tetrapturus albidus*	36	2	5	3	2	2	1	2
Swordfish	*Xiphias gladius*	36	2 320	2 494	2 255	2 434	2 174	2 158	2 171
Tuna-like fishes nei	*Scombroidei*	36	4	7	4	4	1	1	2
Capelin	*Mallotus villosus*	37	33 903	36 730	42 218	37 641	39 316	35 543	26 384
Opah	*Lampris guttatus*	37	0	0	0	0	1	0	0
Dealfish	*Trachipterus arcticus*	37	2	5	0	4	12	3	20
Atlantic silverside	*Menidia menidia*	37	296	269	555	497	460	490	593
Bluefish	*Pomatomus saltatrix*	37	3 418	3 014	3 030	3 181	2 580	2 911	2 955
Cobia	*Rachycentron canadum*	37	6	5	7	7	7	8	6
Rough scad	*Trachurus lathami*	37	-	-	-	25	145	-	-
Blue runner	*Caranx crysos*	37	0	0	0	0	0	0	1
Crevalle jack	*Caranx hippos*	37	0	1	0	0	4	5	1
Florida pompano	*Trachinotus carolinus*	37	1	0	0	0	0	0	0
Greater amberjack	*Seriola dumerili*	37	-	-	-	-	12	-	-
Amberjacks nei	*Seriola spp*	37	1	1	0	1	1	1	0
Common dolphinfish	*Coryphaena hippurus*	37	71	30	44	113	51	180	65
Atlantic mackerel	*Scomber scombrus*	37	107 530	97 493	110 604	78 958	51 436	65 375	48 447
American harvestfish	*Peprilus paru*	37	21	20	18	15	47	78	32
Atlantic butterfish	*Peprilus triacanthus*	37	-	-	-	-	0	-	-
Butterfishes, pomfrets nei	*Stromateidae*	37	521	451	572	708	575	446	588
Bluntnose sixgill shark	*Hexanchus griseus*	38	-	4	-	-	1	-	-
Sand tiger shark	*Carcharias taurus*	38	1	1	1	-	-	15	-
Thresher	*Alopias vulpinus*	38	4	3	12	20	13	9	17
Thresher sharks nei	*Alopias spp*	38	10	6	2	2	1	3	4
Shortfin mako	*Isurus oxyrinchus*	38	113	319	292	156	577	103	642
Longfin mako	*Isurus paucus*	38	1	2	2	1	2	16	0
Mako sharks	*Isurus spp*	38	33	31	42	33	36	10	0
Porbeagle	*Lamna nasus*	38	236	205	194	96	129	65	85
Great white shark	*Carcharodon carcharias*	38	0	0	0	-	0	-	-
Blue shark	*Prionace glauca*	38	965	2 284	2 375	914	2 284	71	7 604
Sandbar shark	*Carcharhinus plumbeus*	38	34	58	102	142	31	0	0
Blacktip shark	*Carcharhinus limbatus*	38	33	11	37	11	31	1	16
Dusky shark	*Carcharhinus obscurus*	38	0	0	0	0	-	0	-
Silky shark	*Carcharhinus falciformis*	38	0	0	0	2	-	0	-
Bull shark	*Carcharhinus leucas*	38	0	0	-	1	-	-	1
Finetooth shark	*Carcharhinus isodon*	38	-	-	-	-	-	-	24
Tiger shark	*Galeocerdo cuvier*	38	-	0	1	0	-	0	-
Lemon shark	*Negaprion brevirostris*	38	1	-	-	0	-	-	-
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*	38	-	0	0	33	89	-	4
Smooth hammerhead	*Sphyrna zygaena*	38	0	0	0	-	0	2	4
Dusky smooth-hound	*Mustelus canis*	38	517	257	239	328	324	651	933
Greenland shark	*Somniosus microcephalus*	38	1	1	8	0	3	6	6
Picked dogfish	*Squalus acanthias*	38	3 171	3 400	4 805	5 265	5 584	4 928	5 087
Portuguese dogfish	*Centroscymnus coelolepis*	38	-	0	11	-	-	-	-
Black dogfish	*Centroscyllium fabricii*	38	-	-	-	6	-	-	-
Dogfish sharks nei	*Squalidae*	38	524	305	154	292	324	907	518
Little skate	*Raja erinacea*	38	...	...	...	...	4 131	3 947	4 207
Raja rays nei	*Raja spp*	38	27 974	19 146	23 219	27 455	23 269	20 989	19 659
Cownose ray	*Rhinoptera bonasus*	38	-	-	-	-	176	102	63
Rabbit fish	*Chimaera monstrosa*	38	-	-	-	-	1	-	-
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	438	1 031	950	374	780	378	376
Groundfishes nei	*Osteichthyes*	39	2 367	2 472	1 592	1 552	2 754	5 064	5 101
Pelagic fishes nei	*Osteichthyes*	39	24	28	152	200	96	169	81
Finfishes nei	*Osteichthyes*	39	2 624	2 437	2 405	1 995	1 732	1 637	1 449
Marine fishes nei	*Osteichthyes*	39	3	14	14	8	10	177	97
Atlantic rock crab	*Cancer irroratus*	42	8 820	9 709	10 832	11 246	10 256	8 933	7 816

C-21 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Northwest
Atlantique, nord-ouest
Atlántico, noroeste

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Jonah crab	*Cancer borealis*	42	2 017	3 257	3 037	4 289	3 918	3 980	4 935
Blue crab	*Callinectes sapidus*	42	42 755	40 618	37 398	30 746	43 131	39 078	59 887
Green crab	*Carcinus maenas*	42	6	6	17	97	75	75	69
Queen crab	*Chionoecetes opilio*	42	109 352	100 244	92 983	93 014	96 174	100 468	87 760
Red crab	*Chaceon quinquedens*	42	1 793	1 667	1 562	1 284	1 414	1 013	1 416
Marine crabs nei	*Brachyura*	42	5 299	2 938	2 232	2 076	1 280	950	1 126
American lobster	*Homarus americanus*	43	81 618	83 750	97 026	82 991	96 104	102 296	115 651
Northern brown shrimp	*Penaeus aztecus*	45	289	141	247	598	1 167	730	860
Northern pink shrimp	*Penaeus duorarum*	45	2	0	0	0	40	28	1
Northern white shrimp	*Penaeus setiferus*	45	121	0	363	1 083	281	183	123
Northern prawn	*Pandalus borealis*	45	356 174	342 591	345 388	351 148	336 997	286 508	308 179
Aesop shrimp	*Pandalus montagui*	45	605	509	1 421	1 959	89	53	-
Pandalus shrimps nei	*Pandalus spp*	45	2 381	2 320	2 766	4 673	1 528	1 400	2 264
Royal red shrimp	*Pleoticus robustus*	45	4	6	2	2	2	5	6
Stomatopods nei	*Stomatopoda*	47	0	0	1	1	8	0	0
Periwinkles nei	*Littorina spp*	52	152	243	210	246	488	757	767
Whelks	*Busycon spp*	52	4 692	6 179	8 800	8 132	10 218	10 447	13 245
American cupped oyster	*Crassostrea virginica*	53	13 133	13 651	12 795	14 424	12 803	11 912	12 695
Cupped oysters nei	*Crassostrea spp*	53	1	0	1	8	42	3	1
Blue mussel	*Mytilus edulis*	54	10 572	9 836	8 547	7 646	8 678	12 841	15 014
American sea scallop	*Placopecten magellanicus*	55	325 088	268 126	284 617	285 803	269 756	280 721	274 970
Atlantic bay scallop	*Argopecten irradians*	55	62	367	349	696	488	954	485
Iceland scallop	*Chlamys islandica*	55	3 388	4 690	3 651	1 723	797	776	905
Blood ark	*Anadara ovalis*	56	13	3	6	4	47	51	85
Ocean quahog	*Arctica islandica*	56	152 030	113 829	119 307	129 783	128 554	130 634	132 233
Northern quahog(=Hard clam)	*Mercenaria mercenaria*	56	3 189	1 307	980	4 256	722	839	818
Atlantic surf clam	*Spisula solidissima*	56	150 379	143 949	145 770	152 101	139 095	123 124	99 330
Stimpson's surf clam	*Spisula polynyma*	56	24 038	19 286	21 922	18 823	20 014	25 594	23 765
Atl.jackknife(=Atl.razor clam)	*Ensis directus*	56	56	173	254	133	93	105	91
Sand gaper	*Mya arenaria*	56	9 761	9 081	9 361	9 023	8 082	8 743	8 344
Clams, etc. nei	*Bivalvia*	56	1 982	2 326	1 409	1 837	613	530	44
Longfin squid	*Loligo pealeii*	57	13 537	16 967	15 899	12 327	11 400	9 293	6 689
Common squids nei	*Loligo spp*	57	1	-	2	1	-	-	-
Northern shortfin squid	*Illex illecebrosus*	57	27 977	12 255	20 835	9 267	16 434	19 142	15 942
Various squids nei	*Loliginidae, Ommastrephidae*	57	282	75	25	15	12	20	35
Octopuses, etc. nei	*Octopodidae*	57	0	-	-	0	0	0	-
Marine molluscs nei	*Mollusca*	58	4 716	16 735	10 368	1 214	135	1 588	896
Horseshoe crab	*Limulus polyphemus*	75	518	749	706	917	779	1 027	602
Starfishes nei	*Asteroidea*	76	0	0	-	-	2	0	-
Sea urchins nei	*Strongylocentrotus spp*	76	4 923	3 800	3 558	2 802	3 510	3 296	3 215
Sea cucumbers nei	*Holothuroidea*	76	4 539	3 886	6 470	4 431	3 817	5 818	5 895
Marine worms	*Polychaeta*	77	450	406	344	425	367	352	364
Total			***2 353 367***	***2 201 025***	***2 198 570***	***2 153 251***	***2 063 538***	***2 047 435***	***2 052 389***

C-21 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Atlantic, Northwest
Atlantique, nord-ouest
Atlántico, noroeste

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Canada	819 450	829 143	853 027	876 076	825 065	832 141	817 482	763 966	758 688	749 468
China,Taiwan	618	570	161	387	359	125	7	10	11	-
Denmark	93	359	1 006	2 754	3 696	3 632	3 520	3 803	5 072	5 130
Estonia	12 402	15 022	15 999	16 261	14 690	8 406	13 329	13 086	5 978	4 328
Faroe Is	12 722	8 262	14 386	6 943	5 993	3 729	4 489	4 379	4 934	5 019
Germany	1 359	2 861	3 550	1 587	1 592	1 541	1 521	3 972	1 879	1 821
Greenland	124 149	151 533	130 366	183 660	194 620	206 296	196 170	203 246	178 608	175 919
Iceland	5 079	6 877	7 226	7 588	6 814	4 054	...	...	...	185
Japan	5 630	7 573	5 985	4 253	4 356	3 515	3 317	3 002	526	592
Korea Rep	-	-	-	-	11	-	-	44	-	-
Latvia	3 330	2 742	4 575	3 979	2 806	2 184	2 435	1 790	1 670	994
Lithuania	7 596	10 948	11 671	8 644	5 484	2 831	3 492	1 293	-	1 542
Norway	14 394	14 435	24 792	13 133	2 450	2 377	3 479	2 767	3 045	2 778
Poland	760	428	921	2 199	1 286	1 093	436	-	-	-
Portugal	15 003	18 526	22 780	13 452	12 985	13 911	12 123	12 436	15 459	15 622
Russian Fed	32 138	34 686	34 364	22 254	17 823	10 312	9 053	7 151	5 245	6 710
St Pier Mq	4 206	3 889	3 894	4 399	4 694	2 876	5 204	4 621	1 761	2 043
Spain	40 235	34 092	35 140	19 395	21 290	20 640	13 802	17 880	14 744	25 897
Ukraine	405	-	389	582	-	404	-	-	-	-
UK	-	-	547	-	-	-	-	303	617	3 605
USA	1 129 820	1 091 699	1 122 681	1 165 821	1 075 011	1 078 503	1 063 392	1 019 789	1 049 198	1 050 736
Total	***2 229 389***	***2 233 645***	***2 293 460***	***2 353 367***	***2 201 025***	***2 198 570***	***2 153 251***	***2 063 538***	***2 047 435***	***2 052 389***

C-27 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Northeast
Atlantique, nord-est
Atlántico, nordeste

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Freshwater bream	*Abramis brama*	11	1 693	1 322	1 240	1 271	1 386	1 691	1 864
Freshwater breams nei	*Abramis spp*	11	1 412	1 420	1 643	1 624	1 617	1 705	1 628
Common carp	*Cyprinus carpio*	11	2	-	0	-	1	0	1
Tench	*Tinca tinca*	11	5	5	10	9	13	14	11
Crucian carp	*Carassius carassius*	11	28	45	24	38	30	43	36
Roach	*Rutilus rutilus*	11	3 467	3 334	3 409	3 571	2 935	2 957	2 723
Orfe(=Ide)	*Leuciscus idus*	11	164	152	220	220	268	263	262
Vimba bream	*Vimba vimba*	11	122	129	84	99	97	93	91
Sichel	*Pelecus cultratus*	11	463	393	254	380	372	417	312
Asp	*Aspius aspius*	11	20	17	27	26	4	31	3
White bream	*Blicca bjoerkna*	11	-	-	-	0	1	1	23
Cyprinids nei	*Cyprinidae*	11	34	80	132	91	121	162	45
Northern pike	*Esox lucius*	13	2 102	2 049	3 125	3 077	1 915	1 902	1 919
Wels(=Som)catfish	*Silurus glanis*	13	0	0	1	1	1	2	3
Burbot	*Lota lota*	13	211	185	257	247	121	134	138
European perch	*Perca fluviatilis*	13	5 213	5 460	6 737	6 563	5 286	5 146	5 713
Ruffe	*Gymnocephalus cernuus*	13	2	1	2	2	1	1	33
Pike-perch	*Sander lucioperca*	13	2 093	1 698	2 017	2 117	1 730	1 768	1 722
Freshwater fishes nei	*Osteichthyes*	13	278	201	588	253	244	269	209
Sturgeons nei	*Acipenseridae*	21	-	-	-	-	0	24	36
European eel	*Anguilla anguilla*	22	1 670	1 708	1 909	1 660	1 553	1 220	1 168
Atlantic salmon	*Salmo salar*	23	2 364	2 012	1 603	1 392	1 197	909	840
Sea trout	*Salmo trutta*	23	962	797	880	837	462	688	659
Trouts nei	*Salmo spp*	23	63	74	83	66	59	55	52
Pink(=Humpback)salmon	*Oncorhynchus gorbuscha*	23	-	136	3	171	-	137	-
Rainbow trout	*Oncorhynchus mykiss*	23	4	3	0	0	0	1	0
European smelt	*Osmerus eperlanus*	23	1 440	1 213	1 630	2 201	3 243	3 743	2 854
Rainbow smelt	*Osmerus mordax*	23	2	4	-	15	4	16	7
Vendace	*Coregonus albula*	23	1 977	1 829	1 376	1 057	750	1 109	1 187
European whitefish	*Coregonus lavaretus*	23	1 620	1 535	1 860	1 723	1 545	1 626	1 511
Whitefishes nei	*Coregonus spp*	23	5	6	6	14	13	10	17
Salmonoids nei	*Salmonoidei*	23	6	9	12	13	12	9	7
Allis shad	*Alosa alosa*	24	56	44	28	46	52	59	20
Twaite shad	*Alosa fallax*	24	13	33	3	50	46	4	4
Alewife	*Alosa pseudoharengus*	24	-	0	-	-	-	-	-
Shads nei	*Alosa spp*	24	42	61	31	163	161	159	308
Sea lamprey	*Petromyzon marinus*	25	43	52	56	42	41	270	65
Lampreys nei	*Petromyzontidae*	25	3	10	24	30	32	35	32
Three-spined stickleback	*Gasterosteus aculeatus*	25	550	463	448	395	406	396	368
Lefteye flounders nei	*Bothidae*	31	658	556	578	204	213	270	219
Atlantic halibut	*Hippoglossus hippoglossus*	31	2 545	2 623	2 731	2 950	3 073	2 783	2 955
European plaice	*Pleuronectes platessa*	31	87 979	76 625	83 200	75 858	74 178	78 515	91 482
Greenland halibut	*Reinhardtius hippoglossoides*	31	53 008	44 888	39 615	37 038	36 001	41 588	41 170
Witch flounder	*Glyptocephalus cynoglossus*	31	9 915	9 506	8 004	8 638	9 800	10 154	10 204
Amer. plaice(=Long rough dab)	*Hippoglossoides platessoides*	31	4 383	3 598	3 895	2 391	1 597	1 534	1 192
Common dab	*Limanda limanda*	31	15 726	15 334	13 789	13 868	12 003	10 698	11 165
Lemon sole	*Microstomus kitt*	31	11 992	12 239	12 348	12 709	11 822	12 623	11 065
European flounder	*Platichthys flesus*	31	22 640	24 137	22 152	22 797	19 448	18 618	19 031
Righteye flounders nei	*Pleuronectidae*	31	144	134	23	19	13	15	12
Common sole	*Solea solea*	31	31 263	29 205	25 413	27 229	24 929	27 291	25 227
Sand sole	*Solea lascaris*	31	333	379	347	464	285	409	404
Wedge sole	*Dicologlossa cuneata*	31	1 056	844	985	856	694	903	1 114
Thickback soles nei	*Microchirus spp*	31	571	526	419	275	208	377	357
Soles nei	*Soleidae*	31	537	460	263	159	130	137	157
Megrim	*Lepidorhombus whiffiagonis*	31	9 471	9 158	9 037	9 378	8 969	10 756	11 944
Four-spot megrim	*Lepidorhombus boscii*	31	8	14	54	40	43	47	23
Megrims nei	*Lepidorhombus spp*	31	8 831	7 911	6 905	5 083	6 530	6 099	5 234
Brill	*Scophthalmus rhombus*	31	2 766	2 576	2 591	2 733	2 271	2 492	2 959
Turbot	*Psetta maxima*	31	5 446	5 194	4 815	5 427	4 672	4 961	4 736
Flatfishes nei	*Pleuronectiformes*	31	1 233	2 039	1 060	904	670	484	457
Common mora	*Mora moro*	32	147	135	236	194	129	157	145
Moras nei	*Moridae*	32	6	35	46	15	21	11	14
Tusk(=Cusk)	*Brosme brosme*	32	19 042	19 725	24 479	25 809	28 296	25 752	30 373
Atlantic cod	*Gadus morhua*	32	865 217	808 230	790 367	732 348	707 277	822 771	909 005
Greenland cod	*Gadus ogac*	32	-	-	-	1	-	-	-
Ling	*Molva molva*	32	35 382	34 306	37 969	37 443	40 594	40 539	33 857
Blue ling	*Molva dypterygia*	32	7 787	11 735	8 086	8 186	9 769	9 420	12 737
Spanish ling	*Molva macrophthalma*	32	-	-	-	-	-	104	2
Lings nei	*Molva spp*	32	28	9	4	0	-	-	-
Greater forkbeard	*Phycis blennoides*	32	2 400	2 763	2 459	2 296	2 283	2 133	2 220
Forkbeard	*Phycis phycis*	32	380	469	572	1 928	2 306	2 290	4 969
Forkbeards nei	*Phycis spp*	32	475	363	401	211	228	225	122
White hake	*Urophycis tenuis*	32	23	11	15	26	26	35	155
Haddock	*Melanogrammus aeglefinus*	32	300 632	283 553	298 724	316 287	305 001	336 508	364 080
Navaga(=Wachna cod)	*Eleginus navaga*	32	768	397	464	437	405	296	256
Saithe(=Pollock)	*Pollachius virens*	32	389 123	444 125	484 648	429 165	440 172	397 239	390 397
Pollack	*Pollachius pollachius*	32	10 324	10 452	10 677	11 528	10 190	9 269	9 198
Polar cod	*Boreogadus saida*	32	1 637	22 447	16 367	26 870	8 221	17 167	27 428
Silvery pout	*Gadiculus argenteus*	32	-	-	625	4 153	1 055	1 927	567
Rocklings nei	*Gaidropsarus spp*	32	77	19	35	23	18	187	159
Norway pout	*Trisopterus esmarkii*	32	22 513	354	54 348	4 809	39 223	57 260	137 079
Poor cod	*Trisopterus minutus*	32	11	26	28	23	13	16	23
Pouting(=Bib)	*Trisopterus luscus*	32	12 670	12 457	12 814	11 662	11 009	13 000	12 631

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Capture production by species items
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Capturas por categorías de especies

Atlantic, Northeast
Atlantique, nord-est
Atlántico, nordeste

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Blue whiting(=Poutassou)	*Micromesistius poutassou*	32	2 419 291	2 059 628	2 023 766	1 672 691	1 277 112	635 160	546 025
Whiting	*Merlangius merlangus*	32	31 709	33 227	36 942	35 810	29 427	31 652	31 425
Fourbeard rockling	*Enchelyopus cimbrius*	32	4	4	-	0	-	-	-
European hake	*Merluccius merluccius*	32	41 069	46 138	43 365	36 556	45 797	55 407	58 956
Roughhead grenadier	*Macrourus berglax*	32	453	827	286	155	368	1 486	898
Roundnose grenadier	*Coryphaenoides rupestris*	32	22 013	29 494	12 516	9 694	7 122	4 001	7 093
Roughsnout grenadier	*Trachyrincus scabrus*	32	-	272	573	543	99	-	-
Common Atlantic grenadier	*Nezumia aequalis*	32	39	8	-	-	-	-	-
Gadiformes nei	*Gadiformes*	32	1 305	3 004	823	2 410	7 465	18 121	7 648
Long snouted lancetfish	*Alepisaurus ferox*	33	-	-	-	-	-	5	-
Morays	*Muraenidae*	33	205	142	163	197	179	136	150
Thicklip grey mullet	*Chelon labrosus*	33	...	...	...	...	...	344	526
Mullets nei	*Mugilidae*	33	1 672	1 893	2 034	2 132	1 674	2 089	1 754
Dusky grouper	*Epinephelus marginatus*	33	32	39	64	127	77	36	61
White grouper	*Epinephelus aeneus*	33	0	1	3	15	3	1	1
Groupers nei	*Epinephelus spp*	33	79	71	45	28	41	25	1
Comber	*Serranus cabrilla*	33	224	292	36	1 149	323	280	369
Groupers, seabasses nei	*Serranidae*	33	159	154	762	175	196	204	182
Spotted seabass	*Dicentrarchus punctatus*	33	106	74	77	101	45	116	115
European seabass	*Dicentrarchus labrax*	33	6 058	6 941	7 634	7 415	5 321	7 472	8 262
Seabasses nei	*Dicentrarchus spp*	33	328	318	209	111	83	46	35
Cardinalfishes, etc. nei	*Apogonidae*	33	699	627	315	212	-	-	-
Rubberlip grunt	*Plectorhinchus mediterraneus*	33	16	15	5	26	170	4	202
Grunts, sweetlips nei	*Haemulidae(=Pomadasyidae)*	33	177	177	181	193	46	189	45
Canary drum(=Baardman)	*Umbrina canariensis*	33	10	13	13	18	7	27	26
Meagre	*Argyrosomus regius*	33	571	1 435	1 510	1 347	1 014	1 230	955
Croakers, drums nei	*Sciaenidae*	33	356	391	438	454	493	520	595
Blackspot(=red) seabream	*Pagellus bogaraveo*	33	1 550	2 130	1 501	1 686	1 590	1 448	1 172
Common pandora	*Pagellus erythrinus*	33	92	117	138	161	130	100	114
Axillary seabream	*Pagellus acarne*	33	864	731	1 070	1 188	794	1 024	1 074
Annular seabream	*Diplodus annularis*	33	35	49	47	23	56	45	31
White seabream	*Diplodus sargus*	33	452	554	766	1 014	922	1 156	1 278
Common two-banded seabream	*Diplodus vulgaris*	33	530	440	450	435	417	490	457
Sargo breams nei	*Diplodus spp*	33	366	346	529	324	264	266	248
Large-eye dentex	*Dentex macrophthalmus*	33	1	1	2	1	-	-	-
Common dentex	*Dentex dentex*	33	5	5	4	6	7	6	9
Dentex nei	*Dentex spp*	33	114	86	69	111	109	118	178
Black seabream	*Spondyliosoma cantharus*	33	3 981	3 762	4 349	5 678	3 403	5 539	5 232
Saddled seabream	*Oblada melanura*	33	72	93	518	193	195	190	243
Red porgy	*Pagrus pagrus*	33	362	239	283	303	299	270	296
Gilthead seabream	*Sparus aurata*	33	613	496	723	672	534	871	1 137
Bogue	*Boops boops*	33	922	804	1 499	1 211	1 360	1 507	2 690
Sand steenbras	*Lithognathus mormyrus*	33	251	300	548	405	292	379	227
Salema	*Sarpa salpa*	33	289	345	496	597	518	603	1 242
Porgies, seabreams nei	*Sparidae*	33	621	937	888	1 128	1 010	887	877
Picarels nei	*Spicara spp*	33	38	68	69	52	52	81	78
Surmullet	*Mullus surmuletus*	33	7 501	5 146	4 273	7 551	6 792	4 102	4 617
Surmullets(=Red mullets) nei	*Mullus spp*	33	547	639	1 626	851	722	774	811
Ballan wrasse	*Labrus bergylta*	33	13	14	26	25	27	121	166
Rock cook	*Centrolabrus exoletus*	33	...	...	...	...	50	59	69
Mediterranean rainbow wrasse	*Coris julis*	33	0	1	1	6	5	5	3
Goldsinny-wrasse	*Ctenolabrus rupestris*	33	3	2	3	2	2	8	159
Corkwing wrasse	*Symphodus melops*	33	1	1	-	-	1	6	163
Wrasses, hogfishes, etc. nei	*Labridae*	33	454	547	589	632	530	692	660
Parrotfish	*Sparisoma cretense*	33	164	161	208	249	284	297	209
Eelpout	*Zoarces viviparus*	33	49	88	58	45	36	59	44
Sandeels(=Sandlances) nei	*Ammodytes spp*	33	389 833	183 926	300 173	233 220	363 061	367 579	422 423
Greater weever	*Trachinus draco*	33	343	449	2 052	983	796	1 427	515
Gobies nei	*Gobiidae*	33	9	20	10	6	3	1	2
Grey triggerfish	*Balistes carolinensis*	33	61	46	58	154	145	218	389
Toadfishes, etc. nei	*Batrachoididae*	33	52	257	69	55	56	53	56
Greater argentine	*Argentina silus*	34	10 662	3 637	2 883	6 247	4 012	894	3 568
Argentine	*Argentina sphyraena*	34	...	2 232	6 150	5 166	1 733	1 567	919
Argentines	*Argentina spp*	34	22 207	24 983	38 744	31 187	36 855	43 649	46 868
Baird's slickhead	*Alepocephalus bairdii*	34	7 492	959	872	215	1 879	1 516	1 567
Silvery lightfish	*Maurolicus muelleri*	34	-	-	-	-	1 482	422	17 894
Duckbill barracudina	*Magnisudis atlantica*	34	-	-	-	-	-	-	4
Lanternfishes nei	*Myctophidae*	34	175	190	1	24	25	34	-
European conger	*Conger conger*	34	11 613	10 092	11 740	12 597	11 635	12 577	14 002
Longspine snipefish	*Macroramphosus scolopax*	34	-	-	0	1	-	-	11
Alfonsino	*Beryx decadactylus*	34	141	548	230	283	156	186	198
Splendid alfonsino	*Beryx splendens*	34	368	524	419	350	246	262	284
Alfonsinos nei	*Beryx spp*	34	610	210	133	169	105	86	95
Mediterranean slimehead	*Hoplostethus mediterraneus*	34	-	-	1	-	-	-	14
Orange roughy	*Hoplostethus atlanticus*	34	1 240	768	671	409	287	130	88
Slimeheads nei	*Trachichthyidae*	34	46	5	78	13	2	3	18
John dory	*Zeus faber*	34	3 996	4 045	3 799	4 000	4 606	4 739	5 142
Silvery John dory	*Zenopsis conchifer*	34	21	18	28	35	35	44	51
Boarfish	*Capros aper*	34	674	242	2 772	18 387	24 703	83 709	137 676
Wreckfish	*Polyprion americanus*	34	358	559	1 005	1 832	1 235	1 067	971
Red bandfish	*Cepola macrophthalma*	34	7	8	12	19	20	56	43
Black cardinal fish	*Epigonus telescopus*	34	218	112	129	63	36	64	53
Atlantic wolffish	*Anarhichas lupus*	34	14 740	16 531	17 901	17 727	15 900	17 452	15 044
Northern wolffish	*Anarhichas denticulatus*	34	3 533	2 382	1 417	880	901	8 034	6 626
Spotted wolffish	*Anarhichas minor*	34	5 497	5 101	5 963	5 053	4 482	10 955	9 252
Wolffishes(=Catfishes) nei	*Anarhichas spp*	34	14 787	15 267	12 463	10 229	8 928	2 019	1 129

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Stargazer	*Uranoscopus scaber*	34	127	33	36	89	31	56	35
Escolar	*Lepidocybium flavobrunneum*	34	35	19	14	28	21	40	58
Oilfish	*Ruvettus pretiosus*	34	69	130	190	360	228	198	212
Snake mackerels, escolars nei	*Gempylidae*	34	22	4	15	14	7	6	24
Largehead hairtail	*Trichiurus lepturus*	34	0	-	2	1	14	9	1
Silver scabbardfish	*Lepidopus caudatus*	34	806	484	965	910	1 016	958	1 093
Black scabbardfish	*Aphanopus carbo*	34	8 092	9 280	6 169	6 972	7 137	8 002	6 892
Hairtails, scabbardfishes nei	*Trichiuridae*	34	86	70	133	188	171	115	81
Imperial blackfish	*Schedophilus ovalis*	34	2	2	2	3	3	9	2
Ruffs, barrelfishes nei	*Centrolophidae*	34	6	1	2	1	136	-	8
Golden redfish	*Sebastes marinus*	34	44 962	52 332	57 523	51 023	57 415	50 807	56 913
Norway redfish	*Sebastes viviparus*	34	2	...	13	7	...	...	2 601
Beaked redfish	*Sebastes mentella*	34	83 980	48 188	60 864	51 178	47 748	53 727	68 776
Atlantic redfishes nei	*Sebastes spp*	34	42 955	34 784	48 089	38 254	18 208	31 840	15 600
Red scorpionfish	*Scorpaena scrofa*	34	47	38	30	36	39	41	33
Blackbelly rosefish	*Helicolenus dactylopterus*	34	1 339	1 162	1 572	3 224	2 129	2 443	3 961
Offshore rockfish	*Pontinus kuhlii*	34	81	52	43	59	57	56	78
Spiny scorpionfish	*Trachyscorpia echinata*	34	42	31	57	20	8	8	1
Scorpionfishes nei	*Scorpaenidae*	34	516	557	559	452	430	482	554
Tub gurnard	*Chelidonichthys lucerna*	34	3 112	3 375	3 602	4 230	3 140	3 142	1 452
Streaked gurnard	*Chelidonichthys lastoviza*	34	66	82	74	72	4	89	88
Red gurnard	*Aspitrigla cuculus*	34	5 247	5 586	5 174	5 186	4 775	4 116	4 404
Grey gurnard	*Eutrigla gurnardus*	34	1 987	2 970	528	394	309	443	635
Gurnards, searobins nei	*Triglidae*	34	2 831	2 578	2 652	2 129	2 260	2 393	2 607
Lumpfish(=Lumpsucker)	*Cyclopterus lumpus*	34	10 833	7 165	6 712	5 921	4 995	8 630	11 393
Angler(=Monk)	*Lophius piscatorius*	34	26 568	28 837	32 997	33 252	30 516	31 808	32 446
Blackbellied angler	*Lophius budegassa*	34	10	16	3	15	43	25	20
Monkfishes nei	*Lophius spp*	34	28 521	26 336	25 378	27 890	25 488	23 111	22 692
Atlantic herring	*Clupea harengus*	35	1 755 498	2 054 770	1 970 964	2 128 350	2 261 053	2 253 632	1 986 432
Sardinellas nei	*Sardinella spp*	35	3	0	2	1	-	-	0
European pilchard(=Sardine)	*Sardina pilchardus*	35	139 521	145 985	140 835	149 935	134 568	130 752	125 997
European sprat	*Sprattus sprattus*	35	634 405	732 620	550 108	534 914	488 992	575 389	538 123
European anchovy	*Engraulis encrasicolus*	35	28 944	6 109	6 023	6 842	3 105	3 548	15 366
Clupeoids nei	*Clupeoidei*	35	549	8	538	613	879	966	852
Atlantic bonito	*Sarda sarda*	36	81	71	358	398	249	149	719
Plain bonito	*Orcynopsis unicolor*	36	9	5	3	1	2	4	3
Frigate and bullet tunas	*Auxis thazard, A. rochei*	36	712	832	863	843	1 017	1 506	1 584
Little tunny(=Atl.black skipj)	*Euthynnus alletteratus*	36	16	37	40	41	48	133	40
Skipjack tuna	*Katsuwonus pelamis*	36	4 337	2 025	8 778	8 404	5 150	944	11 591
Atlantic bluefin tuna	*Thunnus thynnus*	36	5 707	6 261	4 375	5 280	5 145	4 746	3 001
Albacore	*Thunnus alalunga*	36	17 904	28 186	31 580	18 313	17 139	12 813	14 849
Yellowfin tuna	*Thunnus albacares*	36	21	939	246	722	372	868	351
Bigeye tuna	*Thunnus obesus*	36	1 314	6 790	1 290	1 772	1 552	2 860	2 798
Atlantic sailfish	*Istiophorus albicans*	36	15	31	40	20	20	26	47
Blue marlin	*Makaira nigricans*	36	33	8	8	26	15	11	13
Black marlin	*Makaira indica*	36	-	-	-	-	-	-	1
Atlantic white marlin	*Tetrapturus albidus*	36	9	11	2	1	1	1	0
Longbill spearfish	*Tetrapturus pfluegeri*	36	-	0	-	1	1	-	1
Roundscale spearfish	*Tetrapturus georgii*	36	-	-	-	-	1	-	1
Marlins,sailfishes,etc. nei	*Istiophoridae*	36	127	23	2	3	1	9	1
Swordfish	*Xiphias gladius*	36	3 820	2 593	4 031	2 245	2 036	2 460	2 365
Tuna-like fishes nei	*Scombroidei*	36	712	581	280	57	18	26	22
Capelin	*Mallotus villosus*	37	627 877	713 204	224 764	382 211	213 799	327 246	477 679
Garfish	*Belone belone*	37	1 149	1 028	919	725	515	748	701
Atlantic saury	*Scomberesox saurus*	37	352	1 280	682	2 262	281	344	159
Opah	*Lampris guttatus*	37	-	-	1	0	-	-	1
Mediterranean dealfish	*Trachipterus trachipterus*	37	-	-	-	-	-	83	-
Dealfish	*Trachipterus arcticus*	37	-	-	-	-	798	1 940	145
Silversides(=Sand smelts) nei	*Atherinidae*	37	289	303	592	325	350	278	282
Bluefish	*Pomatomus saltatrix*	37	130	132	209	163	131	85	51
Atlantic horse mackerel	*Trachurus trachurus*	37	195 316	203 985	198 237	194 508	173 548	234 417	199 539
Blue jack mackerel	*Trachurus picturatus*	37	4 076	2 303	4 177	5 502	5 692	5 698	4 707
Mediterranean horse mackerel	*Trachurus mediterraneus*	37	1 864	1 306	512	536	86	471	225
Jack and horse mackerels nei	*Trachurus spp*	37	35 871	30 193	32 132	30 471	34 260	34 984	32 497
Greater amberjack	*Seriola dumerili*	37	39	57	78	102	71	68	44
Leerfish	*Lichia amia*	37	2	3	3	1	0	1	1
Carangids nei	*Carangidae*	37	44	74	82	79	51	69	269
Atlantic pomfret	*Brama brama*	37	673	3 703	7 586	4 840	4 506	5 709	9 299
Common dolphinfish	*Coryphaena hippurus*	37	7	5	7	9	8	4	21
Chub mackerel	*Scomber japonicus*	37	15 727	15 902	20 154	27 692	23 999	14 787	24 698
Atlantic mackerel	*Scomber scombrus*	37	587 074	447 608	420 877	474 600	547 506	631 822	831 892
Mackerels nei	*Scombridae*	37	8 239	36 832	61 696	58 212	64 434	11 570	2 286
Butterfishes, pomfrets nei	*Stromateidae*	37	114	47	62	115	109	72	11
Barracudas nei	*Sphyraena spp*	37	41	43	43	42	50	67	76
Ocean sunfish	*Mola mola*	37	0	-	1	0	1	1	4
Bluntnose sixgill shark	*Hexanchus griseus*	38	30	14	16	6	0	9	1
Basking shark	*Cetorhinus maximus*	38	99	94	7	39	6	6	-
Thresher	*Alopias vulpinus*	38	130	152	188	178	102	136	39
Bigeye thresher	*Alopias superciliosus*	38	74	51	1	16	19	62	...
Thresher sharks nei	*Alopias spp*	38	-	-	-	-	9	5	2
Shortfin mako	*Isurus oxyrinchus*	38	2 961	1 620	1 827	2 688	1 778	2 314	1 327
Porbeagle	*Lamna nasus*	38	566	354	293	426	431	420	96
Blackmouth catshark	*Galeus melastomus*	38	158	175	228	158	145	95	21
Mouse catshark	*Galeus murinus*	38	-	-	5	...	...	7	5
Small-spotted catshark	*Scyliorhinus canicula*	38	5 878	6 220	5 772	6 197	5 777	6 091	6 333

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Nursehound	*Scyliorhinus stellaris*	38	208	415	578	626	512	712	708
Catsharks, nursehounds nei	*Scyliorhinus spp*	38	768	633	251	284	234	503	539
Catsharks, etc. nei	*Scyliorhinidae*	38	10	4	3	383	483	473	402
Blue shark	*Prionace glauca*	38	8 984	7 523	8 834	14 142	15 961	15 979	9 785
Tiger shark	*Galeocerdo cuvier*	38	50	68	59	41	34	39	0
Smooth hammerhead	*Sphyrna zygaena*	38	25	13	13	12	9	6	4
Smooth-hound	*Mustelus mustelus*	38	139	200	163	205	198	229	310
Starry smooth-hound	*Mustelus asterias*	38	8	10	22	25	8	15	7
Smooth-hounds nei	*Mustelus spp*	38	2 267	2 421	2 494	2 718	3 051	3 352	3 443
Tope shark	*Galeorhinus galeus*	38	1 017	858	1 014	852	765	943	733
Greenland shark	*Somniosus microcephalus*	38	66	59	25	20	43	25	43
Little sleeper shark	*Somniosus rostratus*	38	1	0	3	3	-	-	0
Longnose spurdog	*Squalus blainville*	38	-	-	-	-	-	1	-
Picked dogfish	*Squalus acanthias*	38	8 020	5 934	3 352	2 454	1 907	1 924	981
Gulper shark	*Centrophorus granulosus*	38	672	167	255	97	63	21	4
Leafscale gulper shark	*Centrophorus squamosus*	38	2 556	1 060	760	260	144	169	149
Lowfin gulper shark	*Centrophorus lusitanicus*	38	-	-	0	180	243	423	271
Velvet belly	*Etmopterus spinax*	38	10	50	-	8	...	-	9
Great lanternshark	*Etmopterus princeps*	38	-	-	-	-	20	-	-
Lanternsharks nei	*Etmopterus spp*	38	63	60	44	120	14	19	1
Birdbeak dogfish	*Deania calcea*	38	323	264	131	58	70	35	4
Arrowhead dogfish	*Deania profundorum*	38	...	...	...	...	...	0	3
Portuguese dogfish	*Centroscymnus coelolepis*	38	4 021	2 296	1 274	557	398	487	119
Longnose velvet dogfish	*Centroscymnus crepidater*	38	301	161	422	138	35	33	3
Knifetooth dogfish	*Scymnodon ringens*	38	11	48	124	292	240	161	216
Kitefin shark	*Dalatias licha*	38	603	472	62	15	11	7	6
Black dogfish	*Centroscyllium fabricii*	38	56	4	6	6	5	95	80
Dogfish sharks nei	*Squalidae*	38	4 196	2 457	2 225	1 672	1 144	968	516
Dogfishes and hounds nei	*Squalidae, Scyliorhinidae*	38	1 491	1 256	1 129	1 312	921	821	904
Angelshark	*Squatina squatina*	38	0	2	...	1	0	2	11
Angelsharks, sand devils nei	*Squatinidae*	38	-	1	1	1	1	1	-
Angular roughshark	*Oxynotus centrina*	38	79	38	54	96	63	76	50
Sailfin roughshark	*Oxynotus paradoxus*	38	1	-	-	2	-	-	-
Bramble shark	*Echinorhinus brucus*	38	3	1	0	2	-	2	1
Blue skate	*Raja batis*	38	661	502	421	387	196	205	155
Thornback ray	*Raja clavata*	38	1 170	1 179	1 192	1 121	1 759	3 178	4 238
Starry ray	*Raja radiata*	38	1 015	660	512	473	639	711	1 039
Spotted ray	*Raja montagui*	38	1 312	1 220	1 098	1 079	625	1 527	1 497
Blonde ray	*Raja brachyura*	38	...	123	384	376	821	1 323	2 028
Sandy ray	*Raja circularis*	38	282	351	301	298	46	165	240
Shagreen ray	*Raja fullonica*	38	56	49	43	57	19	321	434
Small-eyed ray	*Raja microocellata*	38	16	23	19	20	88	224	334
Cuckoo ray	*Raja naevus*	38	2 759	3 057	2 528	2 495	436	4 308	5 412
Longnosed skate	*Raja oxyrinchus*	38	43	49	52	74	35	84	20
Undulate ray	*Raja undulata*	38	...	...	...	...	3	26	12
White skate	*Raja alba*	38	...	...	...	0	1	87	77
Round ray	*Raja fyllae*	38	...	...	...	...	1	1	1
Mediterranean starry ray	*Raja asterias*	38	...	...	...	...	...	1	...
Arctic skate	*Raja hyperborea*	38	0	...	...	2	...	1	3
Sailray	*Raja lintea*	38	8	20	-	-	-	-	-
Norwegian skate	*Raja nidarosiensis*	38	...	...	...	...	52	5	-
Raja rays nei	*Raja spp*	38	19 416	19 264	17 224	17 053	17 716	7 437	3 764
Common stingray	*Dasyatis pastinaca*	38	14	20	13	8	1	4	4
Stingrays, butterfly rays nei	*Dasyatidae*	38	2	1	2	1	1	0	1
Common eagle ray	*Myliobatis aquila*	38	11	18	25	22	15	37	19
Eagle rays nei	*Myliobatidae*	38	4	5	2	6	5	10	10
Devil fish	*Mobula mobular*	38	1	3	3	2	1	3	4
Spiny butterfly ray	*Gymnura altavela*	38	4	6	9	26	7	9	8
Torpedo rays	*Torpedo spp*	38	92	82	103	98	81	96	106
Rabbit fish	*Chimaera monstrosa*	38	618	346	87	152	133	189	287
Ratfishes nei	*Hydrolagus spp*	38	551	514	442	507	438	363	404
Chimaeras, etc. nei	*Chimaeriformes*	38	-	-	-	-	-	26	0
Various sharks nei	*Selachimorpha(Pleurotremata)*	38	735	123	173	614	531	157	1 406
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	560	699	799	1 221	950	553	398
Groundfishes nei	*Osteichthyes*	39	1 124	4 065	16 359	20 013	31 505	17 668	8 494
Pelagic fishes nei	*Osteichthyes*	39	188	75	226	745	5 871	76 468	53 580
Finfishes nei	*Osteichthyes*	39	7 564	10 340	9 955	8 830	7 886	9 519	27 374
Marine fishes nei	*Osteichthyes*	39	1 282	220	205	514	337	428	258
Edible crab	*Cancer pagurus*	42	46 625	33 669	46 183	59 725	42 887	40 138	46 895
Portunus swimcrabs nei	*Portunus spp*	42	2 621	1 501	3 769	4	3 301	3 183	2 812
Green crab	*Carcinus maenas*	42	960	688	999	1 009	898	1 296	1 319
Velvet swimcrab	*Necora puber*	42	662	260	537	442	541	422	582
Spinous spider crab	*Maja squinado*	42	5 393	5 030	6 904	6 706	5 966	6 943	6 299
Deep-sea red crab	*Chaceon affinis*	42	707	1 055	1 079	369	472	322	454
Marine crabs nei	*Brachyura*	42	1 270	870	548	428	549	532	524
Pink spiny lobster	*Palinurus mauritanicus*	43	-	3	3	6	6	2	1
Common spiny lobster	*Palinurus elephas*	43	31	27	25	28	17	77	65
Palinurid spiny lobsters nei	*Palinurus spp*	43	111	32	66	44	44	56	61
Mediterranean slipper lobster	*Scyllarides latus*	43	1	1	1	1	1	1	1
Norway lobster	*Nephrops norvegicus*	43	54 011	52 565	64 568	70 233	67 535	66 747	61 550
European lobster	*Homarus gammarus*	43	2 899	2 022	3 678	3 803	3 955	4 066	4 606
Lobsters nei	*Reptantia*	43	167	179	104	85	55	65	30
Craylets, squat lobsters	*Galatheidae*	44	69	54	66	55	25	42	33
Red king crab	*Paralithodes camtschaticus*	44	2 577	5 383	13 981	12 769	14 540	11 914	5 846
Penaeus shrimps nei	*Penaeus spp*	45	112	148	155	171	117	155	208

C-27 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Northeast
Atlantique, nord-est
Atlántico, nordeste

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Deep-water rose shrimp	*Parapenaeus longirostris*	45	543	613	863	958	2 460	4 672	2 160
Scarlet shrimp	*Plesiopenaeus edwardsianus*	45	37	16	42	59	103	118	73
Blue and red shrimp	*Aristeus antennatus*	45	39	17	31	61	28	25	40
Northern prawn	*Pandalus borealis*	45	83 664	67 930	48 985	49 875	45 993	47 486	43 536
Pandalus shrimps nei	*Pandalus spp*	45	26	23	19	10	13	26	32
Delta prawn	*Palaemon longirostris*	45	13	7	8	9	9	-	3
Common prawn	*Palaemon serratus*	45	332	267	355	327	351	375	404
Palaemonid shrimps nei	*Palaemonidae*	45	278	82	324	280	157	172	110
Common shrimp	*Crangon crangon*	45	38 713	44 733	40 325	38 719	38 881	43 022	43 936
Natantian decapods nei	*Natantia*	45	63	28	17	42	33	85	215
Norwegian krill	*Meganyctiphanes norvegica*	46	-	-	-	-	-	40	-
Goose barnacles nei	*Lepas spp*	47	-	-	0	-	-	-	-
Barnacle	*Pollicipes pollicipes*	47	-	-	12	59	77	79	94
Spottail mantis squillid	*Squilla mantis*	47	176	240	347	233	221	145	231
Marine crustaceans nei	*Crustacea*	47	382	420	454	792	601	411	493
Common periwinkle	*Littorina littorea*	52	1 683	182	1 234	185	1 210	1 096	1 340
Periwinkles nei	*Littorina spp*	52	44	127	205	93	86	140	191
Murex	*Murex spp*	52	47	45	53	40	31	33	36
Tuberculate abalone	*Haliotis tuberculata*	52	28	39	25	31	27	30	43
Abalones nei	*Haliotis spp*	52	-	-	5	-	-	-	-
Whelk	*Buccinum undatum*	52	35 142	26 142	30 381	29 509	28 827	26 499	32 424
Gastropods nei	*Gastropoda*	52	35	29	32	34	41	51	54
European flat oyster	*Ostrea edulis*	53	2 755	1 784	2 156	2 681	2 098	1 884	1 664
Pacific cupped oyster	*Crassostrea gigas*	53	9	17	38	104	134	129	207
Cupped oysters nei	*Crassostrea spp*	53	-	-	-	192	2 118	3 007	5 776
Blue mussel	*Mytilus edulis*	54	113 269	90 624	72 068	66 065	47 638	43 472	35 134
Horse mussels nei	*Modiolus spp*	54	8	5	0	-	0	0	-
Sea mussels nei	*Mytilidae*	54	-	-	1	34	34	-	-
Queen scallop	*Aequipecten opercularis*	55	13 096	13 634	15 527	18 590	11 654	12 700	24 607
Great Atlantic scallop	*Pecten maximus*	55	49 270	49 290	49 660	52 463	52 752	59 828	63 724
Iceland scallop	*Chlamys islandica*	55	14	9	-	-	5	-	-
Scallops nei	*Pectinidae*	55	1 757	4 512	1 895	4 696	3 189	799	2 887
Ocean quahog	*Arctica islandica*	56	10 376	2 357	328	4 620	7 629	-	-
Striped venus	*Chamelea gallina*	56	4 725	5 795	5 251	4 574	3 716	3 927	2 989
Pullet carpet shell	*Venerupis pullastra*	56	1 616	1 177	742	939	1 058	2 159	2 156
Banded carpet shell	*Venerupis rhomboides*	56	0	-	5	-	1	16	109
Smooth callista	*Callista chione*	56	335	293	288	344	238	306	381
Grooved carpet shell	*Ruditapes decussatus*	56	355	196	608	741	799	951	902
Japanese carpet shell	*Ruditapes philippinarum*	56	3	28	26	15	171	13	225
Carpet shells nei	*Ruditapes spp*	56	189	4	663	1 063	1 063	395	461
Northern quahog(=Hard clam)	*Mercenaria mercenaria*	56	0	-	7	-	15	151	195
Venus clams nei	*Veneridae*	56	-	3	1	0	47	93	91
Solid surf clam	*Spisula solida*	56	4 714	2 124	1 509	580	568	873	763
Common European bittersweet	*Glycymeris glycymeris*	56	4 433	5 649	7 591	4 984	4 546	2 787	3 902
Donax clams	*Donax spp*	56	742	785	569	610	596	531	369
Solen razor clams nei	*Solen spp*	56	1 503	1 381	2 249	2 998	3 207	3 514	4 361
Pod razor shell	*Ensis ensis*	56	220	5	456	16	-	-	48
Sword razor shell	*Ensis siliqua*	56	...	...	3	-	284	...	82
Common edible cockle	*Cerastoderma edule*	56	20 350	18 609	18 487	16 686	19 887	11 364	8 676
Bean solen	*Pharus legumen*	56	200	196	178	256	116	82	72
Clams, etc. nei	*Bivalvia*	56	1 615	1 683	1 382	1 400	2 689	3 743	3 744
Common cuttlefish	*Sepia officinalis*	57	4 837	4 523	4 931	5 714	5 766	11 278	16 294
Cuttlefish, bobtail squids nei	*Sepiidae, Sepiolidae*	57	25 830	16 667	17 687	21 300	16 184	2 629	4 110
Veined squid	*Loligo forbesi*	57	261	272	472	721	664	455	554
Common squids nei	*Loligo spp*	57	1 997	1 858	2 166	3 084	3 861	4 177	5 665
Northern shortfin squid	*Illex illecebrosus*	57	126	1 582	784	1 212	3 656	3 770	4 718
Broadtail shortfin squid	*Illex coindetii*	57	235	372	236	204	70	123	118
European flying squid	*Todarodes sagittatus*	57	474	399	404	999	564	765	645
Various squids nei	*Loliginidae, Ommastrephidae*	57	13 448	10 550	8 876	10 139	9 153	9 551	10 264
Common octopus	*Octopus vulgaris*	57	692	3 487	3 953	5 303	9 163	6 758	10 491
Horned octopus	*Eledone cirrosa*	57	365	339	253	572	175	187	269
Musky octopus	*Eledone moschata*	57	...	...	1	-	-	-	-
Octopuses, etc. nei	*Octopodidae*	57	13 825	13 864	9 121	9 748	11 597	6 064	7 627
Cephalopods nei	*Cephalopoda*	57	5	32	34	45	39	-	-
Marine molluscs nei	*Mollusca*	58	163	122	62	217	147	95	75
Echinoderms	*Echinodermata*	76	530	445	471	535	615	436	677
Starfishes nei	*Asteroidea*	76	0	-	-	-	-	-	-
Sea urchins nei	*Strongylocentrotus spp*	76	0	0	28	6	1	6	7
Stony sea urchin	*Paracentrotus lividus*	76	15	1	3	4	3	3	10
European edible sea urchin	*Echinus esculentus*	76	50	30	1	134	126	140	146
Sea cucumbers nei	*Holothuroidea*	76	-	208	50	-	1 051	1 167	2 246
Marine worms	*Polychaeta*	77	-	-	-	1	3	7	7
Aquatic invertebrates nei	*Invertebrata*	77	0	0	0	1	2	1	4
Total			***9 996 590***	***9 649 947***	***9 101 570***	***8 904 663***	***8 522 371***	***8 438 989***	***8 720 395***

C-27 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Atlantic, Northeast
Atlantique, nord-est
Atlántico, nordeste

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Belgium	29 698	28 517	26 320	26 239	24 071	22 523	24 029	22 098	21 211	21 907
Channel Is	3 927	3 449	3 526	3 201	3 505	3 468	3 566	3 228	2 649	3 373
China	-	-	-	61	5 587	137	97	118	41	42
China,Taiwan	564	624	208	218	491	-	46	5	-	-
Denmark	1 510 502	1 441 912	1 030 086	1 087 719	906 842	864 035	649 489	686 741	772 635	822 845
Estonia	88 357	81 072	59 490	68 159	80 255	73 672	81 842	85 116	88 545	86 593
Faroe Is	503 187	517 729	606 605	592 443	559 267	619 393	577 645	490 969	325 871	377 111
Finland	115 270	106 731	86 384	99 159	95 473	112 932	128 169	119 362	125 327	129 845
France	428 223	423 362	416 209	396 063	386 010	404 939	380 094	331 228	301 996	312 169
Germany	184 432	193 625	234 706	235 566	262 676	259 447	212 568	203 467	193 138	192 673
Greenland	34 336	44 091	44 955	41 428	40 244	46 663	37 584	24 419	19 270	33 527
Iceland	1 978 335	2 127 459	1 979 088	1 725 892	1 657 624	1 322 852	1 399 005	1 283 803	1 141 634	1 060 195
Ireland	281 831	242 473	232 165	245 882	234 053	211 321	214 693	203 124	256 824	285 527
Isle of Man	3 112	3 127	2 984	2 627	2 764	1 209	3 760	2 770	3 555	4 814
Japan	1 955	2 344	2 768	3 199	3 358	1 968	2 720	2 829	2 372	1 498
Latvia	76 930	79 863	71 978	82 706	93 605	83 972	90 516	87 385	79 934	76 257
Libya	-	-	-	-	-	49	-	-	-	-
Lithuania	31 381	32 006	27 322	20 082	17 878	34 592	46 456	35 083	39 079	19 854
Netherlands	339 041	300 315	349 023	390 823	429 242	357 335	355 026	294 667	260 636	283 382
Norway	2 671 998	2 725 540	2 523 561	2 510 657	2 389 344	2 243 779	2 335 974	2 364 437	2 476 555	2 552 408
Poland	159 163	151 561	146 111	156 489	129 352	118 790	124 911	98 997	134 003	115 818
Portugal	159 921	165 163	170 116	190 380	186 874	190 723	216 822	188 686	162 600	186 118
Russian Fed	1 061 969	1 119 911	1 010 327	893 465	898 395	890 741	853 238	830 935	926 124	994 468
Spain	430 081	319 878	336 504	307 529	329 328	365 712	335 420	388 228	338 991	374 232
Svalbard Is	0	0	0	0	0	0	0	0	0	0
Sweden	310 583	293 528	285 384	268 537	254 942	267 607	236 707	229 722	201 851	210 667
UK	729 704	679 049	625 363	648 066	658 767	603 711	594 286	544 954	564 148	575 072
Total	***11 134 500***	***11 083 329***	***10 271 183***	***9 996 590***	***9 649 947***	***9 101 570***	***8 904 663***	***8 522 371***	***8 438 989***	***8 720 395***

C-31 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Western Central
Atlantique, centre-ouest
Atlántico, centro-occidental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Highwaterman catfish	*Hypophthalmus edentatus*	13	...	...	...	...	...	44	50
American eel	*Anguilla rostrata*	22	47	17	11	13	13	27	52
American shad	*Alosa sapidissima*	24	202	103	145	149	155	148	169
Alewife	*Alosa pseudoharengus*	24	-	0	0	-	-	-	-
Hickory shad	*Alosa mediocris*	24	38	-	-	-	-	22	-
American gizzard shad	*Dorosoma cepedianum*	24	593	...	...	...	...	10	...
Yellowfin river pellona	*Pellona flavipinnis*	24	...	...	...	...	...	35	40
Striped bass	*Morone saxatilis*	25	88	99	18	14	9	4	7
White perch	*Morone americana*	25	1	...	...	...	...	1	...
Tonguefishes	*Cynoglossidae*	31	-	-	-	4	25	-	-
Summer flounder	*Paralichthys dentatus*	31	8	8	9	8	7	4	-
Bastard halibuts nei	*Paralichthys spp*	31	475	334	399	379	468	444	398
Flatfishes nei	*Pleuronectiformes*	31	511	428	396	339	263	257	3 330
White hake	*Urophycis tenuis*	32	3	1	2	0	0	0	0
Gadiformes nei	*Gadiformes*	32	2	2	2	1	3	1	1
Ladyfish	*Elops saurus*	33	449	1 259	1 224	974	660	571	973
Tarpon	*Megalops atlanticus*	33	146	137	53	71	73	59	83
Bonefish	*Albula vulpes*	33	23	16	51	40	35	32	34
Sea catfishes nei	*Ariidae*	33	29 240	20 353	13 633	14 517	6 615	6 410	6 041
Squirrelfishes nei	*Holocentridae*	33	91	100	175	150	117	168	129
Flathead grey mullet	*Mugil cephalus*	33	10 902	9 066	8 230	6 956	7 362	6 172	6 440
Lebranche mullet	*Mugil liza*	33	5 379	2 868	1 710	2 025	2 085	1 981	1 970
White mullet	*Mugil curema*	33	...	3 152	3 291	4 231	3 660	3 018	3 555
Parassi mullet	*Mugil incilis*	33	...	13	40	80	22	82	90
Bobo mullet	*Joturus pichardi*	33	325	6	6	6	10	7	9
Mullets nei	*Mugilidae*	33	11 219	4 513	6 285	4 640	5 389	5 863	5 718
Common snook	*Centropomus undecimalis*	33	9 555	2 230	1 321	1 639	1 495	1 447	1 455
Snooks(=Robalos) nei	*Centropomus spp*	33	3 232	5 348	5 499	5 537	5 256	4 440	5 317
Black grouper	*Mycteroperca bonaci*	33	5	-	-	-	-	-	-
Gag	*Mycteroperca microlepis*	33	11	12	8	13	9	9	3
Scamp	*Mycteroperca phenax*	33	28	23	18	23	28	25	16
Yellowfin grouper	*Mycteroperca venenosa*	33	3	1	1	1	1	1	1
Brazilian groupers nei	*Mycteroperca spp*	33	...	23	24	24	30	36	37
Nassau grouper	*Epinephelus striatus*	33	330	391	386	274	245	246	161
Yellowedge grouper	*Epinephelus flavolimbatus*	33	52	46	50	34	81	102	80
Red hind	*Epinephelus guttatus*	33	224	207	221	190	180	219	255
Red grouper	*Epinephelus morio*	33	124	2	196	156	88	79	85
Misty grouper	*Epinephelus mystacinus*	33	4	6	5	5	7	4	7
Snowy grouper	*Epinephelus niveatus*	33	6	8	7	8	12	9	8
Warsaw grouper	*Epinephelus nigritus*	33	30	26	28	14	28	46	27
Groupers nei	*Epinephelus spp*	33	9 994	8 046	6 166	6 199	7 114	6 787	6 046
Black seabass	*Centropristis striata*	33	378	229	257	185	212	379	312
Coney	*Cephalopholis fulva*	33	99	96	97	88	86	101	44
Groupers, seabasses nei	*Serranidae*	33	8 235	13 264	13 114	14 658	13 598	11 884	10 756
Bigeyes nei	*Priacanthus spp*	33	1	-	-	-	-	-	-
Sand tilefish	*Malacanthus plumieri*	33	-	-	-	-	6	3	3
Mutton snapper	*Lutjanus analis*	33	35	30	22	21	88	71	82
Southern red snapper	*Lutjanus purpureus*	33	1 470	1 118	1 302	1 762	1 864	2 628	2 844
Blackfin snapper	*Lutjanus buccanella*	33	...	...	...	...	...	13	13
Northern red snapper	*Lutjanus campechanus*	33	3 101	5 117	5 500	4 391	3 711	3 567	1 952
Cubera snapper	*Lutjanus cyanopterus*	33	...	344	359	350	261	172	115
Grey snapper	*Lutjanus griseus*	33	23	229	229	245	230	219	216
Lane snapper	*Lutjanus synagris*	33	1 226	1 175	1 630	1 598	1 981	1 601	1 808
Silk snapper	*Lutjanus vivanus*	33	88	100	73	52	91	73	77
Snappers nei	*Lutjanus spp*	33	1 476	1 443	1 119	1 322	1 464	1 502	1 096
Yellowtail snapper	*Ocyurus chrysurus*	33	2 459	2 901	3 744	3 536	4 453	4 859	3 987
Queen snapper	*Etelis oculatus*	33	59	142	90	85	114	96	155
Vermilion snapper	*Rhomboplites aurorubens*	33	990	4 050	3 575	3 537	3 679	3 859	2 529
Snappers, jobfishes nei	*Lutjanidae*	33	16 384	11 123	8 542	8 865	8 303	8 096	8 532
White margate	*Haemulon album*	33	-	-	15	8	9	9	-
White grunt	*Haemulon plumierii*	33	...	1 664	1 738	1 044	863	881	506
Barred grunt	*Conodon nobilis*	33	...	187	195	165	238	301	299
Grunts, sweetlips nei	*Haemulidae(=Pomadasyidae)*	33	16 371	9 702	6 564	7 072	7 631	7 772	7 832
Spotted weakfish	*Cynoscion nebulosus*	33	1 745	475	523	317	337	387	275
Squeteague(=Gray weakfish)	*Cynoscion regalis*	33	183	96	103	50	57	50	24
Weakfishes nei	*Cynoscion spp*	33	19 443	14 647	11 413	11 951	13 121	13 032	12 814
Whitemouth croaker	*Micropogonias furnieri*	33	6 040	3 230	1 900	2 320	2 650	2 560	2 560
Atlantic croaker	*Micropogonias undulatus*	33	572	465	145	69	122	247	390
Gulf kingcroaker	*Menticirrhus littoralis*	33	409	851	730	377	262	243	281
Black drum	*Pogonias cromis*	33	2 538	2 147	1 994	1 992	1 809	2 208	2 107
Spot croaker	*Leiostomus xanthurus*	33	779	441	432	333	269	396	186
Red drum	*Sciaenops ocellatus*	33	-	24	5	2	-	-	-
Croakers, drums nei	*Sciaenidae*	33	8 370	9 612	2 721	136	496	9	13
Porgies	*Calamus spp*	33	658	517	584	416	339	361	335
Sheepshead	*Archosargus probatocephalus*	33	971	768	526	715	757	774	692
Western Atlantic seabream	*Archosargus rhomboidalis*	33	...	...	...	...	25	23	25
Red porgy	*Pagrus pagrus*	33	5	6	6	9	11	255	208
Porgies, seabreams nei	*Sparidae*	33	351	1 282	1 328	1 171	1 325	1 068	959
Goatfishes, red mullets nei	*Mullidae*	33	152	148	170	89	134	110	236
Mojarras(=Silver-biddies) nei	*Gerres spp*	33	241	196	251	233	296	270	247
Mojarras, etc. nei	*Gerreidae*	33	3 981	2 049	2 048	1 841	1 956	2 121	2 307
Sea chubs nei	*Kyphosidae*	33	6	9	3	9	20	7	6
Hogfish	*Lachnolaimus maximus*	33	...	276	299	637	665	682	841
Wrasses, hogfishes, etc. nei	*Labridae*	33	71	88	25	24	150	139	342

C-31 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Western Central
Atlantique, centre-ouest
Atlántico, centro-occidental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Parrotfishes nei	*Scaridae*	33	680	643	743	826	679	710	643
Angelfishes nei	*Pomacanthidae*	33	4	12	15	17	8	1	6
Surgeonfishes nei	*Acanthuridae*	33	231	338	363	326	301	247	138
Spadefishes nei	*Ephippidae*	33	7	20	7	6	26	10	-
Boxfishes nei	*Ostraciidae*	33	139	156	171	157	149	146	107
Filefishes, leatherjackets nei	*Monacanthidae*	33	2	2	2	11	2	11	3
Triggerfishes, durgons nei	*Balistidae*	33	507	432	626	507	484	519	665
Bearded brotula	*Brotula barbata*	34	0	-	-	-	-	-	-
Cusk-eels, brotulas nei	*Ophidiidae*	34	3	4	1	1	-	-	-
Wreckfish	*Polyprion americanus*	34	7	420	...	3	-	8	63
Atlantic goldeneye tilefish	*Caulolatilus chrysops*	34	41	-	-	-	-	12	28
Great Northern tilefish	*Lopholatilus chamaeleonticeps*	34	189	171	433	381	405	416	284
Tilefishes nei	*Branchiostegidae*	34	272	319	13	11	23	42	32
Tripletail	*Lobotes surinamensis*	34	56	69	103	128	93	113	120
Escolar	*Lepidocybium flavobrunneum*	34	67	43	39	56	45	60	34
Oilfish	*Ruvettus pretiosus*	34	19	9	3	4	4	3	-
Snake mackerels, escolars nei	*Gempylidae*	34	-	9	5	6	2	7	7
Largehead hairtail	*Trichiurus lepturus*	34	15 139	8 185	5 015	6 122	6 922	6 697	6 664
Hairtails, scabbardfishes nei	*Trichiuridae*	34	...	2 386	2 492	3 229	4 071	4 913	5 408
Black driftfish	*Hyperoglyphe bythites*	34	11	2	2	4	2	1	1
Barrelfish	*Hyperoglyphe perciformis*	34	-	-	-	11	7	12	-
Scorpionfishes nei	*Scorpaenidae*	34	-	-	-	282	-	-	-
American angler	*Lophius americanus*	34	6	2	2	3	0	0	0
Demersal percomorphs nei	*Perciformes*	34	10 785	5 532	3 208	3 357	3 801	3 980	4 155
Round sardinella	*Sardinella aurita*	35	121 171	100 456	81 021	98 225	37 140	35 535	35 815
Brazilian sardinella	*Sardinella brasiliensis*	35	-	-	-	0	-	0	-
Atlantic menhaden	*Brevoortia tyrannus*	35	23 762	5 582	199	331	109	118	357
Gulf menhaden	*Brevoortia patronus*	35	464 148	369 906	408 875	456 576	420 719	454 758	438 640
Scaled sardines	*Harengula spp*	35	877	1 262	1 249	1 198	1 143	1 327	1 409
Atlantic thread herring	*Opisthonema oglinum*	35	17 738	9 990	6 889	7 087	8 567	8 449	8 457
Atlantic anchoveta	*Cetengraulis edentulus*	35	790	420	250	310	350	340	340
Anchovies, etc. nei	*Engraulidae*	35	1 166	2 050	2 140	777	1 019	1 091	504
Clupeoids nei	*Clupeoidei*	35	4 546	4 231	4 723	4 540	4 729	4 706	3 680
Atlantic bonito	*Sarda sarda*	36	1 832	1 363	1 376	1 155	1 173	1 604	1 913
Wahoo	*Acanthocybium solandri*	36	966	645	963	953	763	747	864
King mackerel	*Scomberomorus cavalla*	36	15 084	10 871	10 198	9 584	11 656	10 517	11 615
Atlantic Spanish mackerel	*Scomberomorus maculatus*	36	8 935	8 689	8 044	7 430	8 585	6 731	8 271
Cero	*Scomberomorus regalis*	36	15	172	21	12	53	47	52
Serra Spanish mackerel	*Scomberomorus brasiliensis*	36	7 928	6 096	3 856	3 762	4 245	4 011	3 817
Seerfishes nei	*Scomberomorus spp*	36	701	778	252	332	339	388	317
Frigate and bullet tunas	*Auxis thazard, A. rochei*	36	597	44	166	53	48	54	216
Little tunny(=Atl.black skipj)	*Euthynnus alletteratus*	36	269	261	323	330	247	401	558
Skipjack tuna	*Katsuwonus pelamis*	36	4 392	2 330	3 245	1 690	1 591	2 973	2 741
Atlantic bluefin tuna	*Thunnus thynnus*	36	262	276	377	326	327	312	395
Blackfin tuna	*Thunnus atlanticus*	36	1 758	1 354	1 426	1 820	1 538	2 457	2 227
Albacore	*Thunnus alalunga*	36	5 150	3 694	2 419	2 333	1 497	2 094	3 133
Yellowfin tuna	*Thunnus albacares*	36	17 477	10 962	17 570	13 810	11 576	12 655	16 147
Bigeye tuna	*Thunnus obesus*	36	6 216	3 163	2 452	2 547	1 942	2 428	1 825
Atlantic sailfish	*Istiophorus albicans*	36	628	865	806	869	743	628	745
Blue marlin	*Makaira nigricans*	36	501	463	530	662	902	754	860
Atlantic white marlin	*Tetrapturus albidus*	36	127	168	159	142	105	154	134
Longbill spearfish	*Tetrapturus pfluegeri*	36	85	17	139	39	18	24	41
Marlins,sailfishes,etc. nei	*Istiophoridae*	36	52	122	3	78	102	63	10
Swordfish	*Xiphias gladius*	36	4 517	5 060	2 019	5 080	4 215	4 808	4 082
Tuna-like fishes nei	*Scombroidei*	36	3 804	744	611	380	523	565	765
Needlefishes, etc. nei	*Belonidae*	37	27	32	19	26	63	68	77
Ballyhoo halfbeak	*Hemiramphus brasiliensis*	37	308	301	480	444	364	492	519
Balao halfbeak	*Hemiramphus balao*	37	...	...	...	...	...	59	71
Halfbeaks nei	*Hemiramphus spp*	37	0	1	65	9	2	3	62
Flyingfishes nei	*Exocoetidae*	37	1 200	1 203	970	1 355	2 643	2 559	2 576
Opah	*Lampris guttatus*	37	0	-	-	-	-	-	-
Bluefish	*Pomatomus saltatrix*	37	1 315	812	507	619	639	700	805
Cobia	*Rachycentron canadum*	37	246	221	235	381	442	467	593
Scads nei	*Decapterus spp*	37	26	10	19	25	263	497	578
Blue runner	*Caranx crysos*	37	270	4 921	4 979	4 677	4 850	4 916	4 812
Crevalle jack	*Caranx hippos*	37	216	190	259	205	234	261	279
Bar jack	*Caranx ruber*	37	39	28	21	23	33	31	22
Jacks, crevalles nei	*Caranx spp*	37	12 447	5 348	4 687	5 053	5 343	5 344	8 800
Atlantic moonfish	*Selene setapinnis*	37	3 800	2 030	1 224	1 489	1 674	1 616	1 600
Lookdown	*Selene vomer*	37	-	-	-	-	19	15	-
Florida pompano	*Trachinotus carolinus*	37	168	154	221	197	196	187	118
Pompanos nei	*Trachinotus spp*	37	340	655	603	469	509	520	853
Greater amberjack	*Seriola dumerili*	37	738	678	467	445	471	589	637
Amberjacks nei	*Seriola spp*	37	2 063	1 600	1 560	1 521	1 521	1 497	1 443
Rainbow runner	*Elagatis bipinnulata*	37	12	11	13	8	16	13	18
Bigeye scad	*Selar crumenophthalmus*	37	3 736	2 050	1 209	1 480	1 778	2 365	1 895
Carangids nei	*Carangidae*	37	2 778	1 435	928	1 172	1 025	1 078	1 108
Common dolphinfish	*Coryphaena hippurus*	37	3 308	2 658	2 720	4 022	4 717	5 091	4 151
Chub mackerel	*Scomber japonicus*	37	1 782	300	180	220	253	1 462	240
Mackerels nei	*Scombridae*	37	1 600	1 600	1 600	1 600	1 600	1 600	1 600
American harvestfish	*Peprilus paru*	37	66	76	...	...	...	...	...
Gulf butterfishes, etc. nei	*Peprilus spp*	37	2 020	1 080	640	780	1 440	1 390	1 390
Butterfishes, pomfrets nei	*Stromateidae*	37	561	232	567	833	638	751	156
Barracudas nei	*Sphyraena spp*	37	3 071	2 175	1 548	1 504	1 731	1 810	1 659
Pelagic percomorphs nei	*Perciformes*	37	2 370	1 270	750	920	1 030	1 000	1 000

C-31 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Western Central
Atlantique, centre-ouest
Atlántico, centro-occidental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Bigeye thresher	*Alopias superciliosus*	38	...	119	124	52	4	4	4
Thresher sharks nei	*Alopias spp*	38	3	2	1	1	1	0	1
Shortfin mako	*Isurus oxyrinchus*	38	70	125	117	147	90	282	339
Longfin mako	*Isurus paucus*	38	0	0	1	1	1	0	1
Mako sharks	*Isurus spp*	38	-	-	-	-	0	1	1
Porbeagle	*Lamna nasus*	38	...	...	...	...	...	13	-
Nurse shark	*Ginglymostoma cirratum*	38	81	62	21	645	168	155	170
Blue shark	*Prionace glauca*	38	11	1 340	1 984	2 054	884	2 367	5 501
Blacktip shark	*Carcharhinus limbatus*	38	438	559	149	20	32	6	3
Smalltail shark	*Carcharhinus porosus*	38	...	130	10	...	...	...	...
Silky shark	*Carcharhinus falciformis*	38	30	32	26	22	20	20	22
Bull shark	*Carcharhinus leucas*	38	-	1	...	0	10	0	-
Tiger shark	*Galeocerdo cuvier*	38	10	19	23	8	17	14	11
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*	38	...	139	146	72	164	159	153
Requiem sharks nei	*Carcharhinidae*	38	17 964	11 104	8 157	7 697	8 288	8 547	7 738
Scalloped hammerhead	*Sphyrna lewini*	38	...	...	...	...	1	5	...
Hammerhead sharks, etc. nei	*Sphyrnidae*	38	9	198	485	107	80	74	99
Smooth-hounds nei	*Mustelus spp*	38	433	229	479	735	488	370	201
Dogfish sharks nei	*Squalidae*	38	380	253	262	313	366	539	1 202
Raja rays nei	*Raja spp*	38	...	12	30	24	25	18	20
Southern stingray	*Dasyatis americana*	38	...	101	105	68	26	25	26
Rays, stingrays, mantas nei	*Rajiformes*	38	7 984	6 351	5 034	6 365	6 543	6 560	6 986
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	12 206	9 926	9 121	6 711	6 285	4 903	4 435
Marine fishes nei	*Osteichthyes*	39	181 377	128 448	144 109	140 896	121 852	119 920	122 634
Batwing coral crab	*Carpilius corallinus*	42	-	-	-	-	-	1	1
Black stone crab	*Menippe mercenaria*	42	3 094	2 636	2 743	2 961	3 009	2 607	2 567
Portunus swimcrabs nei	*Portunus spp*	42	5	15	28	38	45	52	112
Blue crab	*Callinectes sapidus*	42	64 637	55 328	56 610	52 246	52 811	55 121	47 698
Harbour spidercrab	*Mithrax armatus*	42	67	47	59	27	21	3	3
Portly spider crab	*Libinia emarginata*	42	-	-	-	-	-	-	6
Red crab	*Chaceon quinquedens*	42	24	-	-	-	-	-	-
Golden deepsea crab	*Chaceon fenneri*	42	129	171	222	197	178	223	253
Marine crabs nei	*Brachyura*	42	2 979	2 175	1 603	1 448	1 539	1 268	1 588
Caribbean spiny lobster	*Panulirus argus*	43	33 280	30 287	27 284	25 885	27 536	24 538	28 776
Tropical spiny lobsters nei	*Panulirus spp*	43	687	1 055	838	322	202	117	144
Spanish slipper lobster	*Scyllarides aequinoctialis*	43	-	-	-	-	-	1	0
Slipper lobsters nei	*Scyllaridae*	43	-	7	-	-	-	-	-
Northern brown shrimp	*Penaeus aztecus*	45	56 326	45 315	61 681	47 309	39 764	57 481	36 801
Northern pink shrimp	*Penaeus duorarum*	45	8 627	8 366	8 276	4 185	5 031	4 099	5 732
Northern white shrimp	*Penaeus setiferus*	45	56 818	52 406	64 517	37 390	50 290	55 597	46 754
Southern brown shrimp	*Penaeus subtilis*	45	1 475	1 219	...	...	...	...	...
Penaeus shrimps nei	*Penaeus spp*	45	52 318	38 646	34 991	30 270	25 924	24 626	22 559
Atlantic seabob	*Xiphopenaeus kroyeri*	45	27 206	26 898	29 196	27 337	22 355	25 833	26 440
Whitebelly prawn	*Nematopalaemon schmitti*	45	2 494	2 527	1 800	1 039	1 289	1 329	526
Rock shrimp	*Sicyonia brevirostris*	45	3 753	724	1 628	314	1 013	1 974	805
Royal red shrimp	*Pleoticus robustus*	45	268	196	201	419	243	230	323
Natantian decapods nei	*Natantia*	45	2 227	2 078	2 229	2 219	2 110	2 372	2 113
Marine crustaceans nei	*Crustacea*	47	162	165	159	473	369	261	280
Stromboid conchs nei	*Strombus spp*	52	25 527	25 303	27 785	17 703	18 613	22 769	20 441
Gastropods nei	*Gastropoda*	52	31	97	101	6 015	3 042	2 401	4 589
Mangrove cupped oyster	*Crassostrea rhizophorae*	53	3 593	1 971	1 205	1 405	1 606	1 527	1 507
American cupped oyster	*Crassostrea virginica*	53	99 656	111 446	79 389	95 093	78 144	84 229	46 664
South American rock mussel	*Perna perna*	54	4 280	2 300	1 360	1 660	1 900	1 830	1 830
American sea scallop	*Placopecten magellanicus*	55	37	2	-	-	-	-	-
Atlantic bay scallop	*Argopecten irradians*	55	0	0	-	-	-	74	1
Ark clams nei	*Arca spp*	56	63 000	56 000	52 000	63 450	70 964	68 500	68 500
Northern quahog(=Hard clam)	*Mercenaria mercenaria*	56	5 143	4 733	8 975	7 912	3 361	4 086	3 615
Venus clams nei	*Veneridae*	56	3 342	2 544	2 191	2 538	2 598	2 539	2 671
Clams, etc. nei	*Bivalvia*	56	1 166	1 017	1 088	1 120	845	1 042	949
Common squids nei	*Loligo spp*	57	1 589	836	525	809	710	639	777
Northern shortfin squid	*Illex illecebrosus*	57	-	-	0	-	-	-	-
Various squids nei	*Loliginidae, Ommastrephidae*	57	67	44	80	69	83	83	82
Common octopus	*Octopus vulgaris*	57	24 492	6 837	16 445	11 809	9 022	16 693	15 349
Mexican four-eyed octopus	*Octopus maya*	57	...	3 166	7 675	6 928	2 396	6 879	5 713
Octopuses, etc. nei	*Octopodidae*	57	1 715	915	557	683	1 484	1 441	1 433
Marine molluscs nei	*Mollusca*	58	3 410	1 527	892	1 128	1 768	1 205	1 071
Green turtle	*Chelonia mydas*	72	7	11	5	3	1	0	0
Hawksbill turtle	*Eretmochelys imbricata*	72	7	8	9	-	-	-	-
Loggerhead turtle	*Caretta caretta*	72	6	7	3	3	-	-	-
Marine turtles nei	*Testudinata*	72	4	2	4	3	1	0	0
Horseshoe crab	*Limulus polyphemus*	75	1	4	5	3	8	7	7
Sea urchins nei	*Strongylocentrotus spp*	76	10	10	10	10	10	10	8
Sea cucumbers nei	*Holothuroidea*	76	-	-	5	296	195	720	444
Jellyfishes nei	*Rhopilema spp*	77	1 512	44	...	671	210	...	...
Total			***1 746 583***	***1 399 179***	***1 389 754***	***1 407 073***	***1 267 745***	***1 345 255***	***1 264 622***

C-31 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Atlantic, Western Central
Atlantique, centre-ouest
Atlántico, centro-occidental

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Anguilla	585 F	610 F	635 F	660 F	685 F	710 F	735 F	759	681	701
Antigua Barb	1 824	2 374	2 587	2 527	2 999	3 092	3 092	3 521	2 490	2 293
Aruba	163	163 F	160 F	162	162 F	145	159	151	163	153
Bahamas	9 290	12 192	12 611	11 347	11 064	10 598	8 382	9 117	9 018	11 611
Barbados	2 721	2 520	2 838	2 148	2 182	1 975	2 224	3 551	3 496	3 269
Belize	2 517	2 078	2 477	2 860	2 707	3 033	3 431	3 146	4 043	5 683
Bermuda	309	397	363	386	399	380	424	399	416	382
Br Virgin Is	837	1 062	2 771	1 262	1 300 F	1 308 F	1 250 F	1 200 F	1 200 F	1 200 F
Cayman Is	125	125	125	125	125	125	125	125	125	125
China	-	-	-	-	-	-	-	13	48	-
China,Taiwan	10 597	10 577	4 967	6 135	1 711	2 931	2 184	1 108	1 007	1 033
Colombia	10 414	25 688	8 380	5 663	4 975	5 000 F	5 050 F	5 100 F	5 091	3 135
Costa Rica	899	717	651	601	605	615 F	624	625 F	625 F	625 F
Cuba	39 672	30 509	31 333	29 630	26 631	26 094	26 389	25 797	26 317	21 923
Dominica	1 200 F	1 198	950 F	700 F	579	694	676	696	790	700 F
Dominican Rp	12 059	15 159	16 591	12 243	9 499	11 045	12 228	13 674	13 801	14 140
Fr Guiana	4 599 F	4 782 F	5 565 F	5 514 F	5 285 F	4 442	4 857	3 958	4 140	4 000 F
Grenada	2 250	2 171	2 544	2 039	2 053	2 169	2 407	2 386	2 615	2 452
Guadeloupe	10 100	10 100	10 100	10 100	10 100	10 100	10 100	10 100	10 000 F	10 000 F
Guatemala	360 F	345 F	330 F	315 F	304	264	483	536	428	647
Guyana	52 605	47 217	58 895	55 919	52 570	52 963 F	46 648	41 368	42 805	44 386
Haiti	6 400 F	7 000 F	7 600 F	8 000	8 000 F	8 000 F	8 000 F	8 000 F	8 000 F	8 000 F
Honduras	10 213 F	11 126 F	13 624 F	6 199 F	6 387 F	7 660 F	6 198 F	5 058	5 200	6 971
Jamaica	11 894	7 397	12 082	13 071	12 696	17 505 F	16 148	12 775	15 894	15 040
Japan	3 996	1 928	4 509	4 342	4 207	2 408	1 370	2 594	2 287	2 910
Korea Rep	237	45	-	-	8	26	151	953	239	128
Martinique	6 200	6 200 F	6 200	6 200	5 500	6 300	6 200	6 200	6 200 F	5 000 F
Mexico	259 141	245 069	239 832	248 745	213 705	235 224	215 445	191 849	191 461	199 854
Montserrat	50 F	46	40 F	31	50	49	35	31	37	24
NethAntilles	1 052 F	1 282 F	600 F	600 F	650 F	700 F	705 F	705 F	705 F	1 267 F
Nicaragua	10 255	10 567	10 387	10 001	10 652	10 157	10 468	10 206	10 641	12 294
Panama	845	687	624	684	1 053	3 828	1 085	589	538	2 541
Philippines	37	691	370	1 042	619	230	373	505	560	384
Portugal	-	49	-	-	8	11	297	35	45	61
Puerto Rico	3 794	2 529	2 919	2 428	2 551	2 042	1 675	1 793	1 702	1 898
St Kitts Nev	555	355	400 F	484	470 F	455 F	440 F	425 F	410 F	393
St Lucia	1 983	1 637	1 462	1 508	1 409	1 496	1 555	1 728	1 920	1 844
St Vincent	5 021	3 029	4 843	8 737	1 786	4 661	5 010	3 859	3 984	2 619
Spain	1 789	2 460	3 092	3 436	5 364	3 188	6 329	4 118	5 850	8 007
Suriname	24 665	27 042 F	32 260	30 160	27 192	30 421	29 277	23 461	25 411	33 842
Trinidad Tob	16 598	18 768	14 592	14 713	18 093	13 123	13 086	13 833	13 856	13 931
Turks Caicos	6 419	5 767	5 100	5 685 F	5 505 F	6 040 F	4 860 F	6 133	6 803	5 446
USA	878 343	923 344	880 478	762 368	630 105	670 197	674 648	625 979	699 816	597 735
US Virgin Is	1 198 F	1 296 F	1 492	1 522	1 269	1 615	1 127	1 065	1 120	847
Vanuatu	-	-	-	1 402	1 488	930	751	181	336	628
Venezuela	278 738	348 696	366 986	464 880 F	304 447 F	225 794 F	270 266 F	218 251	212 900 F	214 500 F
Other nei	1 238	44	115	9	30	11	106	89	41	-
Total	***1 693 787***	***1 797 038***	***1 774 480***	***1 746 583***	***1 399 179***	***1 389 754***	***1 407 073***	***1 267 745***	***1 345 255***	***1 264 622***

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Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
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Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Eastern Central
Atlantique, centre-est
Atlántico, centro-oriental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Tilapias nei	*Oreochromis(=Tilapia) spp*	12	2 191	3 778	2 142	2 454	2 374	2 174	2 361
European eel	*Anguilla anguilla*	22	3	1	0	1	0	1	9
Shads nei	*Alosa spp*	24	4	0	76	207	15	10	2
West African ilisha	*Ilisha africana*	24	12 381	11 804	10 498	13 175	15 299	14 827	14 868
Lefteye flounders nei	*Bothidae*	31	7	5	-	-	15	15	46
Common sole	*Solea solea*	31	2 966	3 308	3 723	3 696	3 351	4 140	3 387
Wedge sole	*Dicologlossa cuneata*	31	1 237	835	812	436	492	466	221
Soles nei	*Soleidae*	31	3 029	3 582	4 217	4 870	6 833	5 822	5 263
Tonguefishes	*Cynoglossidae*	31	10 880	13 992	12 139	13 264	10 772	11 682	12 975
Megrim	*Lepidorhombus whiffiagonis*	31	1	282	247	247	197	283	270
Turbot	*Psetta maxima*	31	94	73	76	61	63	57	58
Citharids nei	*Citharidae*	31	238	501	511	442	551	657	207
Spottail spiny turbot	*Psettodes belcheri*	31	1	0	-	-	-	-	-
Flatfishes nei	*Pleuronectiformes*	31	10 224	20 346	14 729	11 137	10 372	7 000	5 840
Forkbeards nei	*Phycis spp*	32	997	644	592	1 201	585	695	619
Pouting(=Bib)	*Trisopterus luscus*	32	1 699	1 745	1 815	1 514	1 147	993	478
Blue whiting(=Poutassou)	*Micromesistius poutassou*	32	-	0	0	0	-	-	4
European hake	*Merluccius merluccius*	32	18 228	15 414	10 562	10 704	7 968	9 226	9 327
Senegalese hake	*Merluccius senegalensis*	32	5 528	2 294	3 585	5 161	4 524	13 489	3 252
Benguela hake	*Merluccius polli*	32	2 503	2 536	3 023	2 657	2 466	1 801	1 363
Hakes nei	*Merluccius spp*	32	1 250	530	461	361	155	41	537
Gadiformes nei	*Gadiformes*	32	46	56	149	38	34	23	25
West African ladyfish	*Elops lacerta*	33	884	1 594	2 184	1 584	1 796	2 582	2 115
Bonefish	*Albula vulpes*	33	626	1 151	460	542	1 007	952	942
Sea catfishes nei	*Ariidae*	33	52 402	60 531	51 739	47 402	54 998	54 975	50 339
Morays	*Muraenidae*	33	701	480	366	372	398	555	531
Cornetfish	*Fistularia tabacaria*	33	...	23	92	75	98	55	53
Mullets nei	*Mugilidae*	33	23 882	24 648	28 166	29 085	23 481	24 013	30 257
Dusky grouper	*Epinephelus marginatus*	33	184	66	120	202	130	81	127
White grouper	*Epinephelus aeneus*	33	1 342	1 285	1 466	1 594	1 906	2 809	3 758
Dungat grouper	*Epinephelus goreensis*	33	54	34	85	202	88	90	90
Groupers nei	*Epinephelus spp*	33	922	1 742	1 446	1 462	1 595	2 242	1 894
Groupers, seabasses nei	*Serranidae*	33	3 716	3 304	4 552	4 022	5 184	7 297	7 911
Spotted seabass	*Dicentrarchus punctatus*	33	376	83	129	153	133	86	133
European seabass	*Dicentrarchus labrax*	33	16	19	32	20	13	10	32
Seabasses nei	*Dicentrarchus spp*	33	286	176	174	131	95	74	177
Bigeyes nei	*Priacanthus spp*	33	6	2	2	2	2	2	3
Cardinalfishes, etc. nei	*Apogonidae*	33	-	-	0	-	-	-	-
Snappers nei	*Lutjanus spp*	33	10 616	10 904	14 583	12 855	11 983	12 246	11 383
African forktail snapper	*Apsilus fuscus*	33	123	50	14	16	10	1	1
Rubberlip grunt	*Plectorhinchus mediterraneus*	33	4 152	5 080	5 529	4 363	4 628	5 283	5 215
Bastard grunt	*Pomadasys incisus*	33	5	4	3	3	2	5	38
Sompat grunt	*Pomadasys jubelini*	33	1 741	2 405	2 060	2 958	3 075	3 678	3 372
Bigeye grunt	*Brachydeuterus auritus*	33	35 635	25 633	27 488	30 419	30 190	30 869	26 136
Grunts, sweetlips nei	*Haemulidae(=Pomadasyidae)*	33	14 803	22 198	16 150	15 574	18 718	25 096	21 416
Shi drum	*Umbrina cirrosa*	33	19	15	70	11	1	1	3
Canary drum(=Baardman)	*Umbrina canariensis*	33	922	807	1 149	1 082	826	880	1 113
Meagre	*Argyrosomus regius*	33	1 760	2 078	1 821	2 644	4 175	2 485	3 595
Southern meagre(=Mulloway)	*Argyrosomus hololepidotus*	33	465	405	130	207	99	30	128
Boe drum	*Pteroscion peli*	33	1 650	1 921	2 251	2 370	1 798	1 959	2 358
Law croaker	*Pseudotolithus brachygnathus*	33	1 544	888	1 570	1 204	2 459	2 425	2 350
Cassava croaker	*Pseudotolithus senegalensis*	33	4 412	4 080	3 640	4 116	5 431	6 766	6 000
Bobo croaker	*Pseudotolithus elongatus*	33	20 016	20 223	22 712	16 039	22 169	21 475	21 573
West African croakers nei	*Pseudotolithus spp*	33	29 138	30 420	30 409	22 766	23 185	21 616	21 996
Croakers, drums nei	*Sciaenidae*	33	30 771	37 562	27 170	30 744	22 200	24 645	26 551
Atlantic emperor	*Lethrinus atlanticus*	33	74	393	118	83	60	40	230
Blackspot(=red) seabream	*Pagellus bogaraveo*	33	7	113	2	5	2	1	1
Common pandora	*Pagellus erythrinus*	33	4 697	2 983	4 368	568	383	608	1 274
Axillary seabream	*Pagellus acarne*	33	1	1	2	1	12	...	1 319
Red pandora	*Pagellus bellottii*	33	7 188	10 879	11 135	11 858	10 038	8 949	9 202
Pandoras nei	*Pagellus spp*	33	1 479	1 423	1 099	1 399	803	1 254	3 084
White seabream	*Diplodus sargus*	33	...	...	...	...	3	1	9
Sargo breams nei	*Diplodus spp*	33	3 169	2 187	2 616	2 119	2 330	2 720	3 520
Large-eye dentex	*Dentex macrophthalmus*	33	183	1 007	1 232	899	718	1 238	966
Common dentex	*Dentex dentex*	33	416	563	220	147	52	26	11
Angolan dentex	*Dentex angolensis*	33	1 975	2 905	3 151	2 488	2 780	1 198	1 499
Congo dentex	*Dentex congoensis*	33	...	1 080	664	559	538	123	73
Dentex nei	*Dentex spp*	33	3 288	5 655	5 884	6 325	4 428	3 479	4 424
Black seabream	*Spondyliosoma cantharus*	33	2 999	2 420	2 330	1 648	2 216	4 670	3 884
Saddled seabream	*Oblada melanura*	33	1	-	0	1	1	-	-
Red porgy	*Pagrus pagrus*	33	627	370	339	217	43	38	37
Pargo breams nei	*Pagrus spp*	33	931	2 512	2 561	2 397	7 876	5 267	5 606
Gilthead seabream	*Sparus aurata*	33	280	342	383	399	293	366	1 095
Bogue	*Boops boops*	33	1 973	1 701	4 548	3 578	3 875	5 708	2 692
Sand steenbras	*Lithognathus mormyrus*	33	621	876	683	400	292	401	293
Salema	*Sarpa salpa*	33	51	71	99	106	126	128	143
Porgies, seabreams nei	*Sparidae*	33	6 632	10 235	11 464	11 387	11 869	11 169	9 881
Surmullets(=Red mullets) nei	*Mullus spp*	33	669	628	569	409	629	937	1 491
West African goatfish	*Pseudupeneus prayensis*	33	1 418	974	2 302	3 077	2 933	2 732	1 514
Guinean striped mojarra	*Gerres nigri*	33	1 811	868	3 872	3 567	2 580	2 815	1 775
African sicklefish	*Drepane africana*	33	3 067	3 809	8 330	3 496	11 304	3 376	3 378
Wrasses, hogfishes, etc. nei	*Labridae*	33	1	...	0	...	...	...	...
Parrotfish	*Sparisoma cretense*	33	0	-	1	1	1	-	-
Parrotfishes nei	*Scaridae*	33	-	-	-	-	1	0	1
Giant African threadfin	*Polydactylus quadrifilis*	33	17 076	18 081	20 631	20 855	21 289	22 527	24 147

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Lesser African threadfin	*Galeoides decadactylus*	33	13 921	13 035	18 568	17 442	16 621	19 191	17 134
Royal threadfin	*Pentanemus quinquarius*	33	1 630	1 094	808	2 076	2 048	2 150	2 475
Threadfins, tasselfishes nei	*Polynemidae*	33	568	1 743	1 989	2 178	2 052	430	430
Weevers nei	*Trachinus spp*	33	1 287	1 353	1 088	1 234	1 026	764	643
Surgeonfishes nei	*Acanthuridae*	33	1 093	661	183	181	163	311	253
Spadefishes nei	*Ephippidae*	33	7	17	9	7	3	9	36
Puffers nei	*Tetraodontidae*	33	2 340	561	2 559	1 842	1 372	874	750
Triggerfishes, durgons nei	*Balistidae*	33	63	109	228	148	247	299	297
Lusitanian toadfish	*Halobatrachus didactylus*	33	1	0	1	-	-	-	-
Argentines	*Argentina spp*	34	229	296	509	555	286	521	57
Lanternfishes nei	*Myctophidae*	34	-	-	13	-	-	-	6 912
European conger	*Conger conger*	34	2 205	1 739	1 509	1 714	1 472	1 521	1 504
Conger eels, etc. nei	*Congridae*	34	1 368	1 412	1 705	1 385	478	1 461	975
Longspine snipefish	*Macroramphosus scolopax*	34	-	80	39	-	-	-	-
Bearded brotula	*Brotula barbata*	34	684	833	1 355	1 121	1 908	3 024	2 766
Stout beardfish	*Polymixia nobilis*	34	-	-	0	1	-	1	-
Alfonsinos nei	*Beryx spp*	34	260	109	90	119	165	164	208
John dory	*Zeus faber*	34	1 619	1 096	1 470	1 413	1 353	1 759	1 780
Silvery John dory	*Zenopsis conchifer*	34	-	-	-	-	-	3	11
Wreckfish	*Polyprion americanus*	34	45	47	50	165	93	98	51
Tilefishes nei	*Branchiostegidae*	34	152	241	309	294	321	460	233
Bonnetmouths, rubyfishes nei	*Emmelichthyidae*	34	6	6	1	-	-	-	-
Escolar	*Lepidocybium flavobrunneum*	34	-	-	-	-	-	1	-
Oilfish	*Ruvettus pretiosus*	34	19	44	26	28	48	48	90
Roudi escolar	*Promethichthys prometheus*	34	4	5	5	5	3	3	2
Snake mackerels, escolars nei	*Gempylidae*	34	71	105	80	50	56	74	85
Largehead hairtail	*Trichiurus lepturus*	34	13 579	14 691	14 133	18 561	12 224	12 835	23 352
Silver scabbardfish	*Lepidopus caudatus*	34	-	9	-	0	-	13	9
Black scabbardfish	*Aphanopus carbo*	34	3 895	3 316	2 640	3 087	3 119	2 429	1 860
Hairtails, scabbardfishes nei	*Trichiuridae*	34	4 410	425	1 073	859	1 603	1 913	1 816
Violet warehou	*Schedophilus velaini*	34	...	...	...	...	...	...	406
Pemarco blackfish	*Schedophilus pemarco*	34	466	278	235	618	275	70	63
Warehou nei	*Seriolella spp*	34	-	-	-	-	-	-	3
Ruffs, barrelfishes nei	*Centrolophidae*	34	51	43	52	41	-	4	6
Blackbelly rosefish	*Helicolenus dactylopterus*	34	74	83	127	150	79	113	49
Scorpionfishes nei	*Scorpaenidae*	34	4 091	3 046	5 916	7 396	6 612	6 575	6 104
Gurnards, searobins nei	*Triglidae*	34	2 420	3 048	3 150	2 458	10 292	3 375	1 407
Angler(=Monk)	*Lophius piscatorius*	34	...	1	15	7	-	1	1
Blackbellied angler	*Lophius budegassa*	34	3	2	3	5	-	-	-
Shortspine African angler	*Lophius vaillanti*	34	...	...	...	9	-	-	-
Monkfishes nei	*Lophius spp*	34	925	869	997	604	618	665	609
Demersal percomorphs nei	*Perciformes*	34	1 086	1 173	1 189	1 032	1 199	1 748	1 751
Round sardinella	*Sardinella aurita*	35	354 300	321 885	281 373	258 189	319 258	268 071	302 690
Madeiran sardinella	*Sardinella maderensis*	35	167 056	150 969	138 997	139 591	124 045	123 288	163 151
Sardinellas nei	*Sardinella spp*	35	169 334	170 298	198 209	189 400	168 433	268 158	359 703
Bonga shad	*Ethmalosa fimbriata*	35	185 557	173 271	196 023	190 450	222 732	220 076	224 944
European pilchard(=Sardine)	*Sardina pilchardus*	35	742 629	730 893	664 989	621 748	754 616	893 136	934 073
European anchovy	*Engraulis encrasicolus*	35	148 405	128 058	122 820	84 596	115 736	113 005	120 718
Clupeoids nei	*Clupeoidei*	35	5 889	2 942	3 055	4 072	3 165	3 260	3 153
Atlantic bonito	*Sarda sarda*	36	5 651	5 024	7 008	4 610	5 659	11 077	13 544
Plain bonito	*Orcynopsis unicolor*	36	638	746	1 260	1 044	424	438	271
Wahoo	*Acanthocybium solandri*	36	600	347	671	596	980	585	897
West African Spanish mackerel	*Scomberomorus tritor*	36	1 123	1 305	2 042	2 041	1 498	2 261	1 367
Frigate tuna	*Auxis thazard*	36	2 770	2 803	3 178	2 900	1 584	2 100	1 555
Frigate and bullet tunas	*Auxis thazard, A. rochei*	36	1 754	1 031	1 200	1 423	2 288	2 241	2 038
Little tunny(=Atl.black skipj)	*Euthynnus alletteratus*	36	13 187	10 329	6 381	10 250	9 305	6 288	13 320
Skipjack tuna	*Katsuwonus pelamis*	36	125 278	130 538	106 748	105 815	120 142	125 155	155 390
Atlantic bluefin tuna	*Thunnus thynnus*	36	2 066	2 768	3 140	2 756	2 499	1 930	1 400
Blackfin tuna	*Thunnus atlanticus*	36	-	-	-	-	124	62	93
Albacore	*Thunnus alalunga*	36	1 487	3 954	3 594	1 066	1 312	815	1 582
Yellowfin tuna	*Thunnus albacares*	36	86 241	78 801	75 342	70 892	89 691	96 592	84 180
Bigeye tuna	*Thunnus obesus*	36	53 836	46 719	47 215	53 970	46 317	55 529	51 447
Atlantic sailfish	*Istiophorus albicans*	36	1 999	1 833	1 267	1 978	1 734	1 656	1 956
Blue marlin	*Makaira nigricans*	36	1 214	2 136	1 133	1 901	2 739	1 762	1 731
Black marlin	*Makaira indica*	36	59	8	11	3	34	55	2
Atlantic white marlin	*Tetrapturus albidus*	36	104	108	61	60	64	77	102
Longbill spearfish	*Tetrapturus pfluegeri*	36	-	1	11	3	3	22	34
Roundscale spearfish	*Tetrapturus georgii*	36	-	-	-	-	3	-	0
Marlins,sailfishes,etc. nei	*Istiophoridae*	36	572	175	129	699	322	292	291
Swordfish	*Xiphias gladius*	36	2 374	2 609	2 674	3 924	3 681	3 425	3 914
Tuna-like fishes nei	*Scombroidei*	36	3 731	7 451	4 772	4 681	8 074	4 110	12 264
Needlefishes, etc. nei	*Belonidae*	37	592	491	502	460	446	718	621
Halfbeaks nei	*Hemiramphus spp*	37	191	174	340	1 955	1 684	1 245	1 689
Flyingfishes nei	*Exocoetidae*	37	1 625	1 936	1 946	3 931	4 707	4 219	3 133
Opah	*Lampris guttatus*	37	0	-	-	-	-	-	-
Bluefish	*Pomatomus saltatrix*	37	1 807	2 006	1 362	362	436	261	403
Cobia	*Rachycentron canadum*	37	150	375	173	163	263	137	16
Atlantic horse mackerel	*Trachurus trachurus*	37	-	-	-	111	26	1	-
Cunene horse mackerel	*Trachurus trecae*	37	2 958	1 434	539	5 617	2 442	2 382	2 612
Jack and horse mackerels nei	*Trachurus spp*	37	265 587	339 072	249 092	190 633	252 786	282 047	339 769
Scads nei	*Decapterus spp*	37	6 904	7 153	4 775	4 133	3 449	5 887	2 623
Crevalle jack	*Caranx hippos*	37	9 255	8 345	6 207	6 828	12 405	2 341	8 351
False scad	*Caranx rhonchus*	37	2 520	2 008	3 627	1 189	1 362	1 205	906
Jacks, crevalles nei	*Caranx spp*	37	4 778	3 989	4 532	5 880	7 337	7 349	8 777
African moonfish	*Selene dorsalis*	37	2 616	3 838	3 071	3 664	1 839	1 880	1 403

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Atlantique, centre-est
Atlántico, centro-oriental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Pompano	*Trachinotus ovatus*	37	-	-	-	-	-	3	13
Pompanos nei	*Trachinotus spp*	37	864	329	264	1 226	385	530	450
Amberjacks nei	*Seriola spp*	37	115	55	92	202	185	193	185
Leerfish	*Lichia amia*	37	754	593	378	467	423	463	818
Alexandria pompano	*Alectis alexandrinus*	37	293	375	474	310	809	1 051	1 092
Rainbow runner	*Elagatis bipinnulata*	37	123	117	137	110	110	110	110
Atlantic bumper	*Chloroscombrus chrysurus*	37	12 355	12 011	15 410	16 372	19 632	11 274	14 751
Vadigo	*Campogramma glaycos*	37	314	444	416	256	290	4	833
Carangids nei	*Carangidae*	37	5 500	7 102	8 386	6 928	8 066	7 398	7 347
Atlantic pomfret	*Brama brama*	37	401	45	915	1 263	1 677	1 769	2 570
Common dolphinfish	*Coryphaena hippurus*	37	400	265	352	406	356	388	342
Suckerfishes, remoras nei	*Echeneidae*	37	1	513	-	-	-	-	-
Chub mackerel	*Scomber japonicus*	37	221 041	187 122	172 921	214 744	203 392	184 937	211 536
Atlantic mackerel	*Scomber scombrus*	37	-	-	-	-	-	-	76
Mackerels nei	*Scombridae*	37	2 790	2 641	3 697	3 027	6 552	3 403	3 201
Blue butterfish	*Stromateus fiatola*	37	4 872	8 069	7 572	7 373	7 210	6 255	6 324
Barracudas nei	*Sphyraena spp*	37	21 148	22 230	23 928	19 359	20 749	22 571	33 340
Pelagic percomorphs nei	*Perciformes*	37	3 784	4 132	4 381	4 839	4 554	4 407	4 136
Bluntnose sixgill shark	*Hexanchus griseus*	38	-	-	-	0	1	-	-
Basking shark	*Cetorhinus maximus*	38	-	-	3	-	-	-	-
Crocodile shark	*Pseudocarcharias kamoharai*	38	-	-	-	14	-	-	-
Thresher	*Alopias vulpinus*	38	5	15	7	9	9	8	24
Bigeye thresher	*Alopias superciliosus*	38	2	7	4	4	6	11	0
Thresher sharks nei	*Alopias spp*	38	1	0	0	-	-	-	-
Shortfin mako	*Isurus oxyrinchus*	38	880	671	818	758	875	980	1 211
Longfin mako	*Isurus paucus*	38	-	-	-	-	-	-	1
Mako sharks	*Isurus spp*	38	-	...	...	-	13	13	-
Porbeagle	*Lamna nasus*	38	9	12	31	4	119	168	8
Great white shark	*Carcharodon carcharias*	38	...	7	...	...	...	...	18
Nurse shark	*Ginglymostoma cirratum*	38	...	...	...	...	...	...	18
Blackmouth catshark	*Galeus melastomus*	38	-	-	-	5	3	2	-
Nursehound	*Scyliorhinus stellaris*	38	-	-	-	-	1	1	1
Blue shark	*Prionace glauca*	38	10 648	8 585	8 289	7 943	9 566	16 003	26 721
Blacktip shark	*Carcharhinus limbatus*	38	-	-	8	10	13	17	...
Silky shark	*Carcharhinus falciformis*	38	56	24	25	44	21	29	100
Milk shark	*Rhizoprionodon acutus*	38	...	...	...	...	...	...	516
Requiem sharks nei	*Carcharhinidae*	38	612	736	598	647	373	394	1 539
Smooth hammerhead	*Sphyrna zygaena*	38	130	255	106	92	54	100	49
Scalloped hammerhead	*Sphyrna lewini*	38	315	153	36	30	7	17	262
Hammerhead sharks, etc. nei	*Sphyrnidae*	38	822	2 430	2 712	3 200	1 848	825	1 727
Smooth-hound	*Mustelus mustelus*	38	...	...	...	1	...	...	100
Smooth-hounds nei	*Mustelus spp*	38	2 284	1 269	2 330	1 817	1 528	1 777	1 344
Tope shark	*Galeorhinus galeus*	38	7	17	17	95	116	118	161
Atlantic weasel shark	*Paragaleus pectoralis*	38	...	...	...	...	...	...	14
Barbeled houndshark	*Leptocharias smithii*	38	...	...	...	...	...	...	111
Gulper shark	*Centrophorus granulosus*	38	0	2	5	40	56	4	-
Leafscale gulper shark	*Centrophorus squamosus*	38	102	79	91	236	338	185	212
Lowfin gulper shark	*Centrophorus lusitanicus*	38	-	-	-	-	59	15	-
Birdbeak dogfish	*Deania calcea*	38	-	-	0	3	15	4	-
Portuguese dogfish	*Centroscymnus coelolepis*	38	-	1	-	102	289	56	-
Longnose velvet dogfish	*Centroscymnus crepidater*	38	-	-	-	1	3	-	-
Knifetooth dogfish	*Scymnodon ringens*	38	-	-	-	-	13	7	-
Kitefin shark	*Dalatias licha*	38	54	...	...	1	15	...	...
Dogfish sharks nei	*Squalidae*	38	75	...	...	0	...	...	...
Blackchin guitarfish	*Rhinobatos cemiculus*	38	...	...	...	...	...	...	161
Guitarfishes, etc. nei	*Rhinobatidae*	38	1 261	1 014	1 478	1 281	1 001	1 402	1 102
Sawfishes	*Pristidae*	38	8	...	...	...	...	...	268
Thornback ray	*Raja clavata*	38	...	...	0	8	18	7	1
Madeiran ray	*Raja maderensis*	38	-	-	-	-	-	1	-
Lusitanian cownose ray	*Rhinoptera marginata*	38	...	...	...	...	...	...	1 166
Mantas, devil rays nei	*Mobulidae*	38	802	435	23	...	...	...	...
Spiny butterfly ray	*Gymnura altavela*	38	...	...	...	...	...	...	144
Rays, stingrays, mantas nei	*Rajiformes*	38	13 950	12 230	14 383	13 647	14 037	15 439	13 402
Chimaeras, etc. nei	*Chimaeriformes*	38	-	1	6	-	-	-	-
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	21 322	33 344	22 144	25 521	28 817	30 612	34 010
Marine fishes nei	*Osteichthyes*	39	311 213	405 660	319 570	341 412	297 794	295 648	204 892
Spinous spider crab	*Maja squinado*	42	108	18	1	2	0	1	4
West African geryon	*Chaceon maritae*	42	48	4	1	2	158	9	-
Marine crabs nei	*Brachyura*	42	5 104	6 313	9 277	4 475	6 671	6 600	6 793
Tropical spiny lobsters nei	*Panulirus spp*	43	2 458	2 861	3 267	1 826	2 663	3 658	5 009
Palinurid spiny lobsters nei	*Palinurus spp*	43	276	221	252	362	331	279	984
Spiny lobsters nei	*Palinuridae*	43	1	...	0	2	0	75	103
Slipper lobsters nei	*Scyllaridae*	43	69	87	96	38	72	35	56
Norway lobster	*Nephrops norvegicus*	43	8	22	39	82	38	14	2
European lobster	*Homarus gammarus*	43	24	181	295	253	264	271	292
Caramote prawn	*Penaeus kerathurus*	45	17	17	43	15	33	22	1
Southern pink shrimp	*Penaeus notialis*	45	13 612	14 660	13 526	13 964	14 331	12 875	11 015
Penaeus shrimps nei	*Penaeus spp*	45	5 029	4 469	5 355	4 827	3 455	3 021	3 250
Deep-water rose shrimp	*Parapenaeus longirostris*	45	1 516	1 623	1 889	2 304	1 221	530	294
Guinea shrimp	*Parapenaeopsis atlantica*	45	324	431	686	109	7	5	5
Scarlet shrimp	*Plesiopenaeus edwardsianus*	45	3	3	28	19	4	1	1
Giant red shrimp	*Aristaeomorpha foliacea*	45	-	-	9	-	-	-	-
Blue and red shrimp	*Aristeus antennatus*	45	0	12	46	90	44	29	-
Striped red shrimp	*Aristeus varidens*	45	745	760	658	612	660	-	2

C-34 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Eastern Central
Atlantique, centre-est
Atlántico, centro-oriental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
West African estuarine prawn	*Nematopalaemon hastatus*	45	10 000	11 700	9 750	11 600	11 500	11 500	11 500
Natantian decapods nei	*Natantia*	45	27 039	32 585	32 501	31 010	17 667	23 517	23 480
Marine crustaceans nei	*Crustacea*	47	64	353	421	452	363	394	316
Murex	*Murex spp*	52	3 090	5 628	2 035	3 020	3 657	2 364	1 415
Pig's snout volute	*Cymbium cymbium*	52	...	...	...	...	...	...	1 007
Volutes nei	*Cymbium spp*	52	5 730	5 975	6 938	7 353	10 184	13 849	11 602
Gastropods nei	*Gastropoda*	52	2 976	2 915	2 682	3 555	3 277	3 693	3 493
Cupped oysters nei	*Crassostrea spp*	53	82	164	43	104	126	116	242
Common edible cockle	*Cerastoderma edule*	56	128	168	80	252	354	534	640
Clams, etc. nei	*Bivalvia*	56	4	3	1	0	-	-	0
Common cuttlefish	*Sepia officinalis*	57	529	435	480	194	199	189	153
Cuttlefish, bobtail squids nei	*Sepiidae, Sepiolidae*	57	24 229	32 395	29 248	28 860	26 282	33 530	30 289
Common squids nei	*Loligo spp*	57	38	73	93	96	125	133	74
Various squids nei	*Loliginidae, Ommastrephidae*	57	2 848	9 269	6 274	3 091	6 482	7 538	5 142
Common octopus	*Octopus vulgaris*	57	9 548	11 455	11 618	6 441	7 125	8 184	5 526
Octopuses, etc. nei	*Octopodidae*	57	36 163	61 073	57 498	48 268	66 238	74 613	49 881
Cephalopods nei	*Cephalopoda*	57	206	154	153	121	1 315	21	36
Marine molluscs nei	*Mollusca*	58	1 312	1 910	1 099	1 087	1 004	1 039	981
Marine turtles nei	*Testudinata*	72	28	37	39	9	9	5	3
Sea cucumbers nei	*Holothuroidea*	76	...	...	...	...	...	...	14
Aquatic invertebrates nei	*Invertebrata*	77	6	11	-	5	-	-	-
Total			***3 605 394***	***3 733 981***	***3 425 743***	***3 282 510***	***3 575 198***	***3 803 744***	***4 044 504***

C-34 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Atlantic, Eastern Central
Atlantique, centre-est
Atlántico, centro-oriental

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Angola	-	470	494	-	-	292	-	-	-	-
Belize	9 794	22 918	1 564	...	24 241	13 368	1 085	29 700	...	104 172
Benin	8 415	10 670	11 648	11 788	9 597	12 007	6 186	7 295	8 678	9 441
Bulgaria	2 154	-	-	-	-	-	-	-	-	-
Cameroon	68 531	65 135	62 801	64 000 F	67 345	62 232	64 232	64 500 F	65 000 F	65 000 F
Cape Verde	8 676	8 145	8 103	10 396	21 617	24 590	18 328	23 768	16 828	19 500 F
China	36 228	13 967	18 539	5 401	21 419	17 074	22 970	24 329	2 820	7 631
China,Taiwan	13 677	9 761	13 695	11 062	9 748	3 094	8 150	7 090	6 533	7 379
Comoros	-	-	-	-	-	-	3 676	9 539	...	31 811
Congo Dem R	5 000 F	5 200 F	5 400 F	5 600 F	5 800 F	6 000	6 000	6 000 F	6 000 F	6 000 F
Congo Rep	22 729	22 433	22 683	26 686	22 116	28 082	29 096	24 742	32 833	34 686
Côte dIvoire	65 503	47 870	46 903	49 545	29 520	48 265	44 111	45 600 F	38 519	64 749
Cuba	12 991	-	-	-	-	-	-	-	-	-
Cyprus	78 743	-	-	-	-	-	-	-	-	-
Eq Guinea	2 600 F	2 600 F	2 650 F	2 650 F	2 900 F	3 100 F	3 633 F	4 500 F	6 669	6 376 F
Estonia	6	4	-	-	-	-	-	-	-	-
France	55 111	53 726	56 331	48 948	41 353	29 316	17 166	22 546	29 591	39 062
Gabon	33 021	32 170	35 972	37 779	34 163	32 162	29 000 F	32 500 F	22 000 F	22 000 F
Gambia	32 027	43 269	34 364	28 923	30 586	32 412	38 709	38 479	41 420	41 970
Georgia	...	...	...	...	...	...	...	...	...	5 544
Germany	2 673	5 168	-	2 339	-	15 407	13 199	-	-	21
Ghana	366 348	296 742	315 770	324 388	316 866	290 675	245 730	274 831	233 115	261 205
Greece	5 972	5 983	4 749	3 204	2 548	4 281	3 296	1 964	1 780	1 780 F
Guatemala	-	-	-	-	10 293	11 213	9 941	11 127	7 633	7 164
Guinea	101 227	87 358	114 845	88 550	98 566	92 581	70 823	81 240	81 000 F	93 000 F
GuineaBissau	6 698 F	7 174 F	6 003 F	6 500 F	6 833 F	6 917 F	6 350 F	6 654 F	6 650 F	6 650 F
Honduras	1 120	67	-	-	45	488	-	-	-	-
Ireland	73 695	39 351	33 438	33 737	33 065	-	-	2 004	12 173	33 299
Italy	7 359	6 202	8 044	7 381	5 354	4 826	4 920	2 910	2 987	1 809
Japan	10 973	8 440	11 585	13 209	12 967	15 734	20 522	17 038	16 291	14 163
Korea Rep	26 809	25 974	28 100	27 225	25 541	23 441	26 121	20 458	23 702	28 873
Latvia	47 335	30 491	37 263	38 346	53 851	53 905	62 015	68 410	81 283	87 238
Liberia	6 496	7 042	6 864	10 525	9 347	6 494	12 745	7 127	7 250 F	7 250 F
Libya	239	666	666	-	-	4	-	-	-	-
Lithuania	110 000	106 434	111 567	131 496	114 876	115 688	99 802	120 731	111 019	116 850
Mauritania	130 142 F	144 131 F	187 650 F	258 733	291 877	150 312	208 207	180 328	201 900	261 238
Morocco	1 066 906	927 648	880 029	877 210	977 488	823 005	833 312	956 935	1 118 464	1 095 101
Netherlands	176 922	161 143	175 108	128 713	117 866	75 900	11 232	80 938	80 205	92 579
NethAntilles	21 753	11 619	19 549	16 686	...	5 547	3 313	15 993	18 169	17 188
Nigeria	297 971	293 814	300 194	282 987	285 131	328 928	303 313	296 955	312 439	323 599
Panama	11 013	7 137	8 347	10 928	45 647	56 824	46 572	18 291	18 805	18 111
Philippines	0	94	-	260	...	41	159	-	-	60
Poland	13 185	28 712	-	-	-	-	-	16 527	41 021	14 604
Portugal	9 899	11 484	11 392	12 653	11 458	14 491	14 661	14 541	13 137	11 921
Russian Fed	129 436	121 505	57 063	159 524	168 913	204 016	170 395	134 814	154 530	206 306
St Kitts Nev	-	-	-	-	-	-	-	-	-	20 706
St Vincent	45 890	41 784	...	14	...	103	215	83	74	63 007
Sao Tome Prn	3 692 F	3 820 F	4 038	4 141	4 196 F	4 150 F	4 250 F	4 500 F	4 550 F	4 650 F
Senegal	380 617	354 328	428 032	400 374	365 500	331 599	374 104	388 653	406 595	375 414
Sierra Leone	61 210	68 990	82 926	120 440	131 993	134 146	130 535	189 582	186 000 F	185 822 F
Spain	159 994	123 680	136 945	116 102	98 812	91 639	84 690	108 262	136 399	131 309
Togo	18 163	15 946	22 485	23 013	22 744	19 879	14 905	18 500 F	22 025	22 535
Ukraine	137 145	91 334	53 407	47 193	66 360	90 260	74 552	47 963	66 794	46 680
UK	31	-	-	1	834	8 507	12 497	35 718	14 167	22 528
Vanuatu	-	-	-	52	814	1 862	1 515	477	412	159
Other nei	120 991	159 115	187 416 F	156 692 F	133 791 F	130 886 F	126 277 F	111 056 F	146 284 F	6 364
Total	***4 007 110***	***3 531 714***	***3 554 622***	***3 605 394***	***3 733 981***	***3 425 743***	***3 282 510***	***3 575 198***	***3 803 744***	***4 044 504***

C-37 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Mediterranean and Black Sea
Méditerranée et mer Noire
Mediterráneo y Mar Negro

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Freshwater bream	*Abramis brama*	11	10	4	3	3	5	6	3
Common carp	*Cyprinus carpio*	11	4	6	8	2	4	-	2
Goldfish	*Carassius auratus*	11	-	-	-	2	3	7	6
Roach	*Rutilus rutilus*	11	5	6	13	18	5	22	16
Roaches nei	*Rutilus spp*	11	47	94	108	126	173	41	79
Sichel	*Pelecus cultratus*	11	39	13	12	4	2	1	-
Asp	*Aspius aspius*	11	-	-	-	1	1	-	1
Cyprinids nei	*Cyprinidae*	11	226	168	126	88	146	107	105
Northern pike	*Esox lucius*	13	-	-	7	6	2	3	3
Wels(=Som)catfish	*Silurus glanis*	13	-	-	-	-	1	-	1
European perch	*Perca fluviatilis*	13	-	-	1	-	-	-	1
Percarina	*Percarina demidoffi*	13	202	14	11	8	1	-	-
Pike-perch	*Sander lucioperca*	13	1 043	906	811	233	142	69	21
Knout goby	*Mesogobius batrachocephalus*	13	-	-	-	-	1	1	0
Freshwater fishes nei	*Osteichthyes*	13	-	260	-	-	11	2	54
Danube sturgeon(=Osetr)	*Acipenser gueldenstaedtii*	21	3	2	1	1	3	2	-
Starry sturgeon	*Acipenser stellatus*	21	3	3	1	...	0	0	-
Beluga	*Huso huso*	21	10	5	-	-	-	-	-
Sturgeons nei	*Acipenseridae*	21	8	6	2	1	1	...	...
European eel	*Anguilla anguilla*	22	524	270	306	344	366	320	360
Rainbow smelt	*Osmerus mordax*	23	-	-	-	-	-	-	1
Salmonoids nei	*Salmonoidei*	23	7	0	1	7	9	7	2
Pontic shad	*Alosa pontica*	24	115	125	59	71	110	150	141
Twaite shad	*Alosa fallax*	24	...	...	...	...	...	...	44
Shads nei	*Alosa spp*	24	3 645	3 999	4 340	5 088	5 116	4 847	4 318
Black and Caspian Sea sprat	*Clupeonella cultriventris*	24	14 538	19 373	16 323	16 975	18 308	16 870	15 449
Three-spined stickleback	*Gasterosteus aculeatus*	25	1	-	2	-	-	-	-
European flounder	*Platichthys flesus*	31	48	322	223	195	184	262	229
Common sole	*Solea solea*	31	5 340	5 246	6 403	6 322	5 795	6 373	6 368
Wedge sole	*Dicologlossa cuneata*	31	7	2	3	5	3	2	1
Soles nei	*Soleidae*	31	19	529	91	53	35	62	57
Megrim	*Lepidorhombus whiffiagonis*	31	218	191	199	197	210	250	227
Brill	*Scophthalmus rhombus*	31	59	55	53	36	33	37	40
Turbot	*Psetta maxima*	31	689	986	1 168	1 276	1 014	890	725
Turbots nei	*Scophthalmidae*	31	561	445	749	1 179	916	794	848
Citharids nei	*Citharidae*	31	68	51	26	30	51	51	2
Flatfishes nei	*Pleuronectiformes*	31	1 605	2 038	1 733	843	828	804	821
Blue ling	*Molva dypterygia*	32	-	-	0	-	-	-	-
Greater forkbeard	*Phycis blennoides*	32	418	579	705	603	633	630	719
Forkbeard	*Phycis phycis*	32	...	105	280	295	245	369	407
Forkbeards nei	*Phycis spp*	32	238	280	314	295	223	233	258
Rocklings nei	*Gaidropsarus spp*	32	20	-	-	12	15	10	1
Poor cod	*Trisopterus minutus*	32	1 205	3 290	2 761	2 278	1 458	1 431	1 693
Pouting(=Bib)	*Trisopterus luscus*	32	159	155	146	125	105	1 339	1 334
Blue whiting(=Poutassou)	*Micromesistius poutassou*	32	9 664	10 717	14 957	12 162	6 424	5 797	5 522
Whiting	*Merlangius merlangus*	32	8 616	10 443	11 206	15 261	14 470	13 328	15 948
European hake	*Merluccius merluccius*	32	21 871	27 434	32 425	28 038	27 718	29 798	25 972
Gadiformes nei	*Gadiformes*	32	80	94	107	85	73	79	104
Atlantic lizardfish	*Synodus saurus*	33	...	...	...	...	...	0	2
Brushtooth lizardfish	*Saurida undosquamis*	33	154	119	76	49	66	83	141
Lizardfishes nei	*Synodontidae*	33	858	1 430	2 112	2 448	2 263	2 163	2 599
Morays	*Muraenidae*	33	11	11	9	10	12	21	24
Flathead grey mullet	*Mugil cephalus*	33	3 373	3 676	3 213	3 052	2 702	3 367	2 752
So-iuy mullet	*Mugil soiuy*	33	4 731	6 843	7 432	6 790	5 027	6 705	3 657
Thicklip grey mullet	*Chelon labrosus*	33	...	...	...	...	...	111	122
Golden grey mullet	*Liza aurata*	33	...	1	0	1	2	56	96
Leaping mullet	*Liza saliens*	33	8	1	2	15	4	7	9
Mullets nei	*Mugilidae*	33	26 837	24 551	21 833	22 329	15 445	15 567	15 914
Dusky grouper	*Epinephelus marginatus*	33	2 222	1 859	1 514	1 207	1 725	1 268	1 204
White grouper	*Epinephelus aeneus*	33	1	1	0	1	2	30	25
Dogtooth grouper	*Epinephelus caninus*	33	6	11	11	4	3	0	3
Groupers nei	*Epinephelus spp*	33	2 163	2 236	2 766	2 780	2 803	2 444	2 552
Groupers, seabasses nei	*Serranidae*	33	1 290	1 570	1 379	1 037	1 120	986	813
Spotted seabass	*Dicentrarchus punctatus*	33	472	640	1 070	759	933	739	737
European seabass	*Dicentrarchus labrax*	33	5 407	2 570	3 502	3 266	2 454	2 539	2 523
Seabasses nei	*Dicentrarchus spp*	33	1 388	1 528	1 352	832	1 075	831	828
Randall's threadfin bream	*Nemipterus randalli*	33	-	-	-	-	-	126	147
Rubberlip grunt	*Plectorhinchus mediterraneus*	33	61	40	37	32	27	54	68
Brown meagre	*Sciaena umbra*	33	102	161	132	74	42	343	335
Shi drum	*Umbrina cirrosa*	33	108	125	90	60	74	75	98
Canary drum(=Baardman)	*Umbrina canariensis*	33	19	4	2	1	4	2	6
Meagre	*Argyrosomus regius*	33	2 534	1 260	1 882	1 534	1 056	1 078	1 025
Croakers, drums nei	*Sciaenidae*	33	187	177	187	271	287	302	509
Blackspot(=red) seabream	*Pagellus bogaraveo*	33	44	18	14	6	14	30	79
Common pandora	*Pagellus erythrinus*	33	5 258	5 226	4 644	5 413	6 620	12 473	13 311
Axillary seabream	*Pagellus acarne*	33	163	127	134	99	153	196	151
Pandoras nei	*Pagellus spp*	33	2 475	3 626	3 835	3 700	2 999	3 528	3 237
Annular seabream	*Diplodus annularis*	33	854	384	882	1 431	1 792	1 479	1 937
White seabream	*Diplodus sargus*	33	1 357	1 626	1 754	1 451	1 651	2 665	2 553
Sargo breams nei	*Diplodus spp*	33	1 638	2 937	2 830	1 948	1 869	2 146	2 417
Large-eye dentex	*Dentex macrophthalmus*	33	485	456	550	712	599	565	558
Common dentex	*Dentex dentex*	33	921	965	1 014	1 752	2 294	1 566	1 555

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Fish, crustaceans, molluscs, etc
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Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Mediterranean and Black Sea
Méditerranée et mer Noire
Mediterráneo y Mar Negro

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Black seabream	*Spondyliosoma cantharus*	33	237	614	934	429	309	350	294
Saddled seabream	*Oblada melanura*	33	683	1 448	1 355	1 619	1 499	1 661	1 569
Red porgy	*Pagrus pagrus*	33	2 387	3 089	4 168	4 312	4 882	4 925	5 132
Pargo breams nei	*Pagrus spp*	33	742	630	718	787	759	790	555
Gilthead seabream	*Sparus aurata*	33	7 271	4 731	5 193	4 790	5 582	5 455	5 456
Bogue	*Boops boops*	33	24 125	30 176	30 744	28 569	32 573	29 045	29 582
Sand steenbras	*Lithognathus mormyrus*	33	913	1 875	2 140	1 710	1 282	1 415	1 410
Salema	*Sarpa salpa*	33	1 795	2 753	3 071	4 071	3 541	3 125	2 996
Porgies, seabreams nei	*Sparidae*	33	6 684	6 096	6 077	2 907	3 228	3 149	3 520
Blotched picarel	*Spicara maena*	33	726	824	713	895	808	673	845
Picarels nei	*Spicara spp*	33	6 934	9 833	8 095	7 368	6 808	6 665	6 871
Surmullet	*Mullus surmuletus*	33	5 824	9 881	10 213	10 780	9 315	8 681	10 600
Red mullet	*Mullus barbatus*	33	6 946	17 121	17 263	17 709	15 325	16 269	15 061
Surmullets(=Red mullets) nei	*Mullus spp*	33	15 539	7 527	9 417	9 758	8 513	12 705	12 689
Goatfishes	*Upeneus spp*	33	-	-	-	-	-	55	66
Pearly razorfish	*Xyrichtys novacula*	33	...	79	181	98	163	274	155
Wrasses, hogfishes, etc. nei	*Labridae*	33	7	7	8	7	6	21	16
Parrotfishes nei	*Scaridae*	33	31	22	63	43	37	362	364
Sandeels(=Sandlances) nei	*Ammodytes spp*	33	403	513	333	491	971	552	784
Greater weever	*Trachinus draco*	33	173	160	226	102	104	134	158
Weevers nei	*Trachinus spp*	33	13	16	16	14	12	10	22
Weeverfishes nei	*Trachinidae*	33	...	95	336	355	267	225	208
Black goby	*Gobius niger*	33	6	3	2	3	1	2	0
Transparent goby	*Aphia minuta*	33	...	365	241	227	238	201	204
Gobies nei	*Gobiidae*	33	14 905	14 132	11 307	10 484	11 747	10 030	11 584
Spinefeet(=Rabbitfishes) nei	*Siganus spp*	33	752	918	1 402	1 727	2 001	1 670	1 696
Flying gurnard	*Dactylopterus volitans*	33	5	4	3	4	5	4	4
Puffers nei	*Tetraodontidae*	33	-	-	-	-	-	-	23
Grey triggerfish	*Balistes carolinensis*	33	146	112	100	70	175	634	683
Triggerfishes, durgons nei	*Balistidae*	33	-	-	-	-	-	7	7
Argentines	*Argentina spp*	34	147	109	128	93	89	73	55
European conger	*Conger conger*	34	2 004	2 688	2 991	3 203	3 284	3 311	2 974
Alfonsinos nei	*Beryx spp*	34	-	-	-	-	-	1	0
John dory	*Zeus faber*	34	336	609	914	1 017	1 066	1 203	1 056
Wreckfish	*Polyprion americanus*	34	189	87	80	75	86	112	118
Red bandfish	*Cepola macrophthalma*	34	224	327	329	294	196	156	134
Black cardinal fish	*Epigonus telescopus*	34	-	-	-	-	-	2	-
Stargazer	*Uranoscopus scaber*	34	...	38	232	262	207	154	172
Oilfish	*Ruvettus pretiosus*	34	7	2	-	-	-	1	3
Largehead hairtail	*Trichiurus lepturus*	34	588	782	1 348	1 237	1 750	1 553	1 815
Silver scabbardfish	*Lepidopus caudatus*	34	524	2 363	2 886	2 845	2 873	3 409	3 487
Ruffs, barrelfishes nei	*Centrolophidae*	34	8	12	24	26	17	16	13
Blackbelly rosefish	*Helicolenus dactylopterus*	34	175	147	154	165	154	164	164
Scorpionfishes nei	*Scorpaenidae*	34	2 307	3 767	3 844	3 818	3 575	4 197	4 090
Tub gurnard	*Chelidonichthys lucerna*	34	35	30	25	25	21	22	21
Red gurnard	*Aspitrigla cuculus*	34	363	434	272	226	226	151	283
Grey gurnard	*Eutrigla gurnardus*	34	526	632	1 224	1 118	1 549	1 224	1 406
Gurnards, searobins nei	*Triglidae*	34	3 710	3 130	3 522	3 166	2 804	2 802	2 970
Monkfishes nei	*Lophius spp*	34	4 456	5 763	5 915	5 510	4 763	5 667	6 174
Demersal percomorphs nei	*Perciformes*	34	264	265	411	560	536	371	426
Round sardinella	*Sardinella aurita*	35	11 231	12 363	12 747	15 246	20 516	10 262	10 287
Sardinellas nei	*Sardinella spp*	35	55 264	54 504	58 569	60 677	63 962	46 163	41 257
European pilchard(=Sardine)	*Sardina pilchardus*	35	181 735	203 557	231 734	212 966	156 428	197 839	159 593
European sprat	*Sprattus sprattus*	35	55 087	59 468	42 801	40 344	73 231	91 835	92 188
European anchovy	*Engraulis encrasicolus*	35	463 778	260 627	410 721	523 263	389 431	363 711	393 531
Clupeoids nei	*Clupeoidei*	35	600	675	761	2 362	2 485	1 885	7 382
Atlantic bonito	*Sarda sarda*	36	11 325	76 224	35 377	12 371	11 697	11 721	14 780
Plain bonito	*Orcynopsis unicolor*	36	11	7	3	172	107	35	29
Wahoo	*Acanthocybium solandri*	36	-	-	-	-	-	-	5
Narrow-barred Spanish mackerel	*Scomberomorus commerson*	36	...	...	...	...	...	89	47
Frigate and bullet tunas	*Auxis thazard, A. rochei*	36	5 832	3 512	3 578	5 241	7 590	6 199	9 829
Little tunny(=Atl.black skipj)	*Euthynnus alletteratus*	36	2 536	2 800	4 041	4 378	4 873	6 684	5 573
Skipjack tuna	*Katsuwonus pelamis*	36	181	30	23	108	80	55	66
Atlantic bluefin tuna	*Thunnus thynnus*	36	23 800	26 062	23 306	25 800	15 743	13 553	6 998
Albacore	*Thunnus alalunga*	36	4 914	3 778	6 077	6 567	3 000	4 745	2 852
Atlantic sailfish	*Istiophorus albicans*	36	3	-	-	-	-	-	-
Mediterranean spearfish	*Tetrapturus belone*	36	87	...	...	...	266	390	1
Atlantic white marlin	*Tetrapturus albidus*	36	0	0	-	-	0	-	-
Marlins,sailfishes,etc. nei	*Istiophoridae*	36	9	50	231	199	14	29	164
Swordfish	*Xiphias gladius*	36	14 436	14 906	14 920	14 508	12 361	12 198	13 764
Tuna-like fishes nei	*Scombroidei*	36	2 696	1 972	1 503	2 022	3 009	4 146	3 851
Garfish	*Belone belone*	37	1 025	1 351	970	933	746	817	1 092
Atlantic saury	*Scomberesox saurus*	37	0	29	26	528	2 204	383	264
Big-scale sand smelt	*Atherina boyeri*	37	293	677	512	1 186	699	1 376	1 096
Silversides(=Sand smelts) nei	*Atherinidae*	37	5 752	7 762	2 441	2 218	2 376	3 301	2 420
Bluefish	*Pomatomus saltatrix*	37	20 585	20 279	9 909	8 015	5 492	7 147	5 989
Shrimp scad	*Alepes djedaba*	37	-	-	-	-	-	61	34
Atlantic horse mackerel	*Trachurus trachurus*	37	10 118	14 972	12 580	9 738	10 766	9 049	7 246
Mediterranean horse mackerel	*Trachurus mediterraneus*	37	21 915	17 476	19 175	27 593	26 687	24 458	18 370
Jack and horse mackerels nei	*Trachurus spp*	37	27 744	43 651	64 881	74 096	73 722	50 568	40 842
Jacks, crevalles nei	*Caranx spp*	37	13	35	23	19	34	25	18
Pompanos nei	*Trachinotus spp*	37	63	89	57	46	68	78	89
Greater amberjack	*Seriola dumerili*	37	1 970	2 658	2 199	2 331	1 666	2 624	2 529
Pilotfish	*Naucrates ductor*	37	...	152	130	126	172	403	70
Leerfish	*Lichia amia*	37	868	738	810	796	784	1 400	1 136

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Vadigo	*Campogramma glaycos*	37	2	1	0	-	0	0	0
Carangids nei	*Carangidae*	37	491	473	494	488	718	709	560
Atlantic pomfret	*Brama brama*	37	37	20	40	17	41	28	36
Common dolphinfish	*Coryphaena hippurus*	37	2 029	3 769	5 046	3 406	3 462	4 178	3 984
Chub mackerel	*Scomber japonicus*	37	28 000	24 924	18 545	14 061	15 327	11 555	10 279
Atlantic mackerel	*Scomber scombrus*	37	11 487	14 945	16 686	13 931	12 064	9 981	6 899
Scomber mackerels nei	*Scomber spp*	37	3 743	825	1 642	1 248	150	152	126
Mackerels nei	*Scombridae*	37	301	321	324	489	465	534	366
European barracuda	*Sphyraena sphyraena*	37	161	226	572	463	436	521	440
Barracudas nei	*Sphyraena spp*	37	2 367	2 503	1 979	2 052	1 721	2 489	2 462
Bluntnose sixgill shark	*Hexanchus griseus*	38	...	...	...	...	...	0	4
Sharpnose sevengill shark	*Heptranchias perlo*	38	...	...	...	...	2	2	2
Basking shark	*Cetorhinus maximus*	38	5	4	4	6	1	-	-
Thresher	*Alopias vulpinus*	38	14	15	14	16	20	25	6
Bigeye thresher	*Alopias superciliosus*	38	-	-	-	-	-	1	-
Shortfin mako	*Isurus oxyrinchus*	38	33	17	9	1	2	29	33
Porbeagle	*Lamna nasus*	38	3	4	5	0	2	1	0
Blackmouth catshark	*Galeus melastomus*	38	90	52	55	77	81	109	117
Small-spotted catshark	*Scyliorhinus canicula*	38	37	28	21	241	28	33	130
Catsharks, nursehounds nei	*Scyliorhinus spp*	38	435	346	412	440	634	735	677
Blue shark	*Prionace glauca*	38	245	67	178	51	86	185	208
Smooth-hounds nei	*Mustelus spp*	38	1 374	2 145	1 844	1 540	1 365	2 914	2 360
Tope shark	*Galeorhinus galeus*	38	23	15	36	21	32	27	38
Longnose spurdog	*Squalus blainville*	38	-	-	-	14	...	...	21
Picked dogfish	*Squalus acanthias*	38	166	121	106	101	131	84	123
Gulper shark	*Centrophorus granulosus*	38	2	3	1	2	11	11	2
Velvet belly	*Etmopterus spinax*	38	1	1	5	8	5	5	7
Portuguese dogfish	*Centroscymnus coelolepis*	38	-	-	-	0	-	-	-
Dogfish sharks nei	*Squalidae*	38	1 213	1 255	1 413	1 310	1 187	8 674	8 405
Angelshark	*Squatina squatina*	38	10	14	36	15	52	74	86
Angelsharks, sand devils nei	*Squatinidae*	38	32	106	106	27	57	34	97
Common guitarfish	*Rhinobatos rhinobatos*	38	...	...	...	...	...	90	69
Guitarfishes, etc. nei	*Rhinobatidae*	38	42	26	44	43	52	165	161
Thornback ray	*Raja clavata*	38	399	390	464	387	423	403	432
Cuckoo ray	*Raja naevus*	38	...	...	...	...	...	1	7
White skate	*Raja alba*	38	...	...	...	...	...	...	6
Mediterranean starry ray	*Raja asterias*	38	...	...	...	...	...	2	6
Raja rays nei	*Raja spp*	38	162	165	216	221	246	271	275
Common stingray	*Dasyatis pastinaca*	38	-	-	-	2	2	2	7
Stingrays, butterfly rays nei	*Dasyatidae*	38	2	2	1	3	2	5	4
Common eagle ray	*Myliobatis aquila*	38	1	0	...	0	...	0	2
Eagle rays nei	*Myliobatidae*	38	9	45	39	33	34	27	18
Rays, stingrays, mantas nei	*Rajiformes*	38	2 809	3 595	3 358	3 584	2 996	3 181	3 172
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	1 738	1 405	4 023	2 978	3 731	2 983	3 517
Marine fishes nei	*Osteichthyes*	39	55 922	67 862	64 021	53 863	67 728	65 628	57 644
Freshwater crustaceans nei	*Crustacea*	41	-	1	-	1	3	3	1
Blue swimming crab	*Portunus pelagicus*	42	...	...	...	...	...	126	115
Mediterranean shore crab	*Carcinus aestuarii*	42	44	73	60	94	92	115	110
Spinous spider crab	*Maja squinado*	42	123	120	77	249	248	27	35
Mediterranean geryon	*Geryon longipes*	42	67	57	60	88	125	119	141
Marine crabs nei	*Brachyura*	42	1 968	3 726	3 826	5 593	4 885	5 363	5 254
Pink spiny lobster	*Palinurus mauritanicus*	43	-	-	0	-	-	-	-
Common spiny lobster	*Palinurus elephas*	43	250	384	383	353	328	449	384
Palinurid spiny lobsters nei	*Palinurus spp*	43	189	100	100	113	181	135	87
Slipper lobsters nei	*Scyllaridae*	43	90	65	46	24	62	85	80
Norway lobster	*Nephrops norvegicus*	43	3 514	5 564	5 783	5 684	4 951	5 403	4 992
European lobster	*Homarus gammarus*	43	110	164	168	171	187	181	185
Lobsters nei	*Reptantia*	43	1	1	1	2	2	2	4
Kuruma prawn	*Penaeus japonicus*	45	10	105	34	61	101	141	229
Caramote prawn	*Penaeus kerathurus*	45	5 901	6 662	6 417	6 588	4 860	5 422	6 257
Speckled shrimp	*Metapenaeus monoceros*	45	2 582	1 564	1 325	1 111	69	477	258
Deep-water rose shrimp	*Parapenaeus longirostris*	45	7 702	16 326	16 451	13 483	13 586	15 569	15 178
Giant red shrimp	*Aristaeomorpha foliacea*	45	65	45	36	23	73	79	79
Blue and red shrimp	*Aristeus antennatus*	45	2 393	2 413	2 454	2 210	2 605	2 363	1 987
Aristeid shrimps nei	*Aristeidae*	45	1 546	3 174	3 623	3 207	2 423	2 957	3 231
Baltic prawn	*Palaemon adspersus*	45	...	...	...	...	...	...	33
Common prawn	*Palaemon serratus*	45	...	23	15	11	31	22	16
Common shrimp	*Crangon crangon*	45	39	120	113	99	82	128	135
Natantian decapods nei	*Natantia*	45	10 841	11 888	9 234	7 803	14 666	14 990	14 872
Spottail mantis squillid	*Squilla mantis*	47	7 177	7 533	7 477	8 008	7 116	7 789	7 473
Red sea mantis shrimp	*Erugosquilla massavensis*	47	-	-	-	-	-	300	295
Marine crustaceans nei	*Crustacea*	47	1 845	757	746	880	937	920	869
Common periwinkle	*Littorina littorea*	52	...	4	4	20	10	33	15
Murex	*Murex spp*	52	217	160	162	138	161	156	162
Sea snails	*Rapana spp*	52	2 737	954	3 295	5 163	3 513	2 885	5 539
Gastropods nei	*Gastropoda*	52	348	5 397	5 560	4 799	3 915	4 177	4 002
European flat oyster	*Ostrea edulis*	53	171	131	141	213	54	37	29
Mediterranean mussel	*Mytilus galloprovincialis*	54	41 264	12 638	9 702	2 603	1 114	8 022	2 407
Great Atlantic scallop	*Pecten maximus*	55	7	8	2	3	...	3	1
Great Mediterranean scallop	*Pecten jacobaeus*	55	1 576	337	124	49	47	156	93

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Scallops nei	*Pectinidae*	55	3	789	788	641	251	337	303
Striped venus	*Chamelea gallina*	56	54 618	26 192	68 260	76 419	62 251	42 219	46 994
Pullet carpet shell	*Venerupis pullastra*	56	-	0	0	0	-	-	0
Smooth callista	*Callista chione*	56	...	2 956	2 190	1 853	1 669	1 955	1 679
Grooved carpet shell	*Ruditapes decussatus*	56	531	622	487	616	538	508	447
Venus clams nei	*Veneridae*	56	12	...	1 266	1 334	1 255	70	58
Donax clams	*Donax spp*	56	228	568	655	391	347	359	212
Solen razor clams nei	*Solen spp*	56	5	-	-	-	-	-	-
Razor clams, knife clams nei	*Solenidae*	56	...	471	304	182	210	364	358
Cockles nei	*Cardiidae*	56	...	166	72	28	48	31	32
Tellins nei	*Tellina spp*	56	...	...	...	...	...	31	30
Clams, etc. nei	*Bivalvia*	56	1 241	1 566	1 261	1 242	1 149	630	941
Common cuttlefish	*Sepia officinalis*	57	10 218	9 826	10 293	10 901	8 839	9 131	10 240
Cuttlefish, bobtail squids nei	*Sepiidae, Sepiolidae*	57	6 940	12 055	14 708	18 884	15 017	13 883	11 637
European squid	*Loligo vulgaris*	57	1	3	5	7	7	6	22
Common squids nei	*Loligo spp*	57	4 655	5 774	6 039	5 491	5 467	5 778	5 716
Broadtail shortfin squid	*Illex coindetii*	57	2 029	5 161	4 414	3 928	4 503	4 226	3 771
European flying squid	*Todarodes sagittatus*	57	120	175	122	113	210	215	328
Various squids nei	*Loliginidae, Ommastrephidae*	57	1 705	1 616	1 596	1 800	2 197	2 294	2 657
Common octopus	*Octopus vulgaris*	57	15 714	12 857	11 715	10 698	8 193	8 974	10 311
Horned and musky octopuses	*Eledone spp*	57	2 232	8 293	8 110	9 598	7 690	8 306	7 007
Octopuses, etc. nei	*Octopodidae*	57	7 067	10 169	9 614	9 811	8 832	8 309	7 970
Cephalopods nei	*Cephalopoda*	57	712	927	936	2 218	830	28	53
Marine molluscs nei	*Mollusca*	58	21 223	18 287	16 310	17 632	15 564	10 591	15 460
Grooved sea squirt	*Microcosmus sulcatus*	74	77	3	3	3	3	5	6
Stony sea urchin	*Paracentrotus lividus*	76	173	18	82	...	...	34	106
Sea cucumbers nei	*Holothuroidea*	76	2	4	4	3	3	5	3
Jellyfishes nei	*Rhopilema spp*	77	1 000	544	1 017	-	-	-	-
Aquatic invertebrates nei	*Invertebrata*	77	96	68	169	132	413	320	289
Total			***1 510 187***	***1 442 302***	***1 618 243***	***1 686 058***	***1 488 723***	***1 468 537***	***1 429 143***

C-37 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Mediterranean and Black Sea
Méditerranée et mer Noire
Mediterráneo y Mar Negro

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Albania	1 937	2 488	1 535	2 742	2 790	3 287	2 906	3 362	3 694	3 103
Algeria	133 623	134 320	140 957	113 462	126 259	145 762	147 362	138 861	127 513	93 607
Bosnia Herzg	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F
Bulgaria	4 880	13 555	10 211	5 818	3 409	5 628	7 830	7 667	7 390	9 684
China,Taiwan	197	131	421	51	277	9	-	-	-	-
Croatia	18 455	21 205	19 927	30 127	34 632	37 807	40 139	48 979	55 325	52 372
Cyprus	2 245	1 908	1 740	1 528	1 886	2 135	2 426	1 991	1 385	1 400
Egypt	59 624	59 619	46 973	47 481	56 721	72 666	83 762	88 882	78 790	77 388
France	43 107	44 754	47 885	37 862	31 176	32 298	37 387	21 900	19 877	17 596
Georgia	1 628	1 801	3 267	11 937	9 923 F	9 659 F	18 147	26 462	25 000 F	25 000 F
Gibraltar	0	0	0	0	0	0	0	0	0	0
Greece	85 037	87 360	85 468	88 742	88 294	92 542	91 358	86 035	80 608	80 280 F
Israel	3 618	3 444	2 961	2 103	2 680	2 145	2 545	2 434 F	2 261	2 136
Italy	294 314	254 642	273 255	262 300	278 384	296 900	273 256	221 652	239 564	228 440
Japan	188	390	487	203	271	556	472	84	19	-
Korea Rep	-	-	-	700	987	68	276	340	122	-
Lebanon	3 650	3 673	3 613	3 601	3 523	3 541	3 541 F	3 541 F	3 541 F	3 541 F
Libya	47 051 F	43 342 F	41 163 F	39 897	37 390 F	34 594 F	31 921	47 645	52 110	50 000 F
Malta	902	1 084	1 138	1 138	1 406	1 330	1 235	1 279	1 595	1 836
Monaco	3 F	3 F	3 F	3 F	2 F	1 F	1 F	1 F	1 F	1 F
Montenegro	...	...	...	...	...	568	539	638	563	610
Morocco	27 517	31 856	36 959	40 091	45 977	50 523	42 137	35 752	40 578	33 913
Palest, O.T.	1 950	2 379	1 507	2 951	1 814	2 323	2 702	2 843	1 525	1 699
Portugal	288	29	8	359	98	54	24	37	58	85
Romania	2 431	2 122	1 612	1 840	2 026	614	518	444	332	231
Russian Fed	33 668	40 004	42 578	35 318	33 725	31 850	26 847	30 413	32 669	30 664
Serbia-Monte	445	466	497	477	443	...	...	...	...	...
Slovenia	1 621	1 460	1 086	814	1 021	931	915	686	868	764
Spain	139 143	118 340	93 083	94 023	109 897	130 759	119 443	105 359	102 416	99 722
Syria	2 322	2 823	3 060	3 077	3 677	3 395	3 381	3 212	3 107	2 956
Tunisia	97 630	95 815	89 367	110 482	107 893	110 024	102 706	96 810	96 668	96 620
Turkey	484 410	522 744	463 074	504 897	380 381	488 966	589 129	453 115	425 046	445 680
Ukraine	90 840	79 654	64 244	65 449	75 335	57 303	53 148	58 294	65 907	69 810
Other nei	571	508	610	709	-	-	-	-	-	-
Total	***1 583 300***	***1 571 924***	***1 478 694***	***1 510 187***	***1 442 302***	***1 618 243***	***1 686 058***	***1 488 723***	***1 468 537***	***1 429 143***

C-41 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Southwest
Atlantique, sud-ouest
Atlántico, sudoccidental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Tonguefishes	*Cynoglossidae*	31	-	-	38	-	-	-	-
Bastard halibuts nei	*Paralichthys spp*	31	8 710	9 857	10 492	10 330	10 840	10 148	10 153
Flatfishes nei	*Pleuronectiformes*	31	39	17	-	-	-	9	2
Blue antimora	*Antimora rostrata*	32	24	18	12	9	35	10	12
Tadpole codling	*Salilota australis*	32	6 384	5 654	6 374	9 815	12 088	12 083	9 938
Brazilian codling	*Urophycis brasiliensis*	32	4 752	5 360	5 260	7 716	5 768	7 435	7 035
Southern blue whiting	*Micromesistius australis*	32	78 864	53 727	52 203	41 209	33 049	32 076	18 108
Southern hake	*Merluccius australis*	32	5 924	3 869	3 425	2 871	3 172	3 343	2 771
Argentine hake	*Merluccius hubbsi*	32	480 588	422 715	406 876	346 832	315 516	331 302	345 685
Hakes nei	*Merluccius spp*	32	1 434	1 661	1 297	1 047	845	1 461	2 260
Patagonian grenadier	*Macruronus magellanicus*	32	145 697	136 182	145 773	116 738	128 446	134 999	103 136
Ridge scaled rattail	*Macrourus carinatus*	32	5 067	1 835	2 360	2 232	12 562	5 383	4 357
Bigeye grenadier	*Macrourus holotrachys*	32	-	-	2	11	53	-	-
Grenadiers nei	*Macrourus spp*	32	198	769	1 449	1 626	1 782	2 322	2 023
Gadiformes nei	*Gadiformes*	32	192	249	1	2	1	116	75
Tarpon	*Megalops atlanticus*	33	1 035	860	898	636	785	865	818
Sea catfishes nei	*Ariidae*	33	33 434	29 638	30 569	28 966	30 270	33 347	31 556
Morays	*Muraenidae*	33	...	...	...	...	41	46	43
Mullets nei	*Mugilidae*	33	14 349	16 920	14 419	22 141	17 526	19 319	18 330
Snooks(=Robalos) nei	*Centropomus spp*	33	4 577	3 442	3 318	3 947	3 499	3 859	3 645
Brazilian groupers nei	*Mycteroperca spp*	33	1 770	2 128	1 757	1 781	1 856	2 047	1 935
Red grouper	*Epinephelus morio*	33	1 714	1 273	1 104	863	1 062	1 171	1 107
Groupers nei	*Epinephelus spp*	33	659	1 855	735	833	722	795	751
Argentine seabass	*Acanthistius brasilianus*	33	5 111	5 983	4 469	4 472	4 570	4 679	4 198
Bigeyes nei	*Priacanthus spp*	33	70	89	102	398	190	210	198
Southern red snapper	*Lutjanus purpureus*	33	5 994	7 793	6 587	3 694	5 943	6 555	6 199
Lane snapper	*Lutjanus synagris*	33	1 306	1 778	1 863	2 036	1 855	2 046	1 933
Yellowtail snapper	*Ocyurus chrysurus*	33	2 667	5 376	5 371	3 717	4 745	5 233	4 945
Snappers, jobfishes nei	*Lutjanidae*	33	5 303	5 339	6 539	7 875	6 861	7 567	7 146
Barred grunt	*Conodon nobilis*	33	133	137	154	161	147	163	154
Grunts, sweetlips nei	*Haemulidae(=Pomadasyidae)*	33	2 459	2 811	3 254	3 792	3 219	3 550	3 298
Acoupa weakfish	*Cynoscion acoupa*	33	21 258	20 778	20 052	20 411	20 039	22 102	20 879
Jamaica weakfish	*Cynoscion jamaicensis*	33	2 486	2 731	3 393	2 776	2 946	3 249	3 068
Smooth weakfish	*Cynoscion leiarchus*	33	694	1 002	1 080	692	910	1 003	948
Striped weakfish	*Cynoscion striatus*	33	26 583	18 692	25 266	24 579	26 191	19 609	18 252
Green weakfish	*Cynoscion virescens*	33	1 136	1 488	431	331	743	820	778
Stripped weakfish	*Cynoscion guatucupa*	33	6 256	9 253	5 135	3 050	5 747	6 339	6 002
Weakfishes nei	*Cynoscion spp*	33	8 544	7 229	12 220	19 239	6 185	6 822	6 435
Whitemouth croaker	*Micropogonias furnieri*	33	77 301	80 322	101 263	97 698	91 104	96 125	74 392
Southern kingcroaker	*Menticirrhus americanus*	33	-	-	-	-	-	1	0
Kingcroakers nei	*Menticirrhus spp*	33	1 655	2 186	2 126	1 961	1 953	2 134	2 036
Argentine croaker	*Umbrina canosai*	33	17 324	9 313	19 666	17 458	15 639	17 885	17 230
King weakfish	*Macrodon ancylodon*	33	5 761	4 476	5 671	5 121	12 753	14 685	12 575
Shorthead drum	*Larimus breviceps*	33	159	207	218	254	221	244	231
Black drum	*Pogonias cromis*	33	634	703	561	702	504	338	747
Bigtooth corvina	*Isopisthus parvipinnis*	33	2	104	131	16	83	91	86
Croakers, drums nei	*Sciaenidae*	33	312	146	407	-	307	338	320
South American silver porgy	*Diplodus argenteus*	33	10	19	32	26	82	14	26
Red porgy	*Pagrus pagrus*	33	4 442	5 287	7 101	6 559	9 336	9 967	8 339
Porgies, seabreams nei	*Sparidae*	33	9	-	-	0	-	1	4
Argentine goatfish	*Mullus argentinae*	33	178	238	416	350	304	447	357
Goatfishes, red mullets nei	*Mullidae*	33	2 102	1 442	1 394	1 388	1 382	1 524	1 440
Irish mojarra	*Diapterus auratus*	33	2 592	1 708	2 087	2 074	1 918	2 115	1 997
Sea chubs nei	*Kyphosidae*	33	47	57	54	44	51	56	53
Parrotfishes nei	*Scaridae*	33	364	280	357	135	254	280	264
Channel bull blenny	*Cottoperca gobio*	33	-	-	5	30	25	17	13
Patagonian blennie	*Eleginops maclovinus*	33	73	59	57	16	21	28	70
Antarctic rockcods, noties nei	*Nototheniidae*	33	568	4 236	10 513	8 363	12 461	42 428	53 572
Brazilian flathead	*Percophis brasiliensis*	33	6 797	8 479	9 139	8 577	8 817	8 886	8 556
Argentinian sandperch	*Pseudopercis semifasciata*	33	2 903	3 768	3 462	3 324	3 224	2 931	2 395
Brazilian sandperch	*Pinguipes brasilianus*	33	-	-	-	1	2	6	15
Spadefishes nei	*Ephippidae*	33	265	315	250	198	246	271	256
Puffers nei	*Tetraodontidae*	33	297	682	724	409	596	657	621
Triggerfishes, durgons nei	*Balistidae*	33	6 590	6 349	5 494	3 787	5 026	5 543	5 240
Bocon toadfish	*Amphichthys cryptocentrus*	33	218	304	340	311	312	344	325
Argentine conger	*Conger orbignyanus*	34	302	256	204	19	133	140	69
Conger eels, etc. nei	*Congridae*	34	-	-	27	5	5	12	0
Pink cusk-eel	*Genypterus blacodes*	34	19 293	21 284	23 889	24 638	20 055	20 538	20 855
Cusk-eels, brotulas nei	*Ophidiidae*	34	577	642	576	626	583	643	608
Silvery John dory	*Zenopsis conchifer*	34	...	...	...	...	46	51	48
Wreckfish	*Polyprion americanus*	34	47	39	116	191	146	76	100
Tilefishes nei	*Branchiostegidae*	34	614	790	782	939	773	845	798
Tripletail	*Lobotes surinamensis*	34	24	21	21	14	18	20	19
Castaneta	*Cheilodactylus bergi*	34	1 183	4 014	4 497	2 273	5 817	2 068	1 458
Patagonian toothfish	*Dissostichus eleginoides*	34	6 671	4 917	5 899	7 571	5 460	5 396	5 988
Patagonian rockcod	*Patagonotothen brevicauda*	34	126	-	-	-	-	-	-
Longtail Southern cod	*Patagonotothen ramsayi*	34	1 088	8 981	23 029	30 977	60 818	33 081	33 217
Mackerel icefish	*Champsocephalus gunnari*	34	75	-	5	17	5	-	-
Pike icefish	*Champsocephalus esox*	34	-	0	22	2	90	1	5
Snoek	*Thyrsites atun*	34	-	-	2	-	-	-	-
Escolar	*Lepidocybium flavobrunneum*	34	30	40	21	8	39	1	14
Oilfish	*Ruvettus pretiosus*	34	-	17	32	72	111	62	65
Snake mackerels, escolars nei	*Gempylidae*	34	74	-	-	29	-	164	122
Largehead hairtail	*Trichiurus lepturus*	34	2 336	2 336	2 293	3 853	2 773	2 981	3 086
Hairtails, scabbardfishes nei	*Trichiuridae*	34	43	21	14	-	-	-	-
Choicy ruff	*Seriolella porosa*	34	5 971	3 785	6 160	4 691	6 241	6 479	2 834
Ruffs, barrelfishes nei	*Centrolophidae*	34	1	53	41	-	-	41	2

C-41 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Southwest
Atlantique, sud-ouest
Atlántico, sudoccidental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Patagonian redfish	*Sebastes oculatus*	34	...	...	...	...	32	...	2
Blackbelly rosefish	*Helicolenus dactylopterus*	34	2 149	2 809	2 544	2 307	2 247	2 494	2 622
Scorpionfishes nei	*Scorpaenidae*	34	1	-	-	-	4	2	33
Atlantic searobins	*Prionotus spp*	34	4 419	7 637	5 660	5 251	5 275	5 826	5 495
Blackfin goosefish	*Lophius gastrophysus*	34	2 434	2 550	2 517	2 508	2 488	2 744	2 592
Demersal percomorphs nei	*Perciformes*	34	341	-	-	-	-	-	-
Brazilian sardinella	*Sardinella brasiliensis*	35	53 421	42 657	54 201	55 940	74 631	83 286	62 134
Brazilian menhaden	*Brevoortia aurea*	35	1 151	1 036	986	1 558	1 046	1 170	1 027
Argentine menhaden	*Brevoortia pectinata*	35	116	110	9	31	61	81	97
Scaled sardines	*Harengula spp*	35	335	296	298	226	268	296	280
Atlantic thread herring	*Opisthonema oglinum*	35	5 754	4 853	7 673	13 252	8 375	9 237	8 710
Falkland sprat	*Sprattus fuegensis*	35	-	-	9	11	-	1	0
Argentine anchovy	*Engraulis anchoita*	35	39 367	44 034	44 275	27 824	22 887	27 754	26 323
Marini's anchovy	*Anchoa marinii*	35	...	...	...	18	36	...	...
Anchovies, etc. nei	*Engraulidae*	35	4 676	3 353	5 181	4 374	4 445	4 902	4 627
Clupeoids nei	*Clupeoidei*	35	19 797	15 923	17 350	18 190	16 780	18 508	17 477
Atlantic bonito	*Sarda sarda*	36	269	200	533	405	360	587	406
Wahoo	*Acanthocybium solandri*	36	519	449	113	76	77	70	19
King mackerel	*Scomberomorus cavalla*	36	247	202	316	33	4 232	4 683	4 473
Serra Spanish mackerel	*Scomberomorus brasiliensis*	36	814	471	1 432	563	407	449	424
Seerfishes nei	*Scomberomorus spp*	36	...	...	...	...	9 187	10 133	9 573
Frigate and bullet tunas	*Auxis thazard, A. rochei*	36	413	532	604	203	149	313	204
Little tunny(=Atl.black skipj)	*Euthynnus alletteratus*	36	324	280	454	399	444	490	463
Skipjack tuna	*Katsuwonus pelamis*	36	23 078	26 405	23 318	24 205	20 866	23 315	21 320
Atlantic bluefin tuna	*Thunnus thynnus*	36	-	-	12	0	-	-	-
Blackfin tuna	*Thunnus atlanticus*	36	118	90	243	233	315	348	329
Albacore	*Thunnus alalunga*	36	10 664	8 004	7 826	5 665	5 716	5 966	4 159
Southern bluefin tuna	*Thunnus maccoyii*	36	-	-	-	8	-	1	1
Yellowfin tuna	*Thunnus albacares*	36	8 420	8 935	4 933	6 687	4 974	5 266	5 097
Bigeye tuna	*Thunnus obesus*	36	7 336	5 357	5 579	6 091	6 759	8 492	6 765
Slender tuna	*Allothunnus fallai*	36	-	-	-	-	0	-	-
Atlantic sailfish	*Istiophorus albicans*	36	665	520	361	343	945	920	248
Blue marlin	*Makaira nigricans*	36	291	698	470	415	426	382	283
Atlantic white marlin	*Tetrapturus albidus*	36	302	282	172	221	214	273	48
Longbill spearfish	*Tetrapturus pfluegeri*	36	...	49	48	19	43	4	15
Marlins,sailfishes,etc. nei	*Istiophoridae*	36	48	12	26	81	213	73	32
Swordfish	*Xiphias gladius*	36	7 977	7 797	9 835	8 443	6 005	7 910	4 027
Tuna-like fishes nei	*Scombroidei*	36	593	208	164	215	1 208	971	1 457
Ballyhoo halfbeak	*Hemiramphus brasiliensis*	37	1 761	429	867	2 081	1 093	1 205	1 136
Flyingfishes nei	*Exocoetidae*	37	1 289	726	1 063	1 256	1 014	1 119	1 056
Opah	*Lampris guttatus*	37	12	0	16	0	0	-	-
...A	*Odontesthes smitti*	37	...	...	...	...	...	3	0
Silversides(=Sand smelts) nei	*Atherinidae*	37	41	46	257	397	526	380	565
Bluefish	*Pomatomus saltatrix*	37	3 952	2 856	5 008	4 003	3 784	4 128	4 429
Cobia	*Rachycentron canadum*	37	919	1 161	898	635	885	976	923
Rough scad	*Trachurus lathami*	37	770	1 456	1 290	2 584	1 767	1 938	1 724
Blue runner	*Caranx crysos*	37	854	1 592	1 813	1 384	1 568	1 730	1 634
Jacks, crevalles nei	*Caranx spp*	37	5 649	5 669	5 451	6 971	5 716	6 306	5 952
Atlantic moonfish	*Selene setapinnis*	37	1 909	1 689	31	23	1 965	2 168	2 046
Pompanos nei	*Trachinotus spp*	37	536	649	453	152	1 048	1 155	1 094
Yellowtail amberjack	*Seriola lalandi*	37	83	162	386	285	339	383	356
Amberjacks nei	*Seriola spp*	37	833	627	940	904	806	898	842
Atlantic bumper	*Chloroscombrus chrysurus*	37	2 982	3 060	2 869	2 868	2 694	2 971	2 806
Parona leatherjacket	*Parona signata*	37	3 101	1 623	2 014	1 552	1 496	1 083	797
Bigeye scad	*Selar crumenophthalmus*	37	441	1 151	458	262	618	682	646
Carangids nei	*Carangidae*	37	806	683	956	1 203	1 781	1 964	1 856
Common dolphinfish	*Coryphaena hippurus*	37	6 395	13 201	8 156	8 875	7 806	8 592	8 003
Chub mackerel	*Scomber japonicus*	37	8 450	12 461	12 928	18 915	18 216	18 193	32 532
Mackerels nei	*Scombridae*	37	1	...	...	0	1 835	2 023	1 911
Southwest Atlantic butterfish	*Stromateus brasiliensis*	37	...	...	1 035	1 162	1 171	2 480	2 489
American harvestfish	*Peprilus paru*	37	118	423	709	1 210	1 202	1 364	1 463
Butterfishes, pomfrets nei	*Stromateidae*	37	4	20	3	7	103	116	35
Barracudas nei	*Sphyraena spp*	37	396	419	346	375	373	412	389
Ocean sunfish	*Mola mola*	37	-	-	-	0	5	5	22
Pelagic percomorphs nei	*Perciformes*	37	-	1	0	0	0	-	-
Bluntnose sixgill shark	*Hexanchus griseus*	38	...	...	...	...	...	21	8
Broadnose sevengill shark	*Notorynchus cepedianus*	38	-	-	-	-	6	3	1
Sand tiger shark	*Carcharias taurus*	38	3	4	0	0	0	5	1
Thresher	*Alopias vulpinus*	38	9	20	4	1	3	...	5
Bigeye thresher	*Alopias superciliosus*	38	83	114	83	70	85	17	22
Shortfin mako	*Isurus oxyrinchus*	38	932	1 067	787	788	971	1 078	624
Porbeagle	*Lamna nasus*	38	12	29	37	8	43	15	6
Great white shark	*Carcharodon carcharias*	38	-	1	-	-	-	-	-
Blue shark	*Prionace glauca*	38	7 361	8 048	8 502	10 260	11 931	11 232	14 433
Oceanic whitetip shark	*Carcharhinus longimanus*	38	187	78	76	14	242	...	...
Silky shark	*Carcharhinus falciformis*	38	286	20	0	1	2	4	1
Copper shark	*Carcharhinus brachyurus*	38	-	-	-	0	1	8	1
Tiger shark	*Galeocerdo cuvier*	38	0	0	3	6	7	10	10
Requiem sharks nei	*Carcharhinidae*	38	257	328	502	1 427	450	201	151
Smooth hammerhead	*Sphyrna zygaena*	38	17	...	5	21	7	9	-
Scalloped hammerhead	*Sphyrna lewini*	38	177	175	177	120	123	87	74
Hammerhead sharks, etc. nei	*Sphyrnidae*	38	47	24	27	1	12	20	...
Narrownose smooth-hound	*Mustelus schmitti*	38	8 748	8 636	10 266	9 873	10 893	9 476	8 264
Smooth-hounds nei	*Mustelus spp*	38	3	-	-	-	-	-	-
Tope shark	*Galeorhinus galeus*	38	383	393	368	206	159	275	233

C-41 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Southwest
Atlantique, sud-ouest
Atlántico, sudoccidental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Picked dogfish	*Squalus acanthias*	38	-	-	113	119	148	232	268
Dogfish sharks nei	*Squalidae*	38	26	2	9	13	17	...	1
Argentine angelshark	*Squatina argentina*	38	4 096	4 097	4 516	4 524	5 453	5 276	5 534
Chola guitarfish	*Rhinobatos percellens*	38	1	5	16	1	4	...	26
Spotback skate	*Raja castelnaui*	38	...	...	...	...	...	25	60
Eyespot skate	*Raja cyclophora*	38	...	...	...	...	...	73	288
Raja rays nei	*Raja spp*	38	18	1	-	-	-	-	59
Broadnose skate	*Bathyraja brachyurops*	38	...	...	...	...	...	182	0
Patagonian skate	*Bathyraja macloviana*	38	...	...	...	...	...	20	12
Yellownose skate	*Dipturus chilensis*	38	...	...	...	...	...	1 331	1 459
Rio skate	*Rioraja agassizi*	38	...	...	...	...	...	237	417
Smallnose fanskate	*Sympterygia bonapartii*	38	...	...	...	...	...	187	424
Bignose fanskate	*Sympterygia acuta*	38	...	...	...	...	...	53	39
Eagle rays nei	*Myliobatidae*	38	-	-	4	11	4	15	1
Rays, stingrays, mantas nei	*Rajiformes*	38	37 092	39 088	38 554	42 046	39 615	37 116	34 534
Plownose chimaera	*Callorhinchus callorynchus*	38	1 646	1 875	1 514	1 692	2 693	2 782	2 139
Various sharks nei	*Selachimorpha(Pleurotremata)*	38	684	1 088	1 337	917	989	820	936
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	10 774	12 103	10 371	10 132	10 892	12 664	13 996
Marine fishes nei	*Osteichthyes*	39	78 968	79 149	77 667	70 556	48 455	55 626	48 419
Dana swimcrab	*Callinectes danae*	42	1 345	2 761	2 415	1 461	2 181	2 405	2 274
Southwest Atlantic red crab	*Chaceon notialis*	42	4 403	4 635	2 640	2 359	1 504	1 712	1 760
Marine crabs nei	*Brachyura*	42	9 328	10 172	8 041	6 881	8 265	9 084	8 683
Caribbean spiny lobster	*Panulirus argus*	43	8 689	6 927	6 724	6 479	6 589	7 268	6 866
Southern lobsterette	*Thymops birsteini*	43	-	-	-	11	-	-	-
Swarming squat lobster	*Munida gregaria*	44	-	17	4	349	-	0	5
Southern king crab	*Lithodes santolla*	44	1 162	961	845	533	769	325	710
Softshell red crab	*Paralomis granulosa*	44	175	58	344	54	0	0	0
King crabs, stone crabs nei	*Lithodidae*	44	0	1	2	-	-	-	-
Redspotted shrimp	*Penaeus brasiliensis*	45	6 355	9 390	12 382	8 238	9 829	10 841	10 237
Sao Paulo shrimp	*Penaeus paulensis*	45	109	38	0	0	54	11	...
Penaeus shrimps nei	*Penaeus spp*	45	13 964	13 319	12 137	12 244	12 342	13 612	12 861
Atlantic seabob	*Xiphopenaeus kroyeri*	45	12 185	15 788	13 943	15 060	14 659	16 168	15 276
Argentine stiletto shrimp	*Artemesia longinaris*	45	166	181	121	104	367	221	104
Argentine red shrimp	*Pleoticus muelleri*	45	27 127	7 510	44 405	47 619	47 406	53 731	72 085
Natantian decapods nei	*Natantia*	45	13	7	-	8 418	660	-	-
Antarctic krill	*Euphausia superba*	46	-	-	43	-	-	-	10
Marine crustaceans nei	*Crustacea*	47	356	511	460	509	1 045	1 160	1 094
Helmet ton	*Tonna galea*	52	0	0	0	0	0	109	...
Angulate volute	*Zidona dufresnei*	52	970	801	546	474	448	104	512
Cupped oysters nei	*Crassostrea spp*	53	1 076	1 368	1 406	800	1 174	1 295	1 223
Chilean mussel	*Mytilus chilensis*	54	-	1	0	1	0	-	-
River Plata mussel	*Mytilus platensis*	54	131	84	81	19	142	33	81
Cholga mussel	*Aulacomya ater*	54	-	-	-	-	88	...	4
Sea mussels nei	*Mytilidae*	54	1 400	2 654	2 338	1 348	5 616	6 194	2 116
Patagonian scallop	*Zygochlamis patagonica*	55	45 654	41 365	81 625	53 746	58 719	80 822	50 873
Carpet shells nei	*Ruditapes spp*	56	...	...	...	...	620	0	346
Rostrate pitar	*Pitar rostratus*	56	833	852	328	865	0	-	25
Triangular tivela	*Tivela mactroides*	56	753	604	2 461	1 820	1 590	1 754	1 652
American yellow cockle	*Trachycardium muricatum*	56	-	11	1	54	-	0	2
Clams, etc. nei	*Bivalvia*	56	-	-	-	-	512	...	...
Patagonian squid	*Loligo gahi*	57	29 699	60 516	43 439	44 636	53 891	34 849	67 040
Common squids nei	*Loligo spp*	57	2 134	2 252	1 393	2 160	1 899	2 095	1 608
Argentine shortfin squid	*Illex argentinus*	57	178 974	287 590	703 804	955 044	837 935	261 227	189 967
Sevenstar flying squid	*Martialia hyadesi*	57	59	3	0	4	0	4	0
Various squids nei	*Loliginidae, Ommastrephidae*	57	4	-	-	-	-	1 468	905
Greater hooked squid	*Moroteuthis ingens*	57	-	109	22	68	34	87	36
Octopuses, etc. nei	*Octopodidae*	57	1 577	1 796	2 619	2 202	1 990	2 192	2 069
Marine molluscs nei	*Mollusca*	58	3 293	4 811	4 330	5 415	1 476	1 143	5 322
Total			***1 795 554***	***1 835 675***	***2 372 302***	***2 506 236***	***2 403 878***	***1 910 273***	***1 762 281***

C-41 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Atlantic, Southwest
Atlantique, sud-ouest
Atlántico, sudoccidental

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Argentina	915 545	927 711	883 604	910 690	895 651	1 138 100	965 453	983 837	845 717	796 262
Belize	2 581	135	2 768	84	363	201	3 251	880	603	1 809
Brazil	509 946	516 167	484 593	500 116	506 826	527 872	539 967	530 612	585 919	537 247
Cambodia	1 200	32	857	17	-	-	-	-	-	94
Chile	9 296	9 650	7 132	9 892	524	2 890	3 771	1 653	-	-
China	93 973	85 872	96 017	15 721	41 046	105 091	210 065	198 793	64 600	37 097
China,Taiwan	156 502	126 337	139 976	61 959	45 948	136 041	291 800	215 960	62 023	35 143
Estonia	1 941	777	-	1 113	1 355	1 471	-	-	-	1 609
Falkland Is	68 331	53 260	74 897	55 368	84 545	75 287	72 146	81 707	62 746	99 559
Ghana	-	-	-	-	-	1 244	-	-	-	-
Japan	81 003	36 344	31 730	27 795	19 534	22 974	9 958	10 931	10 906	8 844
Korea Rep	167 817	130 513	111 270	43 170	65 400	153 179	216 418	168 390	74 645	40 947
Latvia	...	...	162	-	-	-	-	-	-	-
Namibia	-	-	-	1 180	-	-	-	-	-	-
New Zealand	-	-	69	-	-	-	-	-	-	-
Norway	-	-	-	-	-	43	-	-	-	-
Panama	-	-	-	95	194	585	1 255	-	-	-
Philippines	330	172	635	591	1 274	1 608	1 331	1 494	1 274	917
Poland	756	2 754	-	-	-	-	-	-	-	-
Portugal	2 731	3 853	429	1 387	2 778	1 776	3 891	5 808	4 204	5 170
Russian Fed	3 214	8 286	3 415	986	-	-	-	-	-	157
St Vincent	1 818	-	-	-	-	-	-	-	-	-
Seychelles	3 800	-	30	-	-	-	-	-	-	-
Sierra Leone	...	...	-	-	-	-	-	-	-	178
Spain	111 400	50 698	33 001	43 667	41 416	67 622	75 643	87 949	112 426	117 356
Ukraine	-	-	-	-	-	378	378	413	96	200
UK	7 007	5 262	3 544	2 539	6 227	4 791	3 999	5 982	4 066	6 272
Uruguay	97 078	102 341	113 131	119 058	122 462	130 869	106 799	107 701	80 244	72 958
Vanuatu	-	-	-	-	120	133	-	1 419	638	462
Other nei	146	9	26	126	12	147	111	349	166	-
Total	***2 236 415***	***2 060 173***	***1 987 286***	***1 795 554***	***1 835 675***	***2 372 302***	***2 506 236***	***2 403 878***	***1 910 273***	***1 762 281***

C-47 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Southeast
Atlantique, sud-est
Atlántico, sudoriental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
West African ilisha	*Ilisha africana*	24	...	...	...	15 217	17 616	8 930	8 600
West coast sole	*Austroglossus microlepis*	31	8 801	7 386	7 619	11 057	1 446	1 596	1 500
Mud sole	*Austroglossus pectoralis*	31	612	485	429	332	455	569	570
Southeast Atlantic soles nei	*Austroglossus spp*	31	493	415	433	319	225	255	260
Tonguefishes	*Cynoglossidae*	31	42	34	22	13	9	4	18
Flatfishes nei	*Pleuronectiformes*	31	2 636	2 000	1 336	12 275	3 762	3 479	3 350
Blue antimora	*Antimora rostrata*	32	-	-	9	-	-	-	-
Benguela hake	*Merluccius polli*	32	-	-	-	-	155	5 161	4 043
Shallow-water Cape hake	*Merluccius capensis*	32	1 799	1 600	1 800	5 876	2 565	2 146	2 070
Cape hakes	*Merluccius capensis,M.paradox.*	32	330 722	302 662	270 671	269 588	261 575	249 432	256 384
Ridge scaled rattail	*Macrourus carinatus*	32	-	-	15	-	-	-	-
Gadiformes nei	*Gadiformes*	32	-	-	-	0	1	-	3
Sea catfishes nei	*Ariidae*	33	3 624	3 210	3 490	5 404	13 901	11 166	10 700
Mullets nei	*Mugilidae*	33	127	95	104	927	7	11	648
Dusky grouper	*Epinephelus marginatus*	33	-	29	-	-	-	-	-
White grouper	*Epinephelus aeneus*	33	-	25	-	-	-	-	-
Groupers nei	*Epinephelus spp*	33	20	21	11	40	11	8	13
Groupers, seabasses nei	*Serranidae*	33	5 426	4 008	4 131	3 397	1 704	1 539	1 476
Bigeyes nei	*Priacanthus spp*	33	1	1	2	3	2	1	1
Snappers, jobfishes nei	*Lutjanidae*	33	1	1	-	1	1	6	1
Bigeye grunt	*Brachydeuterus auritus*	33	3 484	3 000	3 075	3 168	4 157	6 097	5 880
Grunts, sweetlips nei	*Haemulidae(=Pomadasyidae)*	33	2 142	1 554	1 142	955	399	4 180	4 000
Canary drum(=Baardman)	*Umbrina canariensis*	33	1 366	1 504	4 505	1 138	9	15	13
Southern meagre(=Mulloway)	*Argyrosomus hololepidotus*	33	5 369	4 906	5 351	13 382	27 247	17 883	17 183
Geelbek croaker	*Atractoscion aequidens*	33	658	656	403	427	351	483	422
Boe drum	*Pteroscion peli*	33	-	45	-	-	-	-	-
West African croakers nei	*Pseudotolithus spp*	33	18 289	17 000	19 280	15 268	21 887	19 141	18 400
Croakers, drums nei	*Sciaenidae*	33	1 931	3 907	3 969	3 174	3 118	2 586	2 473
Emperors(=Scavengers) nei	*Lethrinidae*	33	3	3	3	-	1	1	1
White seabream	*Diplodus sargus*	33	2	1	-	-	-	-	-
Sargo breams nei	*Diplodus spp*	33	2	-	-	-	-	-	-
Large-eye dentex	*Dentex macrophthalmus*	33	79	61	109	40	29	56	21
Dentex nei	*Dentex spp*	33	17 879	18 000	22 660	22 098	26 156	33 898	32 211
Black seabream	*Spondyliosoma cantharus*	33	1 065	300	...	212	195	26	25
Carpenter seabream	*Argyrozona argyrozona*	33	272	276	204	294	250	323	345
Santer seabream	*Cheimerius nufar*	33	29	28	21	34	33	19	28
Black musselcracker	*Cymatoceps nasutus*	33	2	2	3	3	3	4	2
Pargo breams nei	*Pagrus spp*	33	3 616	3 947	4 616	1 671	1 087	977	940
Red steenbras	*Petrus rupestris*	33	3	3	4	8	3	5	3
Panga seabream	*Pterogymnus laniarius*	33	3 963	3 048	2 756	2 305	1 880	2 183	2 249
White stumpnose	*Rhabdosargus globiceps*	33	113	123	111	24	51	50	78
Bogue	*Boops boops*	33	...	...	...	...	1	...	...
Daggerhead breams nei	*Chrysoblephus spp*	33	110	117	114	93	117	96	103
Sand steenbras	*Lithognathus mormyrus*	33	3 334	3 000	3 353	223	772	2 031	1 950
Steenbrasses nei	*Lithognathus spp*	33	1	0	4	3	...	...	...
Porgies, seabreams nei	*Sparidae*	33	293	297	107	148	144	214	179
Picarels nei	*Spicara spp*	33	...	400	484	...	...	...	...
Threadfins, tasselfishes nei	*Polynemidae*	33	3 297	3 000	3 945	4 972	7 603	5 724	5 500
Gobies nei	*Gobiidae*	33	-	2	-	0	...	2	2
Hector's lanternfish	*Lampanyctodes hectoris*	34	0	-	-	-	-	-	-
Conger eels, etc. nei	*Congridae*	34	3	1 302	1 468	4	3	4	5
Kingklip	*Genypterus capensis*	34	12 310	9 548	7 910	7 972	6 386	6 865	7 085
Alfonsinos nei	*Beryx spp*	34	328	582	780	382	123	324	533
Mediterranean slimehead	*Hoplostethus mediterraneus*	34	-	1	1	1	2	16	-
Orange roughy	*Hoplostethus atlanticus*	34	1 845	380	568	275	6	8	8
John dory	*Zeus faber*	34	4 232	3 187	2 646	2 646	1 490	1 920	1 848
Boarfishes nei	*Caproidae*	34	144	0	15	-	-	-	112
Oreo dories nei	*Oreosomatidae*	34	497	83	19	7	...	1	1
Wreckfish	*Polyprion americanus*	34	1	6	6	30	-	-	-
Cape bonnetmouth	*Emmelichthys nitidus*	34	156	266	226	183	-	-	367
Pelagic armourhead	*Pseudopentaceros richardsoni*	34	3	-	-	-	-	-	-
Patagonian toothfish	*Dissostichus eleginoides*	34	728	168	172	192	198	151	42
Black cardinal fish	*Epigonus telescopus*	34	30	28	16	9	...	11	10
Snoek	*Thyrsites atun*	34	17 439	16 024	8 492	11 028	10 921	12 208	12 080
Escolar	*Lepidocybium flavobrunneum*	34	-	-	-	-	6	2	1
Oilfish	*Ruvettus pretiosus*	34	28	27	169	244	135	163	166
Largehead hairtail	*Trichiurus lepturus*	34	399	994	742	...	22	39	...
Silver scabbardfish	*Lepidopus caudatus*	34	6 463	8 732	8 506	6 673	4 478	4 263	3 462
Violet warehou	*Schedophilus velaini*	34	8	30	20	33	36	26	-
Pemarco blackfish	*Schedophilus pemarco*	34	...	...	...	4 683	487	91	87
Bluenose warehou	*Hyperoglyphe antarctica*	34	1	56	-	-	-	-	-
Blackbelly rosefish	*Helicolenus dactylopterus*	34	1 918	1 763	1 751	969	959	780	679
Scorpionfishes nei	*Scorpaenidae*	34	0	4	0	1	2	1	-
Cape gurnard	*Chelidonichthys capensis*	34	585	721	732	570	452	826	861
Gurnards, searobins nei	*Triglidae*	34	1	-	-	-	1	-	-
Devil anglerfish	*Lophius vomerinus*	34	17 553	18 887	17 417	8 151	16 411	7 041	7 836
Sardinellas nei	*Sardinella spp*	35	58 569	46 000	50 406	66 837	68 049	74 184	71 000
Southern African pilchard	*Sardinops ocellatus*	35	402 432	274 043	219 642	176 782	114 057	108 037	126 386
Whitehead's round herring	*Etrumeus whiteheadi*	35	51 925	29 438	47 586	52 634	65 501	40 632	88 574
Southern African anchovy	*Engraulis capensis*	35	192 305	283 446	135 463	252 997	266 105	174 493	217 192
Atlantic bonito	*Sarda sarda*	36	...	138	900	934	3	1 979	990
Wahoo	*Acanthocybium solandri*	36	22	28	64	14	18	29	23
Frigate and bullet tunas	*Auxis thazard, A. rochei*	36	...	...	...	95	4	46	23
Little tunny(=Atl.black skipj)	*Euthynnus alletteratus*	36	...	2	1 654	4 365	1 373	1 644	822

C-47 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Southeast
Atlantique, sud-est
Atlántico, sudoriental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Skipjack tuna	*Katsuwonus pelamis*	36	338	343	128	112	54	246	280
Atlantic bluefin tuna	*Thunnus thynnus*	36	-	-	2	-	-	-	-
Albacore	*Thunnus alalunga*	36	11 768	9 051	15 826	14 691	13 813	16 974	15 116
Southern bluefin tuna	*Thunnus maccoyii*	36	952	1 919	968	321	1 481	977	620
Yellowfin tuna	*Thunnus albacares*	36	4 161	3 992	3 923	4 736	2 553	6 066	2 343
Bigeye tuna	*Thunnus obesus*	36	15 204	9 601	8 995	15 339	12 782	12 306	12 926
Atlantic sailfish	*Istiophorus albicans*	36	98	181	330	293	227	296	374
Blue marlin	*Makaira nigricans*	36	291	156	291	499	361	328	241
Black marlin	*Makaira indica*	36	48	15	9	24	29	296	28
Atlantic white marlin	*Tetrapturus albidus*	36	87	51	30	75	125	56	70
Longbill spearfish	*Tetrapturus pfluegeri*	36	-	3	7	5	-	-	24
Marlins,sailfishes,etc. nei	*Istiophoridae*	36	132	49	77	153	65	337	45
Swordfish	*Xiphias gladius*	36	3 868	4 540	5 100	5 582	4 892	3 594	7 039
Tuna-like fishes nei	*Scombroidei*	36	894	4 265	349	85	113	13	102
Bluefish	*Pomatomus saltatrix*	37	15	14	732	28	21	12	12
Cape horse mackerel	*Trachurus capensis*	37	352 965	360 389	334 928	233 400	223 156	233 505	231 396
Cunene horse mackerel	*Trachurus trecae*	37	34 863	30 000	33 563	31 659	44 395	13 826	13 300
Jack and horse mackerels nei	*Trachurus spp*	37	-	-	0	2	7	9	-
Crevalle jack	*Caranx hippos*	37	943	700	643	...	14	...	...
False scad	*Caranx rhonchus*	37	...	...	...	2	6	3	3
Pompano	*Trachinotus ovatus*	37	484	...	...	...	...	...	...
Yellowtail amberjack	*Seriola lalandi*	37	878	876	310	565	311	348	246
Carangids nei	*Carangidae*	37	1	1	1	2	3	2	3
Atlantic pomfret	*Brama brama*	37	1 563	1 788	1 800	1 227	1 069	810	926
Common dolphinfish	*Coryphaena hippurus*	37	1	2	5	5	3	13	12
Chub mackerel	*Scomber japonicus*	37	8 474	11 049	10 293	8 498	9 926	12 716	12 714
Blue butterfish	*Stromateus fiatola*	37	2	158	230	131	6	36	...
Barracudas nei	*Sphyraena spp*	37	...	...	...	16	3	32	30
Ocean sunfish	*Mola mola*	37	20	6	40	3	...	...	...
Bluntnose sixgill shark	*Hexanchus griseus*	38	-	1	-	-	-	-	-
Broadnose sevengill shark	*Notorynchus cepedianus*	38	-	-	-	4	12	12	10
Thresher	*Alopias vulpinus*	38	...	4	1	3	5	2	3
Bigeye thresher	*Alopias superciliosus*	38	-	-	-	-	2	-	-
Thresher sharks nei	*Alopias spp*	38	18	17	6	25	3	20	9
Shortfin mako	*Isurus oxyrinchus*	38	1 433	2 506	2 355	2 135	680	1 162	2 114
Mako sharks	*Isurus spp*	38	-	-	-	-	-	11	-
Porbeagle	*Lamna nasus*	38	3	0	0	0	4	2	1
Catsharks, etc. nei	*Scyliorhinidae*	38	-	-	-	-	-	11	-
Blue shark	*Prionace glauca*	38	6 013	7 583	10 782	11 515	7 555	9 787	9 034
Copper shark	*Carcharhinus brachyurus*	38	-	1	2	20	29	64	88
Requiem sharks nei	*Carcharhinidae*	38	124	167	7	-	-	3	102
Smooth hammerhead	*Sphyrna zygaena*	38	22	21	32	58	28	5	1
Scalloped hammerhead	*Sphyrna lewini*	38	-	-	...	...	1	0	-
Hammerhead sharks, etc. nei	*Sphyrnidae*	38	1	22	55	31	25	...	...
Smooth-hound	*Mustelus mustelus*	38	24	81	81	90	76	85	102
Tope shark	*Galeorhinus galeus*	38	219	163	204	297	319	257	302
Sharptooth houndshark	*Triakis megalopterus*	38	-	-	-	6	-	2	-
Picked dogfish	*Squalus acanthias*	38	-	-	-	11	73	19	10
Angelsharks, sand devils nei	*Squatinidae*	38	...	9	4	7	9	2	3
Brown ray	*Raja miraletus*	38	-	-	1	-	-	-	-
Rays, stingrays, mantas nei	*Rajiformes*	38	4 030	1 989	3 535	6 973	381	1 094	1 206
Cape elephantfish	*Callorhinchus capensis*	38	559	645	749	702	585	623	859
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	2 653	4 869	3 099	6 731	5 856	2 678	3 226
Marine fishes nei	*Osteichthyes*	39	54 168	33 200	48 484	74 974	54 605	45 154	44 615
West African geryon	*Chaceon maritae*	42	3 643	3 611	2 809	4 906	2 139	196	200
Marine crabs nei	*Brachyura*	42	1 596	967	341	209	147	119	112
Cape rock lobster	*Jasus lalandii*	43	3 102	3 185	2 447	3 059	2 141	2 150	3 418
Tristan da Cunha rock lobster	*Jasus tristani*	43	377	373	464	351	406	380	403
Southern spiny lobster	*Palinurus gilchristi*	43	399	843	723	734	425	366	734
Slipper lobsters nei	*Scyllaridae*	43	0	1	-	-	-	-	-
Lobsters nei	*Reptantia*	43	797	518	492	497	293	862	830
Deep-water rose shrimp	*Parapenaeus longirostris*	45	1 677	1 350	1 200	1 070	278	156	146
Scarlet shrimp	*Plesiopenaeus edwardsianus*	45	-	76	24	55	32	-	-
Striped red shrimp	*Aristeus varidens*	45	255	365	317	1 216	616	253	240
Natantian decapods nei	*Natantia*	45	1 257	863	1 135	1 512	1 111	-	-
Marine crustaceans nei	*Crustacea*	47	-	1	-	-	-	-	-
Perlemoen abalone	*Haliotis midae*	52	258	228	212	123	61	-	128
Cupped oysters nei	*Crassostrea spp*	53	30	24	...	20	16	17	17
Donax clams	*Donax spp*	56	2	2	6	19	32	40	32
Cuttlefish, bobtail squids nei	*Sepiidae, Sepiolidae*	57	1 007	792	691	703	324	844	820
Cape Hope squid	*Loligo reynaudi*	57	7 306	10 362	6 777	9 948	8 329	10 107	10 068
Various squids nei	*Loliginidae, Ommastrephidae*	57	11 416	1 083	1 042	845	246	596	376
Octopuses, etc. nei	*Octopodidae*	57	145	386	355	915	284	623	527
Marine molluscs nei	*Mollusca*	58	0	0	0	-	-	6	-
Jellyfishes nei	*Rhopilema spp*	77	-	19	...	20	...	...	...
Total			***1 732 115***	***1 598 512***	***1 380 674***	***1 440 037***	***1 358 699***	***1 196 590***	***1 299 424***

C-47 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Atlantic, Southeast
Atlantique, sud-est
Atlántico, sudoriental

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Angola	246 553	245 973	201 539	230 002	192 616	214 949	297 436	298 262	266 415	250 000 F
Chile	5	-	-	-	-	-	-	-	-	-
China	4 959	3 850	2 881	840	550	1 880	2 036	1 677	249	61
China,Taiwan	16 118	16 070	16 126	12 230	8 904	6 752	16 161	11 383	13 981	17 280
Japan	11 729	11 954	13 589	10 407	10 220	11 420	13 042	14 011	8 673	10 220
Korea Rep	5 026	5 983	7 347	6 296	5 477	5 763	4 537	5 003	4 477	4 966
Lithuania	-	-	4 686	-	-	-	-	-	-	-
Namibia	545 997	623 100	635 299	567 519	551 195	506 770	410 417	369 798	367 548	367 200 F
Philippines	29	16	56	334	154	215	823	267	373	236
Poland	3 100	4 318	4 468	4 123	805	-	-	-	-	-
Portugal	2 084	1 552	2 128	1 194	2 718	2 860	3 541	1 618	2 178	1 542
Russian Fed	39 850	8 611	14 412	323	-	-	-	-	-	-
St Helena	867	598	985	1 061	1 130	1 120	837	794	856	864
Seychelles	-	182	-	-	-	-	-	-	-	-
South Africa	747 719	763 482	819 034	885 717	815 321	616 173	676 396	642 107	510 086	621 480
Spain	22 732	9 839	12 217	11 655	9 330	11 778	13 793	13 389	21 685	25 575
Ukraine	4 312	-	-	-	-	-	-	-	-	-
UK	-	-	-	-	-	851	857	266	34	-
Uruguay	-	906	2 045	402	71	-	-	-	-	-
Vanuatu	-	-	-	-	-	1	-	-	-	-
Other nei	42	18	66	12	21	142	161	124	35	-
Total	***1 651 122***	***1 696 452***	***1 736 878***	***1 732 115***	***1 598 512***	***1 380 674***	***1 440 037***	***1 358 699***	***1 196 590***	***1 299 424***

C-48 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Atlantic, Antarctic
Atlantique, Antarctique
Atlántico, Antártico

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Antarctic armless flounder	*Mancopsetta maculata*	31	-	-	-	0	0	0	0
Smalleye moray cod	*Muraenolepis microps*	32	-	-	-	0	0	0	0
Moray cods nei	*Muraenolepis spp*	32	-	0	-	0	0	0	0
Blue antimora	*Antimora rostrata*	32	8	19	37	28	37	34	16
Grenadiers nei	*Macrourus spp*	32	66	135	148	155	177	140	95
Grenadiers, rattails nei	*Macrouridae*	32	-	-	3	-	-	-	-
Marbled rockcod	*Notothenia rossii*	33	-	0	2	7	3	2	16
Humped rockcod	*Notothenia gibberifrons*	33	-	-	1	4	1	1	2
Grey rockcod	*Notothenia squamifrons*	33	-	-	0	1	0	0	0
Black rockcod	*Notothenia coriiceps*	33	-	-	-	4	-	-	-
Painted notie	*Nototheniops larseni*	33	-	-	-	0	0	0	0
Yellowfin notie	*Nototheniops nudifrons*	33	-	-	0	0	0	0	0
...A	*Nototheniops nybelini*	33	-	-	8	...	-	-	-
Striped rockcod	*Pagothenia hansoni*	33	-	-	-	0	0	0	...
Antarctic silverfish	*Pleuragramma antarcticum*	33	-	0	14	0	-	-	-
Antarctic rockcods, noties nei	*Nototheniidae*	33	-	0	-	0	0	0	0
...A	*Notolepis spp*	34	-	-	1	...	-	-	-
Nichol's lanternfish	*Gymnoscopelus nicholsi*	34	-	-	-	0	0	0	0
Lanternfishes nei	*Myctophidae*	34	-	1	-	-	-	0	0
Antarctic toothfish	*Dissostichus mawsoni*	34	-	2	63	34	11	325	400
Patagonian toothfish	*Dissostichus eleginoides*	34	4 504	3 111	3 654	3 672	3 974	3 473	2 625
Patagonian rockcod	*Patagonotothen brevicauda*	34	-	-	-	0	0	1	1
...A	*Parachaenichthys georgianus*	34	-	-	-	0	0	0	0
Blackfin icefish	*Chaenocephalus aceratus*	34	0	2	3	0	1	0	1
Mackerel icefish	*Champsocephalus gunnari*	34	2 684	202	2 185	4 346	2 492	1 833	12
South Georgia icefish	*Pseudochaenichthys georgianus*	34	1	25	8	1	1	2	2
Ocellated icefish	*Chionodraco rastrospinosus*	34	-	-	0	0	-	-	-
Spiny icefish	*Chaenodraco wilsoni*	34	-	-	0	0	-	-	-
Crocodile icefishes nei	*Channichthyidae*	34	-	0	1	0	0	0	-
Porbeagle	*Lamna nasus*	38	-	-	-	-	1	-	-
Antarctic starry skate	*Raja georgiana*	38	-	0	-	0	0	1	0
Rays, stingrays, mantas nei	*Rajiformes*	38	35	8	9	6	15	22	10
Elephantfishes, etc. nei	*Callorhinchidae*	38	6	-	-	-	-	-	-
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	0	0	0	0	-	-	-
Subantarctic stone crab	*Lithodes murrayi*	44	-	-	-	-	-	-	0
Red stone crab	*Paralomis aculeata*	44	0	-	-	-	-	-	-
Antarctic stone crab	*Paralomis spinosissima*	44	-	0	-	0	1	0	53
Globose king crab	*Paralomis formosa*	44	0	-	-	0	0	0	9
King crabs, stone crabs nei	*Lithodidae*	44	0	0	1	0	0	0	0
Antarctic krill	*Euphausia superba*	46	118 165	129 026	106 548	104 586	156 521	125 824	211 974
Sevenstar flying squid	*Martialia hyadesi*	57	-	-	-	-	0	-	-
Starfishes nei	*Asteroidea*	76	-	0	-	-	-	-	-
Jellyfishes nei	*Rhopilema spp*	77	-	0	-	1	0	0	-
Total			***125 469***	***132 531***	***112 686***	***112 845***	***163 235***	***131 658***	***215 216***

Data in this table refer to catches for which the new fishing season (1 December - 30 November) of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has been adopted. Data are shown under the calendar year in which the split-year ends.

Les données dans ce tableau se réfèrent aux captures pour lesquelles on utilise la nouvelle période de pêche (1er décembre - 30 novembre) de la Commission pour la conservation de la faune et la flore marines de l'Antarctique (CCAMLR). Les données figurent sous l'année civile durant laquelle se termine l'année fractionnée.

Los datos en este cuadro se refieren a las capturas para las que se utiliza el nuevo período de pesca (1 de diciembre - 30 de noviembre) de la Comisión para la Conservación de los Recursos Vivos Marinos Antárticos (CCRVMA). Los datos se incluyen en el año civil en que termina el año emergente.

C-48 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Atlantic, Antarctic
Atlantique, Antarctique
Atlántico, Antártico

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Chile	899	1 545	3 715	2 520	748	1 631	1 851	899	374	356
China	-	-	-	-	-	-	-	-	-	1 946
France	386	-	-	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	14	-	-	-
Japan	67 377	51 191	59 944	33 590	22 848	32 887	24 409	38 828	21 135	30 117
Korea Rep	8 321	15 257	22 079	25 888	29 111	43 907	34 547	38 335	43 678	45 852
New Zealand	-	-	414	-	-	440	497	557	499	415
Norway	-	-	-	-	-	9 185	39 793	63 293	44 175	119 401
Poland	13 717	16 720	8 905	8 967	4 335	6 413	7 414	8 035	8 149	6 995
Russian Fed	225	1 686	617	775	-	-	-	222	9 654	8 127
South Africa	359	332	405	235	315	310	352	327	155	178
Spain	643	832	882	660	373	378	375	838	833	666
Ukraine	14 172	32 015	17 715	12 261	22 441	15 252	...	8 133	-	-
UK	1 161	2 149	2 157	2 175	1 812	2 020	3 349	3 507	2 841	1 016
USA	1 568	12 175	10 150	8 550	2 159	1	-	-	-	-
Uruguay	428	693	347	357	-	262	244	261	165	147
Vanuatu	-	-	-	29 491	48 389	-	-	-	-	-
Total	***109 256***	***134 595***	***127 330***	***125 469***	***132 531***	***112 686***	***112 845***	***163 235***	***131 658***	***215 216***

Data in this table refer to catches for which the new fishing season (1 December - 30 November) of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has been adopted. Data are shown under the calendar year in which the split-year ends.

Les données dans ce tableau se réfèrent aux captures pour lesquelles on utilise la nouvelle période de pêche (1er décembre - 30 novembre) de la Commission pour la conservation de la faune et la flore marines de l'Antarctique (CCAMLR). Les données figurent sous l'année civile durant laquelle se termine l'année fractionnée.

Los datos en este cuadro se refieren a las capturas para las que se utiliza el nuevo período de pesca (1 de diciembre - 30 de noviembre) de la Comisión para la Conservación de los Recursos Vivos Marinos Antárticos (CCRVMA). Los datos se incluyen en el año civil en que termina el año emergente.

C-51 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Indian Ocean, Western
Océan Indien, ouest
Océano Índico, occidental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Hilsa shad	*Tenualosa ilisha*	24	7 558	9 636	7 384	12 572	9 076	8 835	20 336
Bloch's gizzard shad	*Nematalosa nasus*	24	93	15	71	196	263	216	205
Milkfish	*Chanos chanos*	25	101	122	159	135	168	322	198
Barramundi(=Giant seaperch)	*Lates calcarifer*	25	-	-	0	0	0	-	-
Leopard flounder	*Bothus pantherinus*	31	70	91	124	91	93	79	80
Lefteye flounders nei	*Bothidae*	31	78	20	85	1	1	15	25
Mud sole	*Austroglossus pectoralis*	31	-	-	-	-	19	-	-
Tonguefishes	*Cynoglossidae*	31	984	907	907	909	1 002	1 011	1 025
Indian halibut	*Psettodes erumei*	31	2 943	3 792	4 191	5 050	4 975	3 993	4 470
Flatfishes nei	*Pleuronectiformes*	31	13 595	13 582	14 610	22 762	17 719	21 576	13 322
Unicorn cod	*Bregmaceros mcclellandi*	32	1 322	2 717	1 597	852	674	629	468
Cape hakes	*Merluccius capensis,M.paradox.*	32	3	5	5	3	3	3	4
Gadiformes nei	*Gadiformes*	32	-	-	-	-	55	-	-
Bombay-duck	*Harpadon nehereus*	33	135 340	158 829	152 838	185 088	218 639	176 465	134 014
Greater lizardfish	*Saurida tumbil*	33	2 655	4 167	3 656	2 575	2 564	3 030	3 393
Brushtooth lizardfish	*Saurida undosquamis*	33	18	15	17	23	17	20	20
Lizardfishes nei	*Synodontidae*	33	13 886	10 193	13 276	11 202	6 657	15 416	16 211
Giant catfish	*Arius thalassinus*	33	896	805	621	986	1 014	1 202	1 185
Sea catfishes nei	*Ariidae*	33	76 771	76 842	79 314	90 970	108 654	92 927	95 823
Sabre squirrelfish	*Sargocentron spiniferum*	33	114	160	146	67	53	54	54
Flathead grey mullet	*Mugil cephalus*	33	46	30	52	47	62	60	60
Klunzinger's mullet	*Liza klunzingeri*	33	2 900	710	6 127	4 936	7 284	4 943	1 199
Bluespot mullet	*Valamugil seheli*	33	1 149	1 492	2 024	4 297	1 502	2 443	3 555
Mullets nei	*Mugilidae*	33	21 507	20 115	20 662	23 683	22 960	24 830	29 299
Fusiliers nei	*Caesionidae*	33	56	20	50	52	14	17	11
Redmouth grouper	*Aethaloperca rogaa*	33	19	37	50	25	31	36	36
Greasy grouper	*Epinephelus tauvina*	33	786	902	738	1 068	968	920	1 093
Blacktip grouper	*Epinephelus fasciatus*	33	2	5	6	1	0	0	0
Comet grouper	*Epinephelus morrhua*	33	14	28	24	31	22	25	25
Areolate grouper	*Epinephelus areolatus*	33	349	346	347	336	291	377	491
Brownspotted grouper	*Epinephelus chlorostigma*	33	6	26	28	29	56	60	60
Orange-spotted grouper	*Epinephelus coioides*	33	2 676	2 264	2 598	3 396	3 599	2 113	3 265
Camouflage grouper	*Epinephelus polyphekadion*	33	...	34	...	...	...	...	...
Brown-marbled grouper	*Epinephelus fuscoguttatus*	33	31	20	30	29	40	48	48
White-blotched grouper	*Epinephelus multinotatus*	33	329	557	396	310	557	486	453
Smallscaled grouper	*Epinephelus polylepis*	33	150	220	223	279	346	358	417
Summan grouper	*Epinephelus summana*	33	18	26	31	33	80	35	35
Groupers nei	*Epinephelus spp*	33	26 302	24 244	24 592	25 004	26 372	26 312	24 807
Peacock hind	*Cephalopholis argus*	33	21	25	61	49	49	55	55
Yellowfin hind	*Cephalopholis hemistiktos*	33	187	185	243	229	288	231	229
Coral hind	*Cephalopholis miniata*	33	172	323	400	401	459	345	252
Squaretail coralgrouper	*Plectropomus areolatus*	33	299	349	411	338	426	400	400
Roving coralgrouper	*Plectropomus pessuliferus*	33	253	351	385	340	342	330	330
Yellow-edged lyretail	*Variola louti*	33	181	306	404	1 169	1 671	1 274	1 404
Groupers, seabasses nei	*Serranidae*	33	22 095	19 013	17 011	17 474	14 379	15 516	15 317
Terapon perches nei	*Terapon spp*	33	...	...	9	3	12	1	16
Fourlined terapon	*Pelates quadrilineatus*	33	31	57	5	6	82	42	14
Bigeyes nei	*Priacanthus spp*	33	7	9	6	6	6	44	30
Cardinalfishes, etc. nei	*Apogonidae*	33	330	310	382	400	226	320	420
Silver sillago	*Sillago sihama*	33	132	53	75	84	176	96	65
Sillago-whitings	*Sillaginidae*	33	491	426	421	428	444	422	390
Mangrove red snapper	*Lutjanus argentimaculatus*	33	2 260	2 169	2 009	1 890	1 995	1 898	1 765
John's snapper	*Lutjanus johnii*	33	2 115	2 052	2 589	1 576	1 615	1 591	2 475
Malabar blood snapper	*Lutjanus malabaricus*	33	225	503	451	822	434	424	422
Two-spot red snapper	*Lutjanus bohar*	33	348	236	314	308	319	340	341
Humpback red snapper	*Lutjanus gibbus*	33	539	356	340	291	381	284	330
Common bluestripe snapper	*Lutjanus kasmira*	33	14	4	29	25	16	18	18
Five-lined snapper	*Lutjanus quinquelineatus*	33	315	360	340	459	439	299	305
Snappers nei	*Lutjanus spp*	33	983	1 132	1 218	1 411	1 195	758	704
Rusty jobfish	*Aphareus rutilans*	33	138	114	129	195	195	205	205
Snappers, jobfishes nei	*Lutjanidae*	33	7 687	8 933	11 163	8 019	7 544	7 067	8 179
Japanese threadfin bream	*Nemipterus japonicus*	33	5 459	6 748	7 912	5 535	4 313	5 444	6 127
Randall's threadfin bream	*Nemipterus randalli*	33	25	...	6	6	...	...	...
Threadfin breams nei	*Nemipterus spp*	33	13 665	13 357	12 924	11 517	13 226	8 876	7 634
Black-streaked monocle bream	*Scolopsis taeniatus*	33	161	240	724	854	732	751	898
Threadfin and dwarf breams nei	*Nemipteridae*	33	2 959	3 290	3 455	3 641	3 635	5 231	4 499
Ponyfishes(=Slipmouths) nei	*Leiognathidae*	33	13 263	13 786	15 749	18 978	16 382	13 501	15 924
Painted sweetlips	*Diagramma pictum*	33	55	43	0	44	36	35	35
Trout sweetlips	*Plectorhinchus pictus*	33	113	45	62	19	20	7	2
Minstrel sweetlips	*Plectorhinchus schotaf*	33	176	164	225	216	262	184	135
Blackspotted rubberlip	*Plectorhinchus gaterinus*	33	295	241	293	312	316	263	256
Sordid rubberlip	*Plectorhinchus sordidus*	33	132	102	220	90	74	77	60
Striped piggy	*Pomadasys stridens*	33	1 081	799	559	523	1 479	492	668
Silver grunt	*Pomadasys argenteus*	33	252	214	287	305	269	311	321
Javelin grunter	*Pomadasys kaakan*	33	4 164	4 003	4 577	4 010	4 643	4 402	5 704
Grunts, sweetlips nei	*Haemulidae(=Pomadasyidae)*	33	12 430	11 194	10 359	9 365	8 689	7 212	8 493
Southern meagre(=Mulloway)	*Argyrosomus hololepidotus*	33	30	15	24	13	17	11	13
Geelbek croaker	*Atractoscion aequidens*	33	18	21	23	13	56	36	17
Tigertooth croaker	*Otolithes ruber*	33	6 461	6 140	8 598	8 778	9 253	5 513	5 602
Bigeye croaker	*Pennahia anea*	33	1 088	1 717	1 881	2 348	3 494	5 494	5 186
Croakers, drums nei	*Sciaenidae*	33	224 908	223 301	223 922	195 003	188 440	210 104	213 992
Spangled emperor	*Lethrinus nebulosus*	33	2 403	3 416	3 371	2 530	3 053	2 521	2 333
Thumbprint emperor	*Lethrinus harak*	33	18	15	33	70	41	42	42
Sky emperor	*Lethrinus mahsena*	33	425	770	634	560	502	546	659
Pink ear emperor	*Lethrinus lentjan*	33	2 238	2 516	2 821	2 910	2 595	3 097	2 609
Smalltooth emperor	*Lethrinus microdon*	33	36	109	112	139	211	210	176

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Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
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Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Indian Ocean, Western
Océan Indien, ouest
Océano Índico, occidental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Orange-striped emperor	*Lethrinus obsoletus*	33	247	257	356	313	333	308	308
Yellowlip emperor	*Lethrinus xanthochilus*	33	82	32	17	34	23	35	35
Snubnose emperor	*Lethrinus borbonicus*	33	729	651	723	482	429	752	1 020
Humpnose big-eye bream	*Monotaxis grandoculis*	33	29	44	104	52	50	59	59
Emperors(=Scavengers) nei	*Lethrinidae*	33	61 534	56 225	52 551	55 974	57 143	62 871	62 449
King soldier bream	*Argyrops spinifer*	33	9 688	9 026	8 773	8 052	6 741	6 156	5 739
Santer seabream	*Cheimerius nufar*	33	111	93	109	129	126	58	51
Black musselcracker	*Cymatoceps nasutus*	33	1	1	1	1	3	3	2
Red steenbras	*Petrus rupestris*	33	0	0	-	-	-	-	-
Haffara seabream	*Rhabdosargus haffara*	33	1 268	1 117	1 414	1 553	1 498	1 527	1 502
Gilthead seabream	*Sparus aurata*	33	-	-	-	-	-	51	4
Daggerhead breams nei	*Chrysoblephus spp*	33	112	112	110	101	117	120	124
Karanteen seabream	*Crenidens crenidens*	33	100	-	0	78	37	48	35
Sobaity seabream	*Sparidentex hasta*	33	86	110	83	118	126	174	219
Goldsilk seabream	*Acanthopagrus berda*	33	32	40	28	68	72	70	46
Yellowfin seabream	*Acanthopagrus latus*	33	528	547	597	590	644	576	653
Twobar seabream	*Acanthopagrus bifasciatus*	33	3 123	2 854	3 321	3 806	3 979	3 625	3 896
Porgies, seabreams nei	*Sparidae*	33	19 772	14 603	12 433	13 794	14 413	16 705	14 583
Yellowstripe goatfish	*Mulloidichthys flavolineatus*	33	121	180	261	197	142	158	144
Goatfishes	*Upeneus spp*	33	8 552	10 522	11 676	13 955	12 078	12 492	11 456
Goatfishes, red mullets nei	*Mullidae*	33	2 675	1 478	1 884	1 931	1 954	2 140	1 845
Common silver-biddy	*Gerres oyena*	33	402	530	625	1 139	1 302	553	595
Slender silver-biddy	*Gerres oblongus*	33	2	...	46	46	58	61	61
Mojarras(=Silver-biddies) nei	*Gerres spp*	33	564	408	570	751	819	924	798
Spotted sicklefish	*Drepane punctata*	33	1 416	1 196	893	886	793	736	862
Wrasses, hogfishes, etc. nei	*Labridae*	33	2 878	2 149	702	1 344	1 230	1 393	1 709
Gulf parrotfish	*Scarus persicus*	33	57	43	163	49	74	114	317
Blue-barred parrotfish	*Scarus ghobban*	33	64	76	47	87	59	100	96
Green humphead parrotfish	*Bolbometopon muricatum*	33	210	89	134	254	102	168	142
Parrotfishes nei	*Scaridae*	33	3 252	3 482	4 182	3 979	3 729	3 319	3 015
Yellowbar angelfish	*Pomacanthus maculosus*	33	351	220	1 463	781	332	342	347
Angelfishes nei	*Pomacanthidae*	33	0	0	0	0	-	-	-
Fourfinger threadfin	*Eleutheronema tetradactylum*	33	1 909	1 293	1 554	1 507	1 151	974	1 285
Threadfins, tasselfishes nei	*Polynemidae*	33	1 831	1 959	2 793	2 951	2 627	2 902	6 601
Percoids nei	*Percoidei*	33	42 670	48 871	52 791	83 581	79 785	84 768	51 001
Sohal surgeonfish	*Acanthurus sohal*	33	42	62	17	12	43	50	50
Bluespine unicornfish	*Naso unicornis*	33	113	138	182	179	163	210	210
Surgeonfishes nei	*Acanthuridae*	33	12	4	3	8	13	17	17
Batfishes	*Platax spp*	33	5	5	18	29	16	9	5
Spadefishes nei	*Ephippidae*	33	...	8	1	1	5	2	8
Spinefeet(=Rabbitfishes) nei	*Siganus spp*	33	12 766	14 557	12 282	11 431	11 662	11 707	13 373
Spotfin flathead	*Grammoplites suppositus*	33	37	41	48	19	98	50	49
Bartail flathead	*Platycephalus indicus*	33	1 160	1 359	1 183	1 114	1 291	1 370	1 339
Flatheads nei	*Platycephalidae*	33	12	5	29	1	1	5	4
Puffers nei	*Tetraodontidae*	33	1	-	-	3	-	29	-
Triggerfishes, durgons nei	*Balistidae*	33	0	55	11	...	...	...	...
Snaggletooth	*Borostomias antarcticus*	34	-	-	-	-	-	-	1
Skinnycheek lanternfish	*Benthosema pterotum*	34	-	-	-	-	5 137	7 753	9 897
Lanternfishes nei	*Myctophidae*	34	1	-	-	-	-	-	-
Pike-congers nei	*Muraenesox spp*	34	9 005	12 706	10 300	17 614	23 041	18 309	16 003
Conger eels, etc. nei	*Congridae*	34	20	-	-	2	13	82	-
Velvet whalefish	*Barbourisia rufa*	34	-	-	-	-	-	-	210
Alfonsinos nei	*Beryx spp*	34	6	12	13	1	-	-	4 073
Orange roughy	*Hoplostethus atlanticus*	34	-	2	-	-	-	-	607
John dory	*Zeus faber*	34	4	2	4	2	5	2	-
Boarfishes nei	*Caproidae*	34	-	-	-	-	-	-	562
Spiky oreo	*Neocyttus rhomboidalis*	34	-	-	-	-	-	-	72
Smooth oreo dory	*Pseudocyttus maculatus*	34	-	-	-	-	-	-	23
Black oreo	*Allocyttus niger*	34	-	-	-	-	-	-	64
Oreo dories nei	*Oreosomatidae*	34	-	-	-	-	-	-	13
Wreckfish	*Polyprion americanus*	34	2	-	1	-	-	-	-
Patagonian toothfish	*Dissostichus eleginoides*	34	86	420	-	31	101	70	136
Cardinal fishes nei	*Epigonus spp*	34	6	9	9	9	0	5	128
Snoek	*Thyrsites atun*	34	-	-	-	-	-	1	1
Escolar	*Lepidocybium flavobrunneum*	34	-	-	10	-	-	-	9
Oilfish	*Ruvettus pretiosus*	34	17	7	58	41	5	42	27
Snake mackerels, escolars nei	*Gempylidae*	34	69	94	177	229	42	57	64
Largehead hairtail	*Trichiurus lepturus*	34	27 407	26 621	26 834	24 886	27 899	27 434	29 590
Silver scabbardfish	*Lepidopus caudatus*	34	-	-	1	-	2	-	2
Hairtails, scabbardfishes nei	*Trichiuridae*	34	96 939	101 518	117 096	87 773	67 675	82 470	132 283
Indian driftfish	*Ariomma indica*	34	29	11	24	128	39	26	62
Bluenose warehou	*Hyperoglyphe antarctica*	34	-	-	-	-	-	-	384
Ruffs, barrelfishes nei	*Centrolophidae*	34	18	47	28	4	-	-	-
Blackbelly rosefish	*Helicolenus dactylopterus*	34	4	-	2	-	-	-	-
Scorpionfishes nei	*Scorpaenidae*	34	1	1	1	1	3	6	-
Gurnards, searobins nei	*Triglidae*	34	0	1	-	-	-	-	-
Anglerfishes nei	*Lophiidae*	34	-	-	-	-	4	-	-
Demersal percomorphs nei	*Perciformes*	34	18 757	18 677	20 249	21 404	15 028	20 168	23 184
Indian oil sardine	*Sardinella longiceps*	35	356 915	334 179	350 606	355 659	364 771	367 431	360 296
Sardinellas nei	*Sardinella spp*	35	25 751	25 523	13 101	21 037	21 508	24 762	15 928
Southern African pilchard	*Sardinops ocellatus*	35	3	-	-	-	-	12	-
Buccaneer anchovy	*Encrasicholina punctifer*	35	527	2 375	3 358	3 667	5 336	4 230	3 775
Stolephorus anchovies nei	*Stolephorus spp*	35	4 100	4 810	2 000	500	...	...	...
Anchovies, etc. nei	*Engraulidae*	35	82 552	77 450	78 163	80 166	76 059	76 531	80 280
Dorab wolf-herring	*Chirocentrus dorab*	35	2 218	1 279	1 157	1 203	1 288	1 151	1 228
Whitefin wolf-herring	*Chirocentrus nudus*	35	5 098	6 339	3 894	4 758	5 211	5 949	8 033

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Wolf-herrings nei	*Chirocentrus spp*	35	6 503	8 829	10 523	12 898	9 403	9 443	9 329
Clupeoids nei	*Clupeoidei*	35	56 613	64 974	63 112	61 784	59 753	55 826	53 131
Striped bonito	*Sarda orientalis*	36	894	620	679	693	582	162	181
Wahoo	*Acanthocybium solandri*	36	472	409	474	488	496	464	417
Dogtooth tuna	*Gymnosarda unicolor*	36	707	623	653	574	660	727	732
Narrow-barred Spanish mackerel	*Scomberomorus commerson*	36	62 058	55 778	62 226	62 451	64 858	62 305	67 235
Indo-Pacific king mackerel	*Scomberomorus guttatus*	36	14 447	13 619	17 055	16 869	17 043	14 862	13 591
Streaked seerfish	*Scomberomorus lineolatus*	36	1 707	1 702	2 103	2 145	2 156	2 004	1 724
Seerfishes nei	*Scomberomorus spp*	36	1 866	2 172	2 472	2 877	3 210	3 213	3 243
Frigate and bullet tunas	*Auxis thazard, A. rochei*	36	14 353	15 815	16 559	19 519	22 443	20 436	18 675
Kawakawa	*Euthynnus affinis*	36	40 802	41 644	45 300	49 879	58 095	54 593	52 843
Skipjack tuna	*Katsuwonus pelamis*	36	346 440	447 882	511 915	336 667	303 582	295 083	267 537
Longtail tuna	*Thunnus tonggol*	36	45 066	44 240	53 577	57 341	56 862	74 000	92 307
Albacore	*Thunnus alalunga*	36	17 170	14 094	17 764	23 702	20 164	15 566	15 271
Southern bluefin tuna	*Thunnus maccoyii*	36	3 598	1 924	1 905	1 558	1 026	1 168	1 271
Yellowfin tuna	*Thunnus albacares*	36	443 608	423 553	338 047	245 050	228 219	195 362	211 899
Bigeye tuna	*Thunnus obesus*	36	107 661	92 051	88 388	87 560	69 281	64 923	44 694
Indo-Pacific sailfish	*Istiophorus platypterus*	36	16 735	17 563	15 985	11 428	12 203	13 214	14 816
Blue marlin	*Makaira nigricans*	36	3 481	2 133	2 634	2 572	1 980	1 969	1 577
Black marlin	*Makaira indica*	36	519	555	825	874	999	935	878
Striped marlin	*Tetrapturus audax*	36	2 335	928	1 193	912	697	568	679
Shortbill spearfish	*Tetrapturus angustirostris*	36	9	12	9	23	21	19	18
Marlins,sailfishes,etc. nei	*Istiophoridae*	36	6 971	6 955	7 938	9 182	10 273	12 912	11 867
Swordfish	*Xiphias gladius*	36	24 474	22 550	22 173	19 392	13 937	13 497	10 497
Tuna-like fishes nei	*Scombroidei*	36	8 838	8 523	11 579	9 741	9 792	9 295	15 887
Flat needlefish	*Ablennes hians*	37	5	6	22	42	18	12	26
Hound needlefish	*Tylosurus crocodilus*	37	180	192	242	258	169	195	145
Needlefishes nei	*Tylosurus spp*	37	169	931	581	520	613	505	739
Needlefishes, etc. nei	*Belonidae*	37	132	41	79	59	84	167	99
Halfbeaks nei	*Hemiramphus spp*	37	3 558	5 697	7 300	6 631	1 812	1 523	2 015
Flyingfishes nei	*Exocoetidae*	37	79	63	75	140	134	170	209
Silversides(=Sand smelts) nei	*Atherinidae*	37	-	-	-	-	-	-	4
False trevally	*Lactarius lactarius*	37	8 387	6 562	7 404	9 188	12 146	6 205	10 151
Bluefish	*Pomatomus saltatrix*	37	-	-	-	-	8	-	-
Cobia	*Rachycentron canadum*	37	4 444	4 425	4 725	5 053	5 257	5 270	5 708
Shrimp scad	*Alepes djedaba*	37	147	196	203	267	211	200	200
Yellowtail scad	*Atule mate*	37	1 069	938	1 397	581	864	1 158	969
Jack and horse mackerels nei	*Trachurus spp*	37	6 678	6 867	6 891	4 954	2 921	3 512	3 807
Indian scad	*Decapterus russelli*	37	938	1 124	1 398	1 169	1 003	828	1 076
Scads nei	*Decapterus spp*	37	14 605	13 017	12 337	12 583	10 989	13 457	10 475
Giant trevally	*Caranx ignobilis*	37	6 955	9 773	9 885	9 719	10 655	8 543	10 557
Bluefin trevally	*Caranx melampygus*	37	6	2	12	11	34	38	38
Bigeye trevally	*Caranx sexfasciatus*	37	115	11	85	97	141	150	150
Jacks, crevalles nei	*Caranx spp*	37	44 743	45 088	51 481	48 615	55 246	61 298	78 089
Snubnose pompano	*Trachinotus blochii*	37	59	32	59	39	64	131	92
Indian pompano	*Trachinotus mookalee*	37	125	284	54	45	58	66	304
Pompanos nei	*Trachinotus spp*	37	12	29	31	31	31	17	52
Yellowtail amberjack	*Seriola lalandi*	37	0	0	-	-	-	3	6
Amberjacks nei	*Seriola spp*	37	221	217	1 004	955	989	796	714
Black pomfret	*Parastromateus niger*	37	5 555	4 813	5 364	4 709	6 460	7 656	11 071
Orangespotted trevally	*Carangoides bajad*	37	538	617	553	558	979	1 150	1 150
Yellowspotted trevally	*Carangoides fulvoguttatus*	37	156	268	185	175	189	190	190
Malabar trevally	*Carangoides malabaricus*	37	69	473	494	427	467	316	359
Rainbow runner	*Elagatis bipinnulata*	37	...	20	...	...	67	...	...
Golden trevally	*Gnathanodon speciosus*	37	2 040	2 449	2 385	1 707	1 612	1 397	1 187
Torpedo scad	*Megalaspis cordyla*	37	3 455	3 312	3 202	5 866	5 929	5 507	3 328
Talang queenfish	*Scomberoides commersonnianus*	37	8 094	7 628	10 796	10 506	12 995	9 340	11 374
Doublespotted queenfish	*Scomberoides lysan*	37	-	-	5	31	28	26	26
Needlescaled queenfish	*Scomberoides tol*	37	184	215	212	232	252	262	262
Queenfishes	*Scomberoides spp*	37	1 833	1 641	1 931	1 761	2 050	2 663	3 772
Yellowstripe scad	*Selaroides leptolepis*	37	3 900	3 512	2 740	2 000	1 200	...	...
Carangids nei	*Carangidae*	37	54 293	47 856	57 331	67 632	64 121	77 611	88 034
Pomfrets, ocean breams nei	*Bramidae*	37	-	3	4	4	0	2	2
Common dolphinfish	*Coryphaena hippurus*	37	6 527	5 456	4 874	4 248	3 859	3 761	3 540
Live sharksucker	*Echeneis naucrates*	37	3	3	2	2	1	0	0
Chub mackerel	*Scomber japonicus*	37	1 323	670	645	1 047	647	384	121
Indian mackerel	*Rastrelliger kanagurta*	37	96 735	94 623	94 260	128 984	101 984	116 240	93 010
Indian mackerels nei	*Rastrelliger spp*	37	301	263	300	321	335	469	279
Mackerels nei	*Scombridae*	37	11	11	-	-	-	-	-
Silver pomfret	*Pampus argenteus*	37	2 291	2 724	2 797	2 010	1 671	1 945	1 977
Butterfishes, pomfrets nei	*Stromateidae*	37	14 383	28 294	22 460	26 117	26 595	27 801	23 199
Pickhandle barracuda	*Sphyraena jello*	37	54	55	82	91	76	68	68
Obtuse barracuda	*Sphyraena obtusata*	37	97	59	73	137	168	192	142
Great barracuda	*Sphyraena barracuda*	37	798	1 011	1 526	1 195	1 077	1 546	1 262
Barracudas nei	*Sphyraena spp*	37	22 853	24 031	25 895	25 741	28 660	29 846	35 599
Pelagic percomorphs nei	*Perciformes*	37	120 290	106 258	107 088	68 119	39 428	43 324	49 212
Bluntnose sixgill shark	*Hexanchus griseus*	38	-	-	-	-	-	3	3
Thresher	*Alopias vulpinus*	38	-	-	1	1	-	1	-
Shortfin mako	*Isurus oxyrinchus*	38	71	117	376	333	222	187	251
Porbeagle	*Lamna nasus*	38	31	-	-	9	-	-	-
Blue shark	*Prionace glauca*	38	2 857	3 257	3 739	3 186	1 756	2 113	2 419
Oceanic whitetip shark	*Carcharhinus longimanus*	38	-	-	-	-	-	49	56
Silky shark	*Carcharhinus falciformis*	38	-	-	2	2	-	44	34
Spot-tail shark	*Carcharhinus sorrah*	38	13 298	14 086	13 516	11 821	10 451	10 122	9 698
Requiem sharks nei	*Carcharhinidae*	38	19 068	12 386	11 064	8 652	8 666	6 151	5 099
Hammerhead sharks, etc. nei	*Sphyrnidae*	38	9	27	7	16	2	6	2

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Gulper shark	*Centrophorus granulosus*	38	-	-	1	-	-	-	-
Giant guitarfish	*Rhynchobatus djiddensis*	38	157	125	72	29	60	104	98
Guitarfishes, etc. nei	*Rhinobatidae*	38	765	697	554	516	527	484	450
Sawfishes	*Pristidae*	38	21	11	26	11	37	38	142
Sharpnose stingray	*Himantura gerrardi*	38	25	20	39	38	29	36	37
Stingrays, butterfly rays nei	*Dasyatidae*	38	51	1	1	5	5	12	3
Rays, stingrays, mantas nei	*Rajiformes*	38	18 364	15 680	11 623	10 769	11 418	12 472	13 247
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	63 586	72 398	72 725	88 945	78 041	65 482	64 656
Marine fishes nei	*Osteichthyes*	39	683 186	665 583	645 370	575 840	640 403	705 679	846 353
Blue swimming crab	*Portunus pelagicus*	42	6 593	7 479	7 572	8 878	9 421	10 789	9 006
Portunus swimcrabs nei	*Portunus spp*	42	...	...	15	...	...	...	...
Indo-Pacific swamp crab	*Scylla serrata*	42	21	20	2	3	4	5	3
Chaceon geryons nei	*Chaceon spp*	42	184	158	107	125	78	57	40
Marine crabs nei	*Brachyura*	42	12 916	12 440	13 889	13 140	12 753	14 963	16 465
Scalloped spiny lobster	*Panulirus homarus*	43	216	238	237	112	98	105	110
Tropical spiny lobsters nei	*Panulirus spp*	43	2 238	2 146	2 402	2 442	2 279	2 005	2 849
St.Paul rock lobster	*Jasus paulensis*	43	183	183	392	392	390	390	390
Natal spiny lobster	*Palinurus delagoae*	43	4	4	5	2	5	7	19
Spiny lobsters nei	*Palinuridae*	43	2	1	14	43	5	145	203
Flathead lobster	*Thenus orientalis*	43	52	89	89	51	72	26	12
Mozambique lobster	*Metanephrops mozambicus*	43	132	149	94	153	100	120	94
Lobsters nei	*Reptantia*	43	5	-	-	-	-	-	-
Giant tiger prawn	*Penaeus monodon*	45	109 712	126 672	132 352	125 444	128 178	122 175	115 709
Green tiger prawn	*Penaeus semisulcatus*	45	8 153	8 506	9 439	11 433	12 954	12 515	12 170
Indian white prawn	*Penaeus indicus*	45	-	72	-	35	-	-	-
Penaeus shrimps nei	*Penaeus spp*	45	19 203	19 727	16 106	14 548	13 092	13 451	14 373
Speckled shrimp	*Metapenaeus monoceros*	45	675	872	1 123	1 007	1 614	545	2 505
Metapenaeus shrimps nei	*Metapenaeus spp*	45	7 955	5 124	5 004	4 670	4 742	7 121	6 950
Parapenaeopsis shrimps nei	*Parapenaeopsis spp*	45	12 358	10 412	9 727	9 441	9 534	9 438	10 581
Tsivakihini paste shrimp	*Acetes erythraeus*	45	...	...	2 018	2 022	2 443	1 892	2 358
Knife shrimp	*Haliporoides triarthrus*	45	1 120	1 990	1 936	1 487	1 454	1 193	1 259
Natantian decapods nei	*Natantia*	45	142 322	144 462	129 669	130 437	119 613	122 178	55 043
Marine crustaceans nei	*Crustacea*	47	18 383	20 414	21 326	14 694	11 376	9 825	7 330
Abalones nei	*Haliotis spp*	52	44	45	51	46	0	0	0
Spiral babylon	*Babylonia spirata*	52	555	377	731	662	674	625	568
Cupped oysters nei	*Crassostrea spp*	53	0	28	38	16	36	28	38
Razor clams, knife clams nei	*Solenidae*	56	...	...	...	12	18	148	190
Clams, etc. nei	*Bivalvia*	56	...	...	...	240	255	478	465
Pharaoh cuttlefish	*Sepia pharaonis*	57	15 341	15 961	14 084	14 360	14 898	10 505	14 595
Cuttlefish, bobtail squids nei	*Sepiidae, Sepiolidae*	57	30 492	30 409	21 718	14 507	11 614	17 537	22 744
Common squids nei	*Loligo spp*	57	167	138	79	120	172	234	280
Various squids nei	*Loliginidae, Ommastrephidae*	57	7 446	6 483	12 153	8 042	5 626	4 200	5 225
Octopuses, etc. nei	*Octopodidae*	57	2 535	1 934	1 020	1 208	1 263	1 494	1 843
Cephalopods nei	*Cephalopoda*	57	58 582	66 368	71 366	64 885	57 373	57 133	99 463
Marine molluscs nei	*Mollusca*	58	3 078	2 809	2 262	5 060	9 403	10 336	2 442
Sand fish	*Holothuria scabra*	76	1	-	2	1	2	0	2
Black teatfish	*Holothuria nobilis*	76	12	14	11	10	7	8	36
White teatfish	*Holothuria fuscogilva*	76	65	76	54	98	94	230	197
Prickly redfish	*Thelenota ananas*	76	29	43	35	49	53	113	83
Sea cucumbers nei	*Holothuroidea*	76	1 558	1 462	1 799	2 179	1 385	1 527	1 917
Jellyfishes nei	*Rhopilema spp*	77	312	358	43	1 759	325	3 341	7 997
Total			***4 381 394***	***4 441 970***	***4 459 046***	***4 175 977***	***4 105 741***	***4 147 749***	***4 266 917***

C-51 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Indian Ocean, Western
Océan Indien, ouest
Océano Índico, occidental

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Bahrain	11 230	11 204	13 638	14 489	11 854	15 594	15 014	14 175	16 358	13 490
Belize	8 658	28 019	1 074	957	767	983	1 466	586	280	201
Br Ind Oc Tr	0	28	28	28	28	21	24	34	43	40
China	2 772	3 593	7 366	11 889	13 355	26 931	11 175	7 426	3 805	4 540
China,Taiwan	95 003	95 106	98 877	128 406	107 315	90 488	77 993	51 816	46 019	29 811
Comoros	12 180	13 102	14 115	14 935	15 070	15 070 F	16 000	20 450 F	20 450 F	20 450 F
Cook Is	-	-	-	-	-	-	-	-	-	6 082
Djibouti	900	1 000	1 100 F	1 200 F	1 571	1 299	1 229	1 206	1 058	1 058 F
Egypt	73 559	72 881	70 408	63 914	50 732	46 940	46 986	47 361	49 031	43 974
Eritrea	8 820	7 832	6 689	7 404	4 027	8 813	1 932	1 665	3 030	3 286
France	76 625	98 461	108 157	107 422	106 956	97 740	69 526	74 920	58 428	47 856
Fr South Tr	263 F	414 F	463 F	263 F	263 F	472 F	472 F	470 F	470 F	470 F
Guinea	178	1 396	1 081	1 121	2 573	1 070	1 140	1 055	933	766
India	1 862 686	1 983 089	1 984 459	1 889 853	1 955 564	1 960 740	2 013 830	2 034 759	2 046 460	2 146 400
Iran	262 805	269 020	299 201	314 186	343 503	374 474	329 626	341 980	348 122	368 505
Iraq	19 200	14 100	4 000	2 355	6 359 F	12 959	12 319	4 486	12 246	13 490
Israel	120	30	30	100	75	75	50	50 F	50 F	50 F
Italy	3 199	4 760	10 013	12 303	9 326	9 794	4 522	7 645	5 462	-
Japan	24 738	25 169	31 310	30 187	39 855	42 301	40 044	24 767	12 094	7 167
Jordan	170	176	131	144	160	147	156	150	219	136
Kenya	7 388	6 720	6 830	7 774	7 105	6 955	7 448	8 301	5 564	8 264
Korea Rep	10 878	14 457	20 282	24 578	21 408	18 831	17 393	12 812	16 575	9 496
Kuwait	5 846	5 360	4 059	4 833	4 895	5 635	4 373	3 979	4 000 F	4 000 F
Madagascar	93 583	99 299	99 476	103 416	99 930	100 943	115 148	87 834	98 475	93 336
Maldives	127 636	163 770	156 132	158 528	186 274	185 299	144 508	133 338	117 061	94 953
Mauritius	10 986	10 706	10 968	9 971	9 855	8 681	8 097	6 642	7 676	7 786
Mayotte	10 052	4 754	3 464	2 306	2 194	5 772	11 661	12 677	15 006	20 842
Mozambique	21 340	20 515	79 451	71 829	71 004	75 883	68 189	91 260	114 383	118 893
Oman	129 907	142 669	138 481	165 016	157 326	147 668	151 744	151 910	158 551	163 927
Pakistan	420 698	418 104	399 040	386 653	340 206	349 421	340 056	343 414	334 007	337 916
Philippines	1 284	1 103	3 139	1 687	4 250	3 613	2 640	2 732	437	353
Portugal	3 339	2 185	5 588	2 723	3 207	5 177	2 783	912	1 108	2 018
Qatar	8 864	7 155	11 295	11 134	13 935	16 376	15 190	17 688	14 064	13 760
Réunion	3 889	2 870	2 902	3 371	4 281	3 546	3 988	2 978	3 050	3 050 F
Russian Fed	221	123	205	-	-	-	-	-	-	-
Saudi Arabia	55 331	57 211	55 440	55 418	60 421	65 485	66 221	68 898	67 664	65 142
Senegal	-	-	310	269	-	1 070	-	-	-	-
Seychelles	49 423	62 778	85 288	100 048	108 525	92 451	64 802	67 498	79 221	85 606
Somalia	31 700 F	28 800	29 800	29 800	24 800 F	29 800 F	29 800 F	29 800 F	29 800 F	29 800 F
South Africa	1 173	2 045	2 166	896	860	1 072	985	1 065	949	1 206
Spain	135 638	175 305	189 571	159 994	191 880	210 213	126 489	131 670	117 439	137 147
Sudan	5 000	5 000	5 000 F	5 500 F	5 200 F	5 000 F	5 699 F	5 695 F	5 690	5 700 F
Tanzania	53 197	50 376	49 439	51 648	56 134	42 918	45 489	45 121	46 802	49 438
Thailand	273	17	54	443	12 162	23 446	10 367	9 567	10 075	220
Ukraine	845	-	-	-	-	-	-	-	-	-
Untd Arab Em	112 561	97 574	95 150	90 000 F	86 735	82 500 F	78 300 F	74 075	77 705	79 610
UK	-	-	-	562	668	698	760	2 030	1 746	474
Uruguay	7 002	1 928	1 112	86	-	237	31	101	26	-
Yemen	142 198	179 584	228 116	256 300	238 400	229 660	179 916	127 132	159 000 F	191 100
Zanzibar	20 541	20 341	20 859	23 488	23 210	24 418	23 580	24 514	25 394	25 690
Other nei	96 007	79 303	91 232	51 967	37 752	10 367	6 816	7 097	11 723	9 418
Total	***4 029 906***	***4 289 432***	***4 446 989***	***4 381 394***	***4 441 970***	***4 459 046***	***4 175 977***	***4 105 741***	***4 147 749***	***4 266 917***

C-57 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Indian Ocean, Eastern
Océan Indien, est
Océano Índico, oriental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Short-finned eel	*Anguilla australis*	22	105	87	80	70	84	57	44
Chacunda gizzard shad	*Anodontostoma chacunda*	24	2 843	4 117	4 865	5 613	3 592	3 172	5 102
Hilsa shad	*Tenualosa ilisha*	24	223 200	225 103	225 435	213 410	216 704	217 348	260 610
Toli shad	*Tenualosa toli*	24	645	873	1 036	413	1 526	1 854	949
Indian pellona	*Pellona ditchela*	24	5 569	9 514	12 546	13 131	9 544	9 753	7 229
Diadromous clupeoids nei	*Clupeoidei*	24	122	58	64	70	34	20	23
Barramundi(=Giant seaperch)	*Lates calcarifer*	25	11 523	11 316	12 316	12 809	12 791	15 274	12 756
Tonguefishes	*Cynoglossidae*	31	8 454	4 876	7 189	8 241	5 781	5 007	4 458
Indian halibut	*Psettodes erumei*	31	7 359	9 919	11 230	8 906	8 415	7 224	7 314
Flatfishes nei	*Pleuronectiformes*	31	11 683	11 075	11 858	17 558	17 262	18 676	27 279
Unicorn cod	*Bregmaceros mcclellandi*	32	769	505	814	1 496	2 491	2 485	3 088
Blue grenadier	*Macruronus novaezelandiae*	32	8 773	6 562	4 313	2 237	3 458	2 146	3 420
Gadiformes nei	*Gadiformes*	32	18	2	14	11	9	5	7
Indo-Pacific tarpon	*Megalops cyprinoides*	33	15	24	34	36	21	29	30
Bombay-duck	*Harpadon nehereus*	33	38 013	30 872	30 540	27 500	54 246	76 859	82 748
Greater lizardfish	*Saurida tumbil*	33	3 525	3 689	4 633	5 522	4 912	7 106	5 485
Lizardfishes nei	*Synodontidae*	33	25 449	17 265	17 076	19 972	25 289	26 635	30 538
Sea catfishes nei	*Ariidae*	33	59 212	63 083	68 127	78 118	110 222	94 886	84 548
Eeltail catfishes	*Plotosus spp*	33	1 063	986	1 466	1 452	1 242	1 632	1 640
Mullets nei	*Mugilidae*	33	29 021	30 076	32 350	48 885	32 909	38 399	36 941
Fusiliers nei	*Caesionidae*	33	4 917	5 903	6 191	8 351	7 409	7 262	10 055
Honeycomb grouper	*Epinephelus merra*	33	1 307	1 677	1 929	3 750	2 737	1 552	1 834
Greasy grouper	*Epinephelus tauvina*	33	...	...	0	107	670	1 784	1 641
Groupers nei	*Epinephelus spp*	33	1 145	1 000	1 340	1 614	1 361	1 440	1 515
Chocolate hind	*Cephalopholis boenak*	33	5 174	10 327	10 470	11 807	10 830	13 757	14 250
Humpback grouper	*Cromileptes altivelis*	33	856	1 095	1 661	2 662	2 847	3 985	3 465
Leopard coralgrouper	*Plectropomus leopardus*	33	4 427	886	1 008	2 728	1 516	1 857	1 779
Groupers, seabasses nei	*Serranidae*	33	3 882	3 605	3 381	3 145	2 084	2 059	2 598
Terapon perches nei	*Terapon spp*	33	651	646	686	1 467	659	2 308	3 288
Red bigeye	*Priacanthus macracanthus*	33	...	...	...	142	137	451	543
Bigeyes nei	*Priacanthus spp*	33	53 440	40 401	42 088	38 006	21 420	22 602	26 692
Silver sillago	*Sillago sihama*	33	0	12	160	7	0	117	165
Sillago-whitings	*Sillaginidae*	33	10 484	10 404	12 148	8 565	3 937	3 803	4 290
Ruff	*Arripis georgianus*	33	591	465	483	335	407	325	381
Australian salmon	*Arripis trutta*	33	3 196	2 292	3 166	2 334	1 488	1 859	1 502
Mangrove red snapper	*Lutjanus argentimaculatus*	33	772	736	719	794	687	1 083	924
Snappers nei	*Lutjanus spp*	33	11 779	12 173	14 125	17 336	18 744	19 713	19 660
Jobfishes nei	*Pristipomoides spp*	33	265	290	366	1 220	853	816	1 077
Snappers, jobfishes nei	*Lutjanidae*	33	10 802	10 266	9 842	8 069	5 392	5 997	5 882
Threadfin breams nei	*Nemipterus spp*	33	45 860	42 597	47 981	52 629	36 890	45 213	45 363
Monocle breams	*Scolopsis spp*	33	95	7	4	6	178	235	71
Ponyfishes(=Slipmouths)	*Leiognathus spp*	33	311	190	199	499	193	226	260
Ponyfishes(=Slipmouths) nei	*Leiognathidae*	33	60 640	63 486	68 399	66 000	59 529	62 320	65 578
Sweetlips, rubberlips nei	*Plectorhinchus spp*	33	0	31	44	290	369	223	209
Silver grunt	*Pomadasys argenteus*	33	640	656	737	716	669	870	850
Grunts, sweetlips nei	*Haemulidae(=Pomadasyidae)*	33	3 817	3 315	3 629	4 705	4 356	3 849	3 330
Southern meagre(=Mulloway)	*Argyrosomus hololepidotus*	33	272	268	254	211	151	90	109
Croakers, drums nei	*Sciaenidae*	33	89 659	78 199	82 792	95 565	109 648	101 460	100 619
Emperors(=Scavengers) nei	*Lethrinidae*	33	5 167	6 466	6 579	7 783	8 120	7 748	6 977
Silver seabream	*Pagrus auratus*	33	3 379	2 673	2 748	2 563	1 869	1 602	1 119
Porgies, seabreams nei	*Sparidae*	33	447	540	483	192	330	149	726
Goatfishes	*Upeneus spp*	33	26 356	26 013	27 252	31 387	51 234	46 818	44 569
Mojarras(=Silver-biddies) nei	*Gerres spp*	33	83	...	...	...	105	152	114
Parore	*Girella tricuspidata*	33	20	16	21	0	0	1	0
Spotted sicklefish	*Drepane punctata*	33	143	146	155	169	173	247	257
Humphead wrasse	*Cheilinus undulatus*	33	79	89	93	97	970	790	663
Wrasses, hogfishes, etc. nei	*Labridae*	33	153	187	367	338	119	147	201
Fourfinger threadfin	*Eleutheronema tetradactylum*	33	200	237	272	265	488	100	558
Indian threadfin	*Leptomelanosoma indicum*	33	...	...	...	...	1 040	7 733	7 732
Threadfins, tasselfishes nei	*Polynemidae*	33	19 779	20 514	23 093	22 675	25 434	32 990	26 790
Grey rockcod	*Notothenia squamifrons*	33	415	463	460	426	354	331	316
Percoids nei	*Percoidei*	33	37 440	31 251	33 602	39 998	51 810	60 026	57 713
Spinefeet(=Rabbitfishes) nei	*Siganus spp*	33	231	1 106	1 481	2 593	2 217	2 895	2 687
Flatheads nei	*Platycephalidae*	33	5 320	5 064	3 678	3 071	3 380	2 896	3 011
Puffers nei	*Tetraodontidae*	33	905	960	731	475	342	282	442
Triggerfishes, durgons nei	*Balistidae*	33	336	289	257	258	223	332	170
Daggertooth pike conger	*Muraenesox cinereus*	34	2 274	2 352	3 160	2 793	2 986	2 716	2 306
Pike-congers nei	*Muraenesox spp*	34	5 783	5 287	5 300	6 638	8 887	9 355	7 590
Pink cusk-eel	*Genypterus blacodes*	34	1 265	1 384	980	840	947	846	716
Alfonsinos nei	*Beryx spp*	34	-	-	-	-	-	-	2
Redfish	*Centroberyx affinis*	34	968	1 015	802	1 038	820	697	482
Orange roughy	*Hoplostethus atlanticus*	34	2 558	3 250	2 373	1 120	288	659	652
John dory	*Zeus faber*	34	44	48	41	29	31	37	30
Mirror dory	*Zenopsis nebulosus*	34	277	188	171	104	202	176	256
Morwongs	*Nemadactylus spp*	34	733	772	763	625	616	490	391
Trumpeters nei	*Latridae*	34	66	47	49	63	39	31	23
Patagonian toothfish	*Dissostichus eleginoides*	34	13	-	-	-	-	-	-
Snoek	*Thyrsites atun*	34	98	110	415	70	63	66	50
Oilfish	*Ruvettus pretiosus*	34	1	2	-	21	4	-	6
Silver gemfish	*Rexea solandri*	34	503	430	469	500	441	180	178
Snake mackerels, escolars nei	*Gempylidae*	34	61	38	24	12	17	4	7
Largehead hairtail	*Trichiurus lepturus*	34	11 184	11 209	11 632	11 746	8 123	8 012	7 904
Hairtails, scabbardfishes nei	*Trichiuridae*	34	27 424	36 603	39 472	49 507	47 005	50 842	39 228
Warehou nei	*Seriolella spp*	34	3 673	3 055	2 984	2 699	1 978	1 794	1 346

C-57 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Indian Ocean, Eastern
Océan Indien, est
Océano Índico, oriental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Scorpionfishes nei	*Scorpaenidae*	34	-	10	7	5	1	0	2
Bluefin gurnard	*Chelidonichthys kumu*	34	162	145	150	188	203	124	136
Latchet(=Sharpbeak gurnard)	*Pterygotrigla polyommata*	34	137	207	245	199	140	107	96
Demersal percomorphs nei	*Perciformes*	34	17 540	10 570	11 170	13 860	12 670	15 960	20 150
Spotted sardinella	*Amblygaster sirm*	35	408	414	516	1 030	826	1 225	628
Goldstripe sardinella	*Sardinella gibbosa*	35	29 453	39 365	29 696	45 903	45 862	44 652	48 880
Indian oil sardine	*Sardinella longiceps*	35	25 271	26 802	27 087	29 423	63 758	62 350	60 144
Bali sardinella	*Sardinella lemuru*	35	58 430	47 642	114 125	95 122	89 061	103 564	83 558
Sardinellas nei	*Sardinella spp*	35	16 598	16 964	19 258	15 886	17 596	16 415	17 006
Rainbow sardine	*Dussumieria acuta*	35	3 601	4 492	5 763	4 749	3 438	4 192	3 342
Stolephorus anchovies nei	*Stolephorus spp*	35	56 177	52 801	58 959	60 770	73 892	64 416	60 411
Anchovies, etc. nei	*Engraulidae*	35	43 139	36 039	46 116	55 271	66 027	72 991	67 041
Dorab wolf-herring	*Chirocentrus dorab*	35	6 707	5 082	4 806	4 099	2 459	2 525	2 492
Wolf-herrings nei	*Chirocentrus spp*	35	15 941	17 446	19 979	37 848	37 257	37 154	35 645
Clupeoids nei	*Clupeoidei*	35	117 494	99 281	114 796	145 574	155 182	160 388	174 444
Striped bonito	*Sarda orientalis*	36	...	18	47	98	175	117	97
Wahoo	*Acanthocybium solandri*	36	440	436	724	500	446	447	794
Narrow-barred Spanish mackerel	*Scomberomorus commerson*	36	35 470	31 485	37 694	40 466	46 756	45 024	44 321
Indo-Pacific king mackerel	*Scomberomorus guttatus*	36	12 995	12 719	15 634	16 705	19 098	18 194	17 261
Streaked seerfish	*Scomberomorus lineolatus*	36	1 019	1 016	1 256	1 280	1 288	1 197	1 029
Seerfishes nei	*Scomberomorus spp*	36	12 020	11 579	16 104	11 852	9 292	8 626	11 820
Frigate and bullet tunas	*Auxis thazard, A. rochei*	36	38 489	33 852	38 630	42 524	50 662	49 865	55 484
Kawakawa	*Euthynnus affinis*	36	54 615	53 482	62 378	66 468	73 060	76 195	75 597
Skipjack tuna	*Katsuwonus pelamis*	36	126 223	88 749	102 710	128 025	144 883	148 643	164 083
Longtail tuna	*Thunnus tonggol*	36	37 541	32 516	38 165	45 885	50 986	50 691	51 328
Albacore	*Thunnus alalunga*	36	18 586	16 939	10 909	16 708	21 451	20 621	27 420
Southern bluefin tuna	*Thunnus maccoyii*	36	8 492	10 069	9 088	8 241	7 722	6 971	6 046
Yellowfin tuna	*Thunnus albacares*	36	79 798	66 382	68 730	69 127	65 855	69 564	84 995
Bigeye tuna	*Thunnus obesus*	36	34 996	26 344	24 919	30 362	29 130	32 499	27 351
Indo-Pacific sailfish	*Istiophorus platypterus*	36	11 960	6 279	6 433	4 885	4 814	5 007	8 766
Blue marlin	*Makaira nigricans*	36	6 562	6 154	6 330	3 907	3 872	5 191	8 374
Black marlin	*Makaira indica*	36	2 704	2 814	2 883	1 993	2 167	2 830	3 426
Striped marlin	*Tetrapturus audax*	36	1 024	959	1 153	565	568	746	1 123
Shortbill spearfish	*Tetrapturus angustirostris*	36	8	2	4	7	11	8	9
Marlins,sailfishes,etc. nei	*Istiophoridae*	36	1 511	930	1 188	1 595	1 576	2 276	2 058
Swordfish	*Xiphias gladius*	36	13 971	8 319	7 191	6 409	5 195	7 088	9 266
Tuna-like fishes nei	*Scombroidei*	36	13 050	5 389	10 371	12 921	14 054	15 123	17 682
Needlefishes nei	*Tylosurus spp*	37	419	529	870	3 245	3 655	3 424	3 243
Halfbeaks nei	*Hemiramphus spp*	37	12 969	12 006	12 402	9 843	30 408	12 766	33 842
Flyingfishes nei	*Exocoetidae*	37	9 826	6 356	6 347	10 033	7 631	9 019	7 136
False trevally	*Lactarius lactarius*	37	3 624	3 697	4 191	6 908	8 570	10 141	11 906
Bluefish	*Pomatomus saltatrix*	37	62	40	15	-	0	-	-
Cobia	*Rachycentron canadum*	37	164	134	218	246	147	305	236
Greenback horse mackerel	*Trachurus declivis*	37	3 403	1 923	889	608	363	450	262
White trevally	*Pseudocaranx dentex*	37	81	114	115	48	65	51	53
Indian scad	*Decapterus russelli*	37	55 313	59 994	62 190	57 731	60 006	52 133	54 753
Scads nei	*Decapterus spp*	37	33 112	35 757	44 835	47 703	49 624	54 768	47 723
Jacks, crevalles nei	*Caranx spp*	37	24 764	27 688	32 307	35 936	35 137	39 751	28 710
Pompanos nei	*Trachinotus spp*	37	2 028	1 526	2 538	1 737	12 819	2 194	13 493
Amberjacks nei	*Seriola spp*	37	6	-	-	-	2	1	1
Black pomfret	*Parastromateus niger*	37	9 686	10 837	13 570	12 875	16 095	15 512	15 488
Rainbow runner	*Elagatis bipinnulata*	37	3 178	3 210	4 315	2 418	3 060	4 273	3 672
Torpedo scad	*Megalaspis cordyla*	37	22 090	36 654	37 164	36 237	34 925	45 659	53 763
Queenfishes	*Scomberoides spp*	37	2 731	3 979	4 829	6 019	5 014	5 507	4 131
Bigeye scad	*Selar crumenophthalmus*	37	8 359	8 012	8 577	7 872	22 625	24 890	26 819
Yellowstripe scad	*Selaroides leptolepis*	37	31 913	39 575	42 844	40 873	47 698	53 319	66 561
Blackbanded trevally	*Seriolina nigrofasciata*	37	2 936	1 795	2 425	1 653	1 394	1 483	1 439
Carangids nei	*Carangidae*	37	43 292	38 201	43 615	63 013	37 344	47 031	50 895
Common dolphinfish	*Coryphaena hippurus*	37	778	489	1 071	3 046	4 882	2 800	2 163
Blue mackerel	*Scomber australasicus*	37	205	134	672	152	211	124	146
Short mackerel	*Rastrelliger brachysoma*	37	56 630	65 330	69 137	78 291	80 137	67 604	72 467
Indian mackerel	*Rastrelliger kanagurta*	37	42 043	49 970	46 517	45 180	47 465	52 830	49 958
Indian mackerels nei	*Rastrelliger spp*	37	143 484	146 983	133 124	173 942	166 894	191 273	184 754
Mackerels nei	*Scombridae*	37	19 049	10 231	17 391	18 085	19 500	21 791	26 269
Silver pomfret	*Pampus argenteus*	37	7 310	7 030	8 112	10 608	16 158	16 875	15 221
Butterfishes, pomfrets nei	*Stromateidae*	37	22 363	16 106	17 093	26 005	24 006	21 681	19 619
Pickhandle barracuda	*Sphyraena jello*	37	...	...	4	14	0	0	94
Great barracuda	*Sphyraena barracuda*	37	1 079	1 622	1 407	2 952	4 294	4 989	2 579
Barracudas nei	*Sphyraena spp*	37	13 875	9 724	10 282	6 886	29 612	15 110	14 362
Thresher	*Alopias vulpinus*	38	-	-	-	1	-	-	-
Thresher sharks nei	*Alopias spp*	38	...	5 795	773	1 785	6 752	2 526	2 833
Shortfin mako	*Isurus oxyrinchus*	38	-	-	37	44	17	27	82
Mackerel sharks,porbeagles nei	*Lamnidae*	38	250	272	259	296	90	444	537
Blue shark	*Prionace glauca*	38	2 299	655	1 042	746	504	56	118
Oceanic whitetip shark	*Carcharhinus longimanus*	38	-	-	-	-	-	7	104
Silky shark	*Carcharhinus falciformis*	38	3 140	2 340	1 960	980	520	530	670
Requiem sharks nei	*Carcharhinidae*	38	...	7 815	10 382	12 220	2 811	6 881	7 485
Hammerhead sharks, etc. nei	*Sphyrnidae*	38	1	2	89	67	956	1 355	1 358
Smooth-hounds nei	*Mustelus spp*	38	2 945	2 951	2 704	2 612	3 216	2 925	2 641
Tope shark	*Galeorhinus galeus*	38	349	287	329	276	399	355	305
Dogfish sharks nei	*Squalidae*	38	...	6 717	9 866	10 324	2 503	2 067	1 875
Sawsharks nei	*Pristiophorus spp*	38	519	511	499	386	384	372	264
Angelsharks, sand devils nei	*Squatinidae*	38	246	319	336	278	221	141	...
Whitespotted wedgefish	*Rhynchobatus australiae*	38	...	2 304	2 677	716	1 786	625	23
Sawfishes	*Pristidae*	38	...	...	1	6	11	163	20

C-57 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Indian Ocean, Eastern
Océan Indien, est
Océano Índico, oriental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Stingrays, butterfly rays nei	*Dasyatidae*	38	...	7 738	9 657	9 876	11 567	14 588	7 722
Eagle rays nei	*Myliobatidae*	38	...	531	91	2 865	1 114	1 678	2 817
Mantas, devil rays nei	*Mobulidae*	38	...	...	...	761	136	118	265
Rays, stingrays, mantas nei	*Rajiformes*	38	23 017	11 642	10 049	9 207	9 139	7 755	7 333
Ghost shark	*Callorhinchus milii*	38	112	115	146	118	130	146	160
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	119 049	48 251	48 027	70 014	59 445	66 203	54 786
Marine fishes nei	*Osteichthyes*	39	2 488 742	2 596 178	2 679 128	2 493 555	2 539 403	2 877 821	3 004 308
Blue swimming crab	*Portunus pelagicus*	42	12 382	14 417	13 027	14 000	12 591	13 325	14 036
Indo-Pacific swamp crab	*Scylla serrata*	42	5 675	4 255	6 639	6 023	4 705	5 385	5 098
Marine crabs nei	*Brachyura*	42	25 752	24 654	24 988	38 475	42 982	47 177	41 082
Australian spiny lobster	*Panulirus cygnus*	43	13 745	12 304	10 441	8 676	8 990	7 635	5 502
Tropical spiny lobsters nei	*Panulirus spp*	43	2 409	2 546	2 154	2 192	2 659	2 276	2 119
Southern rock lobster	*Jasus novaehollandiae*	43	4 500	4 426	4 258	4 294	4 099	3 497	4 368
Flathead lobster	*Thenus orientalis*	43	588	503	620	414	97	150	124
Slipper lobsters nei	*Scyllaridae*	43	-	27	22	15	20	16	31
Metanephrops lobsters nei	*Metanephrops spp*	43	63	61	42	43	15	37	51
Banana prawn	*Penaeus merguiensis*	45	18 942	18 609	19 427	20 533	26 428	32 467	29 918
Giant tiger prawn	*Penaeus monodon*	45	77 634	69 551	71 111	84 754	102 273	81 853	66 442
Green tiger prawn	*Penaeus semisulcatus*	45	805	967	841	665	771	634	690
Western king prawn	*Penaeus latisulcatus*	45	1 353	1 865	1 817	1 769	1 412	1 100	1 427
Penaeus shrimps nei	*Penaeus spp*	45	13 690	12 667	11 846	10 371	9 312	10 285	10 576
Endeavour shrimp	*Metapenaeus endeavouri*	45	13	36	5	1	5	8	287
Metapenaeus shrimps nei	*Metapenaeus spp*	45	14 120	14 021	15 397	18 622	17 966	22 740	20 385
Sergestid shrimps nei	*Sergestidae*	45	5 617	4 685	4 803	11 699	25 927	28 074	48 209
Natantian decapods nei	*Natantia*	45	113 895	82 823	98 450	122 508	136 776	141 846	147 965
Antarctic krill	*Euphausia superba*	46	-	-	-	-	-	-	3 191
Stomatopods nei	*Stomatopoda*	47	654	375	227	139	1	11	6
Marine crustaceans nei	*Crustacea*	47	58 489	52 707	61 929	85 944	74 475	72 819	82 761
Blacklip abalone	*Haliotis rubra*	52	5 336	5 405	4 882	4 880	4 713	4 858	4 452
Commercial top	*Trochus niloticus*	52	888	888	932	0	0	0	86
Cupped oysters nei	*Crassostrea spp*	53	64	178	370	338	1	23	22
Horse mussels nei	*Modiolus spp*	54	0	30	-	-	-	-	-
Green mussel	*Perna viridis*	54	4	4	313	9	7	4	20
Scallops nei	*Pectinidae*	55	7 279	12 336	7 278	7 161	7 326	4 939	4 620
Blood cockle	*Anadara granosa*	56	21 036	21 062	22 486	30 303	27 659	5 444	7 295
Hard clams nei	*Meretrix spp*	56	3 776	3 664	3 835	3 892	7 762	1 692	2 170
Short neck clams nei	*Paphia spp*	56	230	...	...	...	1 800	2 025	1 798
Pipi wedge clam	*Paphies australis*	56	1 073	1 103	1 025	994	607	469	300
Clams, etc. nei	*Bivalvia*	56	7 944	1 823	1 282	4 312	6 322	23 019	1 544
Cuttlefish, bobtail squids nei	*Sepiidae, Sepiolidae*	57	38 746	29 410	32 051	34 353	25 312	48 022	30 494
Common squids nei	*Loligo spp*	57	25 192	22 194	23 576	28 332	30 005	28 042	36 585
Bigfin reef squid	*Sepioteuthis lessoniana*	57	2 173	2 330	2 171	2 465	3 271	2 431	2 851
Various squids nei	*Loliginidae, Ommastrephidae*	57	23 987	19 572	25 404	28 243	23 184	27 713	23 394
Octopuses, etc. nei	*Octopodidae*	57	12 579	7 080	6 308	6 290	6 799	6 662	6 707
Cephalopods nei	*Cephalopoda*	57	12 567	11 593	11 542	10 988	11 829	12 577	13 990
Marine molluscs nei	*Mollusca*	58	8 226	5 978	5 805	4 010	5 228	6 313	5 963
Marine turtles nei	*Testudinata*	72	137	125	134	139	4	120	96
Sea squirts nei	*Ascidiacea*	74	-	-	-	-	4	4	7
Sea cucumbers nei	*Holothuroidea*	76	694	2 998	1 873	3 275	4 682	4 371	4 641
Jellyfishes nei	*Rhopilema spp*	77	3 161	34 593	137 305	2 857	150 071	118 959	110 884
Aquatic invertebrates nei	*Invertebrata*	77	1 040	818	1 220	1 280	472	850	1 036
Total			***5 576 152***	***5 455 177***	***5 889 863***	***5 941 605***	***6 347 188***	***6 764 362***	***6 950 343***

C-57 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Indian Ocean, Eastern
Océan Indien, est
Océano Índico, oriental

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Australia	106 304	116 749	135 034	150 828	162 141	129 517	117 439	112 226	106 799	112 172
Bangladesh	379 497	415 420	431 908	455 207	474 597	479 810	487 438	497 573	602 642	607 492
Belize	584	1 882	299	247	328	-	13	9	-	-
China	4 007	1 473	506	1 434	953	538	915	470	704	3 534
China,Taiwan	14 308	19 384	17 563	41 447	35 904	26 793	21 351	24 231	33 645	37 899
Cook Is	-	-	-	-	-	-	-	-	-	2
France	-	-	-	-	-	1 051	11	-	512	111
Guinea	...	-	-	1 060	-	160	111	220	194	83
Honduras	637	-	-	-	-	-	-	-	-	-
India	939 003	977 915	970 337	973 866	892 052	991 458	1 022 053	1 117 110	1 096 342	1 079 811
Indonesia	986 224	1 035 128	1 078 939	1 078 757	1 151 068	1 171 301	1 187 386	1 293 805	1 358 806	1 287 371
Japan	17 675	16 276	13 444	8 888	9 864	11 178	16 160	16 254	16 883	11 067
Korea Rep	4 550	4 239	2 206	2 561	1 855	1	390	669	225	1 005
Madagascar	-	-	-	-	68	-	-	-	-	-
Malaysia	475 354	501 466	532 843	578 560	508 545	586 668	671 706	672 590	717 565	733 385
Myanmar	949 670	1 029 460	1 053 720	1 132 340	1 228 710	1 375 670	1 517 940	1 679 010	1 867 510	2 060 780
Philippines	155	319	239	1 508	263	268	992	572	597	311
Portugal	-	-	-	151	327	67	1 245	173	24	83
Senegal	-	-	0	0	135	160	-	-	-	-
Seychelles	368	423	702	623	155	288	712	1 702	1 875	1 502
Spain	...	1 620	8 315	5 613	2 732	1 775	932	1 693	2 806	730
Sri Lanka	265 251	271 603	301 399	302 580	159 296	238 735	268 900	282 904	309 134	383 945
Thailand	759 952	781 032	790 906	829 448	818 813	867 970	621 086	642 117	643 114	623 471
Timor-Leste	356	800 F	1 250 F	1 700 F	2 150 F	2 550 F	2 912	3 125	3 125 F	3 125 F
Ukraine	-	-	-	13	-	-	-	-	-	-
UK	-	-	-	-	100	1 163	910	-	53	677
Uruguay	-	1 847	83	-	-	-	-	-	-	-
Vanuatu	-	-	-	-	-	-	-	-	769	622
Other nei	3 089	3 470	3 639	9 321	5 121	2 742	1 003	735	1 038	1 165
Total	***4 906 984***	***5 180 506***	***5 343 332***	***5 576 152***	***5 455 177***	***5 889 863***	***5 941 605***	***6 347 188***	***6 764 362***	***6 950 343***

C-58 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Indian Ocean, Antarctic
Océan Indien, Antarctique
Océano Índico, Antártico

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Smalleye moray cod	*Muraenolepis microps*	32	0	0	-	-	-	-	-
Moray cods nei	*Muraenolepis spp*	32	-	0	-	0	-	-	-
Blue antimora	*Antimora rostrata*	32	1	105	110	6	141	131	140
Whitson's grenadier	*Macrourus whitsoni*	32	1	42	1	13	85	0	1
Ridge scaled rattail	*Macrourus carinatus*	32	15	0	17	-	951	1 167	997
Bigeye grenadier	*Macrourus holotrachys*	32	2	1	0	-	2	-	-
Grenadiers nei	*Macrourus spp*	32	880	607	637	752	65	136	120
Dogtooth grenadier	*Cynomacrurus piriei*	32	0	1	-	-	-	0	-
Grenadiers, rattails nei	*Macrouridae*	32	-	-	-	-	2	-	-
Marbled rockcod	*Notothenia rossii*	33	0	0	-	-	-	-	-
Grey rockcod	*Notothenia squamifrons*	33	3	2	5	10	20	26	48
Striped-eyed rockcod	*Notothenia kempi*	33	0	-	-	-	-	-	-
Triangular rockcod	*Notothenia acuta*	33	0	0	-	-	-	0	2
Toad notie	*Nototheniops mizops*	33	0	0	-	-	-	0	-
Antarctic rockcods, noties nei	*Nototheniidae*	33	-	0	0	0	0	-	0
Slickheads nei	*Alepocephalus spp*	34	0	0	-	-	-	0	-
Lanternfishes nei	*Myctophidae*	34	0	0	-	-	-	0	...
Antarctic toothfish	*Dissostichus mawsoni*	34	26	910	902	841	726	377	299
Patagonian toothfish	*Dissostichus eleginoides*	34	8 776	8 697	8 741	8 345	8 205	8 676	8 247
...A	*Chionobathyscus dewitti*	34	-	-	-	-	1	-	-
Blackfin icefish	*Chaenocephalus aceratus*	34	0	1	1	1	1	0	-
Mackerel icefish	*Champsocephalus gunnari*	34	78	1 851	660	1	199	83	352
South Georgia icefish	*Pseudochaenichthys georgianus*	34	0	-	-	-	-	-	-
Unicorn icefish	*Channichthys rhinoceratus*	34	14	34	33	15	37	51	81
Crocodile icefishes nei	*Channichthyidae*	34	-	1	0	0	0	0	-
Rudderfish	*Centrolophus niger*	34	0	-	-	-	-	-	-
Antarctic horsefish	*Zanclorhynchus spinifer*	34	-	-	-	-	-	0	-
Albacore	*Thunnus alalunga*	36	-	2	-	-	-	-	-
Southern opah	*Lampris immaculatus*	37	-	0	-	-	-	0	-
Porbeagle	*Lamna nasus*	38	-	-	-	-	-	-	1
Pacific sleeper shark	*Somniosus pacificus*	38	8	2	0	2	-	1	1
Lanternsharks nei	*Etmopterus spp*	38	0	-	-	-	-	0	0
...A	*Raja taaf*	38	-	-	-	-	56	187	176
Antarctic starry skate	*Raja georgiana*	38	-	19	0	5	-	-	-
Eaton's skate	*Bathyraja eatonii*	38	8	7	0	7	8	6	13
McCain's skate	*Bathyraja maccaini*	38	0	1	-	-	-	-	-
Murray's skate	*Bathyraja murrayi*	38	0	2	-	1	1	2	1
Kerguelen sandpaper skate	*Bathyraja irrasa*	38	2	1	8	2	10	1	0
Bathyraja rays nei	*Bathyraja spp*	38	0	-	-	1	-	-	-
Rays and skates nei	*Rajidae*	38	0	-	-	-	369	273	335
Rays, stingrays, mantas nei	*Rajiformes*	38	555	612	376	381	3	19	12
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	-	1	-	-	-	-	-
Marine fishes nei	*Osteichthyes*	39	0	1	-	-	-	0	-
Subantarctic stone crab	*Lithodes murrayi*	44	1	3	-	-	-	-	-
King crabs nei	*Lithodes spp*	44	0	0	-	-	-	-	-
Red stone crab	*Paralomis aculeata*	44	0	-	-	-	-	-	-
Antarctic stone crab	*Paralomis spinosissima*	44	1	-	-	-	-	-	-
...A	*Paralomis spp*	44	0	15	-	-	-	-	-
King crabs, stone crabs nei	*Lithodidae*	44	5	16	-	-	0	0	0
Gastropods nei	*Gastropoda*	52	0	0	0	0	-	0	-
Sevenstar flying squid	*Martialia hyadesi*	57	0	-	-	-	-	-	-
Various squids nei	*Loliginidae, Ommastrephidae*	57	0	-	-	-	-	-	-
Octopuses, etc. nei	*Octopodidae*	57	0	0	0	0	0	0	0
Cephalopods nei	*Cephalopoda*	57	0	0	-	-	-	-	-
Marine molluscs nei	*Mollusca*	58	0	-	-	0	-	-	-
Salps	*Salpidae*	74	1	0	-	-	0	-	-
Echinoderms	*Echinodermata*	76	0	0	0	-	0	-	0
Starfishes nei	*Asteroidea*	76	2	2	3	1	3	3	5
Sea urchins, etc. nei	*Echinoidea*	76	0	0	-	0	-	0	-
Sea cucumbers nei	*Holothuroidea*	76	1	0	-	-	0	-	-
Jellyfishes nei	*Rhopilema spp*	77	1	2	1	1	14	1	1
Aquatic invertebrates nei	*Invertebrata*	77	-	-	-	-	0	0	0
Total			***10 381***	***12 938***	***11 495***	***10 385***	***10 899***	***11 140***	***10 832***

Data in this table refer to catches for which the new fishing season (1 December - 30 November) of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has been adopted. Data are shown under the calendar year in which the split-year ends.

Les données dans ce tableau se réfèrent aux captures pour lesquelles on utilise la nouvelle période de pêche (1er décembre - 30 novembre) de la Commission pour la conservation de la faune et la flore marines de l'Antarctique (CCAMLR). Les données figurent sous l'année civile durant laquelle se termine l'année fractionnée.

Los datos en este cuadro se refieren a las capturas para las que se utiliza el nuevo período de pesca (1 de diciembre - 30 de noviembre) de la Comisión para la Conservación de los Recursos Vivos Marinos Antárticos (CCRVMA). Los datos se incluyen en el año civil en que termina el año emergente.

C-58 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Indian Ocean, Antarctic
Océan Indien, Antarctique
Océano Índico, Antártico

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Australia	4 129	3 628	5 391	3 114	4 793	3 273	2 501	2 669	2 778	3 079
Chile	-	-	-	-	239	74	-	-	-	-
France	6 116	6 546	7 496	7 036	6 782	6 990	6 607	7 178	7 872	7 220
Japan	-	-	-	-	2	-	119	198	99	171
Korea Rep	-	-	-	-	253	295	343	389	226	206
Namibia	-	-	-	-	-	-	116	224	-	-
New Zealand	-	-	-	-	78	0	0	-	-	-
South Africa	319	182	280	231	270	161	193	137	47	156
Spain	-	-	-	-	521	648	329	73	-	-
Ukraine	8	-	-	-	-	-	-	-	-	-
Uruguay	-	-	-	-	-	54	177	31	118	-
Total	***10 572***	***10 356***	***13 167***	***10 381***	***12 938***	***11 495***	***10 385***	***10 899***	***11 140***	***10 832***

Data in this table refer to catches for which the new fishing season (1 December - 30 November) of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has been adopted. Data are shown under the calendar year in which the split-year ends.

Les données dans ce tableau se réfèrent aux captures pour lesquelles on utilise la nouvelle période de pêche (1er décembre - 30 novembre) de la Commission pour la conservation de la faune et la flore marines de l'Antarctique (CCAMLR). Les données figurent sous l'année civile durant laquelle se termine l'année fractionnée.

Los datos en este cuadro se refieren a las capturas para las que se utiliza el nuevo período de pesca (1 de diciembre - 30 de noviembre) de la Comisión para la Conservación de los Recursos Vivos Marinos Antárticos (CCRVMA). Los datos se incluyen en el año civil en que termina el año emergente.

C-61 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Northwest
Pacifique, nord-ouest
Pacífico, noroeste

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Cyprinids nei	*Cyprinidae*	11	127	319	222	199	124	122	112
Trouts nei	*Salmo spp*	23	-	-	-	-	-	-	14 900
Pink(=Humpback)salmon	*Oncorhynchus gorbuscha*	23	103 621	175 674	184 211	242 697	161 860	412 886	181 798
Chum(=Keta=Dog)salmon	*Oncorhynchus keta*	23	256 292	234 366	239 759	233 906	200 159	251 048	43 396
Masu(=Cherry) salmon	*Oncorhynchus masou*	23	934	925	1 198	1 489	1 366	1 305	4
Sockeye(=Red)salmon	*Oncorhynchus nerka*	23	11 818	10 589	16 892	15 686	15 471	17 790	14 124
Chinook(=Spring=King)salmon	*Oncorhynchus tshawytscha*	23	372	551	733	699	285	536	689
Coho(=Silver)salmon	*Oncorhynchus kisutch*	23	1 599	808	1 201	1 778	1 525	1 765	3 911
Pacific salmons nei	*Oncorhynchus spp*	23	-	-	-	-	-	-	163 600
Smelts nei	*Osmerus spp, Hypomesus spp*	23	1 546	1 492	2 240	2 083	2 286	1 675	2 000
Salmonoids nei	*Salmonoidei*	23	719	262	1 381	1 329	2 038	1 304	2 493
Chinese gizzard shad	*Clupanodon thrissa*	24	4 349	6 736	8 255	10 781	7 793	7 685	13 526
Dotted gizzard shad	*Konosirus punctatus*	24	14 331	11 566	8 510	11 815	7 448	6 737	6 500
Elongate ilisha	*Ilisha elongata*	24	80 704	84 490	92 183	88 800	94 192	98 657	86 743
Milkfish	*Chanos chanos*	25	0	-	2	1	5	13	14
Barramundi(=Giant seaperch)	*Lates calcarifer*	25	42	75	57	35	43	68	91
Pacific halibut	*Hippoglossus stenolepis*	31	...	...	...	...	...	2 036	3 094
Greenland halibut	*Reinhardtius hippoglossoides*	31	...	...	...	...	...	9 049	11 610
Kamchatka flounder	*Atheresthes evermanni*	31	16 703	16 625	16 256	14 170	14 719	166	376
Yellow striped flounder	*Pseudopleuronectes herzenst.*	31	12 038	15 319	19 879	24 641	20 562	19 687	20 107
Tonguefishes	*Cynoglossidae*	31	1 853	2 416	2 857	2 949	2 482	2 440	2 542
Bastard halibut	*Paralichthys olivaceus*	31	7 654	8 207	9 686	11 210	11 763	12 657	13 735
Flatfishes nei	*Pleuronectiformes*	31	125 723	144 052	125 884	131 059	119 783	139 194	124 539
Moras nei	*Moridae*	32	25 632	27 341	27 566	26 196	20 320	16 909	17 488
Pacific cod	*Gadus macrocephalus*	32	106 187	111 648	106 049	109 332	114 374	109 975	146 304
Saffron cod	*Eleginus gracilis*	32	20 521	15 562	22 709	25 008	23 294	39 809	32 154
Alaska pollock(=Walleye poll.)	*Theragra chalcogramma*	32	1 169 079	1 241 737	1 314 775	1 514 336	1 612 751	1 652 790	1 938 611
Grenadiers, rattails nei	*Macrouridae*	32	20 998	23 004	16 922	21 786	16 266	29 499	20 508
Gadiformes nei	*Gadiformes*	32	20 854	10 050	16 535	21 217	...	...	4
Hagfishes nei	*Myxinidae*	33	58	11	15	29	37	18	15
Greater lizardfish	*Saurida tumbil*	33	7 165	6 745	6 056	1 885	1 328	1 457	1 186
Brushtooth lizardfish	*Saurida undosquamis*	33	29	77	17	349	102	279	-
Lizardfishes nei	*Synodontidae*	33	6 200	6 000	5 700	5 700	5 850	5 880	6 220
Sea catfishes nei	*Ariidae*	33	596	625	214	221	162	271	162
Korean sandlance	*Hypoptychus dybowskii*	33	2 419	3 925	4 197	3 682	4 033	3 503	-
Flathead grey mullet	*Mugil cephalus*	33	154 706	106 811	86 699	73 109	83 165	96 598	98 271
So-iny (redlip) mullet	*Chelon haematocheilus*	33	139 043	134 391	130 318	125 558	127 133	127 493	156 989
Mullets nei	*Mugilidae*	33	10	10	108	154	67	140	92
Groupers nei	*Epinephelus spp*	33	58 333	59 331	73 319	83 436	80 652	86 475	94 441
Groupers, seabasses nei	*Serranidae*	33	1 200	1 132	1 011	1 035	1 075	1 095	1 089
Japanese seabass	*Lateolabrax japonicus*	33	11 434	11 751	12 615	11 773	11 189	10 064	9 954
Red bigeye	*Priacanthus macracanthus*	33	1 965	1 841	1 569	1 523	1 256	1 580	1 066
Bigeyes nei	*Priacanthus spp*	33	3 850	3 720	3 550	3 550	3 640	3 660	3 870
Sillago-whitings	*Sillaginidae*	33	249	166	265	310	217	292	62
Moonfish	*Mene maculata*	33	2 223	1 512	1 665	2 225	1 681	1 194	1 622
Snappers, jobfishes nei	*Lutjanidae*	33	508	450	437	469	307	310	324
Golden threadfin bream	*Nemipterus virgatus*	33	3 523	3 684	2 670	2 626	1 754	1 886	1 378
Threadfin breams nei	*Nemipterus spp*	33	283 400	242 334	275 305	161 003	328 589	323 576	333 042
Grunts, sweetlips nei	*Haemulidae(=Pomadasyidae)*	33	5 856	5 611	5 262	5 647	4 775	4 986	4 100
Mi-iuy (brown) croaker	*Miichthys miiuy*	33	28 693	17 943	28 779	37 509	34 659	35 726	41 677
Honnibe croaker	*Nibea mitsukurii*	33	974	1 302	2 002	3 030	-	-	-
Large yellow croaker	*Larimichthys croceus*	33	75 804	64 157	66 792	69 469	56 088	62 955	63 550
Yellow croaker	*Larimichthys polyactis*	33	284 936	293 674	316 866	373 249	388 018	407 081	438 837
Blackmouth croaker	*Atrobucca nibe*	33	287	335	370	403	386	501	364
Silver croaker	*Pennahia argentata*	33	96 599	93 010	116 765	111 019	128 088	128 658	132 708
Croakers, drums nei	*Sciaenidae*	33	311 077	317 889	325 956	310 614	327 460	338 096	336 745
Largeeye breams	*Gymnocranius spp*	33	120	116	107	107	110	115	120
Silver seabream	*Pagrus auratus*	33	20 438	20 170	19 624	17 943	17 261	17 095	16 237
Blackhead seabream	*Acanthopagrus schlegeli*	33	826	717	637	602	632	469	365
Porgies, seabreams nei	*Sparidae*	33	150 326	139 860	163 473	149 559	151 617	172 076	184 146
Goatfishes	*Upeneus spp*	33	682	685	609	601	440	484	443
Parrotfishes nei	*Scaridae*	33	78	75	81	55	54	64	58
Fourfinger threadfin	*Eleutheronema tetradactylum*	33	1 233	1 533	1 256	1 548	1 161	923	942
Pacific sandlance	*Ammodytes personatus*	33	259 261	266 443	276 026	188 429	197 529	181 663	235 381
Gobies nei	*Gobiidae*	33	17 112	29 360	14 394	8 882	7 739	9 582	21 754
Okhotsk atka mackerel	*Pleurogrammus azonus*	33	228 621	188 949	166 597	192 224	229 885	182 353	157 534
Bartail flathead	*Platycephalus indicus*	33	1 477	1 738	1 948	1 790	2 082	2 220	2 215
Puffers nei	*Tetraodontidae*	33	10 675	8 492	9 061	7 564	8 027	8 552	8 094
Filefishes nei	*Cantherhines(=Navodon) spp*	33	172 178	215 593	187 054	178 123	185 411	210 541	204 828
Threadsail filefish	*Stephanolepis cirrhifer*	33	1 267	1 055	1 071	2 998	2 632	8 280	3 475
Deep-sea smelt	*Glossanodon semifasciatus*	34	5 223	4 180	4 570	4 689	4 921	4 357	4 000
Daggertooth pike conger	*Muraenesox cinereus*	34	279 106	256 847	344 584	304 484	324 153	344 256	343 008
Pike-congers nei	*Muraenesox spp*	34	2 200	2 130	2 060	2 050	2 100	2 110	2 230
Whitespotted conger	*Conger myriaster*	34	16 506	14 739	15 242	19 399	18 441	13 507	13 757
Conger eels, etc. nei	*Congridae*	34	7 937	6 860	7 917	6 991	6 339	5 959	5 400
Longspine snipefish	*Macroramphosus scolopax*	34	544	-	-	-	-	-	-
Alfonsinos nei	*Beryx spp*	34	1	296	-	-	-	-	86
Boarfishes nei	*Caproidae*	34	-	1	-	-	-	-	-
Oreo dories nei	*Oreosomatidae*	34	-	48	-	-	-	-	-
Tilefishes nei	*Branchiostegidae*	34	62 975	64 578	54 979	59 932	47 667	47 583	44 790
Eelpouts	*Lycodes spp*	34	587	377	73	51	86	21	371
Japanese sandfish	*Arctoscopus japonicus*	34	15 276	16 759	15 864	11 592	17 679	13 691	13 036
Oilfish	*Ruvettus pretiosus*	34	5 404	12 449	35 910	41 920	15 189	17 869	12 971
Largehead hairtail	*Trichiurus lepturus*	34	1 282 512	1 175 114	1 293 833	1 244 460	1 290 042	1 278 154	1 262 862

C-61 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Northwest
Pacifique, nord-ouest
Pacífico, noroeste

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Hairtails, scabbardfishes nei	*Trichiuridae*	34	1 600	1 550	1 470	1 470	1 510	1 520	1 610
Indian driftfish	*Ariomma indica*	34	39	38	37	37	38	40	42
Pacific rudderfish	*Psenopsis anomala*	34	9 945	9 608	9 413	4 831	5 484	4 957	4 235
Pacific ocean perch	*Sebastes alutus*	34	1 192	1 429	1 648	948	739	970	1 700
Shortspine thornyhead	*Sebastolobus alascanus*	34	-	52	227	101	139	29	375
Scorpionfishes nei	*Scorpaenidae*	34	6 445	6 311	6 535	7 139	7 014	5 937	4 907
Bluefin gurnard	*Chelidonichthys kumu*	34	302	375	888	729	1 135	728	979
Skilfish	*Erilepis zonifer*	34	-	-	-	-	-	165	-
Sablefish	*Anoplopoma fimbria*	34	28	6	14	19	27	15	10
Anglerfishes nei	*Lophiidae*	34	11 885	11 448	12 226	14 417	17 944	14 961	13 104
Pacific herring	*Clupea pallasii*	35	236 201	255 218	283 227	225 889	233 272	253 534	272 183
Japanese sardinella	*Sardinella zunasi*	35	755	1 756	953	795	4 893	5 983	1 787
Sardinellas nei	*Sardinella spp*	35	5	5	5	5	5	5	5
Japanese pilchard	*Sardinops melanostictus*	35	203 490	185 164	235 092	248 332	192 039	191 853	208 472
Slender rainbow sardine	*Dussumieria elopsoides*	35	15	15	14	14	14	15	16
Red-eye round herring	*Etrumeus teres*	35	33 507	36 308	38 528	60 504	48 556	53 842	49 143
Silver-stripe round herring	*Spratelloides gracilis*	35	380	199	455	352	47	338	22
Japanese anchovy	*Engraulis japonicus*	35	1 629 486	1 481 442	1 509 170	1 390 596	1 265 763	1 068 334	1 202 212
Stolephorus anchovies nei	*Stolephorus spp*	35	15	15	14	14	14	15	16
Anchovies, etc. nei	*Engraulidae*	35	117	602	155	11	21	4	26
Clupeoids nei	*Clupeoidei*	35	52 355	67 018	50 790	69 528	70 779	57 978	69 931
Narrow-barred Spanish mackerel	*Scomberomorus commerson*	36	3 382	2 533	1 255	1 385	1 471	1 059	1 196
Indo-Pacific king mackerel	*Scomberomorus guttatus*	36	1 171	1 054	509	433	355	257	336
Japanese Spanish mackerel	*Scomberomorus niphonius*	36	47 356	53 521	60 685	75 759	58 544	56 209	53 554
Seerfishes nei	*Scomberomorus spp*	36	327 609	360 987	338 399	458 942	437 375	431 978	479 407
Frigate and bullet tunas	*Auxis thazard, A. rochei*	36	5 582	5 485	4 097	2 383	5 048	7 344	4 750
Skipjack tuna	*Katsuwonus pelamis*	36	92 068	136 939	98 309	119 049	133 919	81 187	114 812
Pacific bluefin tuna	*Thunnus orientalis*	36	14 576	21 357	13 357	14 926	17 938	15 708	8 265
Longtail tuna	*Thunnus tonggol*	36	-	-	-	-	-	2 980	-
Albacore	*Thunnus alalunga*	36	49 371	30 004	33 016	62 809	36 576	53 990	40 636
Yellowfin tuna	*Thunnus albacares*	36	7 913	13 180	16 127	18 573	26 977	26 736	27 730
Bigeye tuna	*Thunnus obesus*	36	11 549	11 676	15 846	18 800	15 653	12 633	12 076
Indo-Pacific sailfish	*Istiophorus platypterus*	36	393	4 263	2 545	4 236	979	883	1 486
Blue marlin	*Makaira nigricans*	36	6 611	12 225	12 377	13 613	15 086	5 674	6 029
Black marlin	*Makaira indica*	36	511	1 359	1 939	1 747	274	317	400
Striped marlin	*Tetrapturus audax*	36	1 239	1 285	1 265	1 454	2 406	1 837	1 982
Marlins,sailfishes,etc. nei	*Istiophoridae*	36	...	30	34	20	46	4	...
Swordfish	*Xiphias gladius*	36	6 557	10 246	12 964	14 566	9 581	8 938	7 454
Tuna-like fishes nei	*Scombroidei*	36	60 208	25 183	62 693	61 186	46 132	93 148	49 864
Capelin	*Mallotus villosus*	37	1 753	1 971	2 164	3 041	1 337	1 504	1 234
Pacific saury	*Cololabis saira*	37	355 790	478 226	394 861	524 947	622 119	475 727	457 584
Japanese halfbeak	*Hyporhamphus sajori*	37	1 137	607	369	293	462	518	-
Japanese flyingfish	*Cypselurus agoo*	37	6 130	7 722	8 101	...	...	...	...
Flyingfishes nei	*Exocoetidae*	37	1 096	532	147	71	85	296	84
Cobia	*Rachycentron canadum*	37	643	405	468	546	246	92	322
Japanese jack mackerel	*Trachurus japonicus*	37	308 198	403 348	328 781	380 178	260 265	216 586	206 210
Japanese scad	*Decapterus maruadsi*	37	33 863	28 873	27 206	29 162	40 217	35 012	34 344
Indian scad	*Decapterus russelli*	37	41	41	152	130	379	36	154
Scads nei	*Decapterus spp*	37	531 287	536 500	536 985	575 225	600 309	545 875	566 993
Jacks, crevalles nei	*Caranx spp*	37	2 666	989	1 139	991	479	345	356
Amberjacks nei	*Seriola spp*	37	71 666	57 766	74 426	78 994	88 607	92 414	124 168
Black pomfret	*Parastromateus niger*	37	1 288	1 161	1 159	1 808	834	548	744
Torpedo scad	*Megalaspis cordyla*	37	140	158	105	250	99	181	77
Carangids nei	*Carangidae*	37	-	-	-	-	-	-	28
Common dolphinfish	*Coryphaena hippurus*	37	22 888	21 543	22 374	14 755	9 307	6 950	9 115
Chub mackerel	*Scomber japonicus*	37	966 235	1 252 457	1 212 102	994 068	1 356 218	1 056 048	1 126 345
Silver pomfret	*Pampus argenteus*	37	3 488	1 531	919	498	716	565	436
Silver pomfrets nei	*Pampus spp*	37	328 102	349 793	335 639	342 747	372 042	373 145	364 776
Butterfishes, pomfrets nei	*Stromateidae*	37	11 757	13 679	15 896	11 469	10 121	7 900	11 048
Barracudas nei	*Sphyraena spp*	37	548	562	656	580	333	495	431
Whip stingray	*Dasyatis akajei*	38	4 700	5 207	5 235	...	...	...	...
Rays, stingrays, mantas nei	*Rajiformes*	38	5 520	6 385	5 969	6 966	5 609	9 507	10 434
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	44 691	52 111	45 077	47 933	38 488	28 254	21 014
Marine fishes nei	*Osteichthyes*	39	2 499 065	2 493 536	2 325 971	2 356 141	2 476 114	3 108 469	3 192 786
Chinese mitten crab	*Eriocheir sinensis*	41	-	-	-	3	3	-	-
Charybdis crabs nei	*Charybdis spp*	42	49 286	60 400	57 363	64 829	64 927	39 779	62 851
Blue swimming crab	*Portunus pelagicus*	42	66 513	55 425	56 325	70 040	65 424	61 307	74 618
Gazami crab	*Portunus trituberculatus*	42	295 500	324 437	355 018	367 223	370 847	366 446	385 281
Indo-Pacific swamp crab	*Scylla serrata*	42	9	717	521	647	409	211	150
Red snow crab	*Chionoecetes japonicus*	42	17 794	19 833	21 456	20 228	20 200	20 300	19 200
Tanner crabs nei	*Chionoecetes spp*	42	57 083	51 029	54 352	58 881	59 417	59 587	65 801
Hair crab	*Erimacrus isenbeckii*	42	5	16	45	96	136	6	1
Marine crabs nei	*Brachyura*	42	130 450	127 513	123 629	91 465	87 797	127 125	131 227
Longlegged spiny lobster	*Panulirus longipes*	43	1 889	2 059	2 041	2 041	1 963	2 459	2 303
Tropical spiny lobsters nei	*Panulirus spp*	43	0	0	0	0	-	-	-
Japanese fan lobster	*Ibacus ciliatus*	43	1 596	1 553	1 570	1 513	1 467	599	9 114
Red king crab	*Paralithodes camtschaticus*	44	2 101	1 317	1 882	4 729	2 084	2 206	1 606
Blue king crab	*Paralithodes platypus*	44	2 391	4 024	4 587	4 831	4 774	3 267	2 915
Brown king crab	*Paralithodes brevipes*	44	155	225	363	302	269	329	763
Golden king crab	*Lithodes aequispina*	44	982	2 220	1 710	2 232	2 886	2 906	3 007
Red vermillion crab	*Paralomis verrilli*	44	-	38	-	45	-	-	-

C-61 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

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Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Northwest
Pacifique, nord-ouest
Pacífico, noroeste

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Kuruma prawn	*Penaeus japonicus*	45	2 913	2 902	2 709	2 742	2 420	1 774	2 473
Giant tiger prawn	*Penaeus monodon*	45	50	38	8	11	13	13	7
Fleshy prawn	*Penaeus chinensis*	45	84 699	90 392	105 682	112 003	89 953	107 837	107 774
Redtail prawn	*Penaeus penicillatus*	45	429	756	1 077	1 073	717	178	60
Shiba shrimp	*Metapenaeus joyneri*	45	414	834	980	1 010	1 646	1 048	652
Metapenaeus shrimps nei	*Metapenaeus spp*	45	207	145	122	125	16	18	22
Southern rough shrimp	*Trachypenaeus curvirostris*	45	254 405	365 207	333 453	349 355	314 984	286 279	293 722
Coonstripe shrimp	*Pandalus hypsinotus*	45	234	213	376	339	457	586	649
Northern prawn	*Pandalus borealis*	45	7 586	7 797	7 359	8 593	7 739	7 925	9 030
Humpy shrimp	*Pandalus goniurus*	45	398	119	41	100	-	187	26
Hokkai shrimp	*Pandalus kessleri*	45	24	32	24	36	27	26	26
Morotoge shrimp	*Pandalopsis japonica*	45	8	13	2	80	3	1	4
Akiami paste shrimp	*Acetes japonicus*	45	579 678	565 260	619 691	620 649	558 124	602 420	573 613
Sculptured shrimps nei	*Sclerocrangon spp*	45	49	32	30	29	29	1	2
Natantian decapods nei	*Natantia*	45	396 926	298 621	258 593	192 364	215 326	225 413	219 135
Squillids nei	*Squillidae*	47	270 452	261 806	282 761	306 969	279 873	303 002	315 360
Marine crustaceans nei	*Crustacea*	47	63 642	63 232	54 459	56 260	58 714	47 225	57 813
Japanese corbicula	*Corbicula japonica*	51	170	145	313	546	282	495	445
Giant abalone	*Haliotis gigantea*	52	1 996	1 768	1 976	2 063	1 687	1 855	1 500
Abalones nei	*Haliotis spp*	52	101	202	170	259	172	226	235
Horned turban	*Turbo cornutus*	52	18 329	16 882	15 407	15 365	10 935	10 090	10 218
Gastropods nei	*Gastropoda*	52	2 118	1 710	1 459	1 659	6 946	7 116	7 305
Pacific cupped oyster	*Crassostrea gigas*	53	25 690	27 320	31 016	29 316	29 185	24 254	22 686
Cupped oysters nei	*Crassostrea spp*	53	-	-	8	-	-	2	39
Korean mussel	*Mytilus coruscus*	54	588	724	1 184	1 620	2 448	3 399	3 271
Sea mussels nei	*Mytilidae*	54	2 488	3 467	5 446	7 935	5 539	7 409	10 284
Yesso scallop	*Patinopecten yessoensis*	55	316 788	290 271	274 459	260 353	313 793	323 485	330 740
Ark clams nei	*Arca spp*	56	2 571	1 827	4 366	481	1 320	3 865	3 959
Half-crenated ark	*Scapharca subcrenata*	56	7 036	10 319	2 175	...	...	...	...
Blood cockle	*Anadara granosa*	56	600	449	289	350	1 523	5 918	6 014
Japanese hard clam	*Meretrix lusoria*	56	7 837	4 106	5 357	2 662	1 415	1 396	1 146
Japanese carpet shell	*Ruditapes philippinarum*	56	49 081	48 708	42 543	44 462	59 978	54 143	39 840
Imperial surf clam	*Pseudocardium sybillae*	56	11 402	8 000	8 618	606	146	331	248
Surf clams nei	*Spisula spp*	56	527	714	524	501	433	594	595
Cockles nei	*Cardiidae*	56	2 846	945	272	1 817	364	3 504	949
Clams, etc. nei	*Bivalvia*	56	67 115	51 357	48 599	70 864	51 463	48 179	53 405
Cuttlefish, bobtail squids nei	*Sepiidae, Sepiolidae*	57	162 563	152 801	174 864	155 892	120 651	124 108	120 909
Common squids nei	*Loligo spp*	57	...	4 333	487	503	1 413	1 564	1 416
Neon flying squid	*Ommastrephes bartrami*	57	11 346	14 422	9 297	22 156	24 400	36 000	16 800
Japanese flying squid	*Todarodes pacificus*	57	447 820	411 644	388 087	429 162	403 722	408 188	357 590
Various squids nei	*Loliginidae, Ommastrephidae*	57	616 523	651 452	524 464	540 207	529 263	455 612	500 164
Octopuses, etc. nei	*Octopodidae*	57	189 026	172 817	190 829	219 649	193 319	190 955	188 343
Schoolmaster gonate squid	*Berryteuthis magister*	57	1 132	1 068	1 084	48 981	54 868	60 639	59 306
Cephalopods nei	*Cephalopoda*	57	43 319	48 151	29 958	44 717	54 848	53 451	51 274
Marine molluscs nei	*Mollusca*	58	725 250	756 975	774 663	749 852	651 493	678 752	629 599
Sea squirts nei	*Ascidiacea*	74	1 336	1 548	1 113	1 135	1 591	1 128	1 238
Echinoderms	*Echinodermata*	76	1 301	2 035	2 596	2 651	3 555	2 846	2 868
Sea urchins nei	*Strongylocentrotus spp*	76	15 511	15 735	15 456	17 953	19 732	21 945	21 148
Japanese sea cucumber	*Stichopus japonicus*	76	10 422	10 508	11 958	2 936	2 260	2 789	3 872
Jellyfishes nei	*Rhopilema spp*	77	174 706	244 242	196 649	223 973	236 707	223 388	216 368
Aquatic invertebrates nei	*Invertebrata*	77	7 771	5 639	5 472	15 753	14 666	33 635	42 147
Total			***19 267 125***	***19 686 893***	***19 613 020***	***19 872 399***	***20 128 757***	***20 485 793***	***20 945 401***

C-61 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Pacific, Northwest
Pacifique, nord-ouest
Pacífico, noroeste

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
China	12 098 896 F	11 960 168 F	11 863 715 F	11 946 892 F	11 997 637 F	11 970 943 F	11 886 523	11 994 337	12 352 699	12 777 782
China,H.Kong	173 972	169 790	157 444	167 544	161 964	154 536	154 147	158 126	158 965	168 010
China, Macao	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F
China,Taiwan	357 797	351 171	456 799	386 174	524 675	406 845	464 334	432 951	359 991	436 771
Japan	4 007 129 F	3 727 012 F	4 106 921	3 795 261	3 785 054	3 797 686	3 816 729	3 852 913	3 677 775 F	3 612 982 F
Korea D P Rp	201 572	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F
Korea Rep	1 472 349	1 145 468	1 155 395	1 119 471	1 157 082	1 144 761	1 186 858	1 331 542	1 284 070	1 195 104
Poland	16 590	-	-	-	-	-	-	-	-	-
Russian Fed	2 121 532	1 688 908	1 926 900	1 650 283	1 858 444	1 936 749	2 162 308	2 157 388	2 450 793	2 553 252
Spain	-	-	-	-	537	-	-	-	-	-
Total	***20 451 337***	***19 244 017***	***19 868 674***	***19 267 125***	***19 686 893***	***19 613 020***	***19 872 399***	***20 128 757***	***20 485 793***	***20 945 401***

C-67 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Northeast
Pacifique, nord-est
Pacífico, nordeste

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
White sturgeon	*Acipenser transmontanus*	21	167	188	158	143	164	154	120
Green sturgeon	*Acipenser medirostris*	21	3	3	3	0	0	0	0
Pink(=Humpback)salmon	*Oncorhynchus gorbuscha*	23	138 729	237 008	102 021	218 820	118 527	146 700	170 264
Chum(=Keta=Dog)salmon	*Oncorhynchus keta*	23	64 638	46 553	78 098	54 408	57 924	54 220	53 689
Sockeye(=Red)salmon	*Oncorhynchus nerka*	23	119 236	120 787	118 293	127 553	103 881	116 847	134 748
Chinook(=Spring=King)salmon	*Oncorhynchus tshawytscha*	23	11 898	10 310	8 558	6 951	5 312	5 366	6 978
Coho(=Silver)salmon	*Oncorhynchus kisutch*	23	20 672	16 806	15 634	12 457	16 756	15 699	15 675
Rainbow trout	*Oncorhynchus mykiss*	23	-	-	1	1	2	-	-
Pacific salmons nei	*Oncorhynchus spp*	23	0	0	-	0	-	0	-
Eulachon	*Thaleichthys pacificus*	23	105	0	7	4	8	8	2
Smelts nei	*Osmerus spp, Hypomesus spp*	23	196	153	206	182	218	164	144
Salmonoids nei	*Salmonoidei*	23	-	2	-	-	-	-	-
American shad	*Alosa sapidissima*	24	120	234	82	82	19	2	14
Atlantic halibut	*Hippoglossus hippoglossus*	31	-	-	-	-	-	-	1
Pacific halibut	*Hippoglossus stenolepis*	31	43 304	41 185	39 658	37 748	37 971	31 113	29 730
English sole	*Pleuronectes vetulus*	31	1 107	1 031	1 006	649	308	335	228
Greenland halibut	*Reinhardtius hippoglossoides*	31	1 879	2 368	1 775	1 692	2 041	4 054	3 910
Arrow-tooth flounder	*Atheresthes stomias*	31	13 042	21 363	24 081	22 596	39 183	40 870	49 580
Petrale sole	*Eopsetta jordani*	31	1 690	2 363	2 236	1 657	1 659	1 431	655
Rex sole	*Glyptocephalus zachirus*	31	3 237	4 105	4 655	4 631	4 065	6 308	4 527
Flathead sole	*Hippoglossoides elassodon*	31	14 147	14 491	16 423	16 902	25 274	20 916	21 761
Yellowfin sole	*Limanda aspera*	31	62 896	85 324	90 571	109 059	141 237	100 644	113 246
Rock sole	*Lepidopsetta bilineata*	31	29 326	28 240	34 241	34 476	52 977	50 039	53 425
Dover sole	*Microstomus pacificus*	31	5 730	5 902	5 313	8 514	10 130	10 653	9 525
Starry flounder	*Platichthys stellatus*	31	85	102	91	37	8	58	23
Pacific sand sole	*Psettichthys melanostictus*	31	132	94	41	14	17	49	60
Curlfin sole	*Pleuronichthys decurrens*	31	1	1	0	0	0	0	0
Pacific sanddab	*Citharichthys sordidus*	31	143	113	296	125	69	176	90
California flounder	*Paralichthys californicus*	31	0	0	0	0	1	0	-
Flatfishes nei	*Pleuronectiformes*	31	7 549	7 503	9 834	11 172	14 236	17 013	17 118
Pacific cod	*Gadus macrocephalus*	32	267 430	250 445	236 256	222 244	224 641	223 755	248 440
Pacific tomcod	*Microgadus proximus*	32	0	-	-	-	-	-	-
Alaska pollock(=Walleye poll.)	*Theragra chalcogramma*	32	1 522 860	1 549 237	1 545 712	1 394 877	1 036 404	849 871	891 093
North Pacific hake	*Merluccius productus*	32	340 116	362 418	354 968	279 967	314 800	170 673	209 163
Grenadiers, rattails nei	*Macrouridae*	32	65	63	66	49	37	70	74
Hagfishes nei	*Myxinidae*	33	236	617	446	990	1 481	1 184	1 725
Lingcod	*Ophiodon elongatus*	33	2 972	2 960	2 641	2 775	2 562	2 221	1 980
Atka mackerel	*Pleurogrammus monopterygius*	33	49 508	58 733	59 337	57 422	57 620	71 164	65 865
Kelp greenling	*Hexagrammos decagrammus*	33	-	-	15	18	22	21	18
Cabezon	*Scorpaenichthys marmoratus*	33	30	32	25	25	27	32	25
Sculpins nei	*Cottidae*	33	417	200	261	583	711	973	383
Widow rockfish	*Sebastes entomelas*	34	151	135	129	159	178	152	137
Yellowtail rockfish	*Sebastes flavidus*	34	612	824	429	320	387	655	861
Pacific ocean perch	*Sebastes alutus*	34	26 577	24 640	28 547	32 813	33 298	31 063	37 812
Bocaccio rockfish	*Sebastes paucispinis*	34	0	0	0	1	1	1	1
Canary rockfish	*Sebastes pinniger*	34	18	11	14	5	11	11	16
Chilipepper rockfish	*Sebastes goodei*	34	24	29	13	6	5	4	21
Splitnose rockfish	*Sebastes diploproa*	34	-	-	-	-	-	-	18
Black rockfish	*Sebastes melanops*	34	119	102	97	105	100	134	102
Darkblotched rockfish	*Sebastes crameri*	34	146	77	78	95	80	91	158
Shortspine thornyhead	*Sebastolobus alascanus*	34	333	307	348	641	961	1 027	840
Scorpionfishes nei	*Scorpaenidae*	34	24 844	24 127	24 467	26 277	26 478	26 439	27 086
Sablefish	*Anoplopoma fimbria*	34	25 797	26 767	28 827	26 235	21 768	20 420	18 807
Pacific herring	*Clupea pallasii*	35	56 763	68 687	59 804	42 832	49 886	52 036	58 910
California pilchard	*Sardinops caeruleus*	35	45 069	51 831	40 031	46 809	28 797	28 847	32 676
Californian anchovy	*Engraulis mordax*	35	226	232	170	158	368	849	251
Skipjack tuna	*Katsuwonus pelamis*	36	-	0	0	-	-	0	-
Pacific bluefin tuna	*Thunnus orientalis*	36	1	0	0	0	0	-	-
Albacore	*Thunnus alalunga*	36	19 108	12 426	17 408	16 439	14 466	16 409	15 882
Yellowfin tuna	*Thunnus albacares*	36	0	0	-	-	-	-	8
Bigeye tuna	*Thunnus obesus*	36	-	-	-	-	5	-	44
Black marlin	*Makaira indica*	36	-	6	-	-	-	-	3
Striped marlin	*Tetrapturus audax*	36	-	-	2	-	-	-	-
Swordfish	*Xiphias gladius*	36	1	6	108	2	0	33	41
Pacific jack mackerel	*Trachurus symmetricus*	37	185	84	8	15	9	1	1
Chub mackerel	*Scomber japonicus*	37	107	318	667	702	30	22	12
Thresher	*Alopias vulpinus*	38	5	1	1	1	0	-	0
Shortfin mako	*Isurus oxyrinchus*	38	0	-	-	-	0	0	-
Blue shark	*Prionace glauca*	38	1	1	0	1	0	0	0
Tope shark	*Galeorhinus galeus*	38	1	0	2	-	0	0	0
Picked dogfish	*Squalus acanthias*	38	5 983	6 009	2 964	4 705	2 986	4 546	1 942
Rays, stingrays, mantas nei	*Rajiformes*	38	12 516	12 108	10 151	9 348	11 467	10 994	10 934
Spotted ratfish	*Hydrolagus colliei*	38	-	-	-	-	-	-	1
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	687	79	96	46	13	20	91
Marine fishes nei	*Osteichthyes*	39	8 713	16 578	3 643	1 543	6 960	11 524	14 646
Dungeness crab	*Cancer magister*	42	39 021	32 649	41 087	30 373	27 353	32 578	27 294
Pacific rock crab	*Cancer productus*	42	3	2	3	7	1	2	2
Tanner crabs nei	*Chionoecetes spp*	42	11 644	12 875	19 287	17 365	29 973	27 910	22 895
Marine crabs nei	*Brachyura*	42	-	-	0	1	-	0	2
Blue mud shrimp	*Upogebia pugettensis*	43	2	1	1	1	1	1	1

C-67 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Northeast
Pacifique, nord-est
Pacífico, nordeste

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Ghost shrimps nei	*Callianassa spp*	43	34	27	14	11	12	26	31
King crabs	*Paralithodes spp*	44	10 013	10 859	9 816	11 767	12 341	10 156	10 905
Ocean shrimp	*Pandalus jordani*	45	8 990	10 908	8 493	11 182	15 570	14 431	20 318
Natantian decapods nei	*Natantia*	45	3 823	3 801	1 440	1 193	1 087	1 199	1 113
Brine shrimp	*Artemia salina*	47	72	71	77	83	69	69	53
Abalones nei	*Haliotis spp*	52	2	3	3	3	2	-	-
Gastropods nei	*Gastropoda*	52	-	-	-	-	-	1	-
Pacific cupped oyster	*Crassostrea gigas*	53	...	...	...	...	...	...	6 326
Cupped oysters nei	*Crassostrea spp*	53	36	131	163	71	307	234	65
Olympia oyster	*Ostreola conchaphila*	53	7	29	71	1	0	4	0
Sea mussels nei	*Mytilidae*	54	488	913	1 405	719	1 010	1 031	1 069
Weathervane scallop	*Patinopecten caurinus*	55	1 274	808	...	...	1 477	1 092	1 818
Butter clam	*Saxidomus giganteus*	56	1 244	1 161	856	660	726	721	578
Pacific littleneck clam	*Protothaca staminea*	56	47	64	64	54	51	57	49
Pacific horse clams nei	*Tresus spp*	56	11	6	4	4	9	6	11
Pacific razor clam	*Siliqua patula*	56	180	97	131	127	174	244	240
Sand gaper	*Mya arenaria*	56	427	741	691	410	1 017	1 236	1 666
Pacific geoduck	*Panopea abrupta*	56	6 079	6 053	6 437	6 141	7 744	9 349	6 370
Basket cockle	*Clinocardium nuttallii*	56	92	65	79	98	104	125	179
Clams, etc. nei	*Bivalvia*	56	1 931	2 290	3 731	2 146	1 970	2 146	1 702
Opalescent inshore squid	*Loligo opalescens*	57	-	0	27	1	-	-	-
Neon flying squid	*Ommastrephes bartrami*	57	132	8	104	-	-	-	-
Various squids nei	*Loliginidae, Ommastrephidae*	57	561	1 487	2 189	1 261	2 129	639	469
Robust clubhook squid	*Moroteuthis robustus*	57	-	5	13	6	-	-	-
Octopuses, etc. nei	*Octopodidae*	57	83	59	41	32	21	36	374
Marine molluscs nei	*Mollusca*	58	3 102	3 471	3 961	4 592	3 502	4 413	2 861
Sea urchins nei	*Strongylocentrotus spp*	76	6 170	4 554	3 938	2 597	2 341	2 638	1 585
Sea cucumbers nei	*Holothuroidea*	76	262	390	1 258	1 369	1 757	1 546	1 848
Total			***3 047 383***	***3 209 847***	***3 076 397***	***2 930 356***	***2 579 294***	***2 259 951***	***2 435 404***

C-67 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Pacific, Northeast
Pacifique, nord-est
Pacífico, nordeste

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Canada	183 886	194 416	217 581	260 323	246 447	214 905	175 792	155 341	158 787	150 861
China,Taiwan	310	210	37	73	57	39	0	32	-	-
Japan	2 061	382	4	722	44	260	4	0	52	129
Korea Rep	-	-	-	-	-	-	-	-	-	59
Poland	4	-	-	-	-	-	-	-	-	-
Russian Fed	-	109	68	-	475	547	2 488	2 869	578	6 368
USA	2 572 829	2 570 374	2 697 585	2 786 265	2 962 824	2 860 646	2 752 072	2 421 052	2 100 534	2 277 987
Total	***2 759 090***	***2 765 491***	***2 915 275***	***3 047 383***	***3 209 847***	***3 076 397***	***2 930 356***	***2 579 294***	***2 259 951***	***2 435 404***

C-71 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Western Central
Pacifique, centre-ouest
Pacífico, centro-occidental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Chacunda gizzard shad	*Anodontostoma chacunda*	24	2 880	3 058	4 423	6 472	7 208	8 130	10 583
Toli shad	*Tenualosa toli*	24	4 708	4 265	4 483	2 812	3 115	2 564	2 135
Indian pellona	*Pellona ditchela*	24	7 346	7 546	7 827	8 700	7 368	3 861	4 368
Diadromous clupeoids nei	*Clupeoidei*	24	889	774	1 026	860	816	1 005	1 399
Milkfish	*Chanos chanos*	25	679	560	572	479	439	329	350
Barramundi(=Giant seaperch)	*Lates calcarifer*	25	48 730	60 494	72 917	82 075	67 935	75 131	88 943
Tonguefishes	*Cynoglossidae*	31	5 032	5 150	4 960	3 883	3 460	3 249	3 194
Indian halibut	*Psettodes erumei*	31	10 512	9 611	8 641	7 489	11 983	12 286	11 624
Flatfishes nei	*Pleuronectiformes*	31	4 210	3 658	3 479	3 663	3 338	3 541	3 837
Gadiformes nei	*Gadiformes*	32	60	89	95	51	42	50	151
Indo-Pacific tarpon	*Megalops cyprinoides*	33	1 490	1 578	1 621	1 473	1 838	1 450	1 649
Bombay-duck	*Harpadon nehereus*	33	5 280	2 914	4 708	4 770	7 007	7 864	8 193
Greater lizardfish	*Saurida tumbil*	33	13 278	14 689	15 551	20 907	15 483	15 851	13 345
Lizardfishes nei	*Synodontidae*	33	62 902	63 343	61 155	59 557	33 270	35 279	33 854
Sea catfishes nei	*Ariidae*	33	92 961	80 999	86 270	87 292	95 374	82 840	94 224
Eeltail catfishes	*Plotosus spp*	33	1 156	1 382	1 302	1 129	1 217	1 355	1 440
Squirrelfishes nei	*Holocentridae*	33	...	...	...	...	...	...	41
Mullets nei	*Mugilidae*	33	47 928	51 319	51 926	52 164	53 208	57 195	59 203
Fusiliers nei	*Caesionidae*	33	47 883	57 892	55 759	77 239	77 765	88 645	84 244
Honeycomb grouper	*Epinephelus merra*	33	875	860	915	1 337	4 249	2 741	2 134
Greasy grouper	*Epinephelus tauvina*	33	...	...	1 020	1 010	4 242	3 878	1 964
Groupers nei	*Epinephelus spp*	33	8 679	7 086	7 279	7 055	7 322	7 619	8 306
Chocolate hind	*Cephalopholis boenak*	33	9 218	18 250	25 624	29 654	20 053	27 557	33 785
Humpback grouper	*Cromileptes altivelis*	33	4 951	4 981	2 928	3 609	3 146	4 189	3 975
Leopard coralgrouper	*Plectropomus leopardus*	33	14 735	7 780	4 634	5 099	7 623	12 740	8 308
Groupers, seabasses nei	*Serranidae*	33	18 816	20 337	21 255	22 489	22 398	20 602	21 820
Terapon perches nei	*Terapon spp*	33	631	1 401	2 959	4 907	3 689	3 455	3 930
Red bigeye	*Priacanthus macracanthus*	33	182	258	256	560	214	588	620
Bigeyes nei	*Priacanthus spp*	33	108 292	97 234	90 410	88 930	44 429	45 274	66 957
Cardinalfishes, etc. nei	*Apogonidae*	33	...	...	...	53	...	...	...
Silver sillago	*Sillago sihama*	33	160	163	301	376	423	97	878
Sillago-whitings	*Sillaginidae*	33	24 527	26 982	27 207	27 361	20 593	19 528	19 423
Moonfish	*Mene maculata*	33	14 407	14 615	14 948	16 409	17 633	16 775	17 326
Mangrove red snapper	*Lutjanus argentimaculatus*	33	12 420	9 163	9 115	9 114	8 288	8 102	7 388
Snappers nei	*Lutjanus spp*	33	84 028	89 924	100 053	104 638	94 914	100 860	109 234
Jobfishes nei	*Pristipomoides spp*	33	766	-	87	538	798	1 559	2 941
Snappers, jobfishes nei	*Lutjanidae*	33	32 234	30 855	28 956	29 185	25 194	27 861	28 630
Threadfin breams nei	*Nemipterus spp*	33	186 957	198 019	194 314	196 074	140 672	136 403	150 608
Monocle breams	*Scolopsis spp*	33	2 129	2 371	2 014	1 921	1 718	1 936	1 986
Ponyfishes(=Slipmouths)	*Leiognathus spp*	33	1 956	2 403	2 020	1 802	2 010	2 571	2 383
Ponyfishes(=Slipmouths) nei	*Leiognathidae*	33	143 815	140 523	139 566	131 728	121 948	125 330	127 079
Sweetlips, rubberlips nei	*Plectorhinchus spp*	33	210	16	152	465	6 386	3 427	1 158
Silver grunt	*Pomadasys argenteus*	33	827	1 371	1 290	1 129	1 422	1 576	2 114
Grunts, sweetlips nei	*Haemulidae(=Pomadasyidae)*	33	14 980	13 294	13 388	13 864	16 870	13 280	13 709
Southern meagre(=Mulloway)	*Argyrosomus hololepidotus*	33	232	308	248	240	222	225	215
Croakers, drums nei	*Sciaenidae*	33	92 780	99 236	90 207	92 855	81 474	68 630	84 304
Largeeye breams	*Gymnocranius spp*	33	110	108	106	75	80	75	100
Emperors(=Scavengers) nei	*Lethrinidae*	33	21 592	22 494	28 158	37 680	31 610	31 934	38 154
Silver seabream	*Pagrus auratus*	33	391	491	518	513	554	465	395
Porgies, seabreams nei	*Sparidae*	33	13 242	13 172	13 036	14 405	17 697	13 691	14 267
Goatfishes	*Upeneus spp*	33	30 070	29 809	36 854	31 097	48 848	36 443	54 914
Goatfishes, red mullets nei	*Mullidae*	33	23 409	23 381	25 302	28 220	24 787	29 136	30 192
Mojarras(=Silver-biddies) nei	*Gerres spp*	33	8 779	7 378	7 824	7 798	9 406	7 655	7 402
Sea chubs nei	*Kyphosidae*	33	1	1	0	...	...	...	...
Spotted sicklefish	*Drepane punctata*	33	1 161	1 071	1 436	1 337	1 229	911	940
Humphead wrasse	*Cheilinus undulatus*	33	36	55	577	663	3 266	3 804	1 354
Wrasses, hogfishes, etc. nei	*Labridae*	33	9 075	10 069	13 704	14 375	14 780	16 368	17 411
Parrotfishes nei	*Scaridae*	33	13	13	12	17	20	35	34
Fourfinger threadfin	*Eleutheronema tetradactylum*	33	5 416	6 729	7 177	6 219	8 465	7 621	8 195
Threadfins, tasselfishes nei	*Polynemidae*	33	38 105	36 528	37 637	37 976	36 574	36 293	36 535
Glassfishes	*Ambassidae*	33	2 016	1 650	1 552	1 492	1 619	1 832	1 882
Percoids nei	*Percoidei*	33	10 755	8 757	9 768	10 350	10 940	17 049	17 031
Gobies nei	*Gobiidae*	33	12 290	10 729	12 791	11 988	10 653	11 635	12 214
Surgeonfishes nei	*Acanthuridae*	33	7 662	6 269	6 005	6 860	6 866	6 999	7 764
Batfishes	*Platax spp*	33	3 204	2 525	2 893	2 798	3 246	3 277	3 040
Scats	*Scatophagus spp*	33	2 370	2 166	2 414	2 805	3 288	2 766	3 005
Spinefeet(=Rabbitfishes) nei	*Siganus spp*	33	24 326	29 273	40 154	47 406	47 081	54 814	45 461
Flatheads nei	*Platycephalidae*	33	118	88	77	1	0	...	60
Puffers nei	*Tetraodontidae*	33	1 783	941	630	2 621	188	-	397
Triggerfishes, durgons nei	*Balistidae*	33	1 242	2 847	2 004	1 386	2 446	1 728	1 072
Daggertooth pike conger	*Muraenesox cinereus*	34	6 022	5 474	6 144	5 435	4 814	4 257	4 303
Pike-congers nei	*Muraenesox spp*	34	...	...	404	...	...	...	...
Conger eels, etc. nei	*Congridae*	34	2 396	2 439	2 730	2 608	2 702	3 068	3 099
Alfonsinos nei	*Beryx spp*	34	-	464	-	237	105	-	-
Redfish	*Centroberyx affinis*	34	0	0	0	4	0	0	1
Silver gemfish	*Rexea solandri*	34	13	3	0	14	-	-	-
Largehead hairtail	*Trichiurus lepturus*	34	15 210	13 608	12 633	13 334	8 433	7 760	8 288
Hairtails, scabbardfishes nei	*Trichiuridae*	34	32 589	35 591	36 525	42 279	72 222	66 464	54 239
Spotted sardinella	*Amblygaster sirm*	35	669	887	12 069	8 877	4 792	3 668	3 690
Goldstripe sardinella	*Sardinella gibbosa*	35	115 975	137 937	140 826	123 920	128 494	135 358	147 187
Bali sardinella	*Sardinella lemuru*	35	44 932	49 352	49 004	81 543	50 289	62 288	47 579
Sardinellas nei	*Sardinella spp*	35	373 530	446 767	394 417	394 644	448 058	551 465	529 792
Rainbow sardine	*Dussumieria acuta*	35	27 759	33 822	29 348	30 409	27 201	26 992	27 626
Bluestripe herring	*Herklotsichthys quadrimaculat.*	35	34	35	35	37	30	25	15

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Fish, crustaceans, molluscs, etc
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Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Western Central
Pacifique, centre-ouest
Pacífico, centro-occidental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Stolephorus anchovies nei	*Stolephorus spp*	35	193 581	184 959	196 059	214 769	218 618	231 127	214 103
Anchovies, etc. nei	*Engraulidae*	35	139 326	135 140	125 919	118 886	119 964	110 410	107 944
Dorab wolf-herring	*Chirocentrus dorab*	35	6 203	5 188	4 711	3 533	2 742	2 523	2 633
Wolf-herrings nei	*Chirocentrus spp*	35	29 542	28 308	18 218	26 511	17 333	13 502	15 777
Clupeoids nei	*Clupeoidei*	35	38 018	37 385	48 228	40 837	36 681	31 753	30 337
Striped bonito	*Sarda orientalis*	36	7	...	7	68	187	348	323
Wahoo	*Acanthocybium solandri*	36	151	117	177	161	266	309	552
Narrow-barred Spanish mackerel	*Scomberomorus commerson*	36	102 600	121 375	107 421	118 576	122 601	116 779	137 074
Indo-Pacific king mackerel	*Scomberomorus guttatus*	36	16 439	13 449	13 521	14 126	11 251	12 655	12 295
Seerfishes nei	*Scomberomorus spp*	36	32 389	30 128	28 684	25 842	18 066	16 079	18 908
Frigate tuna	*Auxis thazard*	36	14 970	43 003	34 271	90 708	79 763	97 700	80 844
Bullet tuna	*Auxis rochei*	36	...	9	539	361	582	460	191
Frigate and bullet tunas	*Auxis thazard, A. rochei*	36	230 033	192 660	192 148	207 072	162 391	157 988	158 922
Kawakawa	*Euthynnus affinis*	36	165 364	172 458	199 300	198 190	186 916	153 032	141 841
Skipjack tuna	*Katsuwonus pelamis*	36	1 217 868	1 267 094	1 373 627	1 494 890	1 360 818	1 598 167	1 484 863
Pacific bluefin tuna	*Thunnus orientalis*	36	129	74	119	15	9	10	2
Longtail tuna	*Thunnus tonggol*	36	172 481	163 053	156 032	174 558	114 793	87 034	91 764
Albacore	*Thunnus alalunga*	36	55 906	58 020	59 575	58 256	69 138	72 039	79 730
Southern bluefin tuna	*Thunnus maccoyii*	36	-	2	-	-	-	0	9
Yellowfin tuna	*Thunnus albacares*	36	322 858	368 162	364 046	395 220	497 310	418 556	480 333
Bigeye tuna	*Thunnus obesus*	36	93 350	95 686	106 529	109 546	119 654	95 468	93 756
Indo-Pacific sailfish	*Istiophorus platypterus*	36	2 439	1 610	1 790	3 014	2 906	4 187	2 392
Blue marlin	*Makaira nigricans*	36	10 311	8 580	5 198	4 249	5 257	5 131	7 965
Black marlin	*Makaira indica*	36	2 492	2 688	2 019	1 706	1 652	2 322	2 682
Striped marlin	*Tetrapturus audax*	36	1 155	1 093	967	716	1 309	1 735	1 113
Shortbill spearfish	*Tetrapturus angustirostris*	36	6	11	15	29	13	14	15
Marlins,sailfishes,etc. nei	*Istiophoridae*	36	4 885	4 035	4 349	5 183	4 830	4 502	6 798
Swordfish	*Xiphias gladius*	36	10 836	9 509	7 874	8 766	9 070	10 150	10 436
Tuna-like fishes nei	*Scombroidei*	36	26 484	41 774	56 157	66 381	79 412	65 311	89 386
Needlefishes nei	*Tylosurus spp*	37	14 111	12 802	16 295	16 683	13 359	15 095	17 483
Halfbeaks nei	*Hemiramphus spp*	37	18 481	21 825	22 694	21 495	21 037	22 414	21 759
Flyingfishes nei	*Exocoetidae*	37	44 375	37 868	41 848	43 046	42 149	36 751	35 093
Silversides(=Sand smelts) nei	*Atherinidae*	37	484	316	444	407	443	581	617
False trevally	*Lactarius lactarius*	37	2 504	2 345	6 721	2 380	11 155	20 588	26 074
Bluefish	*Pomatomus saltatrix*	37	127	150	117	82	...	...	118
Cobia	*Rachycentron canadum*	37	1 904	2 409	2 291	3 709	2 106	2 844	4 140
White trevally	*Pseudocaranx dentex*	37	-	1	1	4	1	0	0
Indian scad	*Decapterus russelli*	37	112 333	106 816	112 030	100 839	63 188	68 373	55 417
Scads nei	*Decapterus spp*	37	588 093	538 666	523 818	581 793	575 696	527 057	578 539
Jacks, crevalles nei	*Caranx spp*	37	36 159	37 664	33 176	34 404	47 523	46 319	47 723
Amberjacks nei	*Seriola spp*	37	6	4	4	0	5	0	1
Black pomfret	*Parastromateus niger*	37	44 545	47 053	54 867	51 921	45 641	45 686	54 523
Rainbow runner	*Elagatis bipinnulata*	37	13 286	13 526	12 613	12 308	13 565	13 487	16 953
Torpedo scad	*Megalaspis cordyla*	37	57 292	44 209	59 210	58 696	52 382	50 050	58 438
Queenfishes	*Scomberoides spp*	37	22 676	18 811	21 132	22 928	19 054	19 135	20 827
Bigeye scad	*Selar crumenophthalmus*	37	162 963	129 937	128 066	127 530	159 025	161 276	175 554
Yellowstripe scad	*Selaroides leptolepis*	37	141 441	122 906	121 018	118 257	123 356	121 608	128 875
Blackbanded trevally	*Seriolina nigrofasciata*	37	2 386	2 747	2 326	1 927	1 253	1 151	1 202
Carangids nei	*Carangidae*	37	113 845	102 162	104 035	136 470	107 594	104 672	110 314
Common dolphinfish	*Coryphaena hippurus*	37	991	1 856	2 445	2 496	3 538	6 208	5 010
Chub mackerel	*Scomber japonicus*	37	847	853	862	1 362	1 255	1 866	2 380
Blue mackerel	*Scomber australasicus*	37	9	45	657	445	244	275	447
Short mackerel	*Rastrelliger brachysoma*	37	188 012	203 512	236 633	230 661	220 287	242 707	259 351
Indian mackerel	*Rastrelliger kanagurta*	37	105 587	112 935	119 344	115 384	122 379	115 239	122 233
Indian mackerels nei	*Rastrelliger spp*	37	158 590	151 086	143 351	119 624	116 009	109 641	115 497
Mackerels nei	*Scombridae*	37	2 751	2 646	2 444	2 384	2 159	2 373	2 422
Silver pomfret	*Pampus argenteus*	37	32 057	30 628	34 384	42 852	33 154	33 113	35 865
Butterfishes, pomfrets nei	*Stromateidae*	37	1 535	1 356	2 419	1 568	2 416	3 094	3 619
Pickhandle barracuda	*Sphyraena jello*	37	61	44	32	20	28	591	700
Great barracuda	*Sphyraena barracuda*	37	3 265	3 498	9 159	4 883	8 249	7 418	5 061
Barracudas nei	*Sphyraena spp*	37	22 712	23 978	22 056	22 455	21 768	23 368	22 887
Thresher sharks nei	*Alopias spp*	38	...	7 479	13 701	11 982	2 633	5 684	10 057
Shortfin mako	*Isurus oxyrinchus*	38	34	26	14	13	273	374	72
Mackerel sharks,porbeagles nei	*Lamnidae*	38	...	...	1 104	201	371	386	196
Blue shark	*Prionace glauca*	38	-	-	-	-	1 039	410	432
Oceanic whitetip shark	*Carcharhinus longimanus*	38	-	-	-	-	-	578	401
Requiem sharks nei	*Carcharhinidae*	38	...	5 156	15 148	17 467	23 189	21 497	18 969
Hammerhead sharks, etc. nei	*Sphyrnidae*	38	...	253	11	1 357	1 410	1 757	2 080
Dogfish sharks nei	*Squalidae*	38	...	9 819	4 606	1 742	2 910	3 235	710
Whitespotted wedgefish	*Rhynchobatus australiae*	38	...	26 188	15 268	8 881	1 859	8 390	3 475
Guitarfishes, etc. nei	*Rhinobatidae*	38	...	120	12	2	0	210	189
Sawfishes	*Pristidae*	38	...	...	5	16	2	0	33
Stingrays, butterfly rays nei	*Dasyatidae*	38	...	19 206	19 412	25 774	24 217	30 677	30 077
Eagle rays nei	*Myliobatidae*	38	...	444	4 699	943	2 757	3 081	1 415
Mantas, devil rays nei	*Mobulidae*	38	...	200	2 768	1 259	4 173	2 296	2 182
Rays, stingrays, mantas nei	*Rajiformes*	38	73 730	21 555	18 879	16 481	16 175	16 257	16 029
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	49 366	22 574	25 597	18 421	17 162	15 064	15 723
Marine fishes nei	*Osteichthyes*	39	2 741 277	2 872 244	2 645 909	2 630 594	2 417 798	2 519 895	2 761 495
Blue swimming crab	*Portunus pelagicus*	42	79 296	71 959	81 356	78 968	88 358	79 722	86 810
Indo-Pacific swamp crab	*Scylla serrata*	42	18 756	17 951	25 347	24 448	25 017	26 768	29 603
Marine crabs nei	*Brachyura*	42	75 973	79 491	80 139	80 164	82 433	88 170	96 304
Tropical spiny lobsters nei	*Panulirus spp*	43	6 656	7 663	5 571	4 646	9 467	5 412	7 125
Flathead lobster	*Thenus orientalis*	43	2 179	1 837	1 619	1 457	908	664	786
Slipper lobsters nei	*Scyllaridae*	43	77	97	112	101	108	109	103

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Metanephrops lobsters nei	*Metanephrops spp*	43	16	10	18	8	24	29	...
Lobsters nei	*Reptantia*	43	1 120	1 200	1 100	1 400	1 500	1 600	1 713
Banana prawn	*Penaeus merguiensis*	45	70 315	64 478	59 264	75 448	63 797	54 698	63 179
Giant tiger prawn	*Penaeus monodon*	45	32 830	29 136	35 403	38 292	24 455	19 387	27 038
Green tiger prawn	*Penaeus semisulcatus*	45	1 751	2 065	2 028	1 718	1 929	1 427	1 678
Western king prawn	*Penaeus latisulcatus*	45	2 167	2 026	2 089	2 014	1 565	1 474	1 485
Penaeus shrimps nei	*Penaeus spp*	45	40 156	38 124	38 093	34 961	29 001	32 321	31 735
Endeavour shrimp	*Metapenaeus endeavouri*	45	3 042	2 779	2 844	2 637	2 199	2 234	1 762
Metapenaeus shrimps nei	*Metapenaeus spp*	45	46 899	40 383	34 319	34 917	35 243	42 086	37 460
Sergestid shrimps nei	*Sergestidae*	45	23 048	24 177	23 986	21 386	24 092	25 709	27 855
Natantian decapods nei	*Natantia*	45	218 481	197 409	217 069	214 373	200 726	212 706	230 274
Squillids nei	*Squillidae*	47	3 789	3 185	2 653	3 657	3 216	2 588	2 276
Stomatopods nei	*Stomatopoda*	47	1 994	1 638	1 526	1 014	845	505	675
Marine crustaceans nei	*Crustacea*	47	2 810	3 510	1 995	2 182	2 416	2 230	2 510
Abalones nei	*Haliotis spp*	52	168	146	175	196	247	202	354
Commercial top	*Trochus niloticus*	52	271	225	794	565	111	112	527
Slipper cupped oyster	*Crassostrea iredalei*	53	78	74	84	88	101	85	119
Cupped oysters nei	*Crassostrea spp*	53	130	683	199	271	289	439	281
Horse mussels nei	*Modiolus spp*	54	-	-	-	-	-	-	1
Green mussel	*Perna viridis*	54	31	32	1 234	440	35	55	456
Scallops nei	*Pectinidae*	55	2 951	4 925	3 811	5 766	4 940	4 802	4 874
Blood cockle	*Anadara granosa*	56	46 029	38 081	31 848	35 542	20 997	27 135	28 524
Anadara clams nei	*Anadara spp*	56	287	301	340	136	171	211	251
Hard clams nei	*Meretrix spp*	56	5 725	129	10 180	3 991	10 029	10 152	9 948
Short neck clams nei	*Paphia spp*	56	28 649	18 082	22 102	13 209	14 137	15 741	11 712
Clams, etc. nei	*Bivalvia*	56	1 383	1 238	1 078	1 065	2 102	1 089	1 280
Cuttlefish, bobtail squids nei	*Sepiidae, Sepiolidae*	57	68 381	65 753	60 723	57 733	42 526	39 552	44 143
Common squids nei	*Loligo spp*	57	174 121	171 652	168 256	166 265	164 566	173 996	184 378
Bigfin reef squid	*Sepioteuthis lessoniana*	57	5 500	3 811	3 584	3 646	4 528	4 523	4 526
Various squids nei	*Loliginidae, Ommastrephidae*	57	33 621	30 548	38 447	37 305	35 780	30 651	28 731
Octopuses, etc. nei	*Octopodidae*	57	19 520	20 574	21 376	20 585	19 308	17 037	22 333
Cephalopods nei	*Cephalopoda*	57	187 850	200 000	203 000	214 600	230 630	249 615	265 600
Marine molluscs nei	*Mollusca*	58	73 840	75 441	77 729	77 334	81 408	89 346	96 166
Green turtle	*Chelonia mydas*	72	0	0	0	0	0	0	-
Marine turtles nei	*Testudinata*	72	28	55	64	59	236	226	43
Sea urchins nei	*Strongylocentrotus spp*	76	198	200	235	199	242	161	157
Sea cucumbers nei	*Holothuroidea*	76	9 317	9 071	7 165	7 656	5 846	7 445	6 138
Jellyfishes nei	*Rhopilema spp*	77	10 241	9 247	10 409	13 315	9 075	7 669	9 091
Aquatic invertebrates nei	*Invertebrata*	77	982	5 163	2 689	2 018	903	2 674	2 275
Total			***10 921 340***	***11 089 711***	***11 095 803***	***11 466 930***	***10 914 603***	***11 228 123***	***11 709 514***

C-71 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Pacific, Western Central
Pacifique, centre-ouest
Pacífico, centro-occidental

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Australia	52 950	49 958	45 923	47 066	43 252	40 927	44 445	43 516	39 462	36 868
Belize	7 271	3 395	3 114	1 060	1 100	655	684	279	212	166
Brunei Darsm	1 578	2 044	1 784	1 912	2 709	2 279	2 550	2 357	1 766	2 272
Cambodia	42 000	45 850	54 750	55 800	60 000	60 500	63 500	66 000	75 000	85 000
China	11 138	12 924	38 094	29 203	55 773	65 881	65 772	79 768	110 289	71 770
China,Taiwan	321 673	380 396	321 937	240 727	221 491	241 398	249 729	218 368	208 537	229 865
Cook Is	-	-	-	0	32	319	283	331	118	101
Ecuador	1 057	427	1 562	3 051	5 193	9 523	9 187	25 415	4 432	8 452
Fiji	37 605	35 000 F	34 511	45 075	40 000 F	44 341	43 775	41 310 F	37 320 F	39 671 F
Guam	801	557	527	682	370	604	640	322	488	291
Indonesia	2 962 879	2 982 647	3 196 176	3 195 799	3 247 541	3 335 399	3 542 046	3 398 992	3 449 061	3 747 923
Japan	224 826	225 025 F	208 550	208 770	232 314	238 626	233 452	234 379	242 682	251 561
Kiribati	33 280	36 694	33 712	31 062 F	30 562 F	25 661 F	34 170	28 000	40 623	44 599
Korea Rep	190 038	225 065	226 366	221 456	245 886	276 563	291 564	275 856	308 859	304 505
Malaysia	755 933	770 639	750 413	753 085	701 056	695 645	709 717	721 942	675 649	695 497
Marshall Is	36 581	39 859	38 886	47 887	57 583	43 974	61 229	35 102	46 246	59 730
Micronesia	19 316 F	22 771 F	33 598 F	31 818	32 207	15 287	20 718	25 290	27 701	30 866 F
Nauru	360 F	342 F	344 F	298 F	300 F	280 F	260 F	240 F	220 F	200 F
NewCaledonia	3 309	3 380	3 453	3 733	3 314	3 146	3 507	3 720	3 554	3 771
New Zealand	7 868	29 444	20 675	20 160	16 211	17 429	25 242	19 962	22 432	11 897
N Marianas	406	296	172	169	214	221	219	168	192	243
Palau	1 084	1 027	1 047	1 079	932	967	985	1 007	1 000 F	1 000 F
Papua N Guin	111 413	127 660	163 344	229 101	240 635	239 519	233 962	208 944	216 119	211 007
Philippines	1 811 150	1 896 651	2 028 886	2 065 544	2 120 997	2 153 294	2 326 918	2 376 276	2 412 856	2 424 053
Singapore	3 342	2 769	2 085	2 173	1 920	3 103	3 522	1 623	2 121	1 732
Solomon Is	23 642 F	25 779 F	35 839 F	34 994 F	30 086 F	39 520 F	31 304 F	27 434 F	27 941 F	35 179 F
Spain	2 402	-	-	5 583	3 449	11 653	20 538	35 570	26 819	29 479
Thailand	1 871 249	1 862 679	1 860 263	1 806 078	1 784 590	1 593 387	1 447 898	993 148	1 010 657	993 708
Tuvalu	500 F	600 F	1 500	2 450	2 560	2 560 F	2 560 F	2 560 F	5 097	11 324 F
USA	113 658	114 089	40 143	33 343	26 242	32 362	34 422	51 617	88 488	109 512
Vanuatu	13 982 F	30 515 F	30 819	68 348	89 592	75 380	85 082	47 807	49 732	39 872
Viet Nam	1 481 175	1 575 640	1 647 233	1 733 434	1 791 100	1 824 800	1 876 400	1 946 600	2 091 700	2 226 600
Wallis Fut I	300 F	300 F	300	400 F	500 F	600	650 F	700 F	750 F	800 F
Total	***10 144 766***	***10 504 422***	***10 826 006***	***10 921 340***	***11 089 711***	***11 095 803***	***11 466 930***	***10 914 603***	***11 228 123***	***11 709 514***

C-77 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Eastern Central
Pacifique, centre-est
Pacífico, centro-oriental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Chinook(=Spring=King)salmon	*Oncorhynchus tshawytscha*	23	2 992	2 205	538	724	-	0	115
Smelts nei	*Osmerus spp, Hypomesus spp*	23	5	1	0	1	0	0	1
Milkfish	*Chanos chanos*	25	3	14	15	422	69	65	68
English sole	*Pleuronectes vetulus*	31	102	69	59	66	72	37	21
Arrow-tooth flounder	*Atheresthes stomias*	31	2	3	2	3	1	0	0
Petrale sole	*Eopsetta jordani*	31	266	371	372	575	549	330	146
Rex sole	*Glyptocephalus zachirus*	31	117	109	54	42	38	31	18
Rock sole	*Lepidopsetta bilineata*	31	13	13	6	5	2	2	2
Dover sole	*Microstomus pacificus*	31	1 590	1 179	826	864	1 046	999	1 035
Pacific sand sole	*Psettichthys melanostictus*	31	22	19	7	6	3	4	8
California flounder	*Paralichthys californicus*	31	456	422	327	177	214	284	239
Flatfishes nei	*Pleuronectiformes*	31	2 367	2 227	2 251	3 051	2 932	3 097	3 717
North Pacific hake	*Merluccius productus*	32	1 091	1 651	1 683	1 088	1 554	1 330	1 246
Grenadiers, rattails nei	*Macrouridae*	32	114	99	58	82	85	49	62
Gadiformes nei	*Gadiformes*	32	40	-	-	34	62	...	...
Hagfishes nei	*Myxinidae*	33	1	54	68	302	416	497	198
Sea catfishes nei	*Ariidae*	33	1 287	3 948	4 174	3 837	2 735	2 820	2 677
Squirrelfishes nei	*Holocentridae*	33	18	15	12	16	27	24	41
Flathead grey mullet	*Mugil cephalus*	33	4	560	584	544	489	350	337
White mullet	*Mugil curema*	33	...	554	578	584	250	274	159
Bobo mullet	*Joturus pichardi*	33	82	...	...	...	...	...	...
Mullets nei	*Mugilidae*	33	2 970	3 097	3 237	3 122	3 202	2 395	2 472
Snooks(=Robalos) nei	*Centropomus spp*	33	1 169	1 409	1 511	1 689	1 608	1 478	1 623
Groupers nei	*Epinephelus spp*	33	51	51	50	51	52	47	46
...A	*Paralabrax spp*	33	...	4 132	4 314	4 457	4 596	4 735	4 893
Groupers, seabasses nei	*Serranidae*	33	2 850	1 750	1 881	2 643	2 863	1 883	1 369
Giant seabass	*Stereolepis gigas*	33	4	3	3	4	3	3	6
Yellow snapper	*Lutjanus argentiventris*	33	1 138	63	66	119	102	84	95
Spotted rose snapper	*Lutjanus guttatus*	33	...	448	1 683	1 153	1 219	1 025	1 084
Pacific red snapper	*Lutjanus peru*	33	...	3 960	4 135	4 104	3 097	1 508	1 178
Snappers nei	*Lutjanus spp*	33	1 979	3 048	704	2 118	1 380	1 105	1 146
Green jobfish	*Aprion virescens*	33	66	66	65	68	62	49	49
Mexican barred snapper	*Hoplopagrus guntherii*	33	...	136	142	222	182	179	210
Snappers, jobfishes nei	*Lutjanidae*	33	6 354	14 605	13 163	10 816	9 151	9 238	8 937
Grunts, sweetlips nei	*Haemulidae(=Pomadasyidae)*	33	252	2 570	2 683	3 430	2 288	2 314	2 532
Weakfishes nei	*Cynoscion spp*	33	1 904	59	72	6 809	6 985	7 211	10 524
Croakers nei	*Micropogonias spp*	33	1 288	3 373	3 522	3 632	4 222	4 812	4 986
White weakfish	*Atractoscion nobilis*	33	143	139	184	220	304	186	258
White croaker	*Genyonemus lineatus*	33	52	38	39	27	33	53	6
Black drum	*Pogonias cromis*	33	0	0	0	0	-	-	-
Croakers, drums nei	*Sciaenidae*	33	1 908	5 533	6 010	3 113	3 945	4 226	3 826
Emperors(=Scavengers) nei	*Lethrinidae*	33	3	1	1	5	7	11	5
Porgies, seabreams nei	*Sparidae*	33	-	-	-	195	-	7	-
Goatfishes, red mullets nei	*Mullidae*	33	22	16	14	12	17	21	28
Mojarras, etc. nei	*Gerreidae*	33	2 049	953	995	818	971	1 023	1 256
Opaleye	*Girella nigricans*	33	8	5	0	1	0	0	0
Sea chubs nei	*Kyphosidae*	33	10	9	16	14	17	8	13
California sheephead	*Semicossyphus pulcher*	33	34	40	39	31	37	33	31
Parrotfishes nei	*Scaridae*	33	15	17	36	28	22	45	40
Surgeonfishes nei	*Acanthuridae*	33	34	41	32	45	39	44	58
Lingcod	*Ophiodon elongatus*	33	48	43	36	50	42	41	38
Cabezon	*Scorpaenichthys marmoratus*	33	46	28	26	23	21	17	21
Sculpins nei	*Cottidae*	33	2	1	1	1	2	2	1
Triggerfishes, durgons nei	*Balistidae*	33	...	1 168	1 220	1 555	1 181	1 199	1 271
Red pike conger	*Cynoponticus coniceps*	34	...	...	254	26	86	33	35
Ocean whitefish	*Caulolatilus princeps*	34	1 286	2 246	2 344	2 526	2 338	2 149	2 261
Escolar	*Lepidocybium flavobrunneum*	34	3	32	29	31	29	40	57
Oilfish	*Ruvettus pretiosus*	34	193	175	194	213	228	252	275
Roudi escolar	*Promethichthys prometheus*	34	...	6	7	2	2	3	7
Hairtails, scabbardfishes nei	*Trichiuridae*	34	7	...	...	...	...	...	...
Widow rockfish	*Sebastes entomelas*	34	1	1	4	7	1	2	1
Yellowtail rockfish	*Sebastes flavidus*	34	1	5	5	7	2	1	1
Pacific ocean perch	*Sebastes alutus*	34	29	14	11	3	3	4	2
Bocaccio rockfish	*Sebastes paucispinis*	34	12	5	5	6	6	6	4
Canary rockfish	*Sebastes pinniger*	34	0	1	1	2	1	1	0
Chilipepper rockfish	*Sebastes goodei*	34	42	41	26	39	95	237	331
Scorpionfishes nei	*Scorpaenidae*	34	1 358	1 036	1 004	800	973	944	950
Sablefish	*Anoplopoma fimbria*	34	1 057	1 124	1 031	875	962	1 614	1 886
Demersal percomorphs nei	*Perciformes*	34	0	0	0	0	-	-	-
Pacific herring	*Clupea pallasii*	35	1 638	354	731	597	757	534	1
California pilchard	*Sardinops caeruleus*	35	520 211	287 299	315 496	512 711	713 231	729 223	663 909
Red-eye round herring	*Etrumeus teres*	35	...	7 065	7 377	3 605	1 025	1 098	1 024
Pacific flatiron herring	*Harengula thrissina*	35	...	162	169	...	...	...	...
Pacific thread herring	*Opisthonema libertate*	35	45 515	202 046	210 798	233 054	150 830	162 970	133 525
Pacific piquitinga	*Lile stolifera*	35	...	141	147	229	203	218	251
Californian anchovy	*Engraulis mordax*	35	9 033	26 219	60 763	18 411	23 528	12 563	4 356
Pacific anchoveta	*Cetengraulis mysticetus*	35	46 972	108 193	104 277	89 595	85 023	102 753	51 244
Clupeoids nei	*Clupeoidei*	35	2 297	19 812	22 300	3 222	3 847	4 004	4 146
Eastern Pacific bonito	*Sarda chiliensis*	36	499	181	2 670	18 418	8 183	9 832	13 420
Wahoo	*Acanthocybium solandri*	36	818	975	1 061	907	785	626	749
Pacific sierra	*Scomberomorus sierra*	36	8 338	8 318	7 210	8 593	10 296	9 055	10 223
Black skipjack	*Euthynnus lineatus*	36	31	115	73	1 458	3 725	1 871	1 444
Kawakawa	*Euthynnus affinis*	36	1	2	1	1	1	2	1
Skipjack tuna	*Katsuwonus pelamis*	36	83 584	120 234	124 384	113 276	126 753	160 641	179 820

C-77 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Eastern Central
Pacifique, centre-est
Pacífico, centro-oriental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Pacific bluefin tuna	*Thunnus orientalis*	36	1 151	6 068	6 117	5 247	4 424	4 885	3 874
Albacore	*Thunnus alalunga*	36	23 999	22 976	19 056	22 744	17 430	16 708	20 590
Yellowfin tuna	*Thunnus albacares*	36	243 756	199 083	153 224	153 358	146 010	190 852	182 347
Bigeye tuna	*Thunnus obesus*	36	94 789	79 674	79 512	78 901	69 324	73 857	76 355
Indo-Pacific sailfish	*Istiophorus platypterus*	36	1 562	1 122	1 260	1 244	1 243	1 399	1 402
Blue marlin	*Makaira nigricans*	36	4 514	4 198	3 468	3 293	2 977	3 401	3 849
Black marlin	*Makaira indica*	36	927	1 342	1 153	898	658	688	635
Striped marlin	*Tetrapturus audax*	36	1 946	2 030	2 095	1 244	1 381	942	1 166
Shortbill spearfish	*Tetrapturus angustirostris*	36	8	13	20	13	15	14	44
Marlins,sailfishes,etc. nei	*Istiophoridae*	36	2 512	2 546	2 165	1 918	1 876	1 806	2 214
Swordfish	*Xiphias gladius*	36	9 243	7 441	8 140	8 070	9 498	9 138	9 243
Tuna-like fishes nei	*Scombroidei*	36	2 883	2 496	2 479	2 202	1 675	1 521	1 736
Flyingfishes nei	*Exocoetidae*	37	90	92	107	70	73	67	78
Opah	*Lampris guttatus*	37	524	626	660	738	775	1 016	984
Silversides(=Sand smelts) nei	*Atherinidae*	37	1 134	4	3	9	9	15	2
Pacific jack mackerel	*Trachurus symmetricus*	37	2 117	524	1 492	2 428	417	269	704
Scads nei	*Decapterus spp*	37	361	427	650	1 234	74	578	93
Jacks, crevalles nei	*Caranx spp*	37	3 858	3 965	4 132	4 506	4 653	4 586	12 823
Pompanos nei	*Trachinotus spp*	37	147	549	574	268	307	310	301
Yellowtail amberjack	*Seriola lalandi*	37	22	10	18	11	6	4	7
Amberjacks nei	*Seriola spp*	37	325	612	493	1 616	1 665	1 370	32
Shortjaw leatherjacket	*Oligoplites refulgens*	37	...	3 547	3 704	1 286	9	0	0
Rainbow runner	*Elagatis bipinnulata*	37	2	2	1	0	1	1	1
Bigeye scad	*Selar crumenophthalmus*	37	132	209	208	242	284	91	328
Carangids nei	*Carangidae*	37	110	115	121	144	156	159	174
Sickle pomfret	*Taractichthys steindachneri*	37	25	22	16	14	17	14	20
Pomfrets, ocean breams nei	*Bramidae*	37	348	293	265	269	304	285	269
Common dolphinfish	*Coryphaena hippurus*	37	4 458	5 092	4 923	4 688	5 311	5 279	5 565
Chub mackerel	*Scomber japonicus*	37	14 779	38 634	16 620	16 096	10 902	12 297	10 585
Butterfishes, pomfrets nei	*Stromateidae*	37	6	3	4	5	2	1	2
Barracudas nei	*Sphyraena spp*	37	346	527	540	436	343	439	341
Thresher	*Alopias vulpinus*	38	111	179	159	200	144	105	94
Bigeye thresher	*Alopias superciliosus*	38	5	10	4	5	6	7	1
Thresher sharks nei	*Alopias spp*	38	47	29	33	45	41	28	18
Shortfin mako	*Isurus oxyrinchus*	38	95	78	93	84	182	161	167
Mako sharks	*Isurus spp*	38	57	92	90	120	113	106	84
Great white shark	*Carcharodon carcharias*	38	0	0	0	0	0	1	1
Nurse shark	*Ginglymostoma cirratum*	38	...	...	1	...	...	...	...
Blue shark	*Prionace glauca*	38	0	1 121	1 170	2 082	3 993	4 141	4 528
Oceanic whitetip shark	*Carcharhinus longimanus*	38	-	-	-	-	-	177	148
Silky shark	*Carcharhinus falciformis*	38	846	838	950	1 060	1 050	1 051	1 050
Requiem sharks nei	*Carcharhinidae*	38	3 494	3 150	3 185	3 193	2 318	3 271	2 895
Hammerhead sharks, etc. nei	*Sphyrnidae*	38	...	77	80	137	178	173	216
Brown smooth-hound	*Mustelus henlei*	38	2	4	3	1	1	0	0
Tope shark	*Galeorhinus galeus*	38	26	26	28	17	8	4	3
Picked dogfish	*Squalus acanthias*	38	28	8	14	11	44	46	6
Pacific angelshark	*Squatina californica*	38	...	763	797	1 914	834	809	1 062
Rays, stingrays, mantas nei	*Rajiformes*	38	5 037	6 022	4 651	5 235	4 333	4 148	4 119
Spotted ratfish	*Hydrolagus colliei*	38	-	0	0	0	0	0	0
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	31 911	29 899	28 578	24 912	21 906	24 354	26 166
Marine fishes nei	*Osteichthyes*	39	108 225	108 340	112 171	88 798	90 800	78 781	94 061
Dungeness crab	*Cancer magister*	42	3 193	2 538	3 114	1 622	1 733	1 251	6 852
Pacific rock crab	*Cancer productus*	42	361	482	522	578	490	585	561
Indo-Pacific swamp crab	*Scylla serrata*	42	3	3	6	6	6	6	6
Marine crabs nei	*Brachyura*	42	8 168	10 576	11 089	16 338	18 589	15 841	19 884
Green spiny lobster	*Panulirus gracilis*	43	118	126	101	98	151	224	110
Tropical spiny lobsters nei	*Panulirus spp*	43	2 206	2 161	2 301	1 977	2 466	2 212	3 282
Pelagic red crab	*Pleuroncodes planipes*	44	6 838	13 708	11 754	11 377	3 971	3 034	...
Craylets, squat lobsters	*Galatheidae*	44	37	...	343	2 696	2 868	7 196	4 395
King crabs	*Paralithodes spp*	44	0	0	0	0	0	0	-
Yellowleg shrimp	*Penaeus californiensis*	45	193	6 948	7 129	8 704	7 907	7 477	8 232
Blue shrimp	*Penaeus stylirostris*	45	20	4 104	4 285	5 894	12 057	11 825	14 600
Whiteleg shrimp	*Penaeus vannamei*	45	1 136	1 609	1 377	1 574	943	635	668
Crystal shrimp	*Penaeus brevirostris*	45	2 185	875	1 124	1 581	2 646	3 327	2 187
Penaeus shrimps nei	*Penaeus spp*	45	43 850	35 855	37 015	42 582	32 903	31 438	30 970
Pacific seabobs	*Xiphopenaeus,Trachypenaeus spp*	45	3 850	2 307	3 204	5 638	3 237	2 541	3 127
Ocean shrimp	*Pandalus jordani*	45	265	174	29	0	-	0	-
Northern nylon shrimp	*Heterocarpus vicarius*	45	150	73	0	...	...	...	...
Crangonid shrimps nei	*Crangonidae*	45	30	24	18	23	21	32	24
Pacific rock shrimp	*Sicyonia ingentis*	45	27	28	73	93	233	235	92
Natantian decapods nei	*Natantia*	45	1 244	1 738	1 603	1 497	1 445	1 402	1 372
Brine shrimp	*Artemia salina*	47	381	273	228	343	-	-	-
Marine crustaceans nei	*Crustacea*	47	2 317	3 899	1 658	2 596	921	832	822
Abalones nei	*Haliotis spp*	52	371	622	649	687	715	743	756
Stromboid conchs nei	*Strombus spp*	52	2 060	1 907	1 994	3	...	5	...
Gastropods nei	*Gastropoda*	52	67	1 799	1 914	3 405	3 264	2 198	3 169
Pacific cupped oyster	*Crassostrea gigas*	53	1 527	1 283	8 344	5 187	2 235	2 370	1 233
Cupped oysters nei	*Crassostrea spp*	53	1 721	1 505	1 571	2 209	1 090	1 029	2 157
Sea mussels nei	*Mytilidae*	54	630	1 627	1 507	4 274	2 858	2 443	3 530

C-77 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Eastern Central
Pacifique, centre-est
Pacífico, centro-oriental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Pacific calico scallop	*Argopecten ventricosus*	55	5 151	15 348	16 027	14 761	16 522	16 284	16 499
Ark clams nei	*Arca spp*	56	257	656	672	618	668	718	717
Venus clams nei	*Veneridae*	56	3 026	6 694	6 990	6 399	7 539	7 678	7 815
Clams, etc. nei	*Bivalvia*	56	1 054	1 433	1 302	1 215	1 572	873	1 040
Opalescent inshore squid	*Loligo opalescens*	57	39 596	55 732	49 178	49 446	36 599	92 376	129 936
Jumbo flying squid	*Dosidicus gigas*	57	87 228	53 439	65 635	57 550	84 473	57 902	42 903
Various squids nei	*Loliginidae, Ommastrephidae*	57	55	25	22	35	2 910	1 982	1 208
Octopuses, etc. nei	*Octopodidae*	57	1 100	819	854	1 066	1 239	2 237	2 194
Marine molluscs nei	*Mollusca*	58	5 059	2 176	2 500	3 129	2 776	2 453	2 427
Echinoderms	*Echinodermata*	76	1 931	103	106	86	97	161	282
Starfishes nei	*Asteroidea*	76	7	2	0	4	0	0	0
Sea urchins nei	*Strongylocentrotus spp*	76	5 668	7 356	6 678	7 037	7 067	8 106	8 228
Sea cucumbers nei	*Holothuroidea*	76	265	467	527	481	535	907	1 220
Marine worms	*Polychaeta*	77	26	23	25	20	16	15	21
Aquatic invertebrates nei	*Invertebrata*	77	48	25	1 006	1 069	1 132	970	970
Total			***1 557 274***	***1 621 537***	***1 639 567***	***1 776 516***	***1 864 771***	***1 996 749***	***1 921 887***

C-77 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Pacific, Eastern Central
Pacifique, centre-est
Pacífico, centro-oriental

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Amer Samoa	3 667	6 939	5 089	4 041	4 019	5 349	6 512	4 423	4 943	5 261
Belize	55	...	...	...	...	...	...	...	...	...
China	14 547	12 494	8 818	18 556	11 077	15 704	11 954	13 619	12 300	13 314
China,Taiwan	10 461	8 717	30 544	46 168	36 354	23 105	22 800	19 513	22 258	20 883
Colombia	9 452	14 977	5 703	2 489	3 256	1 371	5 556	4 470	8 372	9 830
Cook Is	800 F	1 399 F	3 295	4 067	3 962	3 563	3 941	3 409	2 577	3 700
Costa Rica	32 917	31 303	27 746	19 249	20 735	20 385 F	20 111	20 125 F	20 125 F	20 125 F
Ecuador	18 058	14 438	26 437	21 113	27 951	44 033	36 485	31 683	43 071	50 249
El Salvador	17 318	31 792	32 737	40 210	39 063	41 184	46 217	28 345	27 527	33 674
Fr Polynesia	15 351	15 490	13 552 F	12 437 F	12 102	13 356	13 095	11 932	13 321	12 962
Guatemala	12 134 F	17 417	18 516	4 614	3 263	2 077	2 471	3 540	1 773	6 509
Honduras	2 659 F	3 082 F	2 500 F	2 445 F	2 056 F	2 369 F	2 630 F	2 000 F	2 075 F	2 050 F
Japan	55 370	55 507 F	45 333	39 288	32 743	30 053	28 643	25 229	23 924	26 508
Korea Rep	53 668	54 644	23 581	24 932	20 913	20 733	17 252	16 586	15 721	15 228
Mexico	1 039 463	1 119 685	1 015 523	895 957	988 832	1 004 911	1 140 497	1 280 570	1 307 922	1 207 625
Nicaragua	6 208	8 136	4 534	8 340	14 566	12 988	12 245	11 733	17 467	20 486
Niue	200 F	200 F	200 F	200 F	212 F	400	302 F	108 F	192	113
Panama	252 464	226 019	203 440	168 578	159 066	150 593	141 862	145 086	156 403	114 934
Samoa	8 612 F	10 880 F	9 702 F	9 455 F	9 835 F	12 434	14 090	13 898	13 278	12 999 F
Spain	15 722	20 503	23 738	18 027	17 657	24 139	5 936	5 999	14 620	3 847
Tokelau	140 F	128 F	113 F	103 F	96 F	86 F	78 F	68 F	62 F	54 F
Tonga	4 774	4 853	4 435	1 645	2 200 F	2 750 F	3 103 F	2 593 F	2 036 F	2 150 F
USA	212 580	189 277	157 546	170 094	168 136	190 112	216 664	201 559	258 979	310 749
Vanuatu	6 620	2 986	11 349	4 905	2 261	1 472	2 820	2 427	2 616	4 897
Venezuela	55 177	94 560	66 468	39 380	41 147	16 397	21 252	15 856	25 187	23 740
Other nei	9 955	30 208	27 269	981	35	3	-	-	-	-
Total	***1 858 372***	***1 975 634***	***1 768 168***	***1 557 274***	***1 621 537***	***1 639 567***	***1 776 516***	***1 864 771***	***1 996 749***	***1 921 887***

C-81 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Southwest
Pacifique, sud-ouest
Pacífico, sudoccidental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Short-finned eel	*Anguilla australis*	22	13	10	5	...	...	...	...
River eels nei	*Anguilla spp*	22	209	277	210	207	152	107	...
Chinook(=Spring=King)salmon	*Oncorhynchus tshawytscha*	23	1	2	1	1	7	50	0
Southern lemon sole	*Pelotretis flavilatus*	31	251	335	348	608	513	387	448
Sand flounders nei	*Rhombosolea spp*	31	187	437	514	530	351	402	462
Flatfishes nei	*Pleuronectiformes*	31	2 729	3 431	2 702	3 015	2 602	2 545	2 295
Common mora	*Mora moro*	32	1 403	1 154	986	1 180	1 088	1 153	971
Red codling	*Pseudophycis bachus*	32	9 540	8 165	5 854	5 854	6 122	4 636	5 554
Grenadier cod	*Tripterophycis gilchristi*	32	13	13	43	29	26	0	0
Southern blue whiting	*Micromesistius australis*	32	26 576	30 304	32 735	23 943	29 268	39 413	38 619
Southern hake	*Merluccius australis*	32	19 344	12 560	12 858	13 892	8 881	13 159	6 672
Blue grenadier	*Macruronus novaezelandiae*	32	147 032	134 145	119 329	109 537	102 946	99 587	119 255
Ridge scaled rattail	*Macrourus carinatus*	32	-	-	-	9	14	30	40
Thorntooth grenadier	*Lepidorhynchus denticulatus*	32	6 341	3 855	4 056	3 725	3 264	2 827	3 258
Grenadiers, rattails nei	*Macrouridae*	32	3 732	2 660	2 848	1 891	2 143	2 015	2 206
Gadiformes nei	*Gadiformes*	32	298	1 217	46	767	886	1 340	423
Broadgilled hagfish	*Eptatretus cirrhatus*	33	0	0	11	508	347	364	1 142
Sea catfishes nei	*Ariidae*	33	4	4	4	...	...	...	...
Mullets nei	*Mugilidae*	33	4 135	4 951	4 862	4 439	4 573	2 549	3 949
Pink maomao	*Caprodon longimanus*	33	-	5	6	6	3	4	5
Orange perch	*Lepidoperca pulchella*	33	11	58	99	229	46	25	21
Groupers, seabasses nei	*Serranidae*	33	24	27	6	4	4	6	4
Sillago-whitings	*Sillaginidae*	33	1 866	1 469	1 615	1 467	1 397	1 059	967
Australian salmon	*Arripis trutta*	33	3 665	3 684	2 217	4 006	3 944	3 280	2 942
Snappers, jobfishes nei	*Lutjanidae*	33	256	243	252	260	332	252	270
Southern meagre(=Mulloway)	*Argyrosomus hololepidotus*	33	102	54	58	46	48	36	40
Geelbek croaker	*Atractoscion aequidens*	33	13	11	7	...	...	...	...
Croakers, drums nei	*Sciaenidae*	33	108	-	-	-	800	-	-
Silver seabream	*Pagrus auratus*	33	6 740	7 475	6 679	6 134	6 614	6 501	6 474
Porgies, seabreams nei	*Sparidae*	33	2 224	2 756	3 051	3 309	3 536	4 202	2 741
Goatfishes, red mullets nei	*Mullidae*	33	-	-	-	-	-	-	7
Parore	*Girella tricuspidata*	33	442	384	439	494	456	385	351
Wrasses, hogfishes, etc. nei	*Labridae*	33	16	16	12	5	5	2	4
Antarctic rockcods, noties nei	*Nototheniidae*	33	1	0	0	40	63	77	-
Percoids nei	*Percoidei*	33	65	65	62	-	-	-	-
New Zealand blue cod	*Parapercis colias*	33	2 469	2 572	2 126	2 413	2 292	2 349	2 271
Flatheads nei	*Platycephalidae*	33	1 859	984	894	885	1 006	933	807
Puffers nei	*Tetraodontidae*	33	733	353	291	231	365	335	371
Longspine burrfish	*Tragulichthys jaculiferus*	33	5	3	4	7	3	5	6
Velvet leatherjacket	*Parika scaber*	33	662	416	443	427	515	670	666
Argentines	*Argentina spp*	34	78	36	136	306	48	69	71
Slickheads nei	*Alepocephalus spp*	34	7	0	9	22	82	76	57
Lanternfishes nei	*Myctophidae*	34	1	2	1	3	5	18	11
Conger eels, etc. nei	*Congridae*	34	152	138	119	137	157	165	163
Basketwork eel	*Diastobranchus capensis*	34	1	2	0	3	25	34	20
Longspine snipefish	*Macroramphosus scolopax*	34	18	1	1	14	1	8	2
Crested bellowfish	*Notopogon lilliei*	34	0	8	3	7	24	14	0
Banded yellowfish	*Centriscops humerosus*	34	57	34	84	63	43	23	29
Pink cusk-eel	*Genypterus blacodes*	34	21 176	17 433	17 231	19 536	15 780	12 930	14 590
Alfonsinos nei	*Beryx spp*	34	2 632	4 133	2 764	2 967	2 615	2 690	3 331
Redfish	*Centroberyx affinis*	34	742	563	539	269	312	229	213
Orange roughy	*Hoplostethus atlanticus*	34	18 887	19 305	16 824	14 665	13 310	12 448	10 844
Sandpaper fish	*Paratrachichthys trailli*	34	1	...	-	-	-	-	-
Slimeheads nei	*Trachichthyidae*	34	14	12	7	2	7	7	10
John dory	*Zeus faber*	34	1 765	1 587	1 179	1 142	1 045	1 113	685
Mirror dory	*Zenopsis nebulosus*	34	507	448	385	280	304	347	386
Capro dory	*Capromimus abbreviatus*	34	17	...	-	-	-	-	-
New Zealand dory	*Cyttus novaezealandiae*	34	452	...	114	...	...	...	...
King dory	*Cyttus traversi*	34	494	375	450	410	475	454	426
Dories nei	*Zeidae*	34	38	47	38	11	49	16	10
Spiky oreo	*Neocyttus rhomboidalis*	34	184	124	49	97	104	85	95
Smooth oreo dory	*Pseudocyttus maculatus*	34	14 576	12 461	10 782	12 089	9 735	10 876	12 636
Black oreo	*Allocyttus niger*	34	5 459	4 856	6 193	5 652	5 762	4 997	6 496
Oreo dories nei	*Oreosomatidae*	34	210	0	283	0	4	2	2
Hapuku wreckfish	*Polyprion oxygeneios*	34	1 524	1 881	1 684	1 786	1 674	1 646	1 697
Cape bonnetmouth	*Emmelichthys nitidus*	34	5 641	2 163	6 588	2 237	3 068	3 217	971
Rubyfish	*Plagiogeneion rubiginosum*	34	419	489	483	504	714	635	602
Giant boarfish	*Paristiopterus labiosus*	34	7	10	7	5	6	16	7
Bigspined boarfish	*Pentaceros decacanthus*	34	0	1	1	0	0	0	0
Pelagic armourhead	*Pseudopentaceros richardsoni*	34	107	119	69	29	42	42	98
Tarakihi	*Nemadactylus macropterus*	34	5 441	5 947	5 945	5 608	5 481	5 885	5 536
Morwongs	*Nemadactylus spp*	34	423	426	388	348	376	330	284
Trumpeters nei	*Latridae*	34	475	616	570	616	646	602	615
Patagonian toothfish	*Dissostichus eleginoides*	34	3	...	...	90	308	746	-
Black cardinal fish	*Epigonus telescopus*	34	2 067	1 525	3 115	1 806	1 302	1 279	1 151
Giant stargazer	*Kathetostoma giganteum*	34	3 179	3 895	3 206	3 473	3 107	3 165	3 321
Snoek	*Thyrsites atun*	34	29 899	31 165	35 127	28 635	27 370	27 843	26 424
Escolar	*Lepidocybium flavobrunneum*	34	33	21	25	18	15	21	17
Oilfish	*Ruvettus pretiosus*	34	62	29	18	11	12	13	13
Silver gemfish	*Rexea solandri*	34	1 249	1 152	879	709	721	690	732
Frostfishes	*Benthodesmus spp*	34	158	126	131	31	36	54	28
Silver scabbardfish	*Lepidopus caudatus*	34	2 891	3 150	2 715	1 804	1 737	1 529	1 110
Hairtails, scabbardfishes nei	*Trichiuridae*	34	127	47	10	11	96	22	29
Rudderfish	*Centrolophus niger*	34	1	...	-	-	-	-	-
Common warehou	*Seriolella brama*	34	5 319	4 605	4 066	3 498	2 874	3 314	2 805

C-81 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Southwest
Pacifique, sud-ouest
Pacífico, sudoccidental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Silver warehou	*Seriolella punctata*	34	11 294	10 582	11 928	12 296	9 045	8 501	7 728
White warehou	*Seriolella caerulea*	34	2 330	2 669	2 489	3 287	1 771	2 060	1 875
Bluenose warehou	*Hyperoglyphe antarctica*	34	3 178	2 977	2 553	2 627	2 516	2 066	2 254
Ruffs, barrelfishes nei	*Centrolophidae*	34	651	738	1 169	1 154	1 140	1 446	958
Scorpionfishes nei	*Scorpaenidae*	34	1 998	1 543	1 188	1 493	1 607	1 046	1 302
Bluefin gurnard	*Chelidonichthys kumu*	34	3 666	3 951	3 566	3 853	3 290	3 665	3 837
Scaly gurnard	*Lepidotrigla brachyoptera*	34	6	16	21	10	9	10	8
Latchet(=Sharpbeak gurnard)	*Pterygotrigla polyommata*	34	67	37	32	33	33	47	66
Spotted gurnard	*Pterygotrigla picta*	34	53	44	67	67	101	98	116
Australian pilchard	*Sardinops neopilchardus*	35	1 411	760	1 194	837	656	779	495
Anchovies, etc. nei	*Engraulidae*	35	2	50	2	...	...	...	...
Clupeoids nei	*Clupeoidei*	35	637	1 406	2 183	1	526	149	0
Wahoo	*Acanthocybium solandri*	36	2	2	2	1	0	1	0
Seerfishes nei	*Scomberomorus spp*	36	647	1 298	860	4 315	5 828	5 414	3 768
Butterfly kingfish	*Gasterochisma melampus*	36	11	9	14	13	6	16	13
Frigate and bullet tunas	*Auxis thazard, A. rochei*	36	3	12	0	1	0	0	0
Skipjack tuna	*Katsuwonus pelamis*	36	10 787	9 036	7 489	11 421	10 084	5 713	12 524
Pacific bluefin tuna	*Thunnus orientalis*	36	74	42	29	20	18	20	15
Longtail tuna	*Thunnus tonggol*	36	10	1	0	-	0	0	1
Albacore	*Thunnus alalunga*	36	9 942	8 544	9 010	6 150	6 513	5 684	12 596
Southern bluefin tuna	*Thunnus maccoyii*	36	1 562	1 293	818	713	754	1 030	1 306
Yellowfin tuna	*Thunnus albacares*	36	2 434	1 542	1 228	906	1 096	1 252	1 461
Bigeye tuna	*Thunnus obesus*	36	1 700	1 510	1 083	1 085	2 859	3 931	2 915
Slender tuna	*Allothunnus fallai*	36	41	150	34	16	17	53	44
Indo-Pacific sailfish	*Istiophorus platypterus*	36	12	24	31	25	27	10	34
Blue marlin	*Makaira nigricans*	36	29	21	127	123	60	192	178
Black marlin	*Makaira indica*	36	7	11	9	6	87	44	20
Striped marlin	*Tetrapturus audax*	36	573	366	470	261	324	395	403
Shortbill spearfish	*Tetrapturus angustirostris*	36	8	8	4	5	2	2	2
Marlins,sailfishes,etc. nei	*Istiophoridae*	36	-	3	9	-	-	-	75
Swordfish	*Xiphias gladius*	36	2 719	2 907	4 651	4 942	4 199	2 880	2 294
Tuna-like fishes nei	*Scombroidei*	36	200	163	185	0	62	-	-
Halfbeaks nei	*Hemiramphus spp*	37	37	61	47	11	7	12	12
Flyingfishes nei	*Exocoetidae*	37	5	3	0	1	1	0	3
Opah	*Lampris guttatus*	37	136	112	84	80	48	91	113
Dealfishes	*Trachipterus spp*	37	68	25	12	7	8	5	3
King of herrings	*Regalecus glesne*	37	-	-	-	0	0	0	-
Bluefish	*Pomatomus saltatrix*	37	61	54	119	...	0	0	0
Greenback horse mackerel	*Trachurus declivis*	37	22 692	68	20 677	22 778	48	19	22
Jack and horse mackerels nei	*Trachurus spp*	37	43 168	45 805	36 425	46 741	48 057	40 602	41 288
White trevally	*Pseudocaranx dentex*	37	3 940	3 996	3 506	3 076	3 504	3 052	3 598
Scads nei	*Decapterus spp*	37	85	45	89	19	32	33	46
Yellowtail amberjack	*Seriola lalandi*	37	22	...	6	...	1	4	...
Amberjacks nei	*Seriola spp*	37	167	194	166	159	164	151	168
Atlantic pomfret	*Brama brama*	37	154	253	221	152	157	173	117
Common dolphinfish	*Coryphaena hippurus*	37	1	1	3	1	2	1	2
Blue mackerel	*Scomber australasicus*	37	13 315	7 224	17 309	7 735	6 639	10 087	8 026
Mackerels nei	*Scombridae*	37	777	87	77	15	49	4	3
Barracudas nei	*Sphyraena spp*	37	312	373	-	-	-	-	-
Broadnose sevengill shark	*Notorynchus cepedianus*	38	2	2	2	7	5	12	14
Basking shark	*Cetorhinus maximus*	38	26	62	1	7	5	1	0
Thresher	*Alopias vulpinus*	38	41	33	25	35	32	25	19
Bigeye thresher	*Alopias superciliosus*	38	-	-	-	1	-	0	0
Shortfin mako	*Isurus oxyrinchus*	38	110	119	84	182	73	141	78
Porbeagle	*Lamna nasus*	38	68	58	49	52	42	63	56
Draughtsboard shark	*Cephaloscyllium isabellum*	38	40	47	50	47	36	48	64
Blue shark	*Prionace glauca*	38	1 023	945	1 135	2 490	1 140	1 429	1 501
Oceanic whitetip shark	*Carcharhinus longimanus*	38	-	-	-	-	-	-	7
Copper shark	*Carcharhinus brachyurus*	38	25	16	14	16	11	14	12
Smooth hammerhead	*Sphyrna zygaena*	38	11	5	9	8	11	12	7
Spotted estuary smooth-hound	*Mustelus lenticulatus*	38	1 344	1 467	1 373	1 335	1 225	1 244	1 318
Smooth-hounds nei	*Mustelus spp*	38	78	24	16	19	33	41	32
Tope shark	*Galeorhinus galeus*	38	3 098	3 602	3 053	3 330	3 327	3 351	3 569
Picked dogfish	*Squalus acanthias*	38	3 241	3 866	4 798	3 967	2 911	3 129	4 015
Leafscale gulper shark	*Centrophorus squamosus*	38	3	0	0	2	37	12	21
Lanternsharks nei	*Etmopterus spp*	38	10	15	6	13	20	46	62
Birdbeak dogfish	*Deania calcea*	38	94	122	143	105	148	168	142
Longnose velvet dogfish	*Centroscymnus crepidater*	38	1	0	0	0	1	0	3
Kitefin shark	*Dalatias licha*	38	480	455	413	333	1 262	250	276
Dogfish sharks nei	*Squalidae*	38	395	224	303	515	522	814	565
New Zealand smooth skate	*Dipturus innominatus*	38	594	689	667	644	681	525	573
New Zealand rough skate	*Zearaja nasuta*	38	1 911	1 982	1 674	1 710	1 641	1 922	1 962
Eagle rays nei	*Myliobatidae*	38	27	26	33	41	39	38	53
Rays, stingrays, mantas nei	*Rajiformes*	38	306	204	142	228	191	165	121
Dark ghost shark	*Hydrolagus novaezealandiae*	38	1 793	2 170	1 669	2 154	1 779	1 993	2 229
Ratfishes nei	*Hydrolagus spp*	38	1 452	840	684	742	849	823	737
Ghost shark	*Callorhinchus milii*	38	1 191	1 239	1 161	1 353	1 380	1 506	1 448
Chimaeras, etc. nei	*Chimaeriformes*	38	193	152	101	93	95	96	104
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	2 306	1 708	2 095	1 957	1 511	1 236	1 751
Marine fishes nei	*Osteichthyes*	39	27 355	110 235	33 572	65 468	89 545	85 038	75 897
Blue swimming crab	*Portunus pelagicus*	42	198	160	182	...	...	...	...
Marine crabs nei	*Brachyura*	42	390	420	329	247	318	330	205
Green rock lobster	*Jasus verreauxi*	43	127	118	130	139	154	158	157

C-81 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Southwest
Pacifique, sud-ouest
Pacífico, sudoccidental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Red rock lobster	*Jasus edwardsii*	43	2 348	2 573	2 542	2 451	2 749	2 493	2 871
Slipper lobsters nei	*Scyllaridae*	43	0	10	6	2	2	3	3
New Zealand lobster	*Metanephrops challengeri*	43	546	849	811	886	609	565	825
Giant tiger prawn	*Penaeus monodon*	45	4	5	6	...	...	...	466
Penaeus shrimps nei	*Penaeus spp*	45	1 827	869	1 352	1 468	1 830	1 689	733
Natantian decapods nei	*Natantia*	45	0	3	2	3	2	1	-
Marine crustaceans nei	*Crustacea*	47	535	480	491	473	381	292	356
Blacklip abalone	*Haliotis rubra*	52	252	189	129	122	109	103	73
Abalones nei	*Haliotis spp*	52	996	1 043	952	1 132	932	979	1 115
Gastropods nei	*Gastropoda*	52	3	7	0	1	9	1	23
New Zealand dredge oyster	*Ostrea lutaria*	53	465	546	518	512	434	107	980
Pacific cupped oyster	*Crassostrea gigas*	53	0	0	-	-	...	...	...
Australian mussel	*Mytilus planulatus*	54	0	0	0	-	-	-	-
Sea mussels nei	*Mytilidae*	54	1 353	486	403	200	182	152	153
New Zealand scallop	*Pecten novaezelandiae*	55	1 896	2 746	1 952	1 840	1 624	1 355	122
Delicate scallop	*Zygochlamis delicatula*	55	85	26	19	5	34	23	25
Scallops nei	*Pectinidae*	55	-	0	0	-	-	-	-
Stutchbury's venus	*Chione stutchburyi*	56	1 446	1 477	1 450	1 398	1 148	1 202	1 202
Short neck clams nei	*Paphia spp*	56	258	151	176	137	146	153	120
Pipi wedge clam	*Paphies australis*	56	571	568	299	118	73	32	16
Clams, etc. nei	*Bivalvia*	56	83	95	660	81	64	52	85
Cuttlefish, bobtail squids nei	*Sepiidae, Sepiolidae*	57	382	296	203	115	127	84	110
Wellington flying squid	*Nototodarus sloanii*	57	108 437	96 398	89 403	73 921	56 986	47 018	33 413
Various squids nei	*Loliginidae, Ommastrephidae*	57	32 690	31 129	25 618	26 009	15 967	19 503	24 512
Octopuses, etc. nei	*Octopodidae*	57	646	449	319	266	273	191	292
Marine molluscs nei	*Mollusca*	58	61	62	59	45	75	31	117
Echinoderms	*Echinodermata*	76	555	854	812	811	762	741	703
Starfishes nei	*Asteroidea*	76	7	11	6	4	19	14	16
Sea cucumbers nei	*Holothuroidea*	76	1	14	4	10	13	6	7
Aquatic invertebrates nei	*Invertebrata*	77	18	20	12	...	1	1	0
Total			***713 954***	***725 404***	***641 194***	***634 678***	***589 006***	***570 494***	***573 783***

C-81 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Pacific, Southwest
Pacifique, sud-ouest
Pacífico, sudoccidental

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Australia	27 804	26 693	28 608	29 354	25 797	23 056	22 453	21 831	21 022	18 447
Canada	206	144	-	63	72	135	27	-	-	-
China	520	802	562	592	901	1 218	487	-	-	5 991
China,Taiwan	5 901	10 043	9 377	2 144	5 497	9 066	3 767	2 380	2 941	5 017
Cook Is	-	1	2	2	-	31	58	13	0	134
Japan	48 329	64 897 F	47 866	31 670	37 921	30 446	5 820	4 217	3 693	3 468
Korea Rep	38 185	44 243	45 454	53 259	52 551	48 670	54 857	49 335	50 509	52 253
New Zealand	560 189	556 731	527 703	523 714	526 232	456 354	466 720	429 917	414 802	421 627
Norfolk Is	0	0	0	0	0	0	0	0	0	0
Pitcairn Is	5 F	5 F	5 F	3 F	3 F	3 F	3 F	3 F	3 F	3 F
Russian Fed	-	-	-	-	-	-	697	-	-	-
Spain	-	-	-	1 406	1 648	4 249	6 962	5 254	3 003	2 152
Ukraine	58 908	58 773	71 450	71 747	74 782	67 966	72 827	76 056	74 521	64 691
USA	5 942	6 735	-	-	-	-	-	-	-	-
Total	***745 989***	***769 067***	***731 027***	***713 954***	***725 404***	***641 194***	***634 678***	***589 006***	***570 494***	***573 783***

C-87 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Southeast
Pacifique, sud-est
Pacífico, sudoriental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Flatfishes nei	*Pleuronectiformes*	31	513	376	438	342	368	481	613
Tadpole codling	*Salilota australis*	32	2 855	3 131	1 751	685	698	3 356	1 400
Southern blue whiting	*Micromesistius australis*	32	24 951	25 425	26 839	23 419	25 561	22 221	23 301
Southern hake	*Merluccius australis*	32	31 700	31 458	31 493	30 589	28 050	26 272	25 361
South Pacific hake	*Merluccius gayi*	32	112 248	78 036	77 436	77 534	83 256	94 306	90 305
Panama hake	*Merluccius angustimanus*	32	61	85	60	40	20	...	...
Patagonian grenadier	*Macruronus magellanicus*	32	69 644	79 718	73 112	63 370	73 454	78 440	74 330
Chilean grenadier	*Caelorinchus chilensis*	32	11	2	33	62	63	65	156
Grenadiers, rattails nei	*Macrouridae*	32	525	-	-	-	-	-	-
Sea catfishes nei	*Ariidae*	33	173	581	3 157	4 184	2 654	3 096	406
Snake eels nei	*Ophichthidae*	33	188	201	71	50	74	60	38
Pacific cornetfish	*Fistularia corneta*	33	...	...	12 260	364	2 497	6 396	6 443
Mullets nei	*Mugilidae*	33	12 248	7 039	4 258	10 631	16 252	18 673	10 821
Snooks(=Robalos) nei	*Centropomus spp*	33	44	6	12	30	23	25	98
Broomtail grouper	*Mycteroperca xenarcha*	33	55	54	70	85	100	120	14
Spotted grouper	*Epinephelus analogus*	33	43	2	34	65	95	131	143
Groupers nei	*Epinephelus spp*	33	68	80	67	51	68	57	7
Peruvian rock seabass	*Paralabrax humeralis*	33	1 270	857	712	1 318	1 499	2 481	1 020
Groupers, seabasses nei	*Serranidae*	33	95	145	189	557	303	4	5
Yellow snapper	*Lutjanus argentiventris*	33	51	41	35	30	25	15	20
Snappers nei	*Lutjanus spp*	33	299	141	286	451	538	659	785
Cabinza grunt	*Isacia conceptionis*	33	6 812	3 622	2 194	2 622	3 468	4 800	4 180
Grunts, sweetlips nei	*Haemulidae(=Pomadasyidae)*	33	521	474	348	994	120	1 376	575
Peruvian weakfish	*Cynoscion analis*	33	2 673	3 011	1 093	2 093	2 065	2 712	4 326
Croakers nei	*Micropogonias spp*	33	1 147	846	1 875	2 509	602	676	386
Peruvian banded croaker	*Paralonchurus peruanus*	33	2 395	854	880	1 353	1 234	1 091	2 159
Corvina drum	*Cilus gilberti*	33	5 652	6 773	4 744	7 104	10 142	10 393	10 571
Croakers, drums nei	*Sciaenidae*	33	2 731	2 657	1 596	1 350	1 256	1 488	1 326
Porgies, seabreams nei	*Sparidae*	33	-	-	-	-	-	9	-
Mojarras, etc. nei	*Gerreidae*	33	40	...	35	30	25	22	31
Sea chubs nei	*Kyphosidae*	33	70	89	43	43	38	34	28
...A	*Aplodactylus punctatus*	33	13	6	8	12	22	32	13
Threadfins, tasselfishes nei	*Polynemidae*	33	3	8	7	7	6	5	6
Patagonian blennie	*Eleginops maclovinus*	33	312	150	148	124	139	205	151
Pacific sandperch	*Prolatilus jugularis*	33	62	40	27	35	55	60	32
Chilean sandperch	*Pinguipes chilensis*	33	34	56	27	25	51	76	37
Pacific spadefish	*Chaetodipterus zonatus*	33	...	...	42	29	16	...	...
Mote sculpin	*Normanichthys crockeri*	33	70 465	110 383	319 476	20 302	67 409	170 025	32 291
Filefishes, leatherjackets nei	*Monacanthidae*	33	4 995	246	18	-	44	-	-
Pink cusk-eel	*Genypterus blacodes*	34	5 801	3 870	5 225	4 585	3 346	3 690	3 253
Red cusk-eel	*Genypterus chilensis*	34	548	389	377	395	619	654	467
Black cusk-eel	*Genypterus maculatus*	34	1 469	867	514	259	294	309	196
Cusk-eels nei	*Genypterus spp*	34	563	1 037	813	424	398	444	232
Cusk-eels, brotulas nei	*Ophidiidae*	34	383	328	166	609	374	...	...
Alfonsinos nei	*Beryx spp*	34	3 089	3 053	2 478	3 156	4 119	1 109	948
Orange roughy	*Hoplostethus atlanticus*	34	2 176	1 289	459	337	1	-	-
Boarfishes nei	*Caproidae*	34	-	-	-	28	-	-	-
Hapuku wreckfish	*Polyprion oxygeneios*	34	16	2	0	0	3	1	1
Tilefishes nei	*Branchiostegidae*	34	53	...	88	103	139	...	...
Pacific tripletail	*Lobotes pacificus*	34	...	...	4	21	25	...	...
Peruvian morwong	*Cheilodactylus variegatus*	34	494	433	365	964	380	457	322
Patagonian toothfish	*Dissostichus eleginoides*	34	4 864	5 251	4 469	4 383	4 752	4 851	4 946
Cardinal fishes nei	*Epigonus spp*	34	2 070	2 229	1 536	801	351	184	93
Snoek	*Thyrsites atun*	34	734	1 236	673	1 025	838	1 348	2 156
Escolar	*Lepidocybium flavobrunneum*	34	-	7	-	-	-	-	7
Oilfish	*Ruvettus pretiosus*	34	-	-	-	8	-	-	-
Snake mackerels, escolars nei	*Gempylidae*	34	770	448	1 826	1 884	822	193	661
Hairtails, scabbardfishes nei	*Trichiuridae*	34	1 000	500	464	514	...	3 501	2 464
Warehou nei	*Seriolella spp*	34	6 012	3 819	3 382	3 969	4 018	5 071	3 917
Scorpionfishes nei	*Scorpaenidae*	34	303	242	229	256	149	295	271
Gurnards, searobins nei	*Triglidae*	34	400	100	1	2 738	1 586	1 796	404
Demersal percomorphs nei	*Perciformes*	34	70	...	...	...	...	...	...
South American pilchard	*Sardinops sagax*	35	6 898	4 507	1 268	1 035	400	205	105
Red-eye round herring	*Etrumeus teres*	35	4 901	4 629	433	520	2 632	1 154	1 903
Pacific thread herring	*Opisthonema libertate*	35	8 590	8 282	16 851	14 153	25 263	22 527	29 522
Falkland sprat	*Sprattus fuegensis*	35	-	-	39 545	50 705	45 089	52 602	20 173
Pacific menhaden	*Ethmidium maculatum*	35	24 843	20 850	27 932	24 534	30 244	36 006	15 477
Araucanian herring	*Strangomera bentincki*	35	356 090	289 534	440 109	281 382	795 139	855 262	750 750
Anchoveta(=Peruvian anchovy)	*Engraulis ringens*	35	10 679 338	10 244 166	7 007 157	7 611 858	7 419 295	6 910 467	4 205 979
Pacific anchoveta	*Cetengraulis mysticetus*	35	26 231	14 753	28 712	22 223	49 069	13 290	8 910
Longnose anchovy	*Anchoa nasus*	35	4 080	308	26 965	36 847	35 116	26 168	60 727
Striped bonito	*Sarda orientalis*	36	...	...	49	13	437	11	10
Eastern Pacific bonito	*Sarda chiliensis*	36	1 496	3 104	13 629	9 714	42 914	30 684	13 152
Wahoo	*Acanthocybium solandri*	36	...	...	99	211	95	115	1
Pacific sierra	*Scomberomorus sierra*	36	423	317	1 279	796	1 072	1 298	1 275
Frigate and bullet tunas	*Auxis thazard, A. rochei*	36	19 710	6 544	13 023	21 829	19 338	34 956	37 670
Black skipjack	*Euthynnus lineatus*	36	126	269	80	226	297	259	837
Skipjack tuna	*Katsuwonus pelamis*	36	124 149	180 899	206 939	134 535	231 184	176 990	107 972
Pacific bluefin tuna	*Thunnus orientalis*	36	-	0	0	-	-	-	-
Albacore	*Thunnus alalunga*	36	3 549	3 245	2 440	1 347	1 066	1 845	1 354
Southern bluefin tuna	*Thunnus maccoyii*	36	-	1	-	-	-	-	-
Yellowfin tuna	*Thunnus albacares*	36	128 714	108 675	68 418	62 698	71 803	77 430	67 732
Bigeye tuna	*Thunnus obesus*	36	39 556	37 678	47 237	36 830	52 149	38 152	25 304
Indo-Pacific sailfish	*Istiophorus platypterus*	36	15	13	244	369	262	86	22
Blue marlin	*Makaira nigricans*	36	189	150	425	1 327	1 263	661	109

C-87 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Southeast
Pacifique, sud-est
Pacífico, sudoriental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Black marlin	*Makaira indica*	36	...	7	522	861	220	67	7
Striped marlin	*Tetrapturus audax*	36	422	298	764	812	489	437	275
Marlins,sailfishes,etc. nei	*Istiophoridae*	36	1 952	1 188	781	303	279	244	1 745
Swordfish	*Xiphias gladius*	36	10 434	8 155	7 431	6 968	6 548	14 858	9 651
Tuna-like fishes nei	*Scombroidei*	36	23 465	24 760	10 720	11 732	6 837	3 647	3 274
Atlantic saury	*Scomberesox saurus*	37	1 490	756	633	558	1 093	5 979	7 013
Flyingfishes nei	*Exocoetidae*	37	550	85	146	331	295	987	2 676
Chilean silverside	*Odontesthes regia*	37	1 212	706	1 370	1 421	1 411	1 429	397
Silversides(=Sand smelts) nei	*Atherinidae*	37	10 992	9 964	10 464	14 867	9 946	12 618	7 406
Chilean jack mackerel	*Trachurus murphyi*	37	1 936 200	1 754 995	1 992 783	1 992 410	1 468 293	1 287 178	728 301
Shortfin scad	*Decapterus macrosoma*	37	...	...	5 168	9 240	28 782	50 719	21 097
Jacks, crevalles nei	*Caranx spp*	37	229	58	70	90	105	119	350
Peruvian moonfish	*Selene peruviana*	37	...	...	5 287	6 289	3 915	3 923	676
Pompanos nei	*Trachinotus spp*	37	1 509	157	931	159	97	177	202
Amberjacks nei	*Seriola spp*	37	31 526	37 082	33 805	35 433	49 627	57 355	53 572
Pacific bumper	*Chloroscombrus orqueta*	37	4 000	5 000	6 958	9 178	7 067	12 825	585
Carangids nei	*Carangidae*	37	365	383	487	818	1 498	1 174	3 955
Southern rays bream	*Brama australis*	37	3 795	12 761	2 642	3 896	6 210	15 442	17 409
Common dolphinfish	*Coryphaena hippurus*	37	5 432	2 684	4 155	4 212	13 741	7 160	7 130
Chub mackerel	*Scomber japonicus*	37	695 115	450 876	512 410	421 732	264 840	317 409	170 425
Butterfishes, pomfrets nei	*Stromateidae*	37	1 653	5 261	10 971	3 062	4 950	15 958	4 835
Mexican barracuda	*Sphyraena ensis*	37	...	...	29	44	451	44	...
Thresher	*Alopias vulpinus*	38	2	-	3	-	-	-	-
Pelagic thresher	*Alopias pelagicus*	38	...	...	280	2 556	4 583	...	...
Bigeye thresher	*Alopias superciliosus*	38	...	...	7	95	105	2	...
Thresher sharks nei	*Alopias spp*	38	487	675	893	304	-	1 766	3 358
Shortfin mako	*Isurus oxyrinchus*	38	556	553	579	614	319	458	572
Porbeagle	*Lamna nasus*	38	57	26	2	18	47	-	-
Blue shark	*Prionace glauca*	38	2 060	1 530	2 045	1 861	1 512	1 442	2 394
Oceanic whitetip shark	*Carcharhinus longimanus*	38	-	-	-	-	-	7	2
Silky shark	*Carcharhinus falciformis*	38	...	...	...	373	500	...	...
Requiem sharks nei	*Carcharhinidae*	38	430	290	129	32	26	573	1 780
Smooth hammerhead	*Sphyrna zygaena*	38	...	...	11	130	271	...	...
Scalloped hammerhead	*Sphyrna lewini*	38	...	...	11	52	26	...	...
Hammerhead sharks, etc. nei	*Sphyrnidae*	38	149	98	108	47	30	96	304
Brown smooth-hound	*Mustelus henlei*	38	...	...	...	...	8	2	3
Smooth-hounds nei	*Mustelus spp*	38	4 294	5 598	2 334	3 652	3 858	4 849	5 331
Picked dogfish	*Squalus acanthias*	38	-	-	-	-	-	0	99
Pacific angelshark	*Squatina californica*	38	268	168	40	68	84	61	45
Pacific guitarfish	*Rhinobatos planiceps*	38	28	184	173	112	114	79	47
Longtail stingray	*Dasyatis longa*	38	...	...	39	135	45	...	...
Giant manta	*Manta birostris*	38	...	...	...	5	10	...	...
California butterfly ray	*Gymnura marmorata*	38	...	...	20	20	35	...	...
Rays, stingrays, mantas nei	*Rajiformes*	38	4 254	3 683	4 671	4 025	3 009	3 591	3 243
Plownose chimaera	*Callorhinchus callorynchus*	38	1 297	672	386	650	966	1 023	561
Sharks, rays, skates, etc. nei	*Elasmobranchii*	38	5 493	4 853	6 094	3 040	2 250	6 258	4 613
Marine fishes nei	*Osteichthyes*	39	96 698	119 775	52 245	64 999	48 974	62 889	42 968
Mangrove ghost crab	*Ucides occidentalis*	42	517	438	...	...	...	608	1 978
Mola rock crab	*Cancer edwardsi*	42	5 331	4 562	5 109	4 150	5 449	4 222	4 279
Giant stone crab	*Homalaspis plana*	42	95	118	134	186	312	301	195
Marine crabs nei	*Brachyura*	42	3 381	2 970	2 105	2 687	2 866	3 409	2 431
Green spiny lobster	*Panulirus gracilis*	43	12	181	46	3	1	2	3
Juan Fernandez rock lobster	*Jasus frontalis*	43	47	54	45	50	57	58	72
Carrot squat lobster	*Pleuroncodes monodon*	44	809	1 085	1 031	1 545	1 336	3 327	2 786
Blue squat lobster	*Cervimunida johni*	44	1 929	3 002	4 188	4 197	5 552	5 391	5 128
Craylets, squat lobsters	*Galatheidae*	44	509	140	2	12	139	306	1 417
Southern king crab	*Lithodes santolla*	44	3 062	3 243	4 094	2 865	3 241	3 022	3 441
Softshell red crab	*Paralomis granulosa*	44	3 632	5 731	2 275	1 773	2 078	2 145	1 952
King crabs, stone crabs nei	*Lithodidae*	44	10	2	-	1	-	-	-
Yellowleg shrimp	*Penaeus californiensis*	45	372	714	793	274	241	...	360
Blue shrimp	*Penaeus stylirostris*	45	188	253	134	5	...	...	...
Whiteleg shrimp	*Penaeus vannamei*	45	1 171	982	880	21	32	...	...
Crystal shrimp	*Penaeus brevirostris*	45	261	286	648	72	98	...	...
Western white shrimp	*Penaeus occidentalis*	45	356	537	526	560	671	789	852
Penaeus shrimps nei	*Penaeus spp*	45	6 578	9 883	12 032	14 496	15 562	17 519	20 535
Titi shrimp	*Protrachypene precipua*	45	...	...	...	4 645	6 094	7 012	7 064
Pacific seabob	*Xiphopenaeus riveti*	45	511	413	730	1 050	1 350	1 683	1 590
Chilean nylon shrimp	*Heterocarpus reedi*	45	3 663	3 880	4 475	4 481	4 556	4 640	4 795
Kolibri shrimp	*Solenocera agassizii*	45	208	339	300	260	220	189	94
Chilean knife shrimp	*Haliporoides diomedeae*	45	292	252	189	214	157	94	86
Natantian decapods nei	*Natantia*	45	910	7	5	3	1	...	...
Giant barnacle	*Austromegabalanus psittacus*	47	278	290	184	158	176	312	96
Marine crustaceans nei	*Crustacea*	47	539	314	2 469	4 160	180	165	338
False abalone	*Concholepas concholepas*	52	6 507	6 799	6 261	5 474	5 967	3 915	5 246
Gastropods nei	*Gastropoda*	52	18 601	8 465	6 740	6 702	7 420	6 497	5 525
Chilean flat oyster	*Ostrea chilensis*	53	13	6	8	4	3	20	14
Chilean mussel	*Mytilus chilensis*	54	1 046	335	217	8 048	476	293	354
Choro mussel	*Choromytilus chorus*	54	142	47	66	67	152	212	559
Cholga mussel	*Aulacomya ater*	54	11 646	10 684	8 391	12 054	12 861	11 979	12 660
Peruvian calico scallop	*Argopecten purpuratus*	55	15 596	15 228	18 763	24 768	19 618	26 667	62 827

C-87 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Southeast
Pacifique, sud-est
Pacífico, sudoriental

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Scallops nei	*Pectinidae*	55	27	229	-	35	6	687	502
Anadara clams nei	*Anadara spp*	56	522	215	...	...	370	371	336
Gay's little venus	*Tawera gayi*	56	2 910	2 925	6 342	6 644	3 251	7 725	9 608
Taca clam	*Protothaca thaca*	56	18 914	14 113	13 868	9 400	15 725	15 739	21 591
Taquilla clams	*Mulinia spp*	56	4 329	6 971	5 307	7 870	3 843	2 650	3 290
Macha clam	*Mesodesma donacium*	56	1 927	1 530	2 593	2 882	2 108	2 937	4 056
Chilean semele	*Semele solida*	56	3 046	2 640	1 685	1 853	1 143	689	1 752
Clams, etc. nei	*Bivalvia*	56	18 538	12 800	16 121	15 743	12 295	8 476	11 615
Patagonian squid	*Loligo gahi*	57	12 481	10 205	9 093	14 769	4 654	13 178	4 798
Jumbo flying squid	*Dosidicus gigas*	57	747 526	726 241	805 724	630 873	810 892	584 953	773 075
Various squids nei	*Loliginidae, Ommastrephidae*	57	853	1 903	152	281	487	269	219
Octopuses, etc. nei	*Octopodidae*	57	3 578	3 666	4 603	3 035	5 704	3 899	4 441
Marine molluscs nei	*Mollusca*	58	2 955	5 967	3 305	4 839	5 499	2 527	3 513
Marine turtles nei	*Testudinata*	72	1	2	1	1	...	...	...
Red sea squirt	*Pyura chilensis*	74	1 083	1 184	1 233	1 202	1 026	1 251	877
Echinoderms	*Echinodermata*	76	1 388	3 033	281	1 932	2 438	1 866	1 314
Chilean sea urchin	*Loxechinus albus*	76	49 228	37 566	34 826	38 526	38 922	37 866	32 060
Sea cucumbers nei	*Holothuroidea*	76	249	168	33	272	145	658	109
Total			***15 618 861***	***14 675 496***	***12 197 381***	***12 044 446***	***12 117 471***	***11 437 296***	***7 786 834***

C-87 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Pacific, Southeast
Pacifique, sud-est
Pacífico, sudoriental

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Belize	1 902	588	561	2 349	2 300	782	13 972	16 349	5 976	2 261
Chile	3 787 346	4 260 222	3 601 201	4 914 396	4 326 810	4 156 137	3 813 663	3 552 256	3 453 269	2 679 380
China	37 860	126 744	175 690	337 047	230 539	222 305	190 639	222 436	188 182	205 916
China,Taiwan	882	13 060	24 196	42 680	18 315	20 743	15 829	31 345	12 802	30 226
Colombia	99 644	56 319	85 197	75 416	93 478	81 156 F	92 727 F	82 362 F	70 172	45 013
Cook Is	-	-	-	-	-	-	20	-	-	-
Ecuador	568 305	304 004	371 227	319 548	414 697	398 509	353 197	437 772	437 964	332 768
Faroe Is	-	-	-	-	-	-	38 700	22 919	20 213	11 745
Germany	-	-	-	-	-	-	47 047	50 581	33 526	13 246
Ghana	6 332	-	-	-	-	-	-	-	-	-
Guatemala	10 730	...	...	1 048	1 381	1 259	2 430	5 263	7 800	5 179
Honduras	6 304	...	...	5 842	10 229	10 260	6 227	5 746	3 927	1 986
Japan	88 975	77 566 F	36 001	57 843	42 545	44 422	21 871	22 364	35 158	22 877
Korea Rep	10 097	22 346	6 981	20 595	12 175	14 823	12 898	24 326	23 140	23 254
Lithuania	-	-	-	-	-	-	35 889	24 053	21 279	10 295
Mexico	8 020	3 345	2 344	7 151	3 821	792	...	...	...	...
Netherlands	-	-	-	-	6 187	33 766	45 363	39 192	39 401	11 345
Nicaragua	2 619	...	-	90	1 232	6 034	3 466	6 940	6 687	3 700
Panama	11 227	7 707	15 209	28 149	36 108	42 723	27 551	56 297	44 861	25 889
Peru	7 950 450	8 735 221	6 053 120	9 566 839	9 348 292	6 980 025	7 167 911	7 349 126	6 868 732	4 216 723
Poland	-	-	-	-	-	-	-	-	21 922	33 796
Portugal	-	-	-	-	-	-	794	-	-	324
Russian Fed	-	-	137	-	-	-	-	2 323	399	-
Spain	26 817	26 662	16 488	17 076	12 922	10 907	3 514	5 808	13 706	6 172
USA	18	2 215	4 044	3 876	3 648	1 727	1 128	5 276	2 363	...
Uruguay	-	-	-	537	692	-	-	-	-	-
Vanuatu	15 501	11 400	71 647	106 510	84 717	139 346	123 074	117 459	90 775	51 167
Venezuela	50 414	25 862	35 629	31 512	17 988	31 155	26 028	37 277	25 575	11 377
Other nei	12 512	41 067	54 807	80 357	7 420	510	508	1	9 467	42 195
Total	***12 695 955***	***13 714 328***	***10 554 479***	***15 618 861***	***14 675 496***	***12 197 381***	***12 044 446***	***12 117 471***	***11 437 296***	***7 786 834***

C-88 (a)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by species items
Captures par catégories d'espèces
Capturas por categorías de especies

Pacific, Antarctic
Pacifique, Antarctique
Pacífico, Antártico

English name Nom anglais Nombre inglés	Scientific name Nom scientifique Nombre científico	Species group Groupe d'espèces Grupo de especies	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Smalleye moray cod	*Muraenolepis microps*	32	3	1	0	0	0	0	1
Moray cods nei	*Muraenolepis spp*	32	9	6	5	21	7	9	7
Blue antimora	*Antimora rostrata*	32	16	12	3	10	3	8	7
Moras nei	*Moridae*	32	0	-	-	-	-	-	-
Whitson's grenadier	*Macrourus whitsoni*	32	179	198	81	68	73	73	80
Ridge scaled rattail	*Macrourus carinatus*	32	0	-	-	-	-	-	-
Grenadiers nei	*Macrourus spp*	32	219	216	102	139	56	167	84
Porgies	*Calamus spp*	33	-	-	-	-	0	-	-
Grey rockcod	*Notothenia squamifrons*	33	0	-	-	0	-	-	-
Striped-eyed rockcod	*Notothenia kempi*	33	0	-	-	-	-	-	-
Antarctic silverfish	*Pleuragramma antarcticum*	33	-	-	-	-	1	-	-
Antarctic rockcods, noties nei	*Nototheniidae*	33	0	0	0	0	1	0	0
Plunderfish	*Pogonophryne permitini*	34	0	0	0	0	0	0	0
Antarctic toothfish	*Dissostichus mawsoni*	34	2 558	3 510	3 481	3 425	2 665	2 917	2 948
Patagonian toothfish	*Dissostichus eleginoides*	34	12	7	1	12	8	16	0
...A	*Chionobathyscus dewitti*	34	0	-	-	1	0	0	3
Blackfin icefish	*Chaenocephalus aceratus*	34	0	-	-	-	-	0	-
...A	*Chionodraco hamatus*	34	0	-	-	-	-	-	-
Myers' icefish	*Chionodraco myersi*	34	0	-	-	-	-	-	-
Crocodile icefishes nei	*Channichthyidae*	34	5	2	5	19	7	9	11
Southern opah	*Lampris immaculatus*	37	0	-	-	-	-	-	-
Antarctic starry skate	*Raja georgiana*	38	13	35	1	11	4	5	5
Eaton's skate	*Bathyraja eatonii*	38	1	0	0	0	-	2	1
McCain's skate	*Bathyraja maccaini*	38	0	-	-	0	0	0	...
Murray's skate	*Bathyraja murrayi*	38	0	-	-	-	-	-	-
Kerguelen sandpaper skate	*Bathyraja irrasa*	38	2	-	-	-	-	-	-
Bathyraja rays nei	*Bathyraja spp*	38	-	3	0	0	-	-	-
Rays and skates nei	*Rajidae*	38	-	1	0	26	-	-	-
Rays, stingrays, mantas nei	*Rajiformes*	38	10	22	3	1	0	0	1
Marine fishes nei	*Osteichthyes*	39	2	0	0	1	-	-	-
Subantarctic stone crab	*Lithodes murrayi*	44	0	-	-	-	0	-	-
King crabs, stone crabs nei	*Lithodidae*	44	0	0	0	0	0	0	0
Octopuses, etc. nei	*Octopodidae*	57	0	0	0	0	0	0	0
Sea squirts nei	*Ascidiacea*	74	0	-	-	-	-	-	-
Starfishes nei	*Asteroidea*	76	0	0	0	1	1	1	0
Sea cucumbers nei	*Holothuroidea*	76	0	-	-	-	-	-	-
Aquatic invertebrates nei	*Invertebrata*	77	0	2	0	0	-	-	-
Total			***3 029***	***4 015***	***3 682***	***3 735***	***2 826***	***3 207***	***3 148***

Data in this table refer to catches for which the new fishing season (1 December - 30 November) of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has been adopted. Data are shown under the calendar year in which the split-year ends.

Les données dans ce tableau se réfèrent aux captures pour lesquelles on utilise la nouvelle période de pêche (1er décembre - 30 novembre) de la Commission pour la conservation de la faune et la flore marines de l'Antarctique (CCAMLR). Les données figurent sous l'année civile durant laquelle se termine l'année fractionnée.

Los datos en este cuadro se refieren a las capturas para las que se utiliza el nuevo período de pesca (1 de diciembre - 30 de noviembre) de la Comisión para la Conservación de los Recursos Vivos Marinos Antárticos (CCRVMA). Los datos se incluyen en el año civil en que termina el año emergente.

C-88 (b)

Fish, crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas
Captures par pays ou zones
Capturas por países o áreas

Pacific, Antarctic
Pacifique, Antarctique
Pacífico, Antártico

Country or area Pays ou zone País o área	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Argentina	-	-	-	253	284	263	261	0	-	42
Chile	-	-	-	-	-	-	-	-	143	...
Korea Rep	-	-	-	109	-	-	476	430	677	796
New Zealand	678	1 560	1 189	1 316	1 976	1 484	1 224	1 138	916	1 401
Norway	-	-	-	182	293	385	328	-	-	-
Russian Fed	-	-	712	264	674	715	607	288	-	-
South Africa	32	-	150	125	-	-	52	123	147	-
Spain	-	-	-	127	-	-	-	46	387	371
Ukraine	-	-	-	168	-	-	-	-	-	-
UK	-	-	-	32	325	407	516	718	830	538
USA	-	-	-	234	-	-	-	-	-	-
Uruguay	23	-	-	219	463	428	271	83	107	-
Total	***733***	***1 560***	***2 051***	***3 029***	***4 015***	***3 682***	***3 735***	***2 826***	***3 207***	***3 148***

Data in this table refer to catches for which the new fishing season (1 December - 30 November) of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has been adopted. Data are shown under the calendar year in which the split-year ends.

Les données dans ce tableau se réfèrent aux captures pour lesquelles on utilise la nouvelle période de pêche (1er décembre - 30 novembre) de la Commission pour la conservation de la faune et la flore marines de l'Antarctique (CCAMLR). Les données figurent sous l'année civile durant laquelle se termine l'année fractionnée.

Los datos en este cuadro se refieren a las capturas para las que se utiliza el nuevo período de pesca (1 de diciembre - 30 de noviembre) de la Comisión para la Conservación de los Recursos Vivos Marinos Antárticos (CCRVMA). Los datos se incluyen en el año civil en que termina el año emergente.

D - Capture production: by countries or areas

D - Captures: par pays ou zones

D - Capturas: por países o áreas

D-1

Fish crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas and fishing areas
Captures par pays ou zones et zones de pêche
Capturas por países o áreas y áreas de pesca

Africa
Afrique
África

	Fishing area Zone de pêche Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Algeria	01	0	0	0	0	0	0	0	...	...	...
	37	133 623	134 320	140 957	113 462	126 259	145 762	147 362	138 861	127 513	93 607
	Country total	*133 623*	*134 320*	*140 957*	*113 462*	*126 259*	*145 762*	*147 362*	*138 861*	*127 513*	*93 607*
Angola	01	8 000 F	9 000 F	10 000	10 000 F	10 000 F	10 500	9 000 F	7 500 F	5 848	10 000 F
	34	-	470	494	-	-	292	-	-	-	-
	47	246 553	245 973	201 539	230 002	192 616	214 949	297 436	298 262	266 415	250 000 F
	Country total	*254 553*	*255 443*	*212 033*	*240 002*	*202 616*	*225 741*	*306 436*	*305 762*	*272 263*	*260 000 F*
Benin	01	30 000	29 993	30 000 F	28 200	21 900	29 500	30 200	30 200 F	30 250	30 350
	34	8 415	10 670	11 648	11 788	9 597	12 007	6 186	7 295	8 678	9 441
	Country total	*38 415*	*40 663*	*41 648*	*39 988*	*31 497*	*41 507*	*36 386*	*37 495 F*	*38 928*	*39 791*
Botswana	01	118	139	122	161	132	81	122	86	73 F	60
	Country total	*118*	*139*	*122*	*161*	*132*	*81*	*122*	*86*	*73 F*	*60*
Br Ind Oc Tr	51	0	28	28	28	28	21	24	34	43	40
	Country total	*0*	*28*	*28*	*28*	*28*	*21*	*24*	*34*	*43*	*40*
Burkina Faso	01	8 500	8 500	9 000	9 000 F	9 000	9 500	10 200	11 093	11 800	14 520
	Country total	*8 500*	*8 500*	*9 000*	*9 000 F*	*9 000*	*9 500*	*10 200*	*11 093*	*11 800*	*14 520*
Burundi	01	8 964	11 000 F	14 697	13 855	14 800 F	15 750 F	16 700 F	17 766	17 700 F	17 700 F
	Country total	*8 964*	*11 000 F*	*14 697*	*13 855*	*14 800 F*	*15 750 F*	*16 700 F*	*17 766*	*17 700 F*	*17 700 F*
Cameroon	01	52 500 F	65 000	55 000	65 000 F	75 000	75 000	74 380	74 700 F	75 000	75 000 F
	34	68 531	65 135	62 801	64 000 F	67 345	62 232	64 232	64 500 F	65 000 F	65 000 F
	Country total	*121 031*	*130 135*	*117 801*	*129 000 F*	*142 345*	*137 232*	*138 612*	*139 200 F*	*140 000 F*	*140 000 F*
Cape Verde	01	0	0	-	-	-	-	-	-	-	-
	34	8 676	8 145	8 103	10 396	21 617	24 590	18 328	23 768	16 828	19 500 F
	Country total	*8 676*	*8 145*	*8 103*	*10 396*	*21 617*	*24 590*	*18 328*	*23 768*	*16 828*	*19 500 F*
Cent Afr Rep	01	17 000 F	19 000 F	21 000 F	23 000 F	25 000 F	27 000 F	29 000 F	31 000 F	33 000 F	35 000 F
	Country total	*17 000 F*	*19 000 F*	*21 000 F*	*23 000 F*	*25 000 F*	*27 000 F*	*29 000 F*	*31 000 F*	*33 000 F*	*35 000 F*
Chad	01	75 000 F	70 000 F	65 000 F	60 000 F	55 000 F	50 000 F	45 000 F	40 000 F	40 000 F	40 000 F
	Country total	*75 000 F*	*70 000 F*	*65 000 F*	*60 000 F*	*55 000 F*	*50 000 F*	*45 000 F*	*40 000 F*	*40 000 F*	*40 000 F*
Comoros	01	0	0	-	-	-	-	-	-	-	-
	34	-	-	-	-	-	-	3 676	9 539	...	31 811
	51	12 180	13 102	14 115	14 935	15 070	15 070 F	16 000	20 450 F	20 450 F	20 450 F
	Country total	*12 180*	*13 102*	*14 115*	*14 935*	*15 070*	*15 070 F*	*19 676*	*29 989 F*	*20 450 F*	*52 261 F*
Congo Dem R	01	227 433 F	233 800 F	230 365 F	231 772 F	230 840 F	230 588 F	230 000 F	230 000 F	230 000 F	230 000 F
	34	5 000 F	5 200 F	5 400 F	5 600 F	5 800 F	6 000	6 000	6 000 F	6 000 F	6 000 F
	Country total	*232 433*	*239 000*	*235 765*	*237 372*	*236 640*	*236 588*	*236 000*	*236 000 F*	*236 000 F*	*236 000 F*
Congo Rep	01	26 101	29 494	31 182	30 338	32 500	31 000	30 120	29 362	28 385	30 500
	34	22 729	22 433	22 683	26 686	22 116	28 082	29 096	24 742	32 833	34 686
	Country total	*48 830*	*51 927*	*53 865*	*57 024*	*54 616*	*59 082*	*59 216*	*54 104*	*61 218*	*65 186*
Côte dIvoire	01	10 502	22 000	22 000	4 856	13 145	6 565	3 178	4 400 F	5 679	7 063
	34	65 503	47 870	46 903	49 545	29 520	48 265	44 111	45 600 F	38 519	64 749
	Country total	*76 005*	*69 870*	*68 903*	*54 401*	*42 665*	*54 830*	*47 289*	*50 000 F*	*44 198*	*71 812*
Djibouti	01	0	0	0	-	-	-	-	-	-	-
	51	900	1 000	1 100 F	1 200 F	1 571	1 299	1 229	1 206	1 058	1 058 F
	Country total	*900*	*1 000*	*1 100 F*	*1 200 F*	*1 571*	*1 299*	*1 229*	*1 206*	*1 058*	*1 058 F*
Egypt	01	295 450	292 662	313 742	282 099	242 100	256 288	241 743	237 572	259 577	263 847
	37	59 624	59 619	46 973	47 481	56 721	72 666	83 762	88 882	78 790	77 388
	51	73 559	72 881	70 408	63 914	50 732	46 940	46 986	47 361	49 031	43 974
	Country total	*428 633*	*425 162*	*431 123*	*393 494*	*349 553*	*375 894*	*372 491*	*373 815*	*387 398*	*385 209*
Eq Guinea	01	1 000 F	950 F	900 F	850 F	850 F	900 F	900 F	900 F	1 000	1 000 F
	34	2 600 F	2 600 F	2 650 F	2 650 F	2 900 F	3 100 F	3 633 F	4 500 F	6 669	6 376 F
	Country total	*3 600 F*	*3 550 F*	*3 550 F*	*3 500 F*	*3 750 F*	*4 000 F*	*4 533 F*	*5 400 F*	*7 669*	*7 376 F*
Eritrea	01	0	-	-	-	-	-	-	-	-	-
	51	8 820	7 832	6 689	7 404	4 027	8 813	1 932	1 665	3 030	3 286
	Country total	*8 820*	*7 832*	*6 689*	*7 404*	*4 027*	*8 813*	*1 932*	*1 665*	*3 030*	*3 286*
Ethiopia	01	15 390	12 300	9 213	10 005	9 450	9 890	13 253	16 770	17 047	18 058
	Country total	*15 390*	*12 300*	*9 213*	*10 005*	*9 450*	*9 890*	*13 253*	*16 770*	*17 047*	*18 058*
Fr South Tr	01	0	0	0	-	-	-	-	-	-	-
	51	263 F	414 F	463 F	263 F	263 F	472 F	472 F	470 F	470 F	470 F
	Country total	*263 F*	*414 F*	*463 F*	*263 F*	*263 F*	*472 F*	*472 F*	*470 F*	*470 F*	*470 F*
Gabon	01	9 850	9 400	9 507	8 293	9 700	9 359	9 500 F	10 000 F	10 000 F	10 000 F
	34	33 021	32 170	35 972	37 779	34 163	32 162	29 000 F	32 500 F	22 000 F	22 000 F
	Country total	*42 871*	*41 570*	*45 479*	*46 072*	*43 863*	*41 521*	*38 500 F*	*42 500 F*	*32 000 F*	*32 000 F*
Gambia	01	2 500 F	2 500 F	3 000 F	3 500 F	4 000 F	4 500 F	4 865	4 166	4 461	4 454 F
	34	32 027	43 269	34 364	28 923	30 586	32 412	38 709	38 479	41 420	41 970
	Country total	*34 527*	*45 769*	*37 364*	*32 423*	*34 586*	*36 912*	*43 574*	*42 645*	*45 881*	*46 424*
Ghana	01	74 500	74 500	75 000	75 000 F	75 000	83 168	84 756	85 000	88 700 F	90 000 F

D-1 **Fish crustaceans, molluscs, etc** | **Poissons, crustacés, mollusques, etc** | **Peces, crustáceos, moluscos, etc**

Capture production by countries or areas and fishing areas | **Captures par pays ou zones et zones de pêche** | **Capturas por países o áreas y áreas de pesca**

Africa | **Afrique** | **África**

	Fishing area / Zone de pêche / Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	34	366 348	296 742	315 770	324 388	316 866	290 675	245 730	274 831	233 115	261 205
	41	-	-	-	-	-	1 244	-	-	-	-
	87	6 332	-	-	-	-	-	-	-	-	-
	Country total	*447 180*	*371 242*	*390 770*	*399 388*	*391 866*	*375 087*	*330 486*	*359 831*	*321 815*	*351 205*
Guinea	01	4 000	5 000 F	6 000 F	7 000 F	8 000 F	9 000 F	10 000 F	12 000 F	14 000 F	16 000 F
	34	101 227	87 358	114 845	88 550	98 566	92 581	70 823	81 240	81 000 F	93 000 F
	51	178	1 396	1 081	1 121	2 573	1 070	1 140	1 055	933	766
	57	...	-	-	1 060	-	160	111	220	194	83
	Country total	*105 405*	*93 754*	*121 926*	*97 731*	*109 139*	*102 811*	*82 074*	*94 515*	*96 127 F*	*109 849 F*
GuineaBissau	01	150 F	150 F	150 F	150 F	150 F	150 F	150 F	150 F	150 F	150 F
	34	6 698 F	7 174 F	6 003 F	6 500 F	6 833 F	6 917 F	6 350 F	6 654 F	6 650 F	6 650 F
	Country total	*6 848 F*	*7 324 F*	*6 153 F*	*6 650 F*	*6 983 F*	*7 067 F*	*6 500 F*	*6 804 F*	*6 800 F*	*6 800 F*
Kenya	01	156 763	137 792	113 221	119 093	140 199	151 729	124 327	127 097	128 036	134 847
	51	7 388	6 720	6 830	7 774	7 105	6 955	7 448	8 301	5 564	8 264
	Country total	*164 151*	*144 512*	*120 051*	*126 867*	*147 304*	*158 684*	*131 775*	*135 398*	*133 600*	*143 111*
Lesotho	01	24	40	42	45	45	45	48	50	45	45
	Country total	*24*	*40*	*42*	*45*	*45*	*45*	*48*	*50*	*45*	*45*
Liberia	01	4 000	4 000 F	3 600 F	3 200 F	2 800 F	2 400 F	1 743	763	750 F	750 F
	34	6 496	7 042	6 864	10 525	9 347	6 494	12 745	7 127	7 250 F	7 250 F
	Country total	*10 496*	*11 042*	*10 464*	*13 725*	*12 147*	*8 894*	*14 488*	*7 890*	*8 000 F*	*8 000 F*
Libya	01	0	0	0	-	-	-	-	-	-	-
	27	-	-	-	-	-	49	-	-	-	-
	34	239	666	666	-	-	4	-	-	-	-
	37	47 051 F	43 342 F	41 163 F	39 897	37 390 F	34 594 F	31 921	47 645	52 110	50 000 F
	Country total	*47 290 F*	*44 008 F*	*41 829 F*	*39 897*	*37 390 F*	*34 647 F*	*31 921*	*47 645*	*52 110*	*50 000 F*
Madagascar	01	30 000	30 000	30 000	31 500	32 650	32 750	32 630	32 630	32 828	35 500
	51	93 583	99 299	99 476	103 416	99 930	100 943	115 148	87 834	98 475	93 336
	57	-	-	-	-	68	-	-	-	-	-
	Country total	*123 583*	*129 299*	*129 476*	*134 916*	*132 648*	*133 693*	*147 778*	*120 464*	*131 303*	*128 836*
Malawi	01	40 619	41 329	53 543	56 463	59 595	72 787	66 500	70 019	69 325	98 299
	Country total	*40 619*	*41 329*	*53 543*	*56 463*	*59 595*	*72 787*	*66 500*	*70 019*	*69 325*	*98 299*
Mali	01	100 000 F	100 000 F	100 000 F	100 000 F	100 000 F	100 000 F	100 000	100 000 F	100 000 F	100 000
	Country total	*100 000 F*	*100 000 F*	*100 000 F*	*100 000 F*	*100 000 F*	*100 000 F*	*100 000*	*100 000 F*	*100 000 F*	*100 000*
Mauritania	01	10 000 F	12 000 F	12 000 F	12 000 F	13 000 F	15 000 F	15 000 F	15 000 F	15 000 F	15 000 F
	34	130 142 F	144 131 F	187 650 F	258 733	291 877	150 312	208 207	180 328	201 900	261 238
	Country total	*140 142 F*	*156 131 F*	*199 650 F*	*270 733*	*304 877*	*165 312*	*223 207*	*195 328*	*216 900*	*276 238*
Mauritius	01	0	0	-	-	-	-	-	-	-	-
	51	10 986	10 706	10 968	9 971	9 855	8 681	8 097	6 642	7 676	7 786
	Country total	*10 986*	*10 706*	*10 968*	*9 971*	*9 855*	*8 681*	*8 097*	*6 642*	*7 676*	*7 786*
Mayotte	51	10 052	4 754	3 464	2 306	2 194	5 772	11 661	12 677	15 006	20 842
	Country total	*10 052*	*4 754*	*3 464*	*2 306*	*2 194*	*5 772*	*11 661*	*12 677*	*15 006*	*20 842*
Morocco	01	1 660	2 112	1 655	850	2 930	3 350	4 020	4 440	6 020	7 226
	34	1 066 906	927 648	880 029	877 210	977 488	823 005	833 312	956 935	1 118 464	1 095 101
	37	27 517	31 856	36 959	40 091	45 977	50 523	42 137	35 752	40 578	33 913
	Country total	*1 096 083*	*961 616*	*918 643*	*918 151*	*1 026 395*	*876 878*	*879 469*	*997 127*	*1 165 062*	*1 136 240*
Mozambique	01	15 076 F	20 037 F	19 831 F	27 760 F	22 991 F	26 017 F	24 081	28 386	33 666	31 741
	51	21 340	20 515	79 451	71 829	71 004	75 883	68 189	91 260	114 383	118 893
	Country total	*36 416 F*	*40 552 F*	*99 282 F*	*99 589 F*	*93 995 F*	*101 900 F*	*92 270*	*119 646*	*148 049*	*150 634*
Namibia	01	2 000 F	2 000 F	2 500 F	2 500 F	2 800 F	2 800 F	2 800	2 800 F	2 800 F	2 800 F
	41	-	-	-	1 180	-	-	-	-	-	-
	47	545 997	623 100	635 299	567 519	551 195	506 770	410 417	369 798	367 548	367 200 F
	58	-	-	-	-	-	-	116	224	-	-
	Country total	*547 997*	*625 100*	*637 799*	*571 199*	*553 995*	*509 570*	*413 333*	*372 822*	*370 348*	*370 000 F*
Niger	01	20 800	23 560	55 860	51 466	50 018	29 835	29 728	29 960	29 884	29 884 F
	Country total	*20 800*	*23 560*	*55 860*	*51 466*	*50 018*	*29 835*	*29 728*	*29 960*	*29 884*	*29 884 F*
Nigeria	01	154 175	187 242	174 968	182 264	238 051	223 395	227 107	304 413	285 771	293 382
	34	297 971	293 814	300 194	282 987	285 131	328 928	303 313	296 955	312 439	323 599
	Country total	*452 146*	*481 056*	*475 162*	*465 251*	*523 182*	*552 323*	*530 420*	*601 368*	*598 210*	*616 981*
Réunion	01	0	2	2	2	1	2	1	0	0	0
	51	3 889	2 870	2 902	3 371	4 281	3 546	3 988	2 978	3 050	3 050 F
	Country total	*3 889*	*2 872*	*2 904*	*3 373*	*4 282*	*3 548*	*3 989*	*2 978*	*3 050*	*3 050 F*
Rwanda	01	6 828	7 000 F	7 400	7 826	7 800 F	8 400 F	9 050	9 050 F	9 050 F	9 050 F
	Country total	*6 828*	*7 000 F*	*7 400*	*7 826*	*7 800 F*	*8 400 F*	*9 050*	*9 050 F*	*9 050 F*	*9 050 F*
St Helena	47	867	598	985	1 061	1 130	1 120	837	794	856	864
	Country total	*867*	*598*	*985*	*1 061*	*1 130*	*1 120*	*837*	*794*	*856*	*864*
Sao Tome Prn	01	0	0	0	0	0	0	0	-	-	-
	34	3 692 F	3 820 F	4 038	4 141	4 196 F	4 150 F	4 250 F	4 500 F	4 550 F	4 650 F
	Country total	*3 692 F*	*3 820 F*	*4 038*	*4 141*	*4 196 F*	*4 150 F*	*4 250 F*	*4 500 F*	*4 550 F*	*4 650 F*

D-1 **Fish crustaceans, molluscs, etc** | **Capture production by countries or areas and fishing areas** | **Africa**
Poissons, crustacés, mollusques, etc | **Captures par pays ou zones et zones de pêche** | **Afrique**
Peces, crustáceos, moluscos, etc | **Capturas por países o áreas y áreas de pesca** | **África**

	Fishing area Zone de pêche Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Senegal	01	47 500 F	43 000 F	38 500 F	34 127	34 485	34 163	38 731	37 200	35 700 F	34 164 F
	34	380 617	354 328	428 032	400 374	365 500	331 599	374 104	388 653	406 595	375 414
	51	-	-	310	269	-	1 070	-	-	-	-
	57	-	-	0	0	135	160	-	-	-	-
	Country total	*428 117*	*397 328*	*466 842*	*434 770*	*400 120*	*366 992*	*412 835*	*425 853*	*442 295*	*409 578*
Seychelles	01	0	0	-	-	-	-	-	-	-	-
	41	3 800	-	30	-	-	-	-	-	-	-
	47	-	182	-	-	-	-	-	-	-	-
	51	49 423	62 778	85 288	100 048	108 525	92 451	64 802	67 498	79 221	85 606
	57	368	423	702	623	155	288	712	1 702	1 875	1 502
	Country total	*53 591*	*63 383*	*86 020*	*100 671*	*108 680*	*92 739*	*65 514*	*69 200*	*81 096*	*87 108*
Sierra Leone	01	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F	14 000 F
	34	61 210	68 990	82 926	120 440	131 993	134 146	130 535	189 582	186 000 F	185 822 F
	41	...	...	-	-	-	-	-	-	-	178
	Country total	*75 210*	*82 990*	*96 926*	*134 440*	*145 993*	*148 146*	*144 535*	*203 582*	*200 000 F*	*200 000 F*
Somalia	01	200 F	200 F	200 F	200 F	200 F	200 F	200 F	200 F	200 F	200 F
	51	31 700 F	28 800	29 800	29 800	24 800 F	29 800 F	29 800 F	29 800 F	29 800 F	29 800 F
	Country total	*31 900 F*	*29 000 F*	*30 000 F*	*30 000 F*	*25 000 F*	*30 000 F*	*30 000 F*	*30 000 F*	*30 000 F*	*30 000 F*
South Africa	01	900 F	900 F	900 F	900 F	900 F	900 F	900 F	900 F	900 F	900 F
	47	747 719	763 482	819 034	885 717	815 321	616 173	676 396	642 107	510 086	621 480
	48	359	332	405	235	315	310	352	327	155	178
	51	1 173	2 045	2 166	896	860	1 072	985	1 065	949	1 206
	58	319	182	280	231	270	161	193	137	47	156
	88	32	-	150	125	-	-	52	123	147	-
	Country total	*750 502*	*766 941*	*822 935*	*888 104*	*817 666*	*618 616*	*678 878*	*644 659*	*512 284*	*623 920*
Sudan	01	53 000	52 000	54 000 F	57 500 F	53 800 F	52 000 F	59 810	62 900 F	66 000	66 000 F
	51	5 000	5 000	5 000 F	5 500 F	5 200 F	5 000 F	5 699 F	5 695 F	5 690	5 700 F
	Country total	*58 000*	*57 000*	*59 000*	*63 000*	*59 000*	*57 000*	*65 509 F*	*68 595 F*	*71 690*	*71 700 F*
Swaziland	01	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F	70 F
	Country total	*70 F*	*70 F*	*70 F*	*70 F*	*70 F*	*70 F*	*70 F*	*70 F*	*70 F*	*70 F*
Tanzania	01	283 354	273 856	301 855	312 040	320 566	292 519	284 346	281 690	269 402	293 043
	51	53 197	50 376	49 439	51 648	56 134	42 918	45 489	45 121	46 802	49 438
	Country total	*336 551*	*324 232*	*351 294*	*363 688*	*376 700*	*335 437*	*329 835*	*326 811*	*316 204*	*342 481*
Togo	01	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000 F	5 000	5 000
	34	18 163	15 946	22 485	23 013	22 744	19 879	14 905	18 500 F	22 025	22 535
	Country total	*23 163*	*20 946*	*27 485*	*28 013*	*27 744*	*24 879*	*19 905*	*23 500 F*	*27 025*	*27 535*
Tunisia	01	860	870	859	1 049	1 224	1 264	1 084	1 096	1 191	1 123
	37	97 630	95 815	89 367	110 482	107 893	110 024	102 706	96 810	96 668	96 620
	Country total	*98 490*	*96 685*	*90 226*	*111 531*	*109 117*	*111 288*	*103 790*	*97 906*	*97 859*	*97 743*
Uganda	01	220 726	221 898	241 810	371 789	416 758	367 099	431 500 F	403 500 F	412 000 F	413 805
	Country total	*220 726*	*221 898*	*241 810*	*371 789*	*416 758*	*367 099*	*431 500 F*	*403 500 F*	*412 000 F*	*413 805*
Zambia	01	63 000	63 000	66 332	67 725	65 927	60 236	73 542	79 403	84 716	76 396
	Country total	*63 000*	*63 000*	*66 332*	*67 725*	*65 927*	*60 236*	*73 542*	*79 403*	*84 716*	*76 396*
Zanzibar	51	20 541	20 341	20 859	23 488	23 210	24 418	23 580	24 514	25 394	25 690
	Country total	*20 541*	*20 341*	*20 859*	*23 488*	*23 210*	*24 418*	*23 580*	*24 514*	*25 394*	*25 690*
Zimbabwe	01	12 300 F	11 500 F	10 600 F	10 500 F	10 420 F	10 500 F	10 500 F	10 500 F	10 500 F	10 500 F
	Country total	*12 300 F*	*11 500 F*	*10 600 F*	*10 500 F*	*10 420 F*	*10 500 F*	*10 500 F*	*10 500 F*	*10 500 F*	*10 500 F*
Total		***7 117 987***	***7 004 498***	***7 298 826***	***7 505 523***	***7 589 789***	***7 030 179***	***7 094 209***	***7 303 230***	***7 353 466***	***7 618 248***

D-2 **Fish crustaceans, molluscs, etc** | **Poissons, crustacés, mollusques, etc** | **Peces, crustáceos, moluscos, etc**

Capture production by countries or areas and fishing areas | **Captures par pays ou zones et zones de pêche** | **Capturas por países o áreas y áreas de pesca**

Americas | **Amériques** | **Américas**

	Fishing area / Zone de pêche / Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Anguilla	02	0	0	-	-	-	-	-	-	-	-
	31	585 F	610 F	635 F	660 F	685 F	710 F	735 F	759	681	701
	Country total	*585 F*	*610 F*	*635 F*	*660 F*	*685 F*	*710 F*	*735 F*	*759*	*681*	*701*
Antigua Barb	02	0	0	-	-	-	-	-	-	-	-
	31	1 824	2 374	2 587	2 527	2 999	3 092	3 092	3 521	2 490	2 293
	Country total	*1 824*	*2 374*	*2 587*	*2 527*	*2 999*	*3 092*	*3 092*	*3 521*	*2 490*	*2 293*
Argentina	03	15 536	18 474	26 596	33 903	34 002	33 617	19 695	11 246	16 256	15 445
	41	915 545	927 711	883 604	910 690	895 651	1 138 100	965 453	983 837	845 717	796 262
	88	-	-	-	253	284	263	261	0	-	42
	Country total	*931 081*	*946 185*	*910 200*	*944 846*	*929 937*	*1 171 980*	*985 409*	*995 083*	*861 973*	*811 749*
Aruba	31	163	163 F	160 F	162	162 F	145	159	151	163	153
	Country total	*163*	*163 F*	*160 F*	*162*	*162 F*	*145*	*159*	*151*	*163*	*153*
Bahamas	02	0	0	0	0	0	0	0	-	-	-
	31	9 290	12 192	12 611	11 347	11 064	10 598	8 382	9 117	9 018	11 611
	Country total	*9 290*	*12 192*	*12 611*	*11 347*	*11 064*	*10 598*	*8 382*	*9 117*	*9 018*	*11 611*
Barbados	31	2 721	2 520	2 838	2 148	2 182	1 975	2 224	3 551	3 496	3 269
	Country total	*2 721*	*2 520*	*2 838*	*2 148*	*2 182*	*1 975*	*2 224*	*3 551*	*3 496*	*3 269*
Belize	02	0	0	0	0	0	0	0	-	-	-
	31	2 517	2 078	2 477	2 860	2 707	3 033	3 431	3 146	4 043	5 683
	34	9 794	22 918	1 564	...	24 241	13 368	1 085	29 700	...	104 172
	41	2 581	135	2 768	84	363	201	3 251	880	603	1 809
	51	8 658	28 019	1 074	957	767	983	1 466	586	280	201
	57	584	1 882	299	247	328	-	13	9	-	-
	71	7 271	3 395	3 114	1 060	1 100	655	684	279	212	166
	77	55	...	...	...	...	...	...	...	...	...
	87	1 902	588	561	2 349	2 300	782	13 972	16 349	5 976	2 261
	Country total	*33 362*	*59 015*	*11 857*	*7 557*	*31 806*	*19 022*	*23 902*	*50 949*	*11 114*	*114 292*
Bermuda	02	0	-	-	-	-	-	-	-	-	-
	31	309	397	363	386	399	380	424	399	416	382
	Country total	*309*	*397*	*363*	*386*	*399*	*380*	*424*	*399*	*416*	*382*
Bolivia	03	5 940	6 300 F	6 599	6 436	6 360	6 080 F	5 770	6 750	7 568	6 946
	Country total	*5 940*	*6 300 F*	*6 599*	*6 436*	*6 360*	*6 080 F*	*5 770*	*6 750*	*7 568*	*6 946*
Brazil	03	220 432	239 415	227 551	246 101	243 435	251 241	243 210	261 280	239 493	248 122
	41	509 946	516 167	484 593	500 116	506 826	527 872	539 967	530 612	585 919	537 247
	Country total	*730 378*	*755 582*	*712 144*	*746 217*	*750 261*	*779 113*	*783 177*	*791 892*	*825 412*	*785 369*
Br Virgin Is	02	0	0	-	-	-	-	-	-	-	-
	31	837	1 062	2 771	1 262	1 300 F	1 308 F	1 250 F	1 200 F	1 200 F	1 200 F
	Country total	*837*	*1 062*	*2 771*	*1 262*	*1 300 F*	*1 308 F*	*1 250 F*	*1 200 F*	*1 200 F*	*1 200 F*
Canada	02	38 140	39 999	37 383	36 116	32 269	32 234	32 303	31 063	33 023	27 293
	21	819 450	829 143	853 027	876 076	825 065	832 141	817 482	763 966	758 688	749 468
	67	183 886	194 416	217 581	260 323	246 447	214 905	175 792	155 341	158 787	150 861
	81	206	144	-	63	72	135	27	-	-	-
	Country total	*1 041 682*	*1 063 702*	*1 107 991*	*1 172 578*	*1 103 853*	*1 079 415*	*1 025 604*	*950 370*	*950 498*	*927 622*
Cayman Is	02	0	0	0	-	-	-	-	-	-	-
	31	125	125	125	125	125	125	125	125	125	125
	Country total	*125*	*125*	*125*	*125*	*125*	*125*	*125*	*125*	*125*	*125*
Chile	03	0	0	0	0	0	0	0	...	...	...
	41	9 296	9 650	7 132	9 892	524	2 890	3 771	1 653	-	-
	47	5	-	-	-	-	-	-	-	-	-
	48	899	1 545	3 715	2 520	748	1 631	1 851	899	374	356
	58	-	-	-	-	239	74	-	-	-	-
	87	3 787 346	4 260 222	3 601 201	4 914 396	4 326 810	4 156 137	3 813 663	3 552 256	3 453 269	2 679 380
	88	-	-	-	-	-	-	-	-	143	...
	Country total	*3 797 546*	*4 271 417*	*3 612 048*	*4 926 808*	*4 328 321*	*4 160 732*	*3 819 285*	*3 554 808*	*3 453 786*	*2 679 736*
Colombia	03	26 532	27 738	30 512	28 292	19 291	20 000 F	20 800 F	21 700 F	22 686	21 049
	31	10 414	25 688	8 380	5 663	4 975	5 000 F	5 050 F	5 100 F	5 091	3 135
	77	9 452	14 977	5 703	2 489	3 256	1 371	5 556	4 470	8 372	9 830
	87	99 644	56 319	85 197	75 416	93 478	81 156 F	92 727 F	82 362 F	70 172	45 013
	Country total	*146 042*	*124 722*	*129 792*	*111 860*	*121 000*	*107 527 F*	*124 133 F*	*113 632 F*	*106 321*	*79 027*
Costa Rica	02	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F
	31	899	717	651	601	605	615 F	624	625 F	625 F	625 F
	77	32 917	31 303	27 746	19 249	20 735	20 385 F	20 111	20 125 F	20 125 F	20 125 F
	Country total	*34 816*	*33 020*	*29 397*	*20 850*	*22 340*	*22 000 F*	*21 735*	*21 750 F*	*21 750 F*	*21 750 F*
Cuba	02	1 994	2 023	2 698	2 513	1 561	1 449	3 058	2 764	2 526	2 028
	31	39 672	30 509	31 333	29 630	26 631	26 094	26 389	25 797	26 317	21 923
	34	12 991	-	-	-	-	-	-	-	-	-
	Country total	*54 657*	*32 532*	*34 031*	*32 143*	*28 192*	*27 543*	*29 447*	*28 561*	*28 843*	*23 951*
Dominica	02	0	0	0	-	-	-	-	-	-	-
	31	1 200 F	1 198	950 F	700 F	579	694	676	696	790	700 F
	Country total	*1 200 F*	*1 198*	*950 F*	*700 F*	*579*	*694*	*676*	*696*	*790*	*700 F*
Dominican Rp	02	1 158	2 102	1 506	1 980	1 694	1 911	1 481	1 708	432	350

D-2 **Fish crustaceans, molluscs, etc** | **Capture production by countries or areas and fishing areas** | **Americas**
Poissons, crustacés, mollusques, etc | **Captures par pays ou zones et zones de pêche** | **Amériques**
Peces, crustáceos, moluscos, etc | **Capturas por países o áreas y áreas de pesca** | **Américas**

	Fishing area Zone de pêche Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	31	12 059	15 159	16 591	12 243	9 499	11 045	12 228	13 674	13 801	14 140
	Country total	*13 217*	*17 261*	*18 097*	*14 223*	*11 193*	*12 956*	*13 709*	*15 382*	*14 233*	*14 490*
Ecuador	03	350 F	300 F	300 F	250 F	250 F	233	216 F	199	338	245
	71	1 057	427	1 562	3 051	5 193	9 523	9 187	25 415	4 432	8 452
	77	18 058	14 438	26 437	21 113	27 951	44 033	36 485	31 683	43 071	50 249
	87	568 305	304 004	371 227	319 548	414 697	398 509	353 197	437 772	437 964	332 768
	Country total	*587 770*	*319 169*	*399 526*	*343 962*	*448 091*	*452 298*	*399 085*	*495 069*	*485 805*	*391 714*
El Salvador	02	1 692	2 663	2 673	2 205	2 051	2 034	2 422	3 980	3 000 F	2 326
	77	17 318	31 792	32 737	40 210	39 063	41 184	46 217	28 345	27 527	33 674
	Country total	*19 010*	*34 455*	*35 410*	*42 415*	*41 114*	*43 218*	*48 639*	*32 325*	*30 527*	*36 000*
Falkland Is	03	1	1	1	1	1	1	1	1	1	1
	41	68 331	53 260	74 897	55 368	84 545	75 287	72 146	81 707	62 746	99 559
	Country total	*68 332*	*53 261*	*74 898*	*55 369*	*84 546*	*75 288*	*72 147*	*81 708*	*62 747*	*99 560*
Fr Guiana	03	0	0	-	-	-	-	-	-	-	-
	31	4 599 F	4 782 F	5 565 F	5 514 F	5 285 F	4 442	4 857	3 958	4 140	4 000 F
	Country total	*4 599 F*	*4 782 F*	*5 565 F*	*5 514 F*	*5 285 F*	*4 442*	*4 857*	*3 958*	*4 140*	*4 000 F*
Greenland	02	0	0	0	-	-	-	-	-	-	-
	21	124 149	151 533	130 366	183 660	194 620	206 296	196 170	203 246	178 608	175 919
	27	34 336	44 091	44 955	41 428	40 244	46 663	37 584	24 419	19 270	33 527
	Country total	*158 485*	*195 624*	*175 321*	*225 088*	*234 864*	*252 959*	*233 754*	*227 665*	*197 878*	*209 446*
Grenada	02	0	0	-	-	-	-	-	-	-	-
	31	2 250	2 171	2 544	2 039	2 053	2 169	2 407	2 386	2 615	2 452
	Country total	*2 250*	*2 171*	*2 544*	*2 039*	*2 053*	*2 169*	*2 407*	*2 386*	*2 615*	*2 452*
Guadeloupe	02	0	0	-	-	-	-	-	-	-	-
	31	10 100	10 100	10 100	10 100	10 100	10 100	10 100	10 100	10 000 F	10 000 F
	Country total	*10 100*	*10 100*	*10 100*	*10 100*	*10 100*	*10 100*	*10 100*	*10 100*	*10 000 F*	*10 000 F*
Guatemala	02	6 480 F	5 665 F	4 850 F	4 035 F	3 120 F	2 360	2 360 F	2 360 F	2 360 F	2 360 F
	31	360 F	345 F	330 F	315 F	304	264	483	536	428	647
	34	-	-	-	-	10 293	11 213	9 941	11 127	7 633	7 164
	77	12 134 F	17 417	18 516	4 614	3 263	2 077	2 471	3 540	1 773	6 509
	87	10 730	...	...	1 048	1 381	1 259	2 430	5 263	7 800	5 179
	Country total	*29 704 F*	*23 427 F*	*23 696 F*	*10 012 F*	*18 361*	*17 173*	*17 685*	*22 826*	*19 994*	*21 859*
Guyana	03	800	800	800	800	800	800 F	800	800	800 F	800
	31	52 605	47 217	58 895	55 919	52 570	52 963 F	46 648	41 368	42 805	44 386
	Country total	*53 405*	*48 017*	*59 695*	*56 719*	*53 370*	*53 763 F*	*47 448*	*42 168*	*43 605*	*45 186*
Haiti	02	400 F	400 F	400 F	300	300 F	300 F	300 F	300 F	300 F	300 F
	31	6 400 F	7 000 F	7 600 F	8 000	8 000 F	8 000 F	8 000 F	8 000 F	8 000 F	8 000 F
	Country total	*6 800 F*	*7 400 F*	*8 000 F*	*8 300*	*8 300 F*	*8 300 F*	*8 300 F*	*8 300 F*	*8 300 F*	*8 300 F*
Honduras	02	111	102 F	100 F	100 F	100 F	100 F	100 F	100 F	100 F	100 F
	31	10 213 F	11 126 F	13 624 F	6 199 F	6 387 F	7 660 F	6 198 F	5 058	5 200	6 971
	34	1 120	67	-	-	45	488	-	-	-	-
	57	637	-	-	-	-	-	-	-	-	-
	77	2 659 F	3 082 F	2 500 F	2 445 F	2 056 F	2 369 F	2 630 F	2 000 F	2 075 F	2 050 F
	87	6 304	...	...	5 842	10 229	10 260	6 227	5 746	3 927	1 986
	Country total	*21 044 F*	*14 377 F*	*16 224 F*	*14 586 F*	*18 817 F*	*20 877 F*	*15 155 F*	*12 904 F*	*11 302 F*	*11 107 F*
Jamaica	02	400 F	400 F	400 F	400 F	400 F	400 F	400 F	400 F	400	400
	31	11 894	7 397	12 082	13 071	12 696	17 505 F	16 148	12 775	15 894	15 040
	Country total	*12 294*	*7 797*	*12 482*	*13 471*	*13 096*	*17 905 F*	*16 548*	*13 175*	*16 294*	*15 440*
Martinique	02	0	0	-	-	-	-	-	-	-	-
	31	6 200	6 200 F	6 200	6 200	5 500	6 300	6 200	6 200	6 200 F	5 000 F
	Country total	*6 200*	*6 200 F*	*6 200*	*6 200*	*5 500*	*6 300*	*6 200*	*6 200*	*6 200 F*	*5 000 F*
Mexico	02	91 952	82 648	99 604	107 203	113 578	116 268	116 591	108 853	111 792	116 410
	31	259 141	245 069	239 832	248 745	213 705	235 224	215 445	191 849	191 461	199 854
	77	1 039 463	1 119 685	1 015 523	895 957	988 832	1 004 911	1 140 497	1 280 570	1 307 922	1 207 625
	87	8 020	3 345	2 344	7 151	3 821	792	...	...	...	...
	Country total	*1 398 576*	*1 450 747*	*1 357 303*	*1 259 056*	*1 319 936*	*1 357 195*	*1 472 533*	*1 581 272*	*1 611 175*	*1 523 889*
Montserrat	02	0	0	0	0	-	-	-	-	-	-
	31	50 F	46	40 F	31	50	49	35	31	37	24
	Country total	*50 F*	*46*	*40 F*	*31*	*50*	*49*	*35*	*31*	*37*	*24*
NethAntilles	02	0	0	0	0	0	0	0	-	-	-
	31	1 052 F	1 282 F	600 F	600 F	650 F	700 F	705 F	705 F	705 F	1 267 F
	34	21 753	11 619	19 549	16 686	...	5 547	3 313	15 993	18 169	17 188
	Country total	*22 805 F*	*12 901 F*	*20 149*	*17 286*	*650*	*6 247*	*4 018*	*16 698*	*18 874*	*18 455*
Nicaragua	02	700	487	405	866	1 042	412	853	988	868	943
	31	10 255	10 567	10 387	10 001	10 652	10 157	10 468	10 206	10 641	12 294
	77	6 208	8 136	4 534	8 340	14 566	12 988	12 245	11 733	17 467	20 486
	87	2 619	...	-	90	1 232	6 034	3 466	6 940	6 687	3 700
	Country total	*19 782*	*19 190*	*15 326*	*19 297*	*27 492*	*29 591*	*27 032*	*29 867*	*35 663*	*37 423*
Panama	02	20 F	23 F	26	406	2 950	3 555	3 242	3 143	1 909	2 013
	31	845	687	624	684	1 053	3 828	1 085	589	538	2 541
	34	11 013	7 137	8 347	10 928	45 647	56 824	46 572	18 291	18 805	18 111

D-2 **Fish crustaceans, molluscs, etc**
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas and fishing areas
Captures par pays ou zones et zones de pêche
Capturas por países o áreas y áreas de pesca

Americas
Amériques
Américas

	Fishing area Zone de pêche Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	41	-	-	-	95	194	585	1 255	-	-	-
	77	252 464	226 019	203 440	168 578	159 066	150 593	141 862	145 086	156 403	114 934
	87	11 227	7 707	15 209	28 149	36 108	42 723	27 551	56 297	44 861	25 889
	Country total	*275 569 F*	*241 573*	*227 646*	*208 840*	*245 018*	*258 108*	*221 567*	*223 406*	*222 516*	*163 488*
Paraguay	03	25 000 F	21 500 F	18 000 F	14 500 F	11 000 F	8 000 F	5 000 F	1 708	1 700 F	1 700 F
	Country total	*25 000 F*	*21 500 F*	*18 000 F*	*14 500 F*	*11 000 F*	*8 000 F*	*5 000 F*	*1 708*	*1 700 F*	*1 700 F*
Peru	03	35 757	29 968	32 940	37 688	40 196	37 466	42 633	45 412	45 720	44 368
	87	7 950 450	8 735 221	6 053 120	9 566 839	9 348 292	6 980 025	7 167 911	7 349 126	6 868 732	4 216 723
	Country total	*7 986 207*	*8 765 189*	*6 086 060*	*9 604 527*	*9 388 488*	*7 017 491*	*7 210 544*	*7 394 538*	*6 914 452*	*4 261 091*
Puerto Rico	02	0	-	-	-	-	-	-	-	-	-
	31	3 794	2 529	2 919	2 428	2 551	2 042	1 675	1 793	1 702	1 898
	Country total	*3 794*	*2 529*	*2 919*	*2 428*	*2 551*	*2 042*	*1 675*	*1 793*	*1 702*	*1 898*
St Kitts Nev	02	0	0	0	0	0	0	0	-	-	-
	31	555	355	400 F	484	470 F	455 F	440 F	425 F	410 F	393
	34	-	-	-	-	-	-	-	-	-	20 706
	Country total	*555*	*355*	*400 F*	*484*	*470 F*	*455 F*	*440 F*	*425 F*	*410 F*	*21 099*
St Lucia	02	0	0	0	-	-	-	-	-	-	-
	31	1 983	1 637	1 462	1 508	1 409	1 496	1 555	1 728	1 920	1 844
	Country total	*1 983*	*1 637*	*1 462*	*1 508*	*1 409*	*1 496*	*1 555*	*1 728*	*1 920*	*1 844*
St Pier Mq	02	0	0	0	-	-	-	-	-	-	-
	21	4 206	3 889	3 894	4 399	4 694	2 876	5 204	4 621	1 761	2 043
	Country total	*4 206*	*3 889*	*3 894*	*4 399*	*4 694*	*2 876*	*5 204*	*4 621*	*1 761*	*2 043*
St Vincent	02	0	0	0	0	0	0	0	-	-	-
	31	5 021	3 029	4 843	8 737	1 786	4 661	5 010	3 859	3 984	2 619
	34	45 890	41 784	...	14	...	103	215	83	74	63 007
	41	1 818	-	-	-	-	-	-	-	-	-
	Country total	*52 729*	*44 813*	*4 843*	*8 751*	*1 786*	*4 764*	*5 225*	*3 942*	*4 058*	*65 626*
Suriname	03	200	200 F	222	242	218	200	350	350 F	420	560
	31	24 665	27 042 F	32 260	30 160	27 192	30 421	29 277	23 461	25 411	33 842
	Country total	*24 865*	*27 242 F*	*32 482*	*30 402*	*27 410*	*30 621*	*29 627*	*23 811*	*25 831*	*34 402*
Trinidad Tob	02	0	0	0	0	0	0	0	-	-	-
	31	16 598	18 768	14 592	14 713	18 093	13 123	13 086	13 833	13 856	13 931
	Country total	*16 598*	*18 768*	*14 592*	*14 713*	*18 093*	*13 123*	*13 086*	*13 833*	*13 856*	*13 931*
Turks Caicos	02	0	0	-	-	-	-	-	-	-	-
	31	6 419	5 767	5 100	5 685 F	5 505 F	6 040 F	4 860 F	6 133	6 803	5 446
	Country total	*6 419*	*5 767*	*5 100*	*5 685 F*	*5 505 F*	*6 040 F*	*4 860 F*	*6 133*	*6 803*	*5 446*
USA	02	29 578	27 397	26 329	29 275	24 842	18 736	25 270	24 581	22 674	22 821
	21	1 129 820	1 091 699	1 122 681	1 165 821	1 075 011	1 078 503	1 063 392	1 019 789	1 049 198	1 050 736
	31	878 343	923 344	880 478	762 368	630 105	670 197	674 648	625 979	699 816	597 735
	48	1 568	12 175	10 150	8 550	2 159	1	-	-	-	-
	67	2 572 829	2 570 374	2 697 585	2 786 265	2 962 824	2 860 646	2 752 072	2 421 052	2 100 534	2 277 987
	71	113 658	114 089	40 143	33 343	26 242	32 362	34 422	51 617	88 488	109 512
	77	212 580	189 277	157 546	170 094	168 136	190 112	216 664	201 559	258 979	310 749
	81	5 942	6 735	-	-	-	-	-	-	-	-
	87	18	2 215	4 044	3 876	3 648	1 727	1 128	5 276	2 363	...
	88	-	-	-	234	-	-	-	-	-	-
	Country total	*4 944 336*	*4 937 305*	*4 938 956*	*4 959 826*	*4 892 967*	*4 852 284*	*4 767 596*	*4 349 853*	*4 222 052*	*4 369 540*
US Virgin Is	02	0	0	0	0	0	0	0	-	-	-
	31	1 198 F	1 296 F	1 492	1 522	1 269	1 615	1 127	1 065	1 120	847
	Country total	*1 198 F*	*1 296 F*	*1 492*	*1 522*	*1 269*	*1 615*	*1 127*	*1 065*	*1 120*	*847*
Uruguay	03	451	387	551	2 330	2 130	2 137	1 200	620	801	1 048
	41	97 078	102 341	113 131	119 058	122 462	130 869	106 799	107 701	80 244	72 958
	47	-	906	2 045	402	71	-	-	-	-	-
	48	428	693	347	357	-	262	244	261	165	147
	51	7 002	1 928	1 112	86	-	237	31	101	26	-
	57	-	1 847	83	-	-	-	-	-	-	-
	58	-	-	-	-	-	54	177	31	118	-
	87	-	-	-	537	692	-	-	-	-	-
	88	23	-	-	219	463	428	271	83	107	-
	Country total	*104 982*	*108 102*	*117 269*	*122 989*	*125 818*	*133 987*	*108 722*	*108 797*	*81 461*	*74 153*
Venezuela	03	24 326	40 776	49 090	44 000 F	39 000 F	42 000 F	30 000 F	24 882	24 800 F	24 800 F
	31	278 738	348 696	366 986	464 880 F	304 447 F	225 794 F	270 266 F	218 251	212 900 F	214 500 F
	77	55 177	94 560	66 468	39 380	41 147	16 397	21 252	15 856	25 187	23 740
	87	50 414	25 862	35 629	31 512	17 988	31 155	26 028	37 277	25 575	11 377
	Country total	*408 655*	*509 894*	*518 173*	*579 772*	*402 582*	*315 346*	*347 546*	*296 266*	*288 462*	*274 417 F*
Total		***23 084 077***	***24 229 900***	***20 790 963***	***25 652 626***	***24 773 443***	***22 411 517***	***21 958 955***	***21 567 267***	***20 653 137***	***17 216 746***

D-3 **Fish crustaceans, molluscs, etc** | **Capture production by countries or areas and fishing areas** | **Asia**
Poissons, crustacés, mollusques, etc | **Captures par pays ou zones et zones de pêche** | **Asie**
Peces, crustáceos, moluscos, etc | **Capturas por países o áreas y áreas de pesca** | **Asia**

	Fishing area Zone de pêche Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Afghanistan	04	800 F	900 F	900 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F	1 000 F
	Country total	*800 F*	*900 F*	*900 F*	*1 000 F*	*1 000 F*	*1 000 F*	*1 000 F*	*1 000 F*	*1 000 F*	*1 000 F*
Armenia	04	866	465	569	218	250	350	1 065	601	619 F	617 F
	Country total	*866*	*465*	*569*	*218*	*250*	*350*	*1 065*	*601*	*619 F*	*617 F*
Azerbaijan	04	10 893	11 188	6 435	9 258	9 001	4 061	2 949	1 524	1 206	1 081
	Country total	*10 893*	*11 188*	*6 435*	*9 258*	*9 001*	*4 061*	*2 949*	*1 524*	*1 206*	*1 081*
Bahrain	51	11 230	11 204	13 638	14 489	11 854	15 594	15 014	14 175	16 358	13 490
	Country total	*11 230*	*11 204*	*13 638*	*14 489*	*11 854*	*15 594*	*15 014*	*14 175*	*16 358*	*13 490*
Bangladesh	04	688 920	688 435	709 333	732 067	859 269	956 686	1 006 761	1 060 181	1 218 937	1 119 094
	57	379 497	415 420	431 908	455 207	474 597	479 810	487 438	497 573	602 642	607 492
	Country total	*1 068 417*	*1 103 855*	*1 141 241*	*1 187 274*	*1 333 866*	*1 436 496*	*1 494 199*	*1 557 754*	*1 821 579*	*1 726 586*
Bhutan	04	260 F	240 F	240 F	220 F	220 F	200 F	200 F	180 F	180 F	160 F
	Country total	*260 F*	*240 F*	*240 F*	*220 F*	*220 F*	*200 F*	*200 F*	*180 F*	*180 F*	*160 F*
Brunei Darsm	04	19	14	5	11	-	-	-	-	-	-
	71	1 578	2 044	1 784	1 912	2 709	2 279	2 550	2 357	1 766	2 272
	Country total	*1 597*	*2 058*	*1 789*	*1 923*	*2 709*	*2 279*	*2 550*	*2 357*	*1 766*	*2 272*
Cambodia	04	385 000	360 300	308 750	250 000	324 000	422 000	395 000	365 000	390 000	405 000
	41	1 200	32	857	17	-	-	-	-	-	94
	71	42 000	45 850	54 750	55 800	60 000	60 500	63 500	66 000	75 000	85 000
	Country total	*428 200*	*406 182*	*364 357*	*305 817*	*384 000*	*482 500*	*458 500*	*431 000*	*465 000*	*490 094*
China	04	1 871 295 F	1 951 889 F	2 135 086 F	2 097 167 F	2 210 103 F	2 203 316 F	2 256 403	2 248 177	2 183 859	2 289 343
	27	-	-	-	61	5 587	137	97	118	41	42
	31	-	-	-	-	-	-	-	13	48	-
	34	36 228	13 967	18 539	5 401	21 419	17 074	22 970	24 329	2 820	7 631
	41	93 973	85 872	96 017	15 721	41 046	105 091	210 065	198 793	64 600	37 097
	47	4 959	3 850	2 881	840	550	1 880	2 036	1 677	249	61
	48	-	-	-	-	-	-	-	-	-	1 946
	51	2 772	3 593	7 366	11 889	13 355	26 931	11 175	7 426	3 805	4 540
	57	4 007	1 473	506	1 434	953	538	915	470	704	3 534
	61	12 098 896 F	11 960 168 F	11 863 715 F	11 946 892 F	11 997 637 F	11 970 943 F	11 886 523	11 994 337	12 352 699	12 777 782
	71	11 138	12 924	38 094	29 203	55 773	65 881	65 772	79 768	110 289	71 770
	77	14 547	12 494	8 818	18 556	11 077	15 704	11 954	13 619	12 300	13 314
	81	520	802	562	592	901	1 218	487	-	-	5 991
	87	37 860	126 744	175 690	337 047	230 539	222 305	190 639	222 436	188 182	205 916
	Country total	*14 176 195 F*	*14 173 776 F*	*14 347 274 F*	*14 464 803 F*	*14 588 940 F*	*14 631 018 F*	*14 659 036*	*14 791 163*	*14 919 596*	*15 418 967*
China,H.Kong	04	0	0	0	0	0	0	0	...	...	...
	61	173 972	169 790	157 444	167 544	161 964	154 536	154 147	158 126	158 965	168 010
	Country total	*173 972*	*169 790*	*157 444*	*167 544*	*161 964*	*154 536*	*154 147*	*158 126*	*158 965*	*168 010*
China, Macao	04	0	0	-	-	-	-	-	-	-	-
	61	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F	1 500 F
	Country total	*1 500 F*	*1 500 F*	*1 500 F*	*1 500 F*	*1 500 F*	*1 500 F*	*1 500 F*	*1 500 F*	*1 500 F*	*1 500 F*
China,Taiwan	04	591	599	475	245	197	149	242	198	159	77
	21	618	570	161	387	359	125	7	10	11	-
	27	564	624	208	218	491	-	46	5	-	-
	31	10 597	10 577	4 967	6 135	1 711	2 931	2 184	1 108	1 007	1 033
	34	13 677	9 761	13 695	11 062	9 748	3 094	8 150	7 090	6 533	7 379
	37	197	131	421	51	277	9	-	-	-	-
	41	156 502	126 337	139 976	61 959	45 948	136 041	291 800	215 960	62 023	35 143
	47	16 118	16 070	16 126	12 230	8 904	6 752	16 161	11 383	13 981	17 280
	51	95 003	95 106	98 877	128 406	107 315	90 488	77 993	51 816	46 019	29 811
	57	14 308	19 384	17 563	41 447	35 904	26 793	21 351	24 231	33 645	37 899
	61	357 797	351 171	456 799	386 174	524 675	406 845	464 334	432 951	359 991	436 771
	67	310	210	37	73	57	39	0	32	-	-
	71	321 673	380 396	321 937	240 727	221 491	241 398	249 729	218 368	208 537	229 865
	77	10 461	8 717	30 544	46 168	36 354	23 105	22 800	19 513	22 258	20 883
	81	5 901	10 043	9 377	2 144	5 497	9 066	3 767	2 380	2 941	5 017
	87	882	13 060	24 196	42 680	18 315	20 743	15 829	31 345	12 802	30 226
	Country total	*1 005 199*	*1 042 756*	*1 135 359*	*980 106*	*1 017 243*	*967 578*	*1 174 393*	*1 016 390*	*769 907*	*851 384*
Cyprus	04	70 F	60 F	50 F	40 F	30 F	20 F	20 F	20 F	20 F	20 F
	34	78 743	-	-	-	-	-	-	-	-	-
	37	2 245	1 908	1 740	1 528	1 886	2 135	2 426	1 991	1 385	1 400
	Country total	*81 058*	*1 968*	*1 790*	*1 568*	*1 916*	*2 155*	*2 446*	*2 011*	*1 405*	*1 420*
Georgia	04	8	10	39	51	51 F	50 F	50 F	50 F	50 F	50 F
	34	...	...	...	...	...	...	...	...	...	5 544
	37	1 628	1 801	3 267	11 937	9 923 F	9 659 F	18 147	26 462	25 000 F	25 000 F
	Country total	*1 636*	*1 811*	*3 306*	*11 988*	*9 974 F*	*9 709 F*	*18 197*	*26 512*	*25 050 F*	*30 594 F*
India	04	975 403	775 599	757 353	527 290	843 746	892 639	823 410	947 358	923 954	1 468 757
	51	1 862 686	1 983 089	1 984 459	1 889 853	1 955 564	1 960 740	2 013 830	2 034 759	2 046 460	2 146 400
	57	939 003	977 915	970 337	973 866	892 052	991 458	1 022 053	1 117 110	1 096 342	1 079 811
	Country total	*3 777 092*	*3 736 603*	*3 712 149*	*3 391 009*	*3 691 362*	*3 844 837*	*3 859 293*	*4 099 227*	*4 066 756*	*4 694 968*
Indonesia	04	310 240	304 989	308 656	330 879	297 368	293 921	320 908	304 402	295 736	344 972
	57	986 224	1 035 128	1 078 939	1 078 757	1 151 068	1 171 301	1 187 386	1 293 805	1 358 806	1 287 371
	71	2 962 879	2 982 647	3 196 176	3 195 799	3 247 541	3 335 399	3 542 046	3 398 992	3 449 061	3 747 923
	Country total	*4 259 343*	*4 322 764*	*4 583 771*	*4 605 435*	*4 695 977*	*4 800 621*	*5 050 340*	*4 997 199*	*5 103 603*	*5 380 266*

D-3 **Fish crustaceans, molluscs, etc** | **Capture production by countries or areas and fishing areas** | **Asia**
Poissons, crustacés, mollusques, etc | **Captures par pays ou zones et zones de pêche** | **Asie**
Peces, crustáceos, moluscos, etc | **Capturas por países o áreas y áreas de pesca** | **Asia**

	Fishing area Zone de pêche Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Iran	04	88 335	55 853	50 994	55 825	67 066	71 405	74 064	65 862	71 781	75 145
	51	262 805	269 020	299 201	314 186	343 503	374 474	329 626	341 980	348 122	368 505
	Country total	*351 140*	*324 873*	*350 195*	*370 011*	*410 569*	*445 879*	*403 690*	*407 842*	*419 903*	*443 650*
Iraq	04	14 100	11 900	13 200	10 581	23 570 F	46 300	45 460	29 986	22 259	12 230
	51	19 200	14 100	4 000	2 355	6 359 F	12 959	12 319	4 486	12 246	13 490
	Country total	*33 300*	*26 000*	*17 200*	*12 936*	*29 929*	*59 259*	*57 779*	*34 472*	*34 505*	*25 720*
Israel	04	1 286	1 569	1 064	1 137	1 396	1 600	840	224	401	402
	37	3 618	3 444	2 961	2 103	2 680	2 145	2 545	2 434 F	2 261	2 136
	51	120	30	30	100	75	75	50	50 F	50 F	50 F
	Country total	*5 024*	*5 043*	*4 055*	*3 340*	*4 151*	*3 820*	*3 435*	*2 708 F*	*2 712*	*2 588*
Japan	04	61 819	61 725	60 334	60 402	54 327	41 700	39 039	32 626	41 694 F	39 911 F
	21	5 630	7 573	5 985	4 253	4 356	3 515	3 317	3 002	526	592
	27	1 955	2 344	2 768	3 199	3 358	1 968	2 720	2 829	2 372	1 498
	31	3 996	1 928	4 509	4 342	4 207	2 408	1 370	2 594	2 287	2 910
	34	10 973	8 440	11 585	13 209	12 967	15 734	20 522	17 038	16 291	14 163
	37	188	390	487	203	271	556	472	84	19	-
	41	81 003	36 344	31 730	27 795	19 534	22 974	9 958	10 931	10 906	8 844
	47	11 729	11 954	13 589	10 407	10 220	11 420	13 042	14 011	8 673	10 220
	48	67 377	51 191	59 944	33 590	22 848	32 887	24 409	38 828	21 135	30 117
	51	24 738	25 169	31 310	30 187	39 855	42 301	40 044	24 767	12 094	7 167
	57	17 675	16 276	13 444	8 888	9 864	11 178	16 160	16 254	16 883	11 067
	58	-	-	-	-	2	-	119	198	99	171
	61	4 007 129 F	3 727 012 F	4 106 921	3 795 261	3 785 054	3 797 686	3 816 729	3 852 913	3 677 775 F	3 612 982 F
	67	2 061	382	4	722	44	260	4	0	52	129
	71	224 826	225 025 F	208 550	208 770	232 314	238 626	233 452	234 379	242 682	251 561
	77	55 370	55 507 F	45 333	39 288	32 743	30 053	28 643	25 229	23 924	26 508
	81	48 329	64 897 F	47 866	31 670	37 921	30 446	5 820	4 217	3 693	3 468
	87	88 975	77 566 F	36 001	57 843	42 545	44 422	21 871	22 364	35 158	22 877
	Country total	*4 713 773 F*	*4 373 723 F*	*4 680 360*	*4 330 029*	*4 312 430*	*4 328 134*	*4 277 691*	*4 302 264*	*4 116 263 F*	*4 044 185 F*
Jordan	04	350	350	350	350	350	350	350	350	350	350
	51	170	176	131	144	160	147	156	150	219	136
	Country total	*520*	*526*	*481*	*494*	*510*	*497*	*506*	*500*	*569*	*486*
Kazakhstan	04	22 960	24 668	25 195	33 306	37 621	34 724	41 366	55 706	35 028	42 953
	Country total	*22 960*	*24 668*	*25 195*	*33 306*	*37 621*	*34 724*	*41 366*	*55 706*	*35 028*	*42 953*
Korea D P Rp	04	4 928	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F	5 000 F
	61	201 572	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F	200 000 F
	Country total	*206 500*	*205 000 F*	*205 000 F*	*205 000 F*	*205 000 F*	*205 000 F*	*205 000 F*	*205 000 F*	*205 000 F*	*205 000 F*
Korea Rep	04	5 971	5 690	7 539	10 302	7 500	6 447	5 803	11 098	11 707	10 256
	21	-	-	-	-	11	-	-	44	-	-
	31	237	45	-	-	8	26	151	953	239	128
	34	26 809	25 974	28 100	27 225	25 541	23 441	26 121	20 458	23 702	28 873
	37	-	-	-	700	987	68	276	340	122	-
	41	167 817	130 513	111 270	43 170	65 400	153 179	216 418	168 390	74 645	40 947
	47	5 026	5 983	7 347	6 296	5 477	5 763	4 537	5 003	4 477	4 966
	48	8 321	15 257	22 079	25 888	29 111	43 907	34 547	38 335	43 678	45 852
	51	10 878	14 457	20 282	24 578	21 408	18 831	17 393	12 812	16 575	9 496
	57	4 550	4 239	2 206	2 561	1 855	1	390	669	225	1 005
	58	-	-	-	-	253	295	343	389	226	206
	61	1 472 349	1 145 468	1 155 395	1 119 471	1 157 082	1 144 761	1 186 858	1 331 542	1 284 070	1 195 104
	67	-	-	-	-	-	-	-	-	-	59
	71	190 038	225 065	226 366	221 456	245 886	276 563	291 564	275 856	308 859	304 505
	77	53 668	54 644	23 581	24 932	20 913	20 733	17 252	16 586	15 721	15 228
	81	38 185	44 243	45 454	53 259	52 551	48 670	54 857	49 335	50 509	52 253
	87	10 097	22 346	6 981	20 595	12 175	14 823	12 898	24 326	23 140	23 254
	88	-	-	-	109	-	-	476	430	677	796
	Country total	*1 993 946*	*1 693 924*	*1 656 600*	*1 580 542*	*1 646 158*	*1 757 508*	*1 869 884*	*1 956 566*	*1 858 572*	*1 732 928*
Kuwait	04	0	0	0	0	0	0	0	-	-	-
	51	5 846	5 360	4 059	4 833	4 895	5 635	4 373	3 979	4 000 F	4 000 F
	Country total	*5 846*	*5 360*	*4 059*	*4 833*	*4 895*	*5 635*	*4 373*	*3 979*	*4 000 F*	*4 000 F*
Kyrgyzstan	04	57	48	14	7	14 F	8 F	34	8	10 F	27
	Country total	*57*	*48*	*14*	*7*	*14 F*	*8 F*	*34*	*8*	*10 F*	*27*
Lao P.Dem.R.	04	31 000 F	33 440	29 800	29 800 F	26 560	26 925	28 410	29 200	30 000	30 900
	Country total	*31 000 F*	*33 440*	*29 800*	*29 800 F*	*26 560*	*26 925*	*28 410*	*29 200*	*30 000*	*30 900*
Lebanon	04	20	297	285	265	275	270	270 F	270 F	270 F	270 F
	37	3 650	3 673	3 613	3 601	3 523	3 541	3 541 F	3 541 F	3 541 F	3 541 F
	Country total	*3 670*	*3 970*	*3 898*	*3 866*	*3 798*	*3 811*	*3 811 F*	*3 811 F*	*3 811 F*	*3 811 F*
Malaysia	04	3 446	3 450	3 828	4 119	4 582	4 165	4 280	4 353	4 469	4 545
	57	475 354	501 466	532 843	578 560	508 545	586 668	671 706	672 590	717 565	733 385
	71	755 933	770 639	750 413	753 085	701 056	695 645	709 717	721 942	675 649	695 497
	Country total	*1 234 733*	*1 275 555*	*1 287 084*	*1 335 764*	*1 214 183*	*1 286 478*	*1 385 703*	*1 398 885*	*1 397 683*	*1 433 427*
Maldives	04	0	0	-	-	-	-	-	-	-	-
	51	127 636	163 770	156 132	158 528	186 274	185 299	144 508	133 338	117 061	94 953
	Country total	*127 636*	*163 770*	*156 132*	*158 528*	*186 274*	*185 299*	*144 508*	*133 338*	*117 061*	*94 953*
Mongolia	04	290	263	382	305	366	326	185	88	90	90 F

D-3 **Fish crustaceans, molluscs, etc** | **Capture production by countries or areas and fishing areas** | **Asia**
Poissons, crustacés, mollusques, etc | **Captures par pays ou zones et zones de pêche** | **Asie**
Peces, crustáceos, moluscos, etc | **Capturas por países o áreas y áreas de pesca** | **Asia**

	Fishing area Zone de pêche Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Country total	*290*	*263*	*382*	*305*	*366*	*326*	*185*	*88*	*90*	*90 F*
Myanmar	04	238 210	254 880	290 140	454 260	503 540	631 120	717 640	814 740	899 430	1 002 430
	57	949 670	1 029 460	1 053 720	1 132 340	1 228 710	1 375 670	1 517 940	1 679 010	1 867 510	2 060 780
	Country total	*1 187 880*	*1 284 340*	*1 343 860*	*1 586 600*	*1 732 250*	*2 006 790*	*2 235 580*	*2 493 750*	*2 766 940*	*3 063 210*
Nepal	04	16 700	17 900	18 888	19 947	19 983	20 016	20 100	21 500	21 500	21 500
	Country total	*16 700*	*17 900*	*18 888*	*19 947*	*19 983*	*20 016*	*20 100*	*21 500*	*21 500*	*21 500*
Oman	04	0	0	-	-	-	-	-	-	-	-
	51	129 907	142 669	138 481	165 016	157 326	147 668	151 744	151 910	158 551	163 927
	Country total	*129 907*	*142 669*	*138 481*	*165 016*	*157 326*	*147 668*	*151 744*	*151 910*	*158 551*	*163 927*
Pakistan	04	122 468	114 030	92 794	93 687	94 644	140 000	100 000	108 000	112 355	115 348
	51	420 698	418 104	399 040	386 653	340 206	349 421	340 056	343 414	334 007	337 916
	Country total	*543 166*	*532 134*	*491 834*	*480 340*	*434 850*	*489 421*	*440 056*	*451 414*	*446 362*	*453 264*
Palest, O.T.	04	0	0	0	0	0	0	0	-	-	-
	37	1 950	2 379	1 507	2 951	1 814	2 323	2 702	2 843	1 525	1 699
	Country total	*1 950*	*2 379*	*1 507*	*2 951*	*1 814*	*2 323*	*2 702*	*2 843*	*1 525*	*1 699*
Philippines	04	135 845	130 868	132 565	140 409	142 181	159 851	166 459	179 491	186 444	185 406
	31	37	691	370	1 042	619	230	373	505	560	384
	34	0	94	-	260	...	41	159	-	-	60
	41	330	172	635	591	1 274	1 608	1 331	1 494	1 274	917
	47	29	16	56	334	154	215	823	267	373	236
	51	1 284	1 103	3 139	1 687	4 250	3 613	2 640	2 732	437	353
	57	155	319	239	1 508	263	268	992	572	597	311
	71	1 811 150	1 896 651	2 028 886	2 065 544	2 120 997	2 153 294	2 326 918	2 376 276	2 412 856	2 424 053
	Country total	*1 948 830*	*2 029 914*	*2 165 890*	*2 211 375*	*2 269 738*	*2 319 120*	*2 499 695*	*2 561 337*	*2 602 541*	*2 611 720*
Qatar	04	0	0	0	-	-	-	-	-	-	-
	51	8 864	7 155	11 295	11 134	13 935	16 376	15 190	17 688	14 064	13 760
	Country total	*8 864*	*7 155*	*11 295*	*11 134*	*13 935*	*16 376*	*15 190*	*17 688*	*14 064*	*13 760*
Saudi Arabia	04	0	0	0	0	0	0	0	-	-	-
	51	55 331	57 211	55 440	55 418	60 421	65 485	66 221	68 898	67 664	65 142
	Country total	*55 331*	*57 211*	*55 440*	*55 418*	*60 421*	*65 485*	*66 221*	*68 898*	*67 664*	*65 142*
Singapore	04	0	0	-	-	-	-	-	-	-	-
	71	3 342	2 769	2 085	2 173	1 920	3 103	3 522	1 623	2 121	1 732
	Country total	*3 342*	*2 769*	*2 085*	*2 173*	*1 920*	*3 103*	*3 522*	*1 623*	*2 121*	*1 732*
Sri Lanka	04	26 330	25 570	26 920	30 780	31 560	35 290	38 380	44 500	46 560	52 410
	57	265 251	271 603	301 399	302 580	159 296	238 735	268 900	282 904	309 134	383 945
	Country total	*291 581*	*297 173*	*328 319*	*333 360*	*190 856*	*274 025*	*307 280*	*327 404*	*355 694*	*436 355*
Syria	04	5 969	6 355	5 851	5 451	4 770	4 869	6 075	3 784	3 500	3 679
	37	2 322	2 823	3 060	3 077	3 677	3 395	3 381	3 212	3 107	2 956
	Country total	*8 291*	*9 178*	*8 911*	*8 528*	*8 447*	*8 264*	*9 456*	*6 996*	*6 607*	*6 635*
Tajikistan	04	137	181	158	184	146	146 F	146 F	150 F	150 F	160 F
	Country total	*137*	*181*	*158*	*184*	*146*	*146 F*	*146 F*	*150 F*	*150 F*	*160 F*
Thailand	04	202 500	198 700	198 447	203 700	198 730	214 000	225 600	228 600	206 856	209 800
	51	273	17	54	443	12 162	23 446	10 367	9 567	10 075	220
	57	759 952	781 032	790 906	829 448	818 813	867 970	621 086	642 117	643 114	623 471
	71	1 871 249	1 862 679	1 860 263	1 806 078	1 784 590	1 593 387	1 447 898	993 148	1 010 657	993 708
	Country total	*2 833 974*	*2 842 428*	*2 849 670*	*2 839 669*	*2 814 295*	*2 698 803*	*2 304 951*	*1 873 432*	*1 870 702*	*1 827 199*
Timor-Leste	04	0	0	0	0	-	-	-	-	-	-
	57	356	800 F	1 250 F	1 700 F	2 150 F	2 550 F	2 912	3 125	3 125 F	3 125 F
	Country total	*356*	*800 F*	*1 250 F*	*1 700 F*	*2 150 F*	*2 550 F*	*2 912*	*3 125*	*3 125 F*	*3 125 F*
Turkey	04	43 323	43 938	44 698	45 585	46 115	44 082	43 321	41 011	39 187	40 259
	37	484 410	522 744	463 074	504 897	380 381	488 966	589 129	453 115	425 046	445 680
	Country total	*527 733*	*566 682*	*507 772*	*550 482*	*426 496*	*533 048*	*632 450*	*494 126*	*464 233*	*485 939*
Turkmenistan	04	12 749	12 812	14 543	14 992	15 000 F	15 000 F	15 000 F	15 000 F	15 000 F	15 000 F
	Country total	*12 749*	*12 812*	*14 543*	*14 992*	*15 000 F*	*15 000 F*	*15 000 F*	*15 000 F*	*15 000 F*	*15 000 F*
Untd Arab Em	04	0	0	0	0	0	0	0	-	-	-
	51	112 561	97 574	95 150	90 000 F	86 735	82 500 F	78 300 F	74 075	77 705	79 610
	Country total	*112 561*	*97 574*	*95 150*	*90 000 F*	*86 735*	*82 500 F*	*78 300 F*	*74 075*	*77 705*	*79 610*
Uzbekistan	04	2 341	1 564	1 349	1 230	1 330 F	1 431	1 973	2 731	6 051	4 078
	Country total	*2 341*	*1 564*	*1 349*	*1 230*	*1 330 F*	*1 431*	*1 973*	*2 731*	*6 051*	*4 078*
Viet Nam	04	243 583	226 958	208 872	206 600	196 800	202 900	198 200	189 700	188 800	194 200
	71	1 481 175	1 575 640	1 647 233	1 733 434	1 791 100	1 824 800	1 876 400	1 946 600	2 091 700	2 226 600
	Country total	*1 724 758*	*1 802 598*	*1 856 105*	*1 940 034*	*1 987 900*	*2 027 700*	*2 074 600*	*2 136 300*	*2 280 500*	*2 420 800*
Yemen	51	142 198	179 584	228 116	256 300	238 400	229 660	179 916	127 132	159 000 F	191 100
	Country total	*142 198*	*179 584*	*228 116*	*256 300*	*238 400*	*229 660*	*179 916*	*127 132*	*159 000 F*	*191 100*
Total		***43 281 302***	***43 010 268***	***44 012 840***	***43 784 346***	***44 458 226***	***45 641 166***	***46 362 998***	***46 466 520***	***46 899 732***	***48 713 082***

D-4 **Fish crustaceans, molluscs, etc** | **Capture production by countries or areas and fishing areas** | **Europe**
Poissons, crustacés, mollusques, etc | **Captures par pays ou zones et zones de pêche** | **Europe**
Peces, crustáceos, moluscos, etc | **Capturas por países o áreas y áreas de pesca** | **Europa**

	Fishing area Zone de pêche Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Albania	05	1 373	1 167	1 265 F	1 807	2 210	2 442	2 591	2 144	2 251	3 041
	37	1 937	2 488	1 535	2 742	2 790	3 287	2 906	3 362	3 694	3 103
	Country total	*3 310*	*3 655*	*2 800 F*	*4 549*	*5 000*	*5 729*	*5 497*	*5 506*	*5 945*	*6 144*
Andorra	05	0	0	0	0	0	0	0	0	0	0
	Country total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Austria	05	362	350	372	400	370	360	350	350	350	350
	Country total	*362*	*350*	*372*	*400*	*370*	*360*	*350*	*350*	*350*	*350*
Belarus	05	944	1 020	803	583	594	645	689	809	826	897
	Country total	*944*	*1 020*	*803*	*583*	*594*	*645*	*689*	*809*	*826*	*897*
Belgium	05	511	511	511	496	496	496	512	511	511	511
	27	29 698	28 517	26 320	26 239	24 071	22 523	24 029	22 098	21 211	21 907
	Country total	*30 209*	*29 028*	*26 831*	*26 735*	*24 567*	*23 019*	*24 541*	*22 609*	*21 722*	*22 418*
Bosnia Herzg	05	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F	2 000 F
	37	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F
	Country total	*2 005 F*	*2 005 F*	*2 005 F*	*2 005 F*	*2 005 F*	*2 005 F*	*2 005 F*	*2 005 F*	*2 005 F*	*2 005 F*
Bulgaria	05	1 640	1 453	1 824	2 434	2 025	1 916	1 073	1 197	1 588	1 085
	34	2 154	-	-	-	-	-	-	-	-	-
	37	4 880	13 555	10 211	5 818	3 409	5 628	7 830	7 667	7 390	9 684
	Country total	*8 674*	*15 008*	*12 035*	*8 252*	*5 434*	*7 544*	*8 903*	*8 864*	*8 978*	*10 769*
Channel Is	05	0	0	-	-	-	-	-	-	-	-
	27	3 927	3 449	3 526	3 201	3 505	3 468	3 566	3 228	2 649	3 373
	Country total	*3 927*	*3 449*	*3 526*	*3 201*	*3 505*	*3 468*	*3 566*	*3 228*	*2 649*	*3 373*
Croatia	05	34	25	19	37	33	46	60	45	425	456
	37	18 455	21 205	19 927	30 127	34 632	37 807	40 139	48 979	55 325	52 372
	Country total	*18 489*	*21 230*	*19 946*	*30 164*	*34 665*	*37 853*	*40 199*	*49 024*	*55 750*	*52 828*
Czech Rep	05	4 646	4 983	5 127	4 528	4 242	4 646	4 276	4 164	4 112	3 990
	Country total	*4 646*	*4 983*	*5 127*	*4 528*	*4 242*	*4 646*	*4 276*	*4 164*	*4 112*	*3 990*
Denmark	05	99	77	129	123	60	54	44	40	45	41
	21	93	359	1 006	2 754	3 696	3 632	3 520	3 803	5 072	5 130
	27	1 510 502	1 441 912	1 030 086	1 087 719	906 842	864 035	649 489	686 741	772 635	822 845
	Country total	*1 510 694*	*1 442 348*	*1 031 221*	*1 090 596*	*910 598*	*867 721*	*653 053*	*690 584*	*777 752*	*828 016*
Estonia	05	2 461	4 578	3 593	2 373	2 472	2 941	2 665	2 835	2 899	2 868
	21	12 402	15 022	15 999	16 261	14 690	8 406	13 329	13 086	5 978	4 328
	27	88 357	81 072	59 490	68 159	80 255	73 672	81 842	85 116	88 545	86 593
	34	6	4	-	-	-	-	-	-	-	-
	41	1 941	777	-	1 113	1 355	1 471	-	-	-	1 609
	Country total	*105 167*	*101 453*	*79 082*	*87 906*	*98 772*	*86 490*	*97 836*	*101 037*	*97 422*	*95 398*
Faroe Is	05	0	0	0	-	-	-	-	-	-	-
	21	12 722	8 262	14 386	6 943	5 993	3 729	4 489	4 379	4 934	5 019
	27	503 187	517 729	606 605	592 443	559 267	619 393	577 645	490 969	325 871	377 111
	87	-	-	-	-	-	-	38 700	22 919	20 213	11 745
	Country total	*515 909*	*525 991*	*620 991*	*599 386*	*565 260*	*623 122*	*620 834*	*518 267*	*351 018*	*393 875*
Finland	05	34 786	35 570	35 570	36 268	36 268	36 513	36 513	29 274	29 424	29 312
	27	115 270	106 731	86 384	99 159	95 473	112 932	128 169	119 362	125 327	129 845
	Country total	*150 056*	*142 301*	*121 954*	*135 427*	*131 741*	*149 445*	*164 682*	*148 636*	*154 751*	*159 157*
FYRMacedonia	05	128	148	162	213	246	89	122	122	141	177
	Country total	*128*	*148*	*162*	*213*	*246*	*89*	*122*	*122*	*141*	*177*
France	05	2 641	2 600 F	2 600 F	2 600 F	2 600 F	2 600 F	2 600 F	2 600 F	2 500 F	2 500 F
	27	428 223	423 362	416 209	396 063	386 010	404 939	380 094	331 228	301 996	312 169
	34	55 111	53 726	56 331	48 948	41 353	29 316	17 166	22 546	29 591	39 062
	37	43 107	44 754	47 885	37 862	31 176	32 298	37 387	21 900	19 877	17 596
	48	386	-	-	-	-	-	-	-	-	-
	51	76 625	98 461	108 157	107 422	106 956	97 740	69 526	74 920	58 428	47 856
	57	-	-	-	-	-	1 051	11	-	512	111
	58	6 116	6 546	7 496	7 036	6 782	6 990	6 607	7 178	7 872	7 220
	Country total	*612 209*	*629 449*	*638 678*	*599 931*	*574 877*	*574 934*	*513 391*	*460 372*	*420 776*	*426 514*
Germany	05	20 678 F	20 118 F	19 391 F	18 851 F	17 100 F	16 642 F	16 162 F	16 262 F	15 502 F	15 010
	21	1 359	2 861	3 550	1 587	1 592	1 541	1 521	3 972	1 879	1 821
	27	184 432	193 625	234 706	235 566	262 676	259 447	212 568	203 467	193 138	192 673
	34	2 673	5 168	-	2 339	-	15 407	13 199	-	-	21
	48	-	-	-	-	-	-	14	-	-	-
	87	-	-	-	-	-	-	47 047	50 581	33 526	13 246
	Country total	*209 142*	*221 772*	*257 647*	*258 343*	*281 368*	*293 037*	*290 511*	*274 282*	*244 045*	*222 771*
Gibraltar	37	0	0	0	0	0	0	0	0	0	0
	Country total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Greece	05	3 181	3 000	3 166	1 940	1 580	1 413	1 439	1 425	940	940 F
	34	5 972	5 983	4 749	3 204	2 548	4 281	3 296	1 964	1 780	1 780 F
	37	85 037	87 360	85 468	88 742	88 294	92 542	91 358	86 035	80 608	80 280 F
	Country total	*94 190*	*96 343*	*93 383*	*93 886*	*92 422*	*98 236*	*96 093*	*89 424*	*83 328*	*83 000 F*
Hungary	05	6 638	6 750	6 536	7 242	7 609	7 543	7 024	7 394	6 366	6 216

D-4 **Fish crustaceans, molluscs, etc** | **Capture production by countries or areas and fishing areas** | **Europe**
Poissons, crustacés, mollusques, etc | **Captures par pays ou zones et zones de pêche** | **Europe**
Peces, crustáceos, moluscos, etc | **Capturas por países o áreas y áreas de pesca** | **Europa**

	Fishing area Zone de pêche Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Country total	*6 638*	*6 750*	*6 536*	*7 242*	*7 609*	*7 543*	*7 024*	*7 394*	*6 366*	*6 216*
Iceland	05	160	210	225	222	219	173	185	231	235	260
	21	5 079	6 877	7 226	7 588	6 814	4 054	...	...	...	185
	27	1 978 335	2 127 459	1 979 088	1 725 892	1 657 624	1 322 852	1 399 005	1 283 803	1 141 634	1 060 195
	Country total	*1 983 574*	*2 134 546*	*1 986 539*	*1 733 702*	*1 664 657*	*1 327 079*	*1 399 190*	*1 284 034*	*1 141 869*	*1 060 640*
Ireland	05	902	796	615	610	521	443	178	214	86	116
	27	281 831	242 473	232 165	245 882	234 053	211 321	214 693	203 124	256 824	285 527
	34	73 695	39 351	33 438	33 737	33 065	-	-	2 004	12 173	33 299
	Country total	*356 428*	*282 620*	*266 218*	*280 229*	*267 639*	*211 764*	*214 871*	*205 342*	*269 083*	*318 942*
Isle of Man	05	0	0	-	-	-	-	-	-	-	-
	27	3 112	3 127	2 984	2 627	2 764	1 209	3 760	2 770	3 555	4 814
	Country total	*3 112*	*3 127*	*2 984*	*2 627*	*2 764*	*1 209*	*3 760*	*2 770*	*3 555*	*4 814*
Italy	05	5 527	4 242	4 379	5 099	3 823	3 915	3 944	3 552	4 988	3 852
	34	7 359	6 202	8 044	7 381	5 354	4 826	4 920	2 910	2 987	1 809
	37	294 314	254 642	273 255	262 300	278 384	296 900	273 256	221 652	239 564	228 440
	51	3 199	4 760	10 013	12 303	9 326	9 794	4 522	7 645	5 462	-
	Country total	*310 399*	*269 846*	*295 691*	*287 083*	*296 887*	*315 435*	*286 642*	*235 759*	*253 001*	*234 101*
Latvia	05	581	581	565	360	356	328	310	349	326	330
	21	3 330	2 742	4 575	3 979	2 806	2 184	2 435	1 790	1 670	994
	27	76 930	79 863	71 978	82 706	93 605	83 972	90 516	87 385	79 934	76 257
	34	47 335	30 491	37 263	38 346	53 851	53 905	62 015	68 410	81 283	87 238
	41	...	...	162	-	-	-	-	-	-	-
	Country total	*128 176*	*113 677*	*114 543*	*125 391*	*150 618*	*140 389*	*155 276*	*157 934*	*163 213*	*164 819*
Liechtensten	05	0	0	0	0	0	0	0	0	0	0
	Country total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Lithuania	05	1 854	758	1 959	1 766	1 547	1 437	1 874	1 600	1 315	1 310
	21	7 596	10 948	11 671	8 644	5 484	2 831	3 492	1 293	-	1 542
	27	31 381	32 006	27 322	20 082	17 878	34 592	46 456	35 083	39 079	19 854
	34	110 000	106 434	111 567	131 496	114 876	115 688	99 802	120 731	111 019	116 850
	47	-	-	4 686	-	-	-	-	-	-	-
	87	-	-	-	-	-	-	35 889	24 053	21 279	10 295
	Country total	*150 831*	*150 146*	*157 205*	*161 988*	*139 785*	*154 548*	*187 513*	*182 760*	*172 692*	*149 851*
Luxembourg	05	0	0	0	0	0	0	0	0	0	0
	Country total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Malta	05	0	-	-	-	-	-	-	-	-	-
	37	902	1 084	1 138	1 138	1 406	1 330	1 235	1 279	1 595	1 836
	Country total	*902*	*1 084*	*1 138*	*1 138*	*1 406*	*1 330*	*1 235*	*1 279*	*1 595*	*1 836*
Moldova Rep	05	387	565	343	487	531	612	1 160	1 407	1 607	1 633
	Country total	*387*	*565*	*343*	*487*	*531*	*612*	*1 160*	*1 407*	*1 607*	*1 633*
Monaco	37	3 F	3 F	3 F	3 F	2 F	1 F	1 F	1 F	1 F	1 F
	Country total	*3 F*	*3 F*	*3 F*	*3 F*	*2 F*	*1 F*	*1 F*	*1 F*	*1 F*	*1 F*
Montenegro	05	...	...	...	...	...	786	441	841	887	534
	37	...	...	...	...	...	568	539	638	563	610
	Country total	*...*	*...*	*...*	*...*	*...*	*1 354*	*980*	*1 479*	*1 450*	*1 144*
Netherlands	05	2 200 F	2 578	2 150 F	2 100 F	2 100 F	2 100 F	2 000 F	2 000 F	2 000 F	2 051 F
	27	339 041	300 315	349 023	390 823	429 242	357 335	355 026	294 667	260 636	283 382
	34	176 922	161 143	175 108	128 713	117 866	75 900	11 232	80 938	80 205	92 579
	87	-	-	-	-	6 187	33 766	45 363	39 192	39 401	11 345
	Country total	*518 163*	*464 036*	*526 281*	*521 636*	*555 395*	*469 101*	*413 621*	*416 797*	*382 242*	*389 357*
Norway	05	550 F	500 F	450 F	405	507	679	851	874	662	705
	21	14 394	14 435	24 792	13 133	2 450	2 377	3 479	2 767	3 045	2 778
	27	2 671 998	2 725 540	2 523 561	2 510 657	2 389 344	2 243 779	2 335 974	2 364 437	2 476 555	2 552 408
	41	-	-	-	-	-	43	-	-	-	-
	48	-	-	-	-	-	9 185	39 793	63 293	44 175	119 401
	88	-	-	-	182	293	385	328	-	-	-
	Country total	*2 686 942*	*2 740 475*	*2 548 803*	*2 524 377*	*2 392 594*	*2 256 448*	*2 380 425*	*2 431 371*	*2 524 437*	*2 675 292*
Poland	05	17 789	18 947	19 994	20 330	19 469	19 183	19 059	18 937	18 798	18 508
	21	760	428	921	2 199	1 286	1 093	436	-	-	-
	27	159 163	151 561	146 111	156 489	129 352	118 790	124 911	98 997	134 003	115 818
	34	13 185	28 712	-	-	-	-	-	16 527	41 021	14 604
	41	756	2 754	-	-	-	-	-	-	-	-
	47	3 100	4 318	4 468	4 123	805	-	-	-	-	-
	48	13 717	16 720	8 905	8 967	4 335	6 413	7 414	8 035	8 149	6 995
	61	16 590	-	-	-	-	-	-	-	-	-
	67	4	-	-	-	-	-	-	-	-	-
	87	-	-	-	-	-	-	-	-	21 922	33 796
	Country total	*225 064*	*223 440*	*180 399*	*192 108*	*155 247*	*145 479*	*151 820*	*142 496*	*223 893*	*189 721*
Portugal	05	1	12	1	4	6	2	0	0	0	0
	21	15 003	18 526	22 780	13 452	12 985	13 911	12 123	12 436	15 459	15 622
	27	159 921	165 163	170 116	190 380	186 874	190 723	216 822	188 686	162 600	186 118
	31	-	49	-	-	8	11	297	35	45	61
	34	9 899	11 484	11 392	12 653	11 458	14 491	14 661	14 541	13 137	11 921
	37	288	29	8	359	98	54	24	37	58	85

D-4 **Fish crustaceans, molluscs, etc** | **Capture production by countries or areas and fishing areas** | **Europe**
Poissons, crustacés, mollusques, etc | **Captures par pays ou zones et zones de pêche** | **Europe**
Peces, crustáceos, moluscos, etc | **Capturas por países o áreas y áreas de pesca** | **Europa**

	Fishing area Zone de pêche Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	41	2 731	3 853	429	1 387	2 778	1 776	3 891	5 808	4 204	5 170
	47	2 084	1 552	2 128	1 194	2 718	2 860	3 541	1 618	2 178	1 542
	51	3 339	2 185	5 588	2 723	3 207	5 177	2 783	912	1 108	2 018
	57	-	-	-	151	327	67	1 245	173	24	83
	87	-	-	-	-	-	-	794	-	-	324
	Country total	*193 266*	*202 853*	*212 442*	*222 303*	*220 459*	*229 072*	*256 181*	*224 246*	*198 813*	*222 944*
Romania	05	5 178	4 858	8 278	3 255	4 027	6 049	5 665	4 966	3 688	2 457
	37	2 431	2 122	1 612	1 840	2 026	614	518	444	332	231
	Country total	*7 609*	*6 980*	*9 890*	*5 095*	*6 053*	*6 663*	*6 183*	*5 410*	*4 020*	*2 688*
Russian Fed	05	206 430	208 522	190 712	178 403	219 237	209 376	250 248	216 841	246 137	262 983
	18	-	-	-	-	-	-	2	480	-	589
	21	32 138	34 686	34 364	22 254	17 823	10 312	9 053	7 151	5 245	6 710
	27	1 061 969	1 119 911	1 010 327	893 465	898 395	890 741	853 238	830 935	926 124	994 468
	34	129 436	121 505	57 063	159 524	168 913	204 016	170 395	134 814	154 530	206 306
	37	33 668	40 004	42 578	35 318	33 725	31 850	26 847	30 413	32 669	30 664
	41	3 214	8 286	3 415	986	-	-	-	-	-	157
	47	39 850	8 611	14 412	323	-	-	-	-	-	-
	48	225	1 686	617	775	-	-	-	222	9 654	8 127
	51	221	123	205	-	-	-	-	-	-	-
	61	2 121 532	1 688 908	1 926 900	1 650 283	1 858 444	1 936 749	2 162 308	2 157 388	2 450 793	2 553 252
	67	-	109	68	-	475	547	2 488	2 869	578	6 368
	81	-	-	-	-	-	-	697	-	-	-
	87	-	-	137	-	-	-	-	2 323	399	-
	88	-	-	712	264	674	715	607	288	-	-
	Country total	*3 628 683*	*3 232 351*	*3 281 510*	*2 941 595*	*3 197 686*	*3 284 306*	*3 475 883*	*3 383 724*	*3 826 129*	*4 069 624*
San Marino	05	0	0	0	0	0	0	0	0	0	0
	Country total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Serbia	05	...	...	...	...	...	2 632	2 535	3 153	3 846	4 807
	Country total	*...*	*...*	*...*	*...*	*...*	*2 632*	*2 535*	*3 153*	*3 846*	*4 807*
Serbia-Monte	05	646	1 119	1 301	1 909	1 988	-	-	-	-	-
	37	445	466	497	477	443	...	...	...	...	...
	Country total	*1 091*	*1 585*	*1 798*	*2 386*	*2 431*	*...*	*...*	*...*	*...*	*...*
Slovakia	05	1 531	1 746	1 646	1 603	1 693	1 718	1 994	1 655	1 761	1 608
	Country total	*1 531*	*1 746*	*1 646*	*1 603*	*1 693*	*1 718*	*1 994*	*1 655*	*1 761*	*1 608*
Slovenia	05	206	226	195	208	202	200	196	183	164	168
	37	1 621	1 460	1 086	814	1 021	931	915	686	868	764
	Country total	*1 827*	*1 686*	*1 281*	*1 022*	*1 223*	*1 131*	*1 111*	*869*	*1 032*	*932*
Spain	05	7 300 F	6 600 F	6 000 F	6 000 F	6 000 F	6 000 F	6 000 F	6 000 F	6 000 F	6 000 F
	21	40 235	34 092	35 140	19 395	21 290	20 640	13 802	17 880	14 744	25 897
	27	430 081	319 878	336 504	307 529	329 328	365 712	335 420	388 228	338 991	374 232
	31	1 789	2 460	3 092	3 436	5 364	3 188	6 329	4 118	5 850	8 007
	34	159 994	123 680	136 945	116 102	98 812	91 639	84 690	108 262	136 399	131 309
	37	139 143	118 340	93 083	94 023	109 897	130 759	119 443	105 359	102 416	99 722
	41	111 400	50 698	33 001	43 667	41 416	67 622	75 643	87 949	112 426	117 356
	47	22 732	9 839	12 217	11 655	9 330	11 778	13 793	13 389	21 685	25 575
	48	643	832	882	660	373	378	375	838	833	666
	51	135 638	175 305	189 571	159 994	191 880	210 213	126 489	131 670	117 439	137 147
	57	...	1 620	8 315	5 613	2 732	1 775	932	1 693	2 806	730
	58	-	-	-	-	521	648	329	73	-	-
	61	-	-	-	-	537	-	-	-	-	-
	71	2 402	-	-	5 583	3 449	11 653	20 538	35 570	26 819	29 479
	77	15 722	20 503	23 738	18 027	17 657	24 139	5 936	5 999	14 620	3 847
	81	-	-	-	1 406	1 648	4 249	6 962	5 254	3 003	2 152
	87	26 817	26 662	16 488	17 076	12 922	10 907	3 514	5 808	13 706	6 172
	88	-	-	-	127	-	-	-	46	387	371
	Country total	*1 093 896*	*890 509*	*894 976*	*810 293*	*853 156*	*961 300*	*820 195*	*918 136*	*918 124*	*968 662*
Svalbard Is	27	0	0	0	0	0	0	0	0	0	0
	Country total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Sweden	05	1 234	1 436	1 491	1 393	1 417	1 644	1 546	1 614	1 564	1 368
	27	310 583	293 528	285 384	268 537	254 942	267 607	236 707	229 722	201 851	210 667
	Country total	*311 817*	*294 964*	*286 875*	*269 930*	*256 359*	*269 251*	*238 253*	*231 336*	*203 415*	*212 035*
Switzerland	05	1 715	1 544	1 815	1 602	1 475	1 422	1 377	1 582	1 687	1 653
	Country total	*1 715*	*1 544*	*1 815*	*1 602*	*1 475*	*1 422*	*1 377*	*1 582*	*1 687*	*1 653*
Ukraine	05	4 343	3 823	15 144	5 263	6 027	7 171	12 603	4 590	5 855	4 640
	21	405	-	389	582	-	404	-	-	-	-
	34	137 145	91 334	53 407	47 193	66 360	90 260	74 552	47 963	66 794	46 680
	37	90 840	79 654	64 244	65 449	75 335	57 303	53 148	58 294	65 907	69 810
	41	-	-	-	-	-	378	378	413	96	200
	47	4 312	-	-	-	-	-	-	-	-	-
	48	14 172	32 015	17 715	12 261	22 441	15 252	...	8 133	-	-
	51	845	-	-	-	-	-	-	-	-	-
	57	-	-	-	13	-	-	-	-	-	-
	58	8	-	-	-	-	-	-	-	-	-
	81	58 908	58 773	71 450	71 747	74 782	67 966	72 827	76 056	74 521	64 691
	88	-	-	-	168	-	-	-	-	-	-
	Country total	*310 978*	*265 599*	*222 349*	*202 676*	*244 945*	*238 734*	*213 508*	*195 449*	*213 173*	*186 021*

D-4 **Fish crustaceans, molluscs, etc** | **Capture production by countries or areas and fishing areas** | **Europe**
Poissons, crustacés, mollusques, etc | **Captures par pays ou zones et zones de pêche** | **Europe**
Peces, crustáceos, moluscos, etc | **Capturas por países o áreas y áreas de pesca** | **Europa**

	Fishing area Zone de pêche Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
UK	05	3 142	3 431	3 875	1 120	1 172	2 421	2 517	2 529	2 562	2 473
	21	-	-	547	-	-	-	-	303	617	3 605
	27	729 704	679 049	625 363	648 066	658 767	603 711	594 286	544 954	564 148	575 072
	34	31	-	-	1	834	8 507	12 497	35 718	14 167	22 528
	41	7 007	5 262	3 544	2 539	6 227	4 791	3 999	5 982	4 066	6 272
	47	-	-	-	-	-	851	857	266	34	-
	48	1 161	2 149	2 157	2 175	1 812	2 020	3 349	3 507	2 841	1 016
	51	-	-	-	562	668	698	760	2 030	1 746	474
	57	-	-	-	-	100	1 163	910	-	53	677
	88	-	-	-	32	325	407	516	718	830	538
	Country total	*741 045*	*689 891*	*635 486*	*654 495*	*669 905*	*624 569*	*619 691*	*596 007*	*591 064*	*612 655*
Total		***15 934 138***	***15 220 556***	***14 553 314***	***13 897 116***	***13 826 185***	***13 431 433***	***13 366 977***	***13 011 673***	***13 339 638***	***13 793 678***

D-5

Fish crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas and fishing areas
Captures par pays ou zones et zones de pêche
Capturas por países o áreas y áreas de pesca

Oceania
Océanie
Oceanía

	Fishing area Zone de pêche Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Amer Samoa	06	0	-	-	-	-	-	-	-	-	-
	77	3 667	6 939	5 089	4 041	4 019	5 349	6 512	4 423	4 943	5 261
	Country total	*3 667*	*6 939*	*5 089*	*4 041*	*4 019*	*5 349*	*6 512*	*4 423*	*4 943*	*5 261*
Australia	06	185	156	303	317	501	335	1 238	1 275	1 576	844
	57	106 304	116 749	135 034	150 828	162 141	129 517	117 439	112 226	106 799	112 172
	58	4 129	3 628	5 391	3 114	4 793	3 273	2 501	2 669	2 778	3 079
	71	52 950	49 958	45 923	47 066	43 252	40 927	44 445	43 516	39 462	36 868
	81	27 804	26 693	28 608	29 354	25 797	23 056	22 453	21 831	21 022	18 447
	Country total	*191 372*	*197 184*	*215 259*	*230 679*	*236 484*	*197 108*	*188 076*	*181 517*	*171 637*	*171 410*
Cook Is	06	0	0	0	0	0	0	0	0	0	-
	51	-	-	-	-	-	-	-	-	-	6 082
	57	-	-	-	-	-	-	-	-	-	2
	71	-	-	-	0	32	319	283	331	118	101
	77	800 F	1 399 F	3 295	4 067	3 962	3 563	3 941	3 409	2 577	3 700
	81	-	1	2	2	-	31	58	13	0	134
	87	-	-	-	-	-	-	20	-	-	-
	Country total	*800 F*	*1 400 F*	*3 297*	*4 069*	*3 994*	*3 913*	*4 302*	*3 753*	*2 695*	*10 019*
Fiji	06	5 921	3 800 F	1 263	2 993	3 000 F	3 078	2 188	2 100 F	1 850 F	1 680
	71	37 605	35 000 F	34 511	45 075	40 000 F	44 341	43 775	41 310 F	37 320 F	39 671 F
	Country total	*43 526*	*38 800*	*35 774*	*48 068*	*43 000 F*	*47 419*	*45 963*	*43 410 F*	*39 170 F*	*41 351 F*
Fr Polynesia	06	53	53	52 F	51 F	50	53	53	53	53	53
	77	15 351	15 490	13 552 F	12 437 F	12 102	13 356	13 095	11 932	13 321	12 962
	Country total	*15 404*	*15 543*	*13 604 F*	*12 488 F*	*12 152*	*13 409*	*13 148*	*11 985*	*13 374*	*13 015*
Guam	71	801	557	527	682	370	604	640	322	488	291
	Country total	*801*	*557*	*527*	*682*	*370*	*604*	*640*	*322*	*488*	*291*
Kiribati	06	0	0	0	-	-	-	-	-	-	-
	71	33 280	36 694	33 712	31 062 F	30 562 F	25 661 F	34 170	28 000	40 623	44 599
	Country total	*33 280*	*36 694*	*33 712*	*31 062 F*	*30 562 F*	*25 661 F*	*34 170*	*28 000*	*40 623*	*44 599*
Marshall Is	06	0	0	-	-	-	-	-	-	-	-
	71	36 581	39 859	38 886	47 887	57 583	43 974	61 229	35 102	46 246	59 730
	Country total	*36 581*	*39 859*	*38 886*	*47 887*	*57 583*	*43 974*	*61 229*	*35 102*	*46 246*	*59 730*
Micronesia	06	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F	5 F
	71	19 316 F	22 771 F	33 598 F	31 818	32 207	15 287	20 718	25 290	27 701	30 866 F
	Country total	*19 321 F*	*22 776 F*	*33 603 F*	*31 823*	*32 212*	*15 292*	*20 723*	*25 295*	*27 706*	*30 871 F*
Nauru	71	360 F	342 F	344 F	298 F	300 F	280 F	260 F	240 F	220 F	200 F
	Country total	*360 F*	*342 F*	*344 F*	*298 F*	*300 F*	*280 F*	*260 F*	*240 F*	*220 F*	*200 F*
NewCaledonia	06	0	0	-	-	-	-	-	-	-	-
	71	3 309	3 380	3 453	3 733	3 314	3 146	3 507	3 720	3 554	3 771
	Country total	*3 309*	*3 380*	*3 453*	*3 733*	*3 314*	*3 146*	*3 507*	*3 720*	*3 554*	*3 771*
New Zealand	06	1 076	900	850	801	812	865	817	752	729	892
	41	-	-	69	-	-	-	-	-	-	-
	48	-	-	414	-	-	440	497	557	499	415
	58	-	-	-	-	78	0	0	-	-	-
	71	7 868	29 444	20 675	20 160	16 211	17 429	25 242	19 962	22 432	11 897
	81	560 189	556 731	527 703	523 714	526 232	456 354	466 720	429 917	414 802	421 627
	88	678	1 560	1 189	1 316	1 976	1 484	1 224	1 138	916	1 401
	Country total	*569 811*	*588 635*	*550 900*	*545 991*	*545 309*	*476 572*	*494 500*	*452 326*	*439 378*	*436 232*
Niue	06	0	0	-	-	-	-	-	-	-	-
	77	200 F	200 F	200 F	200 F	212 F	400	302 F	108 F	192	113
	Country total	*200 F*	*200 F*	*200 F*	*200 F*	*212 F*	*400*	*302 F*	*108 F*	*192*	*113*
Norfolk Is	06	0	0	0	0	0	0	0	0	0	0
	81	0	0	0	0	0	0	0	0	0	0
	Country total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
N Marianas	06	0	-	-	-	-	-	-	-	-	-
	71	406	296	172	169	214	221	219	168	192	243
	Country total	*406*	*296*	*172*	*169*	*214*	*221*	*219*	*168*	*192*	*243*
Palau	06	0	0	0	-	-	-	-	-	-	-
	71	1 084	1 027	1 047	1 079	932	967	985	1 007	1 000 F	1 000 F
	Country total	*1 084*	*1 027*	*1 047*	*1 079*	*932*	*967*	*985*	*1 007*	*1 000 F*	*1 000 F*
Papua N Guin	06	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F	13 500 F
	71	111 413	127 660	163 344	229 101	240 635	239 519	233 962	208 944	216 119	211 007
	Country total	*124 913 F*	*141 160*	*176 844*	*242 601*	*254 135*	*253 019*	*247 462*	*222 444*	*229 619*	*224 507*
Pitcairn Is	06	0	0	-	-	-	-	-	-	-	-
	81	5 F	5 F	5 F	3 F	3 F	3 F	3 F	3 F	3 F	3 F
	Country total	*5 F*	*5 F*	*5 F*	*3 F*	*3 F*	*3 F*	*3 F*	*3 F*	*3 F*	*3 F*
Samoa	06	1 F	1 F	1 F	1 F	1 F	1	1 F	1 F	1 F	1 F
	77	8 612 F	10 880 F	9 702 F	9 455 F	9 835 F	12 434	14 090	13 898	13 278	12 999 F
	Country total	*8 613 F*	*10 881 F*	*9 703 F*	*9 456 F*	*9 836 F*	*12 435*	*14 091*	*13 899*	*13 279*	*13 000 F*
Solomon Is	06	0	0	0	0	0	0	0	-	-	-
	71	23 642 F	25 779 F	35 839 F	34 994 F	30 086 F	39 520 F	31 304 F	27 434 F	27 941 F	35 179 F

D-5

Fish crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas and fishing areas
Captures par pays ou zones et zones de pêche
Capturas por países o áreas y áreas de pesca

Oceania
Océanie
Oceanía

	Fishing area Zone de pêche Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
	Country total	*23 642 F*	*25 779 F*	*35 839 F*	*34 994 F*	*30 086 F*	*39 520 F*	*31 304 F*	*27 434 F*	*27 941 F*	*35 179 F*
Tokelau	06	0	0	-	-	-	-	-	-	-	-
	77	140 F	128 F	113 F	103 F	96 F	86 F	78 F	68 F	62 F	54 F
	Country total	*140 F*	*128 F*	*113 F*	*103 F*	*96 F*	*86 F*	*78 F*	*68 F*	*62 F*	*54 F*
Tonga	06	0	0	0	0	0	0	0	-	-	-
	77	4 774	4 853	4 435	1 645	2 200 F	2 750 F	3 103 F	2 593 F	2 036 F	2 150 F
	Country total	*4 774*	*4 853*	*4 435*	*1 645*	*2 200 F*	*2 750 F*	*3 103 F*	*2 593 F*	*2 036 F*	*2 150 F*
Tuvalu	06	0	0	-	-	-	-	-	-	-	-
	71	500 F	600 F	1 500	2 450	2 560	2 560 F	2 560 F	2 560 F	5 097	11 324 F
	Country total	*500 F*	*600 F*	*1 500*	*2 450*	*2 560*	*2 560 F*	*2 560 F*	*2 560 F*	*5 097*	*11 324 F*
Vanuatu	06	0	0	0	0	0	0	0	-	-	-
	31	-	-	-	1 402	1 488	930	751	181	336	628
	34	-	-	-	52	814	1 862	1 515	477	412	159
	41	-	-	-	-	120	133	-	1 419	638	462
	47	-	-	-	-	-	1	-	-	-	-
	48	-	-	-	29 491	48 389	-	-	-	-	-
	57	-	-	-	-	-	-	-	-	769	622
	71	13 982 F	30 515 F	30 819	68 348	89 592	75 380	85 082	47 807	49 732	39 872
	77	6 620	2 986	11 349	4 905	2 261	1 472	2 820	2 427	2 616	4 897
	87	15 501	11 400	71 647	106 510	84 717	139 346	123 074	117 459	90 775	51 167
	Country total	*36 103 F*	*44 901 F*	*113 815*	*210 708*	*227 381*	*219 124*	*213 242*	*169 770*	*145 278*	*97 807*
Wallis Fut I	06	0	0	-	-	-	-	-	-	-	-
	71	300 F	300 F	300	400 F	500 F	600	650 F	700 F	750 F	800 F
	Country total	*300 F*	*300 F*	*300*	*400 F*	*500 F*	*600*	*650 F*	*700 F*	*750 F*	*800 F*
Total		***1 118 912***	***1 182 239***	***1 278 421***	***1 464 629***	***1 497 454***	***1 364 412***	***1 387 029***	***1 230 847***	***1 215 483***	***1 202 930***

D-6

Fish crustaceans, molluscs, etc
Poissons, crustacés, mollusques, etc
Peces, crustáceos, moluscos, etc

Capture production by countries or areas and fishing areas
Captures par pays ou zones et zones de pêche
Capturas por países o áreas y áreas de pesca

Other nei
Autres nca
Otros nep

	Fishing area Zone de pêche Área de pesca	2001 t	2002 t	2003 t	2004 t	2005 t	2006 t	2007 t	2008 t	2009 t	2010 t
Other nei	31	1 238	44	115	9	30	11	106	89	41	-
	34	120 991	159 115	187 416 F	156 692 F	133 791 F	130 886 F	126 277 F	111 056 F	146 284 F	6 364
	37	571	508	610	709	-	-	-	-	-	-
	41	146	9	26	126	12	147	111	349	166	-
	47	42	18	66	12	21	142	161	124	35	-
	51	96 007	79 303	91 232	51 967	37 752	10 367	6 816	7 097	11 723	9 418
	57	3 089	3 470	3 639	9 321	5 121	2 742	1 003	735	1 038	1 165
	77	9 955	30 208	27 269	981	35	3	-	-	-	-
	87	12 512	41 067	54 807	80 357	7 420	510	508	1	9 467	42 195
	Country total	*244 551*	*313 742*	*365 180 F*	*300 174 F*	*184 182 F*	*144 808 F*	*134 982 F*	*119 451 F*	*168 754 F*	*59 142*
Total		***244 551***	***313 742***	***365 180***	***300 174***	***184 182***	***144 808***	***134 982***	***119 451***	***168 754***	***59 142***

Notes on individual countries or areas

Notes sur divers pays ou zones

Notas sobre los distintos países o áreas

Notes on individual countries or areas

ALGERIA

Data concerning tuna catches are reviewed in collaboration with the International Commission for the Conservation of Atlantic Tunas (ICCAT), the regional agency concerned with tuna statistics.

AMERICAN SAMOA

Data concerning tuna catches are reviewed in collaboration with the Western and Central Pacific Fisheries Commission (WCPFC), the regional agency concerned with tuna statistics.

ANGOLA

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

Catch data for the Eastern Central Atlantic area have also been taken from the "Estatistícas de Pesca Industrial" published by CIPA (Guinea-Bissau).

ANGUILLA

Data for 'Stromboid conchs nei' since 1974 have been converted to live weight equivalents by using the conversion factor '7.5'.

ANTIGUA AND BARBUDA

Data for 'Stromboid conchs nei' since 1993 have been converted to live weight equivalents by using the conversion factor '7.5'.

ARMENIA

Increased catches since 2007 are due to the inclusion of estimated catches from recreational fisheries.

AUSTRALIA

Data refer to a split-year (1 July – 30 June) shown under the calendar year in which the split-year ends.

Data concerning tuna catches in the Indian Ocean are reviewed in collaboration with the Indian Ocean Tuna Commission (IOTC), the regional agency concerned with tuna statistics.

Catch data, excluding those for tuna species, for the South Pacific high seas area are reviewed in collaboration with the South Pacific Regional Fisheries Management Organisation (SPRFMO).

AUSTRIA

Excludes recreational fisheries.

BANGLADESH

Data refer to a split-year (1 July – 30 June) shown under the calendar year in which the split-year ends.

Data concerning tuna catches are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

Notes sur divers pays ou zones

ALGÉRIE

Les données concernant les captures des thonidés sont révisées en collaboration avec la Commission internationale pour la conservation des thonidés de l'Atlantique (CICTA), l'organisation régionale chargée des statistiques des thonidés.

SAMOA AMÉRICAINES

Les données concernant les captures des thonidés sont révisées en collaboration avec la Commission des pêches pour le Pacifique central et occidental (WCPFC), l'organisation régionale chargée des statistiques des thonidés.

ANGOLA

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

Les données sur les captures pour l'Atlantique centre-est ont également été tirées du "Estatistícas de Pesca Industrial" publié par CIPA (Guinée-Bissau).

ANGUILLA

Les données relatives aux 'Strombes nca' depuis 1974 ont été converties en équivalent poids vif en utilisant le facteur de conversion '7,5'.

ANTIGUA-ET-BARBUDA

Les données relatives aux 'Strombes nca' depuis 1993 ont été converties en équivalent poids vif en utilisant le facteur de conversion '7,5'.

ARMÉNIE

La hausse des captures enregistrée depuis 2007 est due à l'inclusion des estimations relatives à la pêche récréative.

AUSTRALIE

Les données se réfèrent à une année fractionnée (1er juillet - 30 juin) et figurent sous l'année civile durant laquelle se termine l'année fractionnée.

Les données concernant les captures des thonidés dans l'océan Indien sont révisées en collaboration avec la Commission des thons de l'océan Indien (CTOI), l'organisation régionale chargée des statistiques des thonidés.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour la zone de haute mer de l'océan Pacifique Sud, sont révisées en collaboration avec l'Organisation régionale de gestion des pêches du Pacifique Sud (SPRFMO).

AUTRICHE

Non compris la pêche récréative.

BANGLADESH

Les données se réfèrent à une année fractionnée (1er juillet - 30 juin) et figurent sous l'année civile durant laquelle se termine l'année fractionnée.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

Notas sobre los distintos países o áreas

ARGELIA

Los datos relativos a las capturas de atún se revisan en colaboración con la Comisión Internacional para la Conservación del Atún Atlántico (CICAA), el organismo regional encargado de las estadísticas atuneras.

SAMOA AMERICANA

Los datos relativos a las capturas de atún se revisan en colaboración con la Comisión de Pesca para el Pacífico Occidental y Central (WCPFC), el organismo regional encargado de las estadísticas atuneras.

ANGOLA

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

Los datos sobre las capturas en el área del Atlántico centro-oriental también se han extraído de las "Estatistícas de Pesca Industrial" publicadas por el CIPA (Guinea-Bissau).

ANGUILA

Los datos de 'Cobos nep' desde 1974 se han convertido en sus equivalentes de peso en vivo aplicando el factor de conversión '7,5'.

ANTIGUA Y BARBUDA

Los datos de 'Cobos nep' desde 1993 se han convertido en sus equivalentes de peso en vivo aplicando el factor de conversión '7,5'.

ARMENIA

El incremento de capturas desde 2007 se debe a la inclusión de la estimación de la pesca recreativa.

AUSTRALIA

Los datos se refieren a un año emergente (1 de julio - 30 de junio) que se indica como el año civil en que finaliza el año emergente.

Los datos relativos a las capturas de atún en el océano Índico se revisan en colaboración con la Comisión del Atún para el Océano Índico (CAOI), el organismo regional encargado de las estadísticas atuneras.

Los datos relativos a las capturas en el área de alta mar del Océano Pacífico Sur, con exclusión de las de atunes, se revisan en colaboración con la Organización de Ordenación Pesquera Regional del Pacífico Sur (SPRFMO).

AUSTRIA

Se excluye la pesca recreativa.

BANGLADESH

Los datos se refieren a un año emergente (1 de julio - 30 de junio) que se indica como el año civil en que finaliza el año emergente.

Los datos relativos a las capturas de atún se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

Notes on individual countries or areas

BELIZE

Data reported as “fish fillet”, “lobster tail”, “shrimp tails”, “crab claws”, and “conch” have been converted to live weight equivalents by using the conversion factors of ‘2’, ‘2’, ‘2’, ‘4’ and ‘7.5’ respectively.

Data concerning tuna catches are reviewed in collaboration with ICCAT, IOTC and WCPFC, the regional agencies concerned with tuna statistics.

Catch data, excluding those for tuna species, for the Eastern Central area have been taken from the Las Palmas Survey (LPS), the "Bulletin Statistique" published by IMROP (Mauritania), and the “Estatistícas de Pesca Industrial” published by CIPA (Guinea-Bissau).

Catch data, excluding those for tuna species, for the Southwest Atlantic area are provided by the Fisheries Department, Falkland Islands Government.

Catch data, excluding those for tuna species, for the South Pacific high seas area are reviewed in collaboration with SPRFMO.

BERMUDA

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

BRAZIL

The 100,000 tonnes of estimated subsistence catches included between 1995 and 2003 under 'Marine fishes nei' have been removed.

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

BRITISH INDIAN OCEAN TER

Data concerning tuna catches are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

BRITISH VIRGIN ISLANDS

Include Anegada, Jost Van Dyke, Tortola and Virgin Gorda.

Large increase in capture production since 2001 is due to an improved coverage of the data collection system.

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

BULGARIA

Catch data for the Eastern Central Atlantic area have also been taken from the “Estatistícas de Pesca Industrial” published by CIPA (Guinea-Bissau).

CAMBODIA

Due to the introduction of a new methodology to estimate production of semi-commercial and subsistence fisheries, inland water catch statistics since 1999 are not comparable with those of previous years.

Catch data for the Southwest Atlantic area are provided by the Fisheries Department, Falkland Islands Government.

Data for 'Sea cucumber nei' recorded on a dry-weight basis have been converted to wet-weight equivalents by using the conversion factor ‘3’.

Notes sur divers pays ou zones

BELIZE

Les données rapportées comme “fish fillet”, “lobster tail”, “shrimp tails”, “crab claws” et “conch” ont été converties en équivalent poids vif en utilisant respectivement les facteurs de conversion ‘2’, ‘2’, ‘2’, ‘4’ et ‘7,5’.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, la CTOI et la WCPFC, les organisations régionales chargées des statistiques des thonidés.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique centre-est ont été tirées de l'Enquête Las Palmas, du "Bulletin statistique" publié par l’IMROP (Mauritanie) et du “Estatistícas de Pesca Industrial” publié par CIPA (Guinée-Bissau).

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l’Atlantique sud-ouest, sont fournies par le Département des pêches du Gouvernement des Iles Falkland.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour la zone de haute mer de l'océan Pacifique Sud, sont révisées en collaboration avec la SPRFMO.

BERMUDES

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

BRÉSIL

Les 100 000 tonnes des estimations de captures de la pêche de subsistance incluses entre 1995 et 2003 dans 'Poissons marins nca' ont été enlevées.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l’organisation régionale chargée des statistiques des thonidés.

TERR. BRIT. OCÉAN INDIEN

Les données concernant les captures des thonidés sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

ÎLES VIERGES BRITANNIQ.

Comprend Anegada, Jost Van Dyke, Tortola et Virgin Gorda.

L'augmentation des captures enregistrées depuis 2001 est due à une meilleure couverture du système de collecte des données.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l’organisation régionale chargée des statistiques des thonidés.

BULGARIE

Les données sur les captures pour l'Atlantique centre-est ont également été tirées du “Estatistícas de Pesca Industrial” publié par CIPA (Guinée-Bissau).

CAMBODGE

Du fait de l'introduction d'une nouvelle méthodologie pour estimer la production des pêches semi-commerciales et de subsistance, les statistiques des pêches dans les eaux intérieures depuis 1999 ne sont pas comparables avec celles des années précédentes.

Les données sur les captures pour l'Atlantique sud-ouest sont fournies par le Département des pêches du Gouvernement des Iles Falkland.

Les données relatives aux 'Bèches-de-mer nca' enregistrées en poids sec, ont été converties en leurs équivalent poids vif en utilisant le facteur de conversion ‘3’.

Notas sobre los distintos países o áreas

BELICE

Los datos proporcionados como “fish fillet”, “lobster tail”, “shrimp tails”, “crab claws” y “conch” se han convertido en sus equivalentes de peso en vivo aplicando respectivamente los factores de conversión ’2’, ‘2’, ‘2’, ‘4’ et ‘7,5’.

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, la WCPFC y la CAOI, los organismos regionales encargados de las estadísticas atuneras.

Los datos relativos a las capturas en el área del Atlántico centro-oriental, con exclusión de las de atunes, se han extraído de Las Palmas Survey (LPS), del "Bulletin statistique" publicado por el IMROP (Mauritania) y de las “Estatistícas de Pesca Industrial” publicadas por el CIPA (Guinea-Bissau).

Los datos relativos a las capturas en el área del Atlántico sudoccidental, con exclusión de las de atunes, fueron proporcionados por el Departamento de Pesca del Gobierno de las Islas Malvinas (Falkland).

Los datos relativos a las capturas en el área de alta mar del Océano Pacífico Sur, con exclusión de las de atunes, se revisan en colaboración con la SPRFMO.

BERMUDAS

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

BRASIL

Las 100 000 toneladas incluidas desde 1995 hasta 2003 en «Peces marinos nep» como estimación de capturas de subsistencia se han eliminado.

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

TER. BRIT. OCÉANO ÍNDICO

Los datos relativos a las capturas de atún se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

ISLAS VÍRGENES BRITÁN.

Incluye Anegada, Jost Van Dyke, Tortola y Virgin Gorda.

Las mayores capturas registradas desde 2001 se deben a una mejor cobertura del sistema de recopilación de datos.

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

BULGARIA

Los datos sobre las capturas en el área del Atlántico centro-oriental también se han extraído de las “Estatistícas de Pesca Industrial” publicadas por el CIPA (Guinea-Bissau).

CAMBOYA

Debido a la introducción de una nueva metodología para calcular la producción de las pesquerías semicomerciales y de subsistencia, las estadísticas de la pesca continental desde el año 1999 no son comparables con las de años anteriores.

Los datos relativos a las capturas en el área del Atlántico sudoccidental fueron proporcionados por el Departamento de Pesca del Gobierno de las Islas Malvinas (Falkland).

Los datos relativos a los 'Cohombros de mar nep' registrados en peso en seco se han convertido en sus equivalentes de peso húmedo aplicando el factor de conversión ‘3’.

Notes on individual countries or areas

CANADA

Data concerning tuna catches are reviewed in collaboration with ICCAT and WCPFC, the regional agencies concerned with tuna statistics.

CAPE VERDE

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

CHANNEL ISLANDS

The 1970-82 catch data refer to the Bailiwick of Guernsey only. The 1983-2010 catch data include also statistics relating to the Bailiwick of Jersey.

CENTRAL AFRICAN REPUBLIC

After many years in which no official information was submitted, the national authorities reported that total capture production for 2010 was estimated between 20,000 and 50,000 tonnes. Estimates for previous years were revised accordingly.

CHILE

Catch data for the Southwest Atlantic area are provided by the Fisheries Department, Falkland Islands Government.

CHINA

For statistical purposes, the data for China do not include Hong Kong Special Administrative Region (Hong Kong SAR), Macao SAR and Taiwan Province of China.

Catch data for 1997-2006 were substantially revised by FAO according to the report by the Chinese authorities of about 14 percent reduction of 2006 figures at aggregated level, based on the Second National Agriculture Census conducted in 2007.

Data concerning tuna catches in the Indian Ocean are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

Catch data, excluding those for tuna species, for the Eastern Central and Southeast Atlantic areas have been taken from the Las Palmas Survey (LPS), the "Bulletin Statistique" published by IMROP (Mauritania), and the “Estatistícas de Pesca Industrial” published by CIPA (Guinea-Bissau).

Catch data, excluding those for tuna species, for the Southwest Atlantic area are provided also by the Fisheries Department, Falkland Islands Government.

Catch data, excluding those for tuna species, for the South Pacific high seas area are reviewed in collaboration with SPRFMO.

Since 1970, data for 'Aquatic plants nei', recorded on a dry-weight basis have been converted to wet-weight equivalents by using the conversion factor ‘10’.

CHINA, HONG KONG SAR

Since 1999, only a total of marine capture production has been made available to FAO. Species breakdown is estimated.

Notes sur divers pays ou zones

CANADA

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA et la WCPFC, les organisations régionales chargées des statistiques des thonidés.

CAP-VERT

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

ÎLES ANGLO-NORMANDES

Les données relatives aux captures de 1970-82 se rapportent uniquement au bailliage de Guernsey. Les données relatives aux captures de 1983-2010 comprennent aussi les statistiques relatives au bailliage de Jersey.

REP. CENTRAFRICAINE

Après de nombreuses années dans lesquelles aucune information officielle a été soumise, les autorités nationales ont indiqué que la production de capture totale pour 2010 a éte estimée entre 20 000 et 50 000 tonnes. Les estimations pour les années précédentes ont été révisées en conséquence.

CHILI

Les données sur les captures pour l'Atlantique sud-ouest, sont fournies par le Département des pêches du Gouvernement des Iles Falkland.

CHINE

Les données statistiques relatives à la Chine ne comprennent pas celles qui concernent la Région administrative spéciale de Hong Kong (la RAS de Hong-Kong), la RAS de Macao et à Taïwan Province de Chine.

Les données des captures 1997-2006 ont été considérablement révisées par la FAO selon le rapport des autorités chinoises basé sur le Deuxième recensement national de l'agriculture effectué en 2007 qui a établi à peu près à 14 pour cent la réduction des captures totales de 2006.

Les données concernant les captures des thonidés dans l'océan Indien sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique du centre-est et du sud-est ont été tirées de l'Enquête Las Palmas, du "Bulletin statistique" publié par l’IMROP (Mauritanie) et du “Estatistícas de Pesca Industrial” publié par CIPA (Guinée-Bissau).

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique sud-ouest, sont fournies également par le Département des pêches du Gouvernement des Iles Falkland.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour la zone de haute mer de l'océan Pacifique Sud, sont révisées en collaboration avec la SPRFMO.

Depuis 1970 les données relatives aux 'Plantes aquatiques nca' enregistrées en poids sec, ont été converties en leurs équivalent poids vert en utilisant le facteur de conversion ‘10’.

CHINE, RAS DE HONG-KONG

Depuis 1999 la FAO n'a reçu que les données des captures marines totales. La répartition entre les espèces correspond à une estimation.

Notas sobre los distintos países o áreas

CANADÁ

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA y la WCPFC, los organismos regionales encargados de las estadísticas atuneras.

CABO VERDE

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

ISLAS ANGLONORMANDAS

Los datos de capturas de 1970-82 se refieren sólo a la bailía de Guernsey. Los datos de capturas de 1983-2010 incluyen también las estadísticas relativas a la bailía de Jersey.

REPUBLICA CENTROAFRICANA

Después muchos años sin proporcionar datos, las autoridades nacionales informaron que las capturas totales en 2010 se estimaron entre 20 000 y 50 000 toneladas. Las estimaciones de los años anteriores se revisaron en consecuencia.

CHILE

Los datos relativos a las capturas en el área del Atlántico sudoccidental fueron proporcionados por el Departamento de Pesca del Gobierno de las Islas Malvinas (Falkland).

CHINA

Los datos estadísticos relativos a China excluyen los datos correspondientes a la Región Administrativa Especial de Hong Kong (la RAE de Hong Kong), a la RAE de Macao y a Taiwán Provincia de China.

Los datos de capturas de 1997-2006 han sido revisados de manera considerable por la FAO según el informe de las autoridades chinas basado en el Segundo censo nacional de agricultura que se realizó en 2007, el cual estableció una reducción alrededor de 14 por ciento de las capturas de 2006 a nivel total.

Los datos relativos a las capturas de atún en el océano Índico se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

Los datos relativos a las capturas en las áreas del Atlántico centro-oriental y sudoriental, con exclusión de las de atunes, se han extraído de Las Palmas Survey (LPS), del "Bulletin statistique" publicado por el IMROP (Mauritania) y de las “Estatistícas de Pesca Industrial” publicadas por el CIPA (Guinea-Bissau).

Los datos relativos a las capturas en el área del Atlántico sudoccidental, con exclusión de las de atunes, fueron proporcionados también por el Departamento de Pesca del Gobierno de las Islas Malvinas (Falkland).

Los datos relativos a las capturas en el área de alta mar del Océano Pacífico Sur, con exclusión de las de atunes, se revisan en colaboración con la SPRFMO.

Desde 1970 los datos relativos a las 'Plantas acuáticas nep' registrados en peso en seco se han convertido en sus equivalentes de peso húmedo aplicando el factor de conversión ‘10’.

CHINA, RAE DE HONG KONG

Desde 1999 sólo se proporcionaron a la FAO datos de la producción total de capturas marinas. El desglose de especies constituye una estimación.

Notes on individual countries or areas

CHINA, MACAO SAR

Fishery surveys have been suspended since July 1996. Data since 1997 are FAO estimates.

COLOMBIA

Data concerning tuna catches are reviewed in collaboration with the Inter-American Tropical Tuna Commission (IATTC), the regional agency concerned with tuna statistics.

Data for 'Stromboid conchs nei' have been converted to live weight equivalents by using the conversion factor '7.5'.

COMOROS

Data concerning tuna catches are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

Catch data for the Eastern Central Atlantic area have been taken from the "Estatistícas de Pesca Industrial" published by CIPA (Guinea-Bissau) and the "Bulletin Statistique" published by IMROP (Mauritania).

COOK ISLANDS

Data concerning tuna catches are reviewed in collaboration with WCPFC, the regional agency concerned with tuna statistics.

COSTA RICA

Data for shrimps and 'Stromboid conchs nei' have been converted to live weight equivalents by using the conversion factors '2' and '7.5' respectively.

CÔTE D'IVOIRE

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

CROATIA

Catches in inland waters decreased between 1998 and 2008 as statistics on recreational fishery were not collected in those years.

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

CUBA

Total production of 'Blue tilapia' (*Oreochromis aureus*) is estimated as 80 percent capture production and 20 percent aquaculture production.

CYPRUS

Data refer to government-controlled area only.

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

Catch data, excluding those for tuna species, for the Eastern Central Atlantic area have also been taken from the "Bulletin statistique" published by IMROP, Mauritania.

Notes sur divers pays ou zones

CHINE, RAS DE MACAO

Les prospections des pêches ont été suspendues à partir de juillet 1996. Les données depuis 1997 sont des estimations de la FAO.

COLOMBIE

Les données concernant les captures des thonidés sont révisées en collaboration avec la Commission interaméricane du thon tropical (CITT), l'organisation régionale chargée des statistiques des thonidés.

Les données relatives aux 'Strombes nca' ont été converties en équivalent poids vif en utilisant le facteur de conversion '7,5'.

COMORES

Les données concernant les captures des thonidés sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

Les données sur les captures pour l'Atlantique centre-est ont été tirées du "Estatistícas de Pesca Industrial" publié par CIPA (Guinée-Bissau) et du "Bulletin statistique" publié par l'IMROP (Mauritanie).

ÎLES COOK

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l'organisation régionale chargée des statistiques des thonidés.

COSTA RICA

Les données concernant les crevettes et 'Strombes nca' ont été converties en équivalent poids vif en utilisant respectivement le facteurs de conversion '2' et '7,5'.

CÔTE D'IVOIRE

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

CROATIE

La diminution des captures dans les eaux continentales enregistrée pour les années 1998-2008 est due au manque de collecte de données statistiques concernant la pêche récréative.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

CUBA

La production totale de la tilapia *Oreochromis aureus* est estimée à 80 pour cent de production de capture et 20 pour cent de production d'aquaculture.

CHYPRE

Les données ne concernent que la partie du territoire sous contrôle du gouvernement.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique centre-est ont également été tirées du "Bulletin statistique" publié par l'IMROP, Mauritanie.

Notas sobre los distintos países o áreas

CHINA, RAE DE MACAO

Las encuestas pesqueras se suspendieron desde julio de 1996. Los datos desde 1997 son estimaciones de la FAO.

COLOMBIA

Los datos relativos a las capturas de atún se revisan en colaboración con la Comisión Interamericana del Atún Tropical (CIAT), el organismo regional encargado de las estadísticas atuneras.

Los datos de 'Cobos nep' se han convertido en sus equivalentes de peso en vivo aplicando el factor de conversión '7,5'.

COMORAS

Los datos relativos a las capturas de atún se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

Los datos sobre las capturas en el área del Atlántico centro-oriental se han extraído de las "Estatistícas de Pesca Industrial" publicadas por el CIPA (Guinea-Bissau) y del "Bulletin statistique" publicado por el IMROP (Mauritania).

ISLAS COOK

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

COSTA RICA

Los datos relativos a camarones y 'Cobos nep' se han convertido en sus equivalentes de peso en vivo aplicando respectivamente los factores de conversión '2' y '7,5'.

CÔTE D'IVOIRE

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

CROACIA

La disminución de las capturas en aguas continentales desde 1998 hasta 2008 se debe a que en aquellos años no se han recogido datos estadísticos sobre la pesca recreativa.

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

CUBA

La producción total de la tilapia *Oreochromis aureus* ha sido estimada como 80 por ciento producción de captura y 20 por ciento producción de acuicultura.

CHIPRE

Los datos se refieren solamente a la zona controlada por el Gobierno.

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

Los datos sobre las capturas en el área del Atlántico centro-oriental, con exclusión de las de atunes, también se han extraído de la publicación "Bulletin statistique" del IMROP, Mauritania.

Notes on individual countries or areas

ECUADOR

Data concerning tuna catches are reviewed in collaboration with IATTC and WCPFC, the regional agencies concerned with tuna statistics.

EL SALVADOR

Large increase in capture production since 2002 is due to an improved data collection system, particularly for the artisanal sector.

Data concerning tuna catches are reviewed in collaboration with IATTC, the regional agency concerned with tuna statistics.

EQUATORIAL GUINEA

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

FAROE ISLANDS

Catch data, excluding those for tuna species, for the South Pacific high seas area are reviewed in collaboration with SPRFMO.

FIJI

Includes Viti Levu, Vanua Levu, and Rotuma Islands.

Data concerning tuna catches are reviewed in collaboration with WCPFC, the regional agency concerned with tuna statistics.

Data for red and green seaweeds recorded on a dry-weight basis have been converted to wet-weight equivalents by using the conversion factor ‘8’.

FRANCE

Data concerning tuna catches are reviewed in collaboration with ICCAT and IOTC, the regional agencies concerned with tuna statistics.

Catch data, excluding those for tuna species, for the Eastern Central Atlantic area have also been taken from the "Bulletin statistique" published by IMROP, Mauritania.

FRENCH POLYNESIA

Data concerning tuna catches are reviewed in collaboration with WCPFC, the regional agency concerned with tuna statistics.

GEORGIA

Catch data, excluding those for tuna species, for the Eastern Central Atlantic area have been taken from the "Bulletin statistique" published by IMROP, Mauritania.

FRENCH SOUTHERN TERR.

Include Amsterdam Island, Saint-Paul Island, and French scattered Indian Ocean Islands in area 51 (Western Indian Ocean) and Kerguelen Islands and Crozet Archipelago in area 58 (Antarctic Indian Ocean). Catches reported for area 58 are included with those of France.

Notes sur divers pays ou zones

ÉQUATEUR

Les données concernant les captures des thonidés sont révisées en collaboration avec la CITT et la WCPFC, les organisations régionales chargées des statistiques des thonidés.

EL SALVADOR

L'augmentation des captures enregistrées depuis 2002 est due à une meilleure couverture, en particulier de la pêche artisanale.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CITT, l’organisation régionale chargée des statistiques des thonidés.

GUINÉE ÉQUATORIALE

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l’organisation régionale chargée des statistiques des thonidés.

ÎLES FÉROÉ

Les données sur les captures, à l'exclusion de celles concernant le thon, pour la zone de haute mer de l'océan Pacifique Sud, sont révisées en collaboration avec la SPRFMO.

FIDJI

Comprend les îles Viti Levu, Vanua Levu et Rotuma.

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l’organisation régionale chargée des statistiques des thonidés.

Les données relatives aux algues rouges et vertes enregistrées en poids sec, ont été converties en leurs équivalent poids vert en utilisant le facteur de conversion ‘8’.

FRANCE

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA et la CTOI, les organisations régionales chargées des statistiques des thonidés.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique centre-est ont également été tirées du "Bulletin statistique" publié par l’IMROP, Mauritanie.

POLYNÉSIE FRANÇAISE

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l’organisation régionale chargée des statistiques des thonidés.

GÉORGIE

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique centre-est ont été tirées du "Bulletin statistique" publié par l’IMROP, Mauritanie.

TERRES AUSTRALES FR.

Comprennent l’île Amsterdam, l’île Saint-Paul et les îles Éparses de l’océan Indien dans la zone de pêche 51 (océan Indien, ouest) et les îles Kerguelen et l’archipel Crozet dans la zone de pêche 58 (océan Indien, Antarctique). Les données relatives à la zone de pêche 58 sont incluses avec celles de la France.

Notas sobre los distintos países o áreas

ECUADOR

Los datos relativos a las capturas de atún se revisan en colaboración con la CIAT y la WCPFC, los organismos regionales encargados de las estadísticas atuneras.

EL SALVADOR

Las mayores capturas registradas desde 2002 se deben a una mejor cobertura, especialmente de la pesca artesanal.

Los datos relativos a las capturas de atún se revisan en colaboración con la CIAT, el organismo regional encargado de las estadísticas atuneras.

GUINEA ECUATORIAL

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

ISLAS FEROE

Los datos relativos a las capturas en el área de alta mar del Océano Pacífico Sur, con exclusión de las de atunes, se revisan en colaboración con la SPRFMO.

FIJI

Incluyen las islas Viti Levu, Vanua Levu y Rotuma.

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

Los datos relativos a las algas rojas y verdes registrados en peso en seco se han convertido en sus equivalentes de peso húmedo aplicando el factor de conversión ‘8’.

FRANCIA

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA y la CAOI, los organismos regionales encargados de las estadísticas atuneras.

Los datos sobre las capturas en el área del Atlántico centro-oriental, con exclusión de las de atunes, también se han extraído de la publicación "Bulletin statistique" del IMROP, Mauritania.

POLINESIA FRANCESA

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

GEORGIA

Los datos sobre las capturas en el área del Atlántico centro-oriental, con exclusión de las de atunes, se han extraído de la publicación "Bulletin statistique" del IMROP, Mauritania.

TIERRAS AUSTRALES FR.

Incluyen la isla Amsterdam, la isla San Pablo y las islas francesas dispersas del océano Índico en área de pesca 51 (océano Índico occidental) y las islas Kerguélen y el archipiélago Crozet en área de pesca 58 (océano Índico Antártico). Datos relativos al área de pesca 58 se incluyen en los datos de la Francia.

Notes on individual countries or areas

GERMANY

Estimate of total recreational catch in inland waters (18,800 tonnes) provided in 1997 by national authorities was replaced in 2010 by a new official estimate (approximately 12,000 tonnes) and data of 'Freshwater fishes nei' for previous years were revised accordingly.

GHANA

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

Catch data for the Southwest Atlantic area are provided by the Fisheries Department, Falkland Islands Government.

GREECE

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

GREENLAND

Starting with 1993, data reported on aquatic mammals include also harvest for subsistence. 2010 data for aquatic mammals cover only the period between January and September.

GUAM

Large increase in capture production since 2000 is due to the inclusion of catches by shore-based fishers.

Data concerning tuna catches are reviewed in collaboration with WCPFC, the regional agency concerned with tuna statistics

GUATEMALA

Data exclude significant quantities of unrecorded subsistence catches.

Data concerning tuna catches are reviewed in collaboration with IATTC and ICCAT, the regional agencies concerned with tuna statistics.

GUINEA

Data concerning tuna catches are reviewed in collaboration with ICCAT and IOTC, the regional agencies concerned with tuna statistics.

GUYANA

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

Notes sur divers pays ou zones

ALLEMAGNE

L'estimation de la pêche récréative dans les eaux intérieures (18 800 tonnes) fournies par les autorités nationales en 1997 a été remplacé en 2010 par une nouvelle estimation officielle (environ 12 000 tonnes) et les captures de 'Poissons d'eau douce nca' pour les années précédentes ont été révisées en conséquence.

GHANA

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

Les données sur les captures pour l'Atlantique sud-ouest, sont fournies par le Département des pêches du Gouvernement des Iles Falkland.

GRÈCE

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

GROENLAND

À partir de 1993, les données reportées concernant les mammifères aquatiques comprennent également la pêche destinée à la subsistance. Les données de 2010 de mammifères aquatiques se réfèrent exclusivement à la période entre janvier et septembre.

GUAM

L'augmentation des captures enregistrée depuis 2000 est due à l'inclusion des captures des pêcheurs basés sur le littoral.

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l'organisation régionale chargée des statistiques des thonidés.

GUATEMALA

Non compris des captures importantes non enregistrées concernant la pêche de subsistance.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CITT et la CICTA, les organisations régionales chargées des statistiques des thonidés.

GUINÉE

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA et la CTOI, les organisations régionales chargées des statistiques des thonidés.

GUYANA

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

Notas sobre los distintos países o áreas

ALEMANIA

La estimación de la pesca recreativa en aguas interiores (18 800 toneladas) proporcionada por las autoridades nacionales en 1997 fue reemplazada en 2010 por una nueva estimación oficial (aproximadamente 12 000 toneladas) y las capturas de 'Peces de agua dulce nep' de los años anteriores se revisaron en consecuencia.

GHANA

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

Los datos relativos a las capturas en el área del Atlántico sudoccidental fueron proporcionados por el Departamento de Pesca del Gobierno de las Islas Malvinas (Falkland).

GRECIA

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

GROENLANDIA

A partir de 1993, los datos proporcionados sobre mamíferos acuáticos incluyen también la caza con fin de subsistencia. Los datos de mamíferos acuáticos para 2010 se refieren solamente al período entre enero y septiembre.

GUAM

Las mayores capturas registradas desde 2000 se deben a la inclusión de capturas por pescadores costeros.

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

GUATEMALA

Se excluyen importantes cantidades de capturas no registradas relativas a la pesca de subsistencia.

Los datos relativos a las capturas de atún se revisan en colaboración con la CIAT y la CICAA, los organismos regionales encargados de las estadísticas atuneras.

GUINEA

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA y la CAOI, los organismos regionales encargados de las estadísticas atuneras.

GUYANA

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

Notes on individual countries or areas

HONDURAS

Some data refer to a split-year fishing season shown under the calendar year in which the fishing season ends.

Quantities of estimated artisanal catches have been included under 'Marine fishes nei'.

Data concerning tuna catches are reviewed in collaboration with IATTC, the regional agency concerned with tuna statistics.

A portion of the tunas caught in the Indian Ocean by vessels flying the Honduran flag may be included under "Other nei".

Catch data, excluding those for tuna species, for the Eastern Central and Southeast Atlantic areas are provided by the Las Palmas Survey (LPS) and the "Estatistícas de Pesca Industrial" published by CIPA (Guinea-Bissau).

All catch data for 'Caribbean spiny lobster' (*Panulirus argus*) have been revised by using the conversion factor '3' as probably had not been reported in live weight.

Data for 'Stromboid conchs nei' have been converted to live weight equivalents by using the conversion factor '7.5'.

INDIA

Data concerning tuna catches are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

INDONESIA

Starting with the 2001 data and backwards to 1975, officially provided capture statistics are in accordance with the boundary change between fishing areas 57 and 71 in the Australian-Indonesian region.

Data concerning tuna catches in the Indian Ocean are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

IRELAND

Since 1999, catches in inland waters are no longer fully monitored. Data are collected only for 'European eel' (*Anguilla anguilla*), 'Atlantic salmon' (*Salmo salar*) and 'Sea trout' (*Salmo trutta*).

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

ITALY

Change in data collection system since 2005 resulted in improved species breakdown but also caused disruption in some data series.

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

Catch data for 'Mediterranean mussel' (*Mytilus galloprovincialis*) are subject to revision; increased catches after 1999 due to improved coverage.

JAMAICA

Data for 'Stromboid conchs nei' have been converted to live weight equivalents by using the conversion factor '7.5'.

Notes sur divers pays ou zones

HONDURAS

Quelques données se réfèrent à une période de pêche fractionnée et figurent sous l'année civile durant laquelle se termine la période de pêche.

Des estimations des captures de la pêche artisanale ont été incluses sous 'Poissons marins nca'.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CITT, l'organisation régionale chargée des statistiques des thonidés.

Une partie des captures de thonidés attrapés dans l'océan Indien par des navires battant pavillon hondurien peut être incluse avec celles de "Autres nca".

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique du centre-est et du sud-est sont tirées de l'Enquête Las Palmas et du "Estatistícas de Pesca Industrial" publié par CIPA (Guinée-Bissau).

Les données relatives à 'Langouste blanche' (*Panulirus argus*) ont été révisées en utilisant le facteur de conversion '3' car, vraisemblablement, elles n'avaient pas été fournies en poids vif.

Les données relatives aux 'Strombes nca' ont été converties en équivalent poids vif en utilisant le facteur de conversion '7,5'.

INDE

Les données concernant les captures des thonidés sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

INDONÉSIE

A partir des données de 2001 et précédemment à 1975, les statistiques des captures communiquées par le service national sont conformes au changement de la limite entre les zones de pêche 57 et 71 dans la région australienne-indonésienne.

Les données concernant les captures des thonidés dans l'océan Indien sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

IRLANDE

Depuis 1999 les captures dans les eaux continentales ne sont plus intégralement contrôlées. Seules les données relatives à 'Anguille d'Europe' (*Anguilla anguilla),* 'Saumon de l'Atlantique' (*Salmo salar*) et 'Truite de mer' (*Salmo trutta*) sont rassemblées.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

ITALIE

Le changement du système de collecte de données depuis 2005 a abouti à une meilleure répartition par espèces mais a également dérangé quelques séries de données.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

Les données relatives aux 'Moule commune' (*Mytilus galloprovincialis*) sont sujettes à révision; l'augmentation de captures après 1999 s'explique par une meilleure couverture.

JAMAÏQUE

Les données relatives aux 'Strombes nca' ont été converties en équivalent poids vif en utilisant le facteur de conversion '7,5'.

Notas sobre los distintos países o áreas

HONDURAS

Algunos datos se refieren a una temporada de pesca que se indica como el año civil en que finaliza la temporada.

Estimaciones de capturas de la pesca artesanal están incluidas en 'Peces marinos nep'.

Los datos relativos a las capturas de atún se revisan en colaboración con la CIAT, el organismo regional encargado de las estadísticas atuneras.

Una porción de las capturas de atún en el océano Índico por embarcaciones con pabellón hondureño puede ser incluida en los datos de "Otros nep".

Los datos relativos a las capturas en las áreas del Atlántico centro-oriental y sudoriental, con exclusión de las de atunes, fueron extraídos de Las Palmas Survey (LPS) y de las "Estatistícas de Pesca Industrial" publicadas por el CIPA (Guinea-Bissau).

Los datos de capturas de 'Langosta común del Caribe' (*Panulirus argus*) se han revisado aplicando el factor de conversión '3' como probablemente no se había reportado el peso en vivo.

Los datos de 'Cobos nep' se han convertido en sus equivalentes de peso en vivo aplicando el factor de conversión '7,5'

INDIA

Los datos relativos a las capturas de atún se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

INDONESIA

A partir de los datos de 2001, y hasta 1975 retrocediendo en el tiempo, estadísticas de capturas proporcionadas por la oficina nacional son en conformidad del cambio del límite entre las áreas de pesca 57 y 71 en la región australiana-indonesia.

Los datos relativos a las capturas de atún en el océano Índico se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

IRLANDA

Desde 1999 las capturas en aguas continentales ya no son totalmente controladas. Solo se recogen datos para 'Anguila europea' (*Anguilla anguilla*), 'Salmón del Atlántico' (*Salmo salar*) y 'Trucha marina' (*Salmo trutta*).

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

ITALIA

El cambio en el sistema de recopilación de datos desde 2005 ha resultado en un mejor desglose de las especies pero también causó trastorno en algunas series de datos.

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

Los datos de capturas de 'Mejillón común' (*Mytilus galloprovincialis*) están sujetos a revisión; el incremento de capturas después de 1999 se debe a una mejor cobertura.

JAMAICA

Los datos de 'Cobos nep' se han convertido en sus equivalentes de peso en vivo aplicando el factor de conversión '7,5'.

Notes on individual countries or areas

Notes sur divers pays ou zones

Notas sobre los distintos países o áreas

JAPAN

Data for tuna species are not comparable with those of ICCAT, IOTC and WCPFC, with the exception of 2002 data.

Catch data, excluding those for tuna species, for the Southwest Atlantic area are provided also by the Fisheries Department, Falkland Islands Government.

Since 2004 a reduced number of rivers and lakes have been covered for inland water catches and since 2006 recreational catches were no longer collected.

JAPON

Les données concernant les thonidés ne sont pas comparables avec les renseignements fournis par la CICTA, la CTOI et la WCPFC sauf pour les captures relatives à 2002.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique sud-ouest, sont fournies également par le Département des pêches du Gouvernement des Iles Falkland.

Depuis 2004 un nombre réduit des rivières et des lacs sont couverts pour les captures en eaux continentales et depuis 2006 les captures de la pêche récréative ne sont plus collectées.

JAPÓN

Los datos sobre las especies de atún no son comparables con la información de la CICAA, la CAOI y la WCPFC con la excepción de las capturas de 2002.

Los datos relativos a las capturas en el área del Atlántico sudoccidental, con exclusión de las de atunes, fueron proporcionados también por el Departamento de Pesca del Gobierno de las Islas Malvinas (Falkland).

Desde el año 2004 un reducido número de ríos y lagos fueron cubiertos por las capturas en aguas continentales y desde 2006 no se recogieron más datos sobre las capturas de la pesca recreativa.

KIRIBATI

Includes Fanning Island, Washington Island and Christmas Island in the Line Islands; Ocean Island, Phoenix Islands (Birnie, Gardner, Hull, McKean, Phoenix, Sydney, Canton and Enderbury).

Data concerning tuna catches are reviewed in collaboration with the WCPFC, the regional agency concerned with tuna statistics.

Data for 'Sea cucumber nei' recorded on a dry-weight basis have been converted to wet-weight equivalents by using the conversion factor '3'.

KIRIBATI

Comprend Fanning, Washington, l'île Christmas dans les îles de la Ligne; l'île Océan, les îles Phoenix (Birnie, Gardner, Hull, McKean, Phoenix, Sidney, Canton et Enderbury).

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l'organisation régionale chargée des statistiques des thonidés.

Les données relatives aux 'Bèches-de-mer nca' enregistrées en poids sec, ont été converties en leurs équivalent poids vif en utilisant le facteur de conversion '3'.

KIRIBATI

Incluye las islas Fanning, Washington, y Christmas en las islas de la Línea; la isla Océano, y las islas Phoenix (Birnie, Gardner, Hull, McKean, Phoenix, Sidney, Canton y Enderbury).

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

Los datos relativos a los 'Cohombros de mar nep' registrados en peso en seco se han convertido en sus equivalentes de peso húmedo aplicando el factor de conversión '3'.

KOREA REPUBLIC

Data for tuna species not comparable with those of IATTC, ICCAT, IOTC and WCPFC.

Catch data, excluding those for tuna species, for the Southwest Atlantic area are provided also by the Fisheries Department, Falkland Islands Government.

Catch data, excluding those for tuna species, for the South Pacific high seas area are reviewed in collaboration with SPRFMO.

RÉPUBLIQUE DE CORÉE

Les données concernant les thonidés ne sont pas comparables avec les renseignements fournis par la CITT, la CICTA, la CTOI et la WCPFC.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique sud-ouest, sont fournies également par le Département des pêches du Gouvernement des Iles Falkland.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour la zone de haute mer de l'océan Pacifique Sud, sont révisées en collaboration avec la SPRFMO.

REPÚBLICA DE COREA

Los datos sobre las especies de atún no son comparables con la información de la CIAT, la CICAA, la CAOI y la WCPFC.

Los datos relativos a las capturas en el área del Atlántico sudoccidental, con exclusión de las de atunes, fueron proporcionados también por el Departamento de Pesca del Gobierno de las Islas Malvinas (Falkland).

Los datos relativos a las capturas en el área de alta mar del Océano Pacífico Sur, con exclusión de las de atunes, se revisan en colaboración con la SPRFMO.

LATVIA

Catch data, excluding those for tuna species, for the Eastern Central Atlantic area have also been taken from the "Bulletin statistique" published by IMROP, Mauritania.

LETTONIE

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique centre-est ont également été tirées du "Bulletin statistique" publié par l'IMROP, Mauritanie.

LETONIA

Los datos sobre las capturas en el área del Atlántico centro-oriental, con exclusión de las de atunes, también se han extraído de la publicación "Bulletin statistique" del IMROP, Mauritania.

LIBYAN ARAB JAMAHIRIYA

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

JAMAHIRIYA ARABE LIBYENNE

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

JAMAHIRIYA ÁRABE LIBIA

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

LITHUANIA

In 2002, data for the Curronian lagoon have been reported as captures in area 27 (Northeast Atlantic) instead of area 05 (Europe – Inland waters) causing a displacement of catches between the two areas.

Catch data, excluding those for tuna species, for the Eastern Central Atlantic area have also been taken from the "Bulletin statistique" published by IMROP, Mauritania.

LITUANIE

En 2002 les données concernant la lagune de Curronian ont été rapportées comme captures dans la zone 27 (Atlantique nord-est) à la place de la zone 05 (Europe - Eaux continentales) causant un déplacement des captures entre les deux zones.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique centre-est ont également été tirées du "Bulletin statistique" publié par l'IMROP, Mauritanie.

LITUANIA

En 2002 los datos sobre la laguna de Curronian han sido proporcionados como capturas en el área 27 (Atlántico nordeste) en lugar del área 05 (Europa - Aguas continentales) causando una desplazamiento de capturas entre las dos áreas.

Los datos sobre las capturas en el área del Atlántico centro-oriental, con exclusión de las de atunes, también se han extraído de la publicación "Bulletin statistique" del IMROP, Mauritania.

MADAGASCAR

Data concerning tuna catches are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

Data for 'Sea cucumber nei' recorded on a dry-weight basis have been converted to wet-weight equivalents by using the conversion factor '3'.

MADAGASCAR

Les données concernant les captures des thonidés sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

Les données relatives aux 'Bèches-de-mer nca' enregistrées en poids sec, ont été converties en leurs équivalent poids vif en utilisant le facteur de conversion '3'.

MADAGASCAR

Los datos relativos a las capturas de atún se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

Los datos relativos a los 'Cohombros de mar nep' registrados en peso en seco se han convertido en sus equivalentes de peso húmedo aplicando el factor de conversión '3'.

Notes on individual countries or areas

MALAWI

Large increase in capture production of Cyprinidae since 2007 is due to re-allocation by the national reporting office of catches for *Engraulicypris sardella* - the most abundant cyprinid in Lake Malawi - from 'Cichlids nei' to 'Cyprinids nei'.

MALAYSIA

Includes Peninsular Malaysia, Sabah and Sarawak.

Data concerning tuna catches in the Indian Ocean are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

MALDIVES

Data concerning tuna catches are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

Data for 'Sea cucumber nei' recorded on a dry-weight basis have been converted to wet-weight equivalents by using the conversion factor '3'.

Catch data between 1992 and 2003 for "Elasmobranchii – Sharks, rays, skates, etc. nei" are subject to revision.

MALTA

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

Catch data, excluding those for tuna species, for the Eastern Central Atlantic area have been taken from the "Bulletin statistique" published by IMROP, Mauritania.

MARSHALL ISLANDS

Data concerning tuna catches are reviewed in collaboration with the WCPFC, the regional agency concerned with tuna statistics. Increase of tuna catches since 2001 are due to vessels previously flagged in Vanuatu, re-flagged in the Marshall Islands.

MAURITANIA

Increase in capture production in recent years is due to an improved data collection system for industrial fisheries and to revised national estimates of artisanal catches.

MAURITIUS

Data concerning tuna catches in the Indian Ocean are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

MAYOTTE

Includes Grand-Terre and Pamandzi.

Data concerning tuna catches are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

MEXICO

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

Notes sur divers pays ou zones

MALAWI

L'augmentation considérable des captures des Cyprinidés, enregistrée depuis 2007, est due à une réattribution, par le service national déclarant, des captures d'*Engraulicypris sardella*, le cyprinidé le plus abondant dans le lac Malawi, de la catégorie Cichlidés nca' à celle des 'Cyprinidés nca'.

MALAISIE

Comprend la Malaisie Péninsulaire, Sabah et Sarawak.

Les données concernant les captures des thonidés dans l'océan Indien sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

MALDIVES

Les données concernant les captures des thonidés sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

Les données relatives aux 'Bèches-de-mer nca' enregistrées en poids sec, ont été converties en leur équivalent poids vif en utilisant le facteur de conversion '3'.

Les données relatives aux "Elasmobranchii–Requins, raies, etc. nca" pour les années 1992-2003 sont sujettes à révision.

MALTE

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique centre-est ont été tirées du "Bulletin statistique" publié par l'IMROP, Mauritanie.

ÎLES MARSHALL

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l'organisation régionale chargée des statistiques des thonidés. L'augmentation depuis 2001 des captures des thonidés est due aux captures effectuées par les bateaux qui battaient auparavant pavillon de Vanuatu et qui sont passés sous pavillon des îles Marshall.

MAURITANIE

L'augmentation des captures enregistrées ces dernières années est due à une meilleure couverture de la pêche industrielle et à la révision des estimations de la pêche artisanale par le service national.

MAURICE

Les données concernant les captures des thonidés dans l'océan Indien sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

MAYOTTE

Comprend Grande-Terre et Pamandzi.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

MEXIQUE

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

Notas sobre los distintos países o áreas

MALAWI

Las mayores capturas registradas desde 2007 se deben a una reasignación por parte de la oficina nacional de las capturas de *Engraulicypris sardella*, el ciprínido más abundante en el lago Malawi, de 'Cíclidos nep' a 'Ciprínidos nep'.

MALASIA

Incluye la Malasia Peninsular, Sabah y Sarawak.

Los datos relativos a las capturas de atún en el océano Índico se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

MALDIVAS

Los datos relativos a las capturas de atún, se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

Los datos relativos a los 'Cohombros de mar nep' registrados en peso en seco se han convertido en sus equivalentes de peso húmedo aplicando el factor de conversión '3'.

Los datos de capturas desde 1992 hasta 2003 de "Elasmobranchii – Tiburones, rayas, etc. nep" están sujetos a revisión.

MALTA

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

Los datos sobre las capturas en el área del Atlántico centro-oriental, con exclusión de las de atunes, se han extraído de la publicación "Bulletin statistique" del IMROP, Mauritania.

ISLAS MARSHALL

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras. El incremento desde 2001 de las capturas de atún se debe a embarcaciones, registradas previamente con pabellón de Vanuatu, que cambiaron de pabellón en las Islas Marshall.

MAURITANIA

Las mayores capturas registradas en años recientes se deben a una mejor cobertura de la pesca industrial y a la revisión de las estimaciones de la pesca artesanal por la oficina nacional.

MAURICIO

Los datos relativos a las capturas de atún en el océano Índico se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

MAYOTTE

Incluye Grande-Terre y Pamandzi.

Los datos relativos a las capturas de atún se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

MÉXICO

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

Notes on individual countries or areas

MICRONESIA

Includes Yap, Truk, Pohnpei and Kosrae.

Data concerning tuna catches are reviewed in collaboration with the WCPFC, the regional agency concerned with tuna statistics.

MOROCCO

Large increase in inland waters capture production since 2005 is due to restocking of dams.

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

MOZAMBIQUE

Large increases of marine capture production since 2003 and of 'Freshwater fishes nei' since 2007 are due, respectively, to an improved coverage and to a new data collection system for the artisanal fishery sectors.

Recent data concerning sport fishing tuna catches in the Indian Ocean are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics

Historical catches that had been reported for "Scombroidei – Tuna-like fishes nei" may be by Distant Water Fishing Nations (DWFN) in the Mozambican Exclusive Economic Zone (EEZ).

MYANMAR

Data refer to a split-year (1 April – 31 March) shown under the calendar year in which the split-year ends.

Data for 'Jellyfishes' expressed in dry-weight.

NAMIBIA

A significant amount of 'Cape horse mackerel' (*Trachurus capensis*) catches has been added to Namibian capture production for the 1992-2000 period to take account of information provided by the national reporting office.

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

Catch data for the Southwest Atlantic area are provided by the Fisheries Department, Falkland Islands Government.

Data for "Elasmobranchii – Sharks, rays, skates, etc. nei" include also production of shark fins converted to live weight equivalents by using the conversion factor '20'.

NEPAL

Data refer to a split-year (16 July - 15 July) shown under the calendar year in which the split-year ends.

NETHERLANDS

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

Catch data, excluding those for tuna species, for the South Pacific high seas area are reviewed in collaboration with SPRFMO.

Notes sur divers pays ou zones

MICRONÉSIE

Comprend Yap, Truk, Pohnpei et Kosrae.

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l'organisation régionale chargée des statistiques des thonidés.

MAROC

L'augmentation des captures dans les eaux continentales enregistrées depuis l'année 2005 est due au repeuplement des réservoirs.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

MOZAMBIQUE

L'augmentation considérable des captures marines depuis 2003 et de 'Poissons d'eau douce nca' depuis 2007 est due, respectivement, à une meilleure couverture et à un nouveau système de collecte des données pour les secteurs de la pêche artisanale.

Les données récentes concernant la pêche sportive des thonidés dans l'océan Indien sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

Les captures historiques enregistrées sous "Scombroidei – Poissons type thon nca" se réfèrent probablement à pays pratiquant la pêche hauturière (PPPH) dans la zone économique exclusive (ZEE) mozambicaine.

MYANMAR

Les données se réfèrent à une année fractionnée (1er avril - 31 mars) et figurent sous l'année civile durant laquelle se termine l'année fractionnée.

Les données sur les 'Méduses' sont exprimées en poids sec.

NAMIBIE

Une quantité remarquable de captures de 'Chinchard du Cap' (*Trachurus capensis*) a été ajoutée aux captures de Namibie pour la période 1992-2000 en fonction des informations fournies par le service national déclarant.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

Les données sur les captures pour l'Atlantique sud-ouest, sont fournies par le Département des pêches du Gouvernement des Iles Falkland.

Les données sous "Elasmobranchii – Requins, raies, etc. nca" comprennent également la production d'ailerons de requins, convertie en équivalent poids vif en utilisant le facteur de conversion '20'.

NÉPAL

Les données se réfèrent à une année fractionnée (16 juillet - 15 juillet) et figurent sous l'année civile durant laquelle se termine l'année fractionnée.

PAYS-BAS

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour la zone de haute mer de l'océan Pacifique Sud, sont révisées en collaboration avec la SPRFMO.

Notas sobre los distintos países o áreas

MICRONESIA

Incluye Yap, Truk, Pohnpei y Kosrae.

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

MARRUECOS

Las mayores capturas registradas en aguas continentales desde 2005 se deben a la repoblación de las presas.

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

MOZAMBIQUE

Las mayores capturas marinas desde 2003 y de 'Peces de agua dulce nep' desde 2007 se deben, respectivamente, a una mejor cobertura y a un nuevo sistema de recopilación de datos para los sectores de la pesca artesanal.

Los datos recientes relativos a la pesca deportiva de atún en el océano Índico se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

Capturas históricas de "Scombroidei – Peces parec. a los atunes nep" puede ser por Estados que Pescan en Aguas Distantes (EPAD) en la Zona Económica Exclusiva (ZEE) mozambiqueña.

MYANMAR

Los datos se refieren a un año emergente (1 de abril - 31 de marzo) que se indica como el año civil en que finaliza el año emergente.

Los datos relativos a las 'Medusas' se han expresado en peso seco.

NAMIBIA

Una cantidad notable de capturas de 'Jurel del Cabo' (*Trachurus capensis*) se ha agregado a la producción des capturas de Namibia para el período 1992-2000 para tener en cuenta la información notificada por parte de la oficina nacional.

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

Los datos relativos a las capturas en el área del Atlántico sudoccidental fueron proporcionados por el Departamento de Pesca del Gobierno de las Islas Malvinas (Falkland).

Los datos incluidos en "Elasmobranchii – Tiburones, rayas, etc. nep" comprenden también la producción de aletas de tiburón, convertida en sus equivalentes de peso en vivo aplicando el factor de conversión '20'.

NEPAL

Los datos se refieren a un año emergente (16 de julio - 15 de julio) que se indica como el año civil en que finaliza el año emergente.

PAÍSES BAJOS

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

Los datos relativos a las capturas en el área de alta mar del Océano Pacífico Sur, con exclusión de las de atunes, se revisan en colaboración con la SPRFMO.

Notes on individual countries or areas

Notes sur divers pays ou zones

Notas sobre los distintos países o áreas

NETHERLANDS ANTILLES

Include Bonaire, Curaçao, Saba, Saint Eustatius and Sint Maarten.

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

NEW CALEDONIA

Data concerning tuna catches are reviewed in collaboration with the WCPFC, the regional agency concerned with tuna statistics.

NEW ZEALAND

Data concerning tuna catches are reviewed in collaboration with the WCPFC, the regional agency concerned with tuna statistics.

Catch data for the Southwest Atlantic area are provided by the Fisheries Department, Falkland Islands Government.

For the period 1995-2000, data for "Elasmobranchii – Sharks, rays, skates, etc. nei" include also production of shark fins converted to live weight equivalents by using the conversion factor '20'.

Data for 'New Zealand scallop' (*Pecten novaezelandiae*) since 1987 have been converted to live weight equivalents by using the conversion factor '8'.

NICARAGUA

Data reported since 1999 in product weight have been converted to live weight equivalents.

Data concerning tuna catches are reviewed in collaboration with IATTC, the regional agency concerned with tuna statistics.

NIGER

Large increase in capture production since 2003 mainly due to an improved data collection system. The catch decrease in 2006 is due to a great withdrawal of the lake Chad in the Niger part.

NIUE

Data concerning tuna catches are reviewed in collaboration with WCPFC, the regional agency concerned with tuna statistics.

NORTHERN MARIANA IS.

Includes Marianas Islands except Guam.

Data concerning tuna catches are reviewed in collaboration with the WCPFC, the regional agency concerned with tuna statistics.

ANTILLES NÉERLANDAISES

Comprennent Bonaire, Curaçao, Saba, Saint-Eustache et Sint Maarten.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

NOUVELLE-CALÉDONIE

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l'organisation régionale chargée des statistiques des thonidés.

NOUVELLE-ZÉLANDE

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l'organisation régionale chargée des statistiques des thonidés.

Les données sur les captures pour l'Atlantique sud-ouest, sont fournies par le Département des pêches du Gouvernement des Iles Falkland.

Pour la période 1995-2000 les données sous "Elasmobranchii – Requins, raies, etc. nca" comprennent également la production d'ailerons de requins, convertie en équivalent poids vif en utilisant le facteur de conversion '20'.

Les données relatives aux 'Pecten de Nouvelle-Zélande' (*Pecten novaezelandiae*) depuis 1987 ont été converties en équivalent poids vif en utilisant le facteur de conversion '8'.

NICARAGUA

Les données rapportées depuis 1999 en poids produit ont été converties en équivalent poids vif.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CITT, l'organisation régionale chargée des statistiques des thonidés.

NIGER

L'augmentation des captures enregistrées depuis 2003 est due en grande partie à une meilleure couverture du système de collecte des données. Par contre, la diminution des captures en 2006 a été causée par un retrait important des eaux du lac Tchad du côté nigérien.

NIOUÉ

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l'organisation régionale chargée des statistiques des thonidés.

ÎLES MARIANNES DU NORD

Comprend les îles Mariannes sauf Guam.

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l'organisation régionale chargée des statistiques des thonidés.

ANTILLAS NEERLANDESAS

Incluye Bonaire, Curaçao, Saba, San Eustaquio y Sint Maarten.

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

NUEVA CALEDONIA

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

NUEVA ZELANDIA

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

Los datos relativos a las capturas en el área del Atlántico sudoccidental fueron proporcionados por el Departamento de Pesca del Gobierno de las Islas Malvinas (Falkland).

Para el período 1995-2000 los datos incluidos en "Elasmobranchii – Tiburones, rayas, etc. nep" comprenden también la producción de aletas de tiburón, convertida en sus equivalentes de peso en vivo aplicando el factor de conversión '20'.

Los datos de 'Vieira de Nueva Zelandia' (*Pecten novaezelandiae*) desde 1987 se han convertido en sus equivalentes de peso en vivo aplicando el factor de conversión '8'.

NICARAGUA

Los datos proporcionados desde 1999 en peso de los productos se han convertido en sus equivalentes de peso en vivo.

Los datos relativos a las capturas de atún se revisan en colaboración con la CIAT, el organismo regional encargado de las estadísticas atuneras.

NÍGER

Las mayores capturas registradas desde 2003 se deben en gran parte a una mejor cobertura del sistema de recopilación de datos. La disminución de las capturas en 2006 se debe a una gran retirada de las aguas del lago Chad en la parte nigerina.

NIUE

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

ISLAS MARIANAS SEPTENT.

Incluye las islas Marianas excepto Guam.

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

Notes on individual countries or areas

Notes sur divers pays ou zones

Notas sobre los distintos países o áreas

OTHER NEI

Data refer to catches reported by IATTC, ICCAT, IOTC, Las Palmas Survey (LPS), the "Bulletin statistique" published by IMROP (Mauritania) and the “Estatistícas de Pesca Industrial” published by CIPA (Guinea-Bissau), as caught by unidentified countries.

Catch data, excluding those for tuna species, for the South Pacific high seas area are reviewed in collaboration with SPRFMO)

AUTRES NCA

Les données se rapportent aux captures indiqués par la CITT, la CICTA, la CTOI, l'Enquête Las Palmas, le "Bulletin statistique" publié par l'IMROP (Mauritanie), et le “Estatistícas de Pesca Industrial” publié par CIPA (Guinée-Bissau), comme captures de pays non identifiables.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour la zone de haute mer de l'océan Pacifique Sud, sont révisées en collaboration avec la SPRFMO.

OTROS NEP

Los datos abarcan capturas indicado por la CIAT, la CICAA, la CAOI, Las Palmas Survey (LPS), el "Bulletin statistique" publicado por el IMROP (Mauritania) y las “Estatistícas de Pesca Industrial” publicadas por el CIPA (Guinea-Bissau), como capturado por países desconocidos.

Los datos relativos a las capturas en el área de alta mar del Océano Pacífico Sur, con exclusión de las de atunes, se revisan en colaboración con la SPRFMO.

PAKISTAN

Data concerning tuna catches are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

PAKISTAN

Les données concernant les captures des thonidés sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

PAKISTÁN

Los datos relativos a las capturas de atún se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

PALAU

For the 2002-2008 period, 750 tonnes of estimated subsistence catches have been included under 'Marine fishes nei'.

PALAOS

Pour la période 2002-2008, une estimation des captures, traites à la pêche de subsistance, équivalant à 750 tonnes a été incluse sous la catégorie 'Poissons marins nca'.

PALAU

Para el período 2002-2008, se incluyen 750 toneladas métricas en 'Peces marinos nep' como estimación de capturas de la pesca de subsistencia.

PANAMA

Data for shrimp species reported for the Eastern Central Pacific area have been converted to live weight equivalents by using the conversion factors ‘1.6’ and ‘2’.

Data concerning tuna catches are reviewed in collaboration with IATTC and ICCAT, the regional agencies concerned with tuna statistics.

Catch data, excluding those for tuna species, for the Southwest Atlantic area are provided by the Fisheries Department, Falkland Islands Government.

Catch data for the Eastern Central and Southeast Atlantic areas are provided by the Las Palmas Survey (LPS), the "Bulletin Statistique" published by IMROP (Mauritania), and the “Estatistícas de Pesca Industrial” published by CIPA (Guinea-Bissau).

PANAMA

Les données concernant espèces de crevettes dans la zone Pacifique centre-est ont été converties en équivalent poids vif en utilisant les facteurs de conversion ‘1,6’ et ‘2’.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CITT et la CICTA, les organisations régionales chargées des statistiques des thonidés.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique sud-ouest, sont fournies par le Département des pêches du Gouvernement des Iles Falkland.

Les données sur les captures pour l'Atlantique du centre-est et du sud-est sont tirées de l'Enquête Las Palmas, du "Bulletin statistique" publié par l'IMROP (Mauritanie) et du “Estatistícas de Pesca Industrial” publié par CIPA (Guinée-Bissau).

PANAMÁ

Los datos relativos a especies de camarones en el área del Pacífico centro-oriental se han convertido en sus equivalentes de peso en vivo aplicando los factores de conversión ‘1,6’ y ‘2’.

Los datos relativos a las capturas de atún se revisan en colaboración con la CIAT y la CICAA, los organismos regionales encargados de las estadísticas atuneras.

Los datos relativos a las capturas en el área del Atlántico sudoccidental, con exclusión de las de atunes, fueron proporcionados por el Departamento de Pesca del Gobierno de las Islas Malvinas (Falkland).

Los datos relativos a las capturas en las áreas del Atlántico centro-oriental y sudoriental fueron extraídos de Las Palmas Survey (LPS), del "Bulletin statistique" publicado por el IMROP (Mauritania) y de las “Estatistícas de Pesca Industrial” publicadas por el CIPA (Guinea-Bissau).

PAPUA NEW GUINEA

Data concerning tuna catches are reviewed in collaboration with WCPFC, the regional agency concerned with tuna statistics.

PAPOUASIE-NLLE-GUINÉE

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l'organisation régionale chargée des statistiques des thonidés.

PAPUA NUEVA GUINEA

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

PHILIPPINES

Data concerning tuna catches are reviewed in collaboration with ICCAT, IOTC and WCPFC, the regional agencies concerned with tuna statistics.

PHILIPPINES

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, la CTOI et la WCPFC, les organisations régionales chargées des statistiques des thonidés.

FILIPINAS

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, la CAOI y la WCPFC, los organismos regionales encargados de las estadísticas atuneras.

POLAND

Estimated catches from recreational fisheries included in 'Freshwater fishes nei'.

POLOGNE

Estimation de pêche récréative comprises en 'Poissons d'eau douce nca'.

POLONIA

Estimación de la pesca recreativa incluida en 'Peces de agua dulce nep'.

PORTUGAL

Data concerning tuna catches are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

Catch data, excluding those for tuna species, for the Eastern Central Atlantic area have also been taken from the "Bulletin statistique" published by IMROP, Mauritania.

PORTUGAL

Les données concernant les captures des thonidés sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique centre-est ont également été tirées du "Bulletin statistique" publié par l'IMROP, Mauritanie.

PORTUGAL

Los datos relativos a las capturas de atún en el Atlántico se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

Los datos sobre las capturas en el área del Atlántico centro-oriental, con exclusión de las de atunes, también se han extraído de la publicación "Bulletin statistique" del IMROP, Mauritania.

Notes on individual countries or areas

PUERTO RICO

Data for 'Stromboid conchs nei' have been converted to live weight equivalents by using the conversion factor '7.5'.

RÉUNION

Data concerning tuna catches are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

RUSSIAN FEDERATION

Data for tuna species not comparable with those of IATTC, ICCAT, IOTC and WCPFC.

SAINT HELENA

Includes the Islands of Ascension and Tristan da Cunha.

Data for 'Tristan da Cunha rock lobster' (*Jasus tristani*), 'Octopuses, etc. nei' and, since 1994, for most of the quantities included under 'Marine fishes nei' refer to catches from the Tristan da Cunha area. A portion of these catches are taken by foreign fleets.

SAINT KITTS AND NEVIS

Catch data, excluding those for tuna species, for the Eastern Central Atlantic area have been taken from the "Bulletin statistique" published by IMROP, Mauritania.

SAINT LUCIA

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

SAINT VINCENT/GRENADINES

Data for 'Stromboid conchs nei' have been converted to live weight equivalents by using the conversion factor '7.5'.

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

Catch data, excluding those for tuna species, for the Eastern Central and Southeast Atlantic areas are provided by the Las Palmas Survey (LPS) and the "Bulletin statistique" published by IMROP, Mauritania.

SAMOA

Data refer to a split-year (1 July – 30 June) shown under the calendar year in which the split-year ends.

Data concerning tuna catches are reviewed in collaboration with the WCPFC, the regional agency concerned with tuna statistics.

SAO TOME AND PRINCIPE

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

Notes sur divers pays ou zones

PORTO RICO

Les données relatives aux 'Strombes nca' ont été converties en équivalent poids vif en utilisant le facteur de conversion '7,5'.

RÉUNION

Les données concernant les captures des thonidés sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

FÉDÉRATION DE RUSSIE

Les données concernant les thonidés ne sont pas comparables avec les renseignements fournis par la CITT, la CICTA, la CTOI et la WCPFC.

SAINTE-HÉLÈNE

Comprend les îles de l'Ascension et Tristan da Cunha.

Les données concernant la 'Langouste de Tristan da Cunha' (*Jasus tristani*), 'Pieuvres, poulpes nca' et, depuis 1994, pour la plupart des quantités incluses sous 'Poissons marins nca' se réfèrent aux captures effectuées dans la région de Tristan da Cunha. Une partie de ces quantités sont capturées par les flottes étrangères.

SAINT-KITTS-ET-NEVIS

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique centre-est ont été tirées du "Bulletin statistique" publié par l'IMROP, Mauritanie.

SAINTE-LUCIE

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

SAINT-VINCENT/GRENADINES

Les données relatives aux 'Strombes nca' ont été converties en équivalent poids vif en utilisant le facteur de conversion '7,5'.

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique du centre-est et du sud-est sont tirées de l'Enquête Las Palmas et du "Bulletin statistique" publié par l'IMROP, Mauritanie.

SAMOA

Les données se réfèrent à une année fractionnée (1er juillet - 30 juin) et figurent sous l'année civile durant laquelle se termine l'année fractionnée.

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l'organisation régionale chargée des statistiques des thonidés.

SAO TOMÉ-ET-PRINCIPE

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

Notas sobre los distintos países o áreas

PUERTO RICO

Los datos de 'Cobos nep' se han convertido en sus equivalentes de peso en vivo aplicando el factor de conversión '7,5'.

REUNIÓN

Los datos relativos a las capturas de atún se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

FEDERACIÓN DE RUSIA

Los datos sobre las especies de atún no son comparables con la información de la CIAT, la CICAA, la CAOI y la WCPFC.

SANTA ELENA

Incluye las islas de Ascensión y Tristán de Cunha.

Los datos relativos a la 'Langosta de Tristán da Cunha' (*Jasus tristani*), 'Pulpitos, pulpos nep' y, desde 1994, para la mayoría de las cantidades incluidas en 'Peces marinos nep' se refieren a capturas desde el área de Tristan da Cunha. Una porción de estas cantidades se captura por las flotas extranjeras.

SAINT KITTS Y NEVIS

Los datos sobre las capturas en el área del Atlántico centro-oriental, con exclusión de las de atunes, se han extraído de la publicación "Bulletin statistique" del IMROP, Mauritania.

SANTA LUCÍA

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

SAN VICENTE/GRENADINAS

Los datos de 'Cobos nep' se han convertido en sus equivalentes de peso en vivo aplicando el factor de conversión '7,5'.

Los datos relativos a las capturas de atún en el Atlántico se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

Los datos relativos a las capturas en las áreas del Atlántico centro-oriental y sudoriental, con exclusión de las de atunes, fueron proporcionados por Las Palmas Survey (LPS) y por la publicación "Bulletin statistique" del IMROP, Mauritania.

SAMOA

Los datos se refieren a un año emergente (1 de julio - 30 de junio) que se indica como el año civil en que finaliza el año emergente.

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

SANTO TOMÉ Y PRÍNCIPE

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

Notes on individual countries or areas

SENEGAL

Data concerning tuna catches in the Atlantic and in the Indian Oceans are reviewed in collaboration with ICCAT and IOTC, the regional agencies concerned with tuna statistics.

Data on inland water capture production were revised after an official communication informed that detailed submission of 2008 catches included also quantities from marine areas. As coverage of 2010 catches was partial, an estimate of 20,000 tonnes was added to inland waters capture production.

SERBIA

Excludes data for Kosovo and Metohia.

SEYCHELLES

Data concerning tuna catches are reviewed in collaboration with ICCAT and IOTC, the regional agencies concerned with tuna statistics.

Increased catches of tuna species since 1997 due to fishing activities of purse seiners re-flagged under Seychelles flag.

SIERRA LEONE

Large increase in marine capture production is the consequence of a new frame survey conducted in 2003 which produced revised raising factors for artisanal fisheries.

Catch data for the Southwest Atlantic area are provided by the Fisheries Department, Falkland Islands Government.

SOLOMON ISLANDS

Data concerning tuna catches are reviewed in collaboration with WCPFC, the regional agency concerned with tuna statistics.

SOUTH AFRICA

Data concerning tuna catches are reviewed in collaboration with ICCAT and IOTC, the regional agencies concerned with tuna statistics.

Data for brown and red seaweeds recorded on a dry-weight basis have been converted to wet-weight equivalents by using the conversion factor ‘8’.

SPAIN

Data concerning tuna catches are reviewed in collaboration with IATTC, ICCAT, IOTC and WCPFC, the regional agencies concerned with tuna statistics.

Catch data, excluding those for tuna species, for the Eastern Central Atlantic area have also been taken from the "Bulletin statistique" published by IMROP, Mauritania.

Catch data, excluding those for tuna species, for the Southwest Atlantic area are provided also by the Fisheries Department, Falkland Islands Government.

Notes sur divers pays ou zones

SÉNÉGAL

Les données concernant les captures des thonidés dans les océans Atlantique et Indien sont révisées en collaboration avec la CICTA et la CTOI, les organisations régionales chargées des statistiques des thonidés.

Les données sur les captures dans les eaux continentales ont été révisées après une communication officielle a informé que la soumission détaillée de 2008 comprenait également des captures dans zones marines. Comme la couverture de captures de 2010 a été partielle, une estimation de 20 000 tonnes a été ajoutée à les captures dans les eaux continentales.

SERBIE

À l’exclusion des données pour la région Kosovo et Metohia.

SEYCHELLES

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA et la CTOI, les organisations régionales chargées des statistiques des thonidés.

L’augmentation de captures concernant le thon depuis 1997 s’explique par les activités de pêche de quatre senneurs à senne coulissante battant pavillon des Seychelles.

SIERRA LEONE

La remarquable augmentation des captures marines s’explique par une nouvelle enquête cadre conduite en 2003, qui a entraîné une révision des facteurs d'extrapolation pour les pêches artisanales.

Les données sur les captures pour l’Atlantique sud-ouest, sont fournies par le Département des pêches du Gouvernement des Îles Falkland.

ÎLES SALOMON

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l’organisation régionale chargée des statistiques des thonidés.

AFRIQUE DU SUD

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA et la CTOI, les organisations régionales chargées des statistiques des thonidés.

Les données relatives aux algues brunes et rouges enregistrées en poids sec, ont été converties en leurs équivalent poids vert en utilisant le facteur de conversion ‘8’.

ESPAGNE

Les données concernant les captures des thonidés sont révisées en collaboration avec la CITT, la CICTA, la CTOI et la WCPFC, les organisations régionales chargées des statistiques des thonidés.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique centre-est ont également été tirées du "Bulletin statistique" publié par l’IMROP, Mauritanie.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique sud-ouest, sont fournies également par le Département des pêches du Gouvernement des Îles Falkland.

Notas sobre los distintos países o áreas

SENEGAL

Los datos relativos a las capturas de atún en los océanos Atlántico e Índico se revisan en colaboración con la CICAA y la CAOI, los organismos regionales encargados de las estadísticas atuneras.

Los datos sobre las capturas en aguas continentales fueron revisados después una comunicación oficial informó que la presentación detallada de las capturas de 2008 incluía también cantidades procedentes de las zonas marinas. Dado que la cobertura de las capturas de 2010 fue parcial, se agregó una estimación de 20 000 toneladas a las capturas en aguas continentales.

SERBIA

Excluye datos para Kosovo y Metohia.

SEYCHELLES

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA y la CAOI, los organismos regionales encargados de las estadísticas atuneras.

El incremento desde 1997 de las capturas de atunes se debe a los desembarques de cuatro cerqueros con jareta con pabellón de Seychelles.

SIERRA LEONA

El gran aumento de producción de las capturas marinas es la consecuencia de un nuevo estudio marco realizado en 2003 que produjo factores de proyección revisados para la pesca artesanal.

Los datos relativos a las capturas en el área del Atlántico sudoccidental,fueron proporcionados por el Departamento de Pesca del Gobierno de las Islas Malvinas (Falkland).

ISLAS SALOMÓN

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

SUDÁFRICA

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA y la CAOI, los organismos regionales encargados de las estadísticas atuneras.

Los datos relativos a las algas pardas y rojas registrados en peso en seco se han convertido en sus equivalentes de peso húmedo aplicando el factor de conversión ‘8’.

ESPAÑA

Los datos relativos a las capturas de atún se revisan en colaboración con la CIAT, la CICAA, la CAOI y la WCPFC, los organismos regionales encargados de las estadísticas atuneras.

Los datos sobre las capturas en el área del Atlántico centro-oriental, con exclusión de las de atunes, también se han extraído de la publicación "Bulletin statistique" del IMROP, Mauritania.

Los datos relativos a las capturas en el área del Atlántico sudoccidental, con exclusión de las de atunes, fueron proporcionados también por el Departamento de Pesca del Gobierno de las Islas Malvinas (Falkland).

Notes on individual countries or areas

SRI LANKA

In 1999, fishery statistics formerly assigned to area 51 (Western Indian Ocean) have been moved to area 57 (Eastern Indian Ocean) following a modification of the boundary between the two areas.

Data concerning tuna catches in the Indian Ocean are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

ST. PIERRE AND MIQUELON

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

TAIWAN PROVINCE OF CHINA

Data for tuna species not comparable with those of IATTC, ICCAT, IOTC and WCPFC.

Catch data, excluding those for tuna species, for the South Pacific high seas area are reviewed in collaboration with SPRFMO)

TANZANIA, UNITED REP. OF

Data refer only to capture production of mainland Tanzania and do not include captures of the Zanzibar Island.

Data concerning tuna catches in the Indian Ocean are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

THAILAND

Data concerning tuna catches in the Indian Ocean are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

Since 2001, data for 'Green mussel' (*Perna viridis*) have been reported only as aquaculture production. Catch data in previous years are subject to revision.

TOKELAU

Data concerning tuna catches are reviewed in collaboration with the WCPFC, the regional agency concerned with tuna statistics.

TONGA

Data concerning tuna catches are reviewed in collaboration with the WCPFC, the regional agency concerned with tuna statistics.

TRINIDAD AND TOBAGO

For the period 1998-2010, an estimate of 4,680 tonnes has been added to 'Marine fishes nei' to account for catches by vessels for which no data had been submitted.

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

Notes sur divers pays ou zones

SRI LANKA

En 1999 les statistiques des pêches ont été déplacées de la zone 51 (l'océan Indien ouest) à la zone 57 (l'océan Indien est) à la suite d'une modification des limites entre les deux zones.

Les données concernant les captures des thonidés dans l'océan Indien sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

SAINT-PIERRE-ET-MIQUELON

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

PROV. CHINOISE DE TAÏWAN

Les données concernant les thonidés ne sont pas comparables avec les renseignements fournis par la CITT, la CICTA, la CTOI et la WCPFC.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour la zone de haute mer de l'océan Pacifique Sud, sont révisées en collaboration avec la SPRFMO

RÉP.-UNIE DE TANZANIE

Les données se réfèrent seulement aux captures de la Tanzanie continentale et n'incluent pas les captures de l'île de Zanzibar.

Les données concernant les captures des thonidés dans l'océan Indien sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

THAÏLANDE

Les données concernant les captures des thonidés dans l'océan Indien sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

Depuis 2001 les données relatives aux captures de 'Moule verte asiatique' (*Perna viridis*) ont été rapportées seulement comme production de l'aquaculture. Les données des années précédentes sont sujettes à révision.

TOKÉLAOU

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l'organisation régionale chargée des statistiques des thonidés.

TONGA

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l'organisation régionale chargée des statistiques des thonidés.

TRINITÉ-ET-TOBAGO

Pour la période 1998-2010, une estimation de 4680 tonnes a été ajoutée à la catégorie 'Poissons marins nca' pour tenir compte des captures des bateaux qui n'ont pas remis les données,

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

Notas sobre los distintos países o áreas

SRI LANKA

En 1999 las estadísticas pesqueras originalmente asignadas al área 51 (océano Índico occidental) se movieron al área 57 (océano Índico oriental) tras una modificación del límite entre ambas áreas.

Los datos relativos a las capturas de atún en el océano Índico se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

SAN PEDRO y MIQUELÓN

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

TAIWAN PROV. DE CHINA

Los datos sobre las especies de atún no son comparables con la información de la CIAT, la CICAA, la CAOI y la WCPFC.

Los datos relativos a las capturas en el área de alta mar del Océano Pacífico Sur, con exclusión de las de atunes, se revisan en colaboración con la SPRFMO.

REP. UNIDA DE TANZANÍA

Los datos se refieren solamente a las capturas de la Tanzania continental y no incluyen las capturas de la isla de Zanzibar.

Los datos relativos a las capturas de atún en el océano Índico se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

TAILANDIA

Los datos relativos a las capturas de atún en el océano Índico se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

Desde 2001 los datos de capturas de 'Mejillón verde' (*Perna viridis*) han sido proporcionados solamente como producción de acuicultura. Los datos en años anteriores están sujetos a revisión.

TOKELAU

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

TONGA

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

TRINIDAD Y TABAGO

Para el período 1998-2010 una estimación de 4,680 toneladas se ha agregado a 'Peces marinos nep' para dar cuenta de capturas de buques que no habían reportado antes.

Los datos relativos a las capturas de atún en el Atlántico se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

Notes on individual countries or areas

Notes sur divers pays ou zones

Notas sobre los distintos países o áreas

TURKS AND CAICOS IS.

Data refer to a split-year fishing season shown under the calendar year in which the fishing season ends.

Data for 'Stromboid conchs nei' have been converted to live weight equivalents by using the conversion factor '7.5'.

ÎLES TURQUES ET CAÏQUES

Les données se réfèrent à une période de pêche fractionnée et figurent sous l'année civile durant laquelle se termine la période de pêche.

Les données relatives aux 'Strombes nca' ont été converties en équivalent poids vif en utilisant le facteur de conversion '7,5'.

ISLAS TURCAS Y CAICOS

Los datos se refieren a una temporada de pesca que se indica como el año civil en que finaliza la temporada.

Los datos de 'Cobos nep' se han convertido en sus equivalentes de peso en vivo aplicando el factor de conversión '7,5'.

TUVALU

Data concerning tuna catches are reviewed in collaboration with the WCPFC, the regional agency concerned with tuna statistics.

TUVALU

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l'organisation régionale chargée des statistiques des thonidés.

TUVALU

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

UGANDA

Large increases of capture production in 2004 and 2007 are due, respectively, to an improved coverage of the data collection system, and to inclusion of illegal catch estimates and emerging fisheries for new species.

OUGANDA

L'augmentation considérable des captures 2003 et 2007 est due, respectivement, à une meilleure couverture du système de collecte des données et à l'inclusion des estimations relatives à la pêche illicite et aux pêcheries des espèces nouvelles.

UGANDA

Las mayores capturas registradas en 2004 y en 2007 se deben, respectivamente, a una mejor cobertura del sistema de recopilación de datos, y a la inclusión de estimaciones de capturas ilegales y a pesquerías emergentes de nuevas especies.

UK

Data for England and Wales, Scotland and Northern Ireland have been combined.

Data concerning tuna catches in the Atlantic and in the Indian Oceans are reviewed in collaboration with ICCAT and IOTC, the regional agencies concerned with tuna statistics.

Catch data, excluding those for tuna species, for the Southwest Atlantic area are provided also by the Fisheries Department, Falkland Islands Government.

ROYAUME-UNI

Les chiffres concernent l'Angleterre et le pays de Galles, l'Ecosse et l'Irlande du Nord.

Les données concernant les captures des thonidés dans les océans Atlantique et Indien sont révisées en collaboration avec la CICTA et la CTOI, les organisations régionales chargées des statistiques des thonidés.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique sud-ouest, sont fournies également par le Département des pêches du Gouvernement des Iles Falkland.

REINO UNIDO

Se han combinado los datos sobre Inglaterra y Gales, Escocia e Irlanda del Norte.

Los datos relativos a las capturas de atún en los océanos Atlántico e Índico se revisan en colaboración con la CICAA y la CAOI, los organismos regionales encargados de las estadísticas atuneras.

Los datos relativos a las capturas en el área del Atlántico sudoccidental, con exclusión de las de atunes, fueron proporcionados también por el Departamento de Pesca del Gobierno de las Islas Malvinas (Falkland).

UKRAINE

No species breakdown provided for 2005 and 2007-2010 catches in the Southwest Pacific.

Catch data for inland waters and for the Eastern Central Atlantic area are considered underestimated in recent years.

Catch data, excluding those for tuna species, for the Eastern Central Atlantic area have also been taken from the "Bulletin statistique" published by IMROP, Mauritania.

UKRAINE

La ventilation par espèces des captures 2005 et 2007-2010 dans le Pacifique sud-ouest n'a pas été fournie.

Les captures en eaux continentales et pour l'Atlantique centre-est sont considérées sous-estimées ces dernières années.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique centre-est ont également été tirées du "Bulletin statistique" publié par l'IMROP, Mauritanie.

UCRANIA

En 2005 y 2007-2010 no se ha proporcionado el desglose por especies de las capturas en el área del Pacífico sudoccidental.

Las capturas en aguas continentales y en el área del Atlántico centro-oriental se consideran subestimadas en años recientes.

Los datos sobre las capturas en el área del Atlántico centro-oriental, con exclusión de las de atunes, también se han extraído de la publicación "Bulletin statistique" del IMROP, Mauritania.

URUGUAY

Data concerning tuna catches are reviewed in collaboration with ICCAT, the regional agency concerned with tuna statistics.

URUGUAY

Les données concernant les captures des thonidés sont révisées en collaboration avec la CICTA, l'organisation régionale chargée des statistiques des thonidés.

URUGUAY

Los datos relativos a las capturas de atún se revisan en colaboración con la CICAA, el organismo regional encargado de las estadísticas atuneras.

USA

Capture data for recreational fisheries are not included.

Data for tuna species, excluding those for the Eastern Pacific which are reviewed in collaboration with IATTC, are not comparable with those of ICCAT and WCPFC.

Catch data officially reported for selected clams and oysters, have been revised to exclude quantities derived from aquaculture.

Since 1985, data for seals refer exclusively to harvest for subsistence.

ÉTATS-UNIS D'AMÉRIQUE

Les données relatives aux captures ne comprennent pas la pêche récréative.

Les données concernant les thonidés, sauf celles relatives au Pacifique qui sont révisées en collaboration avec la CITT, ne sont pas comparables aux renseignements fournis par la CICTA et la WCPFC.

Les données relatives aux captures de certaines clams et huîtres, reportées officiellement, ont été révisées afin d'exclure les quantités provenant de l'aquaculture.

Depuis 1985 les données concernant les otaries se réfèrent exclusivement à la pêche destinée à la subsistance.

ESTADOS UNIDOS DE AMÉRICA

Los datos de capturas no incluyen la pesca recreativa.

Los datos sobre las especies de atún, con exclusión de los por el Pacífico oriental que se revisan en colaboración con la CIAT, no son comparables con la información de la CICAA y la WCPFC.

Las capturas relativas a algunas especies de almejas y ostras notificadas por parte de la oficina nacional, se han revisado para que excluyan cantidades procedentes de la acuicultura.

Desde 1985 los datos sobre los lobos marinos se refieren exclusivamente a la recogida hecha con fin de subsistencia.

Notes on individual countries or areas

Notes sur divers pays ou zones

Notas sobre los distintos países o áreas

US VIRGIN ISLANDS

Includes Saint Croix, Saint John and Saint Thomas.

Data refer to a split-year (1 July – 30 June) shown under the calendar year in which the split-year ends.

Data for 'Stromboid conchs nei' have been converted to live weight equivalent by using the conversion factor '7.5'.

ÎLES VIERGES AMÉRICAINES

Comprend Sainte-Croix, Saint-John et Saint-Thomas.

Les données se réfèrent à une année fractionnée (1er juillet - 30 juin) et figurent sous l'année civile durant laquelle se termine l'année fractionnée.

Les données relatives aux 'Strombes nca' ont été converties en équivalent poids vif en utilisant le facteur de conversion '7,5'.

ISLAS VÍRGENES DE LOS EU

Incluye Sainte Croix, Saint John y Saint Thomas.

Los datos se refieren a un año emergente (1 de julio - 30 de junio) que se indica como el año civil en que finaliza el año emergente.

Los datos de 'Cobos nep' se han convertido en sus equivalentes de peso en vivo aplicando el factor de conversión '7,5'.

VANUATU

Data concerning tuna catches are reviewed in collaboration with IATTC, ICCAT IOTC and WCPFC, the regional agencies concerned with tuna statistics. Increase of tuna catches in the Western Central Pacific since 1995 due to vessels fishing with flag of convenience. In 2001, these vessels were re-flagged in the Marshall Islands.

Catch data, excluding those for tuna species, for the Southwest Atlantic area are provided by the Fisheries Department, Falkland Islands Government

Catch data, excluding those for tuna species, for the South Pacific high seas area are reviewed in collaboration with SPRFMO.

Data for 'Sea cucumber nei' recorded on a dry-weight basis have been converted to wet-weight equivalents by using the conversion factor '3'.

VANUATU

Les données concernant les captures des thonidés sont révisées en collaboration avec la CITT, la CICTA, la CTOI et la WCPFC, les organisations régionales chargées des statistiques des thonidés. A partir de 1995, l'augmentation des captures pour les thonidés dans le Pacifique centre-ouest s'explique par les captures effectuées sous pavillon de complaisance. En 2001 ces bateaux ont été passés sous pavillon des îles Marshall.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour l'Atlantique sud-ouest, sont fournies par le Département des pêches du Gouvernement des Iles Falkland.

Les données sur les captures, à l'exclusion de celles concernant le thon, pour la zone de haute mer de l'océan Pacifique Sud, sont révisées en collaboration avec la SPRFMO.

Les données relatives aux 'Bèches-de-mer nca' enregistrées en poids sec, ont été converties en leurs équivalent poids vif en utilisant le facteur de conversion '3'.

VANUATU

Los datos relativos a las capturas de atún se revisan en colaboración con la CIAT, la CICAA, la CAOI y la WCPFC, los organismos regionales encargados de las estadísticas atuneras. Desde 1995 el incremento de las capturas de atún en el Pacífico centro-occidental se debe a las capturas de pabellones de conveniencia. En 2001 estas embarcaciones cambiaron de pabellón en las Islas Marshall.

Los datos relativos a las capturas en el área del Atlántico sudoccidental, con exclusión de las de atunes, fueron proporcionados por el Departamento de Pesca del Gobierno de las Islas Malvinas (Falkland).

Los datos relativos a las capturas en el área de alta mar del Océano Pacífico Sur, con exclusión de las de atunes, se revisan en colaboración con la SPRFMO.

Los datos relativos a los 'Cohombros de mar nep' registrados en peso en seco se han convertido en sus equivalentes de peso húmedo aplicando el factor de conversión '3'.

VENEZUELA, BOLIV REP OF

Data concerning tuna catches are reviewed in collaboration with IATTC and ICCAT, the regional agencies concerned with tuna statistics.

VENEZUELA, RÉP BOLIV DU

Les données concernant les captures des thonidés sont révisées en collaboration avec la CITT et la CICTA, les organisations régionales chargées des statistiques des thonidés.

VENEZUELA, REP BOLIV DE

Los datos relativos a las capturas de atún se revisan en colaboración con la CIAT y la CICAA, los organismos regionales encargados de las estadísticas atuneras.

VIET NAM

Data concerning tuna catches are reviewed in collaboration with the WCPFC, the regional agency concerned with tuna statistics.

VIET NAM

Les données concernant les captures des thonidés sont révisées en collaboration avec la WCPFC, l'organisation régionale chargée des statistiques des thonidés.

VIET NAM

Los datos relativos a las capturas de atún se revisan en colaboración con la WCPFC, el organismo regional encargado de las estadísticas atuneras.

YEMEN

Includes Kamaran Islands, Perim and Socotra.

Data concerning tuna catches in the Indian Ocean are reviewed in collaboration with IOTC, the regional agency concerned with tuna statistics.

YÉMEN

Comprend les îles Kamaran, Perim et Socotra.

Les données concernant les captures des thonidés dans l'océan Indien sont révisées en collaboration avec la CTOI, l'organisation régionale chargée des statistiques des thonidés.

YEMEN

Incluyen las islas Kamaran, Perim y Socotra.

Los datos relativos a las capturas de atún en el océano Índico se revisan en colaboración con la CAOI, el organismo regional encargado de las estadísticas atuneras.

ZANZIBAR

The 2000-10 capture production data for the Zanzibar Island have been made available by the Department of Fisheries and Marine Resources, Zanzibar.

ZANZIBAR

Les données des captures 2000-2010 pour l'île de Zanzibar ont été fournies par le Département des pêches et des ressources marines de Zanzibar.

ZANZÍBAR

Los datos de capturas desde 2000 hasta 2010 de la isla de Zanzíbar están disponibles a través del Departamento de Pesca y Recursos Marinos, Zanzíbar.

ZIMBABWE

Data refer only to catches from Lake Kariba which, however, contributes almost 90 percent of the country's total capture production.

ZIMBABWE

Les données se réfèrent exclusivement aux captures du lac Kariba qui, pourtant contribuent à presque 90 pour cent des captures totales du pays.

ZIMBABWE

Los datos se refieren únicamente a las capturas en el lago Kariba que, sin embargo, aporta casi el 90 por ciento de la producción total de captura.

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[a] Starting with the 1998 issue ("Capture production 1996"), the nominal catch statistics include only the production from capture fisheries with the exclusion of aquaculture production.
[a] À partir de l'édition de 1998 («Captures 1996»), les statistiques des captures nominales comprennent uniquement la production des pêches de capture à l'exclusion de la production aquacole.
[a] A partir de la edición de 1998 («Capturas 1996»), las estadísticas de las capturas nominales incluyen únicamente la producción de la pesca de captura con exclusión de la producción de acuicultura.

[b] Aquaculture production statistics were combined with those of capture fisheries and published jointly in the "FAO Yearbook. Fishery statistics. Catches and landings" until volume 80. The 1984-97 data were formerly published yearly as "FAO Fisheries Circular No. 815 Aquaculture production statistics".
[b] Les statistiques de production de l'aquaculture étaient confondues avec celles de la production de pêche et publiées dans «FAO annuaire. Statistiques des pêches. Captures et quantités débarquées» jusqu'au volume 80. Auparavant, les données 1984-97 étaient publiées sur base annuelle dans la «Circulaire de la FAO sur les pêches n° 815: Statistiques de la production de l'aquaculture».
[b] Las estadísticas de producción de acuicultura estaban incluidas en la producción de pesca y publicadas juntas en «FAO anuario. Estadísticas de pesca. Capturas y desembarques», hasta el volumen 80. Anteriormente los datos desde 1984 hasta 1997 se publicaron anualmente en la «Circular de Pesca de la FAO N° 815: Estadísticas de la producción de acuicultura».

[c] Starting with the 2008 issue ("Fishery and Aquaculture Statistics 2006"), the FAO yearbooks of fishery and aquaculture statistics are published in a revised format consisting in a booklet, containing general notes and summary tables, accompanied by a CD-ROM with the complete yearbooks package of statistical tables.
[c] À partir de l'édition de 2008 («Statistiques des pêches et de l'aquaculture 2006»), les annuaires statistiques des pêches et de l'aquaculture adoptent un format révisé, consistant en un fascicule, avec les notes générales et les tableaux résumés, accompagné d'un CD-ROM, contenant tous les tableaux statistiques.
[c] A partir de la edición de 2008 («Estadísticas de pesca y acuicultura 2006»), los anuarios FAO de Estadísticas de pesca y acuicultura se publican con la presentación revisada que incluye un volumen, con las notas generales y los cuadros resúmenes, y un CD-ROM con todos los cuadros estadísticos.

[d] Starting with the 2009 issue ("Fishery and Aquaculture Statistics 2007"), the FAO yearbook of fishery and aquaculture statistics includes the section "Fish and fishery products – World apparent consumption statistics based on food balance sheets". Formerly published as "FAO Fisheries Circular No. 821".
[d] À partir de l'édition de 2009 («Statistiques des pêches et de l'aquaculture 2007»), l'annuaire statistique des pêches et de l'aquaculture de la FAO inclut la section «Poissons et produits de la pêche – Statistiques sur la consommation mondiale apparente, fondées sur les bilans alimentaires». Autrefois publiée comme «FAO Circulaire sur les pêches n° 821»
[d] A partir de la edición de 2009 («Estadísticas de pesca y acuicultura 2007»), el anuario FAO de Estadísticas de pesca y acuicultura incluye la sección «Pescado y productos pesqueros – Estadísticas sobre consumo mundial aparente, basadas en las hojas de balance de alimentos». Anteriormente publicado como «FAO Circular de Pesca N° 821».

[e] The 2011 issue ("Fishery and Aquaculture Statistics 2009) is available in electronic format only at http://www.fao.org/fishery/publications/yearbooks/en [or CD-ROM]
[e] L'édition de 2011 («Statistiques des pêches et de l'aquaculture 2009») est disponible en format électronique seulement sur http://www.fao.org/fishery/publications/yearbooks/en [ou CD-ROM]
[e] La edición de 2011 («Estadísticas de pesca y acuicultura 2009») está disponible únicamente en formato electrónico en http://www.fao.org/fishery/publications/yearbooks/en [o CD-ROM]

ARCTIC
VOL. 41, NO. 3 (SEPTEMBER 1988) P. 239-240

Maximal Feeding Depth of Walruses

F.H. FAY[1] and J.J. BURNS[2]

(Received 26 November 1986; accepted in revised form 26 April 1988)

ABSTRACT. Walruses (*Odobenus rosmarus*) feed mainly on benthic invertebrates in waters less than 80 m deep, and they have been presumed to be incapable of diving to greater depths. Reported here are seven walruses whose stomachs contained significant amounts of benthic sediments and food, some of which must have been ingested in waters more than 100 m deep. Walruses may be able to dive to depths much greater than 100 m, but they usually have little reason to do so, since their benthic prey are most abundant in shallower waters.

Key words: walrus, *Odobenus*, diving, feeding, Bering Sea

RÉSUMÉ. Les morses (*Odobenus rosmarus*) mangent surtout des benthiques invertébrés dans les eaux qui ne dépassent pas 80 m de profondeur et l'on suppose qu'ils sont incapables de plonger plus bas. Nous rendons compte ici de la prise de sept morses ayant dans leurs estomacs des quantités importantes d'aliments et de sédiments benthiques, dont une certaine quantité a dû être ingérée à une profondeur de plus de 100 m. Les morses sont peut-être capables de plonger à des profondeurs qui dépassent 100 m, mais il y a très peu de raison qu'ils le fassent à cause du manque de proie à cette profondeur.

Mots clés: morse, *Odobenus*, plongée, alimentation, Mer de Bering

Traduit par V. Pelletier, l'Université d'Alaska-Fairbanks.

РЕЗУМЕ. Моржи (Odobenus rosmarus) питаются главным образом бентическими беспозвоночными в водах мельче 80 м, и полагалось что они не имели способности нырять ниже. Здесь предоставляем доклад о семи моржах, в чьих желудках было значительное количество бентоса и бентонного гравия, которое добивалось в водах глубже 100 м, где моржи наверно питались некоторым количеством этих материалов. Возможно что моржи имеют нырять глубже 100м, но мало причин почему бы им нырять в такие глубины, так как пища становится самая обильная в более мелких водах.

Ключевые слова: морж, Odobenus, нырание, питание, Берингово море

Перевод по С. Лекомт, Университет Аляски-Фэрбанкс.

Walruses, *Odobenus rosmarus* (Linnaeus), reside mainly in seasonally ice-covered seas of the Arctic and Subarctic. Because they feed primarily on bivalve mollusks (Chapskii, 1936; Tsalkin, 1937; Nikulin, 1941; Brooks, 1954; Loughrey, 1959), they must dive to the bottom of the sea for most of their food. Walruses are not known to bottom-feed in waters deeper than 80 m, which has led some observers to hypothesize that either the walruses are incapable of diving to greater depths (Vibe, 1950, 1956; Mansfield, 1958) or their preferred foods are scarce in deeper waters (Brooks, 1954; Loughrey, 1959). They do venture occasionally into areas of deeper water (Vibe, 1950; Loughrey, 1959; Fay, 1982; Finley and Renaud, 1980), but they are believed to subsist there by preying on pelagic organisms, particularly phocine seals (Vibe, 1950).

In March 1985, we had an opportunity to examine the stomachs from 13 walruses that were killed on ice floes over waters 102-117 m deep in the central Bering Sea. Six of those stomachs were nearly empty, containing only trace amounts of digesta from a previous meal, but four contained partly digested food, and the last three contained food that was very fresh (undigested), along with associated benthic sediments. The presence of fresh, undigested prey, which consisted of infaunal and epifaunal mollusks (fleshy parts only; walruses usually do not ingest the shells) and crustaceans (Table 1), indicates that at least the last three animals had fed very recently, probably in the immediate vicinity of the floes where they lay when killed. The partly digested food in the other four stomachs was of the same kind as that in those three, but it evidently had been eaten some time earlier, possibly a few km away. The nearest waters 80 m and less in depth were at least 50-95 km away from the location where the animals were killed. At the normal swimming speed of walruses (up to about 10 km·h^{-1}; Fay, 1982), those shallow waters were at least 5-9 h distant. Had the walruses eaten their

TABLE 1. Kinds and numbers of prey in the seven walrus stomachs containing fresh (F) and partly digested (P) food, by date, location, and depth of water

Kinds of prey (genera) in stomach	21 March 1985 60°34.4′N lat. 174°49.9′W long. depth 102-104 m			24 March 1985 60°43.8′N lat. 175°33.1′W long. depth 110-113 m			
	(F)	(P)	(P)	(F)	(F)	(P)	(P)
Whelks (*Buccinum, Neptunea,* and *Clinopegma*)	58	2	284	495	6	434	1011
Moon snails (*Natica* and *Polinices*)	10	4	31	14	2	13	69
Cockles (*Serripes* and *Clinocardium*)	17	0	0	39	0	28	2
Nuculanid clams (*Yoldia*)	27	0	0	102	0	0	0
Tellinids (*Tellina* and/or *Macoma*)	2	0	0	4	0	5	2
Ample panomya (*Panomya*)	0	0	0	2	0	1	2
Cephalopods (*Octopus*)	0	0	1	2	0	4	0
Hermit crabs (*Pagurus*)	0	0	0	10	0	67	5
Snow crabs (*Chionoecetes*)	3	7	13	55	20	33	77
Echiuroids (*Echiurus*)	0	0	0	2	0	1	0
Priapulids (*Priapulus*)	0	0	2	2	1	0	0
Polychaetes (indeterminate)	0	2	4	0	5	1	3
Est. total volume (ml)[1]	510	—	—	3675	680	—	—

[1]Not measured for these specimens; based on specimens of the same genera from walruses taken in southeastern Bering Sea (Fay *et al.*, 1984).

[1]Institute of Marine Science, University of Alaska, Fairbanks, Alaska 99775, U.S.A.
[2]Alaska Department of Fish and Game, 1300 College Road, Fairbanks, Alaska. Current address: Living Resources Inc., P.O. Box 83570, Fairbanks, Alaska 99708, U.S.A.
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last meal there, 5-9 h earlier, the digestion of it in their stomach certainly would have been completed before they were captured. Pinnipeds digest their food rapidly (Gurova and Pastukhov, 1974; Parsons, 1977; Miller, 1978; Murie and Lavigne, 1986), and the walrus's digestion is thought to be exceptionally rapid (Murie, 1871).

The bivalves on which walruses feed are abundant in northern seas mainly at depths between 10 and 100 m (Thorson, 1934; Belyaev, 1960; Neiman, 1960; Thompson, 1982). In the Bering Sea, the production of macrobenthos in that range (middle shelf) is an order of magnitude higher than it is on the outer shelf at depths of 100-200 m (Walsh and McRoy, 1986). This is a result of partitioning of primary production to the pelagic food web seaward of the 100 m isobath and to the benthic food web shoreward of 100 m (Cooney and Coyle, 1982).

Judging from our findings, walruses are capable of diving and feeding to depths greater than 100 m in that region, but they probably do not do so very often, because they gain less from it than from feeding in shallower waters. Their geographic distribution, therefore, may be limited less by their diving ability than by the bathymetric distribution of their food.

ACKNOWLEDGEMENTS

This work was done with support from the University of Alaska and the Alaska Department of Fish and Game, with logistic accommodation by the Soviet All-Union and Pacific Research Institutes of Fisheries and Oceanography under the aegis of the Marine Mammal Project (V.6), US-USSR Agreement in the Field of Environmental Protection. We thank Captain Victor Yagupov and his crew on the ZRS *Zakharovo* and Chief Scientist A.A. Kibal'chich for their generous hospitality. Nora Foster, of the University of Alaska-Fairbanks Museum, assisted us by identifying some of the invertebrates from the walrus stomachs, and B.P. Kelly, C.P. McRoy, H.M. Feder, and two anonymous reviewers kindly read and commented on earlier drafts of the manuscript.

REFERENCES

BELYAEV, G.M. 1960. Quantitative distribution of the bottom fauna in the northwestern part of the Bering Sea. Trudy Instituta Okeanologii 34:85-103.

BROOKS, J.W. 1954. A contribution to the life history and ecology of the Pacific walrus. Unpubl. M.S. thesis, University of Alaska, Fairbanks, Alaska, U.S.A. 103 p.

CHAPSKII, K.K. 1936. The walrus of the Kara Sea. Trudy Arkticheskogo Instituta, Biologiya 67:1-124.

COONEY, R.T., and COYLE, K.O. 1982. Trophic implications of cross-shelf copepod distribution in the southeastern Bering Sea. Marine Biology 70:187-196.

FAY, F.H. 1982. Ecology and biology of the Pacific walrus, *Odobenus rosmarus divergens* Illiger. North American Fauna 74:1-279.

———, BUKHTIYAROV, Y.A., STOKER, S.W., and SHULTS, L.M. 1984. Foods of the Pacific walrus in winter and spring in the Bering Sea. NOAA Technical Report NMFS 12:81-88.

FINLEY, K.J., and RENAUD, W.E. 1980. Marine mammals inhabiting the Baffin Bay North Water in winter. Arctic 33:724-738.

GUROVA, L.A., and PASTUKHOV, V.D. 1974. Feeding and trophic relationships of the pelagic fishes and seals of Baikal. Trudy Limnologicheskogo Instituta, Tom 24. Novosibirsk: Nauka. 185 p.

LOUGHREY, A.G. 1959. Preliminary investigation of the Atlantic walrus *Odobenus rosmarus rosmarus* (Linnaeus). Wildlife Management Bulletin, Series 1, Number 14. Ottawa: Canadian Wildlife Service. 123 p.

MANSFIELD, A.W. 1958. The biology of the Atlantic walrus, *Odobenus rosmarus rosmarus* (Linnaeus), in the eastern Canadian Arctic. Fisheries Research Board of Canada, Manuscript Report Series (Biological) 653:1-146.

MILLER, L.K. 1978. Energetics of the northern fur seal in relation to climate and food resources of the Bering Sea. PB-275 296, National Technical Information Service, Springfield, Virginia, U.S.A. 27 p.

MURIE, D.J., and LAVIGNE, D.M. 1986. Interpretation of otoliths in stomach content analyses of phocid seals: quantifying fish consumption. Canadian Journal of Zoology 64:1152-1157.

MURIE, J. 1871. Researches upon the anatomy of the Pinnipedia. Part I. On the walrus (*Trichechus rosmarus* Linn.). Transactions of the Zoological Society of London 7:411-464.

NEIMAN, A.A. 1960. Quantitative distribution of benthos in the eastern part of the Bering Sea. Zoologicheskii Zhurnal 39:1281-1292.

NIKULIN, P.G. 1941. The Chukchi walrus. Izvestiya Tikhookeanskogo Nauchno-Issledovatel'nogo Instituta Rybnogo Khozyaistva i Okeanografii 20:21-59.

PARSONS, J.L. 1977. Metabolic studies on ringed seals (*Phoca hispida*). M.S. thesis, University of Guelph, Guelph, Ontario, Canada. 82 p.

THOMPSON, D.H. 1982. Marine benthos in the eastern Canadian high Arctic: multivariate analyses of standing crop and community structure. Arctic 35:61-74.

THORSON, G. 1934. Contributions to the animal ecology of the Scoresby Sound fjord complex (East Greenland). Meddelelser om Grønland 100(3):1-67.

TSALKIN, V.I. 1937. Materials on the biology of the walrus of the Franz Josef Archipelago. Byulleten' Moskovskogo Obschestva Ispolneniya Prirody, Otdel' Biologii 46:43-51.

VIBE, C. 1950. The marine mammals and the marine fauna in the Thule District (northwest Greenland) with observations on ice conditions in 1939-41. Meddelelser om Grønland 150(6):1-115.

———. 1956. The walrus west of Greenland. International Union for Protection of Nature, Papers and Proceedings of Technical Meeting 5:79-84.

WALSH, J.J., and McROY, C.P. 1986. Ecosystem analysis in the southeastern Bering Sea. Continental Shelf Research 5(1/2):259-288.

ARCTIC
VOL. 36, NO. 1 (MARCH 1983) P. 82-89

Summer Diet of the Bearded Seal (*Erignathus barbatus*) in the Canadian High Arctic

K.J. FINLEY[1] and C.R. EVANS[1]

ABSTRACT. Stomach contents of 34 bearded seals taken in three High Arctic localities (Grise Fiord, Pond Inlet and Clyde) during the summers from 1978-1980 were examined. At least 12 species of fish were present but sculpins (Cottidae) and arctic cod (*Boreogadus saida*) comprised the bulk of the diet. Eelpouts (*Lycodes* spp.) and polar cod (*Arctogadus glacialis*) were also ingested in considerable amounts. In 15 of 19 stomachs containing >1 kg food, fish contributed >90% of the wet weight. The whelk *Buccinum* and the shrimp *Sclerocrangon boreas* accounted for most of the invertebrate component of the diet. Clams, cephalopods, anemones, sea cucumbers, polychaete worms and other invertebrates occurred in small amounts. The largest measured weight of stomach contents was 7.6 kg from a seal that had fed heavily on arctic cod. There were no significant differences amongst the three localities in the amount of food ingested; however, the proportions of arctic cod and sculpins varied considerably among localities. Bearded seals fed on the available size range of arctic cod but were limited to the smaller sculpins (<200 g), eelpouts (<200 g) and polar cod (<350 g).

Key words: bearded seals, Canadian High Arctic, diet

RÉSUMÉ. On a examiné le contenu de l'estomac de 34 phoques barbus pris à trois centres du nord de l'Arctique (Grise Point, Pond Inlet et Clyde) au cours des étés de 1978 à 1980. Au moins douze espèces de poissons s'y trouvaient mais le chabot (Cottidae) et le saida (*Boreogadus saida*) formaient la majeure partie du régime alimentaire. Les lycodes (*Lycodes* spp.) et la "morue polaire" (*Arctogadus glacialis*) furent aussi consommées en quantité considérable. Le poisson comptait pour >90% du poids mouillé dans 15 des 19 estomacs contenant plus de 1 kg de nourriture. Le buccin *Buccinum* et la crevette *Sclerocrangon boreas* comportaient la majeure partie des invertébrés du régime. Les clams, les céphalopodes, les anémones, les concombres de mer, les vers polychètes et d'autres invertébrés s'y trouvaient aussi en petites quantités. Le poids maximal mesuré pour le contenu d'un estomac était de 7.6 kg pour un phoque qui s'était gavé de saida. L'étude n'a indiqué aucune différence marquée dans la quantité de nourriture consommée entre les trois centres. Cependant, la proportion de saida et de chabot variait de façon importante entre les trois centres. Les phoques barbus s'étaient nourris de saidas de la taille disponible mais avaient dû se satisfaire de mets de taille inférieure quant aux chabots (<200 g), aux lycodes (<200 g) et aux "moreus polaires" (<350 g).

Mots clés: phoques barbus, nord de l'Arctique canadien, régime alimentaire

Traduit pour le journal par Maurice Guibord.

INTRODUCTION

The bearded seal, *Erignathus barbatus*, is a large, solitary seal with continuous circumpolar distribution in arctic and subarctic waters (Mansfield, 1967; Benjaminsen, 1973). It is most abundant in areas where it can reach the sea bottom to feed (i.e. generally <200 m — Burns and Frost, 1979) and where it has access to ice pans upon which to haul out (Fig.1). Since the bearded seal has only a limited capability to maintain breathing holes in solid ice, it is excluded from areas of fast ice and is found among pack ice where openings are continually formed (Burns *et al.*, 1981). In many areas, bearded seals are quite sedentary and undertake only local movements in response to ice conditions (Vibe, 1950; McLaren, 1962; Fedoseev, 1973) although in the Bering Sea, bearded seals undertake considerable north-south movements in response to seasonal changes in ice conditions (Burns and Frost, 1979).

The bearded seal is primarily a benthic feeder with a diverse diet that varies with location and time of year (for reviews see Chapskii, 1938; Kosygin, 1971; Davis *et al.*, 1980; Lowry *et al.*, 1980). Most studies of the diet of bearded seals have been conducted in the shallow Bering and Chukchi seas which provide "the largest continuous area of favorable bearded seal habitat in the world" (Burns and Frost, 1979:12). In a comprehensive study and review of the diet of the bearded seal in the Bering and Chukchi seas, Lowry *et al.* (1980) found that it consisted mainly of crabs, shrimps and clams. Fish, they concluded, were of minor importance in the diet.

In the Kara and Barents seas of the western Soviet Arctic, Chapskii (1938) concluded that shrimp, particularly *Sclerocrangon boreas*, and molluscs were the basic food of the bearded seal, though fish, particularly arctic cod (*Boreogadus saida*), were thought to be important when they occurred in



FIG. 1. A solitary bearded seal resting on an ice pan over shallow coastal waters of Somerset Island, August 1977.

[1]LGL Limited, environmental research associates, 414-44 Eglinton Avenue West, Toronto, Ontario, Canada M4R 1A1

large concentrations. Pikharev (1941) found that bearded seals of the Sea of Okhotsk fed on fish when they could not reach the bottom. Vibe (1950) stated that arctic cod were of major importance in areas of NW Greenland where bearded seals could not reach the bottom; in coastal waters they fed on various benthic fishes, crustaceans, gastropods, holothurians, gephyreans, cephalopods and polychaetes. Like Chapskii (1938), Vibe (1950) noted the preference of bearded seals for whelks, *Buccinum* spp.; he and others wondered how the bearded seal managed to remove the snails from the shells without ingesting the shells.

Very little is known about the bearded seal in the Canadian Arctic (Davis *et al.*, 1980). It is taken in relatively small numbers in virtually all coastal communities and is thought to be most abundant in Hudson Strait, Foxe Basin and along the west coast of Hudson Bay (Mansfield, 1967). Bearded seals are excluded by fast ice from large areas of the High Arctic Archipelago during much of the year, but during the summer they are found widely distributed in small numbers throughout much of the archipelago. In the eastern Canadian High Arctic, bearded seals are hunted in fiords, primarily from July to October. The feeding habits of these seals are examined in this paper.

METHODS

Stomachs were obtained from 36 bearded seals taken by hunters from the communities of Grise Fiord, Pond Inlet and Clyde (Fig. 2) during 1978-80. Hunters provided the stomachs along with jaws, reproductive organs and a tag with the date and location of each seal kill. Most seals were taken from July to October (Table 1) and almost all were taken within fiords near the communities.

The stomachs were weighed on a triple-beam balance and all contents were removed and frozen for later processing. In the laboratory all whole organisms were individually weighed and measured. The remaining digested material was sorted into fish, crustaceans, gastropods, cephalopods, clams, etc., and these components, along with whole specimens, were weighed in order to determine composition by weight. Digested material was then further sorted by differential specific gravity in a water bath. Food items were sorted to the lowest possible taxonomic level using published keys and reference collections. In many cases, the number of individuals in each taxon was determined from counts of characteristic hard parts such as the otoliths of fish, beaks of cephalopods, jaws of polychaetes, carapaces of shrimps, and opercula of gastropods.

Fish otoliths are valuable in the interpretation of feeding habits of marine mammals (Fitch and Brownell, 1968; Frost and Lowry, 1981; Finley and Gibb, 1982; in press). Otoliths reveal the identity of the taxon ingested; since the teleost fish has two sagittal otoliths, the number of fish ingested can be estimated as half the number of otoliths within mm length categories. Length distributions of otoliths for certain fish were sometimes determined from subsamples (of one quarter) when the numbers of otoliths in a stomach exceeded 500. Because there are close relationships among otolith length, fish length and fish weight it is possible to estimate the size and weight of fish ingested. Such equations have been developed for *Boreogadus saida* and *Arctogadus glacialis* from the Canadian High Arctic (Finley and Gibb, in press) but are not known for most benthic species of fish that were consumed by bearded seals.

The percent occurrence of food organisms is of limited value in understanding their dietary importance. However, back calculation of weights from diagnostic hard parts provides an important means of estimating the actual biomass contribution of a particular species consumed, particularly since percent occurrence values, as used in many studies of marine mammal diets, are often quite misleading (Frost and Lowry,

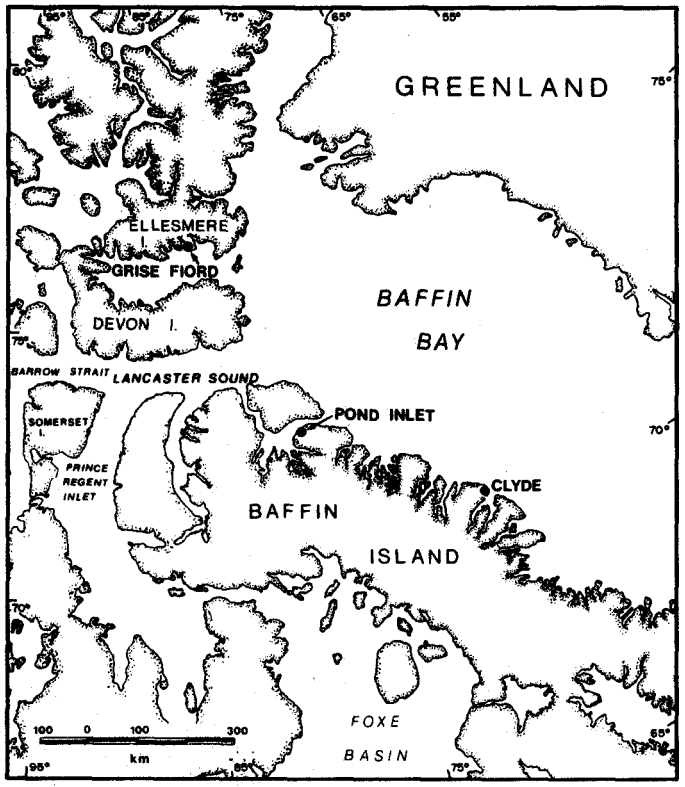

FIG. 2. The study area showing the locations of three settlements where stomachs of bearded seals were collected.

TABLE 1. Number of bearded seal stomachs collected from hunters in three communities during 1978-1980

	Pond Inlet	Grise Fiord	Clyde
June	1		
July	3 (1)[a]		
August	1	5	2
September	4	5	
October	3 (1)	2	4
November	1		
All months	13 (2)	12 + 2[b]	6 + 1[b]

[a] Numbers in parentheses represent empty stomachs.
[b] Additional seals killed in unknown months (probably August-October).

1980; Finley and Gibb, in press). The differential retention and digestion of calcareous (otoliths) or chitinous (beaks, operculae) material poses some problems in terms of reconstruction of the recent dietary intake. Finley and Gibb (1982) conducted simple experiments to demonstrate the resistance and retention of chitinous parts. They and Frost and Lowry (1980) considered that otoliths were indicative of food (fish) intake within the previous 24-h period, whereas chitinous beaks were probably retained and were not necessarily indicative of recent ingestion (see also Pitcher, 1980). To compensate for the differential retention Finley and Gibb (1982) included only identifiable remains of cephalopods or beaks with attached flesh as being representative of recent intake. We have taken the same approach in evaluating the relative biomass contribution of various taxa in the bearded seal diet. In addition, we have used the actual wet weight composition of major taxa (i.e. fish, crustaceans, gastropods, clams) to evaluate their relative biomass.

Our samples were too small to permit detailed analysis of food habits by sex and age classes for each of the three areas. Lowry *et al.* (1980) found no differences in the diets of male and female bearded seals but found that older seals (i.e. ≥3 yr) consumed more clams than did younger seals. Our samples consisted of equal numbers of males (18) and females (18). Reproductive organs indicated that 66% of the seals were mature (maturity is reached at about age 5-6 yr in females and 6-7 yr in males — McLaren, 1958; Burns, 1967). Variability in diet is probably more a function of locality than of sex or age (Lowry *et al.*, 1980), so we combined all ages and both sexes for each of the three localities (Table 1).

RESULTS

Diet Composition

All except two of the 36 stomachs contained food, often in considerable amounts. The diet included a remarkable variety of fishes and invertebrates. The following presentation of data is organized by general categories of food organisms; detailed information on species composition is given in Tables 2 and 3.

Fish. Fishes were found in most of the bearded seal stomachs and comprised 85% of all organisms ingested. At least 12 species of fishes, mostly benthic inhabitants, were identified from whole specimens or characteristic remains in the seal stomachs. Arctic cod, *Boreogadus saida*, were especially abundant (52% of all organisms) in the diet of seals from Grise Fiord, whereas sculpins were the most frequent items (49% and 44%, respectively) at Pond Inlet and Clyde. Many of the sculpin otoliths and identifiable remains appeared to be those of *Myoxocephalus scorpius* and *Gymnocanthus tricuspis*. Eelpouts, particularly *Lycodes polaris*, were also found frequently in the stomachs and comprised 6% of all organisms ingested. Polar cod, *Arctogadus glacialis*, comprised 4% of all organisms ingested. Other fish were, in decreasing order of abundance, seapoachers (*Agonus decagonus*), fish doctors (*Gymnelis* sp.), and seasnails (*Liparis* sp.). Fish constituted >90% of the weight in 15 of 19 stomachs that contained >1 kg of food.

Crustaceans. At least 10 species of benthic shrimps were found in the stomachs of bearded seals but the crangonids, especially *Sclerocrangon boreas*, predominated. Crustaceans comprised only 3% of all organisms ingested (Table 3). Their

TABLE 2. Occurrence and numbers of fish in bearded seal stomachs from three locations in the eastern Canadian High Arctic, 1978-1980

	Percent occurrence in stomachs			Number of each food item in all stomachs			Percent of food items[a]		
	Grise Fiord $n = 14$	Pond Inlet $n = 13$	Clyde $n = 7$	Grise Fiord	Pond Inlet	Clyde	Grise Fiord	Pond Inlet	Clyde
FISH	100	92	100	4510	2046	1699	86	81	89
Gadidae	100	85	100	2836	527	487	54	21	26
Boreogadus saida	100	85	100	2734	405	310	52	16	16
Arctogadus glacialis	36	46	71	102	122	177	2	5	9
Cottidae[b]	79	92	100	1297	1240	847	25	49	44
Zoarcidae	86	77	100	219	141	252	4	6	13
Lycodes polaris	86	69	86	175	95	197	3	4	10
Lycodes mucosus	50	54	43	29	21	16	<1	<1	<1
Gymnelis sp.	21	31	43	15	25	39	<1	<1	2
Agonidae									
Agonus decagonus	21	38	29	3	45	31	<1	2	2
Cyclopteridae[c]	29	38	43	5	21	11	<1	<1	<1
Unidentified fish	36	31	57	150	72	71	3	3	4

[a] The denominator is the total number of fish plus the total number of invertebrates listed in Table 3.
[b] Mainly *Myoxocephalus scorpius* and *Gymnocanthus tricuspis*. Also a few identifiable specimens of *Artediellus uncinatus* and *Icelus spatula* and probable remains of *Triglops pingeli, M. scorpioides* and *M. quadricornis*.
[c] Mainly *Liparis* sp. and three *Careproctus reinhardti*.

TABLE 3. Occurrence and numbers of invertebrates in bearded seal stomachs from three locations in the eastern Canadian High Arctic, 1978-1980

	Percent occurrence in stomachs			Number of each food item in all stomachs[a]			Percent of food items[b]		
	Grise Fiord $n=14$	Pond Inlet $n=13$	Clyde $n=7$	Grise Fiord	Pond Inlet	Clyde	Grise Fiord	Pond Inlet	Clyde
INVERTEBRATES	97	100	100	734	468	199	14	19	11
Snail	71	85	100	313	208	141	6	8	7
Buccinum spp.	71	77	100	300(740)	193(1317)	141(1041)	6	8	7
Other[c]	21	54	14	13 (43)	15 (146)	(1)	<1	<1	<1
Shrimp	71	100	100	111	130	41	2	5	2
Crangonidae[d]	57	92	71	76	105	14	1	4	<1
Hippolytidae[e]	14	31	43	22	19	19	<1	<1	<1
Other[f]	0	8	14	0	2	1	0	<1	<1
Unidentified shrimp	29	38	43	13	4	7	<1	<1	<1
Clam	29	31	14	305	2	15	6	<1	<1
Serripes groenlandicus	7	23	14	305	2	15	6	<1	<1
Other[g]	29	23	14	(5)	(5)	(1)	<1	<1	<1
Cephalopod	79	92	71	3	8	2	<1	<1	<1
Bathypolypus arcticus	64	85	57	2 (28)	5 (61)	2 (29)	<1	<1	<1
Gonatus sp.	71	77	57	1 (38)	3 (35)	(21)	<1	<1	<1
Anemone	7	8	0	2	11	0	<1	<1	0
Sea Cucumber[h]	0	8	0	0	109	0	0	4	0
Polychaete[i]	29	62	29	(18)	(57)	(7)	<1	<1	<1
Miscellaneous[j]	36	8	29	—	—	—	<1	<1	<1

[a] Numbers in parentheses indicate indigestible material such as squid beaks that were not considered representative of recent intake.
[b] Denominator also includes fish in Table 2.
[c] Includes *Colus* spp. and a few *Acmaea* sp.
[d] Primarily *Sclerocrangon boreas*; also *S. ferox*, *Sabinea septemcarinata* and *Argis dentata*.
[e] Includes *Lebbeus polaris*, *Spirontocaris spinus* and *Eualus fabricii*.
[f] *Hymenodora* sp. and one pandalid.
[g] *Clinocardium ciliatum*, *Astarte borealis*, *A. montagui*, *Mya truncata*, *Musculus niger*, *Macoma* sp. and *Mytilus* sp. from whole specimens or shell fragments.
[h] Probably *Thyonidium* sp.
[i] Genus *Harmothoë*.
[j] Includes various amphipods, one brittlestar, one lampshell, one leech and algae in trace (—) amounts.

wet weight contribution to the stomach contents was always <200 g and in stomachs with >1 kg of food, crustaceans always accounted for <10% of the weight.

Snails. The operculae of snails, particularly *Buccinum* spp., were found in almost all bearded seal stomachs but this indigestible material probably was retained and was not necessarily representative of recent intake. Counts of identifiable bodies of snails showed that they comprised at least 7% of all recently-ingested organisms. Their wet weight contribution never exceeded 200 g in any stomach and comprised <10% of the weight in all 19 stomachs containing >1 kg of food.

Clams. Clams were infrequent in bearded seal stomachs (Table 3). Almost all of the clams enumerated in Table 3 were from a seal taken at Grise Fiord; this individual had fed almost exclusively (600+ g) on *Serripes groenlandicus*.

Cephalopods. Chitinous beaks of the octopod *Bathypolypus arcticus* and an unidentified squid of the genus *Gonatus* were found in many bearded seal stomachs but this indigestible material probably was retained and was not representative of recent intake (*cf.* Finley and Gibb, 1982). Small amounts of soft tissue and a few semi-intact specimens of cephalopods were found in 24% of the stomachs. They comprised <1% of all organisms ingested (Table 3) and <5% of the weight in all 19 stomachs that contained >1 kg of food.

Polychaetes. Small numbers of chitinous jaws of polychaetes, all *Harmothoë*, were found in 41% of the stomachs. The chitinous jaws may not be representative of recent ingestion as no other identifiable remains of polychaetes were found.

Sea cucumbers and anemones. All 109 sea cucumbers found were in the stomach of a single bearded seal, an adult female taken at the Pond Inlet floe edge in July 1979. In this individual, they comprised 34% of the weight of the stomach contents (3.3 kg). Thirteen anemones were found in two stomachs.

Feeding Capacity

The feeding rate of bearded seals is unknown. If the rate is 3-8% of body weight per day, as in some other phocid seals (Sergeant, 1973; Parsons, 1977; Ashwell-Erickson and Elsner, 1981), then an average adult bearded seal (240 kg

— Burns and Frost, 1979) would ingest about 7-19 kg of food per day. The maximum weight of stomach contents that we recorded was 7.6 kg, found in an immature male from Grise Fiord which had fed almost exclusively on arctic cod.

The mean weight of contents for 29 stomachs was 2.0 kg; there were no significant differences in amounts in seals from the three localities (Table 4, Kruskal-Wallis H ≥ 0.30, df = 2, $p > 0.8$). Six of 29 stomachs contained >3 kg of food; in contrast, Kosygin (1971) reported a maximum weight of 2.7 kg in a sample of 565 seals from the Bering Sea, and Lowry *et al.* (1980) recorded an average volume of 670 ml (essentially equivalent to wet weight in g — Pitcher, 1981) in a sample of 50 adult seals from the Bering Sea.

TABLE 4. Average and maximum weights of stomach contents from bearded seals from three arctic localities, 1978-1980[a]

	Grise Fiord $n = 12$	Clyde $n = 7$	Pond Inlet $n = 10$
Range of weights (kg)	0.3 - 7.6	0.6 - 4.1	0.3 - 3.7
Average weights (kg) ± SD	2.18 ± 2.10	2.00 ± 1.17	1.56 ± 1.31

[a] Five of the 34 stomachs that contained food also contained considerable amounts of blood or sea water that had been ingested at the time of death. These were excluded.

Prey Size and Estimated Biomass Contribution

The teeth of the bearded seal are too degenerate to be used for shearing/biting, so the species is limited to prey that it can swallow whole (Vibe, 1950; Burns, 1967). Bearded seals are able, however, to remove the shells of clams and snails before ingesting them. Lowry *et al.* (1980) thought that the bearded seal grasped the exposed foot of a *Serripes* clam in its mouth and somehow tore it from the shell. Vibe (1950) believed that the bearded seal removed *Buccinum* snails from their shells by a sucking action, removing the body along with the opercula. Indeed, freshly-ingested snails do retain the opercula, but our frequent finding of the columella within the snail body suggests that the seal removed the shell by crushing it and ejecting the fragments. The shells of both *Buccinum* snails and *Serripes* clams can be crushed easily with hand pressure. Whatever the means, the energetic return to the bearded seal is not large; the maximum weight of a shelled snail was only 8 g, and that of a clam was only 6 g.

The largest whole fish that we found in bearded seal stomachs were sculpins, *Myoxocephalus scorpius*; the largest individual weighed 190 g. The average weight of 17 *M. scorpius* from seal stomachs was 73 g and that of nine *Gymnocanthus tricuspis* was 69 g. *M. scorpius* is highly sexually dimorphic; for example, a netted sample of 11 females averaged 470 g ± SD 180, whereas 12 males averaged 182 g ± SD 57 (Pond Inlet, 23 December 1979). It is apparent that bearded seals were feeding on the smaller individuals of the sculpin population, and a disproportionate fraction of these probably were males. It appears that the seals would be physically unable to swallow the larger spiny females. A maximum of 1717 otoliths representing at least 858 small sculpins were found in the stomach of one seal.

The frequency distribution of otolith sizes indirectly reveals the size range of arctic cod that were ingested by bearded seals (Fig. 3). The average otolith size (5.5 mm ± SD 1.80) of arctic cod ingested by bearded seals corresponded to a 13.2-cm fish (calculated as per Finley and Gibb, in press). The average wet weight of ingested arctic cod was 30 g. The largest calculated wet weight intake of *B. saida* was estimated at 18.9 kg from 1740 otoliths in the stomach of a bearded seal from Grise Fiord. The size range (maximum size about 22 cm and 80 g) of arctic cod ingested by bearded seals encompassed the size range of arctic cod found around N. Baffin Island (Finley, pers.obs.) and other arctic localities (Hognestad, 1968; Frost and Lowry, 1981; Craig *et al.*, 1982) and the size distribution shows emphasis on the 12-16 cm fish — also the sizes most commonly taken in nets in nearshore areas (Craig *et al.*, 1982; Finley, pers.obs.).

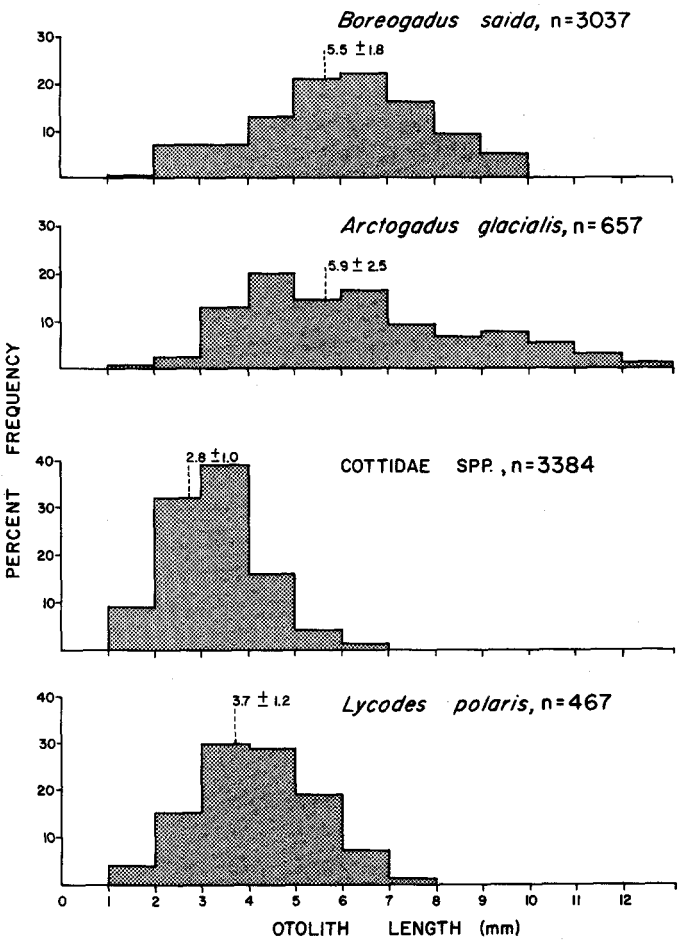

FIG. 3 Frequency distribution of otolith sizes of important fishes found in bearded seals taken in three arctic localities. Sample sizes, means and standard deviations of otolith lengths are given.

Bearded seals ingested a large size range of polar cod (Fig. 3); the average otolith size (5.9 mm ± SD 2.5) corresponded to a 14-cm fish. The average wet weight of an ingested polar cod was 85 g and the largest otoliths indicated that bearded seals had ingested a few individuals up to 340 g in weight (calculated as per Finley and Gibb, in press). The polar cod taken by bearded seals were considerably smaller than those (373 g ± SD 121, $n = 110$ — Finley and Gibb, in press) taken by hook in coastal waters of N. Baffin Island.

Only one intact specimen (108 g) of eelpout (*Lycodes polaris*) was found in a bearded seal stomach. The otoliths of this fish were 5-6 mm long, which is above the average size of eelpout otoliths that we found in bearded seal stomachs (Fig. 3). There are no otolith length-to-wet-weight conversion equations for eelpouts in the Canadian Arctic, but application of a conversion equation developed for the similarly-shaped *L. palearis* in Alaskan waters (Frost and Lowry, 1980) to the otolith size of our specimen shows good agreement between the actual (108 g) and estimated (118 g) weight. From this it appears that the largest specimens of eelpouts (otolith size 7-8 mm, Fig. 3) would not exceed about 200 g wet weight. Bearded seals would be unable to ingest some of the larger specimens of eelpouts such as a 510-g *Lycodes mucosa* that we collected near Pond Inlet in August 1978. A maximum of 234 otoliths representing at least 117 eelpouts were found in a bearded seal stomach.

Other fish in the bearded seal diet were small benthic species such as seasnails, seapoachers and fish doctors. Of these, the seapoachers, *Agonus decagonus*, were the largest specimens (maximum 12 g) that we found in the stomachs. An adult male bearded seal taken in late July at Pond Inlet contained fresh remains of many seapoachers and otoliths that represented at least 112 individuals. The presence of many ripe eggs with the fish bodies indicated that this particular seal had encountered a spawning aggregation.

The invertebrates consumed by bearded seals were generally small. The bottom-dwelling crangonid shrimps *Sclerocrangon boreas* were the largest crustaceans (maximum 30 g) ingested by bearded seals but it should be noted that a proportion of the weight consists of indigestible chitinous exoskeleton. The largest measurable cephalopod, *Bathypolypus arcticus*, weighed about 50 g.

It has already been shown that fish were the major component by weight of the semi-digested stomach contents of the bearded seal, but it is not evident which species or groups dominated. By back calculation from otolith size to wet weight it is possible to derive the wet weight composition of certain species (Frost and Lowry, 1980; Finley and Gibb, in press) but such conversion equations are not available for some species (e.g., sculpins and eelpouts) ingested by bearded seals. However, by substituting average weights of ingested organisms it is possible to roughly approximate the relative composition by weight of the various food organisms (Table 5). This exercise again demonstrates the importance of fish relative to invertebrates in the bearded seal diet, and it emphasizes the greater relative biomass contribution of larger fish such as polar cod and eelpouts (Table 5).

TABLE 5. Summary of occurrence and estimated wet weight of food items from 34 bearded seals taken in the Canadian High Arctic

	Percent occurrence (/34 stomachs)	Percent of food items	Average weight of ingested item (g)[a]	Percent estimated wet weight[b]
Fish	97	85	—	98
Arctic cod	94	36	30	24
Polar cod	47	4	85	8
Sculpin	88	35	70	55
Eelpout	82	6	80	11
Fish doctor	29	<1	5	<1
Seapoacher	29	<1	8	<1
Seasnail	35	<1	10	<1
Unidentified	97	3	10	<1
Invertebrates	100	15	—	2
Snail	82	7	3	<1
Shrimp	88	3	17	1
Clam	26	3	3	<1
Cephalopod	82	<1	20	<1
Polychaete	41	<1	1	<1

[a] Average weights were determined from otolith length - fish weight conversion equations (Frost and Lowry, 1980; Finley and Gibb, in press) or were approximated from actual weights of whole or partial organisms taken from seal stomachs.

[b] Approximate values only.

DISCUSSION

The results of this study provide further documentation of the diverse diet of the bearded seal within its large circumpolar range. Few other seals exhibit such a degree of consumer opportunism. Although bearded seals feed on a wide variety of benthic (both epifaunal and infaunal) invertebrates and demersal fish, they are also capable of exploiting schooling (pelagic and demersal) fish such as arctic cod. This ability to switch from benthic to pelagic feeding was noted by Vibe (1950) in northern Baffin Bay. Recent aerial surveys in late winter showed that some bearded seals do occupy offshore pack ice over deep water (>500 m) in northern Baffin Bay (Finley and Renaud, 1980) and other aerial surveys conducted in association with this study found bearded seals widely distributed in low densities over much of the offshore pack ice of Baffin Bay in June (Koski and Davis, 1979). Presumably they depend on a pelagic food source in Baffin Bay when they are excluded by fast ice from coastal areas.

In coastal waters of the Canadian High Arctic where the bearded seal can reach the bottom, it feeds heavily on benthic fish such as sculpins or takes advantage of schooling fish such as arctic cod. This stands in marked contrast to the situation in the Bering and Chukchi seas where fish are of minor importance in the bearded seal diet (Lowry *et al.*, 1980). Whether this reflects differences in prey availability or in predator selection cannot be evaluated since little is known about the abundance of fish and invertebrates in arctic epibenthic communities.

Most species of arctic fish are found in close association with the bottom. They are generally found under rocks, in

macrophyte beds, or partly buried in soft substrate; they are rarely found on exposed bottom away from cover (Thomson and Cross, 1980). Remotely-employed sampling devices such as otter trawls provide only a rough approximation of the abundance of some species. Trawl sampling and SCUBA diver collections in coastal areas of northern Baffin Island produced 14 species of fish of which the two sculpins, *Myoxocephalus scorpius* and *Gymnocanthus tricuspis*, were the most common species (Thomson and Cross, 1980). The two sculpins were also the most common species found in bearded seal stomachs from northern Baffin Island. Although lumpsuckers (*Eumicrotremus* spp.) were taken in trawl collections they were not found in bearded seal stomachs. Seapoachers (*Agonus decagonus*) were not found in diver and trawl collections. Gill-net catches, although highly selective, also indicate that sculpins, particularly *M. scorpius*, are a dominant component of High Arctic benthic communities. For example, a 24 h set of a 30 m gill-net in 10 m of water at Grise Fiord in September 1979 produced 88 sculpins, primarily *M. scorpius*. A 24 h set of a 50 m gill-net in 40 m of water at Pond Inlet in December 1978 produced 14 *M. scorpius*, 2 *M. scorpioides* and 2 *G. tricuspis* (Finley, pers.obs.).

Burns and Frost (1979) believed that geographic variation in the diet of bearded seals in the Bering and Chukchi seas was a reflection of local faunal differences. This variation was apparent only in the relative amounts of shrimp, crabs and clams that were ingested; fish were always of minor importance. Qualitatively, our results most closely resemble those of Vibe (1950) from nearby NW Greenland, and suggest that the food of bearded seals in these areas reflects the importance of benthic fishes in the composition of benthic communities. An experienced hunter from Grise Fiord, formerly from Port Harrison on Hudson Bay, commented that one of the major differences that he noted in bearded seals from the two areas was that those in Hudson Bay fed on shrimps and clams almost exclusively. Further regional studies on the diet of the bearded seal may provide interesting insight into the composition, distribution and utilization of arctic epibenthic communities.

ACKNOWLEDGEMENTS

This research was funded by Petro-Canada Exploration Inc. as part of a multi-disciplinary research effort, the Eastern Arctic Marine Environmental Studies (EAMES) program. We thank G. Glazier, G. Koenig, W. Speller and B. Veldhoen of Petro-Canada for their support and encouragement.

O. Akeagok of Grise Fiord, P. Aglak of Pond Inlet, and I. Angutijuak of Clyde organized the collection of samples. B. Wooley, N.W.T. Dept. of Fish and Game, provided much support at Clyde. K.J. Frost and L.F. Lowry, Alaska Dept. of Fish and Game, assisted in otolith identification and provided many helpful comments on the manuscript. D.H. Thomson and W.E. Cross of LGL Ltd. assisted in invertebrate identification. F.A. Aldrich and C. Morris, Memorial University of Newfoundland, assisted in octopod identification. J.A. Fournier, Invertebrate Zoology Division, Museum of Natural Sciences, Ottawa, identified the polychaete jaws. R.A. Davis and W.J. Richardson of LGL Ltd. provided constructive comments on the manuscript. We gratefully acknowledge all these people and the many hunters in all three communities who cooperated in this study.

REFERENCES

ASHWELL-ERICKSON, S. and ELSNER, R. 1981. The energy cost of free existence for Bering Sea harbor and spotted seals. In: Hood, D.W. and Calder, J.A. (eds.). The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. II. Seattle: Office of Marine Pollution Assessment, National Oceanic and Atmospheric Administration. 869-900.

BENJAMINSEN, T. 1973. Age determination and the growth and age distribution from cementum growth layers of bearded seals at Svalbard. Fiskeridirektoratets Skrifter, Series Havundersøkelser 16:159-170.

BURNS, J.J. 1967. The Pacific bearded seal. Federal Aid in Wildlife Restoration, Projects W-6-R and W-14-R. Juneau: Alaska Department of Fish and Game. 66 p.

_____, SHAPIRO, L.H. and FAY, F.H. 1981. Ice as marine mammal habitat in the Bering Sea. In: Hood, D.W. and Calder, J.A. (eds.). The Eastern Bering Sea Shelf: Oceanography and Resources. Vol. II. Seattle: Office of Marine Pollution Assessment, National Oceanic and Atmospheric Administration. 781-797.

BURNS, J.J. and FROST, K.J. 1979. The natural history and ecology of the bearded seal, *Erignathus barbatus*. Final Report OCSEAP Contract 02-5-022-53. Fairbanks: Alaska Department of Fish and Game. 77 p.

CHAPSKII, K.K. 1938. [The bearded seal (*Erignathus barbatus* Fabr.) of the Kara and Barents Sea.] Trudy Arktichoskogo Instituta 123:7-70. Canadian Fisheries and Marine Service Translation Series No. 3162. 145 p.

CRAIG, P.C., GRIFFITHS, W.B., HALDORSON, L. and McELDERRY, H. 1982. Ecological studies of arctic cod (*Boreogadus saida*) in Beaufort Sea coastal waters, Alaska. Canadian Journal of Fisheries and Aquatic Science 39:395-406.

DAVIS, R.A., FINLEY, K.J. and RICHARDSON, W.J. 1980. The present status and future management of arctic marine mammals in Canada. Report No. 3, Science Advisory Board of the Northwest Territories, Yellowknife. 93 p.

FEDOSEEV, G.A. 1973. [Biological description of and basis for the kill limit on bearded seals in the Sea of Okhotsk.]. Izvestiya TINRO 86:148-157. Canadian Fisheries and Marine Service Translation Series No. 3282.

FINLEY, K.J. and GIBB, E.J. 1982. Summer diet of the narwhal (*Monodon monoceros*) in Pond Inlet, northwest Baffin Island. Canadian Journal of Zoology 60(12).

_____. In press. Summer diet and feeding behaviour of harp seals in the Canadian High Arctic. In: Lavigne, D.M., Ronald, K. and Stewart, R.E.A. (eds.). The Harp Seal: Perspectives in Vertebrate Science. The Hague, Netherlands: Dr. W. Junk Publishers.

FINLEY, K.J. and RENAUD, W.E. 1980. Marine mammals inhabiting the Baffin Bay North Water in winter. Arctic 33:724-738.

FITCH, J.E. and BROWNELL, R.L. 1968. Fish otoliths in cetacean stomachs and their importance in interpreting feeding habits. Journal of the Fisheries Research Board of Canada 25:2561-2574.

FROST, K.J. and LOWRY, L.F. 1980. Feeding of ribbon seals (*Phoca fasciata*) in the Bering Sea in spring. Canadian Journal of Zoology 58:1601-1607.

_____. 1981. Trophic importance of some marine gadids in northern Alaska and their body-otolith size relationships. Fisheries Bulletin U.S. 79:187-192.

HOGNESTAD, P.T. 1968. Observations on polar cod in the Barents Sea. Rapports et Proces-verbaux des Réunions, Conseil International pour L'Exploration de la Mer 158:126-130.

KOSKI, W.R. and DAVIS, R.A. 1979. Distribution of marine mammals in northwest Baffin Bay and adjacent waters, May-October 1978. Unpubl. rep. by LGL Ltd., Toronto, for Petro-Canada, Calgary. 305 p. [Available from Pallister Resource Management Ltd., 700 - 6 Avenue S.W., Calgary, Alberta.]

KOSYGIN, G.M. 1971. Feeding of the bearded seal *Erignathus barbatus nauticus* (Pallas) in the Bering Sea during the spring-summer period. Izvestiya TINRO 75:144-151. Canadian Fisheries and Marine Service Translation Series No. 3747. 14 p.

LOWRY, L.F., FROST, K.J. and BURNS, J.J. 1980. Feeding of bearded seals in the Bering and Chukchi seas and trophic interaction with Pacific walruses. Arctic 33:330-342.

MANSFIELD, A.W. 1967. Seals of arctic and eastern Canada. Fisheries Research Board of Canada Bulletin 137. 35 p.

McLAREN, I.A. 1958. Some aspects of growth and reproduction of the bearded seal, *Erignathus barbatus* (Erxleben). Journal of the Fisheries Research Board of Canada 15:219-227.

_____. 1962. Population dynamics and exploitation of seals in the eastern Canadian Arctic. In: LeCren, E.D. and Holdgate, M.W. (eds.). The Exploitation of Natural Animal Populations. Oxford: Blackwell Scientific Publications. 168-183.

PARSONS, J.L. 1977. Metabolic studies on ringed seals (*Phoca hispida*). M. Sc. thesis, University of Guelph, Guelph, Ontario. 82 p.

PIKHAREV, G.A. 1941. [Some data on the feeding of the far eastern bearded seal.] Izvestiya TINRO 20:101-120. Translation by University of Alaska, Fairbanks.

PITCHER, K.W. 1980. Stomach contents and feces as indicators of harbor seal, *Phoca vitulina*, foods in the Gulf of Alaska. Fishery Bulletin U.S. 78:797-798.

_____. 1981. Prey of the Steller sea lion, *Eumetopias jubatus*, in the Gulf of Alaska. Fishery Bulletin U.S. 79:467-472.

SERGEANT, D.E. 1973. Feeding, growth and productivity of northwest Atlantic harp seals (*Pagophilus groenlandicus*). Journal of the Fisheries Research Board of Canada 30:17-29.

THOMSON, D.H. and CROSS, W.E. 1980. Benthic and intertidal studies in Lancaster Sound, northwest Baffin Bay and adjacent waters: final report. Unpubl. rep. by LGL Ltd., Toronto, for Petro-Canada, Calgary. 255 p. [Available from Pallister Resource Management Ltd., 700 - 6 Avenue S.W., Calgary, Alberta.]

VIBE, C. 1950. The marine mammals and the marine fauna in the Thule District (northwest Greenland) with observations on ice conditions in 1939-41. Meddelelser om Grønland 150(6):1-117.

Summer diet of the narwhal (*Monodon monoceros*) in Pond Inlet, northern Baffin Island

K. J. FINLEY AND E. J. GIBB[1]

LGL Limited, Environmental Research Associates, Suite 414, 44 Eglinton Avenue West, Toronto, Ont., Canada M4R 1A1

Received March 29, 1982

FINLEY, K. J., and E. J. GIBB. 1982. Summer diet of the narwhal (*Monodon monoceros*) in Pond Inlet, northern Baffin Island. Can. J. Zool. **60**: 3353–3363.

Stomach contents of 73 narwhals (*Monodon monoceros*) taken in Pond Inlet during June to September 1978–1979 were examined. Arctic cod (*Boreogadus saida*) and Greenland halibut (*Reinhardtius hippoglossoides*) comprised 51% and 37%, respectively, of the diet by weight. Arctic cod contributed 57% in 1978 but only 29% in 1979. Squid (*Gonatus fabricii*) beaks were abundant but not representative of recent intake. Deepwater fish (halibut, redfish (*Sebastes marinus*), and polar cod (*Arctogadus glacialis*)), found primarily in male narwhals, indicate a deep diving (>500 m) capability. The largest measured weight of stomach contents was 10.1 kg and weights projected from otoliths did not exceed 19.6 kg. No selection of prey items by size was evident amongst various sex and age groups of narwhals. Feeding was most intensive at the ice edge and ice cracks but little feeding took place in the fiords during late summer. Blubber thickness declined in females but not in males during the summer. The significance of traditional summering areas appears to be related to calving requirements and not to feeding opportunities.

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Les contenus stomacaux de 73 narvals (*Monodon monoceros*) de Pond Inlet, recueillis de juin à septembre en 1978–1979, ont été analysés. La saïda (*Boreogadus saida*) constitue 51% de la diète et le flétan du Groenland (*Reinhardtius hippoglossoides*), 37%. Les becs de seiches (*Gonatus fabricii*) sont abondants dans la diète, mais n'en constituent pas les éléments consommés depuis peu. Les poissons d'eau profonde (flétan, le sébaste (*Sebastes marinus*) et la morue polaire (*Arctogadus glacialis*) se retrouvent surtout dans la diète des mâles et reflètent leur aptitude à plonger en eau profonde (>500 m). Le contenu stomacal le plus lourd qui ait été pesé avait une masse de 10,1 kg et la masse maximale, déterminée par l'examen des otolithes, ne pouvait dépasser 19,6 kg. Il ne semble pas y avoir de sélection des proies en fonction de la taille chez les différents groupes d'âge et de sexe. L'activité alimentaire est intense surtout en bordure des glaces et dans les fentes, mais elle est minime dans les fjords à la fin de l'été. L'épaisseur de la couche de graisse diminue à la fin de l'été chez les femelles, mais pas chez les mâles. L'existence de territoires traditionnels d'été semble reliée aux besoins de la reproduction plutôt qu'à l'alimentation.

[Traduit par le journal]

Introduction

The narwhal (*Monodon monoceros*) is a gregarious odontocete whale that inhabits arctic seas bordering the Atlantic Ocean. It is most numerous in Baffin Bay – Davis Strait and adjacent waters of the eastern Canadian arctic (Davis et al. 1980). The narwhal undertakes seasonal migrations from wintering grounds in Davis Strait – Baffin Bay to traditional summering areas in the eastern Canadian high arctic and in northwest Greenland. In summer it concentrates in the fiord complexes of Admiralty Inlet and Eclipse Sound, northern Baffin Island.

Male narwhals (and very rarely females) have a single long tusk. There has been much speculation about the possible role of the narwhals' tusk in feeding (e.g., Vibe 1950) although Scoresby (1820) reasoned that it could not serve such a function as females did well without it. Scoresby (1820, p. 491) concluded that "the tusk is principally, if not solely, a sexual distinction," a hypothesis that is supported by Silverman and Dunbar (1980). Best (1981) reviews the function of the tusk and concurs.

There have been no systematic, quantitative studies of narwhal feeding although anecdotal accounts indicate that it feeds on fish, squid, and shrimp. Scoresby (1820) believed that the principal food was cephalopods. During voyages to the Greenland Sea, Gray (1889) found that narwhal stomachs contained numerous beaks and other remains of a small squid, *Gonatus fabricii*, and, in July, the pelagic shrimps *Pasiphaea tarda* and *Hymenodora glacialis*. In northwest Greenland the summer diet of the narwhal was found to consist mainly of arctic cod (*Boreogadus saida*) with some halibut (*Reinhardtius hippoglossoides*) and shrimp (Vibe 1950). Brown (1868, p. 552) noted that a female narwhal killed in Pond Inlet, northwest Baffin Island, in August 1861 "contained crustaceans, bones of fish, and an immense quantity of the horny mandibles of some species of Cephalopod." Degerbøl and Freuchen (1935) stated that narwhals in Pond Inlet fed on arctic cod, halibut, decapod shrimp, and arctic char (*Salve-*

[1]Present address: 1843 Cayuga Crescent, Calgary, Alta. T2L 0N7.

0008-4301/82/123353-11$01.00/0

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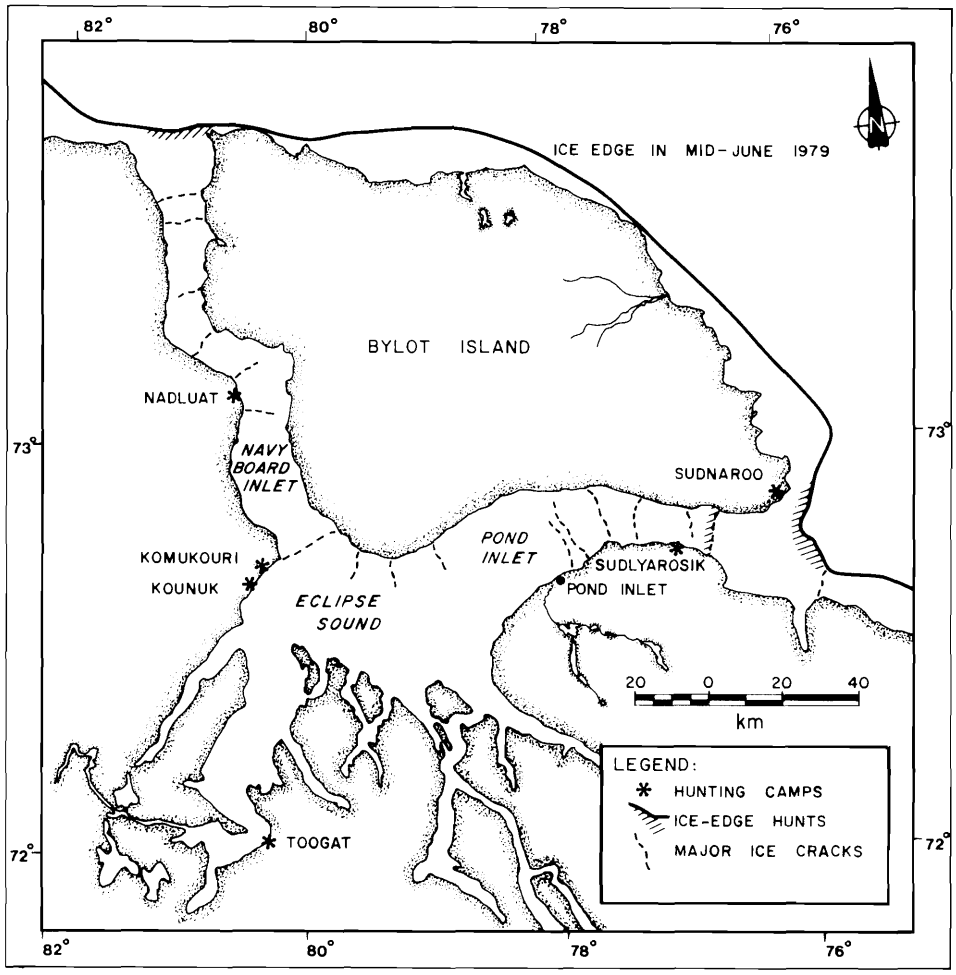

FIG. 1. Pond Inlet area showing positions of ice edges, ice cracks, and hunting areas in 1979. See Finley et al. (1980) for 1978 ice features.

linus alpinus). However, Mansfield et al. (1975) noted that, in spite of large runs of anadromous char in Eclipse Sound near Pond Inlet, no char were found in the stomachs of 62 narwhals netted there in late summer. In fact, they found very little food in the 62 stomachs; identifiable remains consisted only of arctic cod and squid beaks. Observations on the feeding habits of the narwhal have been limited to a rather brief period during the summer and nothing is known of their winter diet.

Narwhals are hunted intensively during the summer by Inuit from northwest Baffin Island (Finley et al. 1980; Finley and Miller 1982). In Pond Inlet, the hunt is conducted in three seasonal phases: at the floe edge, in ice cracks during break up, and during the open water season (Finley et al. 1980; Finley and Miller 1982). The three phases vary in duration depending on ice conditions but generally narwhals are hunted from the ice edge across the eastern entrance of Pond Inlet from mid-June to mid-July, in ice cracks in Pond Inlet briefly during mid-July, and by boat in open water in western Eclipse Sound during August and early September (Fig. 1; see also Finley et al. 1980; Finley and Miller 1982 for details). Specimens killed during the hunt in Pond Inlet – Eclipse Sound from June to September of 1978 and 1979 provided the basis for the present study.

Herein we present a quantitative description of the narwhal diet relative to seasonal changes in ice conditions and movements of the narwhal. We attempt to reconstruct the diet on the basis of the relative biomass contribution from the important dietary components; this approach avoids some of the biases that arise when numerical abundance of different prey items is the only basis of interpretation. Finally we examine blubber thickness as an indicator of condition which may reflect proximate feeding conditions.

Methods

Stomach collection

Narwhals were taken in the same general areas during the same hunting seasons in 1978 and 1979. In both years the

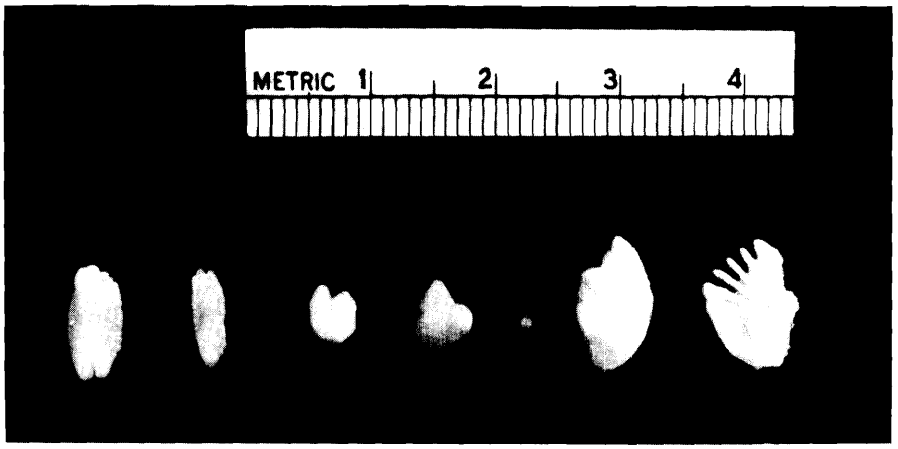

FIG. 2. Fish otoliths from narwhal stomachs. From left to right: *Arctogadus glacialis*, *Boreogadus saida*, *Lycodes mucosus*, *Lycodes polaris*, *Liparis* sp., *Sebastes marinus*, and *Reinhardtius hippoglossoides*.

position of the ice edge was similar (Fig. 1) and all animals that we sampled were taken in areas where the water depth was >500 m. In the Pond Inlet narrows, where the ice crack hunt is conducted, the coast is precipitous and water depth is >500 m in most areas where the narwhals were taken. During the open water season most of the narwhal samples came from the vicinity of Kounuk in Eclipse Sound; water depths in the area were generally <100 m.

Stomachs were excised from narwhals within 1 h after death. All contents were obtained from the forestomach and the epithelium was rinsed for residual matter. We also examined the main and pyloric stomachs but rarely found any identifiable material. Whenever possible the contents of the forestomach were weighed with a spring scale (± 100 g) and then frozen.

Standard measurements (e.g., length, axillary and maximum girths) were taken from all narwhals and the reproductive condition was examined. Measurements and reproductive data were used to differentiate adults from immatures. Mature males were generally >390 cm in length, had a tusk >100 cm long, and a single testicle weight >400 g. Mature females showed indications of ovulation and were >340 cm in length. Blubber thickness (excluding dermis) was measured from a slit cut midlaterally approximately 1.2 m behind the eye.

Laboratory analysis

Stomach samples were thawed and all whole organisms were removed from the sample and then weighed and measured. The remainder of the contents were separated through differential specific gravity in a water bath; denser material such as fish otoliths and squid beaks settled, whereas crustaceans and soft tissues were decanted off. All squid flesh was sorted and weighed.

Fish otoliths are valuable in the interpretation of feeding habits of marine mammals (Fitch and Brownell 1968; Frost and Lowry 1980, 1981; Finley and Gibb 1982). Otoliths reveal the identity of the taxon ingested (Fig. 2). Since the teleost fish has two sagittal otoliths, the number of fish ingested was estimated as half the number of otoliths within millimetre length categories. Because there are close relationships among otolith length, fish length, and fish weight it is possible to estimate the size and weight of fish ingested (Fitch and Brownell 1968). Length and weight equations for two important fish, arctic cod (*Boreogadus saida*) and polar cod (*Arctogadus glacialis*), were determined by Finley and Gibb (1982). Such equations were not available for the Greenland halibut, so we used the average weight (1962 g) of six whole specimens (lengths, 45–61 cm) that we took from narwhal stomachs. This estimated weight is consistent with the weight of 50- to 60-cm halibut from west Greenland (Lear 1968).

Whole crustaceans from narwhal stomachs were identified, counted, and measured. However, crustaceans were usually found in a disarticulated condition and in such cases counts of identifiable heads and telsons were used to estimate the number of each species present. Since there are close relationships among telson length – total length – wet weight, it was possible to estimate wet weight intakes from telsons. We used 27 whole specimens of *Hymenodora glacialis* (50–110 mm in length) from narwhal stomachs to derive conversion equations: total length (in millimetres) = 3.02 (telson length in millimetres) + 0.22, and wet weight (in grams) = 1.63×10^{-6} (total length in millimetres)$^{3.37}$.

All cephalopod beaks were identified (Clarke 1962; Akimushkin 1963) and counted but only beaks with attached muscle were used as an indication of recent ingestion (see below). In all cases the ventral mandibles of the beaks were more numerous than the dorsal mandibles and thus only the former were used to derive total numbers. However, the length of the dorsal mandible was used to estimate the length and weight of ingested squid based on equations developed by Clarke (1962) for squid in the family Gonatidae.

Digestibility of food items

Digestion in odontocete whales is rapid (Shapunov 1971; Gaskin 1978). Indigestible material such as the chitinous beaks of cephalopods, crustacean carapaces, fish bones, and eye lenses are often the only evidence that an organism has been ingested. The chitinous beaks of cephalopods, in particular, appear to be retained for long periods in the stomachs of marine mammals (Clarke and Kristensen 1980; Pitcher 1980). This differential digestibility and retention poses a problem in attempting to reconstruct the composition of the recent diet.

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TABLE 1. Number of narwhal stomachs examined during various phases of the hunt near Pond Inlet, 1978 and 1979

	Ice edge		Ice crack		Open water	
	14 Jun. – 22 Jul. 1978	4 Jun. – 15 Jul. 1979	23 Jul. – 3 Aug. 1978	16–19 Jul. 1979	6 Aug. – 15 Sep. 1978	24 Jul. – 31 Aug. 1979
Males						
Adult	7	3	15	5	3	2 (3)[a]
Immature	4	2	0	1	1	1 (3)
Females						
Adult	8	4	3	1	0	3 (6)
Immature	5	1	0	0	0	1 (1)
Unclassified	1	—	2	—	—	—
Total stomachs with contents	25	10	20	7	4	7

[a]Numbers in parentheses represent empty stomachs.

We attempted to assess this problem by conducting two simple experiments.

In the first experiment we used HCl to simulate a range (pH 0.9–2.4) of acidic conditions that would be expected in a mammalian stomach and examined the rate of dissolution of fish otoliths, crustacean carapaces, and squid beaks over a period of 24 h. As expected this demonstrated the resistance of chitinous material to acidic conditions while the calcareous otoliths underwent considerable dissolution.

In a second *in vivo* experiment we examined relative digestion and retention of soft and hard tissues of fish, squid, and shrimp in the stomachs of pigs. Two pigs were fed large otoliths from polar cod, squid beaks, and large amphipods (*Anonyx nugax*) 15 and 12 h, respectively, before they were killed and examined. The same pigs were fed whole arctic cod, commercial squid, and decapod shrimps 5 and 2 h, respectively, before they were killed. This demonstrated a nearly equal rate of digestion of soft tissues of fish, squid, and shrimp that had been ingested within the previous 2–5 h. By 5 h little soft tissue remained but otoliths, shrimp carapaces, and squid beaks were still intact. Of the hard parts ingested 12–15 h previously, only a few squid beaks remained.

Thus, in the following presentation of results we assume that soft tissues of prey are digested at nearly similar rates and should reflect, in relative proportions, the prey species most recently ingested. Squid beaks are not necessarily indicative of recent ingestion and we have included in our calculations of dietary contribution only squid beaks with attached muscle as an indication of recent ingestion. Otoliths are considered to be indicators of recent ingestion (probably within the previous 24 h); however, otoliths from larger fish such as halibut may be retained longer than those from smaller fish because the former would not be released as rapidly by digestive processes. Thus, estimates of the biomass contribution of halibut may slightly overestimate the importance of halibut in the narwhal diet.

Results

Diet composition

Table 1 presents the seasonal distribution of 49 stomach samples taken in 1978 and 24 in 1979. Food items were found in 85% of 86 narwhal stomachs examined. All (13) of the empty stomachs were taken during the open water season of 1979. Hereafter all precent occurrence values are related to the 73 stomachs that contained food. Detailed information on the occurrence and numbers of prey items is given in Table 2. The following account is organized by the major prey groups.

Fish

Fish remains were found in 92% of the narwhal stomachs examined in 1978 and 1979 and comprised 93% of the calculated wet weight of contents. Arctic cod were found in 88% of the stomachs. Other teleost fishes, including polar cod, snailfishes (*Liparis* spp.), Greenland halibut, redfish (*Sebastes marinus*), sculpins (Cottidae), and eelpout (*Lycodes* spp.), occurred less frequently and in relatively small numbers compared with arctic cod (Table 2). Arctic cod and Greenland halibut were by far the dominant component of the diet in terms of wet weight.

Cephalopods

Squid (*Gonatus fabricii*) beaks were found in 88% of the narwhal stomachs. However, soft tissue, indicative of recent ingestion, was found in only 33% of the stomachs. Only two entire specimens of *Gonatus fabricii* were found in all of the stomachs examined. Relative to the weight of other stomach contents (mainly fish), squid flesh was insignificant; in no stomach did it exceed 5% by weight of the total stomach contents. Based on beak measurements, we estimated (probably liberally) that squid flesh comprised approximately 7% of wet weight at ingestion.

Although squid was not a dominant food item during the period of study (June–September), it may have much more importance at other times. A total of 10 840 squid beaks was enumerated in 73 stomachs. One additional sickly narwhal that we did not include in our analysis contained about 39 000 squid beaks that had

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TABLE 2. Frequency, number, and percent wet weight of various food items found in 73 narwhal stomachs from the Pond Inlet vicinity, 1978 and 1979

	% occurrence in stomachs			No. of each food item in all stomachs[a]		% of food items[b]			% wet weight[c]		
	1978	1979	Pooled	1978	1979	1978	1979	Pooled	1978	1979	Pooled
Boreogadus saida (arctic cod)	94	75	88	9 762	1529	91	65	87	57	29	51
Arctogadus glacialis (polar cod)	33	21	29	89	287	1	12	3	3	14	6
Liparis spp. (sea snails)	27	17	23	221	45	2	2	2	<1	<1	<1
Reinhardtius hippoglossoides (Greenland halibut)	20	17	19	30	13	<0.5	1	<0.5	34	45	37
Sebastes marinus (redfish)	12	4	10	17	1	<0.5	<0.5	<0.5	—	—	—
Cottidae (sculpins)	8	8	8	5	2	<0.5	<0.5	<0.5	—	—	—
Lycodes spp. (eelpouts)	2	8	4	1	3	<0.5	<0.5	<0.5	—	—	—
Unidentified fish	8	8	8	4	6	<0.5	<0.5	<0.5	—	—	—
All teleost fish	98	79	92	10 129	1886	95	80	92	94	87	93
Gonatus fabricii (squid)	92	79	88	32 (8350)	15 (2540)	<0.5	<0.5	<0.5	5	12	7
Bathypolypus arcticus (octopus)	16	17	16	(59)	(7)	<0.5	<0.5	<0.5	—	—	—
Raja hyperborea (dark belly skate)	0	4	1	0	3	0	<0.5	<0.5	—	—	—
Decapoda[d]	47	29	41	434	356	4	15	6	<1	<1	<1
Boreomysis spp. (mostly *nobilis* and some *arctica*)	39	21	33	103	106	1	5	2	—	—	—
All crustaceans	69	46	62	537	462	5	20	8	<1	<1	<1
Grit	31	20	27	—	—	—	—	—	—	—	—
Totals	49	24	73	10 698	2366	100	100	100	100	100	100

[a]Squid beaks without attached flesh given in parentheses.
[b]Only recently ingested squid (beaks with attached flesh) considered.
[c]Derived from wet weight estimates in Table 3.
[d]All *Hymenodora* spp. with the exception of four *Pasiphaea* spp. from one stomach.

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undoubtedly accumulated over considerable time. There was differential retention of the upper and lower beaks of the squid in narwhal stomachs. Ventral beaks were always more numerous and often were stacked within one another, presumably reflecting prolonged retention and considerable physical activity in the narwhal stomach.

Octopus beaks (*Bathypolypus arcticus*) were found in 16% of the narwhal stomachs but they occurred only in small numbers and no octopus flesh was found.

Crustaceans

Pelagic crustaceans (decapods and mysids) were found frequently in narwhal stomachs but occurred in small numbers and contributed less than 1% of the wet weight intake. Their importance would be considerably overestimated if percent occurrence or numerical abundance were the only method of analysis, as in most previous studies.

Other stomach items

Single gastropod opercula were found in two narwhal stomachs and a limpet shell was found in another. The remains of a skate (probably *Raja hyperborea*), two egg capsules and cartilaginous skeletal material, were found in a mature male narwhal. Small bits of grit were found in 20–30% of the stomachs.

Age- and sex-related variability in the diet

Since hunters strongly select for adult narwhals and for those with tusks (Finley et al. 1980), the majority (76%) of our samples were from adults and 61% of these were males (Table 1). Sample sizes by season and by sex and age were generally too small to permit extensive comparisons, nevertheless some differences in the diet were apparent. All sex and age groups of narwhals fed on arctic cod, squid, and crustaceans but the 35 adult males contained most of the deeper-dwelling fishes. Redfish (in seven individuals) and skate (from one individual) were found exclusively in the stomachs of adult males and 83% of all polar cod otoliths and 84% of all halibut were found in adult males. However, most of the halibut and polar cod came from stomachs taken during the ice crack hunt in 1978 when only three adult female stomachs were examined. None of these 3 females contained halibut and 2 contained polar cod but 8 of 15 males taken during the ice crack hunt contained halibut and 7 of 15 contained polar cod.

Where sample sizes permitted we looked for relationships between narwhal sex or age and the sizes or numbers of arctic cod in their stomachs. In seven adult males and seven adult females taken during the 1978 ice-edge hunt, sizes and numbers of arctic cod were similar (respective mean otolith lengths = 4.2 and 4.8 mm, Mann–Whitney $U = 12$; $n = 7$ and 7; $p = 0.46$; respective mean numbers = 66 and 54, $U = 18$; $p = 0.280$). Nor did we find any differences in sizes of cod consumed between the same adult females and five immature females taken during the 1978 ice-edge hunt (respective mean otolith lengths = 4.8 and 5.1 mm, $U = 13$; $n = 7$ and 5; $p = 0.53$; respective mean numbers of cod = 167 and 100, $U = 16$; $n = 7$ and 5; $p = 0.88$).

We also looked for evidence of differential size selection of squids by various ages (i.e. length intervals) of narwhals but found none.

Temporal variability in diet and feeding intensity

Seasonal variability

During June to September the narwhals moved westward from the floe edge through Pond Inlet into western Eclipse Sound (Fig. 1). In both 1978 and 1979, estimated average weights of stomach contents declined markedly from the ice edge and ice crack seasons to the open water season (Table 3).

In both years, but especially in 1978, arctic cod were most important in the diet of narwhals taken at the ice edge. In both years the estimated wet weight intake of arctic cod decreased (significant difference in 1978) from the ice edge to ice crack period (Table 3). Relatively few arctic cod were taken by narwhals during the open water period in 1978 and very few were taken during this period in 1979. There were no major seasonal changes in the average size of arctic cod ingested, although in 1978 there was a slight but significant decrease in the average size of otoliths from the ice edge to ice crack period (4.76 mm ± SD 1.12 vs. 4.29 mm ± SD 1.08, Mann–Whitney $Z = 2.06$, $p < 0.05$).

In contrast to arctic cod, more polar cod by weight were taken by narwhals moving through the ice cracks than at the ice edge (Table 3). Few polar cod were taken during the open water season in 1978 and none were taken during this period in 1979.

In 1978, halibut predominated in the narwhal diet as they moved through the ice cracks (Table 3). Only 13 halibut were found in narwhals in 1979 and 6 of these were found in one individual taken at the ice edge. The ice crack period in 1979 was of such short duration that little can be said about the importance of halibut during this period compared with 1978. No halibut were taken by narwhals during the open water season of 1978 or 1979.

In both 1978 and 1979, the amount of squid in the diet decreased from the ice edge period to the open water season. There was no evidence of recently ingested squid in the open water diet although beaks were still retained, presumably from feedings earlier in the summer.

There were no apparent seasonal differences in the amount of crustaceans ingested. Small amounts of crustaceans were found in narwhal stomachs throughout the three seasons.

TABLE 3. Seasonal variation in estimated weight contribution of various food organisms in narwhal diet, 1978 and 1979

Period	No. of stomachs	Estimated mean wet weight (g) ± SD				
		Boreogadus	*Arctogadus*	*Reinhardtius*	*Gonatus*	Decapods
1978						
Ice edge	25	2965±3388	49±112	98±439	343±491	32±64
Ice crack	20	794±1137	184±321	2845±3897	31±94	8±20
Open water	4	1900±2813	66±148	0	0	0.6±0.8
Pooled 1978	49	2014±2818	103±226	1201±2826	186±387	14±52
1979						
Ice edge	10	1281±2222	57±130	2354±4512	525±536	1±4
Ice crack	7	76±64	1157±2624	280±742	310±710	0.4±0.7
Open water	7	18±17	0	0	0	44±77
Pooled 1979	24	685±1600	326±1351	1062±3612	296±525	15±55
Pooled 1978 and 1979	73	1598±2563	175±782	1156±3082	223±436	14±50

NOTE: For each taxon and year, a Kruskal–Wallis test was used to test for differences in weights within the three seasons. The estimated weight of a particular food item in each stomach was taken as a unit of observation. Significant seasonal differences were found in the 49 samples from 1978 for *Boreogadus* ($H = 6.47$, $p < 0.05$), *Arctogadus* ($H = 6.11$, $p < 0.05$), *Reinhardtius* ($H = 12.86$, $p < 0.01$) and *Gonatus* ($H = 11.56$, $p < 0.01$). Dunn's Multiple Comparison was then used to compare weights for each of these four taxon among the three possible combinations of seasons in 1978. Significant differences were found for *Boreogadus* ($TS = 2.53$, $p < 0.05$), *Reinhardtius* ($TS = 2.42$, $p < 0.05$) and *Gonatus* ($TS = 2.55$, $p < 0.05$) for the ice edge vs. ice crack season.

TABLE 4. Average sizes and numbers of cod and squid ingested by narwhals in the Pond Inlet vicinity, 1978 and 1979

	Year			
	1978 ($n = 49$)	1979 ($n = 24$)	Test statistic Z	P
Boreogadus saida				
Mean otolith length (mm) ± SD	4.6±1.1	4.1±1.3	−1.87	NS
Mean no. fish (and range)	199 (0–1259)	64 (0–590)	−3.19	<0.001
Arctogadus glacialis				
Mean otolith length (mm) ± SD	6.2±0.9	6.8±0.8	−0.29	NS
Mean no. fish (and range)	2 (0–21)	12 (0–214)	−0.72	NS
Gonatus fabricii				
Mean beak length (mm) ± SD	2.8±0.5	3.0±0.5	−3.62	<0.001
Mean no. squid (and range)	170 (0–1392)	106 (9–976)	−2.03	0.04

NOTE: n denotes the number of analyzed stomachs that contained food items. In the Mann–Whitney U-test, the mean otolith/beak length or number in each stomach was taken as a unit of observation. NS, not significant.

Annual variability

The stomachs of narwhals examined in 1979 contained much less food, especially arctic cod, than during the previous year (Table 3). Although the size of arctic cod ingested did not differ significantly between the two years, an average stomach contained significantly more cod in 1978 than in 1979 (Table 4). Considering only the stomachs that contained food items, the mean number of cod per stomach was higher during each of the three seasons in 1978 than during the corresponding periods in 1979. Furthermore, all empty stomachs (13) that we found came from the open water period of 1979.

The average number of squid beaks in narwhal stomachs did not differ significantly between 1978 and 1979 although the squid ingested in 1979 were slightly, but significantly, larger than those taken in the previous year (Table 4).

Feeding capacity and size of prey

Sergeant (1969) estimated that the daily feeding rates of several captive odontocetes, including the white whale *Delphinapterus leucas*, which is closely related to the narwhal, are 4–6% of body weight. It is not known whether feeding rates of odontocetes in captivity can be

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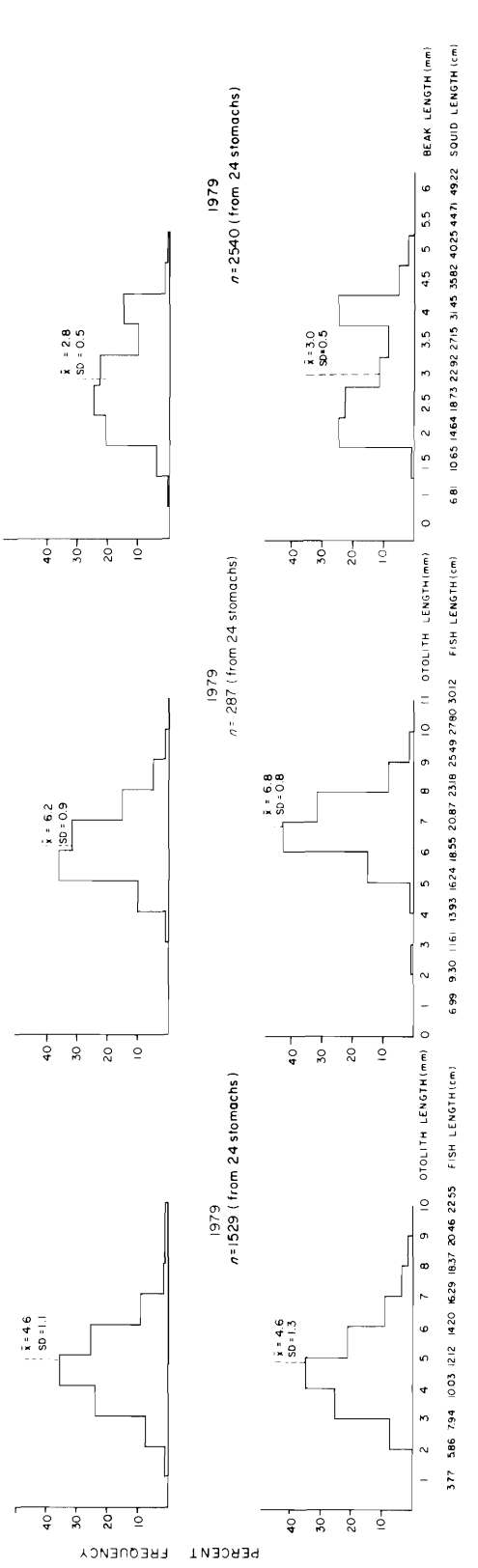

FIG. 3. Size distribution of *Boreogadus saida*, *Arctogadus glacialis*, and *Gonatus fabricii* ingested by narwhals in 1978 and 1979.

applied to the wild state since activity levels, energy requirements, and food availability may be quite different. If these rates do apply to free-ranging narwhals, daily intake would be 45–80 kg assuming weights of 900 kg for an adult female and 1600 kg for a large male (Mansfield et al. 1975).

In 1979 the largest amount of food that we found in any narwhal stomach was 10.1 kg in an adult male and 8.6 kg in an adult female (total weights of stomach contents were not obtained in 1978). In most cases, digestion was well advanced in the forestomach and we found no recognizable remains in the main or pyloric stomachs. Based on the numbers and sizes of otoliths and other remains present, the estimated weight of food items at the time of ingestion never exceeded 19.6 kg. Thus, it is apparent that the stomach contents at any one time represented only a portion of the expected daily intake.

Narwhals consumed arctic cod of similar sizes in 1978 and 1979 (Fig. 3). The average otolith length (4.6 mm) corresponded to a fish with length 11.3 cm and wet weight 9.2 g. The largest wet weight intake of arctic cod was estimated at 13.9 kg from 2500 otoliths in the stomach of an adult male that had fed exclusively on arctic cod at the ice edge in 1978.

Polar cod otoliths from narwhal stomachs were also of a similar size and size range in 1978 and 1979 (Fig. 3). However, the polar cod were much larger than arctic cod taken by narwhals; the mean otolith size (6.5 mm) of the polar cod corresponds to a fish of length 18.6 cm and wet weight 68 g. The largest polar cod taken by narwhals was about 30 cm long. The polar cod taken by narwhals were considerably smaller than those in a sample taken by hook in nearby Arctic Bay in late June 1976 (fork length 309 mm + 28.2 (SD); weight 373 g + 121 (SD); $n = 110$). The largest wet weight intake of polar cod was estimated at 16.6 kg based on 420 otoliths in the stomach of an adult male narwhal taken during the ice crack hunt in 1979. This amount was exceptional; the next largest wet weight contribution of polar cod was 6.5 kg.

The largest whole halibut that we found in a narwhal stomach was 61 cm long and weighed 2378 g. Other whole halibut taken by narwhals were 45–60 cm long. One male narwhal taken at the Pond Inlet ice edge contained two whole and four semidigested halibut weighing 10.1 kg in all. The estimated weight at time of ingestion of these six halibut was 11.8 kg, the maximum estimated amount of halibut in any one narwhal.

The size distribution of squid ingested by narwhals was similar in 1978 and 1979, although the size distribution appeared to be more bimodal in 1979 (Fig. 3). The only whole specimen of squid from a narwhal stomach was 21 cm long and weighed 130 g. Excluding a sick narwhal with 39 000 squid beaks, stomachs contained an average of 170 squid beaks; the maximum for a "normal" individual was 1392 beaks.

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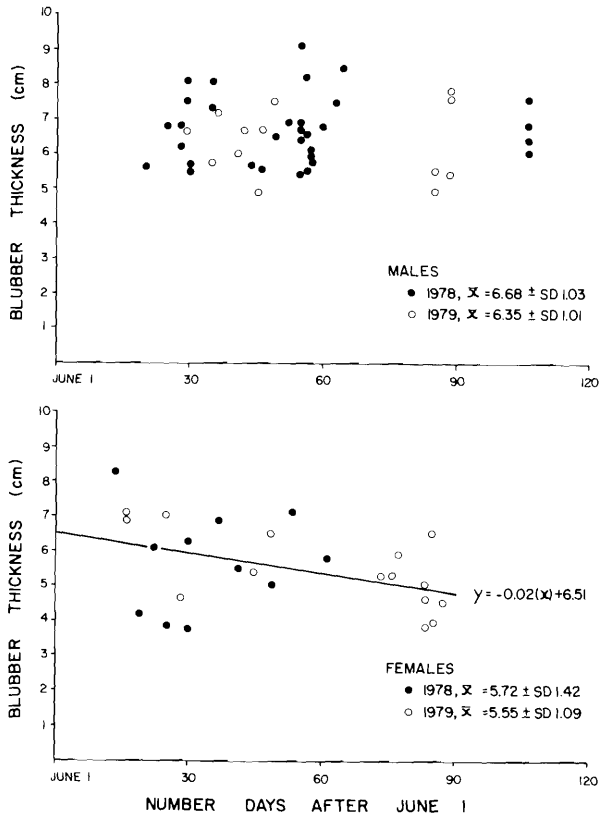

FIG. 4. Variation in blubber thickness of male and female narwhals during the summer seasons of 1978 and 1979.

Some of the crustaceans, especially *Boreomysis* sp., found in narwhal stomachs were of such a small size (30–50 mm) that we wondered whether they had been intentionally ingested or whether they had been released from digested fish stomachs. However, the presence of these crustaceans in samples with few fish remains indicated that they had been purposely ingested.

Blubber thickness

Blubber thickness in whales can be used as a simple index of proximate feeding conditions (Gaskin 1978). In addition to blubber thickness, we also examined a condition index based on maximum girth/length but found that simple regressions of girth to length for 1978 specimens and 1979 specimens showed considerable variation in measurements between the two collections (e.g., $r = 0.26$ for 1978 males, $r = 0.65$ for 1979 males) suggesting inconsistencies in the measuring technique. Blubber thickness showed poor correlation with body length ($r = 0.26$, $p > 0.09$ for males, $r = 0.29$, $p > 0.14$ for females) indicating that it is not a sensitive growth parameter but more purely a condition factor. During the period of sampling in 1978 and 1979, blubber thickness of males remained the same ($r = 0.00$, $p > 0.99$) but that of females decreased significantly ($r = -0.403$, $p < 0.05$; Fig. 4). These results may reflect reduced feeding intensity and (or) additional demands on females with suckling calves.

Discussion

Feeding behavior of the narwhal is not easy to observe and we can only draw inferences based on their stomach contents and their limited activity at the surface, combined with limited knowledge about the distribution and behaviour of prey species.

Feeding at the ice edge in spring

In 1978 and 1979, the occurrence of the narwhals at the Pond Inlet ice edge was sporadic and often they were disturbed by hunters. When undisturbed, their movements were generally parallel to the ice edge but were often interrupted by circling movements and dives that were directed toward the fast ice. Virtually all deep dives (identified by the distinctive flukes-up posture at the onset) were directed toward the fast ice from a distance of usually <10 m; the narwhals moved rapidly downward and disappeared beneath the ice edge. Silverman (1979) described the behaviour of narwhals at ice edges in more detail and reported the average duration of 10 "deep dives" to be 15 ± 7 min. The stomach contents of narwhals taken along the ice edge indicate that they were feeding primarily on arctic cod.

On only one occasion (6 July 1978) did we observe what appeared to be organized feeding activity by narwhals and in this case it was centred about 200–300 m off the ice edge. The group of about 100 appeared to be composed primarily of males organized into several compact units each diving in unison with the distinctive "deep dive" posture. The activity, which lasted about 1 h, was concentrated and quickly attracted an attendant flock of feeding northern fulmars (*Fulmarus glacialis*) and glaucous gulls (*Larus hyperboreus*). A male narwhal killed in the immediate area <1 h after feeding had ceased, contained large amounts of arctic cod. Finley and Gibb (1982) described similar avian–marine mammals "feeding frenzies" that they believed always involved concentrations of arctic cod.

Although narwhals do feed on arctic cod along ice edges there is no evidence that their presence in late June – early July can be attributed to special or favourable feeding opportunities provided by ice edges, as such, or an epontic food chain associated with the undersurface of the fast ice as suggested by Bradstreet and Cross (1982). Indeed during their study, scuba divers at the Pond Inlet ice edge found arctic cod associated with the undersurface of the ice but they were small, widely dispersed and usually inaccessible in crevices along inverted ice ridges (Bradstreet 1982). It is unlikely that narwhals could use this food source. It is possible that arctic cod are more accessible to narwhals in coastal areas (and thus ice edges) but too little is known about

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their distribution for this to be evaluated. Alternatively, we suggest that ice edges act primarily as barriers to movements of narwhals into their traditional summering areas around northern Baffin Island.

Feeding during breakup

As soon as ice breakup begins in July, narwhals move west through ice cracks and enlarged seal holes toward traditional summering areas in Eclipse Sound. Males tend to precede females and their young, and the hunters exercise strong selection for the males (Finley and Miller 1982). In 1978 the breakup was more prolonged than usual and a large number of males were taken. Although our sample is limited largely to males and to the 1978 season, the diet appears to shift to halibut as the narwhals move through Pond Inlet. This indicates a deep diving capability of the narwhal since the inlet is deep (400–1000 m) and Greenland halibut are usually most abundant (in other areas) at depths of 400–800 m (Andriyashev 1964; Nizovtsev 1968). Because of the difficulties of working on the ice during breakup, our observations of "feeding behaviour" at that time are limited. We did observe distinctively marked individuals undertaking deep dives and resurfacing frequently in the same lead or hole in the fast ice. However, narwhals seem to move westward as soon as ice conditions permit. Inuit hunters in western Eclipse Sound reported that narwhals appeared there (a distance of about 100 km) only 1–2 days after they began moving through the ice cracks in Pond Inlet.

Feeding during the open water season

During late summer, after ice has dispersed, narwhals occupy traditional summering areas in western Eclipse Sound, particularly Milne Inlet. The observations of Mansfield et al. (1975) and results of this study indicate that narwhals feed very little during this period. Despite the large runs of anadromous char in this area, none were found in the stomachs of narwhals. H. B. Silverman (1979, personal communication) observed that narwhals spent more time in social interactions while in Eclipse Sound than at the ice edge, and there was little behaviour indicative of feeding. We also noted that narwhals in Eclipse Sound spent much of their time "loafing" at the surface and engaged in local movements. Thus the traditional preference of narwhals for summer areas in Eclipse Sound and Admiralty Inlet does not seem to be related to feeding but may be related to calving, which occurs during July and August (Best and Fisher 1974; Mansfield et al. 1975).

We have few narwhal stomachs from September, but observations strongly suggest that narwhals resume feeding, perhaps intensively, after they leave the summering areas. Finley and Gibb (1982) document several cases of mixed "feeding frenzies" involving narwhals, white whales, and harp seals with attendant flocks of seabirds in late August and September. They suggest that these feeding aggregations involve an inshore movement of arctic cod in late summer. Similarly at Grise Fiord on 14 September 1980, one of us (K.J.F.) observed large numbers of cod driven into shallow water by a feeding aggregation of harp seals and narwhals; the stomach of a male narwhal from this group contained large numbers of fresh arctic cod.

Significance of arctic cod

Arctic cod occupy a key trophic position in the arctic marine ecosystem (Ponomarenko 1968; Hognestad 1968; Frost and Lowry 1981). When they are accessible in local concentrations, they are often heavily utilized by several species of marine mammals including narwhals, while whales, ringed seals, harp seals, and bearded seals (*Erignathus barbatus*) (Davis et al. 1980; Finley and Gibb 1982). In 1978 arctic cod were abundant in the Pond Inlet area apparently accounting for the unusual abundance of harp seals (Finley and Gibb 1982). Arctic cod found in harp seals taken at Pond Inlet in 1978 were the same size (mean otolith length, 4.6 mm) as those ingested by narwhals. The decline of arctic cod in the diet of narwhals between 1978 and 1979 was also observed in the diet of the ringed seals in the same area (K. J. Finley, unpublished data) and was also evident by the absence of harp seals in the area in 1979 (Finley and Gibb 1982). The evidence strongly suggests that arctic cod were not as abundant or available in 1979 as in 1978.

Finley and Gibb (1982) suggest that changes in the numbers and distribution of arctic cod could have profound effects on dependent predators such as the harp seal since there do not appear to be alternate food sources of equivalent abundance or energetic value in arctic waters. The extent to which narwhals are dependent on arctic cod is unknown. At least part of the population is capable of obtaining halibut in the Pond Inlet area; however we did not observe a switch to this prey item when arctic cod appeared unavailable in 1979 nor did we note any movement of narwhals away from the summering areas as was noted with harp seals (Finley and Gibb 1982) and ringed seals (K. J. Finley, unpublished data) when arctic cod appeared to be scarce.

This study provides only a brief seasonal view of the narwhals' feeding habits. Nothing is known about their diet or feeding behaviour during October to June. The numerous squid beaks found in narwhal stomachs in spring may be indicative of a very different feeding habit during the winter. Indeed, it is possible that during much of the year the narwhal is primarily a squid eater or "teuthophage" as proposed by Tomilin (1957).

Acknowledgements

This research was funded by Petro-Canada Exploration Inc. as part of a multidisciplinary research program, the Eastern Arctic Marine Environmental

Studies (EAMES) program. We especially thank G. Glazier, H. Hume, G. Koenig, W. Speller, and B. Veldhoen of Petro-Canada for their support. The hunters of Pond Inlet, particularly P. Aglak and S. Attagotak, were very helpful in collecting samples. H. Silverman of McGill University provided many of the narwhal stomachs from 1978. G. W. Miller of LGL Ltd. provided much assistance in the field. D. Thomson of LGL Ltd. provided expertise in invertebrate identification. J. Fitch, California Department of Fish and Game, and L. F. Lowry, Alaska Department of Fish and Game, assisted in otolith identification. R. A. Davis and W. J. Richardson of LGL Ltd. provided helpful guidance and assistance throughout the study. Thanks also to K. Hay, L. F. Lowry, and E. H. Miller for their constructive reviews. We are grateful to all these people.

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AKIMUSHKIN, I. I. 1963. Cephalopods of the seas of the U.S.S.R. Israel Program for Scientific Translations, Jerusalem.

ANDRIYASHEV, A. P. 1964. Fishes of the northern seas of the U.S.S.R. Israel Program for Scientific Translations, Jerusalem.

BEST, R. C. 1981. The tusk of the narwhal (*Monodon monoceros* L.): interpretation of its function (Mammalia: Cetacea). Can. J. Zool. **59**: 2386–2393.

BEST, R. C., and H. D. FISHER. 1974. Seasonal breeding of the narwhal (*Monodon monoceros* L.). Can. J. Zool. **52**: 429–431.

BRADSTREET, M. S. W. 1982. Occurrence, habitat use, and behavior of seabirds, marine mammals, and arctic cod at the Pond Inlet ice edge. Arctic, **35**: 28–40.

BRADSTREET, M. S. W., and W. E. CROSS. 1982. Trophic relationships at high arctic ice edges. Arctic, **35**: 1–12.

BROWN, R. 1868. Notes on the history and geographical relations of the Cetacea frequenting Davis Strait and Baffin's Bay. Proc. Zool. Soc. London, **35**: 533–556.

CLARKE, M. R. 1962. The identification of cephalopod "beaks" and the relationship between beak size and total body weight. Bull. Br. Museum Zool. **8**: 421–480.

CLARKE, M. R., and T. K. KRISTENSEN. 1980. Cephalopod beaks from the stomachs of two northern bottlenosed whales (*Hyperoodon ampullatus*). J. Mar. Biol. Assoc. U.K. **60**: 151–156.

DAVIS, R. A., K. J. FINLEY, and W. J. RICHARDSON. 1980. The present status and future management of arctic marine mammals in Canada. Science Advisory Board Northwest Territories Report No. 3, Yellowknife, N.W.T.

DEGERBØL, M., and P. FREUCHEN. 1935. Report on mammals collected by the Fifth Thule Expedition 1921–24. Vol. 2. pp. 252–262.

FINLEY, K. J., R. A. DAVIS, and H. B. SILVERMAN. 1980. Aspects of the narwhal hunt in the eastern Canadian arctic. Rep. Int. Whal. Comm. **30**: 459–464.

FINLEY, K. J., and E. J. GIBB. 1982. Summer diet and feeding behaviour of harp seals in the Canadian high arctic. *In* The harp seal: perspectives in vertebrate science. *Edited by* D. M. Lavigne, K. Ronald, and R. E. A. Stewart. Dr. W. Junk Publishers, The Hague. In press.

FINLEY, K. J., and G. W. MILLER. 1982. The 1979 hunt for narwhals (*Monodon monoceros*) and an examination of harpoon gun technology near Pond Inlet, northern Baffin Island. Rep. Int. Whal. Comm. **32**. In press.

FITCH, J. E., and R. L. BROWNELL, JR. 1968. Fish otoliths in cetacean stomachs and their importance in interpreting feeding habits. J. Fish. Res. Board Can. **25**: 2561–2574.

FROST, K. J., and L. F. LOWRY. 1980. Feeding of ribbon seals (*Phoca fasciata*) in the Bering Sea in spring. Can. J. Zool. **58**: 1601–1607.

——— 1981. Trophic importance of some marine gadids in northern Alaska and their body – otolith size relationships. Fish. Bull. **79**: 187–192.

GASKIN, D. E. 1978. Form and function in the digestive tract and associated organs in Cetacea, with a consideration of metabolic rates and specific energy budgets. Oceanogr. Mar. Biol. Annu. Rev. **16**: 313–345.

GRAY, R. 1889. Notes on a voyage to the Greenland Sea in 1888. Zoologist Ser. 3, No. 13. pp. 1–9, 41–51, 95–104.

HOGNESTAD, P. T. 1968. Observations on polar cod in the Barents Sea. Rapp. P. V. Reun. Cons. Int. Explor. Mer, **158**: 126–130.

LEAR, W. H. 1968. Length–weight relationships of commercial-size Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum). Int. Comm. Northwest Atl. Fish. Res. Bull. **5**: 119–121.

MANSFIELD, A. W., T. G. SMITH, and B. BECK. 1975. The narwhal, *Monodon monoceros*, in eastern Canadian waters. J. Fish. Res. Board Can. **32**: 1041–1046.

NIZOVTSEV, G. 1968. Soviet investigations on Greenland halibut in the Barents Sea, 1964–1967. Ann. Biol. **25**: 239–242.

PITCHER, K. W. 1980. Food of the harbor seal, *Phoca hispida richardsi*, in the Gulf of Alaska. Fish. Bull. **78**: 544–549.

PONOMARENKO, V. P. 1968. Some data on the distribution and migrations of polar cod in the seas of the Soviet Arctic. Rapp. P. V. Reun. Cons. Int. Explor. Mer, **158**: 131–133.

SCORESBY, W. 1820. An account of the Arctic regions with a history and description of the northern whale fishery. Vol. 1. The Arctic. Archibald Constable and Co., Edinburgh.

SERGEANT, D. E. 1969. Feeding rates of Cetacea. Fiskidir. Skr. Ser. Havunders. **15**: 246–258.

SHAPUNOV, V. M. 1971. Food requirements and energy balance in the Black Sea bottlenose dolphin (*Tursiops truncatus ponticus* Barabasch). *In* Morphology and ecology of marine mammals. *Edited by* K. K. Chapskii and V. E. Sokolov. Israel Program for Scientific Translations, Jerusalem. p. 207–212.

SILVERMAN, H. B. 1979. Social organization and behaviour of the narwhal, *Monodon monoceros* L. in Lancaster Sound, Pond Inlet, and Tremblay Sound, N.W.T. M.Sc. thesis, McGill University, Montreal.

SILVERMAN, H. B., and M. J. DUNBAR. 1980. Aggressive tusk use by the narwhal (*Monodon monoceros* L.). Nature (London), **284**: 57–58.

TOMILIN, A. G. 1957. Mammals of the U.S.S.R. and adjacent countries. Vol. 9. Cetacea. Israel Program for Scientific Translations, Jerusalem.

VIBE, C. 1950. The marine mammals and the marine fauna in the Thule District (Northwest Greenland) with observations on ice conditions in 1939–41. Meddelelser om Grønland, **150**: 1–117.

ARCTIC
VOL. 33, NO. 4 (DECEMBER 1980), P. 724-738

Marine Mammals Inhabiting the Baffin Bay North Water in Winter

KERWIN J. FINLEY[1] and WAYNE E. RENAUD[1]

ABSTRACT. Aerial surveys in March-April 1978 and March 1979 showed that some species of marine mammals overwinter in isolated areas of open water in the North Water in northern Baffin Bay. About 700 walruses and 37 bearded seals were seen, most over deep water (200-500 m) near SE Ellesmere Island in March 1979. Both species were much less common in 1978. Approximately 500 belugas were found in recurrent leads along the edge of the fast-ice in eastern Jones and Lancaster sounds and, to a lesser extent, in Smith Sound. Only 12 narwhals were seen. It has been concluded that the North Water is not a major overwintering area for marine mammals.

RÉSUMÉ. Les reconnaissances aériennes effectuées en mars et avril 1978 et en mars 1979 ont montré que quelques espèces de mammifères marins peuvent passer l'hiver dans les aires isolées des eaux libres dans les "Eaux du Nord", au nord de la baie de Baffin. En mars 1979, environ 700 morses et 37 phoques barbus ont été observés, la plupart à la surface des eaux profondes (200-500 m.), près de la partie sud-est de l'île Ellesmere. Ces deux espèces étaient moins fréquentes en 1978. Environ 500 bélougas furent découverts dans les fissures qui se forment périodiquement sur les bords de la banquise dans les parties orientales des détroits Jones et Lancaster, et á un moindre degré, dans le bras de mer Smith. Seulement 12 narvals furent apercus. Ainsi, les "Eaux du Nord" ne sont pas une aire majeure d'hivernage pour les mammifères marins.
Traduit par Ian Badgley, Université du Québec à Montréal.

INTRODUCTION

In northernmost Baffin Bay, between NW Greenland and the islands of the Canadian High Arctic, isolated areas of open water persist throughout the winter. During spring and early summer the open water expands greatly as the pack-ice drifts southward. This "great open sea" or "North Water" was a haven for the 19th-century whalers who pursued the bowhead or Greenland right whale (*Balaena mysticetus*) northward in the spring through the treacherous pack-ice of southern Baffin Bay (Markham, 1874). Explorers who overwintered in the area (Kane, 1854; Hayes, 1867) noted the profound influence of the open water on the climate and the lives of the Thule Inuit of NW Greenland, who depended primarily on the sea for subsistence. The North Water continues to be the subject of oceanographic and climatological studies (Dunbar *et al.*, 1967; Dunbar and Dunbar, 1972), and satellite imagery has documented its extent and seasonality (Aber and Vowinckel, 1972).

Except for a few early anecdotes, little is known about the biological significance of the North Water during winter. Some workers have speculated that it is a winter refugium for beluga (white) whales, *Delphinapterus leucas*, and narwhals, *Monodon monoceros*, far to the north of the nearest areas of extensive open water (Sergeant and Hoek, 1974; Sergeant and Brodie, 1975; Mansfield *et al.*, 1975). The possibility of oil and gas exploration in northern Baffin Bay provided the

[1]LGL Ltd., environmental research associates, 44 Eglinton Avenue West, Toronto, Ontario, Canada M4R 1A1

incentive and funding to assess the significance of the North Water for marine mammals. In this paper we present the results of aerial surveys for marine mammals in the winters of 1978 and 1979. Observations of birds during these surveys are presented elsewhere (Renaud and Bradstreet, 1980.)

METHODS

Two aerial surveys were conducted over the North Water in 1978: 1448 linear km on 15-17 March and 1506 km on 18-20 April. Inclement weather in 1979 prevented a complete survey of the North Water, but 1158 linear km of surveys were flown. Place names referred to in the text are shown in Figure 1 and survey routes are shown in Figures 2 and 3.

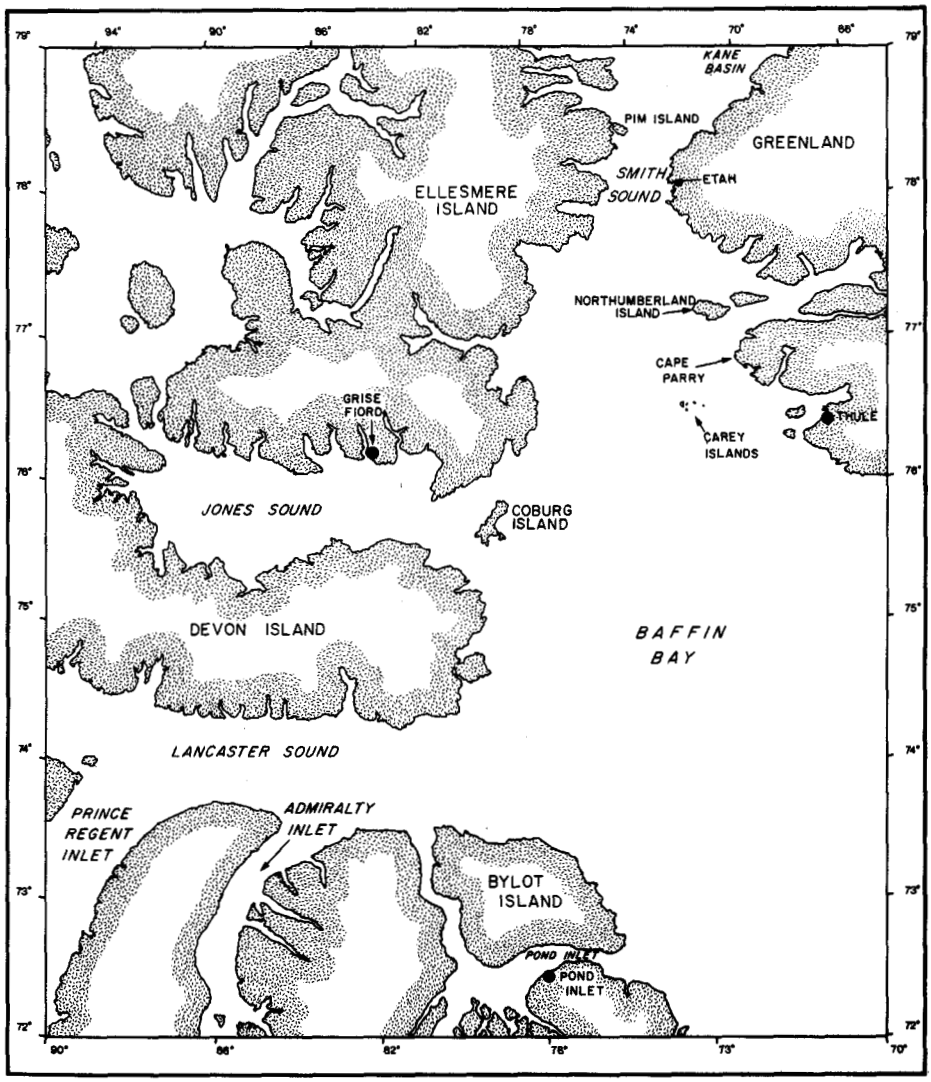

FIG. 1. Study area showing the place names mentioned in the text.

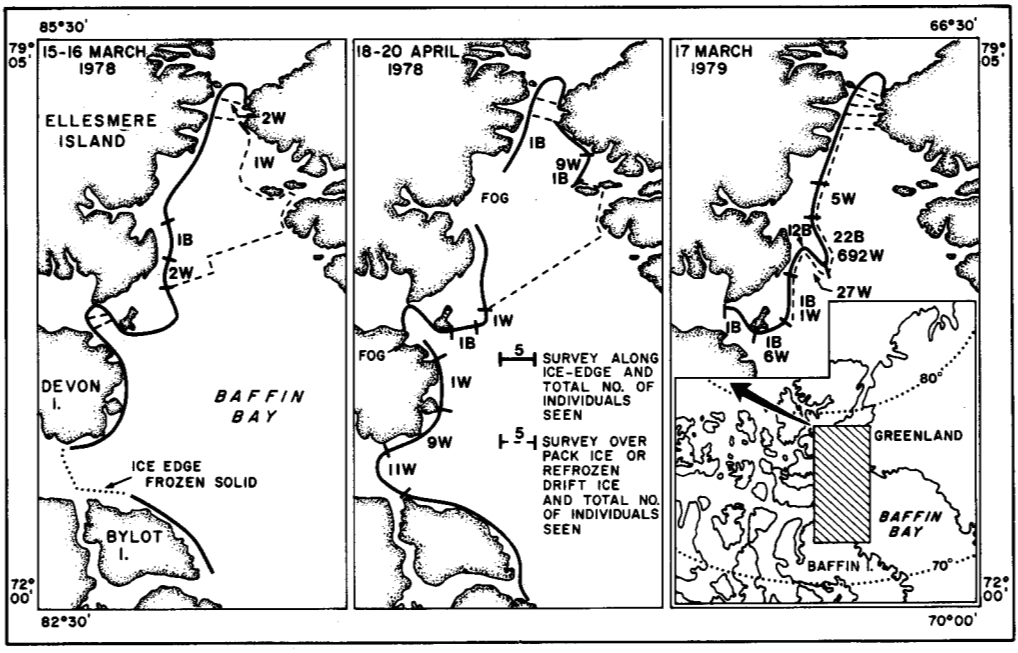

FIG. 2. Distribution of walruses (W) and bearded seals (B) in the North Water, late winter 1978 and 1979.

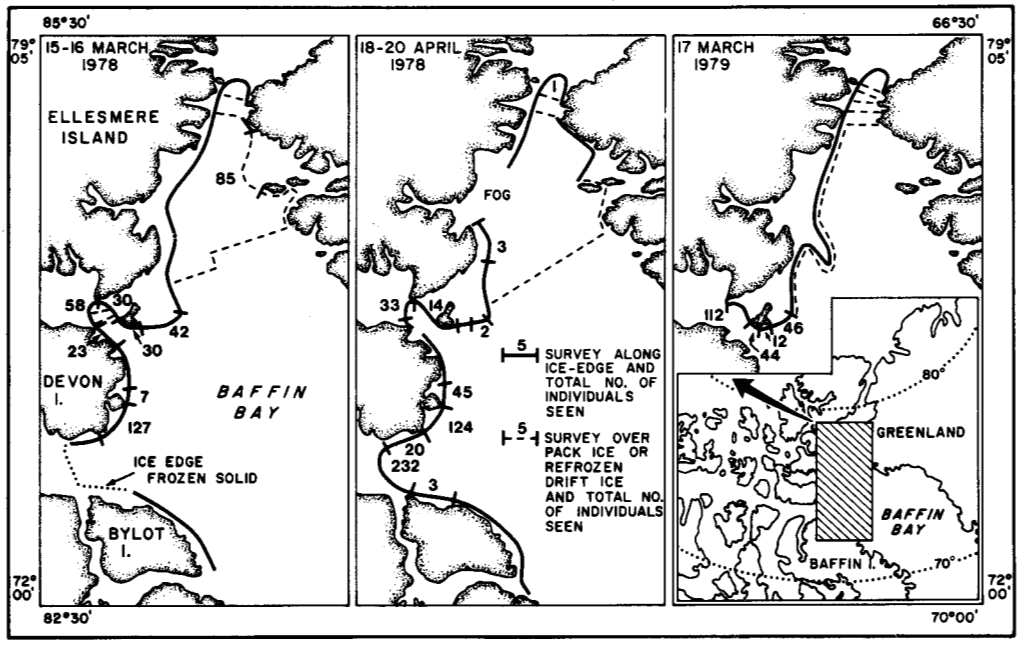

FIG. 3. Distribution of belugas in the North Water, late winter 1978 and 1979.

Surveys were conducted in a de Havilland Twin Otter, usually at altitude 100-200 m ASL and airspeed 200-220 km/h. Occasionally we flew at lower altitudes (about 50 m ASL) or airspeeds (185 km/h) when low cloud or fog was encountered, or when it was necessary to examine animals more closely. Two observers were present, one in the right front (co-pilot's) seat and another in the passenger area on either the right or left side depending on whether open water was present on one or both sides of the aircraft. Because open water was usually restricted to narrow leads (< 500 m wide) along the edge of the fast-ice, most surveys were flown about 50 m to the left of the lead with both observers seated on the right side of the aircraft. When wide leads were encountered, the aircraft was flown 500 m off the ice edge and the observers surveyed on both sides of the aircraft. Offshore transects over open water and pack ice were also flown with the observers surveying on both sides of the aircraft.

Observations of mammals, birds and ice conditions were dictated into tape recorders. Times of all observations were recorded and positions were fixed from landmarks and a Global Navigation System (GNS-500). For each individual or group of animals, the observer recorded the number of individuals, behaviour, and habitat. Whenever possible and appropriate, age, sex, direction of movement and reaction to aircraft were also recorded.

ICE CONDITIONS

In late winter, the west, east and north margins of the North Water are sharply defined by landfast ice-edges along the periphery of the eastern Canadian arctic archipelago and NW Greenland, and across Smith Sound (Figs. 4, 5). The southern limits of the North Water are defined more diffusely by the heavy pack-ice of Baffin Bay. Typically the North Water is most restricted in area during March and begins to enlarge in early spring as the pack-ice in Baffin Bay drifts to the south.

In March of 1978 and 1979, the extent of the North Water appeared typical (*cf.* Anon., 1970; Aber and Vowinckel, 1972; Lindsay, 1975), with the exception that Lancaster Sound was frozen solid to its eastern entrance. Usually Lancaster Sound is covered by pack-ice that remains in intermittent restricted motion throughout the winter (Anon., 1970). In both 1978 and 1979 Lancaster Sound remained frozen, with an ice-edge across its entrance, until July.

Calm cold conditions prevailed during the surveys in March 1978, and areas of open water were very restricted along the fast ice-edges and almost non-existent elsewhere (Fig. 6). At this time the most extensive open water (up to 500 m wide) occurred along the ice-edge across the mouth of Jones Sound. In Lancaser Sound open water was restricteed to intermittent narrow leads between the pack-ice and fast-ice along NE Bylot Island. Open water was less extensive than expected in Smith Sound; the area between the landfast ice-edge across the sound and the pack-ice to the south was covered by a continuous sheet of new ice. This was, no doubt, a temporary phenomenon attributable to the calm, cold conditions. The ice-edge along the coast of NW Greenland was less distinct than elsewhere, and much of the survey in this area was flown over pack-ice interspersed with narrow leads.

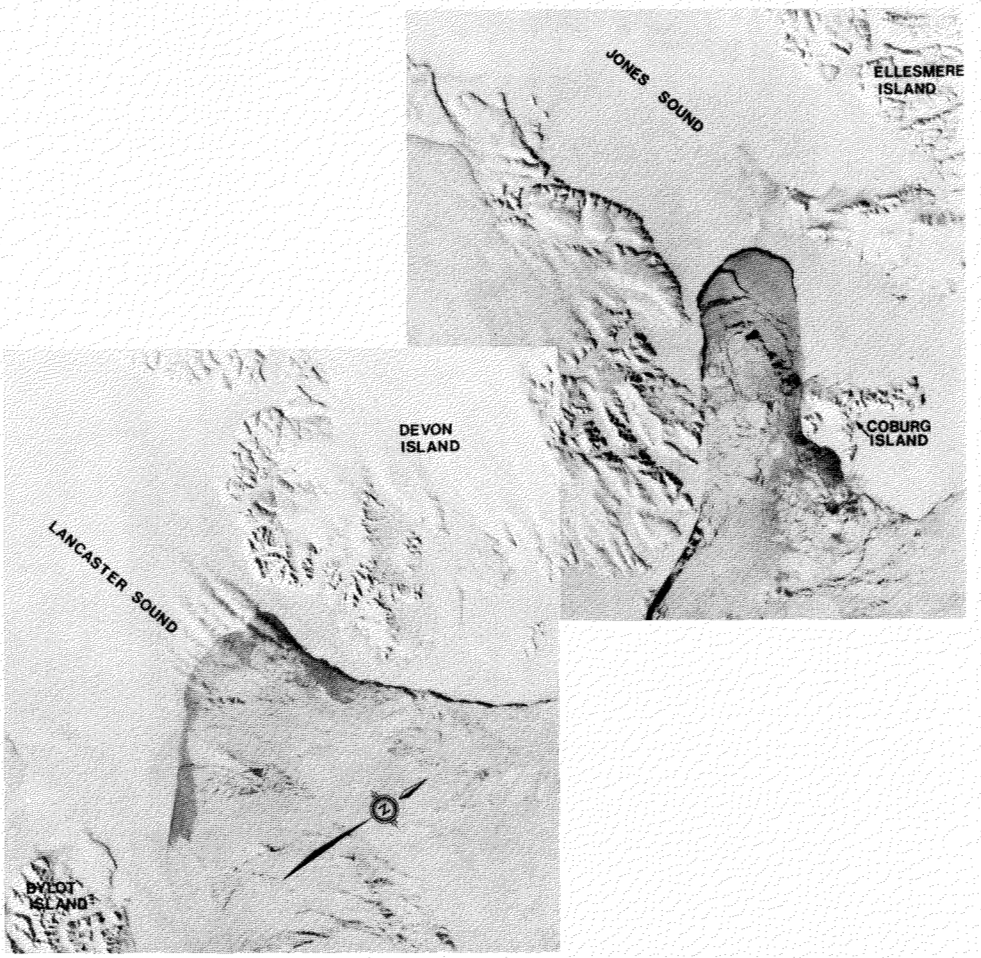

FIG. 4. Ice conditions in the vicinity of Jones and Lancaster sounds, 7 April 1978 (LANDSAT Imagery).

In March 1978, offshore Baffin Bay was almost entirely covered by pack-ice; open water was restricted to occasional cracks and narrow leads, particularly around the Carey Islands. Newly forming ice in most areas of open water in March 1978 appeared to be quickly consolidated into extensive thin ice that was more or less continuous with the pack-ice fields. The gradation of ice thickness is evident in LANDSAT imagery (Figs. 4, 5); however, it is often impossible to distinguish thin ice from open water on LANDSAT imagery, and consequently the open water appears more extensive than it really is.

By mid-April 1978, the leads along ice-edges had widened and the adjacent pack-ice was somewhat more dispersed than in March. A frozen lead that had extended across the entrance to Lancaster Sound in March had opened by April. Its western margin was the Lancaster Sound ice-edge, which persisted until mid-July.

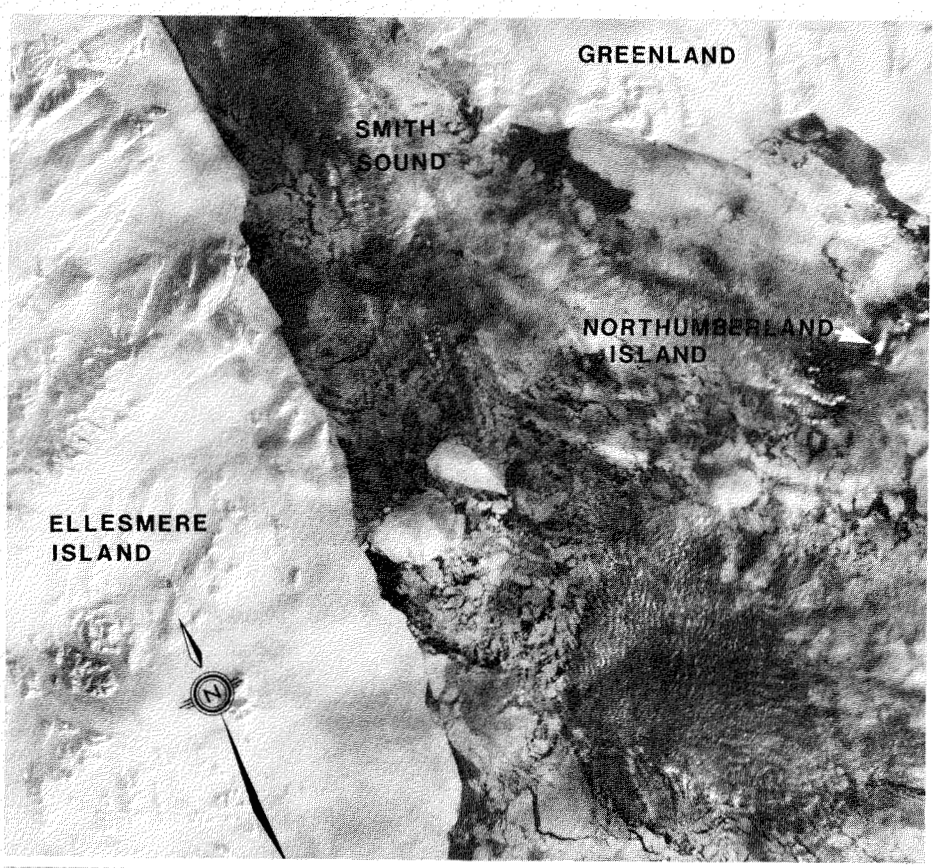

FIG. 5. Ice conditions in Smith Sound and northern Baffin Bay, 16 March 1978 (LANDSAT Imagery).

The positions of the ice-edges in March 1979 were similar to those in March 1978. However, the pack-ice was more dispersed in 1979, probably because of the extensive weather disturbances that also prevented completion of our surveys.

RESULTS AND DISCUSSION

Polar Bear

Stirling and Archibald (1977) suggested that polar bears (*Ursus maritimus*) tend to concentrate in areas of unstable ice where they can prey upon immature ringed seals. However, our limited evidence indicates that polar bears were not particularly concentrated along ice-edges bordering the North Water; few bears or bear tracks were seen during our surveys. Only four single adults were seen during the March 1978 survey and none were seen in April. Only one adult was seen during the March 1979 survey. All polar bears were seen along the edge of the fast-ice, and most (4 of 5) of these were along SE Ellesmere Island.

Ringed Seal

The ringed seal (*Phoca hispida*) is the most abundant marine mammal in the Arctic. During March and April, adults occupy areas of stable fast ice, which is



FIG. 6. A narrow intermittent lead along the east coast of Ellesmere Island, 17 March 1978. The consolidated pack-ice field of northern Baffin Bay is on the right side of the lead and the fast-ice is on the left.

critical for pupping, whereas subadults are thought to be excluded from prime breeding habitat and occupy areas of thin, unstable ice (McLaren, 1958a). Throughout the winter ringed seals are able to maintain breathing holes in solid ice and they are seldom seen before May and June when they begin to haul out on the ice near their holes (Finley, 1979).

Few ringed seals were observed during aerial surveys of the North Water. Four were observed in March and seven in April of 1978; only two were observed in March 1979. Most of these seals were swimming in narrow leads along the fast-ice, although in April 1978 four were observed hauled out on thin ice in Smith Sound. Some seal breathing holes were seen in thin ice.

Bearded Seal

During the winter, bearded seals (*Erignathus barbatus*) are mostly restricted to areas where ice cover is thin or broken. In addition, since bearded seals are normally bottom feeders, they must have access to relatively shallow areas where benthic prey is available (Vibe, 1950; Burns, 1967). Burns and Frost (1979) concluded that bearded seals in the Bering Sea were restricted primarily to waters of less than 100 m where they had access to drifting ice upon which they could haul out. Stirling *et al.* (1977) found that bearded seals preferred shallow areas (< 75 m) in the Beaufort Sea.

Few bearded seals were seen during the two surveys in 1978; only three were observed in March and eight (hauled out on the ice) in April. Seven of these seals were seen along the east coast of Ellesmere Island (Fig. 2).

During the 1979 survey along the east coast of Ellesmere Island a total of 37 bearded seals was seen (about 0.1/linear km, compared with 0.02/linear km in April 1978). At least 21 of these 37 bearded seals were in areas where water depths exceeded 500 m. The others were in areas where the average water depth exceeded 200 m. These depths are much greater than those where bearded seals have been found previously (*cf.* Stirling *et al.*, 1977; Burns and Frost, 1979), although little is known of the winter distribution of this species.

Bearded seals tend to be solitary throughout most of the year (Burns, 1967). Their clumped distribution off SE Ellesmere Island in March 1979, including at least four closely associated pairs, suggests the occurrence of breeding activities. However, conception does not occur until April or May (McLaren, 1958b; Burns, 1967).

Walrus

Walruses (*Odobenus rosmarus*) overwinter in areas with sufficient open water and productive bivalve communities in relatively shallow water. Kane (1892:348), who spent two winters (1853-1855) near the North Water, was "inclined to the opinion that walruses frequent the half broken ice margin throughout the year". Hayes (1867:245), who spent the winter of 1860-61 near Etah, NW Greenland, remarked that in February "The walrus had been very numerous in the open waters outside the harbour all through the winter, and their shrill cry could be heard at almost any time from the margin of the ice". Although some walruses overwinter in polynyas around NW Devon Island (Davis *et al.*, 1978; Kiliaan and Stirling, 1978) and off NW Greenland, the majority are thought to migrate to more southerly wintering grounds along the west Greenland coast (Freuchen, 1921; Vibe, 1950; Loughrey, 1959).

During aerial surveys, walruses on ice pans can be detected from a distance of several kilometres (Estes and Gilbert, 1978). In addition, their presence is often evident from faecal staining of ice pans or from distinctive patterns created when walruses surface through thin ice.

Few walruses or signs of walruses were seen during the surveys in 1978; five walruses were seen in March and 31 in April (Fig. 2). The majority of those seen in April were in the Lancaster Sound - SE Devon Island area, where none had been seen in March.

About 700 walruses were seen in March 1979; all were near SE Ellesmere Island where few walruses had been seen during March-April of 1978 (Fig. 2). The estimate of 700 walruses is approximate because most of these walruses were huddled closely together in groups as large as 45-50 individuals. Attempts at closer examination from 100 m ASL were abandoned because many walruses entered the water before they could be counted. It was rarely possible to determine sex or age, but at least two yearlings were seen, each in close

association with an adult. Most of the 700 walruses were hauled out along the edges of cracks and narrow leads in the pack-ice field close to the fast-ice edges.

Most of the 700 walruses seen in March 1979 were clumped in an area where water depths ranged from 200 to over 500 m. Extensive faecal staining on the ice suggested that they were able to forage in this area, although it is generally believed that walruses cannot feed at depths greater than 80 m and are, therefore, restricted in distribution to shallow waters (Vibe, 1950; Mansfield, 1973; Fay *et al.*, 1977). However, previous discussions of walrus distribution and diving capability have been circular in logic, because statements about diving capability have been based largely on distribution relative to water depth.

The occurrence of large numbers of walruses in the North Water in March 1979 and their virtual absence in early 1978 is not readily explained in the context of the considerable literature about walrus distribution and migrations in this area (*cf.* Freuchen, 1921; Vibe, 1950; 1967; Loughrey, 1959; Mansfield, 1958; 1966). Major wintering grounds formerly were considered to be on the west coast of Greenland between 66° and 69° (Freuchen, 1921) and along the south margin of the Davis Strait pack-ice (Loughrey, 1959; Vibe, 1967). Because of the great distance (about 1000 km) between summering and wintering areas, Freuchen (1921) and Vibe (1967) believed that the migration was not annual but continuous, and that walruses sought favourable ice conditions and foraging areas along the way. However, the Pacific walrus undertakes annual migrations that, in some cases, cover round-trip distances of at least 3200 km (Burns, 1965).

Beluga or White Whale

Belugas vacate their summering areas in the central Canadian High Arctic during September and October (Davis and Finley, 1979). Occasionally some are trapped during freeze-up and attempt (usually unsuccessfully) to maintain breathing holes in the ice (Hill, 1968; Freeman, 1968; Davis and Finley, 1979). However, most of the population of about 10 000 have moved eastward through Lancaster Sound by early October. It has been suggested that these belugas probably make only local migrations and overwinter in the North Water, thus isolating them from populations in west Greenland and southern Baffin Bay (Sergeant and Hoek, 1974; Sergeant and Brodie, 1975). However, this suggestion is unproven. Vibe (1950) suggested that small numbers of belugas may overwinter in the North Water, but he knew of only one winter record: on 6 February 1923, a herd of belugas was observed off Cape Parry (Nielsen, in Vibe, 1950).

We observed 402 belugas during the North Water survey in March 1978; most were in narrow leads along SE Devon Island (134 or 2.1/linear km) and along the Jones Sound ice-edge (183 or 1.8/linear km) (Fig. 3). North of 76°N, the only belugas observed were groups of 35 and 50 in heavy pack-ice near Northumberland Island close to where Nielsen (in Vibe, 1950) had seen a herd in the winter of 1923. The groups of belugas in Lancaster Sound, Jones Sound and Smith Sound appeared to be at least temporarily isolated from one another by extensive areas of impenetrable ice.

A herd of about 100 belugas was seen near Pim Island in Smith Sound on 5 April 1978 (Corp. T. Grant, R.C.M.P., pers. comm.). By mid-April the ice had begun to disperse somewhat and many belugas had moved southward to the entrance of Lancaster Sound (Fig. 3). On 18 April, 189 belugas (2.1/linear km) were seen along SE Devon Island and 232 (2.9/linear km) were seen along a newly formed lead across the mouth of Lancaster Sound. Most of the whales seen along SE Devon Island were moving southwest. When the Lancaster Sound ice-edge was resurveyed two days later, 303 belugas (3.8/linear km) were seen. We saw fewer belugas in and near Jones Sound in April (49) than in March (183), and we saw only four belugas in Baffin Bay north of 76°N during April.

An incomplete survey of the North Water on 17 March 1979 revealed a distribution of belugas similar to that during March 1978. All 214 belugas seen during March 1979 were in the vicinity of Jones Sound and Coburg Island (Fig. 3). The density there (1.6/linear km) was similar to that recorded there in March 1978 (1.8/km).

Most of the belugas observed during the March-April surveys were in narrow leads along the edge of the fast-ice. Their presence was usually evident from the distinctive patterns of breathing holes that they left in thin ice. In several instances belugas were observed beneath ice cupolas (Fig. 7).

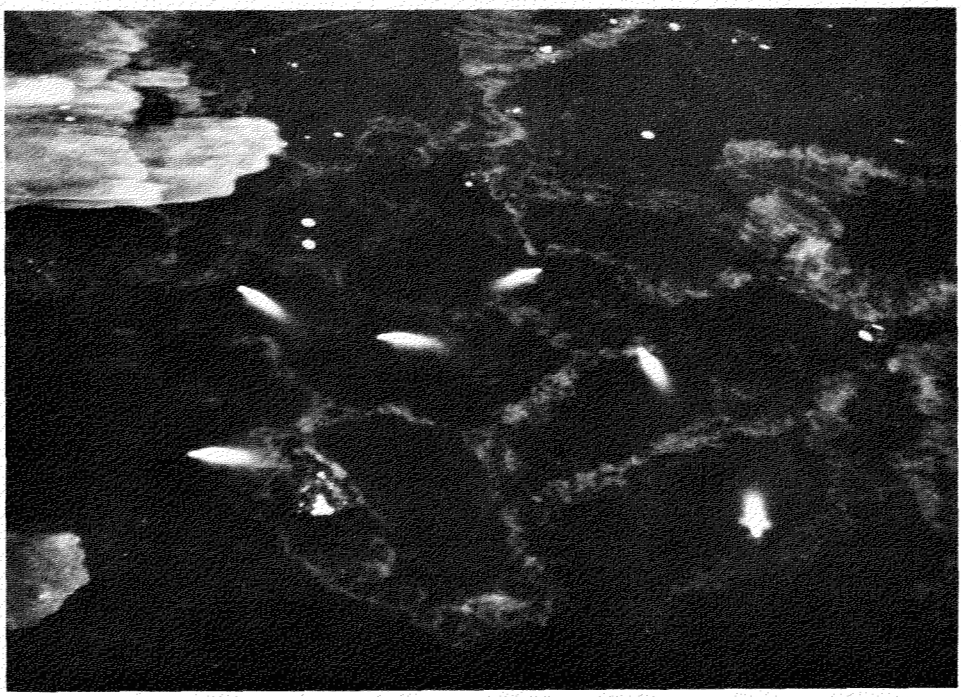

FIG. 7. Six adult belugas lie beneath a thin sheet of ice. The white spots are areas where exhaled air has been trapped beneath the ice. The light diffused patterns are thin sheets of ice that have rafted together.

Many of the groups of belugas along the Jones and Lancaster Sound ice-edges consisted of adults (presumably females) accompanied by immatures. Of 82 belugas classified as adults during the March 1978 survey of these areas, at least 38 were closely accompanied by immatures. Many of the other adults were near immatures but the degree of association was not clear. Of 232 belugas classified as adults during the April 1978 survey, at least 86 were in close association with immatures and many additional immatures were interspersed among the other adults (Table 1). Groups composed entirely of large adults were uncommon

Table 1. Age composition of belugas observed in Lancaster and Jones sounds during Northwater surveys in 1978 and 1979.

Survey Date	Adult		Immatures		Not Classified
	#	%	#	%	
March 1978	82	55	67	45	168
April 1978	232	66	120	34	126
March 1979	81	62	50	38	83

along the Jones and Lancaster Sound ice-edges, but the two groups (total of 85 belugas) observed on 16 March 1978 off NW Greenland consisted entirely of adults. In March 1979, only three all-adult groups (consisting of 4, 5 and 8 individuals) were positively identified. At least 45 of 81 other adult belugas were closely associated with immatures. Subjectively, the proportion of immature belugas and of adult-immature groups seemed high and the proportion of all-adult groups seemed low in relation to our unsystematic observations in the summering areas.

During the period of maximum ice cover, belugas overwintering in northern Baffin Bay appear to be restricted to isolated areas of open water along SE Devon Island, in eastern Jones Sound, and in Smith Sound. Overwintering belugas are apparently most numerous in Jones Sound and along SE Devon Island, which suggests that conditions for overwintering are more favourable or dependable here than in Smith Sound. The extensive formation of new ice that we observed in March of 1978 and 1979 along the Smith Sound ice-edge may preclude continuous occupation of this area by belugas during the winter. Because belugas were very conspicuous and restricted to narrow leads in March 1978, we believe that we detected most of the belugas in northern Baffin Bay. No belugas were observed during offshore transects over the pack-ice and there was no evidence of their conspicuous breathing holes in areas of thin ice. We estimate that about 500 belugas wintered in the North Water in 1978 and it appeared that similar numbers were present in 1979 although we were unable to complete the survey. Clearly, most of the eastern Arctic belugas do not overwin-

ter in the North Water. Vibe (1950) stated that belugas left the Thule area of NW Greenland when ice began to form in October and followed the coast south. These animals are thought to winter along the west coast of Greenland between Disko Bay (70°N) and 63°N (Vibe, 1967; Kapel, 1977).

Narwhal

Narwhals vacate their summering areas in the eastern and central Canadian High Arctic during September and October (Johnson *et al.*, 1976; Finley and Johnston, 1977). Kane (1892) considered their presence in the North Water during winter to be accidental; Inuit of Etah, NW Greenland, secured a young narwhal in the winter of 1854-55. Mansfield *et al.* (1975:1042) suggested, however, that narwhals "probably spend the winter in open water in Baffin Bay, especially in the 'North Water' . . .".

Only one small group of 12 narwhals was observed during the three March-April North Water surveys. They were along the east coast of Ellesmere Island near 78°N on 17 March 1979. The group consisted of seven adult females (one of which was accompanied by a small calf), two adult males, and two individuals of undetermined status.

THE NORTH WATER AS OVERWINTERING HABITAT

In mid-March of 1978, heavy pack-ice covered offshore areas of northern Baffin Bay and most leads had recently frozen over because of prevailing calm conditions. The action of winds and currents on the pack-ice of northern Baffin Bay produces narrow leads along landfast ice-edges at the northern perimeter of the pack-ice. Areas of open water appear to be found most consistently along SE Devon Island, in eastern Jones Sound and, less reliably, in Smith Sound (Figs. 4, 5). These areas of open water provide limited overwintering habitat for some species of marine mammals far to the north of their normal wintering ranges.

The ringed seal and its predator, the polar bear, are the only marine mammals that regularly occupy extensive areas of solid fast-ice. Other pinnipeds, notably the bearded seal and walrus, have only a limited capability to maintain breathing holes in solid ice, and therefore are restricted during the winter to areas where ice cover is (at most) thin or broken. Another factor believed to limit the winter distribution of walruses and bearded seals is their dependence on adequate and accessible benthic food resources. The combination of these factors may severely limit the potential winter range of these two species within the North Water. Most nearshore shallow water areas where benthic food would otherwise be accessible to walruses and bearded seals are covered by fast-ice in winter. Indeed, Burns and Frost (1979) attributed low numbers of bearded seals in the Beaufort Sea to the lack of shallow feeding areas, particularly in the winter when landfast ice extended beyond the continental shelf. Vibe (1950) noted that although the bearded seal was better able to maintain breathing holes than walruses, it was forced to leave coastal waters to winter near the ice-edge. Vibe observed that the bearded seal fed on arctic cod, *Boreogadus saida*, in areas where the water depths exceeded 100 m. Walruses only rarely feed on arctic cod (Mansfield, 1958) and occasionally they are known to feed on ringed seals (Vibe,

1950; Fay, 1960), but it is unlikely that these non-benthic types of food could support many walruses through the winter in the North Water.

Northern Baffin Bay can be an extremely harsh environment for overwintering whales; entrapment by ice is usually fatal. Whales are likely to avoid areas where potentially fatal ice conditions occur, even if these conditions occur only once every few years. Of the three cetaceans that often occur near ice, the narwhal, bowhead and beluga, the last appears to be best adapted for survival in the most restrictive of winter ice conditions.

The prime behavioural adaptations of belugas to ice are their ability to relocate annually those areas with ice conditions suitable for survival, and their ability to maintain holes in thin ice. The presence of belugas in certain areas of the North Water in winter is indicative of the dependence of certain ice conditions necessary for their survival. Such conditions must also exist in local areas of Hudson and James bays, where belugas also overwinter in restricted areas of open water isolated by extensive areas of heavy ice from the closest large areas of open water (Jonkel, 1969; Sergeant, 1973). Kleinenberg *et al.* (1964) reported that in the Soviet Arctic, belugas overwinter in severe ice conditions north to 82°N, particularly in areas of recurrent polynyas that are often hundreds of kilometres from extensive ice-free water.

Although some belugas do overwinter in isolated and restricted areas of open water, it appears that in the Canadian Arctic most belugas and narwhals undertake longer migrations to areas where ice conditions are not as severe. There is no evidence that the limited open water of the North Water supports more than a small percentage of the High Arctic population of belugas during late winter.

ACKNOWLEDGEMENTS

This study was funded by Petro-Canada as part of the Baffin Bay EAMES program administered by the Department of Indian Affairs and Northern Development, Ottawa. We thank G. Glazier, H. Hume, B. Veldhoen and G. Koenig of Petro-Canada and N. Snow and B. Kemper of DIAND for their support.

Aerial surveys were conducted by the authors and M.S.W. Bradstreet. Assistance with planning and report preparation was provided by R. A. Davis and W. J. Richardson of LGL Ltd.

REFERENCES

ABER, P.G. and VOWINCKEL, E. 1972. Evaluation of North Water spring ice cover from satellite photographs. Arctic 25:263-271.

ANON. 1970. Pilot of arctic Canada. Vol. 1. Canadian Hydrographic Service, Dept. Energy, Mines and Resources, Ottawa. 247 p.

BURNS, J.J. 1965. The walrus in Alaska: Its ecology and management. Alaska Dept. Fish and Game, Juneau. 48 p.

_____. 1967. The Pacific bearded seal. Alaska Dept. of Fish and Game, Juneau. 66 p.

_____ and FROST, K.J. 1979. The natural history and ecology of the bearded seal, *Erignathus barbatus*. Final Report, OCSEAP Contract 02-5-022-53. Alaska Dept. Fish and Game, Fairbanks. 77 p.

DAVIS, R.A. and FINLEY, K.J. 1979. Distribution, migration, abundance and stock identity of eastern arctic white whales. Paper presented to International Whaling Commission, Cambridge, June 1979. 55 p.

DAVIS, R.A., KOSKI, W.R. and FINLEY, K.J. 1978. Numbers and distribution of walruses in the central Canadian High Arctic. Unpubl. Rep. by LGL Ltd. to Polar Gas Project. 50 p.

DUNBAR, M. J., DUNBAR, M., and NUTT, D. C. 1967. The Baffin Bay-North Water Project. Rept. No. 1. The Arctic Institute of North America. 71 p.

DUNBAR, M. and DUNBAR, M. J. 1972. The history of the North Water. Proc. Royal Society England 72:231-241.

ESTES, J. A. and GILBERT, J. R. 1978. Evaluation of an aerial survey of Pacific walruses (*Odobenus rosmarus divergens*). Journal of the Fisheries Research Board of Canada 35:1130-1140.

FAY, F. H. 1960. Carnivorous walrus and some arctic zoonoses. Arctic 13:111-122.

———, FEDER, H. M. and STOKER, S. W. 1977. An estimation of the impact of the Pacific walrus population on its food resources in the Bering Sea. U.S. Marine Mammal Commission Report Nos. MMC-75/06, MMC-74/03. 38 p. NTIS-PB-273-505.

FINLEY, K. J. 1979. Haul-out behaviour and densities of ringed seals (*Phoca hispida*) in the Barrow Strait area, N.W.T. Canadian Journal of Zoology 57:1985-1997.

——— and JOHNSTON, G. 1977. An investigation of the distribution of marine mammals in the vicinity of Somerset Island with emphasis on Bellot Strait, August-September 1976. Unpubl. Rep. by LGL Ltd. to Polar Gas Project. 91 p.

FREEMAN, M. M. R. 1968. Winter observations on beluga (*Delphinapterus leucas*) in Jones Sound, N.W.T. Canadian Field-Naturalist 82:276-286.

FREUCHEN, P. 1921. Occurrence and migrations of the walrus near the west coast of Greenland. Danish Society of Natural History, Copenhagen. Scientific Information 72:237-249.

HAYES, I. I. 1867. The open polar sea: a narrative of a voyage of discovery towards the north pole, in the schooner "United States". New York: Hurd and Houghton. 454 p.

HILL, R. M. 1968. Observations on white whales trapped by ice in the Eskimo Lakes during the winter of 1966-67. The Arctic Circular 17:3-4.

JOHNSON, S. R., RENAUD, W. E., DAVIS, R. A. and RICHARDSON, W. J. 1976. Marine mammals recorded during aerial surveys of birds in eastern Lancaster Sound, 1976. Unpubl. Rep. by LGL Ltd. to Norlands Petroleums Ltd. 180 p.

JONKEL, C. J. 1969. White whales wintering in James Bay. Journal of the Fisheries Research Board of Canada 26:2205-2207.

KANE, E. K. 1854. The U.S. Grinnell expedition in search of Sir John Franklin: a personal narrative. London: Sampson Low, Son and Co.

———. 1892. Arctic explorations in search of Sir John Franklin. London: T. Nelson and Sons.

KAPEL, F. O. 1977. Catch of belugas, narwhals and harbour porpoises in Greenland, 1954-75, by year, month and region. Report of the International Whaling Commission 27:507-522.

KILIAAN, H. P. L. and STIRLING, I. 1978. Observations on overwintering walruses in the eastern Canadian High Arctic. Journal of Mammalogy 59:197-200.

KLEINENBERG, S. E., YABLOKOV, A. V., BEL'KOVICH, B. M., and TARASEVICH, M. N. 1964. Beluga (*Delphinapterus leucas*) investigation of the species. Akad. Nauk SSSR, Institut Morfologii Zhivotnykh Im. A.N. Severtsova, Moscow. 450 p. (Translated into English, 1969, Israel Program for Scientific Translations, Jerusalem. 376 p.)

LINDSAY, D. G. 1975. Sea ice atlas of arctic Canada 1961-1968. Dept. of Energy, Mines and Resources, Ottawa. 213 p.

LOUGHREY, A. G. 1959. Preliminary investigations of the Atlantic walrus *Odobenus rosmarus rosmarus* (Linnaeus). Canadian Wildlife Service, Wildlife Management Bulletin (Series 1), No. 14. 123 p.

MANSFIELD, A. W. 1958. The biology of the Atlantic walrus *Odobenus rosmarus rosmarus* (Linnaeus) in the eastern Canadian Arctic. Fisheries Research Board of Canada, MS Report Series (Biology) No. 653. 145 p.

———. 1966. The walrus in Canada's Arctic. Canadian Geographical Journal 73:88-95.

———. 1973. The Atlantic walrus *Odobenus rosmarus* in Canada and Greenland. International Union for Conservation of Nature and Natural Resources, Supplementary Paper 39:69-79.

———, SMITH, T. G. and BECK, B. 1975. The narwhal, *Monodon monoceros*, in eastern Canadian waters. Journal of the Fisheries Research Board of Canada 32:1041-1046.

MARKHAM, A. H. 1874. Whaling Cruise to Baffin's Bay and the Gulf of Boothia. London: Sampson Low, Marston, Low and Searle.

McLAREN, I.A. 1958a. The biology of the ringed seal (*Phoca hispida* Schreber) in the eastern Canadian Arctic. Fisheries Research Board of Canada Bulletin 118. 97 p.

———. 1958b. The economics of seals in the eastern Canadian Arctic. Fisheries Research Board of Canada. Arctic Circular 1:1-94.

RENAUD, W.E. and BRADSTREET, M.S.W. 1980. Late winter distribution of black guillemots, *Cepphus grylle*, in northern Baffin Bay and the Canadian High Arctic. Canadian Field Naturalist 94(4).

SERGEANT, D.E. 1973. Biology of white whales (*Delphinapterus leucas*) in western Hudson Bay. Journal of the Fisheries Research Board of Canada 30:1065-1090.

_____ and BRODIE, P.F. 1975. Identity, abundance and present status of populations of white whales, *Delphinapterus leucas*, in North America. Journal of the Fisheries Research Board of Canada 32:1047-1054.

SERGEANT, D.E. and HOEK, W. 1974. Seasonal distribution of bowhead and white whales in the eastern Beaufort Sea. In: Reed, J.C. and Sater, J.E. (eds.). The Coast and Shelf of the Beaufort Sea. Arlington, VA: The Arctic Institute of North America. 705-719.

STIRLING, I. and ARCHIBALD, W.R. 1977. Aspects of predation of seals by polar bears. Journal of the Fisheries Research Board of Canada 34:1126-1129.

_____ and DeMASTER, D. 1977. Distribution and abundance of seals in the eastern Beaufort Sea. Journal of the Fisheries Research Board of Canada 34: 976-988.

VIBE, C. 1950. The marine mammals and the marine fauna in the Thule district (Northwest Greenland) with observations on ice conditions in 1939-1941. Meddelelser om Grønland 151: 1-1151.

_____. 1967. Arctic animals in relation to climatic fluctuations. Neddelelser on Grønland 170:1-227.

ARCTIC
VOL. 36, NO. 2 (JUNE 1983) P. 162-173

A Distinctive Large Breeding Population of Ringed Seals (*Phoca hispida*) Inhabiting the Baffin Bay Pack Ice

K.J. FINLEY[1], G.W. MILLER[1], R.A. DAVIS[1] and W.R. KOSKI[1]

ABSTRACT. Aerial surveys in June and July, 1978 and 1979, documented an unexpectedly large population (at least 417 000) of ringed seals, some with pups, inhabiting the pack ice of Baffin Bay. Pack-ice seals are smaller than their fast-ice counterparts and have a different diet and gut parasite load. Age and reproductive data, although limited, indicate that the offshore seals are a normal breeding population. Pack-ice seals probably mix with fast-ice seals in coastal areas during the brief open-water season but morphological and ecological differences suggest that the populations are reproductively isolated. This study prompts reconsideration of the importance of offshore pack ice to ringed seals and, therefore, to the coastal hunting economy of Inuit in Greenland and Baffin Island.

Key words: ringed seals, Baffin Bay, pack ice, distribution, population discreteness, management

RÉSUMÉ. Des inventaires aériens effectués en juin et juillet, 1978 et 1979, ont documenté une population importante d'au moins 417 000 phoques annelés, certains accompagnés de jeunes, habitant le pack de la baie Baffin. Les phoques du pack sont plus petits que ceux de la banquise côtière et ont un régime alimentaire et des parasites intestinaux différents. Des données sur l'âge et le reproduction, quoique limitées, indiquent que les phoques au large des côtes suivent un cycle de reproduction normal. Les phoques du pack se mêlent probablement à ceux de la banquise dans les régions côtières durant la brève saison d'eau libre mais les différences morphologiques et écologiques suggèrent que les populations se reproduisent peut-être indépendamment l'une de l'autre. La présente étude encourage une reconsidération de l'importance du pack chez les phoques annelés et ainsi, de son importance dans l'économie côtière des Inuit chasseurs du Groenland et de l'île de Baffin.

Mots clés: phoque annelés, baie Baffin, banquise, distribution, isolation reproductrice de la population, contrôle de la population

Traduit pour le journal par Maurice Guibord.

INTRODUCTION

The life of the ringed seal (*Phoca hispida*) is intimately related to the dynamics of sea ice. The circumpolar distribution of the ringed seal is attributed to its ability to maintain breathing holes in solid ice — a unique adaptation that allows it to occupy large areas of the arctic seas that are inaccessible to most marine mammals during much of the year.

Like most phocid seals, the ringed seal uses sea ice as a platform on which to give birth and suckle its young. McLaren (1958a) hypothesized that stable ice in March-April was critical to pupping success, and that the species therefore preferred complex coastal areas where the ice was most stable. He believed that population size was limited by the amount of suitable fast ice. Immature seals were thought to be excluded from the preferred breeding habitat and to occupy areas of unstable ice. Subsequent accounts have also emphasized the significance of stable fast ice in the life history and population dynamics of this species (McLaren, 1961, 1962, 1966a; Smith, 1973, 1975; Smith and Stirling, 1975; Stirling and Smith, 1977; Finley, 1979; Burns *et al.*, 1981).

Nonetheless, ringed seals do not necessarily depend only on fast ice as preferred breeding habitat. Fedoseev and Yablokov (1964) recognized, on morphometric evidence, a distinctive ringed seal that inhabited and reproduced on the pack-ice fields of the Sea of Okhotsk. Fedoseev (1975) later recognized two basic 'ecotypes' of *P. hispida* in eastern Siberian waters — seals of the fast ice and of the pack ice. He concluded that seals of the pack ice were smaller, grew relatively faster and matured earlier than did seals of the fast ice.

As part of the Eastern Arctic Marine Environmental Studies program (Sutterlin and Snow, 1982) extensive aerial surveys were undertaken during 1978 and 1979 to document the distribution and abundance of marine mammals and birds in NW Baffin Bay. In May and June 1978 we saw unexpectedly large numbers of ringed seals, some with pups, in the offshore pack ice of Baffin Bay. In 1979 the study was expanded in order to better define the status of the offshore seals. We attempted to determine whether seals on pack ice were predominantly non-breeding subadults as implied by McLaren (1958a) and Smith (1973), or a breeding population such as occurs in the Sea of Okhotsk. This question was addressed with: 1) aerial surveys to assess relative numbers and distribution, 2) specimen collections on the pack ice to determine age and reproductive status, and 3) morphological and biochemical comparisons of animals collected on offshore pack ice and coastal fast ice. We also examined the diets, stomach parasites and development of moult of pack-ice and fast-ice seals.

METHODS

Study Area and Ice Conditions

The study area encompassed the coastal waters of NE Baffin Island from Lancaster Sound south to Clyde and adjacent offshore waters of Baffin Bay (Fig. 1). Baffin Bay forms a deep (500-2400 m), enclosed depression between Baffin Island and Greenland. The basin is dominated by cold arctic waters of the southward-flowing Baffin Current along the western side of Baffin Bay, and an intrusion of cold Atlantic water, the West

[1]LGL Limited, environmental research associates, 44 Eglinton Avenue West, Toronto, Ontario, Canada M4R 1A1

Greenland Current, on the eastern side of Baffin Bay (Collin and Dunbar, 1964; Fissel *et al.*, 1982). The physiography, oceanography and climate of Baffin Bay interact to produce a seasonal ice sheet that has a predictable degree of organization.

Freeze-up occurs rapidly in fiords during October leaving characteristically smooth ice. During early winter the fast ice extends in a shelf 30-50 km wide along eastern Baffin Island, anchored in part by numerous stranded icebergs, and fluctuating in extent depending on prevailing winds. In June 1979,

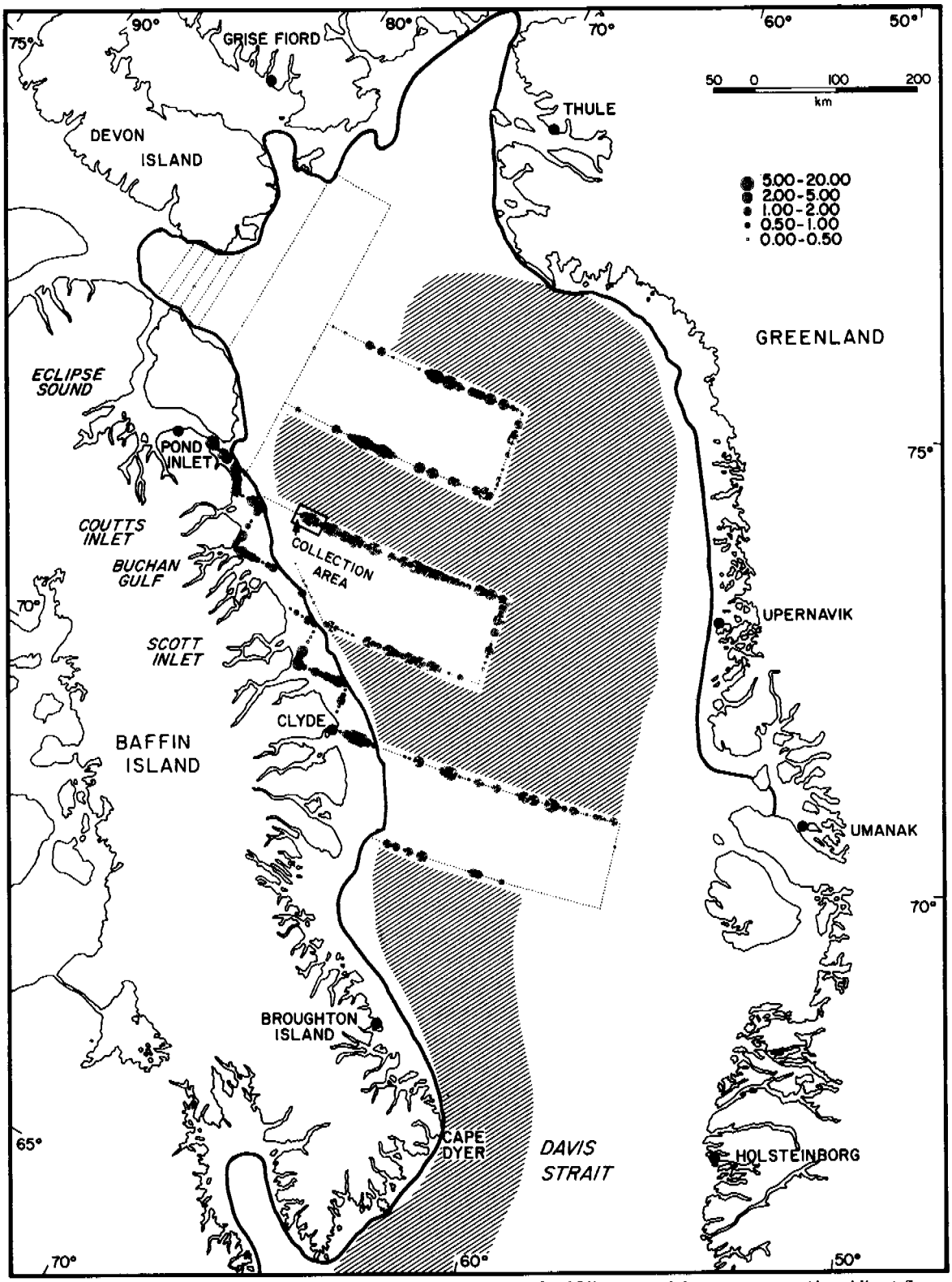

FIG. 1. The Baffin Bay area showing the extent of pack ice (hatched area) of >75% cover and the survey routes (dotted lines) flown repeatedly in 1979. The solid line indicates the edge of the landfast ice (from NOAA imagery, June 1979). Symbols are densities (seals·km^{-2}) in 2-min segments of transects. The collection area for pack-ice seals is shown.

this shelf between Cape Dyer and Pond Inlet covered an area of about 20 000 km² (Fig. 1). Within the same area the fiord ice is constant at about 16 000 km² and remains solid (land-fast) from October until July. The fiord complex of Pond Inlet, Eclipse Sound and Navy Board Inlet has an additional 8000 km² of fast ice.

At its maximum extent in March, the pack ice covers most of Baffin Bay. The ice in western Baffin Bay continually drifts southward, and in spring the first area of open water, the 'North Water', appears along the northern periphery of the ice fields (Fig. 2). In late June 1979, close pack ice (>75% cover) covered about 300 000 km² of Baffin Bay (Fig. 1). Extensive pack ice, known as the 'Middle Ice' to nineteenth-century whalers (cf. Markham, 1874), persists into August on the west side of Baffin Bay. In 1979, Baffin Bay was ice-free by late August but by mid-October new ice was beginning to develop.

Aerial Surveys

In 1978 and 1979 extensive aerial surveys were conducted in NW Baffin Bay and Lancaster Sound from early May to mid-July. These surveys were designed to document the distribution and abundance of marine mammals and seabirds as part of the Eastern Arctic Marine Environmental Studies (EAMES) program (Sutterlin and Snow, 1982). Because of the large

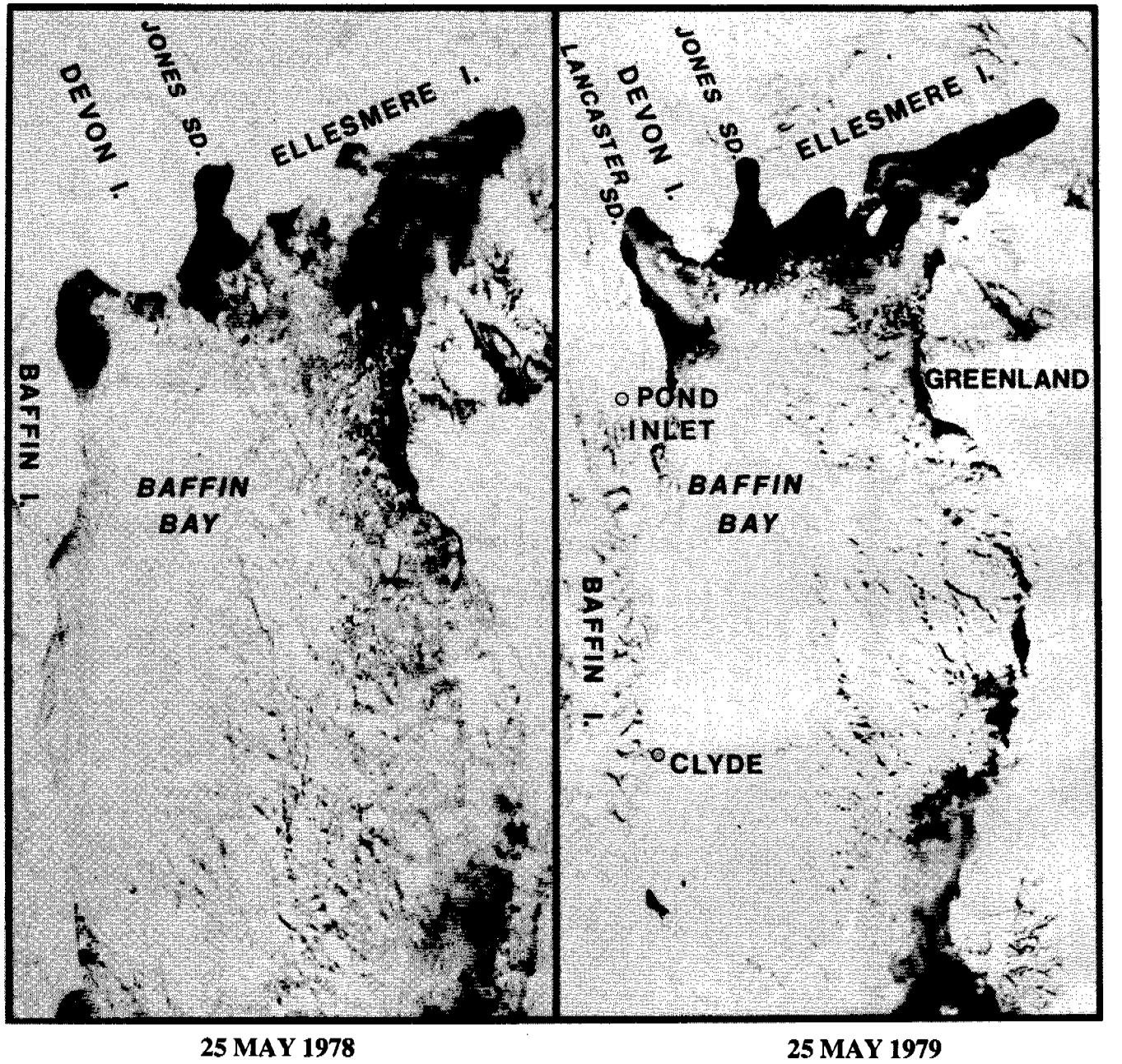

FIG. 2. Synoptic view of ice cover in Baffin Bay on 25 May, 1978 and 1979. Note the clearing of pack ice from the northern periphery of the fast ice leaving a large area of open water, the North Water.

survey area and associated logistic costs, both birds and mammals were counted during low-level (45 m) surveys with a transect width of 400 m. While this technique is adequate for describing the distribution of marine mammals, the low altitude and narrow transect strip are generally of limited value in quantitative evaluations of density, especially of seals that are hauled out on the ice. Thus, in addition to the low-level surveys, we conducted special surveys at 90 m with an 800-m transect width in order to provide density estimates of ringed seals during late June and early July. These surveys were conducted over the fast ice of fiords in NE Baffin Island in 1978, and over the adjacent shelf of fast ice and the pack ice in 1979.

All surveys were conducted in a DeHavilland DHC-6 Twin Otter with one observer in the right front seat and another on the left in the second seat behind the pilot. During surveys at 45 and 90 m, airspeeds were approximately 185 and 240 $km \cdot h^{-1}$, respectively. Survey altitude was maintained by radar altimeter, and accurate navigation in offshore areas was provided by a Global Navigation System (GNS-500).

Survey routes were divided into transects of lengths 18-140 km; most offshore transects were 56-111 km long. Each transect was subdivided into 2-min segments (6.2 km at 185 $km \cdot h^{-1}$ and 8.0 km at 240 $km \cdot h^{-1}$). The observers dictated information concerning transects, seals, visibility and ice conditions into audio recorders. These data were later transcribed, keypunched, and keyverified for computer tabulation, analysis, and mapping. Computer-produced maps were based on the density of seals recorded in each 2-min transect segment. Additional details on survey design and analyses are given in Koski and Davis (1979) and Koski (1980).

Population Estimation and Correction Factors

Only high-level (90 m) surveys during the peak of the haul-out season were used in estimating population sizes. Densities were obtained from three ice types — fiord, coastal shelf and pack ice — and then extrapolated to the total area of each ice type. Coverage with 45-m surveys indicated that extrapolation of densities in a particular ice type was reasonable given the wide and rather uniform distribution of seals. The population estimates are conservative since they do not account for seals that were not hauled out during the surveys. To the extent possible, this source of underestimation was minimized by conducting the surveys during the peak of the haul-out period, during midday and during good weather conditions, but even then only about 70% or fewer of the seals may be on top of the ice (Finley, 1979).

Ringed seals are conspicuous on the ice and it is unlikely that many are missed by competent observers in an aircraft. However, the right front observer in the Twin Otter aircraft has considerable forward-scanning advantage over observers in rear seats. Thus, seals that dive in front of the aircraft or those in the narrow blind strip beneath the aircraft are probably missed by the rear observers. In 1978 and 1979 at 90 m elevation, the front and rear observers recorded 1260 and 639 seals, respectively — a ratio of 1.97:1.

Specimen Collections

We accompanied Inuit who shot ringed seals on fast ice within 10 km of the community of Pond Inlet (n = 12) and on pack ice 65-130 km off NE Baffin Island (n = 45) (Fig. 1). Transport to the pack ice was by helicopter. Most (10 of 12) of the fast-ice seals were taken between 8 and 13 June, and all pack-ice seals were taken between 23 June and 7 July. The hunters used white screens to approach basking seals and attempted to take every seal that was encountered (i.e. no apparent selectivity was exercised). Since pups shed their neonatal coat by May they were not well represented among the moulting seals in late June and early July.

Morphometrics

Body measurements included straight-line body length, axillary and maximum girth, and blubber thickness over the sternum. With the exception of body length these measurements conform with the recommendations of the American Society of Mammalogists (1967). Body length was determined by the criteria used by McLaren (1958a) and Usher and Church (1969). Eleven features were measured from skulls of all adult seals; ten additional features were measured from skulls of adult males. Cranial measurements were made according to the procedure illustrated by Timoshenko (1975). Only adult seals, eight years of age and older, were used in morphometric analyses; at this age they have achieved most of their final body length (McLaren, 1958a). Measurements were made with dial calipers read to 0.1 mm. Student's t tests were used to compare body length, girth and skull measurements of fast-ice and pack-ice seals.

Age Determination

Lower jaws were kept frozen until they were boiled in the laboratory for approximately 1 h to facilitate the extraction of the canine teeth. Thin cross-sections (0.2-0.3 mm) of the extracted canines were cut about one third of the distance from the root end to the crown. Extracted teeth and the thin sections were stored in ethanol and glycerine. Dentinal annuli were counted using a 20X binocular microscope, usually under transmitted light, following McLaren (1958a) and. Smith (1973). Each section was read by one of us (GWM) in blind replicates, i.e. with no knowledge of previous estimates, until two identical readings were obtained or until three estimates had been made. When no two of the three readings were identical, mean age was calculated and rounded to the nearest integer. All seals were aged to their most recent birthday, i.e. April. In 29 of 57 examples (51%), age readings 1 and 2 were identical, and in 18 of the other 28 cases, reading 3 was identical to one of the two previous readings.

Enzyme Electrophoresis

Tissue samples from the heart, liver, kidney and muscle were cooled in ice and frozen within 24 h of collection. To assess genetic variability in seals from pack ice (n = 45) and fast ice (n = 12), tissue samples were examined by J. Bogart

and D. Lavigne, University of Guelph, using horizontal starch-gel electrophoresis (methods as in Lavigne *et al.*, in press). They examined 27 genetic loci from 16 enzyme systems: two acid phosphatase loci; adenylate kinase; α-glycerophosphate dehydrogenase; two general protein loci; two glutamate oxaloacetic transaminase loci; two isocitrate dehydrogenase loci; two lactate dehydrogenase loci; malic enzyme; two malate dehydrogenase loci; 6-phosphogluconate dehydrogenase; three superoxide dismutase loci; four phosphoglucose mutase loci; one sorbitol dehydrogenase locus; aconitase; esterase; and a glucose-6-phosphate dehydrogenase locus.

Reproductive Condition

Female reproductive tracts were preserved in 10% formalin. In the laboratory, uterine cornua were opened and examined for the remains of placental material from a recent pregnancy. Ovaries were cut in 1-mm slices and examined macroscopically for corpora lutea and albicantia.

Pelage and Moult

In the field, seals were examined for evidence of skin (epidermal) and hair moult and the skins were photographed. Strips of skin (4 x 8 cm) were taken from the mid-dorsal area of seals collected in July and these samples were later examined under a 10X microsope. Old hair was easily distinguishable from developing hair by its dull, yellowish appearance. Hair growth was measured from small clumps of hair plucked from the skin. Developing, non-erupted hairs were measured in cross-sections of the epidermis. The epidermis was examined for evidence of sloughing.

Diet and Stomach Parasites

Food items from stomachs and faecal material from colons were collected and frozen. Later, thawed stomach contents and faecal material were weighed and then diluted with water in a shallow tray. The various constituents were separated through differential specific gravity (i.e. panning). Fish otoliths were identified and counted. Crustacean parts were examined under a low-power microscope and an estimate was made of the species composition on a percentage basis.

Seal stomachs were examined for nematodes. Clumps of nematodes on the stomach wall were classified as major (> 10 individuals) or minor (< 10 individuals); major and minor clumps and all individually attached nematodes were counted.

RESULTS

Distribution and Abundance

Small numbers of ringed seals were seen during surveys in May but the peak of haul-out in both offshore and coastal areas occurred during the latter half of June and into early July. Group sizes of seals were similar in offshore and coastal areas, although they tended to increase in size from May to the peak of haul-out (Fig. 3). There were no discernible shifts in the population from offshore to coastal areas or vice versa during the surveys.

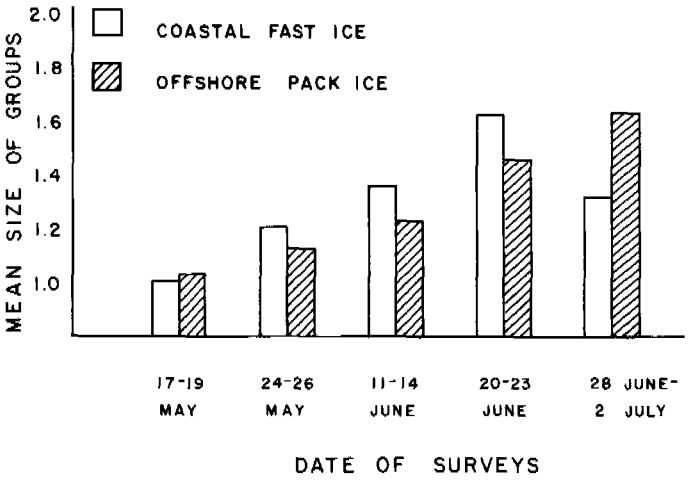

FIG. 3. Group sizes of ringed seals observed on coastal fast ice and offshore pack ice, 17 May-2 July 1979.

Ringed seals were distributed throughout the offshore pack ice and the coastal fast ice of NW Baffin Bay (Fig. 1). Few seals were seen in peripheral areas of the pack-ice fields where the ice was more active and broken. Within the pack-ice fields densities tended to be rather uniform; a series of transects at 90 m elevation conducted during the peak of haul-out in 1979 provided an overall density of 1.39 seals·km^{-2}. This was similar to the density (1.31 seals·km^{-2}) found on the coastal shelf during the same period (Table 1). Densities of seals in fiords in 1978 were variable (0.86-3.20 seals·km^{-2}) but the overall mean density (1.72·km^{-2}) was somewhat higher than that for shelf ice and offshore pack ice in 1979 (Table 1).

TABLE 1. Densities of ringed seals on various ice types in NW Baffin Bay during the period of peak haul-out, 1978-79

Ice Type	Area[a]	Date	Area Surveyed (km²)	Seal Density (km^{-2})
Pack ice	Baffin Bay	2 July 1979	606	1.39
Fast ice (Shelf)	NW Baffin I.	20, 21 June 1979	341	1.31
Fast ice (Fiord)	Coutts Inlet	25 June 1978	121	2.46
	Buchan Gulf	25 June 1978	97	3.20
	Scott Inlet	25 June 1978	133	1.47
	Eclipse Sound	22 June 1978	128	0.96
	Pond Inlet	26, 30 June 1978	118	0.86
	All fiords	22-30 June 1978	597	1.72

[a]For areas covered see Fig. 1.

Application of these raw density estimates to the total area of pack ice in Baffin Bay and the bordering fast ice between Cape Dyer and Navy Board Inlet indicates that the pack ice of Baffin Bay supports a substantially larger population of seals than

does the bordering fast ice along the east coast of Baffin Island. We estimate that the pack ice was inhabited by at least 417 000 seals in late June-early July 1979, whereas the fast ice was inhabited by at least 67 000 seals. These are underestimates since they do not account for seals missed by the left rear observer and seals that were not hauled out during the surveys. Application of correction factors would increase the population estimate for the Baffin Bay pack ice to 550 000 seals, if we allow for reduced efficiency of left rear observers, and to 787 000 seals if we also consider that roughly 30% (Finley, 1979) of the total number of seals may not have been hauled out during the surveys.

Ringed seals apparently abandon offshore Baffin Bay after the ice disappears in late summer. Few ringed seals were seen during low-level surveys during August and September of 1978 and 1979 (details in Koski, 1980; Koski and Davis, 1979, 1980). Seals are not easy to detect in rough water, but some offshore surveys were flown during calm conditions when seals could have easily been detected at the surface. For example, on 11 September 1979, mirror calm conditions prevailed over Baffin Bay, and during 292 km of offshore survey no seals were seen. Most ringed seals observed during aerial surveys in late summer were found in coastal waters. During many hunting trips by boat in Eclipse Sound in August and September we encountered ringed seals, sometimes in considerable concentrations (e.g., KJF counted at least 80 ringed seals within a 1-km radius of a stationary boat in Eclipse Sound on 27 August 1978).

Age Distribution and Reproductive Status

Both the samples (45 pack-ice seals and 12 fast-ice seals) exhibited a similar age range of adult and immature seals, indicating that both samples were drawn from a breeding population (Fig. 4). Young-of-the-year and one-year-old seals were not represented in either sample; this was expected for the young-of-the-year seals but not necessarily for the one-year-olds, which would be expected to moult with older seals. We did observe small seals swimming in leads among the ice pans, and the aerial observers saw adults with pups on the pack ice in May.

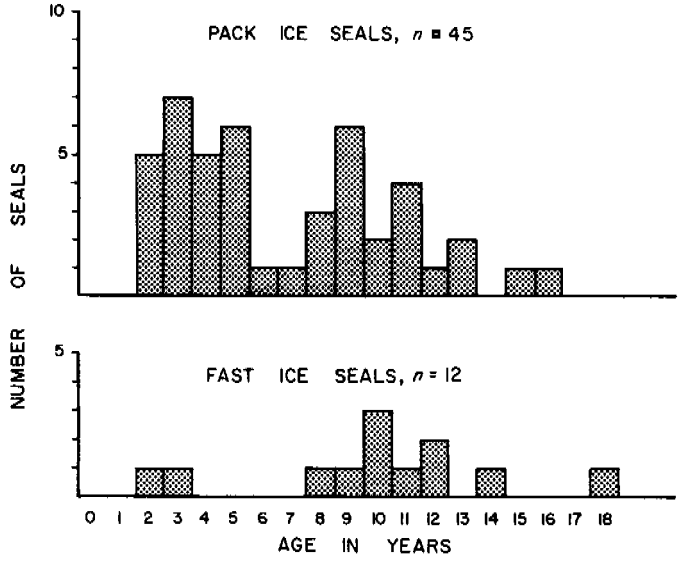

FIG. 4. Age distribution of ringed seals collected on pack ice and fast ice, June-July 1979.

Of the 45 pack-ice seals, 27 were females, of which 14 were sexually mature (Table 2). All females >5 yr old from both the pack ice and the fast ice had ovulated (corpus luteum present) during the most recent breeding season (April-May), but were taken during the period of delayed implantation, when embryos are not detectable. All these females also retained at least one corpus albicans from a previous ovulation. The uterine cornua of these individuals were thick and heavily vascularized with longitudinal foldings (quite distinct from the small, smooth cornua of immature specimens), indicating that these females had been pregnant in previous years.

TABLE 2. Reproductive condition of female ringed seals collected on pack ice and fast ice.

Age	*n*	No ovulation	First ovulation	Previously pregnant
Pack Ice				
2	4	4	—	—
3	5	5	—	—
4	4	1	3	—
5	3	3	—	—
8-15	11	—	—	11
	27	13	3	11
Fast Ice				
2	1	1	—	—
8-12	5	—	—	5
	6	1	0	5

An indication of recent pregnancy was the presence in some uteri of orange stains on the inner wall of a cornus whose ovary contained a corpus albicans. We believe that these stains form at the site of placental attachment on the endometrial lining. This feature was observed in five of eleven of the parous pack-ice females and in four of five of the parous fast-ice females. The earlier collection dates of the fast-ice females may account in part for the greater frequency of this feature in those seals.

Our data are too limited to indicate anything conclusive about the age of sexual maturity; however, it is noteworthy that of the 4-yr-old pack-ice females, three out of four had ovulated (Table 2).

Morphometry

Male ringed seals (≥8 yr old) from the pack ice were significantly smaller in length and girth than males from the fast ice (Table 3). Average estimated weights (calculated by the method of Usher and Church, 1969) of pack-ice and fast-ice males were 51.4 and 72.8 kg, respectively. Female ringed seals from the pack ice were also significantly shorter (t = 2.82, $p<0.05$) in body length than fast-ice females (116.4 cm + SD 6.67, n = 11 *vs.* 126.2 cm + SD 5.40, n = 5).

Pack-ice males were significantly smaller than fast-ice males

TABLE 3. Body and cranial measurements of adult (≥ 8 years old) males from the fast ice and pack ice[a]

Measurement[b]	Fast Ice		Pack Ice				
	n[c]	Mean ± SD	n[c]	Mean ± SD	t	df	p[d]
Body length	5	133.5 ± 4.58	9	125.1 ± 3.89	3.64	12	**
Axillary girth	5	111.9 ± 5.64	9	95.7 ± 4.20	6.16	12	**
Condylobasal length	3	182.4 ± 8.69	7	174.6 ± 4.71	1.89	8	NS
Length of cranium	4	81.2 ± 2.56	8	74.8 ± 1.77	2.25	10	*
Zygomatic width	4	112.3 ± 1.45	6	104.5 ± 3.21	4.45	8	**
Mastoid width	4	112.0 ± 1.98	7	106.1 ± 2.07	4.57	9	**
Width of cranium	4	91.4 ± 2.25	7	88.0 ± 1.77	4.57	9	**
Height of skull	4	71.9 ± 2.18	7	69.1 ± 1.28	2.64	9	*
Rostral width	5	30.3 ± 1.45	9	26.4 ± 0.78	6.60	12	**
Least intraorbital width	5	5.4 ± 1.59	9	5.1 ± 0.73	0.44	12	NS
Width of occipital condyles	4	58.7 ± 1.35	8	56.2 ± 1.85	2.39	10	*
Length of palate	5	75.1 ± 5.43	9	73.3 ± 3.65	0.75	12	NS
Width of facial part of skull	5	43.9 ± 1.44	9	39.3 ± 2.08	4.37	12	**
Width of palate	4	31.0 ± 1.56	8	28.8 ± 2.21	1.82	10	NS
Length of nasal bones	5	43.9 ± 8.00	9	40.8 ± 2.80	0.86	5	NS
Width of nasal bones	5	11.6 ± 1.25	8	11.8 ± 1.58	−0.33	11	NS
Length of tympanic bullae	5	38.9 ± 2.16	9	36.6 ± 1.57	2.22	12	*
Length of upper post-canine row	5	37.4 ± 1.43	9	35.8 ± 1.47	2.03	12	NS
Length of lower post-canine row	4	36.1 ± 1.36	8	35.0 ± 1.47	1.22	10	NS
Length of lower tooth row	5	50.5 ± 1.65	8	47.9 ± 1.21	3.31	11	**
Height of lower jaw	5	50.7 ± 5.23	9	45.1 ± 2.17	2.29	6	NS
Length of lower jaw	5	114.6 ± 3.56	8	107.6 ± 3.67	3.39	11	**
Length of upper tooth row	5	57.2 ± 2.71	9	53.9 ± 1.29	3.13	12	**
Age (yr)	5	12.6 ± 3.44	9	11.7 ± 2.18	0.60	12	NS

[a]All skull specimens have been deposited in the National Museum, Ottawa, catalogue numbers NMC 45419-NMC 45469.
[b]Body measurement in cm, cranial measurements in mm.
[c]Sample sizes were incomplete for some skull features that were damaged during collection.
[d]NS, not significant; *, $p < 0.05$; **, $p < 0.01$.

in 12 of 21 cranial features (Table 3). In general, the skulls of fast-ice males appeared more robust than those of the pack-ice males (Fig. 5). Females from the pack ice also averaged smaller in all cranial measurements but our sample sizes were too small for statistical treatment.

We plotted skull measurements *vs.* age for seals ≥ 8 yr old to assess whether age-related biases occur in these older seals. Examples of these plots are presented in Figure 6. The size differences between the two groups are consistent across the age span of the animals examined and there is little or no overlap in most measurements.

Genetic Variability

Of 27 genetic loci from 16 metabolic enzymes, 24 (88.9%) were monomorphic and demonstrated no variation. Variability was encountered for aconitase, one esterase locus, and a glucose-6-phosphate dehydrogenase locus, but the apparent variability was low and was not statistically different between the pack-ice and fast-ice seals. Low variability has also been found in the same enzyme systems examined for the harp seal (*Phoca groenlandica*) (Lavigne *et al.*, in press).

Pelage and Moult

Although the colouration and markings of the ringed seals varied considerably, we could not discern any consistent differences in the pelage of the pack-ice and fast-ice seals. Fedoseev (1975) identified two pelage types and noted that one type was more predominant in Okhotsk ringed seals than in seals in Bering Strait and the Chukchi Sea.

Only two of ten fast-ice seals taken between 6-12 June showed any epidermal moult. Between 23-30 June epidermal moult was evident in eight of nine pack-ice seals. All seals re-



FIG. 5. Skulls and lower jaws of 10-yr-old male ringed seals from the pack ice (left) and the fast ice (right). Note the generally more robust appearance of the skull of the fast-ice seal.

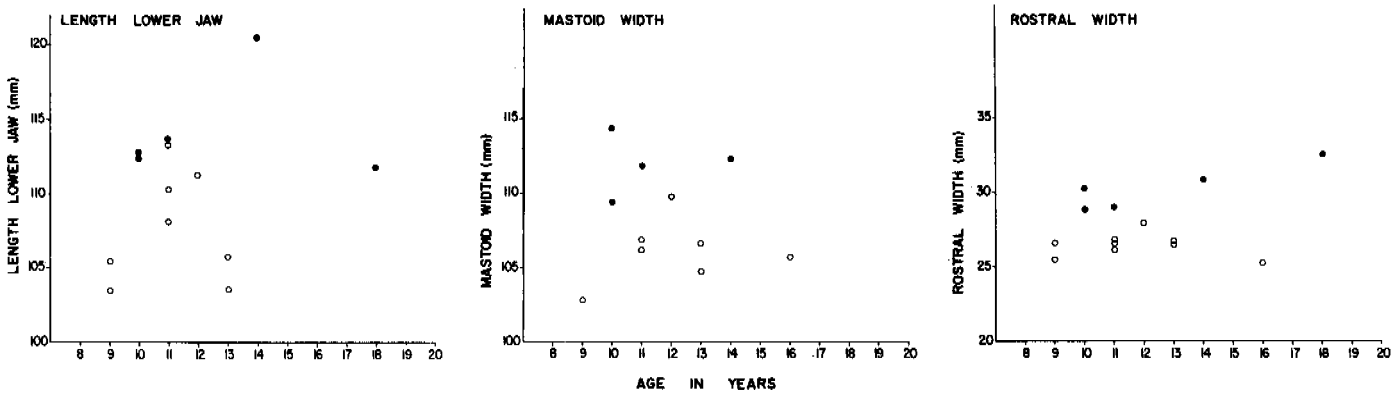

FIG. 6. Age-related comparisons of three cranial measurements of pack-ice (○) and fast-ice (●) seals.

tained their old pelage in June, though by late June it was noticeably looser.

Hair and epidermis in 25 skin samples from pack-ice seals collected during 1-7 July were in various stages of moult, ranging from one animal which had not begun to moult to two in which moult was complete (all old hairs had been shed) (Fig. 7). On most seals new hairs showed early stages of development and epidermal moult was well advanced. Apparently epidermal moult begins before new hairs erupt and is complete when new hairs are about 8 mm long. Old hair does not moult until after mid-July when the new hairs are nearly full length. The pattern and timing of moult appeared similar for both fast-ice and pack-ice seals.

Diet

More pack-ice seal stomachs (18 of 44) than fast-ice seal stomachs (1 of 12) contained food items ($\chi^2 = 4.46$, $df = 1$,

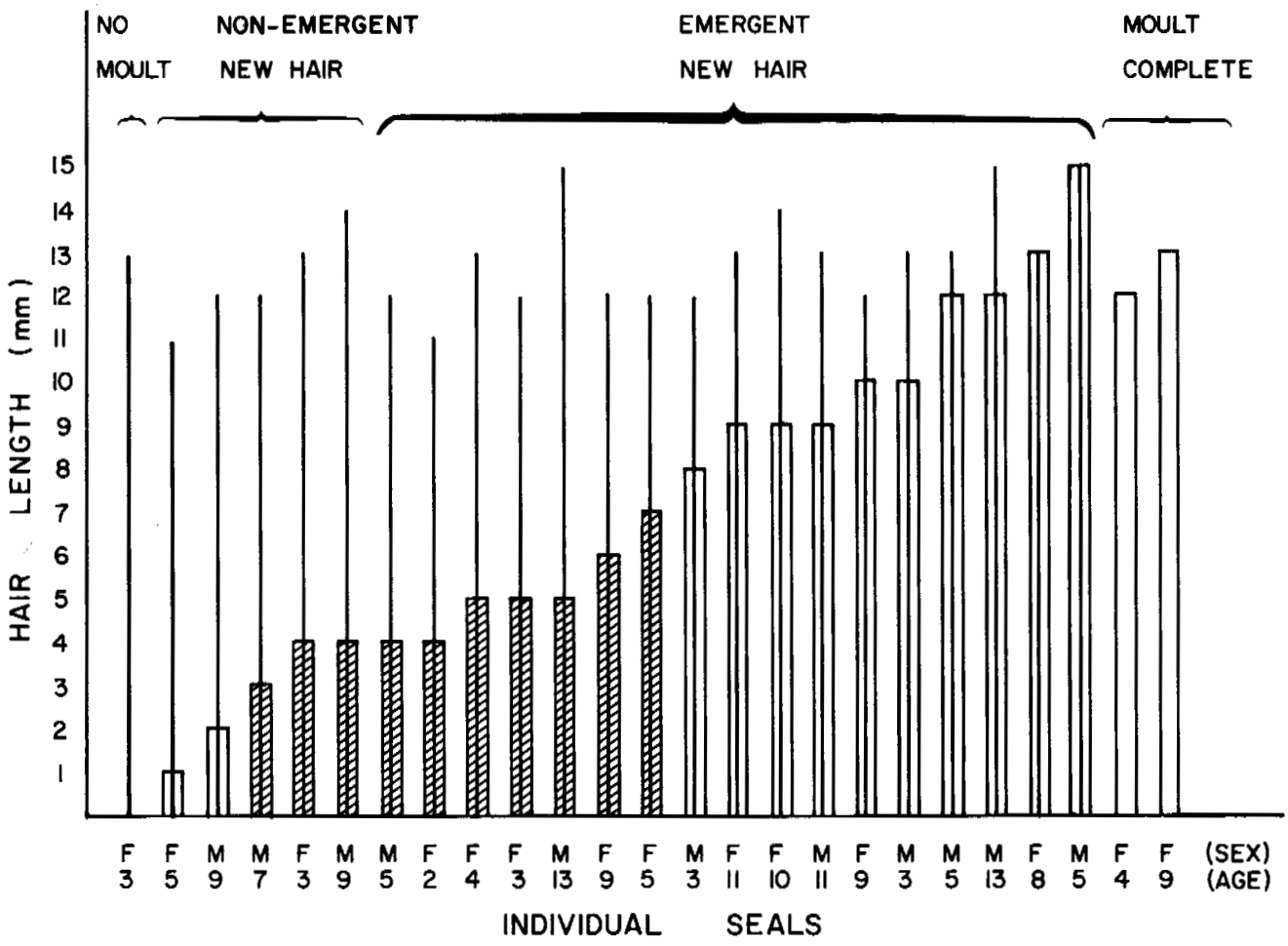

FIG. 7. Stages of hair and epidermal moult of ringed seals collected on offshore pack ice, 1-7 July 1979. Old hair is represented by solid lines and new hair by bars. Hatched bars represent individuals that were undergoing epidermal moult.

$p<0.05$). The amphipod *Parathemisto libellula* was found in all 18 pack-ice seal stomachs that contained food. *P. libellula* comprised 95-100% of the contents of these stomachs and was the only organism present in 14 of the stomachs. Some fish otoliths, primarily seasnails (Cyclopteridae), and a single mysid were the only other food items found. Analysis of faecal matter collected from 39 pack-ice seals also demonstrated the prevalence of *P. libellula* in the diet. Fish otoliths, primarily seasnails, were found more frequently (77%) in faecal samples than in stomach contents (22%), but usually occurred in small numbers.

Stomach Parasitism

The stomachs of pack-ice seals were notably less parasitized than were those of fast-ice seals. Nematodes were present in 10 (91%) of 11 fast-ice seal stomachs but in only 6 (14%) of 44 pack-ice seal stomachs ($\chi^2 = 25.5$; $df = 1$, $p<0.001$). Also, the stomachs of pack-ice seals that did contain nematodes were less parasitized than were the stomachs of the fast-ice seals: most of the fast-ice seals but none of the pack-ice seals contained major clumps of nematodes imbedded in lesions of the stomach wall. An index of the number of nematodes in stomachs of infested seals was significantly lower for pack-ice seals (mean 4.0 $\pm$ SD 2.8, $n=6$) than for fast-ice seals (25.4 $\pm$ 18.8, $n = 10$, Mann-Whitney U = 7, $p<0.02$).

DISCUSSION

Pack ice covers Baffin Bay for more than nine months of the year; both extent and timing are predictable. This platform provides both stable breeding habitat and access to pelagic areas that would otherwise be unavailable to the seals. By its dynamic and transitory nature the pack ice imposes a unique set of living conditions quite different from the fast ice.

Offshore Distribution and Abundance

Our surveys demonstrate that ringed seals are widely and fairly evenly distributed throughout the Baffin Bay pack ice from May through early July. Maintaining this even distribution would require that the seals undertake northward movements, since the pack ice generally flows south in western Baffin Bay throughout winter. The seals presumably

occupy the pack ice when it forms in October and November, and pupping occurs when ice conditions are most stable in March-April. In June and July we noted that the seals and their holes were almost always along refrozen cracks or leads where ice thickness seldom exceeded 50 cm. Unlike seals of the fast ice, which must maintain breathing holes in solid ice up to 2 m thick, pack-ice seals can occupy thin ice that continually forms during winter and thus probably need not maintain and defend one breathing hole (or small groups of holes) throughout the winter.

For purposes of rough estimates of the ringed seal population around Baffin Island, McLaren (1961, 1966a) and Smith (1973) depicted offshore areas as nearly devoid of seals. In fact, densities of seals in offshore Baffin Bay do not appear to be markedly different from densities in coastal areas. Our coverage of the offshore pack ice with 90-m surveys amounted to only 0.2% during the peak of haul-out, which is inadequate to attempt a realistic estimate of the pack-ice ringed seal population. However, we are confident, based on extensive coverage at 45 m, that several hundred thousand ringed seals occupy the pack ice, and certainly the pack ice supports a much larger population of seals than does the bordering area of fast ice.

Breeding Status

Previous studies in coastal Baffin Island have found that floe edges and areas of unstable ice are occupied primarily by immature and non-breeding ringed seals (McLaren, 1958a; Smith, 1973). Miller and Finley (1982) also found that the floe edge is occupied by a high percentage of failed breeders and immatures. Our samples from much farther offshore indicate that many of the offshore seals are breeding animals. Although the sample size is small, the age structure of the offshore seals approximates that of a normal breeding population (cf. composite life table in Smith, 1973:44). All females ≥ 8 yr showed evidence of recent and past reproductive activity. Fedoseev (1975) suggested that the age of first breeding in ringed seals on the pack ice of the Sea of Okhotsk was lower than in areas of fast ice in the Bering Sea, but his data on this are equivocal. Our sample from Baffin Bay is too small to determine the average age of first breeding, although it may be of interest that three of four 4-yr-old females had ovulated. Generally most females do not ovulate until their fifth or sixth year (see review by Davis *et al.*, 1980). Fedoseev (1975) also stated that the lactation period for seals on the pack ice was only three weeks compared to the more normal six weeks on fast ice, but we have no data from Baffin Bay. There is no reason to suspect that ice stability would greatly affect the duration of lactation since the pack ice was stable well into June; the aerial observers saw pups in close association with adults on the pack ice in May and June.

Population Discreteness

Inuit hunters from northern Baffin Island recognize two distinct types of ringed seals; one of these, the *pulajuraaq*, is described as a small seal that enters the fiords after ice disperses in summer and leaves during freeze-up to occupy offshore areas. [*Pulajuraaq* is a syllabic transliteration of the north Baffin Inuktitut dialect. Phonetically it would appear as poo lá ú raá. The fiord seal is distinguished as *tuvamiutaaq*. A resident of Cumberland Sound (Pangnirtung) referred to the offshore seals as *pulaniit*.] Inuit of NW Greenland also distinguish between ringed seals of fiords and those from offshore areas (Vibe, 1950:77). McLaren (1958a:64) noted that Inuit of south Baffin Island were "convinced, through observation, that the 'bay-ice seals' average larger regardless of age"; however, he believed that size differences were related to ice stability (i.e. larger pups were produced on stable coastal ice and smaller non-breeding seals were excluded from this habitat). Our measurements indicate that ringed seals from the Baffin Bay pack ice are smaller than those from nearby coastal fast ice, which agrees with the observations of Inuit hunters. Fedoseev (1975) also found that ringed seals from the "drift ice" were smaller than those from coastal fast ice.

The relationship of the pack-ice seals to the fast-ice seals in Baffin Bay is unclear. Fedoseev (1975) suggests that the pack ice "ecotype" is a genotypic expression of the specific environmental influences of a pack-ice existence. Evidence of such a genotypic response to pack-ice breeding has been shown in the spotted seal *Phoca largha*. The *largha* seal of the Bering Sea was long thought to be an ice-adapted variant of the coastal harbour seal (*Phoca vitulina*), but it was recently accorded species status on the basis of morphological, behavioural and ecological evidence (McLaren, 1966b; Shaughnessy and Fay, 1977). Biochemical analyses were inconclusive in demonstrating genetic distinctiveness between the two species (Shaughnessy, 1975). Given the overall low genetic polymorphism among phocid seals (Lavigne *et al.*, in press; J.P. Bogart, D.M. Lavigne, and R.G. Danzmann, pers. comm. 1982), and the fact that (limited) enzyme electrophoresis was unable to demonstrate genetic differences even between ice-breeding *Phoca largha* and land-breeding *P. vitulina* (Shaughnessy, 1975), it is not surprising that we found no difference between the pack-ice and fast-ice ringed seals of Baffin Bay.

The marked differences in the gut parasite load of pack-ice and fast-ice seals suggests quite different feeding regimes for the two populations. Delyamure (1955) stated that the helminth fauna of the Okhotsk ringed seal differed quantitatively and qualitatively from that of the coastal population, which had a much richer helminth fauna. In fact, the nematode *Terranova skrjabini* was said to be unique to the Okhotsk ringed seals. Unfortunately, few nematodes were properly preserved for identification in our study; several specimens from three stomachs of fast-ice seals were *Contracaecum* sp., while specimens from the stomachs of pack-ice seals were *Terranova* sp.

Our data suggest that the pelagic amphipod *Parathemisto libellula* is important to pack-ice seals, whereas ringed seals from coastal NE Baffin Island feed primarily on arctic cod throughout the year (Finley, pers. obs.). Fedoseev (1975) also observed that Okhotsk seals fed primarily on a pelagic

euphausiid in contrast to the fish diet of coastal ringed seals. K. Frost (pers. comm. 1982) notes that "a difference in diet, which is almost assuredly a reflection of different prey availability, will account for a different parasite load" and that "in general, fish eaters have more parasites than crustacean eaters because fish are usually the final intermediate host."

The question of genetic distinctiveness of the pack-ice ringed seals in Baffin Bay may be resolved through further studies, but for now, it is prudent to recognize the existence of a large and distinctive pack-ice population. This has important management implications.

Management Implications

Ringed seals are the primary renewable resource for Inuit on both sides of Baffin Bay (McLaren, 1958b, 1961, 1962; Vibe, 1950; Bissett, 1967; Haller *et al.*, 1967; Smith, 1973; Kapel, 1975; Treude, 1977; Wenzel, 1978; Davis *et al.*, 1980; Finley and Miller, 1980). In Greenland, catches of ringed seals have averaged 50 000-70 000 per year with an increasing trend, and although there is no knowledge of the population size, it is believed "that the stocks of ringed seals in Greenland are not threatened by hunting" (Kapel and Petersen, 1982). The annual harvest of ringed seals by hunters from Broughton Island, Clyde and Pond Inlet is between 12 000 and 15 000 (Davis *et al.*, 1980; Finley and Miller, 1980). Allowing for hunting losses, Miller *et al.* (1982) estimated that about 17 300 seals are killed annually in this area. Our uncorrected estimate of the number of ringed seals occupying coastal fast ice from Cape Dyer to Navy Board Inlet was about 67 000. When we correct for differential visibility and conservatively assume that half the seals were under the ice during the surveys, then the estimate is about 177 000 seals. If the sustainable yield of the population is 7% (Smith, 1973), then 250 000 seals would be necessary to support an annual kill of 17 300. Obviously this kill cannot be supported by the fast-ice population alone. Yet there is no evidence that coastal populations of ringed seals are declining; present harvest levels appear to have been maintained for many years (Finley and Miller, 1980). Therefore it is highly probable that a considerable portion of the annual harvest comes from the pack-ice population. The limited fast ice in West Greenland suggests that much of the harvest there must also consist of pack-ice seals (Miller *et al.*, 1982).

In 1979, 37-39% of the ringed seal catches at Pond Inlet and Clyde were taken during the open-water season (Finley and Miller, 1980) when the *pulajuraaq* are said to enter the fiords. It may eventually be possible to estimate the proportion of pack-ice seals in coastal harvests by using morphometric analyses of jaws that have been collected from hunter kills. More systematic collections of pack-ice and fast-ice seals will be needed to verify this.

The present documentation of a previously unrecognized large population of ringed seals in Baffin Bay serves to demonstrate how little is known about the population dynamics of this species in the Canadian Arctic. Present knowledge, particularly of population sizes, is inadequate to assess the impact of increasing hunting pressure (Davis *et al.*, 1980) or industrial activities (Davis, 1981) on seal populations in the Canadian Arctic. By contrast, much more attention has been given to the management of the politically sensitive harp seal (*Phoca groenlandica*) hunt (Wenzel, 1978). In view of the cultural and economic importance of the ringed seal to Inuit (Bissett, 1967; Wenzel, 1978; Myers, 1982), at a time when populations of indigenous people are increasing at a rapid rate (Hamelin, 1979), this lack of knowledge is a significant impediment to proper management decisions. The situation is complicated by its international scope. It also has implications to the large population of polar bears (*Ursus maritimus*) that is dependent on the seals of the Baffin Bay pack ice. Management of ringed seals in the Baffin Bay region should, therefore, be international in scope and should consider the conflicting demands for seals by polar bears and by Inuit.

ACKNOWLEDGEMENTS

This research was funded by Petro-Canada Explorations as part of a multi-disciplinary research program, the Eastern Arctic Marine Environmental Studies (EAMES) program. We especially thank G. Glazier, G. Koenig, W. Speller and B. Veldhoen of Petro-Canada for their assistance and support.

This study could not have been accomplished without the assistance of the Pond Inlet hunters, particularly P. Aglak who taught us much. G. Sleno of the Arctic Biological Station, Ste. Anne de Bellevue, assisted in the preparation of tooth sections. D. Campbell of the National Museums of Canada, Ottawa, prepared the skulls and assisted in measurements. A. Sekerak of LGL Ltd. identified the stomach parasites and W.J. Richardson, as usual, kept us in line. K. Frost and I. McLaren provided constructive comments on the manuscript. We are grateful to all of these people.

REFERENCES

AMERICAN SOCIETY OF MAMMALOGISTS. 1967. Standard measurements of seals. Journal of Mammalogy 48:459-462.

BISSETT, D. 1967. Northern Baffin Island: An Area Economic Survey. Vol. 2. A.E.S.R. 67/1. Ottawa: Department of Indian Affairs and Northern Development. 131 p.

BURNS, J.J., SHAPIRO, L.H. and FAY, F.H. 1981. Ice as marine mammal habitat in the Bering Sea. In: Hood, D.W. and Calder, J.A. (eds.). The Eastern Bering Sea Shelf: Oceanography and Resources. Office of Marine Pollution Assessment, NOAA, Seattle. 781-797.

COLLIN, A.E. and DUNBAR, M.J. 1964. Physical oceanography in Arctic Canada. Oceanography and Marine Biology Annual Review 2:45-75.

DAVIS, R.A. 1981. Report of a workshop on arctic marine mammals. Canadian Technical Report of Fisheries and Aquatic Sciences No. 1005. 13 p.

———, FINLEY, K.J. and RICHARDSON, W.J. 1980. The present status and future management of arctic marine mammals in Canada. Yellowknife: Science Advisory Board of the Northwest Territories. Report No. 3. 93 p.

DELYAMURE, S.L. 1955. Helminthofauna of marine mammals (ecology and phylogeny). Akademiya Nauk SSSR. (Israel Program for Scientific Translations, Jerusalem, 1968.)

FEDOSEEV, G.A. 1975. Ecotypes of the ringed seal (*Pusa hispida* Schreber, 1777) and their reproductive capabilities. In: Ronald, K. and Mansfield, A.W. (eds.). Biology of the Seal. Rapports et Proces-verbaux des Réunions, Conseil International pour L'Exploration de la Mer 169:156-160.

_____ and YABLOKOV, A.V. 1964. Morphological characteristics of the ringed seal (*Pusa hispida*, Pinnipedia, Mammalia) in the Okhotsk Sea. Zoologicheskii Zhurnal 44:759-765. (Summary in English.)

FINLEY, K.J. 1979. Haul-out behaviour and densities of ringed seals (*Phoca hispida*) in the Barrow Strait area, N.W.T. Canadian Journal of Zoology 57:1985-1997.

_____ and MILLER, G.W. 1980. Wildlife harvest statistics from Clyde River, Grise Ford and Pond Inlet 1979. Unpubl. Rep. by LGL Ltd., Toronto, for Petro-Canada Exploration, Inc., Calgary. 37 p. [Available from Pallister Resource Management Ltd., Bay 105, 4116-64 Ave. S.E., Calgary, Alberta, Canada T2C 1P4.]

FISSEL, D.B., LEMON, D.D. and BIRCH, J.R. 1982. Major features of the summer near-surface circulation of western Baffin Bay, 1978 and 1979. Arctic 35:180-200.

HALLER, A., FOOTE, D. and COVE, P. 1967. The East Coast of Baffin Island: An Area Economic Survey. A.E.S.R. 66/4. Ottawa: Department of Indian Affairs and Northern Development. 196 p.

HAMELIN, L.-E. 1979. Contribution to the Northwest Territories population studies 1961-1985. Yellowknife: Science Advisory Board of the Northwest Territories. Report No. 1. 54 p.

KAPEL, F.O. 1975. Recent research on seals and seal hunting in Greenland. In: Ronald, K. and Mansfield, A.W. (eds.). Biology of the Seal. Rapports et Proces-verbaux des Réunions, Conseil International pour L'Exploration de la Mer 169:462-478.

_____ and PETERSEN, R. 1982. Subsistence hunting — the Greenland case. Report of the International Whaling Commission (special issue 4).

KOSKI, W.R. 1980. Distribution and migration of marine mammals in Baffin Bay and eastern Lancaster Sound, May-July 1979. Unpubl. Rep. by LGL Ltd., Toronto, for Petro-Canada Exploration, Inc., Calgary. 317 p. [Available from Pallister Resource Management Ltd., Bay 105, 4116-64 Ave. S.E., Calgary, Alberta, Canada T2C 1P4.]

_____ and DAVIS, R.A. 1979. Distribution of marine mammals in northwest Baffin Bay and adjacent waters, May-October 1978. Unpubl. Rep. by LGL Ltd., Toronto, for Petro-Canada Exploration, Inc., Calgary. 305 p. [Available from Pallister Resource Management Ltd., Bay 105, 4116-64 Ave. S.E., Calgary, Alberta, Canada T2C 1P4.]

_____. 1980. Studies of the late summer distribution and fall migration of marine mammals in NW Baffin Bay and E Lancaster Sound, 1979. Unpubl. Rep. by LGL Ltd., Toronto, for Petro-Canada Exploration, Inc., Calgary. 214 p. [Available from Pallister Resource Management Ltd., Bay 105, 4116-64 Ave. S.E., Calgary, Alberta, Canada T2C 1P4.]

LAVIGNE, D.M., BOGART, J.P., DOWNER, R.G., DANZMANN, R.G., BARCHARD., W.W., and EARLE, M. In press. Genetic uniformity in Northwest Atlantic harp seals, *Pagophilus groenlandicus*. In: Lavigne, D.M., Ronald, K. and Stewart, R.E.A. (eds.). The Harp Seal. Perspectives in Vertebrate Science. The Hague: Dr. W. Junk bv Publishers.

MARKHAM, A.H. 1874. Whaling cruise to Baffin's Bay and the Gulf of Boothia. London: Sampson Low, Marston, Low and Searle. 300 p.

McLAREN, I.A. 1958a. The biology of the ringed seal (*Phoca hispida* Schreber) in the eastern Canadian Arctic. Fisheries Research Board of Canada Bulletin 118. 97 p.

_____. 1958b. The economics of seals in the eastern Canadian Arctic. Fisheries Research Board of Canada Arctic Circular 1. 94 p.

_____. 1961. Methods of determining the numbers and availability of ringed seals in the eastern Canadian Arctic. Arctic 14:162-175.

_____. 1962. Population dynamics and exploitation of seals in the eastern Canadian Arctic. In: LeCren, E.D. and Holdgate, M.W. (eds.). The Exploitation of Natural Animal Populations. Oxford: Blackwell Scientific Publications. 168-183.

_____. 1966a. Analysis of an aerial census of ringed seals. Journal of the Fisheries Research Board of Canada 23:769-773.

_____. 1966b. Taxonomy of harbor seals of the western North Pacific and evolution of certain other hair seals. Journal of Mammalogy 47:466-473.

MILLER, G.W., DAVIS, R.A. and FINLEY, K.J. 1982. Ringed seals in the Baffin Bay region: habitat use, population dynamics and harvest levels. Unpubl. Rep. by LGL Ltd., Toronto, for Arctic Pilot Project, Calgary. 93 p. [Available from Arctic Pilot Project, 550-6th Avenue S.W., Calgary, Alberta, Canada T2P 0S2.]

MILLER, G.W. and FINLEY, K.J. 1982. Kill distribution, age and reproductive status of ringed seals (*Phoca hispida*) taken in three eastern Canadian arctic communities. Unpubl. Rep. by LGL Ltd., Toronto, for Petro-Canada Exploration, Inc., Calgary. [Available from Pallister Resource Management Ltd., Bay 105, 4116 - 64 Ave. S.E., Calgary, Alberta, Canada T2C 1P4.]

MYERS, H. 1982. Traditional and modern sources of income in the Lancaster Sound region. Polar Record 21:11-22.

SHAUGHNESSY, P.D. 1975. Biochemical comparison of the harbour seals *Phoca vitulina richardi* and *P. v. largha*. In: Ronald, K. and Mansfield, A.W. (eds.). Biology of the Seal. Rapports et Proces-verbaux des Réunions, Conseil International pour L'Exploration de la Mer 169:70-73.

_____ and FAY, F.H. 1977. A review of the taxonomy and nomenclature of North Pacific harbour seals. Journal of Zoology 182:385-419.

SMITH, T.G. 1973. Population dynamics of the ringed seal in the Canadian eastern Arctic. Fisheries Research Board of Canada Bulletin 181. 55 p.

_____. 1975. Ringed seals in James Bay and Hudson Bay: population estimates and catch statistics. Arctic 28:170-182.

_____ and STIRLING, I. 1975. The breeding habitat of the ringed seal (*Phoca hispida*). The birth lair and associated structures. Canadian Journal of Zoology 53:1297-1305.

STIRLING, I. and SMITH, T.G. 1977. Interrelationships of Arctic Ocean mammals in the sea-ice habitat. In: Circumpolar Conference on Northern Ecology. Ottawa: National Research Council of Canada. 129-136.

SUTTERLIN, N. and SNOW, N. 1982. Introduction to the Eastern Arctic Marine Environmental Studies program. Arctic 35(1):iii-iv.

TIMOSHENKO, Y.K. 1975. Craniometric features of seals of the genus *Pusa*. In: Ronald, K. and Mansfield, A.W. (eds.). Biology of the Seal. Rapports et Proces-verbaux des Réunions, Conseil International pour L'Exploration de la Mer 169:161-164.

TREUDE, E. 1977. Pond Inlet, northern Baffin Island: the structure of an Eskimo resource area. Polar Geography 1:95-122.

USHER, P.J. and CHURCH, M. 1969. On the relationships of weight, length and girth of the ringed seal (*Pusa hispida*) of the Canadian Arctic. Arctic 22:120-129.

VIBE, C. 1950. The marine mammals and the marine fauna in the Thule District (northwest Greenland) with observations on ice conditions in 1939-41. Meddelelser om Grønland 150. 117 p.

WENZEL, G. 1978. The harp seal controversy and the Inuit economy. Arctic 31(1):2-6.

Summer foods of Atlantic walrus, *Odobenus rosmarus rosmarus*, in northern Foxe Basin, Northwest Territories

K.I. Fisher and R.E.A. Stewart

Abstract: Stomach contents of Atlantic walrus, *Odobenus rosmarus rosmarus*, taken by Inuit hunters in northern Foxe Basin in July 1987 and 1988 (n = 105) and September 1988 (n = 2) were examined. In July, 20 of 94 stomachs from immature and adult walrus contained >5 g of food representing 17 prey taxa, including bivalves, gastropods, holothurians, polychaetes, and brachiopods. The bivalve *Mya truncata* contributed 81.4% of the total gross energy in the diet, with the bivalve *Hiatella arctica*, holothurians, and the polychaete *Nereis* sp. contributing 7.5, 3.5, and 2.8%, respectively. The diets of male and female walrus were similar except that females received a significantly ($P < 0.05$) greater percentage of gross energy in their diet from *H. arctica* than did males. Walrus less than 3 years old (n = 11) consumed mostly milk, although some benthic invertebrates were eaten. Analysis of the contents of two stomachs collected in September suggested that walrus may feed more intensively in the fall. *Mya truncata* was again the predominant prey, contributing 59.9% of total gross energy, with the bivalve *Serripes groenlandicus* (37.9%) replacing *H. arctica* (0.3%) as the second most important prey.

Résumé : Les contenus stomacaux de Morses de l'Atlantique, *Odobenus rosmarus rosmarus*, capturés par des chasseurs inuits dans la partie nord de Foxe Basin en juillet 1987 et 1988 (n = 105) et en septembre 1988 (n = 2), ont été examinés. En juillet, 20 sur 94 estomacs de morses immatures et adultes contenaient plus de 5 g de nourriture, représentant 17 taxons, bivalves gastropodes, holothuries, polychètes et brachiopodes. Le vivalve *Mya truncata* représentait à lui-seul 81,4% de l'énergie brute totale contenue dans le régime, le reste étant fourni par *Hiatella arctica* (7,5%), des holothuries (3,5%) et des polychètes du genre *Nereis* (2,8%). Le régime était semblable chez les mâles et les femelles, mais les femelles recevaient une part significativement plus grande ($P < 0,05$) de leur énergie brute d'*H. arctica*. Les morses de moins de 3 ans (n = 11) consommaient surtout du lait, mais quelques invertébrés benthiques ont également été trouvés dans leurs estomacs. L'analyse des contenus stomacaux de 2 morses capturés en septembre indique que les animaux se nourrissent probablement plus intensément à l'automne. À ce moment, *M. truncata* était encore la proie dominante, constituant 59,9% de l'énergie brute totale, mais c'est le bivalve *Serripes groenlandicus* (37,9%) qui était la proie secondaire le plus commune, non plus *H. arctica* (0,3%).
[Traduit par la Rédaction]

Introduction

Atlantic walrus (*Odobenus rosmarus rosmarus*) inhabit arctic waters from the Arctic Archipelago to the Kara Sea (Richard and Campbell 1988; Born et al. 1995). Major concentrations occur in the Canadian eastern Arctic in northern Hudson Bay and Foxe Basin and to a lesser extent in Davis Strait, Baffin Bay, and the High Arctic Islands east of 100°W (Davis et al. 1980; Born et al. 1995).

The food habits of Pacific walrus (*O. r. divergens*) have been studied extensively (Nikulin 1941; Brooks 1954; Fay et al. 1977, 1984; Fay and Lowry 1981; Fay 1982; Fay and Stoker 1982), but there is little information on the foods of Atlantic walrus. Vibe (1950) described the stomach contents of five walrus from the Thule District, Greenland, and Mansfield (1958) examined 19 stomachs containing food in a sample of 111 stomachs of walrus from five locations in the Canadian eastern Arctic. Both authors concluded that bivalves were the major prey group. Loughrey (1959) found food in 5 of 20 walrus stomachs collected in northern Hudson Bay but did not identify the prey.

The Inuit of Igloolik and Hall Beach, on the coast of Foxe Basin, Northwest Territories (N.W.T.), rely heavily on walrus (Anderson and Garlich-Miller 1994; Department of Fisheries and Oceans 1991, 1992*a*, 1992*b*, 1993, 1994) for food for themselves and their dog teams (Beaubier 1970), but little is known about walrus ecology in this region (Mansfield 1966). In the only study of walrus diets in Foxe Basin, three stomachs were examined (Mansfield 1958). The objectives of the present study were to identify major prey species for walrus in northern Foxe Basin and to quantify the relative importance of prey types.

Materials and methods

Walrus stomachs were collected during Inuit subsistence hunts in Foxe Basin near Igloolik and Hall Beach in July 1987 and 1988 and September 1988 (Fig. 1). For each walrus, morphometric data were taken (Garlich-Miller 1994), the stomach and jaw were collected, and the sex was recorded. Samples were frozen (−20°C), usually within 24 h of collection, until they were analysed in the laboratory.

Two samples of benthic invertebrates were collected as reference

Received July 12, 1996. Accepted February 24, 1997.

K.I. Fisher and R.E.A. Stewart. Department of Fisheries and Oceans, Central and Arctic Region, Freshwater Institute, 501 University Crescent, Winnipeg, MB R3T 2N6, Canada.

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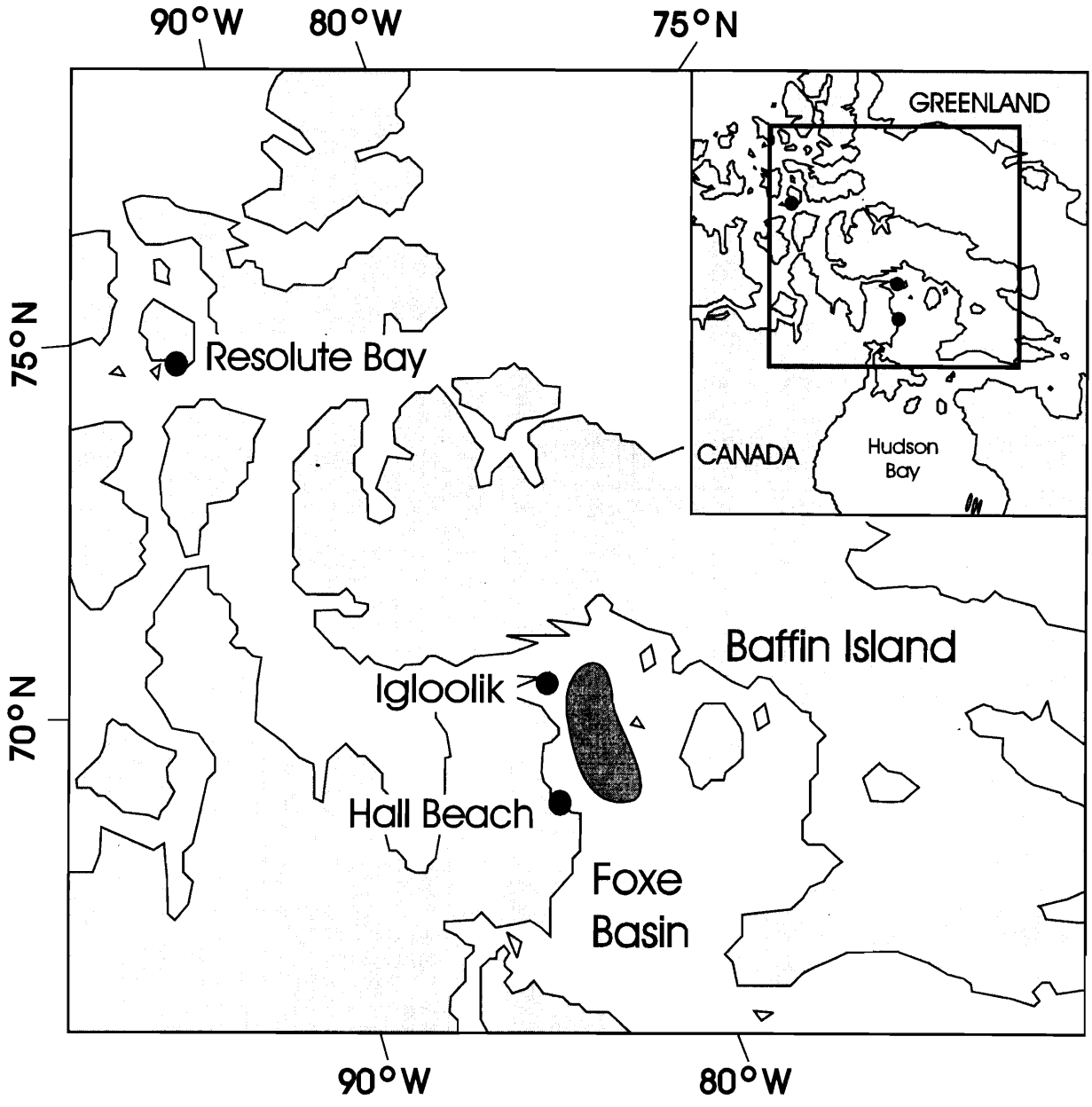
Fig. 1. Walrus (*Odobenus rosmarus rosmarus*) sampling area (darkly shaded) and benthic sampling sites (●).



material and for energy-content determinations. One sample was collected in July 1988 near Igloolik, near the walrus sampling area, by SCUBA divers, an underwater air-lift (Chess 1978), and a bottom grab, all at depths ≤20 m, as well as by hand in the intertidal zone. A second benthic sample was obtained by SCUBA divers near Resolute Bay, N.W.T. (74°42′N, 94°50′W; Fig. 1) in 1986 in water 5–20 m deep. Samples for caloric density analysis were frozen. Reference samples were preserved in 10% neutral buffered formalin or 70% ethanol.

In the laboratory, stomach contents were washed through 4 and 1 mm mesh sieves. Items were identified to the lowest taxonomic level possible using the reference collection and published keys (Shorygin 1948; Grainger 1955; Bousfield 1960; MacPherson 1971; Clarke 1974; Lubinsky 1980). Some representative species were sent to invertebrate taxonomists for identification. Bivalves could only be identified to genus because species identification is based on shells (Keen and Coan 1974), which were usually absent from stomachs. When bivalve genera were represented by only one species in Foxe Basin, genus identification was equated with species identification. The cockles *Serripes groenlandicus* and *Clinocardium ciliatum* (previously known as *Cardium groenlandicus* and *Cardium ciliatum*, respectively; Lubinsky 1980) could not be distinguished using fleshy parts. All cockles were considered to be *S. groenlandicus* because their shell fragments were found in stomachs but *C. ciliatum* shell fragments were not.

Identified prey were counted, blotted dry, and weighed to the nearest 0.1 g. Bivalve numbers were based on maximum counts of identifiable siphons, feet, bodies, or shells. Gastropod, polychaete, and brachiopod numbers were based on diagnostic hard parts such as opercula, jaws, and shell teeth. Numbers of most other prey were counts of whole individuals.

The quantity (percentage) of each prey found in walrus stomachs was quantified as (*i*) occurrence of each prey (number of stomachs in which the prey occurred/total number of stomachs × 100) (Hyslop 1980); (*ii*) numbers of each prey (number of individuals of a prey type in all stomachs/total number of all prey in all stomachs

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Table 1. Walrus (*O. r. rosmarus*) stomachs examined in Foxe Basin in July 1987 and 1988.

	Number of stomachs									
	Empty			With traces of food			With >5 g of food			
Age and sex class	1987	1988	Sum	1987	1988	Sum	1987	1988	Sum	Total
Calf		3	**3**			**0**	3	5	**8**	11
Immature male	1	4	**5**			**0**		2	**2**	7
Immature female		1	**1**			**0**		2	**2**	3
Adult male	3	32	**35**	1	2	**3**	1	8	**9**	47
Adult female	11	6	**17**	2	6	**8**	4	3	**7**	32
Unknown		3	**3**		2	**2**				5
Total	15	49	**64**	3	10	**13**	8	20	**28**	105

Note: Values in boldface type are subtotals.

Table 2. Stomach contents of 11 walrus (*O. r. rosmarus*) calves sampled in Foxe Basin in July 1987 and 1988.

Age[a] (months)	Milk (mL)	Solids
1–3	1650	None
1–3	500	None
1–3	200	None
1–3	850	1 *N. clausa*
1–3	100	1 *H. psittacea*
1–3	0	None
1–3	0	None
1–3[b]	0	None
13–15	25	None
13–15[b]	200	5 *M. truncata*, 2 *Nereis* sp., 1 *Eunoe* sp., 1 *T. cincinnatus*
25–27	75	None

[a]Based on an estimated birth period of May to June (Fay 1985).
[b]Estimated from length.

× 100) (Lowry and Frost 1981; Murie 1984); (*iii*) mass of each prey (total mass of a prey in all stomachs/total mass of prey in all stomachs × 100) (Hyslop 1980; Lowry and Frost 1981); (*iv*) energy contribution (estimated gross energy content of individuals of a prey in all stomachs/total gross energy content of all prey in all stomachs × 100) (Murie 1984). Average reconstructed mass of prey individuals was determined from undigested stomach contents when possible. Mass of ingested individuals of other species was estimated from specimens in benthic collections. Polychaete masses were provided by J.A. Fournier (personal communication in a letter, 1988).

The caloric density and percent dry matter of major prey were determined from the benthic collections. Samples were freeze-dried to a constant mass. Caloric density was measured using an adiabatic bomb calorimeter and is presented as the mean of two replicates that differed by <3%. Means of caloric density estimated for *Mya truncata* from the two collection sites were the same (*t* test, $P \geq 0.05$) and the data were pooled. Data on dry matter and caloric density of taxa not present in the benthic collections were obtained from undigested stomach contents or taken from the literature (Tyler 1973; Wacasey and Atkinson 1987; G. Atkinson, personal communication in a letter, 1988).

To estimate the gross ingested energy represented by each prey type, the number of individuals of a prey in a stomach was multiplied by the average reconstructed mass of those prey or prey components and the average caloric density (wet mass) of the prey. Holothurians were found only in pieces in stomachs and could not be counted, so their energy contribution was calculated by multiplying the mass of holothurian tissue present by the caloric density.

Siphon sheaths were found in walrus faeces, so we assumed that the sheath contributed a negligible amount of energy to the walrus. Siphon sheaths were not included in the calculations of gross energy intake for clams.

Inorganic and unidentifiable organic remains on the small-mesh sieve were sorted by specific gravity in a water column, drained, and weighed to the nearest 0.1 g. The volume of milk in stomachs was measured to the nearest 25 mL.

Two faecal samples were collected in July 1988 from ice floes where walrus had recently hauled out. Samples were washed through a 1 mm mesh sieve and prey remains identified from diagnostic hard parts.

Walrus were aged by counting cemental annuli (Fay 1982; Garlich-Miller et al. 1993). Readings were made in three to five blind replicates, outliers were removed using the 95% maximum normed residual (Snedecor and Cochran 1980), and the median value was accepted as the final age estimate (Stewart and Lavigne 1979[1]; Garlich-Miller et al. 1993). Based on 87% of asymptotic body size (Laws 1956), we considered females to be adults at age 5 and males at age 8 (Garlich-Miller 1994).

Differences in diet between the sexes were tested by the non-parametric Wilcoxon test for ranked data (Sokal and Rohlf 1969) at $P \leq 0.05$ for all analyses.

Results

Twenty-six stomachs were collected in July 1987 and 79 in July 1988 (Table 1). Of the total of 105 walrus stomachs collected in July, 94 were from immature (n = 10) or adult (n = 84) animals and 11 were from calves (<3 years). Among these immature and adult walrus, 20 (21%) of the stomachs contained >5 g of food, 13 (14%) had trace quantities (<5 g) of food, and 61 (65%) were empty. The 20 walrus stomachs with >5 g of food contained 590.6 ± 424.2 g (mean ± SD). The two stomachs collected in September contained 5095.4 ± 1080.1 g of food. Examination of dietary composition was based on the stomachs of the 11

[1] R.E.A. Stewart and D.M. Lavigne. 1979. Age determination in harp seals. *In* Proceedings of an International Workshop on the Biology and Management of Northwest Atlantic Harp Seals, Guelph, Ontario, Dec. 3–6, 1979. Working Paper HS/WP10. Available from R.E.A. Stewart.

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Table 3. Occurrence (percentage of stomachs containing the prey item), amount, proportion of mass of contents, and estimated gross energy contribution of prey in the stomachs of 20 walrus (*O. r. rosmarus*) from Foxe Basin in July 1987 and 1988.

Prey	Occurrence (%)	Amount		Mass		Energy	
		No.	%	g	%	kcal	%
Bivalvia							
Mya truncata	95	5624	67.3	4719.4	40.0	15153.3	81.4
Hiatella arctica	75	1980	23.7	928.4	7.9	1401.8	7.5
Astarte sp.	75	68	0.8	13.2	0.1	15.5	0.1
Unidentified remains	90			3713.8	31.4		
Gastropoda							
Buccinum sp.	55	57	0.7	2.8	<0.1	322.3	1.7
Natica clausa	50	157	1.9	31.2	0.3	139.4	0.8
Unknown feet	20	15	0.2	5.9	0.1	13.2	0.1
Polychaeta							
Eunoe sp.	10	39	0.5	0.2	<0.1	70.8	0.4
Nereis sp.	55	303	3.6	1.9	<0.1	513.0	2.8
Flabelligera affinis	10	10	0.1	7.6	0.1	5.9	<0.1
Thelpus cincinnatus	15	5	0.1	16.3	0.1	12.4	0.1
Holothuroidea[a]	60			1045.3	8.9	649.2	3.5
Echinoidea							
Strongylocentrotus droebachiensis	5	1	<0.1	0.2	<0.1	<0.1[b]	<0.1
Priapulida							
Priapulus caudatus	20	20	0.2	121.4	1	312.3	1.7
Amphipoda							
Anonyx sarsi	15	4	0.1	0.3	<0.1	0.1	<0.1
Boecksimus edwardsi	5	1	<0.1	<0.1	<0.1	<0.1	<0.1
Isopoda							
Arcturus baffini	5	1	<0.1	0.1	<0.1	<0.3	<0.1
Brachiopoda							
Hemithyris psittacea	45	37	0.4	5.2	<0.1	5.3	<0.1
Decapoda	5	2	<0.1	0.1	<0.1	2.5	<0.1
Shell fragments	80			33.3	0.3		
Unidentified organic remains	95			1159.6	9.8		
Total		8363		11811.0		18617.5	

[a]Thirty-nine pieces of holothurian were found, representing an unknown number of individuals.
[b]Based on 287 cal/g wet mass (Cummins and Wuycheck 1971), not reconstructed.

calves and the 20 immature and adult walrus collected in July, unless noted otherwise.

Diet composition

Eleven calf stomachs were examined. Five of eight age 0 calves had milk (100–1650 mL) in their stomachs (Table 2). One of these also contained one gastropod, *Natica clausa*, and another contained one brachiopod, *Hemithyris psittacea*. One yearling stomach contained milk (25 mL) only, while the other contained both milk (200 mL) and invertebrates (nine individuals of four genera). One 2-year-old had milk (75 mL) only in its stomach.

Seventeen taxa were identified in the stomachs of immature and adult walrus, with the bivalves *M. truncata* and *Hiatella arctica* accounting for 90.9% of all organisms ingested (Table 3). *Mya truncata* occurred most frequently and was the most numerous (0–917 individuals/stomach) of all items consumed. Only the siphons, sheaths, and shell fragments of *M. truncata* were found in stomachs; bodies were absent. *Hiatella arctica* was found in 75% of stomachs and comprised 23.7% (0–588 individuals/stomach) of ingested items. Siphon, sheath, and shell remains were present but no intact bodies. Unidentified bivalve remains, including sheaths, viscera, and muscle fragments were found in 90% of the stomachs and comprised 31.4% of the total wet mass in all stomachs. *Astarte* sp. was also found in 75% of stomachs but only a few individuals, found only as shell fragments, were present.

Gastropods were recognized primarily by opercula. *Buccinum* sp. and *N. clausa* occurred in about half the stomachs (Table 3) and comprised 2.6% of all organisms. Four genera of polychaetes were found in walrus stomachs. The most frequent was *Nereis* sp., found in 55% of stomachs, followed by *Thelpus cincinnatus* (15%), and *Eunoe* sp. and *Flabelligera affinis* (10%; Table 3). *Nereis* sp. was the most numerous polychaete (0–123 individuals/stomach). Polychaetes constituted 4.4% of all organisms but contributed less than 1% of total mass.

Holothurians were found in 12 stomachs but could not be counted accurately or identified further because of the absence of diagnostic hard parts in the stomachs we examined. They contributed 8.9% to the total mass, but 85% of this was in three stomachs. *Priapulus caudatus*, which were swallowed

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Table 4. Occurrence (percentage of stomachs containing prey), amount, proportion of mass of contents, and estimated gross energy contribution of prey in the stomachs of two walrus (*O. r. rosmarus*) from Foxe Basin in September 1988.

Prey	Occurrence (%)	Amount		Mass		Energy	
		No.	%	g	%	kcal	%
Bivalvia							
Mya truncata	100	1414	79.4	5772.6	56.7	3809.9	59.9
Hiatella arctica	100	30	1.7	34.2	0.3	21.2	0.3
Serripes groenlandicus	100	269	15.1	2518.7	24.7	2410.3	37.9
Unidentified remains	50			1729.2	17.0		
Gastropoda							
Buccinum sp.	50	14	0.8	0.7	<0.1	79.2	1.2
Natica clausa	50	2	0.1	0.1	0.1	1.8	<0.1
Polychaeta							
Nereis sp.	50	1	0.1	<0.1	<0.1	1.7	<0.1
Flabelligera affinis	100	47	2.6	56.4	0.6	27.7	0.4
Holothuroidea[a]	50			10.4	0.1	6.5	0.1
Echinoidea							
Strongylocentrotus droebachiensis	50	1	0.1	0.6	<0.1	0.3[b]	<0.1
Unidentified organic remains				57.6	0.6		
Total		1778		10180.6		6358.6	

[a]Two pieces of holothurian were found, representing an unknown number of individuals.
[b]Based on 287 cal/g wet mass (Cummins and Wuycheck 1971), not reconstructed.

whole, occurred in 20% of all stomachs and represented 0.2% of total numbers. Brachiopods occurred in 45% of stomachs but contributed less than 1% to total numbers or mass. Amphipods, isopods, echinoderms, and decapods each occurred infrequently and contributed little in terms of numbers or mass (Table 3).

Stones (85.7 ± 124.8 g) were found in stomachs containing food. The largest single amount was 501.5 g in the stomach of an adult male that had fed on bivalves. Shell fragments occurred in small quantities (0–10 g) in 80% of the 20 stomachs.

Both faecal samples contained shell parts of *M. truncata* and *Astarte* sp., opercula of *Buccinum* sp., and jaws of *Nereis* sp. One also contained *N. clausa* and *H. psittacea*. Siphon sheaths were found in both samples. Only 35 individual prey were identified and no taxa were identified that had not been found in the stomachs.

Both stomachs collected in September contained more food than the fullest stomach in July. *Mya truncata* predominated (Table 4), but stomachs collected in September also contained large numbers (269) of *S. groenlandicus*. Not only were the feet of *S. groenlandicus* found, but many bodies and fragments of adductor muscle and mantle were also present, indicating that all fleshy parts were eaten. *Hiatella arctica* was found in small numbers (7 and 23 siphons) and contributed <1% of the total mass.

Prey size and energy contribution

Of the major prey species, only *M. truncata*, *H. arctica*, and *S. groenlandica* were well enough represented in undigested stomach contents to allow reconstruction of the average mass of individuals consumed (Table 5). Individual mass of food components was estimated by weighing all the intact specimens found in two stomachs and dividing by the number of individuals.

The caloric content of food components generally ranged from 0.3 to 6.0 kcal/component (Table 5). For *M. truncata* and *H. arctica*, the estimated gross energy intake was based on siphons only. For *S. groenlandicus* and *Astarte* sp., the caloric content of bodies and siphons was added when gross energy intake values were calculated.

In July, *M. truncata* contributed 81.4% of the gross energy intake (Table 3), followed by *H. arctica*, holothurians, *Nereis* sp., *Buccinum* sp., and *P. caudatus*. *Priapulus caudatus* represented over 15 kcal/individual but contributed little to the total energy content represented by the stomach contents. All other organisms contributed less than 1.0%. *Mya truncata* was the predominant source of energy in 15 of 20 stomachs, while holothurians predominated in three stomachs. *Nereis* sp. and *Buccinum* sp. each predominated in one stomach.

In September, *M. truncata* contributed 59.9% of the gross energy intake in stomach contents (Table 4), followed by *S. groenlandicus* (37.9%) and *Buccinum* sp. (1.2%). All other prey contributed <1.0%.

Sex and age: differences in diet

The occurrence of food in stomachs of male and female walrus was similar (females: 9 of 35, 25.7%; males: 11 of 54, 20.3%). Females tended to consume more food items (females: 679.8 ± 516.7; males: 223.8 ± 173.3), to have larger amounts of food in their stomachs (793.7 ± 463.3 vs. 424.1 ± 320.4 g), and to have greater estimated gross energy ingested (1433.7 ± 1024.7 vs. 519.9 ± 400.6 kcal). These differences, however, were not significant (nonparametric Wilcoxon test for ranked data, $P > 0.05$). *Mya truncata* contributed the same proportion of energy in stomachs of males (74.2%) and females (84.6%), but females received a significantly greater proportion (9.9%) of their energy from *H. arctica* than did males (2.2%, Wilcoxon test, $P < 0.05$).

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Table 5. Wet mass, percent dry mass, caloric density, and calculated average caloric content (mean ± 1 SD, except for pooled samples) for individual prey items in stomachs of walrus (*O. r. rosmarus*) from Foxe Basin.

Prey	Component	Wet mass (g)	*n*	Dry matter (%)	*n*	Caloric density (cal/g dry mass)	*n*	Caloric content (cal/component)
M. truncata	Body	11.03±7.79[a]	98	14.8±3.7[a]	98	4284.4±350.1[a]	27	6994.0
	Siphon	4.32[b]	1312	15.7±3.4[a]	156	3972.6±232.8[a]	23	2694.4
	Sheath	4.05[c]		25.8±6.0[a]	130	2500.3±352.2[a]	10	2612.3
H. arctica	Siphon	1.14[b]	30	15.7[d]		3956.0[e]	4	708.0
	Sheath	1.07[c]		25.8[d]		2500.3[d]		690.2
Astarte sp.	Whole	0.34±0.40[a]	11	19.0[f]		4486.0[e]		289.8
S. groenlandicus	Foot	6.80[b]	180	20.3±3.0[a]	11	4290.1±62.0[a]	11	5922.1
	Body	4.00[b]	269	16.9±2.5[a]	11	4495.0±184.6[a]	11	3038.6
Buccinum sp.		5.70±0.00[a]	2	21.0±1.8[a]	3	4723.9±7.4[a]	3	5654.5
N. clausa		0.90±0.50[b]	20	21.0[g]		4697.0[e]	2	887.7
Eunoe sp.		1.80±1.40[h]	8	25.0[f]		4036.0[e]	1	1816.2
Nereis sp.		2.00±1.00[h]	2	22.0[f]		3848.0[e]		1693.1
F. affinis		1.30[b]	13	20.0[f]		2263.0[e]	1	588.4
T. cincinnatus		3.26[b]		17.0[f]		4487.0[e]		2486.7
Holothurians		8.40±6.70[a]	2	14.9±1.9[a]	2	4168.1±122.8[a]	2	5216.8
S. droebachiensis								2986.0
P. caudatus		20.60[b]	1	15.2[b]	1	4986.1[b]	1	15614.5
Amphipoda		0.03±0.00[b]	2	18.4[i]		3596.0[e]		19.8
Isopoda		0.50[b]	1	18.4[i]		2478.0[e]	5	228.0
H. psittacea		0.34±0.12[a]	6	14.0[f]		3002.0[e]	3	142.9
Decapoda		4.00[a]	1	26.4[j]		1163.1[j]		1228.2

Note: Benthic samples were collected by divers. Caloric contents is based on the estimated mass of ingested prey. Underlined caloric content values were not used in estimating ingested gross energy in Tables 3 and 4.

[a]Calculated using a benthic sample.
[b]Calculated using undigested stomach contents.
[c]Calculated as 94% of sheath mass, using 74 *M. truncata* from the benthic collection.
[d]Value from *M. truncata*.
[e]From Wacasey and Atkinson (1987).
[f]G. Atkinson, personal communication in a letter.
[g]Value from *Buccinum* sp.
[h]J.A. Fournier, personal communication in a letter.
[i]Weighted average of two amphipod species (Tyler 1973).
[j]Weighted average of four decapod species (Tyler 1973).

There was no significant difference between the sexes in the percentage contributed by holothurians to the total energy content (females 0.3%; males 10.8%). Males were much more variable, with over 50% of the energy from holothurians in three stomachs and <1.0% in four.

Although the sample size was too small for statistical comparison, there were no obvious differences in stomach contents between immature walrus (n = 4) and adults (n = 16). The range of stomach content masses from immature animals (6.0–1447.2 g) was similar to that from adults (112.9–1370.4 g). The estimated gross energy ingested was also similar (immature walrus: 13.5–2112.4 kcal; adults: 168.7–2887.7 kcal). *Mya truncata* contributed 71.5% of the energy in the stomachs of immature walrus and 83.2% in adults.

Discussion

Biases in sampling and stomach content analyses

The stomachs we analysed came from the Inuit subsistence hunt. Virtually all walrus examined were hauled out on floating ice, and may have been somewhat removed, in time and space, from the actual feeding site. Also, it may be easier for hunters to approach and kill a walrus that has been hauled out for some time than a recent arrival, biasing the sample towards animals with empty stomachs. However, passage rates in walrus and other pinnipeds range from 5 to 9 h (Parsons 1977; Fisher 1989). Simulated digestion indicated that siphons and feet may persist in stomachs for more than 6 h but bodies disappear within 1 h (Sheffield and Fay 1995). Assuming a random feeding pattern and a 6-h clearance, about 25% of stomachs could be expected to contain feet and siphons. We found that 21% of non-calf stomachs contained >5 g of food, and digestion may be faster than in simulations or feeding intervals may be shorter than assumed, but there did not appear to be a strong sampling bias favouring empty stomachs.

Group feeding could have biased the data if several samples came from one group of walrus. The feeding and haulout rhythms of these walrus are unknown (Loughrey 1959; Richard and Campbell 1988), but a systematic sampling bias is unlikely because stomachs were collected from many groups throughout the 24-h day and over several weeks.

Analysis of stomach contents has been used for many

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years to describe the diet of marine mammals (Lowry and Frost 1981; Beddington et al. 1985). However, it is difficult to assess the relative importance of prey in the diet accurately because of potential errors resulting from the differential digestion and retention of prey types (Bigg and Fawcett 1985). In the present study, percent occurrence, numbers, mass, and estimated gross energy contribution of prey species were used to describe the diet of walrus, although each has limitations.

Percent occurrence provides a qualitative picture of the variety of prey eaten but can overestimate the contribution of relatively unimportant prey types (Berg 1979). For example, *Astarte* sp., *Buccinum* sp., and *N. clausa* were found in 50% or more of our walrus stomachs in July but together provided <1% of the total mass or energy of prey in the stomachs.

Counts of individual prey items are generally accurate, but differential digestion of prey species and the retention of hard parts can obscure the true relative contribution of different species (Bigg and Perez 1985). Some prey that are digested rapidly or have small, easily overlooked diagnostic parts, such as holothurians and some polychaetes, are underrepresented in counts, while the importance of other taxa may be overestimated because of the retention of hard parts (Bigg and Fawcett 1985). The extent to which polychaete jaws and gastropod opercula were retained in walrus is unknown and their representation in the stomachs in this study may not reflect the true significance of these prey types in the walrus diet. However, polychaetes and gastropods represented <2% of the total estimated energy in the diet in July and would have to be greatly underestimated to substantially alter the conclusions.

Mass measurements of stomach contents are also affected by differential digestion rates that cause easily digested prey to be underrepresented (Berg 1979). This error increases with time after feeding and was significant in this study because many of the stomachs contained well-digested contents. The contribution of each prey type based on the mass present is unlikely to be a good indicator of the relative importance of different prey species in the walrus diet.

Back-calculation of the actual gross energy contribution of various prey types provides a good estimate of the relative importance because it is based on numbers, original size, and caloric density of prey. Although it is subject to the same errors as abundance measurements, as well as to errors inherent in estimating mean size, energy, and dry matter content, this calculation allows the diet to be evaluated relative to an energy budget for the consumer.

In this study, the reconstructed masses for the *M. truncata* siphons, *H. arctica* siphons, and *S. groenlandicus* were based on undigested stomach contents. The accuracy with which the mass of other individual bivalves, collected by divers, represents walrus diets remains to be examined. Bivalve siphons and feet were counted easily and the sample size for back-calculating sizes and energy density was large. In July and September, however, 31.4 and 17.0%, respectively, of the mass of stomach contents was unidentified bivalve remains. The gross energy intake represented by these remains could not be calculated because neither the number of individuals consumed nor their mass could be determined, so the energy contribution of bivalves is an underestimate.

For minor prey such as holothurians, which were probably underestimated by all methods, even a tripling of their energy contribution would not have significantly affected their rank as the third most important prey in the diet in July. Similarly, the potential retention of gastropod opercula and polychaete jaws does not alter their minor energy role.

For the calculation of gross energy intake, we assumed that the bodies of *M. truncata* and *H. arctica* were not consumed. Bodies of *S. groenlandicus*, but not *M. truncata*, were present in the two fresh stomachs in September, although those of *M. truncata* were 5 times as numerous. The fresh siphons of *M. truncata* in these stomachs appeared jagged and stringy, consistent with being ripped off and inconsistent with removal of the body by digestion. When our divers tried to pull *M. truncata* out of the ocean floor, even after partially excavating the clam, they produced torn siphons that looked similar to these.

In some areas, Pacific walrus may consume all the soft tissue of clams (Fay and Lowry 1981; Fay and Stoker 1982), and *Mya arenia* buried in sand were consumed whole by Pacific walruses in captivity (Kastelein et al. 1989; Kastelein and Mosterd 1989). However, the ability of walrus to obtain whole clams depends on the behaviour of the clams, which is species-specific, and the substrate in which they reside. The nature of the substrate in Alaska was not reported, but in the study using captive walrus, the sand was loosely deposited in a trough.

Based on the stomachs we examined and the experience of our divers, we concluded that *M. truncata* bodies are seldom eaten by walrus in Foxe Basin. However, if bodies of *M. truncata* were consumed at the same rate as siphons, the caloric content would increase to 9.7 kcal/individual. The total contribution of *M. truncata* would increase to 94% in July and 84% in September, with concomitant decreases in the proportions contributed by other species. However, the ranking of prey species in the diet would not change.

Diet composition

The quantities of milk and benthic invertebrates found in the stomachs of calves in our study were similar to those previously reported (Freiman 1941; Nikulin 1941; Mansfield 1958; Loughrey 1959; Fay 1982). Newborns rely heavily on milk during the first year, although some invertebrates are eaten (Fay 1982). The dependency on milk decreases as foraging skills are acquired, and most calves are fully weaned by 2 years of age (Fay 1982). Some, however, continue to suckle, and calves 25–27 months old have been found with only milk in their stomachs (Freiman 1941; Nikulin 1941; this study). Continuation of nursing into the third summer most likely occurs when females do not produce a new calf (Fay 1982).

Our results for older animals are also similar to those of previous descriptive studies of the food habits of Atlantic walrus. Vibe (1950; n = 5 walrus) and Mansfield (1958; n = 19 walrus) identified the bivalve genera *Mya*, *Hiatella* (= *Saxicava*), and *Serripes/Clinocardium* (= *Cardium*) as major prey items. Holothurians, gastropods, crustaceans, polychaetes, and other organisms were consumed to a lesser extent. The holothurian *Thyonidium* sp., the isopod *Mesidotea sabini*, and ascidaceans (tunicates) were identified by Mansfield (1958) in Foxe Basin samples but were not found in this study. Polychaetes, brachiopods, amphipods, sea urchins, and the isopod *Arcturus baffini* found in this study were not reported by Mansfield.

Pacific walrus in the Bering and Chukchi seas also feed

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mainly on bivalves. In the Bering Sea, the genera *Mya*, *Spisula*, *Hiatella*, *Serripes*, and *Clinocardium* composed 60–80% of identifiable food items in the diet, although over 60 genera of benthic organisms were reported (Nikulin 1941; Brooks 1954; Fay et al. 1977, 1984).

Ringed seal (*Phoca hispida*) and bearded seal (*Erignathus barbatus*) remains have been found in several walrus stomachs in the Canadian Arctic (Mansfield 1958; Loughrey 1959) and other areas (Chapskii 1936; Tsalkin 1937; Vibe 1950; Lowry and Fay 1984). Consumption of ringed seals has been inferred from high organochlorine levels in walrus from northern Quebec (Muir et al. 1995; Wagemann et al. 1993). Fish otoliths (Chapskii 1936; Mansfield 1958) and squid beaks (Mansfield 1958) have been identified in a small number of stomachs. None of these was present in our sample.

Selective feeding, in which the proportions of various species found in stomachs differ significantly from the proportions collected from the sea floor, has been reported for Atlantic (Vibe 1950) and Pacific (Fay et al. 1977) walrus. Fay (1982) suggested that walrus select bivalves but that other foods may be consumed opportunistically. Whether the walrus in our collection were selecting prey or consuming a representative sample of benthic invertebrates on the sea floor is unknown. Asteroids, crinoids, and ophiuroids inhabit Foxe Basin (Grainger 1955; this study) but were not found in our walrus stomachs.

Walrus of both sexes aged ≥3 years consumed the same prey types. As previously reported for Pacific walrus (Fay et al. 1977, 1984), females obtained a larger percentage of their gross energy intake from *H. arctica*, but other differences were not statistically significant. The similarity in diets among walrus age and sex classes suggests that their primary prey, which are relatively small and sedentary, are effectively located and consumed by all segments of the population.

Seasonal feeding patterns of Atlantic walrus are not well documented, largely because of the inaccessibility of walrus populations during the winter. Walrus off Greenland feed throughout the summer and fall (Vibe 1950), but information on walrus feeding in the Canadian Arctic in fall and winter is scant. Mansfield (1958) found an increase in the number of stomachs containing food from July (18%, $n = 39$) to September–November (31%, $n = 42$) in the eastern Canadian Arctic. Although our September sample was quite small ($n = 2$), both stomachs contained food and the mean mass of the stomach contents was 5095 g, 3.5 times that of the contents of the largest stomach sampled in July (1447 g).

A female walrus from Foxe Basin has an asymptotic body mass of approximately 630 kg (Garlich-Miller 1994) and, when not pregnant or lactating, requires 155 kcal · $kg^{-0.75}$ · d^{-1} (Fisher 1989; Fisher et al. 1992), or roughly 19 500 kcal/d. In July, the average reconstructed gross energy intake was 931.8 kcal. With a nominal clearance rate of 6 h and feeding 4 times a day, this represents about 3727 kcal/d, or about 19% of the female's daily energy requirement. If whole *M. truncata* are eaten, the average reconstructed gross energy intake increases to 2900.9 kcal, or about 11 603 kcal/d, representing 59.5% of the daily requirement. This crude calculation and the high percentage of empty stomachs in July (68%; Table 1) suggest that walrus over 3 years old may be in a negative energy balance in Foxe Basin in July, requiring greater energy intake at other times.

In the fall, walrus in Foxe Basin may feed more often or eat larger meals, or both, than they do in July. In the fall, walrus are closer to the west side of Foxe Basin (Orr et al. 1986), where the water is shallower and *S. groenlandicus* is expected to be found (Vibe 1950). The average reconstructed gross energy content in the two stomachs colledted in September was 3179.3 kcal, or 12 717 kcal/d, about 65% of the asymptotic female's daily needs. If whole *M. truncata* are eaten, the value is 8132.3 kcal, representing about 32 529 kcal/d, or 167% of daily requirements. There are several untested assumptions in these calculations, and testing hypotheses about feeding rates and seasonal shifts in prey requires more walrus stomachs to be collected in September, and better distributional data for bivalves to be obtained.

Acknowledgements

We thank the hunters of Igloolik and Hall Beach, R. Walker, and J. Garlich-Miller for their capable assistance in obtaining samples. R. Walker also assisted with the collection of benthic samples during SCUBA dives. Benthic samples from Resolute Bay were provided by H.E. Welch, Department of Fisheries and Oceans, Winnipeg. Representative samples of polychaetes were identified by J.A. Fournier, Canadian Museum of Nature, Ottawa; gastropod opercula by J. Topping, Canadian Museum of Nature, Ottawa; and amphipods and isopods by M. Curtis, Department of Fisheries and Oceans, Winnipeg. We thank them all for their assistance. We also appreciate the assistance of B.E. Stewart, who made the caloric density determinations. This study was part of the requirements for an M.Sc. degree in the Department of Animal Science, University of Manitoba, for K.I.F. We thank the members of her supervisory committee, J. Babaluk, R. Fudge, and anonymous reviewers for their constructive comments on earlier drafts of this paper. Funding was provided by the Department of Fisheries and Oceans, the Science Institute of the Northwest Territories, and the Northern Studies Training Program.

References

Anderson, L.E., and Garlich-Miller, J. 1994. Economic analysis of the 1992 and 1993 summer walrus hunts in northern Foxe Basin, Northwest Territories. Can. Tech. Rep. Fish. Aquat. Sci. No. 2011.

Beaubier, P.H. 1970. The hunting pattern of the Igluligmiut with emphasis on the marine mammals. M.Sc. thesis, McGill University, Montréal, Quebec.

Beddington, J.R., Beverton, R.J.H., and Lavigne, D.M. (*Editors*). 1985. Marine mammals and fisheries. George Allen & Unwin, London.

Berg, J. 1979. Discussions of methods of investigating the food of fishes, with reference to a preliminary study of the prey of *Gobiusculus flavescens* (Gobidae). Mar. Biol. (Berl.), **50**: 263–273.

Bigg, M.A., and Fawcett, I. 1985. Two biases in diet determination of northern fur seals (*Callorhinus ursinus*). *In* Marine mammals and fisheries. *Edited by* J.R. Beddington, R.J.H. Beverton, and D.M. Lavigne. George Allen & Unwin, London. pp. 284–291.

Bigg, M.A., and Perez, M.A. 1985. Modified volume: a frequency–volume method to assess marine mammal food habits. *In* Marine mammals and fisheries. *Edited by* J.R. Beddington, R.J.H. Beverton, and D.M. Lavigne. George Allen & Unwin, London. pp. 273–282.

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Born, E.W., Gjertz, I., and Reeves, R.R. 1995. Population assessment of Atlantic walrus. Meddelelser No. 138, Norsk Polar Institute, Oslo.

Bousfield, E.L. 1960. Canadian Atlantic sea shells. National Museums of Canada, Ottawa.

Brooks, J.W. 1954. A contribution to the life history and ecology of the Pacific walrus. Alaska Cooperative Wildlife Research Unit, University of Alaska, Fairbanks. Spec. Rep. No. 1.

Chapskii, K.K. 1936. The walrus of the Kara Sea. Tr. Arkt. Nauch.-Issel. Inst. **67**: 1–124.

Chess, J.R. 1978. Some procedures for assessing organisms associated with rocky substrata. *In* Gutshop '78. Fish food habits studies. Proceedings of the Second Pacific Northwest Technical Workshop, Maple Valley, Wash., October 10–13, 1978. *Edited by* S.J. Lipovsky and C.A. Simenstad. pp. 25–38.

Clarke, A.H. 1974. Molluscs from Baffin Bay and the northern North Atlantic Ocean. Nat. Mus. Nat. Sci. (Ott.) Publ. Biol. Oceanogr. No. 7.

Cummins, K.F. and Wuycheck, J.C. 1971. Caloric equivalents for investigations in ecological energetics. Int. Ver. Theor. Angew. Limnol. Verh. No. 18.

Davis, R.A., Finley, K.J., and Richardson, W.J. 1980. The present status and future management of arctic marine mammals in Canada. Science Advisory Board of the Northwest Territories, Yellowknife, Rep. No. 3.

Department of Fisheries and Oceans. 1991. Annual summary of fish and marine mammal harvest data for the Northwest Territories, 1988–1989. Vol. 1. Freshwater Institute (Canada), Department of Fisheries and Oceans, Central and Arctic Region, Winnipeg, Man.

Department of Fisheries and Oceans. 1992*a*. Annual summary of fish and marine mammal harvest data for the Northwest Territories, 1989–1990. Vol. 2. Freshwater Institute (Canada), Department of Fisheries and Oceans, Central and Arctic Region, Winnipeg, Man.

Department of Fisheries and Oceans. 1992*b*. Annual summary of fish and marine mammal harvest data for the Northwest Territories, 1990–1991. Vol. 3. Freshwater Institute (Canada), Department of Fisheries and Oceans, Central and Arctic Region, Winnipeg, Man.

Department of Fisheries and Oceans. 1993. Annual summary of fish and marine mammal harvest data for the Northwest Territories, 1991–1992. Vol. 4. Freshwater Institute (Canada), Department of Fisheries and Oceans, Central and Arctic Region, Winnipeg, Man.

Department of Fisheries and Oceans. 1994. Annual summary of fish and marine mammal harvest data for the Northwest Territories, 1992–1993. Vol. 5. Freshwater Institute (Canada), Department of Fisheries and Oceans, Central and Arctic Region, Winnipeg, Man.

Fay, F.H. 1982. Ecology and biology of the Pacific walrus. N. Am. Fauna No. 74.

Fay, F.H. 1985. *Odobenus rosmarus*. Mamm. Species No. 238.

Fay, F.H., Bukhtiyarov, Y.A., Stoker, S.W., and Shultz, L.M. 1984. Foods of the Pacific walrus in winter and spring in the Bering Sea. NOAA Tech. Rep. NMFS (Natl. Mar. Fish. Serv.) No. 12.

Fay, F.H., and Lowry, L.F. 1981. Seasonal use and feeding habits of walrus in the proposed Bristol Bay clam fishery area. North Pacific Fishery Management Council, Anchorage, Alaska, Doc. No. 18. [Available from the North Pacific Fishery Management Council.]

Fay, F.H., and Stoker, S.W. 1982. Reproductive success and feeding habits of walruses taken in the 1982 spring harvest, with comparisons from previous years. Final Report, Eskimo Walrus Commission, Nome, Alaska.

Fay, F.H., Feder, H.M., and Stoker, S.W. 1977. An estimate of the impact of the Pacific walrus population on its food resources in the Bering Sea. U.S. Department of Commerce, National Technical Information Service, Springfield, Va.

Fisher, K.I. 1989. Food habits and digestive efficiency in walrus, *Odobenus rosmarus*. M.Sc. thesis, University of Manitoba, Winnipeg.

Fisher, K.I., Stewart, R.E.A., Kastelein, R.A., and Campbell, L.D. 1992. Apparent digestive efficiency in walruses (*Odobenus rosmarus*) fed herring (*Clupea harengus*) and clams (*Spisula* sp.). Can. J. Zool. **70**: 30–36.

Freiman, S. 1941. Materials on the biology of the Chukchi walrus. Izv. Tikhookean. Nauchno-Issled. Inst. Rybn. Khoz. Okeanogr. (TINRO), **20**: 3–20.

Garlich-Miller, J. 1994. Growth and reproduction of Atlantic walruses (*Odobenus rosmarus rosmarus*) in Foxe Basin, Northwest Territories, Canada. M.Sc. thesis, University of Manitoba, Winnipeg.

Garlich-Miller, J.L., Stewart, R.E.A., Stewart, B.E., and Hiltz, E.A. 1993. Comparison of mandibular with cemental growth-layer counts for ageing Atlantic walrus (*Odobenus rosmarus rosmarus*). Can. J. Zool. **71**: 163–167.

Grainger, E.H. 1955. Echinoderms of Ungava Bay, Hudson Strait, Frobisher Bay and Cumberland Sound. J. Fish. Res. Board Can. **12**: 899–916.

Hyslop, E.J. 1980. Stomach content analysis—a review of methods and their application. J. Fish Biol. **17**: 411-429.

Kastelein, R.A., and Mosterd, P. 1989. The excavation technique for molluscs of Pacific walruses (*Odobenus rosmarus divergens*) under controlled conditions. Aquat. Mamm. **15**: 3–5.

Kastelein, R.A., Wiepkema, P.R., and Slegtenhorst, C. 1989. The use of molluscs to occupy Pacific walrusses (*Odobenus rosmarus divergens*) in human care. Aquat. Mamm. **15**: 6–8.

Keen, A.M., and Coan, E. 1974. Marine molluscan genera of western North America: an illustrated key. Stanford University Press, Stanford, Calif.

Laws, R.M. 1956. Growth and sexual maturity in aquatic mammals. Nature (Lond.), **179**: 193–194.

Loughrey, A.G. 1959. Preliminary investigation of the Atlantic walrus, *Odobenus rosmarus rosmarus* (Linnaeus). Can. Wildl. Serv. Wildl. Manage. Bull. No. 14 Ser. 1.

Lowry, L.F., and Fay, F.H. 1984. Seal eating by walruses in the Bering and Chukchi Seas. Polar Biol. **3**: 11–18.

Lowry, L.F., and Frost, K.J. 1981. Feeding and trophic relationships of phocid seals and walruses in the eastern Bering Sea. *In* The eastern Bering Sea shelf: oceanography and resources. Vol. 2. *Edited by* D.W. Hood and J.A. Calder. University of Washington Press, Seattle.

Lubinsky, I. 1980. Marine bivalve molluscs of the Canadian central and eastern Arctic: faunal composition and zoogeography. Can. Bull. Fish. Aquat. Sci. No. 207.

MacPherson, E. 1971. The marine molluscs of Arctic Canada. Natl. Mus. Nat. Sci. Publ. Biol. Oceanogr. No. 3.

Mansfield, A.W. 1958. The biology of the Atlantic walrus, *Odobenus rosmarus rosmarus* (Linnaeus) in the eastern Canadian Arctic. Fish. Res. Board Can. Manuscr. Rep. Ser. (Biol.) No. 653.

Mansfield, A.W. 1966. The walrus in Canada's Arctic. Can. Geogr. J. **72**: 88–95.

Muir, D.C.G., Segstro, M.D., Hobson, K.A., Ford, C.A., R.E.A. Stewart, R.E.A., and Olpinski, S. 1995. Can seal eating explain elevated levels of PCBs and organochlorine pesticides in walrus blubber from eastern Hudson Bay (Canada)? Environ. Pollut. **90**: 335–348.

Murie, D.J. 1984. Estimating food consumption of free-living seals *Phoca groenlandica* (Erxleben 1777). M.Sc. thesis, University of Guelph, Guelph, Ont.

Nikulin, P.G. 1941. The Chukchi walrus. Izv. Tikhookean.

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Nauchno-Issled. Inst. Rybn. Khoz. Okeanogr. (TINRO), **20**: 21–59.

Orr, J.R., Renooy, B., and Dahlke, L. 1986. Information from hunts and surveys of walrus (*Odobenus rosmarus*) in northern Foxe Basin, Northwest Territories, 1982–1984. Can. Manuscr. Rep. Fish. Aquat. Sci. No. 1899.

Parsons, J.L. 1977. Metabolic studies on ringed seals (*Phoca hispida*). M.Sc. thesis, University of Guelph, Guelph, Ont.

Richard, P.R., and Campbell, R.R. 1988. Status of the Atlantic walrus *Odobenus rosmarus rosmarus* in Canada. Can. Field-Nat. **102**: 337–350.

Sheffield, G.G., and Fay, F.H. 1995. Digestive bias and a re-analysis of Pacific walrus feeding data. Abstracts of the Eleventh Biennial Conference on the Biology of Marine Mammals, 14–18 December 1995, Orlando, Florida. p. 104. [Abstr.]

Shorygin, A.A. 1948. Opredelitel' fauny i flory severnykh morei SSSR. [Guide to the fauna and flora of the northern waters of the USSR.] Fisheries and Marine Service Translation Ser. No. 3865.

Snedecor, G.W., and Cochran, W.G. 1980. Statistical methods. 7th ed. The Iowa State University Press, Ames.

Sokal, R.R., and Rohlf, J.F. 1969. Biometry: the principles and practice of statistics in biological research. W.H. Freeman and Co., San Francisco.

Tsalkin, V.I. 1937. Materials on the biology of the walrus of the Franz Josef Archipelago. Bull. Soc. Nat. Moscou Sect. Biol. **46**: 43–51.

Tyler, A.V. 1973. Caloric values of some North American invertebrates. Mar. Biol. (Berl.), **19**: 258–261.

Vibe, C. 1950. The marine mammals and the marine fauna in the Thule District (northwest Greenland) with observations on ice conditions in 1939–41. Medd. Groenl. **150**: 1–115.

Wacasey, J.W., and Atkinson, E.G. 1987. Energy values of marine benthic invertebrates from the Canadian Arctic. Mar. Ecol. Prog. Ser. **39**: 243–250.

Wagemann, R., Muir, D.C.G., and Stewart, R.E.A. 1993. Trace metal and organic contaminants in walruses from the Canadian Arctic and northern Quebec. Can. Tech. Rep. Fish. Aquat. Sci. No. 1940. p. 67.

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ConocoPhillips Global NVE Greenland LTD. 2012 Program Block 2 (Qamut)

2D-Seismic Survey

Final Environmental Impact Assessment





For submission to:

Bureau of Minerals and Petroleum
Imaneq 29
Post-box 930
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BMP:	1 Electronic Copy and 1 Hard Copy
ConocoPhillips:	1 Electronic Copy
DONG E&P:	1 Electronic Copy
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08 JUNE 2012
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1 Introduction

ConocoPhillips Global NVE Greenland Ltd., DONG E&P Grønland A/S and Nunaoil A/S (referred to collectively as "ConocoPhillips") are pleased to submit an Environmental Impact Assessment (EIA) to the Bureau of Minerals and Petroleum (BMP) for a proposed 2D-seismic survey in Block 2 (Qamut Block). This region is located in northeast Baffin Bay, licence number 2011/11. The 2D-siesmic survey would occur from early August to mid-September 2012, with the option of extending to 1 October 2012 if ice conditions, weather conditions, sea state or other factors delay the program.

This report describes the "Final EIA". It was prepared by revising or amending the EIA that was submitted to BMP in mid-March 2012. A non-technical summary in English, Greenlandic and Danish was submitted at the same time. That version of the EIA will be referred to as the "Preliminary EIA". BMP released the Preliminary EIA Report to the public for a consultation period that was eight weeks in length. ConocoPhillips's responses to Information Requests from this consultation with stakeholders and communities formed the basis for producing the Final EIA.

The Final EIA Report has been prepared by Golder Associates A/S and INUPLAN A/S, in consultation with ConocoPhillips. It was produced in accordance with the January 2011 BMP "Guidelines for preparing an Environmental Impact Assessment [EIA] report for activities related to hydrocarbon exploration and exploitation offshore Greenland" and December 2011 BMP "Guidelines for application, execution and reporting of offshore hydrocarbon exploration activities (excluding drilling) in Greenland", including Appendix G ("Guidelines to environmental impact assessment of seismic activities in Greenland waters", 3rd revised edition) prepared by Danish Center for Environment and Energy (DCE).

ConocoPhillips is aware that Block 2 (Qamut) is closer to the Melville Bay Reserve than other licence areas. It also recognizes that there is an overlap of the proposed seismic survey region with Narwhal Protection Zone I (NPZ-I) in northeast Baffin Bay, where "seismic activities shall be avoided or of limited extent (a few widely spaced (>10 km) lines)", and consequently, if operations occur in NPZ-I between 1 June and 15 October, that "a detailed shooting program is subject to BMP approval, and if approved, impact studies on narwhal shall be considered" (NERI 2010). ConocoPhillips is concerned about the possible effects of underwater sound on marine mammals during the survey period mentioned above. It will support programs carried out on these effects by DCE and the Greenland Institute of Natural Resources (GINR). ConocoPhillips understood before submission of the Preliminary EIA that more discussion with BMP or DCE about seismic operations in NPZ-I would be necessary during the application process, and that it was important to address all aspects of this subject in a proper and appropriate way. This situation was taken into account during preparation of the Final EIA.

ConocoPhillips looks forward to applying its experience from many years of operations in Alaska and other northern locations to exploration activities in northeast Baffin Bay. It welcomes the opportunity to interact and engage with members of communities, the authorities, and other stakeholders about the seismic survey proposed for 2012.

1.1 Project Overview

The proposed exploration program in northeast Baffin Bay during 2012 involves a 2D-seismic survey in the central part of Block 2 (Qamut). This program, referred to as "the Project" below, is described in Section 3 of this report. ConocoPhillips Global NVE Greenland Ltd is "Operator" during exploration activity in Qamut Block. DONG E&P Grønland A/S is a "Partner"; Nunaoil A/S is a "Partner" as well.

1.2 Purpose and Structure of the Preliminary and Final EIA

An EIA has been performed on the Project because BMP decided that it has the potential to have significant impacts on the environment, either by itself, or in combination with other planned exploration activity, in northeast Baffin Bay this year. This decision was made after ConocoPhillips submitted a detailed Scope of Project Report to BMP on 1 February 2012.

The offshore setting of the Project, and the nature of the exploration activity that would occur during the Project, have a strong influence on the purpose and structure of the EIA. It has three objectives: determine if the Project will have an effect on the marine environment in a specific and broader sense of potential impact; identify the

extent of possible effects; and develop or specify means to mitigate, or reduce where possible, the identified possible effects. Possible effects of the environment on the Project are also addressed.

To meet the objectives mentioned above, the physical and biological environments, and land & sea use in Qamut Block, were described from a local and regional point of view. A project description was also developed. A summary of the national and international legal frameworks that provide guidance and set limits on the Project, and on methodology used for impact assessment, was prepared. An assessment was performed on the Project, including potential impacts of the exploration program on the marine environment at local and regional scale, as well as cumulative effects and trans-boundary effects. Other work was conducted during preparation of the Preliminary EIA, including acoustic modeling to investigate cumulative effects from multiple operations occurring at the same time in northeast Baffin Bay, and assembly of an Environmental Protection Plan (EPP) for the Project. This plan was based on the assessment, on regulatory requirements in Greenland, and on "best practice" in other jurisdictions.

After the Preliminary EIA Report was submitted to BMP in mid-March 2012, it was released to communities, agencies, and other stakeholders by posting on <www.nanoq.gl> for a review and consultation process that was eight weeks long. Responses to Supplemental Information Requests that resulted from this process were used to prepare the Final EIA. BMP will make a recommendation about the Final EIA to the Greenland Government. A decision will be made by the Greenland Government to approve the Project, in whole or in part, with or without conditions, and grant a licence for it to proceed.

The Final EIA Report is structured as follows:

- Section 2 provides a brief overview of the Greenland and International legal and regulatory frameworks.
- Section 3 introduces the Project activities, location, survey plan and other details; provides BMP's required tables (four in total), and describes alternatives considered during design of the Project.
- Section 4 presents the exisiting physical and biological environment as well as land & sea use in the Project area.
- Section 5 describes the impact assessment methodology, and how the assessment was performed.
- Section 6 presents the impact assessment on the residual effects from project activities on valued ecosystem components (VECs).
- Section 7 describes acoustic modeling and assessment of cumulative effects of underwater sound on marine mammals and fish in a regional setting.
- Section 8 contains the Environmental Protection Plan (EPP), including the mitigation measures that ConocoPhillips will be applying to Project activities.
- Section 9 describes data gaps and subjects for research that were identified during the assessment process.

Figures are located at end of the main text before a series of appendices. Please refer to these appendices for references, a list of acronyms and abbreviations, a glossary,a summary of the legal and regulatory frameworks, a technical report on acoustic modelling, supporting information on EIA methodology, a summary of project mitigation measures, a Marine Mammal and Seabird Observation (MMSO) Plan, and a table with attachments containing ConocoPhillips's responses to Supplemental Information Requests.

2 Legal and Regulatory Setting

Greenlandic legislation, regulations and guidelines applicable to the Project are listed in Appendix B. Table B-1.

Greenland and Denmark are signatories to a number of international agreements and thus have obligations under several international conventions with regards to the use, administration, and protection of the environment and wildlife. Those potentially applicable to seismic surveys in Greenlandic waters are described in Appendix B, Table B-2.

3 Project Description

The section provides, in accordance with BMP Guidelines (December 2011 version, including Appendix G), a description of the proposed exploration activity, the area where this work will occur, schedule, and equipment and materials for the 2D-seismic survey that ConocoPhillips is proposing to undertake in Qamut Block. Table 3.1-1

contains the details that BMP has requested on the seismic survey. This table, and the other three tables that are specified in the Guidelines, are found at the end of Section 3.1. The location of the survey is shown in Figure 3-1, including a lay-out of the planned seismic lines. This survey grid is a modification of the survey grid that was included in the Preliminary EIA Report. This change was agreed to at a meeting between ConocoPhillips and DCE in Copenhagen on 22 May 2012. The reasons for this change are described in more detail below.

3.1 Scope of Work

The offshore exploration program that ConocoPhillips is proposing for West Greenland in 2012 is a 2D-seismic survey in northeast Baffin Bay, including collection of marine gravity and magnetic data. Roughly 3,000 line-kilometres (line-km) of high quality 2D-seismic reflection data, as well as marine gravity and magnetic data, will be collected in the survey region during the Project. ConocoPhillips will use this data to conduct a detailed geological and geophysical evaluation of the license area.

The Project location will be in the central, eastern and northern parts of the Qamut Block. The survey region extends into the west-central part of Narwhal Protection Zone I (NPZ-I) and northern part of NPZ-II.

Four sail lines extend slightly north of the licence area boundary for line-tie purposes. During preparation of the Preliminary EIA, ConocoPhillips discussed the possibility of obtaining a supplementary or additional exploration licence for the tie-in lines with BMP. It was decided that an extra licence would not be required for this part of the survey.

The portion of the survey that is located in NPZ-I was discussed at a meeting between ConocoPhillips and DCE in Copenhagen on 22 May 2012. This part of the survey has been changed, which ConocoPhillips brought to BMP's attention after the meeting with DCE. It was agreed that modifying the survey grid in NPZ-I would address concerns about proximity to the Melville Bay Reserve, line spacing in NPZ-I, and possible impacts of underwater sound on narwhals during the seismic survey period.

The background and basis for the modification is as follows: ConocoPhillips believes that two of the primary sub-surface targets (possible hydrocarbon reservoirs) in the Qamut licence area extend into the region that is part of NPZ-I. To mature these leads, and determine whether or not an exploration well is justified, additional seismic data in the form of either a 3D survey or an approximately one km by one km 2D-seismic survey is required. ConocoPhillips decided to pursue the 2D solution. In order to limit exposure to underwater sound in the NPZ-I area, the 2D survey plan has been altered to cover only the area occupied by the identified leads, leaving a small number of widely-spaced 2D lines for regional mapping. Two measures are being implemented in this regard:

- The total amount of seismic data within NPZ-I will be reduced by removing every other north-south line in the area between the mapped leads. This effectively removes roughly 100 line-km of acquisition from the survey. To meet the licence obligation of acquiring 3,000 line-km of 2D-seismic data, ConocoPhillips will add roughly 100 line-km of acquisition to the area southwest of the NPZ-I boundary.
- Great effort will be expended to execute a shooting pattern that alternates operations inside NPZ-I with operations outside NPZ-I. The goal is to not operate continuously in NPZ-I for long periods of time.

The proposed schedule for the Project is early August to mid-September, with an option of extending it to 1 October if the seismic survey is delayed by weather conditions, ice conditions, sea state, or other factors. It would proceed for four to six weeks, and take place 24 hours per day, seven days per week based on safe operations when sea ice is not present.

Three vessels have been chartered to carry out the Project, including: one ice-class seismic survey ship; one ice-class chase vessel; and one support and re-supply vessel. The CGGVeritas M/V *Princess* will be used to conduct the 2D-seismic survey (including collection of marine gravity and magnetic data). The chase ship and support/re-supply ship will be the M/V *Thor Supplier* and the M/V *Thor Beamer*, respectively. This information was mentioned in the Preliminary EIA. In early June 2012, it was necessary for ConocoPhillips to change these ships. They have been replaced by equivalent vessels, including the *Artemis Angler* as the seismic ship, F/F *Meredian* as the chase ship, and MV *Arctic Star* as the support/re-supply ship (which may act as a second chase ship). The airgun array and single streamer that will be used by the *Artemis Angler* will be identical to the airgun array and single streamer that would have been used by the *Princess*. CGGVeritas will also continue to be the seismic contractor for the survey.

ConocoPhillips decided that the Final EIA would not be altered to reflect this change in the fleet, since it was an operations planning adjustment that is not uncommon during seismic surveys when release of a ship, or ships, from a previous charter has been delayed, or when any or all of the proposed ships are not available for other reasons. The change is not regarded as material or significant for environmental assessment purposes. It will be addressed by ConocoPhillips as part of the "Application Package" process for the 2012 program in Qamut Block (which is distinct or separate from the EIA process described in Section 1.2), or in a Supplementary Filing or Submission to BMP. Consequently, mention of the *Princess*, *Thor Supplier* or *Thor Beamer* in the rest of Section 3, or in other sections of the Final EIA, was left as is.

Health, Safety & Environment (HSE) performance was taken into account during selection of CGGVeritas as the contractor for the seismic survey, including policies, procedures, vessels, and equipment that were "fit for purpose" in Arctic environments, including conditions in northeast Baffin Bay. This factor was included in the evaluation to lower the likelihood, as much as possible, of the seismic survey having impacts on the environment in the survey region.

The *Princess* is a dual-source, multi-streamer seismic ship well-suited for performing the 2D seismic survey described below. This vessel has integrated geophysical and navigation data acquisition systems, full quality assurance capabilities and onboard positioning and seismic data processing facilities. The seismic source on the ship consist of tuned arrays of G-gun II airguns. The *Princess* is equipped with a full acoustic system to position the in-water seismic equipment. Standard quality control products available in real-time include brute stacks, signal-to-acoustic ratio analyses on shot gathers, and near-trace displays.

The *Princess* will be using or deploying a single airgun array for seismic signal generation. A seismic receiver cable (or streamer) will be towed behind the vessel for recording the reflected signal. Details of the air gun array are provided in Tables 3.1-2 and 3.1-3 at the end of this section. The M/V *Princess* will sail along a total of 50 pre-planned sail lines and release high pressure air to provide a down-going pressure wave at regular intervals. The sail lines are planned to infill the existing license database in order to obtain a regular grid of seismic data to allow an adequate definition of subsurface structures. A line change plan for the seismic survey will be developed. This plan needs to be flexible, and take sea ice and glacial ice conditions, weather conditions, sea state and other factors at the time of survey into account. The survey vessels, equipment and material brought into Qamut Block will leave the licence area at the end of the survey. CGGVeritas has a strict "no spill" policy during operations in Arctic waters. There are no planned discharges into the sea, with the exception of normal discharges permitted by the authorities under Greenlandic regulations or international conventions. No waste disposal is planned, on land, during port calls. No ballast water discharge is contemplated, unless re-ballasting to set or establish an ice draft for any of the ships, or related to re-fuelling, is needed. Re-fuelling may or may not occur during the survey period. It is possible that ship-to-ship transfer from the support/re-supply vessel will be done if re-fuelling is required.

The marine gravity and magnetic measurements will be recorded along the sail lines. The system for collecting gravity data is hull-mounted; the magnetic data is obtained with a submerged system that is towed behind the *Princess*. No energy or sound is emitted by either system when the data are obtained. Equipment for these measurements will be provided by Austin Exploration Inc. The survey ship will not deviate from the sail lines to collect this information. It is normal industry practice to collect gravity and magnetic data during seismic surveys. The ship will use two systems for depth measurements during the survey. The *Princess* is equipped with an Atlas Echograph 461 echosounder for navigation and safety purposes. A single-beam bathymetry system will be used for survey purposes only, to accurately measure water depths along the sail lines. This system is a Kongsberg EA600 echosounder that operates at a frequency of 12 kHz, 32 kHz or 200 kHz. The two echosounders are the only active (hull-mounted) sound sources on the *Princess* that ConocoPhillips is aware of.

It is noted that a simultaneous operations plan, with mitigation added that is related to reducing effects of underwater sound on marine mammals in a regional setting, will be developed and implemented by the three operators in northeast Baffin Bay before their programs, if approved, begin in 2012. The usual purpose of this plan, in addition to safety related to transit and manoeuvring when several ships are operating in one area, is to minimize problems with data quality or integrity when two or more seismic surveys are occurring at the same time. Addition of mitigation to a simultaneous operations plan is not a standard practice. It is one of the actions that the operators will be taking to reduce possible impacts of underwater sound on marine mammals from a cumulative effects point of view. This situation is also discussed in Section 7 and 8 of the Final EIA.

All of the steps outlined in the BMP Guidelines (December 2011 version, including Appendix G), involving operation of an airgun array during a seismic survey, will be followed. These steps, including any survey-specific procedures and measures developed by ConocoPhillips for the Project, are being implemented to reduce or mitigate the effects of underwater sound on the marine environment that are related to operation of the airgun array."Best Practice" during seismic surveys at sea will be employed throughout.

A Safe Operations Plan, or equivalent, including an Emergency Response Plan (for example, procedures for responding to accidental discharges and environmental incidents), is being developed by ConocoPhillips and CGGVeritas. This plan is mentioned in the EPP for the Project (Section 8), but it is not attached to the Final EIA at this time. An Ice Management Plan for the Project is also being developed by ConocoPhillips, assisted by CGGVeritas and other companies. A multi-tier or multiple-level approach, involving actions or procedures before, during and after the survey, will be followed. An important part of this plan, which is summarized in the EPP (Section 8), but not attached to the Final EIA at this time either, will be "ice avoidance" at tactical (near-ship) level. Towing of bergy bits and small icebergs is not anticipated during the survey.

A Marine Mammal and Seabird Observation (MMSO) Plan has been be developed by ConocoPhillips, and will be carried out during the seismic survey. This plan is summarized in the EPP (Section 8), and attached in Appendix J (Marine Mammal Management Plan). The *Princess* will be using a Passive Acoustic Monitoring (PAM) system during the survey period. Table 3.1-4 contains the details requested by BMP on this system. A plan or approach for PAM during seismic operations is discussed in the EPP (Section 8). A mitigation airgun will also be used. It is part of the approach that will be implemented by ConocoPhillips to mitigate impacts of underwater sound on marine mammals.

Table 3.1-1 Survey Data

Specify	Description	Provided
Type of survey (2D, high resolution (3D), well testing, other)	2D seismic survey	ConocoPhillips
Map of the area with all transect lines shown	please refer to Figure 3.1-1	ConocoPhillips
Start and end dates for the survey	Planned operation is from the beginning of August 2012 to middle of September; however, ConocoPhillips requests an option to operate until 1 October 2012 in case of delay caused by weather, sea ice, sea state, or other issues.	ConocoPhillips
Expected duration of seismic program	four (4) to six (6) weeks	ConocoPhillips
Duty cycle of operation (in hours/24 hours); number of hours in the dark per 24 hours	24 hours per day, 7 days per week, based on safe operations when sea ice is not present (i.e., when conditions are "open water" or ice-free" only, and ships can operate safely)	ConocoPhillips
Number and types of accompanying vessels	two (2) chase vessels	ConocoPhillips
Intended use of icebreakers. Will survey be carried out in ice?	Icebreaker will not be used. Seismic survey will not occur when sea ice is present – "open water" or "ice-free" conditions only. Ice management plan being developed (mostly involves glacial ice, but sea ice will not be overlooked in this plan, or at sea).	ConocoPhillips

Table 3.1-2 Array Specification

Specify	Description	Provided
Number and names of vessels towing airgun arrays	one (1) vessel; CGGVeritas *M/V Princess*	ConocoPhillips
For each vessel provide geometric layout of complete airgun array with individual volume specified (in PSI per airgun and in^3 per airgun)	please refer to Figure 3.1-2 and 3.1-3	CGGVeritas
Size of total array (in^3 and PSI for the entire array)	3,940 in^3 (one array consisting of three sub-arrays, as shown in attached diagram),	CGGVeritas
Firing rate in shots/sec. Will sub arrays fire simultaneously or alternate?	firing rate: 10 sec/shot; the sub-arrays will fire simultaneously	CGGVeritas
Operation speed of the vessel in km/hours or knots.	approximately 5 kt over bottom	CGGVeritas

Table 3.1-3 Acoustic Properties of the Airgun Array

Specify	Description	Provided
Far field pressure signature of total airgun output (provide figure)	please refer to Figure 3.1-4	JASCO
Frequency spectrum of the far field airgun signature (broadband) (provide figure)	please refer to Figure 3.1-5	JASCO
Source level (source factor) of airgun array on acoustic axis below array given in all of the following units		
dB re 1 µPa peak-peak (broadband)	262.4 dB re 1 Pa	JASCO
dB re 1 µPa rms (Over 90%* pulse duration) (provide duration for rms calculation) *as defined in Malme et al., 1986; Blackwell et al., 2004	247.1 dB re 1 µPa, duration is 33.5 milliseconds (ms)	JASCO
dB re: 1 μPa^2s. per pulse	232.8 dB re: 1 Pa^2s	JASCO
Energy, joule/m^2 per airgun pulse	9,643 J/m²	JASCO
Signal duration. (Define how it is measured)	33.5 ms (90% rms pulse duration as defined in Malme et al., 1986)	JASCO
Map showing modeled sound pressure levels (rms*), peak-peak and sound exposure level (μPa^2s) for the survey area and surroundings (to levels likely to affect marine mammals or nearest land) * rms calculated by the 90% energy approach for derivation of the duration (Malme et al., 1986; Blackwell et al., 2004).	please refer to Appendix D	JASCO
Provide description of the acoustic propagation model, including assumptions of sound speed profiles.	please refer to Appendix D	JASCO

Table 3.1-4 Specifications of PAM System

Specify	Description	Provided
Number of hydrophones	4	Seiche Measurements Ltd.
Threshold of the recording system	band width20Hz to 200kHz +/–3dB	Seiche Measurements Ltd.
Sample rate of the recording system	low frequency cetaceans samples up to 98kHz higher frequency cetaceans (such as porpoises) sampling rate of 500kHz	Seiche Measurements Ltd.
Where will hydrophones be placed?	behind the vessel mounted on the trailing equipment (rigging / lead-ins), the exact distance aft has not been determined by CGGVeritas	Seiche Measurements Ltd.
Will there be duty cycling of recordings? In that case when will the PAM system be used?	equipment will be recording and manned continuously	CGGVeritas / ConocoPhillips
Name of software	WindowsXP,"Ishmael", Pamguard Sigview	Seiche Measurements Ltd.
Species covered	all vocalizing species	Seiche Measurements Ltd.
Estimated range accuracy, m.	as per manufacturer's specifications	Seiche Measurements Ltd.

3.2 Alternatives Considered

ConocoPhillips is committed to acquiring additional seismic data as part of its license requirements. It has an obligation to obtain a minimum of 3,000 line-km of 2D-seismic data during Exploration Phase 1.

A number of methods have been evaluated for accessing the Qamut sub-surface configuration and hydrocarbon potential. Different geophysical methods can be applied to an area to evaluate its sub-surface geology, including marine gravity surveys, marine magnetic surveys, and marine controlled source electromagnetic surveys, in addition to marine seismic data acquisition. However, seismic surveys are the only viable means of providing enough detail of the sub-surface to better understand the hydrocarbon potential of the licence region, and identify locations for possible drilling sites. Investigating the Qamut Block without acquiring additional seismic data is not possible, and a "no activity" option in 2012 cannot be considered at this time.

ConocoPhillips has evaluated the need for 2D- versus 3D-seismic acquisition for the Qamut license. It was concluded that acquisition of additional 2D lines would provide sufficient data coverage to allow interpretation of the strata and structural configuration at this point in the exploration phase. The interpretation of the 2012 seismic data would help to highlight the areas with significant hydrocarbon potential.

The seismic source will generate an elevated sound level in the northeast Baffin Bay area. ConocoPhillips evaluated alternatives to determine if a solution existed to mitigate the elevated sound levels from a seismic survey in this region. All commercially available seismic airgun systems produce a broadband signal, even though only the lower parts of the frequency spectrum is being recorded in the reflected signal. Methods for reducing the high frequency content have been investigated during Joint Industry Projects (JIPs), but no successful methods have been developed. Alternative seismic signal generation has also been investigated. However, both the watergun and the marine seismic vibrator are not commercially available. The current prototypes appear to produce a frequency spectrum that cannot be used for seismic imaging of deep basins. ConocoPhillips concluded that an airgun system is the only available seismic source for the Qamut seismic survey.

ConocoPhillips evaluated different options for airgun volume to see which volume was needed to produce the required data quality for the proposed 2012 survey. Several seismic surveys have been undertaken in the Baffin Bay area; different airgun volumes have been used during these surveys. For example, employing up to 5,016 in^3, as in the Kanumas 1992 seismic survey, does not appear to provide uplift compared to the 4,100 in^3 volume used in 2009 and 2010. Reducing the volume to 2,050 in^3 in volume, as in the 2000 survey, has an effect on data quality, especially in the deeper parts of the area, and would reduce the value of the seismic data for understanding the structural development of the basins and structures. The proposed airgun volume of 3,940 in^3 will produce the best seismic image.

The seismic acquisition lines proposed for the 2012 seismic survey are pre-planned to in-fill existing seismic data to provide sufficient data coverage over the most prospective sub-surface areas. The current survey layout is the most effective based on the current data base. Other layouts are possible, but these lines would lead to an irregular grid pattern. This pattern could create a requirement for more data, and consequently, a longer survey period, which is not desirable.

With respect to timing of the proposed survey, early August 2012 to mid-September 2012 was deemed the most appropriate period. The actual duration will be dependent on ice conditions, weather conditions, sea state, and other factors at time of survey, but deploying a streamer up to 10 km in length means that data acquisition must occur during a period when sea ice is absent or at a minimum in Qamut Block.

4 Environmental Baseline

4.1 Physical Environment

4.1.1 Introduction

This section of the EIA describes the physical environment of northeast Baffin Bay. It includes information that is relevant to assessment from a regional point of view, as well as information that applies at local (block or licence) level. The following subjects are covered: the setting in Baffin Bay; marine weather; oceanography (including acoustic conditions and bathymetry/seabed); and ice climatology (including sea ice and glacial ice). The Strategic EIA on northeast Baffin Bay (NERI 2011) is not as comprehensive on physical environment as it is on biological environment, and consequently, the approach taken below is detailed and thorough to support the assessment on the Project.

4.1.2 Regional Setting

Baffin Bay is situated between the Arctic Ocean and the Labrador Sea (northwest Atlantic Ocean), between the west coast of Greenland and the east coast of Baffin Island (Canada). The coastal features around Baffin Bay are mountainous, and contain many ice sheets and glaciers, particularly the massive Greenland Ice Sheet (or the “Inland Ice”).

Baffin Bay is about 1,400 km long by 550 km wide and is characterized by relatively shallow sills at its connections with the Arctic and Atlantic Oceans, and by a deep and large abyssal plain in its center. Three narrow (width of the order of 50 km or less) channels connect Baffin Bay to the Arctic Ocean: Smith Sound (through Nares Strait) to the north, Jones Sound to the northwest, and Lancaster Sound to the west (Figure 4.1-1) with sill depths of 250, 120 and 125 m, respectively. On its southern boundary, Baffin Bay is connected to the Atlantic Ocean (via the Labrador Sea) by the much wider and deeper Davis Strait, which has a sill depth of about 650 m and a width of about 170 km at the 500 m isobath, or contour of equal depth.

4.1.3 Marine Weather

4.1.3.1 Atmospheric Circulation

The pattern of atmospheric circulation over Baffin Bay exhibits large changes between winter and summer, and may vary from year to year. In January (winter), in addition to a high pressure system over and north of northern Greenland), a high pressure system, often referred to as the "polar vortex", covers the eastern Canadian Arctic, centered over Baffin Island (Cappelen et al. 2001). A low pressure region develops south and east of Greenland, focused on the Icelandic Low, extending over the Norwegian Sea toward northern Europe. As a result of this pressure pattern, northerly winds will typically prevail over most of Baffin Bay. The pattern usually lasts from November until April or May. In July (summer), the mean pressure gradients are weak, especially around Greenland, resulting in variable wind conditions determined by passing cyclones. Cyclonic activity can occur anywhere in the Greenland area, with most storms or cyclones affecting Baffin Bay arriving from the south to southwest. In winter, if storms follow this track frequently, a warmer, wetter period results, contributing to less severe sea ice conditions along the northwest Greenland coast. A good summary of the regional meteorology and energy balance is found in DMI-DTU (2011).

4.1.3.2 Air Temperature

Maps of air temperature compiled by the Danish Meteorological Institute (DMI) reveal a large west to east gradient in winter, with colder temperatures in western Baffin Bay, while in summer, an almost uniform distribution of temperatures occurs over Baffin Bay (Figure 4.1-2). Mean temperatures in winter are about -20°C, with lows of about -40°C occurring in late winter over unbroken, snow-covered ice in Melville Bay and near the coast of Baffin Island. In summer, the air temperatures are similar to ocean surface temperature in these areas, though the local air temperature, at sea, can be as low as -5°C from time to time during this period. Summer temperatures as high as +5°C, or greater, have been observed at reporting stations along the northwest Greenland coast Valeur et al., 1996).

4.1.3.3 Inter-Annual Variability: North Atlantic Oscillation

Air temperature, wind and other meteorological parameters exhibit large amounts of year-to-year or inter-annual variability in northeast Baffin Bay. Air temperature measurements at coastal weather stations along the west coast of Greenland reveal large variations over time scales ranging over periods of two or three to many years (Figure 4.1-3). The inter-annual variability in annual air temperatures are associated with the North Atlantic Oscillation (NAO) index, computed as the normalized difference in sea level pressure between southwest Iceland and Gibraltar (Figure 4.1-4). Above (below) normal air temperatures off West Greenland are associated with below (above) normal values of the NAO index. A persistent and strong negative North Atlantic Oscillation (NAO) index was responsible for southerly air flow along the west of Greenland (northerly winds, in winter, are the long-term norm), which caused anomalously warm weather in winter 2010 to 2011 and summer 2011 (Box et al. 2011).

4.1.3.4 Wind

Due to the atmospheric circulation pattern noted above, northerly to northwest winds occur frequently in western and central Baffin Bay. Inflow takes place mainly through Smith Sound, Lancaster Sound and Jones Sound, while outflow is through Davis Strait. In both the north-western and north-eastern portions of Baffin Bay regions, gale-force winds often occur. In contrast to this pattern, Melville Bay is in somewhat sheltered by northern Greenland while the coastal area further to the southeast is exposed to south-southeast winds. In summer, south-southeast winds are dominant, particularly near the Greenland coast (Valeur et al. 1996).

A comprehensive wind-wave hindcast dataset (MSC50) prepared by Environment Canada (2012) was used to characterize the wind conditions of northeast Baffin Bay. This is shown in Figure 4.1-5. The time-series data were processed with a time-step of three hours, and provide continuous data for the period 1958 to 2008 inclusive. A complete description of the dataset and the hindcast method is provided by Swail et al. (2006). North-westerly winds are dominant in the western portion of northeast Baffin Bay, while winds are primarily from the southeast in the eastern part of the area. In between, at roughly long. 64°W, a transitional regime occurs. The wind intensifies toward the coast with more frequent wind at speeds greater than 10 m/s at the two sites closest to the Greenland coast. These results are consistent with the results reported by Valeur et al. (1996). Similar results are reported by DMI-DTU (2011), based on DMI's High Resolution Area Model.

The Environment Canada MSC50 datset was also used to characterize the winds in the vicinity of the Qamut Block. The diagram in Figure 4.1-5 was derived from the entire time-series (1958 to 2008); a summary table can be found in Table 4.1-1. The yearly rose demonstrates a wind dominantly from the east to southeast with little contribution from other quadrants. The seasonal pattern, from January to December, features dominant east to southeast winds that veer to southerly winds in spring and summer (May, June and July) with a light winds from the north to northwest sector on Figure 4.1-6 occur mainly in May and June. The winds return to more easterly in the fall to winter period (September to December) with a stronger regime in October. The most energetic period is the fall and winter (October to March), when the mean wind speeds are above 4 m/s, and estimated maximum speeds, above 20 m/s, in November, December and February. Lower mean and maximum wind speeds are seen during summer (June to August) with a lower mean speeds of 2.9 m/s in June and lower maximum speeds of 16.2 m/s in July.

Table 4.1-1 Qamut Block Wind Statistics from MSC50 Hindcast Data Node M3018543

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean wind speed	3.8	3.8	3.6	3.4	3.2	2.5	2.8	3.4	4.4	5.5	4.5	3.8	3.7
Dominant direction	WNW	WNW	WNW	WNW	WNW	SE	SE	SE	ESE	SE	WNW	WNW	WNW
Maximum wind speed	14.6	17.0	13.2	11.3	12.5	13.0	14.3	13.5	15.6	16.5	17.1	16.0	17.1
Direction of max. wind	SE	SE	SSE	SSE	ESE	ESE	SE	ESE	E	SE	SE	SE	SE

4.1.3.5 Precipitation

Due to the low moisture content of the air masses involved, precipitation in the Baffin Bay area is small, about 200 mm/yr, according to Valeur et al. (1996). Precipitation falls mostly in summer and fall along the northwest Greenland coast, occasionally as rain, but mainly as snow, based on observations at Upernavik (Valeur et al. 1996). The precipitation events result from passage of storms associated with atmospheric fronts. In summer, light snow or drizzle may fall from low stratus clouds. In winter, light snowfall occurs near leads and polynyas in the established ice cover. Before this ice cover is fully developed, heavy snow showers typically occur (Valeur et al. 1996).

4.1.3.6 Visibility

The predominant cause of reduced visibility in Baffin Bay is fog, which occurs mainly during the summer months. The frequency of fog events will increase during the spring, and peaks in June/July. The frequency of fog decreases by late August (Valeur et al., 1996) and through September to October as the sea surface temperatures warm following the clearing of sea ice. Coastal weather station data at Aasiaat, Nuuk and Paamiut (Figure 10 in Hansen and Buch, 2004) indicates that the highest frequency of fog occurs in July (10-18%). Fog conditions tend to decrease in August (8-5%) and further decrease in September (3-8%) and October (<1-2%) (see Figure 4.1-7). Advection fog, conditions occur when air temperature falls below 0°C, in association with low wind and clear skies. Icing is possible during periods of advection fog, and rime ice or clear ice may form on exposed surfaces. During the winter months, the fog that occurs is described as “radiation” fog, which develops over snow-covered, unbroken sea ice under clear and calm conditions. Finally, “steam” fog (also known as “sea smoke”) can form where cold air moves over an ice-free or open water area from an ice-covered region. Precipitation events and blowing snow also contribute to reduced visibility to some extent. Additional information on this subject can be found in DMI-DTU (2011).

4.1.3.7 Icing

Icing can form by freezing precipitation, fog or sea spray. Freezing sea spray is the most dangerous form of icing; it is dependent on wind speed, air temperature, sea surface temperature, and the vessel or structure involved. In Arctic offshore areas, including northeast Baffin Bay, where air temperatures and sea surface temperatures during the open water period are both typically lower than in low latitude areas, it can be especially problematic during ship operations. Significant icing by sea spray is most likely to occur from October to December if open water is present and northerly winds develop. Other forms of icing include freezing rain and freezing fog. Freezing rain is generally rare in Baffin Bay; accumulation of ice from freezing fog will be low unless the fog is persistent.

The two icing nomograms in Overland et al. (1986), or the four used by the US Navy, showing light, moderate and heavy icing as a function of air temperature and wind speed at specified sea surface temperatures, are often referred to. The first set is shown in DMI-DTU (2011), and not reproduced here.

4.1.4 Oceanography

4.1.4.1 Bathymetry and Seabed

The bathymetry of northeast Baffin Bay is relatively well-known at regional scale. It is shown on appropriate small-scale Danish and Canadian charts, and is available in digital form as the General Bathymetric Chart of the Ocean (GEBCO) and International Bathymetric Chart of the Arctic Ocean (IBCAO) gridded data. A value-added version of the IBCAO has been used for regional mapping and acoustic modeling during the EIA. This information, including isobaths derived from the elevation surface, appears to be more accurate, and more extensive, than isobath polygons available in digital format from DCE. Water depths are shown on Danish charts 1600, 1700, 3100 and 3200 at 1:250,000 scale, and consist of track or line soundings augmented by spot soundings over the historical period of charting by Danish authorities. The region is characterized by a complex continental shelf of varying width along the coast north of Disko Island. This shelf has been deeply incised by submarine valleys or canyons that were formed by glacial action (outflow from the Inland Ice) in the past.

The most prominent seabed feature in Qamut Block is Isfjeldbanke (Iceberg Bank), centered roughly 90 to 100 km south-southeast of Savissivik, in the central and eastern part of the licence area, bounded on the east by a deep submarine canyon and on the north (between the coast and the licence boundary) by a similarly deep depression. This bank has minimum depths of less than 100 m on Danish chart 3100, and occupies a large area that is less than 200 m deep. The outline of the bank is not entirely accurate compared to ConocoPhillips bathymetry derived from proprietary seismic surveys carried out by TGS Nopec and other companies, but minimum water depths are similar, and it is satisfactory for planning and assessment purposes during the EIA.

Sediment properties and benthic ecology at and below bottom on the continental shelf and slope, and on the abyssal plain at depths of 2,000 m or greater, are not well-known in northeast Baffin Bay, with the possible exception of the North Water region in northern Baffin Bay between northwest Greenland and Devon and Ellesmere Islands in northern Canada. Some reconnaissance box coring and piston or gravity coring has been done by Canadian, American and Danish scientists during international expeditions, in addition to more detailed (site-specific) work carried out by Shell Kanumas A/S during summer/fall 2011 at and near locations proposed for stratigraphic drilling in 2012.

It is very likely that frequent scouring (or gouging) of the seabed by icebergs is a key process that affects sediment properties and benthic ecology on the shelf and upper slope in northeast Baffin Bay when the keels of these icebergs come into contact with the bottom. This suggestion is based on the high numbers of icebergs in these waters, discussed further in Section 4.1.5, that could produce scours during drift or movement in response to currents and the surface wind field. This scouring will typically occur when depths are varying and become shallow, but also, it can happen when the keel depth increases as a result of rotation (roll-over) or other motion of the iceberg. Ice scours have been mapped in several offshore areas where hydrocarbon exploration or production occurs. It is almost certain that scouring takes place along the east Greenland coast, and especially, along the west Greenland coast north of Davis Strait, where high numbers of large icebergs are calved, and transported by the West Greenland Current across banks and other shallow areas on the shelf. Depending of the draft of the large icebergs involved, scouring could occur down to water depths of 250 m on the upper slope. The scours could be as deep as four to six metres in some locations (K Been, pers. comm. 2012) if soft clay sediment is present.

The scours in-fill over time with material that settles through the water column to the bottom, or from boundary layer transport along the seafloor. Depend on the amount of scouring that takes place, it can lead to an upper seabed that consists of mostly or only scoured/in-filled material over periods as short as 50 or 60 to a few hundred years in areas prone to frequent scouring (Smale et al. 2007). The pattern of past and present scours that cross each other can have an important impact on the seabed. When silt or clay soils are disturbed, they generally lose some of their strength, and may absorb water. This process is known as “remoulding”. It can take a long time for the clay soil to regain its strength after remoulding. Sands also lose strength and become looser when they are disturbed, but strength gain can be relatively rapid under wave or other hydrodynamic loading. These observations are related to scouring in the Beaufort Sea, off Sakhalin Island, and off Newfoundland and Labrador, but it is likely the same situation applies in northeast Baffin Bay. Other aspects of scouring by icebergs are discussed in Appendix C.

4.1.4.2 Circulation

The surface circulation of Baffin Bay is primarily cyclonic (counter-clockwise) with an inflow of warm and more saline water (the West Greenland Current) on the east side of Davis Strait, and a broader outflow of cold and less saline water (the Baffin Current) on the west side of the strait. This pattern is shown in Figure 4.1-8.

The West Greenland Current that enters eastern Baffin Bay consists of two components (Buch 2000, 2002 and Myers 2009):

- a modified East Greenland Current component, closest to the coast, carrying water of polar origin (from the Arctic Ocean) northward, after it rounds Cape Farewell; and
- a current component originating from the Irminger Sea and North Atlantic Current, located to the west of and below the East Greenland Current component.

The Atlantic Water component (Irminger Current and North Atlantic water from the Labrador Sea) is significantly larger than the East Greenland Current component. Clarke and Johnson (1984) estimated 11 Sverdrup (Sv, equal to 106 m^3/s) of volume transport for the Atlantic Water versus 3 Sv for East Greenland Current component, for example. As it moves north, a significant portion of the West Greenland Current turns offshore when it encounters the Davis Strait sill, which diverts this water to the interior of the Labrador Sea (Myer et al. 2009). The remaining water continues to flow north, and enters Baffin Bay through Davis Strait. The remaining East Greenland Current component (on the shelf), at this point, is greatly decreased in volume. The properties of this water have been significantly modified by local run-off and interaction with the slope water component (Buch 2000, 2002, NERI 2009). The relatively warm and saline water forming the slope current component flows along the slope and outer shelf, and can be traced as far north as Thule (Buch 1990, 2000, 2002).

A recent estimate of transport by the West Greenland Current indicates that the inflow of the warmer and more saline sub-surface component along the slope is about 1.5 Sv, and that the inflow of the colder and less saline surface component, on the shelf, is about 0.4 Sv (Curry et al. 2011). Seasonality is important; a stronger influx of water from the slope component occurs during fall and early winter (Curry et al. 2011, Tang et al. 2004). Variability from year to year and decade to decade appears to be significant as well. Myer et al (2009), for example, described quasi-decadal variability with the longest consistent period of enhanced transport over a 50-year record taking place during the 2000s. This longer-term variability is probably influenced by the North Atlantic Oscillation (Buch 2002).

As it flows northward along the east coast of Baffin Bay, the West Greenland Current is strongly affected by the topography of the shelf. The West Greenland shelf is deeply incised by large fjords and canyons. Using a numerical circulation model, Tang et al. (2004) described the topographic control and spatial variation of the currents. The results of their simulations illustrate stronger currents along the southern part of the northwest Greenland shelf, and weaker and more variable currents north of lat. 72° N. Canyons divert part the flow toward the coast and off the shelf, particularly to the south and north of Disko Island. When it enters northern Baffin Bay near the North Water Region (see “Sea Ice by Seasonal Period” below), the West Greenland Current mixes with Arctic Ocean outflow that enters Smith Sound from Nares Strait, and essentially ends as a distinct ocean current (Buch 1990, 2000, and Ingram et al. 2002). The combined outflow through Smith, Jones and Lancaster Sounds then drives the south-setting Baffin Current, with estimated volume transport ranging from 0.7 to 2.1 Sv (Tang et al. 2004). Other aspects of regional circulation in Baffin Bay are described in Appendix C.

Except for a small number of moorings deployed by the Bedford Institute of Oceanography (BIO) operational model atlas (Wu and Tang 2011) were retrieved from the BIO database (DFO ODI database 2012). A summary of the analysis is presented below.

The results from the southernmost mooring located in deep water demonstrate both velocity maxima and means that increase with depth, while the second mooring, located further north on the slope and in shallower water, demonstrate similar current strength from surface to bottom. Currents are not strong in general (mean speed <0.1 m/s) but are found to be stronger at the more southerly mooring. Deep currents (below 500 m) are noticeable. They are roughly 0.2 m/s on average during summer, and reach maximum values of more than 0.6 m/s. Seasonality is important down to the 475 m depth measurement, and overall, the currents are higher during summer and lower during winter within the surface and subsurface layer. Winter currents were barely measurable within the surface layer, at less than 1 cm/s in strength. Within the bottom layer, however, the 975 m

deep measurement does not demonstrate as much seasonality, but summer currents are still stronger than winter ones overall.

4.1.4.3 Tides

The tides of Baffin Bay are predominantly semi-diurnal and the major semi-diurnal constituent M2 is characterized by an amphidromic point located at about lat. 70° N, almost in the middle of Baffin Bay (Greisman et al. 1986). Both semi-diurnal (components of the tide that occur twice each day) and diurnal (components of the tide that occur once each day) tidal waves propagate anticlockwise (cyclonically) from this amphidromic point.

Tidal amplitudes increase away from the amphidromic point and are higher in the Davis Strait and Smith Sound regions where the M2 constituent of the tidal heights reaches amplitudes of the order of a meter and more. Strong fortnightly modulation (spring and neap) in the tidal elevations is observed in northern Baffin Bay and Kane Basin (Ingram et al. 2002).

No tidal gauge or other tidal records for the Qamut Block were found in the public domain. The closest record on the northwest Greenland coast is from Foulke-Havn about 300 km north of the area, on the east coast of Smith Sound. Recent modeling studies undertaken by the Bedford Institute of Oceanography (Collins et al. 2011) can be used to provide quantitative estimates of the tides in the Qamut Block. A map of the tidal heights over the region, including the license area, was obtained by running and extracting a 29-day prediction at regular intervals (every 0.1 degree) from lat. 74.5° N to 76.5° N and from long. 70.75° W to 61.25 °W. The results were combined to represent maximum (spring tides) tidal range and the current magnitude that can be expected in this region, as shown in Figure 4.1-10 and Figure 4.1-11. The model results indicate that the tidal range and tidal currents increase toward the northwest, as described above. The maximum tidal currents (Figure 4.1-11) also exhibit a substantial increase of current strength over the Qamut Block due to shallower depth, and particularly on the eastern side, with magnitudes above 20 cm/s.

4.1.4.4 Water Mass Distribution and Structure

The water column of northern Baffin Bay, following Tang et al (2004), consists of three layers:

- a colder and relatively fresh surface layer (temperature 0 to -1°C, salinity less than 33.5 practical salinity units(psu) equivalent to parts per thousand) in the upper 100 to 300 m of the water column;
- a warmer and more saline intermediate layer (temperature +1 to +2°C, salinity up to 34.5 psu) from about 300 to 800 m; and
- a colder and slightly less saline (compared to intermediate water) deep layer (temperature less than 0°C, salinity greater than 34 psu) from 1,200 m down to the bottom.

There is a northward deepening of isopycnals (contours of equal density) in the upper 200 m, supporting the existence of a west-setting current in northern Baffin Bay, as well as a temperature minimum at roughly 100 m depth (which is a remnant of winter cooling), and a temperature maximum at 500 to 800 m depth (Tang et al. 2004).

The upper layer consists of inflow from the Arctic Ocean through Nares Strait and other passages to the west and northwest, and to a lesser extent, inflow along the West Greenland shelf (Tang el al. 2004). The on-shelf component of the West Greenland Current, described in Section 4.1.4.2, carries the latter water north. The middle layer, known as West Greenland Intermediate Water, is related to influx of relatively warm and saline water from the northwest Atlantic Ocean. This water is also transported north, along the slope and outer shelf, by the West Greenland Current. It is warmer during winter compared to the summer period. The temperature of this water mass is not uniform, and is reduced as it circulates (Tang et al. 2004). The origin and fate of the deep layer in Baffin Bay, over the abyssal plain, known as Baffin Bay Deep Water from 1,200 to 1,800 m, then as Baffin Bay Bottom Water from 1,800 m to the bottom, involves vertical processes in the basin itself, rather than advection (inflow) from external areas, such as the Labrador Sea. Deep water exchange with other basins does not occur. Other aspects of water column structure and water mass properties in Baffin Bay are described in Appendix C.

To examine the water column structure of the Qamut Block in more detail, data from the World Ocean Atlas (NOAA 2012) were extracted and processed. The data represent a composite of profiles (a mean or average) collected over a number of years, sometimes back to the early 1900s or eariler. The temperature and salinity profiles provided represent “climatology”, rather than a given profile at a specific date and time in northeast Baffin

Bay. A one-degree latitude, west to east longitudinal profile from long. 70°W to 62°W centred on lat. 75.25° N, was extracted from the 0.25 degree resolution available dataset and averaged to create the profile. Temperature and salinity profiles during summer can be found in Figure 4.1-212.

From July to September, the Qamut Block is characterized by a thin surface layer (roughly, the upper 25 m of the water column) of warm (about 1.5°C) and fresh (less than 33 psu) water above the three water masses, mentioned above, that Tang et al. (2004) described. The lower (deep) water mass, is not present in the licence area, since only a small region in the northeast part of the block has water depths approaching the upper limit of this water mass.

Overall, the water column is slightly colder westward except for the thin surface layer in which warmer temperatures occur from west to east. It is also generally fresher, to the west, in the upper 200 m of the water column. According to Buch (1990, 2000), this surface mixed layer originates from the melting of (winter) sea ice, together with run-off from land, and the melting of glacier ice. This forms a thin, less saline layer of water during spring. Due to the intensification of solar radiation in summer and to the vertical salinity stratification, the heat is stored within this thin layer and temperatures increase significantly.

The water structure is more strongly stratified during the summer from west to east in the licence area, with higher temperatures at the surface and lower sub-surface temperatures. This could be due to higher sea ice melting volume on the western part of the area and/or stronger vertical mixing over the shallow banks present on the eastern part.

No upwelling areas were identified by NERI (2006, 2011) along the northwest Greenland coast, but strong vertical advection due to the tides along or across the steep slopes of banks can occur. This is supported by the temperature profile data reported by Valeur et al. (1996). These vertical mixing areas would be located where the tidal currents are strongest.

4.1.4.5 Large-Scale Variability due to Winds, Air-Sea Fluxes and Fronts

In the upper layer of the water column, from the time of sea ice break-up in late June through to ice freeze-up in early November, there are large temperature and salinity gradients in both the vertical and horizontal domain. An example of this situation is the vertical temperature-salinity distribution at an oceanographic station off Upernavik in July 2009 (Ribergaard 2010). The vertical gradients in this section, in the form of elevated water temperatures of up to 5°C in a thin layer at the surface, develop from the vertical exchanges of heat between the ocean and the atmosphere, in this case, during summer after melting of sea ice. Winds are also important in northeast Baffin Bay. Strong winds result in vertical mixing of water properties to greater depths; when winds are weak, the water column can be more stratified, causing larger vertical gradients. In addition, depending on direction, winds can drive the upwelling of nutrient-rich deeper water to the surface. West or north-westerly winds can lead to upwelling at the shelf edge off northwest Greenland and also along ice edges, when the ice edge is laying to the west. Precipitation and evaporation can decrease or increase the salinity of surface and near-surface waters as well. However, these vertical exchanges result in smaller changes to salinity than those due to ice melt and formation processes in northeast Baffin Bay. Variability of water column properties, which can be considerable in this region, has important effects on the presence and abundance of marine life.

Oceanic fronts, or large horizontal gradients in water properties, are also important biologically active zones in northeast Baffin Bay. Munk et al. (2003) reported that "...the establishment of hydrographical fronts are of primary importance to the plankton communities in the West Greenland shelf area, influencing the early life of fish and the recruitment to the important fisheries resources". Mossbech et al. (2002) also noted that "fronts, upwelling areas and marginal ice zones are examples of...hydrodynamic discontinuities [in Greenland waters] where high surface concentrations of phytoplankton, zooplankton, and shrimp and fish larvae can be expected".

The West Greenland Current Front (WGCF) closely follows the shelf break and the steep upper slope along the northwest Greenland shelf until it reaches long. 52° W where the slope becomes notably less steep and therefore no longer stabilizes the WGCF (Aquarone et al., 2009). This is shown in Figure 4.1-313. This front results in eddy generation that enhances cross-frontal exchange of heat, salt and nutrients, as well as zooplankton and juvenile fish. The Mid-Shelf Front (MSF) is found over the mid-shelf roughly parallel to the coast. It roughly separates the two components of the West Greenland Current, described above in Section 4.1.4.2, from each other as both continue to flow north and the on-shelf component is modified during summer and fall by fresh water from various sources, including meltwater from the Inland Ice. The front between these two components of

the West Greenland Current is weak from January to May and relatively strong the remaining part of the year, with maximum strength in September and October (Hansen et al. 2004).

Other frontal features occur in northern Baffin Bay, such as those measured off Cape York at the boundary between the relatively warm waters of the remaining West Greenland Current in this area and the cold Arctic waters exiting Smith Sound (Melling et al. 2001). The current measurements reveal large-scale or deeply penetrating horizontal gradients, or frontal features, as well as smaller frontal features occurring near the surface.

4.1.4.6 Sea Ice Melt and Upwelling

The near-surface frontal features in the upper layer of northeast Baffin Bay are primarily associated with sea ice break-up and melting, iceberg movement and melting, and direct meltwater run-off along the northwest coast of Greenland. The contribution of the first process to surface and near-surface water column properties is described in this section.

The melting of sea ice in early summer results in reduced salinity waters at the surface of northeast Baffin Bay, since the salinity of first-year sea ice is typically about 8 psu, which is considerably less than the surface water salinities of about 30 psu in this region. The average thickness of the sea ice during the melt season is in the range of 1.5 to 2.0 m (NERI 2011).

In summary, a significant amount of fresh water enters the upper part of the water column in northeast Baffin Bay when this ice melts during the break-up and clearing process on the northwest Greenland shelf. This pattern is described in more detail in Section 4.1.5.1. The volume of water involved is roughly $1.1 \times 10^{11} m^3$. Appendix C describes how this estimate was calculated, and contains other details on the significance of fresh water input from sea ice melting.

Another important attribute of sea ice break-up and melting in early summer is the location of the remaining West Ice in central Baffin Bay through June and into July. Upwelling along the pack ice edge has been shown in other Arctic regions to be an important mechanism. This was noted, for example, by Buckley et al. (1979) and Dumont et al. (2010), involving enrichment of nutrients in the upper layer of the ocean due to transport of the surface waters away from the ice edge under favourable wind conditions which are replaced by higher nutrient waters from depth, and also from beneath the ice itself. In the case of Middle Ice Pack, this means upwelling could occur during periods of westerly to northwest winds, which are not as prevalent as south-easterly winds in northeast Baffin Bay during summer, but still common (DMI-DTU 2011). The importance of ice-edge upwelling to increased ocean productivity levels has been noted in northwest Baffin Bay by Borstad and Gower (1984) and off southwest Greenland by Pederson et al. (2003).

A novel form of localized “upwelling” is possible in northeast Baffin Bay. It does not involve ice-edge processes, but rather, the effect an iceberg has on the upper part of the water column when it is moved by wind or surface currents through the ocean, including the momentum “wake” of glacial ice it creates, which trails behind the iceberg when it is drifting. The water column is locally displaced, bringing up deeper water that is nutrient-rich. Ice in the wake, and the iceberg itself, will continue to melt, contributing fresh water to the surface layer, which continues to be locally altered and mixed, but on a diminishing basis, until the ice disappears. Other aspects of this situation are described in Appendix C.

4.1.4.7 Freshwater Run-off from Land and Icebergs

Freshwater inputs to the sea from land sources are important to the oceanography of northeast Baffin Bay, especially the inshore and shelf regions. Freshwater of land origin can take three forms: direct run-off from rivers and streams along the West Greenland coast, including the extensive fjords; melting of outflow glaciers at tidewater (including drainage via meltwater channels in these glaciers that enters the ocean directly); and the export of glacial ice to the sea in the form of icebergs, which subsequently melt as they move away from the coast.

The total mass loss of Greenland glacial ice will result in considerable amounts of freshwater inputs to Baffin Bay in summer months. The total freshwater volume discharge for all of West Greenland, resulting from loss of ice sheet mass, has been estimated as approximately 2×10^{11} m^3/yr. This total is derived from ice sheet volume reductions (Box et al. 2011) and from iceberg volume fluxes (Valeur et al. 1996). The total freshwater discharge occurs as both run-off and melt into the ocean at the shoreline and at tidewater glaciers, as well as from iceberg calving. Nearly all of this freshwater would be released during the period from mid-May to mid-September during

times of above zero degree air temperature and clearing of sea ice cover. The total volume of freshwater released from land sources of $2x10^{11}$ m^3 is approximately twice that of freshwater input from sea ice melt over the shelf areas for all of eastern Baffin Bay. This input was estimated to be $1.1x10^{11}$ m^3; it was described in Section 4.1.4.6.

Direct meltwater run-off occurs from late spring to late summer (Box et al. 2011) with episodic events according to the weather conditions on the coast and over the Greenland Ice Sheet. The resulting fresh water will be most concentrated in the fjords and along the coastline in shallower waters, and will tend to be localized to higher concentrations near the coastal discharge locations. The nature of the concentrated sources of fresh water leads to formation of fronts at the edges of the brackish plumes that extend into the shelf waters, mostly from mid-July until the end of summer. The plumes and associated fronts will be mixed, and gradually erode over time due to wind forcing and other types of mixing in the ocean with increasing distance from the source areas.

The fronts associated with the freshwater run-off sources along the coast will be important in the Qamut Block on its northern side, which is located about 30 km from shore. This is within the area or zone that would be subject to these freshwater inputs, and associated processes.

The large number of icebergs that calve from tidewater glaciers in northeast Baffin Bay represents a way for freshwater from the Greenland Ice Sheet to reach much greater distance offshore, as these icebergs fracture and melt over their lifetimes. Diemand (2001) noted that the effect of the rapid side-melting of an iceberg along its length or width is "...the vertical mixing of the surrounding seawater. Driven mostly by the release of air from the bubbles in the ice and partly by the lower density of the fresh water of the melted ice, water flows upward near the berg, drawing deep water to the surface." Other aspects of this situation are described in Appendix C.

4.1.4.8 Acoustic Conditions

The propagation of underwater sound in Arctic regions, including northeast Baffin Bay, is influenced by temperature, salinity, and sound velocity variation with depth (the sound speed profile). Gradients or variation in the profile cause refraction (bending of the sound propagation direction) that focuses sound to lower velocity regions. Sound attenuates with distance due to spreading loss, interaction with the seafloor and ocean surface (including sea ice that is floating on the surface), and chemical processes in the water column (particularly at higher frequencies, that is, several kilohertz and greater). In contrast to temperate and tropical waters, the temperature and salinity structure in the upper part of the Arctic water column (typically, "cold" and "fresh", or, at least, cool and less saline, compared to deeper waters) can lead to a low velocity region at or near the surface. The difference between sound velocity profiles in the Arctic (ice-covered and ice-free) and other ocean areas is shown in Figure 4.1-14. At low latitudes, the sound profile results in downward refraction of sound, that is, sound is turned away from the sea surface toward deeper water. In contrast, the upward-refracting (ice-free and ice-covered) Arctic profiles trap sound near the surface.

When a low velocity condition develops and becomes stable in the mixed layer, this region is called a "surface sound channel" from an acoustic point of view. Sound in this part of the water column (especially at lower frequencies) can travel long distances with low transmission loss. When sea ice is present, sound speed is at a minimum at the sea surface. This creates an upward-refracting "Arctic sound speed profile". Sound is "trapped" in the water column by the surface sound channel; ice thickness, air content and bottom roughness influence sound propagation when the sound channel is at the top of the water column. When ice cover melts or ablates, salinity is reduced, but surface waters also begin to warm, or become warmer, from solar input. The depth to the sound channel axis changes – it is near to, but not at, the surface. The sound velocity minimum is typically found at 50 m depth when ice cover is not present.

The surface sound channel is stable during the summer/fall period in the West Greenland Current, which flows over the middle to outer shelf, and along the slope past the shelf break. Waters in this current, which is relatively weak and spatially variable, begin to cool and become less saline as the flow continues north of Davis Strait. This is partly or largely due to substantial fresh water input from various sources, mentioned in Section 4.2.1.8. These inputs reduce surface salinity (and, in some cases, may affect surface temperature), causing the depth of the sound channel to change (or to remain stable near the surface, once established). Other properties of this current, including volume transport, boundary conditions, seasonal differences, varying width, and location of the core flow were described earlier in Sections 4.1.4.2 and 4.1.4.4. Additional details on acoustic conditions are found in Appendix D.

4.1.4.9 Wave Climatology

The regional wind patterns of northeast Baffin Bay have been previously discussed in Section 4.1.3.4. A comprehensive 55-year wind and wave hindcast dataset (MSC50) publically available from Environment Canada (Environment Canada, 2012) was used to characterize the wind and wave conditions of the Qamut Block. The distribution of wave heights by direction (or "wave rose") at an appropriate MCS50 reference point (roughly located at the center of the licence area) is presented in Figure 4.1-15 and Table 4.1-2. Comparable data can be accessed from the ECMWF ERA Interim Re-Analysis 1979-2010 (DMI-DTU, 2011).

The wave climate of the Qamut Block is characterized by north-westerly and south-easterly modal components. As for the wind, the waves from the northwest would occur during winter (November to May) but since the area is covered by ice during that period, the winter waves are actually very small. Waves from the southeast occur during the summer (June to October). Summer wave heights are moderate on average within this area, reaching a maximum mean significant height of 1 m in October for a mean peak period of the order of six seconds. Some longer period swell waves occasionally occur, however, with maximum estimated (over the entire 55 year time-series) between 2.9 m (in July) and 5.5 m (in October) with peak periods of the order of 10 seconds and higher (13.2 seconds in November). These waves also always originate from the southeast to south-southeast sectors.

Table 4.1-2 Qamut Block Wave Statistics from the MSC50 Hindcast Data Node M3018543

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean Hs [(a)]	0	0	0	0	0	0	0.2	0.7	0.9	1.0	0.3	0	0.2
Dominant Direction	WNW	WNW	WNW	WNW	WNW	SE	SE	SSE	SSE	SE	WNW	WNW	SE
Mean Tp	0	0	0	0	0	0	4.7	6.7	7.2	6.9	7.6	0	6.7
Maximum Hs	0	0	0	0	0	0	2.9	4.5	5.2	5.5	4.9	0	5.5
Direction of Max Hs	S	SW	S	NNW	SSW	WNW	SE	SE	SSE	SSE	SSE	WNW	SSE
Tp of Max Hs[(b)]	0	0	0	0	0	0	8.1	10.6	11.1	10.6	13.2	0	10.6

(a) Hs = significant wave height. Significant wave height is the average of the one-third of the largest individual waves present.

(b) Tp = peak period. This is computed from the wave spectra as the period at which the largest wave energy occurs.

4.1.5 Ice Climatology

4.1.5.1 Sea Ice Environment by Seasonal Period

Northeast Baffin Bay is a marginal ice region, which is partially to completely covered mainly by first-year ice from November to June in all years. Sea ice clearing occurs from the last half of June or into July, depending on the year. Ice formation occurs in October to mid-November depending on the year, with freezing progressing from northwest to southeast. Freeze-up has also been known to start as early as September, but this is rare. By the end of September, ice completely blocks the entrance to Jones Sound (Tang et al. 2004). Freeze-up begins in the fjords and coastal waters. Landfast ice simultaneously forms in northeast Melville Bay and along the northeast coast of Baffin Island. The landfast ice extent in Melville Bay shows high inter-annual variability (Hansen et al. 2004 and StormGEO 2011) and can extend 32 to 112 km out from the coast. A "shear zone" area that eventually becomes an open water corridor when clearing begins in the spring occurs at the transition from fast ice to drifting ice, with many cracks and leads developing along this boundary (Tang et al. 2004).

Break-up and clearing of sea ice in southeast Baffin Bay results from the northward-flowing West Greenland Current which brings relatively warm water over the shelf off northwest Greenland. The late spring and summer wind regime of eastern Baffin Bay is dominated by south-easterly winds which drive sea ice further to the north. The clearing of sea ice in northern Baffin Bay results from the spring expansion of the North Water polynya which is present through most of the winter in Smith Sound and extends into northwest Baffin Bay, as well as into Lancaster and Jones Sounds, during the spring months (Dunbar 1969, Melling et al. 2001). The eastward extent of the North Water polynya expands in the spring and extends into Melville Bay in June (Figure 4.1-16), especially in the past decade with the earlier clearing of sea ice being experienced in Baffin Bay.

Starting as early as May, clearing of the sea ice begins in southeast Baffin Bay and in northwest Baffin Bay, and, in the case of the Qamut Block; it converges on this licence area by mid-June to mid-July. The clearing that occurs from the northwest is due to the North Water polynya, discussed further below. By the end of July, sea ice

clears from both the western and eastern side of Baffin Bay, which has happened in most years recently, in contrast to the past, when full clearing from both coasts has generally taken place later. The early summer clearing pattern leaves sea ice in central Baffin Bay only. This ice is often referred to as the "Middle Ice Pack" or "West Ice".

The annual pattern has been reported by many groups and agencies, including DMI-DTU (2011). It is not discussed further below. The North Water region, however, is described in more detail, as is the linear polynya-like feature or "shear zone" area that becomes an open water corridor off the coast, due to their proximity to the northeast Baffin Bay licence areas, and importance from a biological point of view.

The ice clearing in southeastern Baffin Bay results from the northward flowing West Greenland current which brings relatively warm water over the shelf areas of northeastern Baffin Bay, as well as melt waters from ice sheet runoff off southwestern coast of Greenland. The late spring and summer wind regime of eastern Baffin Bay is dominated by southeasterly winds which drive the sea further to the north. The clearing of sea ice in northern Baffin Bay results from the spring expansion of the Northwater Polynya which is present through most of the winter in Smith Sound and extends into northwestern Baffin Bay, as well as into Lancaster and Jones Sounds, during the spring months (Dunbar, 1969, Melling et al., 2001). The eastward extent of the Northwater Polynya expands in the spring and extends into Melville Bay in June especially in the past decade with the earlier clearing of sea ice being experienced in Baffin Bay (as discussed elsewhere).

The thermodynamics and various forcing functions that establish and maintain the North Water polynya have been studied extensively over the past 30 years by shipboard measurements (e.g. Melling et al. 2001) and modelling work (e.g. Yao and Tang 2003; Biggs and Dumont et al. 2011). Strong northerly winds blow the ice downstream of an ice bridge that forms at narrow constriction points between Greenland and Ellesmere in Nares Strait, leaving behind an area of open water downstream of the ice bridge. Both latent heat and sensible heat processes are thought to play a role in formation and maintenance of the polynya as well as the mechanical clearing of ice due to the wind. Melling et al. (2001) estimated that latent heat is the dominant mechanism by a factor of three or more as compared to sensible heat. Dumont et al. (2011) showed through high resolution numerical modelling that the mean circulation may transport Atlantic-derived deeper and warmer Baffin Bay water to the north end of Smith Sound during specific wind events.

Concurrent with the expansion of the North Water polynya, a linear polynya-type feature or "shear zone" area appears to develop off Upernavik. The favourable winds and warm current along Greenland's west coast open this coastal lead or open water corridor. It can extend north of Disko Island by the end of May and reaches lat. 74° N toward the end of June. During the last week of July, it joins the North Water polynya (Tang et al. 2004).

An excellent source of sea ice extent with a maritime or shipping-related focus is the Canatec ICE06 database, which contains digitized ice charts for a large number of years. The general pattern of ice conditions historically was examined and verified with this database for northeast Baffin Bay. A number of these charts are presented in Appendix C, which show average ice conditions for various ice regimes in the region lat. 72° to 76° N, 55° to long.70° W, on a weekly basis for the period May to November. The charts are derived for the period 2001 to 2010 and depict ice conditions for typical ships having "open water" hulls not suited for contact with sea ice during operations in northeast Baffin Bay.

The likelihood of entry into these areas, for this class of ship (with no ice class, or low ice class only), is based on absence or presence of sea ice. The colours pink to red indicate that an open water type vessel cannot safely operate in the given mean sea ice regime unless some form of ice management or other support occurs. The various shades of green indicate that it is safe for an open water type vessel to operate in the given regime without this assistance. The charts indicate that areas along the west coast of Greenland have earlier occurrences of "open water entry" due to earlier melting of sea ice, compared to parts of northeast Baffin Bay (including Melville Bay) further to the north. These results corroborate the findings by Boertmann et al. (2009) and Tang et al. (2004) among others. Glacial ice in various forms will always be found in these waters.

4.1.5.2 Regional Sea Ice Thickness

Winter sea ice in Baffin Bay is composed of new ice up to 10 cm thick, young ice 10 to 30 cm thick, thin ice 30 to 70 cm thick, and medium ice 0.7 to 1.2 m thick (up to 100 km from the Greenland coast). Medium and thick (120 to 200 cm) first-year ice dominates the central and western sections of Baffin Bay (NERI 2009a). The average thickness of level ice increases from about 70 cm to 1.75 m from southeast along the Greenland coast to

northwest across Baffin Bay. Snow cover on the ice can reduce its ultimate winter thickness by 10% to 20%. The North Water polynya during winter contains a large amount of young ice to thin first year ice over 30 cm thick, and is less than 10% leads and cracks. Fast ice in Melville Bay is often 130 to 180 cm thick, while drift ice can reach 120 to 150 cm thick by the end of the winter in a severe season (Tang et al. 2004). Overall, ice thickness is controlled by winter conditions and export rate through the Davis Strait. The winter conditions, in turn, are controlled by the North Atlantic Oscillation index, discussed earlier in Section 4.1.1.2. It is not currently known what effect, if any, climate change may have on NAO (DMI 2011).

4.1.5.3 Regional Multi-Year Sea Ice Occurrence

While first-year ice is dominant in Baffin Bay and the Davis Strait throughout the winter (PAL 2011), small amounts of multi-year ice can drift into Baffin Bay from Smith Sound, Jones Sound, and Lancaster Sound. The occurrence of multi-year ice is limited to the summer and fall when the landfast ice bridges are not present in Nares Strait, which block multi-year ice in the Lincoln Sea from entering Smith Sound via this passage. Glacial ice in the form of ice shelf or ice island fragments, in the past, has entered Smith Sound along this corridor as well. In some years, greater amounts of multi-year ice can drift south from Nares Strait, leading to small areas of 5:10 to 9:10 multi-year ice in the northeast part of Baffin Bay (Tang et al. 2004). This multi-year ice has thicknesses in the range of 240 to 320 cm. Ridging, rafting, and hummocking are widespread. However, this multi-year ice does not usually reach northwest Greenland inshore and shelf areas (NERI 2009a).

4.1.5.4 Regional Sea Ice Dynamics

The drift of sea ice in northeast Baffin Bay has large seasonal variations. During summer and early fall, starting with ice clearing and through the open water season, the ice drifts largely under the influence of the surface winds. Ocean currents in northeast Baffin Bay, other than the direct wind-driven component, are generally low in speed and variable in direction with a weak overall net flow to the north along the west Greenland shelf and slope, turning to the northwest and then to the west in Melville Bay. This weak pattern is an extension of the West Greenland Current, but it is highly variable in time and space (Tang et al. 2004). While there are few direct measurements of sea ice velocities in northeast Baffin Bay, the response of sea ice drift to geostrophic winds will be similar to that observed in other areas of the Arctic. The ice drifts at about 2% of the wind speed with the ice drift direction approximately 45 degrees to the right of the wind direction in summer when internal ice stresses are small and away from major ocean circulation features (Thorndike and Colony 1982).

From late fall through to spring, ice concentrations are much higher. Ice drift is constrained due to internal ice stress, to values typically less than one percent of the wind speed (Thorndike and Colony 1982). The internal ice stress results in heavy deformation of the sea ice, including ridging, which produces large (deep) ridge keels that can be as much as 20 m or greater in draft. This is more than 10 times larger than the level first-year ice thickness values in late winter of 1.6 m (Amundrud et al. 2004, Tang et al. 2004). Some of these very deep keels will persist for some time into the break-up and clearing period, but will eventually melt.

The drifting or mobile ice in northeast Baffin Bay contains a large variety of floe sizes and concentrations. Thick individual ice floes formed as pressure ridges have horizontal sizes of < 20 to 100 m, and rubble or hummock ice features can have widths of hundreds of meters. Floes that have been pushed and frozen together can have composite diameters of hundreds of metres to tens of kilometres. High storm activity tends to keep the landfast ice extent in Melville Bay at the lower end of its range, and increases dispersion of ice floes in the fall. The northern part of this Bay reaches nearly complete ice coverage during December through April of 8:10 to 10:10 concentration, with annual maximum coverage in March of 9+/10:10 concentration (ERM 2011a).

4.1.5.5 Regional Iceberg Dynamics

Most Baffin Bay icebergs calve from glaciers along the west coast of Greenland during the summer and fall, north of lat. 68° N, with most originating north of Disko Island in Disko Bay and Uummannaq Fjord, as well as in other fjords and bays further north along the coast, including Melville Bay (Figure 4.1-17). Iceberg, bergy bit, and growler production occurs throughout the year.

Icebergs calving from glaciers along the coast north of Disko Island are often entrained in the West Greenland Current, and drift northward and counter-clockwise around Baffin Bay, transiting Melville Bay en route (Mosbech et al., 2004). Glaciers in Uummannaq Fjord and Disko Bay produce 10,000 to 15,000 icebergs per year (95 km^3), with total production at 25,000 to 30,000 or even 40,000 icebergs per year in Baffin Bay and northern Davis Strait (Boertmann et al. 2009, Valeur et al. 1996). Until recently, it was thought that the annual volumetric iceberg

production has not varied appreciably (NERI 2009), but the production rate may be increasing due to the rapid changes in the Greenland Ice Sheet (Box et al. 2011). Some of the icebergs being transported by the West Greenland Current periodically ground on banks, or become constrained, or "frozen in", by landfast ice during winter. If they do not melt or fracture during transport, these icebergs drift into northwest Baffin Bay, and continue drifting south along the east coast of Baffin Island. Some of them drift into Lancaster Sound. Iceberg residence time in Baffin Bay can be up to two or three years (Diemand 2001).

Historical measurements of iceberg distributions conducted in northwest Greenland reveal that the highest densities of iceberg occur north of lat. 75° N and east of long 60° W within approximately 50 to 100 km of West Greenland. Icebergs were also measured at much greater distances of 100 to 500 km from the coast but beyond 150 km, and they occur only occasionally and almost always as large icebergs (Valeur et al. 1996).

4.1.5.6 Iceberg Distribution and Mass

The mean sail height of Baffin Bay icebergs is 60 m, and the mean width is 100 m (Diemand 2001). The average draft observed away from the caving grounds has been reported as 187 m. The largest icebergs ever observed in the region had drafts of 250 to 300 m, but exceeding 230 m draft depth is rare because bathymetry near the calving fronts limits draft depths (NERI 2009). Based on detailed observations made in 1997, the largest icebergs in the region had drafts deeper than 260 m, were up to 90 Mt, and more than 1,400 m in length.

The most recent survey of icebergs in the northeast Baffin Bay licence areas took place from mid-August to mid-September 2011 in Melville Bay. Iceberg population and aerial density were estimated from satellite imagery (C-CORE 2011). Of the many thousands of icebergs present in the region (upwards of 100,000), 175 icebergs were documented in terms of length, mass, and drift velocity (GEMS 2011a). Numbers and sizes of bergy bits and growlers were not recorded. However, it was noted that their concentration tends to be highest in the immediate vicinity of icebergs. The aerial density of icebergs varied from >0.4 icebergs/km^2 in nearshore areas to no more than 0.1 icebergs/km^2 50 to 100 km offshore (CCORE 2011). Median iceberg mass was found to be 1.08 Mt, and the largest iceberg documented was estimated to be 92.6 Mt. Drift direction was generally toward the west, west-northwest, and west-southwest, with significant variations due to tidal currents (GEMS 2011b). During surveys in September to October 1968, iceberg frequency was found to be greater than 0.24 icebergs/km^2 (Wolford, 1981). Other details on iceberg distribution and mass are found in Appendix C.

4.1.5.7 Iceberg Drift Speeds and Other Properties

The 2011 iceberg survey of the region found an instantaneous maximum drift speed on radar of 0.5 to 1 m/s in an "iceberg corridor" immediately to the south and southwest of Cape York (GEMS 2011a) off the northwest part of Qamut Block. The C-CORE 2011 report described a mean speed of 0.13 m/s and a maximum speed of 0.67 m/s for 601 icebergs. A re-analysis of the 2011 data found a mean drift speed of 0.175 m/s overall and a maximum of 0.615 m/s (GEMS 2011b). Icebergs in the nearshore area, within 15 km of Cape York, drifted faster (the mean drift speed was calculated at 0.35 m/s) than icebergs farther offshore.

The iceberg survey conducted in late summer 2011 in Melville Bay (GEMS 2011a) recorded the largest iceberg at 860 by 416 m in horizontal extent, with a peak sail height of 99 m, a draft of 275 m, and a mass of 92.6 million tonnes. The median iceberg mass was 1.08 million tonnes, median waterline length was 130 m, median sail height peak was 37 m, and median draft depth was 84 m. The majority of the icebergs had a mean waterline length of less than 400 m. Two icebergs had a waterline length of more than 1,000 m, with the longest recorded at 4,244 m (GEMS 2011a).

Fifteen percent of the icebergs observed during the 2011 survey were greater than 5 Mt and it should be noted that icebergs this large cannot be towed (GEMS 2011a). Data from 118 icebergs observed during the 2011 survey were used as the basis for the following statistics:

- with respect to mass, there is a 100% chance of an iceberg being larger than 104 tonnes, a 50% chance of an iceberg being larger than 106 tonnes, and an 8 to 9% chance of an iceberg being larger than 107 tonnes;
- with respect to length at waterline, there is a 100% chance of an iceberg being longer than 30 m, a 50% chance of a length longer than 140 m, and a 10% chance of a length longer than 240 m;
- with respect to width at waterline, there is a 100% chance of an iceberg being wider than 27 m, a 50% chance of a width greater than 100 m, and a 10% chance of a width greater than 200 m;

- with respect to sail height, a 100% chance of an iceberg possessing a peak sail height larger than 5 m, a 50% chance of a sail height larger than 36 m, and a 10% chance of a sail height larger than 60 m; and
- with respect to draft, a 100% chance of an iceberg having a draft deeper than 32 m, a 50% chance of a draft deeper than 84 m, and a 10% chance of a draft deeper than 130 m.

The predominant drift pattern for larger icebergs differs from that of sea ice because of the much larger drafts of icebergs. Iceberg drifts depend on the combination of sail versus keel profiles. The predominant wind directions in the Qamut licence area are from the southeast in August and September. Along the coast at around lat. 74° N, to the northwest of Qamut wind directions tend to be more northerly and east-northeast (StormGeo 2011). Icebergs with larger drafts and/or reduced sail heights tend to be influenced more by surface (and near-surface) currents, especially those currents below the largely wind-driven mixed layer. Iceberg drift studies in northeast Baffin Bay (Valeur et al. 1996) indicate that most icebergs move erratically with little mean drift. Velocity rarely exceeds 0.2 m/s, which is in generally good agreement with direct field measurements in the summer of 2011. During periods of higher or greater sea ice cover, from late fall through most of spring, iceberg drift is greatly constrained by the movement of surrounding sea ice. The icebergs generally move at the same speeds as drifting sea ice, or, if caught in landfast ice areas along the coast, movement ceases until sea ice clearing occurs.

4.2 Biological Environment

4.2.1 Plankton

Plankton are small (often microscopic) plants and animals floating, drifting or weakly swimming in bodies of fresh or salt water. In general, plankton can be sub-divided into two groups: phytoplankton and zooplankton.

4.2.1.1 Phytoplankton

Phytoplankton perform the majority of primary production, or the formation of organic particulate matter through photosynthesis (UNESCO 1973). Forming the base of the marine food web, phytoplankton provide essential nutrients and energy to higher trophic level organisms ranging from zooplankton to marine mammals.

In northeast Baffin Bay, where stratification is largely controlled by salinity (Carmack and Wassmann 2006, Carmack 2007), a single intense phytoplankton bloom in late spring, immediately after ice break-up, which may last for several months, is typical. An exception to this trend is observed at polynyas where elevated nutrient availability tied to upwelling events during early ice break-up can result in locally high productivity on a confined scale (DCE 2011). The ice-free period in northwest Greenland typically lasts three to four months but may extend beyond six months in polynya regions (DCE 2011). The North Water polynya, located in northern Baffin Bay, is the world's largest polynya and one of the most biologically productive marine areas in the Arctic (Deming et al. 2002). It is also regarded as a "biological hot spot" by DCE and GINR.

The distribution of phytoplankton biomass and primary production has been studied off the coast of northwest Greenland from lat. 65º N to 72º N. Chlorophyll *a* concentration and primary production were found to be generally higher at sites above lat. 69º N (Jensen et al. 1999).

4.2.1.2 Zooplankton

Zooplankton communities in West Greenland waters are dominated by copepods, which constitute 86% of the zooplankton biomass in this region (GINR 2003). The majority of these copepods are of the genus *Calanus* (including larval stages), which occupy the top 100 m of the water column in spring and summer and feed exclusively on algae. They constitute an important prey item for the higher trophic levels in the Arctic marine ecosystem, including fish, baleen whales (primarily bowhead whales), and seabirds (e.g. the little auk is a specialised *Calanus* feeder) (Karnovsky et al. 2003). Calanoid copepods also play a key ecological role by supplying benthic communities with high quality food (Söderkvist et al. 2006). Consequently, a great deal of the biological activity in Greenlandic waters (e.g. fish spawning, bowhead foraging) is synchronized with the life cycle of *Calanus*.

In Melville Bay, the dominant copepod species are: *Calanus glacialis, C. hyperboreus and C. finmarchicu* (Herman 1983, Head et al. 1985). Present knowledge on zooplankton in eastern Baffin Bay is too limited to designate critical zooplankton habitat in this area. The highly productive eastern margin of the North Water polynya has been identified as a region that would be especially sensitive to oil spills (DCE 2011).

4.2.2 Invertebrates

Benthic communities are an important ecosystem component on the West Greenland continental shelf. They provide an important food source for fish, marine mammals, and invertebrates. Scallop, snow crab, and northern shrimp serve as the basis for commercial fisheries in this region.

The highest benthic biomass occurs in the shallow coastal region (10 to 100 m in depth) where a few large species are dominant (e.g. bivalves, gastropods and sea urchins). At greater depths (100 to 1,000 m), communities are dominated by polychaetes which are often present in high abundances. In general, benthic macrofaunal species are an important component of the marine ecosystems. They consume a significant portion of available primary production and, in turn, serve as an important food source for fish, seabirds and mammals. Benthic surveys conducted in eastern Baffin Bay have shown that the benthic community structure varies considerably as a function of location and depth. Benthic zonation is often accompanied by an exponential decline in benthic diversity along a shelf-slope-basin gradient. In addition to depth, additional factors such as sediment heterogeneity, disturbance, food availability, geographical setting, sea-ice cover, particle load from land, and hydrographic regime also influence benthic diversity and species composition (DCE 2011). Benthic invertebrates are important because they represent a significant fraction of the biodiversity in the region. Existing knowledge on the distribution, diversity, and abundance of benthic invertebrates in northwest Greenland is presently too incomplete to identify critical habitats or important conservation areas with the exception of established commercial fishing grounds for snow crab and northern shrimp (Section 4.3.1).

4.2.2.1 Northern Shrimp (Pandalus borealis)

Northern shrimp live on or near the seabed (epibenthic) with highest densities observed at depths between 150 and 600 m (DCE 2011). Northern shrimp spawn in July to September with females carrying the fertilized eggs until spring (March to May). Larvae undergo several pelagic stages before maturing and settling to the seafloor far from their release site (Pedersen et al. 2002)

4.2.2.2 Snow Crab (Chionoecetes opilio)

Snow crab in northwest Greenland are expected to occur regularly in eastern Baffin Bay, preferring deep, cold water conditions and sandy seafloor at depths between 350 and 1,500 meters (NAFO 2007). They are slow to mature, taking more than five years to reach harvestable size. Their maximum lifespan is approximately 12 to 13 years (NAFO 2007). Major predators of snow crab include groundfish, seals and other snow crab.

4.2.3 Marine Fish

A total of 269 fish species are known to occur in the Greenland Exclusive Economic Zone (EEZ), of which 79 are commonly found off the coast of northwest Greenland (Møller et al. 2010). Jørgensen et al. (2005) sampled 105 trawl stations in Baffin Bay and identified seven unique bottom fish communities based on differences in species composition and habitat type. Of these, four communities were unique to Baffin Bay with 44 bottom fish species identified in total. Greenland halibut (*Reinhardtius hippoglossoides*) was the dominant species observed. Other species caught in notable numbers were polar cod (*Boreogadus saida*), Arctic cod (*Actogadus glacialis*) and the Arctic skate (*Raja hyperborea*).

4.2.3.1 Greenland Halibut (Reinhardtius hippoglossoides)

Greenland halibut are an abundant and commercially valuable species in Baffin Bay. They are typically found in deep water along the continental slope, as well as at the interface of warm and cold water masses at temperatures of one to two degrees Celsius (Bowering and Brodie 1995). Spawning takes place in Davis Strait from December to April in water depths of 800 to 1,000 m (Smidt 1969). Larvae are pelagic during the months of March to June (Smidt 1969) where they drift north from Davis Strait along the coast in the West Greenland Current. They settle as semi-demersal juveniles in southern Baffin Bay and later migrate further north in the vicinity of the Qamut Block. Tagging studies suggest that mature fish later migrate back to spawning areas in Davis Strait (DCE 2011). No spawning events have been recorded in Baffin Bay, either offshore or inshore.

The Greenland halibut is considered an important food source for narwhal, particularly during winter. An estimated 50,000 narwhals from two separate wintering grounds were estimated to consume approximately 790 tonnes of Greenland halibut per day, assuming a diet of 50% of Greenland halibut (Laidre et al. 2004).

4.2.3.2 Arctic Cod (Arctogadus glacialis)

Arctic cod are endemic to the Arctic Ocean with a circumpolar distribution along the coasts of Siberia, Alaska, Canada, and Greenland (Aschan et al. 2009). They are believed to spawn in the late fall or early winter, and are most common on surface and near-surface waters, but can occur at depths below 900 m. In ice-free waters, Arctic cod are often found in large schools consuming large amounts of plankton. In ice-covered waters, they prefer rough, under-ice surfaces (multi-year ice) over smooth under-ice conditions for refuge.

Cod are considered a primary food source for narwhals, belugas, ringed seals, and seabirds, and are also preyed upon by Arctic char (*Salvelinus alpinus*), Atlantic salmon (*Salmo salar*) and Greenland halibut. The estimated stock size of Arctic cod in northwest Greenlandic waters is presently unknown.

4.2.3.3 Polar Cod (Boreogadus saida)

Polar cod have a circumpolar distribution, occupying high latitude waters of Russia, Alaska, Canada, and Greenland (Craig et al. 1982). They are a pelagic/semi-pelagic species most commonly found in the upper water column, but occasionally recorded in water depths up to 900 m. Polar cod are known to frequent estuarine environments (river mouths) and tend to group in large schools when in ice-free waters. They feed mainly on plankton and krill (DCE 2011).

Polar cod spawn during winter in ice-covered waters (November to February) with the larvae hatching in late spring (Cohen et al. 1990). They provide an important prey for many marine mammal and seabird species, notably ringed seal, harp seal, thick-billed murre, northern fulmar, black-legged kittiwake and Ivory and Ross's gulls (DCE 2011). There is no information available on polar cod stock size in the Baffin Bay/Melville Bay area.

4.2.3.4 Arctic Skate (Raja hyperborea)

The Arctic skate occurs in cold, polar waters at depths ranging from 260 to 2,500 m in Baffin Bay, and along the west, south, and east coasts of Greenland and eastward to Iceland, the Barents Sea, and northern Norway. This species appears to prefer cold water temperatures from hatching stage through to maturity (Bigelow and Schroeder 1953).

The Arctic skate is thought to feed on a wide variety of benthic organisms (Stehmann and Burkel 1984). The species is oviparous, laying less than 100 eggs annually. Eggs are successfully incubated in water temperatures as low as 0°C. Arctic skate presently have no commercial value in Greenland.

4.2.4 Seabirds

There are three Important Bird Areas (Figure 4.2-1) located directly north of the Qamut Block: Parker Snow Bay, Appat Appai, and the coastline between Appaliarsulissuaq and Kap Atholl (Birdlife International 2011). During ice free-periods, seabirds are abundant in the Baffin Bay area (DCE 2011). The results of seabird-at-sea surveys in Baffin Bay show low densities of seabirds in spring (April to May) when ice is still widespread, and higher densities of seabirds in summer from June to December (DCE 2011). Some species (auks, puffins) spend the majority of their time at sea, except when breeding. A summary of the important seabird species occurring in the Baffin Bay area is provided in Table 4.2-1.

Sixteen seabird species are known to breed in the Eastern Baffin Bay region. Most of these are colonial and are dispersed along the Greenland coastline southeast of the Qamut Block (Figure 4.2-1). The breeding colonies are primarily concentrated on the mainland coastline and in archipelagos located in southern Baffin Bay between Holm Island and Upernavik, and also north of Cape York (DCE 2011). These colonies vary in size from several pairs to several million pairs (DCE 2011).

High concentrations of foraging seabirds occur on the waters adjacent to these colonies, but some species (e.g., little auks) may range up to 100 km offshore (DCE 2011). Many species are piscivorous, while others feed on large zooplankton or benthic invertebrates. The majority of these species use common productive foraging areas where some catch prey by deep diving (e.g., murres, cormorants, auks) while others feed at the surface or by plunge diving (e.g., kittiwakes, terns).

Large concentrations of foraging seabirds can also occur in open water areas, such as polynyas and along ice edges (DCE 2011, Figure 4.2-1). Early ice break-up in northeast Baffin Bay, including costal areas where shear zones are located, may create open water used by seabirds for foraging or resting. Important offshore feeding

areas may also occur where upwelling events are recurrent, and in areas where commercial fisheries occur (DCE 2011).

When the breeding season is over, populations of seabirds from both Canada and Greenland move southwards through the Qamut Block toward overwintering areas off southwest Greenland and Newfoundland/Labrador (DCE 2011). For some species (e.g., thick billed murres), this migration includes extended periods of swimming on the surface by immature individuals and moulted adults (DCE 2011). It is estimated that at least 100 million adult and juvenile seabirds migrate annually through the greater Baffin Bay area during September and October (DCE 2011).

4.2.5 Marine Mammals

There are 20 species of marine mammals that may be present within the Qamut Block for variable periods of time and at different times throughout the year. This includes 14 species of cetaceans, four species of pinnipeds, walrus, and polar bear.

4.2.5.1 Cetaceans

Narwhal (*Monodon monoceros*)

Narwhals in West Greenland and Eastern Canada make long-distance migrations each year between their northern summering grounds and southern wintering grounds (Dietz et al. 2001, Heide-Jørgensen et al. 2003). During the open-water season in summer (July through September), narwhals occur in inshore areas off northwest Greenland and the Eastern Canadian Arctic (Born et al. 1994b, Dietz et al. 1995, Kingsley et al. 1994). In Baffin Bay, narwhals tend to congregate in large numbers at two main summering grounds: Melville Bay and Inglefield Bredning (Figure 4.2-2). When fast ice begins to form along the coast in fall, narwhals migrate south along traditional migratory routes (Dietz and Heide-Jørgensen 1995, Dietz et al. 2001, Heide-Jørgensen et al. 2002, Heide-Jørgensen et al. 2003a) to deep-water wintering areas in central Baffin Bay and northern Davis Strait where they remain for at least five months of the year (Koski and Davis 1994, Laidre and Heide-Jørgensen 2011). The wintering grounds are associated with dense offshore pack ice where large numbers of whales remain concentrated in specific regions with water depths up to 2,300 m. Individuals have been shown to use the same summering and wintering grounds in consecutive years (Heide-Jørgensen et al. 2003a). In early spring, narwhals travel along ice edges off the east coast of Baffin Island (Koski and Davis 1994) and off West Greenland, concentrating in the North Water polynya in late spring prior to entering Inglefield Bredning and Melville Bay in early summer (Born et al. 1994b, Heide-Jørgensen 2004).

The narwhal diet is restricted to a limited number of species and changes throughout the year. The majority of their food reserves are put on during winter, when narwhals target Greenland halibut and squid (Gonatus sp.) found in deep-water offshore areas in Baffin Bay and Davis Strait. Food intake appears to be limited during summer, with prey selection focusing on Arctic cod, polar cod, and squid at this time (Laidre et al. 2003).

The abundance of narwhals at the summering grounds in Inglefield Bredning and Melville Bay was estimated in 2007 at 8,368 and 6,024 respectively (DCE 2011).The northeast margin of the Qamut Block overlaps with the western margin of Narwhal Protection Zone I (NPZ-I).

Beluga (*Delphinapterus leucas*)

Belugas whales may be present in the Qamut Block for a brief period during the spring (May to June) and fall (October to November) when these whales migrate between their summering grounds in Canadian Arctic waters and their wintering grounds off Western Greenland (Heide-Jorgensen et al. 2003b). There are two established core wintering grounds in the Baffin Bay region where whales tend to congregate at the edge of the sea ice (DCE 2011) (Figure 4.2-3). They include the North Water polynya and the near shore waters off central West Greenland (south of Upernavik) at the eastern edge of Baffin Bay pack ice (the “West Ice”).

The total abundance of belugas in West Greenland in 2006 was estimated at 10,595 individuals (Heide-Jørgensen et al. 2010b). The population appears to be increasing as a result of decreased hunting effort over the last several years (Heide-Jørgensen et al. 2010b). Both wintering ground areas are located outside the Qamut Block.

Table 4.2-1 Overview of Seabird Species Found within the Qamut Block

Common Name	Species	Seasonal Occurrence	Distribution	Other Relevant Information	Greenland Red List Status	IUCN Listed Status	Importance Of Assessment Area to Population[a]	VEC
Fulmar	*Fulmaris glacialis*	summer	coastal / offshore	none	LC	LC	high	yes
Great cormorant	*Phalacrocorax carbo*	summer	coastal	large majority of Greenland population occurs in Baffin Bay	LC	LC	high	yes
Greenland white-fronted goose	*Anser albifrons flavirostris*	May – September	coastal	endemic to Greenland, small, declining population breeds exclusively in western Greenland	EN	LC	medium	no
Snow goose	*Anser caerulescens*	May – September	coastal	significant concentrations of snow geese occur in the Baffin Bay area	LC	LC	low	no
Brent goose	*Branta bernicla*	spring and fall	coastal	**national responsibility species**: Internationally important concentrations occur through Baffin Bay during migrations in May/June and August/September	LC	LC	high	no
Common eider	*Somateria mollissima*	summer	coastal	breeding population previously in decline	VU	LC	high	yes
King eider	*Somateria spectabilis*	July - September	coastal	do not breed in assessment area; however, large numbers of moulted individuals assemble in coastal areas and are flightless for three weeks	LC	LC	high	yes
Long-tailed duck	*Clangula hyemalis*	summer	coastal	none	LC	LC	medium	yes
Red-breasted merganser	*Mergus serrator*	summer	coastal	none	LC	LC	low	no
Red-necked phalarope	*Phalaropus lobatus*	spring and fall	coastal	none	LC	LC	low	no
Grey phalarope	*Phalaropus fulicarius*	spring and fall	coastal	none	LC	n/a	low	no
Arctic skua	*Stercorarius parasiticus*	summer	coastal	none	LC	LC	low	no
Black-legged kittiwake	*Rissa tridactyla*	summer	coastal / offshore	west Greenland population has declined since mid-1900s, and is a preferred quarry for hunters in the area	VU	LC	high-medium	yes
Glaucous gull	*Larus hyperboreus*	summer	coastal / offshore	none	LC	LC	low	no
Iceland gull	*Larus glaucoides*	summer	coastal / offshore	none	LC	LC	low	no
Great black-backed gull	*Larus marinus*	summer	coastal / offshore	none	LC	LC	low	no
Sabines gull	*Larus sabinii*	summer	coastal / offshore	none	NT	NT	low	no
Ivory gull	*Pagophila eburnea*	spring and fall	coastal / offshore	most individuals in Baffin Bay are from the Canadian population which has declined by more than 80%	VU	NT	medium	yes
Arctic tern	*Stena paradisea*	May - September	coastal / offshore	west Greenland population = declining (possibly due to over harvesting of eggs)	NT	LC	high	yes
Thick-billed murre	*Uria lomvia*	summer	coastal / offshore	west Greenland population = declining; some entire breeding colonies in assessment area have been abandoned; 15% of global population and >90% of the Greenland population occur in the assessment area in summer	VU	LC	high	yes
Razorbill	*Alca torda*	summer	coastal / offshore	none	LC	LC	high	no
Atlantic puffin	*Fratercula arctica*	summer	coastal / offshore	population is of national concern as approximately 25% of Greenland population breed in Baffin Bay	NT	LC	high	yes
Black guillemot	*Cepphus grylle*	summer	coastal / offshore	**national responsibility species**: very large portion of global population breeds in Greenland with majority of the Greenland population breeds within Baffin Bay	LC	LC	high	no
Little auk	*Alle alle*	summer	coastal / offshore	**national responsibility species**: >80% of global population breeds in Greenland with majority of Greenland population in Baffin Bay	LC	LC	high	yes

[a] Importance of study area to population (conservation value) indicates the significance of the population occurring within the assessment area in a national and international context as defined by Anker-Nilssen (1987).(Source: DCE 2011)

Notes: CR= Critically Endangered, EN=Endangered, NT=Near Threatened, VU=Vulnerable, LC=Least Concern, DD=Data Deficient; VEC= Valued Ecosystem Component; n/a = not applicable

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Bowhead Whale (*Balaena mysticetus*)

Bowhead whales are closely associated with sea ice. They are the only baleen whale known to remain year round in Arctic waters (DCE 2011). Individuals that occur in West Greenland are part of a population that extends from Foxe Basin through the Canadian high-Arctic archipelago, Hudson Bay and Hudson Strait, and along the east coast of Baffin Island (Heide-Jørgensen et al. 2006).

Although some individuals have been reported to winter in the North Water polynya, core wintering areas for this population are located in Disko Bay, with animals arriving in February and concentrating near Disko Island. In late spring (May to June), whales begin their movement north following a migratory corridor that extends in a northwest direction across Baffin Bay, with animals likely using leads and cracks in the pack-ice (Heide-Jørgensen et al. 2003d, 2006). It is at this time of the year when migrating bowhead whales may be present within the Qamut Block. In July, the majority of the population resides in waters off the east coast of Baffin Island. In August, whales begin their migration westwards to the Canadian Arctic archipelago and northern Hudson Bay and Foxe Basin (Figure 4.2-4).

Although considered one population, there is evidence of considerable age and sex segregation between the Hudson Bay and Foxe Basin region and the northwest Greenland region. Adult whales are the dominate sex observed in Baffin Bay and Disco Bay during winter (Heide-Jørgensen et al. 2010b), while mothers with calves and juveniles occur almost exclusively in the Foxe Basin region. Mating is believed to occur in March to April in Disko Bay (Reese et al. 2001).

Bowhead whales are highly specialized filter feeders of small zooplankton prey (Burns et al. 1993). They are seasonally dependent on substantial concentrations of zooplankton. Studies on the diet of bowhead whales indicate that they feed almost exclusively on calanoid copepods (Laidre et al. 2007, Heide-Jørgensen et al. 2010b).

The number of bowheads that migrate through Baffin Bay to their Canadian summering grounds was estimated in 2001 to 2002 at 6,344 (IWC 2008). Despite recent signs of recovery (Heide-Jørgensen and Laidre 2010), the present population size in Baffin Bay is likely much lower than its original size (Allen and Keay 2006).

Bowhead whales may be present within the Qamut Block from late May through June during their spring migration between Disko Bay and Arctic Canada.

4.2.5.2 Pinnipeds

Hooded Seal (*Cystophora cristata*)

Hooded seals are a highly migratory species. During spring (March to April), they concentrate in whelping areas off Newfoundland and in Davis Strait where breeding occurs on the pack-ice (Stenson et al. 1996). In late April to May, the majority of the population migrates to southeast Greenland to moult in June and July (DCE 2011), with some seals also dispersing into eastern Baffin Bay at this time. Following the moult in late July, most seals off southeast Greenland migrate to deep water areas off Davis Strait and Baffin Bay. Here, they forage along steep sections of the continental shelf, mainly preying on large fish (e.g. polar cod, Greenland halibut) and squid at depths of up to 1,500 m (Andersen et al. 2009). During these foraging excursions, seals rarely haul out, even when spending time in coastal areas. Hooded seals may be present in the Qamut Block at any time during the open water season (DCE 2011).

Harp Seal (*Pagophilus groenlandica*)

Harp seals are a highly migratory species and breed in similar areas and times of year as hooded seals. Whelping areas are found off Newfoundland where seals give birth on pack ice in March and undergo moulting in April. Following the moult, seals disperse between the eastern Canadian Arctic and the east and west coasts of Greenland. Seals in the Qamut Block and surrounding areas increases in numbers through the summer and early fall. Once sea ice begins forming in the late fall, these seals migrate back to waters off Newfoundland. They feed mainly on capelin (*Mallotus villosus*), polar cod, krill (*Thysanoessa sp*.) and amphipods (Kapel 1995). Any harp seals found in the Qamut Block belong to the West Atlantic population.

Ringed Seal (*Pusa hispida*)

Ringed seals are abundant throughout the year in eastern Baffin Bay (including the Qamut Block). They prey upon polar cod, Arctic cod, snail fish (Liparis sp.) and amphipods (Siegstad et al. 1998). During winter, adult

seals occupy lairs in fast ice where they maintain breathing holes and establish underwater territories while juveniles typically occupy pack ice areas. Pupping occurs during spring (March) with lactation lasting up to seven weeks (Hammill et al. 1991). Moulting occurs in June when seals spend extended periods hauled-out on the ice and are rarely seen in open water areas (DCE 2011). Average seal densities on the ice in June are 1.3 to 2 seals per square kilometre (Kingsley 1998). Post-moulting studies demonstrate that seals either move offshore to areas with 40% to 80% ice coverage, or remain close to shore near glacial fronts (Freitas et al. 2007).

Bearded Seal (*Erignathus barbatus*)

Bearded seals are widespread throughout the Arctic in shallow areas where they prey on fish and benthic invertebrates in water depths up to 100 m (Gjertz et al. 2000). They can be found in all parts of Eastern Baffin Bay throughout the year, including the Qamut Block.

During winter, bearded seals are typically found in recurring leads, or in polynyas. The breeding season occurs in spring (April to May). Females giving birth on pack-ice or along the ice edges with access to open water (DCE 2011).

4.2.5.3 Walrus (Odobenus rosmarus rosmarus)

Walrus off northwest Greenland are generally confined to continental shelf waters and localized, shallow banks (less than 100 metre deep) where they can access their preferred prey items – benthic bivalves (Mya sp., Macoma spp. and Hiatella Arctica). In winter, walrus have a restricted habitat for feeding and mating and congregate in leads and polynyas.

Two main wintering stocks exist in the Baffin Bay region. The majority of the Baffin Bay wintering stock is found in the North Water polynya where open water provides access to shallow bank feeding areas (Born et al. 1995). Walrus also winter in several areas close to the mainland coast (West Greenland wintering stock) along leads in the shear zone between fast ice and Baffin Bay pack ice (near Upernavik and Uummannaq). The latter wintering grounds are located east and southeast of the Qamut Block (Figure 4.2-5). In summer, most of the population is found along the coasts of the eastern Canadian Arctic (Ellesmere and Baffin Island), where groups of walrus haul-out at traditional sites on land in close proximity to shallow feeding grounds. Recent aerial surveys estimate walrus abundance during winter at 2,300 to 3,000 for the North Water stock (NAMMCO 2009), and 2,700 for the West Greenland stock (Heide-Jorgensen et al. 2010d).

4.2.5.4 Polar Bear (Ursus maritimus)

Polar bears in the Qamut Block belong to the Baffin Bay subpopulation (Taylor et al. 2001). Home ranges for this population are large, and combined, equal about 192,000 km^2 (DCE 2011). This is shown in Figure 4.2-6. The distribution of polar bears in Baffin Bay is linked closely with the presence of sea ice (Wiig et al. 2008). The annual land fast ice along the coast of Baffin Island and northwest Greenland begins to form in October and remains stable until July. Polar bears rely heavily on sea ice during this time as a platform for travelling, hunting, mating and resting (Stirling 1993, Taylor et al. 2001). They are particularly attracted to the edge of landfast ice (Ferguson et al. 2000) which provides habitat for several of their prey species, in particular the ringed seal and the bearded seal (Wiig et al. 2008). Polar bears have also been observed utilizing a major lead that forms each winter in a recurring shear zone between Holm Island and Cape York (Born et al. 2011, DCE 2011, Taylor et al. 2001). This lead is frequented by ringed seals, and also serves as a spring migratory corridor for other prey species such as narwhals and belugas.

During late spring, when consolidated pack ice in central Baffin Bay is diminished, the majority of polar bears follow the retreating ice westward to spend the open-water season on Eastern Baffin Island (NERI 2009a, Taylor et al. 2001). Some polar bears have also been reported in Melville Bay during the open water season when ice has remained in this region over the summer (DCE 2011).

The Baffin Bay subpopulation was estimated in 1997 at 2,074 individuals (Taylor et al. 2001). This number is thought to have recently declined due to over-exploitation (DCE 2011).

Table 4.2-2 Overview of Marine Mammal Species found within the Qamut Block

Common Name	Species	Seasonal Occurrence	Habitat	Occurrence in Project Area	Greenland Red List Status	IUCN Listed Status	Importance of Qamut Block and surrounding area to population[a]	VEC
Narwhal	*Monodon monoceros*	year-round	winter: deep water / edge of banks summer: fjords / coastal waters	abundant in summer	CR	NT	high	yes
Beluga	*Delphinapterus leucas*	winter (Nov-May)	banks	migratory	CR	NT	high	yes
Bottlenose whale	*Hyperoodon ampullatus*	summer	deep water	rare	n/a	DD	low	no
Killer whale	*Orcinus orca*	June-August	coastal / offshore	infrequent	n/a	DD	low	no
Harbour porpoise	*Phocaena phocaena*	April-November	coastal waters	infrequent	n/a	LC	low	no
Long-finned pilot whale	*Globicephala melas*	June-October	deep water	infrequent	LC	DD	low	no
White-beaked dolphin	*Lagenorhynchus albirostris*	summer	continental shelf waters	infrequent	n/a	LC	low	no
Sperm whale	*Physeter macrocephalus*	May-November	deep water	infrequent	n/a	VU	low	no
Bowhead whale	*Balaena mysticetus*	February-June	pack ice / marginal ice zone	locally abundant migrant and winter visitor	NT	LC	medium	yes
Minke whale	*Balaenoptera acutorostrata*	April-November	coastal waters and banks	fairly common in open water conditions	LC	LC	low	no
Blue whale	*Balaenoptera musculus*	July-October	edge of banks	infrequent	DD	EN	low	no
Fin whale	*Balaenoptera physalus*	June-October	edge of banks, coastal waters	fairly common in open water conditions	LC	EN	low	no
Sei whale	*Balaenoptera borealis*	June-October	offshore	occasional in open water conditions	DD	EN	low	no
Humpback whale	*Megaptera novaeangliae*	June-November	edge of banks, coastal waters	fairly common in open water conditions	LC	LC	low	no
Polar bear	*Ursus maritimus*	year-round	drift ice and ice edges	relatively common and mainly when ice is present	VU	VU	high	yes
Walrus	*Odobenus rosmarus*	year-round	polynyas, marginal ice zone, shallow water banks	migratory	EN / CR	DD	high	yes
Hooded seal	*Cystophora cristata*	June-October	deep water	abundant	LC	VU	medium	yes
Bearded seal	*Erignathus barbatus*	year-round	ice-covered waters	abundant	DD	LC	medium	yes
Harp seal	*Pagophilus groenlandica*	June-October	ubiquitous	abundant	LC	LC	medium	yes
Ringed seal	*Pusa hispida*	year-round	ice-covered waters	abundant	LC	LC	high	yes

[a] Importance of study area to population (conservation value) indicates the significance of the population occurring within the assessment area in a national and international context as defined by Anker-Nilssen (1987).

Notes: CR= Critically Endangered, EN=Endangered, NT=Near Threatened, VU=Vulnerable, LC=Least Concern, DD=Data Deficient,VEC=Valued Ecosystem Component; n/a = not applicable.

Source: DCE 2011.

4.2.6 Protected Areas

Measures have been taken by the Greenland Government as well as international organizations to identify, evaluate and protect areas of biological importance in Greenland's marine and coastal environment. This section provides an overview of internationally and nationally protected areas located in eastern Baffin Bay in relation to the Qamut Block. These areas are shown in Figure 4.2-7.

The Government of Greenland has identified several "Areas Important to Wildlife" where mineral and petroleum exploration and extraction activities are regulated in accordance with the Mineral Extraction Act. These areas include polar bear protection areas within Melville Bay, seasonal protection areas for narwhals in relation to seismic activities, and protective boundaries for seabird colonies (moulting areas and adjacent buffer zones).

The Greenland Government passed regulations for polar bear management as part of the 'Greenland Home Rule Executive Order no. 21 of 22 September 2005 on the Protection and Hunting of Polar Bears.' Under this legislation, the Melville Bay Nature Reserve is designated a wildlife protection zone, where restrictions have been placed on hunting, fishing, egg collecting, passage, sailing, and air transport below 500 metres altitude. Only permanent residents from the municipalities of either Upernavik or Avanersuaq with valid status as occupational hunters are permitted to conduct traditional[1] hunting and fishing in the outer boundary of the reserve (Protection Border I). Within the Reserve, it is prohibited to hunt females accompanied by one or more cubs, or to disturb denning polar bears. The quota system dictates the permitted harvest level and hunting period within this area. The northeast boundary of Qamut Block is roughly 30 to 40 km west of the Melville Bay Nature Reserve (closest or nearest portion).

Four Narwhal Protection Zones (NPZ) have been designated in the Baffin Bay region (DCE 2011). These zones are shown in Figure 4.2-7. The northeast margin of the Qamut Block overlaps with the western margin of NPZ-I.

No bowhead whale protection zones have been designated in the Baffin Bay region. However, the winter feeding and mating grounds in Disko Bay are considered one of the most important bowhead whale habitats worldwide (DCE 2011). Bowhead whales may transit through the Qamut Block in late May during their spring migration from Disko Bay to the Eastern Canadian Arctic.

There are no designated protection zones for seals in eastern Baffin Bay (DCE 2011). However, stable ice during the whelping/nursing period is considered critical habitat for all four seal species in Greenland.

Protection zones for walrus in Eastern Baffin Bay are limited to two established wintering grounds located north of the Qamut Block in the Qaanaaq region.

Eleven sites throughout Greenland have been identified by the Government of Greenland for inclusion in the Ramsar list of Wetlands of International Importance (Ramsar sites) (DCE 2011). None of these sites occur within the Qamut Block. Six protected seabird breeding sanctuaries have been identified along the coast of northwest Greenland, in accordance with Greenland's Bird Protection Executive Order. Additional protection zones have also been designated around critical nesting areas (e.g., murre and eider colonies) and moulting sites along the coastline (Figure 4.2-7). None of the protected areas occur within the Qamut Block. It is possible individuals from the colonies may transit through the area during foraging and migratory trips. Eighteen Important Bird Areas (IBA)[2] also occur in eastern Baffin Bay. None of these occur within the Qamut Block, although three IBAs are located north of the proposed survey area: Parker Snow Bay, Appat Appai, and the coastline between Appaliarsulissuaq and Kap Atholl (Birdlife International 2011; Figure 4.2-7).

1 Traditional methods include taking or hunting of marine mammals, fish, birds, and eggs using small boats or dogsleds for transportation. The use of aircraft, helicopters, snowmobiles, and other motorized vehicles or vessels over 20 GRT/15 GT are prohibited. The use of traps, spring guns, or poison is prohibited. Firearms must have a minimum calibre of 7.62 mm.

2 Important Bird Areas (IBA) are sites recognized as being globally important habitat for the conservation of bird populations, as designated by Birdlife International, an international bird protection organization.

4.2.7 Species of Concern

Greenland Red-Listed Species potentially occurring within the Qamut Block include eight bird species and five marine mammal species, as described in Table 4.2-2. Species of National Responsibility[3] potentially occurring within the Qamut Block include six bird species and three marine mammal species (Table 4.2-3).

Table 4.2-3 Summary of Species of Concern Potentially Occurring in the Qamut Block

Common Name	Species	Species of National Responsibility	Greenland Red List Status	IUCN Red List Status
Narwhal	*Monodon monoceros*	yes	CR	NT
Beluga	*Delphinapterus leucas*	no	CR	NT
Bowhead whale	*Balaena mysticetus*	no	NT	LC
Polar bear	*Ursus maritimus*	yes	VU	VU
Walrus	*Odobenus rosmarus*	yes	CR[(a)]/EN[(b)]	DD
Greenland white-fronted goose	*Anser albifrons flavirostris*	yes	EN	LC
Brent goose	*Branta bernicla*	yes	LC	LC
Common eider	*Somateria mollissima*	yes	VU	LC
Black-legged kittiwake	*Rissa tridactyla*	no	VU	LC
Iceland gull	*Larus glaucoides*	yes	LC	LC
Sabines gull	*Larus sabinii*	no	NT	NT
Ivory gull	*Pagophila eburnea*	no	VU	NT
Arctic tern	*Stena paradisea*	no	NT	LC
Thick-billed murre	*Uria lomvia*	no	VU	LC
Alantic puffin	*Fratercula arctica*	no	NT	LC
Black guillemot	*Cepphus grylle*	yes	LC	LC
Little auk	*Alle alle*	yes	LC	LC

(a) West Greenland Stock

(b) North Water polynya Stock

Notes: CR= Critically Endangered, EN=Endangered, NT=Near Threatened, VU=Vulnerable, LC=Least Concern, DD=Data Deficient.

Source: DCE 2011.

4.3 Land and Sea Use

Greenland residents have a strong connection to the environment through hunting and fishing locally-available renewable resources. These practices have endured historically as part of the Greenlandic culture, and provide the basis for food production and economic benefit at both the household and commercial level. Fishing and hunting are the main industries in Greenland (Kolte S. 2011), although employment in these trades is limited to about 2,500 people (including fish processing facilities). The hunting and fishing industry in Greenland is regulated under the Department of Fisheries, Hunting and Agriculture in which hunting and fishing quotas are set annually by the Greenland Government (Greenland Government 2011).

The Qamut Block in Eastern Baffin Bay covers an area of 9,392 km$^{2.}$ The nearest community is Savissivik, located about 60 km north of the Qamut Block and about 110 km south of the US Air Force Base at Thule. Savissivik has a population of about 58 residents. The main source of income in the community comes from hunting and fishing.

4.3.1 Commercial Fisheries

Commercial fisheries represent the most important export industry in Greenland, with northern shrimp, Greenland halibut and snow crab fisheries accounting for 77% of Greenland's total domestic export revenue in 2006 (2.3 billion DKK) (DCE 2011). The commercial fishing industry supports approximately 1,500 jobs in the fish processing industry, as well as many other jobs in affiliated sectors including retail, tourism, and service industries.

3 Those species where the majority of a species' global population resides in Greenland and local management practices are vital to the overall population.

Fishing is administered by the Government of Greenland through quotas and licenses regulating the total allowable catch (TAC) for commercial fish species in Greenlandic Waters. The annual TAC is set based on scientific advice from GINR and several international organizations (e.g., North Atlantic Fisheries Organization (NAFO), North East Atlantic Fisheries Commission (NEAFC), International Council for the Exploration of the Sea (ICES)), as well as consultation with local Greenlandic stakeholders (e.g. KNAPK - Organization for Fishermen and Hunters in Greenland). The TAC is distributed in the form of quotas to individual units of the fleet. In West Greenland, commercial offshore fisheries are conducted by a limited number of operators, including four Greenlandic operators (nine vessels in total), one vessel from the European Union (EU), one vessel from the Faroe Islands and an unknown number of vessels from the Russian Federation (likely less than four vessels due to limited quotas allocated to these ships) (GFLC 2011).

The most important fisheries in Greenland are northern shrimp and Greenland halibut. From 2008 to 2010, annual revenue for the commercial northern shrimp fishery averaged 685 million DKK per year, while annual revenue for the Greenland halibut fishery averaged 204 million DKK per year (Figure 4.3-1) which is equivalent to approximately 62% and 18% of Greenland's total fish export revenue, respectively (Statistics Greenland 2011). Commercial fisheries for Greenland halibut and northern shrimp in West Greenland take place from late June until late September. Annual catch estimates for northern shrimp in Greenlandic waters is over 120,000 tonnes (Statistics Greenland 2011). The fishery mainly occurs along the banks of Davis Strait (west Greenland) and in southern Baffin Bay. In West Greenland, 57% of the TAC for northern shrimp is allocated to the offshore fleet with the remaining 43% allocated to the in-shore fleet (Statistics Greenland 2011). From 2004 to 2006, less than one percent of the total northern shrimp fishery in Greenland occurred in waters north of 71° latitude, compared with up to 30% in previous years (1985 to 1988) (DCE 2011). However, GFLC has observed a northward shift in both fisheries in recent years, with the Greenland halibut fishery presently focused between Disko Island and the Svartenhuk Peninsula and the northern shrimp fishery focused between Sisimiut and Upernavik (GFLC, 2011). No commercial fishery for Greenland halibut or northern shrimp presently exists in the Qamut Block (Figure 4.3-1).

The commercial snow crab fishery in Greenland takes place between 62 to 72° latitude, with the catch limited to large males. The snow crab fishery peaked in 2001 with an annual catch record of 14,247 tonnes (Statistics Greenland 2011). The fishery has declined in recent years potentially due to overharvesting, with the 2008 catch record reported at 2,169 tonnes (Statistics Greenland 2011). No commercial snow crab fishery presently exists in the Qamut Block.

Based on available fisheries records from DCE and GFLC, no commercial fisheries exist north of Nuussuaq. A test fishery for Greenland halibut was carried out west of the Qamut Block between 2005 and 2007. The halibut catch locations identified west of the Qamut Block in Figure 4.3-2 represents halibut test fishing locations and not commercial fishery activities.

4.3.2 Subsistence Fishing

Subsistence fishing is considered an important contribution to the daily household, especially in the settlements. Fishing takes place all year and are concentrated in inshore waters of local fiord systems close to the settlements. During winter (December to May) when dog sleds or snowmobiles can be used for travelling on the sea ice, long lines and nets are used for fishing Greenlandic halibut along ice edges or through holes in the ice. In the open water period (summer), fishing for Greenlandic halibut is supplemented with a fishing for wolfish (*Anarchicas minor*), Atlantic cod, and to a lesser degree, Arctic char. Salleq Island, located south of Savissivik, is the southernmost limit for local subsistence fishing (Qaasuitsup kommunia 2011).

4.3.3 Subsistence Hunting

The Greenland Ministry of Fisheries, Hunting and Agriculture set the annual harvest quotas for whales, walrus, and polar bear for each of its municipalities. Quotas are based on international agreements and biological advice from GINR (Statistics Greenland 2011). Whale quotas are as follows: 310 narwhal whales, 310 beluga whales, 230 mink whales, 10 fin whales, 2 bowhead whales and 9 humpback whales (APNN 2011). Hunting and fishing regulations within Greenland's land and sea territory are described in the Greenland Parliament Act No. 12 dated 29 October 1999. According to Section 4 of the government document, only persons with permanent attachment to Greenland and with appropriate documentation can be granted a recreational or commercial hunting permit/license (APNN 2011). As well, only occupational hunters are allowed to participate in the whale quota

harvest for species such as humpback whales, fin whales (NANOQ 2011). Several seal and bird species, as well as reindeer and musk ox, can also be hunted with a recreational licence.

In the period 2005 to 2010, an annual average of 153,000 seals, encompassing all species, were caught in Greenland. Of this harvest, roughly 34% were caught in the Eastern Baffin Bay area between Upernavik and Qaanaaq (Piniarneq 2012), indicating the importance of this resource in the area. Seals are considered one of the most important resources in Greenland contributing to the local household income and the maintenance of remote settlements. While seal skins are either sold for further processing or used by hunters for clothing, their principle use is for household consumption (KNAPP 2011).

The current population of seven to eight million seals (all species) is considered to be higher than historic levels (Hammill and Stenson 2010). The majority of seals hunted are juveniles (Christiansen 1983) with a peak in hunting observed in late summer in areas north of 74° latitude (DCE 2011).

Ringed seals are the most commonly hunted seal in Greenland. The present annual harvest of ringed seal in northwest Greenland is considered sustainable with a catch of approximately 50,000 seals per year. Harp seal are the second most important hunted seal in the Eastern Baffin Bay area, with annual catches in the order of approximately 10,000 animals. A limited number of bearded seals and hooded seals are also caught every year (< 5,000 pcs) (Piniarneq 2012).

Walrus numbers are estimated at 2,300 to 3,000 for the North Water polyna stock (NAMMCO 2009) and 2,700 individuals for the West Greenland stock (Heide-Jorgensen et al. 2010d). Most walrus are hunted on their wintering grounds or during spring when animals move along the ice edge. Annual harvest quotas for the North Water polynya stock during the period 2007 to 2009 were 90, 80 and 75, respectively (DCE 2011). Annual harvest quotas for the West Greenland stock during the period 2007 to 2010 were 80, 65, 38 and 61, respectively (DCE 2011). Recent satellite telemetry studies indicate that walrus in the West Greenland area and south-eastern Baffin Island area are part of the same population, which is hunted in both Greenland and Nunavut (NAMMCO 2009, Dietz et al. 2010).

Marine mammals are legally hunted along the coast in the Savissivik area. Polar bears are the species most valued by residents. Hunting generates more household income than fishing in this community, although the latter has become more common in recent years. During spring, hunters typically target ringed seal and bearded seal. In summer, narwhal and beluga are taken by hunters in kayaks as boat hunting is not permitted in this region. The 2012 annual quota for the Savissivik region is 18 narwhal and an unidentified number of belugas. Polar bear and occasionally walrus are hunted during winter when ice conditions permit travel by dog sled or snowmobile.

4.3.4 Other Vessel Traffic

Non-Project vessel traffic in or adjacent to the Qamut Block is expected to be low during the summer/fall period, but some aspects of this traffic are not predictable at this time, and may not be known before they occur (specifically, voyages related to military operations). Other non-Project vessels may include: cruise ships operating in Greenlandic waters only, or calling at ports in Greenland en route to or from destinations to the west via the Northwest Passage; merchant ships en route to or from destinations in Arctic Canada; merchant ships heading to or from ports along the West Greenland coast; Danish military (naval) ships; US Military Sealift Command vessels heading to and from the US Air Force Base at Thule, or US Navy ships (including submarines) operating in northeast Baffin Bay for other purposes, US Coast Guard or Canadian Coast Guard ships transiting to or from areas to the west via the Northwest Passage; and commercial fishing vessels.

Shell Kanumas A/S and Maersk Oil Kalaallit Nunaat A/S will be operating a number of ships in northeast Baffin Bay during the 2012 summer/fall navigation period. It is possible that some of the vessels under charter to Shell Kanumas A/S may transit Qamut Block en route to (stratigraphic drilling) locations to the north.

4.3.4.1.1 Cruise Ships

The number of cruise ships in Greenland waters has increased in recent years, including vessels operating in Greenlandic waters only, and vessels calling at Greenland ports en route to or from the central or western Canadian Arctic. The majority of these ships visit Greenland during summer (June to September), and transit

along designated traffic corridors. Most cruise ships visit a number of Greenlandic ports during these voyages. In 2011, approximately 110 landings were made at various ports in the Disko Bay and Melville Bay regions. Approximately seven landings are scheduled for 2012 near the Qamut Block, including one landing in Savissivik and six landings near Qaanaaq/Siorapaluk.

4.3.4.1.2 Merchant Ships

Royal Arctic Line (RAL) A/S is a Greenlandic shipping company headquartered in Nuuk and owned by the Government of Greenland. The RAL operates international cargo services from Nuuk and Aalborg, as well as domestic passenger/cargo vessels between the towns and villages of Greenland. The transportation of goods to and from Qaanaaq, Savissivik, Siorapaluk, Qeqertaq and Pituffik takes place once a year during summer using a vessel from Nuuk. Detailed information on RAL shipping activities for 2011 is provided in RAL's master schedule (RAL 2011). No information is available on foreign-flag cargo ships transiting to or from the US Air Force Base at Thule (Pifuffik).

4.3.4.1.3 Naval Ships

Island Command Greenland/MRCC Grønnedal has a number of naval vessels which act as patrol ships in Greenland territorial waters. A single offshore patrol vessel (OPV-class) is typically assigned to northern Baffin Bay and Melville Bay region during the open-water season, patrolling waters up to Nares Strait and Kane Basin. Vessel patrol activities are strongly influenced by local ice conditions (MRCC 2012 pers. comm.).

Various ships owned or under charter to the US Military Sealift Command, transport cargo to the US Air Force Base at Thule (Pituffik). This cargo includes jet fuel, diesel fuel, other petroleum products, shipping containers, heavy equipment and vehicles, building and construction materials, and secret or classified items. It is possible that cargo will be shipped from Thule, as "back haul", to ports in the United States or other countries. US Coast Guard ships, in addition to US Navy ships, have visited Thule in the past, and these vessels could do that again during the 2012 navigation period. If any of these ships call at Thule in 2012, it is possible they will transit Qamut Block en route to or from this location, depending on ice conditions to the north and northwest, and mission profile at time of passage.

4.3.4.1.4 Other Vessels

No commercial fisheries (Greenland halibut, northern shrimp, or snow crab) presently exist in the Qamut Block (Figure 4.3-2); it is therefore unlikely that commercial fishing boats will be operating in the Qamut Block during the summer "open water" period.

One GINR research ship will operate in the Eastern Baffin Bay/Melville Bay area during the open-water season conducting scientific work (halibut test fishery/noise buoy deployment) with the program scheduled to run until late September (GINR, 2012).

5 Methods Used for the Environmental Impact Assessment

5.1 Purpose and Approach

The purpose of an EIA is to determine whether the Project will have an effect on the environment, to identify the extent of these effects and to develop or specify the means to mitigate, or reduce where possible, the identified effects. Possible effects of the environment on the Project (for example local and regional marine conditions) are also addressed.

The environmental assessment methodology for the proposed Project has been developed to meet BMP regulatory requirements for hydrocarbon exploration and exploitation activities in offshore Greenland (NERI et al. 2011). The methodology entails a structured approach, which includes the following steps:

- Develop the scope of assessment, including: selection of Valued Ecosystem Components (VEC), identification of Project activities with potential to interact with a VEC, and establishing temporal and spatial boundaries for the Project.
- Predict and evaluate potential impacts of the Project on selected VECs.

- Identify mitigation measures and monitoring procedures that have been developed and incorporated in the Project design to eliminate or reduce potential adverse impacts to the selected VECs.
- Determine a level of residual impact significance based on the combined effect of an outcome or consequence of the Project activity on the VEC and the probability that this event may occur.
- Provide the means by which the mitigation measures will be implemented and residual impacts managed, through the provision of an Environmental Protection Plan (EPP). This includes the development of monitoring plans and a mechanism for audit, review and corrective action.

5.2 Scope of Assessment

The environment considered for assessment purposes is described as follows:

- Physical Environment – physical oceanography, ice climatology (sea ice and glacial ice), marine air quality.
- Biological Environment – plankton, invertebrates, fish, seabirds and marine mammals (whales, seals, walrus, and polar bears).
- Land and Sea Use – subsistence hunting and fishing, commercial fisheries, tourism, other human activity, and other ship operations.

5.2.1 Selection of Valued Ecosystem Component

While all components of the environment are important, it is neither practical nor necessary to assess all plausible effects of the Project on every component of the environment. The assessment focuses on the environmental components that have the greatest relevance in terms of environmental value and sensitivity and which are most likely to be affected by the Project.

To achieve this focus, specific Valued Ecosystem Components (VECs) have been identified and selected as endpoints for the assessment. VECs are defined as components of the environment (e.g. species, population, biological event or other environmental feature) that are considered important to the local ecology and human population, have a national or international profile, and, if altered, would be of concern to regulators, general public, indigenous peoples, and other stakeholders (DCE 2011). The VECs that have been identified and assessed in the EIA are presented in Appendix E, Table E-1.

Belugas and narwhals were identified as VECs for the Project, as they are both listed species and their presence in Greenlandic waters is well documented (DCE 2011). For the purpose of the assessment, both species served as ‘indicator’ species for all toothed whales with associations to the Project area. As such, results from the effects assessment, and the mitigation measures proposed, are applicable to all toothed whale species potentially occurring in the Project area during the open-water season.

Similarly, bowhead whales were selected as an ‘indicator’ species for baleen whales for the same reasons. Results from the effects assessment, and the mitigation measures proposed, are thus applicable to all baleen whale species potentially occurring in the Project area during the open-water season.

5.2.2 Interaction of Project with the Environment

In the scoping stage of the assessment, Project activities were examined in order to identify those most likely to interact with the environment and potentially result in an adverse or positive impact. The potential for project interactions with VECs was based on a comprehensive review of the literature, information provided by the proponent including a summary of project-related activities; an appraisal of the environmental setting; temporal and/or spatial overlap; and professional judgment. Assessed activities included routine activities and unplanned (accidental) events.

Interactions carried forward in the assessment (Section 7) are identified in Appendix F, Table F-1. Negligible Project interactions are identified as such and are not considered further in the assessment.

5.2.3 Temporal and Spatial Boundaries of the Assessment

Spatial boundaries considered in the assessment include those areas within which VECs are likely to interact with, or be influenced by Project activities. The assessment considers two levels of spatial boundaries: the local study area (LSA) and the regional study area (RSA):

- the LSA includes those areas used in assessing Project-specific effects; and
- the RSA includes those areas used in assessing Project combined and cumulative effects.

The study areas selected were determined according to the spatial extent of the Project effects and the distribution and mobility of VECs. Some Project effects such as discharges and air emissions from the seismic survey vessel and chase or support ships, have the potential to affect a larger geographic area, whereas others, such as sound from the seismic operation, may affect a smaller area only, or a larger area, depending on the sound source and acoustic conditions at the time of survey. The cumulative effects of multiple seismic surveys that happen at the same time in northeast Baffin Bay, discussed in Section 5.3, including the seismic survey described in the EIA, apply to a large region

Delineation of the spatial boundaries for the assessment of underwater sound was based primarily on the potential zone of impact from Project-generated sound in water (sea) and associated activities. The LSA was defined as all waters within the License Block plus 10 km buffer zone, as this encompasses the acoustic zone of direct impact for potential physical injury (coincident with the 180 dB rel 1 µPa rms ensonificaiton zone) and potential behavioural effects (coincident with the 160 dB rel 1 µPa RMS ensonification zone). The RSA, coincident with all waters under Greenlandic jurisdiction in Baffin Bay, considers indirect as well as far-field regional effects of the Project on VECs, particularly Greenland Red-listed marine mammals.

Temporal boundaries considered in the assessment include the period from when seismic and support vessel(s) first arrive in the Qamut Block until the time all Project vessels have departed, following completion of the survey. Project activities have been assessed during the full life-cycle of the Project. The proposed period of operations is early August to mid-September, with an option of extending to mid-October if the seismic survey is delayed by weather conditions, ice conditions, sea conditions or other factors.

5.2.4 Determining Impact Significance

Following identification of the Project interactions with the environment and in consideration of mitigation measures including all Best Environmental Practices (BEP), the level of impact (impact significance) that may result from each of the interactions with the VEC's was assessed. In assessing impact significance, two main elements were considered: consequence and probability.

The consequence of an impact was categorized as: Negligible; Minor; Moderate; or Severe. It was determined from a number of parameters that describe the nature of the impact, including magnitude, geographic extent, duration, and frequency. Where possible, impact ratings were quantitatively described. Rankings used for each of these parameters are defined in Appendix G, Table G-1. A "decision tree" is used to demonstrate how the individual assessment measures are combined to yield a consequence rating (Appendix H, Table H-1).

Along with consequence, the second variable used to establish impact significance of an effect upon the environment was probability. Probability was defined as the likelihood of the impact occurring during the life of the Project after mitigation has been applied. The probability of impact occurrence was determined, and placed in one of the following categories: Certain (100% probability); Likely (50% to 99% probability); Unlikely (10% to 49% probability); and Rare (0% to 9% probability).

Impacts were rated based on the incorporation of Project mitigation measures to avoid or reduce potential effects. The assessment addresses those effects predicted to exist after mitigation, i.e., residual effects. To determine overall impact significance, impact consequence and impact probability were combined in a risk matrix, as shown in Table 5.2-1. The end result was an overall significance value ranging from 1 to 4: 1-Negligible, 2-Low, 3-Moderate, and 4-Significant. Impacts of negligible consequence were assigned the lowest significance value (1), regardless of impact probability. Effects rated as significant (those rated 4) require additional mitigation to reduce the impact to an acceptable level.

Table 5.2-1 Matrix Combining Impact Consequence and Probability to Determine Overall Impact Significance

Probability	Consequence			
	Negligible	Minor	Moderate	Severe
Certain (100%)	1	2	3	4
Likely (50%-99%)	1	2	3	4
Unlikely (10%-49%)	1	2	2	3
Rare (0-9%)	1	1	1	2

In the impact assessment Section, the assessment of each Project effect is presented separately. This includes information on the Project effect, involving VEC interactions, applicable mitigation measures, summarized in Section 8, Appendix I and Appendix J) and impact criteria rankings (based on impact significance).

6 Potential Impacts and Project Mitigation

6.1 Effects of Airborne Emissions from Project Vessels

The main sources of atmospheric emissions from the Project are exhaust gases from the diesel engines of the seismic survey vessel (MV *Princess*) and the two support vessels (MV *Thor Beamer* and MV *Thor Supplier*). Ancillary equipment (e.g., incinerators, compressor generators, other generator sets, etc) on these vessels will also result in emissions to the atmosphere. However, these emissions are expected to be intermittent and of smaller magnitude, compared to emissions from any vessel's main engines, and therefore, are not considered further in the assessment.

Table 6.1-1 presents an estimate of the fuel consumption for all Project vessels during survey operations in the Qamut Block, periodic refuelling voyages, and positioning to and/or from the Qamut Block. For the purposes of this estimate, the average operating speed and daily fuel consumption of each vessel was used to calculate the total fuel consumption. It was assumed that all Project vessels will be running on Marine Diesel Fuel.

During active seismic operations, all vessels were assumed to be operating 24 hours per day, 7 days per week. This period will be up to 45 days in length; it would begin in early August, and end by 1 October. A 15-day contingency was added to the 45-day survey period for assessment purposes only. This period does not include mobilization or demobilization time from last or next port (coming on or off charter).

The fuel capacities of the vessels identified for the Project imply, based on the survey period and option of extending into October if delayed, that some or many of the vessels may need to complete one voyage to Nuuk to re-fuel. It is also possible that the *Princess* will bunker, or re-fuel, by vessel-to-vessel transfer from one of the support vessels. This possibility was not taken into account for air emission calculations. For both the seismic vessel and support vessels, the transit time between Nuuk and Qamut Block was assumed to be 5 days round-trip (750 nautical miles x 2). Based on these assumptions, the total fuel consumption for the Project is estimated to be roughly 1,631 m^3 (Table 6.1-1).

Table 6.1-1 Estimated Fuel Consumption for Seismic Survey and Support Vessels during the Proposed 2012 Program

Vessel Activity	Vessel Name	Average Operating Speed [knots]	Daily Fuel Consumption [m^3]	Total Fuel Consumption [m^3]
Seismic Survey (60 days)	MV *Princess*	4.0	14.0	840.0
	MV *Thor Beamer*	6.0	1.1	66.0
	MV *Thor Supplier*	4.0	5.0	300.0
Mobilization / demobilization between Nuuk and survey Block (one 5-day round trip per vessel)	MV *Princess*	12.5	15.0	75.0
	MV *Thor Beamer*	12.5	6.5	32.5
	MV *Thor Supplier*	12.5	21.0	105.0
Fuel / resupply trip to Nuuk (one 5-day round trip per vessel)	MV *Princess*	12.5	15.0	75.0
	MV *Thor Beamer*	12.5	6.5	32.5
	MV *Thor Supplier*	12.5	21.0	105.0
Total				**1,631.0**

Table 6.1-2 provides an estimate of the air emissions from all Projects vessels during survey operations in the Qamut Block, periodic re-fuelling voyages, and the assumed positioning to or from the survey area. Table 6.1-3 provides an estimate of greenhouse gas emissions for the Project. Emission factors were used for calculating the associated emissions from the diesel engines based on fuel type and consumption (IVL SERI 2002, Environment Canada 2011). Actual emissions will vary between vessels (different engine types, age and condition, servicing and maintenance history) and change according to vessel speed and operating mode (e.g., transiting, manoeuvring during the survey, maintaining or keeping station, etc).

Table 6.1-2 Total Air Emissions for the Proposed 2012 Program

Emission Parameter	Emission Factor [kg emitted / tonne fuel consumed][(a)]	Total Emission during Seismic Program [tonnes]
PM	1.2	1.92
SOx[(b)]	30.0	48.00
NOx	87.0	139.20
VOC	2.4	3.84
CO	7.4	11.84

(a) Assumes fuel density for marine diesel fuel of 0.981 g/ mL or 0.000981 tonnes/L for calculations (EC 2006)

(b) Assumes sulphur content of 1.5% (maximum allowable sulphur content based on BMP guidelines, 2011).

Notes: CO = carbon monoxide; NO_X = nitrogen oxides; PM = particulate matter; SO_X = sulphur oxides; VOC = volatile organic compounds.
PM, SO_X, NO_X, VOC and CO emissions are calculated using Lloyds Register Engineering Services (1995) for slow speed diesel engines (Lloyds Register Engineering Services 1995 in IVL Swedish Environmental Research Institute Ltd 2002, Table II).

Table 6.1-3 Total Greenhouse Gas Emissions for the Proposed 2012 Program

Greenhouse Gas Parameter	Emission Factor [g emitted / L fuel consumed]	Total Emission During Seismic Program [tonnes]
CO_2	2,663.00	4,343.35
CH_4	0.15	0.24
N_2O	1.10	1.79
CO_2e^a	-	4,904.66[(a)]

(a) The greenhouse gas emissions have been combined and presented in terms of how much CO_2 would be required to produced a similar warming effect. The 100-year Global Warming Potentials (GWP) have been taken from Environment Canada, 2011: CO_2 GWP of is 1, CH_4 GWP of 21, and N_2O GWP of 310.

Notes: CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = Carbon dioxide equivalent.
CO_2, CH_4, and N_2O emissions are calculated using Environment Canada's (2011) Emission Factors for Marine Heavy Fuel Oil Ships (Annex 8, Table A8–11 of EC 2011).

Proposed Mitigation and Best Practices

Project vessels will comply with local and international pollution prevention regulations and best practices, including, but not limited to, the Minerals Resources Act of 2009, the Act on the Protection of the Marine Environment (1993) of Denmark and, where practical, best practices of the International Convention for the

Prevention of Pollution from Vessels (1973) as modified by the Protocol of 1978, MARPOL 73/78 (Annex VI), and various BMP Guidelines that govern the survey and other activity in Qamut Block.

The mitigation measures that will be adopted to reduce the potential impacts of Project vessel emissions on air quality include:

- Diesel engines, incinerators and other equipment onboard Project vessels will be maintained and operated efficiently.
- Ozone-depleting substances will not be used, except in refrigeration equipment where closed recovery systems are employed.
- Project vessels and equipment will use fuel with a sulphur content less than 1.5% (by weight).

Residual Effects and Environmental Significance

The impact assessment indicated that the effects of Project emissions on air quality will be negligible. Table 6.1-4 summarizes the impact ratings classifications for the residual effects of Project-related emissions on marine air quality. The magnitude of any effects is regarded as negligible because the emissions will be dispersed relatively quickly in the atmosphere. Emissions, including particulates in exhaust gases, could be transported outside the LSA by prevailing winds, but it is not likely these emissions will be detectable at any significant concentration by the time they reach the RSA. The frequency of occurrence, however, is continuous, but it is short-term, and therefore, the impact significance will be negligible (1).

Table 6.1-4 Summary of Impacts from Airborne Emissions on Air Quality

VEC	Potential Impact	Planned Mitigation	Impact Assessment Criteria				Consequence	Probability	Overall Significance
			Magnitude	Geographic Extent	Duration	Frequency			
Air Quality	change in ambient air quality concentrations of PM, SO_X, NO_X, VOCs and CO	Section 8.0 & Appendix I Table I-1	negligible	beyond regional	short-term	continuous	negligible	certain	1 (negligible)

No residual effects of emissions are expected beyond the RSA when the proposed mitigation measures are followed, and consequently, no further mitigation will be required.

6.2 Effects of Discharges from Project Vessels

The main sources of potential discharge from the Project are: liquids, including grey water (domestic wastewater), black water (sewage), drainage from decks and exposed (above waterline) structure due to spray and precipitation, cooling water, ballast water, and bilge water: and waste in solid form, including kitchen waste (organic waste and packaging materials), medical waste, potentially hazardous waste (including batteries), non-hazardous waste, and miscellaneous vessel's garbage. Table 6.2-1 summarizes the types of discharge and solid or liquid waste that could be generated on the seismic survey vessel (MV *Princess*) and the two support vessels (MV *Thor Beamer* and MV *Thor Supplier*).

Marine water quality in the Qamut Block should be characterized by low levels of pollutants and other contaminants, due to its remote location and distance from shore (at least 40 km), and the very small amount of maritime activity in this region, notwithstanding comments about vessel traffic under Land & Sea Use in Section 4.3. It is unlikely that unintended discharges to the sea during the Project, or any of allowed or regulated discharges, will affect water quality directly, or marine ecology indirectly, in a long-term fashion.

Table 6.2-1 Types of Waste Potentially Generated from the Project Vessels

Waste Type	Waste Stream	Potential Source	Potential Contents	Comments
Liquid Wastes	grey water	kitchen liquid wastes, bathing water, laundry facilities, deck drains and other non- oily waste water	detergents, soaps, chlorine	disposed at sea
	black water	sewage	microorganisms, nutrients, suspended solids, organic material, chlorine	treated onboard before disposal at sea to standards set out by Annex IV of Marpol
	potentially hazardous waste	waste lubricating oil, hydraulic oil, cable oil	hydrocarbons, heavy metals	stored onboard until proper disposal at the home port
Solid Wastes	medical waste	used first-aid materials, medication	bio-hazardous materials, sharp needles, glass, plastic	stored onboard until proper disposal at the home port
	kitchen waste	culinary activities, unused/uneaten foods	cooked and raw food	macerated and disposed at sea (at least 12 nautical miles/23 km from the coast)
	potentially hazardous waste	batteries, oil drums, filters	heavy metals, acids	stored onboard until proper disposal at the home port
	miscellaneous garbage	packaging, other materials	plastic, paper, glass	sorted by type, compacted where practicable and stored or incinerated onboard until disposal at a certified garbage or recycling reception facility at the home port

It is estimated that 15.2 m^3 of grey water and 1.9 m^3 of black water may be produced and discharged daily from the three Project vessels. These estimates assume that grey water and black water are produced at a rate of up to 254 litres and 32 litres per person per day respectively, based on average usage rates for cruise line operations (EPA 2008) and a probable (maximum) onboard complement of up to 60 persons (all vessels). These estimates are conservative; actual discharges are expected to be lower.

Grey water will be discharged directly to the sea during the Project as treatment of grey water is not required before release under MARPOL (73/78). This discharge may contain residual concentrations of chlorine, but in low or very low concentrations. Residual chlorine will react with organic matter in the upper part of the water column, and become inactive.

Black water (sewage) may contain harmful microorganisms, nutrients, suspended solids, organic material and residual chlorine from treatment. It will disperse and degrade in the environment. Discharge of black water and food wastes will increase Biological Oxygen Demand (BOD), but it is unlikely this will have any appreciable effect on dissolved oxygen content of seawater in the LSA, compared to natural conditions.

Ballast water may contain invasive (exotic) species in the water itself or on particulate. Release of ballast water is strictly regulated under the IMO Convention for the Control and Management of Vessel's Ballast Water and Sediments of 2004 (subject to its full ratification by 2016). This subject is addressed in Section 6.2, and not discussed further below.

Proposed Mitigation and Best Practices

All vessels will follow the Project-specific Waste Management Plan that is identified in the EPP as a supplementary or complimentary plan. Preparation of this plan has not been finished by ConocoPhillips, and it is not attached to the EIA.

Solid waste will be sorted by type, compacted where practical, and stored or incinerated onboard until it can be disposed of at a certified landfill or recycling reception facility in another country. ConocoPhillips will ensure that it is not be transferred to shore, and left at any location in Greenland. Disposal will occur at the home ports of the vessels involved when the Project is finished or at the first port of calling after these vessels leave waters under Greenlandic jurisdiction.

It is remotely possible that emergency waste disposal may be required at a port in Greenland. As a last resort, and with BMP permission, suitable facilities would be identified in Nuuk, and used for temporary handling and storage. ConocoPhillips would remove any waste handled and stored on an emergency basis as soon as practical, and inform BMP when this action is taken.

Food waste will be macerated and disposed at sea at least 12 nautical miles (approximately 23 km) from the nearest point of land. This will be done in accordance with the Act on the Protection of the Marine Environment (Part 7, 22-1, 1993), and Annex V of MARPOL (73/78) for "Special Area", given the sensitive nature and low likelihood of pollution in this region.

Sewage waste, as well as kitchen waste that cannot be macerated, will be treated onboard by all vessels prior to discharge, and will meet IMO standards, Annex IV of MARPOL (73/78).

Some capacity may exist on some vessels for collection and holding of drainage water in limited amount, but drainage from many elements of vessel's structure (above waterline) into the sea cannot be avoided. Decks will be kept clean to prevent drainage from mixing with oil stains, chemical stains, granular material or other residue on the surface of the deck. Bilge water, and any collected drainage water, would be routed through an oil-water separator, and monitored for oil concentration prior to discharge. This process would comply with the best practices of Annex I of MARPOL. Cooling water is part of a closed loop system, and water pumped or taken onboard for this purpose will not be contaminated or mixed with water from other sources before it is returned to the sea during normal operations.

A detailed account of the proposed mitigation measures for managing the effects of discharges to the marine environment is provided in the EPP (Section 8.0) and summarized in Appendix I.

Residual Effects and Environmental Significance

Solid waste (other than organic kitchen waste that can be macerated) will not be discharged into the marine environment. Consequently, no impacts on the environment will occur during normal operations, and hence, no impacts are expected.

The impact assessment indicated that the effects of vessel discharges on marine ecology will be negligible. Table 6.2-2 summarizes the impact rating classifications for the effects of discharges from vessels on VECs. These discharges will occur intermittently or frequently over the course of the Project into an offshore environment when sea ice is absent. The surface water involved in being transported to the west or northwest by the West Greenland Current in this region. It will be well-mixed during transport, even though the water column is more stratified during summer compared to winter. The effects of various discharges on BOD are considered to be negligible. The low amounts of residual chlorine and other harmful material, if any, in treated black water will be dispersed and diluted relatively quickly by mixing and other processes in the surface layer. It is not believed any discharges will result in measurable water quality changes compared to background levels in the LSA or RSA, recognizing that the properties involved have likely not been investigated or reported on in the past, and are not accurately known at this time. However, subsequent indirect adverse effects to marine ecology are not expected. The magnitude of the impact is considered negligible for all VECs, with a short-term duration over a local geographic extent and intermittent to regular frequency, depending on the discharge in question. The consequence is considered negligible. Although the probability of the activity resulting in the effect is rated as likely, the overall impact significance will be negligible. Since residual effects from discharges are expected to be negligible, no further mitigation is required.

Table 6.2-2 Summary of Impacts from Discharges on VECs

VEC	Potential Impact	Planned Mitigation	Impact Assessment Criteria				Consequence	Probability	Overall Significance
			Magnitude	Geographic Extent	Duration	Frequency			
Water Quality	deterioration of water quality	Section 8 (Waste Management Plan) & Appendix I Table I-1	negligible	local	short-term	regular	negligible	likely	1 (negligible)
Marine Fish	indirect effects from the deterioration of water quality		negligible	local	short-term	regular	negligible	likely	1 (negligible)
Seabirds	indirect effects from the deterioration of water quality		negligible	local	short-term	regular	negligible	likely	1 (negligible)
Marine Mammals	indirect effects from the deterioration of water quality		negligible	local	short-term	regular	negligible	likely	1 (negligible)

6.3 Effects of Underwater Sound on the Marine Environment

6.3.1 Introduction

The potential impacts from underwater sound from the seismic survey, ship's engines and onboard activities on marine invertebrates, marine fish, marine birds, and subsistence hunting and fishing are assessed in this section.

There is little known about the ambient (natural) acoustic conditions in northeast Baffin Bay. Measurements on ambient sound are not available in the public domain, or have not been obtained or published to date. It is believed that ambient sound levels are relatively high due to the break-up and movement of sea ice, iceberg calving, iceberg behaviour during transport (including fracturing and degradation, as well as scouring or gouging and grounding), sound from marine mammals, and sound from the existing pattern of maritime activity in these waters, including the commercial fishing fleet, the coastal trade, and other shipping.

6.3.2 Overview of Sound Terminology

Underwater sound can be described through a source-path-receiver model. An acoustic source emits sound energy that radiates outward and travels through the water and the seafloor as pressure waves. The sound level decreases with increasing distance from the acoustic source as the sound pressure waves spread out under the influence of the surrounding environment. The amount by which the sound levels decrease between a source and receiver is called transmission loss. The amount of transmission loss that occurs depends on the source-receiver separation, the frequency of the sound, the properties of the water column and the properties of the seafloor layers, as described in Section 4.1.4.8 (Physical Environment). An animal senses the sound at a level that is dependent on the amount of transmission loss between the source and the receiver. The potential for impact depends on the received sound level and the frequency content of the received sound signal relative to the hearing abilities of the animal and the level of natural background sound. Potential effects range from subtle changes in behaviour at low received levels to strong disturbance effects to temporary hearing impairment and permanent hearing or physical damage at high received levels. Effects from sound exposure scale with the received sound level. Figure 6.3-1 provides a diagram of sound to receiver interaction.

Several metrics are commonly used to characterize sound pressure levels from impulsive sound sources such as airguns. For the present assessment, sound is quantified using the primary sound level metrics of peak sound pressure level (peak SPL), 90% root-mean-square sound pressure level (rms SPL), and sound exposure level (SEL). Underwater sound levels are expressed in decibels (dB) which is a logarithmic ratio relative to a fixed reference pressure of 1 µPa (equal to 10^{-6} Pa or 10^{-11} bar). Cumulative sound exposure level (cSEL) was also used in the assessment criteria for marine fish. cSEL provides a conservative measure that does not account for any hearing recovery that may occur between pulses.

Details of calculation methods used to determine SPL, peak SPL, peak to peak SPL, SEL and cSEL are provided in Appendix D.

6.3.3 Project Sound Sources

The Project sound sources assessed included activities surrounding the seismic survey and vessel sound. The two sources were assessed for marine mammals; however, only seismic activities were assessed for marine invertebrates, marine fish, marine birds, and subsistence hunting and fishing. Details of the Project sources and mitigitation applied can be found in Section 3.1, Section 8 and Appendix D and Appendix I.

6.3.4 Acoustic Behaviour in Arctic Waters

In Arctic waters, sound will attenuate quickly at the surface and then refract and travel at different speeds depending on water currents, water temperature and salinity structure, ocean surface, and chemical processes in the water (Figure 6.3-2). A complete discussion of acoustic behaviours in northeast Baffin Bay is discussed in Section 4.1.4.8 Physical Environment: Acoustic Conditions and Appendix D.

6.3.5 Underwater Acoustic Modelling

Two complementary acoustic models were used to predict the underwater sound field, surrounding the seismic airgun array: JASCO's Airgun Array Source Model (AASM) and JASCO's Marine Operations Sound Model (MONM). The AASM was used to model the airgun array pressure signatures and directional source levels (SL)

(MacGillivray 2006). The MONM was used to model the sound fields. Computed transmission loss values were then combined with the AASM source levels to generate received sound levels over a 3D grid. These models, methodology and results of the modelling are described in (Appendix D).

Full-area acoustic modeling was conducted using AASM and MONM for the full 3,940 in^3 airgun array proposed for use during the seismic survey (results provided in Acoustics Technical Report). Sound levels were modeled over a 305 km by 225 km grid for three different scenarios in August. These locations were chosen to sample the ranges of water depth in the area. The sources and source locations for each scenario are provided in Appendix D.

The modelled received levels were processed to provide sound level isopleth maps in terms of SEL, rms SPL, and peak SPL values. Tables showing distances to specific received sound levels were generated for m-weighted SEL, rms SPL and peak SPL values. Full model results for all the scenarios are found in the Acoustics Technical Report. The radii corresponding to the NMFS exposure criteria, in rms SPL, have been used in this assessment. Radii are presented here as computed in two ways: (1) R_{max}, the maximum range at which the given sound level was encountered in the modelled field grid; (2) $R_{95\%}$, the maximum range to a grid point at which the given sound level was encountered after exclusion of 5% of the farthest such points.

Based on the results from all of the scenarios considered, the maximum range (R_{max}) to an rms SPL of 180 dB re 1 μPa rms is 840 m (710 m $R_{95\%}$) for the full airgun array operating at Site 2. The R_{max} radii to 190 and 160 dB re 1 μPa rms are 230 m and 7,700 m (210 m and 6,400 m for $R_{95\%}$) respectively.

Impacts to the marine environment are discussed below. Only marine fish and marine mammals have acoustic criteria; therefore, the modelling discussed in this assessment applies mainly to those sections.

6.3.6 Marine Invertebrates

Hearing Abilities and Effects of Sound to Marine Invertebrates

Information on the hearing abilities of aquatic invertebrates is limited. Most available data for invertebrates is based on studies conducted on crustaceans and cephalopods (squid and octopods). It is generally thought that invertebrates are not capable of detecting sound given their lack of sound pressure-sensitive organs. However, cephalopods have special sensory structures that are considered to serve primarily for detecting acoustic stimuli (Budelmann 1992 Nixon and Young 2003). Cephalopods have been shown to respond to frequencies in the 100 Hz to 1,500 Hz range (Mooney et al. 2010, Hu et al. 2009). Crustaceans have been shown to be most sensitive to frequencies below 1,000 Hz (Budelmann 1992, Popper et al. 2001); although can detect sound as low as 40 Hz (Tautz et al 1981) and as high as 3,000 Hz (Lovell 2005, 2006).

Marine invertebrates, mainly crustaceans, are capable of producing sound by scraping, rubbing or snapping various parts of their bodies. These sounds may be associated with territorial behaviour, feeding, mating or aggression; and range in frequency from 87 Hz to 200 kHz (Au and Banks 1998, Tolstoganova 2002).

A limited number of studies assessing the impact of seismic operations on invertebrates have been reported in literature. These studies have tended to focus on potential impacts to macrobenthic species of commercial importance.

Several key studies have been conducted in this area. Crustaceans appear to have the highest tolerance to seismic sound and vibration. Cephalopods have the least tolerance and may be adversely affected by seismic sound and vibration. More information on the studies can be found in Norris and Mohl 1983, Matishov 1992, McCauley et al. 2000, Soldal and Lokkeborg 1993, cited in Dalen 1994 studies.

Residual Effects and Environmental Significance

Underwater sound generated by the proposed seismic survey will occur at frequencies which are detectable by some marine invertebrates (e.g. crustaceans). It is unlikely that the seismic operations would increase the mortality or injury of invertebrates unless the source is at close range (within 1 m) (Norris and Mohl 1983). Most invertebrates inhabit the benthic zone which is approximately 100 meters from the source (minimum water depths in the LSA). Furthermore, invertebrates are thought to be resilient to seismic activities because they lack internal gas-filled cavities normally susceptible to sound pressure effects. Effects would likely be limited to short-term

behavioural responses that would vary between species. The consequence of the effect of sound on invertebrates was considered to be minor based on a low magnitude impact restricted to the LSA and occurring over a short duration (survey period). The probability of the effect occurring was considered to be unlikely, resulting in a low (2) overall impact significance rating. Table 6.3-1 summarizes the impact rating classifications and overall significance for the effects of seismic sound on marine invertebrates.

6.3.7 Marine Fish

Hearing Abilities and Effects of Sound on Marine Fish

It is well known that fish use sound for communication, detection of predators and prey and learning about their environment (Popper and Fay 1999, Zelick et al. 1999, Fay and Popper 2000, Popper et al. 2003). All fish species can hear with varying degrees of sensitivity within the frequency range of sound produced by seismic sources and other industrial sound sources (Hawkins 1973, Popper and Fay 1973, Tavolga et al. 1981, Fay 1988, Popper and Fay 1993, Fay 2000). The hearing range for most fish is believed to be in the frequency range of 100 to 1,000 Hz (Fay 1988). A smaller number of species can detect sounds to over 3,000 Hz, while a very few can detect sounds to well over 100 kHz. Because of wide differences in hearing capability and morphologies among fish species, behavioural responses and the susceptibility of fish to auditory trauma varies greatly.

There is considerable anatomical and physiological variation amongst fish with respect to hearing structures, suggesting that various species may detect and process sound in different ways (Popper and Fay 1993). Fish can be divided into two broad categories: hearing generalists and hearing specialists (Popper et al. 2003, Ladich and Popper 2004).

Hearing generalists are fish species without any auditory system specializations. They have relatively poor auditory sensitivity characterized by a narrow bandwidth of hearing; typically detecting sounds from below 50 Hz up to 1 or 1.5 kHz (Popper et al. 2003). This includes most bottom-dwelling species such as Greenland halibut. (Popper et al. 2003). The majority of fish species that fall into this category generally do not hear frequencies much above 1 kHz, with peak sensitivities around 300 to 500 Hz (Ladich and Popper 2004). The sound pressure detection threshold can be as high as 120 dB re 1 µPa at the most sensitive frequency (Nedwell et al. 2004).

Hearing specialists have specialized auditory structures connected to well-developed pressure sensitive organs (Popper and Fay 1993). These morphological adaptations allow hearing specialists to detect sound pressure with greater sensitivity (i.e., lowering their hearing threshold) and in a wider bandwidth than “generalists”, and makes hearing specialists generally more sensitive to high-amplitude sound introduced into the marine environment. Polar cod and Arctic cod are both hearing specialist species and are likely to be present in the Qamut Block and surrounding area. Cod fish can detect both sound acceleration and sound pressure over a substantial frequency range, 20 to 150 KHz. Sound pressure thresholds in cod fish in the frequency range 60 to 300 Hz lie in the range 80 to 90 dB re 1 µPa.

Acoustic Impact Criteria for Marine Fish

National Marine Fisheries Service (NMFS) has established interim sound exposure criteria for the onset of direct physical injury in fish exposed to impulsive sound sources (Popper et al. 2006, Stadler and Woodbury 2009). These criteria were developed specifically for impact pile driving activities, although the criteria are based on measurements taken from different types of impulsive sound sources including airgun arrays. For the purpose of this assessment, these criteria were assumed to be representative of impulsive sound from seismic airgun operations.

NMFS criteria use two metrics, peak sound pressure level ($SPL_{0\text{-}peak}$) and cumulative sound exposure level (cSEL), for establishing the onset of physical effects to fish. NMFS sound exposure criteria are as follows: onset of physical injury in fish would be expected if either the peak SPL exceeds 206 dB re 1 μPa^2s, or the cSEL exceeds 187 dB re 1 μPa^2s for fishes 2 grams or larger; or 183 dB re 1 μPa^2s for smaller fishes.

There is no evidence of fish mortality as a result of seismic activity under non-experimental conditions. The threshold peak impulse sound pressure for direct physical trauma in marine fish is generally considered to be >200 dB (McCauley 1994). Except at close range, the effects of seismic sound sources on fishes are thought to be transitory, mainly evoking a startle response and changes in schooling behaviour (McCauley et al. 2003).

Habituation of fish to underwater sound has been shown to occur, with behavioural changes stopping during the exposure period, sometimes within minutes of commencement of surveying (Pearson et al. 1992).

McCauley et al. (2000, 2003) study suggests that exposure to multiple seismic pulses of 180 dB re 1 µPa or greater can result in significant damage to fish auditory structures.

In general, subtle behavioural changes in fish may be expected to occur at received peak pressures of 160 dB re 1µPa, and peak pressures of 180 dB or higher may cause noticeable changes in behaviour (Chapman and Hawkins 1969, Pearson et al. 1992, Skalski et al. 1992) or auditory trauma (McCauley et al. 2003). A number of other experimental studies have been performed to determine physical and behavioural effects of seismic activity on adult fish. The findings of these studies demonstrate that mortality rarely occurs beyond a range of five meters from the seismic source. Internal injuries tend to occur at received SPL of 220 dB µPa (which occurs at close range to the source) and auditory damage tends to occur at received SPL of 180 dB µPa (Turnpenny and Nedwell 1994). The pressure pulse is considered to be the most import contributor to tissue damage in fish.

Several key studies have been undertaken to assess the extent and type of injuries to fish eggs and larvae exposed to airguns. The results of these studies demonstrate that egg and larvae mortality and damage are highest at close range (within several meters of the airguns) and decrease rapidly with distance from the source. No physical effects were identified at distances of over 5 m from the source (Kostychenko 1973).

Residual Effects and Environmental Significance

Based on a review of the literature, it is expected that underwater sound generated by seismic activities will not exceed levels known to cause irreversible damage or death to fish (adults and eggs), except at close range (within approximately 10 m) to the source. Based on sound modelling results, peak sound pressure levels ($SPL_{0\ peak}$) for a single seismic pulse are predicted to exceed the injury threshold for fish (206 dB re 1 µPa) at distances up to 160 meters from the source. Multiple seismic pulses conducted over a 24-hour period revealed cSEL to exceed the injury threshold for fish > 2 grams (187 dB re 1 μPa^2s) at distances up to 1,950 meters offset from the survey line, and up to 4,950 meters from the survey line for fish < 2 grams (183 dB re 1 μPa^2s).

Sounds produced by the proposed seismic survey (100 to 1,000 Hz) coincide with the most sensitive frequency band of fish hearing. The potential for injury from seismic sound is thought to be minimal for Greenland halibut, given their status as hearing generalists and their preference for benthic habitat where sound effects would be less pronounced; however, they may exhibit behavioural responses (McCauley 1994). Polar cod and Arctic cod are more likely to be effected by seismic sound in the Qamut Block and surrounding area, as both species are hearing specialists and tend to occupy the upper to mid-water column. This is where sound effects would be greater due to the closer proximity to the sound source. As well, the frequency of seismic pulses fall in the peak hearing sensitivity for cod, at frequencies between 80 and 200 Hz with a sensitivity threshold of 80 to 100 dB re 1 µPa (Mitson 1995).

For all fish VECs in the Qamut Block and surrounding area, the magnitude of the effect of seismic sound was considered to be moderate because sound levels will likely exceed established thresholds for the onset of injury and behavioural changes. However, effects are not anticipated at the population level, as fish and ichthyoplankton (fish eggs and larvae) are generally widely distributed, and recovery, in terms of both diversity and abundance, occurs rapidly in response to localized impacts. Seismic sound impacts will be restricted to the LSA and will occur over the short-term (survey period) at a continuous frequency (assuming 24-hour shooting). The consequence of the effect of seismic sound on marine fish was thus determined to be minor for physical effects and moderate for behavioural effects for all fish VECs. With the application of mitigation (ramp-up), the probability for injury or mortality of fish was considered to be unlikely due to avoidance behaviour, and likely for behavioural effects, resulting in a low (2) and moderate (3) impact significance rating, respectively. In summary, effects will likely be limited to short-term behavioural responses (startle, displacement, and schooling behaviour), that will vary by species and hearing group, and will be dependent on the properties of the received sound. Table 6.3-1 summarizes the impact rating classifications and overall significance for the effects of seismic sound on marine fish.

Table 6.3-1 Summary of Impacts from Seismic Sound on Marine Invertebrates, Marine Fish, Seabirds, and Subsistence Hunting and Fishing

VEC	Potential Impact	Planned Mitigation	Impact Assessment Criteria				Consequence	Probability	Overall Significance
			Magnitude	Geographic Extent	Duration	Frequency			
Invertebrates	physical effects	Section 8.0 & Appendix I Table I-1	low	local	long-term	continuous	minor	unlikely	2 (low)
Marine Fish	physical effects	Section 8.0 (ramp-up procedures) & Appendix I Table I-1	moderate	local	long-term	continuous	minor	unlikely	2 (low)
	behavioural effects[(a)]		moderate	regional	short-term	continuous	moderate	likely	3 (moderate)
Seabirds	behavioural effects[(a)]	Section 8.0 (MMSO & PAM), Appendix I Table I-1 and Appendix J	negligible	local	short-term	continuous	negligible	rare	1 (negligible)
Subsistence Hunting and Fishing	declines/ species displacement	Section 8.0 & Appendix I Table I-1	moderate	regional	short-term	continuous	moderate	rare	1 (negligible)

(a) Includes displacement, avoidance and tolerance.

6.3.8 Marine Birds

Effects of Underwater Sound on Marine Birds

Limited experimental data has been collected on the reaction of birds to seismic operations. Based on studies available, it is generally assumed that seabirds are not sensitive to seismic surveys because they are able to avoid the seismic sound source (DCE 2011, Evans et.al. 1998, Lacroix et.al. 2003, Greene and Richardson 1988). Although some species dive underwater for prey, the majority of their time is spent on the water's surface or in flight, where they would not be affected by underwater seismic sound effects. Little information is known on the underwater hearing abilities of diving birds; however, it is likely limited to lower frequencies, and outside the ultrasonic range (DCE 2011). Diving birds may suffer damage to their ears if diving occurs very close to the airgun array. The presence of the seismic vessel itself will likely result in avoidance behaviour and therefore minimize this potential risk. Furthermore, the sensory cells of the inner ear in marine birds can regenerate following incidences of acoustic trauma causing hearing impairment, even after intense exposure (DCE 2011).

Residual Effects and Environmental Significance

The consequence of the effect was considered to be negligible based on a negligible magnitude impact (no measurable effects over baseline); restricted to the LSA and occurring over a short duration (survey period) and continuous frequency. The probability of the effect occurring was considered to be rare, resulting in a negligible (1) significance rating. Since the overall significance of the residual effect is negligible to marine birds, no further mitigation is required. Table 6.3-1 summarizes the impact rating classifications and overall significance for the effects of seismic sound on marine birds.

6.3.9 Commercial Fisheries

Effects of Underwater Sound on Commercial Fisheries

Seismic surveys may result in indirect effects on commercial fisheries in northeast Baffin Bay by potentially displacing or harming fish, and thus affecting catch rates.

Several studies have demonstrated that seismic operations can result in a reduction in fish catch rates. The results of these studies indicate that fish may avoid areas of seismic activities thereby affecting the catch rates of commercial fish species. It has been demonstrated that commercial fish species, including cod, tend to be displaced from fishing grounds when exposed to seismic sound. The extent of fish displacement is, however, considered to fall within the typical distance individual fish travel within their home range (Ryan 1979, Svendsen 1995, Arnold et al. 1994, Lokkeborg and Fernö 1999, Epseland et al. 2007) and vertically within the water column

(Arnold and Walker 1992, Godo and Michalsen 2000, Benoit et al. 2010). Recovery of pre-seismic catch levels have been demonstrated over a relatively short period of time (Lokkeborg 1991, Lokkeborg and Soldal 1993).

There is some evidence that exposure to seismic sound may drive some pelagic and demersal species to the seabed, rendering them more catchable by bottom trawling methods and thus having a positive effect on commercial fisheries (Lokkeborg 1991, Lokkeborg and Soldal 1993, Turnpenny and Nedwell 1994).

Residual Effects and Environmental Significance

There is presently no commercial fishery for any species in or near Qamut Block. Consequently, the effect of underwater sound on commercial fisheries in this region was not assessed during the EIA.

6.3.10 Subsistence Hunting and Fishing

Effects of Underwater Sound on Subsistence Hunting and Fishing

Seismic surveys can result in indirect effects on subsistence fisheries and hunting by potentially displacing fish and marine mammal species harvested by Greenlandic fishers and hunters. The Qamut Block and suurounding area does not overlap with traditional subsistence fishing areas, which mainly occur within coastal and fjord areas. The proposed seismic operations are therefore not anticipated to impact subsistence fishing activities in Northeast Baffin Bay.

In eastern Baffin Bay, belugas, narwhals, walruses, seal (ringed, harp, bearded and hooded), and polar bear are hunted at various times of the year (see Secton 4.3.3). The proposed entry date for the seismic operations is 01 August. The seismic program is predicted to take four to six weeks to complete. In Qaanaaq and Melville Bay, narwhals are caught in summer and hunters are restricted to using kayaks (boat hunting is not permitted in this region). The timing of the proposed seismic survey could overlap with the limited beluga and narwhal hunt that occurs in Melville Bay. The proposed seismic operations are not predicted to result in mortality or physical injury to marine mammals due to the proposed mitigation measures in place (see Appendix I and J). Airgun sound may; however, result in behavioural effects such as displacement of animals from traditional hunting grounds in Melville Bay.

Residual Effects and Environmental Significance

Due to spacing in time and location, no project sound effects are foreseen on local subsistence fishing as there is presently no subsistence fishing activities occurring in the Qamut Block. The environmental consequence of the effect of sound on subsistence fishing is considered negligible and the probability of this effect is rare, resulting in an overall impact significance rating of negligible (1).

The environmental consequence of underwater sound effects on subsistence hunting is considered minor (moderate magnitude, short-term duration, continuous frequency, and local geographic extent as sound will not travel outside the defined LSA at levels above the established NMFS behavioural threshold (160 dB re 1µPa rms). The probability of this effect occurring is considered unlikely based on a statistical review of historical catch rates as a function of seismic activity (see Appendix L), resulting in a low (2) impact significance rating. No adverse effects are expected on the ability of Greenlandic hunters to conduct subsistence hunts for beluga and narhwhal during the open-water season of 2012.

Table 6.3-1 summarizes the impact rating classifications for the effects of seismic sound on subsistence hunting and fishing.

6.3.11 Marine Mammals

The potential impacts of underwater sound to marine mammals depend, to a degree, on the type of marine mammal involved. The potential zone of impact of a man-made sound is also influenced strongly by the properties of ambient sound (Richardson et al. 1995). There is a large volume of literature concerned with the description of various impacts of underwater sound on marine mammals (McCauley 1994, Richardson et al. 1995, Davis et al. 1998, Gisiner 1998, Hildebrand 2005). Generally, these impacts are measured through observations of behavioural responses to sounds. These responses are used as a surrogate measure for sensitivity or susceptibility.

Extensive research efforts have been undertaken by the oil and gas industry, governments and other research institutions to understand the possible effects of seismic exploration activities on marine mammals (for a full review see Richardson et al. 1995, Gordon et al. 2004, Thompson 2000, Simmonds et al. 2004, Southall et al. 2007). A number of extensive reviews have drawn on limited experimental and observational data to indicate that additional studies are required. As the effects of seismic surveying on marine mammals are not fully understood, a precautionary approach is generally adopted for their protection, with mitigation measures aimed at preventing injury and minimizing the risk of biologically significant behavioural changes.

When considering the possibility for underwater sound to impact marine environments, the following factors were considered: 1) the species of interest must have a receptor system for detecting an sound signal; 2) for a sound signal to have a measurable effect on a receptor, the frequency content of that sound must overlap with the hearing range of the species of interest; 3) different types of sound (e.g. pulsed, intermittent, continuous) may have different effects; and 4) different effects may be elicited from an approaching sound source as compared to a stationary or departing sound source; and 5) the scale of the sound disturbance needs to be considered (e.g, number of sources, source levels, and duration of exposure).

6.3.11.1 Hearing Ability and Vocal Behaviour in Marine Mammals

Marine mammals are acoustically diverse, with wide variations in ear anatomy, frequency range, and amplitude sensitivity (Ketten 1991). An animal's sensitivity to sound varies with frequency. Response to sound likely depends strongly on the presence of and level of sounds in the frequency bands or range of frequencies to which the animal is most sensitive (Richardson et al. 1995). The general trend is that larger species, such as bowhead whales, tend to have better hearing sensitivities at lower frequency ranges than smaller species, such as belugas and narwhals. Hearing abilities are generally only well understood in certain captive species where audiograms (plots of hearing threshold at different sound frequencies) have been developed based on behavioural response studies (reactions to sound) and electrophysiological experiments (measuring auditory evoked potentials) (Erbe 2002).

Toothed Whales (Belugas and Narwhals)

The hearing abilities of belugas and narwhals at high frequencies are exceptionally well developed. This is likely related to their use of high frequency sounds for echolocation. Audible frequencies for toothed whales range from 80 Hz to 150 kHz, but they are most sensitive to sounds in the frequency range of 8 to 90 kHz (Richardson et al. 1995).

Belugas are considered 'mid-frequency cetaceans' (Southall et al. 2007); meaning their most sensitive hearing range occurs in the mid-frequency range. Using sound for foraging, navigation and social purposes, they are a highly vocal species with call types consisting of echolocation clicks, pulsed tones, whistles and noisy vocals. Echolocation clicks are produced in the 40 to 60 kHz and 100 to120 kHz range, with source levels reported at 206 to 225 dB re 1 µPa at 1 meter (Au 1993). Non-echolocation calls (e.g., whistles) are centered on frequencies below 6 kHz, but may sometimes attain frequencies up to 14 kHz (Schevill and Lawrence 1949, Sjare and Smith 1986), with dominant frequencies ranging between 400 Hz and 8.3 kHz. Belugas can detect frequencies as low as 40 to75 Hz; however their sensitivity at this range is quite poor (Awbrey et al. 1988). Beluga whales have been documented to communicate with one another at distances of over 300 to 500 meters (Bel'kovich and Shchekotov 1992).

No behavioural or electrophysiological audiograms are available for narwhals. Their vocalizations include echolocation clicks, pulsed tonal calls, and whistles. Narwhal echolocation sounds have been recorded at 40 kHz with source levels reported at 218 dB re 1 µPa at 1 meter (Mohl et al. 1990). Pulsed tones are produced in the 500 Hz to 5 kHz range and whistles have been reported in the 300 Hz to18 kHz range with dominant frequencies occurring at 300 Hz to10 kHz (Ford and Fisher 1978).

Baleen Whales (Bowhead Whales)

On a comparative basis, the baleen whale auditory system does not appear as specialized as that of toothed whales (Ketten 1997). Audiograms are not available for baleen whales due to the lack of these animals in captive settings which is required (based on current technology) in order to conduct behavioural and electrophysiological hearing studies. Hearing thresholds and frequency sensitivities in baleen whales are thus inferred from anatomical ear structure, vocalizations, and behavioural studies in the wild (Richardson et al. 1995). In general,

most baleen whale species have been shown to react to frequencies below 1 kHz (Richardson et al. 1995). They have an estimated auditory bandwidth of 7 Hz to 22 kHz (Southall et al. 2007).

Hearing in bowhead whales can be inferred indirectly by the frequency at which they vocalize and the levels of sound at which behavioural reactions occur. Bowhead whales have been shown to react to sound with dominant frequencies between 50 to 500 Hz (Richardson et al. 1995). Avoidance behaviour has been reported when bowheads were exposed to low broadband sounds of 90 dB re 1µPa (Richardson and Greene 1993). The majority of the sounds produced by bowhead whales are low frequency-modulated calls with reported frequency ranges of approximately 25 to 900 Hz (Ljungblad et al.1982, Clark and Johnson 1984, Cummings and Holliday 1987). Bowhead vocalizations include pulsive and tonal sounds, the latter either descending, ascending, constant, or inflecting in frequency (Clark and Johnson 1984). The duration of bowhead vocalizations range from short 0.5 second signals to long and melodic 4 to 5 second tones (Clark and Johnson 1984). Most single-note tones carry little sound energy above 400 Hz (Wursig and Clark 1993). Source levels from tonal moans and pulsive sounds range from 128 to 185 dB re 1 µPa at 1 m, with some vocalizations recorded by hydrophones up to 20 km away from calling whales (Clark et al. 1986).

Singing behaviour is considered to be an advanced form of vocalization in baleen whales (Clark 1991). Songs are composed of units, phrases, and themes; units sung in a sequence form phrases, a repetition of a phrase is a theme, and several themes combined create a song that can last several minutes (Payne and McVay 1971). Songs have been documented to change within and between seasons (Clark and Johnson 1984, Würsig and Clark 1993, Tervo et al. 2007).

Pinnipeds (Seals and Walrus)

Underwater hearing sensitivity in seals and walrus falls in between that of baleen and toothed whales with an estimated auditory bandwidth between 75 Hz and 75 kHz. Phocinid seals, such as the ringed and bearded seal, have underwater hearing thresholds between 60 and 85 dB re 1µPa, with flat audiograms between 1kHz and 30 to 50 kHz (Mohl 1968, Terhune and Ronald 1972, 1975, Terhune 1981). Some phocinids have been documented to be able to detect very high frequency sounds up to 180 kHz, although, their sensitivity to sounds above 60 kHz is poor and frequencies cannot be discriminated (Mohl 1968).

Ringed seal vocalizations include barks, clicks, and yelps, all of which occur in the 400 Hz to 16 kHz frequency range, with dominant frequencies concentrated above 5 kHz (Stirling 1973, Cummings et al. 1984). Source levels are between 95 and 130 dB re µPa, considerably lower in energy than other marine mammal vocalizations, and likely the reason why ringed seal vocalizations are generally only detectable within 1 km of the source (Cummings et al. 1984).

Bearded seals vocalize in the form of ‘songs’ that are presumed to be associated with territoriality and courtship (Ray et al. 1969, Budelsky 1993). Songs have been recorded at between 20 Hz and 6 kHz, with dominant frequencies occurring at 1 to 2 kHz, and source levels of 178 dB re 1µPa at 1 m (Ray et al 1969, Stirling et al 1983, Cummings et al. 1983). Unlike ringed seals, bearded seal vocalizations can be detected as far as 25 km from the source (Cleator et al. 1989).

Few studies have measured the audiogram of the walrus. In general, walrus have relatively sensitive hearing to low frequency sounds (Kastelein et al. 2002). A study of an 18-year-old captive walrus reported an optimal hearing range between 1kHz and 12 kHz, with maximum sensitivity (67 dB *re* 1 µPa) occurring at 12 kHz (Kastelein et al. 2002). Hearing sensitivity fell gradually below 1 kHz and dropped off sharply above 12 kHz (Kastelein et al. 2002). Walrus vocalizations include bell tones (male-specific), clicks, taps, knocks, rasps and grunts. The dominant frequencies of most vocalizations occur between 400 and 1200 Hz (Ray and Watkins 1975). Clicks and taps are produced in the 100 Hz to 10 kHz range, with dominant frequencies concentrated below 2 kHz. Rasps are produced in the 200 to 600 Hz range, with dominant frequencies occurring between 400 and 600 Hz. The dominant frequencies of grunts occur below 1 kHz (Scheville et al. 1966, Ray and Watkins 1975, Stirling et al. 1983). Vocalizations in walrus are typically associated with herd organization and coordination behaviour (Richardson et al. 1995).

Polar Bear

Little is known on underwater hearing abilities in polar bears. In-air hearing has been studied on captive subjects (using auditory evoked potentials to produce audiograms) demonstrating that polar bears can likely hear in-air at a slightly wider range of frequencies than humans (up to 25 kHz) and have absolute hearing thresholds below 27 to 30 dB re 20 μPa (Nachitgall et al. 2007).

6.3.11.2 Acoustic Impact Criteria

Standard injury and disturbance criteria are used to assess the potential for seismic survey sound to impact marine species. Assessment of the potential for seismic survey sound to impact marine mammals requires sound level thresholds against which received sound levels can be compared. The safety and disturbance sound threshold criteria currently applied to most Arctic marine seismic surveys in Canada and the United States are based on the rms SPL metric as adapted for impulsive sound sources (NMFS) (NMFS 1998). The safety threshold criterion for cetaceans is 180 dB re 1μPa (rms) and for pinnipeds is 190 dB re 1μPa (rms).

The National Marine Fisheries Services (NMFS) thresholds are intended to represent levels at which there is potential for auditory injury. Commonly, the 160 dB re 1μPa (rms) threshold has been used as a behavioural disturbance criterion for all marine mammals. Behavioural responses are not necessarily predictable from the level (loudness) of the sound source and may vary depending on factors such as age, status of the animal, type of activity it is engaged in, and social context (McCauley et al. 2000).

These criteria are understood to be conservative in terms of avoiding auditory injury to marine mammals and have been used throughout this assessment for determining potential for injury from exposure to single airgun pulses and from exposure to sound from the hydrographic survey. These criteria as they are expressed in rms pressure, they do not prevent exposure to high peak pressures (Madison 2005). They also do not take into account certain important attributes of the exposure such as duration, frequency, or repetition rate; nor do they account for the frequency-dependent hearing sensitivity of specific species. Sounds are less likely to disturb or injure animals if they are at frequencies where the animal has low hearing sensitivity. A recent panel report suggests that frequency dependence of hearing ability should be considered when establishing safety and disturbance sound threshold criteria (and corresponding safety radii) for seismic surveys (Southall et al. 2007).

In order to take into account the differential hearing capabilities of various groups of marine mammals, the M-weighting frequency weighting approach described by Miller et al. (2005) is commonly applied. M-weighting is similar to C-weighting (used for loud impulsive sounds on humans) in that it is a filtering system. M-weighting is used to present sound levels in a way that accounts for the hearing abilities of different marine mammals, by filtering out sound at frequencies outside of the most sensitive hearing ranges. The M-weighted levels characterize sound as it would be perceived by different animals. The M-weighting method accounts for sound frequencies extending above and below the most sensitive hearing range of marine mammals within each of five functional groups: low frequency cetaceans, mid-frequency cetaceans, high frequency cetaceans, and pinnipeds in water. The method to calculate M-weighting is provided in Appendix D.

Based on a review of available literature on marine mammal hearing and on the physiological and behavioural responses of marine mammals to man-made sound, Southall et al. (2007) have recently proposed alternative criteria for injury and behavioural disturbance in marine mammals. These alternative criteria are based on both peak pressure and sound exposure level metrics and take into account the type of sound (non-pulse, single-pulse, or multi-pulse), as well as the broad hearing capabilities of the marine mammals involved. These so-called "dual-criteria" are based on both the zero-to-peak SPL of the acoustic wave, expressed in dB re 1 μPa, and the total SEL, expressed in dB re 1 $\mu Pa^2 \cdot s$. A received sound exposure is assumed to cause injury if it exceeds either the peak SPL or the SEL criterion, or both.

For a multi-pulse source such as an airgun array, the injury criteria proposed were SPL: 230 dB_{peak} re 1 μPa (flat-weighted) for cetaceans, 218 dB_{peak} re 1 μPa (flat-weighted) for pinnipeds and SEL: 198 dB re. 1 μPa^2-s (M-weighted) for cetaceans, 186 dB re 1 μPa^2-s (M-weighted) for pinnipeds. A detailed description of the flat-weighted and M-weighted calculation methods used to determine injury criteria for cetaceans is provided in Appendix D.

The SEL criteria must take into account the cumulative effect of multiple exposures in the case of a multi-pulse sound source such as an airgun array. The cumulative effect of exposure to repeated airgun pulses is presented in the Cumulative Effects section of this report (Section 7.0). Southall et al. (2007) sum multiple exposures to produce a single exposure "equivalent" value by assuming that there is no recovery of hearing between sound pulse exposures.

In the case of a multi-pulse source such as an airgun, no single criterion for behavioural impacts was found to be suitable across multiple marine mammal groups. Instead, the likelihood of behavioural modification must be assessed for a given scenario based on available data for the type of sound source and the marine mammal species involved (Southall et al. 2007).

6.3.11.3 Seismic Airgun Survey

Seismic surveys introduce high-amplitude sound into the marine environment (200 to 250 dB re 1 µPa rms at 1 m) with the potential to impact large ocean areas for extended periods of time (Gordon et al. 2004). Most of the sound produced from seismic surveys consists of low frequency pulses at frequencies below 250 Hz with the strongest energies centered in the 10 to 120 Hz range (Goold and Fish 1998). However, it is acknowledged that the spectral distribution of sound from airgun arrays does extend to higher frequencies (>250 Hz) (Madsen et al. 2006, DeRuiter et al. 2007). For example, in the upper surface layer where sound velocity is often reduced (low velocity surface duct), some sound energy at the surface can exceed 500 Hz. (DeRuiter et al. 2007). These high frequency components contribute to the transient, direct-path, first arrivals of received airgun signals.

The acoustic modelling conducted during the EIA took emitted frequencies up to 2 kHz and 1/3-octave band sound levels for the airgun into account. Modelling was done over this frequency range. The high-frequency airgun transients are of short duration and low duty-cycle compared to the lower-frequency, reverberant part of the received signal (Madsen et al. 2006). Due to the short duration of the first arrival in the received signal, the authors concluded that the high-frequency transients are not likely to result in significant masking problems for mammals that are sensitive to high-frequencies. The dominant low frequency pulses emitted during seismic surveys fall below the sensitive hearing range for beluga and narwhal, but are within the sensitive hearing range for bowhead whales, seals, and walrus (Richardson et al. 1995). Possible effects from seismic sound on marine mammals include: physical effects (mortality, hearing impairment), behavioural effects (displacement, avoidance, tolerance), and acoustic masking. This section assesses the potential impacts of those effects to marine mammals.

Physical Effects

There is no direct evidence of sound from seismic surveys resulting in acute physical damage to marine mammals in their natural marine setting, with the possible exception of a report by Gary and Waerenbeek (2011) in which aberrant behaviour was observed in a single pantropical spotted dolphin in close proximity (600 m ahead of the airgun array) to 3D seismic explorations. Hearing impairment effects have only been documented under experimental conditions, and include: permanent hearing loss (known as permanent threshold shift, or PTS), and temporary hearing loss (known as temporary threshold shift, or TTS). TTS and PTS can potentially occur when marine mammals are exposed to high-amplitude impulsive sound (Goold and Coates 2006); with TTS demonstrated in certain captive toothed whales and pinnipeds exposed to loud sound sources (Southall et al. 2007). Prolonged or repeated exposure to sound levels sufficient to induce TTS without recovery time can lead to PTS (Southall et al. 2007). To date, there is no record of either of these effects occurring in marine mammals as a direct consequence of exposure to airgun pulses under natural field conditions.

TTS was observed in belugas after exposure to single pulses in the order of 186 dB re 1 μPa^2-s (SEL) and hearing returning to normal within several minutes of exposure. The study demonstrated that, for very short impulsive sounds, higher sound pressures may be required to induce TTS than for multiple pulsive sounds of longer duration.

TTS has been shown to occur in harbour porpoise at received peak levels above 200 dB re 1 µPa (SPL_{peak}) and sound exposure levels of 164 dB re 1 μPa^2-s, when exposed to 4 kHz signals (Lucke et al. 2008). These values were lower than those reported for other toothed whales (Finneran et al. 2002).

Little is known about the potential for seismic sounds to induce auditory trauma in baleen whales. If physical effects do occur, they would likely be limited to close ranges from the sound source (Richardson et al. 1995). Studies have suggested that higher sound levels may be needed to trigger TTS in baleen whales compared to toothed whales (Southall et al. 2007). Baleen whales are likely to avoid approaching airguns before being exposed to levels high enough for hearing impairment to occur, incidences of TTS or PTS in baleen whales are not expected during the Project.

In pinnipeds, TTS thresholds associated with exposure to brief pulses (single or multiple) of underwater sound have not been measured. Initial evidence from prolonged (non-pulse) sound exposure experiments suggest that some pinnipeds may incur TTS at lower received levels than small toothed whales exposed to similar prolonged non-pulse sounds (Kastak et al. 1999, 2005, Ketten et al. 2001). The TTS threshold for pulsed sounds has been indirectly estimated at an SEL of approximately 171 dB re 1 μPa^2 s (Southall et al. 2007), which would be equivalent to a single pulse with received level approximately 181 to 186 dB re 1 µPa (rms), or a series of pulses for which the highest rms values are a few dB lower.

There is limited information on the physical effects of seismic sound on walruses and polar bears. During the open-water season, both species occur in either pack-ice areas or remain close to shore. Project vessels will be avoiding both of these environments. Furthermore, walruses and polar bears are not expected to be encountered in the Qamut Block during the programs.

Behavioural Effects

The majority of studies conducted on the effects of seismic sound on marine mammals focus on behavioural responses (OSPAR 2011). A wide range of conclusions have been drawn from these studies, which has led to a general lack of consensus in the scientific community on the occurrence, scale and significance of such effects. The following section provides a brief summary on some of the main findings of studies observing the behavioural effects of seismic surveys on marine mammals.

Baleen whales

In general, baleen whales are thought to be the most reactive to airgun sound because they hear well in the low frequency range (Richardson et al. 1995). Baleen whales have been shown to avoid active seismic operations, and have been reported to move away, stay close to the surface, or change their orientation when exposed to seismic sound sources (Richardson et al. 1986). Studies of bowhead, humpback, and gray whales have demonstrated that seismic pulses with received levels of 160 to 170 dB re 1 µPa (rms) seem to elicit avoidance behaviour in the majority of animals exposed (Richardson et al. 1995). Low received sound levels can have subtle effects on surfacing and respiration patterns (Richardson et al. 1986, Koski and Johnson 1987, Ljungblad et al. 1988, Malme et al. 1988, Richardson 1998, Brownell 2004, Gordon et a. 2004). However, under certain circumstances, baleen whales have also been shown to be quite tolerant of low- and moderate-level acoustic pulses from distant seismic surveys (Reeves et al. 1984, Koski and Johnson 1987, Richardson and Malme 1993). Grey whales and bowheads have been shown to continue their normal activities when exposed to pulses at received levels as high as 150 dB re 1 µPa (Richardson et al. 1995). Male humpback whales have demonstrated either toleration or attraction to seismic sources while female humpback whales, by contrast, have shown avoidance behaviour in response to seismic sound (McCauley et al. 2000).

For bowheads in particular behavioural responses are shown to be quite variable and appear to be dependent of the type of activity the whale is engaged in (e.g. foraging vs. migrating). During migratory movements in the Alaskan Beaufort, individual bowheads have demonstrated avoidance behaviour up to 30 km distance from seismic vessels where levels can be up to130 dB re 1 µPa (rms) (Miller et al. 1999, Richardson et al. 1999). During the summer feeding season, bowhead whales appear to be less sensitive to seismic sound, showing no obvious reactions to seismic pulses at distances of 6 to 99 km where sound levels can be up to 107 dB (rms) (Richardson et al. 1986, Miller et al. 2005, Harris et al. 2007). It has been suggested that whales may be tolerant to such increased sound levels due to prioritized foraging requirements (Beale and Monoghan 2004. Baleen whales only demonstrate avoidance behaviour during feeding when sound levels reach up to 178 dB re 1 µPa (rms) (Ljungblad et al. 1988, Richardson et al. 1995, Miller et al. 2005). Bowhead whales in Alaska have also demonstrated tolerance / habituation to seismic activities over extended time scales, with individual whales observed regularly in traditional summering areas despite ongoing exposure to underwater pulsive sound from nearby seismic operations (Richardson et al. 1986, 1987a). Bowhead whales continue to use

the same westward migration corridor through the Beaufort Sea each fall, despite recurring annual seismic operations in this region which coincide with the fall migration period (Miller at al. 1991).

Toothed Whales

Toothed whales seem to adopt different strategies for responding to sound disturbances from seismic surveys (Stone 2003). Some toothed whales have been shown to respond to seismic surveys at considerable ranges (Bowles et al. 1994, Mate et al. 1994). In contrast, several studies have indicated that toothed whales exhibit tolerance behavior (limited response) in response to seismic sound and are not excluded from habitat areas by active seismic surveys (Rankin and Evans 1998, Swift 1998). Rankin and Evans (1998) could not demonstrate that seismic surveys had a negative impact on large-scale distribution of delphinids in the Gulf of Mexico. Swift (1998) conducted acoustic monitoring to determine the relative abundance and distribution of sperm whales before, during, and after a three week seismic survey west of Scotland. Acoustic detection rates were actually higher during the seismic survey period than the weeks before or after the survey. Swift (1998) also found no significant difference in detection rates between 'shooting' and 'non-shooting' periods during the seismic survey itself, suggesting a lack of short-term responses. Madsen et al. (2002) studied the acoustic behaviour of sperm whales in an offshore canyon located in arctic waters (northern Norway) in response to a distant seismic survey. Results demonstrated no changes in vocal activity in response to airgun pulses and no evidence of displacement was observed, as reported by local whale watch operators. Similarly, Stone (1998, 2000) reported that sperm whales sighting rates did not differ significantly as a function of seismic surveys.

Sperm whales in the Gulf of Mexico have been exposed to seismic surveys for many years; visual surveys (Gordon et al. 2006) and satellite tagging studies (Winsor and Mate 2006) have not been able to detect changes in the animals' behaviour. Preliminary conclusions from recent controlled exposure experiments with tagged animals have suggested possible responses to sound exposure in terms of foraging activities (Miller et al. 2006). The same authors found that during exposure, one animal stayed at the surface for an unusual amount of time, and they interpreted that behaviour as potential vertical avoidance (Miller et al. 2006). While most whales in their study continued their normal dive patterns, a behavioural response was inferred from the reduced fluke pitch and vocalisation buzz rates during the dive. However, the animals showed no avoidance behaviour in a 1 to 13 km range from the sound source at received levels of 152 to 162 dB (peak to peak) re 1 µPa (equivalent to 147 dB (rms) re 1 µPa or 115 to 135 dB re 1 μPa^2s). Miller et al. (2006) suggested that the 'observed' foraging might have been related to behavioural reactions of the sperm whale prey to airgun sound, or may simply be an artefact of the habituation of these animals to seismic surveys.

Another study by Gordon et al. (1998) in inshore waters around Orkney, UK, reported on both experimental exposures of harbour porpoises to a small seismic source (approximatley 228 dB re: 1 µPa zero-to-peak@ 1 m), and on harbor porpoise detection rates made during commercial seismic surveys. No changes in the rate of sound contact were observed during two hour periods before, during, and after the controlled exposure, and harbor porpoises were not shown to be excluded from an area of preferred habitat after short-term exposure to the seismic source. Acoustic monitoring of porpoises was also conducted during full-scale seismic surveys near Shetland (Gordon et al. 1988), in which no significant differences in sound detection rates for porpoises were observed between 'shooting' and 'non-shooting' periods (acoustic monitoring equipment was deployed approximately 1.6 km from the source on a seismic support vessel). Stone and Tasker (2006) reported sighting rates of white-sided dolphins and white-beaked dolphins that were significantly lower during periods of shooting compared with non-shooting periods on surveys with large airgun arrays. However, throughout the course of surveys, sighting rates were not found to differ significantly, indicating that any behavioural responses were short-term in nature.

Belugas are one of the few toothed whale species that seem to be reactive to airgun sound, having demonstrated large-scale displacement behaviour from active seismic operations (Richardson et al. 1995). Aerial surveys conducted in the Beaufort Sea during the summer have shown that sighting rates of beluga whales were significantly lower within 20 to 30 km from an operating airgun array (Miller et al. 2005, Harris et al. 2007). Information on the behavioural responses of narwhals to seismic sound is limited, although it is suggested that they share similarities to belugas in terms of responsiveness to sound (Richardson et al. 1995).

Seals, Walrus and Polar Bear

Very little information exists on the reactions of pinnipeds to sounds from seismic exploration in open water, although it is generally understood that pinnipeds are unlikely to exhibit an avoidance reaction to seismic sound (Richardson et al. 1995). Seals are often sighted at close ranges by observers on seismic vessels, with only minor changes in behaviour observed during seismic operations, and little to no avoidance of active airguns. Visual monitoring from seismic vessels in the Beaufort Sea reported that some ringed seals demonstrate avoidance behaviour up to 100 m from an active seismic vessel, however others remained within 100 to 200 m of the sound source during active shooting (Harris et al. 2001, Moulton and Lawson 2002, Miller et al. 2005).

During controlled exposure experiments, harbour seals and grey seals exposed to airgun pulses (source levels of 215 to 224 dB re 1 µPa; peak to peak) exhibited strong avoidance reactions and immediate, but short-term, startle responses to the initial airgun pulses (Thompson et al. 1998). However, the behaviour of all harbour seals seemed to return to normal soon after the end of each trial, even in areas where disturbance occurred on several consecutive days. Only one harbour seal showed no detectable response to the airguns and approached to within 300 m of the source (Thompson et al. 1998). Avoidance behavior was observed during all trials with grey seals, in which individuals switched from foraging dives to v-shaped transiting dives, and moved away from the source, increased swim speed, and/or dive duration. Excluding two seals which hauled out after testing, those that remained in the water seemed to have returned to pre-trial behaviour within two hours of the end of the experiment (Thompson et al. 1998). In a separate report by Greene et al. (1985), gray seals exposed to sound from airguns showed no strong reaction. No changes in sighting rates of ringed seals were observed between periods with a full array firing, a partial array firing, and no guns firing (Harris et al. 2001). Mean radial distance to the seals observed did increase during full array operations, suggesting some local avoidance.

Seals have also demonstrated considerable tolerance and habituation to very high levels (220 dB re 1 µPa; peak Myrick et al. 1990b) of underwater sound pulses from nonexplosive and explosive scaring devices, with avoidance behaviour waning quickly after repeated exposure (Mate and Harvey 1987). It is thus expected that seals would be rather tolerant of, or habituate to, repeated underwater pulsive sound from distant seismic sources, particularly when these animals are strongly attracted to an area (Richardson et al. 1995).

There is limited information on the behavioural effects of seismic operations on walruses and polar bears. As stated previously, effects on both species are considered to be unlikely due to limited time these animals spend in the water during this time and the limited use by the animals in the Qamut Block.

Acoustic Masking

Auditory masking occurs when sound signals used by marine mammals (e.g. echolocation, communication, and environmental cues) overlap in time and frequency with another sound source, such as seismic sound (Richardson et al. 1995). If little or no overlap occurs, communication is not expected to be disrupted (Abgrall et al. 2008). In the case of seismic surveys, the potential masking acoustic (airgun sound) consists of pulsive sounds with a low duty cycle (repetition rate relative to background sound). Most energy in seismic sound sources is emitted at low frequencies, with strongest spectrum levels below 100 Hz and only limited energy emitted up to approximately 150 kHz (Abgrall et al. 2008). Based on optimal hearing ranges, baleen whales are most susceptible to masking effects from low frequency seismic sources, particularly because low frequency sounds have the potential to transmit long distances and potentially affect large geographic areas (Erbe and Farmer 2000, Gordon et al. 2004). Odontocetes have reduced low frequency hearing and they vocalize at higher frequencies so masking for those species is expected to be less important.

Davis et al. (1998) considered the effect of masking from seismic operations to be of little significance to marine mammals due to the low cycle rate of seismic pulses relative to continuous sounds, such as ship sound. In addition, audibility between pulses does not seem to be compromised when marine mammals are exposed to pulsive sound sources such as seismic sounds (Abgrall 2008). However, sound levels after each airgun pulse are unlikely to return fully to background levels prior to the arrival of the subsequent airgun pulse due to reverberation effects (Koski et al. 2011). Reverberation signals are caused by sound energy that reflects multiple times from the seabed and sea surface, and from sound that is scattered non-specularly from rough bottoms. Reverberation is less significant for steep sound propagation angles experienced close to the source. Reverberation increases and results in longer pulse duration with distance from the source, although the overall sound levels also decrease with distance. Masking can occur if those levels are above background level and above the audible

threshold of marine mammals. It is likely that reverberated sound levels will be above audible thresholds to baleen whales over large distances. Bowhead whale vocalizations have been recorded between airgun pulses during active seismic operations (Green et al. 1999), with vocal activity emitted at a slightly slower rate than observed during non-seismic events (Richardson et al. 1986). Similarly, a recent study by Blackwell et al. (unpublished) showed that bowhead vocalizations decreased with exposures to relatively low sound levels, however, no corresponding changes to bowhead migration patterns were observed. The airgun operations during that study occurred within a relatively narrow bowhead migration corridor of approximately 30 km width. The ConocoPhillips operations will occur in a region with substantially lower bowhead densities.

The frequencies contained in seismic pulses are within the audible range of pinnipeds and walrus, and therefore have the potential to interfere with their communication capabilities. Sound levels during pulse intervals may also exceed background levels and the audible threshold of both pinnipeds and walrus due to reverberation effects (Koski et al. 2011) thus also potentially contributing to acoustic masking."

Proposed Mitigation and Best Practices

In order to minimize the potential physical impacts to marine mammals as a result of seismic survey sound, specific vessel-based mitigation measures and best practices have been developed for the seismic survey program, as summarized in Appendix I and detailed in Appendix J.

Residual Effects and Environmental Significance

Physical Effects

Effects from hearing impairment (PTS and TTS) to marine mammals as a result of airgun sound were assessed. Based on sound modeling results (Appendix D), and NMFS exposure criteria for impulsive sounds, the onset of injury for cetaceans and pinnipeds was predicted to occur at 710 meter ($R_{95\%}$) and 210 m ($R_{95\%}$), offset from the survey line, respectively. This exceeds the marine mammal safety zone radii recommended by JNCC guidelines (JNCC 2010). An 800 meter marine mammal safety zone (offset from the survey line) is thus recommended for the proposed seismic operations, based on the NMFS injury criterion for ceteaceans (180 dB re 1 µPa rms), the more conservative of the two established NMFS injury criteria.

Specific vessel-based mitigation actions (discussed in Section 8.0, Appendix I and Appendix J) will be triggered if marine mammals are observed within the safety zone. With the extended safety zone in place, marine mammals outside the 800 meter safety zone are presumed not to be exposed to harmful levels of sound. The environmental consequence of this effect is thus considered to be minor for baleen whales, toothed whales, pinnipeds and walrus (low magnitude, local effect, long-term duration, continuous frequency), and negligible for polar bears. The probability of airgun sound resulting in physical effects on marine mammals is considered rare given the proposed mitigation, resulting in a negligible (1) overall significance rating for all marine mammal VECs.

Behavioural Effects

Potential behavioural effects in marine mammals from seismic sound are assessed in this section. Table 6.3-2 summarizes the impact ratings classifications for the effects of seismic sound on marine mammals.

NMFS currently uses a criterion of 160 dB re 1 µPa (rms) as the onset of behavioural disturbance in marine mammals. Acoustic modeling results indicate that underwater sound from seismic pulses will exceed the NMFS behavioural threshold for marine mammals (160 dB re 1 µPa (rms) – impulsive) at distances up to 7.7 km from the source (offset of the survey line). ConocoPhillips will implement a marine mammal safety zone of 800 m while completing their operations.

Table 6.3-2 Summary of Impacts from Seismic Sound on Marine Mammals

VEC	Potential Impact	Planned Mitigation	Impact Assessment Criteria				Consequence	Probability	Overall Significance
			Magnitude	Geographic Extent	Duration	Frequency			
Toothed Whales (Beluga and Narhwal)	physical effects	Mitigation for physical effects only – see Section 8.0 (MMSO and PAM), Appendix I Table I-1 and Appendix J	low	local	long-term	continuous	minor	rare	1 (negligible)
	behavioural effects[(a)]		moderate	local	short-term	continuous	minor	likely	2 (low)
	masking		moderate	local	short-term	continuous	minor	unlikely	2 (low)
Baleen Whales (Bowhead Whales)	physical effects		low	local	long-term	continuous	minor	rare	1 (negligible)
	behavioural effects[(a)]		moderate	local	short-term	continuous	minor	unlikely	2 (low)
	masking		moderate	regional	short-term	continuous	moderate	unlikely	2 (low)
Pinnipeds and Walrus	physical effects		low	local	long-term	continuous	minor	rare	1 (negligible)
	behavioural effects[(a)]		moderate	local	short-term	continuous	minor	likely for pinnipeds; unlikely for walrus	2 (low)
	masking		moderate	regional	short-term	continuous	moderate	likely for pinnipeds; unlikely for walrus	moderate (3) for pinnipeds; low (2) for walrus
Polar Bears	physical effects		negligible	local	long-term	continuous	negligible	rare	1 (negligible)
	behavioural effects[(a)]		negligible	local	short-term	continuous	negligible	unlikely	1 (negligible)

[(a)] Includes displacement, avoidance and tolerance.

The effect of seismic sound on bowhead behaviour is considered to be of moderate magnitude as the NMFS behavioural threshold criteria will be exceeded, however no population level effects are anticipated and no disruption of critical activities are anticipated (no critical areas for bowhead whales are present in the Qamut Block and surrounding area). This effect is considered to be limited to the LSA, short-term in duration, and of continuous frequency as airguns will be firing throughout the survey period. The environmental consequence is thus considered to be minor. Because bowhead whales are not likely to be in Baffin Bay during the open-water seismic period, the probability of behavioural changes occurring are predicted to be unlikely, resulting in a low (2) overall impact significance rating.

The effect of seismic sound on narwhal and beluga behaviour is considered to be of moderate magnitude as the NMFS behavioural threshold criteria for cetaceans will be exceeded, although most of the sound energy will be emitted outside the sensitive hearing range for both species (Richardson et al. 1995, Gordon et al. 2004) and therefore no severe disruption of critical activities is anticipated. . This effect is considered to be limited to the LSA, short-term in duration, and of continuous frequency as airguns will be firing throughout the survey period. The environmental consequence of this effect is thus considered to be minor. The probability of behavioural effects in toothed whales (narwhal and beluga) occurring from seismic sound is predicted to be likely, as the Qamut Block overlaps with a designated narwhal protection zone during summer (NPZ-I) and therefore narwhal are anticipated to be in this area during the seismic program. The overall impact significance rating for behavioural effects from seismic sound on narwhal and beluga is predicted to be low (2).

The effects of seismic sound on pinnipeds and walrus behaviour is considered to be of moderate magnitude as the NMFS behavioural threshold will be exceeded. No population level effects and no disruption of critical activities are expected since no critical areas for seals are present in the Qamut Block during the survey period and no walrus summering grounds are present within or near the Qamut Block either. This effect is considered to be limited to the LSA, short-term in duration (45 day program + 15 days contingency) and of continuous frequency as airgun operations will be continuous. The environmental consequence of this effect is considered to be minor. Seals will likely be present in the Qamut Block during the active survey program; however, walrus are likely to be outside the Qamut Block area at their summer herding grounds. The probability of this effect is considered to be likely for seals and unlikely for walrus, resulting in a low (2) overall significance rating for both pinnipeds and walrus.

Because the natural behavioural tendencies of polar bears (e.g. remaining on the ice, at the water surface, or on land) greatly reduces their exposure to underwater sounds, the effects of seismic sound on polar whale

behaviour is considered to have a negligible environmental consequences and a rare probability of occurrence, resulting in a negligible (1) overall significance rating.

Acoustic Masking

The potential masking effects of pulsed sounds on beluga and narwhal calls are predicted to be limited, as both species typically communicate at frequencies outside the dominant bandwidth of seismic survey sound. Furthermore, both species may be able to emit and receive sounds between airgun pulses (Davis et al. 1985, Abgrall et al. 2008). The environmental consequence of masking effects of beluga and narwhal communication is considered to be minor (moderate magnitude, short-term duration, continuous frequency, and local geographic extent), with an unlikely probability of occurrence (as communication frequencies are likely not masked by seismic sound), resulting in a low (2) impact significance rating (Table 6.3-2).

The frequencies emitted by seismic pulses overlap with the communication frequencies used by bowhead whales, pinnipeds, and walrus. Although the cumulative seismic sounds are pulsive, sound levels due to reverberation after each airgun pulse are likely to be above background sound levels, as well as above the audible threshold for these animals over large distances and thus capable of masking their communication (Blackwell et al. unpublished, Koski et al. 2011). The environmental consequence of masking effects on bowhead, walrus, and pinniped communication is thus considered to be moderate, given the impact will be short in duration, continuous in frequency, moderate in magnitude, and regional in geographic extent (masking effects may extend outside the LSA + 10 km buffer zone). The probability of this effect is considered likely for pinnipeds and unlikely for bowheads and walrus, as the latter are not likely to be in Baffin Bay during the open-water season when the seismic programs will be taking place. The resulting impact significance rating for masking effects is therefore assessed as low (2) for bowheads and walrus, and moderate (3) for pinnipeds (Table 6.3-2).

6.3.11.4 Project Vessel Sound

In general, the source level of ship sound increases with ship size, speed, propeller blade size, number of blades, and rotations per minute (Gray and Greeley 1980). The largest component of ship sound comes from propeller cavitations, propeller singing, propulsion and other onboard machinery (Richardson et al. 1995). Broadband source levels specific to the Project vessels are unknown. However, broadband source levels of 170 to 180 dB re 1 µPa at 1 m have been reported for similar size vessels (length 55 to 85 m, diesel, 2 propellers with 4 blades, diameter of 3 m and turn at approximately 160 rpm).

Physical Effects

There is no direct evidence of either PTS or TTS occurring in marine mammals as a consequence of exposure to vessel-generated sound. Underwater sound from shipping generally ranges from 10 Hz to 1 kHz and tends to dominate ambient sound at frequencies from 20 Hz to 300 Hz (Richardson et al. 1995). Above 300 Hz, shipping sounds may or may not be significant depending on the level of wind-dependant ambient sound (Richardson et al. 2005). Most of the sound energy emitted by medium- and large-sized ships such as the seismic and support vessels tends to be concentrated in the low-frequency band, below 1 kHz (OSPAR 2009). The optimal hearing range for toothed whales typically occurs between 1 kHz and 100 kHz; whereas baleen whales (such as bowhead whales) and pinnipeds have better hearing in the lower frequency range: (7 Hz to 22 k Hz for baleen whales and 75 Hz to 75 kHz for pinnipeds) (Richardson et al. 1995, Southall et al. 2007). Expected frequencies from Project vessel sound are therefore more likely to overlap with the functional hearing range of baleen whales and pinnipeds than with toothed whales.

Behavioural Effects and Acoustic Masking

Research has demonstrated that vessel sound can influence physical behaviour of marine mammals and potentially result in masking of their communication space (Richardson et al. 1995). Acoustic responses to vessel sound include alteration of the composition of call types, the rates and duration of call production, and the actual acoustic structure of the calls. Types of behaviour influenced include respiration rates, dive patterns, and swim velocities. These adjustments have, in certain cases, been correlated with numbers of vessels and their proximity, speed, and directional changes. Responses have been shown to vary by gender and by individual. Many toothed whales show considerable tolerance of ship traffic. There is no available evidence of toothed whales permanently abandoning parts of their historical range because of vessel traffic (full review in Richardson et al. 1995 and Gordon et al. 2004).

Toothed whale reactions to vessels range from great tolerance to extreme sensitivity, depending on whale activities and experience, habitat, boat type, and boat behaviour (Richardson et al. 1995). Belugas have been shown to engage in avoidance or escape behaviour when exposed to fast and erratically moving small boats or when directly approached by a vessel (Fraker 1977a, 1977b, 1978). Acute behavioural reactions have also been observed in narwhals and belugas in response to early season icebreaker activity in the Canadian High Arctic (LGL and Greenridge 1986, Finley et al. 1990). Narwhals were shown to exhibit “freeze / silent” behaviour rather than the “flight / alarm” response observed in belugas when exposed to the icebreaking sound. Some evidence of narwhal displacement (~80 km) was also observed when animals were exposed to low levels of sound (94 to 105 dB re 1 µPa) in the 20 to 1000 Hz band, although individuals were shown to return several days later during periods when icebreaker sound levels were even higher (120 dB re 1 µPa) and in the same frequency band (Finley et al. 1990), suggesting potential tolerance or habituation to these sound sources.

Other studies have demonstrated that belugas do not always exhibit avoidance behaviour; in certain circumstances, examples of apparent long-term and seasonal habituation to vessel sound are evident in belugas (Fish and Vania 1971, Frost et al. 1984). Belugas have been shown to be rather tolerant of the frequent passages of large ships traveling in consistent directions in summering ground areas such as the St. Lawrence River (Canada), Cook Inlet (Alaska), and the Beaufort Sea (Fraker 1977b, Macfarlane 1981, Sergeant 1981, 1986, Burns and Seaman 1985, Pippard 1985). Belugas have shown declining vessel avoidance responses and increasing interactive behaviour (approaching vessels) in the St. Lawrence estuary (Blane 1990). Belugas that are hunted from small power boats in traditional gathering areas return each summer even though hunting causes short-term displacement and may change local distribution (Fraker 1980, Reeves and Mitchell 1981, Seaman and Burns 1981, Burns and Seaman 1985, Caron and Smith 1990). Belugas have also been shown to return to annual breeding locations in Northern Quebec even if overhunted (Finley 1982, Finley et al. 1982). The West Hudson Bay population returns annually to the port of Churchill annually despite a harvest of approximately 500 whales per summer (Sergeant 1981). Evidence of tolerance to vessel sound is commonly observed in other toothed whales such as dolphins and porpoises, either by a lack of avoidance behaviour to vessels (Duncan 1985), or by means of active interaction with vessels such as bow riding (Shane et al. 1986, Williams et al. 1992). When avoidance behaviour is observed by toothed whales, it is most commonly in response to vessels of types used to hunt these animals (Richardson et al. 1995). Temporary displacement may result, but there is no evidence of toothed whales abandoning significant parts of their range because of vessel traffic and associated sound (Richardson et al. 1995).

Reactions of baleen whales to vessels also vary considerably (Richardson et al. 1995). Lower frequency (10 to 100 Hz) sounds have been shown to be more influential on behaviour (Frankel and Clark 1998, 2000 and 2002). When receiving low-level sounds from distant or stationary ships, baleen whales both ignore and approach the sounds. If ships approach baleen whales slowly and non-aggressively, baleen whales often exhibit slow and inconspicuous avoidance manoeuvres. In response to strong or rapidly changing ship sound, baleen whales often interrupt their normal behaviour and swim rapidly away. Avoidance is especially strong when a boat heads directly toward a whale (Richardson et al. 1995).

Several cases of apparent tolerance and habituation to vessels have been reported in baleen whales (Norris et al. 1983, Withrow 1983, Dahlheim et al. 1984, Richardson et al. 1995). Low-level sounds from distant or stationary vessels often seem to be ignored by animals, particularly when feeding (Richardson et al. 1995). Baleen whales use shipping lanes in the St. Lawrence estuary and off Cape Cod each year despite frequent exposure to vessels (Mitchell and Ghanime 1982, Beach and Winrich 1989). Vessels in grey whale breeding lagoons have been shown to cause short-term escape reactions, particularly when boats move fast or eratically; however, the proportional incidence of escape / avoidance behaviour has been shown to decrease over the course of the winter, suggesting habituation (Reeves 1977, Swartz and Cummings 1978, Swartz and Jones 1981). Jones and Swartz (1984, 1986) found no evidence of grey whales leaving a lagoon despite increased vessel presence. Shipping and evaporative salt works in Guerrero Negro Lagoon reportedly caused grey whales to abandon the lagoon for several years, although the whales returned after shipping decreased (Reeves 1977, Bryant et al. 1984). Hatler and Darling (1974) reported that grey whales in British Columbia return annually to traditional summer feeding areas despite co-occurrence of high vessel traffic in these regions. Individually recognizable bowheads have been shown to return to feeding locations within one day after being displaced by vessels and associated sound (Koski and Johnson 1987), although it was unknown if they would return after repeated disturbance. A radio-tagged bowhead whale exhibited reduced dive times when approached by a small ship on each of three days when the ship was within 500 m of the whale. However, dive patterns were shown to

revert back to normal in the days following ship disturbance, and the whale remained in the same area for several days while the ship continued operating (Wartzok et al. 1989). Some humpbacks in Alaska show little or no reaction of approaching vessels (Watkins et al. 1981), with animals less likely to react overtly when actively feeding than when resting or engaged in other activities (Krieger and Wing 1984, 1986). In southeastern Alaska, vessel activity was observed to elicit short-term avoidance behaviour, although some humpbacks still remained for several weeks in areas of heavy vessel traffic, and returned to the same area in subsequent years (Baker et al. 1988, 1992). The most extensive data are from summer feeding grounds off Cape Cod, where humpback whales have been shown to spend extended periods in high traffic areas, and return there annually despite frequent exposure to vessel activity (Watkins 1986, Beach and Weinrick 1989, Clapham et al. 1993).

Proposed Mitigation and Best Practices

A list of mitigation measures for managing the effects of vessel sound on marine mammals is provided in the EPP (Section 8.0) and Appendix J. A summary is provided below:

- Project vessels shall regularly maintain propellers to minimize propeller cavitations.
- Project vessels shall avoid rapid acceleration (which causes increases in underwater sound).
- Project vessels shall keep speeds to as low as practical as ship-based sound typically increases with ship speed (Fischer and Brown 2005).
- As safe navigation allows, vessel operators shall take every precaution to avoid harassment of marine mammals by means of the following;
  - Under no circumstances, other than in the case of an emergency, will a Project vessel approach within 300 m of a walrus or polar bear observed on glacial or sea ice.
  - Project vessels shall also maintain a minimum distance of 300 m from marine mammals engaged in feeding activities.
  - For all other marine mammal encounter situations, vessels will not approach or be positioned closer than 100 m to a marine mammal.
  - If marine mammals approach within 100 m of a Project vessel, the Project vessel shall reduce its speed and, if safe to do so, will cautiously move away from the animal(s).
  - If it is not possible for the vessels to move away from or detour around a stationary marine mammal or group of marine mammals, the vessel shall wait until the animals depart the area and are at least 100 m from the vessel prior to resuming operational speed.
  - The vessel shall not be operated in such a way as to separate an individual member(s) of a group of marine mammals from other members of the group. When weather conditions require, such as when visibility decreases, the vessel shall adjust its speed accordingly to avoid the likelihood of ship strikes.

Residual Effects and Environmental Significance

Effects of underwater sound from vessel engines, propellers and other on-board activities on marine mammals are assessed in this section (Table 6.3-4). Bowhead whales were identified as a VEC for the Project as their presence in Greenlandic waters is well documented (DCE 2011). However, results from this effects assessment, and the proposed mitigation for this species, are applicable to all other baleen whales potentially occurring in the Project area during the open-water season.

Underwater sound from Project vessels is not predicted to exceed the injury threshold for pinnipeds or cetaceans. ConocoPhillips operations will avoid protected and critical areas therefore, the effects of Project vessel sounds on marine mammal behaviour and acoustic masking is predicted to be of moderate magnitude.

The magnitude of the effect of vessel sounds on marine mammals is considered to be low with respect to physical effects. NMFS threshold criteria for behavioural disturbance would be exceeded, but effects at the population level are not anticipated. The geographic extent was considered to be regional as the potential for vessel sound effects would exist as vessels move outside the LSA towards shipping channels, when in transit to and from local port facilities. The duration of vessel sound is considered long-term with regards to physical effects

and short-term with regards to behavioural effects and acoustic masking (only present during the Project life, 45 days + 15 days contingency).

The potential for effects from vessel sound to result in physical effects on marine mammals was considered be of minor environmental consequence and a rare probability of occurrence, resulting in a negligible overall significance rating for all marine mammal VECs. The potential for vessel sound to result in behavioural effects and acoustic masking is considered to be of moderate environmental consequence for baleen whales, toothed whales, pinnipeds and walruses; and a negligible consequence for polar bears. The probability of this effect occurring is considered rare in polar bears and baleen whales (e.g. bowhead whales), and unlikely for all other marine mammal VECs. The overall significance rating of this effect is predicted to be negligible (1) for baleen whales and polar bears; and low (2) for toothed whales, seals and walruses.

Based on results from the literature, marine mammals will either habituate to vessel sounds generated during the Project and remain in the Qamut Block, or leave the Qamut Block temporalily and return once the seismic program is completed. No significant effects at the population level are anticipated. Table 6.3-3 summarizes the impact rating classifications and overall significance for the effects of vessel sounds on marine mammals.

Table 6.3-3 Summary of Impacts from Vessel Sounds on Marine Mammals

VEC	Potential Impact	Planned Mitigation	Impact Assessment Criteria				Consequence	Probability	Overall Significance
			Magnitude	Geographic Extent	Duration	Frequency			
Toothed Whales (Beluga and Narhwal)	physical effect	Section 8.0 (MMSO and PAM), Appendix I Table I-1 and Appendix J	low	regional	long-term	continuous	minor	rare	1 (negligible)
	behavioural effects[(a)]		moderate	regional	short-term	continuous	moderate	unlikely	2 (low)
	masking		moderate	regional	short-term	continuous	moderate	unlikely	2 (low)
Baleen Whales (Bowhead Whales)	physical effect		low	regional	long-term	continuous	minor	rare	1 (negligible)
	behavioural effects[(a)]		moderate	regional	short-term	continuous	moderate	unlikely	1 (negligible)
	masking		moderate	regional	short-term	continuous	moderate	unlikely	1 (negligible)
Pinnipeds and Walrus	physical effect		low	regional	long-term	continuous	minor	rare	1 (negligible)
	behavioural effects[(a)]		moderate	regional	short-term	continuous	moderate	unlikely	2 (low)
	masking		moderate	regional	short-term	continuous	moderate	unlikely	2 (low)
Polar Bears	physical effect		negligible	regional	long-term	continuous	negligible	rare	1 (negligible)
	behavioural effects[(a)]		negligible	regional	short-term	continuous	negligible	rare	1 (negligible)

(a) Includes displacement, avoidance and tolerance.

6.4 Effects of Vessel Traffic

The impact of vessel traffic related to the Project on marine mammals, commercial fisheries, subsistence fishing and hunting, tourism, and to some extent, other shipping, is assessed in this section. All impacts from more ship traffic in Qamut Block due to the seismic survey are “negligible”.

Marine Mammals

It is possible that more ship strikes involving marine mammals will occur in 2012 because of increased vessel traffic related to the Project in the Qamut Block or during passage to or from the licence area. Studies indicate that maritime activity may have adverse effects on marine mammals due to ship strikes. (Moore and Clarke 2002, Laist et al. 2001). These effects include mortality and physical injury. Baleen whales are more susceptible than other marine mammals due to their large size, slower travel and manoeurving speeds, and lower avoidance capability (Laist et al. 2001). Vessel speed and size are an important factor for determining the probability and severity of ship strikes involving marine mammals. Lethal and severe injuries are caused by ships 80 metres or longer travelling at speeds greater than 13 to 15 knots. These speeds are considered to be a critical threshold, below which ship strikes and mortality are less likely to occur (Dolman et al. 2006, Jensen and Silber 2003).

While there have been reports of toothed whales being struck by some types of ships (Wells and Scott 1997, Van Waerebeek et al. 2007), these animals are at relatively low risk due to their speed and agility (Richardson et al. 1995).

All ships involved with the Project are relatively small vessels. The seismic ship has a length overall of 76.2 m. The *Princess* and two support ships will be operating at reduced speed (4 to 5 knots) during the seismic survey, and consequently, imposing reduced speed as a possible mitigation measure to reduce the likelihood of a ship strike is not necessary. Even during transit to and from Upernavik (or Nuuk) for re-fuelling (including any fuel taken and carried for transfer to other vessels offshore) by one of the support ships, if this occurs, ships will be traveling slower than the critical speed threshold identified above.

Proposed Mitigation and Best Practices

A list of mitigation measures for minimizing the potential of vessel collisions with marine mammals is provided in the EPP (Section 8.0) and Appendix J. A summary is provided below.

- Marine mammal monitoring will be performed on the seismic and hydrographic vessels by trained MMSOs. Observers will notify the vessel operator (Survey Party Chief or other) if there is a concern of the ship striking a marine mammal. These personnel will make a decision if actions are required to avoid a possible collision. This may include slowing the ship, if safe to do so, until the animal has traveled clear of the ship's course. During seismic operations, ramping up the airgun array and use of a mitigation airgun during line changes, will assist in deterring marine mammals from approaching the ship and risking the possibility of a ship strike;
- As safe navigation allows, vessel operators shall take every precaution to avoid harassment of marine mammals by means of the following:
  - Under no circumstances, other than in the case of an emergency, will a Project vessel approach within 300 m of a walrus or polar bear observed on glacial or sea ice.
  - Project vessels shall also maintain a minimum distance of 300 m from marine mammals engaged in feeding activities.
  - For all other marine mammal encounter situations, vessels will not approach or be positioned closer than 100 m to a marine mammal.
  - If marine mammals approach within 100 m of a Project vessel, the Project vessel shall reduce its speed and will cautiously move away from the animal(s).
  - If it is not possible for the vessels to move away from or detour around a stationary marine mammal or group of marine mammals, the vessel shall reduce its speed and wait until the animals depart the area and are at least 100 m from the vessel prior to resuming speed.
  - The vessel shall not be operated in such a way as to separate an individual member(s) of a group of marine mammals from other members of the group. When weather conditions require, such as when visibility decreases, the vessel shall adjust its speed accordingly to avoid the likelihood of ship strikes.
- Survey effort and associated vessel activity will be minimized in marine protected areas and areas identified as important to marine mammals (Section 4.2.2 (Protected Areas) and presented on Figure 4.2 7 of the EIA). COP will cease operations and leave the area before the onset of the NPZ-II protection period on October 15.

Residual Effect and Environmental Significance

The lower vessel speeds that prevail during operations will greatly reduce the likelihood of vessel strikes on marine mammals by providing ample time for these animals to avoid oncoming vessels, as well as time for crew and MMSOs to detect and avoid marine mammals during active operations. The circumstances of the Project in Qamut Block have an important bearing on environmental impact significance. With the application of effective mitigation, such as reduced vessel speed (which applies from the outset owing to the kind of operations carried out), and reducing time in NPZ-I to the lowest required number of days to meet seismic data acquisition requirements, ship strikes involving marine mammals are not expected during the survey period, or during transit to and from the licence area.

In the unlikely event that a ship strike occurs, it would likely cause in an injury only, due to reduced ship speed and lower vessel tonnage (Laist et al. 2001). The magnitude of the effect was considered to be low, and the geographic extent was considered to be regional, since the potential for strikes would exist outside the LSA, when ships transit to or from the licence area along routes normally used for passage. The duration of the impact is considered to be short-term, as the effect is only present when ships are in the licence area (45-day survey plus 15 days contingency). The consequence of the effect was thus determined to be minor for all marine mammal VECs. With mitigation in place, the probability for vessel strikes on marine mammals is predicted to be rare. This results in a "negligible" significance rating.

Subsistence Hunting and Fishing, Tourism and Other Shipping

Project vessel traffic will be sharing the sea with other traffic in the Qamut Block during the open water navigation period. Based on Land & Sea Use described in Section 4.3 of the EIA, other maritime activity could involve: boats used for subsistence hunting and fishing, cruise ships, research ships conducting scientific surveys, military vessels, ships involved with annual re-supply and sealift to communities and other sites along the northwest Greenland coast, and possibly, ships en route to or from the Northwest Passage in the Canadian Arctic Archipelago. It will not include any ships from the commercial fishing fleet, since there is no commercial fishery for any species in Qamut Block or adjacent waters at this time.

It is not expected that ship traffic related to the Project will interfere with subsistence fishing and hunting, since the survey area does not overlap with traditional fishing and hunting grounds. These areas are mainly located in coastal regions near Savissivik and Salleq Island, or in the Melville Bay Reserve.

Project vessel traffic could have an effect on marine tourism due to temporary delays experienced by cruise ships. However, this possibility is regarded as remote to minor in importance. Roughly seven landings are scheduled for 2012 near the Qamut Block, including one landing in Savissivik, and six landings near Qaanaaq and Siorapaluk, but the latter are well to the west and north. Any landings at these communities will not affected by operations in the survey region.

Proposed Mitigation and Best Practices

At the discretion of BMP, as a condition attached to Project approval, a Fishery Liaison Officers (FLO) may be required on one or more of the ships. The FLO would act as an advisor, and assist with matters related to the commercial fishing fleet. However, the likelihood of this happening is believed to be very low, since there are no commercial fisheries, at present, in or near the Qamut Block.

The relevant Greenland authorities (e.g., Island Command Greenland / MRCC Grønnedal) will be notified about intended operations before the Project starts in Qamut Block. This notification is standard practice, and allows Island Command Greenland to alert mariners, via normal marine radio broadcasts, to avoid the survey region, or exercise caution during transit of these waters. An exclusion or restricted operations zone, or equivalent, may be implemented. In addition, with respect to coordination and communication between the three operators in northeast Baffin Bay, ConocoPhillips will participate in the preparing and implementing of a Simultaneous Operations Plan, which involves, but is not limited to, management of vessel traffic related to exploration programs in this region.

During active seismic operations, a Notice to Mariners (Efterretninger for Søfarende, abbreviated E.f.S) would be published by the Danish Maritime Authority before the Project begins, and a Navigation Warning would be broadcast on a regular basis by coastal radio stations, informing mariners in the area about current survey location, schedule and other relevant details. If possible, this information will be provided directly to Royal Arctic Line, research organizations, and government agencies with known operations taking place at the time of survey.

Residual Effect and Environmental Significance

With the application of mitigation, the consequence of Project vessel traffic effects on subsistence hunting and fishing, marine tourism, and other shipping (including ships involved with other exploration programs) are negligible (or non-existent, in the case of commercial fisheries). The level of activity related to these VECs is anticipated to be low or very low, with little or any overlap than cannot be managed by normal maritime procedures. The probability of ineffective or unsuccessful vessel traffic management during normal operations in or near Qamut Block is regarded as rare to very rare. Consequently, the impact rating for all VECs is "negligible".

Table 6.4-1 summarizes the impact rating classifications for the effects of vessel traffic on marine mammals, subsistence hunting and fishing, tourism, and other shipping in Qamut Block and adjacent waters. The "other shipping" component, including military vessels, larger merchant vessels, and the coastal trade, is not rated in the table, but impact significance is believed to be "negligible". This is consistent with the assessment logic or reasoning for tourism, which is ship-based in an offshore setting. It involves vessels that are en route only, transiting to other locations; the licence area is not a destination for cruise ships.

Table 6.4-1 Summary of Impacts from Vessel Traffic on VECs

VEC	Potential Impact	Planned Mitigation	Impact Assessment Criteria				Consequence	Probability	Overall Significance
			Magnitude	Geographic Extent	Duration	Frequency			
Marine Mammals	physical effect due to collisions with vessels	Section 8.0 & Appendix I Table II-1, Appendix J	low	regional	short-term	occasional	minor	rare	1 (negligible)
Bids	displacement		low	local	short-term	continuous	minor	unlikely	2 (low)
Subsistence Hunting and Fishing	displacement of targeted species		negligible	local	short-term	occasional	negligible	rare	1 (negligible)
Tourism / Parks and Recreation	displacement of species of interest		negligible	local	short-term	occasional	negligible	rare	1 (negligible)

6.5 Effects of Vessel Lighting

Project vessel lighting during twilight or darkness may affect birds in the Qamut Block and surrounding area by increasing the risk of bird collisions with vessels. Some species of Birds are prone to colliding with ships and offshore structures if they are attracted by lights during operations at night (Wiese et al 2001, Reed et al 1985, Merkel et al. 2011). Migrating birds that fly low and rapidly over the sea (e.g. king eiders) are particularly susceptible (Day et al. 2003, 2005).

A solar calculator can be used to estimate the length of the daylight period, and the period of nautical twilight before sunrise and after sunset. At the latitude and longitude of interest (center of license area), the daylight period on 15 July and 1 August is 24 hours in length. On 15 August, the sun rises at 00:53 local (West Greenland) time (-04 GMT), and sets at 23:23. On 1 September, the rise and set times are 03:51 and 20:36, respectively. On 15 September, the rise and set times are 05:15 and 19:03. Finally, on 1 October, the rise and set times are 06:44 and 17:24. These times were estimated using the ESRL-GMD calculator (NOAA 2012); other calculators produce similar results. There will be extended periods of nautical twilight before sunrise and after sunset at the latitude of Qamut Block. These periods can be estimated with the US Naval Observatory calculator (USNO 2012). The length-of-daylight estimates are sufficient for assessment purposes.

Based on the length-of-daylight estimates above, any effects of vessel lighting on birds will not occur until the last half or last third of the proposed survey period, and are expected to be limited.

The Qamut Block and surrounding region does not overlap with critical bird nesting or molting sites, as noted in Section 4.2 on Biological Environment. However, individual birds from these colonies or other locations may transit through the area.

Proposed Mitigation and Best Practices

External vessel lights will be shielded and/or reduced during twilight and darkness, with the exception of navigation lights, and used only when necessary. Safety on deck is paramount, and will take precedence over mitigation.

Birds that land on vessels during twilight and darkness should be left undisturbed, unless they impede operations or risk being harmed by onboard operations. If possible, an exhausted bird resting on the ship can be moved to a sheltered location until it is able to fly. Crew members will be asked to handle dead, injured or resting birds in an appropriate manner.

Data on bird encounters can be used to help determine factors associated with collision and mortality risks, and may be useful in developing mitigation to reduce these risks. The MMSOs on the *Princess* will be monitoring for seabirds on a regular basis. A Project-specific bird observing manual will be prepared prior to the start of survey, based on the NERI (2011) Guidelines. In addition, all bird encounters will be reported to the MMSO on duty.

Residual Effects and Environmental Significance

The assessment indicated that impacts from vessel lighting on seabirds were negligible. Table 6.5-1 summarizes the overall impact rating classifications for the effects of Project vessel lighting on seabirds. Lighting will not be necessary during operations until late in the survey period. When lighting is used at night, minimizing the amount of light involved has proved effective in reducing seabird mortalities from collisions (Reed et al. 1985). In addition, seabirds tend to fly slower during darkness, further reducing the chance of collision with a vessel (Day et al. 2003, 2004). The distance of the Qamut Block from land and any coastal breeding sites will further reduce the likelihood of collisions at night (Merkel et al. 2011). Even with application of the proposed mitigation, there is still potential for physical injury or death of seabirds as a result of colliding with a Project ship. The magnitude of this effect is thus considered moderate. The geographic extent of this effect is considered to be regional. Some potential for seabirds to collide with Project ships exists outside the LSA during transit to and from the survey region. The duration of the effect was considered to be short-term, or during the survey period only (up to 45 days plus 15 days contingency). The frequency of the activity causing the effect (vessel lighting) was considered to be occasional because vessel lighting would only be used during the latter part of the survey period and for short periods of time per day. With the application of mitigation, the consequence of the effect was thus considered to be minor and the probability rare, resulting in an impact significance rating of negligible.

Table 6.5-1 Summary of Impacts from Vessel Lighting on Seabirds

VEC	Potential Impact	Planned Mitigation	Impact Assessment Criteria				Consequence	Probability	Overall Significance
			Magnitude	Geographic Extent	Duration	Frequency			
Seabirds	physical effects due to collisions with vessels	see Section 8.0 (MMSO and PAM), Appendix I Table I-1 & Appendix J	moderate	regional	short-term	occasional	minor	rare	1 (negligible)

6.6 Effects of Introduced Species from Ballast Water Exchange

It was noted in Section 6.2 that ballast water is a potential discharge from ships in the Qamut Block during the Project, and that it may contain invasive (exotic) species, either in the water, or on sediment that is suspended in it. The possible but unlikely introduction of invasive species from this source, or other potential sources, is assessed below.

The unintended introduction of invasive species from shipboard sources might impact marine ecosystems in Greenland. Possible introduced species include bacteria and other microbes, microalgae, and aquatic plant and animal species in ballast water or sediment. These organisms are invasive or non-invasive in nature. Invasive species can spread rapidly in the absence of natural predators, and dramatically alter local habitats, making them unsuitable for native species (DFO 2011). Introduced species, if invasive, can also have effects on the abundance of native species, due to predation and/or competition for habitat and food resources.

Proposed Mitigation and Best Practices

It is remotely possible that ballast water could be discharged by one or more of three ships during the Project if re-ballasting is needed to reach ice draft or after ship-to-ship transfer of fuel offshore, but ballast water exchange is not anticipated during normal operations. If any release of ballast water is necessary, all ships during the Project will comply with a Ballast Water Management Plan that is identified in the EPP as a supplementary or complimentary plan. This plan will be followed to make the possibility of invasive species being released in ballast water as small as possible. Preparation of this plan has not been completed by ConocoPhillips, and it is not attached to the EIA. However, all mitigation described in the IMO Convention for the Control and

Management of Ship's Ballast Water and Sediments of 2004 will be implemented. Other potential sources of invasive species during the Project could not be identified on any of the ships.

Residual Effects and Environmental Significance

Since ballast water exchange is not expected during the Project, ballast water would not be released in the LSA, or enter the RSA, from a foreign water source during the Project. In the unlikely event that re-ballasting needs to be done by any of the ships, a Ballast Water Management Plan will be followed. Consequently, the Project will not lead to any introduction of invasive species in the LSA or RSA, or other Greenland waters either.

It is recognized that the impact of an invasive species introduced from ballast water or sediment could be detrimental for marine ecosystems in northeast Baffin Bay. It is also possible that the geographic extent of this effect could be "beyond regional", in that an introduced species could potentially expand to waters to the west of Qamut Block as a result of transport by the West Greenland Current. Further, if this species survived and reproduced during this transport, it could potentially reach waters in northwest Baffin Bay, and then waters to the south, along the coast of Baffin Island. However, this situation is not realistic. The circumstances of the Project, including number and type of ships involved, ballast water exchange not expected during normal operations, any release strictly governed by a Ballast Water Management Plan, and the small or very small amount of ballast water involved if any release took place, do not support this possibility either. It was discounted (as not probable) during assessment.

The likelihood of successfully introducing an invasive species from ballast water or sediment during the Project is very low. A series of events would have to occur, including: existence of an invasive species in a ship's ballast water tanks; ballast water exchange taking place in Qamut Block; adaptability of the species to local environmental conditions after a small amount of ballast water containing or carrying it released; ability of the invasive species to out-compete local species when it is introduced; ability of the invasive species to quickly reproduce or colonize (and reach a population size that can be sustained over time); and ability of the invasive species to alter the local ecosystem to make it permanently less suitable for local species. The probability of all these conditions developing in the right sequence is regarded as rare. If a successful introduction of invasive species in a Greenlandic marine ecosystem did occur, it could have a long-term impact (DFO 2011). At a population level, the magnitude of the impact would be moderate. The geographic extent could move beyond the RSA; however, the frequency of the activity causing the effect is considered to be occasional. This indicates a moderate consequence. Since the probability of the event is rare, the overall significance is negligible for all VECs.

Table 6.6-1 Summary of Impacts from Ballast Water Exchange on VECs

VEC	Potential Impact	Planned Mitigation	Impact Assessment Criteria				Consequence	Probability	Overall Significance
			Magnitude	Geographic Extent	Duration	Frequency			
Marine Fish	introduction of invasive species	Section 8.0 (Ballast Water Management Plan) & Appendix I Table II-1	moderate	beyond regional	long-term	occasional	moderate	rare	(1) negligible
	ecosystem change								
Seabirds	ecosystem change		moderate	beyond regional	long-term	occasional	moderate	rare	(1) negligible
Marine Mammals	ecosystem change		moderate	beyond regional	long-term	occasional	moderate	rare	(1) negligible
Subsistence Hunting and Fishing	changes in important species		moderate	beyond regional	long-term	occasional	moderate	rare	(1) negligible

6.7 Effects of Unplanned Events and Accidental Spills

An unplanned event or accidental spill of solid or liquid material could occur during the Project in Qamut Block, or during transit to or from the licence area. Depending on the type of incident, it could have an impact on the

environment. This situation applies to the ship conducting the seismic survey, as well as to the two vessels supporting this vessel.

These incidents could involve a variety of liquid or solid substances, including fuel in tanks, fuel in drums, lubricants, hydraulic oil, chemicals, hazardous or non-hazardous waste, and even well-secured items on deck that might break free during very heavy seas. For assessment purposes, it was assumed that the unplanned event was an accidental (unintentional) spill, and that the volume or amount of material was minor (small) or major (large).

Minor spills that occur onboard during normal operations, which should be infrequent or occasional, based on "best practice" at sea, could lead to a release into the environment if the material involved cannot be contained or controlled by crew members. This situation is very different from a major spill, which might result, directly, from a ruptured fuel tank (or tanks) after a collision, or indirectly, from fire damage or explosion damage, or from worse incidents.

The worst unplanned event is catastrophic loss after collision with another ship (or iceberg) at economy or maximum speed, which is remotely possible during any operation in northeast Baffin Bay. However, this event is regarded as a highly unlikely situation, and it is not valuable for understanding the implications of a less severe event. Consequently, the assessment is based on a less severe, but still major, incident that is focused on the M/V *Princess*, the largest ship chartered for the Project, which carries more fuel than other vessels.

Minor Spill during Project operations

The types of materials typically used on seismic survey ships and support vessels with potential for spillage were noted above. Fuel, in particular, can be spilled during bunkering in port or during ship to ship transfer offshore if a hose ruptures or a valve, coupler or other fitting fails. It was assumed that any small spill involving fuel during the Project would be contained onboard, and not enter the sea. In the unlikely event this fuel spill could not be contained, and it drained overboard, it was assumed that the release would be less than 0.5 m^3 (ERM 2011) in volume, that it remains in the vicinity of the ship, and that an attempt would be made to contain and clean it up if safe to do so. A drum of fuel, for example, contains about 210 litres, and depending on the specific gravity of the fuel involved, it would hold about half the assumed volume.

A Fuel Spill Response Plan will be prepared and implemented to make sure any small fuel spill, onboard only or reaching the environment in limited amount, can be responded to properly. This plan is part of the EPP, described in Section 8 of the EIA.

Major Spill during Project Operations

It was assumed that a major spill would be the result of a severe collision between two ships or between a ship and an iceberg. The hull would be breached, causing multiple tanks to rupture, and fuel would be released to the environment. To prevent or reduce the likelihood of collisions, all Project vessels will be equipped and operated to appropriate Greenlandic, Danish and/or international standard. In addition, given the prevalence of glacial ice in the form of icebergs, bergy bits and growlers in Qamut Block, ConocoPhillips will be developing and implementing an Ice Management Plan for the Project.

This plan is summarized in the EPP (Section 8 of the EIA). It will be followed to make sure seismic operations proceed safely and successfully during the survey period. The primary goal is preventing or minimizing the possibility of collisions or impacts with glacial ice that would compromise safety, cause damage to a ship, or cause damage to towed equipment.

To limit the possibility of collisions between Project ships and other vessels in the area, or during transit along the west coast of Greenland, ConocoPhillips will notify the Danish Maritime Authority before operations begin, notify Island Command when the seismic survey commences, ensure Island Command is informed throughout, and comply with Vessel Monitoring System (VMS) requirements in Greenland.

Marine Diesel Fuel (MDF) was selected for assessment of a major liquid spill in or near Qamut Block. It was assumed that M/V Princess would be carrying the most MDF if an unplanned event occurred. The Princess has a total fuel capacity of 692 m^3 (CCGVeritas 2011). The vessel's port and starboard tank lay-out was not critical

for developing the scenario. It was also assumed that up to one-third or one-half of this capacity (roughly 300 m^3) could be released to the sea during a major spill of fuel.

MDF is not one fuel with a simple composition; these fuels are normally hydrocarbon blends with variable compositions of differing molecular weights, including some heavier components. It has low viscosity, and does not form a "fuel in seawater" emulsion. The lighter fractions show greater solubility and higher toxicity, but have a tendency to evaporate quickly. Dense components spread less rapidly, but tend to remain longer in the water column. Very dense components may sink to the seafloor and assume a tar-like consistency (CONCAWE 1998). In general, MDF is considered to be "persistent" if it enters the sea, and does not dissipate as quickly as more refined hydrocarbons (ITOPF 2002). To understand how MDF propagates in an Arctic marine environment, the Nielsen et al. (2006, 2008) studies were consulted.

It is emphasized these studies are not completely applicable to MDF, since they involved crude oil only, and the releases that were modelled were much larger in volume than 300 m^3. However, they indicate, in part, how hydrocarbons behave in Arctic marine environments, including waters in northeast Baffin Bay, during sea ice free conditions. Other information on this subject is summarized by Sørstrøm et al. (2010).

Nielsen et al. (2006) conducted trajectory modelling on 15,000 or 30,000 tonne spills of crude oil at five sites in eastern Baffin Bay, ranging from the shelf edge to the inner portion of the shelf in Disko Bay during sea ice free conditions. MDF and crude oil are different products, but they have common fractions, and the ocean-atmosphere processes that control behaviour after a spill would be similar or identical. The modelling involved winds from six directions, and indicated that crude oil reached the shore during only three of 24 scenarios. One-third of the released crude oil was predicted to evaporate within the first 24 hours of the release.

SINTEF (Stiftelsen for industriell og teknisk forskning) in Trondheim (Norway) indicated that 50 to 60% of any MDF released during a spill into seawater with a temperature as low as 5^oC will evaporate in a few hours (Daling 2012, pers. comm.). The balance should disperse in the surface layer in a relatively short period of time, depending on wind, wave, and surface current conditions. Since the assumed volume of MDF that could be spilled from the *Princess* is about 2% of the smaller amount that was modelled for the oil spill scenarios, the volume and aerial extent of MDF remaining after evaporation, dispersion, and mitigation of an offshore 300 m^3 spill should be negligible or very small, and difficult to detect.

Additional oil spill model simulations have been done by Nielsen et al. (2008) for locations in northeast Baffin Bay, including two sites just north of 74°N near 60°W and 63°W between the Tooq and Qamut license blocks, and one site (71° 23'N, 58° 20'W) to the south. These results support the comments made above.

The northern part of Qamut Block is located 40 km or more from the coastline of northwest Greenland. The regional wind and current regime, discussed in Section 4.1, indicates that the West Greenland Current is weak in this region, with a tendency for net flow to the west while the winds are predominantly from the southeast through summer and early fall. Tidal currents have some bearing on transport as well, but less so than over banks to the east and south. The seismic survey will be carried out during sea ice free conditions, avoiding a "fuel under sea ice" or "fuel in sea ice" situation. Given the prevailing winds and currents, the net advection of a 300 m^3 spill of fuel from the Princess would be generally west moving roughly parallel to the shoreline. It is unlikely that a fuel spill of this size would reach the coast, given the small volume left after mitigation has been applied, and the large decrease involving evaporation to the atmosphere, followed by dispersion in the water column. If this release of fuel occurred closer to shore, north of the licence area, it could impact the coast, but no operations are planned in those waters.

The seismic survey extends into the west-central part of NPZ-I. ConocoPhillips is aware this region is an ecologically sensitive area. No operations, such as ship to ship re-fuelling, with any possibility of causing or resulting in a fuel spill, will occur in these waters.

Residual Effects and Environmental Significance

The effects of minor unplanned events involving smaller spills that cannot be contained onboard have a "negligible" impact significance rating for all VECs. These results are shown in Table 6.7-1. These events would be infrequent or occasional to start with, not continuous; containing the spill immediately is normal procedure and "best practice" at sea on a competent, well-run vessel. When this mitigation is applied, the magnitude of effects

was regarded as negligible. Geographic extent would be limited to the survey area, in the immediate vicinity of the ship involved. The duration was anticipated to be short-term in most cases, but it could be longer, depending on the spilled material or substance that could not be contained. The consequence was rated as negligible, and probability, as a result of the foregoing, as unlikely for all VECs. Further mitigation is not required.

Table 6.7-1 Summary of Impacts from Minor Unplanned Events and Accidental Spills on VECs

VEC	Potential Impact	Planned Mitigation	Impact Assessment Criteria				Consequence	Probability	Overall Significance
			Magnitude	Geographic Extent	Duration	Frequency			
Sediment Quality	deterioration of sediment quality	Section 8.0 (Spill Prevention and Response Plan) & Appendix I Table I-1	negligible	local	short-term	occasional	negligible	unlikely	1 (negligible)
Water Quality	deterioration of water quality		negligible	local	short-term	occasional	negligible	unlikely	1 (negligible)
Marine Fish	minor toxic effect		negligible	local	short-term	occasional	negligible	unlikely	1 (negligible)
Seabirds	minor toxic effect		negligible	local	short-term	occasional	negligible	unlikely	1 (negligible)
Marine Mammals	minor toxic effect		negligible	local	short-term	occasional	negligible	unlikely	1 (negligible)
Subsistence Hunting and Fishing	minor toxic effect to important species		negligible	local	short-term	occasional	negligible	unlikely	1 (negligible)

The effects of major unplanned events involving larger spills that enter the sea in Qamut Block have a “negligible” impact significance rating for all VECs, with two exceptions where the rating is “low”, taking evaporation, dispersion and application of mitigation into account. These results are shown in Table 6.7-2. Some observations about two of the ratings are provided below. Sediment quality was included as a VEC because of potential effects on substrate in the inter-tidal zone if any fuel came ashore. While these effects are possible, it is very unlikely that water containing any fuel would move toward the coast. Since commercial fishing does not occur, at present, in or near the licence area, it was not assessed.

Effects on seabirds from major spills have a “low” impact significance rating. Birds would be the most negatively affected receptor after this category of unplanned event. The magnitude of these effects, depending on the amount of fuel remaining in the upper part of the water column after evaporation to the atmosphere, application of mitigation, and dispersion or mixing processes, could be high. It may lead to mortality of vulnerable species, such as common eider or thick-billed murre, both species of concern. The geographic extent could be local to regional, and duration, short-term to medium-term. As a result, the consequence of the effects could be severe. The probability is rare; therefore, the overall significance is low (2).

Effects on marine mammals from major spills have a “low” impact significance rating. Depending on the amount of fuel left in the surface layer after evaporation to the atmosphere, application of mitigation, and dispersion or mixing processes, the magnitude of these effects could be high, involving more than one Greenland red-listed animal (narwhals and beluga whales), possible disruption of marine mammal behaviour, possible harm, and possible damage to sensitive habitat areas. The geographic extent could be local to regional, and the duration, short-term to medium-term. The consequence of the effects, therefore, could be severe. The probability is rare; therefore, the overall significance is low (2).

Table 6.7-2 Summary of Impact from Major Unplanned Events and Accidental Spills on VECs

VEC	Potential Impact	Planned Mitigation	Impact Assessment Criteria				Consequence	Probability	Overall Significance
			Magnitude	Geographic Extent	Duration	Frequency			
Sediment Quality	deterioration of sediment quality	Section 8.0 (Spill Prevention and Response Plan, Emergency Response Plan, Ice Management Plan,) & AppendixI Table I-1	moderate	regional	long-term	occasional	moderate	rare	1 (negligible)
Water Quality	deterioration of water quality		moderate	regional	medium-term	occasional	moderate	rare	1 (negligible)
Marine Fish	physical effect		moderate	regional	medium - term	occasional	moderate	rare	1 (negligible)
Seabirds	physical effect		high	regional	medium-term	occasional	severe	rare	2 (low)
Marine Mammals	physical effect		high	regional	medium-term	occasional	severe	rare	2 (low)
Subsistence Hunting and Fishing	displacement of fishery grounds loss of important species		moderate	regional	medium-term	occasional	moderate	rare	1 (negligible)

7 Cumulative Effects Assessment

7.1 Introduction

Cumulative effect assessment (CEA) is defined as “the combination of multiple impacts from existing projects, the proposed project, and/or anticipated future projects that may result in significant adverse and/or beneficial impacts on an environmental resource / receptor that would not be expected in case of a stand-alone project” (IFC 2007).

The framework for conducting the cumulative effects assessment (CEA) involved the following steps:

- Identification of residual effects for the ConocoPhillips Project in the Qamut Block.
- Identification of spatial and temporal boundaries for the CEA.
- Identification of other past, present, and reasonably foreseeable future Projects or activities in the CEA study area.
- Prediction and evaluation of potential cumulative effects of the Project on selected VEC in the receiving environment.
- Identification of mitigation measures to eliminate or reduce potential cumulative effects.
- Determination of the significance of any residual cumulative effects after mitigation.

Following the identification of Project-specific residual effects, the assessment of cumulative effects focussed on selective VECs that were most likely to be affected by other projects or activities known to take place at the same time and/or in the same general location (RSA). The VECs selected included fish and marine mammals where underwater sound, as a result of other seismic survey operations, was the focus of the cumulative effects assessment.

An approach for investigating and assessing the cumulative effects of underwater sound on fish and marine mammals from multiple seismic operations concurrently taking place in northeast Baffin Bay, at both local and regional scales, was agreed to, in principle, by BMP, DCE, and the three northeast Baffin Bay operators at a meeting in Copenhagen on 20 January 2012. An approach for in-situ monitoring of cumulative underwater sound levels (using bottom-moored or fixed systems) during the multiple seismic operations in northeast Baffin Bay was also part of this agreement.

The following section provides an overview of the approach used to model aggregate or cumulative underwater cSEL on a regional scale. Detailed information on the modeling approach is presented in the Acoustic Technical Report (Appendix D).

7.2 Methods

Acoustic modeling was conducted on a regional scale by JASCO Research to assess the cumulative effects to selected VEC's from exposure to underwater sound from simultaneous seismic operations in adjacent License Blocks in northeast Baffin Bay. Aggregate sound exposure maps were prepared to illustrate the long-range sound contributions from all projects in this region (Appendix D).

The spatial boundary, in general, is the same as the RSA described in Section 5.2.3. The acoustic modeling related to cumulative effects was conducted for northern Baffin Bay as a whole, extending in the North Water Region, on the north, and towards Disko Island, in the eastern part of central Baffin Bay, on the south. The agreed-on methodology for investigating and assessing the cumulative effects of underwater sound on marine mammals, at both local and regional scale, during multiple seismic surveys in northeast Baffin Bay occurring at the same time was followed throughout.

Projects and activities that were included in the CEA included:

- the proposed 2012 ConocoPhillips 2D-seismic program (Qamut Block);
- the proposed 2012 Maersk Oil Kalaallit Nunaat A/S (MOKN) 3D-seismic program, and hydrographic and shallow geophysics survey (Tooq Block); and
- the proposed 2012 Shell Kanumas A/S (Shell) 3D-seismic program and stratigraphic drilling program (Anu Block and Napu Block).

Two modeling approaches were applied:

- modelling aggregate cSEL in the RSA from all airgun pulses from all activities over a 24-hour time period; and
- modelling sound propagation beyond the RSA for a single airgun pulse from each activity.

As mentioned in JASCO's Acoustics Technical Report, the aggregate cSEL model scenario included simultaneous operation of four seismic surveys and vertical seismic profiling (VSP). Activities from MOKN's hydrographic survey were not included in this analysis because contribution of the sound from this work is expected to be negligible relative to the four seismic surveys. This aggregate model scenario was designed with sources positioned such as to provide a conservative assessment of overall sound exposure in sensitive areas such as Melville Bay. Modeled sound levels for all activities in the aggregate model scenario were summed to provide an aggregate measure of the 24-hour cSEL over a grid of receiver locations at a regional scale.

Sound propagation beyond the RSA was modelled using single transects connecting several source and receiver locations. The source locations included each operator's airgun arrays (four in total) and the vertical seismic profiling array. Receiver locations were located several hundred kilometers away, distributed around the Baffin Bay area. The modelling included sound absorption from the water column, applied constant seafloor and water column properties, and made the cautionary assumption of open water (no sea ice) conditions since the presence of sea ice would give rise to scattering of the sound and reduce received sound levels.

7.2.1.1 Modelled Scenarios

In the aggregate model scenario JASCO computed cSEL for all airgun pulses which could realistically be acquired by each operator (ConocoPhillips, MOKN, and Shell) over a 24-hour time period for the following activities:

- ConocoPhillips: acquisition of one complete seismic survey line in the Qamut block;
- MOKN: acquisition of two complete seismic survey lines in the Tooq block;
- Shell: acquisition of two complete seismic survey lines, using two airgun arrays, in the Anu and Napu blocks;

- Shell: vertical seismic profiling occurring at one site north of the Qamut block.

JASCO Research also modeled sound propagation outside of the RSA along single transects connecting each airgun-array to a set of four receivers: (R1) near the western boundary of the Melville Bay Reserve, (R2) in the southern part of the North Water Region between Greenland and Canada, (R3) at or near the entrance to Lancaster Sound, and (R4) to the south towards Disko Island. The source and receiver locations are shown in Figure 7.2-2.

7.2.1.2 Criteria

SEL is a measure of total sound energy and is a convenient metric for summing sound energy from multiple sound pulses. As such, the cumulative SEL (cSEL) metric is appropriate when assessing effects to marine mammals and marine fish from cumulative exposure to multiple airgun pulses. cSEL is calculated as a straight summation of sound energy over multiple pulses and provides a conservative measure that does not account for hearing recovery between pulses.

The cSEL criteria recommended by Southall et al (2007) are: 198 dB re 1 μPa^2-s for cetaceans and 186 dB re 1 μPa^2-s for pinnipeds. These criteria are intended to be M-weighted to account for the variable hearing abilities of different marine mammal groups. These levels provide thresholds for injury but corresponding cSEL thresholds for behavioural impacts from multiple pulses do not exist. Commonly 160 dB re 1µPa (rms) is considered a threshold for behavioural effects in marine mammals, although migrating bowhead whales have been reported to exhibit behavioural reactions to multiple airgun pulses at received levels as low as 120 dB re 1µPa (rms) (Richardson et al, 1999).

7.3 Results

Maps showing sound level contours resulting from the aggregate cSEL calculations (along with more details of the methodology) are provided in the Acoustics Technical Report (Appendix D). Based on the model results, the total areas in which the modeled cSEL are at or above injury threshold criteria (flat-weighted and M-weighted) are presented in Table 7.3-1 for each M-weighted hearing group and for flat-weighted levels (i.e. not filtered for any particular hearing group). The table also presents the distance offset from the survey line at which the modeled levels exceed the injury threshold criteria. These results provide the quantitative basis for the assessment of cumulative effects on fish and marine mammals.

Full results from the transect modelling completed beyond the RSA are found in Appendix D (Acoustic Technical Report, Section 5.3). For the source positions considered, the highest rms SPL received at each receiver location was: (R1) 127.2 in Melville Bay, (R2) 129.3 in the northern waters, (R3) 128.1 in Lancaster Sound, and (R4) 119.8 towards the south.

Although the total area within which the injury threshold is exceeded for pinnipeds is large, this area is confined to a region within 800 m range from the source (offset from the survey line). Using the most conservative marine mammal injury threshold for cSEL (pinnipeds @186 dB re 1 μPa^2s), seismic sound would extend out to a maximum of 600 m at levels high enough to result in auditory injury. The cumulative SEL calculations assume stationary receivers and the greatest dose of sound energy is delivered to the receiver at that the time the vessel is at its closest point of approach to the animal. Therefore, since the 600 m range within which there is a potential for injury from 24-hours of cumulative sound exposure is within the stipulated 800 m safety zone, the risk for injury from cumulative sound exposure is also mitigated through implementation of the safety zone and associated shut-down criteria.

Table 7.3-1 Areas Affected by cSEL in Qamut Block and RSA

Injury Threshold for cSEL (dB re 1 mPa^2s)	Distance Offset from the Survey Line at which Injury Threshold is Exceeded [m]	Total Area in Qamut Block where Injury Threshold is Exceeded over a 24-hour Period [km^2]	Percent of Total Area Available in Qamut Block (11,600 km^2) [%]	Total Area in all Blocks[(a)] where Injury Threshold is Exceeded Over a 24-hour Period [km^2]	Percent of Total Area Available in all Blocks[(a)] (42,196 km^2) [%]
186 (Flat)	1,750	387.9	4.1%	2,734	6.5%
186 (PINN)	600	105.2	1.1%	892	2.1%
198 (Flat)	100	20.0	0.2%	118	0.3%
198 (LFC)	85	17.5	0.2%	103	0.2%
198 (MFC)	<10	1.8	0.02%	<20	<0.05%
198 (HFC)	<10	0.6	0.01%	<14.8	<0.04%

(a) Includes Tooq Block, Qamut Block, Pitu Block, and Anu Block.

Note: Flat = flat-weighted; PINNm = weighted for pinnipeds; LFC=weighted for low-frequency cetaceans, MFC= weighted for medium-frequency cetaceans, HFC= weighted for high-frequency cetaceans

7.4 Interpretation and Mitigation

7.4.1 Identification of Mitigation Measures

Aggregate or 'cumulative' sound exposure modeling is based on the sound metric cSEL, as this is the only metric that takes into account cumulative sound exposure from repetitive pulses and/or overlapping acoustic fields. 'Behavioral disturbance' protection zones cannot presently be determined from cumulative sound exposure modeling because there are no known behavioral impact thresholds for cSEL. The current cSEL thresholds relate to PTS (186 and 198 dB re 1 μPa^2s; M-weighted for pinnipeds and cetaceans respectively). As such, the cumulative acoustic model of the combined four seismic surveys is only able to provide information for cSEL likely to induce hearing loss (TTS and PTS) in marine mammals, and not behavioral reactions. Based on the acoustic modeling results, cSEL capable of inducing TTS or PTS were not predicted in overlap areas of the sound fields away from the sources. Therefore, the combined seismic operations do not necessitate different protection measures other than those recommended for the individual Project surveys, from an injury prevention standpoint.

Section 6.3 identified potential temporary behavioural effects on fish and marine mammals from non-overlapping sound sources occurring in Qamut Block (the LSA). The same effects are predicted to occur at the regional level. Mitigation measures for non-overlapping Project effects in Qamut Block are described in Appendix I (Mitigation Measures) and Appendix J (Marine Mammal Management Plan) of the Final EIA, and summarized in the EPP (Section 8.0).

In addition to ConocoPhillips applying these known and effective mitigation measures during its operations in Qamut Block (including extended safety zones, ramp ups, pre-shooting surveys, and shut-down / low power procedures), the three operators in northeast Baffin Bay have agreed to prepare and implement a simultaneous operations plan with mitigation added that is related to underwater sound and marine mammals in a regional setting. This mitigation involves planning and coordination related to keeping seismic survey ships positioned as far apart as possible when multiple operations are taking place at the same time. Taking these steps is different than following procedures to keep vessels from approaching too close to each other during acquisition such that quality or integrity of seismic data is affected. The latter is what a simultaneous operations plan is normally designed to do, in addition to addressing safety of shipping when many vessels will be operating in, or transiting to and from, an area such as northeast Baffin Bay.

7.4.2 Determination of Significance

Table 7.4-1 summarizes the impact rating classifications for the cumulative effects of seismic sound on fish and marine mammals in Northeast Baffin Bay.

Table 7.4-1 Summary of Cumulative Impacts from Seismic Sound on Marine Mammals and Fish on a Regional Level

VEC	Potential Impact	Planned Mitigation	Impact Assessment Criteria				Consequence	Probability	Overall Significance
			Magnitude	Geographic Extent	Duration	Frequency			
Marine Fish	physical effects	See Section 8.0 & Appendix I Table I-1	Moderate	Regional	Long-term	Continuous	Moderate	Unlikely	Low (2)
	behavioural effects[(a)]		Moderate	Regional	Short-term	Continuous	Moderate	Likely	Moderate (3)
Toothed Whales (Beluga and Narhwal)	physical effects	Mitigation for physical effects only: Section 8.0 (MMSO, PAM, extended safety zone, etc), Appendix I Table I-1, Appendix J	Low	Regional	Long-term	Continuous	Minor	Rare	Negligible (1)
	behavioural effects[(a)]		Moderate	Regional	Short-term	Continuous	Moderate	Likely	Moderate (3)
	acoustic masking		Moderate	Regional	Short-term	Continuous	Moderate	Unlikely	Low (2)
Baleen Whales (Bowhead Whales)	physical effects		Low	Regional	Long-term	Continuous	Minor	Rare	Negligible (1)
	behavioural effects[(a)]		Moderate	Regional	Short-term	Continuous	Moderate	Unlikely	Low (2)
	acoustic masking		Moderate	Regional	Short-term	Continuous	Moderate	Unlikely	Low (2)
Pinnipeds and Walrus	physical effects		Low	Regional	Long-term	Continuous	Minor	Rare	Negligible (1)
	behavioural effects[(a)]		Moderate	Regional	Short-term	Continuous	Moderate	Likely for pinnipeds / Unlikely for walrus	Moderate (3) for pinnipeds / Low (2) for walrus
	acoustic masking		Moderate	Regional	Short-term	Continuous	Moderate	Likely for pinnipeds / Unlikely for walrus	Moderate (3) for pinnipeds / Low (2) for walrus
Polar Bears	physical effects		Negligible	Regional	Long-term	Continuous	Negligible	Rare	Negligible (1)
	behavioural effects[(a)]		Negligible	Regional	Short-term	Continuous	Negligible	Unlikely	Negligible (1)

(a) Includes displacement, avoidance and tolerance.

Cumulative Sound Exposure on Marine Fish

The potential for physical injury (auditory trauma) or behavioral effects from cumulative sound exposure on all fish VECs is considered to be of moderate magnitude, as sound levels could exceed established cSEL injury thresholds at close range to the individual sound sources, and behavioural changes (avoidance behaviour) are anticipated in the far-field, and may potentially result in a temporary disruption of fish behaviours critical to survival. However, effects are not anticipated at the population level, as fish and ichthyoplankton (fish eggs and larvae) are generally widely distributed, and recovery, in terms of both diversity and abundance, is likely to occur rapidly in response to localized impacts. Physical and behavioural effects will be spatially limited to the RSA (regional geographic extent), and will occur on a continuous frequency (assuming 24-hour operations amongst all operators). Physical effects on fish are considered to be long-term in the case of physical injury (auditory damage), and short-term (limited to the open-water season) in the case of behavioural effects. The environmental consequence of the cumulative effects of underwater sound was thus determined to be moderate for both physical and behavioural effects for all fish VECs. With the application of mitigation (ramp-up), the probability for physical injury or mortality of fish is considered to be unlikely due to anticipated avoidance behaviour, and likely for behavioural effects, resulting in a low (2) and moderate (3) impact significance rating, respectively.

Cumulative Sound Exposure on Toothed Whales (Narwhals and Belugas)

Beluga whales and narwhals were identified as VECs for the Project as their presence in Greenlandic waters is well documented (DCE 2011). However, results from this effects assessment, and the mitigation measures as proposed, are applicable to all toothed whale species potentially occurring in the Project area during the open-water season.

Based on the results in the Acoustic Technical Report (Appendix D), the cSEL injury threshold for mid-frequency cetaceans (198 dB re 1 μPa^2-s, Southall et al. 2007) is predicted to be exceeded at distances up to 10 m offset from the survey line. The potential for auditory damage to beluga and narwhal as a result of cumulative seismic sound exposure is thus considered to have a low magnitude, as the cSEL injury threshold will not extend outside the 800 m safety zone. Moreover, most of the sound energy from airguns is emitted outside the sensitive frequency range for both narwhals and belugas. This effect is considered to be long-term in duration (in the case of PTS) over a regional geographic extent (within the RSA), and of continuous frequency (assuming 24-hour operations amongst all operators). The environmental consequence of this effect is thus considered to be minor. With known and effective mitigation in place, the probability of direct physical injury (auditory damage) in toothed whales from cumulative exposure to seismic sound is considered rare, resulting in a negligible (1) impact significance rating for both beluga and narwhal. It is unknown to what degree indirect physical / physiological effects may occur as a result of cumulative sound exposure due to the limited research conducted on this topic. If mammals remain in an area because it is important for feeding, breeding, or some other biologically important purpose, it is possible that physiological stress may occur as a result of chronic exposure to sound. This might, in turn, have negative effects on the well-being or reproduction of the animals involved, although this linkage remains inconclusive at this time.

The effect of cumulative sound exposure on narwhal and beluga behaviour is considered to be of moderate magnitude, as far-field effects on behaviour are likely, however no population level effects are anticipated, and most of the sound energy will be emitted outside the sensitive frequency range for both species. This effect is considered to be limited to the RSA, short-term in duration (during the open-water season of 2012), and of continuous frequency assuming 24-hour operations amongst all operators throughout the survey period. The environmental consequence of this effect is thus considered to be moderate. The probability of this effect occurring is predicted to be likely as toothed whales (particularly narwhal) are likely to be in the regional area (RSA) during the open-water season given the protected summering ground areas (NPZ-1) identified for this species near Melville Bay. The overall impact significance rating for behavioural effects from cumulative sound exposures from seismic sound sources is predicted to be moderate (3) for beluga and narwhal.

Potential masking effects of cumulative seismic sound exposure on the communication space of beluga and narwhal are expected to be limited, as both species typically communicate at frequencies outside the dominant bandwidth of seismic survey sound. Furthermore, both species may be able to emit and receive sounds between airgun pulses (Davis et al. 1985, Abgrall et al. 2008). The environmental consequence of this effect is thus considered to be moderate (moderate magnitude, regional in geographic extent, short-term duration, continuous frequency), with an unlikely probability of occurrence (as communication frequencies are likely not masked by seismic sound), resulting in a low (2) impact significance rating (Table 7.4-1).

Cumulative Sound Exposure on Baleen Whales (Bowheads)

Bowhead whales were identified as a VEC for the Project as their presence in Greenlandic waters is well documented (DCE 2011). However, results from this effects assessment, and the mitigation measures as proposed, are applicable to all baleen whale species potentially occurring in the Project area during the open-water season.

Based on modeling results in the Acoustic Technical Report, attached in Appendix D, the cSEL injury threshold for low-frequency cetaceans (LFC) (198 dB re 1 μPa^2-s; Southall et al. 2007) is predicted to be exceeded at distances up to 85 meters offset from the survey line. The potential for physical injury (auditory damage) to bowhead whales as a result of cumulative seismic sound exposure is thus considered to have a low magnitude, as the cSEL injury threshold will not extend outside the 800 m safety zone. This effect is considered to be long-term in duration (in the case of PTS), over a regional geographic extent (within the RSA), and of continuous frequency (assuming 24-hour operations amongst all operators). The environmental consequence of this effect is thus considered to be minor. With known and effective mitigation in place, the probability of physical injury to bowhead whales from cumulative exposure to seismic sound is considered rare (particularly as most bowhead whales are likely to be absent from the RSA during the seismic program), resulting in a negligible (1) impact significance rating for this species.

The effect of cumulative seismic sound on bowhead whale behaviour is considered to be of moderate magnitude as far-field effects on behaviour are likely; however no population level effects are anticipated. This effect is considered to be limited to the RSA, short-term in duration (during the open-water season of 2012), and of

continuous frequency assuming 24-hour operations amongst all operators throughout the survey period. The environmental consequence of this effect is thus considered to be moderate. Because bowhead whales are not likely to be in Eastern Baffin Bay during the open-water seismic period, the probability of this effect occurring is predicted to be unlikely, resulting in an overall low (2) impact significance rating for bowhead whales.

The frequencies emitted by seismic sound overlap with those used by baleen whales for communication. Although the cumulative seismic sounds are impulsive, sound levels due to reverberation after each airgun pulse are likely to be above background sound levels, as well as above the audible threshold of bowhead whales over large distances and thus capable of masking their communication (Blackwell et al. unpublished, Koski et al. 2011). The environmental consequence of this effect is thus considered to be moderate (moderate magnitude, regional geographic extent, short-term duration, continuous frequency). However, the probability of this effect occurring is considered unlikely because bowheads are expected to be absent from the RSA during the open-water season, and communication is likely possible during pulse intervals, resulting in an overall low (2) impact significance rating (Table 7.4-1).

Cumulative Sound Exposure on Pinnipeds and Walrus

The cSEL injury threshold for pinnipeds (PINN) (186 dB re 1 μPa^2-s; Southall et al. 2007), based on results in the Acoustic Technical Report (Appendix D), is predicted to be exceeded at distances up to 600 m offset from the survey line. The potential for auditory damage to pinnipeds from cumulative seismic sound exposure is thus considered to have a low magnitude, as the cSEL injury threshold will not extend outside the 800 m safety zone. This effect is considered to be long-term in duration (in the case of PTS), over a regional geographic extent (within the RSA), and of continuous frequency (assuming 24-hour operations amongst all operators). The environmental consequence of this effect is thus considered to be minor. With known and effective mitigation in place, the probability of physical injury to pinnipeds and walruses from cumulative exposure to seismic sound is considered rare (particularly for walrus as they are expected to be absent from the RSA during the seismic program), resulting in a negligible (1) impact significance rating for this species (Table 7.4-1).

The effect of cumulative seismic sound on pinniped and walrus behaviour is considered to be of moderate magnitude, as far-field effects on behaviour are likely; however no population level effects are anticipated and no disruption of critical activities are expected (no critical areas for pinnipeds, such as sea-ice are present in the RSA during the survey period and no walrus summering grounds are present in the RSA). This effect is considered to be limited to the RSA, short-term in duration (during the open-water season of 2012), and of continuous frequency assuming 24-hour operations amongst all operators throughout the survey period. The environmental consequence of this effect is thus considered to be moderate. Based on the likelihood of species occurrence in the RSA, the probability of this effect occurring is predicted to be likely for pinnipeds and unlikely for walruses, resulting in an overall impact significance rating of moderate (3) for pinnipeds and low (2) for walruses (Table 7.4-1).

The frequencies emitted by seismic sound overlap those used by pinnipeds and walrus for communication. Although the cumulative seismic sounds are pulsive, sound levels due to reverberation after each airgun pulse are likely to be above background sound levels, as well as above the audible threshold for these animals over large distances and thus capable of masking their communication (Blackwell et al. 2011, Koski et al. 2011). The environmental consequence of masking effects on walrus and pinniped communication is thus considered to be moderate, given the impact will be short in duration, continuous in frequency, moderate in magnitude, and regional in geographic extent (masking effects will extend outside the LSA + 10 km buffer zone). The probability of this effect is considered likely for pinnipeds, and unlikely for walrus, as the latter are not likely to be in Baffin Bay during the open-water season when the seismic programs will be taking place. The resulting impact significance rating for masking effects is therefore assessed as low (2) for walrus and moderate (3) for pinnipeds (Table 7.4-1).

Cumulative Sound Exposure on Polar Bear

All operators will be conducting seismic operations in sea-ice free conditions. It is therefore anticipated that polar bears will be absent from the seismic survey areas during the open water seismic season due to their close association with sea ice. Moreover, because the natural behavioural tendencies of polar bears (e.g. remaining at the water surface, or on land) greatly reduce their exposure to underwater sounds, the potential for physical injury or behavioural disturbance in this species owing to cumulative seismic sound exposure is considered to have a

negligible environmental consequence. The probability of this effect occurring is considered rare for physical injury and unlikely for behavioural disturbance and acoustic masking, resulting in a negligible (1) impact significance rating with regards to physical, behavioural, and acoustic masking effects.

8 Environmental Protection Plan

8.1 Introduction

This section describes the EPP for the Project. It is an overview or summary of this plan. It is based on the environmental assessment, including mitigation measures designed to manage, reduce or eliminate impacts of the Project on Qamut Block, specifically, and northeast Baffin Bay, in general. ConocoPhillips will implement an integrated approach for environmental protection and environmental protection during the Project. As a result, the EPP includes a number of individual plans, and incorporates elements of others. Many of the plans in the latter category are not complete at this time, and will be provided to BMP 40 days prior to the start of survey operations in Qamut Block.

It is noted that a planning and preparation process, including adoption of pre-survey measures based on approval of the Project, and the scheduling of detailed steps to implement and monitor the mitigation measures described in the EIA, will occur after the Final EIA is submitted to BMP by ConocoPhillips. This process will be subject to conditions, if any, attached to the approval.

The EPP has been has been prepared in accordance with the current version of the Guidelines (BMP 2011), and with the Minerals Resources Act. Consequently, all Project activities are governed by the following requirements:

- identification and assessment of the risk of pollution and any other harmful impacts on the environment with the intention to reduce to the extent possible these impacts;
- implementation of mitigation measures that are in compliance with applicable legislation and good industry practice for waste management, refueling, and notification to other operators within the area, coordinating activities to the extent possible to avoid unnecessary impediment; and
- making all project personnel aware of the standards and controls prior to the commencement of work, and conducting all project related activities in a safe and responsible manner with due consideration to actual field conditions encountered.

8.2 Environmental Policy during the Project

ConocoPhillips has an environmental policy in Greenland that is part of the broader Health, Safety and Environment (HSE) framework of its global parent. It embraces this policy, and is committed to protecting the health and safety of everybody who plays a part in its operations, lives in the communities in which it operates, or uses its products. ConocoPhillips will conduct its business with respect and care for both the local and global environment, and systematically manage risks to drive sustainable business growth. It will not be satisfied until it succeeds in eliminating all injuries, occupational illnesses, unsafe practices and incidents of environmental harm from our activities.

To meet its commitment to these goals, ConocoPhillips will:

- Demonstrate visible and active leadership that engages employees and service providers and manage HSE performance as a line responsibility with clear authorities and accountabilities.
- Ensure all employees and contractors understand that working safely is a condition of employment, and that they are each responsible for their own safety and the safety of those around them.
- Maintain "stop work policies" that establish the responsibility and authority for all employees and contractors to stop work they believe to be unsafe.
- Manage all projects, products and processes through their life-cycles in a way that protects safety and health and minimizes impacts on the environment.
- Provide employees with the capabilities, knowledge and resources necessary to instill personal ownership and motivation to achieve HSE excellence.

- Provide relevant safety and health information to contractors and require them to provide proper training for the safe, environmentally sound performance of their work.
- Measure, audit and publicly report HSE performance, and maintain open dialogue with stakeholder groups and with communities where ConocoPhillips operates.
- Comply with applicable regulations and laws.
- Work with both governments and stakeholders where ConocoPhillips operates to develop regulations and standards that improve the safety and health of people and the environment.
- Maintain a secure work environment to protect itself, its contractors and its assets from risks of injury, property loss or damage resulting from hostile acts.
- Communicate its commitment to this policy to subsidiaries, affiliates, contractors and governments worldwide and seek their support.

By implementation of this policy, ConocoPhillips seeks to earn the public's trust and to be recognized as the leader in HSE performance.

8.3 Standards, Controls, Consultation and Notification

All operations in Qamut Block will be carried out according to all applicable regulations, standards, and “best practice” guidelines in waters under Greenlandic jurisdiction, including, but not limited to:

- MARPOL 73/78 “International Convention for the Prevention of Pollution from Ships”;
- IMO International Convention for the Safety of Life at Sea (SOLAS) 1974;
- IAGC “Marine Geophysical Operations Safety Manual” (published by the International Association of Geophysical Operations);
- IAGC “Environmental Guidelines for Worldwide Geophysical Operations” (most recent edition);
- OGP Guideline: Managing HSE in a Geophysical Contract (Report No. 432);
- Order No. 417 of 28 May 2009, “Order on Technical Regulation on Safety of Navigation in Greenland Waters”;
- Order No. 170 of 17 March 2003, “Ship Reporting Systems in the Waters off Greenland”;
- Technical Regulation No. 169 of 4 March 2009, “Technical Regulation on the Use of Ice Searchlights During Navigation in Greenland Waters”;
- Resolution A.1024 (26) IMO 2010, “ Guidelines for Ships Operating in Polar Waters”; and
- any requirements attached to the authorization from the Government of Greenland, or any other conditions required by the authorities.

ConocoPhillips recognizes the importance of regular communication with BMP, DCE, and other agencies, as well as with communities and local organizations in northwest Greenland, on Project issues, including environmental concerns. Some of this interaction occurred during community visits after the Preliminary EIA was submitted to BMP. Additional interaction will occur after submission of the Final EIA. ConocoPhillips is also familiar with BMP requirements related to notification before, during and after the seismic survey, and will comply with all of these requirements.

The importance of internal Project briefings is also understood by ConocoPhillips. It will ensure all contractors are well-informed about operations-related environmental issues before and during the seismic survey, including conditions, if any, attached to Project approval.

8.4 Plans Included in or Related to the Environmental Protection Plan

8.4.1 Safe Operations Plan

Many parts of this plan are relevant to the EPP. It is being prepared by ConocoPhillips and its contractors, and will cover a wide range of activities, procedures, requirements, and other considerations during the seismic survey in Qamut Block this year. In accordance with the Guidelines (BMP 2011), it will include, but is not limited to:

- Complete description of safety management systems and all bridging documents for the health, safety and contingency systems used by ConocoPhillips and its contractors on ships during the Project, including documentation on crew health and safety training.
- Documentation for compliance with all requirements for safe navigation in Greenlandic waters, including certificates of seaworthiness[4], fire management plan, boarding procedures, and other maritime practices during normal and emergency operations, as well as insurance certificates.
- Description or explanation of health systems and medical emergency preparedness, including actions that will be taken to treat and stabilize patients with injuries or acute conditions, means of consulting with a physician about these injuries or conditions (or bringing this physician aboard), and arrangements that have been made for evacuating the injured or ill person or persons to a hospital or medical facility onshore.
- Description of procedures for responding to environmental incidents, including spills, unplanned discharges, collisions with mammals, and other situations.

The Safe Operations Plan will be submitted to BMP by ConocoPhillips 40 days before operations begin in Qamut Block. It is not attached to the Final EIA. The Emergency Response Plan (ERP), described below, and the Simultaneous Operations Plan (if an agreement is reached between the operators in northeast Baffin Bay to prepare this plan), discussed below as well, may be integrated with the Safe Operations Plan.

8.4.2 Simultaneous Operations Plan

This plan is normally developed and implemented as a “best practice” by companies during offshore exploration when two or more seismic surveys are occurring in a given region. The quality and integrity of seismic data can be affected or become impaired or degraded if the survey ships are too close to each other when airgun arrays are being operated, and seismic data is being acquired.

It was mentioned in Section 7 of the Preliminary EIA that a simultaneous operations plan could become part of regional mitigation related to cumulative effects of underwater sound from multiple seismic surveys that occur at the same time. That is, given the possible impacts of higher sound levels on marine mammals from a cumulative effects point of view, planning and coordination could be done to avoid operational situations where a maximum amount of seismic sound is being generated during multiple programs. This planning and coordination could involve maintaining larger separation distances between seismic vessels than ones related to impairment of seismic data quality or integrity, or making choices about sequencing (when and where operations occur on a given day or during a given week). The types of situations to be avoided would be identified by the operators based on experience during concurrent seismic surveys in other offshore areas. Discussions about preparing a plan took place between the operators before each operator’s Preliminary EIA was submitted to BMP in mid-March 2012.

ConocoPhillips, Maersk Oil Kalaallit Nunaat A/S and Shell Kanumas A/S subsequently agreed to prepare and implement a simultaneous operations plan with mitigation added related to underwater sound and marine mammals in a regional setting. As noted in Section 7, this mitigation involves planning and coordination to keep seismic survey ships operating at greatest distance from each other as often as possible when multiple surveys occur at the same time. Taking these steps is not the same as following procedures to keep these vessels from approaching too close to each other during acquisition such that quality or integrity of seismic data is affected.

[4] The ship’s master will demonstrate familiarity with all rules and regulations to navigation and operations with the Greenlandic EEZ (Exclusive Economic Zone), and will ensure that safe voyage planning includes all information necessary to ensure safe navigation, such as weather, wave and ice conditions, bathymetry, local geography, currents and tide, navigational hazards, operational limits, the ship’s design, and means of communication.

The latter is what a simultaneous operations plan is normally designed to do, in addition to addressing safety of shipping when many ships will be operating in, or transiting to and from, an area such as northeast Baffin Bay. The three operators will exchange operational contact information, enabling all seismic vessels to maintain regular communication with each other at sea during execution of operations. The operators will also share their detailed operational plans with each other before any seismic surveys begin in northeast Baffin Bay, and interact on details in a collaborative way. This sharing and consultation between companies is an opportunity to develop and test, in advance, the steps that will be followed to keep seismic ships positioned as far apart as possible when multiple surveys are underway at the same time.

8.4.3 Waste Management Plan

The waste management strategy of ConocoPhillips during the Project was described in Section 6.2. All material and equipment brought into Qamut Block, with the exception of fuel consumed during operations, and discharges authorized under national regulations or international conventions (e.g., grey water, black water, macerated organic waste, drainage from decks and above waterline ship's structure), will leave the license area at the end of the seismic survey. No waste will be disposed of onshore, whether it is hazardous or non-hazardous. This strategy is consistent with BMP's Guidelines related to waste, and with requirements under the Mineral Resources Act.

Waste will be segregated and stored onboard according to type and MARPOL grouping, prior to disposal at a properly equipped and licensed waste disposal facility at a port in another country. Some non-hazardous waste may be incinerated at high temperature, since at least some of the ships chartered for the Project are equipped with incinerators. Hazardous waste, including batteries, will be safely and securely stowed. Waste management records will be maintained as normal operating practice, including quantities of waste incinerated onboard, and hazardous waste retained for onshore disposal.

Procedures and policies related to waste management will be described in a project-specific Waste Management Plan. ConocoPhillips is developing this plan with its contractors. It will be submitted to BMP 40 days before operations begin in Qamut Block. It is not attached to the Final EIA.

8.4.4 Ballast Water Management Plan

The ballast water management strategy involves no discharge of ballast water during the survey period. If this occurs during the Project, which ConocoPhillips regards as unlikely, though it is possible if re-ballasting to ice draft after re-fuelling (e.g. by the vessel receiving fuel after ship to ship transfer offshore), then it will be controlled by the IMO convention on ballast water management.

A plan describing ballast water management is being prepared by ConocoPhillips and its contractors. It is not attached to the Final EIA. It will cover, as a minimum, the following IMO requirements:

- ballast water exchange will be conducted at least 200 nautical miles from land in waters at least 200 m deep;
- in cases where the above is not possible, exchange will occur at least 50 nautical miles from land in water at least 200 m deep;
- if these requirements cannot be met, other areas may be designated for ballast water exchange;
- sediments from the ballast tanks will be removed and properly disposed of; and
- a ballast water record book (ballast exchanges, treatments, and accidental discharges) will be maintained.

Instances of ballast water discharge, if any, during the Project will be reported to BMP as part of post-program activity. ConocoPhillips will submit a ballast water management plan to BMP 40 days before operations begin in Qamut Block.

8.4.5 Fuel Spill Response Plan

A detailed Fuel Spill Response Plan is being developed by ConocoPhillips and its contractors. It can be submitted to BMP on request. It is not attached to the Final EIA. This plan will include the following elements:

- number, type, contents and location of spill kits;

- crew spill response training and ship's spill response certification information;
- spill response communication plans and contact information; and
- procedure for maintaining an Oil Record Book as required under MARPOL 73/78, International Convention for the Prevention of Pollution from Ships.

It is noted that ships involved with the seismic survey may carry small quantities of chemicals for technical (scientific) or maintenance and repair purposes. It is believed any unintended spills of these chemicals during the Project would be minor in amount or volume. If supplies of liquid or solid chemicals are necessary onboard, they will be selected based on the least environmentally harmful alternative. All associated Material Safety Data Sheet (MSDS) information will be available on the ship in question. Appropriate personal protective equipment (PPE) will be onboard that is suited or rated for using these products.

8.4.6 Marine Mammal and Seabird Observation Program

The MMSO Plan is a key component of the EPP. It is attached in Appendix J as the main element of a Marine Mammal Management Plan for the Project, including supplementary material. The primary issue of concern is the effect of underwater sound from the seismic array on marine mammals, and to a lesser but still important extent, from equipment on the ship performing the other survey that is part of the Project.

Trained and certified marine mammal and seabird observers (MMSOs) will be stationed on seismic ship. Four MMSOs will be joining the CGGVeritas M/V *Princess* for the seismic survey. Resumes and qualifications of the MMSOs on this ship will be submitted to BMP 40 days before operations begin in Qamut Block.

The MMSOs will carry out observations in accordance with the JNCC "Guidelines for Minimizing Acoustic Disturbance to Marine Mammals for Seismic Surveys" and the DCE "Guidelines to Environmental Impact Assessment of Seismic Activities in Greenland Waters", both cited earlier sections of the EIA. This will to ensure compliance with operational requirements and completion of the work based on both sets of guidelines, since the DCE Guidelines take precedence over the JNCC Guidelines, but situations could arise where DCE information is absent or not available. In addition, MMSOs may provide environmental advice, as well as avoidance or mitigation recommendations, to the captain or officers on the bridge of the seismic vessel.

The DCE Guidelines require a watch for marine mammals within 500 m of the seismic source prior to the start of operations. ConocoPhillips will establish an 800 m safety zone during its operations to minimize the effects of the operations on marine mammals. The primary mitigation measure will always be reducing the amount of sound entering the marine environment. Acquisition of seismic data will be suspended if marine mammals are sighted within 800 m of the airgun array when it is operating. Marine mammal observations will occur during daylight hours, and include all marine wildlife, including pinnipeds, birds, and cetaceans. Use of the mitigation gun on the seismic ship, if this gun needs to be used during line changes or other operations, will also be noted. In addition, the four MMSOs on this vessel will work closely with the operator of the monitoring system described below. A daily log of sightings, observation locations and data will be maintained using the forms associated with the NERI guidelines (log forms will be included as appendices), and a final report will be submitted.

8.4.7 Passive Acoustic Monitoring Plan

A vessel-based passive acoustic monitoring (PAM) plan will be implemented will be implemented during the seismic survey, in conjunction with the MMSO plan mentioned above. A designated, certified PAM operator will use a PAM system on the *Princess* for monitoring on marine mammals (instead of visual monitoring) at night, during periods of darkness, periods of reduced visibility (such as fog), and during sea states greater than Beaufort 3. This person will contribute information for the same mitigation measures as the MMSO team, involving the pre-shoot searches, ramp-ups, and shut-down procedures, as well as use of the mitigation gun. Communication procedures will be established between the MMSOs, PAM operator, and airgun operator for transfer of monitoring responsibilities, and how that occurs. This protocol with be outlined in the Project-specific MMSO manual. Supplementary information on the PAM plan is provided in Appendix J, the Marine Mammal Management Plan for the Project.

The PAM system used on the *Princess* for detecting marine mammal vocalizations was described in Section 3 of the EIA. It is manufactured by Seiche Measurements, and has been used extensively world-wide since 2008. The four towed hydrophone elements have a large bandwidth of 20 Hz to 200 kHz, which means a number of

marine mammal species can be detected if the mammals in question are vocalizing when the PAM system is operating. The data can be visualized, and monitored in real-time, with the software that operates the system. Identification of the mammals in range at different frequencies involves recognizing and comparing structure and content of the data with standard signatures for species that occur in Qamut Block and adjacent waters.

8.4.8 Ice Management Plan

An Ice Management Plan is relevant to the EPP because problems with sea ice or glacial ice include the possibility of damage to ships or towed equipment. This outcome could have environmental implications, in addition to operational ones.

Drifting sea ice, even in low concentrations (e.g., in the form of more concentrated strips or patches), and calved glacial ice in the form of icebergs, bergy bits or growlers, can interfere with the single-streamer seismic survey that will occur in Qamut Block, and may require the seismic vessel to deviate from a survey line, or cause difficulty during a line change. The IMP for the Project is a multi-tiered or multiple-level approach for the Project that is focused on management of glacial ice, involving various tasks and responsibilities at different times and scales of interest. This approach is supported by well-proven procedures for safe operations in glacial ice and sea ice environments. Key elements of the Plan are iceberg drift forecasts, understanding likelihood of impact with the vessel or array, and avoidance methods. Ice defence methods, such as towing of bergy bits and small icebergs, will not be used during the survey.

Ice management planning will take into account systems for ice detection, ice surveillance, data reporting, collation, and tactical forecasting. This phase of activity will occur before the Project starts in the licence area, and involves pre-deployment preparation, operational requirements and tactics, ways of capturing lessons learned, and requirements for analyzing success or failure during the post-survey period. Operational requirements and tactics include, but are not limited to:

- Following agreed-on procedures for glacial ice (and sea ice) avoidance; ensuring that equipment needed for these procedures is onboard and functional, and that crew have been trained on this equipment, or have experience with it; and
- defining response roles and responsibilities, as well as the decision-making process onboard.

One of the primary duties of the two support ships during the survey in Qamut Block is ice management. These vessels will be used to locate and defend against glacial ice in the vicinity of the seismic ship, the array, or the streamer.

Supplementary information on ice management is found in Appendix C. The IMP is being prepared by ConocoPhillips and its contractors, and will be submitted to BMP 40 days before the Project starts in Qamut Block. It is not attached to the Final EIA.

8.4.9 Emergency Response Plan

An Emergency Response Plan (ERP) is being developed by ConocoPhillips and its contractors. It is not attached the Final EIA. Some parts of this plan are relevant to the EPP. The ERP is project-specific, and will address potential emergency situations (e.g., man-overboard, injuries to personnel, unintended release of hazardous substances to the environment, ship strikes involving marine mammals, flooding of one or more compartments, fire in a cabin or laboratory, fire in the engine room, collisions with towed equipment, collisions with other ships, collisions with glacial ice, etc) that need to be responded to and managed during the seismic survey or the hydrographic / shallow geophysics survey. It must include clear lines of responsibility at sea and onshore, as well as the communication and notification protocols that need to be followed any accidents or incidents.

The ERP will be submitted to BMP 40 days before the Project begins in Qamut Block. BMP will be notified immediately of any significant situation or event, including loss of life, missing personnel, serious injury, onboard fire, fuel spill, and any threat to crew, ships or the environment. As soon as practical after this notification, ConocoPhillips will prepare and send a written report to BMP on the situation or incident.

8.4.10 Fisheries Impact Management Plan

There is no commercial fishery in Qamut Block that currently happens for any species. However, BMP may decide that a Fishery Liaison Officer (FLO), as a condition of approval, should be stationed on M/V *Princess* (or on one of the two support ships) to address any fisheries-related issues that develop during the seismic survey. If so, a fisheries impact management plan will be prepared by ConocoPhillips. It would be sent to BMP on request.

The FLO would transmit survey-related information to any fishing vessel that enters Qamut Block, establish grievance procedures (if needed), maintain records of all fisheries-related communication, events or incidents, and other interaction with this fleet (if any), and prepare reports for ConocoPhillips when the survey is finished. These reports will be submitted as part of post-program activity. A fisheries impact management plan is a framework for planning and organizing this work, and guiding delivery.

8.4.11 Environmental Studies Plan

The plan will be based on the suggestions in Section 8 of the EIA, and specifically, will also include research programs that are relevant to Qamut Block and adjacent waters that DCE, GINR, and other agencies would like to carry out with Strategic EIA funding from the northeast Baffin Bay operators in 2012 and subsequent years. When the Project is approved by BMP, this plan will be finalized, and submitted by ConocoPhillips. It is not attached to the Final EIA.

8.4.12 Mitigation Reporting/Oversight Plan

The strategy for mitigation during the Project will be following all mitigation measures identified in the EIA that reduce or eliminate impacts of the seismic survey on the environment. A reporting/oversight plan for mitigation will be prepared by ConocoPhillips before the work begins. It can be provided to BMP on request. This plan will consist of a table that describes the mitigation measures (Appendix I, Table I-1), including some of the plans mentioned above, and procedures for monitoring or evaluating, and then reporting on, the success of implementing the mitigation strategy.

9 Study Limitations and Future Research

Available information from ConocoPhillips, other northeast Baffin Bay operators, BMP, DCE, other EIAs prepared on projects in northeast and eastern Baffin Bay, universities and other organizations, and publications in the open literature was obtained and referred to during the EIA. While, in general, this information was sufficient for assessment purposes, the amount of analysis or interpretation that could be done on some topics was limited by missing data, or lower quality or deficient data. ConocoPhillips understands that offshore Greenland is an emerging or developing exploration area, that scientific research continues, and that the situation described in not unusual or negative. This section of the EIA describes some of the limitations related to assessment, and provides suggestions for research and other activity in the future.

9.1 Study Limitations and Data Gaps

The following list provides the limitations identified during assessment of the Project and preparation of the Preliminary and Final EIA Reports. That is:

- The acoustic modelling conducted by JASCO Research, used the best available bathymetry in the public domain (the International Bathymetric Chart of the Arctic Ocean, or IBCAO, data set) at regional scale, and bathymetry derived from seismic surveys provided by ConocoPhillips, at licence or block level. Absent or limited information included seafloor properties (sediment type, sediment distribution, upper structure of sediment column, seabed morphology, etc) and seasonal water column structure (specifically, temperature and salinity) in Qamut Block.
- Measurements of ambient sound levels in northeast Baffin Bay would improve modelling and contribute to better interpretation of results. It is not clear what the natural background is (and what it consists of) in these waters at different times of year. Some data on ambient acoustic conditions will be collected during a project proposed by DCE and GINR during summer and fall 2012. Other data should be collected on a broader basis (over a larger region), including far-field locations. Existing sediment and seabed characteristics are not well documented in current literature. Additional research on sediment geochemistry, extent and depth

of scouring by iceberg keels (including re-working or “re-moulding” of scoured soils), contaminants (including persistent organic pollutants, various hydrocarbon compounds, bioavailable metals, other trace metals, etc) at representative shallow and deeper locations, and seasonal and annual changes in benthic ecology, for example, would be helpful for future EIAs.

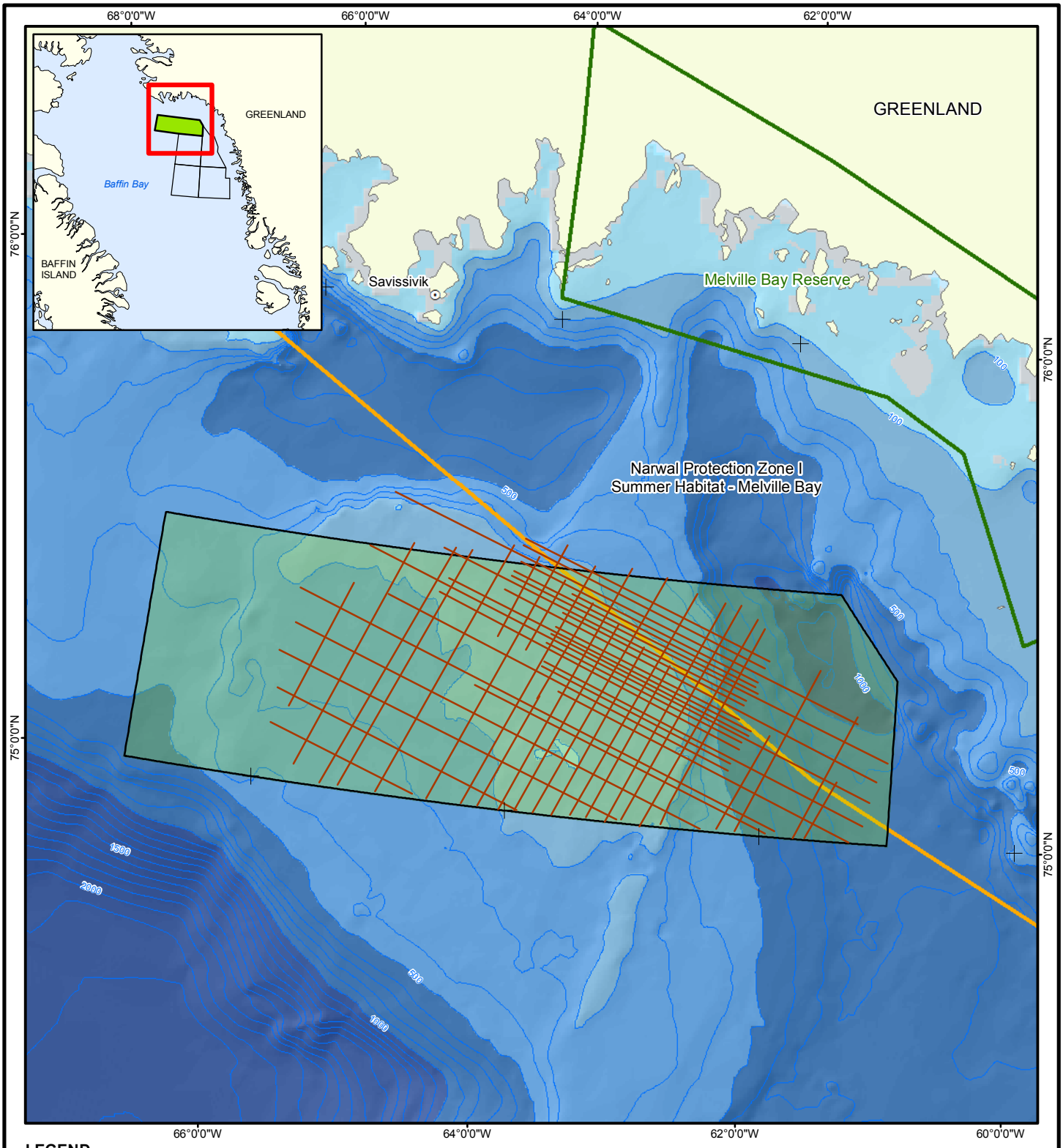
- In addition to a shortage of temperature and salinity data on the water column in Qamut Block at different times of the year, current measurements with bottom-moored systems on the shallow bank in the central part of the licence area, on the flanks of this bank, and on deeper parts of the shelf are absent. Obtaining this information would be valuable in the future.
- Data on the distribution and characteristics of icebergs is not as thorough as it should be on Qamut Block and adjacent waters. Additional data could to be collected in the future. This information would contribute to safe operations during future activities in the area, improved environmental assessment, and also to planning and engineering design.
- The offshore biological environment is one area of marine science that is most studied for Greenland. Invertebrates, marine fish, seabirds and marine mammal species are relatively well-known. However, there are data gaps related to certain species, and more information, in general, is required on marine ecosystems in northeast Baffin Bay, since it is the least studied region off the west coast of Greenland. For example, detailed understanding of marine mammal migration patterns in relation to timing of sea ice break-up and clearing, and residency in summer habitat areas would be useful.

9.2 Future Research

The following list provides suggested research to aid in conducting future EIA assessments:

- As one of the three operators in northeast Baffin Bay, ConocoPhillips will be supporting a passive acoustic monitoring program involving fixed (bottom-moored) sensors or listening systems that will be done by DCE and GINR during multiple seismic surveys in summer and fall of 2012. This program will involve validation of underwater sound levels predicted by acoustic modeling on the seismic survey that ConocoPhillips would like to carry out in Qamut Block, as well as on multiple seismic surveys that take place at the same time in a regional setting. Based on the results of the program, it is possible that ship-based marine mammal safety zones could be revised in the field, or modified during seismic surveys in the future. Acoustic monitoring will be conducted in critical habitat areas (e.g. NPZ-I) on sufficient temporal and spatial scales to adequately capture pre- and post-seismic events.
- ConocoPhillips will also be supporting aerial reconnaissance surveys on narwhal residency and migration patterns before, during and after multiple seismic surveys in northeast Baffin Bay this year. The study will contribute to better understanding of narwhal response to elevated levels of underwater sound, and the behaviour of this species when seismic operations occur in different licence areas. Aircraft-based monitoring of critical habitats will be performed to evaluate potential displacement of narwhal from critical habitat areas and possible disruption of different behaviours in critical habitat areas due to seismic sound.

Finally, ConocoPhillips will be supporting a study on the effects of seismic sound on local subsistence harvest activities. Interviews will be conducted with Greenlandic hunters to determine potential effects of the 2012 seismic program on marine mammal and fish catch rates, changes in hunting locations and effort and marine mammal behavioural observations.



LEGEND

- TOWN / SETTLEMENT
- ISOBATH (100 m CONTOUR INTERVAL)
- PROPOSED SEISMIC SURVEY
- LICENCE BLOCK
- MELVILLE BAY RESERVE
- NARWHAL PROTECTION ZONE I SUMMER HABITAT

BATHYMETRY

- 0 m DEPTH
- 0 m - 100 m DEPTH
- 100 m - 200 m DEPTH
- 200 m - 500 m DEPTH
- 500 m - 1000 m DEPTH
- > 1000 m DEPTH

30 0 30
KILOMETRES

PROJECT
ConocoPhillips
2D SEISMIC PROGRAM

TITLE
PROPOSED 2D SEISMIC SURVEY REGION

REFERENCE

Bathymetry and seismic survey grid was provided by ConocoPhillips in 2012. Protected Areas, narwal protection zones, place names and licence block obtained from DCE report no.9 (DCE, 2011). Coastline obtained from GADM (geographic database of global administrative areas) version 1.0, March 2009.
DATUM: WGS84 PROJECTION: UTM ZONE 21N

Golder Associates INUPLAN A/S

PROJECT		11-1334-0084	FILE No.	
DESIGN	CC	19 Jan. 2012	SCALE AS SHOWN	REV. 0
GIS	VGV	30 May. 2012		
CHECK	CC	30 May. 2012	**FIGURE: 3.1-1**	
REVIEW	ML	30 May. 2012		

I:\2011\11-1334\11-1334-0084\Mapping\MXD\Seismic_survey\FINAL\Fig3.1-1_ConocoProject_scope_30May2012_FINAL.mxd

Figure 3.1-2 Seismic Source Layout

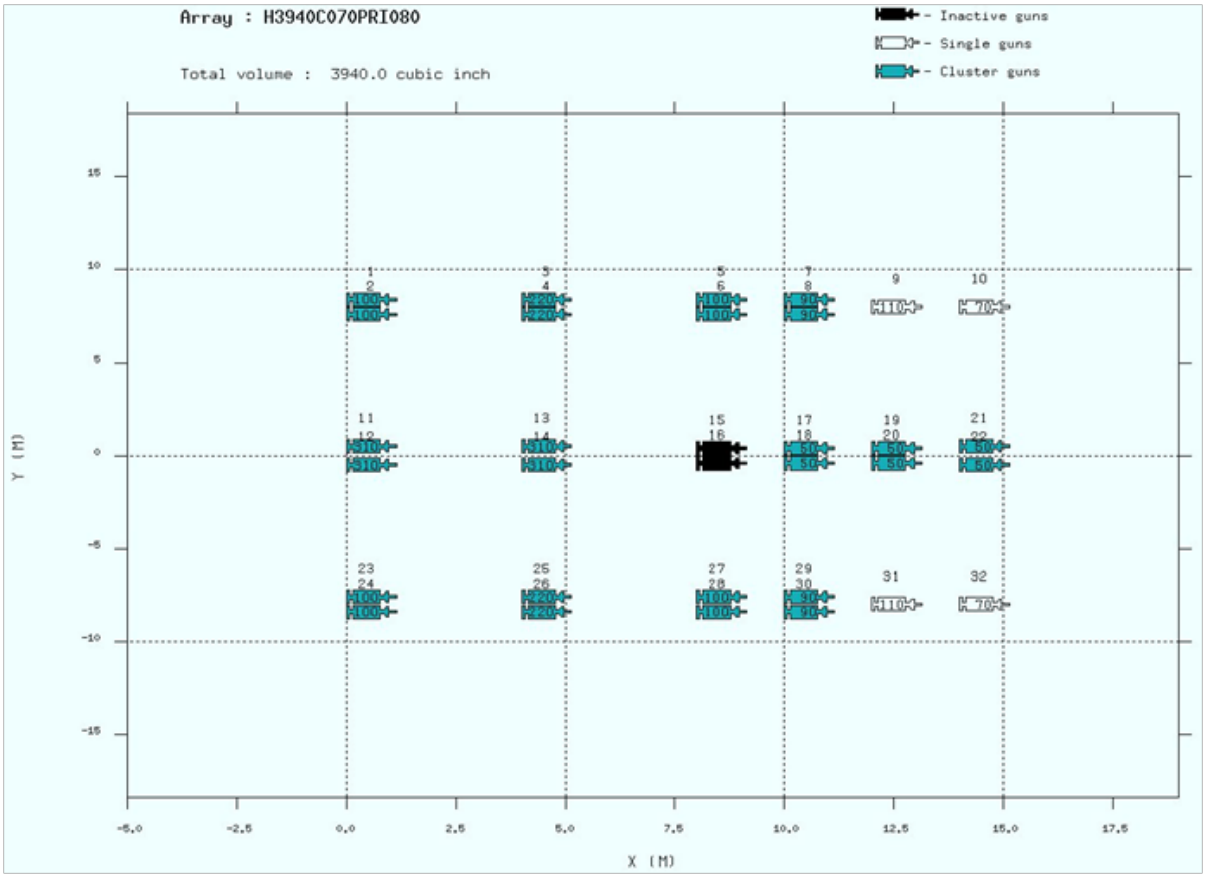


Figure 3.1-3 Geometry of Airgun Array (Starboard)

SOURCE ARRAY LISTING

Source array name : H3940C070PRI080

Array created by Nucleus version 6.5.6
Array created by Marine source modelling version 5.3.0

Number of active guns : 30
Total active volume : 3940 CU.IN.
Number of spare guns : 2

GUN #	GUN TYPE	X (m)	Y (m)	Z (m)	VOLUME (cu.in)	PRESSURE (psi)	DELAY (ms)	CLUSTER NUMBER
1	21	0.00	8.40	7.00	100	2000	0.00	1
2	21	0.00	7.60	7.00	100	2000	0.00	1
3	21	4.00	8.40	7.00	220	2000	0.00	2
4	21	4.00	7.60	7.00	220	2000	0.00	2
5	21	8.00	8.40	7.00	100	2000	0.00	3
6	21	8.00	7.60	7.00	100	2000	0.00	3
7	21	10.00	8.40	7.00	90	2000	0.00	4
8	21	10.00	7.60	7.00	90	2000	0.00	4
9	21	12.00	8.00	7.00	110	2000	0.00	0
10	21	14.00	8.00	7.00	70	2000	0.00	0
11	21	0.00	0.50	7.00	310	2000	0.00	5
12	21	0.00	-0.50	7.00	310	2000	0.00	5
13	21	4.00	0.50	7.00	310	2000	0.00	6
14	21	4.00	-0.50	7.00	310	2000	0.00	6
15	21	8.00	0.40	7.00	310	SPARE	0.00	0
16	21	8.00	-0.40	7.00	310	SPARE	0.00	0
17	21	10.00	0.40	7.00	50	2000	0.00	7
18	21	10.00	-0.40	7.00	50	2000	0.00	7
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21	21	14.00	0.50	7.00	50	2000	0.00	9
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23	21	0.00	-7.60	7.00	100	2000	0.00	10
24	21	0.00	-8.40	7.00	100	2000	0.00	10
25	21	4.00	-7.60	7.00	220	2000	0.00	11
26	21	4.00	-8.40	7.00	220	2000	0.00	11
27	21	8.00	-7.60	7.00	100	2000	0.00	12
28	21	8.00	-8.40	7.00	100	2000	0.00	12
29	21	10.00	-7.60	7.00	90	2000	0.00	13
30	21	10.00	-8.40	7.00	90	2000	0.00	13
31	21	12.00	-8.00	7.00	110	2000	0.00	0
32	21	14.00	-8.00	7.00	70	2000	0.00	0

THE GUN TYPES ARE:
21: G-GUN II

Figure 3.1-4 3,940 in³ Array Far-field Pressure Signature

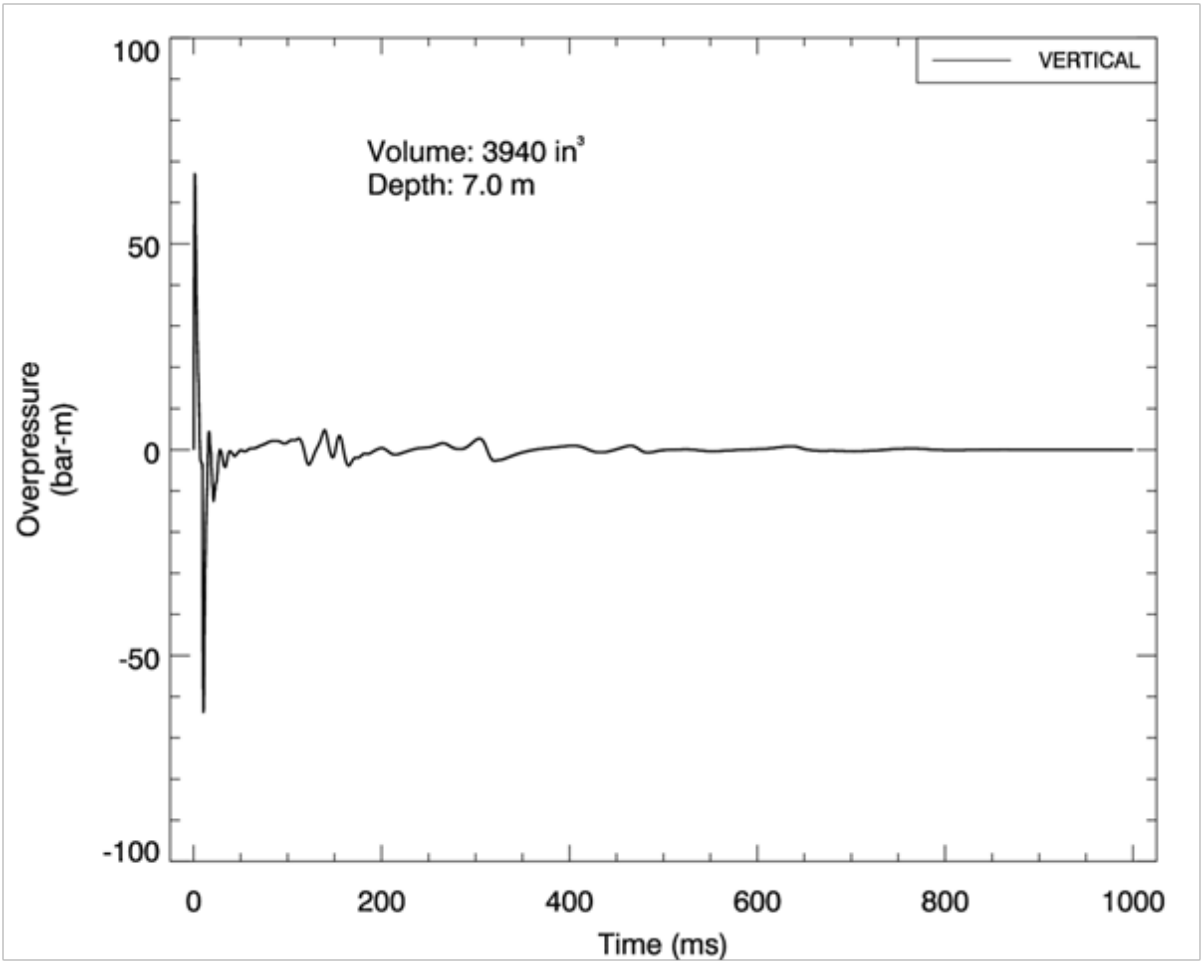
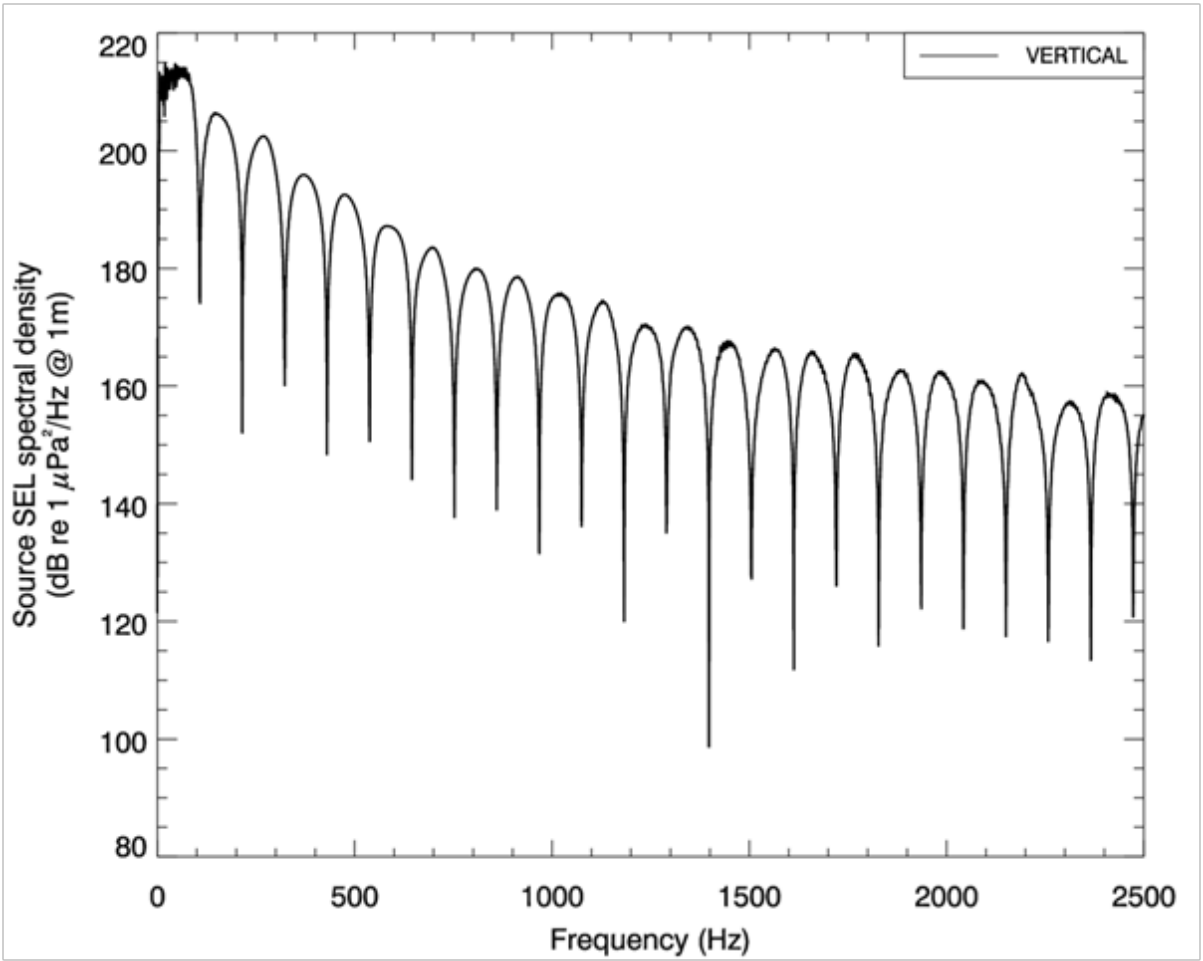
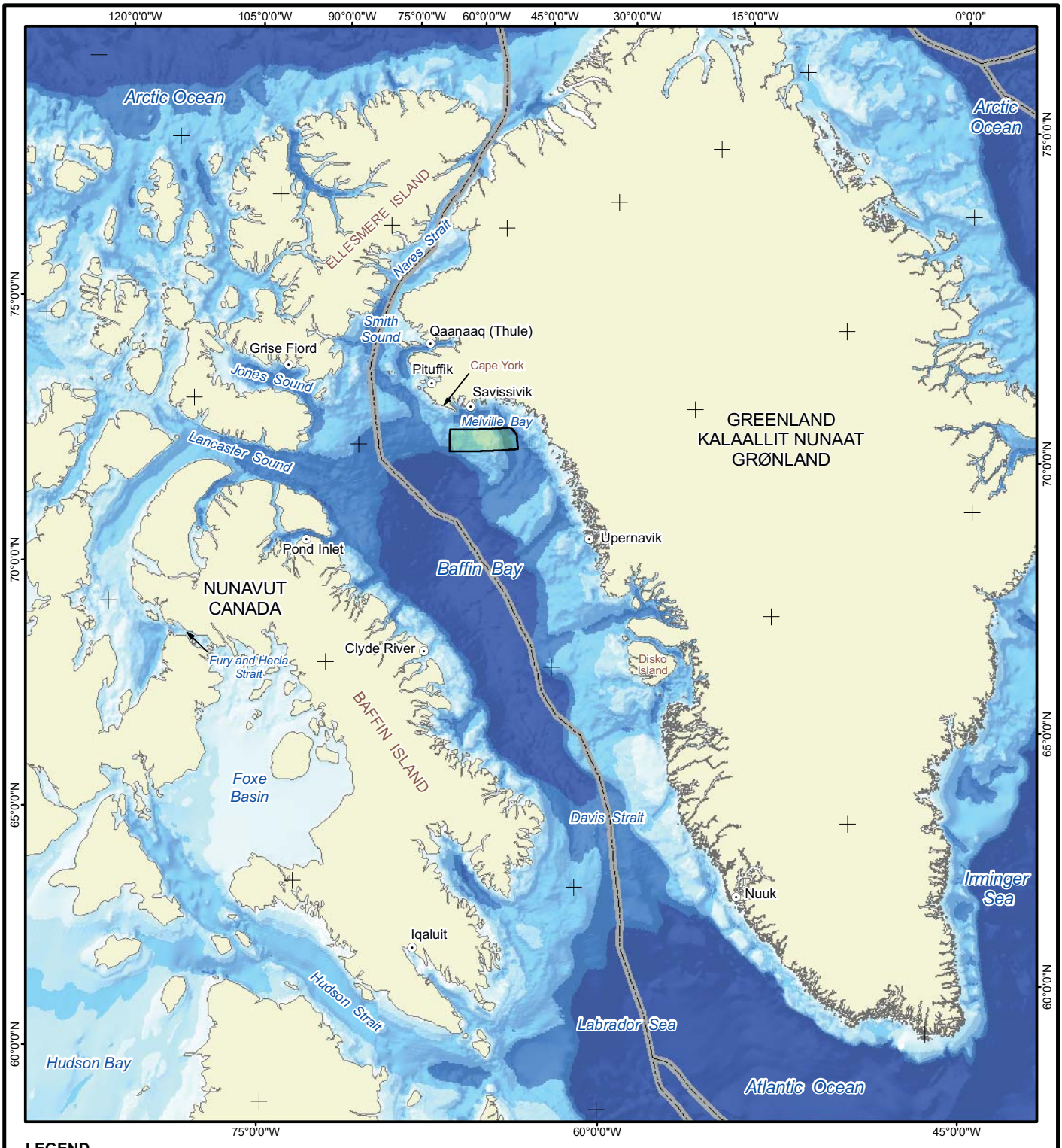


Figure 3.1-5 Frequency Spectrum Including Surface Ghost





LEGEND

- TOWN / SETTLEMENT
- INTERNATIONAL MARITIME BOUNDARY
- LICENCE BLOCK

BATHYMETRY

- 0 m DEPTH
- 0 m - 100 m DEPTH
- 100 m - 200 m DEPTH
- 200 m - 500 m DEPTH
- 500 m - 1000 m DEPTH
- > 1000 m DEPTH

250 0 250
KILOMETRES

REFERENCE

Bathymetry and isobaths reproduced from the GEBCO Digital Atlas published by the British Oceanographic Data Center on behalf of the IOC and IHO), 2003. Protected Areas, bowhead data, place names and licence blocks obtained from DCE report no.9 (DCE 2011). Coastline obtained from GADM (geographic database of global administrative areas) version 1.0, in March 2009.
DATUM: WGS84 PROJECTION: GREENLAND WEST LAMBERT CONFORMAL CONIC

PROJECT
ConocoPhillips
2D SEISMIC PROGRAM

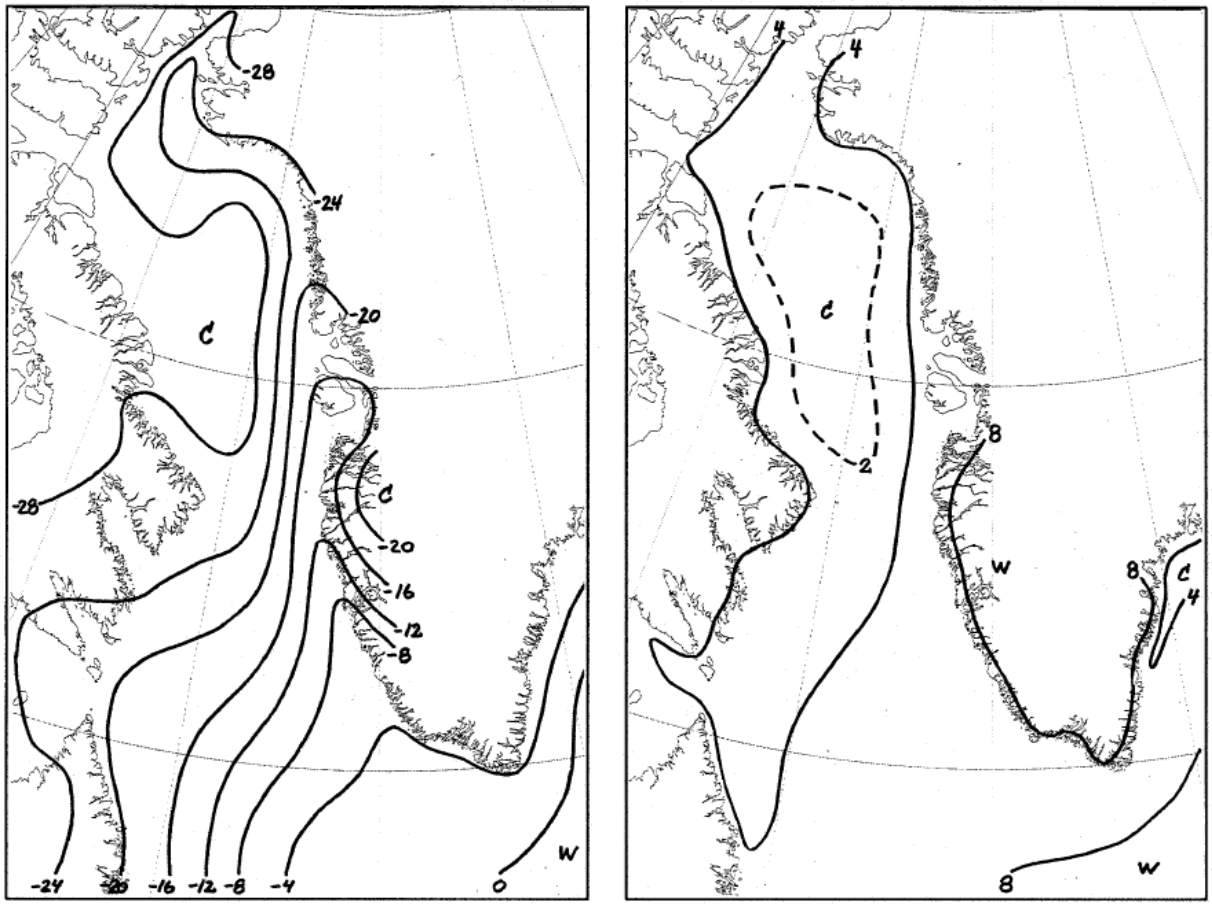
TITLE
REGIONAL SETTING AND HYDROGRAPHIC FEATURES IN THE PROJECT AREA

Golder Associates INUPLAN A/S

PROJECT		11-1334-0084	FILE No.
DESIGN	CC	27 Feb. 2012	SCALE AS SHOWN REV. 0
GIS	VGV	29 Feb. 2012	
CHECK	CC	02 Mar. 2012	**FIGURE: 4.1-1**
REVIEW	CC	02 Mar. 2012	

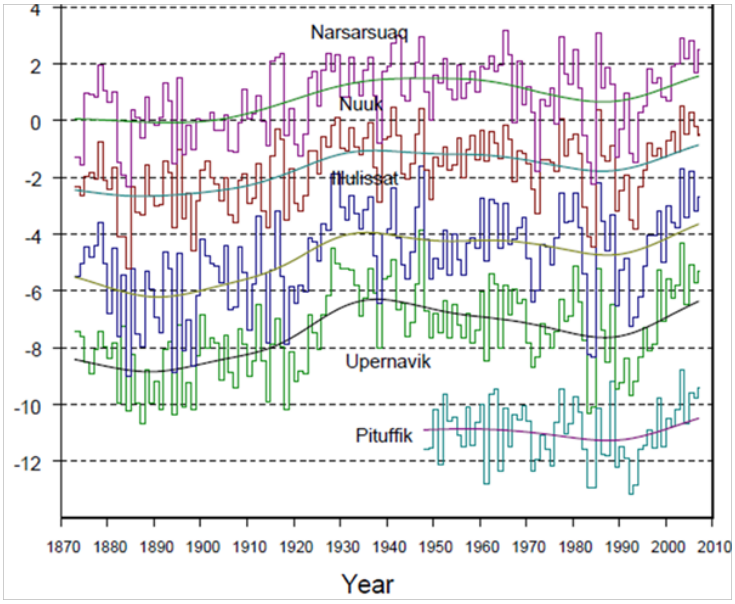
I:\2011\11-1334\11-1334-0084\Mapping\MXD\General\Conoco_Regional_Bathy_01March2012.mxd

Figure 4.1-2 Mean Temperature for February (left) and August (right)



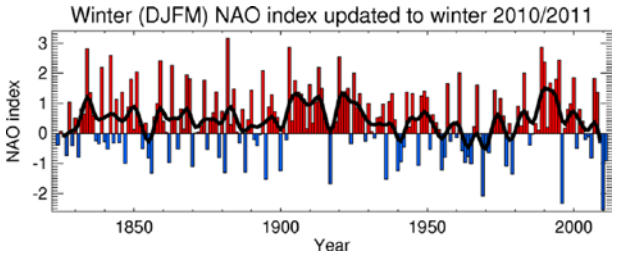
Source: Partly based on ECMWF-data as presented in NERI, 2004

Figure 4.1-3 Mean Annual Air Temperature at West Greenland Weather Stations



Note: Data are from 1873 to 2007 and go from south (Narsaruaq) to north (Pituffik)
Source: Cappelen 2008.

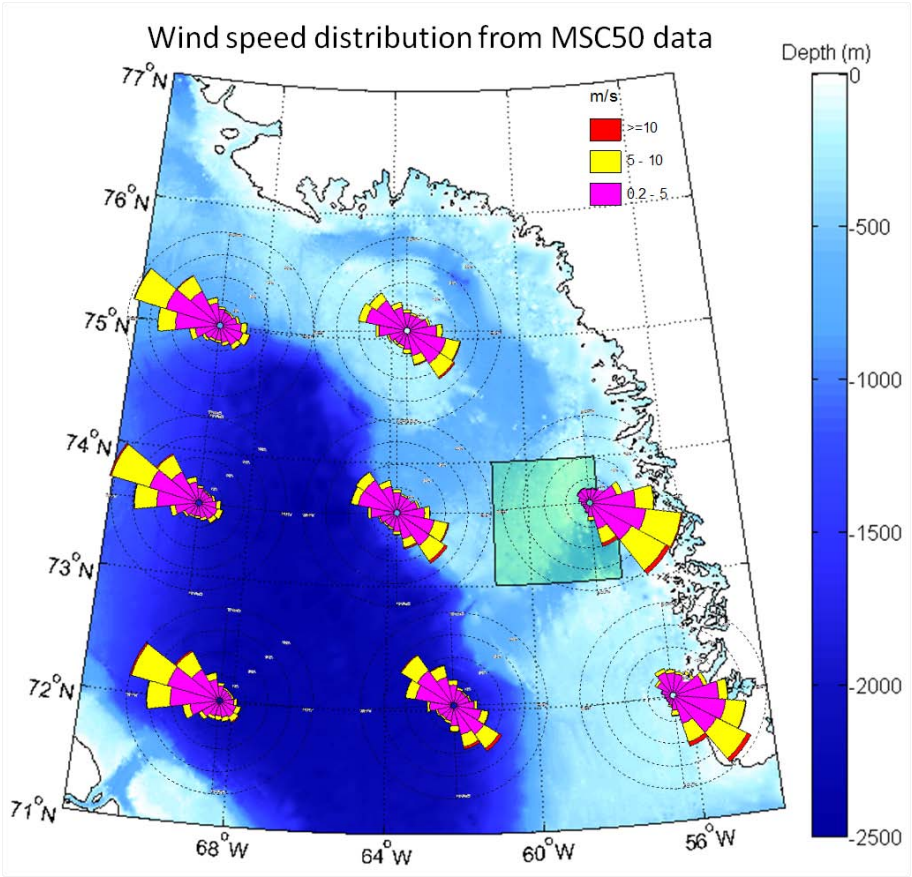
Figure 4.1-4 Time Series of the Winter (December to March) Index of the NAO from 1865/1866 to 2010/2011



Note: The heavy solid line represents the NAO index smoothed with a 3-year running mean filter to remove fluctuations with periods less than 3 years.

Source: Osborne 2011.

Figure 4.1-5 Wind Roses at Selected Locations in Northeast Baffin Bay



Note: Wind rose derived from the wind analyses for the years 1958 to 2008 inclusive; derived for the MSC50 North Atlantic wind-wave modelling domain

Source: Environment Canada 2012; Swail et al. 2006.

Figure 4.1-6: Qamut Block Wind Distribution from the MSC50 Hindcast Data Node M3018543

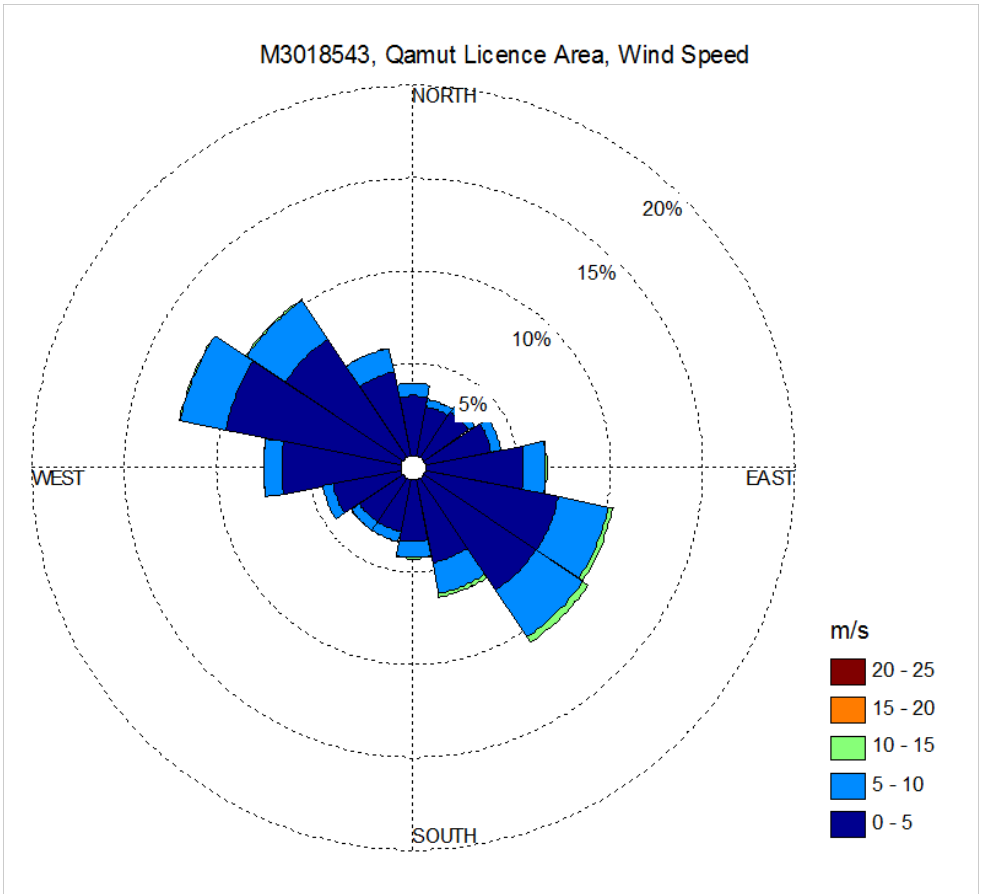


Figure 4.1-7 Frequencies of Fog at Three West Greenland Stations

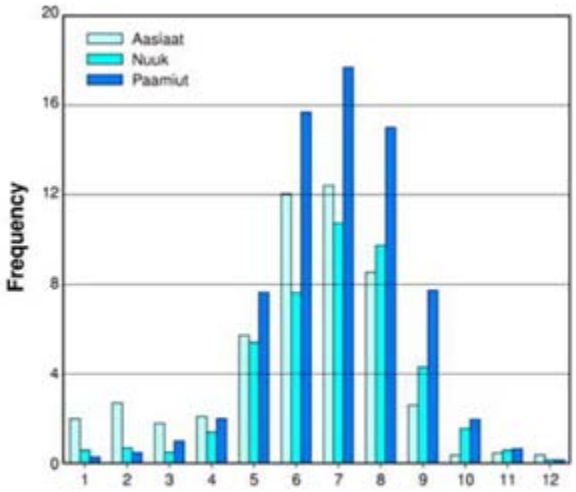
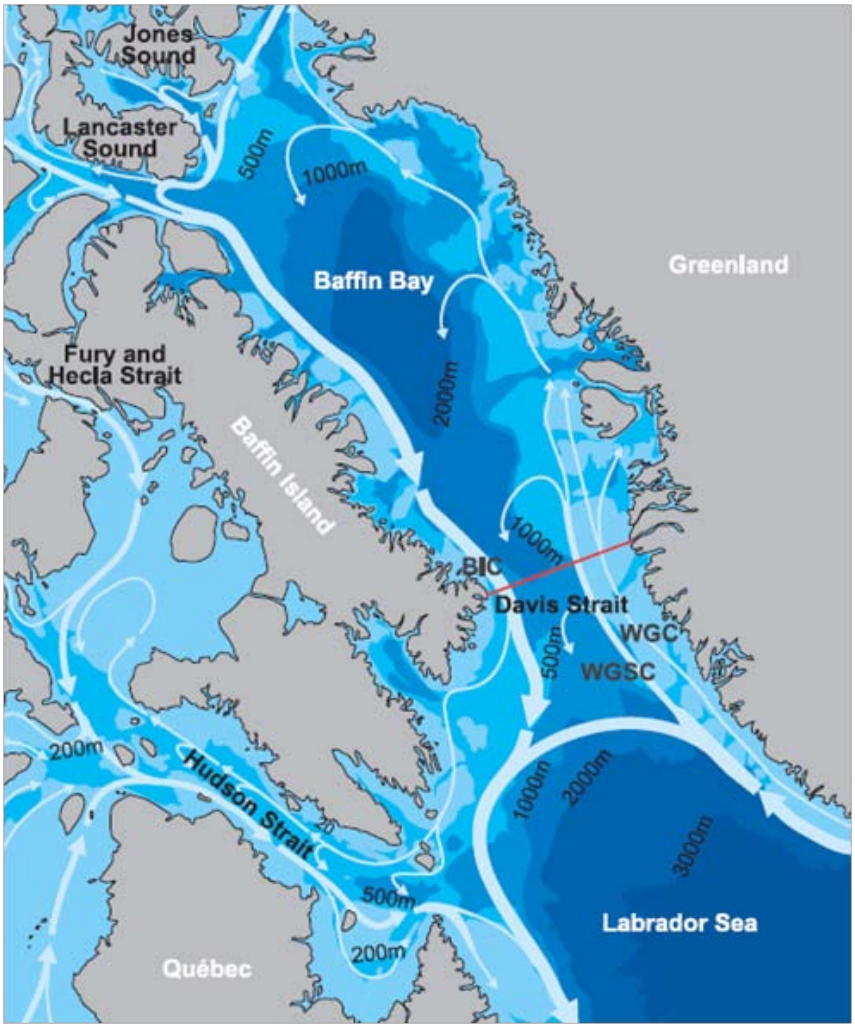


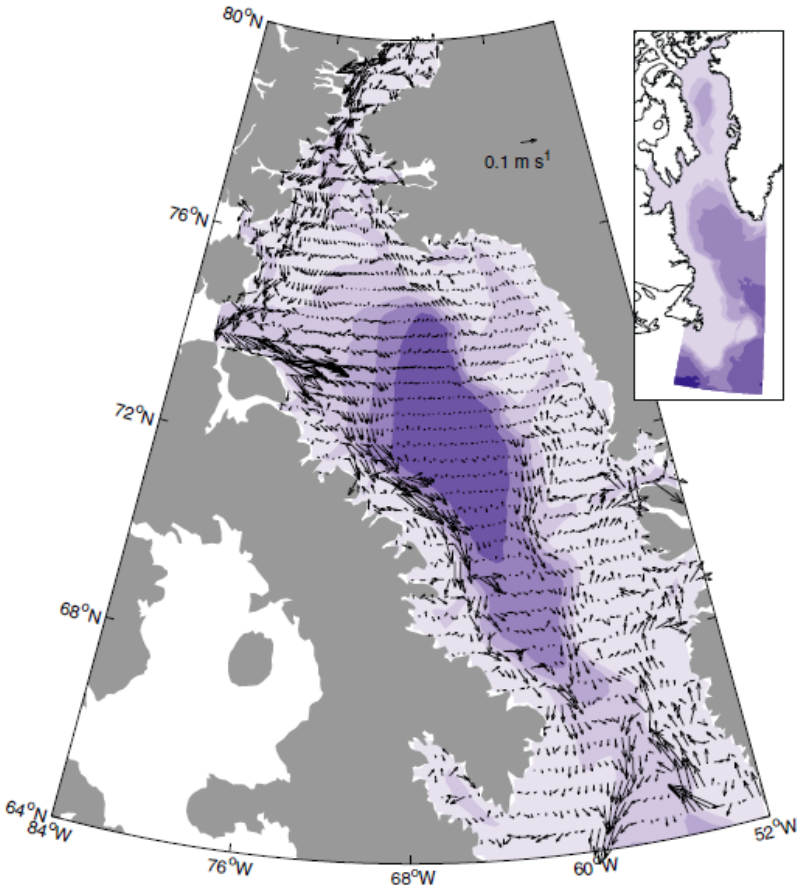
Figure 4.1-8 General Ocean Surface Circulation around Greenland



Notes: Current speeds in knots (1 knot ~ 1.85 km/h). Modified from Oceanographic Atlas of Polar Seas (US Navy Hydrographic Office, 1958)

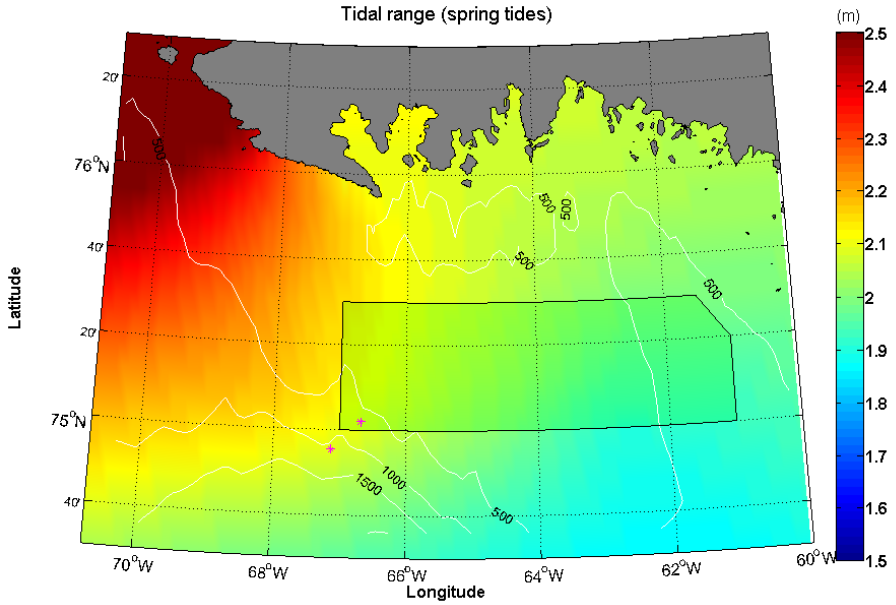
Source: DMI, 1996

Figure 4.1-9 Model Currents at 50 Metres (Tang Model)



Note: The contour interval for depth is 500 m. The model domain is shown in the inset.
Source: Figure 28 of Tang et al. 2004.

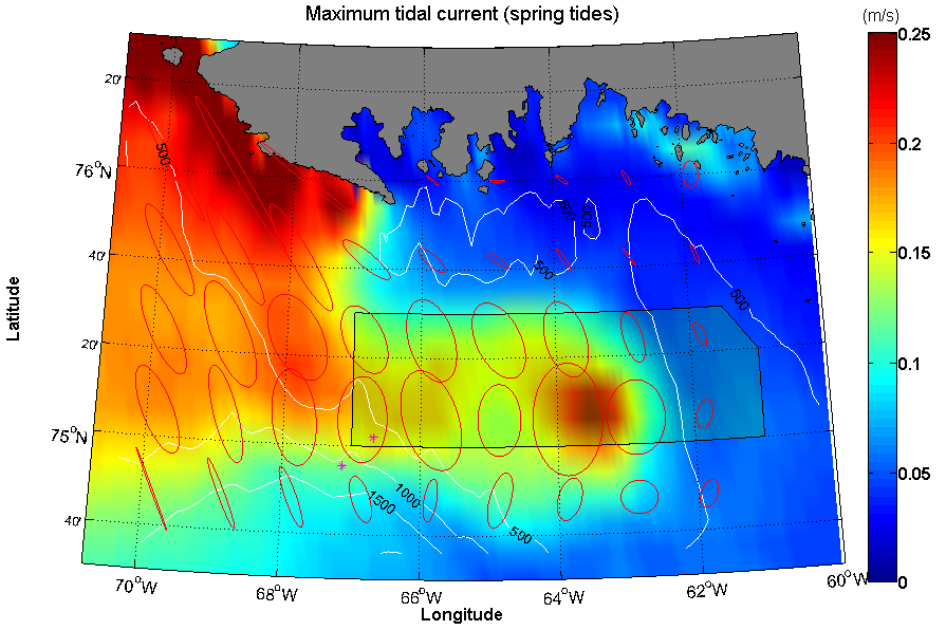
Figure 4.1-10 Qamut Licence Area 29 Days Maximum Tidal Range



Note: Data estimated using Collins et al. (2011) model results; bathymetric contours from 500 m to 2,000 m are represented by the backlines (spacing every 500 m) and BIO mooring locations by the red stars.

Source: Collins et al. 2011.

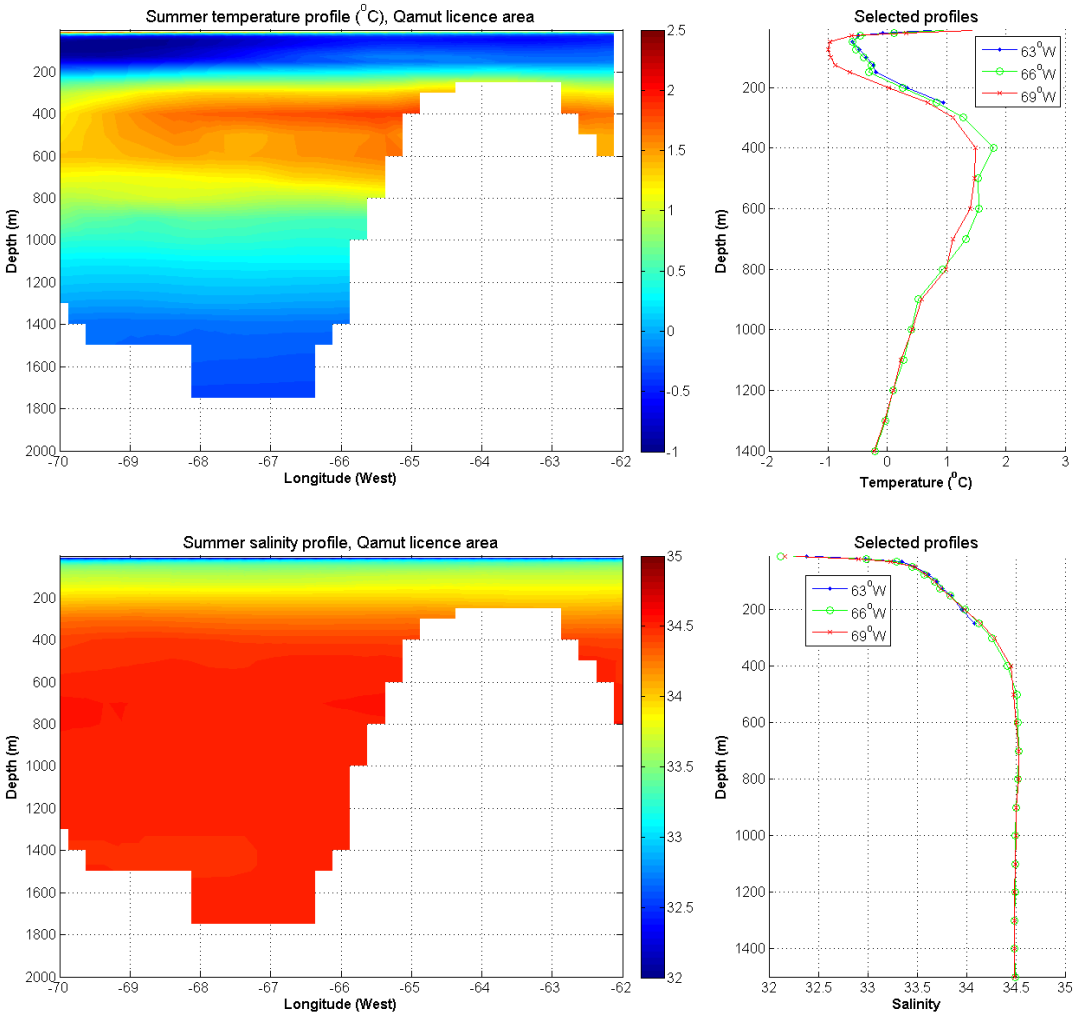
Figure 4.1-11 Qamut Licence Area 29 Days Maximum Tidal Current Magnitude and Direction



Note: Maximum tidal current magnitude and direction estimated using Collins et al. (2011) model results; bathymetric contours from 500 m to 2,000 m are represented by the backlines (spacing every 500 m) and BIO mooring locations by the red stars.

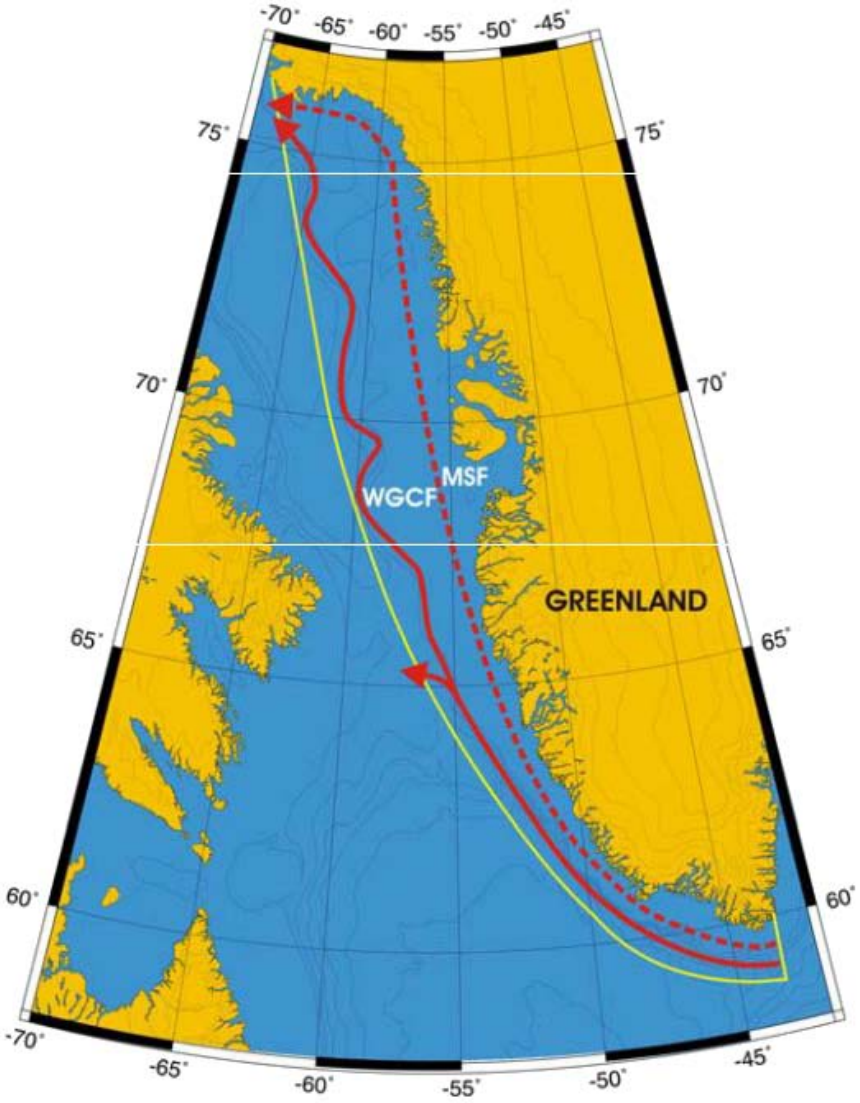
Source: Collins et al. 2011.

Figure 4.1-12 Qamut Temperature and Salinity Profiles during Summer



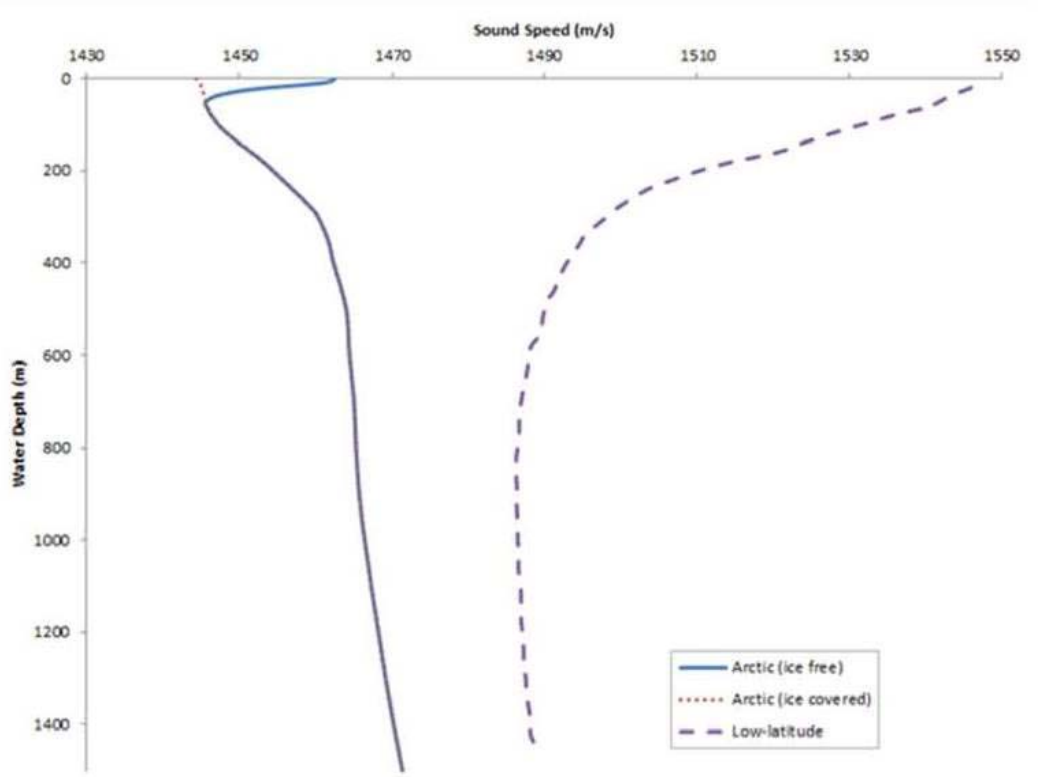
Source: WOD09 atlas data, NOAA 2012.

Figure 4.1-13 Fronts of West Greenland Shelf Large Marine Ecosystems



Notes: MSF: Mid-Shelf Front; WGCFL West Greenland Current Front; Yellow Line: Large Marine Ecosystem Boundary.
Source: Aquarone et al. 2009.

Figure 4.1-14 Sound Speed Profiles typical of Oceanic Conditions in Arctic Waters



Note: Low-latitudes (dashed purple line) in the Arctic for fully Ice-covered (dotted red line) and Ice-free Conditions (solid blue line).

Figure 4.1-15 Qamut Block Wave Distribution from the MSC50 Hindcast Data Node M3018543

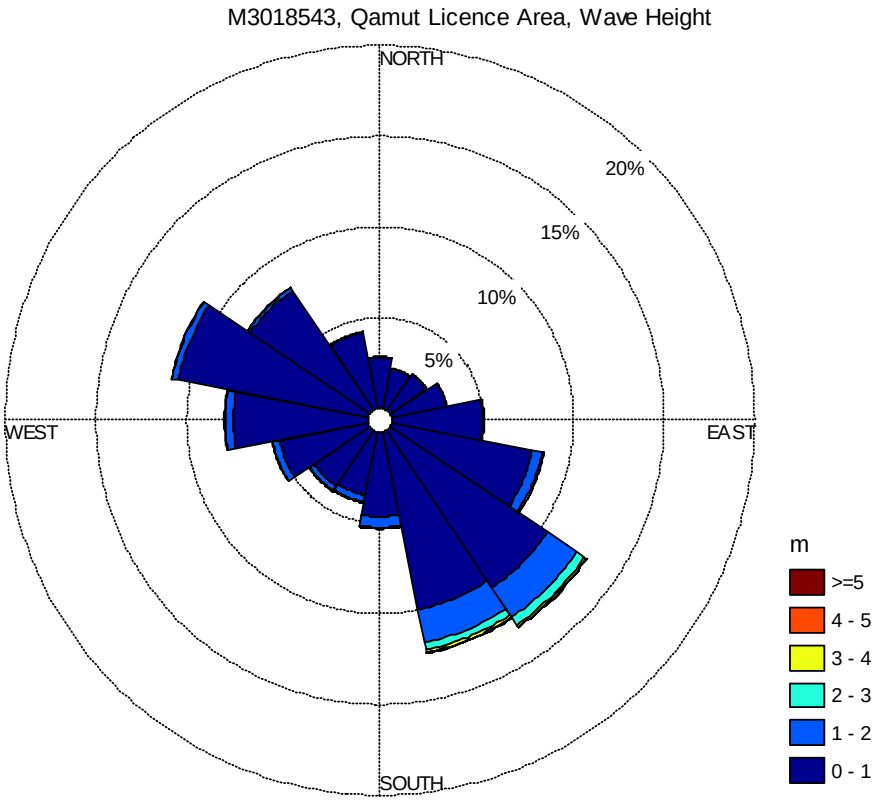
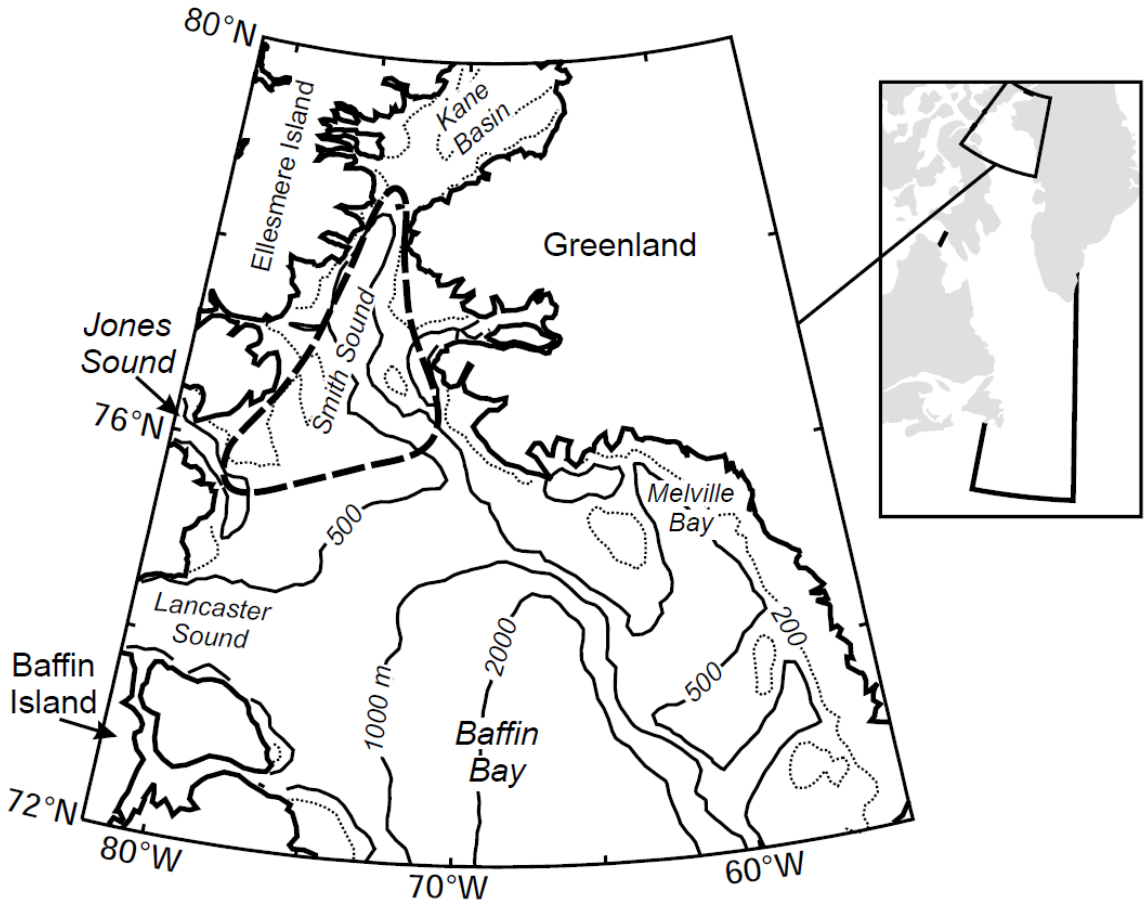


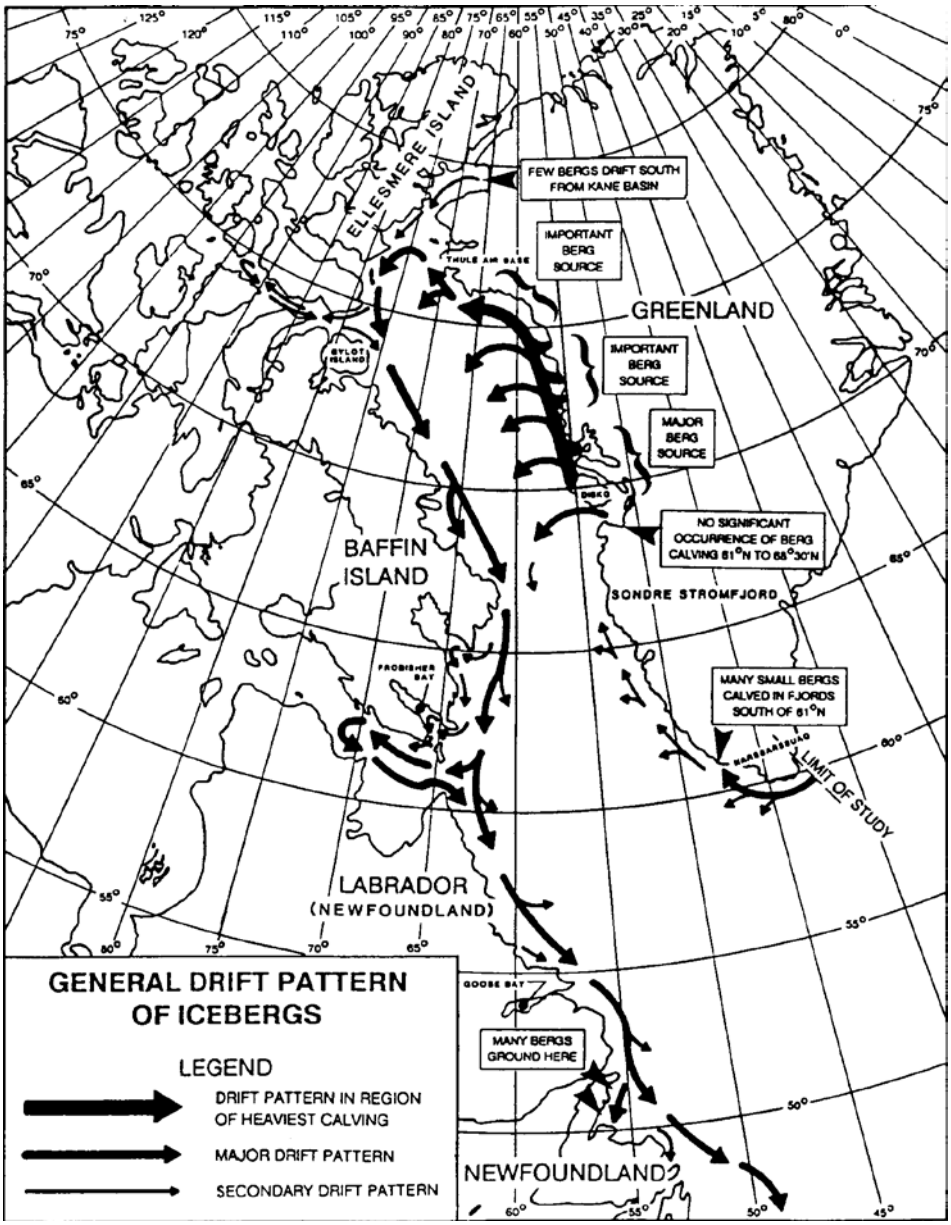
Figure 4.1-16 Mean Monthly Extent of the North Water Polynya



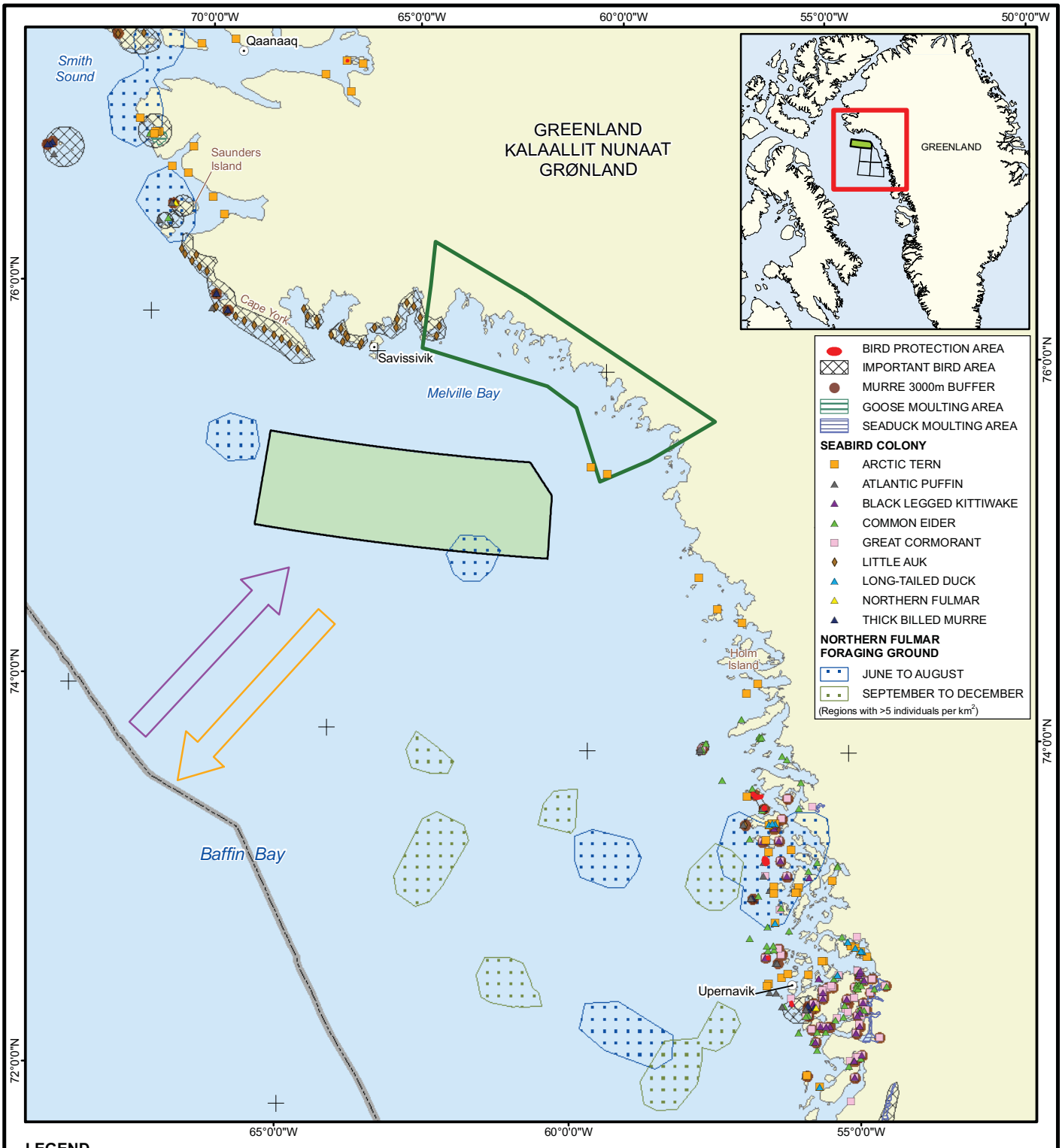
Note: The monthly images are obtained from passive microwave satellite data (AMSR and SMMR). Red and magenta indicate very high ice concentrations (I-10/10) while yellow indicates somewhat reduced concentrations. The lowest ice concentrations of 1-3/10 are not detected by passive microwave satellites.

Source: Boertmann et al. 2011.

Figure 4.1-17 Major Iceberg Sources and General Drift Pattern in West Greenland Waters



Source: U.S. National Ice Center, Washington, DC



LEGEND

- TOWN / SETTLEMENT
- INTERNATIONAL MARITIME BOUNDARY
- LICENCE BLOCK
- MELVILLE BAY RESERVE
- THICK BILLED MURRE: SEPTEMBER-OCTOBER MIGRATION
- THICK BILLED MURRE: MAY MIGRATION

100 0 100
KILOMETRES

NOTE

Data for King Eider and Ivory Gull not available.

REFERENCE

Protected Areas, bird data, place names and licence blocks obtained from DCE report no.9 (DCE 2011). Coastline obtained from GADM (geographic database of global administrative areas) version 1.0, in March 2009.
DATUM: WGS84 PROJECTION: UTM ZONE 21N

PROJECT
ConocoPhillips
2D SEISMIC PROGRAM

TITLE
DISTRIBUTION OF IMPORTANT BIRD SPECIES IN BAFFIN BAY

Golder Associates INUPLAN A/S

PROJECT		11-1334-0084	FILE No.	
DESIGN	AR	15 Jan. 2012	SCALE AS SHOWN	REV. 0
GIS	VGV	10 Feb. 2012		
CHECK	PR	15 Feb. 2012		
REVIEW	CC	02 Mar. 2012		

FIGURE: 4.2-1

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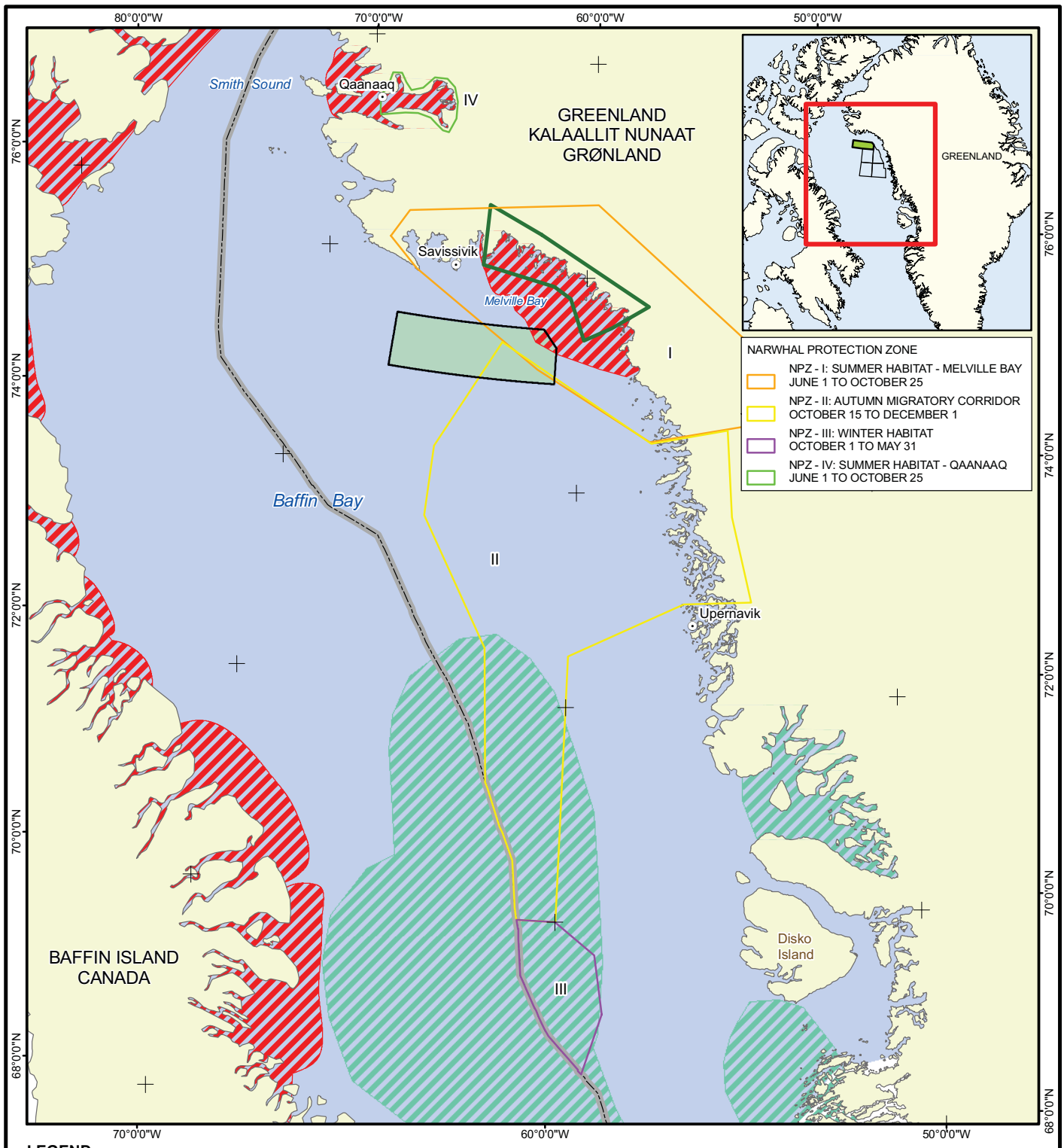

LEGEND

- TOWN / SETTLEMENT
- INTERNATIONAL MARITIME BOUNDARY
- GENERAL RANGE
- LICENCE BLOCK
- MELVILLE BAY RESERVE
- SUMMER AGGREGATION AREA
- WINTER AGGREGATION AREA

125 0 125

KILOMETRES

REFERENCE

Protected Areas, narwhal data, place names and licence blocks obtained from DCE report no.9 (DCE 2011). Coastline obtained GADM (geographic database of global administrative areas) version 1.0, in March 2009.
DATUM: WGS84 PROJECTION: UTM ZONE 21N

PROJECT
ConocoPhillips

2D SEISMIC PROGRAM

TITLE

SEASONAL DISTRIBUTION AND MIGRATORY ROUTES OF NARWHAL IN BAFFIN BAY

Golder Associates INUPLAN A/S

PROJECT		11-1334-0084	FILE No.	
DESIGN	AR	10 Jan. 2012	SCALE AS SHOWN	REV. 0
GIS	VGV	10 Feb. 2012		
CHECK	PR	10 Feb. 2012		
REVIEW	CC	02 Mar. 2012		

FIGURE: 4.2-2

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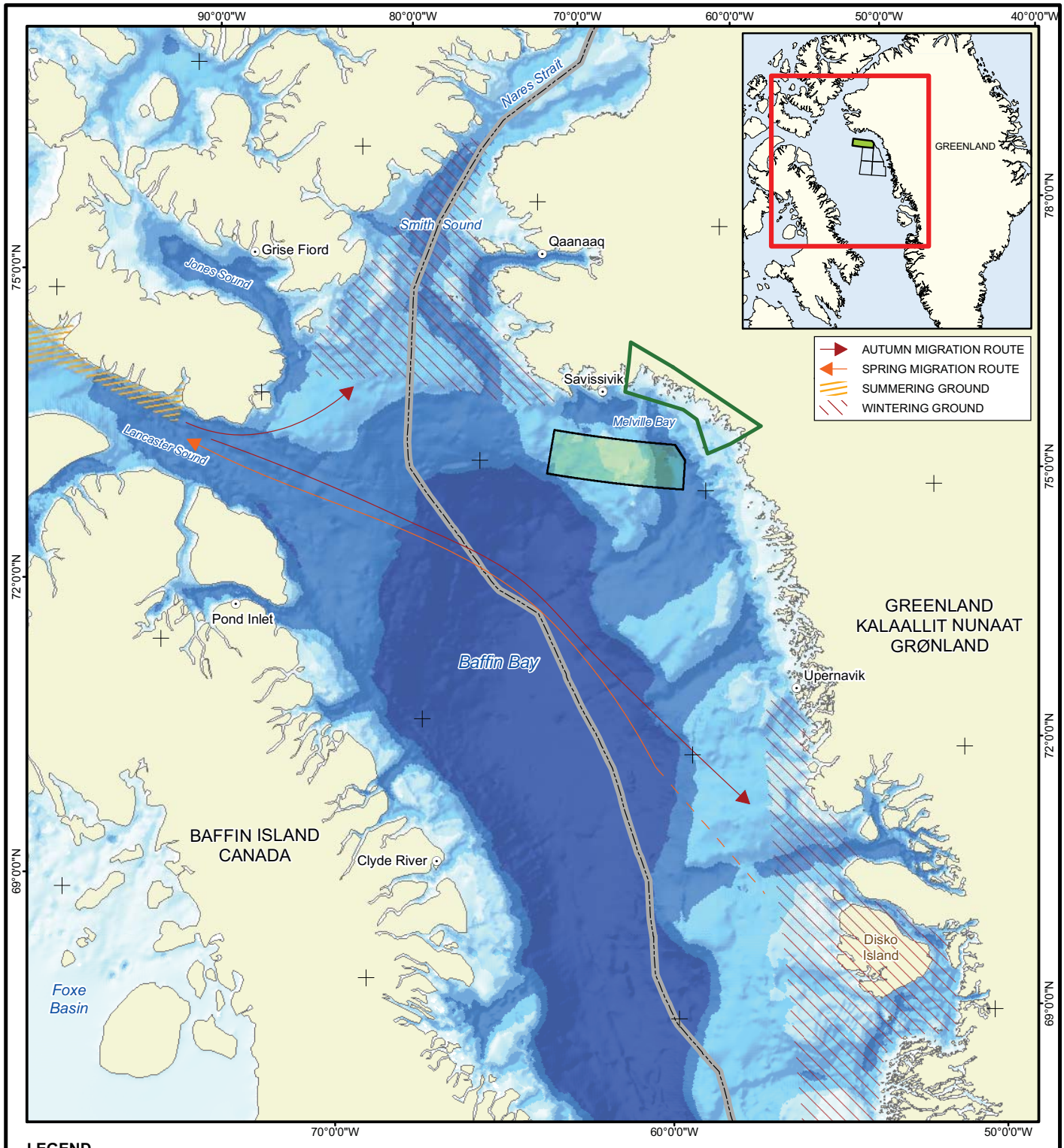

LEGEND

- TOWN / SETTLEMENT
- INTERNATIONAL MARITIME BOUNDARY
- LICENCE BLOCK
- MELVILLE BAY RESERVE

BATHYMETRY

- 0 m DEPTH
- 0 m - 100 m DEPTH
- 100 m - 200 m DEPTH
- 200 m - 500 m DEPTH
- 500 m - 1000m DEPTH
- > 1000 m DEPTH

REFERENCE

IBCAO bathymetry and isobaths from the International Bathymetric Chart of the Arctic Ocean (IBCAO) version 2.33. Protected Areas, beluga data, place names and licence blocks obtained from DCE report no.9 (DCE 2011). Coastline obtained GADM (geographic database of global administrative areas) version 1.0, in March 2009.
DATUM: WGS84 PROJECTION: UTM ZONE 21N

PROJECT

ConocoPhillips

2D SEISMIC PROGRAM

TITLE

BELUGA MIGRATION ROUTES AND WINTERING GROUNDS IN BAFFIN BAY

Golder Associates INUPLAN A/S

PROJECT		11-1334-0084	FILE No.
DESIGN	AR	10 Jan. 2012	SCALE AS SHOWN REV. 0
GIS	VGV	09 Feb. 2012	
CHECK	PR	10 Feb. 2012	FIGURE: 4.2-3
REVIEW	CC	02 Mar. 2012	

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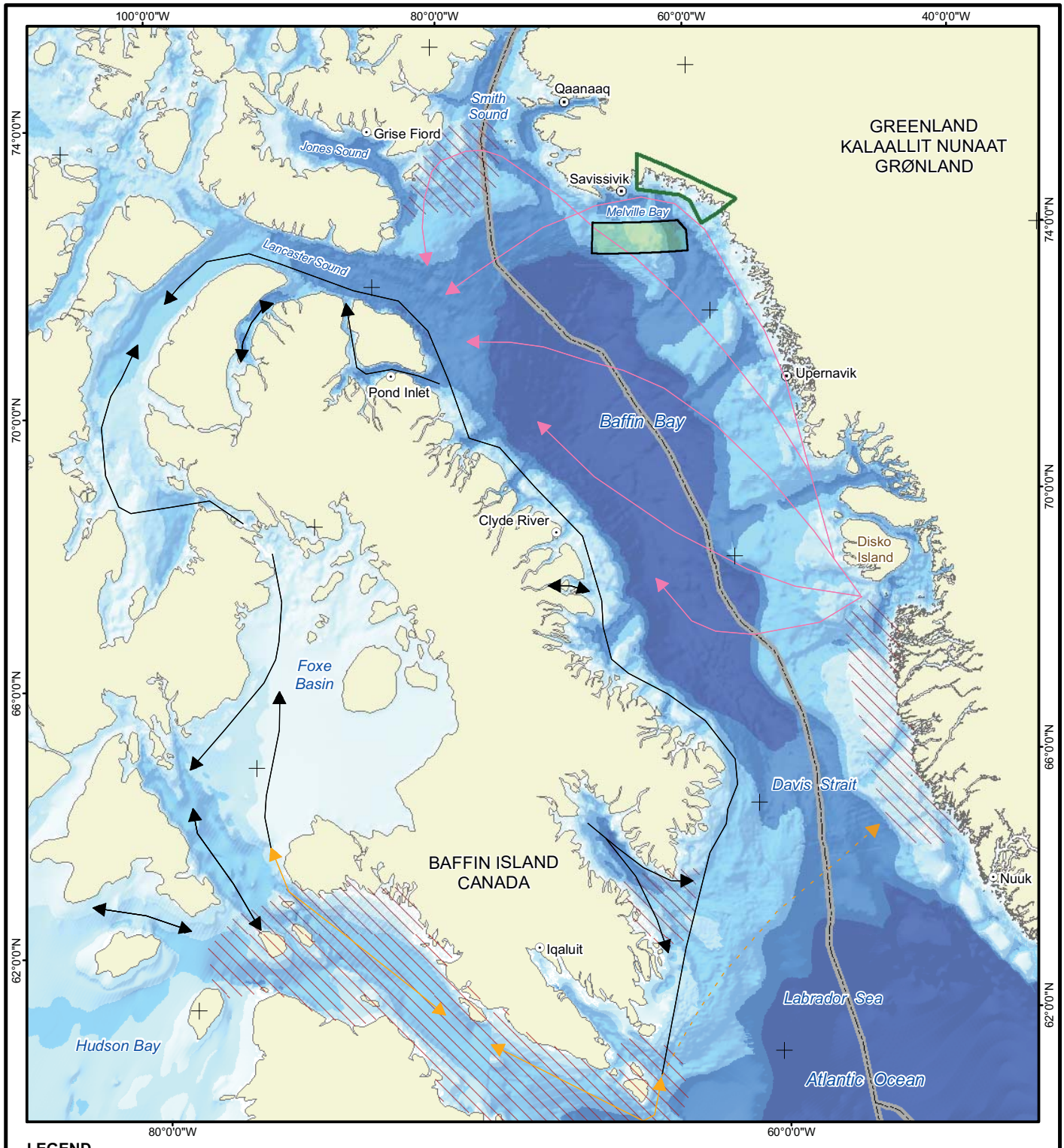

LEGEND

- TOWN / SETTLEMENT
- INTERNATIONAL MARITIME BOUNDARY
- LICENCE BLOCK
- MELVILLE BAY RESERVE

BOWHEAD MIGRATION ROUTE

- WINTERING GROUND
- FALL MIGRATION
- FALL MIGRATION
- SPRING MIGRATION
- WINTER MIGRATION
- PROPOSED WINTER MIGRATION

BATHYMETRY

- 0 m DEPTH
- 0 m - 100 m DEPTH
- 100 m - 200 m DEPTH
- 200 m - 500 m DEPTH
- 500 m - 1000 m DEPTH
- > 1000 m DEPTH

200 0 200
KILOMETRES

REFERENCE

Bathymetry and isobaths reproduced from the GEBCO Digital Atlas published by the British Oceanographic Data Center on behalf of the IOC and IHO, 2003. Protected Areas, bowhead data, place names and licence blocks obtained from DCE report no.9 (DCE 2011). Coastline obtained from GADM (geographic database of global administrative areas) version 1.0, in March 2009.
DATUM: WGS84 PROJECTION: GREENLAND WEST LAMBERT CONFORMAL CONIC

PROJECT
ConocoPhillips
2D SEISMIC PROGRAM

TITLE
SEASONAL DISTRIBUTION AND MIGRATORY MOVEMENTS OF BOWHEAD WHALES IN BAFFIN BAY

Golder Associates INUPLAN A/S

PROJECT		11-1334-0084	FILE No.	
DESIGN	AR	10 Jan. 2012	SCALE AS SHOWN	REV. 0
GIS	VGV	10 Feb. 2012		
CHECK	PR	10 Feb. 2012		
REVIEW	CC	02 Mar. 2012		

FIGURE: 4.2-4

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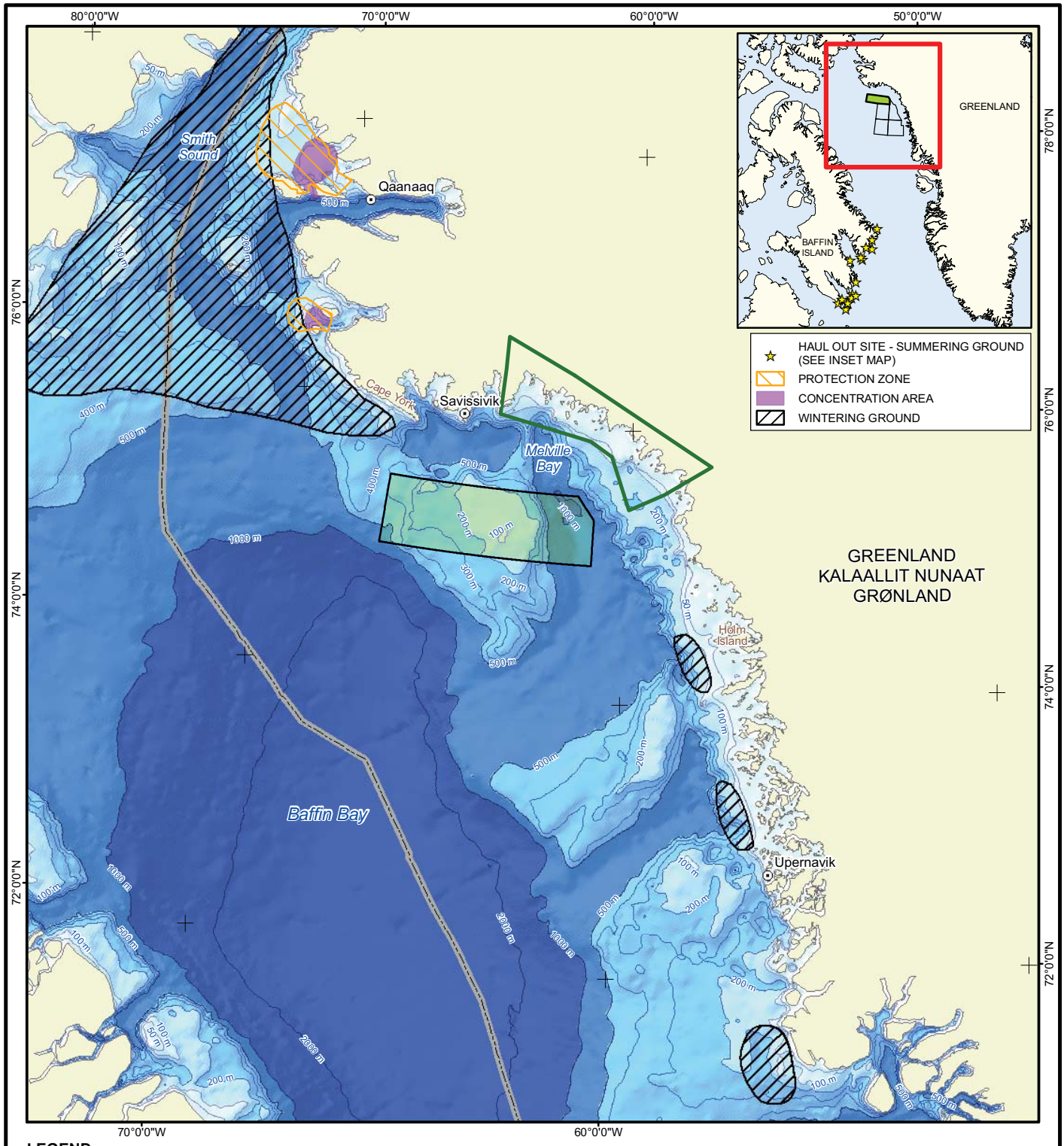

LEGEND

- TOWN / SETTLEMENT
- INTERNATIONAL MARITIME BOUNDARY

ISOBATH (DEPTH IN METRES)

- 50 m CONTOUR INTERVAL (0 m - 100 m)
- 100 m CONTOUR INTERVAL (100 m - 500 m)
- 1000 m CONTOUR INTERVAL (> 1000 m)
- LICENCE BLOCK
- MELVILLE BAY RESERVE

BATHYMETRY

- 0 m DEPTH
- 0 m - 100 m DEPTH
- 100 m - 200 m DEPTH
- 200 m - 500 m DEPTH
- 500 m - 1000 m DEPTH
- > 1000 m DEPTH

100 0 100
KILOMETRES

REFERENCE

IBCAO bathymetry and isobaths from the International Bathymetric Chart of the Arctic Ocean (IBCAO) version 2.33. Protected Areas, walrus data, place names and licence blocks obtained from DCE report no.9 (DCE 2011). Coastline obtained GADM (geographic database of global administrative areas) version 1.0, in March 2009.
DATUM: WGS84 PROJECTION: UTM ZONE 21N

PROJECT
ConocoPhillips
2D SEISMIC PROGRAM

TITLE
SEASONAL DISTRIBUTION OF WALRUS IN BAFFIN BAY

Golder Associates INUPLAN A/S

PROJECT		11-1334-0084	FILE No.
DESIGN	AR	10 Jan. 2012	SCALE AS SHOWN REV. 0
GIS	VGV	10 Feb. 2012	
CHECK	PR	10 Feb. 2012	FIGURE: 4.2-5
REVIEW	CC	02 Mar. 2012	

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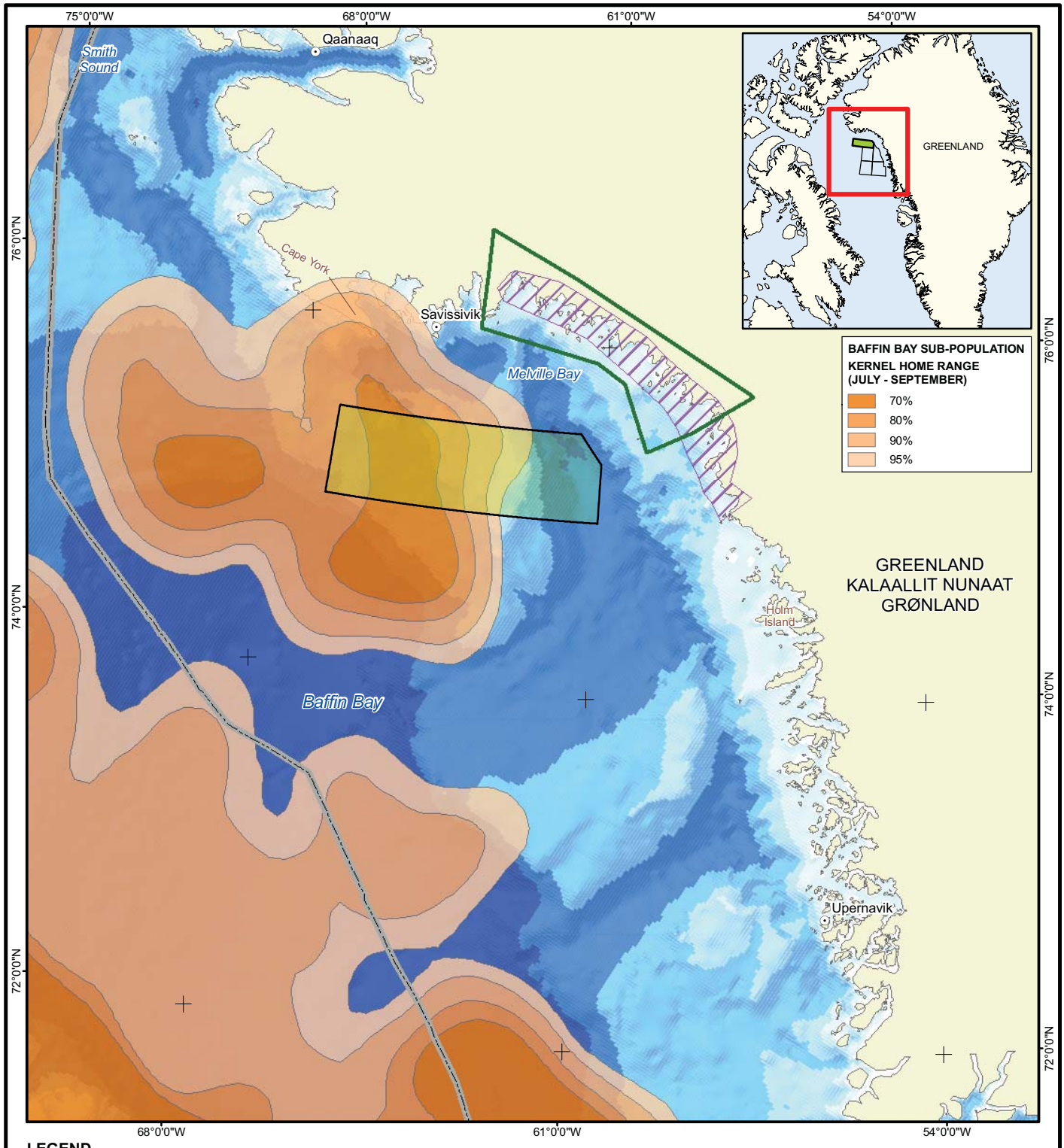

LEGEND

- TOWN / SETTLEMENT
- INTERNATIONAL MARITIME BOUNDARY
- MELVILLE BAY RESERVE
- LICENCE BLOCK
- AREA IMPORTANT TO POLAR BEAR

BATHYMETRY

- 0 m DEPTH
- 0 m - 100 m DEPTH
- 100 m - 200 m DEPTH
- 200 m - 500 m DEPTH
- 500 m - 1000 m DEPTH
- > 1000 m DEPTH

100 0 100
KILOMETRES

NOTES

Satellite-telemetry data may no longer be representative given sea-ice conditions and polar bear occurrence have changed in Northwest Greenland (DCE 2011).

REFERENCE

IBCAO bathymetry and isobaths from the International Bathymetric Chart of the Arctic Ocean (IBCAO) version 2.33. Protected Areas, polar bear data, place names and licence blocks obtained from DCE report no.9 (DCE 2011). Coastline obtained GADM (geographic database of global administrative areas) version 1.0, in March 2009.
DATUM: WGS84 PROJECTION: UTM ZONE 21N

PROJECT
ConocoPhillips
2D SEISMIC PROGRAM

TITLE
JULY TO SEPTEMBER HOME RANGE OF POLAR BEARS (BAFFIN BAY SUB-POPULATION) FROM 1991 TO 1997

Golder Associates INUPLAN A/S

PROJECT		11-1334-0084	FILE No.	
DESIGN	AR	10 Jan. 2012	SCALE AS SHOWN	REV. 0
GIS	VGV	10 Feb. 2012		
CHECK	PR	10 Feb. 2012		
REVIEW	CC	02 Mar. 2012		

FIGURE: 4.2-6

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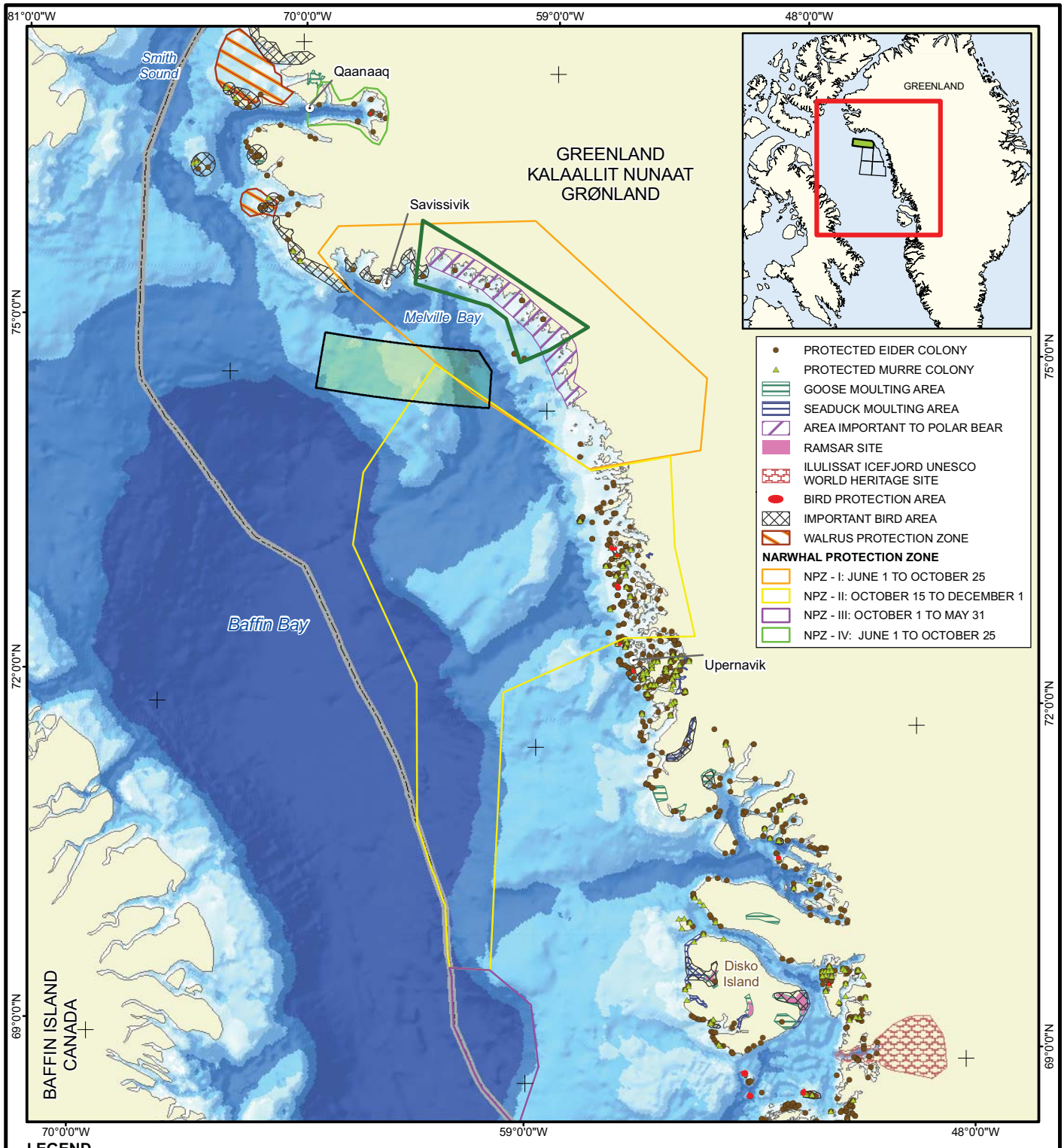

LEGEND

- TOWN / SETTLEMENT
- INTERNATIONAL MARITIME BOUNDARY
- LICENCE BLOCK
- MELVILLE BAY RESERVE

BATHYMETRY

- 0 m DEPTH
- 0 m - 100 m DEPTH
- 100 m - 200 m DEPTH
- 200 m - 500 m DEPTH
- 500 m - 1000 m DEPTH
- > 1000 m DEPTH

100 0 100
KILOMETRES

REFERENCE

IBCAO bathymetry and isobaths from the International Bathymetric Chart of the Arctic Ocean (IBCAO) version 2.33. Protected Areas, place names and licence blocks obtained from DCE report no.9 (DCE 2011). Coastline obtained GADM (geographic database of global administrative areas) version 1.0, in March 2009.
DATUM: WGS84 PROJECTION: UTM ZONE 21N

PROJECT
ConocoPhillips
2D SEISMIC PROGRAM

TITLE
PROTECTED AREAS IN NORTHWEST GREENLAND

Golder Associates INUPLAN A/S

PROJECT		11-1334-0084	FILE No.	
DESIGN	AR	10 Jan. 2012	SCALE AS SHOWN	REV. 0
GIS	VGV	10 Feb. 2012		
CHECK	PR	10 Feb. 2012		
REVIEW	CC	02 Mar. 2012		

FIGURE: 4.2-7

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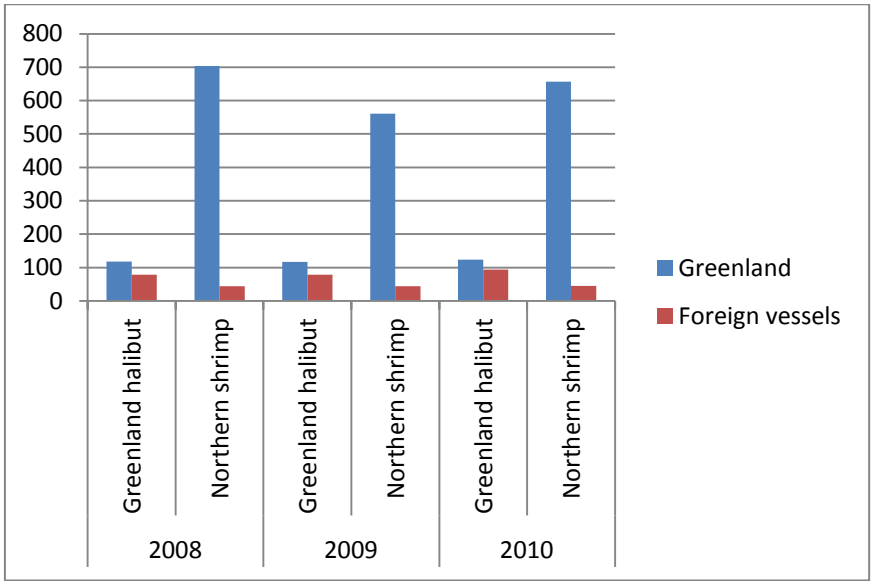
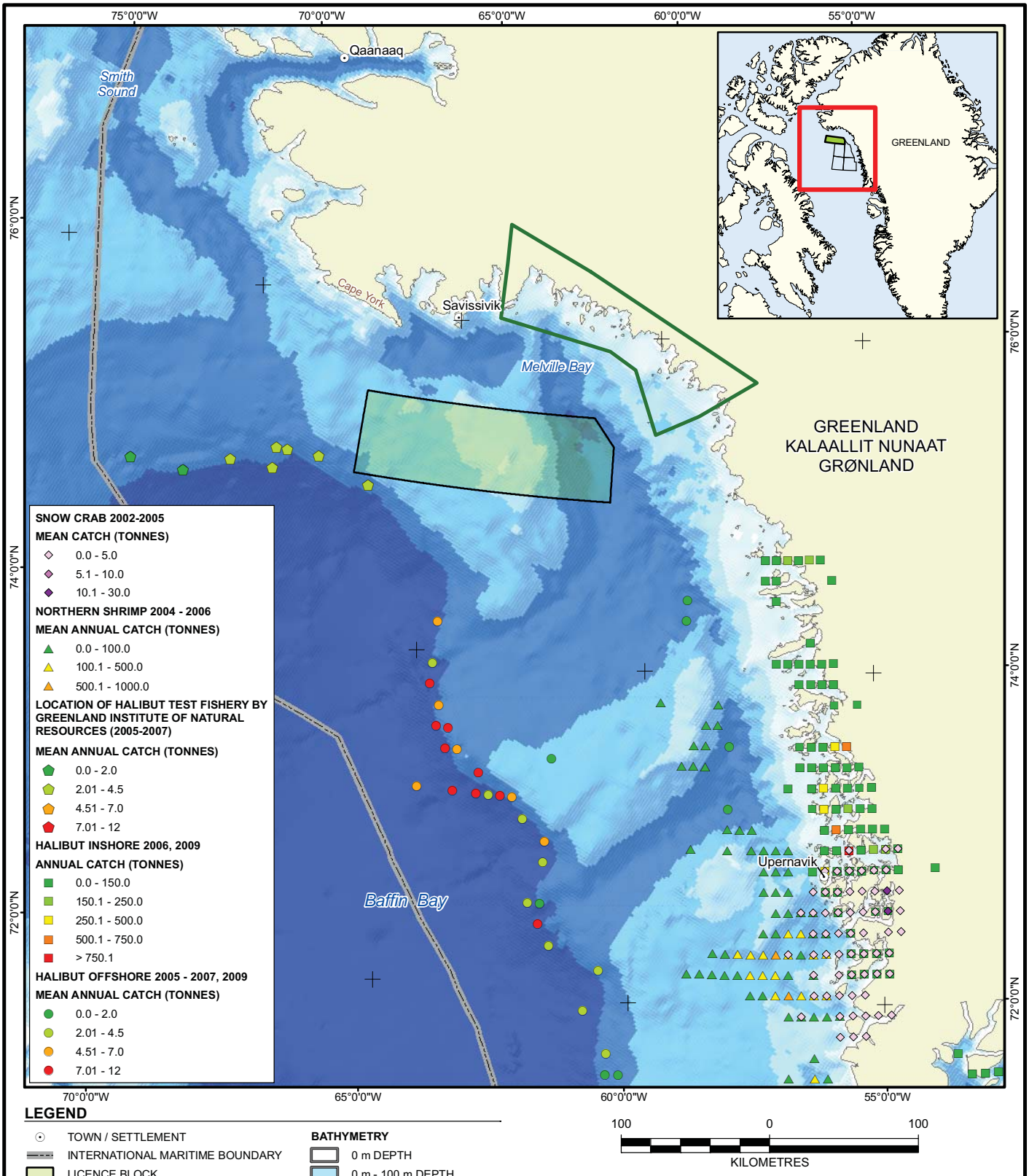
Figure 4.3-1 Annual Revenue Generated by the Northern Shrimp and Greenland Halibut Fisheries in Greenlandic Waters between 2008 and 2010



Note: Annual revenue generated in million DDK.
Source: Greenland Statistics 2011.



LEGEND

- TOWN / SETTLEMENT
- INTERNATIONAL MARITIME BOUNDARY
- LICENCE BLOCK
- MELVILLE BAY RESERVE

BATHYMETRY

- 0 m DEPTH
- 0 m - 100 m DEPTH
- 100 m - 200 m DEPTH
- 200 m - 500 m DEPTH
- 500 m - 1000 m DEPTH
- > 1000 m DEPTH

100 0 100

KILOMETRES

REFERENCE

IBCAO bathymetry and isobaths from the International Bathymetric Chart of the Arctic Ocean (IBCAO) version 2.33. Protected areas, fisheries data, place names and licence blocks obtained from DCE report no.9 (DCE 2011). Coastline obtained from GADM (geographic database of global administrative areas) version 1.0, in March 2009.
DATUM: WGS84 PROJECTION: UTM ZONE 21N

PROJECT

ConocoPhillips

2D SEISMIC PROGRAM

TITLE

OVERVIEW OF COMMERCIAL FISHERIES IN NORTHEAST BAFFIN BAY

Golder Associates INUPLAN A/S

PROJECT	11-1334-0084		FILE No.
DESIGN	LB	09 Jan. 2012	SCALE AS SHOWN REV. 0
GIS	VGV	29 Feb. 2012	
CHECK	PR	29 Feb. 2012	FIGURE: 4.3-2
REVIEW	CC	02 Mar. 2012	

I:\2011\11-1334\11-1334-0084\Mapping\MXD\Fish\CONOCO_Commercial_Fisheries_FINAL.mxd

Figure 6.3-1 Source-path-receiver Model

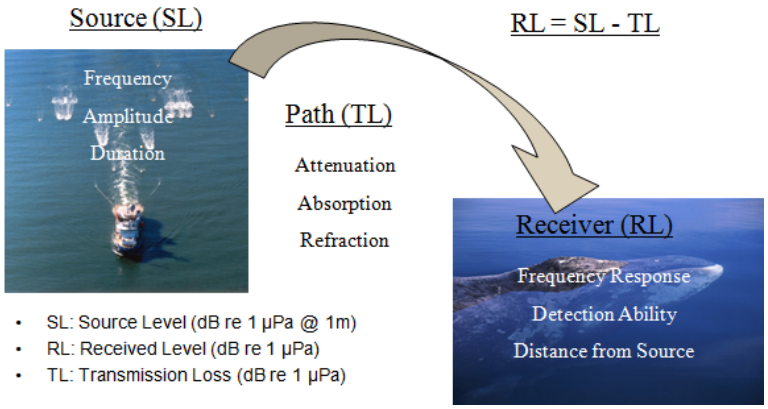
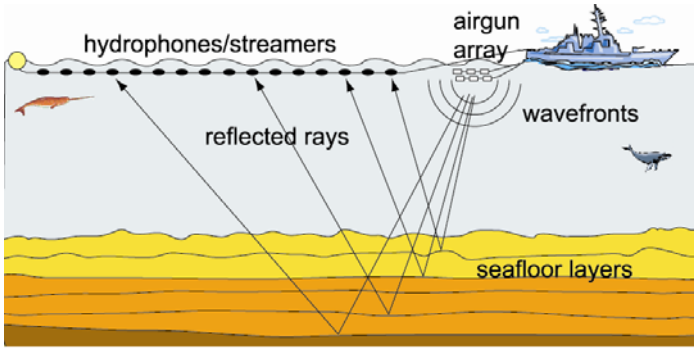
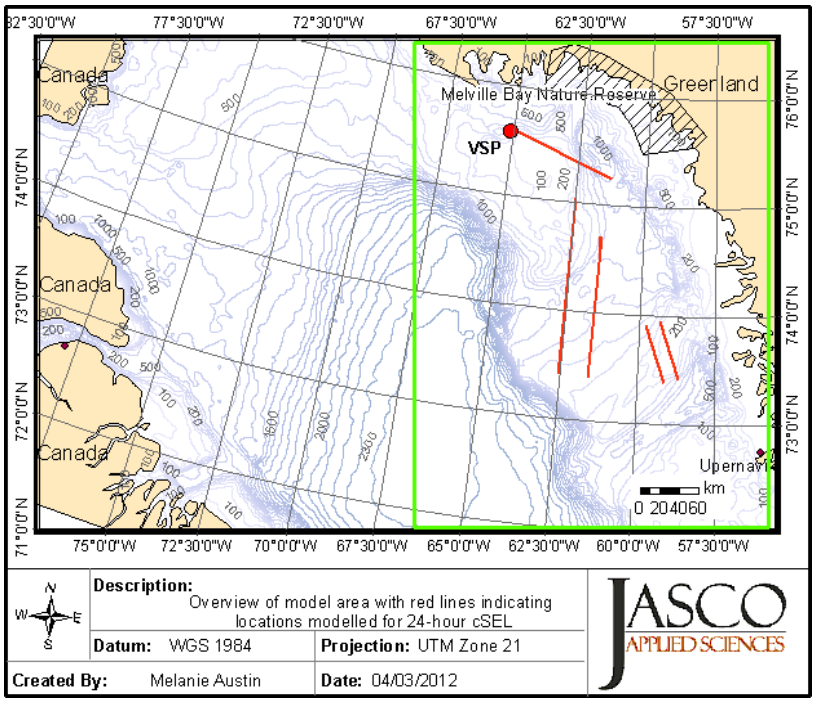


Figure 6.3-2 Underwater Sound Propagation of a Marine Seismic Survey



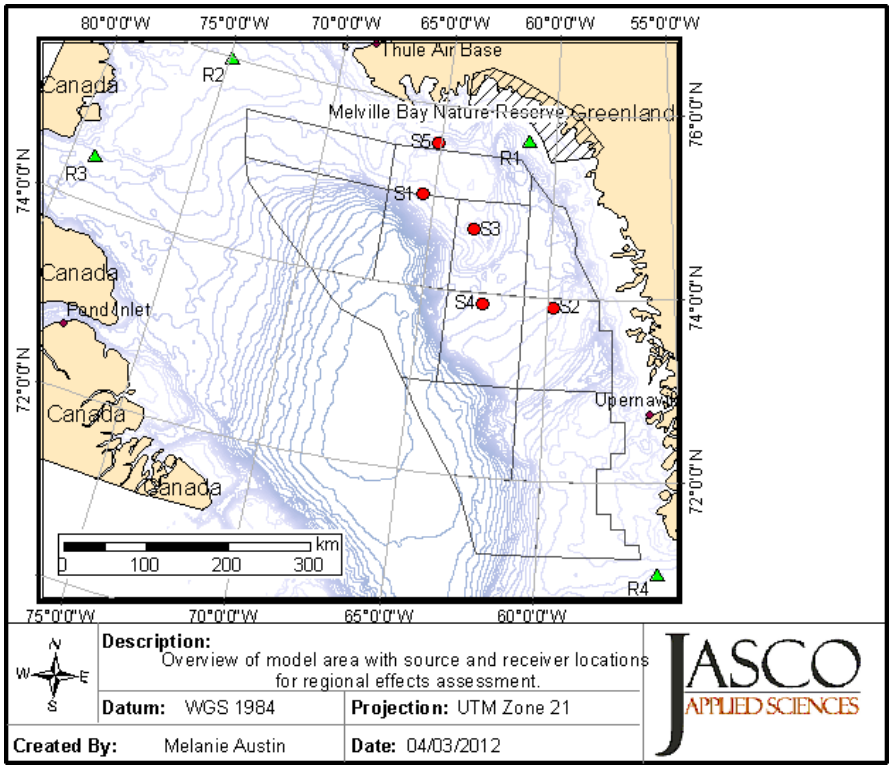
Note: A ship tows an airgun array, which sends acoustic energy through the water. Some of the acoustic energy travels into the ocean bottom. The signals reflected from the seafloor layers are received at towed hydrophone streamers.

Figure 7.2-1 Seismic Survey Lines (red lines) and VSP Source Location (red circle) for the Aggregate cSEL Scenario.



Note: The green box approximately defines the area where cSEL results were computed. Bathymetry contours labelled in metres.

Figure 7.2-2 Sources (red circles) and Receivers (green triangles) for the Model Transects that Extend beyond the RSA.



Note: Bathymetry contours shown in blue.






GXT Northeast Greenland 2011 Marine Survey Environmental Impact Assessment

(from GXT's Survey Program Application)

Prepared for the Bureau of Minerals and Petroleum

Nuuk, Greenland

GX Technology Corporation

May 2011

GX Technology Corporation

May 2011 (with revisions, July 2011)

Prepared by GXT with assistance (environmental impact assessment) from
LGL Ltd, St. John's and King City, Canada

Cover photos by Kevin Simpson, GXT

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1. List of Marine-Associated Birds and Summary of their Distribution and Abundance in Northeast Greenland
2. Important Bird Areas and Ramsar Sites within the KANUMAS East Assessment Area
3. Overview of Marine Mammals Occurring in the KANUMAS East Assessment Area.

GXT 2011 Environmental Impact Assessment

This is the Environmental Impact Assessment (EIA) component of GX Technology Corporation's (GXT) 2011 Application to the Greenland Bureau of Minerals and Petroleum (BMP) for its proposed Northeast Greenland offshore survey program. As described below additional technical information is contained in the Application Appendix Volume, and other sections of the Application documents describe (Volume 1) and contain (Volume 2) the detailed safety, emergency response (including spill response), waste management and pollution prevention plans that will be applied during the survey.

1 Relevant Project Components and Method

As described in detail in Section 4.1 – 4.8 of GXT's 2011 Application, GX Technology Corporation is proposing to conduct a marine 2-D (single streamer) seismic, gravity and magnetic program located offshore of Northeast Greenland. Data acquisition is expected between July and October 2011. GXT is requesting to permit approximately 12,610 km of seismic lines in Greenland waters. However, it is expected that approximately half this amount will actually be acquired in 2011, if ice conditions are favourable. The additional permitted lines will allow options / alternatives in case some areas have ice that is too heavy for acquisition, or cannot be surveyed for other environmental / environmental protection reasons.

This program is similar to, and overlaps the area of GXT's previous two Greenland marine programs conducted successfully and without environmental incidents in 2009 and 2010. As in 2009 and 2010, two vessels will be used for the survey - a seismic source vessel with hull modifications for deploying seismic equipment to work in ice (the *Polar Explorer*) and an icebreaker, which will go ahead to open leads and channels (the *Vladimir Ignatyuk*). The *Polar Explorer* (then named the *Geo Explorer*) was also used in 2009 and 2010, and the *Vladimir Ignatyuk* was used for GXT's 2009 survey. As in 2009 and 2010, the seismic source ship will tow a compressed air sound source array (28 airguns, 4330 in^3 array) and a single submerged solid-core passive hydrophone receiver cable, which will extend up to 8.5 km behind the vessel. (A very similar and successful program was also conducted in the Canadian Beaufort Sea in 2010.)

The maps in this EIS show the location of the seismic lines proposed for 2011. Water depths in the Project Area range from less than 50 m to 3,500 m, and lines range from the closest point, ~22 km from the mainland of Greenland (about 12 km from the closest offshore island), to the maximum offshore point of ~365 km, the outer Greenlandic EEZ boundary. The great majority of the survey acquisition (roughly 90%) is more than 50 km from any shoreline.

1.1 Purpose of the Project

The overall purpose of the Project is to conduct a marine 2-D seismic, gravity and magnetic data acquisition program located offshore of Northeast Greenland focused on the areas from North Denmarkshavn Salt Basin to Northeast Greenland Volcanic Province and eastward into Thetis Basin. The survey overlaps portions of both the East Greenland and North Greenland BMP licence Regions, though the great majority is in the North Region.

The aim of the 2011 study is to continue to collect seismic data, supplementing GXT's 2009 and 2010 programs, to reveal the large scale region-wide geological profile. As with the 2009 and 2010 surveys, the 2011 Project is a Basin Span survey. GXT's world-wide Span surveys examine very broad and deep geological formations in and around basin areas using advanced geophysical techniques. They provide information on the geologic evolution, deep basin architecture, and the depositional and structural histories of an entire region. The Northeast Greenland 2009, 2010 and 2011 surveys are part of GXT's Arctic Basin Span programs which have been conducted previously in Arctic waters off Alaska, western Canada and Norway. Surveying these ultra-deep formations allows for a better evaluation of the evolution of the geological basin areas, including identifying source rocks, migration pathways, and play types. These programs are not designed to identify specific potential drilling locations.

1.2 Recent Studies and Assessments

The physical oceanography and biological environment of Northeast Greenland have been reviewed as part of a detailed and comprehensive Preliminary Strategic Environmental Impact Assessment (PSEIA) of expected activities for the KANUMAS East area (Boertmann et al. 2009a). Funded by the Bureau of Minerals and Petroleum, and prepared by the National Environmental Research Institute (NERI / DMU) and the Greenland Institute of Natural Resources (GINR), the PSEIA covers the offshore waters and coastal areas from the eastern Kangerlussuaq Fjord northwards to Amdrup Land (68ºN and 81ºN). All but 5 km of GXT's proposed 2011 survey lines (part of one line north of 81ºN) fall within the KANUMAS East PSEIA assessment area (See Figure 1.)

The environment of the area for this present survey is well described in the KANUMAS East assessment area PSEIA and was also summarized in the GXT EIAs for the 2009 and 2010 2-D surveys in the east and north Greenland Regions (GXT 2009; GXT 2010). The proposed 2011 seismic program occurs entirely within the GXT Study Area applied in the 2010 EIA (shown in Figure 1). For both the 2009 and 2010 survey Applications, comprehensive project-specific environmental assessments were prepared, and reviewed and approved by BMP/NERI.

In the following Section, the physical and biological environments are summarized and largely referenced to the KANUMAS East PSEIA. Section 3 then provides the assessment of potential Project impacts. The section following (Section 4) contains a summary of the environmental protection plan and mitigations, which follow the current BMP/NERI's Seismic Guidelines (Boertmann et al. 2010).

Source references for the EIA citations are included at the end of this EIA in Section 5.

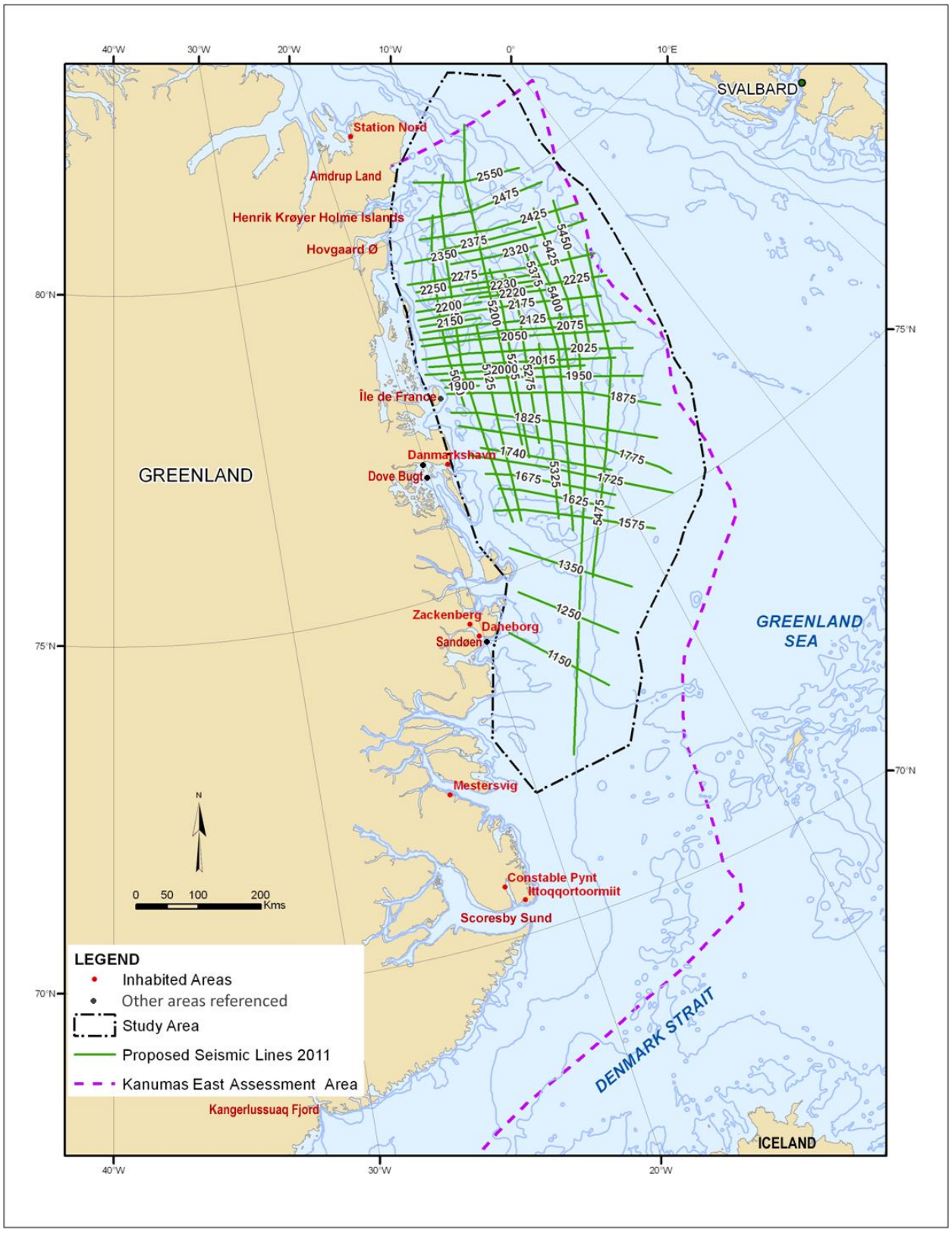

Figure 1. GXT NE Greenland 2011 Seismic Program and Study Areas
(including areas referenced in the text)

2 Project Area Environment (Physical, Biological and Human Use)

Because the Project Area environment is well described in several available studies, such as Mosbech et al. (2000), Jensen and Christiansen (2003), Hvidegaard et al. (2008), Boertmann et al. (2009a; 2009b), key features only are presented here. However, a more detailed technical description is also included in Appendix 4 of GXT's 2011 Application.

2.1 Physical Oceanography

2.1.1 Currents

The dominant current of east Greenland is the cold East Greenland Current which transports massive amounts of cold Arctic water and pack ice southward from the Arctic Ocean. As the current flows south, it encounters the warmer, more saline Irminger Current, a branch of the Gulf Stream, between Iceland and Greenland. Mixing of the two currents causes the East Greenland Current to lose its characteristic polar current traits along the southernmost part of the west coast. The distribution of marine species in Greenland is greatly influenced by the mixing of the currents. The current system of Greenland is also important in the transportation and distribution of sea ice. The East Greenland Current leads the so-called East Greenland Drift Ice (multi-year drift ice of polar origin) from the Arctic Ocean southward.

2.1.2 Ice

Sea ice is very important to Greenland ecosystems because of several factors including the distribution and migration of animals, particularly those that need open water to forage or, in the case of marine mammals, breathe. The ice also provides a platform for seals, Atlantic walrus, polar bear and marine birds.

The sea ice around Greenland is dynamic and varies annually and locally in distribution and shape depending on localized wind and current conditions. The ice conditions on the east coast can be severe with dense ice cover during most of the summer period. The temporary or permanent open areas, such as leads and polynyas (open water areas that form within pack ice in almost the same place and time each year), found within sea ice are important productive areas for a variety of marine life. Leads open and close due to changing water levels and are found in coastal areas and around grounded icebergs. Polynyas are important wintering areas for several Arctic marine mammals and birds. The Northeast Water Polynya, which occurs in the northeast waters by Norøstrundingen, is one of the largest polynyas in Greenland waters (Jensen and Christensen 2003).

2.2 Biological Environment

2.2.1 Primary Production, Zooplankton and Marine Invertebrates

Primary production off Northeast Greenland (phytoplankton, ice algae embedded in fast or pack ice, and benthic algae) varies geographically with water depth and extent of ice cover. Overall, primary productivity is low in Northeast Greenland because large areas are dominated by heavy ice conditions throughout most summers. Areas near the sea ice edge are biologically more important because they become very productive in terms of nutrient concentrations for other species during the spring thaw. The situation for zooplankton is similar, and are likely most concentrated within polynyas.

Crustaceans compose the largest group of marine invertebrates in Greenland with ~800 species including ecologically important ones, such as copepods and krill, and commercial species, such as pink shrimp (northern shrimp; *Pandalus borealis*) and snow crab (*Chionoecetes opilio*). Molluscs and polychaetes are the next largest groups with 282 and 252 species, respectively.

2.2.2 Ice Fauna and Flora

The drifting ice in Northeast Greenland provides habitat for a specialized ecosystem for organisms collectively referred to as "ice fauna and flora". These organisms can form communities that consist of algae living in or on the ice, of small crustaceans (e.g., copepods and amphipods), and of two fish species, namely polar cod (*Boregadus saida*) and Arctic cod (*Arctogadus glacialis*), though little is known about these communities in the Northeast Greenland area.

2.2.3 Fish

Available data suggests that fish diversity in Northeast Greenland waters is lower than in subarctic or boreal regions. The species identified are largely belong benthic-dwelling families, such as Cottidae (sculpins), Zoarcidae (eelpouts), and Liparidae (snailfishes), of low economic value, but high ecological value as food for many Arctic seabirds and marine mammals. Important fish species are described in detail in Section 4.5 of Boertmann et al. (2009a). For species of commercial interest, no major spawning grounds have been identified in east Greenland waters, and sand lance is noted as the only important fish species that spawns in offshore areas during the summer in these waters. Research to date suggests that localized spawning areas with high concentrations of eggs and larvae near the surface are not likely to occur in the area.

2.2.4 Marine-Associated Birds

More than 230 occur in Greenland, with about 75 species occurring regularly, including 58 breeding and 17 non-breeding species. West Greenland's bird life is much better known than other regions of the country. This is largely because most of Greenland's human population live here. Appendix 1 and 2 of this EIA and Appendix 4 of GXT's 2011 Application has more information about the bird species that regularly occur in Northeast Greenland and summarizes their abundance and general distribution. Boertmann et al. (2009a) provided descriptions of important and critical marine habitats for marine-associated birds in the

KANUMAS East assessment area. The areas summarized include breeding colonies, polynyas, other open water (e.g., river outlets, straits, etc), undisturbed areas (for moulting ducks), and the Greenland Sea marginal ice zone.

There are currently 14 Important Bird Areas (IBAs), as designated by the international bird protection organization BirdLife International, in the KANUMAS East assessment area (Boertmann et al. 2009a; see Figure 2). Of these 14 IBAs, one occurs in the GXT 2011 Study Area and seven others occur within 35 to 113 km of the Study Area. Two of these have also been designated as Ramsar sites. A number of regulations, largely concerning mineral exploration, are currently in place for Greenland's Ramsar sites, which include:

- A prohibition of travel within 5 km of a murre site during the breeding season;
- A restriction on helicopters and fixed wing aircraft;
- A ban on hunting or travel within the Ramsar sites additionally designated entirely or partially as nesting bird reserves; and,
- A ban on travel within 500 m of a Ramsar site that is also, in its entirety, designated a nesting bird reserve.

The Ivory Gull is currently listed as *Vulnerable* on Greenland's Red List. Greenland is an international stronghold for the species but the full extent of the breeding population is poorly known. In 2007 and 2008, aerial surveys for seabirds and marine mammals off east and Northeast Greenland, in addition to land surveys and satellite tracking, resulted in locating 35 Ivory Gull breeding sites, including 20 new sites (Gilg et al. 2009). Most of these sites are located in northeasternmost Greenland, including the northern part of the Study Area. See Appendix 1 for a status listing of relevant birds.

2.2.5 Marine Mammals

Boertmann et al. (2009a) provide a detailed review of marine mammals which occur in the KANUMAS East assessment area. The authors noted that 19 marine mammal species occur in the assessment area including the polar bear, walrus, four species of seal, and possibly 13 species of cetaceans. Boertmann et al. (2009a) provide descriptions of periods of occurrence, main habitat, distribution, protection and exploitation, Greenland Red List status, and importance of the assessment area to the marine mammal species (see Section 4.7 *in* Boertmann et al. 2009a). No specific areas have been afforded special status but important ecological areas (as identified by Boertmann et al. 2009a and 2010) are discussed below.

While six species of toothed whales (odontocetes) may occur in the Study Area, only the narwhal is listed as being common in the KANUMAS East assessment area. A significant portion of the global population occurs in the assessment area and the species is a resource for east Greenland communities. This species is also considered a VEC in this EIA. Narwhals usually occur in groups ranging in size from a few individuals to more than 100 and generally occupy relatively shallow summer grounds in fjords and coastal areas (Dietz et al. 1994). Narwhals occur in the wide drift ice belt offshore during the winter. Prior to entering fjords in summer, narwhals tend to congregate along the fast ice edges in spring, waiting for the fjords to open up. Prior to freeze-up of coastal areas in autumn, narwhals migrate to wintering and feeding grounds in deep and densely ice covered waters (Boertmann et al. 2009a).

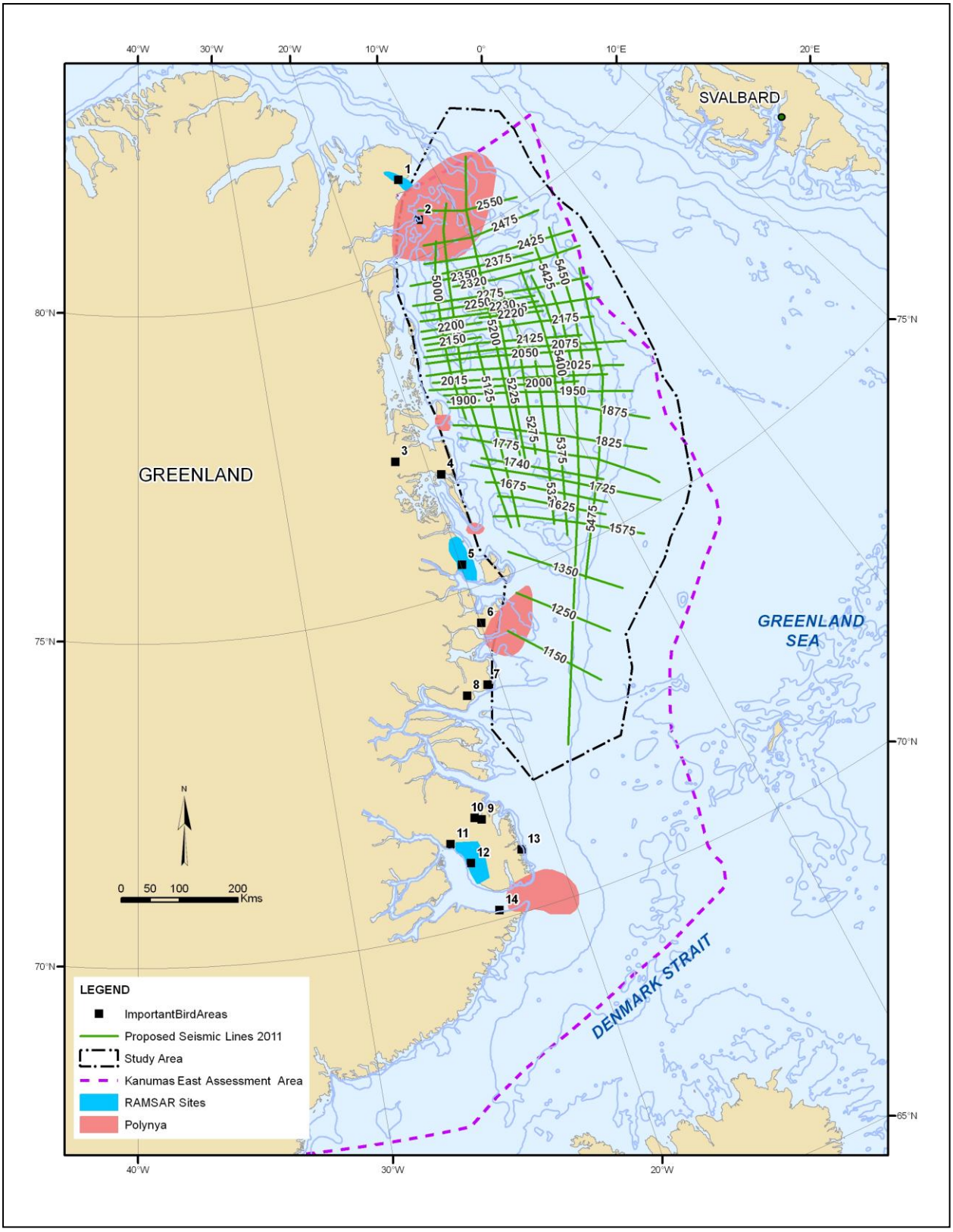

Figure 2. The Locations of Important Bird Areas (IBAs) and Ramsar sites within the KANUMAS East Assessment Area. Numbers in the figure correspond to the IBAs listed in Appendix 2 to this EIA.

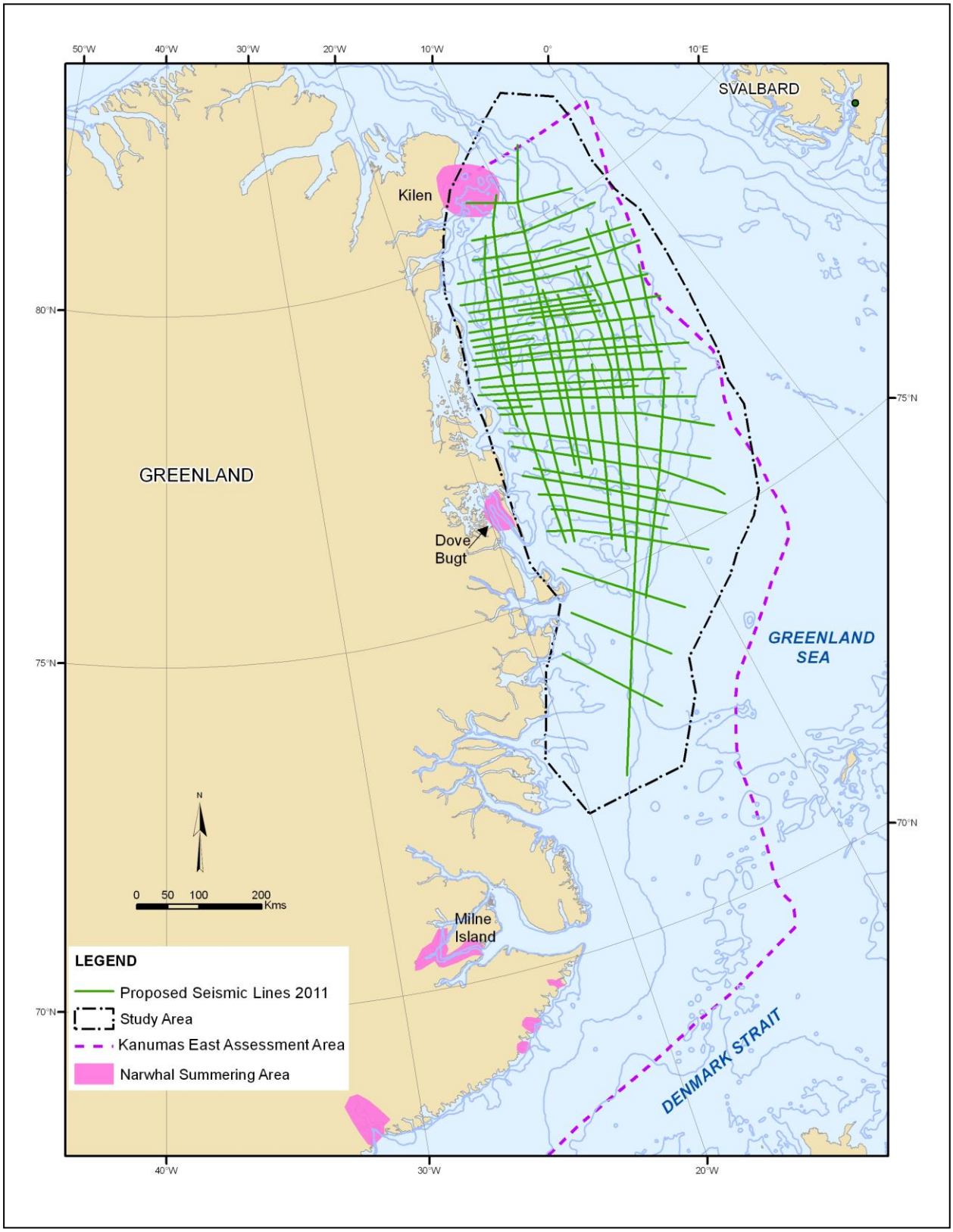

Figure 3. Narwhal Summering Areas in and near the Study Area.

Narwhal protection zones in east Greenland have been designated for the period of 1 July to 30 September, though based on limited information regarding narwhal distribution (Figure 3 shows narwhal summering areas, based on Boertmann et al. 2009a, 2009b and NERI unpublished data; Figure 4 shows the protection zones based on Boertmann et al. 2010). No narwhals were observed during the 2009 or 2010 GXT seismic surveys off Northeast Greenland (Jones et al. 2009, Mactavish and Lang 2011).

Six species of baleen whales (mysticetes) may occur in the Study Area but little is known about the distribution and abundance of these species in the waters off Northeast Greenland. Bowhead whales were considered a VEC in the PSEIA (Boertmann et al. 2009a) because the species is considered *Critically Endangered* and it likely occurs regularly (possibly year-round) in the KANUMAS East assessment area, albeit in low numbers (perhaps a few tens). The remaining five species of baleen whales, all rorquals, are present in the Study Area only during summer. Rorquals migrate north to the North Atlantic in the spring and return south to wintering areas in the fall. Very little information is available regarding these species in the Study Area, but sightings have been most common in drift ice clearings or at the edge of fast ice.

Critical bowhead areas, including potential feeding areas, in Northeast Greenland have not been identified because sightings have been few and very dispersed (Boertmann et al. 2009a); however, precautionary protection zones in east Greenland have been designated (see Figure 4, based on Boertmann et al. 2010).

Bowhead whales were not observed during the 2009 GXT seismic survey off Northeast Greenland (Jones et al. 2009). One cetacean sighting observed within the ice fields was categorized as a single unidentified whale during the 2010 GXT seismic survey off Northeast Greenland, but it is suspected that this cetacean was a bowhead whale based on the habitat (pack ice) and on the features observed during the sighting (Mactavish and Lang 2011).

Pinnipeds. Four species of *seals* (or phocids) are expected to occur in the Study Area including ringed, bearded, harp and hooded seals. Harp seals are most common, followed by hooded seals, ringed seals and bearded seals. Harp and hooded seals are highly migratory species that breed on pack ice off Greenland's west and east coasts. Large aggregations of the two species generally whelp and moult in the same areas on the ice off east and Northeast Greenland. Harp seals typically whelp from March to April and moult in late April. Whelping for hooded seals occurs from late March to early April while moulting occurs from June to early July. After whelping and moulting are completed, individuals of both species disperse into open waters. Ringed and bearded seals occur along all of Greenland's coasts and are commonly associated with sea ice. Unlike harp and hooded seals, these species do not form large whelping and moulting aggregations. The main breeding habitat for ringed seals is considered to be coastal fast ice and consolidated drift ice. From late March to April, the pups are born in lairs made in snowdrifts.

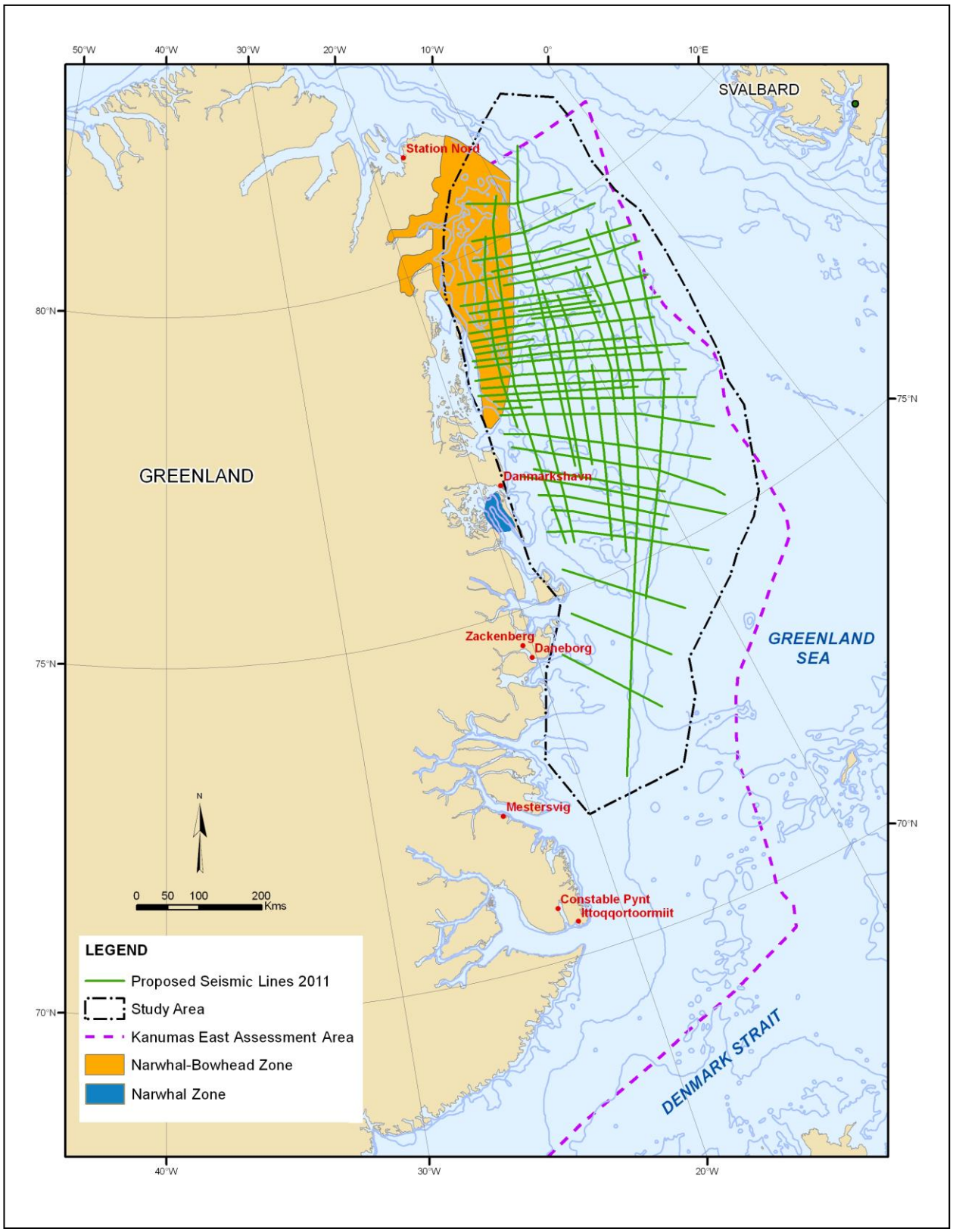

Figure 4. Bowhead and Narwhal Protection Zones in and near the Study Area.

During the 2009 GXT seismic survey off of Northeast Greenland from August through September, there were 16 sightings (18 individuals) of hooded seals, two sightings (two individuals) of ringed seals, and one sighting each of a harp seal and a bearded seal. During the 2010 GXT seismic survey off of Northeast Greenland from July through September, there were 64 sightings (91 individuals) of hooded seals, 15 sightings (15 individuals) of ringed seals, five sightings (six individuals) of harp seals, and three sightings (three individuals) of bearded seals (Mactavish and Lang 2011). The majority of observed seals during the 2009 and 2010 seismic programs could not be identified to the species level (58 sightings of 65 individuals in 2009 and 99 sightings of 145 individuals in 2010; Jones et al. 2009, Mactavish and Lang 2011).

The biology and ecology of the Atlantic walrus in Northeast Greenland is reviewed for the KANUMAS East assessment area in Section 4.7 of Boertmann et al. 2009a). Boertmann et al. (2009a) suggest that close to 1,000 walrus comprise the east Greenland subpopulation; it is listed as *Near Threatened* (Boertmann 2008). The Atlantic walrus generally occurs north of ~63ºN, but principally north of ~73ºN. As described by Boertmann et al. (2009a), the most important areas in Northeast Greenland are (1) the haul-out areas and their surrounding waters, (2) the coastal summer concentration areas, and (3) the winter concentration areas. Walruses can also occur several hundred kilometres offshore from April to August. Mating occurs in winter with an apparent peak in January to April.

No walruses were observed during GXT's 2009 seismic survey offshore of Northeast Greenland (Jones et al. 2009), but four sightings of single walruses were observed during the 2010 GXT seismic survey (Mactavish and Lang 2011). Several protection zones for walruses exist off east Greenland during 1 June to 30 September, although the Northeast Water Polynya is considered a year-round protection zone (see Figure 5, based on Boertmann et al. 2010).

Polar Bears. The polar bear occurs regularly along the entire east coast of Greenland, but the size of this population is unknown (Boertmann et al. 2009a). During summer, polar bears can be found widely distributed in offshore pack ice and prefer areas with dense ice and ice edges. Some bears may also be found associated with the remnants of landfast ice or on land during the minimal ice conditions in summer and early fall (Born and Wiig 1995 *in* Boertmann et al. 2009a). In autumn female bears move to coastal areas where they dig a burrow in snow. This maternity den is where the cubs are born in later winter (Boertmann et al. 2009a).

Polar bear sightings were widespread off of Northeast Greenland during NERI aerial surveys in 2008 (Boertmann et al. 2009b). There were also four sightings (of four individuals) and 21 sightings (24 individuals) during the 2009 and 2010 GXT seismic surveys, respectively, off of Northeast Greenland (Jones et al. 2009, Mactavish and Lang 2011). The biology and ecology of polar bears in Northeast Greenland is extensively reviewed for the KANUMAS East assessment area (see Section 4.7 *in* Boertmann et al. 2009a).

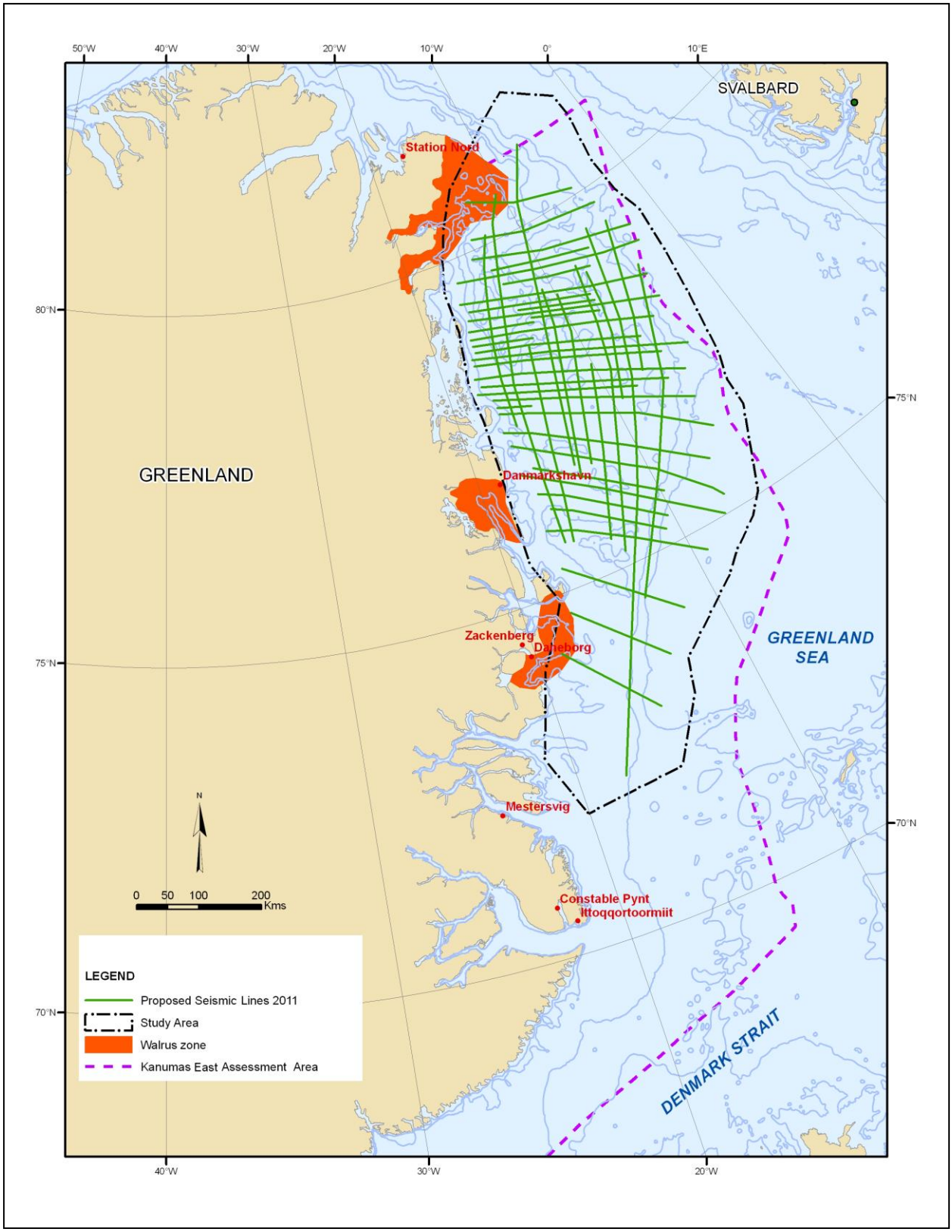

Figure 5. Walrus Protection Zones in and near the Study Area

2.2.6 Threatened Species

Three species of marine mammals and nine species of marine-associated bird species that occur in the KANUMAS East assessment area are listed on the Greenland red list (Boertmann 2008; Boertmann et al. 2009a). In addition, there are seven marine mammals that are currently categorized as *Data Deficient* or *Not Applicable*, but may become red-listed when additional information is available. The *Data Deficient* or *Not Applicable* species include bearded seal, blue whale, killer whale, white-beaked dolphin, narwhal (east Greenland population), sperm whale, and northern bottlenose whale. Appendix 3 to GXT's EIA provides details on relevant species.

Table 1. Greenland Red-listed Marine-associated Species Occurring in the KANUMAS East Assessment Area

Species/Subspecies/Population	Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)	Near Threatened (NT)
Polar Bear			X	
Walrus				X
Bowhead Whale	X			
Great Northern Diver				X
Light Bellied Brent				X
Sabines Gull				X
Ross's Gull				X
Black-legged Kittiwake			X[1]	
Ivory Gull			X	
Arctic Tern				X[1]
Brünnich's Guillemot			X	
Atlantic Puffin				X

Note: [1]Applies to the entire Greenland population and red-listed because the west Greenland population is decreasing, a trend not apparent in east Greenland.
Source: Boertmann (2008) and Boertmann et al. (2009a). The red list was prepared using regional guidelines issued by the International Union for Conservation of Nature (IUCN) in 2001 and 2003. The Greenland red list did not assess marine fish or invertebrates.

In addition to red-listed species, there are marine-associated species with more than 20% of the global population occurring in Greenland. These species include polar bear, Pink-footed Goose, Light Bellied Brent, Barnacle Goose, Red Knot, Black Guillemot, and Little Auk.

Twenty-three species of marine fish occurring in Greenland waters have been assessed by IUCN with 13 species considered *Data Deficient* or *Least Concern*. With the exception of Atlantic cod, the globally threatened fish species are unlikely to occur in the Study Area. No invertebrate species occurring in Greenland marine waters were listed as globally threatened by IUCN.

Within the KANUMAS East assessment area, there are several hotspots for threatened species, particularly at the mouth of Scoresby Sund, the entrance to Dove Bugt, and the islands of Henrik Krøyer Holme. Polynyas occur at these hotspots (see Figure 45 *in* Boertmann et al. 2009a). Dove Bugt and the islands of Henrik Krøyer Holme occur within or near the Study Area.

2.2.7 Protected Areas and Areas of Interest

National Park. The world's largest national park, encompassing an area of 956,000 km^2, is located in Northeast Greenland. The Northeast Greenland National Park includes the entire northeastern coastline and adjacent interior sections of Greenland. The area is sparsely populated and is composed largely of the Greenland Ice Cap though large ice-free areas occur along the coast and in the north. In addition to a variety of terrestrial mammals, including 40% of the world population of muskox, the park is inhabited by polar bear, walrus, ringed seal, bearded seal, harp seal, hooded seal, narwhal, and beluga. Several species of birds, including Common Loon, Barnacle Goose, Pink-footed Goose, Common Eider, and King Eider, breed in the park (Jensen and Christiansen 2003; WWF 2008). Other protected areas in Northeast Greenland include Important Bird Areas and Ramsar sites, discussed above.

It should also be noted that given the nature of 2-D seismic surveys, the seismic vessel will only occur in a given area for a limited period, and in the case of GXT's 2011 project, will only occur there during August to October, thereby, minimizing the potential for affecting marine mammals in such sensitive areas and during the winter.

2.2.8 Subsistence Hunting and Fisheries

Compared to other regions in Greenland, very little hunting and fishing occurs in and near the Study Area. This is largely attributed to the low number of human inhabitants on the east Greenland coast. In 2006, the human population residing in the KANUMAS East assessment area numbered 529 persons with all living in the town of Scoresbysund (Ittoqqortoormiit) and the surrounding settlements (see Figure 1). There are also several military and research outposts located north of Scoresby Sound though the number of year-round permanent resident is generally low (typically 2 to 12 inhabitants).

In 2004, there were registered 23 occupational hunters and 125 leisure hunters (Aastrup et al. 2005 *in* Boertmann et al. 2009a; Statistics of Greenland 2008). Some hunters from southeast Greenland may venture in the southernmost portion of the KANUMAS East assessment area; however, it is unlikely these hunters travel north of 73ºN and as such, are not expected to occur in or near the survey area. Besides low human population numbers, hunting is likely uncommon in Northeast Greenland because certain species, such as walrus and narwhal, are protected within the boundaries of the Northeast Greenland National Park. Also, all seabird colonies and their immediate surroundings are protected from disturbance. Hunters have historically travelled far north into the National Park to hunt polar bears in early spring; however, this activity has apparently ceased in recent years (Aastrup et al. 2005 *in* Boertmann et al. 2009a).

While fishing is very important in other areas of Greenland, the waters off east Greenland have only been fished commercially since the Second World War (Vihjálmsson et al. 2010). The main reason for this is the rough bottom topography as well as the speed and irregularity of the ocean currents, especially near the edge of the continental shelf. These conditions make fishing in east Greenland waters difficult for most harvesters, except for those using large vessels with robust fishing gear. The major commercial fisheries of east Greenland waters target Greenland halibut, Atlantic cod, redfish (*Sebastes* spp.), Atlantic salmon (*Salmo salar*), Arctic char (*Salvelinus alpinus*), and pink shrimp (Boertmann et al. 2009a; Vihjálmsson et al. 2010). With the exception of pink shrimp since the 1980s, the fisheries off

east Greenland have almost exclusively been conducted by foreign fleets (Vihjálmsson et al. 2010). Boertmann et al. (2009a) noted that the only species of commercial interest off Northeast Greenland is the Greenland halibut. This fishery occurs on the east Greenland coast occurs almost exclusively in open water from Denmark Strait southward. In Northeast Greenland, catches are generally small and largely confined to the southernmost part of the KANUMAS East assessment area near Scoresby Sund. Arctic char is largely fished near inhabited areas in Greenland, typically between June and September.

Other species that may be caught occasionally, mainly for domestic use, include spotted wolffish (*Anarchichas minor*), Greenland shark (*Microcephalus somniosus*), Greenland halibut, shorthorn sculpin (*Myxocephalus scorpius*), and polar cod (Sandell and Sandell 1991 *in* Boertmann et al. 2009a; Petersen 1993 *in* Boertmann et al. 2009a). The fisheries for these species within the 2011 survey area are likely to be minor to none.

3 Impact Assessment

3.1 Impact Assessment Methods

This Environmental Impact Assessment uses the methods presented in the Preliminary Strategic Environmental Impact Assessment (PSEIA) for the KANUMAS East area of Greenland (Boertmann et al. 2009a) and also incorporates relevant guidance from the Application Guidelines (BMP 2011), the Seismic Guidelines (Boertmann et al. 2010), Guidelines for Environmental Impact Assessment in the Arctic: Arctic Environmental Protection Strategy (FMOTE 1997), and the *Canadian Environmental Assessment Act (CEAA) Responsible Authorities Guide* (CEAA 1994). It applies the same approach and methodologies used in GXT's 2009 and 2010 Northeast Greenland survey environmental assessments.

The assessment process includes:

- a description of the proposed project (Section 1, above);
- identification of spatial and temporal boundaries;
- identification of Valued Ecosystem Components (VECs);
- overview of the project environment, with emphasis on key VECs;
- assessment of impacts;
- preparation of an interaction matrix
- assessment of interactions
- identification of impacts
- development of mitigation measures
- impact summary;
- assessment of cumulative impacts; and
- development of environmental protection plan / mitigations (presented in Section 3 and summarized in Section 4).

3.2 Spatial and Temporal Boundaries

For the purposes of this EIA, the following spatial and temporal boundaries are defined. These are the same defined for GXT's 2009 and 2010 survey assessments since the relevant parameters have not changed.

Temporal—the temporal boundaries of the Project are July to October 2011.

Project Area—the 'Project Area' is defined as the area of the "footprint" of the seismic lines plus an additional area (~5 km) around the outer perimeter of these lines to accommodate the ships' lead in requirements and turning radii .

Affected Area—the 'Affected Area' varies according to the specific vertical and horizontal distributions and sensitivities of the VECs of interest and is defined as that area within which effects (physical or important behavioural ones) have been reported to occur. It is likely that most potential effects will be confined within the Project Area because the actual effects on animals are caused by the operating array at a particular time. At each point in time, the array

ensonifies a particular area around the array and potentially affects animals in that area. The array then moves along the seismic line and affects new areas while the previously affected areas returns to normal and any effects may be reversed. In the assessment that follows, we have used an area referred to as '*spatial extent*'. This is the area where impacts on VECs may occur at any point in time. As noted, this area is dynamic because it "moves along" with the seismic source vessel within the Project Area.

Study Area—an area around the Project Area large enough to encompass effects reported in the literature. Because belugas in the Canadian Beaufort have been shown to avoid seismic operations by 10-20 km (Miller et al. 2005), this EIA considers an area ~ 20 km around the outer perimeter of the proposed survey lines (see Figure 1). (Though the overall 2011 survey "footprint" is smaller, the same Study Area used in 2010 is used here for consistency of the assessment.)

KANUMAS East Assessment Area—when considering cumulative effects, we have considered a broader or regional area whose boundaries were defined as the "assessment area" for the larger KANUMAS East PSEIA (Boertmann et al. 2009a) (see Figure 1). Cumulative effects assessment would also include the GXT Study Area which extends northward of the KANUMAS East assessment area.

3.3 Identification of Potential Impacts

This EIA focuses on the potential impacts that result from the interactions between project activities and Valued Ecosystem Components (VECs). As defined in the PSEIA, VECs can be "a species, a population, biological events or other environmental features that are important to the human population (not only economically), have a national or international profile, can act as indicators of environmental change or can be the focus of management or other administrative efforts." The VECs selected here are species and faunal groups which potentially can be impacted by seismic exploration activities in the Study Area.

An interaction matrix was prepared that identified all possible Project activities that could interact with any of the VECs. This matrix is used only to identify potential interactions; they make no assumptions about the actual or potential effects of the interactions.

Interactions were then evaluated for their potential to cause effects. In instances where the potential for an effect of an interaction was deemed impossible or extremely remote, these interactions were not considered further. In this way, the assessment focused on key issues and the more substantive potential environmental effects. Although the likelihood of a significant fuel spill is remote, information pertaining to potential effects of accidents and malfunction (primarily the release of hydrocarbons) has been provided.

An interaction was considered to be a potential effect if it could change the abundance or distribution of VECs, or change the prey species or habitats used by VECs. The potential for an effect was assessed by considering:

- the location and timing of the interaction;
- the literature on similar interactions and associated effects;
- when necessary, consultation with other experts; and
- results of similar effects assessments and especially, monitoring studies done in the Arctic, notably the Beaufort Sea.

A Level 1 Interaction Matrix (Table 2) is provided below.

Table 2. Potential Interactions (Level 1 Matrix) between the Project and VECs

VEC	Project Activity				
	Airgun Array	**Vessel/Icebreaker: Noise / Disturbance**	**Vessel Lights**	**Sanitary/ Domestic Wastes**	**Accidental Spills**
Bowhead Whale	X	X	X	X	X
Narwhal	X	X	X	X	X
Walrus	X	X	X	X	X
Seals [1]	X	X	X	X	X
Polar Bear	X	X	X	X	X
Sea-associated Birds	X	X	X	X	X
Fish	X	X	X	X	X
Zooplankton	X		X	X	X
Invertebrates	X		X	X	X

Note: Accidental spills refers to the release of fuel (or other hydrocarbons); see Section 3.12.
[1] Combines ringed, bearded, hooded, and harp seals.

The selection of VECs closely follows those selected for assessment under seismic programs in the PSEIA (Boertmann et al. 2009a). An important factor considered in the assignment of impact significance is the official status of the VEC. For example, particular attention is paid to species considered to be 'at risk' under the Greenland Red List (Boertmann 2008) which are likely to occur in the Study Area, and VECs that have identified protected areas within the Study Area. There is little hunting or commercial harvesting activity in the Study Area and as such, this is not considered further in the EIA.

3.4 Impact Definitions and Evaluation of Impact Significance

It is important that the terminology used to describe potential impacts be clear and easily understood. Words such as minor, moderate, and significant or insignificant are subjective and their meaning differs depending on the context in which they are used and the experience of the reader. Therefore, precise definitions for the ranking of potential impacts have been provided and used in this EIA. The impact definitions used in this EIA are based on those outlined in CEAA (1994) and subsequent CEAA-compliant EAs prepared by LGL Limited[1]. More specifically the terminology of *magnitude*, *spatial (or geographic) extent*, *and duration*, has been used.

Where possible, the assessment technique and terminology provided in the PSEIA (Boertmann et al. 2009a) are considered in the assessment. The PSEIA specifically includes consideration of the risk of impact on critical habitat, the level of impact (individual vs. population), and the risk of long-term population impacts. The assessment of significance of

[1] The following criteria have not been specifically included in this assessment are *frequency of occurrence*, *ecological, socio-cultural and economic context*, *reversibility,* and *likelihood of occurrence*.

the potential effects of the proposed project on environmental components is made considering the application of mitigation measures (see Environmental Protection Plan). The assessment of residual impacts, including mitigation measures, is summarized in Table 3.

3.4.1 Magnitude of Impacts

Magnitude describes the nature and extent of the environmental effects for each activity. It is a challenge to define magnitude since it is unclear which "biological" (and in some cases, "socio-economic") measures should be included in the definition. After careful consideration, we have decided to use definitions similar to those used in the Devon seismic EA for the Canadian Beaufort (IEG 2001) and in recent EAs conducted for seismic programs in Atlantic Canada (e.g., Moulton et al. 2003). The magnitude of impacts can be rated as:

Major: An impact on a VEC is rated major if it is judged to result in a 10%, or greater, change in the size or health of a population, or the carrying capacity of its habitat. A change in a population can result from an absolute reduction in population size or from displacement of animals to areas outside the area of consideration.
Moderate: An impact on a VEC is rated moderate if it is judged to result in a 1% to 10% change in the size or health of a population, or the carrying capacity of its habitat.
Minor: An impact on a VEC is rated minor if it is judged to result in a less than 1% change in the size or health of the population or the carrying capacity of its habitat.
Negligible Impact: Negligible impacts would result in no to very minimal effects to a VEC.

It should be noted that changes as low as 1%, or even 10%, cannot be measured in practice. However, these levels are used so that the reader has a clear indication of the expected magnitude of potential impacts.

Table 3. Summary of Potential Impacts, Proposed Mitigation, and Predicted Residual Impacts for the Project Area VECs

VEC / Interaction	Potential Impact	Mitigation Measure(s)	Impact Definition Ratings			Predicted Residual Impact	Level of Confidence in Prediction
			Spatial Extent	Magnitude	Duration		
Bowhead Whales x Seismic Noise	[1]Hearing damage. Masked communication. [2]Disturbance including avoidance of seismic ship and alteration of migration route.	Ramp-up of airgun array following detailed BMP/NERI advice. Delayed start of airguns if whale sighted in safety zone. Array shutdown (500 m in Protected Zones; 200 m elsewhere). Widely spaced lines in sensitive areas. Additional marine mammal watch from icebreaker.	[1] < 1 km^2 to 1-10 km^2; [2] 11-100 km^2 to 101-1,000 km^2	[1] Minor; [2] Minor to Moderate	Short-term	Not significant	[1] High; [2] Medium
Bowhead Whale x Vessel Noise	Disturbance including avoidance.	Boats will maintain constant course & speed when possible. Widely spaced lines in sensitive areas. Additional marine mammal watch from icebreaker.	11-100 km^2	Negligible to minor	Short-term	Not significant	High
Narwhal x Seismic Noise	[1]Hearing damage. [2]Disturbance including localized avoidance of seismic ship.	Ramp-up of airgun array following detailed BMP/NERI advice. Delayed start of airguns if whale sighted in safety zone. Array shutdown (500 m in Protected Zones; 200 m elsewhere). Widely spaced lines in sensitive areas. Additional marine mammal watch from icebreaker.	[1] na, [2]11-100 km^2 to 101-1,000 km^2	[1]Negligible, [2] Minor to Moderate	[1] na, [2] short-term	Not significant	[1] High; [2] Medium
Narwhal x Boat Noise	Temporary disturbance.	Boats will maintain constant course & speed when possible. Widely spaced lines in sensitive areas. Additional marine mammal watch from icebreaker.	11-100 km^2	Minor to Moderate	short-term	Not significant	Medium

VEC / Interaction	Potential Impact	Mitigation Measure(s)	Impact Definition Ratings			Predicted Residual Impact	Level of Confidence in Prediction
			Spatial Extent	Magnitude	Duration		
Walrus x Seismic Noise	[1]Hearing damage (seismic). [2]Disturbance including localized avoidance (of seismic ship).	Ramp-up of airgun array following detailed BMP/NERI advice. Delayed start of airguns if whale sighted in safety zone. Array shutdown (500 m in Protected Zones; 200 m elsewhere). Widely spaced lines in sensitive areas. Additional marine mammal watch from icebreaker.	[1] na, [2] <1 km^2 to 11-100 km^2	[1]Negligible, [2] Minor to Moderate	[1] na, [2] short-term	Not significant	[1] High; [2] Medium
Walrus x Boat Noise	Temporary disturbance.	Boats will maintain constant course & speed when possible. Minimize time spent near summering areas. Additional marine mammal watch from icebreaker.	[1] < 1 km^2; [2] 101-1,000 km^2	Minor to Moderate	short-term	Not significant	High
Seals x Seismic Noise	[1]Hearing damage. [2]Disturbance including localized avoidance of seismic ship.	Ramp-up of airgun array. Additional marine mammal watch from icebreaker.	[1] na, [2] <1 km^2 to 11-100 km^2	[1]Negligible, [2] Minor to Moderate	[1] na, [2] short-term	Not significant	High
Seals x Boat Noise	Temporary disturbance.	Boats will maintain constant course & speed when possible. Additional marine mammal watch from icebreaker.	na	Negligible	na	Not significant	High
Polar Bear x Seismic Noise	[1]Hearing damage (seismic). [2]Disturbance including localized avoidance (of seismic ship).	Ramp-up of airgun array. Additional marine mammal watch from icebreaker.	[1] na, [2] 1-10 km^2	[1]Negligible, [2] Negligible to Minor	[1] na, [2] short-term	Not significant	High

VEC / Interaction	Potential Impact	Mitigation Measure(s)	Impact Definition Ratings			Predicted Residual Impact	Level of Confidence in Prediction
			Spatial Extent	Magnitude	Duration		
Polar Bear x Boat Noise	Temporary disturbance.	Boats will maintain constant course & speed when possible. Additional marine mammal watch from icebreaker.	na	Negligible	na	Not significant	High
Sea-associated Birds x Seismic and Boat Noise	[1] Hearing damage (seismic). [2] Disturbance including localized avoidance (of seismic vessel)	Ramp-up of airgun array. Boats will maintain constant course and speed. Not near IBA, etc. Aircraft (if used) will avoid important bird areas.	na	Negligible	Short-term	Not significant	High
Zooplankton x Seismic Noise	Physical damage.	None	< 1 km^2	Minor	Short-term	Not significant	High
Macroinvertebrates x Seismic Noise	Physical damage, behavioural disturbance	Ramp-up of airgun array.	<1 km^2 to 11-100 km^2	Minor	Short-term	Not significant	High
Fish x Seismic Noise	[1] Hearing damage. Masked communication. [2] Disturbance including avoidance of seismic ship	Ramp-up of airgun array.	[1] < 1 km^2; [2] 101-1,000 km^2	Minor	Short-term	Not significant	High
Fish x Boat Noise	Localized avoidance	None (not likely in survey area)	<1 km^2 to 101-1,000 km^2	Minor	Short-term	Not significant	Medium

Notes: na = not applicable

3.4.2 Spatial Extent

The spatial or geographic extent of impacts refers to the specific area (km^2) affected by the project activity, which may vary depending on the activity and the relevant VEC. Spatial extent can be categorized as:

- < 1 km^2
- 1-10 km^2
- 11-100 km^2
- 101-1,000 km^2
- 1,001-10,000 km^2
- >10,000 km^2

It should be noted that an area of 100 km² is a circle with a radius of 5.6 km around the airgun array. A circular area of 1,000 km² would have a radius of about 17.8 km and an area of 10,000 km² would have a radius of about 56 km around the array. The PSEIA (Boertmann et al. 2009a) uses "local" to describe a spatial extent of <100 km², "regional" for larger areas, including the entire KANUMAS East Assessment Area, and national and global spatial extents.

3.4.3 Duration of Impacts

Duration refers to the time period impacts are expected to persist. Duration categories include:

- **Immediate:** Impact duration is limited to less than two days.
- **Short-term:** Impact duration is longer than two days but less than one year.
- **Medium-term:** Impact duration is one year or longer but less than ten years.
- **Long-term:** Impact duration extends ten years or longer.

The PSEIA (Boertmann et al. 2009a) uses "immediate", "short term", and "long term", as indicators of duration; specific definitions are not provided.

3.4.4 Significance of Impacts

Significant environmental effects are those that are considered to be of sufficient magnitude, duration, and spatial extent to cause a change in the VEC that will alter its status or integrity beyond an acceptable level, even after mitigation measures are applied. Establishment of the criteria is based on professional judgment, but should be transparent and repeatable. In this EIA, a *significant* effect is defined as:

Having a major magnitude; or a moderate magnitude for a duration of greater than one year and over a spatial extent greater than 100 km^2.

An effect can be considered ***significant*** *(negative by definition)*, ***not significant***, or ***positive***. For this assessment, impacts are judged assuming the implementation of project mitigation measures, i.e., an assessment of residual impacts.

3.4.5 Level of Confidence

An assessment of scientific certainty (low, medium, and high levels of confidence) will be provided based on our confidence in the scientific information available when we have judged an impact as having a particular adverse impact on a VEC.

- **Low:** Based on incomplete understanding of cause-effect relationships and/or incomplete data specific to project area.
- **Medium:** Based on good understanding of cause-effect relationships using data from elsewhere or incompletely understood cause-effect relationships using data specific to project area.
- **High:** Based on good understanding of cause-effect relationships and data specific to project area.

The PSEIA (Boertmann et al. 2009a) use terms such as "most likely" and "most probably" to reflect the level of certainty in the assessment.

3.5 Potential Impact of Project Activities

This assessment of the potential impacts of project activities on VECs is based on recent field studies of similar seismic operations in Northeast Greenland, the Alaskan and Canadian Beaufort Sea (including GXT's 2006, 2007, 2008 and 2010 programs in the Canadian Beaufort Sea) and on an extensive review of the available literature on the subject. Residual impacts (those impacts that result after implementation of mitigation) resulting from the proposed project are identified in terms of their scope and significance for each VEC.

It should be noted that, in terms of whales, seismic operations in ice appear to be less likely to encounter them, particularly when the survey is operating deeper into ice covered areas. This is suggested by the lack of observation in such areas during GXT's two previous Northeast Greenland surveys and GXT's 2010 in-ice survey in the Canadian Beaufort Sea, all of which were conducted with marine mammal observers on board the ships.

To further ensure the accuracy of the assessment predictions that no effects will be significant with mitigations in place, GXT will apply enhanced mitigation measures for the 2011 program, over those applied in previous years, particularly within the Protection Zones (for walrus, narwhal and bowhead). For example, as described in Section 3.6 below, as a further cautionary approach, GXT will increase the shutdown zone implemented during its 2009 and 2010 seismic programs from 200 m to 500 m around the seismic source for bowhead whale, northern right whale, beluga, narwhal, or walrus in all protection areas/zones. Further, in all areas, GXT will maintain an increased marine mammal watch from the icebreaker. This should extend the ability to detect whales / walruses in the approaching waters a further 1000 m or more and to alert the seismic ship MMSOs. These are in addition to previously stated / implemented measures, such as avoidance of the ice edge by 10 km in the Hovgaard - Île de France region.

3.5.1 Underwater Sound

Most treatments of the effects of underwater sound are based on the Source:Path:Receiver concept. In the present case, the sound source is an airgun array that generates short pulses

that contain large amounts of underwater sound. A seismic pulse is created by a burst of compressed air released from each airgun that makes up the array. Sound from the array radiates outward and travels through the water as pressure waves. Approximately 90% of the sound energy is focused downward with some travelling radially in the horizontal plane. Water is an efficient medium through which sounds can travel long distances. The receiver of these sounds is a marine animal of interest (*i.e.* VECs). The sounds received depend upon how much propagation loss occurs between the source and the receiver. Propagation loss is much higher in shallow water due to attenuation.

The ability of the receiver to detect these signals depends upon the hearing capabilities of the species in question and on the amount of natural ambient or background noise in the sea around the receiver. The sea is a naturally noisy environment and this noise can "drown out" or mask weak signals from distant sources.

Pressure waves from airguns used in seismic exploration have slower rise times than traditional explosives and therefore cause much less injury to animals in water. Single airguns produce downward-directed pulses that last only 10-20 ms, with only one strong positive and one strong negative peak pressure (Caldwell and Dragoset 2000).

Current seismic data acquisition practices utilize arrays of airguns to achieve the penetration requirements needed to illuminate the geologic subsurface. The distribution of the airgun elements within the array forms a geometry that increases the efficiency of the total energy source by directing its output downward into the subsurface by means of constructive interference of the signals from the individual guns. This happens at the expense of the amount of energy that propagates laterally due to geometric destructive interference. Approximately 90% of the useful energy is focused downward; the predominant energy is at low frequencies.

3.5.2 Effects of Sound on Marine Animals

Appendix 4 of GXT's Application (Volume 2) contains more detailed information about sound fundamentals, sound exposure measurement, and the effects of underwater sounds on marine animals.

Sounds produced by airgun arrays are lower in frequency than those at which toothed whales (such as narwhals), seals and walrus have optimal hearing, but are probably within the best hearing range of baleen whales (such as bowheads). Data on the specific hearing capabilities of polar bears are limited. However, polar bears' usual behaviour (e.g., remaining on the ice, at the water surface, or on land) reduces or avoids their exposure to underwater sounds.

Recent reviews of the effects of sound from seismic surveys, and sources of man-made noise in general, on marine mammals can be found in several recent sources. There are four types of potential effects of seismic sounds on marine mammals considered in the following sections. These include:

1. temporary reduction in hearing sensitivity, evident as Temporary Threshold Shift (TTS);
2. permanent hearing impairment, evident as Permanent Threshold Shift (PTS);
3. masked communication, and

4. changes in behaviour and distribution of the animals that are of sufficient magnitude to be "biologically significant".

Temporary Threshold Shift (TTS) is the mildest form of hearing impairment that occurs when exposure to a strong sound results in a non-permanent elevation of the hearing threshold. TTS is common in humans. While experiencing TTS, a sound must be louder in order to be heard. TTS is not considered an injury (Southall et al. 2007). Recent preliminary simulation modeling suggested that some baleen whales whose closest point of approach to a seismic vessel is 1 km or more could experience TTS or even PTS (Gedamke et al. 2008). In practice during seismic surveys, few if any cases of TTS are expected in baleen whales given the strong likelihood that baleen whales would avoid the approaching airguns (or vessel) before being exposed to levels high enough for there to be a possibility of TTS. For odontocetes, it is expected that—for impulse sound—the onset of TTS would occur at a lower cumulative sound exposure levels given the assumed greater auditory effect of broadband impulses with rapid rise times.

There are no available data on TTS in polar bears. However, TTS is unlikely to occur if they are swimming at the water surface or on ice, given the pressure release and Lloyd's mirror effects at the water's surface. In pinnipeds, TTS thresholds associated with exposure to brief pulses (single or multiple) of underwater sound have not been measured. Initial evidence from more prolonged (non-pulse) exposures suggested that some pinnipeds (harbour seals in particular) incur TTS at somewhat lower received levels than do small odontocetes exposed for similar durations (Kastak et al. 1999, 2005; Ketten et al. 2001).

The U.S National Marine Fisheries Service (NMFS 1995, 2000) has concluded that whales should not be exposed to impulse noise at received levels exceeding 180 dB re 1 μPa (rms). The corresponding limit for seals has been set at 190 dB. These exposure criteria used by NMFS were intended as a precautionary estimate below which physical injury would not occur from airgun pulses. There was no empirical evidence about whether higher levels of pulsed sound would cause hearing or other injuries.

Permanent Threshold Shift is the result of physical damage to a marine mammal's hearing apparatus can occur if it is exposed to sound impulses that have high peak pressures, especially if they have very short rise times, or if the animal is exposed to long periods of high noise levels. Such damage can result in a permanent decrease in functional sensitivity of the hearing system at some or all frequencies. When PTS occurs, there is physical damage to the sound receptors in the ear. In some cases, there can be total or partial deafness, while in other cases, the animal is unable to hear sounds at specific frequency ranges.

Single or occasional occurrences of mild TTS do not cause permanent auditory damage in terrestrial mammals, and presumably do not do so in marine mammals. However, very prolonged exposure to noise strong enough to elicit TTS, or shorter-term exposure to noise levels well above the TTS threshold, can cause PTS. Some factors that contribute to onset of PTS are

- exposure to single very loud noises,
- repetitive exposure to loud sounds that individually do not cause PTS, and
- health of the receiver's ear (e.g., recurrent ear infections).

Sound impulse duration, peak amplitude, and rise time are the main factors thought to determine the onset and extent of PTS. Based on existing data, Ketten (1995) has noted that

the criteria for differentiating the sound pressure levels that result in PTS (or TTS) are location and species-specific.

On an SEL (Sound Exposure Level, a standard means of quantifying received sound) basis, Southall et al. (2007:441-4) estimated that received levels would need to exceed the TTS threshold by at least 15 dB for there to be risk of PTS. Thus, for cetaceans (like bowhead whales) they estimate that the PTS threshold might be a cumulative SEL (for the sequence of received pulses) of ~198 dB re 1 $\mu Pa^2 \cdot s$.[2] Southall et al. (2007) also note that, regardless of the cumulative received energy (SEL), there is concern about the possibility of PTS if a cetacean or pinniped received one or more pulses with a very high peak pressure. Based on data from terrestrial mammals, a precautionary assumption is that impulse sounds might cause immediate PTS if the received peak pressure were 6 dB (or more) above than the TTS threshold as measured on a peak-pressure basis (Southall et al. 2007). They conclude that PTS might occur if cetaceans (as exemplified by belugas and bottlenose dolphins) and pinnipeds (as exemplified by the harbour seal) were exposed to peak pressures exceeding 230 or 218 dB re 1 µPa (peak), respectively. A peak pressure of 230 dB re 1 µPa (3.2 bar · m, 0-pk) would only be found within a few meters of the largest airguns used in most airgun arrays (Caldwell and Dragoset 2000). A peak pressure of 218 dB re 1 µPa could be received somewhat farther away.

Masking. Masking effects by pulsed sounds on marine mammal calls and other natural sounds are expected to be limited, although there are few specific data on this. Because of the intermittent nature and low duty cycle of seismic pulses, animals can emit and receive sounds in the relatively quiet intervals between pulses. Most studies that have examined the potential adverse effects of masking caused by anthropogenic underwater sounds have involved exposure of marine mammals to sounds that are often continuous or nearly continuous, and are not airgun pulses. Such sounds will mask (*i.e.*, reduce) the effective communication or echolocation distance of a marine mammal only if the anthropogenic sound source overlaps the sound signal in time and frequency. If little or no overlap occurs between the sound and the frequencies used, communication and echolocation are not expected to be disrupted or masked. As previously discussed, most energy in sound pulses emitted by seismic airgun arrays is at low frequencies, with strongest spectrum levels below 200 Hz, considerably lower spectrum levels above 1,000 Hz, and smaller amounts of energy emitted up to ~150 kHz. These low frequencies are mainly used by mysticetes, but generally not by odontocetes and pinnipeds. Strong anthropogenic sounds are presumed not to interfere with signalling of marine mammals that are using frequencies outside the range of the anthropogenic sounds. Furthermore, the discontinuous nature of seismic pulses makes significant masking effects unlikely even for mysticetes.[3]

Masking effects of seismic pulses are expected to be negligible in the case of the smaller odontocetes, given the intermittent nature of seismic pulses plus the fact that sounds important to them are predominantly at much higher frequencies than are airgun sounds. This

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[2] This is based on the evidence from Finneran et al. (2002) that the TTS threshold in a beluga exposed to a watergun pulse is about 186 dB re 1 $\mu Pa^2 \cdot s$ (flat weighted), or 183 dB re 1 $\mu Pa^2 \cdot s$ after discounting the low-frequency components that are not heard well by odontocetes; and on evidence that the PTS threshold, on an SEL basis, would be at least 15 dB higher than the TTS threshold (Southall et al. 2007).

[3] Near the source, the predominant part of a seismic pulse is about 10–20 ms in duration and the interpulse interval for GXT's 2011 program will be ~18 s, which is a longer quiet interval than for most surveys. Other sounds are audible in the gaps except perhaps in the unusual situation where there is strong reverberation of sound that persists for much of the gap between received pulses.

is particularly likely in the case of GXT's proposed seismic program, where seismic pulses would occur ~ every 18 seconds.

***Changes in Behaviour and Distribution*.** There have been studies of the behavioural responses of several types of marine mammals to airgun pulses. However, information is lacking for many species. Detailed studies of short-term responses (or lack thereof) have been done on humpback, gray, bowhead and sperm whales, and on ringed seals. Less detailed data are available for some other species of baleen whales and small toothed whales. The proposed monitoring program will provide additional data on marine mammal response to seismic activities. As suggested in the PSEIA (Boertmann et al. 2009a) and Boertmann et al. (2010), the marine mammal species most vulnerable to seismic survey noise in the KANUMAS East assessment area are narwhals, bowhead whales, and walruses. The authors indicate that there is some risk that these species could be displaced from critical habitat. Particular concern was also suggested for walrus which haul out in coastal areas. Following the guidance in Boertmann et al. (2009a and 2010), the assessment of seismic noise on marine mammals focuses on bowhead whales, narwhals, and walruses.

Behavioural reactions of marine mammals to a sound are difficult to predict. Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, weather, and many other factors.

If a marine mammal does react to an underwater sound by changing its behaviour or moving a small distance, the impacts of the change may not be significant to the individual, the stock, or the species as a whole. On the other hand, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on the animals could be significant.

3.6 Effects on Marine Mammals (Seismic Array)

3.6.1 Narwhals

During summer, narwhals generally occupy relatively shallow waters in fjords and coastal areas. Two summering areas (and protection zones) have been identified in or near the Study Area; one is in the northern portion of the Project Area (Northeast Water Polynya) where ~ 60 km of a seismic line is planned and the other identified summering area occurs shoreward of Store Koldewey Island in Dove Bugt (see Figure 3 below, and Boertmann et al. 2009a). Narwhals could be encountered during the seismic program, particularly in shallower waters and along ice edges, though none were seen by GXT MMSOs in 2010 or 2009. The species is gregarious, usually occurring in groups from a few individuals to more than 100 so it is possible that large groups may be seen from the seismic vessel.

To the best of our knowledge there are no published data on the responses of narwhals to seismic surveys. Despite the relatively poor low-frequency hearing thresholds of small- and medium-sized odontocetes (like narwhals), they should often be able to hear pulses from airgun arrays operating many tens of kilometres away (Richardson et al. 1995; Richardson and Würsig 1997). Few studies similar to the more extensive baleen whale/seismic pulse work have been reported for odontocetes, and none similar in size and scope to the studies of humpback, bowhead, and gray whales. However, there are recent systematic studies on sperm whales (e.g., Gordon et al. 2006; Madsen et al. 2006; Winsor and Mate 2006; Jochens et al.

2008; Miller et al. 2009), and there is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies (e.g., Smultea et al. 2004; Moulton and Miller 2005; Bain and Williams 2006; Holst et al. 2006; Stone and Tasker 2006; Potter et al. 2007; Hauser et al. 2008; Holst and Smultea 2008; Weir 2008; Barkaszi et al. 2009; Richardson et al. 2009).

Seismic operators and MMOs regularly see dolphins and other small odontocetes near operating airgun arrays, but in general there seems to be a tendency for most delphinids to show some limited avoidance of operating seismic vessels, on the order of 1 km or less (e.g., Moulton and Miller 2005; Holst et al. 2006; Weir 2008; Richardson et al. 2009; see also Barkaszi et al. 2009). Some dolphins (and Dall's porpoises) seem to be attracted to the seismic vessel and floats, and some ride the bow wave of the seismic vessel even when large arrays of airguns are active (e.g., MacLean and Koski 2005; Moulton and Miller 2005). Nonetheless, small toothed whales often tend to head away, or to maintain a somewhat greater distance from the vessel, when a large array of airguns is operating than when it is silent (see Stone and Tasker 2006; Weir 2008).

The beluga, the closest odontocete relative of narwhals, may be a species that (at least at times) shows long-distance avoidance of seismic source vessels (see Miller et al. 2005). Aerial surveys conducted in the southeast Beaufort Sea in summer found that sighting rates of belugas were significantly lower at distances 10–20 km compared with 20–30 km from an operating airgun array (Miller et al. 2005). The low number of beluga sightings by marine mammal observers on the vessel seemed to confirm there was a strong avoidance response to the 2,250 in^3 airgun array. More recent seismic monitoring studies in the same area have confirmed that the apparent displacement effect on belugas extended farther than has been shown for other small odontocetes exposed to airgun pulses (e.g., Harris et al. 2007). It is uncertain how narwhals will react to seismic surveys. For the purposes of this assessment, we have (conservatively) assumed that they will react on a similar scale as did belugas in the Canadian Beaufort Sea.

Assessment of Impacts. The Seismic Guidelines (Boertmann et al. 2010, Section 6.1.2, Figure 3) maps important narwhal (and other species) protection areas in Northeastern Greenland waters (reproduced in Figure 4, below). These Guidelines state: "Narwhals occur in these areas throughout the open water season, and in the Northeast Water probably throughout the year. … Seismic activities in the narwhal protection zones of East Greenland should be avoided or of limited extend (a few widely spaced (>10 km) lines). If such limited seismic surveys are planned in the protection zones a detailed shooting program is subject to approval by BMP, and if approved, impact studies on the narwhals shall be considered."

GXT's survey area overlaps a small portion of the narwhal summering area in the Northeast Water Polynya, and the western ends of several of GXT's pre-plot lines are within the northern narwhal/bowhead protection zone (Figure 4). Nearly all are more than 10 km apart (several are much more than this), though portions of 2 or 3 of these lines are between 8 km and 10 km distant from each other in the area. However, given the realities of surveying in these northern areas, it is unlikely that GXT will be able to do all of these lines, and specific ice conditions in the area at the time will determine the actual limitations. (For instance, in previous years GXT has permitted lines in the new narwhal/bowhead protection zone between Hovgaard Island and Île de France but has never been able to do acquisition there because of ice/weather. Project-wide it is estimated that – in a good ice year – only about 50% of the pre-plots would be acquired.) Given that the GXT survey is a large regional 2-D

survey with very long acquisition lines (most in this are generally east-west in orientation, and 200 – 300 km long) unlike a locally focused 3-D survey, the actual time spent in the area with an active array will be relatively short on any one occasion, and there may be many hours to several days between the acquisition of these segments. There is a potential for encountering narwhal within the Project Area. However, narwhals are known to avoid the area around vessels, particularly icebreakers (Richardson et al. 1995). This avoidance greatly reduces the potential for hearing impacts on these whales.

In any case, as advised by NERI and the BMP in 2010, when working in this area the survey ships will avoid the seaward edge of the landfast (permanent / persistent) ice between Hovgaard Ø and Île de France by a distance of at least 10 km.

As specified in Boertmann et al. 2010, the airgun array will be "ramped up" gradually to full power whenever airgun operations start. Hence, any narwhals (or other species) near the array when it starts can move away before being exposed to full power airgun pulses. Also, ramp-up will not begin if any narwhal is detected within a 500 m radius zone of the array 30 minutes prior to ramp-up (or 60 minutes in deeper waters).

Although no shutdown for marine mammals is required, GXT will implement a shutdown if a bowhead whale, northern right whale, beluga, narwhal, or walrus is observed within or about to enter within a 500m radius of the seismic source when operating in any designated Protection Zone or within a 200 m radius in all other areas. Also, in addition to the MMSOs on the seismic ship, GXT will utilize on-watch personnel on the icebreaker bridge to sight and record marine mammals, and to relay this information immediately to the MMSOs on the seismic ship.

Further, if recommended by BMP/NERI, GXT will reduce its overall acquisition in the Narwhal/ Bowhead Protection zone by line 240 km compared to the amount proposed. This is equivalent to reducing every second line by 25 km within the area, though the actual location of the line reductions would likely be dictated by ice conditions at the time.

Given these enhanced mitigations, and that narwhals will likely avoid the icebreaker vessel, GXT's seismic program is predicted to cause *negligible* impacts on narwhal hearing (see Table 3).

As noted in the PSEIA (Boertmann et al. 2009a), there is a risk that narwhal may be displaced from areas where they concentrate during summer. In particular, displacement from the Northeast Water Polynya summering area may occur. It is expected that this displacement, should it occur, would be temporary. GXT is expected to operate the airgun array only ~6 - 8 hours in the summering area as shown in Figure 3.

Given narwhal reactions to icebreakers (see below), it is likely that whales will avoid the seismic operations particularly when the airgun array is operational. Although there are no specific data available on narwhal reactions to seismic survey sound, beluga whales in the Canadian Beaufort Sea have been shown to avoid an area 10-20 km from an operating offshore seismic ship where received sound levels from airgun pulses were estimated to be ~150 to 130 dB re 1 μPa (rms). It is uncertain at what received sound level narwhals in the Study Area may react to seismic surveys. Narwhals are generally believed to be sensitive to noise from seismic surveys (Boertmann et al. 2009a). Marine mammal response to sound is

highly variable and can depend on the activity an animal is engaged in at the time of exposure.

It is likely that narwhals will avoid the immediate area around the active airgun array. Behavioural impacts (i.e., disturbance and displacement) should be *minor to moderate, short-term,* and may occur over a spatial extent ranging from *11-100 km^2* to *101-1,000 km^2*. Therefore, *no significant* behavioural impacts are expected and there is no risk of long-term population impacts given the temporary nature of the seismic program (Boertmann et al. 2009a, 2010). The level of confidence associated with this prediction is judged as medium.

3.6.2 Bowhead Whales

Bowhead whales are expected to occur in the Study Area during GXT's seismic program, although only small numbers occur off Northeast Greenland. These whales seem to occur most often along ice edges or the marginal ice zone, though few have been seen during GXT's Northeast Greenland surveys. It is possible that bowheads which occur in the Study Area during summer engage in foraging but this is not known with certainty.

In the Canadian Beaufort Sea, bowhead whales on their summering grounds showed no obvious reactions to pulses from seismic vessels at distances of 6 to 99 km and received sound levels of 107–158 dB on an approximate *rms* basis (Richardson et al. 1986); their general activities were indistinguishable from those of a control group. Bowheads usually did show strong avoidance responses when seismic vessels approached within a few kilometres (~3–7 km) and when received levels of airgun sounds were 152–178 dB (Richardson et al. 1986, 1995; Ljungblad et al. 1988; Miller et al. 2005). They also moved away when a single airgun fired nearby. In one case, bowheads engaged in near-bottom feeding began to turn away from a 30-airgun array with a source level of 248 dB at a distance of 7.5 km, and swam away when it came within about 2 km. Some whales continued feeding until the vessel was 3 km away. Recently, drawing on data collected by DFO during GXT's western Canadian seismic surveys, Harwood et al. (2010) have found that "While limited in scope, existing research results obtained while seismic or drilling operations were underway have shown no marked or measurable effects on either the behaviour or distribution of these species [bowhead whales, beluga whales and ringed seals] by offshore industrial operations in the [Canadian Beaufort Sea] to date. Differences in behaviour and distribution have been recorded, but were localized and temporary."

The results of a seismic monitoring program conducted in the nearshore waters of the Canadian Beaufort Sea in the summers of 2001 and 2002 (Miller and Davis 2002; Miller and Moulton 2003; Miller et al. 2005) partially supports the findings of the aforementioned study. Lower sighting rates and greater sighting distances during periods of seismic operations vs. periods when no airguns were operating suggested that bowheads did usually avoid close approach to the area of seismic operations. However, the still substantial number of sightings during seismic periods and the relatively small (600 m), but significant difference, in sighting distances suggest that the avoidance was localized and relatively small in nature. Bowheads at the average vessel-based sighting distance (1,957 m) during line seismic would have been exposed to sound levels of about 170 dB re 1 μPa (rms). Similarly, preliminary analyses of recent data from the Alaskan Beaufort Sea indicate that bowheads feeding during late summer and autumn also did not display large-scale distributional changes in relation to seismic operations (Christie et al. 2009; Koski et al. 2009).

Sighting distances during non-seismic (average 2,873 m) and seismic (average 2,903 m) periods were very similar for bowhead whales during GXT's 2006 seismic monitoring program in the Canadian Beaufort Sea (Harris et al. 2007). During GXT's 2007 seismic monitoring program in the Canadian Beaufort Sea, bowheads were sighted closer to the vessel during non-seismic periods (average 1,527 m) than during seismic periods (average 1,976 m). Average sighting distance was greatest when the full array was active (average 2,109 m) (Harris et al. 2008). These results support the monitoring results from 2001 and 2002 and suggest that bowheads avoid airgun noise, at least in a localized area.

Migrating bowhead whales seem more responsive to noise pulses from a distant seismic vessel than are summering bowheads. In 1996–98, a partially-controlled study of the effect of Ocean Bottom Cable (OBC) seismic surveys on migrating bowheads was conducted in late summer and autumn in the Alaskan Beaufort Sea (Miller et al. 1999; Richardson et al. 1999). Aerial surveys showed that some westward-migrating whales avoided an active seismic survey boat by 20-30 km, and that few bowheads approached within 20 km. Received sound levels at those distances were only 116–135 dB re 1 μPa (*rms*). Some whales apparently began to deflect their migration path when still as much as 35 km away from the airguns. At times when the airguns were not active, many bowheads moved into the area close to the inactive seismic vessel. Avoidance of the area of seismic operations did not persist beyond 12–24-h after seismic shooting stopped. These and other data suggest that migrating bowhead whales are more responsive to seismic pulses than were summering bowheads. Analysis of recent data on traveling bowheads in the Alaskan Beaufort Sea also showed a stronger tendency to avoid operating airguns than was evident for feeding bowheads (Christie et al. 2009; Koski et al. 2009). During GXT's 2010 Beaufort Sea in ice survey (similar to the 2011 Greenland survey), very few bowheads were seen compared to the ice-free areas in the southern Beaufort.

Assessment of Impacts. The Seismic Guidelines (Boertmann et al. 2010, Section 6.2.1) states "The Northeast Water Polynya and the waters off the ice edge between Île de France and Amdrup Land are important habitats for bowhead whales in summer and early autumn. The protection zone for this species is similar to the protection zone for narwhals and so are the regulations: Seismic activities shall be avoided or of limited extend (a few widely spaced (>10 km) lines). If limited seismic surveys are planned within the protection zone a detailed shooting program is subject to approval by BMP, and if approved, impact studies on the whales shall be considered."

As noted above for narwhal, parts of several of GXT's pre-plot lines are within the northern narwhal/bowhead zone (Figure 4) but are generally widely spaced. Also, as advised by NERI and the BMP in 2010, when working in this area the survey ships will avoid the seaward edge of the landfast (permanent / persistent) ice between Hovgaard Ø and Île de France by a distance of at least 10 km. Also, as noted for narwhals, if requested by BMP/NERI, GXT will reduce its overall acquisition in the Narwhal/ Bowhead Protection zone.

Further, bowhead whales are expected to move away as the operating airgun array approaches, and to remain outside the zone where received sound levels are 180 dB re 1 μPa (rms) or higher. Pre-watch and ramp-up procedures will be used, as will shutdowns for bowheads and other species, as described above for narwhal (a 500 m shutdown safety zone will be applied in the Protection Areas, and additional watch from the icebreaker.)

Given these enhanced mitigation measures and that bowheads will likely avoid at least the immediate area around the seismic array, GXT's seismic program is predicted to cause *minor* and *short-term* impacts on bowhead hearing over a spatial extent ranging from *<1 km^2 to 1-10 km^2* (see Table 3). Therefore, *no significant* hearing impairment or other physiological effects on bowheads are expected. The level of confidence associated with this prediction is judged as high.

Bowheads may migrate through the Study Area and/or spend time foraging in the area. Based on monitoring studies in the Beaufort Sea, the degree of avoidance seems to be dependent upon the activity the whales are engaged in. Bowheads in feeding areas typically exhibit localized avoidance whereas migrating bowheads exhibit larger scale avoidance. GXT's 2-D SPAN seismic program has widely spaced survey lines which extend over a large area, therefore, the seismic vessel will operate in a given area for only a short period. This should minimize potential impacts of bowheads that may be concentrated in a localized area.

It is predicted that behavioural impacts of airgun sounds on bowheads would be *minor to moderate, short-term,* and may occur over a spatial extent ranging from *11-100 km^2 to 101-1,000 km^2* (Table 3). Therefore, *no significant* behavioural impacts are expected and there is no risk of long-term population impacts given the temporary nature of the seismic program (Boertmann et al. 2009a, 2010). The level of confidence associated with this prediction is judged as medium.

3.6.3 Walruses

Boertmann et al. (2009a) note that the walrus is considered a sensitive species because the population is dependent on relatively few and localized benthic feeding areas. Within GXT's Project Area, walrus (likely females and young) are expected to occur primarily in coastal waters (typically <100 m) near Kilen, Hovgaard Ø, and Amdrup Land where they likely forage on bivalves. Two primary male walrus haul-out sites are located at Sandøen and Lille Snenæs which are located about 40 km - 50 km from the Project Area. Walruses using these haul-out sites may occur at summering and feeding areas associated with sites that border the GXT survey area, although the Northeast Water Polynya may be used year-round. Areas associated with feeding and haul-outs have also been designated as protection zones for walruses from 1 June to 30 September, although the Northeast Water Polynya remains a year-round protection zone (see Figure 5; Boertmann et al. 2010).

There are few data available on walrus responses to seismic surveys. Monitoring data collected during seismic programs in the Alaskan Chukchi Sea during 2006-2008 suggest that Pacific walrus exhibit localized avoidance of active airguns (Haley et al. 2009). Walrus sighting rates decreased as sound levels from the seismic source vessel increased. The authors warn that these results may be biased by a large group (169 of 571 sightings) of walruses which were seen during a 24-hour period when no airguns were operating. Most walruses observed from the seismic source vessel showed no obvious reaction to airgun operations and closest points of approach did not differ significantly relative to sound levels (Haley et al. 2009).

Assessment of Impacts. The Seismic Guidelines (Section 6.3.2) state, "Specific walrus protection zones are designated on Figure 3, and the protection period is from 1 June to 30 Sept., when open water is present at the coasts. However the Northeast Water is a year round habitat and here the protection period is the entire year. … Seismic activities in these walrus

protection zones shall be avoided or of limited extend (a few widely spaced (>10 km) lines). If such limited seismic surveys are planned in the protection zones a detailed shooting program is subject to approval by BMP, and if approved, impact studies on the walruses shall be considered.

Figure 5 indicates GXT's proposed 2011 lines in relation to the identified walrus protection zones. Relatively small portions of three of GXT's pre-plot lines enter any of these areas (a total 15 km in the southernmost zone and ~100 km in the north). Except where the two lines intersect in the north, these lines are not within 10 km of each other, or any other nearby lines. In the south, the one line (1150) that extends into the southern Walrus Protection Zone (15 km) is lines is approximately 68 km from the next nearest line to the north, and is thus within NERI's precaution that any lines in the area should be "of limited extend (a few widely spaced (>10 km) lines)". The same is the case or the two northern nines.

Given this, and since walruses will likely avoid at least the immediate area around the seismic array (and vessels), and that ramp-up will be used, GXT's seismic program is predicted to cause *negligible* impacts on walrus hearing (see Table 3).

Some walruses will likely avoid the operating airgun array by distances of up to several hundred metres. However, some walruses may remain in close proximity to the seismic source vessel; in the Chukchi Sea many walruses were observed within 500 m of the source vessel when the airgun array was active and received sound levels exceeded 160 dB re 1uPa rms (Haley et al. 2009). It is possible that there would be short-term behavioural responses such as interruption of foraging dives. In the Chukchi Sea, there was no indication that Pacific walrus behaviour was affected by seismic surveying; however, effects on foraging were not specifically examined (Haley et al. 2009). Given the design of the GXT SPAN seismic program, as noted, the seismic vessel is expected to operate in the vicinity of a given walrus areas for short time periods only and they will be of limited extent and greater than 10 km apart (see Boertmann et al. 2010). The behavioural impacts of seismic and related underwater sounds on walruses could be *minor to moderate*, *short-term*, and may occur over a spatial extent ranging from *<1 km^2 to 11-100 km^2*. Therefore, *no significant* behavioural impacts are expected and there is no risk of long-term population impacts given the temporary nature of the seismic program (Boertmann et al. 2009a, 2010). The level of confidence associated with this prediction is judged as medium.

3.6.4 Seals

Harp, hooded, ringed and bearded seals are expected to occur in coastal and offshore waters of GXT's Project Area. Concentration areas for seals have not been identified in the Project Area for these species during the period when seismic operations are expected to occur (July to October). Available data indicate that ringed seals show less reaction to seismic sounds than do bowhead and beluga whales. There are few data available for bearded and harp seal response to seismic survey sound but both species have been observed from seismic vessels. Monitoring work in the Alaskan Beaufort Sea during 1996-2001 (Harris et al. 1997, 1998, 2001; Lawson and Moulton 1999; Moulton and Lawson 2000a,b, 2002) as well as the Canadian Beaufort Sea and Alaskan Chukchi Sea in 2006-2009 (e.g., Miller and Davis 2002; Miller et al. 2005; Reiser et al. 2009) has provided considerable information regarding the behaviour of seals exposed to seismic pulses.

In these studies, the numbers of seals sighted from the source vessel were sometimes lower when the airguns were operating than when the vessel was moving without airguns operating.

Seals sighted from the source vessel were located at significantly greater distances when an airgun array was firing than during periods with no guns operating. Overall, avoidance reactions were apparently limited to a radius of no more than a few hundred metres, and many of the seals well inside that distance showed no evidence of either avoidance or behavioural reactions. However, recent vessel-based monitoring suggested that phocid seals were seen less frequently while airguns were operating than when airguns were silent, and observers on seismic vessels saw seals less frequently than did observers on nearby vessels without airguns (Reiser et al. 2009). These results are indicative of a tendency for phocid seals to exhibit localized avoidance of the seismic source vessel when airguns are firing.

Preliminary results of a radio telemetry study by Thompson et al. (1998) suggested that more pronounced (but short-term) behavioural changes can occur in harbour seals and gray seals exposed to airgun pulses. They stated that normal foraging dives were interrupted and that avoidance reactions usually occurred. The seals returned to their previous foraging areas after airgun operations ceased. These preliminary results suggest that seal reactions to airgun pulses may be more pronounced than can be documented by visual observations at the surface.

Assessment of Impacts. Most seals are expected to avoid close approach to the airgun array. If seals are exposed to close approach to the airgun array, any effects would most likely be limited to mild TTS, from which seals would recover. Also, seals that are hauled out on ice floes would be unaffected by underwater sound unless they dove in response to the oncoming vessels. Given this, plus the small proportion of the population that would occur close enough to the airgun array to incur hearing impairment, impacts of seismic sound sources on seal hearing would be *negligible*.

Some seals likely will avoid the operating airgun arrays by distances of up to a few hundred metres. However, some seals are expected to remain in close proximity to the seismic source vessel. It is possible that there would be short-term behavioural responses such as interruption of foraging dives. The behavioural impacts of seismic and related underwater sounds on seals could be *minor to moderate, short-term,* and may occur over a spatial extent ranging from *<1 km^2 to 11-100 km^2*. Therefore, *no significant* behavioural impacts are expected and there is no risk of long-term population impacts given the temporary nature of the seismic program (Boertmann et al. 2009a, 2010). The level of confidence associated with this prediction is judged as high.

3.6.5 Polar Bears

Airgun effects on polar bears have not been studied. However, polar bears on the ice would be unaffected by underwater sound. Sound levels received by polar bears in the water would be attenuated because polar bears generally swim with their heads out of the water or at the surface and polar bears do not dive much below several metres. Received levels of airgun sounds are reduced near the surface because of the pressure release effect at the water's surface (Greene and Richardson 1988; Richardson et al. 1995). Recent measurements of the in-air hearing of polar bears suggest bears have best hearing sensitivity for sounds with frequencies between 11.2-22.5 kHz (Nachtigall et al. 2007). Their hearing is presumably adapted for in-air hearing, and—even when submerged—they may not be very sensitive to underwater sound. There are few published data available for polar bear responses to seismic surveys. Polar bears may occur in the offshore pack ice in the GXT Study Area, particularly in areas with dense ice and ice edges.

Assessment of Impacts. Given the small proportion of the polar bear population involved, and that bears generally swim with their head out of water, impacts of seismic sound sources on polar bear hearing are predicted to be *negligible*. Similarly, impacts of airgun array sound on polar bear behaviour are predicted to be *negligible to minor, short-term, and 1-10 km^2* (see Table 3). Therefore, no significant behavioural impacts are expected and there is no risk of long-term population impacts given the temporary nature of the seismic program (Boertmann et al. 2009a, 2010). The level of confidence associated with this prediction is judged as high.

3.7 Effects on Marine Mammals (Vessel and Ice Breaker Traffic)

Reactions of whales to vessels often include changes in general activity (e.g., from resting or feeding to active avoidance), changes in surfacing-respiration-dive cycles, and changes in speed and direction of movement. Responses to vessel approaches tend to be reduced if the animals are actively involved in a specific activity such as feeding or socializing (reviewed in Richardson et al. 1995). Past experiences of the animals with vessels are important in determining the degree and type of response elicited from a whale-vessel encounter. Whales react most noticeably to erratically moving vessels with varying engine speeds and gear changes, and to vessels in active pursuit, none of which apply to the seismic program.

Icebreakers pushing ice radiate noise ~10-15 dB stronger than when they are underway in open water, mostly due to strong propeller cavitation (Richardson et al. 1995). In quiet ambient conditions in fast ice areas, peak noise levels from icebreakers may exceed the ambient noise level up to 300 km from the icebreaker (Davis et al. 1990). Off NE Greenland, the ambient noise in areas of moving pack ice will be higher and the energy required by an icebreaker to move ice pans will be lower. Therefore, peak noise levels from icebreakers may not exceed ambient levels at distances up to 300 km. Narwhals (and particularly beluga) are known to exhibit long distance avoidance of ships.

3.7.1 Narwhal

As previously discussed, narwhals are expected to occur in the Project Area, particularly in the Northeast Water Polynya. It is uncertain how narwhals will react to the seismic and icebreaker vessels. Some narwhals have moved long distances away (many km) from icebreakers (see Richardson et al. 1995, p. 257). After initially being displaced in response to relatively low levels of noise from the ship (94-105 dB), narwhals sometimes returned 1-2 days later when icebreaker noise levels where still 120 dB.

In the Canadian High Arctic, Finley et al. (1990) studied the reactions of closely related beluga whales at ice edges to the sound of approaching ships. The whales were waiting for the ice edge to break up so they could continue their migration to summering areas. The whales made possible alarm vocalizations when the ships were 80 km distant, and showed strong avoidance reactions when the ships were 35-50 km away. Similar observations have been reported independently by Cosens and Dueck (1988). However, belugas in the Beaufort Sea have not been observed to react to ships or ship sounds at such long distances. Harwood et al. (2005) suggested that belugas likely avoided ice breakers in deep-water regions of the Canadian Beaufort when belugas were expected to be in that area.

Assessment of Impacts. As noted in the PSEIA (Boertmann et al. 2009a), there is a risk that narwhal may be displaced from areas where they concentrate during summer. In particular, displacement from the Northeast Water Polynya summering area may occur. It is expected that this displacement, should it occur, would be temporary. The seismic vessel and icebreaker are expected to occur in the area of the Northeast Water Polynya for only a few days, if acquisition proceeds according to GXT's planned schedule, and lines in important areas to the south are widely spaced.

It is likely that narwhals will avoid the immediate area around the seismic vessel and icebreaker. Behavioural impacts (i.e., disturbance and displacement) should be *minor to moderate, short-term,* and may occur over a spatial extent ranging from *11-100 km^2* to *101-1,000 km^2*. Therefore, *no significant* behavioural impacts are expected and there is no risk of long-term population impacts given the temporary nature of the seismic program (Boertmann et al. 2009a, 2010). The level of confidence associated with this prediction is judged as medium.

3.7.2 Bowhead Whales

Bowheads may swim away from approaching vessels when they come within 2-4 km. If a vessel approaches within several hundred metres, the response usually is conspicuous. The whales typically swim at a higher speed than they normally travel, either attempting to "outrun" the vessel or changing direction to swim perpendicularly away from the vessel's path (Richardson et al. 1985a,b, 1995; Richardson and Malme 1993). In contrast, if the vessel travels slowly, bowhead whales often are more tolerant of the approaching vessel, and may show little or no reaction even when the vessel is within several hundred metres. This is especially so when the vessel is not directed toward the whale and when there are no sudden changes in direction or engine speed (Wartzok et al. 1989; Richardson et al. 1995). Bowhead response to icebreakers is uncertain. During GXT's seismic program, both vessels will be operating at a consistently slow speed.

Assessment of Impacts. Bowhead whales are expected to avoid vessels that are underway, including the icebreaker and the seismic vessel when it is not operating an airgun array. The effects of vessel traffic on bowheads are expected to be *negligible to minor, short-term,* and may occur over a spatial extent of *11-100 km^2* (see Table 3). Impacts on whales can be reduced if the vessels steer a straight course and maintain a constant speed whenever possible, both of which will be normal operating conditions for the seismic source vessel and icebreaker involved with the Project. Therefore, *no significant* behavioural impacts are expected and there is no risk of long-term population impacts given the temporary nature of the seismic program (Boertmann et al. 2009a, 2010). The level of confidence associated with this prediction is judged as high.

3.7.3 Walrus

As previously noted, Boertmann et al. (2009a) suggested that the walrus is a sensitive species because the population is dependent on relatively few and localized benthic feeding areas. Some of these feeding and summering areas occur within and near GXT's Project Area.

The reactions of walruses to icebreaking tend to occur at longer distances than their reactions to ships in open water. Fay et al. (1984) reported that female and young walruses which were on the ice entered the water and swam away when the icebreaker was 0.5-1 km away and

males did so when the ship was 0.1-0.3 km away. The authors noted that some walruses scrambled onto the ice when a ship breaking ice moved towards them. Brueggeman et al. (1992) found that based on aerial survey results, walruses hauled out on ice, tended to avoid the area within ~10-15 km of the icebreaker.

Assessment of Impacts. Given the design of the GXT SPAN seismic program (see Figure 5), the seismic vessel and ice breaker are expected to operate in the vicinity of important walrus areas for short time periods only, on widely spaced lines. Most operations will occur in deeper offshore waters. The behavioural impacts of vessel traffic and related underwater sounds on walrus could be *minor to moderate*, *short-term*, and may occur over a spatial extent ranging from *<1 km^2 to 101-1,000 km^2*. Therefore, *no significant* behavioural impacts are expected and there is no risk of long-term population impacts given the temporary nature of the seismic program (Boertmann et al. 2009a, 2010). The level of confidence associated with this prediction is judged as high.

3.7.4 Seals

Few authors have described the responses of pinnipeds to boats, and most of the available information concerns pinnipeds hauled out on land or ice. Ringed and bearded seals hauled out on pack ice often dove into the water when an icebreaker breaking ice approached within 0.9 km (Brueggeman et al. 1992). Similarly, ringed and harp seals within 1 km of an icebreaker often dove into the water but seals 1-2 km away mostly stayed on the ice (Kanik et al. 1980). During the 2009 GXT seismic program off Northeast Greenland, 59 sightings were of seals initially observed on ice; 25% (15 sightings) of those subsequently dove into the water as the vessels approached (Jones et al. 2009). In areas of open water ringed and bearded seals are commonly observed close to vessels (*e.g.*, Harris et al. 1997, 1998, 2001, 2007, 2008). Inuvialuit hunters in the Canadian Beaufort Sea have indicated that during seal hunting, they often create underwater noise, to attract ringed seals to their boat, noting that seals are "curious" (LGL 2008). Ringed seals have also been seen feeding among overturned ice floes in the wake of icebreakers (Brewer et al. 1993).

Assessment of Impacts. Some seals are likely to avoid the icebreaker when it is breaking ice by ~ 1 km whereas seals may occur within a few tens of metres of the seismic and icebreaker vessel when these vessels are not engaged with activating the airgun array or breaking ice. Some "curious" seals are likely to swim toward vessels. Given that seals are expected to be widely dispersed in the Project Area and that any displacement will be temporary and in a small area, the impact of vessel traffic on seals is expected to be *negligible* (see Table 3).

3.7.5 Polar Bears

Like seals, polar bears exhibit variable responses to boats. Some seem to approach vessels while others exhibit avoidance (e.g., Harwood et al. 2005). Polar bears show either no or very limited reactions to icebreakers (Richardson et al. 1995). The impact of vessel traffic on polar bears is expected to be *negligible* (see Table 3).

3.8 Effects on Marine-associated Birds

3.8.1 Potential Effects of Seismic Survey Sounds

There are few data on the effects of underwater sound on birds. Stemp (1985) made observations on the reactions of birds to seismic exploration programs in southern Davis Strait over three summer periods. No mortality or effects on distribution were detected in 1982, the only year when an airgun-based program was conducted. Evans et al. (1993:8) made observations from operating seismic vessels in the Irish Sea. They noted that when seabirds were near the seismic boats, "there was no observable difference in their behaviour, birds neither being attracted nor repelled by seismic testing".

A study on the effects of underwater seismic surveys on moulting Long-tailed Ducks in the Beaufort Sea showed little effect on their movement or diving behaviour (Lacroix et al. 2003). However, the study did not monitor the physical effects on the ducks. The authors suggested caution in interpretation of the data because they were limited in their ability to detect subtle disturbance effects and recommended studies on other species to fully understand the potential effects of seismic testing. This lack of overt response may be at least partly related to the fact that received levels of underwater sound from airguns are greatly reduced at and immediately below the surface as compared with levels deeper in the water (Greene and Richardson 1988).

Boertmann et al. (2009a) indicate that seabirds are generally not considered to be sensitive to seismic surveys, because they are readily able to avoid the seismic sound source. The authors suggest caution is warranted in coastal waters where the presence of vessels may disturb breeding and moulting concentrations of birds.

Assessment of Impacts. The presence of the survey vessel and icebreaker and perhaps the ramp-up period for the airguns will displace birds from the immediate program area. Thus, any effects of seismic survey sound on birds in the Project Area are expected to be *negligible*.

3.8.2 Potential Effects of Vessel and Icebreaker Traffic

Waterbirds may be affected by vessel traffic in various ways. In extreme responses, some studies have shown that individuals displaced from habitat by vessel activity do not return (Green Heron *Butorides virescens*: Kaiser and Fritzell 1984; waterfowl: Knapton et al. 2000; Kenow et al. 2003). However, limited vessel traffic resulted in only short-term displacement of a seabird (Kittlitz's Murrelet, *Brachyramphus brevirostris*) in southeast Alaska (Agness et al. 2008).

Assessment of Impacts. The closest 2011 survey line is roughly 8 – 10 km from the closest coastal islands, more than 40 km from the closest IBA, and more than 60 km from the nearest Ramsar site (Figure 2). Sea-associated birds encountered during the seismic program are expected to be temporarily displaced by vessels that are underway, including the seismic vessel when it is not operating the airgun array. Because the vessels will be making way at a constant, low speed, the affected area will be limited to the immediate vicinity of each vessel and the effects on birds within that area will be localized and temporary. Because the vessels will be unlikely to return along the same survey-lines on the same day, affected birds in a given area will be unlikely to be disturbed more than once. In addition, it is unlikely that birds will be attracted to vessel lights (particularly given the extended periods of daylight). Bird strandings on ships have not been an issue in recent seismic programs in the Beaufort Sea (LGL Ltd., unpubl. data). The effects of vessel traffic on sea-associated birds are expected to be *negligible*.

3.9 Effects on Zooplankton

In the following sections, zooplankton refers to the small invertebrates generally less than 1 mm in body size that float freely throughout the water column. The potential impacts of ichthyoplankton (i.e., eggs and larvae) of macroinvertebrates and fish are addressed in Sections 3.10 and 3.11, respectively.

Few studies examining the effects of seismic sound on zooplankton have been conducted to date (DFO 2004; Payne 2004). Of the studies that have been completed, the data provided are generally insufficient to evaluate the potential effects on planktonic organisms that might be caused by exposure to seismic sound under field operating conditions (DFO 2004). It is generally accepted that zooplankton cannot actively move away from the airgun source used during seismic surveys. Zooplankton may sustain lethal injuries within 2 m of the sound source while sub-lethal injuries may occur within 5 m (Østby et al. 2003 *in* Boertmann et al. 2009a). No studies examining the effects of seismic sound on zooplankton located further from the sound source were found. Boertmann et al. (2009a) noted that only limited data concerning zooplankton densities in the KANUMAS East assessment area exist and assumed that densities were not higher than in other areas of Greenland where seismic surveying has occurred. Based on this assumption, the authors suggested that the impacts of seismic activity on zooplankton would likely be negligible in the KANUMAS East assessment area.

Assessment of Impacts. The proposed seismic program for 2011 is predicted to have *minor* impacts on the zooplankton VEC over a *short-term* duration in an area *< 1 km*^{2}. Therefore, the impacts of the proposed program on the zooplankton VEC are predicted to be *not significant* (Table 3). There is no risk of long-term population impacts given the temporary

nature of the seismic program (Boertmann et al. 2009a). The level of confidence associated with this prediction is judged as high.

3.10 Effects on Macroinvertebrates

3.10.1 Sound Detection

Because they lack air filled cavities and are often the same density as seawater, marine macroinvertebrates detect underwater acoustics differently than some fish. Rather than being pressure sensitive as some fish appear to be, marine macroinvertebrates appear to be sensitive to particle displacement. However, their sensitivity to particle displacement and hydrodynamic stimulation seem poor compared to fish. Crustaceans appear to be most sensitive to sounds of low frequency (i.e., <1,000 Hz) (Budelmann 1992; Popper et al. 2001).

Lovell et al. (2005) found, via the auditory brainstem response (ABR) technique, that the prawn, *Palaemon serratus*, responds to sounds ranging in frequency from 100 to 3,000 Hz. They also showed that the statocyst of *P. serratus* is sensitive to the motion of water particles displaced by low frequency sounds with a hearing acuity similar to that of a generalist fish. Measured threshold rms SPLs ranged from 106 dB re 1 µPa @ 100 Hz to 131 dB re 1 µPa @ 3,000 Hz.

As with fishes, there are three categories of potential effect of exposure to seismic on aquatic macroinvertebrates. They include (1) physical, (2) physiological, and (3) behavioural. The three categories should not be considered as independent of each other. They are certainly interrelated in complex ways. For example, it is possible that certain physiological and behavioural changes could potentially lead to the ultimate pathological effect on individual animals (i.e., mortality). A wide range of macroinvertebrates occur in Greenland waters and possibly the Study Area. Some examples of macroinvertebrates include crustaceans, molluscs, polychaetes, bryozoans, sponges, cnidarians, echinoderms, tunicates, sea spiders, sea anemones, corals, and many others.

3.10.2 Potential Effects of Seismic Survey Sound

Physical Effects. To date, there have not been any well-documented cases of acute aquatic macroinvertebrate mortality as a result of exposure to seismic sound under normal seismic operating conditions. Sub-lethal injury or damage has been observed but generally as a result of exposure to very high received levels of sound, higher than would be expected in the field under normal seismic operating conditions (Pearson et al. 1994). Possible effects on eggs and larvae have been demonstrated in experimental exposures but only when the eggs and larvae were exposed very close to the seismic sources and the received pressure levels were very high (Pearson et al. 1994; Christian et al. 2003, 2004). Limited information has not indicated any chronic mortality as a direct result of exposure to seismic (LaBella et al. 1996; McCauley et al. 2000a,b; Christian et al. 2003, 2004; DFO 2004).

Physiological Effects. Primary and secondary stress responses of aquatic macroinvertebrates after exposure to seismic energy all appear to be temporary in any studies done to date (McCauley et al. 2000a,b ; Christian et al. 2003, 2004; Payne et al. 2007). The times necessary for these biochemical changes to return to normal are variable depending on

numerous aspects of the biology of the species and of the sound stimulus (Lagardère 1982).

Behavioural Effects. The full determination of behavioural effects of exposure to seismic is difficult. There have been well-documented observations of aquatic macroinvertebrates exhibiting behaviour that appeared to be in response to exposure to seismic (i.e., startle response, change in swimming direction and speed, change in vertical distribution), but the ultimate importance of these behaviours is unclear (McCauley et al. 2000a,b). Some studies indicate that such behavioural changes are temporary while others imply that marine animals might not resume pre-seismic behaviours / distributions for a number of days (Christian et al. 2003). There have been anecdotal reports of decreased snow crab and northern shrimp catches in waters off Newfoundland shortly after exposure to seismic but there is no evidence to support those reports. Other studies have concluded that exposure to seismic did not alter catch rates (Andriguetto-Filho et al. 2005). As is the case with physical and physiological effects of seismic on aquatic macroinvertebrates, available information is relatively scant and often contradictory.

Assessment of Impacts. There is little evidence to suggest that exposure to typical seismic surveying activity has any acute physical and physiological impact on macroinvertebrate animals. Effects have been noted after exposure to very high levels of seismic under conditions that would not occur naturally. These effects under extreme conditions have been noted mostly with egg and larval stages of macroinvertebrates. It appears that some macroinvertebrates will alter behaviour to avoid a seismic source by moving away in either or both the horizontal and vertical planes (e.g., squid, shrimp). These distributional shifts are temporary.

The proposed seismic program for 2011 is predicted to have *minor* impacts on the macroinvertebrate VEC, including eggs and larvae, over a *short-term* duration over a spatial extent ranging between *< 1 km^2 to 11-100 km^2*. Therefore, the impacts of the proposed program on the macroinvertebrate VEC would be *not significant* (Table 3). There is no risk of long-term population impacts given the temporary nature of the seismic program (Boertmann et al. 2009a). The level of confidence associated with this prediction is judged as high.

3.11 Effects on Fish

Exposure to seismic pulses sometimes elicits behavioural reactions by fish, but there is limited information on the effect of noise-induced behavioural changes on fish. Most of the available information indicates that effects of underwater sounds on fish are transitory. Thus, obvious changes in behaviour may have inconsequential biological effects on the fish. Current research indicates that effects on fish behaviour should translate into negligible impacts on individuals and populations.

3.11.1 Hearing in Fish

Fish species are generally divided into two groups – hearing specialists and hearing generalists (see reviews by Popper et al. 2003; Ladich and Popper 2004; Hastings and Popper 2005; Popper 2009; Popper and Hastings 2009a,b). Hearing specialists have special adaptations that enhance their hearing bandwidth and sensitivity (i.e., lower their hearing threshold). Hearing specialists can typically detect signals up to 3,000 to 4,000 Hz with thresholds that are 20 dB lower than the fishes without specializations for sound detection

(i.e, generalists). There have been suggestions that certain fishes, including many clupeiforms (i.e., herring, shads, anchovies, etc.) may be capable of detecting ultrasonic signals with frequencies as high as 180 kHz (Dunning et al. 1992; Nestler et al. 1992; Mann et al. 2001). Studies on Atlantic cod, a non-clupeiform fish, suggested that this species could detect ultrasound at almost 40 kHz (Astrup and Møhl 1993). The majority of fishes are hearing generalists and have a hearing bandwidth range from below 100 Hz to ~2 kHz.

The hearing bandwidth range for many fish species within the Study Area is not currently known. A summary of available information pertaining to fish audiograms was published by Nedwell et al. (2004). Included in this summary paper were audiograms for Atlantic salmon (*Salmo salar*). While this anadromous fish does not occur in the Study Area, the salmonid Arctic char does occur in southern portions of the Project Area, typically within 25 km of shore when summer marine feeding areas are occupied (Jensen and Christiansen 2003). Nedwell et al. (2004) reported a minimum threshold SPL of 95 dB re 1 µPa (unknown metric) at 100-200Hz for Atlantic salmon. Thresholds were measured over a frequency range of 30 to 350 Hz. Knudsen et al. (1992, 1994) reported that juvenile Atlantic salmon exhibited avoidance responses to non-seismic sound at 10 Hz but not at 150 Hz.

It is important to note that data on hearing capabilities exist for approximately 100 of the 27,000 or more extant species of fish; therefore, extrapolation of hearing capabilities between different species must be done with extreme caution (Hastings and Popper 2005). Though hearing capabilities are known for relatively few fish, particularly those that occur in the Project Area, the majority of fish species with known hearing abilities are capable of detecting a range of sounds, including those produced during seismic surveys.

3.11.2 Potential Effects of Seismic Survey Sound

It has been shown that exposure to seismic sound sometimes elicits behavioural reactions by fish, but information on the effect of sound-induced behavioural changes on fish remains limited. Most of the available information suggests that effects of underwater sounds on fish are transitory, and, therefore, obvious changes in behaviour may have inconsequential biological effects on the fish. Current research suggests that effects on fish behaviour likely translate into negligible impacts on individuals and populations.

There are three categories of potential effects of exposure to seismic on fishes. They include (1) physical, (2) physiological, and (3) behavioural. Physical effects include lethal and sub-lethal damage, physiological effects include temporary primary and secondary stress responses, and behavioural effects refer to changes in exhibited behaviours. The three categories should not be considered as independent of each other. They are certainly interrelated in complex ways. For example, it is possible that certain physiological and behavioural changes could potentially lead to the ultimate physical effect on individual animals (i.e., mortality).

Physical Effects. To date, there have not been any well-documented cases of acute post-larval fish mortality as a result of exposure to seismic sound under normal seismic operating conditions. Sub-lethal injury or damage has been observed but generally as a result of exposure to very high received levels of sound, higher than would be expected in the field under normal seismic operating conditions (Enger 1981; McCauley et al. 2000a,b, 2003; Amoser and Ladich 2003; Smith et al. 2004; Popper et al. 2005). Fish that had exhibited temporary threshold shift as a result of exposure to seismic sound (Popper et al. 2005) were

also examined for evidence of physical damage to the ear region (Song et al. 2008). No evidence of physical damage was found. Acute mortality of eggs and larvae have been demonstrated in experimental exposures but only when the eggs and larvae were exposed very close (1-3 m) to the seismic sources and the received pressure levels were presumably very high (Kostyuchenko 1973; Dalen and Knudsen 1987; Holliday et al. 1987; Matishov 1992; Booman et al. 1996; Dalen et al. 1996). A recent study by Payne et al. (2009) exposed fertilized capelin (*Mallotus villosus*) eggs and monkfish (*Lophius americanus*) larvae to seismic sound from a single airgun and subsequently examined and monitored for possible effects of the exposure. Approximate received SPLs measured in the capelin egg and monkfish larvae exposures were 199 to 205 dB re 1 μPa_{p-p} and 205 dB re 1 μPa_{p-p}, respectively. The capelin eggs were exposed to either 10 or 20 airgun discharges, and the monkfish larvae were exposed to either 10 or 30 discharges. No statistical differences in mortality/morbidity between control and exposed subjects were found at 1 to 4 days post-exposure in any of the exposure trials for either the capelin eggs or the monkfish larvae.

Limited information has not indicated any chronic mortality as a direct result of exposure to seismic.

Physiological Effects. Primary and secondary stress responses of fish after exposure to seismic energy all appear to be temporary in studies done to date. The times necessary for these biochemical changes to return to normal are variable depending on numerous aspects of the biology of the species and of the sound stimulus (Sverdrup et al. 1994; McCauley et al. 2000a,b).

Behavioural Effects. The full determination of behavioural effects of exposure to seismic is difficult. There have been well-documented observations of fish exhibiting behaviour that appeared to be in response to exposure to seismic (i.e., startle response, change in swimming direction and speed, change in vertical distribution) (Blaxter et al. 1981; Schwarz and Greer 1984; Løkkeborg 1991; Pearson et al. 1992; Skalski et al. 1992; Engås et al. 1996; McCauley et al. 2000a,b; Wardle et al. 2001; Hassel et al. 2003; Slotte et al. 2004; Broeger et al. 2006; Payne et al. 2008; Popper and Hastings 2009a,b) but the ultimate importance of these behaviours is unclear. Some studies indicate that such behavioural changes are very temporary while others imply that fish might not resume pre-seismic behaviour/distributions for a number of days. As is the case with physical and physiological effects of seismic on fish, available information is relatively scant and often contradictory. There is also evidence that certain clupeids show a graded series of responses to exposure to ultrasound. The strongest responses involve rapid movement away from the sound source.

Assessment of Impacts. As previously mentioned, there is little evidence to suggest that exposure to typical seismic surveying activity has any acute physical and physiological impact on fish. Effects have been noted after exposure to very high levels of seismic under conditions that would not occur naturally. It appears that some fish will alter behaviour to avoid a seismic source by moving away in either or both the horizontal and vertical planes. These distributional shifts appear to be temporary.

The proposed seismic program for 2011 is predicted to have *minor* impacts on the fish VEC, including eggs and larvae, over a *short-term* duration in area spatial extent ranging between < *1 km^2 to 101-1,000 km^2*. Therefore, the predicted impacts of the proposed program on the fish VEC would be *not significant* (Table 3). There is no risk of long-term population impacts

given the temporary nature of the seismic program (Boertmann et al. 2009a). The level of confidence associated with this prediction is judged as high.

3.11.3 Potential Effects of Vessel and Icebreaker Sound on Fish

Underwater sound generated by marine vessels is continuous but of somewhat lower level than other anthropogenic sound sources. Sound generated by marine vessels within the Project Area could potentially have behavioural effects on fish but such effects would be temporary and similar to the effects of sound generated by other marine vessels not associated with the Project (e.g., research vessels, fishing vessels). The loudest sound levels from marine vessels may result from large icebreakers, particularly when they operate in ramming mode (Boertmann et al. 2009a). The peak sound levels of icebreaking may then exceed the ambient sound level up to 300 km from the sound source (Davis et al. 1990). No studies were found that examine the effects of icebreaking sound on fish.

Assessment of Impacts. Vessel noise, including icebreaker noise, is predicted to have *minor* impacts on the fish VEC over a *short-term* duration in an area *<1 km^2 to 101-1,000 km^2*. Therefore, the impacts of underwater sound generated by Project marine vessels on the fish VEC are *not significant* (Table 3). There is no risk of long-term population impacts given the temporary nature of the seismic program (Boertmann et al. 2009a). The level of confidence associated with this prediction is judged as high.

3.12 Accidental Events

For the purposes of this EIA, a worst case scenario approach was used as the basis for assessing the impacts of an accidental event (i.e. a fuel spill) during GXT's proposed seismic program. The fuel capacity of the *Polar Explorer* is 650,000 litres and the fuel capacity of the *Vladimir Ignatyuk* is 1,918,560 litres, though typically less is carried. A worst-case scenario spill would result in a spill of 1,918,560 litres of fuel during a vessel collision at sea. (Response considerations and procedures for other types of accidental events are included in the Project Safety Plan in Application Volume 2, Appendix 3.)

3.12.1 Probability of Occurrence

Fuel spills have occurred in the seismic industry but not to GXT. Such a spill is considered to be highly unlikely. For example, no such spills occurred in the Canadian Beaufort Sea during the 1970s and 1980s or 2000s when some 100,000 km of seismic surveys were conducted.

3.12.2 Mitigation

Fuel is contained in 16 separate tanks onboard the *Vladimir Ignatyuk*. The maximum single tank size is 264,880 litres. Numerous preventative measures and plans will be in place to avoid any fuel spillage or any other accidental events during the GXT seismic program. Plans and measures include: spill prevention plans and ship-board oil pollution prevention plans, crew training, adherence to the safety management procedures including proper bunkering procedures, oil pollution drills and other safety plans to prevent or respond to accidents. (See

Section 5.1 of the GXT Application and Appendix 3, Safety Plan.)

Also, most of the survey will occur in an offshore area away from the Greenland coast and as such will avoid sensitive areas outlined in Boertmann et al. (2009a; see Figure 7.6, below).

If a fuel spill did occur, oil spill kits (kits built for Arctic operations) are aboard both ships and both can be applied. These measures will further reduce the likelihood of an event and/or assist in mitigation if a spill should occur. For a spill, personnel would also follow the *Field Guide for Oil Spill Response in Arctic Waters* (Emergency Prevention, Preparedness and Response 1998) prepared for the Arctic Council, as well as each vessels' Shipboard Oil Pollution Emergency Plan (SOPEP). See Application Volume 2, Appendix 3 (Safety Plan) and Appendix 3-17 to 3-22.

3.12.3 Residual Risk

A major spill of fuel is very unlikely but if one did occur, depending upon location, at least some cleanup is possible. However, Boertmann et al. (2009a) note that "Adding to the severity of an oil spill in the assessment area is the general lack of response methods to recover oil from icy waters. Another important factor in this respect is the remoteness, inaccessibility and lack of infrastructure in the region."

3.12.4 Potential Environmental Effects

In the worst case scenario up to 1,918,560 L of fuel could be lost if all fuel compartments on the *Vladimir Ignatyuk* ruptured. Such a spill would likely form a diminishing surface slick. It is such a slick that has the most potential to harm wildlife. The oil that disperse in the water column would be diluted to low levels that would not be harmful to fish and invertebrates although there could be some very limited mortality of animals near the surface at the spill site just after the spill occurred. Such mortality would be small and would have no effect on the viability of the populations in that area. This topic was reviewed by Sprague et al. (1982) and Thomson et al. (1981). Boertmann et al. (2009a) noted that adult fish occupying coastal habitats, where oil may become trapped within bays and inlets, may be more sensitive to oil spills than those in the open ocean. The authors suggested that Arctic char, a common and important species in the KANUMAS East assessment area, would be vulnerable under such conditions. Refuelling is planned to occur in port, but if any at-sea fuel transfers do occur during GXT's program, it will be in offshore areas away from the Greenland coast. Effects of a spill during fuel transfer on fish, zooplankton, and macroinvertebrate VECs are judged to be not significant. There is no risk of long-term population impacts (Boertmann et al. 2009a).

The known effects of oil on marine mammals have been reviewed by Engelhardt (1983, 1985), Geraci and St. Aubin (1990) and Richardson et al. (1989). In general, the main effect of oil on marine mammals is to destroy the insulating capability of the fur of mammals that rely on fur for insulation. In the Arctic, all whales and seals rely on a layer of blubber, rather than fur, for insulation. During GXT's seismic program, the only species that would be vulnerable to effects on insulation is the polar bear which suffer reduced insulation capabilities if oiled. Also, bears ingest oil when trying to clean their fur and the ingested oil can make them very sick and cause mortality (Engelhardt 1981; Øritsland et al. 1981). Thus, the only effect of the spill examined here would occur if a polar bear happened to be in the

area and happened to become oiled. Mortality might occur. Given that polar bears will be widely dispersed in the Project Area and that GXT will not refuel in or near the Northeast Water Polynya, such mortality is within the annual levels of natural and hunting mortality for this stock of polar bears. It is also possible that marine mammals may be susceptible to the effects of inhaling fuel or its vapours (Matkin et al. 2008). Boertmann et al. (2009a) note that "It is difficult to assess the impacts of an oil spill on seals and whales in the [KANUMAS east] assessment area. There is at least a risk for major impacts on individuals if oil is trapped in a polynya or along an ice edge, where also marine mammals assemble." Given that GXT will not refuel in polynyas, the risk of impacting large numbers of marine mammals is minimized, and the effects of an accidental release of fuel are judged to be not significant.

The main concern about an oil spill is the resulting surface slick that could contaminate birds that landed on it or swam through it. Even very small amounts of oil are enough to breakdown the insulation capability of the feathers and cause the bird to die in cold waters. Spills can cause large bird mortalities if they occur near large concentrations of birds or near large nesting colonies (Joensen 1972; Campbell et al. 1978). Boertmann et al. (2009a, see Section 11.2.6) review the effects of oiling on seabirds and present times and areas where seabirds may be most sensitive to a spill in Northeast Greenland. During summer seabirds will be assembled near the breeding colonies and large numbers of birds, most notably eiders are known to moult in coastal waters. In late summer, large Svalbard populations of Little Auks and Thick-billed Murres migrate through the KANUMAS East assessment area, along with a significant part of the breeding population of the threatened Ivory Gull (from north Greenland, Svalbard and Arctic Russia). If these birds land in spilled fuel near the time of an accidental release, large numbers of birds could experience mortality. GXT will not refuel near the sensitive areas outlined in Figure 6. Given this mitigation measure, the magnitude of potential impacts is reduced. However, much is not known about the offshore distribution of some bird species. Significant impacts on certain seabird species could occur if a spill coincided in time and space with large groups of seabirds in offshore waters.

Figure 6 shows areas as identified in Boertmann et al. (2009a); designations should be considered preliminary (taken from Figure 51 in Boertmann et al. 2009a).

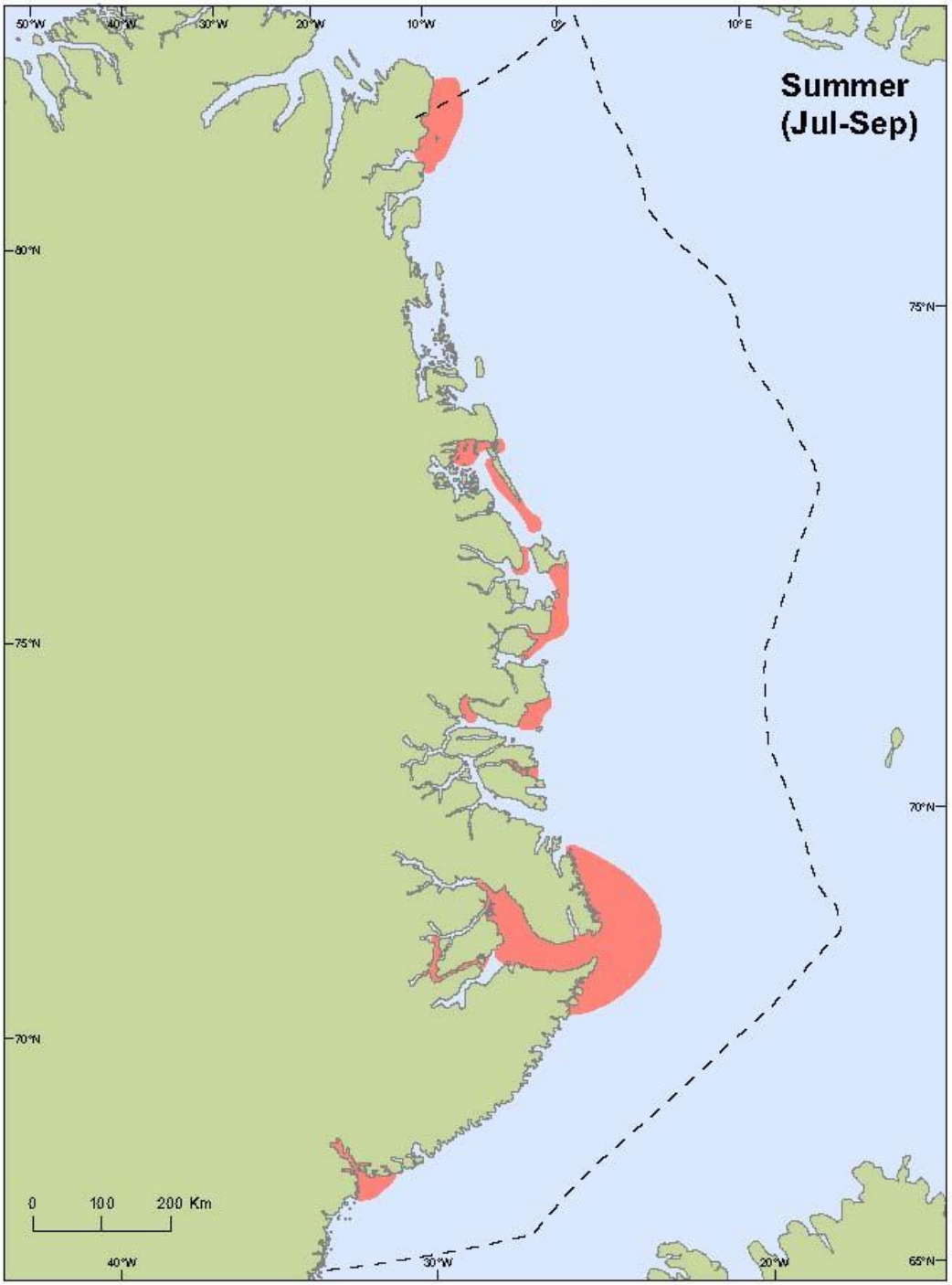

Figure 6. Oil Spill Sensitive Areas for July to September

3.13 Cumulative Effects

Cumulative effects refer to the impacts on the environment that result from combined activities of GXT's proposed seismic program as well as other activities that may occur in Northeast Greenland. Relative to other areas of the Arctic where seismic survey programs occur, there are few other activities which can contribute to cumulative effects on VECs. In 2011, some cruise ships and fishing activity are expected, and the Danish Continental Shelf Project is planned to occur north of GXT's Project Area.

3.13.1 Tourism

Tourism is a growing industry in Greenland, particularly in the KANUMAS East assessment area (Boertmann et al. 2009a). Included in the tourism industry are cruise ships visits that may occur in any ice free waters during the summer (Boertmann et al. 2009a). In Greenland, the cruise ships largely frequent coastal areas where major attractions include wildlife sightings (e.g., marine mammals, birds), scenic views, and visits to inhabited areas. On the east coast, the cruise ships that arrive from Svalbard move southwards along the outer coast and in the fjord lands while those from the south, namely Tasiilaq or Iceland, mainly visit the town of Scoresbysund (Ittoqqortoormiit) and the adjacent fjord land. The number of cruise ship visits to the Scoresbysund area has increased from three in 2002 to 14 in both 2006 and 2007. Over that time period, the number of passengers has increased from <100 to ~1,000. Some cruise ships frequent the waters of the National Park but most areas are only accessible for a short time period because of sea ice. The number of cruise ship visits to the Project Area in 2011 is unknown but expected to be much lower than the number of visits to the Scoresbysund area.

3.13.2 Fishing Activity

As described above, very little fishing activity occurs in the waters off Northeast Greenland. A limited Greenland halibut commercial fishery occurs in the southern portion of the KANUMAS East assessment area and outside of the Project Area. Some Arctic char fishing may occur in coastal areas. This limited fishing activity suggests that very few, if any, fishing vessels will occur within or adjacent the Project Area during the seismic survey.

3.13.3 Research Cruises

TUNU-MAFIG Program. In recent years, fish surveys have been conducted in Northeast Greenland waters during the TUNU-MAFIG Program (2002 to 2012) which is headed by the University of Tromsø in Norway. The program is part of the International Polar Year initiative and involves eight nations and roughly 35 scientists and research students. The program is largely addressing questions related to the diversity of genes, species, and communities in Arctic marine ecosystems, in particular the little studied marine fishes of Northeast Greenland between 69°N to 79°N (the National Park). A minor part of the research is allocated for studies of benthos and plankton communities and seal physiology. Fish surveys are typically conducted in September and October and involve sampling stations distributed from the innermost part of Northeast Greenland fjords to the continental slope (Christiansen 2003, 2005; Christiansen et al. 2008; J. Christiansen, pers. comm. 2010). Four research cruises (TUNU-MAFIG I-IV in 2003, 2005, 2007, and 2010, respectively) have been completed to date (Christiansen et al. 2008). No research cruises are planned for 2011. A fifth and final research cruise (TUNU-V) is planned for 2012 (J. Christiansen, pers. comm. 2010).

Danish Continental Shelf Project. The Danish Continental Shelf Project (DCSP) (see www.A76.dk) has been conducting research cruises in recent years to acquire data to document possible claims for an extended continental shelf (beyond 200 n.mi.) in areas north, northeast, and south of Greenland. The area of interest off Northeast Greenland is bordered by the exclusive economic zones (EEZ) of Svalbard (Norway) to the north, Jan Mayen (Norway) to the south, and Greenland to the west. Refraction and reflection seismic data was collected in the area in 2002 while multibeam bathymetric and seismic data were collected at the end of the LOMROG cruise in 2007 (http://a76.dk/greenland_uk/east_uk/index.html). For 2011, the Continental Shelf Project has planned a cruise using the icebreaker *Oden* in an area off Northeast Greenland. The cruise will acquire seismic refraction and reflection data using an array of ~ 2000 cu. in. along three seismic lines, as well as multibeam bathymetric data along the East Greenland Ridge and the continental slope along the shelf south of the Ridge. Its focus will be generally eastward from the EEZ boundary, between ~74° and 78° N though some acquisition will be inside the EEZ in some areas. The *Oden* will leave Longyearbyen on Svalbard on 17 August 2011 and will be back in Longyearbyen by about 9 September (pers. comm. Christian Marcussen, GEUS, May 2011).

Although GXT's acquisition is within the EEZ and primarily away from this area, there is a potential for sound overlap if the two projects are in the same general area at the same time. It will therefore be necessary to communicate and coordinate with the Continental Shelf Project. GXT has met with relevant GEUS personnel (February 2011) to present information about its survey and GXT will continue to coordinate with them.

3.13.4 Assessment of Cumulative Impacts

With the avoidance of overlap between GXT's survey and the DCSP work, and in the absence of other activities, the impacts of the proposed GXT seismic project (relating to underwater sound and presence of vessels) are expected to be, at most, short-term and minor to moderate based on an assessment of VECs (Table 3). The cumulative effects on VECs of all of the expected activities are expected to be negligible to minor for most parts of Northeast Greenland. There is a possibility that seismic surveys, as part of the Danish Continental Shelf Project, will be conducted off Northeast Greenland. If two concurrent seismic surveys do occur off Northeast Greenland, it is expected that the two seismic vessels will not operate close enough concurrently to affect VECs particularly since they would have to stay apart far enough not to cause mutual acoustic signal interference. Therefore, there will be no synergistic cumulative effects on VECs. Cumulative impacts are judged to be not significant.

3.14 Data Gaps and Potential Research

Section 8 of the Seismic Guidelines (Boertmann et al. 2010) notes several areas for possible future research, including the potential for non-standard sound transmission conditions resulting from the more strongly stratified water columns that might be expected in Arctic areas. They note, "It is therefore difficult to base impact assessments on simple transmission loss models (spherical or cylindrical spreading) and to apply assessment results from southern latitudes …. For example, the sound pressure may be very strong in convergence zones far (> 50 km) from the sound source, and this is particularly evident in stratified Arctic waters." The same section also notes, "Direct measurements around an operating airgun array in the arctic

are missing and future research should focus on this issue."

During the Canadian regulatory process for GXT's 2010 in-ice seismic program in the Arctic waters of the Canadian Beaufort Sea (modeled on GXT's Northeast Greenland surveys), GXT commissioned JASCO Research Ltd. (www.jasco.com) to model its planned seismic array, a somewhat larger sound source (4450 cu. in. *vs* the 4330 array used off Greenland). The work also involved direct measurement of the array in the Beaufort Sea during the 2010 survey (Sound Source Verification).

JASCO's modeling, analysis and report preparation are still under way (as of May 2011), but GXT is prepared to share results from that research with NERI when it is completed.

In terms of discussions and information from JASCO to date, their modeling has not noted instances of convergence zones resulting from the array at great distances (e.g. > 50 km) from the source. They have indicated that water depths and bottom type (including the presence of permafrost) appear to have the greatest influence on propagation loss.

It is also of note that many of the studies used as background information in this EIA were conducted in the U.S. and Canadian Arctic were sound transmission has been shown to be enhanced by such features as subsea permafrost and possibly water column stratification. GXT recognizes that underwater sound propagation can vary widely from region to region. However, the effects predictions are based on the best available scientific information and are considered valid, applying enhanced mitigations described above.

4 Environmental Management and Mitigations Summary

This section summarizes GXT's plan for mitigating, monitoring and otherwise managing potential environmental effects that might result from the Project (detailed above) with particular reference to the Seismic Guideline requirements (Boertmann et al. 2010). Other aspects of GXT's overall environmental management and protection plans, including those for accidental events, are described in GXT 2011 Application Section 5.1 (Safety and Emergency Response) and Appendices under the headings Waste Management and Sewage Pollution Prevention, Air Pollution Prevention, Oil Pollution Prevention and Spill Response, Other Emergency Response, and Safety and Emergency Training (see Section 4.6, below, for waste management and pollution prevention).

GXT's mitigation and monitoring are designed to conform to the requirements and advice set out in Boertmann et al. (2010) and in the Application Guidelines (Section 7.1 – 7.7) with respect to protection of the natural environment and environmental monitoring. As described above in Section 3, no significant residual effects were identified during the preliminary environmental impact assessment for this Project with planned mitigations in place.

To make sure that all personnel are aware of the environmental issues and mitigations that will be applied for the 2011 survey, GXT environmental and Project management personnel had meetings with the seismic survey vessel crew and managers in Munkebo, Denmark, in early July 2011 to ensure full compliance.

4.1 Best Technology and Best Practices

The Project has been planned to use the technology best suited to the requirements of the data to be collected, the working environment and the protection of safety, while minimizing the potential for environmental risks from its use. For instance, the sound source is a compressed air array (no explosives will be used); the array power is the lowest practicable to achieve the data results required; the seismic streamer is solid core which minimizes the potential for cable leaks; there is strict control of waste and emissions; and onboard fuel is separated into multiple compartments. Descriptions of other technology used and practices applied to ensure Project safety (and thus to prevent accidents which could have environmental consequences) are contained in Section 5 of GXT's 2011 Application.

The Project Safety Plan (Appendix 3 of the Application) also contains ION/GXT's QHSE Policy and ISS Marine Environmental Guidelines with which all project vessels and contractors must comply. The following sections describe other environmental best practices GXT will employ during the 2011 Northeast Greenland Project.

4.2 Marine Mammals and Seismic Array Operations

The mitigations / precautions related to the operation of the seismic sound source array (airguns) during the survey follows the guidance provided in the most recent BMP/NERI Seismic Guidelines (Boertmann et al. 2010). GXT will follow the Best Practices as described in Boertmann et al 2010. These are also consistent with "JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys" (Joint Nature

Conservation Committee, August 2010). Specifically, GXT will adhere to the following practices:

- The airgun array will not be larger than needed for the survey.
- A safety zone of 500 m from the airgun array will be applied.
- GXT's MMSOs will conduct a pre-shooting search before commencement of any use of the airguns. If waters are less than 200 m deep, this search will be 30 min. If waters are more that 200 m deep, it will be conducted for 60 min. If marine mammals are spotted within the safety zone, the ramp-up procedure will be delayed 20 minutes, from the time when the animal has left the safety zone (or the ship has moved so far that the animal is outside). The pre-shooting search can be initiated before the end of a survey line, while the airguns are still firing.
- The array will not be started at full power. Individual airguns will be added one by one or else, output of each airgun slowly increased by manipulation of pressure (ramp-up procedure).
- The ramp-up procedure will occur over a period of about 20 min and can occur while the survey ship is en route to the starting point of the transect line.
- Ramp-up will not be initiated if marine mammals are inside the array or within the safety zone (500 m) of the array. If marine mammals are discovered within this safety zone during the ramp-up procedure, the airguns shall be turned off, and a new ramp-up procedure initiated when the mammal has left the safety zone - i.e. at least 20 min. after the last sighting. If proper ramp-up cannot be performed for technical or other reasons, other measures should be taken to assure that no animals are within the safety zone at start up.
- If the array is shut down for any reason while on the transect line it can be re-initiated at full power given that the silent break is not longer than 5 min. Otherwise a full ramp-up procedure should be followed.
- The array will be shut down completely between lines, if the transit time is longer than the time it takes to conduct a ramp-up and a full ramp-up will be initiated prior to arrival at the next line. If transit time is less than 20 min the array can be operated during transit, preferably at reduced power output.
- Two MMSO will be posted on the *Polar Explorer* and at least one will be continuously on the look out particularly for whales during the preshooting search and when airguns are operated.
- Observation of marine mammals during shooting and inside the safety may not lead to shutdown.
- A log of marine mammal observations will be kept on the ship and reported as part of the cruise report.
- Airguns will not be used outside the transect lines, except in the cases mentioned above (ramp-up prior to arrival and on short transit lines) and for strictly necessary testing purposes. Testing the array at full power will be initiated with a ramp-up procedure as above.
- GXT will implement a shutdown if a bowhead whale, northern right whale, beluga, narwhal, or walrus is observed within or about to enter within a 500 m radius of the seismic source within any of the designated Protection Zones and within a 200 m radius in all other areas.

Although BMP/NERI does not require shutdowns for marine mammals entering the safety zone after the array is at full power, a 200 m shutdown was required during the 2009 NE

Greenland survey, and continued to be implemented (voluntarily) for the 2010 survey (see Section 3.6).

GXT's MMSOs who will be implementing these procedures during the 2011 survey are highly qualified and have extensive experience implementing similar procedures in many jurisdictions. In addition, as described earlier, GXT environmental and Project management personnel had meetings with the seismic survey vessel crew and managers in Munkebo, Denmark, in early July 2011 to ensure full understanding of these requirements and the need for full compliance.

4.3 Fishing Activities

Fishing (or other activities) will not be prevented or unnecessarily impeded by GXT's survey (see Section 3.13) Fishing activities will be given priority if encountered. As stated in Section 4.1 of GXT's 2011 Application, acquisition will be coordinated with any other activities in the area to avoid disruption. However, given the very low level of fishing activity (and other marine activity) expected in the seismic survey area it is not expected that any potential for interference will occur.

4.4 Important Wildlife Areas and Protection Zones

The important wildlife areas and sensitive zones (Boertmann et al. 2010, Chapter 6) in the vicinity of the 2011 survey lines are discussed and mapped in Section 3, above, as are the mitigations to be put in place related to them. These are areas for seabirds, narwhals, bowhead whales and walruses, and sensitive areas in relation to fuel spills.

4.5 Monitoring

4.5.1 Fisheries

The 2011 Application Guidelines state (Section 7.5) that "The licensee shall, upon BMP request, include one or more Fishery Liaison Officers (FLO) in the operation. The FLO must be approved by the BMP and shall serve as an advisory observer and communicator in matters related to fishery. BMP may impose specific requirements on the FLO's qualifications, including, for example that he must be speaking Greenlandic in order to communicate with local fishery actors." However, it is not anticipated that a Fisheries Observer will be required considering the location of GXT's 2011 Northeast Greenland survey. Nevertheless, it is understood that GXT will place a FLO onboard if so requested and will bear all associated costs. If a FLO is required, a logbook of observations will be kept using the template in Appendix H of the Application Guidelines, and will be submitted to the BMP (with a copy to GXT) within 2 weeks of the termination of the exploration activity.

4.5.2 Marine Mammals

GXT will have two MMSOs (Biological Observers) aboard the *Polar Explorer* at all times during the seismic program a (as per Section 5.3 of Boertmann et al. 2010). Details about the MMSOs' qualifications have been provided to NERI (same MMSOs as in 2010). The seismic guidelines state:

> At least two Marine mammal and seabird observers (MMSOs) shall be on board the seismic vessels operating in Greenland waters in order to observe continuously when operating the airguns. They shall be especially trained in observation methodology and seismic mitigation.
>
> The MMSOs have two tasks. Firstly, they have to watch systematically for marine mammals before start-up and during seismic survey in order to mitigate and observe safety distances to whales and seals.
>
> Secondly, the MMSOs shall collect data on abundance and distribution of seabirds and marine mammals through systematic surveys. This task shall be carried out both during times when seismic survey is conducted, and when sailing in transit.
>
> The latter task is not secondary to the former, and considerable effort should be spent on the systematic surveys.
>
> The purpose of the second task is to improve the knowledge on temporal and spatial distribution of marine mammals and seabirds in the West [and Eastern] Greenland waters, which generally is low. The collected data will be included in the NERI-databases of background information. The information in these databases will constitute the basis for future EIA-work by NERI and is moreover available to the companies which shall operate in Greenland waters and prepare EIAs of their activities. Data have to be collected according to NERI standards to fit into the databases, and guidelines to observation methodology will be provided when a seismic survey is approved by BMP.

The MMSOs will monitor marine mammals near the seismic source vessel. They will be responsible for monitoring marine mammals and delaying start of the airguns if a cetacean is seen inside the 500 m zone during the 30 minutes prior to ramp-up (60 minutes in deeper waters). GXT monitors will follow specific monitoring and data collection protocols as advised by BMP/NERI (those protocols described in the 2010 Manual for seabird and marine mammal surveys on seismic vessels in Greenland). A log of marine mammal observations will be kept and reported as part of the cruise report.

As noted above, although no shutdown for marine mammals is required, GXT will implement a shutdown if a bowhead whale, northern right whale, beluga, narwhal, or walrus is observed within or about to enter within a 500 m radius of the seismic source in all Protection Zones and within 200 m in all other areas. In addition, further observations for marine mammals will be maintained by bridge personnel on the icebreaker, as described above. GXT will bear all costs associated with the MMSOs' participation in the Project.

Seabirds. GXT's MMSO will place a particular focus on observing and recording seabird sighting data during the 2011 survey, as in 2010. GXT MMSOs will use NERI Field Recording and Data Entry sheets/database forms, and will follow the latest NERI/BMP procedures described in the most recently available manual for seabird and marine mammal surveys on seismic vessels in Greenland.

4.6 Waste Management and Pollution Prevention

The *Polar Explorer* and the *Vladimir Ignatyuk* have Shipboard Garbage Management Plans that are issued in accordance with the requirements of MARPOL Annex V. Both plans include the following components: Garbage Record Book; Incinerator Management; Designated Persons and Duties; Procedures for Collection, Storage and Processing garbage. No non-degradable materials will be disposed of in the area.

Both the *Polar Explorer* and the *Vladimir Ignatyuk* both have sewage treatment plants that comply with MARPOL Annex IV of the International Convention of for the Prevention of Pollution from Ships. Both sewage treatment plants of meet the effluent standards as provided in resolution MEPC.2 (VI).

Both vessels have a MARPOL International Air Pollution Certificate. The *Polar Explorer* certificate was issued under the provisions of the Protocol of 1997 as amended by resolution MEPC.176(58) in 2008. The *Vladimir Ignatyuk* certificate was issued on the Protocol 1997 to amend the International Convention for Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 related thereto and as amended by Resolution MEPC.132(53).

Both vessels have MARPOL International Oil Pollutions Prevention Certificates issued under the provisions of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978. Both vessels have a Shipboard Oil Pollution Emergency Plan issued in accordance with the Requirements of Regulation 26 Chapter IV of MARPOL 73/78 International Convention amended in 1999. The Field Guide for Oil Spill in Arctic Waters, a program by the Arctic Council will be used in the event of an oil spill. The vessels will conduct drill using these guidelines.

GXT's vessels will only use diesel and gasoil with a sulphur content less than 1.5 % (weight). Heavy fuel oil and oil with a sulphur content >1.5 % should will not be used.

4.7 Other Environmental Conditions

The BMP's Application Guidelines (Section 7.7) also note requirements related to other environmental conditions and considerations:

- When acquiring seismic data, the operation shall be conducted in accordance with the Best Practices listed in NERI Report No. 785, Chapter 5 concerning acquisition of seismic data.
- All non-degradable materials and structures shall be removed upon termination of the operation, unless BMP approves otherwise (see 4.5.3, above).
- Discharge of waste water and kitchen waste shall be in compliance with the provisions of Annex IV and Annex V of the MARPOL Convention (see 4.5.3, above).
- Hunting and fishing is not permitted in connection with exploration activities, unless specific permission is given by the Greenland Government.
- BMP may when approving specific exploration activities require the licensee to perform further impact studies and / or limit the operation to certain periods or from certain areas.
- Vessels engaged and machinery used in the exploration activities should only use diesel and gasoil with a sulphur content less than 1.5 % (weight). Heavy fuel oil and oil with a sulphur content >1.5 % should not be used (see 4.5.3, above).

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GXT will comply with each of these requirements (as described above) and has briefed Project personnel about these and all other environmental commitments and requirements during in-person start up meetings before acquisition (during early July 2011). GXT project vessels will also comply with all parts of Landstings-forordning No. 4 of 3 November 1994 on the protection of the marine environment that apply to the GXT project area and vessels.

5 References / Citations

Abgrall, P., V.D. Moulton and W.J. Richardson. 2008. Updated review of scientific information on impacts of seismic survey sound on marine mammals, 2004-present. LGL Rep. SA973-2. Rep. from LGL Limited, St. John's, NL and King City, ON, for Department of Fisheries and Oceans, Habitat Science Branch, Ottawa, ON. 28 p. + appendices.

Agness, A.M., J.F. Piatt, J.C. Ha, and G.R. VanBlaricom. 2008. Effects of vessel activity on the near-shore ecology of Kittlitz's Murrelets (*Brachyramphus brevirostris*) in Glacier Bay, Alaska. Auk 125: 346-353.

Amoser, S. and F. Ladich. 2003. Diversity in noise-induced temporary hearing loss in otophysine fishes. J. Acoust. Soc. Am. 113(4): 2170-2179.

Andriguetto-Filho, J.M., A. Ostrensky, M.R. Pie, U.A. Silva, and W.A. Boeger. 2005. Evaluating the impact of seismic prospecting on artisanal shrimp fisheries. Cont. Shelf Res. 25: 1720-1727.

Árnason, Ú., K. Bodin, A. Gullberg, C. Ledje, and S. Mouchaty. 1995. A molecular view of pinniped relationships with particular emphasis on the true seals. J. Molecular Evol. 40: 78-85.

Astrup, J. and B. Møhl. 1993. Detection of intense ultrasound by the cod *Gadus morhua*. J. Exp. Biol. 182: 71-80.

Bain, D.E. and R. Williams. 2006. Long-range effects of airgun noise on marine mammals: responses as a function of received sound level and distance. Working Paper SC/58/E35 presented to the IWC Scientific Committee, IWC Annual Meeting, 1-13 June, St. Kitts and Nevis. 13 p.

Barkaszi, M.J., D.M. Epperson, and B. Bennett. 2009. Six-year compilation of cetacean sighting data collected during commercial seismic survey mitigation observations throughout the Gulf of Mexico, USA. p. 24-25. *In*: Abstr. 18th Bienn. Conf. Biol. Mar. Mamm., Québec, Canada, Oct. 2009. 306 p.

Berta, A., R. Racicot and T. Deméré. 2009. The comparative anatomy and evolution of the ear in *Balaenoptera mysticetes*. p. 33. *In*: Abstr. 18th Bienn. Conf. Biol. Mar. Mamm., Québec, Oct. 2009. 306 p.

Birchard, E.C. and R. Nancarrow. 1986. The Minuk I-53 Artificial Island oil spill. p. 375-378. *In*: Proceedings 9th Arctic Marine Oilspill Program Technical Seminar, 10-12 June 1986, Edmonton. Conservation and Protection, Environment Canada, Ottawa.

Blackwell, S.B., C.R. Greene, T.L. McDonald, C.S. Nations, R.G. Norman, and A. Thode. 2009a. Beaufort Sea bowhead whale migration route study. Chapter 8. *In*: D.S. Ireland, D.W. Funk, R. Rodrigues, and W.R. Koski (eds.). 2009. Joint Monitoring Program in the Chukchi and Beaufort seas, open water seasons, 2006-2007. LGL Alaska Rep. P971-2. Rep. from LGL Alaska Res. Assoc. Inc. (Anchorage, AK) et al. for Shell Offshore Inc. (Anchorage, AK) et al. 485 p. plus appendices.

Blackwell, S.B., C.S. Nations, T.L. McDonald, A.M. Thode, K.H. Kim, C.R. Greene, and M.A. Macrander. 2009b. Effects of seismic exploration activities on the calling behavior of bowhead whales in the Alaskan Beaufort Sea. p. 35. *In*: Abstr. 18th Bienn. Conf. Biol. Mar. Mamm., Québec, Canada, 12-16 Oct. 2009. 306 p.

Blaxter, J.H.S., J.A.B. Gray and E.J. Denton. 1981. Sound and startle responses in herring shoals. J. Mar. Biol. Ass. UK 61: 851-869.

BMP (Government of Greenland Bureau of Minerals and Petroleum). 2003. Seismic survey standards for offshore West Greenland May 2003. 24 pp.

BMP (Government of Greenland Bureau of Minerals and Petroleum). 2011. BMP Guidelines for application, execution and reporting of offshore hydrocarbon exploration activities (excluding drilling) in Greenland May 2011. 15 pp.

Boertmann, D., A. Mosbech, D. Schiedek, and K. Johansen (eds.). 2009a. The western Greenland Sea. A preliminary strategic impact assessment of hydrocarbon activities in the KANUMAS East area. National Environmental Research Institute, Aarhus University, Denmark. NERI Technical Report No. 719. 246 pp.

Boertmann, D., K. Olsen, and R.D. Nielson. 2009b. Seabirds and marine mammals in Northeast Greenland, aerial surveys in spring and summer 2008. National Environmental Research Institute, Aarhus University, Denmark. NERI Tech. Rep. No. 721. 50 p.

Boertmann, D., M. Flemming, and J. Durinck. 2009c. Bowhead whales in East Greenland, summers 2006-2008. Polar Biol. 32: 1805-1809.

Boertmann, D., Tougaard, J., Johansen, K. & Mosbech, A. 2010. Guidelines to environmental impact assessment of seismic activities in Greenland waters. 2nd edition. National Environmental Research Institute, Aarhus University, Denmark. 42 pp. – NERI Technical Report no.785. http://www.dmu.dk/Pub/FR785.pdf

Boertmann, D. 2008. Grønlands Rødliste – 2007. Danmarks Miljøundersøgelser, Aarhus Universitet, og Grønlands Hjemmestyre. 156 pp. (Danish with English summary).

Boertmann, D. 1994. An annotated checklist to the birds of Greenland. Meddr. Grønland, Bioscience 38.

Booman, C., J. Dalen, H. Leivestad, A. Levsen, T. van der Meeren, and K. Toklum. 1996. Effecter av luftkanonskyting på egg, larver og yngel. Fisken Og Havet 1996(3): 1-83 (Norwegian with English summary).

Born, E.W., R. Dietz, M.P. Heide-Jørgensen, and L.Ø. Knutsen. 1997. Historical and present distribution, abundance and exploitation of Atlantic Walrus (*Odobenus rosmarus rosmarus* L.) in eastern Greenland. Meddr. Grøenland Bioscience 46. 73 pp.

Bowles, A.E., M. Smultea, B. Würsig, D.P. DeMaster, and D. Palka. 1994. Relative abundance and behavior of marine mammals exposed to transmissions from the Heard Island Feasibility Test. J. Acoust. Soc. Am. 96: 2469-2484.

Brandt, A. 1997. Abundance, diversity and community patterns of epibenthic- and benthic-boundary layer peracarid crustaceans at 75 degree N off East Greenland. Polar Biol 17(2): 159-74.

Brewer, K.D., M.L. Gallagher, P.R. Regos, P.E. Isert, and J.D. Hall. 1993. ARCO Alaska, Inc. Kuvlum #1 exploration prospect/Site specific monitoring program final report. Rep. from Coastal & Offshore Pacific Corp., Walnut Creek, CA, for ARCO Alaska Inc., Anchorage, AK. 80 p.

Broeger, W.A., M.R. Pie, A. Ostrensky, and M.F. Cardoso. 2006. The effect of exposure to seismic prospecting on coral reef fishes. Brazilian J. Ocean. 54: 235-239.

Brueggeman, J.J., G.A. Green, R.A. Grotefendt, M.A. Smultea, D.P. Volsen, R.A. Rowlett, C.C. Swanson, C.I. Malme, R. Mlawski, and J.J. Burns. 1992. 1991 marine mammal monitoring program (seals and whales) Crackerjack and Diamond prospects Chukchi Sea. Rep. from EBASCO Environmental, Bellevue, WA, for Shell Western E & P Inc. and Chevron U.S.A. Inc. Var. pag.

Budelmann, B.U. 1992. Hearing in crustacea. p. 131-139. *In*: D.B. Webster, R.R. Fay, and A.N. Popper (eds.). The Evolutionary Biology of Hearing.

Caldwell, J. and W. Dragoset. 2000. A brief overview of seismic air-gun arrays. The Leading Edge 19: 898-902.

Campbell, L.H., K.T. Sandring, and C.J. Cadbury. 1978. Firth of Forth oil pollution incident, February 1978. Mar. Poll. Bull. 9: 335-339.

CEA Agency (Canadian Environment Assessment Agency). 1994. A reference guide for the *Canadian Environmental Assessment Act*, addressing cumulative environmental effects. Prepared by the Federal Environmental Assessment Review Office, November 1994.

Christian, J.R., A. Mathieu, and R.A. Buchanan. 2004. Chronic effects of seismic energy on snow crab (*Chionoecetes opilio*). Environmental Research Funds Report No. 158. Calgary. 45 p.

Christian, J.R., A. Matthieu, D. White, and R.A. Buchanan. 2003. Effects of seismic energy on snow crab (*Chionoecetes opilio*). Environmental Research Funds Report No. 144. Calgary. 106 p.

Christiansen, J.S., O.V. Karamushko, S.-E. Fevolden, and K. Præbel. 2008. TUNU-MAFIG: Marine fishes of North East Greenland – diversity and adaptation. ICES CM 2008/B:19.

Christiansen, J.S. 2005. TUNU-II Expedition: Marine fishes of NE Greenland – diversity and adaptation. Technical Report, University of Tromsø. 28 p.

Christiansen, J.S. 2003. TUNU-I Expedition: The fish fauna of the NE Greenland fjord systems. Technical Report, University of Tromsø. 33 p.

Christie, K., C. Lyons, W.R. Koski, D.S. Ireland, and D.W. Funk. 2009. Patterns of bowhead whale occurrence and distribution during marine seismic operations in the Alaskan Beaufort Sea. p. 55. *In*: Abstr. 18th Bienn. Conf. Biol. Mar. Mamm., Québec, Canada, 12-16 Oct. 2009.

Clark, C.W. and W.T. Ellison. 2004. Potential use of low-frequency sounds by baleen whales for probing the environment: Evidence from models and empirical measurements. p. 564-589. *In:* J.A. Thomas, C.F. Moss and M. Vater (eds.), Echolocation in Bats and Dolphins. Univ. Chicago Press, Chicago, IL. 604 p.

Clark, C.W. and G.C. Gagnon. 2006. Considering the temporal and spatial scales of noise exposures from seismic surveys on baleen whales. Intern. Whal. Commis. Working Pap. SC/58/E9. 9 p.

Cosens, S.E. and L.P. Dueck. 1988. Responses of migrating narwhal and beluga to icebreaker traffic at the Admiralty Inlet ice-edge, N.W.T. in 1986. p. 39-54. *In:* W.M. Sackinger, M.O. Jeffries, J.L. Imm, and S.D. Treacy (eds.), Port and ocean engineering under arctic conditions, vol. II. Geophysical Inst., Univ. Alaska, Fairbanks, AK. 111 p.

Dalen, J. and G.M. Knutsen. 1987. Scaring effects in fish and harmful effects on eggs, larvae and fry by offshore seismic explorations. Symposium on Underwater Acoustics, Halifax, 1986.

Dalen, J., E. Ona, A.V. Soldal, and R. Saetre. 1996. Seismiske undersøkelser til havs: En vurdering av konsekvenser for fisk og fiskerier. Fisken Og Havet 9. English Summary: 4-6.

Davis, R.A., J. Richardson, L. Thiele, R. Dietz, and P. Johansen. 1990. State of the Arctic environment. Report of underwater noise, November 9, 1990. – Finnish Initiative on Protection of the Arctic Environment.

DeRuiter, S.L., P.L. Tyack, Y.-T. Lin, A.E. Newhall, J.F. Lynch, and P.J.O. Miller. 2006. Modeling acoustic propagation of airgun array pulses recorded on tagged sperm whales (*Physeter macrocephalus*). J. Acoust. Soc. Am. 120(6): 4100-4114.

DFO (Fisheries and Oceans Canada). 2004. Potential impacts of seismic energy on snow crab. DFO Can. Sci. Advis. Sec. Habitat Status Report 2004/003.

Dietz, R., M.P. Heide-Jørgensen, E.W. Born, and C.M. Glahder. 1994. Occurrence of narwhals (*Monodon monoceros*) and white whales (*Delphinapterus leucas*) in East Greenland. Meddr. Grønland. Bioscience 39: 69-86.

Di Iorio, L. and C.W. Clark. 2009. Exposure to seismic survey alters blue whale acoustic communication. Biol. Lett. 6(1):51-54.

Dunn, R.A. and O. Hernandez. 2009. Tracking blue whales in the eastern tropical Pacific with an ocean-bottom seismometer and hydrophone array. J. Acoust. Soc. Am. 126(3): 1084-1094.

Dunning, D.J., Q.E. Ross, P. Geoghegan, J. Reichle, J.K. Menezes, and J.K. Watson. 1992. Alewives avoid high-frequency sound. N. Am. J. Fish. Manage. 12: 407-416.

Egevang, C., and D. Boertmann. 2001. The Greenland Ramsar sites. A status report. National Environmental Research Institute, Denmark, NERI Technical Report No. 346. 96 pp.

Engås, A, S. Løkkeborg, E. Ona, and A.V. Soldal. 1996. Effects of seismic shooting on local abundance and catch rates of cod (*G. morhua*) and haddock (*M. aeglefinus*). Can. J. Fish. Aquat. Sci. 53(10): 2238-2249.

Engelhardt, F.R. (ed.). 1985. Petroleum effects in the arctic environment. Elsevier Applied Science Publishers, London.

Engelhardt, F.R. 1981. Oil pollution in polar bears: exposure and clinical effects. p. 139-179. *In*: Proc. 4th Arctic Marine Oilspill Program technical seminar, Edmonton, Alta. Envir. Protect. Serv., Ottawa. 741 p.

Engelhardt, F.R. 1983. Petroleum effects on marine mammals. Aquatic Toxicol. 4: 199-217.

Enger, P.S. 1981. Frequency discrimination in teleosts - central or peripheral. p. 243-255. *In*: W.N. Tavolga and A.N. Popper (eds.), Hearing and sound communication in fishes. Springer-Verlag, New York.

Evans, P.G.H., E.J. Lewis, and P. Fisher. 1993. A study of the possible effects of seismic testing upon cetaceans in the Irish Sea. Rep. by Sea Watch Foundation, Oxford, to Marathon Oil UK Ltd., Aberdeen. 35 p.

Fay, F.H., G.C. Ray, and A.A. Kibal´chich. 1984. Time and location of mating and associated behaviour of the Pacific walrus *Odobenus rosmarus divergens* Illiger. p. 89-99. *In*: F.H. Fay and G.A. Fedoseev (eds.). Soviet-American Cooperative Research on Marine Mammals. Vol 1-Pinnipeds. NOAA Technical Reports NMFS 12., Washington D.C. 104 pp.

Finley, K.J., G.W. Miller, R.A. Davis, and C.R. Greene. 1990. Reactions of belugas, *Delphinapterus leucas* and narwhals, *Monodon monoceros,* to icebreaking ships. *In*: T.G. Smith, D.J. St. Aubin and J. Geraci (eds.) Advances in research on the Beluga whale, (*Delphinapterus leucas*). Can. Bull. Fish. Aquat. Sci. 224:97-117.

Finneran, J.J., C.E. Schlundt, R. Dear, D.A. Carder, and S.H. Ridgway. 2002. Temporary shift in masked hearing thresholds in odontocetes after exposure to single underwater impulses from a seismic watergun. J. Acoust. Soc. Am. 111(6): 2929-2940.

Finneran, J.J., C.E. Schulundt, D.A. Carder, J.A. Clark, J.A. Young, J.B. Gaspin, and S.H. Ridgway. 2000. Auditory and behavioral responses of bottlenose dolphins (*Tursiops truncatus*) and a beluga whale (*Delphinapterus leucas*) to impulsive sounds resembling distant signatures of underwater explosions. J. Acoust. Soc. Am. 108(1): 417-431.

Finneran, J.J., D.A. Carder, C.E. Schlundt, and S.H. Ridgway. 2005. Temporary threshold shift in bottlenose dolphins (*Tursiops truncatus*) exposed to mid-frequency tones. J. Acoust. Soc. Am. 118(4): 2696-2705.

FMOTE (Finnish Ministry of the Environment). 1997. Guidelines for environmental impact assessment (EIA) in the Arctic. Arctic Environmental Protection Strategy. 51 pp.

Gautier, D.L. 2007. Assessment of undiscovered oil and gas resources of the East Greenland Rift Basins Province. U.S. Geological Survey Fact Sheet 2007-3077. 4 p.

Gearing, P.J. and J.N. Gearing. 1982. Behaviour and fate of No. 2 fuel oil in the water column of controlled ecosystems. Mar. Envir. Res. 6: 115-132.

Gedamke, J., S. Frydman, and N. Gales. 2008. Risk of baleen whale hearing loss from seismic surveys: preliminary results from simulations accounting for uncertainty and individual variation. Intern. Whal. Comm. Working Pap. SC/60/E9. 10 p.

Geraci, J.R. and D.J. St. Aubin. 1990. Sea mammals and oil: Confronting the risks. Academic Press, San Diego. 282 p.

Gilg, O., and E.W. Born. 2005. Recent sightings of the bowhead whale (*Balaena mysticetus*) in Northeast Greenland and the Greenland Sea. Polar Biol. 28: 796-801.

Gilg, O., D. Boertmann, F.R. Merkel, A. Aebischer, and B. Sabard 2009. The status of the endangered Ivory Gull, *Pagophila eburnean*, in Greenland. Polar Biol. 32: 1275-1286.

Glahder, C.M., D. Boertmann, J. Madsen, M. Tamstorf, K. Johansen, J.Hansen, A. Walsh, C. Jaspers, and M. Bjerrum. 2010. Biological baseline study in the Ramsar site "Heden" and the entire Jameson Land, East Greenland. National Environmental Research Institute, Aarhus University. NERI Technical Report No. 769. Available at: http://www.dmu.dk/Pub/FR769.pdf.

Goold, J.C. and R.F.W. Coates. 2006. Near source, high frequency air-gun signatures. Paper SC/58/E30 presented to the IWC Scient. Commit., IWC Annu. Meet., 1-13 June, St. Kitts.

Goold, J.C., and P.J. Fish. 1998. Broadband spectra of seismic survey air-gun emissions, with reference to dolphin auditory thresholds. J. Acoust. Soc. Am., 103: 2177-2184.

Gordon, J., D. Gillespie, J. Potter, A. Frantzis, M.P. Simmonds, R. Swift, and D. Thompson. 2004. A review of the effects of seismic surveys on marine mammals. Mar. Tech. Soc. J. 37(4):16-34.

Gordon, J., R. Antunes, N. Jaquet and B. Würsig. 2006. An investigation of sperm whale headings and surface behaviour before, during and after seismic line changes in the Gulf of Mexico. Intern. Whal. Comm. Working Pap. SC/58/E45. 10 p.

Greene, C.R. 1997. An autonomous acoustic recorder for shallow arctic waters. J. Acoust. Soc. Am. 102(5, Pt. 2): 3197.

Greene, C.R., Jr. and W.J. Richardson. 1988. Characteristics of marine seismic survey sounds in the Beaufort Sea. J. Acoust. Soc. Am. 83: 2246–2254.

Greene, C.R., Jr., N.S. Altman, and W.J. Richardson. 1999a. Bowhead whale calls. p. 6-1 to 6-23. *In*: W.J. Richardson (ed.), Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1998. LGL Rep. TA2230-3. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Houston, TX, and U.S. Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 390 p.

Greene, C.R., Jr., N.S. Altman, and W.J. Richardson. 1999b. The influence of seismic survey sounds on bowhead whale calling rates. J. Acoust. Soc. Am. 106(4, Pt. 2): 2280. [Abstract]

GXT (GXT Canada Limited). 2009. GXT 2009 2-D seismic survey application for East/North Greenland regions. Prepared by GXT Canada Limited and LGL Limited, St. John's, NL. Prepared for the Bureau of Minerals and Petroleum, Nuuk, Greenland. Vol. 1: Main Application Document.

GXT (GXT Canada Limited). 2010. GXT 2010 2-D seismic survey application for East/North Greenland regions. Prepared by GXT Canada Limited and LGL Limited, St. John's, NL. Prepared for the Bureau of Minerals and Petroleum, Nuuk, Greenland. Vol. 1: Main Application Document.

Haley, B., J. Beland, D.S. Ireland, R. Rodrigues, and D.M. Savarese. 2009. Chukchi Sea vessel-based monitoring program. Chapter 3. *In*: D.W. Fun, D.S. Ireland, R. Rodrigures, and W.R. Koski (eds.). 2009. Joint Monitoring Program in the Chukchi and Beaufort seas, open water seasons, 2006-2008. LGL Alaska Report P1050-1, Report from LGL Alaska Research Associates, Inc., LGL Ltd., Greeneridge Sciences, Inc., and JASCO Research, Ltd., for Shell Offshore, Inc., and Other Industry Contributers, and National Marine Fisheries Service, U.S. Fish and Wildlife Service. 488 p. plus appendices.

Harris, R.E., A.N. Balla-Holden, S.A. MacLean, and W.J. Richardson. 1998. Seals. p. 4-1 to 4-54. *In*: W.J. Richardson (ed.), Marine mammal and acoustical monitoring of BP Exploration (Alaska)'s open-water seismic program in the Alaskan Beaufort Sea, 1997. LGL Rep. TA2150-3. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for BP Explor. (Alaska) Inc., Anchorage, AK, and U.S. Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 318 p.

Harris, R.E., G.W. Miller, and W.J. Richardson. 2001. Seal responses to airgun sounds during summer seismic surveys in the Alaskan Beaufort Sea. Mar. Mam. Sci. 17(4): 795-812.

Harris, R.E., G.W. Miller, R.E. Elliott, and W.J. Richardson. 1997. Seals. p. 4-1 to 4-42. *In*: W.J. Richardson (ed.), Northstar marine mammal monitoring program, 1996: marine mammal and acoustical monitoring of a seismic program in the Alaskan Beaufort Sea. LGL Rep. TA2121-2. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for BP Explor. (Alaska) Inc., Anchorage, AK, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 245 p.

Harris, R.H., A. Lewin, A. Hunter, M. Fitzgerald, A.R. Davis, R.E. Elliott, and R.A. Davis. 2008. Marine mammal mitigation and monitoring for GX Technology's Canadian Beaufort Span 2-D marine seismic program, open-water season 2007. LGL Rep. TA4460-1-2. Report prepared for GX Technology Corp., Houston, Texas by LGL Limited, King City, Ontario. 100 p.

Harris, R.H., T. Elliott, and R.A. Davis. 2007. Results of marine mammal monitoring and mitigation program, Beaufort Span 2-D marine seismic program, open-water season 2006. LGL Rep. TA4319-1. Report prepared for GX Technology Inc., Houston, Texas by LGL Limited, King City, Ontario. 48 p.

Harwood, L.A., F. McLaughlin, R.M. Allen, J. Lillasiak, Jr., and J. Alikamik. 2005. First-ever marine mammal and bird observations in the deep Canada Basin and Beaufort/Chukchi seas: expeditions during 2002. Polar Biol. 28: 250-253.

Harwood, L., T. Smith, A. Joynt, D. Kennedy, R. Pitt, S. Moore, and P. Millman. 2010. Potential for displacement of whales and seals by seismic and exploratory drilling activity in the Canadian Beaufort Sea - what have research and observations revealed to date? (abstract for presentation by Lois Harwood, DFO Canada, to the Canada - US Northern Oil and Gas Research Forum in Calgary, December 2010).

Hassel, A., T. Knutsen, J. Dalen, S. Løkkeborg, K. Skaar, Ø. Østensen, E.K. Haugland, M. Fonn, Å. Høines, and O.A. Misund. 2003. Reaction of sandeel to seismic shooting: A field experiment and fishery statistics study. Institute of Marine Research, Bergen, Norway.

Hastings, M.C., and A.N. Popper. 2005. Effects of sound on fish. California Department of Transportation Contract 43A0139 Task Order 1. 82 pp.

Hauser, D.D.W., M Holst, and V.D. Moulton. 2008. Marine mammal and sea turtle monitoring during Lamont-Doherty Earth Observatory's marine seismic program in the Eastern Tropical Pacific, April–August 2008. LGL Rep. TA4656/7-1. Rep. from LGL Ltd., King City., Ont., and St. John's, Nfld, for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 98 p.

Heide-Jørgensen, M.P., M.J. Simon, and K.L. Laidre. 2007. Estimates of large whale abundance in Greenlandic waters from a ship-based survey in 2005. J. Cetacean Res. Manage. 9(2): 95-104.

Holliday, D.V., R.E. Pieper, M.E. Clarke, and C.F. Greenlaw 1987. The effects of airgun energy releases on the eggs, larvae, and adults of the northern anchovy (*Engraulis mordax*). API Publication 4453. Report by Tracor Applied Sciences for American Petroleum Institute, Washington, DC. 115 p.

Holst, M., and M.A. Smultea. 2008. Marine mammal and sea turtle monitoring during Lamont-Doherty Earth Observatory's marine seismic program off Central America, February – April 2008. LGL Rep. TA4342-3. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 133 p.

Holst, M., M.A. Smultea, W.R. Koski, and B. Haley. 2005a. Marine mammal and sea turtle monitoring during Lamont-Doherty Earth Observatory's marine seismic program off the Northern Yucatán Peninsula in the Southern Gulf of Mexico, January–February 2005. LGL Rep. TA2822-31. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish Serv., Silver Spring, MD.

Holst, M., M.A. Smultea, W.R. Koski, and B. Haley. 2005b. Marine mammal and sea turtle monitoring during Lamont-Doherty Earth Observatory's marine seismic program in the Eastern Tropical Pacific Ocean off Central America, November–December 2004. LGL Rep. TA2822-30. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD.

Holst, M., W.J. Richardson, W.R. Koski, M.A. Smultea, B. Haley, M.W. Fitzgerald, and M. Rawson. 2006. Effects of large- and small-source seismic surveys on marine mammals and sea turtles. Eos Transactions of the American Geophysical Union 87(36), Joint Assembly Supplement, Abstract OS42A-01. 23-26 May, Baltimore, MD.

Holst, M., W.J. Richardson, W.R. Koski, M.A. Smultea, B. Haley, M.W. Fitzgerald, and M. Rawson. 2006. Effects of large- and small-source seismic surveys on marine mammals and sea turtles. Eos, Trans. Am. Geophys. Union 87(36), Joint Assembly Suppl., Abstract OS42A-01. 23-26 May, Baltimore, MD.

Hutchinson, D.R., and R.S. Detrick. 1984. Water gun vs. air gun: a comparison. Mar. Geophys. Res. 6(3): 295-310.

Hvidegaard, S.M., R. Forsberg, S. Hanson, H. Skourup, and L.T. Pedersen. 2008. Sea ice conditions off NW and NE Greenland from satellite measurements, airbourne, and in-situ data. Contract Report for Greenland Bureau of Minerals and Petroleum. 60 pp.

IEG (Inuvialuit Environmental and Geotechnical Inc.). 2001. Project Description for the proposed Anderson Resources Ltd. Summer 2001/2002 marine seismic program. Project No. 733-00. Rep. by Inuvialuit Environmental and Geotechnical Inc., Calgary, AB, for Anderson Resources Ltd., Calgary, AB. 185 p. + appendices.

IUCN (International Union for Conservation of Nature). 2010. 2008 IUCN Red List of Threatened Species. www.iucnredlist.org

Jensen, D.B., and K.D. Christensen. 2003. The biodiversity of Greenland – a country study. Pinngortitalerifik, Grønlands Naturinstitut Technical Report No. 55.

Jochens, A., D. Biggs, D. Engelhaupt, J. Gordon, N. Jaquet, M. Johnson, R. Leben, B. Mate, P. Miller, J., Ortega-Ortiz, A., Thode, P. Tyack, J. Wormuth, and B. Würsig. 2006. Sperm whale seismic study in the Gulf of Mexico: Summary Report, 2002-2004. OCS Study MMS 2006-034. MMS, Gulf of Mexico OCS Region, New Orleans, LA. 345 p.

Jochens, A., D. Biggs, K. Benoit-Bird, D. Engelhaupt, J. Gordon, C. Hu, N. Jaquet, M. Johnson, R. Leben, B. Mate, P. Miller, J. Ortega-Ortiz, A. Thode, P. Tyack, and B. Würsig. 2008. Sperm whale seismic study in the Gulf of Mexico/Synthesis report. OCS Study MMS 2008-006. Rep. from Dep. Oceanogr., Texas A & M Univ., College Station, TX, for U.S. Minerals Manage. Serv., Gulf of Mexico OCS Reg., New Orleans, LA. 323 p.

Joensen, A.H. 1972. Studies on oil pollution and seabirds in Denmark 1968-1971. Danish Rev. Game Biol. 6: 1-32.

Joint Nature Conservation Committeel. 2010. JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys. Aberdeen, UK. 16 p. http://jncc.defra.gov.uk/pdf/JNCC_Guidelines_Seismic%20Guidelines_August%202010.pdf

Jones, C.G., D.D.W. Hauser, A.L. Lang, and V.D. Moulton. 2009. Marine mammal and seabird monitoring of GX Technology's 2009 2-D seismic program offshore of Northeast Greenland. LGL Rep. SA1067. Rep. by LGL Limited, St. John's, NL, for GX Technology Canada Ltd., Calgary, AB. 33 p + appendices.

Jones, D.O.B., B.J. Bett, and P.A. Tyler. 2007. Depth-related changes in the arctic epibenthic megafaunal assemblages of Kangerdlugssuaq, east Greenland. Mar. Biol. Res. 3(4): 191-204.

Kaiser, M.S., and E.K. Fritzell. 1984. Effects of river recreationists on Green-backed Heron behavior. J. Wildl. Manage. 48: 561-567.

Kanik, B., M. Winsby, and R. Tanasichuk. 1980. Observations of marine mammal and sea bird interaction with icebreaking activities in the High Arctic July 2-12, 1980. Rep. from Hatfield Consultants Ltd., West Vancouver, BC, for Petro-Canada, Calgary, AB. 53 p.

Kastak, D., and R.J. Schusterman. 1998. Low-frequency amphibious hearing in pinnipeds: methods, measurements, noise, and ecology. J. Acoust. Soc. Am. 103(4): 2216-2228.

Kastak, D., B.L. Southall, R.J. Schusterman, and C.R. Kastak. 2005. Underwater temporary threshold shift in pinnipeds: effects of noise level and duration. J. Acoust. Soc. Am. 118(5): 3154-3163.

Kastak, D., R.J. Schusterman, B.L. Southall, and C.J. Reichmuth. 1999. Underwater temporary threshold shift induced by octave-band noise in three species of pinniped. J. Acoust. Soc. Am. 106(2): 1142-1148.

Kenow, K.P., C.E. Korschgen, J.M. Nissen, A. Elfessi and R. Steinbach. 2003. A voluntary program to curtail boat disturbance to waterfowl during migration. Waterbirds 26: 77-87.

Ketten, D.R. 1995. Estimates of blast injury and acoustic trauma zones for marine mammals from underwater explosions. p. 391-406. *In*: J.A. Kastelein, P.E. Thomas, and P.E. Nachtigall (Eds.), Sensory Systems of Aquatic Mammals. De Spil, Woerden.

Ketten, D.R., J. O'Malley, P.W.B. Moore, S. Ridgway, and C. Merigo. 2001. Aging, injury, disease, and noise in marine mammal ears. **J. Acoust. Soc. Am.** 110(5, Pt. 2): 2721.

Knapton, R.W., S.A. Petrie, and G. Herring. 2000. Human disturbance of diving ducks on Long Point Bay, Lake Erie. Wildl. Soc. Bull. 28: 923-930.

Knudsen, F.R., P.S. Enger, and O. Sand. 1992. Awareness reactions and avoidance responses to sound in juvenile Atlantic salmon, *Salmo salar* L. J. Fish Biol. 40: 523-534.

Knudsen, F.R., P.S. Enger and O. Sand. 1994. Avoidance responses to low frequency sound in downstream migrating Atlantic salmon smolt, *Salmo salar*. J. Fish Biol. 45: 227-233.

Koski, W.R., D.W. Funk, D.S. Ireland, C. Lyons, K. Christie, A.M. Macrander, and S.B. Blackwell. 2009. An update on feeding by bowhead whales near an offshore seismic survey in the central Beaufort Sea. Intern. Whal. Comm. Working Pap. SC/61/BRG3. 15 p

Kostyvchenko, L.P. 1973. Effects of elastic waves generated in marine seismic prospecting on fish eggs in the Black Sea. Hydrobiol. J. 9: 45-48.

Kryter, K.D. 1994. The handbook of hearing and the effects of noise. Academic Press, Inc., Orlando, FL. 673p.

Kryter, K.D. 1985. The effects of noise on man. Academic Press, Inc., Orlando, FL. 688 p.

La Bella, G., S. Cannata, C. Froglia, A. Modica, S. Ratti, and G. Rivas. 1996. First assessment of effects of air-gun seismic shooting on marine resources in the Central Adriatic Sea. Society of Petroleum Engineers. International Conference on Health, Safety and Environment, New Orleans, Louisiana, 9-12 June. p. 227-238.

Lacroix, D.L., R.B. Lancot, J.A. Reed, and T.L. McDonald. 2003. Effect of underwater seismic surveys on molting male Long-tailed Ducks in the Beaufort Sea, Alaska. Can. J. Zool. 81: 1862-1875.

Ladich, F., and A.N. Popper. 2004. Parallel evolution in fish hearing organs. pp. 98-127. *In*: G.A. Manley, A.N. Popper, and R.R. Fay (eds). Evolution of the Vertebrate Auditory System. Springer-Verlag, New York.

Lagardère, J.-P. 1982. Effects of noise on growth and reproduction of *Crangon crangon* in rearing tanks. Mar. Biol. 71(2): 177-185.

Larsen, F., M.P. Heide-Jørgensen, A.R. Martin, and E.W. Born. 1994. Line-transect estimation of abundance of narwhals (*Monodon monoceros*) in Scoresby Sund and adjacent waters. Meddr. Grønland. Bioscience 39: 87-91.

Lawson, J.W. and V.D. Moulton. 1999. Seals. p. 4-1 to 4-69. *In*: W.J. Richardson (ed.), Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1998. LGL Rep. TA2230-3. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Houston, TX, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 390 p.

LGL. 2008. Project Description for the proposed GX Technology Beaufort Span 2-D Marine Seismic Program, Open-water Season 2008. Rep. by LGL Limited, St. John's, NL and King City, ON for GX Technology Canada Ltd. LGL Rep. No. TA4460-2. 165 p. + appendices.

Ljungblad, D.K., B. Würsig, S.L. Swartz, and J.M. Keene. 1988. Observations on the behavioral responses of bowhead whales (*Balaena mysticetus*) to active geophysical vessels in the Alaskan Beaufort Sea. Arctic 41(3): 183-194.

Løkkeborg, S. 1991. Effects of geophysical survey on catching success in longline fishing. ICES CM B:40. 9 p.

Lovell, J.M., M.M. Findley, R.M. Moate, and H.Y. Yan. 2005. The hearing abilities of the prawn *Palaemon serratus*. Comp. Biochem. Physiol. Part A 140: 89-100.

MacLean, S.A. and W.R. Koski. 2005. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic program in the Gulf of Alaska, August–September 2004. LGL Report TA2822-28. Prepared by LGL Ltd. environmental research associates, King City, ONT, for Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, and NMFS, Silver Spring, MD. 102 p.

Mactavish, B.D. and A.L. Lang. 2011. Marine mammal and seabird monitoring of GX Technology's 2010 2-D seismic program offshore of Northeast Greenland. LGL Rep. SA1097. Rep. by LGL Limited, St. John's, NL, for GX Technology Canada Ltd., Calgary, AB. 32 p.

Madsen, P.T., B. Mohl, B.K. Nielsen, and M. Wahlberg. 2002. Male sperm whale behavior during exposures to distant seismic survey pulses. Aquat. Mamm. 28(3): 231-240.

Madsen, P.T., M. Johnson, P.J.O. Miller, N. Aguilar de Soto, J. Lynch, and P.L. Tyack. 2006. Quantitative measures of air gun pulses recorded on sperm whales (*Physeter macrocephalus*) using acoustic tags during controlled exposure experiments. J. Acoust. Soc. Am. 120(4): 2366–2379.

Mann, D.A., D.M. Higgs, W.N. Tavolga, M.J. Souza, and A.N. Popper. 2001. Ultrasound detection by clupeiform fishes. J. Acoust. Soc. Am. 109(6): 3048-3054.

Matishov, G.G. 1992. The reaction of bottom-fish larvae to airgun pulses in the context of the vulnerable Barents Sea ecosystem. Fisheries and Offshore Petroleum Exploitation 2nd International Conference, Bergen, Norway, 6-8 April 1992.

Matkin, C.O., E.L. Saulitis, G.M. Ellis, P. Olesiuk, and S. Rice. 2008. Ongoing population-level impacts on killer whales *Orcinus orca* following the *Exxon Valdez* oil spill in Prince William Sound, Alaska. Mar. Ecol. Prog. Ser. 356: 269–281.

Mayer, M., and D. Piepenburg. 1996. Epibenthic community patterns on the continental slope off East Greenland at 75ºN. Mar. Ecol. Prog. Ser. 143: 151-164.

McCauley, R.D, J. Fewtrell, A.J. Duncan, C. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000a. Marine seismic surveys: Analysis and propagation of air-gun signals; and effects of air-gun exposure on humpback whales, sea turtles, fishes and squid. Prepared for Australian Petroleum Production and Exploration Association (APPEA), Centre for Marine Science and Technology, Curtin University, Perth, Australia, 198 p.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000b. Marine seismic surveys – a study of environmental implications. APPEA Journal 2000: 692-708.

McCauley, R.D., J. Fewtrell, and A.N. Popper. 2003. High intensity anthropogenic sound damages fish ears. J. Acoust. Soc. Am., 113: 638-642.

McDonald, M.A., J.A. Hildebrand, and S.C. Webb. 1995. Blue and fin whales observed on a seafloor array in the Northeast Pacific. J. Acoust. Soc. Am. 98(2 Pt.1): 712-721.

Miller, G.W., and R.A. Davis (eds.). 2002. Marine mammal and acoustic monitoring of Anderson Exploration Ltd's open-water seismic program in the southeastern Beaufort Sea. Final report by LGL Limited, King City, ON and JASCO Research Limited, Victoria, B.C. for Devon Canada Corporation, Calgary, AB. 199 p.

Miller, G.W,. and V.D. Moulton. 2003. Vessel-based marine mammal monitoring of Devon Canada Corporation's 2002 open-water seismic program in the southeastern Beaufort Sea. Rep. from LGL Ltd., King City, Ont., for Devon Canada Corporation, Calgary, AB. LGL Rep. TA2717. 49 p.

Miller, G.W., R.E. Elliott, W.R. Koski, V.D. Moulton, and W.J. Richardson. 1999. Whales. p. 5-1 to 5-109. *In*: W.J. Richardson (ed., 1999), Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1998. LGL Rep. TA2230-3. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Anchorage, AK, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. xx + 390 p.

Miller, G.W., V.D. Moulton, R.A. Davis, M. Holst, P. Millman, A. MacGillivray, and D. Hannay. 2005. Monitoring seismic effects on marine mammals-southeastern Beaufort Sea, 2001-2002. P.511-542. *In*: S.L. Armsworthy, P.J. Cranford, and K. Lee (eds.), Offshore oil and gas environmental effects monitoring/Approaches and technologies. Battelle Press, Columbus, OH.

Miller, P.J.O., M.P. Johnson, P.T. Madsen, N. Biassoni, M. Quero, and P.L. Tyack. 2009. Using at-sea experiments to study the effects of airguns on the foraging behavior of sperm whales in the Gulf of Mexico. Deep-Sea Res. I 56(7): 1168-1181.

Møhl, B. 1968. Auditory sensitivity of the common seal in air and water. J. Acoust. Soc. Am. 8(1): 27-38.

Mooney, T.A., P.E. Nachtigall, M. Breese, S. Vlachos, and W.W.L. Au. 2009. Predicting temporary threshold shifts in a bottlenose dolphin (*Tursiops truncatus*): the effects of noise level and duration. J. Acoust. Soc. Am. 125(3): 1816-1826.

Mooney, T.A., P.E. Nachtigall, W.W.L. Au, M. Breese and S. Vlachos. 2005. Bottlenose dolphins: effects of noise duration, intensity, and frequency. Abstracts of the 16th biennial conference on the biology of marine mammals, San Diego, CA, 12-16 December 2005.

Mosbech, A., R. Dietz, and J. Nymand. 2000. Preliminary environmental impact assessment of regional offshore seismic surveys in Greenland. Arktisk Miljo/Arctic Environment. 2nd edition. National Environmental Research Institute, Denmark. Research Notes from NERI No. 132.

Moulton, V.D., and G.W. Miller. 2005. Marine mammal monitoring of a seismic survey on the Scotian Slope, 2003. p. 29-40. *In*: K. Lee, H. Bain, and G.V. Hurley (eds.), Acoustic monitoring and marine mammal surveys in the Gully and Outer Scotian Shelf before and during active seismic programs. Env. Stud. Res. Funds Rep. No. 151. xx + 154 p.

Moulton, V.D., and J.W. Lawson. 2000a. Seals, 1999. p. 4-1 to 4-58. *In*: W.J. Richardson (ed.), Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1998. LGL Rep. TA2313-4. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Anchorage, AK, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 155 p.

Moulton, V.D. and J.W. Lawson. 2000b. Seals, 2000. p. 4-1 to 4-39. *In*: W.J. Richardson (ed., 2000), Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 2000: 90-day report. LGL Rep. TA2424-3. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Anchorage, AK, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 123 p.

Moulton, V.D. and J.W. Lawson. 2002. Seals, 2001. p. 3-1 to 3-48. *In*: W.J. Richardson and J.W. Lawson (eds.), Marine mammal and acoustical monitoring of WesternGeco's open-water seismic program in the Alaskan Beaufort Sea, 2001. LGL Rep. TA2564-4. Rep. from LGL Ltd., King City, Ont. for Western Geco LLC, Anchorage, AK, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 95 p.

Moulton, V.D., R.A. Davis, J.A. Cook, M. Austin, M.L. Reece, S.A. Martin, A. MacGillivray, D. Hannay, and M.W. Fitzgerald. 2003. Environmental assessment of Marathon Canada Limited's 3-D seismic program on the Scotian Slope, 2003. LGL Rep. SA744-1. Rep. by LGL Limited, St. John's, Newfoundland for Marathon Canada Ltd., Halifax, Nova Scotia. 173 p.

Nachtigall, P.E., A.Y. Supin, M. Amundin, B. Röken, T. Møller, T.A. Mooney, K.A. Taylor, and M. Yuen. 2007. Polar bear (*Ursus maritimus*) hearing measured with auditory evoked potentials. J. Exp. Biol. 210: 1116–1122.

Nachtigall, P.E., D.W. Lemonds, and H.L. Roitblat. 2000. Psychoacoustic studies of dolphin and whale hearing. p. 330-363. *In*: W.W.L. Au, A.N. Popper and R.R. Fay (Eds.), Hearing by Whales and Dolphins. Springer-Verlag, New York/NY.

NAMMCO (North Atlantic Marine Mammal Commission). 2005. NAMMCO scientific committee working group on the stock status of walruses in the North Atlantic and adjacent seas, Pp. 279-3008 in NAMMCO Annual Report 2005. 380 pp.

Nedwell, J.R., B. Edwards, A.W.H. Turnpenny, and J. Gordon. 2004. Fish and marine mammal audiograms: A summary of available information. Subacoustech Report ref: 534R0214.

Nestler, J.M., G.R. Ploskey, J. Pickens, J. Menezes, and C. Schilt. 1992. Responses of blueback herring to high-frequency sound and implications for reducing entrainment at hydropower dams. N. Am. J. Fish. Manage. 12: 667-683.

Nieukirk, S.L., K.M. Stafford, D.K. Mellinger, R.P. Dziak, and C.G. Fox. 2004. Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean. J. Acoust. Soc. Am. 115(4): 1832-1843.

NMFS (National Marine Fisheries Service). 2000. Small takes of marine mammals incidental to specified activities; marine seismic-reflection data collection in southern California/Notice of receipt of application. Fed. Regist. 65(60, 28 Mar.): 16374-16379.

NMFS (National Marine Fisheries Service). 1995. Small takes of marine mammals incidental to specified activities; offshore seismic activities in southern California/Notice of issuance of an Incidental Harassment Authorization. Fed. Regist. 60(200): 53753-53760.

Nowacek, D.P., L.H. Thorne, D.W. Johnston, and P.L. Tyack. 2007. Responses of cetaceans to anthropogenic noise. Mammal Rev. 37(2): 81-115.

NRC (National Research Council). 2005. Marine mammal populations and ocean noise, determining when noise causes biologically significant effects. The National Academy Press, Washington, DC.

Øritsland, N.A., F.R. Engelhardt, F.A. Juck, R.J. Hurst, and P.D. Watts. 1981. Effect of crude oil on polar bears. Dep. Indian Affairs and Northern Develop. Ottawa, ON. Environ. Stud. 24. 268 p.

Payne, J.F. 2004. Potential effect of seismic surveys on fish eggs, larvae, and zooplankton. Can. Sci. Advis. Sec. Res. Doc. 2004/125.

Payne, J.F., C. Andrews, L. Fancey, D. White, and J. Christian. 2008. Potential effects of seismic energy on fish and shellfish: An update since 2003. Can. Sci. Advis. Sec. Res. Doc. 2008/060.

Payne, J.F., C.A. Andrews, L.L. Fancey, A.L. Cook, and J.R. Christian. 2007. Pilot study on the effect of seismic air gun noise on lobster (*Homarus americanus*). Can. Tech. Rep. Fish. Aquat. Sci. 2712.

Payne, J.F., J. Coady, and D. White. 2009. Potential effects of seismic airgun discharges on monkfish eggs (*Lophius americanus*) and larvae. Environ. Stud. Res. Funds Rep. 170. St. John's, NL. 35 p.

Pearson, W., J. Skalski, S. Sulkin, and C. Malme. 1994. Effects of seismic energy releases on the survival and development of zoeal larvae of Dungeness crab (*Cancer magister*). Mar. Environ. Res. 38: 93-113.

Pearson, W.H., J.R. Skalski, and C.I. Malme. 1992. Effects of sounds from a geophysical survey device on behaviour of captive rockfish (*Sebastes* spp). Can. J. Fish. Aquat. Sci. 49(7): 1343-1356.

Piepenburg, F., and M.K. Schmid. 1996. Distribution, abundance, biomass, and mineralization potential of the epibenthic megafauna of the northeast Greenland shelf. Mar Biol 125(2): 321-332.

Popper, A.N. 2009. Are we drowning out fish in a sea of noise? Mar. Scient. 27: 18-20.

Popper, A.N., and M.C. Hastings. 2009a. The effects of human-generated sound on fish. Integr. Zool. 4(1): 43-52.

Popper, A.N., and M.C. Hastings. 2009b. The effects of anthropogenic sources of sound on fishes. J. Fish Biol. 75(3): 455-489.

Popper, A.N., M. Salmon, and K.W. Horch. 2001. Acoustic detection and communication by decapod crustaceans. J. Comp. Physiol. A 187: 83-89.

Popper, A.N., M.E. Smith, P.A. Cott, B.W. Hanna, A.O. MacGillivray, M.E. Austin, and D.A. Mann. 2005. Effects of exposure to seismic airgun use on hearing of three fish species. J. Acoust. Soc. Am. 117(6): 3958-3971.

Popper, A.N., R.R. Fay, C. Plat, and O. Sand. 2003. Sound detection mechanisms and capabilities of teleost fishes. pp. 3-38. *In*: S.P. Collin and N.J. Marshall (eds). Sensory Processing in Aquatic Environments. Springer-Verlag, New York.

Potter, J.R., M. Thillet, C. Douglas, M.A. Chitre, Z. Doborzynski, and P.J. Seekings. 2007. Visual and passive acoustic marine mammal observations and high-frequency seismic source characteristics recorded during a seismic survey. IEEE J. Oceanic Eng. 32(2): 469-483.

Reiser, C.M., B. Haley, J. Beland, D.M. Savarese, D.S. Ireland, and D.W. Funk. 2009. Evidence of short-range movements by phocid species in reaction to marine seismic surveys in the Alaskan Chukchi and Beaufort seas. p. 211. *In*: Abstr. 18th Bienn. Conf. Biol. Mar. Mamm., Québec, Canada, Oct. 2009. 306 p.

Richardson, W.J., and B. Würsig. 1997. Influences of man-made noise and other human actions on cetacean behaviour. Mar. Freshwat. Behav. Physiol. 29(1-4): 183-209.

Richardson, W.J., and C.I. Malme. 1993. Man-made noise and behavioral responses. p. 631-700. *In*: J.J. Burns, J.J. Montague and C.J. Cowles (eds.), The bowhead whale. Spec. Publ. 2. Soc. Mar. Mamm., Lawrence, KS. 787 p.

Richardson, W.J., B. Würsig, and C.R. Greene Jr. 1986. Reactions of bowhead whales, *Balaena mysticetus*, to seismic exploration in the Canadian Beaufort Sea. J. Acoust. Soc. Am. 79(4): 1117-1128.

Richardson, W.J., C.R. Greene Jr., C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. Academic Press, San Diego. 576 p.

Richardson, W.J., C.R. Greene, J.P. Hickie, R.A. Davis, and D.H. Thomson. 1989. Effects of offshore petroleum operations on cold water marine mammals: A literature review. 2nd edition. Rep. from LGL Ltd., King City, Ont., for Am. Petrol. Inst., Washington, D.C. 385 p.

Richardson, W.J., G.W. Miller, and C.R. Greene, Jr. 1999. Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea. J. Acoust. Soc. Amer. 106(4, Pt. 2): 2281. (Abstract)

Richardson, W.J., M. Holst, W.R. Koski, and M. Cummings. 2009. Responses of cetaceans to large-source seismic surveys by Lamont-Doherty Earth Observatory. p. 213. *In*: Abstr. 18th Bienn. Conf. Biol. Mar. Mamm., Québec, Oct. 2009. 306 p.

Richardson, W.J., M.A. Fraker, B. Würsig, and R.S. Wells. 1985a. Behaviour of bowhead whales *Balaena mysticetus* summering in the Beaufort Sea: Reactions to industrial activities. Biol. Conserv. 32(3): 195-230.

Richardson, W.J., R.S. Wells, and B. Würsig. 1985b. Disturbance responses of bowheads, 1980-84. p. 89-196. *In*: W.J. Richardson (ed.), Behaviour, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1980-84. OCS Study MMS 85-0034. Rep. from LGL Ecol. Res. Assoc. Inc., Bryan, TX, for U.S. Minerals Manage. Serv., Reston, VA. 306 p. NTIS PB87-124376.

Ridgway, S.H., D.A. Carder, R.R. Smith, T. Kamolnick, C.E. Schlundt, and W.R. Elseberry. 1997. Behavioral responses and temporary shift in masked hearing threshold of bottlenose dolphins, *Tursiops truncatus*, to 1-second tones of 141 to 201 dB re 1 µPa. Tech. Rep. 1751. Tech. Rep. to NRaD, RDT&E Div., Naval Command, Control & Ocean Surveillance Center, San Diego, CA. 27 p.

Schlundt, C.E., J.J. Finneran, D.A. Carder, and S.H. Ridgway. 2000. Temporary shift in masked hearing thresholds of bottlenose dolphins, *Tursiops truncatus*, and white whales, *Delphinapterus leucas*, after exposure to intense tones. J. Acoust. Soc. Am. 107(6): 3496-3508.

Schwarz, A.L., and G.L. Greer. 1984. Responses of Pacific herring, *Clupea harengus pallasi*, to some underwater sounds. Can. J. Fish. Aquat. Sci. 41: 1183-1192.

Sejr, M.K., K.T. Jensen, and S. Rysgaard. 2000. Macrozoobenthic community structure in a high-arctic East Greenland fjord. Polar Biol. 23: 792-801.

Skalski, J.R., W.H. Pearson, and C.I. Malme. 1992. Effects of sounds from a geophysical survey device on catch-per-unit-effort in a hook-and-line fishery for rockfish (*Sebastes* spp.). Can. J. Fish. Aquat. Sci. 49(7): 1357-1365.

Slotte, A., K. Hansen, J. Dalen, and E. Ona. 2004. Acoustic mapping of pelagic fish distribution and abundance in relation to a seismic shooting area off the Norwegian coast. Fish. Res. 67: 143-150.

Smith, C.L., and W.G. McIntyre. 1971. Initial aging of fuel oil films on sea water. p. 457-461. *In*: Proc. Joint Conf. on Prevention and Control of Oil Spills. Amer. Petrol. Instit., Washington, D.C.

Smith, M.E., A.S. Kane, and A.N. Popper. 2004. Noise-induced stress response and hearing loss in goldfish (*Carassius auratus*). J. Exp. Biol. 207: 427-435.

Smultea, M.A., M. Holst, W.R. Koski, and S. Stoltz. 2004. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic program in the Southeast Caribbean Sea and adjacent Atlantic Ocean, April-June 2004. LGL Report TA2822-26. Prepared by LGL Ltd. environmental research associates, King City, ONT, for L-DEO, Columbia University, Palisades, NY. 106 p.

Song, J., D.A. Mann, P.A. Cott, B.W. Hanna, and A.N. Popper. 2008. The inner ears of Northern Canadian freshwater fishes following exposure to seismic air gun sounds. J. Acoust. Soc. Am. 124(2): 1360-1366.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aquat. Mamm. 33(4): 411-522.

Southall, B.L., R.J. Schusterman, D. Kastak, and C. Reichmuth Kastak. 2005. Reliability of underwater hearing thresholds in pinnipeds. Acoust. Res. Lett. Onl. 6(4): 243-249.

Sprague, J.B., J.H. Vandermeulen, and P.G. Wells (eds.). 1982. Oil and dispersants in Canadian seas--research appraisal and recommendations. Envir. Protect. Serv. Rep. Ser. EPS 3-EC-82-2. 185 p.

Starmans, A, J. Gutt, and W.E. Arntz. 1999. Mega-epibenthic communities in Arctic and Antarctic shelf areas. Mar. Biol. 135(2): 269-80.

Statistics of Greenland. 2008. Kalaallit Ninaat/Grønland 2007. – Naatsorsueqqissartarfik/ Grønlands Statistik.

Stemp, R. 1985. Observations on the effects of seismic exploration on seabirds. pp. 217-233. *In*: G.D. Greene, F.R. Engelhardt, and R.J. Peterson (eds.), Proceedings of workshop on effects of explosives use in the marine environment. Cdn. Oil and Gas Admin., Env. Prot. Branch, Tech. Rep. No. 5. Ottawa.

Stone, C.J., and M.L. Tasker. 2006. The effects of seismic airguns on cetaceans in UK waters. J. Cetacean Res. Manage. 8(3): 255-263.

Sverdrup, A., E. Kjellsby, P.G. Krüger, R. Fløysand, F.R. Knudsen, P.S. Enger, G. Serck-Hanssen, and K.B. Helle. 1994. Effects of experimental seismic shock on vasoactivity of arteries, integrity of the vascular endothelium and on primary stress hormones of the Atlantic salmon. J. Fish Biol. 45: 973-995.

Terhune, J., and S. Turnbull. 1995. Variation in the psychometric functions and hearing thresholds of a harbour seal. p. 81-93. *In*: R.A. Kastelein, J.A. Thomas, and P.E. Nachtigall (eds.), Sensory Systems of Aquatic Mammals. De Spil Publishers, Woerden, Netherlands.

Terhune, J.M., and K. Ronald. 1975. Masked hearing thresholds of ringed seals. J. Acoust. Soc. Am. 58(2): 515-516.

Thompson, P.M., M. Sjöberg, E.B. Bryant, P. Lovell, and A. Bjørge. 1998. Behavioural and physiological responses of harbour (*Phoca vitulina*) and grey (*Halichoerus grypus*) seals to seismic surveys. p. 134. *In*: World Marine Mammal Science Conference abstract volume, Monaco. 160 p.

Thomson, D.H., M.A. McLaren, and A.D. Sekerak. 1981. Review of the effects of oil on marine flora and fauna with special reference to arctic regions. Rep. by LGL Limited., for Petro-Canada Exploration Inc., Calgary. 120 p.

Tyack, P., M. Johnson, and P. Miller. 2003. Tracking responses of sperm whales to experimental exposures of airguns. p. 115-120. *In*: A.E. Jochens and D.C. Biggs (eds.), Sperm whale seismic study in the Gulf of Mexico/Annual Report: Year 1. OCS Study MMS 2003-069. Rep. from Texas A&M Univ., College Station, TX, for U.S. Minerals Manage. Serv., Gulf of Mexico OCS Reg., New Orleans, LA.

Tyack, P.L. 2008. Implications for marine mammals of large-scale changes in the marine acoustic environment. J. Mamm. 89(3): 549-558.

Tyack, P.L., M.P. Johnson, P.T. Madsen, P.J. Miller, and J. Lynch. 2006. Biological significance of acoustic impacts on marine mammals: examples using an acoustic recording tag to define acoustic exposure of sperm whales, *Physeter catodon*, exposed to airgun sounds in controlled exposure experiments. Eos, Trans. Am. Geophys. Union 87(36), Joint Assembly Suppl., Abstract OS42A-02. 23-26 May, Baltimore, MD.

Vihjálmsson, H., A. Håkon Hoel, S. Agnarsson, R. Arnason, J.E. Carscadden, A. Eide, D. Fluharty, G. Hønneland, C. Hvingel, J. Jakobsson, G. Lilly, O. Nakken, V. Radchenko, S. Ramstad, W. Schrank, N. Vestergaard, and T. Wilderbuer. 2010. Fisheries and aquaculture in the Central North Atlantic (Iceland and Greenland). Section 13.3 of the Arctic Climate Impact Assessment. Accessed at: http://www.eoearth.org/article/Fisheries_and_aquaculture_in_the_Central_North_Atlantic_%28Iceland_and_Greenland%29

von Dorrien, C., M. Schmid, D. Piepenburg, and J. Rust. 1991. Benthos and Fish. p.27-37. *In*: The expedition ARKTIS VII of RV *Polarstern* in 1990 (Leg ARK VII/2). Ed. Krause, G. Ber. Polarforsch. 93 –ISSN 0176-5027

Wardle, C.S., T.J. Carter, G.G. Urquhart, A.D.F. Johnstone, A.M. Ziolkowski, G. Hampson, and D. Mackie. 2001. Effects of seismic air guns on marine fish. Cont. Shelf Res. 21(8-10): 1005-1027.

Wartzok, D., W.A. Watkins, B. Würsig, and C.I. Malme. 1989. Movements and behaviors of bowhead whales in response to repeated exposures to noises associated with industrial activities in the Beaufort Sea. Rep. from Purdue Univ., Fort Wayne, IN, for Amoco Production Co., Anchorage, AK. 228 p.

Weilgart, L.S. 2007. The impacts of anthropogenic ocean noise on cetaceans and implications for management. Can. J. Zool. 85(11): 1091-1116.

Weir, C.R. 2008. Overt responses of humpback whales (*Megaptera novaeangliae*), sperm whales (*Physeter macrocephalus*), and Atlantic spotted dolphins (*Stenella frontalis*) to seismic exploration off Angola. Aquat. Mamm. 34(1): 71-83.

Wiig, Ø., L. Bachmann, J.M. Vincent, K.M. Kovacs, and C. Lydersen. 2007. Spitsbergen bowhead whales revisited. Mar. Mamm. Sci. 23: 688-693.

Winsor, M.H., and B.R. Mate. 2006. Seismic survey activity and the proximity of satellite tagged sperm whales. Intern. Whal. Comm. Working Pap. SC/58/E16. 8 p.

WWF (World Wildlife Fund). 2008. Kalaallit Nunaat high arctic tundra (NA1112). Accessed at: http://www.worldwildlife.org/wildworld/profiles/terrestrial/na/na1112_full.html.

Personal Communications

J. Christiansen — Department of Aquatic BioSciences, University of Tromsø
C. Egevang — Department of Arctic Environment
C. Marcussen — GEUS
A. Mosbech — National Environmental Research Institute

Appendices

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Appendix 1. Important Bird Areas and Ramsar Sites within the KANUMAS East Assessment Area.
Location includes minimum distance (in parentheses) from the approximate centre of the IBA to the Project Area. Grey shading indicates sites which occur well south of the Study Area.

	Name	Location	Size (ha)	Habitat	Importance
1	Kilen (also Ramsar site)	81º15'N, 13º30'W (35.0 km)	51,300	A flat, gravel plain comprising polar desert and melt-water rivers, surrounded on three sides by glaciers and on the fourth by the polar sea.	*Non-breeding*: 625 Brent Geese (moulting); 2,500 Common Eider and 1,000 King Eider (staging) *Breeding*: 70 pairs Brent Geese, 35 Ivory Gulls 20-30 Sabine's Gulls, 50 Arctic Terns.
2	Henrik Krøyer Holme	80º45'N, 13º45'W (within Proj. Area)	1,000	Three small, low-lying, barren islands located in the north-eastern water polynya.	*Breeding*: 510 Ivory Gulls; possible breeding Ross's Gulls
3	Western part of Germania land	77º15'N, 22º0'W (104.5 km)	100,000	Rolling tundra lowland with lakes and ponds, situated adjacent to the Inland Ice between 76°45'N and 77°35'N. Large expanses of bare ground (moraine) occur close to the ice sheet.	*Non-breeding*: 7,000 Pink-footed Geese, significant moulting site. *Breeding*: Diverse breeding birds that are restricted in Europe to the Arctic/tundra biome (Pink-footed Goose, Barnacle Goose, King Eider, Sanderling, Gray Phalarope and Long-tailed Skua).
4	South coast of Germania Land, and Slaedelandet	76º50'N, 19º20'W (44.4 km)	35,000	A 5-10 km wide expanse of gravel moraines and uplifted former sea floor, separating the large fjord-like Lake Saelsøen from Dove Bay. The area is crossed by several rivers, notably Lakseelven, and there are numerous small lakes and ponds with narrow fringes of vegetation. Arctic tundra grows on the slopes	*Non-breeding*: Moulting area for 1,500 Pink-footed Geese and 350 Barnacle Geese. *Breeding*: Diverse breeding birds that are restricted in Europe the Arctic/tundra biome (Barnacle Goose, Long-tailed Duck, Gyrfalcon, Red Knot, Sanderling, Gray Phalarope, Long-tailed Skua and Snowy Owl.

	Name	Location	Size (ha)	Habitat	Importance
				rising up towards the hinterland.	
5	Hochstetter Forland (also Ramsar site)	75º27'N, 20º0'W (56.5 km)	184,800	An extensive area of coastal tundra with river valleys and wetlands.	*Non-breeding*: Moulting area for 3,000 Pink-footed Geese and 400 Barnacle Geese. *Breeding*: Diverse breeding birds that are restricted in Europe the Arctic/tundra biome (Barnacle Goose, King Eider, Long-tailed Duck, Red Knot, Sanderling, Gray Phalarope and Long-tailed Skua.
6	Albrecht Sletten (Storsletten), Wollaston Forland	74º30'N, 20º0'W (64.3 km)	30,000	An extensive area of tundra with several ponds.	*Non-breeding*: 2,000 Pink-footed Geese moulting. *Breeding*: Long-tailed Duck, waders and Long-tailed Skua.
7	Østersletten and Knudshoved, Hold With Hope	73º34'N, 20º45'W (72.6 km)	55,000	A large, rather dry area of lowland traversed by two rivers. The site includes the mouth of the Tobias Dal valley.	*Non-breeding*: Moulting area for 350 Barnacle Geese
8	Stordal-Moskusoksefjord-Badlanddal-Loch Fyne-Myggbukta	73º30'N, 22º0'W (113.2 km)	90,000	A series of converging, wide glacial valleys in otherwise mountainous terrain, containing fjords, seasonal stream channels and water-bodies, and tundra vegetation overlying thick glacial deposits. Moskusoksefjord and Loch Fyne are long, narrow sea inlets that continue inland as valleys. The site includes Ternholme˜a flat, low-lying island located 2.5 km offshore from Myggbukta.	*Non-breeding*: Moulting area for Pink-footed Geese and 440 Barnacle Geese. *Breeding*: Snowy Owl, waders, Long-tailed Skua and Common Eider
9	Enhjørningens Dal and Pingel	71º37'N, 23º7'W	50,000	Two river valleys situated in eastern Scoresby Land, with marsh	*Non-breeding*: An important moulting and breeding site for Brent Geese (750).

	Name	Location	Size (ha)	Habitat	Importance
	Dal	(269.6 km)		and dwarf-shrub heath vegetation.	
10	Ørsted Dal and Coloradodal	71º40'N, 23º22'W (271.5 km)	40,000	A c.60-km long valley containing marshes, lakes, ponds and gravel plains, bisecting a plateau (700-1,000 m) in Scoresby Land	*Non-breeding*: 1,864 Barnacle Geese *Breeding*: 60 Pink-footed Geese and 200 Barnacle Geese.
11	Liverpool Land coast and mouth of Scoresby Sund	71º0'N, 21º40'W (293.2 km)	150,000	A rocky coastline with cliffs and small offshore islands (Raffles Ø and Rathbone Ø), extending from 70°30'N to 71°30'N. Scoresby Sund is the mouth of a wide fjord between Liverpool Land coast and Kap Brewster (IBA 042), which remains ice-free for much of the year due to strong tidal currents (i.e. a polynya). The nutrient-rich waters provide excellent feeding for seabirds. Subsistence hunting takes place.	*Breeding*: 3.5 million pairs of Little Auks (Internationally significant numbers). Also 2,000 Brünnich's Guillemot.
12	Kjoveland	71º22'N, 24º47'W (330.8 km)	15,000	An area of tundra and dwarf-shrub heath situated in western Jameson Land, containing lakes, rivers and several marshes. Subsistence hunting takes place.	*Non-breeding*: 621 moulting Barnacle Geese
13	Heden (also Ramsar site)	71º0'N, 24º7'W (344.2 km)	252,400	Situated in the western part of Jameson Land, this site comprises flat tundra (mainly dwarf-shrub heath and grassland) and areas of bare ground interspersed with many rivers, lakes and ponds. The	*Non-breeding*: Very important numbers of moulting Pink-footed Geese (5,300) and Barnacle Geese (1,750). Note: In 2010 there is a proposal to add Ørsted Dal to the Ramsar site to compensate for mining activities to take place at Gurreholm located within the Heden

	Name	Location	Size (ha)	Habitat	Importance
				primary habitats for geese are areas of marsh and wet grassland adjacent to lakes and streams, and coastal saltmarshes.	Ramsar site (Glahder et al. 2010). The Ørsted Dal area will include 4,700 moulting Barnacle Geese (an additional 7%) of the breeding population of Greenland Barnacle Geese to the Ramsar site.
14	Kap Brewster and Volquart Boon's coast	70º10'N, 23º22'W (406.5 km)	20,000	Rocky coastline and cliffs located on the south shore of Scoresby Sund (IBA 043), extending from 22°W to 25°W. Subsistence hunting takes place	*Breeding*: Internationally significant numbers of breeding Little Auk (999,999). Brünnich's Guillemot (15,000) and Black-legged Kittiwake also breed.

Source: BirdLife International website (www.birdlife.org/datazone/sites/index.html?action=SitHTMFindResults.asp&INam=&Reg=7&Cty=85). Accessed 3 March 2010.

Appendix 2. List of Marine-Associated Birds and Summary of their Distribution and Abundance in Northeast Greenland

Species	Scientific Name	Occurrence in Northeast Greenland	Greenland Red List Status
Gaviidae			
Red-throated Diver	*Gavia stella*	Widespread, sparse breeder	LC
Great Northern Diver	*Gavia immer*	Sparse breeder	NT
Procellariidae			
Northern Fulmar	*Fulmarus glacialis*	A few colonies, common offshore in summer	LC
Sulidae			
Northern Gannet	*Morus bassanus*	Rare offshore, summer	NL
Anatidae			
Pink-footed Goose	*Anser brachyrhynchus*	Breeder, Common moulting	LC
Snow Goose	*Chen caerulescens*	Breeder, rare	NL
Canada Goose	*Branta Canadensis*	Rare	LC
Barnacle Goose	*Branta leucopsis*	Common breeder.	LC
Brent Goose	*Branta bernicla*	Former breeder, now rare migrant	NT
Common Teal	*Anas crecca*	Rare summer	NL
Mallard	*Anas platyrhynchos*	Rare summer	LC
Common Eider	*Somateria mollissima*	Common breeder. Uncommon winter.	LC
King Eider	*Somateria spectabilis*	Common breeder	LC
Harlequin Duck	*Histrionicus histronicus*	Rare summer	NL
Long-tailed Duck	*Clangula hyemalis*	Common widespread breeder	LC
Red-breasted Merganser	*Mergus serrator*	Rare breeder	NL
Charadriiformes			
Common Ringed Plover	*Charadrius hiaticula*	Common breeder	LC
Red Knot	*Calidris canutus*	Locally common breeder	LC
Sanderling	*Calidris alba*	Common breeder	LC
Purple Sandpiper	*Calidris maritime*	Scarce breeder	NL
Dunlin	*Calidris alpina*	Common breeder	LC
Whimbrel	*Numenius phaeopus*	Rare breeder	NT

Ruddy Turnstone	*Arenaria interpres*	Common breeder	LC
Red-necked Phalarope	*Phalaropus lobatus*	Scarce breeder	LC
Grey Phalarope	*Phalaropus fulicarius*	Uncommon breeder	LC
Laridae			
Pomarine Skua	*Stercorarius pomarinus*	Locally common summer visitor	NL
Arctic Skua	*Stercorarius parasiticus*	Common breeder	LC
Long-tailed Skua	*Stercorarius longicaudus*	Common breeder	NL
Great Skua	*Stercorarius skua*	Uncommon offshore	NL
Lesser black-backed Gull	*Larus fuscus*	Rare breeder, increasing	LC
Herring Gull	*Larus argentatus*	Rare summer vagrant	NL
Iceland Gull	*Larus glaucoides*	Summer and autumn vagrant	LC
Glaucous Gull	*Larus hyperboreus*	Widespread/common to sparse breeder	LC
Great black-backed Gull	*Larus marinus*	Annual summer vagrant	NL
Black-legged Kittiwake	*Rissa tridactyla*	Only a few colonies	VU
Ross's Gull	*Rhodostethia rosea*	Rare visitor	VU
Sabine's Gull	*Xema sabini*	Several breeding colonies; uncommon summer visitor in most coastal areas	NT
Ivory Gull	*Pagophila eburnea*	Locally common migrant and summer visitor; breeds in north.	VU
Arctic Tern	*Sterna paradisaea*	Widespread; sparse and locally common breeder	NT
Alcidae			
Brünnich's Guillemot	*Uria lomvia*	A few large colonies near Scoresby Sund	VU
Razorbill	*Uria aalge*	A few records near Scoresby Sund	LC
Black Guillemot	*Cepphus grylle*	Common breeder	LC
Little Auk	*Alle alle*	Huge colonies near Scoresby Sund	LC
Atlantic Puffin	*Fratercula arctica*	One small breeding colony	NT

Source: Boertmann (1994, 2008); Boertmann et al. (2009a). NL = Not Listed; LC = Least Concern;
VU = Vulnerable; NT = Near Threatened.

Appendix 3: Overview of Marine Mammals Occurring in the KANUMAS East Assessment Area. Modified from Boertmann et al. (2009a).

Common Name	Scientific Name	Period of occurrence	Main habitat	Distribution and occurrence in assessment area	Protection/ exploitation	Greenland Red List status[1]	Assessment area importance to population
Polar bear	*Ursus maritimus*	Whole year	Mainly ice covered waters	Widespread	Hunting regulated	VU	High
Walrus	*Odobenus rosmarus*	Whole year	Coastal waters	Low numbers, very localised	Hunting regulated	NT	High
Hooded seal	*Cystophora cristata*	Mar to Oct	Whelp on drift ice	Numerous	Hunting unregulated	LC	High
Harp seal	*Phoca groenlandica*	Mar to Oct	Whelp on drift ice	Numerous	Hunting unregulated	LC	High
Bearded seal	*Erignathus barbatus*	Whole year	Both in coastal and offshore waters	Widespread in low numbers	Hunting unregulated	DD	High
Ringed seal	*Phoca hispida*	Whole year	Whole area, usually in ice	Common and widespread	Hunting unregulated	LC	High
Bowhead whale	*Balaena mysticetus*	Whole year?	Marginal ice zone	Widespread, few	Protected (1932)	CR	High
Minke whale	*Balaenoptera acutorostrata*	Jun to Oct	Ice free waters	Unknown[2]	Hunting regulated	LC	Potentially medium
Sei whale	*Balaenoptera borealis*	Jun to Oct	Ice free waters	Unknown[2]	Protected	DD	Potentially medium
Blue whale	*Balaenoptera musculus*	Jul to Oct	Ice free waters	Unknown[2]	Protected (1966)	DD	Potentially medium
Fin whale	*Balaenoptera physalus*	Jun to Oct	Ice free waters	Unknown[2]	Hunting regulated	LC	Potentially medium

Common Name	Scientific Name	Period of occurrence	Main habitat	Distribution and occurrence in assessment area	Protection/ exploitation	Greenland Red List status[1]	Assessment area importance to population
Humpback whale	*Megaptera novaeangliae*	Jun to Oct	Ice free waters	Unknown[2]	Protected (1986)	LC	Potentially medium
Pilot whale	*Globicephala melas*	Jun to Oct	Outside the ice covered areas	Unknown[2]	Hunting unregulated	LC	Probably low
White-beaked dolphin	*Lagenorhynchus albirostris*	Jun to Oct	Outside ice covered areas	Unknown[2]	Hunting unregulated	NA	Probably low
Killer whale	*Orcinus orca*	Jun to Aug	Mainly ice free waters, whole area	Unknown[2]	Hunting unregulated	NA	Unknown
Beluga	*Delphinapterus leucas*	Summer	Fjords and shallow waters	Very rare	Hunting unregulated	CR	Low
Narwhal	*Monodon monoceros*	Whole year	Fjords, ice edges	Common	Hunting unregulated	DD	High
Sperm whale	*Physeter macrocephalus*	May to Nov	Deep waters, southern part	Unknown	Protected (1985)	NA	Probably low
Northern bottlenose whale	*Hyperoodon ampullatus*	May to Nov	Deep waters only, mainly in south	Probably rare	Unregulated	NA	Probably low

Modified from Boertmann et al. (2009a)

[1] Red-list status from Boertmann et al (2009a). NA=Not Applicable; DD=Data Deficient; LC=Least Concern; VU=Vulnerable; NT=Near Threatened; CR=Critically Endangered.

[2] No or limited data available for the KANUMAS East assessment area, but species is abundant in neighbouring Norwegian and/or Icelandic waters.

MARINE MAMMAL SCIENCE, 17(4):795–812 (October 2001)
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SEAL RESPONSES TO AIRGUN SOUNDS DURING SUMMER SEISMIC SURVEYS IN THE ALASKAN BEAUFORT SEA

ROSS E. HARRIS
GARY W. MILLER
W. JOHN RICHARDSON[1]

LGL Ltd., environmental research associates,
22 Fisher Street, P. O. Box 280,
King City, Ontario L7B 1A6, Canada
E-mail: wjr@lgl.com

ABSTRACT

Numbers, sighting distances, and behavior of seals were studied during a nearshore seismic program off northern Alaska in July–September 1996. We observed from the seismic vessel for 885.6 h, including all periods (day and night) when airguns operated and many periods without airguns. Of 422 seals seen, 421 were seen in daylight; 91.8% were ringed seals, 7.3% were bearded seals, and 0.9% were spotted seals. About 79% were first seen within 250 m of the seismic boat, and sighting rate declined rapidly at lateral distances >50 m. During daylight, seals were seen at nearly identical rates (0.60–0.63/h) during periods with no airguns firing, one airgun, and a "full-array" of 8–11 120-in^3 airguns. However, seals tended to be farther away ($P < 0.0001$) during full-array seismic. There was partial avoidance of the zone <150 m from the boat during full-array seismic, but seals apparently did not move much beyond 250 m. "Swimming away" was more common during full-array than no-airgun periods, but relative frequencies of five behaviors did not differ significantly among distance categories. Airgun operations were interrupted 112 times when seals were sighted within safety radii (150–250 m). The National Marine Fisheries Service specified these radii in the Incidental Harassment Authorization issued for the project; they are based on a 190 dB re 1 μPa (rms) criterion for broadband received level. Methods for estimating numbers of seals potentially affected by the seismic program are described, and effectiveness of monitoring and mitigation is discussed. There is an urgent need for more data on effects of strong seismic pulses on seals.

Key words: ringed seal, *Phoca hispida,* Beaufort Sea, Alaska, arctic, seismic disturbance, airgun array, underwater noise, behavior, harassment.

[1] Person to whom correspondence should be sent.

In recent years arrays of airguns have been the usual source of the strong pulses of underwater sound used for open-water seismic surveys. Nominal source levels, pertaining to downward propagation, are typically 245–255 dB re 1 μPa-m (instantaneous peak). Several pulses are emitted per minute, usually at uniform intervals. Received levels in the near field are high, but are less than expected from the nominal source level. This occurs because an array of airguns is not a point source, and because less sound propagates horizontally than downward (Caldwell and Dragoset 2000, Dragoset 2000). Nonetheless, in the Beaufort Sea, airgun pulses are often at least faintly detectable 50–100 km away (Greene and Richardson 1988, Richardson *et al.* 1995, Greene 1997). Most emitted sound energy is at frequencies below 125 Hz. However, there is also some energy at higher frequencies. In shallow water it is often the components at 100–500 Hz that are detectable farthest away.

Reactions of pinnipeds to open-water seismic exploration are poorly documented. An airgun caused an initial startle reaction among South African fur seals (*Arctocephalus pusillus*), but was ineffective in scaring them away (Anonymous 1975). Gray seals (*Halichoerus grypus*) exposed to noise from airguns did not react strongly (J. Parsons *in* G. D. Greene *et al.* 1985:283), but no details were given. Seals in the water sometimes tolerate strong noise pulses from scaring devices, especially if attracted to the area for feeding or reproduction (Richardson *et al.* 1995:304, 311; Reeves *et al.* 1996). The relevance of these observations to disturbance by a moving seismic vessel is uncertain. On-ice seismic exploration in winter/spring by the Vibroseis method may cause localized displacement of some ringed seals, *Phoca hispida* (Kelly *et al.* 1988, Richardson *et al.* 1995:291). However, the circumstances and sounds associated with on-ice Vibroseis operations *vs.* open-water airgun operations are very different.

Source levels of pulses from airgun arrays are high enough to raise concern about the possibility that they might cause temporary or even permanent hearing damage to marine mammals exposed at close range (Richardson *et al.* 1995:372, NMFS 1995, HESS 1999). However, there are no specific data on hearing damage from sequences of seismic pulses.

Some recent open-water seismic programs in U.S. waters have been conducted under Incidental Harassment Authorizations (IHAs), as provided for by the 1994 amendments to the Marine Mammal Protection Act (NMFS 1996*a*). An IHA allows disturbance of small numbers of marine mammals if no serious injuries or deaths are expected, impacts on the stocks will be negligible, no unmitigable adverse impacts on subsistence uses are expected, and monitoring is done to confirm these predictions. Received levels that might cause injury (*e.g.*, hearing damage) are uncertain. Since 1995, IHAs issued for high-energy seismic surveys in California and Alaska have required immediate interruption of airgun operations when pinnipeds were seen within the estimated 190 dB re 1 μPa (rms) radius (*e.g.*, NMFS 1995, 1996*b*). The rms level of a seismic pulse is the average broadband level during the duration of the pulse (see Methods).

During the summer and autumn of 1996, BP Exploration (Alaska) Inc. and

its seismic contractor Northern Geophysical of America Inc. conducted a 3-dimensional (3-D) seismic survey in shallow, nearshore waters of the Alaskan Beaufort Sea near Prudhoe Bay. Ringed seals are common in the area. Bearded seals (*Erignathus barbatus*) and a few spotted seals (*Phoca largha*) are also present. None of these species is listed as endangered, threatened, or a strategic stock (Hill and DeMaster 1998). This seismic program was conducted under the provisions of an IHA (NMFS 1996*b,c*). We stationed marine mammal observers aboard the source vessel to monitor the numbers and reactions of seals and other marine mammals, and to call for the airguns to be shut down when mammals were seen within a specified radius. For seals, this was the 190 dB re 1 μPa (rms) radius. Levels and characteristics of the sound pulses were also measured (Greene 1997). This paper describes the observations of seals near the seismic operation, and discusses the monitoring and mitigation implications.

Methods

Study Area and Season

Seismic exploration occurred on 49 of 57 d from 24 July to 18 September 1996. Seismic surveys were suspended when wind speed exceeded ~65 km/h, when there was too much ice for operations, and for other logistical reasons. Drifting ice pans were present at most times, usually covering 1%–5% of the surface but occasionally up to 20%. New ice began to form after 11 September.

Up to 8 August seismic operations were ~30 km east of Prudhoe Bay near the McClure Islands, mainly in a lagoon inshore of the barrier islands (water depths 3–8 m). Thereafter, seismic operations occurred 10–50 km northwest of Prudhoe Bay, from 0 to 13 km offshore of the barrier islands (water depths 3–17 m).

Seismic Operations and Sounds

This 3-D seismic program employed a conventional array of airguns as the energy source, but used the Ocean Bottom Cable (OBC) method to receive seismic data. The receiving hydrophones were in a series of six 5.9-km cables placed parallel to shore (and to one another) on the ocean bottom. In contrast to the more typical "streamer surveys," a seismic vessel conducting an OBC survey does not tow any hydrophone streamers. The OBC method allows use of a smaller source vessel and smaller-radius turns. However, support vessels are needed to deploy and retrieve receiver cables.

The source vessel was a 27-m tugboat, the *Pt. Barrow,* powered by two diesel engines totaling 2,100 hp and driving two propellers in nozzles. The source vessel moved back and forth at 7–9 km/h along source lines 7.3 km long. Source lines were oriented perpendicular to shore and to the OBCs, and were spaced 330 m apart.

The airgun array consisted of 11 Bolt 1900LX airguns, each of 120 in^3, for

a total array volume of 1,320 in^3 or 21.6 litres. At times, seismic work continued with fewer than 11 operating airguns. We considered an array of 8–11 operating airguns to be a "full array"; 2–7 operating guns were a "partial array." The guns were suspended from floats and positioned in a 5 × 5-m array. Most guns were at the relatively shallow depth of 3.5 m, as required for work in shallow waters. Nominal gun pressure was 2,000 psi (13.8 MPa). All airguns fired simultaneously, with the usual interval between shots being 15–18 sec (44 m).

The airgun array used in this project was low-powered by modern standards, and the shallow gun depth also reduced the effective source level. The measured effective source level for *horizontal* propagation was ~222 dB re 1 μPa-m (rms), 230 dB re 1 μPa-m (instantaneous peak), and 236 dB re 1 μPa-m or 6.3 bar-meters peak-to-peak (Greene 1997). This was well below the expected source level for vertical (downward) propagation, 242 dB re 1 μPa-m (instantaneous peak) or 26.4 bar-m. The rms received levels from the 11-gun array diminished to 200, 190, 180, and 160 dB re 1 μPa (rms) at ranges not exceeding, respectively, 44 m, 257 m, 1,020 m, and 4,900 m. More typically, those levels were attained at ranges of 31, 240, 960, and 3,600 m (Greene 1997).

Different workers have used varying procedures in measuring source and received levels of airgun sounds, making it difficult to compare results. Procedures and terminology used here are those of Greene (1997), which have also been used by McCauley *et al.* (1998). The rms pulse levels quoted here are broadband (10–4,000 Hz) sound pressure levels averaged over the duration of the pulse. Duration was defined as the time interval including 90% of the pulse energy, *i.e.,* from the time when the 5th to the time when the 95th percentile of the energy was received. In this study rms received levels averaged ~10 dB lower than the instantaneous peak level and ~16 dB lower than the peak-to-peak level, all measured in dB re 1 μPa. The rms levels averaged ~15 dB higher than the total pulse energy, measured in dB re 1 μPa^2-s (Greene 1997).

At times, a single airgun was used to localize positions of the bottom cables. It usually fired at intervals of ~8 sec (22 m) along shot lines parallel to the OBCs. Also, a single airgun or partial array (2–7 airguns) often operated while the source vessel turned from one line to the next. The received levels from a single airgun diminished below 190 dB re 1 μPa (rms) within several meters of the source (Greene 1997).

Whenever airgun operations began after an interruption of more than 1–2 min, the number of guns being fired was increased ("ramped up") progressively over about 3–4 min. The ramp-up procedure varied. Sometimes one additional airgun began firing every 20 sec until all guns were firing. At other times, one gun fired for the first minute, 2 guns for the 2nd minute, 4 guns for the 3rd, 8 guns for the 4th, and then all 11 guns.

Observation Procedures

Watches were conducted from the source vessel in 4-h shifts by a team of 2–3 biologists plus one Inupiat observer. An observer was on watch during

all periods with airgun operations (585.5 h), and during many periods when the source vessel was underway but not shooting seismic (300.1 h). A second observer was also on watch 5%–10% of the time.

Whenever shooting was underway, or was expected to begin within the next 30 min, the on-duty observer watched continuously for mammals. Observations were from the glass-enclosed wheelhouse—the highest useable vantage-point (eye level ~7.5 m above water). There was a 360° view with only minor obstructions toward the stern. The airgun array was towed ~30 m behind the observer. The observer scanned around the vessel using unaided vision and 7 × 50 Fujinon FMTRC-SX binoculars. Although the observer scanned all around the boat, effort was concentrated in a 180° arc ahead and to the sides because one objective was to detect seals before they were within 150–250 m of the airguns (see Shutdown Procedures, below). A reticle in the binoculars was used to measure depression angle relative to the horizon, and thus distance. Also, a Bushnell Lytespeed 400 laser rangefinder with 4× optics was used to test and improve the observers' abilities to estimate visually the distances to objects in the water. It did not provide direct measurements of distances to seals.

Daylight was continuous until mid-August, but thereafter the duration of darkness increased rapidly, reaching almost 9 h/night by 18 September (civil twilight counted as daylight). At night the observer used the 7 × 50 binoculars and a Bushnell/ITT Night Ranger 250 binocular night vision device (NVD) with up to 6× optics. No seals were detected *via* this "Generation 2+" NVD. The one seal seen at night was sighted 60 m away in a floodlit area during full-array seismic. Overall, the observers' abilities to detect marine mammals were severely reduced at night. Also, we had no method for detecting or tracking seals that were below the surface.

Survey Effort

Of the 885.6 h of observation, 751.9 h were in daylight and 133.7 h in darkness. There were 585.5 h of watches during airgun operations, including 332.8 h when 8–11 airguns were firing ("full array") and 105.2 h with a single airgun. This paper emphasizes daylight observations during full array, single airgun, and no airgun conditions, which were the most common (Table 1).

Data Recorded

The observer recorded, on a data sheet, information about watch times, vessel location/speed/heading, seismic status (full array, partial array, *etc.*), and environmental conditions (visibility, wind, sea state, ice cover). For each mammal sighted, we recorded species, number, sighting cue, bearing and distance from boat when first sighted, seal heading, initial and subsequent behavior, and seismic status. Initial behavior categories were dive, swim (directed), mill, thrash, look, and unknown. Seals that "milled" swam sedately in a limited

Table 1. Observation hours, seal sighting rates, and number of airgun shutdowns under different seismic states.

	No guns	Single gun	Partial array	Full array	Ramp up	Testing	Total
Observation hours							
Daylight	262.3	95.3	72.1	269.2	26.7	26.3	751.9
Darkness	37.8	9.9	14.4	63.6	4.8	3.2	133.7
Total	300.1	105.2	86.5	332.8	31.5	29.4	885.6
Seals seen in daylight							
Number	164	57	17	168[a]	15	0	421[a]
Seals/hour	0.63	0.60	0.24	0.63	0.56	0	0.56
No. of shutdowns	N/A	17	5	70	17	3	112

[a] One additional seal was seen at night with the full airgun array operating.

area with no consistent direction of movement. Seals that "thrashed" plunged below the surface head-first in a particularly vigorous way, often accompanied by a splash. Seals that "looked" floated at the surface and faced the source vessel. Subsequent behavior categories were no change, dive, swim away, swim toward, swim parallel, look, and other (with description).

The seal's radial distance from the source vessel was estimated visually and, usually, determined more accurately using the reticle binoculars. Distance and bearing were measured from the observer location in the wheelhouse, ~30 m ahead of the airgun array.

Shutdown Procedures

The IHA required that the airgun array be shut down immediately when a seal was seen within, or about to enter, a safety zone around the source vessel. The safety radius was the distance within which received levels of seismic pulses were expected to be ≥190 dB re 1 μPa (rms). Up to 30 August, the designated safety radius was 150 m—the predicted 190 dB radius for the full array. Underwater sound measurements taken near the full array during August 1996 showed that, at times, the received level was ≥190 dB out to ~250 m (Greene 1997). On 30 August, the safety radius was increased to 250 m for full or partial array operations. It remained 150 m for one-airgun work, although the actual 190 dB radius around one airgun was <<150 m (Greene 1997).

When a seal was seen within the safety radius, the airguns were shut down, normally within 3–5 sec (*i.e.*, usually either no shots or one shot between the sighting and the shutdown). A total of 112 shutdowns occurred because of seals sighted within or near the safety zone. Procedures after a shutdown varied. Sometimes the source vessel circled (diameter ~400 m), beginning a ramp-up halfway around the circle if the seal was not resighted, and returning to the original course along the source line with gun(s) firing. On other oc-

casions, the vessel continued along the source line (missing shot points) and began firing when the seal was beyond the safety zone. The IHA did not require suspension of seismic operations during times with poor visibility or at night, and work continued during such periods.

RESULTS

Detection of Seals

A total of 422 seals were seen by observers on the source vessel—421 during 751.9 h of daylight observations but only one at night (133.7 h). Of the 331 seals identified, 304 (91.8%) were ringed seals, 24 (7.3%) were bearded seals, and three (0.9%) were spotted seals. The 421 seals seen in daylight involved 381 separate sightings; 23 sightings consisted of groups of 2–5 seals. All seals except one were in the water, although many were near ice pans or amidst new ice. The only dead or injured seal noted was a ringed seal carcass on an ice pan with polar bear (*Ursus maritimus*) tracks.

Seals were first sighted at estimated radial distances of 2–1,491 m from the wheelhouse (Fig. 1A). However, only 70 (19.3%) of 362 daylight sightings at known distances were beyond 250 m. Distances were not determined for 19 sightings. Part of the reduction in sightability beyond 250 m occurred because observers concentrated on searching for seals within or near the safety radius (150 m or 250 m). Also, two types of evidence showed that the observers missed many seals within 250 m: (1) The numbers of daylight sightings in the various 50-m annuli out to 250 m were generally similar (Fig. 1A) even though the areas of those annuli increased with increasing distance. (2) The number of daylight sightings declined rapidly at lateral distances beyond 0–50 m (Fig. 1B). Detectability also undoubtedly varied with glare, sea state, and ice cover.

Sighting Rates and Distances

During daylight, seals were seen at nearly identical rates during periods with no guns firing (0.63 seals/h), one gun firing (0.60/h), and full array firing (0.63/h)—the three common seismic categories (Table 1).

Absolute sighting rates at different distances should be interpreted with caution because (1) the areas under observation at the three distances were not equal, and (2) sightability decreased with increasing distance. However, it is appropriate to compare sighting rates at a given distance under different seismic states, the pattern of change in sighting rate with increasing distance, and the median sighting distances.

The daytime sightings tended to be farther from the seismic vessel during full-array seismic than during no-seismic or single-gun seismic periods (Fig. 2). The sighting rate within 150 m was higher during no-seismic and one-gun seismic (0.37 and 0.34 seals/h) than during full-array seismic (0.21 seals/h). The sighting rate declined with increasing distance during no-seismic and

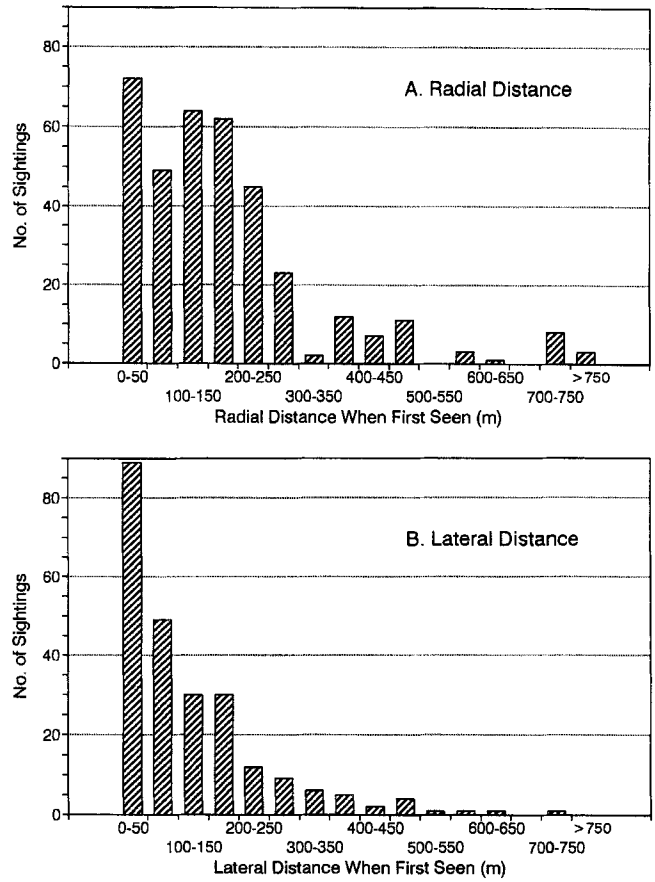

Figure 1. Numbers of seal sightings during daylight by 50-m distance intervals from source vessel, based on approximate bearing and distance from vessel when seal was first sighted. *(A)* Radial distance from vessel (n = 362). *(B)* Lateral distance from vessel's trackline (n = 240).

single-gun seismic, but not with full-array seismic (Fig. 2). Sighting rates in the >250 m distance category were lower with no seismic or single-gun seismic (0.10 and 0.07 seals/h) than with full-array seismic (0.17/h). Consistent with these patterns, the median sighting distance was significantly greater with full-array seismic than no seismic (Mann-Whitney U = 8,408, n = 150 *vs.* 161 sightings; $P < 0.0001$). The mean sighting distance was 234 m with full array seismic *vs.* 144 m with no seismic.

These results suggest that seals tended to avoid at least the zone closest to the boat (<150 m) during full-array seismic, possibly combined with a tendency to come to (or spend more time at) the surface at greater distances. There was no such indication during single-gun seismic. Seals apparently did not move much beyond 250 m, as the sighting rate at all ranges combined

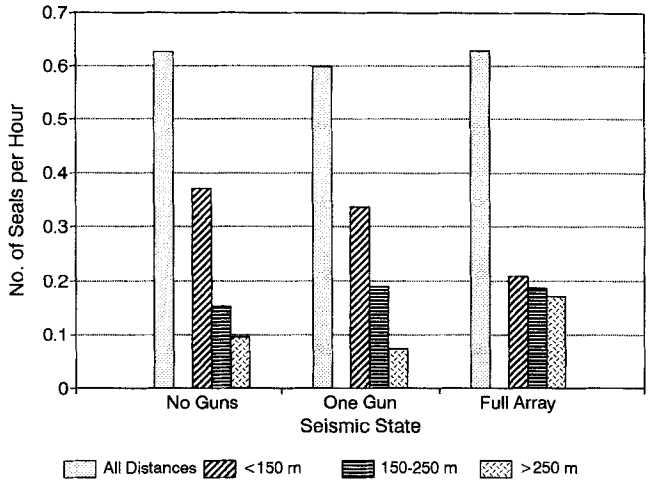

Figure 2. Numbers of seals observed per hour of daylight observation by seismic state and distance category. "All Distances" category includes a few seals at undetermined distances (*i.e.*, not included in any specific distance category).

was the same with full-array seismic as with no seismic (0.63/h; Fig. 2). Seismic operations did not cause many (if any) seals to desert the general area of operations.

Some seals did not move outside the 150-m zone around the operating full array. During daylight, we saw 55 seals in those conditions (0.21 seals/h). Seals were not seen behind the source boat near the airguns when airguns were in operation, but were often seen just ahead of, or alongside, the vessel. The closest seal sightings under various seismic states, as measured from the wheelhouse, were as follows: 16 m during full-array seismic, 30 m during partial array, 12 m during ramp up, and 20 m during single gun.

The distributions of seals, when first seen, were nearly symmetrical on the port and starboard sides. The majority of the seals seen were to the front and sides of the vessel (85% with no seismic; 89% with full-array seismic). This pattern reflects the fact that the observers concentrated their search for seals ahead and to the sides of the approaching boat.

Behavior

Seals in the water were difficult to observe for extended periods because of their small sizes, often-brief surfacings, and the need to maintain a watch for other seals. Consequently, behavioral observations were brief. Figure 3 shows the percentages of all seals seen in a given seismic state that were classified as exhibiting each behavior. For example, of those sighted when the full array was firing and for which behavior was recorded (n = 143), 18% looked, 2% approached, 5% swam parallel to the boat's track, 36% dove, and 39% swam away (Fig. 3).

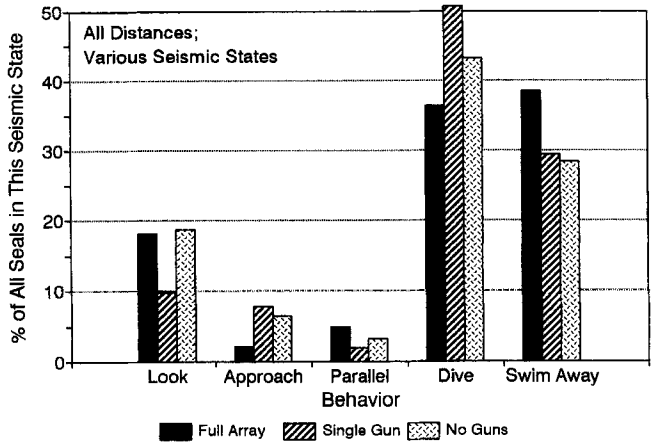

Figure 3. Frequencies of various types of seal behavior during full array (n = 143 seals), single airgun (n = 51), and no airgun (n = 155) conditions, with all distances combined. For each seismic state, bars show percentages of seals that showed each type of behavior.

All distances combined—All five behaviors were seen during each of the three common seismic states (Fig. 3). For each of those seismic states, the most commonly recorded behaviors were dive and swim away. Looking occurred at intermediate frequency; approaching and swimming parallel to the boat's track were uncommon. Overall, the frequencies of the various behaviors were not significantly different under different seismic states (χ^2 = 11.57, df = 8, $P \approx 0.17$). However, during full-array seismic, proportionally fewer seals dove or approached and more swam away as compared with no seismic and single-gun seismic.

Distance effects—When the vessel was underway with no guns firing, the overall frequencies of the five behaviors were not significantly related to distance (Fig. 4A; χ^2 = 5.86, df = 8, $P \approx 0.66$). However, the frequency of swimming away diminished with increasing distance, and the frequency of looking increased.

If proximity to airgun operations causes some seals to swim away, as the sighting distance data suggest, we would expect to see differences in the proportional frequencies of some behaviors for seals sighted at various distances under full array conditions. Swimming away would be expected to be more common for seals close to the operating airgun array. Also, seals might also reduce exposure to strong airgun sounds by remaining at the surface (see Discussion). If so, frequency of diving might be low within 150 m, and frequency of surface behaviors such as looking might be higher.

With full-array seismic, distance did not seem to have major effects on the frequencies of the five behaviors (Fig. 4B; χ^2 = 6.98, df = 8, $P \approx 0.54$). The frequencies of swimming away and looking were not strongly related to distance. Seals swimming away underwater were, of course, not visible. Most

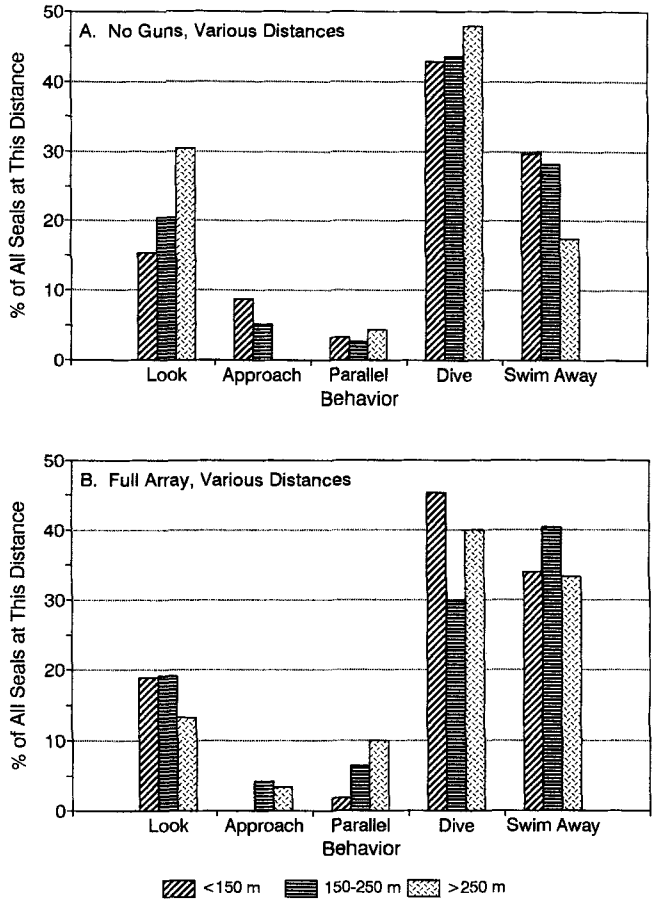

Figure 4. Frequencies of various seal behaviors in each of three distance categories when source vessel was underway with *(A)* no airguns firing, and *(B)* full array firing. For each distance category, bars show percentages of seals that showed each behavior. In (A), n = 91, 39 and 23 seals for <150 m, 150–250 m, and >250 m. In (B), n = 53, 47 and 30 seals, respectively.

seals dove or swam away at all distances. However, swimming away was more common at all distances during full-array seismic than with no seismic (Fig. 4B *vs.* A). Also, approaching was not seen within 150 m of the vessel during full-array seismic, and swimming parallel became somewhat more common as initial sighting distance increased (Fig. 4B).

Discussion

Seal Responses and Tolerance

Overall, seals did not react dramatically to seismic operations insofar as we could see. Seals remained in the general area as airgun operations continued.

Only a fraction of the seals swam away, and even this avoidance was apparently quite localized.

A total of 422 seals were seen from the source vessel during the 1996 seismic surveys: 91.8% ringed seals, 7.3% bearded seals, and 0.9% spotted seals. Of these, 169 seals were seen during periods of full-array seismic, most within 500 m of the airgun array. Overall, vessel-based observers saw seals at nearly identical rates regardless whether no airguns, a single airgun, or 8–11 airguns (full array) were firing. Received levels of noise pulses from the full array were ≥180 dB re 1 μPa (rms) out to a radius of about 1 km when measured at least a few meters below the surface (Greene 1997). Therefore, most if not all seals seen from the source vessel during full-array seismic were exposed to pulses with levels above 180 dB when they dove. Despite this, many seals showed little or no obvious avoidance and no obvious tendency to avoid diving. We could not observe behavior while the seals were below the surface. However, many seals remained near the trackline as the operating airguns approached, and those seals that did move away apparently did not move beyond visible range (a few hundred meters at most).

Seals that remained near the trackline as the operating airguns passed received a sequence of about 45 pulses from the time the source vessel was 1 km away and approaching until it was 1 km away and moving away. (The usual shot interval was 44 m.) These seals received additional strong pulses as the full array was towed along the adjacent seismic lines (spaced 330 m apart), and weaker pulses when the vessel was operating on lines >1 km away.

Seals were often seen within 150 m even during full-array seismic. This, plus the similar overall sighting rates with and without seismic, indicates that seals did not vacate the region around the approaching seismic vessel. However, the median distances of the observed seals were significantly greater ($P < 0.0001$) with full-array seismic than no seismic (means 234 m *vs.* 144 m, respectively). Sound levels received from the full array typically diminished by ~3 dB from 144 m to 234 m (Greene 1997). Thus, the horizontal avoidance reaction by the average seal resulted in only a slight reduction in sound exposure during dives.

An alternative potential explanation for the distributional observations might be that seals close to the source boat (<150 m away) behaved in ways that made them less detectable during full-array seismic than at other times. Seals often dive when exposed to disturbance. However, if anything, we expected that seals might spend more time at the surface when close to the seismic vessel ("vertical avoidance"). Received levels of low-frequency underwater sounds diminish as the receiver approaches the surface because of the pressure-release or "Lloyd mirror" phenomenon (Urick 1983, Richardson *et al.* 1995). For example, Greene and Richardson (1988) found that measured levels of airgun sounds at depth 3 m averaged 7 dB less than the simultaneous levels at depths 9 and 18 m. The reduction would exceed 7 dB for a seal closer to or especially at the surface. To achieve that much reduction in received sound level by swimming horizontally away, a seal 10s or 100s of meters from the airguns would have to travel a much greater distance.

Most seals within a few hundred meters of the seismic vessel would have been exposed to many pulses as the vessel approached and/or traveled along nearby seismic lines. Thus, most seals would have had an opportunity to learn that received levels diminish rapidly as the seal approaches the surface. Despite this, there was no clear tendency for diving to be less common, or for looking (a surface behavior) to be more common, in seals close to the operating airgun array. Also, although the frequency of various behaviors was not significantly different under different seismic states ($P \approx 0.17$), swimming away was somewhat more common with full-array *vs.* no seismic, and approaching was less common with full-array seismic, especially within 150 m (Fig. 3, 4).

Thus, the differences in apparent distribution with full-array *vs.* no seismic were probably mainly a result of local horizontal avoidance by some seals. However, avoidance reactions were not universal even within 150 m. Given the similar overall sighting rates with and without full-array seismic, avoidance was probably limited to a radius of a few hundred meters. Within that distance, received sound levels below the surface were well above 180 dB re 1 μPa (rms), and sometimes >190 dB.

Full-array seismic influenced the local distribution of seals within a few hundred meters of the source vessel, and (in some cases) may have affected their behavior. In contrast, when a single 120 in^3 airgun was in use, seal numbers, distribution, and behavior were similar to those when seals were exposed to the source vessel without airgun operations. The difference between the full-array and single-airgun results is at least partly understandable on the basis of the large differences in the received levels (see Methods).

Estimated "Take by Harassment"

The Incidental Harassment Authorization (IHA) under which the seismic program was conducted authorized disturbance ("take by harassment") of small numbers of seals, but did not authorize serious injuries or deaths (NMFS 1996*b,c*). This study was conducted, in part, to satisfy the IHA's requirement to estimate how many seals were harassed. The following describes some possible ways of making such estimates.

Direct counts—It is not known whether seismic pulses can cause injury to the auditory or other systems of seals. However, based largely on extrapolation from studies in terrestrial mammals (Richardson *et al.* 1995:372*ff*), the IHA required suspension of seismic operations when seals were within the estimated 190 dB re 1 μPa (rms) radius. This was initially estimated as a radius of 150 m around the full array. Sound measurements during August 1996 showed that, at 150 m, the actual received level was sometimes as high as 195 dB re 1 μPa (rms) (Greene 1997). Some seals seen within the 150–250-m annulus were exposed to received levels of 190–195 dB (rms). Before 30 August airgun operations were not necessarily suspended in these cases. After 30 August a shutdown radius of 250 m was used. Both before and after 30 August seals often were not seen until they were well within the shutdown radius. These

seals were exposed to strong sound pulses if they were below the surface just before the time of sighting, when airgun operations were interrupted.

During daylight 128 seals were first sighted within 250 m during full-array, partial array, or ramp-up operations, and thus were potentially exposed to strong sounds at least briefly. During single-airgun operations, an additional 32 seals were seen within the 150-m radius defined (very conservatively) as the safety radius around one airgun. Measured levels 150 m from the single airgun were almost always <175 dB re 1 μPa (rms) (Greene 1997). Another 33 seals were estimated to have been present within these radii during nighttime seismic operations, assuming that the numbers present at night were the same as during the day. Thus, ~193 seals would have been detectable within the final safety radii if all seismic operations had been conducted during daylight. This total no doubt includes some resightings of the same individual seals along adjacent seismic lines.

Indirect estimates based on density—The detectability of seals diminished rapidly with increasing distance from the seismic vessel, and we undoubtedly did not see all seals that were within 250 m of the vessel's trackline (Fig. 1B). The observed rate of decline in sightings with increasing lateral distance was similar to that shown by Leopold *et al.* (1997) in a vessel survey of harbor seals (*Phoca vitulina*). The minimum density of seals in our study area, based on the numbers seen within 50 m of the trackline when seismic operations were not underway, was 0.30 seals/km^2. This figure can be used to derive more realistic estimates of "take by harassment," although it does not allow for the unknown number of unseen seals within 50 m of the trackline.

Seismic operations in 1996 totaled about 3,787 km of airgun array operations and 884 km of single-gun work. Based on these figures, the respective 250-m or 150-m safety radii, and the minimum density of 0.30 seals/km^2, we estimate that at least 648 seal "takes" occurred during the entire seismic program. This assumes that all seals occurring within the safety radii, or that moved out of those areas as the seismic vessel approached, were "taken by harassment." Because of the proximity of adjacent seismic lines, and the overlapping grids of full-array *vs.* single airgun lines, many seals would be "taken" more than once. The total area surveyed in 1996, including a 250-m buffer around the outside, was about 629 km^2. Based on the minimum density of 0.30 seals/km^2, ~189 different seals may have been "taken by harassment" during the project.

Recently, NMFS (1999) indicated that the zone of influence of airgun sounds for marine mammals should be considered to include the area where received levels exceed 160 dB re 1 μPa. The 160 dB (rms) level has no known special significance for seals; it is the approximate rms level above which some baleen whales show obvious avoidance reactions to seismic pulses (Richardson *et al.* 1995). In this study the received level sometimes was ≥160 dB re 1 μPa (rms) at distances out to 4.9 km from the full array. The total area of water within 4.9 km of the regions surveyed in 1996, excluding areas "shadowed" by intervening barrier islands, was about 1,348 km^2. The minimum

estimated number of seals within that area, assuming 0.30 seals/km^2, would be 404 seals.

Management Implications

This study showed that arctic seals (mainly ringed seals) exhibit no more than localized avoidance of an approaching seismic vessel. Many remain close enough to a seismic line to be exposed to received levels exceeding 190 dB re 1 μPa (rms) when they dive. During daytime some of these seals can be seen by an observer aboard the seismic vessel, whereupon seismic operations can be interrupted. However, many seals within 250 m of the vessel apparently are not seen. Some reduction in the proportion of the nearby seals that are missed is possible if more than one observer is on duty (LGL Ltd., unpublished data). However, logistics, living space, and financial constraints often make it difficult to provide two on-duty observers on a 24-h per day basis. Also, if a larger array of airguns were used, the safety radius would need to be increased, further compounding the "undetected seals" problem.

The IHA issued for this project placed no special restrictions on seismic operations at night or with poor visibility. Despite use of 7 × 50 binoculars and an image intensifier, nighttime visual monitoring for seals was not effective under the conditions of this study. It is unlikely that passive acoustical monitoring would be of any value in detecting ringed seals near a seismic vessel at night. Thermal infrared methods may warrant investigation if effective nighttime monitoring is required. We have considered the possibility of using an active high-frequency sonar to detect seals under water (*cf.* U.S. Navy 2001). However, interference from surface and bottom reverberations would be severe if an active sonar were used in shallow nearshore waters such as those where this project was done.

The IHA provisions, especially for night and poor-visibility periods, were designed on the assumption that, if strong seismic sounds are aversive, seals will move away as the seismic vessel approaches or as the airgun array is "ramped up." If they did so, this would limit their exposure to noise. However, the daytime results show that only a fraction of the seals moved out of the safety radius as the sound level increased, and they apparently did not move far. Presumably the same occurs at night. Whether the seals that remain within the safety radii are affected deleteriously by the strong sound pulses is not known.

Although not all seals within the safety radii were detected, there were sufficient detections to result in 112 temporary shutdowns of the airguns during 585.5 h of airgun operations (Table 1). During full-array operations, a shutdown and the subsequent ramp-up typically required 4–6 min. During single-airgun operations, shutdowns usually required only 1–2 min, mainly because no ramp-up was needed while resuming operations. The total operating time lost to these 112 shutdowns was 8 hours. This was a significant disruption to this OBC seismic operation. It would have been much more disruptive if the seismic vessel had been towing long streamers, which would

prevent the circling maneuver sometimes used during shutdowns in this project.

There is an urgent need for more data on the actual effects of sequences of strong seismic pulses on seals. If deleterious behavioral or auditory effects occur near received levels of 190 dB re 1 μPa (rms), improved monitoring and mitigation measures may be desirable to protect seals. Conversely, if seismic pulses have no negative effects on seals, or if the effects occur only at received levels well above 190 dB, seismic programs are unnecessarily impeded by some procedures required by recent IHAs.

Studies of Temporary Threshold Shift (TTS) in captive marine mammals could be useful in addressing the possibility of auditory damage (NRC 1994, Kastak *et al.* 1999, Finneran *et al.* 2000*a*). TTS data can establish the received level below which there is no likelihood of injury, and above which there is reason for concern. TTS measurements are underway for odontocetes exposed to single pulses of water-gun sound, which are similar to airgun pulses (Finneran *et al.* 2000*b*). For maximum relevance in assessing the effects of ongoing seismic surveys, TTS studies would need to expose marine mammals to sequences of repetitive low-frequency sound pulses consistent with those received from an approaching seismic vessel.

Acknowledgments

This study was funded by BP Exploration (Alaska) Inc. (BPXA) and conducted with the cooperation of Northern Geophysical of America (NGA), Crowley Marine Services, and Pelagos Corp. The work was done under an Incidental Harassment Authorization issued to BPXA by the U.S. National Marine Fisheries Service (NMFS), Office of Protected Resources. We thank C. Herlugson and A. Ross of BPXA, J. Hastings and S. Nish of NGA, and K. Hollingshead of NMFS. A stakeholder group including representatives of NMFS, the Alaska Eskimo Whaling Commission, Minerals Management Service, and North Slope Borough Department of Wildlife Management provided valuable advice on plans and draft reports. For comments on this manuscript, we thank M. Gilders, C. Greene, C. Herlugson, J. Lawson, V. Moulton, A. Ross, and an anonymous referee.

The marine mammal observers included, at various times, Inupiat observers A. Napageak, M. Solomon, and S. Franklin, plus LGL biologists A. Balla-Holden, B. Haley, L. Martin, and M. Bentley (as well as REH and GWM). Others who helped in the field included K. Kinden and L. Wyman of BP; J. Gardner, F. Hall, K. Karn, and R. Stjernholm of NGA; the crew of the *Pt. Barrow,* including B. Kinder (captain), T. Robinson, D. Lemke, P. Martinez, and B. Harker; and D. Millar, D. Mingo, D. Sarty, and B. Jimmo of Pelagos Corp. J. Carey (Crowley Marine Services) and P. Crosbie and S. Hulse (Peregrine Marine) were also very helpful. We thank them all.

R. E. Elliott of LGL Ltd. helped with data analysis. C. Greene of Greeneridge Sciences provided data on the underwater sounds. A. Bishop and W. Wilson (LGL Alaska) and T. Jarvie, B. Griffen, K. Hester, and V. Moulton (LGL Ltd.) provided administrative and technical assistance.

Literature Cited

Anonymous. 1975. Phantom killer whales. The South African Shipping News and Fishing Industry Review 30(7):50–53.

CALDWELL, J., AND W. DRAGOSET. 2000. A brief overview of seismic air-gun arrays. The Leading Edge 19:898–902. Available at www.seg.org.

DRAGOSET, B. 2000. Introduction to air guns and air-gun arrays. The Leading Edge 19:892–897. Available at www.seg.org.

FINNERAN, J. J., C. E. SCHLUNDT, D. A. CARDER, J. A. CLARK, J. A. YOUNG, J. B. GASPIN AND S. H. RIDGWAY. 2000*a*. Auditory and behavioral responses of bottlenose dolphins (*Tursiops truncatus*) and a beluga whale (*Delphinapterus leucas*) to impulsive sounds resembling distant signatures of underwater explosions. Journal of the Acoustical Society of America 108:417–431.

FINNERAN, J. J., C. E. SCHLUNDT, R. DEAR, D. A. CARDER AND S. H. RIDGWAY. 2000*b*. Masked temporary threshold shift (MTTS) in odontocetes after exposure to single underwater impulses from a seismic watergun. Journal of the Acoustical Society of America 108:2515.

GREENE, C. R., Jr. 1997. Physical acoustics measurements. Pages 3–1 to 3–63 *in* W. J. Richardson, ed. Northstar marine mammal monitoring program, 1996: Marine mammal and acoustical monitoring of a seismic program in the Alaskan Beaufort Sea. Report from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for BP Exploration (Alaska) Inc., Anchorage, AK, and National Marine Fisheries Service, Anchorage, AK, and Silver Spring, MD. 245 pp. Available at Library, National Marine Mammal Lab., Seattle, WA.

GREENE, C. R., JR., AND W. J. RICHARDSON. 1988. Characteristics of marine seismic survey sounds in the Beaufort Sea. Journal of the Acoustical Society of America 83:2246–2254.

GREENE, G. D., F. R. ENGELHARDT AND R. J. PATERSON, EDS. 1985. Proceedings of the workshop on effects of explosives use in the marine environment, Halifax, N.S., January 1985. Technical Report 5. Canada Oil & Gas Lands Administration, Environmental Protection Branch, Ottawa, Ont. 398 pp.

HESS. 1999. High Energy Seismic Survey review process and interim operational guidelines for marine surveys offshore Southern California. Report from High Energy Seismic Survey Team for California State Lands Commission and U.S. Minerals Management Service [Camarillo, CA]. 39 pp. + Appendices. Available from MMS, Camarillo, CA.

HILL, P. S., AND D. P. DEMASTER. 1998. Alaska marine mammal stock assessments, 1998. NOAA Tech. Memo. AFSC-97. National Marine Fisheries Service, National Marine Mammal Laboratory, Seattle, WA. 165 pp.

KASTAK, D., R. J. SCHUSTERMAN, B. L. SOUTHALL AND C. J. REICHMUTH. 1999. Underwater temporary threshold shift induced by octave-band noise in three species of pinniped. Journal of the Acoustical Society of America 106:1142–1148.

KELLY, B. P., J. J. BURNS AND L. T. QUAKENBUSH. 1988. Responses of ringed seals (*Phoca hispida*) to noise disturbance. Pages 27–38 *in* W. M. Sackinger, M. O. Jeffries, J. L. Imm and S. D. Treacy, eds. Port and ocean engineering under arctic conditions, vol. II. Geophysical Institute, University of Alaska, Fairbanks, AK.

LEOPOLD, M. F., B. VAN DER WERF, E. H. RIES AND P. J. H. REIJNDERS. 1997. The importance of the North Sea for winter dispersal of harbour seals *Phoca vitulina* from the Wadden Sea. Biological Conservation 81:97–102.

MCCAULEY, R. D., M.-N. JENNER, C. JENNER, K. A. MCCABE AND J. MURDOCH. 1998. The response of humpback whales (*Megaptera novaeangliae*) to offshore seismic survey noise: preliminary results of observations about a working seismic vessel and experimental exposures. Australian Petroleum Production & Exploration Association Journal 38:692–707.

NMFS. 1995. Small takes of marine mammals incidental to specified activities; offshore seismic activities in southern California/Notice of issuance of an Incidental Harassment Authorization. Federal Register 60:53753–53760.

NMFS. 1996*a*. Small takes of marine mammals; harassment takings incidental to spec-

ified activities in arctic waters; regulation consolidation. Federal Register 61: 15884–15891.

NMFS. 1996*b*. Taking and importing of marine mammals; offshore seismic activities in the Beaufort Sea/Notice of issuance of an Incidental Harassment Authorization. Federal Register 61:38715–38717.

NMFS. 1996*c*. Taking and importing of marine mammals; offshore seismic activities in the Beaufort Sea/Notice of modification of an Incidental Harassment Authorization. Federal Register 61:49300–49301.

NMFS. 1999. Small takes of marine mammals incidental to specified activities; seismic hazards investigation in southern California/Notice of receipt of application. Federal Register 64:10644–10648.

NRC. 1994. Low-frequency sound and marine mammals/Current knowledge and research needs. U.S. National Research Council, Ocean Studies Board, Committee on low-frequency sound and marine mammals. National Academy Press, Washington, DC. 75 pp.

REEVES, R. R., R. J. HOFMAN, G. K. SILBER AND D. WILKINSON, EDS. 1996. Acoustic deterrence of harmful marine mammal-fishery interactions: proceedings of a workshop held in Seattle, WA, 20–22 March 1996. NOAA Tech. Memo NMFS-OPR-10. U.S. Department of Commerce, National Marine Fisheries Service. 70 pp.

RICHARDSON, W. J., C. R. GREENE JR., C. I. MALME AND D. H. THOMSON. 1995. Marine mammals and noise. Academic Press, San Diego, CA.

URICK, R. J. 1983. Principles of underwater sound. Third edition. McGraw-Hill, New York, NY. Reprinted 1996, Peninsula Publishing, Los Altos, CA.

U.S. NAVY. 2001. Final overseas environmental impact statement and environmental impact statement for surveillance towed array sensor system low frequency active (SURTASS LFA) sonar. Department of the Navy, Arlington, VA.

Received: 17 August 1999
Accepted: 6 February 2001



Royal Swedish Academy of Sciences

Declining Extent of Open-Water Refugia for Top Predators in Baffin Bay and Adjacent Waters
Author(s): Mads Peter Heide-Jørgensen and Kristin L. Laidre
Source: *Ambio*, Vol. 33, No. 8 (Dec., 2004), pp. 487-494
Published by: Springer on behalf of Royal Swedish Academy of Sciences
Stable URL: http://www.jstor.org/stable/4315535
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 Mads Peter Heide-Jørgensen and Kristin L. Laidre

Declining Extent of Open-water Refugia for Top Predators in Baffin Bay and Adjacent Waters

Global climate change is expected to severely impact Arctic ecosystems, yet predictions of impacts are complicated by region-specific patterns and nonuniform trends. Twentyfour open-water overwintering areas (or "microhabitats") were identified to be of particular importance for eight seabird and marine mammal species in the eastern Canadian High Arctic and Baffin Bay. Localized trends in the available fraction of open-water were examined in March during 1979–2001, derived from approximate sea ice concentrations from satellite-based microwave telemetry. Declines in the fraction of open-water were identified at microhabitats in Baffin Bay, Davis Strait, coastal West Greenland, and Lancaster Sound. Increases in open-water were observed in Hudson Bay, Hudson Strait, and Foxe Basin. The biological importance of each microhabitat was examined based on species distribution and abundance. Potential consequences of reduced open-water for top marine predators include impacts on foraging efficiency and oxygen and prey availability.

INTRODUCTION

The waters adjacent to the Arctic Ocean are generally perceived as barren and inaccessible, completely covered in sea ice and darkness during winter months. However, in this white stretch of frozen Arctic sea, winter refugia or "microhabitats" exist for millions of air-breathing marine animals. The refugia range widely in size, existing as cracks or leads only a few hundred meters long to hundreds of kilometers of vast open-water. They remain ice-free during even the coldest period of winter and are generally surrounded by solid sea ice. These areas can be annually recurrent 'polynyas' (the Russian word for 'open-water area surrounded by ice') driven by upwelling or wind, variable shore leads and cracks, or tidal- and wind-driven openings in the consolidated pack ice (1). These microhabitats occur predictably in the same locations year after year, despite the variety of ways in which they are physically generated and maintained. The geographical and temporal predictability permits numerous Arctic seabirds and marine mammals to utilize open-water during winter when survival in the sea ice is most critical. Large-scale upwelling events occur along the ice edge, driven by the absence of ice, providing early availability of light for photosynthesis (2). Consequently, the high levels of production found in many of these open-water habitats are used by predators seeking to benefit from high densities of zooplankton and associated fish abundance.

Species utilizing open-water winter refugia include cetaceans, pinnipeds, seabirds and polar bears (*Ursus maritimus*). Their winter habitat preferences are diverse and unique to their species-specific requirements for survival and reproductive success. One of the largest Arctic winter refugia, the North Water, is utilized by approximately 13 000 belugas or white whales (*Delphinapterus leucas*) (who undertake a northbound migration to this locality from Lancaster Sound in the fall) during winter and spring, thousands of narwhals (*Monodon monoceros*), and 30 million breeding pairs of little auks (*Alle alle*) (3–6). In other areas, alternate and smaller open-water localities of great importance are situated over shallow banks, such as Store Hellefiske Bank in West Greenland. This region contains vast benthic resources utilized by species with limited diving abilities like king eiders (*Somateria spectabilis*), common eiders (*Somateria mollissima*), and walrus (*Odobenus rosmarus*) (7–10). Hundreds of thousands of thick-billed murres (*Uria lomvia*) from Canada, Greenland, Iceland, Svalbard, and eastern Russia overwinter in smaller regions along the productive coastal open-water area in West Greenland (7–9). Other microhabitats occur in offshore areas of Baffin Bay and Davis Strait, where leads and cracks in the ice over deep waters serve as the primary wintering grounds for narwhals utilizing benthic fish and squid resources (11, 12).

Global warming, predicted with considerable certainty (13), is assumed to severely impact sea ice formation in the Arctic. The extent of sea ice has declined in the past 20 years, at a rate of about 3% per decade in the Northern Hemisphere (14). However, this trend is not uniform throughout the Arctic and several regional deviations from the general warming pattern have been observed. For example, the length of the sea ice season and the concentrations of sea ice have increased in the past two decades in the Baffin Bay and Davis Strait (14–16). Passive microwave telemetry and mapping of sea ice distribution over the past 5 decades demonstrate a significant increase in sea ice amounting to about 600 km^2 or 1.3% per decade in Baffin Bay (17). The causes of the cooling trend in Baffin Bay are uncertain but are likely due to simultaneous changes in the thermohaline circulation (causing changes in the relatively warm northward flowing West Greenland current), the North Atlantic Oscillation, and the formation of the sea ice bridge in Smith Sound (17, 18). In Hudson Bay and Foxe Basin a non significant sea ice extent decrease of 1.8% per decade was observed between 1979–1996 (14). However, the length of the sea ice season declined in northwestern Hudson Bay and increased in central Hudson Bay and in Foxe Basin (16, 18).

There have been scattered attempts to study the biological importance of winter refugia in the Arctic. Most have focused only on the larger polynyas (e.g. the North Water or the Northeast Water in East Greenland (19)). Generally, the importance of the smaller high Arctic microhabitats has not been well understood or studied because of obvious logistic problems with field research in dark, cold, and ice covered regions. Due to the importance of open-water pack ice refugia for marine mammals and seabirds, it is critical to identify the changes in these microhabitats and develop predictions of how changes will alter the trophic web or biological resources. Baffin Bay and the eastern Canadian High Arctic have a complex coastline, an influx of warm Atlantic water along the West Greenland coast, and a restricted opening to the polar basin through Robeson Channel, which results in numerous microhabitats in the region. In addition, the abundance of animals overwintering in the dense pack ice in this region is large, making it important for examination of

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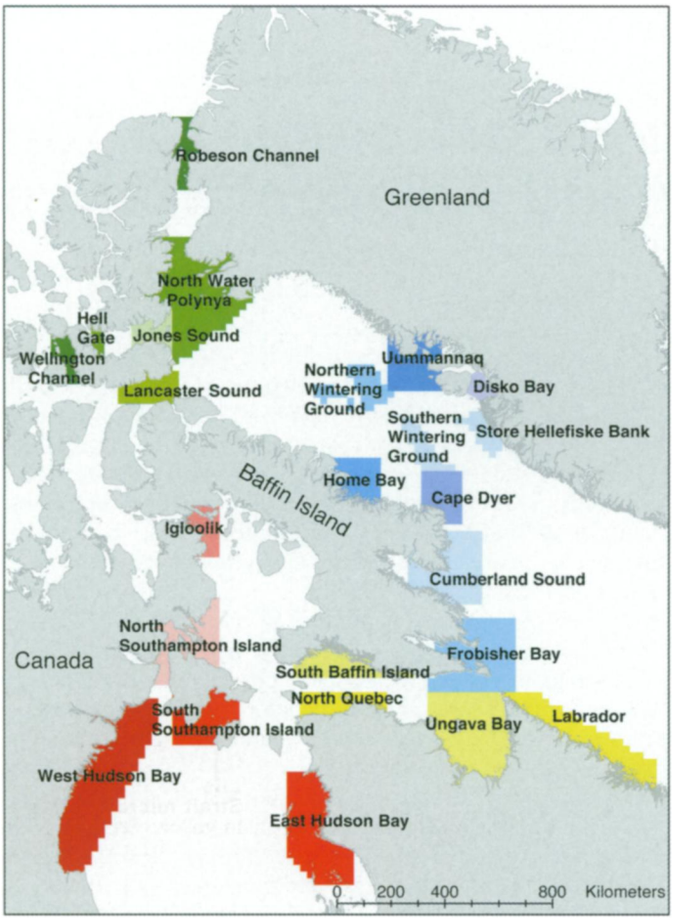

Figure 1. Map of selected microhabitats examined for trends in the fraction of open-water (regions with less than 85% sea ice on 15 March for more than two years within the study period). Regions are indicated by shades or colors; Foxe Basin and Hudson Bay microhabitats are in red, Hudson Strait microhabitats are in yellow, Baffin Bay-Davis Strait microhabitats are in blue, and Northern Baffin Bay and Lancaster Sound microhabitats are in green.

trends in sea ice conditions. In this study, changes in the fraction of open-water in 24 pack ice microhabitats were examined over a 23-year time series using remotely-sensed microwave sea ice data. Observed trends were related to the relative importance of each wintering microhabitat for eight marine indicator species and potential impacts on winter success and survival were examined.

MATERIAL AND METHODS

Selection of Localities and Dates

The overall study area was chosen to encompass the year-round range of selected birds and marine mammals, including Baffin Bay, Davis Strait, Hudson Strait, northern Hudson Bay, Foxe Basin, Lancaster Sound, and Robeson Channel (Fig. 1). Specific microhabitats were selected based on visual investigation of the sea ice time series on 15 March each year (Fig. 2). Recurrent open-water areas were identified and delineated, where 85% or less sea ice was found on 15 March for more than two years within the study period. Some additional areas were selected based on the literature, where specific areas have been documented to harbor wintering populations of marine mammals and seabirds.

SSMR/SSMI Methods

Sea ice concentration data were obtained from passive microwave telemetry available in two datasets from the National Snow and Ice Data Center (NSIDC). The Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR) dataset extending from 1979 through 1987 and the Defense Meteorological Satellite Programs Special Sensor Microwave/Imager dataset covering the period from 1987 through 2001 were used. Sea ice concentration was derived using the Bootstrap algorithm following Comiso (20), where daily sea ice concentrations for the Northern Hemisphere were mapped to a polar stereographic projection (true at 70°N) at a 25 km resolution. Sea ice data obtained from the NSIDC were converted from raw binary to ASCII format using a program written in Compaq Visual Fortran 90 and imported into a geographic information system (ESRI ArcINFO 8.3) as raster grids. The center of each cell received the estimate of average sea ice concentration in that 625 km² (a constant approximation for pixel areas) area and pixels were consistently classified as land or sea ice across all years. A March composite was created as the product of the vertical spatial and temporal average ice concentration for each cell for all days in March each year and used to calculate the fraction (or percentage) of open-water.

The fraction of open-water, the 'ice-free'portion of each microhabitat, (F) was modeled as:

$$F = \left(\sum_{i=1}^{h} (PC^{*}(1-(IC/100)) \right) / MHA$$

where i indexes the lowest sea ice concentration in the microhabitat to h, the highest sea ice concentration, IC is specific sea ice concentration calculated in full integer units and recorded as a percent, PC is pixel count for each specific sea ice concentration, and MHA is the microhabitat area in number of pixels. Trends in the fraction of open-water were examined for each microhabitat between 1979–2001. Open-water localities smaller than 7 pixels were not examined because the sea ice data were not of sufficient resolution to describe the ice formation at those localities. Several microhabitats were, however, composed of a mosaic of many smaller areas.

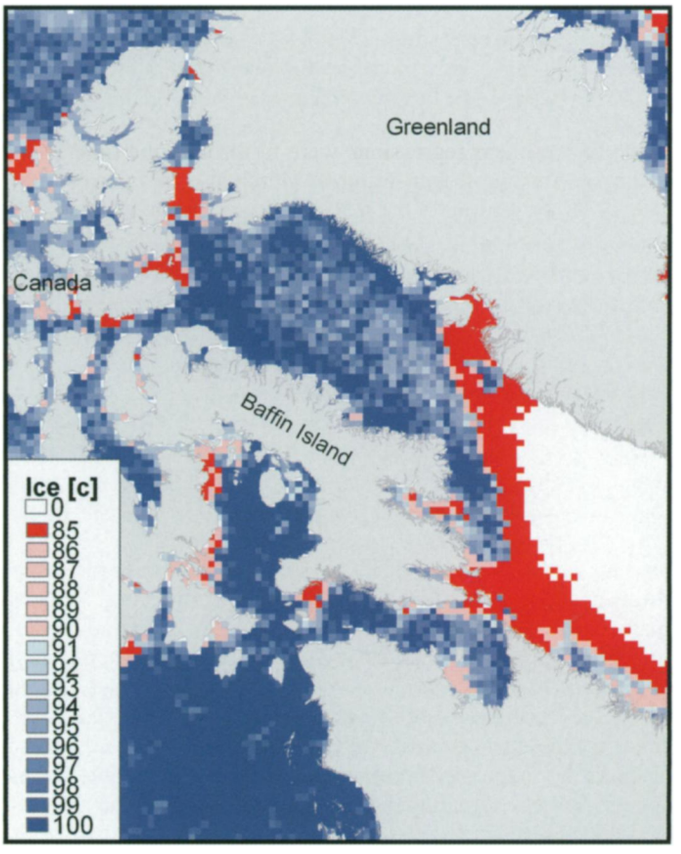

Figure 2. Example of SSMI/SSMR sea ice concentration readings from 14 March 1986. Red regions are 85% sea ice concentration or less and pixels are approximated at 25 km².

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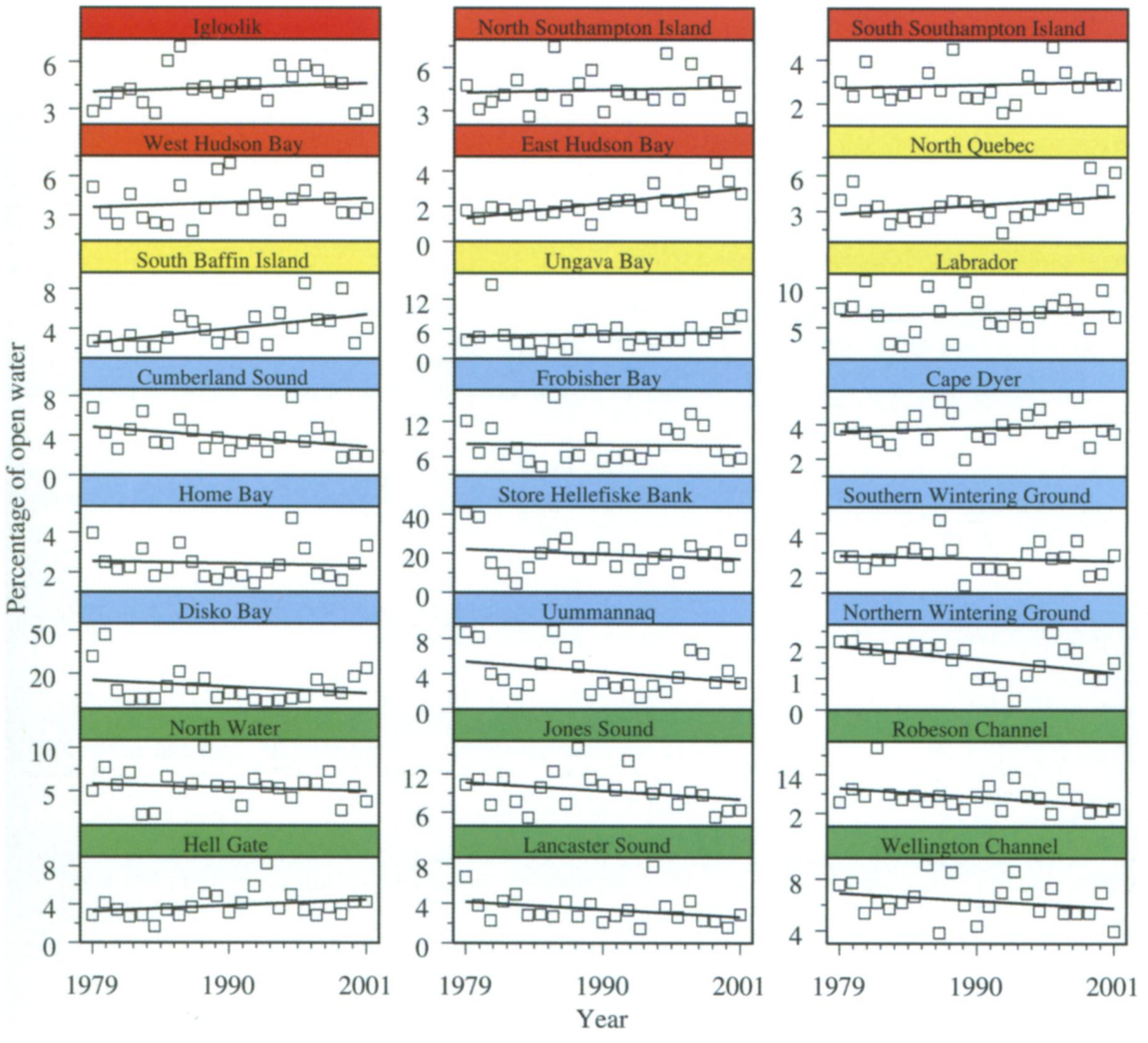

Figure 3. Trends in the fraction of open-water at 24 microhabitats in Canada and West Greenland. Regions are indicated by colors (following Fig. 1) where Foxe Basin and Hudson Bay microhabitats are in red, Hudson Strait microhabitats are in yellow, Baffin Bay-Davis Strait microhabitats are in blue, and Northern Baffin Bay and Lancaster Sound microhabitats are in green.

Statistical Analyses of the Extent of Open Water

Least square linear regressions were fit through the time series of the proportion of open-water in March at each microhabitat. The probability of each trend was assessed from the marginal posterior distribution of the Bayesian regression of the fraction of open-water over time. This method was chosen to provide a specific probability for the observed trends rather than a standard significance level.

Biological Importance of Microhabitats

The biological importance of each pack ice microhabitat was determined based on the occurrence and abundance of eight High Arctic indicator species: the walrus, the bowhead whale (*Balaena mysticetus*), the narwhal, the beluga, the king eider, the common eider, the little auk, and the thick-billed murre. These species were chosen because of their specific dependence on open-water localities during winter. Other Arctic species such as the black guillemot (*Cepphus grylle*), gull species (Laridae), Northern fulmar (*Fulmarus glacialis*), bearded seal (*Erignathus barbatus*), ringed seal (*Phoca hispida*), and polar bear were not included either because little is known about their occurrence (e.g. gulls and bearded seals) or because they are found virtually at all the open-water localities (e.g. black guillemot) or in the coastal fast ice (e.g. ringed seals and polar bears). Basic information on distribution, abundance, and habitat use was compiled from existing literature and used to document the dependence on open-water areas during winter and potential effects of changes in open-water on success and survival.

RESULTS

Trends in Open Water

Within the overall study area, six large regions were identified and examined: Foxe Basin, Hudson Bay, Hudson Strait, Baffin Bay-Davis Strait, northern Baffin Bay, and Lancaster Sound. Within these six regions, 24 specific pack ice microhabitats were identified based on open-water in March (Table 1, Fig. 1). Regionally, Foxe Basin, Hudson Bay, and Hudson Strait showed increasing trends in the fraction of open-water and the trend at all microhabitats combined ranged from 0.2 to 0.7% per decade. Regions of Baffin Bay-Davis Strait, northern Baffin Bay, and Lancaster Sound showed overall decreasing trends in the fraction of available open-water in March. The trend in all microhabitats combined in Baffin Bay-Davis Strait and northern Baffin Bay was -1% per decade and the trend in Lancaster Sound microhabitats was -0.6% per decade.

The two pack ice microhabitats in Foxe Basin (North Southampton Island and Igloolik) were equivalent to an area of approximately 50 000 km^2. These two microhabitats showed slight increasing trends in the proportion of open-water between 1979–2001 (Table 1). Approximately 200 000 km^2 were examined in the Hudson Bay region and trends in the fraction of open-water in the three microhabitats were also slightly increasing. In the region of Hudson Strait, four localities were examined, approximately 200 000 km^2, and increasing trends in the fraction of open-water were detected in all four (Fig. 3 and Table 1).

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In the region of Baffin Bay-Davis Strait (total area of 280 000 km^2), eight out of nine microhabitats demonstrated declines in available open-water. Decreasing trends ranged widely, from -0.01 in Frobisher Bay to -0.40% per year in Disko Bay. Four of these eight had high probabilities of a negative trend > 0,86 (Cumberland Sound, Disko Bay, Uummannaq, and the Northern Wintering Ground, Table 1) and four other localities (Home Bay, Store Hellefiske Bank, Frobisher Bay) also had moderately high probabilities of a decline (> 0.56). Only the locality of Cape Dyer in central Baffin Bay showed a trend for increasing open water (0.02% yr^{-1}) (Fig. 3, Table 1).

In the northern Baffin Bay region, three of four microhabitats (110 000 km^2) had high probabilities of a negative slope (> 0.73) and only Hell Gate had an increasing proportion of open-water with a low probability (0.1) that the trend is actually negative. The small size of Hell Gate (only 7 pixels) and substantial amount of land surrounding the microhabitat probably affected the results. Finally, both the microhabitat of Lancaster Sound and Wellington Channel (in the Lancaster Sound region) (30 000 km^2) demonstrated declines in open-water (- 0.05 to - 0.07% yr^{-1}) with probabilities > 0.88.

Arctic Species Diversity and Abundance

Of the eight selected species of Arctic birds and marine mammals, abundance and diversity supported conclusions on the most important wintering regions within the study area. In the case of marine mammals, important microhabitats included South Baffin Island (in the region of Hudson Strait), Cumberland Sound and offshore, the North Water, Store Hellefiske Bank, and Disko Bay (Table 1). In the case of seabirds, important winter microhabitats included Store Hellefiske Bank, the North Water, Lancaster Sound, and Jones Sound (Table 1). As expected, there was considerable overlap of important areas for seabirds and marine mammals.

Walrus

Walrus make seasonal movements from coastal areas to offshore wintering grounds where open-water can be predictably found in the pack ice. Walrus depend on shallow water banks with open-water (< 80 m), where they can access benthic prey and oxygen. Data on numbers of walruses distributed across the 24 pack ice microhabitats were based on counts made during summer surveys at haul-out sites. The location of wintering preferences is unknown for most of these summering aggregations, as the stock delineation of walrus in West Greenland and eastern Canadian Arctic is incomplete. Due to this, correct allocation of the already sparse information to the wintering localities was uncertain. Two major winter aggregations of walrus are known for certain: those within the microhabitats of Store Hellefiske Bank and the North Water. Of these, only Store Hellefiske Bank has been systematically surveyed for walrus abundance in winter (10). The North Water is probably supplied by animals that summer in the Canadian High Arctic or in Kane Basin. Due to the large proportion of walrus that are not accounted for at the two winter microhabitats, the data indicate that many animals must use other unidentified open-water areas (e.g. Foxe Basin, Hudson Bay and Hudson Strait, especially the areas around North and South Southampton Island) during winter (Table 1).

Table 1. Important microhabitats used by wintering sea birds and marine mammals. Slope of regression for annual trends (1979–2001) in the percentage point (fraction) of open-water are reported with probabilities of slopes being negative. Estimated winter and spring abundance of selected marine mammals and birds are indicated based on past surveys reported in the literature. Within each region the microhabitat names refer to the map in Figure 1. The term 'some' refers to the presence of the species however in unknown numbers.

Region	Microhabitats	# of pixels	Area (km^2)	Trend	Probability of slope < 0	Walrus	Bowhead whale	Narwhal	Beluga	King eider	Common eider	Little auk	Thick billed murre
Foxe Basin	Igloolik	25	15 625	0.03	0.25	0	0	0	0	0	0	0	0
	North Southampton Island	55	34 375	0.02	0.33	5500	0	0	0	0	0	0	0
Hudson Bay	South Southampton Island	47	29 375	0.01	0.28	3000	0	0	0	0	0	0	0
	West Hudson Bay	170	106 250	0.03	0.24	0	0	0	0	0	0	0	0
	East Hudson Bay	113	70 625	0.08	0.00	500	< 100	0	> 1000	some	12 000	0	0
Hudson Strait	North Quebec	37	23 125	0.07	0.05	0	< 100	2000	> 25 000	0	some	some	some
	South Baffin Island	52	32 500	0.13	0.01	3000	> 100			some	some	some	0
	Ungava Bay	129	80 625	0.04	0.33	< 100	some	0	some	0	some	0	some
	Labrador	93	58 125	0.02	0.38	< 1000	some	0	some	0	some	0	some
Baffin Bay-Davis Strait	Cumberland Sound and offshore	83	51 875	-0.09	0.96	< 1000	< 100	> 1000	1000	some	some	some	0
	Frobisher Bay and offshore	109	68 125	-0.01	0.56	< 1000	< 100	> 1000	< 1000	some	some	some	some
	Cape Dyer	41	25 625	0.02	0.27	< 1000	< 100	> 1000	0	0	0	0	some
	Home Bay	40	25 000	-0.01	0.64	< 1000	0	> 1000	0	0	0	0	0
	Store Hellefiske Bank	25	15 625	-0.13	0.67	< 1000	250	< 1000	8000	> 100 000	> 100 000	> 10 000 000	> 100 000
	Disko Bay	20	12 400	-0.40	0.86	0		3000		0	some	some	some
	Southern Wintering Ground	37	23 125	-0.02	0.26	0	0	5000	0	0	0	0	0
	Uummannaq	52	32 500	-0.11	0.92	0	0	some	0	0	0	some	some
	Northern Wintering Ground	40	25 000	-0.04	1.00	0	0	45 000	0	0	0	0	0
Northern Baffin Bay	North Water	129	80 625	-0.04	0.73	< 3000	< 100	< 1000	13 000	0	some	> 50 000 000	> 100 000
	Jones Sound	20	12 500	-0.12	0.92	< 1000	0	0	some	0	some	> 10 000 000	> 100 000
	Robeson Channel	19	11 875	-0.25	0.97	0	0	0	0	0	0	0	0
	Hell Gate	7	4375	0.06	0.10	< 1000	0	0	0	0	0	0	0
Lancaster Sound	Lancaster Sound	32	20 000	-0.07	0.93	< 1000	0	0	0	some	some	> 10 000 000	> 100 000
	Wellington Channel	17	10 625	-0.05	0.88	< 1000	0	0	0	some	some	0	some
References						10	4, 45, 46	24, 25, 47, 48, 49	46, 49, 50	8, 29, 51	7, 8, 29, 51	6, 51	7, 8, 41, 51

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Bowhead Whale

In winter, bowhead whales are generally found in association with dense pack ice or at the ice edge. During spring migration periods, bowheads have been observed penetrating severe pack ice in Baffin Bay and apparently have the ability to break breathing holes (21, 22). The low abundance of bowheads in Baffin Bay is a result of past exploitation, however, there are recent indications of an increase in population size (23). The most important wintering microhabitats for bowhead whales are in West Greenland (Store Hellefiske Bank and Disko Bay) and in the region of Hudson Strait in Canada. Bowheads may also be found in low numbers in winter in the North Water, off Cape Dyer, and off Cumberland Sound. The two microhabitats in West Greenland display declining trends in open-water, however, in Canada the trends in the region of Hudson Strait are increasing (Table 1). In spring, bowheads are dependent on opportunities for feeding on zooplankton blooms in Disko Bay, the North Water, northern Foxe Basin and Lancaster Sound.

Narwhal

Narwhals are the most abundant cetaceans in Baffin Bay, with an estimated abundance exceeding 50 000 (24). Narwhals depend heavily on open-water for their winter survival and build up of fat deposits. Narwhals winter in the regions of Hudson Strait and Baffin Bay-Davis Strait, as well as Disko Bay. Narwhals wintering in Hudson Strait in smaller numbers however are assumed to belong to the Northern Hudson Bay summer population (25). The largest abundance of narwhals is found in the offshore areas of Baffin Bay and Davis Strait, and within this region, two offshore microhabitats have been identified (the Northern and Southern Wintering Ground) (11). The narwhal population in Baffin Bay is presumed to be separate from that in Foxe Basin and within Baffin Bay, several subpopulations occur each with high site fidelity to separate wintering grounds (11). There is sufficient evidence to detect a clear decline in the amount of open-water in several narwhal wintering microhabitats, including the Northern Wintering Ground, Southern Wintering Ground, Disko Bay, Store Hellefiske Bank, North Water, and Cumberland Sound and adjacent offshore areas (Table 1). The increase in the extent of open-water at some localities in Hudson Strait, where narwhals from Foxe Basin are believed to winter, indicates that different subpopulations experience different sea ice trends.

Beluga

Arctic belugas have been found in most types of sea ice but appear to prefer loose pack and avoid longer stays in dense ice. Discrete stocks of belugas are found across Arctic Canada and in West Greenland, all of which have specific wintering grounds. The 20 000 belugas summering in the Canadian High Arctic (near Somerset Island) (24) move out of the area in fall to either the North Water (where the largest abundance overwinters) or the coast of West Greenland (in the microhabitats of Disko Bay and Store Hellefiske Bank) (3). A fourth microhabitat is occupied by a resident population of belugas in Cumberland Sound, which moves offshore with forming fast ice for the winter. All four of these microhabitats show a declining trend in the extent of open-water. Other distinct beluga stocks occupy eastern and western Hudson Bay in summer numbering up to 25 000 animals (26). The exact area where these whales overwinter is unknown, however, there are increasing trends in open-water in Hudson Strait where a large majority likely is found.

The King and Common Eider

King eiders breed in northern Canada and North Greenland. Nearly the entire population from eastern Canada and Greenland winters in the dense pack ice on Store Hellefiske Bank, West Greenland (> 100 000 pairs, Table 1) (27, 28). In this area king eiders can find ideal feeding opportunities during winter on the shallow banks, as they can dive to the bottom and take mussels. Common eiders also breed in West Greenland and Canada, however, this species is more coastal in its distribution and occurrence during winter (7). In eastern Hudson Bay, a sedentary population of common eiders also winters in the shallow open-water areas (29). A large proportion of common eiders from the Canadian Arctic and Northwest Greenland winter in the coastal areas of West Greenland and Store Hellefiske Bank (8). Here, they similarly utilize shallow coastal open-water areas for feeding.



Little auks at bird cliffs in Northwest Greenland. Photo: M.P. Heide-Jørgensen.

The Little Auk

The wintering areas for little auks extend from Davis Strait to Newfoundland. Many birds are found along the West Greenland coast, especially on Store Hellefiske Bank. It is likely that both little auks from North Greenland and Svalbard winter in southwest Greenland waters, however, the total number of little auks wintering in southwest Greenland is unknown (9). The little auk is planktivorous and is highly dependent on primary and secondary production in their feeding areas. In spring, little auks move north to breed in colonies in Northwest Greenland in the North Water and adjacent waters. When the birds arrive at breeding sites in early May, they feed in the offshore open-water in the North Water utilizing the rich abundance of copepods (primarily *Calanus hyperboreus* and *C. glacialis*) (5, 30). Recent surveys have estimated the population to number at least 33 000 000 breeding pairs in the North Water during this time (6). The ice-free areas of the North Water and Lancaster Sound are declining and less water is available for the little auks in May.

The Thick-billed Murre

In winter, large numbers of thick-billed murres move to West Greenland from areas as far as Svalbard, East Greenland, East Baffin, the Canadian High Arctic, Iceland, and eastern Russia (8). Later in spring, these birds return from their wintering grounds in southwest Greenland to their breeding grounds

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where they require open-water for feeding. Thick-billed murres breed at bird cliffs in Northwest Greenland, along the east coast of Baffin Island, in Hudson Strait and in the Canadian High Arctic. In these areas they are dependent on open-water with high productivity close to the colonies.

DISCUSSION

Regional increasing trends in sea ice coverage in Baffin Bay and Davis Strait (resulting in declining open-water) were as high as 7.5% per decade between 1979–1999 (14, 16, 18, 31, 32) and comparable significant increases have been detected back to 1953 (17). Similar trends in sea ice have also been detected locally along the West Greenland coast, with slightly lower increases of 2.8% per decade ($p < 0.07$) (17). Until now, regional trends have not been detected on microhabitat scales and little has been done to investigate the effect on aggregations or sub-populations of marine predators dependent on these localized areas. Several species rely heavily on open-water during winter periods, which is often critical to their survival or survival of their offspring. With respect to resource management of Arctic marine predators, it is necessary to incorporate understanding of the impacts of climate change on habitats into decisions for resource use.

Open-water wintering areas smaller than 25 km^2 were not examined in this study because the coarse resolution of the sea ice data prevented localized trend detection. It is likely that marine mammals and seabirds also use very small open-water areas during winter (e.g. shore leads < 1 km in width). The extent to which they rely on these areas is unknown and most likely, these species utilize larger or more predictable areas most frequently. It is reasonable to assume that the 24 microhabitats examined here represent the majority of the intensively utilized wintering areas in the Canadian High Arctic and West Greenland. It is also likely that the smaller areas, not examined here but adjacent to larger localities, have similar trends in the proportion of open-water and that these trends may be inferred from their larger neighboring localities.

In this study, contrasting trends in the fraction of open-water were observed. The eastern Canadian High Arctic microhabitats generally showed an increase in open-water, whereas microhabitats in Baffin Bay-Davis Strait showed decreasing open-water. Although trends varied across regions in this study, the 'biologically' most important wintering areas were found in regions with increasing sea ice, with the exception of Hudson Strait. This increase has both obvious direct effects on oxygen access as well as indirect effects on marine productivity. It is, however, important to note that top marine predator vulnerability may not merely lie in the gradual reduction of open-water, as it must be assumed that the animals have some ability to adapt to long-term changes in their environment. What may be more important is the increasing sea ice coverage in combination with environmental variability, which leads to an increased frequency of periodic complete freeze-over. This can result in catastrophic mortalities that can affect population trajectories. For example, in Disko Bay, less than 5% open-water was observed on 89% of the days (n = 124) in March between 1992–1995, and during this period, 15% of these days had complete freeze-over of Disko Bay (< 0.1% open-water).

Vulnerability of Marine Mammals

Failure to maintain access to oxygen has been documented to cause immediate mortality in Arctic cetaceans (33, 34). Narwhals and belugas are not capable of breaking breathing holes in the ice and are occasionally found trapped in large numbers. Marine mammals are more capable of tolerating longer periods with nutritional stress than seabirds as they have thick blubber layers, which can be used as a reserve during periods with little forage. Despite this, density dependent effects of nutritional stress on reproduction and survival for marine mammals cannot be discarded regardless of their relative resilience (e.g. 35, 36). Seabirds, in contrast, have an active strategy for avoiding nutritional stress due to a much higher mobility, easily travelling several hundred km a day in search of favorable feeding areas.

The walrus is the only one of the four marine mammal species examined here that is truly capable of breaking thick ice for access to air (37). Walrus are often found in small leads or open-water created by tidal movements around icebergs. There are no reports of fatal ice entrapments of walruses and they are clearly well adapted to life in the sea ice, flexible in their selection of foraging sites and prey. Walruses do depend heavily on shallow banks for feeding on bivalves but are reported to occasionally take seals over deeper water (38, 39). The walrus may be less vulnerable to reduced open-water space in the pack ice than the other marine mammal species.

Bowhead whales travel long distances over short time periods and have less firm migratory patterns than observed for belugas and narwhals. Furthermore, bowhead whales often travel alone and are widely dispersed during both summer and winter, so only a small fraction of the population will, at any given time, be susceptible to ice entrapments. Although bowhead whales can break thick new ice, they are also occasionally trapped in sea ice together with either narwhals or belugas. Bowhead whales depend on access to zooplankton, and changes in marine productivity may either have nutritional effects or cause changes in movement patterns. The timing and composition of the zooplankton blooms, related to extension and residency of sea ice, is critical for optimal feeding opportunities for bowhead whales.



Bowhead whale and belugas at an ice entrapment in Lancaster Sound in May 1999. Photo: M. Ramsay.

Narwhals utilize leads and cracks for access to air in dense ice and are occasionally found in ice entrapments in the thousands. Narwhals feed heavily on the wintering grounds and are dependent on access to open-water for breathing between deep foraging dives. The large numbers of narwhals on the Northern Wintering Ground are assumed to be geographically isolated from those on the Southern Wintering Ground. Due to their strong site fidelity, the narwhal aggregations must be considered functionally separate units, highly sensitive to any further

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increase in pack ice, as they inhabit areas with the least amount of open-water. On the wintering grounds, the fraction of open-water can be as low as 0.5–2.0% at the end of March. The regional decrease of open-water of 1.0% per decade detected in Baffin Bay will clearly impact this species.

In Baffin Bay, belugas overwinter in the four microhabitats with the largest fractions of open-water: the North Water, Jones Sound, Disko Bay, and Store Hellefiske Bank. These microhabitats all show declining trends in open-water with high probabilities of slopes less than zero. Like narwhals, belugas are occasionally trapped in sea ice in large numbers, especially in Disko Bay and Jones Sound (33–35). Belugas also winter offshore in Cumberland Sound, where they may face reduced amount of open-water at the wintering site. The belugas wintering in West Hudson Bay and Hudson Strait do not appear to be at risk of ice entrapments as open water is increasing in their wintering areas.

Vulnerability of Seabirds

The vulnerability of Arctic seabirds diverges from marine mammals in that reduced open-water generally only limits access to prey. Common eiders, little auks, and thick-billed murres have, however, been reported to occasionally succumb in ice entrapments (29, 40). Seabirds have high metabolic rates and require dependable year-round access to rich prey resources for survival, reproduction, and chick rearing. Several species of seabirds rely heavily on the open-water areas in the Arctic for overwintering and feeding during critical periods determining success for their breeding cycle. Reduced marine production may have immediate effects on seabirds as their fat deposits cannot sustain them through a season with intensive nutritional stress. Seabirds wintering in West Greenland appear to rely heavily on a few specific localities, one of which is Store Hellefiske Bank. This locality is important because access to shallow water is available in winter, when most coastal shallow areas are covered with fast ice.

Store Hellefiske Bank is particularly important for king and common eiders, which must reach benthic prey at depths < 50 m and < 20 m, respectively (7, 8). The declining trend in open-water on Store Hellefiske Bank may significantly inhibit successful benthic foraging for these species. Even though the total amount of the open-water on Store Hellefiske Bank is still large (> 10%), the area shows a strong decline in the amount of open-water and some critical feeding grounds for the sea ducks may be disappearing. Further reduction of the open-water will force the eiders to move south, to areas with deeper water and less available prey. Store Hellefiske Bank is also host for several species of alcids during winter and spring migration. These alcids differ from sea ducks in that they rely on pelagic prey and can take advantage of deeper open-water further south in Davis Strait if sea ice continues to increase on Store Hellefiske Bank.

Other important regions for seabirds are northern and southern Baffin Bay and Hudson Strait, used for intensive feeding in spring by the little auk and the thick-billed murre during the early stages of the breeding cycle. In spring, the North Water, Jones Sound, and Lancaster Sound are completely surrounded by pack ice when the birds arrive at the bird cliffs, which are strategically located close to the productive open-water areas. Increased distance from colonies to open-water will impact the energetic costs. Further, a reduction of open-water with a subsequent reduction in productivity will affect the feeding success of the millions of little auks and hundreds of thousands of thick-billed murres that rely on these resources for successful breeding. Failure to breed due to extended sea ice cover has been reported for little auks and thick-billed murres (41).

Marine Productivity

The timing and extent of primary production is strongly related to the patterns of ice formation. Extensive and prolonged ice coverage cools the water column during the critical spring period when herbivorous zooplankton graze on phytoplankton (42). Late ice break up of sea ice may delay phytoplankton production and may disrupt the connection between the phytoplankton and copepod grazers that ascend from depth at specific times of the year (43, 44). A cold upper layer of the water column would slow the production of copepods and make the surface waters less productive. Species such as little auks and bowhead whales, which rely on predictable copepod resources during spring in the open-water areas, will be affected by extended ice coverage during this critical feeding period. Fish species like polar cod (*Boreogadus saida*), Arctic cod (*Arctogadus glacialis*), capelin (*Mallotus villosus*), and the larvae of Greenland halibut (*Reinhardtius hippoglossoides*) are also dependent on the spring production of zooplankton. A negative influence from poor production on these forage fish species will ultimately affect top predators such as the thick-billed murre, beluga, and narwhal. If the timing of the coupling between phytoplankton and zooplankton is disrupted by sea ice, changes in the benthos are also to be expected. Phytoplankton that is not consumed by zooplankton will ultimately sink to the bottom and contribute positively to benthic production. This may benefit benthic feeders such as walrus and eiders if they have access to the feeding grounds.

CONCLUSION

Among the pan-Arctic responses to climate change, Baffin Bay and Davis Strait are regions that uniquely deviate from warming patterns and decreasing sea ice. This creates an opportunity for comparing and contrasting effects of climate change on top predators. Here, two types of vulnerability have been identified relative to increasing sea ice: *i)* the direct physical impact of sea ice as a barrier for air-breathing foraging animals; and *ii)* the cascading effects of changes in marine productivity.

Generally the cetaceans are the most vulnerable to a reduction in available open-water, because they urgently require oxygen after dives that cannot exceed 25 minutes. Horizontal displacement within the pack ice is limited to *i)* their maximum swimming speeds (approximately 2 m sec^{-1}); *ii)* available leads and cracks; and *iii)* their ability to detect alternative open-water areas. The frequency of occurrence and fate of whales in ice entrapments outside the inhabited coastal areas of West Greenland and Arctic Canada may even go undetected. Little is known about the ability of cetaceans to react to decreased marine production.

Given the severity of the detected trends in increasing sea ice coverage at important wintering areas, it remains pertinent to focus research efforts on the fate of the eight indicator species examined here. Future studies should specifically address questions related to changes in phenology of migration, alterations in focal areas of importance, signs of nutritional stress, and effects on survival and reproduction for top predators utilizing the Arctic ecosystem during periods of extensive sea ice coverage. Finally, harvest management of top predators must account for the additional risk introduced by reduction in carrying capacity caused by increased sea ice coverage, which may naturally adjust populations downward in response to environmental change.

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References and Notes

1. Stirling, I. and Cleator, H. 1981. Polynyas in the Canadian Arctic. *Can. Wildl. Serv. Occas. Pap. 45*, 1-73.
2. Sakshaug, E. and Skjoldal, H.R. 1989. Life at the ice edge. *Ambio 18*, 60-67.
3. Heide-Jørgensen, M.P., Richard, P., Dietz, R., Laidre, K.L., Orr, J. and Schmidt, H.C. 2003. An estimate of the fraction of belugas (*Delphinapterus leucas*) in the Canadian High Arctic that winter in West Greenland. *Polar Biol. 26*, 318-326.
4. Richard, P.R., Orr J.R., Dietz, R. and Dueck, L. 1998. Sightings of belugas and other marine mammals in the North Water, late March 1993. *Arctic 51*, 1-4.
5. Karnovsky, N.J. and Hunt Jr., G.L. 2002. Estimation of carbon flux to dovekies (*Alle alle*) in the North Water. *Deep Sea Res. II 49*, 5117-5130.
6. Egevang, C., Boertman, D., Mosbech, A. and Tamsdorf, M.P. 2003. Estimating colony area and population size of little auks *Alle alle* at Northumberland Island using aerial images. *Polar Biol. 26*, 8-13.
7. Merkel, F.R., Mosbech, A., Boertmann, D. and Grøndahl, L. 2002. Winter seabird distribution and abundance off south-western Greenland, 1999. *Polar Res. 21*, 17-36.
8. Mosbech, A. and Johnson, S.R. 1999. Late winter distribution and abundance of sea-associated birds in south-western Greenland, the Davis Strait and southern Baffin Bay. *Polar Res. 18*, 1-17.
9. Boertmann, D., Lyngs, P., Merkel, F.R., and Mosbech, A. The significance of South-west Greenland as winter quarters for seabirds. *Bird Cons. Intl.* (In Press).
10. Born, E.W., Gjertz I. and Reeves. R.R. 1995. Population assessment of Atlantic walrus. *Norsk Polarinst. Meddel. 138*, 100 pp.
11. Heide-Jørgensen, M.P., Dietz, R., Laidre, K.L., Richard, P., Orr, J. and Schmidt, H.C. 2003. The migratory behaviour of narwhals (*Monodon monoceros*). *Can. J. Zool. 81*, 1298-1305.
12. Laidre, K.L., Heide-Jørgensen, M.P., Dietz, R., Hobbs, R.C and Jørgensen, O.A. 2003. Deep diving by narwhals (*Monodon monoceros*): differences in foraging behavior between wintering areas? *Mar. Ecol. Prog. Ser. 261*, 269-281.
13. Wigley, T.M.L. and Raper, S.C.B. 2001. Interpretation of high projections for global-mean warming. *Science 293*, 451-454.
14. Parkinson, C.L., Cavalieri, D.J., Gloersen, P., Jay Zwally H. and Comiso, J.C. 1999. Arctic sea ice extents, areas, and trends, 1978-1996. *J. Geo. Res. 104*, 20,837-20,856.
15. Parkinson, C.L. 1995. Recent sea-ice advances in Baffin Bay/Davis Strait and retreats in the Bellingshausen Sea. *Ann. Glaciol. 21*, 348-352.
16. Parkinson, C.L. 2000.Variability of Arctic sea ice: the view from space, and 18-year record. *Arctic 53*, 341-358.
17. Stern, H.L. and Heide-Jørgensen, M.P. 2003. Trends and variability of sea ice in Baffin Bay and Davis Strait. *Polar Res. 22*, 11-18.
18. Parkinson, C.L. 2000. Recent trend reversals in Arctic sea ice extents: possible connections to the North Atlantic Oscillation. *Polar Geogr. 24*, 1-12.
19. The journals *Deep-Sea Research II* 2002, volume 49, and *Journal of Marine Systems* 1997, volume 10, were special issues dealing with the North Water and the Northeast Water.
20. Comiso, J.C. 1995. SSMI concentration using the bootstrap algorithm. *NASA Report 1380. Ann. Glaciol. 34*, 441-446.
21. Heide-Jørgensen, M.P., Laidre, K.L., Wiig, Ø., Jensen, M.V., Dueck, L., Maiers, L.D., Schmidt, H.C. and Hobbs, R.C. 2003. From Greenland to Canada in ten days: Tracks of bowhead whales, *Balaena mysticetus*, across Baffin Bay. *Arctic 56*, 21-31.
22. George, J.C., Clark, C., Carroll, G.M. and Ellison, W.T. 1989. Observations on the ice-breaking and ice navigation behaviour of migrating bowhead whales (*Balaena mysticetus*) near Point Barrow, Alaska, spring 1985. *Arctic 42*, 24-30
23. Nunavut Wildlife Management Board 2000, *Final Report of the Inuit Bowhead Knowledge Study*, 90 pp.
24. Innes, S., Heide-Jørgensen, M.P., Laake, J., Laidre, K.L., Cleator, H., Richard, P. and Stewart, R.E.A. 2002. Surveys of belugas and narwhals in the Canadian High Arctic 1996. *NAMMCO Sci. Publ. 4*, 169-190.
25. Richard, P.R. 1991. Abundance and distribution of narwhals (*Monodon monoceros*) in northern Hudson Bay. *Can. J. Fish. Aquat. Sci. 48,* 276-283.
26. Richard, P.R. 1993. Status of the beluga (*Delphinapterus leucas*) in western and southern Hudson Bay. *Can. Field Nat. 107,* 524-532.
27. Salomonsen, F. 1967. *Birds in Greenland (Fuglene på Grønland),* København, Rhodos. 340 pp. (In Danish).
28. Lyngs, P. 2003. Migration and winter ranges of birds in Greenland. *Dan. Ornithol. Foren. Tidsskr. 97*, 1-167.
29. Gilchrist, H.G. and Robertson, G.J. 2000. Observations of marine birds and mammals wintering at polynyas and ice edges in the Belcher Islands, Nunavut, Canada. *Arctic 53*, 61-68.
30. Pedersen, C.E. and Falk, K. 2001. Chick diet of dovekies *Alle alle* in Northwest Greenland. *Polar Biol. 24*, 53-58.
31. Deser, C.J., Walsh, E., and Timlin, M.S. 2000. Arctic sea ice variability in the context of recent atmospheric circulation trends. *J. Clim. 13*, 617-633.
32. Parkinson, C.L. and Cavalieri, D.J. 2002. A 21-year record of Arctic sea-ice extents and their regional, seasonal and monthly variability and trends. *Ann. Glaciol. 34*, 441-446.
33. Siegstad, H. and Heide-Jørgensen, M.P. 1994. Ice entrapments of narhwals *(Monodon monoceros*) and white whales (*Delphinapterus leucas*) in Greenland. *Meddr Grønland, Bioscience 39*, 151-160.
34. Heide-Jørgensen, M.P., Richard, P., Ramsay, M. and Akeeagok, S. 2002. Three recent ice entrapments of Arctic cetaceans in West Greenland and the eastern Canadian High Arctic. *NAMMCO Sci. Publ. 4*, 143-148.
35. Freeman, M.M.R. 1968. Winter observations on beluga (*Delphinapterus leucas*) in Jones Sound, N.W.T. *Can. Field-Nat. 82*, 276-286.
36. Hanks, J. 1981. Characterization of population condition. In: *Dynamics of Large Mammal Populations*. Fowler, C.W. and Smith, T.D. (eds). John Wiley and Sons, New York, pp. 47-73.
37. Fay, F.H. 1982. Ecology and biology of the Pacific walrus, *Odobenus rosmarus divergens* Illiger. *North Am. Fauna 74*, 1-279.
38. Born, E.W., Dietz, R., Heide-Jørgensen, M.P. and Knutsen, L.Ø. 1997. Historical and present distribution, abundance and exploitation of Atlantic walruses (*Odobenus rosmarus rosmarus* L.) in eastern Greenland. *Meddr Grønland, Bioscience 46*, 1-73,
39. Born, E.W., Rysgaard, S., Ehlmé, G., Sejr, M., Acquarone, M. and Levermann, N. 2003. Underwater observations of foraging free-living Atlantic walruses (*Odobenus rosmarus rosmarus*) and estimates of their food consumption. *Polar Biol. 26*, 348-357.
40. Porsild, M.P. 1918. On "Savssat": A crowding of arctic animals at holes in the sea ice. *Geogr. Rev. 6,* 215-228.
41. Brown, R.G.B. and Nettleship, D.N. 1981. The biological significance of polynyas to arctic colonial seabirds. In: *Polynyas in the Canadian Arctic.* Stirling, I. and Cleator, H. (eds). *Can. Wildl. Serv. Occas. Pap. 45*, 59-66.
42. Hunt, G.L. Jr. and Stabeno, P.J. 2002. Climate change and the control of energy flow in the southeastern Bering Sea. *Progr. Oceanogr. 55*, 5-22
43. Hansen, A.S., Nielsen, T.G., Levinsen, H., Madsen, S.D., Thingstad, T.F. and Hansen, B.W. 2002. Impact of changing ice cover on pelagic productivity and food web structure in Disko Bay, West Greenland: a dynamic model approach. *Deep-Sea Res. I*, 171-187.
44. Rysgaard, S., Finster, K. and Dahlgaard, H. 1996. Primary production, nutrient dynamics and mineralization in a northeastern Greenland fjord during the summer thaw. *Polar Biol. 16*, 497-506.
45. Moore, S.E. and Reeves, R.R. 1993. Distribution and movements. In: *The Bowhead Whale.* Burns, J.J., Montague, J.J. and Cowles, C.J. (eds). Special Publication No. 2 Society for Marine Mammalogy, Allen Press, Lawrence, Kansas, USA, 313-378.
46. Heide-Jørgensen, M.P. and Acquarone, M. 2002. Size and trends of the bowhead whale, beluga and narwhal stocks wintering off West Greenland. *NAMMCO Sci. Publ. 4*, 191-210.
47. Heide-Jørgensen, M.P., Dietz, R., Laidre, K.L. and Richard, P. 2002. Autumn movements, home range and winter density of narwhals (*Monodon monoceros*) from Tremblay Sound, Baffin Island. *Polar Biol. 25*, 331-341.
48. Koski, W.R. and Davis, R.A. 1994. Distribution and numbers of narwhals (*Monodon monoceros*) in Baffin Bay and Davis Strait. *Meddr Grønland, Bioscience 39*, 15-40.
49. NAMMCO 2000. *NAMMCO Annual Report 1999*. North Atlantic Marine Mammal Commission, Tromsø, Norway, 265 pp.
50. Richard, P.R., Orr J.R. and Barber, D.G. 1990. The distribution and abundance of belugas, *Delphinapterus leucas*, in eastern Canadian sub-arctic waters: A review and update. *Can. Bull. Fish. Aquat. Sci. 224*, 23-38.
51. Riewe, R.R. (ed.). 1992. *Nunavut Atlas*. Canadian Circumpolar Institute, Edmonton, Alberta, Canada. 259 pp.

52. This study was financially supported by the Danish Cooperation for the Environment in the Arctic (Dancea), Ministry of Environment and Energy, and the Greenland Institute of Natural Resources.
53. First submitted 16 Sept. 2003. Revised manuscript received 24 Nov. 2003. Accepted for publication 1 Dec. 2003.

Mads Peter Heide-Jørgensen, Dr.Sci., is a senior scientist at the Greenland Institute of Natural Resources, Nuuk. His area of expertise is in high Arctic cetacean ecology, population trends, movements, and habitat utilization. His address: Greenland Institute of Natural Resources, Box 570, DK-3900 Nuuk, Greenland.
mhj@dpc.dk

Kristin Laidre, PhD, is a post-doctoral fellow at the Greenland Institute of Natural Resources supported by the National Science Foundation. Her expertise is in spatial modeling of Arctic top predator habitat use. Her address: Greenland Institute of Natural Resources, Box 570, DK-3900 Nuuk, Greenland.
krla@natur.gl

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Polar Biol (2003) 26: 318–326
DOI 10.1007/s00300-003-0488-x

ORIGINAL PAPER

M.P. Heide-Jørgensen · P. Richard · R. Dietz
K.L. Laidre · J. Orr · H.C. Schmidt

An estimate of the fraction of belugas (*Delphinapterus leucas*) in the Canadian high Arctic that winter in West Greenland

Received: 20 July 2002 / Accepted: 25 January 2003 / Published online: 7 March 2003
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Abstract Five belugas, or white whales (*Delphinapterus leucas*), were tracked by satellite from Creswell Bay, Somerset Island, in the Canadian high Arctic towards West Greenland in autumn 2001. After 1 October, three of the whales stayed in the North Water polynya and the other two whales moved to West Greenland. One of the whales that moved to Greenland migrated south along the west coast, following a route and timing similar to another beluga tracked in 1996. The belugas that moved towards West Greenland from Canada did so before or near 1 October. The movements of both these whales followed a similar timing and assumed migratory route of belugas hunted in autumn in West Greenland. In Greenland, the hunt begins in September, where the first whales are taken in the northernmost community of Qaanaaq. Hunting takes place farther south in Upernavik in October, and finally in November and December, belugas are taken even farther south in Uummannaq and Disko Bay. The whales that remain in the North Water after 1 October most likely do not contribute to the harvest in West Greenland. Based on the total number of belugas satellite-tracked in Canada between 1995 and 2001 with tags that lasted beyond 1 October, approximately 0.15 (95% CI 0.06–0.35; $n = 26$) of the summering stock of belugas in the Canadian high Arctic move to West Greenland for the winter. Genetic studies have indicated that belugas moving east through Lancaster Sound are significantly differentiated from belugas taken in the autumn hunt in West Greenland. These conflicting results suggest molecular genetics cannot be solely relied on to reveal the stock identity of these belugas.

M.P. Heide-Jørgensen (✉)
Greenland Institute of Natural Resources,
c/o National Marine Mammal Laboratory,
7600 Sand Point Way NE Seattle, WA 98115, USA
E-mail: madspeter.heide-joergensen@noaa.gov

P. Richard · J. Orr
Freshwater Institute, Department of Fisheries and Oceans,
501 University Crescent, R3T 2N6 Winnipeg,
Manitoba, Canada

R. Dietz
Department of Arctic Environment,
National Environmental Research Institute,
Frederiksborgvej 399, Box 358, 4000 Roskilde, Denmark

K.L. Laidre
School of Aquatic and Fishery Sciences,
University of Washington, Box 355020, 98195 Seattle,
Washington, USA

H.C. Schmidt
Greenland Institute of Natural Resources,
Box 570, 3900, Nuuk, Greenland

Introduction

Historically, it has been assumed that the majority of belugas, or white whales (*Delphinapterus leucas*), summering in the Canadian high Arctic move to West Greenland for the winter. It has been proposed that only a small proportion remain in the North Water polynya (referred to here as the "North Water"), situated at the entrance to Smith Sound between Northwest Greenland and the northeastern Canadian high Arctic (Vibe 1967; Finley and Renaud 1980; Reeves and Mitchell 1987; Richard et al. 1998a). However, results from recent satellite-tracking studies of belugas have revealed that a large number of tagged belugas actually remain in the North Water, long after the major migratory pulse arrives in West Greenland (Richard et al. 2001a).

The seasonal timing of beluga catches and observations of beluga arrival in hunting areas in West Greenland suggest that a large pulse of whales arrive in the northernmost municipalities of Qaanaaq in late September and Upernavik in early October. Whales appear to be passing through these areas throughout October, and arrive farther south in the Disko Bay area in November (Heide-Jørgensen 1994). Furthermore, belugas are frequently seen and caught from

January to March south of Disko Bay, and are only occasionally seen south of 65°N. Visual observations and catches indicate that belugas remain between Maniitsoq and Disko Island until mid-May, after which they move north. Belugas are occasionally taken along the ice edge in Upernavik in spring, supporting the idea of this northward movement.

Satellite telemetry, genetic studies and organochlorine analyses show belugas have strong site fidelity to certain fjords, estuaries and wintering grounds (O'Corry-Growe et al. 1997, 2002; Richard et al. 2001a; de March et al. 2002; Innes et al. 2002a, 2002b; Palsbøll et al. 2002). To date, two different beluga wintering grounds have been identified in the Baffin Bay region: one in Central West Greenland between Maniitsoq and Disko Island, and the other in the North Water. A large decline in beluga abundance was detected in the area between Maniitsoq and Disko Island between 1981 and 1999 (Heide-Jørgensen and Acquarone 2002). The cause of the decline has been attributed to unsustainable beluga hunting in West Greenland (Butterworth et al. 2002; Innes and Stewart 2002). No data are available to detect changes in population abundance in the North Water, where only limited hunting takes place (Richard et al. 1998a).

There is a need to develop catch levels, which can be applied to abundance estimates, to adjust catches to sustainable levels or levels that would allow a recovery of the depleted beluga stock in West Greenland (cf. Butterworth et al. 2002; Innes and Stewart 2002; Sejersen 2002). It is important to know from which locality a harvested stock of a migratory animal originates, and also what fraction of the source population is subjected to a hunt (or multiple hunts in different areas). Belugas follow strict spatial and temporal patterns of movements and display a high degree of site fidelity to seasonal habitats. Because of these tendencies, beluga stock or sub-population discreteness must be evaluated on a small geographical scale. This study presents results of satellite-tracking studies of belugas in the Canadian high Arctic from August 2001 to February 2002, and links relevant evidence on movement patterns to population discreteness within Canada and Greenland. Additionally, an estimate of the fraction of belugas from the Canadian high Arctic that move to West Greenland for the winter is calculated, based on satellite-tracking studies conducted between 1995 and 2001 (Richard et al. 1998b, 2001a; present study).

Materials and methods

Satellite tracking

Six belugas were live captured at Creswell Bay, Somerset Island, Canada (Fig. 1) in August 2001 using hoop nets (cf. Orr et al. 2001). The whales were instrumented with satellite-linked radio-transmitters attached to the dorsal ridge with stainless-steel wires and either 6-mm nylon pins or 5-mm titanium rods (see Table 1 for specifications). The satellite transmitters (SPOT1 and SPOT2, Wildlife Computers, Redmond, Wash.) provided geographic positions of the whales and were either programmed to transmit on the 5th, 15th and 25th day of each month, or to transmit every 4 days. Data from the transmitters were collected via the ARGOS system (Service Argos 1989; Harris et al. 1990). Only good-quality positions were used in the analysis. Positions from ARGOS were examined visually and dates of passage between different landmarks or geographic coordinates were compiled. The data were compared to departure and passage dates for specific localities from other satellite-tracking data collected from belugas tagged in the Canadian high Arctic in 1995 and 1996 (Richard et al. 1998b, 2001a).

Harvest statistics

Statistics on monthly distribution of catches of belugas in West Greenland were obtained from the Directorate of Hunting and Fisheries under the Greenland Home Rule (Piniarneq 1993–2000). Direct observations of catches and reports collected from hunters were extracted from unpublished reports (Greenland Institute of Natural Resources, Nuuk). Catches were examined on a monthly scale, and peaks for each of the regions where belugas were taken in Greenland were identified. These data were compared to the temporal scale of the migratory path taken by the belugas that travelled to Greenland.

Data analysis

The probability that a beluga moved to West Greenland for the winter (or stayed in the North Water) was assumed to be binomially distributed where $\hat{p}$ was the proportion of whales moving to West Greenland with standard deviation

$$\mathrm{sd}(\hat{p}) = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

Confidence limits (95%) were calculated by log-odds transformation where:

$$\hat{P}_{lower} = \frac{\hat{p}}{\hat{p} + (1-\hat{p}) * C}$$

and

$$\hat{P}_{upper} = \frac{\hat{p}}{(\hat{p} + (1-\hat{p}))/C}$$

where

$$C = \exp\left[\frac{1.96 * sd(\hat{p})}{(\hat{p}(1-\hat{p}))}\right]$$

(Burnham et al. 1987)

Table 1 List of instrumented belugas in Creswell Bay, 2001. Transmitter 7931 was programmed to transmit every 4 days and all other tags were programmed to transmit on the 5th, 15th and 25th day of each month

Animal ID	Date in August 2001	Sex	Length (cm)	Fluke width (cm)	Colour	Last day with positions
7931	8	Male	320	–	Grey	1 February
20160	8	Male	370	–	White	15 October
20688	10	Female	373	79	White	5 November
20689	10	Male	325	68	Grey	5 October
20693	10	Female	375	90	White	15 August
26712	14	Female	390	89	White	15 October

Results

Belugas in 2001–2002

Between 8 and 14 August, six belugas were tagged at Creswell Bay (Somerset Island) on the west side of Prince Regent Inlet. All whales immediately left the area and travelled to Peel Sound or Barrow Strait, where they headed east towards Lancaster Sound as late as 25 August (Figs. 1, 2). They continued in this direction to the end of September. At this time, four of the remaining five whales were either in the eastern part of Lancaster Sound moving north along the east coast of Devon Island, or had reached Jones Sound (Figs. 2, 3). The whales with the latest departure date from Lancaster Sound were the last to arrive in Jones Sound (arrival on 5 October), and one whale remained in Barrow Strait longer than the others (20688).

Of the five whales that provided positions beyond 1 October, three (7931, 20160, 26712, Fig. 2) reached the coast of Northwest Greenland (north of 76°N) at approximately 76°N, 72°W between 2 and 5 October 2001. One of these whales (26712) remained in Northwest Greenland until 15 October, while a second whale (20160) was further southeast in Melville Bay, West Greenland at approximately 75°N, 61°W on 5 October. The third whale (7931) provided more detailed movements along the West Greenland coast because the tag was programmed to give positions every 4 days and batteries had greater longevity. Between 2 and 12 October 2001, this whale travelled close to the coast of the Qaanaaq and Upernavik municipalities (Fig. 3) and stayed in the northern part of Upernavik (> 74°N) until 1 November. Between early November to mid-December, it frequented coastal areas of southern Upernavik (between 72° and 74°N). It passed offshore of Uummannaq municipality by mid-December, and reached the entrance to Vaigat Strait on 28 December. It continued south offshore of Disko Island and approached the coast of West Greenland south of Disko Bay in mid-January. Finally, the beluga reached its southernmost position on 24 January, just north of the town of Sisimiut. From there, it moved northwest until contact was lost in early February 2002.

Timing of catches in West Greenland

According to catch statistics based on catches of 4,807 belugas collected between 1993 and 2000, catches show a pronounced peak in October in Upernavik, after a broader catch period farther north in Qaanaaq between September and October (Fig. 4). Catches in Uummannaq are concentrated in November and in Disko Bay, and farther south, peaks appear in November and April.

The range of dates of the first and last autumn catches of belugas in Upernavik (based on data from jaw collections, hunters, or other observations) show a clear temporal pattern. No catches occur before 28 September, and most catches take place during the 1st week of October (Fig. 5). This suggests whales are taken as they move south from Qaanaaq.

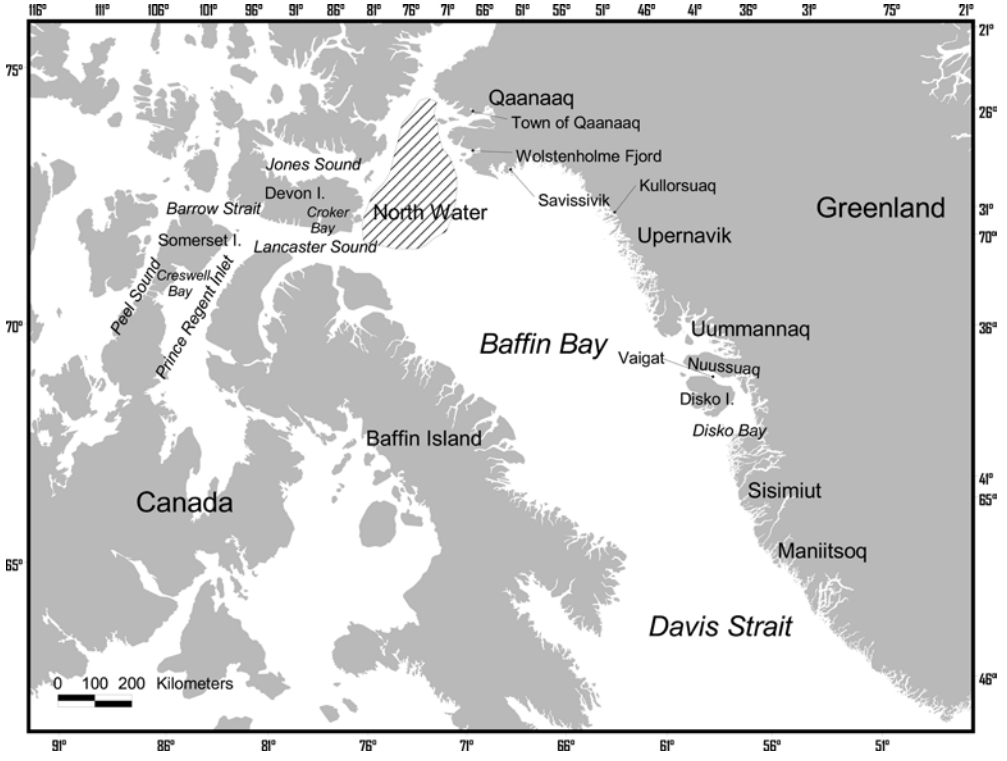

Fig. 1 Map of localities mentioned in the text and the location of the North Water polynya

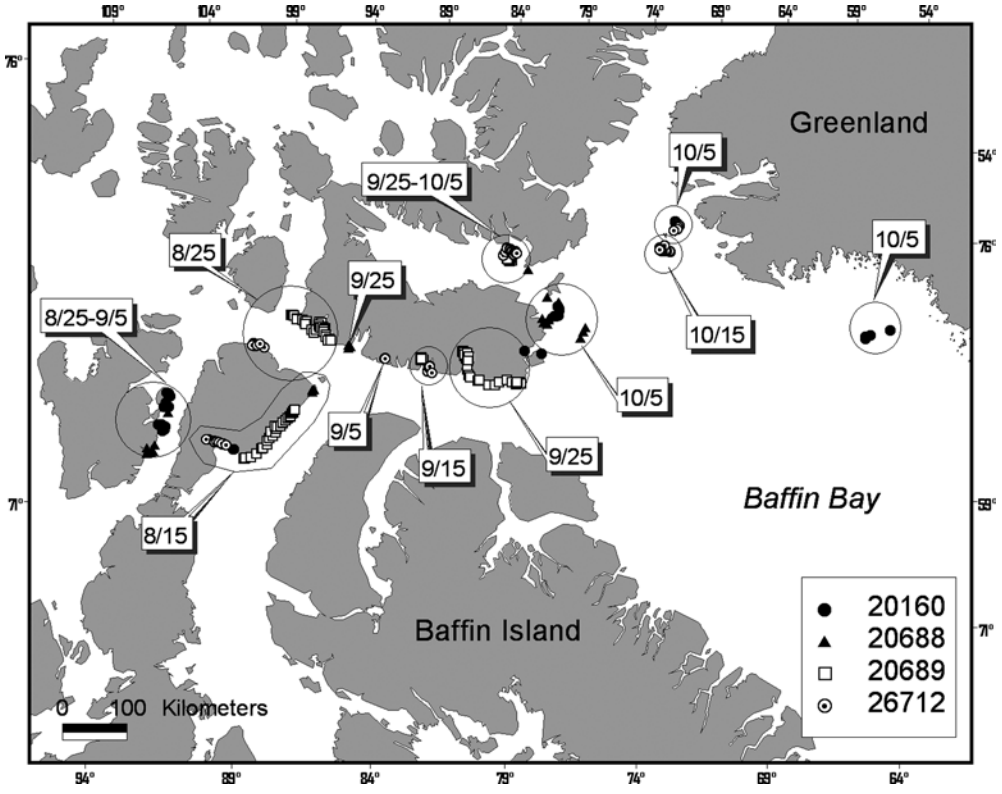

Fig. 2 Geographic positions of four belugas satellite tracked from Creswell Bay, Somerset Island, 2001. All whales were tagged in August. Whale 26712 is included in the fraction of whales that were considered to remain in the North Water in the winter because the whale did not reach West Greenland (south of 76°N) by early October. Whale 20160 was included in the fraction that move to West Greenland because it left the North Water and travelled east before early October

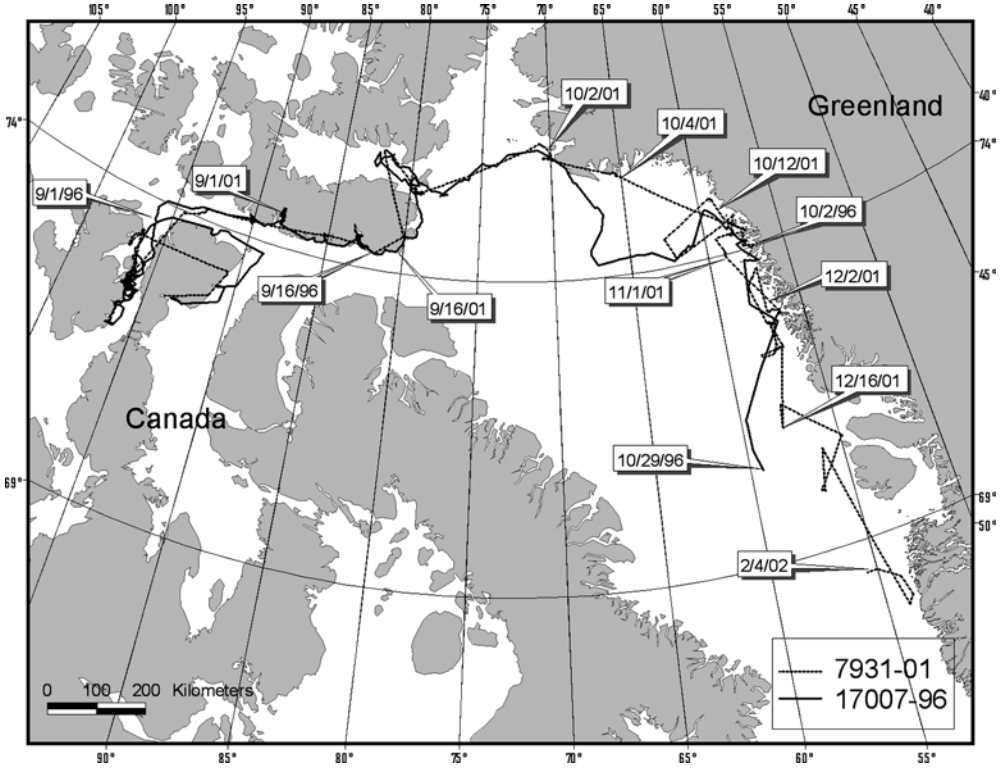

Fig. 3 Tracklines of beluga 7931 tagged in 2001 (present study) and whale 17007 tagged in 1996 (results reported in Richard et al. 2001a). The total distance travelled for whale 7931 was 8,679 km when distances between all positions between 8 August 2001 and 4 February 2002 were used, 4,814 km when only good-quality positions (LC > 0) were used for the same time period, and 4,037 km when average daily positions were used. Whale 17007 travelled 17,748 km between 22 July and 30 October (100 days) when all position qualities were considered and 5,160 km when only good-quality positions (LC > 0) were used for the same time period

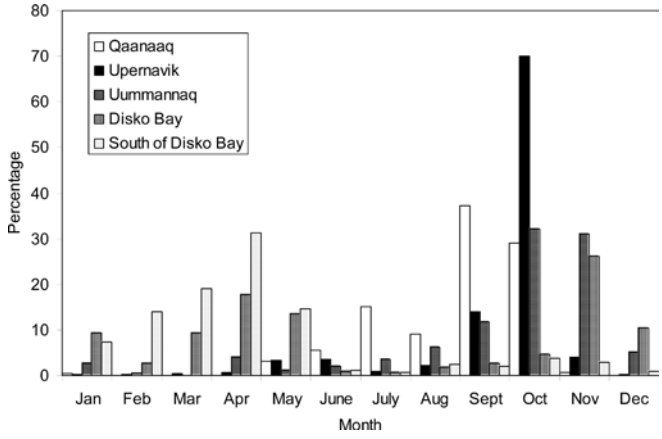

Fig. 4 Distribution of reported beluga catches by month in West Greenland between 1993 and 2000 ($n = 4{,}807$). Catches were reported for the municipalities of Qaanaaq, Upernavik, Uummannaq, Disko Bay, and south of Disko Bay (Piniarneq 1993–2000)

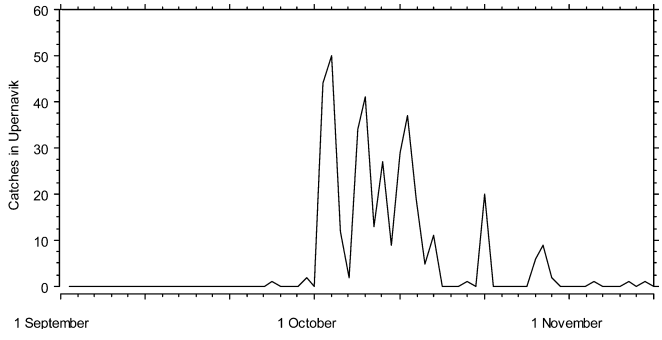

Fig. 5 Peak period of catches of belugas from direct observations of date and number of whales killed in Upernavik 1989–1999

Review of previous autumn tracking of belugas from Canada to Greenland

Approximately 33 belugas have been satellite-tracked in the Canadian high Arctic during 4 studies at 4 different localities between 1995 and 2001. Six of the 33 whales failed to provide positions beyond 1 October (the date after which belugas are expected to reach the West Greenland coast, based on the occurrence of belugas in the coastal hunt), and were excluded from the analysis. The remaining 26 tags, used in this analysis, provided positions well into October (beyond 10 October), with 5 tags lasting at least into November.

In mid-September 1995, six belugas were instrumented on the south coast of Devon Island (Croker Bay) and tracked for several months. They remained in the North Water from mid-October to mid-November, when contact was lost (Richard et al. 1998b). In early September 1996, nine belugas were tagged in Croker Bay and tracked to the North Water. None of the whales moved towards Northwest Greenland (i.e. passed 73°W) even though they were tracked for several weeks after 1 October (tags stopped between 16 October and 18 November; Richard et al. 2001a).

In mid-July 1996, 12 belugas were tagged in 3 different estuaries around Somerset Island (Cunningham Inlet, Elwin Bay, and Creswell Bay). Seven tags provided positions after 1 October (Richard et al. 2001a). Six of the seven whales stayed in the North Water area until contact was lost between 12 October and 28 November. The last remaining whale (17007) moved east on 23 September and reached the Greenland coast south of Wolstenholme Fjord on 25 September (Fig. 3). Around 2 October, it approached the northernmost settlement (Kullorsuaq) in Upernavik and followed a route and timing that were both similar to the movements of the belugas tracked in the present study, and similar to the sequence of hunting events in West Greenland. The last locations from this whale were obtained on 29 October when it was offshore of Disko Island, Greenland (Fig. 3).

The belugas tracked in our study closely followed the migratory schedule observed during previous tracking studies; the whales moved to Peel Sound in mid-August, left Lancaster Sound in mid-September, and moved north into Jones Sound in late September (Tables 2, 3). The tracks indicate that whales can apparently be segregated into two groups in the second half of September: some whales head towards the banks off Jones Sound, and others continue towards Northwest Greenland, where they appear in early October.

Fraction of Canadian high-Arctic belugas that move to West Greenland

Of the 26 beluga tags that lasted beyond 1 October, 4 individuals reached the West Greenland coast (south of 76°N) around 5 October, and 22 individuals stayed in the North Water. All four whales that went to Greenland were tagged in Creswell Bay, on Somerset Island. Of the 22 that stayed in the North Water, 8 (1995: 2, 1996: 5, 2001: 1) gave positions in this area well into November, indicating there was not a delayed migration from the North Water to West Greenland. Therefore, it can be assumed that the belugas that stayed in the North Water in November also stayed there during the winter. When results from all 3 years were combined, the fraction of whales that moved to West Greenland was 0.15 (95% CI 0.06–0.35).

Discussion

The departure of belugas from the central Canadian high Arctic follows a regular schedule that has apparently not changed much over the past century. Based on aerial surveys, Koski et al. (2002) found that most belugas left Lancaster Sound in mid-September in the 1970s. A similar timing was also observed at Croker Bay in 1934, where the beluga hunting peaked between 20 and 22 September (Reeves and Mitchell 1987).

Table 2 Details on the travel distances, duration of tracking and the arrival at certain positions for 5 whales tracked in 2001. Data were compared to averages of the 6 whales tracked in 1995 (Richard et al. 1998b) and the 20 whales tracked in 1996 (Richard et al. 2001a). *NA* indicates "not applicable" and *dashes* indicate that the whales did not move to those localities or the tags stopped transmitting. Dates are in Julian days after 1 January

	1995		1996		2001				
Whale ID	Females	Males	Females	Males	7931M	20160M	20688F	20689M	26712F
Travel distance (km)	1554–2661	2258–2761	1245–4599	191–5160	4814	1477	1434	985	1146
Duration of tracking (days)	32–49	32–54	40–99	2–106	184	68	87	56	62
Speed (km/day)	54	61	46	52	26	22	16	18	18
Enter Lancaster Sound (89°W)	NA	NA	253	245	244–247	258–268	268–278	237–247	237–247
Exit Lancaster Sound (80°W)	266	262	259	258	258–268	258–269	268–278	258	258–268
Arrival Jones Sound (>75°N, 81°W)	262	266	262	267	267–271	268	268–278	268–278	268–278
Arrival West Greenland (73°W)	–	–	–	268	275	278–288	–	–	278–288
Arrival Upernavik (74°30′N-57°30'W)	–	–	–	276	285	–	–	–	–
Passing Nuussuaq (70°45′N)	–	–	–	271	362	–	–	–	–

Table 3 An overview of results from satellite-tracking studies of belugas in the Canadian high Arctic, 1995–2001. Tagging at Somerset Island includes three estuaries: Creswell Bay, Cunningham Inlet and Elwin Bay

Localities and years	*n*	*n* with contact after 1 October	Last dates with contact after 1 October	Number in West Greenland/North Water	Reference
Croker Bay 1995	6	6	16 October–10 November	0/6	Richard et al. (1998b)
Somerset Island 1996	12	7	12 October–28 November	1/6	Richard et al. (2001a)
Croker Bay 1996	9	8	19 October–18 November	0/8	Richard et al. (2001a)
Creswell Bay 2001	6	5	5 October–February 2002	3/2	This study
Total	33	26		4/22	

The timing of the autumn movements of belugas in Northwest and West Greenland also follows a regular pattern. Beluga whales arrive and are hunted in the municipality of Qaanaaq (either at the settlements of Qaanaaq or Savissivik) in late September (usually around 20 September in Qaanaaq and 25 September in Savissivik) (Heide-Jørgensen 1994). The settlements of northern Upernavik take their first belugas around 28 September, and catches peaked in this area in the first 2 weeks of October during the 1990s. Catches farther south in Uummannaq and Disko Bay occur in November and December, and belugas are taken in winter and spring south of Disko Bay.

The whale that was tracked in this study through February 2002, was located near the West Greenland communities during times that are consistent with knowledge on beluga phenology obtained from catch statistics, aerial surveys and observations. The whale arrived in northern Upernavik exactly when autumn catches peak, and also in the very same area where the majority of the catches took place during the 1980s and 1990s. In January, the whale was found outside Disko Island at the same time when belugas are hunted in this area. In February, the beluga appeared in the same concentration area where multi-annual surveys have been conducted for trends in beluga abundance (Heide-Jørgensen et al. 1993; Heide-Jørgensen and Reeves 1996; Heide-Jørgensen and Acquarone 2002). The track of the whale in this study was consistent with that from the beluga tracked from Creswell Bay between July and November 1996 (Richard et al. 2001a).

Satellite-tracking studies of belugas were conducted in three estuaries in the Canadian high Arctic (Creswell Bay, Elwin Bay, Cunningham Inlet); however, only whales tagged at Creswell Bay moved to West Greenland. Based on these results, there appears to be some segregation within the beluga population in Canada and, possibly, within a single summering locality. Tagging at Devon Island (Croker Bay) in September most likely included whales from all summering grounds around Somerset Island (including the three estuaries above), and possibly even localities where tagging studies have not yet been conducted. This is because the general pattern is such that most whales (from all areas around Somerset Island) move out through Lancaster Sound and pass this area in September, visiting Croker Bay (Richard et al. 2001a). It should also be noted that the two belugas that went to West Greenland passed Croker Bay on 15 September, the peak time of the capture operations at this locality. Thus the autumn tagging at Croker Bay is likely a

random sample, which constituted more than half of the whales in this study.

Current knowledge on molecular genetics of high-Arctic belugas shows that belugas from Lancaster Sound are significantly different from those caught in West Greenland (Upernavik and Disko Bay) based on mitochondrial DNA haplotype distribution (de March et al. 2002). This contradicts the evidence presented here collected by satellite tracking of known individuals moving between the two areas. An overall genetic difference was also reported for belugas between Creswell Bay and West Greenland in 1996 (where the beluga that moved from Creswell Bay to West Greenland was included in the genetic analysis reported by de March et al. 2002); however, a difference was not found for samples taken in Creswell Bay in 1993. No whales were tagged in that year. In both 1996 and 2001, the satellite-tagged whales visited several West Greenland beluga hunting grounds. These results question how clearly genetic studies can discriminate between wintering stocks of belugas that summer in the same area. One explanation, suggested by Palsbøll et al. (2002), is that due to the nature of the genetic sampling programs, genetic studies are more likely to discriminate pods of related whales, rather than stocks in different areas. The samples for genetic studies are often collected from harvest events, where whales from the same pod are killed. Consequently, there is a high risk of obtaining samples from related individuals. This same sampling bias may be true for whales from satellite-tagging studies at a specific site; however, in many harvest situations, entire pods of a single family unit are sampled for genetic studies, which results in a higher degree of interrelatedness than individual whales that are live captured over a period of days in estuaries.

Regardless of sample size, the satellite tracks presented here provide direct evidence that there is a link between the belugas summering in the Canadian high Artic and those in the West Greenland wintering area. Therefore, to assess the contribution of the summering population to the hunted West Greenland winter stock, it seems more effective to examine the probability that whales from a single summering ground move to one of two wintering grounds. This is especially important in situations (like the present) where most hunting occurs in the wintering area. Satellite tracking provides an opportunity for direct estimation of movement probability, and pooling tracks from several years (and localities if justified) can augment sample size. Our estimate of 0.15 (4/26) of the belugas from the Canadian high Arctic moving to West Greenland for the winter updates the estimate of 0.04 (1/21) based on earlier tracking studies with smaller sample sizes (Richard et al. 1998b, 2001a). It is important to note the percentage of whales moving to West Greenland can be variable. None of the whales from the two Devon Island studies moved to Greenland, yet as many as two-thirds of the whales from Creswell Bay in 2001 did. This variability stresses the need for additional studies to elucidate the inter-annual and inter-region differences in movement probability. If the 2001–2002 data alone had been used to calculate a fraction, as many as 60% would have been estimated to move to Greenland.

Only 4 of the 26 whales that were tracked after 1 October could have been subjected to hunting in West Greenland in October or later. If the remaining 22 belugas were available for the Greenland hunt, they would have had to move east later in the season (i.e. in December) after contact was lost. Although such a late movement of belugas from the Canadian high Arctic cannot be entirely excluded, it is highly unlikely. The geographic positions where contact was lost were in an area where belugas are known to occur and most likely remain in winter. Heavy pack ice surrounds the North Water polynya from December to May (Canadian Ice Service 2002), and belugas have not been found outside this area from March to May, except for the coastal open-water areas in West Greenland and some coastal leads in Lancaster Sound (Heide-Jørgensen and Reeves 1996; Heide-Jørgensen and Acquarone 2002). Furthermore, the belugas that were tracked through November did not suggest a secondary pulse of whales moving to Greenland. Thus, there is presently little support for the idea of additional whales moving to Greenland beyond those that leave in October.

Another possibility that could explain the results presented here is that the belugas may alternate between wintering grounds. This possibility is considered unlikely because monodontids are creatures of habit, with extreme site fidelity to their selected summering and wintering grounds in the Arctic (O'Corry-Growe et al. 2002). Additionally, comparisons of organochlorine profiles in the blubber of belugas caught in Jones Sound (probably North Water animals) and in Upernavik-Disko Bay (West Greenland animals), corrected for age and sex differences, have revealed significant differences in the relative composition of organochlorine contaminants between the two areas, which indicates whales are segregated during the winter season (Innes et al. 2002a).

The most recent estimate of beluga abundance in the Canadian high Arctic is 21,213 whales (SE 5,359) in 1996, corrected for the proportion of whales submerged (availability bias) and those missed by the observers (perception bias) (Innes et al. 2002b). Using the fraction of whales that move to West Greenland (0.15, $n = 26$), the actual number wintering in West Greenland can be derived by resampling the lognormal distribution of the population size and the binomial fraction ($\hat{p}$) that move to Greenland and taking their product. Repeating this procedure 1,000 times provides mean abundance estimates of 3,156 (95% C.L.: 643–7,334) belugas wintering in West Greenland, and 18,057 (95% C.L.: 13,879–20,570) belugas wintering in the North Water and adjacent areas.

The wintering stock of belugas in West Greenland was estimated to be 7,941 (95% CI 3,650–17,278) in 1998–1999 (Heide-Jørgensen and Acquarone 2002). This wintering stock is approximately 37% of the estimate of

the summer population in the Canadian high Arctic (Innes et al. 2002b), and implies that 13,000 whales winter in the North Water and adjacent areas. Both methods of estimating the number of whales in the North Water indicate that substantially more belugas winter in the North Water than what was estimated from reconnaissance surveys in the area. Finley and Renaud (1980) and Richard et al. (1998a) gave counts of approximately 500 whales at the surface in leads and cracks in the North Water in winters 1978 and 1994, respectively. These figures were not corrected for whales that were submerged and overlooked by the observers, which could be a factor of 5–6 times the numbers reported (cf. Heide-Jørgensen and Acquarone 2002). Furthermore, the estimates do not include numbers of whales from unsurveyed areas. Recent evidence of ice entrapments in northern Baffin Bay (Heide-Jørgensen et al. 2002) indicate that belugas also occur in shore leads in Lancaster Sound and Jones Sound, and perhaps in other areas adjacent to the North Water. The figures for the population sizes presented above are both associated with considerable uncertainty and if the range of the uncertainty is considered, the expected number of whales wintering in the two areas, derived from the fraction that move to West Greenland, does not deviate from the abundance estimates.

Regardless of the uncertainty about population size or the specific fraction of belugas that move to West Greenland, it appears that less than 50% of the total beluga population in the Canadian high Arctic winter in West Greenland, based on a combination of satellite telemetry, genetic and organochlorine data. Most of these whales may winter in the North Water or use leads in Lancaster Sound, which have not been adequately covered by past surveys. Belugas are creatures of habit, following strict migratory patterns with strong fidelity to certain areas despite being intensively hunted at these localities. The estimated fraction that moved to West Greenland based on the studies reported here may be an artefact of the decrease in winter abundance in West Greenland, and may not reflect the natural equilibrium between the fraction wintering in West Greenland and the fraction in the North Water. A natural equilibrium could possibly be close to 50% wintering in Greenland, or even higher, since the beluga abundance in West Greenland historically was substantially higher than that observed today (Butterworth et al. 2002).

Acknowledgements Two Inuit hunters, Mosesie Keenainak and Randy Itdlout, participated in the capture and handling of the belugas. Karen Motzfeldt kindly provided the hunting statistics from Piniarneq. The study was funded by the Greenland Institute of Natural Resources, the National Environmental Research Institute, the Department of Fisheries and Oceans, the Nunavut Wildlife Management Board, the Danish Natural Research Council (51-00-0131) and the Danish Environmental Protection Agency as part of the environmental support program Dancea (Danish Cooperation for Environment in the Arctic). Polar Continental Shelf Program supplied logistics for the fieldwork. Brigitte de March and two anonymous reviewers improved the manuscript.

References

Burnham KP, Anderson DR, White GC, Brownie C, Pollock KH (1987) Design and analysis methods for fish survival experiments based on release-recapture. American Fisheries Society Monograph 5

Butterworth DS, Plagányi EE, Geromont HF (2002) Resource assessment and projections for the belugas off West Greenland using the population model of HITTER-FITTER. NAMMCO Sci Publ 4:211–224

Canadian Ice Service (2002) Sea ice climatic atlas: Northern Canadian Waters, 1971–2000. Public Works and Government Services, Ottawa

Degerbøl M, Nielsen NL (1930) Biologiske iagttagelser over og malinger af hvidhvalen (*Delphinapterus leucas*) og dens foster. Medd Grøn 77:119–144

Finley KJ, Renaud WE (1980) Marine mammals inhabiting the Baffin Bay North Water in winter. Arctic 33:724–738

Harris RB, Fancy SG, Douglas DC, Garner GW, Amstrup SC, McCabe TR, Pank LF (1990) Tracking wildlife by satellite: current systems and performance. United States Department of the Interior, Fish and Wildlife Technical Report 30

Heide-Jørgensen MP (1994) Distribution, exploitation and population status of white whales (*Delphinapterus leucas*) and narwhals (*Monodon monoceros*) in West Greenland. Medd Grøn Biosci 39:135–149

Heide-Jørgensen MP, Acquarone M (2002) Size and trends of the bowhead whale, beluga and narwhal stocks wintering off West Greenland. NAMMCO Sci Publ 4:191–210

Heide-Jørgensen MP, Reeves RR (1996) Evidence of a decline in beluga, *Delphinapterus leucas*, abundance off West Greenland. ICES J Mar Sci 53:61–72

Heide-Jørgensen MP, Lassen H, Teilmann J, Davis RA (1993) An index of the relative abundance of wintering belugas, *Delphinapterus leucas*, and narwhals, *Monodon monoceros*, off West Greenland. Can J Fish Aquat Sci 50:2323–2335

Heide-Jørgensen MP, Richard P, Ramsay M, Akeeagok S (2002) Three recent ice entrapments of Arctic cetaceans in West Greenland and the eastern Canadian High Arctic. NAMMCO Sci Publ 4:143–148

Innes S, Stewart REA (2002) Population size and yield of Baffin Bay beluga (*Delphinapterus leucas*) stocks. NAMMCO Sci Publ 4:225–238

Innes S, Muir DCG, Stewart REA, Heide-Jørgensen MP, Dietz R (2002a) Stock identity of beluga (*Delphinapterus leucas*) in Eastern Canada and West Greenland based on multivariate analysis of the concentrations of organochlorine contaminants in their blubber. NAMMCO Sci Publ 4:51–68

Innes S, Heide-Jørgensen MP, Laake J, Laidre KL, Cleator H, Richard P, Stewart REA (2002b) Surveys of belugas and narwhals in the Canadian high Arctic 1996. NAMMCO Sci Publ 4:169–190

March BGE de, Maiers LD, Friesen MK (2002) An overview of genetic relationships of Canadian and adjacent stocks of beluga whales (*Delphinapterus leucas*) with emphasis on Baffin Bay and Canadian eastern Arctic stocks. NAMMCO Sci Publ 4:17–38

O'Corry-Growe GM, Suydam RS, Rosenberg A, Frost KJ, Dizon AE (1997) Phylogeny, population structure, and dispersal of the beluga whale *Delphinapterus leucas* in the western Nearctic revealed by mitochondrial DNA. Mol Ecol 6:955–970

O'Corry-Growe GM, Dizon AE, Suydam RS, Lowry LF (2002) Molecular genetic studies of population structure and movement patterns in a migratory species: the beluga whale, *Delphinapterus leucas*, in the Western Nearctic. In: Pfeiffer CJ (ed) Molecular and cell biology of marine mammals. Krieger, Malabar, Fla, pp 53–63

Orr JR, Joe R, Evic D (2001) Capturing and handling of white whales (*Delphinapterus leucas*) for instrumentation and release, in the Canadian Arctic. Arctic 54:299–304

Palsbøll P, Heide-Jørgensen MP, Berubé M (2002) Analysis of mitochondrial control region nucleotide sequences from Baffin Bay belugas, *Delphinapterus leucas*: detecting pods or sub-populations? NAMMCO Sci Publ 4:39–50

Piniarneq (1993–2000) Hunting statistics for 1993–2000 for Greenland. Direktoratet for Erhverv, Greenland Home Rule

Reeves RR, Mitchell E (1987) Distribution and migration, exploitation, and former abundance of white whales (*Delphinapterus leucas*) in Baffin Bay and adjacent waters. Can Spec Publ Fish Aquat Sci 199

Richard PR, Orr JR, Dietz R, Dueck L (1998a) Sightings of belugas and other marine mammals in the North Water, late March 1993. Arctic 51:1–4

Richard PR, Heide-Jørgensen MP, St. Aubin D (1998b) Fall movements of belugas (*Delphinapterus leucas*) with satellite-linked transmitters in Lancaster Sound. Arctic 51:5–16

Richard PR, Heide-Jørgensen MP, Orr J, Dietz R, Smith TG (2001a) Summer and autumn movements and habitat use by belugas in the Canadian high Arctic and adjacent waters. Arctic 54:207–222

Richard PR, Martin AR, Orr JR (2001b) Summer and autumn movements of belugas of the eastern Beaufort Sea Stock. Arctic 54:223–236

Sejersen F (2002) Hunting and management of beluga whales (*Delphinapterus leucas*) in Greenland: changing strategies to cope with new national and local interests. Arctic 54:431–443

Service Argos (1989) Guide to ARGOS system, September 1989. CLS ARGOS, Toulouse

Vibe C (1967) Arctic animal in relation to climatic fluctuations. Medd Grøn 170:1–227

ARCTIC
VOL. 56, NO. 1 (MARCH 2003) P. 21–31

From Greenland to Canada in Ten Days: Tracks of Bowhead Whales, *Balaena mysticetus*, across Baffin Bay

M.P. HEIDE-JØRGENSEN,[1,2] K.L. LAIDRE,[3] Ø. WIIG,[4] M.V. JENSEN,[1] L. DUECK,[5] L.D. MAIERS,[5] H.C. SCHMIDT[1] and R.C. HOBBS[6]

(*Received 16 October 2001; accepted in revised form 18 March 2002*)

ABSTRACT. Five bowhead whales (*Balaena mysticetus*) were instrumented with satellite transmitters in northwestern Disko Bay, West Greenland, in May 2001. Best results were obtained when tags were deployed with a pole rather than a pneumatic gun. At least three of the tagged whales remained in the northwestern part of the bay for one to two weeks after tagging. A male and a female whale moved from Disko Bay to northern Canada. They left Disko Bay 11 days apart and took different routes across Baffin Bay to the southern part of the North Water polynya, just east of the entrance to Lancaster Sound. The whales crossed the central part of Baffin Bay relatively rapidly (travel time of 9–10 days, 3.1 and 4.5 km/h). Dive behaviour of one whale was monitored and showed changes in dive depths, dive rates, and surfacing times in different localities, indicating behavioural changes probably related to feeding. The whales were presumably feeding in both Disko Bay in May and in the southern part of the North Water (southeast of Bylot Island) in June. This study confirms whalers' observations that bowhead whales move between West Greenland and the east coast of Baffin Island.

Key words: bowhead whale, *Balaena mysticetus*, satellite telemetry, dive behavior, sea ice, Baffin Bay, Canada, Greenland

RÉSUMÉ. En mai 2001, cinq baleines boréales (*Balaena mysticetus*) ont été équipées d'émetteurs spatiaux dans le nord-ouest de la baie de Disko (Groenland occidental). Les meilleurs résultats ont été obtenus lorsque les marqueurs ont été apposés avec une perche plutôt qu'avec un fusil à air comprimé. Au moins trois des baleines marquées sont restées dans la partie nord-ouest de la baie pendant une à deux semaines après le marquage. Deux individus, un mâle et une femelle, se sont déplacés de la baie de Disko au nord du Canada. Ils ont quitté la baie à 11 jours d'écart et ont emprunté des trajets différents pour traverser la baie de Baffin et rejoindre la partie méridionale de la polynie de l'Eau du Nord, située juste à l'est de l'entrée du détroit de Lancaster. Les baleines ont traversé la partie centrale de la baie de Baffin assez vite (en 9 et 10 jours, soit 3,1 et 4,5 km/h). On a suivi le comportement de plongée d'une baleine, qui a montré des changements dans la profondeur des plongées, leur fréquence et le temps en surface à divers endroits, révélant des modifications du comportement probablement associées au nourrissage. On suppose que les baleines s'alimentaient dans la baie de Disko en mai aussi bien que dans la partie méridionale de l'Eau du Nord (au sud-est de l'île Bylot) en juin. Cette étude confirme les observations des baleiniers à l'effet que les baleines boréales se déplacent entre l'ouest du Groenland et la côte est de l'île de Baffin.

Mots clés: baleine boréale, *Balaena mysticetus,* télémétrie par satellite, comportement de plongée, glace marine, baie de Baffin, Canada, Groenland

Traduit pour la revue *Arctic* par Nésida Loyer.

INTRODUCTION

The population of bowhead whales, *Balaena mysticetus*, in the Baffin Bay and Davis Strait area numbered at least 12 000 individuals in the 1800s (Woodby and Botkin, 1993). The population was severely depleted by commercial whalers before 1900 and is now considered to be between 250 and 350 whales (Finley, 1990; Zeh et al., 1993). Most of the information on the migration routes and former high-density areas in Canada and Greenland is based on observations from whalers in the 1800–1900s and Inuit hunters (e.g., Reeves et al., 1983; Ross, 1993; NWMB, 2000). The general hypothesis is that bowhead whales spend the winter distributed from the northeast coast of Labrador to the east

[1] Greenland Institute of Natural Resources, Box 570, DK-3900 Nuuk, Greenland
[2] Present address: National Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, NOAA, 7600 Sand Point Way, Seattle, Washington 98115, U.S.A.; madspeter.heide-joergensen@noaa.gov
[3] School of Aquatic and Fishery Sciences, University of Washington, Box 355020, Seattle, Washington 98195, U.S.A.
[4] Zoological Museum, University of Oslo, P.O. Box 1172 Blindern, N-0318 Oslo, Norway
[5] Department of Fisheries and Oceans, Freshwater Institute, 501 University Crescent, Winnipeg, Manitoba R3T 2N6, Canada
[6] National Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, NOAA, 7600 Sand Point Way, Seattle, Washington 98115, U.S.A.

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coast of Baffin Island across to West Greenland. In the spring, the bowhead whales are found at the ice edge of Davis Strait and Hudson Strait, in localized areas in West Greenland, and along the east coast of Baffin Island. Whales from West Greenland are thought to cross Baffin Bay (at approximately 72˚ N) and reach Lancaster Sound between May and July, while the whales on the east coast of Baffin Island move north. During the summer, bowhead whales are widely distributed and enter many fjords and bays of the Canadian High Arctic. The fall migration begins in September and continues through October, when whales either move south along the east coast of Baffin Island or cross over to the West Greenland coast, appearing there in September and October (Reeves et al., 1983).

Over the past 20 years, scattered observations of bowhead whales have been reported from West Greenland, suggesting that bowhead whales still occupy their historic locations (Born and Heide-Jørgensen, 1983; Kapel, 1985; Reeves and Heide-Jørgensen, 1996; Heide-Jørgensen and Acquarone, 2002). The winter abundance of bowhead whales along West Greenland (derived from aerial surveys of belugas, *Delphinapterus leucas*) has been estimated to be at least "a few tens" of bowheads between 1981 and 1994 (Reeves and Heide-Jørgensen, 1996). This crude estimate was not corrected for whales that were submerged during the surveys, a phenomenon also known as availability bias. In 1998, Heide-Jørgensen and Acquarone (2002) produced an estimate of 233 bowheads (SE = 165) that included a correction for availability bias.

Studies of the migratory behaviour of bowhead whales in Baffin Bay are of interest for stock delineation, especially in the light of renewed hunting in Canada (Finley, 2001). The only direct evidence of a relationship between bowhead aggregations in eastern Canada and western Greenland is the photographic documentation of a whale in Isabella Bay, NE Baffin Island, in September 1986 being re-sighted near Disko Bay in April 1990 (Heide-Jørgensen and Finley, 1991). Bowhead whales inhabit areas with extensive ice cover and may be affected by habitat variability that results from climate change. Information on the plasticity of the migratory routes of bowhead whales provides insight on their vulnerability to changes in available habitats, and determination of migration routes also elucidates stock discreteness. The purposes of this study were to improve satellite tracking techniques for bowhead whales, to document the spring movements of bowhead whales from Disko Bay, West Greenland, and to investigate diving behaviour and habitat use over the course of the migration period.

METHODS

Daily searches for whales were conducted from four small boats between 28 April and 7 May 2001 near the town of Qeqertarsuaq, Disko Island. The overall ice coverage in the western part of Disko Bay was about 10% during the field period, which was unusually light for this time of the year. Most of the ice consisted of broken pieces of fast ice that drifted with the current. When a whale was sighted, the boats moved towards the whale until it dove. While the whale was underwater, the four boats spread out to search for the next surfacing location. When the whale was re-sighted, the process was repeated again until the whale was surfacing in a predictable manner, which usually took less than half an hour. When a whale was first approached (within 4–5 m), a skin biopsy for genetic studies was taken using a crossbow.

Bowhead whales were instrumented with three different types of satellite-linked radio transmitters: ST15 and ST16 (Telonics, Mesa, Arizona) and SPOT1 tags (Wildlife Computers, Redmond, Washington). The ST16 was modified by Wildlife Computers to include binned information on dives. All transmitters were equipped with lithium thianyl batteries and were glued to a cup-shaped stainless steel base, mounted to a titanium spear (diameter 8 mm) with three barbs and a sharp pointed tip. The ST15 tags were deployed with the 'ARTS' (Air Rocket Transmitter System; see detailed description in Heide-Jørgensen et al., 2001a). The ST16 and SPOT1 tags were deployed with an 8 m fiberglass pole approximately 4–5 m from the whale. The tag was mounted on the tip of the pole, secured by a nylon line. The titanium spear was pushed through the skin and into the blubber using the pole to attach the tag. When the tag was implanted in the whale, the nylon line was cut by a sharp edge on the pole. It was important to position the satellite tag high on the whale's back to ensure it was above the water, so that the satellite could receive its transmissions. The tag delivery system was designed so that a biopsy of the whale skin was taken simultaneously (with a 10 mm hollow cylinder, 28 mm in length with internal barbs). Tags were deployed only when the whale was positioned alongside the boat 4–5 m away, and when the whale remained at the surface long enough for us to place the tag in a good position.

Compressed and summarized dive data were transmitted to the satellite for one whale (ID 24638). A dive was defined as submergence below 8 m, and the surface was defined as above 9 m, following sampling schemes also used for narwhals and belugas (Heide-Jørgensen et al., 2001b). The tag sampled depth every 10 seconds, accumulating information on depth of dives, duration of dives, and time spent at different depths across four six-hour periods each day. Time spent was coded in 10 duration classes (0–1, 1–3, 3–6, 6–9, 9–12, 12–15, 15–18, 18–21, 21–24, > 24 min), and depth in 14 depth classes (8–19, 20–35, 36–51, 52–99, 100–151, 152–199, 200–299, 300–399, 400–499, 500–599, 600–699, 700–799, 800–900, > 900 m). The maximum depth of dives for each 24-hour period was also determined. Dive data were examined for temporal variability. Vertical speeds were calculated from dive duration through depth classes of known length to 'destination depths' where the dives ended (see Heide-Jørgensen et al., 1998). Every fifteenth transmission

TABLE 1. Transmitters deployed on bowhead whales in Disko Bay during 3–7 May 2001. 'ARTS' is the Air Rocket Transmitter System described in Heide-Jørgensen et al. (2001a).

Whale ID No.	Sex	Tag Type / Duty Cycling / Method of Deployment	Date Tagged in May 2001	Length of Spear (cm)	Number of Good-quality Positions (LC 0-3)	Number of Poor-quality Positions (LC A and B)	Tag Longevity (days)
20158	Female	ST15 / 1 day on-3 off / ARTS	3	35	15	7	2
24638	Male	ST16 / none / pole	5	36	198	383	44
26712	Female	SPOT / none / pole	6	36	13	49	5
21800	Male	ST16 / 1 day on-1 off / pole	6	45	1	5	9
26716	Female	SPOT / none / pole	7	45	24	280	50

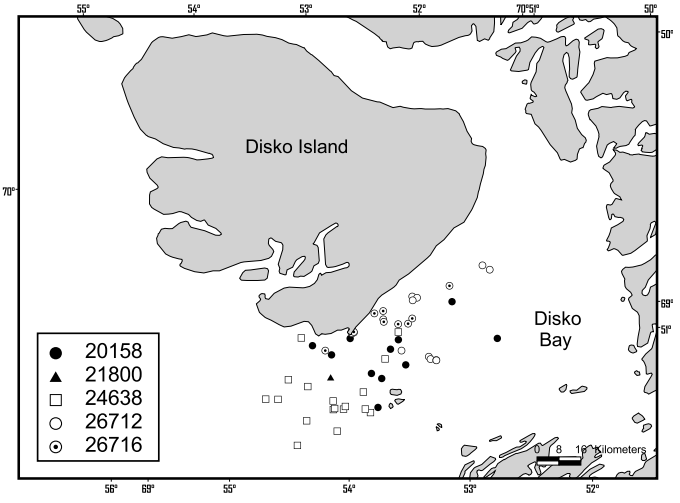

FIG. 1. Map of positions received for all bowhead whales (n = 5) tagged in Disko Bay in May 2001. Only positions with quality of 0 or better are reported.

provided readings of voltage and the cumulative number of transmissions.

Locations and dive data were collected using the Argos System (see Harris et al., 1990). Location qualities were provided by Service Argos and coded according to predicted accuracy. Location codes (LC) were B, A, and 0–3 in order of increasing accuracy of position. All location qualities were used to calculate an average daily position for each whale over the entire tracking period. The average positions were also used to calculate distance and speed over each 24-hour period and provide mean distances and speeds for selected periods during the movements of the whales.

DNA was extracted from the skin samples using DNeasy tissue extraction kits (QIAGEN). The sex of each animal sampled was then determined using a polymerase chain reaction (PCR)-based method that amplifies a portion of the X-chromosome and a portion of the Y-chromosome (if present) (Bérubé and Palsbøll, 1996). Animals were scored as female if there was only a single amplification product corresponding to the X-chromosome fragment and male if there were two products, one from the X-chromosome and one from the Y-chromosome.

Standard descriptive statistical analyses of the dive data were conducted and the level of significance was determined at $p = 0.05$. Since the dive data were categorized and summarized over six-hour periods, independence between samples was assumed, and ANOVA and ANCOVA were used to determine the effects of periods and day on the diving activity.

RESULTS

From 29 April through 8 May 2001, bowhead whales were observed in the northwestern part of Disko Bay daily (or whenever weather conditions permitted searches). All sightings consisted of single whales. Skin biopsies were collected from 15 whales, including all those that were tagged. Molecular sex identification of the samples revealed that 8 of the 15 were females.

Movements

Five bowheads, all estimated to be 12–15 m long (Table 1), were tagged with transmitters during this period. Tags provided locations for a minimum two days. The tagged whales appeared to prefer the northwestern part of Disko Bay (Fig. 1). Tags deployed on two whales (ID nos. 24638 and 26716) transmitted data for 44 and 50 days, and results from those tags are presented in detail here.

On 3 May 2001, an ST16 tag was implanted on a male whale (ID 24638) on the right side, 35 cm below the dorsal line and halfway down the long-axis. This whale (tagged at approximately 69˚12′ N, 53˚08′ W) left the Disko Bay area (69˚30′ N) on 10 May and headed northwest directly towards the east coast of Baffin Island (Fig. 2). Travelling a distance of 846 km, it reached an area only 100 km from Bylot Island, Canada, on 20 May, ten days after departing from Disko Bay (Table 2). Once this male crossed 73˚ W, it slowed down and moved to the southern margin of an area called the North Water polynya, east of Bylot Island. It made localized movements in this area (approximately 74˚ N, 75˚ W) from 30 May until 17 June, when transmissions stopped. Approximately 12 000 transmissions were obtained from this tag, which is about its maximum longevity, and the tag stopped transmitting because of declining voltage.

On 7 May 2001, a SPOT1 tag was implanted on a female whale (ID 26716) 20 cm below the dorsal line, halfway

TABLE 2. Total distance and mean rate of travel for whales 24638 and 26716 in three areas. Standard deviations are shown in parentheses. Since the two whales took different migratory paths, the arrival in the North Water was defined as crossing 73˚ N for 24638 and crossing 76˚ W for 26716.

Whale ID No.		Tagging to Departure from Disko Bay	Travel Across Baffin Bay	In the North Water	Average Speed and Total Distance
24638	Speed km/h	1.15 (0.8)	3.11 (1.6)	0.93 (0.7)	1.53 (1.4)
26716		0.87 (0.5)	4.53 (1.1)	2.41 (2.0)	1.96 (1.8)
24638	Distance km	120	846	622	1590
26716		287	1063	809	2159

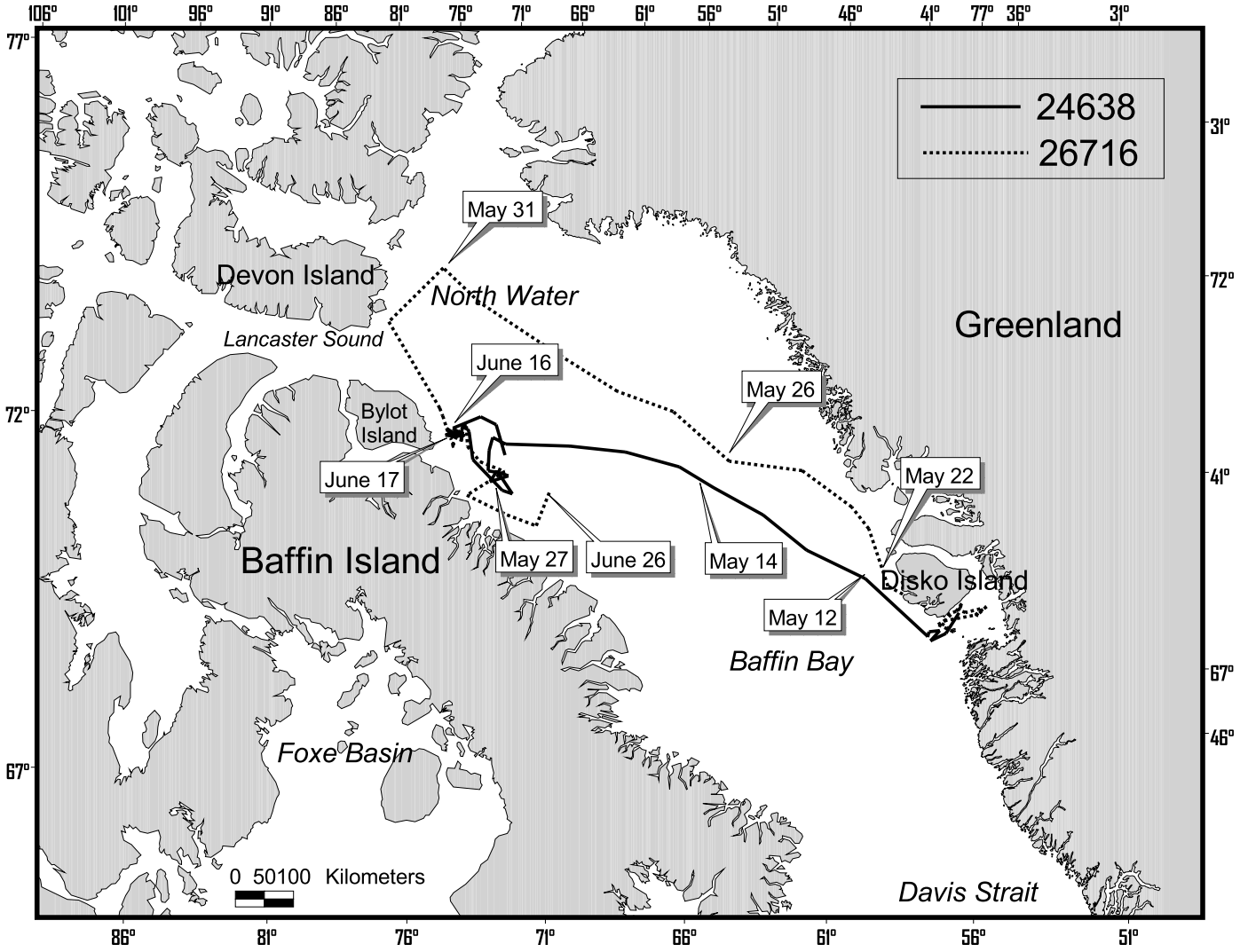

FIG. 2. Movements of two bowhead whales (24638, solid line; 26716, dashed line) from West Greenland to Canada in May–June 2001.

down the long axis. This whale (tagged at 69˚15′N, 53˚30′W) remained in Disko Bay for a longer period than the other whale and departed on 21 May (Fig. 2). It headed farther north closer to the Greenland coast and turned west towards Lancaster Sound at 72˚ N. It passed 73˚ W and reached an area off Devon Island in the central part of the North Water on 30 May, 10 days after departing from Greenland. From here it moved south, across the entrance to Lancaster Sound and frequented the same area as the other whale, an area approximately 100 km southeast of Bylot Island (Fig. 2). It continued moving south and spent approximately three days near Buchan Gulf. It then moved offshore (where there was a five-day period of no transmissions from the tag), and the final position was received on 26 June near the 500 m depth contour off the east coast of Baffin Island. This tag provided the expected 25 000 transmissions before its battery voltage dropped, causing the tag to stop transmitting.

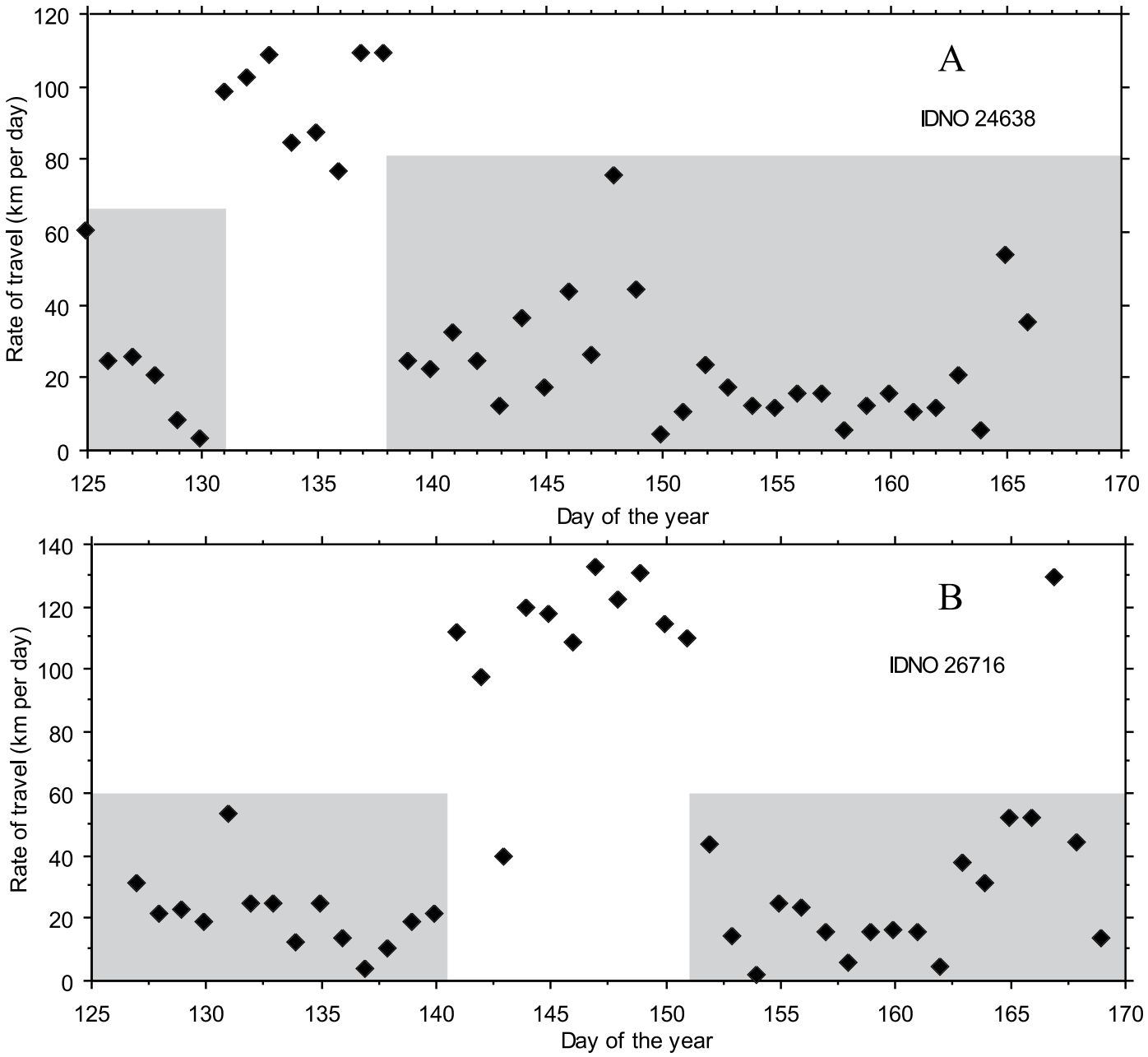

FIG. 3. Graphs of rate of travel (in km per day) relative to Julian day for (a) whale 24638 and (b) whale 26716. The shaded areas represent the whales' presence in Disko Bay after tagging (24638: 5–10 May, 26716: 7–21 May) and in the North Water-Southeast Bylot Island after crossing Baffin Bay (24638: 20–30 May, 26716: 22–30 May). The unshaded area represents the travel period across Baffin Bay (24638: 10–20 May, 26716: 31 May–26 June). Note the increase in travel rate as the whales moved west to Canada and the decrease in travel rate once they arrived in the North Water area.

The two whales were tagged approximately 10 km from each other in Disko Bay, and left Disko Bay 11 days apart. The whales took different routes with different timing across Baffin Bay. On the west side of Baffin Bay, the whales were approximately 350 km from each other on 31 May, with whale 26716 farther north on the east coast of Devon Island and whale 24638 at the southeastern corner of Bylot Island. Sixteen days later, the whales were less than 50 km from each other off the southeastern tip of Bylot Island.

The distance and speeds travelled by the two whales differed for both localized movements (in Disko Bay and the vicinity of Baffin Island) and long-distance travel (across Baffin Bay) (Table 2). Using average positions for each day, whale 24638 travelled a total of 1590 km during a 44-day tracking period, and whale 26716 travelled 2159 km during a 50-day tracking period. Average speed for the entire tracking period was calculated as 1.53 km/hr for whale 24638 and 1.96 km/hr for whale 26716.

Both whales maintained low speeds in Disko Bay and near Baffin Island, but increased their speeds when travelling across Baffin Bay. The rate of travel (based on average positions each day) demonstrated that whale 24638 travelled between 3 and 60 km per day when it was in Disko Bay and the vicinity of Baffin Island (Fig. 3a).

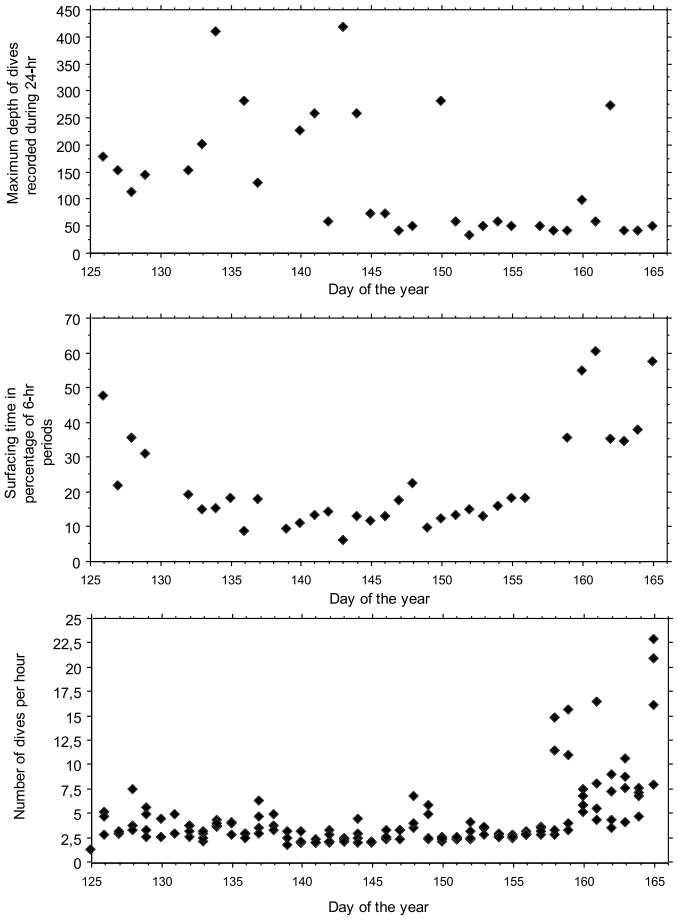

FIG. 4. Maximum daily dive depths (upper panel), surfacing time in percentage of 6-hour periods (middle panel), and dive rate in dives per hour (lower panel) for whale 24638.

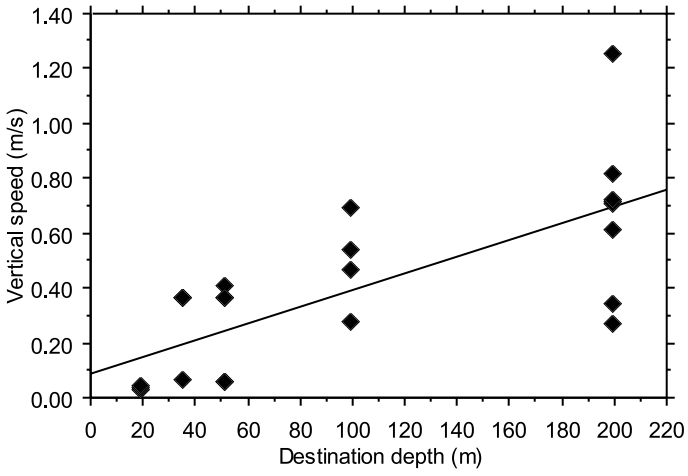

FIG. 5. Vertical speed by destination depth recorded for whale 24638 during the tracking period. The equation for the regression line is $y = 0.087 + 0.003 \times$ ($r^2 = 0.53$).

When the whale was travelling across Baffin Bay, its speed increased to over 100 km per day. Whale 26716 displayed a similar pattern, maintaining low speeds within Disko Bay and the North Water and travelling at higher speeds across Baffin Bay (Fig. 3b).

Diving Behaviour

One whale (24638) provided dive data for the entire tracking period. The mean of the maximum dive depths in Disko Bay (where water depth > 300 m) was 146 m (n = 4). En route to Baffin Island (water depth > 2000 m), maximum dive depths increased to 235 m (n = 7). After the whale arrived at Bylot Island (depth > 500 m), maximum dive depths declined to 155 m (n = 8) and to 67 m (n = 15) after 1 June (Fig. 4). The deepest dive depth recorded during the entire tracking period was 416 m. The dive rate remained relatively constant from the tagging date to 5 June, with a mean of 3.0 dives/hr below 8 m (SD 1.1, range 1.2–7.3). However, after 5 June the dive rate increased to 7.9 dives/hr (SD 5.0, range 2.7–22.8) (see Fig. 4).

Fewer than 15% of the dives were deeper than 152 m. There was a significant shift in the number of dives to all depth categories with time (ANOVA). The number of dives shallower than 36 m increased significantly from May to June, whereas the number of dives to deeper depth categories declined during this period. The steep rise in dive rate (after 5 June) was related to increased diving activity in the 8–20 m depth category, although dives to the depth category between 20–36 m also contributed to the increase. Dives to depths between 100 and 200 m almost ceased after 15 May, with infrequent dives to these depths until 9 June.

Percent of time spent above 20 m was 65% in Disko Bay, 49% while traveling across Baffin Bay, and 54% during the stay off Bylot Island, increasing after 1 June to 81%. The average time spent above 20 m for the entire tracking period was 64%. In all three areas, the whale spent more than 90% of its time above 50 m depths.

In Disko Bay the surfacing time averaged 34% (SD 10.7, n = 4). En route to east Baffin Island this declined to 14% (SD 3.9, n = 9, $p = 0.0004$), and it remained low (13%) after the arrival at the area off Bylot Island (SD 4.4, n = 10, $p = 0.6568$). Surfacing time increased again after 1 June to 33% (SD 16.7, n = 13, $p = 0.0013$) (Fig. 4). The vertical speeds were significantly correlated with the destination depth of the dives and only once exceeded 1 m/s (Fig. 5).

There was no discernible difference between the four six-hour periods in dive rate, duration of dives, time spent at different depths, or the number of dives to different depths (ANOVA). Diurnal patterns of dive activities did not emerge over the two months of data collection (ANCOVA with day as covariate). Most dives lasted less than one minute, and the number of dives decreased as the duration categories increased (Fig. 6). Only 5% of the dives lasted more than 24 minutes.

DISCUSSION

Performance of Tags

Two of the five tags deployed on bowhead whales performed as expected, providing positions for up to 50 days

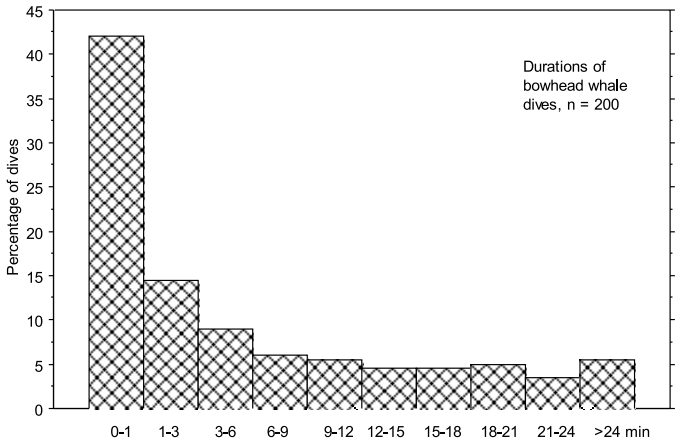

FIG. 6. Percentage of dives in different duration bins for whale 24638.

and ultimately draining their batteries. The reasons that some tags transmit longer than others are unclear. Failure is most likely related to poor implantation of the tag in the blubber, improper placement of the tag on the back of the whale (positioned too low for transmissions), or failure of the satellite tag itself. The tags deployed with the pole performed better than the tags deployed with the pneumatic gun (the 'ARTS'). During the instrumentation, both whales were close to the boats (< 10 m) and moving slowly, which facilitated the use of the pole. The use of the ARTS at short distances may harm the tags because of the impact upon implantation (i.e., the deceleration). The optimal tool for deploying satellite tags on baleen whales may depend on species, distance to the whale, and speed of the whale.

There have been no previous studies of satellite-monitored movements of tagged bowhead whales in Greenland, Baffin Bay, or Canada. In 1992, 12 juvenile (< 13 m body length) bowhead whales were satellite tagged in the Beaufort and Chukchi Seas and tracked for periods ranging from 3.1 to 32.5 days (Mate et al., 2000). The tagging procedure differed from the one reported here: whales were tagged in the open-water season in very shallow water (< 10 m depth) from a large vessel. Tags consisted of a cylinder with two 14 cm stainless steel rods, each with folding toggles, and tags were implanted using a crossbow. The tagging conducted in our study occurred in deep water (200 m) that was partially covered with ice. The whales were pursued from fast boats, and the tags were implanted using a pole. Tags in this study also differed in design, as only one rod was used to anchor the tags deep in blubber. These differences make it difficult to compare the technical performance of the two methods. The longest recorded track in Mate et al. (2000) was from one bowhead whale that moved 3886 km over the course of 33 days, with an overall speed of 5 km/h. The whale rapidly moved west from the Beaufort Sea to the western Chukchi Sea, only occasionally leaving the continental shelf.

In the present study, only whale 24638 provided a large number of good-quality positions (Table 1). Consequently, all position qualities were used, and an average daily position was calculated for both whales with long-term tracking records. A comparison of the trackline created from good-quality positions (LC 0–3) with the trackline created from average daily positions indicated that the poor-quality positions had only marginal influence on the bearing and length of the trackline.

Occurrence in Disko Bay

Eschricht and Reinhardt (1861) collected information on the time of departure (latest observations in spring) of bowhead whales from Qeqertarsuaq from 1780 to 1837. Their mean date for the last observations of whales in the Disko Bay area was 1 June, with a range from 26 April to 25 June. The two whales that were tracked in the present study left Disko Bay in mid-May, approximately 11 days apart. Information collected from local hunters before and after the field season confirmed that bowheads were present in the area at least from mid-April through 20 May. It appears that bowhead whales in Disko Bay may still maintain their historical patterns of distribution and movement, in spite of the severe reduction in numbers.

Bowhead whales feed on crustacean zooplankton, primarily large copepods of the genus *Calanus* and euphausiids (Brown, 1868; Lowry, 1993). In spring, the largest concentrations of copepods in Disko Bay are found in the upper 50 m of the water column (Madsen et al., 2001). The observed diving behaviour of the bowhead whale in Disko Bay and along the east coast of Baffin Island is consistent with preying on copepods in the upper part of the water column because the whale spent over 90% of its time above 50 m (water depth > 300 m in both areas). The biomass of copepods is known to reach a peak in Disko Bay in early June, when values of more than 100 mg C m^{-3} have been measured (Madsen et al., 2001). In the upper 50 m of the water column, 90% of this biomass estimate was composed of three *Calanus* species, *C. finmarchicus*, *C. glacialis* and *C. hyperboreus*. The bowhead whales tracked in this study apparently left the Disko Bay area prior to the peak availability of their preferred food species. Bowhead whales in Alaska have been reported to display similar behaviour, leaving the productive Bering Sea each year just before the spring bloom of copepods and migrating 3000 km to the less productive Beaufort Sea (Lowry, 1993). It is unclear why the bowhead whales leave Disko Bay and move to the North Water before the peak of the *Calanus* production in West Greenland.

Baffin Bay

This study demonstrates that bowhead whales are capable of navigating through the heavy pack ice in central Baffin Bay. Most likely the whales move north along the West Greenland coast until they find a suitable lead in the pack ice. These leads are known to intersect Baffin Bay from northwest to southeast (Environment Canada, 1990–2000). If whales find a lead heading northwest, they may

be able to cross from Disko Bay to Lancaster Sound in a short time. Once whales cross the Baffin Bay pack ice, they can expect to find open water in the North Water polynya. It could not be determined which lead (or series of leads) the whales chose for moving across Baffin Bay. There were, however, areas of open water used by the whales at both ends of their movements, in Disko Bay and northeast of Baffin Island. The rate of travel did not appear to indicate that the bowhead whales were feeding in the ice-covered areas in Baffin Bay. While crossing Baffin Bay, the daily maximum dive depth for whale 24638 increased to an average of 235 m. While the dive rate remained constant (3 dives/hr), the surfacing time declined to approximately 14%. The increase observed in maximum dive depths is possibly related to navigation in the dense pack ice (i.e., using deeper depths to localize spots with open water) or low-frequency communication with other whales (low-frequency sounds are known to travel longer distances at deeper depths). Bowhead whales travelling under the ice may spend more time at deeper depths to avoid interacting with the ice (Krutzikowsky and Mate, 2000). The decrease in surfacing time indicates that the whale spent more time in water deeper than 8 m, in the layer between 8 and 50 m.

Average speeds for the two whales were similar for the course of the tracking period. Total distance was slightly lower for whale 24638 than for whale 26716. Whale 24638 may have taken a more direct course across Baffin Bay, which may have been related to available openings in the sea ice. One would assume that a whale would take the shortest distance between two feeding grounds for energetic reasons. Whale 26716, which took the longer route across Baffin Bay, had a higher average total speed than whale 24638 (1.96 km/h vs. 1.53 km/h), as well as a higher speed crossing Baffin Bay (4.53 km/h vs. 3.11 km/h).

The rapid rate of travel for both whales across the Baffin Bay pack ice does not agree with reports that bowhead whales occur in winter in central Davis Strait and southern Baffin Bay (see Brown, 1868; Southwell, 1898; Finley, 1990, 2001). Aerial surveys conducted in March 1981 and 1982 covered Davis Strait and most of Baffin Bay, but encountered bowheads only in the coastal areas off West Greenland and East Baffin Island (McLaren and Davis, 1981, 1983). Most likely bowhead whales occur in seasonal aggregations in coastal areas and traverse offshore areas only when moving/migrating to other concentration areas.

Occurrence in the North Water

Davis and Koski (1980), who surveyed the waters off northwest Baffin Island in spring 1976 and 1978, reported that bowhead whales first arrived at the eastern entrance to Lancaster Sound around 8–11 May. The migration from offshore areas towards Lancaster Sound lasted through 8 August and apparently peaked during 19–30 June in both years. The timing of the arrival of the two whales from Disko Bay seems to coincide well with these observations. In addition, Holst and Stirling (1999) reported 14 sightings of bowhead whales in the North Water, east of Devon Island, between 4 May and 13 June 1998, which coincides with the period when the whales from the present study were in this same area. The North Water polynya is known to be a highly productive area; it is capable of supporting a high degree of primary and secondary production early in the season and, consequently, a high abundance of marine mammals and sea birds (Stirling, 1997). It seems likely that the bowhead whales using the southern part of the North Water in spring are indeed whales from Disko Bay, as also proposed by Holst and Stirling (1999). This implies that the bowhead whales move quickly from one productive area (Disko Bay) to another highly productive area (the North Water) and take advantage of the early productivity blooms in the North Water polynya.

The whales' rapid transit across Baffin Bay makes it unlikely that they were feeding in the pack ice. However, it appears they may be feeding in the North Water polynya, since travel rate decreased and movements became more localized once they arrived there (Table 2, Figs. 4 and 5). Detailed quantitative information on copepod abundance in eastern Lancaster Sound in spring is not available. However, presumably the North Water polynya provides a spring bloom of copepods that is comparable to what is found in Disko Bay. After 1 June, when whale 24638 arrived in the North Water area, daily maximum dive depths decreased (to 67 m), surfacing time increased (to > 80%), and dive rate increased (to 7.9 dives/hr), behavioural changes that may indicate increased feeding. Sampling in eastern Lancaster Sound in July through October 1978 showed that copepods were most abundant between 0 and 50 m depth and declined with increasing depth (Buchanan and Sekerak, 1982). In August 1980, zooplankton were vertically distributed, with peak abundance just below the surface (< 5 m) and a higher abundance at 50–70 m depths in eastern Lancaster Sound (Longhurst et al., 1984). Copepods of the *Calanus* species were the most abundant zooplankton species in both studies.

Dive Behaviour

Krutzikowsky and Mate (2000) reported several dives of bowhead whales in the Beaufort and Chukchi Seas that lasted over 20 minutes, with few lasting more than 60 minutes. The maximum depth of the dives recorded for bowhead whales in Alaska was 352 m. Most dives went to depths above 100 m and most time was spent above 16 m. Despite their differences in bathymetry and seasonality, the two studies showed remarkably similar diving characteristics. The vertical speeds observed for the bowhead whale in this study were significantly lower than those reported for fin whales (*Balaenoptera physalus*) and blue whales (*Balaenoptera musculus*) (Croll et al., 2001).

Plasticity of Movement Patterns

Our observations of the dispersed distribution, solitary occurrence, and presumed solitary migration routes of whales from Disko Bay seem to confirm the reported solitary habits of bowhead whales in West Greenland during this period (cf. Reeves and Heide-Jørgensen, 1996; Heide-Jørgensen and Acquarone, 2002). However, despite the observations of solitary whales (which may be an effect of the past overexploitation of the stock), the whales may still maintain acoustic contact over large distances. The two other High Arctic cetaceans, the narwhal (*Monodon monoceros*) and the beluga, migrate to and from summer and wintering grounds in pods along specific corridors (Dietz et al., 2001; Richard et al., 2001; Heide-Jørgensen et al., 2002). The different routes chosen by the two bowhead whales, as well as the information on the phenology of their occurrence in West Greenland (i.e., variations in departure dates, Eschricht and Reinhardt, 1861) and the North Water (i.e., widespread solitary occurrence, Davis and Koski, 1980; Holst and Stirling, 1999), indicate that bowhead whales may have more plasticity in their migratory patterns than the two other Arctic cetaceans. This would increase the opportunities for widespread genetic exchange and may explain the relatively large genetic diversity among bowhead whales (Maiers et al., 1999). Of the three High Arctic cetaceans, narwhals show the lowest level of genetic diversity (Palsbøll et al., 1997) and the most restricted range of movements (cf. Dietz et al., 2001). Belugas fall between bowhead whales and narwhals in genetic variability (de March et al., 2002; Palsbøll et al., 2002), possibly reflecting their preference for open-water areas (the North Water and West Greenland), where they can sustain a wider range of movements (cf. Richard et al., 2001).

Evidently bowhead whales are dependent on the success of the marine production in focal areas of the North Water and Disko Bay. Although bowheads display characteristics that make them appear flexible in their choice of migratory corridors and the timing of migrations, climatic change could change the nature of the ice, ultimately affecting the distribution and characteristics of leads and polynyas. Reduced ice coverage in one or both of these areas may enhance plankton production and feeding opportunities of bowhead whales. However, the timing of the peak production will determine whether they can take advantage of that productivity.

Implications for Stock Identification

This study confirms the connection between bowhead whales in West Greenland and the east coast of Baffin Island. It appears the movements from one area to the other are accomplished over short time periods, without major stops en route, as proposed earlier by Eschricht and Reinhardt (1861), who based their conclusion on information from whalers that pursued bowheads during their spring migration to Baffin Bay (cf. Southwell, 1898). Prior to this study, the connection between bowheads in eastern Canada and West Greenland was established solely by a single whale photographed in Canada (NE Baffin Island) in late September and re-identified in Greenland in early April four years later (Heide-Jørgensen and Finley, 1991). The relationship between the bowhead whales found near the entrance to Lancaster Sound and those found in summer and autumn farther west in Lancaster Sound and tributaries remains unresolved. Bowhead whales in the eastern part of Lancaster Sound most likely come from Baffin Bay, as suggested by Eschricht and Reinhardt (1861) and by Davis and Koski (1980). However, the bowhead whales found in western Lancaster Sound and tributaries in summer may come either from the east coast of Baffin Island (from Disko Bay) or from Hudson Bay (through Fury and Hecla Strait). Clearly, more data and larger sample sizes are needed to identify the stocks of bowheads found in Canada in summer. Satellite tracking has proved to be a promising tool for studying stock identity and elucidating important information on movement patterns and habitat use of a species.

ACKNOWLEDGEMENTS

We wish to thank Kale Mølgård, Abel Brandt, Kaleeraq Heilmann, Søren Karl Broberg, and Frederik Broberg for their excellent help during the search, pursuit, and tagging of the bowhead whales. The board of the Arctic Station, University of Copenhagen, is acknowledged for providing the facilities at Arctic Station, including the research vessel *Porsild*. This study was funded by the Commission for Scientific Research in Greenland, the Greenland Institute of Natural Resources, the Carlsbergfondet (990379/40), and the Department of Fisheries and Oceans, Canada. This manuscript was improved by comments from Chris Clark and two anonymous reviewers.

REFERENCES

BÉRUBÉ, M., and PALSBØLL, P. 1996. Identification of sex in cetaceans by multiplexing with three ZFX and ZFY specific primers. Molecular Ecology 5:283–287.

BORN, E.W., and HEIDE-JØRGENSEN, M.P. 1983. Observations of the bowhead whale (*Balaena mysticetus*) in central West Greenland in March-May 1982. Report of the International Whaling Commission 33:545–547.

BROWN, R. 1868. Notes on the history and geographical relations of the Cetacea frequenting Davis Strait and Baffin's Bay. Proceedings of the Zoological Society of London 1868: 533–556.

BUCHANAN, R.A., and SEKERAK, A.D. 1982. Vertical distribution of zooplankton in eastern Lancaster Sound and western Baffin Bay, July-October 1978. Arctic 35:41–55.

CROLL, D.A., ACEVEDO-GUTIERREZ, A., TERSHY, B.R., and URBAN-RAMIREZ, J. 2001. The diving behavior of blue and fin whales: Is dive duration shorter than expected based on

oxygen stores? Comparative Biochemistry and Physiology Part A. 129:797–809.

DAVIS, R.A., and KOSKI, W.R. 1980. Recent observations of the bowhead whale in the eastern Canadian High Arctic. Report of the International Whaling Commission 30:439–444.

DE MARCH, B.G.E., MAIERS, L.D., and FRIESEN, M.K. 2002. An overview of genetic relationships of Canadian and adjacent populations of belugas (*Delphinapterus leucas*) with emphasis on Baffin Bay and Canadian eastern Arctic populations. NAMMCO Scientific Publications Vol. 4:17–38.

DIETZ, R., HEIDE-JØRGENSEN, M.P., RICHARD, P.R., and ACQUARONE, M. 2001. Summer and fall movements of narwhals (*Monodon monoceros*) from northeastern Baffin Island towards northern Davis Strait. Arctic 54:244–261.

ENVIRONMENT CANADA. 1990–2000. Arctic winter ice analysis and SAR imagery. Available from Canadian Ice Service, Lasalle Academy, Block E, Ottawa, Ontario K1A 0H3.

ESCHRICHT, D.F., and REINHARDT, J. 1861. Om Nordhvalen (*Balaena mysticetus* L.) navnlig med Hensyn til dens Udbredning i Fortiden og Nutiden og til dens ydre og indre Saerkjender. K. Danske Videnskabernes Selskabs Skrifter. Series 5, Naturvidenskabelig og Mathematisk Afdeling 5:433–590.

FINLEY, K.J. 1990. Isabella Bay, Baffin Island: An important historical and present-day concentration area for the endangered bowhead whale (*Balaena mysticetus*) of the Eastern Canadian Arctic. Arctic 43:137–152.

———. 2001. Natural history and conservation of the Greenland whale, or bowhead, in the Northwest Atlantic. Arctic 54:55–76.

HARRIS, R.B., FANCY, S.G., DOUGLAS, D.C., GARNER, G.W., AMSTRUP, S.C., McCABE, T.R., and PANK, L.F. 1990. Tracking wildlife by satellite: Current systems and performance. United States Department of the Interior, Fish and Wildlife Service, Fish and Wildlife Technical Report 30. 52 p.

HEIDE-JØRGENSEN, M.P., and ACQUARONE, M. 2002. Size and trends of the bowhead, beluga and narwhal stocks wintering off West Greenland. NAMMCO Scientific Publications Vol. 4:191–210.

HEIDE-JØRGENSEN, M.P., and FINLEY, K.J. 1991. Photographic reidentification of a bowhead whale in Davis Strait. Arctic 44:254–256.

HEIDE-JØRGENSEN, M.P., RICHARD, P.R., and ROSING-ASVID, A. 1998. Dive patterns of belugas (*Delphinapterus leucas*) in waters near eastern Devon Island. Arctic 51:17–26.

HEIDE-JØRGENSEN, M.P., KLEIVANE, L., ØIEN, N., LAIDRE, K.L., and JENSEN, M.V. 2001a. A new technique for deploying satellite transmitters on baleen whales: Tracking a blue whale (*Balaenoptera musculus*) in the North Atlantic. Marine Mammal Science 17:949–954.

HEIDE-JØRGENSEN, M.P., HAMMEKEN, N., DIETZ, R., ORR, J., and RICHARD, P.R. 2001b. Surfacing times and dive rates for narwhals (*Monodon monoceros*) and belugas (*Delphinapterus leucas).* Arctic 54:284–298.

HEIDE-JØRGENSEN, M.P., DIETZ, R., LAIDRE, K.L., and RICHARD, P.R. 2002. Autumn movements, home ranges, and winter density of narwhals (*Monodon monoceros*) tagged in Tremblay Sound, Baffin Island. Polar Biology 25:342–349.

HOLST, M., and STIRLING, I. 1999. A note on sightings of bowhead whales in the North Water Polynya, northern Baffin Bay, May-June, 1998. Journal of Cetacean Research Management 1:153–156.

KAPEL, F.O. 1985. A note on the net-entanglement of a bowhead whale (*Balaena mysticetus*) in Northwest Greenland, November 1980. Report of the International Whaling Commission 35: 377–378.

KRUTZIKOWSKY, G.K., and MATE, B.R. 2000. Dive and surfacing characteristics of bowhead whales (*Balaena mysticetus*) in the Beaufort and Chukchi Seas. Canadian Journal of Zoology 78:1182–1198.

LONGHURST, A., SAMEOTO, D., and HERMAN, A. 1984. Vertical distribution of Arctic zooplankton in summer: Eastern Canadian archipelago. Journal of Plankton Research 6: 137–168.

LOWRY, L. 1993. Foods and feeding ecology. In: Burns, J.J., Montague, J.J., and Cowles, C.J., eds. The bowhead whale. Society for Marine Mammalogy, Special Publication No. 2. Lawrence, Kansas: Allen Press. 201–239.

MADSEN, S.D., NIELSEN, T.G., and HANSEN, B.W. 2001. Annual population development and production by *Calanus finmarchicus*, *C. glacialis* and *C. hyperboreus* in Disko Bay, western Greenland. Marine Biology 139:75–93.

MAIERS, L.D., DE MARCH, B.G.E., CLAYTON, J.W., DUECK, L.P., and COSENS, S.E. 1999. Genetic variation among populations of bowhead whales summering in Canadian waters. Canadian Stock Assessment Secretariat, Research Document 99/134.

MATE, B.R., KRUTZIKOWSKY, G.K., and WINSOR, M. 2000. Satellite-monitored movements of radio-tagged bowhead whales in the Beaufort and Chukchi Seas during the late-summer feeding season and fall migration. Canadian Journal of Zoology78:1168–1181.

McLAREN, P.L., and DAVIS, R.A. 1981. Distribution of wintering marine mammals off West Greenland and in southern Baffin Bay and northern Davis Strait, March 1981. Report by LGL Ltd., Toronto, for Arctic Pilot Project, Calgary, Alberta. 85 p.

———. 1983. Distribution of wintering marine mammals off West Greenland and in southern Baffin Bay and northern Davis Strait, March 1982. Report by LGL Ltd., Toronto, for Arctic Pilot Project, Calgary, Alberta. 98 p.

NWMB (NUNAVUT WILDLIFE MANAGEMENT BOARD). 2000. Final report of the Inuit bowhead knowledge study. Iqaluit, Nunavut: NWMB.

PALSBØLL, P., HEIDE-JØRGENSEN, M.P., and DIETZ, R. 1997. Genetic studies of narwhals, *Monodon monoceros*, from West and East Greenland. Heredity 78:284–292.

PALSBØLL, P.J., HEIDE-JØRGENSEN, M.P., and BÉRUBÉ, M. 2002. Analysis of mitochondrial control region nucleotide sequences from Baffin Bay beluga, *Delphinapterus leucas*: Detecting pods or sub-populations? NAMMCO Scientific Publications Vol. 4:39–50.

REEVES, R.R., and HEIDE-JØRGENSEN, M.P. 1996. Recent status of bowhead whales, *Balaena mysticetus*, in the wintering grounds off West Greenland. Polar Research 15:115–125.

REEVES, R.R., MITCHELL, E., MANSFIELD, A., and McLAUGHLIN, M. 1983. Distribution and migration of the bowhead whale, *Balaena mysticetus*, in the eastern North American Arctic. Arctic 36:5–64.

RICHARD, P.R., HEIDE-JØRGENSEN, M.P., ORR, J.R., DIETZ, R., and SMITH, T.G. 2001. Summer and autumn movements and habitat use by belugas in the Canadian High Arctic and adjacent areas. Arctic 54:207–222.

ROSS, W.G. 1993. Commercial whaling in the North Atlantic sector. In: Burns, J.J., Montague, J.J., and Cowles, C.J., eds. The bowhead whale. Society for Marine Mammalogy, Special Publication No. 2. Lawrence, Kansas: Allen Press. 511–561.

SOUTHWELL, T. 1898. The migration of the right whale (*Balaena mysticetus*). Natural Science 12:397–414.

STIRLING, I. 1997. The importance of polynyas, ice edges, and leads to marine mammals and birds. Journal of Marine Systems 10:9–21.

WOODBY, D.A., and BOTKIN, D.B. 1993. Stock sizes prior to commercial whaling. In: Burns, J.J., Montague, J.J., and Cowles, C.J., eds. The bowhead whale. Society for Marine Mammalogy, Special Publication No. 2. Lawrence, Kansas: Allen Press. 387–407.

ZEH, J.E., CLARK, C.W., GEORGE, J.C., WITHROW, D., CARROLL, G.M., and KOSKI, W.R. 1993. Current population size and dynamics. In: Burns, J.J., Montague, J.J., and Cowles, C.J., eds. The bowhead whale. Society for Marine Mammalogy, Special Publication No. 2. Lawrence, Kansas: Allen Press. 409–489.

Animal Conservation

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Animal Conservation. Print ISSN 1367-9430

A metapopulation model for Canadian and West Greenland narwhals

M. P. Heide-Jørgensen[1], P. R. Richard[2], R. Dietz[3] & K. L. Laidre[4]

1 Greenland Institute of Natural Resources, Nuuk, Greenland
2 Department of Fisheries and Oceans, 501 University Crescent, Winnipeg, MB, Canada
3 Department of Bioscience, Arctic Research Centre, Aarhus University, Roskilde, Denmark
4 Polar Science Center, Applied Physics Laboratory, University of Washington, Seattle, WA, USA

Keywords
stock definition; narwhal; satellite tracking; range; subsistence harvest; wildlife management; Arctic.

Correspondence
Mads Peter Heide-Jørgensen, Greenland Institute of Natural Resources, Strandgade 91, 3, DK-1016 Copenhagen K, Denmark.
Tel: +45 40257943
Email: mhj@ghsdk.dk

Editor: Karina Acevedo-Whitehouse
Associate Editor: Rob Williams

Received 29 February 2012; accepted 19 September 2012

doi:10.1111/acv.12000

Abstract

A model of the metapopulation structure of narwhals *Monodon monoceros* in Baffin Bay, Hudson Bay and adjacent waters is proposed based on satellite telemetry data collected over two decades from six coastal aggregations of narwhals in the eastern Canadian high Arctic, Hudson Bay and West Greenland. In addition, data on seasonal catches of narwhals in 11 Inuit communities are used to provide information on the occurrence of narwhals. The tracking data suggest that disjunct summer aggregations of narwhals are, to some extent, demographically independent subpopulations, with minimal or no exchange with other summering aggregations. We propose that these should be considered separate stocks for management purposes. Year-round satellite tracking of individuals demonstrates that whales return to the same summering areas the following year, suggesting inter-annual site fidelity. We propose that the narwhals in Canada constitute five separate stocks, with limited exchange between three of the stocks. Coastal summer aggregations in Greenland constitute two stocks in addition to two fall and winter aggregations supplied by narwhals from several summering areas. Several narwhal stocks mix on the wintering areas in Baffin Bay, but the metapopulation structure is likely maintained through a combination of life-history traits and migratory routes, as mating most likely occurs after the initiation of the return migration toward summering areas. The metapopulation structure in Baffin Bay narwhals will be impacted differentially by Inuit subsistence hunting, depending on the migratory schedule of narwhals and dates at which whales occur in different seasonal hunting areas. It is therefore important to identify which narwhal stocks contribute to which subsistence hunts in order to assess the sustainability of those hunts. This paper proposes a preliminary stock model for this purpose.

Introduction

Understanding population structure of a species is vital for the conservation and management of factors affecting its demography. This is particularly important in the case of species hunted for subsistence, such as the narwhal *Monodon monoceros*. Metapopulation theory was developed to study population structure and demography of spatially segregated populations of a single species (Levins, 1970; Hanski & Gilpin, 1991). In essence, a metapopulation is a 'population of populations' (Levins, 1970) or a collection of spatially separated subpopulations that have a degree of demographic independence but also some degree of exchange of animals. A species with metapopulation structure may therefore exhibit dynamics that are different from the dynamics of a collection of completely isolated populations or a single extensively mixed (panmictic) population.

The narwhal is an ice-associated cetacean that inhabits Arctic seas bordering the Atlantic Ocean. During summer, narwhals visit inshore bays and fjords in the Canadian Arctic archipelago and Greenland (Fig. 1). In the autumn, upon the formation of fast ice, narwhals are forced to move east and south and spend the winter in ice-covered areas where they are widely dispersed in Baffin Bay and Davis Strait with the highest aggregations between 55–64°W and 68–71°N and off Disko Bay (Heide-Jørgensen *et al*., 1993, 2002, 2003; Koski & Davis, 1994; Dietz & Heide-Jørgensen, 1995; Dietz *et al*., 2001; Heide-Jørgensen & Acquarone,

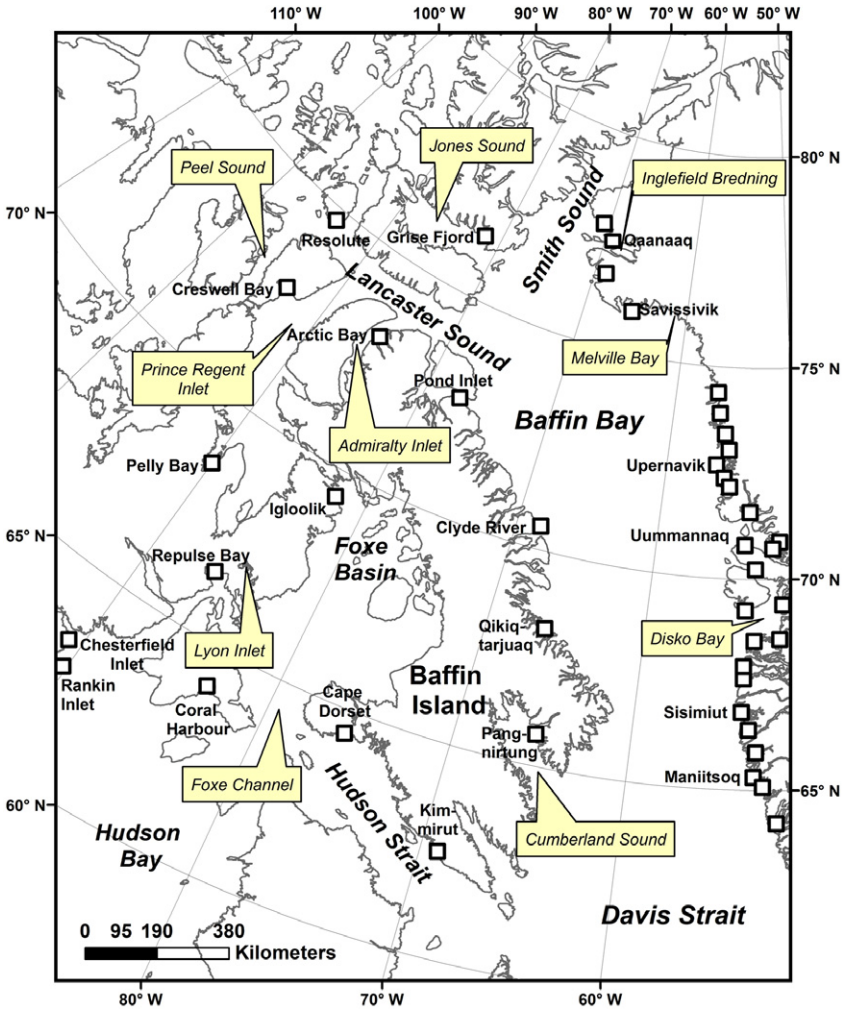

Figure 1 Map of Nunavut and West Greenland with localities, towns and settlements where narwhal *Monodon monoceros* hunting occur indicated. The four towns in Disko Bay where narwhal hunting occurs are Qeqertarsuaq, Ilulissat, Qasigiannguit and Aasiaat.

2002). During spring, aggregations of narwhals are seen along ice edges on the east coast of Baffin Island, at the entrances of Lancaster and Jones Sound, and in Smith Sound (e.g. Bradstreet and Cross, 1982). Narwhals are also known to move along the ice edges along West Greenland and to aggregate in the North Water in spring before entering Inglefield Bredning (Heide-Jørgensen, 2004). Narwhals spend the summer in bays and fiords of north-west Greenland, Hudson Bay and the north-eastern Canadian archipelago (Richard, 1991; Heide-Jørgensen *et al.*, 2010; Richard *et al.*, 2010).

Narwhals in Baffin Bay and adjacent waters are an example of a migratory species, where different stocks are hunted over varying temporal and spatial scales. Narwhals are hunted during both their northbound spring and southbound autumn migrations and during their stay at summering or wintering areas. In addition to summer stocks, there are also segments of the population that are observed as 'aggregations' outside the summer season. Following this, the total allowable narwhal catch should be allocated to individual whaling areas based on the information on the distribution and movement patterns of each stock, reducing the risk of local overexploitation. Allocation of allowable catches to aggregations or stocks can only safely be performed when the relationship between catches and stocks of known abundance has been established. Persistence and integrity of subpopulations rely on reproductive isolation of subpopulations maintained by strong philopatry, that is, seasonal homing to specific habitats.

Metapopulation theory has largely been applied to non-migratory species, where subpopulations are defined geographically. Nevertheless, the theory offers a valuable conceptual framework for migratory species as well (Esler, 2000). In this paper, we present evidence for the metapopulation structure of narwhals in the Canadian Arctic and West Greenland. We propose the distinction of a number of subpopulations or 'stocks' of narwhals to be used for conservation and subsistence hunt management. We also discuss spatial, temporal, genetic and behavioral factors that affect the demographic independence of narwhal subpopulations throughout the year.

Material and methods

Temporal and spatial distribution of the hunt for narwhals in Canada and West Greenland

Data on the seasonal occurrence of the narwhal subsistence hunt in Canada for the period 1979–2002 and for Greenland during 1993–1999 were extracted from Romberg & Richard (2005) and Piniarneq (1993–1999), respectively. Catch data before the installation of quotas were chosen because they show a better picture of the seasonality of both catches and occurrence of narwhals at the hunting localities. In the more recent catch data, the catches are stopped before the whales leave the hunting areas.

Historical data on satellite tracking of narwhals 1993–2004

Satellite-tagging studies of narwhals were initiated in 1993 to determine the movement patterns and migratory routes of narwhals in Canada and Greenland (Dietz & Heide-Jørgensen, 1995; Dietz *et al.*, 2001). In 1993 and 1994, nine whales from Melville Bay, West Greenland (Fig. 1), were tracked from late August to early December. Between 1997 and 1999, 17 narwhals were tracked from Eclipse Sound, Canada (Dietz *et al.*, 2001; Heide-Jørgensen *et al.*, 2002). In 2000 and 2001, 16 narwhals were tagged in Creswell Bay (Prince Regent Inlet), on the coast of Somerset Island, Canada (Heide-Jørgensen *et al.*, 2003). In August 2003–2004, 20 narwhals were tagged in Admiralty Inlet, the third summering aggregation in the Canadian high Arctic (Dietz *et al.*, 2008). These data were analyzed and published in several papers between 1995 and 2009 and provided background on the movements of narwhals from four of their largest summering areas.

Satellite tracking data from narwhals 2005–2009

An additional 22 narwhals were captured and instrumented with satellite-linked transmitters in Admiralty Inlet, Canada, August 2005 ($n = 14$) and 2009 ($n = 8$) as well as five in the Eclipse Sound area in 2010 (Table 1), following methods similar to previous live captures in the Inlet (Heide-Jørgensen *et al.*, 2002; Dietz *et al.*, 2008). Seven narwhals were instrumented at Fisher Islands (7606.965°N, 6142.453°W) Melville Bay, West Greenland in September 2006 and 2007, supplementing the tagging information from the area from 1993 to 1994 (Dietz & Heide-Jørgensen, 1995). Two narwhals were instrumented in Uummannaq in November 2007 and 2008 (Table 1) using nets set at the promontory of Niaqornat (7047.600°N, 5338.600°W). A total of nine narwhals were tagged over 2 years in Repulse Bay and Lyon Inlet using set nets in the same way as the other tagging projects above (Westdal, Richard & Orr, 2010).

The amount and quality of location data obtained from the satellite telemetry studies varied during the studies because of improvements in satellites' transmitter functionality and attachments over time, but also because of improved performance of the Argos Data Collection and Location System. Here, we only use good quality positions, that is, location class 1, 2 and 3 with estimated precision of < 500 m.

Results

Timing, locations and magnitude of the hunting of narwhals

Hunting along the east coast of Baffin Island (Qikiqtarjuaq and Clyde River) occurs between July and October [annual average of catches (AAC) 1996–2000: 18], except for the community of Pangnirtung (AAC = 23), which has an extended hunting period ranging from March to November (Fig. 2; Ditz, 2001). The majority of the Pond Inlet (AAC = 116) hunt occurs between May and September. The hunt in Arctic Bay (AAC = 99) is shorter, taking place between June and September, and the hunt at Somerset Island takes place in July–August (Resolute and Creswell Bay; AAC = 6). The hunt in Grise Fjord (AAC = 7) takes place between July and September. Catches in Pelly Bay, Igloolik and Hall Beach are low (AAC = 11).

Catches in Hudson Bay were taken in Chesterfield Inlet, Coral Harbour, Rankin Inlet and Repulse Bay. Most catches in Hudson Bay were taken by Repulse Bay in July–August. Only 2% ($n = 347$) were taken in June or September.

In West Greenland, catches reported from Sisimiut and south (AAC 1993–1998: 40; Figs 1 and 2) include whales taken further north. Hunting in Disko Bay (AAC = 154) takes place from late autumn throughout the winter and peaks in spring (April–May). The hunting in Uummannaq (AAC = 315) takes place in October–December, with lower catches during winter and spring. Hunting statistics identify that the largest catch in Upernavik (AAC = 81) takes place between August and November. Hunters from Qaanaaq sometimes see narwhals in the Smith Sound area in winter and spring (January–June); however, most hunting takes place between May and September with peaks in July–August (AAC = 106).

Results of narwhal tracking studies in the eastern Canadian Arctic and West Greenland

Satellite tracking data from 107 individual narwhals from six different coastal localities in Arctic Canada (Somerset Island, Admiralty Inlet, Eclipse Sound and North Hudson Bay) and West Greenland (Melville Bay and Uummannaq) were available for this analysis (Figs 3–8).

Somerset Island

For management purposes, we refer to narwhals occupying that area as the 'Somerset Island stock'. Narwhals tagged on

Table 1 List of narwhals *Monodon monoceros* tagged in this study. Whale ID # 37235 had a 225-cm long calf

Tagging locality	Tagging date	Transmitter ID #	Sex	Standard length (cm)	Tusk length (cm)
Admiralty Inlet	14 Aug 2005	20685	F	360	–
Admiralty Inlet	14 Aug 2005	20686	M	483	194
Admiralty Inlet	17 Aug 2005	20689	F	360	–
Admiralty Inlet	17 Aug 2005	37235	F	358	–
Admiralty Inlet	17 Aug 2005	37236	F	380	–
Admiralty Inlet	17 Aug 2005	37280	F	380	–
Admiralty Inlet	17 Aug 2005	37282	F	364	–
Admiralty Inlet	21 Aug 2005	37283	F	390	–
Admiralty Inlet	21 Aug 2005	20688	F	386	–
Admiralty Inlet	21 Aug 2005	7928	F	373	–
Admiralty Inlet	21 Aug 2005	20696	M	453	179
Admiralty Inlet	21 Aug 2005	20158	F	330	–
Melville Bay	9 Sept 2006	3960	F	372	–
Melville Bay	9 Sept 2006	3962	F	390	–
Melville Bay	13 Sept 2006	3964	M	437	187
Melville Bay	26 Aug 2007	7618/10946	F	390	100
Melville Bay	3 Sept 2007	6335/20162	F	420	100
Melville Bay	4 Sept 2007	3965	F	390	99
Melville Bay	4 Sept 2007	7617/37227	M	490	110
Uummannaq	15 Nov 2007	3961/3962	M	462	200
Uummannaq	24 Nov 2008	3961	F	406	–
North Hudson Bay	11 Aug 2006	57595	M	437	152 (broken)
North Hudson Bay	11 Aug 2006	57596	F	396	–
North Hudson Bay	11 Aug 2006	57597	M	262	27
North Hudson Bay	11 Aug 2006	57598	M	353	91
North Hudson Bay	11 Aug 2006	57599	F	396	–
North Hudson Bay	8 Aug 2007	36641	F	400	–
North Hudson Bay	9 Aug 2007	40152	M	375	98
North Hudson Bay	9 Aug 2007	37024	M	385	110
North Hudson Bay	10 Aug 2007	40622	M	364	101
Admiralty Inlet	15 Aug 2009	39290	F	374	–
Admiralty Inlet	15 Aug 2009	39309	M	376	79
Admiralty Inlet	16 Aug 2009	39313	F	391	–
Admiralty Inlet	17 Aug 2009	39256	M	450	165
Admiralty Inlet	17 Aug 2009	39287	M	439	150
Admiralty Inlet	17 Aug 2009	39211	M	307	51
Admiralty Inlet	17 Aug 2009	39312	M	455	211
Admiralty Inlet	18 Aug 2009	39249	F	386	–
Eclipse Sound	21 Aug 2010	51871	M	444	156
Eclipse Sound	21 Aug 2010	51872	M	461	100
Eclipse Sound	22 Aug 2010	51873	F	400	–
Eclipse Sound	22 Aug 2010	51874	F	390	–
Eclipse Sound	24 Aug 2010	51875	F	380	–

the east coast of Somerset Island in August ranged over waters on both sides of Somerset Island, including Prince Regent Inlet, Peel Sound and adjacent waters (Heide-Jørgensen *et al.*, 2003; Dietz *et al.*, 2008; magenta lines in Fig. 3). In September and October, the Somerset Island stock of narwhals were tracked leaving Peel Sound and Prince Regent Inlet and moving east along the southern and the northern coast of Lancaster Sound. The whales moved further east across Baffin Bay to the western side of the deep basin toward West Greenland and continued south to a wintering area centered at 71°N and 62°W where they remained stationary through March, after which the whales still transmitting ($n = 2$) began a return migration through Lancaster Sound along the southern shoreline of Devon to the Somerset Island summering area (Heide-Jørgensen *et al.*, 2003; Dietz *et al.*, 2008).

Admiralty Inlet

We refer to narwhals in Admiralty Inlet during summer as the 'Admiralty Inlet stock' (black lines in Fig. 3). Tracking studies of narwhals from Admiralty Inlet in 2003–2004

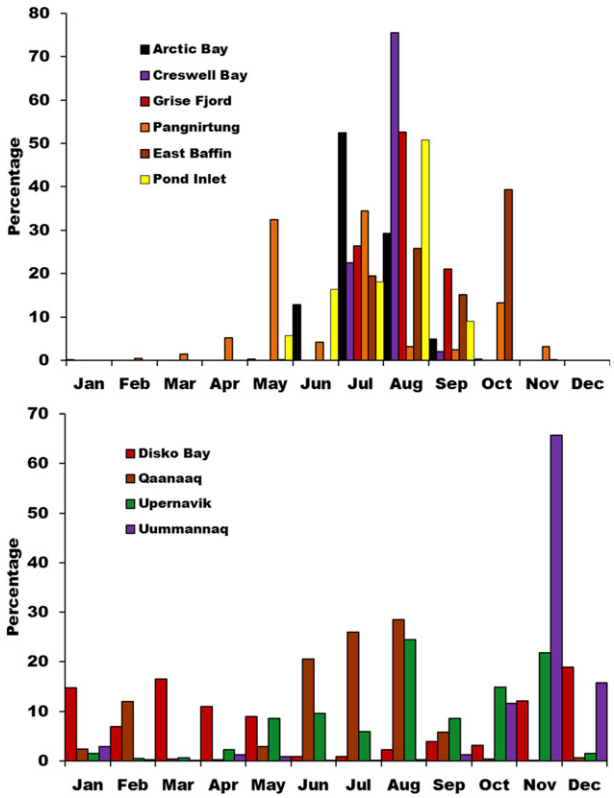

Figure 2 Upper panel: the five primary hunting areas in the Canadian high Arctic and the distribution of catches by month ($n = 2890$). Catches in Pangnirtung are considered part of East Baffin Island catches. Lower panel: the four primary hunting areas in West Greenland and the distribution of catches by month ($n = 4877$). The area from Sisimiut and south is considered mainly to consist of catches in the Disko Bay area because the hunters in this area are highly mobile and narwhals *Monodon monoceros* are rare in the area south of Disko Bay (Sources: Department of Fisheries and Oceans for Canada for the period 1979–2002 and *Piniarneq* for 1993–1999; Greenland Home Rule, http://www.nanoq.gl).

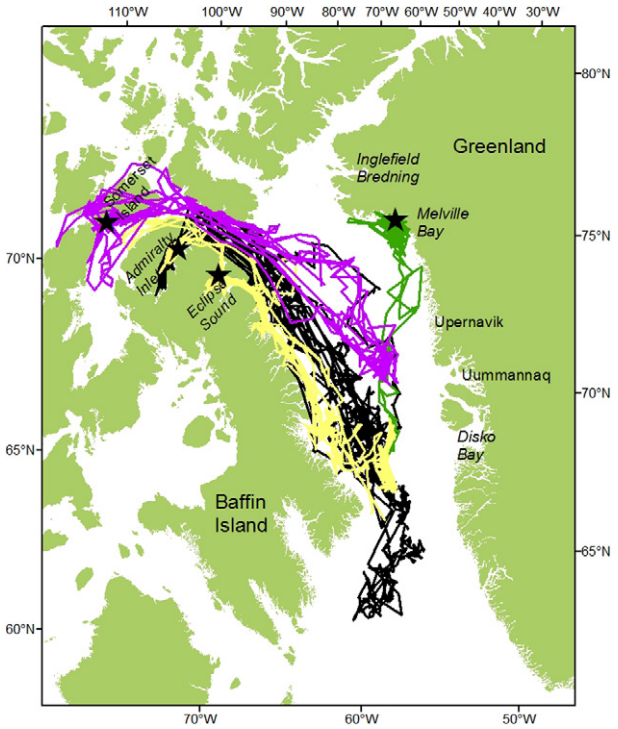

Figure 3 Tracklines of narwhals *Monodon monoceros* tagged from 1993 to 2004 (after Dietz et al., 2008). The black stars indicate the tagging positions.

showed that the whales remained in the Inlet for the summer through August and early September. However, in 2005, one Admiralty Inlet whale visited Prince Regent Inlet ('Somerset Island stock') in early September before heading east with the other whales from Admiralty Inlet (Fig. 4). This was also observed in 2009, where five out of seven tracked whales went to Prince Regent Inlet between early to mid-September before heading east (Fig. 5). Except for one whale that moved through the Furry and Hecla Strait into Foxe Basin in November (and remained there throughout the winter), all other whales from the Admiralty Inlet stock moved eastward through Lancaster Sound in late September, and southward along the east coast of Baffin Island. They eventually terminated their migration offshore in the northern part of Davis Strait. One male moved to the coastal areas close to Disko Island and Uummannaq in West Greenland during the month of January 2006 (Fig. 4).

Eclipse Sound

The geographic range of narwhals from Eclipse Sound did not generally overlap with that of narwhals from other aggregations during August and they are therefore referred to as the 'Eclipse Sound stock' (yellow lines in Figs 3 and 6). One exception to this was, in 1999, three tagged whales from Eclipse Sound moved to Admiralty Inlet and Prince Regent Inlet before returning east toward Baffin Bay (Dietz *et al.*, 2001; Heide-Jørgensen *et al.*, 2002). In late September, tagged narwhals from Eclipse Sound began to depart on their autumn migration. They moved south along the east coast of Baffin Island and visited several of the fjords along the way. In November, several of these whales moved into a wintering area in central Davis Strait (yellow tracks in Fig. 3), whereas others (Fig. 6) continued south toward southern Davis Strait. Two whales entered Cumberland Sound in late fall, and of them, a male crossed Davis Strait and entered Disko Bay in December 2010. Most narwhals from Eclipse Sound wintered in central Baffin Bay, roughly between 69°N and 60°W in the same area as narwhals tracked from Melville Bay, but some chose a more southern wintering area in northern Davis Strait (Figs 3 and 6).

Northern Hudson Bay

Narwhals tagged in northern Hudson Bay in 2005 and 2006 remained in the area between Repulse Bay, Lyon Inlet and western Foxe Channel until the end of October, at which

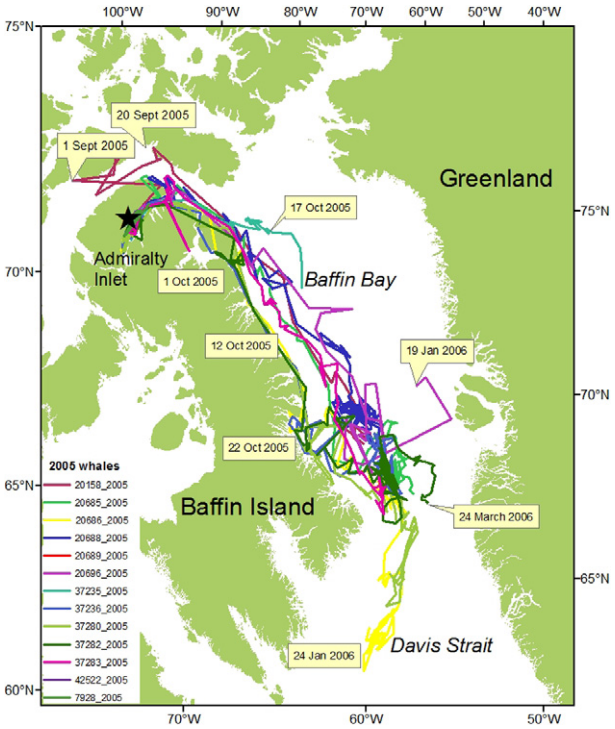

Figure 4 Tracklines of 14 narwhals *Monodon monoceros* tagged in Admiralty Inlet in 2005 (data from this study). The black star indicates the tagging positions.

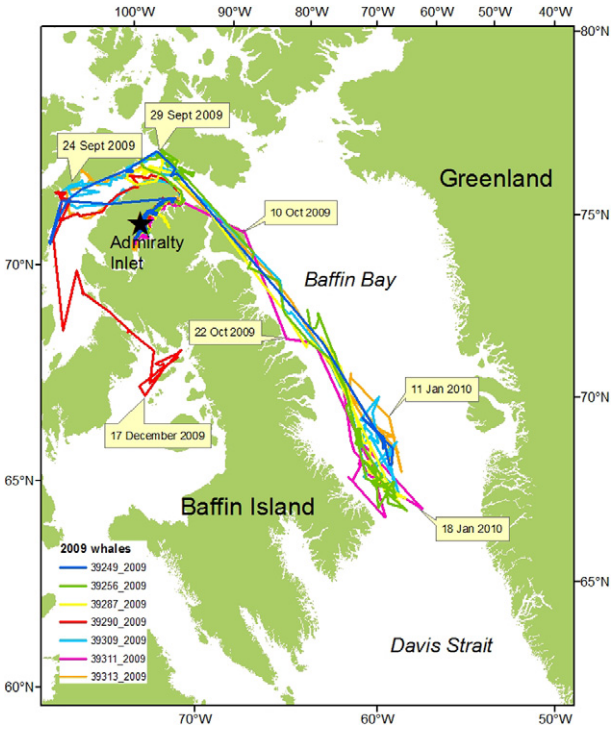

Figure 5 Tracklines of eight narwhals *Monodon monoceros* tagged in Admiralty Inlet in 2009 (data from this study). The black star indicates the tagging positions.

time they started moving eastward toward Hudson Strait (Westdal, 2008; Westdal *et al.*, 2010; Fig. 7). They transited through Hudson Strait during the months of November and early December. Four animals were tracked throughout the winter months east of Hudson Strait. Two of them transmitted long enough to be tracked returning westward into Hudson Strait in June, which suggests that they were on their way back to their previous year's summering range in northern Hudson Bay. The narwhals that summer in northern Hudson Bay and winter off Hudson Strait do not seem to be overlapping year-round with any of the other stocks. They are referred to as the 'Hudson Bay stock'.

Melville Bay

Narwhals tracked from Melville Bay in 1993, 1994, 2006 and 2007 spent the summer in that bay without visiting other areas with narwhal summer aggregations and we refer to these animals as the 'Melville Bay stock' (Figs 3 and 8). Their fall migration began in October, when some individuals took a southern route along the 1000-m depth contour, while the others moved south but remained closer to land. Most of them arrived in central Davis Strait in mid-November where they presumably spent the winter. One of them left the wintering area late December 2006 and moved to the south end of Disko Bay where it stayed until 13 January 2007 before returning to the central Davis Strait wintering area.

Uummannaq

A male narwhal tagged in November 2007 spent the entire winter inside Uummannaq Fjord or just outside the Uummannaq area after in late January (Fig. 6). On 13 March 2008, it headed north (< 72°N) along the West Greenland coast, but contact was lost on 4 April 2008. A 2008 female also tagged in November immediately left Uummannaq Fjord after tagging and spent December through mid-February 2009 off the banks west of Disko Island (Fig. 6). On 24 March, it started moving north along West Greenland reaching northern Baffin Bay in early April where it remained through May. In late May, it migrated westward, moved through Lancaster Sound and ended in Peel Sound where contact was lost on 24 July. Based on the track of this narwhal, it is reasonable to assume that some narwhals from the Uummannaq fall aggregation belong to the Somerset Island stock.

Evidence for inter-annual site fidelity

Eight satellite-linked tags on narwhals transmitted for a full year, allowing for the assessment of inter-annual site fidelity to be based on individuals that returned in spring to the summering area where they were tagged the previous year (Table 2). At least six of the eight whales re-entered the area where they were tagged the previous year. The two other whales were close to (and heading toward) the summering

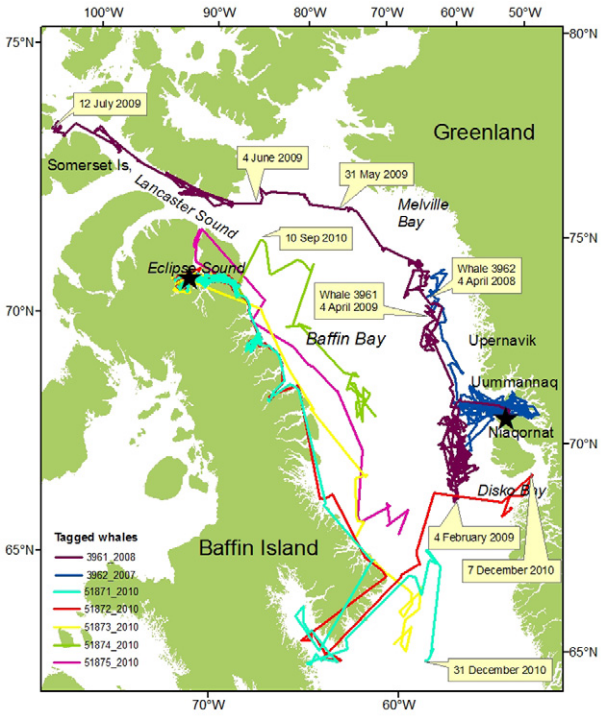

Figure 6 Tracklines of five narwhals *Monodon monoceros* tagged in Eclipse Sound in August 2010 and of two narwhals tagged in Uummannaq: one in November 2007 (blue) in November 2008 (purple). The black stars indicate the tagging positions.

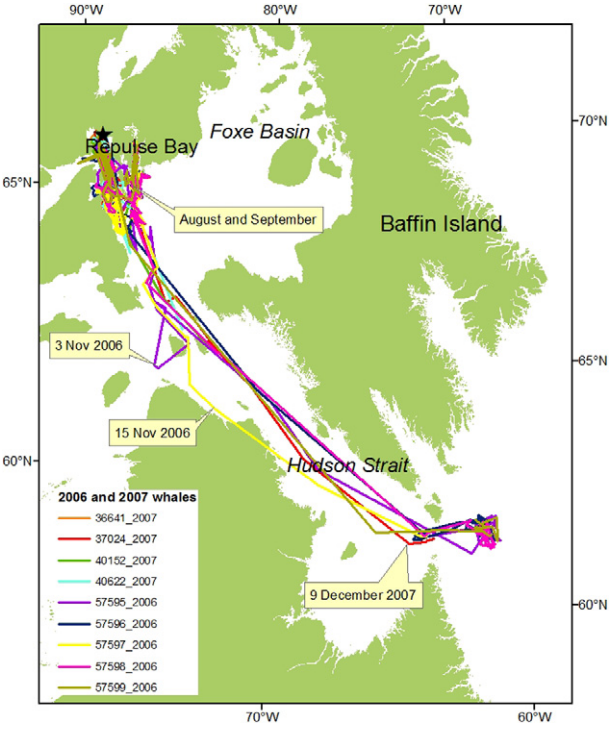

Figure 7 Tracklines of nine narwhals *Monodon monoceros* tagged in Northern Hudson Bay in 2006 and 2007 (data from this study). The black star indicates the tagging positions.

area where they were tagged, but contact with the transmitter was lost before they were inside the summering ground range.

Proposed relationship between summering area and subsistence harvest

The proposed metapopulation structure of the narwhal population in Baffin Bay and adjacent waters (Fig. 9) has important implications for the management of narwhal hunting in Canadian and West Greenland communities (Fig. 10). Occurrence in summering areas defines the stock unit, and the utilization of the narwhals in each stock must be balanced against the productivity of those local summer stocks and their exposure to hunting in other seasons and areas (Table 3). At least two additional putative stocks for the areas of 'East Baffin Island' (east of Pond Inlet to Cumberland Sound) and 'the North Water' (i.e. Smith Sound, Jones Sound and Inglefield Bredning) that have not been studied by satellite-linked tracking need to be considered as well. Three of the hunting communities (Grise Fjord, Qaanaaq, Arctic Bay and Creswell Bay/Resolute) rely on summer catches of these narwhals when their local subpopulations (stocks) are present in the area. However, when narwhals depart from the summering areas, they are exploited in other communities that only have narwhal subsistence harvests during winter months (e.g. Uummannaq and Disko Bay) or communities that hunt them during the fall and spring migrations (e.g. East Baffin Island). In several cases, the hunt outside the summering areas constitutes a mix of whales from different stocks (e.g. Melville Bay, Somerset Island and Eclipse Sound narwhals in Disko Bay, Admiralty Inlet, Eclipse Sound along East Baffin Island); in other situations, the migrations are unknown (e.g. Qaanaaq and East Baffin stocks), and in one case, there is evidence for a connection between a summering ground (Somerset Island) and a fall aggregation that is being hunted (Uummannaq). Only in Hudson Bay and Strait communities are the annual catches attributable to a single stock, the Northern Hudson Bay narwhal stock.

Discussion

Among marine mammal species, metapopulation models has so far only been described for pinnipeds, such as sea lions or gray seals (*Eumetopias jubatus, Halichoreus grypus*) (Harwood *et al.*, 1996; York, Merrick & Loughlin, 1996). Most cetaceans range widely over offshore areas that are difficult to access and it is often a complicated task to observe the underlying population structure. Although metapopulation structures has been suggested for several species of cetaceans (e.g. Pirzl *et al.*, 2009; Heide-Jørgensen *et al.*, 2011), metapopulation models have yet to be developed for cetaceans, and the spatial model proposed here for narwhals is the first attempt to develop such a model. Traditional methods of comparing genetic traits by

hypothesis testing alone have failed to clarify the stock structure of narwhals in the Baffin Bay region (Palsbøll, Heide-Jørgensen & Dietz, 1997); however, the satellite tracking results presented here provide insight into the metapopulation structure for a species that aggregates in coastal areas and island passages in summer.

Esler (2000) suggested that the applicability of metapopulation theory as a conceptual framework for understanding the population structure and dynamics of migratory animals requires consideration of spatial, temporal and behavioral factors that affect demographic independence throughout the year. Following Esler (2000), we propose that narwhal population structure in the eastern Canadian Arctic and West Greenland consists of separate summering stocks, which probably also represent separate breeding units, with little dispersal between them.

This study presents a conceptual model of narwhal population structure. Some narwhal subpopulations may be more isolated than others and there are subpopulations (stocks) for which movements remain unknown (e.g. Inglefield Bredning, East Baffin). Nevertheless, the metapopulation approach is a proposed framework for studying those relationships and should serve as a basis for conservation and management of narwhals.

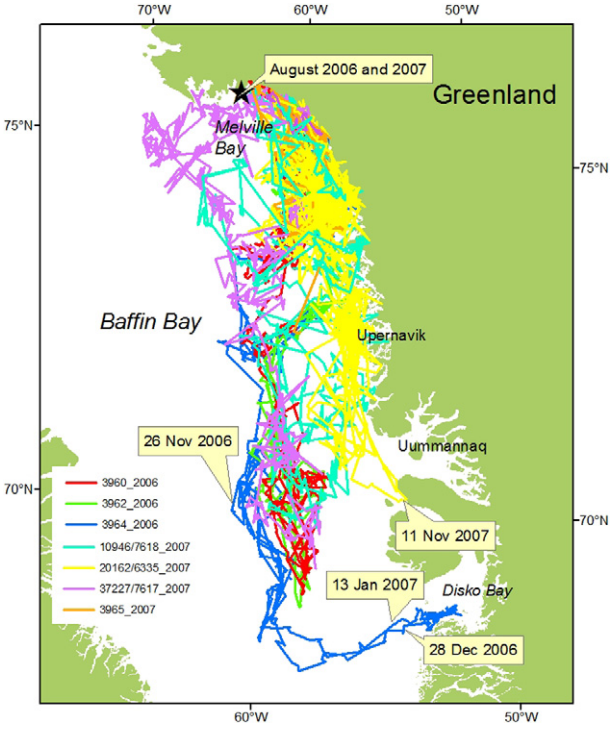

Figure 8 Tracklines of seven narwhals *Monodon monoceros* tagged in Melville Bay in 2006 and 2007 (data from this study). The black star indicates the tagging positions.

Tracking data and observational evidence for population structure

The observations presented here suggest that at least some of the narwhal summer aggregations in eastern Canada and West Greenland are, to some extent, demographically independent subpopulations. The evidence for this includes regular occurrence of stable numbers of narwhal aggregating in summering areas, minimal movements out of summering sites during summer months, fall migration routes that differ between subpopulations and return spring migrations of some animals to the same summering area where they originated. The observation that animals from identified stocks are local in summer and do not appear to overlap in their range with adjacent stocks suggests that narwhals in other not-yet-studied summering areas should also be considered separate summer stocks.

A growing number of satellite tags deployed on narwhals in summering areas have transmitted long enough to show that the majority of them return to the

Table 2 Examples of evidence for site fidelity obtained from satellite-tracked narwhals *Monodon monoceros* returning to the tagging locality the subsequent year or later

Stock	Years	Observation	Reference
Somerset Island	2001–2002	Two whales tagged in 2001 returned to the summering area the following year	Heide-Jørgensen *et al.*, 2003
Somerset Island	2001–2006	One whale tagged in 2001 was resighted in Lancaster Sound 5 years later on its return migration toward Somerset Island	Heide-Jørgensen *et al.*, 2008
Admiralty Inlet	2004–2005	One whale tagged in 2004 returned to the ice edge at Admiralty Inlet in June–July 2005 but departed again and went east in Lancaster Sound passing the ice edge at Navy Board Inlet en route to the north coast of Baffin Island. Contact was lost before the August destination could be determined.	Dietz *et al.*, 2008
Admiralty Inlet	2009	One whale migrated back to the mouth of Admiralty Inlet and was last recorded a few tens of kilometers inside the inlet in June 2010	This study
Melville Bay	2007–2008	One whale tagged in 2007 returned the following year to the exact same area	This study
Northern Hudson Bay	2008	Two whales tagged in and Lyon Inlet in 2006 were tracked back to the same general area in June the following year	Westdal *et al.*, 2010

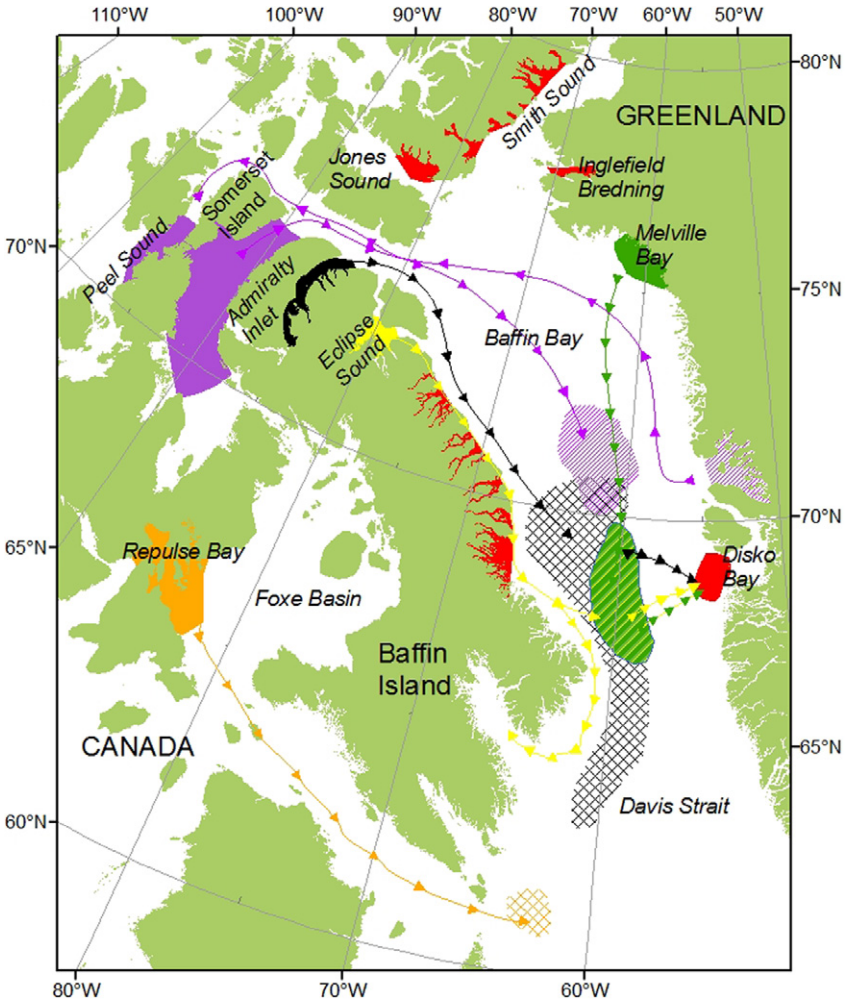

Figure 9 Map of the major summering aggregations (=stocks) of narwhals *Monodon monoceros*. Narwhals from the Melville Bay, the Eclipse Sound, the Somerset Island stock, the Admiralty Inlet and the Hudson Bay stocks (Repulse Bay) have been tracked by satellite and their late summer and autumn movements to four different wintering areas (cross-hatched) are shown. One narwhal from the Uummannaq November aggregation has been tracked to the summering area of the Somerset Island stock. Other localities that have not been studied (marked in red) include Disko Bay, Smith Sound and adjacent fjords, Jones Sound, Inglefield Bredning and fjords along the east coast of Baffin Island.

same summering areas the following summer. These tracking results, combined with the observations of recurring summer aggregations, lend support to the assumption that narwhalsummering stocks are philopatric aggregations and should be considered separate stocks for management and conservation purposes. Tagged narwhals leave these summering areas at about the same time each year and animals tagged in the same summering areas, with few exceptions, follow similar migration routes every year during their autumn, again suggesting philopatry to migration routes.

While summering aggregations are large and recurring in known areas as described earlier, there are occasional sightings of narwhals in areas not known to be aggregation areas. For example, narwhals are occasionally caught in Pangnirtung in August and September, but they are more often caught there in spring and fall. That catch is presumably supplied by narwhals from stocks further north, which winter in or migrate through that area. The low number of winter catches may be due to inclement weather, ice and light conditions. However, an aerial survey conducted in late March has documented the presence of many narwhal pods through the pack ice of Cumberland Sound (P. Richard, unpubl. data).

Genetic and contaminant lines of evidence

Palsbøll *et al.* (1997) described the genetic population structure of narwhals based on mtDNA and suggested that the three aggregations of narwhals in West Greenland (i.e. Inglefield Bredning, Melville Bay and Uummannaq) were genetically distinct. However, Palsbøll *et al.* (1997) also suggested that Disko Bay, the fourth aggregation, was a mixing area where narwhal pods from northern Baffin Bay and Melville Bay were wintering. A study of stable isotope ratios of $\delta^{15}N$ showed significant differences for narwhals in Inglefield Bredning and Uummannaq, and it was suggested this was due to a difference in short-term reflections of the trophic levels between the two areas (Dietz *et al.*, 2004). The reflection of trophic level through stable isotope examination in muscle tissue likely result from short-term feeding and it is unknown exactly what time period these proxies are

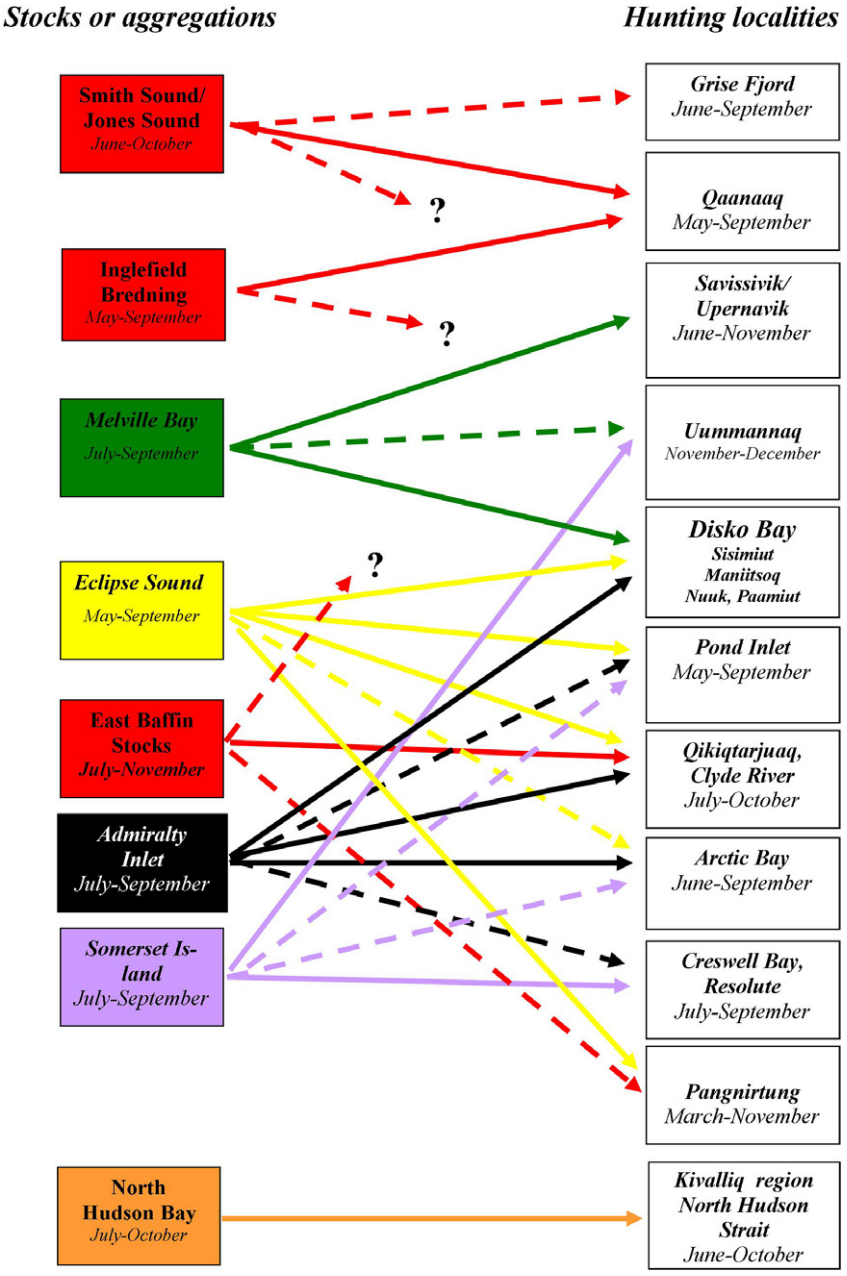

Figure 10 Hypothesized contribution to community catches in Canada and Greenland (right side) by stocks of narwhals *Monodon monoceros* (left side). Solid lines indicate catches by local communities adjacent to the stock's summering area. Broken lines indicate contribution of a stock to non-summer catches. Community names are given in italics to the right including Disko Bay that is a combination of several towns and the Kivallig region that includes Repulse Bay, Coral Harbour, Chesterfield Inlet, Rankin Inlet, and Arviat, and North Hudson Strait that includes Cape Dorset and Kimmirut. The month indicates the approximate time when the whales are present at their summering or aggregation areas and when they are available to the hunting communities. Question marks indicate unknown occurrence at other seasons.

Table 3 Approximate sizes of summering stocks of narwhals *Monodon monoceros* in Canada and West Greenland (Innes *et al.*, 2002; Heide-Jørgensen *et al.*, 2010; Richard, 1991; Westdal, 2008; Richard *et al.*, 2010). Confidence intervals (95%) are given in parenthesis

	Stock	Year	Stock size
Canada	Eclipse Sound stock	2004	20 225 (9471–37 096)
	Admiralty Inlet stock	2003	5362 (1920–12 199)
	Somerset Island stock	1996	45 358 (23 397–87 932)
	East Baffin Fiords stocks	2003	10 073 (5333–17 474)
	Northern Hudson Bay	2000	5627 (3543–8 935)
West Greenland	Inglefield Bredning stock	2007	8368 (5209–13 442)
	Melville Bay stock	2007	6024 (1403–25 860)

integrated over. Narwhals are thought to feed most heavily during winter and samples from stocks in summer do not necessarily reflect the prey choice and magnitude of feeding that occurs in winter (Laidre & Heide-Jørgensen, 2005).

Factors that may lead to demographic independence of subpopulations

Demographic independence between subpopulations of narwhals both on summering areas and, to a lesser extent, on the wintering areas is probably maintained through a combination of life-history traits and migratory routes. The mechanisms that lead to demographic independence of summering aggregations are probably related to nurturing and learning in mammals. Migratory and gregarious mammalian species, including odontocetes, tend to learn from one another and particularly from older experienced animals in their migrating group. Like other long-lived mammals, narwhal calves are believed to spend more than a year with their mother (Hay & Mansfield, 1989) and, consequently, learn from their migratory behavior. Although narwhals do not exhibit 'natal philopatry' in terms of calving and mating at the same locality, it is still conceivable that they learn their migration routes and the location of their summer and winter aggregation areas by following their mother and siblings, and, later on, other conspecifics from the same subpopulation.

While the extent of the mating season is not well known, it has been estimated that the average mating date is in the latter part of May (95% confidence interval: 1 May–12 June (Heide-Jørgensen & Garde 2011). Although some of the subpopulations utilize the same wintering areas and may be mating early in the season, other subpopulations are separated from April onward, when they are following migration routes to their summering areas and unlikely to encounter whales from other stocks. Some levels of cross-mating between stocks likely occur in late winter and low levels of cross-breeding are sufficient to dampen genetic differences between stocks, but animals composing a subpopulation (stock) are more related than in a perfect panmixia.

The degree of migratory divergence may vary between stocks, but evidently, some stocks are less likely to encounter whales from other stocks at that time of year. Mating is therefore likely to take place more between migrating whales and, consequently, with narwhals going to the same summering area (e.g. the three stocks that passes through Lancaster Sound in spring). This would contribute to maintain behavioral affinity for the same migration routes, probably a learned response, and philopatry to the same summering area.

The exception to the above seems to be the northern Hudson Bay narwhals, which segregate genetically from Baffin Bay narwhals (de March, Tenkula & Postma, 2003), probably because their seasonal distributions are separate year-round (Westdal *et al.*, 2010). These whales are also distinguished through contaminant analyses from other Canadian stocks (de March & Stern, 2003) and are therefore likely a population in the biological sense.

Three males were observed during winter to make incursions into other areas and they seem to be more likely to visit wintering areas of other stocks than the females. Satellite tracking provides insight into the coarse metapopulation structure, but estimation of the magnitude of exchange rates clearly would require substantially larger sample sizes to estimate exchange rates.

Management implications

This study proposes a metapopulation structure of narwhals in Baffin Bay and Hudson Bay, where discrete stocks are maintained through behavioral segregation. Panmixia is not supported by the data presented here on the relative stationary behavior in summer, and a return spring migration of individuals between years. The migratory destinations of narwhals from Inglefield Bredning and the East Baffin Stocks remain unknown and the association between the Uummannaq aggregation and the Somerset Island stock is based on limited information. However, for narwhal stocks, it is obvious that several stocks are hunted at many coastal locations in both Canada and Greenland, and that management action must take that into account (Fig. 8). From a management perspective, it is conservative to assume that stocks are demographically independent and therefore differentially exploited. Assuming that the Baffin Bay population is panmictic could lead to unsustainable catch levels at some localities or by some communities, which would severely affect these local narwhal stocks and the Canadian Inuit and Greenlandic populations that rely seasonally on those predictable aggregations.

Acknowledgments

We thank the many hunters of Greenland and Canada who shared their knowledge of narwhal distribution and behavior and for their field assistance in narwhal tagging projects. We are particularly grateful to Jack Orr who led several of those tagging field studies in the Canadian Arctic and whose field and organizational skills made them very successful. Stefan Romberg is acknowledged for the database on Canadian narwhal catches. This study was funded by the Greenland Institute of Natural Resources, National Environmental Research Institute, Department of Fisheries and Oceans, Nunavut Wildlife Management Board, Polar Continental Shelf Project, US National Science Foundation, NOAA Ocean Exploration, The Danish Natural Research Council and The Danish Cooperation for the Environment in the Arctic (DANCEA).

References

Bradstreet, M.S.W. & Cross, W.E. (1982). Trophic relationships at high Arctic ice edges. *Arctic* **35**, 1–12.

de March, B.G.E. & Stern, G. (2003). Stock separation of narwhal (*Monodon monoceros*) in Canada based on organochlorine contaminants. *DFO Can. Sci. Advis. Sec. Res. Doc.* **2003/079**, 1–16.

de March, B.G.E., Tenkula, D.A. & Postma, L.D. (2003). Molecular genetics of narwhal (*Monodon monoceros*) from Canada and West Greenland (1982–2001). *DFO Can. Sci. Advis. Sec. Res. Doc.* **2003/080**, 1–19.

Dietz, R. & Heide-Jørgensen, M.P. (1995). Movements and swimming speed of narwhals (*Monodon monoceros*) instrumented with satellite transmitters in Melville Bay, Northwest Greenland. *Can. J. Zool.* **73**, 2106–2119.

Dietz, R., Heide-Jørgensen, M.P., Richard, P., Orr, J., Laidre, K. & Schmidt, H.C. (2008). Movements of narwhals (*Monodon monoceros*) from Admiralty Inlet monitored by satellite telemetry. *Polar Biol.* **31**, 1295–1306.

Dietz, R., Heide-Jørgensen, M.P., Richard, P.R. & Acquarone, M. (2001). Summer and fall movements of narwhals (*Monodon monoceros*) from northeastern Baffin Island towards northern Davis Strait. *Arctic* **54**, 244–261.

Dietz, R., Riget, F., Hobson, K., Heide-Jørgensen, M., Møller, P., Cleemann, M., de Boer, J. & Glacius, M. (2004). Regional and inter annual patterns of heavy metals, organochlorines and stable isotopes in narwhals (*Monodon monoceros*) from West Greenland. *Sci. Total Environ.* **331**, 83–105.

Ditz, K. (2001). *Catch Statistics for Narwhal and Beluga in selected communities in the Eastern Canadian Arctic (1996–2000)*. JCNB/NAMMCO Joint Scientific Meeting, Qeqertarsuaq, Greenland, May 9–13, 2001.

Esler, D. (2000). Applying metapopulation theory to conservation of migratory birds. *Conserv. Biol.* **14**, 366–372.

Hanski, I. & Gilpin, M.E. (1991). Metapopulation dynamics: brief history and conceptual domain. *Biol. J. Linn. Soc.* **42**, 3–16.

Harwood, J., Stranley, H., Beudels, M.-O. & Vanderlinden, C. (1996). Metapopulation dynamics of the Mediterranean monk seal. In *Metapopulation and wildlife conservation*: 241–257. McCullough, D.R. (Ed.). Washington: Island Press.

Hay, K.A. & Mansfield, A.W. (1989). Narwhal *Monodon monoceros* Linnaeus, 1758. In *Handbook of marine mammals*: 145–176. Ridgway, S.H. & Harrison, R. (Eds). London: Academic Press.

Heide-Jørgensen, M.P. (2004). Aerial digital photographic surveys of narwhals, *Monodon monoceros*, in Northwest Greenland. *Mar. Mamm. Sci.* **20**, 58–73.

Heide-Jørgensen, M.P. & Acquarone, M. (2002). Size and trends of the bowhead, beluga and narwhal stocks wintering off West Greenland. *NAMMCO Sci. Publ.* **4**, 191–210.

Heide-Jørgensen, M.P., Dietz, R., Laidre, K., Nicklen, P., Garde, E., Richard, P. & Orr, J. (2008). Resighting of a narwhal (*Monodon monoceros*) instrumented with a satellite transmitter. *Arctic* **61**, 395–398.

Heide-Jørgensen, M.P., Dietz, R., Laidre, K. & Richard, P. (2002). Autumn movements, home range and winter density of narwhals (*Monodon monoceros*) from Tremblay Sound, Baffin Island. *Polar Biol.* **25**, 331–341.

Heide-Jørgensen, M.P., Dietz, R., Laidre, K., Schmidt, H.C., Richard, P. & Orr, J. (2003). The migratory behaviour of narwhals (*Monodon monoceros*). *Can. J. Zool.* **81**, 1298–1305.

Heide-Jørgensen, M.P. & Garde, E. (2011). Fetal growth of narwhals (*Monodon monoceros*). *Mar. Mamm. Sci.* **27**, 659–664.

Heide-Jørgensen, M.P., Laidre, K.L., Burt, M.L., Borchers, D.L., Marques, T.A., Hansen, R.G., Rasmussen, M. & Fossette, S. (2010). Abundance of narwhals (*Monodon monoceros* L.) on the hunting areas in Greenland. *Mammalogy* **91**, 1135–1151.

Heide-Jørgensen, M.P., Laidre, K.L., Quakenbush, L.T. & Citta, J.J. (2011). The Northwest Passage opens for bowhead whales. *Biol. Lett.* **8**, 270–273.

Heide-Jørgensen, M.P., Lassen, H., Teilmann, J. & Davis, R.A. (1993). An index of the relative abundance of wintering belugas, *Delphinapterus leucas*, and narwhals, *Monodon monoceros*, off West Greenland. *Can. J. Fish. Aquat. Sci.* **50**, 2323–2335.

Innes, S., Heide-Jørgensen, M., Laake, J.L., Laidre, K.L., Cleator, H.J., Richard, P. & Stewart, R.E.A. (2002). Surveys of belugas and narwhals in the Canadian High Arctic in 1996. *NAMMCO Sci. Publ.* **4**, 169–190.

Koski, W.R. & Davis, R.A. (1994). Distribution and numbers of narwhals (*Monodon monoceros*) in Baffin Bay and Davis Strait. *Meddr. Grønland, Bioscience* **39**, 15–40.

Laidre, K.L. & Heide-Jørgensen, M.P. (2005). Winter feeding intensity of narwhals (*Monodon monoceros*). *Mar. Mamm. Sci.* **21**, 45–57.

Levins, R. (1970). Extinction. In *Some mathematical questions in biology*: 77–107. Gerstenhaber, M. (Ed.). Providence, Rhode Island: American Mathematical Society.

Palsbøll, P., Heide-Jørgensen, M.-P. & Dietz, R. (1997). Genetic studies of narwhals, *Monodon monoceros*, from West and East Greenland. *Heredity* **78**, 284–292.

Piniarneq (1993–1999). *Catch statistics for Greenland*. Greenland Home Rule, http://www.nanoq.gl.

Pirzl, R., Patenaude, N.J., Burnell, S. & Bannister, J. (2009). Movements of southern right whales (*Eubalaena australis*) between Australian and subantarctic New Zealand populations. *Mar. Mamm. Sci.* **25**, 455–461.

Richard, P.R. (1991). Abundance and distribution of narwhals (*Monodon monoceros*) in northern Hudson Bay. *Can. J. Fish. Aquat. Sci.* **48**, 276–283.

Richard, P.R., Laake, J.L., Hobbs, R.C., Heide-Jørgensen, M.P., Asselin, N. & Cleator, H. (2010). Baffin Bay narwhal population distribution and numbers: aerial

surveys in the Canadian high Arctic, 2002–04. *Arctic* **63**, 85–99.

Romberg, S. & Richard, P. (2005). *Seasonal distribution and sex ratio of narwhal catches in the Baffin region of Nunavut Territory, Canada*. Working paper presented to the NAMMCO/JCNB Working Group on Belugas and Narwhals, October 2005. NAMMCO/SC/13-JCNB/SWG/2005-JWG/9: 16 p.

Westdal, K. (2008). *Movement and diving of Northern Hudson Bay narwhals (Monodon Monoceros): relevance to stock assessment and hunt co-management*. MSc thesis, University of Manitoba.

Westdal, K., Richard, P. & Orr, J. (2010). Migration route and seasonal home range of the Northern Hudson Bay narwhal (*Monodon monoceros*). In *A little less Arctic: top predators in the world's largest northern inland sea, Hudson Bay*: 71–91. Ferguson, S.H., Loseto, L.L. & Mallory, M.L. (Eds). Dordrecht: Springer Publishing Company.

York, A.E., Merrick, R.L. & Loughlin, T.R. (1996). An analysis of the stellar sea lion metapopulation in Alaska. In *Metapopulation and wildlife conservation*: 259–292. McCullough, D.R. (Ed.). Washington: Island Press.

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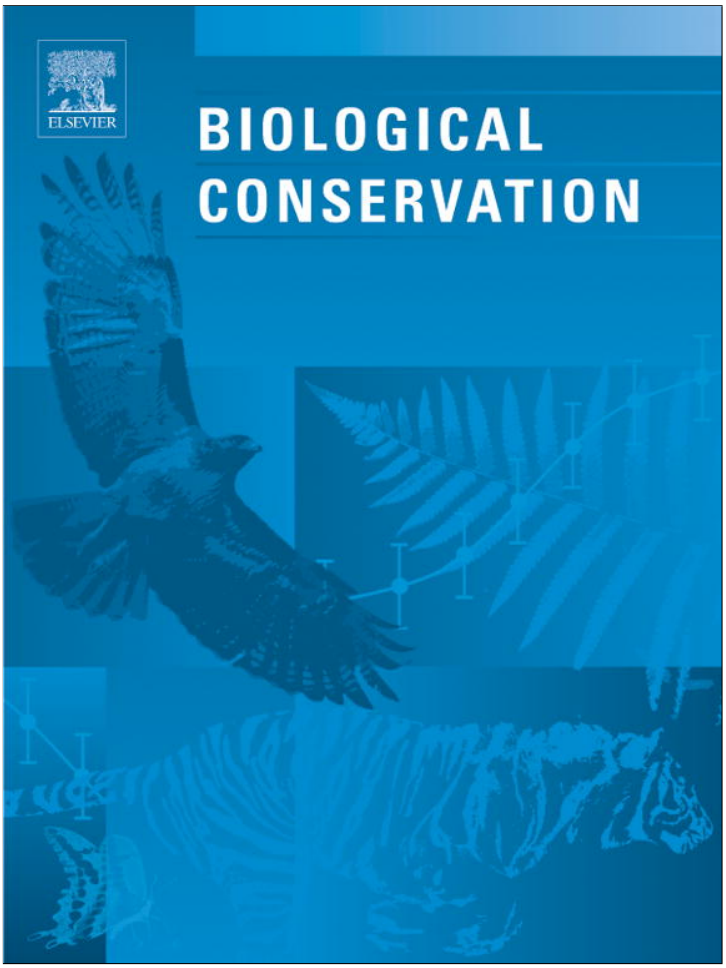

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Biological Conservation 158 (2013) 50–54

Contents lists available at SciVerse ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

Perspective

Narwhals and seismic exploration: Is seismic noise increasing the risk of ice entrapments?

Mads Peter Heide-Jørgensen [a,*], Rikke Guldborg Hansen [a], Kristin Westdal [b], Randall R. Reeves [c], Anders Mosbech [d]

[a] Greenland Institute of Natural Resources, Box 570, DK-3900 Nuuk, Greenland
[b] Oceans North Canada, 515-70 Arthur Street, Winnipeg, Manitoba, Canada
[c] Okapi Wildlife Associates, 27 Chandler Lane, Hudson, Quebec, Canada J0P 1H0
[d] Department of Bioscience, Aarhus University, Frederiksborgvej 399, 4000 Roskilde, Denmark

ARTICLE INFO

Article history:
Received 11 May 2012
Received in revised form 1 August 2012
Accepted 6 August 2012

Keywords:
Ice entrapment
Noise pollution
Arctic
Greenland
Canadian high Arctic

ABSTRACT

There is great interest in exploring and exploiting hydrocarbon resources in the Arctic, and one of the main methods of locating and assessing such resources is seismic survey. Marine seismic surveys involve the use of airguns that introduce high-energy noise to the Arctic's largely pristine underwater acoustic environment. Narwhals may be particularly sensitive to this noise but so far no studies have addressed the question of direct effects of high-energy airgun pulses on these animals. We are concerned about the possibility that three large recent ice entrapments were causally linked to seismic survey activities. On these occasions narwhals remained in coastal summering areas until well into the fall and early winter season, delaying their annual offshore migration and becoming lethally entrapped by rapidly forming fast ice. About 1000 narwhals died in an ice entrapment in Canada in 2008 and about 100 in two entrapments in Northwest Greenland in 2009–10. We conclude that studies of the direct effects of seismic surveys on narwhals are urgently needed and should ideally precede further seismic surveys in narwhal habitats.
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Some of the largest unexplored geological basins for hydrocarbon development are located in offshore seasonally ice-covered shelf-areas of the Arctic (Gautier et al., 2009; Schenk, 2010). With the prospects for a continued reduction in extent and thickness of sea ice (Perovich and Richter-Menge, 2009), these areas are of increasing interest to the oil and gas industry. On the shelf areas of East and West Greenland alone, it has been estimated that >20 million barrels of undiscovered oil might exist and would be potentially recoverable (Gautier et al., 2009). The prospect of large-scale untapped but accessible hydrocarbon resources in a country with a stable political system has fueled interest in oil and gas exploration in Greenland. Both offshore seismic surveys and exploratory drilling have taken place in West Greenland since 2007 and licensing for areas of East Greenland is expected to take place in 2012 (http://www.bmp.gl/petroleum/).

The underwater environment in the Arctic often has high background sound levels from activity of icebergs, sea ice, wind, waves, and wildlife, but there has been, until recently, relatively little noise of anthropogenic origin (Carey and Evans, 2011; Moore et al., 2012). Despite opening of the Northwest and Northeast Passages (Arctic Marine Shipping Assessment, 2009), the level of shipping activity remains low and is largely limited to the open-water season. Therefore the underwater acoustic environment in much of the Arctic is still nearly pristine, without the chronic noise from shipping, drilling, seismic exploration and sonar. In Baffin Bay large-scale industrial seismic surveys were only recently initiated.

Arctic marine mammals use underwater sounds to locate prey, detect and avoid predators, find openings in sea ice for breathing, and to communicate and maintain contact (Richardson et al.,

* Corresponding author. Address: Greenland Institute of Natural Resources, Strandgade 91, 3, DK-1016 Copenhagen, Denmark. Tel.: +45 40257943; fax: +45 32833801.
E-mail address: mhj@ghsdk.dk (M.P. Heide-Jørgensen).

0006-3207/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biocon.2012.08.005

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1995). Historically, cetaceans and pinnipeds that live year-round in the Arctic have been exposed to very limited amounts of anthropogenic sound and there is no reason to believe that these animals have become desensitized or habituated to such noise. In fact, there is published evidence of dramatic responses to ship noise by belugas (*Delphinapterus leucas*) and narwhals (*Monodon monoceros*) (Finley et al., 1990; Cosens and Dueck, 1993; Lesage et al., 1999) and to airgun pulses by bowhead whales (*Balaena mysticetus*) (Richardson et al., 1995; Blackwell et al., 2010). The effects of anthropogenic noise on several temperate-region species have been studied (Wright et al., 2007; Rolland et al., 2012) but few studies have addressed this issue for Arctic marine mammals. Depending on the type and level of the sound as well as its spatial and temporal character, the impacts on marine mammals may include short- or long-term changes in behavior (i.e. disruption of feeding activity, avoidance, shifts in habitat-use patterns), physical damage to hearing abilities, and masking of important signals. Change in calling behavior is a commonly detected effect of noise exposure.

The narwhal, primarily found in the Atlantic sector of the Arctic with the largest numbers centered in Baffin Bay and adjoining waters (Richard et al., 2010; Heide-Jørgensen et al., 2010), is of particular concern. Narwhals are skittish, highly sensitive to human activities and easily disturbed by approaching boats, even in areas without hunting. Hunting of narwhals in several areas of West Greenland continues to be conducted from kayaks because the whales react with long submergence times and often simply disappear when pursued by boats with noisy outboard engines. No direct studies have been conducted of the effects of seismic airgun noise on narwhals but they are known to react at long distances to underwater noise from vessels, with and without ice-breaking (Finley et al., 1990). The reactions of narwhals to approaching vessels include long-distance displacement, even at relatively low received sound levels (94–105 dB re 1 μPa; 20–1000 Hz). This responsiveness at such long distances is exceptional in the literature on marine mammal disturbance (see Richardson et al., 1995). It should be noted however that recent studies indicate that some other species also react to noise at long distances (e.g. Risch et al., 2012). The responsiveness of narwhals confirmed by the paucity of sightings obtained from vessels passing through areas known (from hunting returns and aerial surveys) to have high densities of narwhals (Heide-Jørgensen et al., 2010; GINR unpublished data). In particular, observers on active seismic survey vessels rarely if ever encounter narwhals, even when surveying areas where narwhals are known to occur (Lang and Mactavish, 2011). It is likely that the animals disappear before the survey vessels are within the observers' range of visual detection.

The sounds produced by narwhals span a wide range of frequencies, from <300 Hz to >150 kHz (Miller et al., 1995), and the low-frequency sounds of seismic surveys are likely to overlap in frequency with at least a portion of the narwhal's vocal repertoire. It is uncertain at what distance from an operating seismic airgun array the sound pressure received by the narwhals would elicit a behavioral or physiological response. The received level would depend not only on distance but, perhaps more critically, on the size of the array and other factors. It is a combination of distance (to the airguns) and received level (at the whale) that is likely to elicit a response.

Although narwhals dive to depths exceeding 1000 m (maximum recorded depth was 1900 m; Laidre et al., 2003), they are not considered fast swimmers. Based on contraction times, dominance of slow-twitch muscle fibers and exceptionally high myoglobin concentrations, narwhals have been characterized as slow, aerobic swimmers (Williams et al., 2010). Observations of narwhals instrumented with satellite-linked time-depth recorders showed that horizontal speeds averaged 1.4 m s^{-1} (range = 0.81–2.36 m s^{-1}) and vertical speeds were within approximately 10% of this range (Dietz and Heide-Jørgensen, 1995; Heide-Jørgensen and Dietz, 1995). These values are among the slowest reported for any marine mammal (Williams, 2009).

The usual escape response of narwhals exposed to killer whales (*Orcinus orca*) or Inuit hunters involves prolonged submergence and entry into dense pack ice, if this is available (Williams et al., 2010; Laidre et al., 2006). In other words, they tend to hide or flee slowly and cryptically to avoid predators. Their observed response to an icebreaker was similar (Finley et al., 1990) and this is in contrast to the responses of other cetaceans with locomotor muscles divided equally into slow-twitch and fast-twitch fiber types, allowing for high-speed movement away from a disturbance (Ponganis and Pierce, 1978). Narwhals make long-distance migrations in the spring and autumn (>3000 km per year), moving between coastal summering grounds (Heide-Jørgensen et al., 2003) and winter feeding areas in the pack ice (Laidre et al., 2004). Such migrations across areas with few predators require endurance swimming (Williams et al., 2010). In summary, narwhals adhere to strict migratory schedules and routes with a high degree of site fidelity to specific localities (Heide-Jørgensen et al., in press). They live in an environment with strong seasonal variability in habitat conditions, have few predators, and are rarely exposed to human disturbances except during the short periods when they are hunted along the edges of fast ice and in open water.

Narwhals remain in the Arctic or sub-Arctic throughout the year. Although they spend approximately half of the year in dense pack ice and have done so for centuries (and presumably for millennia), they are still susceptible to ice entrapment. At intervals, large numbers succumb in this way during the winter (February through April). Ice entrapments are caused by a sudden freeze-up during periods of stable but high atmospheric pressure (Egede, 1788; Porsild, 1918; Siegstad and Heide-Jørgensen, 1994). Ice entrapments are well documented in West Greenland and to some extent also in Canada as these are major events in the lives of people living in Arctic communities. The Disko Bay area of West Greenland has long been the area with the highest incidence of narwhal ice entrapment, and it was the site of the largest such event on record: more than 1000 whales died in a February 1915 ice entrapment in Disko Bay (Porsild, 1918). This bay typically provides excellent feeding conditions for narwhals, and sea ice coverage is highly variable according to the changing strength of the warm Atlantic water and the cold polar currents that meet there. During certain weather conditions in winter, hunters are "on the lookout" for ice-entrapped whales at sites where entrapments are to some extent predictable based on local experience and knowledge. This situation, specifically the high level of local interest and consequent vigilance by people, gives us confidence in asserting that ice entrapments of narwhals occur mainly between February and March and most often in the Disko Bay region of West Greenland. There are few historical records of entrapments north of Disko Bay, none from Qaanaaq (Northwest Greenland) and few from winter in the Canadian high Arctic (Fig. 1).

Three recent ice entrapments of narwhals occurred in summering areas outside the normal range of ice-entrapment events. Two of these took place in the autumn in locations where entrapments of narwhals had not been reported previously. In November 2008 thousands of narwhals were seen moving quickly through the freezing seas near the community of Pond Inlet (northern Baffin Island, Canada) a few days before being entrapped (Watt and Ferguson, 2011). Some of the whales apparently avoided entrapment. However, after the ice had frozen solid, local residents discovered about 1000 narwhals at breathing holes about 50 km from open water. During late September and early October 2008, 2D seismic surveys (m/v Geolog Dmitriy Nalivkin) were underway

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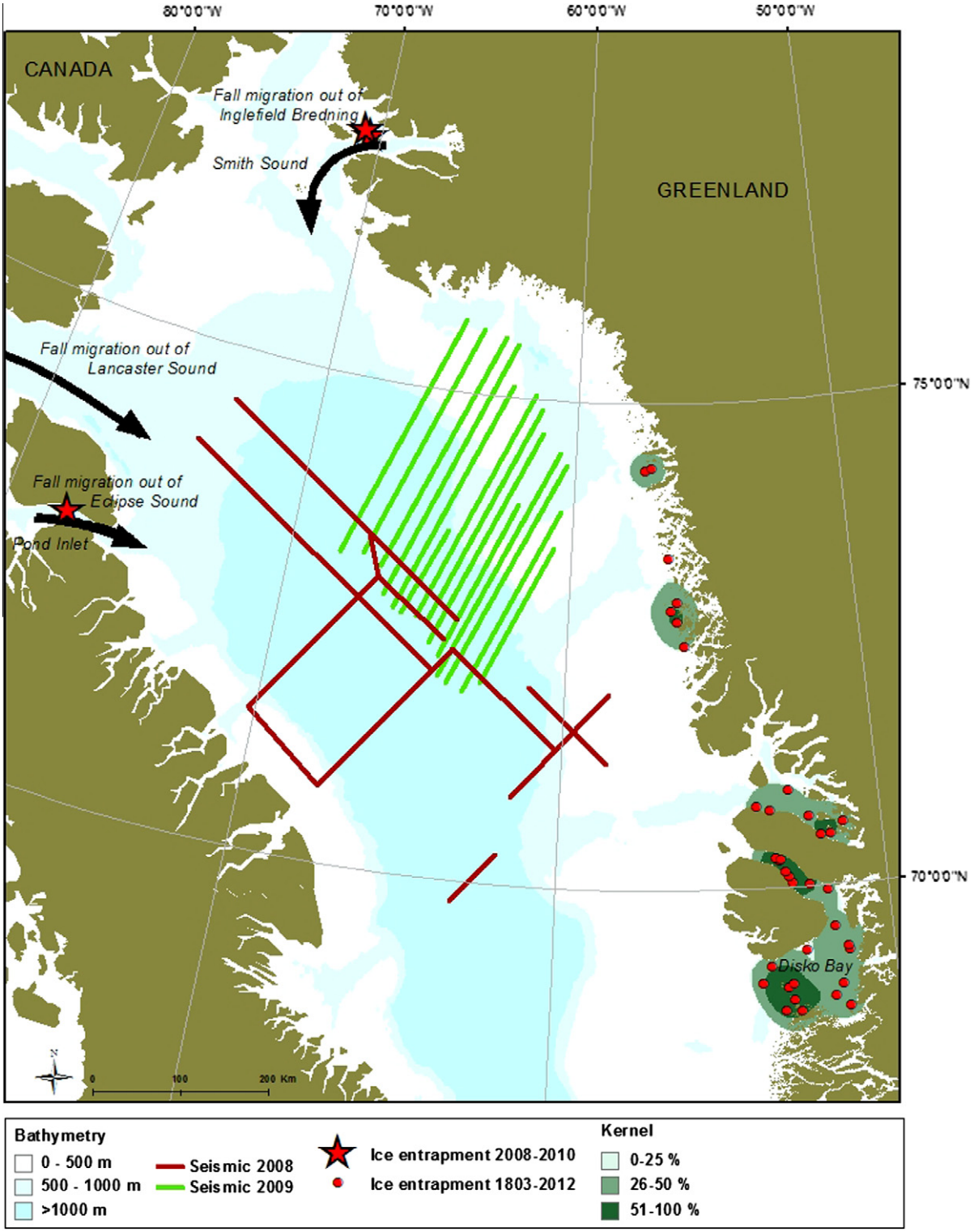

Fig. 1. Tracks of seismic survey operations in northern Baffin Bay during September–October 2008 and 2009. Historical ice entrapments in West Greenland are indicated with red dots and shown with kernel home ranges in green. Three recent entrapments are shown with red stars in Canada (November 2008) and Northwest Greenland (November 2009, February 2010). Major fall migration routes of narwhals exiting Lancaster and Eclipse sounds in Canada and Inglefield Bredning in Northwest Greenland are shown with black arrows. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

in Baffin Bay at the time when narwhals would normally be moving out of Pond Inlet and Lancaster Sound and starting their southward migration in Baffin Bay (Fig. 1). This seismic vessel normally operates with four arrays of up to 37 airguns with a combined maximum volume of 4200 inch^3 and a pressure of 2000 psi.

Two other unusual, and similarly lethal, incidents occurred in November 2009 and February 2010 in Inglefield Bredning, involving 30–100 and 50–100 narwhals, respectively (Laidre et al., 2011). Similar to 2008, seismic activity (m/v Bergen Surveyor) was taking place in northern Baffin Bay in September–October 2009, i.e. at the

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time when narwhals would normally be moving out of their summering area in Inglefield Bredning. This vessel operates with an airgun arrangement (4 arrays with 12 two-gun clusters and source energy of 3460–4210 inch^3) similar to that used by m/v Geolog Dmitriy Nalivkin and both vessels deploy airgun arrays with more than enough power to produce pulses that would be audible in the entire Baffin Bay. We have no records of previous seismic surveys as late in the year as late September–October in northern Baffin Bay.

Narwhals that have spent the summer in and near Pond Inlet usually depart the fjord system around the 25th of September and head towards their wintering grounds in central Baffin Bay (Heide-Jørgensen et al., 2002; Fig. 2). The large number that remained in Pond Inlet during freeze-up in November 2008 was exceptional. Inglefield Bredning is an important summering ground for narwhals (Heide-Jørgensen et al., 2010) but the whales always leave the area in late September-early October (Born, 1986). Although the migratory destination of this population of narwhals is still not known with certainty, the narwhals traditionally move south and abandon Smith Sound for the winter (Finley and Renaud, 1980; Richard et al., 1998).

The areas where ice entrapments of narwhals usually occur along West Greenland (shown as kernel ranges in Fig. 1) are characterized by mobile pack ice where leads and cracks in most winters provide open spaces for air-breathing mammals. However, the coastal areas in northern Baffin Bay where the narwhals were entrapped in 2008 and 2009–10 are usually covered with fast ice in late November, thus it remains a mystery why the whales remained in these areas during freeze-up. Narwhals inhabit areas where climate imposes strong forcing on the habitat conditions, meaning the conditions can change from suitable (ice-free or unconsolidated pack ice) to unsuitable (solid and continuous ice cover) over short timescales. It has been speculated that, with climate change, later freeze-up on the summering grounds will delay the departure of narwhals from these areas and make them increasingly vulnerable to rapid freeze-up and ice-entrapment late in the fall (Laidre et al., 2011). This suggestion is inconsistent with the tight schedule of narwhal fall migrations; for decades, the whales have been observed to depart their summering grounds well ahead of the formation of fast-ice (Dietz and Heide-Jørgensen, 1995; Dietz et al., 2008; Heide-Jørgensen et al., 2003).

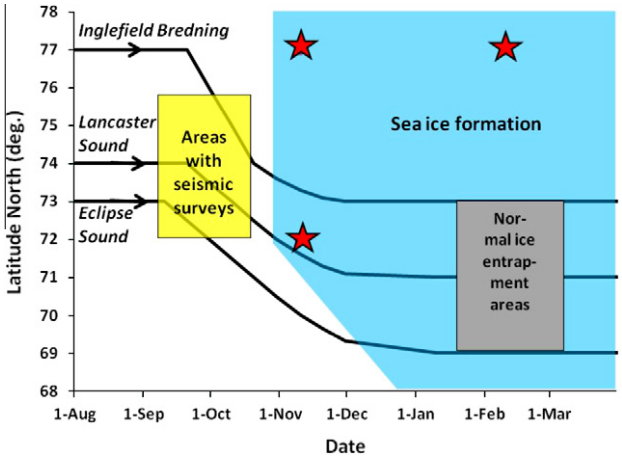

Fig. 2. Generalized model of autumn sea ice development with latitude (*y*-axis) and date (*x*-axis) in Baffin Bay. The fall migration of narwhals from three summering areas (Inglefield Bredning, Lancaster Sound and Eclipse Sound, see Fig. 1) from high latitudes towards lower latitudes is shown with black lines, and the normal latitude and season for ice entrapments of narwhals are shown as the gray box, with the three unusual entrapment events in 2008 and 2009–10 indicated with red stars in areas and seasons where entrapments have generally not been reported before. The seismic surveys (yellow square) happened just after the narwhals normally would have begun to depart from their summering grounds and while they would have been heading towards wintering areas in central Baffin Bay. For background data see Dietz et al. (2008) and Heide-Jørgensen et al. (in press). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Low-frequency sounds from airguns can be transmitted over long distances. For example, Nieukirk et al. (2012) monitored seismic activity from moored stations along the mid-North Atlantic and documented sounds from seismic survey vessels located >3000 km away. Airgun sounds were recorded in Fram Strait, off northeastern Greenland, year-round, even during the winter when the area was ice covered and no seismic exploration was being conducted locally (Moore et al., 2012). The seismic surveys conducted in Baffin Bay in 2008 and 2009 were in a relatively deep basin (500–2000 m). The airgun pulses from the >3000 inch^3 industrial seismic arrays would have ensonified the underwater environment of most of the northern part of Baffin Bay during the early part of the narwhal fall migration, and there is little doubt that the pulses were audible to narwhals, which would have been within 200 km of the seismic vessels at least during parts of the period.

The general proximity in space and time of the seismic survey activity and the 2008 and 2009–10 ice entrapments leads us to propose as a possibility that there was a causal connection, with the seismic surveys in 2008 and 2009 interrupting the outmigration of narwhals and prompting them to return to the summering grounds which would eventually be covered with fast ice. Although direct proof of such a connection is not possible in retrospect and would be difficult even in a "real-time" situation, we believe a very cautious approach to seismic surveys in narwhal habitats is warranted. This remains true even if, as an alternative hypothesis, the recent entrapments are considered stochastic events, possibly more related to climate change than to the disruptive effects of industrial activity within the Baffin Bay region.

Persistent disturbance of narwhals (and other acoustically sensitive Arctic species) could disrupt important behavior, cause the animals to abandon important summering areas, and change their migration patterns. As they leave the summering grounds, narwhals are generally heading towards winter feeding grounds, and disturbance could cause them either to return and risk ice entrapment or to move to wintering areas that are sub-optimal for feeding. Considering that narwhals already appear to be approaching their physiological capacity and may have little flexibility to adjust their swimming and diving behavior (Williams et al., 2010), it seems critical that the whales are not disturbed to such an extent that their basic annual cycle is disrupted.

We conclude that extreme caution should be taken by companies and agencies involved in planning and conducting marine seismic surveys in or in close proximity to narwhal summering grounds and migratory routes. We also identify as an urgent research priority specific studies on the effects of seismic airgun noise on narwhals (and belugas). Such studies should include assessment of the effects of airgun noise on escape movements (dosis response experiments), migratory movements, diving activity, vocalizations and, if possible, heart rate changes during long dives. Given the uncertainty in relation to potential population effects of seismic noise, it is also recommended to monitor the population trends of exposed narwhal populations carefully.

Acknowledgements

We thank the Bureau of Minerals and Petroleums, Greenland Government, for assistance with locating data on seismic operations in Baffin Bay.

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References

Arctic Marine Shipping Assessment, 2009. Arctic Council. <http://www.pame.is/amsa/amsa-2009-report>.

Blackwell, S.B., Nations, C.S., McDonald, T.L., Thode, A., Kim, K.H., Greene, C.R., Macrander, A.M., 2010. Effects of seismic exploration activities on bowhead whale call distribution in the Alaskan Beaufort Sea. J. Acoust. Soc. Am. 127, 1756–1756.

Born, E.W., 1986. Observations of narwhals (*Monodon monoceros*) in the Thule area (NW Greenland), August 1984. Rep. int. Whal. Commn 36, 387–392.

Carey, W.M., Evans, R.B., 2011. Ocean Ambient Noise. Measurement and Theory. The Underwater Acoustics Series. Springer ISBN 978-1-4419-7831-8.

Cosens, S.E., Dueck, L.P., 1993. Icebreaker noise in Lancaster Sound, N.W.T., Canada: Implications for marine mammal behavior. Mar. Mammal Sci. 9, 285–300.

Dietz, R., Heide-Jørgensen, M.P., 1995. Movements and swimming speed of narwhals, *Monodon monoceros*, equipped with satellite transmitters in Melville Bay, Northwest Greenland. Can. J. Zoolog. 73, 2120–2132.

Dietz, R., Heide-Jørgensen, M.P., Richard, P., Orr, J., Laidre, K., Schmidt, H.C., 2008. Movements of narwhals (*Monodon monoceros*) from Admiralty Inlet monitored by satellite telemetry. Polar Biol. 31, 1295–1306.

Egede, P., 1788. Efterretninger om Grønland uddragne af en Journal holden fra 1721 til 1788. (Observations on Greenland from a journal from 1721 to 1788. Original from 1788 but reissued by Mads Lidegaard 1988). Det grønlandske Selskabs Skrifter XXIX:1–204.

Finley, K.J., Renaud, W.E., 1980. Marine mammals inhabiting the Baffin Bay North Water in winter. Arctic 33, 724–738.

Finley, K.J., Miller, G.W., Davis, R.A., Greene, C.R., 1990. Reactions of belugas, *Delphinapterus leucas*, and narwhals, *Monodon monoceros*, to ice-breaking ships in the Canadian high arctic. Can. J. Fish. Aquat. Sci. 224, 97–117.

Gautier, D.L., Bird, K.J., Charpentier, R.R., Grantz, A., Houseknecht, D.W., Klett, T.R., Moore, T.E., Pitman, J.K., Schenk, C.J., Schuenemeyer, J.H., Sørensen, K., Tennyson, M.E., Valin, Z.C., Wandrey, C.J., 2009. Assessment of Undiscovered Oil and Gas in the Arctic. Science 324 (5931), 1175–1179. http://dx.doi.org/10.1126/science.1169467.

Heide-Jørgensen, M.P., Dietz, R., 1995. Some characteristics of narwhal, *Monodon monoceros*, diving behaviour in Baffin Bay. Can. J. Zoolog. 73, 2106–2119.

Heide-Jørgensen, M.P., Dietz, R., Laidre, K., Richard, P., 2002. Autumn movements, home range and winter density of narwhals (*Monodon monoceros*) from Tremblay Sound, Baffin Island. Polar Biol. 25, 331–341.

Heide-Jørgensen, M.P., Dietz, R., Laidre, K., Schmidt, H.C., Richard, P., Orr, J., 2003. The migratory behaviour of narwhals (*Monodon monoceros*). Can. J. Zoolog. 81, 1298–1305.

Heide-Jørgensen, M.P., Laidre, K.L., Burt, M.L., Borchers, D.L., Marques, T.A., Hansen, R.G., Rasmussen, M., Fossette, S., 2010. Abundance of narwhals (*Monodon monoceros* L.) on the hunting grounds in Greenland. J. Mammal. 91, 1135–1151.

Heide-Jørgensen, M.P., Richard, P.R., Dietz, R., Laidre, K.L. in press. A metapopulation model for Canadian and West Greenland narwhals. Animal Conservation.

Laidre, K.L., Heide-Jørgensen, M.P., Dietz, R., Hobbs, R.C., 2003. Deep-diving by narwhals, *Monodon monoceros*: differences in foraging behavior between wintering areas. Mar. Ecol. Prog. Ser. 261, 269–281.

Laidre, K.L., Heide-Jørgensen, M.P., Jørgensen, O.A., Treble, M.A., 2004. Deep-ocean predation by a high Arctic cetacean. ICES J. Mar. Sci. 61, 430–440.

Laidre, K.L., Heide-Jørgensen, M.P., Orr, J., 2006. Reactions of narwhals, *Monodon monoceros*, to killer whale, *Orcinus orca*, attacks in the Eastern Canadian Arctic. Can. Field Nat. 120 (4), 457–465.

Laidre, K.L., Heide-Jørgensen, M.P., Stern, H., Richard, P., 2011. Unusual narwhal sea ice entrapments and delayed autumn freeze-up trends. Polar Biol. 35, 149–154.

Lang, A.L., Mactavish, B.D. 2011. Marine mammal and seabird monitoring of GX Technology's 2011 2-D seismic program offshore northeast Greenland. LGL Rep. SA1139. Rep. by LGL Limited, St. John's, Newfoundland and Labrador, for GX Technology Canada Ltd., Calgary, Alberta. p. 36

Lesage, V., Barrette, C., Kingsley, M.C.S., Sjare, B., 1999. The effect of vessel noise on the vocal behavior of belugas in the St. Lawrence River estuary, Canada Mar. Mammal Sci. 15, 65–84.

Miller, L.A., Pristed, J., Møhl, B., Surlykke, A., 1995. The click-sounds of narwhals (*Monodon monoceros*) in Inglefield Bay. Northwest Greenland. Mar. Mammal Sci. 11, 491–502.

Moore, S.E., Stafford, K.M., Melling, H., Berchok, C., Wiig, Ø., Kovacs, K.M., Lydersen, C., Richter-Menge, J., 2012. Comparing marine mammal acoustic habitats in Atlantic and Pacific sectors of the high arctic: year-long records from Fram Strait and the Chukchi Plateau. Polar Biol. 35, 475–480.

Nieukirk, S.L., Mellinger, D.K., Moore, S.E., Klinck, K., Dziak, R.P., Gosselin, J., 2012. Sounds from airguns and fin whales recorded in the mid-Atlantic Ocean, 1999–2009. J. Acoust. Soc. Am. 131, 1102–1112.

Perovich, D.K., Richter-Menge, J.A., 2009. Loss of sea ice in the Arctic. Annu. Rev. Mar. Sci. 1, 417–441.

Ponganis, P.J., Pierce, R.W., 1978. Muscle metabolic profiles and fibre type composition in some marine mammals. Comp. Biochem. Physiol. 59B, 99–102.

Porsild, M., 1918. On 'Savssat': a crowding of arctic animals at holes in the sea ice. Geogr. Rev. 6, 215–228.

Richard, P., Orr, J.R., Dietz, R., Dueck, L., 1998. Sightings of belugas and other marine mammals in the North Water, Late March 1993. Arctic 51, 1–4.

Richard, P.R., Laake, J.L., Hobbs, R.C., Heide-Jørgensen, M.P., Asselin, N., Cleator, H., 2010. Baffin bay narwhal population distribution and numbers: aerial surveys in the Canadian high Arctic, 2002–04. Arctic 63, 85–99.

Richardson, W.J., Greene, C.R., Malme, C.I., Thomson, D.H., 1995. Marine Mammals and Noise. Academic Press, Inc, San Diego, CA, pp. 576.

Risch, D., Corkeron, P.J., Ellison, W.T., Van Parijs, S.M., 2012. Changes in humpback whale song occurrence in response to an acoustic source 200 km away. PLoS ONE 7 (1), e29741. http://dx.doi.org/10.1371/journal.pone.0029741.

Rolland, R.M., Parks, S.E., Hunt, K.E., Castellote, M., Corkeron, P.J., Nowacek, D.P., Wasser, S.K., Kraus, S.D., 2012. Evidence that ship noise increases stress in right whales. Proc. R. Soc. B. http://dx.doi.org/10.1098/rspb.2011.2429, February 8.

Schenk, C.J. 2010. Geologic assessment of undiscovered oil and gas resources of the West Greenland–East Canada Province. U.S. Geological Survey Open-File Report 2010–1012, 1 sheet.

Siegstad, H., Heide-Jørgensen, M.P., 1994. Ice entrapments of narwhals *(Monodon monoceros*) and white whales (*Delphinapterus leucas*) in Greenland. Meddr. Grønland, Biosci. 39, 151–160.

Watt, C.A., Ferguson, S.H. 2011. Stable isotope and fatty acid analyses of samples from entrapped narwhals (*Monodon monoceros*). DFO Can. Sci. Advis. Sec. Res. Doc. 2010/134. iv + 12 p.

Williams, T.M., 2009. Swimming. In: Perrin, W.F., Würsig, B., Thewissen, J.G.M. (Eds.), Encyclopedia of Marine Mammals. Academic Press, San Diego, CA, pp. 1140–1147.

Williams, T.M., Noren, S.R., Glenn, M., 2010. Extreme physiological adaptations as predictors of climate-change sensitivity in the narwhal, *Monodon monoceros*. Mar. Mammal Sci. 27, 334–349.

Wright, A.J., Aguilar Soto, N., Baldwin, A.L., Bateson, M., Beale, C.M., Clark, C., Deak, T., Edwards, E.F., Fernández, A., Godinho, A., Hatch, L.T., Kakuschke, A., Lusseau, D., Martineau, D., Michael Romero, L., Weilgart, L.S., Wintle, B.A., Notarbartolo-di-Sciara, G., Martin, V., 2007. Do marine mammals experience stress related to anthropogenic noise? Int. J. Comp. Psycho. 20, 274–316.

Impacts of Anthropogenic Sound on Cetaceans

John Hildebrand
Scripps Institution of Oceanography
University of California San Diego
La Jolla, CA 92093-0205

ABSTRACT

Anthropogenic sound is created in the ocean both purposefully and unintentionally. The result is noise pollution that is high-intensity and acute, as well as lower-level and chronic. The locations of noise pollution are along well-traveled paths in the sea and particularly encompass coastal and continental shelf waters, areas that represent critical marine mammal habitat. The problem is one of isolation and a lack of awareness between humans who use the sea and marine mammals that inhabit the sea. Increased use of the sea for commercial shipping, geophysical exploration, and advanced warfare has resulted in a higher level of noise pollution over the past few decades. Informed estimates suggest that noise levels are at least 10 times higher today than they were a few decades ago. Without some effort to reduce or at least cap these noise levels, future ocean noise levels are likely to increase and further degrade the acoustic environment.

A long-term monitoring program is needed to track future changes in ocean noise. Acoustic data should be included in global ocean observing systems now being planned by U.S. and international research foundations. Data from these monitoring systems should be openly available, and accessible to decision makers in industry, in the military, and in regulatory agencies. In tandem, a database should be developed to collect, organize and standardize data on ocean noise measurements and related anthropogenic activities. Currently, data regarding shipping, seismic exploration, oil and gas production, and other marine activities are either not collected or are difficult to obtain and analyze because they are maintained by separate organizations. Marine noise measurements and anthropogenic source data should be used to develop a global model of ocean noise. An important component of model development is better understanding of the characteristics for anthropogenic noise sources such as commercial shipping, arigun arrays, and military sonar. Research should be conducted relating the overall levels of anthropogenic activity (such as the types and numbers of vessels) with the resulting noise.

Review of the evidence suggests that noise pollution is an important factor in the health of marine mammal habitats. There is sufficient evidence to conclude that high-intensity sounds are harmful and, on occasion, fatal to marine mammals. Behavioral data on marine mammal reaction to sound is complex, partially because of our meager abilities to observe marine mammal behavior in the wild. Evidence suggests that given the opportunity, marine mammals avoid high-intensity sound. Damage to marine mammal hearing due to anthropogenic sound exposure has been documented in the most extreme cases. Multiple mass-stranding events of beaked whales following high-intensity sound exposure demonstrate a repeated pattern of events. Following exposure to high-intensity sonar or airguns, beaked whales rapidly swim to the beach, and the animals die if not returned to the sea by human intervention. Those that are returned to the sea have an unknown fate. Understanding the causes and consequences of beaked whale mass stranding should be a high research priority. What is the mechanism for damage and/or disturbance?

An impediment to assessing the biological effects of ocean noise is a continued lack of knowledge about marine mammal behavioral response to sound. Behavioral data must be collected in the wild to reveal potential effects. Significant ocean noise effects may be confined to a few individuals exposed at high sound pressure levels, and/or from widespread exposure at a population level. Discerning population level effects is challenging since the observations must be conducted over broad distances and long time periods. Our lack of understanding marine mammal behavioral reaction to sound is vast and must be addressed in the face of raising ocean noise levels.

Research tools are needed to better observe marine mammal behavior in the wild. These are needed both to characterize normal behaviors and to detect changes in behavior associated with anthropogenic noise. Tools

also are needed to study marine mammal physiology in the wild. For instance, indicators of stress may be one way to assess the impact of anthropogenic noise on marine mammals. Anthropogenic ocean noise sources are primarily concentrated into a few well defined zones, at major commercial ports and along shipping lanes, in areas of oil exploration and development, and within military test and training sites. The marine mammal populations within these zones should be characterized and monitored for potential impact due to anthropogenic noise.

INTRODUCTION

There is growing concern that sound introduced into the sea by human activities has detrimental effects on marine mammals. Mounting evidence suggests that high-intensity anthropogenic sound from sonar and airguns leads to strandings and subsequent mortality of beaked whales. Although the mechanisms of injury in these events are unclear, the species affected and implicated sound levels follow a consistent pattern. A potentially more pervasive, yet more subtle, problem may be the effects on marine mammals due to increases in ambient noise levels from commercial shipping. Higher levels of ambient noise may interfere with marine mammals' ability to detect sounds, whether these are calls of conspecifics, echos from prey, or natural sounds that aid in navigation or foraging. Such noise may affect reproductive or immune functions and cause more generalized stress. The effects of other pollutants (e.g., chemicals) may be additive or synergistic with those of noise.

Sources of anthropogenic noise are becoming both more pervasive and more powerful, increasing both oceanic background sound levels and peak intensity levels. Ambient noise in the ocean has increased over the past 50 years at both at low (less than 1000 Hz) and mid-frequencies (1-20 KHz). Contributors to ambient noise are commercial shipping, defense-related activities, hydrocarbon exploration and development, research activities, and recreational activities.

Sound is an extremely efficient way to propagate energy through the ocean, and marine mammals have evolved to exploit its potential. Many marine mammals use sound as a primary means for underwater communication and sensing. Toothed whales have developed sophisticated echolocation systems to sense and track the presence of prey and engage in complex exchanges of vocalizations with conspecifics. Baleen whales have developed long-range acoustic communication systems to facilitate mating and social interaction. Some produce intricately patterned songs that continue for hours or days. Marine mammals may use sound from natural sources as a guide for navigation, prey detection, and avoidance of predation. The sound environment of the ocean is an important aspect of marine mammal habitat and we can expect marine mammals to choose their locations and modify their behavior based, in part, on natural and anthropogenic sounds.

Human presence at sea is normally on the surface, and the sounds that we produce within the water are rarely given much consideration. The air-sea interface creates a substantial sound barrier. Sounds waves in the water are reduced in intensity by more than a factor of a thousand when crossing the air-sea boundary. This means that we are effectively insulated from the noise produced by rotating propellers that drive our ships or by high-intensity sonars used to measure the depth or probe the interior of the sea. The conflict between human and marine mammal use of the sea is fundamentally a consequence of the fact that we do not inhabit the same sound environment. Marine mammals live with their ears in the water, and we live, even at sea, with our ears in the air.

A notable exception is when the military uses submarines, and stealth is required. Minimization of sound production then becomes crucial to survival. Reduction in noise has been achieved by placing rotating machinery on isolating mounts and by designing efficient propellers that thrust without unnecessary accompanying vibrations and cavitations. Thus, when it has seemed important to keep the sea quiet, the necessary technology has been developed and made available. .

NOISE LEVELS IN THE OCEAN

Sound is a vibration or acoustic wave that travels through some medium, such as air or water. Acoustic waves can be described either by the speed at which a small piece of the medium vibrates, called the particle velocity, or by the corresponding pressure associated with the vibration. Frequency is the rate of vibration, given in Hertz (Hz) or cycles per second; we perceive frequency as the pitch of the sound. A tone is a sound of a constant frequency that continues for a substantial time. A pulse is a sound of short duration, and it may include a broad range of frequencies.

In water, sound waves are typically measured by their pressure using a device called a hydrophone. When discussing ambient noise, the implicit assumption is that sound pressure fluctuations are being described, although it is not clear whether a particular marine organism is able to sense particle velocity or acceleration. Sound pressure is measured in Pascals (Pa) in the international system of units (SI), although it is expressed in bars by the geophysical community ($1\ Pa = 10^{-5}$ bar). Since mammalian hearing and sound production cover a large range of pressure values, sound pressure level (SPL) is usually measured on a logarithmic scale called the decibel (dB), and compared against a 1 µPa reference (P_o) for underwater sound as follows:

$$\text{SPL dB re: 1 µPa} = 10 \log_{10} (P / P_o)^2$$

$$\text{SPL dB re: 1 µPa} = 20 \log_{10} (P / P_o)$$

Pressure is squared in the above expression as a proxy for acoustic intensity, that is, the power flow per unit area in the sound wave, with units of watts/m^2. Sound intensity is the product of pressure (P) and particle velocity (v). Acousticians working in one medium (water or air) use the fact that for plane waves the pressure and particle velocity are related by the characteristic impedance (Z) of the medium as follows:

$$Z = P / v$$

This allows the acoustic intensity (I) to be related to the pressure squared, divided by the impedance:

$$I = 10 \log_{10} (P^2 / (Z * I_o))$$

Acoustic power is obtained by integrating intensity over some area, and acoustic energy is obtained by integrating the power over some time period. The same acoustic energy can be obtained from a high-intensity source over a short time (impulse) and a low-intensity source over a long time (continuous wave).

When sound propagates from water into air, there is a 30 dB (1000 x) decrease in acoustic intensity because the characteristic impedance of water is much greater than that of air. This means that sounds made by a high-intensity underwater source (such as a sonar) are not transmitted into the air with the same intensity. In essence, sailors and passengers on ships are protected from the sounds that they generate. Without the air-sea boundary for protection, there would be a strong incentive to protect human hearing from the noise of sonars and cavitating propellers on ships. (Note that for sound in air a different reference level is used, P_o = 20 µPa, and this is a source of much confusion when comparing underwater and in-air sounds.)

Underwater sounds are classified according to whether they are transient or continuous. Transient sounds are of short duration, often called pulses, and they may occur singly, irregularly, or as part of a repeating pattern. For instance, an explosion represents a single transient, whereas the periodic pulses from a ship's sonar are patterned transients. Underwater sounds also can be classified as continuous, that is, they occur without a pause or hiatus. Continuous sounds are further classified as periodic, such as the sound from rotating machinery or pumps, or aperiodic, such as the sound of a ship breaking ice.

Pulsed sounds are measured in terms of their total energy, rather than just their pressure or intensity. Pressure and power measures are difficult to interpret for a brief pulse since they depend on the averaging

time. Energy is proportional to the time integral of the squared pressure, described in the units μPa^2-s. For brief pulses, energy in dB re: μPa^2-s is less than peak squared pressure values in dB μPa^2. As others have warned, better standardization of measurement methods for pulsed underwater sounds is urgently needed to permit meaningful comparisons (Greene 1995).

Ambient noise in the ocean is the background sound that incorporates the broad range of individual sources, some identified and others not. Ocean noise may come both from distant sources, such as ships, or from nearby sources, such as the waves breaking directly above the listener. Although ambient noise is always present, the individual sources that contribute to it do not necessarily create sound continuously.

Natural ocean acoustic environment

The ambient acoustic environment of the ocean is highly variable. At a given time and place, a broad range of sources may be combined. In addition, conditions at a particular location may affect how well ambient sounds are received (e.g., sound propagation, water depth, bathymetry, and depth). Natural phenomena known to contribute to oceanic ambient noise include: (a) wind, sea state and swell patterns, (b) bubble distributions, (c) currents and turbulence, (d) seismic activity, (e) precipitation, (f) ice cover and activity, and (g) marine life.

Wind, Waves and Ice

Ocean surface motions due to wind, sea state and swell patterns are the dominant physical mechanisms for natural sound in the ocean. Noise is primarily associated with wind acting on the surface, causing wave activity. In the absence of anthropogenic and biological sound, ambient noise is wind dependent over an extremely broad frequency band from below 1 Hz to at least 100 kHz. At frequencies below 10 Hz, interactions of surface gravity waves are the dominant mechanisms for sound generation. Across the remainder of the band from 10 Hz – 100 kHz, oscillating bubbles in the water column are the primary noise source, both as individual bubbles and as bubble clouds.

In early descriptions, ocean noise was related to sea state (Knudsen et al. 1948). By this theory, noise levels increase with increasing sea state by the same amount across the entire frequency band from 1 kHz to 100 kHz. More recent work has suggested that noise is better correlated with wind speed than with sea state or wave height. The correlation between noise and wind speed allows for more accurate prediction, as sea states are more difficult to estimate than wind speeds. In the open ocean, the noise of breaking waves is correlated with wind speed. Spilling and plunging breakers raise underwater sound levels by more than 20 dB across the band from 10 Hz to 10 kHz (Wilson et al. 1985). Precipitation is another factor that can increase ambient noise levels by up to 35 dB across a broad band of frequencies from 100 Hz to more than 20 kHz (Nystuen and Farmer 1987). Ice cover alters the ocean noise field depending on its type and degree, for instance, whether it is shore-fast pack ice, moving pack ice, or at the marginal ice zone (Milne 1967). Shore-fast pack ice isolates the water column from the effects of wind, and results in a decrease in ambient noise of 10-20 dB. Sounds from ice cracking, however, may increase noise levels by as much as 30 dB. Ice cracking can generate broadband pulses up to 1 kHz lasting for a second or longer. Interaction of ocean waves with the marginal ice zone may raise noise levels by 4-12 dB (Diachok and Winokur 1974).

Earthquakes

Earthquakes and thunder are examples of transient natural sound sources. Underwater recordings of thunder from storms 5 to10 km distant show peak energy between 50 and 250 Hz, up to 15 dB above background levels (Dubrovsky and Kosterin 1993). Seismic energy from undersea earthquakes couples into the ocean and is called T-phase (tertiary) in addition to the usual P-phase (primary) and S-phase (secondary) seismic waves that are observed on land. At ranges of less than 100 km, T-phase energy can have frequencies greater than 100 Hz, with peak energy at 5-20 Hz. It can be as much as 30-40 dB above background noise, with a sharp onset, and can last from a few seconds to several minutes (Schreiner et al. 1995).

Anthropogenic Sound

Human activity in the marine environment is an important component of the total oceanic acoustic background. Sound is used both as a tool for probing the ocean and as a byproduct of other activities. Anthropogenic noise sources vary in space and time, but may be grouped into general categories: (a) large commercial ships, (b) airguns and other seismic exploration devices, (c) military sonars, (d) ship-mounted sonars, (e) pingers, (f) acoustic harassment devices (AHDs), (g) polar ice-breakers, (h) offshore drilling implements, (i) research sound sources, and (j) small ships.

Commercial Shipping

At low frequencies (5 to 500 Hz), commercial shipping is the major contributor to noise in the world's oceans. Distant ships contribute to the background noise over large geographic areas. The sounds of individual vessels are often spatially and temporally indistinguishable in distant vessel traffic noise. Noise from vessel traffic at high latitudes is particularly efficient at propagating over large distances because in these regions the oceanic sound channel (zone of most efficient sound propagation) reaches the ocean surface.

Ships generate noise primarily by (a) propeller action, (b) propulsion machinery, and (c) hydraulic flow over the hull. Propeller noise is associated with cavitation (Ross 1987, 1993), the creation of voids from zones of pressure above the ambient. The collapse of these voids generates sound. Cavitation creates both broadband noise and tonal sounds, as it may be modulated by blade-passage frequencies and their harmonics (the blade lines). The broadband and tonal components produced by cavitation account for 80-85 percent of ship-radiated noise power (Ross 1987). Propeller noise may be also generated by unsteady propeller blade-passage forces. Additional ship noise results from propulsion machinery such as diesel engines, gears, and major auxiliaries such as diesel generators.

Particular vessels produce unique acoustic signatures associated with noise source levels and frequency bands. Sharp tonal peaks produced by rotating and reciprocating machinery such as diesel engines, diesel generators, pumps, fans, blowers, hydraulic power plants, and other auxiliaries often are seen in these acoustic signatures. Hydrodynamic flow over the ship's hull and hull appendages is an important broadband noise-generating mechanism, especially with increased ship speed. At relatively short ranges and in isolated environments, the spectral characteristics of individual ships can be discerned. At distant ranges in the open ocean, multiple ships contribute to the background, and the sum of many distant sources creates broad spectral peaks of noise in the 5 to 500-Hz band.

Models for representative noise spectra for different classes of ships have been developed by the U.S. Navy. The Research Ambient Noise Directionality (RANDI) model (Wagstaff 1973; Schreiner 1990; Breeding 1993) uses ship length and speed as well as an empirically derived power law to determine the broadband (5-500 Hz) spectral level for various classes of vessels. Peak spectral densities for individual ships range from 195 dB re μPa^2/Hz @ 1 m for fast moving supertankers, to 140 dB re μPa^2/Hz @ 1 m for small fishing vessels. Source-level models have been also developed for the propeller tonal blade lines, occurring at 6-10 Hz for most of the world's large merchant fleet (Gray and Greeley 1980). Small vessels do not contribute significantly to the global ocean acoustic environment, but may be important local sound sources. Examples of noise levels for whale-watching boats are presented by (Au and Green 2000) and (Erbe 2002). A recent study of noise levels from small powerboats suggests peak spectral density levels in the 350-1200 Hz band of 145-150 dB re $1\mu Pa^2$/Hz @ 1 m (Bartlett and Wilson 2002).

Vessel traffic is not uniformly distributed. The major commercial shipping lanes follow great circle routes, or follow coast lines to minimize the distance traveled. Dozens of major ports and "megaports" handle the majority of the traffic, but in addition hundreds of small harbors and ports host smaller volumes of traffic. The U.S. Navy defines 521 ports and 3,762 traffic lanes in its catalog of commercial and transportation marine traffic (Emery et al. 2001). Vessels found in areas outside major shipping lanes include fishing vessels, military ships, scientific research ships, and recreational craft – the last typically found near shore.

Lloyd's Register of the world's commercial fleet for the year 2001 listed 92,817 vessels (NRC 2003). The principal types (their numbers in parentheses) are cargo/passenger transport (34,704), fishing (23,841),

towing/dredging (13,835), oil tankers (10,941), bulk dry transport (6,357), and offshore supply (3,139). Gross tonnage may be a more important index of noise production than vessel numbers. From that perspective, oil tankers and bulk dry transport vessels represent nearly 50 percent of the total tonnage, but less than 8 percent of the total number of vessels.

The numbers of recreational craft are poorly documented. Some information on the number of U.S. boat registrations, by state and category, is available from the National Marine Manufacturer's Association (2003). The vessel categories are outboard, inboard, sterndrive, personal watercraft, sailboats, and miscellaneous.

Vessel operation statistics indicate steady growth in vessel traffic over the past few decades (Mazzuca 2001). There has been an increase both in the number of vessels and in the tonnage of goods shipped. For example, a 30 percent increase has occurred in the volume of goods shipped by the U.S. fleet (by flag and ownership) over the past 20 years (U.S. Maritime Administration, 2003). Oceanic shipping is an efficient means of transporting large quantities of goods and materials globally. The globalization of economic infrastructure means that more raw materials, as well as finished goods, require long-distance transport. The economic incentives for oceanic shipping are strong, and in the near term, there is no viable alternative for transporting large-tonnage materials to distant global locations.

The bulk of U.S. waterborne trade is conducted through a few ports (Table 1). For instance, the combined ports of Los Angeles and Long Beach carry 37 percent of the total (U.S. Maritime Administration 2003). Within the U.S. Exclusive Economic Zone, this concentrates the noise from shipping into the regions adjacent to these ports and their approaches. Since the Southern California Bight is a particularly productive habitat for marine mammals, the concentration of shipping noise within this region is a cause for concern. Significant concentrations of shipping traffic also occur in New York (13 percent) and the Puget Sound area (8 percent).

Table 1: U.S. Foreign Waterborne Trade, Calendar Year 2002
Units are thousands of Twenty-Foot-Equivalent (TEU) containers.
Source: U.S. Maritime Administration (2003)

Rank	U.S. Port	Total	Export	Import
1	Los Angeles	4,060	866	3,194
2	Long Beach	3,184	717	2,467
3	New York	2,627	747	1,879
4	Charleston	1,197	521	676
5	Savannah	1,014	453	561
6	Norfolk	982	431	551
7	Oakland	979	469	482
8	Houston	851	430	420
9	Seattle	850	338	512
10	Tacoma	769	278	491
TOTAL		19,729	6,814	12,916

Plans exist for a new generation of container ship that is significantly faster (36 knots) and has a larger carrying capacity (1,400 Twenty-Foot-Equivalent containers) (Morrison 2000). These plans involve cross-over ship designs from the fast-ferry industry and appear technically feasible. The economic viability of fast shipping depends on the balance between the additional fuel and other expense for shipping the goods, and the value of the goods being shipped. When the cost of greater ship speed is offset by the value gained from diminished time spent in shipping, then faster container ships will become economically competitive. With respect to noise, these vessels will generate more low-frequency noise than current vessel designs owing to their greater speed and propulsive power.

Seismic Exploration

Seismic reflection profiling uses high-intensity sound to image the earth's crust. It is the primary technique for finding and monitoring reserves of oil and natural gas. Seismic reflection profiling is used by academic and government groups to gather information on crustal structure, for the purpose of understanding the origin and tectonic history of the earth's crust.

Arrays of airguns are the sound-producing elements in seismic reflection profiling (Dragoset 1984, 2000). Airguns release a specified volume of air under high pressure, creating a sound pressure wave from the expansion and contraction of the released air bubble. To yield high intensities, multiple airguns are fired with precise timing to produce a coherent pulse of sound. Oil industry airgun arrays typically involve 12 to 48 individual guns, operate at pressures of 2000 psi, and are dispersed over a 20 m by 20 m region, typically towed about 200 m behind a vessel. The pressure output of an airgun array is proportional to (1) its operating pressure, (2) the number of airguns, and (3) the cube root of the total gun volume. For consistency with the underwater acoustic literature, airgun-array source levels are back-calculated to an equivalent source concentrated into a one-meter-radius volume, yielding source levels as high as 256 dB re 1µPa @ 1 m for the Root-Mean-Square (RMS) output pressure (Greene and Moore 1995). This source level predicts pressures in the far-field of the array, but in the near-field the maximum pressure levels encountered are limited to 235-240 dB re 1µPa. The far field pressure from an airgun array is focused vertically, being about 6 dB stronger in the vertical direction than in the horizontal direction for typical arrays. The peak pressure levels for industry arrays are in the 5-300 Hz range. The guns are towed at speeds of about 5 knots and are typically fired about every 10 seconds. A seagoing seismic-reflection operation includes a series of parallel passes through an area by a vessel towing an airgun array as well as 6-10 seismic receiving streamers. A recent practice is the use of repeated seismic reflection surveys for "time-lapse" monitoring of producing oil fields.

Offshore oil and gas exploration and construction activities occur along continental margins. Currently active areas include northern Alaska and northwestern Canada, eastern Canada, the U.S. and Mexican Gulf of Mexico, Venezuela, Brazil, West Africa, South Africa, North Sea, Middle East, northwestern Australia, New Zealand, southern China, Vietnam, Malaysia, and Indonesia. New areas of exploration include the deepwater U.S. Gulf of Mexico and deepwater West Africa, both of which have seen activity in the past 5 to10 years.

Sonar

Sonar systems intentionally create acoustic energy to probe the ocean. They seek information about objects within the water column, at the sea bottom, or within the sediment. Active sonar emits high-intensity acoustic energy and receives reflected and/or scattered energy. A wide range of sonar systems are in use for both civilian and military applications. For purposes of discussion, sonar systems can be categorized as low-frequency (< 1000 Hz), mid-frequency (1 – 20 kHz), and high-frequency (> 20 kHz).

Military sonars are used for target detection, localization, and classification. They generally cover a broader frequency range with higher source levels than civilian sonars. They are operated during both training exercises and combat operations. Because far more time is spent in training than in combat, training exercises may be the primary context in which marine mammals are exposed to military sonar. Low Frequency Active (LFA) sonars are used for broad-scale surveillance; they are designed to allow submarine tracking over scales of many hundreds to thousands of kilometers. Specialized support ships are used to deploy LFA sonars, which consist of arrays of source elements suspended vertically below the ship. The U.S. Navy's Surveillance Towed Array Sensor System (SURTASS) LFA sonar uses an array of 18 projectors operating in the frequency range of 100 to 500 Hz, with 215 dB re 1µPa @ 1 m source level for each projector (Johnson 2002). These systems are designed to project beams of energy in a horizontal direction. The effective source level of an LFA array, when viewed in the horizontal direction, can be 235 dB re 1µPa @ 1 m or higher. The signal includes both continuous-wave (CW) and frequency-modulated (FM) components with a bandwidth of approximately 30 Hz. A ping sequence can last 6 to 100 seconds, with a time between pings of 6 to 15 minutes and a typical duty cycle of 10 to 15 percent. Signal transmissions are emitted in patterned sequences that may last for days or weeks.

Mid-frequency tactical Anti-Submarine Warfare (ASW) sonars are designed to detect submarines over several tens of kilometers. They are incorporated into the hulls of submarine-hunting surface vessels such as destroyers, cruisers, and frigates (see Table 2). There are 117 of these sonars on U.S. Navy ships currently in active service, and equivalent systems in allied navies (e.g., British, Canadian, French). The AN/SQS-53 is the most advanced surface ship ASW sonar used by the U.S. Navy. The AN/SQS-53C sonar generates frequency-modulated pulses of 1-2 second duration in the 1-5 kHz band, at source levels of 235 dB re 1µPa @ 1 m or higher (Evans and England 2001). These sonars emit beams of sound in the horizontal direction. The AN/SQS-53C is designed to perform direct-path ASW search, detection, localization, and tracking from a hull mounted transducer array of 576 elements housed in a bulbous dome located below the waterline of the ship's bow. These systems are used to track both surface and submerged vessels, often picking up surface ships at greater range than most radar systems.

Table 2. US Navy surface ships with Anti-Submarine Warefare active sonars.

Type of Ship	Class	Type of Sonar	Number in use
Cruiser	Ticonderoga	SQS-53	27
Destroyer	Spruance	SQS-53	11
Destroyer	Arleigh Burke	SQS-53	49
Frigate	Oliver Hazard Perry	SQS-56	30
Total			117

Other mid-frequency military sonars in use by the Navy include depth sounders and communication sonars for interplatform information exchange or device activation.
High-frequency sonars are incorporated either into weapons (torpedoes and mines) or weapon countermeasures (mine countermeasures or anti-torpedo devices). They are designed to operate over ranges of a few hundred meters to a few kilometers. Mine-hunting sonars operate at tens of kHz for mine detection and above 100 kHz for mine localization. These sonars are highly directional and use pulsed signals. Other high-frequency military sonars include sidescan sonar for seafloor mapping, generally operated at frequencies near 100 kHz.

Over the past decade, there has been a trend in the U.S. Navy to emphasize training operations in coastal and shallow-water settings. There are currently plans to construct shallow-water training ranges on both the U.S. West and East Coasts. The use of active sonar in these settings means that large numbers of marine mammals may be exposed to high-intensity sonar.

Commercial sonars are designed for fish finding, depth sounding, and sub-bottom profiling. They typically generate sound at frequencies of 3 to 200 kHz, with only a narrow frequency band generated by an individual sonar system. Source levels range from 150-235 dB re 1µPa @ 1 m. Commercial depth sounders and fishfinders are typically designed to focus sound into a downward beam. Depth sounders and sub-bottom profilers are operated primarily in nearshore and shallow environments, however, fish finders are operated in both deep and shallow areas.

The acoustic characteristics of small-scale commercial sonars are unlikely to change significantly in the future since they are limited by several key physical properties. At the low-frequency end (about 3 kHz), they are limited by the physical dimensions of the transducers. At the high-frequency end (200 kHz) they are limited by severe attenuation of sound. Likewise, the maximum power level that can be emitted by a single transducer (200 dB re 1µPa @ 1 m) is limited by cavitation at shallow depths of operation. Higher power levels can be achieved by constructing arrays of sensors on the hull of the vessel. For example, multibeam echosounding systems (e.g., SeaBEAM or Hydrosweep) form narrow directional beams of sound and are used for precise depth sounding. Using hull-mounted arrays of transducers, these systems can achieve 235 dB re 1µPa @ 1 m source levels and are typically operated at 12-15 kHz in deep water, and at higher frequencies (up to 100 kHz) in shallow water.

A significant fraction of the 80,000 vessels in the world's commercial fleet and the 17 million small boats owned in the US are equipped with some form of commercial sonar. Sonar is an extremely efficient means for fish finding and depth sounding/sub-bottom profiling, and new applications may lead to even greater proliferation of these systems.

Research in underwater acoustic propagation and acoustical oceanography often involves use of sound sources. Almost all of these programs are sponsored by the Office of Naval Research, and the information obtained is of value for improving military sonar systems. The sound sources used for these studies are either commercially available transducers or systems specially designed to meet specific research requirements. A wide variety of signals, bandwidths, source levels, and duty cycles are transmitted during these projects. The spatial extent of most experiments is tens of kilometers, but basin-scale projects such as the Acoustic Thermometry of Ocean Climate (ATOC) program have also been undertaken.

The ATOC (later the North Pacific Acoustic Laboratory [NPAL]) project was initiated in the early 1990s to study ocean warming, and received much attention from regulatory agencies, the public, and the scientific community due to concerns regarding the potential impact of its sound source on marine mammals (Baggeroer et al. 1998). This program was extensively discussed in two National Research Council reports (NRC 1994, 2000). The ATOC source has a 195 dB re 1µPa @ 1 m level and is deployed at 939 m, near the axis of the deep sound channel (Howe 1996). It is designed to study the entire North Pacific basin, with the sounds being received by the U.S. Navy's fixed hydrophone arrays. The transmitted signal is centered at 75 Hz with a bandwidth of 37.5 Hz. It broadcasts on 4-hour intervals with a "ramp-up" period of 5 minutes and a full power signal duration of 20 minutes. The long time frame for operation of this experiment was a key aspect that led to questions regarding its potential impacts on marine mammals (Potter 1994).

Another basin-scale sonar research project uses drifting sources (Rossby et al. 1986), called SOFAR or RAFOS floats. These devices drift at depth and periodically emit a high-intensity tone (195 dB re 1µPa @ 1 m) that is frequency swept at 200-300Hz or a CW signal at 185-310 Hz with durations of 120 sec or more. The sounds are detected at distant receivers and their timing is used to determine the float location and therefore its drift, as a proxy for deep currents.

Acoustic Deterrent Devices

Acoustic deterrent devices (ADD) use sound in an effort to repel marine mammals from fisheries activities. The idea behind these devices is that they keep marine mammals away by introducing a local acoustic annoyance. Pingers are used in some fisheries to reduce the bycatch of marine mammals. These are typically low-power ADDs with source levels of 130 – 150 dB re 1µPa @ 1 m. Acoustic harassment devices (AHD) are used to reduce depredation by marine mammals on caught or cultured fish. These are high-powered devices with source levels of 185 – 195 dB re 1µPa @ 1 m. Both pingers and AHDs have frequencies in the 5 – 160 kHz band, and generate pulses lasting from 2 – 2000 msec. To reduce habituation, a single device may transmit a variety of waveforms and have pseudo-random time intervals between transmissions.

Pingers have been shown to be effective in reducing bycatch, at least for some marine mammal species in some settings (Kraus et al. 1997; Culik et al. 2001; Bordino et al. 2002). A trial of pinger use in the California drift gillnet fishery for swordfish and sharks showed that for both cetaceans and pinnipeds, the entanglement rate in nets with pingers was only one third of what it was in nets without these devices (Barlow and Cameron 2003). Likewise, a large-scale trial of pingers in Danish gillnet fisheries showed a reduction in bycatch of harbor porpoises (Larsen 1997; Vinther 1999).

Concerns have arisen that use of AHDs in aquaculture facilities leads to unintended displacement of marine mammals in the cases of killer whales (Morton and Symonds 2002) and harbor porpoises (Olesiuk et al. 2002) in the vicinity of salmon farms off British Columbia. Likewise, there are concerns that widespread use of AHDs may lead to the exclusion of porpoises from important feeding habitat (Johnston 2002). AHDs have sufficiently high source levels that they could result in hearing damage to marine mammals exposed at close range.

Explosions

There are two classes of man-made explosions in or over the ocean: nuclear and chemical. Until the advent of the Comprehensive Test Ban Treaty, nuclear devices were tested regularly in the ocean, in the atmosphere above the ocean, or on oceanic islands. The most recent series of oceanic tests was conducted by France in 1995-1996 on the islands of Fangataufa and Mururoa in the South Pacific. There is currently a low probability of continued ocean testing of nuclear devices although this situation could change with geopolitical developments over the coming years or decades.

Nuclear explosion are extremely strong sources of underwater sound. It is likely that past tests had significant impacts on marine mammals in the vicinity of the test sites. No monitoring data are available, however, to document impacts of nuclear tests on marine mammals. To ensure compliance with the test ban treaty, an international monitoring system is being implemented, including a series of hydrophone- and island-based seismic stations to detect high-intensity sounds (www.ctbto.org). This information is transmitted, in real time, to the International Data Centre where analysts evaluate the data for indications of nuclear explosions. Physical characteristics of the oceans allow the sounds of such explosions to travel for extremely long distances with little energy loss, and monitoring is conducted over a large fraction of the world's oceans with a small number of stations. The network designed for ocean monitoring contains 11 stations located primarily in the Southern Hemisphere.

Clemical explosions are more portable and more easily conducted in an ocean setting. They have been used for oceanic research, for construction, and for military testing. A surprisingly large number (300-4000 per month) of underwater explosions were reported in the North Pacific during the 1960's (Spiess et al. 1968). In the past, chemical explosions were commonly used for marine seismic exploration, but they have been replaced by airgun arrays that provide a more reliable source signature. Chemical explosions continue to be used in the construction and removal of undersea structures, primarily by the oil industry, but the frequency of shot detonation presumably has decreased over the past few decades.

New classes of military vessels undergo tests, called ship-shock trials, to determine their ability to withstand explosions (Commander_Naval_Air_Warfare_Center 1994). During a ship-shock trial, a large chemical explosion (e.g. 10,000 lb) is detonated near the vessel's hull, while measurements of hull stress are conducted. Ocean explosions are also conducted by other Navy programs, such as the "Sinkex" program that sinks retired ships using torpedos or other chemical explosions. Weapons are tested during development, and operational stores are test-fired to monitor their military readiness. During the recent Iraq war, Navy SEA LS disposed of a dozen 500 pound sea mines confiscated from the Iraqi Navy by simultaneously detonating them in the Persian Gulf, a blast that could be heard 50 miles away in Kuwait (Dao 2003).

The spectral and amplitude characteristics of chemical explosions vary with the weight of the charge and the depth of the detonation. The RMS source level of the initial shock wave, a large component of the energy, is given by

$$SL\,(\text{dB re } 1\mu\text{Pa @ 1 m}) = 269\ \text{dB} + 7.53 * \log(w),$$

where w is the charge weight in pounds (Urick 1975). For instance, 100 lb of TNT would produce a shockwave SL of 284 dB re 1µPa @ 1 m with almost constant frequency content from 10 to 1000 Hz. The energy from the bubble pulse oscillations will contribute approximately 5 additional dB of source level, yielding a total SL of 274 dB re 1µPa @ 1 m. Research on blast damage to animals suggests that the mechanical impact of a short duration pressure pulse (positive acoustic impulse) is best correlated with organ damage (Greene and Moore 1995).

Industrial Activities and Construction

Industrial activities and construction both in the ocean and along the shoreline can contribute to underwater noise. Examples include coastal power plants, pile driving, dredging, tunnel boring, power-generating wind

mills, and canal lock operations (Greene and Moore 1995). The coupling of these sounds into the marine environment is poorly understood, but it is generally more efficient at low frequencies.

Marine dredging is commonly conducted in coastal waters to deepen channels and harbors, reclaim land, and mine seabed resources. Reported source levels for dredging operations range from 160 to 180 dB re 1µPa @ 1 m for 1/3 octave bands with peak intensity between 50 and 500 Hz (Greene and Moore 1995).

Oil and gas activities that generate marine noise include drilling, offshore structure emplacement and removal, and production. The associated noise levels from drilling, structures, and production are typically lower than those from seismic surveying. Sound pressure levels associated with drilling are the highest with maximum broadband (10 Hz to 10 kHz) energy of about 190 dB re 1µPa @ 1 m. Drill-ship noise comes from both the drilling machinery and the propellers and thrusters for station-keeping. Jack-ups are the most commonly used offshore drilling devices, followed by platform drill rigs. Drilling generates ancillary noise from the movements of supply boats and support helicopters. Emplacement of offshore structures creates localized noise for brief time periods. Powerful support vessels are used to transport these large structures from the point of fabrication to the point of emplacement. This activity may last for a few weeks and may occur 8 to 10 times a year worldwide. Additional noise is generated during oil production activities, which include borehole casing, cementing, perforating, pumping, pipe laying, pile driving, and ship and helicopter support. Production activities can generate source levels as high as 135 dB re 1µPa at 1 km from the source (Greene and Moore 1995) which suggests as much as 195 dB re 1µPa @ 1 m with peak levels at 40 to 100 Hz.

Oil and gas production is moving from shallow-water settings into water depths of up to 3000 m. Deep-water drilling and production have the potential to generate greater noise than shallow-water production, owing to the use of drill ships and floating production facilities. This noise may be more easily coupled into the deep sound channel for long-range propagation. The worldwide count of offshore mobile drill rigs in use fluctuates with business conditions, but there are an increasing number of drill rigs available, with an approximate 10 percent increase over the past five years.

Comparison and summary of anthropogenic sound sources

The anthropogenic sound sources discussed above are summarized by source level and other parameters in Table 3, ordered by their relative potential for large-scale exposure of marine mammals to high-intensity sound. Underwater nuclear tests and ship-shock trials produce the highest overall sound pressure levels, sufficient to cause physical damage, yet these are rare events and so may be assumed to have limited population-level impacts. Military SURTASS-LFA sonars and large-volume airgun arrays both have high SPLs. The long ping lengths and nearly continuous duty cycle of LFA sonars increase their likelihood of exposing marine mammal populations on a basin-scale. Both the SURTASS-LFA and airgun arrays have dominant energy at low frequencies, where long-range propagation is likely. Tactical military sonars (such as the 53C) have shorter ping durations and more moderate duty cycles than LFA sonars; they also operate at mid-frequencies, where propagation effects limit their range. Concern for the impact of these sonars is for local settings, particularly where deep-diving animals may be present (as discussed later in this paper). Commercial supertankers are arguably the most ubiquitous high-intensity sound source, with more than 10,000 vessels operating worldwide. Concern with these noise sources will be concentrated near major ports and along the most heavily utilized shipping lanes. The moored research sound source for the ATOC project is an equivalent source level to a supertanker although it operates on a much lower duty cycle. Acoustic harassment devices have source levels of concern for long-term hearing damage, and may displace marine mammals from important habitat. Multibeam hull-mounted echo-sounders have a high source level, but their narrow beam widths and mid-frequency character limit their range and the ensonified area. Research acoustic floats (RAFOS) produce a moderately high source level but are operated at a very low duty cycle. Fishing vessels and acoustic deterrent devices have moderate source levels but may represent at least local acoustic annoyances, although in the case of ADDs there is a significant benefit from the reduction of marine mammal bycatch.

TABLE 3. Comparison of anthropogenic underwater sound sources ordered by their potential for marine mammal high-intensity sound exposure.

Sound Source	**SPL** dBre 1µPa @1m	**Ping Energy** (dB re 1µPa^2*s)	**Ping Duration**	**Duty Cycle** (%)	**Peak Frequency** (Hz)	**Band Width** (Hz)	**Direct-ionality**
Underwater Nuclear Device (30 kilo-ton)	328	?	1000 s	Inter-mittant	Low	Broad	Omni
Ship Shock Trial (10,000 lb TNT)	299	?	100 s	Inter-mittent	Low	Broad	Omni
Military Sonar (SURTASS/LFA)	235	243	6 – 100 s	10	250	30	Horizontal
Airgun Array 2000 psi and 8000 in^3	256	241	30 ms	0.3	50	150	Vertical
Military Sonar (53C)	235	232	0.5 – 2 s	6	2,600-3,300	Narrow	Horizontal
Super Tanker 270 m long	198		CW	100	23	5-100	Omni
Research Sonar (ATOC Source)	195		20 minutes	8	75	37.5	Omni
Acoustic Harrassment Device	185	185	0.5 - 2 s	50	10,000	600	Omni
Multibeam (Echosounder Hull-mounted)	235	218	20 ms	0.4	12,000	Narrow	Vertical
Research Sonar (RAFOS float)	195		120 s	small	250	100	Omni
Fishing Vessel 12 m long (7 knots)	150		CW	100	300	250-1000	Omni
Acoustic Deterrent Device (AquaMark300)	132	127	300 ms	8	10,000	2000	Omni

Long Term Trends in Ocean Noise

What is the long-term trend for ocean noise? Overall trends of the level of sounds in the sea can be broken down into anthropogenic and non-anthropogenic components. For instance, there is evidence that global climate change may have resulted in higher sea states (Bacon and Carter 1993; Graham and Diaz 2001), which would increase ambient noise levels. Over the past few decades, however, it is likely that increases in anthropogenic noise have been more prominent. In order of importance, the anthropogenic sources most likely to have contributed to increased noise are: commercial shipping, offshore oil and gas exploration and drilling, and naval and other uses of sonar.

To isolate the effects of anthropogenic and non-anthropogenic noise, waters surrounding Australia, which are remote from commercial shipping, have been examined. At low frequency (100 Hz), Australian data suggest that ocean noise levels may be as low as 50 dB re $1\mu Pa^2$/Hz, which is about 30 to 40 dB below levels in North American and European waters ((Cato and McCauley 2002)). These data further suggest that wind/wave noise increases at low frequencies, in contrast to the predictions of the deepwater curves developed from northern hemisphere data (Wenz 1962). Cato (2001, from NRC2003) points to the difficulty of separating wind/wave-generated noise from shipping noise in North American datasets.

Trends in ambient noise over the past few decades suggest that sound levels have increased by 10 dB or more between 1950 and 1975 (Ross 1987, 1993). These trends are most apparent in the eastern Pacific and eastern and western Atlantic, where they are attributed to increases in commercial shipping. A doubling of the number of ships explains 3 to 5 dB, and greater average ship speeds, propulsion power, and propeller tip speeds explain an additional 6 dB.

Other data on long-term noise trends come from comparison of historical U.S. Navy acoustic array data (Wenz 1969) with modern recordings along the west coast of North America (Andrew et al. 2002). A low-frequency noise increase of 10 dB over 33 years is observed at a site off the central California coast. The explanation for a noise increase in this band is the growth in commercial shipping, in terms of both number of ships and gross tonnage. From 1972 to 1999 the total number of ships in the world's fleet increased from approximately 57,000 to 87,000, and the total gross tonnage increased from 268 to 543 million gross tons.

Mazzuca (2001) compared the results of Wenz (1969), Ross (1987), and Andrew (2002) to derive an overall increase of 16 dB in low-frequency noise from 1950 to 2000. This corresponds to a doubling of noise power (3 dB) every decade for the past five decades, equivalent to a 7 percent annual increase in noise. During this period the number of ships in the world fleet tripled (from 30,000 to 87,000) and the gross tonnage increased by a factor of 6.5 (from 85 to 550 million gross tons) (NRC 2003; from (McCarthy and Miller 2002).

Ocean Noise Research Priorities

Ocean noise is an important component of the marine habitat. Data on ocean noise trends are scarce, however, despite substantial investment by the U.S. government in underwater sound data collection for military purposes (e.g. SOSUS and other ASW monitoring systems). Informed estimates suggest noise has increased significantly during the past few decades. Expanding use of the sea for commercial shipping and advanced warfare has resulted in noise levels are at least 10 times higher today than they were a few decades ago. Without some effort to monitor, reduce or at least cap these noise levels, they are likely to increase and further degrade the acoustic environment of marine mammals. A summary of recommendations for tracking and improving our understanding of ocean noise sources are presented in Table 4.

Table 4. Research Priorities for Understanding and Tracking Ocean Noise.

Priority	Research Topic
1	Initiate long-term ocean noise monitoring programs
2	Collect, organize, and analyze historic marine anthropogenic noise data
3	Develop global models for ocean noise
4	Report signal characteristics for anthropogenic noise sources
5	Determine the relationship between anthropogenic activity level and noise level

Priority 1: Initiate long-term ocean noise monitoring

A long-term monitoring program is needed to track future changes in ocean noise (NRC 2003:90). Acoustic data should be included in global ocean observing systems now being developed by U.S. and international research foundations. Data from these monitoring systems should be openly available, and presented in a manner accessible to decision makers in industry, in the military, and in regulatory agencies.

Priority 2: analyze historic marine anthropogenic noise data

In tandem with the effort to collect and monitor present-day ocean noise, a database should be developed to collect, organize and standardize data on ocean noise measurements and related anthropogenic activities (NRC 2003:89). Infrastructure already is in place that is appropriate for maintaining an archive of these data (e.g. the National Oceanographic Data Center, www.nodc.noaa.gov). Currently, data regarding shipping, seismic exploration, oil and gas production, and other marine activities are either not collected or are difficult to obtain and analyze because they are maintained by separate organizations. International cooperation in this effort should be encouraged.

Priority 3: Develop global models for ocean noise

Marine noise measurements and anthropogenic source data should be used to develop a global model of ocean noise (NRC 2003:92). This model should incorporate both transient events, and continuous noise sources. The development an accurate global model depends on access to ocean noise data and anthropogenic activity data, as described for the database research priority above.

Priority 4: Report signal characteristics for anthropogenic noise sources

An important component of model development is better understanding of the signal characteristics for representative anthropogenic noise sources. The description of these signals should include enough information to allow reconstruction of its character (e.g. frequency content, pressure and/or particle-velocity time series, duration, repetition rate).

Priority 5: Determine the relationship between anthropogenic activity level and noise level

Research should be conducted relating the overall levels of anthropogenic activity (such as the types and numbers of vessels) with the resulting noise (NRC 2003:90). These relations will help to extend noise modeling to areas without direct long-term monitoring, but where anthropogenic noise sources are present.

HOW NOISE AFFECTS MARINE MAMMALS

The response of marine mammals to sound depends upon a range of factors including: (1) the sound pressure level and other properties (e.g., frequency, duration, novelty), (2) the physical and behavioral state of the animals, and (3) the ambient acoustic and ecological features of the environment (see Richardson et al. 1995 for a review of marine mammal responses to specific noise sources). No comprehensive understanding of marine mammal responses to noise is available, either to predict how marine mammals respond behaviorally to intense sounds, or to long-term increases in ambient noise.

In humans, the perceived loudness level of a sound involves not only hearing sensitivity but also psychological/physiological factors (Beranek and Ver 1992). A loudness-level scale has been developed

from detailed testing where the human subject judges the relative loudness of two sounds. For instance, the phon (in dB) compares the loudness level of a 1 kHz tone to tones of varying frequency. In practice the annoyance level of a sound depends upon a range of factors in addition to loudness, such as the sound's fluctuation. Intermittent sounds are more annoying than continuous ones. How reliably human noise studies can be extrapolated to marine mammals is problematic, of course, in view of the vast differences in the role of sound in sensing the marine and terrestrial environments.

Marine mammal sound production

The frequency band of noise that may be important to marine mammals should approximately match the range of the sounds that they produce. For large mysticetes, sound production is in the low-frequency range of 10 to 1,000 Hz, whereas for small odontocetes, sound production is in the mid- and high-frequency range of 1 to 200 kHz. Marine mammal call frequencies show an inverse correlation with body size (Watkins and Wartzok 1985), Richardson et al. 1995, Wartzok and Ketten 1999).

Odontocetes produce (a) broadband clicks with peak energy between 5 and 150 kHz, varying by species, (b) burst-pulse click trains, and (c) tonal or frequency-modulated whistles that range from 1 to 25 kHz. Mysticetes generally produce low-frequency sounds in the range 10 Hz to 2 kHz. Mysticete sounds can be broadly characterized as (a) tonal calls, (b) frequency-modulated sweeps, and (c) pulsed tonals. These sounds can be generated either as individual calls or combined into patterned sequences or songs. Pinnipeds that breed on land produce a limited range of barks and clicks ranging from <1 to 4 kHz. Those that mate in the water produce complex vocalizations during the breeding season. All pinnipeds, the sea otter, and manatees use sound to establish and maintain the mother-young bond, especially when attempting to reunite after separation (Sandegren et al. 1973; Hartman 1979).

The ability to use self-generated sounds to obtain information about objects and features of the environment — echolocation — has been demonstrated for at least 13 odontocete species (Richardson et al. 1995). No odontocete has been shown to be incapable of echolocation. Based on their echolocation signals, odontocetes have been divided into two acoustic groups: (a) type I species produce clicks with peak spectra above 100 kHz and few whistles, and (b) type II species produce clicks with peak spectra below 80 kHz and use whistles regularly (Ketten and Wartzok 1990). Type I odontocetes are inshore and riverine delphinids that operate in acoustically complex environments. Examples are Amazon river dolphins (*Inia geoffrensis)* that sometimes hunt small fish in the flooded forest (Norris et al. 1972) and harbor porpoises (*Phocoena phocoena)* that live primarily in shallow, near-shore waters (Kamminga 1988).

Type II odontocetes include nearshore and offshore species that inhabit environments with low object densities and that engage in conspecific communication. Examples are bottlenose dolphins (*Tursiops truncates*), which are coastal, and pantropical spotted dolphins (*Stenella* spp.), which often occur in offshore waters. There is some suggestion of a negative correlation between body size and the maximum frequency of whistles (Ding et al. 1995). Odontocete whistles have been described as "signature" calls which identify individuals (Caldwell and Caldwell 1965). Likewise burst-pulse sounds produced by killer whales are group-specific (Tyack 2000) and click train codas in sperm whales show geographic variation (Rendell and Whitehead 2003).

Source levels for odontocete clicks have been reported to be as high as 228 dB re 1µPa @ 1 m for false killer whales (*Pseudorca crassidens)* (Thomas and Turl 1990) and for bottlenose dolphins echolocating in the presence of noise (Au 1993) and 232 dB re 1µPa @ 1 m for male sperm whale (*Physeter macrocephalus*) clicks (Mohl et al. 2000). The short duration of these echolocation clicks (50 to 200 µs) means that their total energy is low (197 dB re 1µPa^2-sec) although their source levels are high. Odontocete whistles have lower source levels than their clicks, ranging from less than 110 dB re 1µPa @ 1 m for the spinner dolphin (*Stenella longirostris*) (Watkins and Schevill 1974) to 169 dB re 1µPa @ 1 m for bottlenose dolphins (Janik 2000) and 180 dB re 1µPa @ 1 m for short-finned pilot whales (*Globicephala macrorhychus*) (Fish and Turl 1976). The detection range for odontocete clicks and whistles may be 1 km or less, although much greater detection ranges also have been reported (Leaper et al. 1992; Barlow and Taylor 1998; Gordon et al. 2000).

Mysticete calls can be detected over long ranges (Payne and Webb 1971). For instance, blue whales (*Balaenoptera musculus*) produce low-frequency (10 to100 Hz) calls with estimated source levels of 185 dB re 1µPa @ 1 m (McDonald et al. 2001). Most large mysticetes (blue, fin, bowhead, right, humpback, Bryde's, and gray whale) are known to vocalize at frequencies below 1 kHz, with estimated source levels as high as 180 dB re 1µPa @ 1 m (Richardson et al. 1995).

Source levels and frequencies have been estimated for the underwater calls of several species of pinnipeds. Examples are the Weddell seal (*Leptonychotes weddellii*), which produces calls from 148 to 193 dB re 1µPa @ 1 m at frequencies of 0.2 to 12.8 kHz (Thomas and Kuechle 1982), and the Ross seal (*Ommatophoca rossi*), which produces calls at 1 to 4 kHz (Watkins and Ray 1985). These calls may be detected at ranges of several kilometers both in the open ocean and under ice (Wartzok et al. 1992).

Marine mammal hearing

Sound propagates efficiently underwater, and one reflection of its importance to marine mammals is their development of broader hearing frequency ranges than is typical for land mammals. Audiograms have been produced for 10 species of odontocetes and 11 species of pinnipeds, out of a total of approximately 119 marine mammal species (data are summarized by Wartzok and Ketten 1999). All hearing data are from species that are small enough to be held in captivity. Direct hearing data are not available for the species that are not readily tested by conventional audiometric methods. For these species, audiograms must be estimated from mathematical models based on ear anatomy or inferred from the sounds they produce and from field exposure experiments.

Most odontocetes have functional hearing from 200 Hz to 100 kHz, and some species may hear frequencies as high as 200 kHz. Odontocete hearing has peak sensitivity between 20 and 80 kHz, along with moderate sensitivity in the 1–20 kHz range. Because ambient noise decreases at high frequencies, odontocetes may find an advantage in having their hearing and echolocation at high a frequency to filter out as much of the low-frequency noise as possible.

Based on modeling but with no measured audiograms, mysticete hearing ranges between 20 Hz and 20-30 kHz. Several of the larger species, such as blue and fin whales, are predicted to hear at infrasonic (10 Hz) frequencies. Pinnipeds have their best hearing between 1 and 20 kHz, with the exception of the northern elephant seal, which has good hearing below 1 kHz (Kastak and Schusterman 1998). Some pinnipeds hear moderately well in both water and air, while others are better adapted for underwater than for in-air hearing.

Marine mammal hearing is adapted to an aquatic environment, yet their inner ears resemble those of land mammals. The divergence in hearing physiology between land and marine mammals is most pronounced in the external ears, which are absent in most marine mammal species, and in the middle ears, which are extensively modified in marine mammals. Because hearing loss in land mammals is often related to physical damage to the inner ear, hearing loss in marine mammals may involve similar mechanisms. Because ambient noise in the sea can vary by many orders of magnitude due to storms and other natural phenomena, marine mammals may have developed resilient inner ears to guard against hearing loss. Existing studies do not allow for prediction of the impacts of high-intensity sounds on marine mammal hearing except in general terms.

Hearing Losses

Hearing thresholds for hearing may be degraded by exposure to high-intensity sound. Hearing losses are classified as either temporary threshold shifts (TTS) or permanent threshold shifts (PTS), where repeated TTS may lead to PTS. The extent of hearing loss is related to the sound power spectrum, the hearing sensitivity, and the duration of exposure. High-intensity, impulsive blasts can damage cetacean ears (Ketten et al. 1993). Hearing losses may result in poor conspecific communication, lessened abilities for echolocation and foraging, and erratic behavior with respect to migration, mating, stranding, and

vulnerability to predators. For cetaceans, which are highly dependent on their acoustic sense, both TTS and PTS must be considered serious.

There are relatively few data on hearing loss in marine mammals. Experiments on captive bottlenose dolphins (Ridgway et al. 1997) suggest that TTS is observed at levels of 193 to 196 dB re 1µPa for exposure to 1-second tones at 20 kHz. Recent work by (Finneran et al. 2002) with impulsive sources (seismic waterguns) suggest that exposure to sound pressure levels of 217 dB dB re 1µPa and total energy fluxes of 186 dB dB re 1µPa^{2}s produces TTS in beluga whales (*Delphinaptera leucas*). One assumption is that animals are most vulnerable to TTS at the frequencies of their greatest hearing sensitivity. For baleen whales, this suggests low-frequency sensitivity and for smaller cetaceans, mid- and high-frequency sensitivity. It also raises the question of why marine mammals (apparently) do not damage their hearing by their own sound production, as both the tonal and impulsive sounds that they produce can be comparable in SPL to those found to induce TTS in the controlled experiments mentioned above. It appears that there are internal mechanisms that protect an animal from its own vocalisations. For instance, the pterygoid sinus cavities of odontocetes may be positioned to shield their inner ears from their own sound production.

Noise Masking

Acoustic signals are detected against a background of ambient noise. When background noise increases, it may reduce an animal's ability to detect relevant sound, called noise masking. Noise is effective for masking when it is within a critical band (CB) of frequency around the desired signal. The amount by which a pure tone must exceed the noise spectral level to be audible is called the critical ratio (CR). The CR is related to the bandwidth within which background noise affects the animal's ability to detect a sound. Estimates of marine mammal CBs and CRs come from captive odontocetes and pinnipeds (Richardson et al. 1995). For all species, when CB is plotted as a function of frequency, there is a steep rise at low frequencies (25 – 75 percent at 100 Hz), and a much lower level (1 – 10 percent) at mid and high frequencies (1 – 100 kHz). This suggests that narrow-band noise is more effective at masking low frequencies than mid and high frequencies. An animal's directional hearing capabilities may aid in avoiding masking by resolving the different directions of propagation between the signal and the noise. A directivity index of as much as 20 dB has been measured for bottlenose dolphins (Au and Moore 1984), whereas directional hearing is less acute in pinnipeds.

Masking of beluga whale sounds by icebreaker noise has been studied (Erbe and Farmer 1998; Erbe 2000; Erbe and Farmer 2000), including construction of software to model this process (Erbe et al. 1999). Icebreaker noise from ramming, ice cracking, and bubbler systems were shown to produce masking at noise-to-signal ratios of 30 to 800 (15 to 29 dB). The predicted zone of masking for beluga calls from ramming noise was 40 km (Erbe and Farmer 2000). Beluga whales' vocal output changes when they are moved to locations with higher background noise. With noise at low frequencies, an animal increases both the sound pressure level and the frequency of its vocalizations, perhaps in an attempt to avoid masking. Beluga whales also have been observed to increase call rates and shift to higher call frequencies in response to boat noise (Lesage et al. 1999).

Hearing Development

Is increased noise in the oceans causing developmental problems for young animals? High-noise environments affect speech and language development in very young rats (Chang and Merzenich 2003). Brain circuits that receive and interpret sound did not develop at the same rate in animals living in an environment of continuous background noise as in animals that were raised in a quiet environment. It took three to four times as long for rats raised in a noisy environment to reach the basic benchmarks of auditory development. For marine mammals, these data may be difficult to obtain but should be an important consideration of the potential impact of ocean noise.

Effects of Noise on Marine Mammal Behavior

The behavioral responses of marine mammals to noise are complex and poorly understood (Richardson et al. 1995). They may depend upon hearing sensitivity, behavioral state, habituation or desensitization, age,

sex, presence of offspring, location of exposure, and proximity to a shoreline. Behavioral responses may range from subtle changes in surfacing and breathing patterns to cessation of vocalization to active avoidance or escape from the region of highest sound levels. For instance, several studies suggest that bowhead whales (*Balaena mysticetus*) follow a pattern of shorter surfacings, shorter dives, fewer blows per surfacing, and longer intervals between blows when exposed to anthropogenic noise, even at moderate received levels (114 dB re 1µPa). Another common response pattern is a reduction or cessation of vocalization, such as for right whales (*Eubalaena* spp.) in response to boat noise (Watkins 1986), bowheads in response to playback of industrial sounds (Wartzok et al. 1989), sperm whales in response to pulses from acoustic pingers (Watkins and Schevill 1975) and in the presence of military sonar (Watkins et al. 1985), and sperm and pilot whales in response to the Heard Island test acoustic source (Bowles et al. 1994). Moreover, humpback whales (*Megaptera novaeangliae*) lengthen their song cycles when exposed to the LFA source (Miller et al. 2000), move away from mid-frequency sonar (Maybaum 1993), and tend to cease vocalizations when near boats (Watkins 1986). Beluga whales adjust their echolocation clicks to higher frequencies and higher source levels in the presence of increased background noise (Au et al. 1985). Gray whales (*Eschrichtius robustus*) exhibited an avoidance response when exposed to airgun noise, and their response became more as the source level increased from 164 to 180 dB re 1µPa (Malme et al. 1984). They also preferentially avoided LFA transmissions conducted in a landward direction (Tyack and Clark 1998).

Marine mammals have also been observed to have little or no reaction to some anthropogenic sounds. For example, sperm whales continued calling when they encountered echosounders (Watkins 1977) and when they were exposed to received sound levels of 180 dB re 1µPa from a detonator (Madsen and Mohl 2000). A fin whale (*Balaenoptera physalus*) continued to call with no change in rate, level, or frequency in the presence of noise from a container ship (Edds 1988).

Age and sex are important factors in marine mammal noise sensitivity. For instance, juvenile and pregnant northern sea lions (*Eumetopias jubatus*) are more likely to leave a haul-out site in response to aircraft overflights than are territory-holding males and females with young (Calkins 1979). Walruses (*Odobenus rosmarus*) may stampede and crush calves (Loughrey 1959) or temporarily abandon calves (Fay et al. 1984) when exposed to sounds from aircraft or vessels. Likewise, in gray whales cow-calf pairs are more sensitive than other age or sex classes to disturbance by whale-watching boats (Tilt 1985), and humpback groups containing at least one calf are more sensitive to vessel traffic than are groups without calves (Bauer et al. 1993).

Marine mammal responses also appear to be affected by the location, motion, and type of onset of a sound source. California sea lions (*Zalophus californianus*) and harbor seals (*Phoca vitulina*) react at greater range from a ship when they are hauled out, and this is also true of walruses (Fay et al. 1984). Bowheads are more responsive to overflights of aircraft when they are in shallow water (Richardson and Malme 1993). Fin whales are more tolerant of a stationary than a moving source (Watkins 1986). Humpback whales are less likely to react to a continuous source than to one with a sudden onset (Malme et al. 1985). In the St. Lawrence River, beluga whales are less likely to change their swimming and diving patterns in the presence of vessels moving at low speed than in the presence of fast-moving boats (Blane and Jaakson 1994). In Alaska, beluga whales feeding on river salmon may stop and move downstream in response to noise from small boats, whereas they are relatively unresponsive to noise from fishing boats (Stewart et al. 1982). In Bristol Bay beluga whales continue to feed even when surrounded by fishing vessels, and they may resist dispersal even when purposely harassed (Fish and Vania 1971).

Few studies document long-term responses to anthropogenic noise by marine mammals. At Guerrero Negro Lagoon in Baja California, shipping and dredging noise associated with a salt works may have induced gray whales to abandon the area through most of the 1960s (Bryant et al. 1984). After ship traffic declined, the lagoon was reoccupied, first by single whales and later by cow-calf pairs. Killer whales (*Orcinus orca*) in the British Columbia region were displaced from Broughton Archipelago during 1993-1999, a period when acoustic harassment devices were in use at existing salmon farms (Morton and Symonds 2002).

Habituation and tolerance of noise

Habituation is the loss of sensitivity to noise over time. The best evidence for habituation of marine mammals to intense sound comes from attempts to use acoustic harassment devices (AHDs) to keep marine mammals away from aquaculture facilities or fishing equipment (Jefferson and Curry 1994). For instance, there is some evidence that harbor seals habituate to AHDs, partly because they modify their swimming behavior to keep their heads out of the water when they are in high-intensity sound fields (Mate and Harvey 1987). Likewise, harbor porpoises have been shown to habituate to gillnet pingers over a span of 10 or 11 days (Cox et al. 2002).

Observations of responses to whale-watching and other vessels also suggest some level of habituation to noise. Near Cape Cod, minke whales (*Balaenoptera acutorostrata)* changed from being attracted to vessels to appearing generally uninterested; fin whales from flight reactions to disinterest, and humpback whales from mixed but usually strongly negative to strongly positive reactions (Watkins 1986). At San Ignacio Lagoon, gray whales become less likely to flee from whale-watching boats as the season progresses (Jones and Swartz 1984).

Habituation does not signify that hearing loss or injury from high-intensity sounds has not occurred. Humpback whales found in Newfoundland remained in a feeding area near where seafloor blasting was being conducted (Todd et al. 1996). Received sound pressure levels at 1 mile from the explosions were typically 145-150 dB re 1µPa at 240-450 Hz, with presumed source levels of 295-300 dB re 1µPa at 1 m. The whales showed no clear reaction to the blasting in terms of behavior, movement, or residence time. However, increased entrapment in nets followed the blast exposure (Todd et al. 1996). In addition, two whales were found dead after a 5000-kg explosion, and examination of the temporal bones of their inner ears revealed significant blast trauma (Ketten et al. 1993). This incident highlights the difficulty of using overt behavioral reactions to monitor marine mammal harassment by noise or high intensity sound.

Incidents of Mass Stranding Associated with High-Intensity Sound

On several occasions multiple-animal strandings have been associated with the use of high-intensity sonar during naval operations and airguns during seismic reflection profiling. Most of these incidents involved Cuvier's beaked whales (*Ziphius cavirostris)*. At many of these sites, Cuvier's beaked whale is not thought to be the most abundant cetacean species present.

Only odontocetes are known to mass strand, that is, to come ashore in groups of two or more animals (Walsh et al. 2001). Mass strandings of beaked whales are relatively rare events. The National Museum of Natural History, Smithsonian Institution (James Mead, pers. comm.) has compiled a global list of *Ziphius cavirostris* strandings involving two or more animals (Table 5). Except for a stranding of two individuals in 1914, there are no records of multiple-animal strandings until 1963. However, from 1960 to 2000, 3 to 10 multi-animal strandings have been recorded per decade.

The first published suggestion of a connection between beaked whale strandings and naval activity was by (Simmonds and Lopez-Jurado 1991). They described a set of three multi-animal strandings associated with naval activity in the Canary Islands in 1985, 1988, and 1989. Additional incidents of beaked whale mass strandings in the Canary Islands were noted in 1986 and 1987. Simmonds and Lopez-Jurado (1991) did not draw a connection between beaked whale mass strandings and the use of ASW sonar, but rather to the nearby presence of naval operations.

The increased incidence of multi-animal beaked whale stranding events indeed may be correlated with the advent of high-intensity sonar. Prototypes of hull-mounted ASW sonars (e.g., SQS-23 and 26) were first tested in 1957 (Gerken 1986) and were deployed on a broad range of naval ships (frigates, cruisers, and destroyers) operated by the United States and other nations beginning in the early 1960s. This timing coincides with increased reports of mass strandings of Cuvier's beaked whales (Table 5). A third (11 of 32) of the documented strandings of *Ziphius cavirostris* strandings are associated with concurrent naval activities.

An examination of the circumstances surrounding mass strandings of beaked whales may help to define their relationship with the use of high-intensity sound. Two such strandings have been documented by investigative reports: the Kryparissiakos Gulf, Greece, incident of May 1996 (D'Amico and Verboom 1998), and the Bahamas incident of March 2000 (Evans and England 2001). Examination of other beaked whale mass strandings provides additional perspective on the diversity of sound sources, environment, and conditions associated with these events.

Table 5. Strandings involving at least two *Ziphius cavirostris* (Zc) from Smithsonian records (James Mead, pers. comm., with author updates). These represent the only known multiple stranding events for *Mesoplodon europaeus* (Me) and *Mesoplodon densirostris* (Md).

Year	Location	Species (numbers)	Correlated Activity
1914	United States (NY)	Zc (2)	
1963	Italy	Zc (15+)	
1965	Puerto Rico	Zc (5)	
1968	Bahamas	Zc (4)	
1974	Corsica	Zc (3), *Stenella coeruleoalba* (1)	Naval patrol
1974	Lesser Antilles	Zc (4)	Naval explosion
1975	Lesser Antilles	Zc (3)	
1980	Bahamas	Zc (3)	
1981	Bermuda	Zc (4)	
1981	United States (AK)	Zc (2)	
1983	Galapagos	Zc (6)	
1985	Canary Islands	Zc (12+), Me (1)	Naval maneuvers
1986	Canary Islands	Zc (5), Me (1)	
1987	Canary Islands	Zc (group), Me (2)	
1987	Italy	Zc (2)	
1988	Canary Islands	Zc (3), Me (1), *Hyperoodon ampullatus* (1), *Kogia breviceps* (2)	Naval maneuvers
1989	Canary Islands	Zc (19+), Me (2), Md (3)	Naval maneuvers
1991	Canary Islands	Zc (2)	Naval maneuvers
1991	Lesser Antilles	Zc (4)	
1993	Taiwan	Zc (2)	
1994	Taiwan	Zc (2)	
1996	Greece	Zc (12)	Navy LFAS trials
1997	Greece	Zc (3)	
1997	Greece	Zc (8)	
1998	Puerto Rico	Zc (5)	
2000	Bahamas	Zc (9), Md (3), ziphiid sp. (2), *Balaenoptera acutorostrata* (2), *Stenella frontalis* (1)	Naval maneuvers
2000	Galapagos	Zc (3)	Seismic airgun
2000	Madeira	Zc (3)	Naval maneuvers
2001	Solomon Islands	Zc (2)	
2002	Canary Islands	Zc (7), Me (2), Md (1), ziphiid sp. (9)	Naval maneuvers
2002	Baja California	Zc (2)	Seismic airgun
2003	Australia	Zc (2+)	Naval maneuvers

Kryparissiakos Gulf, Greece, May 1996

Frantzis (1998) first brought attention to a mass stranding of Cuvier's beaked whales in the Ionian Sea, which coincided with tests of an ASW sonar (LFAS) by the North Atlantic Treaty Organization (NATO). Along 56 km of coastline, 14 *Ziphius cavirostris* stranded during 12–13 May 1996. Twelve of 14 animals stranded alive, with no apparent disease or pathogenic cause. These strandings corresponded with a four-day period (12–16 May) when the vessel *NRV Alliance* was towing an acoustic source in the vicinity. The acoustic source generated both low-frequency and mid-frequency sound at source levels of 226 dB re 1µPa @ 1m. The transmitted low-frequency signal included a 2 sec upsweep at 450-650 Hz, and a 2 sec cw tone at 700 Hz. The mid-frequency signal included a 2 sec upsweep at 2.8-3.2 kHz and a 2 sec tone at 3.3 kHz. Both sources projected horizontally directed beams of sound with vertical beamwidths of about 23 degrees. Three source tows of about 2 hours duration were conducted each day; and the strandings occurred most closely in time with the first two source runs of 12 May (runs 9 and 10, D'Amico and Verboom [1998]) and the last two source runs of 13 May (runs 13 and 14, D'Amico and Verboom [1998]).

The association of stranding locations and acoustic source tracks in space and time is compelling evidence that these animals were affected by the ASW sonar (D'Amico and Verboom 1998). Figure 1 shows the acoustic source tracks and stranding locations for 12 and 13 May. There is a general correlation between the offshore source track locations and the inshore stranding locations. The 13 May source tow track is shifted northward from the 12 May track, and likewise some of the 13 May stranding locations are farther north. Correlation of stranding times and source track locations for 12 May suggests that at least three of the six animals with known stranding times were affected by the 0600-0800 source tow (run 9) as their stranding times precede the 1100-1300 source tow (run 10). Assuming that they were near the source when they were exposed to a high sound level, their swimming distances were approximately 30 nm to reach the shore, covered at speeds of approximately 10 knots. The two strandings in the afternoon of 12 May with known times likewise required swimming distances of 20-30 nm.

Bahamas, March 15 -16, 2000

Sixteen cetaceans were found stranded along the Providence Channel in the Bahamas Islands during a two-day period in March 2000. This mass stranding correlated with a U.S. Navy training exercise using ASW sonar (Evans and England 2001). The stranded animals were predominantly beaked whales (*Z. cavirostris* [9], *Mesoplodon densirostris* [3]), and *Ziphiid* sp. [2]). At least two minke whales (*Balaenoptera acutorostrata)* were also found stranded. One dolphin *(Stenella frontalis)* stranded at a somewhat distant location and may have died of unrelated causes. Eight of the beaked whales died, and the remaining animals were refloated and their fate is unknown. None of these animals has been recognized as restranded or resighted (Balcomb and Claridge 2001). Tissue samples were collected from five of the dead beaked whales. Gross necropsy results suggested that all five were in good body condition; none showed evidence of debilitating disease. Some kind of auditory damage was found in four of the beaked whales examined. Hemorrhages were found in the acoustic fats of the head, the inner ears, and some spaces around the brain, with no evidence of external blunt force trauma. The pattern of injury in the freshest specimens suggested that the ears were structurally intact and the animals were alive at the time of injury (Evans and England 2001).

Four U.S. Navy ships were operating hull-mounted ASW sonars in the area, two SQS-53C and two SQS-56. The SQS-53C sonars were operated at 2.6 and 3.3 kHz with a source level of 235 dB re 1µPa @ 1 m or higher, and 0.5 - 2 sec ping lengths alternating between tones and frequency-modulated sweeps. The SQS-56 sonars were operated at 6.8, 7.5, and 8.2 KHz at 223 dB re 1µPa @ 1 m. Integrated sound exposure levels >160 dB for 10-30 sec were found throughout much of the Providence Channel during 15 March 2000 (Evans and England 2001).

The association of stranding locations and acoustic source tracks in space and time is compelling evidence that these animals were affected by the high-intensity sound sources (Evans and England 2001). The acoustic source tracks and stranding locations are shown in Figure 2, divided into the morning (0700-1100) and afternoon (1200-1430). During the morning two source ships were in the Providence Channel off the southwest end of Abaco Island and moving toward the west, and the other two source ships were entering the channel from the east. A cluster of strandings occurred at the south end of Abaco Island during this

time, at minimum ranges of 10-30 nm from the ships' closest points of approach. During the afternoon, the source ships moved northwestward, approaching Grand Bahama Island. A cluster of noon and afternoon strandings occurred on the south coast of Grand Bahama Island, again with minimum source-to-shore ranges of 20-30 nm. Assuming that these animals received peak sound exposures at locations near the source tracks, then immediately following exposure they would have swum toward the stranding sites at high speed (~ 10 kts). Alternatively, lower exposure levels more distant from the source tracks and closer to the stranding sites would imply slower swim speeds.

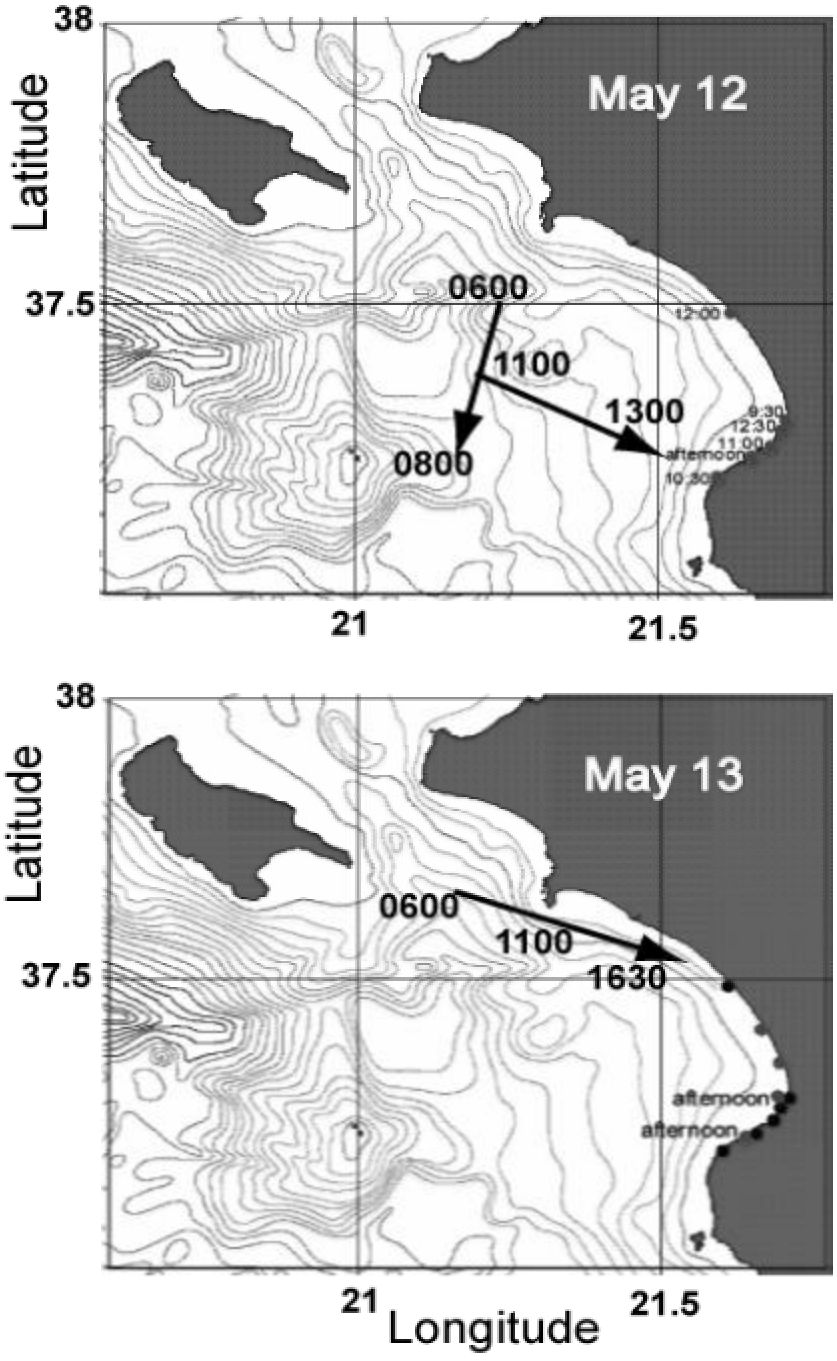

Figure 1. Kyparissiakos Gulf, Greece, *Ziphius cavirostris* stranding locations and acoustic source tracks for 12 May (upper) and 13 May (lower) 1996. Known times are indicated in GMT.

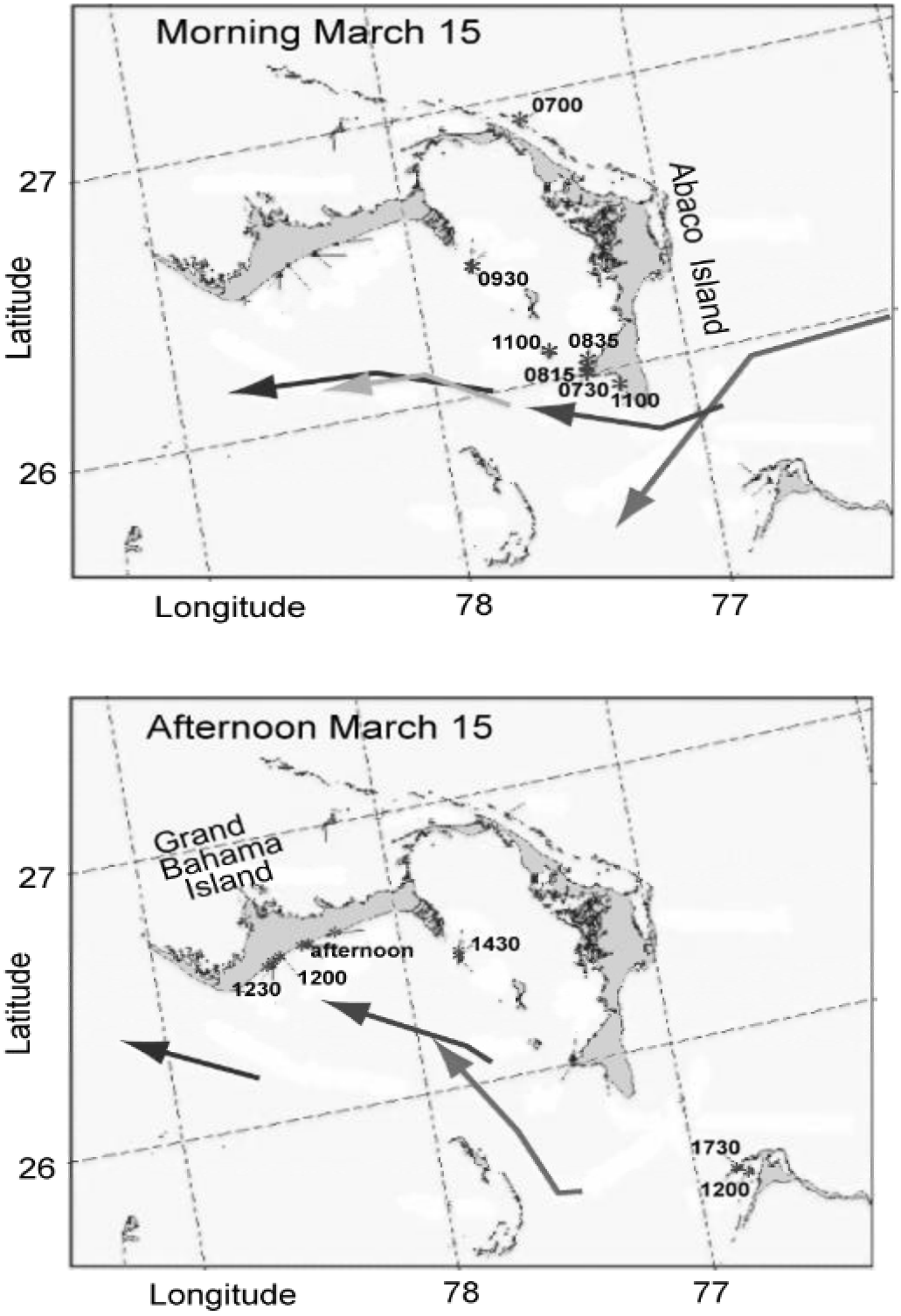

Figure 2. Bahamas strandings locations and acoustic source tracks for 15 March 2000, morning (upper) and afternoon (lower). Known times are indicated in GMT.

Madeira, May 2000

A stranding of three *Ziphius cavirostris* occurred in May 2000 on the Madeira Archipelago, in the northeastern Atlantic (Luis Freitas, Madeira Whale Museum, pers. comm.). The deep-water channel between islands has been the site of repeated observations of live *Z. cavirostris*. The animals that stranded in May 2000 consisted of two subadults (one male, one female) and a female of unknown age. The two subadults were examined and found to have hematomas, eye hemorrhages, pleural hemorrhages, and lesions of the lungs (Luis Freitas, pers. comm.). The third animal was found in an advanced state of decomposition and did not receive a detailed examination. The presence of a NATO exercise was signaled by naval vessels and aircraft in the deep-water channel, coincident with the stranding events. Details of the acoustic sources in use during this exercise are lacking at this time.

Canary Islands, 24 September 2002

A mass stranding of as many as 19 beaked whales occurred on the Canary Islands of Fuerteventura and Lanzarote, associated with naval maneuvers by Spain and other NATO countries on 24–25 September 2002. The stranded animals were predominantly *Ziphius cavirostris* (7), but also included *Mesoplodon europaeus* (2) and *Mesoplodon densirostris* (1). On 24 September a total of 14 animals were found stranded; five were dead, three were alive and subsequently died, and six were pushed back to sea. Five more animals were found dead and in a state of decomposition between 25 and 28 September. It is possible that these included animals that had been pushed out to sea and subsequently stranded . Preliminary necropsy results for six of the beaked whales suggest that they were healthy. The strandings occurred at dawn or in the early morning, and the animals that were found alive all appeared disoriented. Those that were found dead had been feeding recently (Vidal Martín and Antonella Servidio, pers. comm.).

Necropsies and dissections revealed no visible signs of trauma (Antonio Fernández, Universidad de Las Palmas de Gran Canaria). Hemorrhages were observed along acoustic paths and in the brain and spinal cord. All animals were bleeding profusely in the eyes. Multifocal petechial (pinpoint) hemorrhages were observed, similar to decompression sickness. Fat embolism was observed, which could have been responsible for hemorrhages in the macrovascular system. Degeneration (in vivo) of vestibucochlear portions of the ear were noted, specifically, degeneration and resorption of some hair cell bundles and associated nerve fibers. This may suggest a chronic condition, and that some damage to the cochlea had occurred prior to this stranding event.

The strandings occurred along the southeastern coast of the islands of Fuerteventura and Lanzarote. At the time of the 24–25 September strandings, 10 NATO countries — Germany, Belgium, Canada, France, Greece, Norway, Portugal, Britain, Turkey, and the United States — were conducting a multinational naval exercise; however, the acoustic sources employed during the exercise are not known at this time. There have been seven mass strandings of *Z. cavirostris* in the Canary Islands since 1985, and naval exercises have been recorded as associated with five of them (Table 5).

Gulf of California, 24 September 2002

A stranding of two *Ziphius cavirostris* occurred on 24 September 2002 on Isla San Jose in the Gulf of California, Mexico, coincident with seismic reflection profiling by the *R/V Maurice Ewing* operated by Columbia University, Lamont-Doherty Earth Observatory (Malakoff 2002). On 24 September at about 2 to 4 PM local time (2100–2300 GMT), fishermen discovered two live stranded whales and unsuccessfully attempted to push them back out to sea (Jorge Urbán, pers. comm.). A group of marine biologists found the whales dead on 25 September (Barbara Taylor, pers. comm.). By 27 September, when one carcass was necropsied, the advanced state of decomposition did not allow the cause of death to be determined.

On 24September the *R/V Ewing* had been firing an array of 20 airguns with a total volume of 8500 cubic inches. These airguns have an equivalent broadband source level of 256 dB re 1µPa @ 1m, with peak energy frequencies at 40-100 Hz. Source levels at mid-frequencies (1-5 kHz) may be diminished by 20 to 40 dB (Goold and Fish 1998). The airguns were fired with an approximately 20 sec repetition rate (50 m distance between shots). Figure 3 indicates the ship track for 24–25 September; the *R/V Ewing* was on a transect line directed toward the stranding site and reached the closest point-of-approach (within 22 km) at 1400 local time (2100 GMT) range.

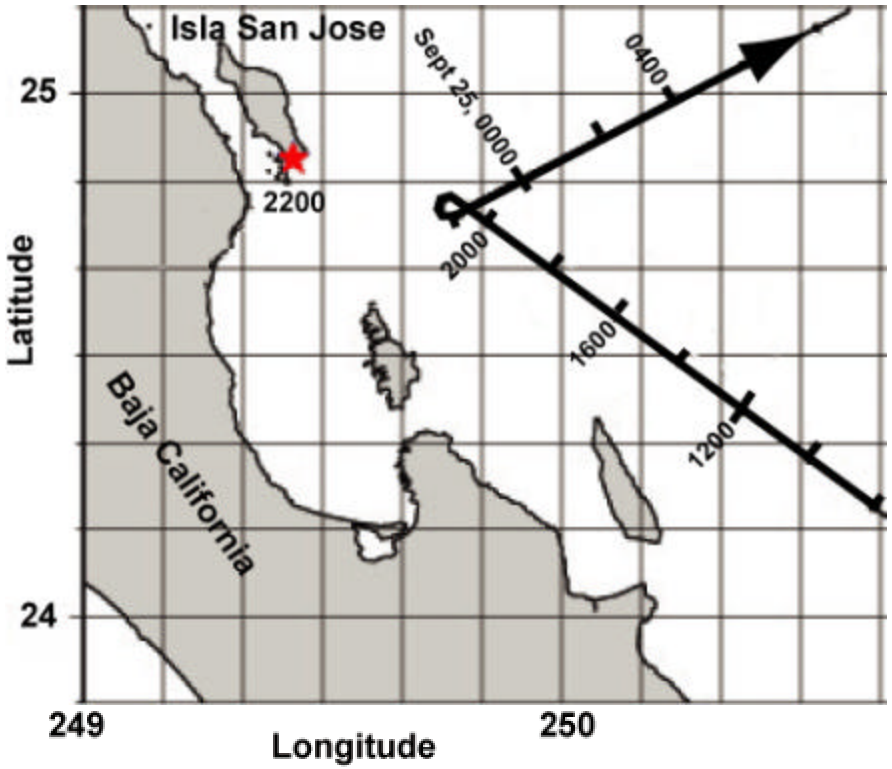

Figure 3. Gulf of California standings location and acoustic source tracks for 24–25 September 2002. Times are indicated in GMT.

Summary of Beaked Whale Stranding Events

Repeated mass strandings of beaked whales following high-intensity sound exposure demonstrate a pattern of events. Cuvier's beaked whales are, by far, the most common species involved in these stranding events; they make up 81 percent of the total number of stranded animals. Other beaked whales (including *Mesoplodon europaeus*, *Mesoplodon densirostris*, and *Hyperoodon ampullatus)* comprise 14 percent of the total, and other species (*Stenella coeruleoalba*, *Kogia breviceps*, and *Balaenoptera acutorostrata*) are sparsely represented. It is not clear whether (a) *Ziphius cavirostris* is more prone to injury from high-intensity sound than other species, (b) its behavioral response to sound makes it more likely to strand, or (c) it is substantially more abundant than the other affected species in the areas and times of the exposures leading to the mass strandings. One, two, or three of these possibilities could apply. In any event, *Ziphius cavirostris* has proven to be the "miner's canary" for high-intensity sound impacts. The simultaneous deployment of naval ASW sonars in the 1960s and the coincident increase in *Ziphius cavirostris* mass strandings suggest that lethal impacts of anthropogenic sound on cetaceans have been occurring for at least several decades.

The settings for these incidents are strikingly consistent: an island or archipelago with deep water nearby, appropriate for beaked whale foraging habitat. The conditions for mass stranding may be optimized when the sound source transits a deep channel between two islands, such as in the Bahamas incident. When exposed to high sound levels, beaked whales rapidly swim to the nearest beach. The animals appear on the beach not as one tight cluster of individuals but rather distributed over miles of coastline. Hypothermia ensues, and the animals die if they are not returned to the sea by human intervention. The fates of those animals that are returned to the sea are unknown. Necropsies of stranded animals suggest internal bleeding in the eyes, ears, and brain, as well as fat embolisms.

The implicated sound levels involve long-duration (~ 1 sec) and high-intensity (235 dB re 1µPa @ 1 m) sonar pings or equivalent airgun blasts. Mid-frequency (1-6 kHz) sound is clearly implicated in the sonar-

induced stranding incidents. It is unclear whether low-frequency sound also causes injury to beaked whales. Although airguns create predominantly low-frequency energy, they also have ample mid-frequency energy, which may be related to the associated injuries.

Research Priorities for Marine Mammal Noise Effects

Almost a decade has passed since the NRC (1994) outlined a set of research priorities for understanding the effect of noise on marine mammals. In most of the areas outlined for study by the NRC (1994) report, we still lack basic understanding. Many of the same research priorities were reiterated by two subsequent NRC (2000, 2003) reports directed at understanding marine mammal noise impacts. The need to conduct most of these noise impact studies in the field, rather than in captive settings, means that it may be many years before a clear understanding of these issues becomes available. There is an additional need to differentiate those effects that are significant to individual animals from those that are significant on a population level. This distinction points to the need for observations that are distributed in space and time, and involve large numbers of cases to create strong statistics. With these issues in mind, Table 6 summarizes key research priorities needed to diminish the uncertainties associated with anthropogenic noise production and the protection of marine mammals.

Table 6. Summary of Research Priorities for the Effect of Noise on Marine Mammals.

Priority	Research Issue
1	Understand the detailed causes of beaked whale mass stranding events
2	Determine behavioral responses to anthropogenic sound
3	Improve tools for marine mammal behavioral observation including acoustic recording tags and passive acoustic methods
4	Develop tools to study marine mammal physiology in the wild including stress indicators and hearing capabilities
5	Characterization of marine mammal populations within areas of high intensity sound generation

Priority 1: Understand the causes of beaked whale mass stranding events

When exposed to high intensity sound levels, beaked whales strand and die in mass. Understanding the causes and consequences of beaked whale mass stranding represents the highest research priority for our community. The sound levels implicated in these events is probably not sufficient to cause permanent hearing threshold shifts. What is the mechanism for damage and/or disturbance? The behavioral reaction is swift, and vigorous on an individual level. The lack of close animal clustering on the beach suggests little or no social component to these stranding, yet the potential for large numbers of stranded animals suggests significance at a population level. What are the source parameters that lead to damage? Is low frequency sound (the primary energy component of airguns) as damaging as mid frequency sound (used by SQS-53 ASW tactical sonars)? What sound pressure exposure level creates damage and/or disturbance? Beaked whale mass stranding events make it abundantly clear that high intensity anthropogenic sound is a threat to marine mammals, yet there are key parameters that we must understand about beaked whale strandings before we can predict the impact of high intensity sound on other species in other settings.

Priority 2: Determine behavioral responses to anthropogenic sound

A key impediment to assessing the biological effects of ocean noise is a continued lack of knowledge about marine mammal behavior in general, and lack of understanding their behavioral response to anthropogenic sound in particular. Behavioral data must be collected in the wild to provide a full picture of the potential

effects. Significant ocean noise effects may be confined to a few individuals exposed at high sound pressure levels, and/or from widespread exposure at a population level. Controlled exposure experiments may be helpful in defining obvious and/or short term impacts to individuals, but may not reveal long term impacts. Discerning population level effects is challenging since the observations must be conducted over broad distances and long time periods. Relating migration and movement to noise level is one potential approach. Do marine mammals systematically avoid habitat areas with high noise levels? More subtle behavioral changes may be associated with exposure to high ambient ocean noise. Is natural sound (e.g. snapping of shrimp) useful for prey location? A better understanding of how and why marine mammals make and use sound would greatly aid or ability to predict how ocean noise might be disruptive to marine mammal behavior. The sound avoidance reaction of marine mammals has been exploited to exclude them from fisheries interactions by acoustic harassment devices, but does their behavioral reaction occur before losses to their hearing? Our lack of understanding marine mammal behavioral reaction to sound is vast and must be addressed in the face of raising ocean noise levels.

Priority 3: Improve tools for marine mammal behavioral observation

Research tools are needed to better observe marine mammal behavior in the wild. These are needed both to characterize normal behaviors and to detect changes in behavior associated with anthropogenic noise. Marine mammal acoustic recording tags are an important technology for detailed behavioral studies in the presence of noise. Technical improvements are needed over current tags to increase their duration of attachment, to expand the volume of stored data and to enhance the suite of available sensors. Tag attachment system improvements are particularly needed for large cetaceans than cannot be captured for tag emplacement. Current non-invasive attachments have limited duration, whereas invasive attachments involve both damage and disturbance to the animal. Technology for passive acoustic tracking of animals is another important component of behavioral study with the potential for future improvement.

Priority 4: Develop tools to study marine mammal physiology in the wild

For many species of marine mammal it is unlikely that large number of individual animals will be kept in captivity for study of their physiology. Tools are needed to study marine mammal physiology in the wild. For instance, indicators of stress may be one way to assess the impact of anthropogenic noise on marine mammals. If stress factors can be measured fromblubber or blood samples, perhaps biopsy of other tissue samples collected in the wild could reveal regional or population-wide stress levels associated with noise. Likewise, without a rapidly deployed field method for determination of hearing capabilities, it will be difficult to collect audiometric data on the full range of marine mammal species and under conditions were chronic noise may have degraded hearing capabilities. The ability to collect audiometric data on beached or ensnared animals would be a first step, particularly useful when high intensity sound may be suspected in the animals' stranding.

Priority 5: Marine mammal populations within areas of high intensity sound generation

Anthropogenic ocean noise sources are primarily concentrated into a few well defined zones: (1) at major commercial ports and along shipping lanes, and (2) within military test and training sites. The marine mammal populations within these zones should be characterized and monitored for potential impact due to anthropogenic noise. A combination of both visual and acoustic monitoring may provide an efficient means for monitoring both marine mammal distributions and ambient noise. These data will further aid efforts to determine if ocean noise is a factor in discouraging habitat use by marine mammals.

REFERENCES

Andrew, R. K., B. M. Howe, J. A. Mercer and M. A. Dzieciuch (2002). Ocean ambient sound: Comparing the 1960's with the 1990's for a receiver off the California coast. Acoustic Research Letters Online **3**(2): 65-70.

Au, W. W., D. A. Carder, R. H. Penner and B. L. Scronce (1985). Demonstration of adaptation in beluga whale echolocation signals. J Acoust Soc Am **77**: 726-730.

Au, W. W. and M. Green (2000). Acoustic interaction of humpback whales and whale-watching boats. Mar Environ Res **49**(5): 469-481.

Au, W. W. L. (1993). The Sonar of Dolphins. New York, Springer-Verlag.

Bacon, S. and D. J. T. Carter (1993). A connection between mean wave height and atmospheric pressure gradient in the North Atlantic. International Journal of Climatology **13**: 423-436.

Baggeroer, A. B., T. G. Birdsall, C. Clark, J. A. Colosi, B. D. Cornuelle, D. Costa, B. D. Dushaw, M. Dzieciuch, A. M. G. Forbes, C. Hill, B. M. Howe, J. Marshall, D. Menemenlis, J. A. Mercer, K. Metzger, W. Munk, R. C. Spindel, D. Stammer, P. F. Worcester and C. Wunsch (1998). Ocean climate change - comparison of acoustic tomography, satellite altimetry, and modeling. Science **281**(5381): 1327-1332.

Balcomb, K. C. I. and D. E. Claridge (2001). A mass stranding of cetaceans caused by naval sonar in the Bahamas. Bahamas J. Sci. **2**: 2-12.

Barlow, J. and G. A. Cameron (2003). Field experiments show that acoustic pingers reduce marine mammal by-catch in the California drift gill net fishery. Mar. Mamm. Sci. **19**(2): 265-283.

Barlow, J. and B. Taylor (1998). Preliminary abundance of sperm whales in the northeastern temperate Pacific estimated from a combined visual and acoustic survey. International Whaling Commission Working Paper **SC/50/CAWS20.**

Bartlett, M. L. and G. R. Wilson (2002). Characteristics of small boat signatures. J Acoust Soc Am **112**: 2221.

Bauer, G. B., J. R. Mobley and L. M. Herman (1993). Responses of wintering humpback whales to vessel traffic. J Acoust Soc Am **94**: 1848.

Beranek, L. L. and I. L. Ver (1992). Noise and Vibration Control Engineering. New York, Wiley and Sons.

Blane, J. M. and R. Jaakson (1994). The impact of ecotourism boats on the St. Lawrence beluga whales. Environmental Conservation **21**: 267-269.

Bordino, P., S. Kraus, D. Albareda, A. Fazio, A. Palmerio, M. Mendez and S. Botta (2002). Reducing incidental mortality of Franciscana dolphin Pontoporia blainvillei with acoustic warning devices attached to fishing nets. Marine Mammal Science **18**(4): 833-842.

Bowles, A. E., M. Smultea, B. Wursig, D. P. DeMaster and D. Palka (1994). Relative abundance and behavior of marine mammals exposed to transmissions from the Heard Island Feasibility Test. J Acoust Soc Am **96**(4): 2469-2484.

Breeding, J. E. J. (1993). Description of a noise model for shallow water: RANDI-III. J Acoust Soc Am **94**: 1920.

Bryant, P. J., C. M. Lafferty and S. K. Lafferty (1984). Reoccupation of Laguna Guerrero Negro, Baja California, Mexico, by gray whales. Pp 375-386 in The Gray Whale *Eschrichtius robustus*. M. L. Jones (ed.), Academic Press,Orlando, Fl.

Caldwell, M. C. and D. K. Caldwell (1965). Individual whistle contours in bottlenosed dolphins (*Tursiops truncatus*). Nature **207**: 434-435.

Calkins, D. G. (1979). Marine Mammals of Lower Cook Inlet and the potential for impact from outer continental shlef oil and gas exploration, development, and transport. Pp 171-263 in Environmental Assessment of the Alaskan Continental Shelf: Final Reports of Principal Investigators, Volume 20. NTIS PB85-201226. (ed.), NOAA,Juneau, AK.

Cato, D. H. and R. D. McCauley (2002). Australian research in ambient sea noise. Acoustic Australia **30**: 13-20.

Chang, E. F. and M. M. Merzenich (2003). Environmental noise retards auditory cortical development. Science **300**: 498-502.

Commander_Naval_Air_Warfare_Center (1994). "Marine Mammal Protection/Mitigation and Results Summary for the Shock Trial of the USS John Paul Jones (DDG 53). Naval Air Warfare Center, Weapons Division, 521 9th St., Point Mugu, CA 93042-5001. Prepared for: The Assistant Administrator for Fisheries, National Oceanic and Atmospheric Administration, US Department of Commerce, 1335 East-West Highway, Silver Spring, MD 20910. 26 + Appendix pp.

Cox, T. M., A. J. Reed, A. Solow and N. Treganza (2002). Will harbour porpoises, *Phocoena phocoena*, habituate to pingers? Journal of Cetacean Research and Management **3**(81-86).

Culik, B. M., S. Koschinski, N. Treganza and G. M. Ellis (2001). Reactions of harbour porpoises *Phocoena phocoena* and herring *Clupea harengus* to acoustic alarms. Marine Ecology Progress Series **211**: 255-260.

D'Amico, A. and W. C. Verboom (1998). Summary record of the SACLANTCEN Bioacoustics Panel, La Spiezia, 15-17 June 1998. SACLANT Undersea Research Center 72 pp.

Dao, J. (2003) Waterways declared nearly clear of mines NEW YORK TIMES Mar. 28, 2003.

Diachok, O. I. and R. S. Winokur (1974). Spatial variability of underwater ambient noise at the Arctic ice-water boundary. J Acoust Soc Am **55**(4): 750-753.

Ding, W., B. Wursig and W. E. Evans (1995). Comparisons of whistles among seven odontocete species. Pp in Sensory Systems of Aquatic Mammals. R. A. Kastelein (ed.), De Spil Publishers,Woerden, Netherlands.

Dragoset, W. (1984). A comprehensive method for evaluating the design of air guns and air gun arrays. Geophysics: The Leading Edge of Exploration **3**(10): 52-61.

Dragoset, W. (2000). Introduction to air guns and air-gun arrays. Geophysics: The Leading Edge of Exploration **19**: 892-897.

Dubrovsky, N. A. and S. V. Kosterin (1993). Noise in the ocean caused by lightning strokes. Pp 697-709 in Natural Physical Sources of Underwater Sound. B. R. Kerman (ed.), Kluwer

Edds, P. L. (1988). Characteristics of finback *Balenoptera physalus* vocalizations in the St. Lawrence Estuary Canada. Bioacoustics **1**: 131-150.

Emery, L., M. Bradley and T. Hall (2001). Data Base Description (DBD) for the Historical Temporal Shipping Data Base (HITS), Version 4.0, PSI Tech. Rep. TRS-301. Planning Systems Incorporated, Slidell, LA 35 pp.

Erbe, C. (2000). Detection of whale calls in noise: Performance comparison between a beluga whale, human listeners, and a neural network. Journal of the Acoustical Society of America **108**(1): 297-303.

Erbe, C. (2002). Underwater noise of whale-watching boats and potential effects on killer whales (Orcinus orca), based on an acoustic impact model. Marine Mammal Science **18**(2): 394-418.

Erbe, C. and D. M. Farmer (1998). Masked hearing thresholds of a beluga whale (Delphinapterus leucas) in icebreaker noise. Deep-Sea Research Part II-Topical Studies in Oceanography **45**(7): 1373-1388.

Erbe, C. and D. M. Farmer (2000). Zones of impact around icebreakers affecting beluga whales in the Beaufort Sea. J Acoust Soc Am **108**(3 Pt 1): 1332-1340.

Erbe, C., A. R. King, M. Yedlin and D. M. Farmer (1999). Computer models for masked hearing experiments with beluga whales (Delphinapterus leucas). J Acoust Soc Am **105**(5): 2967-2978.

Evans, D. L. and G. R. England (2001). Joint Interim Report Bahamas Marine Mammal Stranding Event of 14-16 March 2000. Washington, D.C., US Department of Commerce and US Navy, available at: www.nmfs.noaa.gov/prof_res/overview/Interim_Bahamas_Report.pdf.

Fay, F. H., B. P. Kelley, P. H. Gehnrigh, J. L. Sease and A. A. Hoover (1984). Modern populations, migrations, demography, tropics, and historical status of the Pacific walrus. Pp 231-376 in Environmental Assessment of the Alaskan Continental Shelf: Final Reports of Principal Investigators, Volume 37. OCS Study MMS 86-0021. NTIS PB87-107546 (ed.), NOAA,Anchorage, AK.

Finneran, J. J., C. E. Schlundt, R. Dear, D. A. Carder and S. H. Ridgway (2002). Temporary shift in masked hearing thresholds in odontocetes after exposure to single underwater impulses from a seismic watergun. J Acoust Soc Am **111**(6): 2929-2940.

Fish, J. F. and C. W. Turl (1976). Acoustic source levels of four species of small whales. U.S. Naval Undersea Center, San Diego, CA,NUC TP 547. NTIS AD-A037620**:** 14 pp.

Fish, J. F. and J. S. Vania (1971). Killer whale, *Orcinus orca*, sounds repel white whales, *Delphinapterus leucas*. Fishery Bulletin **69**: 531-535.

Frantzis, A. (1998). Does acoustic testing strand whales? Nature **392**(6671): 29.

Gerken, L. (1986). ASW versus Submarine Technology Battle. Chula Vista, CA, American Scientific Corp.

Goold, J. C. and P. J. Fish (1998). Broadband spectra of seismic survey air-gun emissions, with reference to dolphin auditory thresholds. Journal of the Acoustical Society of America **103**(4): 2177-2184.

Gordon, J. C. D., J. N. Matthews, S. Panigada, A. Gannier, F. J. Borsani and G. Notarbartolodisciara (2000). Distribution and relative abundance of striped dolphins in the Ligurian Sea Cetacean Sanctuary: results from an acoustic collaboration. Journal of Cetacean Research and Management **2**: 27-36.

Graham, N. E. and H. F. Diaz (2001). Evidence for intensification of North Pacific winter cyclones since 1948. Bulletin of the American Meteorological Society **82**: 1869-1893.

Gray, L. M. and D. S. Greeley (1980). Source level model for propeller blade rate radiation for the world's merchant fleet. J Acoust Soc Am **67**(2): 516-522.

Greene, C. R. J. and S. E. Moore (1995). Man-made Noise. Pp 101-158 in Marine Mammals and Noise. W. J. Richardson, C. R. J. Greene, C. I. Malme and D. H. Thomson (ed.), Academic Press,San Deigo.

Hartman, D. S. (1979). Ecology and behavior of the manatee (*Trichechus manatus*) in Florida. Am. Soc. Mammal., Spec Publ. 5: 153 p.

Howe, B. M. (1996). Acoustic Thermometry of Ocean Climate (ATOC): Pioneer Seamount Source Installation. Tech Memo Applied Physics Laboratory, University of Washington, Seattle, WA,TM 3-96**:** pp.

Janik, V. M. (2000). Source levels and the estimated active space of bottlenose dolphin (Tursiops truncatus) whistles in the Moray Firth, Scotland. Journal of Comparative Physiology A-Sensory Neural & Behavioral Physiology **186**(7-8): 673-680.

Jefferson, T. A. and B. E. Curry (1994). Review and evaluation of potential acoustic methods of reducing or eliminating marine mammal-fishery interactions. Marine Mammal Research Program, Texas A&M University, for the U.S. Marine Mammal Commission, Washington, D.C., College Station, TX,NTIS PB95-100384**:** pp.

Johnson, J. (2002). Final Overseas Environmental Impact Statement and Environmental Impact Statement for Surveillance towed Array Sensor Sytem Low Frequency Active (SURTASS LFA) Sonar, Vols. 1 and 2.pp.

Johnston, D. W. (2002). The effect of acoustic harassment devices on harbour porpoises (Phocoena phocoena) in the Bay of Fundy, Canada. Biological Conservation **108**(1): 113-118.

Jones, M. L. and S. L. Swartz (1984). Demography and phenology of gray whales and evaluation of whale-watching activities in Laguna San Ignacio, Baja California sur, Mexico. Pp 309-374 in The Gray Whale (*Eschrichtius robustus*). M. L. e. a. Jones (ed.), Academic Press,Orlando, FL.

Kamminga, C. (1988). Echolocation signal types of odontocetes. Pp 9-22 in Animal Sonar Processes and Performance. P. E. Nachtigall and P. W. B. Moore (ed.), Plenum Press,New York.

Kastak, D. and R. J. Schusterman (1998). Low-frequency amphibious hearing in pinnipeds - methods, measurements, noise, and ecology. Journal of the Acoustical Society of America **103**(4): 2216-2228.

Ketten, D. R., J. Lien and S. Todd (1993). Blast injury in humpback whale ears: Evidence and implications. J Acoustic Soc Am**94**: 1849-1850.

Ketten, D. R. and D. Wartzok (1990). Three-dimensional resonstructions of the dolphin ear. Pp 81-105 in Sensory Abilities of Cetaceans, Laboratory and Field Evidence. J. A. Thomas and R. A. Kastelein (ed.), Plenum Press,New York.

Knudsen, V. O., R. S. Alford and J. W. Emling (1948). Underwater ambient noise. J Marine Res **7**: 410-429.

Kraus, S., A. J. Read, A. Solow, K. Baldwin, T. Spradlin, E. Anderson and J. Williamson (1997). Acoustic alarms reduce porpoise mortality. Nature **388**: 525.

Larsen, F. (1997). The effects of acoustic alarms on the by-catch of harbour porpoises in bottom set gill nets. Danish Institute for Fisheries Research Report No 44-97pp.

Leaper, R., O. Chappell and J. Gordon (1992). The development of practical techniques for surveying sperm whale populations acoustically. Report of the International Whaling Commission **42**: 549-560.

Lesage, V., C. Barrette, M. C. S. Kingsley and B. Sjare (1999). The effect of vessel noise on the vocal behavior of belugas in the St. Lawrence River Estuary. Marine Mammal Science **15**: 65-84.

Loughrey, A. G. (1959). Preliminary investigations of the Atlantic walrus, *Odobenus rosmarus rosmarus (Linnaeus)*. Canadian Wildlife Service Wildlife Management Bulletin Series 1, Number 14: 123.

Madsen, P. T. and B. Mohl (2000). Sperm whales (Physeter catodon L. 1758) do not react to sounds from detonators. J Acoust Soc Am **107**(1): 668-671.

Malakoff, D. (2002). Suit ties whale deaths to research cruise. Science **298**: 722-723.

Malme, C. I., P. R. Miles, C. W. Clark, P. Tyack and J. E. Bird (1984). Investigations on the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior. Phase II: January 1984 migration. BBN Laboratories Inc., Cambridge, MA for U.S. Minerals Management Service, Washington, D. C,BBN Report 5586, NTIS PB86-218377**:** pp.

Malme, C. I., P. R. Miles, P. Tyack, C. W. Clark and J. E. Bird (1985). Investigation of the potential effects of underwater noise from petroleum industry activities on feeding humpback whale behavior. BBN Laboratories Inc., Cambridge, MA for U.S. Minerals Management Service, Anchorage, AK,BBN Report 5851, NTIS PB86-218385**:** pp.

Mate, B. R. and J. T. Harvey (1987). Acoustical deterrents in marine mammal conflicts with fisheries. Oregon State University Sea Grant College Program, Corvallis, OR,ORESU-W-86-001**:** 116 pp.

Maybaum, H. L. (1993). Responses of humpback whales to sonar sounds. J Acoustic Soc Am **94**: 1848-1849.

Mazzuca, L. L. (2001). Potential Effects of Low Frequency Sound (LFS) from Commercial Vessels on Large Whales. Master of Marine Affairs, University of Washington**:** 70 pp.

McCarthy, E. and J. H. Miller (2002). Is anthropogenic ambient noise in the ocean increasing? J Acoustic Soc Am **112**(5): 2262.

McDonald, M. A., J. Calambokidis, A. M. Teranishi and J. A. Hildebrand (2001). The acoustic calls of blue whales off California with gender data. J Acoust Soc Am **109**(4): 1728-1735.

Miller, P. J., N. Biassoni, A. Samuels and P. L. Tyack (2000). Whale songs lengthen in response to sonar. Nature **405**(6789): 903.

Milne, A. R. (1967). Sound propagation and ambient noise under sea ice. Pp 120-138 in Underwater Acoustics. V. M. Albers (ed.), Plenum Press,New York.

Mohl, B., M. Wahlberg, P. T. Madsen, L. A. Miller and A. Surlykke (2000). Sperm whale clicks: directionality and source level revisited. J Acoust Soc Am **107**(1): 638-648.

Morrison, E. (2000). Fast Ships: improving marine transportation to further propel logistic systems. The Voyager International (http://translog.seta.com/voyager/VoyagerSep2000.pdf) **2**(3): 1-6.

Morton, A. B. and H. K. Symonds (2002). Displacement of *Orcinus orca* (L.) by high amplitude sound in British Columbia. ICES Journal of Marine Science **9**: 1-9.

Norris, K. S., G. W. Harvey, L. A. Burzell and D. K. Kartha (1972). Sound production in the freshwater porpoise *Sotalia cf. fluviatilis* Gervais and Deville and *Inia geoffrensis* Blainville in the Rio Negro Brazil. Investigations on Cetacea **4**: 251-262.

National Research Council (1994). Low-Frequency Sound and Marine Mammals: Current Knowledge and Research Needs. National Academy Press, Washington, D. C.pp.

National Research Council (2000). Marine Mammals and Low-Frequency Sound. National Academy Press, Washington, D. C.pp.

National Research Council (2003). Potental Impacts of Ambient Noise in the Ocean on Marine Mammals. National Academy Press, Washington, D. C.pp.

Nystuen, J. A. and D. M. Farmer (1987). The influence of wind on the underwater sound generated by light rain. J Acoust Soc Am **82**: 270-274.

Olesiuk, P. F., L. M. Nichol, M. J. Sowden and J. K. B. Ford (2002). Effect of the sound generated by an acoustic harassment device on the relative abundance and distribution of harbor porpoises (Phocoena phocoena) in retreat passage, British Columbia. Marine Mammal Science **18**(4): 843-862.

Payne, R. and D. Webb (1971). Orientation by means of long range acoustic signaling in baleen whales. Ann N Y Acad Sci **188**: 110-141.

Potter, J. R. (1994). ATOC: Sound policy or enviro-vandalism? Aspects of a modern mediafueled policy issue. Journal of Environment and Development **3**: 47-76.

Rendell, L. E. and H. Whitehead (2003). Vocal clans in sperm whales (Physeter macrocephalus). Proceedings of the Royal Society of London Series B-Biological Sciences **270**(1512): 225-231.

Richardson, W. J., C. R. J. Greene, C. I. Malme and D. H. Thomson (1995). Marine Mammals and Noise. San Diego, Academic Press.

Richardson, W. J. and C. Malme, I, (1993). Man-made noise and behavioral responses. Pp in The Bowhead Whale. J. J. e. a. Burns (ed.), Society for Marine Mammology,Lawrence, KS.

Ridgway, S., D. A. Carder, R. R. Smith, T. Kamolnick, C. E. Schlundt and W. Elsberry (1997). Behavioral responses and temporary shift in masked hearing threshold of bottlenose dolphins *Tursiops truncatus*, to 1-second tones of 141 to 201 dB *re:* 1 *mu* Pa. NRAD, RDT&RE Div., Naval Command, Control & Ocean Surveillance Center, San Diego, CA,Tech. Rep. 1751**:** pp.

Ross, D. G. (1987). Mechanics of Underwater Noise. Los Altos, CA, Peninsula Publishing.

Ross, D. G. (1993). On ocean underwater ambient noise. Acoustics Bulletin **January/February**: 5-8.

Rossby, T., D. Dorson and J. Fontaine (1986). The RAFOS system. J. Atmos. Oceanic Tech **3**: 672-679.

Sandegren, F. E., E. W. Chu and J. E. Vandevere (1973). Maternal behavior in the California sea otter. J. Mammal. **54**(3): 668-679.

Schreiner, A. E., C. G. Fox and R. P. Dziak (1995). Spectra and magnitudes of t-waves from the 1993 earthquake swarm on the juan de fuca ridge. Geophysical Research Letters **22**(2): 139-142.

Schreiner, H. F. J. (1990). The RANDI-PE noise model. Proc. IEEE Oceans 90, 576-577.

Simmonds, M. P. and L. F. Lopez-Jurado (1991). Whales and the military. Nature **351**: 448.

Spiess, F. N., J. Northrup and E. W. Werner (1968). Locations and enumeration of underwater explosions in the North Pacific. J Acoust Soc Am **43**(3): 640-641.

Stewart, B. S., W. E. Evans and F. T. Awbrey (1982). Effects of man-made waterborne noise on behavior of belukha whales (*Delphinapterus leucas*) in Bristol Bay, Alaska. Hubbs/Sea World Research Institute for the U.S. National Oceanic and Atmospheric Administration, Juneau, AK, San Diego, CA,HSWRI Technical Report 82-145**:** 29 pp.

Thomas, J. A. and V. B. Kuechle (1982). Quantitative analysis of weddell seal (*Leptonychotes weddelli*) underwater vocalizations at McMurdo Sound, Antarctica. J Acoust Soc Am **72**(6): 1730-1738.

Thomas, J. A. and C. W. Turl (1990). Echolocation characteristics and range detection threshold of a false killer whale *Pseudorca crassidens.* Pp 321-334 in Sensory Abilities of Cetaceans: Laboratory and Field Evidence. J. A. Thomas and R. A. Kastelein (ed.), Plenum Press,New York.

Tilt, W. C. (1985). Whales and whalewatching in North America with special emphasis on the issue of harassment. New Haven, CT, Yale School of Forestry and Environmental Studies.

Todd, S., P. Stevick, J. Lien, F. Marques and D. R. Ketten (1996). Behavioral effects of exposure to underwater explosions in humpback whales (*Megaptera novaeangliae)*. Canadian Journal of Zoology **74**: 1661-1672.

Tyack, P. L. (2000). Functional aspects of cetacean communication. Pp 270-307 in Cetacean Societies: Field Studies of Dolphins and Whales. J. Mann (ed.), University of Chicago Press,Chicago.

Tyack, P. L. and C. W. Clark (1998). Quick-look report: Playback of low-frequency sound to gray whales migrating past the central California coast. Unpublished Report.pp.

Vinther, M. (1999). Bycatches of harbour porpoises (Phocoena phocoena L.) in Danish set-net fisheries. Journal of Cetacean Research & Management. **1**(2): 123-135.

Wagstaff, R. A. (1973). RANDI: Research ambient noise directionality model. Naval Undersea Center, Tech. Pub. 349 pp.

Walsh, M. T., R. Y. Ewing, D. K. O'Dell and G. D. Bossart (2001). Mass stranding of cetaceans. Pp 83-96 in CRC Handbook of Marine Mammal Medicine. L. A. Dierauf and F. M. D. Gulland (ed.), CRC

Wartzok, D., S. Sayegh, H. Stone, J. Barchak and W. Barnes (1992). Acoustic tracking system fo rmonitoring under-ice movements of polar seals. J Acous Soc Am **92**(2): 682-687.

Wartzok, D., W. A. Watkins, B. Wursig and C. I. Malme (1989). Movements and behaviors of bowhead whales in response to repeated exposures to noises associated with industrial activities in the Beaufort Sea. Report from Purdue University for Amoco Production Company, Anchorage, AK 228 pp.

Watkins, W. A. (1977). Acoustic behavior of sperm whales. Oceanus **20**(2): 50-58.

Watkins, W. A. (1986). Whale reactions to human activities in Cape Cod waters. Marine Mammal Science **2**: 251-262.

Watkins, W. A., K. E. Moore and P. Tyack (1985). Sperm whale acoustic behaviors in the southeast Caribbean. Cetology **49**: 1-15.

Watkins, W. A. and G. C. Ray (1985). In-air and underwater sounds of the Ross seal, *Ossmatophoca rossi*. J Acous Soc Am **77**(4): 1598-1600.

Watkins, W. A. and W. E. Schevill (1974). Listening to Hawaiian spinner porpoises (*Stenella cf. longirostris*) with a three-dimensional hydrophone array. Journal of Mammology **55**: 319-328.

Watkins, W. A. and W. E. Schevill (1975). Sperm whale codas. J Acoustic Soc Am **26**: 1485-1490 + phono record.

Watkins, W. A. and D. Wartzok (1985). Sensory biophysics of marine mammals. Marine Mammal Science **1**: 219-260.

Wenz, G. M. (1962). Acoustic ambient noise in the ocean: spectra and sources. J Acoustic Soc Am **34**: 1936-1956.

Wenz, G. M. (1969). Low-frequency deep-water ambient noise along the Pacific Coast of the United States. Jounral of Underwater Acoustics **19**: 423-444, recently declassified.

Wilson, O. B. J., S. N. Wolf and F. Ingenito (1985). Measurements of acoustic ambient noise in shallow water due to breaking surf. J Acoust Soc Am **78**(1): 190-195.

Interaction Assessment

TGS-NOPEC Geophysical Company ASA, Petroleum Geo-Services and Multi Klient Invest AS (TGS/PGS/MKI) Northeastern Canada 2D Seismic Exploration Survey.

Prepared by: NEXUS Coastal Resource Management

August 22, 2013

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Introduction

Multi Klient Invest AS (MKI) contracted NEXUS Coastal Resource Management (NEXUS) to complete an assessment of the interaction of several marine mammals and MKIs proposed 2D seismic survey in Baffin Bay and Davis Strait. This assessment will be used to inform MKIs acquisition plan for the proposed seismic survey. This assessment includes the following 'species of interest': narwhal, beluga whale, bowhead whale, walrus, bearded seal, ringed seal and harp seal.

This report is limited to a general discussion of migration trends to inform the planning of MKIs proposed Baffin Bay and Davis Strait seismic program. It is not meant to be a definitive assessment of the migration routes of the species of interest. As well, the Proponent cannot guarantee that a species will or will not be found in the survey area outside of the times discussed in this report.

Information to inform the preparation of this report was obtained from government, research and organizational studies and reports. The studies and reports were published from 1980 to 2013 and include a range of methodologies (satellite tracking, workshops, aerial surveys, etc). Due to the lack of documented information on whale, seal and walrus migration routes, the interaction maps include only documented summer and winter habitat ranges near the survey area.

Methodology

Interaction maps of the proposed survey lines (total plan, year 1, year 2 and year 3) in relation to marine mammal habitat ranges (interaction maps) in the survey area were produced. MKI provided maps of their proposed survey plan which served as base-map to create the interaction maps.

Narwhal, beluga and bowhead whales, walrus and bearded, ringed and harp seal habitat ranges were discerned and digitized from sources. NEXUS contacted the lead authors in each report that was included in the analysis and requested a higher quality image to be used in creating the maps. The images were digitized using Arc GIS to create digital layers that were placed over the base-map. As a result of the varying amount of geographic detail in the PDFs used to prepare the interaction maps, the margin of error is between 375m to 5km.

Supplementary Report II (TGS/PGS/MKI, 2013) and the Environmental Assessment (LaPierre et al., 2011) provide a complete description of the papers and reports used in preparing the interaction maps and analysis. Twenty interaction maps were created. Interaction maps were created for each species of interest (5) for the proposed survey lines (4).

Results

The following papers and reports were used to prepare the interaction maps and accompanied summaries:

Narwhal

- Dietz, R., Heide-Jørgensen, M.P., Richard, P.R. and M. Acquarone. (2001). Summer and fall movements of narwhals (Monodon monoceros) from Northeastern Baffin Island towards Northern Davis Strait. Arctic, 54(3): 244-261.
- Heide-Jørgensen, M.P., Dietz, R., Laidre, K.L., Richard, P., Orr, J. and H.C. Schmidt. (2003). The migratory behaviour of narwhals (Monodon monoceros). Canadian Journal of Zoology, 81: 1298-1305.
- Dietz, R., Heide-Jørgensen, M.P., Richard, P., Orr, J., Laidre, K., and H.C. Schmidt. (2008). Movements of narwhals (Monodon monoceros) from Admiralty Inlet monitored by satellite telemetry. Polar Biology, 31: 1295-1306.
- Nunavut Planning Commission (2009). State of Knowledge in Maps. Nunavut Planning Commission. 28p.
- Heide-Jørgensen, M.P., Richard, P.R., Dietz, R., Laidre, K.L. (2013). A metapopulation model for Canadian and West Greenland Narwhals. Animal Conservation, 16:331-343.

Beluga whales

- North Atlantic Marine Mammal Commission. (n.d.) Status of Marine Mammals in the North Atlantic: The Beluga Whale. North Atlantic Marine Mammal Commission. Tromsø, Norway. 12p.
- DFO. (2002). Cumberland Sound Beluga. Stock Status Report. E5-32(2002).
- Heide-Jørgensen, M.P., Richard, P., Dietz, R., Laidre, K.L., Orr, J. and H.C. Schmidt. (2003). An estimate of the fraction of belugas (Delphinapterus leucas) in the Canadian high Arctic that winter in Greenland. Polar Biology, 26: 318-326.
- COSEWIC. (2004). COSEWIC assessment and update status report on the beluga whale Delphinapterus leucas in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Ix + 70p.
- DFO. (2009). Stock definition of Belugas and Narwhals in Nunavut. DFO Canadian Science Advisory Secretariat. Science Advisory Report 2009/079.
- Nunavut Planning Commission (2009). State of Knowledge in Maps. Nunavut Planning Commission. 28p.
- Richard, P.R. (2010). Stock definition of belugas and narwhals in Nunavut. Canadian Science Advisory Secretariat. 2010/22.18p.

Bowhead whales

- Reeves, R., Mitchell, E., Mansfield, A. and M. McLaughlin. (1983). Distribution and Migration of the Bowhead Whale, Balaena mysticetes, in the Eastern North American Arctic. Arctic, 36(1): 5-64.

- Nunavut Wildlife Management Board. (2000).Final report of the Inuit Bowhead Knowledge Study. Nunavut Wildlife Management Board, Iqaluit, NU. 101p.
- Nunavut Planning Commission (2009). State of Knowledge in Maps. Nunavut Planning Commission. 28p.
- Ferguson, S.H., Dueck, L., Loseto, L.L. and S.P. Luque. (2010). Bowhead whale Balaena mysticetes seasonal selection of sea ice. Marine Ecology Progress Series, 411: 285-297.
- Wheeler, B., Gilbert, M. and S. Rowe. (2012). Definition of critical summer and fall habitat for bowhead whales in the eastern Canadian Arctic. Endangered Species Research, 17: 1-16.

Walrus

- Born, E.W., Gjertz, I and R.R. Reeves. (1995). Population assessment of Atlantic walrus (Obdenus rosmarus rosmarus). Meddelelser Nr. 138. Oslo: Norsk Polar Institute. 100p.
- COSEWIC. (2006). COSEWIC assessment and update status report on the Atlantic walrus Odobenus roasmarus rosmarus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Ix+65p. (www.sararegistry.gc.ca/status/status_e.cfm)
- Stewart, R. (2008). Redefining Walrus Stocks in Canada. Arctic, 61(3): 292-308.
- Nunavut Planning Commission (2009). State of Knowledge in Maps. Nunavut Planning Commission. 28p.

Seals: bearded, ringed and harp

- Kovacs, K.M. (n.d.). Background document for development of a circumpolar ringed seal (Phoca hispida) monitoring plan. Retrieved June 19, 2013 from http://www.arlis.org/docs/vol1/D/778551575.pdf
- Finley, K.J. and W.E. Renaud. (1980). Marine Mammals Inhabiting the Baffin Bay North Water in Winter. Arctic, 30(4): 724-738.
- Finley, K.J. and C.R. Evans. (1983). Summer Diet of the Bearded Seal (Erignathus barbatus) in the Canadian High Arctic. Arctic, 36(1): 82-89
- Finley, K.J., Miller, G.W., Davis, R.A. and W.R. Koski. (1983). A distinctive large breeding population of ringed seals (Phoca hispida) inhabiting the Baffin Bay pack ice. Arctic, 36(2): 162-173.
- Born, E.W., Teilmann, J., Acquarone, M. and F.F. Riget. (2004). Habitat use of Ringed Seals (Phoca hispida) in the North Water Area (North Baffin Bay). Arctic, 57(2): 129-142.
- Shell. (2013). Shell Greenland A/S 2013 Site Survey in Baffin Bay Blocks 5 (Anu) and 8 (Napu). Preliminary Environmental Impact Assessment
- Nunavut Planning Commission (2009). State of Knowledge in Maps. Nunavut Planning Commission. 28p.

Migration Routes

The following summarizes the known migration routes (if applicable) for the species of interest from the articles and reports listed in the methodology. When applicable, discussion focused on individual stocks of the population.

- **Narwhal**: All three narwhal stocks leave their summering grounds located around Lancaster Sound from the middle of September to the middle of October to migrate to their wintering grounds.
    - Somerset Island stock: Narwhal begin their migration in early October east through Lancaster Sound directly offshore to their wintering grounds in Northern Baffin Bay in early November. Some narwhal continue their migration to the west coast of Greenland.
    - Eclipse Sound stock: Narwhal migrate east through Lancaster Sound continuing south along the coast of Baffin Island, arriving near Qikiqtarjuaq and Pangnirtung in October/November. Narwhal from this stock remain close to the coast stopping in fjords and bays on their fall migration. The whales then head offshore to Baffin Bay to their wintering ground in Southern Baffin Bay.
    - Admiralty Inlet stock: Narwhal migrate east through Lancaster Sound, then south along the eastern coast of Baffin Island within 100km of the land. Once narwhal reach Clyde River and Qikiqtarjuaq in October, they migrate offshore to their wintering ground in Southern Baffin Bay.
- **Beluga whale**
    - Cumberland Sound stock: Beluga whales remain in Cumberland Sound year round. During the winter, belugas can be found in the fjords of Cumberland Sound, while in the summer, belugas are located at the mouth of Cumberland Sound.
    - Western-Northern-Southern Hudson Bay stock: Beluga whales from this stock appear to migrate east through the Hudson Strait and north along Baffin Island and are hunted in Iqaluit and Kimmirut.
- **Bowhead**
    - Davis Strait- Baffin Bay population: Bowhead whales summer in the High Arctic take one of two migration paths to their wintering grounds. Bowhead whale fall migration begins in September or October when some bowhead whales begin their migration south along the east coast of Baffin Island, while other whales cross northern Baffin Bay and arrive near Upernavik, Greenland. It is at this time that large congregations of bowhead whales may occur in Cumberland Sound.
- **Walrus**
    - Northern Hudson Bay-Hudson Strait- Southeastern Baffin Island- Northern Labrador stock: Walrus generally remain close to land or within proximity to sea ice in the summer. There is a suspected migration corridor for walrus between Qikiqtarjuaq and Greenland. We do not know what time of year walrus migrate between Qikiqtarjuaq and Greenland.

- **Bearded Seal**
    - Bearded seals spend a large portion of the summer in coastal areas and in the many fjords and bays within and around Baffin Island and Ellesmere Island. They have been known to spend time in deeper waters.
- **Ringed Seal**
    - During the summer months, ringed seals can either be found near the coast of Baffin Island or offshore in northern Baffin Bay and the North Water. There may be two populations of ringed seals with one group preferring coastal fast ice, while the other prefers offshore pack ice.
- **Harp Seal**
    - Harp seals are located throughout Baffin Bay.

Interaction Maps: Total Program

Narwhal

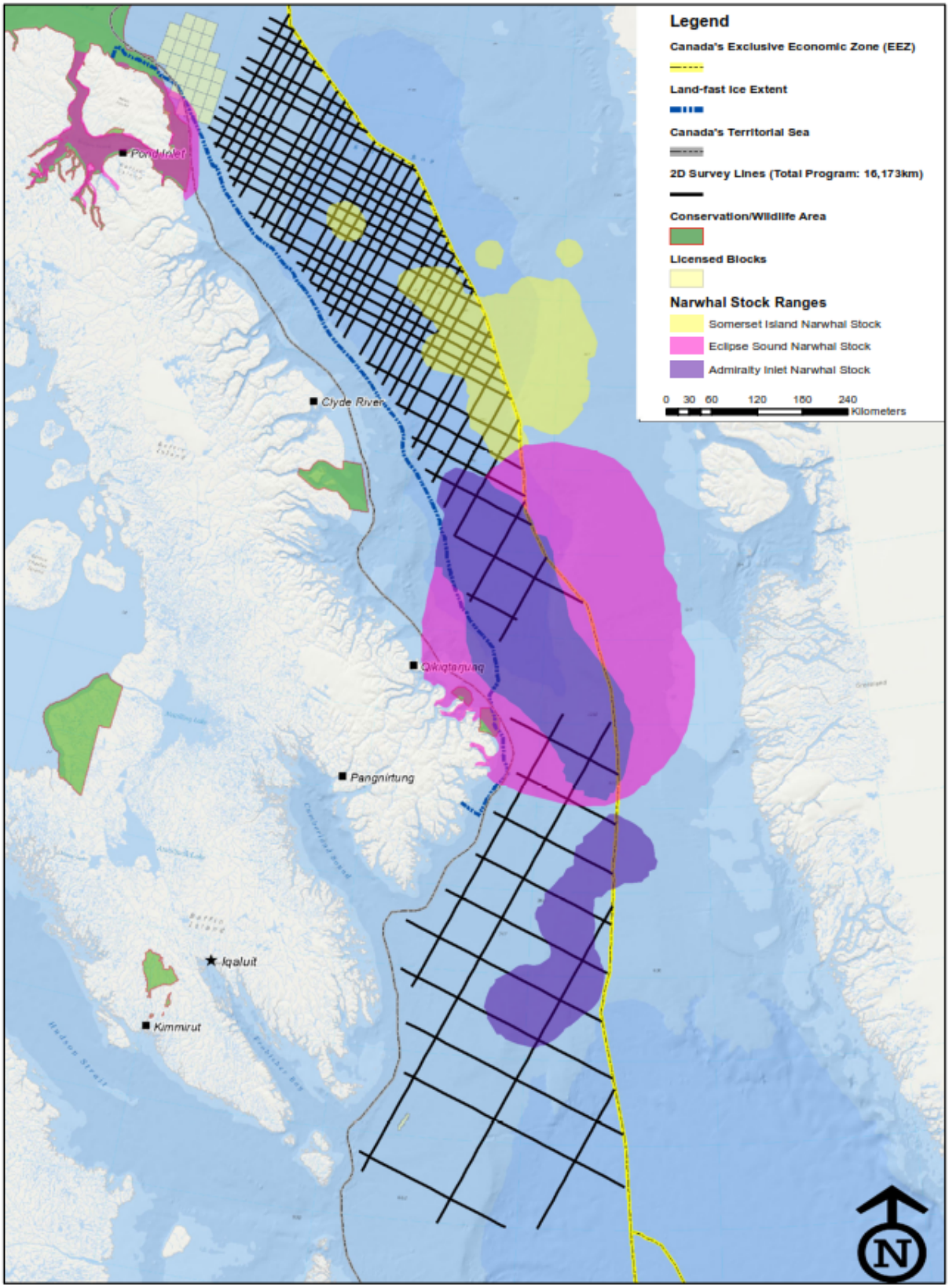
Beluga whale

Bowhead whale

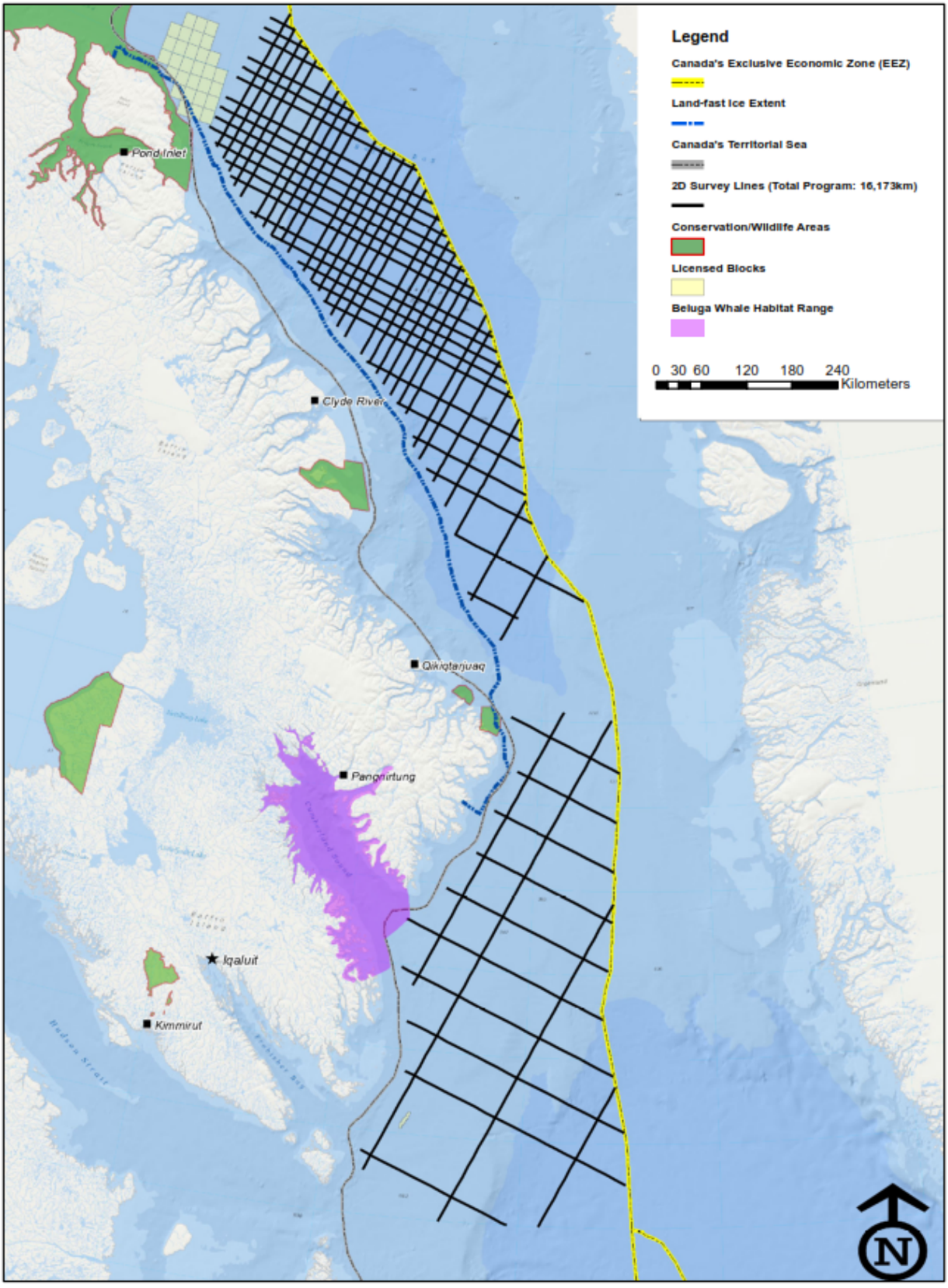
Walrus

Seals: bearded, ringed and harp

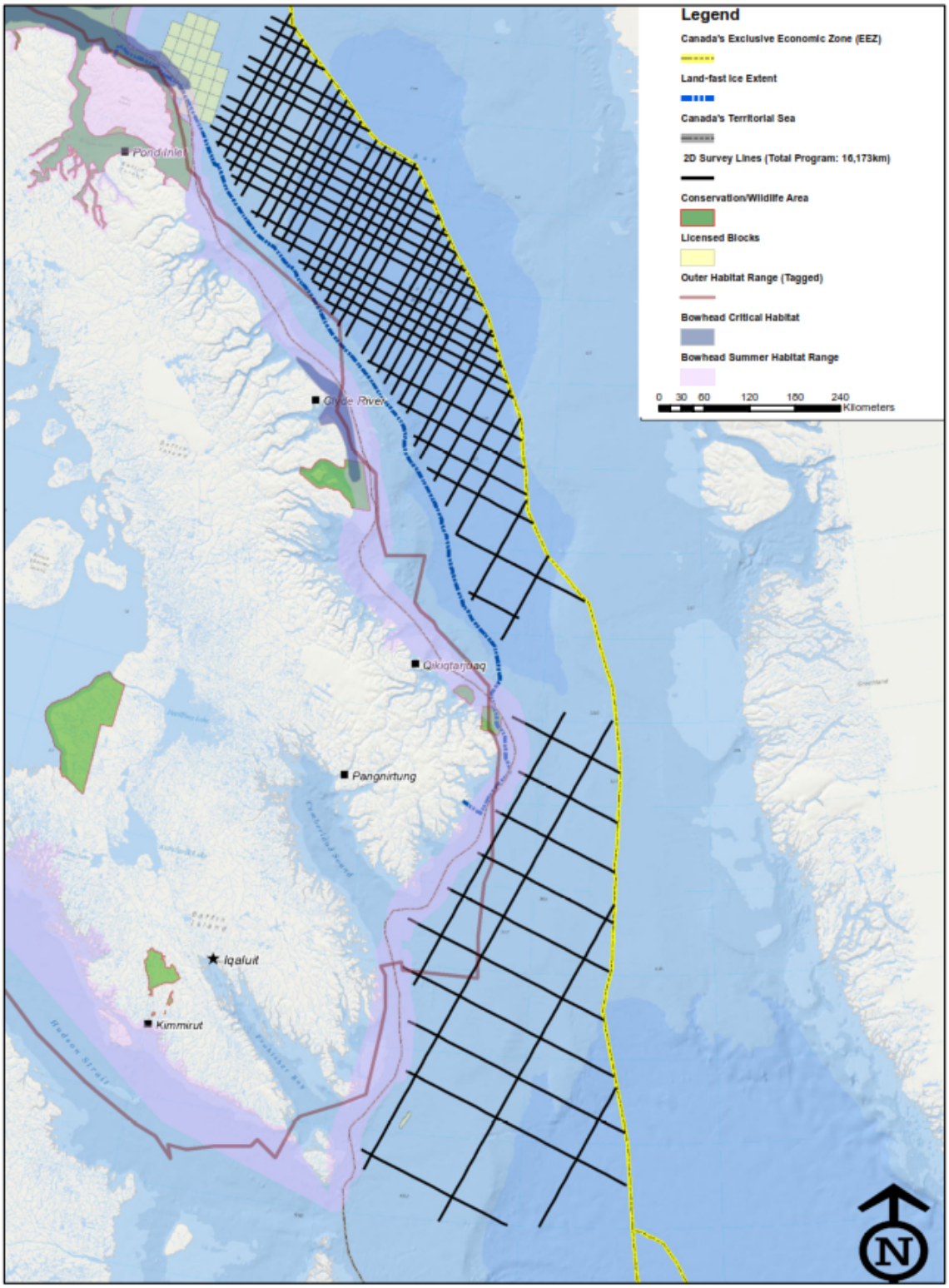
Narwhal Habitat Ranges near Survey Area (Total Program: 16,173km)



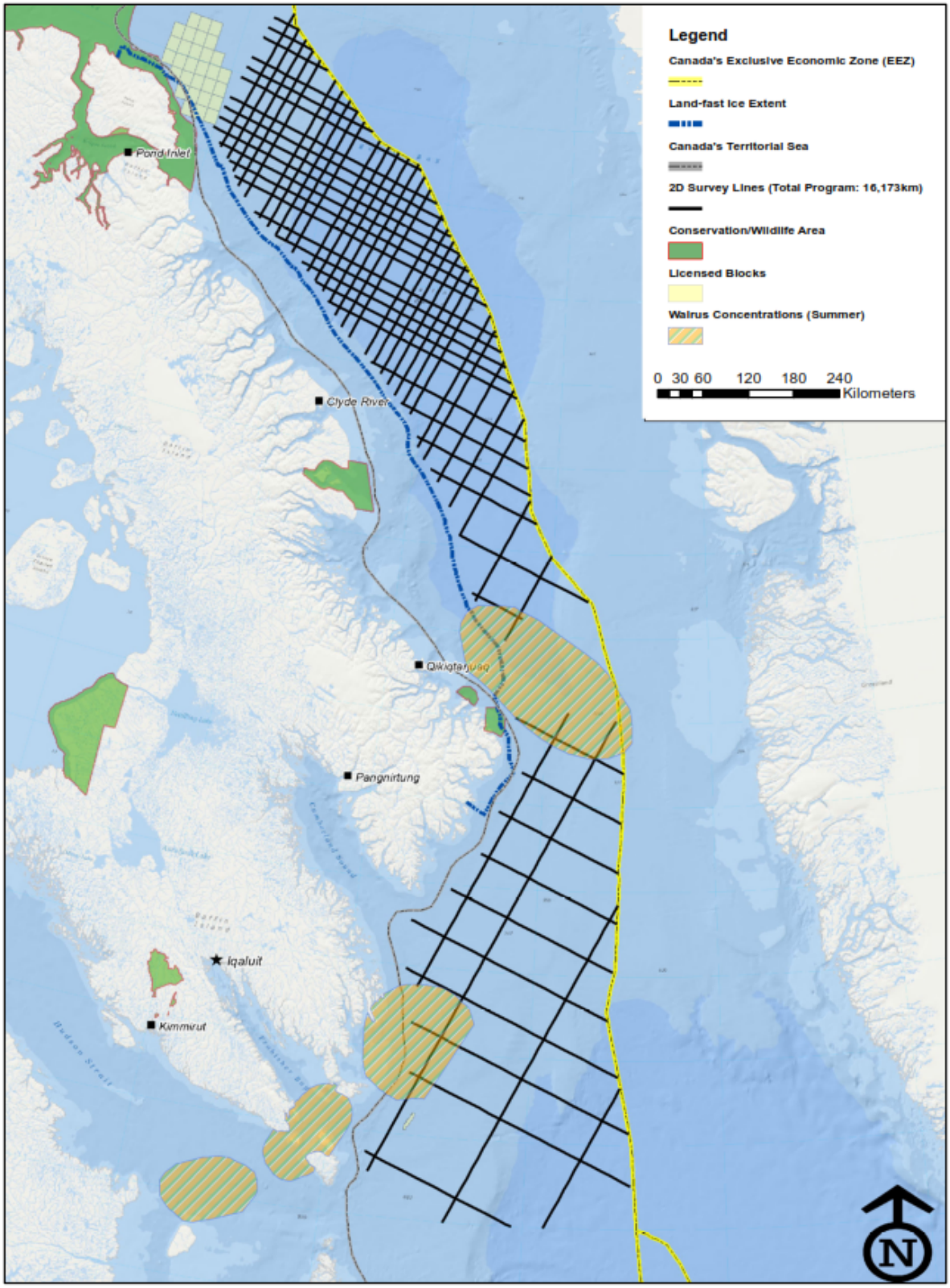
Beluga Whale Habitat Range near Survey Area (Total Program: 16,173km)



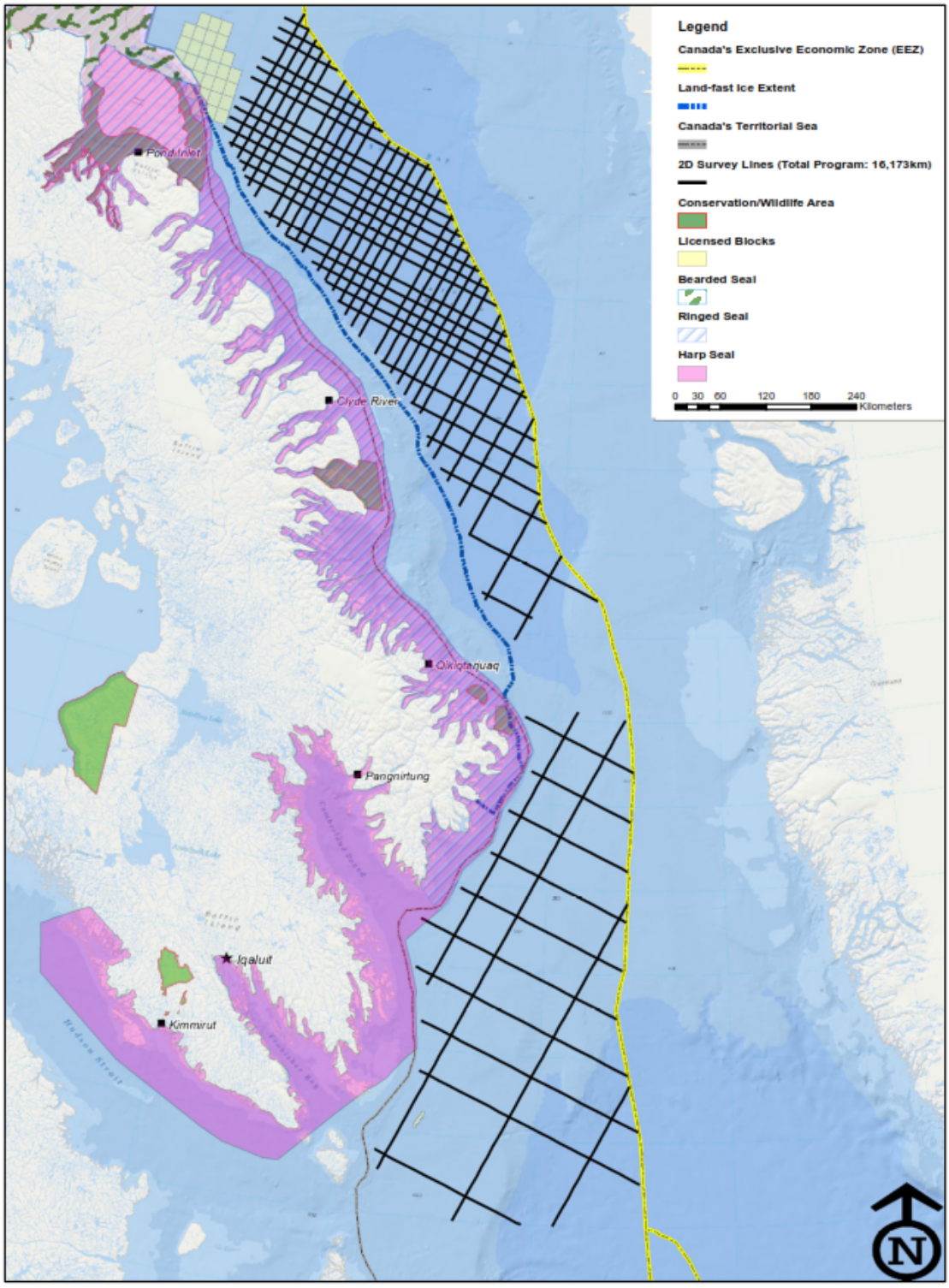
Bowhead Whale Habitat Range near Survey Area (Total Program: 16,173km)



Walrus Concentrations near Survey Area (Total Program: 16,173km)



Areas of High Seal Concentration near Survey Area (Total Program: 16,173km)



Interaction Maps: Year 1

Narwhal

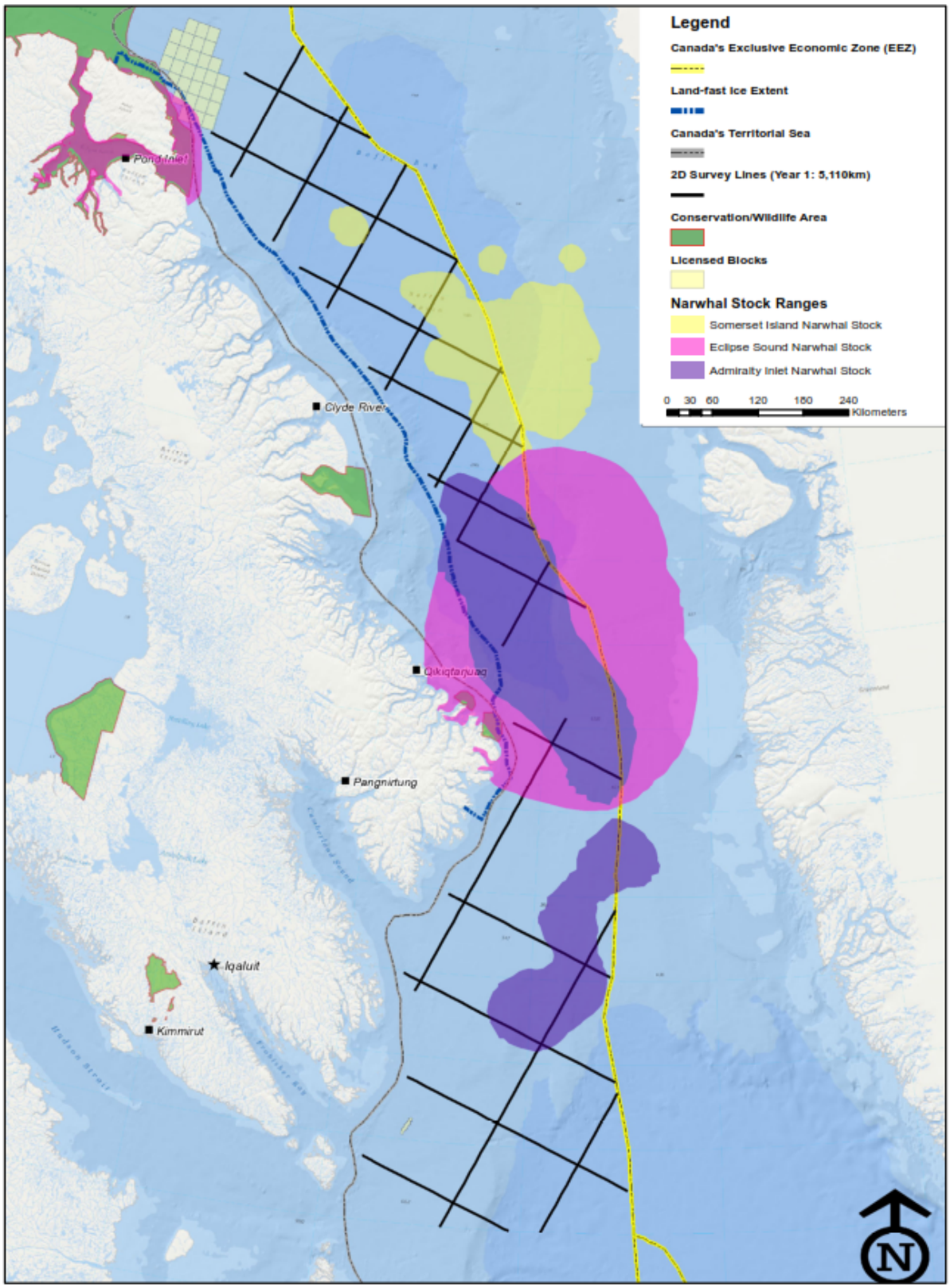
Beluga whale

Bowhead whale

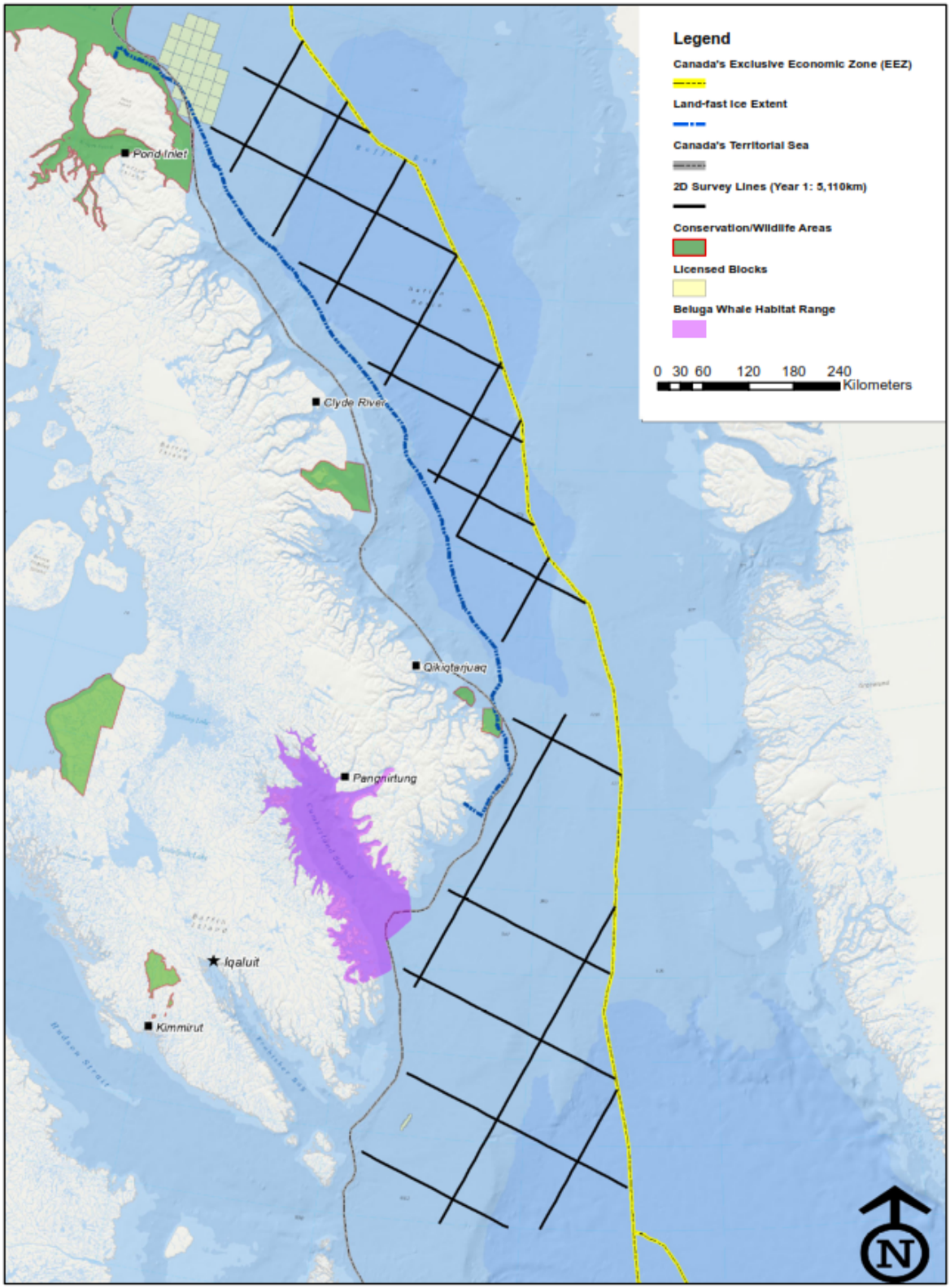
Walrus

Seals: bearded, ringed and harp

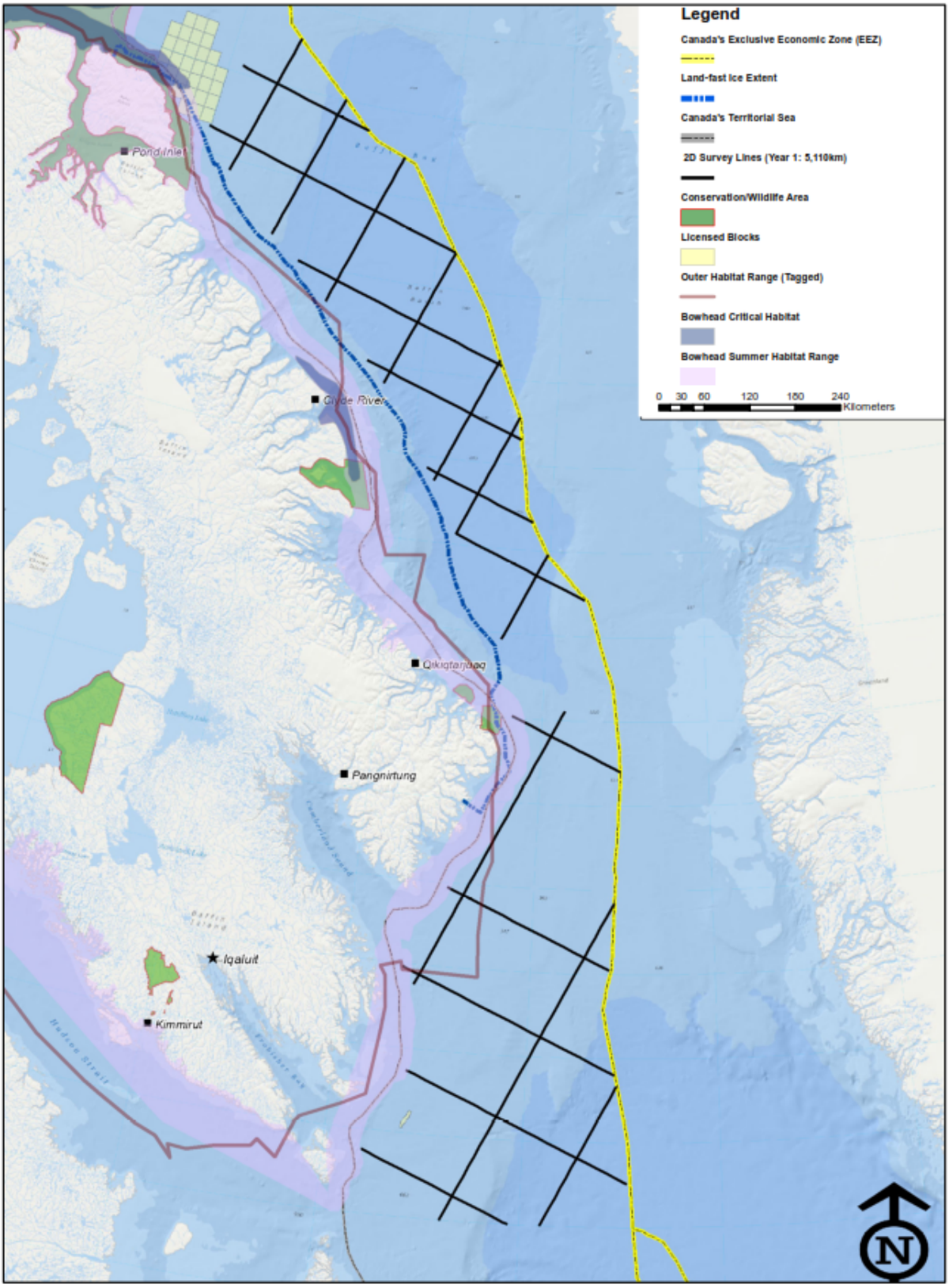
Narwhal Habitat Ranges near Survey Area (Year 1: 5,110km)



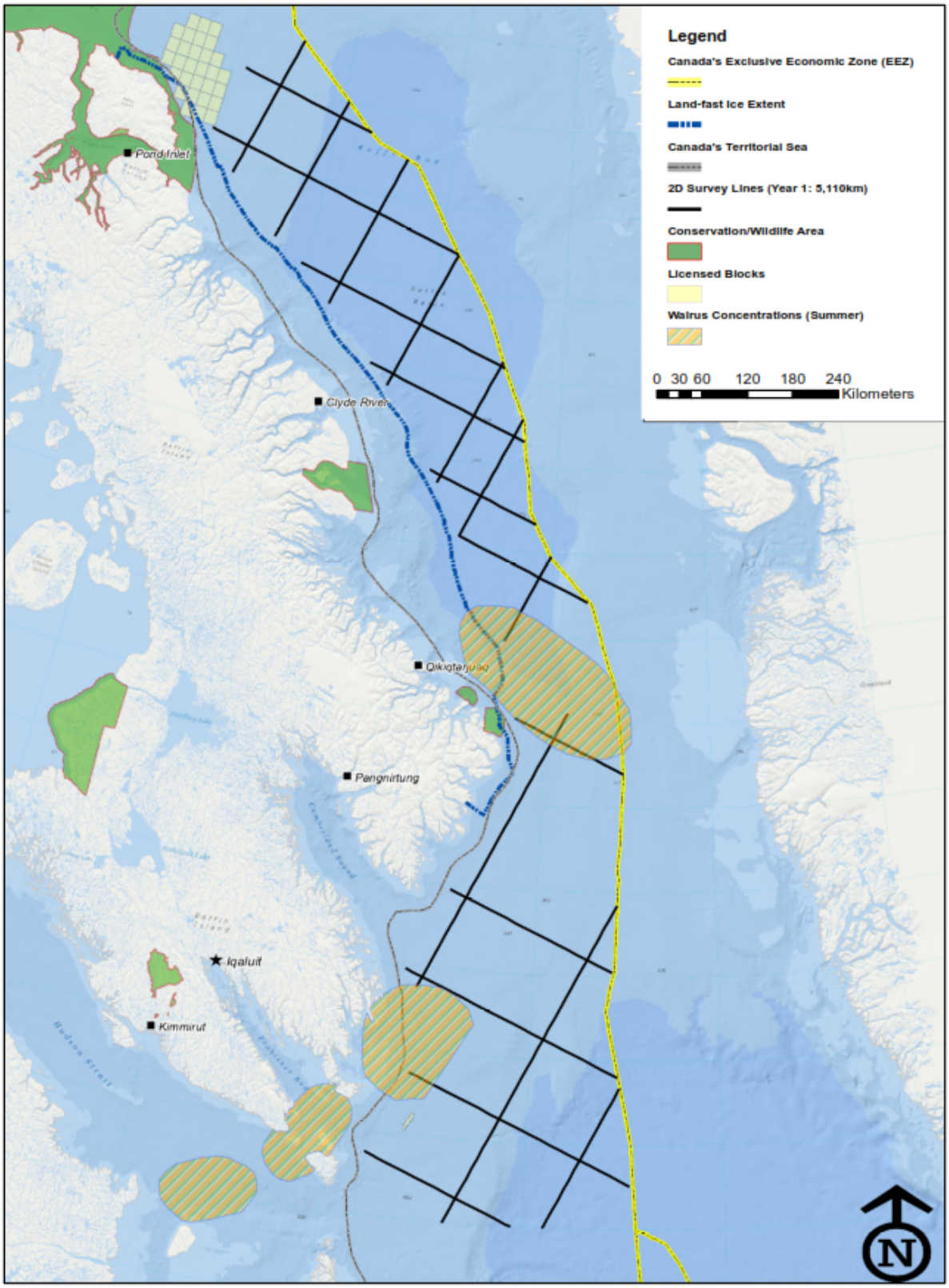
Beluga Whale Habitat Range near Survey Area (Year 1: 5,110km)



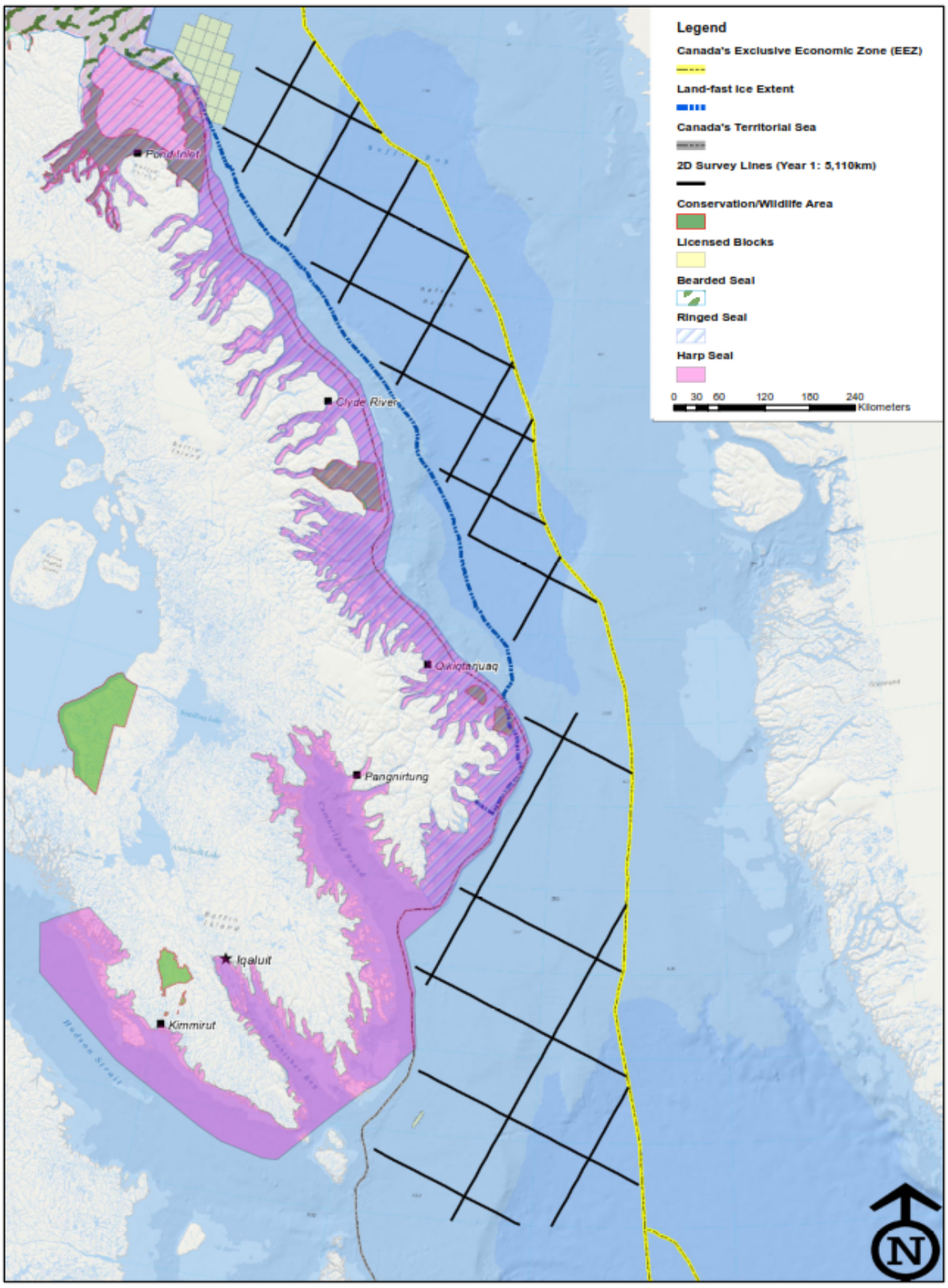
Bowhead Whale Habitat Range near Survey Area (Year 1:5,110km)



Walrus Concentrations near Survey Area (Year 1: 5,110km)



Areas of High Seal Concentration near Survey Area (Year 1: 5,110km)



Interaction Maps: Year 2

Narwhal

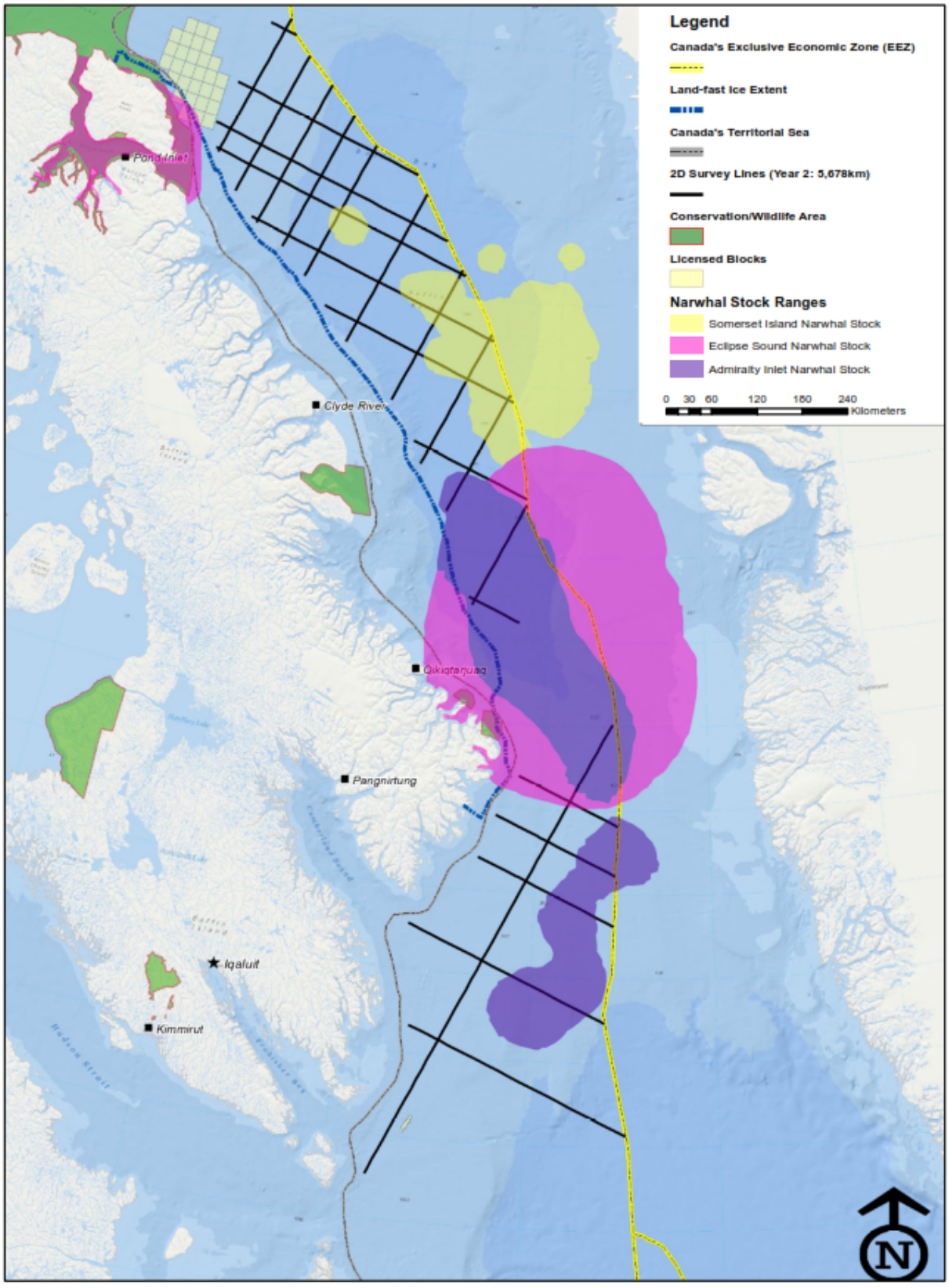
Beluga whale

Bowhead whale

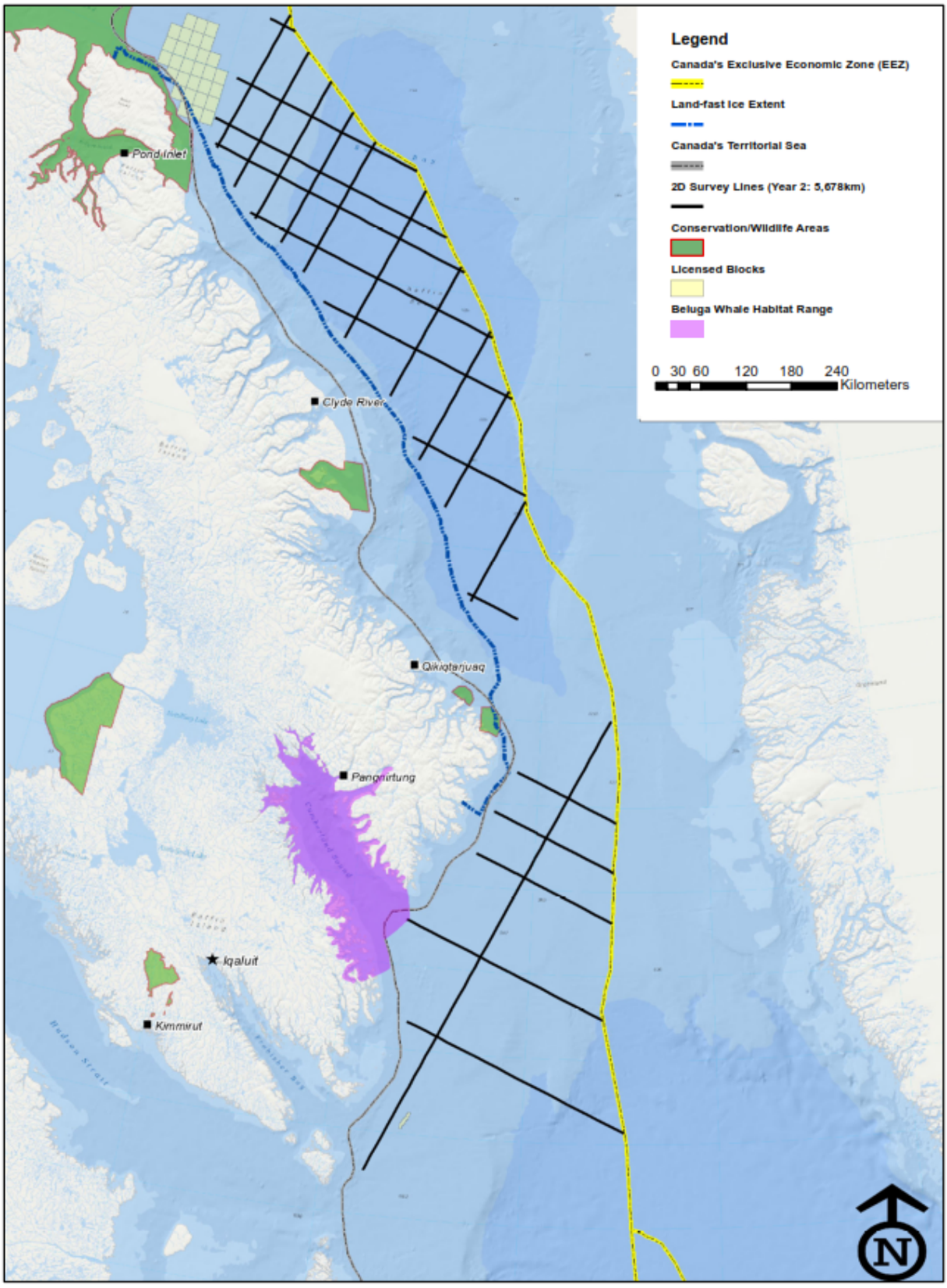
Walrus

Seals: bearded, ringed and harp

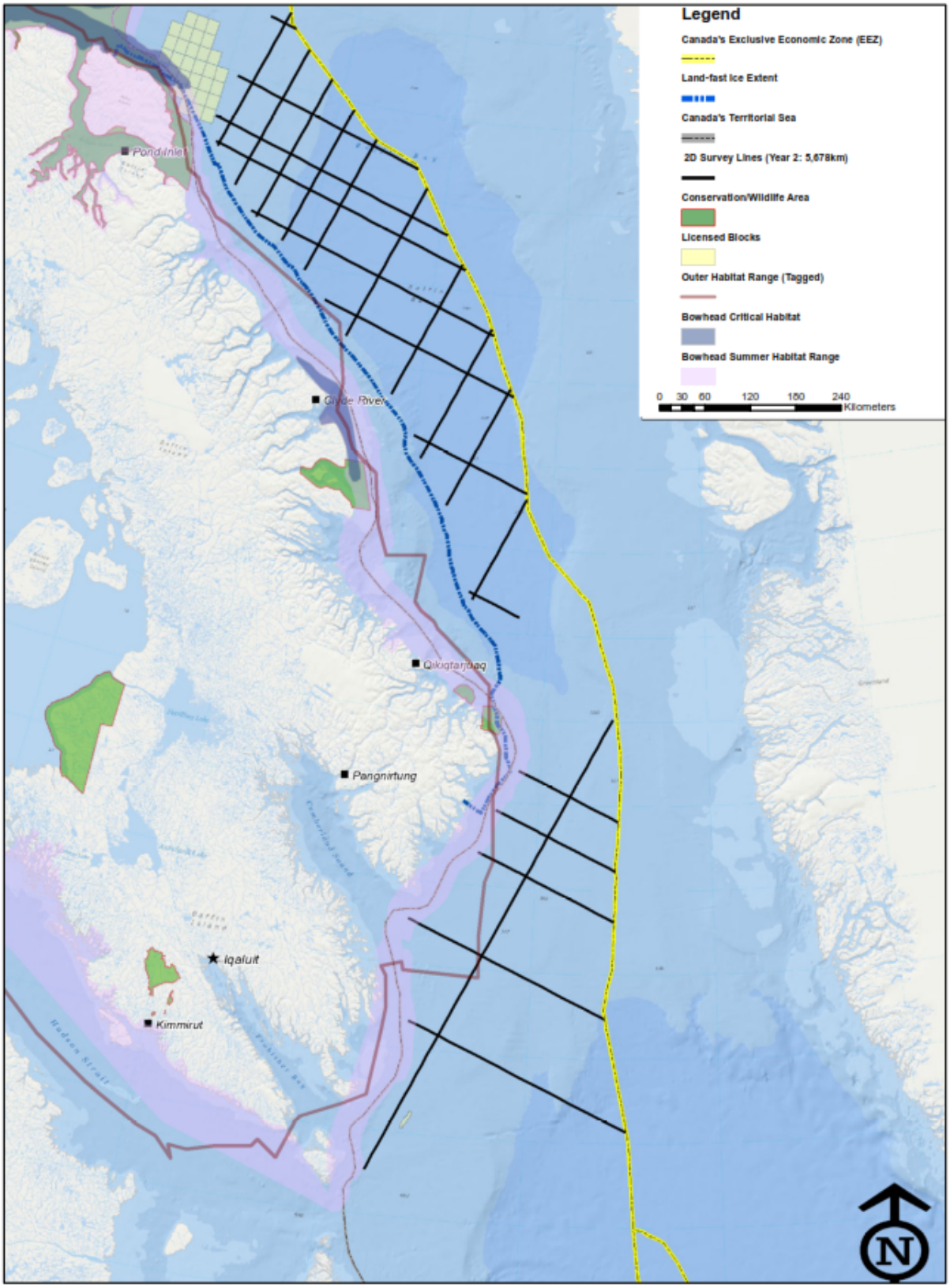
Narwhal Habitat Ranges near Survey Area (Year 2: 5,678km)



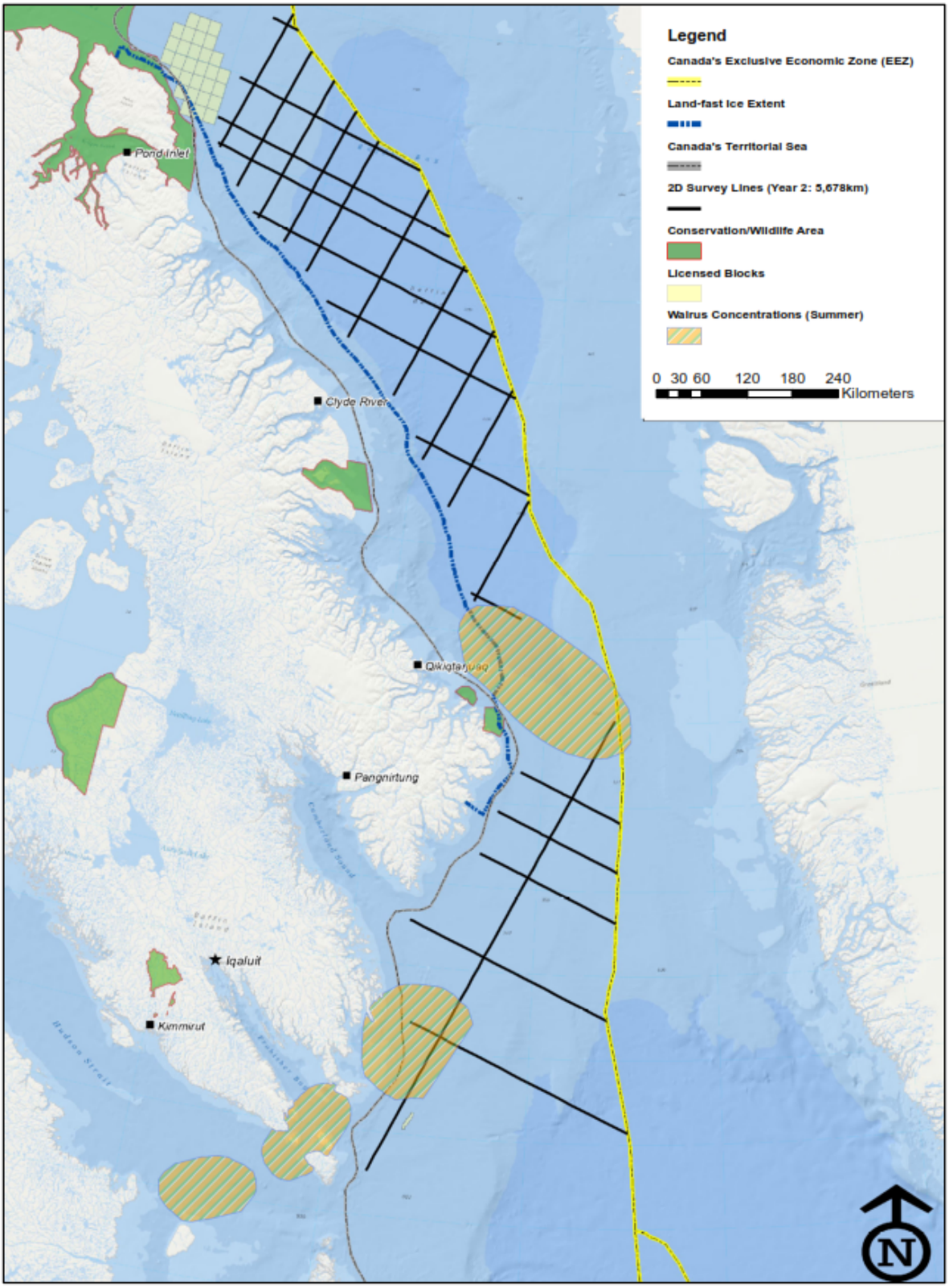
Beluga Whale Habitat Range near Survey Area (Year 2: 5,678km)



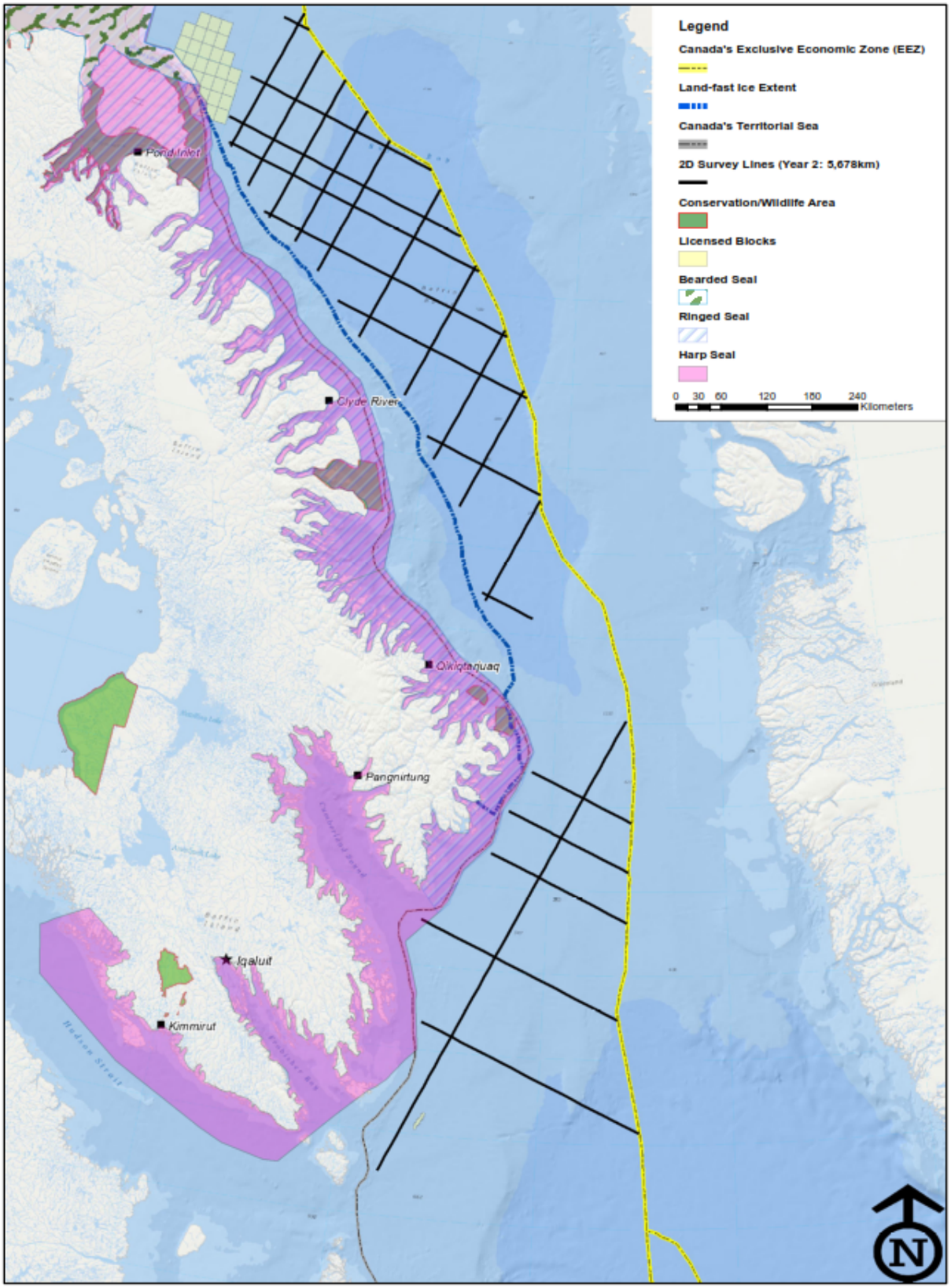
Bowhead Whale Habitat Range near Survey Area (Year 2: 5,678km)



Walrus Concentrations near Survey Area (Year 2: 5,678km)



Areas of High Seal Concentration near Survey Area (Year 2: 5,678km)



Interaction Maps: Year 3

Narwhal

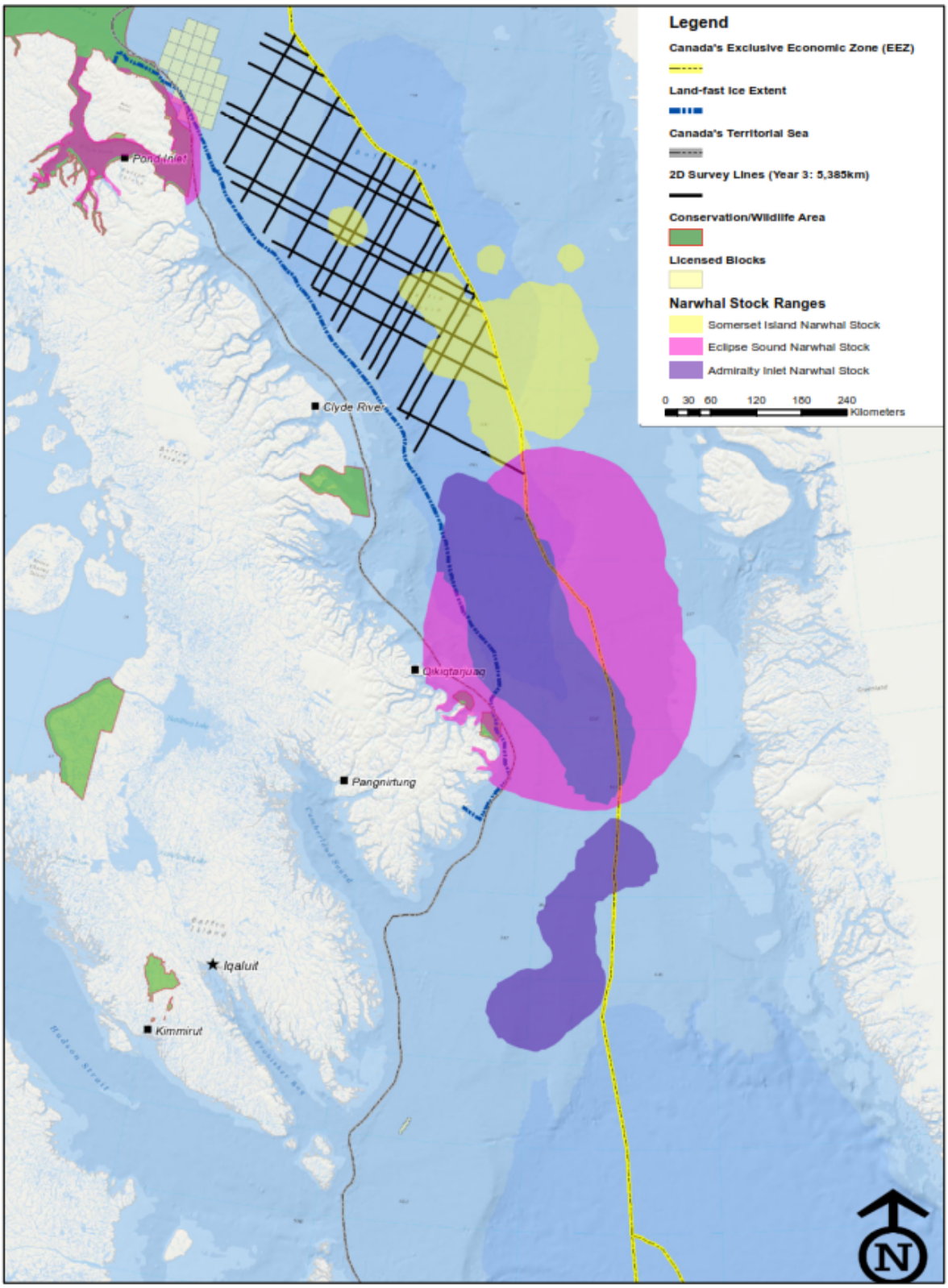
Beluga whale

Bowhead whale

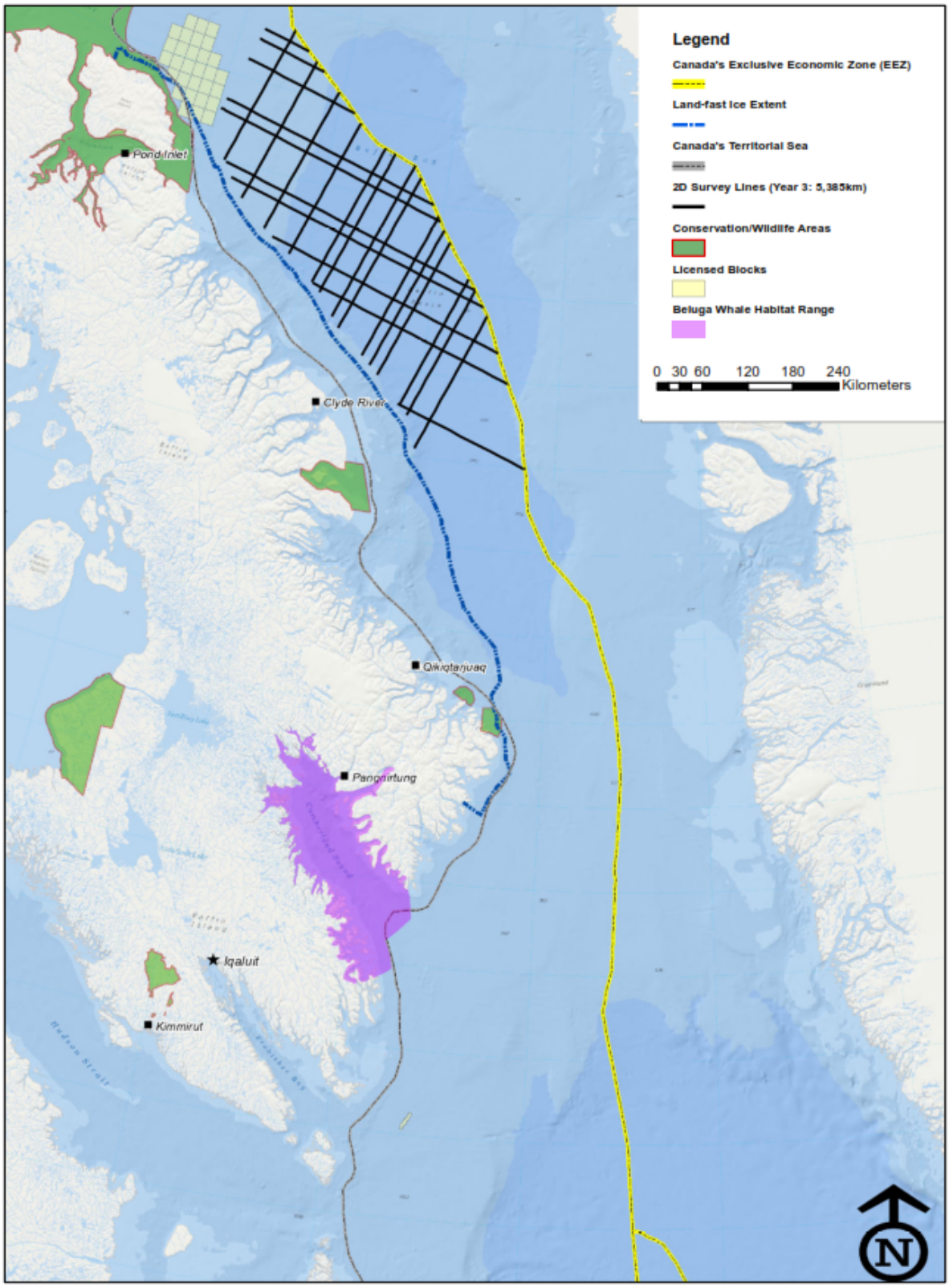
Walrus

Seals: bearded, ringed and harp

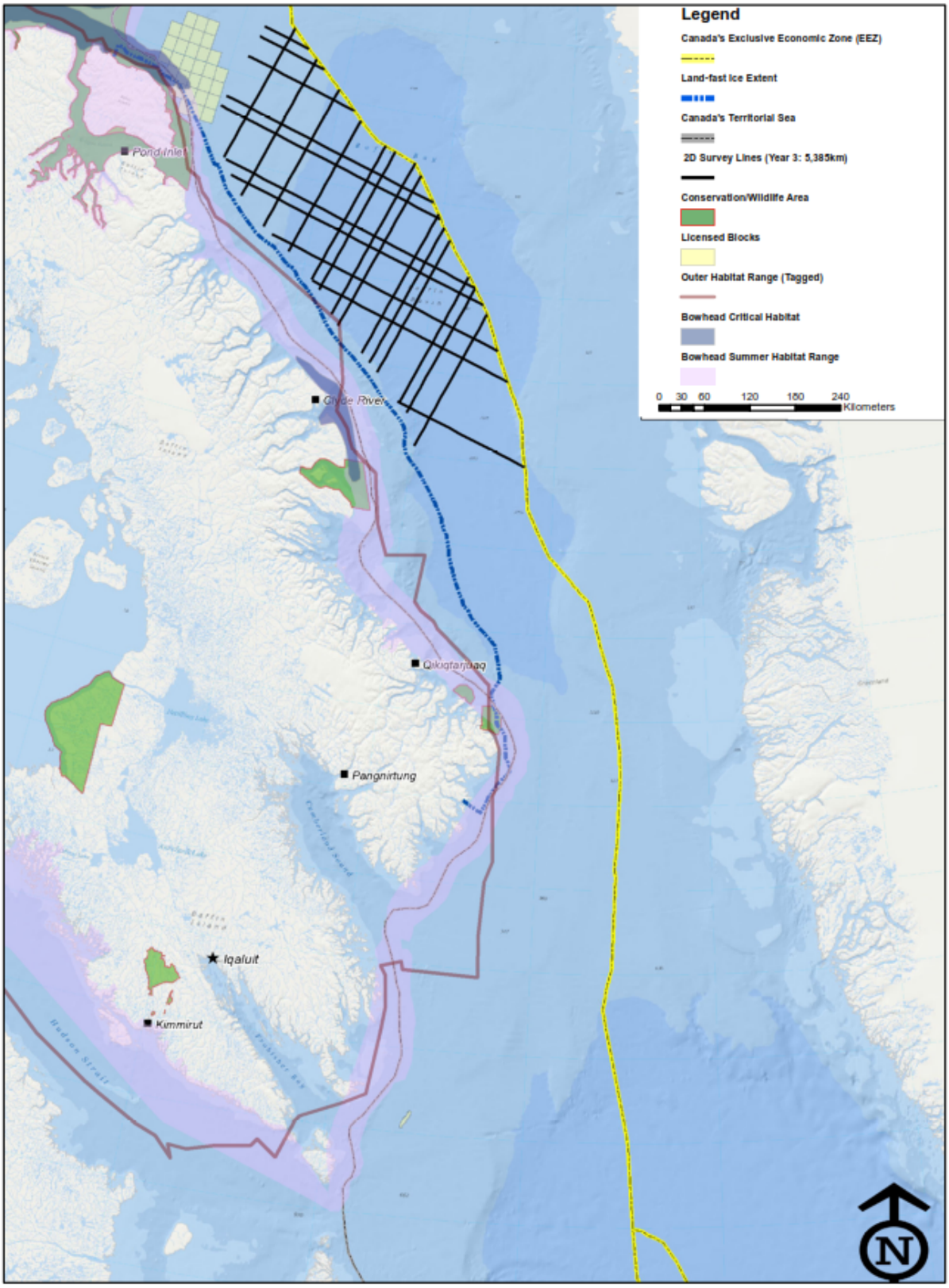
Narwhal Habitat Ranges near Survey Area (Year 3: 5,385km)



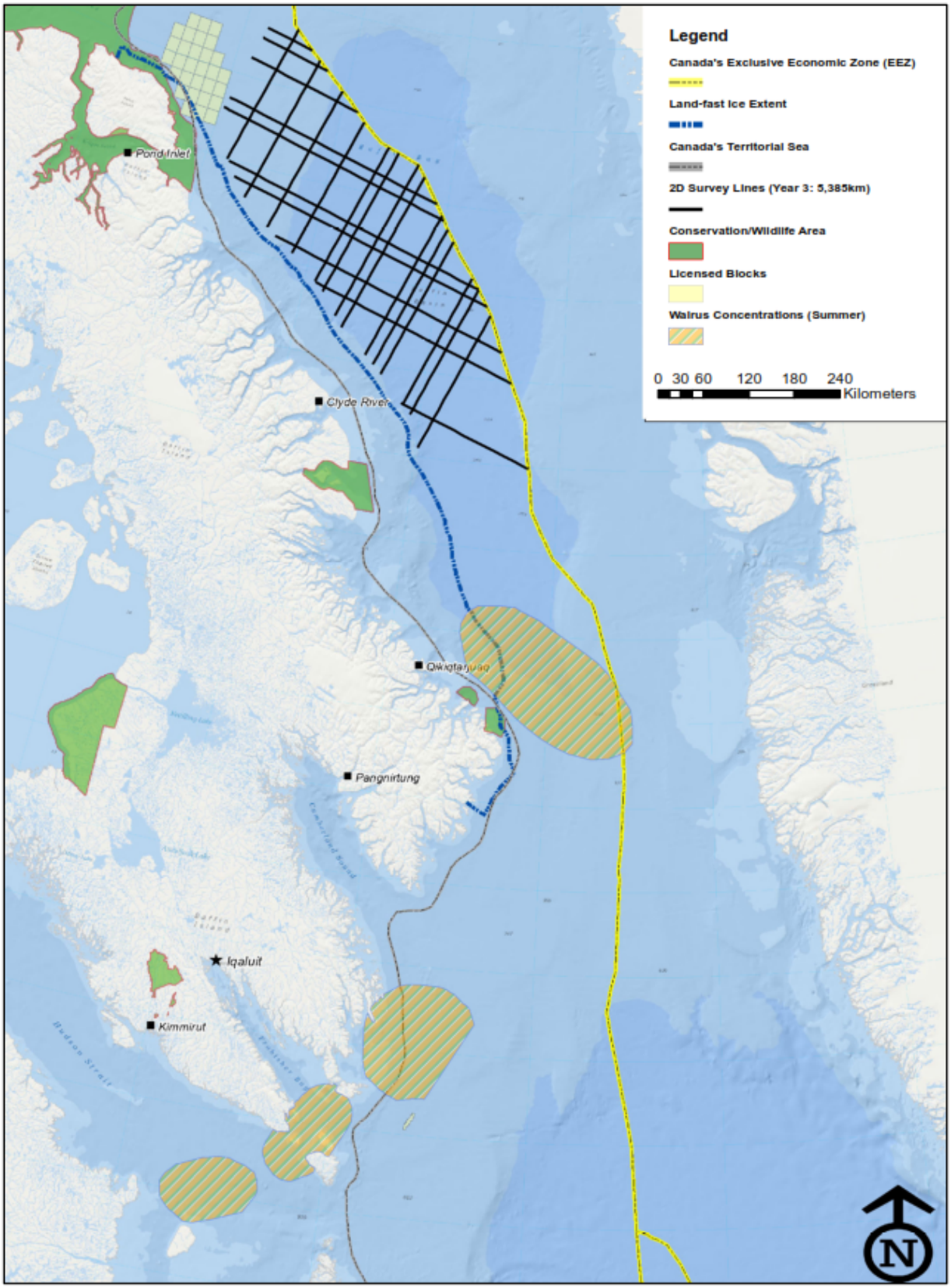
Beluga Whale Habitat Range near Survey Area (Year 3: 5,385km)



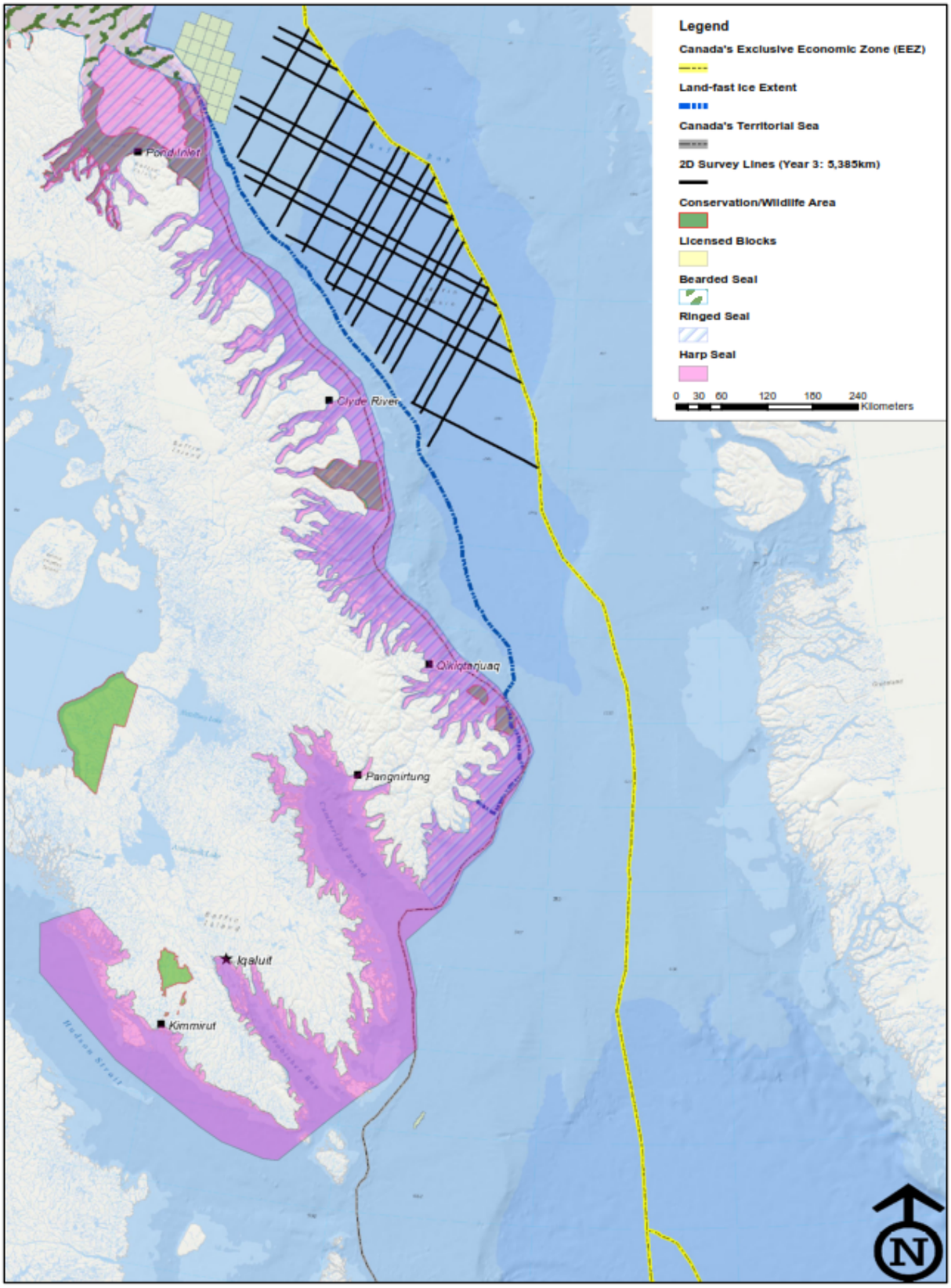
Bowhead Whale Habitat Range near Survey Area (Year 3: 5,385km)



Walrus Concentrations near Survey Area (Year 3: 5,385km)



Areas of High Seal Concentration near Survey Area (Year 3: 5,385km)



Analysis

All three narwhal stocks will follow their fall migration routes into the survey area. Papers discussing satellite tracking of the Somerset Island mention that this stock is thought to begin their migration the middle of October. Therefore, they may begin to enter the location of the proposed survey toward the end of October. Peer reviewed papers discussing the results of satellite tracking of narwhal from the Admiralty Inlet and Eclipse Sound stocks suggest that these stocks begin their migrations around the middle of September. Unlike the Somerset Island stock, these stocks migrate south along the eastern coast of Baffin Island remaining within close proximity to the coast. Satellite tracking demonstrated that whales from these stocks begin their offshore migration from Clyde River to Pangnirtung from mid to late October.

Beluga whales from the Cumberland Sound stock are unlikely to be in the survey area as reports indicate that they remain in Cumberland Sound throughout the year. It is unlikely that belugas from the Western-Northern-Southern Hudson Bay stock migrating east through Hudson Strait towards Iqaluit would be located in the survey area.

The Davis Strait- Baffin Bay bowhead whale population undertakes a coastal migration route beginning in September into October from the North Water south towards Cumberland Sound and Davis Strait. Bowhead whales already in Cumberland Sound move south to Hudson Strait in early September to late October. Information obtained from bowhead whales tracked using satellite telemetry suggests that bowhead whales fall migration occurs near the coast of Baffin Island. Therefore, it is unlikely that coastal migrating bowhead whales will interact with the proposed offshore project.

Walrus from the Northern Hudson Bay-Hudson Strait- Southeastern Baffin Island- Northern Labrador stock may occur in the survey area. The limited survey lines within proximity to Qikiqtarjuaq reduce the likelihood of encountering a walrus migrating between Qikiqtarjuaq and Greenland.

Identified areas of high concentration of bearded, ringed and harp seals are outside of the survey area.

In summary, narwhal are likely to be in the survey area north of Cumberland Sound beginning in mid to late October. It is unlikely that beluga whales from the Cumberland Sound stock will be found within the survey area. Despite available reports and studies which suggest that the Western-Northern-Southern Hudson Bay beluga stock and the Davis Strait- Baffin Bay bowhead whale population migration routes occur outside of the survey area, individual whales may move offshore into the survey area. Walrus may be found within the survey area as a result of the suspected walrus migration corridor between Qikiqtarjuaq and Greenland. However, it is not known how many walrus use this route or when they complete this migration. Areas of high seal concentration are outside of the survey area. However, it is likely that seals will be in the survey area.

Sources

LaPierre, T., Arnott, A., Hawkins, C., Simpson, K. and Davis, D. (2011). Environmental Impact Assessment for Marine 2D Seismic Reflection Survey Baffin Bay and Davis Strait Offshore Eastern Canada by Multi Klient Invest AS. 232p. Available from http://www.neb-one.gc.ca/clf-nsi/rthnb/nrthffshr/dclrtnsgnfcntcmmrcldscvr/tgspgs2011nrthstrncnd/tgspgs2011nrthstrncnd-eng.html

TGS-NOPEC Geophysical Company ASA, Petroleum Geo-Services and Multi Klient Invest AS (TGS/PGS/MKI) Northeastern Canada 2D Seismic Exploration Survey. (2013). Supplementary Report II. 78p. Available from http://www.neb-one.gc.ca/clf-nsi/rthnb/nrthffshr/dclrtnsgnfcntcmmrcldscvr/tgspgs2011nrthstrncnd/tgspgs2011nrthstrncnd-eng.html

FINAL REPORT ON / ᑭᖑᓪᓕᕐᐸᒥ ᑐᓴᕐᑎᑎᔾᔪᓐ ᑕᒪᑐᒥᖓ

A Study of Inuit Knowledge of the Southeast Baffin Beluga

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Report Prepared By
Peter Kilabuk
March, 1998
for
The Southeast Baffin Beluga Management Committee

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Final Report on

A Study of Inuit Knowledge of the Southeast Baffin Beluga

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REPORT PREPARED BY
PETER KILABUK
MARCH, 1998
FOR
THE SOUTHEAST BAFFIN BELUGA MANAGEMENT COMMITTEE

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ᒪᔾᔨ, 1998

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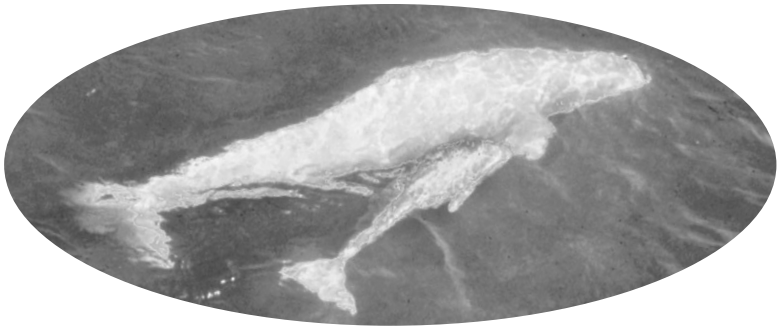

Published by:

Nunavut Wildlife Management Board
P.O. Box 1379
Iqaluit NT X0A 0H0
Telephone: (867) 979-6962
Fax: (867) 979-7785
E-Mail: jnoble@nunanet.com

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Nunavut Wildlife Management Board
P.O. Box 1379
Iqaluit NT X0A 0H0
ᐅᖃᓗᑎ: (867) 979-6962
ᓯᕗᔪᐊᑦ: (867) 979-7785
ᖃᓄᑕᐅᔨᒃᑯᑦ: jnoble@nunanet.com

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Foreword

The collection of Inuit Traditional Knowledge in this report has been implemented by the current Southeast Baffin Beluga Management Committee (SEBBMC) which was a recommendation of the former SEBB Management Plan. The study was carried out in the three communities of Pangnirtung, Iqaluit and Kimmirut for which the SEBBMC is responsible. The information contained herein is from the knowledge and experiences of the people living in these communities.

Peter Kilabuk, Writer

Pangnirtung, NT

March, 1998

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ᒎᑯᐊ ᓄᐊᑕᐅᓂᖏᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᑦ ᑕᕐᕋᓂ ᑐᓴᖏᑎᒃᓴᕐᓂᖅ ᐱᓕᐊᖏᑎᑕᐅᓂᑯᑦ ᒪᑉᓵᓕᐅᔪᖅ (SEBBMC) ᖁᑭᖏᒍᑦ ᓂᒋᐊᓂ ᖁᓕᓴᐃᖏᓂ ᓯᓚᒃᑲᖏᑎᒃ ᑲᑎᒪᔨᖅ ᐱᓕᐊᖏᑎᑕᐅᓂᒃᑯᓗᓂ ᑕᐃᑯᓂᖅ ᓯᓚᒃᑲᐅᓂᒃᑯᓂᖅ SEBB-ᓯᓚᒃᑲᖏᑎᒃ ᑲᖏᕐᕋᐅᖏᓐᓄᑦ. ᒎᓐᓄ ᖃᐅᔨᓴᖏᓐᓄᑦ ᐊᐅᓚᑕᐅᓚᐅᖏᑐᖃᖅ ᐱᖓᓱᓂ ᓄᓇᕗᐅᔪᓂ ᑲᓐᓂᖅᑐᖃᖅ, ᐃᖃᓗᐃᑦ ᐊᒻᒪ ᑭᒡᓕᑦ ᒎᑯᓄᖓᓐ SEBBMC ᐅᒪᑎᔭᖏᔪᑦ. ᒎᑯᐊ ᑐᑭᖏᑲᒪᓐ ᐃᓗᐊᓂᑐᓐ ᑕᕐᕋᖓᖏᓪᓗᒡᓗᓐ ᓄᓇᕗᐅᔪᓂᑦ ᖃᐅᔨᓴᐅᔪᓂᑦ ᐊᒻᒪ ᐊᑐᖏᕐᕋᖃᑕᖏᓪᓗᒡᓗᓐ.

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ᒪᑦᔨ, 1998

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ᐃ) ᑐᓴᕐᑎᑎᔪᑎᖏᑦ ᐃᖃᓗᓐᓄᑦ
ᐱ) 5 ᓄᓇᖑᐊᑦ
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ᓄᓇᓕᖓᓂ ᐸᖅᓂᖅᑑᖅ 59
ᐃ) ᑐᓴᕐᑎᑎᔪᑎᑦ ᖃᐅᔨᔭᒥᓂᕐᓂ
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Acknowledgments

I would like to thank the following people for their hard work in helping to complete this final report.

First, I'd like to thank the three community HTOs for their involvement, and especially the chairpersons for their guidance. I'd also like to thank the three cameramen for assisting me in the three communities: Mark Kilabuk in Iqaluit, Ricky Kilabuk in Pangnirtung and Eezeedsiak Padluq in Kimmirut. I'd also like to thank Daisy Sowdluapik, Eena Alivaktuk, Rosie Kilabuk and Mary Kilabuk for writing the transcripts, and finally, thanks to Jonah and Bill Kilabuk for their translation and transcribing services.

Again, thanks to everyone for all your help, dedication and encouragement.

ᓇᓗᓇᐃᖅᑭᐱᐃᐅᓪᓚᑦ

ᐃᓕᓴ ᖃᓄᓕᕆᓚᐅᖅ ᐅᓄᐊ ᐃᓄᐃᑦ ᐊᖑᑎᓂᐊᖅᑕᓕᐅᖅᑐᑦ ᐱᒻᓇᕆᓯᐅᓂᖓᓪᓚᓄᑦ ᐅᓇ ᑭᓯᐳᓕᖅᑕ ᑐᕿᖅᑎᑎᒃᓴᑦ. ᐊᓪᓚ ᖃᓄᓕᕆᓚᐅᖅ ᐃᓄᐃᑦᑐᐃᓕᓕᐅᑦᑐᑦ ᐊᓪᓚ ᓄᓇᖅᑲᐃᓕᓕᐅᑦᑐᑦ. ᓯᐅᒃᓕᕆ, ᑭᓄᐊ ᐱᖓᓱᑦ ᓄᓇᕗᑦ ᐅᒪᔨᓕᕆᔨᒪᑦ ᐃᓕᐅᓂᖅᓴᓄᑦ, ᐊᓪᓚ ᐱᓗᐊᖅᐅᑎᓂᖅᑐᑦ ᐃᓄᖅᓯᐅᑎᓂᖅᓴᓄᑦ. ᑭᓄᐊ ᐱᖓᓱᑦ ᐊᖏᕆᐅᓇᓂᐅᔨᓕᖅᑐᖅ ᑕᐃᓄᓂ ᐱᖓᓱᓂ ᓄᓇᕗᓪᓂ ᓴᕆᔨᖅᑎᓕᖅᖢᖓ; ᒪᑉ ᕿᓚᒻᒥᐅᑦ ᐃᓄᐃᕆᐅᔨᖅᑐᒥᐅᑦ ᐃᓐᓇᓪᓂ, ᓇᑭ ᕿᓚᒻᒥᐅᑦ ᕿᓂᖅᓯᒪᓕ ᐊᒪᓕᐊᒥᐅᑦ ᕿᓐᓄᑦ ᑕᕿᓂᖅᑐᐊᒥᐅᑦ ᑐᓴᕐᕕᖏᓐᓂᒃ. ᑕᐃᓕ ᓴᐅᓪᓗᐊᓂᒃ, ᐃᓄᐊ ᕿᓚᒻᒥᐅᑦ ᑕᓪᓕᐊᓂᖅᑐᑦ ᓄᓇᕗᑦ ᐊᓯᐊᓂᖅᑐᑦ ᐱᓕᕆᔨᒃᑯᓐᓂᒃ ᐃᓄᐃᑦᑐᐃᓕᓕᐅᑦᑐᑦ ᐊᓪᓚ ᐅᖃᓕᒫᓂᖅᑐᑦ ᐊᓪᓚ ᑎᑎᕋᐅᓕᖅᑐᑦ.

ᐊᒃᑕᐅᓯᐊᖅᑲᓪᓂᖓ, ᑭᒃᑯᐊᓕᒫᑦ ᖃᓄᖅᑭᑐᖅ ᐊᓪᓚ ᐊᓯᓂᖓᓂᒃ, ᖃᓄᖅᑭᑐᖅ ᐊᓪᓚ ᐊᓯᓂᖓᓂᒃ ᐃᓄᐃᑦᑐᐃᓕᓕᐅᑦᑐᑦ ᐊᓪᓚ ᐅᖃᓕᒫᓂᖅᑐᑦ ᐊᓪᓚ ᑎᑎᕋᐅᓕᖅᑐᑦ.

ᐊᒃᑕᐅᓯᐊᖅᑲᓪᓂᖓ, ᑭᒃᑯᐊᓕᒫᑦ ᖃᓄᖅᑭᑐᖅ ᐊᓪᓚ ᐊᓯᓂᖓᓂᒃ, ᖃᓄᖅᑭᑐᖅ ᐊᓪᓚ ᐊᓯᓂᖓᓂᒃ ᐃᓄᐃᑦᑐᐃᓕᓕᐅᑦᑐᑦ ᐊᓪᓚ ᐅᖃᓕᒫᓂᖅᑐᑦ ᐊᓪᓚ ᑎᑎᕋᐅᓕᖅᑐᑦ.

Introduction

This study has resulted in an abundance of Traditional Knowledge being obtained. It is through the sharing of Traditional Knowledge by the elders/hunters interviewed that I am able to submit this report on the Southeast Baffin Beluga and hunting.

Historically, fewer people have lived in the occupied areas of the Southeast Baffin. Most of the inhabitants were scattered along the coastal areas permanently residing in camps. By sharing what they had and conserving their catches even when game was abundant, the people were able to live in harmony with the wildlife and the surrounding environment and survived many hardships.

Today, many people in the bigger communities no longer live in harmony with the wildlife and the surroundings. Regrettably, a lot of Traditional Knowledge concerning the Southeast Baffin Beluga and its habitat has been lost over the past five decades. As Elder Nooveeya Ipeelee of Iqaluit said during the workshop, “I am glad I was given this opportunity at my age to pass along this information as I am no longer able to instruct out on the land.” Nooveeya is of a past generation that used kayaks to hunt Beluga whales.

ᖁᐅᓵᒃᑕᒋᐊᕐᑕᖏᑐᖅ

ᑕᒪᓐᓇ ᖁᐅᓵᓴᖏᓂᖅ ᐊᒃᓱᐊᓗᒃ ᑐᑭᓯᔪᕐᓂ-ᐅᒃᓄᓂᖅᑕ ᐊᖏᔪᐊᓗᓴᓗᑉᒃ ᓄᑯᖕᒪᑐᖅᑕᓂᑐᓂ ᐱᖕᓂᖅᑐᖅᑕᓂᑐᓂ. ᓄᑯᑎᒃ ᑐᑭᓯᔪᓂᖅᑕᓂᖅᓯᒪᓕᖅ ᑕᒪᒃᑯᓇᖅᓂᓐ ᐃᓐᓇᑐᖅᓂᕐᒪ/ ᐊᓱᓕᕋᑎᓂᒃ ᐅᓇ ᑐᓂᓕᕆ ᑐᓴᕋᑎᑎᕐᔪᓂ ᑕᒪᑐᒧᖅ ᐱᖕᓂᖅᑐᖅᑕᓂᑐᓂᒃ ᐱᕐᔪᑎᑎᓕᔪ ᖃᑭᖅᑑᓂᕐᒪ ᐅᓪᓚᑕᒥᓂᕐᒪ ᑕᒪᓐᓇ ᖁᐅᓵᓴᖅᑐᓂᖅ ᐱᕐᔪᑎᑎᓕᔪ ᓄᑯᖕᒪᑐᖅᑕᓂᑐᓂᒃ ᐱᕐᔪᑎᑎᓕᔪ ᐊᓱᓕᕋᑎᓂᒃ ᖁᐅᓵᓴᖅᑐᓂᖅᑕᓂᑐᓂ ᐱᕐᔪᑎᑎᓕᔪ ᐱᕐᔪᑎᑎᓕᔪ ᐱᕐᔪᑎᑎᓕᔪ

Methodology

In planning and carrying out the study, the Nunavut Wildlife Management Board (NWMB), Department of Fisheries & Oceans (DFO), and the three communities were involved in the planning and collection of topics and questions for the three-day workshops. The study was carried out in three phases:

In Phase 1, Study Coordinator Peter Kilabuk visited each of the HTO boards to collect the topics for discussion and questions concerning the Southeast Baffin Beluga and methods of hunting Beluga whales.

In Phase 2, three-day workshops were carried out in the communities to collect the Traditional Knowledge of the Southeast Baffin Beluga as per the topics, issues and questions collected from Phase 1. The collection of information was done with eight Hunters/Elders who had been selected in Phase 1. The information was collected on videos which were then transcribed and translated into Inuktitut and English. Maps were also used to record ecological information.

Phase 3 involved the Study Coordinator who wrote the final report with the information provided by each of the communities.

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ᑕᓪ ᐸᖅᓇᑕᐅᑎᓪᓗᒍ ᖃᐅᔨᓴᖅᓂᖅ ᐅᒪᔭᕆᓚᐅᔨᔪᐊᐸᑦ, ᐃᒪᖏᐅᑕᕆᓚᐅᒃᑯᑦ ᐊᓪᒪ ᐱᖓᓱᑦ ᓄᓇᕆᐅᔪᓐ ᐃᓕᐅᑎᑕᐅᖅᑎᓪᓗᑎᑦ ᐸᖅᓇᑕᐅᑎᓪᓗᓕᑦ ᐊᓪᒪ ᓄᐊᑕᐅᓂᖏᓐᓄᑦ ᑭᓱᓂᖏᑦ ᐊᓪᒪ ᐊᐱᖅᑎᓴᐃᓐ ᑕᐃᓄᖓ ᐱᖓᓱᓄᓐ ᐅᓪᓗᓄ ᑲᑎᒪᓂᖅᓂ.

ᑕᕝᕙᓂ ᓯᕐᓕᓪᓕᐊᒥ 1, ᖃᐅᔨᓴᖅᓂᖅᓯᑦ ᐊᐅᓚᑎᑦᔨ ᐲᑕ ᖃᓚᕝᕙᖅ ᓴᓚᖅᑕᐅᔨᑐᖅ ᑕᒪᖏᖅ ᐅᒪᔭᕆᓚᐅᒃᑯᑦ ᑲᑎᒪᔨᖃᖅᓂᒃ ᓄᓇᕗᑦᑐᐊᓂᒃ ᐊᐱᖅᓯᑎᕐᓴᖅᓂᓪᓚ ᐊᑐᖅᑕᐅᓕᖅᑎᑦ ᓄᓇᕗᑦᑐᐊᕐᓂᐅᒃ ᐅᓄᖅᑕᐅᓂᖅᓂᒃ ᖃᓄᖅᑭᔪᓐ ᐅᕐᓚᐅᑎᓂᒃ ᐊᑐᖅᑕᐅᓂᖅᓂᒃ ᖃᓄᐃᓕᐅᖅ. ᐃᓕᓴᐅᑎᓯᒪᔨᖅ ᑐᓄᓇᐊᓂ ᑐᑭᓯᐊᓂᒃ ᐊᐱᖅᓯᑎᕐᓴᖅᓂᖅᓂᒃ ᐅᓄᖅᑕᐅᓂᖅᓂᒃ ᖃᓄᐃᓕᐅᖅ.

ᐊᐅᓚᑎᓪᓗ 2, ᐱᖓᓱᓂᒃ ᐅᓪᓚᓂᒃ ᑲᑎᒪᓂᖅᓴᖅᓯᓚᐅᔨᑐᖅ ᓄᓇᕗᐅᒍᓂ ᓄᐊᑕᐅᑎᓪᓚᓕᒃ ᐱᓕᕐᓂᑐᐃᓪᓕ ᖃᐅᔨᓴᖅᐅᓂᖏᓐᓂᒃ ᖃᓄᖅᑭᔪᓐ ᓂᒋᐊᓂ ᖃᓚᕝᕙᖅᓂᒃ ᐊᑐᔨᑦᑕᑦ ᓄᓇᑕᐅᓂᐸᐃᓪ ᑕᕐᓂᖓᓪ ᐊᐅᓚᑎᓂᖅ 1. ᒡᓗᐊ ᓄᓇᑕᐅᓂᖏᓐ ᑐᓴᔭᕆᐃᓪ ᐱᓚᕆᐊᖓᓚᐅᔨᑦᑕᑦ 8-ᓂᒃ ᐊᓯᐅᑎᓂᒃ/ᐃᓪᓇᑐᖃᖅᓂᒃ ᒡᓗᐊᓗ ᓂᓗᐊᑦᑕᐅᓂᐹᓗᑎᒃ ᐊᐅᓚᓂᖅᑎ 1. ᒡᓗᐊ ᑐᓴᐅᒪᔭᕆᐊᖃᖅᐃᓪ ᓄᓇᑕᐅᓚᐅᔨᑦᓴ ᐊᔪᓚᐊᖓᔪᓗᑎᒃ ᐊᒪᒡᑕᐅᖅ ᖃᓪᓗᓇᑎᑐᓂᒃ/ᐃᓄᑦᑎᑐᓚᑦᑕᐅᓪᓗᑎᒃ ᑎᑎᕋᑕᐅᓪᓗᑎᓪᓗᓗ ᑕᒪᑲᒃᖃᓪᓚᕆᐊᖃᖅ ᖃᓪᓗᓇᐃᓐᑐᓚᐅᔨᑦᓴᖅᓂᒃ ᓇᒥᑐᐃᓐᓇᖅᑐᑦ ᖃᐅᔨᓴᖅᐅᓂᖏᓐᓄᑦ.

ᐊᐅᓚᑎᓪᓗ 3, ᑎᑎᕋᑕᐅᓂᓕᕆᓚᐅᖏᓐᓂ ᑭᖑᓪᓕᕐᓂᐊᓕᒫᓂ ᑐᓴᔭᕆᐊᖓᔪᓐ ᑕᓯᓕᒪ ᖃᐅᔨᓴᖅᓂᐅᑦ ᐊᐅᓚᑎᑕᐅᔪᖏᓐᑕ ᐱᓕᓂᐊᓘᓕᖏᓐᓄᑦ ᐊᑐᔨᑦᑕᓐᓄᑦ ᖃᐅᔨᓴᖅᐃᓕᐅᔪᓚᐃᓪ ᒡᓗᐊᖏᓐ ᓄᓇᕗᐅᒍᓂ ᖃᐅᔨᓴᖅᓂᖅᓂᒃ ᐱᓪᓕᐊᑎᓪᓗᓂᓐᓄᑦ ᑭᑭᖅᑕᓪᓚᕆᐊᖃᖅ ᑐᓄᓇᕗᑦ.

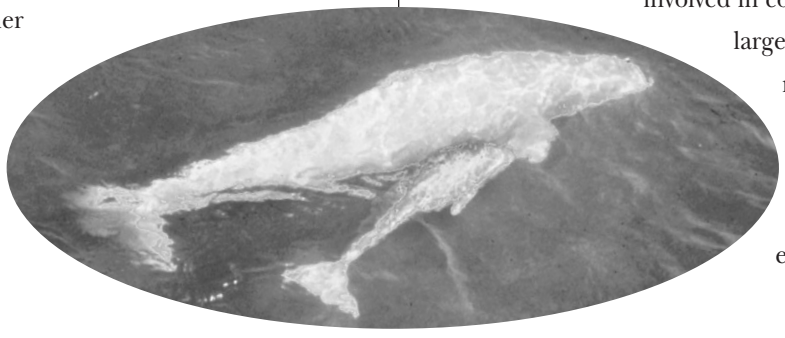
Overview of Southeast Baffin Beluga

Migration of whales

When Beluga whales leave the three communities in the fall, hunters are not certain where they go to winter.

Many believe some of the whales congregate in winter near the mouth of Frobisher Bay. This area is known by hunters from Iqaluit who hunt there when conditions permit. Beginning in April, whales are often seen from the floe-edge at all three communities. It appears that Iqaluit hunters can hunt both Pangnirtung and Kimmirut whale populations during this spring migration. In the summer very few whales are sighted around Frobisher Bay. Although an undetermined number of whales do summer around the bay, no permanent numbers are known to reside in the area.

Kimmirut hunters, with no whales summering in their area, instead hunt whales migrating towards Cape Dorset and beyond. It is in the fall migration that these whales return to the mouth of Frobisher Bay. The whales that migrate to the Clearwater Fiord reside there until fall or sometime in August after they have given birth to their young and have shed their skins or moulted. When they leave, they head towards the mouth of Frobisher Bay. However, due to high winds in the fall around the mouth of Frobisher Bay, minimal hunting for Beluga whales takes place. From this information, it appears that because of the extremely transient nature of the various whale populations – especially during the summer season – only a minimal number are being hunted by each community as per the allowable quotas.



Interestingly, hunters in each of the communities are able to identify individual whales sighted at different times of the year and belonging to different populations. These whales are identified by their physical characteristics and behaviour.

Different Stocks

It is certain that different whale populations or stocks migrate through the Kimmirut area, as opposed to those whales that go up to Clearwater to give birth and shed. The populations – though similar in body size and behaviour – travel in opposite directions at the same time of year. It is not clear, however, which stock Iqaluit hunters are hunting in the summer and, in fact, this could be a separate, smaller population from the two mentioned.

Changes in the behaviour, abundance and population of whales

All three communities agree that behavioural changes have occurred due to the noise of motorized boats and snowmobiles. Since the 1960s when motorized boats were first introduced to the North and hunters started using them to hunt whales, many changes have happened, both when and in the way the whales are hunted. Today, the whales are scattered in areas where they were once densely concentrated. Initially, the alien noise motorized boats brought was not feared. In fact, most whales were curious when they first heard them. Today, however, it is the last thing a whale wants to hear. Whales can hear from great distances and, as a result, avoid areas where motorized boats are heard. This has contributed to the thinning of whale concentrations and their population sizes.

Though Kimmirut and Iqaluit hunters have never been involved in commercial hunts to any large degree, still they have noticed a definite decrease in the numbers of whales available today compared to the numbers they hunted five decades ago.

In Pangnirtung, the commercial hunts carried out by whalers from the late 1800s into the early 1900s have had a great impact that has resulted in a significant decrease in the whale population. The Hudson's Bay Company was also active in the commercial hunts of Beluga whales in the early 1900s. Great numbers were taken and as a result, elders recall that the size of the population continued to shrink even years after the commercial hunts were stopped.

Despite the quota given to each of the three communities, an emphasis for more commercial hunting was not a consideration of those interviewed, instead they see a need to implement better methods of conservation and hunting as a primary concern.

Traditional ways, modern ways and equipment

Today, there is a high degree of competition among the hunters. This is the result of a decline in Traditional Knowledge and the introduction of modern hunting equipment. Quotas are the most cited reasons given for the increase in competition among hunters. It is apparent that irreversible changes have occurred since the mass introduction of modern equipment that hunters avail themselves to today. The elders interviewed are still optimistic that there is a chance for compromise – by adopting and abiding by the practices of Traditional Knowledge, the elders feel that once again hunters can re-establish a harmonious relationship with the Beluga whales.

As hunter Jooeelee Papatsie of Pangnirtung stated during the study: "We, the younger group of hunters, have taken you away from your traditional ways and replaced them with our modern ways of rushing into everything." This is a strong statement advocating the use of Traditional Knowledge to help close the extensive gap in the use of Traditional Knowledge that today exists in each of the communities.

Educational needs a priority

This study has introduced new views and understanding about the need to restore Traditional Knowledge as part of our school systems' curriculum. Currently, students learn about whales from other sources. There is no involvement from community elders on the subject. The three communities favour the creation and introduction of videos on selected topics. The videos could be produced in the communities and made available to the schools. There is also an identified need for written material in Inuktitut and English for teachers and students. Both videos and written material would promote Traditional Knowledge and skills.

There is also a desire to produce local or regional hunters' guidelines for hunting Beluga whales. These guidelines would ensure that hunters use the right equipment, that they use nets properly, butcher the whales properly, make safety a priority, use the proper calibre rifles, use proper harpoons and floats, practice proper hunting techniques and other related matters. An established set of guidelines would help ensure that there is minimal loss and wastage and keep the safety of hunters a priority. These guidelines would also be made available to the public in written form in Inuktitut and English.

Sampling program carried out by DFO

The Beluga Sampling Program has been conducted in the southeast Baffin communities since 1989. The Department of Fisheries and Oceans has led the program. Hunters are supplied with sampling kits through the community HTO, and hunters are paid for the samples they return. The purpose of the program is to collect important information on Beluga hunting and tissue samples and measurements from Belugas that are harvested. This information is used primarily to answer questions about stock identity through genetic and contaminant studies, and to monitor the reproductive rate and general health of Belugas.

It is unfortunate that the three communities have very little or no knowledge of the sampling program. Most participants at these workshops had not been consulted on the intentions and goals of the program. Because there has been no proper community consultation, only a few active HTO board members have any knowledge on the program. All participants expressed a sense of urgency for proper

community consultations. This could be done with written material on the program and the ensuing results. The participants felt that hunters would be more willing to assist if they were made to understand more about the sampling program. They also feel that NWMB should be more proactive in making the program better known to hunters and people involved in the program. There is, at this time, a lot of mixed feelings towards the program and its progress as those who have contributed information feel that they are getting little, if any, feedback, on the study results. Consequently, some hunters are avoiding using the kits. This needs to be addressed by the NWMB and DFO.

Conclusion

Because this has been the most in-depth study to ever take place on the collection of Traditional Knowledge on the Southeast Baffin Beluga, the study has brought a better understanding to all the community participants. New opportunities and ways of hunting are being created with the information that has been collected, and new perspectives and views are being expressed. One would hope that this is how the study will be used – to improve the understanding and undertakings of all those involved.

I have enjoyed working with the people in the three communities and their hospitality was more than welcomed. I'd like to thank all those who gave me their advice, guidance and support in helping me to complete the study.

ᐊᐅᓪᓚᑦᓂᓂᖅᐳᓪ ᖃᓪᓗᓈᐃᓪ

ᑕᐃᒪ ᖃᓪᓗᓈᐃᓪ ᐊᐅᓪᓚᕐᓇᐃᒪᓕ ᑕᒪᖏᓪ ᐱᖏᓂᑐᖅ ᓄᓇᓕᐅᔪᓂ ᐅᑭᐊᖅᓴᐅᑦ, ᐊᓂᓕᕆᓂᖅ ᖃᐅᔨᒪᓂᕐᒥᓪᓗᑎᒃ ᓄᓇ ᖃᓪᓗᓈᐃᓪ ᐅᑭᐊᖅᓯᐅᓇᐊᓂᖓᓕᒫᑦ.

ᑭᓯᐊᓂ ᐱᑕᖃᖅᓯᒃ ᓄᐃᑕᐅᔪᓂᒃ ᐃᓕᖅᒍᔪᓂ ᖃᓪᓗᓈᐃᓪ ᖃᓄᐅᔾᔨᓂᒪᓕᑕ ᓴᖅᓂ ᐃᖃᓗᐃᓪ ᐅᑭᐅᖅᑎᓪᓗᒍ. ᑕᒪᑦᔨᐊ ᖃᐅᔨᒪᓂᕐᒥᓪᓗᑎᒃ ᐊᓂᓕᕆᓂᖅ ᑕᒪᓐᓇᖅᑐᓂᒃ ᐊᓂᓕᖅᑐᓂᒃ ᐊᓂᓕᒍᓂᒃ ᐊᓂᒍ ᐊᖏᔪᒃ ᐱᐃᓕᓴᕐᓂᒪᓕᒫᑦ. ᑕᓪᓕᒃ ᑕᑭᒥ ᐊᐃᐅᐊᖅ ᑭᓯᐊᓂᓕᕆᓂᖅ ᑕᒪᓐᓇᖅᑐᓂᒃ ᐊᓂᓕᖅᑐᓂᒃ ᑕᐅᓇᖓᑕᒃᑯᓂᖅᓴᓂᒃ ᐊᓂᓕᒍᓂᒃ ᐊᓂᒍ ᐊᖏᔪᒃ ᐱᐃᓕᓴᕐᓂᒪᓕᒫᑦ. ᑕᓪᓕᒃ ᑕᑭᒥ ᐊᐃᐅᐊᖅ ᐊᓂᓕᖅᑐᓂᒃ ᑕᒪᓐᓇᖅᑐᓂᒃ ᐊᓂᓕᒍᓂᒃ ᐊᓂᒍ ᐊᖏᔪᒃ ᐱᐃᓕᓴᕐᓂᒪᓕᒫᑦ. ᑕᒪᑦᔨᐊ ᐊᐃᐅᐊᖅ ᐊᓂᓕ

ᓯᑐᓪᓕᕐᓂᒥ ᑲᕐᐱᐊᒋᕆᐅᓪᓗᐊᓚᐅᕕᖓᓕᖅᑐᖅ ᐊᒻᒪ ᐃᓚᖓᑦ ᓄᕐᐃᓯᕐᓚᓚᐅᕐᓇᑐᖅ. ᑐᓪᓗᒥ, ᓄᓇ ᕿᓚᓗᓂᐊᓪᓕᐅᑦ ᑐᓴᖓᑕᑐᐊᓚᓗᐊᖅᑐᐅᓕᐅᖅ ᖃᓄᐃᔪᖅᓯ. ᕿᓚᓗᓂᐊᕐᓯ ᑐᓴᕐᔪᖅᓚᖓᑦ ᖃᓄᖅᑕᑐᐊᓗᒥᖅ ᐊᒻᒪ ᓯᔪᓚᓴᔪᒪ ᑕᒪᖅ ᓄᑖᒪᑦᑎᓂᓕᕐᓂᒥᖅ ᓇᒪᔪᓂᓄᓕᕐᓂᒥᖅ ᓇᓕᓄᓕᕐᓂᒥᖅ ᐊᒻᒪ ᐊᒥᓄᓕᕐᓂᒥᖅ. ᑕᒪᖅᓚᑕᐅᖅ ᐱᓚᕐᓄᓄᓕᕐᓂᒥᖅ ᐊᒥᓄᓕᕐᓂᒥᖅ ᐊᒻᒪ ᐊᒥᓄᓕᕐᓂᒥᖅ. ᑕᐃᒪ ᑭᒡᓕᔪᐅᑦ ᐃᓚᖓᑦ ᐃᖅᓯᒪᔨᓕᕐᓂᒥᖅ ᐊᒻᒪ ᐃᖅᓯᒪᔨᓕᕐᓂᒥᖅ ᐊᒥᓄᓕᕐᓂᒥᖅ ᐊᒻᒪ

ᐅᖄᐃᓂᐅᕙᑦᑐᖅ ᐊᐅᓪᒋᑕᐅᔪᖅ ᐃᒪᖏᑕᒥᓂᕐᓂᓂᒃ

ᐃᓚᒃ ᐅᓄᔭᖅᑐᒃᓗᐊᖅ ᒋᑦᔨᐊ ᐱᖓᓱᑦ ᓄᓇᓕᐅᔪᑦ ᒥᑭᔨᔨᓗᒥᒃ ᐅᕙᓪ ᑐᑭᓯᐅᒪᓂᖅᖢᑎᑦ ᐊᖅᐳᓂᐅᔪᑎᑐᑦ. ᐊᒥᓱᓂᖅᓴᐃᑦ ᐃᓚᒋᐅᔪᑦ ᑲᑎᒪᓂᐅᔨᓂ ᐅᖅᐅᔪᐅᓯᒪᖢᑎᑦᑐᖅ ᑕᒪᑐᒪ ᓄᐃᓴᔨᓂᖅᓂᒃ ᐊᒻᒪ ᑐᔪᖅᖢᓂᒃ ᐱᓕᕆᔨᓴᒃ. ᐅᐱᖓᓇᔪᓂ ᐱᑕᖅᓚᐅᖅᓯᖢᑎᑐᖅ ᐊᐅᓚᓂᖅᑎᐊᖅᑐᒥᒃ ᓄᓇᓕᖅᓄᑦ ᐅᖅᖅᑎᖅᓂᒋᑦ, ᑭᓯᐊᓂ ᐃᓚᐃᖓᓇᖢᑦ ᒪᖓᓇᐅᔪᖅ ᖃᐅᔨᓴᖅᑎᑦᑐᖅ ᐊᐅᓚᓂᖅᑎᐊᖅᑐᒥᒃ ᐊᒻᒪ ᖃᐅᔨᓴᖅᑎᓯᓚᐅᖅᓯᒪᓂᖅᓯᒪᓕᖅᑐᒥᒃ. ᑕᒪᒃᑯᐊ ᐃᓕᐱᔨᓴᕐᔪᐊᓂᖅᓯᒪᓕᖅᑐᒥᒃ ᐊᒻᒪ ᖃᐅᔨᓴᖅᑎᓯᓚᐅᖅᓯᒪᓕᖅᑐᒥᒃ. ᑕᒪᒃᑯᐊ ᐃᓕᐱᔨᓴᕐᔪᐊᓂᖅᓯᒪᓕᖅᑐᒥᒃ ᐊᒻᒪ ᖃᐅᔨᓴᖅᑎᓯᓚᐅᖅᓯᒪᓕᖅᑐᒥᒃ ᐊᐅᓚᓂᖅᑎᐊ

Inuit Ecological Knowledge Study of the S/E Baffin Beluga

KIMMIRUT NT
APRIL 8, 9 & 10, 1997

INTRODUCTION

As part of the S/E Baffin Beluga Management Committee goals, an Inuit Ecological Traditional Knowledge Study was done in Kimmirut. Peter Kilabuk of Pangnirtung, with the involvement of the three communities, NWMB and DFO, planned out the study.

The Inuit knowledge and recommendations have been collected and are included in this report. The collection of the material was done with the involvement and support of eight hunters/elders in each of the three communities. This included the general knowledge, health, population, and hunting of the S/E Baffin Beluga. All the working material and final documents are the property of the NWMB and are available only through them.

The study was conducted at the Kimmirut HTO office with the group of eight hunters/elders listed below:

Newyaliak Qimirpik	Hunter
Sandy Akavak	Hunter/Elder
Josephee Padluq	Hunter
Paulosie Lyta	Hunter/Elder
Simeonie Aqpik	Hunter/Elder
Joanasie Lyta	Hunter/Elder
Eliyah Michael	Hunter Elder
Eeyeevadloo Josephee	Hunter
Mikidjuk Kolola	Hunter S/E Baffin Beluga Committee Member
Peter Kilabuk	Interviewer
Eezeedsiak Padluq	Assistant and Camera Man

MIGRATION

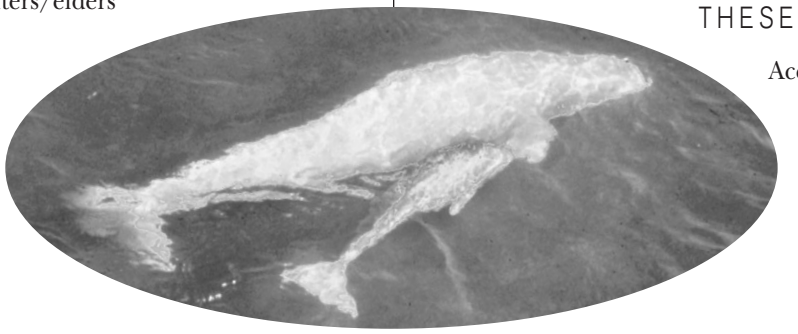
From their many years of combined Traditional Knowledge, the group of hunters and elders interviewed believe that because Beluga whales are rarely encountered during the summer months, Kimmirut hunters are hunting mostly migrating whales.

The whales that migrate through Kimmirut first arrive at the floe-edge in the spring (around April). They travel from the east to the west towards Cape Dorset (see map #97-01 enclosed) and may be found feeding in the waters near Kimmirut. There are no known areas near Kimmirut where the Beluga whales spend any length of time (during summer). Most of the whales that migrate tend to travel outside Big Island near Kimmirut (refer to map 97-01) as the current of the tide is steadier, allowing the whales to travel further.

On their return migration through Kimmirut waters in the fall, the whales tend to travel the same paths but in bigger herds. It has been noted that compared to the past, the whales are reaching Kimmirut much later in the fall, closer to freeze up.

CHANGES IN THE MIGRATION OF THESE WHALES

According to the study participants, the whales that migrate through



Kimmirut nowadays appear later in the spring and in smaller numbers. It was noted that this decrease is not due to over-hunting but rather due to some members of the population taking a different route during the migration. The decrease in numbers has been noticed since the early 1980s. Today, the whales do not return in the fall migration until much later – when the ice is forming and when it is difficult for the hunters to do any hunting by boat. The majority of the whales that migrate in these fall herds are females with young and juveniles. There are fewer male adults as there were originally in the mid 1900s.

Hunters in Kimmirut have very recently seen an increase in the number of individual whales and have noticed that the noise from motorized boats is deterring whales from reaching certain camps that were previously visited. This deterring effect changes from year to year, as does the number of returning whales.

Like Pangnirtung and Iqaluit, the main cause of this change in behaviour is attributed to the noise created by motorized boats and snowmobiles.

A more recent concern of the hunters has been an unknown source of explosive sounds that have been heard out in the open waters near Kimmirut. The sounds have been encountered by different hunters at different times in the summer. There is still no explanation for the cause of these sounds.

Feeding

Beluga whales do not stay near Kimmirut in the summer. The only time they may visit is when they are feeding off Arctic cod at the floe-edge in the spring or when following the direction of the currents when searching for cod in the summer. It is also thought that after a period of time if no more disturbances are sensed, the previously-hunted whales return to feed. This may be at the next tide or the following day. Aside from cod, there are no other food sources available near Kimmirut, although some invertebrates have been found in the stomachs of whales. See feeding area on map #97-02.

There are no calving areas known near Kimmirut.

Populations and distribution of migrating whales

When migrating west, upon reaching Kimmirut waters, the whales travel in more scattered herds than they do in the fall upon their return. The whales are often seen in small groups or individually when feeding, they then regroup later to form bigger herds. If disturbed, scattered whales will also eventually regroup to form bigger herds from the same numbers. Today it is felt that there are fewer whales than there were 40 or more years ago. No actual numbers are available on how many fewer whales there really are. Hunters suggest that motorized boats and the noise they bring may be redirecting some of the whales elsewhere. Overhunting is believed to have had little to do with this decline.

Commercial hunts by whalers or traders

According to the elders, in the early 1900s traders would trade for whale blubber. This, however, had a minimal effect on how many whales were actually hunted. Though some hunters may have traded blubber for tobacco if they couldn't make cash payments, most families only hunted what was needed for the camp. There were no organized hunts or blubber stored for the coming year or for trading which, if there had been, would have led to an increase in the numbers of whales being killed.

Health of the Beluga whales

Since the introduction of motorized boats, there is no evidence that there have been any detrimental changes in the general health of the Beluga whales. Though some individual whales have been found sick, too skinny or badly deformed, the general health of the Belugas has remained unchanged. Generally, the whales are fat when they reach Kimmirut in the spring, and skinnier in the fall when returning from their summering waters. Whales carrying young and calves tend to be fatter than the males in the same population. This is the natural annual cycle of all S/E Baffin Beluga whales.

Hunters have no reason to believe that there are any differences today in the way the muktuk and meat may appear in color or taste as compared to the earlier 1900s. The change that occurs with shedding (moulting) is an annual cycle and has no bearing on any other changes over the last decades. These whales are differentiated by age and by the color of their skin – the youngest calves being dark grey, then as they get older they turn whiter until they reach adulthood and remain white from then on. Hunters prefer the greyish whales as they are considered better eating.

Behaviour of the whales

Kimmirut hunters have seen major changes in the way these whales behave in their natural environment. Most behaviour changes started with the introduction of motorized transportation. The noise created by the motorized boats has made the whales detour by great distances. Whales will also flee any area where a motorized boat is detected. Hunters have also noticed changes in whale behaviour at the floe-edge. Where most whales used to dive close to the ice to feed, today, they either do less dive-ins or make their dive-ins from further out. During the night when all is quiet, the whales will often return to feed at the floe-edge. This is evident with the breathing holes they leave on the newly forming ice alongside the thicker ice. In general the major causes of behavioural changes are suspected to be the motorized means of transportation whether they be boats or snowmobiles.

Differences in sizes

Kimmirut hunters may very well be hunting smaller-sized whales than they would have been in the 1950s when there were bigger whales that are today notably absent from the population. The bigger whales were distinguished by being clean white in colour and having longer and bigger teeth than the present whales. They also travelled in larger pods. These larger whales can be traced back to "Numaayuuq" a scout and known whale leader who disappeared in the 1950s. This whale was particularly noted for its large physical appearance and its dominant role in the herd. The disappearance of "Numaayuuq" may be related to the ensuing absence of large whales which is still evident today in the Kimmirut area.

Sampling studies carried out by DFO

Hunters in Kimmirut, like hunters in Pangnirtung and Iqaluit, claim that they are not benefiting from the sampling studies carried out by DFO. Hunters have been very patient in waiting to hear about the results of these studies, as very little, if any, information is being passed onto them. Hunters here say the progress and process have been very slow with no consultations with the public and no written material being provided. There have also been no visits made by those running the study. Most people do not even know what the intentions of the study are.

Hunters also say that they have forwarded information to DFO and then never hear the study results. Though these studies have been carried out for a number of years, the hunters claim that there are not enough meetings or consultations being carried out on the study's progress or purpose. Although the hunters receive postcards acknowledging their input, it was suggested by the group that more information be returned to the hunters on the cards. The hunters have been given no indication on the health of the Belugas or any of the other findings from the studies. They also feel that the population group the whale is from should be noted on the cards.

Different populations reaching Baffin

Hunters in Kimmirut have noted different kinds and shapes of flukes and flippers for different whales. The ends of the fins often vary with the different populations. It is suggested that photos be made available to distinguish the different whales. The Kimmirut hunters feel that a certain population of larger Belugas that has longer teeth is no longer present. However, Sandy Akavak an elder/hunter, is not sure if this can be used accurately to determine the different populations. There was also mention of bigger whales with bent

front flippers that have been notably absent from Kimmirut since around 1982. The hunters feel that there may be different populations reaching the Kimmirut area now.

Changes at the outpost camps

There are notable changes that hunters have seen over the years concerning Beluga whales near the outpost camps. They are arriving later in the fall and they are fewer in number than in the past. The whales are also migrating farther out, probably in response to the sound of motorized boats. However, when an area has been undisturbed by motorized sounds, there are signs at the floe-edge that the whales do return. Kimmirut hunters still go out to the old outpost camps looking for whales but much less are found.

Hunters here are not able to recall if there have ever been any studies or counts done near these older outpost camps. The outpost camps are marked on map #97-03.

General hunting areas

Though Kimmirut hunters hunt at the different times of the year, they hunt in the same general areas in the spring, summer and fall. The spring and fall hunting area is marked on map #97-04. In these areas the hunters feel there has been a decrease in the population of migrating whales due to the more numerous motorized means of transportation. But in general, the hunters of Kimmirut are hunting the same general areas they would have hunted years back.

Hunting of Beluga whales

In avoiding unnecessary injury to the whales, only the injured are chased. Whales are chased closer to the land where it is shallower and where it's possible to hook dead sunken whales. This takes careful planning as the whales sink more in the fall. Kimmirut hunters insist that harpoons be used and that injured whales be hunted first to avoid unnecessary wounding of other whales. The percentage of hunters who use these practices is unknown. Other examples of knowledgeable hunting methods include: In deep waters where the whale might sink if killed outright, it is instead shot in an area that will not kill it right away – it is only shot and killed in shallower waters. Kimmirut hunters have also adopted new hunting methods. One example is that at the floe-edge harpoons are used less; big hooks (to retrieve a dead whale) are used instead which can be thrown out further and require less accuracy.

Nonetheless, hunters here have indicated that they would welcome and support the creation of local or regional hunting guidelines. Some of the topics suggested as guidelines include:

1) Distribution of catch (Traditional distribution methods)
2) Chasing of whales, including steering of whales
3) Safe hunting practices
4) Hunt leaders
5) Traditional laws i.e.: leaders to take first shot, etc.

The importance of developing guidelines was underscored by everyone in the group.

Traditional knowledge in the school programs

In Kimmirut, students learn about Beluga whales from outside sources. The reason for this is that there is no local knowledge material available to them in the schools. Hunters here feel this is a serious oversight and that material should be made available to the students. "We learned by taking part in the hunts and events," said one hunter. Hunters recognize the value of including students in the hunts and letting them witness first hand how they are correctly done. Sandy Akavak, an elder/hunter feels that this would be very beneficial for the students, and that it could be funded either through cultural inclusion programs, or activated through NWMB. It is also felt that it would be very beneficial if written materials could be made available to the students in Inuktitut and English. Some of the topics covered could include hunting methods, proper placement of shots, names and parts of whales, edible parts, sinew threads, drying of meat, and class visits by elders.

Beluga studies or counts

This was not discussed as hunters and elders said there had never been a study or count conducted near Kimmirut.

Beluga hunting with nets

Nets have been used near Kimmirut since the 1920s. They were used successfully even in the past when net material was hard to obtain. Seal nets were often used to catch whales. Today most nets are used in the fall when the whales are on their return migration. This occurs starting around September and usually lasts until freeze up.

The hunters in Kimmirut today use larger mesh sizes to avoid catching seals. The differences in a whale that is shot and killed and a whale caught in a net are quite noticeable. A whale that was caught in a net tends to be more salty, there is more blood in the blubber, the muktuk texture may be different and most noticeably the whale may be bloated. Bloated whale remains may not be suitable for consumption. Netted whales often yield products of lower quality than those from shot whales. To avoid this, hunters need to check their nets frequently.

Whales in Kimmirut Inlet

It was expressed that Beluga whales used to enter the inlet of Kimmirut more frequently and in larger numbers in the past. Today this is rarely the case. Numerous motorized boats and vibrations from the power plant are suspected to be the reasons why whales are not seen at Kimmirut anymore. The Beluga whales do not like foreign noises, and if they hear a foreign noise they will avoid the area. There are also natural cycles in certain years where whales will not show in a particular area.

Hunts and distribution of catch

Though there are no significant changes in the way whales are hunted today compared to the past, the introduction of motorized boats and snowmobiles have changed how a whale is hunted.

Today, unlike in the past, the whales are met at the floe-edge by snowmobiles or from lookout spots by boats. Before, people didn't hunt whales unless the whales were in the vicinity of the camp, thus the hunters didn't need to travel. Besides, there were no motorized means of transportation anyway.

At the conclusion of a successful hunt, the distribution of the catch is still an important part of the hunt in Kimmirut. Some traditional means of distribution are still practiced and are important to the community. Today in Kimmirut, hunters cut up the whale differently. Certain parts are not harvested anymore. In the past, the hunter who caught the whale would be allowed to take his share first, and have it cut up in a certain way. Not today. Now the skin is cut up in forms that have no traditional use. They used to make rope from the top part of the whale only. This was equally distributed among the hunters. Meat and tendons were cut in a certain way to make sinew. But this is not considered necessary anymore and as a result, the practice has disappeared. Today the flippers and vertebrae are still taken back for all the women to eat. However, because today there are more women, muktuk is added to make up for the insufficient number of flippers and vertebrae. This allows those less fortunate the opportunity to taste traditional country food within the community. One of the biggest changes has been in the way everything used to be divided equally for distribution. This is rarely practiced anymore.

Behavioural changes at the floe-edge

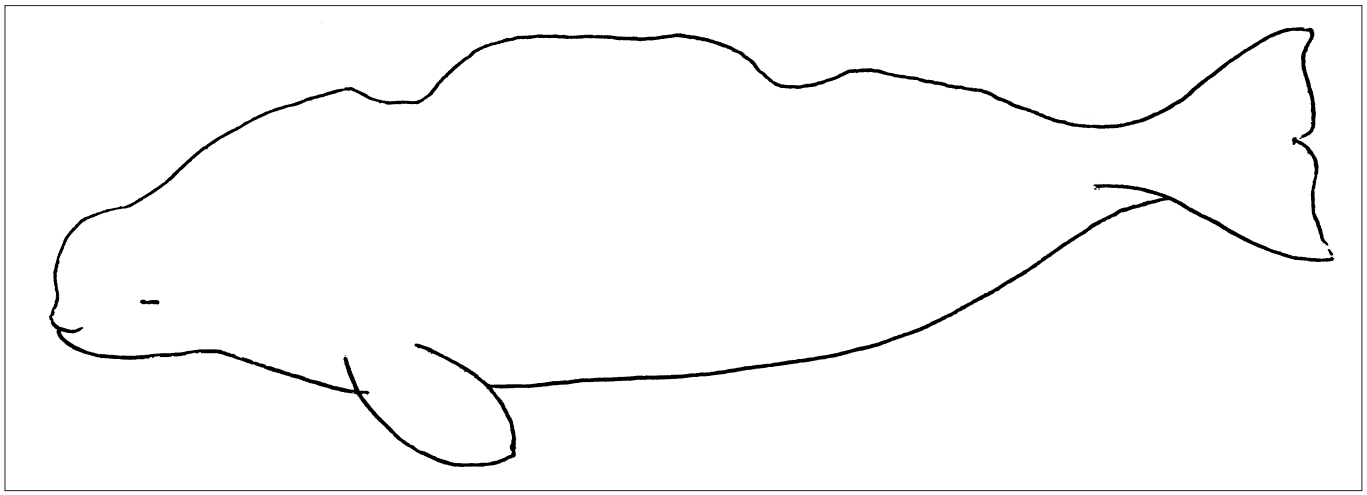
Like the other communities, Kimmirut hunters hunt whales at the floe-edge towards the spring. Some elders recall that there used to be more whales diving under the ice to feed. This was when hunters still used dogteams. As a result the whales were more vulnerable at the floe-edge. To minimize noise the hunters used to walk out to the floe-edge when they came across whales. Today there are less whales and the hunters use snowmobiles to arrive at the floe-edge before the whales arrive. Once again, foreign noise is suspected to be a problem for their shrinking numbers. The whales do not appear to be as playful anymore, but this could be due to the fact that they are just passing through during migration. There is no known area of mainstay (summering) for the whales or for shedding. Whales do not float still by the ice anymore; now they first move away from the ice and then float still. Some suspect this could be because they are

waiting for other whales who are still feeding. Whales are known to make noises of distress and playful whistling noises. When the leaders sense danger they give the distress call and all move away. But playful noise is hardly ever encountered by hunters here.

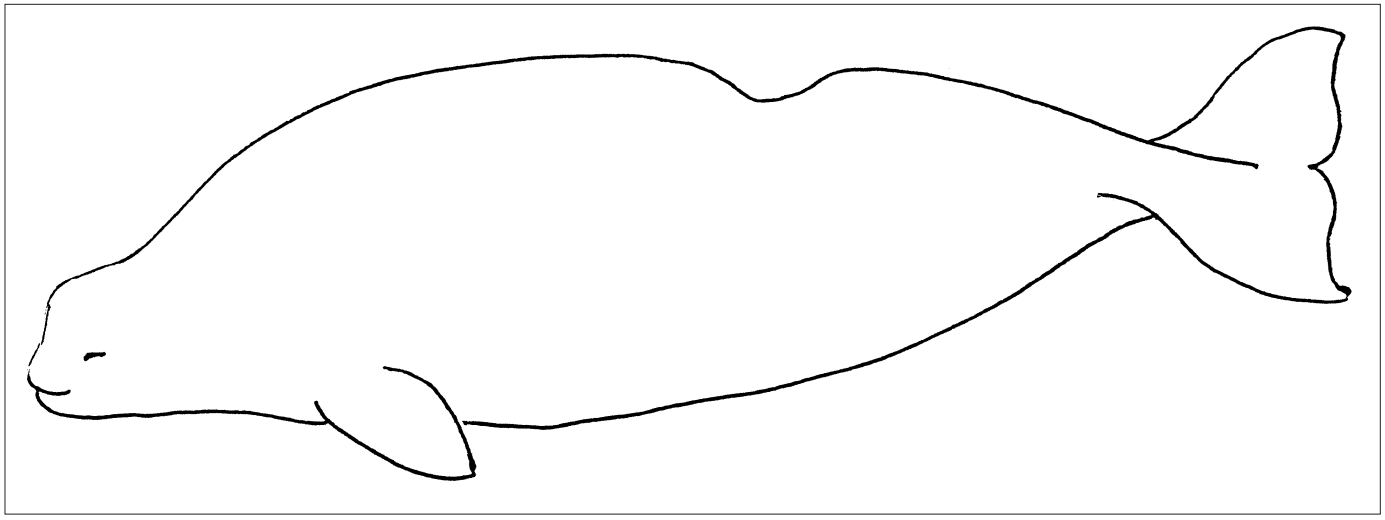
Some hunters think that less cod in the area, or because the cod have moved to another area, may be a factor in the decrease. There are many more harp seals feeding in the area now than before. When whales have fed, or if they sense danger, they move out to open water. They return to the floe-edge later. It was also noted that more dive-ins occur when there are more whales in the vicinity.

Badly scarred whales

There is a small group of three or four individual whales that Kimmirut hunters recognize at the floe-edge or near Kimmirut. They seem to act as scouts patrolling an area before the larger groups appear. The others may appear the same day or the next day after the scouts. These scarred whales tend to travel away from the ice and travel alone, but one is usually seen before the others. One whale has been known to appear almost annually since 1977. The others could not be dated. See diagram below of the badly scarred whales seen near Kimmirut.



A) 2 notches from side view (still seen today).



B) Notch in the lower back (still seen today).

EXPECTATIONS FROM THE WORKSHOP

A strong sense of finally having a say in the gathering and distribution of Inuit Traditional Knowledge to the public, and especially to younger age groups, was expressed by all hunters/elders involved. It was felt that the younger age groups will have a lot of new information to absorb and learn from, providing the information is made accessible to them. The people of Kimmirut expect that with the Final Report out, the information can also be used by Inuit to deal with Government Departments on various issues. Those interviewed felt that the other communities would share similar views and as a result, the report findings would make the three communities more united.

It was also expressed that hunters are not accustomed to note-taking but that if diary books could be made available for them to use, it could prove very beneficial (e.g. recording their sightings and catches of Belugas).

CONCLUSION

It is apparent that the hunters and elders of Kimmirut have seen changes in the behaviour, feeding, migration, and sensitivity patterns of the S/E Baffin Beluga. These changes have been caused since the 1960s, by the introduction of numerous motorized means of transportation. Beluga whales continue to be a very important part of their lives and means of diet. The changes in the whales' behaviour are not known by the younger generation. That makes this study all the more vital in preserving Traditional Knowledge and passing it on to a new audience. Kimmirut residents are strongly committed to preserving the whales which is apparent in the measures and practices being carried out by the hunters today.

SUGGESTIONS MADE TO NWMB AND DFO

The Kimmirut participants in this study would like to make the following suggestions to NWMB. This is with the understanding that they would be approached first before the guidelines are activated as other important topics may need to be addressed:

1) More Traditional Knowledge material should be made available for learning to the school systems and to the students of Kimmirut. These should include: hunting methods, places of proper fatal shots, safe hunting practices, names and parts of whales, edible parts, sinew thread making, drying of meat, and class visits by elders.
2) That a local or regional guideline be drawn up to include the following:
    1) Distribution of catch.
    2) Chasing of whales, including steering of whales.
    3) Safe hunting practices.
    4) Hunt leaders.
    5) Traditional Laws be used at hunts, i.e.: leaders to take the first shots, etc.

The nine participants would also like to suggest that the DFO sampling program be reviewed by NWMB and DFO regarding the following problems being addressed by hunters involved with the sampling program:

1) The intentions and goals of the program should be made known fully to the hunters in Kimmirut.
2) The cards being sent back to the hunters should include more information as to which populations the whales belonged to.
3) More meetings or consultations should take place with the public as to the results of the studies.

The above suggestions should be reviewed to improve the present school programs with the above noted, as there are no local materials available in Kimmirut on the Traditional Knowledge of S/E Baffin Beluga.

The sampling program as in the other two communities, can be improved to better the return of information. It has been made obvious with the participants that hunters are not clear at all as to the intentions and goals of the sampling program carried out by DFO. Nor are they getting any of the results these studies have to offer.

ᐃᓄᐃᑦ ᓇᒫᓂᕆᔨᒥᓄᑦ ᖃᐅᔨᓴᖏᓐᓂᖅ ᖃᐅᔨᓴᓇᓂᖅ ᒡᓗᓂᖓ ᓂᒋᐊᓂ ᑭᑭᓯᒡᓗᑉ ᑭᓪᓚᕆᖏᓐᓂᖅ

ᑭᒡᒉᔨᒥ ᓄᓇᑦᑎᐊᖅ
ᐊᐃᐅᓯ 8, 9, 10, 1997

ᖃᐅᔨᖅᐃᐱᕐᐊᖏᑦ

*ᐃᓕᓴᐅᓪᓗᓂᑐᑦ ᓂᒋᐊᓂ ᑭᑭᓯᒡᓗᑉ ᑭᓪᓚᕆᖏᓐᓄᓂ ᖅᑎᒪᔨᓴᓯᒡᓘᑉ ᑐᓴᖏᓪᓗᔪ, ᐃᓄᐃᑦ ᓇᒫᓂᕆᔨᒥᓄᓂ ᐱᔭᕇᖃᐅᔨᔪᐃᑦ ᖃᐅᔨᓴᓇᓂᖅ. ᒡᓗᐊ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔨᑐᖃᖏᑦ ᐊᒻᒪ ᐊᑐᓕᕐᒥᔨᖏᑦ ᐃᓕᓴᐅᓪᓗᓂᑐᑦ ᐅᐸᐅᓂ ᑐᑭᖅᑐᑎᒃᓴᒥᓂ. ᒡᓗᐊ ᓄᐊᕐᒥᐅᓂᖏᑦ ᐱᔨᐅᓕᐅᖅᑐᑦ ᐃᓕᓴᐅᓪᓗᓂᑐᑦ 8 ᐊᓯᔾᔨᑎᑦ/ᐃᓐᓇᖃᖅᐃᓐᓇᑦ ᒡᓗᓇ ᐃᓕᖑᕐᓂᖅ, ᐊᒻᒪᓗ ᐃᓄᐃᑦ ᖃᐅᔨᓴᓇᓂᖅ ᐊᑐᖅᑕᐅᓯᒪᔪᓂᑦ ᐃᓕᓴᐅᓪᓗᓂᑐᑦ ᐅᐸᐅᓂ

ᓴᖅᑭᕆᓂᕐᒧ ᐅᐱᖓᓱᓴᐅᔨᓂᖅᓴᖅᓄᑦ ᐊᒻᒪ ᖃᕋᐃᓇᔪᑕᐅᓂᖅᓴᓕᐅᔨᓂᐅᑉ ᐃᓕᓴᐃᓂᖅ ᑕᒪᓐᓇᔪᑕᐅᓂᖅᓴᖅᑎᑦ. ᓄᓇᓕᖅ ᐃᓚᖓᔾᔪᑎᒃᓴᓕᐅᓂᖅᓴᖅᑐᑦ ᑐᓴᐅᒃᑯᑦ ᐊᒻᒪ ᓄᓇᕗᑦ

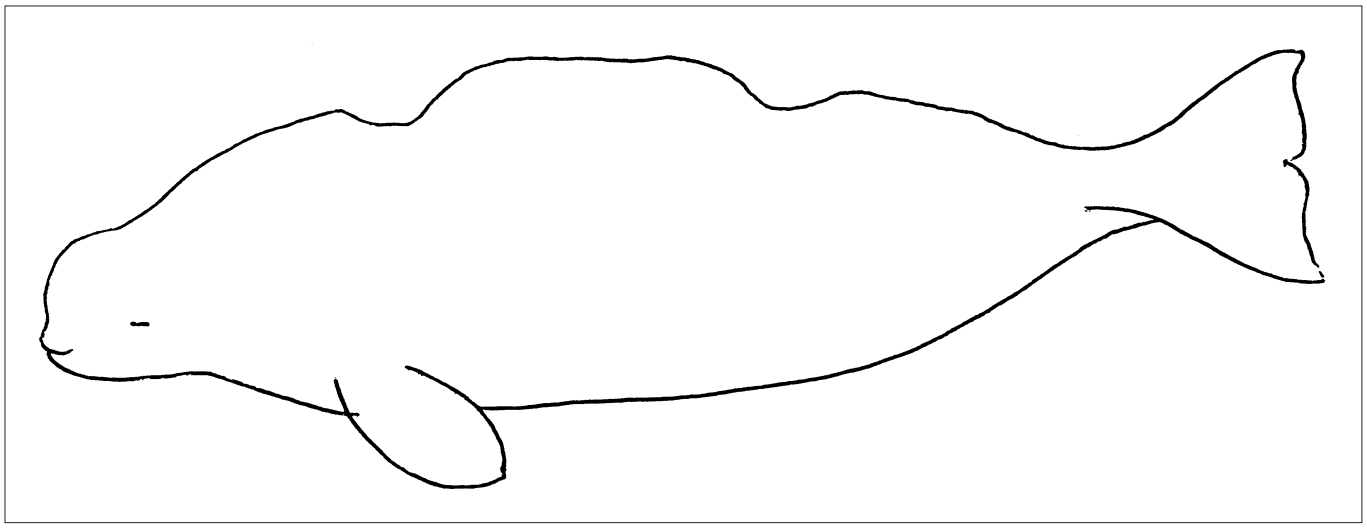
ᐃᓕᓴᐱᐅᓪᓚᑐᑎᓪ ᑭᑭᑦᑕᓪᓗ ᓂᕆᐊᓂ ᑭᓪᓚᕆᖅᓂᓄᑦ. ᑕᒪᒃᑯᐊ ᐊᒥᓪᓚᑦᑏᓐ ᐱᑕᖅᑭᖅᑐᑦ ᐅᓴᐱᓪᓂᕿᒻᒥᒃ ᐊᖅᐅᓪᓚᓂᖅᓯᒪᖅᑕᑦ ᒪᑦᑕᖅᒪᑦ, ᓂᑭᖅᑕᓗ, ᐊᒥᐊᖅᑕ, ᑎᐱᖅᑕ ᑕᐃᒪᓐᖅᓄᑦ ᐱᓕᕆᔨᑎᒋᓪᓗᑦ 1900-ᓪᓚᑦ. ᑕᒪᓐᓇ ᐊᖏᕐᒪᑐᒪᑦ ᐊᒥᓱᑎᑦᓚᓪᓚᖅ ᒪᒪᑦᓂᖅᒪᔪᑦ ᐊᖏᕐᒪᑐᐊᒪᖅᑕ ᐃᓕᖅᒥᓱᓕᒪᔪᑦ ᐃᓕᓴᐅᑎᒪᒪᔪ ᐊᒪᓗᓗ ᐊᒥᓱᑎᐅᒪᒪᖅᑎᑦ ᑲᖏᖅᓇᐅᑎᖅᖏᑦ ᐊᖏᕐᒪᑐᐃᓐᓇᖅᑐᑦ ᓇᓕᕆᔨᒋᓪᓚᑦ. ᑕᒪᒃᑯᐊ ᖃᓄᐃᓗᐊᖅ ᐊᒥᓱᑎᑦᓚᓪᓚᖅ ᑲᖏᖅᓯᒪᓂᖅᖏᑦ ᐊᖏᕐᒪᑐᐃᓐᓇᖅᑐᑦ ᑎᑎᕋᖅᑕᐅᓂᖅᖏᑦ ᑕᐅᑐᖅᓯᒪᓂᖅ ᖃᓄᖅᑕᖅᑭᑦ, ᑕᐃᒪ ᐃᓐᓇᕐᓂᖅᖏᑦ ᐃᓕᓴᐅᑎᒪᒪᔪ ᐊᒥᓱᑎᑦᓚᓪᓚᖅ ᐃᓕᓴᐅᑎᒪᒪᔪ ᐊᒥᓱᑎᐅᒪᒪᖅᑎᑦ

ᓄᓇᕗᑦᓴᓕᕆᔨᒃᑯᓐᓂᖅ ᐊᐅᔪᖅᑎᑦᑕᐃᓂᖅ ᐸᓚᓕᖅᑎᓂᖅ. ᐊᓯᐅᒃᑎᓐ ᑕᒫᓂ ᐃᓕᓴᕐᓂᖃᖅᑯᑦ ᐱᑕᖃᓂᖅᓱᖅᑕᒡᒐ ᑕᐃᔭᐸᐊ ᖃᓚᓕᓚᐃᑦ ᑭᒍᑎᐸᖃᖅᑐᓂᕐᓴᐃᑦ, ᑭᓯᐊᓂᑕᐅ ᓴᓐᑎ ᐊᑲᓐ, ᐃᓐᓇᑐᖅ ᐊᓯᐅᒃᑎᑎ ᒪᓕᑐᓯᓚᐅᒃᑐᖅ ᑕᒪᓐᓇ ᐊᑐᖅᑕᐅᔨᒃᑯᓐᓂᖅ ᐅᓇᓱᓐᓂ ᐊᐸᑦᑐᕐᑐᓂᖅ ᖃᓚᓕᓚᐃᑦ. ᑕᐃᒪᑦᑕᐅ ᐅᖃᓕᑕᐅᓚᐅᖅᓯᐊᐃᑦ ᐊᖏᔪᓕᑕᐅᓂᖅᓴᐃᑦ ᖃᓚᓕᓚᐃᑦ ᒪᓕᑐᓯᓚᐅᒃᑐᖅ ᑕᒪᓐᓇ ᐊᑐᖅᑕᐅᔨᒃᑯᓐᓂᖅ. ᑕᐃᒪᑦᑕᐅ ᐅᖃᓕᑕᐅᓚᐅᖅᓯᐊᐃᑦ ᐊᖏᔪᓕᑕᐅᓂᖅᓴᐃᑦ ᖃᓚᓕᓚᐃᑦ ᒪᓂᓯᖅᓴᐃᓚᐅᓂᖅᓴᐃᑦ ᖃᓚᓕᓚᐃᑦ ᑭᒍᑎᐸᖃᖅᑐᓂᕐᓴᐃᑦ ᑕᒪᓐᓇ ᐊᑐᖅᑕᐅᔨᒃᑯᓐᓂᖅ ᐱᓕᕆᔨᒃᑯᓐᓂᖅ ᑭᒍᑎᐸᖃᖅᑐᓂᕐᓴᐃᑦ ᖃᓚᓕᓚᐃᑦ ᑭᒍᑎᐸᖃᖅᑐᓂᕐᓴᐃᑦ ᖃᓚᓕᓚᐃᑦ ᐱᓕᕆᔨᒃᑯᓐᓂᖅ ᐱᓕᕆᔨᒃᑯᓐᓂᖅ ᐱᓕᕆᔨᒃᑯᓐᓂᖅ

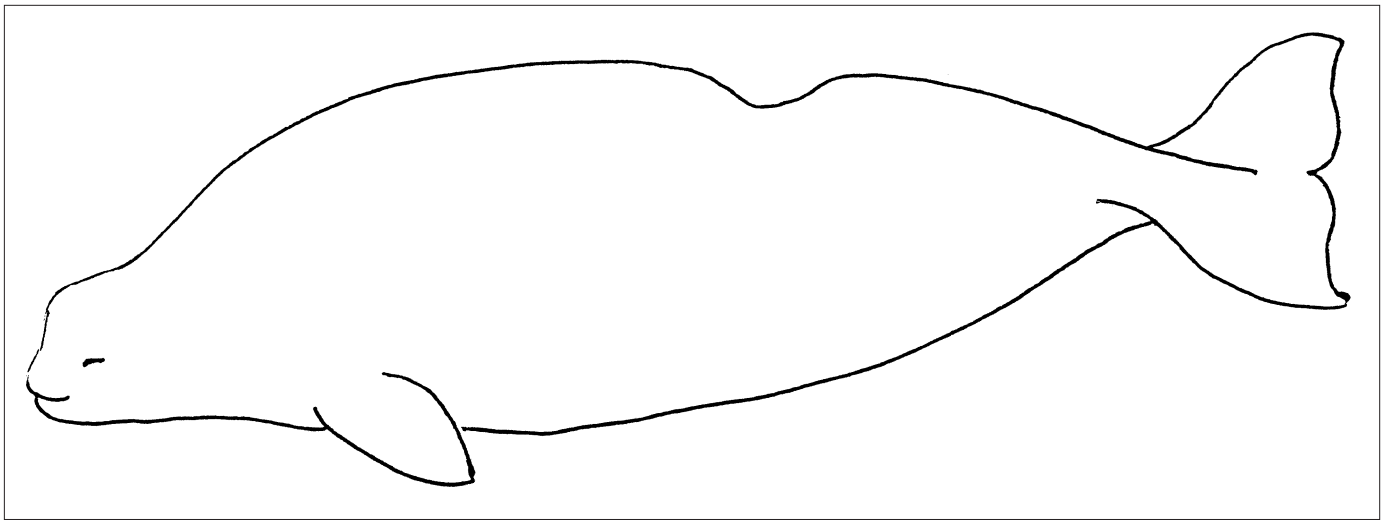
ᐱᖅᓯᓪᓗᖅᐅᒃ ᖃᐅᔨᒪᓴᐅᓂᖅᖢᓂ ᐃᓕᓐᓂᐊᕐᓇᖅ

ᑭᒡᒉᒡᒥ ᐃᓕᓐᓂᐊᖅᑎᓐ ᐃᓕᓐᓂᐊᕐᑎᑕᐅᑦᑐᖅᑐᓐ ᑭᓪᓚᕆᐊᑦ ᒥᓴᕐᓚᓂᑦ ᓯᓚᑦᑕᓂᖅᓱᒪᓕᕆᓂᑦ ᐱᑕᖃᓐᖓᓕᑦ ᐊᑐᐃᓐᓇᖅᑐᖅ ᓄᓇᕗᐅᔪᒃ ᖃᐅᔨᒪᓴᖅᓂᓕᒃ ᐊᒥᒪ ᐊᖏᓇᓯᑕᐅᓂᖅᓂᓕᒃ ᑭᓪᓚᕆᐊᒃ ᖃᓄᐃᑦᑐᓕᕐᓂᐊᓯᒪᓴᖅᓂᓪᓗ. ᐊᖏᓇᓯᑎᑦ ᑕᒧᓂ ᐃᒋᐅᖃᖅᑎᒋᔪᑦ ᑕᖃᖅᑎᓪᓗᒍ ᐃᓕᓐᓂᐊᕐᑎᑕᐅᑦᑐᖅᑐᓐ ᐊᑐᐃᓐᓇᕐᓂᖅᓱᒪᓕᕆᓂᑦ ᐃᓕᓐᓂᐊᕐᑎᑕᐅᑦᑐᖅᑐᓐ ᐊᖏᓇᓯᓐ-ᖃᕆᑦᓂᔪᓄ ᐊᑦᒪ ᐱᓕᕆᔨᖃᕆᑦᓂᔪᓄ” ᑕᐃᒪᓐᓇᖅ ᐅᖃᓕᖅᖢᓂᖅᓂᖅ. ᐊᒥᒪᑕᐅᖅ ᓇᒋᓂᕐᒥᓄ ᑕᑯᓇᔨᑦᑕᓪᓗᖅᓱᒪᓕᕆᓂᑦ ᓄᑎᓐᓂᔪᒪ ᐊᖏᓇᓯᓐ-ᖃᕆᑦᓂᔪᓄ. ᓴᓐᑎ ᐊᖃᓕᖅ ᐃᓄᑐᖅ ᐃᓯᐊᓯᖅᑎᑐᖅ ᐃᓱᐱᔨᖃᓕᕐᖓᓂᖅ ᐱᓕᕆᔨᒪᓕᕆᓂᑦ ᐃᓕᓐᓂᐊᕐᑎᑕᐅᑦᑐᖅᑐᓐ ᖃᓄᐃᑦᑐᓕᕐᓂᐊᓯᒪᓴᖅᓂᓪᓗ ᐃᓕᓐᓂᐊᕐᑎᑕᐅᑦᑐᖅᑐᓐ ᐊᖏᓇᓯᓐ-ᖃᕆᑦᓂᔪᓄ. ᐃᓕᓐᓂᐊᕐᑎᑕᐅᑦᑐᖅᑐᓐ ᐊᖏᓇᓯᓐ-ᖃᕆᑦᓂᔪᓄ

ᐅᓪᓗᒥ ᑭᓱᖏ ᐊᒻᒪᓕᐅᕈᓪᓕᖅᑐᖅ ᖃᓄᐃᐃᓐᓇᖅ ᐊᑐᑎᖃᖅᓇᓂᖅ ᖃᓄᐃᓕᒪᓐᓂᖅ ᑎᑭᓐᓂᒃ ᓂᕆᐊᓂᒃ ᑕᓪᓕᐊᓂᖅᑐᑦ. ᑕᐃᓕᒃ ᐱᒋᐊᕈᓐᓇᖅᑐᑦ ᑕᐃᓕᓐᓂᐊᖅ ᐊᒻᒪᓗᑎᑕᐅᓂᖅᑐᑦ ᐊᓂᒍᖅᑐᑦ. ᑕᐃᓕᖅᑐᒥ ᐃᓕᓴᐅᔪᓂᖅ ᐊᑐ



A) ᒪᓕᒃᓂ ᐃᓕᓴᕐᓂᖅ ᖃᓄᖅᓱᒃ ᓂᓚ ᑕᑯᐅᓕᕆᖅ



B) ᐃᓕᓴᕐᓂᖅ ᐊᒥᐅᔪᓂᓪᓕᐊᔭᓂᓴᖅ ᓂᓚ ᑕᑯᐅᓕᕆᖅ

ᓂᓗᐅᒋᔭᐃᑦ ᐱᓚᓗᖅᑎᒃᓂᔪᒥᑦ

ᓴᖅᓯᐊᒥᖅ ᐃᔪᐱᔭᐅᓚᐅᔪᓐᖅ ᐱᕕᖅᓚᑕᐃᓐᓇᕐᒥᑦ ᐅᖅᓯᓐᓇᔪᖅᑕᑎᖅ ᓄᐃᑕᐅᓂᖓᓂ ᐃᓄᓕᑦ ᐱᖁᓪᓗᖅᖃᔪᖅᓱᒍ, ᐅᓄᐊᔪᑎᒥᖅ ᐃᓄᓪᓂᓂᓴᐃᑦ ᐃᔪᐱᑦᓂᐅᑕᓄᐊᓚᐅᔪᓐᓇᑦ, ᐃᓄᓪᓂᓂᓴᐃᓐ ᐊᖏᓪᐊᓗᓄᒥᖅ ᑐᑭᓯᐊᖅᑐᑦᓂᖅ ᑐᓴᔪᓴᖅᖃᓂᖅᓱᒥᑦ ᑐᓴᔪᓴᖅᖃᓂᖅᓱᒥᑦ ᑲᑎᕕᒃᓴᓂᖅᓱᒥᑦ ᐊᑕᐅᓪᓚᐅᔪᓐᓇᑦ ᑕᒪᓐᓇᖅᑐᑦ ᐱᓕᕆᔨᒃᑯᓂᖅ

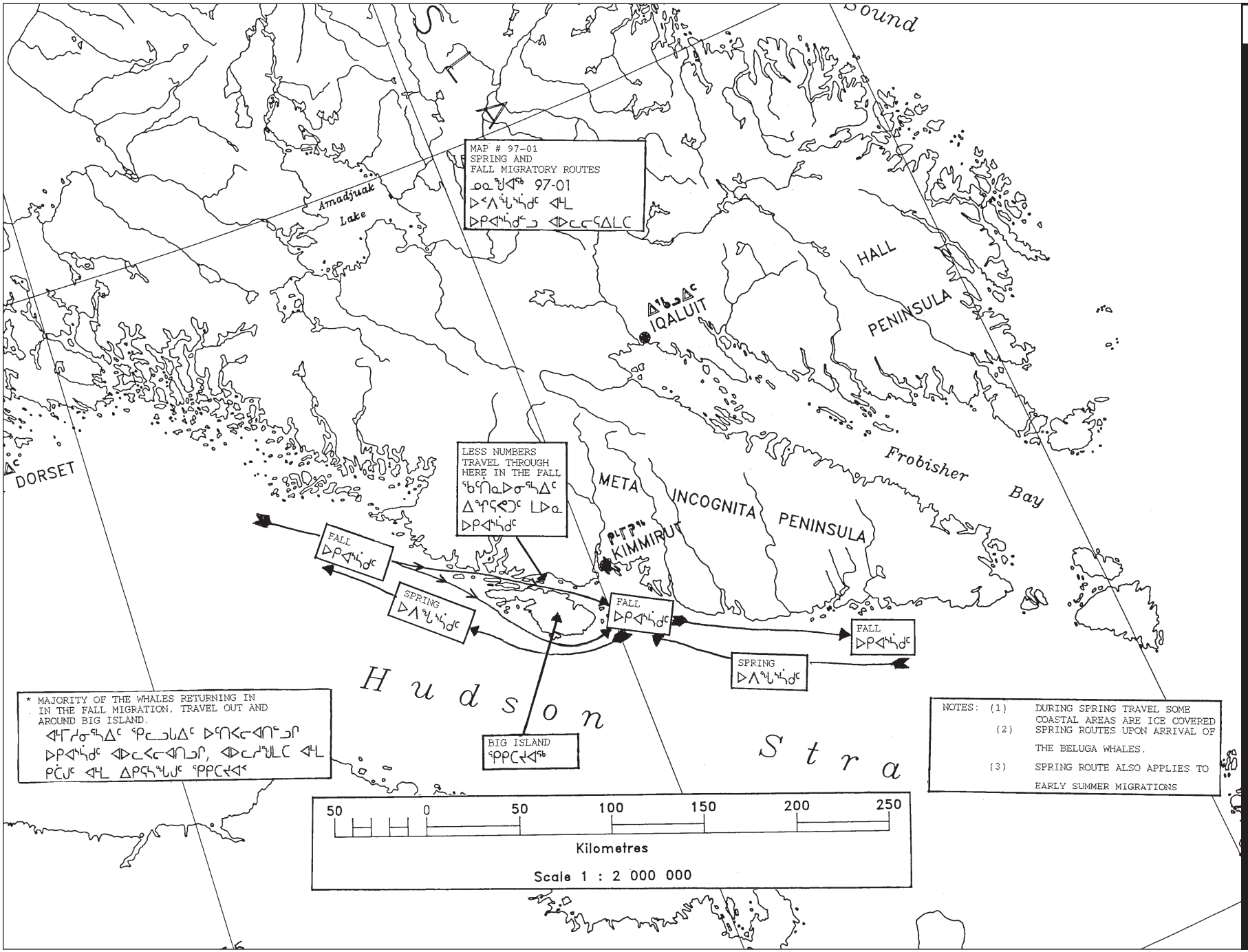
ᐃᓱᓕᑦᑎᐅᔪᓐᓇᖅᑐᖅ

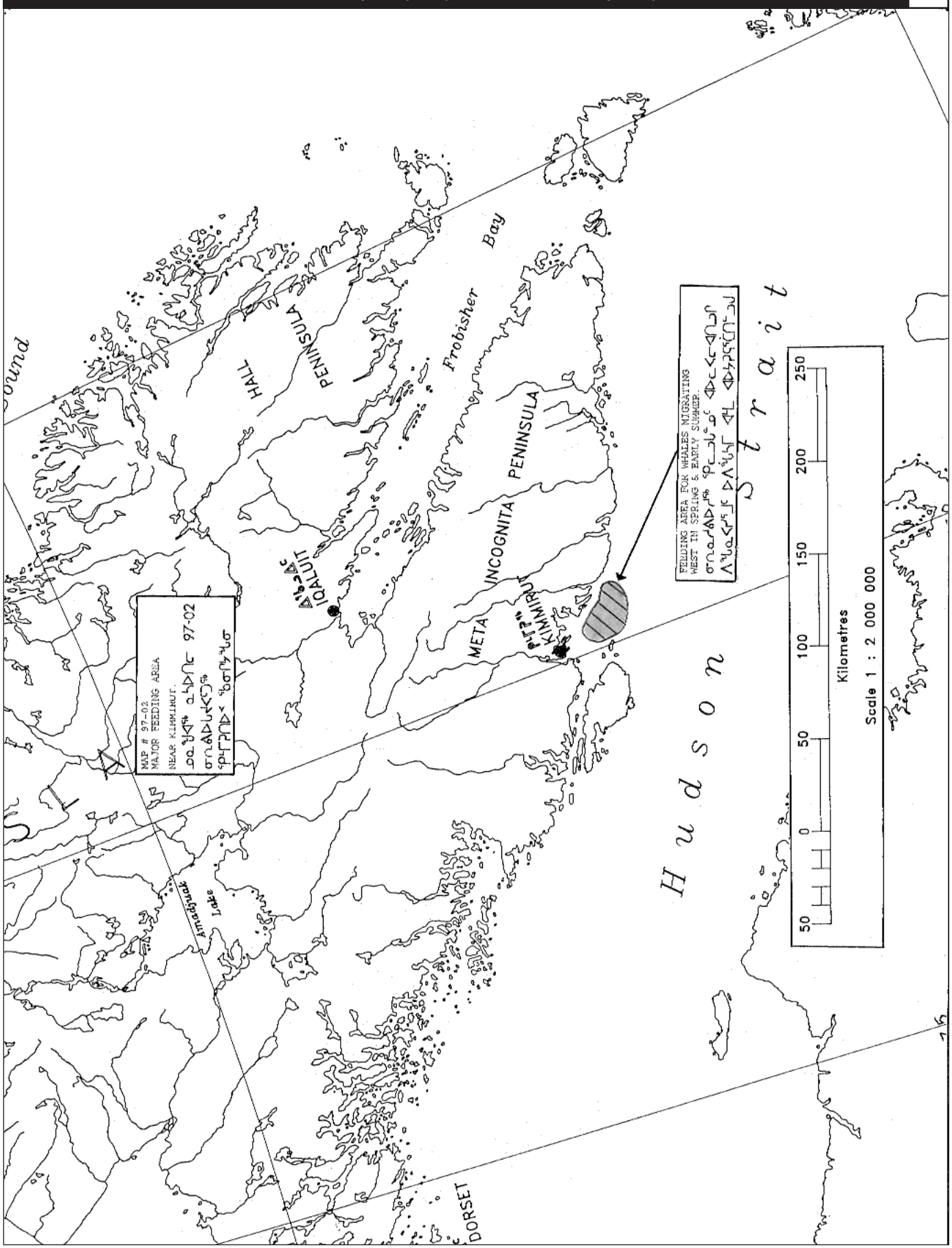
ᓄᓗᓇᔭᖅᓂᔪᖅ ᐊᓱᓚᑎᑲᖅ ᐊᒻᒪ ᐃᖅᓇᑐᖃᖅᑎᖅ ᑕᕐᓚᓂ ᑭᒡᒉᔪᒥᑦ ᑕᐃᓱᒪᔪᐃᓂ ᐊᓱᔪᓱᒪᔪᓂ ᐃᓕᓴᐃᓱᑎᓂ, ᓂᓚᓂᖅᑎᓂ, ᐊᒻᒪ ᐃᕐᐱᐅᓴᓐᖏᑐᐃᓂᓂ ᑭᑭᑦᑕᓗᒍ ᑭᓚᓗᖅᑎᓂᖅ, ᐊᒻᒪ ᐃᕐᐱᐅᓴᓐᖏᑐᐃᓂᓂ ᑭᑭᑦᑕᓗᒍ ᑭᒪᓗᖅᑎᓂᖅ. ᑕᒪᖅᐸᐃᔪᒪᒪᓪ ᐱᓗᐊᔪᒪᔪᓪ ᓴᑭᑦᑕᐅᑎᐊᔪᓂᑎᓂᖅᓂᖅ ᐊᑎᓯᓂᓴᐃᓪ ᐊᐅᓚᐅᑎᓕᑦᑕᑐᓪ ᑕᒪᖅᑐ 60ᖏᑦ ᑭᖓᓂᐊᓕᓄᑦ. ᑭᓚᓗᖅᑐᓪ ᓂᓪ ᐱᓪᓚᓂᔪᐅᑦᑐᑦ ᐃᓄᓂᖅᓂᖅ ᐊᒻᒪ ᓂᑭᒥᔪᐅᓪᓗᓂ. ᐊᓱᔪᑕᐅᓂᒪᓕᕆᑐᐃᓪ ᑭᒪᓗᖅᑎᔪᐅ ᐃᓕᓴᐅᓂᖅᓂᖅ ᖃᐅᔨᓴᐅᐃᓕᒪᑕ ᒪᐅᓂᓴᓂᖅ. ᒥᓐᓄᓪ ᐱᓪᓚᐃᓪ ᐅᓂᒃ ᐱᓪᓚᓂᔪᐅᑦᑐᑦᓯᑦ ᐃᓄᓂᖅᓂᖅ ᐊᒻᒪ ᓂᑭᒥᔪᐅᓪᓗᓂ. ᐊᓱᔪᑕᐅᓂᒪᓕᕆᑐᐃᓪ ᑭᒪᓗᖅᑎᔪᐅ ᐃᓕᓴᐃᓱᒪᔪᓂ ᖃᐅᔨᓴᐅᐃᓕᒪᑕ ᒪᐅᓂᓴᓂᖅ. ᒥᓐᓄᓪ ᓴᓐᓂ ᐋᕐᓯᓪᓗᓂ. ᑭᒡᒉᔪᒥ ᓴᖅᓯᐊᒥᖅ ᐃᓱᐊᑎᔪᓂᑦ ᐱᐅᔪᓴᐊᓂᖅᑎᓂᖅ ᑭᓚᓗᖅᑎᓂᖅ ᐊᒻᒪ ᑕᐅᔭᓴᐃᓐᓇᑎᓂᖅ ᐅᓐᓂᑐᐅᓯᓂᖅ ᐊᒻᒪ ᑕᐃᔪᑕᐅᓚᐅᓂᖅ ᐅᓐᓂᑐᐅᓯᓂᖅ ᐊᓱᔪᓂᑎᖅᑐᖅ.

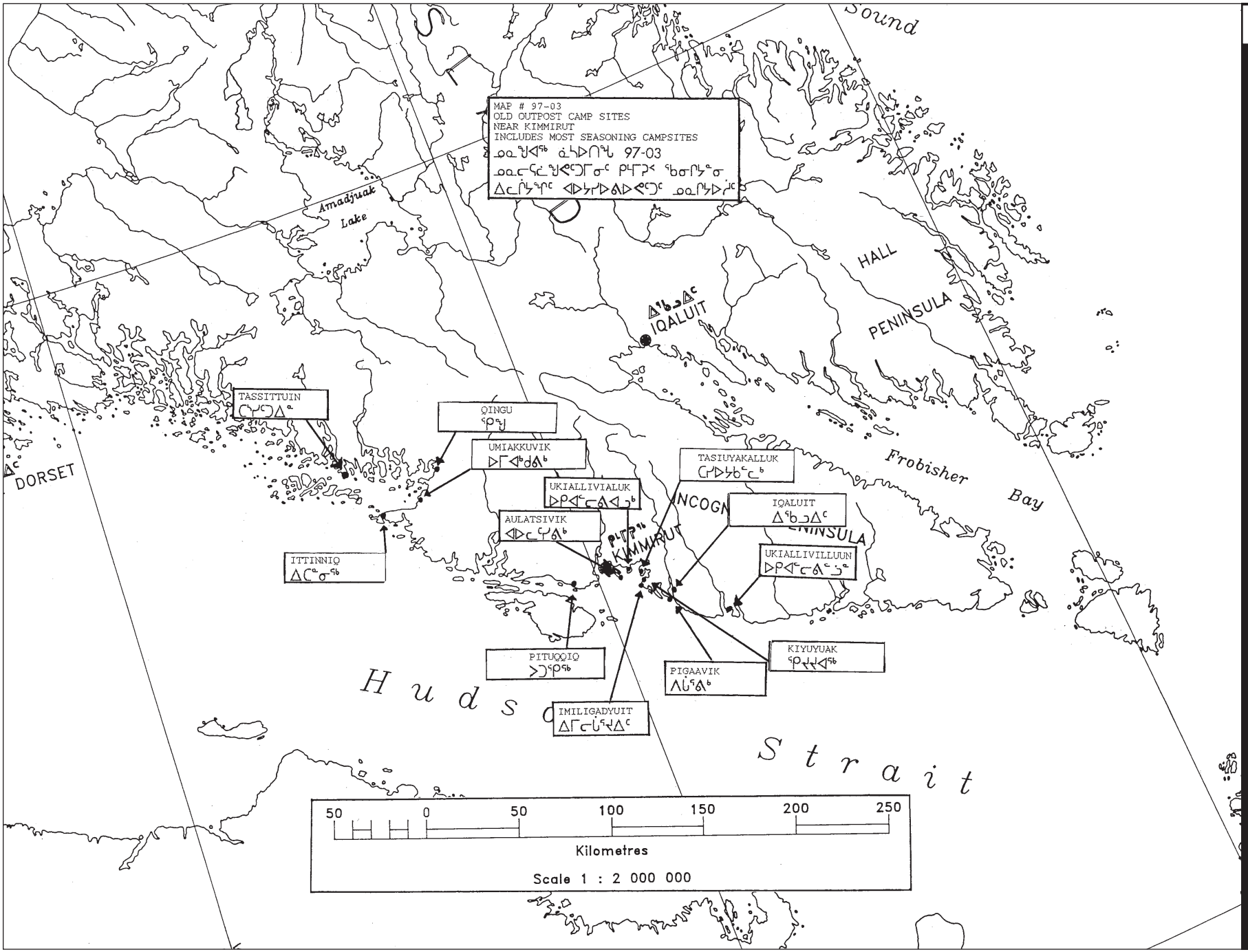
ᐃᓱᒪᓕᐅᔾᔨᑎᓴᐃᓐ ᓴᓇᔭᐅᔪᓐ ᐅᒪᓴᔪᐅᓯᓐᓂᐊᓕᐊᑯᓐᓇᓕᑦ ᐊᒻᒪ ᐃᓚᖏᑦᑕᓕᕐᓂᓐᓂᐊᓕᐊᑯᓐᓇᓕᑦ

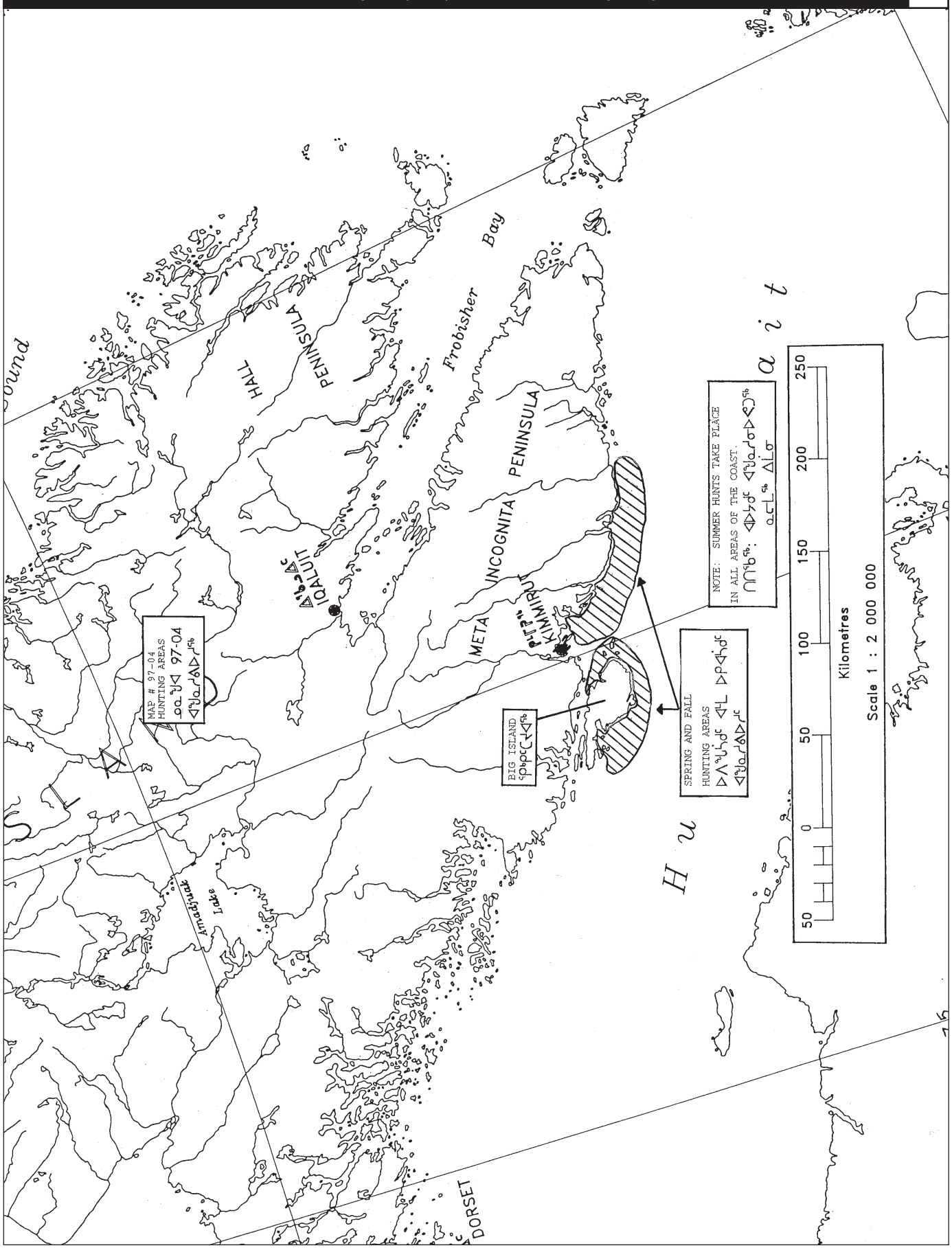
ᐃᓕᐅᔪᐃᐃᓪ ᑭᒡᒉᔪᒥ ᑕᕐᓚᓂ ᖃᐅᔨᓴᖅᓂᑯᓐ ᐊᖏᐅᓴᓴᖅᓯᒪᓕ ᐃᓚᐃᓕᓴᓐᓂᑎᓪ ᐅᑯᓂᖅ ᐃᓱᒪᒥᔭᐅᑎᓯᓂᖅᑎᓪ ᐅᒪᓴᔪᐅᓯᓐᓂᐊᓕᐊᑯᓐᓇᓕᑦ ᑕᒪᓐᓇ ᑐᑭᓯᐅᓚᓐᖏᑐᖅᓯᒪᓕ ᐊᒻᒪ ᐃᓚᖏᑦᑕᓕᕐᓂᓐᓂᐊᓕᐊᑯᓐᓇᓕᑦ ᐊᓱᔪᓂᑎᖅᑐᖅ ᐊᒻᒪ ᐃᓚᖏᑦᑕᓕᕐᓂᓐᓂᐊᓕᐊᑯᓐᓇᓕᑦ ᐊᓱᔪᓂᑎᖅᑐᖅ.

1) ᐱᐅᖃᓂᓴᐃᓂᖅᓯᒪᓕ ᐱᓱᓕᑐᖃᖅᑎᖅ ᖃᐅᔨᓴᖅᓂᑯᓐᓇᓕᑦ ᐃᓕᓐᓂᐊᓕᐊᑯᓐᓇᓕᑦ ᐊᑐᐃᐃᓐᓇᖅᑐᖅ ᐃᓕᓐᓂᐊᓕᐊᑯᓐᓇᓕᑦ ᐅᓐᓂᑐᐅᓯᓂᖅᑎᓪ ᐃᓕᓐᓂᐊᓕᐊᑯᓐᓇᓕᑦ ᐅᓐᓂᑐᐅᓯᓂᖅᑎᓪ ᐃᓕᓐᓂᐊᓕᐊᑯᓐᓇᓕᑦ ᐅᓐᓂᑐᐅᓯᓂᖅᑎᓪ. ᑕᒪᓐᓇ ᐃᓕᖃᓚᐅᖃᖅᑎᖅᓯᒪᓕ: ᐊᖏᐅᓴᓐᓂᓕᓪ, ᓇᐅᔨᑦ ᓯᑕᐃᓴᖃᐅᔨᓴᕐᓇᑐᖅᓯᒪᓕ, ᐊᑎᓕᓴᐃᑎᐅᓂᓴᒧᑦ, ᐊᑎᓂᑦ ᑭᓴᖅᓂᑎᓕᕐᓂᓪ ᖃᐅᔨᓴᐅᓕᕆᓂᖅ, ᓂᓚᔨᓴᐃᐅᓂᖅᓂᖅ, ᓂᓚᔨᐃᓕᐅᓂᖅᓂᖅ ᐊᒻᒪ ᐳᓕᖃᖅᑕᑦᓂᖅᓂᖅ ᐃᓇᑐᓂᖅᓂᖅ ᐃᓕᓐᓂᐊᓕᐊᑯᓐᓇᓕᑦ.
2) ᓇᓇᕐᐳᒍᑦ ᐅᕐᓴᓗ ᓇᓇᕐᓚᓂᑦ ᐊᑐᐃᐃᓐᓇᖅᑐᖅ ᓴᓇᔭᖅᓂᓗᓂ ᐃᓕᓴᐅᑎᓪᓗᑦ ᐅᔨᒪᓂ:
   1) ᓂᖅᑎᔪᓂᖅ ᖃᐅᔨᓴᕐᒥᖅ.
   2) ᒪᓕᓐᓂ ᖃᐅᔨᓴᔪᓂᖅ ᐃᓕᖃᓗᓂ ᐅᖓᓯᓂᒥᖅ ᖃᐅᔨᓴᔪᓂᖅ.
3) ᐊᕐᑕᕆᓕᖅᓯᒪᓕ ᐊᓱᓚᑎᑲᖅ ᑐᓴᐅᒪᔪᓂᑦ ᐅᖓᓯᓂᒥᖅ ᐃᓕᓐᓂᐊᓕᐊᑯᓐᓇᓕᑦ ᐊᓱᓚᑎᑲ


MAP # 97-01
SPRING AND
FALL MIGRATORY ROUTES
ᓄᓇᕗᑦ 97-01
ᐅᖃᐅᓯᖏᑦ ᐊᒪ
ᐅᑭᐊᖏᑦᓗ ᐊᐅᓚᕋᐃᒪᒃ
Amadjuak
Lake
HALL
PENINSULA
ᐃᖃᓗᐃᑦ
IQALUIT
DORSET
LESS NUMBERS
TRAVEL THROUGH
HERE IN THE FALL
ᖃᓕᑎᓐᓄᐅᑉᓴᖅᐃᑦ
ᐃᓕᓴᕐᔪᑦ ᒪᐅᓐ
ᐅᑭᐊᖏᑦ
META
INCOGNITA
PENINSULA
Frobisher
Bay
ᑭᒥᒥᕈᑎ
KIMMIRUT
FALL
ᐅᑭᐊᖏᑦ
SPRING
ᐅᐱᓯᖏᑦ
FALL
ᐅᑭᐊᖏᑦ
FALL
ᐅᑭᐊᖏᑦ
SPRING
ᐅᐱᓯᖏᑦ
Hudson
Strait
BIG ISLAND
ᖃᑭᒡᓘᖅ
* MAJORITY OF THE WHALES RETURNING IN
IN THE FALL MIGRATION, TRAVEL OUT AND
AROUND BIG ISLAND.
ᐊᒥᓱᓄᖅᐃᑦ ᖃᑭᓗᒪᐃᑦ ᐅᖃᑎᒌᓕᐊᑎᒋᓗᑎ
ᐅᑭᐊᖏᑦ ᐊᐅᓚᕋᓕᐊᑎᓗᑎ, ᐊᐅᓚᓯᖓᒪᑕ ᐊᒪ
ᑭᒃᑯᑦ ᐊᒪ ᐃᑭᕆᖓᑲᑦ ᖃᑭᑭᓚᐊᑦ
NOTES: (1) DURING SPRING TRAVEL SOME
COASTAL AREAS ARE ICE COVERED
(2) SPRING ROUTES UPON ARRIVAL OF
THE BELUGA WHALES.
(3) SPRING ROUTE ALSO APPLIES TO
EARLY SUMMER MIGRATIONS
50 0 50 100 150 200 250
Kilometres
Scale 1 : 2 000 000


MAP # 97-02
MAJOR FEEDING AREA
NEAR KIMMIRUT.
97-02
FEEDING AREA FOR WHALES MIGRATING
WEST IN SPRING & EARLY SUMMER.
Hudson Strait
Frobisher Bay
HALL PENINSULA
IQALUIT
META INCOGNITA PENINSULA
KIMMIRUT
Amadjuak Lake
DORSET
50 0 50 100 150 200 250
Kilometres
Scale 1 : 2 000 000


MAP # 97-03
OLD OUTPOST CAMP SITES
NEAR KIMMIRUT
INCLUDES MOST SEASONING CAMPSITES
ᓄᓇᕗᑦ ᐊᒃᑲᑎᖅ 97-03
ᓄᓇᓕᒋᐊᕐᓂᑦ ᑭᒪᔪᑦ ᖃᓄᖅᑐᓂᒃ
ᐃᓕᓴᕐᓂᑦ ᐊᑐᕆᐅᐊᑦᑕᕐᓂᑦ ᓄᓇᕋᐅᔪᓐᓇᖅ
Sound
Amadjuak Lake
HALL PENINSULA
IQALUIT
ᐃᖃᓗᐃᑦ
TASSITTUIN
ᑕᓵᑦᑐᐃᓐ
QINGU
ᖁᓐᖏᖅ
UMIAKKUVIK
ᐅᒥᐊᒃᑯᕕᒃ
UKIALLIVIALUK
ᐅᑭᐊᓪᓕᐊᓕᓗᒃ
AULATSIVIK
ᐊᐅᓚᑦᓯᒃ
ITTINNIQ
ᐃᑎᓐᓄᖅ
DORSET
TASIUYAKALLUK
ᑕᕆᐅᔪᒃᓚᒃ
IQALUIT
ᐃᖃᓗᐃᑦ
UKIALLIVILLUUN
ᐅᑭᐊᓪᓚᐃᓪᓗᓐ
KIMMIRUT
ᑭᒥᒥᕐᒃ
PITUQQIQ
ᐳᑐᖁᖅ
PIGAAVIK
ᐱᒋᖁᐊᒃ
KIYUYUAK
ᖁᓕᓴᐊᖅ
IMILIGADYUIT
ᐃᒥᓕᒋᖁᐊᑦ
Frobisher Bay
Hudson Strait
50 0 50 100 150 200 250
Kilometres
Scale 1 : 2 000 000

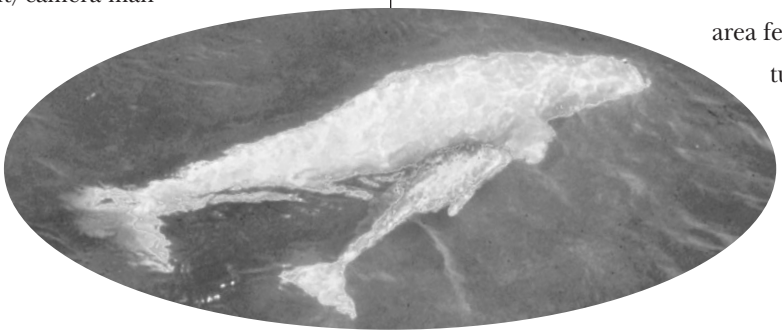

HALL PENINSULA
Frobisher Bay
IQALUIT
META INCOGNITA PENINSULA
KIMMIRUT
MAP # 97-04
HUNTING AREAS
97-04
BIG ISLAND
SPRING AND FALL
HUNTING AREAS
NOTE: SUMMER HUNTS TAKE PLACE
IN ALL AREAS OF THE COAST.
Amadjuak Lake
DORSET
Hu
ait
50 0 50 100 150 200 250
Kilometres
Scale 1 : 2 000 000

Inuit Traditional Knowledge on the S/E Baffin Beluga and Hunting Study, Report for Iqaluit

April 15 & 16, 1997, HTO Office in Iqaluit

As part of the Traditional Knowledge study on the S/E Baffin Beluga and hunting, eight hunters and/or elders from Iqaluit selected by their HTO participated in this study. The participants included:

Johnny Nowdlak	HTO chairman/hunter
Qutaiggut Lyta	Hunter
Akakaa Sataa	Elder/Hunter
Peter Itungat	Elder/Hunter
Jeetaloo Kakee	Hunter
Noshoota Jimmy	Hunter
Noveeya Ipeelee	Elder/Hunter
Simaniq Kilabuk	Hunter
Peter Kilabuk	Interviewer
Mark Kilabuk	Assistant/camera man



An introduction was given by Peter Kilabuk on the study plans for the next few days. It was also noted that the study was being done in two other communities: Pangnirtung and Kimmirut. The study was being carried out through the NWMB to collect Inuit Traditional Knowledge of the S/E Baffin Beluga and hunting.

Migratory routes

The whales that come into Frobisher Bay and the Iqaluit area do not permanently reside there. The whales spend a very short time in the area throughout the summer and in some years very few have been sighted. In the spring, however, many are found at the floe-edge out in Frobisher Bay. Many or most of these whales will migrate outside of the bay. When the whales do travel towards Iqaluit, they travel mostly on the west side of Frobisher Bay, although some have been seen travelling in the middle of the bay. (See map #97-01 Migratory Routes.) As in the other two Communities – Pangnirtung and Kimmirut – motorized boats and other means of transportation have affected where the whales travel. As one hunter said, "The whales are not given the chance to settle down." Hunters maintain lookout spots out in the bay. It was pointed out that there are probably whales throughout the winter further out in Frobisher Bay as evidenced by traces where they had surfaced through the ice at the floe-edge. When the whales are more active – in the early spring – the bigger yellowish whales tend to appear first, guiding the smaller whales. They seem to have the same travel pattern near the floe-edge each year. Overall, Iqaluit hunters have seen a decrease in the number of whales. Fewer are found today compared to the number found before on the west side of Frobisher Bay.

Feeding

The whales in Frobisher Bay or the Iqaluit area feed off Arctic cod, though turbot have also been found in the stomach contents of whales caught at both the floe-edge and the

Iqaluit area. Whales have been known to feed off char when char are returning up to the lakes. There are small size turbot on the deeper west side of Frobisher Bay which the whales also feed on at the floe-edge. Some invertebrates have also been found in some stomachs. (See map #97-02.)

Traditional hunting methods and equipment

Before the use of motorized boats towards the 1960s, the hunting of Beluga whales was quite different. Since ammunition was hard to come by, rifle shots were not used to steer the whales towards the land where hunters waited with their rifles. Kayaks were also used to steer the whales, the hunters created noise with the use of rocks and banging on their kayaks, or any other tools they could use to create noise. Harpoons were relied on much more and the "anguvigaq"* – similar to a harpoon – was sometimes the only weapon used to kill the whale.

Some families used nets, mainly in the fall. At the floe-edge the whales were only hunted if they showed up the same time that a hunter did. Hunters didn't go looking for whales at lookout spots like they do today. Also, no noise was allowed at any time before the hunters were ready to strike. The behaviour of the whales was undisturbed and as a result, methods used to hunt them were different. Whales came close to the ice and floating was part of their feeding and resting behaviour. Back then, designated hunters were chosen as sharp shooters. So accurate was their aim that some whales were killed with the use of 22 long rifles from sharp shooters perched high atop lookout spots.

Realizing that today, students and younger groups are less knowledgeable about Beluga whale hunting, the elder/hunter participants feel it would be beneficial if a video could be produced on the traditional ways of hunting whales.

** anguvigaq – killing lance or spear.*

Whalers and traders history

In Iqaluit and the Frobisher Bay area, the elders say there were no whalers and traders in the early 1900s. The elders suspect that because of the small number of whales back then, Beluga whale hunting never developed as an industry. Some elders only recall such activities near Kimmirut.

General health of the Beluga whales

In Iqaluit, the physical health of the whales has not changed according to the hunters and elders. Just a few sick individual whales have been found in the area over the years. Like the other Baffin belugas, the whales are fat from spring to summer and then lose a lot of their fat in the fall. The shedding (moulting) period is when they lose most of their fat. This is an annual change that the whales go through in the region. In the Iqaluit area, there is no evidence of any physical changes that have occurred in the whale population; not in their appearance and size, nor in the taste and texture of the muktuk and meat.

Behavioural changes of the Beluga whales

In Iqaluit, the hunters have seen changes in the whales' behaviour in feeding, migration, and in their populations and groupings. According to the Iqaluit hunters, the changes in whale behaviour can be attributed to the motorized boats and other mechanized means of travel. Whales are also feeding less at the floe-edge and in the summer due to numerous hunts in the area. They are migrating or travelling in smaller numbers and they are more scattered. Repeat disturbances in the area by hunters are also making the whales avoid areas where earlier they would have been found. Some of them are known to travel within ice packs to avoid hunters.

At the floe-edge, their behaviour has also changed in terms of feeding patterns. They no longer stay close to the ice when feeding nor do they float still after feeding. Many whales have learned to avoid hunters at the floe-edge. It is believed that noise has caused these changes. Hunting methods have also changed in the Iqaluit area with new equipment available to the hunters. Hunters no longer walk out to the ice to approach the whales. Instead they travel to the whales by snowmobile. Hunters also chase the whales

with their snowmobiles along the floe-edge. This is affecting the whales' behaviour to a great degree since most of Iqaluit's whales are found at the floe-edge.

Population and distribution of whales

In the Iqaluit area there are no summering whales. The number of Beluga whales differs from one year to the next. Some years, there have hardly been any whales due to ice packs in the bay.

Hunters and elders agree that there are not as many whales in Frobisher Bay nowadays as there used to be. The adult males travel in smaller pods unlike the juveniles and females who often travel in larger groups. It is not clear if there has really been a decrease in the number of whales with the information and knowledge forwarded, although it has been noticed that the whales are travelling in groups smaller than before. The elders and hunters are certain that motorized boats are causing the whales to be more scattered in the area. Before the introduction of motorized boats, elders recall seeing many whales that have never been seen in the area again. The noise of motorized boats is suspected to have been a big factor in the changes of the whale population and their distribution, especially when compared to past recollections prior to motorized vehicles being introduced.

As indicated earlier there are more whales found at the floe-edge than in the summer. The elders suspect the whales travel towards Pangnirtung from the Frobisher Bay floe-edge after the winter.

Sampling studies carried out by DFO

Like the hunters at Kimmirut and Pangnirtung, the hunters here have little knowledge if any on the intentions or reasons why there is even a sampling program on whales. It is apparent that a lot of the hunters are not being reached and that there is a definite lack of communication. Here again the hunters have not seen any results of studies that have been carried out. In Iqaluit the lack of communication between DFO, HTO and the public is creating problems. Some hunters are hesitant to use the sampling kits. Some of them feel that the information they forward on the questionnaire contains negative information that has no bearing on the sampling of the whales. They are also unclear on the intentions of this study. Here in Iqaluit like Pangnirtung and Kimmirut, it is felt that more hunters would be willing to assist with the program if they had a better understanding of the sampling program as a whole.

Some questions raised by the participants include:

- Why are there no consultations with the community on the results?
- What are the intentions of the sampling program?
- Is it to determine different populations?
- Is it to see if other populations are reaching Baffin Island?
- Is it to see how many males/females are being killed?
- If it's to determine contamination levels – what contaminant levels are harmful to the human body?
- What goals or purposes do biologists have in this sampling program?
- Are there any policies in place for any whales that may be found sick?
- Why are the results only discussed at the management level or board level, and not at the community level?

Regardless of the situation, Iqaluit hunters are certain that there are not enough community consultations to explain the intentions, results, and contents of the kits or questionnaires. It is strongly suggested that community consultations be done so that the hunters can have more knowledge and will be more willing to assist. "Cash payments are good," said one, "but, there are too many unanswered questions." In some instances, hunters are sampling other hunters' whales for the money. Another problem some hunters have measuring the whales is that some don't have the manpower to move the whale and as a result, they cannot complete the sampling.

Other concerns include: A follow-up on the samples that were to be studied in Winnipeg and due to a backlog were left in storage. No results are yet forthcoming. The resulting DFO study, determined it was clear that Pangnirtung and

Iqaluit do not share the same whale population. It was also pointed out that there are foreign (contaminants) material being brought into the north, and that this study would assist in finding contaminant levels in the whales. What are the results?

As cited by the other communities, more community consultations are needed on the goals and intentions of the study here in Iqaluit.

Different populations of whales

There are different populations of whales reaching Frobisher Bay according to the participants of the study. They are distinguished by their flippers and flukes, as well as the whales' size, behaviour, and their colours at different times of year. These differences may not be apparent to the younger hunters – which is why experience is important. Elders here have seen and know of the different populations but are unable to differentiate one from the other. As one elder said, "it is impossible to differentiate the populations as they have no boundaries to block their travels." Like the other communities they are certain that different Beluga whales are reaching S/E Baffin. The whales are first spotted at the floe-edge at the east side of Frobisher Bay, then they are seen and hunted on the west side in the spring and summer. These different populations may travel into the Iqaluit area in the latter part of spring as the ice recedes.

Outpost camps and the whales

Today it is hard to determine the populations of whales in the outpost camps as the elders and most families do not live there anymore. In the past, whales were only hunted when they reached the outpost camps and not from the lookout spots that are used today. In any case those interviewed felt that there has been a decrease in the number of whales reaching the camps today. In the past, there were also more successful hunts from the land, due to the fact that the hunters didn't have motorized boats to chase the whales with.

Because of the motorized boats, hunters are spending less time at the camps and are hunting in other areas. The elders felt that they would have to spend time at the camps in order to determine the populations. According to the participants, there have never been any studies done at or near the outpost camps. Airplanes have been used to do counts before, but the results are not felt to be accurate. See map #97-03 for locations of the outpost camps.

Hunting areas

Weather permitting, the hunters of Iqaluit hunt mostly in Frobisher Bay or in the Iqaluit area. Due to the strong winds in the bay, hunts rarely take place further out. See map #97-04 for areas of hunts. It was noted that the elders' knowledge goes back a long way, prior to when the studies or counts started in the 1960s. They find it difficult to understand why Inuit knowledge has not been included in the final reports of these studies, when it was they who had originally taken part in the actual counts or studies.

Since the commercial hunts were lifted in the late 1970s, there have been no noticeable differences in the populations of whales. It is with the noise motorized boats create, that the elders say there is a significant difference on the west side of Frobisher Bay, where today there are fewer encounters with whales.

Different hunting methods and equipment

In the Iqaluit area, high-powered rifles are being used to hunt Beluga whales. This is done to avoid unnecessary injury to whales. Hunters also prefer shallow to deep water; even though the whales can travel faster in the shallow waters, there is still less chance of loss. The 222 and 223 calibre rifles are less used today as Inuit prefer higher powered rifles such as the .303, 30-30, or higher. Today's hunts also include a sense of rush and urgency. This is due to hunters wanting to get their whale before the quota is filled, particularly if they encounter a whale after a long wait. There is also more random shooting and more scarred whales. Most importantly, there are a lot more boats out hunting whales. With the problems this has created, the participants would like to see instructions given to newer and older hunters alike on how to run more effective and safe hunts. They suggest harpoons

be used before the whales are killed to avoid loss, and that higher powered rifles be used from 22-250 and up. They also suggest guidelines be made available to all hunters (in both Inuktitut and English). These guidelines would include information that would make hunter safety a priority. Examples of other useful information would be: not to shoot at whales that are too far, hunt the injured first, use proper floats, bring proper equipment before the hunts and, that there be designated leaders at these hunts. The group feels that the creation of such guidelines would prove beneficial, help to organize hunts better, and make hunter safety a priority.

Traditional hunting laws

When people were still living at the outpost camps, traditional laws and rules were strongly adhered to. In hunting Belugas there were designated hunters who would take the first shot. Nobody would take the first shot except for the designated shooter in order to minimize any chance of loss. These designated hunters would usually kill the whale on the first shot. In times when the designated hunter was not available the whales were left alone. Also, in the past, kayaks were used to steer whales towards the land where hunters waited quietly with their rifles. Those in kayaks would create loud noises outside the perimeter of the whales' location. A long harpoon-like tool was used to kill the whale by striking at the heart. They also had designated harpooners who would strike, tug on the line to see if it was hooked properly, and then finally release the line if it was hooked right. This was done to avoid loss of equipment and game. The people in the kayaks had to be careful when harpooning a whale as the whale might turn on the side where it was struck and topple the kayak. So hunters always aimed for the far side of the whale from the kayak. These practices are hardly used anymore, if at all.

Traditional knowledge in the school programs

In Iqaluit there is no traditional material on the S/E Baffin Beluga in the school programs. Some elders feel that they are no longer able to educate the young with the knowledge they have accumulated. There is agreement that this knowledge gap should be addressed in order to help educate students about traditional Inuit ways and to help the younger generations understand why the beluga whale is so important to the S/E Baffin. Students would learn to make use of these traditional skills. Elders feel this would have to be written in both languages, and that a video should be produced on the step by step procedures involving hunting, traditional uses of parts, cutting and butchering, distribution of the catch, making sinew and ropes, and uses of blubber and meat.

The elders/hunters recognize there is a need to make this material available to the students and request that NWMB take note and address this issue.

Beluga surveys and counts

In the Iqaluit area and Frobisher Bay, counts by airplanes are not considered reliable. Hunters here who took part in counts by planes have been disappointed with the results, especially how and when the counts were taken. Inuit involvement and Traditional Knowledge have not been included in the reports. There were some hunters or elders that had or knew of somebody who had taken part in the counts and said that their input was often ignored. At times when they said whales had been spotted the response was, "No, it's a seal." But these elders and hunters knew better – because of the size and shape of fins and the size and colour of the animal, it was actually a Beluga. They also felt that aircraft were not covering the appropriate areas at the right time of year. For the counts to be accurate, they should be done when daylight is longer, around June and July, as more whales are known to be in the area at that time of the year. The hunters and elders feel that a cliff count would have to be carried out with the use of today's telescopes and communication means in order to determine the numbers accurately. This has proven successful in Clearwater Fiord and has been carried out several times. The surveys and counts should be done away from the ice and have parties on both sides of Frobisher Bay. By having parties stationed on both sides of the bay, they feel that more accurate data will be obtained, as hunters who know the area can pick the best

locations to conduct studies. Today's younger hunters, unlike the elders, have little knowledge on the whales in the fall and would like to learn more about them by running a fall count or survey. The hunters here would favor cliff counts and more Inuit Knowledge in the final reports.

Tudgat area (Resolution Island)

It was requested by the Iqaluit HTO that Traditional Knowledge be collected about the Beluga in the Tudgat area. As none of the participants had resided in that area, no information was available.

Whale hunting with nets

As far back as the elders at this workshop can recall, nets have always been used in hunting whales. These were used especially at the outpost camps. Today they are still used effectively. Back when the elders were growing up, net material was hard to come by and the nets were constructed of poor quality rope. Today they are made with stronger material and in the sizes needed. Some hunters had whales taken from their net by others, and there had been whales that got caught in the net while being chased. Nets are used in the summer when the area is free of ice but mostly in the fall when the ice is gone. Today about half of the nets in Iqaluit are used successfully. If a video and learning materials on nets could be put together, the elders and hunters would like to include information pertaining to the anchor, net tightness, location, floats, and the need to check the nets frequently.

Whales giving premature births in the area

As there is no known calving area near Iqaluit or in Frobisher Bay, births are scarce. Though according to the hunters and elders, births do happen in their waters. There are apparently not enough whales in the months of July and August for numerous births to occur. A small number of births are known to happen in the summer.

Traditional uses of meat, muktuk and bones

As modern tools and equipment were being introduced to the hunters and their families, the traditional needs met by the whale began to disappear quickly. Today hardly anything from the whale is used except as a food source. The way a whale was cut up before has also changed. Back when they were using the muktuk for rope, the muktuk was cut from the head area to the back according to the number of hunters. Everything was shared equally. The rope made from the muktuk was flexible and strong. It was also heavily used as a seal pup luring rope or made into a base for whips. It also served as an all purpose rope. The rope "Siaruaq" was an all purpose rope carried by most hunters. It was also used as "Sulujaq" the thin end part of the whip.

Fat from the whale's lower jaw was also used to oil rifles as a rust protection base. The intestines are also edible. Adults used the cartilage of the throat as a whistle. Bones from the flippers were used for dolls. The other bone parts were made into carvings after they had turned white which usually took a few years.

Ice entrapment of whales

According to the hunters and elders, there have been no such entrapments of any whales that they can recall. Some suspect there may have been the odd one that got trapped, but none in any great numbers.

Closing remarks by participants

Some elders said they are grateful for the opportunity of being able to take part in this very important meeting. Nooveya Ipeelee, "I am glad that I was able at my age to pass along this information at this meeting, as I am no longer able to instruct out in the land anymore." Others were also grateful that with the mix of hunters at this meeting they were able to bridge many existing gaps in Traditional Knowledge. "We show our sons by sketching on the sand on where to shoot the whale," said Noshuttaq.

Conclusion

It is apparent with the knowledge that has been shared that changes have occurred in both the hunters and the hunted. The hunters are adapting to new equipment, but also losing some of the Traditional Knowledge. The introduction of motorized boats has had an enormous impact on the whales and is suspected to be the main cause of the changes in the whales' behaviour in their natural environment, as hunters are able to travel faster and further with the motorized boats. The whales have had to learn new methods and ways of avoiding hunters.

With the realization of the existing knowledge and intergenerational gaps and the need to educate younger and older hunters alike, those interviewed suggested that educational material be made available to preserve Traditional Knowledge and the whales. Other suggestions to NWMB and DFO include:

1) To NWMB: An educational package be put together to be made available to school programs. These should include topics like: Preparation before hunts, Traditional Uses of Whales, Cutting and Butchering, Distribution of Catch, Hunting Equipment, Hunting Techniques, Using Nets at Whale Hunts, Safe Hunting Practices and Traditional Hunting Techniques.
2) A hunters' guide be put together to include: Uses of Proper Equipment, Safety Guides, Uses of Higher Powered Rifles, Leaders of Hunts, Chasing the Injured Only, Lethal Target Areas of the Whale, as well as other areas of importance to the community.
3) The sampling program should be reviewed as there are problems with the current setup and lack of communication. This applies to both the NWMB and DFO.
4) To DFO: That cliff surveys be considered because past survey counts with the use of airplanes have not been reliable and have resulted in negative feedback from the community. They feel that a cliff count would be best tried with people who know the area and the movement of the whales. A fall survey should also be considered as there is a lack of knowledge on the number of whales in the fall.

With the above information it is felt that this study has opened up new opportunities for both the community and the people involved with the hunters in understanding the S/E Baffin Beluga whales and their habitat. The participants expect this to produce new knowledge and a better understanding of the Beluga whale and hunting. It is obvious that improvements can be made to preserve the knowledge and use it to educate the less knowledgeable members and students in the community.

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- ᑭᓱᓂᒃ ᑐᖁᒫᖅᖅ ᐅᕐᓂᓗ ᐱᔪᐊᑎᖅᖅᓐ ᖃᐅᔨᓴᖁᑎᒃ ᑕᕐᔪᓐᓇ ᔭᖅᐃᓂᒃᓯᒃ ᖃᐅᔨᓴᖏᑕᐅᔪᓂᖅ?
- ᐱᕈᖅᓂᓗ ᐊᑐᐊᖁᓴᒥᒃ ᐃᓕᓴᐱᒥᒃ ᑭᓚᓴᖁᓂ ᓇᓂᐅᐅᔪᖅᖅᓐ ᖃᓂᒪᔪᒥᒃ?
- ᓴᓪᓚᓐ ᖃᐅᔨᓴᒋᐅᓂ ᑭᓱᐊᓂ ᐅᖃᕈᑕᐅᓪᓚᕐᓂᓐ ᐊᐅᓚᑎᑦᓯᓂ ᖃᑎᒌᔨᓂ?

ᓴᖃᐅᐃᓐᓇᖁᓕᒍ ᖃᓄᐃᓂᐅᐅᔪᖏᓐ, ᐃᖃᓗᓐᓂ ᐊᓱᓪᓚᕆᑎᓐ ᖁᓕᓯᖅᓂᑐᖁᔭᕐᓴᓪᓕᒻᒥᓗ ᓇᓇᕐᐅᔪᓂᖅᓄᑦ ᐅᖃᖅᑎᖅᓂᕐᒥᑦ ᐅᓂᒃᑲᓂᕐᔪᐊᖅᓄᑦ ᐱᔪᓐᓇᐅᑎᓂᖅ, ᖃᐅᔨᓴᐅᓪᓚᕐᓂᕐᓗᐊᖅᓄᑦ, ᐊᒻᒪ ᐃᓕᓴᕐᓂᐊᕐᓂᖅᓄᑦ ᐅᖃᓕᕐᓂᖅᓄᑦ ᐱᔪᓐᓇᐅᑎᓂᖅ, ᐊᒻᒪᓗ ᐱᓕᕆᔨᒃᑯᑦ ᐅᖃᓕᕐᓂᖅᓄᑦ ᐊᐅᓚᑎᑦᓯᓂᖅ? ᐃᓚᖓ ᐊᑐᐊᖁᓴᒥᒃ ᐱᓕᕆᔨᒃᑯᑦ ᐅᖃᓕᕐᓂᖅᓄᑦ ᐊᐅᓚᑎᑦᓯᓂᖅ? ᓴᓪᓚᓐ ᖃᐅᔨᓴᖏᑕᐅᔪᓂᖅ ᐊᐅᓚᑎᑦᓯᓂᖅ ᐅᖃᓕᕐᓂᖅᓄᑦ ᐊᐅᓚᑎᑦᓯᓂᖅ?

ᐊᐅᓚᑎᑦᓯᓂᖅᓄᑦ ᐊᒥᓱᓂᒃᑯᓂ ᑭᓚᓴᖅᓴᐃᓐ

ᐱᔭᕇᖅᓯᒪᔪᖅ ᐊᐅᓚᑎᑦᓯᓂᖅᓄᑦ ᑭᓚᓴᖅᓴᐃᓐᓄᑦ ᑎᑎᕋᖅᑕᐅᔪᖅᓄᑦ ᐃᓕᓴᕐᓂᖅᓄᑦ ᐊᐅᓚᑎᑦᓯᓂᖅᓄᑦ ᐊᒻᒪ ᐃᓕᓴᕐᓂᐊ

ᐱᒋᐊᒋᐃᓐᓇᕐᓯᒪᓕᒡᓗ ᖃᓄᐹᔪᓂ 1960. ᐱᓕᕆᔨᓂᕐᓴᐅᒪᓐ ᐃᓕᓴᕆᔨᐊᖅ ᐃᓄᐃᑦ ᖃᐅᔨᓴᖅᑐᒪᓐ ᐃᓕᓴᕐᔪᐊᓂᖅᓯᒪᔪᖅ ᓴᖅᑭᒪᓕᒡᓗ ᑭᖑᓪᓕᕐᕕᒃ ᑐᓴᕐᓯᓚᐅᑎᓂᖅᓯᒪᔪᖅ ᐱᖓᓱᖃᖅᑐᑦ ᐃᓄᐃᑦ ᐊᑐᐊᓂᖅᓯᒪᔪᖅ

ᐱᓕᓴᐊᓂᖅ. ᐃᓕᖏᓐ ᐃᓐᓇᑐᖃᐃᓐ ᐃᓵᐱᒍᓵᓐᓄᑦ ᒪᑉᓐᓇ ᐱᓕᓴᐅᓇᐃᓕᓚᒪᑕ ᐃᓕᓐᓂᐊᑎᑦᑎᓗᑎᑦ ᐃᓅᓵᓐᓂᕐᓴᓂᖅ ᑕᕿᑲᓕᑐᓂᖅ ᖃᐅᔨᓴᖅᑭᓂᖅ. ᐃᓚᐃᑦᑐᒥᑦ ᑐᑭᓯᖃᖅᑎᑲᓂᖅᖃᖅᑎᑐᓂᖅ ᑕᒪᑉᓂ ᑕᒪᓐᓇ ᓴᖅᖃᕐᓴᖅᓯᐊᓕᓐᓂᒃ ᐃᓕᓐᓂᐊᑎᑦᑎᓂᖅ ᐱᐅᓯᓂᖅ. ᑕᒪᑉᓐᓇ ᐃᖅᔪᓴᖅᖃᖅ ᑕᒪᖅᓂᖅᖃᓄᑦᑎᓂᖅ ᐱᐅᓂᖅᓴᒥᒃ ᑐᓴᓕᓴᐃᓂᖅ ᐱᓪᓗᐊᓕᐅᖅᑕᐅᔪᓂᖅ ᐃᓕᓐᓂᐊᑎᑦᑎᓗᑎᑦ ᐱᐅᓂᖅᓴᒥᒃ

ᑭᓪᓗᒍᐃᑦ ᐃᓕᓴᐅᑦᑐᑦ ᑕᒪᐅᓇᓯᔪᒃ ᖃᓄᐅᔾᔨᓂᒃ

ᐱᑕᖃᖏᓂᖅᓄᑦ ᖃᐅᔨᒪᓇᕐᑐᒃ ᐃᓕᓴᐅᕐᒪᑐᒃ ᖃᓄᐅᔾᔨᓂ ᐃᖃᓗᐃᑦ ᐅᕙᓪᓕᕐᔪᐊᒥ, ᐃᓕᓴᐊᐃᑦ ᖃᐅᔨᓪᓚᓐᓇᖏᓪᓕᓐᓂ. ᒡᓗᑎᒍᓇ ᐊᓯᔪᖅᑎᓯᑦ ᐃᓐᓇᑐᖃᖅᑎᑦᓯᓗ ᐃᓕᓴᐊᔪᖅ ᐃᓚᖏᓐᓂ. ᐱᑕᖃᓗᓕᕆᓂᖅᓯᓄᓇᑦ ᑭᓪᓗᒍᓄᑦᓂ ᕿᓚᐅ ᐊᒻᒪ ᐊᒋᐊᓂ ᐃᓕᓴᐊᓂᑦ. ᐅᓯᐊᓂ ᖃᕆᑲᓇᖅᑐᑦ ᑕᑯᓯᖏᓐᓄᑦ ᐅᐱᖃᓕᕆᓂᖅᓄᑦ ᖃᐅᔨᓴᕐᔪᐊᓘᓐᓃᑦ ᑕᑯᓯᖏᓐᓄᑦ ᐅᐱᖃᓕᕆᓂᖅᓄᑦ.

ᐱᖁᓯᑐᖃᖅᑎᒍ ᐊᑐᑎᒥᓂᖏᑦ ᓂᕆᖏᖅᑕ, ᒪᑦᑕᖅᑕ ᓴᐅᓂᖏᑕᓗ

ᐊᓯᐊᓂᖅᓱᓯᒪᔨᐃᑦ ᐅᓯᓪᓚᑲᑦ ᓴᖅᑭᑕᐅᖏᓪᓕᐊᓕᖅᑎᓪᓗᓂᑦ ᐊᓯᖏᓐᓇᓂᑦ ᐊᒻᒪ ᐃᓕᒥᐅᔨᓂᑦ, ᐱᖁᓯᑐᖃᖅᑎᑦᓯᓂᑦ ᐊᑐᑎᒥᓂᑦ ᐃᓐᓇᑐᖃᖅᑎᑦᓯᓂᑦ ᐱᖁᓯᑐᖃᖅᑎᑦᓯᓂᑦ ᑕᐃᒪᐃᓐᓇᖅᑐᑦ ᓄᓇᕗᑦ ᐊᑐᖅᑐᑦ ᐃᓕᓴᐅᕐᒪᑐᒃ ᑕᑯᓯᖏᓐᓄᑦ ᐊᑐᖅᑐᑦ ᐃᓕᓴᐅᕐᒪᑐᒃ

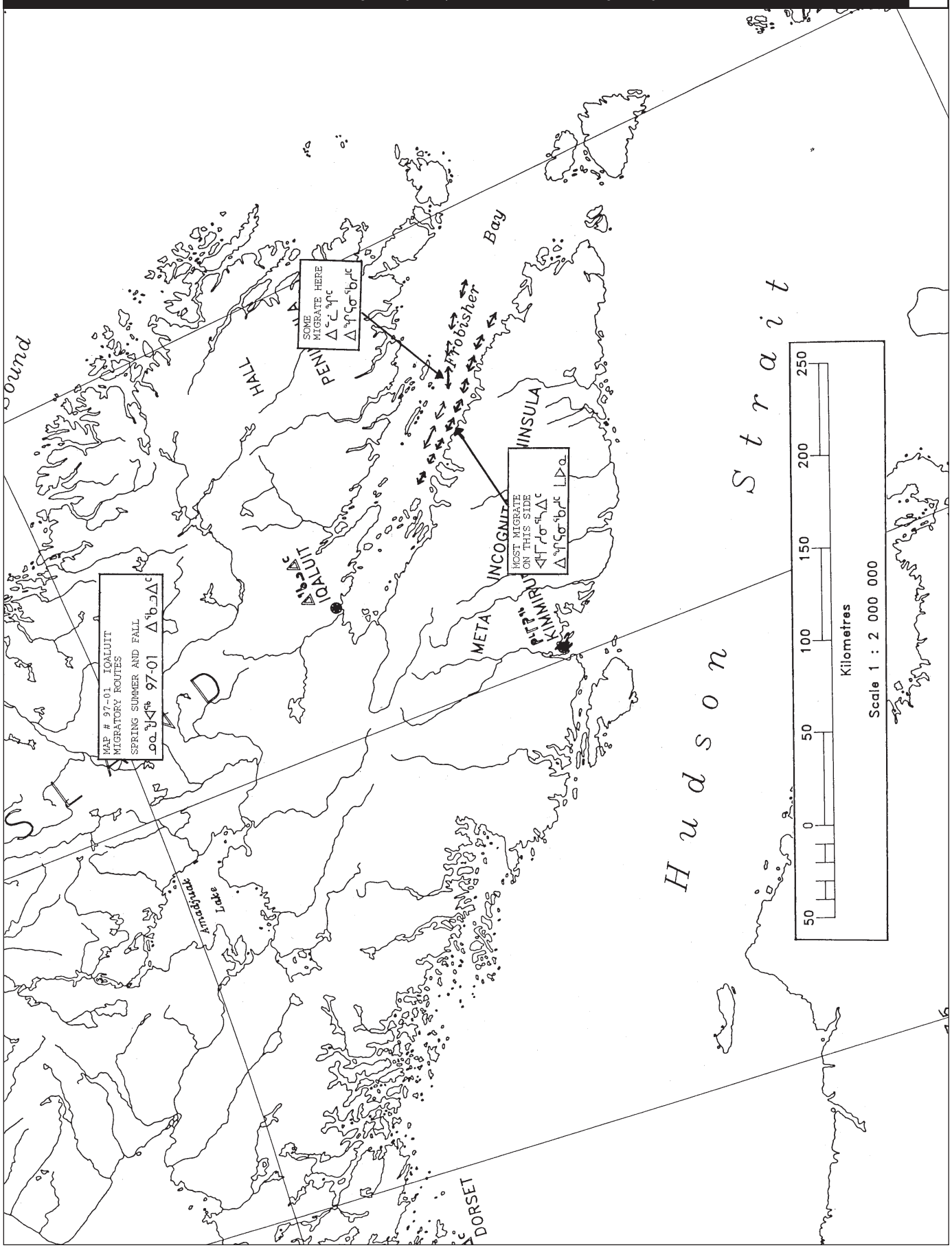
ᐊᒻᒪ ᓯᓴᐃᔾᔪᑎᑕᐅᓂᖏᓐ, ᓂᕆᑭᖏᓂᖅᖏᓐ ᐱᔾᒥᓂᐅᑦ, ᐊᖏᓐᓇᑲᓐᓂᖅ, ᐊᖏᓐᓇᓐᓂᒋᑦ ᐱᐅᓯᖏᑦ, ᓄᓇᐊᑦᓂᐊᓂᖅ ᑭᓪᓗᓐᓂᖅ, ᐊᑦᑕᓐᑦᑕᐃᓕᓚᓂᑦᒧᑦ ᐊᑐᑦᑎᐅᓯᑦ ᐊᒻᒪ ᐱᖁᓯᖏᑐᐃᓐᓇᖅ ᐱᓐᓇᓯᓪᓗᓂ.

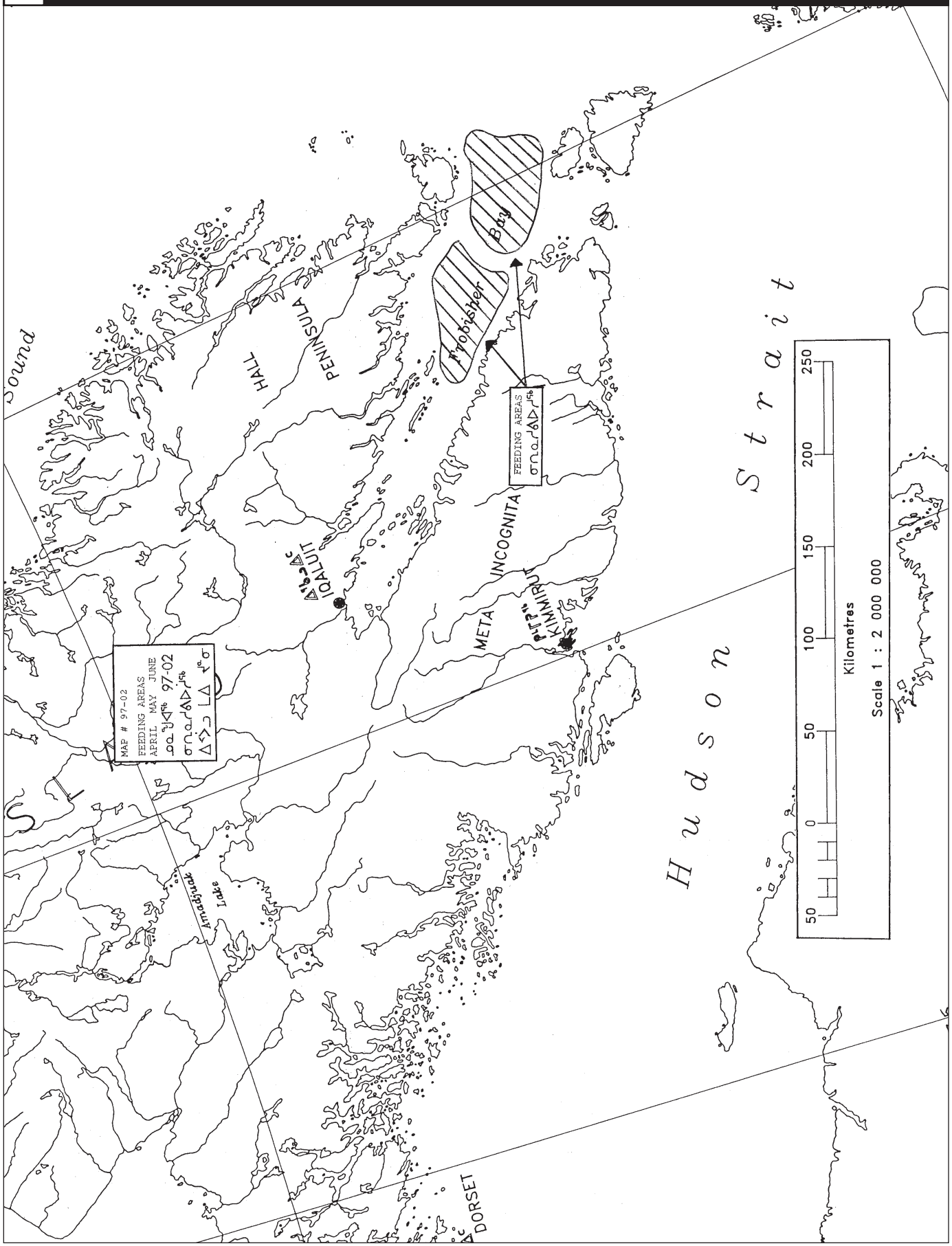
2) ᐊᓯᐅᑎᓂᑦ ᐊᑐᐊᓚᑦᑎᒃ ᑲᑎᑎᓯᐃᖁᔨᓪᓚᑦ ᐃᓕᖅᑲᓂᐊᑦᓗᓂ: ᐊᑐᑦᑎᐅᓯᑦ ᓱᓚᒋᑐᐃᓐ ᐱᓐᓇᑲᓐᓀᐦ, ᐊᑦᑕᓐᑦᑕᐃᓕᓴᖅᓂᒋᑦ ᐊᑐᐊᓚᐃᓐ, ᐊᑐᓚᐊᖅᑲᓂᖅ ᓴᐳᑭᓂᓴᓂᒃ ᓴᖅᑭᓂᓴᓂᒃ ᐊᖏᓐᓇᓯᑐᖅᑎᓪᓗᒍ, ᒪᓕᑭᐊᖅᑲᓂᖅ ᐃᖅᑭᓕᒫᖅᑕᐅᓯᓕᒫᑦ ᑭᓚᓗᐊᖅᑐᑦ ᐃᓚᖅᑲᓐᓂᖅ ᐊᓯᖏᓪᓂᒃ ᐱᓪᓗᐊᓕᓴᓂᒃ ᓄᓇᓕᐅᕐᓂᖅ. ᐃᓚᖅᑲᓐᓂᖅ ᐊᓯᖏᓪᓂᒃ ᐱᓪᓗᐊᓕᓴᓂᒃ ᓄᓇᓕᐅᕐᓂᖅ.

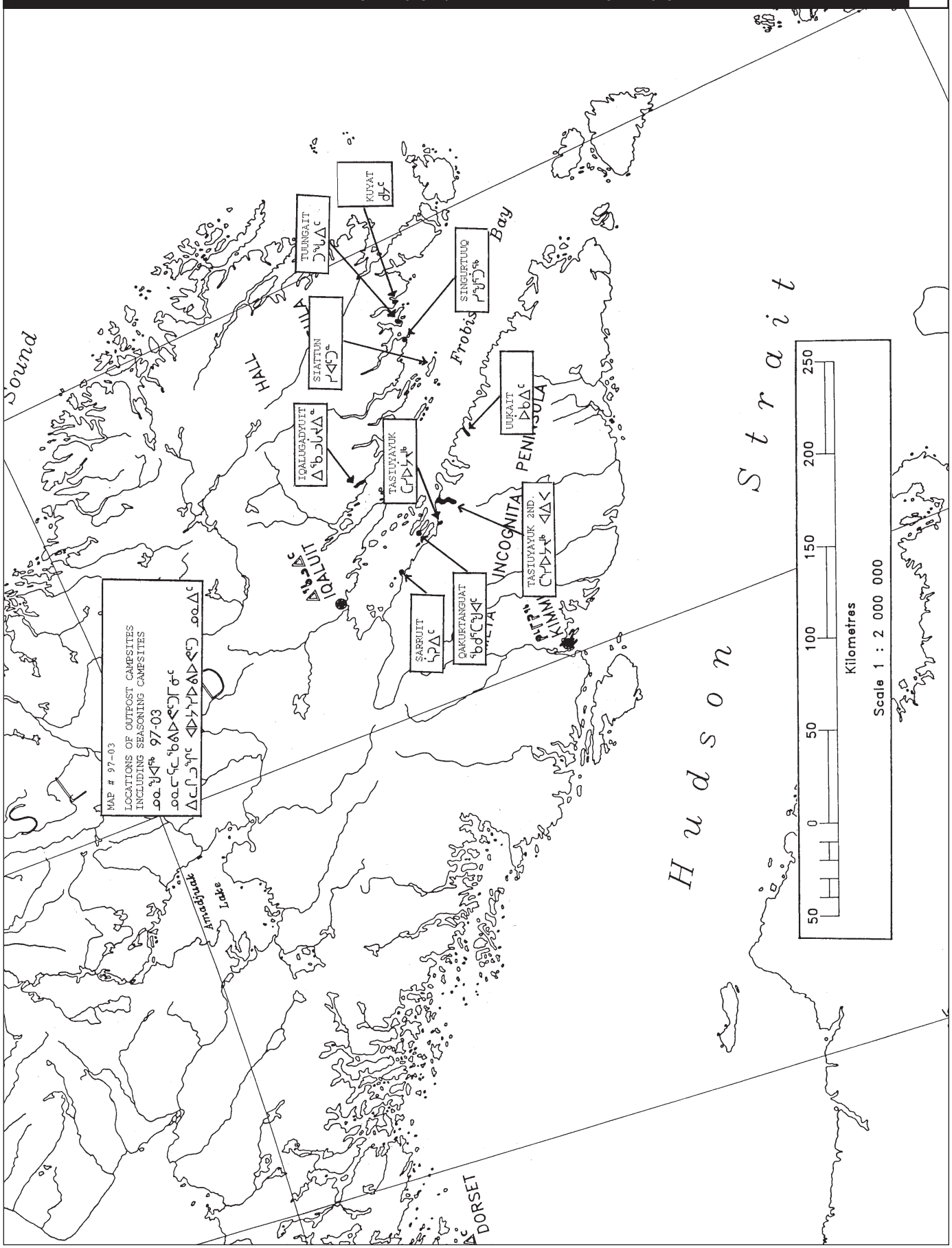
3) ᐅᖅᐃᓂᐅᕐᓕᑐᖅ ᐊᐅᓚᓂᖏᓐ ᑭᒥᓯᔾᔨᐅᓴᓪᓕᒍ, ᒪᓐᓇᐅᕐᓂᖅ ᐊᖏᐃᓪᓕᓚᐅᕐᓯᒪᔪᓂᒃ ᐊᑭᑦᑕᐅᓯᒪᔪᓂᒃ ᐊᑭᑦᑕᐅᓯᒪᔪᓂᒃ ᐊᒻᒪ ᑐᓴᐅᒪᑎᑦᑎᓂ-ᑭᐊᖏᓂᒥᒃ. ᒐᓐᓇ ᐊᑦᑐᐊᔪᖅ ᑕᒪᑭᐸᓂᑦ ᐅᐱᒋᐊᖅᑐᓂᖅ ᐊᐅᓚᓂᖏᓐ ᐊᒻᒪ ᐃᒪᒥᐅᑕᓚᐅᓴᓴᓂᑦ.

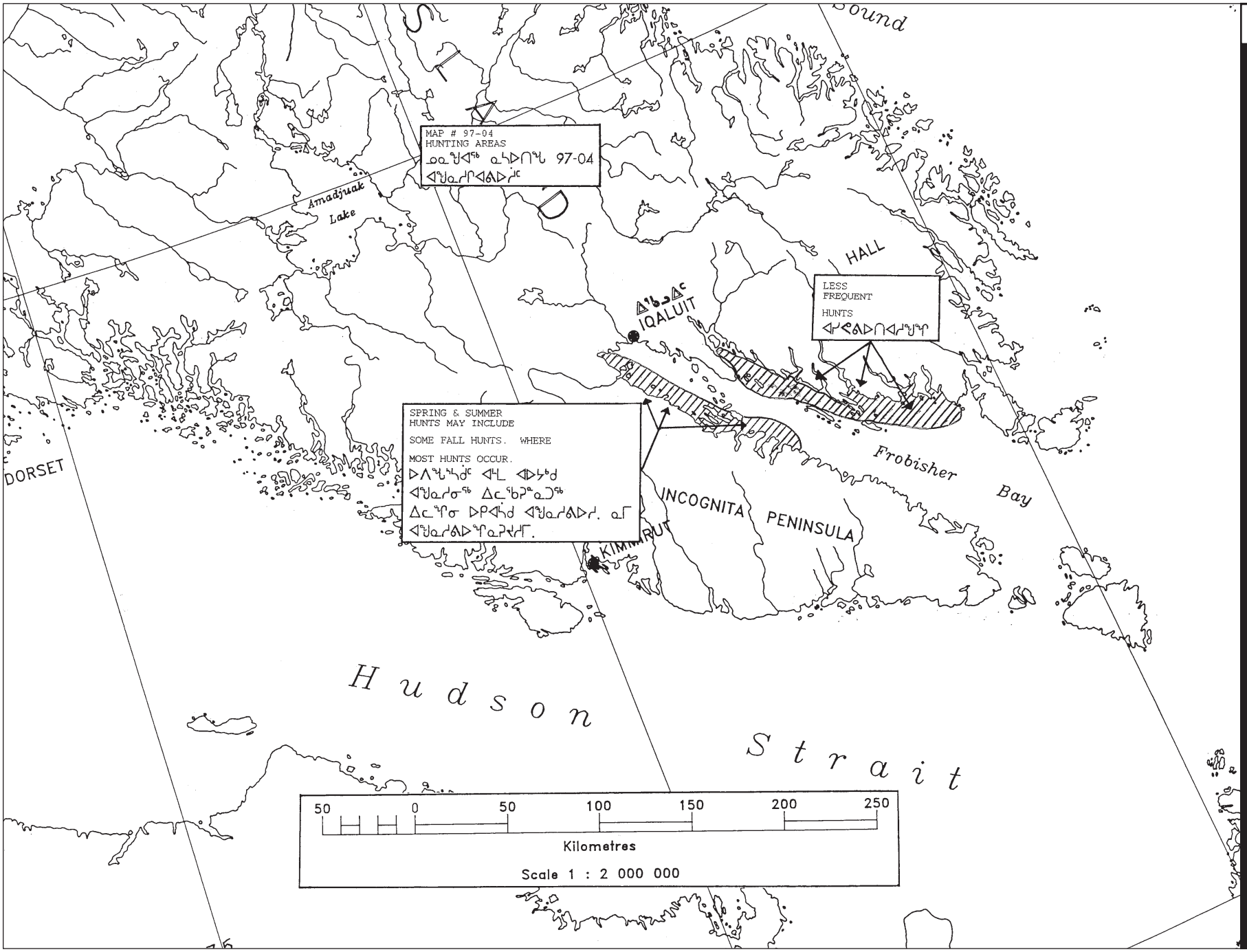
4) ᐃᒪᒥᐅᑕᓚᐅᓴᓴᓂᓐᓄᑦ: ᖃᖅᑎᒃ ᖃᐅᔨᓴᓂᓂᑦ ᐃᓕᓴᕐᕕᖏᓐᓂᑦ ᑕᒪᓴᐊ ᖃᐅᔨᓴᓂᓂᐅᖃᑦᑕᓂᕐᓕᓪᓕᑦ ᐊᑐᓂᑎᒃ ᖃᖅᑕᓕᓴᐃᓐᓇᖅᑐᓕᒫᓂᒃ ᐱᓪᓗᐊᓕᓴᐅᓕᓴᖅᑐᓕᒫᓂᒃ ᓂᓪᓕᐊᔪᓪᓗᑕᐅᖃᑦᑕᓂᕐᓂᖅᓴᓂᒃᓂᓪᓚᓂᑦ ᓄᓇᓕᐅᕐᓂᖅ. ᐃᓴᐱᕐᓴᖃᑦᑕᐃᓐᓄᑦ ᖃᖅᑎᒃ ᓱᓴᐃᓂᓂᒃ ᐃᓕᖅᑲᓐᓂᖅ ᐃᓚᖅᑲᓐᓂᖅ ᐃᓄᓐᓂᒃ ᖃᐅᔨᓴᓂᓂᐅᖃᑦᑕᓂᕐᓂᖅᓴᓂᒃ ᐃᓕᖅᑲᓐᓂᖅ ᐊᒻᒪ ᐊᐅᓚᓂᖏᓐᓂᒃ ᑭᓪᓗᓐᓂᖅ. ᐅᑭᐅᖅᓴᖅᑭᑦ ᖃᐅᔨᓴᓂᒃ ᐃᓚᖅᑲᓐᓂᖅᓴᖅᑭᑦᑕᓚᐅᖅ ᐱᓕᕆᔨᒃᑯᑦᑎᓐᓄᑦ ᖃᐅᔨᓴᓪᓕᑦ ᐊᒥᓱᓂᖏᓐᓂᒃ ᐅᑭᐅᖅᑕᕐᓂᖅ.

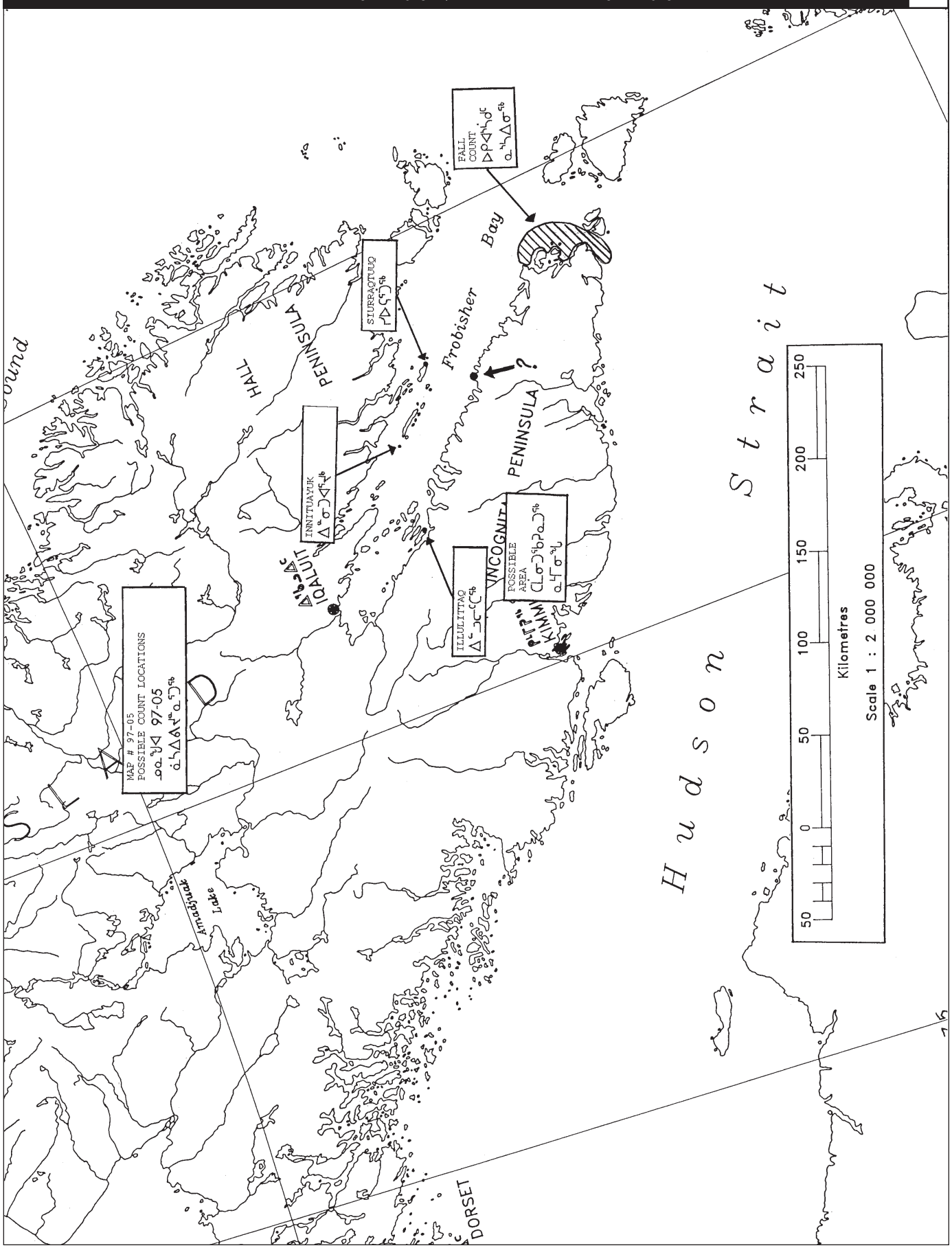
ᑕᐃᒪᐃᓪᓗᒍ ᐋᔪᓂ ᑐᓴᕐᓴᓴᐅᔨᓄᑦ ᑕᒪᓐᓇ ᖃᐅᔨᓴᓂᒃ ᒪᑐᐃᓐᓇᖅᑐᒥᒃ ᐅᔾᔨᓕᐅᔨᓐᓇᖅᑐᓂᒃ ᑕᒪᒃᑯᓄᑦ ᓄᓇᓕᐅᔨᔪᑦ ᐊᒻᒪ ᑎᑎᐅᔨᓄᑦ ᐱᓪᓚᖃᓂᖅᓴᖅᑭᑦᑕᓚᐅᖅᑐᑦ ᐊᓯᐅᓯᑎᓂᒃ ᐱᔾᔪᑌᓐᓂᒃ ᑕᒪᓐᓇ ᖃᐅᔨᓴᖏᓐ. ᑕᒡᔪᐊ ᐃᓕᐅᔨᓄᑦ ᓂᓪᓕᐅᔾᔨᑦ ᒪᓕᒐᓱᐃᓐᓇᖅᑐᑦ ᐱᓪᓚᖃᓂᖅᓴᖅᑭᑦᑕᓚᐅᖅᑐᑦ ᐊᑐᐊᓚᐃᓐ ᐃᓕᖅᑲᓐᓂᖅᓴᖅᑭᑦᑕᓚᐅᖅᑐᑦ


MAP # 97-01 IQALUIT
MIGRATORY ROUTES
SPRING SUMMER AND FALL
97-01
SOME
MIGRATE HERE
MOST MIGRATE
ON THIS SIDE
Frobisher
Bay
HALL
PENINSULA
IQALUIT
INCOGNITA
INSULA
KIMMIRUT
META
Amadjuak
Lake
DORSET
Hudson
Strait
Kilometres
Scale 1 : 2 000 000
50
0
50
100
150
200
250


Sound
HALL PENINSULA
Frobisher Bay
FEEDING AREAS
IQALUIT
META INCOGNITA
KIMMIRUT
MAP # 97-02
FEEDING AREAS
APRIL MAY JUNE 97-02
Hudson Strait
Amadjuak Lake
DORSET
0 50 100 150 200 250
Kilometres
Scale 1 : 2 000 000


MAP # 97-03
LOCATIONS OF OUTPOST CAMPSITES
INCLUDING SEASONING CAMPSITES
97-03
Sound
HALL
Frobis
Bay
Hudson
Strait
IQALUIT
INCOGNITA
PENINSULA
Amadjuak
Lake
DORSET
TUUNGAIT
KUYAT
SIATTUN
SINGURTUUQ
IQALUGADYUIT
TASIUYAYUK
UUKAIT
TASIUYAYUK 2ND.
SARRUIT
QAKURTANGUAT
50
0
50
100
150
200
250
Kilometres
Scale 1 : 2 000 000


MAP # 97-04
HUNTING AREAS
ᓄᓇᕗᑦ ᓇᕆᐅᑎᖏᑦ 97-04
ᐊᖏᓚᓂᑦᐊᓕᐅᓂᒃ
Amadjuak
Lake
HALL
IQALUIT
LESS
FREQUENT
HUNTS
ᐊᓂᔪᓕᐅᑎᐊᓂᖏᓐᓂᑦ
SPRING & SUMMER
HUNTS MAY INCLUDE
SOME FALL HUNTS. WHERE
MOST HUNTS OCCUR.
ᐅᐱᖏᓴᓐᓇᑦ ᐊᓯᒪ ᐊᐅᓴᓐᑯ
ᐊᖏᓚᓂᓂᒃ ᐃᓕᖏᕐᓄᓚᑦᒃ
ᐃᓕᓴᓂ ᐅᑭᐊᓐᑯ ᐊᖏᓚᓂᕕᐅᓂ. ᓇᒥ
ᐊᖏᓚᓂᕕᐅᓴᓐᓄᓚᕐᓂᒥ.
DORSET
Frobisher
Bay
INCOGNITA
PENINSULA
KIMMIRUT
Hudson
Strait
50
0
50
100
150
200
250
Kilometres
Scale 1 : 2 000 000


FALL COUNT
SIURRAQTUUQ
INNITUAYUK
ILLULITTAQ
POSSIBLE AREA
MAP # 97-05
POSSIBLE COUNT LOCATIONS
97-05
HALL PENINSULA
Frobisher Bay
PENINSULA
IQALUIT
Amadjuak Lake
DORSET
Hudson Strait
Kilometres
Scale 1 : 2 000 000
50 0 50 100 150 200 250

Inuit Ecological Traditional Knowledge on the S/E Baffin Beluga

PANGNIRTUNG NT X0A 0R0
MARCH 25, 26 & 27, 1997

INTRODUCTION

The collection of the material in Pangnirtung was done with the involvement of eight hunters/elders from the community. Material collected included the general knowledge, health, population, hunting and history of the S/E Baffin beluga. All the working materials and final documents are property of the NWMB and are available only through them.

The study was conducted at the Pangnirtung HTO Office with a group of eight selected elders/hunters consisting of:

Jaco Evic	Elder/Hunter
Enoosilk Nashalik	Elder/Hunter
Mososee Keyuayuk	Elder/Hunter
Peterosie Karpik	Elder/Hunter
Apak Qaqasiq	Elder/Hunter
Manasa Evic	Hunter
Joeelee Papatsie	Hunter
Levi Evic	Hunter/HTO Chairman
Peter Kilabuk	Study coordinator
Ricky Kilabuk	Camera man

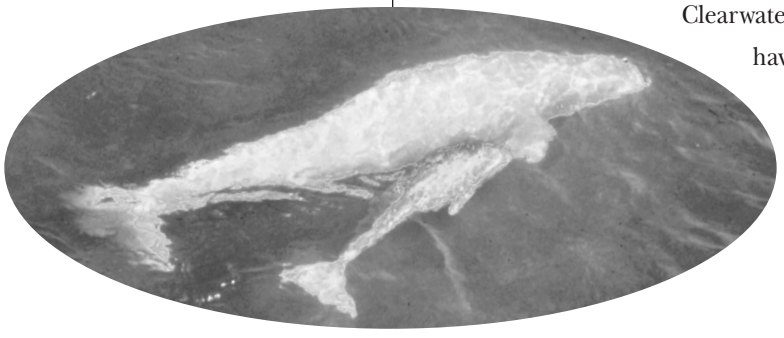
MIGRATION OF WHALES

According to the eight participants, the majority of the whales that migrate to and from the calving waters of Clearwater Fiord travel on the west side of Cumberland Sound. (See map 97-01.) Before the introduction of motorized transportation (snowmobiles and boats) in the 1960s, the Beluga whales would follow the newly formed ice cracks heading towards Clearwater. This was from June until the Sound was free of ice in July. The migrating whales upon arrival at these cracks were vulnerable and were only hunted then. At the floe-edge they were only hunted if they were very close to the ice where they could be harpooned when shot. Today, they migrate to and from Clearwater in groups within the same general period of time due to the noise created by the motorized means of transportation and hunting.

FEEDING

When whales reach the floe-edge they tend to feed off mostly Arctic cod and turbot under the ice. However, this feeding behaviour at the floe-edge has changed. Before the motorized means of transportation and more numerous hunts at the floe-edge the whales used to dive close to the ice to feed below the ice. This is known to take place less frequently nowadays probably due to the noise created by the hunters or in fear of the hunters' rifles.

Upon migrating to the Clearwater Fiord, whales used to feed in bigger numbers (as marked in map 97-01) and also upon leaving Clearwater Fiord. During their stay in Clearwater the whales are known to have less stomach contents probably due to shedding (moulting) and females giving birth in the area.



The reason for less feeding activity is not exactly known. The whales feed more on shrimp and some invertebrates that are available in that area. This reduced feeding activity explains why they are much skinnier when they leave Clearwater in the fall.

Births

As Clearwater is the only place where whales are known to give birth to their calves in S/E Baffin, hunters have learned a great deal about these Beluga whales. Most of the whales will come to Clearwater to give birth when Cumberland Sound is free of ice. Most of the young are born in July or early August. Inuit and hunters here believe a whale may give birth annually. A lot of the females are accompanied by new borns, yearlings and another from the year before.

In Clearwater more numerous births occur in certain areas as outlined in map 97-02. Fewer births are known to take place upon the whales arriving at Clearwater. It is only after spending some time in Clearwater that they will give birth.

Commercial hunts

Until the 1940s the Hudson's Bay Company was still active in the commercial hunts of Beluga whales in Clearwater. Some of these hunts were not documented and it is impossible for today's elders to estimate how many whales were taken. People from camps would gather in Pangnirtung before the hunts. Whales were taken by means of drive-ins, a method where whales were herded by many boats towards shore and left stranded on the falling tide. Here everybody was given a specific role to play in the drive-ins of whales at Clearwater. One successful drive-in area was near Usualuk where both Belugas and Narwhals were taken. (See map #97-03.) This also suggests that there were probably more whales travelling on the east side of Cumberland Sound and is indicative of there having been larger whale populations. According to the elders there were no drive-ins taking place in the 1940s and 1950s. The elders have since seen a decrease in the number of whales even after the commercial hunts were stopped.

Outpost camps

According to the elders there used to be more frequent appearances of whales during the arrival, departure and seasonal periods. At outpost camps (on map #97-04), whales were abundant near the camps while they were in Clearwater. At night the breaths of whales could be heard all night in front of Camp 6 until morning. Today, encounters with whales at the camp are rare.

Hunters at this camp had designated shooters most likely to make an instant kill should a whale come close to the land. This was a common practice at all camps. Even if there were numerous whales in the nearby waters they were not hunted unless a sure shot was determined. Back in the 1930s and until the 1960s ammunition was hard to come by and no shots were wasted. Despite the numerous whales in the area the camps would hunt only what they were going to use, minimizing wastage of meat and muktuk.

The meat back then was used mostly for dog food though usable parts were removed with care. These were mostly the tendons used for sinew. Certain sinews from the parts of the whale were used for certain types of women's work. There were also bones used for carving and there were certain parts that were considered a delicacy.

Motorized boats

Today the biggest factor that is considered to be causing a decline in the number of whales at the outpost camps and the whole Cumberland Sound area is the noise created by the numerous motorized boats. The noise is preventing the whales from reaching certain areas in the large numbers identified before the 1960s. Overall the behaviour of the whales is very different than in the past. The noise and activities of the boats are suspected to be a major factor as to why fewer whales are reaching the Clearwater area than before.

Health of the whales

Today's elders have seen a slight decrease in the thickness of the whales' fat. It is suspected that this is due to the whales needing to travel farther and faster to avoid the motorized boats.

In the past, when the whale muktuk (skin) was cut back it would overflow with oil and split along the cut easier. The whale's back would also appear to have smaller bumps, due to the fatness of the whale's body. It was noted also that the intestines used to have more fat surrounding them. The elders suspect it's not due to the whales being poor in health but due to the increased travel and runs they must do to avoid boats and hunters. Essentially, the whales today have to expend more energy.

The thickness of muktuk, its texture, taste and colour have not changed in any way or form. The muktuk is thicker in spring and summer than in the fall. This is a natural change that has always taken place.

Today the whales leave Clearwater as early as late August, whereas until the 1960s they would not leave until late October. Some suspect it could be that the smaller numbers of whales in the area are more sensitive to the motorized boats and noise; that a killer whale population is no longer in the area; and, that the ice is forming sooner in Clearwater. It was also noted that there are fewer premature births taking place outside the calving area which could be a change due to the decreased number of whales in the area.

Populations and distribution

Today's hunters are encountering smaller numbers in both male and juvenile pods as compared to the 1940s and 1950s. In one case a hunter at Camp No. 6 witnessed whales entering Clearwater from midday until sunset travelling in big numbers with no breaks. Today the male, female and juvenile pods have decreased in both numbers and groupings quite dramatically.

The commercial hunts before the 1940s were suspected to be the major factor in the decrease. Even after the commercial hunts were lifted at the end of the 1970s, hunters saw a decrease in numbers. Since then the numbers have steadied and are suspected to be rising in numbers due to the more numerous females carrying young and juveniles today. It is important to note the changes the hunters have seen over the years. The more recent decrease in numbers has not been due to overhunting, as some whales may stay elsewhere outside Clearwater or even Cumberland Sound. The participants feel that the heavy commercial hunts that took place during the drive-ins in the early 1900s have reduced today's populations substantially.

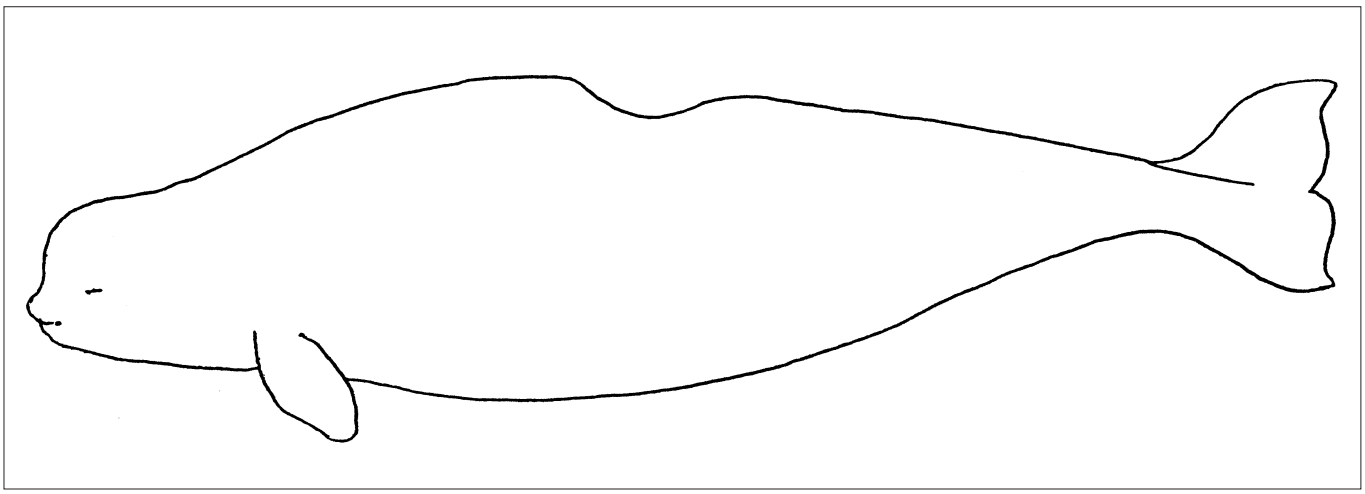
Scarring of whales

These whales appear to be more scarred with rifle shots than before. From the early 1900s to the 1960s it was a tradition that only the injured would be hunted as long as conditions permitted.

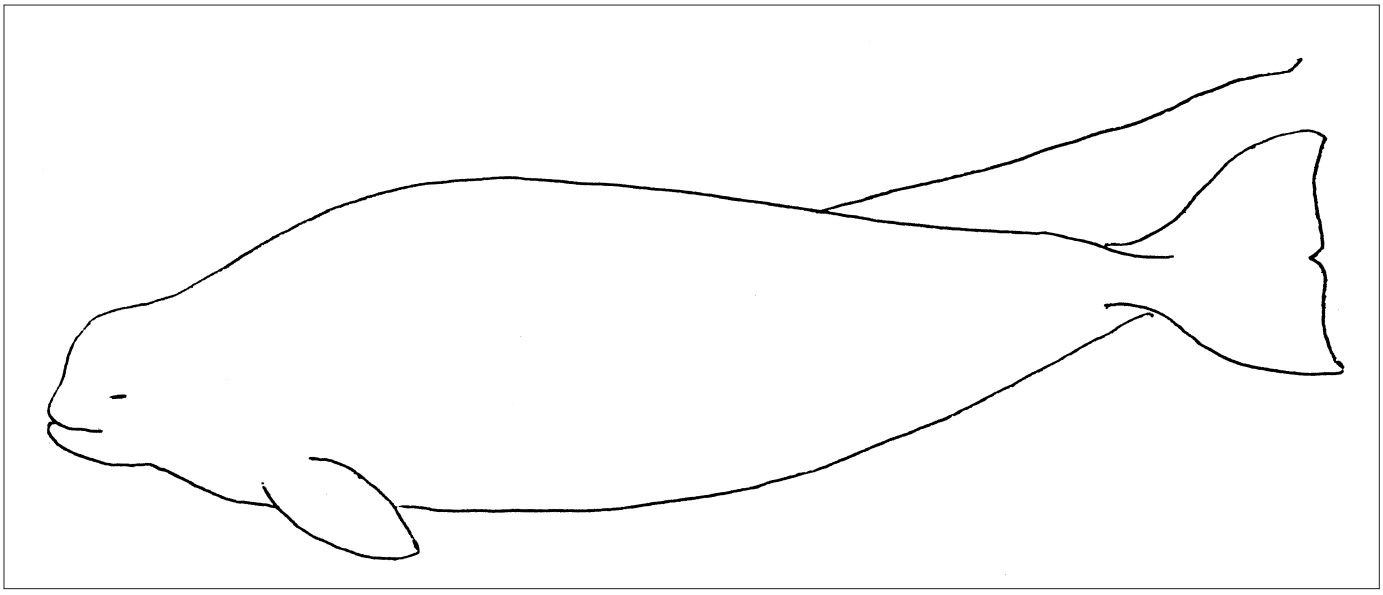
Motorized boats were also not available to these hunters and they were more selective in the methods they used. The motorized boats have been a major factor allowing hunters to chase the whales at random, therefore more shots are fired during a hunt. Today it is common to see more than 10 boats chasing a herd of scattered whales.

Badly scarred whales and their roles

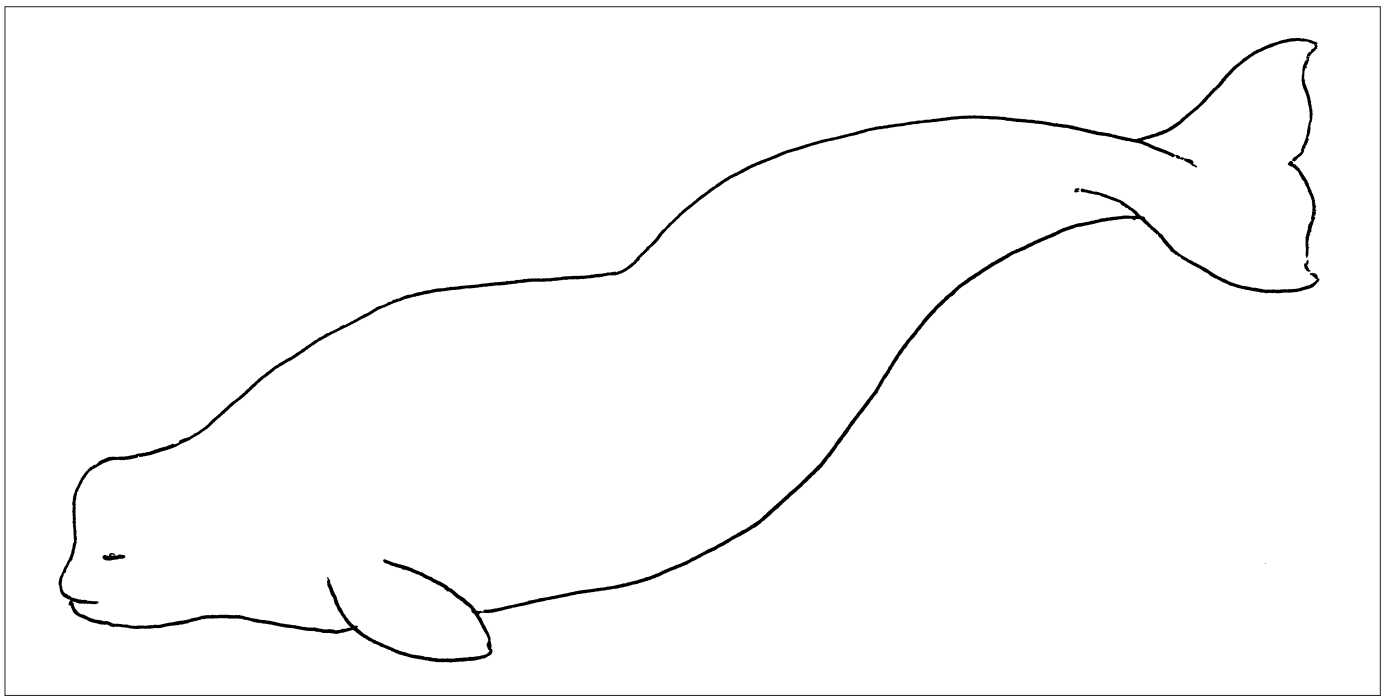
There is a certain group of badly scarred whales. These are ones with big notches in their back or disfigured bodies. They are known by most hunters to appear almost annually at the floe-edge or summer migration. The hunters respect these whales as they have been seen repeatedly scouting an area before the larger number of whales advance. Certain scarred whales scout for both the Narwhal or the Beluga. (The bigger scarred whales are shown below in diagrams A–D.) These are known to be found at a distance from the herds or groupings that are either travelling or resting. These badly scarred whales have been known for decades by the elders and hunters and their role has always been the same. Hunters avoid hunting them as they have proven to lead whales into this area year after year.



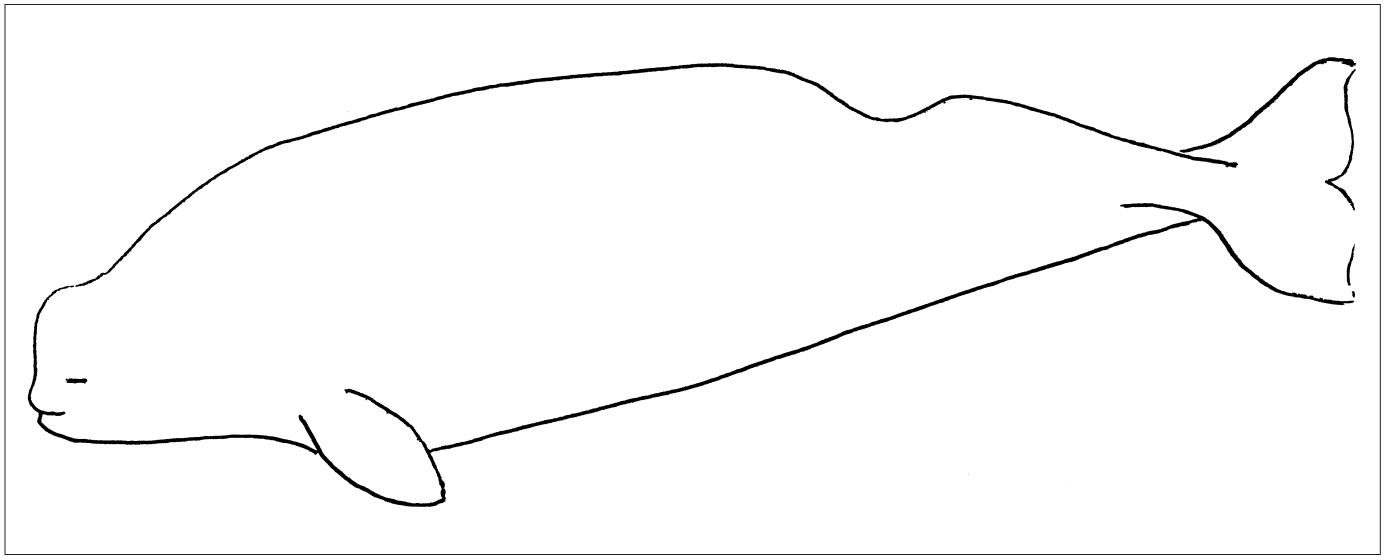
A) Notch in the back (still seen today).



B) Dragging a rope (still seen today).



C) Disfigured body (still seen today).



D) Notch near fin area (still seen today).

Sampling collection by DFO

The sampling collection program that has been conducted annually by DFO for the three communities has generated some mixed feelings and support. The hunters involved in this study and in the collection program, were not clear as to what was the purpose of the program. The general feeling was that if the hunters were made aware of the intent of the program, they would be more willing to provide information.

Possible solutions discussed to improve this program were:

1) Written reports be made available to hunters and the general public on the purpose and results of these studies.
2) More direct consultations between the DFO, HTO and the general public.
3) NWMB be notified of the problem and that they be included in the process.
4) That DFO and HTO should not rely on verbal conversations with small groups or individuals as a sufficient means of relaying the message to the public.

Distinguishing the different populations

In Cumberland Sound alone there are three different Beluga populations being hunted during the year. The main group is the Clearwater population. There is also a group of smaller whales being hunted at the floe-edge, and there is a small population that summers on the west side of Cumberland Sound.

These are distinguished by the hunters with the notable differences in appearance, size, health and behaviour. Differences:

1) The Clearwater whales are the biggest in body size of the three populations. Also upon arrival the outer layer of skin is yellow and in its early stage of shedding. These whales are fat and most float when killed. They reach Cumberland Sound usually in late June or early July and travel in big herds. These characteristics apply to most adult whales. The younger ones are not as white or are still grey in colour.
2) The whales hunted at the floe-edge are different in appearance and in size. They are noticeably smaller and skinnier and appear in the Spring – April, May or June. These whales are really white in colour and do not show any sign of shedding as the Clearwater whales do. Hunters suspect that these whales spend more time in the faster currents and that this is probably the reason why they are thinner and skinnier. Another difference they show in their behaviour is that they are much easier to hunt because they come closer to the ice and they do not stay under the water as long as the Clearwater whales do. These whales are usually not in as great numbers as the Clearwater whales. They also travel in smaller groups. It is not known from where these whales come or where they go.
3) The whales on the west side of Cumberland Sound are also smaller than the Clearwater whales. They are also not as fat and appear to spend their time along the coast and in faster currents of water. Though these are smaller in size, the skin (Maayak) is thicker than the other two populations. They also tend to sink when killed. The meat and muktuk is also stronger in taste than the other two populations and the muktuk tends to be more flexible.

Most counts have taken place only in Clearwater. The numbers found have been used in determining the size of the population and distribution.

To get a more accurate number of whales that are entering and being hunted in Cumberland Sound there should be more effort made to include the other populations. These are hunted and taken off the Pangnirtung quota annually. Further studies would help determine if these are different populations. The hunters feel that taking these other populations into account would improve the accuracy of the studies and counts. Another interesting note raised here was the fact that before the introduction of motorized transportation it was harder for the hunters to determine if there were different populations reaching the area. This was because they did not have the means of transportation to venture out to other parts of Cumberland Sound.

Beluga populations and distributions at the outpost camps

There is a great difference in the population and distributions of whales at the outpost camps. This is due to smaller numbers and changes in the behaviour of the whales at the northern part of Cumberland Sound. The decrease in numbers are the result of the commercial hunts by the Hudson's Bay Company into the 1940s, and local commercial hunts for a number of years until 1979. These hunts all took place at Clearwater. For years after the hunts, the number of whales continued to decrease. Today the hunters are seeing more whales carry young and suspect that the numbers are finally increasing.

At Nunatak (area 6 of map 97-04) at the mouth of the entrance to Clearwater where several families permanently resided into the 1960s, Peterosie Qarpik (elder/hunter) recalls that from the 1940s to the 1950s, the whales used to spend a lot of time near Nunatak in the summer months, almost right till freeze-up late in the month of October. These whales, he recalls, were in the hundreds.

He further recalls that while heading to the end of Clearwater, he used to see many whales, guessing the numbers to be over a thousand along one side of the fiord. He remembers the whales whistling and making noises near the Nunatak camp in the night.

Another Elder/Hunter, Mosesee Qiyuadyuk recalls when whales used to give birth at Iqalugadyuk (area 7 of map 97-04) outside Clearwater.

In Bon Accord (Illungayut, area 3 of map 97-04) Jaco Evic, an elder/hunter, recalls when there were much more whales travelling near the camp heading to or leaving Clearwater. He recalls that whales used to temporarily leave Clearwater more frequently and in bigger numbers. He recalls whales travelling closer to the land. Today the whales tend to travel further out in the open water. Hunts were limited to only what was needed and also to avoid spoilage of meat and muktuk. Manasa Evic, a Hunter, also recalls when they used to hunt them in the late fall; today the whales are leaving in late August or early September. This is also a behavioural change suspected to be due to the motorized boats or because of the lesser numbers of whales in Clearweater.

Enoosilk Nashalik, an elder/hunter who used to live at Sauniqtuuradyuk, (area 1 of map 97-04) recalls how the whales used to follow the new forming cracks towards land in the later part of spring near the camp. Then in the fall they would migrate back out, passing the same area. They used to hunt the whales in the newly forming cracks. The hunters killed only what they needed to share amongst the camp. He knows that today, most of the whales travel further out in the open water.

Whales used to travel below the ice of the high tide mark. This is rarely encountered today. In the past many of the whales would have travelled below the ice in a day or less. These comments were backed up by Apak Qaqasiq, an elder/hunter, who also resided at the same camp. Because there were no motorized boats in Clearwater when families camped for a part of a season, whales were left undisturbed in the waters.

In the late 1980s only one count study was ever taken involving the camps outside Clearwater. With the counts only taking place in Clearwater, it is felt by the group that it would be best if the counts were done at the entrance of Clearwater while they are entering, to determine how many really do enter.

General hunting areas

Pangnirtung hunters take advantage of all seasons to hunt Beluga, as long as the quota is still not taken. Most spring hunts are done at the floe-edge out in Cumberland Sound between April, May and June. The beluga are mostly hunted only if there are no Narwhals to hunt. Summer is when the heaviest of hunts will take place in Cumberland Sound and outside of the Clearwater boundaries. (This boundary is marked on map 97-03.) A gradual decrease in the number of whales has been noticed, and only in the last few years have hunters started noticing more Beluga carrying young and calves. As a result, they are certain there is an increase in the numbers of the Beluga in recent years.

Hunting methods and hunting of Beluga

Hunting methods and equipment have changed dramatically in the last 35+ years. The behaviour of the Beluga whales has also changed dramatically. Today hunters are using rifle shots to get the whales to go under water during chases. This has contributed to the number of scarred whales and to a general changed behaviour in the whales. A contributing factor in the wounding and chasing of whales at large is the quota of 35 which makes the hunter rush for his catch. At most hunts there are more than three times the hunters for the quota. This usually takes place at the time the Beluga arrives in Cumberland Sound. These rushed hunts originated with the introduction of the quota.

When a number of boats are chasing whales, hunters are taking shots with other boats and hunters in the line of fire. The group suggests that the hunter who first wounds the whale gets the whale when it is killed and not the harpooner. Another practice was that when a whale had been injured, the oil slick on the water's surface was used to pursue the wounded whale. Today the elders feel that to restore some order in the hunting of Beluga whales, traditional laws and practices need to be applied and adhered to more strictly. The group also feels there should be more community consultations to make the public more aware of the problems. This should be addressed at the school level.

Community knowledge and school programs re: traditional knowledge of the S/E Baffin Beluga

Today there are no libraries available for the students and instructors to educate themselves on Inuit Traditional Knowledge of S/E Baffin Beluga whales. Local knowledge is not available to the students and they learn of the Beluga elsewhere. The problem is recognized where a new teacher may have no knowledge or local information available to him/her at all.

It is strongly recommended that this be addressed to the local Education Council and system through NWMB so that Traditional Knowledge can be made available to both the school system, the teachers and to the students.

Some of the topics suggested for educating students could include:

1) Traditional hunting methods.
2) Research on Beluga by students.
3) Hunting and Hunting Methods before, during and after hunts.
4) Hands-on experience on traditional uses of meat and parts.
5) Butchering, cutting and distributing of the muktuk and parts.

Community hunts within Pangnirtung

Pangnirtung HTO organizes annual hunts to distribute muktuk and meat amongst the elders, to less supported members, and to the public through certain community events throughout the year. This serves a good purpose and has been welcomed by the community in general.

As the HTO does not have an adequate budget to run these hunts, they are getting harder to run because of rising costs. It is also getting harder to find hunters to participate.

Upon returning from the hunts community feasts take place. This event is thought to be a good way of bringing the community together and is encouraged.

Because of the problem of high costs, the following suggestions are being made to organize and run the hunts more cost-effectively:

1) Run the hunts in the spring while they can still use snowmobiles to reach the floe-edge to keep costs down.
2) The meat can be better prepared when the weather is not too warm to avoid spoilage.
3) Hunters should remain at certain look out spots at the time of hunt.
4) Activate the hunts only when whales have been spotted at the floe-edge.

5) Should hunts take place in the summer, they should be organized at the time the whales first start heading for Clearwater, in Cumberland Sound.
6) That the Hamlet of Pangnirtung assist more often in these hunts.

These suggestions are raised to help keep costs down and to further avoid any spoilage of meat or muktuk.

General health of Beluga in the spring, summer and fall

The elders and hunters share the same knowledge on the health of the whales from season to season. These whales are fat and healthy when they first arrive in Cumberland Sound. Clearwater whales will float when killed between the months of April to August. Later in the fall from September on, the whales have lost weight and tend to sink when killed.

When these whales leave Clearwater in the fall, they tend to be more adventurous and can be found in more of the inlets and fiords along their migratory route. The whales will travel closer to the coast more than they would have upon arrival and they feed on their way out. When these whales have thinned out, they will travel faster and go without air for much longer periods of time (in the fall).

Stomach contents of the whales have shown that they feed more towards the last part of their stay in Clearwater, and feed regularly upon leaving Clearwater. (Note: some of the elders had witnessed dead whales that had died while feeding on a "tupiyyutik" better known as the grenadier.)

Aging of meat and muktuk

This traditional method of aging meat is still practiced, depending on the season of kill. Most of the aging was done with the younger and smaller whale meat and muktuk later in the summer. Regardless of the age of whales, the muktuk can be aged and made into "Singittaq" which is the stripping of muktuk from the skin and blubber after it has been aged.

Hunting Beluga with nets

Today these nets are not used in any season to hunt Beluga. Some hunters avoid using seal nets fearing they will catch whales after the quota has been filled. In Pangnirtung or outside, whale nets are only used to hunt Narwhal. Elder/hunter Jaco Evic recalls that nets at the outpost camps were not used before the 1930s. This was probably due to no rope material being available to be made into nets. After the 1930s nets were introduced, but even these were made with very poor rope and material.

Ice conditions at the floe-edge and ice packs in the summer

When hunting at the floe-edge thin ice is always a threat and creates problems for the hunters. Heavy ice packs at the floe-edge can be used to the hunters advantage where whales may be found in small openings of water and are vulnerable.

In the summer when heavy ice packs are in Cumberland Sound, it is harder to hunt game. Losses may be greater and travel may be impossible due to the heavy ice packs.

Ice entrapment of whales

In 1956 over a hundred Beluga whales were trapped during the forming of ice on the west side of Cumberland Sound. It was only in later years that it was noticed that the whales were missing. There are other areas that trapped whales repeatedly on the west side of Cumberland Sound. Most of these whales may survive the winter if not hunted. Another area that is known to have trapped more than 35 whales is Irvine Inlet, (see map #97-04). There are fast currents there and shallow waters. Enoosilk Nashalik (elder/hunter) suspects that the whales could have been washed ashore by a sudden fast current of water as their remains were found above the high tide mark. Another area that occasionally traps whales is the openings of water in Nettilling Fiord. Enoosilk has encountered a few trapped whales a number of times in that area.

Studies and counts of Beluga whales

Inuit knowledge has always been lacking or not included in some of the studies, final reports or findings where Inuit hunters participated. Some individuals, during aerial surveys, returned feeling neglected or found their input not included in the final reports. The group feels that there needs to be improvements made in the studies and reporting methods to include Inuit knowledge in the final reports. Even in the last few studies and counts, adequate Inuit knowledge was not included. Changes have been requested with DFO to work closer with the communities on such activities.

Traditional uses of whale meat and parts

Today the uses of a whale and its parts are less known by the younger generations, even though traditional uses and needs are still an important part of our culture. This is an area where elders need to educate and pass on their knowledge. Elder/hunter Enoosilk Nashalik said, "We must restore this (practice of Traditional Knowledge) ... as it used to be part of our daily lives." In the past, most parts of the whale were used except for the head. People made thread, jerky, and used the meat for dog food. There were different kinds of thread made from the tendons of certain parts – the type used would depend on what the women were going to use it for. It was done this way because certain tendons were weaker than others. Even the meat is not used for food today as it was in the past. Certain parts of the whale that were considered a delicacy back then are still eaten today by some hunters. The stomach was boiled by some people, the skin was made into the base of whip handles. Hunters made from the skin a certain type of rope used in luring the seal pup's mother to the hole. This type of rope turned white after repeated use and would not freeze in the cold. This was cut out from the top part of the whale skin. Uncleaned bones were stored to be used in the winter as fox bait, or, eaten when there was no other meat available. The meat on the front part of the whale head was not consumed as it could make people or dogs dizzy or sick. The blubber was used extensively to fuel the "Qullik" (stove) which burns cleaner and brighter than most types of blubber. The blubber of the whale had even been used repeatedly as a gasoline mix to run motors.

The distribution of the whale parts were split evenly amongst the camp when a whale was caught either at the immediate camp site or elsewhere. There were also certain procedures followed in the preparation of the whale. Certain types of bones, the front flippers and tail fins were divided equally after being cut into smaller pieces.

"Today when a whale is caught, it is cut wherever it is convenient regardless of its possible uses. Very small parts of the meat or intestines are taken, and the parts that were eaten as a delicacy are hardly touched," said hunter Jooeelee Papatsie.

With the changing needs for whale parts and uses, respect by hunters for Belugas has changed too. "This is becoming a more common problem," says hunter Levi Evic. "This was never a problem when all parts and uses were divided equally amongst the camp," recalls elder/hunter Mosesee Qiyuayuk.

The elders and hunters recognize that the ignorance of traditional ways and laws are part of the problems today. Hunts are too rushed and too much eagerness is shown by most hunters. Even the elders are having to rush to get their catch or share. This was never done while living at the outpost camps. Before, more of the camp members were related unlike the many different families and community members today. The gaps between the elders and the younger generations are far and wide. "We the elders acknowledge that there is a need for us to give better guidance," says elder/hunter Enoosilk Nashalik. Elder/hunter Mosesee Qiyuayuk stated, "Hunters can obtain the elders' knowledge by listening to elders on the radio."

Closing remarks

Levi Evic, Hunter/HTO Chairman: "This study will bring out a lot of new information regarding educational views and other aspects on the hunting of Beluga whales."

Manasa Evic, Hunter: "I expect good results from this study and want to hear the outcome of this study sooner than later. I thank the elders for participating."

Jaco Evic, Elder/Hunter: "I have high expectations from this study, not only on hunting Beluga whales but on the way we live our lives and through the teaching of more of our traditional ways of living."

Enoosilk Nashalik, Elder/Hunter: "I express my thanks. We expect good things to come from these meetings. Hopefully, with this information NWMB can make improvements through further studies and such."

Peterosie Qarpik, Elder/Hunter: "I express my thanks and expect Question #11 on "Traditional Knowledge in the school programs" and Question #19 on "Traditional needs and uses of whale parts and meat," to be most beneficial as educational tools."

Jooeelee Papatsie, Hunter: "I also express my thanks. From 1960 to 1970 the younger generation has lost a lot of traditional skills and ways that used to be followed. Having lived with an elder and therefore recognizing how far we have to go, I expect that there may be more hardships along the way."

Apak Qaqasiq, Elder/Hunter: "I express my thanks. This study has been very informative, I also respect the questions that were raised as they were very relevant to our traditional ways of life."

Suggestions and recommendations to NWMB

The eight participants from Pangnirtung involved in this study and meeting would like to request that the need to put out educational material in a written format for students, teachers and local people be addressed seriously.

The educational videos to be used at the school programs should include such topics as:

1) Traditional uses of meat and whale parts.
2) Proper hunting methods before, during and after the hunts.
3) Butchering, cutting and distribution of muktuk and parts.

Another idea mentioned for teaching students is to have the students do research work on the Beluga whales.

Suggestions to DFO on the sampling program:

1) The purpose and intentions should be made clear to the hunters and public on the sampling program being carried out by DFO.
2) There should be more direct consultations between DFO, HTO and the public on the progress of the study.
3) That NWMB should be addressed and take a part in the progress of these studies.
4) DFO and HTOs should not rely on verbal conversations to small groups or individuals as sufficient for conveying the messages of the study.

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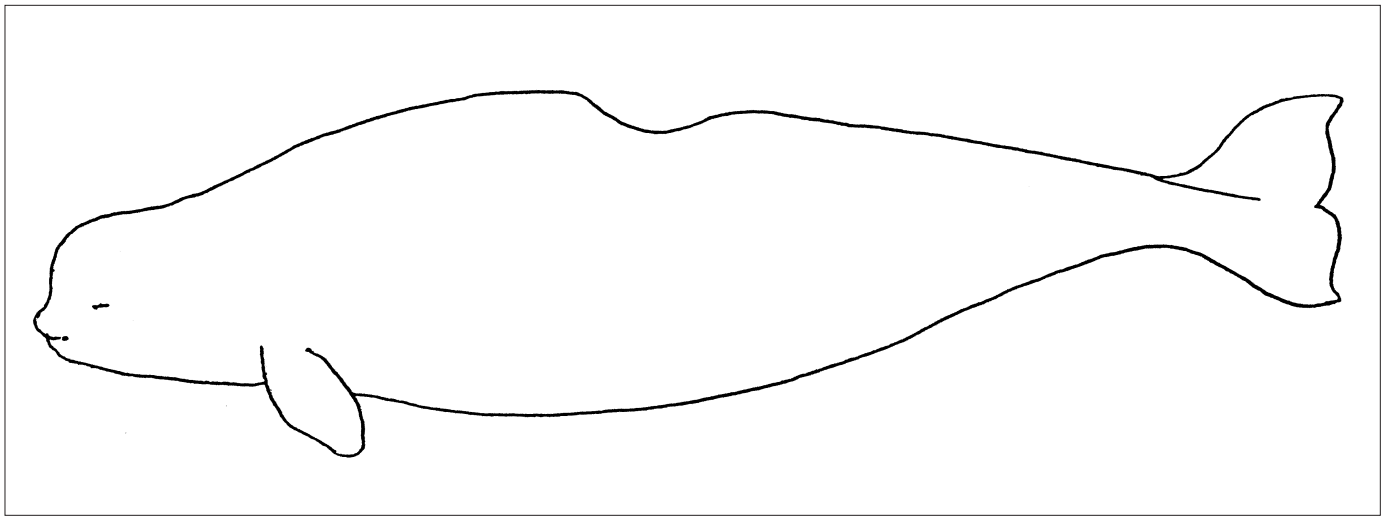
ᕿᓐᓂᑐᐃᓐ ᓄᓇᕗᑦ X0A 0R0
ᒪᑐᓴ 25, 26, ᐊᖏᒪ 27, 1997

ᐃᓕᓴᖅᓯᒪᔪ ᖃᓄᖅᑲᓐᓂᑦ ᓂᒥᐊᓂ ᖃᓄᐃᓂᖅᓄᑦ ᑲᑎᒪᔨᖅᑕᕐᓂᒃ ᑐᓴᖅᓯᒪᓂᖅ, ᐃᓄᐃᑦ ᐱᖁᓯᖏᓐᓄᐃᖅᑕᕐᓂᒃ ᖃᐅᔨᓴᕐᓂᖅᓯᒪᓂᖅᓄᑦ ᖃᐅᔨᓴᓂᕐᓂᖃᖅᖢᓂᖅᓯᒪᓕᖅᓯᒪᔪᓕᖅᑐᑦ ᑲᑎᕋᖅᓯᒪᓂᑦ ᐱᓕᕆᔨᒃᑯᑦ, ᐱᓕᕆᔨᓂᖅᓄᑦ ᐃᓚᖓᑦ ᐊᖏᖅᑐᑦ, ᐃᖅᓯᒪᓕᖅᑐᑦ ᐊᖏᖅᑐᑦ.

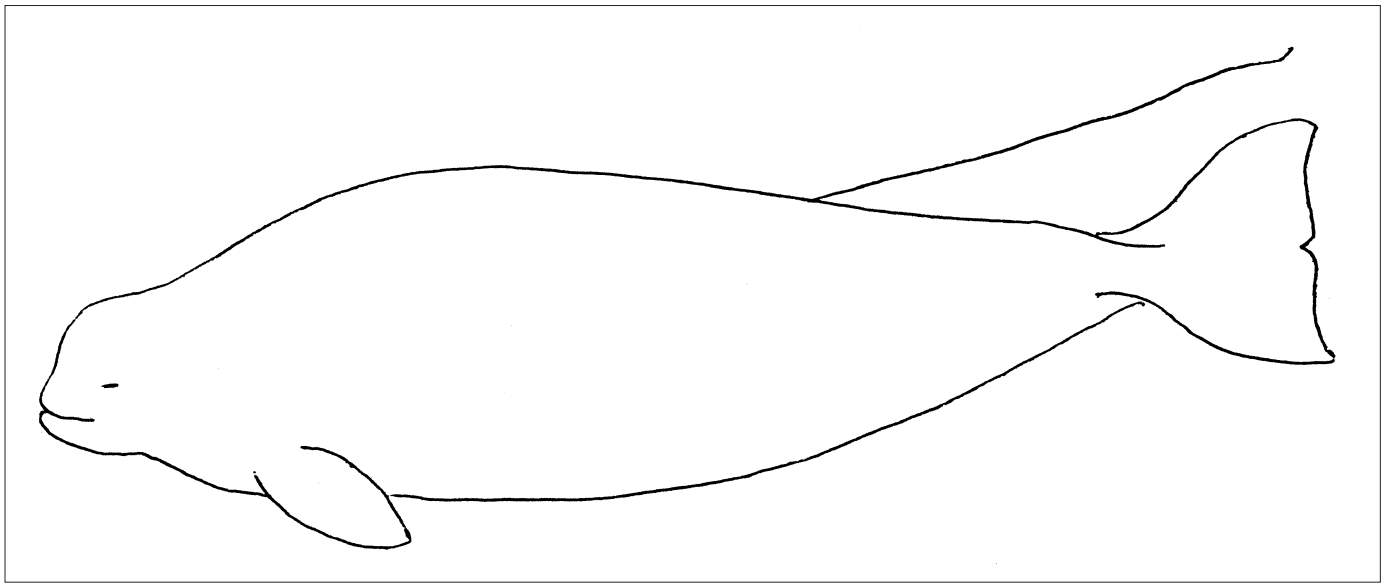
ᑕᒪᒃᓴ ᖃᐅᔨᓴᓂᖅ ᑐᓂᔨᐅᓕᐅᔨᑐᖅ ᐲᑕ ᖃᓕᕐᓂᒡᓗ ᕿᓐᓂᑐᐃᑎᖅ ᕿᓐᓇᖅᑎᖅᓂᐅᕐᓴᓗᓂ ᐃᓕᓴᕐᓗᓂ ᐱᖓᓱᓐ ᓄᓇᕗᐅᕐᓂ. ᑕᒪᒃᓴ ᐃᓄᐃᑦ ᖃᐅᔨᒪᓂᖅᓂᑦ ᐊᖏᒪ ᐃᓱᒪᓕᐅᓕᕐᓴᐅᓂᑦ ᓄᓇᕗᐅᕐᓇᖅᑐᖅ ᐊᖏᖅᑐᑦ ᐃᓕᓴᕐᓗᓂᑦ ᐅᒪᑐᓗᓂ ᑐᓴᕐᓗᓂᑦ ᐊᖏᖅᑐᑦ ᐃᓕᓴᕐᓗᓂᑦ ᐅᒪ

ᑕᐃᒪᐃᑦᓴᐃᓐᓂᖏᓐᓇᕐᓂᑦ ᐃᓕᒪᖏ ᐱᔭᔪᑎᖏᔪᓂᓄ ᐱᖁᓪᓚᐸᓪᓕᐊᓂᑦ ᑐᓴᕐᓂᑦ, ᓄᑖᖅᓯᓄᑦ, ᓄᑖᖅᑎᑦ ᐊᓄᖅᓯᒃᑎᑦ ᖃᐅᔨᓴᖅᑎᑦ. ᑕᐃᒪ ᐊᐅᓪᓚᓪᓕᐊᓪᓚᑐᓄᑦ ᐃᓄᐃᑦᑐᒃᑯᑦ ᖁᓕᓴᐃᓐᓇᑦ ᓂᓇᓴᓪᓕᐊᑦ 97-01 ᐊᓕᓗ ᐊᐅᓪᓚᓪᓕᐊᓪᓚᑐᓄᑦ ᐃᓄᐃᑦᑐᑎᓪᓗᓂᑎᑦ. ᑕᒪᓐᓂᖅᓯᓄ ᐃᓄᐃᑦᑐᑦ ᖁᓕᓴᐃᓐᓇᑦ ᖃᐅᔨᓴᕐᕕᑦ ᐃᓕᒪᖏ ᐱᔭᔪᑎᖏᔪᓂᓄ ᒥᖁᐊᕐᒥᓗᕐᓂᐊᓂᖅᓯᓂᖅᓯᒪᓂᖅᑎᑦ ᖃᐅᔨᓴᕐᕕᑦ ᐊᓂᖅᓯᒪᓂᖅᓯᒪᓂᖅᑎᑦ ᓂᕈᐊᓂᖅᓯᓄᑦ ᖃᐅᔨᓴᕐᕕᑦ ᐃᓄᐃᑦᑐᑦ ᐊᓂᖅᓯᒪᓂᖅᓯᒪᓂᖅᑎ

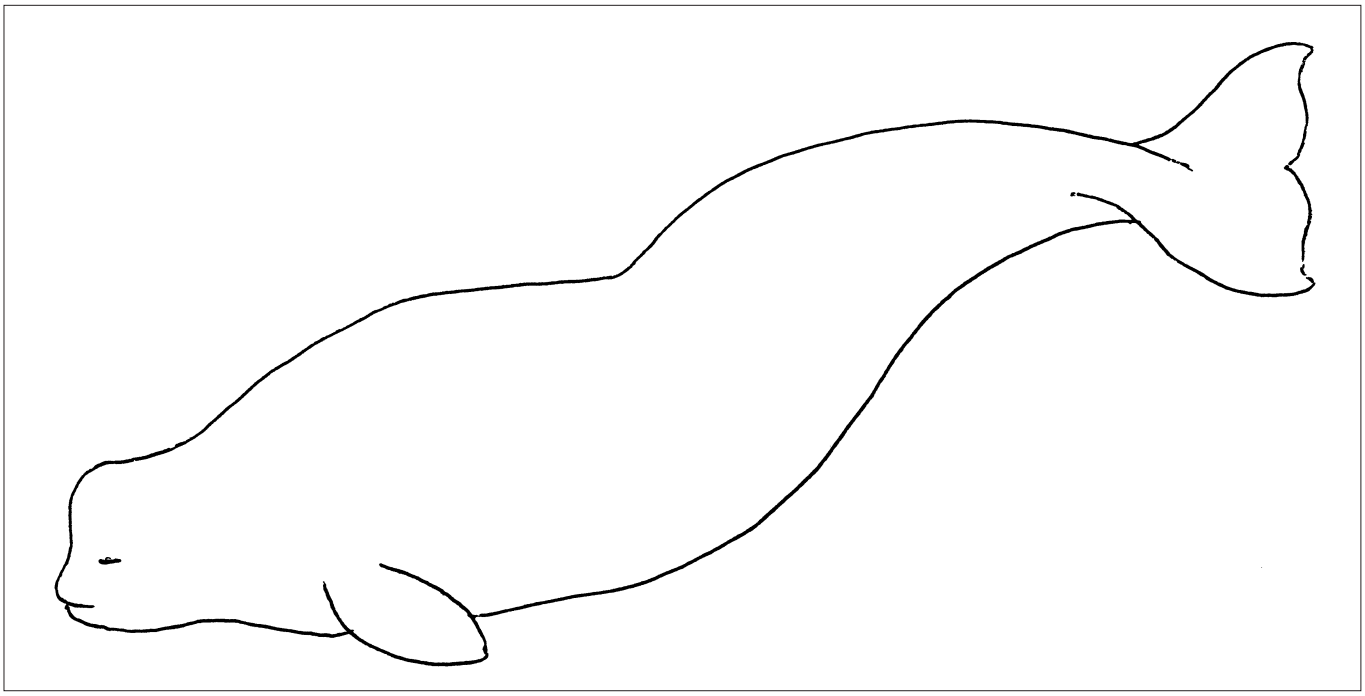
ᑕᒫᓂᒪᖅ ᖃᖓᓐᓂᔨᐊᒥᒥ ᑕᒪᐃᓄᒃᓴᓂᓄ ᐱᓕᕆᓂᐅᓂᖅ ᑕᒫᖅᑐᖅ ᐊᑐᓂᖅᑐᖅ ᑕᒫᓂᖅᑐᖅ ᐊᑐᓵᐃᓂᓕᒃ ᐅᑎᓕᒃᑐᖅ ᐅᓪᓗᒥᒃ ᐅᖃᓕᒫᖅ. ᑲᖏᑎᒃ-ᐅᓪᒥᔨᖅ ᑕᒪᐃᓐ ᐱᖁᓯᓂᑎᑎᓄᖅ ᑕᐃᒪᓐᓇᐅᖅ ᓴᓇᔨᓴᓂᓂᖅ ᖃᓄᐃᓕᖅᑐᖅ ᑕᐃᔨᓂᒃᑯᓐᓇᖅᑐᖅ ᐊᒥᓱᒍᐅᓴᓕᐅᔨᓂᑦᓴᖅ ᑕᐃᔨᓂᒃᑯᓐᓇᖅᑐ



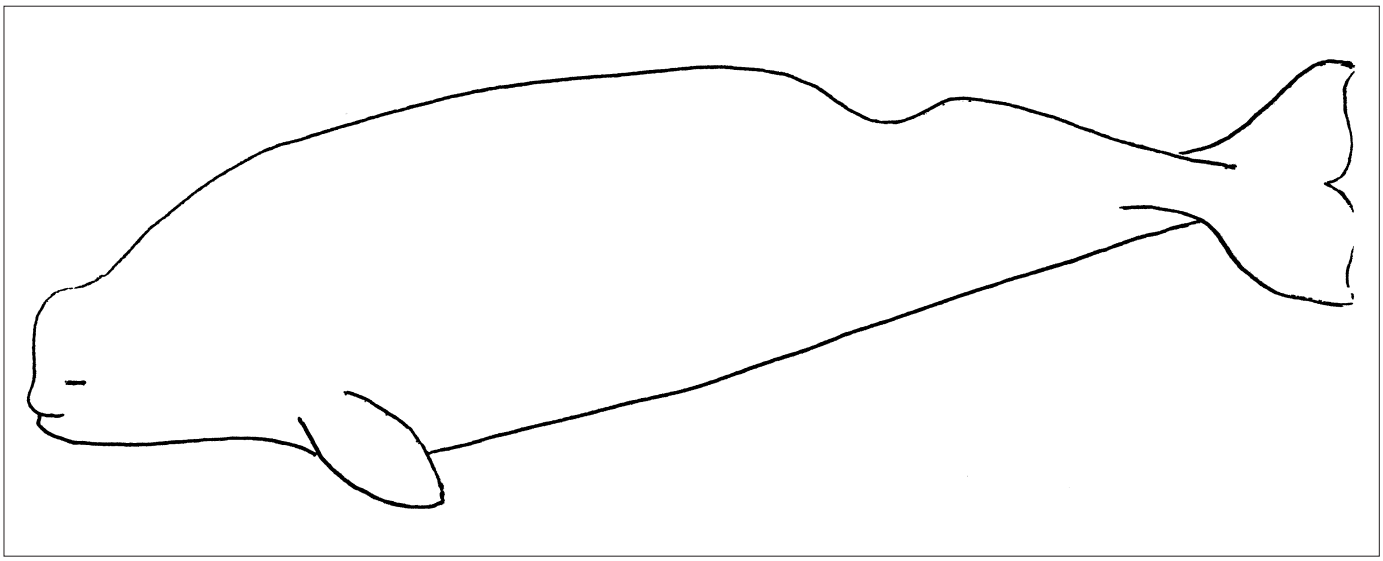
A) ᐃᔨᖅᓴᓕᒃ (ᓱᓕ ᑕᑯᔭᐅᓲᖅ)



B) ᑲᓕᑦᑐᖅ (ᓱᓕ ᑕᑯᔭᐅᓲᖅ)



C) ᓇᐱᓯᒪᔪᐊᓘᔭᕐᑐᖅ (ᓱᓕ ᑕᑯᔭᐅᓱᖅ)



D) ᐊᒥᕈᕐᐸᔨᐊᒍᑦ ᐃᓯᕐᓴᓕᒃ (ᓱᓕ ᑕᑯᔭᐅᓱᖅ)

ᐱᖁᐃᓂᒃᑯᓐ ᓄᐊᑦᑎᖏᑦᑕᕐᓂᒃ ᐃᒪᖁᑎᒋᐊᕐᓂᖅᐳᑎᒍᔪᓐ

ᑕᖅᓇ ᐱᖁᐃᓂᒃᑯᓐ ᓄᐊᑦᑎᓂᐅᕙᓪᓕᖏᓐᖓᒃ ᐊᐅᓚᐸᖅ ᖃᒪᔨᖏᐅᕙᓪᓕᖏᓐᖓᒃ ᐊᖁᖏᑐᒍᓐᓇᖅ ᐃᒪᖁᑎᒋᐊᕐᓂᖅᐳᑎᒍᔪᓐ ᖃᓄᐃᓐᓇᖅᑐᓂᒃ ᐃᓕᓴᐃᖅᓯᓐᓇᖅ ᐃᓕᓴᐃᖅᑐᑦ ᐃᓕᓴᐃᖅᓯᓐᓇᖅᑐᑦ. ᐊᒻᒪ ᐃᖃᓗᐊᓂᐅᔪᓐᓇᔪᒍ. ᑕᒪᓐᓇᐅᑉ ᐊᓂᔪᓂᑦ ᐃᓚᐅᕙᓪᓕᖏᓐᖓᒃ ᑕᕐᔪᐊ ᖃᐅᔨᓴᖅᓯᓐᓇᖅᑐᑦ ᓄᐊᑦᑎᓪᓕᖏᓐᖓᒃ ᐃᖏᕐᓂᓕᕆᓐᓇᖅᑐᑦ ᑭᓚᐅᖅ ᑕᒪᓐᓇᐅᑉ ᐊᓂᔪᓂᑦ ᐱᓕᕆᔨᒃᑯᑦ ᐊᐅᓚᑦᑎᓪᓕᖏᓐᖓᒃ ᐃᖏᕐᓂᓕᕆᓐᓇᖅᑐᑦ ᐊᐅᓚᑦᑎᓪᓕᖏᓐᖓᒃ ᐃᓕᓴᐃᖅᓯᓐᓇᖅᑐᑦ ᐊᐅᓚᑦᑎᓪᓕᖏᓐᖓᒃ ᐃᓕᓴᐃᖅᑐᑦ, ᑕᒪᓐᓇᐅᑉ ᐊᓂᔪᓂᑦ ᐱᓕᕆᔨᒃᑯᑦ ᐊᐅᓚᑦᑎᓪᓕᖏᓐᖓᒃ ᐃᓕᓴᐃᖅᓯᓐᓇᖅᑐᑦ ᐊᐅᓚᑦᑎᓪᓕᖏᓐᖓᒃ ᐃᓕᓴᐃᖅᑐ

ᓯᑐᐃᓇᖅᑎᓂᖅ. ᑕᐃᒪ ᓯᓚᓂᓴᓂᒃ ᖃᑎᐅᓂᖅᑎᓂ ᐱᓕᒪᐸᑦ ᖃᓄᐃᓕᖅᑕᐃᑦ ᑕᐸᐅᖅᖃᑦ ᐃᓯᐸᑐᑦ ᐊᒪᒪᓗ ᐊᖏᓇᓯᑕᐅᓕᑐᑐᑐ ᖃᓄᖅᔪᐊᑎᓂᓗ, ᐊᓯᖏᑐᖃᖃᓂᓇᐊᓕᓐ ᑕᓄᐊ ᐃᓕᓚᐅᑎᑎᖃᓕᓐ ᐊᓯᖏᑦ ᐊᒥᓯᓚᓐ. ᑕᓄᐊ ᐊᖏᓇᓯᑕᐅᓴᕐᕕᑦᑎᒃ ᐱᑕᐅᓕᑐᑐᑦ ᐸᓐᓇᑐᑦ ᓄᓪᒋᑕᒪᓐ. ᑕᓄᐊ ᐃᖏᔪᓂᐅᓕᖅᖃᖅ ᐊᒥᓯᓚᐅᑎᓯᓕᖅᑐᑦ ᑕᐃᒪ ᐃᓚᔪᓂᐅᓕᖅᑐᑦ ᑕᐃᒪ ᓇᓴᐅᓂᐅᓕᖅᑐᑦ ᑕᐃᒪ ᓇᓴᐅᑕᐅᓕᖅᑐᑦ ᑕᐃᒪ ᐃᓚᔪ

ᐊᐅᓚᑕᖏᑕᕐᓯᒪᓂᖅᓄᑦ ᐃᓕᐃᑐᑐᐊᒥᑦ, ᐃᐸᐱᕆᐅᔨᖅ ᑕᒪᓐᓇᖅᑎᑦ ᑕᒪᓐᓇ ᐱᐅᓂᖅᑕᐅᓴᓇᖅᑐᖅ ᓇᕆᔭᐅᑕᖏᑕᖏᑕ ᐸᖅᑐᐃᓂᖅ ᐃᓕᐃᑐᑦ ᑕᒪᓐᓇ ᐃᓕᓴᐸᓚᐅᑎᓗᒍ, ᓴᖅᐃᓕᓴᐸᑕᐅᓂᖅ ᓂᐅᖅᑕᓚᓂᖅ ᐃᓕᑐᖏᓚᖅᑐᖅ.

ᐊᒥᓕᓂᕐᓴᓂᖅ ᐊᖏᓇᓴᐅᑦᑕᑐᑐᐃ ᖃᓂᒪᔭ

ᕿᓂᓂᑦ ᐊᓴᓀᑎᖏᑦ ᐊᐅᑭᓇᓕᒪᐊᕐᑐᑦ ᐊᖅᔪᑦ ᐃᓗᐊᓂ ᐊᖏᓇᓴᑐᑎᓂᖅ ᖁᑕᓚᓐᓂᖅ ᐊᒥᐃᓇᑎᖏᓐᓄᐃᖅᑐᐃᓕ ᑯᑕᒪᔭ. ᑕᒪᑦᑯᐊ ᐅᓂᒃᓴᓇᓕᖅ ᐊᖏᓇᓴᐅᑦᑕᑐᑐᐃ ᐱᓕᕆᓂᖅ ᑕᐅᓇᓂ ᑲᖏᑐᐊᒥᑦ ᐊᐅᓚᖅᑎᑦᑐᑐᐃ ᐊᑯᓂᖅᓂ ᐊᐅᐊᓕ, ᒪᓇ ᐊᒪᓪᓚᖅ ᐊᒥᓕᓂᕐᓴᓂᖅ ᐊᖏᓇᓴᐅᑦᑕᑐᑐᐃ ᐱᓕᕆᓂᖅ ᐊᒥᓕᓂᕐᓴᓂᖅ ᐊᖏᓇᓴᐅᑦᑕᑐᑐᐃ

ᓄᓇᓕᐅᔪᒥᑦ ᐊᖏᓇᓯᕕᓂᖅ ᑕᕐᓂ ᕿᓐᓂᑐᒥ

ᕿᓐᓂᑐᑦ ᐅᓪᓚᔪᓕᓴᕕᖏᖅᑕ ᑲᑎᒪᔨᖏᑦ ᐋᖅᓯᐃᓚᖅᑐᑦ ᐊᖏᔪᑕᒪᒃ ᐊᖏᓇᓯᐅᔪᒥᑦ ᐱᔨᔾᔪᐅᔪᓂᖅ ᒪᑕᓂᖅ, ᓂᖅᖏᓗᓪ ᑕᔪᓄᖏ ᐃᓄᑐᖃᓐᓄᑦ, ᐱᔨᖅᑎᐊᖏᑐᑐᓄ, ᓄᓇᓕᒥᐅᖏᓪᓕᓄᑦ ᐊᑐᐃᓇᓕᑕᐅᔪᓐᓇᑐᑐ ᖃᖏᐅᓕᓂᐊᒪᒪ ᓄᓇᓖᑦ ᓯᑎᕈᑎᑐᓕ ᐃᓕᓴᐅᒪ ᐊᖏᔪᑦ. ᑕᒻᒪᓄ ᐱᓕᓇᓂᖏᓪ ᐱᐅᔪᓄ ᑐᔪᖏᓐᓇᒪᓕᖅ ᐊᒻᒪᓗ ᑐᓄᖏᓐᓇᑐᓂᖅ ᑕᒻᒪᓗ ᐅᖏᓪᓗᓂᑦᑐᓂᖅ ᓄᓇᓕᒥᐅᖏᓪᓕᓄᑦ ᑕᒻᒥᑎᓕᓪ.

ᒐᔪᐊ ᐊᖏᓇᓯᑐᓇᓚᔪᓂᑦ ᑲᑎᒪᔨᖏᑦ ᐱᕕᖃᖅᑎᒪᑕ ᓴᒪᑦᑐᒥᖃᑦ ᑭᓇᐅᔨᓄ ᐊᐅᓚᑎᔨᑎᓂᖃᑦ ᑕᒪᔪᓂᖓ ᐊᖏᓇᓯᐅᔪᓕᔪᓄᑦ, ᑕᒪᔪᐊ ᐊᖏᓇᓯᓐᓂᑦ ᐱᓱᓇᔨᓯᓪᓕᐊᔪᑦ ᐊᐅᓚᔭᓇᐊᖏᑕ ᐱᑦᑐᐃ ᐊᑎᖃᕐᓇᓂᖏᑦ. ᐊᒻᒪᑕᐅᖅ ᐱᓱᓇᓯᓪᓕᐊᔪᖅ ᓇᓂᓯᕈᐊᖅ ᐊᖏᓇᓯᐃᓴᓂᒥᑦ. ᑕᐱᒪ ᐅᑎᖅᑎᒥᑦ ᐊᖏᓇᓯᐊᓯᒪᔪᐊᓂᑦ ᓄᓇᓕᒥᐅᑦ ᓂᓚᕆᔪᐊᑎᑕᐅᓪᓕᖅᑐᑦ.

ᑕᒪᒪᓇ ᐊᐅᓚᓂᖓ ᐃᓕᓴᕆᐅᔪᖅ ᐱᐅᔨᖏᓚᐅᖅ ᑲᑎᑎᒥᓂᖅᑐᖅ ᑕᒪᐅᖏᓐᓄᑦᑐᖅ ᐊᒻᒪ ᓯᓚ ᐃᑲᔪᓯᑕᐅᓪᓕᖅᑐᖅ.

ᒐᔪᓂᖓ ᐊᑲᐅᖏᓚᐅᔾᔨᑎᐅᔪᓂᑦ ᐊᒻᒪ ᐊᐸᑐᐊᓚᓂᐅᔪᓄᑦ ᓄᒋᓂᑦ ᐃᓯᒪᓕᕆᓂᑦ ᓄᐃᑎᔪᖅᓴᖅ ᐊᖏᑭᐊᔪᒋᑕᑦ ᐊᒻᒪ ᐊᐅᓚᓂᖅᓴᐃᓂᑦ ᑕᒪᔪᐊ ᐊᖏᓇᓯᐅᔪᓕᔪᓄᑦ ᐊᐸᑭᓂᓚᓂᑦ.

1) ᐊᐅᓚᓂᒃ ᐊᖏᓇᓯᓐᓂᑦ ᐅᐱᖏᓚᔪᑦ ᓯᓚ ᐊᐅᑕᐅᔪᓇᓂᖏᓂ ᖃᒧᑕᐅᕆᐃᑦ ᑕᐅᓄᖏ ᓯᓇᖏᓄᑦ ᐊᐸᑭᓇᓂᓚᐅᔾᔨᒋᓪᓕᓐᓂᑦ.
2) ᑕᒪᓇ ᓂᐸᖏ ᐱᐅᓂᓚᑎᒃ ᕿᓇᑕᐅᔪᓇᖅᑐᒍ ᓯᓚᖏ ᐅᔾᔨᒧᐊᖏᓂᖏᓕ ᓯᓂᐅᖃᐃᓇᓇᐊᖏᓚᓪᓕᖅ.
3) ᒐᔪᐊ ᐊᓯᓯᑎᖅ ᑕᒪᓂᓚᐃᓇᓵᔪᓪᓗᓂᖅ ᖃᖅᓴᓯᕕᓂ ᑕᐃᒃᓂ ᐊᖏᓇᓯᓕᖅᑕ.
4) ᐊᐅᓪᓚᕆᐊᖅᑕᕿᓪᓗᓐᓄᖅ ᐊᖏᓇᓯᓐᓂᑦ ᑭᓯᐊᓂ ᑕᔪᓯᒪᔪᐊᖅᑐᕿᓂᑦ ᓯᓇᖏᓄᑦ.
5) ᑕᐃᒪᓕ ᐊᖏᓇᓯᓐᓂᑦ ᐱᓕᓚᐊᖏᓂᐊᖅᑕ ᐅᐱᖏᓪᓗ, ᐊᖏᑕ-ᐅᓯᒪᔨᓚᐊᓕᑦ ᑕᐃᒃᓂ ᖃᓄᐃᓚᖅ ᓯᑲᓕᕐᓂᑦ ᑕᕐᐅᖏᓐᓄᖅᑕᐅᔪᓂᖅ ᐃᓯᒪᓕᕆᓂᑦ.
6) ᒐᔪᐊ ᕼᐊᒪᓕᔪᖏᑦ ᕿᓐᓂᑐᑦ ᐃᒃᔨᖃᓂᓚᐅᔾᔨᒋᓪᓕᓐᓂᑦ ᑕᒪᔪᓂᖓ ᐊᖏᓇᓯᓂᐅᔪᓄᑦ.

ᒐᔪᐊ ᐃᓯᒪᓕᐅᔾᔨᑎᓚᐃᑦ ᓄᐃᑕᐅᔪᑦ ᐃᒃᔨᑕᐅᓄᓯᑐᑦ ᐊᖏᓇᓯᓚᐅᔾᔨᒋᓪᓕᓐᓂᑦ ᑕᒪᔪᓂᖓ ᐅᕐᓗ ᒪᑕᓂᖅ.

ᑕᒪᔪᐊ ᖃᓄᐃᓚᐃ ᐋᒻᒪᓂᖃᖅᑐᑦ ᐃᓐᓇᐃᓐᓇᖅᑐᖅ ᓴᓇᔨᓂᖅ ᐊᖏᓇᓯᐅᔪᓄᑦ ᐱᔨᔾᔪᐅᔪᓂᖅ. ᑕᒪᔪᐊ ᐃᓯᐃᑐᑦ ᖃᓄᐃᓚᖅᑐᑦ ᐅᑎᖅᑎᒥᑦ ᐃᓐᓇᐃᓐᓇᖅᑐᖅ ᐊᖏᓇᓯᐅᔪᓄᑦ ᐊᐅᓚᑎᔨᑎᓂᖃᑦ ᑕᒪᔪᐊ ᐃᓯᐃᑐᑦ ᐃᓐᓇᐃᓐᓇᖅᑐᖅ ᐊᖏᓇᓯᐅᔪᓄᑦ ᐊᐅᓚᑎᔨᑎᓂᖃᑦ ᐃᓯᒪᓕᕆᓂ

ᓂᐩᐸᑦ ᖃᓄᐃᒋᓂᖏᓐ ᓂᐩᓇᖏᓂ ᐊᒻᒪ ᓂᐩᖃᖏᓪᓗᓂᔪ ᐅᐱᖏᓐᓂᔪ

ᐊᖏᓇᓂᖏᑎᒃᓗᔪ ᓂᐩᓇᖏᓂ ᓴᖅᑐ ᓂᐩ ᑕᐃᒪᖏᓕᒪᖏᖅ ᐅᓗᓚᐊᓇᖏᓐᓂ ᐊᒻᒪ ᐊᖏᐅᖏᓕᓕᐅᑎᖏᓐᓂᕐᒪᓂᐅᓂ ᐊᓂᔨᕐᑎᓄᑦ. ᑕᐃᒪ ᓂᐩᓕᐊᓄᓚᐊᑎᓗᔪ ᓂᐩᓇᖏᓂ ᑕᒻᒪᓇ ᐊᓂᔨᕐᑎᒧᑦ ᐊᖏᐅᓇᓱᐊᕆᓇᖏᓐ ᓇᒻᒥ ᖃᓄᐃᓐᖏᑦ ᓇᓂᓂᐊᐅᔪᓂ ᐃᒪᓐᓴᒻᒥ ᐊᒻᒪ ᒪᓂᒪᖓᓂᕐᓴᐅᓗᓂ.

ᐅᐱᖏᓐᓂᑦ ᓂᓈᓚᐊᑎᓗᔪ ᑲᖏᑐᔪᐊᖅ, ᐱᒪᓇᓂᕋᐅᒪ ᐊᖏᓇᓂᐊᖅ ᖁᓇᐱᑐᐊᖅᓯᒪᓕᖅᓂ. ᔪᒪᐃᓂᕋᐅᔪᓂᖓᓂᖅᓴᖅ ᐅᓂᒃᑯᓂᖅ ᐊᓂᔨᕐᑎᓄᑦ ᓂᓈᖁᓚᐊᑎᓗᔪ.

ᓂᓴᔪᒻᒪᒋᔭᓂ ᖃᓕᓚᒪᐃᑦ

ᑕᕐᓂ 1956 ᐅᖏᒪᓂ 100 ᖃᓕᓚᒪᐃ ᓂᓈᐅᓕᑐᑦ ᓂᓈᕐᓕᐊᓕᓐᓂᔪᓗ ᐱᖏᓇᓕᓂᐊᓂ ᑲᖏᑐᔪᐊᐸᑦ. ᐳᓂᓂ ᐊᖕᔪᐃᐃ ᐳᖓᓂᐊᔪᑦ ᓂᔪᓴᐅᓕᐅᑐᑦ ᖃᓕᓚᒪᐃᑦ ᐅᐱᖏᒻᒪᒋ ᒋᕐᒪᐃᐃᓐᓂᖅ. ᑕᐃᒪᑕᐅᖓ ᐊᓂᖏᓂ ᐃᓕᑑᐅᓕᐅᑐᑦ ᓂᑐᐃᓐᓇᖅ. ᑕᐃᒪᑕᐅᖓ ᐊᓂᖏᓂ ᐃᓕᑑᐅᓕᐅᑐᑦ ᓂᐱᖏᓂᐊᓕᓕᐅᑎᖏᓐᓂᕐᒪᓂᐅᓂ ᖃᓕᓚᒪᐃᑦ ᐅᐱᖏᒻᒪᒋ ᒋᕐᒪᐃᐃᓐᓂᖅ ᐊᒻᒪ ᐃᓐᓇᐃᓐᓂᖅᑐᑦ ᐊᖏᐅᓇᓱᐊᕆᓇᖏᓐᓂᕐᒪᓂᐅᓂ ᐊᓂᔨᕐᑎᓄ

ᐃᓱᐊᓪᓚᑎᐊᖅᑐᓂᕐᕿᐅᒪ ᓴᓇᒪᓇᓂ ᐊᓪᒪ ᖃᐅᒪᓂᕿᐅᓇᓂ ᐊᓯᖏᓂ ᐅᖅᓯᐃᐅ. ᐋᖅᓯᖓ ᖁᓕᓴᐃᐅᑦ ᐊᑦᓪᓕᐅᓪᓕᐅᑐᖃᖅ ᐊᒥᓯᐊᑎᖅ ᒐᕐᓯᐃᓐᓇᑦ ᐃᑐᐊᖅᑐᓂᒃ ᐊᐅᓪᓕᐅᑎᓄᑦ.

ᑕᒪᒻᓄ ᓂᖏᖅᖃᓄᖓ ᑭᓯᐊᑎᖏᑕ ᐊᪧᒪ ᐊᑐᑎᖃᑐᐃᓄᑦ ᐊᔪᑕᐅᑎᐊᑦᓴᓕᐅᑐᖃᑦ ᑕᐃᓇᖓ ᓄᓇᓕᐅᔪᒥᑦ ᖁᓕᓴᐃᖓᓄᖅᑐᑦ ᓇᓕᕐᓂᖅᓯᒪᓂᖅ ᐅᓪᓗᐊᓂ ᑕᐃᓇ ᐊᓯᐊᓂ ᑕᐃᓇ ᐊᓯᓪᓚᑎᓵ ᑐᓂᖅᐳᓗᑎᒃ ᐱᓂᐊᑕᒥᓂ. ᑕᐃᒪᓕᑕᐅᖅ ᖃᓄᐃᓕᓴᐅᓕᖅᑐᑦ ᓇᓕᕐᓂᖅᓯᒪᓂᖅ ᐊᔪᑕᐅᓂᖓ. ᓇᓕᐊᑐᐃᓇᖅ ᓴᐅᓂᑦ, ᑕᓕᕐᖏᒃ ᐊᒥᒪ ᓴᓘᖓ ᐊᔪᑐᑕᐅᑎ-ᐊᐸᓕᐅᑐᑦ ᐱᓕᑐᑕᐅᓕᐅᑐᓂ ᒥᑭᐊᓚᖅᑐᑦ. ᑎᑭᔪᑦ ᖁᓕᓴᐃᖓᓄᑦ ᒪᒃᑯᐱᐅᓚᔪᑐᑦ ᓯᓚ ᐊᑐᑕᐅᓚᖅᑐᑦ ᐅᖅᓱᑕᐅᓇᓂᖅ, ᐊᒥᒪᑦᑕᐅ ᑭᓯᐊᑎᖏᑕ ᒪᒪᓇᓴᐅᓚᔪᑐᑦ ᓱᓚ ᐊᑐᑕᐅᓕᖅᑐᑦ ᐅᖅᓱᓕᐅᑐᖅ ᐊᓯᓕᖅᑎ ᔪᐃᓚ ᐸᐸᓯ.

ᑕᓄᓇ ᐊᓯᔪᐸᓕᐊᔪᑦ ᑭᓛᒪᔾᐃᑦ ᖁᓕᓴᐃᐅᑦ ᑭᓯᐊᑎᖏᑕ ᐊᒪᒥ ᐊᑐᑎᖃᖏᓐᓂᑦ, ᐊᓯᓕᑎᑦ ᐃᐸᐱᔪᓂᖅ ᐊᓯᔪᓯᒪᓕᖅᑐᑎᑕᐅᖅ ᐊᖏᔪᒥᑦ. ᑕᒪᒻᓄ ᐊᖅᐅᖏᓕᐅᔪᑎ ᑕᐃᒪᐃᓴᐃᓇᓵᓴᓂᔾᔪᑎᐅᓕᖅᑐᖅ ᐅᖅᓱᓕᐅᑐᖅ ᐊᓯᓕᑎ ᓕᓕᐃ ᐃᐃᖅ. ᑕᒪᒻᓄ ᑕᐃᒪᐃᐸᓕᐅᖏᒪᒃ ᑕᒪᓐᓇᖏᓕᓕᐅᑐᖅ ᑕᓕᒪᐃᓕᐅᑐᖅ ᐊᖅᐅᖏᓕᓕᐅᑐᖅ ᐊᒥᖏᓕᓕᐅᑐᖅ ᐊᔪᑕᐅᑎᓄᑦ ᐃᓕᓴᖅᑐᑦ ᐊᒥᓱᓕ ᐊᑐᑕᐅᓚᖅᑐ

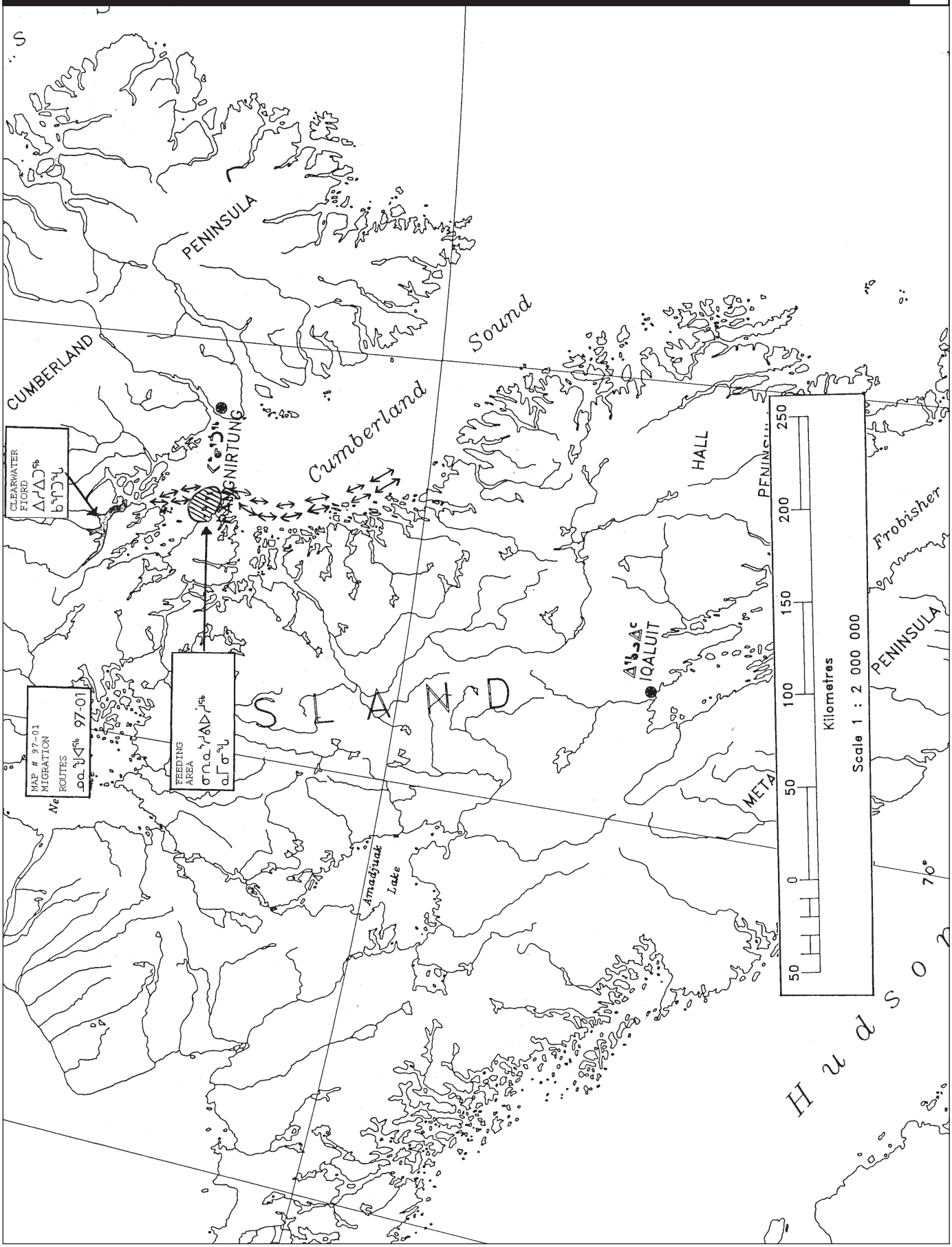
ᐃᓱᒪᑎᖁᔭᐅᔪᑦ ᐊᒻᒪ ᑎᓕᐅᓇᔪᑎᑦ ᐅᒻᒪᔪᓕᓇᕐᐊᑯᓄᓐ

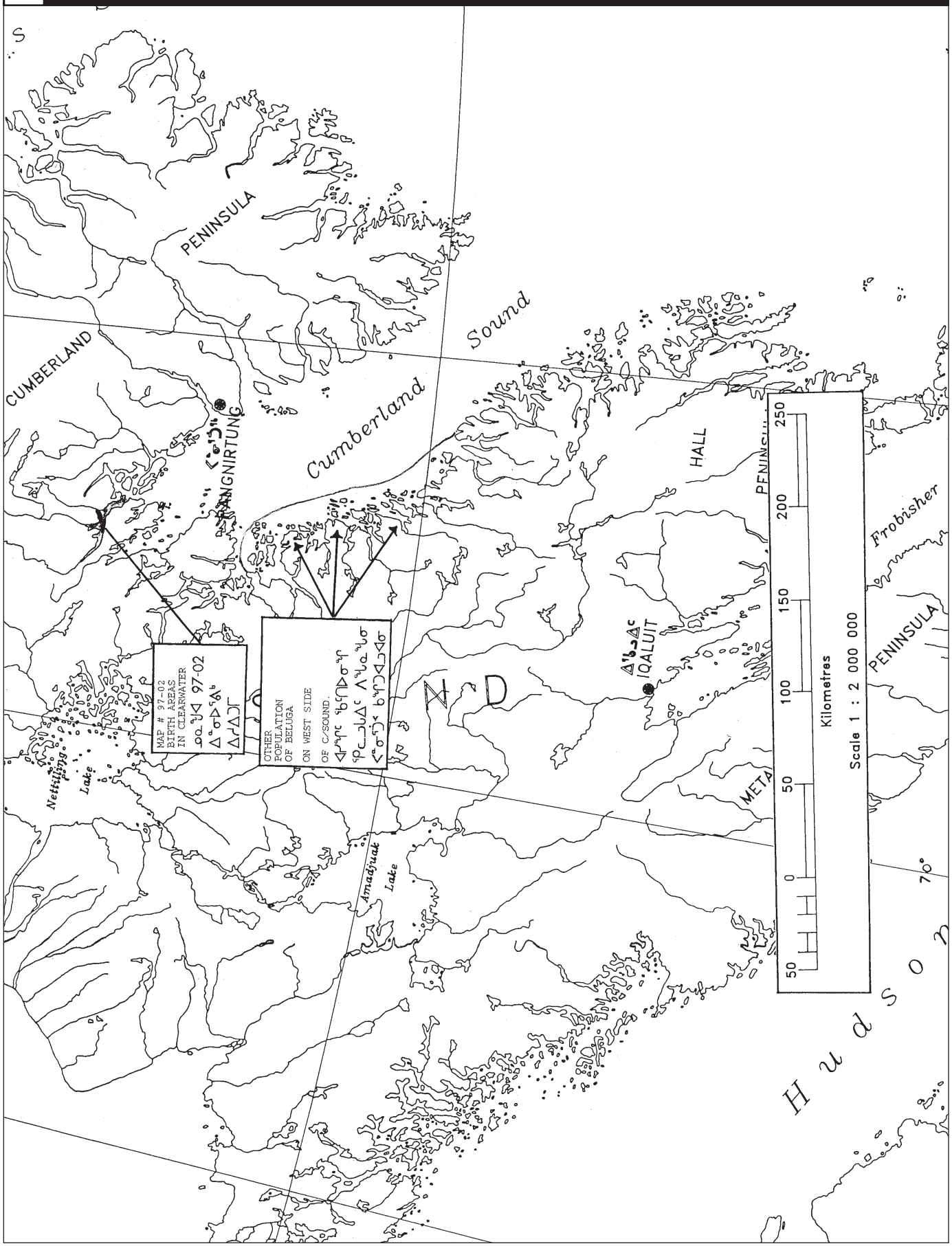
ᒡᒃᖁᐊ 8 ᐃᓕᐅᔪᑦ ᑕᕐᖏᑦ ᐸᒃᓂᔅᑎᒥᑦ ᑕᕐᔨᓐ ᖃᐅᔨᒪᓂᖁᑦ ᐊᒻᒪ ᑲᑎᒪᓂᖁᑦ ᐊᐱᓇᔪᒪᔭᑦ ᑕᒃᖁᐊ ᓄᐃᑕᐅᔾᓇᐊᖅᓂᕆᓄᑦ ᐃᓕᓴᐅᕐᓂᐊᐃᑦ ᑕᒪᓕᐊᑎᒍᑦ ᐃᓕᓴᐅᐊᑎᓄᑦ ᐃᓕᓴᐃᓐᓇ-ᔨᓄᑦ, ᓄᓇᕗᓂ ᐃᓕᓴᐅᐊᑐᓇᔨᑦ ᑲᑎᒪᔨᖏᑦ ᓄᐃᑦᐸᐃᑦᑕᐅᖁᓪᓗᑎᑦ.

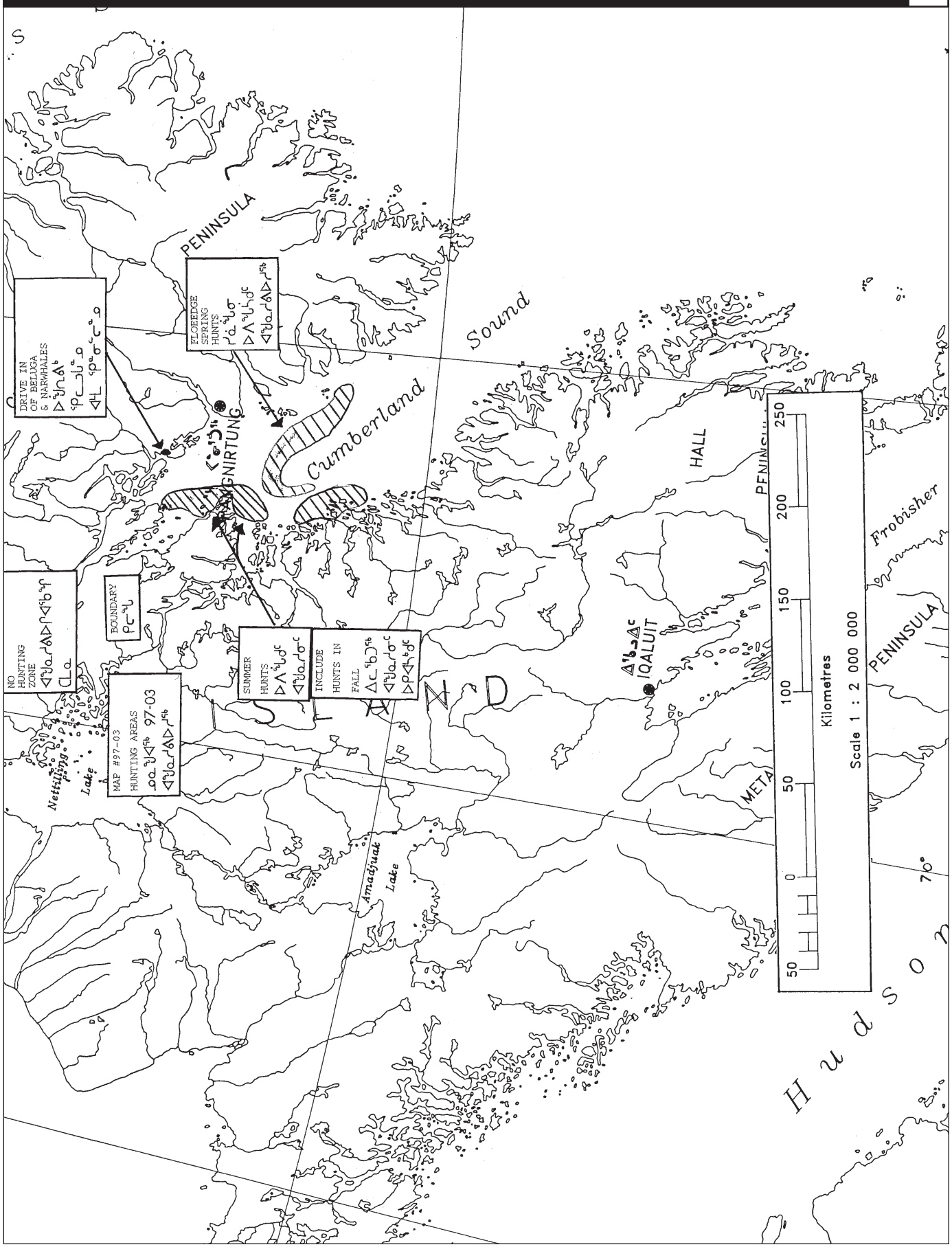
ᐃᓕᓴᐅᐊᑎᓄᐃᑦ ᐊᔨᓕᐊᖓᔪᒪᔪᑦ ᐊᑐᑕᐅᑲᔪᖁᑐᑦ ᐃᓕᓴᐅᐊᐃᓕᓴᖅᑎᑦ ᐊᓕᓇᖅᑎᒥ ᐱᓕᓇᓂᖅᓄᓐᓂᒃ ᑕᒪᓐᓇᖅᑐᑦ ᐊᒻᒪ ᑭᖑᓇᐊᔪᑦ ᐊᖑᓇᓯᓂᐅᑦ:

1) ᐱᖁᓯᖏᓐᓄᐃᐧᐃ ᐊᑐᑎᖓᑦ ᓂᕆᖏᓐᑕ ᐊᒻᒪ ᑭᓕᓇᑎᐅᑉ ᑭᓯᐊᑎᖓᑕ.
2) ᑕᐃᒪᒪᑎᐊᖅ ᐊᓯᔪᖏᑎᓄ ᐱᖁᓯᑦ ᓯᑲᓂᐊᔪᑦ, ᐱᓕᕆᑎᓇᑦ ᐊᒻᒪ ᑭᖑᓂᐊᔪᑦ ᐊᖑᓇᓯᓂᐅᑉ.
3) ᓯᕿᐃᕐᑕᐅᓂᖅ, ᐱᓕᑕᐅᓂᖅ ᐊᒻᒪ ᓂᖏᔪᖑᓂᖅ ᒪᑦᖏᓪᑕ ᑭᓯᐊᑎᖓᓕᓪᓗ.

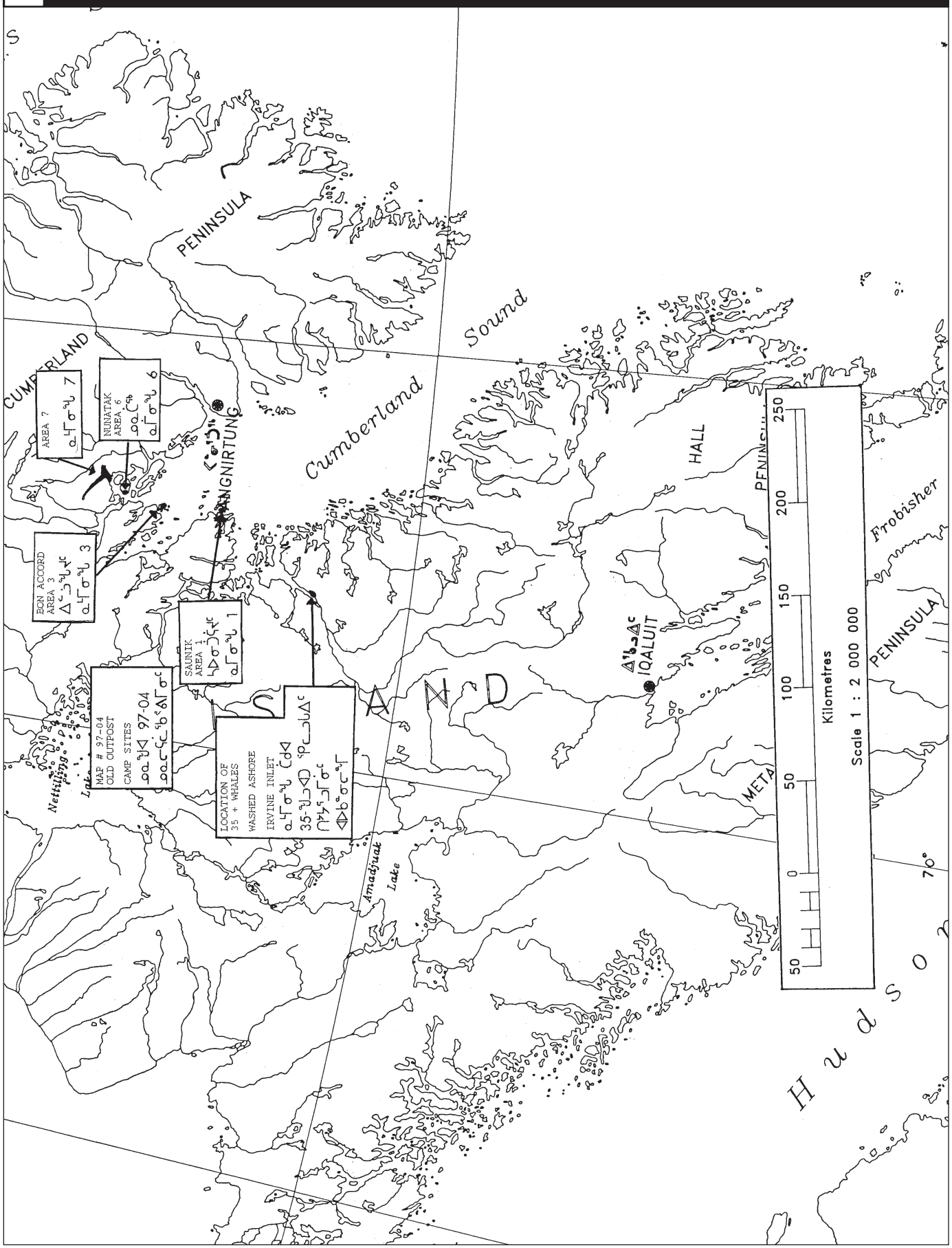
ᐊᓯᖏᑦ ᐃᓯᒪᓕᐅᕐᔪᑦ ᐃᓕᓴᐅᐊᑕᐅᓪᓗᑎᒃ ᐊᑐᑕᐅᔪᖅᓴᖓᑦ ᐃᓕᓴᐅᐊᑐᑦ ᖃᐅᔨᓴᖓᓕᖅᑎᒃ ᐱᓕᓇᖅᖃᓪᓗᑎᒃ ᑲᒥᖓᖅ ᑭᓕᓇᓕᖅᓂᒃ. ᐃᓯᒪᓂᖁᑎᓕᐅᕐᔪᑦ ᐃᒪᒋᐅᑕᓇᓕᐅᓂᖅᓄᑦ ᑕᒪᓐᓇᖅᑐᑦ ᐃᓕᓴᐅᐊᑐᓇᔨᑦ ᐊᑐᑕᐅᔪᖅᓴᖓ


CUMBERLAND
PENINSULA
Cumberland Sound
CLEARWATER FIORD
ᐃᓱᐃᑐᖅ
ᑲᖏᑐᖅ
ᐸᓐᓂᐊᖅ
KANGNIRTUNG
MAP # 97-01 MIGRATION ROUTES
ᓄᓇᕗᐊᖅ 97-01
FEEDING AREA
ᓂᕆᓇᓯᓱᐃᔪᖅ
ᓇᒥᓂᖅ
SLAND
Amadjuak Lake
HALL
PENINSULA
Frobisher
IQALUIT
META
Hudson
70°
50 0 50 100 150 200 250
Kilometres
Scale 1 : 2 000 000


PENINSULA
CUMBERLAND
Sound
Cumberland
HALL
Frobisher
PENINSULA
IQALUIT
Netilling Lake
Amadjuak Lake
MAP # 97-02
BIRTH AREAS
IN CLEARWATER
OTHER
POPULATION
OF BELUGA
ON WEST SIDE
OF C/SOUND.
Scale 1 : 2 000 000
Kilometres
50
0
50
100
150
200
250
70°
Hudson


PENINSULA
FLOEDGE SPRING HUNTS
DRIVE IN OF BELUGA & NARWHALES
Cumberland Sound
HALL
Frobisher
PENINSULA
IQALUIT
NO HUNTING ZONE
BOUNDARY
SUMMER HUNTS
INCLUDE HUNTS IN FALL
MAP #97-03 HUNTING AREAS
Nettilling Lake
Amadjuak Lake
Hudson
Kilometres
Scale 1 : 2 000 000
50
0
50
100
150
200
250
70°

MAP #97-04 / ᓄᓇᕗᐊᓐ #97-04



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Observations on Overwintering Walruses in the Eastern Canadian High Arctic
Author(s): H. P. L. Kiliaan and Ian Stirling
Source: *Journal of Mammalogy*, Vol. 59, No. 1 (Feb., 1978), pp. 197-200
Published by: American Society of Mammalogists
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($F = 1.09$; df = 1,121; $P > 0.25$). Thus, rates of weight gain do not vary between juveniles born in spring (0.7 g/day) and summer (0.8 g/day).

Food in spring consists of invertebrates and various parts of herbaceous plants, whereas mast is the major constituent of the diet in autumn (Wrazen, 1976). Spring foods are dispersed and small in size compared to mast items which are produced in abundant quantities and are relatively larger in size. Thus, the ratio of time spent foraging to eating is much greater in spring compared to autumn simply because autumn sources of food are more readily obtained and take more time to consume (Yahner, 1977). Yet weight gain of spring and summer litters are comparable regardless of type and dispersion of food resources (Fig. 1).

My data suggest that rates of weight gain do not vary with season and are for the most part genetically determined, provided that sufficient food resources are available. Limited data available in the literature indicate that chipmunks found in other geographic regions may gain weight at a similar rate. For example, rates of weight gain in 18 juveniles in Ontario, Canada, ranged from 0.3 to 1.5 g/day during a period of 16 days (Pidduck and Falls, 1973). These rates are roughly equivalent to those which I found in my population. Future studies may verify that rates of weight gain are uniform regardless of geographic region despite the fact that populations of *Tamias* in northern latitudes are active for a smaller proportion of the annual cycle compared to populations in southern latitudes (Yahner and Svendsen, 1978). In young yellow-bellied marmots, *Marmota flaviventris*, rates of weight gain in populations occupying high elevations exceed rates of populations in intermediate elevations. The length of the annual cycle of activity in marmots inhabiting high elevations is reduced because of a shorter growing season relative to intermediate elevations where the longer growing season permits additional time for marmot activity (Andersen et al., 1976). I therefore propose that although rates of weight gain vary markedly among species of sciurids (Hirshfield and Bradley, 1977), perhaps rates of weight gain are species-specific in certain species but differ among populations of other species which occupy a continuum of environmental conditions.

I thank G. E. Svendsen for his suggestions during this study. Funds were provided by the Department of Zoology and Microbiology at Ohio University, by a Grant-in-Aid of Research from Sigma Xi, and by an Ohio Biological Survey Grant (UT 1673) to G. E. Svendsen.

Literature Cited

Andersen, D. C., K. B. Armitage, and R. S. Hoffmann. 1976. Socioecology of marmots: female reproductive strategies. Ecology, 57:552–560.

Hirshfield, J. R., and W. G. Bradley. 1977. Growth and development of chipmunks: *Eutamias panamintinus* and *E. palmeri*. J. Mamm., 58:44–52.

Pidduck, E. R., and J. B. Falls. 1973. Reproduction and emergence of juveniles in *Tamias striatus* (Rodentia: Sciuridae) at two localities in Ontario, Canada. J. Mamm., 54:693–707.

Wrazen, J. 1976. Feeding ecology of a population of chipmunks (*Tamias striatus*) in southeast Ohio. Unpublished M.S. thesis, Ohio Univ., Athens, 26 pp.

Yahner, R. H. 1977. Behavior and social system in the eastern chipmunk, *Tamias striatus*. Unpublished Ph.D. dissertation, Ohio Univ., Athens, 79 pp.

Yahner, R. H., and G. E. Svendsen. 1978. The effects of climate on the circannual rhythm of the eastern chipmunk, *Tamias striatus*. J. Mamm., 59:109–117.

Richard H. Yahner, *Department of Zoology and Microbiology, Ohio University, Athens, Ohio 45701 (present address: Conservation and Research Center, National Zoological Park, Front Royal, Virginia 22630).* *Submitted 31 May 1977. Accepted 4 August 1977).*

OBSERVATIONS ON OVERWINTERING WALRUSES IN THE EASTERN CANADIAN HIGH ARCTIC

The walrus (*Odobenus rosmarus*) is an abundant pinniped in the eastern Canadian High Arctic. For most of the year, walruses are associated with pack ice although during the open water season they may haul out on land in large numbers at certain traditional sites (Mansfield, 1967). During the winter, they congregate to feed in shallow water areas which are either relatively ice free or in which they can maintain breathing holes in the leads, thereby assuring access to the molluscs

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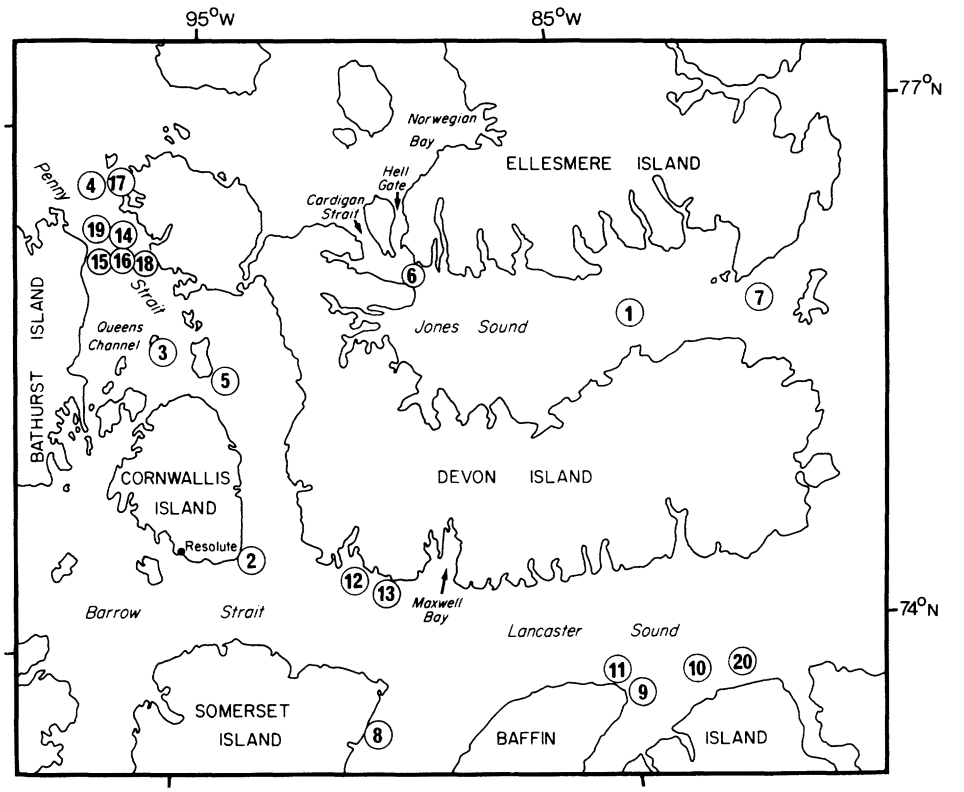

FIG. 1.—Observations on overwintering walruses in waters surrounding Devon and Cornwallis Islands, Northwest Territories: 1) one killed by Inuit at frozen out hole 90 km west of floe edge in Baffin Bay, March 1971; 2) two on tide crack 120 km west of floe edge, April 1971; 3) one beside hole in ice, April 1972; 4) 40 along polynias, May 1972; 5) 20 along polynias, May 1972; 6) 100 along polynias, May 1972; 7) 15 along cracks, May 1972; 8) three along crack, 30 April 1975; 9) seven along polynias, 8 April 1976; 10) one along open lead, 12 April 1976; 11) four along open lead, 14 April 1976; 12) two along open lead, 16 April 1976; 13) three along open lead, 16 April 1976; 14) one killed by polar bear by breathing hole, 19 April 1976; 15) one killed by polar bear beside small lead, 19 April 1976; 16) one along polynias, 19 April 1976; 17) one mauled by polar bear beside breathing hole, 20 April 1976; 18) one on ice by breathing hole, 29 April 1976; 19) one along open lead, 2 May 1976; 20) one along open lead, 2 May 1976.

upon which they feed. Walruses are apparently capable of breaking ice up to 15 cm thick in such areas (Vibe, 1950). The availability of such habitat is probably the limiting factor to walrus distribution. In areas where access to the water may be reduced because of heavy ice, walruses may become vulnerable to predation from polar bears (*Ursus maritimus*), although few such encounters have been documented.

The seasonal distribution of the walrus is reasonably well known around southeastern Baffin Island, Hudson Bay, and the Thule District (Vibe, 1950; Mansfield, 1958, 1967; Loughrey, 1959). In comparison, the seasonal distribution of walruses in the eastern Canadian High Arctic is less known, especially during the winter, because the area is largely uninhabited and visibility from aircraft that do travel in the area at that time is reduced by the extended dark period. However, human activities, such as offshore petrochemical exploration, are increasing there at a rapid rate, which makes it vital that areas critical to the survival of the indigenous fauna be identified so that adequate protection can be assured. This paper summarizes our information on areas which appear to be important to walruses overwintering in the eastern Canadian High Arctic.

Our observations were made from March to mid-May (which is late winter and early spring in those latitudes) from 1971 through 1976 during extensive travel by helicopter to tag polar bears

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and by oversnow machine searching for polar bear dens (Stirling et al., 1977). Observations made by Eskimos and pilots are included.

Figure 1 summarizes 20 observations on the late winter and early spring distribution of walruses in the eastern Canadian High Arctic. These data indicate two areas where significant numbers of walruses apparently aggregate during winter—Hell Gate-Cardigan Strait and Penny Strait-Queen's Channel.

The Hell Gate-Cardigan Strait area is well known for strong tidal currents which may reach 4 km/h (J. R. Wilson, Dept. Environment, Ottawa, personal communication). Taylor (1955) quotes Sverdrup as stating, after viewing Hell Gate in March 1900, "none of us had ever seen waters so utterly impossible to navigate, as the sound here," and "great pressure hummocks were drifting along at terrific speed in a violent whirlpool caused by the strong tidal current." In May 1972, the ice in Hell Gate and Fram Sound was thin and perforated with walrus breathing holes and 100 walruses were observed. The combination of these currents and a water depth of only about 80 m (Canadian Hydrographic Service Chart 7930) apparently creates an area suitable for walruses during winter. Mansfield (1967) and Grise Fiord Inuit hunters report that walruses are abundant in summer to the east of Hell Gate, along the southern coast of Ellesmere Island. It may be some of these walruses that spend the winter near Hell Gate.

The second important area for overwintering walruses was Penny Strait-Queen's Channel (Canadian Hydrographic Service Chart 7950). There are no accurate records of ice thickness or current speeds in this area but cracks, polynias, and thin ice are characteristic there in April when the mean temperature at Resolute is still −22.7°C (Meteorological Branch, 1970). Thus, we suspect that strong currents prevail there as well. Summer sightings of walruses in Penny Strait and Queen's Channel are common (Soper, 1928; Loughrey, 1959; Mansfield, 1967 and this study), indicating that the area is important to walruses throughout the year.

The remainder of the sightings in Fig. 1 lie variable distances to the west of the floe edge, at the eastern ends of Jones and Lancaster sounds. Loughrey (1959) reported that walruses winter in the open water of Lancaster and Jones sounds and Baffin Bay and then move westward in the spring as the ice begins to break up. The floe edge in Lancaster Sound in most years runs south from Maxwell Bay on Devon Island, although in the winter of 1975–1976, the whole of the sound was frozen over. To the west of the floe edge, the ice thickness may exceed 150 cm and there is little movement until the beginning of break-up in late May to early June. Thus, although it appears that the walruses in observations 1 and 2 and 9–13 (Fig. 1) overwintered where they were observed, they probably do not do so on a regular basis. A similar instance of an isolated walrus overwintering on a winter lead was reported in the western Arctic (Stirling, 1974).

Walruses that overwinter in an area with restricted access to water become potentially vulnerable to predation by polar bears. Three observations support this. On 19 April 1976 one of us (HPLK) found two walruses that apparently had been killed by polar bears (Fig. 1, nos. 14 and 15). One was an adult female 22+ years old (289 cm long, estimated weight 400+ kg). There was blood on top of her frozen over haul-out hole, indicating that she might have been frozen out when the bear attacked. The other walrus (unsexed) was just under 2 years old (243 cm long, estimated weight 270 kg). A blood trail indicated that it had been captured beside or in a 60 cm wide channel that went around the circumference of a 25 to 30 m diameter grounded iceberg.

Examination showed that both walruses had large numbers of sharp deep punctures about their heads which could only have been made by bear claws, suggesting that they may have been killed by multiple blows. Soper (1928) quotes a report by Hantzch of a large bear in the vicinity of Kikerten Islands, Cumberland Gulf, attacking three walruses and killing a large male which it tore extensively about the head. Akpaleeapik, a Grise Fiord Eskimo, also informed us of a walrus that a polar bear killed with a blow in the head as it surfaced to breathe through a hole in the ice.

On 29 April 1976 Mr. Tai-Ho of Klondike Helicopters tracked a polar bear to a walrus that he estimated to be less than 3 m long with tusks 20 to 25 cm long (Fig. 1, no. 17). Tracks and blood in the snow around the walrus's breathing hole (1 to 1.5 m diameter) indicated a fight had taken place very recently. The walrus was covered with blood and one tusk was broken. Despite a careful search, no bear tracks leading away from the site were found, suggesting that the bear may have been killed and sunk in the water. Freuchen (1935) reported finding a polar bear that had been killed by a walrus, and Perry (1966) summarizes similar observations from the journals of early arctic explorers. Although predation by bears is likely not of any significance to the walrus population as a whole (Mansfield, 1958; Loughrey, 1959) such encounters may be more frequent than previously seemed apparent.

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We are grateful to the Canadian Wildlife Service and the Polar Continental Shelf Project for logistic support; T. G. Smith for ageing one of the walrus specimens, and the following for use of unpublished observations: Akpaleeapik, C. Jonkel, Tai-Ho and J. R. Wilson.

Literature Cited

FREUCHEN, P. 1935. Mammals, part 2. Field notes and biological observations. Rep. 5th Thule Exped. 1921–24, 2:68–278.

LOUGHREY, A. G. 1959. Preliminary investigation of the Atlantic Walrus (*Odobenus rosmarus rosmarus*, Linnaeus). Canadian Wildlife Serv. Wildlife Mgmt. Bull. Ser. 1, 14:1–123.

MANSFIELD, A. W. 1958. The biology of the Atlantic walrus, (*Odobenus rosmarus rosmarus*, Linneaus) in the eastern Canadian Arctic. Fisheries Research Board of Canada, Manuscript Rep. Ser. (Biol.) 653:1–146.

———. 1967. Seals of Arctic and eastern Canada. Bull. Fisheries Research Board of Canada, 137 (second ed., rev.):1–36.

METEOROLOGICAL BRANCH. 1970. Climate of the Canadian Arctic. Department of Transport, Canada, 7 pp.

PERRY, R. 1966. The world of the polar bear. Univ. Washington Press, Seattle, 195 pp.

SOPER, J. D. 1928. A faunal investigation of southern Baffin Island. National Mus. Canada, Biol. Ser. Bull. 53, 15:1–143.

STIRLING, I. 1974. An overwintering walrus in the Beaufort Sea. Murrelet, 55:40–41.

STIRLING, I., R. E. SCHWEINSBURG, W. CALVERT, AND H. P. L. KILIAAN. 1977. Population ecology of the polar bear along the proposed Arctic Islands Gas Pipeline route. Progress Rep. to Environ. Mgmt. Serv. Dept. Environ., Edmonton, 69 pp.

TAYLOR, A. 1955. Geographical discovery and exploration in the Queen Elizabeth islands. Canada Dept. Mines and Tech. Surv. Geog. Branch, Memoir 3:1–172.

VIBE, C. 1950. The marine mammals and marine fauna in the Thule District (Northeast Greenland) with observations on ice conditions in 1939–41). Meddelelser om Grønland, 150:21–35.

H. P. L. KILIAAN AND IAN STIRLING, *Canadian Wildlife Service, 10025 Jasper Avenue, Edmonton, Alberta, Canada T5J 1S6.* *Submitted 18 April 1977. Accepted 1 August 1977.*

A WINTER STUDY OF SMALL RODENTS IN ASPEN PARKLAND

This note reports on a live-trapping study conducted during the winter of 1969–1970 on the northeastern shore of Ministik Lake, 37 air km east of Edmonton, Alberta, Canada. The area is aspen parkland (Bird, 1961) with scattered spruce. Our goal was to learn how circadian activity, territorial behavior, movement, and mortality are related to snow cover characteristics and temperature changes, and especially to the times of Pruitt's (1957) thermal overturn, hiemal threshold, and onset of snow.

Iverson and Turner (1972) and Turner et al. (1975) have studied winter interspecific relationships of *Microtus* and *Clethrionomys* in grassland and in spruce forest. Studies of some effects of snow cover have been reported both for tundra (Fuller, 1967; Pruitt, 1966) and taiga areas (Fuller, 1969; Fuller et al., 1969; Johnson, 1957; Pruitt, 1957), but at the time of our experiment no such work had been reported for the aspen parkland. Snow cover is more complex in aspen parkland than in either tundra or taiga. In open areas it is formed, shifted, and reshaped by wind and piled in the lee of woodlots and around every piece of brush growing separately in the fields; however, because the fields are interrupted by woodlots, the impact of wind is less severe than on completely open tundra or prairie. Woodlots, although offering some protection, are still more exposed to the action of wind and sun than is the continuous taiga because of their restricted size and the predominance of deciduous trees. Bowl-shaped depressions-qamaniqs (Pruitt, 1965) are weakly formed or not present under deciduous trees. Thus, rodents do not avoid tree bases, but use small spaces formed around the bases as passageways from undersnow tunnels to the surface. Such spaces are formed by wind moving trunks and stems.

A plot 130 by 60 m was laid out half in the open field and half in the woodlot. Longworth traps protected by plywood roofs (Iverson and Turner, 1969) were set in 10 m grids and operated for four nights every second week. All rodents were toe-clipped and released at site of capture. Air temperatures 60 cm above ground were measured with maximum-minimum thermometers and subnivean temperatures (at the ground surface) were recorded by thermistors. All measurements were taken in both woodlot and field. Snow depth, hardness, and density were measured with

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Reactions of Narwhals, *Monodon monoceros,* to Killer Whale, *Orcinus orca,* Attacks in the Eastern Canadian Arctic

KRISTIN L. LAIDRE[1,2], MADS PETER HEIDE-JØRGENSEN[2], and JACK R. ORR[3]

[1] Polar Science Center, Applied Physics Laboratory, University of Washington, 1013 NE 40th Street, Seattle, Washington 98105 USA
[2] Greenland Institute of Natural Resources, Box 570, DK-3900 Nuuk, Greenland
[3] Fisheries and Oceans Canada, 501 University Crescent, Winnipeg, Manitoba R3T 2N6 Canada

Laidre, Kristin, L., Mads Peter Heide-Jørgensen, and Jack Orr. 2006. Reactions of Narwhals, *Monodon monoceros,* to Killer Whale, *Orcinus orca,* attacks in the eastern Canadian Arctic. Canadian Field Naturalist 120(4): 457–465.

A Killer Whale attack on Narwhals was observed at Kakiak Point in Admiralty Inlet, Nunavut, Canada, in August 2005. Behavioral responses of both Narwhals and Killer Whales were documented by direct observation. Data collected from Narwhals instrumented with satellite-linked transmitters 5 days prior to the arrival of Killer Whales were used to examine changes in Narwhal movement patterns (e.g., dispersal and clumping) five days before the attack, during the attack, and five days after Killer Whales left the area. A minimum of four Narwhals were killed by 12-15 Killer Whales in a period of 6 hours. Narwhals showed a suite of behavioral changes in the immediate presence of Killer Whales including slow, quiet movements, travel close to the beach (<2 m from shore), use of very shallow water, and formation of tight groups at the surface. These behavioral changes are consistent with Inuit accounts of Killer Whale attacks on Narwhals. During the attack, Narwhals dispersed broadly, the groups were less clumped (standard deviation of inter-whale mean latitudes and longitudes), Narwhal space-use doubled from pre-attack home ranges of 347 km^2 to 767 km^2 (kernel 50% probability), and Narwhals shifted their distribution further south of the attack site. After the disappearance of Killer Whales, north-south dispersal of Narwhals contracted and was similar to pre-attack levels, total space use decreased slightly (599 km^2), yet west-east dispersal remained high. Narwhals were distributed significantly ($P < 0.001$) more broadly offshore in areas not used before the occurrence of Killer Whales. In general, short-term reactions of Narwhals to Killer Whale presence were obvious; yet normal behavior (as observed from shore) resumed shortly after Killer Whales left the area. Long-term (five day) Narwhal behavioral responses included increased dispersal of Narwhal groups over large offshore areas. This is among the few reports of eyewitness Killer Whale attacks on Narwhals in the high Arctic and is the first time changes in Narwhal behavior have been documented in response to a predation event through the use of satellite telemetry.

Key Words: Killer Whale, *Orcinus orca*, Narwhal, *Monodon monoceros*, predation, satellite telemetry, Admiralty Inlet, Nunavut, Canada.

Killer Whales (*Orcinus orca*) occur widely in Arctic waters, yet their abundance, movements, site fidelity, and specific distribution are poorly known (Forney and Wade 2006). Generally, Killer Whales are sighted during ice-free months and often near areas with high densities of other marine mammals, such as summering grounds for Belugas (*Delphinapterus leucas*) and Narwhals (*Monodon monoceros*). In the eastern Canadian High Arctic, this includes eastern Lancaster Sound and associated inlets or fjords around Baffin Island (e.g., Eclipse Sound, Admiralty Inlet, and Prince Regent Inlet) (Markham 1874; Reeves and Mitchell 1988).

Few eyewitness accounts are available of Killer Whale attacks on Narwhals (Steltner at al. 1984). This is because Killer Whales occur over large, sparsely inhabited Arctic areas and the timing and location of attacks are unpredictable. Thus, the majority of descriptions, both of Killer Whale attacks themselves and of the response of Narwhals, come from Inuit observations (Degerbøl and Freuchen 1935; Freuchen and Salomonsen 1961) or from scattered opportunistic reports (Campbell et al. 1988). Generally these accounts made by locals are limited in that observations extend only as far as what can be observed from shore and generally cover short time scales (hours). Also, Inuit observations of Killer Whale occurrence or Killer Whale attacks may not always be reported. There is little information about the natural mortality of Narwhals and generally, Killer Whales are assumed not to significantly depress Narwhal populations (Davis et al. 1980). Furthermore, the extent to which Killer Whales affect the behavior of Narwhals (e.g., movement patterns) is unknown.

In August 2005, a Killer Whale attack on Narwhals was observed from a camp operating a month-long Narwhal satellite tagging operation in Admiralty Inlet, Canada. Several kills of Narwhals by Killer Whales were inferred from vigorous surface and diving activity of Killer Whales within large oiled areas on the surface and congregations of seabirds. In combination with eyewitness observations of behavior of Narwhals and Killer Whales, data collected from satellite tags deployed on Narwhals up to five days before Killer Whales arrived in the area were used to examine clustering and dispersal of Narwhals prior to and following the predation events. These are the first quantitative movement data obtained from Narwhals subjected to Killer Whale predation.

Visual Observations of Attack

Killer Whales were reported by Inuit hunters in a camp about 3 km north of Kakiak Point (72º31'N 86º38'W), in Admiralty Inlet, Nunavut, Canada, on 19 August 2005. On 20 August, we witnessed a Killer Whale predation event on Narwhals just offshore of Kakiak Point. Approximately 12-15 Killer Whales arrived in a single group at Kakiak Point at 12 noon local time. At least several hundred Narwhals had been seen daily in the area for at least two weeks preceding the arrival of the Killer Whales and also on the morning of 20 August. On several occasions thousands of Narwhals had been seen moving past Kakiak Point over periods of 2-3 hours.

The Killer Whale group consisted of one adult male, 7-10 adult females, and several juveniles of undetermined sex. Narwhals were attacked less than 1 km from shore. At least two Narwhals were killed during the first observed attack between 12:00-13:00 local time. After this event, the Killer Whales left the vicinity of Kakiak Point for approximately 3 hours and returned at 16:00, when at least two more Narwhals were killed ~0.5 km from the coast. Killer Whales were not seen or reported again in the area until 25 August. Active subsistence hunting for Narwhals was practiced at several hunting camps along the shore north and south of the research camp.

The four independent kill events occurred over a 6 hour period in daylight hours. Narwhal kills were inferred from large oil/blubber slicks at the surface, congregations and diving of Fulmars (*Fulmarus glacialis*) in surface waters, and focal movements of Killer Whales diving in the center of oiled areas for 15-30 minutes at a time (Figure 1). No body parts or pieces of Narwhals were directly seen.

Narwhal Movements

Narwhal satellite tagging operations were ongoing prior to the Killer Whales' arrival at Kakiak Point. Narwhals were captured using nets set perpendicular to the shoreline 50-100 m from shore (details described in Dietz et al. 2001) and instrumented with SPOT4 and SPOT5 satellite tags made by Wildlife Computers (Redmond, Washington). Tags recorded daily geographic positions based on Doppler shift of tag transmissions received by polar orbiting satellites through Service Argos (Harris et al. 1990). Transmitters were attached to Narwhals on the dorsal ridge with three 6-10 mm polyethylene pins. The Narwhals were usually released after less than 30 minutes (Table 1).

Only data collected from Narwhals instrumented prior to the Killer Whales' arrival were used in the analysis to control for differences in sample size (number of individuals monitored before and after the predation event). Since the Narwhals were instrumented and released on different occasions, they were assumed to represent different groups or pods. Average daily geographic positions were calculated for each Narwhal based on good quality Argos locations (location quality >=0). Average daily positions for each whale were averaged to create inter-whale means. The standard deviation of daily average inter-whale positions was calculated for each of three time periods: five days before Killer Whales arrived (14–18 August), during the immediate Killer Whale observations or attacks (19–20 August), and five days after the Killer Whale attack (21–25 August) when no Killer Whales were seen in the area. Narwhals were distributed along a north-south gradient along the west coast of Admiralty Inlet; therefore the variation in latitude was interpreted as coastwise dispersion and the variation in longitude was interpreted as inshore-offshore dispersion. Narwhal space-use patterns were quantified in each of the three time periods with a kernel home range polygon (probabilistic measure of space use) [ArcView 3.1 Environmental Systems Research Institute] based on average daily positions from each whale.

Results

Pre-attack Narwhal behavior (> 5 days)

Narwhals observed passing Kakiak Point before the Killer Whale attack moved in groups of 3-8 whales at a distance of 20-200 m from the beach. Most whales were heading south. Between 14 and 17 August, seven Narwhals were instrumented with satellite tags before the Killer Whales arrived in the vicinity of Kakiak Point (Table 1). These Narwhals moved along the western side of Admiralty Inlet south of Kakiak Point and less than 1-2 km from shore. No tagged Narwhals were located in the center or eastern side of the inlet and the linear home range along the west coast was <100 km.

TABLE 1. Seven Narwhals instrumented with satellite transmitters prior to Killer Whale occurrence and attack at Kakiak Point, Admiralty Inlet, Canada, 2005. Calf accompanying female on 17 September 2005 was not tagged.

ID	Tagging date	Time of release	Sex	Body length (cm)
20685	14 September 2005	15:06	F	360
20686	14 September 2005	15:56	M	483
20689	17 September 2005	06:25	F	360
37235	17 September 2005	10:45	F + calf	358
37236	17 September 2005	21:20	F	380
37280	17 September 2005	21:27	F	380
37282	17 September 2005	21:45	F	364



FIGURE 1. Oil film on the surface created by Killer Whales feeding on Narwhals in Admiralty Inlet, Canada, August 2005. Large aggregations of Fulmars appeared in the area shortly after each kill. Photo by M. P. Heide-Jørgensen.

The standard deviation of average daily positions indicated that dispersal of Narwhal groups varied approximately 19.9 km north-south, and 13 km west-east before Killer Whales arrived (Table 2). The core of the pre-attack kernel home range (50% probability area) was concentrated just offshore of Kakiak Point and distributed along the west coast of the inlet encompassing 347 km^2 (Table 2).

Immediate Reactions of Narwhals to Killer Whale Attack

On 19 August, Killer Whales were reported by Inuit hunters north of the camp, yet no detailed observations of predation events or behavior were collected. On that day, we observed Narwhals passing very close to the shore (within the surf zone approximately 2-3 m from land) and remaining still at the surface in large groups.

TABLE 2. Dispersal of Narwhals before, during, and after a Killer Whale attack in August 2005 as measured by the distance between average daily satellite positions obtained from seven Narwhals instrumented at Kakiak Point prior to the arrival of the Killer Whales. The standard deviation (SD) in latitude and longitude is reported and also converted to north-south dispersal and west-east dispersal with distance units of km.

	Latitude SD	Longitude SD	N-S dispersal (km)	W-E dispersal (km)	Kernel core (50%) km^2
Before attack (5 days)	0.18	0.12	19.9	13.0	347
During attack (2 days)	0.33	0.29	36.4	32.8	767
After attack (5 days)	0.18	0.25	19.7	27.6	599



FIGURE 2. When Killer Whales arrived in the vicinity of Kakiak Point, Narwhals formed tight groups and remained close to the shore lying still. Photo M. P. Heide-Jørgensen.

On 20 August, Killer Whales were visually observed arriving at Kakiak Point traveling a northbound route along the west side of the inlet. Narwhals were already present in the coastal area (<500 m from the shore) around Kakiak Point and in a small bay just behind the point. When the Killer Whales were within 2-4 km, Narwhals suddenly moved closer to the shore in shallow water (<2 m). Some Narwhals formed tight groups and others moved slowly or lay very still at the surface (Figure 2). One Narwhal stranded on a flat gravel beach (<0.5 m of water) and made violent tail thrashes for >30 seconds (Figure 3), either as a warning signal or in attempts to remove itself from the beach.

Satellite telemetry data indicated instrumented Narwhals clearly responded to the presence of Killer Whales (Figure 4). During the attack, both the north-



FIGURE 3. During the Killer Whale attack, Narwhals beached themselves in sandy areas and made tail slaps. Coastline can be seen in lower left. Photo by K. L. Laidre.

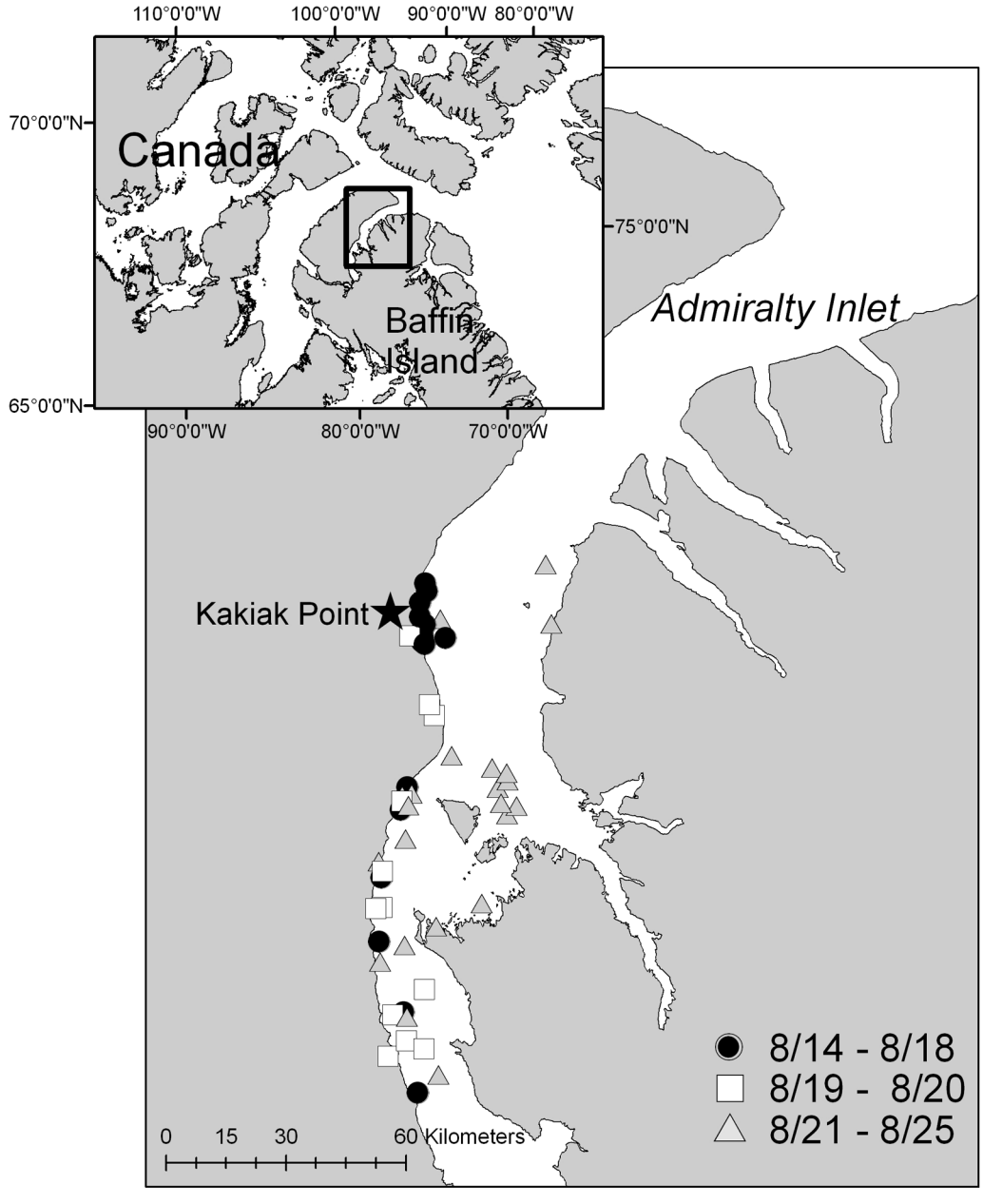

FIGURE 4. Average daily positions received from seven Narwhals instrumented with satellite tags before the Killer Whale attack. Average positions are shown in 3 time periods: the five days prior to Killer Whale arrival (14-18 August), the two days Killer Whales were observed (19-20 August), and the five days after the Killer Whale departure (21-25

south and west-east dispersal (as measured by inter-whale mean latitude and longitude standard deviations) doubled (Table 2). When Killer Whales were in the area, the core kernel home range shifted south by approximately 80 km and doubled in size (767 km^2) (Figure 5, Table 2). Generally, the groups of Narwhals were more widely dispersed in all directions during the attack than before the Killer Whales arrived.

Post-Attack Narwhal Behavior (>5 days)

Narwhals resumed their normal swimming behavior and distance from the coast within an hour after the Killer Whales left the locality. No whales were ob-

served closer than 20 m from the beach and tight groups at the surface broke-up and dispersed.

The instrumented Narwhals moved offshore and utilized a wider area after the attack (ANOVA on longitude, $F_{2,9}$=17.6, $P < 0.001$). Standard deviations of the mean inter-whale latitude (19.7 km) were reduced by half after the departure of the Killer Whales and were nearly identical to pre-attack values (19.9 km), demonstrating a contraction of the north-south dispersal (Table 2). The mean inter-whale longitude standard deviation was slightly lower than during the Killer Whale attack (27.6 km), yet did not return to pre-attack value, indicating a general inshore-offshore dispersal from the attack site.

Post-attack kernel home range core area (599 km^2) was less than that during the attack, yet the core area was located east of the pre-attack core in the center of Admiralty Inlet extending across to the eastern shoreline (Figure 5, Table 2). In general the Narwhal groups maintained a wider offshore dispersal and ranged more widely than before the Killer Whale attack.

Discussion

Narwhals exhibited clear reactions to the immediate presence of Killer Whales. Their suite of behaviors included slow, quiet movements, travel very close to the beach in the surf zone, movement into very shallow water less than 2 m, and formation of tight groups at the surface. All of these observations are consistent with Inuit accounts. Within an hour after the Killer Whale attack and when Killer Whales had left the area, direct observations suggested Narwhals resumed normal behavior (e.g., distances from the coast increased and tight groups dispersed).

Satellite telemetry data revealed long-term (multi-day) observations of Narwhal movements before and after the attack, in addition to observations during the attack. Average daily positions indicated that Narwhal groups were more dispersed during and after the Killer Whale attack. Dispersal primarily increased in the offshore (west-east) direction as measured by longitude standard deviations and home ranges. Cores of area use calculations demonstrated that the range of Narwhal movements increased two-fold during the Killer Whale attack, shifted south in a direction away from the attack point, and then expanded to offshore areas afterwards (where Narwhals had not been observed previously in 2005).

Later in the season, Killer Whales were reported in "fairly large numbers" in Admiralty Inlet and vicinity (especially Adams Sound) until October 2005 (Niore Annie Iqalukjuak, Arctic Bay, personal communication). The exact location and movements of these Killer Whales between August and September are not known, nor is it known whether other attacks on Narwhals occurred. Satellite tagging data showed that Narwhals remained in Admiralty Inlet until the third week of October, after which the southbound fall migration was underway. Thus, it appears that even on longer time scales (~2 months) Narwhals do not alter their site fidelity to the summering grounds (see Heide-Jørgensen et al. 2003) or depart early in response to the presence of Killer Whales.

Killer Whales were also reported in Admiralty Inlet in late August 2004 but no data or specific observations were available. It is unknown if the occurrence observed in 2004 involved the same group of Killer Whales as observed in 2005. On 25 August 2004, one of the authors (J.R.O.) observed a young Bowhead Whale (*Balaena mysticetus*) killed by Killer Whales at Kakiak Point, and bones were found on the beach less than 1 km away from the attack site the following year in 2005. Furthermore, on the same date as the attack reported here, several Killer Whales were observed attacking Narwhals in Repulse Bay, Hudson Strait, Canada (Joani Kringayark, personal communication). Therefore, at least two separate groups of Killer Whales feed on Narwhals on their summering grounds in the eastern Canadian Arctic in August.

When Killer Whales attacked Narwhals, there was limited action at the surface with no struggle or splashing observed. Killer Whales consumed the Narwhals below the surface of the water, and made multiple dives in the center of oiled areas (presumed kills) for 15-20 minutes. An eyewitness account of a Killer Whale attack on Narwhals in Inglefield Bredning, West Greenland in August 2004 noted Killer Whales jumping on top of Narwhals and holding them under the surface until they drowned (Gretchen Freund, personal communication).

If the predation level observed at Kakiak Point (4 Narwhals over 6 hours) is representative of the daily predation level of a similar sized pod of Killer Whales in the High Arctic, then consumption of Narwhals during a two-month stay in Admiralty Inlet would amount to approximately 200-300 Narwhals. A photographic survey estimated 5,556 (CV=0.22) Narwhals in Admiralty Inlet in 1984 (Richard et al. 1994). If the photographic survey results are corrected for whales that were diving using a correction factor of 0.38 (0.06) developed by Heide-Jørgensen (2004), then the abundance would have been in the order of 14,621(0.23). A mortality of 200-300 Narwhals from Killer Whale predation would represent <3% of this abundance estimate. It is possible that predation constitutes a larger proportion of the annual natural mortality of Narwhals than previously expected; however, it is not known if this natural mortality is fully compensatory. In this case, a continued high level of Killer Whale predation in combination with a population reduction by subsistence harvest could reinforce a decline. Killer Whale predation has been responsible for the decline of sea otters in Alaska (Estes et al. 1998; Doroff et al. 2003) and has been hypothesized as the driver for a decline of other top predators in the North Pacific (Springer et al. 2003).

The reason Narwhals occupy deep and narrow fjords during summer is unknown and it has been hypothesized that their summer distribution may be related to

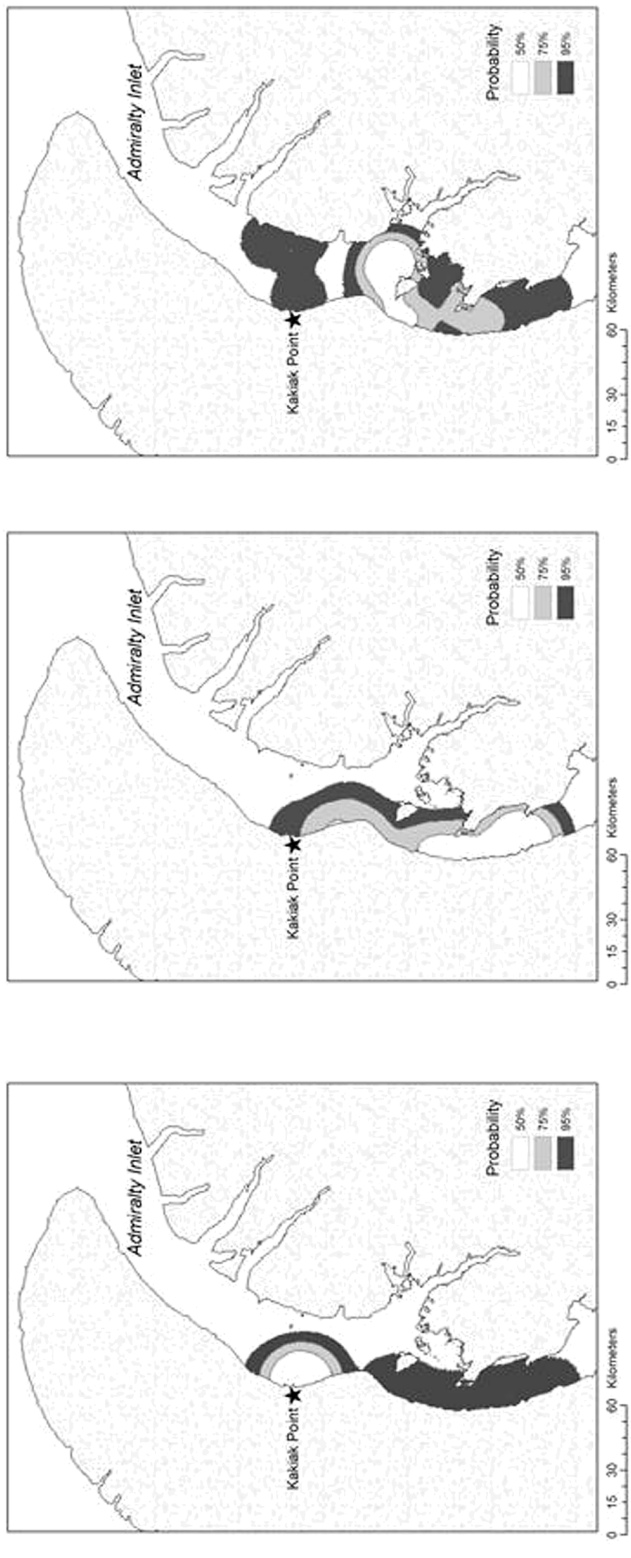

FIGURE 5. Narwhal space-use patterns before, during, and after the Killer Whale attack estimated with kernel home range polygons (50% is white). Home ranges were calculated for three time periods: The five days prior to Killer Whale arrival (14-18 August), the two days Killer Whales were observed (19-20 August), and the five days after the Killer Whale departure (21 August-25 August). The Killer Whale attack was observed at Kakiak Point (star symbol) on the west coast.

potential predation by Killer Whales (Kingsley et al. 1994). Narwhals feed very little during the summer season (Laidre and Heide-Jørgensen 2005a), and summering grounds do not appear to be related to calving needs given calves are born in the spring. The summer refuge from Killer Whales hypothesis lacks conclusive evidence as Narwhal distribution in other seasons is clearly driven by biological needs, such as sea ice formation, open water, or access to prey resources (Laidre and Heide-Jørgensen 2005b) and Narwhals did not seek refuge or depart early in response to the observed attack. Little is known about what proportion of different types of Killer Whales occurs in Arctic waters (i.e., mammal-eating vs. fish-eating). Stomach contents of 30 Killer Whales harvested in Disko Bay, West Greenland in February 2003 contained only Lumpsucker fish (*Cyclopterus lumpus*), despite the fact these Killer Whales were taken in an area with a large abundance of Bowhead Whales, Ringed Seals (*Phoca hispida*), Narwhals, Belugas, and other potential marine mammal prey items (Greenland Institute of Natural Resources, unpublished data).

Few observations have been collected of Killer Whales during winter in Arctic ice conditions. It is generally assumed that Killer Whales avoid the Arctic pack ice (Heide-Jørgensen 1988) despite the fact many Killer Whales occur and thrive in the dense pack-ice of the Antarctic. It is possible that changes in sea ice (lighter sea ice cover and earlier break-up) will alter (or have already altered) the occurrence of Killer Whales in Arctic waters. These changes may facilitate increased or longer visits by Killer Whales to ice-free Arctic areas.

The predicted reduction of annual sea ice, together with a longer open water season, will likely lead to an increase in Killer Whale predation on Narwhals. At the same time, reduced sea ice will also decrease the probability that Narwhals succumb in ice entrapments (also known as Sassats), another important source of natural mortality (Laidre and Heide-Jørgensen 2005b). It is unclear how the interplay between these two elements of natural mortality will evolve under changing sea ice regimes.

Acknowledgments

Research was funded by the Greenland Institute of Natural Resources, Fisheries and Oceans Canada, and the Nunavut Wildlife Management Board. The Polar Continental Shelf Project in Resolute supported logistics for field work in August 2005. The work was also supported by the Arctic Bay Hunters and Trappers Organization. Narwhal tagging was conducted under permits from Fisheries and Oceans Canada and Animal Care Permit FWISLACC#013. Robert Pitman, Randall Reeves, and an anonymous reviewer improved earlier drafts.

Documents Cited (marked * in text)

Davis, R.A., K. J. Finley, and **W. J. Richardson.** 1980. The present status and future management of Arctic marine mammals in Canada. Report by LGL Ltd. Prepared for Science Advisory Board of the Northwest Territories, Yellowknife, N.W.T., January 1980; 93 pages.

Literature Cited

Campbell, R. R., D. B. Yurick, and **N. B. Snow.** 1988. Predation on Narwhals, *Monodon monoceros*, by Killer Whales, *Orcinus orca*, in the Eastern Canadian Arctic. Canadian Field-Naturalist 102: 689-696.

Degerbøl, M., and **P. Freuchen.** 1935. Zoology I, Mammals. Report of the Fifth Thule Expedition 1921-24. The Danish Expedition to Arctic North America in Charge of Knud Rasmussen, PhD. Volume II 4-5. 278 pages.

Dietz, R., M. P. Heide-Jørgensen, P. Richard, and **M. Acquarone.** 2001. Summer and fall movements of Narwhals (*Monodon monoceros*) from Northeastern Baffin Island towards Northern Davis Strait. Arctic 54: 244-261.

Doroff, A. M., J. A. Estes, M. T. Tinker, D. M. Burn, and **T. J. Evans.** 2003. Sea otter population declines in the Aleutian archipelago. Journal of Mammalogy 84: 55-64.

Estes, J. A., M. T. Tinker, T. M. Williams, and **D. F. Doak.** 1998. Killer whale predation on sea otters linking coastal with oceanic ecosystems. Science 282: 473-476.

Forney, K. W., and **P. Wade.** 2006. Worldwide distribution and abundance of killer whales. Pages 145-162 *in* Whales, Whaling, and Ocean Ecosystems. *Edited by* J. A. Estes, D. P. DeMaster, D. F. Doak, T. M. Williams and R. L. Brownell. University of California Press, Berkeley.

Freuchen, P., and **F. Salomonsen.** 1961. Det arktiske år. Gyldendal, København. 382 pages [In Danish].

Harris, R. B., S. G. Fancy, D. C. Douglas, G. W. Garner, S. C. Amstrup, T. R. McCabe, and **L. F. Pank.** 1990. Tracking wildlife by satellite: Current systems and performance. United States Department of the Interior, Fish and Wildlife Service, Fish and Wildlife Technical Report 30. 52 pages.

Heide-Jørgensen, M. P. 1988. Occurrence and hunting of killer whales in Greenland *in* North Atlantic Killer Whales. *Edited by* J. Sigurjonsson and S. Leatherwoods. Rit Fiskideildar 11: 115-135.

Heide-Jørgensen, M. P. 2004. Aerial digital photographic surveys of narwhals, *Monodon monoceros*, in Northwest Greenland. Marine Mammal Science 20(2): 58-73.

Heide-Jørgensen, M. P., R Dietz, K. L. Laidre, P. Richard, J. Orr, and **H. C. Schmidt.** 2003. The migratory habits of narwhals. Canadian Journal of Zoology 81: 1298-1305.

Kingsley, M. C., H. J. Cleator, and **M. Ramsay.** 1994. Summer distribution and movements of narwhals (*Monodon monoceros*). Meddelelser om Grønland, Bioscience 39: 163-174.

Laidre K. L., and **M. P. Heide-Jørgensen.** 2005a. Winter feeding intensity of narwhals. Marine Mammal Science 21(1): 45-57.

Laidre K. L., and **M. P. Heide-Jørgensen.** 2005b. Arctic sea ice trends and narwhal vulnerability. Biological Conservation 121: 509-517.

Markham, A. H. 1874. A whaling cruise to Baffin's Bay and the Gulf of Boothia in the whaler *Arctic* commanded by Captain Adams. London, Low and Searle. 319 pages.

Reeves, R., and **E. Mitchell.** 1988. Distribution and seasonality of killer whales in the eastern Canadian Arctic. Rit Fiskideildar 11: 136-160.

Richard, P. R., P. Weaver, L. Dueck, and **D. Barber.** 1994. Distribution and numbers of Canadian High Arctic Narwhals (*Monodon monoceros*) in August 1984. Meddelelser øm Groenland Bioscience 39: 41-50.

Springer, A. M., J. A. Estes, G. B. Van Vliet, T. M. Williams, D. F. Doak, E. M. Danner, K. A. Forney, and **B. Pfister.** 2003. Sequential megafaunal collapse in the North Pacific Ocean: An ongoing legacy of industrial whaling? Proceedings of the National Academy of Sciences 100(21): 12, 223-12, 228.

Steltner, H., S. Steltner, and **D. E. Sergeant.** 1984. Killer Whales, *Orcinus orca*, prey on Narwhals, *Monodon monoceros*: An Eyewitness Account. Canadian Field-Naturalist 98: 458-462.

Received 9 February 2006
Accepted 18 June 2007

RPS Energy
Liberty Place, 2nd Floor, 1545 Birmingham Street, Halifax, Nova Scotia, B3J 2J6, Canada
P.O. Box 29068, Halifax, Nova Scotia, B3L4T8 ,Canada
Tel: +1 902 425 1622, Fax: +1 902 425 0703, Web: www.rpsgroup.com/energy/

MAIL ROOM
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NEB/ONE

April 29, 2011

Christy Wickenheiser
Environmental Specialist
National Energy Board
444 Seventh Avenue SW
Calgary, Alberta
T2P 0X8

Dear Sir/Madame:

RE: 2D Seismic Survey offshore Baffin Bay/Davis Strait 2011.

TGS-NOPEC Geophysical Company ASA (hereinafter referred to as TGS) & Multi Klient Invest AS (hereinafter referred to as KMI or the Operator) a company associated with Petroleum GeoServices (herein referred to as PGS) have entered into a joint venture to conduct a regional marine 2D (two-dimensional) seismic reflection survey offshore Baffin Bay, Davis Strait within the regulatory jurisdiction of the National Energy Board (NEB).

As you are aware, Federal coordination was initiated for this project in the spring of 2010, however the project was suspended until 2011 and the project area has since expanded and Federal coordination initiated for 2011 program.

Under section 5 of the Canadian Environmental Assessment Act, an Environmental Assessment is required because the National Energy Board may take action in relation to paragraph 5 (1) (b) of the Canada Oil and Gas Operations Act for the purpose of enabling the project to be carried out in whole or in part.

Attached you will find three hard copies of the Environmental Assessment and three electronic copies.

If you require anything further, please donot hesitate to contact me.

Regards,

Darlene Davis

Darlene Davis
Project Manager
RPS Energy
Tel: (902) 492-0281
Cell☹902) 790-1212

ENVIRONMENTAL IMPACT ASSESSMENT
FOR
MARINE 2D SEISMIC REFLECTION SURVEY
BAFFIN BAY AND DAVIS STRAIT
OFFSHORE EASTERN CANADA
BY
MULTI KLIENT INVEST AS



Report No. HOPH417(B)

Authors
Tony LaPierre, M.A.Sc., P.Geoph.
Alexandra Arnott, PhD. (Earth Sciences)
Chris Hawkins, PhD. (Marine Ecology)
Kent Simpson, B.Sc., Dip. GIS, P. Geo.
Darlene Davis, Project Co-ordinator

RPS Energy (Halifax)
Liberty Place, 2nd Floor
1545 Birmingham Street
Halifax, Nova Scotia, B3J 2J6
Canada
Tel: +1 902 425 1622
Fax: +1 902 425 0703
Web: www.rpsgroup.com/energy/

Date of Issue April 28, 2011

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NON TECHNICAL SUMMARY

TGS-NOPEC Geophysical Company ASA (hereinafter referred to as TGS) & Multi Klient Invest AS (hereinafter referred to as KMI or the Operator) a company associated with Petroleum GeoServices (herein referred to as PGS) have entered into a joint venture to conduct a regional marine 2D (two-dimensional) seismic reflection survey offshore Baffin Bay, Davis Strait within the regulatory jurisdiction of the National Energy Board (NEB).

This Environmental Assessment prepared by RPS Energy assesses potential impacts from the proposed operations on the surrounding environment.

The main sensitivities and environmental constraints identified in this area include marine mammal and fish species, benthic and pelagic habitats, and resident breeding and migrant bird species.

An appreciation of the traditional knowledge was obtained by consulting two major studies: The Nunavut Wildlife Harvest Study (Nunavut Wildlife Management Board, August 2004), and the Final Report of the Inuit Bowhead Knowledge Study (Nunavut Wildlife Management Board, March 2000).

The operator will use mitigation measures to minimize the impacts on the marine environment, in particular “The Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment.” (Appendix A).

Contractors must have in place Shipboard Oil Pollution Emergency Plans (SOPEP) to combat any spills and ensure adequate training for all crew members. For port spills Port Oil Contingency Plan must be adhered to.

It must be ensured that waste segregation, handling and disposal are carried out in line with existing company and contractor environmental policies and standards. Any hazardous wastes produced throughout the course of operations should be disposed of with great care and in conformity with environmental aims, objectives, and Canada legislation.

The environmental performance of any project is dependent largely on the commitment of the contractors involved. MKI must employ best practice in pollution prevention programmes to effectively protect the environment. They must also ensure that contractors employ best environmental practice in their waste disposal programmes and spill contingency planning.

To this end, an Operational Project Plan incorporating the measures specified in the Environmental Protection Plan will be implemented to ensure operations are completed in full compliance of the company's stated environmental aims and objectives. This will facilitate the final planning, implementation, and follow-up activities associated with the operations.

MKI representatives need to monitor contractors and measure their practices through active programmes that are reviewed at regular intervals. This will help ensure that operations are carried out in an environmentally acceptable manner.

1. INTRODUCTION

In accordance with the Canadian Environmental Assessment Act (CEAA) and based on the information presented in the project description “Project Description for 2D Marine Seismic Survey Offshore Baffin Bay, Davis Strait (MKI December 2010). This document is a screening level environmental assessment (EA) as defined by the Canadian Environmental Assessment Act (CEAA) for a multi-year seismic program (2011-2015) proposed for Baffin Bay/Davis Strait by MKI.

In early January, representatives of RPS Energy and Environmental Manager for PGS travelled to Iqaluit for consultation meetings with several Federal and territorial groups for in person meetings to explain the potential project and seek information which could be used in this assessment and project planning.

They included:

- Department of Economic Development
- Department of Environment
- Fisheries and Sealing’s
- Manager of Mineral Resources
- Resources Development Advisor
- Department of Fisheries
- Indian Northern Affairs Canada
- Nunavut Development Corporation
- Nunavut Research Institute
- Quikiqtani Inuit Association (QIA)

It was determined in these meetings that based on the previous years concerns re: Lancaster Sound, that there were many concerns and questions with regards to seismic activity in Baffin Bay with the local communities.

In mid February RPS representatives on behalf of MKI travelled to several Inuit communities to share information and seek assistance in the preparation of the program. A representative of INAC (Petroleum Advisor) travelled along with our group. The Petroleum Advisor attended the meetings to advise the communities that INAC would be returning to speak with them on a future date concerning the possibility of opening lease blocks in Baffin Bay. A member of QIA also was invited and attended our meeting in Pond Inlet. (QIA/ Nigel Qaumariaq).

We had tried to schedule a meeting in Pangnirtung with no success. The manager of their Hunters and Trappers Association had left the position and they were in the process of seeking a replacement.

The Meetings were held in the following communities:

- Clyde River
- Pond Inlet
- Qikiqtarjuaq
- Iqaluit

A brief meeting was held in Iqaluit with the Manager of the HTO group, to briefly explain the project.

In addition to the above meetings, direct email contact was made with the following stakeholders;

- Parks Canada
- WWF-Canada
- Nunavut Planning Commission
- NIRB
- Baffin Fisheries Coalition
- Nunavut Wildlife Management Board
- Nunavut Tunngavik Inc.

You can find the minutes of the meetings in (Appendix B).

The meetings were held with Hunters and Trappers Association members in each community listed here. It was asked that we return for a public meeting in the communities.

Time didn't seem to allow for these meetings between our return and end March. As I understand it; INAC and NEB were also scheduling meetings in March month. In April a notice was sent around advising the communities of our intention to conduct public meetings from May 1-6th in Iqaluit, Clyde River, Pond Inlet, Quik and Pang. However, these meetings were cancelled at the last minute due to negative feedback with regards to public meetings during election week.

Best efforts are now being made for public meetings prior to the end of May 2011.

This EA has been based on the information available, which we believe is adequate to complete this assessment.

2. REGULATORY REQUIREMENTS AND JURISDICTION

Authorizations to Conduct a Geophysical Program will be required from the National Energy Board (NEB). As the federal authority that received the project description, the NEB will distribute to the other federal authorities, which may also have a responsibility or interest and need to be notified. The NEB has been appointed Federal Environmental Assessment Coordinator (FEAC) under the CEAA for this project, and in this role is responsible for coordinating the review activities of the federal and provincial authorities participating as expert departments in the environmental assessment.

Geophysical programs (seismic surveys) in the area proposed for this project require authorization from the National Energy Board (NEB). The Canadian Environmental Assessment Act (CEAA) requires federal authorities to conduct environmental assessments (EA) before issuing regulatory permits for certain projects (Section 5(1) d).

Legislation that is relevant to the environmental aspects of this Project is provided
Table 1

Table 1. Summary of Authorizing Agencies

Instrument and Legislation	Agency	Activities	Remarks
• Canada Environmental Assessment Act (CEAA) • Canada Environmental Protection Act (CEPA) • Oceans Act • Fisheries Act • Navigable Waters Act • Canada Shipping Act • Migratory bird Convention Act • Species at Risk Act (SARA) • Canada Oil and Gas Operations Act	National Energy Board (NEB)	Geophysical Operation Authorization	Screening required pursuant to CEAA. EA submission herein.

3. PROJECT DESCRIPTION

MKI proposes to conduct an offshore two-dimensional (2D) seismic reflection survey within Baffin Bay and Davis Strait over the next 5 years scheduled to start sometime after mid-end July as weather and ice conditions allow.

All proposed program activities will occur seaward of Canada's 12 nautical mile boundary, to the east of the land-fast ice limit. No Geophysical data will be recorded within the Land Fast Ice Zone. The survey is approximately 180km from the mouth into Lancaster Sound. The majority of the survey lines to be collected are in deep water. MKI requests approval of all lines in the program in order to allow flexibility in the collection of the data in 2011.

3.1 PURPOSE

The proposed project is a regional survey designed to provide a better understanding of the offshore geology in Baffin Bay and Davis Strait and to use this information to introduce new exploration opportunities to the industry. This information will be used to determine the regional extent of geological formations. This program is being used to develop geological concepts and is not the basis of an exploration drilling program, as the survey line spacing is much too coarse for that purpose.

3.2 LOCATION

Figure 1 shows the location of the entire multiyear survey area. Subsequent years will include infill lines within the same assessed area.

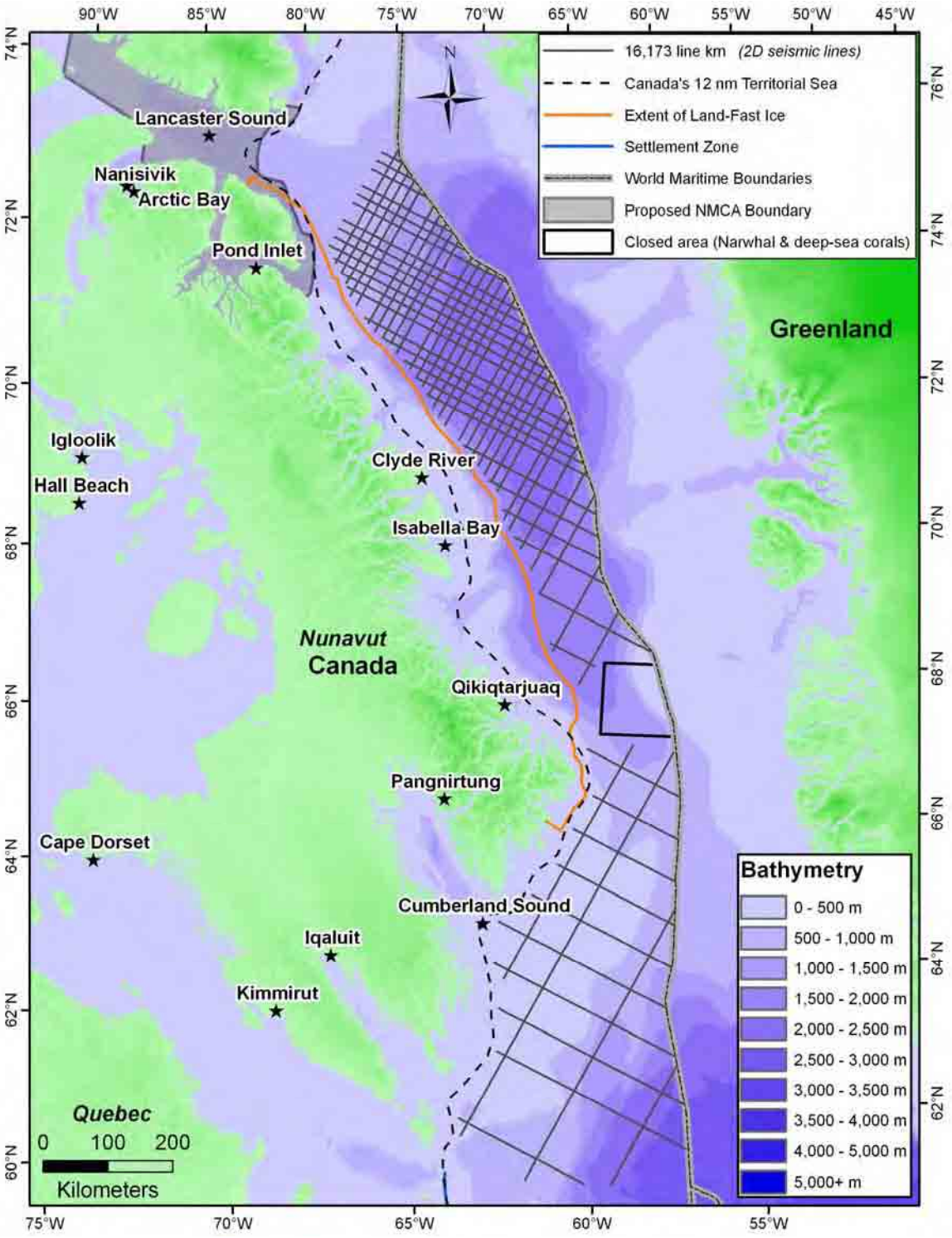

Figure 1. Location of Survey

3.3 SITE HISTORY

Marine geophysical data has been acquired over the Baffin Bay / Davis Strait area since 1969. Figure 2 illustrates these data as documented by the Geological Survey of Canada – Atlantic (GSC-A) BASIN database (http://basin.gsca.nrcan.gc.ca/index_e.php). BASIN is a federal government archive of geological, geophysical, and engineering information (including seismic data) acquired during the many years of petroleum exploration offshore northern and eastern Canada.

A full listing of these geophysical projects is provided in Appendix C, and consists of approximately two hundred (200) seismic reflection surveys (2D and 3D), seismic refraction surveys, and shallow seismic / seabed surveys, and five (5) aeromagnetic surveys. The most recent program in the area of the proposed 2010 survey was acquired by Husky Oil in the Davis Strait / southern Baffin Bay in 2008. TGS's most recent exploration program in the area was also in 2008, with fairly continuous work completed in the Davis Strait through the 1990's.

The proposed project represents a small program relative to the historic totals. The acquisition of a high-quality modern regional dataset is required to compliment this vintage data. Advances in seismic technology, in particular advances in longer receiver arrays (streamers) and recording systems, have allowed geophysicists to use advanced signal processing and image the subsurface geology with much greater accuracy, and to much greater depth below the seafloor, than was previously possible.

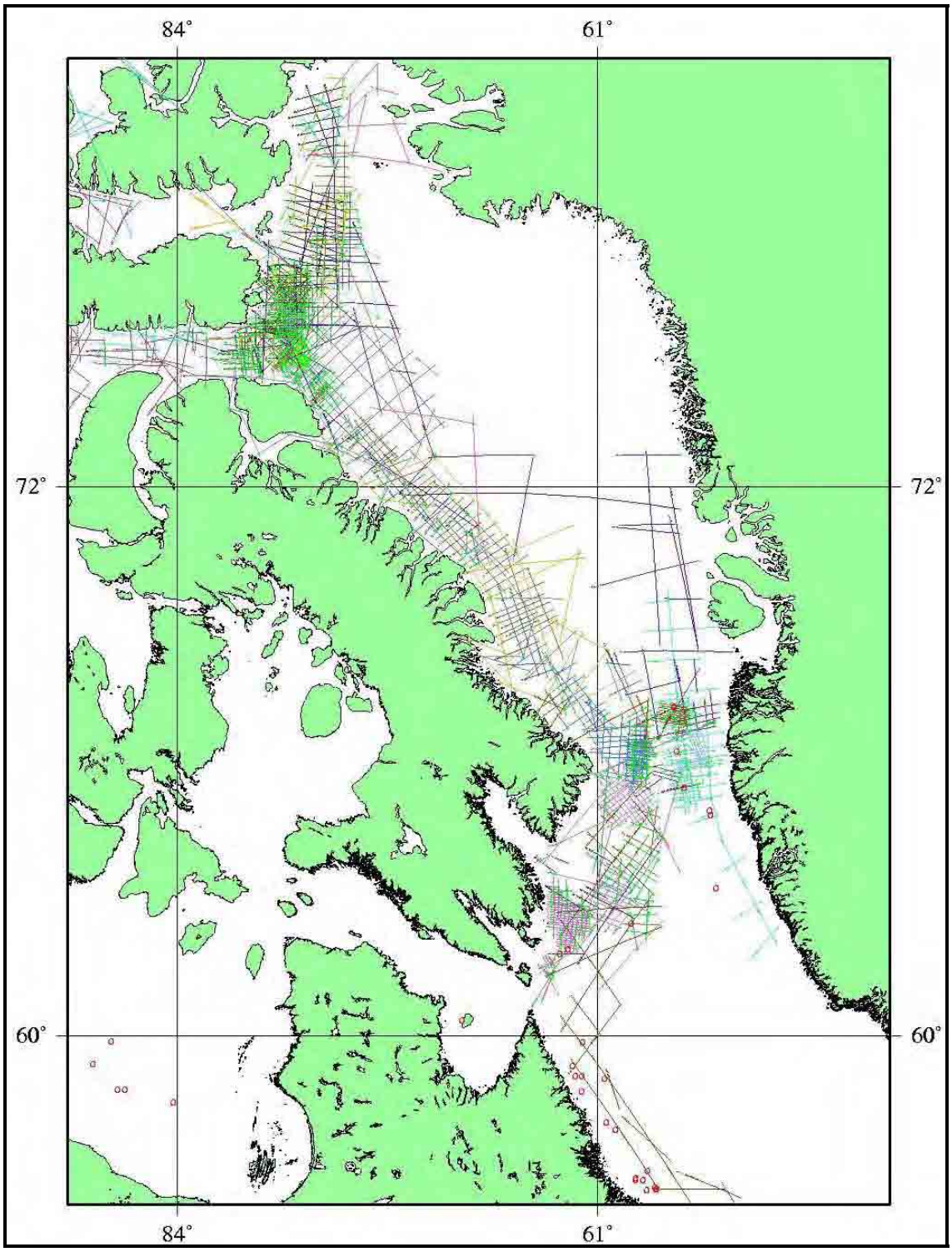

Figure 2. Exploration History within the Project Area
(BASIN, 2007)

3.4 SCHEDULE

The proposed survey season is end July through mid November 2011, depending on the location, weather conditions, and vessel availability. Based on previous work in Davis Strait/Baffin Bay weather usually allows productive recording until approximately mid October. It is possible that work might be able to continue as late in the year as November. The proposed survey lines (Figure 1) represent the proposed program for 2011. Infill lines will be acquired in subsequent seasons.

Although the proposed survey vessel is an ice-class vessel (1A1 Ice C) data will not be acquired in areas of pack ice. The survey data will be acquired such that ice-free areas are surveyed first (i.e. the southern portion of the survey area) then, as the season progresses, the vessel will move north.

It is possible that there may be transects in pack ice waters; however, the sound source will not be active during these periods and the vessel will merely be transiting through. Marine mammal observations will still be made during these transects, which will serve to enhance the database of observations that will be obtained during the project. Due to the seasonal nature of offshore marine conditions, it is hoped that work will also take place in future years, as the area is mapped.

The vessel will be at sea and operate continuously (i.e. 24-hour operations) during survey operations. Seismic vessels typically operate on a 5/6-week crew change schedule, which will be maintained for this project.

3.5 OFFSHORE SEISMIC SURVEY

The follow is an introduction to seismic surveying.

“A marine seismic survey is a method of determining geological features below the seafloor, by sending acoustic sound waves into the various buried rock layers beneath the seafloor and then recording the time it takes for each wave to bounce back as well as measuring the strength of each returning wave. It is the most reliable form of initial exploration for oil and gas and is essential in identifying geological features that may contain oil or gas deposits.

Seismic surveys generally take place over a few weeks in a given area. Once geophysicists have studied the subsurface “picture”, they may ask for some parts of the area to be surveyed again to provide greater detail. This extra data helps them to map potential prospects more accurately and to decide the best place to drill exploration wells. Shallow seabed surveys can also be used to detect changes in the sub-surface rock layers that may present a safety hazard during drilling operations.

A marine seismic survey is conducted using purpose-built ships, towing a number of air guns as the acoustic energy source at depths of 6-10 metres below the sea surface. The sound (or seismic) waves are generated by the rapid release of compressed air from an underwater piston. These seismic waves are directed down toward the seabed. They are reflected back to the surface by the layers of different rock types under the

seafloor. The returning sound waves are detected and recorded by hydrophones that are spaced out along “streamers” that are typically 6 – 10 kilometres in length, towed behind the survey vessel (Figure 3). For regional surveys (often referred to as 2D surveys) the seismic vessel sails up and down gridlines which can be 5 to 100 kilometres apart.

Seismic waves travel through different rock types at different speeds, so it is possible to calculate the depth and the shape of the rock layers by measurements such as the two-way travel time taken for the reflected seismic waves to reach the hydrophones and the strength of each returning wave. In 2D surveys the resultant picture is a general view because the cross sections are far apart.

As further background on marine seismic surveys, Appendix D contains the International Association of Geophysical Contractors (IAGC) overview document *Marine Seismic Operations – An Overview*, which provides a thorough introduction to all aspects of marine seismic operations, including the underlying principles of seismic data acquisition, methodology, and equipment. This document is also available on the Canadian Association of Geophysical Contractors (CAGC) website (IAGC, 2002). The reader is also referred to *Seismic and the Marine Environment* (APPEA, 2004).

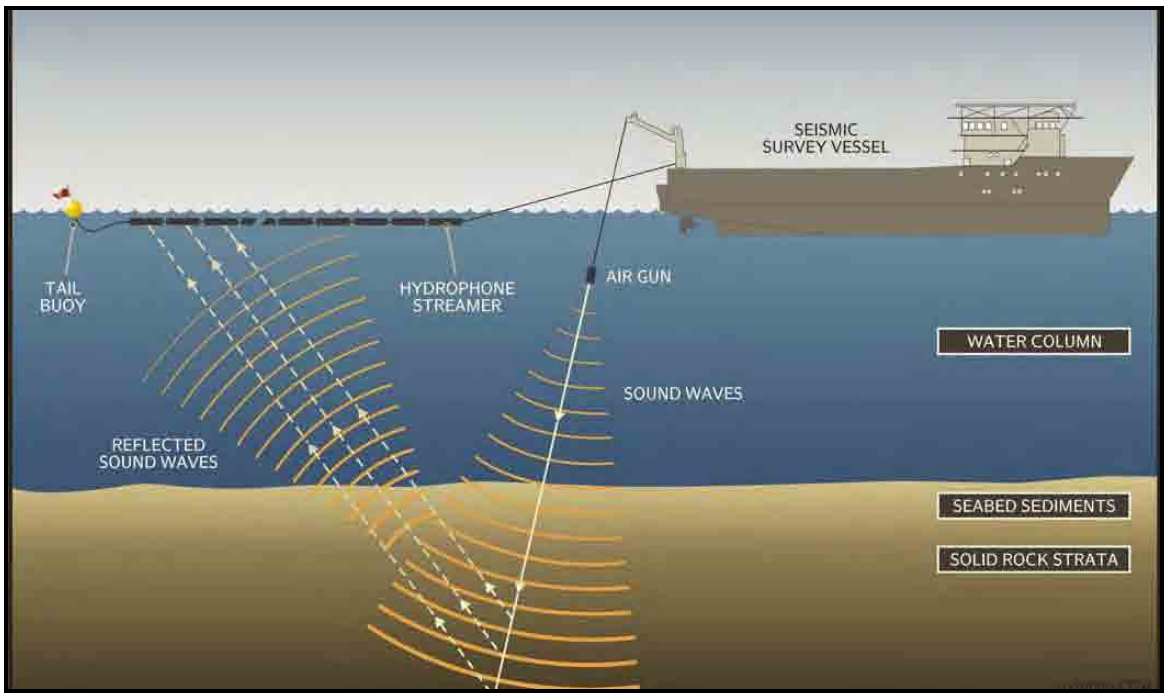

Figure 3. Seismic Acquisition using Seismic Reflection Method (Sikumuit 2008)

A 2D marine seismic survey will be conducted within the proposed project areas. The field acquisition program will consist of the following four activities:

- Mobilization to the survey area
- Deployment and calibration of the seismic gear
- Data acquisition, and
- Seismic gear retrieval and demobilization.

3.6 SEISMIC EQUIPMENT

3.6.1 Survey Vessel

The M/V Sanco Spirit is the dedicated research vessel that has been chosen to conduct this project. The vessel is a new build in 2009 with state of the art technology and equipment. The vessel has a total of 47 berths, and a dedicated hospital. The vessel has all equipment, systems, and protocols in place for prevention of pollution by oil, sewage, and garbage in accordance with international standards and certification authorities, specifically the Arctic Shipping Pollution Prevention Act (ASPPA) and Arctic Shipping Pollution Prevention Regulations (ASPPR). Regulations require that the survey vessel possess an Arctic Pollution Prevention Certificate. The vessel will be subject to pre-survey audits by the operator in the port of mobilization prior to survey commencement. Transport Canada will conduct a Safety Inspection of the vessel in accordance with the issuing of the Coasting Trade License to operate in Canada.

The survey vessel will comply with all applicable regulations concerning management of waste and discharges of materials into the marine environment. The vessel has a ballast water management plan. The International Maritime Organization (IMO; http://www.imo.org/) is the United Nations specialized agency with responsibility for the safety of shipping and the prevention of marine pollution by ships. Canada became a member of the IMO in 1948. Full specifications of the vessel M/V Sanco Spirit are shown in Appendix E.



Figure 4. Survey Vessel Sanco Spirit

3.6.2 Supply Vessel

The primary function of the supply vessel is to provide supplies for the seismic vessel and to assist in emergency situations (including oil spills). At least one support vessel will be utilized for the proposed seismic survey.

Seismic vessels are recognized as having a restricted manoeuvrability and, in this respect, under marine sailing directions, they have priority over vessels that are not similarly restricted. In areas where poor charting, or the presence of other vessels, may pose a potential problem to the survey operation, the chase boats will ensure that other vessels do not cross over, or otherwise interfere with, the towed equipment. The supply boat may also check that the way ahead of the survey vessel is clear of obstructions, such as uncharted shallow water and fishing equipment. Fishing nets are a particular problem to seismic operations as they can become entangled around the survey equipment and force operations to stop. It is likely that the FLO and one of the two MMO's will travel onboard the supply vessel, ahead of the research vessel.

3.6.3 Energy Source

Manufacturer and type	Sercel – G Gun 2
Effective volume of standard array(s)	4135 ci
Maximum number of sub-arrays	6
Standard array depth(s)	7 M
Position of depth transducers	Front and tail of sub-array
Working pressure	2000 psi psi
Type of firing sensors	Pressure activated
Position of firing sensors	Mounted directly on the gun.
Type of firing synchroniser unit	RTS BigShot
Timing resolution	0.1ms ms
Timing accuracy	+/- 1.0ms
Position of near field phones	1 mounted on each gun hang frame.
Air compressors capacity	Neuman & Esser, 2200 cfm each
Number of air compressors	2

3.6.4 Streamer

Manufacture and type	PGS GeoStreamer® Solid
Skin material	Polyurethane
Outside diameter	62mm cm
Length of each group	12.5m m
Streamer set-up	Typical 1 x 10050m
Manufacture and type of hydrophones	Hydrophones: Teledyne T-2BX or equivalent, Velocity Sensors: PGS

	confidential (MarkIII)
Type of array (e.g. linear, binomial)	Linear
Number of hydrophones per group/distance apart	Hydrophones: 12 per 12.5m, Velocity Sensors: PGS confidential
Coupling between phones and pre-amp	Capacitive
Sensitivity of near group at 1/P to recorder	20V/Bar
Sensitivity of far group at 1/P to recorder	20V/Bar
Bandwidth over which above sensitivities apply	Specified at 100Hz
Availability of shore-side spares if required	Pool system
Manufacturer and type of depth controller	ION DigiCourse 5011
Manufacturer and type of compass	ION DigiCourse 5011

3.7 PROJECT ALTERNATIVES

Alternatives to survey method:

No method for surveying deep marine geology has been developed that is more accurate, time efficient, or has fewer environmental impacts than the use of a towed airgun array and hydrophones contained in a long streamer. Prior to the development of airguns, dynamite was used for marine seismic surveying, but that survey method was abandoned over 30 years ago by the exploration industry.

Alternatives to survey parameters:

The main survey parameters such as line position, line length, line spacing, shot-point interval, and streamer length are determined by geophysicists considering the objectives of the survey. With regard to location, proposed survey lines are carefully selected based on a current understanding of the geological conditions of the study area and are intended to test geological concepts at those specific locations. The survey lines tie into the grid established offshore Greenland. Extensive geophysical survey work, over the past 10 years, of the same nature proposed here, has been taking place.

Parameters such as airgun array and streamer tow depths may be adjusted at the start of the survey to optimize data quality. Gun types, array configurations, and streamer type are limited to what equipment is available on the vessel and, therefore, cannot be easily changed.

Alternatives to program timing:

Specific timing of the program will depend on a variety of factors, including ice conditions, weather conditions, timing, and sensitivities associated with biological and socio-economic constraints. For example, mitigation options to minimize potential impacts can potentially include modification of the operations schedule within specific areas, and the survey plan has been developed on this basis.

Because there are no viable alternatives that can be genuinely considered from an environmental viewpoint (as described above), the two alternatives may simply be proceeding or not proceeding (i.e. no-go alternative).

No-go alternative

In the case that the project does not proceed, the mitigated impacts of seismic operations on the environment will of course not occur, however, the environment will not necessarily maintain its current baseline condition as impacts from fishing and vessel activity (i.e. ice breakers, cargo vessels, cruise ships, and other research vessels), waste materials, sedimentation, fall-out of atmospheric pollutants, discharge of ballast waters, etc. will still take place.

The 'no-go alternative' would also mean that the renewed interest in exploration in this area would cease, or at least be significantly set back, as geologists would not have the information required to map the sub-surface in this area. This would consequently mean

that the potential to assess the hydrocarbon potential of this area would not proceed, along with the assessment of opportunity for further subsurface exploration and drilling programs. Ultimately, the project not proceeding in this case would effectively preclude the potential to evaluate the area's offshore hydrocarbon resources. This would result in the removal of future potential business, royalty, and tax revenue sources and the data would not exist for future knowledge and research.

It would also lead to significant reduction in direct employment opportunities on the vessel and the opportunity to collect biological observation information.

3.8 PHYSICAL SETTING

The north seismic survey area is proposed to take place in portions of Davis Strait, and Baffin Bay (Figure 1). Davis Strait is situated between Baffin Island and Greenland and is the entrance to Baffin Bay from the North Atlantic. This large body of water is over 950 kilometres across at its greatest width and never less than 300 kilometres wide.

3.9 CLIMATE

The Davis Strait is within the Arctic Climatic Region with mean air temperatures below 10° C annually. The coldest month is February and the warmest is August (July in coastal regions). In summer air temperatures will be similar to those of the surface water. Freezing temperatures may occur over sea ice. In winter, very low air temperatures occur over snow covered pack ice. Over open water, air temperatures are generally below those of the sea surface. Coastal regions may experience summer temperatures as high as 15° C. Visibility within this region is mainly reduced by fog (visibility < 1 km). Fog is primarily a summer phenomenon, with increasing frequency during May and peak occurrences in June / July. It is uncommon by late August. In winter, advection fog may form as a result of mixing of warm moist masses advected from the south. Sea smoke is often very local in occurrence and is formed from cold air flowing from pack ice or from cold land over open water.

Most precipitation falls in late summer or early autumn. In winter, it will be in the form of snow. In summer, light snow or freezing rain may fall over pack ice or open water with surface temperatures near the freezing point. Generally, the months of June and October are the rain / snow transition months in the north, with May and November the transition months in the south. Freezing rain often occurs with the advection of warm air from the south in the winter. It is unlikely to occur over a sea with surface temperatures greater than 5° C.

Freezing fog is typically a summer event occurring over vast ice fields. It is not likely to occur over open waters with surface temperatures above 1° C. Freezing spray may be frequent from November to April but rare in October and May.

Wind in the northern part of the region, north of 65° N, has an annual speed of 5-6 metres/second that increases south of 65° N to 7-8 metres/second. In the north the maximum wind speed occurs as early as October / November but elsewhere in midsummer. The minimum wind speed is in midsummer throughout the region (MacLaren, 1978a).

3.9.1 Sea-Ice Climate

In June, the ice in the North Water Polynya of Northern Baffin Bay disintegrates, and then clearing extends southward across the approach to Lancaster Sound. Since pack deteriorates more quickly around the eastern shores (i.e. Greenland) than it does in the centre of the bay, by the beginning of August ice remains near the coast from Cape Dyer to Clyde River and in central parts of the Bay northward to near latitude 74° N. The pack is finally reduced to offshore isolated patches between Cape Dyer and Home Bay late in August. Clearing occurs on the average by September.

Historically the north-flowing current along the Greenland coast is relatively warm, and the south-flowing current along eastern Baffin Island is relatively cold. Consequently, ice formation along the west side of the bay (Canadian side) begins earlier than on the Greenland side. In September, new ice begins to form in the north western reaches of Baffin Bay. By the end of the September a fringe of new ice forms all along the Baffin Island coast. Ice formation accelerates through October, such that first-year ice becomes predominant north of Cape Dyer. On average, the southern extent of sea ice achieves equilibrium near a line from the Greenland Coast near latitude 68° N generally southwest-ward to a point some 200 kilometres off Resolution Island.

In general, Baffin Bay and Davis Strait have cleared of all sea ice as early as mid-August. Freeze-up in north western Baffin Bay has developed as early as the last week of August and been delayed until the middle of October. In Frobisher Bay, new ice formation has begun as early as mid-October, and as late as the second week of November.

The typical retreat of the sea ice cover from the late winter to late summer is shown in Figure 5 below. Melting of sea ice begins in spring in the Gulf of St. Lawrence and East Newfoundland, retreating northward towards the Labrador coast. In June openings appear in Baffin Bay and the Beaufort Sea, while clearing is already underway in Hudson Bay. Break-up continues throughout the summer months, reaching a minimum extent around mid-September.

With the changes seen in the ice this past year, it is anticipated that work may start sooner and end later.

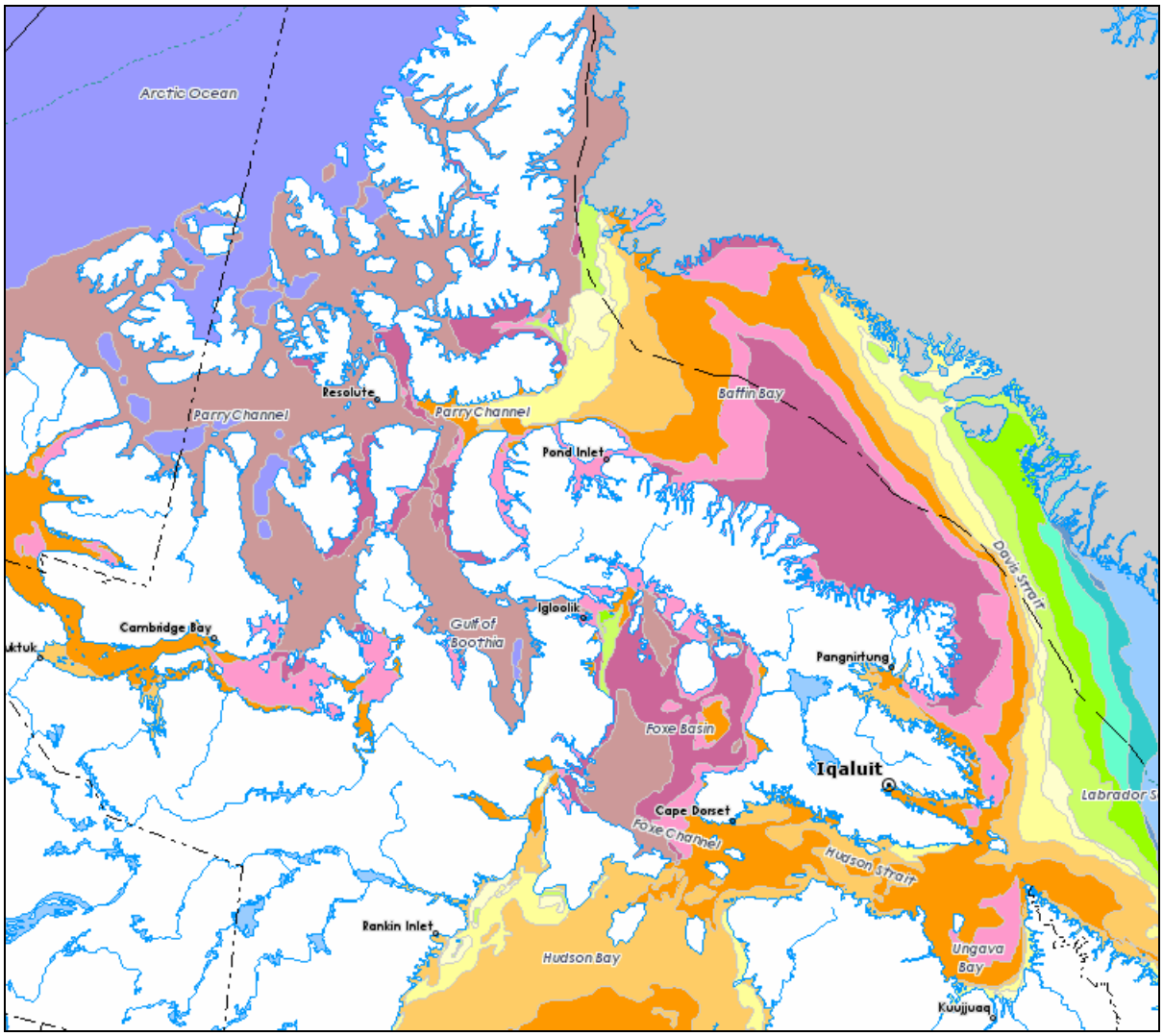

Figure 5. Break up of Sea Ice NRCAN 2007

3.10 OCEANOGRAPHY

The physical oceanographic environment of the eastern Davis Strait and north-eastern Labrador Sea has been well documented and an excellent overview is provided in a Mineral Resources Administration for Greenland (Nazareth and Steensboe, 1998) publication. uch of this overview includes the survey area and it indicates that there are no physical oceanographic environmental conditions that can significantly affect the proposed seismic program within the scheduled period (Nazareth and Steensboe, 1998).

The surface water circulation in Davis Strait is strongly affected by counter-clockwise flowing currents.

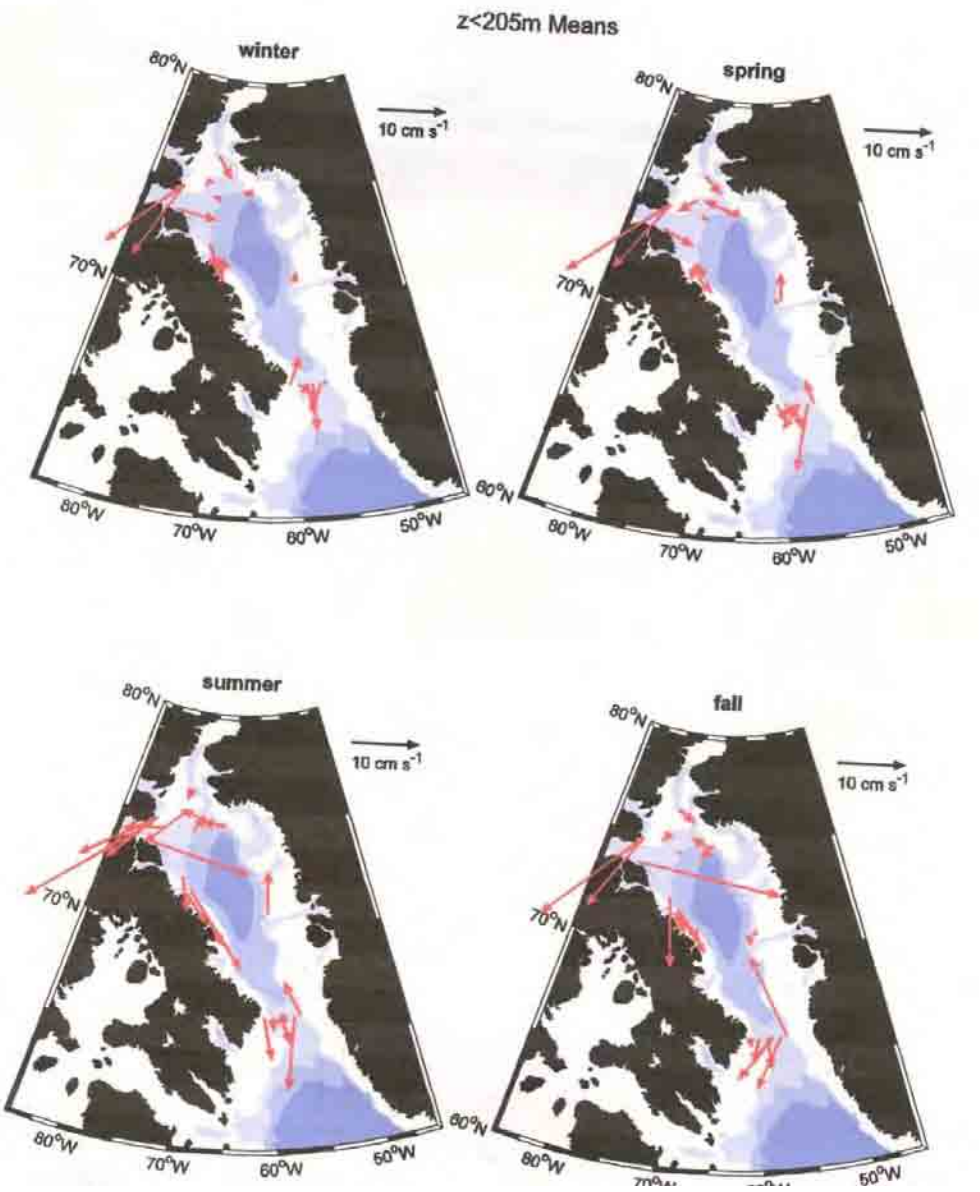

Figure 6. Circulation, within Baffin Bay (Tang et al. 2004)

3.11 BATHYMETRY

Its submarine topography includes an undersea ridge that is the continuation of the mid-Labrador ridge. This ridge extends from the coast of Baffin Island to Greenland. The shallowest waters in Davis Strait occur along this sill and extend from 350 to 500 metres depth before dropping down to the abyssal basins on either side. In the southern end of Davis Strait, some of the greatest depths on the eastern Arctic are reached (3,660 metres).

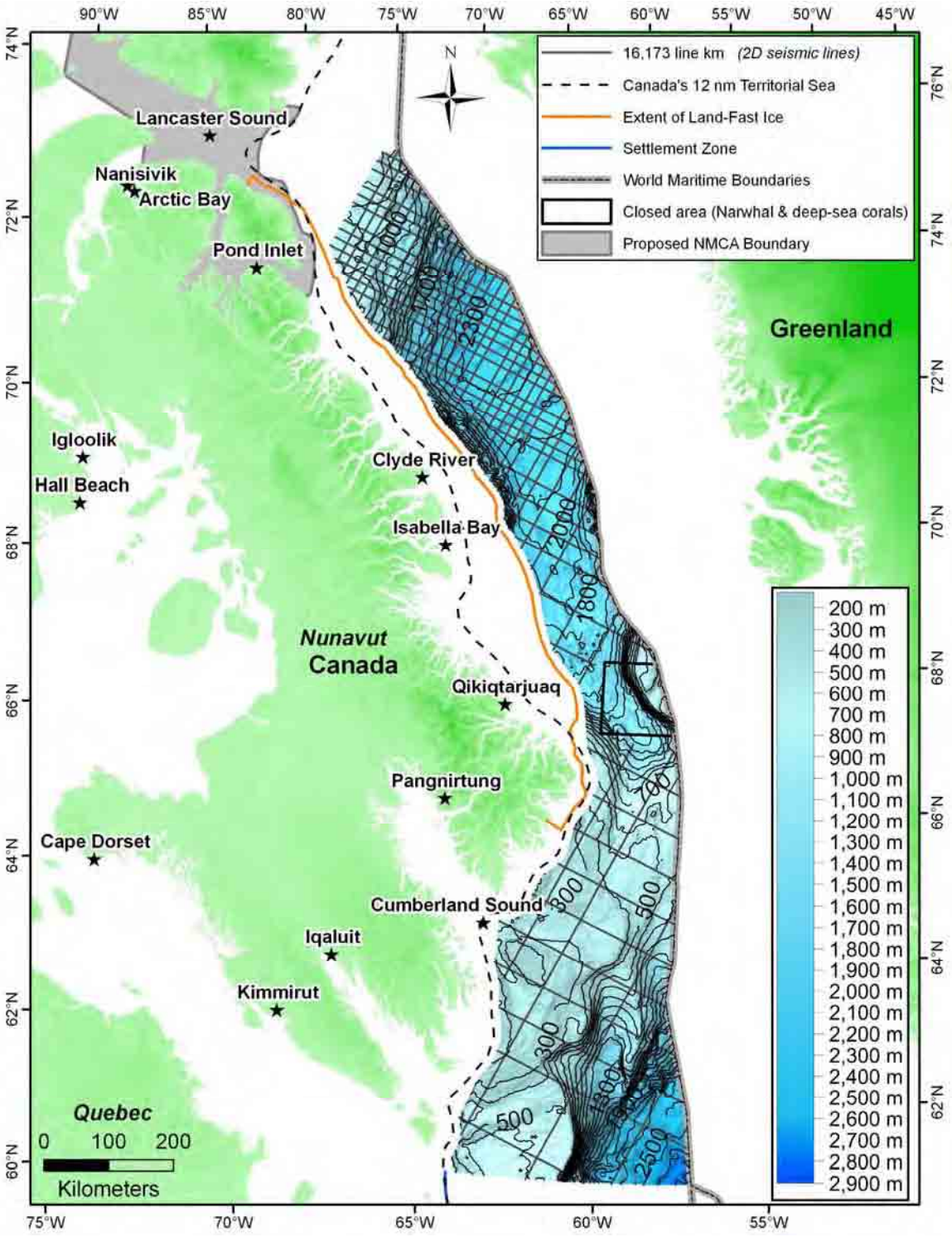

Figure 7. Bathymetry Baffin Bay

3.12 GEOLOGY

Baffin Bay is the north western extension and terminus of the North Atlantic-Labrador Sea rift system. The progressive northward stepping of sea floor spreading in the North Atlantic resulted in graben development in the incipient Baffin Bay area in the Early Cretaceous. Oceanic crust began to form in Baffin Bay in the Paleocene but sea-floor spreading appears to have ceased in the Oligocene. Baffin Bay is bounded to the north by Nares Strait, a probable transform fault, and to the south by the Ungava transform underlying Davis Strait. Sedimentary strata are thickest along the narrow east Baffin shelf and the opposing and much broader west Greenland shelf. A major depocentre is present at the northern end of the Baffin shelf opposite the mouth of Lancaster Sound. Sedimentation has been characterized by the influx of coarse elastic material across the rifted and rapidly foundering margin of Baffin Island. The sediments were derived from the surrounding highlands of the Baffin coast and by clastics brought from the lower Paleozoichinterland of the Canadian Arctic Islands by major rift controlled drainage systems (MacLean et al.1990).

3.13 EXPLORATION HISTORY

No wells have been drilled in Baffin Bay, with the exception of ODP site 645. In 1976-77, five wells were drilled in Davis Strait, at the southern entrance to Baffin Bay. These dry and abandoned wells are in Danish waters on the west Greenland Shelf. The Geological Survey of Greenland suggests that they failed to test prospective pre-Tertiary sequences indicated by seismic. Seismic exploration of the north-eastern Baffin shelf has been limited. The few reconnaissance program shot are insufficient to delineate drilling prospects (Rice and Shade, 1982).

3.14 STRATIGRAPHY

The Mesozoic sediments of Baffin Bay are probably underlain by Proterozoic rocks comparable to those now exposed on Baffin Island. Ordovician to Silurian rocks may be preserved in the offshore, but there is no seismic evidence to suggest that this is the case.

4. BIOLOGICAL ENVIRONMENT

4.1 PRIMARY PRODUCTION

Arctic climatic conditions impose a variety of conditions on the open water annual cycle phytoplankton production. The presence of ice inhibits light penetration, and the annual growth cycle of free living (non-ice algae) may be more compressed in high latitudes such as is experienced in the Davis Strait Region. Nonetheless, a considerable contribution to the overall plant production is attributed to ice algae that develops prior to and independent of the phytoplankton.

The spring phytoplankton bloom in the western Davis Strait begins in May and June with *Fragilaria oceanica* playing an important role (Gran, 1929) along with *Thalassiosira* sp. and *Leptocylindrus danicus* by July and August. In contrast, the waters of the western side of Davis Strait experienced different phytoplanktonic species assemblages. Here the species include the dinoflagellate *Ceratium arcticum* and various diatoms (*Chaetoceros*, *Asteromphalus*, and *Coscinodiscus*) (MacLaren, 1978a, 1978b). Ice flora in the western Arctic consist primarily of diatoms (*Nitzchia* sp., *Amphipora hyperborean*, *Nitzchia coterie*, *Pleurosigma stuxbergii*, *Gomphonema exiguuem arctica*, *Navicula* sp., and dinoflagellates *Peridinium* sp.) and flagellates (*Dimema litorale*, *Eutreptiella* sp. and *Platymonas* sp.) (Horner and Alexander, 1972; MacLaren, 1978a, 1978b). Jensen et al. (1999) have studied phytoplankton biomass distribution and productivity in the Davis Strait region and determined that overall primary phytoplankton production is in the range of 67-3,207 mgC m^2 $d^{1,}$ which is within the range of the few results published for eastern Canadian Arctic and West Greenland waters. Hsaio and Pinkewycz (1987) conducted a detailed survey of the area. A list of species recorded from their investigations is presented for the region in Appendix F. Additional information on the phytoplankton species composition within the area of study may be gained through review of Dunbar and Moore (1980).

4.2 ZOOPLANKTON

Zooplankton species, found in north-eastern Baffin Bay, Davis Strait area are common to Arctic regions in eastern Canada (LGL 1983, Granger 1965, Dunbar and Moore 1980). Like other Arctic regions, copepods are the most important group of zooplankton, both in terms of numbers and biomass (LGL 1983). Species of Calanus (C. finmarchicus, C. hyperboreus and C.glacialis) along with Oithona similis, Pseudocalanus minutus, Microcalanus spp. and Metridia longa are the most common (LGL 1983, Granger 1965 and Dunbar and Moore 1980). Other important groups include: chaetognaths, amphipods, gastropods ctenophores and hydrozoans (LGL 1983). A tabulated list of marine zooplankton occupying the study area may be reviewed by consulting Appendix G (Kennedy 2005).

Here in the Davis Strait region, the marine arctic zooplankton planktonic ecosystem is characterized by a brief summer period of intense productivity following the spring phytoplankton bloom. Young zooplankton stages feed in the surface waters (Grainger,

1959) and there may be spatial and temporal variation in zooplankton reproduction that varies from year to year (Grainger, 1959).

Specifically in the Davis Strait region, the *calanoid copepods Calanus finmarchicus, Calanus glacialis, and Calanus hyperboreus* and *the cyclopoid copepod Oithona similis* are the most numerically abundant species (Bainbridge and Corlett, 1968; MacLaren, 1978a, 1978b). In more coastal realms the *calanoids Acartic longiremis* and *Pseudocalanus minutus* may also be numerically important (Grainger, 1961). According to Grainger (1961, 1963), *Calanus glacialis* and *Calanus hyperboreus* are thought to be indicators of cold arctic waters while Calanus finmarchius indicates a boreal watermass. The zooplankton found in eastern Davis Strait by Bainbridge and Corlett (1968) is similar to that seen in the North Atlantic (Matthews, 1969), and is dominated by Calanus finmarchicus. Bainbridge and Corlett (1968) found that the second most abundant species were the *euphausiids* specifically *Thysanoessa inermis, Thysanoessa rashii, and Thysanoessa longicaudata.*

The Northern shrimp (*Pandalus borealis*) is the most important commercial invertebrate species within the project area. They are generally found in deep depressions and captured using trawl nets. Northern shrimp spawn during late summer and fall, with the eggs remaining attached to the female until spring. Females with eggs move inshore in late autumn and winter to release the eggs (Parsons, 1993).

Table 2 lists the major zooplankton species occurring in the Davis Strait (MacLaren, 1978a, 1978b).

Table 2. Major Zooplankton Species Occurring in the Davis Strait

Acartia longiremis	*Euchaeta norvegica*	*Parathemisto gaudichaudi*
Aglantha digitale	*Gaidius tenuispinus*	*Pseudocalanus minutus*
Beroe cucumis	*Limacina helicoids*	*Sagitta elegans*
Calanus finmarchicus	*Limacina retroversa*	*Sagitta maxima*
Calanus glacialis	*Metrida longa*	*Scolecithricella minor*
Calanus hyperboreus	*Microcalanus pygmaeus*	*Thysanoessa inermis*
Cochoecia obtusata	*Oikopleura labradorienis*	*Thysanoessa rashii*
Conchoecia elegans	*Oithona similis*	*Thysanoessa longicaudata*
Euchaeta norvegica	*Pandulas borealis*	

4.2.1 Marine Benthos

Investigations of the marine benthic community of the region of concern have focused primarily on bivalves. Dunbar and Moore (1980) list 51 species of bivalve (their chart 20) occurring in the Eastern Canadian Arctic. They also record 3 crab species (their chart 19), none of these listed species are of commercial importance to the area. An extensive list of marine plants, benthic invertebrates, and other bivalve mollusks and decapods crustacean collected in the Eastern Canadian Arctic is provided also in Dunbar and Moore (1980). Further to the region, Lubinsky (1980) has published a definitive

monograph on the faunal composition and zoogeography of marine bivalve mollusks of the Canadian Central and Eastern Arctic.

Specific to the Davis Strait and Western Baffin Bay Region, LGL (1983) presents information on the *infaunal, epibenthic* and *epifaunal* species. None of these species are commercially harvested. Thompson (1982) has described the marine benthic community of Lancaster Sound and northern and central Baffin Bay. More recently, Mohammed (2001), in a study of the energy flow within Lancaster Sound, found that the benthic species *Mya truncata, Hiatella artica, Serripes groelandicus* and *Macoma calcarea* were key players in the energy transformation within the benthic community. Other important groups included echinoderms (sea cumbers, brittle stars), annelids, terebellid polychaetes and small crustacea.

4.3 MARINE FISH

Dunbar and Moore (1980) in a biogeographic study of marine life in the Canadian eastern Arctic, indicated, for that period, that the state of knowledge of the fishes occurring in the eastern Canadian Arctic was rudimentary. In their report, they list only 13 species of marine fish of which only five species could be attributed to the study area. The five species included: *Boreogadus saida* (Arctic cod), *Moxocephalus scorpius* (Arctic sculpin), *Gymnelis viridis* (fish doctor), *Icelus bicornic* (two horn sculpin) *Coryphaenoides repestris* (rock grenadier) and *Oncocottus quadricornus* (now called Triglopsis quadricornis, fourhorn sculpin). Since then, there has been considerable more information revealed on the species of marine fish that inhabit the region of Lancaster Sound, Jones Sound and Baffin Bay. LGL (1983) in a study of the biological environment of eastern Lancaster Sound and western Baffin Bay recorded 28 species of marine fish (see their Table 2.6.1 for a listing of species). More recently, Coad and Reist (2004) have expanded our knowledge of the species of marine fish that inhabit the Canadian Arctic. In their comprehensive study of Canadian Arctic Ecozones many more species of marine fish have been identified. Here, for the region three Ecozones are represented. These zones are: Baffin Bay-Davis Strait near shore, Lancaster Sound region (including Jones Sound) and Baffin Bay-Davis Strait Offshore. For these three Ecozones combined, a total of 183 species of marine fish have been recorded. This list is presented in Appendix H.

In particular, Davis Strait region of the proposed seismic survey supports a wide variety of fish species. In excess of 80 species from Otter trawls taken between 400 and 1,500 metres have been identified (Treble et al., 2001; Table 3). Earlier studies sampling shallower waters and the benthic environment for fish found several other species (MacLaren, 1978a, 1978b; Table 4). The seasonal distribution of eggs and larvae of several of the more commercially abundant species is documented below for this area of the Davis Strait.

Table 3. Fish Species within the Davis Strait Region

Alepocephalus agassizii	*Coryphaenoides rupestris*	*Malacosteus niger*
Alepocephalidae	*Cyclopterus*	*Myctophidae*
Alleposomus copei	*Gadus morhua*	*Myxiniformes*
Amblyraja hyperborean	*Gaidropsarus argentatus*	*Nemichthyidae*

Amblyraja radiate	*Gaidropsarus ensis*	*Nemichthys scolopaceus*
Anarhichas denticulatus	*Gaidropsarus sp.*	*Nezumia bairdi*
Anarhichas minor	*Glyptocephalus cynoglosslls*	*Nezumia sp.*
Anoplogaster cornula	*Gonostoma bathyphilum*	*Notacanthus chemnitzi*
Antimora rostrata	*Gonostoma sp.*	*Notoscopelus kroeyeri*
Arctozenus rissoi	*Hippoglossoides platessoides*	*Octopodidae*
Artediellus atlanticus	*Hippoglossus hippoglossus*	*Oneirodes sp.*
Astronesthes sp.	*Holtbyrnia sp.*	*Paraliparis copei*
Bajacalifornia megalops	*Lampanyctus macdonaldi*	*Paralepididae*
Bathylagus euryops	*Leptagonus decagon*	*Paralepis coregonoides*
Bathylagus sp.	*Liparidae*	*Raja fyllae*
Bathyraja spinicauda	*Liparis fabricii*	*Raja sp.*
Bathytroctes sp.	*Lophiformies*	*Reinhardtius hippoglossoides*
Benthosema glaciale	*Lycenchelys muraena*	*Saccopharynx ampullaceus*
Boreogadus saida	*Lycodes esmarki*	*Scopelosaurus sp.*
Borostomias antarcticus	*Lycodes eudipleuroslictus*	*Sebastes marinus*
Bythites fuscus	*Lycodes pallidus*	*Sebastes mentella*
Careproctlls reinhardti	*Lycodes sp.*	*Serrivomer beani*
Caristius sp.	*Lycodes terraenovae*	*Stephanoberyciformes*
Centroscyllium fabricii	*Lycodes vahlii*	*Stomias boa*
Chauliodus sloani	*Lycodonus mirabilis*	*Stomias boa ferox*
Chiasmodon niger	*Macdonaldia rostrata*	*Stomiatidae*
Conttunculls microps	*Macrouridae*	*Synaphobranchus kaupi*
Conttunculls thompsoni	*Macrouriformes*	*Triglops nybelini*
Coryphaenoides brevibarbis	*Macrourus berglax*	*Xenodermichthys*
Coryphaenoides guentheri	*Malacosteidae*	

Table 4. Shallow Water Benthic Fish Species within the Davis Strait Region

Ammodytes sp.	*Gymnelis viridis*	*Myoxocephalus scorpius*
Benthosema glaciale	*Gymnocanthus tricuspis*	*Myoxocephalus sp.*
Boreogadus saida	*Liparis liparis*	*Paralepis coregonoides borealis*
Cyclopterus lumpus	*Macrourus rupestris*	*Salmo salar*
Eurnicrotremus spinous	*Myoxocephalus quadricornis*	*Salvelinus alpinus*
Gadus ogac	*Myoxocephalus scorpioides*	

Greenland halibut is a commercially important species that spawn in deep waters (600 to 1,000 metres) in the Davis Strait in the winter or early spring and produce bathypelagic eggs that rise to the surface where larvae are released. These larvae are in the water column during the months of March to June (Smidt, 1968; MacLaren, 1978a, 1978b). Recently however, Morgan and Treble (2006) suggest from gonad development studies that Greenland halibut spawning takes place in the winter or early spring in Davis Strait. The only recognized major nursery area is near the northern end of its distribution, west of Disko Bay, approximately 69° N.

The roundnose grenadier is thought to spawn all year round in this area (Parsons, 1976), while redfish larvae are found from May to August (Dunbar, 1970). Atlantic cod (COSEWIC, 2003) and Greenland cod have similar spawning periods, February to April (Postolaky, 1969; Dunbar, 1970). In general, the eggs and larvae of the major commercial species are not in the water column nor is there significant spawning activity when project-related seismic activity is proposed.

Commercial fisheries within the Davis Strait region are discussed in Section 4.9 of this document.

4.4 MARINE ASSOCIATED BIRDS

There are many species of seabirds and related bird species that can be found associated with the waters of Davis Strait. Not all are breeding populations and may only contact water or the shore area for brief period in the summer (Mallory and Fontain 2004). Both food and nesting site availability affect seabird distribution locally and seasonally and many variations in the summer habitat and feeding areas will occur each season. A list of seabirds associated with Davis Strait is presented below and adapted from MacLaren (1978a, 1978b) Table 5. There are no endangered or threatened species within the seismic survey area according to the latest information on the Species at Risk (SARA) Registry. The Ivory Gull is however a species of special concern (COSEWIC, 2006).

Table 5. Major Seabirds within the Davis Strait Region

Thick-billed Murr (*Uria lomvia)*	Greenland Mallard (*Anas platyrhynchos conboschas)*
Dovekie *(Alle alle)*	Common Mallard (*Anas platyrhynchos platyrhynchos)*
Atlantic Puffin (*Fratercula arctica)*	Brant *(Branta bernicla)*
Black-legged Kittiwake *(Rissa tridactyla)*	Lesser Snow Goose *(Anser Caerulescens)*
Icelandic Gull *(Larus glaucoides)*	Northern Fulmar *(Fulmarus glacialis)*
Herring Gull *(Larus argentatus)*	Greater Sherewater *(Puffinus grabis)*
Glaucous Gull *(Larus hyperboreus)*	Red Phalarope *(Phalaropus fulicarius)*

Great Black-backed Gull *(Larus marinus)*	Parasitic Jaeger *(Stercorarius parasiticus)*
Arctic Tern *(Sterna paradisaea)*	Pomarine Jaeger *(Stercorarius pomarinus)*
Northern Eider (*Somateria mollissima borealis)*	Long-tailed Jaeger *(Stercorarius lonicaudus)*
King Eider *(Somateria spectabilis)*	Skua *(Catharacta shus)*
Oldsquaw *(Clangula hyemalis)*	Redthroated Loon *(Gavia stellata)*
Harlequin Duck *(Histrionicus histrionicus)*	Common Loon *(Gavia immer)*
Red-Breasted Merganser *(Mergus serrator)*	Arctic Loon *(Gavia arctica)*
Barrow's Goldeneye *(Bucephala islandica)*	Ivory Gull *(Pagophilia eburnea)*

According to Dr. M. Mallory of the Canadian Wildlife Service (Nunavut) the following list of seabirds may be encountered, to a greater or lesser degree (Table 6). In addition, the distribution and abundance of some of these seabirds has been studied for the region by D. Fiefield (Canadian Wildlife Service, St. Johns Newfoundland).

Table 6. Likelihood of encounter of major seabird species within the northern study region

Species	Likely hood of encounter
Thick-billed Murr (*Uria lomvia)*	Certain
Dovekie *(Alle alle)*	Certain
Atlantic Puffin (*Fratercula arctica)*	Possible
Black-legged Kittiwake *(Rissa tridactyla)*	Certain
Icelandic Gull *(Larus glaucoides)*	Certain
Common Eider (*Somateria mollissima)*	Certain
Glaucous Gull *(Larus hyperboreus)*	Certain
Northern Fulmar *(Fulmarus glacialis)*	Certain
Arctic Tern *(Sterna paradisaea)*	Probable
Parasitic Jaeger *(Stercorarius parasiticus)*	Probable

King Eider *(Somateria spectabilis)*	Certain
Long-tailed Jaeger *(Stercorarius lonicaudus)*	Probable
Thayer's Gull (*Larus thayeri*)	Certain
Long-tailed Duck (*Clangula hyemalis*)	Probable
Sabine's Gull *(Xema sabini)*	Possible
Black Guillemot (*Cepphus grylle)*	Certain
Ivory Gull *(Pagophilia eburnea)*	Possible
Pomarine Jaeger *(Stercorarius pomarinus)*	Possible
Ross's Gull (*Rhodostethia rosea)*	Doubtful

(Dr. M. Mallory CWS, Nunavut)

It is not expected that seismic activity will measurably impact seabirds within the study area for the period of August through September (Lacroix et al 2003, Evans et al.1993, Stemp 1985, Huettmann and Diamond 2000). The surveys will begin far offshore and mitigation measures such as "ramping-up" the airgun array will aide in the dispersion of any concentration of seabirds that may be within the immediate area being studied. Nevertheless there are several seabird and related species that merit closer attention including the Thick-billed Murre, Black-legged Kittiwake, King Eider, Northern Fulmar and Ivory Gull; they are discussed below.

4.4.1 Thick-billed murres

Thick-billed murres are the most abundant colonial seabird in eastern Canada (Orr and Ward 1982, Gaston 1980, Figure 8). They breed along the Labrador coast and the northern islands between May and August (McLaren 1982, McLaren and McLaren 1982). At this time flightless birds (adults and chicks) from both western and eastern arctic colonies utilize surface water currents and travel rapidly through Hudson Strait, Davis Strait and the Labrador Sea (Orr and Ward 1982). During this period, August to October, sever hundred thousand flightless adults and chicks will be migrating. However as Figure 8 indicate these birds may be encountered during seismic activity.



Figure 8. Thick-billed Murre seasonal distribution (Gaston 1980)

Common and Thick-billed Murres are divers and may be affected by seismic activity. This is also true for *Alcidae* that breed in Newfoundland and Labrador including Razorbill and Atlantic Puffin. The largest colony of Razorbill in North America is at the Gannet Islands in southern Labrador. Shearwaters also dive for their food and may be susceptible to seismic interactions. Although diving birds may be susceptible to seismic interactions studies by Lacroix et al (2003) found no measurable impact of seismic activity on diving ducks (*Clangula hyemalis*), see also McLaren and McLaren 1982.). Stemp (1985).

4.4.2 Northern Fulmars

Northern Fulmars that reside in the Canadian Arctic in summer, winter in offshore open water areas in southern Baffin Bay, Davis Strait and the Labrador Sea (McLaren 1982). From May to June, prior to nesting, Fulmars generally occur in similar densities on coastal and ice edge habitats.

4.4.3 Black-legged Kittiwakes

Black-legged Kittiwakes that summer in the eastern Canadian Arctic winter pelagically in open waters of the Labrador Sea and North Atlantic (McLaren 1982). During the spring and early summer their densities were found to be higher along coastal areas than along fast ice edges and both higher than in offshore areas (McLaren 1982).

4.4.4 King Eiders

King Eiders, according to Mosbech and Boertmann (1999) will not be in the survey area during the period scheduled for this seismic activity (Figure 9).

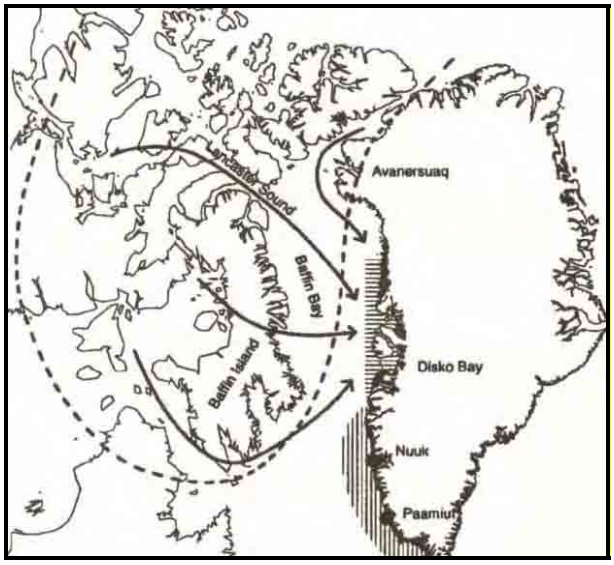

Figure 9. Molt migration of King Eiders and main molting area off Greenland (Mosbech and Boertmann 1999)

Most recently, D. Fiefield, CWS (Newfoundland) has compiled the latest abundance and distribution of several bird species within the region of concern. The distribution and estimated abundance for some of the above mentioned species from July through September over the period 2006 to 2009 is presented in the following figures (Figure 10 to Figure 14). Graphic distribution and abundance for the period of the northern field program in the eastern Arctic for some of these species is presented below. (We gratefully acknowledge the assistance of C. Gjerdrum CWS, Dartmouth, Nova Scotia for these figures.) Additional information on regional seabirds may be acquired through review of Mallory and Fontaine (2004).

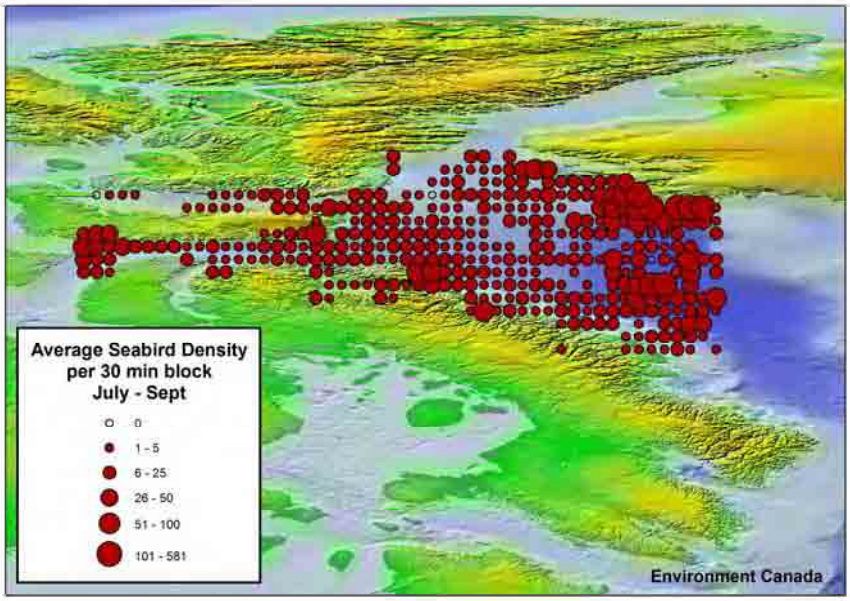

Figure 10. Average seabird distribution and abundance (all seabirds) for the period of July to September

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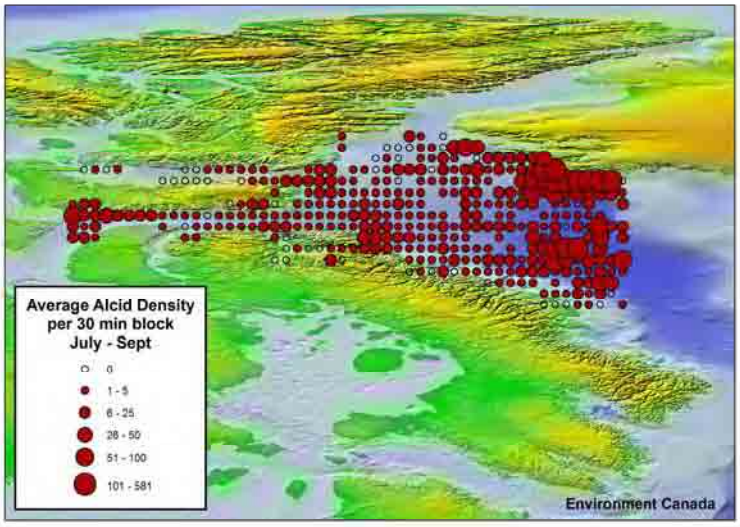

Figure 11. Average *Alcid* seabird distribution and abundance (Razorbills, Auklets, Puffins and Murres) for the period of July to September

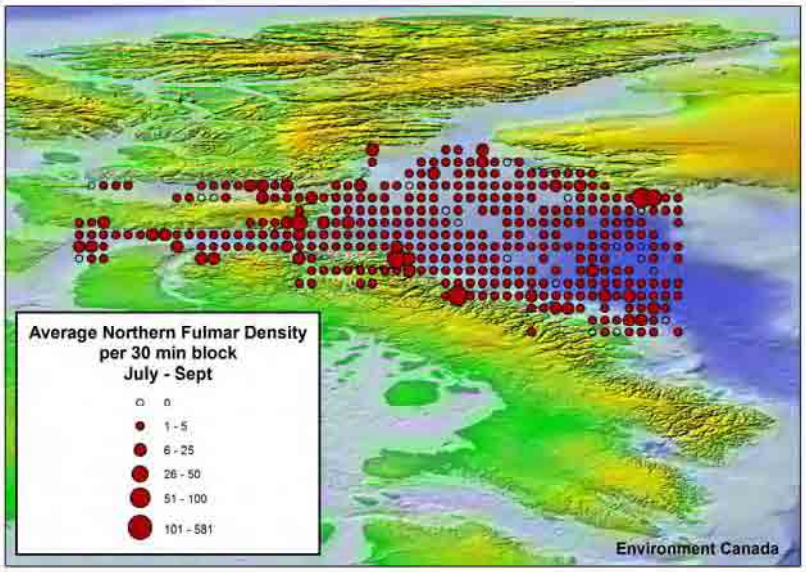

Figure 12. Average distribution and abundance of Northern Fulmars for the period of July to September

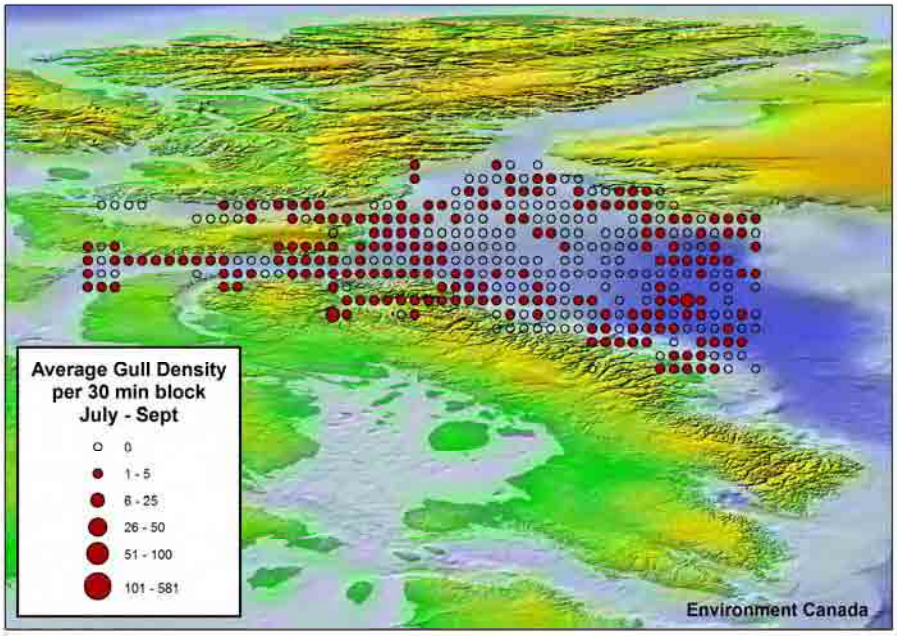

Figure 13. Average Gull distribution and abundance for the period of July to September

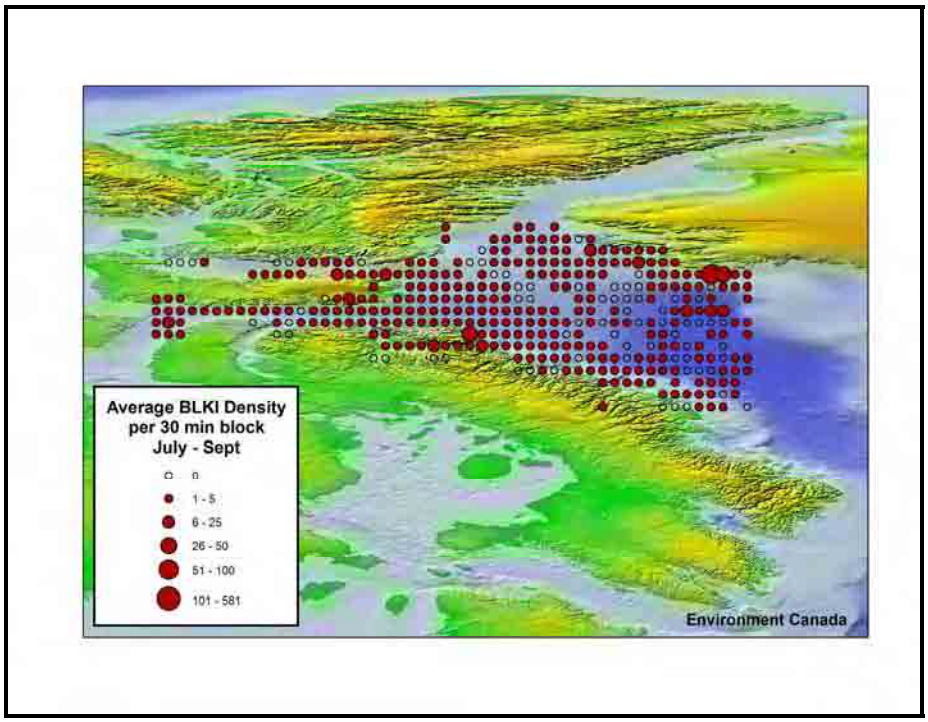

Figure 14. Average Black-Legged Kittiwake distribution and abundance for the period of July to September

4.4.5 Ivory Gull

Although the east coast of northern Baffin Island, Lancaster Sound and Jones Sound support many seabird colonies only one species has been identified as at risk by SARA and COSEWIC 2006. The Ivory Gull was assigned as an endangered species by COSEWIC (2006c) and SARA due to decline in their distribution and abundance (Gilchrist and Mallory 2005). Although the historic winter range (Figure 15) shows that the species may frequent areas of the proposed seismic survey in the late fall the seismic survey will be completed by the end of September. Consequently, these birds that may frequent the most southern regions of the seismic survey area for wintering (November) are less likely to be exposed to measurable influences related to human activity undertaken in the summer.

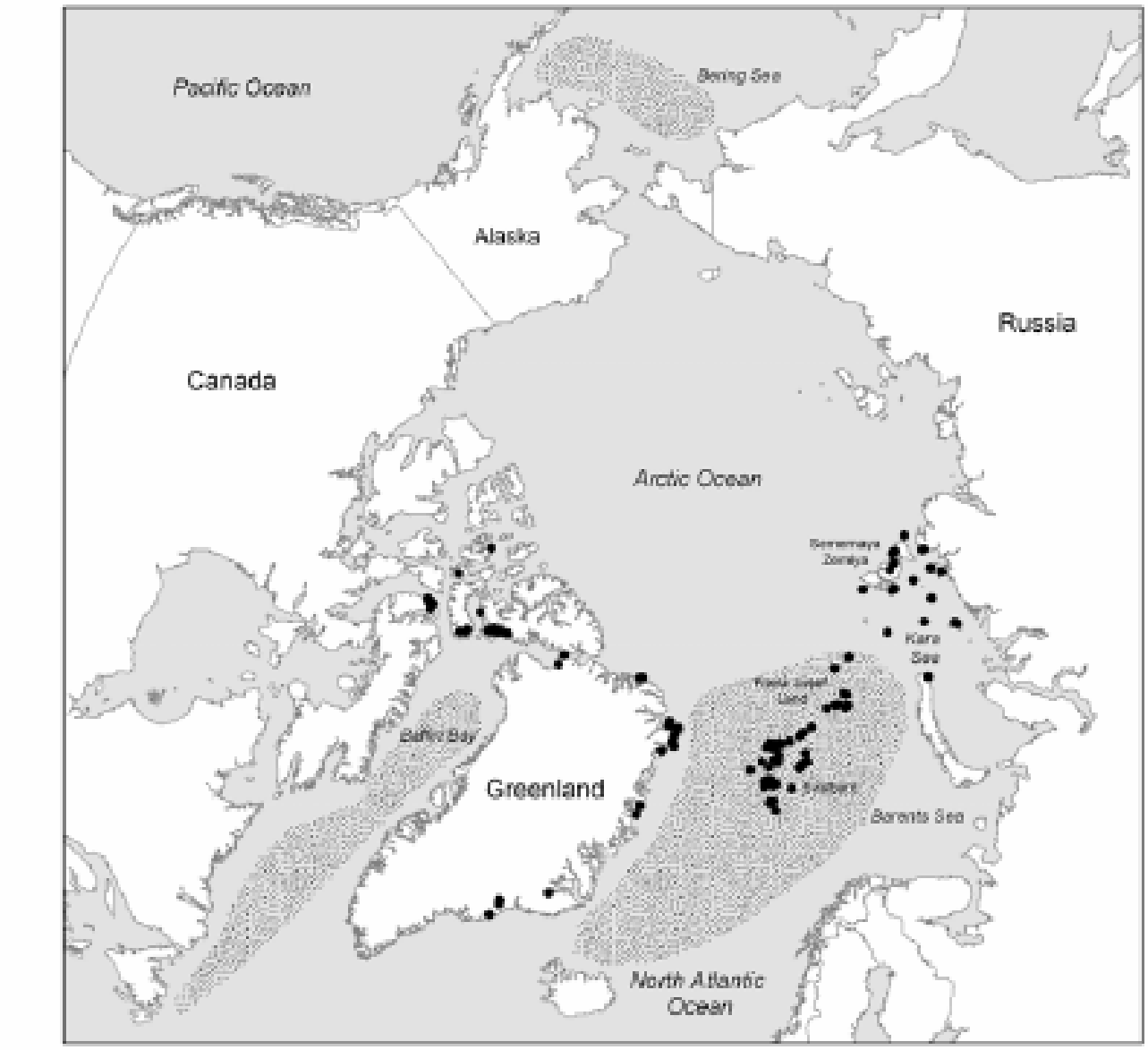

Figure 15. Distribution of ivory gull, stippled indicates winter range, dots identified colonies (active and inactive, COSEWIC 2006c).

4.4.6 Dovekies

Dovekies (*Little Auks*) breed in northwest Greenland and migrate through Davis Strait during the latter part of April and early May (Renaud et al., 1982). The number of dovekies wintering in North American waters and breeding colonies in northwest Greenland has been estimated to be in the tens of millions (Montevecchi and Stenhouse, 2002). The only known breeding area in the Canadian Arctic is in Home Bay on eastern Baffin Island (Montevecchi and Stenhouse, 2002). This species winters in low arctic waters of the Labrador Sea, Grand Banks, and coastal Newfoundland (Montevecchi and Stenhouse, 2002). Colonies are abandoned by late August and birds start to leave northern Baffin Bay through to October, where they remain at the edge of pack-ice in southern Baffin Bay and Davis Strait. Here, in these offshore habitats, dovekies generally occur in higher densities associated with moderate to heavy pack-ice. Ice-free areas or areas with total ice cover are generally avoided (Renaud et al., 1982). Because ice-free areas are the only areas where seismic activity will take place, it is unlikely that significant numbers of dovekies will be encountered during the survey period. Nevertheless, mitigation measures will be adopted to reduce potential interaction of seismic activity on dovekies.

4.4.7 Long-tailed Ducks

Long-tailed ducks (*formerly Oldsquaws*) may occur in large numbers along coastal areas and shore-ice areas of eastern Lancaster Sound and northern Baffin Bay from May to July (McLaren and McLaren, 1982); however, they are rarely seen greater than 1 kilometre from the coast or shore-fast ice. Although densities may peak in September, by mid-October only a few individuals remained when surveys were undertaken in Lancaster Sound (McLaren and McLaren, 1982). Since these ducks are rarely seen out as far as 1 kilometre from the shore, it is unlikely that the seismic survey will encounter this species.

4.4.8 Black Guillemots

Black Guillemots within Baffin Bay and eastern Lancaster Sound, during the spring and early summer, have densities that are higher along fast ice edges than along coasts, and densities offshore were lower than along interfaces (McLaren and McLaren, 1982). Their distribution in the most northern areas during early to mid-summer. Like Murres, Guillemot densities were highest in light to heavy pack-ice and lowest in ice-free areas and areas with total ice cover. Since the proposed seismic activity will take place in ice-free waters, the potential for interaction with this species is significantly reduced. Nevertheless mitigation measures to reduce the potential for interaction will be in place

4.5 MARINE MAMMALS

Marine mammal occupation of this region of eastern Canadian high Arctic may include up to 22 species: 5 seal, 1 walrus, 6 species of baleen whale, 6 species of toothed whale, 3 porpoises, and the polar bear (MacLaren Atlantic Limited, 1978, McLaren et al.1982). The proposed study area forms the northern most range extent for several species and the likelihood of their presence here is therefore less understood during the proposed period of seismic activity in this area of the high Arctic. Most notably, the marine mammal species that could be encountered during this portion of the northern survey include: ring, harbour, bearded and harp seals, possibly hooded seals; the walrus, polar bear as well as beluga, narwhal and bowhead whales and possibly killer whales (LGL 1983, Dunbar and Moore 1980).

Pinnipeds

4.5.1 Ringed seal (*Phoca hispida*)

The Ring seal, (*Phoca hispida*), has a circumpolar distribution (DF0 2009) and they are generally closely associated with the distribution of land fast ice. They are the most common seal within Nunavut (MacLaren, 1958, LGL 1983, Dunbar Moore 1980). Immature ringed seals may move offshore during open water season, but adults remain around islands and within the bays and fiords (MacLaren, 1958, LGL 1983, Dunbar Moore 1980). Consequently, they are unlikely to be encountered during the seismic survey that will take place in the summer. There is no evidence of large scale migrations. The native harvest within Nunavut takes place throughout the year (Priest and Usher 2004, Table 7. Their general distribution/range is shown in Figure 16

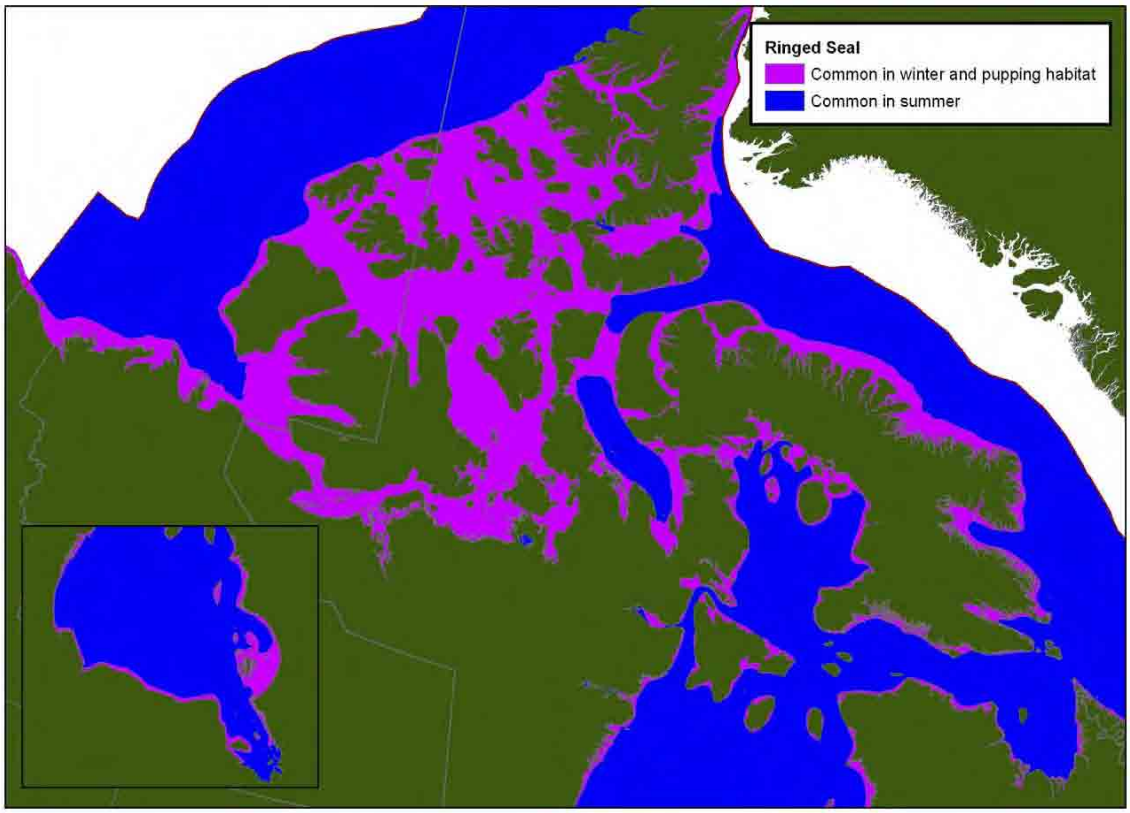

Figure 16. Distribution of Ringed Seal (*Pusa hispida*) in the Canadian Arctic. (Stephenson and Hartwig 2010)

Table 7. Month with Species captured in Nunavut (Priest and Usher 2004).

	June	July	August	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May
Seals												
(unspecified)												
Ringed												
Bearded												
Harp												
Harbour												
Hooded												
Walrus												
Whales												
Narwhal												
Beluga												
Bowhead												
Polar Bear												

4.5.2 Bearded Seal (*Erignathus barbatus*)

The Bearded seal, *Erignathus barbatus*, is sparsely distributed throughout the Canadian Arctic and restricted in distribution by the extent of pack ice and shallow water (MacLaren, 1958, LGL 1983, Dunbar Moore 1980, CNLOPB 2008). Unlike many of the other seal species occurring in the Canadian Arctic, this species has not been well investigated (Stephenson and Hartwig 2010). Studies of their general distribution have lead to adopt the 250 m benthic contour interval as a measure to delineate the area in which Bearded Seals are commonly seen (Stephenson and Hartwig 2010). Their general distribution/range is shown in Figure 17. Note that they are absent from the central portion of Baffin Bay and Davis Strait where the northern portion of the survey will take place and they generally occur near shore. Bearded seals are harvested throughout the year by native populations (Priest and Usher 2004).

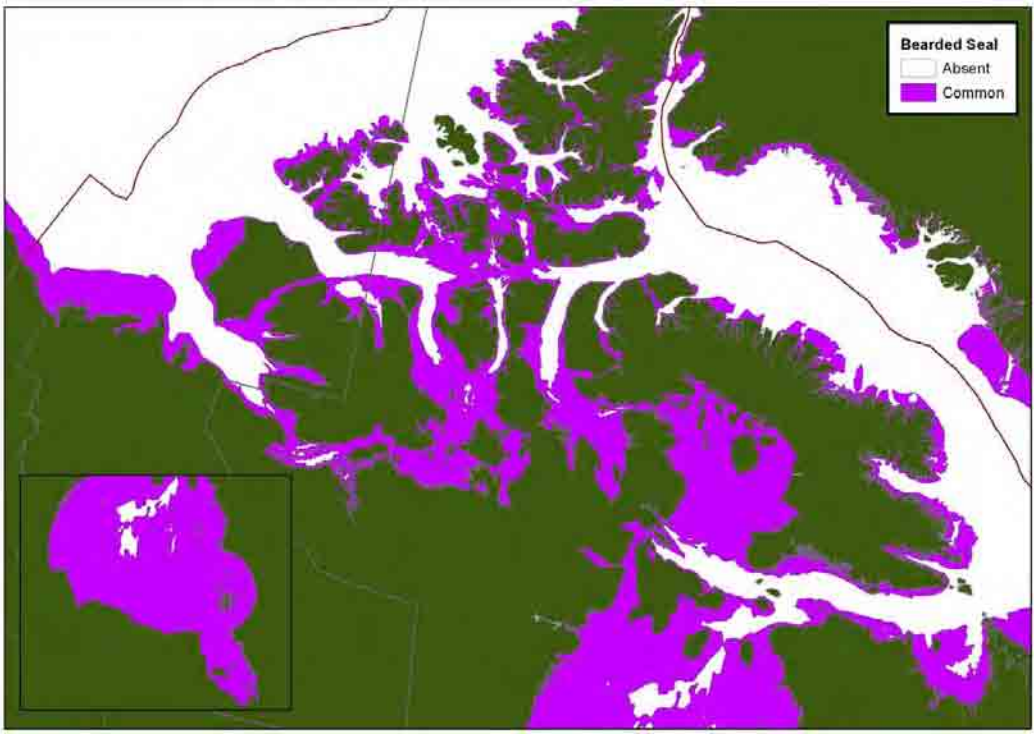

Figure 17. Distribution of Bearded Seal (*Erignathus barbatus*) in the Canadian Arctic. (Stephenson and Hartwig 2010)

4.5.3 Harp seals (*Phoca groenlandica*)

Harp seals (*Phoca groenlandica*) are known to occur in large numbers during the summer season in the region. The population of Harp Seals is presently estimated to be about 6 million individuals (Stephenson and Hartwig 2010). Harp seals migrate westward throughout the summer, from Baffin Bay into Lancaster Sound (Stephenson and Hartwig 2010) and may travel in large groups (50 to 500+) during ice break-up (Fallis et al., 1983). They are common at the floe edge feeding or hauled out on ice floes (DFO, 2005). Their migratory pathways and whelping grounds are shown in Figure 18. Groups tend to be smaller during the open water season. Harp Seals are hunted throughout Nunavut primarily during the months of June through September Table 7 (Priest and Usher 2004). Their general distribution/range is shown in Figure 19.

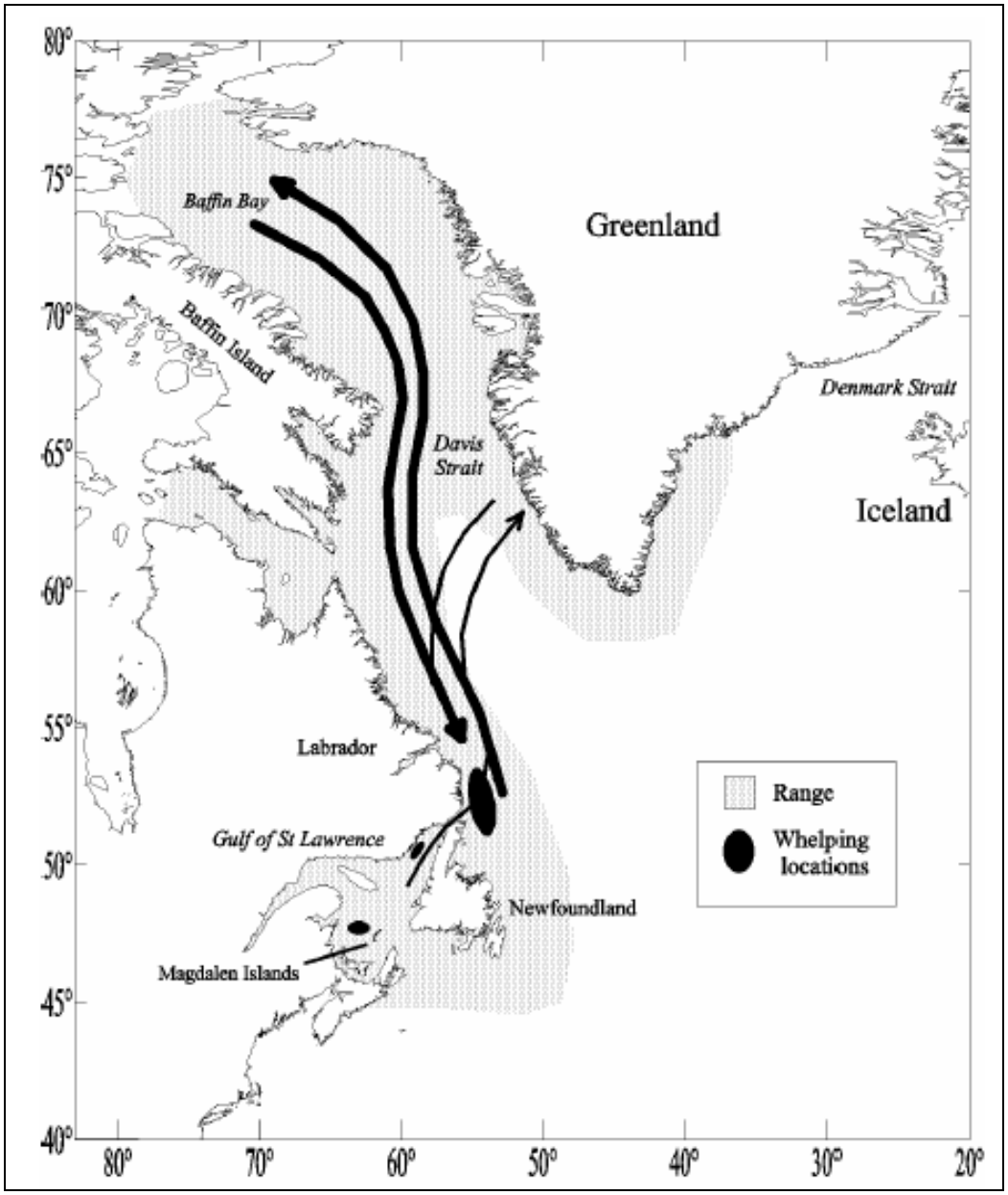

Figure 18. Range, Migratory Pathways, and Whelping Locations of Harp Seals in the Northwest Atlantic (DFO, 2005)

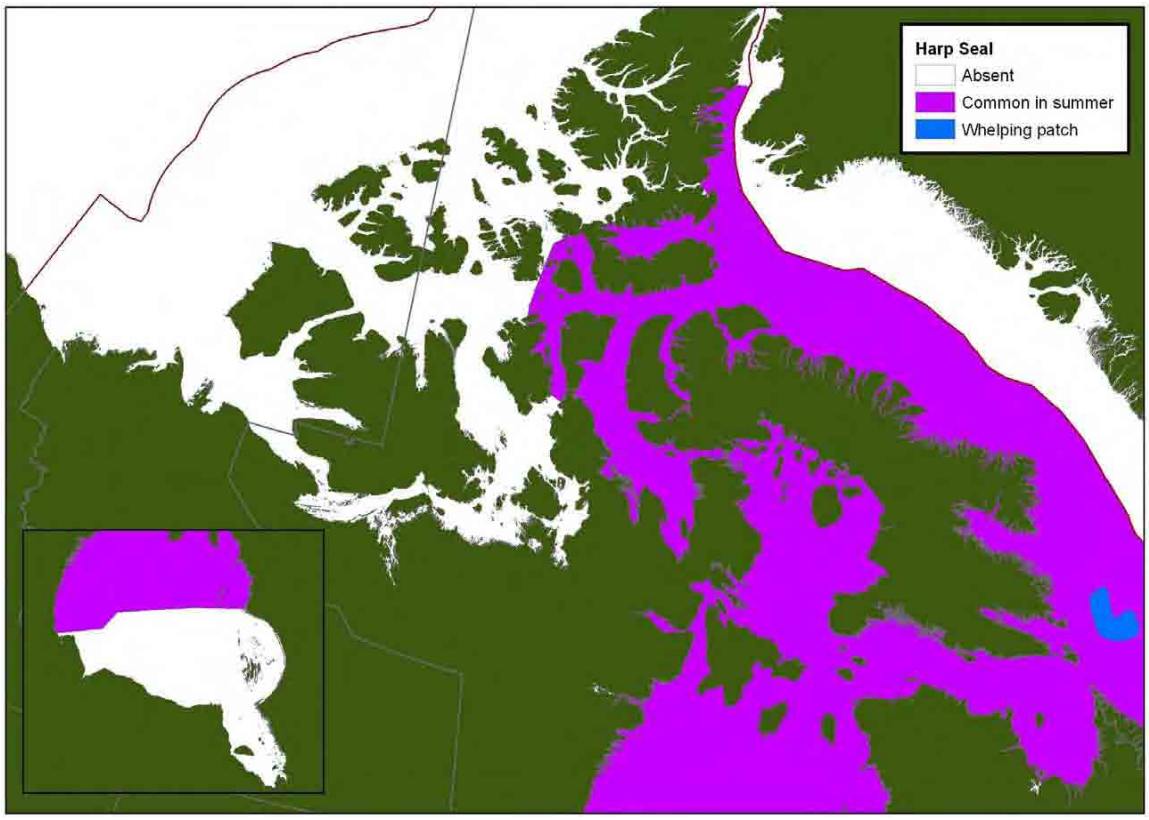

Figure 19. Distribution of Harp Seal (*Pagophilus groenlandica*) in the Canadian Arctic (Stephenson and Hartwig 2010)

4.5.4 Harbour Seal (*Phoca vitulina*)

The Harbour Seal, *Phoca vitulina*, is a coastal species and is generally associated with near shore shallow water with regions of up welling and tidal action or out on the floe edge (Mansfield, 1967). In general they prefer not to venture greater than 11 km offshore in waters that are in the order of 50 m (COSEWIC 2007). This depth limitation has been supported by radio telemetry studies that have indicated that the 50 m benthic contour line may be used to demarcate their offshore limit of distribution (Stephenson and Hartwig 2010). This distribution pattern may be related to the fact that this species of seal does not maintain breathing holes in the ice and thus they are restricted in their offshore distribution to areas with open water during ice-covered seasons (Stephenson and Hartwig 2010). Harbour Seals are harvested by members of the Nunavut community primarily during the period from July through October (Table 7). Their distribution and range is shown in Figure 20.

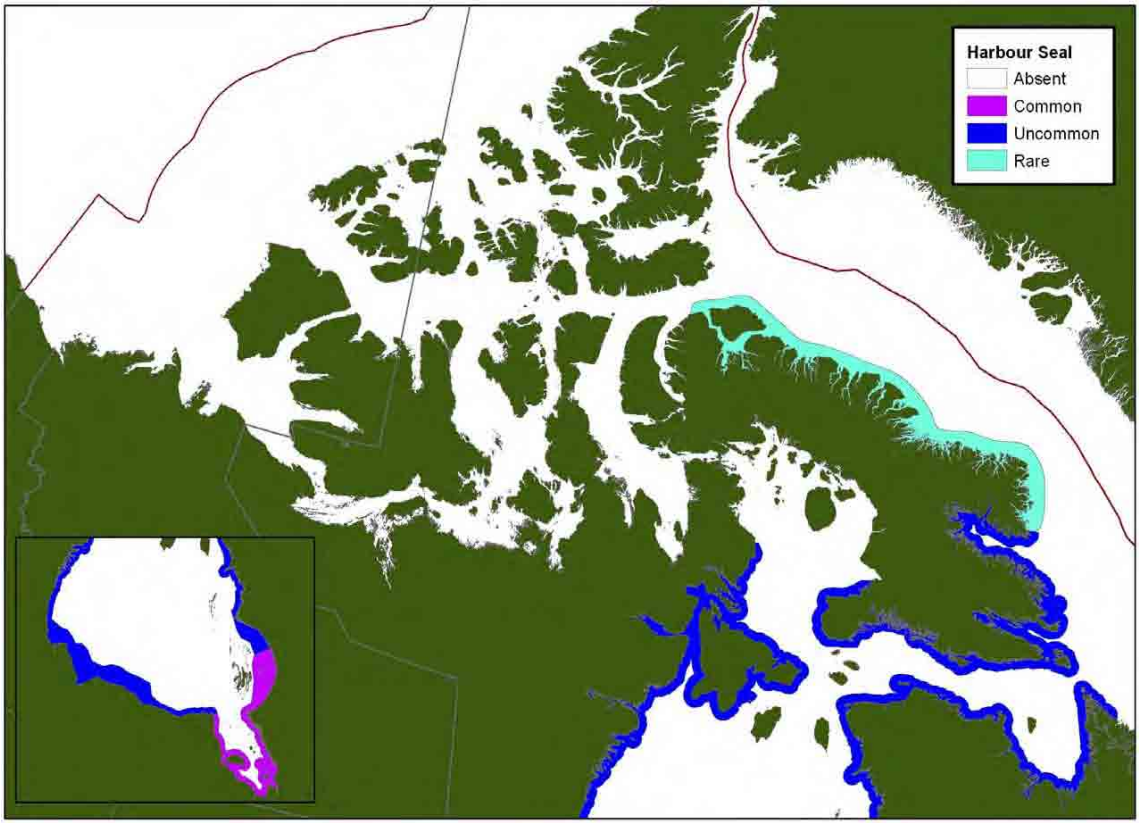

Figure 20. Distribution of Harbour Seal (*Phoca vitulina*) in the Canadian Arctic. (Stephenson and Hartwig 2010)

4.5.5 Hooded seals (*Cystophora cristata*)

Hooded seals (*Cystophora cristata*), within Nunavut are occasionally seen migrating into Lancaster Sound from Baffin Bay (Sergeant, 1976, Hammill and Stenson 2006). Although they have not been extensively studied, they are generally associated with heavy pack ice and their presence would extend until ice break-up (Sergeant, 1974). Hooded Seals are considered a deep-water feeder (Stephenson and Hartwig 2010). Since they are primarily deep-water feeders, the 200 m bathymetric contour interval has been adopted to estimate the offshore distribution boundary of this species (Stephenson and Hartwig 2010). Native hunting for this seal takes place primarily during the months of June through December (Priest and Usher 2004, Table 7). Their general distribution throughout the region is presented in Figure 21. Furthermore, the Nunavut Wildlife Management Board has produced a series of species distribution maps for resources that occur within the Nunavut Settlement Area. These maps, based on many years of traditional ecological knowledge (TEK), provide insight on the local distribution patterns of marine related aquatic resources important to the members of the Nunavut community.

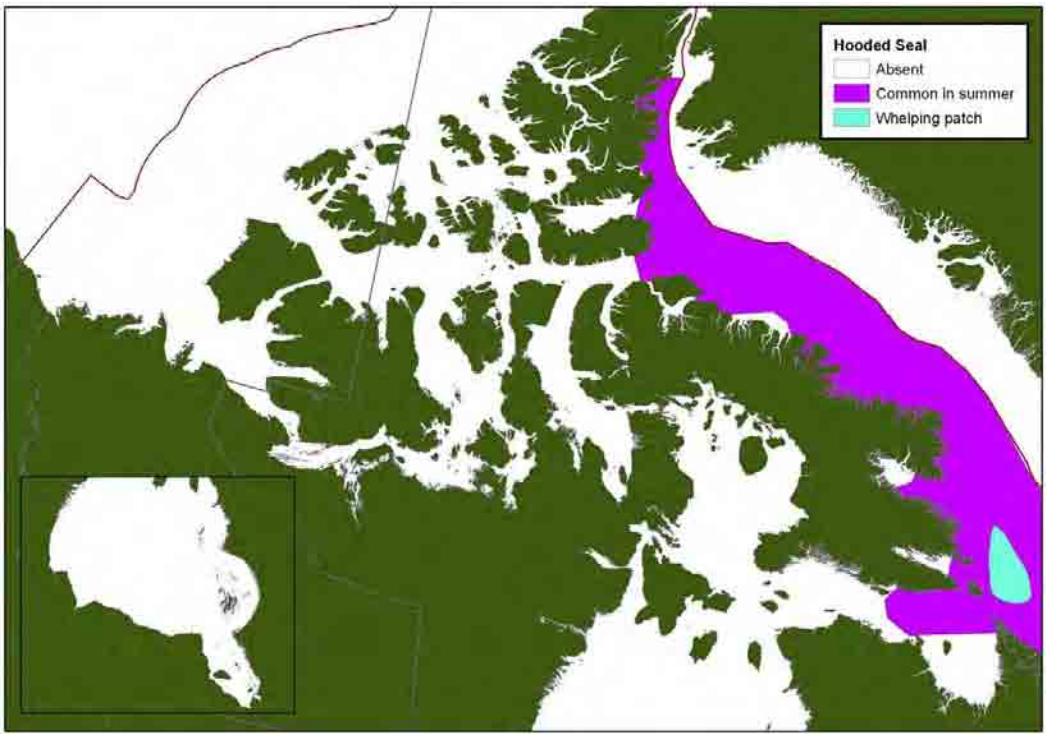

Figure 21. Distribution of Hooded Seal (*Crystophora cristata*) in the Canadian Arctic. (Stephenson and Hartwig 2010)

Nunavut traditional ecological knowledge for the sea species in their jurisdiction has been mapped. This map, Figure 22, shows the high density distribution pattern of the most important species to the Nunavut, notable the Harp Seal, Ring Seal and to some extent the Bearded Seal (Nunavut Planning Commission 2009).

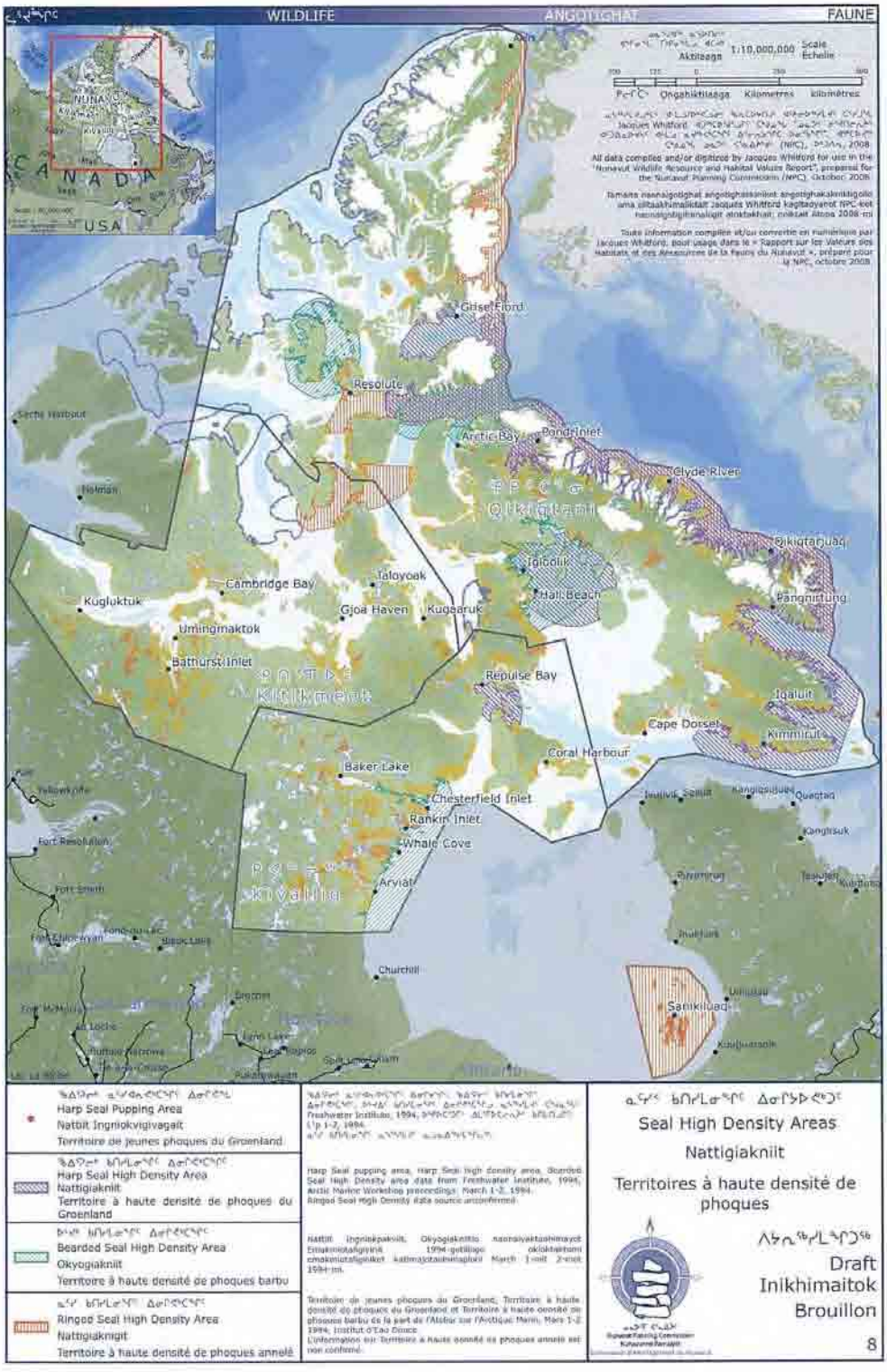

Figure 22. High density distributional pattern of major seal resources within Nunavut (Nunavut Planning Commission 2009).

4.5.6 Atlantic walrus (*Odobenus rosmarus*)

The Atlantic walrus, *Odobenus rosmarus*, once common in the region, is now more rare and has recently been up-listed by COSEWIC from a designation of “not at risk” to a designation of “Special Concern” (COSEWIC, 2006). Ecologically, the Atlantic walrus prefers shallow water (<80 metres) regions with high bivalve productivity. Bivalves are their primary prey (Evans and Raga 2001). The general distribution and range of this species is shown in Figure 23. There are several populations within the Canadian Arctic and their specific distribution pattern is presented in Figure 24 and Figure 25. The Nunavut Wildlife Management Board has mapped the seasonal distribution of walrus for the Nunavut region, this pattern of seasonal distribution is presented in Figure 26. Walrus are hunted in the Nunavut region year round (Priest and Usher 2004). The general distribution pattern and their habitat preference for shallow near shore areas substantially reduce the potential for interaction with this project in far offshore regions.

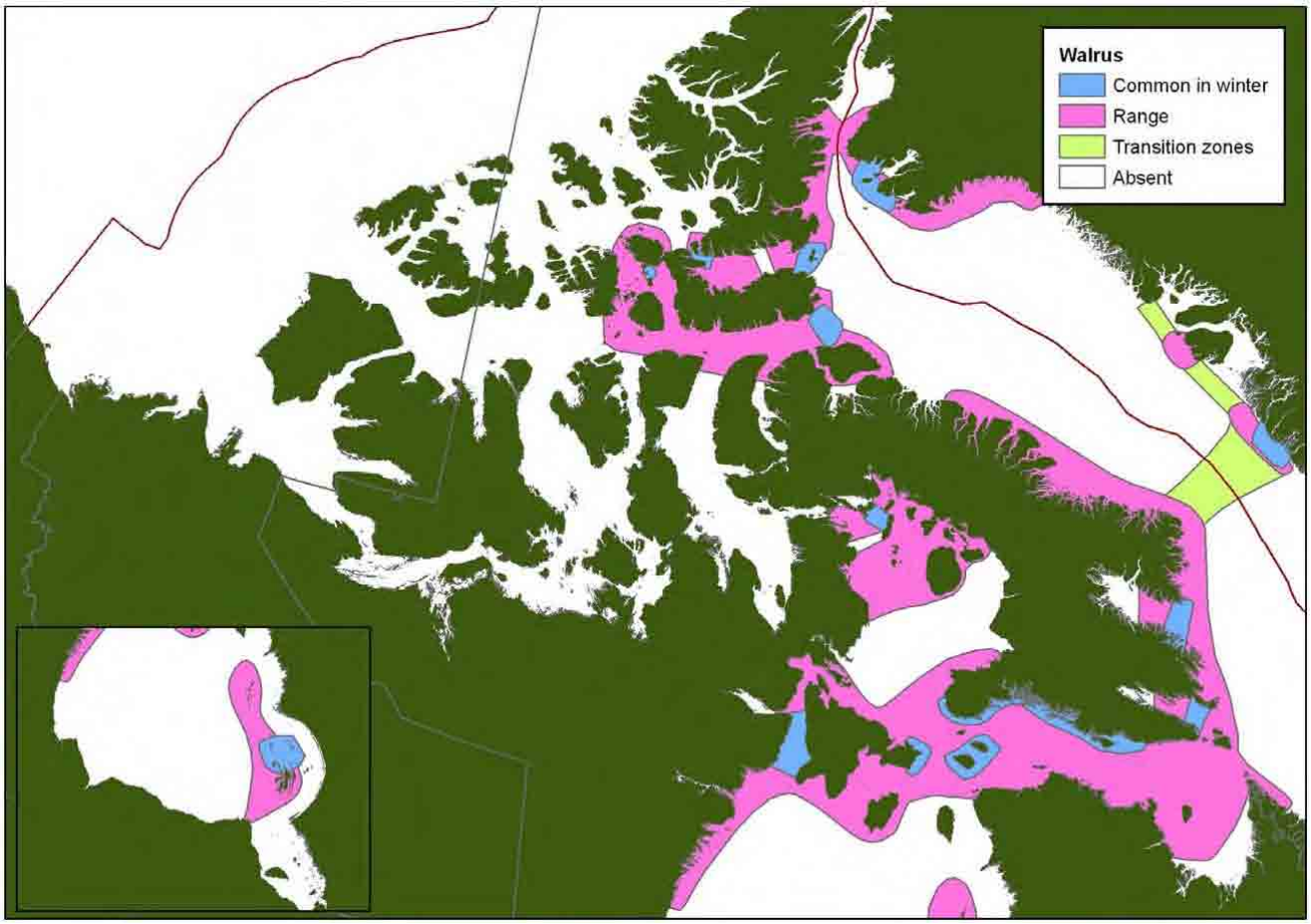

Figure 23. Distribution of Walrus (*Odobenus rosmarus*) in the Canadian Arctic. (Stephenson and Hartwig 2010)

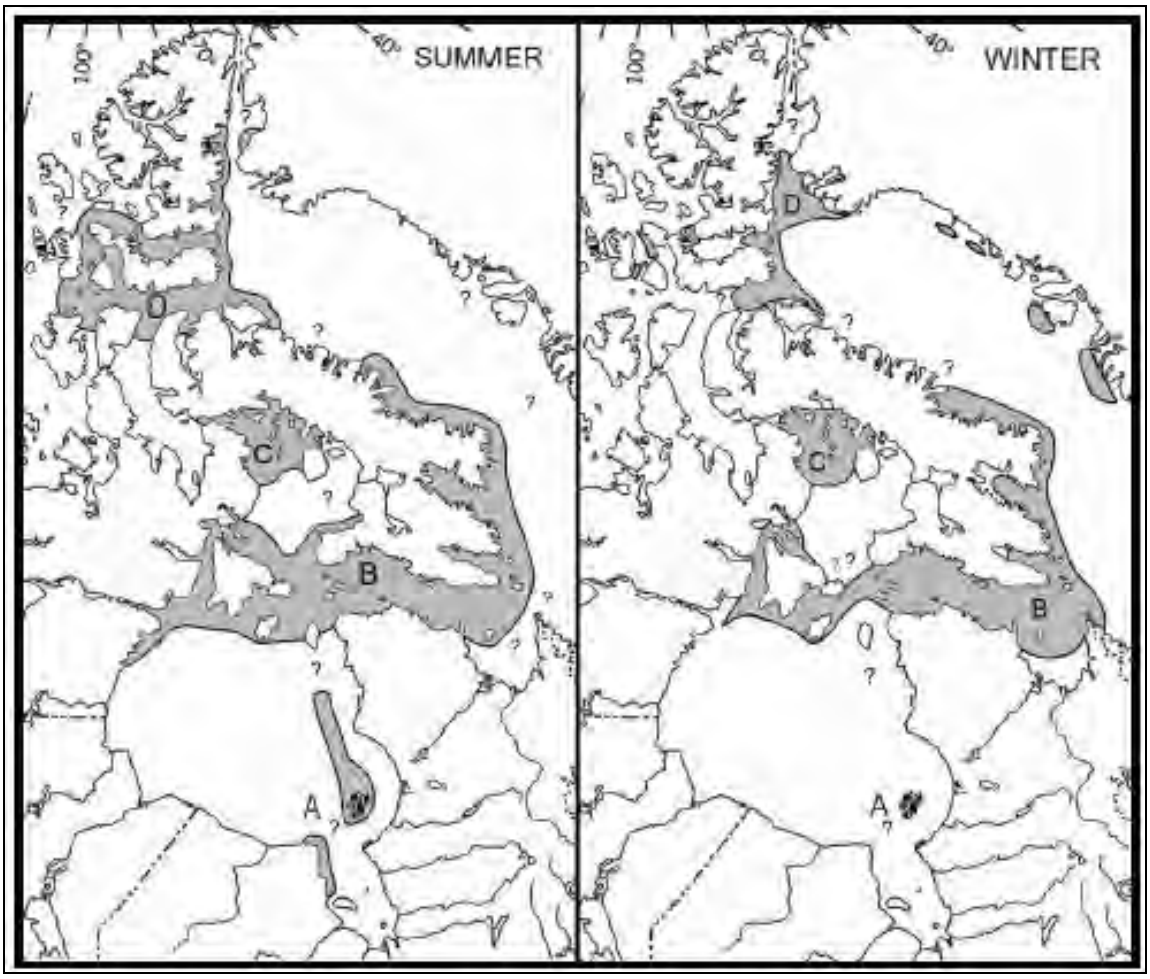

Figure 24. Approximate summer and Winter Distributions of Atlantic Walrus Populations in Canadian Waters South and East Hudson Bay (A), Northern Hudson Bay - Davis Strait(B), Foxe Basin (C), and Baffin Bay (High Arctic) (D) populations. Question marks indicate uncertainty with respect to distributions and/or movements (COSEWIC 2006).

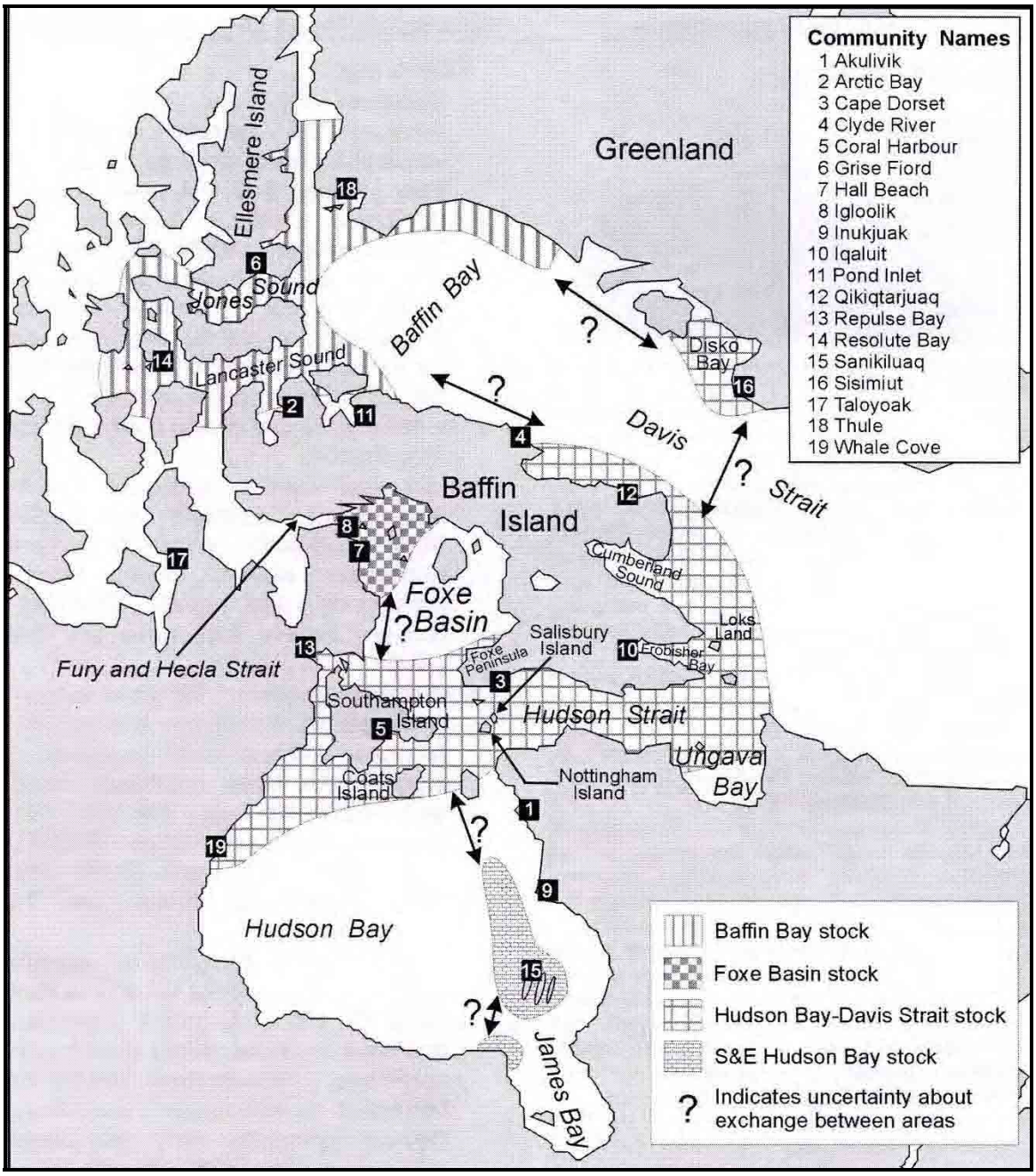

Figure 25. Map of the range and distribution of Atlantic walrus stocks in eastern Canadian waters (from DFO 2000).

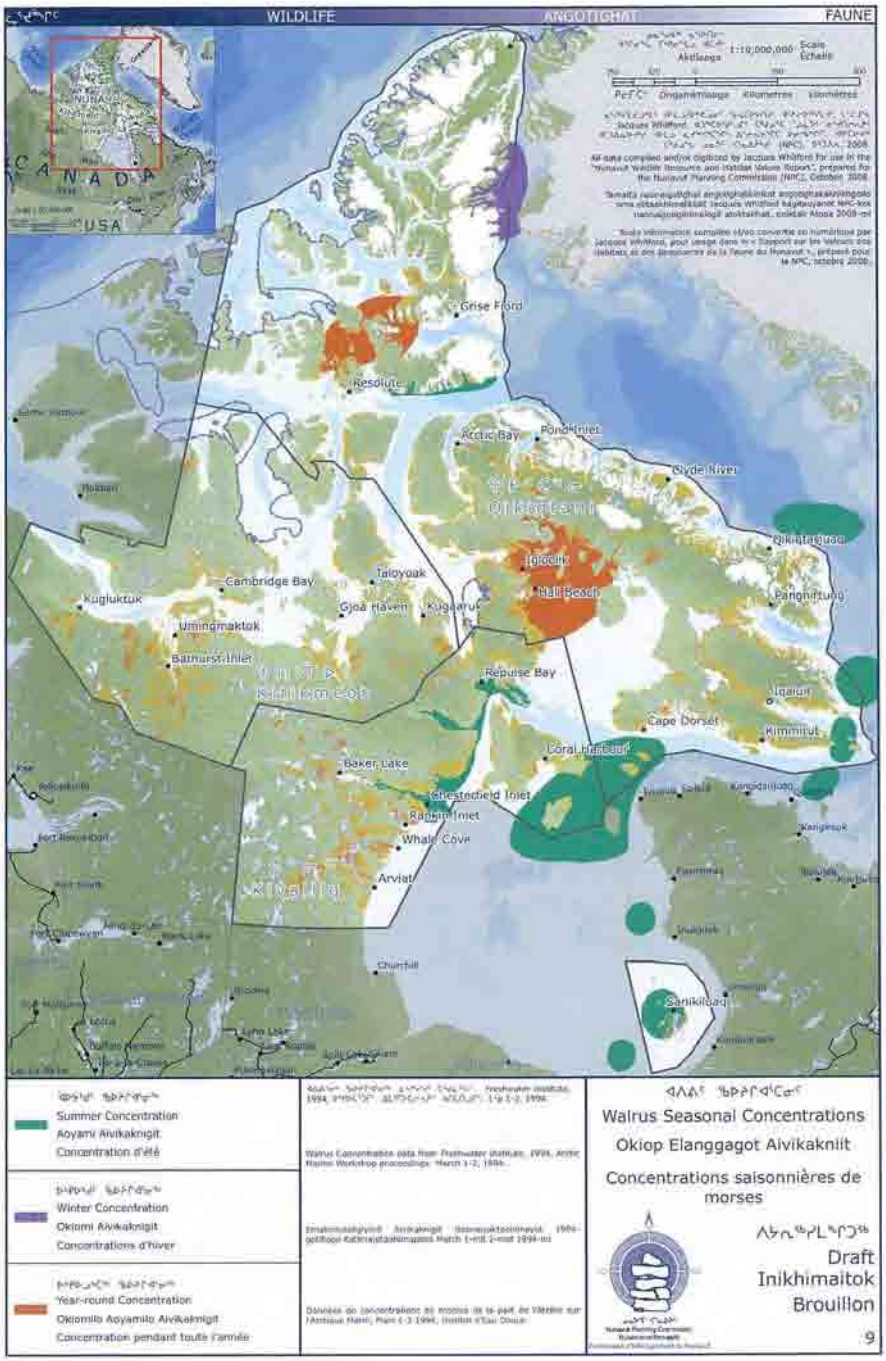

Figure 26. Walrus seasonal concentrations within Nunavut

4.6 CETACEANS

Toothed Whales

4.6.1 Killer Whale (*Ornicus orca*)

The killer whale, *Ornicus orca*, frequents the eastern Canadian Arctic Davis Strait and Baffin Bay Region in summer (MacLaren, 1978a, 1978b, Dunbar and Moore 1980, COSEWIC 2008). Current detailed information on their distribution within Nunavut is lacking. Killer Whales tend to be seen inshore during the spring and summer, likely searching for prey such as seals (Leatherwood et al., 1976) and juvenile bowhead whales (Finley, 2001). Information regarding use of offshore habitat by killer whales is lacking. Inuit are reporting increases in killer whale presence within coastal Nunavut waters. Killer whales are not actively hunted by the peoples of Nunavut. Killer whale distribution and range is shown in Figure 27.

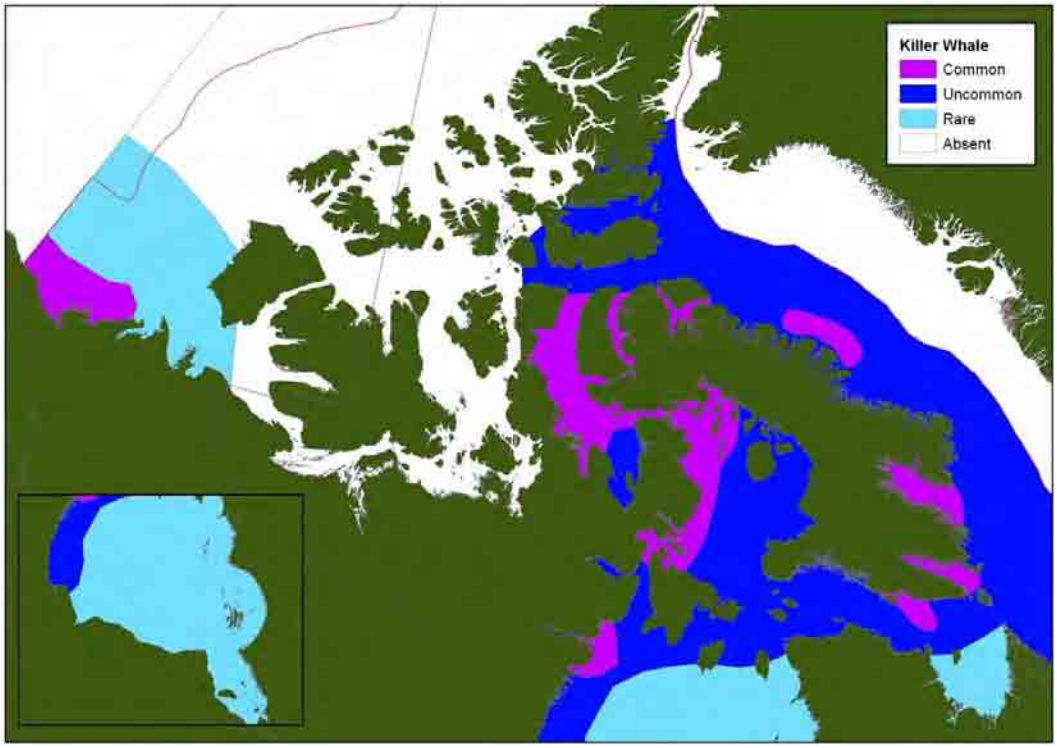

Figure 27. Distribution of Killer Whale (*Orcinus orca*) in the Canadian Arctic (Stephenson and Hartwig 2010)

4.6.2 Beluga Whale (*Delphinapterus leucas*)

Beluga whales (*Delphinapterus leucas*) are circumpolar in distribution. In the summer, it can be found in the warm shallow bays and estuaries of large rivers, whereas in the fall (mid-September) it migrates south to over-winter amongst the pack ice, in leads and polynyas, where open water provides access to air (Doidge and Finley, 1993; DFO 2002; NAMMCO, 2005). Their general distribution and range is shown in Figure 28. The highest concentrations of Beluga Whales in the Canadian Arctic waters are found in Hudson Bay especially in the Nelson River area in summer (Stephenson and Hartwig

2010). This population is called the Western Hudson Bay population (WHB) and they migrate to the Hudson Strait area in winter (Stephenson and Hartwig 2010).There is also an Eastern Hudson Bay population (EHB) that summer around the Nastapoka River of eastern Quebec (Stephenson and Hartwig 2010). In general, Beluga over-winter in highly productive areas like Baffin Bay, Hudson Strait and Davis Strait (Stephenson and Hartwig. 2010.), (DFO 2010), (Hammill and Lesage 2009, Hammill et al. 2009), (Gosselin et al. 2009). Both SARA and COSEWIC (2004) have identified that the Cumberland Sound beluga population with a "Threatened" status and the Eastern Hudson Bay Beluga population assigned a status of "Special Concern". Their distributions are shown in Figure 29.

Due to the beluga's summertime preference for shallow warm estuarine waters, it is unlikely that it would be encountered offshore at this time where the majority of the seismic activity will take place. Beluga is harvested by members of the Nunavut community on a year round basis (Table 7).

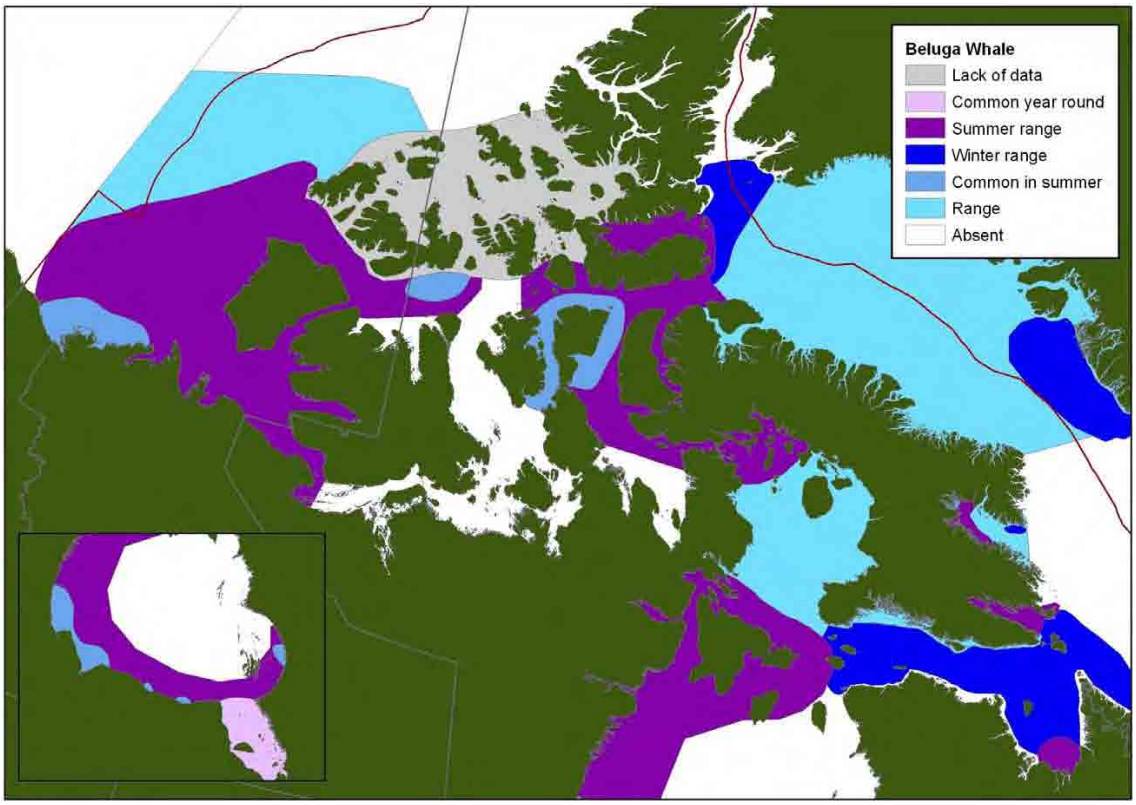

Figure 28. Distribution of Beluga Whale (*Delphinapterus leucas*) in the Canadian Arctic. (Stephenson and Hartwig 2010)

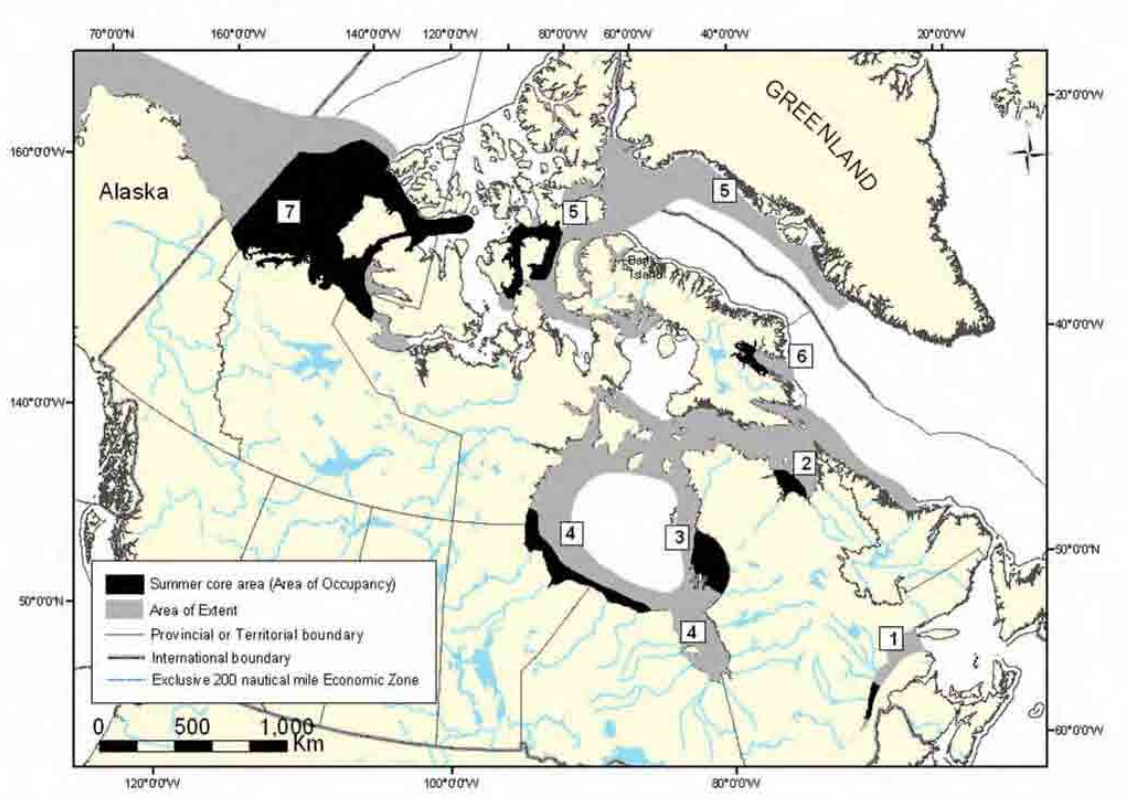

Figure 29. Location of Canadian Beluga Populations: (1) St. Lawrence Estuary population (2) Ungava Bay population (3) Eastern Hudson Bay population (4) Western Hudson Bay population (5) Eastern High Arctic – Baffin Bay population (6) Cumberland Sound population (7) Eastern Beaufort Sea population (COSEWIC 2004).

4.6.3 Narwhal (*Monodon monoceros*)

The narwhal, *Monodon monoceros*, is a toothed whale and its distribution and range in the Canadian Arctic is shown in Figure 30. The Narwhal also is common in coastal areas (Figure 31 and Figure 32) (COSEWIC, 2004). Most animals are believed to over-winter in Baffin Bay, Davis Strait, and Hudson Strait. When the pack ice breaks up in Davis Strait these whales move up the leads into Pond Inlet and Lancaster Sound. (Mansfield et al. 1975).

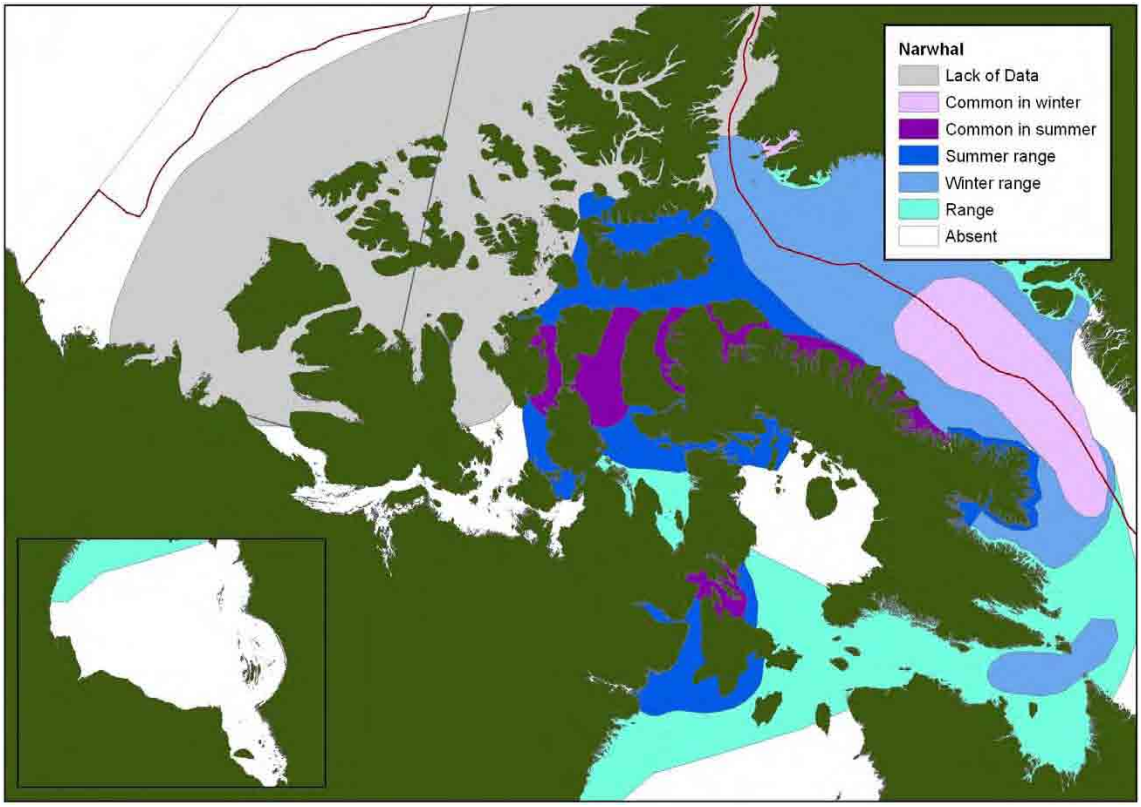

Figure 30. Distribution of Narwhal (*Monodon monoceros*) in the Canadian Arctic. (Stephenson and Hartwig 2010)

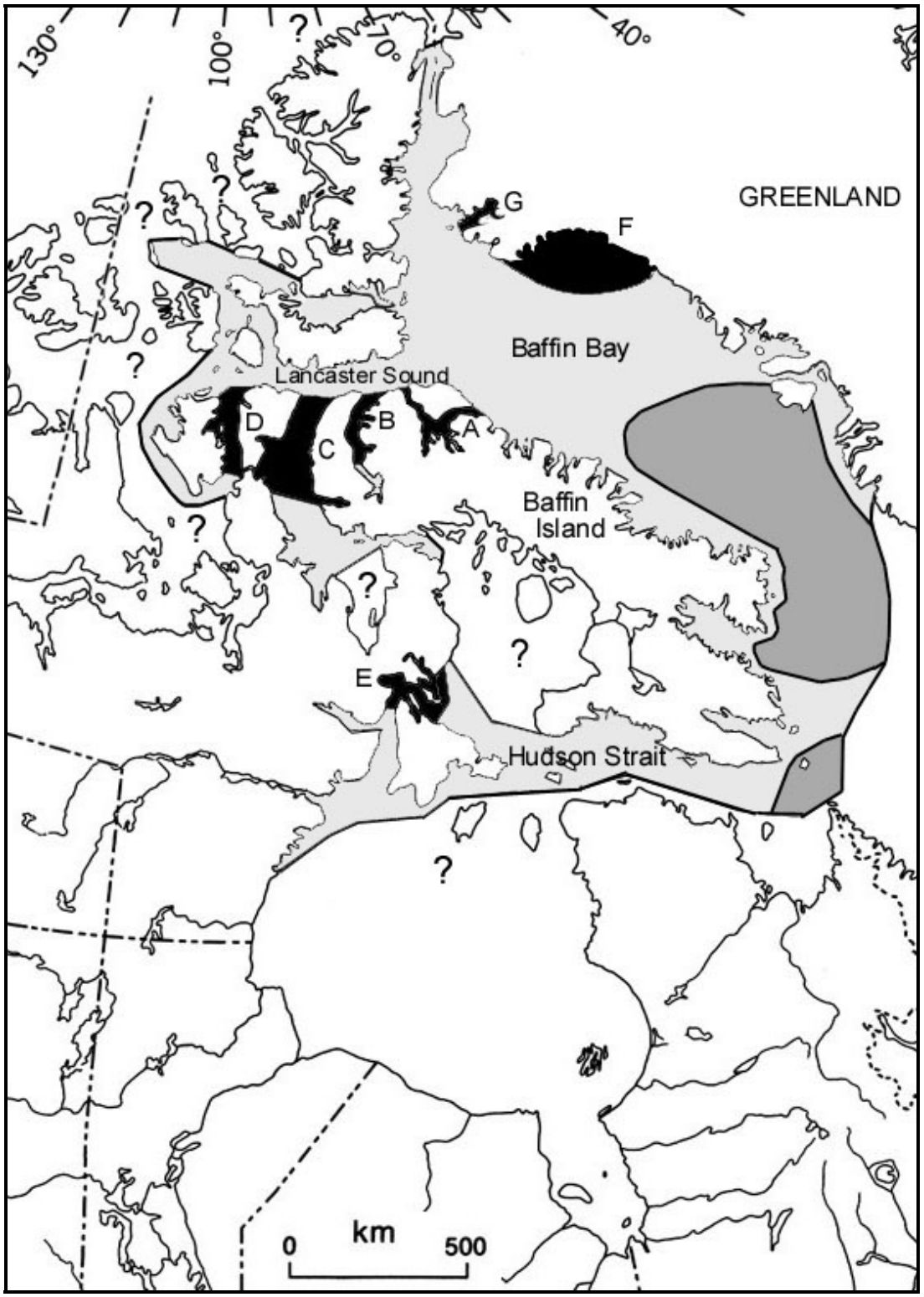

Figure 31. Narwhal summer concentrations in solid black include: A. Eclipse Sound/Navy Board Inlet, B. Admiralty Inlet, C. Prince Regent Inlet,D. Peel Sound, E. Foxe Channel, F. Melville Bay, and G. Inglefield Bredning. Wintering concentrations are shown in medium grey and known range in pale grey. Question marks indicate areas where the extent of the narwhal's distribution is uncertain. (Stephenson and Hartwig 2010).

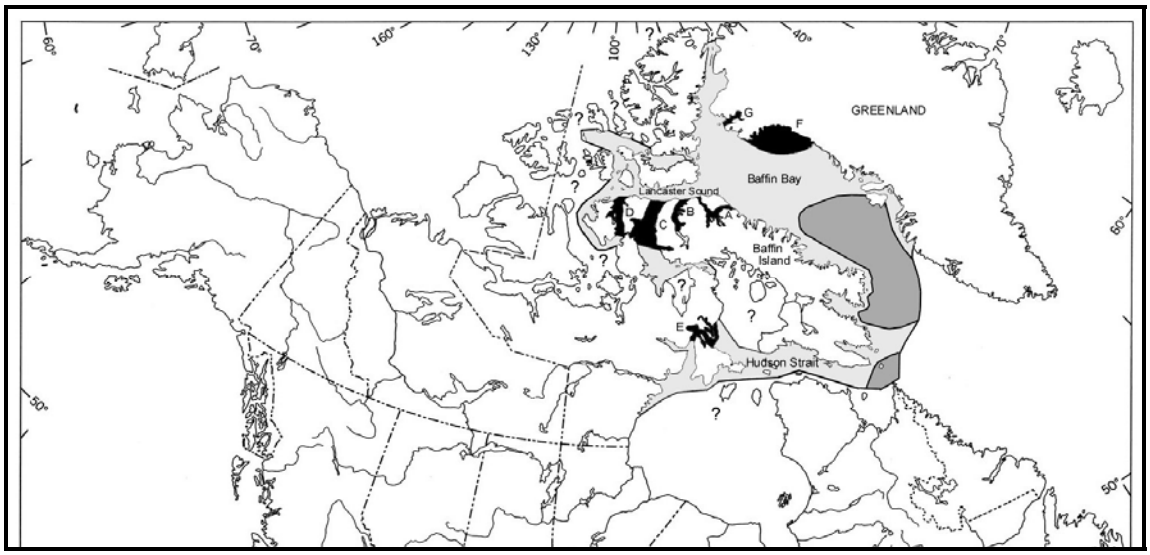

Figure 32. Distribution of Narwhals in Northern Canada

Summer concentrations in are shown in solid black, wintering concentrations in medium grey, and known range in pale grey (COSEWIC, 2004).

Narwhal research in Nunavut waters is conducted primarily by the Department of Fisheries and Oceans. Studies on summer and fall movements of narwhals, as determined through satellite telemetry, suggested that Narwhals showed a preference for deep fjords and for the continental slope (1,000-1,500 m) along eastern Baffin Island Figure 33 (Dietz et al., 2001, Dietz and Heide-Jørgensen, 1995). Within Nunavut narwhal are hunted from May through September Table 9, Priest and Usher (2004). COSEWIC (2005) and SARA have identified that Narwhal, in the Canadian Eastern Arctic are of “Special Concern” with respect to their population stability.

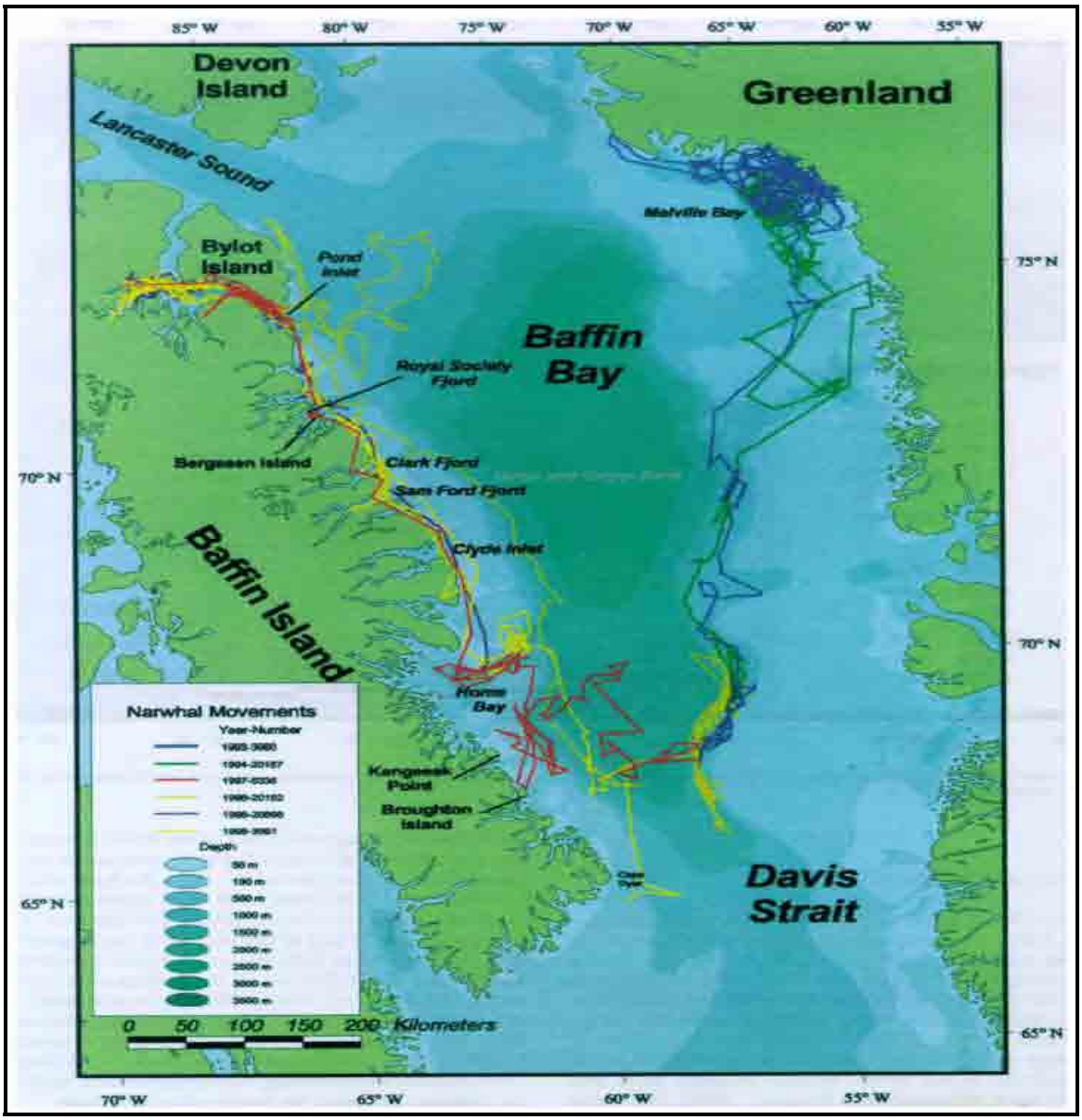

Figure 33. Map of Narwhal Movements (Dietz et al., 2001)

4.6.4 Bowhead whale (*Balaena mysticetus*)

The bowhead, *Balaena mysticetus* (or Greenland right whale), was once common and abundant in the region (Leatherwood et al., 1976, COSEWIC 2005). The present general distribution/range is shown in Figure 34. This whale is often associated with the edge of the pack ice and moves closer to shore during the summer months (MacLaren 1977 1978a and 1978b; Moshenko 2003). Both SARA and COSEWIC (2005) have identified that both the Hudson Bay/Foxe Basin and Davis Strait /Baffin Bay population of Bowhead whale populations are “Threatened”. Seasonal distribution of this species as well as general ranges are presented in Figure 34 to Figure 39. Inuit TEK for this species is shown in Figure 40.

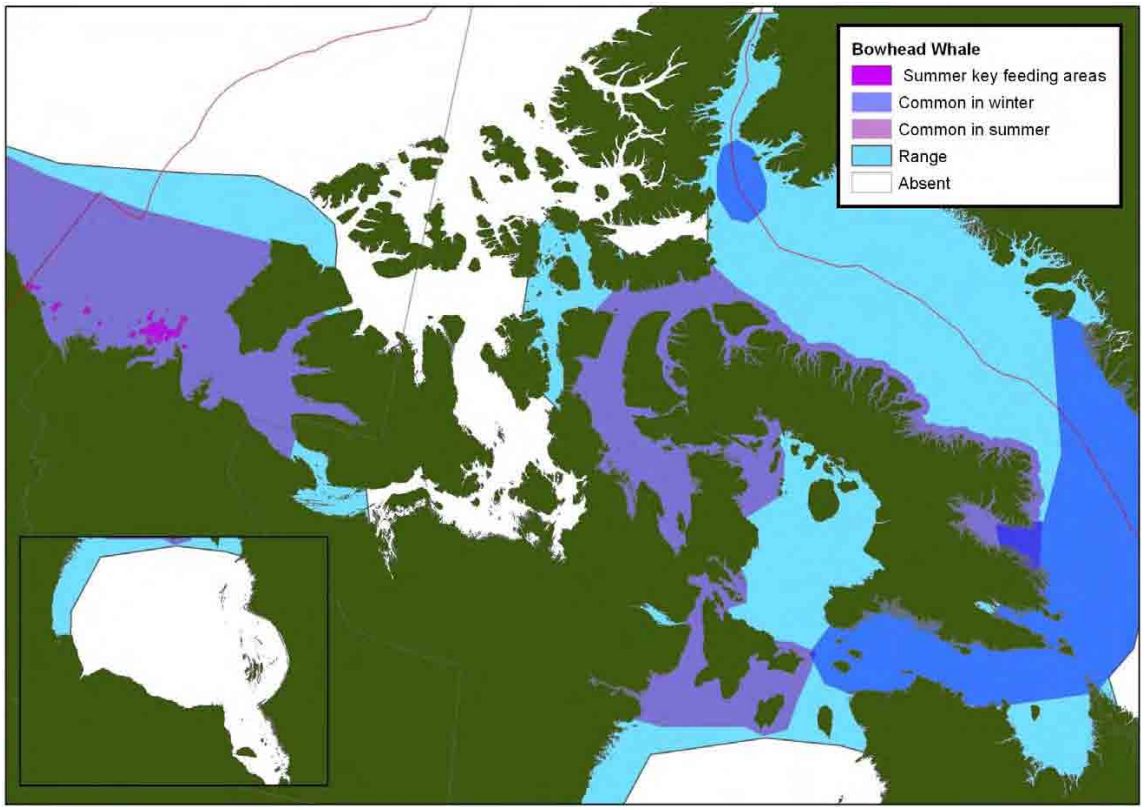

Figure 34. Distribution of Bowhead Whale (*Balaena mysticetus*) in the Canadian Arctic. (Stephenson and Hartwig 2010)

In the high Canadian Arctic the understanding of bowhead movements within Baffin Bay and Davis Strait has been refined through the use of satellite-linked telemetry combined with habitat modeling techniques (Dueck et al. 2006, Husky 2008). Remote telemetry studies show that bowheads migrate large distances throughout the eastern Canadian Arctic from both Foxe Basin and Baffin Bay regions Figure 35, COSEWIC 2005, Cosens et al. 2006). Some satellite tracking information of bowheads in the proposed study area is summarized in Figure 36 (Heide-Jorgensen et al, 2003, COSEWIC 2005). This figure demonstrates that migrating bowheads may be encountered in offshore regions and perhaps with higher likelihood east of Bylot Island, although the bowhead habitat near Bylot Island will likely not be impacted by the project due to temporal differences (i.e. bowhead's use this habitat primarily in June and surveys here will be conducted later in the season). Bowheads using the east coast of Baffin Island in August and September may however be encountered during this period. Bowheads using the offshore habitat due east of the Clyde Inlet region will also be potentially encountered during seismic surveys. Migration within Davis Strait of whales tagged in west Greenland indicated a general westward movement across Davis Strait using leads in the ice in the spring to the Lancaster Sound and northern Baffin Island region in the summer (Dueck et al., 2006). Tagged whales in Baffin Bay and Davis Strait migrated southward along the east coast of Baffin Island using bays and fiords in late summer and early fall (Dueck et al., 2006). Please note that the number of whales tagged was only 19 in Canadian and 25 in Greenlandic waters.

Habitat modeling of known bowhead locations with environmental and geographic variables suggests that at least one discrete area of highly suitable bowhead habitat may exist along the coastal region (within approximately 30 kilometres from shore) of the eastern shore of Baffin Island. Positions from satellite-tagged bowheads have been recorded in this coastal area during the summer (Dueck et al., 2006).

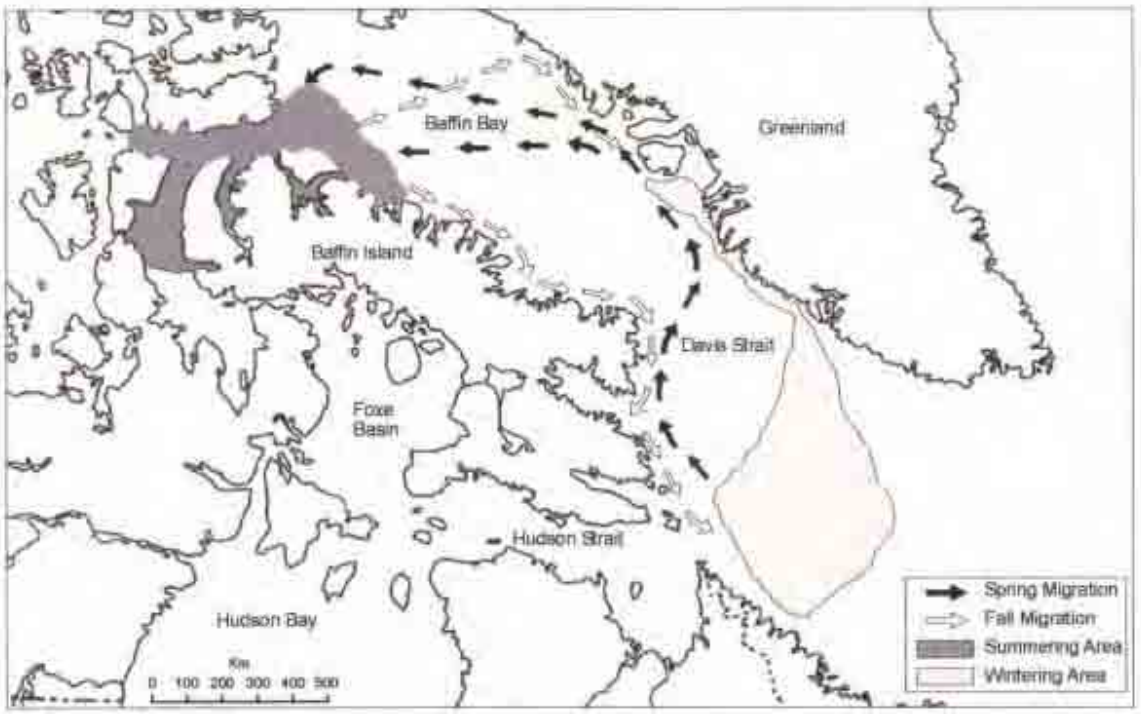

Figure 35. . Generalized seasonal occurrence and migration corridor for the Davis Strait-Baffin Bay population of bowhead whales (COSEWIC 2005).

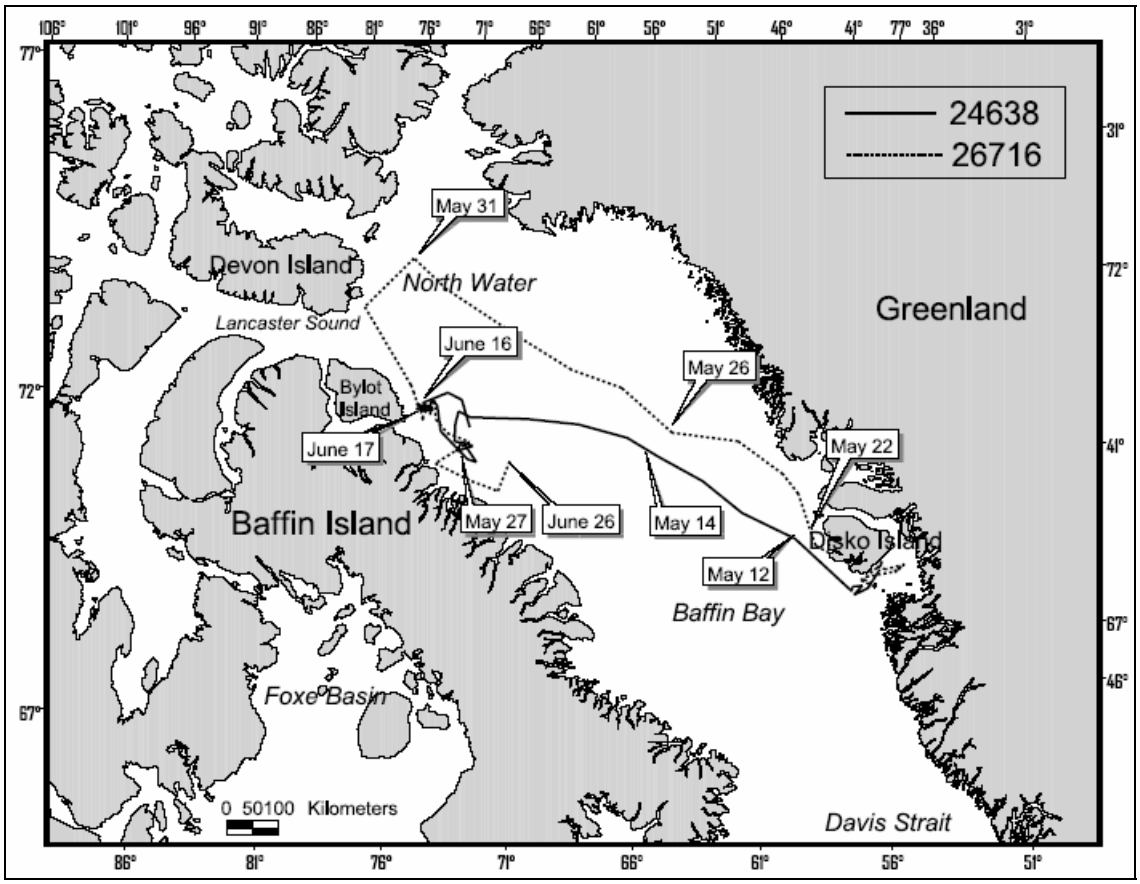

Figure 36. Satellite Tracks of Bowhead Whales (Heide-Jorgensen et al., 2003)

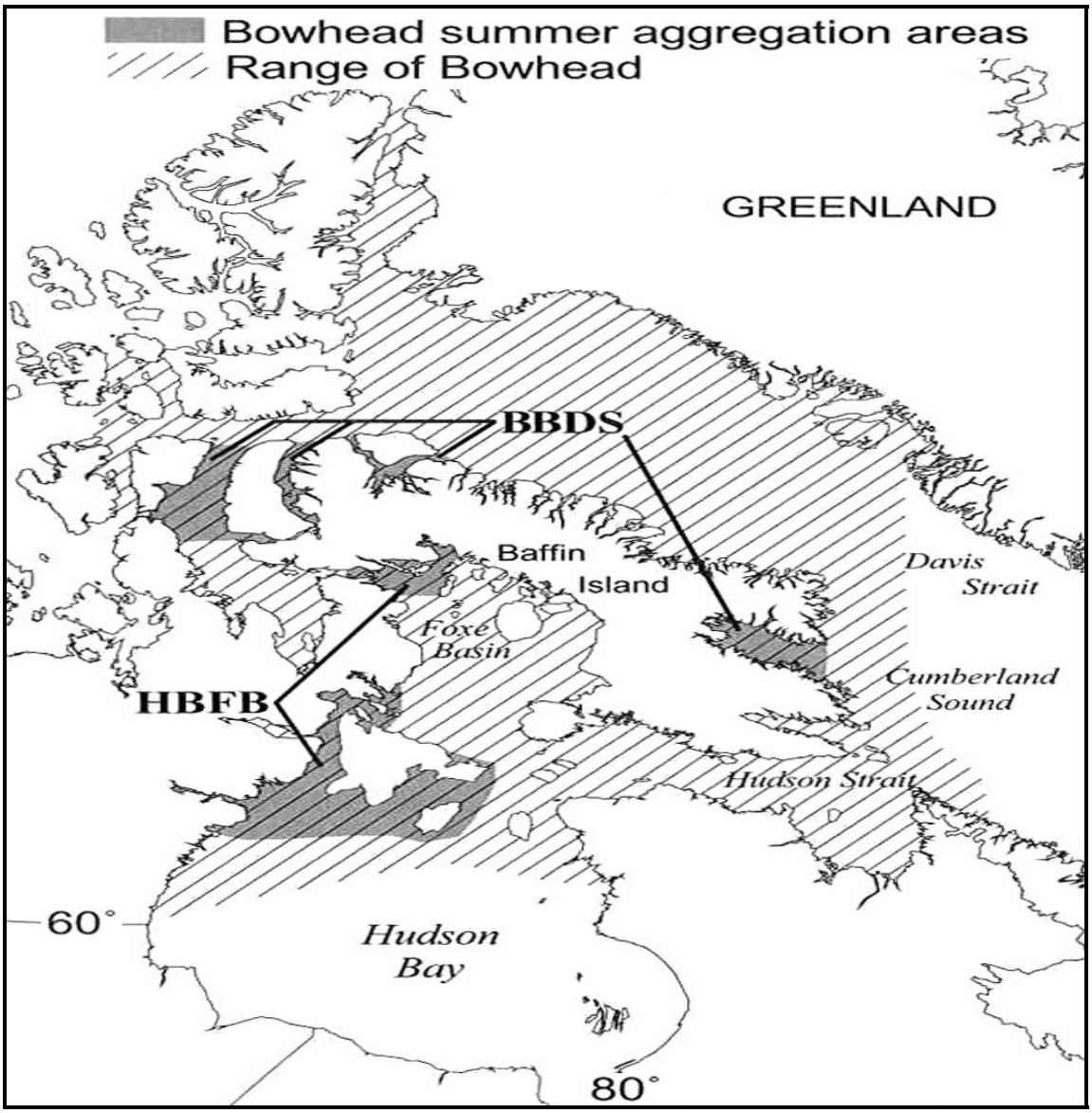

Figure 37. Ranges and summer aggregation areas of the two putative stocks of bowhead whales in eastern Canadian Arctic waters (modified from Reeves and Cosens 2003:284). BBDS = Baffin Bay-Davis Strait stock; HBFB = Hudson Bay-Foxe Basin stock) (Stephenson and Hartwig 2010).

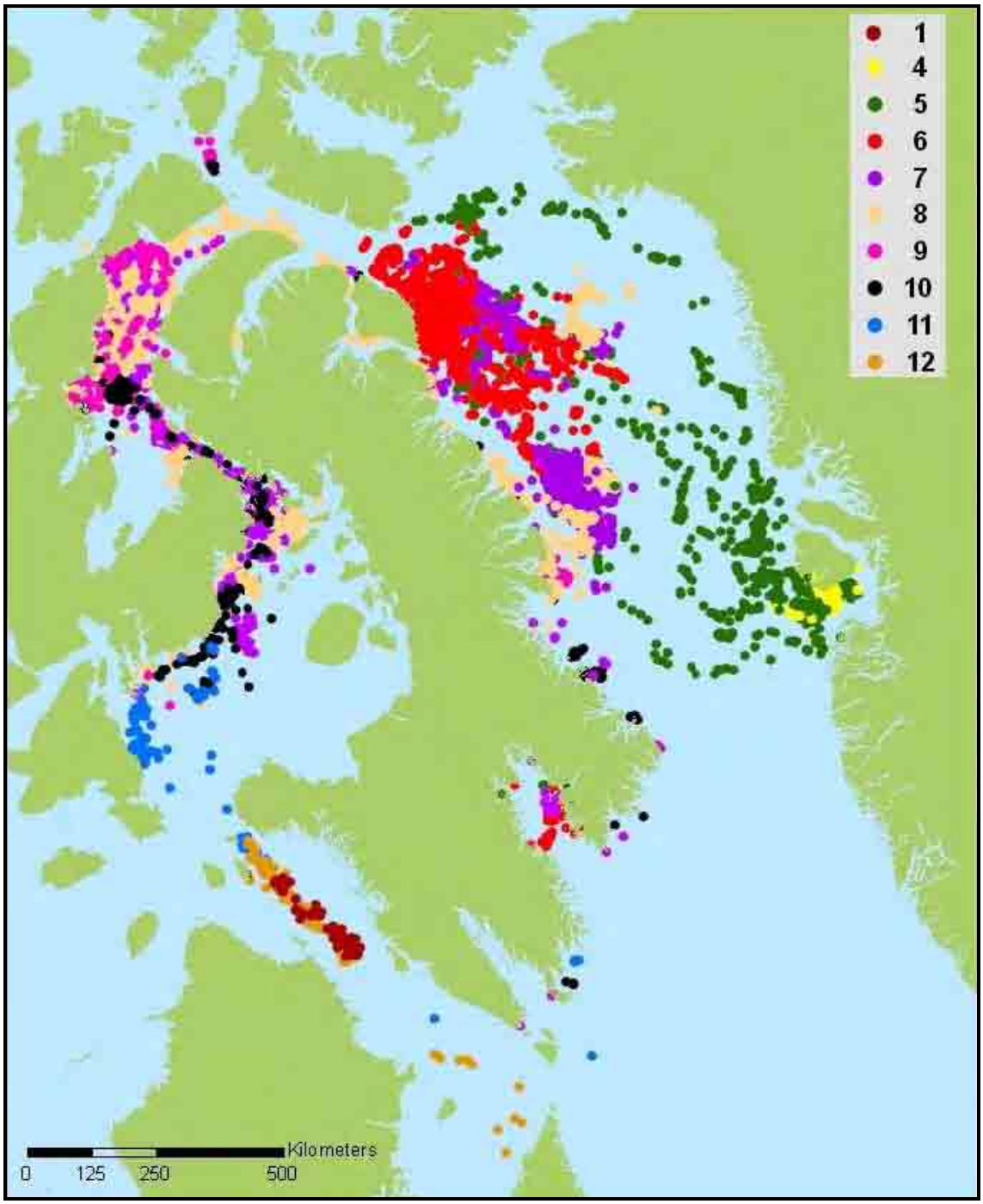

Figure 38. Seasonal Distribution of Bowhead Whale Locations Based on satellite-linked telemetry; results for whales tagged in Canada (n = ~19) and west Greenland (n = ~25); numbers for colour codes refer to calendar month (Dueck et al., 2006 including Mads Peter Heide Jørgensen's unpublished data).

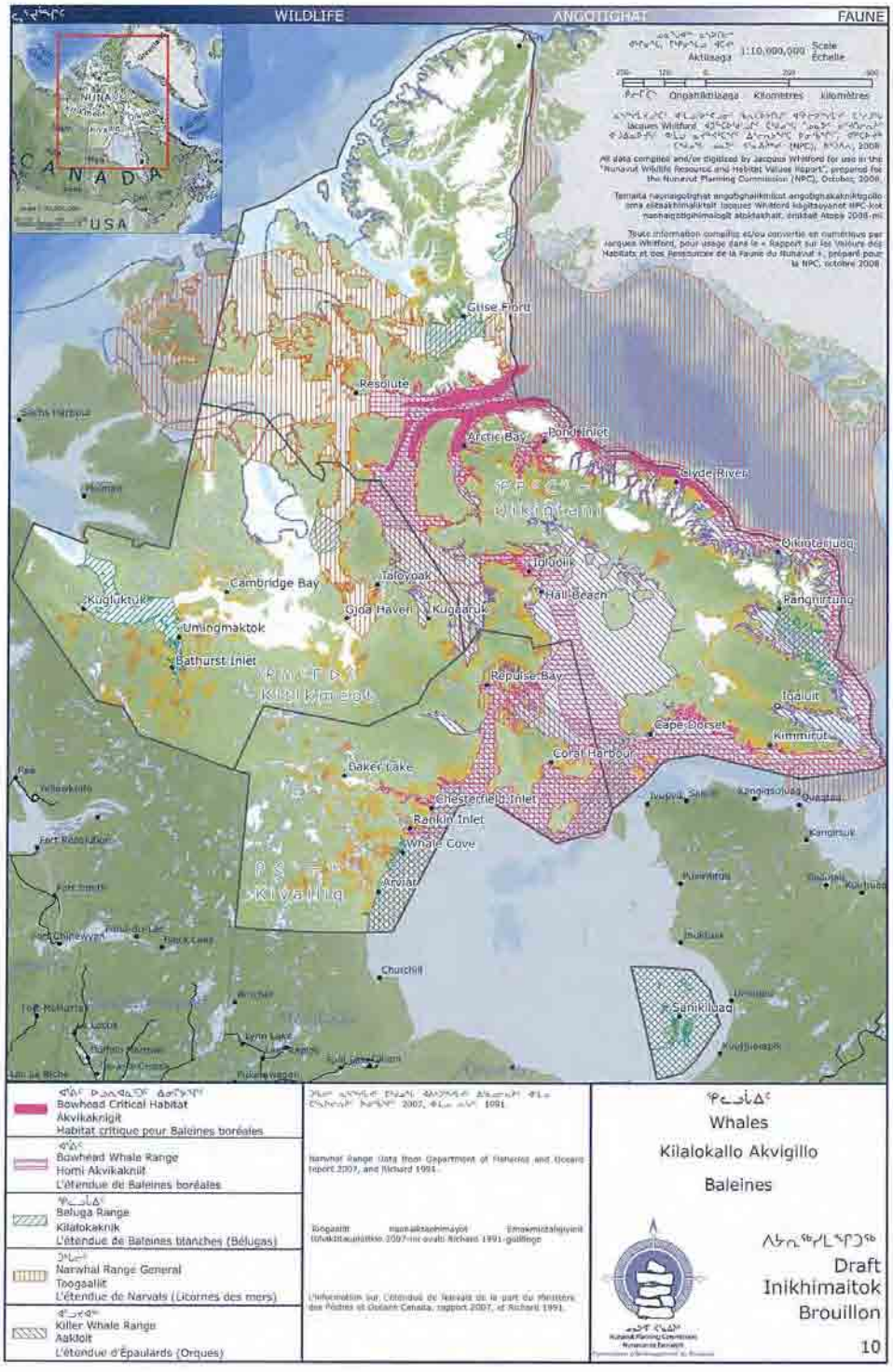

Figure 39. Whale distributions

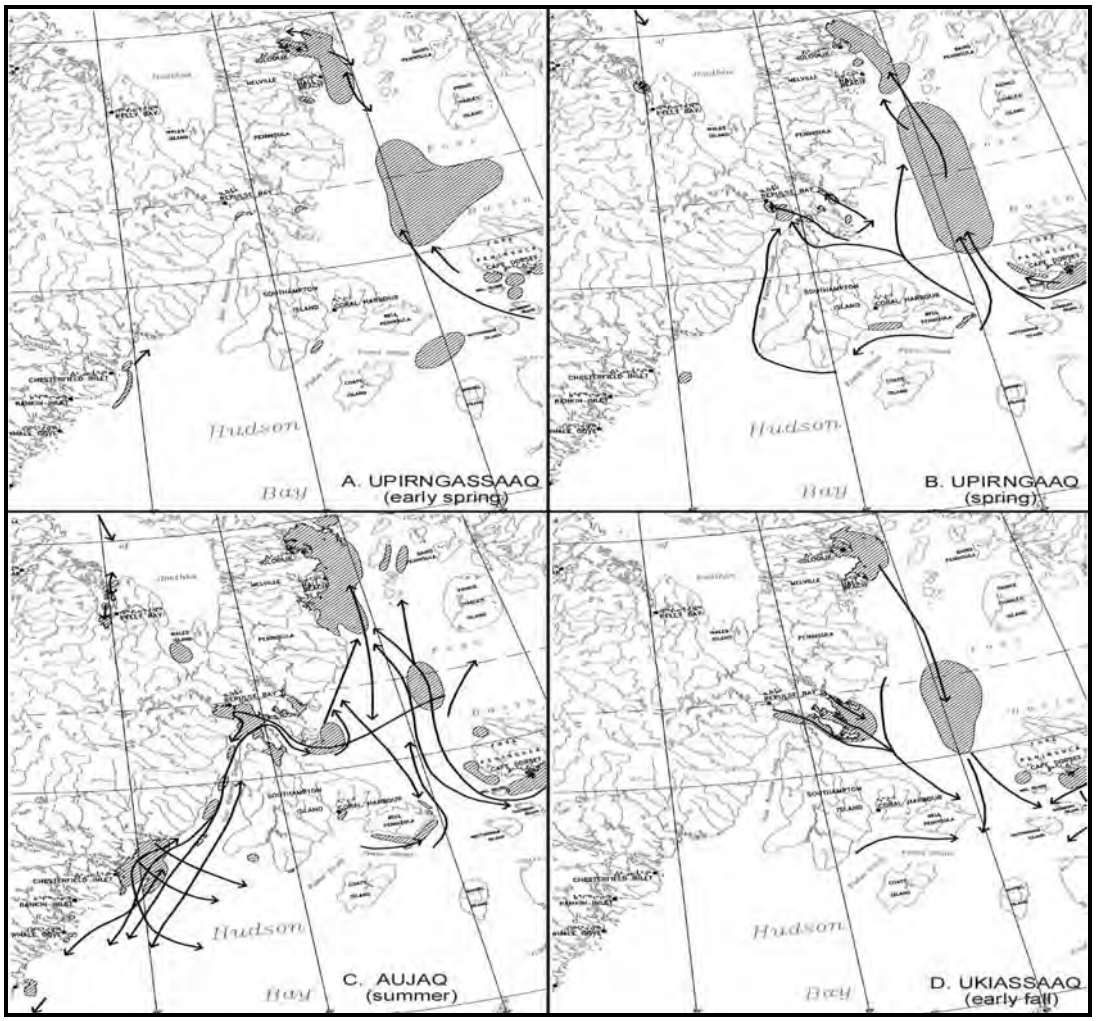

Figure 40. Inuit knowledge of the seasonal movements of bowheads in Hudson Bay and Foxe Basin from A. UPIRNGASSAAQ (early spring) to D. UKIASSAAQ (early fall) (adapted from NWMB 2000) (Stephenson and Hartwig 2010).

4.6.5 Harbour Porpoise (*Phocoena phocoena*)

There are three sub-populations of harbour porpoise (*Phocoena phocoena*) in Atlantic Canadian waters. There is the Newfoundland and Labrador, the Gulf of St. Lawrence and the Bay of Fundy-Gulf of Maine population. Harbour porpoise are most commonly occurring in association with continental shelves, where they frequent bays and harbours. No dedicated harbour porpoise surveys have been conducted in the study area (COSEWIC 2006). It is assumed that harbour porpoise winter along the coast of the US, as far south as North Carolina, and very little is known about the movements of harbour porpoise sub-populations in the far north (COSEWIC 2006, Figure 41). As they are not commonly found in deep oceanic waters, it is unlikely that they will be measurably influenced by the project if they are seen at all. SARA and COSEWIC (2006) have classified the Northwest Atlantic population of Harbour porpoise as a population that is of “Special Concern”.



Figure 41. Distribution of harbour porpoises in eastern Canada. Dashed lines indicate approximate delineations of the three subpopulations. (COSEWIC 2006).

4.6.6 Polar Bear (*Ursus maritimus*)

Polar bears (*Ursus maritimus*) are year-round inhabitants of the Arctic. There general arrange and distribution is shown in

Figure 43. Two populations overlap within the study area; the Baffin Bay population and the Davis Strait population (Figure 42,

Figure 43, Figure 45 COSEWIC, 2002/2008). By in large the most important factor influencing the seasonal distribution pattern as well as movement is the seasonal variation in sea-ice condition (Stephenson and Hartwig 2010).

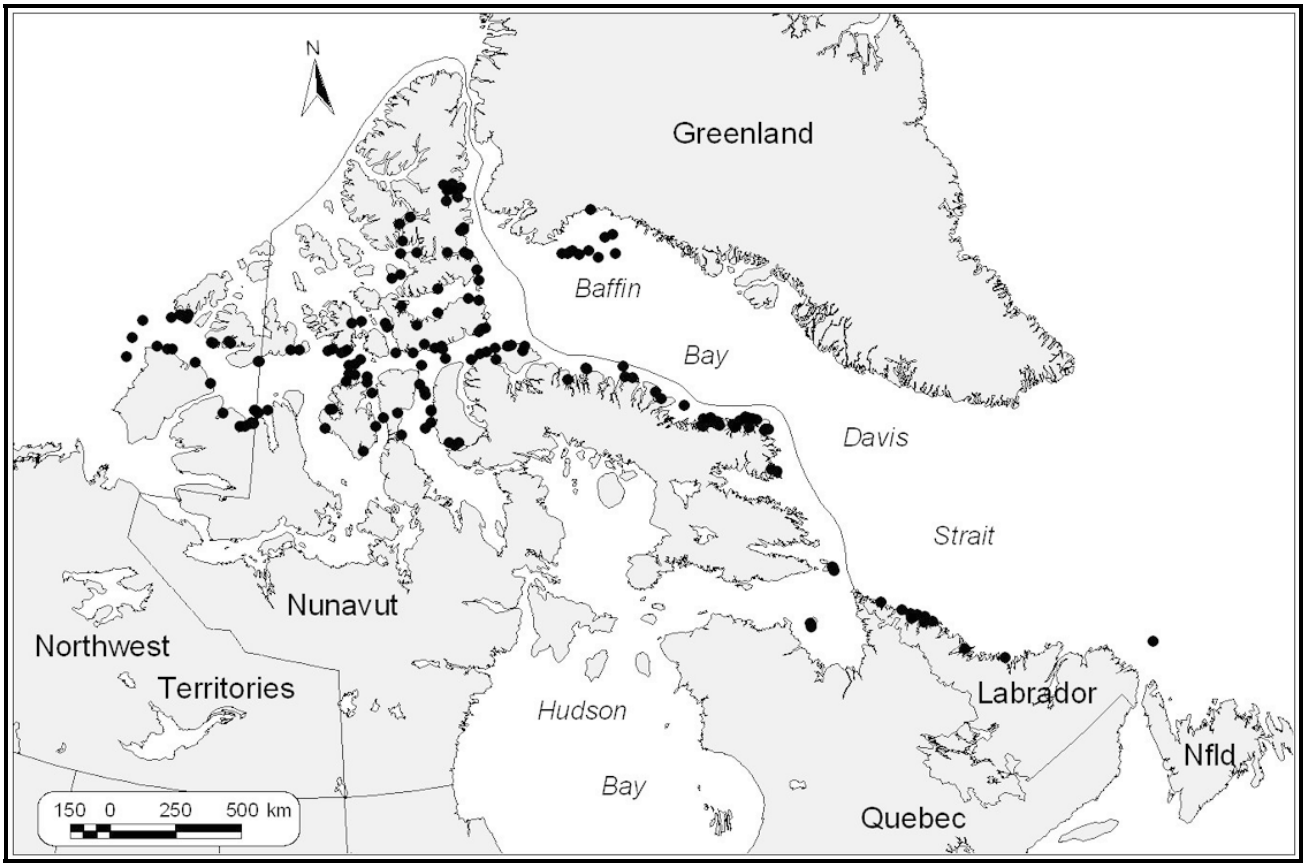

Figure 42. Initial Capture Locations for Adult Female Polar Bears Fitted with Satellite Radio Collars
(Taylor et al. 2001)

Polar bears are often associated with flow edges and pack ice where they can forage. For ringed seals, their main prey. Polar bears readily traverse this pack ice and can travel over large distances (Taylor et al., 2001). When large swells from autumn storms begin to wash over the remaining ice, individuals within Baffin Bay retreat from the offshore pack ice to live on land in late August and early September (Taylor et. al., 2001). In Davis Strait, most bears seek land as the ice retreats in early July (Taylor et. al., 2001). Both of these populations spend the open-water season on Bylot Island and the windward shores of Baffin Island (Taylor et al., 2001). SARA and COSEWIC (2008) have determined that the Polar Bear is a species of "Special Concern". A distribution/range map for Nunavut based on traditional ecological knowledge is presented in
Figure **43**. As the seismic program will take place offshore in the summer and fall when there is no pack ice over the proposed seismic survey area, it is unlikely that polar bears will be encountered.

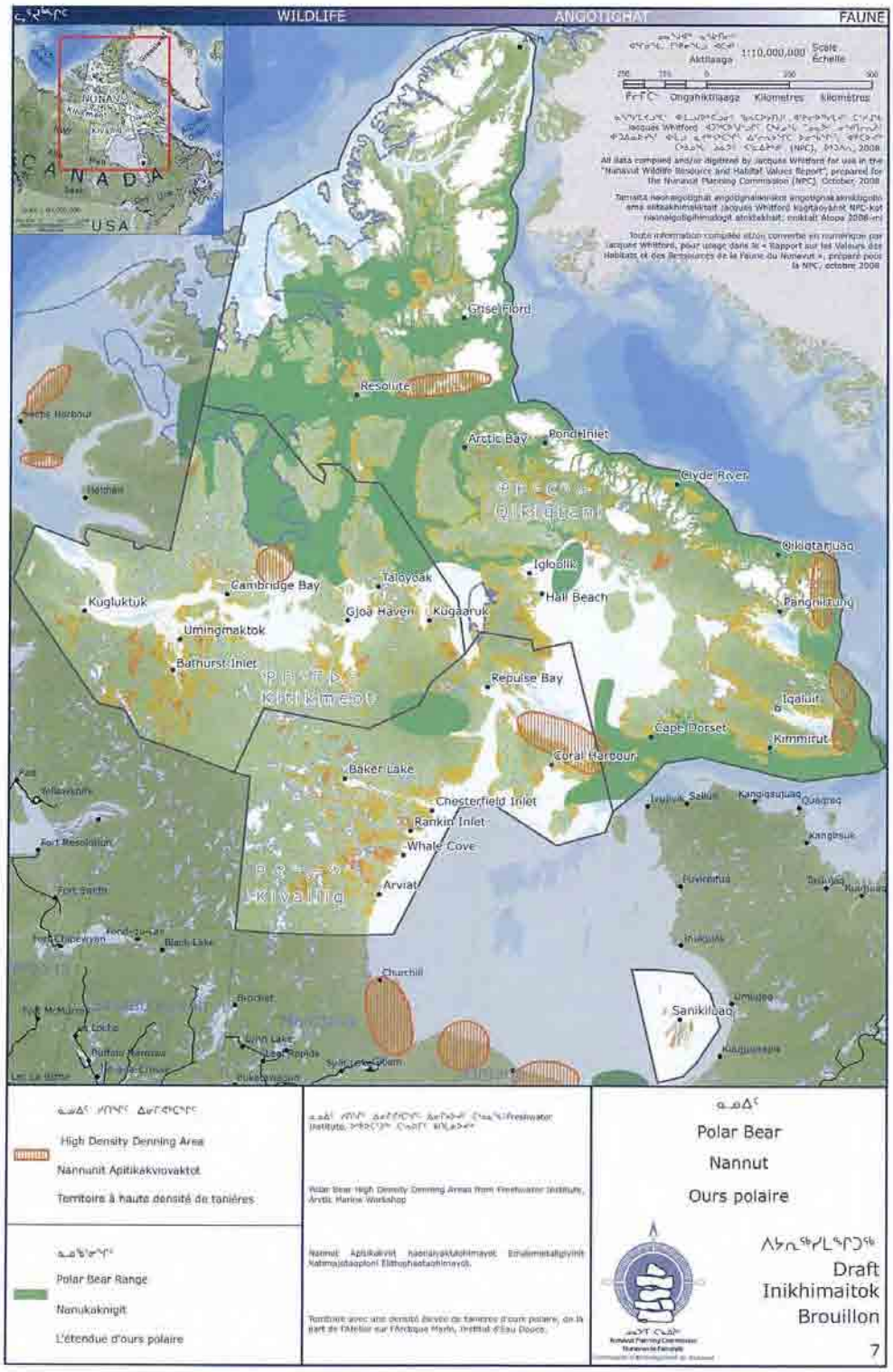

Figure 43. Polar Bear distribution according to Inuit traditional ecological knowledge.

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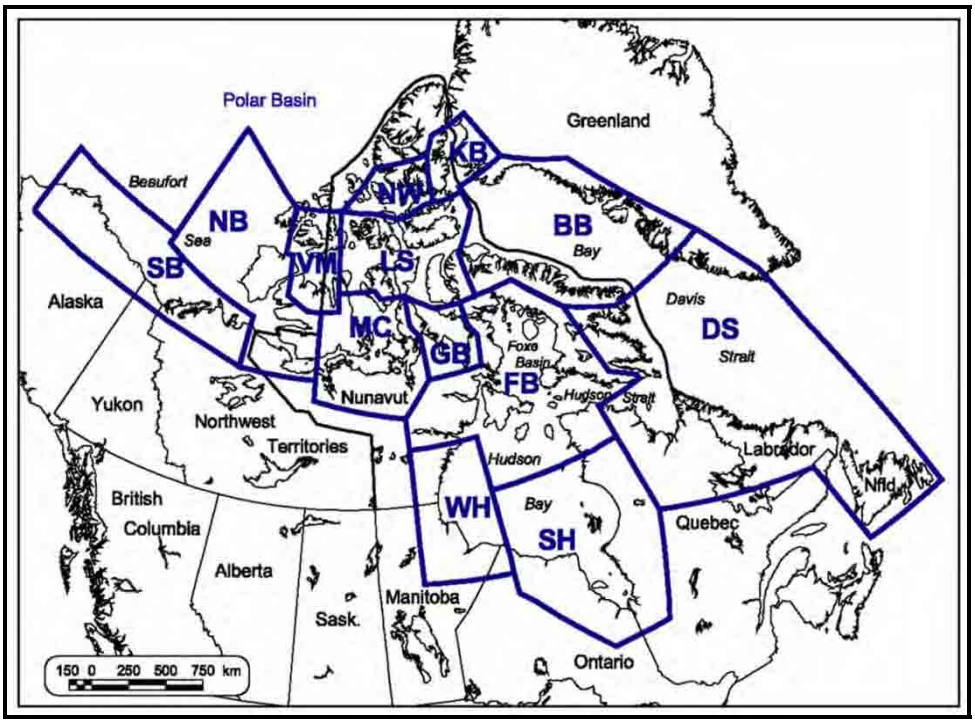

Figure 44. Initial Capture Locations for Adult Female Polar Bears Fitted with Satellite Radio Collars (Taylor et al. 2001)

Figure 44 shows a map of the boundaries of Canadian Polar Bear Populations (1996).These boundaries have been determined from analyses of movements of bears in mark-recapture studies, returns of tags from bears killed by Inuk hunters, and the movements of adult females with satellite radio collars (Taylor et al., 2001; reproduced from COSEWIC, 2008).

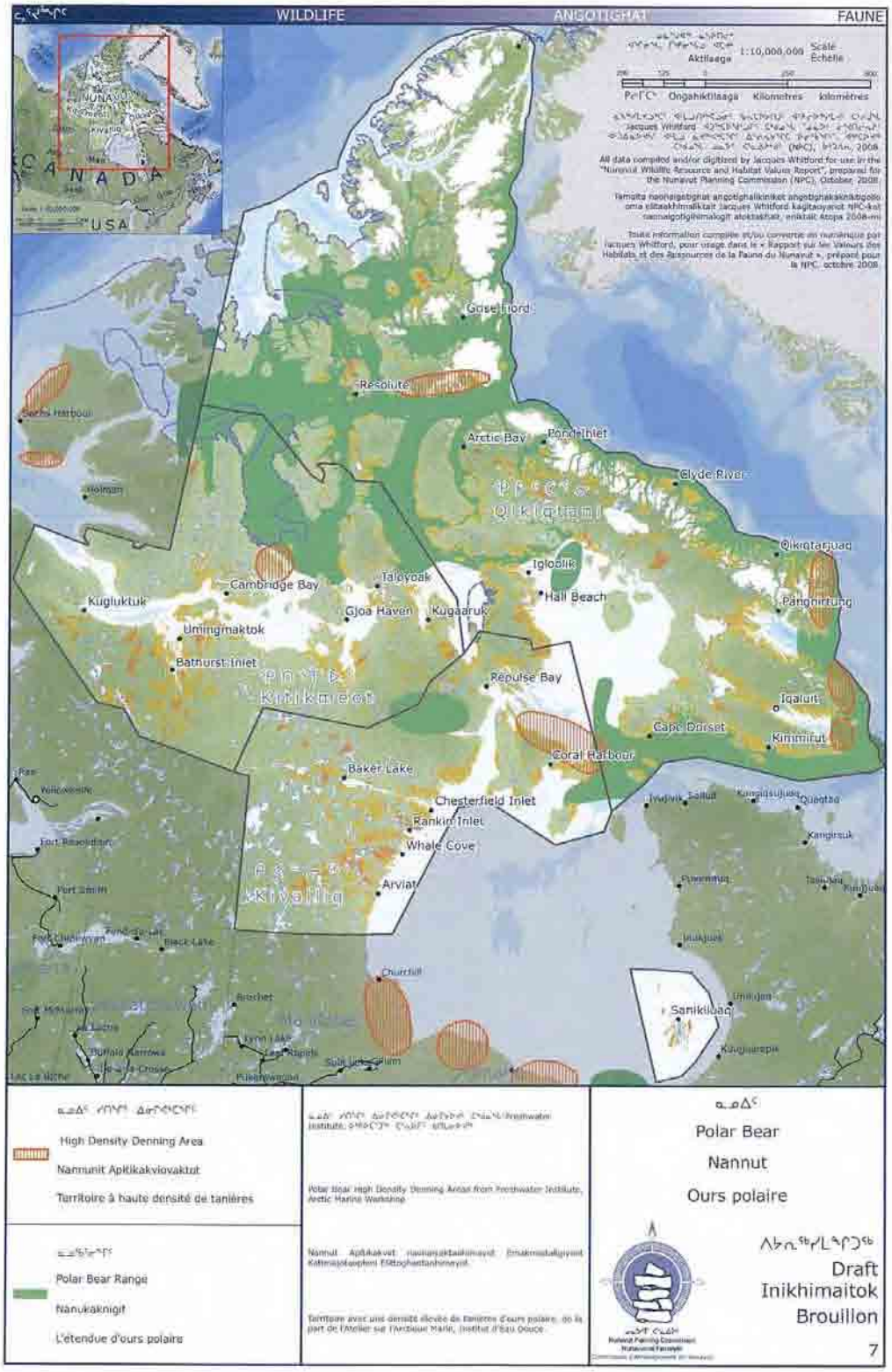

Figure 45. Map Polar Bear distribution according to Inuit traditional ecological knowledge.

4.6.7 Marine Reptiles

There is only one marine reptile that may be encountered in the North Atlantic, the leatherback sea turtle (*Dermochelys coriacea)*. The leatherback has been recorded off Labrador by Bleakney (1965), and Goff and Lein (1988) determined from survey studies that this species is found off Labrador and may occur further north during July to September when seawater temperatures are seasonally high. This species has been relegated to a Species at Risk category of Endangered. Figure 46 illustrates the distribution of the leatherback turtle in Canadian waters (COSEWIC, 2001). Note that the extent of the leatherback sea turtle is not in the vicinity of the presently proposed survey area; therefore, no further discussion is presented.

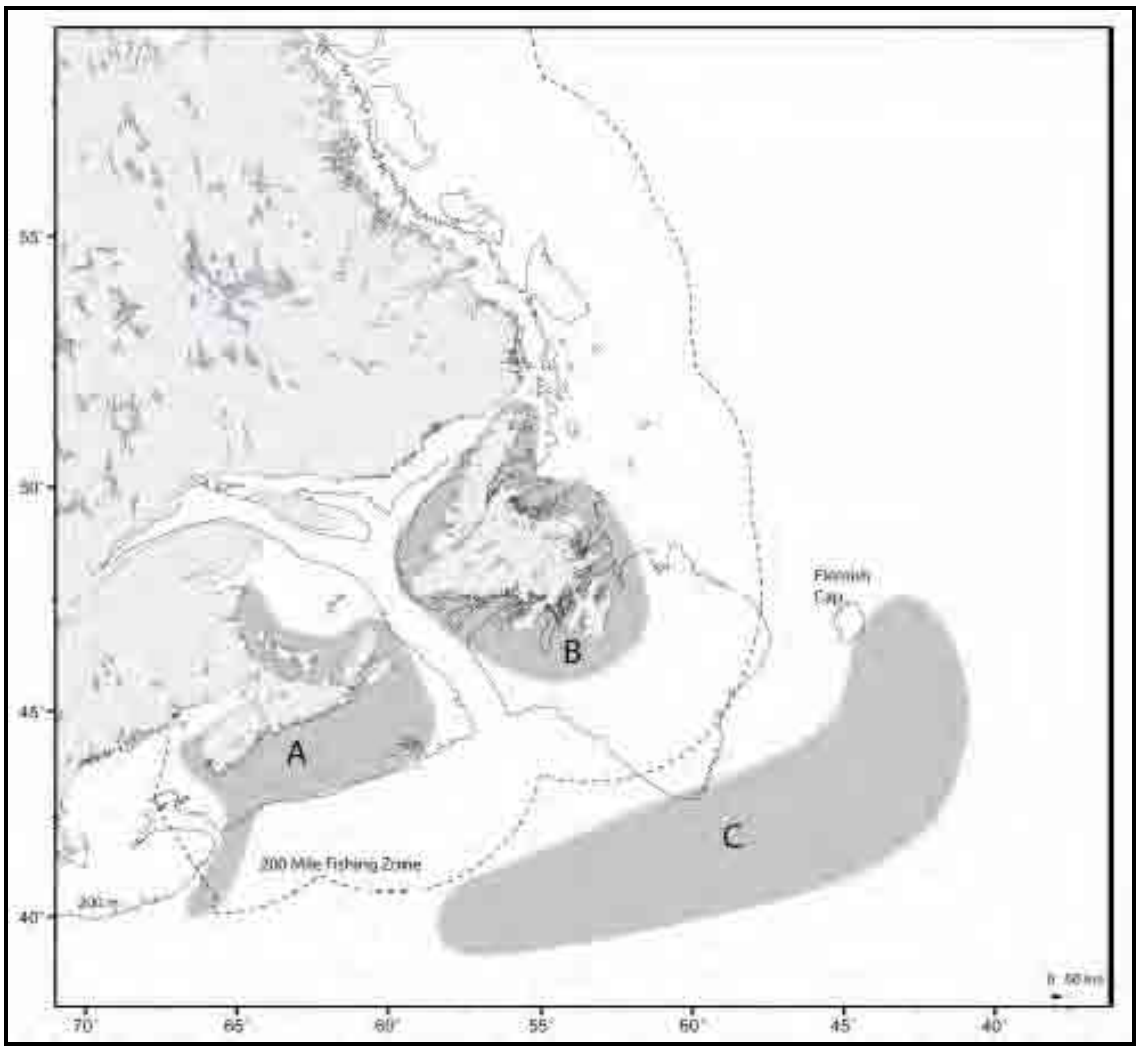

Figure 46. Distribution of the Leatherback Turtle in Canadian Waters
(COSEWIC, 2001)

4.7 SPECIES AT RISK

Canada's Species at Risk Act (SARA) received Royal Assent on December 12th, 2002, and took full effect on June 1st, 2004 when the prohibitions and enforcement provisions came into effect. The overall goal of the SARA is to prevent wildlife species from extinction and to help in the recovery of species at risk, and will confer legal standing on the species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The Act also builds on other laws and programs, such as the Fisheries Act, the National Parks Act, the Migratory Birds Convention Act, and the North American Waterfowl Management Plan, as well as other legislation and programs.

The Act incorporates measures to protect species and their environment and prohibits the killing, harming, harassing, capturing, or taking of species protected under the Act (Schedule 1) which are listed as threatened, endangered, or extirpated, and the destruction of their residences. Once identified, critical habitat will be protected by conservation agreements, provincial or territorial legislation, or federal prohibitions. No critical habitat has yet been identified under SARA.

Initially, 233 species were included on Schedule 1 (Wildlife Species at Risk) of the Act, under the designations of Extirpated, Endangered, Threatened, and Special Concern.

In January 2005, the Schedules were revised and 73 additional species were added to Schedule 1 (SOR 2005-14). Some of the species added to Schedule 1 had been on Schedules 2 and 3, and others were added from the current COSEWIC listings. As with the original 233 species, recovery strategies and action plans must be developed for SARA species listed as Endangered or Threatened, and management plans must be established for those of Special Concern.

The SARA species that might be within or adjacent to the north project are listed in the following **Table 8** and discussed in sections that follow.

Table 8 also identifies "Species at Risk" that could be found within the Study area during the scheduled survey period.

Table 8. Month with Species

Species	Risk Category	Comment	Source
Marine Mammals			
Beluga whale (Eastern Hudson Bay Population)	Endangered	Not in survey area during seismic activity	COSEWIC (2004a)
Bowhead Whale (Davis Strait Population)	Threatened	Late fall wintering area north tip off Labrador , unlikely to be in study area	COSEWIC (2005)
Narwhal	Special Concern	Potentially in study area	COSEWIC (2004b)
Harbour Porpoise	Special Concern	Potentially in study	COSEWIC (2006a)

		area	
Atlantic Walrus	Special Concern	Potentially in study area and coastal	COSEWIC (2006b)
Polar Bear	Special Concern	Potentially in study area	COSEWIC (2002)
Birds			
Ivory Gull	Endangerd	Potentially in study area	COSEWIC (2006c)
Marine Fish	See note below		
NOTE: According to the SARA Registry, there are no marine fish within the Nunavut Region that have a SARA or COSEWIC status rating.			

4.7.1 Cetaceans and Pinnipeds

The Bowhead whale (East Canada – West Greenland) was listed as a Threatened species until April of 2009. It is presently listed as a species of Special Concern. Although the population was severely depleted by whaling, recent trends indicate an increase in their numbers, thus downgrading it to special concern status (COSEWIC, 2009).

The Narwhal is presently listed as a species of Special Concern. The Baffin Bay population appears to be large, however, this population could be affected if hunting in Greenland is not effectively managed (COSEWIC, 2004a).

The Atlantic Walrus has been assigned the status of Special Concern, as the total size of the Northern Hudson Bay – Davis Strait population could be as small as 4,000 to 6,000 individuals. The population's ability to sustain minimum current removals is questionable, as some portion of this population is hunted in Greenland waters (COSEWIC, 2006b).

Additional marine mammal species that have the potential to occur, but are not likely to be encountered during the survey, include the Blue and North Atlantic Right Whale, with SARA Endangered status designation, nor are the Nova Scotia populations of the Northern Bottlenose Dolphin. SARA has assigned the Fin Whale to a status of Special Concern, but these species are not known in the area where seismic activity will occur. COSEWIC has assigned Special Concern to other marine mammals, including the Polar Bear and Sowerby's Beaked Whale, however, as survey activity will commence at a distance of 12 nautical miles offshore (from the shoreline and Outer Land Fast Ice Zone), the survey will unlikely measurably impact those species that may be in the region.

The mitigation measures proposed for this seismic survey will ensure that any potential interaction with marine mammals of any designation is kept to a minimum. It is unlikely that any individual will be measurably impacted by the program if encountered during the survey considering the mitigation methods adopted.

4.7.2 Marine Birds

There have been no studies on the effect of seismic airgun exploration on seabirds (Davis et al., 1998), although Stemp (1985) made observations on the reactions of seabirds to seismic exploration programs in Davis Strait over three summer periods, and no distributional or mortality effects were detected.

The Ivory Gull is considered a species of Special Concern by SARA. This species spends summers in the extremely high Arctic (Ellesmere Island area) and winters in the Baffin Bay and the northern Davis Strait region. This species is not expected to be in the region at the time of the seismic survey.

4.7.3 Fish

Three wolfish species may occur in the most southern regions of the survey area. However, all species are at the limits of their northern extents in Canadian waters off the north of Labrador. It is unlikely that any individual will be measurably impacted by the seismic program.

In summary, by adopting all industry mitigation standards, as well as more stringent measures discussed below, no anticipated measurable environmental impacts are predicted on SARA species for this seismic exploratory research field program.

4.8 SENSITIVE AREAS

4.8.1 Niginganiq (*formerly Igaliqtuuq*) National Wildlife Area

The Niginganiq (*formerly Igaliqtuuq*) National Wildlife Area, near Clyde River in Isabella Bay, represents a sensitive marine area adjacent to the project area (Figure 47). This marine wildlife area extends from the coast to 12 nautical miles (approximately 22.2 kilometres, 13.8 statute miles). As the survey area does not commence until the 12 nautical mile limit, the project area does not encroach into this area. Furthermore, the closest survey line is approximately 28 kilometres from the seaward limit of this area, and approximately 60 kilometres from the entrance to Isabella Bay.

Note that a Proposed Biosphere Reserve also exists around this area, and its seaward limit is approximately defined by the limit of land-fast ice. As described in Section 3.2, only a very small portion of the survey area exists within the Outer Land Fast Ice Zone. Within this zone approximately 245 line kilometres of 2D data are proposed to be acquired, which represents approximately 2.2% of the total line kilometres for the survey (10,970 kilometres).

The mitigation measures that will be adopted during the survey will ensure minimal, if any, measurable interaction with local marine related wildlife that may be in the area at the time of the survey.

Other (terrestrial) wildlife areas / parks on the eastern coast of Baffin Island include:

- Qaqulluit National Wildlife Area (also known as Cape Searle, near Qikiqtarjuaq)
- Akpait National Wildlife Area (near Qikiqtarjuaq)
- Bylot Island Migratory Bird Sanctuary (Pond Inlet)
- Nirjutiqavvik National Wildlife Area (Grise Fiord)

The figure below illustrates the Niginganiq (*formerly Igaliqtuuq*) National Wildlife Area and Proposed Biosphere Reserve (New Parks North, 2004).

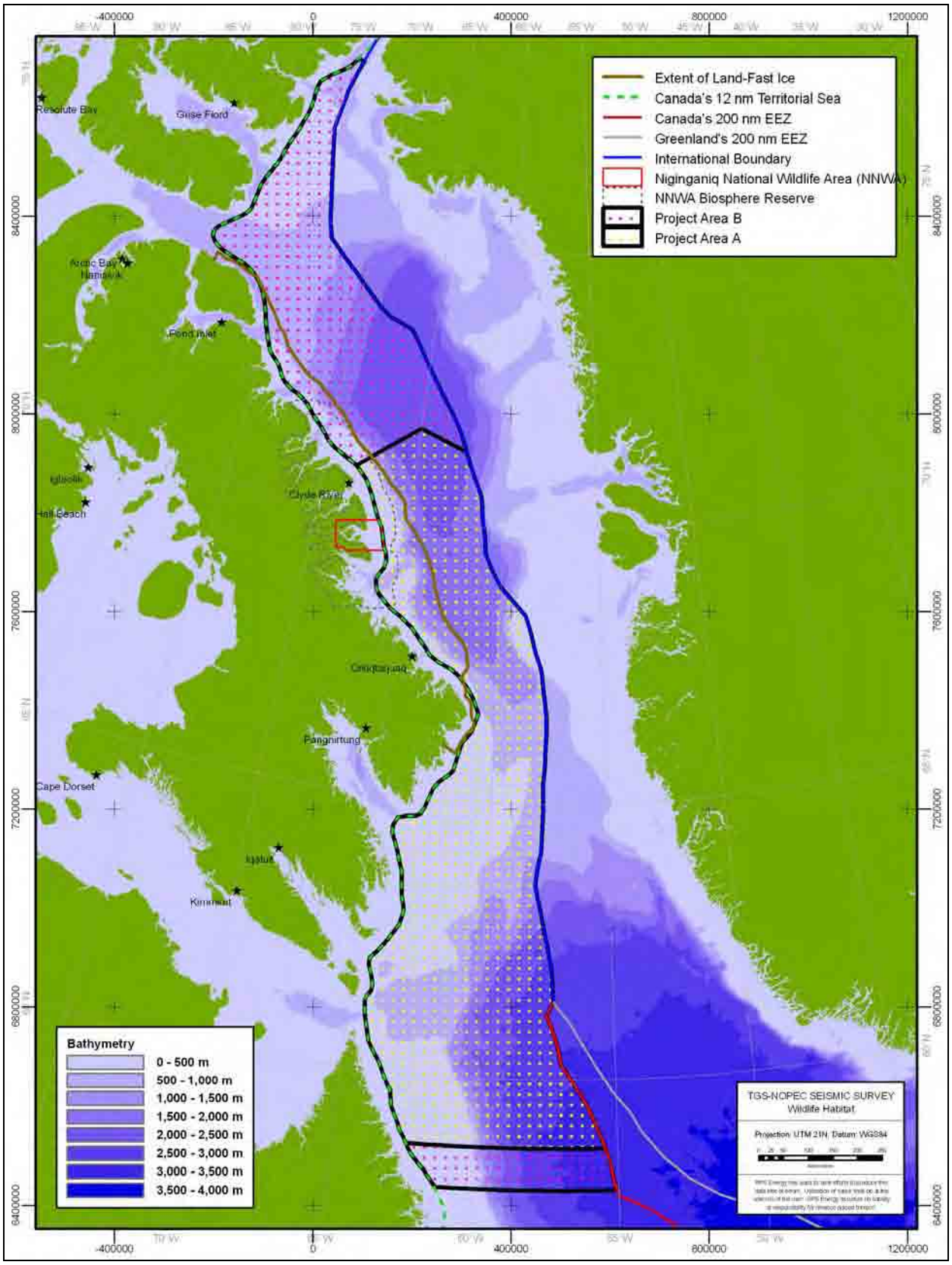

Figure 47. Niginganiq (*formerly Igaliqtuuq*) National Wildlife Area

4.8.2 Narwhal Over-Wintering Area

Since 1998, fishing effort restrictions have been in place to limit the time spent by vessels fishing for Greenland halibut (turbot) in an area identified as a narwhal over-wintering area in Davis Strait.

In April 2006, DFO Fisheries Management decided that a large portion of the narwhal over-wintering grounds should be closed to all Greenland halibut fishing. Reasons for this decision included the status of “special concern” of the narwhal that use this area, the importance of halibut in its diet during the winter, concerns over entanglement in gillnets, and the presence of deep-sea corals (see below), which may play an important role in this ecosystem (Fisheries and Oceans Canada, 2007). The closed area was described and included in the draft 2006-2008 Fisheries Management Plan NAFO SA0, and DFO is currently developing related policies (Fisheries and Oceans Canada, 2007).

The northern narwhal over-wintering area is illustrated in Figure 48, and overlap with the proposed 2011 survey lines; however, narwhals do not tend to occupy this area until November (Dietz et al., 2001; Mosbech et al., 2000). The survey will not take place in the area during this critical period; consequently, it is unlikely that narwhals will be in the area during active surveying.

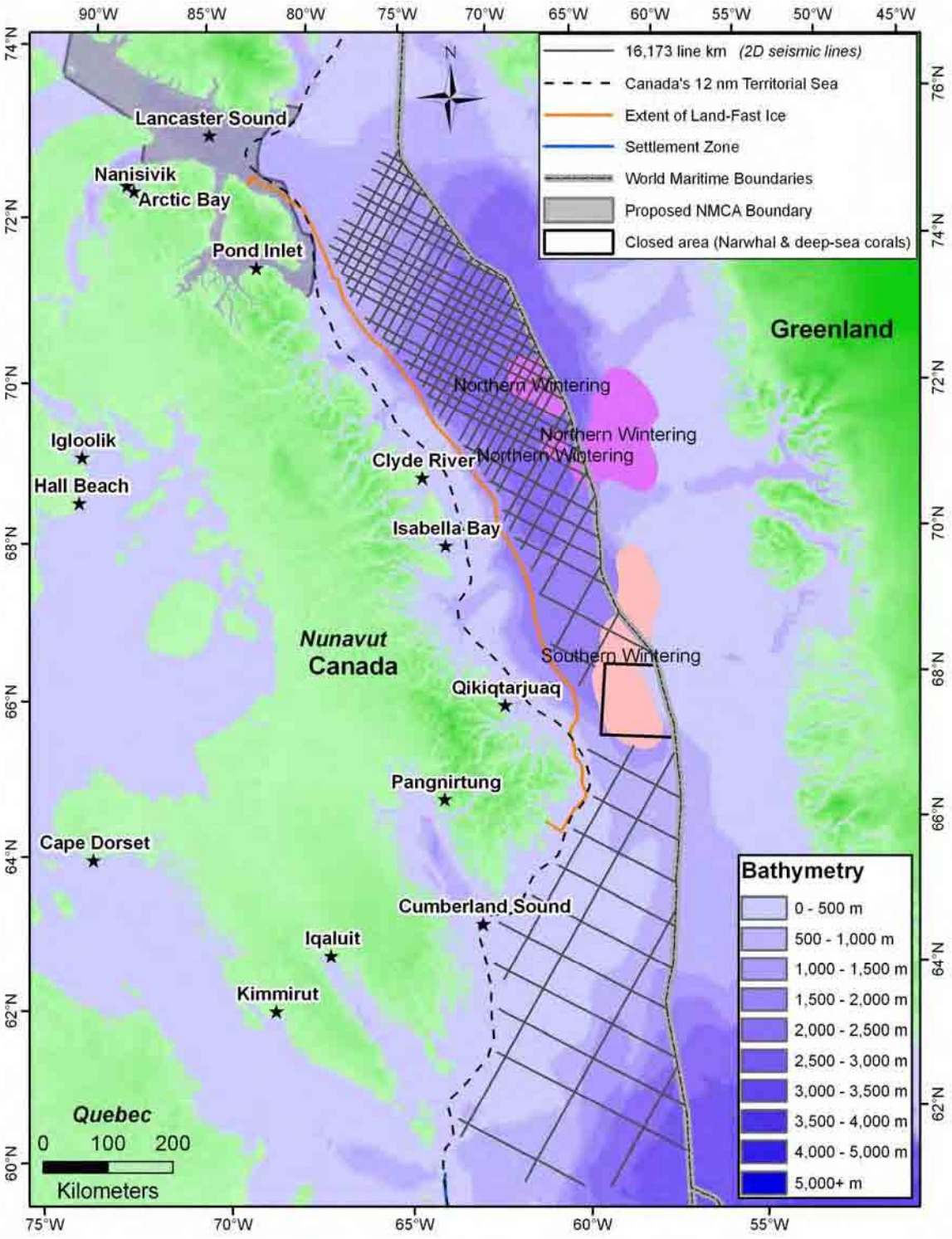

Figure 48. Location of Narwhal Over-wintering Areas Relative to the 2011 Survey

4.8.3 Deep-Sea Corals

There are more than 27 species of deep sea corals identified off the coast of Atlantic Canada but their distribution is largely unknown. The coral have been identified along the edge of the continental shelf from the Gulf of Maine to the Davis Strait by DFO fisheries observers and local fishermen (Gass and Willison 2005). A personal communication from K. MacIsaac (DFO) confirms that deep sea corals are present in Baffin Bay.

Deep-sea corals, by the nature of their physiology (i.e. having no pressure sensitive or sound detecting organs such as swim bladders and ears), are extremely unlikely to be impacted by seismic array activity. Also, the acoustic source is towed at a fixed depth (<7 metres) during seismic surveying, well above the coral that grow on the seafloor.

4.8.4 Lancaster Sound

Ottawa, Ontario, December 6, 2010 – John Baird, Canada's Environment Minister, John Duncan, Minister of Indian Affairs and Northern Development, Christian Paradis, Minister of Natural Resources, and Leona Aglukkaq, Minister of Health, all today proudly announced the Government of Canada's position on a potential future boundary for a national marine conservation area (NMCA) in Lancaster Sound, Nunavut. Today's announcement represents a key step in Canada's commitment to protect the marine waters and wildlife of Lancaster Sound, a globally-significant ecological treasure that has been referred to as the "Serengeti of the Arctic". Ministers also announced that the government will immediately begin consultations to finalize the boundary. (Reference: CP2010-01348 Government of Canada presents boundary proposal for Lancaster Sound National Marine Conservation Area), shown in Figure 50. This present survey will not encroach more than 180km from the mouth of Lancaster Sound.

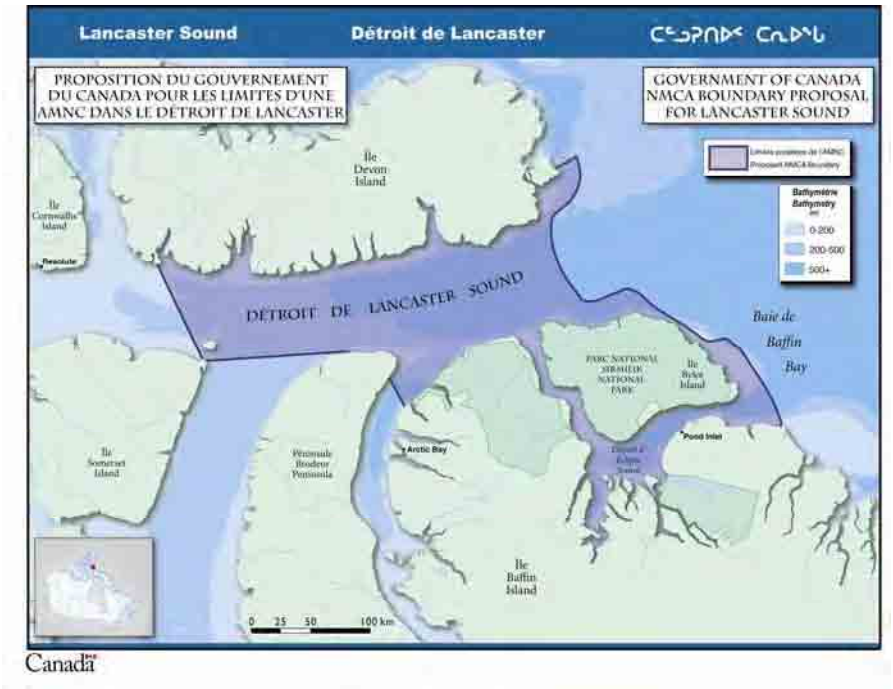

Figure 49. NMCA Boundary Proposal for Lancaster Sound

4.9 COMMERCIAL FISHING

There are two major commercial fisheries in the Baffin Bay – Davis Strait area; the Greenland halibut, also known as the Greenland turbot, (*Reinharditus hippoglossoides*), and shrimp (*Pandalus borealis*).

4.9.1 Greenland halibut (*Reinharditus hippoglossoides*)

Bowering and Nedreaas (2000) note that "Greenland halibut spawning in the western Atlantic has long been postulated to occur in Davis Strait during the late fall-early winter near the submarine ridge between Baffin Island and Greenland at about 67° N." More recently, spawning Greenland halibut have been sampled at various times of the year throughout the range of its offshore distribution along the continental slope from Davis Strait to the Flemish Pass (Morgan and Bowering, 1997). Junquera and Zamarro (1994) studied turbot spawning in the Flemish Pass and observed peak spawning in winter and another in summer. These spawning differences might be the result of a change in fish behaviour associated with a shift in distribution pattern (Bowering and Power, 1995). This could represent normal behaviour observed as a result of now obtaining samples from very deep water (1,250 to 1,800 metres) compared to earlier years. The only recognized major nursery area is near the northern end of its distribution, west of Disko Bay, approximately 69°N (Smidt, 1969; Jørgensen, 1997a, 1997b; in Bowering and Nedreaas, 2000). The fishing methods used in this area include long-lines, gill nets, and bottom trawls.

The turbot fisheries occur from August to November and peak in the months of August and September. Turbot catches in 2007 were near the survey area but were concentrated within extent of the land-fast ice and along the Canada – Greenland international boundary (Figure 50); this represent the farthest extents of the survey. Interactions with this fishery are not expected to be significant.

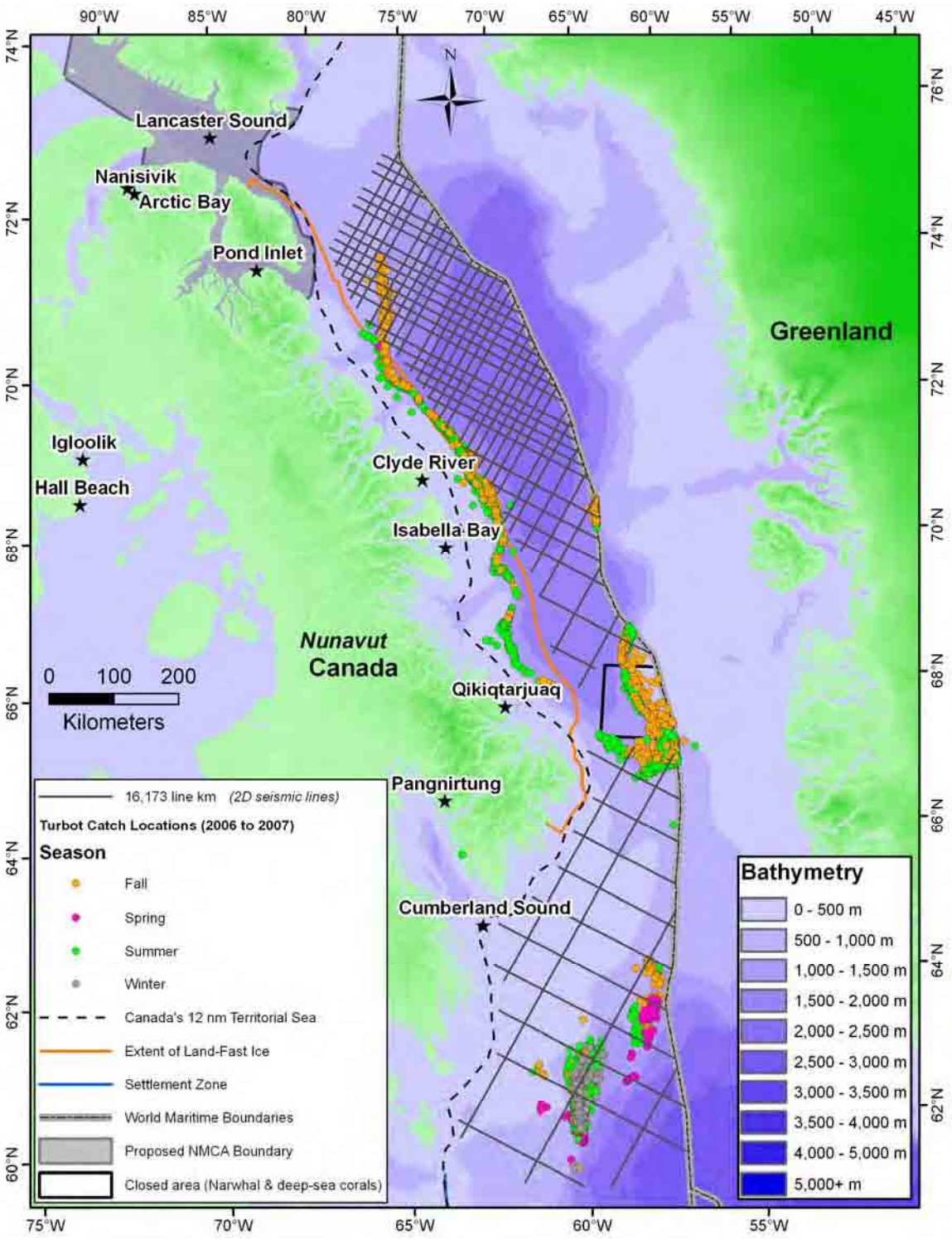

Figure 50. Turbot Fisheries Catch Data for 2006 – 2007 by Season

4.9.2 Northern Shrimp (*Pandalas borealis*)

The Northern Shrimp (*Pandalas borealis*) is the most important commercial invertebrate species within the project area. They are generally found in deep depressions and capture using trawl nets. Northern shrimp spawn during late summer and fall, with the eggs remaining attached to the female until spring. Females with eggs move inshore in late autumn and winter to release the eggs (Parsons, 1993). The proposed 2011 survey lines do not occur in an area of shrimp fishing, which is active south of the survey area from May through December, with peak activity in September and October.

The shrimp are caught from trawlers, which are mobile, whereas turbot are caught in gill nets, which are fixed in position. Gill nets may be anchored to the seabed to keep the gear stationary or positioned in varying water depths, depending on the location of the species, and are marked by buoys on each end, which float on the sea surface. Gill nets may be joined together to increase the efficiency of the operation.

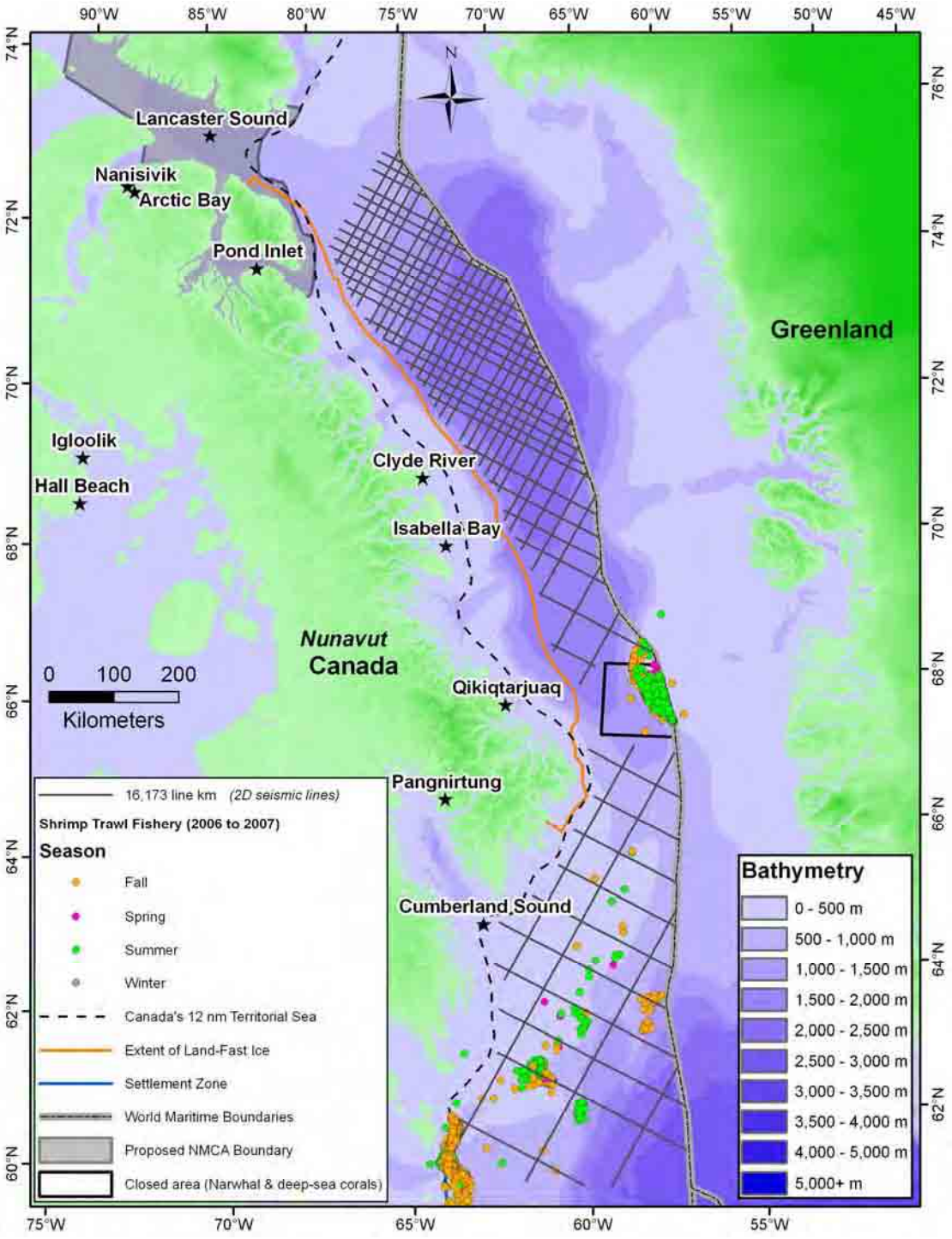

Figure 51. Harvest Data – Shrimp

4.9.3 Fishing Gear

Avoiding fishing gear is a very important component of seismic operations and fixed gear historically is more of a hazard than mobile gear due to the fact that direct communication is maintained between trawlers (using towing mobile gear) and seismic vessels at sea. Refer to Section 5.2.4 for additional discussion on potential fishing gear conflict management.

4.9.4 Fisheries Liaison Officer

The operator will provide a Fisheries Liaison Officer for the duration of the survey to facilitate communications with the fishing industry. The operator will provide a single point of contact in the event of a suspected conflict with fishing gears or vessels during the 2011 program.

4.10 HUMAN AND SOCIOECONOMIC ENVIRONMENT

The seismic survey will take place entirely in marine waters no closer than 12 nautical miles (approximately 22.2 kilometres, 13.8 statute miles) from the Canadian coastline, as defined by the limit of Canada's territorial sea. No Geophysical data will be collected within the Land Fast Ice Zone. Therefore, no survey work will be performed in fjords, inlets, or bays and the survey will be well removed from harvesting areas.

The largest consideration related to the human and socioeconomic environment is with respect to traditional harvesting activities. An appreciation of the traditional knowledge was obtained by consulting two major studies: The Nunavut Wildlife Harvest Study (Nunavut Wildlife Management Board, August 2004), and the Final Report of the Inuit Bowhead Knowledge Study (Nunavut Wildlife Management Board, March 2000). In addition, the operator will employ an Inuit Observer to advise the crew of local knowledge.

Both of these reports are available on the Nunavut Wildlife Management Board website:

http://www.nwmb.com/english/resources/harvest_study/NWHS%202004%20Report.pdf

http://www.nwmb.com/english/resources/Bowheadreport.pdf

Of particular importance are the harvesting activities related to marine species from coastal communities (including Iqaluit, Pangnirtung, Qikiqtarjuaq, Clyde River, and Pond Inlet). The figures below show these data for the Davis Strait and Baffin Bay, and illustrate that harvesting occurs within coastal areas well removed from the proposed survey lines.

The following harvesting data are presented in the figures below:

- Figure 52. Harvest Data – Marine Mammals
- Figure 53. Harvest Data – Fish
- Figure 54. Harvest Data – Big Game
- Figure 55. Harvest Data – Waterfowl
- Figure 56. Harvest Data – Eggs

These harvesting data represent the most comprehensive study completed regarding harvesting levels and patterns of Inuit use of wildlife resources, and are the results of five (5) years of harvest data. The raw data from this study were transposed from the study report to the EIA GIS files and project maps for this assessment purposes. Subject to funding constraints, the NWMB intended to continue to gather, review, and analyze such data into the future, and to report on the results of its efforts, however at this time the data presented in the EIA represent the most recent data published.

The Nunavut Wildlife Harvest Study (NWHS) was mandated by the Nunavut Lands Claim Agreement (NLCA) and carried out under the direction of the Nunavut Wildlife Management Board (NWMB). Harvest data were collected monthly from Inuit hunters for a total of five (5) years covering the harvest months from June 1996 to May 2001. The

Harvest Study covered the entire Nunavut Settlement Area (NSA) involving participants from 28 communities, in all of the three administrative regions: Baffin, Kitikmeot, and Kivalliq regions.

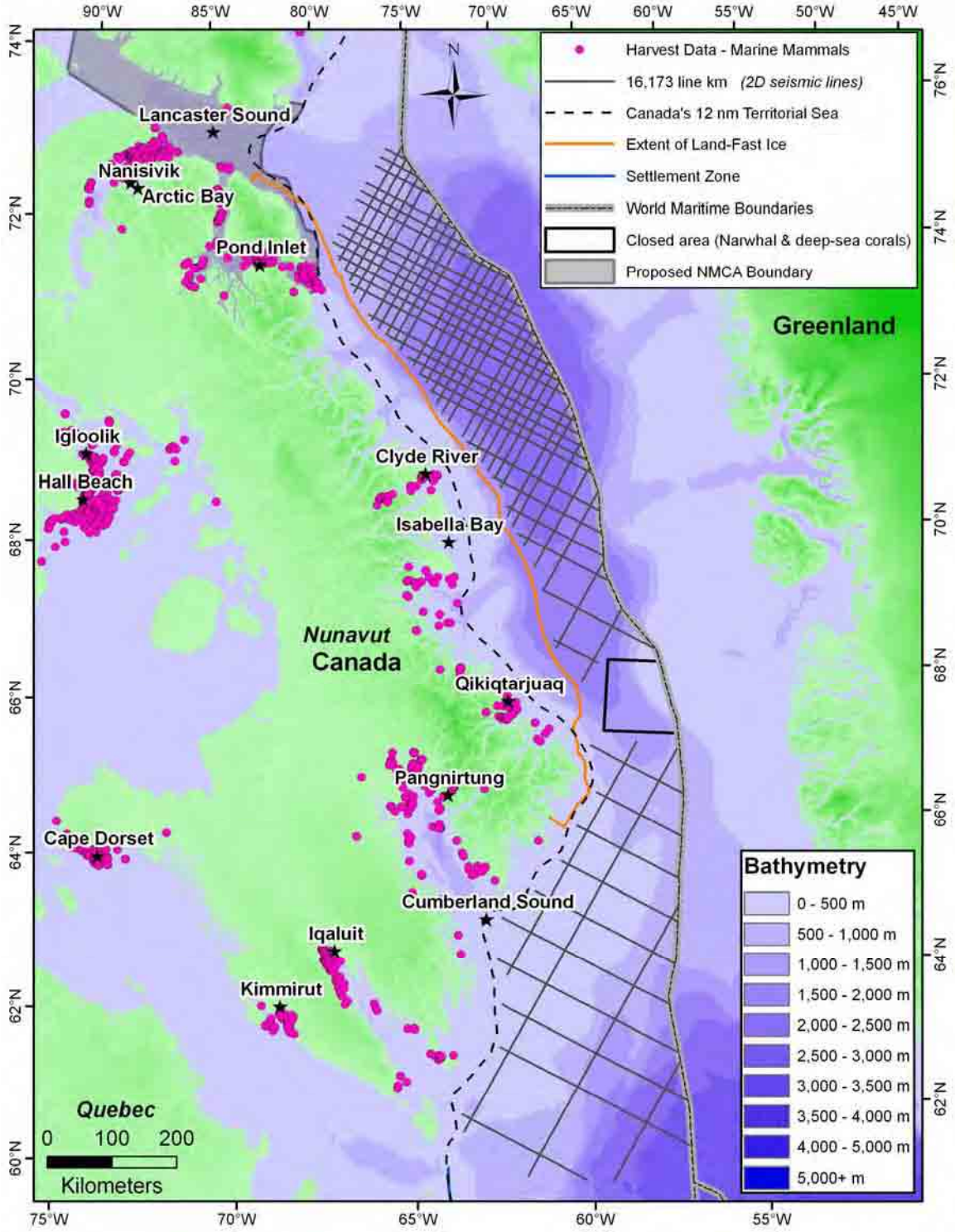

Figure 52. Harvest Data – Marine Mammals

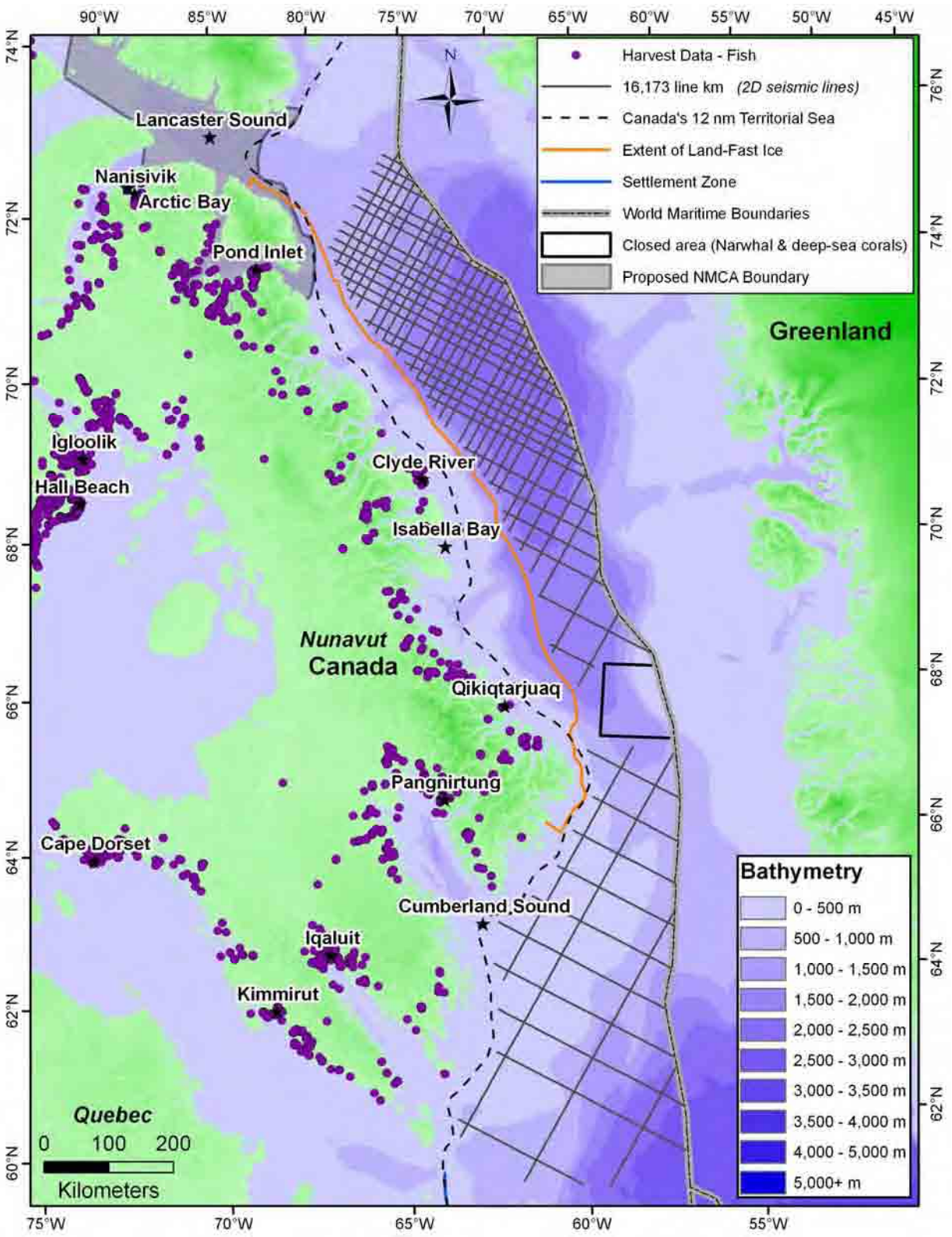

Figure 53. Harvest Data – Fish

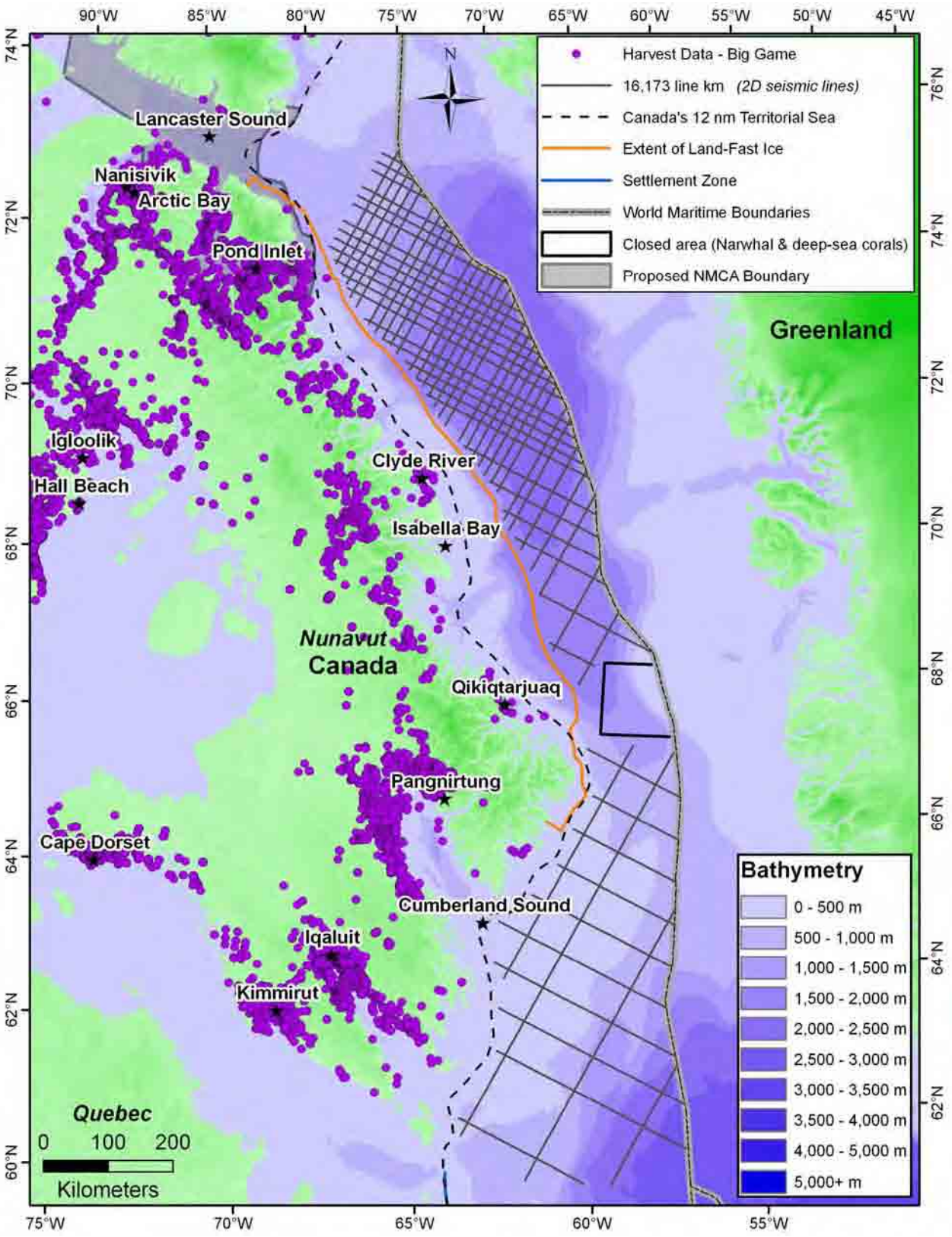

Figure 54. Harvest Data – Big Game

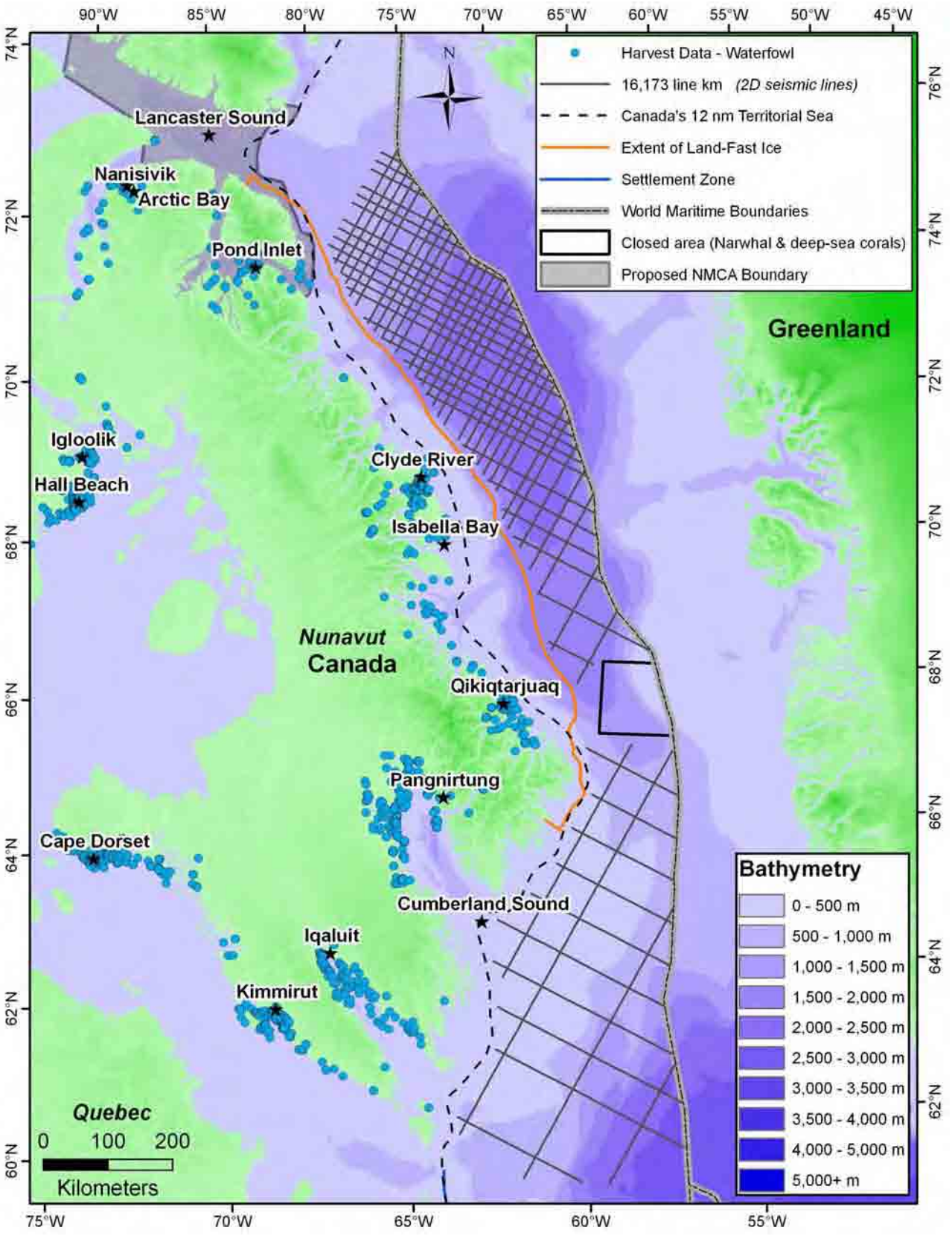

Figure 55. Harvest Data – Waterfowl

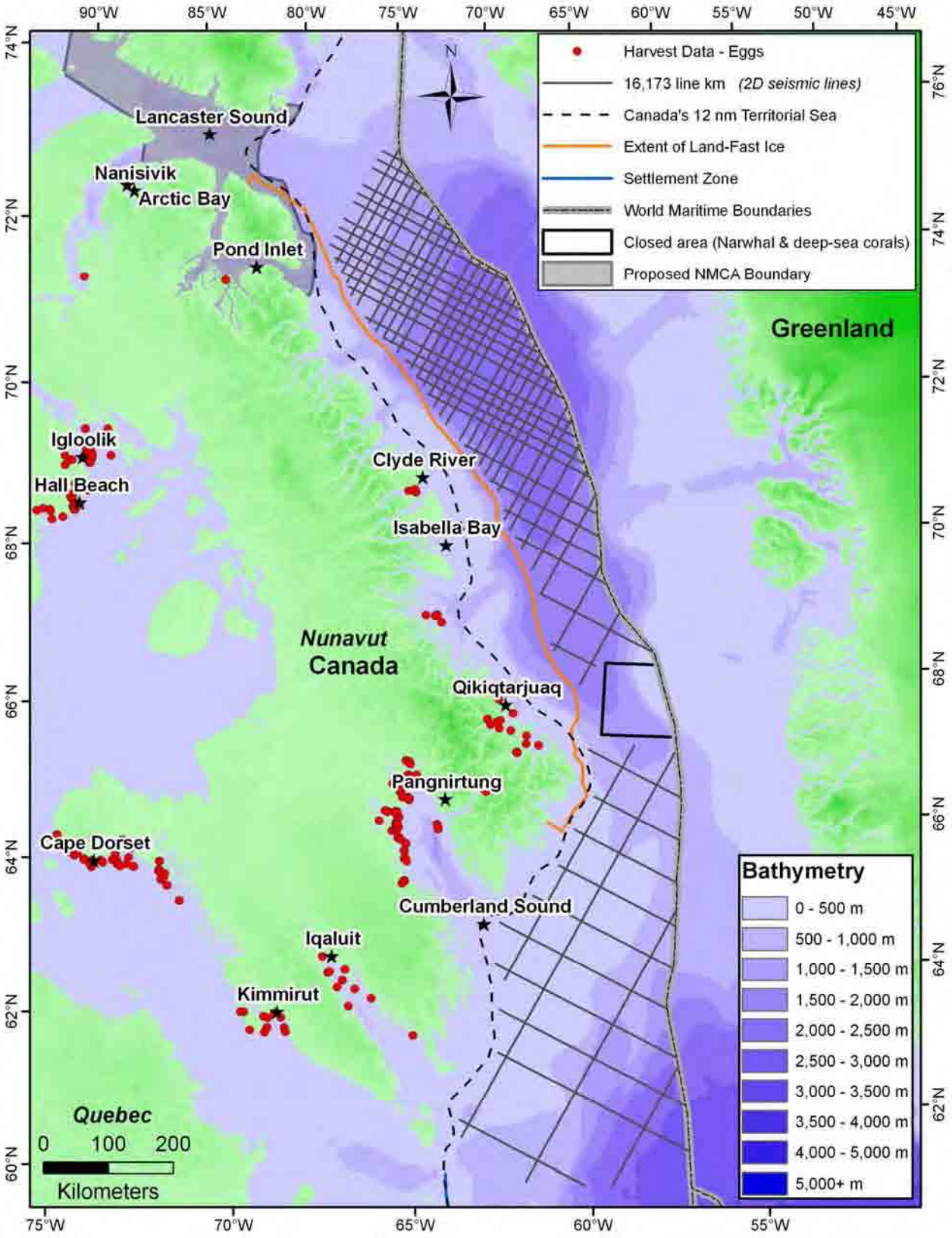

Figure 56. Harvest Data – Eggs

5. ENVIRONMENTAL IMPACT ASSESSMENT

5.1 VALUED ECOSYSTEM COMPONENT (VEC) SELECTION

This assessment uses a valued ecosystem component (VEC) approach to define and focus the issues and factors considered in this assessment. These include components that are important for a variety of reasons, such as their economic or social value, their status (e.g. at-risk species), or their importance to/as habitat. The selection of VEC's is limited, however, to those components that have some reasonable potential for interaction with, or sensitivity to, the planned project activities, most notably the Field Data Acquisition Program during the period of active profiling. This approach was also used in the '*Environmental Impact Assessment for Marine 2D Seismic Reflection Survey, Baffin Bay / Davis Strait / Labrador Sea, Offshore Canada*', also prepared by RPS Energy (April 2007), as commissioned by TGS.

5.1.1 Impact Definitions and Criteria

The Canadian Environmental Assessment Agency's Practitioner's Guide states that "the criteria for determining significance include magnitude, geographic extent, duration and frequency, irreversibility, ecological context" and that the assessment considers the likelihood of an adverse impact occurring. Significant adverse environmental effects are those that will cause a change in the VEC, such that its status or integrity is altered beyond an acceptable level. In other words, a significant adverse anthropogenic environmental effect may alter the assigned VEC in terms of its physical, chemical, or biological quality or extent to such a degree that there is a detrimental change in its ecological integrity beyond which natural mechanisms would not return that VEC to its former level of ecological integrity within the system. The following Table 9 describes the criteria applied for this project within the ecological context described in this report. Residual impacts are determined after application of applicable mitigation measures.

Table 9. Impact Definitions and Criteria

Magnitude	LOW > within natural variation/less than one generation
	MEDIUM > temporarily outside natural variation / 1 to 2 generations
	HIGH > permanently outside natural variation / whole population affected
Geographic Extent	LOW > localized
	MEDIUM > sectoral
	HIGH > widespread
Duration	LOW > less than one month
	MEDIUM > one to two months
	HIGH > greater than two months
Frequency	LOW > one time event
	MEDIUM > several events low duration
	HIGH > continuous

Reversible / Irreversible	Reversible > by natural processes and / or mitigation
	Irreversible > permanent regardless of mitigation
Limits of Confidence	LOW > high degree of scientific uncertainty
	MEDIUM > medium degree of scientific uncertainty
	HIGH > low degree of scientific uncertainty (conclusions are accurate)
Significance Characterization Post-Mitigation	No Significant Residual Impact Significant Residual Impact Positive Residual Impact

The assessments for each VEC considered: impact pathways, a review of relevant literature / research, evaluation of potential effects, and identification of specific appropriate mitigation. Table 10 shows which potential VEC's are considered in this document. Explanation of why phytoplankton, zooplankton, and invertebrates are not considered is discussed in Section 5.1.2.

Table 10. Initial Potential Interactions Matrix Field Acquisition Component

Potential Valued Ecosystem (VEC)	Seismic Air-Gun Interaction Project Component
Phytoplankton	-
Zooplankton	-
Macro-Invertebrates (pelagic and benthic)	-
Marine Reptiles	-
Marine Birds	√
Marine Fish	√
Marine Mammals	√
Fishing Gear Conflict	√

5.1.2 Fish Eggs, Zooplankton, and Invertebrates

While it is recognized that fish eggs, zooplankton (*including icthyoplankton and pelagic / benthic invertebrates*), and their larvae could be killed or damaged at distances up to or less than 5 metres from a large array, various studies have indicated that the impact would be indistinguishable from natural mortality, given the extent of exposure and the numbers of organisms involved.

Sætre and Ona (1996), in a worst-case risk analysis, estimated the total mortality from a typical 3D seismic survey (conducted in a tight, close grid over a relatively small area) on a typical larval population in the North Sea and calculated an effective mortality radius. Their results showed that the maximum population mortality from a large 3D seismic survey would be just 0.45% of the fish larvae, or 0.18% of the total population in the area per day. They note that since natural mortality for eggs and larvae is estimated at 5-15% per day, the effects of the array on fish larvae would be impossible to differentiate from natural mortality, and well within natural variability.

A workshop with oil industry, Fisheries and Oceans Canada, and fisheries participants from Nova Scotia and Newfoundland (sponsored by Environmental Studies Research Funds (ESRF)) took place in Halifax in 2000. During the workshop, LGL Griffiths Muecke (Thomson et al., 2001) noted that studies of seismic effects on fish eggs and larvae were of low priority and were not considered further at the workshop.

In addition, the 1998 seismic Scotian Shelf class screening assessment (Davis et al., 1998) calculated that, a volume of water equivalent to about 1% of the volume of water in the study area would contain impulses lethal to fish larvae, but not all types of fish larvae would be affected by the seismic pulses and those that have the potential to be affected would not be within range at all times. For example, herring spawning occurs close to shore in very shallow water and eggs would not be affected by seismic exploration. During the day, few pollock, redfish, flatfish, and mackerel larvae would be found in surface waters and they tend to be found at or below the thermocline. At night, the larvae of mackerel and redfish and other species do rise in the water column and are found in surface waters. Lethal ranges for flatfish larvae, which have no swim bladders, would be considerably less than those with swim bladders. Therefore, considerably less than 1% of fish larvae, in the potentially affected water mass, would be affected by seismic pulses. The assessment concluded that “Impacts on fish eggs and larvae, including those in nursery areas, would be minor, sub-local and short-term and likely to occur’. Authors concluded that “Direct physical impacts on invertebrates and their larvae are likely to be negligible”.

In another study, Kostyuchenko (1973) concluded that damage to fish eggs would likely be limited to within 5 metres. Dalen and Knutsen (1986) exposed Atlantic cod eggs, larvae, and fry to airguns, with no effects seen on eggs, larvae, and fry at a distance of 1 metre from a seismic energy source where received levels were 222 dB re 1 µPa. Fry that were 110 days old were also exposed to received levels of 231 dB re 1 µPa from a seismic energy source and all survived. Booman et al. (1996) conducted a study of close-range exposure of fish, fish larvae, and eggs (cod, pollock, plaice, turbot, and herring) to seismic sounds from an airgun cluster (242-220 dB re 1 µPa). Mortality and reduction in hatching success were not measurable beyond a few metres from the cluster. The report concludes that the existing mortality and injuries are near distance incidents with highest mortality rates and most frequent injuries observed out to 1.4 metres distance, while low and no mortality rate and more infrequent injuries were observed out to 5 metres distance.

Studies of invertebrate species show similar results. Pearson et al. (1988) reports that stage II zoeae of the Dungeness crab (*Cancer magister*) were not affected by exposure up to 231 dB re 1 µPa. They concluded that exposure did not affect survival, development, or behaviour.

With regard to phytoplankton, Kosheleva (1992; cited in Turnpenny and Nedwell, 1994) reported that arrays with source levels of 220-240 dB re 1 µPa had no effect on phytoplankton or benthos at distances of 1 metre or more. Studies by the Minerals Management Services of the United States Department of the Interior have indicated that, in general, seismic surveys are expected to have little or no effect on plankton, since the energy source (the airgun array) does not appear to have any effect on this group of organisms. Seismic activities are, therefore, considered to elicit little or no effect on lower trophic level organisms (MMS, 1998).

In 2004, Fisheries and Oceans Canada concluded a detailed review of scientific information on impacts of seismic sound on fish, invertebrates, marine turtles, and marine mammals (Fisheries and Oceans Canada, 2004b). It concluded, in relation to zooplankton, eggs, and larvae of fish and invertebrates, the following:

1) Few studies of the effects of seismic sound on eggs and larvae or on zooplankton were found. A number of these studies provided inadequate description of experiment design; properties of the sound applied as treatments, or had methodological shortcomings.
2) Data are generally insufficient to evaluate the potential damage to eggs and larvae of fish and shellfish (or other planktonic organisms) that might be caused by seismic sound under field operating conditions.
3) From the experiments reported to date, results do show that exposure to sound may arrest development of eggs, and cause developmental anomalies in a small proportion of exposed eggs and/or larvae; however, these results occurred at numbers of exposures much higher than are likely to occur during field operation conditions, and at sound intensities that only occur within a few metres of the sound source.
4) Effects of seismic sounds on behavioural functions and sensory perception of fish and invertebrate eggs and larvae are unknown.
5) In general, the magnitude of mortality of eggs or larvae that models predict could result from exposure to seismic sound would be far below that which would be expected to affect populations. However, special life history characteristics such as extreme patchiness in distribution and timing of key life history events in relation to the duration and coverage of seismic surveys may require case-by-case assessment.
6) No studies were found which specifically investigated the role of seismic sounds in recruitment variation of marine fish or invertebrates. There have been a large number of research studies on causes of variation in recruitment of marine fish or invertebrates, and none has considered that there are recruitment anomalies (positive or negative), which might be linked in space or time to seismic survey operations. This negative evidence applies at the scale of stocks, but does not provide information about the potential for effects on local-scale recruitment dynamics.

Given the above findings and since the exposure for most such organisms would be a “one time” occurrence, environmental elements such as phytoplankton, zooplankton, invertebrate (pelagic and benthic), their associated larvae, as well as fish eggs and larvae were not directly assigned VEC status (Table 10).

Studies by Payne et al. (2007) have indicated that adult American lobsters may experience physiological effects from intense seismic sound / pressure. American lobsters are not found in the proposed seismic study area and consequently will not be potentially impacted by seismic operations. Payne et al. (2007) further indicate that the damaging exposure levels could reach a depth of 100 metres. Most of the seismic survey will take place in deeper waters and there are no commercially exploited benthic macro-invertebrates within the study area. Thus it is unlikely that the seismic survey will measurably impact benthic macro-invertebrates within the study area. Furthermore, although there are commercially exploited pelagic macro-invertebrates within the study

area, there are no scientific studies that address the potential impact of seismic exploration practices on them. There has been considerable seismic activity within the region historically, and no measurable effects have been identified and documented for either benthic or pelagic macro-invertebrates of the region.

Furthermore, since the impacts on eggs, larvae, and juveniles are expected to be insignificant, no specific mitigations are required. The proposed survey does not adversely impact critical or unique spawning grounds, including those of Species at Risk, and the majority of the survey is not on the upper shelf or banks (i.e. shallower than 200 metres). Line spacing, frequency of exposure (effectively 1 time event), location, and water depths, reduce the likelihood of impacts on any areas of concentration. Furthermore, the survey will be conducted progressively by a single vessel, the area occupied by the survey at any given time will be a moving “point” in deeper waters away from the near shore, and there will be no continuing ensonification in any one area.

5.2 SELECTED VEC ASSESSMENT

5.2.1 Impacts on Marine Fish

Marine fish species differ widely in their ability to hear or identify sound. Fish, such as herring, in which the swim bladder is connected directly to the inner ear, appear to perceive sounds more acutely than those that do not. Herring, for example, have the upper frequency limit of hearing ranges from 4,000 to 13,000 Hz, whereas the upper limit in fish without the swim bladder connection to the inner ear is about 1,000 to 1,200 Hz (Enger, 1967). While herring are relatively sensitive to sound, cod do not have a direct connection between swim bladder and inner ear, and, therefore, are less sensitive (Olsen, 1969).

Finfish held in cages and unable to avoid an approaching array have shown physical damage to their hearing, and fish held immediately under an array may be killed (Thomson et al., 2001). For instance, Falk and Lawrence (1973; cited in Davis et al., 1998) exposed adult Arctic cisco and other small *coregonids* with swim bladders to a 300 cubic inches source unit operating at 2,000 to 2,200 psi. While no mortalities were observed, some fish sustained damage to their swim bladder. Based on the damage observed, they concluded that the lethal radius of the airgun was between 0.6 and 1.5 metres (at 226-234 dB re 1 µPa). Weinhold and Weaver (1982) tested effects on salmon smolts (130 millimetres, 25 grams). Nineteen of twenty fish survived exposure to pressures of 70 to 166 psi (234 dB re 1 µPa) at a distance of 1 metre from airguns. Studies by Enger, (1981) and Hastings et al. (1996) suggest that exposure to continuous sounds of 180 dB re 1 µPa RMS for 1 to 5 hours can cause damage to the sensory hair cells that are the fundamental sound receptors in fish, McCauley (2000b c.f. Thomson et al, 2001) found some damage to fish hearing organs after 10 exposures to seismic sounds at received energy levels of 132-182 dB re 1 μPa^2.

In general, under normal circumstances, most fish would be expected to swim away to avoid the source as it approaches. Gausland (2000), in a review of known impacts on marine organisms, concluded that airgun operations cause little direct physical damage to fish at distances greater than 12 metres from the source. Nevertheless, it is evident that fish respond to sounds emitted from airguns. Reactions to the sound impulses are reported at levels from 180 dB re 1 µPa, but the full extent of the reactions is unknown. Due to the avoidance behaviour by free-swimming fish, they should not suffer physical damage from the airguns. However the immediate catch rate near surveys can be affected, but the reduction in catch rates is not expected to be long lasting. The reason for reduced catches is probably because fish dive to the bottom or disperse when exposed to high-level sound. For mitigation it is standard industry practice to ‘ramp-up’ airguns when starting a survey to ‘warn’ fish and marine mammals in the area.

Similarly, the Western Australian Department of Minerals and Energy’s “*Guidelines on minimising acoustic disturbance to marine fauna”* (2001, Section 5) state that the effects of seismic surveys on fish are generally observed to be transitory, except at close range. Seismic shots are known to elicit a startle response in fish, resulting in a movement away from the source of the noise, and changes in schooling behaviour. Behavioural changes are observed to cease during the exposure period, sometimes within minutes of commencement of surveying, indicating habituation to the noise. Fish are considered to have good low frequency hearing and so are likely to be able to hear seismic shots for up to several kilometres from the source. Disturbance of fish is believed to cease at

noise levels below 180 dB re 1µPa (Western Australian Department of Minerals and Energy, 2001).

Davis et al. (1998) also concluded that adult fish on the Scotian Shelf would not be physically injured by seismic arrays unless immediately adjacent to an airgun and direct impacts of seismic exploration on adult fish should be negligible.

McCauley et al. (2000a) investigated physiological stress indicators in several species of caged finfish exposed to airgun arrays by measuring changes in cortisol levels. They report, for all species studied, there were no significant increases in stress measurements, which could be definitively associated with airgun exposure. They concluded that there had been no significant physiological stress increase as a result of exposure.

The recent 2004 Fisheries and Oceans Canada review of potential seismic impacts (Fisheries and Oceans Canada, 2004b) in relation to physical effects on marine fish concluded the following:

1) There are no documented cases of fish mortality upon exposure to seismic sound under field operating conditions. With regard to the detect ability of fish kills, if they occurred, it was noted that in Canada seismic surveys have frequently, but not always, included follow-on vessels instructed to watch for fish kills, and none have been observed. It was also noted that fish kills are not necessarily cryptic events, and kills caused by anoxic events, toxic spills etc are often readily detected. However, it was also argued that the efficiency of detecting fish kills by the follow-on vessels was not tested independently, so the possibility of undetected fish kills cannot be eliminated.
2) Under experimental conditions one study found that some subjects from three of four species tested suffered lethal effects from low-frequency (<500 Hz) tonal sounds, under exposure levels of 24 h at >170 dB. Participants noted that the experimental regime differed greatly from field operating conditions of seismic surveys, so extrapolation of the results to seismic surveys was not warranted. However some participants argued that the result indicates that risk of direct fish mortality from sounds with some characteristics of seismic sound cannot be discounted completely.
3) One anecdotal report of fish mortality upon exposure to an airgun less than 2 metres away was discussed and found to be inconclusive when considered relative to field operating conditions. Overall, exposure to seismic sound is considered unlikely to result in direct fish mortality.
4) Under experimental conditions, sub-lethal and/or physiological effects, including effects on hearing, have sometimes been observed in fish exposed to an airgun. The experimental design made it impossible to determine to the satisfaction of all experts what intensity of sound was responsible for the observed damage to ear structures, nor the biological significance of the damage that was observed. Simulated field experiments attempting to study such effects have been inconclusive. Currently, information is inadequate to evaluate the likelihood of sub-lethal or physiological effects under field operating conditions. The ecological significance of sub-lethal or physiological effects, were they occur, could range from trivial to important depending on their nature.

Considering the limited duration that the survey will be in any particular area and expected distances from the array based on fish avoidance, physical impacts on fish, including sub lethal and chronic impacts (e.g. permanent effects on hearing), are not expected. Nevertheless, to avoid potential impacts on fish the survey will employ a "ramp-up" procedure (i.e. starting with low energy array components and slowly increasing the volume) each time it starts the array. This will allow finfish (and other non-planktonic organisms such as marine mammals and turtles) to move away from the area before they can be exposed to the full array energy. The ramp-up procedures will begin prior to the use of seismic equipment in accordance with the Statement of Canadian Practice (Appendix A) and will progress continuously until recording starts. Ramp-up will begin with a single low cubic inch airgun firing singly, followed gradually by other airgun units in the array.

Overall, seismic operations will not measurably impact marine fish within the profiling area (Table 11).

5.2.2 Impacts on Marine Mammals

Many species of marine mammals, such as cetaceans, depend on sound to communicate, forage, avoid danger, and navigate. Increases in anthropogenic noise levels can result in the masking of these sounds or a decrease in the distance over which they can be detected. The likelihood that an animal would be impacted by a noise is dependent on its intensity, frequency, duration of exposure, and the distance between the animal and the source. It is also dependent on the frequency of the noise being emitted relative to the hearing sensitivity of the marine mammal.

Because of the potential affects of seismic surveys on marine mammals, with close proximity to the seismic array, a marine mammal observer (MMO) will be employed on the seismic vessel and an additional MMO onboard the supply vessel during the proposed survey. MMO's are used to detect cetaceans and pinnipeds in the survey area and advise the crew to take corrective action and shut down operations if marine mammals enter the exclusion zone. They will keep a daily log of wildlife sightings, observation location, and effort data using the forms associated with the guidelines. The MMO will be a trained observer, preferably with experience working in the Arctic.

As a group, marine mammals have a functional hearing range of 0.01 to 200 kHz. However, different species of marine mammals have different acoustic abilities and sensitivities. Toothed and baleen whales, for instance, are known to be sensitive to different frequencies of noise. Toothed whales are less sensitive to low frequency sounds (<500 Hz), but have good sensitivity at up to 100 kHz or more (Evans and Raga, 2001). In contrast, baleen whales are thought to be sensitive to the low frequency sounds (<500 Hz), the frequencies at which they vocalize (Evans and Raga, 2001). If man-made noises occur within these frequencies there is the potential to negatively affect marine mammals either physiologically or behaviourally.

The potential effects of acoustic emissions on marine mammals can be divided into four categories:

- Permanent threshold shift (PTS): Long-term hearing damage due to physical injury to a marine mammal's hearing apparatus. Occurs when an animal is exposed to high peak pressure sound impulses (Richardson et al., 1995).
- Temporary threshold shift (TTS): Temporary reduction in hearing sensitivity. Occurs when an animal is exposed to a strong sound that results in a non-permanent elevation of the hearing sensitivity threshold (Richardson et al., 1995).
- Masking: Failure to distinguish the signal when both the signal and masking noise have similar frequencies and either overlap or occur very close to each other in time (NRC, 2003); and
- Changes in the behaviour and/or distribution (i.e. habitat avoidance) of a marine mammal that is of sufficient magnitude to be "biologically significant" (Richardson et al., 1995; NRC, 2005).

The noises emitted during seismic operations have higher peak source levels than other man-made noises including drilling, construction, and vessel activity. However, seismic exploration sounds tend to be short, discontinuous pulses, which are separated by quiet periods.

The energy from seismic activity varies; however, airgun arrays and other "high energy" sources are generally between 20 and 1,500 Hz. As a result, it is likely below the hearing sensitivities of toothed whales. This may explain why there is no known seismic data on the behaviour of toothed whales exposed to seismic noise. However, overall received levels of airgun pulses are often ≥ 130 dB re 1 µPa, a level that is potentially audible to toothed whales. Therefore, despite the toothed whales poor low-frequency hearing, it has been suggested that they may be able to hear seismic noise out to a radius of 10-100 kilometres.

In contrast to toothed whales, the low hearing sensitivity of baleen whales makes them much more sensitive to seismic noise. Baleen whales have been seen slowing, turning away, and increasing respiration rates as a result of airgun noise (Richardson et al., 1995). These behavioural observations have been detected in bowheads 5-10 kilometres away from the sound source and in humpbacks at ranges of up to 3.2 kilometres away (Richardson et al., 1995).

A scientific review on what is known regarding marine mammals and acoustic noise is presented in Appendix I (Fisheries and Oceans Canada, 2004b). This document, titled *Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals*, forms the basis of the *Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment* described in Section 5.3 of this document (Fisheries and Oceans Canada, 2004a), and is available on the Fisheries and Oceans Canada website:

http://www.dfo-mpo.gc.ca/csas/Csas/status/2004/HSR2004_002_E.pdf

Based on current knowledge on hearing sensitivities, it is possible that seismic activity related to the project may affect marine mammals, particularly baleen whales. However, because the project will be following the Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment, the more serious PTS and TTS effects are unlikely. Impacts to marine mammal behaviour, particularly habitat

avoidance, are possible (e.g. bowheads at the Isabella Bay sanctuary may hear the seismic operation and temporarily alter their behaviour), but overall these impacts are expected to be limited due to the short term and periodic nature of the proposed seismic activity. The survey acquisition plan (i.e. order of survey lines to be acquired) is intended to maximize separation between marine mammals and the survey vessel, and includes starting acquisition in the south and progressing north. This detailed survey acquisition plan will be prepared prior to project initiation.

5.2.3 Impacts on Bowheads and Baleen Whales

Oil and gas exploration in the Arctic has prompted considerable research to investigate the potential effect of seismic noise on bowhead whales. Early studies on the effects of seismic noise indicate that bowheads show behavioural changes when seismic noises are within 8.2 kilometres, a range where received levels would be 142-157 dB re 1 µPa. In addition, whales will move away from the noise when it is within 3 to 7.2 kilometres (152-178 dB) (Richardson et al., 1986). These responses result in the whales being displaced by approximately 2 kilometres and their behaviour being altered for up to 1 hour (Ljungblad et al., 1988).

Findings from a more recent study by Richardson et al. (1999) suggest that these early sensitivity estimates may be an underestimate. Richardson et al. (1999) reported bowheads avoiding areas within 20 kilometres of seismic sources, corresponding to received noise levels of 120-130 dB re 1 µPa. The presence of this large avoidance zone was supported by the observation that areas outside of the zone had significantly higher densities of whales.

Other changes in behaviour that have been associated with seismic activity include reduced surface interval and dive duration, lower numbers of blows per surfacing, and longer intervals between successive blows. These effects have been detected at distances of up to 5-10 kilometres (Richardson, 1995).

Thresholds for temporary threshold shift (TTS) and permanent threshold shift (PTS) in baleen whales are unknown (Davis et al., 1998). It is not prudent to assume that the measured TTS thresholds for bottlenose dolphins apply to baleen whales, which seem to be much better adapted for low frequency hearing. TTS threshold levels could be important for assessing effects on baleen whales because individuals of some species of baleen whales occur quite close to ships and to seismic operations. McCauley et al. (1998) found that some individual humpback whales approached an operating seismic airgun to within 100-400 metres. Thus, the received levels that induce TTS may be particularly relevant for baleen whales such as the bowhead. The US National Marine Fisheries Service uses the threshold received level of 180 dB when considering potential TTS and PTS to marine mammals.

Based on United States National Marine Fisheries Service, available bowhead and acoustic impact information, they are likely to be disturbed only temporarily when encountered by the survey vessel. This disturbance is unlikely to result in auditory damage (i.e. TTS and PTS), especially given that professional marine mammal observers will ensure operations are suspended if marine mammals are identified within 500 metres of the arrays (see the following mitigation section for details). The most significant behavioural reactions are likely to consist of mid-range avoidance movements

(Davis et al., 1998), and it is not presently possible to quantify the overall long-term biological significance of such disturbances, however the proposed survey is well-removed from the continental shelf region, in particular from the Niginganiq (formerly Igaliqtuuq) National Wildlife Area (Isabella Bay). Bowheads are closely associated with pack-ice (possibly for feeding, protection, or other reasons), hence survey lines approaching summer pack-ice regions may potentially induce temporary habitat displacement, but will likely return after several hours. It is unlikely that this temporary disturbance will significantly reduce the overall value (i.e. feeding, resting) of this habitat.

5.2.4 Impacts on Narwhals and Toothed Whales

There is very little information about the behavioural responses of *odontocetes* to seismic exploration (Davis et al., 1998); this is especially true for responses of narwhals. The narwhal, in particular, is poorly studied and no scientific reports addressing hearing sensitivity and reactions to noise are available. However, it is known that narwhals are very sensitive to vessel activity and exhibit “freeze” or “flight” responses similar to those seen in beluga whales (Richardson et al., 1995). Their acute responsiveness has been linked to their confinement to heavy ice and the associated good sound propagation conditions. Goold (1996a) found that common dolphins (conceivably having comparable hearing sensitivity to narwhals) were tolerant of the noises from an array at distances of over 1 kilometre. The threshold levels for behavioural responses by bottlenose dolphins to single 1-second pulse ranged from 178 to 186 dB re 1 µPa for frequencies from 75 to 3 kHz (Finneran et al., 2002).

It is concluded that the effects of seismic pulses on narwhals would be minor, sub-local, short-term, and likely to occur. The use of professional marine mammal observers onboard the survey vessel will ensure operations are suspended if marine mammals are identified within 500 metres of the array (see the following mitigation section for details). The possibility of non-auditory physiological effects cannot be evaluated with present data, however if they occur they would be limited to animals very close to the operating array.

The situation for sperm whales is less clear, as the available data limited. Nevertheless the initial results of a major MMS study in the Gulf of Mexico involving the tagging and tracking of endangered sperm whales suggests that these whales may not significantly alter their behaviour when seismic arrays are active (Biers, 2003), and the US National Marine Fisheries Service (1995, 2000) has advised that whales in general should not be exposed to impulse noise at received levels exceeding 180 dB re 1 µPa (RMS), and have established a 500 metre radius precautionary safety zone for seismic arrays.

With the proposed mitigation methods in place the predicted effects for this study in the proposed study area are negligible to minor, local, short-term, and therefore not considered significant.

5.2.5 Impacts on Pinnipeds

Preliminary results of a radio telemetry study by Thompson et al. (1998; cited in Anderson Resources 2001) suggest that pronounced (but short-term) behavioural changes can occur in harbour seals and gray seals exposed to airgun pulses. They

stated that normal foraging dives were interrupted and that avoidance reactions usually occurred. The seals returned to their previous foraging areas after airgun operations ceased. The USNMF Service has also set a safety limit of 190 dB for seals.

Overall, on the basis of the above information, as well as implementation of appropriate mitigation measures, no measurable impact on marine mammals is anticipated during the period of seismic acquisition in the Baffin Bay region (Table 11).

5.2.6 Impacts on Marine Birds

There are many species of seabirds and related species that can be found associated with the waters of proposed survey area. Not all are breeding populations and may only contact water or the shore area for brief period in the summer. There are no endangered or threatened species within the seismic survey area according to the latest information on the Species at Risk (SARA) Registry, however, the Ivory Gull is designated a species of special concern by COSEWIC. Environment Canada protocols for seabird observations will be used for seabirds for this project.

In general, there is little scientific information about impacts of seismic array sounds on birds. Davis et al. (1998) reports, “Stemp (1985) made observations on the reactions of birds to seismic exploration programs in southern Davis Strait over three summer periods. No distributional or mortality effects were detected. Evans et al. (1993b) made observations from operating seismic vessels in the Irish Sea. They noted that, when seabirds were in the vicinity of the seismic boats, there was no observable difference in their behaviour, birds neither being attracted nor repelled by seismic testing.

Many of the birds that might forage in the project area are divers, such as the Dovekie, Thick-billed Murre, and Atlantic Puffin that dive quite deeply and may spend considerable time under water. Murres regularly dive to depths of 100 metres and have been recorded underwater for more than three minutes (Gaston and Jones, 1998; cited in LGL, 2003).

Since the array will be gradually ramped-up at each start, and the array will generate impulses every 13 seconds, seabirds will be warned as they approach the ship and array. This will reduce or remove the likelihood that birds will choose to come close enough to the array to experience hearing damage or other physical harm.

In terms of risk to birds from pollutants, oil slicks, or wastewater, the survey vessel will comply with all applicable regulations concerning discharges of materials into the marine environment, as described above. The vessel is equipped to minimize risk of any spills and has an emergency response plan in place.

With respect to seabird interaction with surface oil, Lehoux and Bordage (2000) present deterrent techniques and a bird dispersal approach for oil spills that could be applied to any significant spill of oil of any variety. By utilizing the proposed mitigation measures, no measurable contribution of hydrocarbons is anticipated to enter the marine environment and impact marine life.

Onboard lights are known to attract birds, though the situation on the survey vessel is not expected to be any different than for any other similar-sized cargo or fishing ship, and the survey vessel will not typically be stationary.

In general, considering the small impact of seismic sounds in the air and the brief time the survey vessel will be in specific areas, the presence of the survey vessel should pose little risk and no measurable impact is predicted on seabirds within the area of survey (Table 11).

Table 11. Matrix of Potential Environmental Effects of the Project Components on Value Ecosystem / Environmental Components

Valued Ecosystem Component (VEC)		Magnitude	Geographic Extent	Duration	Frequency	Reversible / Irreversible	Limits of Confidence	Significance Level Post-Mitigation
Marine Mammals	Whales	LOW	LOW	MED	LOW	Reversible	MEDIUM	No Significant Residual Impact
	Seals	LOW	LOW	MED	LOW	Reversible	HIGH	No Significant Residual Impact
	Walrus	LOW	LOW	MED	LOW	Reversible	HIGH	No Significant Residual Impact
	Polar Bear	LOW	LOW	MED	LOW	Reversible	HIGH	No Significant Residual Impact
Sea Turtle		LOW	LOW	MED	LOW	Reversible	HIGH	No Significant Residual Impact
Birds		LOW	LOW	MED	LOW	Reversible	HIGH	No Significant Residual Impact
Fish		LOW	LOW	MED	LOW	Reversible	MEDIUM	No Significant Residual Impact
Fishing Gear Conflict		LOW	LOW	MED	LOW	Reversible	HIGH	No Significant Residual Impact

Key:

Magnitude	LOW	Within natural variation/less than one generation
	MEDIUM	Temporarily outside natural variation / 1 to 2 generations
	HIGH	Permanently outside natural variation / whole population affected
Geographic Extent	LOW	Localized
	MEDIUM	Sectoral
	HIGH	Widespread

Duration	LOW	Less than one month
	MEDIUM	One to two months
	HIGH	Greater than two months
Frequency	LOW	One time event
	MEDIUM	Several events low duration
	HIGH	Continuous
Reversible / Irreversible	Reversible	By natural processes and or mitigation
	Irreversible	Permanent regardless of mitigation
Limits of Confidence	LOW	High degree of scientific uncertainty
	MEDIUM	Medium degree of scientific uncertainty
	HIGH	Low degree of scientific uncertainty (conclusions are accurate)
Significance Level Post-Mitigation	No Significant Residual Impact	
	Significant Residual	
	Positive Residual Impact	

5.2.7 Fishing Gear Conflict

All proposed activity associated with this project will occurs offshore, fishing vessels and their associated in-sea gear represent the main group that could be potentially affected by the physical presence of the survey vessel and in-sea equipment. In order to manage this effectively, Fisheries Liaison Officers (FLO) familiar with the survey area's fisheries will be employed on the vessel during the proposed survey as means of facilitating inter-industry communications, advising on fisheries issues, and avoiding fishing / gear conflicts. It is anticipated that the FLO individuals will be hired based on the recommendation of the local fishing industry (FFAW), and personnel with experience working in the Arctic are appropriate for this type of project. The FLO will provide dedicated marine radio contact for all fishing vessels in the vicinity of the survey vessel to discuss potential interactions and solutions. These persons, knowledgeable about local fishing, will assist the vessel's bridge personnel with information about established fishing activities and harvesting methods.

As discussed in Section 4.9 of this report, commercial fish harvesting activities may occur throughout the survey period within some parts of the survey area, though the timing of specific fisheries varies. The fixed-gear (gill nets and long lines) of the turbot fishery poses the highest potential for gear conflict if they are concurrent and co-location with seismic survey operations. Historically, such gear conflicts have occurred in other areas, typically 2-3 times annually throughout Atlantic Canada. All incidents have involved fixed gear (typically crab or lobster pots, gill nets, or large pelagic long lines). When these events occur, they are assessed on a case-by-case basis and compensation paid for determined losses.

Mitigation plans to avoid active fishing areas are presented below. These focus on reducing the likelihood of conflicts. With precautions and compensation plans in place, the economic impacts on fishers would be negligible, and thus not significant.

5.2.8 Avoidance

As discussed above, potential impacts on fishing gear will be mitigated by avoiding active fixed gear fishing areas. The FLO, good at-sea communications, and mapping of fishing locations have proven effective in the past at preventing such conflicts.

5.2.9 Fisheries Liaison Officer (FLO)

As described above, the onboard fisheries industry FLO will provide a dedicated marine radio contact for all fishing vessels in the vicinity of the survey vessel to help identify gear locations, discuss potential interactions and find solutions, and provide essential guidance to the Bridge.

5.2.10 Communications with Fishing Industry

Good communications are the best way to minimize interference with fishing activities. Maintaining good communication with fishers is important before and during the survey.

The Operator (through its consultants) will communicate with appropriate fisheries organizations to inform them of planned survey activities and to facilitate information exchange with fisheries participants.

Relevant information about the survey will also be publicized using established communications mechanisms, such as the Notices to Shipping and CBC Radio's Fisheries Broadcast, as well as direct communications between the survey vessel and fishing vessels via marine radio at sea.

5.2.11 Single Point of Contact

The operator will arrange for the services of a Single Point of Contact (SPOC) with the fisheries industry. The SPOC role will include updating vessel personnel (i.e. the FLO, the Captain, and the Party Manager) about known fishing activities in the area, and will relay relevant information from Fisheries and Oceans Canada.

5.2.12 Fishing Gear Compensation

In case of accidental damage to fishing gear, the operator will have available a gear damage compensation contingency plan to provide appropriate and timely compensation to any affected fisheries participants. The Notices to Shipping filed by the vessel will also inform fishers that they may contact the SPOC, if they believe that they have sustained survey-related gear damage.

The Operator is familiar with the C-NLOPB / CNSOPB Compensation Guidelines Respecting Damages Related to Offshore Petroleum Activity (C-NLOPB / CNSOPB, 2002), and with programs developed jointly by the fisheries industry and offshore petroleum operators (e.g. by the Canadian Association of Petroleum Producers and other Operators) as alternatives to claims through the courts, to address all aspects of compensation for attributable gear damage. These programs include provisions for paying compensation for lost or damaged gear, and any additional financial loss that is demonstrated to be associated with the incident. The programs include mechanisms for claim payments and dispute resolution. The operator will implement similar procedures to settle claims promptly for any gear damage that may be caused by survey operations, including the replacement costs for lost or damaged gear, and any additional financial loss that is demonstrated to be associated with the damage, as recommended under the C-NLOPB Guidelines. The operator will provide the NEB with the details of any compensation to be paid.

By adopting the above mitigation measures it is unlikely that a significant impact on fishing gear will occur during the seismic program (Table 11).

5.3 MITIGATIONS

The operator will follow the 'Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment' developed by Fisheries and Oceans Canada in order to minimize the negative effects of its activity on the environment (Fisheries and Oceans Canada, 2004a). This document is available for review online:

http://www.dfo-mpo.gc.ca/oceans-habitat/oceans/im-gi/seismic-sismique/pdf/statement-enonce_e.pdf

This Statement of Canadian Practice was created to formalize and standardize the mitigation measures used in Canada with respect to the conduct of seismic surveys in the marine environment. Based on current knowledge and experience, seismic surveys conducted with the mitigation measures contained in the Statement of Canadian Practice are not expected to cause significant adverse environmental effects. A copy of this document is provided in Appendix A.

A scientific review on what is known regarding marine mammals and acoustic noise is also presented in Appendix I. (Fisheries and Oceans Canada, 2004b). This document, titled 'Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals', forms the basis of the 'Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment', and is also available on the Fisheries and Oceans Canada website:

http://www.dfo-mpo.gc.ca/csas/Csas/status/2004/HSR2004_002_E.pdf

No residual environmental impacts are expected on the marine resources in the survey area. A seismic energy source for this type of survey produces about 230 db re 1 µPa @ 1 m. Note this is a theoretical level and is not actually reached the array is not a point source. At a distance of about 1 kilometre from the sound source the received sound is in the order of 170 db re 1 µPa. The Department of Fisheries and Oceans has concluded that exposure to seismic sound is considered unlikely to result in direct fish or invertebrate mortality (Fisheries and Oceans Canada, 2004a).

For marine mammals a safety zone distance of 500 metres from the sound source will be established. At this distance the received sound level (180 dB re 1 µPa) is similar to the vocalization sounds made by Humpback, Bowhead, Right, Blue, Fin, as well as other large marine mammals (175-190 dB). Furthermore, vessel traffic in the area, such as commercial fishing, produces sound levels in the order of 154 dB (Richardson et al., 1995). As a note, rain will increase the background noise by up to 35 dB above ambient.

All standard and industrially related mitigation measures pertaining to the use of seismic airgun arrays for exploration will be adopted and followed. For marine mammals, especially whales, the safety radius or zone of 500 metres from the sound generating source will be adopted to reduce received sound levels in the order of 180 dB at the maximum (LGL, 2005). Note that this sound level is about the same sound production level that is produced by cracking and breaking pack ice that is prevalent in this high Arctic environment, and represents a background noise level. Further mitigation measures with respect to potential marine mammal interaction with the project will also be adopted. These include the following:

1) Alteration of vessel speed / course providing it will not compromise operational safety requirements.
2) Airguns will be shut down if any marine mammal enters or is anticipated to enter the 500 metres safety zone through observations by a trained marine mammal observer on the seismic vessel.
3) Airgun start-up procedures will not commence unless a full 500 metres safety zone is clear of any marine mammal by visual inspection by a trained marine mammal observer for a continuous period of at least 30 minutes.
4) The airgun array will be "powered down" during transit from one seismic line to another. All guns will be turned off except for one gun, which will function as a signal intended to alert marine mammals of the presence of the vessel.
5) Total shut down of all airgun activity will occur and not resume until all marine mammals have cleared the 500 metres safety zone.
6) Airgun start-up procedures will include a "ramping-up" period.
7) The location of the seismic activity associated with this project will not take place in the vicinity of any native harvest area.
8) Notice to mariners posting where and when surveying will occur.
9) Adherence to recent Fisheries and Oceans Canada guidelines for conducting seismic surveys in Canadian waters (Appendix A).

With respect to polar bears, it is highly unlikely that the sub-sea sound produced will impact bears if they are encountered. If seen by the trained marine mammal observer within the 500 metres safety zone, all of the above mitigation measures will be applied to ensure that no project interaction occurs.

For marine fish and invertebrates, federal Department of Fisheries and Oceans and other scientific studies have indicated that no fish kills have taken place that can be directly attributed to seismic exploration activity, and no measurable impact on populations of phytoplankton, zooplankton, as well as fish eggs, larvae, or juveniles have been reported at distances of 8 metres from the seismic sound source.

Overall, by adopting all industrial mitigation standards as well as more stringent measures discussed above, no anticipated measurable environmental impacts are predicted for this seismic exploration research field program in the Davis Strait project area.

5.3.1 Ramp-Up

"Ramping-up" (i.e. starting with low energy array components and slowly increasing the volume) will allow marine mammals to avoid the survey area if they choose to. The survey vessel will gradually ramp-up (soft-start) the energy of the airgun array to warn away marine mammals and finfish before they can be exposed to the full array energy.

As specified in the Statement of Canadian Practice, the ramp-up procedures will begin after a 30-minute observation period (see below), at least 20 minutes prior to the use of seismic equipment, and be continuous until recording starts. Ramp-up will begin with a

single air-source unit firing singly followed by other source units in the array. The array will then increase intensity, either through adding units or increasing pressure (or both), at a planned rate until the full intensity of the array is achieved.

5.3.2 Start-Up and Shutdown Procedures

Guidelines for the mitigation of seismic noise in the marine environment established DFO in 2004 (Mitigation of Seismic Noise in the Marine Environment – Statement of Canadian Practice; Appendix A) will be adopted. A designated observer for the presence of marine mammals and/or sea turtles will conduct a visual inspection of the area 30 minutes prior to commencement of the soft start.

The operator undertakes not to commence the array start-up, or to recommence firing the array if stopped, if any marine mammal is sighted within 500 metres of the survey vessel during this period. During ramp-up, if a marine mammal is sighted within 500 metres of the array, the array will be shut down.

If for any reason the array is shut down, ramp-up procedures will be followed prior to recommencing survey operations. Outside daylight hours, or in periods of low visibility, visual observations may not be practicable. In these situations, a soft-start approach will still be employed, and the reasons for “no observations” will be recorded.

Employing these mitigation methods, no measurable impact is anticipated for the leatherback sea turtle that could potentially enter the area of seismic profiling (Table 11).

5.3.3 Mitigations with Respect to Seabirds

The array will be gradually ramped-up and the array will generate impulses approximately every 15 seconds. Seabirds will therefore be warned as they approach the ship and array, which will reduce the likelihood that birds will choose to come close enough to the vessel or array to experience any measurable deleterious interaction.

Onboard lights are known to attract birds, although the situation on the survey vessel is not expected to be any different than that for any other similar sized cargo vessel or fishing ship. Nevertheless, the measures adopted to address stranding of *Storm Petrels* as described by Williams and Chardine will be adopted. A copy of this document is provided within Appendix J.

5.4 ACCIDENTS AND MALFUNCTIONS

All safety measures established on the research vessel will be enforced while seismic data are collected. Dedicated safety officers and crew of the research vessel will be fully briefed on the procedures required by the scientific staff for deployment, data collection, and instrument retrieval. No instrument deployment / data collection will occur at any time without the knowledge of the vessel Captain or designate. The vessel carries

trained personnel and applies specific protocols to deal with equipment malfunctions that may lead to the spill of toxic materials.

5.5 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Sea and ice conditions are the primary sources of potential effects of the environment on the project. If sea states exceed a Beaufort wind scale value of 7, with sea waves in excess of 3-4 metres in height, seismic activity cannot take place. Additionally, if pack-ice is covering the proposed survey area, no seismic data can be acquired in that region and another ice-free survey area must be visited.

As described in detail in Section 5.3.2, airgun start-up procedures will not commence unless a full 500 metre safety zone is clear of any marine mammal by visual inspection by a trained marine mammal observer for a continuous period of at least 30 minutes. Outside of daylight hours, or in periods of low visibility, visual observations may not be practicable. In these situations, start-up procedures (including a soft-start approach, described below) will still be employed, and the reasons for "no observations" will be recorded.

This gradual ramp-up / soft-start of the seismic array commences by firing a single source (preferably the smallest source in terms of energy output and volume), and then continuing to active additional sources in ascending order of size over a 20 minute period until the desired operating level is attained.

5.6 CUMULATIVE ENVIRONMENTAL EFFECTS

Environmental effects resulting from individual projects may accumulate and interact within the environment to result in cumulative environmental effects. Potential cumulative effects due to accumulation and/or interaction of the seismic program's activities are considered below. In this regard, the evaluation of cumulative environmental effects considers the nature and degree of change from baseline environmental conditions as they pertain to the proposed program, the program in combination with past and ongoing projects, and the program in combination with future planned projects and activities.

With regards to future activities, a critical step in the assessment process is determining what other projects or activities have reached a level of certainty (e.g. reasonable foreseeable) that they will be undertaken. Within the study area, other projects / activities that meet this level of certainty include: commercial fishing, commercial vessel / shipping (both domestic and international), scientific research surveys, and mineral resource exploration and development.

Seismic surveys are of particular interest since cumulative impacts from seismic impulses within the marine environment are significantly harder to quantify than effects attributed to other activities. This is because the acquisition of seismic data requires the temporary creation of sound / pressure waves (airgun-derived) that dissipate and soon disappear when the sound energy source is stopped. Unlike other mineral resource

exploration / extraction activities that are tangible in nature, such as the production and deposition of drilling muds on the seafloor, or other industrial related cumulative impacts, such as deposition of mine tailings and contaminant loading, any cumulative impact that maybe attributed to a seismic energy source is intangible and can only be measured as impacts associated with organisms in the environment.

Specifically, the energy source produces sound / pressure that, in it, do not “accumulate” in the physical environment from one project to another. There is no bioaccumulation of sound / pressure within the food chain as there can be with contaminants and noxious materials. However, there may be a relatively temporary additive effect if sounds from one activity coincide and overlap spatially and temporally with another concurrent activity. In any case, the “added sound” dissipates and is removed from the receiving environment once one or the other sound-generating source ceases or passes out of the area of concern.

To our knowledge, there have been no historical or current documented measurable cumulative physical environmental effects on any marine organism that can be attributed to, in part, a seismic energy source operating within the survey region. Thus, any cumulative impacts from a seismic survey energy source would have to be measured as behavioural impacts caused by repeated exposure to the energy source in conjunction with other sound sources.

Within the study area there may be many sound generating sources present when the seismic energy source is active. Commercial fishing occurs within the proposed survey area. Concurrent with fishing activity is domestic and international shipping. Propeller noise from these vessels combines to make the ocean a very noisy place, especially near and at primary fishing and commercial ports. Since the proposed seismic survey will not be concentrating efforts in areas of major commercial shipping activity for any extended period of time, it is not anticipated that the relatively small seismic survey vessel, with its associated propeller noise, will contribute a significant addition to the overall domestic / international vessel traffic noise within the region. This conclusion also applies to government research survey vessels that may occur within the proposed seismic survey area.

The behaviour of marine mammals and birds may be influenced by noise. Existing marine activities within the study area that contribute to background noise include: commercial fishing, general marine traffic (domestic and international shipping), government research surveys, as well as recreational boaters. In addition, there is considerable naturally occurring background noise, such as that cause by the cracking and breaking of sea ice. When combined, this combination of routine and naturally occurring sounds make the underwater environment considerably noisy. It is anticipated that the additional noise generated as a result of the present proposed seismic survey activities will be minimal, in part due to the broad area that is to be surveyed over an extended sampling time, and not concentrated in a particular area over a short period of time. Mitigation measures are in place to protect marine mammals and reptiles thus reducing the potential for impacts.

As noted in Appendix C, a considerable number of seismic studies have been undertaken in the region (190 seismic reflection surveys (2D and 3D), seismic refraction surveys, and shallow seismic / seabed surveys) and no measurable cumulative impact

on any fishery, nor other marine resource, has been identified that can be attributed to seismic exploration; therefore it is unlikely that cumulative impacts will result from the proposed program. Potential cumulative impact related to seabirds may primarily be related to accidents and malfunctions that may release hazardous materials, such as oils, into the marine environment that would combine with other materials already present. Mitigation methods are in place to address these issues. Furthermore, lights from several vessels operating in close proximity may cause cumulative impacts relating to stranding of birds on the vessels. However, due to the nature of the seismic survey method, where the seismic apparatus is towed up to several kilometres behind the survey vessel, no other vessel is likely to be in close proximity. Therefore, the likelihood of cumulative accidents / malfunctions releasing hazardous materials from the seismic survey vessel and another vessel is low, as is the attraction of seabirds to multiple vessels in close proximity to each other at night.

Commercial fishing and domestic / international shipping, as well as government research surveys, will continue to occur. However, no measurable cumulative impacts / effects associated with past or current activities have been identified despite over 1.5 million line kilometres of seismic survey data having been collected in the region. Overall, the proposed seismic survey is not projected to measurably contribute to residual cumulative environmental effects within the proposed survey area

5.7 CONSULTATIONS

As mentioned early in this document, in person meetings were held with HTO groups in the communities, meetings with Federal and territorial groups in Iqaluit prior to the commencement of the EA development. A copy of these meetings can be found in Appendix B. It is anticipated that RPS Energy will return to some communities for public meetings in late May 2011. These meetings were scheduled for May 1-6th but negative feedback due to it being election week, resulted in the decision to re-schedule.

Consultations with the fisheries industry have been conducted by the authors for marine 2D seismic reflection surveys in the Davis Strait in 2007 – '*Environmental Impact Assessment for Marine 2D Seismic Reflection Survey, Baffin Bay / Davis Strait / Labrador Sea, Offshore Canada* ' (LaPierre et al., 2007). The primary issues raised during these consultations were concerns regarding the potential impacts of seismic operations on the spawning of Greenland halibut in general, gear conflicts, and communications with the fisheries fleet in the field.

Spawning will not be impacted as there are no concentrated areas or timing of spawning to avoid in the survey area. Regardless, the commercial species of fish spawn at the ocean bottom, at depths well-removed from the surface where the sound could potentially result in temporary dispersal of fish. Science does not currently have sufficient data to identify a set period when spawning occurs in NAFO Divisions 0A and 0B; however, research on the Flemish Cap suggests that turbot do not have a peak spawning period, with some fish in spawning conditions year-round (Fisheries and Oceans Canada, 2005).

For fishing activity that takes place concurrently with the proposed geophysical program there is potential for gear interaction between the seismic and fishing vessels / gear;

however, the presence of a fisheries liaison officer (FLO) onboard the seismic vessel will ensure good communication at sea so that areas of fishing can be avoided when fishing is taking place. In practice seismic vessel yield to and/or avoid fixed gear locations, and work around fishing activity. It is routine for seismic vessels to break off survey lines in order to avoid fishing gear.

Since 1998, fishing effort restrictions have been in place to limit the time spent by vessels fishing for Greenland halibut (turbot) in this area, as the harvesting of this species is considered a potential impact on narwhal food supply. A fifteen-year rebuilding programme started in 2004 to attain a sustainable level of exploitable biomass. This issue will be closely monitored by the operator as it develops, and the onboard FLO and operator will be made aware of any developments related to the adoption of this policy in order to be fully aware of the potential fishing activity, and to facilitate appropriate communications with expected fishers. Effective communication between fishing vessels in the field and the survey vessel is recognized as a high priority for these operations.

As mentioned early in this document, in person meetings were held with HTO groups in the communities, meetings with Federal /Provincial groups in Iqaluit prior to the commencement of the EA development. A copy of these meetings can be found in Appendix B. It is anticipated that RPS Energy will return to some communities for public meetings in late May 2011. These meetings were scheduled for May 1-6th but negative feedback due to it being election week, resulted in the decision to cancel the meetings and reschedule.

5.8 FOLLOW-UP

No specific effects monitoring programs are indicated by this assessment. The survey provides a very good opportunity to collect environmental observation data related to some of the region's VEC's, specifically seabirds and marine mammals. After the survey the observation data will be submitted to the NEB (to pass onto Environment Canada and Fisheries and Oceans Canada), and will include a report on the results of the monitoring program.

Importance of ensuring the location of the survey activity is conveyed to the communities before the program begins. Onboard MMO will communicate this to the Hunters & Trappers Organization onshore, such that there is good awareness.

Further discussions will take place with the fishing fleet's to ensure exchange of contacts before survey work commences.

6. BIBLIOGRAPHY

Anderson Resources. 2001. Project Description for the Proposed Anderson Resources Ltd. Summer 2001/2002 Marine Seismic Program (Beaufort Sea), Inuvaluit Environmental and Geotechnical Inc. Calgary and Inuvik.

APPEA. 2004. Seismic and the marine environment. Australian Petroleum Production and Exploration Association Limited, Canberra.

Atlantic Leatherback Turtle Recovery Team. 2006. Recovery Strategy for the Leatherback Turtle (*Dermochelys coriacea*) in Atlantic Canada, Fisheries and Oceans Canada 2006.

Bainbridge, V. and J. Corlett. 1968. The zooplankton of the Northwestlant Surveys. ICNAF Special Publication. 5: 101-122 p.

BASIN Database. 2007. BASIN Database – Geophysical Surveys. Natural Resources Canada. Available at: http://basin.gsca.nrcan.gc.ca/index_e.php Accessed: April, 2010.

Booman, C., J. Dalen, H. Leivestad, A. Levsen, T. van der Meeren, and K. Toklum. 1996. Effects of airguns on eggs, larvae and fry. Fisken og Havet No. 3, Havforskningsintituttet-Institute of Marine Research.

Bowering, W.R. and K.H. Nedreaas. 2000. A comparison of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) fisheries and distribution in the Northwest and Northeast Atlantic. Sarsia. 85: 61-76.

Bowering, W.R. and D. Power. 1995. Spatial distribution of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) in the Labrador-eastern Newfoundland area of the Northwest Atlantic. NAFO Scientific Council Studies. 22: 51-62.

C-NLOPB / CNSOPB. 2002. Compensation Guidelines Respecting Damages Related to Offshore Petroleum Activity. Canada-Newfoundland and Labrador Offshore Petroleum Board and Canada-Nova Scotia Offshore Petroleum Board.
Available at: http://www.cnlopb.nl.ca/leg_guidelines.shtml
Accessed: April, 2010.

CNLOPB. 2008. Canada-Newfoundland and Labrador Offshore Petroleum Board Strategic Environmental Assessment Labrador Shelf Offshore Area Final Report. CNLOPB St Johns Newfoundland.

Coad, B.W. and J.D. Reist. 2004. Annotated List of the Arctic Marine Fishes of Canada. Canadian Manuscript Report of Fisheries and Aquatic Sciences: 2674.

Cosens, S.E., H. Cleator, and P. Richard. 2006. Numbers of bowhead whales (*Balaena mysticetus*) in the eastern Canadian Arctic, based on aerial surveys in August 2002, 2003 and 2004. Canadian Science Advisory Secretariat Research Document, 2006/052.
Available at: http://www.dfo-mpo.gc.ca/csas/Csas/DocREC/2006/RES2006_052_e.pdf
Accessed: April, 2010.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2001. COSEWIC assessment and update status report on the leatherback turtle *Dermochelys coriacea* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 25 p.
Available at: http://dsp-psd.pwgsc.gc.ca/Collection/CW69-14-116-2002E.pdf
Accessed: Apri, 2010.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2002a. COSEWIC assessment and update status report on the Blue Whale *Balaenoptera musculus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 32 p.
Available at: http://www.sararegistry.gc.ca/document/default_e.cfm?documentID=124
Accessed: Apri, 2010.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2002b. COSEWIC assessment and update status report on the polar bear *Ursus maritimus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 29 p.
Available at: http://dsp-psd.pwgsc.gc.ca/Collection/CW69-14-351-2004E.pdf
Accessed: Apri, 2010.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2003a. COSEWIC assessment and update status report on the Atlantic cod *Gadus morhua* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 76 p.
Available at: http://dsp-psd.tpsgc.gc.ca/Collection/CW69-14-311-2003E.pdf
Accessed: April, 2010.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2004a. COSEWIC assessment and update status report on the narwhal *Monodon monoceros* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 50 p.
Available at: http://dsp-psd.tpsgc.gc.ca/Collection/CW69-14-420-2005E.pdf
Accessed: April, 2010.

COSEWIC. 2004b. Assessment and Update Status Report in the Beluga Whale (*Delphinapterus leucas*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix+70 p.
Available at: http://www.sararegistry.gc.ca/document/default_e.cfm?documentID=410
Accessed: April, 2010.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2005. COSEWIC assessment and update status report on the bowhead whale *Balaena mysticetus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. viii + 51 p.
Available at:
http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr%5Fbowhead%5Fwhale%5Fe%2Epdf
Accessed: April, 2010.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2006a. COSEWIC assessment and update status report on the harbour porpoise *Phocoena phocoena* (Northwest Atlantic population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 32 p.
Available at: http://dsp-psd.tpsgc.gc.ca/Collection/CW69-14-232-2006E.pdf
Accessed: April, 2010.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2006b. COSEWIC assessment and update status report on the Atlantic walrus *Odobenus rosmarus rosmarus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Ix + 65 p.
Available at: http://dsp-psd.pwgsc.gc.ca/Collection/CW69-14-461-2006E.pdf
Accessed: April, 2010.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2006c. COSEWIC assessment and update status report on the Ivory Gull *Pagophila eburnea* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 42 p.
Available at: http://dsp-psd.pwgsc.gc.ca/Collection/CW69-14-13-2006E.pdf
Accessed: April, 2010

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2007. Canadian Species at Risk.
Available at: http://www.cosewic.gc.ca/eng/sct0/index_e.cfm
Accessed: April, 2010.

COSEWIC. 2008. COSEWIC assessment and update status report on the Killer Whale *Orcinus orca*, Southern Resident population, Northern Resident population, West Coast Transient population, Offshore population and Northwest Atlantic / Eastern Arctic population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. viii + 65 pp.

COSEWIC. 2008. COSEWIC assessment and update status report on the polar bear *Ursus maritimus* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. vii + 75 pp.

Dalen, J. and G.M. Knutsen. 1986. Scaring effects in fish and harmful effects on eggs, larvae and fry by offshore seismic explorations. In H.M. Merklinger (ed.), Progress in Underwater Acoustics. Plenum Press, New York, 93-102.

Davis, R.A., D.H. Thomson, and C.I. Malme. 1998. Environmental Assessment of Seismic Exploration on the Scotian Shelf. LGL Ltd.
Available at: http://www.cnsopb.ns.ca/environment_publications.php
Accessed: April, 2010.

DFO. 2000. Atlantic Walrus. DFO Science Stock Status Report E5-21(2000).

DFO. 2002. Underwater World – The Beluga. Canadian Department of Fisheries and Oceans, Communications Directorate. Ottawa, Ontario.

DFO. 2004. Potential Impacts of Seismic Energy on Snow Crab. Habitat Status Report 2004/003.

DFO. 2005. Stock Assessment of Northwest Atlantic Harp Seals (*Pagophilus groenlandicus*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2005/037.

DFO. 2005. State of the Ocean: Physical Oceanographic Conditions in the Newfoundland and Labrador Region. DFO Can. Sci. Advis. Sec. Advis. Rep. 2005/018.

DFO. 2006. Assessment of Divisions 0B-3K Northern Shrimp. Canadian Science Advisory Secretariate Science Advisory Report 2006/007.

DFO. 2006. 2005 State of the Ocean: Physical Oceanographic Conditions in the Newfoundland and Labrador Region. DFO. Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/018.

DFO. 2006. Assessment of Division 0B – 3K Northern Shrimp. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/007.

DFO. 2009. Review of aerial survey estimates for ringed seals (*Phoca hispida*) in westernHudson Bay. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/004.

DFO. 2010. Stock assessment of Northern Quebec (Nunavik) Beluga (*Delphinapterus leucas*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/076.

Dietz, R. and M.P. Heide-Jørgensen. 1995. Movements and swimming speed of narwhals (*Monodon monoceros*) instrumented with satellite transmitters in Melville Bay, Northwest Greenland. Canadian Journal of Zoology, 73: 2106-2119.

Dietz, R., M.P. Heide-Jørgensen, P.R. Richard, and M. Acquarone. 2001. Summer and Fall Movements of Narwhals (*Monodon monoceros*) from Northeastern Baffin Island towards Northern Davis Strait. Arctic, 54(3):244-261.
Available at: http://pubs.aina.ucalgary.ca/arctic/Arctic54-3-244.pdf
Accessed: April, 2010.

Dietz, R., M.P. Heide-Jørgensen, P.R. Richard, and M. Acquarone. 2001. Summer and Fall Movements of Narwhals (*Monodon monoceros*) from Northeastern Baffin Island towards Northern Davis Strait. Arctic, 54(3):244-261.

Doidge, D.W. and K.J. Finley. 1993. Status of the Baffin-Bay population of beluga, *Delphinapterus-leucas*. Canadian Field-Naturalist, 107 (4): 533-546.

Dueck, L.P., M.P. Heide-Jørgensen, M.V. Jensen, and L.D. Postma. 2006. Update on investigations of bowhead whale (*Balaena mysticetus*) movements in the eastern Arctic, 2003-2005, based on satellite-linked telemetry. Canadian Science Advisory Secretariat Research Document, 2006/050.
Available at: http://www.dfo-mpo.gc.ca/csas/Csas/DocREC/2006/RES2006_050_updated_E.pdf
Accessed: April, 2010.

Dunbar, M. J. 1970. On the Fishery Potential of the Sea Waters of the Canadian North Arctic. 23(3):150-174.
Available at: http://pubs.aina.ucalgary.ca/arctic/Arctic23-3-150.pdf
Accessed: April, 2010.

Dunbar, M. J.1988. Animal Life Section. The New Encyclopedia Britanica Volume 14. 1988. page 6 of Arctic Section. Encylopedia Briticanica 1988.Macropedia, The Arctic, Volume 14, pp.1-41.

Dunbar, M.J., and D.M. Moore. 1980. Marine Life and Its Environment in the Canadian Eastern Arctic: a Biographic Study. Marine Sciences Manuscript No. 33., McGill University 1980, 119 p.

Enger, P.S. 1967. Hearing in herring. Comparative Biochemistry and Physiology, Part A. 22: 527-538.

Enger, P.S. 1981. Frequency discrimination in teleosts – central or peripheral. In W.N. Tavolga and A.N. Popper (eds.), Hearing and Sound Communication in Fishes. Springer-Verlag, New York, New York. 243-255.

Evans, M.I., P. Symens, and C. Pilcher. 1993a. Short-term damage to coastal bird populations in Saudi Arabia and Kuwait following the 1991 Gulf War Marine Pollution. Marine Pollution Bulletin, 22: 157-161.

Evans, P.G.H., E.J. Lewis, and P. Fisher. 1993b. A study of the possible effects of seismic testing upon cetaceans in the Irish Sea. Sea Watch Foundation for Marathon Oil UK Ltd., Aberdeen.

Evans, P.G.H. and J.A. Raga, eds. 2001. Marine Mammals: Biology and Conservation. Kluwer Academic / Plenum Publishers. New York. 630 p.

Falk M.R. and M.J. Lawrence. 1973. Seismic Exploration: Its Nature and its Effects on Fish. Tech. Rep. Ser. No. Vol. CEN/T 73-9. 51p.

Fallis, B.W., W.E. Klenner, and J.B. Kemper. 1983. Narwhal surveys and associated marine mammal observations in Admiralty Inlet, Navy Board Inlet, and Eclipse Sound, Baffin Island, N.W.T., during 1974-1976. Canadian Technical Report of Fisheries and Aquatic Sciences, 1211: 20 p.

Finley, K.J. 2001. Natural History and Conservation of the Greenland Whale, of Bowhead in the northwest Atlantic. Arctic 54(1):55-76.

Finneran, J. J., C.E. Schlundt, R. Dear, D.A. Carder, and S.H. Ridgway. 2002. Temporary shift in masked hearing thresholds in odontocetes after exposure to single underwater impulses from a seismic watergun. Journal of the Acoustical Society of America. 111 (6): 2929-2940.

Fisheries and Oceans Canada. 2004a. Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment. DFO HSR 2004/002.
Available at: http://www.dfo-mpo.gc.ca/oceans-habitat/oceans/im-gi/seismic-sismique/index_e.asp
Accessed: April, 2010.

Fisheries and Oceans Canada. 2004b. Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals.
Available at: http://www.dfo-mpo.gc.ca/csas/Csas/status/2004/HSR2004_002_E.pdf
Accessed: April, 2010.

Fisheries and Oceans Canada. 2005a. Recovery Potential Assessment of Cumberland sound, Ungava Bay, Eastern Hudson Bay and St. Lawrence beluga populations (*Delphinapterus leucas*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2005/036. Updated March 2006.
Available at: www.dfo-mpo.gc.ca/csas/Csas/status/2005/SAR-AS2005_036_e.pdf
Accessed: April, 2010.

Fisheries and Oceans Canada, 2005b. Stock Assessment of Northwest Atlantic Harp Seals (Pagophilus groenlandicus). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2005/037.
Available at: http://www.dfo-mpo.gc.ca/csas/Csas/status/2005/SAR-AS2005_037_E.pdf
Accessed: April, 2010.

Fisheries and Oceans Canada. 2005c. Fisheries Management Plan, Greenland Halibut, NAFO Subarea 0, 2003-2005. Fisheries and Oceans Canada – Central and Arctic Region. DFO 2005/795.
Available at: http://www.dfo-mpo.gc.ca/Library/315348.pdf
Accessed: April, 2010.

Fisheries and Oceans Canada. 2007. Development of a Closed Area in NAFO 0A to Protect Narwhal Over-Wintering Grounds, Including Deep-sea Corals. Canadian Science Advisory Secretariat. Science Response 2007/002.
Available at: http://www.dfo-mpo.gc.ca/csas/Csas/Publications/ScR-RS/2007/ScR-RS2007_002_e.pdf
Accessed: April, 2010

Gass, S.E. and J.H.M. Willison. 2005. An Assessment of the distribution of deep sea corals in Atlantic Canada by using both scientific and local forms of knowledge. *In* A.R. Freiwald, and J.M. Roberts (eds) Cold water Corals and Ecosystems. Springer – Verlag Berlin Heidelberg, 223-245.

Gaston, A.J. and I.L. Jones. 1998. The Auks: Alcidae (Bird Families of the World). Oxford University Press.

Gaston A.J. 1980. Populationss, movements and wintering areas of Thick-billed Murres Uria lomvis in eastern Canada. Can. Wildl. Ser.Prog. Notes 110:1-10.

Gausland, I. 2000. Impact of seismic surveys on marine life. The Leading Edge. 19 (8): 903-905.

Gilchrist, H.G. and M.L. Mallory. 2005. Declines in abundance and distribution of the Ivory Gull (*Pagophila burnean*) in Arctic Canada. Biological Conservation 121: 303-309.

Goold, J.C. 1996a. Acoustic assessment of populations of common dolphin *Delphinus delphis* in conjunction with seismic surveying. Journal of the Marine Biological Association 76: 811-820.

Gosselin, J-F. Lesage, V. et Hammill, MO. 2009. Abundance indices of beluga in James Bay, eastern Hudson Bay and Ungava Bay in 2008. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/006. iv + 25 p.

Gouvernment of Canada, 4, 8, 4-Lancaster Sound, CP 2010-01348, Press Release - Communiqué

Grainger, E.H. 1959. The annual oceanographic cycle at Igoolik in the Canadian Arctic. The zooplankton and physical and chemical observations. Journal of the Fisheries Research Board of Canada. 16 (4): 453-501.

Grainger, E.H. 1961. The copepods Calanus glacialis Jaschnov and Calanus finmarchicus (Gunnerus) in the Canadian Arctic-Subarctic waters. Journal of the Fisheries Research Board of Canada. 18: 663-678.

Grainger, E.H. 1963. Copepods of the genus Calanus as indicators of eastern Canadian waters. Royal Society of Canada Special Publication. 5: 68-94.

Granger, E.H. 1965. Zooplankton from the Arctic Ocean and adjacent Canadian waters. Journal of the Fisheries Research Board of Canada. 22:543-564.

Hammill, M.O. and G. Stenson. 2006. Abundance of northwest Atlantic hooded seals (1960-2005). Canadian Science Advisory Secretariat Research Document 2006/068.

Hammill, M. O. and Lesage, V. 2009. Seasonal movements and abundance of beluga in northern Quebec (Nunavik) based on weekly sightings information. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/010. iv + 14 p.

Hammill, M. O. Kindsley, M. C. S. Lesage and Gosselin, J.-F. 2009. Abundance of Eastern Hudson Bay belugas. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/009. iv + 22 p.

Hastings, M.C., A.N. Popper, J.J. Finneran, and P.J. Lanford. 1996. Effects of low frequency underwater sound on hair cells of the inner ear and lateral line of the teleost fish *Astronotus ocellatus*. Journal of the Acoustical Society of America. 99 (3): 1759-1766.

Heide-Jørgensen, M.P., K.L. Laidre, Ø. Wiig, M.V. Jensen, L. Dueck, L.D. Maiers, et al. 2003. From Greenland to Canada in Ten Days: Tracks of Bowhead Whales, *Balaena mysticetus*, across Baffin Bay. Arctic, 56 (1): 21-31.
Available at: http://pubs.aina.ucalgary.ca/arctic/Arctic56-1-21.pdf
Accessed: April, 2010.

Horner, R and V. Alexander, 1972. Algal Populations in Arctic Sea Ice: An Investigation of Heterotrophy. Limnology and Oceanography. 17 (3): 454-458.

Hsiao, S.I.C. and N. Pinkewycz. 1987. Phytoplankton data from western Baffin Bay and adjacent waters. Can. Data Rep. Fish Aquatic Sci. 674 : iv + 55 p.

Huettmann F. and A.W. Diamond. 2000. Seabird migration in the Canadian northwest Atlantic Ocean: moulting locations and movement patterns of immature birds Can J. Zoology 78:624-647.

Husky. 2008. Environmental Impact Assessment For Marine 2d Seismic Reflection Survey Davis Strait Offshore Greenland And Canada Husky Oil Operations Limited (Husky) 2008.

IAGC (International Association of Geophysical Contractors). 2002a. Marine Seismic Operations – An Overview.
Available at: https://www.cagc.ca/index.html?DISPLAY=studies_arrays
Accessed: April, 2010

IAGC (International Association of Geophysical Contractors). 2002b. Airgun Arrays and Marine Mammals.
Available at: https://www.cagc.ca/index.html?DISPLAY=studies_arrays
Accessed: April, 2010

Jensen, H.M., L. Pedersen, A.D. Burmeister, and B.W. Hansen. 1999. Pelagic primary production during summer along 65 to 72 degrees N off West Greenland. Polar Biology, 21: 269-278.

Jørgensen, O.A. 1997a. Movement patterns of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)), at West Greenland, as inferred from trawl survey distribution and size data. Journal of Northwest Atlantic Fishery Science. 21: 23-37.

Jørgensen, O.A. 1997b. Pelagic occurrence of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)), in West Greenland waters. Journal Science. 21: 39-50.

Junquera, S. And J. Zamarro. 1994. Sexual maturity and spawning of Greenland halibut (*Reinhardtius hippoglossoides*) from Flemish Pass area. NAFO Scientific Council Studies. 20: 47-52.

Kennedy, M. 2005. Davis Strait and Baffin Bay Zooplankton. In: Fisheries and Oceans, Canada - Biological and Chemical Marine Environmental Database (BioChem) . OBIS Canada, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, 2005, Version 1, Digital. Retrieved from http://www.iobis.org.

Kosheleva, V. 1992. The impact of air guns used in marine seismic explorations on organisms living in the Barents Sea. Fisheries and Offshore Petroleum Exploitation 2nd International Conference, Bergen, Norway, April 6th-8th, 1992.

Lacroix, D.L., R.B. Lancetot, J.A. Reed, and T.L.McDonald. 2003. Effect of underwater seismic surveys on molting male Long-tailed Ducks in the Beaufort Sea, Alaska Canadian Journal of Zoology 81:1862-1875.

LaPierre, T., C. Hawkins, S. Bigg, and B. Wheeler. 2007. Environmental Impact Assessment for Marine 2D Seismic Reflection Survey, Baffin Bay / Davis Strait / Labrador Sea, Offshore Canada. RPS Energy, Halifax, Nova Scotia, Canada, for TGS-NOPEC Geophysical Company ASA, Asker, Norway. RPS Energy Report No. 06-256.1. 361 p.

Leatherwood, S., D.K. Caldwell, and H.E. Winn. 1976. Whales, Dolphins, and Porpoises of the Western North Atlantic. A Guide to their Identification. NOAA Technical Report. NMFS Circ. 396. 176 p.

Lehoux, D., and D. Bordage. 2000. Deterrent techniques and bird dispersal approach for oil spills. Environment Canada Canadian Wildlife Service 2000.

LGL. 1983. Biological Environment of Eastern Lancaster Sound and Western Baffin Bay: Components and Important Processes. Environmental Studies No. 30, Northern Affairs Program. Indian and Northern Affairs Ottawa 288p.

LGL. 2003. Orphan Basin Strategic Environmental Assessment. LGL Ltd. For Chevron Canada Resources, St. John's, Canada.

LGL. 2005. Husky Delineation/Exploration Drilling Program for Jeanne d'Arc Basin Area Environmental Assessment, Husky Oil Operations Limited.

Ljungblad, D.K., B. Wursig, S.L. Swartz, and J.M. Keene. 1988. Observations on the behavioral responses of bowhead whales (*Balacena mysticetus*) to active geophysical vessels in the Alaskan Beaufort Sea. Arctic. 41: 183-194.

Lubinsky, I.1980. Marine Bivalve Molluscs of the Canadian Central and Eastern Arctic: Faunal Composition and Zoogeography. Bulletin 207, Department of Fisheries and Oceans.

MacLaren, I. A. 1958. The biology of the ringed seal (Phoco hispida Schreber) in the eastern Canadian Arctic Bull. Fish. Res. Bd. Canada, 118: viii + 97.

MacLaren, P. 1977. Report on biological literature review of the Labrador Sea region. Report for Imperial Oil Ltd., by MacLaren Atlantic Ltd., St John.s, Newfoundland. 109 p.

MacLaren Atlantic Limited. 1978a. Biological Literature Review of the Davis Strait Region. Arctic Petroleum Operators Association Project No. 138, January 1978.

MacLaren Atlantic Limited. 1978b. Biological Studies, Offshore Cruise 77-7 through 77-7, July to December 1977 *in* Davis Strait. Arctic Petroleum Operators Association Project No. 138, May 1978.

MacLaren Atlantic Limited. 1978c. Aerial surveys 77-2, 77-3, 77-4. Studies of seabirds and marine mammals in Davis Strait, Hudson Strait and Ungava Bay. Arctic Petroleum Operators Association, Project No. 134 and 138. Unpublished report.

MacLean, B., G.L. Williams, and S.P. Srivastava. 1990. Geology of Baffin Bay and Davis Strait. In Geology of Canada No. 2: Geology of the continental margin of eastern Canada, M.J. Keen and G.L. Williams (eds.). Geological Survey of Canada, Paper 79=23, 20 p.

Mallory, M.L. and A.J. Fontaine 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Canadian Wildlife Service Occasional Paper Number 109, March 2004.

Mansfield, A.W., T. Smith, and B. Beck. 1975. The Narwhal in Eastern Canadian Waters. J. Fish. Res. Bd. Canada 32: 1041-1046.

Matthews, J.B.L. 1969. Continuous plankton records: the geographical and seasonal distribution of Calanus finmarchicus S.L. in the north Atlantic. Bulletins of Marine Ecology. 6: 251-273.

McCauley, R.D., M.N Jenner, C. Jenner, K.A. McCabe, and J. Murdoch. 1998. The response of humpback whales (*Megaptera novaeangliae*) to offshore seismic survey noise: Preliminary results of observations about a working seismic vessel and experimental exposures. Journal of the Australian Petroleum Production and Exploration Association, 692-707.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000a. Marine seismic surveys: Analysis of and propagation of air-gun signals and effects of air-gun exposure on humpback whales, sea turtles, fishes and squid. Prepared for Australian Petroleum Production and Exploration Association. Centre for Marine Science and Technology, Curtin University, Perth, Australia.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000b. Marine Seismic Surveys: A Study of Environmental Implications. Journal of the Australian Petroleum Production and Exploration Association, 40: 692-706

McLaren, P.L. 1982. Spring migration and habitat use by key seabirds in eastern Lancaster Sound and western Baffin Bay. Arctic. 35 (1):88-111.
Available at: http://pubs.aina.ucalgary.ca/arctic/Arctic35-1-88.pdf
Accessed: April, 2010.

McLaren, P.L. and M.A. McLaren 1982. Waterfowl populations in eastern Lancaster Sound and western Baffin Bay. Arctic. 35 (1): 149-157.
Available at: http://pubs.aina.ucalgary.ca/arctic/Arctic35-1-149.pdf
Accessed: April, 2010.

McLaren, P.L., R.E. Harris, and I.R. Kirkham. 1982. Distribution of marine mammals in the southern Labrador Sea, April 1981 – April 1982. Offshore Labrador Biological Studies (OLABS) Program. Canadian Oil and Gas Lands Administration, Environmental Protection Branch.

MKI December 2010

MMS. 1998. MMS, Mineral Management Service, U.S. Department of the Interior. 1998 Beaufort Sea Planning Area, Oil and Gas Lease Sale 170, Final WIS, May, MMM 98-0007.

Mohammed 2001

Montevecchi, W.A. and I.J. Stenhouse 2002. Dovekie (Alle alle). *In* A. Poole and F. Gill (eds), The birds of North America No. 701. The Birds of North America, Inc. Philadelphia, Pennsylvania. 24 p.

Morgan, M. J. and W. R. Bowering. 1997. Temporal and geographic variation in maturity at length and age of Greenland halibut (*Reinhardtius hippoglossoides*) from the Canadian north-west Atlantic with implications for fisheries management. ICES Journal of Marine Science. 54:5.

Morgan, M.J., and M.A. Treble. 2006. A First Look at Maturity Data for Greenland Halibut from Trawl Surveys of NAFO Subarea 0. NAFO SCR Doc. 06/5. 10 p.
Available at: http://archive.nafo.int/open/sc/2006/scr06-005.pdf
Accessed: April, 2010.

Mosbech, A. and D. Boertmann 1999. Distribution, abundance and reaction to aerial surveys of postbreeding king eiders (*Somateria spectabilis*) in western Greenland. – Arctic 52: 188-203.

Mosbech, A., R. Dietz, and J. Nymand. 2000. Preliminary Environmental Impact Assessment of Regional Offshore Seismic Surveys in Greenland. Arktisk Miljø/ Arctic Environment. 2nd Ed. National Environmental Research Institute, Denmark. 25 pp. – Research Notes from NERI No. 132.
Available at: http://www.bmp.gl/petroleum/NERI%20Rapport%20132_sec_dmu.pdf
Accessed: April, 2010.

Moshenko, R.W., S.E. Cosens, and T.A. Thomas. 2003. Conservation Strategy for Bowhead Whales (Balaena mysticetus) in the Eastern Canadian Arctic. National Recovery Plan No. 24. Recovery of Nationally Endangered Wildlife (RENEW). Ottawa, Ontario. 51 p.

NAMMCO (North American Marine Mammal Commission). 2005. Status of Marine Mammals in the North Atlantic – The Beluga Whale. NAAMCO Scientific Publications. 12 p.
Available at: http://www.nammco.no/webcronize/images/Nammco/667.pdf
Accessed: April, 2010

Nazareth, J. and J. Steensboe (eds). 1998. Physical Environment of Eastern Davis Strait and Northeastern Labrador Sea. Mineral Resources Administration (MRA) for Greenland, Copenhagen, Denmark.
Available at: http://www.geus.dk/ghexis/pdf/davisst.pdf
Accessed: April, 2010.

New Parks North. 2004

NRC (National Research Council). 2003b. Marine Mammals and Low-frequency Sound: Progress Since 1994. National Academy Press, Washington DC. 158 pp.

NRC (National Research Council). 2005. Population, land use, and environment: research directions, By Barbara Entwisle, Paul C. Stern, National Research Council (U.S.). Panel on New Research on Population and the Environment. 307 pp.

NRC2007

NRCan (Natural Resources Canada). 2008. The Atlas of Canada.
Available at: http://atlas.nrcan.gc.ca/site/english/maps/environment/seaice/1
Accessed: April, 2010.

Nunavut Wildlife Management Board. 2000. Final Report of the Inuit Bowhead Knowledge Study.
Available at: http://www.nwmb.com/english/resources/Bowheadreport.pdf
Accessed: April, 2010.

Nunavut Wildlife Management Board. 2004. Final Report: The Nunavut Wildlife Harvest Study. Available at: http://www.nwmb.com/english/resources/harvest_study/NWHS%202004%20Report.pdf Accessed: April, 2010.

Olsen, K. 1969. A comparison of acoustic threshold in cod with recordings of shipnoise. Proceedings of the FAO Conference on Fish Behaviour in Relation to Fishing Techniques and Tactics. FAO Fisheries. 62 (2): 431-438.

Orr, C.D. and R.M.P. Ward. 1982. The autumn migration of Thick-billed Murres near Southern Baffin Island and Northern Labrador. Arctic 35 (4): 531-536. Available at: http://pubs.aina.ucalgary.ca/arctic/Arctic35-4-531.pdf Accessed: April, 2010.

Parsons, D.G. 1993. Underwater World: The Northern Shrimp. DFO.

Parsons, L.S. 1976. Distribution and relative abundance of roundnose, roughhead and common grenadiers in the Northwest Atlantic International Commission for the Northwest Atlantic Fisheries Selected Papers. 1: 73-88.

Payne, J.F., C. Andrews, L. Fancy, D. White, and J. Christian. 2008. Potential effects of seismic energy on fish and shellfish: An update since 2003. Canadian Advisory Secretariat Research Document 2008/060.

Pearson, W.H., J.R. Skalski, and C.I. Malme. 1987. Effects of sounds from a geological device on fishing success. OCS Study MMS-87-0020. Prepared by Battelle Memorial Institute under Contract No. 14-12-0001-30273 to the Department of the Interior, Minerals Management Service, Pacific Outer Continental Shelf Region, Los Angeles, CA.

Postolaky, A.I. 1969. The life cycle pattern of Labrador cod, Gadus morhua L., in ICNAF subarea 2. International Commission for the Northwest Atlantic Fisheries Special Publication. 7: 139-144.

Priest, H. and P. Usher. 2004. The Nunavut Harvest Study. Nunavut Wildlife Management Board, Iqaluit, Nunavut Canada.

Reeves and Cosens 2003

Renaud, W.E., P.L. McLaren, and S.R. Johnson. 1982. The Dovekie, *Alle alle*, as a spring migrant in eastern Lancaster Sound in western Baffin Bay. Arctic. 35 (1): 118-125. Available at: http://pubs.aina.ucalgary.ca/arctic/Arctic35-1-118.pdf
Accessed: April, 2010.

Richardson, W. J., B. Wursig, and C.R. Greene. 1986. Reactions of bowhead whales, *Balaena mysticetus*, to seismic explorations in the Canadian Beaufort sea. Journal of the Acoustical Society of America. 79 (4): 1117-1128.

Richardson, W.J., C.R. Greene Jr., C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. Academic Press, San Diego, California.

Richardson, W.J., G.W. Miller, and C.R. Green. 1999. Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea. Journal of the Acoustical Society of America. 106: 2281.

Rice, P.D., and B.D. Shade. 1982. Reflection seismic interpretation and seafloor spreading history of Baffin Bay. In Arctic Geology and Geophysics, A.F. Embry and H.R. Balkwill (eds.). Canadian Society of Petroleum Geologists, Memoir 8, p. 245-265.

Sætre, R. and E. Ona. 1996. Seismike undersøkelser og på fiskeegg og larver en vurdering av mulige effecter pa bestandsniva. [Seismic investigations and damages to fish eggs and larvae; an evaluation of possible effects on stock level]. (Norwegian, with English summary), Fisken og Havet 1-17, 1-8.

SARA 2004

Sergeant, D.E. 1974. A rediscovered whelping population of hooded seals, *Cystophora cristata* Erxleben, and its possible relationship to other populations. Polarforschung 44 (1): 1-7.

Sergeant, D. E. 1976. History and present status of populations of harp and hooded seals. Biol. Conserv.,10: 95–118.

Sikumuit. 2008. Sikumiut Environmental Management Ltd. 175 Hamlyn Road St. John's, Newfoundland and Labrador, A1E 5Z5.

Smidt, E. 1968. Report on Greenland halibut and halibut eggs and larvae. International Commission for the Northwest Atlantic Fisheries Special Publication. 7: 175-179.

Smidt, E. 1968. Report on Greenland halibut and halibut eggs and larvae. International Commission for the Northwest Atlantic Fisheries Special Publication. 7:175-179.

Stemp, R. 1985. Observations on the effects of seismic exploration on seabird. I G.D. Greene, F.R. Engelhardt, and R.J. Peterson (eds.), Proceedings of workshop on effects of explosives use in the marine environment, Canadian Oil and Gas administration. Environmental Protection Branch, Technical Report No. 5. Ottawa.

Stephenson, S.A., and L. Hartwig. 2010. The Arctic Marine Workshop: Freshwater Institute Winnipeg, Manitoba, February 16-17, 2010. Can. Manuscript Rep. Fish. Aquat. Sci. 2934:

Tang, C.C.L., C.K. Ross, T. Yao, B. Petrie, B.M. DeTracy and E. Dunlap. 2004. The circulation, water masses and sea-ice of Baffin Bay. Bedford Institute of Oceanography. 60 p.

Taylor, M.K., S. Akeeagok, D. Andriashek, W. Barbour, E.W. Born, W. Calvert, et al. 2001. Delineating Canadian and Greenland polar bear (*Ursus maritimus*) populations by cluster analysis of movements. Canadian Journal of Zoology, 79: 690-709.
Available at: http://article.pubs.nrc-cnrc.gc.ca/ppv/RPViewDoc?_handler_=HandleInitialGet&journal=cjz&volume=79&calyLang=eng&articleFile=z01-028.pdf
Accessed: April, 2010.

Thompson, D.H. 1982. Marine Benthos in the Eastern Canadian High Arctic: Multivariate Analysis of Standing Crop and Community Structure. Arctic Vol 35(1):61-74.

Thompson, P.M., M. Sjöberg, E.B. Bryant, P. Lovell, and A. Bjørge. 1998. Behavioural and physiological responses of harbour (*Phoca vitulina*) and grey (*Halichoerus grypus*) seals to seismic surveys. World Marine Mammal Science Conference, Monac.

Thompson, P.O., W.C. Cummings, and S.J. Ha. 1986. Sounds, source levels, and associated behavior of humpback whales, Southeast Alaska. Journal of the Acoustical Society of America. 80 (3): 735-740.

Thomson, D.H., J.W. Lawson, and A. Muecke. 2001. Proceedings of a Workshop to Develop Methodologies for Conducting Research on the Effects of Seismic Exploration on the Canadian East Coast Fishery, Halifax, Nova Scotia, September 7th - 8th, 2000. Environmental Studies Research Funds Report No. 139.

Treble, M.A., W.B. Brodie, W.R. Bowering, and O.A. Jørgensen. 2001. Analysis of data from a trawl survey in NAFO Division 0B, 2000. NAFO SCR Doc. 01/42. 19 p.
Available at: http://www.iim.csic.es/pesquerias/Pesca/NAFO/SCDocs/2001/scr01-042.pdf
Accessed: April, 2010.

Turnpenny, A.W.H. and J.R. Nedwell. 1994. The Effects on Marine Fish, Diving Mammals and Birds of Underwater Sound Generated by Seismic Surveys. Fawley Aquatic Research Laboratories Ltd., for United Kingdom Offshore Operators Association Limited, London.

US National Marine Fisheries Service. 1995. Small takes of marine mammals incidental to specified activities; offshore seismic activities in southern California/Notice of issuance of an Incidental Harassment Authorization. Federal Register, 60 (200, 17 October):53753-53760.

US National Marine Fisheries Service. 2000. Small takes of marine mammals incidental to specified activities; marine seismic-reflection data collection in southern California/Notice of receipt of application. Federal Register, 65 (102, 25 May):34014-34032.

Weinhold, R.J. and R.R. Weaver. 1982. Seismic air guns affect on immature coho salmon. Preprint, Society of Exploration Geophysicists, Tulsa, Oklahoma.

Western Australian Department of Minerals and Energy. 2001. Guidelines on minimising acoustic disturbance to marine fauna. Petroleum Information Series, Guidelines Sheet 1.

Appendix A

Statement of Canadian Practice

Fisheries and Oceans Canada | Pêches et Océans Canada

Canada

Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment

Context

The Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment specifies the mitigation requirements that must be met during the planning and conduct of marine seismic surveys, in order to minimize impacts on life in the oceans. These requirements are set out as minimum standards, which will apply in all non-ice covered marine waters in Canada. The Statement complements existing environmental assessment processes, including those set out in settled land claims. The current regulatory system will continue to address protection of the health and safety of offshore workers and ensure that seismic activities are respectful of interactions with other ocean users.

Definitions

Cetacean: means a whale, dolphin or porpoise.

Critical habitat: means the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species.

Marine Mammal Observer: means an individual trained to identity different species of marine mammals and turtles that may reasonably be expected to be present in the area where the seismic survey will take place.

Marine mammals: means all cetaceans and pinnipeds.

Passive Acoustic Monitoring: means a technology that may be used to detect the subsea presence of vocalizing cetaceans.

Pinniped: means a seal, sea lion or walrus.

Ramp-up: means the gradual increase in emitted sound levels from a seismic air source array by systematically turning on the full complement of an array's air sources over a period of time.

Seismic air source: means an air source that is used to generate acoustic waves in a seismic survey.

Seismic air source array(s): means one or a series of devices designed to release compressed air into the water column in order to create an acoustical energy pulse to penetrate the seafloor.

Seismic survey: means a geophysical operation that uses a seismic air source to generate acoustic waves that propagate through the earth, are reflected from or refracted along subsurface layers of the earth, and are subsequently recorded.

"Statement": means the Statement of Canadian Practice for the Mitigation of Seismic Sound in the Marine Environment.

Whale: means a cetacean that is not a dolphin or porpoise.

Application

1. Unless otherwise provided, the mitigation measures set out in this Statement apply to all seismic surveys planned to be conducted in Canadian marine waters and which propose to use an air source array(s).

2. The mitigation measures set out in this Statement do not apply to seismic surveys conducted:
    a. on ice-covered marine waters; or
    b. in lakes or the non-estuarine portions of rivers.

Planning Seismic Surveys

Mitigation Measures

3. Each seismic survey must be planned to
    a. use the minimum amount of energy necessary to achieve operational objectives;
    b. minimize the proportion of the energy that propagates horizontally; and
    c. minimize the amount of energy at frequencies above those necessary for the purpose of the survey.

4. All seismic surveys must be planned to avoid:
    a. a significant adverse effect for an individual marine mammal or sea turtle of a species listed as endangered or threatened on Schedule 1 of the *Species at Risk Act*; and
    b. a significant adverse population-level effect for any other marine species.

5. Each seismic survey must be planned to avoid:
    a. displacing an individual marine mammal or sea turtle of a species listed as endangered or threatened on Schedule 1 of the *Species at Risk Act* from breeding, feeding or nursing;
    b. diverting an individual migrating marine mammal or sea turtle of a species listed as endangered or threatened on Schedule 1 of the *Species at Risk Act* from a known migration route or corridor;
    c. dispersing aggregations of spawning fish from a known spawning area;
    d. displacing a group of breeding, feeding or nursing marine mammals, if it is known there are no alternate areas available to those marine mammals for those activities, or that if by using those alternate areas, those marine mammals would incur significant adverse effects; and
    e. diverting aggregations of fish or groups of marine mammals from known migration routes or corridors if it is known there are no alternate migration routes or corridors, or that if by using those alternate migration routes or corridors, the group of marine mammals or aggregations of fish would incur significant adverse effects.

Safety Zone and Start-up

Mitigation Measures

6. Each seismic survey must:
    a. establish a safety zone which is a circle with a radius of at least 500 metres as measured from the centre of the air source array(s); and
    b. for all times the safety zone is visible,
        i. a qualified Marine Mammal Observer must continuously observe the safety zone for a minimum period of 30 minutes prior to the start up of the air source array(s), and
        ii. maintain a regular watch of the safety zone at all other times if the proposed seismic survey is of a power that it would meet a threshold requirement for an assessment under the *Canadian Environmental Assessment Act*, regardless of whether the Act applies.

7. If the full extent of the safety zone is visible, before starting or restarting an air source array(s) after they have been shut-down for more than 30 minutes, the following conditions and processes apply:
    a. none of the following have been observed by the Marine Mammal Observer within the safety zone for at least 30 minutes:
        i. a cetacean or sea turtle,
        ii. a marine mammal listed as endangered or threatened on Schedule 1 of the *Species at Risk Act*, or
        iii. based on the considerations set out in sub-section 4(b), any other marine mammal that has been identified in an environmental assessment process as a species for which there could be significant adverse effects; and
    b. a gradual ramp-up of the air source array(s) over a minimum of a 20 minute period beginning with the activation of a single source element of the air source array(s), preferably the smallest source element in terms of energy output and a gradual activation of additional source elements of the air source array(s) until the operating level is obtained.

Shut-down of Air Source Array(s)

Mitigation Measures

8. The air source array(s) must be shut down immediately if any of the following is observed by the Marine Mammal Observer in the safety zone:
    a. a marine mammal or sea turtle listed as endangered or threatened on Schedule 1 of the *Species at Risk Act*; or
    b. based on the considerations set out in sub-section 4(b), any other marine mammal or sea turtle that has been identified in an environmental assessment process as a species for which there could be significant adverse effects.

Line Changes and Maintenance Shut-downs

Mitigation Measures

9. When seismic surveying (data collection) ceases during line changes, for maintenance or for other operational reasons, the air source array(s) must be:
    a. shut down completely; or
    b. reduced to a single source element.

10. If the air source array(s) is reduced to a single source element as per subsection 9(b), then:
    a. visual monitoring of the safety zone as set out in section 6 and shut-down requirements as set out in section 8 must be maintained; but
    b. ramp-up procedures as set out in section 7 will not be required when seismic surveying resumes.

Operations in Low Visibility

Mitigation Measures

11. Under the conditions set out in this section, cetacean detection technology, such as Passive Acoustic Monitoring, must be used prior to ramp-up for the same time period as for visual monitoring set out in section 6. Those conditions are as follows:
    a. the full extent of the safety zone is not visible; and
    b. the seismic survey is in an area that
        i. has been identified as critical habitat for a vocalizing cetacean listed as endangered or threatened on Schedule 1 of the *Species at Risk Act*, or
        ii. in keeping with the considerations set out in sub-section 4(b), has been identified through an environmental assessment process as an area where a vocalising cetacean is expected to be encountered if that vocalizing cetacean has been identified through the environmental assessment process as a species for which there could be significant adverse effects.

12. If Passive Acoustic Monitoring or similar cetacean detection technology is used in accordance with the provision of section 11, unless the species can be

identified by vocal signature or other recognition criteria:

a. all non-identified cetacean vocalizations must be assumed to be those of whales named in sections 8(a) or (b); and
b. unless it can be determined that the cetacean(s) is outside the safety zone, the ramp-up must not commence until non-identified cetacean vocalizations have not been detected for a period of at least 30 minutes.

Additional Mitigative Measures and Modifications

Mitigation Measures

13. Persons wishing to conduct seismic surveys in Canadian marine waters may be required to put in place additional or modified environmental mitigation measures, including modifications to the area of the safety zone and/or other measures as identified in the environmental assessment of the project to address:
    a. the potential for chronic or cumulative adverse environmental effects of
        i. multiple air source arrays (e.g., two vessels on one project; multiple projects), or
        ii. seismic surveys being carried out in combination with other activities adverse to marine environmental quality in the area affected by the proposed program or programs;
    b. variations in sound propagation levels within the water column, including factors such as seabed, geomorphologic, and oceanographic characteristics that affect sound propagation;
    c. sound levels from air source array(s) that are significantly lower or higher than average; and
    d. species identified in an environmental assessment process for which there is concern, including those described in sub-section 4b).

14. Variations to some or all of the measures set out in this Statement may be allowed provided the alternate mitigation or precautionary measures will achieve an equivalent or greater level of environmental protection to address the matters outlined in sections 6 through 13 inclusive. Where alternative methods or technologies are proposed, they should be evaluated as part of the environmental assessment of the project.

15. Where a single source element is used and the ramping up from an individual air source element to multiple elements is not applicable, the sound should still be introduced gradually whenever technically feasible.

Appendix B

Meeting Notes
To Support the
Environmental Assessment
Of
An Offshore Seismic Project
Baffin Bay Area 2011

Prepared by:

RPS Energy
Liberty Place 2nd Floor
1545 Birmingham St.
Halifax, Nova Scotia, B3J 2J6
Tel: (902) 425-1622
Fax: (902) 425-0703

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Appendix A Meeting Scheduled

1. Introduction

RPS Energy on behalf of Multi Klient Invest filed with the National Energy Board a Project Description for the potential 2D Seismic Survey offshore Baffin Bay within their jurisdiction.

NEB has issued a Section 5 Federal Coordination Notification (FCN) for the proposed TGS/PGS Northeastern 2D offshore seismic program in the Baffin Bay/Davis Strait area (MKI the operator an association of PGS). Federal coordination was initiated for this project in the spring of 2010, however the project was suspended until 2011 and the project area has since expanded.

They have request that stakeholders kindly respond to this Notification by 10 February 2011.

The following documents were attached.
- a Letter of Federal Coordination Notification
- a Response Form
- a Project Description received by the NEB for the project

A public registry for this was posted on the NEB website and an opportunity for public comment on the draft scope and draft environmental screening report will be provided when available.

RPS Energy is engaged by MKI to carry out the consultation program in support of the Environmental Assessment for the proposed Seismic Project to be conducted offshore Baffin Bay in 2011.

The consultation was planned to facilitate the consideration of stakeholders regarding public issues and concerns that are relevant to the overall project and that will need to be specifically addressed in the environmental assessment report.

These consults have enabled a much better understanding on the relationship between the peoples, land, sea, and wildlife. Safeguarding wildlife and habitats through the food chain was emphasised at the Qikiqtarjuaq meeting.

The consultations conducted as part of this study were the first in the field of marine seismic 2008, and again in 2011, as such there were many questions about how the survey was to be performed, why it being done, what were the potential impacts, and what were the safeguards. Some of the feedback which came early in the consults was how appreciative the communities were to receiving this knowledge in light of the fact that work has been performed in the past without similar consultations taking place.

Thus, from the standpoint of opening up lines of communication there was no substitute for these in-person presentations. In particular, the HTO’s were very welcoming and provided facilities and their own time

The mitigation measures proposed for this survey, which follow the Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment, will

ensure that any potential interaction is kept to a minimum. As this survey is a single event and the lines are widely spaced, it is highly unlikely that any measurably impact will occur during the survey considering the mitigation methods adopted.

The proposed program is an exploration survey only, designed to map the sub-sea geology, and is a first step in the exploration cycle. The issues pertaining to drilling and development were not considered here, as they represent separate processes which would occur many years in the future, if at all.

An appreciation of the traditional knowledge was obtained by consulting two major studies: *The Nunavut Wildlife Harvest Study* (Nunavut Wildlife Management Board, August 2004), and the *Final Report of the Inuit Bowhead Knowledge Study* (Nunavut Wildlife Management Board, March 2000). And this knowledge was shared in the meetings.

2. Federal/Provincial Meetings

2.1 Nunavut Department of Development and Transportation

Date & Time of the meeting	Monday Jan. 10th, 2011 10:00 - 12:00 a.m. Tuesday Jan. 11th, 2011 2:00-3:00 Separate discussions on PAM with Dave Hedgeland-PGS.
Location	Iqualuit
Organization	Nunavut Department of Development and Transportation
Proponent Speaker	Tony LaPierre / Darlene Davis-RPS Energy PGS – Dave Hedgeland – Environmental Manager
Proponent Translator	None
Personnel	Peter Frampton Senior Petroleum Advisor Eric Prosh Director Minerals & Petroleum Resources Diane LaPierre Mgr, Environmental Assessments & Reg Janelle Kennedy BSc.Envs., MMM-Environment (Sr. Advisor, Aquatic Science, Fisheries and Sealing)
Advertisement for the meeting:	Direct e-mail contact / Telephone
Delivery of the meeting	PowerPoint Presentation
Duration of the meeting	2 hour
Issues /Concerns Expressed: - Support the program - Shared knowledge and discussion on how to consult with the communities - PAM (Passive Accoustic Monitoring) discussion on the possibility of using this and benefits of using this for the program - Source Discussion - Lancaster sound (Exact Area) discussion on this program in relation to NRCan survey in 2010	
Methods of Addressing Concerns: - Discussion and follow-up correspondence - Community Meetings	
Significance of impact	Not significant
Recommendations: -Very supportive of the Program -Observer should come from the communities -Photos (graphics) are great for community meetings -Animation of “Statement of Practice” -Translate as much as possible -Bring hard copies of the maps to leave with communities -“Don’t deny that Seismic can lead to development”	
Feedback / Future meeting	Separate presentation in the afternoon at 2:00 pm with Dave Hedgeland (PGS Environmental Mgr) as he couldn’t be in the a.m. meeting, late flight arrival. February 21st-Met with Diane LaPierre to discuss the facilitation of Pubic meetings in the communities and share information.

2.2 Department of Indian and Northern Affairs (INAC)

Date & Time of the meeting	Monday, January 11th, 2011 2:00-4:00 pm
Location	Iqualuit
Organization	Department of Indian and Northern Affairs
Proponent Speaker	Tony LaPierre / Darlene Davis –RPS Energy Dave Hedgeland-PGS Environmental Manager
Proponent Translator	None
Personnel	Robynn Gillis Petroleum Advisor Bernie McIsaac Director Operations Nunavut Regional Karen Costello Mgr.Minerals Resources Linda Ham Nunavut Development Corporation Resource Development Advisor (Telephone Conference) Derek Moggy –Habitat Team Leader, Eastern Arctic -DFO Gilles Norell-Oil & Gas INAC
Advertisement for the meeting	Direct e-mail contact/Telephone
Delivery of the meeting	PowerPoint Presentation
Duration of the meeting	2 hrs

Issues /Concerns Expressed:
-Support to build a presentation for the communities and conversation on concerns
-Concerns: LanCaster Sounds, Seismic in the 70's
-Need to build trust in the communities, need for several meetings in communities
-Robyn – Will participate in assisting to build information for the communities and travel with Darlene Davis & Tony LaPierre
-Bernie McIssac expressed that there is a huge concern in the communities on "Impacts of Wildlife", migration as it is their livelihood.
-Discussions on Air Gun Sound;
-Gilles brought up the possibility to clearly graphically displace the attenuation of sound away from the source, what it means? Modeling diagrams have been created to explain this clearly and can be found within the EA. (Figure 4 & 5).
-Discussion on Passive Accoustic Monitoring, will it be used?
-Benefits plan for the northern communities / -People want to be part of the planning

Methods of Addressing Concerns:

- Prepare the proposed benefits plan by the operator in consultation with aboriginals and northern communities in the vicinity of the proposed exploration (i.e. coastal communities)
- Look into further the possibility of using Passive Accoustic Monitoring

Significance of impact	Not significant

Recommendations

- Advised consulting with northern communities; also to use diagrams while explaining issues while avoiding graphs and technical language
- Explain how low the sound from the seismic is and the response of marine mammals
- Adhere to the requirement of the Northern Benefits Requirements for New Exploration Programs
- More than one visit to the communities
- Passive Accoustic Monitoring should be a mitigation if possible
- Marine Mammal Observers from the communities
-

Feedback / Future meeting	**Darlene Davis met with Robynn Jan 11th** – afternoon for further discussion. Robynn will travel to community meetings (mid Feb). **April 4, 2011 Spoke with George McCormick and Ursela Beddoes (**INAC) who travelled last week to the communities to talk with them about the possibility of opening lease blocks. They felt the overall of their meetings was positive. That Inuit were not opposed to Exploration buy in turn don't want Harvesting affected and have concerns about spills and commercial fishery. In our consultation work, we continue to explain "The Canadian Statement of Practice and the role of the Marine Mammal Observer and Fisheries Liaison Officer onboard the vessel

2.3 Consultation with Nunavut Development Corporation

Date & Time of the meeting	Jan 10th, 2011
Location	Office of INAC
Organization	Nunavut Development Corporation
Proponent Speaker	Tony LaPierre
Proponent Translator	None
Personnel	Linda Ham
Advertisement for the meeting	Direct e-mail contact / Linda Ham came to the meeting in the Boardroom of INAC
Delivery of the meeting	Presentation given using MS PowerPoint for 1 hour.
Duration of the meeting	2.0 hours
Issues /Concerns Expressed: Participated in the conversations as above -	
Methods of Addressing Concerns: - Complete consultations prior to the survey start - Involve community members as fisheries representatives or environment observer roles on the project	
Significance of impact	Not significant
Recommendations - Complete consultations with coastal communities	
Feedback / Future meeting	Progress feedback to be sent during and after the survey

2.4 Derrick Moggy –Habitat Team Leader, Eastern Arctic Area -DFO

Date & Time of the meeting	Wednesday January 12th, 2011 Noon – 1:00 pm
Location	Iqualuit-DFO Tumit Plaza
Organization	Department Fisheries & Oceans
Proponent Speaker	Tony LaPierre RPS Energy Dave Hedgeland PGS Environmental Mgr
Proponent Translator	None
Personnel	Derrick Moggy-Habitat Leader Eastern Arctic Area DFO
Advertisement for the meeting	Direct e-mail derrick.moggy@dfo-mpo.gc.ca Telephone (705) 522-9909 Cell: (705) 919.6255
Delivery of the meeting	Powerpoint
Duration of the meeting	1 Hr
Issues /Concerns Expressed: Tony LaPierre and Dave Hedgeland met in-person with Derrick Moggy for further discussions on the project. -	
Methods of Addressing Concerns: Consultation in the communities Mitigation Measures Observers from the communities -	
Significance of impact	Not significant
Recommendations -	
Feedback / Future meeting	

2.5 Consultation with Baffin Fisheries Coalition

Date & Time of the meeting	Tuesday January 11th 2:00pm.
Location	Iqualuit
Organization	Baffin Fisheries Coalition
Proponent Speaker	Darlene Davis
Proponent Translator	None
Personnel	Jerry Ward
Advertisement for the meeting	Direct e-mail contact / Telephone
Delivery of the meeting	Meeting cancelled.
Duration of the meeting	
Issues /Concerns Expressed: Jerry was unable to be in Iqaluit at this time as he travels back and forth to Newfoundland. Tried to re-schedule and Jerry would be in Halifax on March 30th, schedules did not allow. Darlene to try to facilitate a meeting with Jerry when back in Newfoundland if possible. -	
Methods of Addressing Concerns: -	
Significance of impact	Not significant
Recommendations -	
Feedback / Future meeting	Will be advised of Public Meeting

2.6 Consultation with Nunavut Wildlife Management Board

Date & Time of the meeting	November 30, 2011
Location	Iqaluit
Organization	Nunavut Wildlife Management Board
Proponent Speaker	Tony LaPierre / Darlene Davis
Proponent Translator	None
Personnel	Robert Kidd-Director of Wildlife Management
Advertisement for the meeting	Direct e-mail contact /Telephone
Delivery of the meeting	
Duration of the meeting	

Issues /Concerns Expressed:

In order to meet with NWMB you must send a letter in both languages and ask permission to make a presentation. There next scheduled meeting is in March 2011.

-

Methods of Addressing Concerns:

RPS Energy will be returning to Iqaluit first week in May for a public meeting. The meeting will be posted and on the radio. This will give members of NWMB and opportunity to attend if they want information on the project.

Due to election meeting in Iqaluit is to be re-scheduled. This will be a public meeting.

-

Significance of impact	Not significant

Recommendations

-

Feedback / Future meeting	Public Meeting

2.7 Consultation with Nunavut Research Institution

Date & Time of the meeting	Tuesday, January 11th 10:00 a.m.
Location	Iqualuit-Frobisher Inn
Organization	Nunavut Research Institution
Proponent Speaker	Tony LaPierre/Darlene Davis/Dave Hedgeland
Proponent Translator	None
Personnel	Mary Ellen Thomas Senior Research Officer
Advertisement for the meeting	Direct e-mail contact
Delivery of the meeting	Brief ½ hour meeting in her office.
Duration of the meeting	.30 hours

Issues /Concerns Expressed:

- Review the need for Fisheries Liaison Officers and Environmental Observers for the seismic program
- Two year Environmental tech program
- 15 first year students, 10 second year
- Don't see a lot of support from the communities
- Bowhead hunt in Iqaluit area will bring discussions
- Lancaster Sound, makes "Seismic a Dangerous word in Baffin"
- Don't expect a positive reaction in communities
- Pond Inlet the only community with an Environmental Program
-

Methods of Addressing Concerns:

- Candidates with offshore safety training and with data collection ability would be good for the MMO role
- Six candidates recently completed the Fisheries Observer program
- Their primary role, onboard fishing vessels, is monitoring catches and observations on marine mammals
- Recommended a translator though Simone (phone: 867-473-2653) for community visits

Significance of impact	Not significant

Recommendations

-Public meeting will be held (Appendix A)
-Two Marine Mammal and one Fisheries Liaison Officer will be onboard at all times
-Canadian Statement of Practice to be followed

Feedback / Future meeting	Public Meeting in Iqaluit May 1, 2011 Re-scheduled end May, early June 2011.

2.8 Consultation with Qikiqtani Inuit Association (QIA)

Date & Time of the meeting	January 11th, 2011 10:00 am -12:00 noon
Location	Iqaluit
Organization	Qikiqtani Inuit Association
Proponent Speaker	Tony LaPierre
Proponent Translator	None
Personnel	Okalik Eegeesiak President Sal Shoo Director of Lands Matthew Akavak Lands Officer Evie Eegeesiak Implementation Co-ordinator Joanasie Akumalik CLO co-ordinator Nigel Qaumariaq Env. & Regulary Affairs Advisor
Advertisement for meeting	Direct e-mail contact/Telephone
Delivery of the meeting	PowerPoint Presentation
Duration of the meeting	2 hours
Issues /Concerns Expressed: -Time of year for the project -Mitigation Measures -Community Meetings, how much time we are willing to devote? -Passive Accoustic Monitoring (PAM)? -Possibility of Nigel/president attending the community meetings -details on the vessel -Supply vessel, remaining after the survey to monitor the area for several days after -Marine Mammal Observer training, candidates from the communities -Add Artic Bay to consultation list of another communities to consult -If the communities are not happy the program will not proceed -Science says the mammals leave the area, how do you know they are gone? -	
Methods of Addressing Concerns: -Discussions -Follow /up conference call on Jan. 17/2011 at 3:00 pm Atlantic Time. (QIA advises they do not have time/resources to support the project in 2010, but they advise they would in 2011. -Attendees: Darlene Davis, Dave Hedgeland (TGS Nopec), Tony LaPierre -Nigel invited to attend community meeting in Pond Inlet. -Nigel sent his community Liaison officer to community meeting in Clyde River -	
Significance of impact	Significant
Recommendations -Passive Accoustic Monitoring -Supply vessel remain to observe after the program -Marine Mammal Observers from the communities -Several meetings with the communities, listen to their concerns and make them feel they are being asked and participating in the program -Consult information for the communities pictures and as much translated documentation as possible should be with you	
Feedback / Future meeting	Conf. Call Jan 17th at 3 pm Atlantic for further discussions. Attend Meeting Pond Inlet February 16th, 2011, Meeting Feb. 18th – Iqaluit (Nigel cancelled), Meeting Feb. 21st – Iqaluit (cancelled), Conf. call March 17th, advice on Public Meeting.

2.9 Consultation with Nunavut Tunngavik Inc.

Date & Time of the meeting	Contacted via email Nov 29th, 2011
Location	Iqaluit
Organization	Nunavat Tunngavik Inc
Proponent Speaker	Darlene Davis
Proponent Translator	None
Personnel	Jeffrey Maurice, Inuit Rights Fisheries Advisor (phone: 867-975-4734)
Advertisement for the meeting	Direct e-mail contact /telephone
Delivery of the meeting	N/A
Duration of the meeting	N//a
Issues /Concerns Expressed: - Consultation with the communities - Sent consultation note from previous project in 2008 for review	
Methods of Addressing Concerns: -	
Significance of impact	Not significant
Recommendations -	
Feedback / Future meeting	None/ Public Meeting will be advertised.

2.10 Nunavut Planning Commission

Date & Time Contact Via Email	January 19th, 2011
Location	Via Email
Organization	Nunavut Planning Commission (NPC)
Contact Initiated by	Darlene Davis, Marine Project Coordinator
Delivery	Full Project Description Summary on Meetings in Iqaluit & Planned HTO Meetings
Issues /Concerns Expressed: Good morning Darlene; Email is to confirm that the above noted/attached proposal falls outside the boundaries of the North Baffin Regional Land Use Plan. Therefore no conformity review with the approved plan is required. Any questions concerns, please do not hesitate. Brian Aglukark, NPC Arviat -	
Methods of Addressing Concerns: - Via Email sent Project Description.	
Significance of impact	Not significant
Recommendations Not within their Jurisdiction	

2.11 Parks Canada

Date & Time Contact Via Email	January 17th, 2011
Location	Via Email
Organization	Parks Canada Doug Yurick Chief Marine Program Coordinator
Contact Initiated by	Darlene Davis, Marine Project Coordinator
Delivery	Full Project Description

Issues /Concerns Expressed:
Email from Doug Yurick:

I understand that you are aware of the controversy generated last year by the proposed Canada - Germany Eastern Canadian Arctic Seismic Experiment in the Baffin Bay - Lancaster Sound region.

As you likely know, several ministers of the Government of Canada announced jointly, on December 6, 2010, the federal position regarding the boundary of the proposed NMCA. I am attaching the press release of that date, and the mapped boundary. My understanding from the petroleum regulatory affairs group in Indian and Northern Affairs Canada is that the project you are contemplating is entirely beyond the limits of territorial sea ofCanada. Nowhere does the eastern limit of the presently proposed NMCA boundary extend beyond the territorial sea.

Please contact me directly at Parks Canada should you require additional information about the NMCA.

Best wishes,

-

Methods of Addressing Concerns:
Via Fisheries and Oceans Canada to obtain a map indicting the limits of the proposed national marine conservation area (NMCA) in Lancaster Sound.

Significance of impact	Not significant

Recommendations

2.12 World Wildlife Federation (Peter Ewan)

Date & Time Contact Via Email	January 19th, 2011 Peter Ewans, D. Phil Senior Officer, Species
Location	Via Email
Organization	WWF
Contact Initiated by	Darlene Davis, Marine Project Coordinator
Delivery	Full Project Description via email

Issues /Concerns Expressed:
Email Response Peter Ewan:
many thanks Darlene. I will consult with some key colleagues on this one, especially in light of the current NEB offshore review underway, and now that the US Gulf incident report is out. Hope to get back to you soon.

best wishes

Pete

-

Methods of Addressing Concerns

NEB has placed the project description for Federal Coordination along with opportunity for public comment.
See Email:
Please find attached a Section 5 Federal Coordination Notification (FCN) for the proposed TGS/PGS Northeastern 2D offshore seismic program in the Baffin Bay/Davis Strait area. Federal coordination was initiated for this project in the spring of 2010, however the project was suspended until 2011 and the project area has since expanded.

I am requesting that you kindly respond to this Notification by 10 February 2011.

Attached are the following documents:
- a Letter of Federal Coordination Notification
- a Response Form
- a Project Description received by the NEB for the project

A public registry for this file will be posted on the NEB website shortly, and an opportunity for public comment on the draft scope and draft environmental screening report will be provided when available. Should anyone included in this notification be addressed incorrectly, or should you have any questions, please do not hesitate to contact me at the address below.

Significance of impact	Not significant

Recommendations

-

3. Communities Meetings

3.1 Consultation with Baffin HTO's (Clyde River)

Date & Time of the meeting	February 14th, Monday 7:00pm-10:00 pm
Location	Office of HTO
Organization	Baffin HTO, Clyde River Email: cedo@clyderiver.ca (Billy) Rebecca HTO Manager htoclyde@qiniq.com 867-924-6202
Proponent Speaker	Tony LaPierre Geologist Darlene Davis – Project Manager
Proponent Translator	
Personnel	HTO Manager - Rebecca Lizzy Palituq – Community Liason Officer Jayko Asheuak – Chariman Anasic Audlakiak – Vice Chairman Leah Arreak – Secretary Treasurer Tommy Kumiliusie - Director Joanasic Apak – Director Jaycopic Iqaukjuak – Director Jayko Apak (member) Deckhand Certificate INAC – Robynn Aberney Gillis
Advertisement for the meeting	Direct e-mail contact
Delivery of the meeting	Presentation given using MS PowerPoint during Meeting
Duration of the meeting	7:00 pm-9:45 pm

Issues /Concerns Expressed:

- Opportunities for local persons on the project
- How much company is looking at benefiting Clyde River?
- In the past surveyors don't give benefit to the community
- Mine further North – Is not giving them opportunities?
- Concerned that they have no birth certificates or passports, and how this will effect the ability for someone to ride onboard the vessel to be involved in project
- Wanted to know if we have approval (NEB)?
- Want to have a public meeting, $100 hour to rent community centre, give door prized to get people to attend or they won't come out, they suggest 45 gal of fuel and 45 gal of heating oil, cash prize
- HTO will set up public meeting for April 1st or 2nd and communicate with Darlene Davis on details
- Overall very concerned about Marine Mammals./harvesting/Migration and effects from seismic activity

Methods of Addressing Concerns:

- Conduct public meeting
- Keep them informed
- Notify them when the vessel starts work and is in the area
- Select MMO from their community
- Look into Transport Canada would they need passport to ride vessel in Canada
- Involve community members as fisheries representatives or environment observer roles on the project

While in Clyde River, Tony LaPierre (Geologist) taught two classes in Geology to grade 10

students and told then about the project.	
Significance of impact	Not significant
Recommendations -	
Feedback / Future meeting	Public Meeting April 1st or 2nd, follow up meeting Provide copies of Marine Mammal reports after survey. -RPS follow-up with an email upon return, no meeting was set up by HTO, RPS has proceeded to schedule meetings via meeting notice for return visits Appendix A. Due to negative feedback from HTO Manager Clyde river, the meeting is being re-scheduled due to election week.

3.2 Consultation with Baffin HTO's (Pond Inlet)

Date & Time of the meeting	February 16th (Wednesday) 2011 1:00 pm
Location	Office of HTO
Organization	Baffin HTO, Pond Inlet
Proponent Speaker	Tony LaPierre – Geologist / Project Darlene Davis – Project Manager
Proponent Translator	
Personnel	James – Acting Vice Chairman Charmin and Vice Chairmen out of town to another meeting QIA-Nigel Qaumariaq INAC-Robyn Aberney Gillis
Advertisement for the meeting	Direct e-mail contact
Delivery of the meeting	Presentation given using MS PowerPoint for 1 hour.
Duration of the meeting	1.5 hours

Issues /Concerns Expressed:

- Ships spilling into the water, happened last year?
- Will it bother the whales?
- Narwhales start migrating June – August ?
- Ice is always going through this area
- Very concerned about are whales and sensitive about are food supply
- While we are here, we are protective of our animals and are way of life
- How loud is the sound?
- Will you have a public meeting?
- Concerned about the Narwhales
- Are you coming back?
- QIA (Nigel attended meeting) advised he would be back for Public meeting
- QIA advised possible two other projects, he would return to speak about this
- Robyn – INAC would return to speak to them about their opinions on opening up lease blocks?

Methods of Addressing Concerns:

- This marine wildlife area extends from the coast to 12 nautical miles, however as the survey area does not commence until the 12 nautical mile limit, the project area does not encroach into this area.
- Involve community members as fisheries representatives or environment observer roles on the project
- Conduct Public Meeting

Significance of impact	Not significant

Recommendations

-

Feedback / Future meeting	Public Meeting, as per Appendix A. Meeting re-scheduled due to election.

3.3 Consultation with Baffin HTO's (Qikiqtarjuaq)

Date & Time of the meeting	February 17th (Thursday) 2011-02-20 7:00 pm – 9:30 pm
Location	Office of HTO
Organization	Baffin HTO, Qikiqtarjuaq
Proponent Speaker	Darlene Davis – Project Manager
Proponent Translator	
Personnel	HTO Manager – Harry Alookie Samuel Nuqingaq – Secretary-Treasurer Board Members Robyn Aberthy Gillis - INAC
Advertisement for the meeting	Direct e-mail contact
Delivery of the meeting	Presentation given using MS PowerPoint during meeting. Minutes of the meeting were kept by the General Secretary.
Duration of the meeting	2.5 hrs

Issues /Concerns Expressed:

- Harvesting activities are very important, very concerned about the whales and their way of life;
- They know that seismic will hurt the whales, they will be dead and not float to the surface for three months because they are heavy
- Concerned about sedimentary areas for the turbot fish live their
- Concerned about Corel zone and how airguns will affect this?
- Concerned about Trophy Week, fishing trip they make to take people to catch a whale in Baffin Bay in July August time, they make $2500 per trip, Will this affect them catching whales?
- Will you get approval whether we agree or not?
- Do you have permission?
- We want to be informed
- We will work with you
- Government doesn't listen to us
- Will you do a public meeting
- What did the other communities think of this project? We are certain they would not agree
-

Methods of Addressing Concerns:

- Hold a public meeting
- Deal with HTO Manager to share information and keep them informed
- Stay in contact
- Share information via email

Significance of impact	Not significant

Recommendations

-

Feedback / Future meeting	Public Meeting as per Appendix A. Meeting being re-scheduled due to election.

3.4 Consultation with Baffin HTO's (Iqaluit)

Date & Time of the meeting	February 21st, 2011 (Monday) 4:00-4:30 pm
Location	Office of HTO Jose – HTO Manager amrok@qiniq.com Phone: 867-979-3066
Organization	Iqaluit HTO Chairman
Proponent Speaker	Darlene Davis Project Manager
Proponent Translator	Not necessary
Personnel	David Alexander Baffin Fisheries Coalition Manager Chairman for HTO
Advertisement for the meeting	Contacted while in Iqaluit to set up a short meeting to introduce myself and RPS Energy role in the permit process.
Delivery of the meeting	Conversation.
Duration of the meeting	30 min
Issues /Concerns Expressed: - Introduced myself, told him about the proposed program offshore Baffin Bay. - Asked him to set up a meeting with HTO members and public meeting for a return visit end of March 2011-02-21 - He expressed if we want their approval they would need support letters from other communities, supporting the project - Expressed he is concerned with commercial fisheries as he works with - Baffin Fisheries Coalition - Left him a copy of the program - Left him a copy of the Canadian Statement of Practice both in English and Inuktitut	
Methods of Addressing Concerns: - Left him a copy of Canadian Statement of Practice both in English and Inuktitut - Will send follow up information via email - Will hold a public meeting, and meeting with all HTO and follow up meeting when they have been completed to address additional questions -	
Significance of impact	Not significant
Recommendations - Share information about the proposed project, and have representatives from the communities onboard as environmental observers	
Feedback / Future meeting	Public meeting as per Appendix A. Meeting will be re-scheduled due to election week.

3.5 Consultation with Baffin HTO's (Pangnirtung)

Date & Time of the meeting	No Meeting
Location	
Organization	Baffin HTO, Pangnirtung
Proponent Speaker	Darlene Davis
Proponent Translator	
Personnel	
Advertisement for the meeting	Direct e-mail contact Contracted Eric Joamie from Pang to set up meeting.
Delivery of the meeting	
Duration of the meeting	
-We were unable to get a scheduled meeting unfortunately in Pang on this visit. They were in the process of changing HTO managers and this meeting did not come together. -Upon arrival for the other communities, the contracted translator (Eric Joamie) did not show. This made the task much more difficult in each community. -March 3th – Eric Joamie advised he had worked with council and mentioned the matter to the new HTO Manager. (Jackie Maniapik new HTO Manager) -March 7th – HTO board to hold meeting -March 8th – Provide Jacki with information (Project Description sent via email) -March 10th – Advised best dates for meeting approximately April 3 or 4th -April 7th – Sent RPS schedule for meetings in communities to include Pang in both languages.	
Significance of impact	Not significant
Recommendations : Include Pang in the public meeting notice (Appendix A). -	
Feedback / Future meeting	Public meeting being re-scheduled due to the election week.

4. Baffin Bay Public Meetings

Upon completion of the initial meetings with Hunters and Trappers Associations in the communities, it was apparent that a need for public meetings would be adhered to.

Upon completion of the in-person meetings with the HTO groups it was understood that HTO Managers would set up public meetings by communicating and working together to do so. Unfortunately time did not allow for this to come together.

In a conference call meeting with QIA on March 17, 2011 it was recommended that RPS Energy take the following steps to set-up public meetings:

- Select Dates Translate
- Send to SAO of Hamlet
- Advertise on the Radio
- Rent meeting Hall

A copy of the meeting notice can be located in Appendix A.

The meetings have been re-scheduled, due to negative feedback based on the timing being election week. RPS is making efforts currently to make arrangements to re-schedule and get notices out to the communities for tentatively late May, early June 2011.

Appendix A.

A representative of RPS Energy of Behalf of Multi Klient Invest (MKI) will be in your community on the following dates for Public Meeting to share information on a potential 2D Seismic Survey offshore Baffin Bay for the 2011 season.

Community	Date	Location	Time
Iqaluit	May 1/11	Frobisher Inn	7:00 pm
Clyde River	May 2/11	Community Centre	7:00 pm
Pond Inlet	May 3/11	Community Centre	7:00 pm
Quik	May 4/11	Community Centre	7:00 pm
Pangnirtung	May 5/11	Community Centre	2:00 pm

Please listen to your local Radio Station for further updates or you may contact:

Darlene Davis
1545 Birmingham Street
Halifax, Nova Scotia, B3J 2J6
Tel: (902) 492-0281
davisd@rpsgroup.com

Appendix C

Natural Resources Canada, Geological Survey of Canada, Geoscience Data Repository, BASIN Database
Date: April 27, 2011, 10:01 am EDT

Project	Company	Year	Area
BB09	TGS-NOPEC	2009	BAFFIN BAY/DAVIS STRAIT/W GREENLAND SHELF
ULAM09	TGS-NOPEC	2009	DAVIS STRAIT/LABRADOR SEA/W GREENLAND SHELF
5552841	TGS-NOPEC	2008	BAFFIN BAY/DAVIS STRAIT
5554046	HUSKY OIL	2008	DAVIS STRAIT/W GREENLAND SHELF
5554118	ENCANA	2008	DAVIS STRAIT
BB08	TGS-NOPEC	2008	BAFFIN BAY/DAVIS STRAIT/W GREENLAND SHELF
ULAM08	TGS-NOPEC	2008	DAVIS STRAIT/LABRADOR SEA/W GREENLAND SHELF
BLF03	TGS-NOPEC	2003	DAVIS STRAIT/W GREENLAND SHELF
FBSE03	TGS-NOPEC	2003	DAVIS STRAIT/W GREENLAND SHELF
GREEN03	TGS-NOPEC	2003	DAVIS STRAIT/W GREENLAND SHELF
KW03	TGS-NOPEC	2003	DAVIS STRAIT/W GREENLAND SHELF
9724-T063	TGS-NOPEC	2002	DAVIS STRAIT
9724-T063	TGS-NOPEC	2002	DAVIS STRAIT
DW02	TGS-NOPEC	2002	DAVIS STRAIT/W GREENLAND SHELF
GRC02	TGS-NOPEC	2002	DAVIS STRAIT/W GREENLAND SHELF
GREEN02	TGS-NOPEC	2002	DAVIS STRAIT/W GREENLAND SHELF
9724-T063	TGS-NOPEC	2001	DAVIS STRAIT
9728-C138	CANNAT RESOURC	2001	DAVIS STRAIT
GRC01	TGS-NOPEC	2001	DAVIS STRAIT/W GREENLAND SHELF
GREEN01	TGS-NOPEC	2001	DAVIS STRAIT/W GREENLAND SHELF
9724-P055	PHILLIPS/TGS-NOP	2000	DAVIS STRAIT
GEUS 200	GEUS	2000	DAVIS STRAIT/W GREENLAND SHELF
GREEN00	TGS-NOPEC	2000	DAVIS STRAIT/W GREENLAND SHELF
KR00	TGS-NOPEC	2000	DAVIS STRAIT/W GREENLAND SHELF
NUNAOIL 2	NUNAOIL	2000	DAVIS STRAIT/W GREENLAND SHELF
SW00	TGS-NOPEC	2000	DAVIS STRAIT/W GREENLAND SHELF
GREEN99	TGS-NOPEC	1999	DAVIS STRAIT/W GREENLAND SHELF
FUGRO-G	FUGRO-GEOTEAM	1998	DAVIS STRAIT/W GREENLAND SHELF
NUNAOIL	NUNAOIL	1998	DAVIS STRAIT/W GREENLAND SHELF
NUNAOIL	NUNAOIL	1998	DAVIS STRAIT/W GREENLAND SHELF
NUNAOIL	NUNAOIL	1998	DAVIS STRAIT/W GREENLAND SHELF
NUNAOIL	NUNAOIL	1997	DAVIS STRAIT/W GREENLAND SHELF
NUNAOIL	NUNAOIL	1997	DAVIS STRAIT/W GREENLAND SHELF
GEUS	GEUS	1995	DAVIS STRAIT/W GREENLAND SHELF
NUNAOIL	NUNAOIL	1994	DAVIS STRAIT/W GREENLAND SHELF
WESTERN	WESTERN GEOPHY	1990	DAVIS STRAIT/W GREENLAND SHELF
8624-G005	GSI	1982	E NFLD SHELF/LABRADOR SHELF/DAVIS STRAIT
8624-P028	PETRO-CANADA	1982	LABRADOR SHELF/DAVIS STRAIT
9720-C055	CANTERRA ENERG	1982	LABRADOR SHELF/DAVIS STRAIT
9726-C055	CANTERRA ENERG	1982	DAVIS STRAIT
673-09-12-	AQUITAINE	1981	DAVIS STRAIT/FROBISHER BAY
8624-P028	PETRO-CANADA	1981	LABRADOR SHELF/DAVIS STRAIT
8624-P028	PETRO-CANADA	1981	LABRADOR SHELF/DAVIS STRAIT
037-09-12-	SHELL CANADA	1980	DAVIS STRAIT
673-09-12-	AQUITAINE	1980	DAVIS STRAIT/CUMBERLAND SOUND
673-09-12-	AQUITAINE	1980	DAVIS STRAIT/BAFFIN BAY

8624-J001	ESSO RESOURCES	1980	LABRADOR SHELF/DAVIS STRAIT
8624-P028	PETRO-CANADA	1980	LABRADOR SHELF/DAVIS STRAIT
8624-P028	PETRO-CANADA	1980	LABRADOR SHELF/DAVIS STRAIT
007-09-12-	ESSO RESOURCES	1979	DAVIS STRAIT/BAFFIN BAY
007-09-12-	ESSO RESOURCES	1979	DAVIS STRAIT
007-09-12-	ESSO RESOURCES	1979	DAVIS STRAIT
007-09-12-	ESSO RESOURCES	1979	DAVIS STRAIT/BAFFIN BAY
007-09-12-	ESSO RESOURCES	1979	DAVIS STRAIT/CUMBERLAND SOUND
246-09-12-	PETRO-CANADA	1979	DAVIS STRAIT/BAFFIN BAY
246-09-12-	PETRO-CANADA	1979	DAVIS STRAIT/BAFFIN BAY
673-09-12-	AQUITAINE	1979	DAVIS STRAIT/BAFFIN BAY
673-09-12-	AQUITAINE	1979	DAVIS STRAIT
673-09-12-	AQUITAINE	1979	DAVIS STRAIT
8620-J001	ESSO RESOURCES	1979	FLEMISH PASS/LABRADOR SHELF/DAVIS STRAIT
037-09-12-	SHELL CANADA	1978	LABRADOR SEA/DAVIS STRAIT
246-09-12-	PETRO-CANADA	1978	DAVIS STRAIT/BAFFIN BAY/LANCASTER SOUND
246-09-12-	PETRO-CANADA	1978	DAVIS STRAIT/BAFFIN BAY
673-09-12-	AQUITAINE	1978	DAVIS STRAIT/FROBISHER BAY
8627-A011	AQUITAINE	1978	LABRADOR SHELF/DAVIS STRAIT
007-09-12-	ESSO RESOURCES	1977	DAVIS STRAIT/CUMBERLAND SOUND
039-09-12-	BRITISH PETROLE	1977	LABRADOR SHELF/DAVIS STRAIT/CUMBERLAND SOUN
673-09-12-	AQUITAINE	1977	LABRADOR SHELF/DAVIS STRAIT/FROBISHER BAY
8620-A011	AQUITAINE	1977	LABRADOR SHELF/DAVIS STRAIT
BGR 1977	B.G.R.	1977	LABRADOR SHELF/LABRADOR SEA/DAVIS STRAIT/W G
007-09-12-	ESSO RESOURCES	1976	LABRADOR SHELF/DAVIS STRAIT
037-09-12-	SHELL CANADA	1976	DAVIS STRAIT
039-09-12-	BRITISH PETROLE	1976	DAVIS STRAIT/CUMBERLAND SOUND
062-21-12-	CANADA CITIES SE	1976	DAVIS STRAIT
547-03-12-	AQUA-TERRA	1976	BAFFIN BAY/DAVIS STRAIT
673-09-12-	AQUITAINE	1976	LABRADOR SHELF/DAVIS STRAIT/CUMBERLAND SOUN
834-09-12-	RAM PETROLEUMS	1976	LABRADOR SHELF/DAVIS STRAIT/CUMBERLAND SOUN
8624-A011	AQUITAINE	1976	LABRADOR SHELF/DAVIS STRAIT
8627-T022	TRICENTROL OILS	1976	LABRADOR SHELF/DAVIS STRAIT
007-09-12-	ESSO RESOURCES	1975	DAVIS STRAIT
037-09-12-	SHELL CANADA	1975	DAVIS STRAIT
037-09-12-	SHELL CANADA	1975	DAVIS STRAIT
037-09-12-	SHELL CANADA	1975	DAVIS STRAIT
037-09-12-	SHELL CANADA	1975	DAVIS STRAIT
037-09-12-	SHELL CANADA	1975	DAVIS STRAIT
038-09-12-	HUDSONS BAY OIL	1975	DAVIS STRAIT
039-09-12-	BRITISH PETROLE	1975	DAVIS STRAIT/CUMBERLAND SOUND
062-09-12-	CANADA CITIES SE	1975	DAVIS STRAIT
528-09-12-	EUREKA EXPLORA	1975	DAVIS STRAIT/BAFFIN BAY/LANCASTER SOUND
528-09-12-	EUREKA EXPLORA	1975	LABRADOR SHELF/DAVIS STRAIT/BAFFIN BAY
528-09-12-	EUREKA EXPLORA	1975	DAVIS STRAIT/BAFFIN BAY
673-09-12-	AQUITAINE	1975	LABRADOR SHELF/DAVIS STRAIT/FROBISHER BAY
8620-A011	AQUITAINE	1975	LABRADOR SHELF/DAVIS STRAIT
8620-J001	IMPERIAL OIL	1975	SCOTIAN SHELF/SCOTIAN SLOPE/GRAND BANKS/FLE
8620-P011	PACIFIC PETROLE	1975	LABRADOR SHELF/DAVIS STRAIT
8624-A011	AQUITAINE	1975	LABRADOR SHELF/DAVIS STRAIT
8627-W002	WEST COAST PET	1975	LABRADOR SHELF/DAVIS STRAIT
8627-W006	WESTERN DECALT	1975	LABRADOR SHELF/DAVIS STRAIT

007-08-12-	ESSO RESOURCES	1974	LABRADOR SHELF/DAVIS STRAIT/CUMBERLAND SOUN
007-09-12-	ESSO RESOURCES	1974	LABRADOR SHELF/DAVIS STRAIT/CUMBERLAND SOUN
528-09-12-	EUREKA EXPLORA	1974	DAVIS STRAIT/BAFFIN BAY/HOME BAY
673-09-12-	AQUITAINE	1974	DAVIS STRAIT/CUMBERLAND SOUND/FROBISHER BAY
8620-J001	IMPERIAL OIL	1974	E NFLD SHELF/LABRADOR SHELF/DAVIS STRAIT
002-09-12-	GULF CANADA	1973	DAVIS STRAIT/CUMBERLAND SOUND
007-09-12-	ESSO RESOURCES	1973	DAVIS STRAIT/CUMBERLAND SOUND
038-08-12-	HUDSONS BAY OIL	1973	DAVIS STRAIT
038-09-12-	HUDSONS BAY OIL	1973	DAVIS STRAIT
062-09-12-	CANADA CITIES SE	1973	LABRADOR SHELF/DAVIS STRAIT
528-09-12-	EUREKA EXPLORA	1973	DAVIS STRAIT/BAFFIN BAY
626-09-12-	CGG	1973	DAVIS STRAIT
626-09-12-	CGG	1973	LABRADOR SEA/DAVIS STRAIT/BAFFIN BAY
733-09-12-	GETTY OIL	1973	DAVIS STRAIT
838-09-12-	GSI	1973	LABRADOR SHELF/DAVIS STRAIT/BAFFIN BAY
8620-G005	GSI	1973	LABRADOR SHELF/DAVIS STRAIT
8620-J001	IMPERIAL OIL	1973	SCOTIAN SHELF/SCOTIAN SLOPE/LAURENTIAN SUBBA
8627-A011	AQUITAINE	1973	LABRADOR SHELF/DAVIS STRAIT
8627-A011	AQUITAINE	1973	LABRADOR SHELF/DAVIS STRAIT
8627-M003	MOBIL OIL CANADA	1973	E NFLD SHELF/LABRADOR SHELF/DAVIS STRAIT
007-07-12-	ESSO RESOURCES	1972	DAVIS STRAIT/BAFFIN BAY
007-09-12-	ESSO RESOURCES	1972	DAVIS STRAIT/CUMBERLAND SOUND
039-07-12-	BRITISH PETROLEU	1972	DAVIS STRAIT/BAFFIN BAY
039-09-12-	BRITISH PETROLEU	1972	DAVIS STRAIT/CUMBERLAND SOUND
039-09-12-	BRITISH PETROLEU	1972	DAVIS STRAIT
062-09-12-	CANADA CITIES SE	1972	DAVIS STRAIT/BAFFIN BAY
528-09-12-	EUREKA EXPLORA	1972	DAVIS STRAIT/BAFFIN BAY/LANCASTER SOUND
733-09-12-	GETTY OIL	1972	DAVIS STRAIT/BAFFIN BAY
745-09-12-	PAN NORTHERN	1972	LABRADOR SEA/DAVIS STRAIT
8620-A011	AQUITAINE	1972	LABRADOR SHELF/DAVIS STRAIT
8620-J001	IMPERIAL OIL	1972	SCOTIAN SHELF/SCOTIAN SLOPE/LAURENTIAN SUBBA
8624-E002	EASTCAN	1972	E NFLD SHELF/LABRADOR SHELF/DAVIS STRAIT
058-09-12-	TEXACO CANADA	1971	DAVIS STRAIT/FROBISHER BAY
062-09-12-	CANADA CITIES SE	1971	DAVIS STRAIT/CUMBERLAND SOUND
062-09-12-	CANADA CITIES SE	1971	DAVIS STRAIT/BAFFIN BAY
673-09-12-	AQUITAINE	1971	DAVIS STRAIT/CUMBERLAND SOUND
693-09-12-	KENTING EXPLORA	1971	DAVIS STRAIT/BAFFIN BAY/LANCASTER SOUND
829-09-12-	HIGH COUNTRY	1971	LABRADOR SHELF/DAVIS STRAIT
829-09-12-	HIGH COUNTRY	1971	LABRADOR SHELF/DAVIS STRAIT
838-09-12-	GSI	1971	DAVIS STRAIT
8620-G005	GSI	1971	LABRADOR SHELF/DAVIS STRAIT
GREENLA	VARIOUS	1971	DAVIS STRAIT/BAFFIN BAY
8624-A011	AQUITAINE	1970	LABRADOR SHELF/DAVIS STRAIT
BAFFIN BA	EUREKA EXPLORA	1969	DAVIS STRAIT

Status	Geophysical Type	Approx. Release Date	Nav	Digital Data
COMPLETED	SEISMIC REFLECTION SURVEY (2	al status, release date	N	
COMPLETED	AEROMAGNETIC SURVEY	ial status, release date	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	26-Apr-19	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	06-Apr-14	N	
COMPLETED	GRAVITY SURVEY	27-Dec-13	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	al status, release date	N	
COMPLETED	AEROMAGNETIC SURVEY	ial status, release date	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	31-Dec-13	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	31-Dec-13	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	31-Dec-13	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	31-Dec-13	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	03-Mar-13	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	05-Feb-13	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	31-Dec-12	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	31-Dec-12	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	31-Dec-12	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	26-Feb-12	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	31-Dec-11	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	31-Dec-11	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	31-Dec-10	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	31-Dec-10	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	31-Dec-10	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	COMBINED GEOPHYSICAL SURVI	released	Y	
COMPLETED	SHALLOW SEISMIC, SEABED SUR	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	COMBINED GEOPHYSICAL SURVI	released	N	

COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SHALLOW SEISMIC, SEABED SUR	released	N	
COMPLETED	SHALLOW SEISMIC, SEABED SUR	released	N	
COMPLETED	SHALLOW SEISMIC, SEABED SUR	released	N	
COMPLETED	SHALLOW SEISMIC, SEABED SUR	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SHALLOW SEISMIC, SEABED SUR	released	D	
COMPLETED	SHALLOW SEISMIC, SEABED SUR	released	D	
COMPLETED	SHALLOW SEISMIC, SEABED SUR	released	N	
COMPLETED	COMBINED GEOPHYSICAL SURVI	released	D	
COMPLETED	REPROCESSING/REINTERPRETA	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	N	
COMPLETED	REPROCESSING/REINTERPRETA	released	N	
COMPLETED	REPROCESS/REINTERPRET OF A	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	COMBINED GEOPHYSICAL SURVI	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SHALLOW SEISMIC, SEABED SUR	released	D	
COMPLETED	GEOLOGICAL/GEOPHYSICAL RES	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	REPROCESS/REINTERPRET OF A	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	N	
COMPLETED	REPROCESSING/REINTERPRETA	released	N	
COMPLETED	REPROCESS/REINTERPRET OF A	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	COMBINED GEOPHYSICAL SURVI	released	Y	
COMPLETED	COMBINED GEOPHYSICAL SURVI	released	Y	digital data availa
COMPLETED	COMBINED GEOPHYSICAL SURVI	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	REPROCESS/REINTERPRET OF A	released	D	
COMPLETED	REPROCESS/REINTERPRET OF A	released	D	

COMPLETED	GRAVITY SURVEY	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	COMBINED GEOPHYSICAL SURVI	released	Y	
COMPLETED	COMBINED GEOPHYSICAL SURVI	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	GRAVITY SURVEY	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	REPROCESSING/REINTERPRETA	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	COMBINED GEOPHYSICAL SURVI	released	Y	
COMPLETED	COMBINED GEOPHYSICAL SURVI	released	Y	digital data availa
COMPLETED	REPROCESS/REINTERPRET OF A	released	D	
COMPLETED	REPROCESS/REINTERPRET OF A	released	D	
COMPLETED	REPROCESS/REINTERPRET OF A	released	D	
COMPLETED	AEROMAGNETIC SURVEY	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	AEROMAGNETIC SURVEY	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	COMBINED GEOPHYSICAL SURVI	released	D	
COMPLETED	COMBINED GEOPHYSICAL SURVI	released	Y	digital data availa
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION/REFRACTI	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	D	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	COMBINED GEOPHYSICAL SURVI	released	N	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	
COMPLETED	SEISMIC REFLECTION SURVEY (2	released	Y	

Description
9600 KMS? OF 2-D SEISMICS (AN INFILL OF PREVIOUS TGS SURVEYS) COMPLETED? 2009
41000 KM OFFSHORE SOUTHWEST GREENLAND AEROMAG AND GRAVITY SURVEY (UNGAVA
2704 KM 2-D SEISMIC SURVEY (BAFFIN BAY AND DAVIS STRAIT) COMPLETED 26-OCT-2008 (CA
591 KM 2-D SEISMIC AND GRAVITY SURVEY COMPLETED 06-OCT-2008 (CANADIAN SECTION O
85.3 KM MARINE GRAVITY AND MAGNETIC SURVEY (LADY FRANKLIN BLOCK?) COMPLETED 27
7108 KMS OF 2-D SEISMICS (AN INFILL OF THE BB2D07 SURVEY ALONG WITH A REGIONAL GR
75000 KM OFFSHORE SOUTHWEST GREENLAND AEROMAG AND GRAVITY SURVEY (UNGAVA
2016 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY (BASIN OF LADY FRANKLIN 2003)
634 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY (FYLLA BASIN SOUTH EAST 2003)
3078 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY (GREENLAND 2003)
435 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY (KANGAMIUT WEST 2003)
260 KMS OF 2-D SEISMICS COMPLETED 31-AUG-2002
200 KMS OF 2-D SEISMICS COMPLETED 05-AUG-2002
2235 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY (DISKO WEST 2002)
1791 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY (GREENLAND-CANADA 2002)
2417 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY DESIGNED TO INFILL EARLIER TGS-NOPEC SU
1288.15 KMS OF 2-D SEISMICS COMPLETED 26-AUG-2001 (PART OF GREEN 2001 SURVEY)
SURVEY STARTED 15-SEP-2001
2828 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY TYING DAVIS STRAIT CANADIAN WELLS TO OI
904 KM 2-D SEISMIC SURVEY CONDUCTED NORTH OF 68 DEGREES
630 KM 2-D & (800 KM 3-D ?) SEISMIC SURVEY COMPLETED 22-OCT-2000 (PART OF GREEN 200
2700 KM SEISMIC SURVEY CONDUCTED BY THE GEOLOGICAL SURVEY OF DENMARK & GREE
4526 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY - BETWEEN THE FYLLA AND SISIMIUT WEST A
1104 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY (KANGAMIUT RIDGE 2000)
1200 KM 2-D SEISMIC SURVEY - SISIMIUT WEST AREA
584 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY (SISSIMIUT RIDGE 2000)
2897 KM NON-EXCLUSIVE REGIONAL 2-D SEISMIC SURVEY
3098 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY - NORTH & SOUTH OF THE FLYYA AREA
367 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY - SISIMIUT WEST AREA
534 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY - SISIMIUT WEST AREA
709 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY - SISIMIUT WEST AREA
2115 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY - HECLA RISE AREA
194 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY - SISIMIUT WEST AREA
9460 KM REGIONAL SEISMIC SURVEYS CONDUCTED BY THE GEOLOGICAL SURVEY OF DENM
1708 KM NON-EXCLUSIVE 2-D SEISMIC SURVEY - FYLLA AREA
1915 KM NON-EXCLUSIVE REGIONAL SEISMIC SURVEY
REGIONAL NON-EXCLUSIVE SURVEY
CAPE CHIDLEY BLOCKS
MARINE SEISMIC SURVEY
WELLSITE SURVEY FOR RALEGH N-18
SEISMIC SURVEY - FROBISHER BAY
ASSOCIATED WITH 8624-P028-008E (PETRO-CANADA 1980)
ASSOCIATED WITH 8624-P028-008E (PETRO-CANADA 1980)
SEISMIC REFLECTION - DAVIS STRAIT
SEISMIC REFLECTION SURVEY - CUMBERLAND SOUND
SIDE SCAN SONAR & BATHYMETRY SURVEY

CUMBERLAND AREA
SAGLEK & CAPE CHIDLEY BLOCKS
SAGLEK & CAPE CHIDLEY BLOCKS
WELLSITE HIGH RESOLUTION SURVEY FOR C-92
WELLSITE SURVEY FOR C-5 (RESOLUTION ISLAND)
WELLSITE SURVEY FOR GJOA G-37
WELLSITE SURVEY FOR SITE C-76
SEISMIC SURVEY - CUMBERLAND
BAFFIN BAY SEISMIC SURVEY
BAFFIN BAY SURVEY
WELLSITE HIGH RESOLUTION SURVEY FOR FINNBOGI
WELLSITE HIGH RESOLUTION SURVEY FOR RALEGH & HEKJA
WELLSITE HIGH RESOLUTION SURVEY FOR RALEGH & HEKJA
FLEMISH PASS AREA AND CUMBERLAND & NORTH LABRADOR BLOCKS
SEISMIC INTERPRETATION - DAVIS STRAIT & LABRADOR
REGIONAL SEISMIC SURVEY - BAFFIN BAY
GEOLOGICAL FIELD OPERATIONS
REPROCESSING OF 1977 FROBISHER BAY SEISMIC
INTERPRETATION OF AVAILABLE GRAVITY & MAGNETIC DATA
1977 SEISMIC SURVEY - CUMBERLAND
TIE LINE FROM EASTCAN KARLSEFNI TO BP CUMBERLAND SOUND
SAME AS PROJECT 8620-A011-003E
HEKJA AND FINNBOGI STRUCTURES
SURVEY INCLUDES AREAS OFFSHORE WEST GREENLAND
SEISMIC SURVEY - ESSO & HBOG BLOCKS
MARINE SEISMIC - DAVIS STRAIT
MARINE REFLECTION SURVEY - CUMBERLAND SOUND
SITE SURVEY - DAVIS STRAIT
MAGNETIC SURVEY - BAFFIN BAY & DAVIS STRAIT
SEISMIC REFLECTION SURVEY - FROBISHER & CUMBERLAND (SAME AS 8624-A011-004E)
SEISMIC SURVEY - CUMBERLAND & NORTH LABRADOR
LABRADOR AND CUMBERLAND BLOCKS (SAME AS 673-09-12-00077)
PURCHASE OF GEOLOGICAL & GEOPHYSICAL REPORTS, 8627-A014-003P (AQUA-TERRA 1975)
REGIONAL SEISMIC SURVEY
MARINE SEISMIC - DAVIS STRAIT
SEISMIC SURVEY - DAVIS STRAIT
MARINE SEISMIC REPROCESSING - DAVIS STRAIT
INTERPRETATION OF TRADE DATA - DAVIS STRAIT
MARINE SEISMIC - DAVIS STRAIT
SEISMIC SURVEY - DAVIS STRAIT
SEISMIC SURVEY OFFSHORE BAFFIN ISLAND - CUMBERLAND SOUND
MARINE SEISMIC SURVEY - OFFSHORE BAFFIN ISLAND
SEISMIC SURVEY - LANCASTER SOUND, BAFFIN BAY & DAVIS STRAIT
SEISMIC SURVEY - NORTHERN LABRADOR SHELF, BAFFIN BAY & DAVIS STRAIT
BAFFIN BAY SURVEY
SAME AS PROJECT 8620-A011-002E
NORTH LABRADOR AND CUMBERLAND BLOCKS
1975 GEOPHYSICAL SURVEYS: FLEMISH PASS, SOUTH LABRADOR, ORPHAN BLOCK AND NOF
LABRADOR SHELF SURVEY
LABRADOR SHELF AND SLOPE
PURCHASE OF GEOLOGICAL AND GEOPHYSICAL REPORTS, 8627-A014-003P (AQUA TERRA 19
PURCHASE OF GEOLOGICAL AND GEOPHYSICAL EVALUATION OF LABRADOR SHELF, 8627-A0

GRAVITY SURVEY - CUMBERLAND & NORTH LABRADOR
MARINE SEISMIC SURVEY - CUMBERLAND & NORTH LABRADOR
BAFFIN BAY SURVEY
MARINE SEISMIC SURVEY - CUMBERLAND SOUND & FROBISHER BAY
CUMBERLAND, NORTH & SOUTH LABRADOR AND ORPHAN BLOCKS
MARINE SEISMIC & GRAVITY SURVEY - CUMBERLAND (SOUTHEAST BAFFIN ISLAND)
DAVIS STRAIT PORTION OF PROJECT 8620-J001-002E
MARINE SEISMIC & SHIPBORNE GRAVITY - DAVIS STRAIT
MARINE SEISMIC SURVEY - DAVIS STRAIT
REINTERPRETATION - LABRADOR & DAVIS STRAIT
SEISMIC SURVEY - BAFFIN BAY & DAVIS STRAIT
MARINE SEISMIC SURVEY - DAVIS STRAIT
MARINE SEISMIC SURVEY - BAFFIN & LABRADOR (SAME AS PROJECT 8624-C010-001P)
MARINE SEISMIC SURVEY - OFFSHORE BAFFIN ISLAND
SAME AS PROJECT 8620-G005-005P
REGIONAL NON-EXCLUSIVE SURVEY
REGIONAL SURVEY: LAURENTIAN FAN, ORPHAN BLOCK AND NORTH & SOUTH LABRADOR
PURCHASE OF GSI LINE
HIGH SENSITIVITY AEROMAGNETIC SURVEY
PURCHASE OF REGIONAL DATA FROM DELTA
SENSITIVITY MAGNETOMETER SURVEY
DAVIS STRAIT PORTION OF PROJECT 8620-J001-001E
AEROMAG SURVEY - SOUTHEAST BAFFIN & DAVIS STRAIT
MARINE SEISMIC SURVEY - CUMBERLAND SOUND
MARINE SEISMIC SURVEY - DAVIS STRAIT
BAFFIN BAY & DAVIS STRAIT SURVEY
SEISMIC SURVEY - BAFFIN BAY, LANCASTER SOUND & DAVIS STRAIT
SEISMIC SURVEY - OFFSHORE BAFFIN ISLAND
SEISMIC SURVEY - BAFFIN ISLAND & LABRADOR SEA
LABRADOR SHELF SURVEY
LAURENTIAN CONE, CUMBERLAND, NORTH & SOUTH LABRADOR AND ORPHAN BLOCKS
RECONNAISSANCE OVER SAGLEK, NAIN, HARRISON, DOMINO & SAGLEK AREAS
MARINE SEISMIC SURVEY - FROBISHER BAY
MARINE SEISMIC SURVEY - OFFSHORE BAFFIN ISLAND
STRUCTURAL MAPS ONLY
MARINE SEISMIC SURVEY - CUMBERLAND SOUND
MARINE SEISMIC REFLECTION & REFRACTION SURVEY
SEISMIC SURVEY - BAFFIN ISLAND & LABRADOR OFFSHORE
SEISMIC SURVEY - BAFFIN ISLAND & LABRADOR OFFSHORE
MARINE SEISMIC SURVEY - DAVIS STRAIT
SAME AS PROJECT 838-09-12-00001
BAFFIN BAY SURVEY
3 RECONNAISSANCE LINES
DAVIS STRAIT SURVEY

- LABRADOR SEA) COMPLETED? 2009 (SOUTH OF THE ULAM08 SURVEY)
ANADIAN PART OF BB08)
F A 7000 KM 2-D SURVEY DONE ON THE WEST GREENLAND KANGERLUK & IKERMIUT BLOCKS
-JUN-2008
ID COVERING THE CANADIAN PART OF BAFFIN BAY) COMPLETED? 26-OCT-2008 (8200 KM PLA
- LABRADOR SEA) COMPLETED? OCT-2008 (A SOUTHERN CONTINUATION OF THE BBAM07 SU

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Marine Seismic Operations

An Overview

Produced by IAGC to provide a reference to other marine operations in general and the fishing industry in particular.

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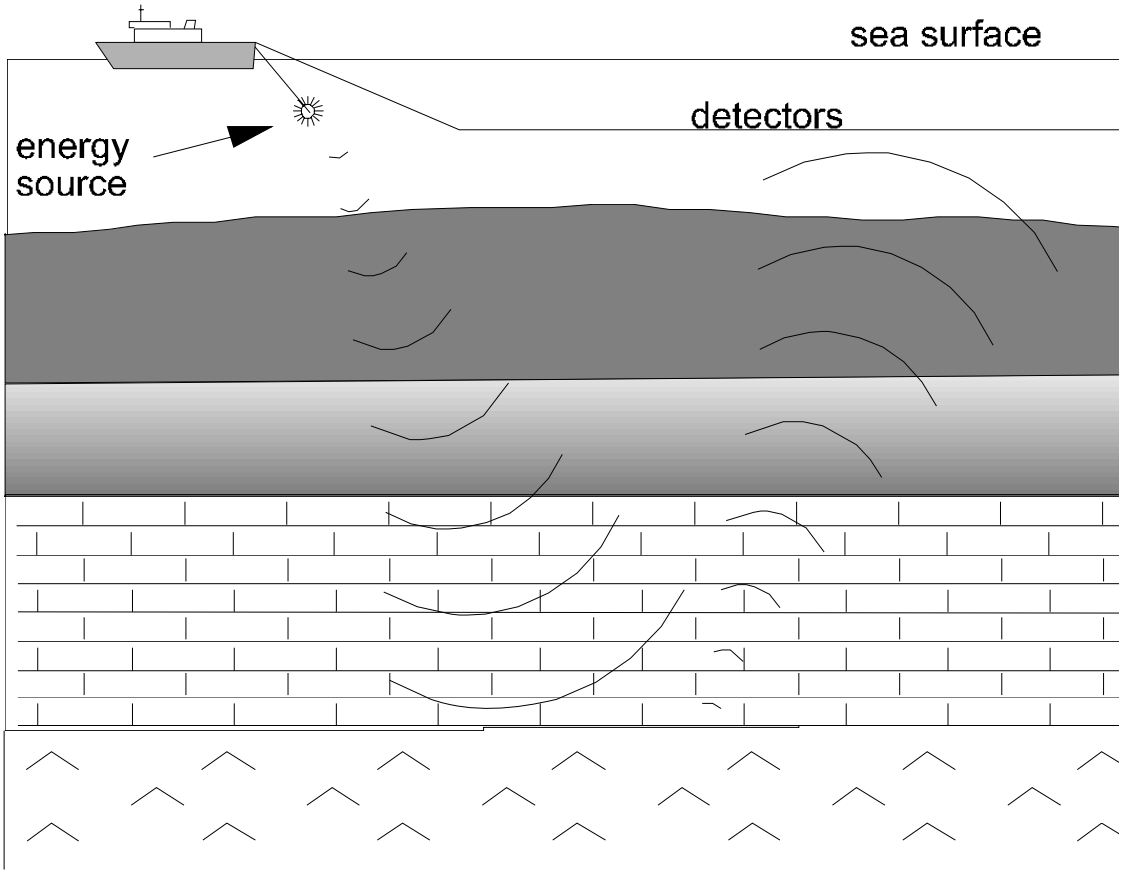
Underlying Principles

The dictionary definition for the word seismic means "of or relating to an earthquake" and indeed it comes from the Greek word seismos meaning an earthquake. In its broad scholarly or teaching sense this is what seismic study is about. It involves earthquake measurement, monitoring and prediction. What is measured are the energy waves created by the earthquakes and the effect of these waves close to where the earth's crust actually moved.

Basic Seismic Reflection

In seismic surveying, geophysicists use the same basic physical properties as the earthquake seismologists. Relatively low energy waves are mechanically generated and directed into the earth. Some of the energy is reflected back to the surface from the different layers of rock below the surface. The returning waves are detected with sensitive measuring devices that accurately record the strength of the wave and the time it has taken to travel through the various layers in the earth's crust and back to the surface. These recordings are then taken and, after various adjustments, done mostly by computers, transformed into visual images that give a picture of what the subsurface of the earth is like beneath the seismic survey area. To summarise, although geophysicists cannot see directly beneath the ground, they can use seismic surveying to get a picture of the structure and nature of the rock layers indirectly.



There are many reasons for doing seismic surveys. They are used to check foundations for roads, buildings or large structures such as bridges. They can help to

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detect ground water. They can be used to assess where coal and minerals are. One of the most common uses is in the search for hydrocarbon resources, gas and oil, and most commercial seismic surveying is carried out in this energy sector.

Oil and gas exploration takes place all over the Earth's surface. It can be generally considered as falling into the two main categories:
- Onshore or Land Exploration
- Offshore or Marine Exploration.

There is a third zone, which is currently of lesser commercial significance. This is commonly called Shallow Water Exploration, but is also sometimes referred to as Transition Zone Exploration (TZ). This involves shallow water areas such as tidal zones, river estuaries or swamplands. Exploration activities in these areas can be very complex.

This document will focus on marine seismic exploration.

2D and 3D Seismic Methodology

The complexity of the seismic survey operation can vary enormously. There are, however, two main types of seismic surveying. These are Two Dimensional or 2D Exploration and Three Dimensional or 3D Exploration. 2D can be described as a fairly basic and inexpensive survey method, which although somewhat simplistic in its method, has been and still is used very effectively to find oil and gas. 3D surveying on the other hand is a much more complex and accurate method of seismic surveying, which involves greater investment and much more sophisticated equipment than 2D surveying. Until the beginning of the 1980's, 2D work predominated in oil and gas exploration but now 3D is the dominant exploration tool.

2D Acquisition

In the 2D method, a single seismic cable or streamer is towed behind the seismic vessel, together with a single source. The reflections from the subsurface are assumed to lie directly below the sail line that the seismic vessel traverses – hence the name 2D. The processing of the data is, by nature of the method, less sophisticated than that employed for 3D surveys. 2D lines are typically acquired several kilometres apart, on a broad grid of lines, over a large area. The method is generally used today in frontier exploration areas before drilling is undertaken, to produce a general understanding of the regional geological structure.

3D Acquisition

A 3D survey covers a specific area, generally with known geological targets generated by previous 2D exploration. Prior to the survey, careful planning will be undertaken to ensure that the survey area is precisely defined, usually carried out by the Oil Company or by specialist contractor personnel. Since much time, money and effort will be put into the acquisition, processing and interpretation of the survey, it is very important that it is designed to achieve the survey objectives. The result of the detailed planning will be a map defining the survey boundaries and the direction of the survey lines. Specific acquisition parameters such as energy source, firing and receiver station intervals, together with the seismic listening time, will also be defined. In 3D surveying, groups of sail lines (or swathes) are acquired with the

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same orientation, unlike 2D where there is a requirement for orthogonal or oblique lines to the prominent acquisition direction. Simplistically, 3D acquisition is the acquisition of many 2D lines spaced in parallel close together over the area.

The 3D sail line separation is normally of the order of 200 to 400 metres. By utilising more than one source and many parallel streamers towed by the seismic vessel, the acquisition of many closely spaced sub-surface 2D lines, typically between 25 and 50 metres apart, can be achieved by a single sail line. A 3D survey is therefore much more efficient in that many times more data is generated than for 2D. The size of a 3D survey is usually referred to in square kilometres or sometimes the number of line kilometres to be acquired. A small 3D survey size is of the order of 300 square kilometres or 1000 sail line kilometres or 12000 sub-surface 2D kilometres.

3D surveys are typically acquired with a racetrack pattern being employed, to allow adjacent sail lines to be recorded in the same direction (swathe), whilst reducing the time necessary to turn the vessel in the opposite direction. This increases the efficiency of acquiring the data and minimises processing discontinuities, which could adversely affect the interpretation of the data.

With the number of sail line kilometres involved, 3D surveys can take many months to complete. The way in which the data is acquired greatly affects the efficiency of the acquisition and considerable planning goes into this aspect. Whilst a racetrack approach is the favoured one, size and shape of the survey, obstructions, tides, wind, weather, fishing vessels and client specifications amongst others, will clearly affect the efficiency and design of the operations. Usually, a survey is broken into areas and swathes of lines are completed in phases or individual racetracks, but there is no rigid procedure which is followed.

Powerful computers are required to process the large volume of data acquired into a three-dimensional image of the subsurface – hence the term 3D seismic. 3D surveys have now become the preferred method for providing the geological interpreter with subsurface information and account for more than 95% of marine seismic data acquired worldwide. 3D surveys are used in all phases of hydrocarbon exploitation from identifying geological structures which are considered likely to contain hydrocarbons to, in areas of established production, establishing those portions of the reservoir which are not being drained by existing wells. Increasingly, 3D surveys are being repeated regularly on established production fields to monitor the reservoir characteristics and depletion rates, so-called Time Lapse surveys.

Seismic Survey Vessel

Now days, seismic vessels are purpose built with many special features, including accommodation for the seismic crew, the instruments, helideck and quiet engines and propellers. The Captain, is responsible for the safety of the seismic vessel and he has the final say in how the seismic vessel is operated and manouvered.

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A recently built seismic vessel has the following specifications:
Length: 84 m
Beam: 18.5 m
Draft: 6.2 m
Displacement: 5600 metric tons
Cruising speed: 13.5 Knots
Berths: 50
Endurance at sea: 50 days



The instrument room

This is where the main seismic instrumentation is located and operated. The position of the instrument room varies from vessel to vessel but normally is located centrally, somewhere below the bridge and forward of the back deck. It contains the main seismic instruments for recording seismic data and controlling the seismic streamer(s) and energy source firing. The main navigation system is also here with its links to satellite, radio systems, compasses and all the various positioning control devices and monitors. There is usually a working area for instrument testing and repair.

The back deck

This is an area, which although in detail can vary from vessel to vessel, has the same basic purpose – storage, retrieval and deployment of the seismic equipment that is placed in the sea. The seismic streamers are stored here on large reels and when acquisition is ongoing, they are deployed over the back and/or sides of the vessel and towed directly behind the vessel, subject to feather. The number of streamers varies depending on the vessel but can be as many as sixteen for 3D surveys. All the wiring from the streamers is fed through special connectors to the instrument room. Most vessels have a small streamer repair area on the back deck. The seismic streamers are under control of the geophysical observer section of the crew.

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The back deck is also the location of the energy source equipment. The energy source is usually made up of airguns, which are fed with high-pressure air. Each source is made up of an array of many different sizes of airguns, linked together with special harnesses and fed with airlines and electronic control cables. When not in use, these cables are stored on reels usually at the forward end of the back deck. During deployment, they are put to sea through a slipway at the rear of the deck. The air feed from the seismic vessel compressors to the arrays is monitored from a control panel, which is housed in a small work shack where airgun repairs can also be done.



In association with the streamers and source arrays is the towing equipment. This is a complex, carefully designed arrangement of specialised gear that enables the multiple streamers and source arrays to be positioned accurately behind the seismic vessel and allows different source and streamer separations depending on the survey design. The airgun system and the towing equipment are the main responsibilities of the mechanical section of the seismic crew.

Finally on the back deck is the navigation or positioning equipment. This usually involves buoy systems containing navigation instruments. Tail buoys are attached to the end of each of the streamers furthest from the vessel. Additional buoys can be attached to the source arrays and towing equipment for example. These are not the only buoys in the system however, and in complex multi streamer/ source/ boat arrangements, the navigators need a lot of other control and monitoring systems on sources, streamers and any other vessels so that the relative positions of all the equipment can be recorded.

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Compressor room

This contains the compressor engines and compressors, which supply high pressure (nominally 2000 psi) air to the source arrays. The compressors are capable of recharging the airguns rapidly and continuously, enabling the airgun arrays to be fired, typically every ten seconds or so during acquisition of data and for periods of up to 12 hours continuous firing, depending on the length of the sail line. This room is under the mechanics' control and is usually situated in proximity to the back deck.

Seismic Streamer

It is worth noting that due to the action of wind, tides and currents, the seismic streamer does not normally tow directly behind the seismic vessel, but lies in an arc offset from the nominal sail line. This is referred to as feathering and whilst such lateral displacements are not typically crucial to the success of 2D data surveys, they are critically important in 3D, where accurate knowledge of the positions of all sources and receivers is fundamental to the successful application of the technique.

The seismic cable or streamer detects the very low level of reflection energy that travels from the seismic source, through the water layer down through the earth and back up to the surface, using pressure sensitive devices called hydrophones. The hydrophones convert the reflected pressure signals into electrical energy, that is digitised and transmitted along the seismic streamer to the recording system on board the seismic vessel, where the data is recorded on magnetic tape.

The sensitivity and robustness of the streamers is remarkable. Normal noise levels in calm weather conditions are of the order of 2-3 μbar and it is quite common for streamers to remain operating in the water for months at a time.

The streamer itself is made up of five principal components:
- hydrophones, usually spaced one metre apart, but electrically coupled in groups of 12.5 or 25 metres in length.
- electronic modules, which digitise and transmit the seismic data.
- stress members, steel or kevlar, that provide the physical strength required, allowing the streamer to be towed in the roughest of weather. Each streamer may be subjected to several tonnes of towing strain.
- an electrical transmission system, for power to the streamer electronic modules and peripheral devices, and for data telemetry.
- the skin of the streamer in which all the above are housed.

The streamer is divided into sections, each 50-100 metres in length, to allow modular replacement of damaged components. Each section is terminated with a connector unit, which houses the electronic modules. Each section is filled with electrical isolating fluid, which has a specific gravity of less than one, to make the overall streamer neutrally buoyant. Although historically, this fluid was an organic compound, more recently a purely synthetic material has been used.

Recent advances in cable technology have led to a new generation of seismic streamers, moving away from the traditional fluid filled cable to a solid cable, constructed of extruded foam, where the requirement for fluid is minimised or removed entirely. This generation of streamers has many advantages in that they

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are more robust and resistant to damage, do not leak when damaged either on the vessel or in the sea, and are less sensitive to weather and wave noise. This has been achieved without reducing the sensitivity of the cable to the reflection energy.

Streamer lengths have increased over time with improving technology. The streamer length utilised is dependent on the depth and type of the geological target for a given survey. Recent surveys have seen streamer lengths typically in the order of 5000 to 6000 metres, with some detailed surveys using streamers up to 12000 metres in length. This increase in length, coupled with the increasing number of deployed streamers, has resulted in a marked increase in the quantity of streamers in the water, with seismic vessels deploying 40 to 50 kilometres of streamer becoming more prevalent.

Streamer tow depths are a compromise between the requirement to operate these sensitive devices away from the surface weather and wave noise, which limits the usability of the recorded data, and other technical requirements. The deeper the tow depth, the quieter the streamer and the greater the immunity to weather noise, but also unfortunately, the narrower the bandwidth of the data.

Typically the range of operating depths varies from 4 to 5 metres for shallow, high resolution surveys in relatively good weather areas to 8 to 10 metres for deeper penetration, lower frequency targets in more open waters.

In addition to the internal components of the streamer, there are three types of external device, which are attached to the streamer:
- depth control units or birds.
- magnetic compasses.
- acoustic positioning units.

Power for these systems is provided both through the streamer itself, inductively coupled, and by batteries in each external device.

In addition, a tailbuoy is connected to the far end of each streamer to provide both hazard warning of the submerged towed streamer, especially important at night, and positional information.

The Seismic Source

Although there are now three types of seismic source, airguns, waterguns and vibrators, that can be utilised, almost all surveys conducted world-wide use airguns. Explosives are an historic source, and are not used in present day operations.

The airgun, comprises two high pressure air chambers; an upper control chamber and a discharge chamber. High pressure air, at typically 2000 to 2500 psi, is supplied to the upper control chamber from the compressor onboard the seismic vessel via an air hose and bleeds into the lower firing chamber through an orifice in the shank of the shuttle. The airgun is actuated by sending an electrical pulse to the solenoid valve which opens, allowing high pressure air to flow to the underside of the triggering piston. The high pressure air in the lower (firing) chamber is

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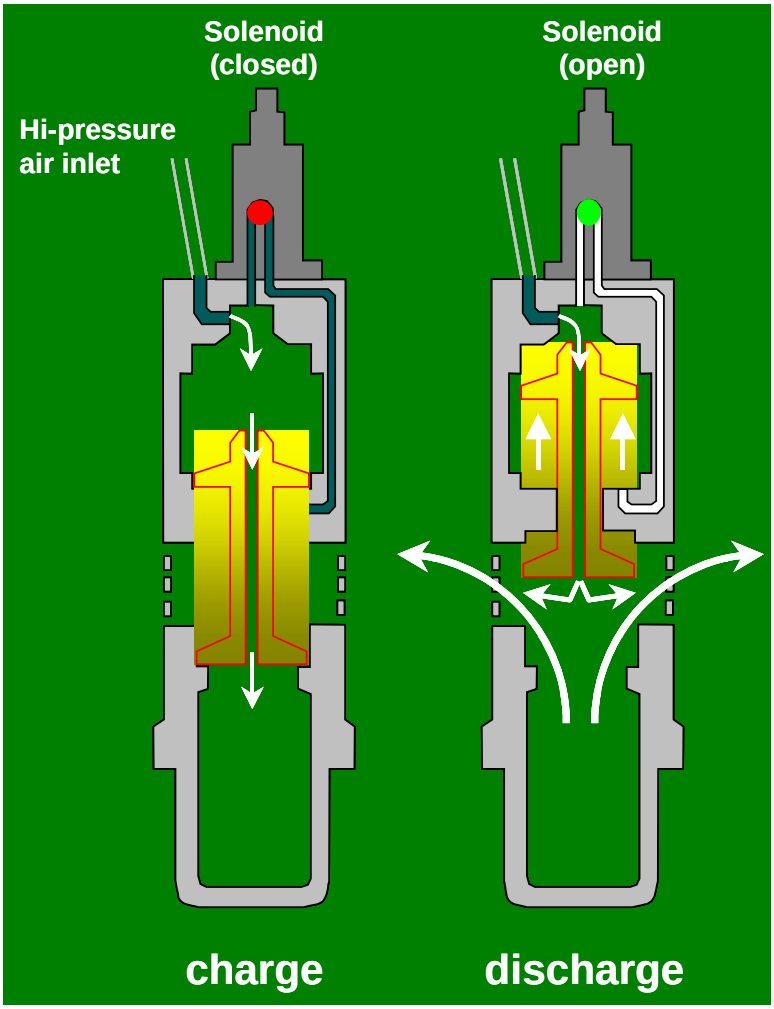
discharged into the surrounding water through the airgun ports. The air from these ports forms a bubble, which oscillates according to the operating pressure, the depth of operation, the temperature and the volume of air vented into the water.
The shuttle is forced back down to its original position by the high-pressure air in the



control chamber, so that once the discharge chamber is fully charged with high-pressure air, the airgun can be fired again. The opening of the shuttle is very rapid, taking only a few milliseconds, which allows the high-pressure air to be discharged very rapidly.

Total energy source volumes vary from survey to survey and are designed to provide sufficient seismic energy to illuminate the geological objective of the survey, whilst minimising environmental disturbance.

An airgun array is made up of sub-arrays or strings, which are suspended from floatation devices to maintain the specified operating depth. Array dimensions are usually of the order of 25 metres wide by 15 to 20 metres long.

Typical source outputs in use today will output approximately 220 dB relative to 1µ Pascal/Hz at 1 metre. In pressure terms the zero-peak output of an array is of the order of 40 bar-metres.

Source arrays are designed to focus energy downward into the subsurface.

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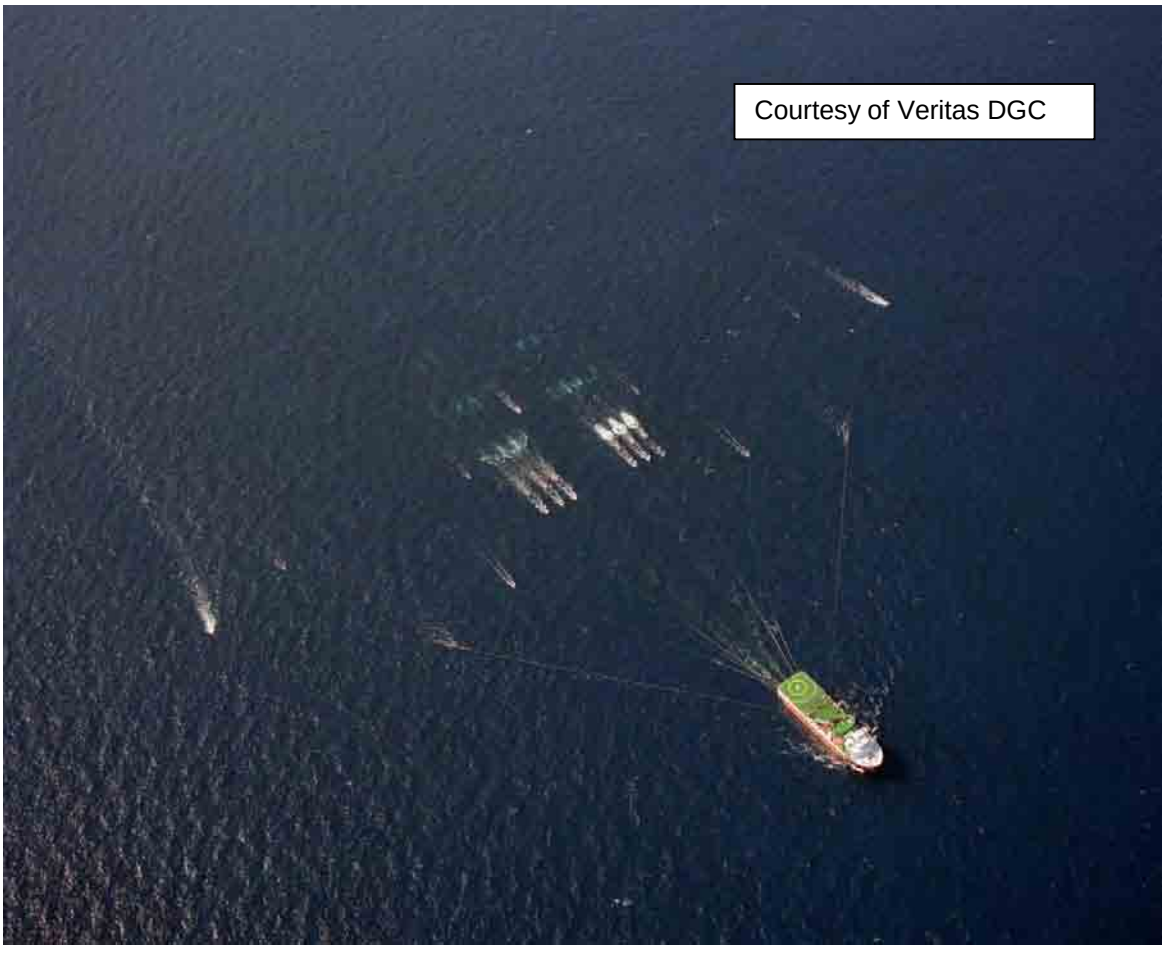
Operations

The first stage of normal operations is that the seismic vessel should be fully supplied with all necessary fuel, water, food, seismic equipment and crew. It will then transit to the designated survey site. The seismic vessel will have been provided in advance with all necessary details regarding the survey layout and design and what and how much equipment will be deployed. The navigators will have information, which specifies where each seismic line must start and finish, and what the energy source firing, or shooting, interval must be. This information will have been fed into the onboard integrated navigation system.

On the bridge, the captain will ensure that while the seismic vessel is under normal manual control, he will be navigating as agreed to the first line start position. The seismic vessel will maintain a constant speed of around 5 Knots. He and the seismic crew (party) manager will be closely monitoring wind, weather and any incoming reports.

As the survey area is approached, the geophysical observers will deploy and check the streamers, attaching depth monitor and control devices (birds) as they go. The mechanics will start the compressors and prepare and check the required airgun arrays. These will be launched when necessary but after the streamers. The navigators will work with both mechanics and observers to attach the necessary buoys for positioning.



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In the instrument room, all equipment will be powered up, tested and checked for trouble free operation. Test records (no airguns operating) for insea noise will be made. The streamer, airgun and buoy links will all be checked and tested and the whole system confirmed as OK and ready to go.

As the seismic vessel approaches the line start or first firing point, it is said to be on the run in. This is the stage where it is very close to the agreed start position and the seismic vessel has the correct heading and the streamers are as much in line behind the seismic vessel as conditions will allow. The seismic vessel by this point is steered according to the input from the navigation system. Around the seismic vessel all involved crew members will be monitoring the seismic vessel's position from information screens in their areas. The navigator will be at his desk keeping a close eye on his console, where he can monitor in detail the approach to line start in terms of distance to go, heading and speed and can ensure that no positioning problems arise at the last moment. The mechanics will be keeping a close eye on the compressor monitors and will make a last minute visual inspection of the airgun equipment that can be seen from the vessel. The observers will take final test records and record the system noise for future reference and will check out the airgun control system.

It is during the approach to the line start, that environmental protection procedures may be applicable. Depending on the country of operations and the area specific environmental controls in place, a visual watch for marine mammals from the seismic vessel may be ongoing for at least 30 minutes before the first firing of the airguns. On some surveys, acoustic methods may additionally be utilised to identify the presence of marine mammals within the vicinity of the airgun array. It is only when the crew has been informed that no marine mammals are present, that the survey line can proceed with the firing of the airguns. A 20 minute run-in is required in some regions where the airgun array energy output is slowly increased to full power.

All systems are now ready to go and at the first predetermined position, the first shot is fired from the airgun array and data recorded. At successive intervals, as determined by the navigation system programme, the recording process is repeated and so on, to the end of the line. Throughout the recording period, all personnel involved perform detailed prescribed tasks. The navigator monitors the system output, checking for any discrepancies and completes the line paperwork and prepares plans for moving to the next line to be recorded. The mechanic watches the compressor performance, checks the back deck towing systems and is ready to deal with any hose or airgun problems. The geophysical observer monitors each shot, keeps an eye on insea noise, changes recording media and fills in the line log as the line progresses.

When the line is complete, all systems stop recording. The ship is now in line change mode. The navigator has planned how the vessel should manoeuvre to get into the run in for the next line. The line change time varies according to the layout of the survey and the configuration of the equipment but is usually between one and three hours. During the changeover period, all the crew involved work quickly to resolve any problems and make modifications or repairs in readiness for the next line. The run in is then started, all equipment is readied, and the cycle repeats.

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Infrequently, technical failures occur and line starts are delayed or lines are terminated early.

Other types of Seismic Source

Waterguns

Waterguns operate in a similar manner to airguns, but in place of air being vented into the water when the gun is triggered, a volume of water is used. The advantage of this is that as there is no air in the water, there is consequently no air bubble to oscillate, so the need to use differing volumes of guns is removed.

The disadvantage is that the low frequency bandwidth of the signal generated by forcing water under high pressure into the surrounding water, is much less than that provided by an equivalent airgun and thus the signal is unable to penetrate as deeply into the subsurface. Water guns were briefly popular in the 1980s but are not used commercially today.

Marine Vibrators

A marine vibrator operates by using either hydraulic or electrical power to drive an actuating plate, that is immersed in the sea, in a controlled manner.

The advantage of this is that a very precise signal can be injected into the subsurface. The signal usually employed is a sweep of frequencies, say 10-80 Hz for example, over a 10-second interval. The instantaneous sound pressure level is much lower than that from an airgun. The recorded data is then correlated against the input sweep to recover the reflection record.

The control of these devices is very complex. The output from a single vibrator is comparable to that from an airgun sub-array but suffers the disadvantage, like waterguns, that its low frequency response has historically been poor, so that deep penetration into the subsurface has not been possible. The vibrator has also suffered poorly in comparison with airguns with regards to mechanical failure, having a much higher failure rate.

Other insea equipment

Depth control birds are used to control the depth of the streamer to an accuracy of typically plus or minus 1 metre. The wings on the bird are electronically controlled to pivot in response to the hydrostatic pressure (depth) measured by a pressure transducer inside each bird. As the streamer is weighted to be neutrally buoyant, the birds are used to counteract depth variations in the streamers introduced by seismic vessel pitching movements in heavy weather or when different currents are experienced, with corresponding fluctuations in density and/or temperature of the sea water.

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Birds are normally spaced approximately 300 metres apart on each streamer.

Positioning

One of the most critical elements in the 3D seismic method is the positioning of the in-sea equipment. The tailbuoy is used to house Differential Global Positioning System (DGPS) receivers that are used in the positioning solution for the hydrophone groups in the streamers. Compasses, and acoustic ranging units are fitted along each streamer which contribute to the location accuracy of 3 to 8 metres absolute, with which seismic surveys are normally conducted. Differential GPS is the standard system used for positioning the seismic vessel itself and Relative



DGPS is used to position both source floats and tailbuoys.

Vessel Configurations

The 2D method involves the use of a single source and a single streamer from which one subsurface data is generated. In 1984, the first twin streamer operation was undertaken, which effectively doubled the efficiency of the seismic vessel by generating two subsurface lines per vessel traverse. By moving to twin source/twin streamer configurations in 1985, the output was increased to four lines per pass. The next logical step of towing three streamers and two sources behind a single vessel, six lines per pass, was not achieved until 1990, but thereafter the rate of progress has been very rapid.

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Multi-Vessel Operations

In addition to the single vessel geometries described above, the industry has been using a number of multi-vessel operations.

By using two three streamer seismic vessels side-by-side, with two sources deployed from one vessel, twelve subsurface lines per traverse can be achieved.

There are many variations in the numbers of vessels, streamers and configurations, and the techniques to acquire data.

The system used for a particular survey will best match the objectives of the survey and the conditions found at the survey site.

Other Marine Seismic Techniques

Seabed Recording Systems

There are three principal types of seabed recording systems used in marine seismic; Ocean Bottom Seismometers (OBS), Dragged Array (DA) and Ocean Bottom Cables (OBC). Of these, OBS and DA are used in multi-component (sensor) acquisition and OBC is used in both dual component and multi-component data acquisition. The term multi-component refers to the use of three component geophones in addition to a hydrophone for each seismic receiver location. The term dual component refers to the use of just a single geophone in addition to a hydrophone. A geophone measures particle displacement velocity in contrast to pressure which a hydrophone detects. The use of geophones, which must be in contact with the sea floor, sense particle motion along three orthogonal axes, allowing the geophysicist to infer more information concerning the subsurface geological layers from which the reflections occur. This has particular application in producing reservoirs, where multi-component techniques have the potential to enhance hydrocarbon recovery.

Of the three techniques, OBC is by far the most prevalent technique in use in world-wide marine acquisition.

Ocean Bottom Seismometers

Such systems have been historically used by university research groups to provide large-scale information for crustal studies and lithospheric investigations. They are battery powered individual units, which contain both the three-component geophones and hydrophone detectors, in addition to the associated recording system. The electronics are placed in a pressure housing, which also includes a flotation collar and navigation pinger. The unit, with an anchor system attached, is deployed onto the sea floor, typically in fairly deep water. The unit is then used to record data internally from a seismic energy source operating near the sea surface as in conventional marine seismic. Once this has been accomplished, the unit is released from its anchor to float up to the sea surface to be recovered. The data recorded on the internal tape drive is then removed from the buoy for subsequent processing and analysis, the batteries replaced or recharged and the whole operation repeated.

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Buoys are typically deployed several kilometres apart for crustal investigations, but more recently have been used in areas like the Atlantic Margin for oil related projects in a closely spaced configuration. The interest here has been to see if the OBS method can assist in enabling geophysicists to “look through” the basalt rocks which cover much of the subsurface area and which are opaque to conventional towed streamer seismic techniques.

The fact that the buoys are physically separate and their positions are not, especially in deep water, sufficiently accurately known for 3D means that this technology is unlikely to see large volume commercial usage.

Dragged Array

In this system, a number of multi-component sensors are connected together by a short length of streamer that is electrically connected to a recording vessel. The equipment, which can comprise no more than 16-24 individual sensor stations, is lowered onto the seabed and a separate seismic source vessel used to conduct a 2D shot line over the seabed deployed sensors. The data is transmitted to the recording vessel, which is usually dynamically positioned off to one side of the survey line. Once this line has been acquired, the recording vessel repositions itself online and moves forward along this line, carrying the seabed deployed equipment with it, the so-called dragging operation. The system is moved forward to provide continuous coverage of the subsurface and the shot line re-acquired by the source vessel. The system used has operational capability down to 2000 metres of water depth.

Dual Component/Multi-Component Ocean Bottom Cable

The dual component or multi-component OBC technique utilises both geophones and hydrophones in a combined cable that is deployed from a cable/recording vessel down to the seabed. Existing equipment design has limited the depth to which these sensors can be used to less than 200 metres, although newer generations of cables are being used in deeper waters. Unlike the dragged array, the equipment is laid out or dropped on the seabed and data recorded using a separate source vessel.

The principal difference between OBC and dragged array operations is that as much as 72 kilometres of ocean bottom cables can be laid or deployed on the seabed, compared to less than one kilometre for the dragged array. This allows the OBC method to be used for 3D surveys.

The separations of source and recording vessel allow for different acquisition approaches to be used in ocean bottom cable 3D surveys. Two different methods are typically used: swath, where the source and seabed receiver lines are oriented along the same direction, and patch where they are oriented at right angles.

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Vertical Cable

A rarely used technique, closely related to VSP. Only one survey has been conducted in the North Sea so far. This involves the use of hydrophone cables set out vertically in the water column across the survey area.

Each cable typically comprises single hydrophones spaced at intervals, together with a concrete anchor block, subsurface flotation buoys and a surface buoy, which houses the recording and radio telemetry systems.

The vertical cables are deployed at pre-determined locations by a dynamically positioned cable-laying vessel. The separation of the cables is determined by both the water depth and the geological objective. A separate source vessel fires its airguns into the 2D source lines producing a regular grid of shot point locations. The cable vessel replaces batteries and recovers the recorded data. The source technology is identical to that used for conventional towed streamer.

Survey duration will depend on the specific target objective for the survey but the method is more focussed towards reservoir imaging rather than general exploration.

Vertical Seismic Profiling (VSP)

In this technique, a number of geophones are lowered into a well and used to record data from a seismic source deployed from the well platform itself, called zero offset VSP, or from a source vessel which travels away from the well, known as offset VSP.

The main advantage of this method is that the seismic energy only has to travel one way through the earth. The reflected signal only has to travel a short way from the reflector to reach the downhole geophones. This results in higher bandwidth data being recorded, since there is less absorption of the higher frequency energy due to the shorter ray path lengths.

Source volumes are generally smaller than for conventional data but larger than for site surveys. The duration of these surveys is typically short, one or two days at most.

There have been a number of 3D VSPs recorded but these are relatively expensive to acquire. Much like the dragged array system, they require many passes of the source vessel to achieve complete 3D coverage and are hence relatively expensive, especially when the cost of the well time is included.

Site Surveys

Before a well is drilled, there is both a legal and operational need to have detailed information about the seabed in the area immediately surrounding the well location and the geological layers immediately below the subsurface.

The information about the nature of the seabed is needed to ensure that the rig legs and/or anchors will not encounter any problems when they are lowered to the seafloor and will provide the necessary stability for the structure. If the well is

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successful, this information will also be needed for any platform or subsea completion systems that would be installed.

The near subsurface data is needed to ensure that there are no unforeseen hazards, such as shallow gas pockets or buried river channels, that could have catastrophic effects when penetrated during the drilling process. The sudden release of gas below a drill rig could result in a catastrophic loss of life.

The resolution from conventional seismic is not sufficient for these purposes and a high resolution or site survey is undertaken. This technique is identical in principle to conventional 2D marine, except that the energy source is much smaller, and the streamer is much shorter at between 600 to 1200 metres. The source and streamer are towed at a depth of only two or three metres, corresponding to the much shallower depth of investigation. This limits operations to very good weather conditions only, to avoid wave noise.

Survey durations are short, depending on weather, but are usually of the order of four or five days. Other equipment may be deployed from the survey vessel during the course of the site survey. This may include side scan sonar fish for seabed profiling and the dropping of coring equipment to determine the seabed conditions.

Transition Zone Acquisition

This is by far the most complex and challenging area of seismic acquisition.

Shallow shelving waters are the most common problem, for they often require small, shallow draft, specialised vessels to move cables, sources, people and equipment around. With bad surf conditions it is very difficult to deploy, retrieve or operate equipment in a flat-bottomed boat.

Source types may have to be varied across an area. Where water is deep enough, it might be possible to deploy the source from the back of a barge for example, but where it is shallow, the use of explosives might be required, which are jetted or pushed into the mud or sand of the sea bottom.

Providing reliable recording sensors is also problematic. Marine hydrophones are suitable, provided they are located in deep enough water to enable them to operate properly, They are unreliable when the tide goes out for example. An additional problem involves placing the cable at a reasonable depth in the deeper water. In these environments, the streamer is not being pulled through the water with depth controlling devices. Personnel are often required to weight the cable to the sea bottom with chains and anchor blocks. With active surf or current conditions, it is likely that the cables will move and then subsequently have to be manhandled back into position.

One form of cable that can be used very successfully in transition areas is called a bay cable. It is effectively a very well sealed land cable with geophones on gimbals so that they remain upright. Some variants of these cables can contain hydrophones as well. This cable is lighter and easier to handle than a marine type of cable, but it is still not either straightforward or effortless in its use.

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Another method of recording data in these zones is to integrate the sensors with electronics, creating rugged sensor stations that radio transmit the received earth signal back to an instrument position, either continuously or on command from the observer. In some areas this is often the only equipment that can be effectively used, but these units still need to be positioned and anchored appropriately and this is seldom easy.

Positioning of the equipment can be complicated. Close inshore areas are usually less problematic, but the highly variable mid zone complete with fast currents, drifting cables, wandering shots, big tides and lots of mud can make it a navigator's nightmare.

Transition zone surveys conducted in UK waters are limited in number and are unlikely to become more numerous in the future.

Operational Performance

The rate of progress for a seismic survey is constrained by many factors but the most dominant is usually the weather. Other issues that affect the duration of a specific survey are:

- Survey Location
- Time of Year
- Survey Size, particularly Sail Line Length
- Technical Acquisition Parameters
- Vessel Configuration
- Line Orientation and Prevailing Current Direction
- Fishing and Shipping Activity in the Survey Area – trawling especially
- Other Seismic Operations nearby
- Marine Mammal Activity
- Drilling and Subsea Equipment Maintenance, including diving
- Technical Equipment Downtime

The net effect of all of these factors is to limit the time actually spent acquiring seismic data to just 35-40% of the available time.

The reason the weather is so important is that the signal levels that are recorded by the seismic streamer are very small. Because there is a requirement to record data with as wide a bandwidth as possible, to improve the resolution with which geologic features in the subsurface can be identified and mapped, the streamers are towed at quite shallow depths to avoid technical problems. Thus any wave action, which is directly proportional to weather conditions, causes noise that degrades the quality of the recorded data.

The location of the survey dictates the weather environment for the survey, as does the time of year the survey is being conducted. Offshore West Africa, for example, the weather is much better than in the North Sea, and thus two identically sized surveys in these two regions would have significantly different durations.

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Activity Levels – Historical - Europe

The first 2D seismic was acquired in the Dutch sector of the North Sea in 1959. Activity started in the UK sector some three years later, Norway two years after that. A steady increase in exploration saw a peak in the mid seventies, followed by a lull until the late eighties. 2D activities have been trailing off since then apart from the UK non North Sea area, namely the Atlantic Margin area, which has seen a major upturn in activity since 1993.

The decline in 2D acquisition has been matched by a rapid increase in the use of the 3D technique. This is a result of the reduction in unit costs for 3D, following the rapid increase in the capabilities of seismic vessels to tow more streamers. From just two streamers towed in 1989, 8 to 10 streamers in 1998, up to the current maximum of 16 in 2001. 3D seismic acquisition therefore, has changed from being just a tool to appraise discoveries and fine tune production, to being used for exploration purposes in frontier areas.

The sharp peaks and troughs in seismic acquisition operations can be traced to a number of factors. Exploration seismic is usually acquired in the period immediate before and after Licencing Rounds issued by the governments, originally annually in the UK but now every two years or so. Oil company budgets are subject to the vagaries of the oil price; downturns in the oil price have led historically to reductions in exploration.

Other Marine Operations

If the survey is in an area of high shipping activity or other marine operations, seismic operations can be difficult. A seismic vessel is limited in its manoeuvrability due to the streamers deployed from the stern, which may be several kilometres long. The seismic vessel itself is in little danger, but with lots of vessels in close proximity, the streamers may well be fouled or cut. Trawl fishing can be a particular hazard. With very high towing strain (may be several tonnes) on the insea equipment cables, there is a danger of both a safety and environmental accident. Aside from the large financial loss from the value of the streamers themselves this can mean a serious loss of earnings through disrupted operations. In difficult areas, chase or escort boats are employed. These are smaller vessels, usually ex-fishing boats, which contact potentially threatening shipping traffic and direct them away from possible contact with the streamers.

Legislative Environment - UK

Under the terms of the Petroleum (Production) Act of 1934 and the 1964 Continental Shelf Act, the Exploration Companies (oil companies) of all surveys conducted in the UKCS to search for petroleum in the strata in the islands and in the sea and subsoil require a license from the UK Department of Trade and Industry (DTI). These exploration licenses have a three year term, are renewable, and have no specific geographical reference.

Production licences for specific blocks or areas are usually applied for in response to invitations issued by the DTI or national equivalent, in respect of blocks or areas specified in the invitation or ‘Round of Licencing’. The licence grants the holder exclusive rights to explore for, and produce petroleum, in the block covered by the

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licence. The duration of the licence has varied with each Round. Blocks or areas may on occasion be offered for Licencing between Rounds (out-of-Round).

The conditions for each licensed area have evolved over time.

JNCC Requirements

All seismic surveys in designated areas in the UK are subject to the JNCC (Joint Nature Conservation Committee) Guidelines for Minimising Acoustic Disturbance to Marine Mammals. These guidelines have been in place, and formed part of licence conditions, since 1995. These guidelines cover:

1) Before starting a survey line, seismic company personnel should carefully make a visual check to see if there are any cetaceans within 500 metres

   If cetaceans are present, the start of the survey should be delayed until the cetaceans have moved away, allowing adequate time after the last sighting (30 minutes) for the animals to move well out of range. Hydrophones may also be useful in determining when cetaceans have moved out of range.

2) Airgun energy should be built up slowly from low energy to operating level over 30 minutes, to give adequate time for cetaceans to leave the vicinity.

3) Throughout the survey, the lowest practicable energy levels should be used.

4) Reporting of sightings and details of watches (using standard forms)

All seismic acquisition contractors have agreed to conduct survey operations in the UK in accordance with these guidelines and have employed marine mammal observers on their vessels. The JNCC have reported that the data that has been gathered from seismic vessels in the Atlantic margin in recent years has added significantly to their knowledge of cetacean population distributions in the area.

Future Trends

3D survey sizes have historically been increasing due to a variety of economic and technical factors. This trend is likely to be maintained for exploration 3D, but the areas covered in the mature UKCS in recent years are very large and there is a finite limit to the acreage to be surveyed. This does not, however, take into account the potential for reacquiring older 3D surveys in the light of new acquisition and processing technology when it becomes available.

Reservoir specific 3D surveys, which are designed to maximise hydrocarbon recovery from a given reservoir, are necessarily much smaller than exploration 3Ds, since almost all reservoirs in the North Sea are much less than 100 square kilometres in extent. With increased subsurface imaging potentially available from multi-component data, it is probable that there will be a number of geographically small, but geophysically intense, production 3D surveys in the coming years. The exact configurations and techniques employed will be very specific to each particular reservoir, but will involve combinations of most, if not all, the methods described in this booklet.

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The complexity of the equipment deployed in the water has dramatically increased in the last decade and whilst there are geophysical limits to how many streamers can be used to image a specific geological target, it is certain that this trend will continue.

The use of seabed receivers, especially multi-component systems, will increase for both 3D surveys and the newly emerging 4D or time lapse 3D technique. In this method, successive 3D surveys acquired months or years apart depending on the characteristics of reservoir production, are compared to determine where fluid movement has occurred (or not) in the reservoir itself.

Research into how improvements to both the quality and productivity of the seismic method will continue as will investigations into how best to quantify and minimise any environmental impact that seismic surveys may have.

Marine seismic surveys have experienced strong growth in the last ten years and it is likely that this growth will continue well into the next millennium. However activity levels will always reflect the economic conditions in which the oil companies are working.

Worldwide there are presently a total of some 80 seismic vessels available. In the past a maximum of about 120 seismic vessels were operating.

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Appendix E
Sanco Spirit Maritime and Seismic Specification

Maritime Specification Summary

Name	**Sanco Spirit**
IMO number	9429936
Owner	Sanco Shipping AS
Maritime operator	Jon Aklestad (Sanco Shipping AS)
Flag	GIBRALTAR
Port of registry	Gjerdsvika, Norway
Call sign	ZDJN 3
Builder	Vaaggland Båtbggeri AS, Norway
Built	2009
Classification society and notations to class	DNV + 1A1, ICE-C, HELDK-SH, RP, EO, DYNPOS-AUTR.

Vessel Dimensions

Length	86 M
Breadth	16,00 M
Draft	5,80 Loaded . 4,50 M in Ballast

Vessel Tonnage

Gross (IMO-69)	4396
Net	1319

Vessel Capacities

Fuel	1100m3
Maximum endurance (shooting/transit)	Transit = 27m3/day..Shooting endurance..?10 m3.day,when not towing cables
Vessel Cruising Speed Knots	13 kts
Vessel Speed Knots	13
Maximum Transit Speed Knots	15 kts
Power Plant	4 x 1593 kW, ABC Diesel, 8 DZC, 900 RPM
Propulsion type	2 x Stadt Stascho 2500 KW
Pumps	[Pumps]
Fresh water maker capacity	117m3
Accomodation	47 (13 x Single cabins and 17 double cabins)
Helideck	Diameter 20 m, 11 ton

Communications Systems

Inmarsat B	+870764946968 (69)
Direct Phones	[Direct Phones]
Norsat	+31107130612 (13) (14)

Navigational Aids

Radar	3 cm Furuno FR 2117 and 10 cm Furuno FR 2137 S, Arpa
Auto pilot	Kongsberg with track steering
Heading sensor	Kongsberg Seapath
Echosounder	Furuno FE-700
Water speed log	Furuno DA-80

Vessel Fire Fighting Equipment

Fire detection system	
Pumps	Allweiler
Portable Fire Extinguishers	[Portable Fire Extinguishers]
Hydrants and hoses	[Hydrants And Hoses]

Inert gas and other fixed systems	CO2.Flexifog/ Water mist
Foam deluge system	Foamsystem for helideck ,

Vessel Safety and Survival

Fireman's outfits	4
Breathing apparatus	[Breathing Apparatus Spares] spares
Life boats	n/a
Life rafts	6 x 25 persons
MOB raft	n/a
Life jackets	99
Survival suits	52
Life buoys	10

HSE

[Vessel HSE]

Seismic Specifications

Streamer Systems

Manufacture and type	PGS GeoStreamer® Solid
Skin material	Polyurethane
Outside diameter	62mm cm
Length of each group	12.5m m
Streamer set-up	Typical 1 x 10050m
Manufacture and type of hydrophones	Hydrophones: Teledyne T-2BX or equivalent, Velocity Sensors: PGS confidential (MarkIII)
Type of array (e.g. linear, binomial)	Linear
Number of hydrophones per group/distance apart	Hydrophones: 12 per 12.5m, Velocity Sensors: PGS confidential
Coupling between phones and pre-amp	Capacitive
Sensitivity of near group at 1/P to recorder	20V/Bar
Sensitivity of far group at 1/P to recorder	20V/Bar
Bandwidth over which above sensitivities apply	Specified at 100Hz
Availability of shoreside spares if required	Pool system
Manufacturer and type of depth controller	ION DigiCourse 5011
Manufacturer and type of compass	ION DigiCourse 5011

Recording System

Manufacturer, type	Acquisition System: PGS GeoStreamer 24bit, Recording System: PGS gAS
Number of seismic and auxiliary channels	Typical 1 x 804 + 48
Format(s) available	SEG-D revision 1.0 and 2.1
Tape drives	IBM 3592
Sample rates	1ms, 2ms, 4ms
High cut filter	428Hz, 214Hz, 107Hz @ 341dB/oct
Low cut filter	Hydrophones: 3.04Hz @ 7.5dB/oct, 4.4Hz @ 12dB/oct, Velocity Sensors: PGS confidential
Auxiliary channels allocation	Recorded as separate streamer or appended to streamer 1
Telemetry systems array forming capabilities	Optional

Energy Source

Manufacturer and type	Sercel – G Gun 2
Effective volume of standard array(s)	3111 ci
Maximum number of sub-arrays	6
Standard array depth(s)	7 M
Position of depth transducers	Front and tail of sub-array
Working pressure	2000 psi psi
Type of firing sensors	Pressure activated
Position of firing sensors	Mounted directly on the gun.
Type of firing synchroniser unit	RTS BigShot
Timing resolution	0.1ms ms
Timing accuracy	+/- 1.0ms
Position of near field phones	1 mounted on each gun hang frame.
Air compressors capacity	Neuman & Esser, 2200 cfm each
Number of air compressors	2

Navigation and Positioning Systems

Differential GPS

Standard system	Starfix XP and HP
Subcontractor	[Subcontractor Differential GPS]
Processing software	[Processing Software Differential GPS]

Relative GPS

Standard system	Fugro Seatrack RGPS
Processing software	[Processing Software Relative GPS]

Vessel Heading Sensors

GPS heading reference	[GPS Heading Reference]
Survey gyrocompasses, No/Make/Model	SGBrown Meridien

Acoustic Ranging System

Manufacturer/Model	n/a
Frequency	n/a
Type of units	n/a

Sound Velocity Meters	[Sound Velocity Meters]

Echosounder

Manufacturer, type and model number	Kongsberg EA-600
Frequencies	18 Khz and 32kHz to be confirmed
Maximum sounding depth	[Maximum Sounding Depth M] m

Integrated Navigation Computer System

Type	ORCA
Supplier	Concept - ORCA
Hardware description	[Hardware Description Integrated Navigation Computer System]
Tape drives	[Tape Drives Integrated Navigation Computer System]

Binning System

Type	n/a
Supplier	Concept System, Limited
Hardware description	Reflex

Navigation Post Processing System

Type	[Type Navigation Post Processing System]
Supplier	Concept - ORCA
Software Version	[Software Version Navigation Post Processing System]
Hardware description	Concept Sprint
Plotter	HP-4550..?

Onboard Seismic Data Processing

Standard hardware configuration	N/A
Secondary hardware configuration	2 x IBM x3650 server, 1 x EonStor RAID disk array (9TB), 1 x HP z800 visualisation terminal, 1 x HP xw6600 visualisation terminal, 4 x IBM 3592 tape drive
Standard hardware capacity	N/A

Secondary hardware capacity	[Secondary hardware capacity Onboard Seismic Data Processing]

Appendix F.

List of Phytoplankton Species found in the Study Area. Ocean Biogeographic Information System. www.iobis.org

Scientificname
Ceratium furca
Actiniscus pentasterias
Bacteriastrum spp.
Ceratium arcticum
Ceratium bucephalum
Ceratium carriense
Ceratium extensum
Ceratium fusus
Ceratium hexacanthum
Ceratium horridum
Ceratium lineatum
Ceratium longipes
Ceratium macroceros
Ceratium massiliense
Ceratium minutum
Ceratium trichoceros
Ceratium tripos
Chaetoceros(phaeoceros) spp.
Cladopyxis spp.
Coccolithaceae
Corethron criophilum
Coscinodiscus concinnus
Coscinodiscus wailesii
Cylindrotheca closterium
Dactyliosolen antarcticus
Dactyliosolen mediterraneus
Detonula confervacea
Dictyocysta spp.
Dinoflagellate cysts
Dinophysis spp.
Eucampia zodiacus
Exuviaella spp.
Favella serrata
Fragilaria spp.
Glenodinium spp.
Gonyaulax spp.
Gyrosigma spp.
Halosphaera spp.
Lauderia borealis
Leptocylindrus danicus

Navicula planamembranacea
Navicula spp.
Neodenticula seminae
Nitzschia delicatissima
Nitzschia seriata
Odontella aurita
Odontella sinensis
Oscillatoria spp.
Oxytoxum spp.
Parafavella gigantea
Paralia sulcata
Phaeocystis pouchetii
Phalacroma spp.
Pinus pollen
Podolampas spp.
Prorocentrum spp.
Protoperidinium spp.
Pterosperma spp.
Ptychocylis spp.
Radiolaria
Rhizosolenia acuminata
Rhizosolenia alata alata
Rhizosolenia alata curvirostris
Rhizosolenia alata indica
Rhizosolenia alata inermis
Rhizosolenia bergonii
Rhizosolenia delicatula
Rhizosolenia hebetata semispina
Rhizosolenia imbrica. shrubsolei
Rhizosolenia stolterfothii
Rhizosolenia styliformis
Schroederella delicatula
Scrippsiella spp.
Silicoflagellatae
Skeletonema costatum
Stellate body (land plant hair)
Stephanopyxis spp.
Thalassionema nitzschioides
Thalassiothrix longissima
Tintinnidae
Unidentified coscinodiscus spp.
Unidentified nitzschia spp.
Zoothamnium pelagicum
Foraminifera
Chaetoceros(hyalochaete) spp.
Thalassiosira spp.

Appendix G:

List of Zoooplankton Species found in the Study Area. Ocean Biogeographic Information System. www.iobis.org

Scientificname

Euphausiacea adult
Echinoderm larvae
Decapoda larvae
Copepod nauplii
Copepod eggs
Coelenterata tissue
Chaetognatha traverse
Chaetognatha eyecount
Total copepods
Calanus fin. finmarchicus
Calanus i-iv
Unidentified pleuromamma spp.
Unidentified heterorhabdus spp.
Unidentified gymnosomata
Unidentified euchaeta spp.
Unidentified centropages spp.
Undeuchaeta plumosa
Calanus total traverse
Acartia longiremis
Acartia spp.
Aetideus armatus
Anomalocera patersoni
Atlanta spp.
Calanus fin. glacialis
Calanus helgolandicus
Unidentified pneumodermopsis spp
Calanus hyperboreus
Calanus tenuicornis
Calanus v-vi total
Calocalanus spp.
Candacia armata
Candacia i-iv
Centropages bradyi
Centropages hamatus
Centropages typicus
Cephalopoda larvae
Cirripede larvae
Clausocalanus spp.
Clio spp.

Clione limacina
Cyphonautes larvae
Echinoderm post-larvae
Eucalanus elongatus
Euchaeta acuta
Euchaeta glacialis
Euchaeta norvegica
Euchirella rostrata
Euphausiacea calyptopis
Euphausiacea eggs
Euphausiacea juvenile
Euphausiacea nauplii
Euphausiacea total
Evadne spp.
Fish eggs
Fish larvae
Gaidius spp.
Gammaridea
Harpacticoida total
Heterorhabdus abyssalis
Heterorhabdus norvegicus
Heterorhabdus papilliger
Hyperiidea
Lamellibranchia larvae
Larvacea
Limacina retroversa
Lucicutia spp.
Mecynocera clausi
Metridia i-iv
Metridia longa
Metridia lucens
Metridia total traverse
Microcalanus spp.
Nannocalanus minor
Neocalanus gracilis
Oithona spp.
Oncaea spp.
Ostracoda
Parasites of the plankton
Parasitic nematoda
Parathalestris croni
Pleuromamma abdominalis
Pleuromamma borealis
Pleuromamma gracilis
Pleuromamma piseki
Pleuromamma robusta
Pleuromamma xiphias
Pneumodermopsis paucidens

Podon spp.
Polychaeta larvae
Pseudocalanus elongatus adult
Rhincalanus nasutus
Rotifer eggs
Salpidae
Sapphirina spp.
Scolecithricella spp.
Sergestidae
Siphonophora
Temora longicornis
Temora stylifera
Thaliacea
Tomopteris spp.
Para-pseudocalanus spp.

Appendix H: Marine Fish from the region

Source:

Coad, B.W. and J.D. Reist. 2004. Annotated list of the Arctic Marine Fishes of Canada. Can. MS Rep. Fish. Aquat. Sci. 2674: iv + 112 p.

Acantholumpenus mackayi
Alepocephalus agassizii
Alepocephalus bairdii
Amblyraja hyperborea
Amblyraja jenseni
Amblyraja radiata
Ammodytes dubius
Ammodytes hexapterus
Anarhichas denticulatus
Anarhichas lupus
Anarhichas minor
Anarhichas orientalis
Anoplogaster cornuta
Anotopterus pharao
Antimora rostrata
Aphanopus carbo
Arctogadus glacialis
Arctozenus risso
Argentina silus
Artediellus atlanticus
Artediellus scaber
Artediellus uncinatus
Aspidophoroides monopterygius
Astronesthes cf. *richardsoni*
Bajacalifornia megalops
Bathylagus euryops
Bathyraja sp.
Bathyraja spinicauda
Benthosema glacialis
Boreogadus saida
Borostomias antarcticus
Bythites fuscus
Careproctus longipinnis
Careproctus reinhardti
Caristius sp.
Centroscyllium fabricii

Chaenophryne longiceps
Chauliodus sloani
Chiasmodon niger
Chirolophis ascanii
Clupea harengus
Clupea pallasii
Coregonus artedi
Coregonus autumnalis
Coregonus clupeaformis
Coregonus laurettae[1]
Coregonus nasus
Coregonus sardinella
Coryphaenoides brevibarbis
Coryphaenoides guentheri
Coryphaenoides rupestris
Cottunculus microps
Cottunculus thomsonii
Cyclopteropsis jordani
Cyclopterus lumpus
Cyclothone microdon
Dipturus linteus
Eleginus gracilis
Eumesogrammus praecisus
Eumicrotremus derjugini
Eumicrotremus spinosus
Eurypharynx pelecanoides
Gadus morhua
Gadus ogac
Gaidropsarus argentatus
Gaidropsarus ensis
Gasterosteus aculeatus
Glyptocephalus cynoglossus
Gonostoma bathyphilum
Gymnelus barsukovi
Gymnelus bilabrus
Gymnelus knipowitschi
Gymnelus retrodorsalis
Gymnelus viridis
Gymnocanthus tricuspis
Halargyreus johnsonii
hippoglossoides
Hippoglossoides platessoides
Hippoglossoides robustus
Hippoglossus hippoglossus
Holtbyrnia sp.
Hydrolagus affinis

Icelus bicornis
Icelus spatula
Lampanyctus crocodilus
Lampanyctus intricarius
Lampanyctus macdonaldi
Lampetra camtschatica
Lepidion eques
Leptagonus decagonus
Limanda proboscidea
Lionurus carapinus
Liparis atlanticus
Liparis fabricii
Liparis gibbus
Liparis tunicatus
Lota lota
Lumpenus
Lumpenus fabricii
Lumpenus maculatus
Lumpenus medius
lumpretaeformis
Lycenchelys kolthoffi
Lycenchelys muraena
Lycenchelys paxillus
Lycenchelys sarsii
Lycodes adolfi
Lycodes esmarkii
Lycodes eudipleurostictus
Lycodes frigidus
Lycodes jugoricus
Lycodes lavalaei
Lycodes luetkenii
Lycodes marisalbi
Lycodes mcallisteri
Lycodes mucosus
Lycodes paamiuti
Lycodes pallidus
Lycodes polaris
Lycodes reticulatus
Lycodes rossi
Lycodes sagittarius
Lycodes seminudus
Lycodes terraenovae
Lycodes vahlii
Lycodonus mirabilis
Macrourus berglax
Magnisudis atlantica

Malacoraja spinacidermis
Malacosteus niger
Mallotus villosus
Melanostigma atlanticum
Myoxocephalus aenaeas
Myoxocephalus octodecemspinosus
Myoxocephalus quadricornis
Myoxocephalus scorpioides
Myoxocephalus scorpius
Myxine glutinosa
Nematonurus armatus
Nemichthys scolopaceus
Nezumia bairdii
Notacanthus chemnitzii
Notoscopelus kroeyerii
Oncorhynchus gorbuscha
Oncorhynchus keta
Oncorhynchus kisutch
Oncorhynchus nerka
Oncorhynchus tshawytscha
Oneirodes sp.
Osmerus mordax
Paralepis coregonoides
Paraliparis bathybius
Paraliparis copei
Paraliparis garmani
Peprilus triacanthus
Pholis fasciata
Platichthys stellatus
Pleuronectes glacialis
Pleuronectes putnami
Polyacanthonotus rissoanus
Prosopium cylindraceum
Protomyctophum arcticum
Pungitius pungitius
Rajella fyllae
Reinhardtius
Rhadinesthes decimus
Rhodichthys regina
Saccopharynx ampullaceus
Salmo salar
Salvelinus alpinus
Salvelinus fontinalis
Salvelinus malma
Scopelosaurus lepidus
Sebastes mentella

Sebastes norvegicus
Serrivomer beanii
Somniosus microcephalus
Spiniphryne gladisfenae
Stenodus leucichthys
Stichaeus punctatus
Stomias boa
Symbolophorus veranyi
Synaphobranchus kaupii
Trachyrincus murrayi
Triglops murrayi
Triglops nybelini
Triglops pingelii
Ulcina olrikii
Urophycis chesteri
Xenodermichthys copei
Zoarces americanus

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National Capital Region **Habitat Status Report 2004/002**

Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals

Background

A Workshop to develop a "Decision Framework for Seismic Survey Referrals" held in March 2003 produced an inventory of ecological factors that DFO should consider when dealing with referrals for seismic surveys in Canadian waters. The workshop also discussed the sources of uncertainty about effects of seismic sounds on those ecological factors, and ways that the uncertainty could be presented in science documents evaluating possible impacts. The workshop did not attempt to review critically the scientific literature on impacts of seismic sounds or effectiveness of mitigation options. Consequently the meeting did not address tolerances for ecological impacts, if any, or operational standards for respecting such tolerances.

Following that Workshop, teams of scientists prepared major literature reviews of the primary and secondary literature that reports on experimental studies and field monitoring of effects of sound, particularly seismic sound, on marine organisms. Reviews were also contracted of the standards and mitigation methods applied by other national and international bodies which regulate seismic surveys in marine ecosystems, and of the strengths and problems with various sound propagation models in marine environments. These papers were reviewed at a National Advisory Process meeting on Seismic Impact Evaluation Framework in May 2004, although time did not allow a detailed critical review of the paper on standards and mitigation methods.



Figure 1: Map of Canada

Summary

- From the evidence available, it can be concluded that seismic sounds in the marine environment are neither completely without consequences nor are they certain to result in serious and irreversible harm to the environment. In the huge range of effects between those extremes, however there are many *potential* detrimental consequences. In general risks of these consequences are poorly quantified, often unknown, and likely to be variable with both conditions of the environment and of the organisms exposed to the sounds. The long and widespread history of seismic surveys globally in marine environments with no documented fish or invertebrate kills, and only circumstantial evidence of associations with infrequent strandings of marine mammals and giant squid, suggest that seismic surveys with fairly routine mitigation measures in place are unlikely to pose high risk of mortality of marine organisms. However, this suggestion must be qualified, because sublethal or longer-term effects could have occurred and not have been detected by the monitoring programs typically in place.

- Immediate behavioral reactions to exposure to seismic sound have been widely documented in marine organisms, especially marine mammals; particularly behaviors which would result in avoiding the immediate area where the sounds are being produced, or reducing vocalisations. The possible longer-term consequences of these short-term behavioral changes are debated among experts. The debate is largely speculative and there is little empirical basis to determine the likelihood of the full chain of events which would lead to serious longer-term consequences of the short-term behavioral reactions. However, the risk to be managed would be the combined probability of all the events in the chain occurring.

- Whatever the absolute level of risk posed by seismic sounds, there are mitigation measures available which the evidence available suggests can reduce the risk by varying, but sometimes substantial, amounts. The effectiveness of specific mitigation measures was not reviewed in detail at the meeting, but was generally agreed likely to depend on the effect of concern and how the measures are implemented. The impact on the seismic operations of application of some mitigation methods, such as not conducting surveys in critical times and places, will also vary with many factors, but sometimes also could be large. Clearly much more research and monitoring are needed to better clarify and quantify the unknown risks and uncertain effects, if they occur, and the effectiveness of mitigation measures to a wider range of potential effects. Towards that end, some key research needs are listed below.

Introduction

Literature reviews of the primary and secondary literature that reports on experimental studies and field monitoring of effects of sound, particularly seismic sound, on marine organisms were evaluated in May 2004, by a group of scientists from DFO, other federal and international agencies, the hydrocarbon exploration industry and environmental groups. The review indicated that information was incomplete to varying degrees in essentially all areas related to impacts of seismic sound on marine ecosystems. Nonetheless, the background papers and scientific deliberations resulted in a body of information that allowed the following conclusions to be reached.

These conclusions provide a science basis for developing a regulatory framework for use of sound in aquatic environments, at least in the frequencies used for seismic surveys. Some of the conclusions based on the laboratory studies reviewed may generalise to higher frequencies as well, but the review focused on scientific studies directly applicable to seismic sound. The conclusions also contribute to the scientific basis for an integrated approach to managing human impacts on marine ecosystems, and for dealing with referrals of applications for seismic surveys at the regional to national level within DFO.

Habitat Concern

The issue of concern was the effects of sound, particularly seismic sound, on marine organisms. Advice was sought to provide a scientific basis for developing a regulatory framework for use of sound in aquatic environments, at least in the frequencies used for seismic surveys.

Management Considerations

Overall Considerations:

1) The following statements and conclusions are based on information available and presented at the time of the Seismic Impacts Evaluation Framework workshop. Additional research is needed in many areas, and a number of these are identified in the meeting proceedings. These statements and conclusions

should be re-evaluated as new information becomes available.

2) When considering the possible impacts of seismic sounds on the marine ecosystem, it makes sense to embed these considerations within the larger framework of the impact of all anthropogenic noise on the ecosystem. The major anthropogenic sources of noise that might be appropriate to consider in a holistic view would include seismic sounds, shipping, explosives, construction, and low-frequency SONAR. Moreover, the significance of impacts of sound in the environment, if any, should be evaluated in the context of other uses of ecosystem.

3) The dearth of scientific information, especially concerning field experiments on fish, invertebrates, and the larger marine mammals, makes it extremely difficult to evaluate the impact of a particular type of seismic sound, or more generally noise, on a particular species. Restricting our consideration to only seismic sound impacts would have reduced the already-sparse information base to one that would not have supported any conclusions with an acceptable level of confidence, so we have looked more widely for relevant information.

4) If was not just for convenience that we looked for information more widely than just considering publications on effects of seismic sound on marine species. Given the scarcity of hard information on so many facets of this multi-dimensional problem, it is likely that a meaningful appreciation of risk can only be obtained by taking an integrated view of all the sources of information available.

5) Many conclusions refer to the likelihood of various biological effects, if animals were exposed to seismic sound. Likelihood is used in a relative sense, and not as the product of quantitative risk assessments, which are not possible with the information available. Saying that an event has a "high likelihood" does not mean we necessarily expect to see it in nine out of every ten animals exposed to the sound, or even in nine out of ten replicates of the same experiment. Rather, it means that compared to the expectation of the event in the absence of seismic sound, the likelihood of the event has increased substantially, and it would be observed if sought with due diligence. However, it still may not be the typical event. Where quantification of the probability of an event is possible, we use the term "probability" rather than "likelihood".

6) The conclusions that follow often refer to "seismic sound" and "field operating conditions". These terms are used colloquially and are not defined prescriptively. In this document "seismic sound" refers generally to that produced by the types of airguns and arrays normally used at present in Canadian waters. "Field operating conditions" refers to 2-D and 3-D seismic surveys using measures such as ramp-up of sound level at onset, and ceasing sound emissions when cetaceans are known to be in the proximity of the operations.

7) Both the likelihood and severity of biological effects that may result from seismic surveys are likely to vary with local conditions of the environment (ice coverage, bottom topography, sea state, etc.) and conditions of the organisms (breeding state, nutritive condition, etc.). These conditions should not be ignored when evaluating risks and the potential for mitigation, however regulatory frameworks do not need complex rules to be effective.

Limitations for quantitative conclusions:

8) It was agreed that the biologically meaningful aspect of seismic sound is the "received sound" by the organism(s) potentially being affected. However, "received sound" is multi-dimensional. Seismic sound (or noise in general) can

be characterised by its frequency spectrum (acoustic energy or pressure as a function of acoustic frequencies), peak pressure (a time domain concept, referring to the maximum instantaneous amplitude of the pressure signal), rms pressure (mean pressure averages over a time interval), Sound Exposure Level (a measure of the "dosage" of sound energy received over a time interval), and in other ways.

9) The mechanisms by which exposure to seismic sound could result in biological impacts are sufficiently varied that no one metric may be sufficient to describe the risk of impact from a particular type of seismic sound. Some mechanisms may be well characterised by one or two of these metrics; others may not be well characterised by any of them. For example, peak pressure may be the most relevant parameter for risk of trauma, whereas rms pressure may be the most relevant parameter for non-trauma effects such as Temporary Threshold Shifts [TTS]. The frequency band, intensity, and duration of exposure all contribute to auditory effects, because although the impact must occur within the frequency band of exposure, we anticipate that auditory impact is greater within the hearing range of a species, and will decline towards the margins of its hearing threshold.

10) Many studies of the impacts of seismic sound on marine animals reduce the information about the sound used or received to a few numbers. This practice often discards important information, and makes inter-comparison of results across studies very difficult.

11) Although careful experimentation ought to be able to determine which feature(s) of the sound stimulus caused the observed reactions (when they occurred), the existing literature on experiments with marine fish and invertebrates rarely describes completely enough the characteristics of the sounds used to allow biological observations to be interpreted with confidence.

12) The literature on experiments and field observations of marine mammals exposed to sound stimuli is more extensive than the literature on effects on other types of marine organisms, and therefore likely to provide a more complete (but still partial) basis for setting thresholds. However the results, taken together, were complex and inconsistent and were an insufficient basis for agreement on quantitative thresholds for impacts on marine mammals, even from those studies where there were adequate descriptions of the sound characteristics. The major review by the NMFS Acoustic Criteria Panel is devoting much more time to this information, and may contain a quantitative synthesis of stimulus-response relationships from the information available at present. That review, when released, may comprise a useful source of information for defining regulatory tolerances. Where sensitivities of marine turtles, fish, or invertebrates are documented to be greater than sensitivities of marine mammals those factors should be taken into account in the Canada standards, guidelines and/or regulations. It was conjectured that sedentary species that cannot leave an area may experience higher levels of exposure to seismic sound than mobile animals, and this factor may be taken into account in management as well.

13) Ecological "significance" can be a value-laden term, although in these conclusions "significant" is used only in the context of DFO's areas of responsibility. Specifically, DFO has a responsibility for conservation of aquatic species (except birds) and ecosystems, and where detrimental population-scale impacts are considered likely, DFO must ensure that the impacts are mitigated or remediated. Likewise, for aquatic species protected under Schedule 1 of SARA, if deaths, harm or harassment of individuals is considered likely to occur, DFO must

either act to ensure the impacts are ameliorated, or issue permits under the provisions of Section 73 of SARA.

Other limitations:

14) A number of studies reported sub-lethal effects on marine organisms, such as elevated stress-related chemicals, and damage to ears or other morphological structures. The dearth of long-term studies of marine organisms exposed to seismic sounds means that the long-term consequences of these effects, when they occur, are unknown.

15) The severity of impact at the population level may be higher for an effect like auditory masking, if it occurs, because masking has the potential to affect a very large geographical area for low frequency sounds. Masking also may have few immediately observable signs that impacts are occurring, so mitigation may be less likely to be triggered than with individual mortalities due to trauma, (which have limited geographical extent and are more easily observable).

Conclusions Regarding Fish

Physical Effects

1) There are no documented cases of fish mortality upon exposure to seismic sound under field operating conditions. With regard to the detectability of fish kills, if they occurred, it was noted that in Canada seismic surveys have frequently, but not always, included follow-on vessels instructed to watch for fish kills, and none have been observed. It was also noted that fish kills are not necessarily cryptic events, and kills caused by anoxic events, toxic spills etc are often readily detected. However, it was also argued that the efficiency of detecting fish kills by the follow-on vessels was not tested independently, so the possibility of undetected fish kills cannot be eliminated.

2) Under experimental conditions one study found that some subjects from three of four species tested suffered lethal effects from low-frequency (<500 Hz) tonal sounds, under exposure levels of 24 h at >170 dB. Participants noted that the experimental regime differed greatly from field operating conditions of seismic surveys, so extrapolation of the results to seismic surveys was not warranted. However some participants argued that the result indicates that risk of direct fish mortality from sounds with some characteristics of seismic sound cannot be discounted completely.

3) One anecdotal report of fish mortality upon exposure to an airgun less than 2 m away was discussed and found to be inconclusive when considered relative to field operating conditions. Overall, exposure to seismic sound is considered *unlikely* to result in direct fish mortality.

4) Under experimental conditions, sub-lethal and/or physiological effects, including effects on hearing, have sometimes been observed in fish exposed to an airgun. The experimental design made it impossible to determine to the satisfaction of all experts what intensity of sound was responsible for the observed damage to ear structures, nor the biological significance of the damage that was observed. Simulated field experiments attempting to study such effects have been inconclusive. Currently, information is inadequate to evaluate the likelihood of sub-lethal or physiological effects under field operating conditions. The ecological significance of sub-lethal or physiological effects, were they occur, could range from trivial to important depending on their nature.

Behavioral Effects

5) There is high likelihood of obtaining the following effects in some fish exposed to seismic sound:

   - startle response,

- change in swimming patterns (potentially including change in swimming speed, and directional orientation), and
- change in vertical distribution.

6) These effects are expected to be short-term, with duration of effect less than or equal to the duration of exposure, are expected to vary between species and individuals, and be dependant on properties of received sound. The ecological significance of such effects is expected to be low, except where they influence reproductive activity.

7) Several scientific studies have investigated other behavioral effects on fish during seismic surveys. Some have found the effects listed below and some have not:

- Change in horizontal distribution of fish not closely associated with habitat structures such as a reefs or pinnacles,
- Change in catchability of fish possibly related to changes in behavior. Differences in experimental regimes and lack of adequate controls in some of the experiments means that the published results are an insufficient basis to predict the nature of any change that may occur, or even if a change will occur.

8) The duration of these effects may or may not extend beyond the duration of exposure, are expected to vary between species and individuals, and be dependant on the properties of received sound. The ecological significance of such effects is expected to be low, except when they may lead to a dispersion of spawning aggregations or deflection from migration paths. The magnitude of effect in these cases will depend on the biology of the species and the extent of the dispersion or deflection.

Functional Uses of Sound

9) The potential for seismic sound to disrupt communication, detection of predators/prey, navigation and other functional uses of sound by fish has not been studied. There is speculation that the discontinuous nature of seismic signals may allow these functions to occur between sound "pulses". There is also speculation that behavioral responses may include cessation of sound production by fish. If it were to occur, hearing damage would also be expected to impact these functions. Ecological significance of such effects is unknown.

Conclusions Regarding Invertebrates

Physical Effects

1) There are no documented cases of invertebrate mortality upon exposure to seismic sound under field operating conditions. An anecdotal report of beachings of giant squid on two occasions, which corresponded to periods of seismic activity, was discussed and found to be inconclusive.

2) Under experimental conditions, lethal and/or sub-lethal effects, including effects on external structure, have sometimes been observed in invertebrates exposed close to (less than 5 m) an airgun.

3) Therefore, exposure to seismic sound is considered *unlikely* to result in direct invertebrate mortality.

Physiological Effects

4) There is a series of publications showing effects of extended exposure to non-seismic sounds on the physiology of crustacean under experimental conditions. Effects include reduced growth and reproduction rates and behavioral changes, which indicate the

sensitivity of some invertebrates to noise. In a gastropod (mollusc) the physiological effects (sign of stress) were reported under field seismic operating conditions. In other species such effects were rarely present, except for some sign of excitation of ensonified crabs compared to control crabs.

5) Currently, information is lacking to evaluate the likelihood of sub-lethal or physiological effects on crustaceans during pre-molt, molting and post-molt periods.

6) The ecological significance of sub-lethal or physiological effects, were they occur, could range from trivial to important depending on their nature.

Behavioral Effects

7) There is high likelihood of obtaining the following effects in some invertebrates exposed to seismic sound:

   - startle response,
   - change in swimming/movement patterns (potentially including change in swimming/movement speed, and directional orientation).

8) Both increases and decreases in catch rates of commercially exploited species have been documented, but changes do not occur consistently.

9) These effects are expected to be short-term, with duration of effect often less than the duration of exposure, are expected to vary between species and individuals, and be dependent on properties of received sound.

10) Some invertebrates are sedentary or have limited locomotive capacity. Therefore their capacity to avoid seismic sound is extremely limited compared to many fish and marine mammals. This may increase their exposure to seismic sounds, but there is no basis on which to assume that increased exposure makes such species inherently more or less sensitive to those sounds.

11) The ecological significance of the effects is expected to be low, except if effects of exposure to seismic sounds were to influence reproductive or growth (molting) activities, or lead to a dispersion of spawning aggregations or deflection from migration paths. The magnitude of effect in these cases will depend on the biology of the species and the extent of the dispersion or deflection.

Functional Uses of Sound

12) The potential for seismic sound to disrupt communication, orientation, detection of predators/prey, locomotion and other functional uses of sound by invertebrates has not been studied. Loud sounds will reduce the efficiency of communication and other functional uses of sounds, but the severity and conditions under which this occurs with invertebrates are unknown. It is not known if invertebrates can communicate acoustically during the inter-pulse intervals that occur between seismic transmissions. Ecological significance of such effects, if they occur, is unknown.

Conclusions about Zooplankton, Eggs and Larvae of Fish and Invertebrates

1) Few studies of the effects of seismic sound on eggs and larvae or on zooplankton were found. A number of these provided inadequate description of experiment design, properties of the sound applied as treatments, or had methodological shortcomings.

2) Data are generally insufficient to evaluate the potential damage to eggs and larvae of fish and shellfish (or other planktonic organisms) that might be caused by seismic sound under field operating conditions.

3) From the experiments reported to date, results do show that exposure to sound may arrest development of eggs, and cause developmental anomalies in a small proportion of exposed eggs and/or larvae; however these results occurred at numbers of exposures much higher than are likely to occur during field operation conditions, and at sound intensities that only occur within a few meters of the sound source.

4) Effects of seismic sounds on behavioral functions and sensory perception of fish and invertebrate eggs and larvae are unknown;

5) In general, the magnitude of mortality of eggs or larvae that models predict could result from exposure to seismic sound would be far below that which would be expected to affect populations. However, special life history characteristics such as extreme patchiness in distribution and timing of key life history events in relation to the duration and coverage of seismic surveys may require case by case assessment.

6) No studies were found which specifically investigated the role of seismic sounds in recruitment variation of marine fish or invertebrates. There have been a large number of research studies on causes of variation in recruitment of marine fish or invertebrates, and none has considered that there are recruitment anomalies (positive or negative) which might be linked in space or time to seismic survey operations. This negative evidence applies at the scale of stocks, but does not provide information about the potential for effects on local-scale recruitment dynamics.

Conclusions Regarding Marine Turtles

1) Auditory studies suggest that sea turtles, specifically loggerhead and green turtles, are able to hear and respond to low frequency sound, but their hearing threshold appears to be high.

2) In three studies, the following behavioral responses of sea turtles in enclosures exposed to airgun sounds were sometimes observed:

   - increased swimming speed,
   - increased activity,
   - change in swimming direction, and
   - avoidance.

3) Sea turtles may become accustomed to seismic sound over time, but results of three studies were inconclusive on this matter.

4) Loss of hearing sensitivity and physiological stress response has also been considered as a possible consequence of exposure of sea turtles to seismic sound, but the one study reviewed was inconclusive.

5) The response, if any, of free-ranging sea turtles to seismic sound conducted under field operating conditions is unknown.

6) Based on studies that have been conducted to date, it is considered *unlikely* that sea turtles are more sensitive to seismic operations than cetaceans or some fish. Therefore, mitigation measures designed to reduce risk or severity of exposure of cetaceans to seismic sounds may be informative about measures to reduce risk or severity of exposure of sea turtles to seismic sounds. However sea turtles are harder to detect both visually and acoustically than are many species of cetaceans, so mitigation strategies based on sightings or acoustic detection of turtles, are expected to be less effective for turtles than for cetaceans.

Conclusions Regarding Marine Mammals

Mortality and Physical Effects

1. There are no documented cases of marine mammal mortality upon exposure to oil and gas exploration seismic surveys. There is one case of a stranding event involving two whales coincident in space and time with a research vessel conducting seismic operations. There is one stranding event involving the same vessel and whales, coincident in time but not space, with no obvious mechanism that could bridge the distance between the vessel and the stranding site. In both cases the research vessel was also operating mid-frequency airgun systems that produce sound significantly more similar in character to the tactical mid-frequency sonar implicated in whale mass stranding events, than is seismic sound. The role of the different sound sources in the stranding events could not be resolved by the study. Therefore, although whale strandings have been linked to exposure to anthropogenic sound, exposure to seismic sound is considered *unlikely* to cause direct marine mammal mortality.

2. Under experimental conditions, sub-lethal, temporary elevations in hearing thresholds (TTS) have sometimes been observed in captive marine mammals exposed to pulsed sounds. Currently, the likelihood of these effects have not been evaluated under field operating conditions; for some species of marine mammals the levels and types of sounds which may produce TTS can be predicted, so such evaluations may be possible. The significance of such TTS effects, were they occur, are likely to be unimportant, unless:

    a. the threshold was elevated repeatedly or for an extended period of time, which could result in a Permanent Threshold Shift [PTS]; or

    b. other threats were present at the same time as the temporary elevations in hearing thresholds, and the threats were ones normally avoided by acoustic means, such as predators or entanglements in fishing gear.

3. There are no documented cases of a marine mammal experiencing damage to non-auditory body tissues upon exposure to seismic surveys under field operating conditions. Therefore, exposure to seismic sound under field operating conditions is considered *unlikely* to result in such types of tissue damage to marine mammals, but the presence of other sound sources operating simultaneously with seismic operations should be taken into account when proposals are evaluated.

Direct Behavioral Effects

<u>Displacement and Migratory Diversion:</u>

4) There is documented displacement and migratory diversion in some marine mammal species exposed to seismic sound. The duration of these effects may or may not extend beyond the duration of exposure. The effects are expected to vary between contexts, species, gender and age class, and individuals, and be dependant on the properties of received sound. The ecological significance of such effects is expected to be low, but may be higher if they:

- displace feeding marine mammals from areas where there are no alternates,
- displace marine mammals from resting areas where there are no alternates,
- displace marine mammals from breeding or nursery areas, or
- divert migrating animals from routes for which their alternate routes either do not exist or would incur substantially greater costs to traverse.

5) The magnitude of effect in these cases will depend on the biology of the species and the extent and duration of the dispersion or deflection. Also, there is a risk that a seismic project occurring in another area could cause incursion of displaced competitors into the critical habitat or area of high biological productivity occupied by other species.

6) In summary, exposure to seismic sound can result in displacement and/or migratory diversion in some marine mammals, but this effect is species, individual, and contextually-related. The ecological significance of such effects is *unknown*, but there are conditions under which the worst-case scenarios could be high.

Changes in Dive and Respiratory Patterns

7) There are documented changes in dive and respiratory patterns in some marine mammal species (e.g., bowhead whales, harbour and grey seals) exposed to seismic sound. There are records of the duration of these effects extending beyond the duration of exposure. The effects are expected to vary between contexts, species and individuals, and be dependant on the properties of received sound. The ecological significance of such effects is expected to be low, except if such effects:

   - interfere with feeding, or
   - incur substantial energetic costs;

   The magnitude of effect in these cases will depend on the biology of the species and the extent and duration of the dispersion or deflection.

8) In summary, exposure to seismic sound can result in changes in dive and respiratory patterns in some marine mammals, but this effect is expected to vary with species, individual, and context. The ecological significance of such effects is *unknown*, but there are conditions under which the worst-case scenarios could be high.

Changes in Social Behavior

9) Social behavior can include a wide variety of activities such as mating, cooperative feeding, play, aggressive interactions, and communication (see below). Studies of behavioral changes in other subsections of this summary describe effects on some of the activities that could be considered "social". However, there have been no directed studies of the effects of seismic sounds on mating, cooperative feeding, play, or aggressive interactions.

10) In summary, it is *unknown* if exposure to seismic sound can result in changes in marine mammal social behavior, but if it were to occur there are conditions under which the worst-case consequences of such changes could be highly significant.

Changes in Vocalisation Patterns

11) There have been direct studies of the potential for anthropogenic sound to cause changes in the vocalisation patterns of marine mammals. For most cetacean species studied, there were measurable changes in vocalisation patterns, but these studies were not conducted during seismic operations. In the UK, Norway, and the Sable Gully, sperm whales did not stop calling when exposed to seismic sounds. A study off Heard Island, found that sperm whales did not call during distant (690-1070 km away) seismic transmissions in some parts of the study, but did call during seismic transmissions during another part of the study. Blue whales in the NE Pacific stopped calling for approximately one hour when within 10 kilometers of a small (1600 in^3) seismic array; they resumed calling as they swam away from the array.

12) There is evidence that exposure specifically to seismic sounds has sometimes caused changes in vocalisation patterns in marine mammals. However, it has not been possible to measure the functional consequences of

these changes (such as loss of contact between individuals or reduced ability to coordinate social behaviors), if any, nor the percent of time which they would occur.

13) In summary, it is *known* that exposure to seismic sound can result in changes in marine mammal vocal behavior, and when it occurs there are conditions under which the worst-case consequences could be highly significant.

Functional Consequences of Physical and Behavioral Effects

Reduced Communication Efficiency

14) Many species of marine mammals both produce and respond to sounds. Studies have shown these vocalisations to sometimes communicate information that is functionally important for feeding, breeding, parental care, predator avoidance, or maintenance of social groupings. Studies have also found vocalisations can occur when there are no observable functional consequences, although in such cases it is unclear if the vocalisations had no consequences, or if the effects were longer term or farther afield than the studies. Hence it is difficult for research to produce conclusive results about the frequency of occurrence and consequences of disruption of communication by anthropogenic activities, including seismic sounds.

15) There have been no published studies of the potential for seismic sound to reduce the efficiency of communication in marine mammals. Loud sounds will reduce the efficiency of communication but the severity and conditions under which this occurs with marine mammals are poorly known. When seismic sounds are produced there are inter-pulse intervals which present the opportunity for cetaceans to place vocal communication signals, but cetaceans have not been shown to use this mechanism in the field. Moreover, there is unpublished information that when multi-path echoes occur, such as in areas of complex bathymetry, the pulses of the seismic sound may smear over distance and time, such that the quieter inter-pulse intervals may be reduced or eliminated. This creates the potential for calls of cetaceans such as blue whales to be masked by seismic sounds although the distances over which the masking would be effective, if it were to occur, are unknown. It is unknown if whales could reduce the effects of masking through processes such as changes in their calling patterns, and the consequences of these changes (if they occur) are unknown. This facultative response has been documented in some other marine mammal species exposed to loud manmade sounds. Therefore, it is *unknown* if exposure to seismic sound can result in such reduced communication efficiency in marine mammals.

Reduced Echolocation Efficiency

16) There have been no direct studies of the potential for seismic sound to reduce the efficiency of echolocation in marine mammals. Therefore, it is *unknown* if exposure to seismic sound can result in reduced echolocation efficiency in marine mammals.

Hampered Passive Acoustic Detection of Prey

17) There have been no direct studies of the potential for seismic sound to hamper the passive acoustic detection of prey by marine mammals. In a published study on the effects of whale watching vessels on killer whale behavior, it was postulated that sounds from these vessels could reduce the ability of killer whales to detect their prey. It is not known if such an effect could result during exposure to seismic sounds, or even which species of marine mammals use passive acoustic detection of prey as an important feeding strategy. However the potential for an effect is greatest for mysticetes whose best hearing sensitivity is thought to be at lower frequencies than other marine mammals. Therefore, it is *unknown* whether exposure to seismic sound could hamper the passive acoustic detection of prey by marine mammals.

Hampered Passive Acoustic Detection of Predators

18) There have been no direct studies of the potential for seismic sound to hamper the passive acoustic detection of predators by marine mammals. The potential for an effect is greatest for mysticetes, whose best hearing sensitivity is thought to be at lower frequencies than other marine mammals. However it is not known if such an effect occurs during exposure to seismic sounds, and if so, to what extent. Therefore, it is *unknown* whether exposure to seismic sound could increase the vulnerability of marine mammals to predators.

Hampered Avoidance of Anthropogenic Threats (such as ship strikes, net entanglement)

19) There have been no direct studies of the potential for seismic sound to reduce the ability of marine mammals to avoid anthropogenic threats. There are published reports of other types of sounds interfering with the ability of individual whales to avoid anthropogenic threats such as ship strikes and net entanglements, but it is not known how widespread this response is. It is also not known if such an effect could result from exposure to seismic sounds. Therefore, it is a *concern* that exposure to seismic sound could reduce the ability of marine mammals to avoid anthropogenic threats, but the risk has not been demonstrated.

Hampered Parental Care or Bonding

20) There have been no direct studies of the potential for seismic sound to hamper parental care or bonding in marine mammals. Therefore, it is *unknown* if exposure to seismic sound can hamper parental care or bonding in marine mammals.

Chronic Effects (e.g., stress-related physiological changes, reduced fecundity)

21) There have been no studies of the potential for seismic sound to induce chronic effects, such as immunosuppression or reduced fecundity, in marine mammals. Therefore, it is *unknown* if exposure to seismic sound can result in such chronic effects on marine mammals.

Indirect Effects (e.g., reduced prey availability)

22) There have been no studies of the potential for seismic sound to reduce prey availability, through displacement or reduced catchability, for marine mammals. Therefore, it is *unknown* if exposure to seismic sound can result in such indirect effects on marine mammals.

Research Needs

In the review a large number of areas of future research were identified. Some emerged as particularly helpful in increasing the information available to those quantifying and those managing the risks of seismic surveys in marine ecosystems.

1) More work is required to determine the sound characteristics and environmental conditions under which seismic effects on behavior, physiology, and physical well-being of all types of marine species might occur.

2) The available information on the effectiveness of mitigation measures needs to be more fully evaluated, as a basis for both interim advice on appropriate operational requirements in the short term and additional research needs to increase our knowledge in the longer term.

3) In addition to targeted research, there is great value to linking a program of structured collection of information to the conduct of seismic surveys, to facilitate learning-by-doing. However, such information collection programs must be well coordinated, and accompanied by the resources to analyse, interpret, and apply the new information, as it is collected and submitted to scientific authorities.

4) A few representative studies on distance-effect relationships for all taxa, but particularly eggs and larvae, would greatly aid understanding of potential risks posed by seismic sound. The potential for effects stemming from sound exposure level (cumulative over a survey) as well as peak received sound pressure level should be considered, including under conditions of 3-D surveys.

5) Specific research is needed on the level of received sound experienced by sessile invertebrates, and the effects of seismic sounds on such organisms. The physics of the sound levels to which benthic organisms are exposed is complicated due to shear effects interacting with pressure effects, and the proximity to the bottom substrates. Hence results of generic sound propagation models are likely to be misleading with regard to exposure levels of sessile benthic species. However, the errors could be in any direction, and in sites of complex bathymetry there could be very patchy distributions of areas with higher intensities of exposure than predicted by sound propagation models and other areas with lower intensities.

6) There is a specific absence of information on the effects of seismic sounds on molting of invertebrates with hard exoskeletons.

7) There is a need to further clarify the best sound propagation models for the areas likely to host seismic exploration, and how habitat characters should influence model selection. Generic models also need to be evaluated relative to the sensitivity and precision of their predictions relative to requirements for evaluating potential impacts, although site-specific implementations of generic models will continue to be desirable.

8) Better data input is needed during modelling of the expected pattern of spread of seismic sounds during surveys. Near-and far-field sound measurements should be encouraged as part of seismic operations planned for an area that has not been surveyed previously, or if previous models have been shown to be inaccurate.

9) Further research on potential impacts of seismic sound on marine mammals is urgently needed. The issues in most need of attention through scientific research or further analysis of existing data include:

    a) An important scientific unknown limiting our ability to predict the effects of seismic surveys on marine mammal populations is knowledge of their spatio-temporal distribution, and physiological state and needs. Without knowledge about what species are present in which areas at what time of the year and for what purpose, there will always be risks of disturbance and injury to sensitive species. An effort should also be made to characterise the degree of

long-term natural variation in abundance and residency.

b) There is a need for significantly more information regarding the reactions of marine mammals (and their prey) to underwater sound from seismic arrays. Baseline studies prior to seismic operations, plus comparative reports during periods with and without seismic would contribute important new data.

c) There is a need for better and more accurate information on naturally-occurring and man-made noise in the ocean.

d) The effectiveness of all potential mitigation measures needs to be explored and documented more fully. In particular there is a need to document the extent to which passive and/or active acoustic monitoring of marine mammals from the source vessel is an effective mitigation strategy.

e) There is a particular need for directed studies of social behavior of marine mammals during seismic exposures, given the importance of these activities to marine mammals' biology.

f) The effects of anthropogenic sounds on the vocalisation patterns of marine mammals are well documented, but the effects of specifically seismic sounds are poor known, and warrant further study.

Many of these factors are also poorly known for many taxa of marine turtles, fish, and invertebrates. Research to fill in such knowledge gaps, particularly with regard to spatio-temporal distribution of important prey taxa and their reactions to seismic sound, would be valuable, although the topics listed above were given higher priority. A number of other topics requiring additional research were proposed by various individuals, and are recorded in the meeting proceedings.

References

DFO, 2003. A Framework to Assist DFO Consideration of Requests for Review of Seismic Testing Proposals. DFO Can. Sci. Advis. Sec. Habitat Status Report 2003/001.

LGL. 2004. Assessment of Regulatory Practices Governing the Limits of Sound Energy Produced during Seismic Operations (draft). LGL Limited, environmental research associates, Report TA4014-1. (Unpublished)

For more Information

Contact: Hugh Bain
Environmental Science
Fisheries and Oceans Canada
200 Kent Street
Ottawa, Ontario
K1A 0E6

Tel: (613) 990-0288
Fax: (613) 954-0807
E-Mail: bainh@dfo-mpo.gc.ca

This report is available from the:

Canadian Science Advisory Secretariat
200 Kent Street
Ottawa, Ontario
K1A 0E6

Telephone: (613) 990-0293
Fax: (613) 954-0807
E-Mail: CSAS@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

ISSN 1708-6272 (Print)
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La version française est disponible à l'adresse ci-dessus.

Correct citation for this publication

DFO, 2004. Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. DFO Can. Sci. Advis. Sec. Habitat Status Report 2004/002.

The Leach's Storm-Petrel:
General information and handling instructions

Urban Williams (Petro-Canada)
&
John Chardine (Canadian Wildlife Service)

The Grand Banks is an area that is frequented by large numbers of seabirds, representing a variety of species. Large populations are found in this area in both summer and winter, and come from the Arctic, northern Europe, and the south Atlantic, as well as from colonies along the Newfoundland Coast. One of the species found in the area of the Terra Nova Field is the Leach's Storm-Petrel (*Oceanodroma leucorhoa*).



The Bird:

Leach's Storm-Petrels are small seabirds, not much bigger than a Robin. They have relatively long wings and are excellent fliers. Leach's Storm-Petrels are dark brown in colour and show a conspicuous white patch at the base of the tail. In the hand, you can easily notice a small tube at the top of their bill, and you will also notice that the birds have a peculiar, not unpleasant smell (although some Newfoundlanders call these birds "Stink Birds"). Storm-Petrels are easy prey for gulls and other predators, and so to protect themselves from predation, Leach's Storm-Petrels are only active at night when on land at the breeding colonies.

Nesting Habitat:

Leach's Storm-Petrels are distributed widely in the northern hemisphere, however, their major centres of distribution are Alaska and Newfoundland. The bird breeds on offshore islands, often in colonies numbering tens or hundreds of thousands of pairs, even millions at one colony in Newfoundland. The nest is a chamber, sometimes lined with a some grass, located at the end of a narrow tunnel dug in the topsoil.. Depending on the colony, burrows may be under conifer or raspberry thickets or open grassland.

Reproduction:

In Newfoundland, Leach's Storm-Petrels lay their single egg in May and June. The egg is incubated by both parents alternately, sometimes for stretches exceeding 48 hours. The egg is incubated for 41-42 days, which is a long time for such a small egg. The peak hatching period is in the last half of July. The young petrel remains in the tunnel for about 63-70 days. Once breeding is over in late-August or early September, the birds disperse from the colonies and migrate to their wintering grounds in the Atlantic. September is the most important period for migration of Storm-Petrels to the offshore areas such as near the Terra Nova field.

Populations:

Canada alone supports more than 5 million pairs of Leach's Storm-Petrels. Most of them are found in Newfoundland. The Leach's Storm-Petrel colony located on Baccalieu Island is the largest known colony of this species.

Nesting sites for Leach's Storm-Petrels are found along the southeast coast of Newfoundland. These are - i) Witless Bay Islands (780,00 nesting pairs), ii) Iron Island (10,000 nesting pairs), iii) Corbin Island (100,000 nesting pairs), iv) Middle Lawn Island (26,000 nesting pairs), v) Baccalieu Island (3,336,000 nesting pairs), vi) Green Island (72,000 nesting pairs), and vii) St. Pierre Grand Columbier (100,000 nesting pairs).

Feeding Habits:

Leach's Storm-Petrels feed at the sea surface, seizing prey in flight. Prey usually consists of myctophid fish and amphipods. The chick is fed planktonic crustaceans, drops of stomach oil from the adult bird, and small fish taken far out at sea. Storm-Petrels feed far out from the colony and it would be reasonable to assume that birds nesting in eastern Newfoundland can be found feeding around the Terra Nova site.

The Problem:

As identified in the C-NOPB Decision 97-02, seabirds such as Leach's Storm-Petrels are attracted to lights on offshore platforms and vessels. Experience has shown that Storm-Petrels may be confused by lights from ships and oil rigs, particularly on foggy nights, and will crash into lighted areas such as decks and portholes. Fortunately, this type of accident does not often result in mortality, however, once on deck the bird will sometimes seek a dark corner in which to hide, and can become fouled with oil or other contaminants on deck.

Period of Concern:

Leach's Storm-Petrels are in the Terra Nova area from about May until October and birds could be attracted to lights at any time throughout this period. The period of greatest risk of attraction

to lights on vessels appears to be at the end of the breeding season when adults and newly fledged chicks are dispersing from the colonies and migrating to their offshore wintering grounds. September is the most important period for migration of storm-petrels to the offshore areas. Past experience suggests that any foggy night in September could be problematic and may result in hundreds or even thousands of birds colliding with the vessel.

The Mitigation:

On nights when storm-petrels are colliding with the vessel, the following steps should be taken to ensure that as many birds as possible are safely returned to their natural habitat.

- All decks of the vessel should be patrolled as often as is needed to ensure that birds are picked up and boxed (see below) as soon as possible after they have collided with the vessel. After collision, birds will often "freeze" below lights on deck or seek dark areas underneath machinery and the like.
- Birds should be collected by hand and gently placed in small cardboard boxes. Care should be taken not to overcrowd the birds and a maximum of 10-15 birds should be placed in each box, depending upon its size. The birds are very easy to pick up as they are poor walkers and will not fly up off the deck so long as the area is well-lit. They will make a squealing sound as they are picked up- this is of no concern and is a natural reaction to be handled (the birds probably think they have been captured to be eaten!).
- When the birds are placed in the box the cover should be put in place and the birds left to recover in a dark, cool, quiet place for about 5-10 minutes. The birds initially will be quite active in the box but will soon settle down.
- Following the recovery period, the box containing the birds should be brought to the bow of the boat or to some other area of the vessel that has minimal (if any) lighting. The cover should be opened and each bird individually removed by hand. The release is usually accomplished by letting the bird drop over the side of the vessel. There is no need to throw the bird up in the air at release time. If the birds are released at a well-lit part of the vessel they usually fly back towards the vessel and collide again.
- If any of the birds are wet when they are captured (i.e. they drop into water on the deck) then they should be placed in a cardboard box and let dry. Once the bird is dry it can be released as per the previous instruction. Also, temporarily injured birds should be left for longer to recover in the cardboard box before release.
- Any birds contaminated with oil should be kept in a separate box and not mixed with clean birds. Contact Canadian Wildlife Service at (709) 772-5585 for instructions on how to deal with contaminated birds.
- In the event that some birds are captured near dawn and are not fully recovered before daylight, they should be kept until the next night for release. Storm-Petrels should not be released in daylight as at this time they are very vulnerable to predation by gulls. Birds should be kept in the cardboard box in a cool, quiet place for the day, and do not need to be fed.
- Someone should be given the responsibility of maintaining a tally of birds that have been captured and released, and those that were found dead on deck. These notes should be kept with other information about the conditions on the night of the incident (moonlight, fog, weather),

date, time, etc). THIS IS A VERY IMPORTANT PART OF THE EXERCISE AS IT IS THE ONLY WAY WE CAN LEARN MORE ABOUT THESE EVENTS.

Handling Instructions:

- Leach's Storm-Petrels are small, gentle birds and should be handled with care at all times.
- It is recommended that the person handling the birds should wear thin rubber gloves or clean, cotton work gloves. The purpose of the gloves is to protect both the Storm-Petrel and the worker.
- As mentioned Storm-Petrel's have a strong odor that will stick to the handler's hands. Washing with soap and water will remove most of the smell.
- Handling Leach's Storm-Petrels does not pose a health hazard to the worker, however some birds may have parasites on their feathers, such as feather lice. These parasites do not present any risk to humans, however, as a precaution we recommend wearing cotton work gloves or thin rubber gloves while handling birds and washing of hands afterwards.

Wilson's Storm Petrels:

A relative of the Leach's Storm-Petrel is the Wilson's Storm-Petrel. They breed in the south Atlantic and Antarctica and migrate north in our spring to spend the summer in Newfoundland waters. This species is very numerous on the Grand Banks in the summer, and shares the same nocturnal habits as the Leach's Storm-Petrel. Thus it is possible that Wilson's Storm-Petrels may also be attracted to the lights of a vessel at night. The two species are very similar and should be handled in the same way as described above for our Leach's Storm-Petrel.

Permits:
A permit to handle storm-petrels issued by the Canadian Wildlife Service will be held on board the vessel to cover personnel involved in bird collision incidents.

MARINE MAMMAL MONITORING AND MITIGATION DURING OPEN WATER SEISMIC EXPLORATION BY SHELL OFFSHORE INC. IN THE CHUKCHI AND BEAUFORT SEAS, JULY–SEPTEMBER 2006: 90-DAY REPORT

Prepared by

Alaska Research Associates, Inc.
1101 E. 76th Ave. Suite B, Anchorage, AK 99518

LGL Ltd., environmental research associates
P.O. Box 280, 22 Fisher Street, King City, Ont. L7B 1A6, Canada

and

Greeneridge Sciences, Inc.
1411 Firestone Rd., Goleta, CA 93117

for

Shell Offshore, Inc.
P.O. Box 576, Houston, TX 77001-0576

and

National Marine Fisheries Service, Office of Protected Resources
1315 East-West Hwy, Silver Spring, MD 20910-3282

and

U.S. fish and Wildlife Service, Marine Mammal Management
1101 E. Tudor Road, M.S. 341, Anchorage, AK 99503

LGL Report P891-1

January 2007

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by

Heather Patterson[b], Susanna B. Blackwell[c], Beth Haley[a],
Andrea Hunter[b], Meaghan Jankowski[b], R. Rodrigues[a],
Darren Ireland[a], Dale W. Funk[a]

[a] **LGL Alaska Research Associates, Inc.**
1101 East 76th Ave., Suite B, Anchorage, AK 99518, U.S.A.

[b] **LGL Limited, environmental research associates**
P.O. Box 280, 22 Fisher Street, King City, Ont. L7B 1A6, Canada

[c] **Greeneridge Sciences, Inc.**
1411 Firestone Rd., Goleta, CA 93117, U.S.A.

for

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LGL Report P891-1

January 2007

Suggested format for citation:

Patterson, H., S.B. Blackwell, B. Haley, A. Hunter, M. Jankowski, R. Rodrigues, D. Ireland and D. W. Funk. 2007. Marine mammal monitoring and mitigation during open water seismic exploration by Shell Offshore Inc. in the Chukchi and Beaufort Seas, July–September 2006: 90-day report. LGL Draft Rep. P891-1. Rep. from LGL Alaska Research Associates Inc., Anchorage, AK, LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Goleta, CA, for Shell Offshore Inc, Houston, TX, and Nat. Mar. Fish. Serv., Silver Spring, MD. 199 p.

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LIST OF ACRONYMS AND ABBREVIATIONS

~	approximately
AASM	Airgun Array Source Model
AEWC	Alaska Eskimo Whaling Commission
Bf	Beaufort Wind Force
BO	Biological Opinion
CAA	Conflict Avoidance Agreement
CFR	(U.S.) Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species
cm	centimeter
CPA	Closest (Observed) Point of Approach
CTD	conductivity, temperature, depth
dB	decibel
EA	Environmental Assessment
EFD	Energy Flux Density
ESA	(U.S.) Endangered Species Act
$f(0)$	sighting probability density at zero perpendicular distance from survey track; equivalently, 1/(effective strip width)
ft	feet
FRC	Fast Rescue Craft
GI	Generator Injector
GIS	Geographic Information System
GMT	Greenwich Mean Time
GPS	Global Positioning System
$g(0)$	probability of seeing a group located directly on a survey line
h	hours
hp	horse power
Hz	Hertz (cycles per second)
IHA	Incidental Harassment Authorization (under U.S. MMPA)
in^3	cubic inches
IUCN	International Union for the Conservation of Nature
kHz	kilohertz
km	kilometer
km^2	square kilometers
km/h	kilometers per hour
kt	knots
L-DEO	Lamont-Doherty Earth Observatory (of Columbia University)
LoA	Letter of Authorization
µPa	micro Pascal
m	meters
MBB	Multibeam Bathymetric (sonar)
MCS	Multi-Channel Seismic

min	minutes
MMO	Marine Mammal Observer
MMPA	(U.S.) Marine Mammal Protection Act
MONM	Marine Operations Noise Model
n	sample size
n.mi.	nautical miles
NMFS	(U.S.) National Marine Fisheries Service
No.	number
NTCL	Northern Transportation Co., Ltd.
PAM	Passive Acoustic Monitoring
PD	Power down of the airgun array to one airgun (in this study, from an output of 3147 in^3 to 30 or 155 in^3)
PE	Parabolic Equation
pk-pk	peak-to-peak
RAM	Range-dependent Acoustic Model
re	in reference to
rms	root-mean-square: an average, in the present context over the duration of a sound pulse
s	seconds
SD	Shut Down of airguns not associated with mitigation
s.d.	standard deviation
SEL	Sound Exposure Level: a measure of energy content, in dB re 1 $\mu Pa^2 \cdot s$
SOI	Shell Offshore, Inc.
SPL	Sound Pressure Level; the SPL for a seismic pulse is equivalent to its rms level
SZ	Shut Down of all airguns because of a marine mammal sighting near or within the safety radius
TTS	Temporary Threshold Shift
UNEP	United Nations Environmental Programme
"Useable"	Visual effort or sightings made under the following observation conditions: daylight periods within the Chukchi and Beaufort Seas, ***excluding*** periods 3 min to 1 h (pinnipeds) or 2 h (for cetaceans) after airguns were turned off (post-seismic), periods when ship speed was <3.7 km/h (2 kt), and periods with seriously impaired sightability. The following conditions were defined as involving seriously impaired sightability: all nighttime periods, and daytime periods with one or more of the following: visibility <3.5 km, Bf >5 (Bf >2 for porpoises), or >60º of severe glare between 90º left and 90º right of the bow. Sightings of marine mammals hauled out on the ice in both the Beaufort and Chukchi seas were considered "useable" for analyses. Sightings of cetaceans from the *Kilabuk* were considered "unuseable" for analyses.

EXECUTIVE SUMMARY

Background and Introduction (Chapter 1)

Shell Offshore, Inc. (SOI), collected marine seismic data in the Chukchi and Beaufort Seas during the summer of 2006 in support of potential future oil and gas leasing and development. Deep seismic acquisition for SOI was conducted in the Chukchi Sea by WesternGeco using the M/V *Gilavar*, a source vessel that towed an airgun array as well as hydrophone streamers to record reflected seismic data. Seismic acquisition was originally planned to be conducted in both the Chukchi and Beaufort Seas using the *Gilavar*; however, ice conditions during the 2006 field season precluded most data collection in the Beaufort Sea. Activities in the Beaufort Sea were confined to site clearance, shallow hazard surveys and geotechnical activities, which were conducted from the M/V *Henry Christoffersen*, an NTCL vessel.

Marine seismic surveys emit strong sounds into the water that could affect marine mammal behavior and distribution, or perhaps cause temporary or permanent reduction in hearing sensitivity. These effects could constitute "taking" under the provisions of the U.S. Marine Mammal Protection Act (MMPA) and the U.S. Endangered Species Act (ESA). The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) share jurisdiction over the marine mammal species that were likely to be encountered during the project. Cetaceans and most pinnipeds are managed by NMFS; Pacific walruses and polar bears are managed by USFWS.

SOI's seismic surveys and other exploration activities in the Chukchi and Beaufort seas were conducted under the jurisdiction of Incidental Harassment Authorizations (IHAs) issued by NMFS and USFWS. The IHAs included provisions to minimize the possibility that marine mammals close to the seismic source might be exposed to levels of sound high enough to cause hearing damage or other injuries, and to reduce behavioral disturbances that might be considered as "take by harassment" under the MMPA. Under current NMFS guidelines, "safety radii" for marine mammals around airgun arrays are customarily defined as the distances within which the received pulse levels are ≥180 dB re 1 μPa (rms) for cetaceans and ≥190 dB re 1 μPa (rms) for pinnipeds. Those safety radii are based on an assumption that seismic pulses at lower received levels will not injure these mammals or impair their hearing abilities, but that higher received levels *might* have some such effects. The IHA issued by NMFS required monitoring of the distances within which received sound levels would be ≥180 and ≥190 dB, and implementation of appropriate mitigation when marine mammals were seen within or about to enter those zones. The IHA also required monitoring of the distance within which received sound levels might be ≥160 dB re 1 μPa (rms).

NMFS and USFWS granted the IHAs to SOI on the assumptions that

- the numbers of whales and seals potentially harassed (as defined by NMFS criteria) during seismic operations would be "small",
- the effects of such harassment on marine mammal populations would be negligible,
- no marine mammals would be seriously injured or killed,
- there would be no unmitigated adverse effects on the availability of marine mammals for subsistence hunting in Alaska, and
- the agreed upon monitoring and mitigation measures would be implemented.

The main purpose of the mitigation program was to avoid or minimize potential effects of SOI's seismic survey on marine mammals. This required that shipboard personnel detect marine mammals

within or about to enter the designated safety radii, and in such cases initiate an immediate power down (or shut down if necessary) of the airguns.

Mitigation was also required at the 160 dB isopleth. This area was monitored by the chase boat that accompanied the seismic vessel. Power down of the seismic airgun array was required if an aggregation of 12 or more non-migratory bowhead or gray whales was detected ahead of, or perpendicular to, the seismic vessel track. Monitoring of the 120 dB isopleth around the seismic vessel was also required after 25 September in the Chukchi Sea and after 1 September in the Beaufort Sea. Power down was required if 4 migratory cow/calf pairs were detected within the surveyed 120 dB isopleth.

The primary objectives of the monitoring program were as follows:

1. provide real-time sighting data needed to implement the mitigation requirements;
2. estimate the numbers of marine mammals potentially exposed to strong seismic pulses; and
3. determine the reactions (if any) of marine mammals potentially exposed to seismic sound impulses.

This 90-day report describes the methods and results for the monitoring work specifically required to meet the above primary objectives.

Seismic Surveys Described (Chapter 2)

The *Gilavar* was used as the seismic source vessel during SOI's activities in the Chukchi Sea in 2006. The *Gilavar* was accompanied by the *Jim Kilabuk*, an icebreaker-class support vessel (chase vessel). The proposed deep seismic survey was originally scheduled to occur in two phases. Phase one commenced in July in the Chukchi Sea and was planned to continue there until late summer when the *Gilavar* and *Kilabuk* were to transit to the Beaufort Sea to conduct phase two seismic surveys on Shell lease-holdings in the mid- and eastern parts of the Alaskan Beaufort Sea. Heavy ice conditions delayed the date when operations could have transferred to the Beaufort Sea, and seismic operations continued in the Chukchi Sea. During September, SOI decided not to attempt to conduct deep seismic exploration in the Beaufort Sea during 2006 due to high concentrations of ice and other operational considerations. The *Gilavar*'s airguns and streamers were retrieved on 19 September and the *Gilavar* departed southward from the project area and left the Chukchi Sea on 23 September. The geographic region where the deep seismic survey occurred was located in the Chukchi Sea MMS OCS Program Area designated as Chukchi Sea Sale 193 (1989) and in the proposed 2002–2007 Chukchi Sea Program Area.

SOI used WesternGeco's 3147 in^3 3-string array of Bolt airguns for its 3–D seismic survey operations in the Chukchi Sea. For each airgun shot, WesternGeco's source array was composed of 3 identically-tuned Bolt airgun sub-arrays, each with 8 airguns and a total volume of 1049 in^3, operated at an air pressure of 2000 psi. This energy source was towed approximately 245 m behind the *Gilavar*. The system also included 6 hydrophone streamers 4200 m in length and spaced 100 m apart, which recorded reflected sound energy. Air compressors aboard the *Gilavar* were the source of high pressure air used to operate the airgun arrays. Seismic pulses were emitted at intervals of 25 m (~10 sec) while the *Gilavar* traveled at a speed of 4.5 to 5 knots (8.3–9.3 km/h).

SOI used the *Henry Christoffersen* to conduct site clearance and shallow hazards surveys of potential exploratory drilling locations within SOI's lease areas in the Beaufort Sea. The surveys were conducted between 8 Aug. and 2 Oct. 2006, on an intermittent basis as allowed by ice and weather conditions at specific nearshore areas ranging from east of Kaktovik west to Thetis Island near the Colville River Delta.

Offshore site clearance surveys use various geophysical methods and tools to acquire graphic records of seafloor and sub-seafloor geologic conditions. Small geophysical survey sources with limited energy output were employed to measure bathymetry, topography, geohazards, and other seabed characteristics. The strongest sound source was a cluster of four 70 in^3 airguns, which was used on 8 Aug. during the sound source measurements. Two 70 in^3 airguns were used during a deeper site clearance survey on 25 Sept. Those were the only dates in 2006 when SOI operated airguns in the Beaufort Sea. Other equipment used during the shallow hazards surveys included a bubble pulser operating at frequencies near 400 Hz for medium penetration and a chirp sonar operating at 2–7 and 8–23 Hz for shallow penetration. Other acoustic sources used to map the seafloor included multibeam bathymetric sonar operating at 240 kHz and side-scan sonar operating at 190–210 kHz.

SOI originally intended to conduct aerial surveys in the Beaufort Sea in support of deep seismic acquisition by the *Gilavar*. Since SOI did not conduct any deep seismic acquisition from the *Gilavar* in the Beaufort Sea in 2006, aerial surveys in the Beaufort Sea were only in support of the shallow hazards and site clearance activities conducted from the *Henry Christoffersen*.

A series of 8 north-south transect lines was established to monitor the project area in Camden Bay where SOI planned to conduct shallow hazard and site clearance surveys. Nine aerial surveys of the project area were conducted using a Twin Otter aircraft flown at 1000 ft above ground level at airspeed of approximately 120 knots. The first 7 surveys, conducted from 26 Aug. to 14 Sept., were pre-seismic surveys intended to collect baseline data on the distribution and abundance of marine mammals in the project area. On 23 and 24 Sept., surveys were flown to monitor the 120 dB zone around the *Henry Christoffersen* prior to seismic activities on 25 Sept.

Acoustic Modeling (Chapter 3).

Prior to conducting seismic and shallow hazards survey activities, SOI contracted with JASCO Research Ltd. to provide an acoustic model to estimate the extent of ensonification from the seismic acquisition and shallow hazards survey equipment in the Chukchi and Beaufort seas. The purpose of the modeling was to provide estimates of the received sound levels as a function of distance and aspect around the various acoustic sources when operating in the planned study regions. The model applied by JASCO takes account of the specific configuration of the airgun array. It also allows for the effects of the anticipated environmental conditions, including water properties, bathymetry, and bottom conditions, on the propagation of the sound through the water and bottom.

The main sound sources that were considered in this modeling study included three configurations of airgun arrays planned for use during seismic acquisition on the *Gilavar*. These consisted of one, two and three strings of airguns with 8 airguns per string and total volumes of 1049 in^3, 2098 in^3 and 3147 in^3 respectively. Also considered in the modeling were three potential shallow hazards survey sound sources. These were individual airguns of 10 in^3 and 20 in^3 volume, and a small airgun array consisting of four 70 in^3 airguns.

The acoustic modeling predicted distances at which the received sound level, on an rms basis, would be 190, 180, …, 120 dB re 1 μPa rms. In the original calculations the radii were "flat weighted" and did not take into account differences in hearing sensitivity among marine mammal groups. In addition, sensitivity weighting (*M*-weighting) was applied to underwater sound levels to weight the sound at various frequencies in accordance with the hearing characteristics of different marine mammal groups, i.e., baleen whales, toothed whales, and pinnipeds. The safety radii applied during initial airgun operations were the unweighted distances predicted by the modeling. Those predicted distances were used until the actual sound field around the operating airguns was measured empirically in the field (Chapter 4).

Acoustic Measurements (Chapter 4)

Seismic and shallow hazards surveys conducted by SOI relied on the generation of underwater acoustic pulses. Greeneridge Sciences, Inc., measured the underwater sound levels produced by the acoustic equipment that was used, including airguns and shallow-hazards sources, and by the vessels involved, including both seismic and support vessels. These measurements were acquired at the start of the respective periods of operation in the Chukchi and Beaufort Seas.

Values measured by Greeneridge were compared to the values that JASCO Research Ltd. had estimated (Chapter 3) by modeling, and were used to recommend updated mitigation radii for use by marine mammal observers on the seismic and shallow hazards ships during data acquisition.

Airgun pulses were received and analyzed at distances of 0.3–34 km in the Chukchi Sea and 0.06–20.5 km in the Beaufort Sea. Logarithmic sound propagation models were fitted to pulse sound pressure levels (SPL), sound exposure levels (SEL), and peak levels. A three-string array (24 airguns totaling 3147 in^3) used in the Chukchi Sea produced the highest values but showed little aspect dependence. A one-string array (8 airguns totaling 1049 in^3) used in the Chukchi Sea showed stronger aspect dependence, with the broadside aspect producing the highest values. Received levels produced by the small airgun array used in the Beaufort Sea (4 airguns totaling 280 in^3) were generally ~15–30 dB lower (depending on distance from the source) than those in the Chukchi Sea, mainly because the Beaufort Sea array was considerably smaller.

A comparison of empirical vs. modeled SPL values showed that the empirical distances exceeded predicted distances in most (but not all) situations. For the *three-string array,* the E:P (Empirical:Predicted) ratios ranged from 1.2× to 2.0× for the 160 dB, 180 dB, and 190 dB distances, depending on aspect. E:P ratios for the 120 dB distance were higher: 2.6× to 3.2× (considering only bow and stern aspect). For the *single-string array*, E:P ratios were somewhat higher for the 190 dB and 120 dB distances than for the 160–180 dB distances, but in some cases the empirical distances were in fact less than the predicted distances (E:P < 1.0). The E:P ratios for the airgun array used in the Beaufort Sea were in general lower (better) than those obtained in the Chukchi Sea.

Broadband (10–20,000 Hz) levels of vessel sound were analyzed as a function of distance from the sound source. Received levels at 500 m distance were 125–132 dB re 1 μPa for the seismic ship *Gilavar*, and 127–135 dB for the chase vessel *Jim Kilabuk*, depending on aspect (bow, stern, broadside). Both of these ships were recorded in the Chukchi Sea. In the Beaufort Sea, the received broadband level for the tug *Henry Christoffersen* at 500 m distance was ~122 dB re 1 μPa.

Monitoring and Mitigation Methods (Chapter 5)

The main purposes of the vessel-based monitoring program were to ensure that the provisions of the IHAs issued to SOI by NMFS and USFWS were satisfied, effects on marine mammals were minimized, and residual effects on animals were documented.

Under current NMFS guidelines, "safety radii" for marine mammals around airgun arrays are customarily defined as the distances within which received pulse levels are ≥180 dB re 1 μPa (rms) for cetaceans and ≥190 dB re 1 μPa (rms) for pinnipeds. Marine mammals exposed to ≥160 dB (rms) are assumed by NMFS to be potentially subject to behavioral disturbance. For the current seismic project there has also been concern that received pulse levels as low as 120 dB (rms) may have the potential to disturb some whales. In 2006, there was a requirement to implement special mitigation measures if specified numbers of bowhead cow/calf pairs might be exposed to ≥120 dB rms or if large groups (≥12

individuals) of bowhead or gray whales might be exposed to ≥160 dB rms. Sound levels were measured in the field to determine safety and disturbance radii to be used for mitigation during seismic acquisition and shallow hazards surveys.

The primary mitigation measures that were implemented during the seismic activities in the Chukchi and Beaufort seas included ramp up, power down, and shut down of the airguns. Mitigation was implemented by marine mammal observers (MMOs) onboard the *Gilavar* and *Kilabuk* who visually monitored the safety radii, and informed the airgun operators when a marine mammal was observed within or about to enter the appropriate safety radius.

In summary, during the seismic and shallow-hazards surveys in the Chukchi and Beaufort Seas, at least one MMO onboard the source vessel (*Gilavar* or *Henry Christoffersen*) maintained a visual watch for marine mammals during all daylight hours while seismic or shallow-hazards surveys were underway. During the surveys, two visual observers were on duty for 45% of the time watches were conducted on the *Gilavar* and for 2% of the time watches were conducted on the *Henry Christoffersen*. Observers focused their search effort forward of the vessel but also searched aft of the vessel while it was underway. Watches were conducted with the naked eye, Fujinon 7 × 50 reticle binoculars, and Zeiss 20 × 60 binoculars. MMOs instructed seismic operators to power down or shut down the airguns if marine mammals were sighted within or about to enter the appropriate safety radii.

An aerial survey program was conducted in support of the shallow-hazards program in the Beaufort Sea during fall of 2006 to advise the *Henry Christoffersen* as to the presence of marine mammals in the general area of operation. During the aerial surveys, observers also collected data on the distribution and abundance of marine mammals. Nine aerial surveys were conducted between 26 Aug. and 24 Sept. SOI's only use of airguns in the Beaufort Sea in 2006 occurred on 8 Aug. and 25 Sept., and was related to site clearance and shallow hazard surveys. Aerial surveys were conducted on 23 and 24 Sept. to monitor the 120 dB zone prior to airgun operations on 25 Sept.

In general, vessel-based data were categorized as "seismic", "post-seismic", or "non-seismic". "Seismic" included all data collected from the source vessel (*Gilavar* or *Henry C.*) while the airguns were operating. Non-seismic included all data obtained before the airguns were activated (pre-seismic) or >1 or >2 h (for pinnipeds and cetaceans, respectively) after the airguns were deactivated. Data collected during post-seismic periods from 3 min to 1 h (for pinnipeds) or 2 h (for cetaceans) after cessation of seismic activity were considered either "recently exposed" (3–30 min) or "potentially exposed" (30 min to 1 or 2 h) to seismic sound levels, and were excluded from analyses. Thus, the post-seismic data (3 min to 1 or 2 h after cessation of seismic) were not included in either the "seismic" or "non-seismic" categories.

Marine mammal sightings during the "seismic" and "non-seismic" periods were used to calculate sighting rates. Sighting rates were then used to calculate the corresponding densities of marine mammals near the survey and chase ships during seismic and non-seismic periods. These densities were used to estimate the numbers of marine mammals that may have been exposed to various levels of ensonification, and to determine the estimated take by harassment.

Monitoring and Mitigation Results (Chapter 6)

Marine mammal observers aboard the *Gilavar* conducted 13,527 km and 1537 h of visual observation and MMOs aboard the *Kilabuk* conducted 14,058 km and 1251 h of visual observation, together documenting 353 sightings of 442 pinnipeds and 115 sightings of 219 cetaceans (Table ES.1). There were numerous sightings of supply and chase vessels within 5km of each of the observation vessels.

TABLE ES.1. Summary of *Gilivar*, *Kilabuk*, and *Henry Christoffersen* operations, observer monitoring effort, and marine mammal sightings during SOI marine geophysical surveys in the Chukchi and Beaufort Seas 2006.

	Non-Seismic			Seismic		Total	
	Useable[a]	Other	Post-seismic	Useable[a]	Other	Useable[a]	Total
A. Gilavar							
Total operations in h	173	264	8	292	800	465.0	1537
Total operations in km	1677	2225	69.0	2537	7019	4214.0	13527
Marine mammal sightings (indv.)							
Cetaceans	52 (94)	20 (24)	3 (7)	1 (1)	4 (4)	53 (95)	80 (130)
Pinnipeds in water	64 (73)	9 (13)	19 (20)	60 (62)	37 (37)	124 (135)	189 (205)
Pacific Walrus	8 (11)	2 (3)	1 (2)	1 (1)	1 (1)	9 (12)	13 (18)
Pinnipeds on ice	13 (47)	2 (2)	0	0	0	13 (47)	15 (49)
Pacific Walrus	3 (35)	0	0	0	0	3 (35)	3 (35)
Polar Bears	0	0	0	0	0	0	0
B. Kilabuk							
Total operations in h	895	356	*NA*	*NA*	*NA*	895	1251
Total operations in km	10220	3838	*NA*	*NA*	*NA*	10220	14058
Marine mammal sightings (indv.)							
Cetaceans	0	35 (89)	*NA*	*NA*	*NA*	0	35 (89)
Pinnipeds in water	114 (130)	39 (42)	*NA*	*NA*	*NA*	114 (130)	153 (172)
Pacific Walrus	9 (17)	8 (11)	*NA*	*NA*	*NA*	9 (17)	17 (28)
Pinnipeds on ice	7 (28)	1 (1)	*NA*	*NA*	*NA*	7 (28)	8 (29)
Pacific Walrus	3 (23)	0	*NA*	*NA*	*NA*	3 (23)	3 (23)
Polar Bears	0	0	0	0	0	0	0
C. Henry Christoffersen							
Total operations in h	292	218	7	4	6	298	527
Total operations in km	3179	1783	85.0	60	38	3239	5145
Marine mammal sightings (indv.)							
Cetaceans	0	0	0	0	0	0	0
Pinnipeds in water	270 (288)	129 (145)	3 (3)	0	0	270 (288)	399 (433)
Pacific Walrus	0	0	0	0	0	0	0
Pinnipeds on ice	1 (1)	5 (5)	0	0	0	1 (1)	6 (6)
Pacific Walrus	0	0	0	0	0	0	0
Polar Bears	3 (4)	1 (5)	0	0	0	3 (4)	4 (9)
Power downs/shut downs							
Gilivar							48
Henry Christoffersen							0

Note: N/A means not applicable.

[a] See *Acronyms and Abbreviations for description of "useable" sightings.*

A total of 8213 km and 526 hours of visual observation was conducted aboard the *Henry Christoffersen*, during which 412 sightings of 451 marine mammals were logged. The ringed seal was the most abundant species recorded. No sightings were noted during the limited periods when airguns were in use in the Beaufort Sea. Few vessels were sighted during the cruise, and only two of these approached within 5 km of the *Henry Christoffersen*.

Based on the estimated densities of marine mammals in the Chukchi Sea during this project, about 416 different individual seals, 49 walruses, and 91 cetaceans would be expected to occur within the areas ensonified to ≥190 dB re 1 μPa (rms) for pinnipeds and 180 dB re 1 μPa (rms) for cetaceans at some time during the field season. Calculated estimates for individual pinnipeds and cetaceans potentially exposed to sound levels ≥160dB re 1 μPa (rms) were 1317 and 198 respectively.

No animals observed from the *Henry Christoffersen* were potentially exposed to sound levels ≥180 dB re 1 μPa (rms). Based on calculations involving estimated densities of marine mammals, there would have been approximately 180 seals exposed to sound levels ≥160 dB re 1 μPa (rms).

On the two days of aerial surveying in support of seismic activities on the *Henry Christoffersen*, 219.4 km of transect were flown, of which 188.4 km were flown in good surveying conditions. There was one sighting of a bowhead during these surveys.

1. BACKGROUND AND INTRODUCTION[1]

Shell Offshore, Inc. (SOI), collected marine seismic data in the Chukchi and Beaufort seas during the summer of 2006 in support of potential future oil and gas leasing and development. Deep seismic acquisition for SOI was conducted in the Chukchi Sea by WesternGeco using the M/V *Gilavar*, a seismic vessel that towed an airgun array as well as hydrophone streamers to record reflected seismic data. Seismic acquisition was originally planned to be conducted in both the Chukchi and Beaufort Seas using the *Gilavar*; however, ice conditions during the 2006 field season precluded most data collection in the Beaufort Sea. Activities in the Beaufort Sea were confined to site clearance, shallow hazard surveys and geotechnical activities, that were conducted from the M/V *Henry Christoffersen*, an NTCL vessel.

Marine seismic surveys emit sound energy into the water (Greene and Richardson 1988; Tolstoy et al. 2004a,b), and have the potential to affect marine mammals given the reported auditory and behavioral sensitivity of many such species to underwater sounds (Richardson et al. 1995; Gordon et al. 2004). The effects could consist of behavioral or distributional changes, and perhaps (for animals close to the sound source) temporary or permanent reduction in hearing sensitivity. Either behavioral/distributional effects or (if they occur) auditory effects could constitute "taking" under the provisions of the U.S. Marine Mammal Protection Act (MMPA) and the U.S. Endangered Species Act (ESA), at least if the effects are considered to be "biologically significant".

Numerous species of cetaceans and pinnipeds inhabit parts of the Chukchi and Beaufort seas. Two species listed as "Endangered" under the ESA do or may occur in portions of the survey area, including bowhead whale (*Balaena mysticetus*) and perhaps the fin whale (*Balaenoptera physalus*). The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) share jurisdiction over the marine mammal species that were likely to be encountered during the project. USFWS manages two species occurring in the Chukchi and Beaufort Seas, the walrus (*Odobenus rosmarus*) and the polar bear (*Ursus maritimus*); NMFS manages all the other marine mammals occurring in those areas.

Other species of concern (birds) that might occur in the survey area are the spectacled (*Somateria fischeri*) and Steller's (*Polysticta stelleri*) eiders that are listed as "Threatened" under the ESA. Of the two species, spectacled eiders are more abundant, have been documented farther offshore (40 km) in the Beaufort Sea, and use some lagoon systems in the Beaufort and Chukchi seas during their molt migration.

On 16 November 2005, SOI requested that NMFS issue Incidental Harassment Authorizations (IHAs) to authorize non-lethal "takes" of marine mammals incidental to SOI's planned seismic operations in the mid- and eastern parts of the Alaskan Beaufort Sea (SOI 2005a) and in the Chukchi Sea (SOI 2005b). The IHAs were requested pursuant to Section 101(a)(5)(D) of the MMPA. A single IHA to cover activities in both the Beaufort and Chukchi seas was issued to SOI by NMFS on 5 July 2006 (Appendix A). The IHA authorized "potential take by harassment" of various cetaceans and seals during the marine geophysical cruises described in this report. On 10 Jan. 2006, SOI also requested from USFWS an IHA to authorize potential "taking" of walruses and polar bears in the Chukchi Sea. USFWS issued that IHA to SOI on 29 June 2006 (Appendix B).

This document serves to meet reporting requirements specified in the IHA. The primary purposes of this report are to describe the seismic survey in the Chukchi and Beaufort seas, to describe the associated marine mammal monitoring and mitigation programs and their results, and to estimate the

[1] Chapter 1 by R. Rodrigues, B. Haley, and D. Ireland (LGL).

numbers of marine mammals potentially exposed to levels of sound generated by the project at or above presumed effects levels.

Incidental Harassment Authorization

IHAs issued to seismic operators include provisions to minimize the possibility that marine mammals close to the seismic source might be exposed to levels of sound high enough to cause hearing damage or other injuries. During this project, sounds were generated by the *Gilavar*'s airguns, as used during the seismic study, and by several types of lower-energy sound sources on the *Henry Christoffersen* including bottom mapping and seafloor imaging sonar, a chirp sonar, a bubble pulser, and a cluster of four small airguns. No serious injuries or deaths of marine mammals were anticipated from the seismic and shallow hazards surveys, given the nature of the operations and the mitigation measures that were implemented, and no injuries or deaths were attributed to these activities. Nonetheless, the seismic survey operations described in Chapter 2 had the potential to "take" marine mammals by harassment. Behavioral disturbance to marine mammals is considered to be "take by harassment" under the provisions of the MMPA. Appendix C provides further background on the issuance of IHAs relative to seismic operations and "take".

Under current NMFS guidelines (e.g., NMFS 2005a, 2006a), "safety radii" for marine mammals around airgun arrays are customarily defined as the distances within which the received pulse levels are ≥180 dB re 1 μPa (rms)[2] for cetaceans and ≥190 dB re 1 μPa (rms) for pinnipeds. Those safety radii are based on an assumption that seismic pulses at lower received levels will not injure these mammals or impair their hearing abilities, but that higher received levels *might* have some such effects. The mitigation measures required by IHAs are, in large part, designed to avoid or minimize the numbers of cetaceans and pinnipeds exposed to sound levels exceeding 180 and 190 dB (rms), respectively. The development and implementation of the safety radii for the current project are discussed in detail in Appendix C.

Disturbance to marine mammals could occur at distances beyond the safety (shut down) radii if the mammals were exposed to moderately strong pulsed sounds generated by the airguns or perhaps by sonar (Richardson et al. 1995). NMFS assumes that marine mammals exposed to airgun sounds with received levels ≥160 dB re 1 μPa (rms) are likely to be disturbed. That assumption is based mainly on data concerning behavioral responses of baleen whales, as summarized by Richardson et al. (1995) and Gordon et al. (2004). Dolphins and pinnipeds are generally less responsive than baleen whales (e.g., Stone 2003; Gordon et al. 2004), and 170 dB (rms) may be a more appropriate criterion of potential behavioral disturbance for those groups (LGL Ltd. 2005a,b). In general, disturbance effects are expected to depend on the species of marine mammal, the activity of the animal at the time of disturbance, distance

[2] "rms" means "root mean square", and represents a form of average across the duration of the sound pulse as received by the animal. Received levels of airgun pulses measured on an "rms" basis (sometimes described as Sound Pressure Level, SPL) are generally 10–12 dB lower than those measured on the "zero-to-peak" basis, and 16–18 dB lower than those measured on a "peak-to-peak" basis (Greene 1997; McCauley et al. 1998, 2000a,b). The latter two measures are the ones commonly used by geophysicists. Unless otherwise noted, all airgun pulse levels quoted in this report are rms levels. Received levels of pulsed sounds can also be described on an energy or "Sound Exposure Level" basis, for which the units are dB re $(1\ \mu Pa)^2 \cdot s$. The SEL value for a given airgun pulse, in those units, is typically 10–15 dB less than the rms level for the same pulse (Greene 1997; McCauley et al. 1998, 2000a,b), with considerable variability (Madsen et al. 2006; see also Chapter 4 of this report). SEL (energy) measures may be more relevant to marine mammals than are rms values, but the current regulatory requirements are based on rms values.

from the sound source, the received level of the sound and the associated water depth. Some individuals may exhibit behavioral responses at received levels somewhat below the nominal 160 or 170 dB (rms) criteria, but others may tolerate levels somewhat above 160 or 170 dB without reacting in any substantial manner. For example, migrating bowhead whales in the Alaskan Beaufort Sea show avoidance at received levels substantially lower than 160 dB re 1 μPa_{rms} (Miller et al. 1999; Richardson et al. 1999). In contrast, bowhead whales on the summer feeding grounds tolerate received levels of 160 dB or sometimes more (Richardson et al. 1986; G. Miller et al. 2005). Beluga whales also show avoidance at levels below 160 dB (G. Miller et al. 2005).

A notice regarding the proposed issuance of an IHA for the survey in the Chukchi and Beaufort seas was published by NMFS in the *Federal Register* on 3 May 2006 and public comments were invited (NMFS 2006a). On 24 Aug. 2006, NMFS published a second notice in the *Federal Register* to announce the issuance of the IHA (NMFS 2006b). The second notice responded to 32 comments received by NMFS during the 30-day public comment period. A copy of the IHA is included in this report as Appendix A.

The IHA issued by NMFS to SOI authorized harassment "takes" of one ESA-listed species (bowhead whale) as well as several non-listed species: gray (*Eschrichtius robustus*), killer (*Orcincus orca*), and beluga (*Delphinapterus leucas*) whales, harbor porpoises (*Phocoena phocoena*), and ringed (*Phoca hispida*), spotted (*Phoca largha*), and bearded (*Erignathus barbatus*) seals.

NMFS granted the IHA to SOI on the assumptions that

- the numbers of whales and seals potentially harassed (as defined by NMFS criteria) during seismic operations would be "small",
- the effects of such harassment on marine mammal populations would be negligible,
- no marine mammals would be seriously injured or killed,
- there would be no unmitigated adverse effects on the availability of marine mammals for subsistence hunting in Alaska, and
- the agreed upon monitoring and mitigation measures would be implemented.

USFWS determined in 2006 that proponents of arctic seismic projects should operate under IHAs issued by USFWS. The process of obtaining an IHA from USFWS was very similar to that of obtaining one from the NMFS. On 10 January 2006, SOI requested an IHA from USFWS for the incidental taking of walruses and polar bears in conjunction with seismic activities in the Chukchi Sea (SOI 2006). A notice regarding the proposed issuance by USFWS of an IHA for the survey in the Chukchi Sea was published in the *Federal Register* on 8 May 2006 and public comments were invited (USFWS 2006). This IHA was issued to SOI by USFWS on 29 June 2006. USFWS did not publish a second notice in the *Federal Register* to announce the issuance of the IHA. A copy of the USFWS IHA is included in this report as Appendix B. The IHA required SOI to observe a 190 dB safety radius for walruses and polar bears.

Mitigation and Monitoring Objectives

The objectives of the mitigation and monitoring program were described in detail in SOI's IHA applications (SOI 2005a,b, 2006) and in the IHA issued by NMFS to SOI (Appendix A). Explanatory material about the monitoring and mitigation requirements was published by NMFS and USFWS in the *Federal Register* (NMFS 2006a,b; USFWS 2006).

The main purpose of the mitigation program was to avoid or minimize potential effects of SOI's seismic survey on marine mammals. This required that shipboard personnel detect marine mammals within or about to enter the designated safety radii (190 dB for pinnipeds and 180 dB for cetaceans), and in such cases initiate an immediate power down (or shut down if necessary) of the airguns. A power down involves reducing the source level of the operating airguns, in this case by reducing the air volume. A shut down involves temporarily terminating the operation of all airguns. An additional mitigation objective was to detect marine mammals within or near the safety radii prior to starting the airguns, or during ramp up toward full power. In these cases, the start of airguns was to be delayed or ramp up discontinued until the safety radius was free of marine mammals insofar as this can be determined visually for a period of 30 minutes (see Appendix A and Chapter 5).

In 2006 mitigation was also required, as specified by the IHA, at the 160 dB isopleth. This area was monitored by the chase boat that accompanied the seismic vessel. Power down of the seismic airgun array was required if an aggregation of 12 or more non-migratory bowhead or gray whales was detected ahead of, or perpendicular to, the seismic vessel track and within the 160 dB isopleth. Monitoring of the 120 dB isopleth around the seismic vessel(s) was also required after 25 September in the Chukchi Sea and after 1 September in the Beaufort Sea. Power down would be required if 4 migratory cow/calf pairs were detected within the surveyed 120 dB isopleth.

The primary objectives of the monitoring program were as follows:

1. provide real-time sighting data needed to implement the mitigation requirements;
2. estimate the numbers of marine mammals potentially exposed to strong seismic pulses; and
3. determine the reactions (if any) of marine mammals potentially exposed to seismic sound impulses.

Specific mitigation and monitoring objectives identified in the IHAs are described in Appendices A and B. Mitigation and monitoring measures that were implemented during the activities in the Chukchi and Beaufort seas are described in detail in Chapter 5.

This 90-day report describes the methods and results for the monitoring work specifically required to meet the above primary objectives. Various other marine mammal and acoustic monitoring and research programs not specifically tied to the above objectives were also implemented by SOI (or by SOI plus other industry operators) in the Chukchi and/or Beaufort Seas during 2006. Results of those additional efforts are, for the most part, not mentioned in this 90-day report. Those additional results will be reported at a later date.

Report Organization

The primary purpose of this report is to describe the 2006 seismic survey activities in the Chukchi and Beaufort seas including the associated monitoring and mitigation programs, and to present results as required by the IHAs (Appendices A and B). This report includes six chapters:

1. background and introduction (this chapter);
2. description of SOI's seismic and site clearance studies;
3. sound source and propagation modeling prior to the field season;
4. sound source measurements during the field season;
5. description of the marine mammal monitoring and mitigation requirements and methods,

including safety radii; and

6. results of the marine mammal monitoring program, including estimated numbers of marine mammals potentially "taken by harassment".

Those chapters are followed by Acknowledgements and Literature Cited sections.

In addition, there are nine Appendices that provide copies of relevant documents and details of procedures that are more-or-less consistent during seismic surveys where marine mammal monitoring and mitigation measures are in place. These procedural details are only summarized in the main body of this report. The Appendices include

A. a copy of the IHA issued by NMFS to SOI for this study;

B. a copy of the IHA issued by USFWS to SOI for this study;

C. background on development and implementation of safety radii;

D. characteristics of the *Gilavar* and *Henry Christoffersen*;

E. details on visual and acoustic monitoring, mitigation, and data analysis methods;

F. conservation status and densities of marine mammals in the project region;

G. monitoring effort and list of marine mammals seen or heard during this cruise;

H. marine mammal sightings with power downs and shut downs during the seismic activities;

I. marine mammal density estimates for the project area.

2. SEISMIC SURVEYS DESCRIBED[3]

Chukchi Sea

The *Gilavar* was used as the source vessel during SOI's activities in the Chukchi Sea in 2006. The *Gilavar* was accompanied by the *Jim Kilabuk*, an icebreaker-class support vessel (chase vessel). Two other support vessels were also used in the Chukchi Sea at various times during the field season. The *Gulf Provider* was used as a supply vessel for transfer of personnel during crew changes, for fuel transfers to the *Kilabuk*, and to resupply the *Gilavar* with equipment and supplies. In addition, the *Peregrine*, a flat-bottom landing craft with minimal draft, was used for transfer of personnel and equipment from shore areas to the *Gulf Provider*. Appendix D contains a description of the vessels used during the seismic activities. These four vessels operated in accordance with the provisions of a Conflict Avoidance Agreement (CAA) between the seismic industry, the Alaska Eskimo Whaling Commission (AEWC), and the Whaling Captains Associations with respect to subsistence activities including but not limited to the hunts for bowhead and beluga whales. The objective of the CAA was to provide avoidance and other mitigation guidelines to be followed by industry participants working in or transiting the vicinity of active whaling crews. Under the terms of the CAA, communication centers were established at Barrow and Deadhorse, and Call Centers at Pt. Hope, Pt. Lay, Wainwright, and Kaktovik. The CAA outlined a communication program and specified times and areas to be surveyed in order to avoid any possible conflict with the subsistence hunts.

Operating Areas, Dates, and Navigation

The proposed deep seismic survey was originally scheduled to occur in two phases. Phase one commenced in July when sea ice conditions allowed access to the Chukchi Sea. Operations were originally planned to continue there until some date in late summer when the *Gilavar* and *Kilabuk* were to transit to the Beaufort Sea to conduct seismic surveys on Shell lease-holdings in the mid- and eastern parts of the Alaskan Beaufort Sea. Heavy ice conditions delayed the date when operations could have transferred to the Beaufort Sea, and seismic operations continued in the Chukchi Sea. During September, SOI decided not to attempt to conduct deep seismic exploration in the Beaufort Sea during 2006 due to high concentrations of ice and other operational considerations. The *Gilavar*'s airguns and streamers were retrieved on 19 September and the *Gilavar* departed southward from the project area and left the Chukchi Sea on 23 September.

The geographic region where the deep seismic survey occurred was located in the Chukchi Sea MMS OCS Program Area designated as Chukchi Sea Sale 193 (1989) and in the proposed 2002–2007 Chukchi Sea Program Area (see Fig. 2.1). Since the Chukchi Sea deep seismic program was conducted as a pre-lease activity, the exact locations where operations occurred remains confidential for business reasons. That is, the seismic data acquired in 2006 will be used by SOI to identify leases on which it may bid in a forthcoming competitive lease sale. However, in general, seismic acquisition occurred in the Chukchi Sea well offshore from the Alaska coast in OCS waters averaging greater than 40 meters (m) or 131 ft deep and outside the polynya zone.

The *Gilavar* left Dutch Harbor on 7 July to travel to the project area, and entered the Chukchi Sea on 10 July. Operations were then delayed due to ice conditions in the planned operating areas and to avoid potential disruption of the Pt. Lay beluga hunt. SOI's seismic contractor began deploying the seismic acquisition equipment on 21 July. After deployment of the airguns, the underwater sounds

[3] Chapter 2 by R. Rodrigues, B. Haley, and D. Ireland (LGL).

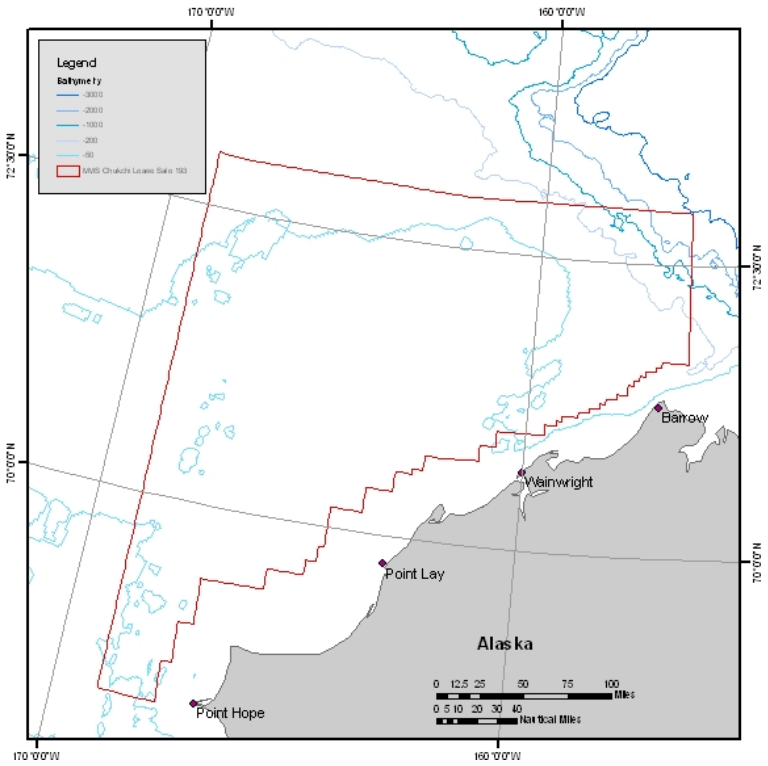

FIGURE 2.1. Location of the proposed MMS Chukchi Sea Lease Sale 193 within which SOI's 2006 high-energy seismic activities were conducted.

produced by the airgun array were recorded and analyzed to verify or refine the various radii to be used for mitigation purposes during the exploration activities (see Chapter 4 below). Those radii had been predicted prior to the field season via acoustic modeling procedures (see Chapter 3), but site-specific empirical measurements were required to confirm or refine the predictions. The airgun sounds were recorded as a function of airgun configuration, distance, and aspect on 21 and 22 July, and safety and disturbance radii based on these measurements were determined within 72 hrs. Seismic acquisition began on 27 July 2006 and continued through most of the field season until 19 September. SOI then determined that ice conditions and other operational considerations precluded continuation of the exploration program or a transition of the program into the Beaufort Sea, and seismic activities were terminated. SOI completed ~5297.4 km (3291.7 statute mi) of deep-seismic survey line in the Chukchi Sea in 2006.

Throughout the survey the *Gilavar's* position, speed, and water depth were logged digitally every ~60 s. In addition, the position of the *Gilavar*, water depth, and information on the airgun array were logged for every airgun shot while the *Gilavar* was on a seismic line and collecting geophysical data. The geophysics crew kept an electronic log of events, as did the marine mammal observers (MMOs) while on duty. The MMOs also recorded the number and volume of airguns that were firing when the *Gilavar* was offline (e.g., prior to shooting at full volume) or was online but not recording data (e.g., during airgun or computer problems).

Airgun Description

SOI used WesternGeco's 3147 in^3 3-string array of Bolt airguns for its 3–D seismic survey operations in the Chukchi Sea. WesternGeco's source array was composed of 3 identically-tuned Bolt airgun sub-arrays, each with 8 airguns and a total volume of 1049 in^3, operated at an air pressure of 2000

psi. Each string was 15 m in length, and each string was 8 m from the adjacent string(s). The individual airguns ranged in volume from 30 to 235 in^3, and each string included two 235 in^3 and two 125 in^3 airguns in 2-gun clusters. This energy source was towed approximately 245 m behind the *Gilavar*. The system also included 6 hydrophone streamers 4200 m in length and spaced 100 m apart, which recorded reflected sound energy. In general, the *Gilavar* towed this system along a predetermined survey track although adjustments were made during the course of the field season in accordance with ice conditions.

Air compressors aboard the *Gilavar* were the source of high pressure air used to operate the airgun arrays. Seismic pulses were emitted at intervals of 25 m (~10 sec) while the *Gilavar* traveled at a speed of 4 to 5 knots (7.4–9.3 km/h). The airgun arrays were towed at a depth of 6 m and were 8 m apart. Characteristics of the airgun arrays are detailed in Appendix D.

Beaufort Sea—Vessel-based Component

In addition to deep seismic surveys in the Chukchi Sea, SOI also conducted site clearance and shallow hazards surveys of potential exploratory drilling locations within SOI's lease areas in the Beaufort Sea as required by MMS regulations. Before drilling can begin, a site clearance survey and analysis is necessary to identify and/or evaluate potentially hazardous or otherwise sensitive conditions and sites at or below the seafloor that could affect the safety or appropriateness of operations. Examples of such conditions include subsurface faults, fault scarps, shallow gas, steep-walled canyons and slopes, buried channels, current scour, migrating sedimentary bedforms, ice gouging, permafrost, gas hydrates, unstable soil conditions, pipelines, anchors, ordnance, shipwrecks, or other geophysical or man-made features.

Offshore site clearance surveys use various geophysical methods and tools to acquire graphic records of seafloor and sub-seafloor geologic conditions. The data acquired and the types of investigations outlined below are performed routinely for most exploratory drilling and production facilities in marine areas, and for submarine pipelines, port facilities, and other offshore projects. High-resolution geophysical data such as two-dimensional, high-resolution multi-channel seismic, medium penetration seismic, subbottom profiler, side scan sonar, multibeam bathymetry, magnetometer, and possibly piston core sediment sampling are typical types of data acquired. These data are interpreted to define geologic, geotechnical and archeological conditions at the site and to assess the potential engineering significance of these conditions. The following section provides a brief description of the operations and instrumentation used during SOI's 2006 Beaufort Sea site clearance program insofar as they may impact marine mammals.

Operating Areas, Dates, and Navigation

The site clearance surveys were confined to very small specific areas within defined OCS blocks (Fig. 2.2). The surveys were conducted from the M/V *Henry Christofferson*. This vessel is 47 m (153 ft) long and the gross tonnage is 783 metric tons. It is powered by four Caterpillar V16 D399 diesel engines and can travel at a speed of 14 knots (see Appendix D). Small geophysical survey sources with limited energy output were employed to measure bathymetry, topography, geohazards, and other seabed characteristics. The strongest sound source was a cluster of four 70 in^3 airguns, which was used during the sound source measurements. Two 70 in^3 airguns were used during a deeper site clearance survey on 25 Sept. Chapter 4 describes results of measurements of sounds from this and other acoustical sources used during site clearance operations.

Measurements of sounds from the 4-airgun array and from other acoustic sources on the *Henry C.* were conducted on 8 Aug. in the Beaufort Sea east of Kaktovik (see Chapter 4 for details). The sound sources (including the cluster of 4 airguns) were operated for 2.5 hours on this date. Between

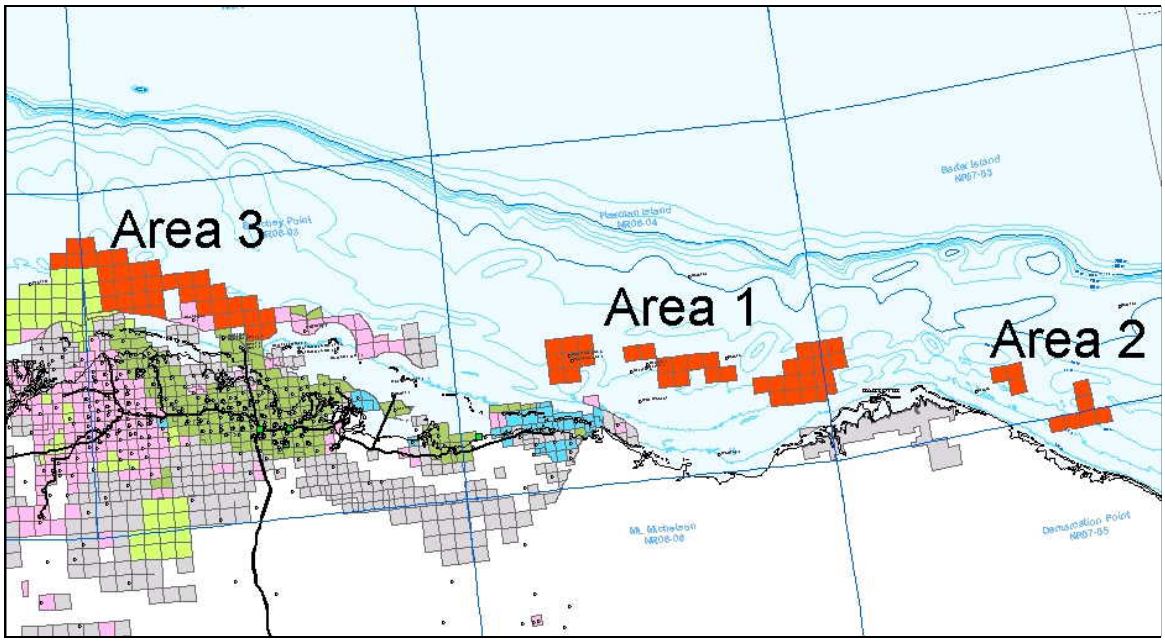

FIGURE 2.2. Location of SOI lease holdings in the Alaskan Beaufort Sea.

8 Aug. and 2 Oct. 2006, on an intermittent basis as allowed by ice and weather conditions, various types of site clearance surveys were conducted from the *Henry C.* These operations were in specific nearshore areas ranging from east of Kaktovik west to Thetis Island near the Colville River Delta (Fig. 2.2). Site clearance survey activities occurred on ~23 days during this period. However, during that period the airgun cluster (2 airguns) was operated only once for ~12 hrs on 25 Sept. At all other times during surveys, the acoustical sources in use were lower-energy medium- and high-frequency sources as described below. On days when surveys did not occur, the *Henry Christoffersen* was usually transiting to a new site or anchored while waiting for bad weather or ice conditions to subside.

Throughout the survey the *Henry Christoffersen*'s position, speed, and water depth were logged digitally every ~60 s. In addition, the position of the *Henry C.*, water depth, and information on the output of the airgun array or other geophysical tools were logged during all site clearance activities. The geophysics crew kept an electronic log of events, as did the marine mammal observers (MMOs) while they were on duty.

Geophysical Tools for Site Clearance

An airgun cluster consisting of four 70-in^3 airguns was planned for use during site clearance operations to locate potential hazards, such as gas deposits, at relatively shallow locations. The results of the source measurements indicated to the operators that the use of the 4-airgun array was excessive for their needs. Therefore, a pair of 70-in^3 airguns was the sound source used during the ~12-h of airgun operations on 25 Sept.

Several other lower-energy acoustic sources were operated for shallow-penetration subbottom surveys and to map the bottom. A bubble pulser operating at frequencies near 400 Hz was used for medium penetration and a chirp sonar operating at 2–7 and 8–23 Hz was used for shallow penetration. Other acoustic sources used to map the seafloor included a multibeam bathymetric sonar operating at 240

kHz and a side-scan sonar operating at 190–210 kHz. Characteristics of this equipment are described in more detail in Appendix D.

Beaufort Sea—Aerial Component

SOI originally intended to conduct aerial surveys in the Beaufort Sea in the summer (July to late Aug.) to collect pre-seismic baseline data and to conduct fall surveys (late Aug. to Oct.) as part of the monitoring and mitigation effort associated with seismic survey activities. Logistical problems early in the summer season precluded SOI's ability to conduct summer aerial surveys, and since SOI did not conduct any deep seismic acquisition from the *Gilavar* in the Beaufort Sea in 2006, the aerial surveys in the Beaufort Sea were only in support of the shallow hazards and site clearance activities conducted from the *Henry Christoffersen*.

A series of 8 north–south transect lines was established to monitor the project area in Camden Bay where SOI planned to conduct shallow hazard and site clearance surveys using their 240 in^3 airgun array (Fig. 2.3). Nine aerial surveys of the project area were conducted using a Twin Otter aircraft flown at 1000 ft above ground level at an airspeed of approximately 120 knots. The first 7 surveys, conducted between 26 Aug. and 14 Sept., were pre-seismic surveys intended to collect baseline data on the distribution and abundance of marine mammals in the project area. Surveys were flown on 23 and 24 Sept. to monitor the 120 dB zone prior to seismic activities on 25 Sept.

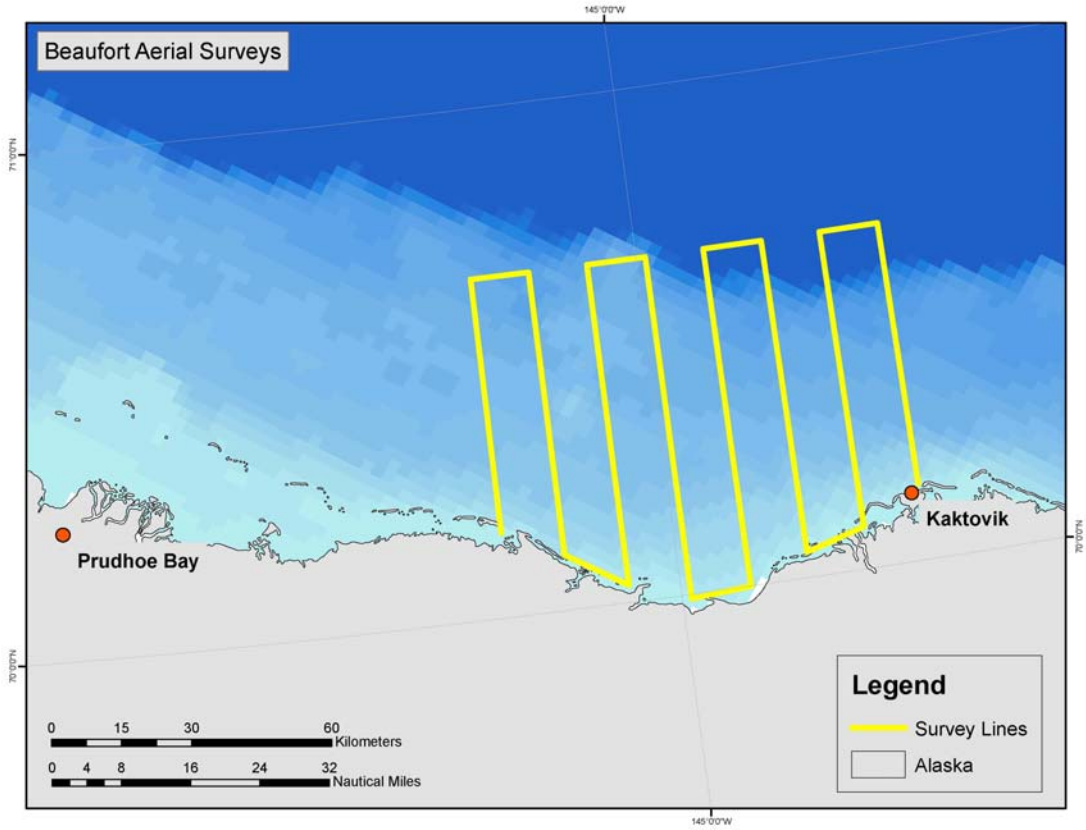

FIGURE 2.3. Approximate location of transect lines for aerial surveys of marine mammals in Camden Bay, Alaska 2006.

3. ACOUSTIC MODELING[4]

INTRODUCTION

Shell Offshore, Inc. (SOI), conducted seismic exploration activities in the Chukchi Sea and shallow hazards surveys in the Alaskan Beaufort Sea during summer 2006. Prior to conducting these activities SOI contracted with JASCO Research Ltd. to provide an acoustic model to estimate the extent of ensonification from the seismic acquisition and shallow hazards survey equipment in the Chukchi and Beaufort seas. The purpose of the modeling was

- to characterize the acoustic environment in the areas of the Chukchi and Beaufort seas where the seismic and shallow hazards programs were to be conducted,
- to predict the anticipated source characteristics of the emitted sounds, and
- to provide estimates of the received sound levels as a function of distance and aspect around the various acoustic sources when operating in the planned study regions.

Sound propagation modeling was performed for six locations, three in the Chukchi Sea and three in the Beaufort Sea, to provide predictions representative of the areas over which seismic exploration and shallow hazards surveys were to occur. The particular type of model used is state-of-the-art. It takes account of the specific configurations of the planned airgun arrays, and also allows for the anticipated effects of local environmental conditions on propagation of sound. Those propagation effects can have strong influences on received sound levels and other acoustic parameters, especially in shallow-water environments such as those where SOI's 2006 programs were to occur. The specific modeling approach used in this study has been subject to expert review by an IUCN scientific panel (Reeves 2005). Model input parameters, notably bathymetry, seabed properties, and sound velocity profiles for the water column, were chosen to be appropriate for the respective geographic regions and seasons modeled. The site locations for modeling were near the prospect or in areas similar with respect to the parameters mentioned above.

Use of acoustic modeling techniques to estimate the noise footprint associated with the seismic and shallow hazards survey activities provided a basis for planning the mitigation procedures that were implemented to minimize impacts of SOI's project on marine mammals. However, the project plans also provided for field measurements of the actual sound levels and characteristics early in the period of operation in both the Chukchi and Beaufort Seas. Results of those field measurements are described in Chapter 4 of this report. The modeling and field measurement programs were complementary to one another.

The main sound sources that were considered in this modeling study included three airgun arrays consisting of one, two and three strings of airguns with 8 airguns per string (i.e., totals of 8, 16 and 24 airguns with a total volumes of 1049 in^3, 2098 in^3 and 3147 in^3 respectively). Also considered in the modeling were three potential shallow hazards survey sources. These were individual airguns of 10 in^3 and 20 in^3 volume, and a small airgun array consisting of four 60 in^3 airguns for a total volume of 240 in^3. The 24-airgun 3147 in^3 configuration that was modeled closely matched the actual airgun configuration used by SOI for the Chukchi Sea seismic survey. The actual airgun configuration for the limited airgun operations during the 2006 shallow-hazards survey in the Beaufort Sea was a 4-airgun 280 in^3 array, slightly larger than the configuration that was modeled. Given that peak pressure from an airgun source increases in proportion

[4] Summarized by LGL from a detailed technical report (Austin et al. 2006b; 21 August 2006 version 3) by JASCO Research Ltd. for Shell Offshore Inc.

to the cube root of the source volume, an increase from 240 to 280 in^3 would have minimal effect on the received sound levels at any distance; at any location, the change would be less than 1 dB.

JASCO's modeling is a two-stage process. *(1)* A proprietary airgun array source-level model was used to characterize the sounds emitted by individual elements within each airgun array, and by the array as a whole. This source model took account of the specifications and spacing of the individual airguns planned for use during the 2006 seismic and shallow-hazards programs. *(2)* The modeled source levels were incorporated into an N×2-D sound propagation model, JASCO's Marine Operations Noise Model (MONM), to estimate the sound field as a function of distance and direction from each source. From this, JASCO estimated the ranges corresponding to the various safety and disturbance criteria that are typically applied during seismic programs conducted under Incidental Take Authorizations issued by the National Marine Fisheries Service (e.g., the 190, 180 and 160 dB re 1 μPa rms distances). Other distances of interest, including the 170 dB and 120 dB distances, were also estimated. This Chapter summarizes the methods and results of the sound source modeling. This summary of the modeling effort and results is based on JASCO's detailed technical report on the modeling, by Austin et al. (2006b).

JASCO SOURCE MODEL

JASCO currently employs a full-waveform airgun array signature model, called AASM, to compute the source level and directionality of airgun arrays (MacGillivray et al. 2004). The source signature model numerically simulates the oscillation and radiation of a collection of airgun bubbles. The theory of the airgun array model is beyond the scope of this report but is based on the pioneering work of Ziolkowski (1970) who first modeled the pressure waveforms of seismic airguns, with additional physics to account for pressure interactions between airguns, port throttling, bubble damping and GI-gun behavior, as described by such authors as Dragoset (1984), Laws et al. (1990), and Landro (1992). The source model includes four empirical parameters that are tuned so that the model output matches observed airgun behavior. The model parameters were fitted to a large library of real airgun data using a "simulated annealing" global optimization algorithm. The airgun data used in the optimization were obtained from a previous study (Racca and Scrimger 1986) that measured the signatures of Bolt airguns, ranging in volume from 5 in^3 to 185 in^3.

The output of the airgun array source model is a set of "notional" signatures for the individual array elements (i.e., the airguns). The notional signatures are the pressure waveforms of the individual guns, which are summed together with the appropriate phase delays to obtain the far-field source signature of the array (Parkes and Hatton 1986). The far-field array signature, in turn, is filtered into 1/3-octave pass bands to compute the source level of the array as a function of frequency band and propagation azimuth.

Seismic Sources Modeled

The three seismic airgun arrays modeled in this study were configured as per the specifications for the three arrays planned for use during the seismic program. One array had total volume 3147 in^3 and consisted of three sub-strings, with eight guns each. Each string of 8 airguns was 15 m in length, and the strings were spaced 8 m apart for total array dimensions of 16 m (cross-track) by 15 m (along-track). Individual airguns in each string ranged in volume from 30 in^3 to 235 in^3, and each string included two 235 in^3 airguns in a cluster. The second airgun array had a total volume of 2098 in^3 and consisted of two identical sub-strings as described above, with eight guns each (array dimensions 8 m cross-track by 15 m along track). The third airgun array had a total volume of 1049 in^3 and consisted of one 15-m-long sub-string (as described above) with eight guns total.

All three arrays were modelled using AASM to compute notional source signatures and 1/3-octave band source levels as a function of azimuth angle. The source depth was set at the anticipated operating depth of 6 m. Broadside and endfire overpressure signatures and corresponding power spectrum levels were calculated.

Shallow Hazards Sources Modeled

Shallow hazards surveying was to be accomplished using a source such as an individual airgun or a small airgun array, an echosounder, a bubble pulser, chirp sonar (sub-bottom profiler), a multibeam sonar, or a sidescan sonar. The source signatures of a single airgun of two different sizes (10 in^3 and 20 in^3) and of a small airgun array (4 airguns totaling 240 in^3) were modeled for this report. The 4-airgun source was the strongest source anticipated for use during the shallow hazards program. Sounds from a bubble pulser and chirp sonar were not modeled in advance of the field season, but were measured in the field at the start of the shallow-hazards program (Chapter 4). The multibeam and sidescan sonars operate at very high frequencies (240 kHz and 190–210 kHz, respectively) that are too high to be of concern for the marine mammal species that inhabit the Beaufort Sea and were not considered for this report.

SOUND PROPAGATION MODELING METHODOLOGY

Acoustic models can be used to predict sound transmission loss in defined environments. Subtracting the modeled transmission loss values (in decibels) from estimated source levels provides estimates of received levels at defined receiver positions. The transmission loss model used in this study is JASCO Research's MONM acoustic model. Airgun array source levels, predicted with AASM, were input to MONM and received levels were predicted.

MONM computes the expected received sound levels in terms of energy flux density (EFD), also referred to as Sound Exposure Level (SEL), for 3-dimensional range-varying acoustic environments. It does so by utilizing a wide-angled parabolic equation (PE) solution to the acoustic wave equation. The parabolic equation code in MONM is based on the Naval Research Laboratory's Range-dependent Acoustic Model (RAM), which has been extensively benchmarked for accuracy and is widely employed in the underwater acoustics community (Collins 1993). MONM computes acoustic fields in 3-D by modeling transmission loss along radial traverses at evenly-spaced angles covering a 360º swath from the source (known as N×2-D modeling). MONM employs several kinds of environmental data, including bathymetry, sound speed profiles, and geoacoustic profiles, and samples the acoustic environment every 50 meters in range along model traverses. MONM handles frequency dependence by computing acoustic transmission loss in 1/3-octave bands from 10 Hz to 2 kHz. MONM computes received sound pressure level by combining transmission loss with frequency-dependent source levels. MONM's sound level predictions have been validated against experimental data from shallow-water environments, and in those prior applications have proven to be highly accurate (Hannay 2004).

Environmental data for each modeling location, such as bathymetry, water column profiles, and geology were obtained from various sources for the appropriate times of year. For locations in the Chukchi Sea, environmental data appropriate to the month of July were used. For Beaufort Sea locations, data for the month of August were used.

SOUND LEVEL RADII

Seismic Airgun Array

MONM computes the received energy level of an airgun pulse in SEL units, expressed in dB re 1 $\mu Pa^2 \cdot s$ (e.g., Fig. 3.1), and does not directly compute peak or rms sound pressure level (SPL, in dB re 1 µPa rms). However, current U.S. regulatory requirements are based on the SPL (rms) metric, i.e., the root-mean-square sound pressure level calculated over the interval within 90% of the pulse energy reaches the receiver (sometimes abbreviated as "90% rms"). The rms value for a received airgun pulse is a function not only of distance, but also of the extent to which the pulse duration has been extended by propagation effects. To compute sound pressure levels directly, allowing for dispersion phenomena, would require calculation times that would be prohibitive for large geographic areas like those considered in the current study.

In order to convert the MONM results (in SEL units) to rms values compatible with the U.S. regulatory requirements, the "Fourier synthesis" technique as described in Jensen et al. (1994) has been used to develop a conversion procedure. For each source configuration and modeling site, the result is a set of predicted radii at which the received sound level, on an rms basis, would be 190, 180, …, 120 dB re 1 µPa rms. Table 3.1 shows the predictions for the three modeling sites in the Chukchi Sea and the three airgun configurations that were considered (1-, 2- and 3-string; 8, 16 and 24 airguns; 1049, 2098 and 3147 in^3). These values

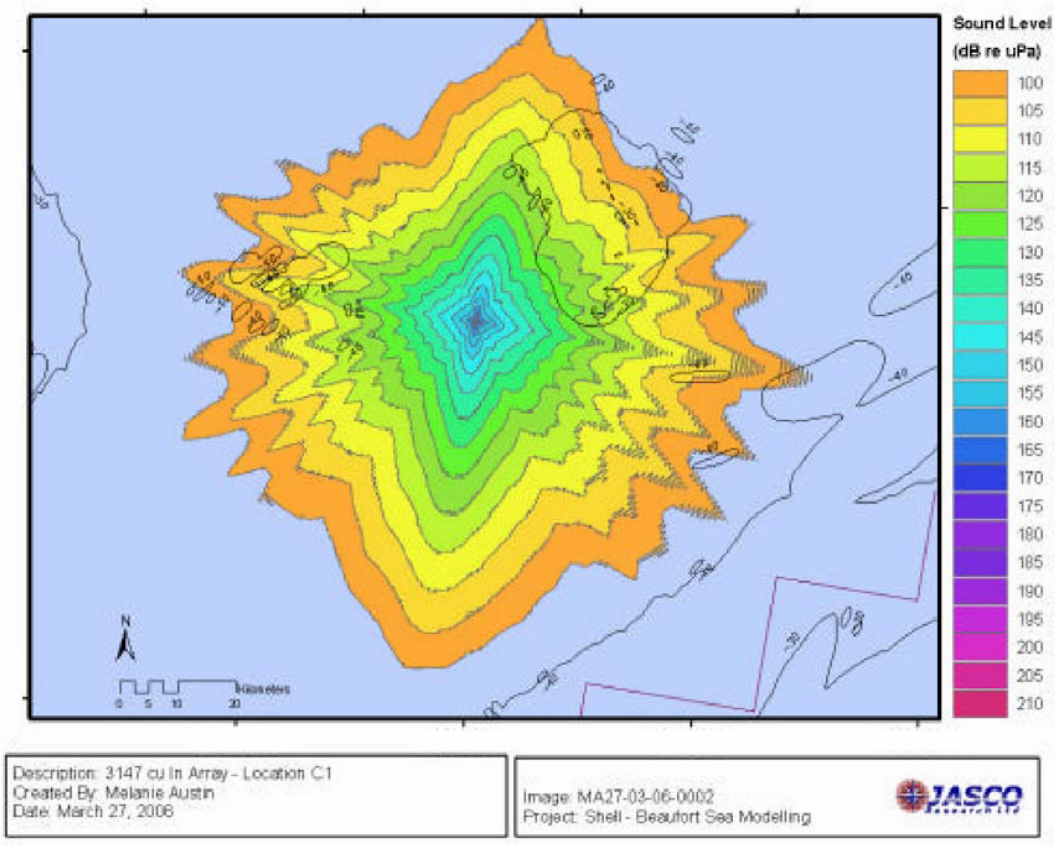

FIGURE 3.1. Map of predicted received levels on an energy basis, in Sound Exposure Level (SEL) units, at 10 m depth for a 3147 in^3 airgun array being towed approximately East–West at source location C1.

TABLE 3.1. Predicted rms radii, in kilometers, for the 1049 in^3, 2098 in^3 and 3147 in^3 airgun arrays operating at 3 modeled locations in the Chukchi Sea.

90% rms [dB re μPa]	C1			C2			C3		
	1049 in^3	2098 in^3	3147 in^3	1049 in^3	2098 in^3	3147 in^3	1049 in^3	2098 in^3	3147 in^3
120	21.27	24.73	25.95	23.08	29.42	30.96	31.3	40.34	41.91
130	14.95	17.70	18.41	15.46	19.11	20.35	20.91	26.06	27.4
140	9.9	12.03	12.55	9.73	12.47	13.24	13.02	16.86	17.28
150	6.2	7.56	7.95	5.79	7.72	8.16	7.53	10.05	10.51
160	3.59	4.25	4.53	3.18	4.40	4.62	3.80	5.25	5.67
170	1.73	2.05	2.19	1.67	2.10	2.20	1.88	2.17	2.44
180	0.61	0.76	0.81	0.64	0.80	0.85	0.58	0.77	0.82
190	0.09	0.22	0.23	0.11	0.11	0.13	0.05	0.23	0.23

are derived based on predicted received levels at a large number of grid points (e.g., Fig. 3.1), and there is some variability in the specific distance at which the received sound level would be expected to diminish to any given level. The tabulated distances for a given level (e.g., 180 dB rms) are those encompassing 95% of the locations at which the received level is expected to be ≥180 dB re 1 μPa rms.

The sound from the main 3-string airgun array is predicted to be ~5 dB stronger in the broadside direction than in the endfire direction (e.g., Fig. 3.1). This aspect dependence is predicted to be larger for a single string array than for a 2- or 3-string array (e.g., Fig. 3.2).

The radii calculated in Table 3.1 are "flat weighted" and do not take into account differences in hearing sensitivity among marine mammal groups. Sensitivity weighting (*M*-weighting) was applied to underwater sound levels to weight the sound at various frequencies in accordance with the hearing characteristics of different marine mammal groups. Weighting sound levels in this way decreases the contribution to the overall received level by sound energy in frequency bands outside the frequency range where the mammal in question hears well. Weighting curves appropriate for various categories of marine mammals exposed to strong sounds were first presented by the Advisory Committee on Acoustic Impacts on Marine Mammals in April 2004 (Gentry et al. 2004). They have subsequently been presented in more detail by J. Miller et al. (2005) and in Southall et al. (submitted).

Baleen whales hear well at low frequencies, which are the dominant frequencies in airgun pulses, and frequency weighting would not significantly affect the estimated 190, 180, …, 120 dB rms radii for baleen whales. However, pinnipeds and especially the "mid-frequency cetaceans" (like beluga whales) do not hear as well at low frequencies, and frequency weighting appropriate to those groups was expected to result in reduced effective radii for them. Tables 3.2 and 3.3 show how frequency weighting reduces the predicted rms radii for those two groups, as compared with flat weighting (Table 3.1).

Shallow Hazards Survey Sources

10 in^3 and 20 in^3 Airgun Sources

During the planning phase for this project, it was considered possible that an individual airgun might be used to survey for shallow hazards. It was anticipated that the largest-volume single airgun that might be used in this way would be 20 in^3. Alternatively, a single 10 in^3 airgun might be used. Either of

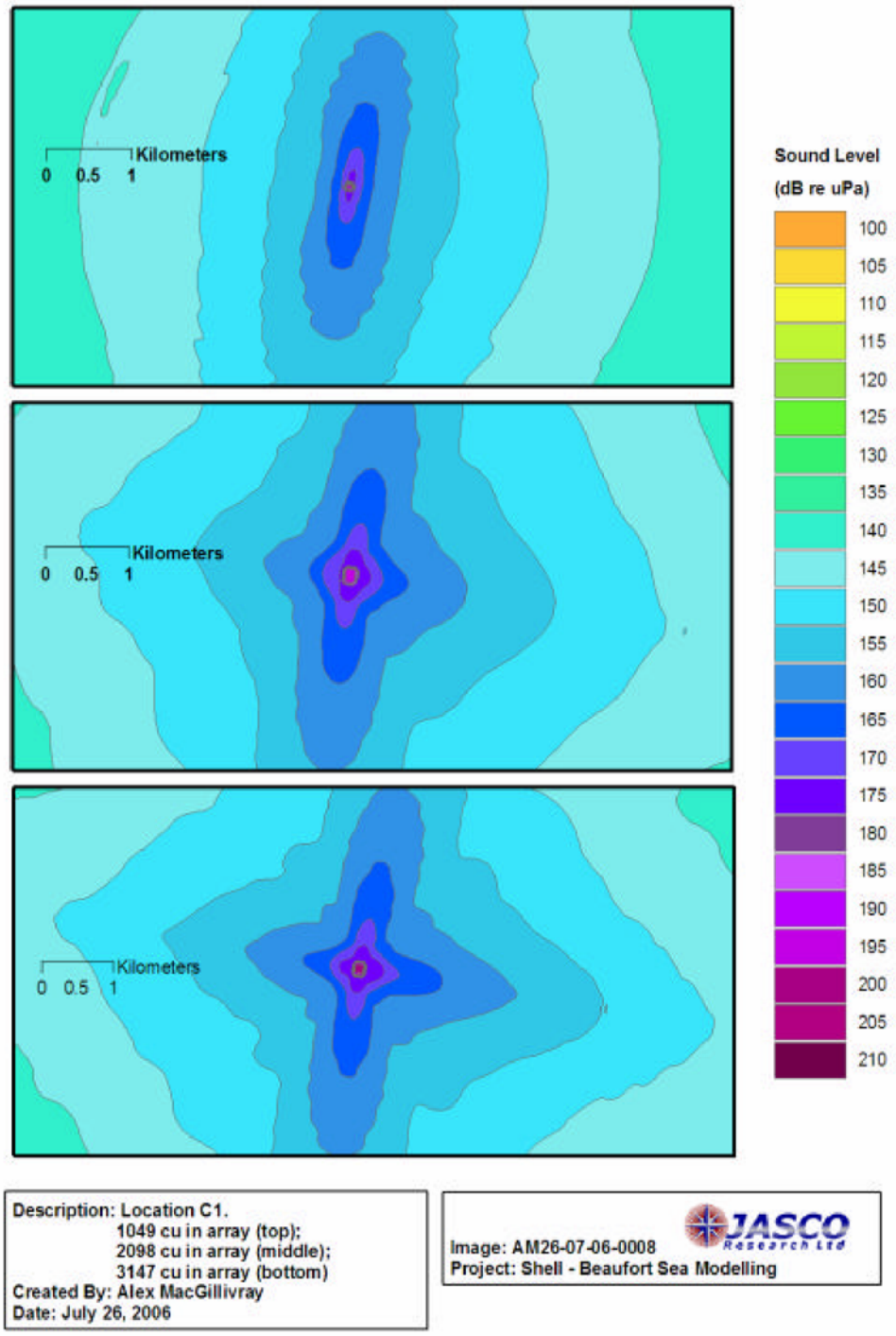

FIGURE 3.2. Maps of predicted received levels at 10 m depth, in SEL (energy) units, within several kilometers of a 1-string (top), 2-string (middle) and 3-string (bottom) airgun array being towed approximately East–West at source location C1.

TABLE 3.2. Predicted M_{mf}-weighted rms radii (as appropriate for "mid-frequency" odontocetes such as the beluga), in kilometers, for the 1049 in^3, 2098 in^3 and 3147 in^3 airgun arrays operating at 3 modeled locations in the Chukchi Sea.

90% rms [dB re μPa]	C1			C2			C3		
	1049 in^3	2098 in^3	3147 in^3	1049 in^3	2098 in^3	3147 in^3	1049 in^3	2098 in^3	3147 in^3
120	17.77	18.35	20.	18.13	20.95	22.7	24.95	28.7	30.85
130	12.3	12.71	13.64	12.16	13.37	14.64	16.26	17.41	18.7
140	7.92	8.64	9.22	7.38	8.83	9.51	9.62	11.38	11.79
150	4.75	5.43	5.76	4.14	5.38	5.88	5.08	6.72	7.03
160	2.88	3.15	3.48	2.38	3.16	3.41	2.63	3.58	4.09
170	1.4	1.65	1.77	1.26	1.65	1.67	1.35	1.66	1.90
180	0.61	0.76	0.81	0.64	0.80	0.85	0.58	0.77	0.82
190	0.09	0.22	0.23	0.11	0.11	0.13	0.05	0.23	0.23

TABLE 3.3. Predicted M_{pw}-weighted rms radii (as appropriate for pinnipeds in water), in kilometers, for the 1049 in^3, 2098 in^3 and 3147 in^3 airgun arrays operating at 3 modeled locations in the Chukchi Sea.

90% rms [dB re μPa]	C1			C2			C3		
	1049 in^3	2098 in^3	3147 in^3	1049 in^3	2098 in^3	3147 in^3	1049 in^3	2098 in^3	3147 in^3
120	19.82	20.10	21.65	21.08	23.65	25.35	28.8	32.65	34.65
130	13.85	14.36	15.14	14.01	15.33	16.59	19.11	20.36	21.75
140	9.07	9.89	10.47	8.63	10.20	11.01	11.42	13.68	14.04
150	5.60	6.33	6.81	5.09	6.28	6.73	6.53	8.12	8.73
160	3.41	3.50	3.88	2.93	3.71	3.86	3.41	4.43	4.74
170	1.58	1.92	2.05	1.47	1.94	1.99	1.52	1.97	2.26
180	0.59	0.75	0.79	0.63	0.79	0.84	0.57	0.76	0.81
190	0.07	0.22	0.22	0.10	0.24	0.22	0.03	0.22	0.22

these sources would be deployed at 1 m depth. The radii predicted for 90% rms levels, calculated using the Fourier synthesis technique, are presented in Table 3.4 (for the 20 in^3 source) and Table 3.5 (for the 10 in^3 source). Predicted radii both without and with frequency weighting, as described above, are shown. The predicted radii are small in part due to the small source, and in part due to the very shallow source depth (1 m). The latter would cause cancellation of a significant portion of the low frequency airgun energy through interactions between sound arriving via a direct-path and that arriving via a surface reflection path (surface ghost). Propagation modeling for these small sound sources was performed for two locations (B1 and B2) in the Beaufort Sea (Fig. 3.1).

240 in^3 Airgun Array

A small airgun array with total volume of 240 in^3 that could be used for shallow hazards surveying was also considered in the modeling. The array configuration consisted of two 2-gun clusters spaced 50 cm apart; each gun has a volume of 60 in^3. The radii predicted for the various 90% rms levels, without and with frequency-weighting, are presented in Table 3.6.

TABLE 3.4. Predicted rms radii, in kilometers, for a single 20 in^3 airgun operating at 2 modeled locations in the Beaufort Sea.

90% rms [dB re μPa]	B1			B2		
		M-weighted			*M*-weighted	
	Flat weighted	Mid Freq Cet	Pinniped in Water	Flat weighted	Mid Freq Cet	Pinniped in Water
120	18.77	16.86	17.68	19.24	17.51	18.70
130	12.31	11.22	11.64	7.01	5.99	6.67
140	4.24	3.75	3.99	2.84	2.16	2.53
150	1.49	1.33	1.42	1.09	0.70	0.86
160	0.58	0.57	0.57	0.30	0.15	0.21
170	0.16	0.15	0.16	0.05	0.03	0.04
180	0.05	0.005	<0.01	0.015	0.005	0.01
190	< 0.005	< 0.005	<0.01	< 0.005	<0.005	<0.01

TABLE 3.5. Predicted rms radii, in kilometers, for a single 10 in^3 airgun operating at 2 modeled locations in the Beaufort Sea.

90% rms [dB re μPa]	B1			B2		
		M-weighted			*M*-weighted	
	Flat weighted	Mid Freq Cet	Pinniped in Water	Flat weighted	Mid Freq Cet	Pinniped in Water
120	18.30	16.66	17.39	18.93	17.4	18.46
130	11.66	10.75	11.05	6.70	5.85	6.39
140	4.02	3.47	3.71	2.70	2.08	2.39
150	1.37	1.19	1.26	1.02	0.665	0.82
160	0.52	0.51	0.51	0.28	0.135	0.19
170	0.15	0.025	0.15	0.04	0.025	0.03
180	0.05	<0.005	<0.01	0.015	<0.005	0.005
190	< 0.005	<0.005	<0.01	< 0.005	<0.005	<0.01

TABLE 3.6. Predicted rms radii, in kilometers, for a 240 in^3 airgun array with 4 airguns operating at 2 modeled locations in the Beaufort Sea.

90% rms [dB re μPa]	B1			B2		
		M-weighted			*M*-weighted	
	Flat weighted	Mid Freq Cet	Pinniped in Water	Flat weighted	Mid Freq Cet	Pinniped in Water
120	35.98	31.96	34.58	40.48	38.42	39.91
130	19.31	16.94	18.16	26.09	24.85	25.73
140	7.37	5.88	6.53	9.33	8.41	8.93
150	2.90	2.15	2.36	3.47	2.89	3.16
160	0.99	0.62	0.71	1.34	1.07	1.16
170	0.30	0.28	0.28	0.48	0.44	0.45
180	0.15	0.14	0.15	0.15	0.14	0.15
190	0.02	0.005	<0.01	0.01	0.005	<0.01

CONCLUSIONS

The acoustic environments at locations of the Beaufort and Chukchi Seas have been characterized by JASCO Research Ltd. (Austin et al. 2006b) and summarized in this chapter. The noise sources considered were three seismic airgun arrays with total volumes of 1049, 2098 and 3147 in^3 and several potential shallow hazards sources including individual airguns and a small airgun array. The acoustic output of each source was modeled and used as input to a state-of-the-art sound propagation model. This, in turn, was used to predict the acoustic energy levels that would be received as a function of distance and direction from these sources operating at representative locations in the Chukchi and Beaufort Seas. From these predictions of the received sound field in energy units, JASCO determined the distances at which received sound levels were expected to diminish below various levels that are of relevance for regulatory purposes, as measured on an rms basis (190, 180, … , 120 dB re 1 μPa rms). These predictions were expected to be considerably more accurate than could be achieved with simpler models that do not take account of site specific environmental conditions, such as sound velocity profile, water depth, and bottom and sub-bottom conditions. All of those factors are taken into account in JASCO's modeling, to the extent that these variables are known when modeling is done.

Species specific sensitivity weighting was applied to all of the model results to provide alternative safety radii that account for the relative sensitivity of different marine mammal groups to low-frequency sounds such as those that dominate seismic airgun sound. *M*-weighting curves were applied for "mid-frequency" cetaceans such as beluga whales, and for pinnipeds listening in water. These weighting functions reduced the predicted effective rms radii for airgun noise by a small amount for pinnipeds and by a larger amount for mid-frequency cetaceans. Although these reduced radii were not applied as safety radii or when calculating the number of mammals exposed to various sound levels during the project, the results indicate that the standard "unweighted" procedures used for pinnipeds and toothed whales during the project were protective in this respect.

Predicted distances for various sources and received levels are tabulated in this chapter. The maximum distances at which rms received levels of 190, 180, 160 and 120 dB re μPa were predicted to occur during operation of the 3147 in^3 airgun array in the Chukchi Sea were 0.23 km, 0.85 km, 5.7 km, and 42 km, respectively. The sound from the main airgun arrays was predicted to be ~5 dB stronger in the broadside direction than in the endfire direction. Comparisons of many of the predictions summarized in this chapter with empirical measurements from the Chukchi and Beaufort Seas can be found in Chapter 4.

4. ACOUSTIC MEASUREMENTS[5]

INTRODUCTION

During July through most of September 2006, Shell Offshore Inc. (SOI) conducted 3D seismic surveys in the Chukchi Sea. During August through early October SOI conducted shallow-hazards surveys in the Beaufort Sea. Both types of surveys relied on the generation of underwater acoustic pulses. Arrays of airguns towed behind a vessel were used for both the seismic and the shallow-hazards survey, and additional acoustic sources were used for the shallow-hazards survey. Greeneridge Sciences, Inc., measured the underwater sound levels produced by the vessels involved, including both seismic and support vessels, and by the acoustic equipment that was used, including airguns and the other shallow-hazards sources.

Shutdown or power-down radii are the ranges from a sound source within which the presence of a protected species requires suspension or alteration of operations because of the possibility of adverse effects, as defined in the applicable permits and authorizations. These mitigation criteria are commonly established to avoid or minimize the possibility of hearing damage. They may also be designed to reduce behavioral disturbance. For airguns, the government-mandated shutdown or power-down radii used in this project were the maximum distances within which received levels of the pulsed sounds could exceed 190 dB re 1 μPa SPL[6] (for pinnipeds) or 180 dB re 1 μPa SPL (for cetaceans). In certain situations, mitigation would also be required when cetaceans were found within the 160 or 120 dB re 1 μPa SPL radii.

Before the onset of field work, JASCO Research Ltd. had estimated, by numerical modeling, the distances from the airgun arrays at which the broadband (rms) received levels would be 190 dB, 180 dB, 170 dB, 160 dB, and 120 dB re 1 μPa (see Chapter 3). Early in the respective periods of operation of the seismic and shallow-hazards vessels, Greeneridge Sciences measured the actual underwater sounds from these sources to establish appropriate mitigation radii for the seismic and shallow-hazards survey equipment. Measured values were used to recommend mitigation radii for use by marine mammal observers on the seismic ships during data acquisition and subsequent data analyses, and these empirically-determined values were compared to the values that had been predicted by modeling.

This chapter reports on data collected during two separate field trips involving three different vessels. The seismic ship *MV Gilavar* and the chase vessel *MV Jim Kilabuk* were used in the Chukchi Sea for seismic data acquisition, and the tug and shallow-hazards survey vessel *MV Henry Christoffersen* (or *Henry C.*) was used in the Beaufort Sea for acquisition of shallow-hazards data.

Objectives

Field objectives were similar in the Chukchi and Beaufort seas and included three components:

- Field measurements of the sounds produced by airguns (*Gilavar* and *Henry Christoffersen*) or sources used in shallow-hazards surveys (only *Henry C.*). These measurements were to be made at the beginning of the seismic surveys in each region, and the collected data were to be analyzed immediately to the extent necessary to establish the mitigation radii. Ranges at which broadband levels were received at 190, 180, 170, 160, and 120 dB (SPL) re 1 μPa were to be determined and reported within 72 hours to Shell.

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[5] By Susanna B. Blackwell, Robert G. Norman, Charles R. Greene Jr. (Greeneridge Sciences Inc.), and W. John Richardson (LGL).

[6] SPL: sound pressure level, i.e., root mean square (rms) pressure level averaged over duration of sound pulse.

- After the field season, the empirical data were to be further analyzed to obtain a more comprehensive assessment of pulse characteristics—including duration, peak level, and SEL (sound exposure level) as well as SPL (=rms)—as a function of range and aspect. Spectral properties of the pulses, in particular one-third octave band characteristics, were also to be documented.
- Field measurements of radiated propulsion sounds as a function of distance from all vessels involved: the seismic vessel *Gilavar* and the support/supply/chase vessel *Jim Kilabuk* in the Chukchi Sea, and the shallow-hazards survey vessel *Henry C.* in the Beaufort Sea.

Measurements were obtained in July (Chukchi Sea) and August (Beaufort Sea) 2006 and the results are presented in this report. Field reports including recommended mitigation radii were submitted to Shell on 26 July and 10 August 2006, respectively, for measurements in the Chukchi and Beaufort seas. The final versions of these field reports are appended to this chapter as Annexes 4.1 and 4.2.

METHODS

Equipment

Recordings were made using two Autonomous Seafloor Acoustic Recorders model B (ASAR-B). A picture and schematic representation of an ASAR-B are shown in Figure 4.1. The ASAR-B consists of a pressure housing containing the recording electronics and a rechargeable gel cell battery. The recorder includes a two-channel signal digitizer with 16-bit quantization. It was initially programmed to sample at 44.1 kHz on each channel, providing a useable frequency range of 5 to 20,000 Hz. One of the ASAR-Bs in the Beaufort Sea measurements was re-programmed to sample at 192 kHz, because of the presence of higher frequency sound sources (see below). Data were written to an 8 GB solid state memory (Flash card), providing ~13 hours of continuous recording at the 44.1 kHz sampling rate. For deployment on the sea floor the ASAR-B housing was mounted in the center of a pyramidal steel frame weighing ~41 kg (~90 lbs, Fig. 4.1). Hereafter ASAR-Bs will be referred to simply as ASARs.

Two different types of hydrophones were used concurrently, one on each recording channel:

- A calibrated ITC model 8212 broadband hydrophone with a low-noise preamplifier: This was the more sensitive of the two hydrophone types, best suited for recording sound levels below ~135 dB re 1 μPa (this type of hydrophone saturated at peak levels of about 145 dB re 1 μPa 0-peak).
- A calibrated ITC model 1032 spherical broadband hydrophone without preamplifier: This hydrophone was included to permit undistorted recordings of high-level sound pulses. This type of hydrophone saturated at peak levels close to 207 dB re 1 μPa 0-peak.

The hydrophone cables were threaded through the top of the pyramidal frame and the hydrophones were buoyed up from the sea floor by a glass sphere (Fig. 4.1A). When deployed, the two hydrophones were ~3.5 m (1032) and ~2 m (8212) off the sea floor. The hydrophone cables were faired to minimize strumming (see Fig. 4.1B).

All hydrophones had been calibrated before the onset of the field season at the ITC calibration facility in Goleta, California, which employs standards traceable to the National Standards for underwater sound measurements. The ITC 8212 hydrophones were recalibrated on 9 November 2006. Thorough calibration of the hydrophones and recording equipment allowed all results to be referred to the standard acoustic

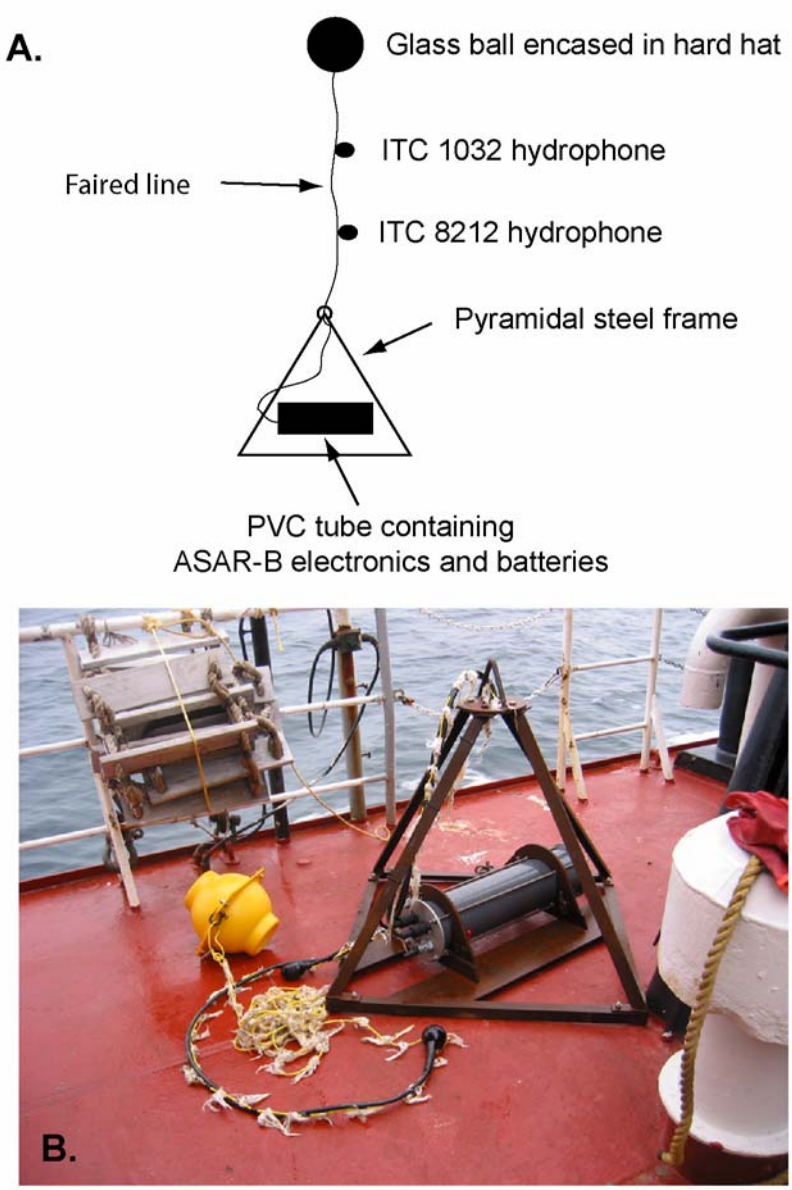

FIGURE 4.1. ASAR-B recorder. ***(A)*** Schematic diagram of the components of the ASAR-B recorder as deployed on the sea floor. Not drawn to scale. ***(B)*** An ASAR-B on the deck of the M/V *Kilabuk* after retrieval. The hydrophones are the black spheres on the cable in the foreground. The yellow sphere to the left of the frame is the hard hat containing the glass ball.

pressure of one micropascal (1 μPa). Both hydrophone types therefore had calibrated responses for the frequency range 5–30,000 Hz, and the ITC 1032 hydrophones were calibrated to 50 kHz.

A Seabird model 19Plus CTD (conductivity-temperature-depth) probe was used at each recording site to obtain a sound velocity profile.

Deployment Procedure

Both ASARs were used in each recording session. The basic layout was the same during measurements of vessel sounds and airgun / shallow-hazards survey sounds and is shown in Figure 4.2. In

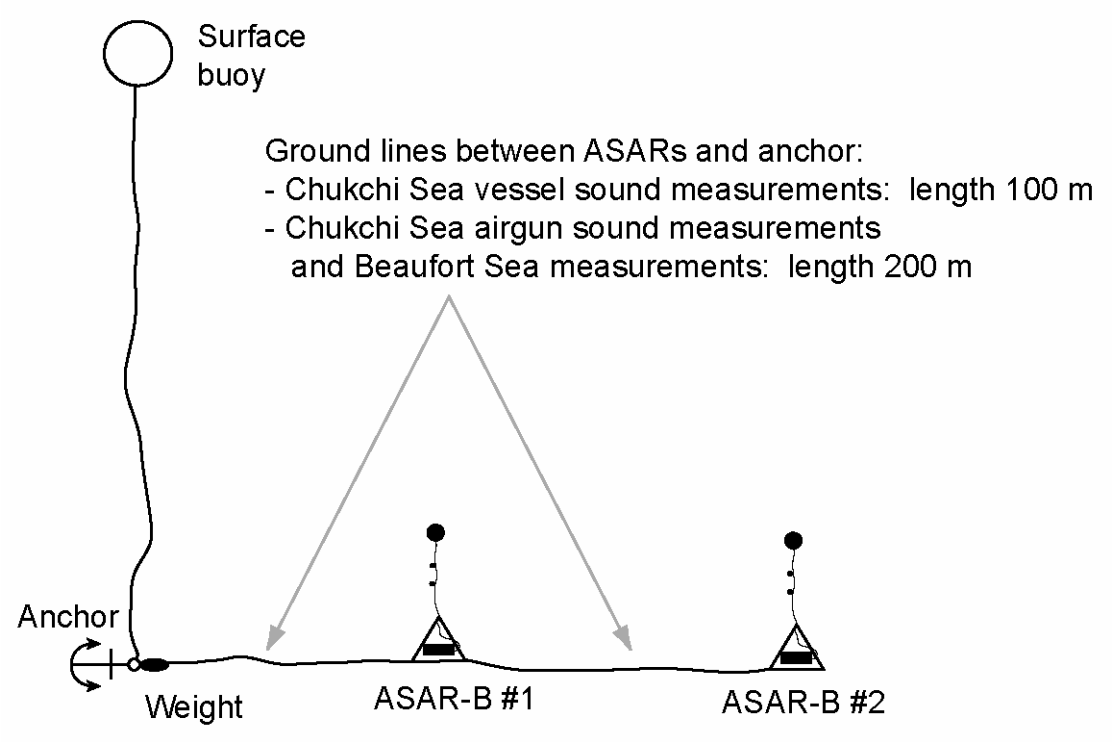

FIGURE 4.2. Deployment layout for ASAR-B recorders. A small weighted anchor is attached to a surface buoy to facilitate retrieval. A ground line connects the anchor to the first ASAR-B, itself connected by a ground line to the second ASAR-B. Anchor and recorders are laid out in a line on the seafloor.

the Chukchi Sea, deployments were done from the *Kilabuk*'s FRC (Fast Rescue Craft) with a crew of four people (boat driver, scientist, and two deck hands). In the Beaufort Sea, deployments were done directly from the deck of the *Henry C.* At the desired deployment location, the anchor and weight were lowered to the bottom with a line connecting them to a surface buoy. A GPS waypoint[7] for the location was obtained. A ground line connecting the anchor to the first ASAR was laid out in a straight line. The length of this line, and of the line between the two ASARs, was 200 m except in the Chukchi vessel sound measurements in which it was 100 m (Fig. 4.2). When the end of the ground line was reached, a "lowering line" was threaded through the "hoop" at the apex of the ASAR's pyramidal cage and the recorder was lowered to the sea floor. A GPS waypoint was obtained at the recorder location. The second length of ground line and the second recorder were deployed in similar fashion.

Deployments in the Chukchi Sea were made on 12 July to record vessel sounds of the *Kilabuk* and *Gilavar*, and on 21 July to record airgun sounds. In the Beaufort Sea the airgun and vessel sound recordings (*Henry C.*) were done concurrently during a single deployment of the ASARs on 8 August. Table 4.1 summarizes information pertaining to these deployments.

[7] A Garmin GPS model 12CX was used during the Chukchi Sea measurements. Deployment positions in the Beaufort Sea were recorded directly by the GPS on the *Henry Christoffersen*.

TABLE 4.1. Deployment dates, deployment locations (WGS84) and water depth for ASARs during recordings of vessel and airgun sounds.

	CHUKCHI SEA (M/V *Gilavar* and M/V *Jim Kilabuk*)		BEAUFORT SEA (M/V *Henry Christoffersen*)
	Vessel sounds	Airgun sounds	Vessel & airgun sounds
Deployment date	12 July 2006	21 July 2006	8 August 2006
ASAR-B #1 position:			
Latitude N	69° 23.40'	69° 35.90'	70° 10.09'
Longitude W	167° 33.33'	166° 00.16'	142° 12.61'
ASAR-B #2 position:			
Latitude N	69° 23.47'	69° 35.83'	70° 10.12'
Longitude W	167° 33.33'	165° 59.92'	142° 12.29'
Water depth (m)	52	42	48

Recording Procedure

After the ASARs were deployed the sound source — airguns (see specifics below) or vessel — was operated over a dedicated test course referenced to the ASAR positions. There were two main types of recording legs:

- endfire aspect with the sound source opening (stern aspect) or closing (bow aspect) range from the ASARs. In the Chukchi Sea measurements, the test course included travel directly over ASAR #2, but not ASAR #1. Therefore, strictly-endfire data were only available from ASAR #2, even though at farther distances ASAR #1 was at very close to endfire aspect, and the data recorded by both ASARs were identical. For the endfire aspect, measurements were obtained to ~10 km distance for vessel sound measurements in the Chukchi Sea, ~30 km for airgun sound measurements in the Chukchi Sea, and ~20 km for the Beaufort Sea measurements.
- crossfire aspect (broadside aspect) with the sound source passing laterally at several closest points of approach (e.g., 100 m, 500 m, 1000 m) from the recorders. We restricted broadside data to those collected while the sound source was within ±5° of broadside, i.e., within an ~10° span of angles (Fig. 4.3).

During all recordings, the time and GPS position of the sound source were logged every 4–20 sec, depending on the type of measurements:

- The Chief Positioning Specialist on the *Gilavar* provided source positions. During measurements of vessel sounds, the position of the *Gilavar*'s stern was logged every 10 sec. During measurements of airgun sounds the position of the geometric center of the airgun array was logged at every shot, which took place every 19–20 sec.
- During measurements of the *Kilabuk*'s vessel sounds, a handheld GPS receiver (Garmin GPS model 12CX) logged the *Kilabuk's* position every 16 sec.
- On the *Henry C.*, position information was provided by the Geo LLC navigator for every shot of the airgun cluster, about every 4 sec.

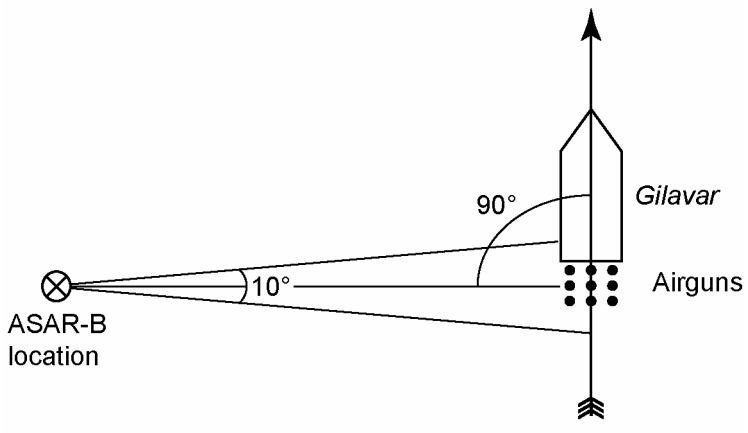

FIGURE 4.3. Circumstances in which data were included in the broadside category (see text).

Sound Sources

The ***Gilavar*** is a seismic research vessel, 84.9 m (279 feet) in length. It has five diesel electric engines, of which four are Bergen KRGB-9 units (2067 brake horse power or BHP each) and one is a Caterpillar 3516B (1855 BHP), for a total of 10,123 BHP. During the Chukchi Sea measurements, the *Gilavar* used two airgun array configurations:

- A three-string array with a total volume of 3147 in^3, with eight airguns per string (i.e., 24 guns total)
- A one-string array with a total volume of 1049 in^3, comprised of eight airguns.

Source depth was 6 m and firing interval was ~19 sec (50 m). Recordings were made using both array configurations consecutively. Although hydrophone streamers are deployed during production operations, they were not deployed during the sound source verification recordings.

The ***Jim Kilabuk*** is an icebreaking tug and supply vessel, 62.5 m (205 feet) in length. It has two turbo-charged diesel engines, for a total of 7200 brake horse power (BHP). The *Kilabuk* was previously (in the 1980s) named the *Canmar Supplier IV*.

The ***Henry Christoffersen*** is a pusher-towing tug, 56.4 m (185 feet) in length. The *Henry C.* has four engines at 1125 HP each for a total of 4500 BHP. The *Henry C.* used five different sound sources for shallow-hazards surveys. These included the following:

- An airgun cluster consisting of four 70 in^3 airguns in a tuned array cluster (total volume 280 in^3), at source depth 2.5 m, with firing interval of ~4 sec (6.25 m)
- A Seabat 8101 bottom mapping sonar operating at 240 kHz
- An SIS 1500 seafloor-imaging sonar operating at 190 kHz
- A chirp sonar (sub-bottom profiler) operating at 2–7 and 8–23 kHz, transducer depth ~1 m, 0.25–5 sec interval
- A bubble pulser operating at frequencies near 400 Hz, 0.5–5 sec interval

The airgun cluster was expected to be the strongest of these sound sources. Since the operational frequencies of the bubble pulser overlapped with those for the airguns, different pulse intervals for the two sources were used: 8 s for the airguns and 6 s for the bubble pulser. The Seabat 8101 bottom mapping

sonar and the SIS 1500 seafloor-imaging sonar both operate at frequencies >180 kHz. That is the highest frequency considered to be of possible influence to any species of marine mammal, including mid- and high-frequency specialists such as toothed whales (Odontocetes) (Miller et al. 2005). No measurements of sounds from these two high-frequency sources were planned since there should be no exclusion zones for seals or whales during their operation.

Retrieval Procedure

When recordings of sound-producing activities were complete, the ASARs were retrieved. In the Chukchi Sea, this was done using the *Kilabuk*'s FRC and a crew of five people (boat driver, scientist, and three deck hands). The surface buoy was retrieved first, followed by the anchor and weight, ASAR #1, and lastly ASAR #2 (see Fig. 4.2). All gear was hauled in by hand. On the *Henry C.*, the gear was hauled in from the port side of the vessel, with help from the vessel's main winch.

Data Analysis

Recorded data were saved as a series of 422.1 MB files which were transferred from the Flash card to laptop computers running MATLAB and custom analysis software. They were then calibrated in units of sound pressure over the data bandwidth (5–20,000 Hz or 5–90,000 Hz depending on sampling rate).

Broadband Analysis

For ***vessel sound measurements*** the data were partitioned into non-overlapping segments of 1 sec each and a broadband (10–20,000 Hz) sound pressure level was obtained for each 1-s segment.

For ***airgun sound measurements*** the sound pressure time series (see Fig. 4.5, later) was used for selecting samples for analysis. Four parameters were determined for each selected pulse (see McCauley et al. 1998, 2000a,b; Burgess and Greene 1999):

- **peak pressure**, i.e. the instantaneous maximum of the absolute sound pressure, in dB re 1 μPa;
- pulse **duration**, defined as the time interval between the arrival of 5% and 95% of the total pulse energy;
- pulse **sound pressure level** (SPL), squared pressure averaged over the pulse duration, in dB re 1 μPa;
- pulse **sound exposure level** (SEL), defined as the squared instantaneous sound pressure integrated over the pulse duration, in dB re 1 $\mu Pa^2 \cdot s$. This measure is related to the total physical energy conveyed in each pulse, and was calculated excluding the contributions of background sound as characterized by measurements between pulses.

SPL and pulse duration are highly interdependent. For example, low-level reverberation that extends the pulse length can result in a longer averaging time and thus a lower SPL. The SEL is not influenced by the duration, as it is a measure of the total energy in the pulse regardless of the pulse duration.

One of two propagation models was fitted by the least squares method to broadband levels of vessel sounds, or to the peak, SPL, and SEL values for seismic pulses, in order to characterize propagation loss underwater. These models were based on logarithmic spreading loss:

$$\text{Received Level } (\mathbf{RL}) = A + B \cdot \log(R) \quad (1)$$

$$\text{Received Level } (\mathbf{RL}) = A + B \cdot \log(R) + C \cdot R \quad (2)$$

In these equations, R is the range to the source in m and the units for **RL** are dB re 1 μPa or 1 $\mu Pa^2 \cdot s$. The constant term (A) is the hypothetical level 1 m from the source, extrapolated back to 1 m range based on far-field measurements. This hypothetical value would equal the actual level at 1 m only if the source were a point source and if loss rates were consistent at all distances from 1 m to the maximum measurement distance, neither of which is the case. The estimated A value is useful mainly as a basis for comparison with other sources operating in the same region. The spreading loss term (B), which is negative, varies with the dominant frequency in the pulse, water depth, bottom topography, and bottom composition. C (in dB/m) is the coefficient describing losses due to scattering and absorption; like B it is negative. The composition and topography of the seabed and sea surface roughness will affect such losses.

The choice of one model over the other is generally determined by the range and water depth over which the measurements were made. In our measurements, water depths were all similar, so our choice was determined by range. When the maximum measurement distance was less than ~10 km, Eq. (1) was used. When measurements extended to greater distances, as for most of the airgun sound measurements, the $C \cdot R$ term was expected to become significant, and Eq. (2) was used. C is a small number except in very shallow water and therefore its effect is difficult to measure until R becomes large.

Spectral Analysis

The spectral composition of each vessel's sound and of the airgun pulses was obtained from data recorded at short ranges (at or close to the CPA). Spectral processing yielded both one-third octave band levels and sound spectral density levels. The one-third octave band levels represent the amount of sound in parts of the frequency spectrum (bands) whose lower and upper frequencies differ by a factor of 1.26×. Spectral density levels represent the amount of sound in 1-Hz bands and are expressed in dB re 1 $\mu Pa^2/Hz$.

M-weighting

Hearing abilities differ among different types of marine mammals, with some marine mammals being more sensitive to low frequencies (e.g., baleen whales) while others are more sensitive to high frequencies (e.g., porpoises). In assessing the effects of sound on different types of marine mammals it is useful to weight the sounds reaching the animal by de-emphasizing frequencies which the animal of concern cannot hear, or hears only weakly. Ideally there should be a specific weighting function for each species of marine mammal, but audiograms are not available for most species. In the interim, all marine mammal species have been placed into one of five groups, based on their hearing function (Miller et al. 2005; Southall et al., submitted). These five groups are low-, mid-, and high-frequency cetaceans, pinnipeds in water, and pinnipeds in air. Three of these groups are of interest in this report: mid-frequency cetaceans (including beluga whales), pinnipeds in water (seals and walruses), and low-frequency cetaceans (bowhead and gray whales). The different M-weighting functions are determined by the variables f_{low} and f_{high}, which are conservative estimates of the lower and upper boundaries of effective hearing for each group:

- mid-frequency cetaceans: f_{low} = 150 Hz, f_{high} = 160 kHz;
- pinnipeds in water: f_{low} = 75 Hz, f_{high} = 75 kHz;
- low-frequency cetaceans: f_{low} = 7 Hz, f_{high} = 22 kHz;

The M-weighting functions have been defined primarily for applications involving exposure to strong sounds, including pulsed sounds (Miller et al. 2005; Southall et al., submitted). These functions are analogous to the C-weighting function that is widely used in characterizing effective levels of strong pulsed sounds insofar as they affect humans. Annex 4.3 shows the M-weighting functions in relation to frequency.

To assess the effect of *M*-weighting on broadband SPLs and SELs, a subset of seismic pulses was analyzed after being weighted according to the three types of *M*-weighting functions described above.

RESULTS

Seismic and Sonar Sound Measurements

Broadband Levels for Seismic Vessel Gilavar *(Chukchi Sea)*

On 21 July 2006 both ASARs were deployed in the locations given in Table 4.1. To maximize recording time, the ASAR start times were offset by 6 h (11:00 for ASAR #2 and 17:00 for ASAR #1). The *Gilavar* followed a predetermined course over and away from the ASAR locations, to provide recordings of airgun sounds from different distances and different aspects (bow, stern, broadside). The *Gilavar*'s course is shown in Figure 4.4. During these recordings the *Gilavar* traveled at a speed of ~5.5 knots (10.2 km/h or 6.3 mph).

Sound pressure time series of airgun sounds (three-string array), as recorded by ASAR #2 (hydrophone ITC 1032), are shown in Figure 4.5. Data recorded with the more sensitive hydrophone (model ITC 8212) were saturated for most of the obtained pulses, so we only present data obtained with the less sensitive hydrophone.

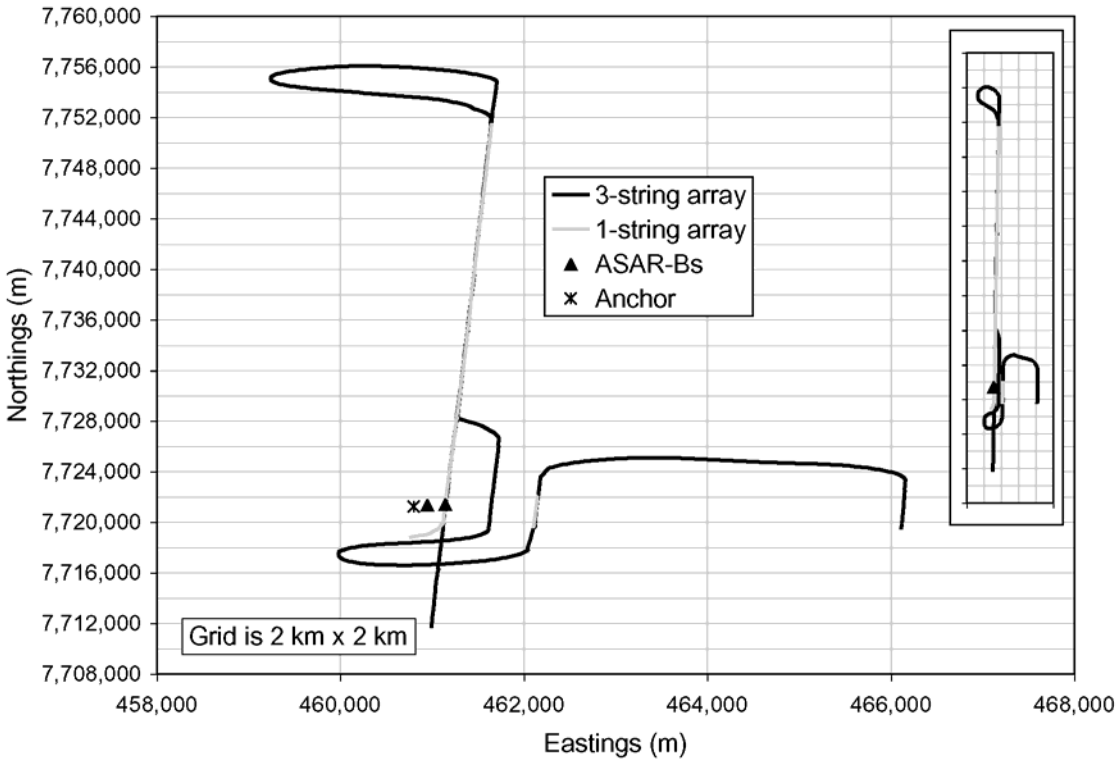

FIGURE 4.4. Track of the M/V *Gilavar* during airgun sound measurements, while towing a three-string airgun array (black) and a one-string array (gray), 21 July 2006, Chukchi Sea. The grid squares are 2 km × 2 km; the main map has been extended in the E–W direction to better show the ship track but the inset map shows the track to scale. Filled triangles show the ASAR locations.

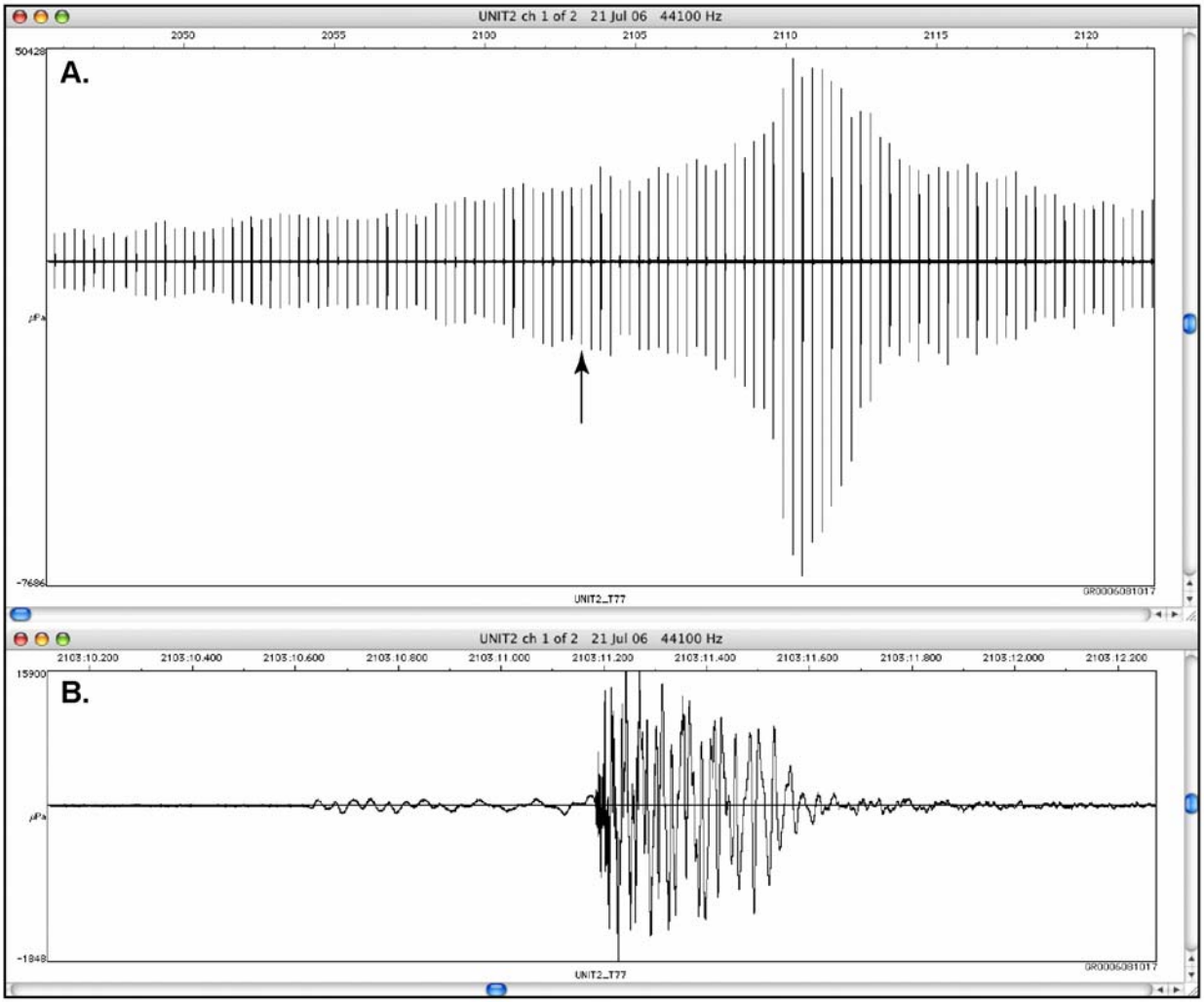

FIGURE 4.5. Sound pressure time series (SPTS) of airgun sounds as recorded on 21 July 2006 by ASAR #2, ITC 1032 hydrophone. ***(A)*** About 37 min of recording while the *Gilavar* passed by ASAR #2 at a distance of 1 km. Calculated distance from ASAR #2 to the center of the airgun array was 3880 m at the time of the first pulse shown, 1008 m at the CPA, and 2007 m at the time of the last pulse shown. ***(B)*** Detail of pulse shown by arrow in plot (A).

Three-String Array Configuration (3147 in^3).—Broadband levels of airgun sounds for the three-string array configuration are shown in Figures 4.6–4.9. Figure 4.6 shows bow aspect data for four pulse parameters as a function of distance from the airguns: peak level, SPL, SEL, and pulse duration. For peak, SPL, and SEL values Eq. (2) was fitted to the data. The resulting equations and correlation coefficients (R or r, as appropriate) are shown in Table 4.2.

Figures 4.7 and 4.8 show the same types of data as Figure 4.6, but for the stern and broadside aspects. Broadside data were only collected to a distance of ~5 km. Therefore Eq. (1) was fitted to the data, instead of the more complex model [Eq. (2)] which takes scattering and absorption losses into account but requires measurements over a larger span of distances.

Propagation effects, such as geometric dispersion, predictably lengthen pulse durations with increasing distance from the sound source (see Greene and Burgess 2000). This can be seen in Figures 4.6–4.8 for all three aspects.

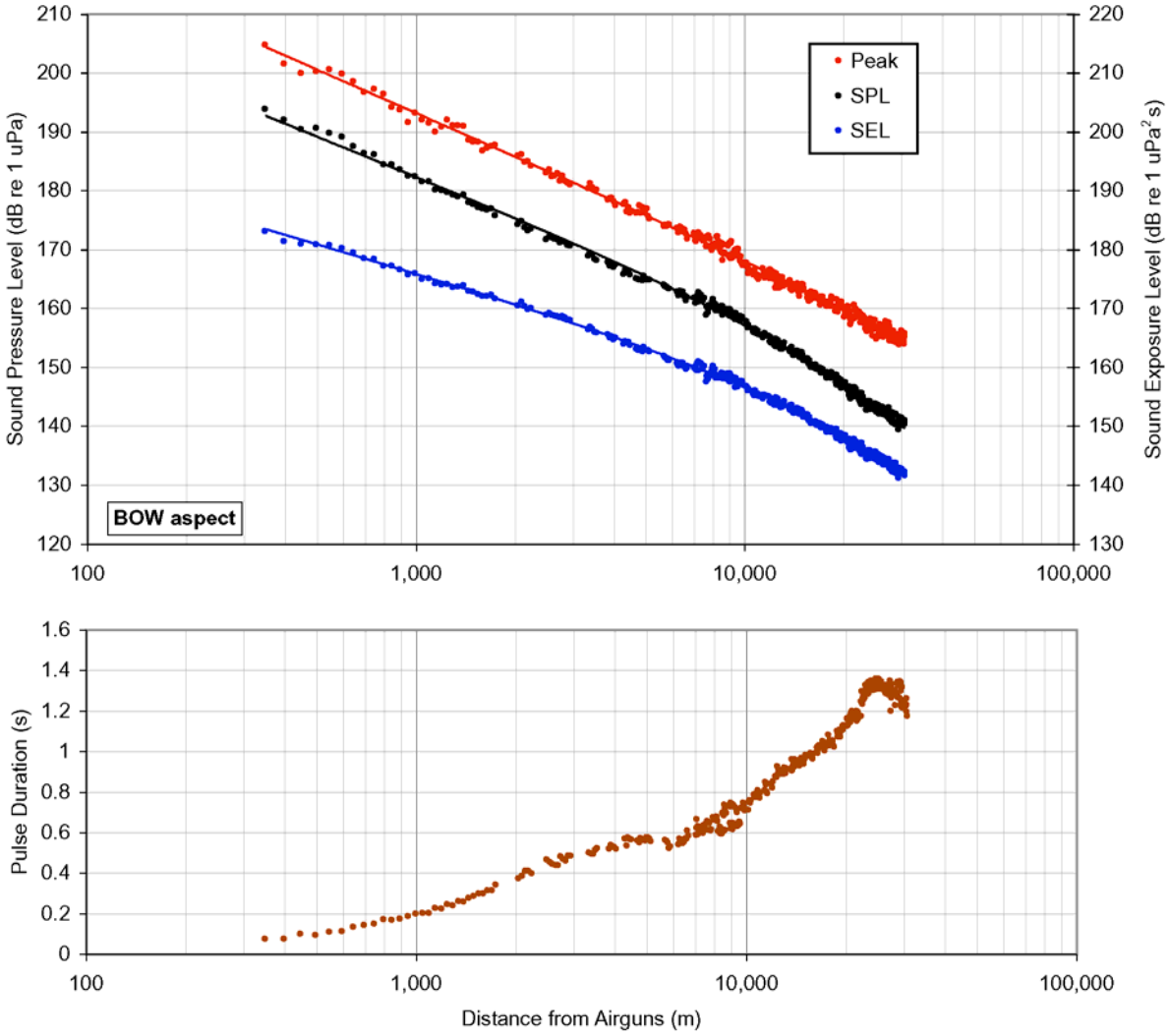

FIGURE 4.6. Received broadband levels of sound with *Gilavar*'s three-string array (3147 in^3) for **bow** aspect, as a function of distance from the airguns, 21 July 2006, Chukchi Sea. The top plot shows peak levels and SPLs, with values to be read on the left y-axis (dB re 1 μPa), and SELs with values to be read on the right y-axis (dB re 1 $\mu Pa^2 \cdot s$). Note that to avoid overlap, values on the two y-axes are offset by 10 dB. Equations for the regressions are given in Table 4.2. The bottom plot shows pulse duration as a function of distance from the airguns.

Figure 4.9 compares the fitted regression lines from Figures 4.6–4.8 in order to illustrate the effect of aspect (bow, stern, and broadside). For bow and stern aspects, the SPL and SEL regressions have been extrapolated beyond the maximum distances of our measurements to the range where the received level has diminished to 120 dB. These extrapolations are for purposes of comparison only, due to uncertainties in the propagation model and the effects of measurement variability on the regressions. However, for SEL, the consistency of the results for the 3 aspects suggests that—for this acoustic measure—measurement variability was small. Figure 4.9 shows that, for the *Gilavar*'s 3-string array, aspect dependence was relatively small, at least out to the maximum distance (5 km) at which broadside-aspect data were acquired.

TABLE 4.2. Values for variables *A*, *B*, and *C* [Eq. (1) and (2)] in the regressions shown in Figures 4.6–4.9; data were collected using the three-string airgun array in the Chukchi Sea. Values are shown for peak level, sound pressure level (SPL), and sound exposure level (SEL) for all three aspects (bow, stern, broadside). The multiple-*R* or *r*-value is also shown for each equation, as well as the range of distances over which the measurements were made and the sample size (number of pulses analyzed).

	A	*B*	*C*	*R* (or *r*)	Range of distances (km)	Sample size
BOW					0.35–30.6	391
Peak	266.4	–24.34	$-9.45\ 10^{-5}$	–0.997		
SPL	249.5	–22.26	$-3.25\ 10^{-4}$	–0.998		
SEL	224.6	–16.11	$-3.54\ 10^{-4}$	–0.998		
STERN					0.30–33.9	232
Peak	249.8	–19.90	$-2.24\ 10^{-4}$	–0.997		
SPL	247.2	–22.40	$-2.05\ 10^{-4}$	–0.997		
SEL	221.0	–15.44	$-3.55\ 10^{-4}$	–0.998		
BROADSIDE					0.52–5.16	54
Peak	253.5	–19.71	N.A.	(–0.986)		
SPL	239.7	–18.96	N.A.	(–0.994)		
SEL	222.9	–15.41	N.A.	(–0.994)		

One-String Array Configuration (1049 in^3).—Broadband levels of airgun sounds for the one-string array configuration are shown in Figures 4.10–4.12. Figure 4.10 shows stern aspect data for peak level, SPL, SEL and pulse duration, as a function of distance from the airguns. For all sound level parameters Eq. (2) was fitted to the data. The resulting equations and multiple-R values are shown in Table 4.3. The equivalent bow and broadside data are shown in Figure 4.11. Bow and broadside data were only collected to a distance of less than 2 km; therefore Eq. (1) was fitted to the data. The resulting equations and *r*-values are shown in Table 4.3.

Figure 4.12 compares the fitted regressions lines from Figures 4.10 and 4.11 in order to illustrate the effect of aspect. For the stern aspect, the regression has been extrapolated beyond the maximum distance of our measurements to the distance where the received level was 120 dB. (Data for bow and broadside aspects were not collected over a large enough range to justify extrapolation.) As predicted by the pre-field-season modeling (Chapter 3), aspect dependence was more marked for data collected with the one-string array, compared to the three-string array (*cf.* Fig. 4.9).

Relationship Between SPL, SEL, and Range.—Figure 4.13 summarizes the relationship between SPL, SEL, and the distance from the hydrophone to the airguns. The difference between SPL and SEL is mathematically related to pulse duration and is shown in Fig. 4.13A (i.e., if the actual data were plotted they would fall on the shown line and *r* would equal 1.0). Since we define pulse duration as the time interval between the arrival of 5% and 95% of the total pulse energy (see Methods section), SPL and SEL are equal (i.e., their difference is 0) when pulse duration = 0.9 sec. When x = 0.9, y = – 0.4576 – 10·log(0.9) = 0, as

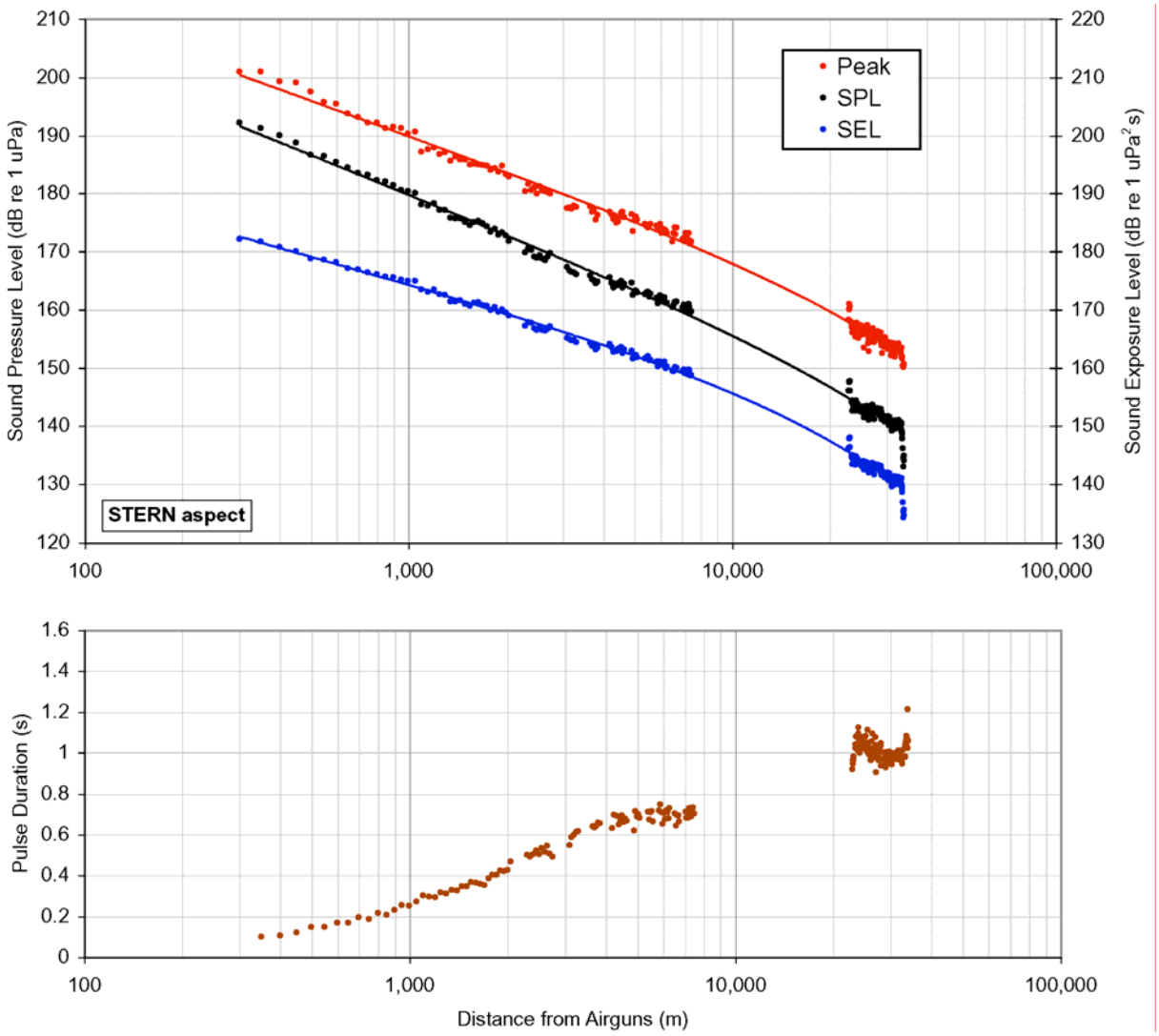

FIGURE 4.7. Received broadband levels of sound with *Gilavar*'s three-string array (3147 in^3) for **stern** aspect, as a function of distance from the airguns, 21 July 2006, Chukchi Sea. Plotted as in Figure 4.6.

10·log(0.9) = –0.4576 (see Fig. 4.13A). Figures 4.13B and C illustrate how the difference between SPL and SEL changes with distance from the airguns for data collected with the three- and one-string arrays, respectively. The difference between SPL and SEL values was highest closest to the sound source, with SPLs about 10 dB higher than SELs ~300 m from the airguns. Out to ~3 km the difference between SPL and SEL decreased by about 8.5 dB / tenfold change in distance. Beyond 10–16 km the difference becomes negative, i.e., SEL values are larger than SPL values. This reflects the fact that most pulse durations had been "stretched" by propagation phenomena to 1 sec or greater at distances beyond 10–16 km (Fig. 4.6, 4.7, 4.10).

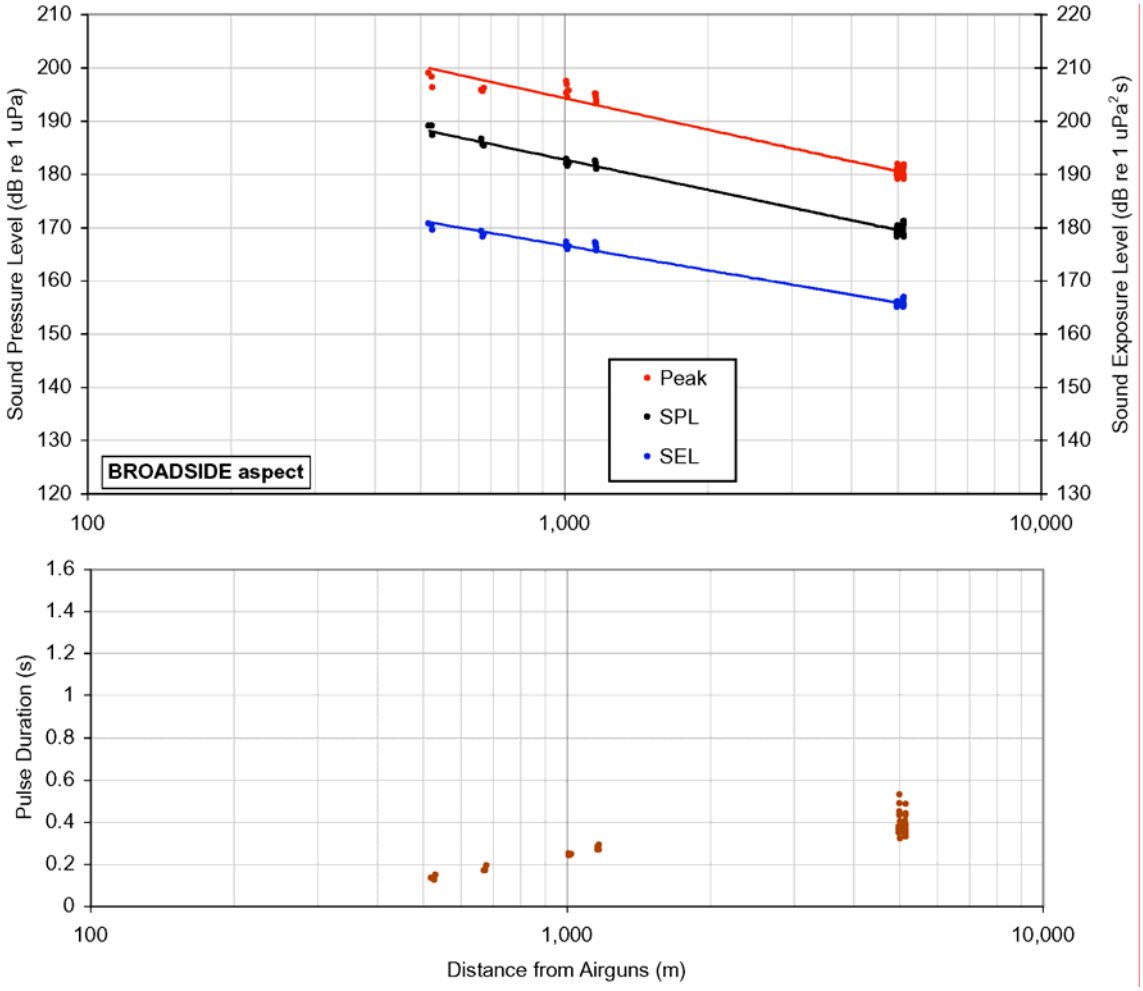

FIGURE 4.8. Received broadband levels of sound with *Gilavar*'s three-string array (3147 in^3) for **broadside** aspect, as a function of distance from the airguns, 21 July 2006, Chukchi Sea. Plotted as in Figure 4.6.

Comparison of Empirical and Modeled Radii for Airgun Sounds.—Table 4.4 summarizes the distances to a set of specified SELs and SPLs, as determined using the field measurements presented above for the one-string and three-string airgun arrays. These empirical distances are compared to distances predicted by sound propagation modeling (see Chapter 3). JASCO used their MONM acoustic model to generate SEL contours, from which SPLs were derived by Fourier synthesis analysis (see Chapter 3, Jensen et al. 2000). Because the contours produced by the MONM model are anisotropic (i.e., not distributed evenly in all directions), the predicted distances given in Table 4.4 are the radii encompassing 95% of the locations where the predicted SEL or SPL equals or exceeds the criterion value. For each array type, metric (SEL vs SPL), received level, and aspect (bow, stern, broadside) an "empirical : predicted" (E:P) ratio was calculated and is shown in Table 4.4.

Considering the SPL values (which are the ones used for mitigation purposes under current NMFS guidance), the empirical distances exceeded predicted distances in most (but not all) situations. For the *3-string array*, the E:P ratios for the 190-dB distance ranged from 1.5× to 2.0×, depending on aspect (Table 4.4A). The E:P ratios for the 180-dB distance around that array ranged from 1.2× to 1.7×. The ratios for the 160-dB distance ranged 1.5× to 1.8× (considering bow and stern aspect only). E:P ratios for the 120 dB

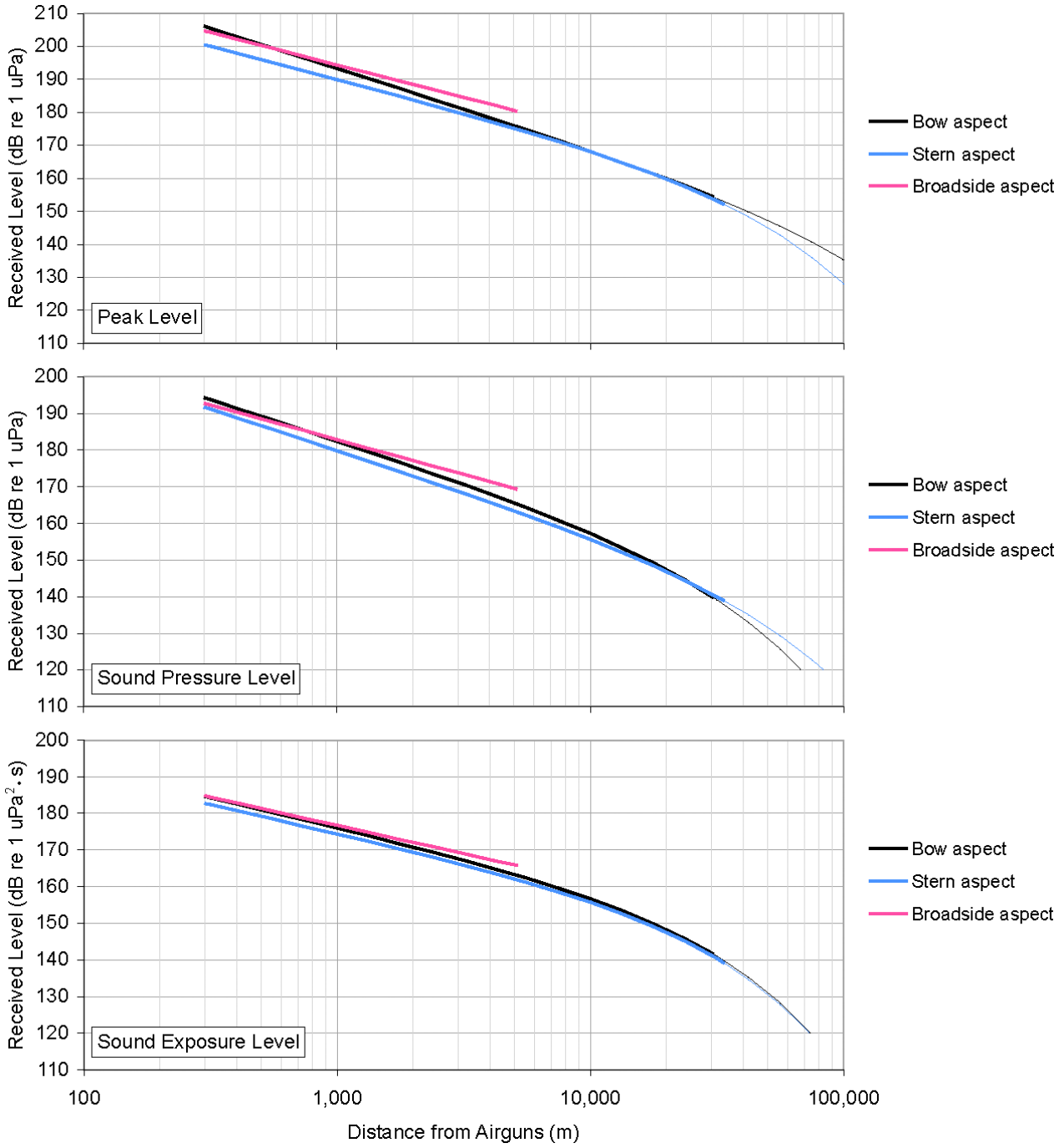

FIGURE 4.9. Summary of broadband levels for *Gilavar*'s three-string array configuration, 21 July 2006, Chukchi Sea. Data for all aspects are shown for peak (top plot), sound pressure (center plot), and sound exposure levels (bottom plot). Received levels which were obtained by extrapolating the regressions beyond the range of distances within which the measurements were made are indicated with a thinner line. Farthest measurement distances were 30.6 km, 33.9 km, and 5.2 km for bow, stern, and broadside data, respectively.

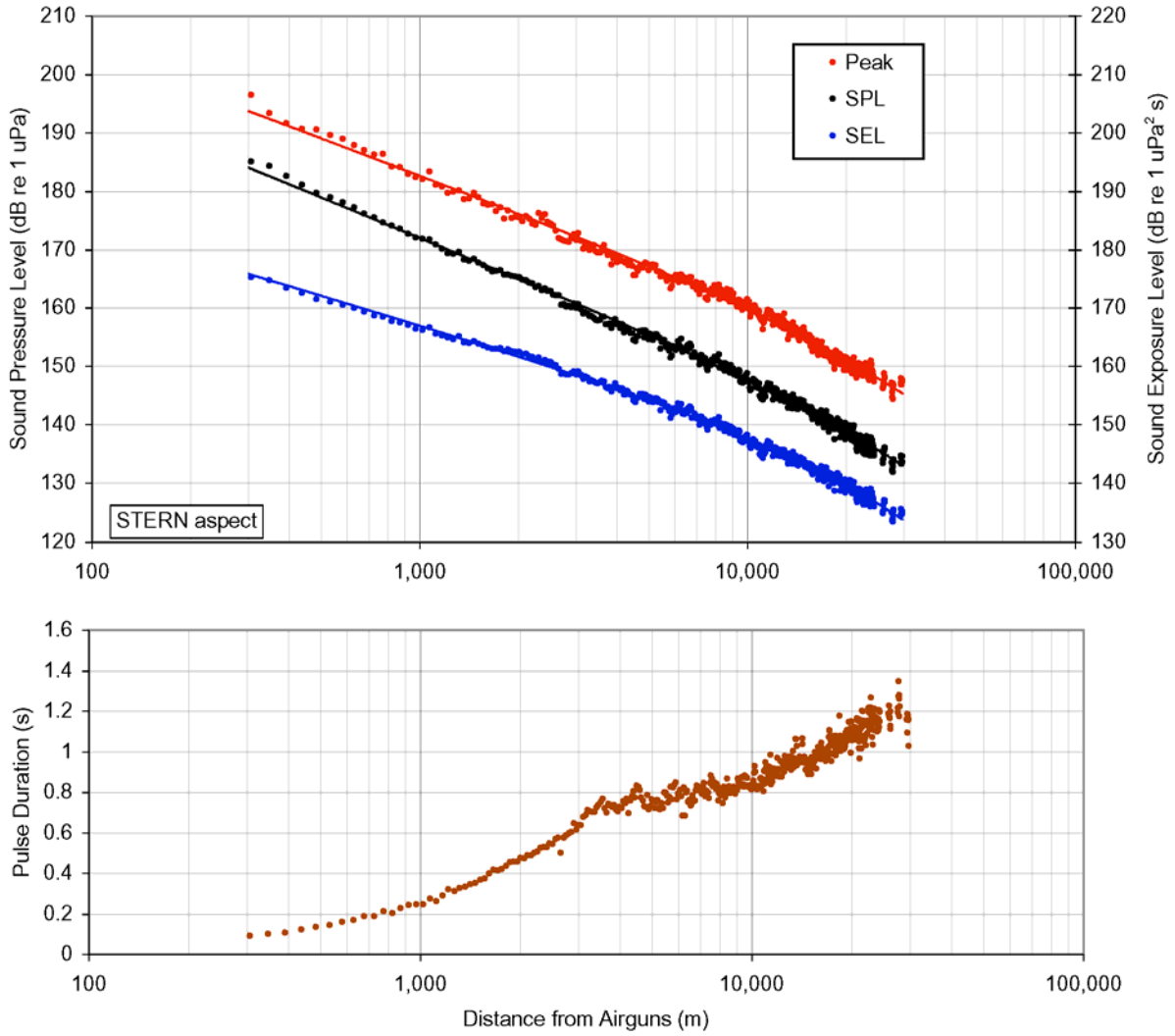

FIGURE 4.10. Received broadband levels of sound with *Gilavar*'s one-string array (1049 in^3) for **stern** aspect, as a function of distance from the airguns, 21 July 2006, Chukchi Sea. Equations for the regressions are given in Table 4.3. Otherwise plotted as in Figure 4.6.

distance were higher: 2.6× to 3.2× (again considering only bow and stern aspect). For the *single-string array*, the results also showed a tendency for higher E:P ratios when dealing with the 190 dB and 120 dB distances than when dealing with 160–180 dB distances. However, for the single-string array, the empirical distances were in fact less than the predicted distances (E:P < 1.0) in some cases (Table 4.4B). It should be noted that, because of ice conditions, the empirical measurements were taken at a location about 127 km from the C_1 site considered in JASCO's modeling. Differences in environmental conditions between those two sites probably accounted for some of the difference between empirical and predicted distances; the model would be expected to perform better if run for the actual site where the empirical measurements were acquired (D. Hannay, JASCO, pers. comm.).

Considering the SEL (energy) measure, the E:P ratios were higher than those for the SPL measure for almost all combinations of criterion level and aspect (Table 4.4). The underestimation of SEL levels by the model was particularly severe at the closer distances, i.e., those where the SEL value was 180–190

TABLE 4.3. Values for variables *A*, *B*, and *C* [Eq. (1) and (2)] in the regressions shown in Figures 4.10–4.12. Data were collected using the one-string airgun array in the Chukchi Sea. Values are shown for peak level, sound pressure level (SPL), and sound exposure level (SEL) for all three aspects (bow, stern, broadside). The multiple-*R* or *r*-value is also shown for each equation as well as the range of distances over which the measurements were made and the sample size (number of pulses analyzed).

	A	*B*	*C*	*R* (or *r*)	Range of distances (km)	Sample size
BOW					0.28–1.48	25
Peak	260.4	–24.94	N.A.	–0.992		
SPL	253.1	–25.99	N.A.	–0.992		
SEL	222.2	–17.87	N.A.	–0.991		
STERN					0.30–29.8	509
Peak	245.7	–20.94	$-2.25\ 10^{-4}$	–0.996		
SPL	240.6	–22.78	$-1.87\ 10^{-4}$	–0.997		
SEL	216.9	–16.54	$-3.06\ 10^{-4}$	–0.997		
BROADSIDE					0.17–1.16	7
Peak	247.2	–17.71	N.A.	(–0.998)		
SPL	242.2	–19.85	N.A.	(–0.999)		
SEL	210.7	–11.57	N.A.	(–0.997)		

dB re $(1\ \mu Pa)^2 \cdot s$. The SEL metric is not currently used for mitigation purposes, but would be used under the new procedures proposed by Southall et al. (submitted).

The fitted regressions resulting from Eq. (1) and (2) are based on a standard least-squares fit to the measured data, which means that about 50% of the empirical measurements fall above the line and 50% fall below (Fig. 4.6–4.8, 4.10, 4.11). Increasing the intercept value of each regression by 2 dB "elevates" each fitted curve by 2 dB, and nearly all the empirical measurements then are along or below the curves. Using these adjusted curves to determine mitigation radii results in protective radii that provide some margin for the inevitable variability in received levels. Table 4.5 is based on the same data as is Table 4.4, but the empirical distances are based on the curves with 2 dB added to all intercept values. The "E:P" ratios are larger in this case, as was to be expected when a protective factor was added to the empirical estimates but not to the model predictions.

Effect of M-weighting on Broadband SPLs and SELs.—Figure 4.14 illustrates the effects of *M*-weighting (as defined for mid-frequency cetaceans M_{mf}, pinnipeds in water M_{pw}, and low-frequency cetaceans M_{lf}) on SPLs (Fig. 4.14A) and SELs (Fig. 4.14B) for data collected in the Chukchi Sea. The amount (in dB) by which broadband (10–20,000 Hz) levels decreased as a result of being *M*-weighted is shown as a function of distance from the airguns. As expected given the varying low-frequency inflection points (f_{low}) for the three weighting functions, M_{lf} with $f_{low} = 7$ Hz had almost no effect on broadband SPLs or SELs, while M_{mf} with $f_{low} = 150$ Hz had the highest effect, and M_{pw} with $f_{low} = 75$ Hz had an intermediate effect. At close distances (400–650 m) pulse SPLs and SELs dropped by about 10 dB and 11 dB, respectively, for M_{mf}. At the same distance pulse SPLs and SELs dropped by about 5.5 dB and 6 dB,

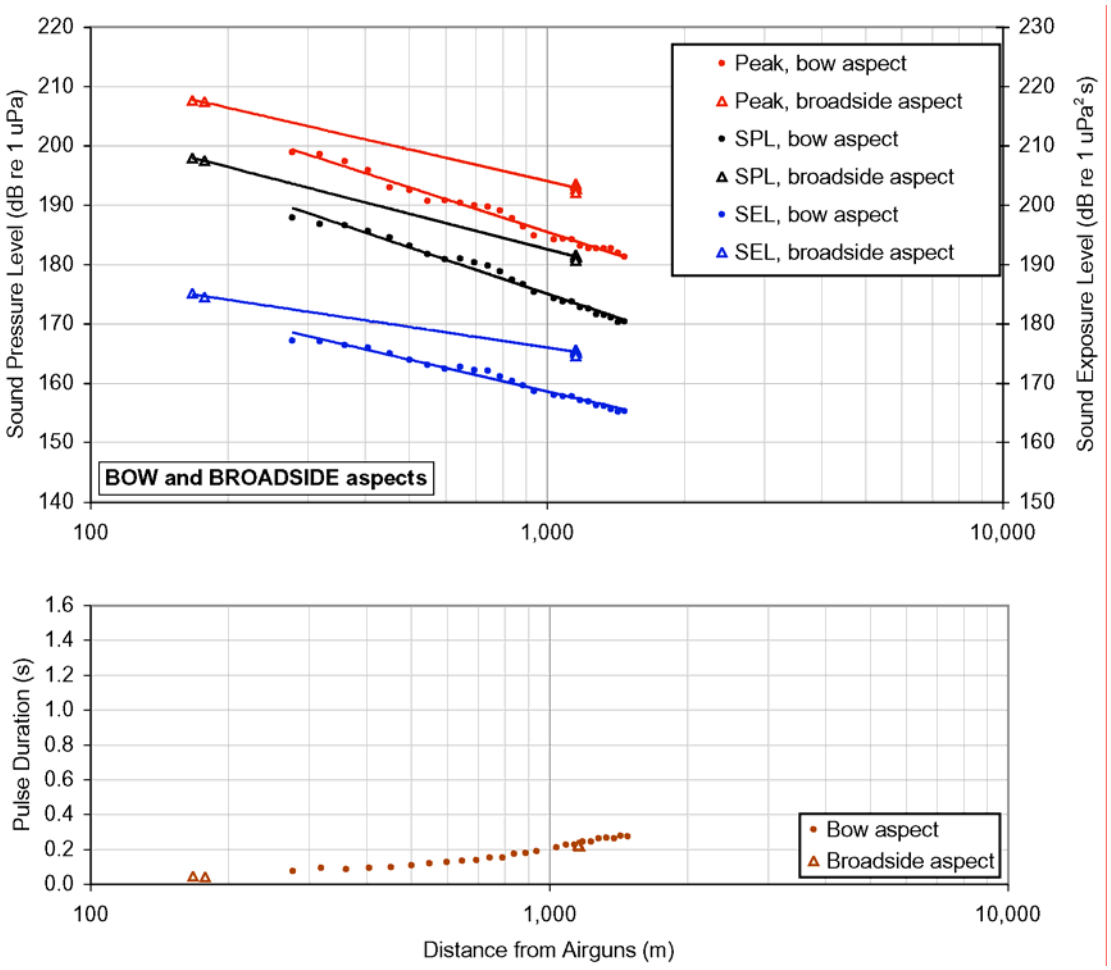

FIGURE 4.11. Received broadband levels of sound with *Gilavar*'s one-string array (1049 in^3) for **bow** (filled circles) and **broadside** (open triangles) aspects, as a function of distance from the airguns, 21 July 2006, Chukchi Sea. Plotted as in Figure 4.10.

respectively, for $M_{pw,}$. The effect of *M*-weighting decreased with distance from the sound source. At the farthest measurement distance, ~34 km, pulse SPLs and SELs dropped by less than 4 dB for M_{mf} and less than 2 dB for $M_{pw,}$. This was a result of the more rapid attenuation of the lower frequency components of the pulses with increasing distance.

To estimate how the 190 dB and 180 dB radii would change if *M*-weighted data were used instead of unweighted data, we fit two regressions to the points in Figure 4.14A, one for mid-frequency cetaceans and one for pinnipeds in water. The regressions were fitted to combined bow and stern aspect data. These represent the amounts (dB) by which SPLs drop as a result of M-weighting the data, as a function of distance from the airguns. For each distance (every m), we then subtracted the resulting decrease in SPL from the SPL regression shown in Figure 4.6 (bow aspect, three-string array) and reassessed the distances at which the 190 and 180 dB levels were reached. With unweighted data the 190 dB and 180 dB radii were 462 m and 1266 m, respectively (Table 4.4). For mid-frequency cetaceans (M_{mf}) these values decrease to 132 m and 455 m, respectively (28% and 36% of their former values, respectively). For pinnipeds in water (M_{pw}) these values decrease to 247 m and 776 m, respectively (53% and 61% of their former values, respectively).

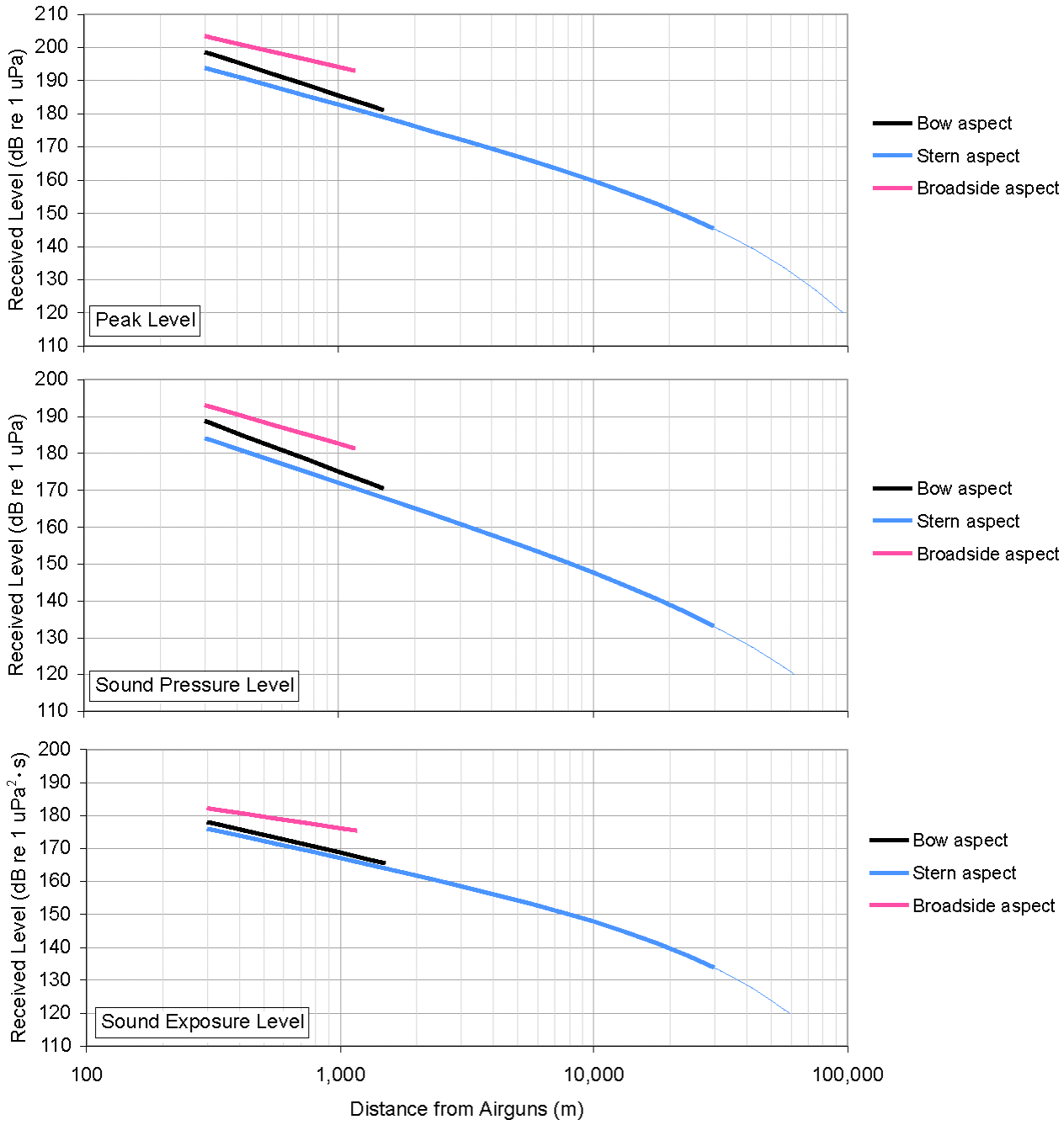

FIGURE 4.12. Summary of broadband levels for *Gilavar*'s one-string array configuration, 21 July 2006, Chukchi Sea. Data for all aspects are shown for peak (top plot), sound pressure (center plot), and sound exposure levels (bottom plot). Received levels which were obtained by extrapolating the regressions beyond the range of distances within which the measurements were made are indicated with a thinner line. Farthest measurement distances were 1.5 km, 29.8 km, and 1.2 km for bow, stern, and broadside data, respectively.

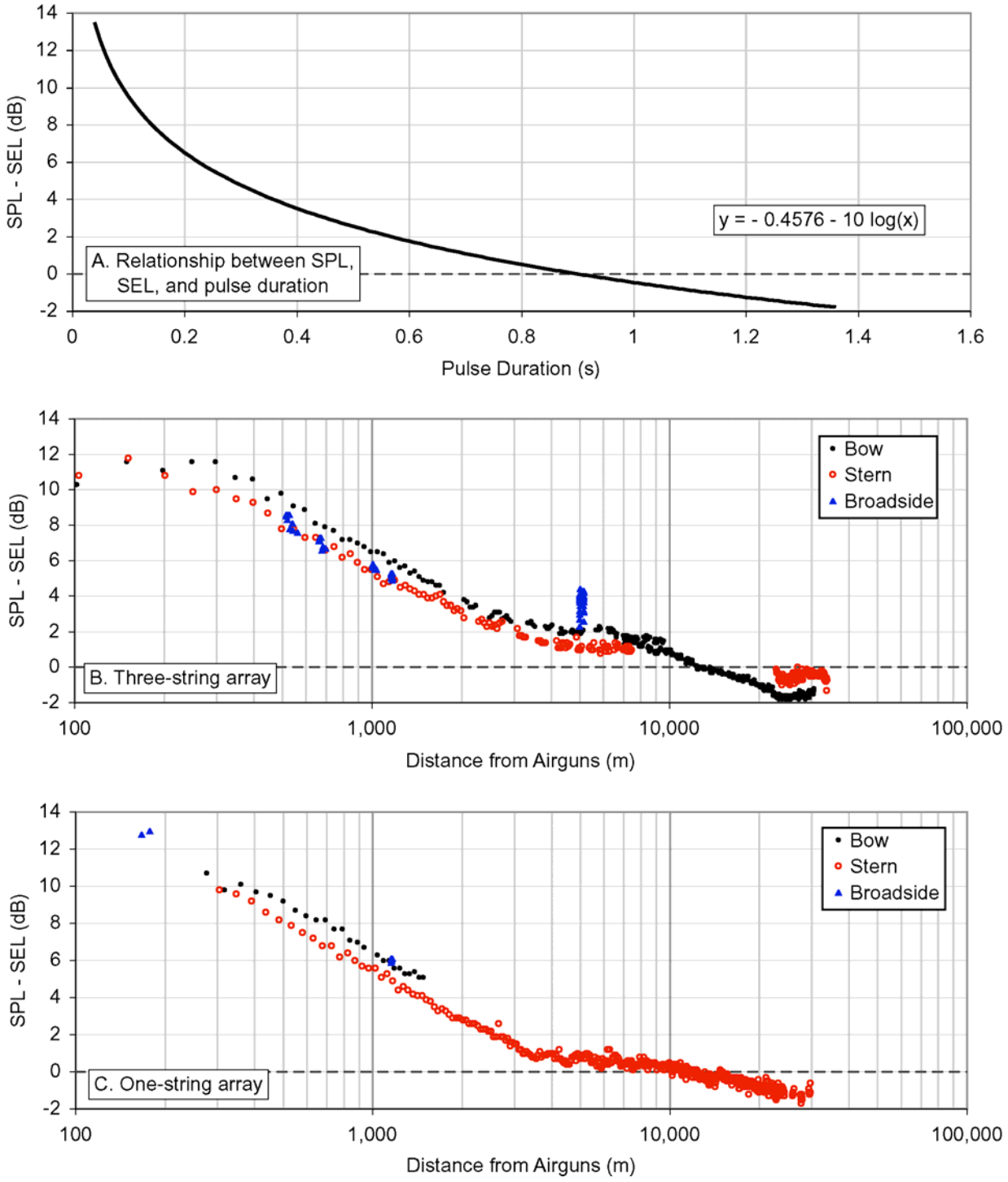

FIGURE 4.13. Relationship between SPL, SEL, pulse duration, and distance from *Gilavar*'s airguns for data collected in the Chukchi Sea. ***(A)*** SPL–SEL (i.e., the difference, for each analyzed pulse, in the received sound pressure level and sound exposure level) as a function of pulse duration. This relationship is defined mathematically as SPL–SEL = –0.4576–10 log(pulse duration). ***(B)*** SPL–SEL as a function of distance from the airguns for the three-string array data. ***(C)*** SPL–SEL as a function of distance from the airguns for the one-string array data.

TABLE 4.4. Distances to specified received sound exposure levels (SEL) and sound pressure levels (SPL) obtained with both array sizes used in the Chukchi Sea, and comparison with modeled values. All distances are in kilometers. C_1 is the site modeled by JASCO that most closely resembled the site where the empirical measurements were made. The "empirical : predicted" ratios were calculated with unrounded distances. For values shown in italics, the empirical distance was based on an extrapolation of the fitted curve beyond the range of the measured data.

	JASCO Predictions (km)	Empirical measurements (km)			"Empirical : Predicted" ratios		
		Bow	Stern	Broadside	Bow	Stern	Broadside
A. 3-string array	C_1, 3147 in^3						
SEL							
190 dB	0.03	*0.14*	*0.10*	*0.14*	*4.6*	*3.4*	*4.5*
180 dB	0.07	0.57	0.44	0.61	8.1	6.3	8.7
170 dB	0.53	2.19	1.82	2.70	4.1	3.4	5.1
160 dB	2.30	7.11	6.35	N.A.	3.1	2.8	N.A.
120 dB	25.95	*73.87*	*72.86*	N.A.	*2.8*	*2.8*	N.A.
SPL							
190 dB	0.23	0.46	0.36	*0.42*	2.0	1.5	*1.8*
180 dB	0.81	1.27	0.98	1.40	1.6	1.2	1.7
170 dB	2.19	3.32	2.64	4.72	1.5	1.2	2.2
160 dB	4.53	7.99	6.77	N.A.	1.8	1.5	N.A.
120 dB	25.95	*67.62*	*82.89*	N.A.	*2.6*	*3.2*	N.A.
B. 1-string array	C_1, 1049 in^3						
SEL							
190 dB	0.02	*0.06*	*0.04*	*0.06*	*3.2*	*2.1*	*3.1*
180 dB	0.06	*0.23*	*0.17*	0.45	*3.8*	*2.8*	7.5
170 dB	0.41	0.84	0.67	N.A.	2.0	1.6	N.A.
160 dB	1.50	N.A.	2.49	N.A.	N.A.	1.7	N.A.
120 dB	19.45	N.A.	*58.83*	N.A.	N.A.	*3.0*	N.A.
SPL							
190 dB	0.09	*0.27*	*0.17*	0.42	*3.0*	*1.8*	4.7
180 dB	0.61	0.65	0.45	*1.35*	1.1	0.7	*2.2*
170 dB	1.73	*1.57*	1.22	N.A.	*0.9*	0.7	N.A.
160 dB	3.59	N.A.	3.24	N.A.	N.A.	0.9	N.A.
120 dB	21.27	N.A.	*61.40*	N.A.	N.A.	*2.9*	N.A.

TABLE 4.5. Protective distances to specified received sound exposure levels (SEL) and sound pressure levels (SPL) obtained with both array sizes used in the Chukchi Sea, and comparison with modeled values. In this table, 2 dB have been added to all intercept values in the regressions used to calculate the size of radii. Otherwise as in Table 4.4. All distances are in kilometers.

	JASCO Predictions (km)	Field measurements (km)			"Field : predicted" ratios		
		Bow	Stern	Broadside	Bow	Stern	Broadside
A. 3-string array	C_1, 3147 in^3						
SEL							
190 dB	0.03	*0.19*	*0.14*	*0.18*	*6.2*	*4.5*	*6.1*
180 dB	0.07	0.75	0.59	0.82	10.7	8.4	11.7
170 dB	0.53	2.82	2.38	3.64	5.3	4.5	6.9
160 dB	2.30	8.73	7.89	N.A.	3.8	3.4	N.A.
120 dB	25.95	*78.36*	*77.35*	N.A.	*3.0*	*3.0*	N.A.
SPL							
190 dB	0.23	0.57	0.44	0.53	2.5	1.9	2.3
180 dB	0.81	1.54	1.20	1.79	1.9	1.5	2.2
170 dB	2.19	4.00	3.21	*6.02*	1.8	1.5	*2.8*
160 dB	4.53	9.38	8.09	N.A.	2.1	1.8	N.A.
120 dB	25.95	*71.94*	*89.17*	N.A.	*2.8*	*3.4*	N.A.
B. 1-string array	C_1, 1049 in^3						
SEL							
190 dB	0.02	*0.08*	*0.06*	*0.09*	*4.1*	*2.8*	*4.6*
180 dB	0.06	0.30	*0.22*	0.67	5.0	*3.7*	11.2
170 dB	0.41	1.08	0.87	N.A.	2.6	2.1	N.A.
160 dB	1.50	N.A.	3.19	N.A.	N.A.	2.1	N.A.
120 dB	19.45	N.A.	*63.55*	N.A.	N.A.	*3.3*	N.A.
SPL							
190 dB	0.09	0.32	*0.20*	0.53	3.5	*2.3*	5.9
180 dB	0.61	0.77	0.55	*1.70*	1.3	0.9	*2.8*
170 dB	1.73	*1.88*	1.49	N.A.	*1.1*	0.9	N.A.
160 dB	3.59	N.A.	3.91	N.A.	N.A.	1.1	N.A.
120 dB	21.27	N.A.	*67.26*	N.A.	N.A.	*3.2*	N.A.

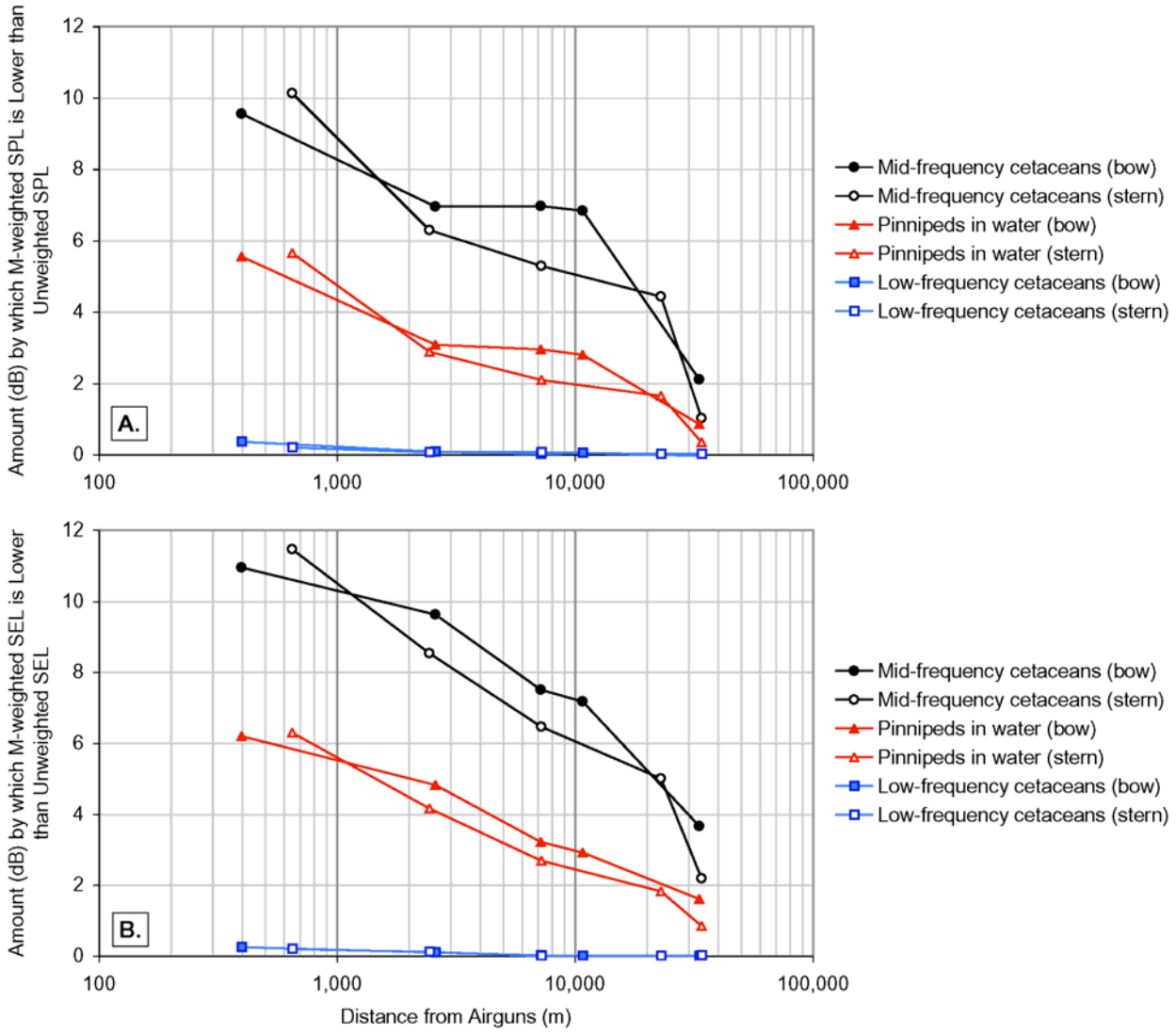

FIGURE 4.14. Effect of *M*-weighting on broadband levels, as a function of distance from the airguns (Chukchi Sea data). Both plots show the amount (dB) by which *M*-weighting decreases (A) pulse sound pressure levels (SPL) and (B) sound exposure levels (SEL). Three different types of *M*-weighting were used: for mid-frequency cetaceans (M_{mf}), pinnipeds in water (M_{pw}), and low-frequency cetaceans (M_{lf}). Each data point is the average of five consecutive pulses. Bow aspect data are distinguished from stern aspect data.

Broadband Levels for Shallow-Hazards Vessel Henry Christoffersen *(Beaufort Sea)*

On 8 August 2006, both ASARs were deployed in the locations given in Table 4.1, about 54 km east of Kaktovik off the north coast of Alaska. ASAR #1 was set to sample at 192 kHz (therefore filling its memory capacity in ~3 hours) and ASAR #2 at 44.1 kHz. Both ASARs started recording at 09:30 local time. The *Henry Christoffersen* followed a predetermined course over and away from the ASAR locations, providing endfire aspect data for various types of seismic sound sources. The *Henry C.*'s track is shown in Figure 4.15. The seismic and sonar sources were all operating simultaneously, but only on the outbound trip (away from the ASARs). While the sources were on, the *Henry C.* traveled at a speed of ~4 knots (7.4 km/h or 4.6 mph), using its two outer engines at reduced power (the two inner engines were turned off).

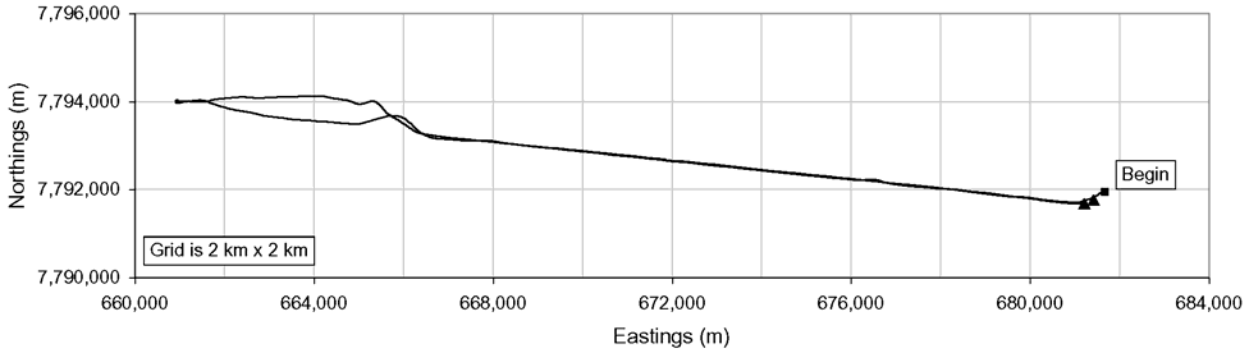

FIGURE 4.15. Track of the *Henry Christoffersen* during seismic, sonar, and vessel sound measurements. The grid squares are 2 km × 2 km. The *Henry C.* started its course at the filled square, steered over the two ASARs, then headed WNW at a speed of ~4 knots while seismic and sonar sound sources were turned on. On its return trip to the ASAR locations the *Henry C.* traveled at ~12 knots without any seismic or sonar sound sources turned on (see text for details). Filled triangles show the ASAR locations.

Airguns.—Figure 4.16 shows broadband levels for four pulse parameters as a function of distance from the Henry C.'s 4-airgun array: peak level, SPL, SEL and pulse duration. All aspects are combined, but the small, symmetric configuration of the four-gun array suggested there would be virtually no aspect dependence. For peak, SPL, and SEL values, Eq. (2) was fitted to the data. The resulting equations and multiple-*R* values are shown in Table 4.6. As expected, the received levels at a given distance were much lower for the small airgun array deployed from the *Henry C* than for the larger airgun arrays deployed from the Gilavar.

Comparison of Empirical and Modeled Radii for Airgun Sounds.—Table 4.7 summarizes the distances to a set of specified SELs and SPLs, as determined using the field measurements presented above for the *Henry Christoffersen*'s airgun array. These empirical distances are compared to distances predicted by sound propagation modeling (see Chapter 3). Note however that the empirical measurements were made with a 4-airgun 280 in^3 array whereas a 4-airgun 240 in^3 array was assumed in the modeling. JASCO used their MONM acoustic model to generate SEL contours, from which SPLs were derived by Fourier synthesis analysis (see Chapter 3, Jensen et al. 2000). Because the contours produced by the MONM model are anisotropic, the predicted distances given in Table 4.7 are the radii encompassing 95% of the locations where the predicted SEL or SPL equals or exceeds the criterion value. An "empirical : predicted" (E:P) ratio was calculated for each metric (SEL and SPL) and received level, as shown in Table 4.7. The E:P ratio was in general better (lower) for the Beaufort Sea measurements in Table 4.7 than the Chukchi Sea measurements in Table 4.4.

TABLE 4.6. Values for variables *A*, *B*, and *C* [Eq. (2)] in the regressions shown in Figure 4.16 for sounds from the airgun array towed by the *Henry Christoffersen*. Values are shown for peak level, sound pressure level (SPL), and sound exposure level (SEL) for all three aspects combined. The multiple-*R* value is shown for each equation as well as the range of distances over which the measurements were made and the sample size (number of pulses analyzed).

	A	*B*	*C*	Mult.-*R* value	Range of distances (km)	Sample size
					0.06–20.53	15
Peak	242.7	–21.70	$-6.31\ 10^{-4}$	–0.996		
SPL	233.4	–22.21	$-7.58\ 10^{-4}$	–0.993		
SEL	203.9	–15.72	$-7.47\ 10^{-4}$	–0.986		

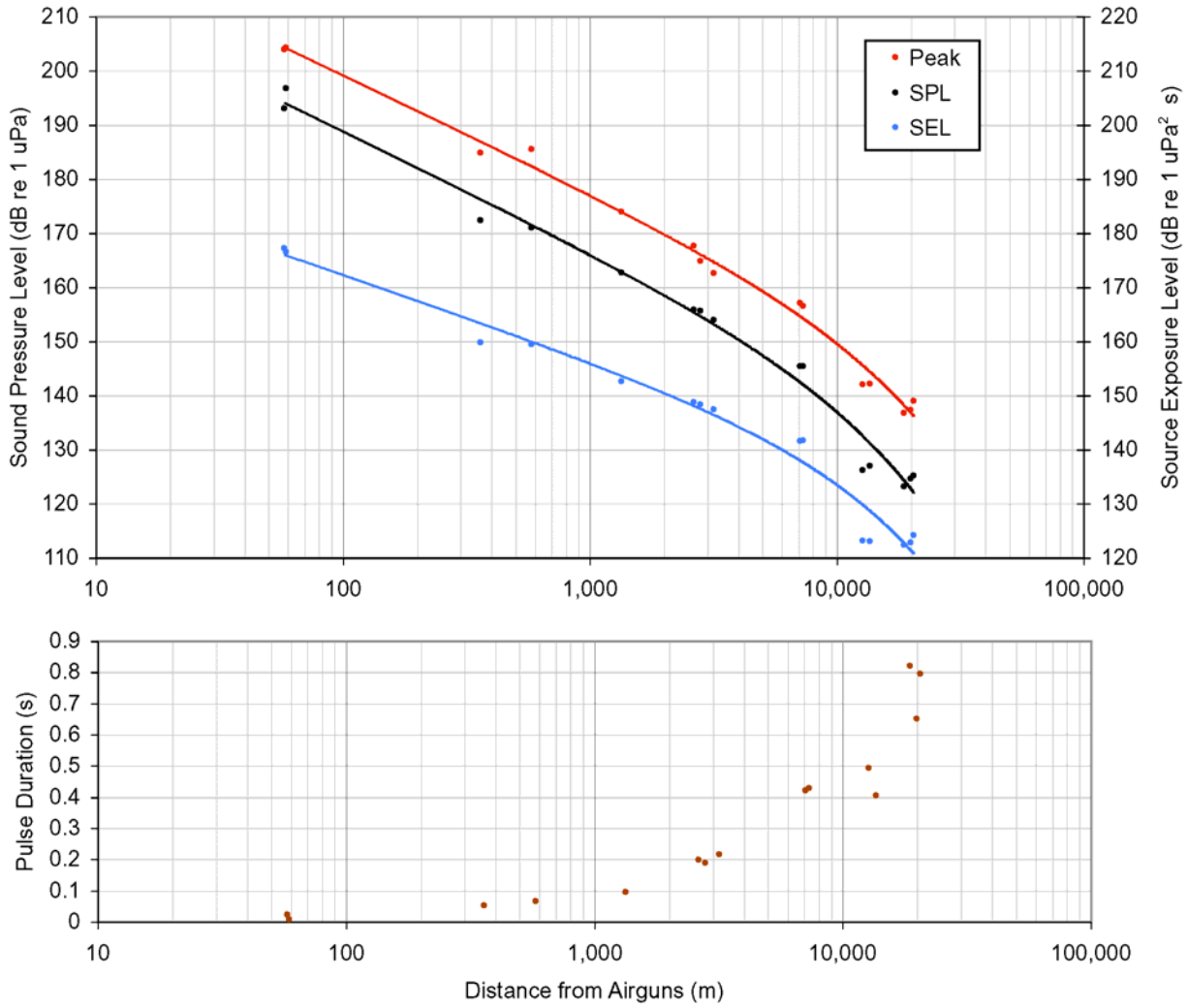

FIGURE 4.16. Received broadband levels of sound from airguns towed by the *Henry Christoffersen*, as a function of distance from the source (all aspects combined). The top plot shows peak levels and SPLs, with values to be read on the left y-axis (dB re 1 μPa), and SELs with values to be read on the right y-axis (dB re 1 $\mu Pa^2 \cdot s$). Note that to avoid overlap, values on the two y-axes are offset by 10 dB. Equations for the regressions are given in Table 4.5. The bottom plot shows pulse duration as a function of distance from the airguns.

The equations (Table 4.6) that resulted from fitting Eq. (2) to the empirical data were derived via a standard least-squares procedure, which means that about 50% of the empirical measurements fall above the line and 50% fall below. As for the Chukchi Sea, we calculated an alternate set of mitigation radii by increasing the intercept value of each regression in Table 4.6 so that almost all empirical data fall below the regression line. In the Chukchi data set, intercept values were increased by 2 dB. For the Beaufort measurements, we adjusted by 3 dB because of the somewhat greater variability in received levels at a given distance. These conservative radii and their comparison with the modeled ones are also shown in Table 4.7.

Chirp Sonar.—Received peak levels, SPLs, and SELs are shown in Figure 4.17 as a function of distance from the chirp sonar (sample size 73 pulses). Eq. (1) was fitted to the data for each parameter.

TABLE 4.7. Distances to specified received sound exposure levels (SEL) and sound pressure levels (SPL) obtained with 4-airgun array used in the Beaufort Sea, and comparison with modeled values. All distances are in kilometers. B_1 is the site modeled by JASCO that most closely resembled the site where the empirical measurements were made. However, modeling assumed a 240 in^3 array whereas the one used in the field was a 280 in^3 array. The "empirical : predicted" (E:P) ratios were calculated with unrounded distances. For values shown in italics, the empirical distance was based on an extrapolation of the fitted curve beyond the range of the measured data.

	JASCO Predictions (km)	Empirical Measure-ments (km)	E : P ratios
	B_1, 240 in^3		
SEL			
190 dB	0.005	*0.008*	*1.5*
180 dB	0.020	*0.033*	*1.6*
170 dB	0.055	0.14	2.6
160 dB	0.54	0.58	1.1
120 dB	23.42	*21.22*	*0.9*
SPL			
190 dB	0.02	0.089	4.5
180 dB	0.15	0.25	1.7
170 dB	0.30	0.68	2.3
160 dB	0.99	1.75	1.8
120 dB	35.98	*22.22*	*0.6*
SEL (with 3 dB added to intercept)			
190 dB	0.005	*0.012*	*2.4*
180 dB	0.020	*0.051*	*2.5*
170 dB	0.055	0.216	3.9
160 dB	0.54	0.87	1.6
120 dB	23.42	*24.08*	*1.0*
SPL (with 3 dB added to intercept)			
190 dB	0.02	0.12	6.1
180 dB	0.15	0.34	2.2
170 dB	0.30	0.91	3.0
160 dB	0.99	2.29	2.3
120 dB	35.98	*24.79*	*0.7*

Pulse durations are also shown as a function of distance from the sound source. Unlike seismic pulses (see Fig. 4.6–4.8, 4.10, 4.11 or 4.16), the durations of the "chirps" did not increase with distance, at least not over the small range of distances over which measurements were made (56–480 m).

Comparison of Empirical and Modeled Radii for Chirp Sonar.—The intercepts for both the SPL and SEL regressions (see Fig. 4.17) are below 190 dB so the data suggest that a 190 dB level was not reached at any distance from this source. However, there were no measurements at distances closer than

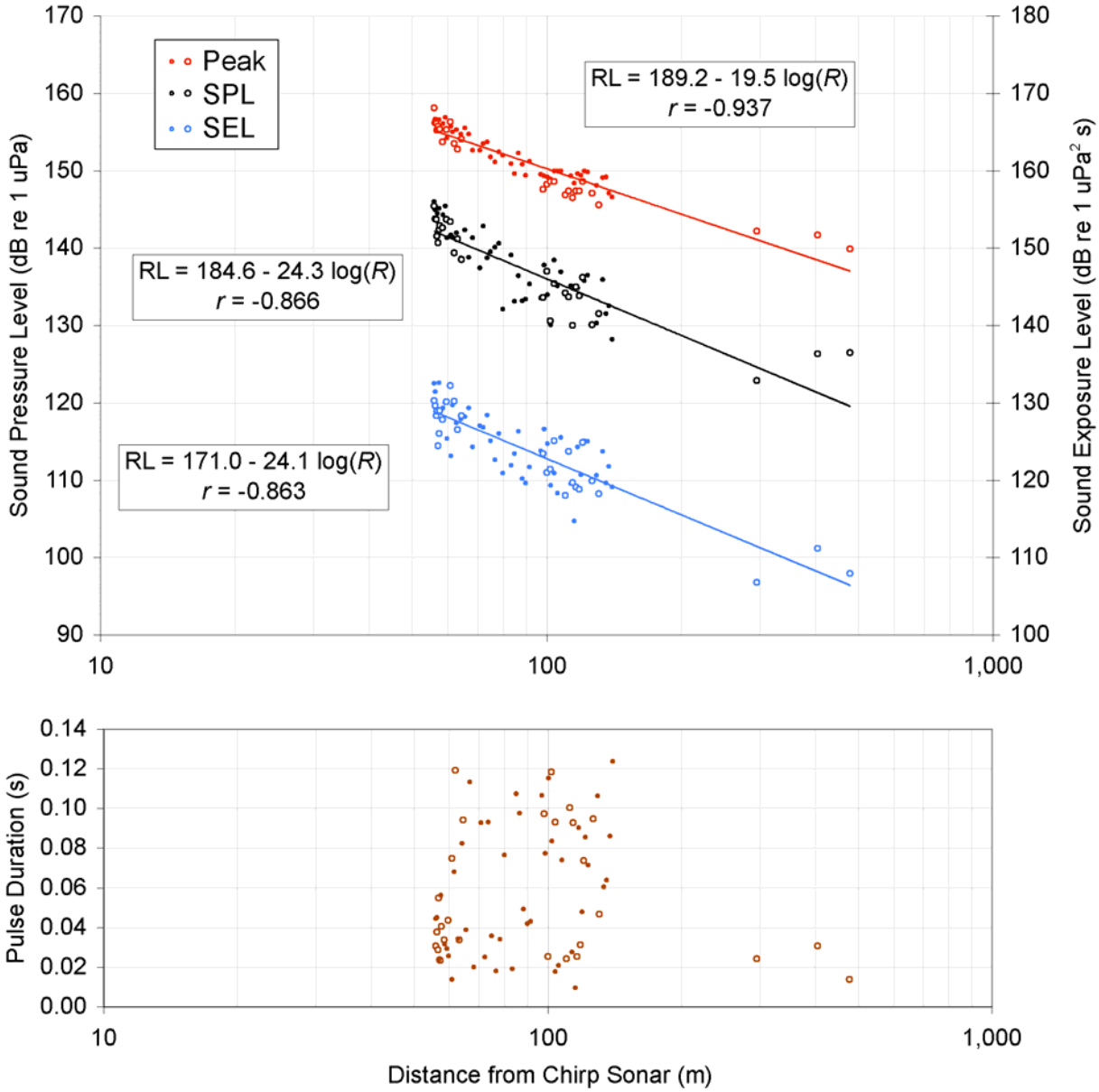

FIGURE 4.17. Received broadband levels of sound from chirp sonar towed by the *Henry Christoffersen*, as a function of distance from the source. The top plot shows peak levels and SPLs, with values to be read on the left y-axis (dB re 1 μPa), and SELs with values to be read on the right y-axis (dB re 1 $\mu Pa^2 \cdot s$). Filled circles are bow aspect data, open circles are stern aspect data. All data combined were used in the regressions. The bottom plot shows pulse durations as a function of distance from the chirp sonar.

~56 m, and no measurements were taken directly below the source. Using a ray tracing approach, JASCO estimated that 180 dB SPL would occur at a distance of 30 m for the B_1 location. This compares to an (extrapolated) estimate of ~1.6 m based on the empirical data shown in Figure 4.17.

Bubble-Pulser.—Received peak levels, SPLs, and SELs are shown in Figure 4.18 as a function of distance from the bubble pulser (sample size 48 pulses). Eq. (1) was fitted to the data for each parameter. Pulse durations are also shown as a function of distance from the sound source. As seen for the chirp sonar there was no change in pulse duration with distance. Bubble pulser sounds were of very short duration

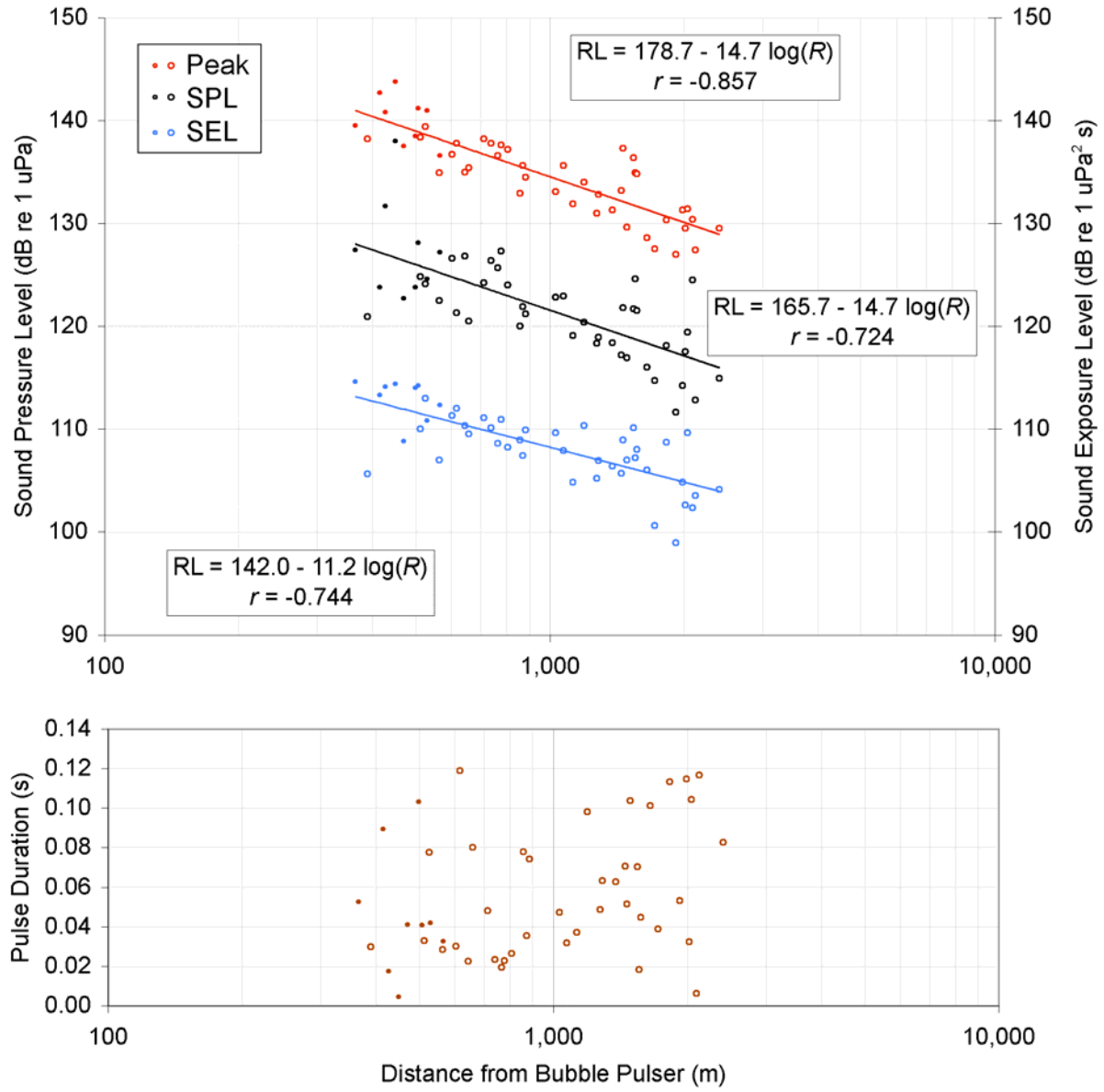

FIGURE 4.18. Received broadband levels of sound from bubble pulser towed by the *Henry Christoffersen*, as a function of distance from the source. The top plot shows peak levels and SPLs, with values to be read on the left y-axis (dB re 1 μPa), and SELs with values to be read on the right y-axis (dB re 1 $\mu Pa^2 \cdot s$). Filled circles are bow aspect data, open circles are stern aspect data. All data combined were used in the regressions. The bottom plot shows pulse durations as a function of distance from the bubble pulser.

(0.005 to 0.12 sec) and quite weak. Even for peak levels, the intercept of the regression (i.e., estimated nominal "source level" at 1 m) did not reach 180 dB re 1 μPa. However, there were no measurements at distances closer than ~56 m, and no measurements were taken directly below the source.

Spectral Analyses

Seismic Vessel Gilavar (Chukchi Sea).—Spectral density plots of seismic pulses at close and far ranges are presented in Figure 4.19. Each plot shows a broadside sample and an endfire sample taken at about the same distances. At close ranges (Fig. 4.19A) most of the pulse energy was below 300 Hz,

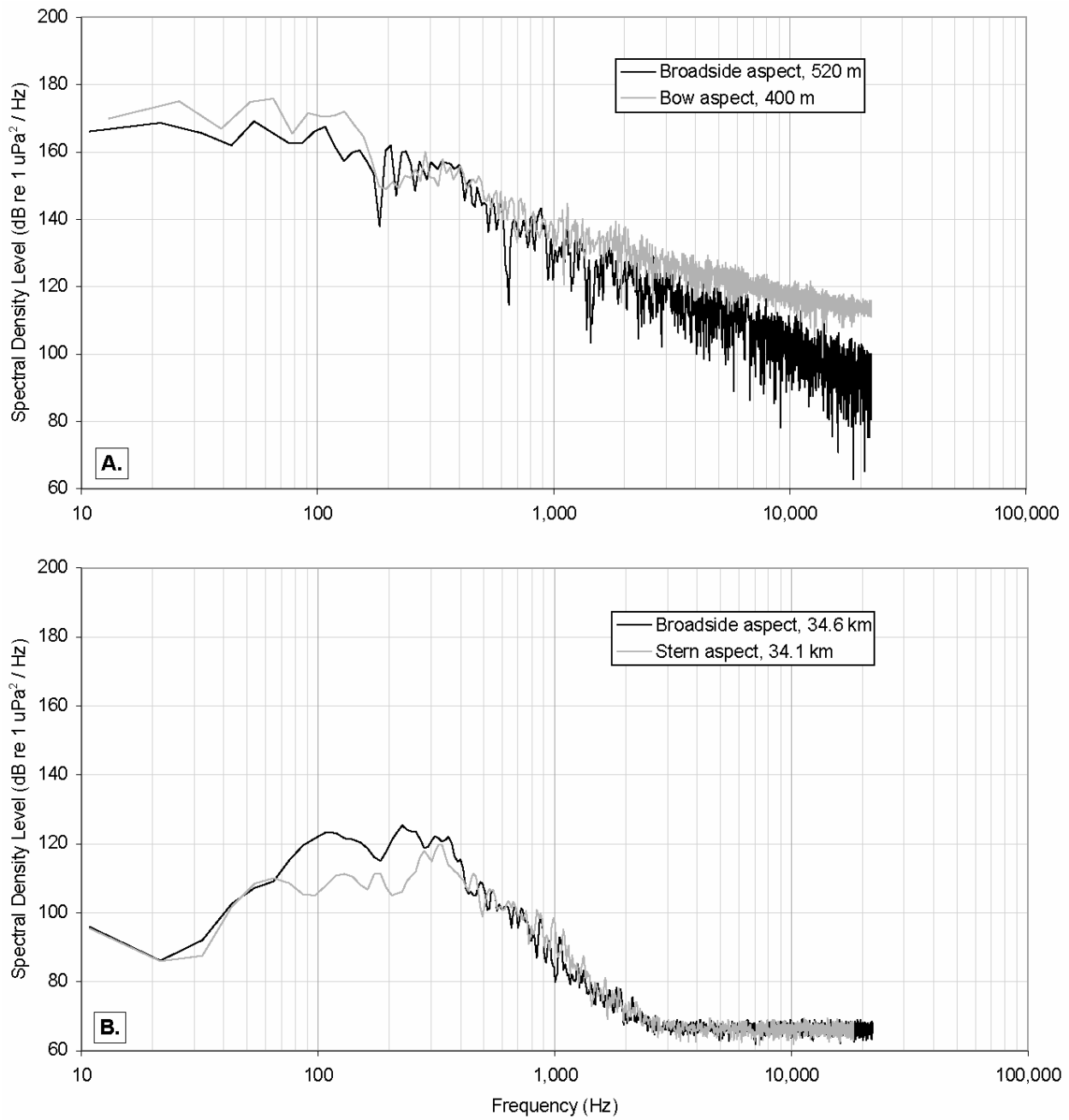

FIGURE 4.19. Spectral density levels for seismic pulses produced with the *Gilavar*'s three-string array, at ***(A)*** short ranges and ***(B)*** long ranges, 21 July 2006, Chukchi Sea. Two different aspects are shown in each plot. Each spectral density plot was produced by analyzing one typical pulse. FFT size was 4009 samples for all but the closest sample, for which it was 3392. This resulted in 11 and 13 Hz bin widths, respectively.

but there was still significant energy at higher frequencies. At the maximum measurement distance (~ 34 km), spectral density levels were lower at all frequencies, and most of the remaining pulse energy was between 70 and 400 Hz. Energy at higher and lower frequencies had attenuated (with distance) at a proportionally higher rate than occurred at 70–400 Hz.

Shallow-Hazards Vessel Henry Christoffersen (Beaufort Sea).—Spectral density plots of *airgun* pulses received at close and far ranges from the *Henry C.* are presented in Figure 4.20. The low-frequency components at close range could not be characterized because of the very short duration of the pulses received at that distance. In similar fashion to the seismic pulse measurements in the Chukchi Sea (Fig. 4.19), frequencies below ~70 Hz and above ~700 Hz have been attenuated in the distant sample (20.5 km).

The *chirp sonar* produced a 50 ms linear sweep of two sinusoids at frequencies of 2–7 and 8–23 kHz. This can be seen in Figure 4.21, showing a 0.13 s spectrogram of the chirp sonar sound source.

A spectral density plot of a pulse from the *bubble pulser* is shown in Figure 4.22. The bubble pulser was described as having most of its energy close to 400 Hz. The short duration of the pulse shown (0.04 s) resulted in low resolution (47 Hz) at the frequencies of interest. The spectral density plot shows a dip at 400 Hz, surrounded by two peaks, one at ~280 Hz and the other at ~610 Hz.

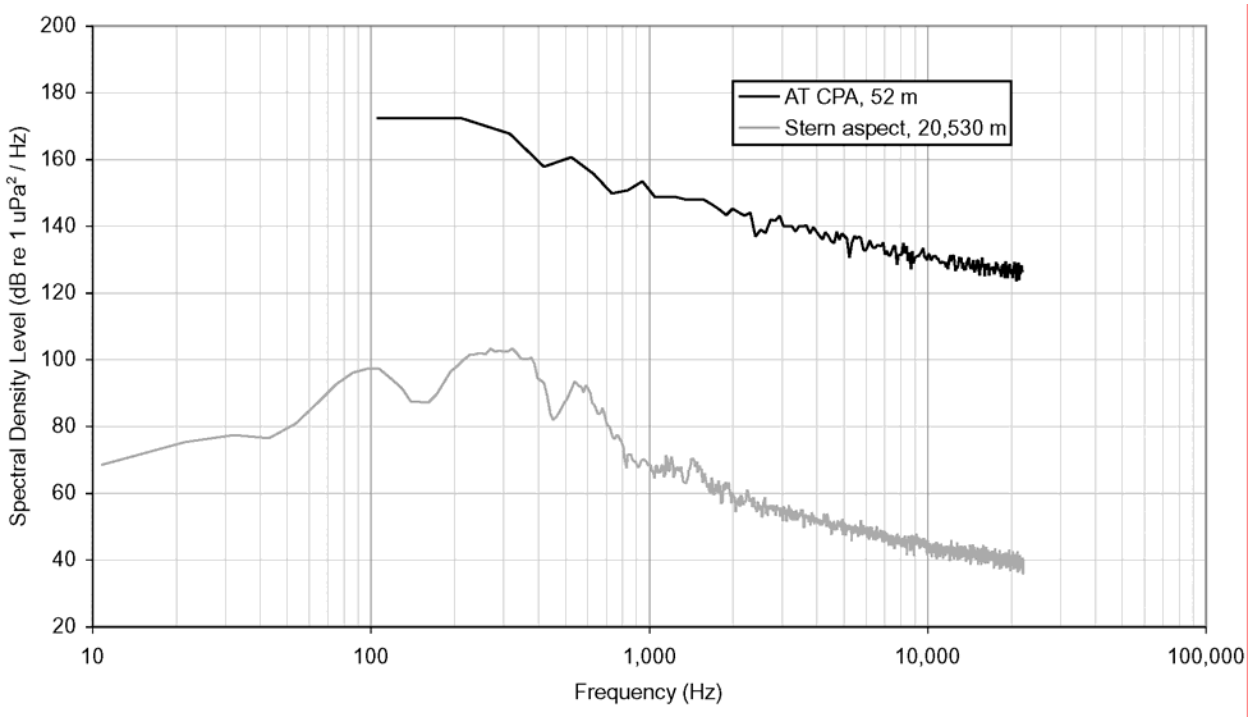

FIGURE 4.20. Spectral density levels for seismic pulses produced by the airgun array towed by the *Henry Christoffersen* at short and long range, 8 August 2006, Beaufort Sea. Each spectral density plot was produced by analyzing one typical pulse. FFT size was 420 and 4096 samples for the close and far pulse, respectively (the small FFT size was necessary for the CPA pulse, which was of extremely short duration). This resulted in 105 and 11 Hz bin widths, respectively.

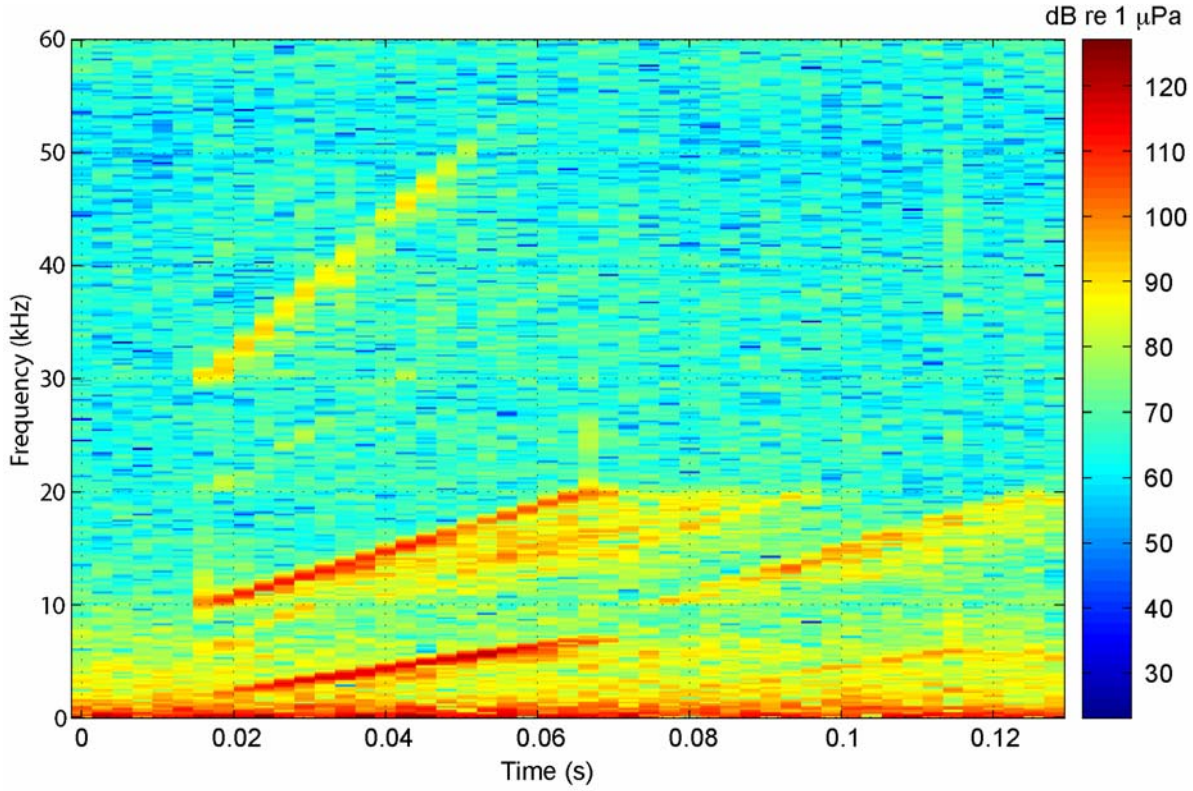

FIGURE 4.21. Spectrogram of the chirp sonar towed behind the *Henry Christoffersen*. This 0.13 sec sample was taken at the closest point of approach (56 m). The scale is in dB re 1 μPa.

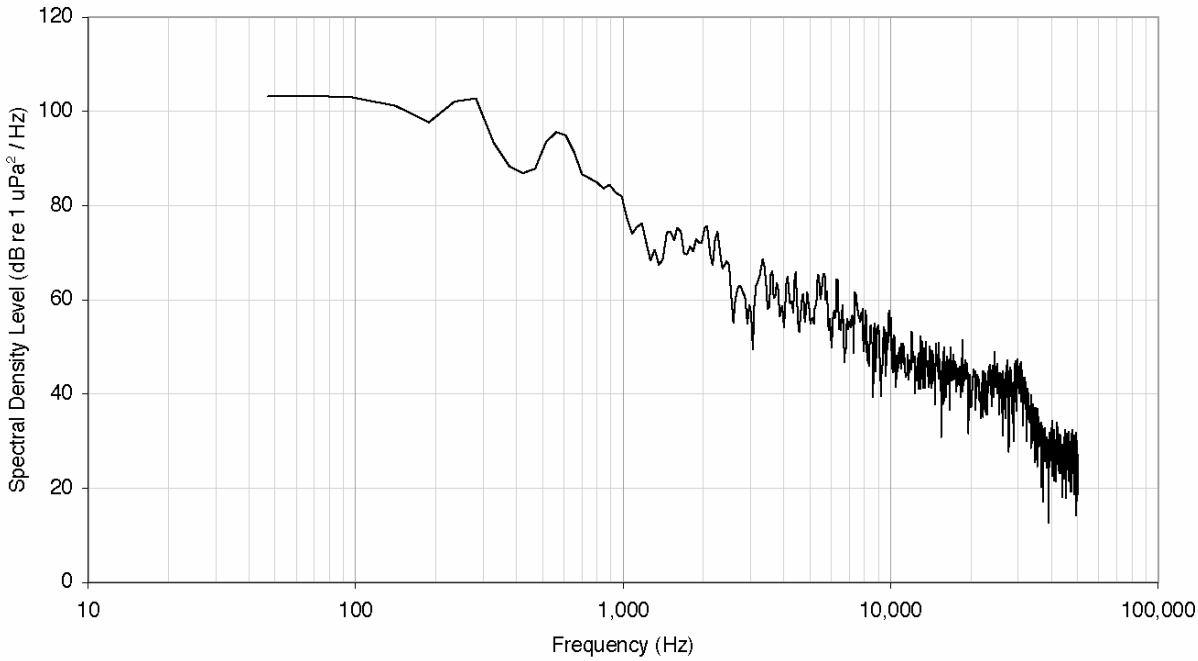

FIGURE 4.22. Spectral density levels for bubble pulser towed by the *Henry Christoffersen* at short range, 8 August 2006, Beaufort Sea. The spectral density plot was produced by analyzing one typical pulse 140 m from ASAR #1. FFT size was 4096 samples, resulting in a 47 Hz bin width. The short duration of the pulse limited the size of the FFT that could be used, and therefore low resolution at the frequencies of interest.

Vessel Sound Measurements

Measurement Circumstances

Gilavar and Kilabuk.—On 12 July 2006 both ASARs were deployed in the Chukchi Sea in the locations shown in Table 4.1. After deployment the *Kilabuk* and then the *Gilavar* followed a predetermined route over and away from the ASAR locations, to provide recordings of the vessel sounds from different distances and different aspects (bow, stern, broadside). As an example, the route taken by the *Gilavar* is shown in Figure 4.23. It is similar to the course followed during airgun sound measurements, but on a smaller scale (maximum distance from the ASARs was ~10 km, as opposed to ~30 km during the airgun sound measurements). The *Kilabuk* and *Gilavar* were traveling at speeds of ~10 and 12 knots (18.5 and 2.2 km/h, or 11.5 and 13.8 mph), respectively. The vessels passed over ASAR #2 in both directions[8] (eastward and westward) to provide bow and stern aspect data. They then zigzagged back and forth at several distances from the recorders to provide broadside data (see Fig. 4.23). While the *Kilabuk* followed its course the *Gilavar* idled 5.6 km southeast of the ASAR location. While the *Gilavar* followed its course the *Kilabuk* idled 9.3 km northwest of the ASAR location.

Henry Christoffersen.—On 8 August 2006 both ASARs were deployed in the Beaufort Sea in the locations shown in Table 4.1. The *Henry C.*'s course is shown in Figure 4.15. The vessel passed close to the ASARs[4] before heading WNW. On the outward (westerly) leg seismic and sonar sources were operating, and the ship was cruising at a speed of ~4 knots. On the return (easterly) leg the seismic sources were turned off and the ship was traveling at a speed of ~12 knots (22.2 km/h or 13.8 mph) with all four engines running. The vessel sound measurements presented in this report were taken from the return leg.

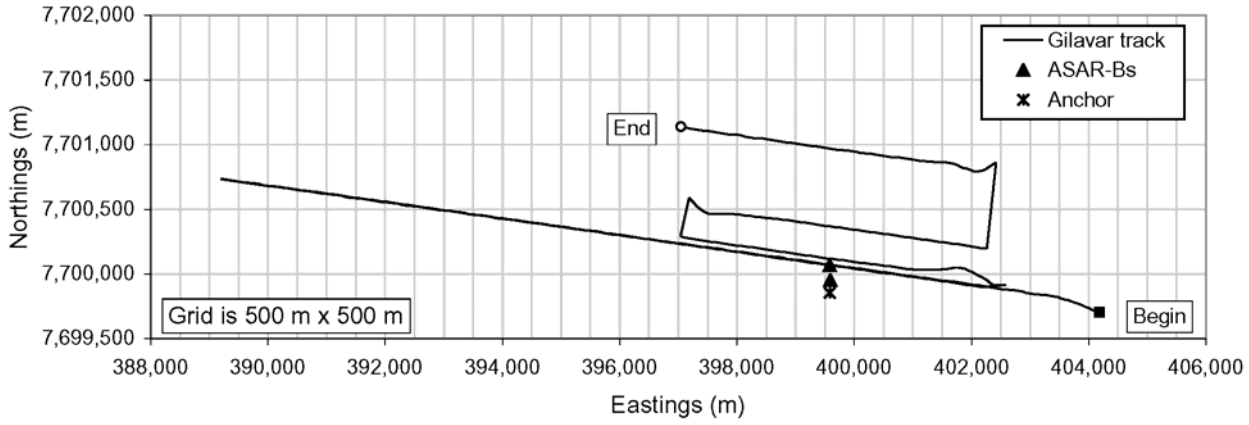

FIGURE 4.23. Track of the M/V *Gilavar* during vessel sound measurements. The grid squares are 500 m × 500 m; the map has been extended in the N-S direction to better show the ship track. The track starts at the filled square and ends at the open circle. Filled triangles show the ASAR locations. The first two runs (west and then east) were on top of each other and over ASAR #2 and provided bow and stern aspect data. The remaining runs provided broadside aspect data.

[8] Both the *Kilabuk* and the *Henry Christoffersen* missed passing directly over one or both ASAR-Bs.

Broadband Levels

Kilabuk and Gilavar.—Broadband (10–20,000 Hz) levels, as calculated for each non-overlapping 1-s segment throughout the entire vessel sound measurement session, are shown in Figure 4.24 as recorded by the ITC 1032 hydrophone on ASAR #2. The large spikes in received levels correspond to each vessel's closest points of approach during consecutive passes by the ASARs (see Fig. 4.23). Heightened levels indicated by diamonds correspond to the *Gilavar* turning around. Note that minimum ("background") levels during the *Gilavar's* run were lower than during the *Kilabuk's* run.

Broadband (10–20,000 Hz) levels are shown as a function of distance from the source in Figure 4.25 for the *Kilabuk* and in Figure 4.26 for the *Gilavar*. Data from both hydrophone types are mixed in these plots, with data from the ITC 1032 and ITC 8212 hydrophones used at received levels above and below ~125 dB re 1 μPa, respectively. These data are presented as a function of aspect: bow, stern, or broadside. Eq. (1) was fitted to each data set and the resulting equations are shown in each plot. When computing these regressions, data at increasing distances from the sound source were included until the broadband levels reached a minimum and remained constant. For example, broadband levels for the *Kilabuk* (Fig. 4.25) apparently reached background levels 2–3 km from the recorders. For both vessels, bow-aspect data in the near-field (less than 300 m) were also erratic and were excluded when fitting the curves.

Henry Christoffersen.— Broadband (10–20,000 Hz) levels are shown as a function of distance from the *Henry C.* in Figure 4.27. These are bow aspect data (ASAR #2, ITC 8212 hydrophone) obtained during the *Henry C.*'s eastward return trip to the ASAR locations (see Fig. 4.15), while seismic and sonar sources were turned off and the ship was traveling at 10–12 knots. Eq. (1) was fitted to the data acquired from distances up to 10 km, beyond which broadband levels remained constant and had presumably reached background values. The discontinuity in received levels at 9–10 km coincides with a sudden shift in water depth from ~45 to ~41 m.

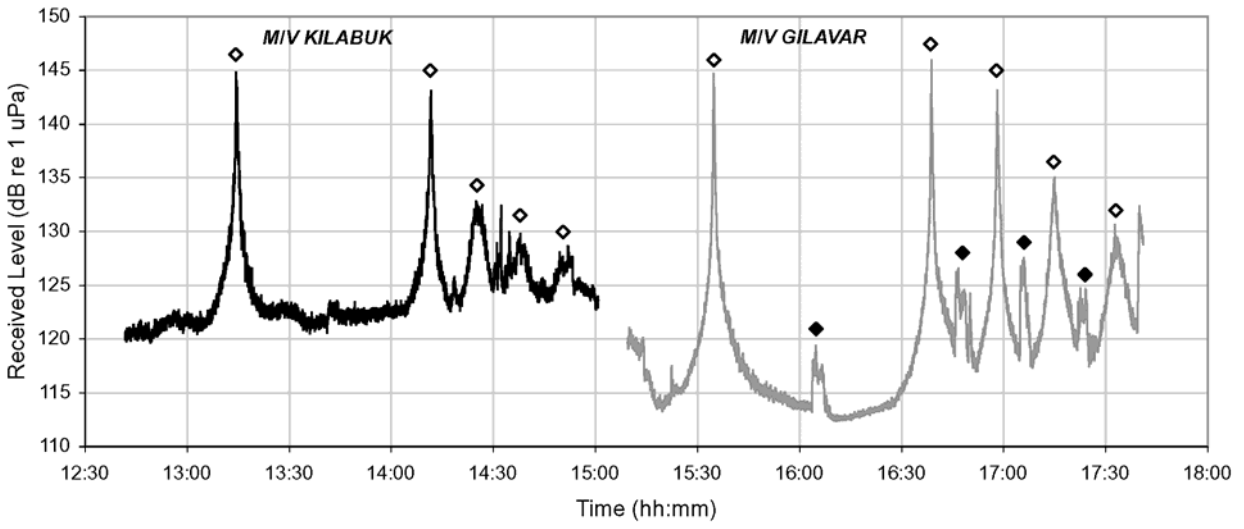

FIGURE 4.24. Broadband levels (one value for each 1-s interval) of vessel sounds as recorded by the ITC 1032 hydrophone (less sensitive) on ASAR #2, Chukchi Sea, 12 July 2006. The *Kilabuk* followed its track between 12:45 and 15:00 while the *Gilavar* stood by. Between 15:15 and 17:45 the *Gilavar* followed its track (see Fig. 4.20) while the *Kilabuk* stood by. Open diamonds indicate times when the vessels were at their closest points of approach to the ASARs on each pass. Closed diamonds indicate times when the *Gilavar* was turning around.

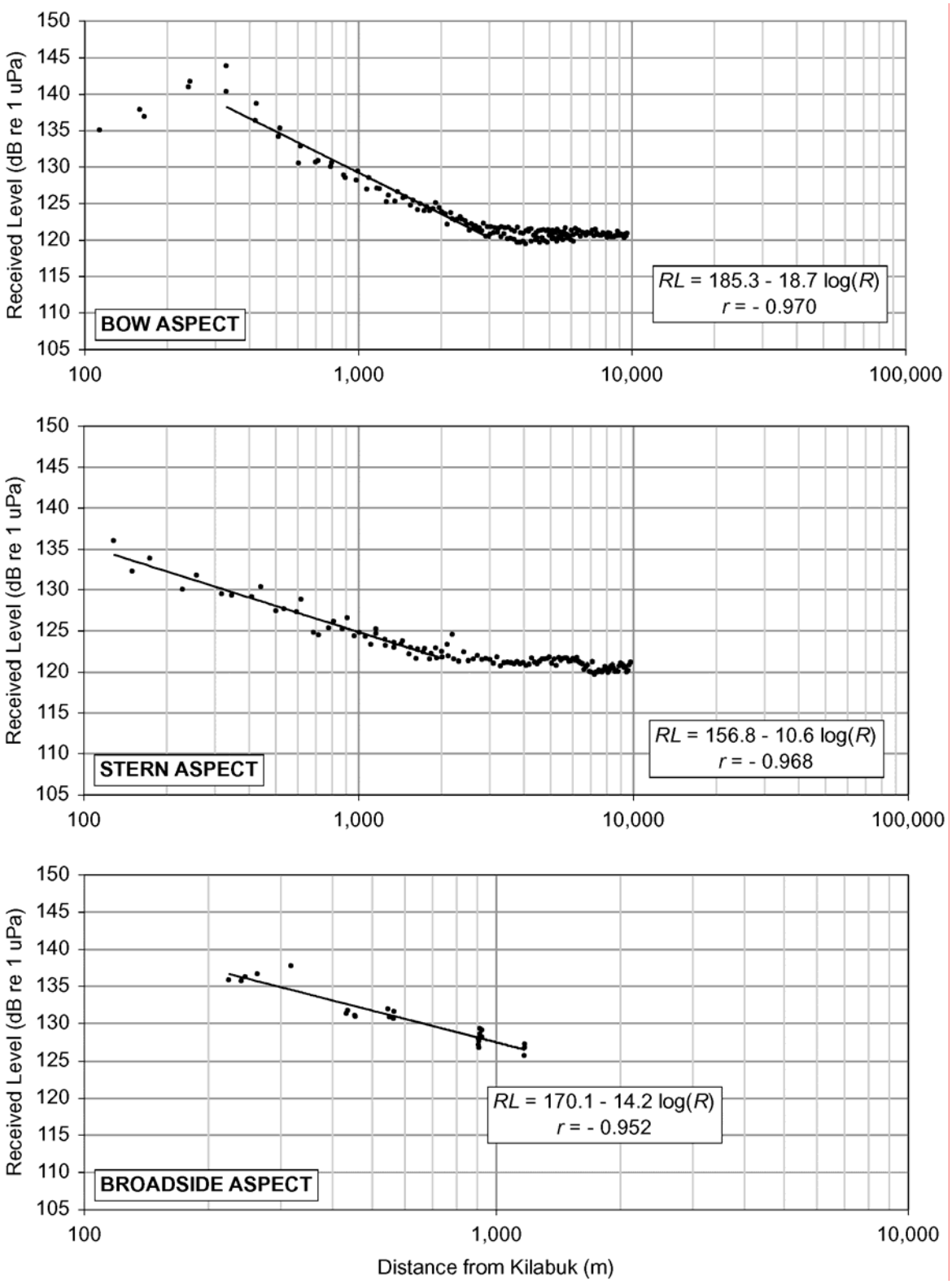

FIGURE 4.25. Broadband levels (10–20,000 Hz) of vessel sounds as a function of distance from the *Kilabuk*, for bow aspect (top), stern aspect (center), and broadside aspect (bottom). The regressions shown were calculated using data over the following ranges: ~300–3000 m for bow aspect, 100–2000 m for stern aspect, all data for broadside aspect (see text).

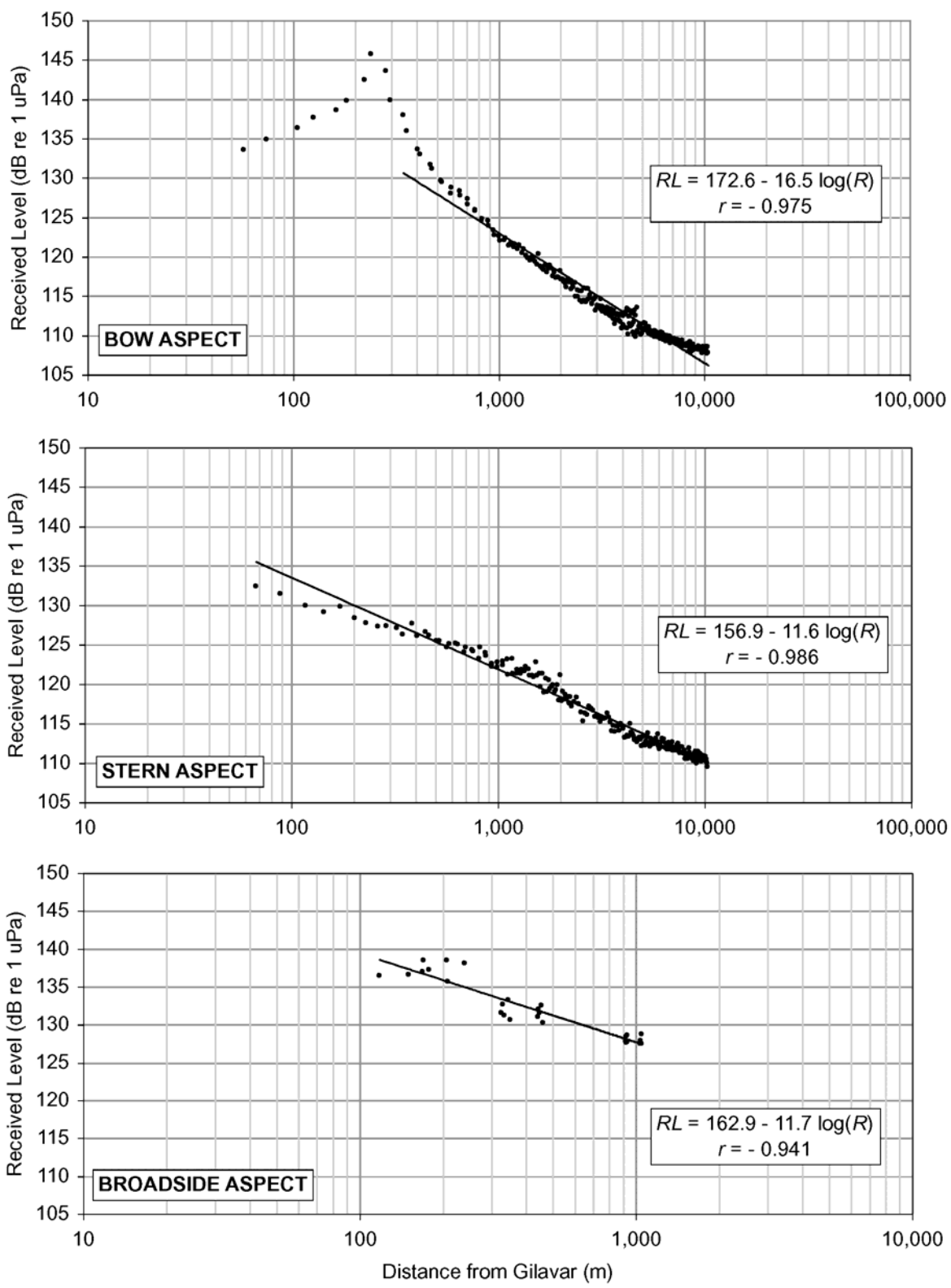

FIGURE 4.26. Broadband levels (10–20,000 Hz) of vessel sounds as a function of distance from the *Gilavar*, for bow aspect (top), stern aspect (center), and broadside aspect (bottom). The regressions shown were calculated using data over the following ranges: ~300–10,000 m for bow aspect, all data for stern and broadside aspects (see text).

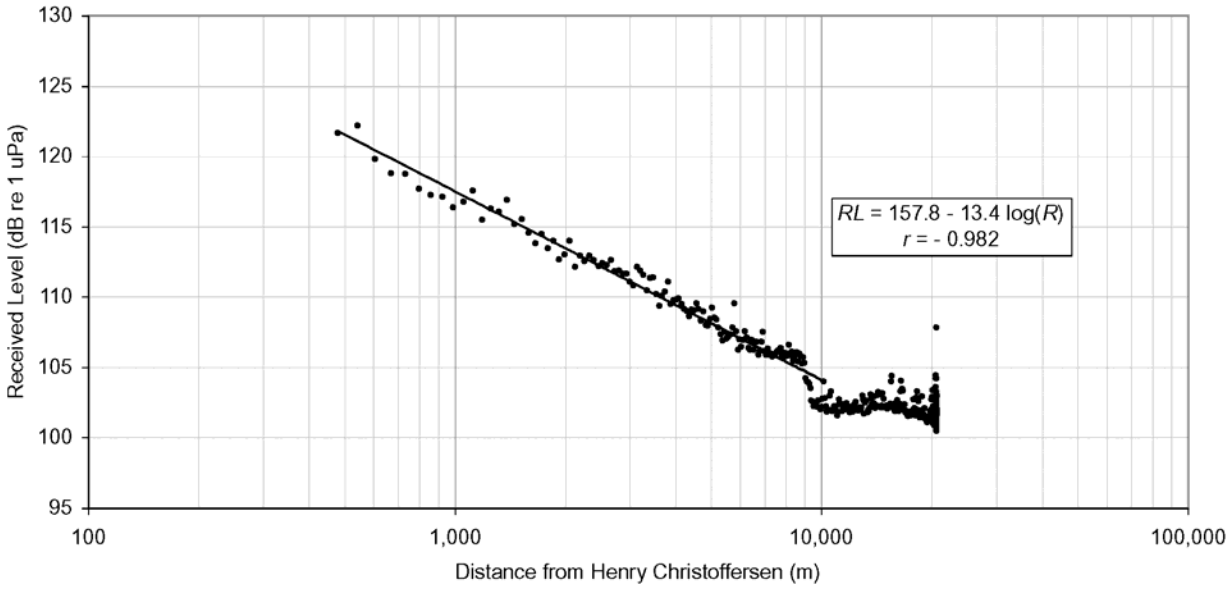

FIGURE 4.27. Broadband levels (10–20,000 Hz) of vessel sounds as a function of distance from the *Henry Christoffersen*.

Spectral Analyses

Kilabuk and Gilavar.—To describe the "sound signature" of each vessel, spectral analyses were performed on 10 s samples from recordings obtained when the vessels were close to the ASARs (i.e., with a high signal to background noise ratio). The results from these analyses are shown in Figures 4.28 and 4.29, showing one-third octave band levels and sound spectral density levels (respectively) for both ships. The *Gilavar* produced two large peaks at 15 and 31 Hz, and then several peaks at higher frequencies (359, 622, 1129, and 1246 Hz). The *Kilabuk* produced a series of peaks at low frequencies (32, 42, 45, 53, 67, 90, and 100 Hz).

Henry Christoffersen.—Spectral density levels for a 10 s sample while the *Henry C.* was about 310 m from the ASAR are shown in Figure 4.30. Again there are large peaks at low frequencies, 16–17 Hz, 47 Hz, and 93–94 Hz.

Sound Speed Profiles

Figure 4.31 shows sound speed profiles for the three sampling areas presented in this report: the locations of the recorders for the seismic measurements in the Chukchi Sea, the vessel sound measurements in the Chukchi Sea, and the seismic and vessel sound measurements in the Beaufort Sea. These profiles are relevant in assessing propagation of sound in each sampling area, and may be important in any future modeling or interpretation of the results presented above.

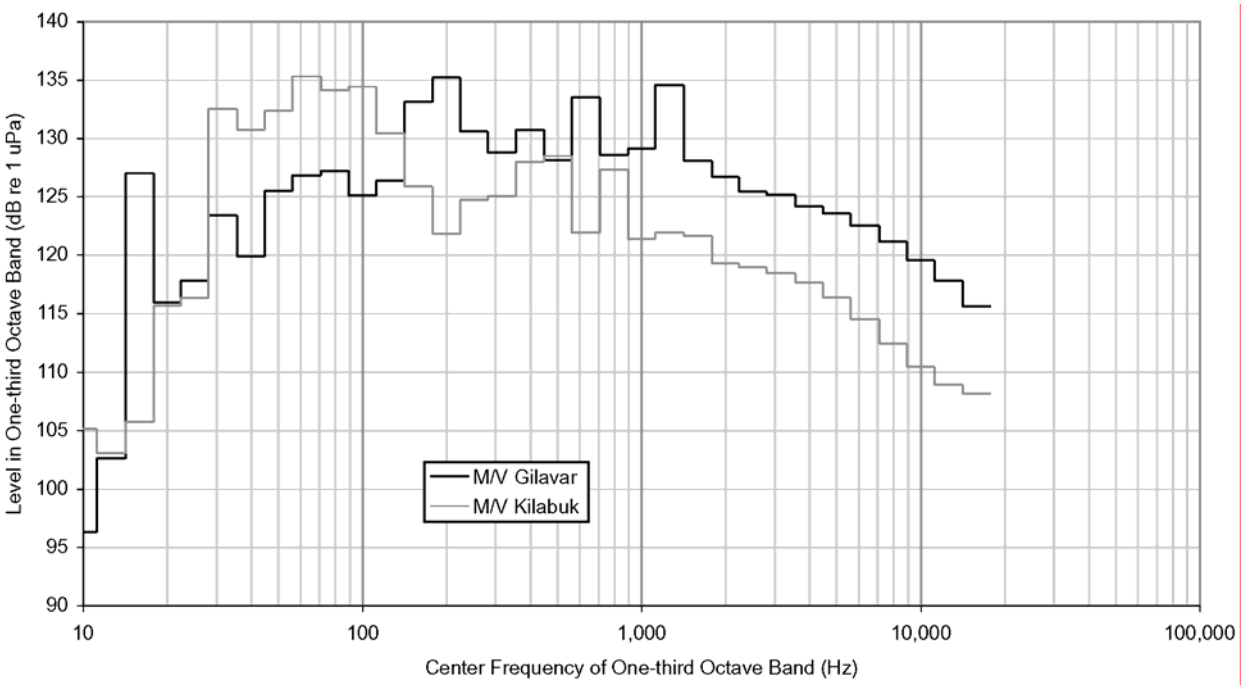

FIGURE 4.28. One-third octave band levels of vessel sounds for the *Gilavar* (black line) and *Kilabuk* (gray line). For each vessel, a 10 s sample was analyzed, taken at each vessel's closest point of approach to ASAR #2.

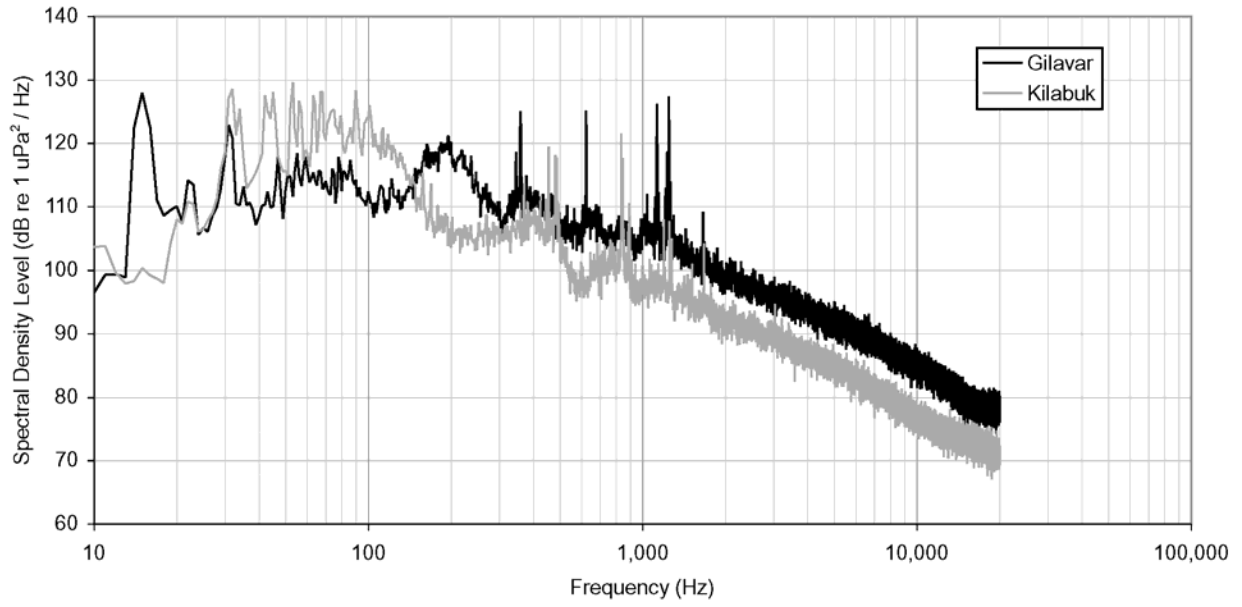

FIGURE 4.29. Spectral density levels of sounds from the *Gilavar* (black line) and the *Kilabuk* (gray line). For each vessel a 10 s sample was analyzed, taken at each vessel's closest point of approach to ASAR #2. FFT size was 44,100 samples, resulting in a 1 Hz bin width.

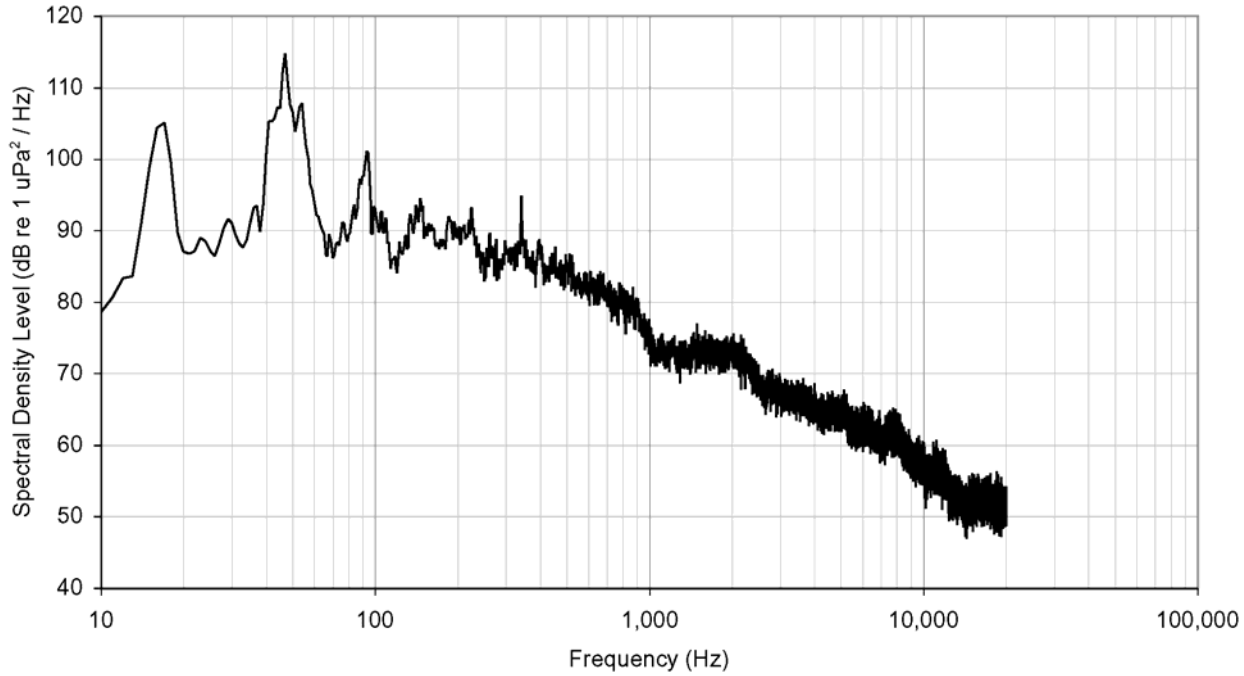

FIGURE 4.30. Spectral density levels of sounds from the *Henry Christoffersen*. A 10 s sample was analyzed, taken while the *Henry C.* was about 310 m from ASAR #2. FFT size was 44,100 samples, resulting in a 1 Hz bin width.

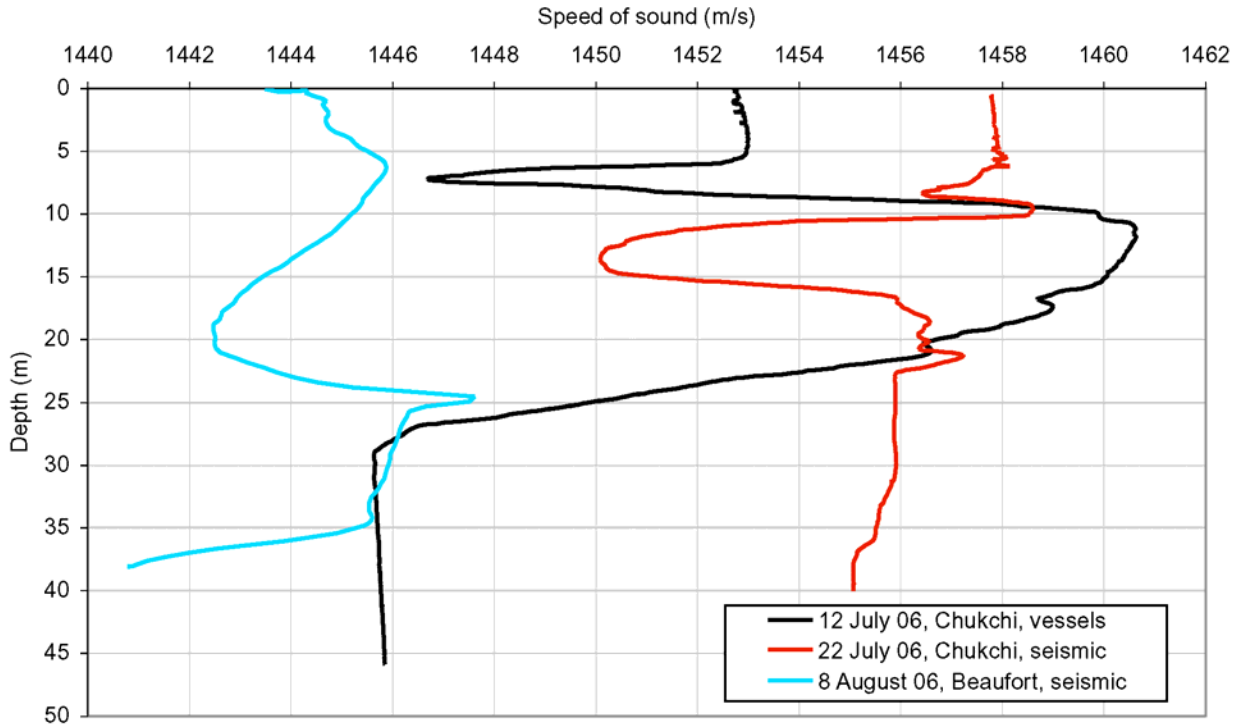

FIGURE 4.31. Sound speed profiles for three sampling locations in the Chukchi and Beaufort Seas (see text).

DISCUSSION

Seismic Sound Measurements

Airgun Pulse Properties

Figures 4.9 and 4.12 show that aspect dependence in the Chukchi Sea measurements was stronger for data collected with the one-string versus the three-string array. This was to be expected since, with the one-string array, there was only one "layer" of airguns (as opposed to three with three strings) and therefore no canceling between pulses traveling different distances to the receiver. This effect was predicted in quantitative terms in JASCO's pre-season modeling of the expected sound fields around the 1-string vs. 3-string arrays. With the one-string array, the highest values for all three level parameters—peak, SPL, and SEL—were found at broadside aspect. Stern aspect data had the lowest values. In three out of four cases (Table 4.4A) the distances to 190 dB and 180 dB (SEL and SPL) shown for the one-string array were 1.5–2 times greater for broadside data than for stern aspect data.

The broadside "face" of the airgun array does not change significantly as parallel strings are added, but the bow and stern "faces" significantly increase with the addition of parallel strings. Thus broadside values for the one-string vs. three-string arrays should be more similar than would be the stern or bow values for one-string vs. three-string arrays. A comparison of received levels (SPL, peak, SEL) at 1 km, as presented in Fig. 4.9 and 4.12, shows that bow and stern values are 7.2–7.8 dB lower for the one-string array compared to the three-string array, but broadside values are only 0.2–0.6 dB lower for the one-string array.

Received levels for all airgun pulse parameters were significantly lower for measurements made in the Beaufort Sea. The airgun cluster towed by the *Henry Christoffersen* included only 4 airguns with a total volume of 280 in^3, compared to 8 airguns totaling 1049 in^3 (one-string array) and 24 airguns totaling 3147 in^3 (three-string array) for the *Gilavar*. All else being equal, the amplitude of the pulses emitted by an array of airguns is proportional to the number of airguns and to the cube root of the total airgun volume (Caldwell and Dragoset 2000). Thus the pressure amplitude should be reduced by 83% (or 15.6 dB), between the *Gilavar*'s three-string (24 gun) array and the *Henry Christoffersen*'s four-gun cluster. The reduction in total gun volume from 3147 in^3 to 280 in^3 is expected to cause a further 45% reduction in amplitude (i.e., a further 7 dB). This adds up to an expected drop of ~23 dB between the *Gilavar*'s three-string array and the *Henry C.*'s four-gun cluster. In actuality, measured peak, SPL, and SEL values for the *Henry C.* were 16–20 dB lower than those for the *Gilavar* at 1000 m from the source, and 24–31 dB lower 10,000 m from the source.

Empirical Versus Predicted Radii

Table 4.4 shows that the difference between measured and predicted radii, as expressed by the E:P ratio, was generally smaller for SPLs than for SELs in the Chukchi Sea dataset. For SPLs the E:P ratios ranged between 0.7 and 4.7 (median = 4.1 and 2.9 for three-string and one-string arrays, respectively), whereas for SELs the E:P ratios ranged between 1.4 and 8.7 (median = 1.7 and 1.5 for three-string and one-string arrays, respectively). Since JASCO's MONM model generates SEL contours from which SPLs are calculated, this seems to indicate that there are variables that are either unknown and therefore not included in the model or that some variables have not been completely taken into account in the model. Differences in environmental conditions between the locations assumed in the model runs as compared with conditions at the ice-free locations where the empirical data were acquired presumably contributed to the deviations between empirical and predicted values. The sound speed profiles collected at the ASAR sites (see Fig. 4.31) are somewhat different than those used in the MONM model; however these differences would probably only contribute to discrepancies at distances larger than the ones of concern for the safety radii.

Differences in bottom properties at the ASAR vs. modeling sites, to the extent they existed, could have had an important effect on the predictions given the shallow water depth. Shallow depths normally cause strong dependence of propagation loss on the local bottom properties. Also, Figure 4.13 shows that the relationship between SPL, SEL, and distance from the sound source may be more complicated than assumed in converting JASCO's model output (in SEL) into the SPL values needed for mitigation purposes (see Chapter 3). Pulse duration and the SEL-to-SPL relationship depended on range, which was expected, but there also were nonlinearities in the way pulse durations increased with range.

Relationship Between SPL, SEL, and Source Distance

Sound exposure levels (SEL) do not depend on the duration of a pulse. Therefore SEL is the measure that is the least susceptible to variability from shot-to-shot, local propagation effects on pulse duration, and background noise. There is general agreement (Madsen 2005; Southall et al. submitted) that SEL is a better measure of an animal's exposure to pulsed or transient sound than is the commonly used SPL. In the dataset from the Chukchi Sea presented in this chapter, pulse-to-pulse variability was unusually low for all parameters (peak, SPL, SEL), but this was most likely due to homogenous physical conditions (i.e., water depth, bottom composition) in the recording area. Another advantage of SELs over SPLs is that a measure of cumulative sound exposure can be calculated when an animal is subjected to a sequence of short transient sounds (e.g., airgun or pile driving pulses) over extended time periods (see for example Madsen et al. 2006).

Despite the increasing popularity of SEL as a metric for reporting impulsive noise, current mitigation requirements and "take" criteria for noise transients, as applied in the U.S., are still based on the SPL metric. This includes the 180 and 190 dB re 1 μPa SPL safety radii for cetaceans and pinnipeds, respectively, and the 160 and 120 dB SPL disturbance criteria used in some situations. It is therefore important to understand the relationship between SPL, SEL, and distance from the sound source. Unfortunately most investigators have not reported their data in such a way as to allow comparisons with Figure 4.13. However, a few other studies provide relevant information as a function of distance from source:

- Greene and Burgess (2000, Fig. 3.5D) present SPLs and SELs for data collected in the Beaufort Sea in 23–26 m deep water and with a 5-m airgun tow depth. The difference between SPL and SEL was ~12 dB at 300 m range and ~5 dB at 6 km. In the Chukchi Sea we measured generally comparable differences, 10–12 dB at 300 m and 1–2 dB at 6 km (Fig. 4.13). Greene and Burgess (2000) did not make measurements at distances large enough for the SEL and SPL to assume equal numeric values.
- Austin et al. (2006), in a preliminary account of sound source verification measurements in the Chukchi Sea for GX Technology Corp., reported SPL–SEL differences of ~7 dB at 300 m and ~1.6 dB at 2.5 km. They made measurements to distances of over 50 km. Unlike the data we present in Fig. 4.13, there was no clear "cross-over" in their data (*cf.* Fig. 7 in Austin et al. 2006), where SEL values consistently exceeded SPL values. Instead their SPL and SEL values converged at ~3–9 km and then diverged out to the farthest measurement distance, with SEL values remaining on average smaller than SPL values. This suggests that, in their dataset, pulse durations did not exceed ~0.9 sec.
- Turner et al. (2006) is a preliminary report on similar measurements in the Chukchi Sea for ConocoPhillips. At ~300 m, SPL and SEL differed by ~10 dB and at 6 km by ~2 dB; this is nearly identical to results of Greene and Burgess (2000) from the Beaufort Sea. Beyond ~10 km in the data of Turner et al., SPL and SEL values were similar.

The results from these studies in the Chukchi and Beaufort seas indicate that the relationship between SPL, SEL, and distance from the sound source is not constant (e.g., see Fig. 4.6 vs. 4.16). It probably depends on the complex interaction between source spectrum and the dispersion characteristics of the propagation environment. A future regulatory focus on SEL rather than SPL would avoid many of the uncertainties involved with pulse durations and their effect on SPL-based safety radii. However, judging from the results of the present study, it will also be important to have an improved way of predicting SEL values for airgun arrays in advance of seismic projects: At least for the Chukchi Sea, the procedure used in 2006 under-predicted the SEL values and associated distances more seriously than it under-predicted the SPL values (Table 4.4).

Effects of M-weighting on Mitigation Results

The results presented in Figure 4.14 make it clear that *M*-weighting, as recommended by Miller et al. (2005) and Southall et al. (submitted), will affect the size of the 180 dB and 190 dB safety radii around an airgun array for certain species of marine mammals.

- For ***baleen whales*** such as bowhead and gray whales, with (presumed) good low-frequency hearing, weighting the received-level data will not change the size of safety radii appreciably. M_{lf}-weighted and unweighted SPL and SEL values are virtually the same (Fig. 4.14).

- For ***pinnipeds*** underwater, the M_{pw}-weighted 190 dB safety radius could shrink to roughly half of its unweighted value. However, the use of a 190- rather than 180-dB safety criterion for seals is at least in part in recognition of their reduced auditory sensitivity to low-frequency sound as compared to baleen whales. If M_{pw}-weighting is to be applied in deriving safety radii for seals, then it may be appropriate to use the M_{pw}-weighted 180 dB (not 190 dB) radius as the safety criterion for seals. The M_{pw}-weighted 180-dB radius is 168% of the unweighted 190-dB radii that are now used as the safety ranges for pinnipeds.

- For ***mid-frequency cetaceans*** such as beluga whales, the M_{mf}-weighted 180 dB safety radius would shrink to a third of its unweighted value.

Most power-downs and shut-downs of airguns during seismic production operations in the Chukchi and Beaufort seas are the result of ringed seal observations by the marine mammal observers (see Chapter 6). Therefore, taking *M*-weighting into account should lead to fewer such interruptions of seismic operations if the safety criterion is the M_{pw}-weighted 190 dB radius. If the safety criterion for seals were defined as the M_{pw}-weighted 180 dB radius, then the number of interruptions would actually increase.

Vessel Sound Measurements

Broadband (10–20,000 Hz) sound levels produced by the *Henry Christoffersen* in the Beaufort Sea were somewhat lower than those produced by the *Gilavar* and *Jim Kilabuk* in the Chukchi Sea. For both the *Gilavar* and *Kilabuk* the highest recorded broadband level was about 145 dB re 1 μPa at distances of ~200–300 m and broadband levels at 1000 m were between 120 and 130 dB. The highest level for the *Henry C.* was 122 dB at ~500 m and the value at 1000 m was ~117 dB re 1 μPa. Figure 3.19 in Greene and Burgess (2000) shows broadband levels as a function of range for four different ships (*Arctic Star, Western Endeavor*, *Saber Tooth,* and *Peregrine*) performing different activities in the Beaufort Sea or recorded over consecutive years. Overall, values for the *Henry Christoffersen* fall in the center of the cloud of points shown in the Greene and Burgess (2000) Figure, and the *Gilavar* and *Kilabuk* fall on the upper edge of that

cloud of points. The small landing craft *Peregrine*, which was also used during the 2006 seismic work described in this report (see Appendix D), was particularly quiet with broadband levels of ~111 dB and 95 dB re 1 μPa at distances of 200 m and 1000 m, respectively.

One noticeable difference between the *Gilavar* and *Kilabuk* data sets is the range at which "background" levels were reached, which was much shorter for the *Kilabuk* (~2 km) than the *Gilavar* (>10 km, see Fig. 4.24–4.26). This was due to different background levels rather than a difference in vessel broadband levels. The difference in background levels did not appear to correlate with changes in sea state; visual observations detected no obvious difference in sea state during the 2.25 hours separating the onset of each vessels' run. During the *Kilabuk* measurements the *Gilavar* was idling 5.6 km from the ASAR locations, whereas during the *Gilavar* measurements the *Kilabuk* was idling 9.3 km from the ASAR locations. However, it is unlikely that the idling *Gilavar* contributed noticeably to the background levels during the *Kilabuk*'s run, since during the zigzag portion of the *Gilavar*'s run, at distances of 0.3–1 km from the ASARs, minimum broadband levels were below "background" levels during the *Kilabuk*'s run (see Fig. 4.24, 16:45–17:30). Another possibility is the presence of another vessel within hearing range during the *Kilabuk*'s run, but we have no information on this possibility. Further spectral analyses would be needed to test these hypotheses.

In the mid-eighties, the *Jim Kilabuk* was named the *Canmar Supplier IV*. Greene (1985, 1987, also presented in Richardson et al. 1995) made recordings of broadband (20–1000 Hz) levels produced by the *Canmar Supplier IV*: ~147 dB at ~200 m, ~135 dB at ~1 km, and ~128 dB at ~10 km. These levels are noticeably higher than the ones presented for the *Kilabuk* in this report, and are also higher than any of the values reported in Figure 3.19 in Greene and Burgess (2000).

SUMMARY

During July through most of September 2006, Shell Offshore Inc. (SOI) conducted 3D/2D seismic surveys in the Chukchi Sea. During August through early October SOI conducted shallow-hazards surveys in the Beaufort Sea. Both types of surveys relied on the generation of underwater acoustic pulses. Greeneridge Sciences, Inc., measured the underwater sound levels produced by the vessels involved, including both seismic and support vessels, and by the acoustic equipment that was used, including airguns and shallow-hazards sources.

Before the onset of field work, JASCO Research Ltd. had estimated, by numerical modeling, the distances from the airgun arrays at which the broadband (rms) received levels would be 190 dB, 180 dB, 170 dB, 160 dB, and 120 dB re 1 μPa. Values measured by Greeneridge were compared to the values that had been predicted by modeling, and were used to recommend updated mitigation radii for use by marine mammal observers on the seismic and shallow hazards ships during data acquisition.

This chapter reports on data collected during two separate field trips involving three different vessels. The seismic ship MV *Gilavar* and the chase vessel MV *Jim Kilabuk* were used in the Chukchi Sea for seismic data acquisition, and the tug and shallow-hazards survey vessel MV *Henry Christoffersen* was used in the Beaufort Sea for acquisition of shallow-hazards data.

Airgun pulses were analyzed at distances of 0.3–34 km in the Chukchi Sea and 0.06–20.5 km in the Beaufort Sea. Logarithmic sound propagation models were fitted to pulse sound pressure levels (SPL), sound exposure levels (SEL), and peak levels. A three-string array (24 airguns totaling 3147 in^3) used in the Chukchi Sea produced the highest values but showed little aspect dependence. A one-string array (8 airguns totaling 1049 in^3) used in the Chukchi Sea showed stronger aspect dependence, with the broadside aspect producing the highest values. Received levels produced by the small airgun array used in the Beaufort Sea

(4 airguns totaling 280 in^3) were generally ~15–30 dB lower (depending on distance from the source) than those in the Chukchi Sea, mainly because the Beaufort Sea array was considerably smaller.

A comparison of empirical vs. modeled SPL values showed that the empirical distances exceeded predicted distances in most (but not all) situations. For the *three-string array,* the E:P (Empirical:Predicted) ratios ranged from 1.2× to 2.0× for the 160 dB, 180 dB, and 190 dB distances, depending on aspect. E:P ratios for the 120 dB distance were higher: 2.6× to 3.2× (considering only bow and stern aspect). For the *single-string array*, E:P ratios were somewhat higher for the 190 dB and 120 dB distances than for the 160–180 dB distances, but in some cases the empirical distances were in fact less than the predicted distances (E:P < 1.0). The E:P ratios for the airgun array used in the Beaufort Sea were in general lower (better) than those obtained in the Chukchi Sea.

A subset of pulses from the Chukchi Sea were *M*-weighted to assess the effect of *M*-weighting on the 190 dB and 180 dB mitigation radii. Three types of *M*-weighting functions were used, those for mid-frequency cetaceans (M_{mf}, e.g. beluga whales), pinnipeds in water (M_{pw}, e.g. ringed seals or walruses), and low-frequency cetaceans (M_{lf}, e.g. bowhead whales). M_{lf}-weighting had virtually no effect on mitigation radii as it barely affected received SPL, SEL, and peak levels. M_{mf}-weighting decreased the 180 dB and 190 dB mitigation radii by about two thirds. M_{pw}-weighting decreased the same mitigation radii by about a half. Since most shut-downs during production are due to the presence of ringed seals, using *M*-weighted data could decrease the number of shut-downs during production if the *M*-weighted 190 dB ratios were used as the safety radius.

Broadband (10–20,000 Hz) levels of vessel sound were analyzed as a function of distance from the sound source. Received levels at 500 m distance were 125–132 dB re 1 μPa for the seismic ship *Gilavar,* and 127–135 dB for the chase vessel *Jim Kilabuk*, depending on aspect (bow, stern, broadside). Both of these ships were recorded in the Chukchi Sea. In the Beaufort Sea, the received broadband level for the tug *Henry Christoffersen* at 500 m distance was ~122 dB re 1 μPa.

ACKNOWLEDGEMENTS

We wish to thank the captains and crews of the *Gilavar*, the *Jim Kilabuk*, and the *Henry Christoffersen* for their support in making these measurements. We could not have obtained any of these data without them. A special thanks to Chris Rollings (chief positioning specialist on the *Gilavar*) for providing the position data for the *Gilavar*. We also thank Michael Schlegel and his team (Geo LLC) for help and advice during the sound measurements from the *Henry C.* Dr. Bill Burgess (Greeneridge Sciences) reviewed the report and provided many useful comments. Dr. Dale Funk and Bob Rodrigues (LGL Alaska) also provided comments on a draft.

ANNEX 4.1: PRELIMINARY MEASUREMENTS OF *GILAVAR* AIRGUN SOUNDS

FIELD REPORT FOR VALIDATION MEASUREMENTS OF SOUNDS PRODUCED BY AIRGUNS ON *M/V GILAVAR* IN THE CHUKCHI SEA ON 21 JULY 2006

Prepared by Susanna B. Blackwell
Greeneridge Sciences, Inc.
120 Tamarack Drive
Aptos CA 95003
(831) 685 2773
susanna@greeneridge.com

Revised 6 August 2006[9]

On 21 July 2006 (at ~10:15 local time) two Autonomous Seafloor Acoustic Recorders model B (ASAR-Bs) were deployed on the seafloor ~200 m apart, close to the location 69º 35.85' N, 166º 0.0'W (water depth = 42 m). The recorders have a maximum recording time of about 13 hours at a 44.1 kHz sampling rate, so to maximize recording time their start times were offset. ASAR #2 started recording at 11:00 and ASAR #1 started recording 6 hours later, at 17:00. Between 11:00 on 21 July and 6:00 on 22 July the *M/V Gilavar* followed a course more than 125 km in length designed to provide information on airgun sounds at various distances (~200 m to nearly 35 km), different aspects (bow, stern, and broadside to the vessel) and for two array configurations (one-string and three-string).

Both ASARs were retrieved at ~6:15 on 22 July and 16 GB of acoustic data were downloaded to a laptop computer. Both recorders performed as expected.

The *Gilavar* provided us with time and location information for most of the airgun pulses produced during the recordings. A total of >700 pulses were individually selected and analyzed from most parts of the acoustic records. Groups of 10 consecutive pulses were analyzed about every 10 minutes from all tracks. All or most pulses were analyzed during the few hundred meters preceding and following the *Gilavar*'s closest point of approach (to the ASARs) during each pass. Each analyzed pulse was matched with the location information provided. Broadband sound pressure levels (SPL), which are equivalent to rms (root mean square) levels as used by NMFS for mitigation purposes, were determined for each analyzed pulse. These SPL values were plotted as a function of distance and a sound propagation equation of the type

$$\boldsymbol{RL} = a - b*\log(R) - c*R \qquad \text{Eq. I}$$

[9] This revision supersedes the draft of 26 July 2006, in which the distance estimates to 190 dB, 180 dB, 170 dB, and 160 dB were based on a simpler and less appropriate regression approach which did not take scattering and absorption losses into account.

was fitted to the data. ***RL*** is the received level and *R* is the distance (m) from the source. Two separate data sets were analyzed:

(1) Full array configuration (3 strings, 3147 in^3) – most of the data obtained were with the full array configuration. Data were split into three categories: (a) bow aspect (bow of ship oriented towards ASARs); (b) stern aspect (stern of ship and thus airgun array oriented towards ASARs) and broadside aspect (side of ship oriented towards ASARs). A separate regression was done for sound pressure level data for each of those three categories.

(2) Reduced configuration (1 string, 1149 in^3) – this configuration was used during a few hours in early morning on 22 July. Data were insufficient to split into the three aspect categories mentioned above, so a sound propagation equation was fitted to all pulses analyzed regardless of their aspect (the vast majority of the pulses belonged to the stern aspect category).

Values of *a* (intercept, see Eq. I), *b*, and *c* for the obtained equations are shown in Table 1. The scatter plots and regressions themselves are shown in Figure 1 for the three categories of data obtained with the three-string array, and in Figure 2 for data obtained with the one-string array. The equations shown in Table 1 were used to calculate the distances to 190 dB, 180 dB, 170 dB, 160 dB, and 120 dB re 1 μPa. These distances are shown in Table 2 for the three-string array and Table 3 for the one-string array. Each table also shows the radii predicted by sound propagation modeling done by JASCO Research Ltd. prior to the start of the field season, and the ratios between the field measurements and the predicted values.

With the full three-string array configuration (Table 2), the "field : predicted" ratios for the 190 dB, 180 dB, 170 dB, and 160 dB ranges are 1.2 to 1.9, with most being below 1.5, i.e. the measured values exceeded the modeled values, but generally by no more than a factor of 1.5x. The "field : predicted" ratios for the distances to the 120 dB level were higher, 2.4x to 3.3x. However, the empirical estimates shown in Table 2 are the result of extrapolations over 30+ km beyond the farthest measurement distances. A certain amount of uncertainty is therefore associated with these distances and the resulting ratios.

TABLE 1. Values for variables *a*, *b*, and *c* (Eq. I) in the regressions (sound propagation equations) fitted to four different data sets: pulses produced with the full array (3 strings), for three different aspects, and pulses produced with the reduced array (1 string). The multiple-*R* value is also shown for each equation as well as the range of distances over which the measurements were made and the sample size (number of pulses analyzed).

	a	*b*	*c*	*R* value	Range of distances (km)	Sample size
Full array						
- bow	248.74	22.02	0.000345	-0.998	0.2–30	193
- stern	248.17	22.66	0.000192	-0.994	0.2–34	153
- broadside	238.12	18.85	0.000436	-0.993	0.5–33	148
Reduced array	255.54	26.55	0.000132	-0.990	0.2–30	239

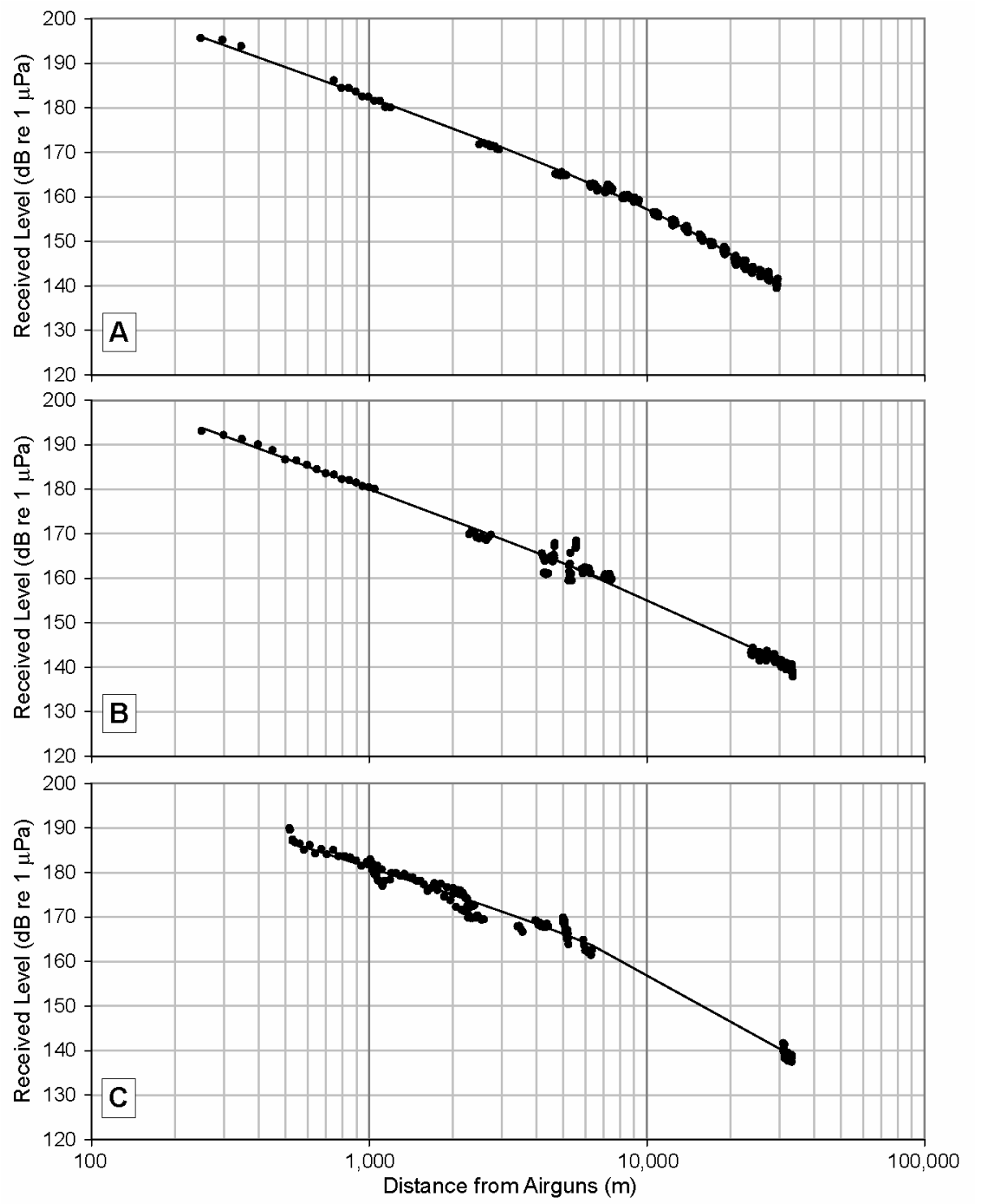

FIGURE 1. SPL values as a function of range for the three-string array. Equations for the lines shown are in Table 1. ***(A)*** Bow aspect; ***(B)*** Stern aspect; ***(C)*** Broadside aspect.

TABLE 2. Distances to specified received SPLs obtained for three-string airgun array, and comparison with modeled values. All distance values are in kilometers. The "field : predicted" ratios were calculated with unrounded distances.

	JASCO predictions	Field measurements			"Field : predicted" ratios		
	C_1, 3147 in^3	Bow	Stern	Broadside	Bow	Stern	Broadside
190 dB	0.23	0.44	0.35	0.33	1.9	1.5	1.4
180 dB	0.81	1.2	0.95	1.1	1.5	1.2	1.3
170 dB	2.19	3.2	2.6	3.3	1.5	1.2	1.5
160 dB	4.53	7.7	6.5	8.4	1.7	1.4	1.9
120 dB	26	65	84	62	2.5	3.3	2.4

TABLE 3. Distances to specified received SPLs obtained for one-string airgun array, and comparison with modeled values. All distance values are in kilometers. The "field : predicted" ratios were calculated with unrounded distances.

	JASCO predictions C_1, 1149 in^3	Field measurements	"Field : predicted" ratios
190 dB	0.26	0.28	1.1
180 dB	0.96	0.67	0.7
170 dB	2.5	1.6	0.6
160 dB	4.7	3.6	0.8
120 dB	35	61	1.7

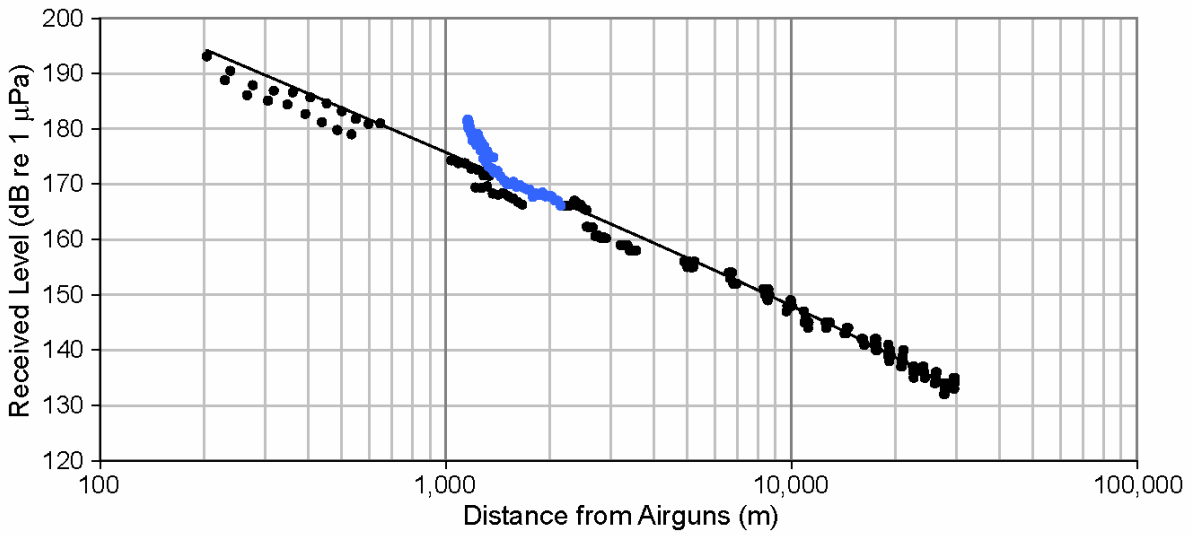

FIGURE 2. SPL values as a function of range for the one-string array. Stern and bow aspect data are shown in black symbols and broadside data are shown in blue symbols. All data were used in calculating the regression. The equation for the line is in Table 1.

There was good agreement between modeled and empirical values for the reduced array configuration (Table 3). The modeled radii for 180 dB, 170 dB, and 160 dB were actually larger than the empirical values, probably because of aspect effects. Most of the empirical data (~85%)

collected with the one-string array fell in the stern aspect category. Broadside data (blue symbols in Fig. 2) were collected during a 2.6 km long southward run ~1.2 km east of the ASARs, with the guns at full volume during the entire run. As the ASARs' latitude was close to the northern end of this run the data became progressively more "stern-like" as the *Gilavar* went south and range increased. For a single-string array aligned parallel to the ship's trackline, we would expect somewhat higher levels at the broadside aspect than from the bow or stern aspects. The empirical data are consistent with this.

Table 4 shows recommended mitigation radii for use by marine mammal observers on the *M/V Gilavar* for both types of arrays. The actual 190 dB, 180 dB, and 160 dB radii will vary depending on aspect (as shown in Table 2) and local conditions. For the ***three-string array*** the maximum of the 3 values (bow, stern, broadside) for each mitigation radius is therefore reasonable as a protective estimate and is shown in Table 4. For the ***one-string array***, the recommended mitigation distance for each criterion is the larger of the empirical or predicted distance (from Table 3). For the one-string array, distances in the cross-track (broadside) direction were not measured. As it is likely that the cross-track distances exceeded those in the along-track direction, the protective approach is to use the predicted distances where these exceed the measured along-track distances.

TABLE 4. Mitigation radii based on empirical data.

	Array size	
	Three-string 3147 in^3	One-string 1149 in^3
190 dB	440 m	280 m
180 dB	1200 m	960 m
160 dB	8.4 km	4.7 km

The actual 120 dB (rms) radius is inevitably more variable than are the radii for the higher received levels, given the longer distances that are involved and the effects of local variations in propagation conditions along those long propagation paths. Also, the necessity to use the fitted regression equations to extrapolate beyond the range of distances with empirical data results in some further uncertainty. Given these considerations, plus the different aspects that were involved, the span of the three estimates for the full 3-string array (62 km to 84 km, Table 2) is relatively narrow.

ANNEX 4.2: PRELIMINARY MEASUREMENTS OF SHALLOW HAZARDS SURVEY SOUNDS

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16 August 2006

To: Shell International Offshore Inc.
Attn: Mark Kosiara and Michael Macrander

From: Charles Greene, Greeneridge Sciences Inc.

Subject: Measurements of the tug propulsion sounds for *M.V. Henry Christoffersen*, 8 August 2006, Field Report #2

Reference: Measurements of the acoustic sources for the shallow hazard survey by *M.V. Henry Christoffersen*, 8 August 2006, Field Report dated 14 August 2006

Dear Mark and Michael:

This letter presents preliminary results of the measurements of received sound levels vs. distance for propulsion sounds from the tug M.V. Henry Christoffersen to the autonomous seafloor acoustic recorders, model B (ASAR-Bs), not including any survey sound sources. The vessel sounds correspond to survey conditions: only two of four engines, both operating at reduced power and at a speed on the order of 4 knots. The water depth at the recorder installation site was about 48 m and diminished to 37 m at the end of the 20 km course. The starting location was about 54 km east of Kaktovik and the course followed was about 280° T.

The sound level measurements were from the periods between survey pulses and hence represent broadband received levels vs. distance for the tug propulsion sounds. The tug has four engines, each driving a propeller lined up from side to side with two on the outside ("outboard") and two in the middle ("inboard"). The tug was operating on its two outboard engines at reduced power and was making a speed of about 4 knots, suitable for a survey.

This letter is intended for readers who are already familiar with the background and objectives for the measurements. Analyses for this report were for the broadband sounds without frequency analysis.

The letter presents the result of fitting an equation of the form

$$RL \text{ (received level in dB re 1 } \mu\text{Pa rms)} = A - B*\log(R) \quad \text{(for R in meters)}$$

to the measurements. The reference report used an equation with a – C*R term to account for absorption and scattering of the survey sound sources, but the range of distances available here (see below) is inadequate for expecting a rational result for such a term. The equation permits calculating the distances to specific broadband received levels like 120 dB re 1 μPa rms.

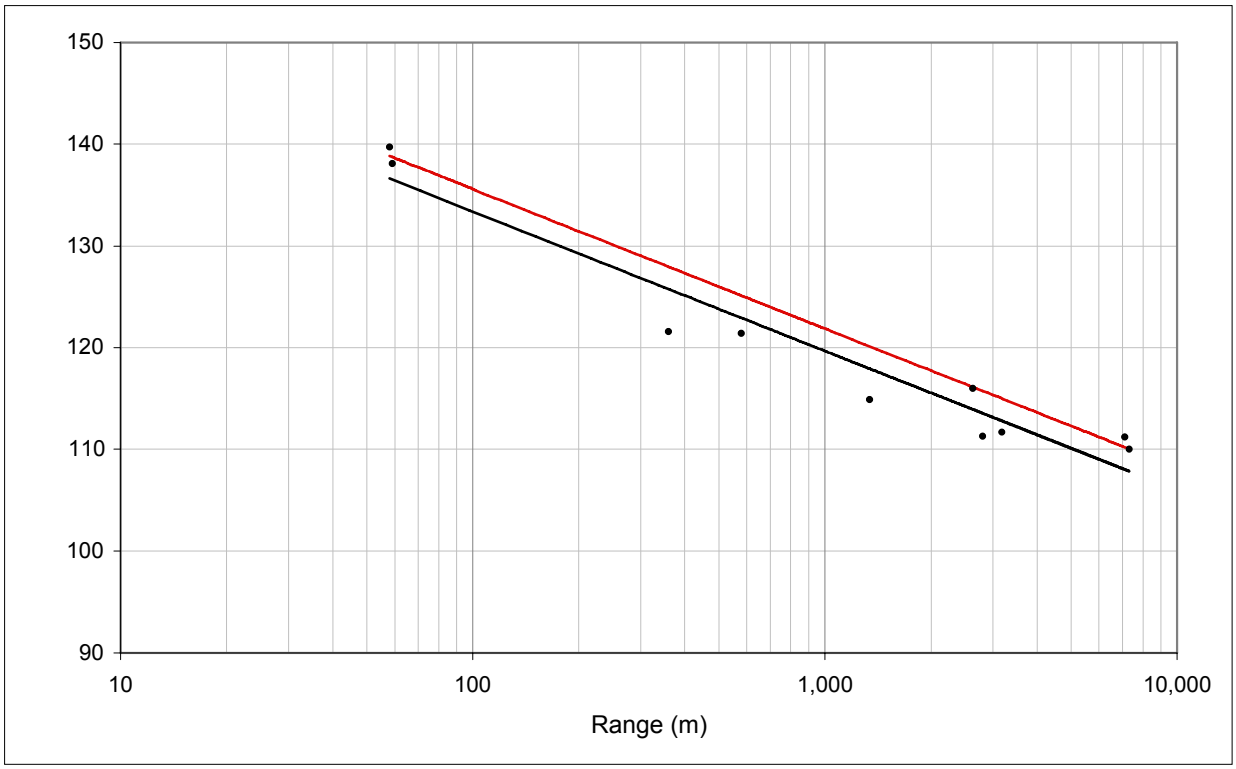
The following Figure shows 10 measured received levels at distances from 58 to 7,320 m. The most distant four measurements, for distances from 12,730 to 20,530 m, were all in the range from 100.1

to 101.4 dB re 1 µPa rms, showing no variation with distance, and are taken to be the background ambient noise level at the measurement site uninfluenced by the tug. They are not plotted. For the 10 remaining values, measured from 58 to 7320 m and resulting in sound pressure levels of 139.7 to 110 dB re 1 µPa rms, the following equation was derived by standard least-squares curve fitting:

RL (received level in dB re 1 µPa rms) = 160.8 – 13.71*log(R) (for R in meters).

The equation results in distances <1 m to 190, 180, and 170 dB and <2 m for the 160 dB received level. The coefficient of determination is 0.9754. The equation results in a distance of 950 m to a received level of 120 dB re 1 µPa rms. This is the distance that would be used in conjunction with an animal density in estimating the number of animals that might have been exposed to a 120-dB sound pressure level.

Because the fitted equation is based on a standard least-squares fit to the measured data, about 50% of the measurements fall above and 50% fall below the fitted curve. Increasing the constant term from 160.8 to 163 results in an equation that exceeds most of the measurement points and predicts a 120 dB (rms) distance of 1370 m. This is the distance beyond which a sound pressure level of 120 dB would not be expected to occur. The following Figure shows the measured data points and the lines corresponding to both the original regression result (lower) and the raised equation (upper).



The 950- and 1370-m distances cited above for the 120 dB contour and monitoring ranges are specifically for the tug operating with survey sources deployed and at slow speed with only two engines each operating at reduced power. For a transiting situation with four engines at normal power and higher speed, longer distances are inevitable. The sound recordings made on 8 August include measurements under those conditions from about 20 km to <100 m but have not been analyzed.

Please call or send email if you have questions about this preliminary material.

Sincerely,

Charles R. Greene
Tel and Fax: 805-967-7720
E-mail: cgreene@greeneridge.com

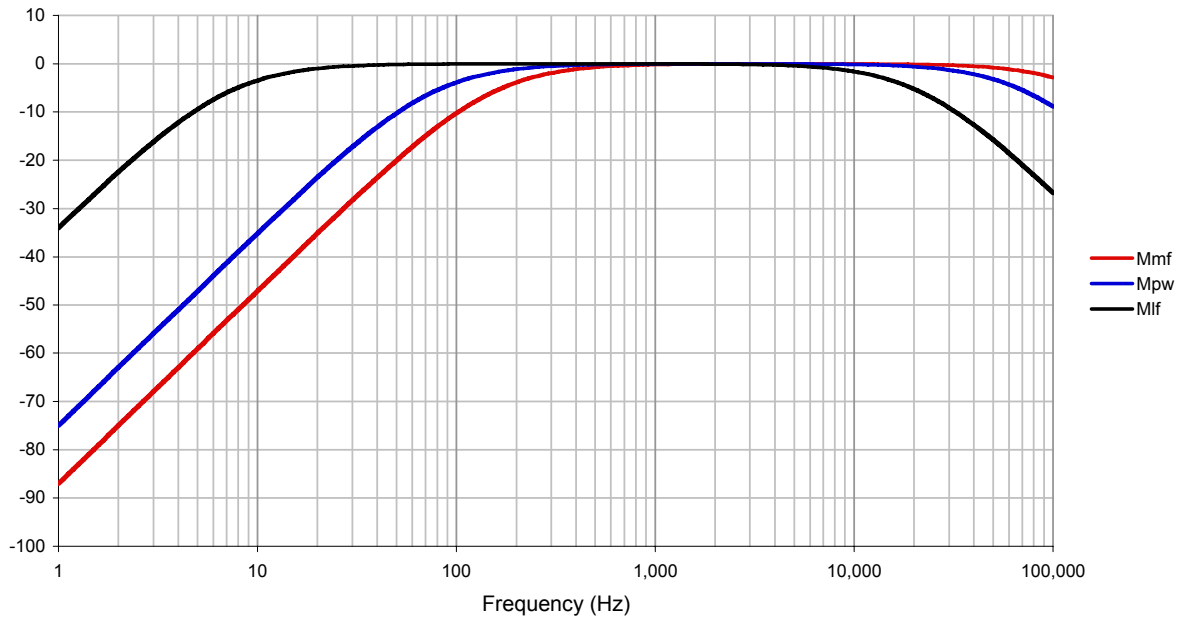
cc: Dale Funk, PhD, LGL Alaska, and W. John Richardson, Ph.D., LGL Ltd.

ANNEX 4.3: M-WEIGHTING FUNCTIONS

M-weighting is a filtering algorithm that de-emphasizes frequencies which an animal of concern cannot hear, or hears only weakly. In this report recordings of airgun sounds collected in the Chukchi Sea on 21 July 2006 were *M*-weighted to show the effect of this filtering on received sound pressure levels (SPL) and sound exposure levels (SEL). These results are presented in Figure 4.14. Three different types of *M*-weighting functions were used, one for mid-frequency cetaceans (which include beluga whales), one for pinnipeds in water (seals and walruses), and one for low-frequency cetaceans (bowhead and gray whales). The different *M*-weighting functions are determined by the variables f_{low} and f_{high}, which are conservative estimates of the lower and upper boundaries of effective hearing for each group. F_{low} and f_{high} take on the following values:

- mid-frequency cetaceans (M_{mf}): f_{low} = 150 Hz, f_{high} = 160 kHz;
- pinnipeds in water (M_{pw}): f_{low} = 75 Hz, f_{high} = 75 kHz;
- low-frequency cetaceans (M_{lf}): f_{low} = 7 Hz, f_{high} = 22 kHz;

The Figure below is a graphic representation of the three *M*-weighting functions described above. In this Figure unweighted data would be plotted as a horizontal line at y = 0. Similarly, frequencies between 1 kHz and 3 kHz are untouched by all three weighting functions. The break frequencies (listed above) are the points at which the frequency response has been de-emphasized by 6 dB.



5. MONITORING AND MITIGATION METHODS [10]

This chapter describes the marine mammal monitoring and mitigation measures implemented for SOI's seismic studies in the Chukchi Sea and Shallow hazards survey work in the Beaufort Sea, addressing the requirements specified in the IHAs (Appendices A and B). The section begins with a brief summary of the monitoring tasks relevant to mitigation for marine mammals. A summary of the mitigation measures required by NMFS and USFWS is then presented. The section ends with a description of the vessel-based and aerial survey monitoring and mitigation methods implemented for these surveys and a description of data analysis methods.

Monitoring Tasks

The main purposes of the vessel-based monitoring program were to ensure that the provisions of the IHAs issued to SOI by NMFS and USFWS were satisfied, effects on marine mammals were minimized, and residual effects on animals were documented. Tasks specific to monitoring are listed below (also see Appendix A):

- Provide qualified MMOs for the source and support vessels throughout the seismic surveys in the Chukchi and Beaufort seas.
- Visually monitor the occurrence and behavior of marine mammals near the airguns when the airguns are operating and during a sample of the times when they are not.
- Visually monitor the occurrence and behavior of marine mammals near support vessels when underway.
- Use support vessels to conduct visual surveys of areas where airgun sound could have received levels ≥160 dB re 1 μPa $_{rms}$.
- Record (insofar as possible) the effects of the airgun operations and the resulting sounds on marine mammals.
- Use the visual monitoring data as a basis for implementing the required mitigation measures.
- Estimate the number of marine mammals potentially exposed to strong airgun sounds.

Safety and Potential Disturbance Radii

Chukchi Sea—Gilavar

Under current NMFS guidelines (e.g., NMFS 2000), "safety radii" for marine mammals around airgun arrays are customarily defined as the distances within which received pulse levels are ≥180 dB re 1 μPa (rms) for cetaceans and ≥190 dB re 1 μPa (rms) for pinnipeds. The ≥190 dB re 1 μPa (rms) guideline was also employed by the USFWS for the animals under its jurisdiction (polar bears and walruses) in its IHA issued to SOI. These safety criteria are based on an assumption that seismic pulses at lower received levels will not injure these animals or impair their hearing abilities, but that higher received levels *might* have some such effects. Marine mammals exposed to ≥160 dB (rms) are assumed by NMFS to be potentially subject to behavioral disturbance. However, for certain groups (dolphins,

[10] Chapter 5 by R. Rodrigues, T.A. Thomas, B. Haley and H. Patterson (LGL).

pinnipeds), available data indicate that disturbance is unlikely to occur unless received levels are higher, perhaps ≥170 dB rms for an average animal.

For the current seismic project there has also been concern that received pulse levels as low as 120 dB (rms) may have the potential to disturb some whales. In 2006, there was a requirement to implement special mitigation measures if specified numbers of bowhead cow/calf pairs might be exposed to ≥120 dB rms or if large groups (≥12 individuals) of bowhead or gray whales might be exposed to ≥160 dB rms (MMS 2006). Monitoring of the 160 and 120 dB zones, which was required in the IHA issued by NMFS, is discussed below in the section on Special Mitigation Measures.

SOI's IHA applications described the anticipated underwater sound field around the planned 3147 in^3 airgun array with guns at a depth of 6 m (20 ft). The anticipated acoustic signature for this array was first computed using GSAP, WesternGeco's in-house signature modeling software, and sound output radii for the array were estimated (Table 5.1A).

Subsequent to submitting its applications, SOI contracted with JASCO Research Ltd. to model sound source characteristics using a different model (see Chapter 3). The JASCO implementation of a parabolic equation model was believed by SOI and NMFS to be superior in these waters because it accounts for effects of bathymetry, water properties, and the geoacoustic properties of seabed layers. The radii predicted by JASCO (Table 5.1B) were based on the worst case model predictions. This model was used by SOI to estimate sound level isopleths and radii for received rms sound levels between 120 and 190 dB. These predicted distances were multiplied by a safety margin of 1.5× to obtain initial protective marine mammal safety radii (based on the 190 and 180 dB rms criteria) as well as estimates of "disturbance radii".

Field measurements of the received airgun sounds as a function of distance and aspect were acquired prior to the beginning of routine seismic data acquisition (Blackwell 2006). In all cases involving the primary airgun array (3 strings; total of 24 airguns), measured radii were greater than modeled radii (Table 5.1C). The empirical measurements of the 180 and 190 dB rms radii, as presented by Blackwell (2006), were adopted as safety radii for the survey.

More extensive analysis of the field measurements was completed after the field season, as described in Chapter 4. Those analyses resulted in some refinements of the various radii (Table 5.1D). The refined values were not available for use by the MMOs in the field. However, the refined estimates have been used in Chapter 6 to estimate the numbers of marine mammals exposed to various sound levels.

Airguns operating underwater do not produce strong sounds in air. Accordingly, no shut downs or power downs were implemented for marine mammals on ice. (In any case, none of the sightings of marine mammals on the ice occurred during periods of airgun operation.)

Beaufort Sea—Henry Christoffersen

Sound levels for the equipment on the *Henry Christoffersen* were also modeled by JASCO (see Chapter 3 and Table 5.2A). The actual underwater sounds were recorded as a function of distance on 8 Aug. 2006 in the Beaufort Sea east of Kaktovik, and Table 5.2B,C shows the preliminary and final results of analyses of those data (from Greene 2006 and Chapter 4, respectively). Measured 190, 180, 170 and 160 dB (rms) distances were greater than corresponding predicted distances (Table 5.2). The measured 120 dB distance was less than the predicted distance. The preliminary measurements of the 190 and 180 dB (rms) radii were applied as the safety radii during seismic operations; the final values were used for the analyses in Chapter 6.

TABLE 5.1. Comparison of various predictions and measurements of the 190, 180, 170, 160 and 120 dB rms distances (in km) for sound pulses from the 3-string airgun array deployed from M/V *Gilavar* in the Chukchi Sea, Alaska, 2006.

Received Level (dB re 1 µPa $_{rms}$)	**A.** Radii based on WesternGeco modeling (SOI 2005a,b)	**B.** Radii based on JASCO modeling (Chapter 3)	**C.** Preliminary Measured Radii (Black-well 2006)	**D.** Final Measured Radii (km) (Chapter 4)
190	.120	0.23	0.44	0.46
180	.225	0.81	1.2	1.40
170	.425	2.19	3.3	4.72
160	.650	4.53	8.4	7.99
120	N/A	26	84[a]	82.89

[a] Broadside- and bow-aspect distances (those most relevant for mitigation) were estimated as 62 and 65 km.

TABLE 5.2. Comparison of various predictions and measurements of the 190, 180, 170, 160 and 120 dB rms distances (in km) for sound pulses from the 4-airgun cluster deployed from M/V *Henry Christoffersen* in the Alaskan Beaufort Sea, 2006.

Received Level (dB re 1 µPa $_{rms}$)	**A.** Radii based on JASCO modeling (Chapter 3)	**B.** Preliminary Measured Radii (Greene 2006)	**C.** Final Measured Radii (km) (Chapter 4)
190	0.02	0.12	0.09
180	0.15	0.33	0.25
170	0.30	0.88	0.68
160	0.99	2.22	1.75
120	35.98	24.5	22.2

Mitigation Measures as Implemented

The primary mitigation measures that were implemented during the seismic activities in the Chukchi and Beaufort seas included ramp up, power down, and shut down of the airguns. These measures are standard procedures during seismic cruises and are described in detail in Appendix E. Mitigation also included those measures specifically identified in the IHAs (Appendices A and B) as indicated below.

Standard Mitigation Measures

Standard mitigation measures implemented during the study included the following:

1. Safety radii implemented for the seismic activities were determined based on the preliminary results of the empirical sound measurement studies reported by Blackwell (2006; Table 5.1C) and by Greene (2006; Table 5.2B).
2. Power-down or shut-down procedures were implemented when a marine mammal was sighted within or approaching the applicable safety radius while the airguns were operating. At SOI's request, power-down and shut-down procedures were implemented for pinnipeds sighted within 600 m and 300 m of the *Gilavar*'s operating airguns (i.e., at distances greater than the 190 dB distance from the 3-string array and from a single airgun). This protective measure was in response to the observation of reactions by seals sighted outside the measured 190 dB radius but within 600 m of the airgun array.

3. A change in vessel course and/or speed alteration was identified as a potential mitigation measure if a marine mammal was detected outside the safety radius and, based on its position and motion relative to the ship track, was judged likely to enter the safety radius. In practice, this measure was not implemented because the Gilavar was unable to maneuver while towing the airguns and streamers.
4. A ramp-up procedure was implemented whenever operation of the airguns was initiated.
5. In order for seismic operations to start up during day or night, the full applicable safety radius must have been visible for at least 30 min.

The specific procedures applied during power downs, shut downs, and ramp ups are described in Appendix E. Briefly, a ***power down*** as implemented aboard the *Gilavar* involved reducing the number of operating airguns from the full array of 24 airguns to either one or two airguns when a marine mammal was observed approaching or was seen within the safety radius. Power down also occurred when the *Gilavar* was between seismic survey lines to reduce the area of ensonification. The 190 and 180 dB radii around the much-reduced source operated during a power down were 230 m and 360 m. A ***shut down*** involved suspending operation of all airguns. A shut down was sometimes implemented when a mammal was first sighted within or approaching its safety radius. At other times the airgun array was first powered down, and was later fully shut down if the mammal approached the safety radius around the small source that operated during power downs. A ***ramp-up*** involved a gradual increase in the number of airguns operating, with the number of operating guns generally being doubled every 5 min until the full array was operating.

Special Mitigation Measures as Required by NMFS

In addition to the standard safety radii based on the 190 and 180 dB (rms) distances for pinnipeds and cetaceans, respectively, NMFS (in the IHA) required SOI to monitor the 160 dB radius during all seismic activities. Also, SOI was required to monitor the 120 dB radius after 1 Sept. in the Beaufort Sea and after 25 Sept. in the Chukchi Sea during periods when seismic surveys were occurring. (In the Chukchi Sea, monitoring of the 120 dB zone would have been necessary at an earlier date if 4 migratory bowhead cow/calf pairs were observed during the vessel-based monitoring, or if bowhead whale hunters had determined that cow/calf pairs were passing Barrow in significant numbers.) None of those special criteria were met, so 25 Sept. was the operative date after which monitoring of the 120 dB zone was required in the Chukchi Sea.)

Depending on the results of the monitoring of the 160 dB or 120 dB zones, special mitigation measures were to be implemented:

1. Power-down or shut-down procedures were to be implemented if groups of 12 or more bowhead or gray whales were within the 160 dB (rms) radius while the airguns were in operation.
2. Power-down or shut-down procedures were to be implemented if 4 or more bowhead cow/calf pairs were within the 120 dB (rms) radius after the specified date.

The 160 dB radius was determined by Blackwell (2006) to extend ~8.4 km from the airgun source on the *Gilavar* and was monitored by MMOs onboard the *Kilabuk*. During monitoring of the 160 dB zone the *Kilabuk* followed a zig-zag pattern ~6–8 km ahead of the *Gilavar* (Fig. 5.1). MMOs onboard the *Kilabuk* searched the area ahead of the *Gilavar* within the 160 dB zone for marine mammals. Mitigation (i.e., power down or shut down of the airgun array) was to be implemented if a group of 12 or more bowhead or gray whales entered the 160 dB zone. However, no large groups of baleen whales were observed within the 160 dB zone and no power downs or shut downs were necessary to meet this IHA requirement.

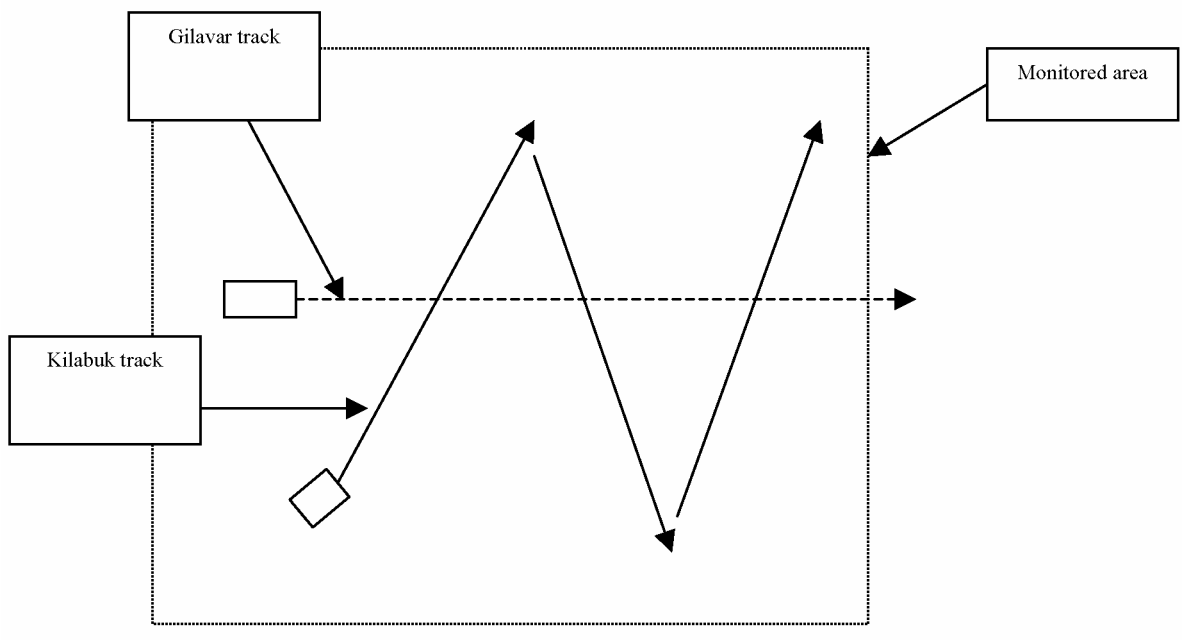


FIGURE 5.1. Diagram of the path of the *Kilabuk* in front of the *Gilavar* during monitoring of the 160 dB zone.

The 120 dB radius was estimated by Blackwell (2006) to extend as much as ~84 km from the *Gilavar,* and the 120 dB mitigation zone covered an area as much as ~22,167 km^2. Monitoring of the 120 dB zone was required at specified times in late summer and autumn due to concerns that seismic noise might disturb bowhead whales, particularly migrating cow/calf pairs, within the 120 dB radius. The IHA allowed for two mechanisms to monitor this large area including (1) the use of survey aircraft to locate cow/calf pairs within the 120 dB radius, and (2) the use of a dedicated passive acoustic monitoring (PAM) system capable of detecting bowhead whale calls within the 120 dB radius. The IHA required that seismic operations be shut down if 4 or more bowhead cow/calf pairs were seen within the 120 dB radius during the aerial monitoring, or if the PAM system detected one or more calling bowhead whales within the 120 dB radius.

In the Chukchi Sea, SOI terminated seismic activities prior to 25 Sept., the date when monitoring of the 120 dB radius was necessary. Therefore, aerial or PAM surveys of the 120 dB zone were not implemented in the Chukchi Sea.

In the Beaufort Sea, 25 Sept. was the one date after 1 Sept. when site clearance activities involving use of airguns were conducted from the *Henry Christoffersen*. An aerial survey was flown on 24 Sept., prior to the beginning of seismic activities, to determine whether bowhead cow/calf pairs were within the 120 dB zone. The aerial survey procedures are described below. No bowhead whales were observed during the survey flight on 24 Sept.

Visual Monitoring Methods

Vessel-Based Monitoring—Chukchi and Beaufort Seas

Visual monitoring methods were designed to meet the requirements identified in the IHAs (see above and Appendices A and B). The primary purposes of MMOs aboard the seismic, shallow hazards, and support vessels were as follows: ***(1)*** Conduct monitoring and implement mitigation measures to

avoid or minimize exposure of cetaceans to airgun sounds with received levels >180 dB re µPa (rms), or of pinnipeds to >190 dB. ***(2)*** Conduct monitoring and implement mitigation measures to avoid or minimize exposure of groups of 12 or more bowhead or gray whales to airgun sounds with received levels >160 dB re µPa (rms). ***(3)*** Document numbers of marine mammals present, any reactions of marine mammals to seismic activities, and whether there was any possible effect on accessibility of marine mammals to subsistence hunters in Alaska. Results of the monitoring effort are presented in Chapter 6.

The visual monitoring methods that were implemented during SOI's seismic exploration were very similar to those used during various previous seismic cruises conducted under IHAs since 2003. The standard visual observation methods are described in Appendix E.

In summary, during the seismic and shallow-hazards surveys in the Chukchi and Beaufort Seas, at least one MMO onboard the source vessel (*Gilavar* or *Henry Christoffersen*) maintained a visual watch for marine mammals during all daylight hours while seismic or shallow-hazards surveys were underway. During the surveys, two visual observer were on duty for 45% of the time watches were conducted on the *Gilavar* and for 2% of the time watches were conducted on the *Henry Christoffersen*. Observers focused their search effort forward of the vessel but also searched aft of the vessel while it was underway. Watches were conducted with the naked eye, Fujinon 7 × 50 reticle binoculars, and Zeiss 20 × 60 binoculars. MMOs instructed seismic operators to power down or shut down the airguns if marine mammals were sighted near or about to enter the appropriate safety radii.

MMOs onboard the *Kilabuk* conducted watches similar to those of MMOs onboard the *Gilavar* and *Henry Christoffersen*. The *Kilabuk* was the chase vessel for the *Gilavar* and generally traveled ~6 to 8 km ahead of the *Gilavar* to monitor the 160 dB radius, which Blackwell (2006) found to extend ~8.4 km from the *Gilavar* sound source. MMOs onboard the *Kilabuk* were thus prepared to notify MMOs onboard the *Gilavar* if groups of bowheads or gray whales (or bowhead cow/calf pairs) were sighted within the 160 dB radius, allowing the *Gilavar* to implement the appropriate mitigation. MMOs aboard the *Gulf Provider* also conducted watches similar to those of MMOs aboard other vessels; these data are not presented in this report but were used in the calculation of densities used to calculate take estimates. Appendix E provides further details regarding visual monitoring methods.

Aerial Surveys—Beaufort Sea

An aerial survey program was conducted in support of the seismic program in the Beaufort Sea during fall of 2006. The objectives of the aerial survey were

- to advise operating vessels as to the presence of marine mammals in the general area of operation;
- to collect and report data on the distribution, numbers, orientation and behavior of marine mammals near the seismic operations with special emphasis on migrating bowhead whales;
- to support regulatory reporting and Inupiat communications related to the estimation of impacts of seismic operations on marine mammals;
- to monitor the accessibility of bowhead whales to Inupiat hunters; and
- to document how far west of seismic activities bowhead whales travel before they return to their normal migration paths, and if possible, to document how far east of seismic operations the deflection begins.

SOI originally intended to conduct aerial surveys in the summer (July to late Aug.) to collect pre-seismic, baseline data although few cetaceans were expected to occur in the project area at that time. Fall

surveys (late Aug. to Oct.) were planned to obtain detailed data (weather permitting) on the occurrence, distribution, and movements of marine mammals, particularly bowhead whales, within about 50 km to the east and 70 km to the west of the primary seismic vessel, and to monitor the 120 dB radius for bowhead whales prior to seismic activities. Logistical problems early in the summer season precluded SOI's ability to conduct summer aerial surveys and the aerial survey program did not begin until 26 Aug.

SOI's seismic source vessel, the *Gilavar*, conducted seismic operations in the Chukchi Sea until late September at which time it was to transit to the Beaufort Sea to continue seismic acquisition within specific lease holdings. However, due to weather and ice conditions, the *Gilavar* terminated its seismic activities in late September and did not conduct deep seismic acquisition in the Beaufort Sea in 2006. SOI's vessel-based activities in the Beaufort Sea were confined to site clearance and shallow hazard surveys in the mid- and eastern Alaskan Beaufort Sea. Consequently, some of the original objectives of the aerial survey program could not be achieved. For example, since the *Gilavar* did not conduct any seismic activities in the Beaufort Sea, it was not possible to document any bowhead deflection away from and subsequent return to their migration path.

Nine aerial surveys were conducted between 26 Aug. and 24 Sept. SOI's only use of airguns in the Beaufort Sea in 2006 occurred on 25 Sept. and was related to site clearance and shallow hazard surveys. Aerial surveys on 23 and 24 Sept. to monitor the 120 dB zone were conducted prior to seismic activities on 25 Sept. Seven other aerial surveys between 26 Aug. and 14 Sept. were conducted to collect data on marine mammal distribution and abundance within the project area prior to any seismic activities. The general location of the aerial surveys and aircraft route are shown on Figure 5.2.

During the aerial surveys 2 primary observers were seated at bubble windows on opposite sides of the aircraft. The two primary observers searched the water visible through the bubble windows with the unaided eye concentrating on the area within 1 km of the aircraft. When a marine mammal was sighted, the observers dictated into a digital recorder the species, number of individuals, size/sex/and age class when determinable, activity, heading, swimming speed category (if traveling), sighting cue, ice conditions (type and percentage), and inclinometer reading. The inclinometer reading was recorded when the animal's location was 90° to the side of the aircraft track, allowing calculation of lateral distance from the aircraft trackline. In addition, each observer recorded the time, sightability (subjectively classified as excellent, good, moderately impaired, seriously impaired or impossible), sea state (Beaufort wind force), ice cover (in 10ths) and sun glare (none, up to 10% glare, 10–30% glare, >30% and <70% glare, and >70% glare) at 2-min intervals along the transect, and at the end of each transect. This provided data in units suitable for statistical summaries and analyses of effects of these variables (and position relative to seismic vessel) on the probability of detecting animals (see Davis et al. 1982; Miller et al. 1999; Thomas et al. 2002).

A third observer's primary duty was to enter data into a laptop computer although this observer also searched for marine mammals during periods when data entry was not necessary. Transect information, sighting locations, and environmental data were entered into a GPS-linked laptop computer by the third observer, and simultaneously recorded on audiotape for backup and validation. At the start of each transect, a designated primary observer recorded the transect start time and position, ceiling height (ft), cloud cover (in 10ths), wind speed (knots), wind direction (°T) and outside air temperature (°C). The laptop computer used Garmin Mapsource (ver 6.9) position logging software. Mapsource automatically stored the time and aircraft position at pre-selected intervals (typically at 6 sec for straight-line transect surveys) to a file as they were obtained. The observer operating the computer recorded a waypoint at the start and end of each transect, at 2-min intervals along the transect line coinciding with the environmental data collected by the primary observers, and when a marine mammal was sighted by any of the observers.

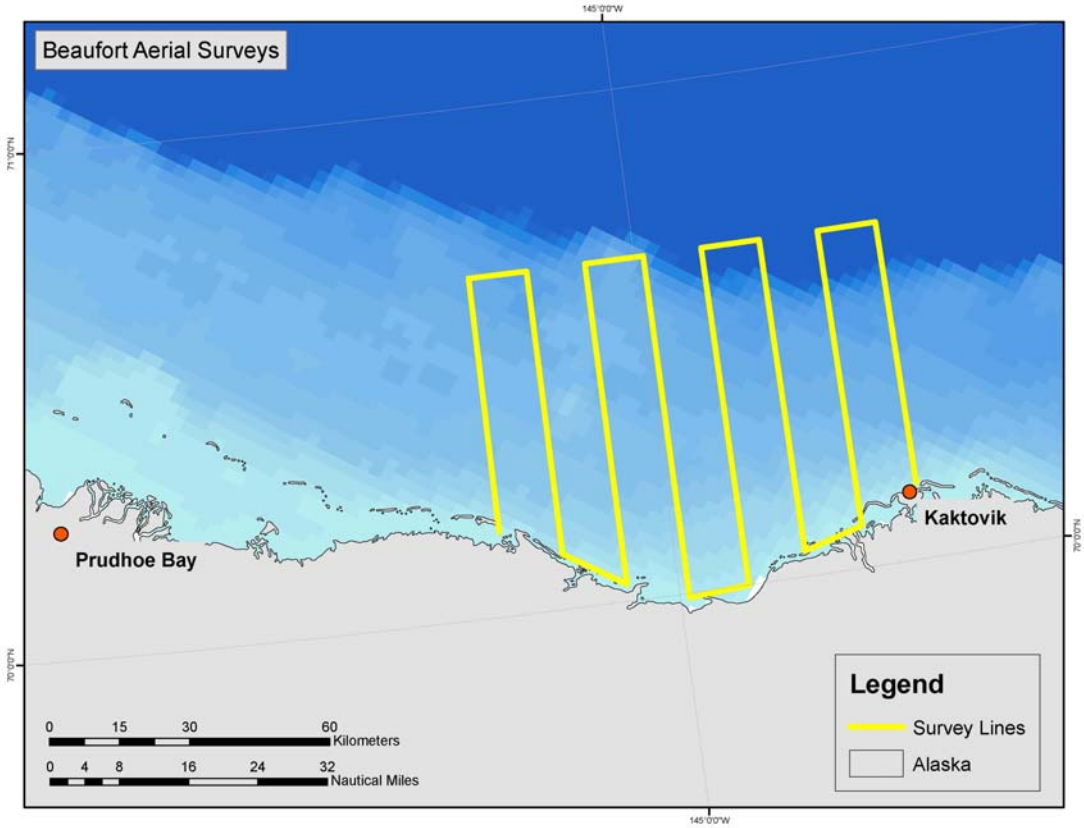


FIGURE 5.2. Approximate locations of transect lines for aerial surveys of marine mammals in Camden Bay, Alaska 2006.

Analyses

Vessel-Based Surveys

Categorization of Data.—Observer effort and marine mammal sightings were divided into several analysis categories related to vessel and seismic activity. The categories were similar to those used during various other recent seismic studies conducted under IHAs (e.g., Haley and Koski 2004; MacLean and Koski 2005; Smultea et al. 2005; Holst et al. 2005a,b; Ireland et al. 2005). These categories are defined briefly below, with a more detailed description provided in Appendix E.

In general, data were categorized as "seismic" or "non-seismic". "Seismic" included all data collected from the source vessel (*Gilavar* or *Henry C.*) while the airguns were operating. Non-seismic included all data obtained before the airguns were activated (pre-seismic) or >1 or >2 h (for pinnipeds and cetaceans, respectively) after the airguns were deactivated. Data collected during post-seismic periods from 3 min to 1 h (for pinnipeds) or 2 h (for cetaceans) after cessation of seismic activity were considered either "recently exposed" (3–30 min) or "potentially exposed" (30 min to 1 or 2 h) to seismic sound levels, and were excluded from analyses. Thus, the post-seismic data (3 min to 1 or 2 h after cessation of seismic) were not included in either the "seismic" or "non-seismic" categories. The 3 min cutpoint was considered appropriate because of the relatively slow speed during seismic operations (~4 kt or 7.4 km/h, average). The 1 and 2 h cutoff periods correspond to the time required to transit to an area in which the received sound level would not be likely to have much (if any) effect on the distributions of pinnipeds and cetaceans, respectively. The chosen sound levels were comparable to those used in other recent seismic

cruises (Haley and Koski 2004; MacLean and Koski 2005; Holst et al. 2005a; Ireland et al. 2005). Periods of time during which other vessels were sighted within 1 km of the *Gilavar* (for pinnipeds) and 5 km of the *Gilavar* (for cetaceans) were also excluded. At the time of publishing it was not possible to calculate the specific distance between the *Kilabuk* and *Gilavar* beyond the usual operating distance of ~3 nm or ~6 km apart. At this distance it is unlikely that the distribution of pinnipeds would have been affected by the seismic noise generated by the *Gilavar*; thus all pinniped sightings from the *Kilabuk* are included as 'non-seismic'. The distance at which the distribution of cetaceans may have been affected by the *Gilavar* was greater; therefore we did not classify cetacean sightings from the *Kilabuk* as either seismic or non-seismic.

This categorization system was designed primarily to distinguish potential differences in behavior and distribution of marine mammals with and without seismic surveys. The rate of recovery toward "normal" during the post-seismic period is uncertain. Marine mammal responses to seismic sound likely diminish with time after the cessation of seismic activity. The end of the post-seismic period was defined as a time long enough after cessation of airgun activity to ensure that any carry-over effects of exposure to sounds from the airguns would have waned to zero or near-zero. The reasoning behind these categories was explained in MacLean and Koski (2005) and Smultea et al. (2005) and is discussed in Appendix E.

Line Transect Estimation of Densities.—Marine mammal sightings during the "seismic" and "non-seismic" periods were used to calculate sighting rates (#/km). Sighting rates were then used to calculate the corresponding densities (#/km^2) of marine mammals near the survey and chase ships during seismic and non-seismic periods. Density calculations were based on line-transect principles (Buckland et al. 2001). Because of assumptions associated with line-transect surveys [sightability, $f(0)$, $g(0)$, etc.], only "useable" effort and sightings were included in density calculations. Effort and sightings were defined as "useable" when made under the following conditions: daylight periods both within the seismic survey area and during transit to and from that area, excluding

- periods 3 min to 1 or 2 h after the airguns were turned off (post-seismic), or
- when ship speed was <3.7 km/h (2 kt), or
- with seriously impaired sightability. (This included all nighttime observations, and daytime periods with one or more of the following: visibility <3.5 km, Beaufort sea state (Bf) >5 (Bf >2 for porpoises), or >60º of severe glare between 90º left and 90º right of the bow.)

When calculating sighting rates and densities in non-seismic periods (for comparison with those in seismic periods), only the observations in the Chukchi Sea were considered, i.e., observations during transit through the Bering Sea were excluded. Pinnipeds hauled out on the ice were encountered in both the Beaufort and Chukchi seas; these sightings were considered "useable" for analyses.

Correction factors for missed animals, i.e., $f(0)$ and $g(0)$, were calculated for gray whales, bowhead whales, unidentified whales, bearded seals, ringed seals, Pacific walruses, unidentified seals, and unidentified pinnipeds (see Appendix E). Other correction factors were taken from other related studies, as summarized by Koski et al. (1998) and Barlow (1999). This was necessary because of the low number of sightings of any individual species, making estimation of $f(0)$ from project specific data problematic, and because of the inability to assess trackline sighting probability, $g(0)$, during a study of this type.

Densities estimated from non-seismic observations were used to estimate the numbers of animals that presumably would have been present in the absence of seismic activities. Densities during seismic periods were used to estimate the numbers of animals present near the seismic operation and exposed to various sound levels. The difference between the two estimates could be taken as an estimate of the number of animals that moved in response to the operating seismic vessel, or that changed their behavior sufficiently to affect their

detectability to visual observers. However, in the case of the *Henry Christoffersen,* because of the very limited duration of airgun operations during this study, the reported densities during seismic periods are not reliable indicators of actual densities during seismic operations. Thus, a comparison of densities observed from the *Henry Christoffersen* during seismic and non-seismic periods is not a valid method for estimating changes in distribution or behavior during this study. Further details on the line transect methodology used during the survey are provided in Appendix D.

Estimating Numbers Potentially Affected.—For purposes of the IHA, NMFS assumes that any marine mammal that might have been exposed to airgun pulses with received sound levels ≥160 dB re 1 µPa (rms) may have been disturbed. When calculating the number of mammals potentially affected, we used the measured 160 dB radii with some adjustments based on JASCO's model for situations where specific measurements were not available (Tables 5.1D, 5.2C).

Two approaches were applied to estimate the numbers of marine mammals that may have been exposed to sound levels ≥160 dB re 1 µPa (rms):

1. Estimates of the numbers of potential *exposures* of marine mammals, and
2. Estimates of the number of different *individual* mammals exposed (one or more times).

The first method ("exposures") involved multiplying the following three values for each airgun configuration in use: (A) km of seismic survey; (B) width of area assumed to be ensonified to ≥160 dB (2 × 160 dB radius); and (C) densities of marine mammals estimated from this study (Appendix I). Thus, areas of water ensonified on more than one occasion, due to overlapping or adjacent tracklines, were counted in the area calculation as many times as they were ensonified.

The second approach ("individuals") involved multiplying the same three values, except that areas ensonified to ≥160 dB on more than one occasion, due to overlapping tracklines, were counted only once. The area of water considered ensonified in this calculation is therefore smaller than in the first calculation. During the Chukchi Sea surveys by the *Gilavar,* many of the tracklines were in close proximity to one another in comparison with the 160 dB distance, leading to much overlap of the areas ensonified to ≥160 dB during transits along the various tracklines. In this situation, the two approaches lead to very different values for the ensonified area, and the estimated number of exposures is much higher than the estimated number of individuals exposed.

The two approaches can be interpreted as providing maximum and minimum (respectively) estimates of the number of marine mammals that would have been exposed to sound levels ≥160 dB re 1 µPa (rms) if they did not show avoidance reactions. The actual number is probably somewhere between these two estimates. This approach was originally developed to estimate numbers of seals potentially affected by seismic surveys in the Alaskan Beaufort Sea conducted under IHAs (Harris et al. 2001). The method has recently been used in estimating numbers of seals and cetaceans potentially affected by other seismic surveys conducted under IHAs (e.g., Haley and Koski 2004; Smultea et al. 2004, 2005; MacLean and Koski 2005; Holst et al. 2005a,b). The methodology is described in detail in these past reports and in Appendix E.

Aerial Surveys

Seismic activities when each aerial survey was flown were determined from data compiled by the marine mammal observers on the seismic source vessels. In 2006, the seismic source vessel (*Henry Christoffersen*) conducted seismic activities on 25 Sept. No aerial surveys were flown on 25 Sept. due to poor weather conditions, but surveys were flown on 23–24 Sept. to monitor the 120 dB zone. Only these

surveys flown on 23–24 Sept. are analyzed in this report. Given the very limited airgun operations in the Beaufort Sea in autumn 2006, there are insufficient 2006 data with which to analyze differences in cetacean distribution with and without seismic activity.

Determination of Estimated Take by Harassment

160 dB Criteria.—NMFS practice in situations with intermittent impulsive sounds like seismic has been to assume that "take by harassment" (Level B) may occur if baleen whales are exposed to received levels of sounds exceeding 160 dB re 1 μPa rms (NMFS 2005b, 2006b). The reaction threshold for most toothed whales is unknown but presumably higher because of their poorer hearing sensitivity at low frequencies (NMFS 2005b; NMFS 2006b; Richardson et al. 1995; Richardson and Würsig 1997). However, the limited empirical data for beluga whales indicate that they may be relatively responsive to airgun sounds as compared with other toothed whales (G. Miller et al. 2005). The monitoring plan for 2006 called for estimates of the numbers of bowhead and beluga whales observed within the 160 dB (and 180 dB) zones, along with other estimates of take described later.

When calculating the number of cetaceans potentially affected, we used the nominal 160 dB (or 180 dB) distances for the situation in which the survey took place (Table 5.1D, 5.2C). As described above, two approaches were applied to estimate the number of exposures of marine mammals to sound levels ≥160 dB re 1 μPa (rms), and the number of different individual marine mammals exposed to such levels. These two approaches can be interpreted as providing maximum and minimum (respectively) estimates of the number of marine mammals that would have been exposed to sound levels ≥160 dB re 1 μPa (rms) if they did not show avoidance reactions.

120 dB Criteria.—Corresponding procedures were used to estimate the numbers of whales that either occurred within or avoided the zones within 24.5 km (Table 5.2B) of the airguns operated by the *Henry C*. The "120 dB criterion" was called for by MMS (2006) and the IHA issued by NMFS because 1996–98 monitoring results showed that most migrating bowheads avoided the areas within 20 km of the operating airgun arrays (Miller et al. 1999; Richardson et al. 1999). During the 1996–98 studies, received levels of airgun pulses at 20 km at times were as low as 120 dB re 1 μPa rms (Burgess and Greene 1999). Shell's IHA (NMFS 2005b, 2006b) required, during operations in the Beaufort Sea after 1 Sept., monitoring areas within the 120 dB distance for bowhead mother/calf pairs.

SOI's seismic operations in the Chukchi Sea terminated on 23 Sept. Because seismic operations in the Chukchi Sea did not occur after 25 Sept., there was no requirement to estimate numbers of cetaceans exposed to ≥120 dB rms in that area.

6. RESULTS OF SHELL'S MARINE MAMMAL MONITORING PROGRAM[11]

INTRODUCTION

This chapter provides background information on the occurrence of marine mammals in the Chukchi and Beaufort Seas, and describes the results of Shell's 2006 marine mammal monitoring program. In addition, the numbers of marine mammals potentially affected during project operations within the two study areas are estimated. The study areas, for the purposes of marine mammal data analyses, were the actual seismic survey areas and transit areas within the Chukchi Sea (see Fig. 2.1, 2.2).

The marine mammals known to occur along the cruise trackline across the Beaufort and Chukchi Seas belong to four taxonomic groups: odontocetes (toothed whales, including the beluga whale), mysticetes (baleen whales), pinnipeds (seals and walruses), and ursids (polar bear). Nine cetacean species and five species of pinnipeds are known to occur along the cruise trackline, along with the polar bear. Of the total 15 species, three (all cetaceans) are listed under the U.S. Endangered Species Act (ESA) as endangered: the bowhead, humpback, and fin whales. Appendix F summarizes the abundance, habitat, and conservation status of the marine mammal species likely to occur in the cruise area.

CHUKCHI SEA MONITORING

Monitoring Effort and Marine Mammal Encounter Results

This section summarizes the visual monitoring effort and sightings from the *Gilavar* and *Kilabuk* during the Chukchi seismic survey from 7 July to 25 Sept. 2006. Summaries of results of visual monitoring are presented here, with more detailed data presented in Appendices G and H, including survey effort in both kilometers and hours. A general summary of effort and sightings is shown in Table 6.1 and Appendix Table G.1. Marine mammals observed during transits outside the study area are summarized in Table G.2.

Seismic survey activities by the *Gilavar* occurred along 9556 km of trackline over a total of 1092 h (Fig. 2.1; Table G.1). In total, 27,585 km and 2788 h of visual observations were conducted within the Chukchi Sea study area, including 13,527 km and 1537 h of observation from the *Gilavar* and 14,058 km and 1251 h from the chase vessel *Kilabuk*. "Useable" survey conditions occurred during 52% (in km; 49% in h) of the total visual effort (Table G.1). "Useable" effort excluded periods 3 min to 1 h (for pinnipeds) or 2 h (for cetaceans) after the airguns were turned off, poor visibility conditions (visibility <3.5 km or extensive glare), and Bf >5. Periods of time during which other vessels were sighted within 1 km of the *Gilavar* (for pinnipeds) and 5 km of the *Gilavar* (for cetaceans) were also excluded. At the time of publishing it was not possible to calculate the specific distance between the *Kilabuk* and *Gilavar* beyond the usual operating distance of ~3 nm or ~6 km apart. At this distance it is unlikely that the distribution of pinnipeds would have been affected by the seismic noise generated by the *Gilavar*; thus all pinniped sightings from the *Kilabuk* are included as 'non-seismic'. The distance at which the distribution of cetaceans may have been affected by the *Gilavar* was greater; therefore we did not classify cetacean sightings from the *Kilabuk* as either seismic or non-seismic. As such, cetacean sightings from the *Kilabuk* are described but *not* included in any analyses

[11] By Heather Patterson, Tannis Thomas, Andrea Hunter, Meaghan Jankowski, Beth Haley, and Ross Harris (LGL).

TABLE 6.1. Detection rates for sightings from the Gilavar (10 Jul.−23 Sept. 2006) and Kilabuk (10 Jul.−4 Oct. 2006) during the Chukchi Sea cruise.

	Non-Seismic			Post-Seismic			Seismic			*Total*		
Effort Type	No. of Detections	Effort (km)	Detection Rate (No./1000 km)	No. of Detections	Effort (km)	Detection Rate (No./1000 km)	No. of Detections	Effort (km)	Detection Rate (No./1000 km)	No. of Detections	Effort (km)	Detection Rate (No./1000 km)
A. Gilavar												
Useable[a]												
Cetaceans	52	1677	31.0	N/A	N/A	N/A	1	2537	0.4	**53**	**4214**	**12.6**
Pinnipeds in water	64	1677	38.2	N/A	N/A	N/A	60	2537	23.6	***124***	***4214***	***29.4***
Pacific Walrus in water	8	1677	4.8	N/A	N/A	N/A	1	2537	0.4	***9***	***4214***	***2.1***
Pinnipeds on ice	13	1677	7.8	N/A	N/A	N/A	0	2537	0.0	***13***	***4214***	***3.1***
Pacific Walrus on ice	3	1677	1.8	N/A	N/A	N/A	0	2537	0.0	***3***	***4214***	***0.7***
Total All Pinnipeds	*77*	*1677*	*45.9*	*N/A*	*N/A*	*N/A*	*60*	*2537*	*23.6*	**137**	**4214**	**32.5**
Total Unidentified Pinnipeds	*8*	*1677*	*4.8*	*N/A*	*N/A*	*N/A*	*2*	*2537*	*0.8*	***10***	***4214***	**2.4**
Total All Pacific Walrus	*11*	*1677*	*6.6*	*N/A*	*N/A*	*N/A*	*1*	*2537*	*0.4*	***12***	***4214***	***2.8***
Total Seals	*58*	*1677*	*34.6*	*N/A*	*N/A*	*N/A*	*57*	*2537*	*22.5*	***115***	***4214***	***27.3***
Non-Useable[b]												
Cetaceans	20	2197	9.1	3	97	30.9	4	7019	0.6	**27**	**9313**	***2.9***
Pinnipeds in water	9	2225	4.0	19	69	275.4	37	7019	5.3	***65***	***9313***	***7.0***
Pacific Walrus in water	2	2225	0.9	1	69	14.5	1	7019	0.1	***4***	***9313***	***0.4***
Pinnipeds on ice	2	2225	0.9	0	69	0.0	0	7019	0.0	***2***	***9313***	***0.2***
Pacific Walrus on ice	0	2225	0.0	0	69	0.0	0	7019	0.0	***0***	***9313***	***0.0***
Total All Pinnipeds	*11*	*2225*	*4.9*	*19*	*69*	*275.4*	*37*	*7019*	*5.3*	**67**	**9313**	***7.2***
Total Unidentified Pinnipeds	*1*	*2225*	*0.4*	*0*	*69*	*0.0*	*2*	*7019*	*0.3*	***3***	***9313***	***0.3***
Total All Pacific Walrus	*2*	*2225*	*0.9*	*1*	*69*	*14.5*	*1*	*7019*	*0.1*	***4***	***9313***	***0.4***
Total Seals	*12*	*2225*	*5.4*	*18*	*69*	*260.9*	*30*	*7019*	*4.3*	***60***	***9313***	***6.4***
***Gilavar* Totals**												
Cetaceans	***72***	***3874***	***18.6***	***3***	***97***	***30.9***	***5***	***9556***	***0.5***	**80**	**13527**	**5.9**
Pinnipeds	***88***	***3902***	***22.6***	***19***	***69***	***275.4***	***97***	***9556***	***10.2***	**204**	**13527**	**15.1**
Unidentified Pinnipeds	*9*	*3902*	*2.3*	*0*	*69*	*0.0*	*4*	*9556*	*0.4*	13	13527	1.0
Pacific Walrus	*13*	*3902*	*3.3*	*1*	*69*	*14.5*	*2*	*9556*	*0.2*	16	13527	1.2
Seals	*70*	*3902*	*17.9*	*18*	*69*	*260.9*	*87*	*9556*	*9.1*	175	13527	12.9
B. Kilabuk												
Useable[a]												
Pinnipeds in water	114	10220	11.2	N/A	N/A	N/A	N/A	N/A	N/A	***114***	***10220***	***11.2***
Pacific Walrus in water	9	10220	0.9	N/A	N/A	N/A	N/A	N/A	N/A	***9***	***10220***	***0.9***
Pinnipeds on ice	7	10220	0.7	N/A	N/A	N/A	N/A	N/A	N/A	***7***	***10220***	***0.7***
Pacific Walrus on ice	3	10220	0.3	N/A	N/A	N/A	N/A	N/A	N/A	***3***	***10220***	***0.3***
Total All Pinnipeds	*121*	*10220*	*11.8*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	**121**	**10220**	***11.8***
Total Unidentified Pinnipeds	*0*	*10220*	*0.0*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	***0***	***10220***	***0.0***
Total All Pacific Walrus	*12*	*10220*	*1.2*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	***12***	***10220***	***1.2***
Total Seals	*109*	*10220*	*10.7*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	***109***	***10220***	***10.7***
Non-Useable[b]												
Pinnipeds in water	39	3838	10.2	N/A	N/A	N/A	N/A	N/A	N/A	***39***	***3838***	***10.2***
Pacific Walrus in water	8	3838	2.1	N/A	N/A	N/A	N/A	N/A	N/A	***8***	***3838***	***2.1***
Pinnipeds on ice	1	3838	0.3	N/A	N/A	N/A	N/A	N/A	N/A	***1***	***3838***	***0.3***
Pacific Walrus on ice	0	3838	0.0	N/A	N/A	N/A	N/A	N/A	N/A	***0***	***3838***	***0.0***
Total All Pinnipeds	*40*	*3838*	*10.4*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	**40**	**3838**	***10.4***
Total Unidentified Pinnipeds	*0*	*3838*	*0.0*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	***0***	***3838***	***0.0***
Total All Pacific Walrus	*8*	*3838*	*2.1*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	***8***	***3838***	***2.1***
Total Seals	*32*	*3838*	*8.3*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	***32***	***3838***	***8.3***
***Kilabuk* Totals**												
Pinnipeds	***161***	***14058***	***11.5***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	**161**	**14058**	**11.5**
Unidentified Pinnipeds	*0*	*14058*	*0.0*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	0	14058	0.0
Pacific Walrus	*20*	*14058*	*1.4*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	20	14058	1.4
Seals	*141*	*14058*	*10.0*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	141	14058	10.0
Overall Totals for Both Vessels												
Cetaceans	**72**	**3874**	**18.6**	**3**	**97**	**30.9**	**5**	**9556**	**0.5**	**80**	**13527**	**5.9**
Pinnipeds	**249**	**17960**	**13.9**	**19**	**69**	**275.4**	**97**	**9556**	**10.2**	**365**	**27585**	**13.2**
Unidentified Pinnipeds	9	17960	0.5	0	69	0.0	4	9556	0.4	13	27585	0.5
Pacific Walrus	33	17960	1.8	1	69	14.5	2	9556	0.2	36	27585	1.3
Seals	211	17960	11.7	18	69	260.9	87	9556	9.1	316	27585	11.5

Note: N/A means not applicable.

[a] Useable sightings are those made during useable daylight periods of visual observation, as defined in *Acronyms and Abbreviations*.

[b] Includes the "Post-Seismic" category.

or calculations. The project provided data on the summer occurrence, distribution, and abundance of marine mammals in the Chukchi Sea, an area where few systematic survey data had been collected previously.

Visual Survey Effort

Survey effort from the *Gilavar* and *Kilabuk,* in km and h, subdivided by seismic activity and Beaufort wind force, is summarized in Table G.1.

Gilavar.—During 13,527 km of *Gilavar* observations during the cruise, 4214 km of useable visual observations were made (Table G.1). MMOs observed almost exclusively from the bridge (99% of watch time, eye-height 10.8 m), with the remaining observations conducted from the flying bridge or stern (0.5% each). Of the 1537 h and 13,527 km of visual observation effort, 18 h and 156 km occurred during nighttime ramp up and the preceding half hour before the airguns were on. One observer was on visual watch aboard the *Gilavar* during 901 h (8626 km), with at least two observers on watch during the remaining 731 h (6636 km).

Kilabuk.—Within the Chukchi Sea, the MMOs aboard the *Kilabuk* observed over a distance of 14,058 km, with useable visual observations occurring during 13,377 km (Table G.1). Useable survey effort is shown in Table G.1. All visual observations from the *Kilabuk* were made from the bridge and during daytime. One observer was on visual watch aboard the *Kilabuk* during 1313 h (15,381 km), with at least two observers on watch during the remaining 28 h (497 km).

Beaufort Wind Force (sea state) during observations aboard the *Gilavar* and *Kilabuk* ranged from 0 to 8 within the Chukchi Sea, with 0.6% (in h) of the observation effort during conditions of Bf = 0 (Table G.1). The majority (65%) of the 2788 h of observation effort occurred with Beaufort Force 3 to 5 (wind speed 7–21 kt or 13–39 km/h). This is typical for the summer in the study region (Pilot Chart, date unkn.).

Visual Sightings of Marine Mammals and Other Vessels

Numbers of Marine Mammals Seen.—An estimated 674 individual marine mammals were seen in 480 groups through the Chukchi sea study area (Table 6.2). Twelve different marine mammal species were identified, with the gray whale being the most commonly identified (n = 117 individuals in 53 groups), followed by Pacific walruses (n = 104 in 36 groups; Table 6.3). In addition, 13 groups (34 individuals) of bowhead whales, 5 groups (5 individuals) of minke whales, and 10 groups (12 individuals) of bearded seals were identified. Of the 51 seals identified in the study area, 28 (or 55%) were ringed seals. Other seal species that were identified were spotted seals (20 individuals), bearded seals (15) and ribbon seal (1). There were many sightings of unidentified seals (n = 273 individuals in 258 groups); most of these were likely ringed seals, given the visual monitoring results and the known occurrence of this species throughout the study area.

The number of cetacean groups seen from the *Kilabuk* (n = 35) was less than half the number seen from the *Gilavar* (n = 80; see Tables ES.1 and 6.3. Pinniped sightings from the *Gilavar* were also more numerous than from the *Kilabuk* (n= 204 and 161, respectively), with 16 and 20 of these sightings being confirmed as Pacific walruses. A detailed list of sightings is provided in Table G.3.

Most of the 480 sightings (65% or 311 groups) made within the study area were "useable" (Table 6.2, 6.3). These "useable" sightings, along with the corresponding effort data, are the basis for the ensuing analyses comparing sighting rates and behaviors of marine mammals during seismic and non-seismic periods.

No deaths or injury of animals was observed during the seismic program. Numerous carcasses of whales, seals, and walruses were sighted; these are included in the summary of marine mammal sightings

TABLE 6.2. Numbers of sightings and of individual marine mammals, both (A) total, and (B) useable[a], observed in the study area from the Gilavar (10 Jul.−23 Sept. 2006) and from the Kilabuk (10 Jul.−4 Oct. 2006), during the Chukchi Sea cruise.

	Kilabuk		*Gilavar*								*Total*	
	Non-Seismic		Non-Seismic		Post-Seismic		Seismic		*Gilavar Total*			
Species	**Sightings**	**Indiv.**	**Sightings**	**Indiv.**	**Sightings**	**Indiv.**	**Sightings**	**Indiv.**	**Sightings**	**Indiv.**	**Sightings**	**Indiv.**
A. All Sightings												
Cetaceans												
Unidentified Whale	4	4	17	23	0	0	2	2	*19*	*25*	***23***	***29***
Odontocetes												
Beluga Whale	0	0	0	0	0	0	1	1	*1*	*1*	***1***	***1***
Harbor Porpoise	2	3	5	8	3	7	1	1	*9*	*16*	***11***	***19***
Mysticetes												
Bowhead Whale	8	24	5	10	0	0	0	0	*5*	*10*	***13***	***34***
Fin Whale	0	0	1	3	0	0	0	0	*1*	*3*	***1***	***3***
Gray Whale	13	47	40	70	0	0	0	0	*40*	*70*	***53***	***117***
Humpback Whale	1	1	0	0	0	0	0	0	*0*	*0*	***1***	***1***
Minke Whale	0	0	4	4	0	0	1	1	*5*	*5*	***5***	***5***
Unidentified Mysticete Whale	7	10	0	0	0	0	0	0	*0*	*0*	***7***	***10***
Total Cetaceans	***35***	***89***	***72***	***118***	***3***	***7***	***5***	***5***	***80***	***130***	115	219
Pinnipeds in Water												
Unidentified Pinniped	0	0	8	9	0	0	4	4	*12*	*13*	***12***	***13***
Odobenids												
Pacific Walrus	17	28	10	14	1	2	2	2	*13*	*18*	***30***	***46***
Phocids												
Bearded Seal	0	0	4	6	4	4	2	2	*10*	*12*	***10***	***12***
Ringed Seal	9	9	6	6	2	2	8	9	*16*	*17*	***25***	***26***
Spotted Seal	3	3	3	5	1	1	11	11	*15*	*17*	***18***	***20***
Unidentified Seal	124	132	42	46	11	11	70	71	*123*	*128*	***247***	***260***
Pinnipeds on Ice												
Unidentified Pinniped	0	0	1	1	0	0	0	0	*1*	*1*	***1***	***1***
Odobenids												
Pacific Walrus	3	23	3	35	0	0	0	0	*3*	*35*	***6***	***58***
Phocids												
Ribbon Seal	0	0	1	1	0	0	0	0	*1*	*1*	***1***	***1***
Ringed Seal	0	0	1	2	0	0	0	0	*1*	*2*	***1***	***2***
Spotted Seal	0	0	3	3	0	0	0	0	*3*	*3*	***3***	***3***
Unidentified Seal	5	6	6	7	0	0	0	0	*6*	*7*	***11***	***13***
Total Pinnipeds	***161***	***201***	***88***	***135***	***19***	***20***	***97***	***99***	***204***	***254***	365	455
Total Unidentified Pinnipeds	*0*	*0*	*9*	*10*	*0*	*0*	*4*	*4*	*13*	*14*	***13***	***14***
Total Pacific Walrus	*20*	*51*	*13*	*49*	*1*	*2*	*2*	*2*	*16*	*53*	***36***	***104***
Total Seals	*141*	*150*	*66*	*76*	*18*	*18*	*91*	*93*	*175*	*187*	***316***	***337***
B. Useable[a] Sightings												
Cetaceans												
Unidentified Whale	N/A	N/A	7	10	0	0	0	0	*7*	*10*	***7***	***10***
Odontocetes												
Harbor Porpoise	N/A	N/A	4	7	0	0	1	1	*5*	*8*	***5***	***8***
Mysticetes												
Bowhead Whale	N/A	N/A	5	10	0	0	0	0	*5*	*10*	***5***	***10***
Fin Whale	N/A	N/A	1	3	0	0	0	0	*1*	*3*	***1***	***3***
Gray Whale	N/A	N/A	31	60	0	0	0	0	*31*	*60*	***31***	***60***
Humpback Whale	N/A	N/A	0	0	0	0	0	0	*0*	*0*	***0***	***0***
Minke Whale	N/A	N/A	4	4	0	0	0	0	*4*	*4*	***4***	***4***
Unidentified Mysticete Whale	N/A	N/A	0	0	0	0	0	0	*0*	*0*	***0***	***0***
Total Cetaceans	***N/A***	***N/A***	***52***	***94***	***0***	***0***	***1***	***1***	***53***	***95***	53	95
Pinnipeds in Water												
Unidentified Pinniped	0	0	7	8	0	0	2	2	*9*	*10*	***9***	***10***
Odobenids												
Pacific Walrus	9	17	8	11	0	0	1	1	*9*	*12*	***18***	***29***
Phocids												
Bearded Seal	0	0	4	6	0	0	0	0	*4*	*6*	***4***	***6***
Ringed Seal	9	9	5	5	0	0	5	6	*10*	*11*	***19***	***20***
Spotted Seal	3	3	2	2	0	0	8	8	*10*	*10*	***13***	***13***
Unidentified Seal	93	101	38	41	0	0	44	45	*82*	*86*	***175***	***187***
Pinnipeds on Ice												
Unidentified Pinniped	0	0	1	1	0	0	0	0	*1*	*1*	***1***	***1***
Odobenids												
Pacific Walrus	3	23	3	35	0	0	0	0	*3*	*35*	***6***	***58***
Phocids												
Ribbon Seal	0	0	1	1	0	0	0	0	*1*	*1*	***1***	***1***
Ringed Seal	0	0	1	2	0	0	0	0	*1*	*2*	***1***	***2***
Spotted Seal	0	0	3	3	0	0	0	0	*3*	*3*	***3***	***3***
Unidentified Seal	4	5	4	5	0	0	0	0	*4*	*5*	***8***	***10***
Total Pinnipeds	***121***	***158***	***77***	***120***	***0***	***0***	***60***	***62***	***137***	***182***	258	340
Total Unidentified Pinnipeds	*0*	*0*	*8*	*9*	*0*	*0*	*2*	*2*	*10*	*11*	***10***	***11***
Total Pacific Walrus	*12*	*40*	*11*	*46*	*0*	*0*	*1*	*1*	*12*	*47*	***24***	***87***
Total Seals	*109*	*118*	*58*	*65*	*0*	*0*	*57*	*59*	*115*	*124*	***224***	***242***

Note: N/A means not applicable.

[a] Useable sightings are those made during useable daylight periods of visual observation, as defined in *Acronyms and Abbreviations*.

TABLE 6.3. Number of marine mammal sightings from the Gilavar (10 Jul.−23 Sept. 2006) and Kilabuk (10 Jul.−4 Oct. 2006) during the Chukchi Sea cruise, and number that were "useable" in analyses[a]. Numbers in parentheses are numbers of individuals.

	Gilavar **Sightings (Individuals)**		***Kilabuk*** **Sightings (Individuals)**		***Total*** **Sightings (Individuals)**	
Species	**All**	**Useable[a]**	**All**	**Useable[a]**	**All**	**Useable[a]**
Cetaceans						
Unidentified Whale	19 (25)	7 (10)	4 (4)	N/A	***23 (29)***	***7 (10)***
Beluga Whale	1 (1)	0	0	N/A	***1 (1)***	***0***
Harbor Porpoise	9 (16)	5 (8)	2 (3)	N/A	***11 (19)***	***5 (8)***
Bowhead Whale	5 (10)	5 (10)	8 (24)	N/A	***13 (34)***	***5 (10)***
Fin Whale	1 (3)	1 (3)	0	N/A	***1 (3)***	***1 (3)***
Gray Whale	40 (70)	31 (60)	13 (47)	N/A	***53 (117)***	***31 (60)***
Humpback Whale	0	0	1 (1)	N/A	***1 (1)***	***0***
Minke Whale	5 (5)	4 (4)	0	N/A	***5 (5)***	***4 (4)***
Unidentified Mysticete Whale	0	0	7 (10)	N/A	***7 (10)***	***0***
Total Cetaceans	***80 (130)***	***53 (95)***	***35 (89)***	***N/A***	**115 (219)**	**53 (95)**
Pinnipeds						
Unidentified Pinniped	13 (14)	10 (11)	0	0	***13 (14)***	***10 (11)***
Pacific Walrus	16 (53)	12 (47)	20 (51)	12 (40)	***36 (104)***	***24 (87)***
Bearded Seal	10 (12)	4 (6)	0	0	***10 (12)***	***4 (6)***
Ringed Seal	17 (19)	11 (13)	9 (9)	9 (9)	***26 (28)***	***20 (22)***
Ribbon Seal	1 (1)	1 (1)	0	0	***1 (1)***	***1 (1)***
Spotted Seal	18 (20)	13 (13)	3 (3)	3 (3)	***21 (23)***	***16 (16)***
Unidentified Seal	129 (135)	86 (91)	129 (138)	97 (106)	***258 (273)***	***183 (197)***
Total Pinnipeds	***204 (254)***	***137 (182)***	***161 (201)***	***121 (158)***	**365 (455)**	**258 (340)**
Total Seals	*175 (187)*	*115 (124)*	*141 (150)*	*109 (118)*	*316 (337)*	*224 (242)*
Total Marine Mammals	***284 (384)***	***190 (277)***	***196 (290)***	***121 (158)***	**480 (674)**	**311 (435)**

Note: N/A means not applicable.

[a] Useable sightings are those made during useable daylight periods of visual observation, as defined in *Acronyms and Abbreviations*.

(Table G.3). Where feasible, which was the majority of cases, carcasses were approached to closer range by the *Kilabuk*, observed in detail, and photographed by the MMOs. Most carcasses showed signs of advanced decomposition. The exceptions to this were walrus carcasses that were headless and undoubtedly taken by hunters.

Sightings with Airguns On.—Of the total 480 sightings, 102 were made while the airguns were operating, 356 were made during non-seismic periods, and the remaining 22 were noted during "post-seismic" periods (Tables ES.1, 6.2).

Power downs were requested on 10 occasions and shut downs were requested on 38 occasions when pinnipeds or cetaceans were sighted in the water within the 190 dB or 180 dB (rms) safety radii

(respectively) around the operating airguns. Further details on these encounters are provided later in this chapter (see *Mitigation Measures Implemented*) and in Appendix H.

Sighting Rates.—Sighting rates (# groups sighted per unit effort) during various types of MMO effort are presented in Table 6.1. Sighting rates for all types of marine mammals were higher from the *Gilavar* than the *Kilabuk*. This is not surprising given that observers on the *Gilavar* stood at a greater height above the water.

Based on the number of groups seen per kilometer, sighting rates were generally higher during non-seismic operations than during seismic conditions (Table 6.1). This is true regardless of whether the *Kilabuk* sightings are included. For cetaceans, the sighting rate from the *Gilavar* was only 0.5 detections/1000 km during seismic periods vs. 18.6 per 1000 km during non-seismic periods. The sighting rate for cetaceans was higher (30.9 detections/1000 km) during post-seismic periods, but the survey effort during post-seismic periods was low and the sightings involved very large aggregations of feeding gray whales.

Useable seal sighting rates were also higher during non-seismic than seismic periods, though the difference between seismic and non-seismic periods was not nearly as marked as for cetaceans. When all data are considered (meaning useable and non-useable), sighting rates for pinnipeds in water were actually highest during seismic periods. When considering only useable data, pinnipeds were seen in water more frequently during non-seismic periods. This was also true for pinnipeds on ice; however ice was less likely to be visible during seismic periods as it posed a navigational hazard. Detections of Pacific walruses in water were most frequent during post-seismic periods and nearly 0 during seismic periods. The extremely low number of detections could be an indication of displacement. If displacement was occurring, the high numbers of post-seismic sightings may indicate that animals were not displaced very far or for long periods of time.

The presence of fog (visibility <3.5 km) was the most common reason that sightings were considered non-useable. During seismic periods, the detection rate in non-useable periods was about ½ of that in useable periods, consistent with what would be expected during periods of poor vs. good visibility (Table 6.1). For non-seismic periods, the difference in detection rate between non-useable and useable periods was even greater than for seismic periods (Table 6.1).

Other Vessels.—While the *Gilavar* and *Kilabuk* were working in tandem, the vessels were typically within ~5 km of each other and often as close as a few hundreds of meters from each other. The location and proximity of the *Kilabuk* were extremely variable, and probably had some effect on the number of sightings and the behavior of marine mammals that were sighted. This effect, however, was not apparent to the MMOs in real time when they were observing marine mammals. Other than the *Kilabuk*, one other chase/supply vessel (the *Gulf Provider*) associated with the survey was sighted regularly. On some occasions this vessel relieved the *Kilabuk* and on other occasions the two vessels were present simultaneously. The seismic vessel *Western Patriot* was also operating in the area but was rarely close enough to be seen by the MMOs.

Distribution of Marine Mammals

Observations during the Chukchi Sea study indicate that phocid seals (spotted and ringed) were the most abundant marine mammals in the area (Tables 6.2, 6.3). It is expected that the majority of unidentified seals were ringed or spotted seals as bearded seals would be more easily confused with Pacific walruses (because of their size) and therefore classified as unknown pinnipeds. Pacific walruses were more abundant than bearded seals. All species of pinnipeds, with the exception of the one sighting of a ribbon seal, were seen during both seismic and non-seismic periods.

The gray whale was the most abundant species of cetacean, followed by the bowhead whale (Tables 6.2, 6.3). Harbor porpoises and minke whales were seen on multiple occasions and there was one sighting of a group of 3 fin whales plus one sighting of a single humpback whale. Harbor porpoises were seen during both seismic and non-seismic periods. The only large whale seen during seismic periods was one minke whale. The numerous gray whale sightings all occurred during non-seismic periods; however, it should be noted that the sightings of gray whales tended to be clustered and their distribution is more likely an indication of distribution of food resources than a response to seismic activity.

Specific locations of sightings are not mapped given the sensitivity of information about the exact locations where the seismic survey was done (see Chapter 2).

Marine Mammal Behavior

The data collected during visual observations provide information about behavioral responses of marine mammals to the seismic survey. The relevant data include estimated closest observed points of approach (CPA) to the vessel, movement relative to the vessel when the airguns were and were not firing, and observed behavior of animals at the time of the initial sightings.

Closest Observed Point of Approach

There was a statistically significant difference between the CPA distances for seals in water during seismic vs. non-seismic periods. When considering combined useable sightings from the *Gilavar* and *Kilabuk*, CPA during non-seismic periods was less than CPA during seismic periods (Wilcoxon rank sum test, $n = 56$ vs. 154; $Z = 6.139$, P 0.000; Table 6.4 and 6.5). When only *Gilavar* data are considered, the trend is reversed ($n = 56$ vs. 50; $Z = -2.3418$, P 0.0192). No meaningful comparison was possible for cetaceans because there was only one sighting from the *Gilavar* during seismic periods. Similarly, there were insufficient walrus data for statistical analyses of CPA. The mean CPA during seismic periods, as presented in Table 6.4, is underestimated if some animals avoided the airguns at distances beyond those where they could be detected by MMOs.

Although most sample sizes are small, the sighting-distance data from this study are not consistent with those from many previous seismic studies. In other studies, marine mammals were usually observed at greater distances from the vessel and lower sighting rates when the airguns were operating than when the airguns were silent (e.g., Smultea et al. 2004; Haley and Koski 2004; MacLean and Koski 2005; Holst et al. 2005a,b). This is also true for similar studies conducted in nearby Arctic regions (Harris et al. 2001; Haley and Ireland 2005).

Categories of Behavior

Marine mammal behavior is difficult to observe, especially from a seismic vessel, because individuals and/or groups are often at the surface only briefly, and there may be avoidance behavior. This causes difficulties in resighting those animals, and in determining whether two sightings some minutes apart are repeat sightings of the same individual(s). Only limited behavioral data were collected during this project because marine mammals were often seen at a distance from the vessel, and they were typically not tracked for long distances or durations while the vessel was underway. The two variables that were examined quantitatively to assess potential seismic effects on behavior were the categories of movement and behavior when the animal(s) were first observed (see Appendix Table E.1 for variables and definitions). The CPA distance recorded for each sighting was also an indicator of behavior (see above and Appendix Table G.3 for details on sightings). Results regarding movement and behavior are presented in Tables 6.6 and 6.7. (In those tables, cetacean data include only useable sightings from the *Gilavar*; however, seal and walrus data include useable sightings from both the *Gilavar* and the *Kilabuk*.)

TABLE 6.4. Closest observed points of approach (CPA) of useable marine mammal sightings from the Gilavar to the airguns during non-seismic and seismic periods during the Chukchi Sea survey 27 July–20 Sept. 2006.

		Non-seismic				Seismic			
Taxonomic Group	**# Sightings**	**Mean CPA (m)**	**s.d.**	***n***	**Range (m)**	**Mean CPA (m)**	**s.d.**	***n***	**Range (m)**
Cetaceans									
Mysticete	48	1898	1177	48	350 - 4641	N/A	N/A	0	N/A
Odontocete	5	589	261	4	370 - 930	507	N/A	1	N/A
Pinnipeds in Water	124	808	476	65	301 - 2165	633	340	59	308 - 2592
Unidentified Pinnipeds	9	834	383	7	301 - 1342	853	6	2	849 - 857
Pacific Walrus	9	1099	538	8	531 - 2165	350	N/A	1	N/A
Seals	106	756	469	50	306 - 2130	630	345	56	308 - 2592
Pinnipeds on Ice	13	977	488	13	462 - 2031	N/A	N/A	0	N/A
Unidentified Pinnipeds	1	750	N/A	1	N/A	N/A	N/A	0	N/A
Pacific Walrus	3	1363	255	3	1119 - 1628	N/A	N/A	0	N/A
Seals	9	874	517	9	462 - 2031	N/A	N/A	0	N/A

Note: N/A means not applicable.

TABLE 6.5. Closest observed points of approach (CPA) of useable marine mammal sightings to observers on board the Kilabuk during non-seimic periods during the Chukchi Sea cruise from 27 Jul.-5 Oct. 2006.

		Non-seismic		
Taxonomic Group[a]	**# Sightings**	**Mean CPA (m)**	**s.d.**	**Range (m)**
Pinnipeds in Water	114	149	200	1 - 774
Pacific Walrus	9	304	244	5 - 659
Seals	105	136	191	1 - 774
Pinnipeds on Ice	7	891	424	5 - 1193
Pacific Walrus on Ice	3	712	626	5 - 1193
Seals	4	1025	206	774 - 1193

[a] Includes only useable sightings as defined in *Acronyms and Abbreviations.*

Movement.—Movement was observed and recorded for 41 sightings of cetaceans (Table 6.6). (Of the total of 53 cetacean sightings, there were 12 sightings for which movement was either unknown or not recorded.) Of the 40 sightings during non-seismic periods for which movement was recorded, most were of cetaceans swimming parallel to the vessel (18 of 40, or 45%; Table 6.6) or swimming perpendicular (11 of 40, or 27.5%). The one cetacean sighting made during seismic activity was swimming away from the vessel.

TABLE 6.6. Numbers of useable sightings of marine mammals by movement category during seismic and non-seismic periods from the *Gilavar* (10 Jul.-23 Sept. 2006) and the *Kilabuk* (10 Jul.-4 Oct. 2006) within the Chukchi Sea. See Appendix E for definitions of movement categories.

	Movement Relative to Vessel[a]								
Taxonomic Group[b]	**Mill**	**Swim Perpen-dicular**	**Swim Away**	**Swim Parallel**	**Swim Toward**	**No Movement**	**Total of Known/Recorded Movement**	**Unknown/Not Recorded**	***Total***
Cetaceans									
Non-seismic	0	11	4	18	7	0	40	12	***52***
Seismic	0	0	1	0	0	0	1	0	***1***
Total	***0***	***11***	***5***	***18***	***7***	***0***	***41***	***12***	**53**
Seals in Water									
Non-seismic	6	19	30	13	2	5	75	86	***161***
Seismic	2	8	18	12	0	4	44	15	***59***
Total	***8***	***27***	***48***	***25***	***2***	***9***	***119***	***101***	**220**
Pacific Walrus in Water									
Non-seismic	5	4	6	0	0	0	15	2	***17***
Seismic	0	0	0	0	1	0	1	0	***1***
Total	***5***	***4***	***6***	***0***	***1***	***0***	***16***	***2***	**18**

[a] Includes only useable sightings as defined in *Acronyms and Abbreviations* .

[b] Cetacean sightings include only those from the *Gilavar* ; seal and Pacific walrus sightings include those from the *Gilavar* and the *Kilabuk* . All *Kilabuk* pinniped sightings were treated as non-seismic. See text for explanation.

Movement category was recorded for 119 seal sightings had movement records, of which 75 sightings were during non-seismic periods and 44 sightings were made during seismic periods. During both seismic and non-seismic periods, those seals in the water for which movement was recorded were most often seen swimming away from the vessel (40% during non-seismic; 41% during seismic; Table 6.6). Swimming perpendicular (25% during non-seismic; 18% during seismic) and swimming parallel (17% during non-seismic; 27% during seismic) were the next most frequently-observed movements in relation to the vessel. Only two sightings of seals in the water involved individuals swimming toward the vessel.

Of the 15 sightings of walruses in the water during non-seismic periods, six (40%) were of animals swimming away, five (33%) were of animals milling, and four (27%) were of animals swimming perpendicular. The one sighting of a walrus during seismic activity was swimming toward the vessel (Table 6.6).

The movement of pinnipeds first observed on ice was always categorized as hauled out and is therefore not presented in Table 6.6.

First Observed Behavior.—The most common "first observed behavior" of cetaceans, all but one sighting of which were during non-seismic periods, was blowing (43 of 52 sightings for which behavior was recorded, or 83%; Table 6.7). Looking and swimming/traveling were the most common "first observed behaviors" of seals in the water during non-seismic periods, accounting for 45% and 43% of the 159 non-seismic sightings respectively. However, swimming/traveling was observed first most often during seismic periods (41 of 59 sightings with behavior recorded, or 69%). Twenty-five per cent (15 of 59) of sightings of seals in the water during seismic periods were of animals looking. There were 17 sightings of Pacific walruses in the water during non-seismic periods, and one sighting during seismic periods. The first-observed behavior of 15 of those 18 sightings, including the one sighting during seismic, was swimming/traveling. The other three sightings were of animals looking at the vessel.

TABLE 6.7. Comparison of first observed behaviors of useable marine mammal sightings during non-seismic and seismic periods from the *Gilavar* (10 Jul.-23 Sept. 2006) and the *Kilabuk* (10 Jul.-4 Oct. 2006) within the Chukchi Sea. See Appendix E for definitions of behavior categories.

	First-observed Behavior[a]																
Taxonomic Group[b]	**Blow**	**Fluke**	**Dive / Forward Dive**	**Swim / Travel**	**Porpoise/ Surface Active Travel**	**Log / Raft**	**Rest**	**Spyhop / Look**	**Sink**	**Thrash**	**Feed**	**Mill**	**Surface Active**	**None**	**Total of Known/Recorded Behavior**	**Behavior Unknown/ Not Recorded**	***Total***
Cetaceans																	
Non-seismic	43	0	0	7	1	0	0	0	0	0	0	0	0	1	52	0	***52***
Seismic	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	***1***
Total	***43***	***0***	***0***	***8***	***1***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***1***	***53***	***0***	**53**
Seals in Water																	
Non-seismic	N/A	N/A	8	69	1	5	0	71	1	1	0	0	1	2	159	2	***161***
Seismic	N/A	N/A	2	41	0	0	0	15	0	1	0	0	0	0	59	0	***59***
Total	***N/A***	***N/A***	***10***	***110***	***1***	***5***	***0***	***86***	***1***	***2***	***0***	***0***	***1***	***2***	***218***	***2***	**220**
Pacific Walrus in Water																	
Non-seismic	N/A	N/A	0	14	0	0	0	3	0	0	0	0	0	0	17	0	***17***
Seismic	N/A	N/A	0	1	0	0	0	0	0	0	0	0	0	0	1	0	***1***
Total	***N/A***	***N/A***	***0***	***15***	***0***	***0***	***0***	***3***	***0***	***0***	***0***	***0***	***0***	***0***	***18***	***0***	**18**
Seals on Ice																	
Non-seismic	N/A	N/A	N/A	N/A	N/A	N/A	12	0	N/A	N/A	0	N/A	N/A	1	13	4	***17***
Seismic	N/A	N/A	N/A	N/A	N/A	N/A	0	0	N/A	N/A	0	N/A	N/A	0	0	0	***0***
Total	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***12***	***0***	***N/A***	***N/A***	***0***	***N/A***	***N/A***	***1***	***13***	***4***	**17**
Pacific Walrus on Ice																	
Non-seismic	N/A	N/A	N/A	N/A	N/A	N/A	0	0	N/A	N/A	0	N/A	N/A	0	0	3	***3***
Seismic	N/A	N/A	N/A	N/A	N/A	N/A	0	0	N/A	N/A	0	N/A	N/A	0	0	0	***0***
Total	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***0***	***0***	***N/A***	***N/A***	***0***	***N/A***	***N/A***	***0***	***0***	***3***	**3**

Note: N/A means not applicable.

[a] Includes only useable sightings as defined in *Acronyms and Abbreviations*.

[b] Cetacean sightings include only those from the *Gilavar*; seal and Pacific Walrus sightings include those from the *Gilavar* and the *Kilabuk*. All *Kilabuk* pinniped sightings were treated as non-seismic. See text for explanation.

Mitigation Measures Implemented

A total of 10 power downs and 38 shut downs of the airguns were requested due to sightings of pinnipeds approaching or within the safety radii applied during the Chukchi Sea cruise (Table 6.8; for a full account of each power down and shut down, see Appendix H). The applied safety radii for pinnipeds were 600 m from the *Gilavar's* airgun array for a power down and 300 m from the array for a shut down (Table 5.1). These **safety radii** were larger than the estimated and measured 190 dB rms **sound level radii** for *Gilavar*'s 3- and 1-string airgun arrays (see Table 4.4), leading to the application of protective mitigation measures. The 190 dB rms sound level distance used in assessing the likelihood of exposures (Table 6.8) is also protective, since the single largest measured 190 dB rms distance was applied, when in fact the 190 dB rms distance is not uniform around the vessel (see Table 4.4). Sound levels are also not uniform with depth (Greene and Richardson 1988; Tolstoy et al. 2004a,b), so animals would need to dive well below the surface to encounter sound levels ≥190 dB rms near the measured sound level radii.

No power downs or shut downs were implemented, or needed, for cetaceans. During periods when the airguns were operating, there were two sightings of cetaceans within 1100 m of the *Gilavar*, i.e., within the applied "180 dB rms" safety radius of 1100 m for power downs (sightings 230 and 266, Appendix Table G.3). However, only the two mitigation guns (155 in^3) were firing during both of these sightings, so the airguns were essentially already "powered down". Neither cetacean entered the 180 dB rms sound level radius of 360 m around the two airguns and it is very unlikely that either of the animals was exposed to sound levels ≥180 dB rms.

Of the 48 interruptions of airgun operations for sightings of pinnipeds, 14 shut downs occurred when the *Gilavar* was using its mitigation airguns (155 in^3). A further nine shut downs (six during ramp-ups) and one power down (also during a ramp-up) occurred when the *Gilavar* was firing eight airguns (1049 in^3). However, the majority of mitigation measures were implemented when the full 24-airgun array (3147 in^3) was in use: 15 shut downs (two during ramp-ups) and nine power downs (four of which were during ramp-ups).

If an animal approaches the airgun array during a ramp-up sequence, it is difficult to evaluate the level of sound exposure the animal may have received before mitigation occurred. The number and combined volume of firing airguns is often not precisely known at specific times during ramp-up sequences. It was assumed that, within the first 15 min of a ramp-up sequence, the volume was 1049 in^3 (8 guns), after which time it was assumed to be the full 3147 in^3 (24 guns). The assumed volume of firing airguns during ramp-ups will in most cases be an overestimate, decreasing the likelihood that animals were exposed to sound levels ≥190 dB rms.

All power downs or shut downs were the result of individual pinnipeds, except for one sighting of two ringed seals (sighting 318, Table 6.8). The majority of the 48 power downs (10) and shut downs (38) were for unidentified seals (29), followed by spotted seals (9), ringed seals (8), bearded seal (1), and Pacific walrus (1).

Of the 10 power downs, nine occurred when the full 24−airgun 3147 in^3 array was firing, so the estimated 190 dB rms sound level distance was 460 m (Tables 4.4, 5.1). The one exception was a power down from the 1049 in^3 array, where the 190 dB rms distance was 420 m (Table 4.4). Two of the ten power downs were unnecessary, as the seals involved did not actually come within the 600 m safety radius. Of the eight seals within the 600 m safety radius, two did not enter the 190 dB rms sound level distance. The remaining six cases involved individuals that were "likely" or "very likely" exposed to a received sound level of ≥190 dB rms. Those six seals approached the airguns to distances ranging from 310 to 417 m and diving well below the surface before the power downs occurred. These six likely exposures to ≥190 dB rms include four unidentified seals, one ringed seal, and one spotted seal.

TABLE 6.8. List of power downs (PZ) and shut downs (SZ) of the airguns implemented for pinnipeds sighted in or near the *Gilavar*'s safety radii (600 m for power downs, 300 m for shut downs), during the Chukchi Sea seismic survey, 27 Jul.−9 Sept. 2006. No power downs or shut downs were implemented for cetaceans. See Appendix Table G.3 for more details on these sightings. Also see Appendix H for an account of each power down and shut down.

Sighting ID	Species	Group Size	Day in 2006	Water Depth (m)	Initial Sighting Distance (m) from observer	Initial Movement[a]	Dove before mitigation?	Maximum airgun Vol. (in^3) prior to SZ or PZ	Estimated 190 dB sound level distance	CPA (m) to operating airguns before mitigation	Mitigation measure taken (SZ, PZ)	Exposed to ≥190 dB re 1 µPa (rms)?[b]
192	Pacific walrus	1	22-Jul	34	476	ST	Yes	1049	420	647	SZ	Very unlikely
193	Unidentified seal	1	22-Jul	34.8	200	SP	Yes	1049	420	396	SZ	Likely
203	Unidentified seal	1	27-Jul	39.1	30	SA	Yes	3147	460	317	PZ	Very likely
204	Unidentified seal	1	27-Jul	<100	200	PE	Yes	3147	460	483	PZ	Very unlikely
206	Unidentified seal	1	31-Jul	38.6	30	SA	Yes	3147	460	321	PZ	Very likely
210	Unidentified seal	1	3-Aug	<100	192	SP	Yes	1049	420	250	SZ	Very likely
211	Spotted seal	1	3-Aug	<100	192	SA	Yes	3147	460	400	PZ	Likely
215	Unidentified seal	1	6-Aug	38	100	SA	No	3147	460	389	SZ	Likely
218	Spotted seal	1	9-Aug	37.7	192	PE	No	3147	460	492	PZ	Very unlikely
219	Unidentified seal	1	15-Aug	38.5	500	NO	Yes	155	230	550	SZ	Very unlikely
360	Spotted seal	1	15-Aug	38.4	300	UN	–	155	230	424	SZ	Very unlikely
220	Spotted seal	1	16-Aug	35.3	350	SA	Yes	3147	460	555	SZ	Very unlikely
225	Unidentified seal	1	16-Aug	38.3	300	SP	No	155	230	600	SZ	Very unlikely
232	Spotted seal	1	16-Aug	38.3	275	SP	No	155	230	435	SZ	Very unlikely
241	Unidentified seal	1	16-Aug	38.4	306	UN	Yes	1049	420	435	SZ	Unlikely
246	Unidentified seal	1	16-Aug	37.7	306	UN	Yes	3147	460	476	SZ	Unlikely
260	Spotted seal	1	17-Aug	37.8	273	PE	Yes	155	230	553	SZ	Very unlikely
262	Unidentified seal	1	18-Aug	31.5	450	NO	Yes	1049	420	750	PZ	Very unlikely
264	Spotted seal	1	20-Aug	37.8	20	SP	No	3147	460	310	SZ	Likely
268	Unidentified seal	1	22-Aug	38.3	75	SP	Yes	155	230	344	SZ	Very unlikely
271	Unidentified seal	1	24-Aug	40	50	SP	No	155	230	344	SZ	Very unlikely
273	Ringed seal	1	25-Aug	35.5	80	SA	Yes	3147	460	304	SZ	Very likely
275	Unidentified seal	1	26-Aug	37.7	50	NO	Yes	3147	460	344	SZ	Very likely
276	Unidentified seal	1	26-Aug	39.7	75	SA	No	155	230	366	SZ	Very unlikely
277	Unidentified seal	1	26-Aug	39	100	SA	Yes	1049	420	389	SZ	Very likely
278	Unidentified seal	1	26-Aug	39	10	SP	Yes	3147	460	310	PZ	Very likely
279	Unidentified seal	1	27-Aug	39.1	75	UN	Yes	155	230	366	SZ	Very unlikely
281	Unidentified seal	1	28-Aug	37.8	450	SP	Yes	3147	460	653	PZ	Very unlikely
282	Bearded seal	1	28-Aug	38.3	50	SP	No	1049	420	327	SZ	Likely
283	Spotted seal	1	28-Aug	39.3	75	UN	Yes	155	230	344	SZ	Very unlikely
284	Unidentified seal	1	28-Aug	38.8	75	NO	Yes	3147	460	301	SZ	Very likely
285	Unidentified seal	1	28-Aug	38.1	150	SP	Yes	3147	460	366	SZ	Very likely
359	Ringed seal	1	28-Aug	34.8	200	SP	Yes	3147	460	323	SZ	Very likely
294	Unidentified seal	1	29-Aug	37.8	250	SP	Yes	1049	420	476	SZ	Very unlikely
295	Ringed seal	1	29-Aug	32.5	150	SP	Yes	3147	460	450	SZ	Likely
300	Ringed seal	1	29-Aug	34.9	240	SP	Yes	3147	460	360	SZ	Very likely
302	Unidentified seal	1	29-Aug	35.7	179	SA	Yes	3147	460	349	PZ	Very likely
304	Unidentified seal	1	30-Aug	39	75	SP	Yes	1049	420	366	SZ	Very likely
306	Ringed seal	1	30-Aug	38	400	SA	Yes	3147	460	417	PZ	Very likely
307	Spotted seal	1	30-Aug	37.7	70	UN	Yes	155	230	362	SZ	Very unlikely
314	Unidentified seal	1	31-Aug	<100	300	SP	Yes	3147	460	519	SZ	Very unlikely
318	Ringed seal	2	31-Aug	35.7	150	SA	No	155	230	308	SZ	Very unlikely
319	Unidentified seal	1	2-Sep	37.3	25	UN	Yes	3147	460	321	SZ	Very likely
320	Unidentified seal	1	12-Sep	33.9	5	SA	Yes	3147	460	305	SZ	Very likely
321	Unidentified seal	1	12-Sep	37.4	50	UN	Yes	155	230	344	SZ	Very unlikely
322	Unidentified seal	1	12-Sep	37.3	10	SA	Yes	1049	420	308	SZ	Very likely
324	Ringed seal	1	16-Sep	38	150	UN	No	155	230	366	SZ	Very unlikely
325	Ringed seal	1	18-Sep	35.5	130	PE	Yes	3147	460	343	SZ	Very likely

[a] Initial movement of group relative to vessel: PE=swimming perpendicular or across bow, ST=swimming toward, SA=swimming away, SP=swimming parallel, NO=none, UN=unknown.
[b] Categories of likelihood of exposure range from least likely to most likely: Very unlikely, Unlikely, Likely, Very likely.

Considering the 38 full shut downs, for all cases but one, powering down to the mitigation airguns would have sufficed to avoid exposing animals to a sound level ≥190 dB rms. The one case where the full shut down was necessary, to avoid exposing an animal to ≥190 dB rms from the mitigation airguns (155 in^3), involved a single bearded seal (sighting 282, Appendix H). The seal was 327 m away from the *Gilavar* when the shut down was initiated, and subsequently approached the airguns within 5 m after the shut down, at which time it dove and was not seen again. The remaining 37 full shut downs occurred because the applied safety radii were more protective than the measured 190 dB rms sound level distances, as mentioned above.

Of the 38 shut-downs, there was one case that involved a single Pacific walrus (sighting 192, Table 6.8) where the individual did not enter the 600 m safety radius before the shut down occurred. Of the remaining 37 cases, there were only 18 sightings involving 18 seals where individuals actually entered the 190 dB rms sound level distance before the airguns were shut down. Fifteen of these seals were likely or very likely exposed to ≥190 dB rms, coming within 250 to 450 m of the airguns and diving well below the surface before the shut downs occurred. The remaining three seals (sightings 215, 264, and 282, Table 6.8) were each sighted within the 190 dB rms sound distance and remained at the surface until after the shut downs occurred. All three seals were likely exposed to ≥190 dB rms before they surfaced and were initially detected. The 18 seals likely exposed to ≥190 dB rms included 11 unidentified seals, five ringed seals, one spotted seal, and one bearded seal.

Overall, considering both power downs and shut downs, there were 24 cases when seals were exposed to ≥190 dB rms. These included 15 unidentified seals, six ringed seals, 2 spotted seals, and one bearded seal.

Estimated Number of Marine Mammals Present and Potentially Affected

It is difficult to obtain meaningful estimates of "take by harassment" for several reasons: ***(1)*** The relationship between numbers of marine mammals that are observed and the number actually present is uncertain. ***(2)*** The most appropriate criteria for "take by harassment" are uncertain and presumably variable among species and situations. ***(3)*** The distance to which a received sound level exceeds a specific criterion such as 190 dB, 180 dB, 170 dB, or 160 dB re 1 μPa (rms) is variable. It depends on water depth, source depth, water-mass and bottom conditions, and—for directional sources—aspect (Chapters 3 and 4; see also Greene 1997; Greene et. al. 1998; Burgess and Greene 1999; Caldwell and Dragoset 2000; Tolstoy et al. 2004a,b). ***(4)*** The sounds received by marine mammals vary depending on their depth in the water, and will be considerably reduced for animals at or near the surface (Greene and Richardson 1988; Tolstoy et al. 2004a,b) and further reduced for animals that are on the ice.

Disturbance and Safety Criteria

Table 5.1 shows estimated received sound levels at various distances from the *Gilavar*'s 3147 in^3 3-string airgun array. The 160 and 170-dB radii are assumed behavioral disturbance criteria. The 180 and 190 dB radii are safety radii, used in determining when mitigation measures were required. During this and many other recent projects, NMFS has required that mitigation measures be applied to avoid or minimize the exposure of cetaceans and pinnipeds to impulse sounds with received levels ≥180 dB and ≥190 dB re 1 μPa (rms), respectively. NMFS commonly assumes that cetaceans and seals exposed to pulsed sounds with received levels ≥160 dB rms might be disturbed, although there is little evidence that most pinnipeds or delphinids exposed to airgun sounds with levels just above 160 dB rms are disturbed. The safety and disturbance radii summarized in Table 5.1D were used after the field season to estimate numbers of marine mammals exposed to various received sound levels.

Two methods were applied to estimate the number of pinnipeds and cetaceans exposed to seismic sound levels strong enough that they might have caused disturbance or other effects. The procedures include ***(A)*** minimum estimates based on direct observations, and ***(B)*** estimates based on pinniped and cetacean densities obtained during this study. The actual number of individuals exposed to, and potentially affected by, strong seismic survey sounds likely was between the minimum and maximum estimates provided below.

Estimates from Direct Observations

The number of marine mammals observed close to the *Gilavar* during the Chukchi Sea survey provides a minimum estimate of the number potentially affected by seismic sounds. This is likely an underestimate of the actual number potentially affected. Some animals probably moved away before coming within visual range, and not all of those that remained would have been seen by observers.

Pinnipeds Potentially Exposed to Sounds ≥190 dB re 1 µPa (rms).—During this project, there were 48 sightings involving 49 pinnipeds that resulted in the implementation of mitigation measures (Table 6.8). Of these 48 cases, there were 47 cases involving 48 seals that were within the "190 dB rms" pinniped safety radius of 600 m around the *Gilavar*'s airguns. However, given that the safety radius was larger than the measured 190 dB rms sound level distance, only 24 seals from 24 sightings came within the 190 dB rms distance. Of these 24 seals, 21 seals were likely exposed to ≥190 dB rms, as they were seen diving within the 190 dB rms sound distance before mitigation was implemented. The remaining three seals did not dive before mitigation action was taken, but were still likely to have been ensonified at a level ≥190 dB rms before they surfaced and were initially detected. Based on direct observations in the field, the 24 animals that were likely exposed to ≥190 dB include 15 unidentified seals, six ringed seals, two spotted seals, and one bearded seal. One pinniped, a ribbon seal, was sighted within the 160 dB radius. However, this animal was hauled out on ice and would not have received sound levels high enough to be considered a "take" according to NMFS criteria.

Cetaceans Potentially Exposed to Sounds ≥180 dB re 1 µPa (rms).—There were two sightings involving two individual cetaceans, one harbor porpoise and one minke whale, within 1100 m around the *Gilavar*'s airguns when they were operating (sightings 230 and 266, Table G.3). However, there were only 2 airguns (155 in^3) operating during both sightings, so no power down was implemented. Neither cetacean came within the 180 dB rms sound level distance for the two operating airguns, so they were very unlikely to have been exposed to ≥180 dB rms. However, each of these cetaceans was observed within the 160 dB radius of the 2 guns (1.37km).

Estimates Extrapolated from Density

The numbers of marine mammals directly sighted during the Chukchi Sea study no doubt underestimated the actual numbers present because some animals present near the trackline would not be seen by the observers. During daylight, animals are missed if they are below the surface when the ship is nearby. Some other mammals, even if they surface near the vessel, are missed because of limited visibility, intervening ice, glare, or other factors limiting sightability. High sea state (Bf) was a significant factor during limited periods of this cruise. Also, sound levels were estimated to be ≥160 dB re 1 µPa (rms) out to 8 km. This distance is well beyond those at which MMOs can detect even the more conspicuous animals under favorable sighting conditions during daytime. Furthermore, marine mammals could not be seen effectively during periods of darkness, which occurred for increasing numbers of hours per day after 14 August and nighttime observations were generally not required or attempted except prior to and during nighttime ramp-ups.

Also, some animals may have avoided the area near the seismic vessel while the airguns were firing (see Richardson et al. 1995, 1999; Stone 2003; Gordon et al. 2004; Smultea et al. 2004). Within the assumed 160–170 dB radii around the source (i.e., ~4.7–8 km), and perhaps farther away in the case of the more sensitive species and individuals, the distribution and behavior of pinnipeds and cetaceans may have been altered as a result of the seismic survey. This could occur as a result of reactions to the airguns, or as a result of reactions to the *Gilavar* or the *Kilabuk* themselves. The extent to which the distribution and behavior of pinnipeds might be affected by the airguns is uncertain, given variable previous results (Thompson et al. 1998; Harris et al. 2001; Moulton and Lawson 2002; Miller et al. 2005).

However, it is safe to assume that some pinnipeds that were on the ice as the two ships approached would have gone into the water in response to the *Kilabuk* before they were in view of observers on the *Gilavar*. Likewise, it is safe to assume that some cetaceans when approached by the seismic survey would have moved away before they were in view.

The methodology used to estimate the areas exposed to received levels ≥160 dB, ≥170 dB, ≥180 dB and ≥190 dB was described briefly in Chapter 5 *Monitoring and Mitigation Methods* and in more detail in Appendix E. Densities were based on data collected from the three vessels (*Gilavar*, *Kilabuk*, and *Gulf Provider*) during SOI's seismic operations in the Chukchi Sea. The density data are summarized in Appendix Table I.1..

The aforementioned densities were used to estimate both the number of *individual* marine mammals exposed to 160, 170, 180, and 190 dB, and the number of *exposures* of different individual marine mammals. These numbers provide estimates of the number of animals potentially affected by seismic operations, as described in Chapter 5 and Appendix E.

The estimates provided here are based on the actual amount of seismic surveying during this project. In contrast, the estimates provided in the IHA applications for this project (SOI 2005a,b) were based on the then-anticipated amount of survey, with an allowance for the possibility that some lines would be surveyed more than once. The estimates in the IHA applications assumed that there would be more seismic surveying than actually occurred. Thus, the present estimates are lower than those in the IHA application even though they are based on comparable density data. In addition, the following estimates assume that all mammals present were well below the surface where they would be exposed to the sound levels predicted in Table 5.1 at a given distance. In fact, some pinnipeds were hauled out on the ice, and remained there as the ship passed, and some pinnipeds and cetaceans in the water might remain close to the surface, where sound levels would be reduced by pressure-release effects (Greene and Richardson 1988). Finally, some pinnipeds and cetaceans may have moved away from the path of the *Gilavar* before it arrived, either because the *Kilabuk* frequently traveled in front of *Gilavar*, or because of an avoidance response to the approaching *Gilavar* and its airguns. Thus, the following estimates, though lower than those in the IHA Application, are nonetheless likely to overstate actual numbers exposed to various received sound levels.

Estimates of the densities of pinnipeds and cetaceans are given in Table I.1, including approximate corrections for sightability biases. These corrected densities were used to estimate the number of marine mammals that were exposed to various received levels of airgun sound, and thus potentially affected by seismic operations (Tables 6.9, 6.10).

Pinnipeds.—Table 6.9 summarizes the estimated numbers of pinnipeds that might have been exposed to received sounds with various levels relative to the number of "takes" requested in SOI's IHA application for the Chukchi Sea. These estimates are based on the ensonified area figures from Table E.1 and the density data from Table I.1. The latter Appendix table gives the density estimates derived from vessel-based surveys during both non-seismic and seismic periods. Note that the estimated numbers in Table 6.9A, based on density data from non-seismic periods, represent the pinnipeds that would have been exposed had the animals not shown localized avoidance of the airguns or the ship itself, and assume that all pinnipeds present were in the water. Some of the animals calculated (based on density) to be within the ≥190-dB zone would in fact move away before being exposed to sounds that strong. Also, some of those calculated to be in the ≥160- or ≥170 dB zones would be on the ice and not exposed to the underwater sounds.

TABLE 6.9. Estimated numbers of exposures, and estimated numbers of individual pinnipeds within the Chukchi Sea that might have been exposed to received levels of sounds at levels shown, divided into (1) seals and (2) Pacific walrus. Requested takes for the Chukchi Sea are also shown. Estimates are based on "corrected" densities of pinnipeds calculated from sighting effort (see text in Chapter 6 for species-specific estimates).

Exposure level in dB re 1µPa (rms)	A. Based on Non-seismic density[a]		B. Based on Seismic density[a]		*Requested Take*
	Exposures	Individuals	Exposures	Individuals	
1. Seals					
160	20512	1317	13194	847	2206
170	11389	872	7326	561	
180	3531	607	2271	390	
190	1145	416	737	267	
2. Pacific Walrus					
160	2397	154	90	6	
170	1331	102	50	4	
180	413	71	16	3	
190	134	49	5	2	

[a] These density estimates are presented in Appendix Table I.1

TABLE 6.10. Estimated numbers of exposures, and estimated numbers of individual cetaceans within the Chukchi Sea that might have been exposed to received levels of sounds at levels shown. Requested takes for the Chukchi Sea are also shown. Estimates are based on "corrected" densities of cetaceans calculated from sighting effort (see text in Chapter 6 for species-specific estimates).

Exposure level in dB re 1µPa (rms)	A. Based on Non-seismic density[a]		B. Based on Seismic density[a]		*Requested Take*
	Exposures	Individuals	Exposures	Individuals	
160	3089	198	62	4	422
170	1715	131	34	3	
180	532	91	11	2	
190	172	63	3	1	

[a] These density estimates are presented in Appendix Table I.1

(A) ≥160 dB (rms): We estimate that there would have been ~20,512 exposures of ~1317 different individual seals to airgun pulses with received levels ≥160 dB re 1 µPa (rms) during the survey if all seals were in the water and showed no avoidance of the ≥160 dB zone (Table 6.8A). Based on the available densities and prorating of unknown individuals, 4558 of the exposures would have been of spotted seals, 2012 of bearded seals, 1550 of ringed seals, and 257 of ribbon seals. The sighting rate of spotted seals was higher than

expected given the known prevalence of ringed seals in the area. Pacific walruses are estimated to have been exposed to ≥160 dB on 2397 occasions. Prorating of unidentified individuals may have artificially inflated the estimated takes of two species and underestimated the takes of one species. It is likely that ringed seals, known to be very common in the area, actually comprised a higher proportion of unidentified animals than did spotted seals. In addition, only one ribbon seal was sighted throughout the entire cruise and it is not likely that any significant number of this species were present during seismic operations.

The numbers of different individual seals and walruses that might have been exposed to levels ≥160 dB rms, calculated from sighting rates during non-seismic periods, were only 1317 and 154 as compared with the corresponding estimates of numbers of exposures (20,512 seals and 2397 walruses). The lower numbers of individuals than of exposures is a result of the fact that many areas were ensonified repeatedly to ≥160 dB as the seismic vessel moved back and forth along different seismic lines. Most animals that lingered in the area would have been exposed to levels ≥160 dB numerous times over an extended period, but the number of different individuals so exposed would be far less than the estimated number of exposure incidents.

(*B) ≥170 dB (rms):* On average, pinnipeds may be disturbed only if exposed to received levels of airgun sounds ≥170 dB re 1 µPa (rms). If so, then the estimated number of exposures would be ~56% of the corresponding estimates for ≥160 dB, based on the proportionally smaller areas exposed to ≥170 dB (Table E.1). Overall, there would have been ~11,389 exposures of seals, involving ~872 individuals, and 1331 exposures of walruses, involving 102 individuals, to seismic sounds ≥170 dB (Table 6.9A). Again, numbers of different individuals exposed were far lower than numbers of exposures (Table 6.9A).

(C) ≥180 dB (rms): Some pinnipeds no doubt were within the 180 dB radius (estimated as being up to 1.4 km, Table 4.4) around the operating airguns but were missed by the observers even during airgun operations conducted in good visibility conditions. It is estimated that there were 3531 exposures of 607 individual seals and 413 exposures of 71 individual walruses to sounds ≥180 dB (Table 6.9A). These figures assume that there was no effective avoidance by pinnipeds of the 180 dB radius around the approaching airguns.

(*D) ≥190 dB (rms):* Based on densities calculated from sighting rates during non-seismic periods, we estimated that there would have been 1145 exposures of 416 different seals and 134 exposures of 49 different walruses to airgun sounds at ≥190 dB (rms) if there were no avoidance (Table 6.9A). Even the smaller of these estimates is far higher than the number of pinnipeds (n = 21) that direct observations indicated were possibly exposed to ≥190 dB (Table 6.8). Some pinnipeds within the 190 dB radius presumably were missed during times when MMOs were on watch as well as at night when MMOs generally were not on watch. Even during times when MMOs are on watch, some seals at the surface can be missed due to brief surface times, poor visibility, rough seas, and other factors. Because of this, density-based estimates of exposures and exposed individuals are higher than those based on direct observation. However, estimates based on densities during non-seismic periods may be overestimates. The *Kilabuk* might be expected to displace some pinnipeds from the trackline before the *Gilavar* arrived, and some additional pinnipeds likely swam away in response to the approaching *Gilavar* to avoid exposure to such strong seismic sound. Therefore, the actual number exposed to ≥190 dB rms was probably lower than the above estimates. However, there was no tendency for observed CPA distances to be higher in seismic than non-seismic periods (Table 6.4). Thus, it is likely that actual numbers exposed to ≥190 dB rms were closer to those estimated based on density data than to the much lower figures based on direct observation.

Estimates Based on Densities during Seismic Periods: The estimates quoted in the above paragraphs are all based on densities recorded during non-seismic periods. Densities of seals recorded during seismic periods were similar to those recorded during non-seismic, but densities of unidentified pinnipeds and of walruses recorded with seismic were markedly lower than those during non-seismic periods (Table I.1). Lower densities might be expected during seismic periods, either because of displacement (to the extent it occurs) or the tendency of seismic activity to take place further away from pack ice. (Arctic pinnipeds tend to concentrate near ice in summer.) On the other hand, locally abundant food resources near seismic track lines may be responsible for occasional high densities there. On several occasions the *Gilavar* passed through very strong tide rips and fronts. These areas frequently contain prey biomass higher than surrounding areas and thus attract seals (Suryan and Harvey 1998). The minimum numbers of exposures and minimum numbers of individuals exposed, based on the corrected densities recorded during seismic periods, are summarized in Table 6.9B.

Overall, these minimum figures are somewhat lower than those based on densities during non-seismic periods. Again, the minimum estimates of the numbers of individuals exposed are much lower than the minimum estimates of numbers of exposures to various received levels. In other words, many of the individuals pinnipeds exposed to a given sound level were exposed to that level several times. This reflects the degree of overlap in the ensonified areas around different seismic lines.

Cetaceans.—The estimated numbers of cetaceans that might have been exposed to various levels of received sounds, relative to the number of "takes" requested in the IHA application, are summarized in Table 6.10. The density data used to calculate these numbers, for non-seismic as well as seismic periods, are presented in Table I.1. Note that the estimated numbers in Table 6.10A represent the cetaceans that would have been exposed had the animals not shown localized avoidance of the airguns or the ship itself. Many of the animals calculated (based on density) to be within the ≥180- or ≥190-dB zones would in fact move away before being exposed to sounds that strong. This is presumably at least part of the reason for the fact that estimates based on sightings during seismic periods (Table 6.10B) were much lower than those during non-seismic periods (Table 6.10A).

(A) ≥160 dB (rms): We estimate that there would have been ~3089 exposures of ~198 different individual cetaceans to airgun pulses with received levels ≥160 dB re 1 µPa (rms) during the survey if all cetaceans showed no avoidance (Table 6.10A). Based on the available densities, 1824 of the exposures would have involved gray whales, 589 bowhead whales, 179 beluga whales, 388 harbor porpoises, 54 fin whales, 40 minke whales, and 19 killer whales. As with pinnipeds, the prorating of unidentified individuals may have resulted in a slight overestimation of takes of less frequently seen species. Minimum estimates of the numbers of different individuals exposed to ≥160 dB were far lower than were the estimates of the number of exposures to that level. This reflects the overlap in the ensonified areas around different seismic lines, and the fact that an animal remaining in the area would have been exposed repeatedly to ≥160 dB.

(B) ≥170 dB (rms): On average, some odontocete species may be disturbed only if exposed to received levels of airgun sounds ≥170 dB re 1 µPa (rms). If so, then the estimated number of exposures would be ~56% of the corresponding estimates for ≥160 dB, based on the proportionally smaller areas exposed to ≥170 dB. Overall, there would have been ~1715 exposures of cetaceans, involving ~131 individuals, to seismic sounds ≥170 dB (Table 6.10A).

(C) ≥180 dB (rms): If there were no avoidance of airgun noise by cetaceans, it is estimated that there would have been ~531 exposures of ~91 individual cetaceans to seismic sounds ≥180 dB (Table 6.10A). However, most of these cetaceans probably moved away before the airguns were close enough to create a

received level ≥180 dB. As noted earlier, there were only two cetacean sightings from *Gilavar* when airguns were operating. It is possible that some additional cetaceans were present within the 180dB radius and not seen by the MMOs during good visibility conditions. However, under those conditions, most cetaceans present probably were seen.

Estimates Based on Densities during Seismic Periods: Only one species, the harbor porpoise, had useable sightings sufficient for the calculation of a density applicable to periods of seismic activity (Table I.1). The density of harbor porpoises during non-seismic periods was significantly higher. This may represent avoidance of the seismic operation by harbor porpoises. It could also be related, in part, to the fact that seismic surveys did not occur in close proximity to ice, where food was likely abundant. Based on the corrected densities recorded during seismic periods, the minimum numbers of exposures and minimum numbers of individuals exposed are summarized in Table 6.10B.

BEAUFORT SEA MONITORING

Vessel-based Monitoring Effort and Marine Mammal Encounter Results

This section summarizes the visual monitoring effort and marine mammal sightings from the *Henry Christoffersen* during the Beaufort Sea shallow hazards, bathymetric, and seismic survey work, 3 August to 3 October 2006. Summaries of results from visual monitoring are presented here, with more detailed data presented in Appendix G, including monitoring effort in both kilometers and hours (Tables G.4, G.5). A general summary of effort and sightings is shown in Table ES.1. All marine mammals were observed inside the study area shown in Figure 6.1, as no monitoring occurred during transit to and from Kaktovik through the Canadian Beaufort Sea before 3 August or after 3 October 2006 (Table G.7).

Visual Survey Effort

MMOs observed primarily from the conning tower of the *Henry C.* (eye-height ~15.4 m above water; 96.2% of watch time), with the remaining observations conducted from the bridge (eye-height ~8.4 m). During 8213 km of *Henry C.* cruise operations within the study area in the Alaskan Beaufort Sea, there was 5145 km of visual observation effort over 526 h; of that, 3239 km of effort over 296 h was classified as "useable" (Tables ES.1, G.4). Useable survey effort, subdivided by whether the airguns were firing or not and water depth strata, is shown in Appendix G (Table G.4). Seismic survey effort with the *Henry C.*'s small airgun system was very limited because of persistent, heavy, ice conditions. Airguns were operated for only 98 km over 10 h, with 4 h of airgun operations classified as useable for analysis purposes.

Beaufort Wind Force (Bf sea state) during observations ranged from 0 to 5 within the study area, with 41.6% of the total effort and 45.9% of the useable effort (in h) occurring during conditions of Beaufort 1 (Table G.5). Most useable observations were conducted during conditions with Bf ≤ 2 (73.9% in h; Table G.5). The prevailing low sea state was typically due to heavy floe ice coverage and the proximity of the vessel to pack ice throughout the survey area. None of the observations within the study area were deemed "non-useable" because of high Beaufort Wind Force.

Visual Sightings of Marine Mammals and Other Vessels

Numbers of Marine Mammals Seen.—An estimated 451 individual marine mammals were seen in 412 groups through the study area (Table 6.11). This included, during systematic observation periods, 408 sightings of seals (managed by NMFS) plus 4 sightings of polar bears (managed by USFWS). No walruses were identified from the *Henry C.* A detailed list of sightings is provided in Appendix G (Table G.6).



FIGURE 6.1. Beaufort Sea study area where the *Henry C.* conducted shallow hazards, bathymetric, and seismic surveys, 3 Aug. to 3 Oct. 2006. Monitoring effort began and ended in Kaktovik, Alaska.

Three different seal species were identified, with ringed seals being the most frequently identified species (n = 90 individuals in 80 groups), followed by spotted seals (n = 75 in 65 groups; Table 6.11). In addition, 15 groups (16 individuals) of bearded seals were observed. Of the 181 seals in the study area that were identified by MMOs, 90 (or 49.7%) were ringed seals. Most of the unidentified seals (n = 261 individuals in 248 groups) were likely ringed seals given the visual monitoring results and the known occurrence of this species throughout the study area. However, the unidentified seals moved too rapidly or were too far away for the observer to make a positive identification. Also, it seems likely that some of the seals identified as spotted seals were in fact ringed seals, given the much higher frequency of ringed than spotted seal sightings in the study area in the past.

No animal deaths were observed during monitoring, but on 12 August 2006 a polar bear was observed on ice feeding on a dead seal. The seal's death was likely due to direct predation, and was not attributed to seismic activity, as no seismic gear had been deployed from the *Henry C.* in over three days.

The majority of the 412 sightings (66.5% or 274 groups) within the study area were "useable" (Table 6.11). These "useable" sightings, along with corresponding effort data, are the basis for the ensuing analyses comparing sighting rates and behaviors of marine mammals seen during the cruise.

TABLE 6.11. Numbers of sightings (groups) and of individual marine mammals, both ***(A)*** total and ***(B)*** useable[a], observed from the *Henry C.* in the study area during the Beaufort Sea monitoring cruise, 3 Aug. to 3 Oct. 2006. No sightings were made during seismic activity.

	Non-Seismic		Post-Seismic		*Total*	
	Sightings (groups)	**Indiv.**	**Sightings (groups)**	**Indiv.**	**Sightings (groups)**	**Indiv.**
A. All Sightings						
Pinnipeds in Water						
Phocids						
Bearded Seal	14	15	0	0	***14***	***15***
Ringed Seal	79	89	0	0	***79***	***89***
Spotted Seal	64	74	1	1	***65***	***75***
Unidentified Seal	242	255	2	2	***244***	***257***
Pinnipeds on Ice						
Phocids						
Bearded Seal	1	1	0	0	***1***	***1***
Ringed Seal	1	1	0	0	***1***	***1***
Spotted Seal	0	0	0	0	***0***	***0***
Unidentified Seal	4	4	0	0	***4***	***4***
Total Pinnipeds	***405***	***439***	***3***	***3***	**408**	**442**
Ursids						
Polar bear	4	9 0	0	0 0	***4***	***9***
Total	***409***	***448***	***3***	***3***	**412**	**451**
B. Useable[a] Sightings						
Pinnipeds in Water						
Phocids						
Bearded Seal	11	11	N/A	N/A	***11***	***11***
Ringed Seal	45	45	N/A	N/A	***45***	***45***
Spotted Seal	46	55	N/A	N/A	***46***	***55***
Unidentified Seal	168	177	N/A	N/A	***168***	***177***
Pinnipeds on Ice						
Phocids						
Bearded Seal	0	0	N/A	N/A	***0***	***0***
Ringed Seal	0	0	N/A	N/A	***0***	***0***
Spotted Seal	0	0	N/A	N/A	***0***	***0***
Unidentified Seal	1	1	N/A	N/A	***1***	***1***
Total Pinnipeds	***271***	***289***	***N/A***	***N/A***	**271**	**289**
Ursids						
Polar bear	3	4 0	N/A	N/A 0	***3***	***4***
Total	***274***	***293***	***N/A***	***N/A***	**274**	**293**

Note: N/A means not applicable.

[a] Useable sightings are those made during useable daylight periods of visual observation, as defined in *List of Acronyms and Abbreviations*.

[b] Sightings of pinnipeds on ice and polar bears that occurred during "useable" sighting conditions.

Sightings with Airguns On.—No marine mammal sightings were noted during the 10 h (4 h useable) while the airguns were operating. There were three seal sightings during 7 h of post-seismic observation effort, all of which were classified as non-useable (Tables ES.1, 6.11). Thus, all useable sightings were

recorded during non-seismic periods, which constituted the overwhelming majority of the observation time (Tables ES.1, 6.11). No power downs or shut downs were required during seismic activity, as no marine mammals were sighted in the water within the 190 dB safety radius around the operating airguns, and no whales were sighted from the *Henry C.*

Sighting Rates.—The lack of sightings while the airguns were on (0 sightings in 10 h, of which 4 h were useable) could simply reflect the brief duration and location of seismic operations. However, it was also consistent with the possibility of a reduced sighting rate with seismic operations as compared to that in non-seismic periods (409 groups in 510 h, or 274 groups in 292 useable hours—Tables 6.11, G.4).

Sighting rates (# groups sighted per unit effort) during various types of MMO effort are presented in Table 6.12. During post-seismic operations, the sighting rate (in groups per km, all effort considered) was about half that during non-seismic conditions (35.3 vs. 82.4 groups/1000 km; Table 6.12).

The lower sighting rates under seismic and post-seismic conditions than under non-seismic conditions could have resulted if there was avoidance of airguns, but could also have occurred because the seismic operators took advantage of minimal ice conditions to conduct seismic activities. Operating the seismic gear away from pack ice margins and floe ice reduces the danger of damaging equipment in the ice. In summer and early fall, seals in the Beaufort Sea typically favor areas near drifting ice (Moulton and Lawson 2002). Polar bears would also presumably favor these same areas because of the higher density of seals. Fewer marine mammal encounters were expected in the open water where the seismic activities were conducted than within the ice floes and along the ice margin where much of the non-seismic observation effort was conducted. In non-seismic periods, the highest sighting rates were for pinnipeds in water (85.2 seals/1000 km of useable effort), distantly followed by polar bears (0.9 bears/1000 km) and pinnipeds on ice (0.3 seals/1000 km). The large difference in sighting rates between seals in water and seals on ice could be due in part to seals that were initially hauled out on ice entering the water as the vessel approached. Useable sightings only occurred during non-seismic periods.

Reduced visibility due to fog (visibility <3.5 km) was the most common reason that sightings and effort were considered non-useable (53.9% of non-useable data), followed by insufficient ship speed (speed < 2 knots, 32.6% of non-useable data). During non-seismic periods, the detection rate of non-useable sightings was about ⅞ of that for useable sightings (Table 6.12), which is a rather high fraction. In other studies, including the 2006 *Gilavar* effort in the Chukchi Sea (Table 6.1), sighting rates during non-useable periods have often been proportionally lower relative to those during useable periods.

Other Vessels.—The IHA required that MMOs record the number and characteristics of vessels <5 km from any marine mammal sightings (Appendix A). There were few vessels near the *Henry C.* during the 2006 monitoring period. Vessels that were present in the eastern half of the study area were generally barges. Most of these vessels were at distances >5 km; however two vessels were sighted at ~3.5 km from the *Henry C.* No marine mammals were sighted while another vessel was known to be within 5 km of the *Henry C.*; therefore, no obvious reactions by marine mammals to other vessels were observed.

Distribution of Marine Mammals

Marine mammal sightings in the study area are listed in Table G.6. Observations during the Beaufort Sea operations indicate that, as expected, the ringed seal was the most abundant species in the study area (Table 6.11). The large number of ringed seal sightings was expected based on limited previous survey efforts. Ringed seals were seen throughout the survey area wherever visual observations occurred, including before and after seismic operations (Fig. 6.1; Tables 6.11, G.6). The majority of mammal sightings occurred in the southern portion of the cruise, where ice coverage was presumably.

TABLE 6.12. Detection rates for sightings from the *Henry C.* during non-seismic, post-seismic, and seismic monitoring in the Beaufort Sea, 3 Aug. to 3 Oct. 2006. All pinnipeds were seals.

	Non-Seismic			Post-Seismic			Seismic			*Total*		
Effort Type	**No. of Detect.**	**Effort (km)**	**Detection Rate (No./1000 km)**	**No. of Detect.**	**Effort (km)**	**Detection Rate (No./1000 km)**	**No. of Detect.**	**Effort (km)**	**Detection Rate (No./1000 km)**	**No. of Detect.**	**Effort (km)**	**Detection Rate (No./1000 km)**
Useable[a]												
Pinnipeds in water	271	3179	85.2	0	0	--	0	60	--	***271***	***3239***	***83.7***
Pinnipeds on ice	1	3179	0.3	0	0	--	0	60	--	***1***	***3239***	***0.3***
Polar bears	3	3179	0.9	0	0	--	0	60	--	***3***	***3239***	***0.0***
Total useable	***274***	***3179***	***86.2***	***0***	***0***	***--***	***0***	***60***	***--***	**275**	**3239**	**84.9**
Non-Useable[b]												
Pinnipeds in water	134	1783	75.2	3	85	35.3	0	38	--	***137***	***1906***	***71.9***
Pinnipeds on ice	5	1783	2.8	0	85	--	0	38	--	***5***	***1906***	***2.6***
Polar bears	1	1783	0.6	0	85	--	0	38	--	***1***	***1906***	***0.5***
Total non-useable	***135***	***1783***	***75.7***	***3***	***85***	***35.3***	0	***38***	***--***	**143**	**1906**	**75.0**
All	***409***	***4962***	***82.4***	***3***	***85***	***35.3***	***0***	***98***	***--***	**418**	**5145**	**81.2**

[a] Useable detections are those made during useable daylight visual observations; see *Acronyms and Abbreviations* for the definition of "useable" observation effort.

[b] Includes the "Post-seismic" category.

greater, and could be considered the ice margin. The lowest concentration of marine mammal sightings occurred along the more northerly parts of the tracklines where ice coverage was less dense, or occurred outside the shallow-hazards survey areas, where there was less observation effort.

Polar bears were sighted infrequently, but throughout the duration of the cruise, in areas close to land and ice. Useable sightings occurred during August and September 2006, and there was a non-useable sighting in October. Of the two sightings in August, both were on ice. The first sighting was of a single adult bear feeding on a seal. The bear did not react overtly to the presence of the vessel. The second sighting was of a mother and cub. Both bears entered the water upon noticing the vessel and began swimming away. The single observation in September consisted of a lone adult swimming parallel to and heading astern of the vessel. The behavior of the animal did not appear to be altered due to vessel presence. On 1 October 2006, there was a sighting of 2 adults and 3 cubs resting on Cross Island; this was classified as "non-useable" due to insufficient visibility. An additional opportunistic sighting was recorded at Cross Island on 30 September 2006, but the data were not included in the results because the vessel was anchored when the observation occurred. Two adults and four other bears were resting on ice near whale bone piles north of the island.

Marine Mammal Behavior

The data collected during visual observations provide information about behavioral responses of marine mammals to the seismic survey. The relevant data collected from the *Henry C.* include estimated closest observed points of approach (CPA) to the vessel, movement relative to the vessel when the airguns were not firing, and observed behavior of animals at the time of the initial sightings. CPA of marine mammals to the vessel was calculated from the location airguns would have been positioned if deployed.

Closest Observed Point of Approach

The mean CPA for pinnipeds (seals) in water was 249 m (n = 271), which was about 1/6th of that for polar bears on ice and in the water combined (1486 m; n = 3). These figures consider only useable sightings, all of which were during non-seismic periods (Table 6.13). The difference is reduced if only the animals in water are considered (249 m vs. 593 m; n = 271 vs. 2), as the most distant polar bear sighting was on land. In the absence of any sightings during seismic periods, nothing can be said about CPA values during seismic vs. non-seismic periods.

TABLE 6.13. Closest observed points of approach (CPA) of useable marine mammal sightings during the *Henry C.'s* non-seismic and seismic operating periods in the Beaufort Sea, 3 August to 3 October 2006. No sightings were observed during seismic activity. All pinnipeds were seals.

		Non-seismic			
Taxonomic Group[a]	**No. of Sightings**	**Mean CPA (m)**	**s.d.**	***n***	**Range (m)**
Pinnipeds in Water	271	249	200	271	1301
Pinnipeds on Ice	1	97	--	1	--
Polar Bears	3	1486	1555	3	2943

[a] Includes only useable sightings as defined in *Acronyms and Abbreviations.*

For seals in water, the mean CPA distance found during this project was 249 m (n = 271). The mean CPA distance would be less than the mean of the initial sighting distances. Nonetheless, the mean CPA value for 2006 is higher than the mean initial sighting distances in 5 of 6 prior years of seismic monitoring in the Alaskan Beaufort Sea: In 1996 to 2001, mean sighting distances to seals observed during non-seismic periods ranged from 113 m in 1998 to 294 m in 2000 (Table 3.9 *in* Moulton and Lawson 2002). The relatively high mean value in 2006 (despite the fact that it summarizes CPA distances and not initial sighting distances) is probably related to two factors: the good visibility afforded by the high conning tower on the *Henry C.*, and to the relatively low Beaufort state that prevailed due to the proximity of ice.

Categories of Behavior

The two behavior variables that were examined quantitatively were the same as for the Chukchi Sea (see earlier): behavior category and movement category when the animal(s) were first observed (see Appendix E for variables and definitions). The CPA distance recorded for each sighting was also an indicator of behavior (see above and Appendix E).

Sample sizes for this cruise were small and there were no useable sightings during the limited seismic operations. However, previous studies in the Alaskan Beaufort Sea have provided comparable data on seal behavior in the presence and absence of airgun operations (e.g., Moulton and Lawson 2002). The 2006 data from non-seismic periods could be useful as a basis of comparison with any future related results. The 2006 results are presented in Tables 6.14 and 6.15.

Movement.—During non-seismic periods, pinnipeds (mainly ringed seals) in the water were most often seen swimming toward the vessel (24.6% of sightings for which "movement category" was recorded; Table 6.14). The second most frequently observed movement was swimming parallel to the vessel (12.5%). A single record of a pinniped first observed on ice was categorized as hauled out (although it dove into the water from the hauled out position).

A polar bear first observed on ice was included with all other polar bear sightings in Table 6.14 and recorded as stationary (no movement).

First Observed Behavior.—Across all categories of animals, the most common "first observed behavior" during non-seismic periods was "looking" (Table 6.15). Looking was the first observed behavior for 30.5% of the seal sightings during non-seismic periods. However, pinnipeds observed in the water were nearly as likely (24.4%) to dive as they were to look at the vessel as it approached (Table 6.15). The single pinniped that was observed hauled out on ice dove into the water as the vessel passed (Table 6.15). Polar bear activity was variable, as they were observed actively feeding or swimming during three separate useable sightings.

Mitigation Measures Implemented

No power downs or shut-downs of the airguns were necessary or requested due to marine mammal sightings within the 180 and 190 dB safety radii during the Beaufort Sea shallow-hazards survey. All sightings of marine mammals occurred during non-seismic periods.

Estimated Number of Pinnipeds Present and Potentially Affected

It is difficult to obtain meaningful estimates of "take by harassment" for several reasons, as enumerated in the corresponding Chukchi Sea section, earlier. During the 2006 vessel-based monitoring in the Beaufort Sea, there were additional factors to consider: • Several of the sightings were of seals and polar

TABLE 6.14. Movement categories recorded for useable marine mammal sightings in water during the *Henry C.*'s Beaufort Sea cruise, 3 Aug. to 3 Oct. 2006. All useable sightings were non-seismic and are presented as number of groups with number of individuals in parentheses. See Appendix E for definitions of movement categories. All pinnipeds were seals.

	Movement Relative to Vessel									
Taxonomic Group[a]	**Mill**	**Swim Away**	**Swim Parallel**	**Swim Toward**	**Flee**	**Swim Across Bow**	**No movement**	**Unknown**	**Total Known**	***Total***
Pinnipeds in Water										
Non-seismic	6(12)	99(102)	29(31)	57(63)	5(5)	17(18)	19(19)	39(39)	232(250)	***271(289)***
Polar Bears										
Non-seismic	--	2(3)	--	--	--	--	1(1)[b]	--	3(4)	***3(4)***

[a] Includes only useable sightings are as defined in *Acronyms and Abbreviations*.

[b] Polar bear observed on ice.

TABLE 6.15. First observed behavior of useable marine mammal groups during he *Henry C.*'s Beaufort Sea cruise, 3 Aug. to 3 Oct. 2006. All useable sightings were non-seismic and are presented as number of groups with number of individuals in parentheses. See Appendix E for definitions of behavior. All pinnipeds were seals.

Taxonomic Group	**Breach**	**Dive / Front Dive**	**Feed**	**Fluke**	**Log**	**Look**	**Rest**	**Surface Active**	**Sink**	**Surface-active Travel**	**Swim**	**Thrash**	**Travel**	**Unknown**	**Total Known**	***Total***
Pinnipeds in Water																
Non-seismic	1(1)	68(73)	4(4)	1(1)	5(5)	85(93)	2(2)	7(12)	7(7)	1(1)	56(56)	19(19)	15(15)	--	271(289)	***271(289)***
Pinnipeds on Ice																
Non-seismic	--	1(1)	--	--	--	--	--	--	--	--	--	--	--	--	1(1)	***1(1)***
Polar Bears																
Non-seismic	--	--	--	--	--	--	--	--	--	--	1(1)	--	1(2)	1(1)[b]	2(3)	***3 (4)***

[a] Includes only useable detections as defined in *Acronyms and Abbreviations*.

with seismic operations was very limited, and there were no useable marine mammal sightings with seismic operations.

Disturbance and Safety Criteria

Table 5.2 shows estimated received sound levels at various distances from a 4-airgun array with total volume 240 or 280 in^3. The 120, 160, and 170 dB rms radii quoted in Table 5.2B,C are assumed disturbance criteria, and they are based on limited acoustic measurements in the Beaufort Sea made by Greeneridge Sciences (see Chapter 4). The most protective empirical measurements by Greeneridge Sciences (see Chapter 4, Table 5.2B) were used to calculate areas ensonified and potential exposures.

The 180 and 190 dB radii are safety radii, used in determining when mitigation measures were required. During this and many other recent projects, NMFS has required that mitigation measures be applied to avoid, or minimize, the exposure of cetaceans and pinnipeds to impulse sounds with received levels ≥180 dB and ≥190 dB re 1 µPa (rms), respectively. Given the lack of mammal sightings during SOI's brief periods of airgun operations in the Beaufort Sea in 2006, no power downs or shut downs of the airguns were required. However, the safety and disturbance radii were used after the field season to estimate numbers of marine mammals exposed to various received sound levels.

This section applies two methods to estimate the number of pinnipeds exposed to seismic sound levels strong enough that they might have caused disturbance or other effects. The first procedure is based on direct observations of seals exposed to airgun sounds. The second is based on an indirect estimation process that involves calculating the total areas ensonified by various levels of sound (Appendix E, Table E.3), and multiplying those areas by the estimated density of seals within the study area (Appendix I, Table I.2).

Estimates from Direct Observations

The number of marine mammals observed close to the *Henry C.* during Beaufort Sea monitoring provides a minimum estimate of the number potentially affected by seismic sounds. This is likely an underestimate of the actual number potentially affected. Some animals probably moved away before coming within visual range, and not all of those that remained would have been seen by observers.

Seals Potentially Exposed to Sounds ≥190 dB re 1 µPa (rms).—During this project, no marine mammals were sighted within the small safety radius around the airguns while seismic operations were conducted. The estimated 180 dB and 190 dB radii shown in Table 5.2 are the *maximum* distances from the airguns where sound levels were expected to be ≥180 or ≥190 dB re 1 µPa (rms). These distances would have been applied as mitigation radii if any marine mammals had been seen during airgun operations. As no marine mammals were seen during airgun operations in the Beaufort Sea, the direct estimate of numbers exposed to ≥190 dB rms was zero.

Marine Mammals Potentially Exposed to Sounds ≥160 dB re 1 µPa (rms).—Likewise, no marine mammals were sighted in the water under "useable" (or non-useable) conditions during the Beaufort Sea cruise when the airguns were operating (Tables ES.1, G.6).

Estimates Extrapolated from Density

The numbers of mammals directly sighted by MMOs underestimate the actual numbers, as described in the Chukchi Sea section earlier. Indirect estimates based on the ensonified area and estimated mammal density provide alternative estimates that can avoid this underestimation.

The methodology used for the indirect estimates was described briefly in Chapter 5 and in further depth in Appendix E. Methods used to estimate the areas exposed to received levels ≥160, ≥170, ≥180 and ≥190 dB were described there. Densities of marine mammals in the study area were estimated based on direct observations during non-seismic periods, analyzed using standard line-transect estimation procedures, and adjusted to allow for missed animals.

The aforementioned densities were used to estimate both the number of different *individual* marine mammals exposed to 160, 170, 180, and 190 dB rms, and the number of *exposures* of marine mammals to the various levels. As discussed in the Chukchi Sea section, estimated number of exposures will exceed the estimated number of different individuals exposed if the airguns are towed back and forth through the same region a number of times, exposing some animals to airgun sound on more than one pass.

The estimates provided here are based on the actual airgun operations during the Beaufort Sea portion of this project. In contrast, the estimates provided in the IHA application and EA for this project were based on the then-anticipated amount of survey. The estimates in the IHA Application assumed that SOI would conduct far more seismic surveying in the Beaufort Sea than actually occurred. The requested "takes" by Shell Offshore Incorporated in the Beaufort Sea included those from the planned 3-D work that was not conducted. Thus, the present estimates of numbers actually exposed to various sound levels are lower than those anticipated in the IHA Application. In addition, the following estimates assume that all mammals present were well below the surface, and that mammals did not move away from the path of the approaching *Henry C.* Those assumptions probably did not apply to all animals, so (as described earlier for the Chukchi Sea), indirect estimates based on densities in non-seismic periods are probably overestimates. Also, the estimated number of animals exposed could be further overstated because the size of the airgun array assumed in these calculations (4 airguns totaling 280 in^3) exceeded the size used for the majority of seismic acquisition in the Beaufort Sea (2 guns totaling 140 in^3).

Pinnipeds.—Estimates of the densities of pinnipeds in the Beaufort Sea study area are given in Appendix I (Table I.2), based on useable sightings and observation effort from the *Henry C.* during non-seismic periods, and including approximate corrections for sightability biases. These corrected densities were used to estimate the number of marine mammals that were exposed to various received levels of airgun sound, and thus potentially affected by seismic operations (Table 6.16). The table summarizes the estimated numbers of seals that might have been exposed to sounds with various received levels, along with the number of "takes" for which authorization was requested in Shell's IHA Application for the Beaufort Sea (SOI 2005a). As noted in the preceding paragraph, the numbers in Table 6.16 are probably overestimated.

NMFS commonly specifies that marine mammals exposed to pulsed sounds with received levels ≥160 dB re 1 µPa (rms) should be considered potentially disturbed. However, most pinnipeds are unlikely to be disturbed appreciably by airgun sounds when exposed to received levels of 170 dB (Harris et al. 2001; Moulton and Lawson 2002). These are not considered to be "all-or-nothing" criteria; some individual mammals may react strongly at lower received levels, but others are unlikely to react strongly unless levels are substantially above 160 or 170 dB.

(A) ≥160 dB (rms): We estimate that there would have been ~180 exposures of ~149 different individual seals (ringed, bearded, and spotted) to airgun pulses with received levels ≥160 dB re 1 µPa (rms) during the shallow-hazards survey if all seals were below the surface of the water and showed no avoidance of the approaching vessel, and if the 4-airgun 280-in^3 source had been used for all airgun operations (Table 6.16). Given the predominance of ringed seals in the Beaufort Sea, most of the exposures would have been of ringed seals, with lesser numbers of exposures of bearded and spotted seals.

TABLE 6.16. Estimated numbers of exposures, and estimated minimum numbers of individual pinnipeds (ringed seals, spotted seals, and bearded seals) that might have been exposed, to sounds with various received levels during airgun operations from the *Henry C*. Numbers of exposures are overestimated as the calculations assume that all seals were in the water well below the surface, that they did not move away from the approaching airguns, and that all airgun operations were with a 4-airgun 280 in^3 array (see text). Also shown in boldface is the "harassment take" authorized by NMFS under the IHA.

Exposure level in dB re 1 µPa (rms)	**Estimated total**		***Requested Take***
	Exposures	**Individuals**	
160	180	149	***2206***
170	66	63	
180	24	23	
190	9	8	

(B) ≥170 dB (rms): Seals were unlikely to be disturbed unless exposed to received levels of airgun sounds ≥170 dB re 1 µPa (rms). If so, then the estimated number of exposures would be ~37% of the corresponding estimates for ≥160 dB, based on the proportionally smaller areas exposed to ≥170 dB. Overall, there would have been ~66 exposures of seals, involving ~63 individuals, to seismic sounds with received levels ≥170 dB (Table 6.16).

(C) ≥180 dB (rms): Some seals probably were within the 180 dB radius around the operating airguns but were not seen by the observers even though all airgun operations were in daylight. The 180 dB radius for the 4-airgun 280-in^3 source was empirically measured by Greeneridge Sciences as 250 m (Tables 4.7, 5.2). Based on the densities of seals estimated from this project's sighting data under non-seismic conditions, there would be ~24 exposures of seals to ≥180 dB, involving ~23 individuals, under the assumptions listed under (A) above (Table 6.16). The latter estimate far exceeds the zero seals observed directly in areas possibly exposed to ≥180 dB (Table G.6). The difference can be attributed, in part, to the fact that the estimates in Table 6.16 include any seals that

- avoided exposure to ≥180 dB by swimming away from the approaching shallow-hazards survey vessel before entering the 180 dB radius, or
- were present but missed by visual observers because of the inevitable difficulties in sighting small seals in the water in the presence of ice, glare, wave action, etc. [Earlier studies have shown that the detectability of ringed seals in the water diminishes rapidly as distance increases beyond about 50 m—Harris et al. (2001); Moulton and Lawson (2002).]

(D) ≥190 dB (rms): Likewise, based on the densities of seals calculated from our sighting data, we estimate that there would have been 9 exposures of 8 different seals to airgun sounds with received levels ≥190 dB (rms) given the usual assumptions: all seals were below the surface, they showed no avoidance, and the total volume of 4 airguns was 280 in^3 (Table 6.16). However, some of these seals likely would have swum away before the received level reached 190 dB. Others might not have been far enough below the surface to be exposed to ≥190 dB. Also, given the use of a smaller airgun source part of the time, the 190 dB radius sometimes would have been less than the assumed 89 m. Thus, the actual number exposed to ≥190 dB was probably lower than the above estimates.

Aerial Surveys for Cetaceans

Monitoring Effort

Aerial surveys were flown on 23–24 Sept. to "clear" the area out to the 120 dB distance, i.e., to assess the occurrence of bowhead whales within that distance of locations where the *Henry Christoffersen* was about to conduct airgun operations. During the aerial survey on 23 Sept., 45.1 km of transect surveys were flown, of which 35.5 km were flown in good conditions (Bf < 5 and/or sightability ≤ 3). There was one sighting of a bowhead whale during this survey (Fig. 6.2). On 24 Sept., 174.3 km of transect surveys were flown, of which 152.9 km were flown in good conditions. No whales were seen during this survey. Poor weather prevented complete surveys from being flown on either of the days.

Additional aerial surveys were flown by LGL for Shell in the Beaufort Sea during the 26 Aug. through 24 Sept. period. However, in the absence of airgun operations by the *Henry C.* on any dates in September other than 25 Sept., only the surveys on 23–24 Sept. were needed for purposes of "clearing" an area where the airguns were about to be used.

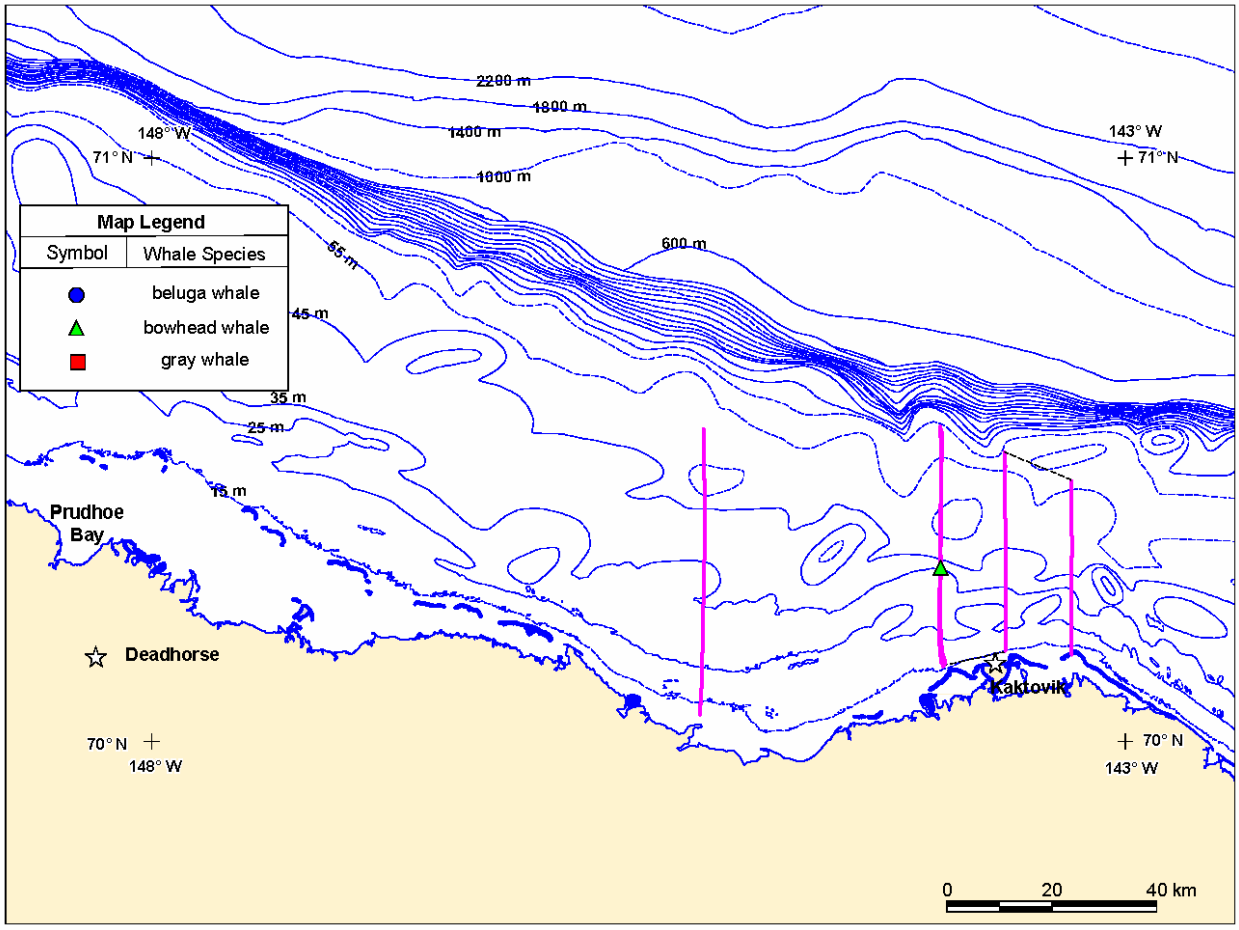


FIGURE 6.2. Aerial survey transects (purple lines) flown by LGL on 23–24 Sept. 2006 in the central Alaskan Beaufort Sea. The third transect from the right was flown twice, on both 23 and 24 Sept.; other transects were flown once.

Distribution of Cetaceans

All whale sightings during LGL/Shell aerial surveys in the Beaufort Sea during late August and September 2006 are shown in Figure 6.3.

In 2006, nearly all bowhead whales sighted during the surveys were found in waters between the 40 m and 100 m depth contours. Only one bowhead sighting occurred shoreward of the 30 m depth contour. Bowhead sightings were concentrated in waters from 40 m to 100 m deep, ~30 to 60 km from shore. Ice conditions during the 2006 field season consisted of a band of pack ice (5 to 40% ice cover) from the shore out to ~20 to 40 km. Beyond this band of ice the waters were open with 0% ice cover. Most bowhead sightings were either at the northern edge of the pack ice in about 5–10 % ice cover, or north of the pack ice in the open water. The most numerous bowhead sightings occurred on 4 Sept. with 13 sightings of 20 bowhead whales, and on 6 Sept. with 14 sightings of 22 bowhead whales. Numbers of sightings during the surveys prior to and after these two varied from 1 to 5. Group sizes throughout the field season varied from 1 to 4, and the predominant activity observed was traveling in a westerly direction.

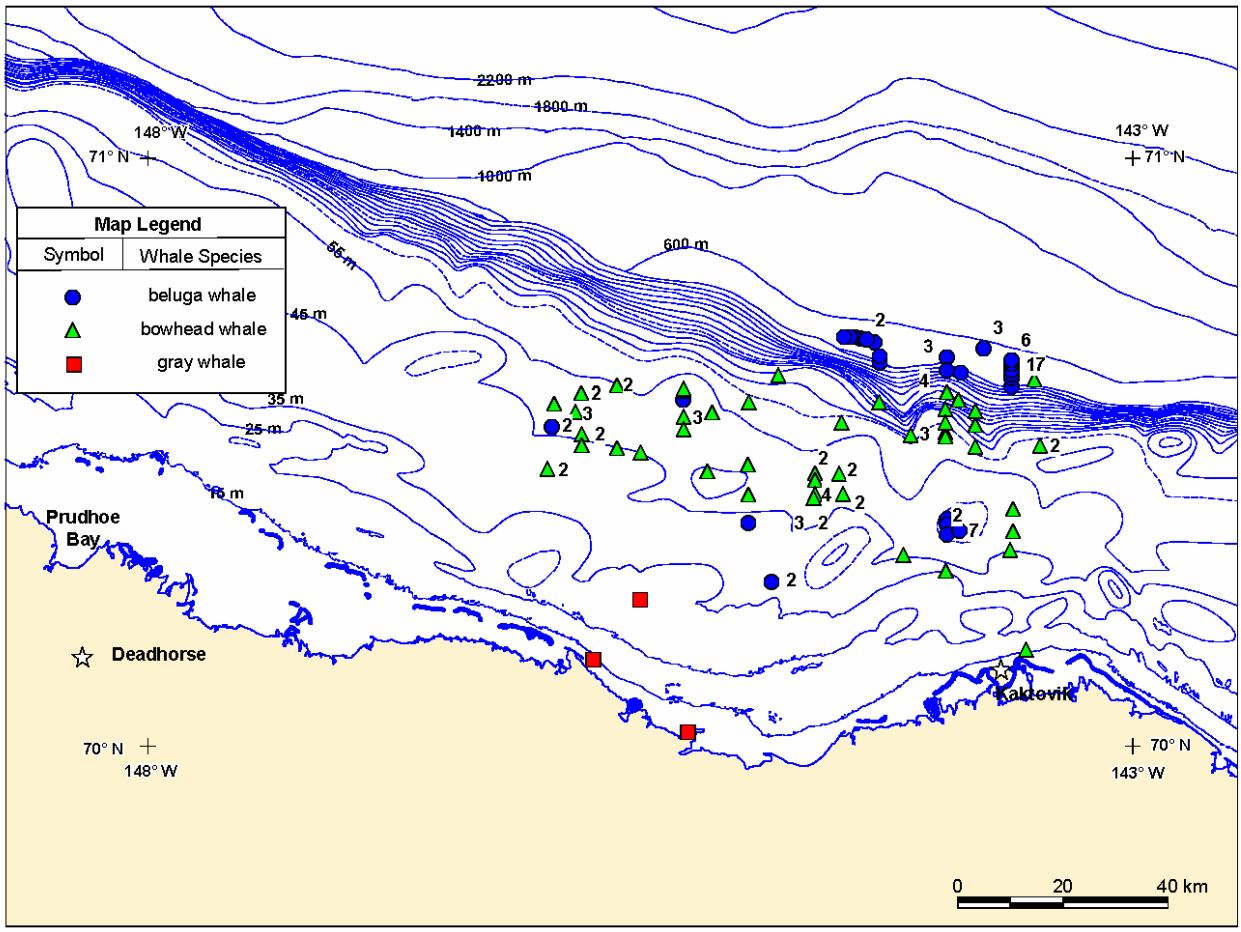


FIGURE 6.3. All whale sightings (on and off transect) in the 2006 SOI shallow-hazards survey area from 26 Aug. to 24 Sept. 2006 based on LGL/Shell aerial surveys. The center of the area of airgun operation on 25 Sept. 2006 is depicted with the ⊗ symbol. Numbers beside symbols indicate group sizes when group size > 1.

Beluga whale sightings were primarily concentrated at the northern end of the transect lines near the 200 m depth contour in 0% ice cover, with a few scattered sightings closer to shore around the 40 m depth contour (Fig. 6.3). The beluga sightings were most numerous on 6 Sept. with 22 sightings of 52 beluga whales. The numbers of sightings during surveys prior to and after 6 Sept. varied from 0 to 4. Group sizes varied from 1 to 7, except for one sighting of 17 beluga whales on 6 Sept. The predominant activity observed was traveling in a southwesterly direction.

Gray whales were seen near the Canning River Delta on three occasions (two on 4 Sept. and one on 14 Sept.). On all three occasions there was only a single whale observed. Of the three gray whales observed, two were traveling and the third was feeding.

Mitigation Measures Implemented

One bowhead whale was sighted on 23 Sept. (Fig. 6.2) but there were no sightings during the 24 Sept. survey. That cleared the area out to the 120 dB distance from the area of planned airgun operations, which proceeded on 25 Sept. No aerial surveys were flown on 25 Sept. due to poor weather conditions.

Estimated Number of Cetaceans Present and Potentially Affected

The three received level criteria that have been specified by NMFS as relevant in estimating cetacean "take by harassment" are as follows:

- 180 dB re 1 μPa (rms), above which there is concern about possible effects on hearing;
- 160 dB re 1 μPa (rms), above which avoidance and other behavioral reactions are likely; and
- 120 dB re 1 μPa (rms), above which displacement of migrating bowhead whales can occur (bowhead mother/calf pairs must be monitored and not exceed three) (NMFS 2006a).

180 dB Criterion.—NMFS (1995, 1999) concluded that noise pulses from a nearby seismic vessel might affect the hearing abilities of baleen whales if received levels exceed 180 dB re 1 μPa rms. The IHA issued for Shell's 2006 seismic program (NMFS 2006a; see Appendix A) called for immediate shutdown if cetaceans were detected within the 180 dB (rms) radius. It is assumed that the received rms pulse levels might have been 180 dB re 1 μPa or more at distances as great as 330 m (Table 5.2B) from the Henry C. The 330 m value is based on the preliminary field measurements and is more protective than the final field measurement of 250 m for 180 dB re 1 μPa (Table 5.2B,C).

MMOs working onboard the *Henry C.* saw no bowhead whales within (or beyond) the 180 dB distance on 8 Aug. or 25 Sept. when the airguns were operating. It is unlikely that an MMO would miss a bowhead within the 180 dB distance if it was at the surface, and even if it were submerged, the MMO probably would have seen the bowhead earlier or later when it did eventually surface. Thus, the estimated number of bowhead whales exposed to sound pulses with received levels ≥ 180 dB re 1 μPa rms is **zero**.

No beluga whales were sighted by MMOs working onboard the *Henry C.* within the 180 dB radius on 8 Aug. or 25 Sept. when seismic activity was underway. It is unlikely that a beluga was present during this time given the rarity of belugas in nearshore waters in this area during summer and autumn.

160 dB Criterion.—NMFS' practice involving impulsive sounds such as seismic has been to assume that a "take by harassment" may occur if cetaceans are exposed to received levels of sound that exceed 160 dB re 1 μPa rms. Takes of this type involve avoidance and other short-term changes in behavior that occur at distances well beyond those where there is any reasonable possibility of injury to the whales (Richardson

et al. 1986, 1995:372ff; Ljungblad et al. 1988; NMFS 1995). We assume that the 160 dB (rms) distance for Shell's 2006 shallow-hazard source may have been as much as 2.22 km (Table 5.2B) from the Henry C.

MMOs working onboard the *Henry C.* saw no bowhead whales within the 160 dB distance on 8 Aug. or 25 Sept. when airgun operations were underway. We have no specific information on the probability that boat-based observers will sight a bowhead that is within 2.22 km of the vessel. However, given that bowhead whales are below the surface a high proportion of the time, it is possible that a bowhead could have been within 2.22 km of the source vessel when the airguns were operating. However, bowheads were unlikely to have been in the area by 8 Aug. Also, the bulk of the bowhead migration in Sept. 2006 was well offshore, some 20 km north of the seismic operations. Thus, it is unlikely that many (if any) bowheads were within 2.22 km of the shallow-hazards survey vessel during the brief period of airgun operations.

No beluga whales were sighted by MMOs working onboard the *Henry C.* within the 160 dB distance on 8 Aug. or 25 Sept. when seismic activity was underway. It is unlikely that a beluga was present during this time given the rarity of belugas in nearshore waters in this area during late summer and autumn.

120 dB Criterion.—In 2006, NMFS specified that it should be assumed that a "take by harassment" may occur if ≥4 bowhead cow/calf pairs are exposed to received levels of sounds that exceed 120 dB re 1 μPa rms. Takes of this type, if they occurred, would involve avoidance and other short-term changes in behavior that sometimes occur at distances far beyond those where there is any reasonable possibility of injury to the whales (Richardson et al. 1986, 1995:372ff; NMFS 1995; Miller et al. 1999). It is assumed that the 120 dB (rms) distance for Shell's 2006 shallow-hazards source was as much as 22.2 km (Table 5.2B) from the Henry C. Again, that value considers all aspects and is based on modeling; the measured value, in the along-trackline direction, was 22.2 km (Tables 4.7, 5.2C).

One bowhead was sighted within the 120 dB distance on 23 Sept., two days prior to airgun operations. That survey provided about 15% coverage of the area within which received levels were expected to be ≥120 dB. It is conceivable that, had aerial surveys been flown on 25 Sept., there might also have been one or more sightings of bowhead whales on that day. Based on the overall distribution of bowhead whales in the 2006 field season, the presence of bowheads is plausible at that date and location. The average detection probability for bowhead whales during late summer/autumn aerial surveys in the central Beaufort Sea is 14.4%, considering all whale activities (Thomas et al. 2002). Based on that, and the one sighting on 23 Sept., the number of bowheads that may have been exposed to the 120 dB re 1 μPa is on the order of **fifteen** bowheads. The calving success of bowheads in 2006 has not been quantified but the proportion of the bowheads that are calves varies between about 2 and 10% of the population (Koski et al. 1993). Even if 2006 was an optimal calving year, it is unlikely that more than 1–2 mother/calf pairs would have been exposed to 120 dB based on the above considerations. These estimates would apply if the bowheads did not avoid the area around the operating seismic vessels before approaching the various radii.

Bowhead whales generally avoid areas around operating seismic vessels, but the avoidance distance varies widely depending on some combination of region, season, and bowhead activity. At some times and places, bowheads generally begin to show active avoidance upon receiving airgun sounds with levels above ~160 dB re 1 μPa rms (Richardson et al. 1986; Ljungblad et al. 1988; Richardson and Malme 1993; G. Miller et al. 2005; LGL unpubl. data). However, migrating bowheads in nearshore

waters of the Alaskan Beaufort Sea in autumn 1996–1998 showed avoidance at lower received levels and longer distances (Miller et al. 1999; Richardson et al. 1999).

SUMMARY OF CHUKCHI AND BEAUFORT SEA MONITORING RESULTS

Vessel-Based Monitoring Effort

Marine mammal observers aboard the *Gilavar* conducted 13,527 km and 1537 h of visual observation, and MMOs aboard the *Kilabuk* conducted 14,058 km and 1251 h of visual observation, together documenting 353 sightings of 442 pinnipeds and 115 sightings of 219 cetaceans. There were numerous sightings of supply and chase vessels within 5 km of each of the observation vessels.

A total of 8213 km and 526 hours of visual observation were conducted aboard the *Henry Christoffersen*, during which 412 sightings of 451 marine mammals were logged. Ringed seals were the most abundant. No sightings were noted during the brief period with airgun operations. Few vessels were sighted during the cruise, and only two of these approached within 5 km of the vessel.

Estimated Number of Marine Mammals Present and Potentially Affected

Based on direct observations from the *Gilavar*, it is estimated that 24 seals were potentially exposed to sound levels ≥180 dB re 1 µPa (rms). Estimates for individual pinnipeds and cetaceans potentially exposed to sound levels ≥160 dB re 1 µPa (rms) are 1317 and 198 respectively.

No animals observed from the *Henry Christoffersen* were potentially exposed to sound levels ≥180 dB re 1 µPa (rms). Based on calculations involving estimated densities of marine mammals, there would have been approximately 180 seals exposed to sound levels ≥160 dB re 1 µPa (rms).

Aerial Survey Effort

On the two days of surveying for mitigation purposes, 219.4 km of transect was flown, of which 188.4 km were flown in good surveying conditions. There was one sighting of a bowhead during these surveys.

AVAILABILITY OF MARINE MAMMALS FOR SUBSISTENCE PURPOSES

SOI exerted a concerted effort to assure that their seismic operations in the Chukchi and Beaufort Seas did not adversely affect subsistence hunting. Representatives of SOI visited rural communities in the spring, months before the project started, to discuss the project with the people who use the Chukchi and Beaufort Seas as their hunting ground. The SOI representatives sought input on how to best accomplish the seismic survey without interfering with subsistence harvests. SOI signed the CAA that outlined strategies of communication and operations to best avoid any impact on subsistence hunting.

In accordance with the CAA, SOI's seismic surveys were arranged to avoid areas of subsistence whaling during the hunting seasons at the various communities. Early in the season Shell's activities in the Chukchi Sea were delayed until after the beluga whale hunt was completed. Later in the year this coordination was effective in preventing the seismic activities from influencing the migration pattern of bowhead whales and affecting the whales' availability. The *Henry C.* worked in the western part of the SOI's Beaufort Sea study area until the whalers to the east, operating from Kaktovik and Cross Island, landed their quotas of whales. The *Henry C.* then moved to the east side of the study area while subsistence whaling was conducted out of Barrow.

All of the vessels involved in the SOI project communicated at least once daily with Communication Centers that were established to relay information between subsistence hunters and seismic and other vessel operators. The locations and activities of each vessel were reported to the Communication Centers. If subsistence hunting was being conducted in an area where seismic or other support activities had been planned, the communicators would have conveyed that information to the vessel personnel and the vessel's work location would have been adjusted accordingly. One instance of this occurred on 6 Sept. when a support vessel, being used to deploy acoustic recorders, turned back when Nuiqsut whalers asked them not to proceed offshore of the Cross Island area. Also, if the whalers had perceived a shift in the bowheads' migration route, the vessels would have been asked to move the operations further away from the subsistence hunting area.

Additional measures that helped reduce the impacts of the Shell operations on subsistence hunting were seasonal accommodations in operations of the *Henry C.,* the decision not to bring the *Gilavar* into the Beaufort Sea in Sept., and the decision to send the *Gilavar* south before many bowhead whales arrived in the Chukchi Sea (where one or two communities planned to conduct fall hunts in 2006). In general, the efforts of SOI to prevent their seismic operations from affecting the availability of marine mammals to subsistence hunters were successful. Kaktovik, Barrow, and Nuiqsut all had successful hunts in 2006.

7. ACKNOWLEDGEMENTS

We thank all of the marine mammal observers (MMOs)—biologists and Inupiat—who participated in the project. They were essential to the completion and success of this endeavor. We thank the captains and crews of the *Gilavar*, the *Jim Kilabuk*, the *Gulf Provider*, the *Peregrine*, and the *Henry Christoffersen* for their support during the cruises. Additionally, we appreciate the help of John Davis and his team at WesternGeco and Mike Schlegel and his team (Geo LLC). We thank the pilots and crew of ERA Aviation for their help with the aerial survey program. We also thank representatives of the National Marine Fisheries Service, U.S. Fish & Wildlife Service, North Slope Borough Department of Wildlife Management, Alaska Eskimo Whaling Commission and Minerals Management Service for their advice and comments during the "open-water meetings" convened by NMFS in April and October 2006 and at various other times. Michael Macrander, Paul Smith, Mark Kosiara, Bob Rosenbladt, Peter Littlewood, Dan Taylor, Travis Allen, Susan Childs, Jason Smith, and Rick Fox at Shell made it easy for us to do our jobs. Additional acknowledgements associated with the acoustical measurements are listed near the end of Chapter 4 in this report.

8. LITERATURE CITED

Amstrup, S.C. 1995. Movements, distribution, and population dynamics of polar bears in the Beaufort Sea. Ph.D. Dissertation. Univ. Alaska–Fairbanks, Fairbanks, AK. 299 p.

Amstrup, S.C., T.L. McDonald and I. Stirling. 2001. Polar bears in the Beaufort Sea: a 30-year mark-recapture case history. **J. Agric. Biol. Environ. Stat.** 6(2):221-234.

Angliss, R.P. and K.L. Lodge. 2004. Alaska marine mammal stock assessments, 2003. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-144. 230 p.

Austin, M., M. Laurinolli and D. Hannay. 2006a. Preliminary acoustic level measurements of airgun sources from GX Technology Corporation's 2006 Arctic Span Seismic Survey. Rep. from JASCO Res. Ltd., Victoria, B.C. [for GX Technol. Corp., Houston, TX]. 11 p.
Available at http://www.nmfs.noaa.gov/pr/permits/incidental.htm.

Austin, M., A. MacGillivray, M. Zykov and D. Hannay. 2006b. Seismic exploration of selected lease areas in the Alaskan Beaufort Sea and Chukchi Sea / Acoustics pre-season estimate modeling report. [vers. 3.0, 21 Aug 2006]. Rep. from JASCO Res. Ltd., Victoria, B.C., for Shell Intern. Explor. & Prod. Co., Houston, TX. 78 p.

Barlow, J. 1999. Trackline detection probability for long-diving whales. p. 209-221 *In*: G.W. Garner, S.C. Amstrup, J.L. Laake, B.F.J. Manly, L.L. McDonald and D.G. Robertson (eds.), Marine mammal survey and assessment methods. A.A. Balkema, Rotterdam. 287 p.

Bengtson, J.L., P.L. Boveng, L.M. Hiruki-Raring, K.L. Laidre, C. Pungowiyi and M.A. Simpkins. 2000. Abundance and distribution of ringed seals (*Phoca hispida*) in the coastal Chukchi Sea. p. 149-160 *In:* A.L. Lopez and D. P. DeMaster. Marine Mammal Protection Act and Endangered Species Act Implemention Program 1999. AFSC Processed Rep. 2000-11, Alaska Fish. Sci. Cent., Seattle, WA.

Blackwell, S.B. 2006. Field report for validation measurements of sounds produced by airguns on M/V *Gilavar* in the Chukchi Sea on 21 July 2006, 6 Aug. ed. Rep. from Greeneridge Sciences Inc., Santa Barbara, CA [for Shell Offshore Inc., Houston, TX]. 5 p. Available at http://www.nmfs.noaa.gov/pr/permits/incidental.htm. Also included in this report as Annex 4.1.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers and L. Thomas. 2001. Introduction to distance sampling/Estimating abundance of biological populations. Oxford Univ. Press, Oxford, U.K. 432 p.

Burgess, W.C. and C.R. Greene. 1999. Physical acoustics measurements. p. 3-1 to 3-65 *In:* W.J. Richardson (ed.), Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1998. LGL Rep. TA2230-3. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Anchorage, AK, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 390 p.

Burns, J.J. 1981. Ribbon seal-*Phoca fasciata*. p. 895-109 *In:* S.H. Ridgway and R.J. Harrison (eds.), Handbook of Marine Mammals. Vol. 2. Seals. Academic Press, New York.

Calambokidis, J. and J. Barlow. 2004. Abundance of blue and humpback whales in the eastern North Pacific estimated by capture-recapture and line-transect methods. **Mar. Mamm. Sci.** 20(1):63-85.

Calambokidis, J., G.H. Steiger, J.M. Straley, T.J. Quinn, II, L.M. Herman, S. Cerchio, D.R. Salden, M. Yamaguchi, F. Sato, J. Urban R., J. Jacobsen, O. von Ziegesar, K.C. Balcomb, C.M. Gabriele, M.E. Dahlheim, N. Higashi, S. Uchida, J.K.B. Ford, Y. Miyamura, P. Ladron de Guevara, S.A. Mizroch, L. Schlender, and K. Rasmussen. 1997. Abundance and population structure of humpback whales in the North Pacific Basin. Final Contract Report 50ABNF500113 to Southwest Fish. Sci. Cent., La Jolla, CA 92038. 72 p.

Caldwell, J. and W. Dragoset. 2000. Brief overview of seismic air-gun arrays. **The Leading Edge** 19(8, Aug.):898-902.

Clark, J.T. and S.E. Moore. 2002. A note on observations of gray whales in the southern Chukchi and northern Bering Seas, August-November, 1980-1989. **J. Cetac. Res. Manage**. 4(3):283-288.

Davis, R.A., W.R. Koski, W.J. Richardson, C.R. Evans and W.G. Alliston. 1982. Distribution, numbers and productivity of the Western Arctic stock of bowhead whales (*Balaena mysticetus*) in the eastern Beaufort Sea and Amundsen Gulf, summer 1981. SC/34/PS20. Int. Whal. Comm., Cambridge, UK. 13 p.

DFO Canada. 2004. North Atlantic Right Whale. Fisheries and Oceans Canada. Available at http://www.mar.dfo-mpo.gc.ca/masaro/english/Species_Info/Right_Whale.html

Dragoset, W.H. 1984. A comprehensive method for evaluating the design of airguns and airgun arrays. p. 75-84 *In:* 16th Annu. Proc. Offshore Technol. Conf, vol. 3.

Finneran, J.J., C.E. Schlundt, R. Dear, D.A. Carder and S.H. Ridgway. 2002. Temporary shift in masked hearing thresholds in odontocetes after exposure to single underwater impulses from a seismic watergun. **J. Acoust. Soc. Am.** 111(6):2929-2940.

Gentry, R., A. Bowles, W. Ellison, J. Finneran, C. Greene, D. Kastak, D. Ketten, J. Miller, P. Nachtigall, W.J. Richardson, B. Southall, J. Thomas and P. Tyack. 2004. Noise exposure criteria. Presentation to U.S. Mar. Mamm. Commis. Advis. Commit. on Acoustic Impacts on Marine Mammals, Plenary Meeting 2, Arlington, VA, April 2004. Available at http://mmc.gov/sound/plenary2/pdf/gentryetal.pdf.

George, J.C., J. Zeh, R. Suydam and C. Clark. 2004. Abundance and population trend (1978-2001) of Western Arctic bowhead whales surveyed near Barrow, Alaska. **Mar. Mamm. Sci.** 20(4):755-773.

Gordon, J., D. Gillespie, J. Potter, A. Frantzis, M.P. Simmonds, R. Swift and D. Thompson. 2004. A review of the effects of seismic surveys on marine mammals. **Mar. Technol. Soc. J.** 37(4):16-34.

Greene, C.R. 1985. Characteristics of waterborne industrial noise, 1980-84. p. 197–253 *In:* W.J. Richardson (ed.), Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1980–84. OCS Study MMS 85-0034. Rep. from LGL Ecol. Res. Assoc. Inc., Bryan, TX, for U.S. Minerals Manage. Serv., Reston, VA. 306 p. NTIS PB87-124376.

Greene, C.R. 1987. Acoustic studies of underwater noise and localization of whale calls. Sect. 2 *In:* LGL and Greeneridge, Responses of bowhead whales to an offshore drilling operation in the Alaskan Beaufort Sea, autumn 1986. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for Shell Western E & P Inc., Anchorage, AK. 128 p.

Greene, C.R., Jr. 1997. Physical acoustics measurements. (Chap. 3, 63 p.) *In*: W.J. Richardson (ed.), 1997. Northstar Marine Mammal Marine Monitoring Program, 1996. Marine mammal and acoustical monitoring of a seismic program in the Alaskan Beaufort Sea. Rep. TA2121-2. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for BP Explor. (Alaska) Inc., Anchorage, AK, and U.S. Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 245 p.

Greene, C.R. 2006. Measurements of the acoustic sources for the shallow hazard survey by M/V *Henry Christoffersen*, 8 August 2006, Field Report. Rep. from Greeneridge Sciences Inc., Santa Barbara, CA, for Shell Intern. Offshore Inc., Houston, TX. 4 p. Also included in this report as Annex 4.2.

Greene, C.R. Jr., and W.C. Burgess. 2000. Physical acoustics measurements, 1999. p. 3-1 to 3-45 *In:* W.J. Richardson (ed., 2000), Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1999. LGL Rep. TA2313-4. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Anchorage, AK, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 155 p.

Greene, C.R., Jr. and W.J. Richardson. 1988. Characteristics of marine seismic survey sounds in the Beaufort Sea. **J. Acoust. Soc. Am.** 83(6):2246-2254.

Greene, C.R., Jr., R. Norman and J.S. Hanna. 1998. Physical acoustics measurements. p. 3-1 to 3-64 *In:* W.J. Richardson (ed.), Marine mammal and acoustical monitoring of BP Exploration (Alaska)'s open-water seismic program in the Alaskan Beaufort Sea, 1997. LGL Rep. TA2150-3. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for BP Explor. (Alaska) Inc., Anchorage, AK, and U.S. Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 318 p.

Haley, B. and D. Ireland. 2005. Marine mammal monitoring during University of Alaska Fairbanks' marine geophysical survey across the Arctic Ocean, August–September 2005. LGL Rep. TA4122-3. Rep. from LGL Ltd., King City, Ont., for University of Alaska Fairbanks, Fairbanks, AK, and Nat. Mar. Fish. Serv., Silver Spring, MD. 96 p.

Haley, B., and W.R. Koski. 2004. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic program in the Northwest Atlantic Ocean, July–August 2004. LGL Rep. TA2822-27. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 80 p.

Hannay, D.E. 2004. Noise. In: Comparative environmental analysis (CEA). Sakhalin Energy Invest. Corp. Available at http://www.sakhalinenergy.com/documents/doc33ceachp4.pdf.

Harris, R.E., G.W. Miller and W.J. Richardson. 2001. Seal responses to airgun sounds during summer seismic surveys in the Alaskan Beaufort Sea. **Mar. Mamm. Sci.** 17(4):795-812.

Harwood, L.A., S. Innes, P. Norton and M.C.S. Kingsley. 1996. Distribution and abundance of beluga whales in the Mackenzie estuary, southeast Beaufort Sea, and the west Amundsen Gulf during late July 1992. **Can. J. Fish. Aquatic Sci.** 53(10):2262-2273.

Heide-Jørgensen, M.P., N. Hammeken, R. Dietz, J. Orr and P. Richard. 2001. Surfacing times and dive rates for narwhals (*Monodon monoceros*) and belugas (*Delphinapterus leucas*). **Arctic** 54(3):284-298.

Holst, M. 2004. Marine mammal monitoring during Lamont-Doherty Earth Observatory's TAG seismic study in the mid-Atlantic Ocean, October-November 2003. LGL Rep. TA2822-21. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory, Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 42 p.

Holst, M., M.A. Smultea, W.R. Koski, and B. Haley. 2005a. Marine mammal and sea turtle monitoring during Lamont-Doherty Earth Observatory's marine seismic program in the Eastern Tropical Pacific Ocean off Central America, November-December 2004. LGL Rep. TA2822-30. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 125 p.

Holst, M., M.A. Smultea, W.R. Koski, and B. Haley. 2005b. Marine mammal and sea turtle monitoring during Lamont-Doherty Earth Observatory's marine seismic program off the Northern Yucatan Peninsula in the Southern Gulf of Mexico, January-February 2005. LGL Rep. TA2822-31. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 96 p.

Ireland, D., M. Holst, and W.R. Koski. 2005. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic program off the Aleutian Islands, Alaska, July–August 2005. LGL Rep. TA4089-3. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 83 p.

IUCN (The World Conservation Union). 2003. 2003 IUCN Red List of Threatened Species. Available at http://www.www.redlist.org

IWC (International Whaling Commission). 2000. Report of the Scientific Committee from its Annual Meeting 3-15 May 1999 in Grenada. **J. Cetac. Res. Manage.** 2 (Suppl):1-65.

Jensen, F.B., W.A. Kuperman, M.B. Porter and H. Schmidt. 2000. Computational Ocean Acoustics. Springer-Verlag, New York Berlin Heidelberg. 578 p.

Keller, A.C. and L.R. Gerber. 2004. Monitoring the Endangered Species Act: revisiting the eastern North Pacific gray whale. **Endangered Species Update** 21(3):87-92.

Koski, W.R., D.H. Thomson and W.J. Richardson. 1998. Descriptions of marine mammal populations. p. 1-182 plus Appendices *In*: Point Mugu Sea Range Marine Mammal Technical Report. Rep. from LGL Ltd., King City, Ont., for Naval Air Warfare Center, Weapons Div., Point Mugu, CA, and Southwest Div. Naval Facilities Engin. Command, San Diego, CA. 322 p.

Landro, M. 1992. Modeling of GI gun signatures. **Geophys. Prosp.** 40(7):721-747.

Laws, M., L. Hatton and M. Haartsen. 1990. Computer modeling of clustered airguns. **First Break** 8(9):331-338.

LGL Ltd. 2005a. Request by the University of Alaska Fairbanks for an Incidental Harassment Authorization to allow the incidental take of marine mammals during a marine geophysical survey across the Arctic Ocean, August-September 2005. LGL Rep. TA4122-2. Rep. from LGL Alaska Res. Assoc. Inc., Anchorage, AK, for Univ. Alaska Fairbanks, Fairbanks, AK, and Nat. Mar. Fish. Serv., Silver Spring, MD. 84 p

LGL Ltd. 2005b. Environmental assessment of a marine geophysical survey across the Arctic Ocean, August-September 2005. LGL Rep. TA4122-1. Rep. from LGL Alaska Res. Assoc. Inc., Anchorage, AK, for Univ. Alaska Fairbanks, Fairbanks, AK, and Nat. Sci. Found., Arlington, VA. 98 p.

Ljungblad, D.K., B. Würsig, S.L. Swartz and J.M. Keene. 1988. Observations on the behavioral responses of bowhead whales (*Balaena mysticetus*) to active geophysical vessels in the Alaskan Beaufort Sea. **Arctic** 41(3):183-194.

MacGillivray, A.O., N.R. Chapman and D.E. Hannay. 2004. An airgun array source signature model for environmental impact assessments**. J. Acoust. Soc. Am.** 116(4, Pt. 2):2649.

MacLean, S.A. and B. Haley. 2004. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic study in the Støregga Slide area of the Norwegian Sea, August - September 2003. LGL Rep. TA2822-20. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory, Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 59 p.

MacLean, S.A. and W.R. Koski. 2005. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic program in the Gulf of Alaska, August–September 2004. LGL Rep. TA2822-28. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 102 p.

Madsen, P.T. 2005. Marine mammals and noises: problems with root mean square sound pressure levels for transients. **J. Acoust. Soc. Am.** 117(6):3952–3957.

Madsen, P.T., M. Johnson, P.J.O. Miller, N. Aguilar Soto, J. Lynch and P. Tyack. 2006. Quantitative measures of air-gun pulses recorded on sperm whales (*Physeter macrocephalus*) using acoustic tags during controlled exposure experiments. **J. Acoust. Soc. Am.** 120(4):2366–2379.

Martin, A.R. and T.G. Smith. 1992. Deep diving in wild, free-ranging beluga whales, *Delphinapterus leucas.* **Can. J. Fish. Aquatic Sci.** 49:462-466.

McCauley, R.D., M.-N. Jenner, C. Jenner, K.A. McCabe, and J. Murdoch. 1998. The response of humpback whales (*Megaptera novaeangliae*) to offshore seismic survey noise: preliminary results of observations about a working seismic vessel and experimental procedures. **APPEA J.** 38:692–708.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000a. Marine seismic surveys: Analysis of airgun signals; and effects of air gun exposure on humpback whales, sea turtles, fishes and squid. Rep. from Centre for Marine Science and Technology, Curtin Univ., Perth, W.A., for Austral. Petrol. Prod. Assoc., Sydney, N.S.W. 188 p.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch and K. McCabe. 2000b. Marine seismic surveys – a study of environmental implications. **APPEA J.** 40:692–706.

Miller, G.W., R.E. Elliott and W.J. Richardson. 1998. Whales. p. 5-1 to 5-124 *In*: W.J. Richardson (ed.), Marine mammal and acoustical monitoring of BP Exploration (Alaska)'s open-water seismic program in the Alaskan Beaufort Sea, 1997. LGL Rep. TA2150-3. Rep. from LGL Ltd., King City, Ont., and Greenridge Sciences Inc., Santa Barbara, CA, for BP Explor. (Alaska) Inc., Anchorage, AK, and U.S. Nat. Mar. Fish. Serv., Anchorage, AK., and Silver Spring, MD. 318 p.

Miller, G.W., R.E. Elliott, W.R. Koski, V.D. Moulton, and W.J. Richardson. 1999. Whales. p. 5-1 to 5-109 *In*: W.J. Richardson (ed.), Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1998. LGL Rep. TA2230-3. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Houston, TX, and U.S. Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 390 p.

Miller, G.W., R.E. Elliott, T.A. Thomas, V.D. Moulton and W.R. Koski. 2002. Distribution and numbers of bowhead whales in the eastern Alaskan Beaufort Sea during late summer and autumn, 1979-2000. p. 9-1 to 9-39 (Chap. 9) *In:* W.J. Richardson and D.H. Thomson (eds.), Bowhead whale feeding in the eastern Alaskan Beaufort Sea: update of scientific and traditional information, vol. 1. OCS Study MMS 2002-012; LGL Rep. TA2196-7. Rep. from LGL Ltd., King City, Ont., for U.S. Minerals Manage. Serv., Anchorage, AK, and Herndon, VA. 420 p. NTIS PB2006-100382.

Miller, G.W., V.D. Moulton, R.A. Davis, M. Holst, P. Millman, A. MacGillivray and D. Hannay. 2005. Monitoring seismic effects on marine mammals--southeastern Beaufort Sea, 2001-2002. p. 511-542 *In:* S.L. Armsworthy, P.J. Cranford and K. Lee (eds.), Offshore oil and gas environmental effects monitoring/Approaches and technologies. Battelle Press, Columbus, OH.

Miller, J.H., A.E. Bowles, R.L. Gentry, W.T. Ellison, J.J. Finneran, C.R. Greene Jr., D. Kastak, D.R. Ketten, P.E. Nachtigall, W.J. Richardson, B.L. Southall, J.A. Thomas and P.L. Tyack. 2005. Strategies for weighting exposure in the development of acoustic criteria for marine mammals. **J. Acoust. Soc. Am.** 118(3, Pt. 2):2019. Presentation to 150th Meet. Acoust. Soc. Am., Minneapolis, MN, Oct. 2005. Available at http:/www.oce.uri.edu/facultypages/miller/NoiseWeighting10182005.ppt.

MMS. 2006. Final Programmatic Environmental Assessment / Arctic Ocean Outer Continental Shelf Seismic Surveys – 2006. OCS EIS/EA MMS 2006-038. U.S. Minerals Manage. Serv., Alaska OCS Region, Anchorage, AK. 294 p. plus Figures, Tables and Appendices.

Moulton, V.D. and J.W. Lawson. 2002. Seals, 2001. p. 3-1 to 3-48 *In*: W.J. Richardson and J.W. Lawson (eds.), Marine mammal monitoring of WesternGeco's open-water seismic program in the Alaskan Beaufort Sea, 2001. LGL Rep. TA2564-4. Rep. from LGL Ltd., King City, Ont., for WesternGeco LLC, Anchorage, AK; BP Explor. (Alaska) Inc., Anchorage, AK; and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 95 p.

NMFS. 1995. Small takes of marine mammals incidental to specified activities; offshore seismic activities in southern California. **Fed. Regist.** 60(200, 17 Oct.):53753-53760.

NMFS. 1999. Small takes of marine mammals incidental to specified activities; seismic hazards investigation in southern California/Notice of receipt of application and proposed authorization for a small take exemption; request for comments. **Fed. Regist**. 64(43, 5 Mar.):10644-10648.

NMFS. 2000. Small takes of marine mammals incidental to specified activities; marine seismic-reflection data collection in southern California/Notice of receipt of application. **Fed. Regist.** 65(60, 28 Mar.):16374-16379.

NMFS. 2005a. Small takes of marine mammals incidental to specified activities; marine geophysical survey across the Arctic Ocean/Notice of receipt of application…. **Fed. Regist.** 70(89, 10 May):24539-24553.

NMFS. 2005b. Small takes of marine mammals incidental to specified activities; marine geophysical survey across the Arctic Ocean/Notice of issuance of an incidental take authorization. **Fed. Regist.** 70(156, 15 Aug.): 47792-47809.

NMFS. 2006a. Small takes of marine mammals incidental to specified activities; seismic surveys in the Beaufort and Chukchi seas off Alaska. **Fed. Regist.** 71(85, 3 May.):26055-26069.

NMFS. 2006b. Small takes of marine mammals incidental to specific activities; seismic surveys in the Beaufort and Chukchi seas off Alaska. **Fed. Regist.** 71(164, 24 Aug.):50027-50045.

Parkes, G.E. and L. Hatton. 1986. The marine seismic source. D. Reidel Publ. 128 p. ISBN 90-277-2228-5.

Racca, R.G. and J.A. Scrimger. 1986. Underwater acoustic source characteristics of air and water guns. DREP Tech. Rep. 06SB 97708-5-7055. Rep. from JASCO Res. Ltd., Victoria, B.C., for Def. Res. Estab. Pacific.

Reeves R. (ed). 2005. Report of the Independent Scientific Review Panel on the Impacts of Sakhalin II Phase 2 on Western North Pacific Gray Whales and Related Biodiversity, IUCN Report, February 2005.

Richardson, W.J. and C.I. Malme. 1993. Man-made noise and behavioral responses. p. 631-700 *In*: J.J. Burns, J.J. Montague and C.J. Cowles (eds.), The bowhead whale. Spec. Publ. 2. Soc. Mar. Mamm., Lawrence, KS. 787 p.

Richardson, W.J. and B. Würsig. 1997. Influences of man-made noise and other human actions on cetacean behaviour. **Mar. Freshwat. Behav. Physiol.** 29(1-4):183-209.

Richardson, W.J., B. Würsig and C.R. Greene Jr. 1986. Reactions of bowhead whales, *Balaena mysticetus*, to seismic exploration in the Canadian Beaufort Sea. **J. Acoust. Soc. Am.** 79(4):1117-1128.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme and D.H. Thomson. 1995. Marine mammals and noise. Academic Press, San Diego. 576 p.

Richardson, W.J., G.W. Miller and C.R. Greene Jr. 1999. Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea. **J. Acoust. Soc. Am.** 106(4, Pt. 2):2281.

Rugh, D., R.C. Hobbs, J.A. Lerczak and J.M. Breiwick. 2005. Estimates of abundance of the eastern North Pacific stock of gray whales (*Eschrichtius robustus*) 1997-2002. **J. Cetac. Res. Manage.** 7(1):1-12.

Shell Offshore, Inc. (SOI). 2005a. Application for incidental harassment authorization for the non-lethal taking of whales and seals in conjunction with a proposed marine geophysical (seismic acquisition) survey program in the mid and eastern Beaufort Sea, Alaska, during 2006. Submitted to the National Marine Fisheries Service by Shell Offshore, Inc., and WesternGeco.

Shell Offshore, Inc. (SOI). 2005b. Application for incidental harassment authorization for the non-lethal taking of whales and seals in conjunction with a proposed marine geophysical (seismic acquisition) survey program in the northern Chukchi Sea, Alaska, during 2006. Submitted to the National Marine Fisheries Service by Shell Offshore, Inc., and WesternGeco.

Shell Offshore, Inc. (SOI). 2006. Application for incidental harassment authorization for the non-lethal taking of Pacific walrus and polar bear in conjunction with a proposed marine geophysical (seismic acquisition) program in the northern Chukchi Sea, Alaska, during 2006. Submitted to the U.S. Fish and Wildlife Service by Shell Offshore Inc. and WesternGeco.

Small, R.J. and D.P. DeMaster. 1995. Alaska marine mammal stock assessments 1995. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-57, 93 pp.

Smultea, M.A. and M. Holst. 2003. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic study in the Hess Deep area of the Eastern Equatorial Tropical Pacific, July 2003. LGL Rep. TA2822-16. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory, Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 68 p.

Smultea, M.A., M. Holst, W.R. Koski and S. Stoltz. 2004. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic program in the Southeast Caribbean Sea and adjacent Atlantic Ocean, April–June 2004. LGL Rep. TA2822-26. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 106 p.

Smultea, M.A., W.R. Koski and T.J. Norris. 2005. Marine mammal monitoring during Lamont-Doherty Earth Observatory's marine seismic study of the Blanco Fracture Zone in the Northeastern Pacific Ocean, October-November 2004. LGL Rep. TA2822-29. Rep. From LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 89 p.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas and P.L. Tyack. [Submitted]. Marine mammal noise exposure criteria: initial scientific recommendations. Submitted to Acoust. Soc. Am., Oct. 2006.

Stone, C.J. 2003. The effects of seismic activity on marine mammals in UK waters 1998-2000. JNCC Rep. 323. Joint Nature Conserv. Commit., Aberdeen, Scotland. 43 p.

Suryan RM and JT Harvey. 1998 Tracking harbor seals (*Phoca vitulina richardsi*) to determine dive behavior, foraging behavior, and haul-out site use. **Mar. Mamm. Sci.** 14(2):361-372.

Thomas, T.A., W.R. Koski and W.J. Richardson. 2002. Correction factors to calculate bowhead whale numbers from aerial surveys of the Beaufort Sea. p. 15-1 to 15-28 (Chap. 15) *In*: W.J. Richardson and D.H. Thomson (eds.), Bowhead whale feeding in the eastern Alaskan Beaufort Sea: update of scientific and traditional information, vol. 1. OCS Study MMS 2002-012; LGL Rep. TA2196-7. Rep. from LGL Ltd., King City, Ont., for U.S. Minerals Manage. Serv., Anchorage, AK, and Herndon, VA. 420 p.

Tolstoy, M., J. Diebold, S. Webb, D. Bohnenstiehl and E. Chapp. 2004a. Acoustic calibration measurements. Chap. 3 *In:* W.J. Richardson (ed.), Marine mammal and acoustic monitoring during Lamont-Doherty Earth Observatory's acoustic calibration study in the northern Gulf of Mexico, 2003. Revised ed. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. (Advance copy).

Tolstoy, M., J.B. Diebold, S.C. Webb, D.R. Bohenstiehl, E. Chapp, R.C. Holmes and M. Rawson. 2004b. Broad-band calibration of R/V *Ewing* seismic sources. **Geophys. Res. Lett.** 31: L14310.

Turner, S., M. Zykov and A. MacGillivray. 2006. Preliminary acoustic level measurements of airgun sources from ConocoPhillips' 2006 seismic survey in Alaskan Chukchi Sea. Rep. from JASCO Res. Ltd., Victoria, B.C. [for ConocoPhillips]. 10 p. Available at http://www.nmfs.noaa.gov/pr/permits/incidental.htm.

UNEP-WCMC. 2004. UNEP-WCMC species database: CITES-listed species. Available at http://www.unep-wcmc.org/index.html?http://sea.unep-wcmc.org/isdb/CITES/Taxonomy/tax-gs-search1.cfm?displaylanguage=eng&source=animals~main

USDI/MMS. 1996. Beaufort Sea Planning Area oil and gas lease sale 144/Final Environmental Impact Statement. OCS EIS/EA MMS 96-0012. U.S. Minerals Manage. Serv., Alaska OCS Reg., Anchorage, AK. Two volumes. Var. pag.

USFWS. 2000. Pacific walrus (*Odobenus rosmarus divergens*): Alaska Stock. p. 185-190 *In*: R.C. Ferrero, D.P. DeMaster, P.S. Hill, M.M. Muto, and A.L. Lopez (eds.) Alaska marine mammal stock assessments, 2000. NOAA Tech. Memo. NMFS-AFSC-119. U.S. Dep. Comm. NOAA, NMFS, Alaska Fisheries Science Center.

Zeh, J.E. and A.E. Punt. 2005. Updated 1978-2001 abundance estimates and their correlations for the Bering-Chukchi-Beaufort Seas stock of bowhead whales. **J. Cetac. Res. Manage.** 7(2):169-175.

Zerbini, A.N., P.R. Wade and J.M. Waite. 2004. Summer abundance and distribution of cetaceans in coastal waters of the western Gulf of Alaska and the eastern and central Aleutian Islands. p. 179 *In*: Abstract Book ASLO/TOS 2004 Ocean Research Conference. Honolulu, 15-20 Feb. 2004.

USFWS. 2006. Marine mammals: incidental take during specified activities. **Fed. Regist.** 71(88, 8 May.):26770-26781.

Ziolkowski, A. 1970. A method for calculating the output pressure waveform from an air gun. **Geophys. J. R. Astron. Soc.** 21:137-161.

ARCTIC
VOL. 41, NO. 3 (SEPTEMBER 1988) P. 183-194

Observations on the Behavioral Responses of Bowhead Whales (*Balaena mysticetus*) to Active Geophysical Vessels in the Alaskan Beaufort Sea

DONALD K. LJUNGBLAD,[1] BERND WÜRSIG,[2] STEVEN L. SWARTZ[3] and JAMES M. KEENE[4]

(Received 21 July 1986; accepted in revised form 15 March 1988)

ABSTRACT. The responses of bowhead whales to controlled approaches by geophysical vessels producing airgun blasts were observed during the course of four field experiments conducted in the Alaskan Beaufort Sea in September 1984. Behavioral responses included shorter surfacing and dive times, fewer blows per surfacing, longer blow intervals and subtle to overt changes in surface behaviors. Subtle behavioral responses occurred at 3.5 and 8.2 km with received airgun noise levels of 142 and 157 dB respectively (all levels in dB re 1μPa). Partial avoidance (i.e., some whales leaving the observation area while others remained) occurred at ranges of 3.5 and 7.6 km, with sound levels of 142 and 158 dB respectively. Total avoidance (i.e., all whales leaving the observation area) occurred at 1.3, 7.2, 3.5 and 2.9 km, with corresponding sound levels of 152, 165, 178 and 165 dB. The similarities among experiments reported here support the conclusion that short-term behavioral changes occur when bowhead whales are exposed to airgun blasts from approaching geophysical vessels at ranges <10 km. These disturbance effects wane within one hour after a disturbance; long-term effects on social, behavioral or physiologic parameters are not known at this time.

Key words: bowhead whale, *Balaena mysticetus*, geophysical vessel, bioacoustics, airguns

RÉSUMÉ. Au cours de quatre expériences sur le terrain, menées dans la mer de Beaufort de l'Alaska en septembre 1984, on a étudié le comportement des baleines franches en réponse à l'approche contrôlée de navires de prospection géophysique qui émettaient des ondes de choc à l'aide de canons à air. Parmi les comportements provoqués, on a remarqué une diminution du temps à la surface et du temps en plongée, une diminution du nombre de souffles par remontée à la surface, une augmentation de l'intervalle entre les souffles ainsi que des changements dans le comportement à la surface, allant de peu visibles à nettement visibles. Les modifications peu visibles du comportement ont été observées à 3,5 et 8,2 km, alors que le niveau de bruit des canons à air atteignait respectivement 142 et 157 dB (Les niveaux en dB ont tous une pression de référence de 1 μPa). Une fuite partielle (c.-à-d. que quelques baleines ont quitté la zone d'observation alors que d'autres y sont restées) a été observée à des distances de 3,5 et 7,6 km avec des niveaux de bruit respectifs de 142 et 158 dB. Une fuite totale (c.-à-d. que toutes les baleines ont quitté la zone d'observation) a été observée à 1,3, 7,2, 3,5 et 2,9 km, avec des niveaux de bruit correspondants de 152, 165, 178 et 165 dB. Les ressemblances entre les expériences rapportées ici soutiennent la conclusion que des changements dans le comportement à court terme se produisent quand les baleines sont exposées aux ondes de choc du canon à air des navires de prospection géophysique, à des distances inférieures à 10 km. Ces effets dus à la perturbation disparaissent dans l'heure qui la suit, mais on ne connaît pas encore les effets à long terme sur les paramètres sociaux et physiologiques ainsi que sur ceux du comportement.

Mots clés: baleine franche, *Balaena mysticetus*, navire de prospection géophysique, bioacoustique, canons à air

Traduit pour le journal par Nésida Loyer.

INTRODUCTION

The bowhead whale, *Balaena mysticetus*, is a large baleen whale that resides in or near icy polar waters. Of the four stocks recognized, the largest is the Western Arctic Stock (ca. 7200; International Whaling Commission, 1988), which migrates annually from wintering areas in the western Bering Sea to summer feeding areas in the eastern Canadian Beaufort Sea (Ljungblad *et al.*, 1986). In the fall (September, October), bowheads migrate west through the Alaskan Beaufort Sea and pass through regions being explored or developed for oil resources. The fall migration coincides with the only ice-free period of the year. These open water conditions are of particular importance to geophysical companies that conduct marine seismic surveys to detect optimal drilling sites for oil companies. During a typical seismic survey, noise pulses produced by airguns (hereafter, airgun blasts) with source levels of 245-252 dB are emitted every 10-15 s from an airgun array towed by a geophysical vessel (Barger and Hamblen, 1980). Geophysical vessels cannot operate unless sea ice is absent from the area to be explored. The shortness of the ice-free season, and the need to complete seismic explorations in such a brief period (generally less than six weeks), forces numerous vessels to operate simultaneously within the bowhead migration corridor as the whales pass through the Beaufort Sea.

The potential effects of geophysical seismic survey activities on westward migrating bowheads in the Alaskan Beaufort Sea have been a concern of the U.S. Minerals Management Service (MMS) and the U.S. National Marine Fisheries Service (NMFS). In response to this concern the MMS, with advice and assistance from the NMFS, implemented a program to obtain behavioral observations of whales in the presence of airgun blasts and to monitor and regulate seismic exploration in the Alaskan Beaufort Sea each fall, 1981-84. In 1981, behavioral data were collected on whales located at varying distances from operating geophysical vessels (Fraker *et al.*, 1985). In 1982 and 1983, systematic grid surveys were flown in the Alaskan Beaufort Sea near actively "shooting" geophysical vessels (Reeves *et al.*, 1983; Ljungblad *et al.*, 1984). Visual observations of whales in the presence of seismic sounds were supplemented with acoustic sonobuoys to listen to and record underwater sounds made by the vessels, their airguns and bowheads. In addition, observations of whales that were not near operating geophysical vessels were made on an opportunistic basis.

The results of these studies and similar work conducted in the Canadian Beaufort Sea (Richardson *et al.*, 1984) supported the contention that bowheads seldom reacted to working geophysical vessels when they were over 10 km away. Because few additional conclusions could be drawn, a dedicated aircraft and scientific team was assigned to conduct controlled field experiments designed to collect data on the responses of bowheads to the direct approach of active geophysical vessels operating in the Alaskan Beaufort Sea in 1983 and 1984. Due to the severe ice conditions that prevailed in the fall of 1983, no experiments were undertaken. In fall 1984, four experiments were success-

[1]Naval Ocean Systems Center, Code 5141, San Diego, California 92152, U.S.A.
[2]Moss Landing Marine Laboratories, P.O. Box 223, Moss Landing, California 95039, U.S.A.
[3]Cetacean Research Associates, 2104 Vista Grande Drive, Vista, California 92083, U.S.A.
[4]Science Applications International, 10260 Campus Point, San Diego, California 92121, U.S.A.
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fully completed by the Naval Ocean Systems Center (NOSC), with support provided by the MMS. The experiments were conducted under the provisions of a scientific research permit issued to MMS by NMFS and with the cooperation of geophysical vessels operating in the Alaskan Beaufort Sea. The findings of the experiments and comparisons with similar studies are presented in this paper.

METHODS

The principal objectives of the direct approach geophysical vessel response experiments were to gauge bowhead behavioral response to airgun blasts and to determine at what distance from an active vessel subtle, partial and total avoidance behaviors or other manifestations of disturbance were likely to be displayed. Such information is vital in defining a "zone of influence" that potentially exists around an active geophysical vessel emitting low-frequency, high-energy airgun blasts.

The general approach in conducting the experiments was to use an aircraft and scientific team to locate bowheads and observe and measure the behavior of the whales while recording waterborne noise and environmental variables, and at the same time control by radio communication the approach and operation of the participating geophysical vessel.

Aircraft Operation

The survey aircraft was a deHavilland Series 300 Twin Otter, capable of 9 h of continuous flight and equipped with bubble windows to enhance viewing, a radar altimeter for precise altitude determination, and a Global Navigation System (GNS) 500A Series VLF computer to provide position updates accurate to ±0.6 km (0.37 nm)·h^{-1} of flying. Observations from the aircraft were conducted at an altitude of 457 m (1500 ft) or greater to minimize possible disturbance to the whales under observation (Richardson *et al.*, 1984). An airspeed of approximately 100 knots (204 km·h^{-1}) was maintained while searching and circling. When ice floes were present in an observation area, they were used as reference points while the whales were submerged. When suitable natural reference points were not available, Fluorescein dye markers or smoke flares were dropped from the aircraft.

Flight data were stored on a portable computer interfaced to the aircraft's GNS. The computer was programmed to automatically input the following variables at 4 min intervals: entry number, time (local and GMT), latitude, longitude and altitude. Specific comments, such as number of whales, behaviors, change in environmental conditions, etc., could be entered at any time during a flight. The computer was accessed to a serial plotter/printer to provide a hard copy of all data stored in the computer's memory. In addition, crew members were linked to a common communication system and recorder to insure that all comments were heard and recorded. Additional onboard equipment included 35 mm single-lens reflex cameras with 70-210 mm zoom lenses, ASA-200 color slide film, binoculars, clinometers, stopwatches and a video recorder with 75 mm lens (6:1 zoom ratio).

Sonobuoys

Sonobuoys are expendable underwater sound measurement devices that can be reliably deployed from an aircraft. In this study, the sonobuoys were used to obtain calibrated airgun blast levels from geophysical vessels, as well as for recording bowhead whale sounds. Three types of sonobuoys were used: the AN/SSQ-57A and 41B for whale sounds and airgun detection, and the AN/SSQ-41A (modified) for recording airgun blasts. Sonobuoy signals were received via a FM link by a modified USQ-42 receiver and recorded on a Nagra IV-SJ analog tape recorder.

Sonobuoys are designed to detect and amplify extremely low levels of underwater sound and therefore become overloaded when exposed to the high levels generated by the seismic air guns. To reduce the overloading problem, modifications were performed on the AN/SSQ-41A to allow it to operate in a normal manner in the presence of signals up to 165 dB; levels in excess of 165 dB were calculated and plotted from undistorted measurements. The 41A was chosen because the buoy could be disassembled, modified and resealed without significantly affecting its overall reliability.

The bulk of the modification effort was centered on the desensitization of the sonobuoy main amplifier circuitry, because it was determined that the hydrophone array and its associated preamplifier were capable of passing a 250-Hz sine wave equivalent to 190 dB without significant distortion. The main amplifier board distorted the same signal at approximately 140 dB. With a design goal of 165 dB operation in mind, the preamplifier gain was reduced by 16 dB and an attenuating resistor was inserted in the signal path to further reduce the amplitude of the incoming pulse. In addition, the automatic gain control circuit was disabled and the buoy's frequency response was flattened to ±0.5 dB from 25 to 1000 Hz.

To insure that the data quality was consistent regardless of the buoy used, a calibration was performed on each buoy prior to use in the field. The calibration effort was approached on three levels: electronic, water tank and open ocean. The electronic calibration, performed on each unit, consisted of injecting a calibrated sine wave into the hydrophone preamplifier and stepping the frequency from 20 to 1000 Hz. This allowed precise adjustment of the system gain as well as confirmation of the electronic frequency response. Random buoys were then chosen to undergo a complete system calibration, performed in a water tank using a variable sound source and calibrated hydrophones. Sonobuoy hydrophone characteristics were also confirmed at NOSC's TRANSDEC transducer calibration facility. Finally, several of the modified sonobuoys were tested in the open ocean, again using a variable sound source and calibrated hydrophones.

Analysis of Airgun Blasts

The analog tape recordings were analyzed in the laboratory in both the time and frequency domains, using the transient-capture mode of a Spectral Dynamics Model 375 spectrum analyzer. With an analysis band width set to 500 Hz, the SD375 digitized the input signal at a rate of 1280 samples·s^{-1}. The memory period, or time width of the time-domain signal, was 0.8 s, which allowed for a total of 1024 samples for each seismic pulse analyzed. To examine the signal frequency components, the SD375 performed a Fast Fourier Transform on the time data. The transformed data, combined with a weighting function (which limits spurious frequency components) was presented as a spectrum of 400 cells, with a cell band width of 1.25 Hz.

The analysis of the data collected from the experiments had to be approached carefully due to the configuration of the modified 41A's transducers. Frequency-dependent vertical directionality

is introduced into the system when a linear array of hydrophones is used, which results in a rejection of spurious noise due to reflections from the ocean floor and surface. This is a distinct advantage for the buoy's intended naval mission, but potentially causes difficulties in interpretation of the data in our application. However, the hydrophone is specified to operate omnidirectionally in the vertical plane to ±3 dB between 10 and 300 Hz and undergoes a "soft" transition to full directionality between 300 and 1540 Hz, so data collected to 300 Hz can be considered valid for this analysis.

The airgun wave form was stored and plotted in the time domain with linear scaling appropriate to the size of the signal. In keeping with the analysis procedure adopted by Greene (1984), the root-mean-square (rms) level of the signal in dB re 1 volt was determined by measuring and squaring the peak value of the highest amplitude component of the blast, dividing by 2, and computing 10 times the logarithm of the result. The sound pressure level in dB was then determined by comparing the signal to a calibration standard.

In interpreting the results of this analysis, it is important to consider several key points. To describe the characteristics of a pulse-type signal using the procedure adopted by Greene (1984) it is necessary to make the assumption that the largest peak in the wave form is sinusoidal in nature, which is generally the case with seismic-like signals. In addition, the sound pressure levels reported are rms values and are directly related to the instantaneous peak level of the seismic signal. This peak value did not persist for the entire duration of the airgun discharge cycle, and thus does not provide information as to the overall energy contained in the pulse (as reported by Malme *et al.*, 1983). Finally, the peak value of the signal tended to be quite variable from one pulse to the next, undoubtedly due to transmission anomalies between the source and the receiver. In an effort to smooth out some of this variability, the peak levels represent an average of 5 successive seismic pulses, chosen such that they bracketed the pulse at the reported range.

Coordination with Geophysical Vessels

Arrangements were made in advance of the field season for the research team on board the aircraft to establish direct marine-band communications with the seismic vessels operating in the Beaufort Sea. In addition, the research team communicated daily with the geophysical base camps of Western Geophysical Co. and Geophysical Service Inc. in Deadhorse. This close coordination between the aerial research team and the cooperating geophysical companies was designed to provide reasonable notice to vessel operators of when and where a seismic response experiment might occur. Both parties agreed to the following experimental protocol. Whenever the necessary minimum field conditions for an experiment were met, the operator of the vessel nearest the whales under observation was notified and requested to operate the vessel as required to conduct an experiment under the conditions of the scientific research permit.

Experimental Design

Certain conditions were required for the successful completion of a direct approach experiment. The fall bowhead migration and concomitant whale behaviors (preferably feeding or milling) needed to occur in an area of open water with acceptable environmental conditions and the presence of cooperating geophysical vessel(s). Adequate visibility (little or no fog or precipitation and high cloud ceiling(s), low sea state (Beaufort 03 or less) and little or no wind were necessary to ensure the completion of an experiment from start to finish.

The experimental procedure was to guide a participating geophysical vessel, operating as if conducting a full-scale geophysical survey, directly toward bowheads under observation by the aerial survey crew. Pre-experiment, experiment and post-experiment scenarios were desirable. Pre-experiment observations began once a group of whales (3-20 individuals) was located. During the initial 1-3 h of pre-experiment observations, vessels in the area were contacted and, if possible, one was selected to participate in the experiment. The experimental observations commenced as the participating vessel began its approach. If the whales under observation remained in the same general region in which they were first located and continued with their first-observed behaviors until after the participating vessel began its active approach, it was assumed that there was negligible disturbance from other sources. Based on earlier studies (Fraker *et al.*, 1982; Reeves *et al.*, 1983; Richardson *et al.*, 1984; Ljungblad *et al.*, 1984), it was assumed that overt behavioral responses would not occur until the vessel had closed to approximately 10 km. Therefore 10 km was selected as the range beyond which behavioral responses would be negligible, and observed behaviors were classified as pre-experiment. Post-experiment observations, following each "active" approach, were dependent upon fuel reserves and remaining daylight. Whenever possible, observations were made in half-hour increments after the discontinuation of the participating vessel's airgun blasts.

When the vessel had approached to within 1 km of the whales or, in the judgment of the investigators, when all the whales were responding adversely to the vessel, the operator of the vessel was asked to shut down its airguns. One condition of the scientific research permit stipulated that seismic vessels were not to approach whales closer than 1 km during the experiments. Therefore, mid-course changes in vessel direction were made to ensure an approach of 1 km or greater. Additional changes in the vessel's course and its operational status were made only to avoid collisions with ice or other potential hazards.

Analysis of Behavioral Data

Whale positions and aircraft altitude were taken from the computerized flight data, while behavioral observations were transcribed from audiotape onto data recording sheets in the laboratory. Measures of surfacing, respiration and dive characteristics were used to identify behavior changes associated with the presence or absence of airgun blasts. We adopted the five major quantitative behavioral characteristics used by Reeves *et al.* (1983), Richardson *et al.* (1984) and Würsig *et al.* (1984a) to describe the surface/dive profiles of bowhead whales. These are: 1) interval between blows (respiration), 2) number of blows per surfacing, 3) length of time at the surface (surface interval), 4) length of time below the surface (dive time), and 5) blow rate (the number of blows divided by the combined length of the surface interval and subsequent dive).

The first three of these behavioral characteristics can be ascertained while watching individual whales that cannot be re-identified. Dive time, however, requires that a whale be recognized by some distinguishing feature or features, i.e., distinctive white chin patches, scars or other reliable marks on the head, back or flukes. Since dive times required the identifi-

cation of individuals at the initiation of a dive and at the subsequent moment of surfacing, they were gathered less frequently. Blow rate, calculated from a complete surface and subsequent dive cycle, was also infrequently obtained. Interval between blows, on the other hand, was the only characteristic that did not require observation of a full surfacing, and consequently was the most frequently collected datum.

Observations during each experiment were sorted into categories for comparison: pre-experiment (no airgun sounds or a source greater than 10 km away), experiment (sound source 10-5 km away), close-experiment (sound source less than 5 km away) and post-experiment (0-30 and 30-60 min following the vessel departure). In some instances sample sizes for individual categories obtained during an experiment were too small for meaningful statistical analysis. In these cases, the data from similar categories were pooled to obtain sample sizes adequate for analysis. Subsequently, the data for all adult whales were pooled and sorted into either pre-experiment (no airgun sounds present or with the source at a distance of greater than 10 km) or experiment (exposed to airgun blasts whose source was at a range of 10 km or less) categories. These data were then analyzed for differences between pre-experiment and experimental conditions.

Parametric and nonparametric statistical tests were employed as appropriate and are referred to in the sections in which they appear. All statistical tests used may be found in Sokal and Rohlf (1981) and Zar (1984). Sample sizes of behavioral characteristics for cow-calf pairs were too low for statistical analysis but are presented for pre-experiment through post-experiment conditions for subjective comparison.

RESULTS

Experimental Results

Experiment No. 1: On 18 September, the first direct approach experiment, toward a group of eight whales, was undertaken approximately 20 km north of Barter Island, with cooperation from the geophysical vessel *Western Beaufort* (Fig. 1:1). The *Western Beaufort* is a "high resolution" geophysical vessel equipped with a single 11 311 cm^3 (80 in^3) airgun, which fired once every 4 s. The calculated source level for the seismic blasts produced by this airgun is approximately 220 dB at 1 m (Barger and Hamblen, 1980). Sonobuoys dropped in 46 m water near the whales provided data on airgun blast levels, vessel noise and ambient levels throughout the 5.5 h experimental period. During the vessel approach, airgun blast levels ranged from 132 dB at 9.7 km to 152 dB at 1.3 km, when the airguns were shut down (Fig. 2).

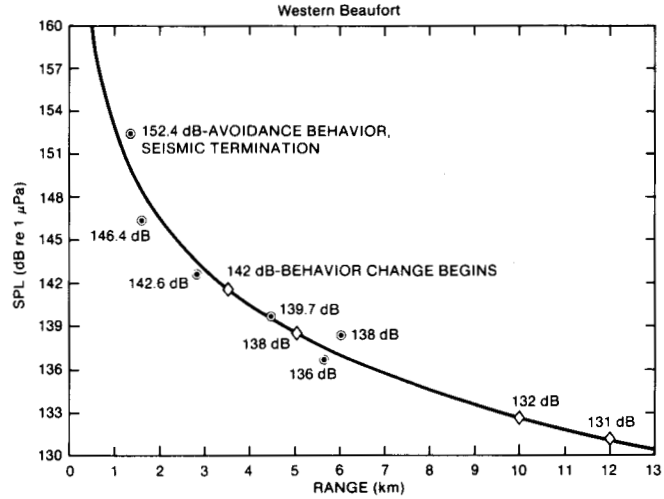

FIG. 2. Received airgun blast noise levels vs. range for the *Western Beaufort*. Line is a least squares regression line fit to the measured sound levels. ♦ = estimated sound level; + = measured sound level.

Thirty-one surfacings were observed during the initial 2.6 h of observations, with the vessel more than 12 km away. The general behavior of the whales included milling, socializing and traveling at slow to medium speeds (Table 1). Thirty-two surfac-

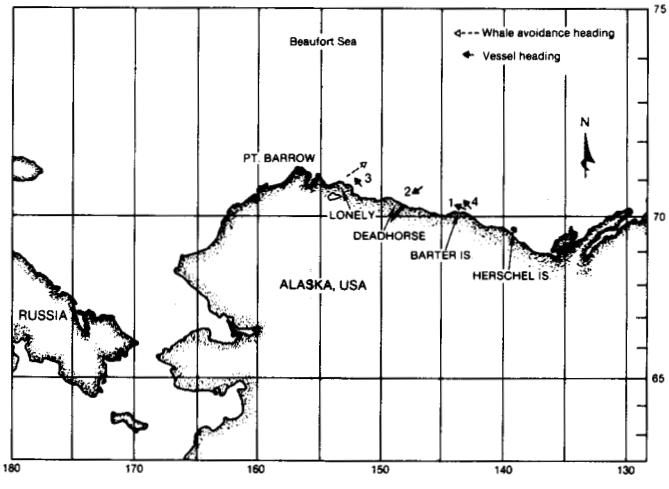

FIG. 1. Study area in the Alaskan Beaufort Sea showing the locations of seismic response experiments: No. 1, 18 September, *Western Beaufort*; No. 2, 20 September, *Western Aleutian*; No. 3, 23 September, *Arctic Star*; and No. 4, 26 September, *Western Polaris*.

TABLE 1. General bowhead whale surface behavior during four seismic vessel approach experiments

Experiment no: *vessel*	Number of surfacings	Behavior as % of whales: Milling	Socializing	Traveling
No. 1: *Western Beaufort*				
Pre-experiment >10 km	31	13	19	68
Experiment 10-5 km	32	17	22	61
Close-experiment <5 km	16	0	0	100
No. 2: *Western Aleutian*				
Pre-experiment >10 km	9	22	56	22
Experiment 10-5 km	8	0	0	100
Post-experiment <30 min	9	0	0	100
Post-experiment >30 min	7	12	2	86
No. 3: *Arctic Star*				
Pre-experiment >10 km	43	18	13	69
Pre-experiment >10 km	13	14	0	86
Experiment 10-5 km	15	2	0	98
Close-experiment <5 km	15	0	0	100
No. 4: *Western Polaris*				
Pre-experiment >10 km	84	37	56	7
Experiment 10-5 km	18	0	0	100
Close-experiment <5 km	25	0	0	100
Post-experiment <30 min	18	28	0	72
Post-experiment >30 min	21	28	20	52

ings were observed as the vessel approached from approximately 10 to 5 km. Milling and socializing behaviors increased and traveling decreased during this period.

Overt changes in the whales' behavior began to occur as the vessel approached to within 3.5 km of the whales. Individual whales that had previously been widely separated surfaced synchronously within a few whale lengths of each other. Others huddled tightly together for a short time before traveling away from the approaching vessel at medium to fast speeds. The vessel discontinued its approach at 1.3 km, when all whales were dispersing at medium to fast speed.

The principal surfacing, respiration and dive variables for adult whales changed significantly as the vessel approached to within 5 km (Table 2; Fig. 3). Mean blow interval, which was relatively unchanged at ranges greater than 5 km, increased significantly when the vessel was <5 km away. Concomitantly, the mean number of blows per surfacing declined significantly when the vessel closed to within less than 5 km. Mean length of surfacing declined as the vessel approached from 10 to 5 km and continued to decline as the vessel closed to within 1.3 km. Mean length of dive showed a pronounced and significant decrease at all ranges as the vessel approached (Table 2).

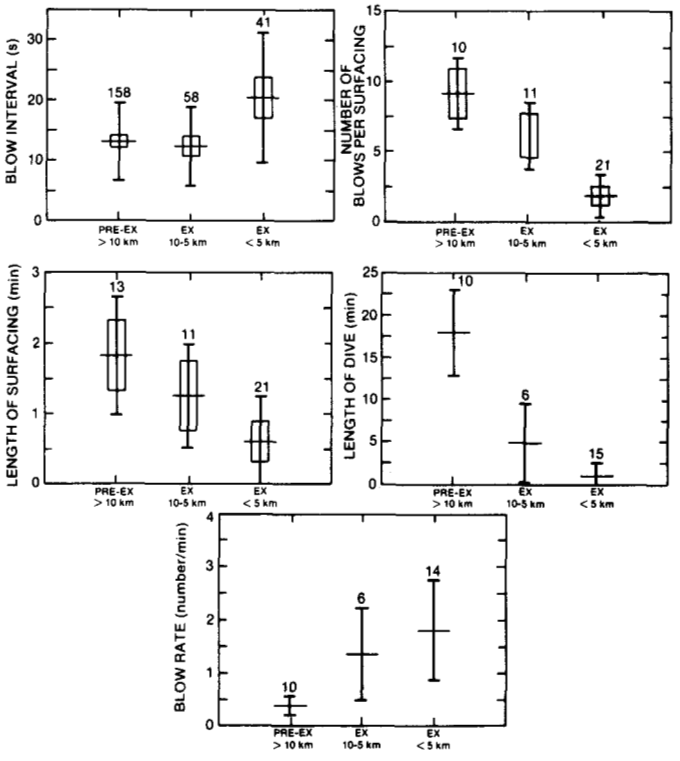

FIG. 3. Surfacing, respiration and dive characteristics for bowhead whales during different categories of exposure to airgun blasts from the *Western Beaufort*. Horizontal bars are means, vertical lines are 1 standard deviation from the mean, closed bars are 95% confidence limits to the mean and numbers at the top of bars are sample sizes. ex = experiment.

Experiment No. 2: On 20 September, a second direct approach experiment, toward a group of three whales, was undertaken approximately 66 km northeast of Deadhorse, with cooperation from the geophysical vessel *Western Aleutian* (Fig. 1:2). The *Western Aleutian* is equipped with a multiple airgun array, of which 20 guns are activated and fire synchronously every 12-14 s. The estimated source level of sound produced by this airgun array is between 230 and 240 dB at 1 m (Western Geophysical, pers. comm.). Sonobuoys dropped in 36 m of water near the whales provided data on airgun blast levels, vessel noise and ambient levels throughout the 5.0 h experimental period. During the vessel's approach, airgun blast levels ranged from 165 dB at startup (7.2 km) to an estimated 170 dB at shutdown (3.5 km) (Fig. 4).

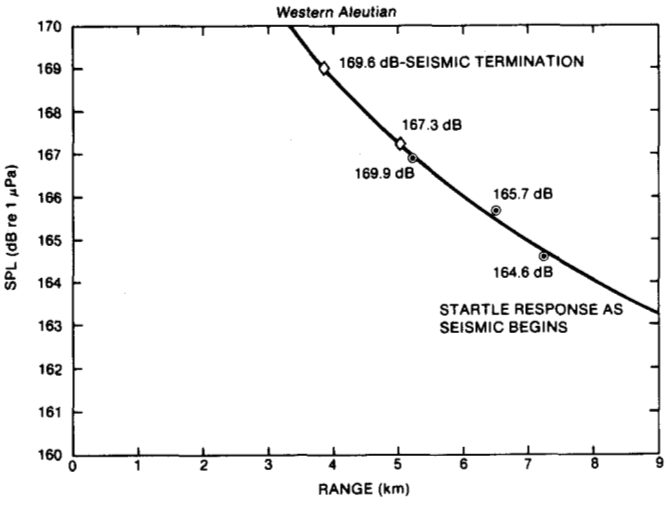

FIG. 4. Received airgun blast noise levels vs. range for the *Western Aleutian*. Line is a least squares regression line fit to the measured sound levels. ♦ = estimated sound level; + = measured sound level.

Nine surfacings were observed while the vessel's airguns were inactive. The general behavior for the whales during these surfacings included milling, socializing and slow traveling (Table 1). Three whales were at the surface as the vessel approached to a range of 7.2 km; two were within one whale length of each other, and the third was 3-5 whale lengths from the pair. The whales' behavior changed abruptly with the commencement of the airgun blasts at 7.2 km. They exhibited a "startle" response, which included considerable water disturbance, tail slaps and sudden travel at moderate to fast speed away from the approaching vessel. The vessel continued its approach toward the whales until it was within 3.5 km, when the airguns were shut down.

After the airgun blasts ceased, the number of whales under observation increased from three to ten, including two cow/calf pairs. Nine surfacings were recorded during the first 30 min of post-experiment observations. All whales were traveling at slow to medium speed away from the inactive vessel (Table 1). Seven surfacings were recorded during the second 30 min post-experiment period, and observed behaviors included milling, social behaviors that included cow/calf nursing bouts and play, and traveling at slow to medium speeds to the west (Table 1).

All respiration parameters changed significantly as the whales were approached by the seismic vessel and throughout the first 30 min of post-experiment observations but returned toward pre-experiment levels during the second 30 min post-experiment period (Table 2; Fig. 5). Mean blow interval increased significantly during exposure to the airgun blasts and continued to increase during the first 30 min of post-experiment observa-

TABLE 2. Summary statistics of the principal surfacing, respiration and dive characteristics during four seismic experiments; all categories are for non-calves

Seismic Experiment	Blow Interval (s)				No. Blows/Surfacing				Length of Surfacing (min)				Length of Dive (min)				Blow Rate (No./min)			
	$\bar{x}$	Rank[a]	S.D.	n	$\bar{x}$	Rank	S.D.	n	$\bar{x}$	Rank	S.D.	n	$\bar{x}$	Rank	S.D.	n	$\bar{x}$	Rank	S.D.	n
Western Beaufort, Sept 18																				
Pre-Experiment > 10 km	13.1	2	6.49	158	9.2	3	2.53	10	1.82	3	0.829	13	17.93	3	5.044	10	0.38	1	0.180	1
Experiment 10-5 km	12.3	1	6.54	58	6.3	2	2.37	11	1.25	2	0.737	11	4.93	2	4.639	6	1.36	2	0.868	6
Experiment < 5 km	20.3	3	10.81	41	2.0	1	1.53	21	0.59	1	0.643	21	1.12	1	1.548	15	1.81	3	0.937	14
	$F = 18.087$ $p < 0.001$ $df_e = 254$ MRT[b] 1 2 3				$F = 45.665$ $p < 0.001$ $df_e = 39$ MRT 1 2 3				$F = 11.774$ $p < 0.001$ $df_e = 42$ MRT 1 2 3				$H(c)$[d] $= 21.077$ $p < 0.001$ $df = 2$ MRT 1 2 3				$H(c)$[d] $= 15.323$ $p < 0.001$ $df = 2$ MRT 1 2 3			
Western Aleutian, Sept 20																				
Pre-Experiment > 10 km	13.0	1	3.78	49	8.5	4	2.33	8	1.81	4	0.593	8	17.80	4	11.703	4	1.46		1.788	5
Experiment 10-5 km	16.6	2	6.51	25	3.0	2	2.52	7	0.73	1	0.823	7	3.11	1	2.103	6	0.78		0.899	4
Post-Experiment < 30 min	22.2	4	10.11	13	2.0	1	0.00	2	0.87	2	0.174	3	7.15	2	2.257	4	0.43		0.230	3
Post-Experiment > 30 min	17.4	3	4.56	27	5.5	3	2.65	4	1.77	3	0.354	2	15.64	3	9.683	3	0.46		—	1
	$F = 10.342$ $p < 0.001$ $df_e = 110$ MRT 1 2 3 4				$t = 4.217$[c] $p < 0.001$ $df = 20$ 1 2 3 4				$t = 3.761$[c] $p = 0.001$ $df = 18$ 1 2 3 4				U[e] $= 59.5$[c] $0.01 < p < 0.02$ MRT 1 2 3 4				No Tests			
Arctic Star, Sept 23																				
Pre-Experiment > 10 km	15.3	1	6.14	132	3.8		1.98	19	1.07		0.578	21	14.15		10.520	6	—		—	—
Pre-Experiment > 10 km	15.9	2	6.10	22	4.5		1.73	4	1.35		0.225	4	—		—	—	—		—	—
Experiment 10-5 km	17.2	3	4.24	17	3.3		2.08	3	1.18		0.436	2	24.27		2.334	2	—		—	—
Experiment < 5 km	19.4	4	3.97	30	3.8		2.99	6	1.19		0.773	6	16.13		13.289	3	—		—	—
	$F = 4.428$ $p < 0.001$ $df_e = 197$ MRT 1 2 3 4				No Tests				No Tests				No Tests				No Tests			
Western Polaris, Sept 26																				
Pre-Experiment > 10 km	14.8	2	7.10	246	8.0	4	2.05	24	1.97	4	0.638	25	16.17	5	11.471	4	0.78	1	0.933	4
Experiment 10-5 km	16.8	5	8.64	182	4.6	3	3.95	29	1.26	3	0.984	31	1.91	2	4.255	9	1.81	2	0.981	8
Experiment < 5 km	15.3	3	9.05	23	3.8	2	2.82	8	0.78	1	0.643	8	0.56	1	0.365	2	2.84	5	0.623	2
Post-Experiment < 30 min	16.2	4	5.08	30	3.6	1	2.30	7	0.93	2	0.442	7	8.44	3	16.353	4	2.01	3	1.127	4
Post-Experiment > 30 min	14.3	1	6.38	160	8.1	5	4.25	16	2.09	5	1.164	18	12.56	4	14.053	4	2.06	4	1.987	4
	$F = 3.039$ $p < 0.05$ $df_e = 636$ MRT 1 2 3 4 5				$F = 6.806$ $p < 0.001$ $df_e = 79$ MRT 1 2 3 4 5				$F = 6.275$ $p < 0.001$ $df_e = 84$ MRT 1 2 3 4 5				U[e] $= 96.0$[c] $p = 0.02$ 1 2 3 4 5				$H(c)$[d] $= 5.122$ $p = 0.27$ $df = 4$ 1 2 3 4 5			

a Rank = rank of means from smallest to largest b MRT = multiple rank test c Groups pooled to give adequate sample sizes d Kruskal-Wallace test e Mann-Whitney test

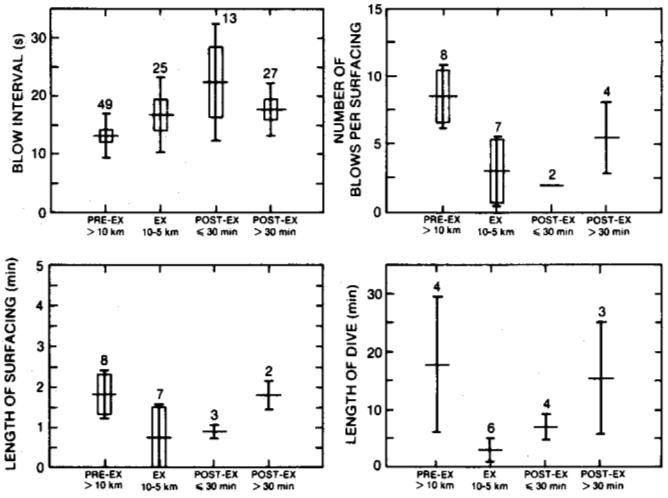

FIG. 5. Surfacing, respiration and dive characteristics for bowhead whales during different categories of exposure to airgun blasts from the *Western Aleutian*. Horizontal bars are means, vertical lines are 1 standard deviation from the mean, closed bars are 95% confidence limits to the mean and numbers at top of bars are sample sizes. ex = experiment.

tions. By the second 30 min period, blow intervals had declined to pre-experiment values. The mean number of blows per surfacing also declined significantly during the first 30 min of the post-experiment period, but as with blow intervals, the number of blows per surfacing began to recover during the second 30 min period. Number of blows per surfacing during the pre-experiment and second post-experiment periods combined were significantly higher than during the period of active seismic sounds and the first post-experiment period combined (Table 2).

Mean length of surfacing and dive duration declined with the onset of airgun blasts. The length of surfacing during exposure to airgun blasts and during the first 30 min of post-experiment observations combined was significantly shorter than lengths of surfacing during the pre-experiment and second 30 min of post-experiment observations combined. The length of dives during the airgun disturbance and immediately following the shutdown of the airguns was also significantly shorter than during the pre-experiment and second post-experiment periods combined (Table 2; Fig. 5). There were insufficient data to determine whether blow rate changed during this experiment.

Experiment No. 3: On 23 September, a third direct approach experiment was undertaken toward a group of seven whales approximately 32 km northeast of Lonely, with cooperation from the geophysical vessel *Arctic Star* (Fig. 1:3). The *Arctic Star* is equipped with a multiple airgun array, of which 18 of 24 guns are fired once every 12-14 s, producing an estimated airgun source level of 246 dB (Ljungblad *et al.*, 1984). Sonobuoys dropped in 17 m of water near the whales provided data on airgun blast levels, vessel noise and ambient levels throughout the 6.0 h experimental period. Airgun blast levels ranged

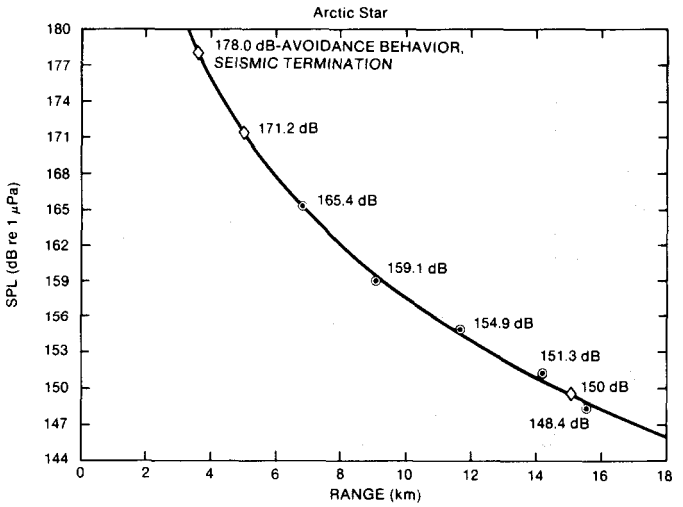

FIG. 6. Received airgun blast noise levels vs. range for the *Arctic Star*. Line is a least square regression line to fit to the measured sound levels. ♦ = estimated sound level; + = measured sound level.

from 148 dB at a distance of >10 km to an estimated 178 dB at 3.5 km when the airguns were shut down (Fig. 6).

The behaviors observed throughout this experiment were somewhat different from those in the earlier experiments, as most of the whales moved slowly through our observation area, stopping for short periods to feed. Forty-three surfacings of at least seven whales were recorded during the initial period of pre-experiment observations when the vessel was active at 15.5 km. General behavior during these surfacings included milling, socializing and traveling at slow to medium speeds (Table 1). During the second pre-experiment period, while the vessel was inactive at a range of 12 km, 13 whale surfacings were recorded. General behavior during these surfacings included milling and traveling at slow to medium speeds (Table 1).

The vessel began its active approach at approximately 11.6 km. During the vessel's approach from 10 to 5 km, the majority of whales were moving at slow to medium speeds (Table 1). When the vessel closed from 5 to within 3.5 km, two whales that had been under constant observation ceased milling and diving and exhibited avoidance behaviors by turning away from the approaching vessel and swimming rapidly to the north. The experiment was terminated at that time.

To analyze the *Arctic Star* experiment the behavioral data were divided into four subsets: a pre-experiment period when the airgun source was *active* at a range of >10 km; a second pre-experiment period when the vessel was *inactive* at a distance of >10 km; an experiment period when the vessel was closing from a range of approximately 12 to 5 km while firing its airguns; and a period of close approach by the vessel when its range to the whales closed from 5 to 3.5 km.

Blow intervals increased as the vessel approached during the pre-experiment period (Table 2; Fig. 7). Blow intervals during the closest approach of the active vessel were significantly greater than at any other point during the experiment. Mean number of blows per surfacing decreased as the vessel approached from 10 to 5 km and then increased slightly during the close (<5 km) approach. The mean length of surfacing increased slightly as the vessel approached to <5 km. No complete dive cycles for individual whales were observed during the pre-experiment period, but mean length of dive decreased during the close approach by the active vessel.

Experiment No. 4: On 26 September, the fourth and final direct approach experiment was undertaken toward a group of 50 whales approximately 42 km northeast of Barter Island, with cooperation from the geophysical vessel *Western Polaris* (Fig. 1:4). The *Western Polaris* is equipped with a multiple airgun array, of which 18 of 24 guns are fired every 12-14 s. The array produces an estimated seismic source level of 250 dB (Ljungblad *et al.*, 1984). Sonobuoys dropped in 46 m of water near the whales again provided data on airgun blast levels, vessel noise and ambient levels throughout the experimental period. During the vessel approach, airgun blast levels ranged from 155 dB at 10.4 km to an estimated 169 dB at 1.8 km (Fig. 8).

Pre-experiment observations on three cow/calf pairs, four single whales, and two groups of 7 and 9 whales were conducted while the inactive vessel approached from 30 km to approximately 12 km. Behaviors during 84 whale sufacings included milling, socializing and traveling at slow to medium speeds (Table 1). Cow-calf interactions and synchronous group diving were also seen during this period.

The airguns were activated at a range of approximately 10.4 km. The whales at the surface gave no obvious response to the airguns' start-up. Eighteen whale surfacings were observed as the vessel closed from approximately 10 to 5 km. All whales were traveling at slow, medium or fast speeds; no whales were milling or socializing (Table 1). When the vessel was 9.5 km from the whales, two calves moved toward each other, within one calf length, then began touching, rolling and flipper slapping. As the vessel approached to 8.2 km, the two calves were joined by three adults, two of which were assumed to be their mothers. The two calves and three adults began socializing on the surface until the vessel was approximately 7.6 km distant, at which time they began moving away from the vessel. A third cow-calf pair, also socializing at the surface, remained in the area of observations until the vessel was 7.0 km away, then began moving slowly to the west, across the course of the approaching vessel. When the vessel was at a range of 6.6 km, another group of seven whales began moving away single file, in a nose to tail formation. In the final phase of the approach (2.9-1.8 km), all whales were traveling west at various rates of speed.

The active approach of the vessel was discontinued when the vessel was at a range of 1.8 km. Within minutes some of the whales ceased traveling and began to mill at the surface. During 18 whale surfacings observed in the first 30 min post-experiment period, whales were milling or continued to travel at slow and medium speeds (Table 1). All fast swimming ceased as the vessel moved away. Twenty-one whale surfacings were observed during the second 30 min post-experiment period. During this period, 48% of the whales were milling and socializing, with some groups surfacing synchronously. The remainder of the whales were traveling at medium to slow speeds (Table 1).

All surfacing, respiration and dive characteristics, except blow rate, changed significantly during the approach of the vessel and the first 30 min post-experiment observation period, but they returned to pre-experiment values during the second 30 min post-experiment observation period (Table 2; Fig. 9). Mean length of surfacing, mean length of dive and mean number of blows per surfacing decreased significantly, and mean blow interval increased significantly, as the vessel approached. Blow rate increased when the vessel was <5 km away and decreased during the post-experiment period, but these changes were not significant (Table 2).

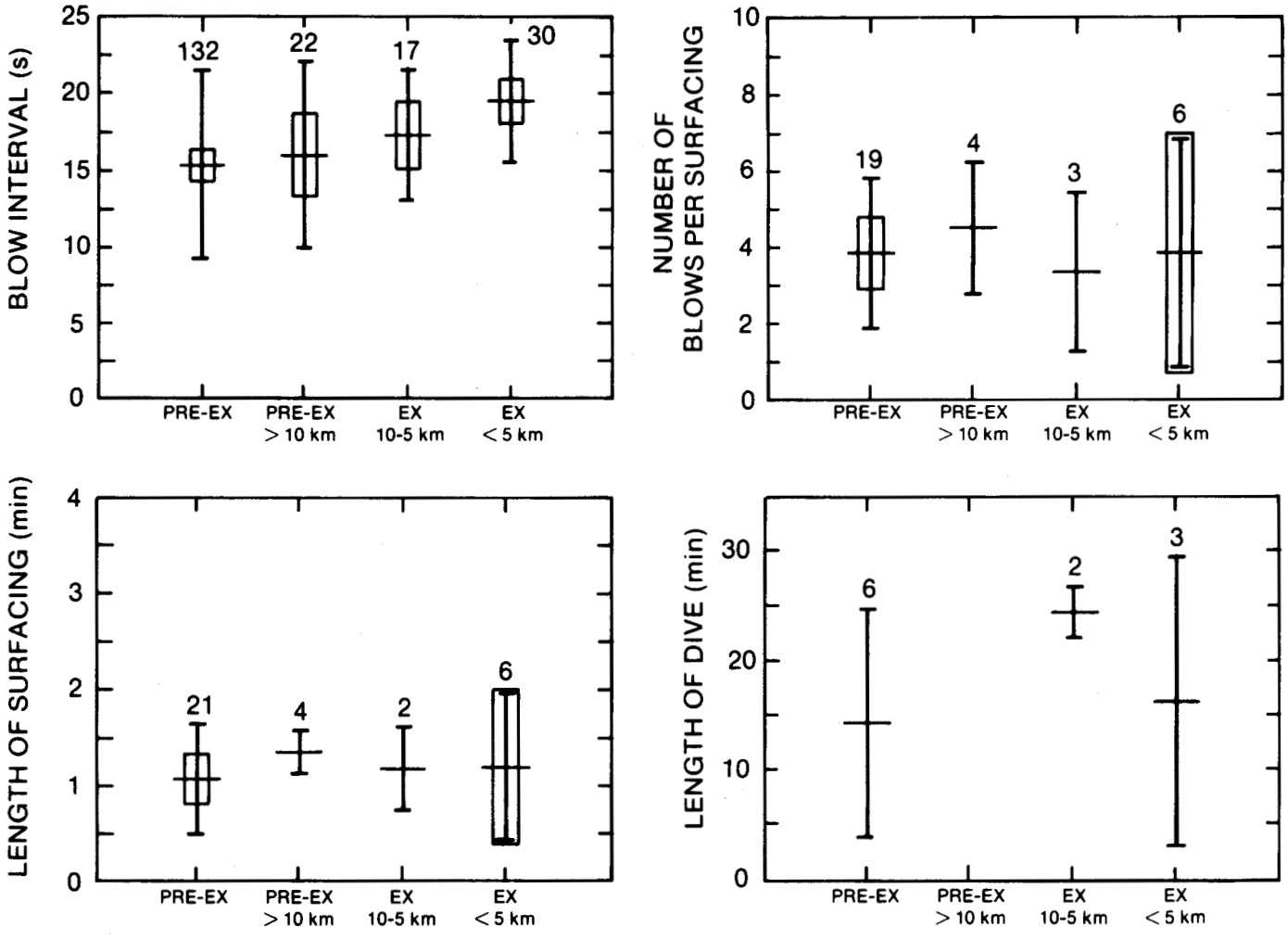

FIG. 7. Surfacing, respiration and dive characteristics for bowhead whales during different categories of exposure to airgun blasts from the *Arctic Star*. Horizontal bars are means, vertical lines are 1 standard deviation from the mean, closed bars are 95% confidence limits to the mean and numbers on top of bars are sample sizes. ex = experiment.

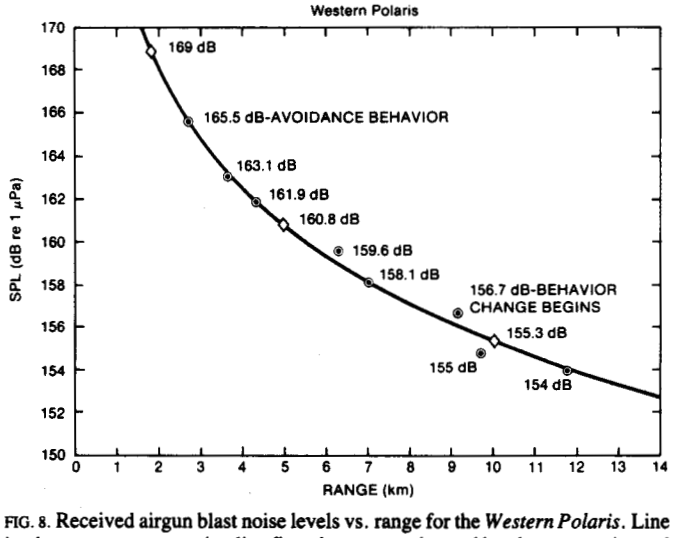

FIG. 8. Received airgun blast noise levels vs. range for the *Western Polaris*. Line is a least squares regression line fit to the measured sound levels. ◆ = estimated sound level; + = measured sound level.

Combined Experimental Results

The data for all adult whales were pooled into pre-experiment and experiment categories and tested for significant differences (Table 3). Blow interval, number of blows per surfacing and length of surfacing showed distributions approaching normality, but length of dive and blow rate were less normally distributed. Therefore, the first three variables were compared with parametric testing procedures, while the last two variables were treated non-parametrically.

All of the surfacing, respiration and dive characteristics showed changes when whales were exposed to seismic sounds at ranges of <10 km. Mean blow interval was the only character to increase, from 12.7 to 15.0 s ($t = 7.854$, $p<0.001$). The remaining characteristics all decreased significantly when whales were exposed to increasing levels of seismic sounds (Table 3, Fig. 10). The number of blows per surfacing decreased from 5.5 to 4.6 blows ($t = 2.221$, $p<0.02$), duration of surfacing decreased from 1.19 to 1.14 min ($t = 0.501$, $p<0.50$), duration of dive decreased from 9.61 to 8.15 min ($t = 0.730$, $p<0.20$), and blow rate declined from 1.43 to 1.25 blows·min^{-1} ($t = 0.641$, $p<0.50$).

The whale behaviors observed during the four direct approach experiments changed progressively with vessel range. When the airguns were shut down the whales began to exhibit behaviors similar to those seen prior to exposure to airgun blasts. The trend for surfacing, respiration and dive characteristics to first change and then recover became apparent when the data from the experiments were analyzed in the five categories: pre-experiment,

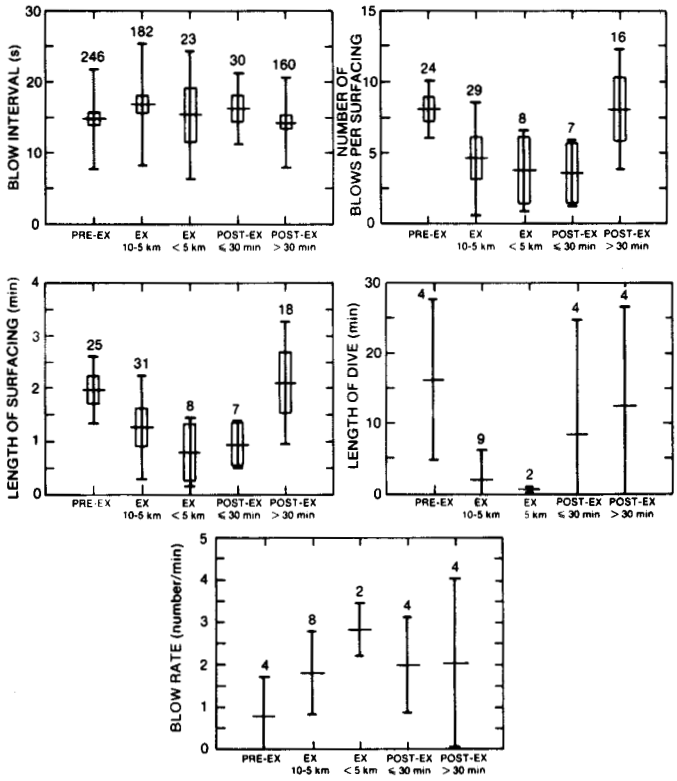

FIG. 9. Surfacing, respiration and dive characteristics for bowhead whales during different categories of exposure to airgun blasts from the *Western Polaris*. Horizontal bars are means, vertical lines are 1 standard deviation from the mean, closed bars are 95% confidence limits to the mean and numbers at top of bars are sample sizes. ex = experiment.

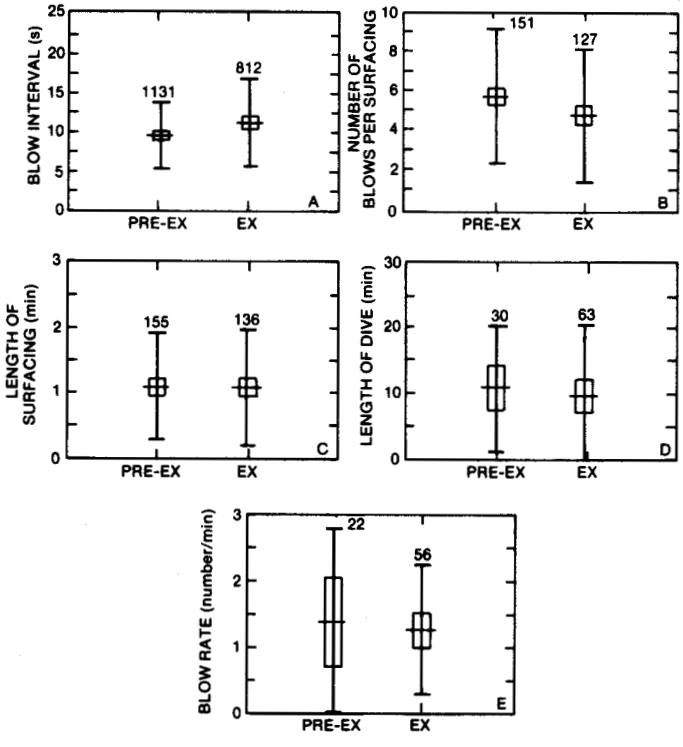

FIG. 10. Pooled mean values for surfacing, respiration and dive characteristics of pre-experiment and experimental whales. Horizontal bars are means, vertical lines are 1 standard deviation from the mean, closed bars are 95% confidence limits to the mean and numbers at top of bars are sample sizes. ex = experiment.

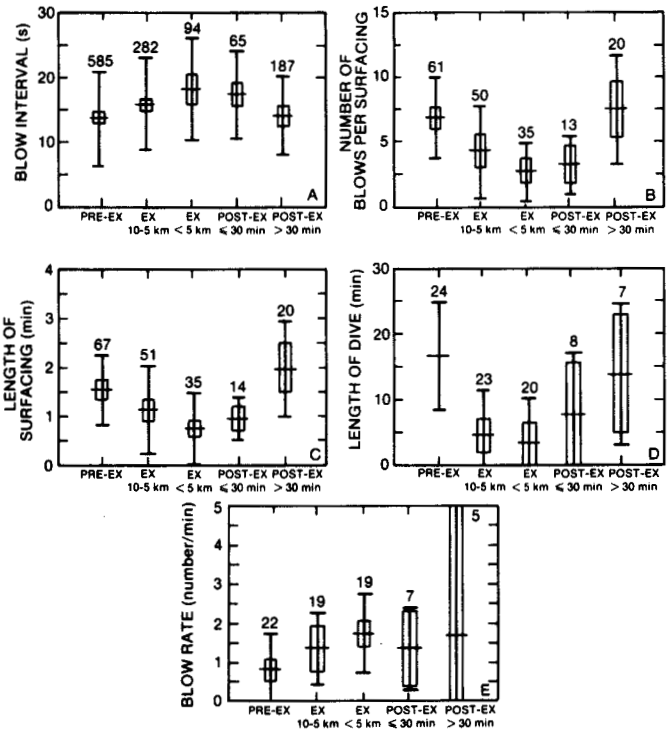

FIG. 11. Overall changes in the behavior characteristics for bowhead whales during different categories of exposure to airgun blasts. Horizontal bars are means, vertical lines are 1 standard deviation from the mean, closed bars are 99% confidence limits to the mean, and numbers at top of bars are sample sizes. ex = experiment.

experiment at 5-10 km, experiment at <5 km, 0-30 min post-experiment, and 30-60 min post-experiment (Fig. 11).

Blow interval increased with exposure to seismic sounds at progressively closer ranges and began to decline once seismic sounds ceased. Number of blows per surfacing, length of surfacing and length of dive all decreased with the onset of the experiment, with the lowest values obtained when the sound source was <5 km away. Values for these behaviors continued to decrease during the first 30 min post-experiment period and then began to increase toward values equivalent to those before the experiment began. Values for blow rates followed a similar pattern.

Association between Measured Behavior Characteristics and Swimming Speed

Whale swimming speed was subjectively estimated from the aircraft as stationary, slow, medium or fast. Slow speeds produced no wake, medium speeds produced a slight wake and fast speeds produced a large wake of "white water" behind the swimming whales. To evaluate differences in the behavior characteristics of whales traveling at different speeds, differences among speed categories for pre-experiment and experiment conditions were tested separately. We then tested for differences between pre-experiment and experiment conditions within each speed category (Table 3).

For pre-experiment whales, mean blow intervals did not change appreciably with different swimming speeds, but mean number of blows per surfacing, mean length of surfacing and mean length of dive all decreased as whales moved faster (Table 3).

TABLE 3. Summary of statistics of the principal surfacing, respiration and dive characteristics, fall 1984; all categories except those marked otherwise are for non-calves

	Blow Interval (s)			No. Blows/Surfacing			Length of Surfacing (min)			Length of Dive (min)			Blow Rate (No./min)		
	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n
AGE CLASSES															
ALL ADULTS															
Pre-Experiment	12.7***	5.61	1131	5.5*	3.36	151	1.19	0.868	155	9.61	8.140	30	1.43	1.404	22
Experiment	15.0	7.29	812	4.6	3.37	127	1.14	0.828	136	8.15	9.407	63	1.25	0.985	56
ALL ADULTS NON-COW															
Pre-Experiment															
Experiment	14.4	7.01	668	4.4	3.32	106	1.04	0.745	114	7.92	9.395	51	1.30	0.991	45
COWS															
Pre-Experiment															
Experiment	17.8	7.94	144	5.4	3.57	21	1.68	1.026	22	9.14	9.811	12	1.03	0.974	11
CALVES															
Pre-Experiment															
Experiment	18.7	12.65	113	3.1	3.90	21	0.87	1.084	22	8.14	9.470	11	0.68	0.814	10
SPEED OF MOVEMENT															
NONE															
Pre-Experiment	13.1	5.55	274	8.4	2.59	27	1.85	0.740	27	16.17	8.045	4	0.33	0.114	3
Experiment	13.7	7.07	223	6.5	3.62	15	1.64	0.790	20	15.43	5.803	8	0.45	0.189	7
SLOW															
Pre-Experiment	13.4	6.40	348	5.1*	2.63	50	1.12*	0.622	48	10.57	8.169	10	1.11	1.251	7
Experiment	13.9	5.82	179	6.8	3.04	26	1.52	0.755	25	17.00	10.303	11	0.74	0.647	11
MEDIUM															
Pre-Experiment	12.7***	4.94	256	6.9***	3.58	27	1.57*	1.188	28	6.58	6.586	6	1.70	1.798	5
Experiment	16.2	7.94	306	3.9	2.96	58	1.03	0.794	63	5.66	7.750	31	1.28	1.000	25
FAST															
Pre-Experiment	11.6**	2.94	18	3.3	2.75	10	0.57	0.570	10	3.89	6.674	4	1.94	0.297	3
Experiment	16.5	8.16	42	2.5	2.67	15	0.51	0.694	15	0.46	0.268	12	2.20	0.712	12

* = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$

This trend was significant for mean number of blows per surfacing ($F = 11.699$, $df = 110$, $p<0.001$) and mean length of surfacing ($F = 8.417$, $df = 109$, $p<0.001$), and not significant for mean length of dive. Mean blow rate increased significantly during faster movement (Mann-Whitney $U = 64.0$, $n = 18$, $p<0.05$).

Under experimental conditions, mean blow intervals increased significantly for faster whales ($F = 6.847$, $df = 746$, $p<0.001$), while mean blow rate also increased greatly as swimming speed increased (Kruskal-Wallace $H_c = 19.673$, $df = 3$, $p<0.001$). The mean number of blows per surfacing, mean length of surfacing and mean length of dive all decreased with increasing speed ($F = 10.017$, $df = 110$, $p<0.001$; $F = 8.428$, $df = 119$, $p<0.001$; and Mann-Whitney $Z = 4.834$, $p<0.001$ respectively). The mean length of dive during experiments was the characteristic most changed at different swimming speeds, with a mean length of 17 min at slow speed and only 0.46 min at fast speed. Whales exposed to seismic sounds at close range generally swam fast and only dove for brief times.

Overall there were differences in the values for the behavior characteristics of whales traveling at different speeds during pre-experiment and experimental conditions. The only significant changes were a lengthening of mean blow interval at medium and fast speeds from 12.7 to 16.2 s ($t = 6.129$, $p<0.001$) and 11.6 to 16.5 s ($t = 2.469$, $p<0.01$) respectively, an increase in the mean number of blows per surfacing of 5.1 to 6.8 for slow-swimming whales ($t = 2.533$, $p<0.05$), a decrease in number of blows per surfacing from 6.9 to 3.9 ($t = 4.065$, $p<0.05$) for medium-swimming whales, a slight but significant increase in the length of surfacing from 1.12 to 1.52 min ($t = 2.421$, $p<0.05$) for slow whales, and a significant decrease in the mean length of surfacing from 1.57 to 1.03 min ($t = 2.553$, $p<0.05$) for whales swimming at medium speeds (Table 3).

Correlations between Measured Behavior Characteristics

Correlations were found between some behavioral characteristics measured during the vessel approach experiments that were similar to correlations documented for whales in previous studies (Ljungblad *et al.*, 1984; Würsig *et al.*, 1984b). Length of surfacing was correlated with number of blows per surfacing ($r = 0.896$, $p<0.001$, $n = 182$) and with length of previous ($r = 0.566$, $p<0.001$, $n = 37$) and subsequent dives ($r = 0.526$, $p<0.001$, $n = 37$). Length of dive prior to a surfacing was correlated with length of dive subsequent to that surfacing ($r = 0.782$, $p<0.001$, $n = 38$), indicating that particular dive patterns tend to occur in bouts. These data further indicate that the surfacing, respiration and dive characteristics are related, for both physiological and behavioral reasons, and that one variable may be predicted by the changes or pattern of another.

DISCUSSION

Although the ranges at which bowheads responded to approaching seismic vessels varied, general trends between experiments can be summarized (Table 4). These trends clearly indicate that whales responded to the airgun blasts at ranges of less than 10 km, with the strongest responses occurring when the whales were within 5 km of the sound source. Whale behavior began to recover to pre-experiment conditions within 30 min after the airguns were shut down, with definite reversals of the response to airguns and/or vessel seen within one hour of the last airgun activity.

Determining when subtle behavioral changes began to occur was the most difficult part of the experimental observations. Each observer's interpretations were carefully assessed until all agreed that behavioral changes were taking place. Subtle to

TABLE 4. Summary of significant experimental ranges, vessel status, airgun blast levels (dB re 1 μPa) and observed bowhead whale behavioral responses

Range (km)	Vessel status	Behavioral response
Western Beaufort		
>10	Airgun firing, ongoing seismic survey (130 dB)	None
9.6	Airgun firing as vessel approaches (132 dB)	None
3.5	Airgun firing as vessel approaches (142 dB)	Huddling, followed by avoidance responses
1.3	Airgun shut down, vessel departs (152 dB)	All whales exhibiting avoidance responses
Western Aleutian		
>8.0	Airguns shut down, vessel maneuvering for approach	None
7.2	Airguns begin firing as vessel approaches (165 dB)	Startle responses, followed by avoidance responses
3.5	Airguns shut down, vessel departs (170 dB)	All whales exhibiting avoidance responses
Arctic Star		
15.5	Airguns firing, ongoing seismic survey (148 dB)	None
>12	Airguns shut down as vessel maneuvers for approach	None
11.6	Airguns firing as vessel approaches (155 dB)	None
3.5	Airguns shut down, vessel departs (178 dB)	Whales exhibiting avoidance responses
Western Polaris		
12	Airguns shut down, vessel maneuvering for approach	None
10.4	Airguns begin firing as vessel approaches (155 dB)	None
8.2	Airguns firing as vessel approaches (157 dB)	Possible subtle behavior changes
7.6	Airguns firing as vessel approaches (158 dB)	5 whales begin vessel avoidance responses
7.0	Airguns firing as vessel approaches (158 dB)	2 additional whales begin vessel avoidance responses
6.6	Airguns firing as vessel approaches (159 dB)	7 additional whales begin vessel avoidance responses
2.9	Airguns firing as vessel approaches (165 dB)	All whales exhibiting avoidance responses
1.8	Airguns shut down, vessel departs (169 dB)	

obvious changes in behaviors were evident in the *Western Beaufort* experiment in the form of huddling and in the *Western Polaris* experiment in the form of changes in surface behaviors when airgun levels reached intensities of 142 dB and 157 dB at ranges of 3.5 km and 8.2 km respectively. The fact that we waited until all observers were in agreement may have introduced a small degree of error, most likely <0.5 km, in the reported ranges of initial subtle responses.

The interpretations of partial avoidance followed by total avoidance were more straightforward, beginning when the first whale was observed swimming away (partial avoidance) to eventually include all whales moving away (total avoidance) from the approaching vessel. Partial avoidances were obvious in the *Western Beaufort* and *Western Polaris* experiments at ranges of 3.5 km and 7.6 km with airgun intensity levels of 142 dB and 158 dB respectively (Table 4). Total avoidance responses for all experiments occurred at ranges of 1.3 to 7.2 km, with sound intensities of 152 to 165 dB. Although initiation of airgun blasts at 7.2 km (*Western Aleutian* experiment) produced an obvious "startle effect" and elicited immediate avoidance response by three whales, the airgun initiation at 10.4 km (*Western Polaris* experiment) elicited no obvious response, implying that the range of start-up "startle effects" probably occurs somewhere between 7.2 and 10.4 km, assuming intensity levels are similar.

All but one experiment were conducted in water ≥40 m deep. The *Arctic Star* experiment was conducted in water ≤20 m deep, and the sound levels for this experiment at ranges of less than 5 km were approximately 10 dB greater than levels measured at similar ranges for the experiments in deeper water. These differences are thought to be due to sound propagation characteristics that are highly dependent on bottom loss components for shallow water transmission paths (Urick, 1967). Differences in sound propagation properties, combined with variations in site-specific bowhead behaviors, may be responsible for some of the observed responses to approaching geophysical vessels. Bowheads along the shelf break north of Harrison Bay, near where the *Arctic Star* experiment occurred, have been seen feeding less and traveling more than whales seen farther to the east (Ljungblad *et al.*, 1986). Therefore, in this experiment, site-specific behavior (i.e., traveling vs. milling/feeding) may have influenced the whale's response to the approaching seismic vessel.

The tendency for bowhead whales to dive for shorter periods during exposure to close seismic sounds may also be related to the transmission characteristics of the airgun blasts through the water column. Greene (1984) reported that received levels of airgun sounds are reduced near the surface, and if seismic sound is irritating to the whales, one would expect the animals to spend more time where the sound is the least intense. This effect may have been demonstrated during the *Western Polaris* experiment when whales surfaced frequently and their dives were short and shallow as they moved away from the approaching vessel. These whales may have been swimming away near the surface to avoid relatively higher levels of sound in deeper water.

Although conspicuous behavior changes occurred consistently as the geophysical vessels approached to within 5 km, bowhead whales appeared to tolerate continuous full-scale seismic sounds at distances greater than 10 km. Previous studies of bowhead whales also suggest that, in general, little change occurs in behavior when whales are exposed to airgun blasts generated from vessels farther than 10 km away (Reeves *et al.*, 1983; Ljungblad *et al.*, 1984). Richardson (1985) found little evidence that bowhead whales changed their behavior or oriented away from airgun sources at ranges between 6 and 89 km or during three experiments with a single airgun that produced received sound levels of 113-118 dB at ranges of 3-5 km. Richardson *et al.* (1986) did observe bowhead whales orienting away from a single airgun when exposed to sound levels of at least 124-134 dB at ranges of 0.2-4.6 km and during an experiment with a full-scale seismic vessel at ranges of 1.5-7.5 km. Richardson *et al.* (1984) point out that bowheads must routinely experience low-frequency calls from conspecifics that may reach source levels of 189-200 dB (Clark and Johnson, 1984) and that short-duration loud seismic pulses may be equally tolerated. However, whale calls and airgun blasts are *very* different types of sounds, each with different fundamental components and tonal qualities, and responses to each probably vary greatly. Different behavioral responses may also be caused by the approaching ship-noise components that may cue avoidance reactions. It has been demonstrated that bowhead whales react to ship noise alone at distances of up to 4 km (Fraker *et al.*, 1982). Experiments to determine the responses of bowhead whales to approach-

es by inactive geophysical vessels were not conducted; however, such experiments may contribute valuable information on the significance of airgun blasts in concert with ship noise and their individual and combined effects on bowhead whale behavior.

The observed changes in bowhead behaviors may be comparable to behavior changes of migrating gray whales (*Eschrichtius robustus*) in response to exposure to seismic sounds with average pulse pressure levels of 160 dB (Malme *et al.*, 1983). Malme *et al.* (1983) indicated that some behavior changes occurred at sound pressure levels between 140 and 160 dB but that limited observations precluded definite quantification of the responses. Although behavior responses appear similar, the Malme techniques for deriving dB levels using average pulse pressure vs. rms values directly related to peak result in dB levels that are somewhat lower than those described in this paper. Due to the variations between the data sets and analysis techniques, only a relative comparison of dB levels can be made. The similarities between experiments reported here support the conclusion that short-term behavioral changes occur when bowhead whales are exposed to industrial seismic sounds at ranges <10 km. We also conclude that the disturbance effects wane within one hour after a disturbance; we cannot make further statements about long-term effects on social, behavioral or physiologic parameters.

ACKNOWLEDGEMENTS

This work was funded by the Minerals Management Service, U.S. Department of the Interior, and completed under the auspices of the Naval Ocean Systems Center. We would like to acknowledge those people and organizations that contributed to the safety and success of this field work: Seair, Inc., of Anchorage, Alaska, provided the survey aircraft and pilots. Our pilots, Bill Redmond, Ken Johansson and Robert Elmer, performed above and beyond the call of duty and were extremely supportive of the work. John Bennett, of SEACO, provided all interfacing hardware and software for the aircraft computer system. At Minerals Management Service, we appreciate the guidance and encouragement of Jerome Montague, Cleve Cowles, Jerry Imm and Tim Sullivan. We also appreciate the cooperation of the personnel of Geophysical Service, Inc., and Western Geophysical Co., especially the crews of the vessels involved, without whom the acoustic response experiments would not have been possible. Jill Schoenherr and Kevin Lohman, of the Moss Landing Marine Laboratories, provided computer software for the analysis, statistical testing and computer-generated graphics of the behavior data. Gloria Young, of SEACO, typed drafts and tables. An earlier draft of the manuscript was reviewed by Jerome Montague, of MMS, Forrest Wood, of NOSC, and Sue Moore, of SEACO. Our thanks to all.

REFERENCES

BARGER, J.E., and HAMBLEN, W.R. 1980. The airgun impulsive underwater transducer. Journal of the Acoustical Society of America 68:1038-1045.

CLARK, C.W., and JOHNSON, J.H. 1984. The sounds of the Bowhead Whale (*Balaena mysticetus*) during the spring migrations of 1979 and 1980. Canadian Journal of Zoology 62:1436-1441.

FRAKER, M.A., RICHARDSON, W.J., and WÜRSIG, B. 1982. Disturbance responses of bowheads. In: Richardson, W.J., ed. Behavior, disturbance responses and feeding of bowhead whales, *Balaena mysticetus* in the Beaufort Sea, 1980-1981. Unpubl. report from LGL Ecological Research Associates Inc., Bryan, Texas, for U.S. Minerals Management Service, Reston, Virginia. 145-248. Available from Minerals Management Service, Alaska Outer Continental Shelf Region, 949 East 36th Avenue, Room 110, Anchorage, Alaska 99508-4302, U.S.A.

FRAKER, M.A., LJUNGBLAD, D.K., RICHARDSON, W.J., and VAN SCHOIK, D.R. 1985. Bowhead whale behavior in relation to seismic exploration, Alaskan Beaufort Sea, Autumn 1981. Unpubl. report from LGL Ecological Research Associates Inc., Bryan, Texas, for U.S. Minerals Management Service, Reston, Virginia. 37 p. Available from Minerals Management Service, Alaska Outer Continental Shelf Region, 949 East 36th Avenue, Room 110, Anchorage, Alaska 99508-4302, U.S.A.

GREENE, C.R. 1984. Characteristics of waterborne industrial noise, 1983. In: Richardson, W.J., ed. 1984. Behavior, disturbance responses and distribution of bowhead whales, *Balaena mysticetus* in the eastern Beaufort Sea, 1983. Unpubl. report from LGL Ecological Research Associates Inc., Bryan, Texas, for U.S. Minerals Management Service, Reston, Virginia. 217-308. Available from Minerals Management Service, Alaska Outer Continental Shelf Region, 949 East 36th Avenue, Room 110, Anchorage, Alaska 99508-4302, U.S.A.

INTERNATIONAL WHALING COMMISSION. 1988. Report of the Scientific Committee on protected species and aboriginal subsistence whaling. Report of the International Whaling Commission (Annex H) 36:95-111.

LJUNGBLAD, D.K., WÜRSIG, B., REEVES, R.R., CLARKE, J.T., and GREENE, C.R., Jr. 1984. Fall 1983 Beaufort Sea seismic monitoring and bowhead whaling behavior studies. Unpubl. report for U.S. Minerals Management Service, Reston, Virginia. 77 p. Available from Minerals Management Service, Alaska Outer Continental Shelf Region, 949 East 36th Avenue, Room 110, Anchorage, Alaska 99508-4302, U.S.A.

LJUNGBLAD, D.K., MOORE, S.E., and VAN SCHOIK, D.R. 1986. Seasonal patterns of distribution, abundance, migration and behavior of the western arctic stock of bowhead whales, *Balaena mysticetus* in Alaskan Seas. Report of the International Whaling Commission, Special Issue 8:177-205.

MALME, C.I., MILES, P.R., CLARK, C.W., TYACK, P., and BIRD, J.E. 1983. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior. Unpubl. report from Bolt Beranek and Newman, Inc., Cambridge, Massachusetts, for U.S. Minerals Management Service, Reston, Virginia. Variously paginated. Available from Minerals Management Service, Alaska Outer Continental Shelf Region, 949 East 36th Avenue, Room 110, Anchorage, Alaska 99508-4302, U.S.A.

REEVES, R.R., LJUNGBLAD, D.K., and CLARKE, J.T. 1983. Bowhead whales and acoustic seismic surveys in the Beaufort Sea. Polar Record 22:271-280.

RICHARDSON, W.J., ed. 1985. Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1980-84. Unpubl. report from LGL Ecological Research Associates, Inc., Bryan, Texas, for U.S. Minerals Management Service, Reston, Virginia. 306 p. Available as NTIS P887-124376 from National Technical Information Service, Springfield, Virginia.

_____, WELLS, R.S., and WÜRSIG, B. 1984. Disturbance responses of bowheads, 1983. In: Richardson, W.J., ed.1984. Behavior, disturbance responses and distribution of bowhead whales, *Balaena mysticetus* in the eastern Beaufort Sea, 1983. Unpubl. report from LGL Ecological Research Associates, Inc., Bryan, Texas, for U.S. Minerals Management Service, Reston, Virginia. 101-215. Available from Minerals Management Service, Alaska Outer Continental Shelf Region, 949 East 36th Avenue, Room 110, Anchorage, Alaska 99508-4302, U.S.A.

RICHARDSON, W.J., WÜRSIG, B., and GREENE, C.R., Jr. 1986. Reactions of bowhead whales, *Balaena mysticetus*, to seismic exploration in the Canadian Beaufort Sea. Journal of the Acoustical Society of America 79(4):1117-1128.

SOKAL, R.R., and ROHLF, F.J. 1981. Biometry; the principles and practice of statistics in biological research. 2nd ed. San Francisco: W.H. Freeman. 859 p.

URICK, R.J. 1967. Principles of underwater sound for engineers. New York: McGraw-Hill. 341 p.

WÜRSIG, B., DORSEY, E.M., FRAKER, M.A., PAYNE, R.S., RICHARDSON, W.J., and WELLS, R.S. 1984a. Behavior of bowhead whales, *Balaena mysticetus*, summering in the Beaufort Sea: surfacing, respiration and dive characteristics. Canadian Journal of Zoology 62:1910-1921.

WÜRSIG, B., DORSEY, E.M., RICHARDSON, W.J., CLARK, C.W., PAYNE, R.S., and WELLS, R.S. 1984b. Normal behavior of bowheads, 1983. In: Richardson, W.J., ed. Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1983. Unpubl. report from LGL Ecological Research Associates, Inc., Bryan, Texas, for U.S. Minerals Management Service, Reston, Virginia. 23-99. Available from Minerals Management Service, Alaskan Outer Continental Shelf Region, 949 East 36th Avenue, Room 110, Anchorage, Alaska 99508-4302, U.S.A.

ZAR, S.H. 1984. Biostatistical analysis. 2nd ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 718 p.

Aquatic Mammals 2002, **28.3,** 231–240

Male sperm whale behaviour during exposures to distant seismic survey pulses

P. T. Madsen, B. Møhl, B. K. Nielsen and M. Wahlberg

Department of Zoophysiology, Institute of Biological Sciences, University of Aarhus, Building 131, C.F. Moellers Alle, 8000 Aarhus C, Denmark

Abstract

The behaviour of adult, male sperm whales in polar waters (69°20′N, 15°40′E) during exposure to pulses from a remote (>20 km) seismic survey vessel and artificial codas is described and discussed. Five hours of recordings with a large aperture array contained both air gun pulses and sperm whale clicks. The seismic survey pulses received were smeared-out in time and high-pass filtered due to multipath propagation in shallow water. The pulses received had a −10 dB spectrum content in the frequency range of 210–260 Hz and a maximum −10 dB duration of 1400 ms. Estimated maximum sound pressure received at the whales were 146 dB re 1 μPa (p-p) (124 dB re 1 μPa^2s in energy terms). The exposure to the seismic survey pulses did not elicit observable avoidance and the whales stayed in the area for at least 13 days of exposure. Nor did the whales fall silent or change their normal vocal patterns during feeding dives. It appears that foraging male sperm whales in this habitat and at these received levels are not more susceptible to air gun pulses than are cetaceans in general.

During emissions of artificial codas, sound levels at the whales being unknown, the sperm whales did not cease clicking as reported from previous investigations, but two whales seemed to direct their high power, narrow-beam sonar towards the coda transmitter.

Key words: Sperm whale, seismic survey, air gun, coda, noise, *Physeter*

Introduction

Because sound, unlike other stimuli, propagates efficiently in water, fully aquatic mammals have developed sensory systems suited for detection and processing of sounds used in orientation and communication. The crucial role of sound reception in marine mammals makes them potentially vulnerable to noise that masks or interferes with signals of interest. Marine mammals are exposed to sound from natural sources such as vociferous animals, wave-action and natural seismic activity.

During the last century increased human activity offshore has elevated background noise levels in the oceans. Due to the possible deleterious effects of noise on marine organisms, a number of investigations have tested the effects of anthropogenic sound sources on marine mammals (Richardson *et al*., 1995). Motorized shipping is a prominent and constant source of noise in the sea with possible masking effects on baleen whale communication as a possible consequence (Payne & Webb, 1971). Nevertheless, most effort has been put into understanding the effects of ATOC (Acoustic Thermography of Ocean Climate) (Au *et al*., 1997; Popper *et al*., 2000), LFA (Low Frequency Active Sonar), (Frantzis, 1998; Miller *et al*., 2000), and seismic surveys on the behaviour and physiology of marine mammals.

In a seminal review, Richardson *et al*. (1995) outlined four zones of influence of human-made noise on marine mammals: (1) zone of audibility, (2) zone of responsiveness, (3) zone of masking, and (4) zone of discomfort and injury. Various natural and anthropogenic sound sources may cause effects pertaining to one or more of the zones of influence, depending on source parameters and transmission effects.

Pulse-generators used in seismic surveys are the most powerful, routinely used, civilian sound sources with nominal source levels[1] (SL) up to 265 dB re 1 μPa (p-p) (Richardson *et al*., 1995). Such high SL's are back-calculated from far-field properties of the sound pulse, where the array can be considered a point source. The actual SL in the near-field (<75 m or so) of an air gun array is some 15–20 dB lower due to multiple sources (Caldwell & Dragoset, 2000).

Seismic survey pulses are normally generated by rapid emission of a large volume of gas into the

[1]Referenced to 1 m.

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water (Greene & Richardson, 1988). The output pulse are of short duration (<100 ms) and have a centre frequency of 50–100 Hz. Using an array of guns, achieves a largely downward-projected, directional beam of the pulse (Barger & Hamblen, 1980). Owing to the high sound pressure levels and widespread use of this technique, the possible effects on marine animals have been investigated (for a review, see McCauley *et al*., 2000). The possible deleterious effects of seismic surveys on marine mammals may be relevant at all four zones of influence, including discomfort and injury, if the animal is in close proximity beneath the source.

The effects of seismic surveys on baleen whales include studies on bowhead whales off Alaska (Ljungblad *et al*., 1988; Richardson *et al*., 1986; Richardson *et al*., 1999), humpback whales (McCauley *et al*., 1998) and gray whales (Malme & Miles, 1985). The general observation is that baleen whales change their behaviour by avoidance or increased ventilation rates when the levels received exceed 130–150 dB re1 μPa, with some inter- and conspecific variation (Reeves *et al*., 1984; Richardson *et al*., 1995).

Odontocetes have shown mixed reactions to seismic survey noise. Rankin & Evans (1998) could not demonstrate that seismic surveys had a negative impact on large-scale distribution of delphinids in the Gulf of Mexico. Goold (1996) indicated avoidance reactions by common dolphins to operating air guns. Mate *et al*. (1994) found a negative correlation between seismic surveys and the presence of sperm whales in the Gulf of Mexico. Bowles *et al*. (1994) reported that sperm whales in the Indian Ocean ceased clicking, possibly as a response to seismic survey pulses, with received levels some 15 dB above background noise levels. In contrast, Stone (1998, 2000) reported that sperm whales sighting rates did not differ significantly with seismic surveys.

Sperm whales seem to respond to various sound sources (for a summary see: Madsen & Møhl, 2000). In particular, coda-like patterns of transients with modest received levels have been shown to evoke reactions among exposed sperm whales (Watkins & Schevill, 1975; Andre *et al*., 1997).

Recordings in July 2000 of sperm whale sounds off Andenes, northern Norway, coincided with the activity of a seismic survey vessel. The recordings provided information on sperm whale clicking behaviour before, during, and after exposures to pulses from the seismic survey vessel. Sperm whales were also exposed to artificial codas to test the responsiveness of the whales.

Materials and Methods

Recordings were carried-out from 12 to 21 July 2000 in Bleik Canyon, off Andenes, northern Norway (69°20′N, 15°40′E). Variable numbers of adult, male sperm whales inhabit the canyon all the year round, presumably engaged in feeding (Ciano & Huerle, 2001). Andenes Whale Safari has two vessels for whale watching in the canyon area. On every trip, time and position of the whales observed are noted in the ship's log. Observations from 6 to 25 of July were made available to the present study (courtesy of G. Maan).

A seismic survey vessel was exploring the continental shelf between 20 and 140 km SW of the canyon between the 12 and 25 July 2000 at water depths varying between 30 and 1100 m (Fig. 1). The survey vessel towed a tuned HGS sleeve air gun array with four sub-arrays of 10 guns. The array was towed at a depth of 7 m and the guns were firing simultaneously.

Total volume of the array was 3800 cubic inches (62 L) with a nominal working pressure of 2000 psi and a 10 s repetition period. The far-field signal was a one-cycle transient with 30 ms duration and most energy in the frequency range of 10–80 Hz. The SL (with the amendments of a point source, see introduction) of the downward propagating part of the signal was 109 bar-m (p-p) (filter bandwidth unknown), corresponding to 261 dB re 1 μPa (p-p) (Kjell Aubert, pers. comm.). The SL of the horizontally propagating part of the signal was lower due to the downward directing properties of the array (Richardson *et al*., 1995).

A custom-built piezo-ceramic pinger, omnidirectional in the horizontal plane, was used for generation of artificial codas. The signal applied to the piezo-ceramic element was a 20 ms downward sweep from 30 kHz to 10 kHz. The operator manually controlled the repetition pattern. The pinger was lowered to a depth of 5 m during transmissions. The SL was 164 dB re 1 μPa (p-p).

Acoustic recordings during sleeve air gun investigations were performed on 15, 18 and 20, July with a large aperture array of non-linked recording platforms spaced in the order of one kilometer. Each platform was equipped with a calibrated hydrophone (B&K 8101, HS-150 or Reson TC-4032), which via an anti-alias filter (-12 dB/oct, $f_0 = 11$ kHz) relayed the signals to one of the channels of a DAT stereo-recorder (Sony TCD-D3,7 and 8), sampling at 48 kHz. Hydrophones were lowered to depths between 5 and 30 m. Calibration signals from a B&K 4223 pistonphone-calibrator were sent through the entire recording chain and stored on each tape. Filters were compensated for during analysis, given a flat (within 2 dB) frequency response from 0.01 to 22 kHz of the recording systems. A 40-dB attenuator could be inserted in the recording chain to avoid overload.

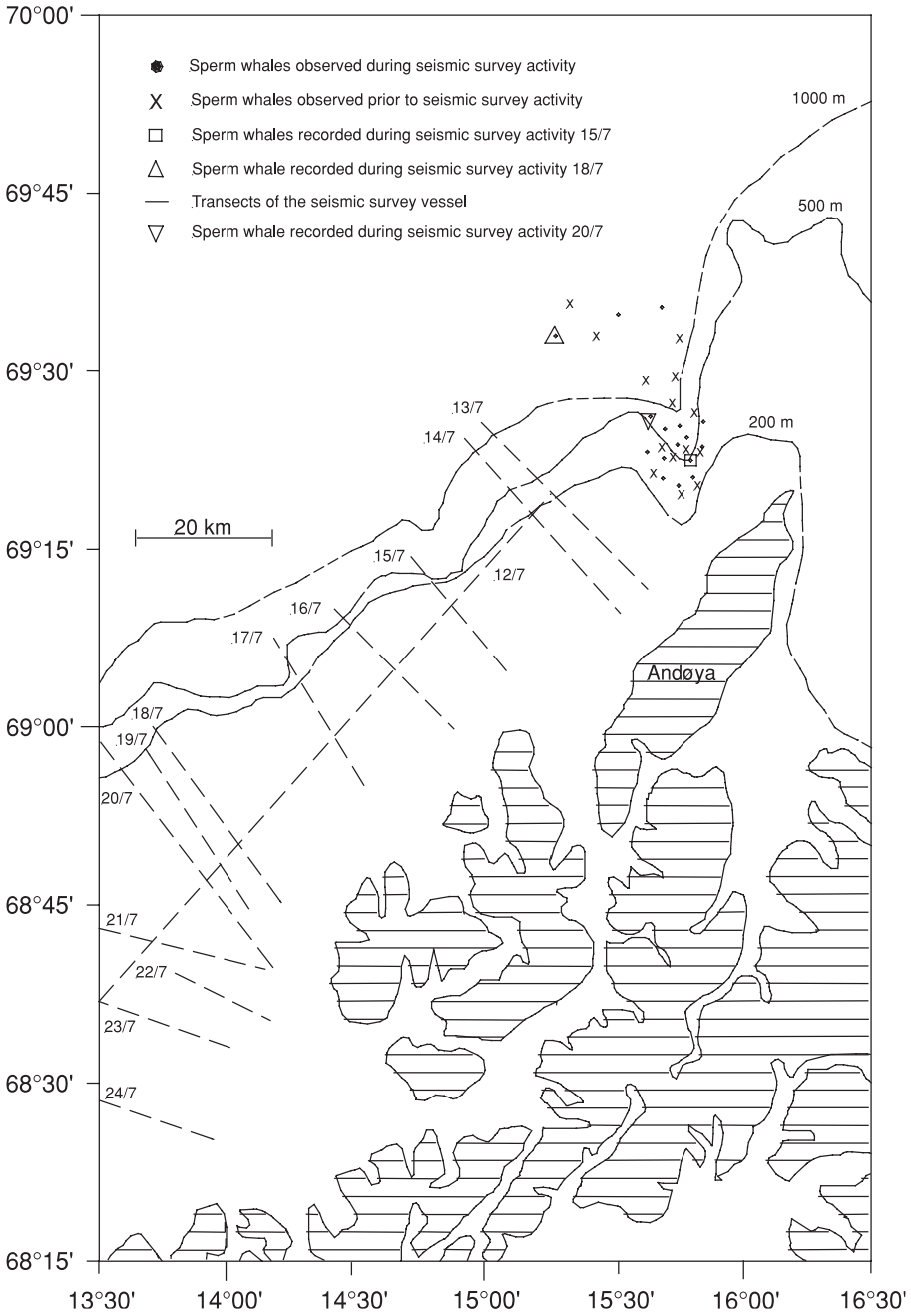

Figure 1. Map of sperm whale observations and transect lines of the seismic survey vessel. Abscissa—numbers denote eastern longitude and ordinate -numbers denote northern latitude. Numbers associated with transect lines denote date. Whale Safari boats and/or research vessels were looking for whales during the entire period (6 to 25 July) and whales were observed on all dates except on the 17 July. The five sperm whale observations in the outermost part of the canyon were all concomitant with observations of pilot whales or killer whales in the inner part of the canyon.

Table 1. Properties of received seismic pulses. Energy integration time 200 ms, rms SL calculated from − 3 dB interval of the envelope function. S/N calculated from energy integration of the signal and a segment of background noise of equal length.

Date	Receiver depth [m]	Transmission range [km]	Duration − 3dB/ − 10dB [msec]	Received sound pressure [dB//1μPa, rms]	Received sound pressure [dB//1μPa, p-p]	Received energy [dB//μPa^{2}s]	S/N energy [dB]
15 July 2000	5	40	124/1480	123	138	116	11
18 July 2000	5	86	40/1420	130	141	120	15
18 July 2000	30	86	200/1400	130	146	124	24

All platforms were equipped with a dGPS-receiver, writing UTC (Universal Time Code) and absolute position every second to the other channel of the DAT recorder. For further information on this system, see Møhl *et al.* (2001). Data were tranferred from DAT-tapes to PC with a Zefiro card. Analysis was performed with commercially available software (Cool Edit, Syntrillium). The whales were localized from time of arrival differences of the same click at the dGPS positioned receiver platforms, using custom software (A. Heerford & M. Wahlberg) and algorithms as outlined in Wahlberg *et al.* (2001). Energy and duration calculations were made with Matlab 5.3 (MathWorks). The spectral content of the sleeve air gun pulses was described by the end points of the − 10 dB bandwidth. The duration of a received sleeve air gun pulse was defined as the interval restricted by the − 3 or − 10 dB points relative to the peak of envelope function. Energy was derived by integrating the square of the pressure over 200 ms (see discussion) around the maximum value of the envelope function.

Results

Positions of sperm whales, observed from Whale Safari boats and research vessels during the period from 8 to 25 July, are plotted in Figure 1, along with the transect-lines of the seismic survey initiated on 12 July. Sperm whales were observed from the Whale Safari boats in the canyon area both prior to (x) and during (o) the exposure (Fig. 1). The whales were observed in the area during 13 exposure days. Positions of sperm whales, observed from the Whale Safari boats from 25 July and onwards, were not available, but whales were seen throughout August (G. Maan, pers. comm.) and thereby more than a month after the last exposure.

On 15 July, the survey vessel was operating on a transect 22 nmi (40 km) SW of the canyon area (Fig. 1). The pulses received in the study area had been propagating some 30 km in rather shallow water before entering the canyon. The maximum values for the pulses received in the study area are listed in Table 1. Due to lack of reporting standard in the literature, sound pressure is given in both rms (− 3 dB interval as integration time) and peak-peak measures. The energy content of the seismic pulses was derived, beacuse it is a more robust measure of the sound level than p-p sound pressure for reverberant pulses.

The received levels across pulses varied in time within 10 dB for pressure units and 6 dB for energy units. The duration was also highly variable (Table 1). These durations are conservative numbers as the reverberation of the pulses were detectable above ambient noise for more than two seconds (Fig. 2a). The received pulses were frequency-modulated, sweeping from 100–500 Hz to 100–300 Hz. The spectral content (− 10 dB) ranged from 110 to 260 Hz (Fig. 2b).

Due to bad weather, the recording session on 15 July was terminated after 55 min. Both sperm whale clicks and air gun pulses were detectable throughout the recording. The sea conditions precluded visual observations of surface behaviour. During the recording session, three different sperm whales (distinguished via time of arrival differences at the various hydrophones of the array) were phonating within 2 km of the hydrophone array. The acoustic behaviour of the sperm whales consisted of patterns of usual clicks and creaks during the exposure (Fig. 3).

The next recording session, lasting 2.5 h, commenced on 18 July at 19.21 UTC in the outermost part of the canyon in the presence of a single sperm whale. No other sperm whales were observed in the canyon area on that day either by the research vessels or by the two Whale Safari boats. However, in the innermost part of the canyon, a pod of long-finned pilot whales was observed. The seismic survey ship started a transect at UTC 19.54, 47 nmi (86 km) SW of the study area. The recordings on this day were performed with hydrophones lowered to depths of 5 and 30 m. The levels recorded on the 5 m hydrophone were about 5 dB lower for energy and peak-peak sound pressure, than for the same

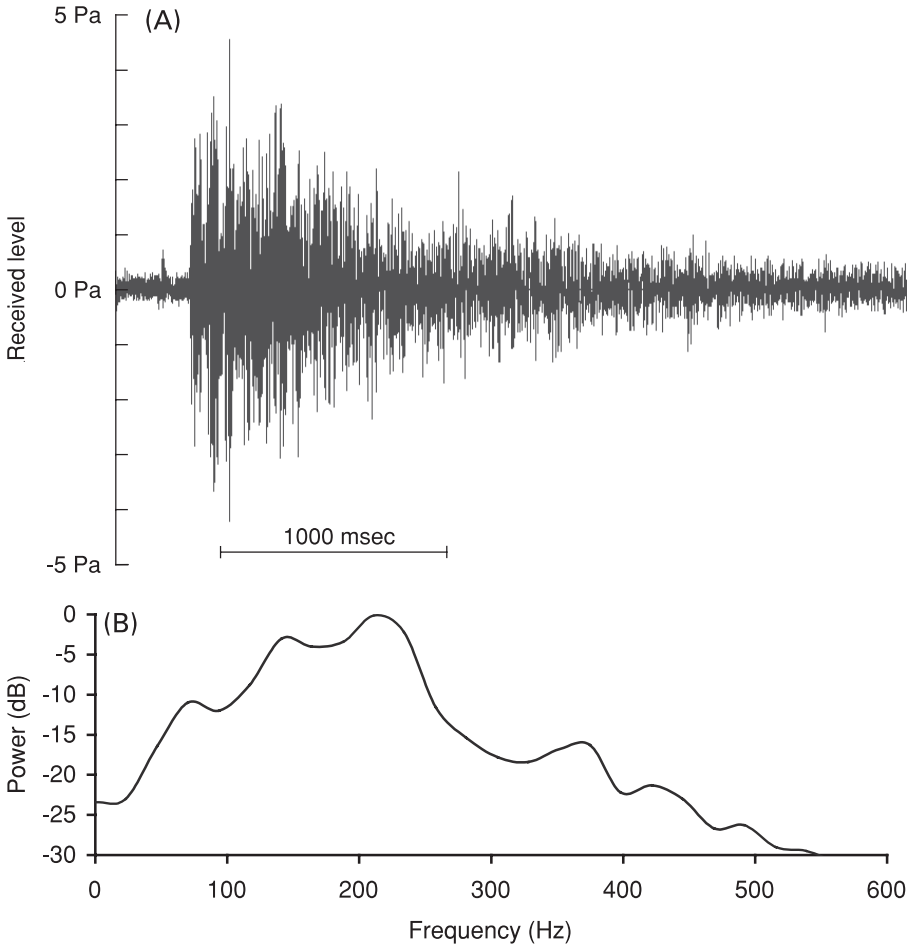

Figure 2. (A) Waveform of a sleeve air gun pulse. (B) Power-spectrum of the pulse from Figure 2A. FFT-size = 2048.

pulse recorded on a 30 m hydrophone (Table 1). During the start-up of the sleeve air gun, the whale continued clicking. In addition, the mean click rate 10 s before and after the first air gun pulse was not significantly different (*t*-test, $P = 0.53$). The sounds from this specimen also consisted of patterns of usual clicks and creaks. The final recording session, lasting 2 h, was carried-out on 20 July at 20.10 UTC in the presence of three phonating sperm whales. The recording setup was similar to the one deployed on 18 July and the distance between the recording area and the survey ship was 51 nmi (94 km). The seismic pulses received showed generally the same properties as derived from recordings on 18 July and they are accordingly not tabulated. All three whales performed a normal acoustic behaviour of usual clicks and creaks.

On 22 July, a single hydrophone and a pinger were deployed in the presence of soniferous sperm whales at unknown range. Artificial codas (3+1) were generated every 5 to 10 s during a 15 min period in an attempt to mimic coda signatures (Watkins & Schevill, 1977). After two min of artificial coda emissions, the hydrophone, placed within 5 m of the pinger, was illuminated for 10 s by the sound beam (Møhl *et al*., 2000) of one of the sperm whales with received click levels of at least 170 dB re 1 µPa (p-p). Five min later, another specimen illuminated the hydrophone-pinger assembly for 5 s with received click levels of at least 180 dB re 1 µPa (p-p).

Discussion

Seismic pulses

Data presented in this study are opportunistic in the sense that the array was deployed to gain information on properties of sperm whale clicks and diving

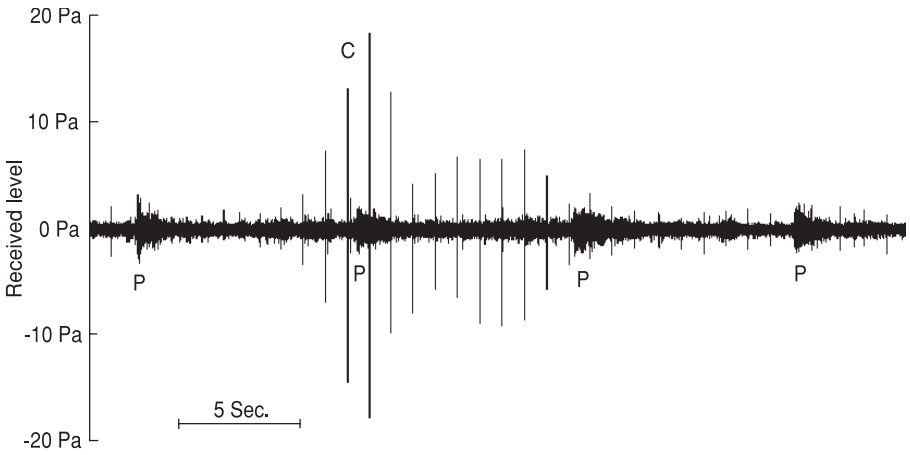

Figure 3 Waveform of sperm whale clicks and air gun pulses. P denotes seismic pulses. C denotes clicks.

behaviour. Only three of the recording sessions happened to coincide with the presence of the operating seismic survey vessel. The interpretation of the acoustic data should therefore be evaluated in the light of limited sampling.

The properties of the pulses received at the location of the whales are different from the output signal from the sleeve air guns. The duration has increased by a factor of 40, and the signal had a frequency emphasis at 200 Hz (Fig. 2b) compared to the 50 Hz peak of the signal at the source. These changes are the effects of multi-path propagation in shallow and subsequently deep water before the pulses reach the hydrophones and the whales in the canyon. When the signal is reflected from bottom and surface in shallow water, the received pulse will be the sum of several pulses with different transmission path lengths and therefore, different arrival times at the receiver, causing a smeared-out waveform with a -10 dB duration of up to 1400 ms (Table 1). This observation is consistent with the results from Greene & Richardson (1988) and Bowles *et al*. (1994). Multipath propagation leads to interference among pulses with different transmission paths, which could cause at least part of the rippled spectrum seen in Figure 2b.

The shift in spectral content (-10 dB) from 10–80 Hz in the output signal to 110–260 Hz in the received pulse (Fig. 2b) is characteristic of shallow water propagation by which the signal is high pass filtered (Richardson *et al*., 1995). The 5-dB difference in received level (dB re 1 μPa (p-p)) between a hydrophone lowered to 5 m and a hydrophone at a depth of 30 m is consistent with observations by Greene & Richardson (1988), and can probably in part be explained by the Lloyd Mirror Effect (Urick, 1983). It is therefore expected that submerged whales are subjected to similar or higher sound pressures than what is recorded by the 30 m hydrophones.

Pressure units as dB re 1 μPa (peRMS, pp, p or rms) for characterizing the magnitude of an acoustic signal is merely a description of the instantaneous intensity. This is not a good measure for the level received by a mammalian ear, considering that this receiver is modeled as an energy detector, integrating intensity over time (Green, 1985). Since the integration time of the sperm whale ear is unknown, the value of a standard mammalian ear of 200 ms (Green, 1985) was used in sound energy derivations. This 200 ms integration time should not be confused with the integration time of 264 μs found in double-click experiments with *Tursiops* (Au, 1993). For a discussion of this topic, see Green (1985) and Tougaard (1998).

During all three recording sessions, the range between the source (the survey vessel) and the receivers (hydrophones and whales) was fairly constant. Nevertheless, within 1 h of recording, the received level varied some 10 and 5 dB, for sound pressure and energy, respectively. Transmission loss can ideally be estimated from a constant * log (range) (Urick, 1983), but variations observed in received levels during a recording session cannot be explained by range variations. Neither do the variations reflect variable outputs from the sleeve air gun array. The variations are presumably the result of minor changes in aspect and distance to the seismic survey vessel and changes in the submarine topography profile, bottom composition and sound velocity profile between the source and the receivers. This acts to change the interference patterns of the multi-paths, and thereby produce fluctuations in the amplitude of the received signals (Urick, 1983).

Accordingly, the measured levels at 30 m depth are the best available estimate of the level received at the whales. True received levels can only be provided by deployment of a calibrated sound recording tag on the target animal (Fletcher *et al*., 1996; Burgess *et al*., 1998; Malakoff, 2001). The influence of the submarine topography and water depth also is illustrated by the fact that the seismic pulses recorded on 15 July propagating some 40 km in shallow water, had a lower received level than the seismic pulses recorded on the 18 and 20 July, propagating mostly in deeper water for 86 km and 94 km, respectively (Fig. 1 and Table 1).

When trying to evaluate the potential impact of seismic pulses on sperm whales from the four zones of influence outlined by Richardson *et al*. (1995), it is worthwhile to consider the potential low frequency hearing capabilities of this species. Baleen whales are, based on their sounds (Au, 2000) and the anatomy of the ear (Fleischer, 1976), believed to be low frequency specialists with best hearing sensitivity below 3 kHz (Ketten, 2000). Smaller odontocetes are most sensitive in the 30 kHz -120 kHz range (Au, 1993) and rather insensitive to low frequency sounds (Au *et al*., 1997). It is accordingly assumed that baleen whales, in general, are more susceptible to low frequency anthropogenic sounds than are odontocetes (Ketten, 2000). However, the sperm whale is not a normal odontocete in any respect, and its hearing abilities are unlikely to resemble those of smaller odontocetes. Ridgway & Carder (2001) provided the only existing information on sperm whale hearing. From ABR experiments on a neonate sperm whale, they found best hearing sensitivity between 5 kHz and 20 kHz with a better sensitivity at 40 kHz than at 2.5 kHz. This frequency range matches the spectral content (− 10 dB) of an on-axis click from an adult male sperm whale (Madsen & Møhl, 2000). Assuming that sperm whales possess the u-shaped hearing curve characteristic of all mammals investigated, it seems reasonable to believe that sperm whales have a lower best hearing range than most other odontocete species, but not as low as baleen whales.

Based on these assumptions, it is predicted that the sperm whales would have detected the seismic pulses with received levels between 136–146 dB re 1 μPa (p-p). Since the spectral content (− 10 dB) of the seismic pulses was in the frequency range of 110 Hz–260 Hz, it is unlikely that these pulses, being more than a decade lower in frequency, interfere strongly with the reception of echoes from sperm whale clicks in terms of masking. The pulses could interfere with low frequency sounds originating from prey-items and surroundings, potentially used by the sperm whales for passive sonar and navigation. However, the discontinuous nature of the seismic pulses presumably would have a strong ameliorative effect on any masking that might occur.

Sperm whales were sighted from the research vessels and Whale Safari boats every day (except on 17 July) throughout the entire exposure period of 13 days (Fig. 1), demonstrating that the received levels from the seismic survey vessel did not elicit general avoidance or displacement of the sperm whales in the canyon. On 18 July, only one sperm whale was found in the outermost part of the canyon. This apparent displacement was presumably not linked with the seismic pulses as it coincided with the presence of a large pod of long-finned pilot whales in the innermost part of the canyon. Pilot whales have been reported to harass sperm whales (Weller *et al*., 1996), and their presence in the canyon area seems to be negatively correlated with the presence of sperm whales (Fig. 1, and G. Maan, pers. com). On 18 July, it is therefore possible that the sperm whales moved from the canyon to avoid the pilot whales.

The rather limited body of recordings from seven specimens shows that sperm whales in this habitat do not cease clicking, nor do they seem to alter their normal acoustic behaviour during feeding as a response to the seismic pulses (Fig. 3). During start-up of the seismic survey on 18 July, the first pulse did not evoke any abrupt changes in click rate as the mean click rate 10 s before and after the first pulse was not significantly different.

These observations are not consistent with two previous studies by Mate *et al*. (1994) in the Gulf of Mexico, where sperm whales reportedly moved more than 50 km away as a response to seismic survey pulses, and by Bowles *et al*. (1994) where male sperm whales reportedly ceased clicking as a response to weak seismic survey pulses (received level of 115 dB re 1 μPa). Mate *et al*. (1994) provided no estimates of the received levels at the whales and the difference from the results of the present study may simply be due to higher received levels in the Mate *et al*. study. Another plausible explanation for the discrepancy may relate to differences in sperm whale stock structure in the two habitats. Females and calves in social groups in tropical waters could be more susceptible to anthropogenic noise than solitary males engaged in feeding. This has been indicated to be the case for humpback whales, where males show less avoidance than females and calves when exposed to air gun pulses (McCauley *et al*., 1998). The observation by Bowles *et al*. (1994) that male sperm whale may have ceased clicking as a response to low level (received level of 112–115 dB re 1 μPa) pulses from a seismic survey vessel more than 300 km away also differs from our results. Sperm whales stop clicking during ascents from feeding dives and during short

and long periods of rest at the surface (pers. obs.). Even when they do produce clicks, the received levels may vary some 35 dB within seconds due the directional properties of the sound beam (Møhl *et al*., 2000). Moreover, sperm whales can alter the acoustic output by at least 20 dB (Madsen *et al*., 2002), which together with the directional effects can make it difficult to tell if a particular whale stopped clicking.

If the male sperm whales in the Bowles *et al*. study indeed stopped clicking as a response to seismic pulses with received levels of 115 dB re 1 μPa, it may be explained by differences in responsiveness of different groups of male sperm whales, depending on their prior exposures to anthropogenic noise.

The limited body of data in this study is consistent with reports by Stone (1998, 2000) and weighted to the view that foraging male sperm whales are not more susceptible to remote air gun pulses than other cetaceans investigated.

Artificial codas

The acoustic repertoire of sperm whales often includes stereotyped patterns of 3–20 clicks, termed codas, which are believed to serve a communicative purpose (Watkins & Schevill, 1977) in maintaining social cohesion (Weilgart & Whitehead, 1993). When coda-like signals are emitted near sperm whales, they often respond by click cessation and in some cases avoidance. The observed behavioural changes may reflect the response to a strange sound pattern rather than coda-recognition (André *et al*., 1997; Gordon, 1987; Watkins & Schevill, 1975; Watkins *et al*., 1985).

Since sperm whales generally react to coda-like signals, this signal type was used in the present study as a possible response reference to the potential effects of the seismic pulses. These pinger experiments were only performed on one occasion with only one hydrophone deployed, precluding derivation of the range to the whales. Accordingly, no estimates of levels received of the artificial codas at the whales can be given, but assuming the range between the pinger and the whales was more than 10 m, the levels at the whales would be equal to or lower than the maximum levels received of the seismic pulses. Two clicking sperm whales were exposed to artificial codas. None of them ceased clicking as the pinger was excited, but after two min of artificial coda emission, one of the sperm whales illuminated the hydrophone with its sonar beam and so did the other five min later. Recorded levels of sperm whale clicks are highly variable (Møhl *et al*., 2000). Normally, only a few powerful clicks are recorded as the beam sweeps by, as seen from Figure 3. However, during coda exposure, the sperm whale illuminated the hydrophone-pinger assembly twice with several powerful, usual clicks, indicating sonic investigation.

It cannot be excluded that the whales responded to a strange sound pattern, rather than to something perceived as codas. Given the two sperm whales in the present study were aroused by the artificial codas, the response is very different from the reactions reported from females and calves in the tropics. The whales did not stop clicking, but seemed to direct their sonar beam towards the coda source. This contrasting mode of response may be explained by the lack of apparent social cohesion among the solitary males off Andenes. During analysis of more than 100 h of recordings from the summers of 1997, 1998 and 2000 off Andenes, no click patterns resembling codas were identified.

That the sperm whales in the present study apparently reacted to coda-like signals and did not seem to respond to seismic pulses with levels received equal to or higher than the coda-like signals, advocate that assessment of potential impacts of anthropogenic noise cannot solely be based on received sound pressure levels. The characteristics of the possible deleterious sounds in terms of frequency content, duration and temporal pattern as well as habitat, sex, and size of the individuals exposed should also be evaluated.

In conclusion, the sleeve air gun pulses with received levels up to 146 dB re 1 μPa (p-p) did not elicit any apparent avoidance behaviour of the male, adult sperm whales off Andenes, nor did the pulses evoke changes in the acoustic behaviour during foraging. It is estimated that the pulses were well within the zone of audibility of the sperm whales, but that the pulses did not have masking effects in the frequency band of sperm whale clicks. The limited body of data in this study is consistent with reports by Stone (1998, 2000) and weighted to the view that foraging male sperm whales are not more sensitive to remote air gun pulses than are other cetaceans investigated. Present data should not be extrapolated to the possible effects of seismic pulses with higher received levels and different sperm whale stock compositions in different habitats.

At present, the small body of data on this issue is contradictory, and mitigations of seismic surveys in the presence of sperm whales must await data from controlled exposures and, optimally, deployment of sound recording tags on different animals in different habitats. Artificial codas did not make the whales cease clicking but may have caused two sperm whales to direct their high power, narrow-beam sonar towards the source.

Acknowledgments

K. Aubert, TGS-Nopec Geophysical Company ASA, provided the seismic survey data and his

comments on the manuscript are appreciated. We thank the crews of the research vessels that took part in the Andenes 2000 Sperm Whale Expedition. Andenes Whale Safari provided shore-based facilities and support. The help from M. F. Christoffersen, T. Similä, M. Simon, A. Svensson, and F. Ugarte during pinger experiments is acknowledged. We thank Glenn Mann, Geir Mann and T. Sletten, Andenes Whale Safari, for sharing information on whale observations from the Whale Safari boats. A. Heerford developed the software and N. U. Kristiansen assembled the electronics. We thank Dr W. John Richardson, B. Dahl, Dr G. Hampson, Dr M. André, an anonymous reviewer and Dr J. Thomas for comments on the manuscript. This work was funded by the National Danish Science Foundation through the Center for Sound Communication, USD.

Literature Cited

André, M., Terada, M. & Watanabe, Y. (1997) Sperm whales (*Physeter macrocephalus*) behavioral response after playback of artificial sounds. *Report of The International Whaling Commission* **47,** 499–504.

Au, W. W. L., Nachtigall, P. E. & Pawloski, J. L. (1997) Acoustic effects of the ATOC signal (75 Hz, 195 dB) on dolphins and whales. *Journal of the Acoustical Society of America.* **101,** 2973–2977.

Au, W. W. L. (1993) *The Sonar of Dolphins*. Springer Verlag, N.Y.

Au, W. W. L. (2000) Hearing in Whales and Dolphins – an overview. In: W. W. L. Au, A. N. Popper and R. R Fay, (eds.) *Hearing in Whales and Dolphins*, pp. 1–42. Springer Verlag, NY.

Barger, J. E. & Hamblen, W. R. (1980) The air gun impulsive underwater transducer. *Journal of the Acoustical Society of America* **68,** 1038–1045.

Bowles, A. E., Smultea, M., Würsig, B., DeMaster, D. P. & Palka, D. (1994) Relative abundance and behavior of marine mammals exposed to transmissions from the Heard Island Feasibility Test. *Journal of the Acoustical Society of America* **96,** 2469–2484.

Burgess, W. C., Tyack, P. L., Le Boeuf, B. J. & Costa, D. P. (1998) A programmable acoustic recording tag and first results from free-ranging northern elephant seals. *Deep-Sea Research* II **45,** 1327–1351.

Caldwell, J., & Dragoset, W. (2000) A brief overview of seismic air gun arrays. *The Leading Edge* **19,** 898–902.

Ciano, J. N. & Huerle, R. (2001) Photo-identification of sperm whales at the Bleik Canyon, Norway. *Marine Mammal Science* **17,** 175–180.

Fleischer, G. (1976) Hearing in extinct cetaceans as determined by cochlear structure. *Journal of Palaeontology* **50,** 133–152.

Fletcher, S., Le Boeuf, B. J., Costa, D. P., Tyack, P. L. & Blackwell, S. B. (1996) Onboard acoustic recording from diving northern elephant seals. *Journal of the Acoustical Society of America* **100,** 2531–2539.

Frantzis, A. (1998) Does acoustic testing strand whales? *Nature* **392,** 29.

Goold, J. (1996) Acoustic assessment of populations of common dolphin *Delphinus delphis* in conjunction with seismic surveying. *Journal of the Marine Biological Association U.K.* **76,** 811–820.

Gordon, J. (1987) Behavior and ecology of sperm whales off Sri Lanka. PhD. thesis. Dept. of Zoology, University of Cambridge, Cambridge, UK.

Green, D. M. (1985) Temporal factors in Psychoacoustics. In: A. Michelsen, (ed). *Time Resolution in Auditory Systems*, pp. 120–140. Springer Verlag, NY.

Greene, C. R. & Richardson, W. J. (1988) Characteristics of marine seismic survey sounds in the Beaufort Sea. *Journal of the Acoustical Society of America* **83,** 2246–2254.

Ketten, D. R. (2000) Cetacean ears. In: W. W. L. Au, A. N. Popper & R. R. Fay (eds.) *Hearing in Whales and Dolphins*, pp. 43–108. Springer Verlag NY.

Ljungblad, D. K., Würsig, B., Swartz, S. L. and Keene, J. M. (1988) Observations on the Behavioral Responses of Bowhead Whales (*Baleana mysticetus*) to Active Geophysical Vessels in the Alaskan Beaufort Sea. *Arctic* **41,** 183–194.

Madsen, P. T. & Møhl, B. (2000) Sperm whales (*Physeter catodon L.* 1758) do not react to sounds from detonators. *Journal of the Acoustical Society of America* **107,** 668–671.

Madsen, P. T., Payne, R., Kristiansen, N. U., Wahlberg, M., Kerr, I., & Møhl, B. (2002) Sperm whale sound production studied with ultrasound-time-depth-recording tags, *J. Exp. Biol.* **205,** 1899–1906.

Malakoff, D. (2001) A roaring debate over Ocean Noise. *Science* **291,** 576–578.

Malme, C. I. & Miles, P. R. (1985) Behavioral responses of marine mammals (gray whales) to seismic discharges. In: G. D. Greene, F. R. Engelhardt & R. J. Paterson (eds.) Proc. Workshop on effects of explosives use in the marine environment, pp. 253–280. Jan 1985. Tech. Rep. 5. Can. Oil & Gas Lands Adm., Inviron. Prot. Br. 398 pp.

Mate, B. R., Stafford, K. M. & Ljungblad, D. K. (1994) A change in sperm whale (*Physeter macrocephalus*) distribution correlated to seismic surveys in the Gulf of Mexico. *Journal of the Acoustical Society of America* **96** pt. 2, 3268–3269.

McCauley, R. D., Fewtrell, J., Duncan, A. J., Jenner, C., Jenner, M. N., Penrose, J. D., Prince, R. I. T., Adhitya, A., Murdoch, J. & McCabe, K. (2000) Marine seismic surveys—A study of environmental implications. *APPEA Journal,* 692–708.

McCauley, R. D., Jenner, M. N., Jenner, C., McCabe, K. A. & Murdoch, J. (1998) The response of humpback whales (*Megaptera novaeangilae*) to offshore seismic survey noise: preliminary results of observations about a working seismic vessel and experimental exposures. *APPEA Journal* **38,** 692–707.

Miller, P. J. O, Biassoni, N., Samuels, A. & Tyack, P. (2000) Whale songs lengthen in response to sonar. *Nature* **405,** 903.

Møhl, B., Wahlberg, M. & Heerfordt, A. (2001) A large aperture array of nonlinked receivers for acoustic positioning of biological sound sources. *Journal of the Acoustical Society of America* **109**(1), 434–437.

Møhl, B., Wahlberg, M., Madsen, P. T., Miller, L. A. & Surlykke, A. (2000) Sperm whale clicks: Directionality and source level revisited. *Journal of the Acoustical Society of America* **107,** 638–648.

Payne, R. & Webb, D. (1971) Orientation by means of long range acoustic signaling in baleen whales. *Annual N.Y. Academy Sciences* **188,** 110–141.

Popper, A. N., Deferrari, H. A., Dolphin, W. F., Edds-Walton, P. L., Greeve, G. M., McFadden, D., Rhines, P. B., Ridgway, S. H., Seyfarth, R. M., Smith, S. L. & Tyack, P. L. (2000) *Marine Mammals and Low-frequency sound—Progress since 1994.* National Academy Press. Washington D.C.

Rankin, S. & Evans, W. E. (1998) Effect of low-frequency seismic exploration signals on the cetaceans of the Gulf of Mexico. *Journal of the Acoustical Society of America* **103** pt. 2, 2908.

Reeves, R. R., Ljungblad, D. K. & Clarke, J. T. (1984) Bowhead whales and acoustic seismic surveys in the Beaufort Sea. *Journal of the Acoustical Society of America* **62,** 271–280.

Richardson, W. J., Würsig, B. & Greene, C. R. (1986) Reactions of Bowhead whales, *Balaena mysticetus*, to seismic exploration in the Canadian Beaufort Sea. *Journal of the Acoustical Society of America* **79,** 1117–1128.

Richardson, W. J., Greene, C. R., Malme, C. I. & Thompson, D. H. (1995) *Marine Mammals and Noise*. Academic Press. San Diego CA.

Richardson, W. J., Miller, G. W. & Greene, C. R. (1999) Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea. *Journal of the Acoustical Society of America* **106,** 2281.

Ridgway, S. H. & Carder, D. (2001) Assessing hearing and sound production in cetacean species not available for behavioral audiograms: experience with *Physeter, Kogia*, and *Eschrichtius. Aquatic Mammals* **27,** 267–276.

Stone, C. J. (1998) Cetacean observations during seismic surveys in 1997. *JNCC Rep.* **278.** Joint Nature Conserv. Commit., Aberdeen, Scotland. 55 p.+Appendices.

Stone, C. J. (2000) Cetacean observations during seismic surveys in 1998. *JNCC Rep.* **301.** Joint Nature Conserv. Commit., Aberdeen, Scotland. 62 p.+Appendices.

Tougaard, J. (1998) Detection of short pure-tone stimuli in the noctuid ear: what are temporal integration and integration time all about? *Journal of Comparative Physiology A.* **183,** 563–572.

Urick, R. J. (1983) *Principles of Underwater Sound.* 3rd edn. McGraw-Hill. New York.

Wahlberg, M., Møhl, B. & Madsen, P. T. (2001) Estimating source position accuracy of a large aperture hydrophone array for bioacoustics. *Journal of the Acoustical Society of America* **109,** 397–406.

Watkins, W. A. & Schevill, W. E. (1975) Sperm whales (*Physeter catodon*) react to pingers. *Deep-Sea Research* **22,** 123–129.

Watkins, W. A., Moore, K. E. & Tyack, P. (1985) Sperm whale acoustic behaviors in the southeast Caribbean. *Cetology* **49,** 1–15.

Watkins, W. A. & Schevill, W. E. (1977) Sperm whale codas. *Journal of the Acoustical Society of America* **62,** 1485–1490.

Weilgart, L. & Whitehead, H. (1993) Coda vocalizations in sperm whales off the Galapàgos Islands. *Canadian Journal of Zoology* **71,** 744–752.

Weller, D., Würsig, B., Whitehead, H., Norris, J. C., Lynn, J. K., Davis, R. W., Clauss, N. & Brown, P. (1996) Observations of an interaction between sperm whales and short-finned pilot whales in the Gulf of Mexico. *Marine Mammal Science* **12,** 588–593.

Blue and fin whales observed on a seafloor array in the Northeast Pacific

Mark A. McDonald, John A. Hildebrand, and Spahr C. Webb
Scripps Institution of Oceanography, University of California at San Diego, La Jolla, California 92093-0205

(Received 1 April 1994; accepted for publication 21 March 1995)

Calling blue and fin whales have been tracked using relative travel times and amplitudes from both direct and multipath arrivals to a seafloor array of seismometers. Calls of three fin whales swimming in the same general direction, but several kilometers apart, are believed to represent communication between the whales because of signature differences in call character, an alternating call pattern, and coordination of call and respiration times. Whale call tracks, call patterns, call character, and swimming speeds were examined during periods with and without the presence of noise. Noise sources included airguns, when the whales were subject to sound levels of up to 143 dB P-P (peak-to-peak) *re*: 1 μPa over the 10 to 60-Hz band, and transits of merchant ships, when the whales received continuous levels up to 106 dB rms *re*: 1 μPa over the 10 to 60-Hz band (115 dB P-P). Whale responses associated with these noises remain arguable. © *1995 Acoustical Society of America.*

PACS numbers: 43.80.Jz, 43.80.Ka, 43.80.Nd

INTRODUCTION

Many baleen whales produce loud low-frequency underwater sounds a significant percentage of the time, providing a practical tool with which to study whale distribution and movements (Watkins and Wartzok, 1985; Nishimura and Conlon, 1994; Clark, 1994). Studies of whales have used arrays of acoustic sensors to determine swimming speed and direction as well as to monitor call interaction between whales (Patterson and Hamilton, 1964; Cummings *et al.*, 1968; Watkins and Schevill, 1977; Cummings and Holliday, 1985). Temporal patterns in acoustic call sequences provide a measure of respiration times (Cummings *et al.*, 1986) while call characteristics may separate stocks or groups within the species (Winn *et al.*, 1981; Ford and Fisher, 1983). Further study of whale calls may allow them to be used to monitor behavioral changes associated with man-made noise sources.

The data used for this study were recorded with a seafloor seismometer array having an aperture of about 10 km, allowing measurement of directionality, apparent acoustic velocity, relative amplitude and absolute amplitude of signals. Whale calls were detected during approximately 10% of the eleven day recording period (a seismology experiment provided these whale recordings incidentally). Whale calls were most easily identified when observed in repetitive sequences, typically lasting for hours. With the 128-Hz sampling rate used in our seafloor recording system, only low-frequency sounds, such as those produced by blue and fin whales, were recorded. Whale calls were detectable at ranges up to 30 km during this study, although only calls within about 15 km of the array were analyzed because of the higher signal-to-noise ratio.

I. METHODS

A. Recording instruments

The study site is about 500 km offshore from Astoria, Oregon (Fig. 1), in 2400 m of water on the southern Juan de Fuca Ridge, about 60 km north of the Blanco Fault Zone. During August of 1990, eight seafloor seismometer recording packages were deployed with 4 to 6 km between adjacent instruments. Data were recorded internally on optical disks and examined after instrument retrieval. There were two instrument deployments during the study, each for about 5.5 days. The location of the instruments on the seafloor was known to within a few tens of meters and instrument clock drifts were known to within about 10 ms, as discussed in McDonald *et al.* (1994). Imprecision in the instrument timing and navigation is negligible relative to the errors in call locations resulting from picking errors in the arrival times of the whale calls. The call arrival time picking errors limit call position accuracy to several hundred meters theoretically and to some lesser accuracy, on the order of 1 km, as practiced in these analyses. The number of instruments used in plotting the call tracks varied, but was never less than four.

The primary sensor used for recording the signals under discussion was the vertical component of a 3-axis seismometer (Mark Products L-4, 1-Hz natural period). The response for this sensor is nearly flat to particle velocity from 1 to over 100 Hz. The electronics system response was low pass filtered at 60 Hz because of the 128-Hz sampling rate used. Background ambient ocean noise levels are higher at low frequency, so the system gain was 20 dB lower at 1 Hz relative to 10 Hz. The spectrograms and amplitude plots shown in this paper are not corrected for system roll-off below 10 Hz and above 60 Hz. Signal amplitudes were converted to dB *re*: 1 μPa using correlations between the seismic sensor package and calibrated hydrophones (Benthos AQ-1), as performed during previous seafloor experiments in similar water depths where the hydrophones were attached to the seafloor recording package. No hydrophones were deployed during this study. Experiments using both vertical seismometers and hydrophones have shown a higher signal-to-noise ratio for whale calls on seismometers than on hydrophones. We suggest this is partially due to the direction-

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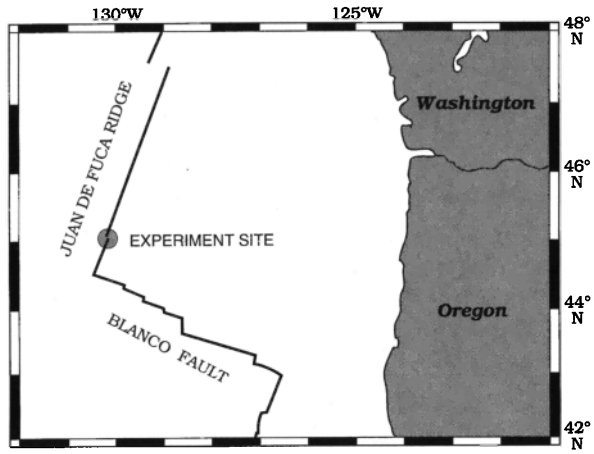

FIG. 1. The observation site was located on the Juan de Fuca Ridge about 500 km offshore Oregon in 2400 m of water.

ality of the vertical component seismometer and the high incidence angles associated with the whale signals.

B. Signal localization methods

Different methods are used to locate short transient sound sources (fin whale calls), long transient sources (blue whale calls) and earthquakes. The short (one second) transient sounds were most easily located, because multipath arrivals are separated in time from the direct arrival and from each other. Figure 2(a) shows an example of the received signal from a one second transient sound (fin whale call) on four array elements. Figure 2(b) shows the corresponding raypaths for each arrival. Since most whale calls occurred outside of the array, the relative travel time information allows computation of the azimuth to the source. Relative amplitudes of the several multipath arrivals allow range estimation from each instrument. The amplitude of the direct arrival in Fig. 2(a) decreases steadily with range, while the first bounce path amplitude reaches a maximum at about 12 km and the second bounce path provides a relatively higher amplitude signal at longer ranges.

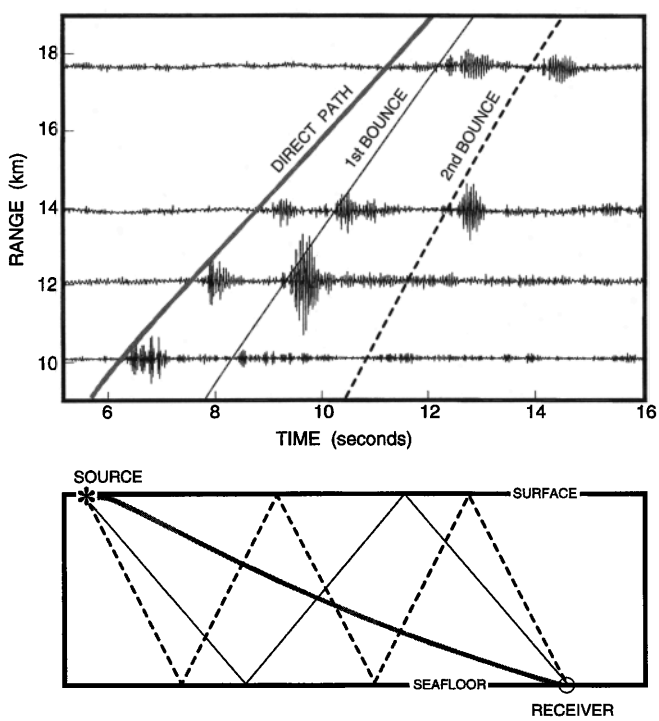

FIG. 2. (a) The amplitude display of a 1-s duration fin whale pulse received on each of four seafloor recorders at different ranges. The earliest arrivals are the direct water path and the later arrivals are bounce paths between the seafloor and sea surface. (b) A cross-section diagram illustrating the direct and bounce paths seen in (a).

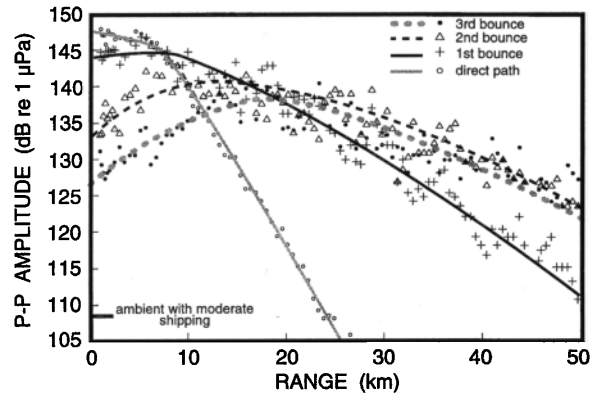

FIG. 3. The amplitude of an airgun source versus range for the direct water path and bounce paths as received on a seafloor recorder during this study.

Direct and multipath amplitude ratios are plotted versus range from airgun pulses during this study in Fig. 3. The airgun pulses are sufficiently similar to the whale calls under discussion to expect similar reflection coefficients and similar multipath amplitude variations as a function of range. Most of the energy in these airgun pulses is in a frequency band between 10 and 35 Hz and has a duration of several hundred milliseconds. The observed amplitude variation as a function of range can be explained in terms of the downward refraction of the direct path due to the water sound-speed profile and by the change in seafloor reflection coefficient as a function of incidence angle. We compared these airgun data to whale data to estimate the range of the whale from each instrument. Range information has been combined with relative arrival time information to determine best estimates for call locations. Each location is overdetermined by using range data from several instruments, resulting in better location estimates. Because the reflection coefficients are site dependent and the sound-speed profile is both site dependent and time variant it was important that the airgun amplitude data were gathered at the same site and at nearly the same time as the fin whale calls.

Transient signals having durations greater than several seconds (blue whale calls) have overlapping multipath arrivals making it more difficult to use multipath relative amplitudes for range estimation. When the source is within 10 km of the array or inside the array, relative arrival times locate the source adequately. At ranges beyond 10 km from the array, the bearing determination is quite accurate but the range determination, using only arrival time data, becomes poor. By calculating the average source level of well-located calls of a given type, the amplitude versus range relationship

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derived from the airgun data was used to estimate range. Earthquake ranges are readily determined using relative arrival times of the compressional and shear wave energy traveling in the rock (e.g., Mallick and Fraser, 1990) while their bearing is determined by relative arrival times on multiple instruments.

II. RESULTS

A. Recorded sounds

The observed signals can be described in three categories; seismic, biologic, and man-made. The most common signals are those in the seismic category, including those from seafloor hydrothermal flow (Sohn *et al.*, 1992), earthquake T-phases (Walker and Bernard, 1993) and earthquake body waves. In the biologic category are whale calls and the so called "fishbumps" (Buskirk *et al.*, 1981), which can sometimes be identified as biologic because they occur more frequently at certain times of day and certain water depths. Man-made signals observed were primarily those associated with ships. Less common signals in this type of data include tidal current flow noise (Duennebier *et al.*, 1981; Ambos *et al.*, 1985) and volcanic tremor (Talandier and Okal, 1984; Talandier and Okal, 1987).

We analyzed two sequences of repetitive, two part, approximately 20 Hz, whale calls from the eleven days of recordings. These two part calls consist of: A 19-s signal (type A) followed by a 24-s interval, a different 19-s signal (type B), followed by a 60-s interval before the first signal (type A) of the next pair occurs. These signals lasted for 10.5 h (August 18, 0030 to 1100 Local) and 5.2 h (August 19, 0640 to 1150 Local), consisting of about 375 and 180 calls, respectively. The 10.5-h sequence was in progress when data recording began and continued until the whale was beyond the detection range of the array. There were also other faint 19-s signals which were not analyzed because of low signal-to-noise ratio, but which have the same characteristics.

There were two sequences of 1-s duration whale calls near 20 Hz, repeating at an average interval of 19 s, except for pauses which typically last 150 s. These sequences lasted 2.2 h (August 21, 0410 to 0620 Local) and 8.0 h (August 28, 2010 Local to August 29, 0410 Local), consisting of about 1000 and 4000 calls, respectively. Only the 8.0-h sequence was analyzed because of the poor signal-to-noise ratio on the 2.2-h sequence. We also recorded signals from 65 regional and local earthquakes, several of which occurred during a whale call sequence.

III. CALLS ASSOCIATED WITH BLUE WHALES (*B. musculus*)

A. Spectra

The 19-s duration signals are recognized as blue whales because of a similarity to signals recorded in the presence of blue whales (Cummings and Thompson, 1971; Edds, 1982; Thompson *et al.*, 1987; Alling *et al.*, 1991; Alling and Payne, unpublished manuscript), and because of considerable unpublished navy research on these signals (Cummings and Thompson, 1994). Similar recordings are reported that lack

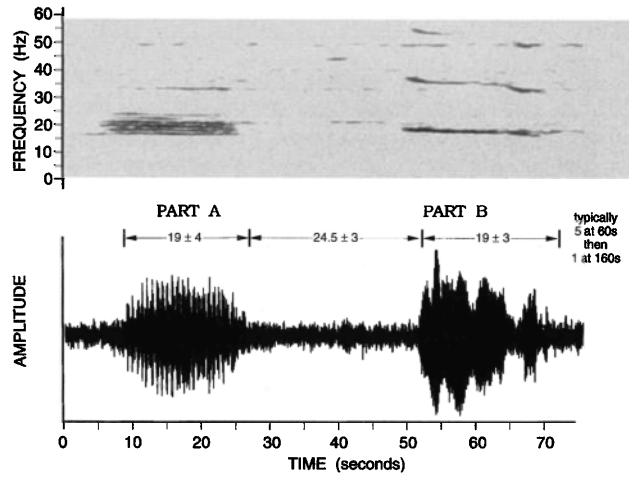

FIG. 4. The spectrogram and corresponding time series record of a typical blue whale call pair. The spectrogram was made using a filter bandwidth of 1.55 Hz and a time window of four seconds. The average duration and standard deviation for each portion of the call pair sequence is shown from one sequence of 132 call pairs. The call is divided into two portions, parts A and B.

visual corroboration (Weston and Black, 1965; Kibblewhite *et al.*, 1967; Northrup *et al.*, 1968; Northrup *et al.*, 1971; Thompson, 1965; Thompson *et al.*, 1979; Thompson and Friedl, 1982) and we understand that other recordings with visual corroboration remain unpublished as this correlation is well accepted in the whale acoustics field.

A typical two part blue whale call waveform and corresponding spectrogram are shown in Fig. 4. The first 19-s call segment (part A) shows a series of six spectral lines about 1.5 Hz apart with the lowest at 17.5 Hz. Spectral lines like this can be generated by a pulsed tone and have been referred to as pulsive (Watkins, 1964). A pulselike amplitude modulation is evident in the waveform display. Spectrograms computed for more than 100 call pairs from the August 18 sequence reveal remarkably little variability in character.

The second segment (part B) in the blue whale call pair is probably not amplitude modulated. The amplitude variability seen in the records appears to be the result of constructive and destructive interference of several reflected paths and the direct travel path as evidenced by differences in the time-versus-amplitude character of the same signal observed at different ranges. The fundamental tone in this call begins at 19 Hz and sweeps down in frequency to 18 Hz in the first 3 to 4 s (Fig. 4). The 18-Hz tone is then carried until the last 5 s where the dominant tone sweeps down to 17 Hz. Since the sampling rate was 128 Hz there may be segments or components of the call sequence above 60 Hz which were not recorded. Higher frequency segments and components have been reported by Cummings and Thompson (1971), Thompson *et al.* (1979), and Alling *et al.* (1991), although the whales recorded by Alling *et al.*, may be pygmy blue whales (*B. musculus brevicauda*).

B. Temporal pattern in calls

Only the August 18 blue whale call series was suitable for analysis in terms of the gaps between calls, since airgun shot noise made it difficult to pick the beginning and end of

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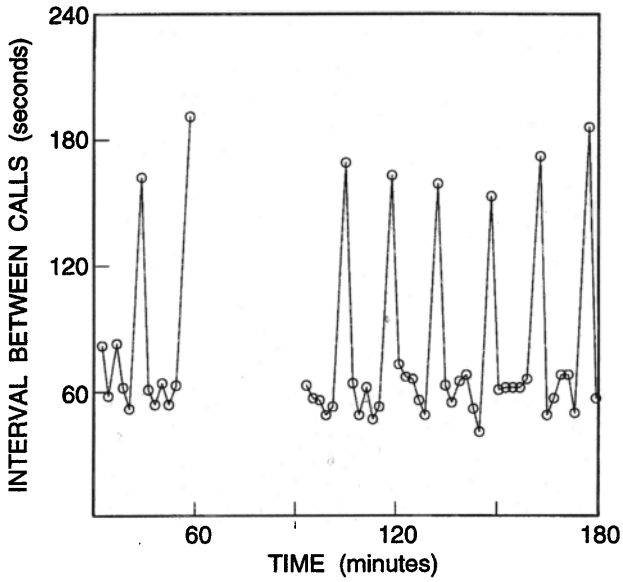

FIG. 5. The time interval between successive blue whale call pairs is typically 60 s but after about five calls there is a longer (160 s) interval, interpreted to be a breathing pause.

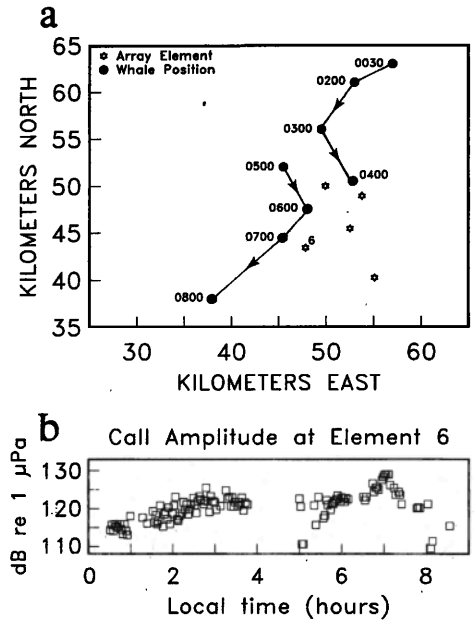

FIG. 6. (a) The track of a blue whale with local time shown adjacent to each of the points for which position was calculated. (b) The blue whale call amplitude changes with time. Each point plotted represents one blue whale call pair, so the gaps indicate breaks in the call sequence.

each call from the August 19 series. Spectrograms were computed and call start and stop times were picked for 134 consecutive pairs having a high signal-to-noise ratio. All but one of the 134 call pairs followed a stereotype pattern consisting of a 19-s pulsive signal followed by a 24.5-s gap and a 19-s monotonic signal. One unusual call was missing part B and the next call pair began 45 s later.

A plot of interval time between call pairs (Fig. 5) shows a longer time after every five or six calls, which may represent a respiration pattern. This would correspond to a typical dive time of 660 s and a breathing time of 160 s. Similar patterns in call intervals were reported by Thompson *et al.* (1987) where call pairs occurred in series of two to six with a median repetition interval (breathing time) of 131 s. Edds (1982), however, reports exceptions to the pattern of calling during dives and not calling during breathing and reports surface slicks during the call sequences demonstrating the whale to be at shallow depth during some calls.

C. Call tracking

Call locations were calculated [Fig. 6(a)] at regular time intervals for a portion of the August 18 series by fitting smoothed curves through the amplitude and relative arrival time data from four seafloor instruments. Changes in both bearing and received call amplitude [Fig. 6(b)] occur smoothly, suggesting relatively continuous movement of the whale during the call series. Each track could have been generated by either a single whale or a group of whales traveling together if separations were less than one km. This series contains no overlapping calls which would be indicative of a second whale at the same location. Other recordings (Thompson, 1965, in Urick, 1983, p. 219) have shown overlapping calls.

The speed of the whale(s) was 6 km/h averaged over the first track and 10 km/h averaged over the second, while the average speed per $\frac{1}{2}$-h interval ranged from 4.5 to 13 km/h. All speeds were computed between the points marked with times on the track plot of Fig. 6(a). The whale(s) may be swimming an irregular course between the computed points implying a higher speed. Reported observed speeds for blue whales are 2 to 6.5 km/h while feeding, 5 to 33 km/h while cruising or migrating and a maximum speed of 20 to 48 km/h when being chased or harassed (Yochem and Leatherwood, 1985).

IV. CALLS ASSOCIATED WITH FIN WHALES (*B. physalus*)

A. Correlation of 1-s signal with fin whales

The 1-s, frequency-downswept, pulses recorded during this study (Fig. 7) are known to be typical fin whale calls

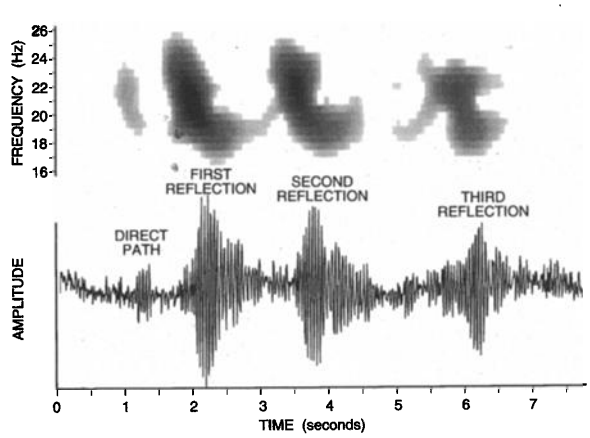

FIG. 7. Spectrogram and time series for a typical fin whale call, the first sound at 1.3 s is the direct water arrival and subsequent sounds are the multipath arrivals of the same signal. The spectrogram was made using a filter bandwidth of 6.19 Hz and a time window of 2 s.

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(Schevill *et al.*, 1964; Thompson *et al.*, 1979; Watkins *et al.*, 1987; Richardson *et al.*, 1991; Thompson *et al.*, 1992). Identification of acoustic signals from the fin whale is primarily from combined visual observations and recordings off the east coast of the U.S. where there is a seasonal pattern of signals common off Bermuda only in winter and common in the St. Lawrence estuary and off the New England coast only in summer (Edds, 1988; Watkins, 1981).

B. Temporal pattern in calls

We describe call series durations and rest intervals, associated with the respiration cycle of fin whales (Cummings *et al.*, 1986), using the terms: Pulse interval, rest, and gap, as defined by Watkins *et al.* (1987). The average pulse interval of the fin whales, excluding rests, is 19 s averaged over 467 calls from one continuous series, having no gaps (exceptionally long rests), during the 28–29 August series. This 19-s pulse interval is similar to prior observations (Watkins *et al.*, 1987). The rest durations, corresponding to breathing times and the pulse series durations corresponding to dive times, suggest typical dive times of 600 s and breathing times of 150 s, from this study. Pulse interval times of 900 and 720 s with corresponding breathing times of 150 and 120 s have been reported respectively by Patterson and Hamilton (1964) and by Watkins *et al.* (1987). These acoustically interpreted durations are longer than the 201 and 90 s average dive times and the 90 and 55 s average breathing times from visual observations, reported by Stone *et al.* (1992) and by Edds and MacFarlane (1987), although, other factors such as the activity of the whale and the water depth, make these comparisons difficult to interpret.

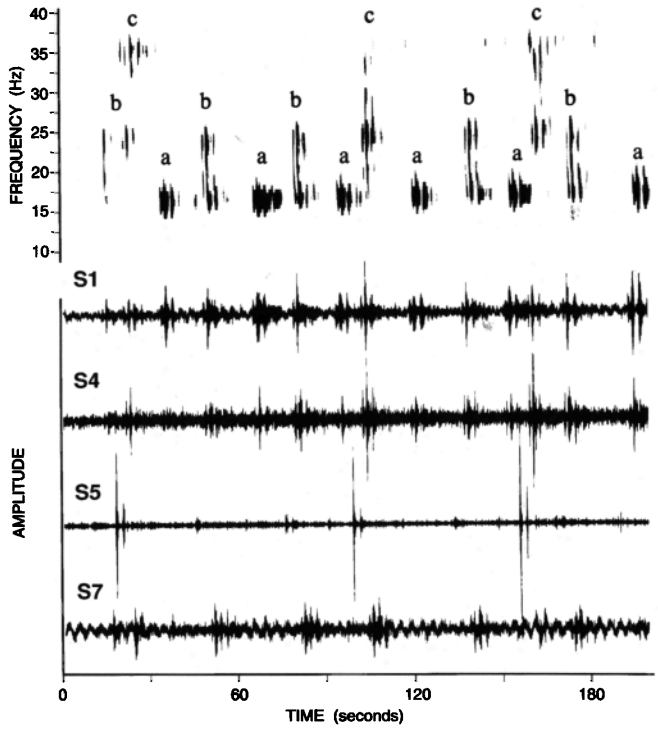

FIG. 8. Time series for elements S1, S4, S5, and S7, and spectrogram for element S1 from several minutes of a typical fin whale call series with multiple whales. The frequency and bandwidth differences make up the distinctive signatures associated with three whales labeled "a," "b," and "c." That the whales are interacting rather than just independently calling is suggested by the consistent alternate spacing between calls with nonoverlapping calls and a distinctive call signature for each whale. The time series records from the four seafloor instruments demonstrate the separation between the three whales with different instruments showing the highest amplitude for the nearest whale.

C. Call tracks and whale interaction

The 28–29 August series of fin whale calls indicates repeat interactions among three whales located several kilometers apart. Figure 8 shows the time series and corresponding spectrogram from several minutes of a typical fin whale call series with multiple whales. At this compressed time scale it is not possible to see the downsweep associated with each pulse, but the frequencies and bandwidth show the distinctive signature associated with each of three whales. Whale "a" in Fig. 8 has a signature consisting of a downsweep from 18 to 14 Hz, while whale "b" has a 25- to 16-Hz downsweep signature, and whale "c" a 37- to 22-Hz downsweep signature. These signatures were very consistent throughout the sequence of 467 calls which were examined in detail. That the whales are interacting, rather than just independently calling, is suggested by the consistent alternate spacing between calls with the calls never overlapping, the distinctive call signature of each whale and the apparent synchronization of respiration. The time series records from the four seafloor instruments demonstrate the separation between these whales, with different instruments showing the highest amplitude for the whale nearest that instrument.

For the sequence of 467 calls analyzed in detail, the whale labeled "a" in Fig. 8 produced 46% of the total calls, "b" produced 41% and "c" produced 13%. Within these 467 calls there are only six occasions when a whale called twice without an intervening countercall, including the rest gaps in this sequence. Of these occasions, whale "a" called consecutively only once, that after a particularly long rest gap, such that the two calls were some 5 min apart. Whale "b" twice called consecutively and whale "c" on three occasions. On the occasions when whale "c" repeated its call without a response, it called two, three, and five times consecutively. Cursory examination of other similar data sets from the same area suggest this to be a common pattern, where calls of the type produced by whale "c" are fewer in total number but are most often repeated consecutively.

Figure 9 shows the tracks of the three whales over the 1.5 h while they were nearest the array. The whales traveled side-by-side rather than single-file and no whale appeared to be leading. The whales tracked in Fig. 9 were swimming at speeds of 5 to 14 km/h as averaged over the $\frac{1}{2}$-h intervals shown. Swimming speeds for fin whales from visual data are reported as 10 to 16 km/h for long periods when in transit and 20 km/h or more for shorter periods (Watkins, 1981). The lowest frequency whale, "a," swam most quickly, called most often and never called twice in a row; while the highest frequency whale, "c," swam slowest, called least often and called consecutively most often.

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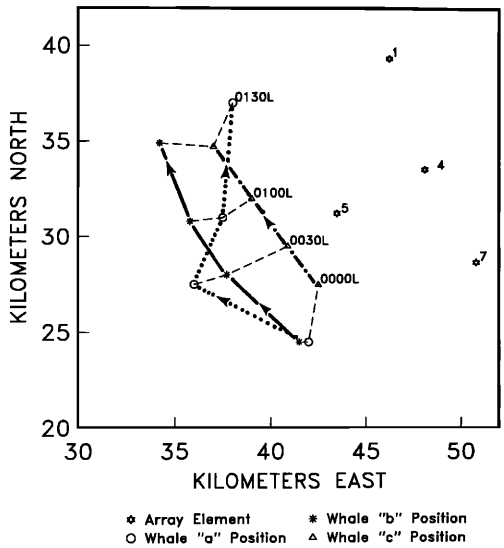

FIG. 9. Tracks of the three fin whales ("a," "b," and "c") from Fig. 8 travel together, showing their positions at equivalent times connected by dashed lines. The whales appear to travel side by side rather than in a single file. Whale "a" with the lowest frequency signature, travels the fastest (circles), whereas whale "c" with the highest frequency signature, travels the slowest (triangles).

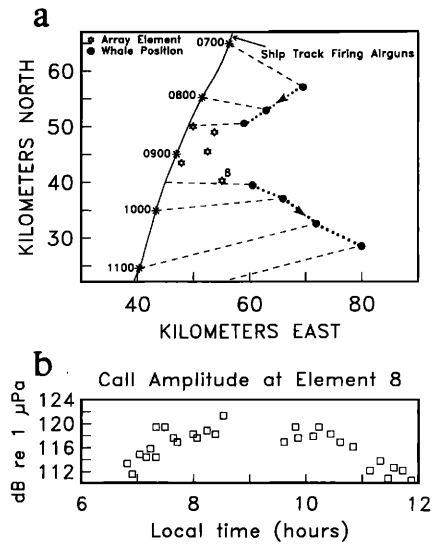

FIG. 10. (a) A blue whale track during airgun operations. The dashed lines connect the location of the airgun ship with the whale location at the corresponding time. The whale started its call sequence well within the tracking range of the array when the airgun ship was 15 km distant (0700 h local time). The whale followed a pursuit track until it stopped calling at a range of 10 km. After a gap in the call sequence, the whale track moved diagonally away from the ship. (b) The received whale call amplitude changed with time. Each point plotted represents one blue whale call pair, so the gaps indicate pauses in the call sequence.

V. WHALE RESPONSE TO MAN-MADE AND SEISMIC NOISE IN THE OCEAN

A. Significance

Concern for the welfare of marine mammals has focused attention on the effects man-made noise may have on the behavior, communication, or general welfare of whales. Under the Marine Mammal Protection Act, increasingly strict guidelines for the use of man-made noise in the oceans are being applied as a precaution against disruption of whale behavior (Hofman, 1989; Green *et al.*, 1994). Natural transient noises in the ocean are primarily associated with earthquakes and volcanic eruptions while man-made transients include shipping, geophysical surveying with airguns, underwater explosions and hydraulic sound sources such as are used with acoustical oceanography experiments.

B. Airgun noise

We conducted a seismic refraction survey with a four airgun array having a total capacity of 1600 cubic in., fired at 1800 psi. These airguns are individually larger than those typically used in oil exploration, resulting in lower maximum sound levels at lower frequency, near 15 Hz. The airgun array produced about 215 dB P-P *re*: 1 μPa at 1 m over a 10- to 60-Hz band (a suboptimal sound-pressure level because of depth and towing speed constraints) as estimated from seafloor measurements. The array was nearly symmetric in azimuth. The directionality of the airgun array was not measured, but this source level measurement is appropriate for estimating received level at the whales because the seafloor reflected paths will be the loudest received at the whales. Figure 10 shows a blue whale track during airgun operations. The dashed lines connect the airguns location with the whale location for the matching time. This whale, in Fig. 10, was moving slightly faster than the whale tracked in Fig. 6(a), with an average speed of 10 km/h, varying from 7 to 13 km/h. The whale started its call sequence well within the tracking range of the array when the airgun ship was 15 km distant (0700 h local time). The whale closed on the ship following a pursuit track until it stopped calling at a range of 10 km. At this point, the ship was moving about 10 km/h and was beginning to increase its distance from the whale; the sound level of the airguns then was 143 dB P-P *re*: 1 μPa over a 10- to 60-Hz band at the whale. After a gap in the call sequence, a new call series, presumably by the same whale, was again located 10 km from the ship, suggesting it had taken a track generally paralleling the ship. The series of positions after 0930 shows the whale moving diagonally away from the ship. Comparing this track with that of Fig. 6(a), it appears the whale may have been approaching the ship intentionally, or perhaps was unaffected by the airgun ship. More data of this type will be needed to draw conclusions about the affect of such noise on blue whale behavior. Studies of bowhead and gray whale behavior in the presence of airgun noise indicate avoidance at broadband levels of about 160 to 170 dB 0-P *re*: 1 μPa (Malme *et al.*, 1984; Richardson *et al.*, 1986; Richardson *et al.*, 1991; Tyack, 1993).

C. Ship-generated noise

Noise created by the research vessel did not significantly increase the background noise level between 10 and 60 Hz at the study site (except during airgun operations), but regular passages of larger merchant ships were observed to increase 10- to 60-Hz noise levels by as much as a factor of 20 in amplitude (26 dB) relative to times when no merchant ships

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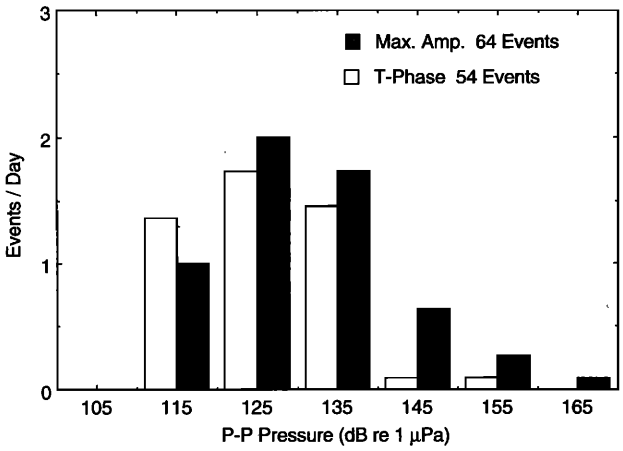

FIG. 11. The peak amplitudes of body-phase or t-phase pressure signals, whichever is greater, and the t-phase pressure signals from the 64 earthquakes observed in this study. At low amplitudes the smaller number of detected events is attributed to detection limitations related to the variability of background noise from local shipping.

were nearby. The blue whale track illustrated in Fig. 6 could not be located after 0800 h because an approaching merchant vessel increased the noise level so that it was difficult to pick the arrival times and amplitudes of the blue whale calls. This merchant vessel came from the north-northwest, passing about 5 km west of the nearest array element at 0940 h when the whale was approximately 5 km west of the vessel. Sound levels at the whale were about 106 dB rms *re*: 1 μPa over the 10- to 60-Hz band (115 dB P-P), yet the blue whale continued to call as before. In contrast, avoidance behaviors have been observed in beluga whales at ship noise levels of only 94 to 105 dB rms *re*: 1 μPa in the 20- to 1000-Hz band from ships 35 to 50 km distant (Finley *et al.*, 1990). Bowhead whale avoidance behaviors have been observed in half the animals when exposed to 115 dB rms *re*: 1 μPa broadband drillship noises (Richardson *et al.*, 1990), but behavioral reactions are considered to vary depending on the characteristics of the noise, whale activity and the physical situation (Richardson and Greene, 1993).

D. Earthquake-generated noise

Earthquakes are believed to have generated ocean noise at similar frequencies and magnitudes throughout the evolution of whales, and thus are a background noise to which the whales are presumably adapted. The frequency of occurrence of earthquakes producing transient sounds of given amplitude in the ocean can be predicted using observations such as were collected in this study together with the empirical relationship by which the frequency of earthquake occurrence rises by a factor of 10 (a close approximation) for each decrease in earthquake magnitude (Frohlich and Davis, 1993). The histogram shown in Fig. 11 provides a reference level upon which the empirical relationship is applied for this region of the north Pacific. Similar north Pacific data has been reported by Johnson and Jones (1978), Jones and Johnson (1978), Hyndman and Rogers (1981), and Fox *et al.* (1994) and there are at least 20 similar published data sets for other areas of the Pacific.

The data of Fig. 11 have been divided into two types, tertiary-phase (T-phase) energy which is transmitted in the water and body-phase energy transmitted in the rock, entering the water near the receiver. The earthquakes that generated the signals recorded during this study occurred at ranges as far as 170 km and as near as 1.1 km, with most at ranges near 65 km, the range from the study site to the Blanco Transform Fault Zone. Body-phase energy provides the highest amplitude sound in the water at near ranges, while at longer ranges the T-phases dominate showing energy above background levels from 3 to 35 Hz (Walker *et al.*, 1992) regardless of the earthquake range. Different regions in the ocean will be dominated by one or the other, depending on local seismicity levels.

Using this information, it is possible to estimate the earthquake sound level a whale will hear with a given frequency of occurrence. If we assume whale hearing has evolved to withstand the maximum level of earthquake generated sound, occurring once per lifetime, this level suggests how loud a man-made sound might be without causing permanent damage. For purposes of the calculation, we assume our study site receives earthquake noise typical of that received by the hypothetical whale. We believe the earthquake noise at our study site to be above average for the worlds oceans, but not extremely so. We also assume for the calculation that the pressure amplitude produced in the ocean is directly related, one to one on a logarithmic scale, with earthquake magnitude increase. Extrapolating from our sound level of 140 dB P-P *re*: 1 μPa in the 10- to 60-Hz band, from earthquakes once per day (Fig. 11), we calculate a sound level exposure of 204 dB P-P *re*: 1 μPa in the 10- to 60-Hz band for earthquakes occurring once per lifetime (50 years). In the less likely occurrence where the whale happened to be directly over the earthquake, the sound exposure level would be 231 dB P-P *re*: 1 μPa. We anticipate that SOSUS data (Gagnon *et al.*, 1993; Nishimura and Conlon, 1994; Fox *et al.*, 1994) will soon provide direct answers to the question of maximum earthquake sound pressure levels detected over a period of years, avoiding the assumptions implicit in our calculation. Very distant earthquakes, such as the very large and deep Bolivian event in 1994, have no bearing on this calculation, as that event produced no significant energy above 2 Hz in the region of this study. Possible effects of an intermediate range earthquake on gray whales is discussed by Malme *et al.*, 1989.

Figure 12 shows earthquake sound energies, both T-phase and body-phase during a fin whale call series. There is no disruption of the call interaction in this case when the sound level from the earthquake is 121 dB P-P *re*: 1 μPa over the 10- to 60-Hz band at the whale. When extrapolated back to the Blanco Transform Fault Zone, sound levels from this earthquake would be 27 dB higher (148 dB P-P *re*: 1 μPa) within a few kilometers of the epicenter. The range between the earthquake and the whales is practically the same as the earthquake to recording instrument range at the time scale of this plot.

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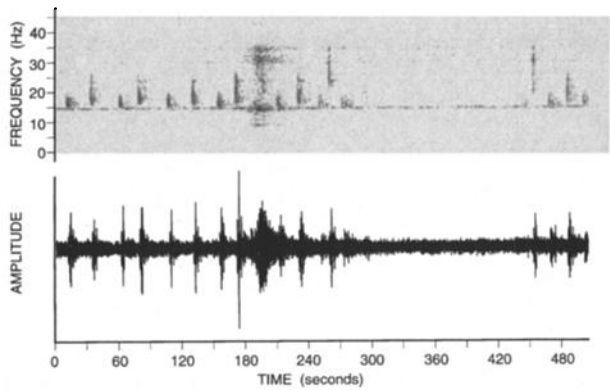

FIG. 12. Earthquake noise, including both t-phase and body phases during a fin whale call sequence. There appears to be no disruption of the call interaction in this case when the noise level from the earthquake is 121 dB P-P *re*: 1 μPa over the 10- to 60-Hz band, at the whale.

VI. DISCUSSION

A. Noise pollution of the deep ocean

Noise pollution, herein defined as anthropogenic noise, in the deep sound channel is basically of two types: Transient noises and background noise levels. Natural transients are primarily associated with earthquakes and volcanic eruptions, while manmade transients include geophysical surveying with airguns, underwater explosions and hydraulic sources such as those used for acoustical oceanography experiments. First we discuss the possible anthropogenic effects on background noise levels in the deep sound channel. It is important to keep in mind during this discussion that the sound channel has a profound effect: 20-Hz ambient noise levels in the sound channel are about 30 times louder in amplitude (30 dB) than noise levels at typical seafloor depths, such that while local wind noise (associated with breaking waves) may set the background noise level at the seafloor (McCreery *et al.*, 1993; Shooter *et al.*, 1990), the background level in the deep sound channel is associated with distant sources, including wind noise, shipping, seismicity and distant whale calls.

The analysis of Payne and Webb (1971) proposes that propeller driven shipping has changed the background noise levels of the entire worlds' oceans, negatively affecting the ability of the 20-Hz whale calls to be heard at long range. More recent work challenges that hypothesis, suggesting that sources other than shipping may cause the observed background levels at 20 Hz. Ambient noise levels in the deep ocean sound channel near the 20-Hz frequency range are bounded on the low side (below 5 Hz) by nonlinear wave–wave interaction, a phenomena which is relatively well measured and understood (Kibblewhite, 1985; Webb, 1992). Noise levels between 5 and 50 Hz have traditionally been attributed to shipping noise (Wenz, 1962), but may be alternatively and/or regionally sourced from high latitude winds (Bannister, 1986). Some authors have suggested other noise sources in this frequency range including atmospheric turbulence (Wilson, 1979; Copeland, 1993), lightning (Dubrovskiy and Kosterin, 1993), and glacial ice flow (Copeland, 1993), but we consider these sources improbable or insignificant.

Many observations of ambient noise levels have a peak at 20 Hz which is usually attributed to whale calls and assumed to be caused by whales relatively local to the observation site even though the whale calls may not be distinctive in the time series data (Kibblewhite *et al.*, 1976; Copeland, 1993). The important question is whether the source of background noise near this 20-Hz peak is shipping, a source the whales did not evolve with and may not be readily adapting to. Our calculations of earthquake T-phase noise levels in the sound channel, when extrapolated back to a frequency of occurrence of nearly continuous noise (the distinction between background and transient noise becomes blurred), suggest seismicity may be the dominant noise source at 20 Hz in some otherwise quiet regions of the ocean. This is significant because earthquakes would have been present throughout the period of whale evolution. A discussion of the assumptions used in these calculations would be too lengthy for this paper and recent SOSUS data may also provide better data upon which to base this type of calculation.

A good example of transient noise pollution is that from the seismic airgun array. Transient noises associated with geophysical surveying off the California coast have been readily recorded on land seismometer arrays 6100 km distant in Polynesia after traveling via the deep sound channel with little dispersion (Okal and Talandier, 1986). These noises, however, were probably not even heard by a whale near the surface in the mid-Pacific, because of the trapping of the sound in the deep sound channel. This type of noise will be heard only by the whales which dive below several hundred meters depth and to those in the polar regions where the sound channel shallows, assuming some land mass has not blocked the path. Prediction of airgun noise propagation is also complicated by the environment near the airguns, which in this instance may have been well suited for introduction of the airgun noise into the deep sound channel by downslope conversion where the sound is reflected off the seafloor, providing an efficient means of entering the deep sound channel (Jensen *et al.*, 1994).

B. Why blue and fin whales call

Speculations on why blue and fin whales call at 20 Hz have focused primarily on the question of communication with, or at least the broadcasting of relative location information to other whales of like species (Payne and Webb, 1971). The use of 20-Hz signals for depth finding sonar is somewhat discounted by the observation of calls when the whales are moving slowly and calling frequently, making the information content redundant. The whales would be expected to perceive the depth from the 20-Hz echos, but the signal is louder than would be necessary and a higher frequency signal would seem a more logical choice for this purpose. Relative location information is undoubtedly important to survival of the species if breeding pairs are to meet. Recent developments in long distance call tracking of blue whales using navy hydrophone arrays (Gagnon *et al.*, 1993) has raised speculation that the whales are horizontally echo-sounding the island of Bermuda from ranges up to 1000 miles (Clark, 1993).

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The information contained in the multipath amplitude ratios, as used to track fin whales in this study, suggests that fin whales could measure oceanic sound speed profiles by countercalling among the pod. The direct path amplitude relative to the bounce path amplitudes would provide a measure of the magnitude of downward refraction associated with the shallow (upper 500 m) sound-speed profile. Sufficient information could be obtained by the whale receiving the signal if the source were at least several km distant from the calling whale. Countercalls could provide measurements of variability in the sound-speed profile which would not be possible simply by listening to the echo of their own call, because a horizontal travel path amplitude would be added for comparison with reflected path amplitudes. Extraction of water sound-speed and corresponding temperature profiles may be possible using the principles of matched field processing (Jensen *et al.*, 1994). Changes in the depth and sharpness of the thermocline may be estimated from these amplitude ratios and may help the whale locate food.

VII. CONCLUSIONS

The use of passive seafloor arrays to track and monitor the calls of passing whales has advantages over other methods, such as radio tracking or visual observations, not only in cost but also because seafloor recording arrays are unobtrusive, unlike methods, using ships or aircraft as observing platforms, which may interfere with whale behavior. The recordings from this study further show the use of signature calls among fin whales, as suggested by Watkins (1981). These recordings provide a minimum measure of how many whales were present in an area and provide information on the character and pattern of their calls, which may eventually lead to association with specific behaviors and/or the separation of population groups by characteristic calls. Tracking of the calls provides direction and speed of travel information which may prove complementary to future efforts towards an acoustic census of pelagic baleen whale populations.

As demonstrated during the eleven days of this study, acoustic recordings provide a measure of the low-frequency noise levels that whales are exposed to and observations of any response to such noise. The observed noise levels at the whale during this study were 143 dB P-P *re*: 1 μPa over the 10- to 60-Hz band for airgun noise, 106 dB rms *re*: 1 μPa over the 10- to 60-Hz band for ship noise and 121 dB P-P *re*: 1 μPa over the 10- to 60-Hz band for earthquake noise. These observations may help set the minimum level at which a response might be expected.

ACKNOWLEDGMENTS

This research was supported by the NOAA Vents Program. We thank LeRoy Dorman and Chris Fox for helpful suggestions; Vince Pavlicek, Tom Deaton, and Jacques Lemire for their assistance building the instruments, Paul Wade for his encouragement in learning about whales, John Richardson, Sue Moore, Cyndy Tynan, and three anonymous reviewers for their comments on the manuscript, and the officers and crew of the NOAA ship DISCOVERER.

Alling, A., Dorsey, E. M., and Gordon, J. C. D. (**1991**). "Blue Whales (*Balaenoptera musculus*) off the Northeast Coast of Sri Lanka: Distribution, Feeding and Individual Identification," in *United Nations Mar. Mammal. Tech. Rep. 3, Cetaceans and Cetacean Research in the Indian Ocean Sanctuary*, edited by S. Leatherwood and G. P. Donovan (Nairobi, Kenya), pp. 248–258.

Ambos, E. L., Hussong, D. M., and Holman, C. E. (**1985**). "An Ocean Bottom Seismometer Study of Shallow Seismicity Near the Mid-American Trench Offshore Guatemala," J. Geophys. Res. **90**(B13), 11397–11412.

Bannister, R. W. (**1986**). "Deep sound channel noise from high-latitude winds," J. Acoust. Soc. Am. **79**, 41–48.

Buskirk, R. E., Frohlich, C., Latham, G. V., Chen, A. T., and Lawton, J. (**1981**). "Evidence that biological activity affects ocean bottom seismograph recordings," Mar. Geophys. Res. **5**, 189–205.

Clark, C. W. (**1993**). "Bioacoustics of baleen whales: From infrasonics to complex songs," J. Acoust. Soc. Am. **94**, 1830, Abstract.

Clark, C. W. (**1994**). "Blue deep voices: Insights from the Navy Whales '93 program," Whalewatcher, J. Am. Cetacean Soc., 6–11.

Copeland, G. J. M. (**1993**). "Low frequency ambient noise—generalized spectra," in *Natural Physical Sources of Underwater Sound* (Kluwer Academic, Dordrecht), pp. 17–30.

Cummings, W. C., Thompson, P. O., and Cook, R. (**1968**). "Underwater sounds of migrating gray whales, *Eschrichtius glaucus* (Cope)," J. Acoust. Soc. Am. **44**, 1278–1281 (1968).

Cummings, W. C., and Thompson, P. O. (**1971**). "Underwater sounds from the blue whale, *Balaenoptera musculus*," J. Acoust. Soc. Am. **50**, 1193–1198.

Cummings, W. C., and Holliday, D. V. (**1985**). "Passive acoustic location of bowhead whales in a population census Point Barrow, Alaska," J. Acoust. Soc. Am. **78**, 1163–1169.

Cummings, W. C., Thompson, P. O., and Ha, S. J. (**1986**). "Sounds from bryde, *Balaenoptera edeni*, and finback, B. physalus, whales in the Gulf of California," Fish. Bull. **84**(2), 359–370.

Cummings, W. C., and Thompson, P. O. (**1994**). "Characteristics and seasons of blue and finback whale sounds along the U.S. west coast as recorded at SOSUS stations," J. Acoust. Soc. Am. **95**, 2853 (A).

Dubrovskiy, N. A., and Kosterin, S. V. (**1993**). "Noise in the Ocean Caused by Lightning Strokes," in *Natural Physical Sources of Underwater Sound* (Kluwer Academic, Dordrecht), pp. 697–709.

Duennebier, F. K., Blackinton, G, and Sutton, G. H. (**1981**). "Current-generated noise recorded on ocean bottom seismometers," Mar. Geophys. Res. **5**, 109–115.

Edds, P. L. (**1982**). "Vocalizations of the blue whale, *Balaenoptera musculus*, in the St. Lawrence River," J. Mammal. **63**(2), 345–347.

Edds, P. L., and MacFarlane, J. A. F. (**1987**). "Occurrence and general behavior of balanopterid cetaceans summering in the St. Lawrence Estuary, Canada," Can. J. Zool. **65**, 1363–1376 (1987).

Edds, P. L. (**1988**). "Characteristics of finback *Balaenoptera physalus*, vocalizations in the St. Lawrence River," Bioacoustics **1**, 131–149.

Finley, K. J., Miller, G. W., Davis, R. A., and Green, C. R. (**1990**). "Reactions of Belugas, *Delphinapterus leucas* and narwhals, *Monodon monoceras*, to ice-breaking ships in the Canadian High Arctic," Can. Bull. Fish. Aqua. Sci. **224**, 97–117.

Ford, J. K. B., and Fisher, H. D. (**1983**). "Group specific dialects of killer whales (*Orcinus orca*) in British Columbia," in *Communication and Behavior of Whales*, edited by R. Payne (Westview, Boulder), pp. 333–358.

Fox, C. G., Dziak, R. P., Matsumoto, H., and Schreiner, A. E. (**1994**). "Potential for monitoring low-level seismicity on the Juan de Fuca Ridge using military hydrophone arrays," Mar. Technol. Soc. J. **27**(4), 22–30.

Frohlich, C., and Davis, S. D. (**1993**). "Teleseismic b Values; Or, Much Ado About 1.0," J. Geophys. Res. **98**(B1), 631–644.

Gagnon G., Nishimura, C., Fleming, H., Clark, C., Conlon, D., Liechty, J., and Olson, L. (**1993**). "Results of the Whales '93 Program Utilizing SOSUS Array Data for Monitoring Cetaceans and T-Phases," EOS **74**, 342, Abstract.

Green, D. M., DeFerrari, H. A., McFadden, D., Pearse, J. S., Popper, A. N., Richardson, W. J., Ridgeway, S. H., and Tyack, P. L. (**1994**). "Low-frequency Sound and Marine Mammals: Current Knowledge and Research Needs," National Research Council Report, 96 pp., National Academy Press, Washington, DC.

Hofman, R. J. (**1989**). "The Marine Mammal Protection Act, A First of Its Kind Anywhere," Oceanus **32**(1), 21–28.

Hyndman, R. D., and Rogers, G. C., (**1981**). "Seismicity Surveys With

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Ocean Bottom Seismographs Off Western Canada," J. Geophys. Res. **86**(B5), 3867–3880.

Jensen, F. B., Kuperman, W. A., Porter, M. B., and Schmidt, H. (**1994**). *Computational Ocean Acoustics* (AIP, Woodbury, NY).

Johnson, S. H., and Jones, P. R. (**1978**). "Microearthquakes Located on the Blanco Fracture Zone With Sonobuoy Arrays," J. Geophys. Res. **83**(B1), 255–261.

Jones, P. R., and Johnson, S. H. (**1978**). "Sonobuoy Array Measurements of Active Faulting on the Gorda Ridge," J. Geophys. Res. **83**(B7), 3435–3440.

Kibblewhite, A. C., Denham, R. N., and Barnes, D. J. (**1967**). "Unusual Low-Frequency Signals Observed in New Zealand Waters," J. Acoust. Soc. Am. **41**, 644–655.

Kibblewhite, A. C., Shooter, J. A., and Watkins, S. L. (**1976**). "Examination of attenuation at very low frequencies using the deep-water ambient noise field," J. Acoust. Soc. Am. **60**, 1040–1047.

Kibblewhite, A. C., and Ewans, K. C. (**1985**). "Wave-wave interactions, microseisms, and infrasonic ambient noise in the ocean," J. Acoust. Soc. Am. **78**, 981–994.

Mallick, S., and Frazer, L. N. (**1990**). "Po/So synthetics for a variety of oceanic models and their implications for the structure of the oceanic lithosphere," Geophys. J. Int. **100**, 235–253.

Malme, C. I., Miles, P. R., Clark, C. W., Tyack, P., and Bird, J. E. (**1984**). Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior, Phase II: January 1984 migration, prepared by Bolt Beranek and Newman Inc., var. pag., OCS study MMS 84-025, U.S. Department of the Interior, Minerals Management Service, Alaska OCS Office, Anchorage, AK, NTIS PB 86-218377.

Malme, C. I., Miles, P. R., Miller, G. W., Richardson, W. J., Roseneau, D. G., Thomson, D. H., and Green, C. R. (**1989**). Analysis and ranking of the acoustic disturbance potential of petroleum industry activities and other sources of noise in the environment of marine mammals in Alaska, prepared by BBN Systems and Technologies Corporation, var. pag., OCS study MMS 89-0006, U.S. Department of the Interior, Minerals Management Service, Alaska OCS Office, Anchorage, AK, NTIS PB 90-188673.

McCreery, C. S., Duennebier, F. K. and Sutton, G. H. (**1993**). "Correlation of deep ocean noise (0.4–30 Hz) with wind, and the Holu Spectrum—A worldwide constant," J. Acoust. Soc. Am. **93**, 2639–2648.

McDonald, M. A., Webb, S. C., Hildebrand, J. A., Cornuelle, B. D., and Fox, C. G. (**1994**). "Seismic Structure and Anisotropy of the Juan de Fuca Ridge at 45° N," J. Geophys. Res. **99**(B3), 4857–4875.

Nishimura, C. E., and Conlon, D. M. (**1994**). "IUSS Dual Use: Monitoring Whales and Earthquakes Using SOSUS," Mar. Technol. Soc. J. **27**(4), 13–21.

Northrup, J. W., Cummings, W. C., and Thompson, P. O. (**1968**). "20-Hz Signals Observed in the Central Pacific," J. Acoust. Soc. Am. **43**, 383–384.

Northrup, J. W., Cummings, W. C., and Morrison, M. F. (**1971**). "Underwater 20-Hz signals recorded near Midway Island," J. Acoust. Soc. Am. **49**, 1909–1910.

Okal, E. A., and Talandier, J. (**1986**). "T-wave duration, magnitudes and seismic moment of an earthquake-application to tsunami warning," J. Phys. Earth **34**, 19–42.

Patterson, B., and Hamilton, G. R. (**1964**). "Repetitive 20 cycle per second biological hydroacoustic signals at Bermuda," in *Marine Bio-Acoustics*, edited by W. N. Tavolga (Pergamon, New York), pp. 125–145.

Payne, R., and Webb, D. (**1971**). "Orientation by means of long range acoustic signaling in baleen whales," Ann. N. Y. Acad. Sci. **188**, 110–141.

Richardson, W. J., Würsig, B., and Green, Jr., C. R. (**1986**). "Reactions of bowhead whales, *Balaena mysticetus*, to seismic exploration in the Canadian Beaufort Sea," J. Acoust. Soc. Am. **79**(4), 1117–1128.

Richardson, W. J., Würsig, B. and Greene, Jr., C. R. (**1990**). "Reactions of bowhead whales, *Balaena mysticetus*, to drilling and dredging noise in the Canadian Beaufort Sea," Mar. Environmental Res. **29**, 135–160.

Richardson, W. J., Greene, Jr., Malme, C. I., and Thomson, D. H. (**1991**). Effects of noise on marine mammals, prepared by LGL Ecological Research Associates Inc., pp. 462, OCS study MMS 90-0093, U.S. Department of the Interior, Minerals Management Service, Atlantic OCS Region, Herndon, VA, 1991, NTIS PB 91-168914.

Richardson, W. J., and Greene, Jr., C. R. (**1993**). "Variability in behavioral reaction thresholds of bowhead whales to man-made underwater sounds," J. Acoust. Soc. Am. **94**, 1848, Abstract.

Schevill, W. E., Watkins, W. A., and Backus, R. H. (**1964**). "The 20-cycle signals and Balaenoptera (fin whales)," in: *Marine Bio-Acoustics*, edited by W. N. Tavolga (Pergamon, Oxford), pp. 2, 147–152.

Shooter, J. A., DeMary, T. E., and Wittenborn, A. F. (**1990**). "Depth dependence of noise resulting from ship traffic and wind," IEEE J. Ocean Eng. **15**(4), 292–298.

Sohn R. A., Hildebrand, J. A., Webb, S. C., McDonald, M. A., and Fox, C. G. (**1992**). "Microearthquake studies at the Megaplume Site on the Southern Juan de Fuca Ridge," EOS **73**, 530, Abstract.

Stone, G. S., Katona, S. K., Mainwaring, A., Allen, J. M., and Corbett, H. D. (**1992**). "Respiration and surfacing rates of fin whales (*Balaenoptera physalus*) observed from a lighthouse tower," Rep. Int. Whal. Commun. **42**, 739–745.

Talandier, J., and Okal, E. A. (**1984**). "The Volcanoseismic Swarms of 1981–1983 in the Tahiti-Mehetia Area, French Polynesia," J. Geophys. Res. **89**, 11216–11234.

Talandier, J., and Okal, E. A. (**1987**). *Seismic Detection of Underwater Volcanism: The Example of French Polynesia* (Birkhauser Verlag, Basel), pp. 919–950.

Thompson, P. O. (**1967**). Marine Biological Sounds West of San Clemente Island, U.S. Navy Electron. Lab. Rep. 1290.

Thompson, P. O., and Friedl, W. A. (**1982**). "A long term study of low frequency sounds from several species of whales off Oahu, Hawaii," Cetology **45**, 1–19.

Thompson, P. O., Findlay, L. T., and Vidal, O., Doublet Stereotyped and other blue whale phonations recorded in the Gulf of California, Mexico, Abstr. 7th Bien. Conf. Biol. Mar. Mamm., Dec. 1987, Miami, FL, p. 70.

Thompson, P. O., Findlay, L. T., and Vidal, O. (**1992**). "20-Hz pulses and other vocalizations of fin whales, balaenoptera physalus, in the Gulf of California, Mexico," J. Acoust. Soc. Am. **92**, 3051–3057.

Thompson, T. J., Winn, H. E., and Perkins, P. J. (**1979**). "Mysticete Sounds," in *Behavior of Marine Animals, Current Perspectives in Research*, edited by H. E. Winn and B. L. Olla (Plenum, New York), Vol 3: Cetaceans, pp. 403–431.

Tyack, P. L. (**1993**). "Reactions of bottlenose dolphins, *Tursiops truncatus*, and migrating gray whales, *Eschrichtius robustus*, to experimental playback of low frequency man-made noise," J. Acoust. Soc. Am. **94**, 1830, Abstract.

Urick, R. J. (**1983**). *Principles of Underwater Sound* (McGraw-Hill, New York), pp. 377–405.

Walker, D. A., McCreery, C. S., and Yoshihisa, Y. (**1992**). "T-phase spectra, seismic moments, and tsunamigenesis," Bull Seismol. Soc. Am. **82**(3), 1275–1305.

Walker, D. A., and Bernard, E. N. (**1993**). "Comparison of T-phase Spectra and Tsunami Amplitudes for Tsunamigenic and Other Earthquakes," J. Geophys. Res. **98**(C7), 12557–12565.

Watkins, W. A. (**1964**). "Harmonic interval: Fact or artifact in spectral analysis of pulse trains," in *Marine Bio-Acoustics*, edited by W. N. Tavolga (Pergamon, New York), pp. 15–42.

Watkins, W. A. (**1981**). "Activities and underwater sounds of fin whales," Sci. Rep. Whales Res. Inst. **33**, 83–117.

Watkins, W. A., and Schevill, W. E. (**1977**). "Spatial Distribution of *Physeter catadon* (sperm whales) underwater," Deep Sea Res. **24**, 693–699.

Watkins, W. A., and Wartzok, D. (**1985**). "Sensory biophysics of marine mammals," Mar. Mamm. Sci. **1**(3), 219–260.

Watkins, W. A., Tyack, P., Moore, K. E., and Bird, J. E. (**1987**). "The 20-Hz signals of finback whales (*Balaenoptera physalus*)," J. Acoust. Soc. Am. **82**, 1901–1912.

Webb, S. C. (**1965**). "The equilibrium oceanic microseism spectrum," J. Acoust. Soc. Am. **92**, 2141–2158.

Weston, D. E., and Black, R. L. "Some unusual low-frequency biological noises underwater," Deep Sea Res. **12**, 295–298.

Wenz, G. M. (**1962**). "Acoustic Ambient Noise in the Ocean: Spectra and Sources," J. Acoust. Soc. Am. **34**(12), 1936–1956.

Wilson, J. H. (**1979**). "Very Low Frequency (VLF) Wind-Generated Noise Produced by Turbulent Pressure Fluctuations in the Atmosphere near the Ocean Surface," J. Acoust. Soc. Am. **66**, 1499–1507.

Winn, H. E., Thompson, T. J., Cummings, W. C., Hain, J., Hudnall, J., Hays, H., and Steiner, W. W. (**1981**). "Song of the Humpback Whale–Population Comparisons," Behav. Ecol. Sociobiol. **8**, 41–46.

Yochem, P. K., and Leatherwood, S. (**1985**). "Blue Whale: *Balaenoptera musculus* (Linnaeus, 1758)," in *Handbook of Marine Mammals, Vol 3: The Sirenians and Baleen Whales* (Academic, London), p. 223.

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Status of Marine Mammals in the North Atlantic

THE BELUGA WHALE



(Photo: M.P. Heide-Jørgensen)

This series of reports is intended to provide information on North Atlantic marine mammals suitable for the general reader. Reports are produced on species that have been considered by the NAMMCO Scientific Committee, and therefore reflect the views of the Scientific Committee of NAMMCO.

North Atlantic Marine Mammal Commission
Polar Environmental Centre N-9296 Tromsø, Norway
Tel.: +47 77 75 01 80, Fax: +47 77 75 01 81 Email: nammco-sec@nammco.no, Web site: www.nammco.no

BELUGA WHALE *(Delphinapterus leucas)*

The beluga (Norwegian: *hvithval*; Greenlandic: *Qilalugaq qaqortaq*; Faroese: *Hvítfiskur*; Icelandic: *Mjaldur*) or white whale, is a medium-sized toothed whale that belongs to the family Monodontidae. The only other member of this family is the narwhal. The English name “beluga” comes from the Russian word *belukha*, which means “white”. Beluga whales have stout bodies, flexible necks and a disproportionately small head with a well defined beak and a prominent forehead bulge or "melon". They have short but broad paddle-shaped flippers, no dorsal fin, a narrow ridged back and a broad tail fluke with a deeply notched centre. The name “*delphinapterus*”, meaning “dolphin-without-a-wing” reflects the absence of a dorsal fin.

Adult beluga whales grow to lengths of 3-5 m, and can weigh up to 1,500 kg. Males grow slightly larger than females. Newborns are brown or slate-grey in colour and average 1.6 m in length and 78 kg in weight. They become bluish-grey as they mature, then progressively lighten in colour, fading to white after 6 years of age. Most females mature sexually while still light grey, while males become white before maturing. Older males have a marked upward curve at the tip of their flippers

Beluga mate in the early spring, and calving occurs a little over a year later. Calving for beluga in the Canadian High Arctic population occurs mainly during early July to early August, although calves have been reported there as early as May 31, and as early as late March off west Greenland (Koski *et al.* 2002).

Distribution and stock definition

Beluga whales have a discontinuous circumpolar distribution, and in general occur only in seasonally ice-covered parts of Arctic and sub-Arctic seas (Fig. 1). Some isolated populations, however, extend into subarctic regions as far south as the St. Lawrence River in Canada. Throughout their range belugas inhabit cold Arctic waters, living amongst pack ice, in leads and polynyas in winter and migrating to shallow bays and estuaries of large northern rivers in the summer. Their seasonal movements depend on both oceanographic conditions (primarily the dynamics of ice cover) and the distribution of their primary prey species (Boltunov and Belikov 2002). Belugas usually travel in pods of 2 to 10 whales, although larger pods are not uncommon. Females with young are found in calm shallow waters along reef edges, close to islands and in large bays. These areas have a warm surface temperature and sand, gravel or mud bottoms that support molluscs, crustacea and bottom fish. Adults and weaned young prefer areas where the water depth varies, where surface temperatures are cold, and where there are reef bottoms of sand and gravel or deep bottoms of sandy mud and coarse material.

A “stock” of animals is usually defined as a management unit, that is, a group of animals that can be managed independently of other groups. Because of their annual migration patterns, and with difficulties in sampling and studying these animals in the field, stock identification for beluga is currently not well defined. Determination of stocks for beluga is particularly important since in several areas beluga numbers have declined considerably over the past century. Because people wish to continue to hunt beluga, it is essential to have knowledge of stock structures, their distribution and population sizes in order to determine sustainable harvest levels.

Genetic studies have been used to try to differentiate beluga stocks, though results have not been as clear cut as with some other animals. Difficulties arise in using genetics for beluga because adequate sampling designs are hard to achieve (de March *et al.* 2002). Sample numbers are sometimes lower than desired, due to the difficulty and expense of obtaining samples, and sampling is usually concentrated in areas and times where belugas are hunted rather than throughout their seasonal range. As well, because beluga are social animals and occur in pods of closely related animals, sampled animals may be close relatives rather than random individuals from a stock (Palsbøll *et al.* 2002). These difficulties mean that genetic studies alone will probably not be enough to define beluga stocks, and that a combination of methods and information is needed. For beluga, the annual migration path

and the hunters who have access to the whales along this path may best describe the term “stock” (Innes *et al.* 2002b).

There are two main groups of belugas in the Russian Arctic. The “Karskaya” group inhabits the western and central parts of the Russian Arctic, including the Barents, White, Kara and Laptev Seas (Fig. 1) (NAMMCO 2000). Another group inhabits the Bering Sea.

A separate group of belugas is found in the Barents Sea and around Svalbard. In summer, belugas are observed close to shore on the west, south and southeastern parts of the archipelago (NAMMCO 2000). Their distribution overlaps the winter distribution of the Karskaya belugas, and it is possible that there could be mixing of these two groups.

Belugas are rare along the east coast of Greenland, likely due to lack of suitable habitat, and whales which do appear there from time to time probably belong to the Svalbard population (Dietz *et al.* 1994).

On the west coast of Greenland, belugas are found from Qaanaaq in the north to Paamiut in the south in the fall, winter and spring (Fig. 1). Belugas are rare along this coast in summer (NAMMCO 2000). Beluga migrate past the Upernavik region in October and are found later in the fall and winter between Disko Bayand Sisimiut (NAMMCO 2000). It is unclear how many stocks winter off the west coast of Greenland (Palsbøll *et al.* 2002).

Beluga occur throughout the Canadian Arctic. With the exception of one group in the Beaufort Sea, all other groups are found in the eastern Arctic (Fig. 1). Fifteen groups are currently recognised in the eastern and High Arctic, and it appears in general that there are more separate groups or populations than was previously thought (NAMMCO 2000). In the Canadian High Arctic, for example, both satellite tracking and genetic studies have been unable to determine the stock structure of the beluga which spend the summer there (NAMMCO 2002a). Some beluga from this area migrate to western Greenland in the winter, while others winter in the "North Water" in Baffin Bay and Smith Sound (Fig. 1). Heide-Jørgensen *et al.* (2003) estimated that the proportion of animals moving to West Greenland in the winter was approximately 15% (95% confidence limit 6-35%) based on satellite tagging data. It is likely that this “High Arctic” stock consists of 2 or more smaller stocks (de March *et al.* 2002), one or more of which winters off West Greenland and one or more of which winters in the North Water.

Ecology

Young beluga begin feeding on fish and invertebrates after their first year, but may continue to take milk from their mothers during their second year of life (Heide-Jørgensen and Teilmann 1994). As the animals grow, they are able to take larger food items, and gradually switch from benthic to more pelagic foraging.

Polar cod (*Boreogadus saida*) and Arctic cod (*Actogadus glacialis*) were found to contribute more than any other item to the diet of beluga in the Upernavik area in Greenland (Heide-Jørgensen and Teilmann 1994). Polar cod was also found to be the principle food item for Canadian High Arctic and Svalbard beluga (Koski *et al.* 2002, Dahl *et al.* 2000). Squid beaks were commonly found in beluga stomachs from western Greenland. Other prey items found were redfish (*Sebastes marinus*), halibut (*Reinhardtius hippoglossoides*) and northern shrimp (*Pandalus borealis*) (Heide-Jørgensen and Teilmann 1994). Polar cod was also found to be the main prey item for beluga in Russian waters, with various whitefishes (*Coregonidae*) contributing to the diet in summer (Boltunov and Belikov 2002).

Capelin (*Mallotus villosus*) are an important food for belugas in the St. Lawrence River and also in Hudson Bay (Kingsley 2002). Other important food items were sand-lance (*Ammodytes* spp.), Atlantic cod (*Gadus morhua*), tomcod (*Microgadus tomcod*), decapod and amphipod crustaceans and polychaete worms.

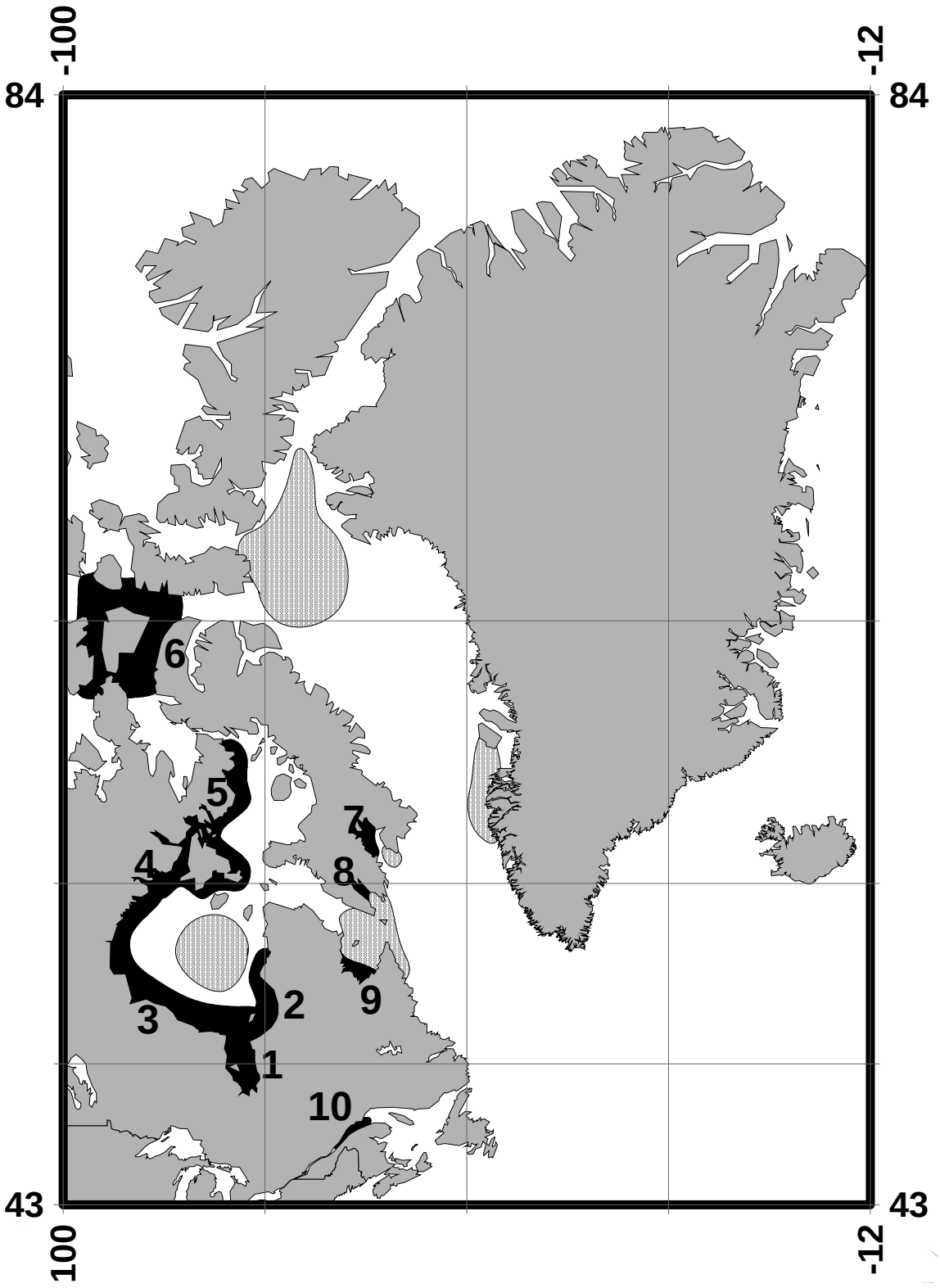

Fig. 1a. Beluga distribution in the western (a) and eastern (b) Atlantic. Summering areas are black and wintering areas are stippled. a) 1. James Bay; 2. Eastern Hudson Bay; 3. Western Hudson Bay; 4. Northern Hudson Bay; 5. Foxe Basin; 6. High Arctic; 7. Cumberland Sound; 8. Frobisher Bay; 9. Ungava Bay; 10. St. Lawrence River.

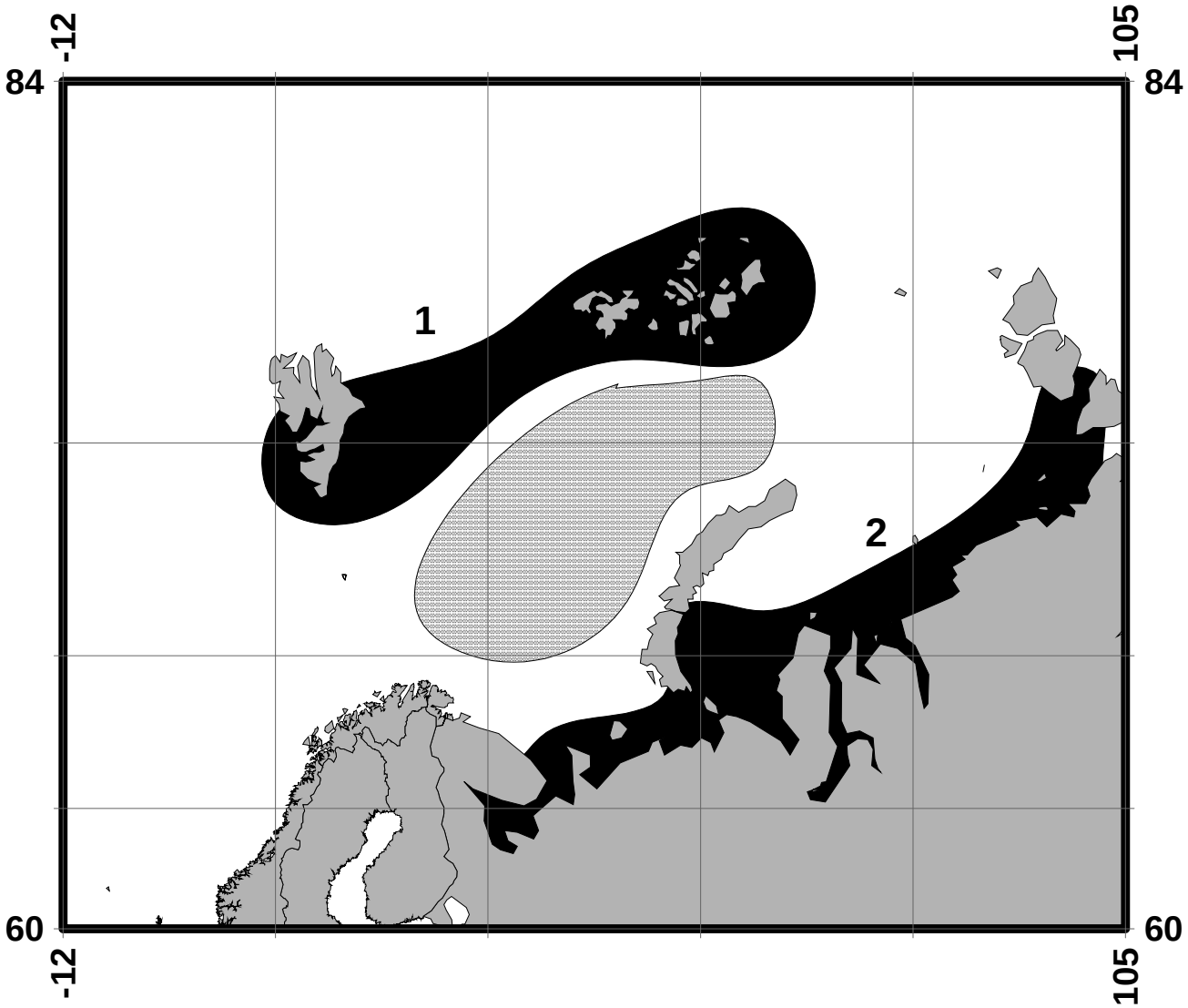

Fig. 1b. 1. Svalbard; 2. Karskaya..

Belugas have few natural predators. Killer whales (*Orcinus orca*) and polar bear (*Ursus maritimus*) may prey on beluga. Mainly calves and younger belugas are susceptible to such predation, although older animals can be taken by bears if they become trapped in ice. Ice entrapments of belugas usually occur during periods of very cold weather when ice forms rapidly. Belugas trapped this way usually die from predation, hunting or exhaustion. In Disko Bay, Greenland, there have been entrapments observed involving large numbers of belugas: at least 1,000 in 1915, and up to 3,000 in 1955 (Heide-Jørgensen *et al.* 2002). Entrapments, termed *sassat* in Greenlandic, occur fairly regularly in this area. Fewer entrapments are known from Canada, and ones that are known tend to involve smaller numbers of animals. This is likely due to the more stable ice conditions found in Canada relative to west Greenland (Heide-Jørgensen *et al.* 2002). As well, the lower human population density in the Canadian Arctic means that some entrapments would go unreported.

Abundance and trends:
Estimating the abundance of beluga is difficult due to the remoteness and large size of their distribution area and the mobility of the animals. Aerial surveys are most commonly used, but the results obtained must be corrected for both whales at the surface missed by observers, plus those that are below the surface out of sight when the survey airplane is overhead. Another problem is that direct comparisons between surveys are not always possible, since surveys rarely have the same timing or cover the same area.

Canadian High Arctic
The size of this population had not been estimated before the early 1970s. The first reconnaissance survey at that time, of concentrations of belugas in estuaries, gave a very rough estimate of 10,000 belugas (Koski *et al.* 2002). Surveys conducted in the late 1970s estimated that 10,250 to 12,000 belugas were involved in the fall migration out of the central Arctic (Koski *et al.* 2002). A survey in 1996 estimated 21,213 belugas (95% CI 10,985 to 32,619) in the waters surrounding Somerset Island.: Barrow Strait, Peel Sound and Prince Regent Inlet (Innes *et al.* 2002a). This estimate takes into account both whales missed by observers and those that might be unseen due to diving behaviour.

Any apparent trends of increase or decline in this population are difficult to assess since the confidence intervals for all estimates are quite large. Though beluga here were subject to commercial hunting in the past, hunting pressure today in Canada on these animals is low (NAMMCO 2000), but is higher for those beluga which migrate to Greenland.

Southeast Baffin Island
This area contains as many as 3 groups of beluga, which were previously believed to belong to a single stock. Commercial hunting of beluga occurred in this area, starting in the late 1800s. It is estimated that 7,000 animals were taken between 1868 and 1939, not counting those which were struck and lost, mainly in Cumberland Sound (DFO 2002b). The Cumberland Sound beluga numbers have been reduced by past overexploitation, and this group appears vulnerable as it is a relatively small population that is heavily harvested (NAMMCO 2000). This group is listed as “endangered” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), however a survey of this group in 1999 suggested that this population is increasing (DFO 2002a). The Frobisher Bay and Hudson Strait components are migratory and are occur sporadically in these areas in the summer. The status of these two stocks is not known (NAMMCO 2000).

Ungava and Hudson Bay
Ungava Bay was formerly a summering area for a group of beluga, but these appear to have been extirpated by over-harvesting. Only very small numbers of belugas are observed there now, and are sometimes harvested. These animals may be remnants of the former stock, or transient or re-colonising animals (NAMMCO 2000). This stock is listed as “endangered” by COSEWIC.

There are 6 separate groups found in Hudson Bay. The North Hudson Bay group includes both summer resident beluga and migrants from other areas in the spring and fall. A recent genetic study

gave no clear picture of their stock structure. Beluga from this area were similar to other Hudson Bay collections, and had a relatively high genetic diversity. However, collections within the group were often significantly different from each other (de March and Postma 2003). The status of this group is difficult to determine. Northern Hudson Bay and Foxe Basin may include belugas from western Hudson Bay in early spring and summer, belugas from the High Arctic that are moving southward in late summer, and beluga that spend the summer in Foxe Basin (de March and Postma 2003).

In Eastern Hudson Bay, the population was subject to a large commercial harvest. This caused the fishery to experience a rapid decline by the late 1800s (de March and Postma 2003). Subsistence hunting continued after that time, but it was not until the 1980s that concerns about this population arose. The group is considered vulnerable, as it is a small population with relatively heavy exploitation (NAMMCO 2000), and is listed as "threatened" by COSEWIC.

The Belcher Islands area appears to have belugas which are both summer and winter resident. Recent genetic work indicates that these are probably a separate stock, although there is still the possibility that these beluga mix with those in Eastern Hudson Bay (de March and Postma 2003). There is no estimate available for the population size, but exploitation is fairly low. The status of this group is not known (NAMMCO 2000).

Western Hudson Bay has a large number of summer resident beluga. A partial survey in 1987 reported 25,100 beluga (95% CI 18,300 to 52,800) (NAMMCO 2000). Harvest of this group is estimated to be from 130 to 200 animals a year, which is likely a sustainable number for such a large group (NAMMCO 2000).

The coast of southern Hudson Bay has several large rivers where belugas congregate in the summer. James Bay also has a large summering population, probably exceeding 10,000 animals (DFO 2002c). Belugas in these areas are not hunted, although an unknown amount of harvest may occur during their migration (NAMMCO 2000). It is also unclear to what extent mixing between James Bay beluga and other groups occurs, and also between these and Western Hudson Bay beluga (de March and Postma 2003).

St. Lawrence River

The original size of this stock is unknown, but it has been back calculated to be in the low thousands. It has been estimated that about 16,000 animals were taken from the population between 1870 and 1960 (Kingsley 2002). This harvest, for commercial products, to protect fisheries and for recreation, was uncontrolled and led to serious depletion of the population. Studies in the early and mid 1970s found numbers in the low hundreds, and all hunting was prohibited in 1979 (Kingsley 2002). More recent estimates that the population is recovering and numbered about 1200 animals in 1997 (Kingsley 2002). This population was classified as "endangered" by COSEWIC in 1983.

West Greenland

Commercial harvesting of beluga in west Greenland and Baffin Bay began in the late 1800s. Their occurrence in west Greenland has changed over the past 90 years, largely due to changes in hunting patterns. The introduction of motor boats to the area in the early 20th century led to increased catches. After a period with large catches in Nuuk (from 1906-22) and in Maniitsoq (1915-29), beluga disappeared from the area south of 66° N (Heide-Jørgensen and Acquarone 2002). Between 1927 and 1951, large catches were reported in the southern part of the municipality of Upernavik, and since 1970 in the northern part. Catches in this area in the 1990s were about 700 whales per year (Heide-Jørgensen and Rosing-Asvid 2002).

Aerial surveys flown in west Greenland between 1981 and 1994 found that beluga numbers decreased by 62% during that period, probably because of overharvesting (Heide-Jørgensen and Reeves 1996). Further suveys in 1998 and 1999 confirmed the decline and found 7,941 (95% CI: 3650-17278) belugas in West Greenland, including whales missed by the observers and whales that were submerged during the survey (Heide-Jørgensen and Acquarone 2002).

Russia
Beluga exploitation in Russia goes back several centuries, although there is little data available on population or harvest numbers. One estimate, made in 1939, gave a population of 40,000 to 50,000 beluga in the Barents, Kara and Laptev Seas (Boltunov and Belikov 2002). These numbers are very rough, and were based on observations of beluga during mass inshore movements in the fall. Another estimate made later guessed that from 15,000 to 20,000 beluga inhabited the White, Barents and Kara Seas (Boltunov and Belikov 2002).

Harvests in Russia were quite variable, depending on the timing of migration and the numbers of animals moving inshore. The harvest did not likely cause any appreciable change in the population (Boltunov and Belikov 2002). One exception seems to be in the period 1954 to 1966, when annual harvests were high, averaging 1,500 individuals per year. This caused a noticeable decline in the number of beluga approaching Nova Zemlya and entering Baidaratskaya Inlet and Yugorskiy Shar Strait (Boltunov and Belikov 2002). Fewer whales were taken in the following decades.

Russians also harvested belugas at Svalbard, beginning in the 18th century. Little information is available on catch numbers. The best known year is 1818, when a crew overwintering caught about 1,200 belugas (Gjertz and Wiig 1994). Norwegians began hunting belugas at Svalbard in 1866, and continued up until the early 1960s. Over that period, more than 15,000 animals were taken (Gjertz and Wiig 1994). Belugas are thought to migrate to Svalbard in April or May, from wintering areas in the Barents Sea.

Current management and utilisation:
Belugas have long been a staple food resource for indigenous peoples throughout the Arctic, and continues to be an important part of northern diets today.

In West Greenland, beluga is one of the most important marine mammal species harvested, and the recent annual catches of between 500 and 1,000 belugas often exceeded the catch of all other whale species combined (Heide-Jørgensen and Rosing-Asvid 2002, see Table 1). There is evidence that the number of beluga wintering off West Greenland has declined since 1981. The Scientific Committee of NAMMCO has advised that the West Greenland stock is substantially depleted and that delay in reducing the catch to about 100 animals per year will result in further population decline and will further delay the recovery of this stock (NAMMCO 2001). Concern over this decline led to introduction of regulations during the 1990s with the intention of reducing catches. The drive hunt, which was the main method of beluga capture, was prohibited in 1995 (Heide-Jørgensen and Rosing-Asvid 2002). In 2004, a quota of 320 beluga per year was established for West Greenland.

Beluga were considered primarily a commercial resource in Russia up until the 1990s, and management activities were largely aimed at utilising the resource most efficiently. Harvests in the Barents, Kara and White Seas were as high as 3,000 beluga per year in the late 1950s and early 1960s (NAMMCO 2000). Harvests declined after that, and commercial harvest of beluga was prohibited in 1999. Currently the beluga harvest in the Russian Arctic has all but ceased, although harvest for subsistence is allowed (Boltunov and Belikov 2002). The State Fishery Committee of Russia (SFC) and its regional affiliates are responsible for beluga management in Russia.

Beluga were hunted commercially at Svalbard, beginning with the Russians in the 18th century. Norwegians also hunted beluga there, starting in 1866. The beluga hunt at Svalbard ended in the 1960s, and since 1961 beluga have been totally protected in Norwegian waters.

YEAR	CATCH
1992	900
1993	798
1994	618
1995	780
1996	542
1997	576
1998	744
1999	493
2000	606
2001	397
2002	399

Table 1. Recent catches of beluga in West Greenland. 1992-1998 from Heide-Jørgensen and Rosing-Asvid (2002), 1999-2002 are from NAMMCO (2002b, 2003, 2004, in prep.)

Beluga have long been a vital food resource for Canadian Inuit. The top layer of skin, called muktuk, is a good source of Vitamin C and other nutrients. Management of beluga and other marine mammals in Canada are a federal responsibility. The Canadian Department of Fisheries and Oceans (DFO) has lead responsibility for beluga management, and the Marine Mammal Regulations, which deal with beluga conservation and management measures, are part of the Fisheries Act. The establishment of land claim settlement areas in parts of northern Canada in recent years has led to increased co-management of marine mammals. Under the Nunavut Land Claims agreement of 1993, for example, the Nunavut Wildlife Management Board (NWMB) was established. The NWMB is a decision-making body within the Nunavut Settlement Area, with advisory authority in the adjacent waters. Ultimate responsibility for wildlife management, however, lies with the governments of Nunavut and Canada. These governments carry out NWMB decisions, once they are made. A similar board exists for the James Bay Settlement Area in northern Quebec.

Canada discontinued all commercial whaling in 1972, and hunting of beluga today is allowed for subsistence purposes only. Between 1988 and 1996, the total annual subsistence harvest of beluga varied between 400 and 700 (DFO 2002b). In some places, harvests take place under a quota system.

Belugas are listed under Appendix II of the Convention on International Trade in Endangered Species of Flora and Fauna (CITES). Special permits are required for both the export and import of beluga or beluga products between countries.

Threats

The major threat to beluga, apart from hunting, is pollution of their environment. Contaminants which enter the sea tend to become concentrated as they move up the food chain, and could pose a health risk to beluga and other top marine predators. Organochlorines such as PCBs, pesticides and other persistent organic pollutants (POPs) are of concern. In Russia, high levels of PCBs are found in the Kara and Laptev Seas, possibly due to inputs from several large rivers which flow into these seas. As well, concentrations of PCBs and other persistent organic pollutants (POPs) are high in some parts of the Barents Sea and around Svalbard (Boltunov and Belikov 2002)

Beluga found dead along the shores of the St. Lawrence river have contained high levels of organochlorines, lead and mercury, but it is not known what effect their presence has at the population level (Kingsley 2002). About 23% of dead adults found on the shores of the St. Lawrence have malignant cancers, but again it is not known if this has consequences for the population.

In some areas, such as Svalbard and the Barents Sea, habitat may be threatened by oil exploration or extraction activities. Beluga could be disturbed by increased ship traffic, and possible oil spills.

Status and Outlook

West Greenland

The stock that winters in this area is substantially depleted, the population is estimated to be only a fraction of its pre-exploitation size (Innes and Stewart 2002, Alvarez-Flores and Heide-Jørgensen 2004) and present harvests are several times the sustainable yield (NAMMCO 2002). If harvests continue at present levels, there is a high risk that the stock will become extinct within 20 years.

Svalbard
Belugas here are protected from hunting, and the population is assumed to be stable.

Eastern Hudson Bay
Although there is some uncertainty in the available data, it seems that this population has declined from about 4,000 whales in 1985 to 2,000 in 2001. If current levels of harvest continue, this population could disappear in the next 10 to 15 years (DFO 2002c).

Beluga in Ungava Bay are still being harvested, despite recommendations that no whales be taken from this group. In 2001, 91 beluga were taken by Ungava Bay communities, some within Ungava Bay and some outside of the bay (DFO 2002c). This group is classified as "endangered" by COSEWIC.

Cumberland Sound
Recent survey results and local Inuit knowledge suggest that this population is increasing. Current levels of harvest are thought to be sustainable, and it is anticipated that COSEWIC will reassess the status of this population in the next two or three years.

Canadian High Arctic
At least 2 stocks occupy the Canadian High Arctic in the summer, one of which winters in the North Water and one of which winters off West Greenland (see Fig. 1). There is evidence that the stock that winters in West Greenland is severely depleted (see above). However there is no evidence from surveys conducted in the Canadian High Arctic that the number of beluga occupying this area has declined (Innes *et al.* 2002a, Koski *et al.* 2002). More information is needed about stock structure in this area.

In all areas, better information is needed on beluga stock sizes, distribution and population parameters in order to determine the best possible management scheme for these whales.

REFERENCES

Alvarez-Flores, C.M. and Heide-Jørgensen, M.P. 2004. A risk assessment of the sustainability of the harvest of beluga *Delphinapterus leucas* (Pallas 1776) in West Greenland. *ICES J. Mar. Sci.* 61:274-286.

Boltunov, A. N. and Belikov, S. E. 2002. Belugas (*Delphinapterus leucas*) of the Barents, Kara and Laptev seas. *NAMMCO Scientific Publications* 4:149-168.

Dahl, T., Lydersen, C., Kovacs, K.M., Falk-Petersen, S., Sargent, J., Gjertz, I. and Gulliksen, B. 2000. Fatty acid composition of the blubber in white whales (*Delphinapterus leucas*). *Polar Biol.* 23:401-409.

de March, B. G. E. and Postma, L. D. 2003. Molecular genetic stock discrimination of belugas (*Delphinapterus leucas*) hunted in Eastern Hudson Bay, Northern Quebec, Hudson Strait, and Sanikiluaq (Belcher Islands), Canada, and comparisons to adjacent populations. *Arctic* 56:111-124.

de March, B. G. E., Maiers, L. D. and Friesen, M. K. 2002. An overview of genetic relationships of Canadian and adjacent populations of belugas (*Delphinapterus leucas*) with emphasis on Baffin Bay and Canadian eastern Arctic populations. *NAMMCO Scientific Publications* 4:17-38.

DFO. 2002a. Cumberland Sound Beluga. Stock Status Report E5-32. Canadian Department of

Fisheries and Oceans, Central and Arctic Region, Winnipeg, MB.

DFO. 2002b. Underwater World – The Beluga. Canadian Department of Fisheries and Oceans, Communications Directorate. Ottawa, ON.

DFO 2002c. Northern Quebec (Nunavik) Beluga (*Delphinapterus leucas*). Stock Status Report E4-01. Canadian Department of Fisheries and Oceans, Quebec Region, Mont-Joli, QC.

Dietz, R., Heide-Jørgensen, M. P., Born, E. W. and Glahder, C. M. 1994. Occurrence of narwhals (*Monodon monoceros*) and white whales (*Delphinapterus leucas*) in East Greenland. *Meddelelser om Grønland Bioscience* 39:69-86.

Gjertz, I. and Wiig, Ø. 1994. Distribution and catch of white whales (*Delphinapterus leucas*) at Svalbard. *Meddelelser om Grønland Bioscience* 39:93-97.

Heide-Jørgensen, M. P. and Teilmann, J. 1994. Growth, reproduction, age structure and feeding habits of white whales (*Delphinapterus leucas*) in West Greenland waters. *Meddelelser om Grønland Bioscience* 39:195-212.

Heide-Jørgensen, M. P. and Reeves, R.R. 1996. Evidence of a decline in beluga, *Delphinapterus leucas*, abundance off West Greenland. *ICES J. Mar. Sci.* 53:61-72.

Heide-Jørgensen, M. P. and Acquarone, M. 2002. Size and trends of the bowhead whale, beluga and narwhal stocks wintering off West Greenland. *NAMMCO Scientific Publications* 4:191-210.

Heide-Jørgensen, M. P. and Rosing-Asvid, A. 2002. Catch statistics for belugas in West Greenland 1862 to 1999. *NAMMCO Scientific Publications* 4:127-142.

Heide-Jørgensen, M.P., Richard, P., Dietz, R., Laidre, K.L., Orr, J. and Schmidt, H.C. 2003. An estimate of the fraction of belugas (*Delphinapterus leucas*) in the Canadian high Arctic that winter in West Greenland. *Polar Biol.* 26:318-326.

Heide-Jørgensen, M. P., Richard, P., Ramsay, M. and Akeeagok, S. 2002. Three recent ice entrapments of Arctic cetaceans in West Greenland and the eastern Canadian High Arctic. *NAMMCO Scientific Publications* 4:143-148.

Innes, S. and Stewart, R. E. A. 2002a. Population size and yield of Baffin Bay beluga (*Delphinapterus leucas*) stocks. *NAMMCO Scientific Publications* 4:225-238.

Innes, S., Heide-Jørgensen, M. P., Laake, J.L., Laidre, K. L., Cleator, H. J., Richard, P., and Stewart, R. E. A. 2002a. Surveys of belugas and narwhals in the Canadian High Arctic in 1996. *NAMMCO Scientific Publications* 4:169-190.

Innes, S., Muir, D. C. G., Stewart, R. E. A., Heide-Jørgensen, M. P. and Dietz, R. 2002b. Stock identity of beluga (*Delphinapterus leucas*) in Eastern Canada and West Greenland based on organochlorine contaminants in their blubber. *NAMMCO Scientific Publications* 4:51-68.

Kingsley, M. C. S. 2002. Status of the belugas of the St. Lawrence estuary, Canada. *NAMMCO Scientific Publications* 4:239-258.

Koski, W. R., Davis, R. A. and Finley, K. J. 2002. Distribution and abundance of Canadian High Arctic belugas, 1974-1979. *NAMMCO Scientific Publications* 4:87-126.

[NAMMCO] North Atlantic Marine Mammal Commission 2000. Report of the NAMMCO Scientific Committee Working Group on the Population Status of Narwhal and Beluga in the North Atlantic. In: *NAMMCO Annual Report 1999.* NAMMCO, Tromsø, Norway, pp. 153-188.

[NAMMCO] North Atlantic Marine Mammal Commission 2002a. Report of the Joint meeting of the Scientific Committee Working Group on the Population Status of Narwhal and Beluga in the North Atlantic and the Scientific Working Group of the Joint Commission on the Conservation and Management. In: *NAMMCO Annual Report 2001*. NAMMCO, Tromsø, Norway, pp. 213-248.

[NAMMCO] North Atlantic Marine Mammal Commission 2002b. Greenland Progress Report on Marine Mammal Research. In: *NAMMCO Annual Report 2001*. NAMMCO, Tromsø, Norway, pp. 279-282.

[NAMMCO] North Atlantic Marine Mammal Commission. 2003. Greenland Progress Report on Marine Mammal Research. In: *NAMMCO Annual Report 2002.* NAMMCO, Tromsø, Norway, pp. 291-295.

[NAMMCO] North Atlantic Marine Mammal Commission. 2004. Greenland Progress Report on Marine Mammal Research. In: *NAMMCO Annual Report 2003.* NAMMCO, Tromsø, Norway, pp. 319-322.

Palsbøll, P. J., Heide-Jørgensen, M. P. and Bérubé, M. 2002. Analysis of mitochondrial control region nucleotide sequences from Baffin Bay belugas (*Delphinapterus leucas*): detecting pods or sub-populations? *NAMMCO Scientific Publications* 4:39-50.

TGS NOPEC Geophysical Company ASA, Petroleum GeoServices and Multi Klient Invest (TGS/PGS/MKI) Northeastern Canada 2D Seismic Exploration Survey.

-National Energy Board-

Addendum to November/December 2012 Community Engagement Report

After the meeting with the Pond Inlet Hamlet and Hunters and Trappers Organization, a member of the community informed the TGS-NOPEC representative that he had witnessed a large number of whales, seals and fish leaving Baffin Bay, passing Pond Inlet, on their way west in August 2012. This individual asked the TGS-NOPEC representative if he knew what would cause so many marine mammals and fish to leave Baffin Bay.

In response to this question, Zig Doborzynski, TGS-NOPEC representative, researched seismic survey and earthquake activity in Baffin Bay around August 2012 and provided the following information to the Pond Inlet Hamlet to forward on to the individual:

- No seismic survey occurred on the Canadian side of Baffin Bay or Davis Strait in the summer of 2012 (NEB 2012a; NEB 2012b)
- There was a seismic survey in the Beaufort Sea (2000km west of Pond Inlet). As sound intensity decreases with increasing distance, sound produced in the Beaufort Sea from a seismic survey would be virtually undetectable when it reached Pond Inlet. Therefore, the Beaufort Sea seismic survey is not the cause of the observation (NEB 2012a; NEB 2012b).
- On the Greenland side of Baffin Bay, four seismic surveys were completed in the summer of 2012 (Uulex, 2012):
    - Qamut license block: seismic survey started after August 17, 2012. This is after whales, seals and fish were seen leaving Baffin Bay
    - Tooq license block: survey area is closest to Greenland and furthest from Pond Inlet (~600km). Vessel arrived in early August, but surveying was delayed as the size and output of the seismic source was reduced
    - Anu and Napu license blocks: Seismic survey (one in each block) was completed from mid-July to mid-October 2012. These two licenses are between 100km and 180km off the Greenland cost and 500km and 420km from Pond Inlet. The sound pressure that would have reached Pond Inlet would have been equivalent to a whisper[1]. If a whisper could affect the behaviour of whales and seals, then there would have been a large migration of whales through Pond Inlet throughout the summer. Since this was not

[1] At a distance of 300km, the sound pressure from a 220dB seismic source would be 110.5dB re 1µPa/Hz in water or 48 dB re 20 µPa/Hz in the air, equal to a whisper. A chart describing the sound pressure in water and air and related conditions and meanings from Ingebret Gausland's (2000) paper "Impact of seismic surveys on marine life" was provided to the individual.

observed, it is likely that the seismic survey off Greenland did not have a significant impact on whales, seals and fish.

- Two earthquakes happened near Pond Inlet in the summer of 2012 (NRCan, 2012):
    - July 23, 2012 on Baffin Island between Clyde River and Pond Inlet
    - August 11, 2012 under Baffin Bay, 136km southeast of Pond Inlet. This earthquake measured 3.0 on the Richter scale. This is the result of an enormous amount of rock moving, which produced a pressure wave that could be felt by marine species which could cause them to flee the area.

References

Gausland, I. 2000. Impact of seismic surveys on marine life. *The Leading Edge.* p. 903-905

NEB. 2012a. National Energy Board: Weekly Status of Oil and Gas Activities on Frontier Lands for 7 August 2012. Retrieved from http://www.neb-one.gc.ca/clf-nsi/rnrgynfmtn/sttstc/wklysttslgsfrntr/2012/wklysttslgsfrntr2012_08_07.pdf

NEB. 2012b. National Energy Board: Weekly Status of Oil and Gas Activities on Frontier Lands for 14 August 2012. Retrieved from http://www.neb-one.gc.ca/clf-nsi/rnrgynfmtn/sttstc/wklysttslgsfrntr/2012/wklysttslgsfrntr2012_08_14.pdf

NRCan. 2012. Earthquakes Canada. Retrieved from http://www.earthquakescanada.nrcan.gc.ca/index-eng.php

Uulex. 2012. Greenland Oil Exploration Newsletter. Uulex No. 4- November 2012. Retrieved from http://www.bmp.gl/images/stories/petroleum/uulex/uulex_no4_november_2012.pdf

Is climate change causing the increasing narwhal (*Monodon monoceros*) catches in Smith Sound, Greenland?

Martin Reinhardt Nielsen

Faculty of Life Sciences, University of Copenhagen, Bülowsvej 17, DK-1870 Frederiksberg C, Denmark

Keywords
Climate change; Greenland; *Monodon monoceros*; Narwhal; whale management; whaling.

Correspondence
Martin Reinhardt Nielsen, Faculty of Life Sciences, University of Copenhagen, Bülowsvej 17, DK-1870 Frederiksberg C, Denmark. E-mail: nielsenmr@gmail.com

doi:10.1111/j.1751-8369.2009.00106.x

Abstract

This paper evaluates recent changes in narwhal (*Monodon monoceros*) catches in Siorapaluk, the northernmost community in Greenland, in consideration of the effects of changing climate and uncertainty of stock delineation. The catch statistics show a significant increase in narwhal catches by hunters in Siorapaluk after 2002, which does not appear to be a result of increased effort. Hunters attribute the increase to changed sea-ice conditions providing access by boat to Smith Sound as early as June and July. This indicates that climate change is likely to have a considerable impact on narwhal hunting in northern Greenland. Traditional ecological knowledge and scientific surveys suggest that narwhal in Smith Sound constitute an independent stock. The absence of scientific recommendations for this stock has been seen as an opportunity to increase quotas in West Greenland. Scientific management recommendations are urgently needed to allow the authorities to assign sustainable quotas for this stock. The development of collaborative management agreements and locally based monitoring are recommended to ensure local acceptance of regulations, and to allow rapid responses to climate change.

Three independent stocks of narwhal (*Monodon monoceros*) are currently recognized in Greenland waters (Heide-Jørgensen & Laidre 2006). The summer stock at Inglefield Bredning, in Qaanaaq municipality, is considered to be the same stock that is caught in autumn and winter in Uummannaq municipality and the Disko Bay area (Heide-Jørgensen et al. 2005), with individuals straying only rarely as far south as Maniitsoq. This stock is referred to as the West Greenland stock. The summer stock in Melville Bay is caught by hunters from Upernavik municipality and from Savisivik in Qaanaaq municipality. This stock spends the winter in the central part of Baffin Bay (Dietz & Heide-Jørgensen 1995). Narwhal in East Greenland are genetically distinct from stocks in West Greenland (Palsbøll et al. 1997), and are considered to comprise one stock, largely because of a lack of information (Nielsen, unpubl. ms.). Surveys reveal that the narwhal summer stock in Inglefield Bredning halved over the course of 20 years (Heide-Jørgensen et al. 2002). The West Greenland winter population has also been reduced, and the latest population assessment predicts local extinction of this stock in less than 30 years if current harvest levels continue (JCNB/NAMMCO 2004). No reliable population estimates are available for the Melville Bay stock.

Quotas were introduced by the Greenland Home Rule Government through an executive order on protection and hunting of beluga and narwhal in 2004. Management advice is provided by the Canada–Greenland Joint Commission on Conservation and Management of Narwhal and Beluga (JCNB). The JCNB receives scientific recommendations on harvest sustainability by a Joint Working Group (JWG) comprising the JCNB Scientific Working Group and a working group from the Scientific Committee of the North Atlantic Marine Mammal Commission (NAMMCO). The JWG recommends a maximum catch of 135 narwhal from the West Greenland stock (Witting 2005). However, uncertainty surrounds the stock delineation of narwhal populations in Baffin Bay and the northern strait between Greenland and Canada, the so-called Smith Sound, which in the winter constitutes part of the North Water Polynya (Heide-Jørgensen et al. 2005). Unclear stock delineation and the lack of reliable population estimates prevent the assignment of population-specific quotas to the relevant Greenlandic municipalities, where isolated communities depend on narwhals as a source of nourishment and income (Stevenson et al. 1997; Freeman et al. 1998). The urgency to solve this problem increases as the Greenland

Home Rule Government repeatedly exceeds quota allocations proposed by its Department of Fisheries, Hunting and Agriculture (DFFL). It is important to ensure that information on sustainable harvest levels is available for all stocks, so that the lack of information cannot be used as an argument for increasing quotas that would otherwise have been gradually reduced in accordance with scientific advice.

The potential effects of climate change on narwhal populations also remain uncertain. Generally, declining Arctic sea-ice trends are expected as a result of climate change (Symon et al. 2005; Solomon et al. 2007). Remotely sensed sea-ice concentrations in the period 1979–2001, however, indicate a decreasing fraction of open water and increasing interannual variability in narwhal wintering grounds in central Baffin Bay (Laidre & Heide-Jørgensen 2005). These wintering grounds are critically important for narwhal energy intake and overall fitness, suggesting that recent changes entail an increased risk of ice entrapment and vulnerability (Laidre & Heide-Jørgensen 2005). This result extends to Jones Sound in the North Water Polynya for the month of March (Heide-Jørgensen & Laidre 2004). However, as sea-ice concentrations are primarily driven by wind and current patterns as well as by temperature (Heide-Jørgensen et al. 2007), trends may vary according to local conditions, and may result in less sea ice locally. The potential effects of reduced sea-ice cover on marine mammal stocks include nutritional stress resulting from the redistribution of prey, changes in survivorship or fecundity, and altered migration routes or timing caused by changing ice patterns (Simmonds & Isaac 2007). The effects on higher tropic levels are, however, particularly difficult to investigate, because they involve relationships that may be non-trivial, non-linear and affected by time lags (Lusseau et al. 2004; Leaper et al. 2006). Furthermore, few studies have considered the impact of changing hunter behaviour as a result of climate change (but see Stirling & Parkinson 2006). The aim of this paper is therefore to evaluate the recent changes in narwhal catches in Siorapaluk, in consideration of the effects of changing climate as well as the uncertainty of stock delineation.

Study area

Siorapaluk (77°47′N, 70°43′E) is the northernmost community in Greenland and the one nearest to Smith Sound (Fig. 1). The community has a church, school, a general store and electricity, but no running water. There are approximately 60 inhabitants, of which 16 held an occupational hunter's license and seven held a part-time hunter's license in 2004. Almost all households depend on hunting and fishing for subsistence and income. Halibut, seal, narwhal, walrus, polar bear, reindeer, muskoxen and various birds are caught. Sealskin and halibut are produced for the national market, but only in small quantities on account of limited local freezer capacity, and because the products have to be transported to Qaanaaq to be sold. Particularly valuable catches such as narwhal, which may bring in the equivalent of approximately 5800 USD for an adult (Nygård & Topp-Jørgensen 2007), are also occasionally transported for marketing in Qaanaaq. However, often narwhal is not traded because it is considered to be of high cultural value, and important for the upkeep of social relationships through traditional sharing practices (Sejersen 2001). Hunting and fishing is carried out exclusively using dog sledges on the sea ice and from small dinghies. In accordance with Qaanaaq municipality by-laws, narwhal are hunted with hand-held harpoons with attached floats, and from kayaks, which are transported to the hunting area by dinghies: sometimes dinghies are dragged over long stretches of sea ice. The actual kill is undertaken with a rifle once the narwhal has been secured with several floats.

Methods

Siorapaluk was selected as the focal research community as it had been identified as a location of a considerable increase in narwhal catches. The evaluation is based on quantitative and qualitative inquiry, including catch statistics, information on the number of hunters and focus group discussions. The Siorapaluk catch statistics were extracted from the national catch database, Piniarneq, for the period 1993–2004. All hunters record catches per month, and report their annual catch to the DFFL, which maintains the database. Reported catches were verified during meetings or subsequently by telephone. Prior to 2004, narwhal hunting was permitted for both occupational and part-time hunters. Information on the number of active hunters in the period 1993–2004 was extracted from the national hunting license register. Sufficiently detailed and reliable data are not available for Siorapaluk prior to the establishment of Piniarneq (see Heide-Jørgensen 1994). Statistical tests were conducted with SAS software. Correlations were tested with the Pearson product-moment correlation coefficient. Significant differences in the means were tested with the Mann–Whitney *U*-test.

Semi-structured focus group discussions (Bryman 2004; Lloyd-Evans 2006) on narwhal hunting, hunting methods and the impacts of climate change were conducted in Greenlandic, with the aid of a local interpreter, with 12 members from the local hunting organization, KNAPK, and four members of the village board, on 30 November and 1 December 2006, respectively. All

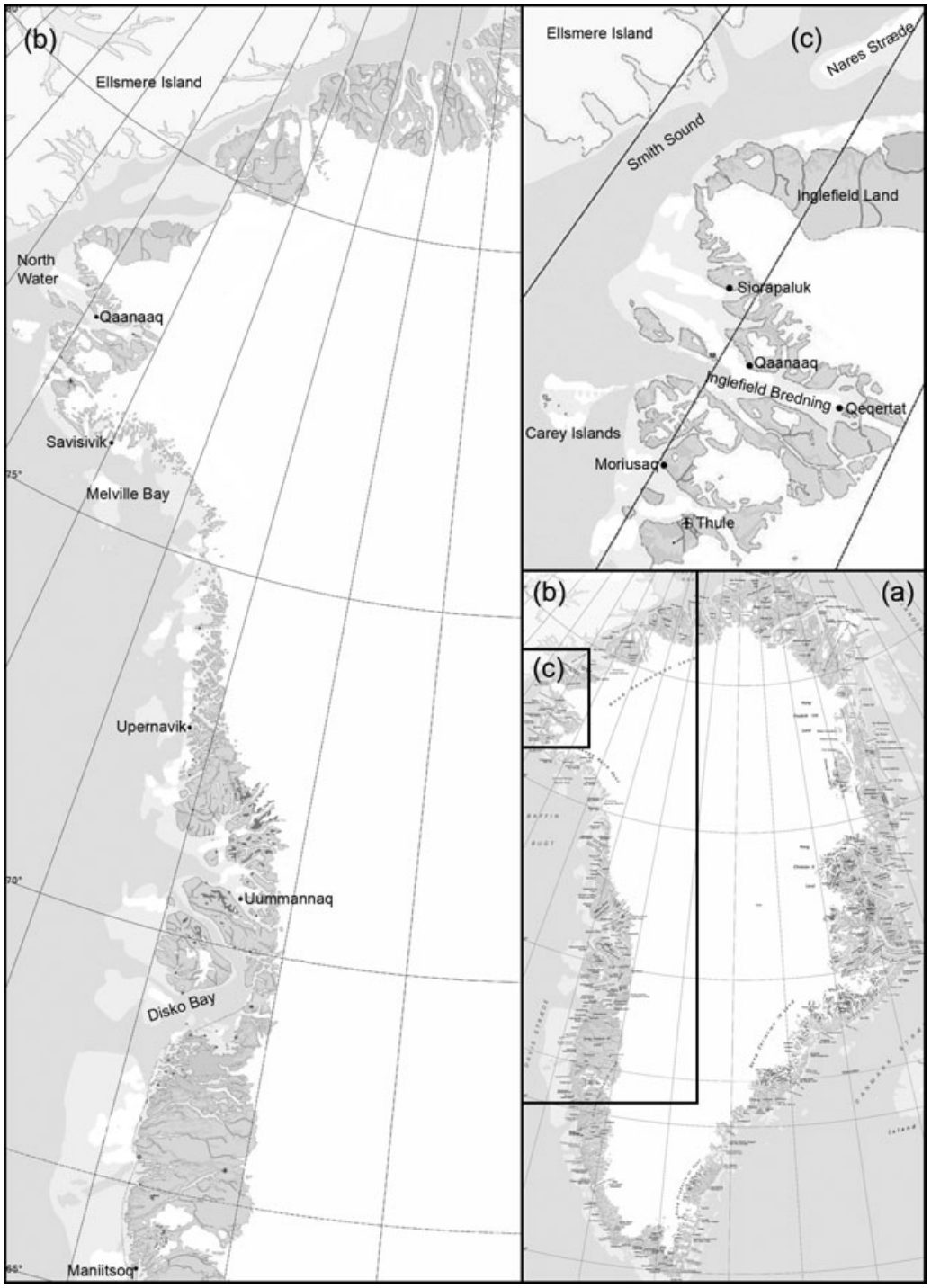

Fig. 1 Map of (a) Greenland, with insets (b) and (c) of the study area.

hunters in the community were invited for the discussion, and as more than half of the hunters and the village board participated in the discussion the results are considered to be representative for these groups. A meeting was also conducted with four members of the board of KNAPK in Qaanaaq on 3 December 2006. This approach was selected so that information could be collected from the primary stakeholders, including individual hunters, local hunting organizations and local authorities. Semi-structured focus group discussions were selected instead

of more open-ended or structured methods, to ensure the collection of the required information while retaining a measure of flexibility (Bryman 2004; Lloyd-Evans 2006). The key points raised were reviewed with the local interpreter immediately after the focus group discussions, and after the completion of the fieldwork a summary report was forwarded to the local KNAPK and the village board for verification and validation, and to allow for the consideration and inclusion of further comments. The consensus results of the discussions are reported unless otherwise stated. Names of participants and respondents have been kept confidential to protect their privacy.

Results

The results (Fig. 2) illustrate a significant increase in narwhal catches by hunters in Siorapaluk after 1998, compared with previous data ($U_{6.6} = 0$; $P < 0.05$). No significant correlation was found between the size of the catch and the total number of hunters ($r_{12} = 0.42$, $P > 0.05$), or the number of occupational hunters ($r_{12} = 0.49$, $P > 0.05$), suggesting that the increased catch is not a result of increased effort, assuming that hunting technology and the narwhal distribution have remained relatively stable throughout the period. These assumptions may not be valid, and will be considered in the discussion.

Hunters in Siorapaluk attribute the increased catch to the changing sea-ice conditions in Smith Sound. Previously, narwhal populations in Smith Sound were only accessible by dog sledge on the sea ice, and, according to the hunters, no one travelled there to hunt narwhal. One hunter from Siorapaluk recalled traveling to Smith Sound by dog sledge in May 1976 on a polar bear hunt, and seeing large pods of narwhal. According to the hunters, the formation of the ice is occurring later, the ice is thinner, it breaks up earlier, and, since 1998, Smith Sound can therefore be accessed by boat as early as June or July. This is supported by a substantial change in the distribution of the catch, with the bulk of the catch caught in June and July after 1998 (Fig. 3).

A more detailed look at the catch statistics, breaking it down into three periods, indicates a close connection between the catch and the number of hunters in the period 1993–98 (see Fig. 2), although no significant correlation was found ($r_6 = 0.48$, $P > 0.05$). The increasing number of hunters from 1999 to 2001 may explain the increasing catch in this period. However, from 2002 the number of hunters has remained stable, whereas the catch has almost tripled. This suggests that that effect of changing ice conditions on narwhal hunting, as emphasized by the hunters, cannot be disentangled from the effects of increased effort, until 2002. From July 2004 quotas were introduced on narwhal hunting in West Greenland. Unfortunately, remotely sensed sea-ice data are not readily available at sufficient spatial and temporal resolution for Smith Sound to enable correlation tests with the catch from 1993 to 2004 (Laidre, pers. comm.). Similarly, the air-temperature records available from Qaannaq and the Carey Islands are of dubious utility in this context, because of the distance from Smith Sound, and because local sea-ice concentrations are determined by wind and current patterns, as well as by temperature (Heide-Jørgensen et al. 2007). Assessing the correlations reported here with measures of climate change is thus beyond the scope of this study. Documentation of similar changes in sea-ice cover is, however, abundant from other locations in the Arctic, and will be considered in the discussion.

Hunters in Siorapaluk consider the narwhal in Smith Sound to be a separate population that either migrates between Canada (Ellesmere Island and Humbolt Brink) and Greenland, or remains in Smith Sound all year round. According to local knowledge, the winter population is very variable. Narwhal hunting in Smith Sound is primarily carried out by hunters from Siorapaluk, but hunters from Qaanaaq and perhaps Moriusaq are

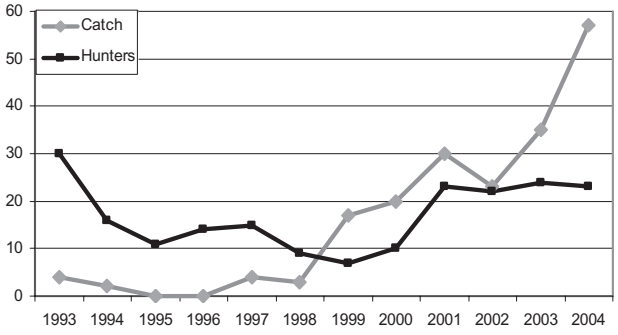

Fig. 2 Narwhal catch by hunters from Siorapaluk and total number of hunters in the period 1993–2004.

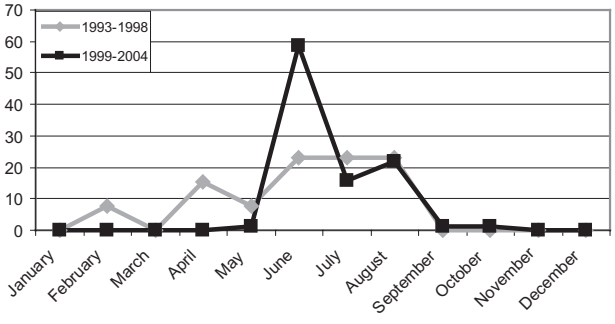

Fig. 3 Percentage of accumulated narwhal catches by hunters in Siorapaluk per month, before and after 1998.

increasingly targeting this area as well. This means that the increase in the catch in Smith Sound may be higher than Fig. 2 indicates. According to the KNAPK in Qaanaaq, approximately three boats from Qaanaaq hunt narwhal in Smith Sound, and annually return with between one and three narwhal each. It was also rumoured that unlicensed hunting is on the increase. The window of opportunity is, however, decreasing: according to the hunters, the break-up of the ice occurs earlier and earlier, causing the narwhal to disperse and head to the fjords.

Discussion and recommendations

The hunters' observations of changes in sea ice correspond to scientifically documented changes in sea-ice cover, ice thickness, and dates of freeze and break-up in the Arctic (Johannessen et al. 1999; Maslanik et al. 1999; Parkinson et al. 1999; Rothrock et al. 1999; Copley 2000; Rigor et al. 2002; Rothrock et al. 2003; Serreze et al. 2003; Comiso & Parkinson 2004; Fowler et al. 2004; Gough, Cornwell et al. 2004, Gough, Gagon et al. 2004; Gagon & Gough 2005; Lindsay & Zhang 2005; Rothrock & Zhang 2005; Stroeve et al. 2005; Stirling & Parkinson 2006). They also correspond to changes observed by Inuit in other parts of the Arctic (see review in Laidler 2006). These changes are considered to be the result of anthropogenic climate change (Solomon et al. 2007). The results indicate that climate change is likely to have been making a considerable impact on narwhal hunting in Smith Sound since 2002, and potentially since 1999.

This conclusion is based on the assumption that hunting technology and narwhal distribution and stock size have remained stable. All vessels used by occupational hunters must be registered in the Greenland vessel register managed by the Greenland Fisheries License Office (GFLK). GFLK has, however, only received three reports from Qaanaaq municipality. The reports mention one vessel in 1992, two more in 1993 and another two in 1999, bringing the total to five dinghies in Siorapaluk, all below 4 gross metric tonnes. The Danish Maritime Authority registered one vessel in Siorapaluk in a survey in 2000, and none in 2007. However, in the period 2000–02, about 13 600 USD was allotted to support the purchase of three 19-foot/115-horsepower dinghies by occupational hunters in Siorapaluk, from the Home Rule Government's fund for development of the hunting sector. No information is available on vessels owned by part-time hunters. Because of the incomplete information about vessels in use, it cannot be ruled out that improvement in technology has had an effect on narwhal hunting by hunters from Siorapaluk. Based on the available information and observations of vessels, and the lack of snowmobiles in Siorapaluk, it is, however, considered unlikely that improved technology is the main reason for the increase in catch from an average of two whales per year from 1993 to 1998 (95%; *CI* [confidence interval] $\pm$ 0.05), to 30 whales per year from 1999 to 2004 (95%; *CI* $\pm$ 0.37).

Aerial surveys conducted in June recorded narwhals in Smith Sound at the same time as pods were observed at Inglefield Bredning (Koski & David 1994). This indicates that the Smith Sound pods belong to an independent population, which also accords with local knowledge. In combination with the reduction of narwhal stocks at Inglefield Bredning (Heide-Jørgensen et al. 2002), primarily attributed to unsustainable exploitation, this indicates that the increased catch is not caused by a change in the narwhal distribution. However, it cannot be excluded that a potential increase in stock size has contributed to the increased catch by hunters in Siorapaluk, although this is unlikely given the general declining trend in narwhal stocks in Greenland for the period (Born et al. 1994; Heide-Jørgensen et al. 2002; Heide-Jørgensen & Acquarone 2002; Heide-Jørgensen 2004; JCNB/NAMMCO 2004).

As no abundance estimates exist for Smith Sound, no information is available on sustainable catch levels for this stock. The optimal sustainable use of all Greenlandic narwhal populations is imperative, in consideration of the cultural and economic importance of narwhal hunting (Sejersen 2001). With the introduction of quotas from July 2004, catches have been reduced drastically, and hunters struggle to find alternative income-generating activities. Hunting is a central part of Greenlandic culture and identity, and the Greenlandic hunter's organization, KNAPK, has strong political support. The existence of a population of narwhal in Smith Sound for which scientific recommendations are lacking has been seen as an opportunity to increase narwhal quotas in West Greenland. Coupled with the effects of climate change, which appear to be accelerating and leading to changes in sea-ice cover earlier than expected (Holland et al. 2006; Stroeve et al. 2007; Serreze et al. 2007), this could have serious detrimental implications for narwhal stocks.

The DFFL have been attempting to reduce quotas gradually to the scientifically recommended sustainable levels in order to give narwhal hunter's time to adapt and develop alternative income options. However, in the quota year 2005–06, the Home Rule Government added 50 extra narwhal to the quota of 260 whales recommended by the DFFL for West Greenland, a number that already greatly exceeded the recommended harvest of 135 whales from the West Greenland stock (no recommendation is available for the Melville Bay stock). In

December 2006 an additional 100 animals were allotted to the 2006–07 quota of 285 whales. In July 2007, an initial quota of 300 whales was allocated for the quota year 2007–08. The Home Rule Government simultaneously pledged in a press release to develop a plan to reduce quotas to levels in accordance with scientific advice by April 2008. However, the quota for the year 2008–09 was again set at 300 animals, and by December 2008 a plan had not yet been produced. Instead, 90 animals had been allocated in addition to the initial quota. In a press release by the Home Rule Government this was justified on the basis of the fact that the hunters had applied for additional whales. On a more positive note, a preliminary analysis of new data indicates a higher abundance of narwhal than has previously been assumed (NAMMCO 2008).

Scientific recommendations are urgently needed to allow authorities to assign sustainable quotas for the Smith Sound population of narwhals. To prevent untimely interference by politicians in quota allocation, and to ensure compliance and optimal adaptation to local circumstances, collaborative management agreements should be developed with local hunter organizations. This could ensure local acceptance of regulations, and thus prevent the inclination for politicians to allot extra quotas to show their support for the hunters and gain local popularity and votes.

Collaborative management could also include a jointly developed monitoring strategy (Huntington 2000; Russel et al. 2000; Harwood et al. 2002). This should, in addition to scientific population counts, use the large and cost-efficient data potential of systematically recorded quantitative observations from the hunters (Kofinas et al. 2001; Moller et al. 2004; see also Danielsen et al. 2000), who regularly traverse Smith Sound and other narwhal areas. This would give hunters a valid basis for their arguments in discussions on quota allocations, and could provide biologists with an indirect measure of population trends and other information in the periods between scientific counts (Fernandez-Gimenez et al. 2006), and would therefore permit rapid management responses to changing circumstances, occurring as a result of climate change for instance.

Although not unproblematic (Richard & Pike 1993; Collings 1997; Kruse et al. 1998; Klein et al. 1999; Kaplan & McCay 2004; Tyrrell 2007; Fernandez-Gimenez et al. 2008), co-management initiatives could ease a strained relationship between biologists and hunters, who have been in strong opposition since the introduction of quotas in Greenland (Sejersen 2003). Recently, a collaboration agreement was signed between KNAPK and the Greenland Institute of Natural Resources. Hopefully this can help ensure that the common goals of large viable populations, and compliance with international agreements that Greenland has adopted, are achieved.

Acknowledgements

I want to thank the people of Siorapaluk for their hospitality, and the hunter's organizations and local administration in Siorapaluk and Qaanaaq for providing information for this study. Thanks also to the Hunting Division of the Directorate for Fisheries, Hunting and Agriculture for access to catch statistics and other information, and to Kristine Laidre, Mads Peter Heide-Jørgensen, Elmer Topp-Jørgensen, Erik W. Born, Fernando Ugarte and Natasja Kingod for useful information and comments on earlier drafts of the manuscript.

References

Born E.W., Heide-Jørgensen M.P., Larsen. F. & Martin A.R. 1994. Abundance and stock composition in Inglefield Bredning (NW Greenland). *Meddelelser om Grønland. Bioscience 39*, 51–68.

Bryman A. 2004. *Social research methods*. Second edn. Oxford: Oxford University Press.

Collings P. 1997. Subsistence hunting and wildlife management in the central Canadian Arctic. *Arctic Anthropology 34*, 41–56.

Comiso J.C. & Parkinson C.L. 2004. Satellite-observed changes in the Arctic. *Physics Today 57(8)*, 38–44.

Copley J. 2000. The great ice mystery. *Nature 408*, 634–636.

Danielsen F., Balete D.S., Poulsen M.K., Enghoff M., Nozawa C.M. & Jensen A.E. 2000. A simple system for monitoring biodiversity in protected areas of a developing country. *Biodiversity and Conservation 9*, 1671–1705.

Dietz R. & Heide-Jørgensen M.P. 1995. Movements and swimming speed of narwhals (*Monodon monoceros*) instrumented with satellite transmitters in Melville Bay, northwest Greenland. *Canadian Journal of Zoology 73*, 2106–2119.

Fernandez-Gimenez M.E., Huntington H.P. & Frost K.J. 2006. Interaction or co-optation? Traditional knowledge and science in the Alaska Beluga Whale Committee. *Environmental Conservation 33*, 306–315.

Fernandez-Gimenez M.E., Hays J.U., Huntington H.P., Andrew R. & Goodwin W. 2008. Ambivalence towards formalizing customary resource management norms among Alaska Native beluga whale hunters and Tohono O'odham livestock owners. *Human Organization 67*, 137–150.

Freeman M.M.R., Bogoslovskaya L., Caulfield R.A., Egede I., Krupnik I.I. & Stevenson M.G. 1998. *Inuit, whaling and sustainability*. Walnut Creek, CA: Altamira Press.

Fowler C., Emery W.J. & Maslanik J. 2004. Satellite-derived evolution of Arctic sea ice age: October 1978 to March 2003. *IEEE Geosciences Remote Sensing Letters 1*, 71–74.

Gagnon A.S. & Gough W.A. 2005. Climate change scenarios for the Hudson Bay region: an intermodel comparison. *Climatic Change 69*, 269–297.

Gough W.A., Cornwell A.R. & Tsuji L.J.S. 2004. Trends in seasonal sea ice duration in southwestern Hudson Bay.*Arctic 57*, 299–305.

Gough W.A., Gagon A.S. & Lau H.P. 2004. Interannual variability of Hudson Bay ice thickness. *Polar Geography 28*, 222–238.

Harwood L.A., Norton P., Day B. & Hall P.A. 2002. The harvest of beluga whales in Canada's western Arctic: hunter-based monitoring of size and composition of the catch. *Arctic 55*, 10–20.

Heide-Jørgensen M.P. 1994. Distribution, exploitation and population status of white whales (*Delphinapterus leucas*) and narwhals (*Monodon monoceros*) in West Greenland. *Meddelelser fra Grønland. Bioscience 39*, 135–149.

Heide-Jørgensen M.P. 2004. Aerial digital photographic surveys of narwhal, *Monodon monoceros*, in West Greenland. *Marine Mammal Science 20*, 246–261.

Heide-Jørgensen M.P. & Acquarone M. 2002. Size and trends of the bowhead whale, beluga and narwhal stocks wintering off West Greenland. *NAMMCO Scientific Publications 4*, 191–210.

Heide-Jørgensen M.P., Dietz R. & Laidre K. 2005. Metapopulation structure and hunt allocation of narwhals in Baffin Bay. In: *NAMMCO Annual Report*. Pp. 221–223. Tromsø: North Atlantic Marine Mammal Commission.

Heide-Jørgensen M.-P., Hemmeken N. & Hollebeek P. 2002. *Optælling af Narhvaler i Qaanaaq Kommune i august 2001. (Census of narwhal in Qaanaaq municipality in August 2001.) Teknisk Rapport 50*. Nuuk: Institute of Natural Resources.

Heide-Jørgensen M.P. & Laidre K.L. 2004. Declining extent of open water refugia for top predators in Baffin Bay and adjacent waters. *Ambio 33*, 488–495.

Heide-Jørgensen M.P. & Laidre K. 2006. *Greenland's winter whales: beluga, narwhal and bowhead whale*. Nuuk: Ilinniusiorfik Undervisningsmiddelforlag.

Heide-Jørgensen M.P., Stern H. & Laidre K.L. 2007. Dynamics of the sea ice edge in Davis Strait. *Journal of Marine Systems 67*, 170–178.

Holland M.M., Blitz C.M. & Tremblay B. 2006. Future abrupt reductions in the summer Arctic sea ice. *Geophysical Research Letters 33*, article no. L23503.

Huntington H.P. 2000. Using traditional ecological knowledge in science: methods and applications. *Ecological Applications 10*, 1270–1274.

JCNB (Canada–Greenland Joint Commission on Conservation and Management of Narwhal and Beluga)/ NAMMCO (North Atlantic Marine Mammal Commission) 2004. *Joint Meeting of the NAMMCO Scientific Committee Working Group on the Population Status of Narwhal and Beluga in the North Atlantic and the Canada/Greenland Joint Commission on Conservation and Management of Narwhal and Beluga Scientific Working Group. 3–6 February 2004*. Tromsø, Norway: North Atlantic Marine Mammal Commission.

Johannessen O.M., Shalina E.V. & Miles M.W. 1999. Satellite evidence for an Arctic sea ice cover in transformation. *Science 286*, 1937–1939.

Kaplan I.M. & McCay B.J. 2004. Cooperative research, co-management and the social dimension of fisheries science and management. *Marine Policy 28*, 257–258.

Klein D.R., Moorehead L., Kruse J. & Braund S.R. 1999. Contrasts in use and perceptions of biological data for caribou management. *Wildlife Society Bulletin 27*, 488–498.

Kofinas G., Lyver P., Russell D., White R., Nielson A. & Flanders N. 2001. Towards a protocol for community monitoring of caribou body condition. *Rangifer 14*, 43–52.

Koski W.R. & David R.A. 1994. Distribution and numbers of narwhals (*Monodon monoceros*) in Baffin Bay and Davis Strait. *Meddelelser om Grønland. Bioscience 39*, 15–40.

Kruse J., Klein D., Braund S., Moorehead L. & Simeon B. 1998. Co-management of natural resources: a comparison of two caribou management systems. *Human Organization 57*, 447–458.

Laidler G.J. 2006. Inuit and scientific perspectives on the relationship between sea ice and climate change: the ideal complement? *Climate Change 78*, 407–444.

Laidre K.L. & Heide-Jørgensen. M.P. 2005. Arctic sea ice trends and narwhal vulnerability. *Biological Conservation 121*, 509–517.

Leaper R., Cooke J., Trathan P., Reid K., Rowntree V. & Payne R. 2006. Global climate drives southern right whale (*Eubalaena australis*) population dynamics. *Biology Letters 2*, 289–292.

Lindsay R.W. & Zhang J. 2005. The thinning of Arctic sea ice, 1988-2003: have we passed a tipping point? *Journal of Climate 18*, 4879–4894.

Lloyd-Evans S. 2006. Focus groups. In V. Desai & D. Potter (eds.): *Doing development research*. Pp. 153–163. London: Sage Publications.

Lusseau D., Williams R., Wilson B., Grellier K., Barton T.R., Hammond P.S. & Thompson P.M. 2004. Parallel influences of climate on the behavior of Pacific killer whales and Atlantic bottlenose dolphins. *Ecology Letters 7*, 1068–1076.

Maslanik J.M., Serreze M.C. & Agnew T. 1999. On the record reduction in the western Arctic sea ice cover in 1998. *Geophysical Research Letters 26*, 1905–1908.

Moller H., Berkes F., Lyver P.O. & Kislaioglu M. 2004. Combining science and traditional ecological knowledge: monitoring populations for co-management. *Ecology and Society 9(3)*, article no. 2.

NAMMCO (North Atlantic Marine Mammal Commission) 2008. *Scientific Committee. Report of the fifteenth meeting. Qeqertarsuaq, Greenland. 11–14 April 2008*. Tromsø, Norway: North Atlantic Marine Mammal Commission.

Nygård L.A. & Topp-Jørgensen J.E. 2007. Paper on significant trade review: beluga whale, narwhal, Atlantic walrus and polar bear. Nuuk: Hunting Department, Ministry of Fisheries, Hunting and Agriculture.

Palsbøll P.J., Heide-Jørgensen M.P. & Dietz R. 1997. Population structure and seasonal movements of narwhals,

Monodon monoceros, determined from mtDNA analysis. *Heredity 78*, 284–292.

Parkinson C.L., Cavalieri D.J., Gloersen P., Zwally H.J. & Comiso C.J. 1999. Arctic sea ice extents, areas and trends, 1978–1996. *Journal of Geophysical Research—Oceans 104*, 20 837–20 856.

Richard P.R. & Pike D.G. 1993. Small whale co-management in the eastern Canadian Arctic: a case history and analysis. *Arctic 46*, 138–143.

Rigor I.G., Wallace J.M. & Colony R.L. 2002. Response of sea ice to the Arctic oscillation. *Journal of Climate 15*, 2648–2663.

Rothrock D.A., Yu Y. & Maykut G.A. 1999. Thinning of the Arctic sea ice cover. *Geophysical Research Letters 26*, 3469–3472.

Rothrock D.A., Zhang J. & Yu Y. 2003. The Arctic sea ice anomaly of the 1990s: a consistent view from observations and models. *Journal of Geophysical Research—Oceans 108*, article no. 3083.

Rothrock D.A. & Zhang J. 2005. Arctic Ocean sea ice volume: what explains its recent depletion? *Journal of Geophysical Research—Oceans 110*, article no. C01002.

Russel D., Kofinas G. & Griffith B. 2000. Need and opportunity for a North American caribou knowledge cooperative. *Polar Research 19*, 117–130.

Sejersen F. 2001. Hunting and management of beluga whales (*Delphinapterus leucas*) in Greenland: changing strategies to cope with new national and local interests. *Arctic 54*, 431–443.

Sejersen F. 2003. *Grønlands naturforvaltning: ressourcer og fangstrettigheder. (Greenland's nature management: resources and hunting rights.)* Copenhagen: Akademisk Forlag.

Serreze M.C., Holland M.M. & Stroeve J. 2007. Perspectives on the Arctic's shrinking sea-ice cover. *Science 315*, 1533–1536.

Serreze M.C., Maslanik J.A., Scambos T.A., Fetterer F., Stroeve J., Knowles K., Fowler C., Drobot S., Barry R.G. & Haran T.M. 2003. A record minimum Arctic sea ice extent and area in 2002. *Geophysical Research Letters 30*, article no. 1110.

Simmonds M.P. & Isaac S.J. 2007. The impacts of climate change on marine mammals: early signs of significant problems. *Oryx 41*, 19–26.

Solomon S., Qin D., Manning M., Chen Z., Marquis M., Averyt K., Tignor M.M.B. & Miller H. L. Jr. (eds.) 2007. *Climate change 2007. The physical science basis. Contribution of Working Group I to the fourth assessment report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.

Stevenson M.G., Madsen A. & Maloney E. 1997. *The anthropology of community-based whaling in Greenland*. Edmonton: Canadian Circumpolar Institute, University of Alberta.

Stirling I. & Parkinson C.L. 2006. Possible effects of climate warming on selected populations of polar bears (*Ursus maritimus*) in the Canadian Arctic. *Arctic 59*, 261–275.

Stroeve J.C., Serreze M.C., Fetterer F., Arbetter T., Meier W., Maslanik J. & Knowles K. 2005. Tracking the Arctic's shrinking ice cover: another extreme September minimum in 2004. *Geophysical Research Letters 32*, L04501, doi: 10.1029/2004GL021810.

Stroeve J., Holland M.M., Meier,W., Scambos T. & Serreze M. 2007. Arctic sea ice decline: faster than forecast? *Geophysical Research Letters 34*, article no. L09501.

Tyrrell M. 2007. Sentient beings and wildlife resources: Inuit, beluga whales and management regimes in the Canadian Arctic. *Human Ecology 35*, 575–586.

Symon C., Arris L. & Heal B. 2005. *Arctic climate impact assessment*. Cambridge: Cambridge University Press.

Witting L. 2005. A model selection based assessment for West Greenland narwhals with uncertain stock structure. In: *Final report. Joint Meeting of the NAMMCO Scientific Committee Working Group on the Population Status of Narwhal and Beluga in the North Atlantic and the Canada/Greenland Joint Commission on Conservation and Management of Narwhal and Beluga Scientific Working Group. 13–16 October 2005. Nuuk, Greenland, October 2005*. Pp. 15–16. Tromsø, Norway: North Atlantic Marine Mammal Commission.

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ᑕᒪᓐ ᖃᐅᔨᒪᓂᖅ ᓄᓇᖅᓯᐊᕐᓴ ᐅᓂᒃᑲᖅᓯᒪᔪᑐᑦ (SOKIM) ᓴᖅᑎᑕᐅᓕᐅᕐᓂᖅ ᓄᓇᕗᑦ ᕿᓐᓄᐃᓕᒃᑯᓄᑦ (NPC) ᓯᕗᓕᕐᕿᖅᓯᒪᔪᖅ ᐊᑦᓗᓚᐊᕐᓂᖅ ᐱᓕᓕᐊᓂᕆᑦ ᑕᕐᓯᒥᖅ ᓄᓇᕗᑦ ᓄᓇᐅᑦ ᐊᑐᕐᑕᐅᓕᕐᓂᖅᑕ ᕿᓐᓄᐃᓐᓇᑦ (NLUP) ᑕᕐᑯᓄᖅᓗᒃᑕᖅ ᑕᓕᖅᖢᖅ ᓄᓇᕗᑦ ᓄᓇᓕᕐᔪᐊᑎᖏᑦ ᐃᓂᒋᔭᖅ (NSA). ᑕᒪᓐ ᐱᕐᔪᐊᑎᖅ ᑎᑎᖅᑦ ᑲᑎᖅᓯᐃᓗᑎᑲ ᖃᐅᔨᒪᕐᔪᐊᑎᕐᑲᓂᖅ ᓂᕐᔪᑎᑦ ᐃᓂᒋᔭᖏᑦᓂᖅ ᐊᒪᒪᓗ ᖃᐅᔨᑎᑕᓯᓗᑎᑲ ᖃᓄᖅ ᑕᒪᓐ ᓄᓇ ᐊᑐᖅᑕᐅᔪᒪᖅᑎᑦ ᐱᔪᓕᐊᓂᕐᒧᑦ. ᑕᒪᓐ ᖃᐅᔨᒪᓂᖅ ᓄᓇᐅᑦ ᐅᓂᒃᑲᖅᓯᒪᔪᑐᑦ ᐊᑐᕐᑕᐅᓂᕐᓂᖅ ᐅᖃᐅᓯᐅᕐᓂᖅᑕ ᐊᒪᒪᓗ ᐃᓱᒪᒃᑲᕐᓂᐅᓂᑦ ᖃᓄᖅ ᑕᒪᓐ ᓄᓇ, ᐃᒪᖅ ᐊᒪᒪᓗ ᐊᑐᑐᐃᓇᐅᔪᒃᑲᑦ ᑕᒃᓄᓇᓕᐅᕐᓄᑦ ᓄᓇᕗᑦ ᓄᓇᓕᕐᔪᐊᑎᖏᑦ ᐃᓂᒋᔭᖅ ᐊᐅᓚᑕᐅᓂᕐᓂᖅ ᓄᓇᕗᑦ ᓄᓇ ᐊᑐᕐᑕᐅᓕᕐᓂᖅᑕ ᕿᓐᓄᐃᓐᓇᑦ.

ᑕᒪᓐ ᓇᓴᖅᓯᒪᔪᑦ ᑕᒃᓄᓇᖅᑕᑦ ᓄᓇᖅᓯᐊᕐᑦ ᐃᓕᖃᓪᓗᑎᒃ ᖃᐅᔨᓂᒃᓄᓇᕐᓂᑦ ᑕᒃᓄᓇᖅᑕᑦ:

- ᐊᑐᕐᑕᐅᔪᖅ ᓄᓇᕗᑦ ᕿᓐᓄᐃᓕᑦ ᓄᓇ ᐊᑐᕐᑕᐅᓕᕐᓂᖅᑕ ᕿᓐᓄᐅᑎᑦ,
- “ᓄᓇᕗᑦ ᓂᕐᔪᑎᑦ ᐊᑕᐃᓇᐅᔪᒃᑲᑦ ᐊᒪᒪᓗ ᓇᔪᖅᕿᒃᑕᖅᑐᓕ ᐃᕐᓕᓚᓴᐃᑕ ᐅᓂᒃᑲᖅᑦ”, ᐊᖏᑕᐅᔪᖅ ᑕᒃᓄᓇᓄᖅᑐᓕ ᓄᓇᕗᑦ ᕿᓐᓄᐃᓕᒃᑯᑦ, ᐊᐅᑐᓪᓗ, 2008 ᑕᒃᓄᓇᓄᖅᑐᓕ ᐊᑎᓕᒃ ᓄᓇᒥ Jacques Whitford
- *“ᓄᓇᖅᓯᐊᕐᑦ ᐋᖏᓪᓚᓂᓇᔾᔪᑎ ᐊᒪᒪᓗ ᐱᔭᕐᓕᐅᓂᖅ ᖃᐅᔨᓴᓂᓂᒃᑯᑦ ᐅᓂᒃᑲᖅᖁᓪ,”*, ᐋᖏᑕᐅᔪᖅ ᓄᓇᕗᑦ ᕿᓐᓄᐃᓕᒃᑯᑦ, ᐊᖑᓚᓯ, 2008 ᑕᒃᓄᓇᓄᖅᑐᓕ ᑕᐃᓴᐅᔪᑦ Terriplan ᐅᖃᖃᑎᖃᓂᑦ.

ᑕᒪᓐ ᖃᐅᔨᒪᑦᔪᑎᑲᓴᖅ ᐅᑦᓗᒥᒧᑦ ᐋᖏᓚᒪᔪᑲᓴᖅ ᐱᔾᓕᐊᖃᖅᑎᑐᓂᒃ. ᑭᓯᐊᓂ,ᓕᓂ, ᑕᒪᓐ ᐱᑎᑦᔪᒍ, ᐃᒡᓗᒪᓕᖅᑐᑦ, ᐅᑦᔨᑐᓓᐊᖅᖃᖅᑎᑦᓂ, ᐅᒃᖠᓄᓂᑦ ᐋᖅᖁᐅᒪᑦᓯᐊᖅᑎᑐᓂᒃ ᓇᔾᔪᓚᒪᔪᑦ ᐱᑦᑕᖃᓂᖓᑦ, ᑕᒃᓄᐊ ᓄᓇᕗᑦ ᕿᓐᓄᐃᓕᒃᑯᑦ ᐅᖃᐅᓯᒃᑲᓂᒃ ᐱᔪᓚᕗᑦ, ᑕᒃᓄᐊ ᓄᓇᕗᑦ ᕿᓐᓄᐃᓕᒃᑯᑦ ᐅᖃᐅᓯᒃᑲᓂᒃ ᐱᔪᓚᕗᑦ ᐊᒪᒪᓗ ᐱᖁᓇᒃᖃᓂᒃ. ᐅᓐᓇ ᖃᐅᔨᑎᓗᔪᒍ:

ᒪᐃᒃ ᑕᐅᓐᓯᓐ,
ᓄᓇᖅᐊᑕᓇᓂᕐᒧᑦ ᖃᐅᔨᒪᑕᖅ,
ᓄᓇᕗᑦ ᕿᓐᓄᐃᓕᑦ
PO Box 2101
ᐃᖃᓗᐃᑦᑯᐊᖅ, ᓄᓇᕗᑦ X0B0C0
ᐅᖃᓗᑕ: 867-983-4635
ᓯᐅᓴᐅᔪᑦ: 867-983-4626
ᖃᓇᑕᐅᔾᔨᔪᑦ ᑐᕋᕐᑕ: mtownsend@npc.nunavut.ca

Introduction

This State of Knowledge in Maps Report (SOKIM) has been created by the Nunavut Planning Commission (NPC) as a first step towards the development of a Regional Land Use Plan for the entire Nunavut Settlement Area. The purpose of this document is to open up dialog and encourage feedback concerning the many data layers on the maps.

The data from the maps contained herein are derived from:

- Existing NPC Land Use Plans,
- "*Nunavut Wildlife Resource and Habitat Values Report*", prepared for the NPC, October, 2008 by Jacques Whitford
- *"Socio-Demographic and Economic Sector Analysis Report",* prepared for the NPC, August, 2008 by Terriplan Consultants.

This information has been updated where possible. However, in the event that you, the reader, should be aware of, or have more relevant data available, the NPC would like to receive your comments and suggestions. Please contact:

Mike Townsend, Land Information Technologist, Nunavut Planning Commission
PO Box 2101
Cambridge Bay, NU
X0B0C0
Ph: 867-983-4635
Fx: 867-983-4626
Email: mtownsend@npc.nunavut.ca

Naonaigotighak

Ona elittogijotighak Nunaoyalikinikot tohagotighak (SOKIM) NPC-kot hanakiyaat hivolik eniktigotaovaliayoghak Nunavunmi Nunat Atoktaonighaitigot tamatkiomatiyot Nunavunmot. Ona naonaigotighak pihimalakiyok naonaiyakpaaliotighanik elittogijotaoyoghaniklo nunani angotighakakniknik ovalo kanoktot nunap atoktaoningga nunamit manighiotaovakniakmagaat pivaliajotaoloni hivonighaptikni. Ona nunaoyaliginikot naonaigotighak pihimayok okaotaovaliayaagani kanoktot nuna, emaklo nunamitlo atoktaghat Nunavunmi monagiyaovagiakhainik kanoktollo amigiyaovagiakhainik Nunat Atoktaonighaitigot Opalonggaiyaotaoyot nunavunmi.

Omani naonaigotighat nunaoyatigot pihimayot okonangga:

- Tajta NPC-kot atoktait Nunap Atoktaonighaitigot Opalonggaiyaotaohimayonit,
- "*Nunavutmi Angotighat Angotighakaknigillo ehagiagiyaoyotigot tohagotighak* ", eniktikhimayok NPC-konnot Aktopa 2008-mi omangga NUNAMI Jacques Whitford
- *"Inuktigollo Manighioknikollo tohagotighak" ,* eniktikhimayok NPC-konnot Akasi 2008-mi omangga Terriplan Consultants.

Ona naonaigotighak nutaagokhimaliktok malikhogo kanogilivaliajotaoyot. Kihimi, imaa innikat ilvit taigoktotit, oinggaihimanahoajavotit ovaloniit naonaikpaaliotighanik pihimayakaklotit titikanik, NPC-kot ilingnit tohagomayot kanok ehomagiyakagiakhaknik okaalaotikakgomagovilooniit. Ona hivayainnagialik okakvigilogo:

Mike Townsend,
Nunalikinikot Naonaikvighak Ehoaghaiyi,
Nunavut Paknaiyiit
Titigakakvia 2101
Ekaluktutiak, NU X0B0C0
Okaotaa: 867-983-4635
Kayomiktokot: 867-983-4626
Kagitaoyakot: mtownsend@npc.nunavut.ca

Introduction

Ce Rapport sur l'état de connaissance des cartes (RECC) a été créé par la Commission d'aménagement du Nunavut (NPC) comme première étape envers le développement du Plan d'utilisation des terres au Nunavut (PUTN) couvrant l'ensemble des Régions établies au Nunavut (RÉN). L'objectif de ce document est d'amasser de l'information au sujet des régions de faune et flore sauvages importantes et de démontrer de quelles façons les terres sont utilisées pour le développement économique. Ce RECC sera utilisé afin de faciliter les discussions et faire des décisions au sujet de la gestion des terres, de l'eau et des ressources des RÉNs dans le PUTN.

Les informations des cartes contenues dans ce document proviennent de:

- Les plans actuels de la NPC au sujet de l'usage des terres;
- Le « Rapport sur la valeur des ressources de faune et d'habitat », préparé pour la NPC, en octobre 2008, par NUNAMI Jacques Whitford;
- Le « Rapport d'analyse du secteur socio-démographique et économique », préparé pour la NPC, en août 2008, par Terriplan Consultants.

L'information est mise à jour là où il l'est possible. Toutefois, dans le cas où vous, le lecteur, êtes au courant, ou bien avez de renseignements plus pertinants, la NPC aimerait recevoir vos commentaires et suggestions. Veuillez contacter:

Mike Townsend,
Technologue de l'information des terres,
Commission d'Aménagement du Nunavut
Boîte postale 2101
Cambridge Bay, NU X0B0C0
Tél: 867-983-4635
Fax: 867-983-4626
Courriel: mtownsend@npc.nunavut.ca

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ᓄᓇᕗᑦ ᐃᓕᓴᕐᓂᑦ NUNAVUT PLANNING COMMISSION NPC-KOT HANAKIHIMAYAIT COMMISSION D'AMÉNAGEMENT DU NUNAVUT



ᓄᓇᕗᑦ ᐃᓕᓴᕐᓂᑦ
ᐊᖏᔪᓂᖅ, ᒥᑭᔪᓂᕆᓪ ᐊᑕᐅᖅ
Aktilaaga

1:10,000,000 Scale Échelle

250 125 0 250 500
ᑭᓚᒥᑦᑕᑦ Ongahiktilaaga Kilometres kilomètres

ᑕᒪᓐ ᓄᓇᕗᑦ ᐊᖏᑕᐅᔪᖅ ᑕᒃᑯᓂᖅ ᓄᓇᑦ ᐊᖑᓇᐅᔭᒃᑯᓪᓗᒍ 9ᓐᖏᕐᑐ, ᐅᖃᐃᓕᖏᓐᓄᖅᓯᓗᓂ ᓄᓇᑦ ᓄᓇᕐᑯᑎᖏᑦ ᐃᓂᒋᔭᖏᑦᓂᖅ. ᓄᓇᕗᑦ ᓇᓗᓇᐃᒃᑯᑕᓂᒃ ᖃᐅᔨᒪᑎᕐᒥᓂ ᖃᓄᐃᓂᖏᑦᓂᒃ ᑲᓇᐃᓂᖏᑦᓂᒃ ᐃᓂᒋᔭᖏᑦᓂᒃ. ᐃᓂᐃᓕᓴᕐᓂᑦ ᓄᓇᕐᑯᑎᖏᓐᓄᑦ 9ᓕᓂᓗ0 ᓇᓕᕆᓂᒪᔪᑦ ᐊᖏᑕᐅᔪᑦ ᓄᓇᑦ ᑐᓴᖏᓚᐃᒃ. ᐊᑐᖅᑕᐅᓂᐊᖅᑐᖅ ᖃᐅᔨᒪᕐᓂᖏᓐᓄᑦ ᐱᕐᔪᐊᑎᖏᓄᑦ ᑕᒃᑯᓂᖅᓯᒪᓂᖅ ᓄᓇᑦ ᐸᕐᓴᐃᔭᐃᓐᓇᖅᑐᑦ. ᐅᖓᑖᑕᐅᓂᐊᖅᑐᖅ ᑕᒪᓐ ᓄᓇᕗᑦ ᐅᓴᐅᓂᒃᑯᓂᒃ ᑕᒪᓐᓇᐅᔭᓕᕆᔨᒃᑯᑦ ᓄᓇᑦ ᑐᓴᖏᓚᐃᒃ. ᐃᓂᐃᓕᓴᕐᓂᑦ ᓄᓇᕗᑦ ᑐᓴᖏᓚᐃᒃ ᐅᓴᐅᓂᒃᑯᓂᒃ ᓄᓇᑦ ᑐᓴᖏᓚᐃᒃ ᐃᓂᒋᔭᖏᑦ

ᐅᓇᐅᑦ ᐸᖅᓇᐱᖅᑐᑦ ᑭᓪᓗᒍᑦ NPC LAYERS NPC-KOT HANAKIHIMAYAIT COUCHES DE LA NPC



ᓄᓇᕗᑦ ᐊᒃᑲᐅᔪᖅ 1:10,000,000 Scale Échelle

250 125 0 250 500

ᑭᓕᒫᑦ Ongahiktilaaga Kilometres kilomètres

Alert
Grise Fiord
Resolute
Sachs Harbour
Arctic Bay
Pond Inlet
Clyde River
Holman
ᖃᐅᑭᑐᓂ Qikiqtani
Qikiqtarjuaq
Igloolik
Taloyoak
Cambridge Bay
Hall Beach
Pangnirtung
Kugluktuk
Gjoa Haven
Kugaaruk
Umingmaktok
Bathurst Inlet
ᑭᐅᖅᑎᑦᑎᓂᖅ Kitikmeot
Repulse Bay
Iqaluit
Cape Dorset
Kimmirut
Coral Harbour
Baker Lake
Rae
Yellowknife
Chesterfield Inlet
Rankin Inlet
Ivujivik
Salluit
Kangiqsujuaq
Quaqtaq
Kangirsuk
Fort Resolution
Whale Cove
ᕿᓚᒻᒥ Kivalliq
Arviat
Puvirnituq
Tasiujaq
Kuujjuaq
Fort Smith
Fond-du-Lac
Fort Chipewyan
Black Lake
Inukjuak
Alberta
Churchill
Brochet
Fort McMurray
Saskatchewan
Manitoba
Umiujaq
Sanikiluaq
La Loche
Lynn Lake
Leaf Rapids
Buffalo Narrows
Gillam
Split Lake
Île-à-la-Crosse
Lac La Biche
Pukatawagan
Ontario
Kuujjuarapik

ᑕᒃᑯᐊᓗᒃᑕᑦ ᐊᑐᕐᓗᒃ ᓇᓱᒋᑎᓕᕆᔨᒐᓱᑐᑦ
ᐊᑐᖅᑐᒃᓴᖏᑦ ᓇᓗᓇᐃᔨᓂᖏᑦ ᑲᑎᖅᓯᒪᔨᓂᖏᓐᓂᒃᑯᑦ
All UOM Points Collected
Tamaita UOM Novoit Piyaotaaktot
Tous les points rassemblés par la CUO

ᑕᒃᑯᐊᓗᒃᑕᑦ ᐊᑐᕐᓗᒃ ᓇᓱᒋᑎᓕᕆᔨᒐᓱᑐᑦ
ᐊᑐᖅᑐᒃᓴᖏᑦ ᑎᑎᖅᑕᐅᓂᖏᑦ ᑲᑎᖅᓯᒪᔨᓂᖏᓐᓂᒃᑯᑦ
All UOM Lines Collected
Tamaita UOM Naligimayot Piyaotaaktot
Toutes les lignes rassemblées par la CUO

ᑕᒃᑯᐊᓗᒃᑕᑦ ᐊᑐᕐᓗᒃ ᓇᓱᒋᑎᓕᕆᔨᒐᓱᑐᑦ
ᐊᑐᖅᑐᒃᓴᖏᑦ ᐃᓕᖅᑐᑎᓂᖏᑦ (ᐃᓂᒋᔭᐅᔪᑦ)
All UOM Polygons(Areas) Collected
Tamaita Homiitotlikaa Piyaotaaktot
Tous les secteurs rassemblés par la CUO

ᐸ(ᖅᐸᒐᑦ ᐸᒪᓪᓗ ᓇᔪᖅᕐᓀᓪᓕᐊᑐᑦ ᐅᓇᒍᑦ (UOM)
ᐊᑐᐸᒐᑦ ᓇᔪᑎᕐᓀᓪᓕᐊᑐᓂᑦ ᐊᑐᖅᑐᒃᓴᖏᑦ ᑕᒃᔾᔪᖅᖏᓐ ᐱᓕᓇᐋᓚᐅᕐᓀᓪᓕᐊᑐᓂᑦ ᓄᓇᕗᑦ ᐸᖅᑲᐅᔾᔨᒃᑯᑦ ᐊᐱᒃᑐᖅᑐᒃᓴᖏᑦ ᐸᖅᑲᐅᔾᔨᒃᑯᑦ ᐊᑐᖅᑎᑦᑎᓂᖅ ᓄᓇᕗᑦ ᐊᑐᖅᑕᐅᓂᖏᑦ ᐱᓕᓇᐋᓚᐅᕐᓀᓪᓕᐊᑐᓂᑦ "ᐃᓅᖅᖃᐅᒪᔭᕆᔪᑦ". ᖃᐅᔨᒪᓕᐊᑎᒃᓴᒃᑕᑦ ᐊᑦᐱᖅᓯᒪᔨᓄᑦᓯᑦ ᖃᐅᔨᒪᔨᐅᑕᐃᓕᓕᑦ, ᐊᒪᓪᓗ ᓇᓴᕐᓯᒪᓂᖏᑦ ᑭᓯᐊᓂ ᐊᑐᕐᑕᐅᓇᕐᓂᑦ ᑲᑎᖅᓯᒪᔨᓂᖅᓂᒃᑯᑦ ᑕᑕᑎᕐᑎᑦ ᐃᓅᒃᑲᕐᔪᐊᑎᓕᐅᑉ ᓄᓇᕗᑦ ᐸᖅᑲᐅᔾᔨᒃᑯᓂᓐᓂᒃ ᓇᓗᓇᐃᖅᑲᓂᖏᑦ ᖃᐅᔨᒪᔨᐅᑕᐃᓕᓕᑦ ᐃᓕᓴᕐᓂᖏᑦ ᐃᓕᖅᑐᑎᓂᖅ ᓄᓇᕗᑦ ᐸᖅᑲᐅᔾᔨᒃᑯᑦ ᐊᑐᕐᑕᐅᓇᕐᓂᑦ ᐃᓕᖅᑐᑎᓂᖅ ᐱᓕᓇᐋᓚᐅᕐᓀᓪᓕᐊᑐᓂᑦ.
USE AND OCCUPANCY MAPPING(UOM)
UOM sessions are carried out by the NPC Regional Planners and focuses on traditional land use activities "within living memory". All individual information is confidential, and the data is only used in a congregated form to assist the NPC in identifying patterns of Nunavumiut traditional land use activities.
ATOKLOGIT NUNAGIYAOHIMAYOT NUNAOYALIOKNIKOT
UOM katimapkaivaktot NPC-kot Opalonggaiyaiyiinit naonaiyaitiakhotiklo nunanik atoktaoloakpaktonik “tatja holi poigoomayaonggitot” Tamaita naonaiyaktaoyot tatja anggiagiyaoyot, ovalo NPC-kot naonaiyaotigilogit atokniakmatigik holilokaagotaoyoghallo.
CARTOGRAPHIE DE L'UTILISATION ET L'OCCUPATION CUO
Les séances de la CUO sont réalisées par les planificateurs régionaux de la NPC et focalise sur les activités d'utilisation des terres traditionnelles « de mémoire d’homme ». Toute information individuelle est confidentielle, et les données sont seulement utilisées dans une forme rassemblée afin d'assister la NPC à identifier les tendances traditionnelles des activités d'utilisation des terres Inuites.

ᓄᓇᕗᑦ ᐸᖅᑲᐅᔾᔨᒃᑯᑦ ᐊᑐᖅᑕᐅᓂᖏᑦ ᐊᓕᓚᐅ ᓇᔪᖅᕐᓀᓪᓕᐊᑐᓂᑦ ᓄᓇᕗᑦ ᐅᖃᓕᒫᓂᖏᑦ
NPC Use & Occupancy Mapping
NPC-kot Atokpagait Inukaknigitlo Nunaoyami
Cartographie de l'utilisation et l'occupation de la NPC

ᐱᔾᓚᖅᓯᒪᔪᑐᖅ
Draft
Inikhimaitok
Brouillon

ᓄᓇᕗᒻᒥ ᐸᖅᑲᐅᔾᔨᒃ
Nunavut Planning Commission
Nunavunmi Parnaiyiit
Commission d'Aménagement du Nunavut

ᐅᓇᐅᑦ ᐸᖅᓇᐱᖅᑐᑦ ᑭᓪᓗᒍᑦ NPC LAYERS NPC-KOT HANAKIHIMAYAIT COUCHES DE LA NPC



ᓄᓇᕗᑦ ᐊᒃᑲᐅᑎᒃ ᓇᓕᕆᔨᒃᑐᖅ
Aktilaaga 1:10,000,000 Scale Échelle

100 50 0 100 200 300
ᑭᓕᒋᑦ Ongahiktilaaga Kilometres kilomètres

Grise Fiord
Resolute
Arctic Bay
Pond Inlet
Clyde River
Igloolik
Hall Beach
Taloyoak
Cambridge Bay
Gjoa Haven
Kugaaruk

Essential Areas
Atogaoloakpaktok
Secteurs essentiels

Important Areas
Pimmagioyot
Secteurs importants

General Use Areas
Atoktaokataktot
Secteurs d'utilisation générale

Areas of Unknown Importance
Atoktaovagiakhainik nunat elittogimayaonggitot
Secteurs d'importance inconnue

ᐃᓕᓴᕐᕕᒃ ᐃᓕᓴᐅᔪᓐᓇᖅᑐᑦ ᐃᓄᐩᓯᐊᓂᖅ ᑕᐃᓇᐃᓕᓴᕐᕕᒃ ᐃᓕᓐᓄᐊᖅᑐᑦ ᓄᓇᖃᖅᓯᒪᔪᖅ ᓄᓇᕗᒻᒥ ᐊᑐᖅᑐᕐᓂᖅᑕ ᐱᖓᓱᒃᑐᑦ, ᓇᒥᕆᔨᕕᖏᓐᓇᖅ ᐅᕙᓪᓕ ᐅᖃᐅᔨᒪᑦ ᖃᓄᐃᓕᖅᑐᑦ ᐊᑐᖅᑐᕐᓂᖅᑕ ᐊᒃᓱᕈᓐᓇᖅᑐᑦ ᓄᓇᕗᒻᒥ ᐊᑐᖅᑐᕐᓂᖅᑕ ᐱᖓᓱᒃᑐᑦ, ᓇᒥᕆᔨᓕᕆᔨᒋᑦᓯᖏᓐᓇᖅ ᐅᖃᐅᔨᒪᑦ 2000.

Areas of Importance originally developed as a supplement to the original Lancaster Sound Regional Land Use Plan, Approved in 1990 and contained in the North Baffin Regional Land Use Plan, approved 2000

Nuna pipmagioyogiyaoyot nalvaakhiokvioplotik havakviohimalihaaktot Lancaster Sound-mi nunap atoktaonighaa anggiktaohimayok 1990-gotillogo ovalo elagiyaa Kikiktaaloop tononikpahiani angiktaohimakyok 2000-goktillogo okiomi

Les Régions d'importance ont originairement été développées comme supplément pour le Plan régional d'utilisation des terres dans le détroit de Lancaster, originairement approuvé en 1990, et contenu dans le Plan régional de l'utilisation des terres dans le Baffin Nord, approuvé en 2000.

ᐃᓄᐃᑦᑐᕐᓂᖅ ᐱᓕᕆᔨ ᑕᒪᓐ ᖃᐅᔨᓴᖅᑎᑕᐅᑦ ᖃᐅᑉᑕᒥ
Areas of Importance in the North Baffin
Nuna Annigiyaoyok Kikiktaalokmi
Régions d'importance dans le Baffin Nord

ᐱᖁᓇᖅᓯᒪᔪᖓᓂᖅ

Draft
Inikhimaitok
Brouillon

ᓄᓇᕗᑦ ᐊᑐᓇᖅ
Nunavut Planning Commission
Nunavunmi Parnaiyiit
Commission d'Aménagement du Nunavut

ᐅᓇᐅᑦ ᐸᖅᓇᐱᖅᑐᑦ ᑭᓪᓗᒍᑦ NPC LAYERS NPC-KOT HANAKIHIMAYAIT COUCHES DE LA NPC



ᓄᓇᕗᑦᓯᐊᕐᓂᖅ ᐊᒃᑐᐊᓗᒃ 1:10,000,000 Scale Échelle

Aktilaaga

250 125 0 250 500

ᑭᓕᒫᑦ Ongahiktilaaga Kilometres kilomètres

Alert
Grise Fiord
Resolute
Sachs Harbour
Holman
Arctic Bay
Pond Inlet
Clyde River
ᖃᐅᑭᖅᑕᓂ
Qikiqtani
Qikiqtarjuaq
Igloolik
Taloyoak
Cambridge Bay
Hall Beach
Pangnirtung
Kugluktuk
Gjoa Haven
Kugaaruk
Umingmaktok
Bathurst Inlet
ᑭᐃᑎᒪᐃᐅᑦ
Kitikmeot
Repulse Bay
Iqaluit
Cape Dorset
Kimmirut
Coral Harbour
Baker Lake
Chesterfield Inlet
Rankin Inlet
Whale Cove
Rae
Yellowknife
Fort Resolution
ᑲᕙᐊᓕᖅ
Kivalliq
Arviat
Fort Smith
Fond-du-Lac
Fort Chipewyan
Black Lake
Alberta
Churchill
Brochet
Saskatchewan
Manitoba
Fort McMurray
La Loche
Lynn Lake
Leaf Rapids
Buffalo Narrows
Île-à-la-Crosse
Lac La Biche
Pukatawagan
Split Lake
Gillam
Ontario
Ivujivik
Salluit
Kangiqsujuaq
Quaqtaq
Kangirsuk
Puvirnituq
Tasiujaq
Kuujjuaq
Inukjuak
Umiujaq
Sanikiluaq
Kuujjuarapik

ᐃᓕᓴᕐᓂᐊᓕᖅᑐᑦ ᐃᓕᓴᕐᓂᐊᓕᖅᑐᑦ ᓇᓗᓇᕐᓂᖅᓯᒪᓂᖅᓄᑦ ᑲᑎᕐᓗᒍᑦᑐᓴᖅᓯᒪᓂᖅᓄᑦ ᑕᐃᒪᓐᓇᖅᑐᑦ ᐃᓕᓴᕐᓂᐊᓕᖅᑐᑦ ᐃᓕᓴᕐᓂᐊᓕᖅᓯᒪᓂᖅᓄᑦ ᐃᓕᓴᕐᓂᐊᓕᖅᑐᖅᓯᒪᓂᖅᓄᑦ ᓇᓗᓇᕐᓂᖅᓯᒪᓂᖅᓄᑦ ᑕᐃᒪᓐᓇᖅᑐᑦ ᐅᓂᒃᑳᖅᑐᑦ ᐊᑐᐊᓗᒃ ᐊᑐᐊᓗᒃᑕᐅᔪᓂᒃ ᐃᓕᓴᕐᓂᐊᓕᖅᑐᑦ ᐃᓕᓴᕐᓂᐊᓕᖅᓯᒪᓂᖅᓄᑦ ᐃᓕᓴᕐᓂᐊᓕᖅᑐᖅᓯᒪᓂᖅᓄᑦ ᓇᓗᓇᕐᓂᖅᓯᒪᓂᖅᓄᑦ ᑕᐃᒪᓐᓇᖅᑐᑦ ᐅᓂᒃᑳᖅᑐᑦ ᐊᑐᐊᓗᒃ ᐊᑐᐊᓗᒃᑕᐅᔪᓂᒃ

ᐃᓕᓴᕐᓂᐊᓕᖅᑐᑦ ᐃᓕᓴᕐᓂᐊᓕᖅᓯᒪᓂᖅᓄᑦ ᓇᓗᓇᕐᓂᖅᓯᒪᓂᖅᓄᑦ ᑕᐃᒪᓐᓇᖅᑐ

ᐅᓇᐅᑦ ᐸᖅᓇᐱᖅᑕ ᑭᓪᓗᑎᑦ NPC LAYERS NPC-KOT HANAKIHIMAYAIT COUCHES DE LA NPC



ᓄᓇᕗᑦ ᐊᑐᓕᖅᑐᑦ 1:10,000,000 Scale Échelle

Aktilaaga

250 125 0 250 500

ᑭᓪᓗᒍ Ongahiktilaaga Kilometres kilomètres

Alert
Grise Fiord
Resolute
Sachs Harbour
Holman
Arctic Bay
Pond Inlet
Clyde River
ᖃᐅᑭᑦᑕᖅᓯ
Qikiqtani
Qikiqtarjuaq
Igloolik
Taloyoak
Cambridge Bay
Hall Beach
Kugluktuk
Gjoa Haven
Kugaaruk
Pangnirtung
Umingmaktok
Bathurst Inlet
ᑭᐃᑎᑲᒥᐅᑦ
Kitikmeot
Repulse Bay
Iqaluit
Cape Dorset
Kimmirut
Coral Harbour
Baker Lake
Rae
Yellowknife
Chesterfield Inlet
Rankin Inlet
Whale Cove
Fort Resolution
ᕿᓚᒃᓴᓗᒃ
Kivalliq
Arviat
Fort Smith
Fond-du-Lac
Fort Chipewyan
Black Lake
Alberta
Churchill
Brochet
Saskatchewan
Manitoba
Fort McMurray
La Loche
Lynn Lake
Leaf Rapids
Buffalo Narrows
Ile-à-la-Crosse
Split Lake
Gillam
Lac La Biche
Pukatawagan
Ontario
Ivujivik
Salluit
Kangiqsujuaq
Quaqtaq
Kangirsuk
Puvirnituq
Tasiujaq
Kuujjuaq
Inukjuak
Umiujaq
Sanikiluaq
Kuujjuarapik

ᓴᓪᓕᒪᓐᓄᑦ ᐃᓕᓴᕐᓂᐊᕐᓂᒃ ᐃᓕᓴᕐᓂᐊᕐᓂᒃ ᓄᓇᕗᒻᒥᐅᑦ ᐊᑐᖅᑐ



ᓄᓇᖃᖅᑐᖅ ᓇᓴᐅᑎᓕᒃ
ᐊᖏᕐᓂᖏᓐᓄᑦ, ᒥᑭᕐᓂᖏᓐᓇᓗ ᐊᑕᐅᒃ
Aktilaaga

1:10,000,000 Scale Échelle

250 125 0 250 500
ᑭᓕᒫᑦᑕᓴᑦ Ongahiktilaaga Kilometres kilomètres

ᓇᓴᖅᓯᒪᔪᓗᒃᑕᑦ ᐊᒻᒪᓗ/ᐅᑦᔪᓐᓇᓂᑦ ᖃᓄᑕᐅᔾᔨᑎᒍᑦ ᐊᑦᔨᓕᐅᖅᓯᒪᔪᑦ ᑕᑦᓯᒧᖏᓐ Jacques Whitford ᐊᑐᖅᑕᐅᑦᑯᑦᓗᑦᑕ ᑕᖅᓄᖏᓐ "ᓄᓇᕗᑦ ᓂᑦᔨᑎᓕᓂᔨᑦ ᐊᑦᑐᐃᓄᐅᔪᑦᑎᑦ ᐊᒻᒪᓗ ᓇᔨᖅᑲᖅᑕᖏᑦ ᐃᓕᓴᕐᓂᖏᑦ ᐅᓂᒃᑳᖏᑦ", ᐊᖏᕐᑕᐅᔪᖅ ᑕᖅᓄᖏᓐ ᓄᓇᕗᑦ ᑮᓇᐅᔭᖅᑯᑦ (NPC), ᐅᖅᑐᐱᓗ, 2008.

All data compiled and/or digitized by Jacques Whitford for use in the "Nunavut Wildlife Resource and Habitat Values Report", prepared for the Nunavut Planning Commission (NPC), October, 2008.

Tamaita naonaigotighat angotighalikinikot angotighakakniktigollo oma elitaakhimaliktait Jacques Whitford kagitaoyanot NPC-kot naonaigotigihimalogit atoktakhait, eniktait Atopa 2008-mi

Toute information compilée et/ou convertie en numérique par Jacques Whitford, pour usage dans le « Rapport sur les Valeurs des Habitats et des Ressources de la Faune du Nunavut », préparé pour la NPC, octobre 2008.

ᐊᖏᕐᓂᖅᑲᓕᖅ ᑭᒡᒐᓕᐊᓕᖅ ᐃᓂᕐᕕᒃᑕᖏᑦ ᐱᓕᕆᔨᒃᑯᑦ
Falcon Areas of Significant Interest
Kilgavikaknigit Nunami Hilgagiyaoloaktot
Régions d'intérêts significatifs de faucons

ᑲᓇᑕᐅᑦ ᐅᒪᔨᓕᓗᒃᑐᖏᑦ ᐱᓂᕐᑎᖏᑦ ᐃᓂᕐᕕᒃᑕᖏᑦ ᐊᒻᒪᓗᒃᑐᖏᑦ ᓇᔨᖅᑲᖅᑕᖏᑦ ᐃᓂᕐᕕᒃᑕᖏᑦ
CWS Key Terrestrial Habitat Sites
CWS-kot Hogaakaknigit Tagiokmiotanik
Emplacements d'habitats terrestres clefs du SCF

ᑲᓇᑕᐅᑦ ᐅᒪᔨᓕᓗᒃᑐᖏᑦ ᐱᓂᕐᑎᖏᑦ ᓄᓇᑦ ᓇᔨᖅᑲᖅᑕᖏᑦ ᐃᓂᕐᕕᒃᑕᖏᑦᓗ
CWS Key Marine Habitat Sites
CWS-kot homilikaa nunami hogaakaknigit
Emplacements d'habitats marins clefs du SCF

ᑭᒡᒐᓕᐊᓕᖅ ᐃᓂᕐᕕᒃᑕᖏᑦ ᐱᓂᕐᑎᖏᑦ ᐊᒻᒪᓗᒃᑐᖏᑦ "ᑭᒡᒐᓕᐊᓕᖅ ᐊᖏᕐᓂᖅᑲᖅ ᐊᒻᒪᓗ ᑭᒡᒐᓕᐊᓕᖅ ᐃᓂᕐᕕᒃᑕᖏᑦ "ᑕᑯᓇᖓᒻᒥᑦ ᓂᑦᔨᑎᑦ ᐃᓂᕐᕕᒃᑕᖏᑦ ᐱᓂᕐᑎᖏᑦ" ᑕᑯᓇᖓᒻ ᓄᓇᕗᑦ ᑲᓛᒪᑦ, ᐊᐃᓕᖅᑐᖅᓯᒪᔪᑦ ᐊᐅᑎᓕᓂᔨᑦ.
ᑲᓇᑕᒥᑦ ᐅᒪᔨᓕᓂᔨᓇᐊᖅᑯᑦ (CWS) ᐱᓐᓂᖅᑎᑕᐅᔪᑦ ᐃᒪᒥᐅᑕᑦ ᐃᓂᕐᕕᒃᑕᖏᑦ ᐊᒻᒪᓗ ᑲᓇᑕᒥᑦ ᐅᒪᔨᓕᓂᔨᔪᓇᐊᑦ ᐱᓐᓂᖅᑎᖏᑦ ᓇᔨᖅᑕᐅᑎᓕᐅᔾᔨᑦ ᐃᓂᕐᕕᒃᑕᖏᑦ ᓇᓴᖅᓯᒪᔪᑦ ᑕᑯᓇᖓᒻ ᐊᐅᑎᓕᓂᔨᑦ ᑲᓇᑕᒥᑦ, ᑲᓇᑕᒥᑦ ᐅᒪᔨᓕᓂᔨᔪᖅᐃᐃᑦ.
Falcon Areas of Interest are "Gyrfalcon and Peregrine Falcon Areas" from "Wildlife Areas of Significant Interest" courtesy of the Government of Nunavut, Department of Environment.
Canadian Wildlife Service (CWS) Key Marine Areas and CWS Key Terrestrial Habitat Sites data courtesy of Environment Canada, Canadian Wildlife Service
Kilgavikaknigit Nunami Hilgagiyaoloaktot hapkoa, kilgavikpait; kilgaviinaitlo Angotighakaknikni homilikaa nunami naonaiyakhimayait Nunavut Kavamaita Avatiligiyiinit hapkoningga naonaiyaihimayot hogaanik tagiokmiotanik nunamiotaniklo talvalo kagitaoyanot tokoktaohimalotik Kanatami Angotighalikiyikyoaginnit.
Les Régions d'intérêts de faucons sont des « Régions de Gerfauts et de Faucons Pèlerin » de les « Régions de Faune d'Intérêts Significatifs » gracieuseté du Ministère de l'Environnement, Gouvernement du Nunavut.
L'information des Emplacements d'habitats marins clefs et les Emplacements d'habitats terrestres clefs du SCF gracieuseté du Service canadien de la faune, Environnement Canada.

ᖃᐅᔨᓴᓂᖅ ᓇᔨᖅᑲᖅᑕᖏᑦ ᐃᓂᕐᕕᒃᑕᖏᑦ
Bird Habitat Sites
Hogaakaknigit
Emplacements d'habitats d'oiseaux

ᓄᓇᕗᑦ ᓯᕗᓪᓕᖅᐹᒪᓐᓇᖅ
Nunavut Planning Commission
Nunavunmi Parnaiyiit
Commission d'Aménagement du Nunavut

ᐱᔭᕇᖅᑎᑦ
Draft
Inikhimaitok
Brouillon



ᓄᓇᕗᑦ ᓇᓴᐅᑎᓕᒃ
ᐊᖏᕐᓂᖅ, ᒥᑭᓂᖅᓴᓗ ᐊᑕᐅᒃ
Aktilaaga

1:10,000,000 Scale Échelle

250 125 0 250 500
ᑭᓕᒥᑕᑦ Ongahiktilaaga Kilometres kilomètres

ᓇᓴᖏᓪᓗᓇᐅᑦᑕᑦ ᐊᒪᒪᓗ/ᐅᑉᐹᓵᓂᑦ ᖃᓚᑕᐅᔨᑎᒍᑦ ᐊᑦᓯᓕᐅᖏᓪᓗᓇᐅᑦ ᑕᑦᓭᒧᖏᓐ Jacques Whitford ᐊᑐᖏᑕᐅᖏᑦᓭᓕᑦ ᑕᖃᓄᖏᓐ “ᓄᓇᕗᑦ ᓂᑦᔨᑎᑕᓂᔪᓕᑦ ᐊᑦᑐᐃᓇᐅᔪᓕᑦ ᐊᒪᒪᓗ ᓇᐅᖏᑦᑕᖏᑦ ᐅᓂᒃᑲᖏᑦ ᐃᓕᓴᕐᓂᖅᓯᒪᓕᑦ ᐊᖏᑕᐅᓕᖅᑐᑦ”, ᐃᖏᑕᐅᐅᓕᖏᓐ ᑕᖃᓄᖏᓐ ᓄᓇᕗᑦ ᐸᑦᓇᐃᐅᑦᑎᑦ (NPC), ᐅᑐᑐᒧᓗ, 2008.

All data compiled and/or digitized by Jacques Whitford for use in the “Nunavut Wildlife Resource and Habitat Values Report”, prepared for the Nunavut Planning Commission (NPC), October, 2008.

Tamaita naonaigotighat angotighalikinikot angotighakakniktigollo oma elitaakhimaliktait Jacques Whitford kagitaoyanot NPC-kot naonaigotigihimalogit atoktakhait, eniktait Atopa 2008-mi

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ᑐᑲᑐᑦ ᓄᓇᕗᒻᒥᖏᓐᓂ
Sea Ice Crossings
Tuktut Noggiokpakviit Nunami
Traversées sur glace en mer

ᓂᓪᔨᐅᑎᑦ ᐃᓂᒋᓱᒃᑕᖏᓐᓂ ᐱᔨᒥᑎᕐᒃᐅᔨᑦ ᑐᑲᑐᑦ ᓄᓇᕗᒻᒥᖏᓐᓂ ᐃᓂᒋᓱᑦᑕᖏᓐᓂ
Water Crossings
Homilikaa Noggiokpakviit
Traversées de cours d’eaux

ᐃᒪᒃᑯᑦ ᐃᒃᑲᖏᓐᓂ
Caribou Calving Grounds
Nalloit
Chantiers de vêlage de Caribous

ᑕᓪᓕᐅᒃᑯᑦ ᓱᑯᓱᒪᕐᖁᓪᓚᑦ ᐃᒃᑲᖏᓐᓂ
WASI Caribou Calving Areas
Tagiomi Okiokot Ekaagiagit Tuktut
Territoires de vêlage de Caribous des RFIS

ᑐᑲᑐᑦ ᓂᓪᓕᐅᒪᖏᓐᓂ, ᐃᓂᔨᑎᑦ ᐃᓂᒋᑉᑲᖏᓐᓂ, ᐱᔨᑎᑦᑕᓪᓕᐅᑦᑎᑐᑦ (WASI) ᑐᑲᑦ ᓄᓇᕗᑕᖏᓪᓗ ᐃᓂᒋᑉᑲᒃᑕᖏᓐᓂ, ᑕᓪᓕᐅᒃᑯᑦ ᓱᑯᓱᒪᕐᖁᓪᓚᑦ ᐃᒃᑲᖏᓪᓗᓂ, ᐊᒪᒪᓗ ᑭᓴᓕᐅᔨᔪᓕᑦ ᐊᖏᑕᐅᔨᑦ ᑕᖃᓄᖏᓐ ᓄᓇᕗᑦ ᒪᓴᒪᑯᑦ, ᐊᐃᒃᑐᓂᖅᓯᒪᔨᑦ ᐊᖏᑕᐅᓕᖅᑐᑦ ᐊᒃᓱᕈᓐᓇᖅᑐᑦ ᐃᒃᑲᖏᓪᓗᓂ ᐱᓕᕐᓂᖅᓱᖓᓂᒃ ᐊᐃᒃᑐᓂᖅᓯᒪᓕᖅᑐᑦ ᑕᖃᓄᖏᓐ ᓄᓇᕗᑦ ᐅᑭᐅᖅᑕᕐᓂᖅ (WASI) ᑐᑲᑦ ᓄᓇᕗᑕᖏᓪᓗ ᐃᓂᒋᑉᑲᒃᑕᖏᓐᓂ, ᑕᓪᓕᐅᒃᑯᑦ ᓱᑯᓱᒪᕐᖁᓪᓚᑦ ᐃᒃᑲᖏᓪᓗᓂ, ᐊᒪᒪᓗ ᐅᓪᓗᕈᓘᔪᓕᑦ ᐃᒃᑲᖏᓐᓂ ᐃᓂᒋᑉᑲᒃᑕᖏᓐᓂ ᐱᓕᕐᓂᖅᓱᖓᓂᒃ ᑕᖃᓄᖏᓐ ᓄᓇᕗᑦ ᐅᑭᐅᖅᑕᕐᓂᖅ.

Caribou Calving Grounds, Wildlife Areas of Significant Interest (WASI) Caribou Calving Areas , Sea Ice Crossings, and Kivalliq water crossings from the Government of Nunavut, Department of Environment. Water and ice crossings in West Kitikmeot region are from internal NPC data.

Tuktut Nunami Noghiokpakviit, Angotighakaknigillo hapkoa Kagitaoyanot totkoomayaoliktot NPC-kot opalonggaiyainighakot naonaigotigihimayaghait naonaigotighani totkoomaliktot.

Chantiers de vêlage de Caribous, Territoires de vêlage de Caribous des Régions de Faune d'Intérêt Significatif (RFIS), Traversées de cours d’eaux, et la traversée de Kivalliq proviennent de la part du Ministère de l'Environnement, Gouvernement du Nunavut. Traversées des cours d’eaux et sur glace en mer dans la région de Kitikmeot Ouest proviennent des données internes de la NPC.

ᑐᑲᑐᑦ

Caribou

Tuktut

Caribou

ᓄᓇᕗᒻᒥᓕᖅᑐᑦ ᓄᓇᕗᑦ ᐊᖏᓪᓗᓂ ᐊᓯᐅᓯᒪᓕᖅᑐᑦ

Nunavut Planning Commission
Nunavunmi Parnaiyiit
Commission d'Aménagement du Nunavut

ᐱᒋᐊᕐᓇᖅᑐᖅ
Draft
Inikhimaitok
Brouillon



ᓄᓇᕗᑦ ᓇᓴᐅᑎᓕᒃ
ᐊᖏᔪᓂᖅ, ᒥᑭᔪᓂᖅᓱᓗ ᐊᑕᐅᑦ
Aktilaaga

1:10,000,000 Scale Échelle

250 125 0 250 500
ᑭᓕᒥᑦᑕᓴ Ongahiktilaaga Kilometres kilomètres

ᓇᓴᖏᓪᓗᓇᓕᒃᑕᑦ ᐊᒻᒪᓗ/ᐅᑉᐹᓵᓕᓂᑦ ᖃᓄᑕᐅᔾᔨᑎᒍᑦ ᐊᑦᔨᓕᐅᖏᓪᓗᓂᓚᐅᑦ ᑕᑦᓭᒧᖅ Jacques Whitford ᐊᑐᖏᑕᐅᕐᖁᓪᓕᒥᑦ ᑕᑯᓀᖅᖢ “ᓄᓇᕗᑦ ᓂᕆᐊᑎᓕᓐᓄᑦ ᐊᑦᑐᐃᓇᐅᔪᓂᑦ ᐊᒻᒪᓗ ᓇᓂᕐᔪᐊᖅᑕᒥᑦ ᐃᓕᓴᕐᔪᐊᖅᑕᒥᑦ ᐅᓂᒃᑲᓂᖅᑕᒥᑦ”, ᐊᖏᑕᐅᓂᖅ ᑕᑯᓀᖅᖢ ᓄᓇᕗᑦ ᑕᓪᓕᐊᔪᖅᑕᒥᑦ (NPC), ᐅᖃᑐᐱᓗ, 2008.

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ᐊᓂᒍᖅᓯᒪᔪᖅ ᐊᑐᖅᑕᐅᓂᖅ ᐊᓂᔑᓇᐯᒪᔪᖅ ᐊᓂᔑᓇᐯᓂᖅ ᐊᓂᔑᓇᐯᓕᕆᔨᒃᑯᑦ ᑕᑯᔪᓐᓇᖅᑐᑦFreshwater Institute, ᐅᖃᐅᓕᕐᓂᖅ ᑕᕐᓇᐅᒥᑦ ᖃᑎᒌᓂᐅᔪᓐᓇᖅ

Polar Bear High Density Denning Areas from Freshwater Institute, Arctic Marine Workshop

Nannut Apitikakviit naonaiyaktaohimayot Emakmiotaligiyinit Katimajotaoploni Elittoghaotaohimayot.

Territoire avec une densité élevée de tanières d'ours polaire, de la part de l'Atelier sur l'Arctique Marin, Institut d'Eau Douce.

ᐊᓂᔑᓇᐯᓂ ᔨᑎᖏᑦ ᐃᓂᔑᓇᐯᓕᕆᔨᒃᑯᑦ
High Density Denning Area
Nannunit Apitikakviovaktot
Territoire à haute densité de tanières

ᐊᓂᖃᖅᓂᖏᑦ
Polar Bear Range
Nanukaknigit
L'étendue d'ours polaire

ᐊᓂᕐᑐᑦ
Polar Bear
Nannut
Ours polaire

ᐃᓄᒃᓯᒪᔪᖅ
Draft
Inikhimaitok
Brouillon

ᓄᓇᕗᑦ ᑕᓪᓕᐊᔪᖅᑕᒥᑦ
Nunavut Planning Commission
Nunavunmi Parnaiyiit
Commission d'Aménagement du Nunavut



ᓄᓇᕗᑦ ᓇᓴᐅᑎᓕᒃ
ᐊᖏᔪᖓ, ᒥᑭᔪᖓᓗ ᐊᑕᐅᑦ
Aktilaaga

1:10,000,000 Scale Échelle

250 125 0 250 500
ᑭᓕᒥᑕᑦ Ongahiktilaaga Kilometres kilomètres

ᓇᓴᖅᓯᒪᔨᓗᒃᑕᑦ ᐊᒻᒪᓗ/ᐅᑦᑐᓂᓕᓂᑦ ᖃᓄᑕᐅᔾᔨᑎᒍᑦ ᐊᑦᔨᓕᐅᖅᓯᒪᔨᑦ ᑕᑦᓯᒧᖏᑐ Jacques Whitford ᐊᑐᖅᑕᐅᖅᑐᓯᓕᑦ ᑕᑯᓇᖏᑐ “ᓄᓇᕗᑦ ᓂᕆᐊᑎᓕᓵᔨᑦ ᐊᑦᑐᐃᓇᐅᔨᓴᑦ ᐊᒻᒪᓗ ᓇᔨᖅᑕᖅᑎᑦ ᐃᓕᓴᕐᕕᖏᑦ ᐅᓂᒃᑲᖏᑦ”, ᐊᖏᑕᐅᔨᖅ ᑕᑯᓇᖏᑐ ᓄᓇᕗᑦ ᑕᓪᓕᐊᔪᖅᑐᑦ (NPC), ᐅᑦᑐᐱᓕ, 2008.

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Alert
Grise Fiord
Resolute
Sachs Harbour
Arctic Bay
Pond Inlet
Clyde River
Holman
ᖃᐅᔨᒪᑦᑐᖅ Qikiqtani
Qikiqtarjuaq
Igloolik
Hall Beach
Taloyoak
Cambridge Bay
Kugluktuk
Gjoa Haven
Kugaaruk
Pangnirtung
Umingmaktok
Bathurst Inlet
ᑭᑎᑦᑎᒥᐅᑦ Kitikmeot
Repulse Bay
Iqaluit
Cape Dorset
Kimmirut
Coral Harbour
Baker Lake
Chesterfield Inlet
Rankin Inlet
Whale Cove
Rae
Yellowknife
Fort Resolution
ᑭᐊᓕᕆᔨᖅ Kivalliq
Arviat
Fort Smith
Fond-du-Lac
Fort Chipewyan
Black Lake
Alberta
Churchill
Ivujivik
Salluit
Kangiqsujuaq
Quaqtaq
Kangirsuk
Puvirnituq
Tasiujaq
Kuujjuaq
Inukjuak
Umiujaq
Sanikiluaq
Kuujjuarapik
Brochet
Fort McMurray
Saskatchewan
Manitoba
La Loche
Lynn Lake
Leaf Rapids
Buffalo Narrows
Île-à-la-Crosse
Lac La Biche
Pukatawagan
Split Lake
Gillam
Ontario

ᖃᐅᔨᒪᑦᑐᖅ ᓇᓕᔪᐊᓕᖅᑕᖏᑦ ᐃᓄᐅᕐᓂᖏᑦ
Harp Seal Pupping Area
Nattiit Ingniokvigivagait
Territoire de jeunes phoques du Groenland

ᖃᐃᕐᓂᐅᑎᒃ ᑲᑎᒪᔨᖏᑦ ᐃᓄᑦᑕᖏᑦ
Harp Seal High Density Area
Nattigiakniit
Territoire à haute densité de phoques du Groenland

ᐅᖅᓱᒃ ᑲᑎᒪᔨᖏᑦ ᐃᓄᑦᑕᖏᑦ
Bearded Seal High Density Area
Okyogiakniit
Territoire à haute densité de phoques barbu

ᓇᓕᒪ ᑲᑎᒪᔨᖏᑦ ᐃᓄᑦᑕᖏᑦ
Ringed Seal High Density Area
Nattigiaknigit
Territoire à haute densité de phoques annelé

ᖃᐃᕐᓂᐅᑎᒃ ᓇᓕᔪᐊᓕᖅᑕᖏᑦ ᐃᓄᑦᑕᖏᑦ, ᖃᐃᕐᓂᐸᑦ ᑲᑎᒪᔨᖏᑦ ᐃᓄᑦᑕᖏᑦ, ᐅᖃᐅᓯᖏᑦ Freshwater Institute, 1994, ᐅᑭᐹᐅᑕᕐᒥᑦ ᐃᒪᓕᒃᑐᐅᓕᕆᔨᑦ ᑲᑎᒪᔨᖏᑦ: ᒪᑦp 1-2, 1994.
ᓇᓕᔪ ᑲᑎᒪᔨᖏᑦ ᓇᓴᖅᓯᒪᔨᑦ ᓇᓗᓇᐃᖅᓯᒪᔪᖏᓕᖅ.

Harp Seal pupping area, Harp Seal high density area, Bearded Seal High Density area data from Freshwater Institute, 1994, Arctic Marine Workshop proceedings: March 1-2, 1994.
Ringed Seal High Density data source unconfirmed.

Nattiit Ingniokpakviit, Okyogiakniitlo naonaiyaktaohimayot Emakmiotaligiyinit 1994-gotillogo okioktaktomi emakmiotaliginikot katimajotaohimaploni March 1-mit 2-mot 1994-mi.

Territoire de jeunes phoques du Groenland, Territoire à haute densité de phoques du Groenland et Territoire à haute densité de phoques barbu de la part de l'Atelier sur l'Arctique Marin, Mars 1-2 1994, Institut d'Eau Douce.
L'information sur Territoire à haute densité de phoques annelé est non confirmé.

ᓇᓕᔪᑦ ᑲᑎᒪᔨᖏᑦ ᐃᓄᑦᑕᖏᑦ
Seal High Density Areas
Nattigiakniit
Territoires à haute densité de phoques

ᐅᓴᓇᖅᓯᒪᔪᑦ
Draft
Inikhimaitok
Brouillon

ᓄᓇᕗᑦ ᑭᓪᓕᐊᔾᔨᒃᑯᑦ
Nunavut Planning Commission
Nunavunmi Parnaiyiit
Commission d'Aménagement du Nunavut



ᓄᓇᖃᐊᖅ ᓇᓴᐅᑎᓕᒃ
ᐊᖏᕐᓂᖏᓐᓄᑦ, ᒥᒃᑭᓂᖏᓐᓇᓗ ᐊᑕᐅᒃ
Aktilaaga 1:10,000,000 Scale Échelle

250 125 0 250 500
ᑭᓕᒥᑦᑐᓴ Ongahiktilaaga Kilometres kilomètres

ᓇᓴᖅᓭᓯᔨᓗᒃᑐᑦ ᐊᒻᒪᓗ/ᐅᒃᖁᓪᓗᓂᑦ ᖃᓚᑕᐅᔾᑎᒍᑦ ᐊᑦᔨᓕᐅᖅᓭᓯᒪᔨᑦ ᑕᑯᓯᒧᖏᓐ Jacques Whitford ᐊᑐᖅᑕᐅᕐᖃᑦᓯᓕᑦ ᑕᒃᓂᓇᖏᓐ “ᓄᓇᕗᑦ ᓂᕆᐊᑎᓕᓚᓵᑦ ᐊᑦᑐᐃᓇᐅᔨᓴᑦ ᐊᒻᒪᓗ ᓇᔨᖅᑮᒃᑯᑦ ᐃᓕᓴᕐᓂᖏᑦ ᐅᓂᒃᑲᖏᑦ”, ᐃᖅᑭᑕᐅᔨᖅ ᑕᒃᓂᓇᖏᓐ ᓄᓇᕗᑦ ᕿᖅᓇᐃᒃᓂᓂᑦ (NPC), ᐅᒃᑐᐱᓚ, 2008.

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ᐅᑭᐅᖅ ᖃᐅᔨᓴᓕᕆᔨᒃᑯᑦ
Summer Concentration
Aoyami Aivikaknigit
Concentration d'été

ᐅᖃᐅᖅᑯᑦ ᖃᐅᔨᓴᓕᕆᔨᒃᑯᑦ
Winter Concentration
Okiomi Aivikaknigit
Concentrations d'hiver

ᐅᖃᐅᓪᓗᒥᒃᑯᑦ ᖃᐅᔨᓴᓕᕆᔨᒃᑯᑦ
Year-round Concentration
Okiomilo Aoyamilo Aivikaknigit
Concentration pendant toute l'année

ᐊᐃᐲᖅᓯᒃ ᖃᐅᔨᓴᓕᕆᔨᒃᑯᑦ ᓇᓴᖅᓭᓯᔨᑦ ᑕᒃᑯᓇᖏᑦᑐᑦ Freshwater Institute, 1994, ᐅᖃᖅᐅᑕᖅᑐᒥᑦ ᐃᒪᖏᑕᐅᓕᕆᔨᑦ ᑲᑎᒪᔨᖅᑕᐅᓂᖅ: ᒪᑦp 1-2, 1994.

Walrus Concentration data from Freshwater Institute, 1994, Arctic Marine Workshop proceedings: March 1-2, 1994.

Emakmiotaligiyinit Aivikaknigit Naonaiyaktaohimayot 1994-gotillogo Katimajotaohimaploni March 1-mit 2-mot 1994-mi

Données de concentrations de morses de la part de l'Atelier sur l'Arctique Marin, Mars 1-2 1994, Institut d'Eau Douce.

ᐊᐱᕆᑦ ᖃᐅᔨᓴᓕᕆᔨᒃᑯᓂᑦ

Walrus Seasonal Concentrations

Okiop Elanggagot Aivikakniit

Concentrations saisonnières de morses

ᓄᓇᕗᑦ ᕿᖅᓇᐃᒃᓂᓂᑦ ᐊᓂᔑᓇᓯᒪᔪᖅ
Nunavut Planning Commission
Nunavunmi Parnaiyiit
Commission d'Aménagement du Nunavut

ᐱᒋᐊᕆᔭᐅᓂᖅ
Draft
Inikhimaitok
Brouillon



ᓄᓇᖃᐊᖅ ᓇᓴᐅᑎᓕᒃ
ᐊᖏᕐᓂᖅ, ᒥᑭᓂᖏᓗ ᐊᑕᐃᒃ
Aktilaaga 1:10,000,000 Scale Échelle

250 125 0 250 500
ᑭᓕᒥᑦᑕᑦ Ongahiktilaaga Kilometres kilomètres

ᓇᓴᖅᓱᒪᔪᓚᑦᑕᑦ ᐊᒻᒪᓗ/ᐅᑲᓵᓐᓂᑦ ᖃᓄᑕᐅᕗᑎᒍᑦ ᐊᑦᔨᓕᐅᖅᓱᒪᔪᑦ ᑕᑦᓯᒧᖏᑦ Jacques Whitford ᐊᑐᖅᑕᐅᕋᖅᔪᓕᑕᑦ ᑕᑭᓄᖏᖅ “ᓄᓇᕗᑦ ᓂᕆᐊᑎᓕᓵᔨᑦ ᐊᑦᑐᐃᓇᐅᔪᓴᑦ ᐊᒻᒪᓗ ᓇᔪᖅᑲᑦᑕᖏᑦ ᐃᔪᓕᓕᖅᖏᑦ ᐅᓂᒃᑲᖏᑦ”, ᐊᖏᕐᑕᐅᔪᖅ ᑕᑭᓄᖏᖅ ᓄᓇᕗᑦ ᑭᓇᐃᔨᑲᓄᑦ (NPC), ᐅᑦᑐᐱᓕ, 2008.

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ᐊᖏᖅ ᐅᓗᓚᐊᓐᑐᑦ ᐃᓂᒋᔭᖏᑦ
Bowhead Critical Habitat
Akvikaknigit
Habitat critique pour Baleines boréales

ᐊᖏᖅ
Bowhead Whale Range
Homi Akvikakniit
L'étendue de Baleines boréales

ᖃᓄᓕᒃᑲᖅ
Beluga Range
Kilalokaknik
L'étendue de Baleines blanches (Bélugas)

ᑐᖓᓕᑦ
Narwhal Range General
Toogaaliit
L'étendue de Narvals (Licornes des mers)

ᐊᖑᓚᐊᖅ
Killer Whale Range
Aakloit
L'étendue d'Épaulards (Orques)

ᑐᖓᓕᑦ ᓇᓴᖅᓱᒪᔪᑦ ᑕᑯᓄᖏᖅ ᐊᖅᑯᑐᖅᓱᒪᔪᑦ ᐃᖅᓗᓕᕐᓂᐊᓕᑦ ᐊᓚᒐ ᑕᖅᐅᓕᕐᓂᐊᓕᑦ ᐅᓂᒃᑲᖏᑦ 2007, ᐊᓚᒐ ᓇᑦᓱᑦ 1991.

Narwhal Range Data from Department of Fisheries and Oceans report 2007, and Richard 1991.

Toogaaliit naonaiktaohimayot Emakmiotaligiyinit tohaktitaoplotiklo 2007-mi ovalo Richard 1991-gotillogo

L'information sur L'étendue de Narvals de la part du Ministère des Pêches et Océans Canada, rapport 2007, et Richard 1991.

ᖃᖅᓯᓕᐃᐃᑦ
Whales
Kilalokallo Akvigillo
Baleines

ᓄᓇᕗᖅᓱᒪᔪᖅ
Draft
Inikhimaitok
Brouillon

ᓄᓇᕗᑦ ᑭᓇᐃᔨᑲᓄᑦ
Nunavut Planning Commission
Nunavunmi Parnaiyiit
Commission d'Aménagement du Nunavut



ᓄᓇᖃᐊᖅ ᓇᓴᐅᑎᓕᒃ
ᐊᖏᕐᓂᖅ, ᒥᒃᑭᓂᖅᓱᓗ ᐊᑕᐅᒃ
Aktilaaga

1:10,000,000 Scale Échelle

250 125 0 250 500
ᑭᓕᒥᑦᑕᓴ Ongahiktilaaga Kilometres kilomètres

ᓇᓴᖏᓪᓗᓇᔭᒃᑕᑦ ᐊᒻᒪᓗ/ᐅᖃᖅᑎᓗᓂᑦ ᖃᓄᑕᐅᔨᑎᒍᑦ ᐊᑦᔨᓕᐅᖏᓪᓗᓇᐯᑦ ᑕᑦᓭᒧᖅ Jacques Whitford ᐊᑐᖏᑕᐅᕐᖏᓪᓕᔪᓂᑦ ᑕᒃᓂᓗᖅ “ᓄᓇᕗᑦ ᓂᕆᐊᑎᓕᓇᓕᑦ ᐊᑦᑐᐃᓇᐅᔨᓪᓕᑦ ᐊᒻᒪᓗ ᓇᐯᖏᓪᓕᖏᑦᑕᑦ ᐃᓕᓴᕐᖏᑦᑕ ᐅᓂᒃᑲᖅᑕᑦ ᐊᑦᑐᐃᓇᐅᔨᓪᓕᑦ (NPC), ᐅᑐᐱᓚ, 2008.

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NAFO (ᐃᖃᓗᓕᕆᔨᑦ ᖃᑐᐸᖃᑎᒋᑦ)
NAFO Area
NAFO-kot Homi
Zone de l'OPANO

ᐃᖃᓗᵇᐱᐅᓂᖏᑦ ᐃᓂᒋᔭᖏᑦ
Arctic char Areas of Abundance
Ekalokpikaknigit Amigaitonik
Régions d'abondance d'ombles arctiques

ᖁᓕᓕᑲᐃᑦ ᐃᓂᒋᔭᖏᑦ ᐊᒥᓱᓕᓗᑎᒃ
Capelin Areas of Abundance
Quliligakaknigit
Régions d'abondance de Capelans

ᑭᖑᔪᐃᑦ ᐃᓂᒋᔭᖏᑦ ᐊᒥᓱᓕᓗᑎᒃ
Shrimp Areas of Abundance
Kigokpait homi Amigaitot
Régions d'abondance de crevettes

ᑲᓕᕋᓕᵇ ᐃᓂᒋᔭᖏᑦ ᐊᒥᓱᓕᓗᑎᒃ
Turbot Areas of Abundance
Kaliraliit Amigaitonik
Régions d'abondance de turbots

ᐃᖃᓗᐃᑦ ᐃᓂᒋᔭᖏᑦ Freshwater Institute, ᐅᵇᑭᐅᑕᕐᔪᐊᖅ ᐃᒪᓕᒃᑕᓕᕆᔨᑦ ᑲᑎᒪᓂᖏᑦ. NAFO ᐃᓂᒋᔭᖏᑦ ᑕᕐᓂᓕᖏᓪᓕᑦ Northwest Atlantic ᐃᖃᓗᓕᕆᔨᑦ ᖃᑐᐸᖃᑎᒋᑦ ᒪᓕᒐᖏᑦ ᐃᓂᖏᔭᖏᑦ.

Fish Areas of Abundance are from Freshwater Institute, Arctic Marine Workshop. NAFO Areas are Northwest Atlantic Fisheries Organization Regulatory Areas.

Ekalogiaknigit naonaiyaktaohimayot Emakmiotaligiyinit katimajotaoplotik elittoghaktaohimayot NAFO-konnit

Régions d'abondance de poissons de la part de l'Atelier sur l'Arctique Marin, Institut d'Eau Douce. Les régions de l'OPANO sont des zones de contrôle de l'Organisation de pêche de l'Atlantique nord-ouest.

ᐃᖃᓗᓂᖏᑦ ᐃᓂᒋᔭᖏᑦ
Fish Areas of Abundance
Ekalokaknigit Ekalogiaknigillo
Régions d'abondance de poissons

ᓄᓇᕗᖅᓯᒪᔪᖅ
Nunavut Planning Commission
Nunavunmi Parnaiyiit
Commission d'Aménagement du Nunavut

ᐱᒃᓱᖅᓯᒪᔪᖅ
Draft
Inikhimaitok
Brouillon

ᓴᖅᑭᑎᑦ

WILDLIFE ANGOTIGHAT FAUNE



ᓄᓇᕗᑦ ᓇᓴᐅᑎᓕᒃ
ᐊᖏᔪᖓ, ᒥᒃᑭᓂᖏᓗ ᐊᑕᐅᓚᖅ
Aktilaaga

1:10,000,000 Scale Échelle

250 125 0 250 500
ᑭᓕᒥᑦᑕᕐ Ongahiktilaaga Kilometres kilomètres

ᓇᓴᖁᓕᐊᓗᒃᑕᑦ ᐊᒻᒪᓗ/ᐅᒃᐸᓗᓂᑦ ᖃᓚᑕᐅᔨᑎᒍᑦ ᐊᑦᓯᓕᐅᖁᓕᐊᓪᓚᑦ ᑕᑦᓭᒧᖅ Jacques Whitford ᐊᑐᖁᑕᐅᖁᑦᓭᓪᓕᑦ ᑕᒃᓂᓇᖅ “ᓄᓇᕗᑦ ᓂᑦᔨᑎᑕᓂᔅᑦ ᐊᑕᑐᐃᓇᐅᔪᓐᓇᑦ ᐊᒻᒪᓗ ᓇᐊᖁᑦᑕᖁᑦᑕ ᐃᓕᓴᕐᓂᖏᑕ ᐅᓂᐸᖁᓕᖅᑐᓂᖅ”, ᐊᖏᑕᐅᐊᖁᖅ ᑕᒃᓂᓇᖅ ᓄᓇᕗᑦ ᑭᓇᐃᔅᒃᑯᑦ (NPC), ᐅᒃᑐᐱᓗ, 2008.

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ᓄᓇᕗᑦ ᑭᓇᐃᔅᒃᑯᑦ
Territorial Park,
Minggoikhikviit,
Parc territorial

ᓂᕆᔨᒃ ᐃᓂᓕᓐᓂᕆᑦ ᐃᓕᓴᕐᓄᑦ ᐱᔪᒥᑦᑕᕐᓂᖅ
Wildlife Areas of Significant Interest
Nunami Angotighakaknigit
Région de faune d'intérêt significatif

ᑐᒃᑐᑦ ᓴᓪᓕᐊᓂᓴᕐᓂᑦ ᐃᓂᒥᔨᑎᒍᑦ
Caribou Protected Area
Tuktukaknigit Hapommiyaoyot
Zone protégée de caribou

ᑲᓇᙵᑦ ᑭᓱᐃᓕᓴᖅᑕᑦ
National Park
Kaanatami Mingoikhikvik
Parc national

ᓂᕆᔨᑎᓄᑦ ᐱᑦᑕᖃᑦᑕᐃᓕᓚᖅᑕᑦ
Wildlife Sanctuary
Anggotighakaknigit
Réserve faunique

ᖃᐅᔨᓄᖃᖅᑕᐃᓕᓚᖅᑕᑦ
Migratory Bird Sanctuary
Hogaakakniit
Refuge d’oiseaux migrateurs

ᑲᓇᙵᑦ ᓂᕆᔨᑎᑦ ᐃᓂᒥᔨᖃᖅᑕᕐᓂᑦ
National Wildlife Area
Kaanatami Anggotighakaknigit
Réserve national de faune

ᓄᓇᕗᑦ ᑭᓱᐃᓕᓴᖅᑕᑦ, ᓂᕆᔨᑎᑦ ᐃᓂᒥᔨᖃᖅᑕᕐᓂᑦ ᐃᓕᓴᕐᓄᑦ ᐱᔪᒥᑦᑕᕐᓂᖅ, ᐊᒻᒪᓗ ᑐᒃᑐᓄᑦ ᑭᓇᐃᔅᒃᑯᑦ ᐃᓂᒥᔨᑎᒍᑦ ᓇᓴᖁᓕᖅᑐᓂᖅ ᐱᔪᒥᑦᑕᕐᓂᑦ ᐱᓕᕆᔨᒃᑯᐊᓕᖅᑐᒃᑐᖅ ᓄᓇᕗᑦ ᑲᓇᑕᒥᑦ, ᐊᐱᖅᑐᖁᓕᐊᖅ ᐊᖏᑎᓪᓗᓂᖅ, ᑲᑎᕆᔨᖅ ᑭᓱᐃᓕᓴᖅᑕᑦ ᐱᑦᑕᖃᑦᑕᐃᓕᓚᖅᑕᑦ ᐱᓕᕆᔨᒃᑯᐊᓕᖅᑐᒃᑐᖅ ᐊᓯᑐᐃᓇᐅᑎᓯᒪᔪᖅ ᐊᓯᑐᐃᓇᐅᔪᓐᓇᑦ ᐊᑐᐃᓇᐅᑎᓯᒪᔪᖅ ᑲᓇᙵᑦ.

Territorial Park, Wildlife Area of Significant Interest, and Caribou Protected Area data courtesy of the Government of Nunavut, Department of Environment. National Park, Wildlife Sanctuary, Migratory Bird Sanctuary, and National Wildlife Area data courtesy of Natural Resources Canada.

Mingoikhikviit, Anggotighakaknigillo Tuktukaknitlo Nunami Hapommiyaoyot talva hapkonatigot naonaigotighat piyaohimayot Nunavut Kavamaita Avatiligiyiinit, Minggoikhikviligiyitkonnitlo Kaanatami.

Parc territorial, Région faunique d'intérêt significatif et Zone protégée de caribou gracieuseté du Ministère de l'Environnement, Gouvernement du Nunavut.
Parc national, Réserve faunique, Refuge d’oiseaux migrateurs et Réserve national de faune gracieuseté de Ressources naturelles Canada.

ᐅᑦᔪᑐᓗᕆᐅᔨᒃᑯᑦ ᐊᐅᓚᑦᑎᑐᑦ
Special Management Areas
Nunami Amigiyaoloaktot
Régions de gestion spéciale

ᓄᓇᕗᑦ ᑭᓇᐃᔅᒃᑯᑦ
Nunavut Planning Commission
Nunavunmi Parnaiyiit
Commission d'Aménagement du Nunavut

ᐱᔾᓇᖅᓯᒪᔪᑐᑦ
Draft
Inikhimaitok
Brouillon



ᓄᓇᖃᐊᖅ ᓇᓴᐅᑎᓕᒃ
ᐊᖏᕐᓂᖅ, ᒥᑭᓂᖅᓴᓗ ᐊᑕᐃᒃ
Aktilaaga 1:10,000,000 Scale Échelle

250 125 0 250 500
ᑭᓕᒥᑦᑕᓴ Ongahiktilaaga Kilometres kilomètres

ᓇᓴᖅᓭᒪᔨᓗᒃᑕᑦ ᐊᒪᒪᓗ/ᐅᑲᐅᓐᓂᓕᑦ ᖃᓚᑕᐅᔾᑎᒍᑦ ᐊᑦᕆᓕᐅᖅᓭᒪᔨᓄᑦ ᑕᑦᓭᒧᖅ Jacques Whitford ᐊᑐᖅᑕᐅᕐᓭᔨᓗᑕᑦ ᑕᑯᓀᖅ "ᓄᓇᕗᑦ ᓂᑦᔨᑎᓕᓚᓵᑦ ᐊᑦᑐᐃᓇᓀᔨᓄᑦ ᐊᒪᒪᓗ ᓇᔨᖅᓴᐅᑎᖅᑕᑦ ᐅᓂᐊᖅᑕᑦ ᐃᓕᓴᕐᓂᖅ, ᐃᓕᓴᕐᓂᖅ ᐊᑦᑐᐃᓇᓀᔨᓄᑦ (NPC), ᐅᖃᐅᓚᓗ, 2008.

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ᐱᔾᒥᑦᑎᐅᔾᔨᖅ ᐱᓕᓗᐊᖏᖅᓴᓗᑎᒃ ᑲᓇᑕ ᒥᓯᐊᓕᐅᖅᓭᒪᔨᓄᑦ
Proposed National Parks
Minggoikhikvinggoktaoyomayot
Parcs nationaux proposés

ᐅᒪᔨᑦ ᐊᖏᕐᓂᓗ ᓂᓪᖏᑎᓂᓂᓗ ᖃᐅᔨᓴᓂᖅ ᐃᓕᓴᕐᓂᖅᓂᓗ ᐃᓕᓴᕐᓂᐊᖅᑕᑦ (IBP)
Ecological Sites (IBP)
Nunami Naovaknigit
Emplacements écologiques (PBI)

ᓄᓇᕗᑦ ᑭᓕᕐᓂᖅᑕᑦ ᑲᑎᒪᔨᖅ ᐱᓕᕆᔨᒃᑯᑦ (Ramsar)
Wetlands of International Importance (Ramsar)
Nunami Mihaligakaknigit Natingnaitlo
Marécages d'importance internationale (Ramsar)

ᐱᔾᒥᑦᑎᐅᔾᔨᖅ ᐱᓕᓗᐊᖏᖅᓴᓗᑎᒃ ᖃᓚᒋᑦ ᒥᓯᐊᓕᐅᖅᓭᒪᔨᓄᑦ ᑕᑯᓀᖅ ᑕᑯᓂᖅ ᒥᓯᐊᓕᐅᖅᓭᒪᔨᓄᑦ ᐱᔾᒥᑦᑎᐅᔾᔨᖅ ᐱᓕᓗᐊᖏᖅᓴᓗᑎᒃ ᖃᓚᒋᑦ ᑕᑯᓂᖅ ᒥᓯᐊᓕᐅᖅᓭᒪᔨᓄᑦ ᐱᔾᒥᑦᑎᐅᔾᔨᖅ ᐱᓕᓗᐊᖏᖅᓴᓗᑎᒃ ᖃᓚᒋᑦ ᑕᑯᓂᖅ " ᐅᒪᔨᑦ ᐊᖏᕐᓂᓂᓗ ᓂᓪᖏᑎᓂᓂᓗ ᖃᐅᔨᓴᓂᖅ ᐃᓕᓴᕐᓂᐊᖅᑕᑦ ᐃᓕᓴᕐᓂᓂᓗ ᖃᐅᔨᓴᓂᖅ, 1975, ᓄᓇᕗᒻᒥᑦ ᐱᓕᓗᐊᖏᖅᓴᓗᑎᒃ (IBP). ᓄᓇᑦ ᑭᓕᓂᖅᑕᑦ ᓄᓇᕗᒻᒥᑦ ᑕᐃᒪᐃᓇᐃᑐᑦ ᐱᓕᓗᐊᖏᖅᓴᓗᑎᒃᑯᑦᓂᓗ ᐅᒪᔨᑦᑎᓂᒃᑯᑦᓂᓗ, ᑲᓛᒪᑦ ᓄᓇᕗᑦ ᐊᒪᒪᓗ ᑕᑯᓂᐊ ᑕᐃᒪᐃᓇᐅᔨᑦ ᖃᐅᔨᓴᓂᖅᓂᒃᑯᑦ ᓄᓇ ᑭᓕᓂᖅᑕᑦ, www.ramsar.org/
Proposed National Parks data from Parks Canada
Ecological Sites data from "Ecological Sites in Northern Canada, 1975, International Biological Programme (IBP).
Wetlands of International Significance from Department of Sustainable Development, Government of Nunavut and the Ramsar Convention on Wetlands, www.ramsar.org/
Minggoikhikvinggoktaoyomayotigot naonaigotighat pihimayot Kaanatami Minggoikhikvilikiyiinit 1975-gotillogo naonaikhimayait honatigollokaa Angotighanik nunamilo Naovakniginnik talvalo nunami mihaligakaknigit natiknatlo homilikaa naonaiktaohimagiplogit Nunavut Kavamaita Pivaliayoligiyiinit.
Informations sur les Parcs nationaux proposés de la part de Parcs Canada.
Informations sur les Emplacements écologiques de la part de « Emplacements écologiques du Nord Canadien, 1975 », Programme biologique international (PBI).
Marécages d'importance internationale de la part du Département de développement durable, Gouvernement du Nunavut et la convention RAMSAR au sujet des marécages, www.ramsar.org/

ᓂᕆᔨᒃᑯᑦ ᐱᔾᔪᑌᒃᑯᑦᑎᐊᖅ ᐃᓚᖓᑕᐅᓂᖅᓴᖅ
Areas of Importance to Wildlife
Nunami Angotighakaknigit Pimmagioyot
Région d'importance à la faune

ᓄᓇᕗᒻᒥᑦ ᓇᓕᓕᒫᑦ ᐃᓕᓴᕐᓂᖅ
Nunavut Planning Commission
Nunavunmi Parnaiyiit
Commission d'Aménagement du Nunavut

ᐱᔾᔪᑌᒃᑯᑦᑎᐊᖅ
Draft
Inikhimaitok
Brouillon



ᓄᓇᖏᔪᐊᖅ ᓇᓴᐅᑎᓕᒃ
ᐊᖏᕐᓂᖏᓐᓄᑦ, ᒥᒃᑭᓂᖏᓐᓄᓗ ᐊᑕᐅᒃ
Aktilaaga

1:10,000,000 Scale Échelle

250 125 0 250 500
ᑭᓕᒥᑦᑐᓕᖅ Ongahiktilaaga Kilometres kilomètres

ᐱᖏᕐᑎᑦ ᐊᒻᒪᓗ ᐱᖏᑎᓕᔪᓂᐊᕐᓂᖅ ᖃᐅᔨᒪᓕᔪᑎᒃᓴᓂᒃ ᑕᒃᑯᐊ ᐱᖏᑎᓕᔪᓵᑎᒃ: ᐃᓄᓕᓵᔨᑐᖏᒃᑯᑦ ᑲᓇᑕᒥᑦ, ᖃᐅᔨᒪᕐᕕᐅᑎᑦ ᑕᒃᑯᓇᖏᓐᓇᑦ ᐱᔪᓐ Terriplan ᐅᖏᖏᑎᖏᕐᑎᑦ “ᐃᓄᐸ ᖃᓪᓗᐅᓂᖅᑎᑦ ᐊᒻᒪᓗ ᐱᓕᕆᐊᓂᔪᒥᑦ ᖃᐅᔨᒪᕐᕕᐅᑎᑦ ᐅᓂᐸᑲᕆᐊᑦ”, ᐊᖏᑕᐅᔪᑦ ᑕᒃᑯᓇᖏᓐᓄᑦ ᓄᓇᔭᐅᒃᑯᓂᒃ, ᐊᒻᒪᓕᒃ, 2008.

Permit and commodity information source: Indian and Northern Affairs Canada. Symbology from Terriplan Consultants “Socio-Demographic and Economic Sector Analysis Report”, prepared for the Nunavut Planning Commission, August, 2008.

Laisitigollo maniliogotighatigollo naonaigotighat pihimayot Kavamatokait Enoligiyitokainnit pipkaktaoplotik NPC-konnot Akasi 2008-mi

L'information au sujet des permis et des matières premières: Ministère des affaires indiennes et du Nord Canada. Symbologie provenant du « Rapport d'analyse des secteurs Socio-démographique et Économique », préparé par les Consultants Terriplan, pour la Commission d'Aménagement du Nunavut, août 2008.

Alert
Grise Fiord
Resolute
Sachs Harbour
Holman
Arctic Bay
Pond Inlet
Clyde River
Qikiqtani
Qikiqtarjuaq
Igloolik
Taloyoak
Cambridge Bay
Hall Beach
Pangnirtung
Kugluktuk
Gjoa Haven
Kugaaruk
Umingmaktok
Bathurst Inlet
Kitikmeot
Repulse Bay
Iqaluit
Cape Dorset
Kimmirut
Coral Harbour
Baker Lake
Rae
Yellowknife
Chesterfield Inlet
Rankin Inlet
Ivujivik
Salluit
Kangiqsujuaq
Quaqtaq
Kangirsuk
Fort Resolution
Whale Cove
Puvirnituq
Tasiujaq
Kuujjuaq
Arviat
Kivalliq
Fort Smith
Fond-du-Lac
Fort Chipewyan
Black Lake
Inukjuak
Alberta
Churchill
Brochet
Fort McMurray
Saskatchewan
Manitoba
Umiujaq
Sanikiluaq
Kuujjuarapik
Split Lake
Gillam
Ontario

ᓇᓗᓕᒃᑐᐃᓐᓇᖅᑐᑦ ᐅᖃᖅᑐᑦ
Base Metals
Havilghat
Métaux de base

ᐊᖏᖅᑲᒃ
Coal
Aloak
Charbon

ᑕᐃᒪᓐ
Diamonds
Kipligiat
Diamants

ᓂᐸᑦᑎᓪᓗᒍ ᐅᖃᖅᑲᒃᑯᑦ ᐊᓕᔪᖅᑎᑐᑦ
Gemstones
Pinniktot
Pierres gemmes

ᔪᓕᑎ
Gold
Gold
Or

ᖃᓄᐃᓕᐅᖅᑎᑐᖅ - copper PGE’s
Nickel-copper PGE's
Akilgollo – Kannoyaitlo
Nickel-Cuivre (Éléments de groupe de platine)

ᖃᐃᒃᑯᓂᒃᓴᓂᖅ ᐅᖃᖅᑎᑦ
Precious Metals
Pinnikpiaktot haviit Nonggolaitot
Métaux précieux

ᓇᖕᒪᑦ
Uranium
Nonggolaitot
Uranium

ᑐᓴᕐᕕᖏᓐᓇᖅᑐᖅ ᐱᖅᖁᑎᓂᒃ
Prospecting Permits
Nalvaakhiogotighat laisit
Permis de prospection

ᐅᖃᖅᑲᒃᑲᓕᖅᑐᖅ
Mineral Claims
Nalvaakviohimayot
Réclamation minérale

ᐅᖃᖅᑎᖅᑕᖅᑐᑦ ᖃᖅᑲᐅᑎᖅᑐᖅ

Mineral Exploration

Oyagakhioknik

Exploitation minière

ᐃᓄᓐᓂᒃᓴᒪᓕᕐᓂᑦ

Draft Inikhimaitok Brouillon

ᓄᓇᕗᑦ ᐃᓕᓴᕐᕕᐃᓕᒃ
Nunavut Planning Commission
Nunavunmi Parnaiyiit
Commission d'Aménagement du Nunavut



ᓄᓇᖏᔪᐊᖅ ᓇᓴᐅᑎᓕᒃ
ᐊᖏᕐᓂᖏᓐᓄᑦ, ᒥᒃᑭᓂᖏᓐᓄᓗ ᐊᑕᐅᒃ
Aktilaaga

1:10,000,000 Scale Échelle

250 125 0 250 500

ᑭᓕᒥᑦᑐᑦ Ongahiktilaaga Kilometres kilomètres

ᐅᖃᓕᔪᓂᒃ ᐊᒻᒪᓗ ᐅᖃᓕᖏᓐᓄᑦ ᓴᓗᖃᖏᓐᓂᕐᒧᑦ ᓇᓂᓐᖏᕐᓂ, ᐊᑦᑕᕐᖏᓐᓂᑦ ᓯᐃᓴᑦᓂᓕ ᑕᒪᓐᓇᖏᑦ ᑕᐃᔨᐅᔪᑦ Terriplan ᐅᖃᖅᑎᖃᖏᑎᑦ “ᐃᓄᐃᑦ ᖃᐅᔨᐅᓂᖏᑦ ᐊᒻᒪᓗ ᐱᓕᕆᓂᐅᔪᑦ ᖃᐅᔨᓴᓐᓂᑦ ᐅᓂᒃᑲ”, ᐊᖏᑭᐅᔪᑦ ᑕᒃᓄᓄᓐᖓ ᓄᓇᕗᑦ ᐸᖅᐃᐱᒃᓄᓄᑦ, ᐊᒡᓕᓯ, 2008.

ᐅᖃᓕᔪᓂᒃ ᐊᒻᒪᓗ ᐅᖃᓕᓴᖅ ᖃᕐᓂᖅ ᑕᐃᒪᐅᓂᖏᑦ ᐅᑲᓐᓂᑦ ᐃᒪᖃᑦᖃᖏᓐᓄᑦ, ᑕᐃᔨᐅᔪᑦ ᐊᒻᒪᓗ ᓄᓇᖏᔪᐊᖏᑦ ᓇᓗᓄᐃᕐᑕᐅᔪᑦ ᑕᒃᓄᓄᓐᖓ ᐅᖃᓕᓴᖅᑎᓂᓕᒃᑐᑦ PETROLEUM ᖃᓄᓂᑦ ᐅᖃᐅᔨᑦᑐᖅ ᑲᓇᑕᑦ, ᑐᖃᒧᐊᖏᑐᑦ ᑕᒃᓄᓄᓐᖓ ᐅᖃᓕᓴᖅ ᐊᒻᒪᓗ ᐅᖃᓕᓴᖅ ᖃᕐᓂᖅ ᖃᐅᔨᓴᓐᓂᑦ ᐊᒻᒪᓗ ᐱᖃᓂᑦ, ᐅᖃᓕᓴᖅ ᐊᒻᒪᓗ ᐊᖏᓕᓴᖅ ᐊᖏᓚᐲᖃᖅ, ᐃᓄᓕᓵᔨᑐᖃᓕᑦ ᑲᓇᑕᑦ, 1995

Oil and gas well locations, license type from Terriplan Consultants “Socio-Demographic and Economic Sector Analysis Report”, prepared for the Nunavut Planning Commission, August, 2008. Oil and Gas potential based on presence or absence of sedimentary basins, as described and mapped in PETROLEUM EXPLORATION IN NORTHERN CANADA, A Guide to Oil and Gas Exploration and Potential, Northern Oil and Gas Directorate, Indian and Northern Affairs Canada, 1995

Oghokyoakhioknikot kaasiliikhioknikollo ekootakhimayot , kanogitollo nalvaakhiogotit ilaisitigot naonaigotighat pihimayot Inuktigot Manighioknighakollo havakvioyomit toniyaohimayot pipkaktaoplotik NPC-konnot Akasi 2008-mi. okioktaktomi OGHOKYOAKHIOTIT KAANATAMI maligaghanik ehoaghaihimayot okoa Kavamatokait enoligiyitkaginit 1995-gotillogo.

Les endroits de puits de pétrole et de gaz naturel et les types des permis dans le « Rapport d'analyse des secteurs Socio-démographique et Économique », préparé par les Consultants Terriplan, pour la Commission d'Aménagement du Nunavut, août 2008.

Le potentiel de pétrole et de gaz naturel est basé sur la présence ou l’absence de bassins sédimentaires, comme décrit et cartographié dans PROSPECTION PÉTROLIÈRE AU CANADA NORDIQUE, un guide au sujet du potentiel et de la prospection de pétrole et gaz naturel, Direction du pétrole et du gaz naturel du Nord, Ministère des affaires indiennes et du Nord Canada.

ᐱᓕᕆᔨᒃᑯᑦ ᑲᑎᒪᔨᖅ
Development well
Ekootakpalliaplotik Piyot
Puits de développement

ᓇᓗᓇᐃᖅᑲᓇᖅ ᑲᑎᒪᔨᖅᑲᓇᖅ
Delineation well
Ekootakhotik Kiniktot
Puits délinéé

ᖃᐅᔨᑲᓐᓂᖅ ᑲᑎᒪᔨᖅᑲᓇᖅ
Exploratory well
Ekootakhotik Nalvaagahoaktot
Puits exploratoire

ᖁᑎᐅᑎᕗᑲᓇᖅ ᑲᑎᒪᔨᖅᑲᓇᖅ
Relief well
Amoyakakviitlo Ekookakhimayot
Puits d'assistance

ᐱᓕᕆᐊᖓᔪᖅᑐᖅ ᑲᑎᒪᔨᖅᑲᓇᖅ
Service well
Hannaviohimmaakhotik Ekootakhimayot
Puits de service

ᐊᓯᖏᑦ
Others
Aalatlo
Autres

ᓯᐃᓴᑦᓂᖅᓴᐅᑦ
Production Licence
Havaotaolotik Laisighat
Production Licence

ᓇᓂᓯᓯᒪᓂᖅᑐᖅᑐᖅ ᓯᐃᓴᖅᓴᖅ
Significant Discovery Licence
Nalvaagoyonotlo Laisighat
Significant Discovery Licence

ᐅᖃᓕᔪᓂᒃᑲᓇᖅ ᐊᒻᒪᓗ ᐅᖃᓕᖏᓐᓄᑦ ᐱᖓᓱᐊᕐᓂᖓᓄᑦ
No Oil and Gas Potential
Oghokyoaniklo Kaasiliiniklo Nalvaakviohimaitot
Aucun potentiel de pétrole et gaz naturel

ᐅᖃᓕᔪᓂᒃ ᐊᒻᒪᓗ ᐅᖃᓕᓴᖅ
Oil & Gas
Oghokyoatlo Kaasiliitlo
Pétrole et gaz naturel

ᓄᓇᕗᒻᒥᐅᑎᓯᒪᔪᖅ
Nunavut Planning Commission
Nunavunmi Parnaiyiit
Commission d'Aménagement du Nunavut

ᐱᒃᓱᕆᖅᓯᒪᓕᕐᒥᔪᒃᑯᑦ
Draft
Inikhimaitok
Brouillon

ᐱᐅᓚᑦ ᐱᓕᓕᕋᖏᑐᓇᒋᑦ SOCIO-ECONOMIC INUKTIGOLLO - MANIKTIGOLLO SOCIO-ÉCONOMIQUE



ᓄᓇᕗᑦ ᓇᓴᐅᑎᓕᒃ
ᐊᖏᓂᖅᓱᒃ, ᒥᑭᓂᖅᓱᓗᓪ ᐊᑕᐅᒃ
Aktilaaga
1:10,000,000
Scale
Échelle

250 125 0 250 500
ᑭᓚᒥᑦᑕᓴ Ongahiktilaaga Kilometres kilomètres

ᓄᓇᕋᐊᑦ ᒥᖓᐃᓕᓴᐃᓪᓗᑦ, ᓇᓴᖅᓭᒪᔪᖅ ᐱᓕᓇᐊᓇᔅᑐᐅᔪᑦ ᑕᐅᐊᓇᖅᓱᓕᑦ ᑲᒪᓚᑲᑦ ᓄᓇᕗᑦᑎ, ᐊᐃᓵᑐᖅᓭᒪᔪᖅ ᐊᐊᑎᓕᓚᓴᑦ, ᑲᓇᐃᓐᓂᖅ ᓄᓇᒥ ᐱᑕᖅᑕᐃᓕᓕᓂᑦ, ᖃᐅᔨᓄᐊᑦ ᓄᓇᒥ ᐱᑕᖅᑕᐃᓕᓕᓂᑦ ᓇᓴᖅᓭᒪᔪᖅ ᑕᐅᐊᓇᖅᓱᓕᑦ ᑲᓇᐃᓐᓂᖅ. ᐳᓪᓴᑎᑦ, ᒪᖃᐃᑎᑦ ᐅᐅᓪᓗᓂᑦ ᐃᖃᓗᐊᓂᖅ ᐸᓪᓕᐊᓂᖅ ᓇᓴᖅᓯᐅᑦᓯᔪᑦ ᐱᖓᓱᓇᖅ ᖃᐅᔨᓴᖅᑎᑦᑎᓂᒃ 2003-ᒥ, ᓄᓇᕗᑦ ᐸᓴᓇᔅᑦ.

Territorial Park, data courtesy of the Government of Nunavut, Department of Environment. National Park, Wildlife Sanctuary, Migratory Bird Sanctuary data courtesy of Natural Resources Canada.
Tourism, Hunting or Fishing Lodge data from the West Kitikmeot Tourism Workshop, 2003, Nunavut Planning Commission

Minggoikhikviliginikot Naonaigotighat pihimayot Nunavut Kavamaita Avatiligiyiinit. Hapkoataok Kaanatami mingoikhikviktigot, Angotighakakniktigollo, Hogaakakniktigollo naonaigotighat pihimakmiyot kaanatap nunamiotaligiyiinit. Polaagaktoliginikollo, Manikhiotaoplotiklo Angonahoakvioyot Angonahoaktitiyikakhotik pihimakmiyot Kitikmeoni Polaagaktoliginikot Katomajotaohimaploni 2003-gotillogo NPC-konnit

Parc territorial, information gracieuseté du Ministère de l'Environnement, Gouvernement du Nunavut. Parc national, Réserve faunique, Refuge d'oiseaux migrateurs de la part de Ressources naturelles Canada.
Tourisme, chasse, ou loges de pêche, information de la part de l'Atelier pour le Tourisme pour le Ouest Kitikmeot, 2003, Commission d'Aménagement du Nunavut.

ᓄᓇᖅ
Polar Bear
Nannut
Ours polaire

ᑐᖅᑐᐃᓕᑦ
Caribou
Tuktut
Caribou

ᐅᒥᖕᒪᖅ
MuskOx
Umingmak
MuskOx

ᐊᐱᕆᑦ
Walrus
Qiviq
Morse

ᐃᖃᓗᓕᖅᐱᒃ
Arctic Char
Iqalukpik
Ombles arctiques

ᐃᓕᓴᖅ
Lake Trout
Ihuuqiq
Truite

ᓱᓕᖅᐸᐅᒪᖅ
Arctic Grayling
Grayling
Grayling

ᐳᓪᓴᑎᑦ, ᒪᖃᐃᑎᑦ, ᐅᖅᑯᓂᑦ ᐃᖃᓗᐊᓂᖅᓱᒃ ᐳᓇᖅᑐᑐᑦ
Lodges
Polaagaktoliginik, Kablonaat
Angonahoagiaktokhimayot, Ekalokhiokvioyollo
Loges

ᓄᓇᕋᐊᑦ ᒥᖓᐃᓕᓴᐃᓪᓗᑦ
Territorial Park
Minggoikhikviit
Parc territorial

ᑲᓇᐃᓐᓂᖅ ᒥᖓᐃᓕᓴᐃᓪᓗᑦ
National Park
Kaanatami Mingoikhikvik
Parc national

ᓂᕿᔨᑎᓄᑦ ᐱᑕᖅᑕᐃᓕᓚᕆᐊᓕᑦ
Wildlife Sanctuary
Anggotighakaknigit
Réserve faunique

ᖁᓕᓴᓄᐊᖅᑕᐃᓕᓚᕆᐊᓕᑦ
Migratory Bird Sanctuary
Hogaakakniit
Refuge d'oiseaux migrateurs

ᐳᓴᖏᑦ
Tourism
Polaagaktoliginik
Tourisme

ᓄᓇᕗᑦᑎ ᐊᓯᔾᔨᖅ
Nunavut Planning Commission
Nunavunmi Parnaiyiit
Commission d'Aménagement du Nunavut

ᐃᓄᐃᒪᐃᑦᑐᖅ
Draft
Inikhimaitok
Brouillon

ᐱᐅᐱᑦ ᐱᓕᓀᑎᖏᑦᑐᓇᒋᑦ SOCIO-ECONOMIC INUKTIGOLLO - MANIKTIGOLLO SOCIO-ÉCONOMIQUE



ᓄᓇᖏᔪᐊᖅ ᓇᓴᐅᑎᓕᒃ
ᐊᖏᕐᓂᖏᓐ, ᒪᑦᑭᓕᖏᓐᓇᓗ ᐊᑕᐅᒃ
Aktilaaga 1:10,000,000 Scale Échelle

250 125 0 250 500
ᑭᓕᒥᑦᑕᕐ Ongahiktilaaga Kilometres kilomètres

ᐃᓚᒪᑲᓂᑦ ᐃᖏᕐᓴᐅᓕᓗᓂᑦ ᐊᑦᕿᑎᖏᑦ ᓴᖅᑭᑕᐅᓪᓚᐅᔾᔨᖅ ᐱᖓᕐᑭᑎᑎᒍᑦ ᐱᓪᓗᐊᖅᓂᖅᑐᑦ ᑕᑯᓂᖓᓂᑦ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ ᑲᑎᒪᔨᐅᑉᐳᖅ ᐊᑦᑐᐊᖅᑕᐅᔪᖅᓴᖅ 2008, ᐊᖏᑕᐅᓚᐅᔾᔨᖅ ᓄᓇᖏᔪᐊᓕᓕᒫᓂᑦ ᑲᑎᒪᓂᖅ.
ᐱᓕᓕᐊᖏᔪᐊᓚᐅᑦ ᑐᑭᓯᐅᑎᑎᒋᑦ ᐊᑦᕿᑎᒃᓴᖅ ᐊᒪᒪᓗ ᓄᓇᒃᑯᓯᑎᕐᕕᐊᑦ ᐊᑦᕿᑎᒃᓴᖅ ᓇᓴᖅᓭᒪᓕᐅᑦ ᐅᕙᓂ Baffinland Iron Project. ᑕᒃᑯᓄᖏ ᐊᖏᑕᐅᔪᖅMary River, ᐱᓕᓕᐊᖏᔪᐊᓚᐅᑦ ᑐᑭᓯᐅᑎᑎᒋᑦ ᐊᑦᕿᑎᒃᓴᓪᓚᒍᑦ ᐊᓂᔪᓯᑦᓴᒃ ᖃᓇᑕᐅᔾᔨᑎᒍᑦ ᐊᖏᓕᓂᖅᑐᑦ ᑕᒃᑯᓄᖏ ᓄᓇᒃᑦ/ᒪᓂᑐᒃ ᐊᑦᕿᑎᓕᐅᖅᑎᖅᑎᖏᑦ ᓂᕈᐊᖅᑕᐅᔪᑦᓗᐊᑦ x ᑎᓕᑦᐱᓇ ᑮᖅᒪ ᐅᓂᒃᑳᖅᑎᑦᑎᓕᐅᑉ ᐃᒃᑯᓴᖅᑕᐅᔪᑦ ᐊᑦᕿᑎᑎᒋᑦ ᓇᒪᔪᓐᓇᖅᑐᒃᑯᑦ ᑕᒃᑯᓄᖏ ᐊᑎᓕᐅᑦ ᓄᓇᒃᑯᓯᑎᕐᕕᐊᑦ ᑕᒃᑯᓄᖏ ᓄᓇᒃᑦ ᐊᑎᓕᐅᑦ ᐅᕙᓂ ᐃᒃᑯᓴᖅᑕᐅᔪᑦ ᐊᑦᕿᑎᑎᒋ



ᓄᓇᖏᓚᐅᖅ ᓇᓴᐅᑎᓕᒃ
ᐊᖏᔪᓂᖏᓐᓄᑦ, ᒥᖏᔪᓂᖏᓐᓇᓗ ᐊᑕᐅᖅ
Aktilaaga 1:10,000,000 Scale Échelle

250 125 0 250 500
ᑭᓕᒥᑕᕐᓂ Ongahiktilaaga Kilometres kilomètres

ᑯᐱᖏᑕᕐᕕᑦ ᓇᓗᓇᐃᔨᑯᑎᑦ ᐃᖅᑭᑕᐅᔪᓂᑦ ᑕᐃᒪᐃᓕᓐᖏᓚᐅᖅᑐᖅᓯᒪᓕᒃᑐᑦ ᐊᑐᐃᓇᐅᔪᕐᓴᖅᓯᒪᓕᒃ ᑲᓇᑕᒥᑦ, ᑲᓇᑕᒥᑦ ᐊᑎᖏᕐᔾᔪᑎᑦ Centre for Remote Sensing, ᓄᓇᖏᓚᐅᓂᒃᓴᕐᔪᐃᓕᑦ ᑲᓇᑕᒥᑦ, 2003, ᑲᓇᑕᒥᑦ ᐱᓕᓂᐊᓕᑦ Frameworks Hydrology – ᑯᐱᖏᑕᕐᕕᑦ ᐃᓕᓴᕐᓂᑦ, ᑲᓇᑕᒥᑦ

Drainage basin data courtesy of Natural Resources Canada, Canada Centre for Remote Sensing, The Atlas of Canada, 2003, National Scale Frameworks Hydrology - Drainage Areas, Canada

Nunami Hakvaknigitigot naonaigotighat pihimayot Kaanatami Nunamiotaligiyiinit. Kaanatap Uunaoyalikiyikyoaginnitlo 2003-gotillogo homilikaa koogavaloknik hakvaktoniklo Kaanatami nunami.

L'information au sujet des Bassins versants provient des données à l'échelle national sur l'hydrographie - aires de drainage, l'Atlas du Canada, 2003, gracieuseté de Ressources naturelles Canada et le Centre canadien de télédétection.

Grise Fiord
Resolute
Sachs Harbour
Holman
Arctic Bay
Pond Inlet
Clyde River
Qikiqtani
Qikiqtarjuaq
Igloolik
Hall Beach
Taloyoak
Cambridge Bay
Kugluktuk
Gjoa Haven
Kugaaruk
Pangnirtung
Umingmaktok
Bathurst Inlet
Kitikmeot
Repulse Bay
Iqaluit
Kimmirut
Cape Dorset
Coral Harbour
Baker Lake
Rae
Yellowknife
Rankin Inlet
Chesterfield Inlet
Fort Resolution
Whale Cove
Kivalliq
Arviat
Fort Smith
Fond-du-Lac
Fort Chipewyan
Black Lake
Ivujivik
Salluit
Kangiqsujuaq
Quaqtaq
Kangirsuk
Puvirnituq
Tasiujaq
Kuujjuaq
Inukjuak
Umiujaq
Sanikiluaq
Kuujjuarapik

ᐃᒪᓴᐱᒃ	Amundsen Gulf	Amundsen Gulf	Golfe d'Amundsen
ᓴᓐᓂᖏᓕᕐᓂ ᑯᖏᖓ	Back	Otkohikhalik	Rivière Back
ᖃᐱᑕᓐᓂ x ᐅᖃᐅᔨᖅᑕᕐᔪᒥ ᑯᐃᖅᑕᕐᓴᐃᑦ	Baffin Island - Arctic Drainage	Kikiktaalokmi - Hakvaktot	Île de Baffin - versant arctique
ᐃᒡᓗᓕᕆᓂᖅ	Chesterfield Inlet	igluligaarjuk	Baie Chesterfield
ᑲᑯᓗᖅᑐᖅ	Coppermine	kugluktuk	Rivière Coppermine
ᖃᑎᖑᒥᑦ ᑕᕆᐅᖏᓐ x ᐃᓗᐃᓕᖅ	Coronation Gulf - Queen Maud Gulf	Eloilgoplo Kiilinioplo Ekigahakyoaga - KookyoaploCoronation	Baie Coronation - Baie Queen Maud
ᑐᑦᓴᓐ	Dubawnt	Dubawnt-mi	Cours d'eau Dubawnt
ᓴᓂᕆᐅᒃ ᑕᕆᐅᖏᓐ x ᖃᐱᑕᓂ	Foxe Basin - Baffin Island	Foxe Basin – Kikiktaalokmi	Bassin de Foxe - Île de Baffin
ᓴᓂᕆᐅᒃ ᑕᕆᐅᖏᓐ x ᖃᐱᑕᓂ	Foxe Basin – Melville Peninsula	Foxe Basin - Melville Peninsula	Bassin de Foxe - Péninsule de Melville
ᓴᓂᕆᐅᒃ ᑕᕆᐅᖏᓐ x ᓴᓪᓚᑦ ᑕᕆᐅᖏᓐ	Foxe Basin - Southampton Island	Foxe Basin – Salliit	Bassin de Foxe - Île Southampton
ᕆᓗᓇᐃᓐ ᖃᒪᓂᖏᓐ	Great Bear	Emakyoak	Grand lac de l'Ours
ᐊᑲᑯᓕᖅ	Gulf of Boothia	Gulf of Boothia	Baie Boothia
ᐄᐊᑦᓴᓐ ᐸᐃ ᑕᕆᐅᖏᓐ x ᓴᓪᓕᖅ	Hudson Bay - Southampton Island	Tahioyakyoak – Salliit	Baie d'Hudson - Île Southampton
ᐄᐊᑦᓴᓐ ᐸᐃ ᑕᕆᐅᖏᓐ x ᖃᐱᑕᓂ ᐊᒪᒪᓗ ᓴᓪᓕᖅ Hudson Strait –Kikiktalok onalo Slliit			Hudson Strait - Baffin and Southampton Islands Détroit d'Hudson - Îles de Baffin et de Southampton
ᓴᖅᓯᖅᑐᑦ ᑯᖏᖓ	Kazan	Kazan	Cours d'eau Kazan
ᐅᖃᐱᐅᑦᑐᑎᑦᑕᑦ ᖃᐱᑦᑕᐃᓪᓕ	Northern Arctic Islands	Tononggani Kikiktat	Îles arctiques du nord
ᐊᖅᑯᑦᓴᐊᖅ	Seal - Coast	Seal - Coast	Rivière Seal - Côte
ᓂᓚᑦ ᐅᖃᐅᔨᑦᑐᑎᑦ ᖃᐱᑦᑕᐃᓪᓕᑦ	Southern Arctic Islands	Southern Arctic Islands	Îles arctiques du sud
ᐊᖏᓕᓴᑎᑦ ᑯᖏᖓ	Thelon	Hanningayok	Rivière Thelon
ᐄᐊᑦᓴᓐ ᐸᐃ ᑕᕆᐅᖏᓐ x ᖃᐅᖏᓂ	Western Hudson Bay - Central	Tahioyakyoak – Kikkani	Ouest de la baie d'Hudson - Central
ᐄᐊᑦᓴᓐ ᐸᐃ ᑕᕆᐅᖏᓐ x ᑲᓇᑕᓇ	Western Hudson Bay - Northern	Tahioyakyoak - Tononga	Ouest de la baie d'Hudson - Nord
ᐄᐊᑦᓴᓐ ᐸᐃ ᑕᕆᐅᖏᓐ x ᑭᓵᒋᑦ	Western Hudson Bay - Southern	Tahioyakyoak - Hivogaa	Ouest de la baie d'Hudson - Sud

ᑯᐱᖏᑕᕐᕕᑦ

Drainage Basins

Hakvaknigit

Bassins versants

ᓄᓇᓕᖕᒥ ᐸᕐᓇᓂᖅ
Nunavut Planning Commission
Nunavunmi Parnaiyiit
Commission d'Aménagement du Nunavut

ᐱᓴᓇᖅᓯᒪᔪᖅ
Draft
Inikhimaitok
Brouillon

Summary of Community Consultations conducted on March 21-22, 2012 about the Department of Fisheries and Oceans
Integrated Fisheries Management Plan for Narwhal in the Nunavut Settlement Area
Prepared by: Nunavut Wildlife Management Board Staff

Management Unit: East Baffin
Host Community: Pangnirtung
HTO Representatives: Pangnirtung
Other Organizations: Nunavut Tunngavik Inc., Qikiqtaaluk Wildlife Board, Government of Nunavut, Nunavut Wildlife Management Board

Administration / Logistics:

- The fact that the community's input and concerns with the proposed guidelines and their potential effect on the hunts was appreciated.
- However, some participants felt that the process was rushed and that not all of the material in the presentation was covered. They were concerned about the implications for hunters, who ultimately will be affected by the management plan.
- Many hunters were fishing and a problem with the local radio likely prevented larger attendance at the meeting.

CITES / Exporting of Tusks Outside of Canada:

- Some participants felt the management plan and consultations were rushed by the CITES meeting deadline.
- Some felt that the hunt overall is hampered by the sale of byproducts (tusks).
- There was concern over how the new rules would apply to carvings from narwhal tusks. DFO indicated that all full tusks, carved or not, must have a tag. However, smaller pieces of tusk do not require tags for each piece.
- It was noted that the certification of tusks will aid in information recording and reporting.

Harvest Limits / Total Allowable Harvest / Quotas:

- Numerous community members expressed that the current system for managing narwhal in Pangnirtung is working well and the quota is being respected. There was concern that new proposed tag and reporting measures would create new problems.
- There was some concern that catch can be affected by environmental conditions, and that this could affect harvest statistics. DFO reassured participants that catch was not used in determining quotas.
- Hunting behaviour changed in the community after quotas were implemented; there is now a scramble for narwhal until all of the quota is used.
- The risk of going over quota is stressful for harvesters because they can be charged. DFO indicated that the proposed tag transfer policy will help to deal with this.
- With respect to the regulations surrounding discarding and kill times, Inuit law promotes minimizing suffering, wounding, and unnecessary killing. Sometimes, however conditions do not allow for the animal to die right away.
- Lack of DFO presence in the community makes monitoring the hunt and enforcing the quota difficult.

Population Size / Factors Affecting Population Size:

- There was a lot of interest in what the population numbers and Total Allowable Landed Catch numbers were based on, as well as survey data, and population trends. There was also concern that making decisions before new survey data is available is premature.
- In 2008 and 2010 narwhals were plentiful in the area and many were harvested.

Tagging / Reporting:

- There were many comments and questions from the community on tags and the issue of a hunter needing to have a tag with them on the hunt in order to legally harvest a narwhal.
    - When narwhal arrive in Pangnirtung, anyone can go out and hunt. Currently, the HTA keeps track of the number of tags that are left, and the hunt is stopped when the quota (40 whales) is reached. Hunters pick up tags after they harvest a narwhal. However, some attendees felt that the community needs to better communicate how many tags are left during the hunt.
    - If hunter is required to have a tag before landing a whale, this could cause problems because of the opportunistic nature of the hunt. For example, there may be situations where a hunter without a tag catches a whale instead of a hunter with a tag, and charges could be laid. Hunters won't necessarily share tags, and the system may not be practical.
    - QWB suggested that perhaps hunters could take just the tag number, instead of the whole tag when they go out hunting.
    - DFO indicated that if all hunters took tags with them hunting, that would be preferable.
    - However, DFO is willing to work with NTI and other organizations to see if a better system can be developed that helps prevent overharvesting and prove diligence in management to the international community.
- Some participants were concerned with how long a hunter can keep a tag, and if he would need to return it if it is not used on a trip. DFO indicated that the HTO to can set these rules.
- Many felt that issuing of tags should be done locally and the HTO should have full control of harvesting.
- It was noted that there was a potential mistranslation in Inuktitut of the sex (male/female) terminology on the narwhal tags, and that the current wording is not appropriate for a marine mammal. DFO indicated they would follow up on providing the correct terminology.
- Many communities saw that enforcement is and will be an issue with a new management plan. There are no fisheries or wildlife officers in some communities. This may contribute to some tags not being filled out properly. If the HTA will be responsible for enforcement of some of the hunting rules under the new management plan, there was concern about its role, authority, and compensation. DFO clarified that RWOs and HTOs can only establish bylaws and practices, not enforce them (that is the fishery or wildlife officer's responsibility). To help promote greater awareness and understanding of local hunting rules, one participant suggested announcing them on the radio periodically, but others felt that funding should be available for this.
- Some community members agreed that the management plan is not necessarily directed at telling hunters how to hunt, but to show others (e.g. CITES) what management measures are in place. For this purpose, showing consistent use of tags, etc. is important.

Distribution / Stock Boundaries / Migration:

- Community members requested clarification regarding management units and the move from managing two populations to managing six summering stocks and management units. DFO

indicated that the best available current science indicated that managing the six stocks is the best precautionary approach to consider when making decisions.

- Narwhal calving areas do not exist near Pangnirtung; the whales only pass through. Since the community does not have a summering population some felt that it should be treated differently.
- Participants felt that HTOs need to be more involved in surveys, and the surveys should preferably be done all in one season. Perhaps a winter survey should be considered, as weather conditions are not always poor. Changes to the surveys are needed and are important for population estimates and harvest decisions.

Community Management:

- The community does not have hunting rules for narwhal (only for beluga).
- Community members were in favour of more local input and control over harvesting, and are concerned that the new management plan will cause arguments between the four communities in the East Baffin Management Unit.
- Some community members were very opposed to DFO management of the narwhal hunt, as opposed to strictly community based management.
- Some attendees were frustrated that DFO decisions do not reflect community decisions (e.g. from community AGMs).

Other Comments and Concerns:

- Some hunters from Pangnirtung use nets to hunt both narwhal and beluga. This hunting method is not currently covered under DFO's proposed narwhal management plan or DFO's Marine Mammal Regulations. DFO was not aware that this hunting method was used and indicated that they would need to consider including this new information in the management plan.
- Inuit Qaujimajatuqangit (IQ) must be considered in regulations and legislation, and in future documents. There were questions about who was monitoring and enforcing the inclusion of IQ this. NTI and NWMB indicated that the information shared at the consultations was being recorded, and the IQ would be considered in any subsequent NWMB hearings on the proposed management plan.
- There was an issue with a number of tusks from one of the hunts being seized and the promise of return after 6-7 years (after the case went to court). Some community members wanted to know whether the tusks would be returned.

Summary of Community Consultations conducted on March 23-24, 2012 about the Department of Fisheries and Oceans Integrated Fisheries Management Plan for Narwhal in the Nunavut Settlement Area

Prepared by: Nunavut Wildlife Management Board Staff

Management Unit: East Baffin
Host Community: Qikiqtarjuaq
HTO Representatives: Qikiqtarjuaq
Other Organizations: Nunavut Tunngavik Inc., Qikiqtaaluk Wildlife Board, Government of Nunavut, Nunavut Wildlife Management Board

Administration / Logistics:

- Community members were thankful for the DFO consultation tour on the management plan, and stated that even though they did not agree with everything in the plan, discussion and working together could be beneficial. Community members acknowledged DFO's work in developing their presentation and management plan, and acknowledged that DFO was trying to help. They also noted that the community input would be considered in the NWMB's decision on approving the management plan. Some expressed that they felt this was the first time DFO and the community were working together.
- However, there was frustration that the communities and HTOs were not consulted at an earlier stage of management plan development. Some felt that they were being presented with a finished product from DFO. The community felt it could have been better prepared if it had more information on the surveys and management plan before the meeting.
- Some community members felt that it was inappropriate that were no representatives from DFO Science on the consultation tour to talk about the surveys. It was noted that DFO Science had come to the community previously, but community members indicated that their presentation focused on tusks, not the management plan.
- Community members were also thankful for the NTI lawsuit and the additional consultation by DFO that resulted.
- There was also concern that the discussion only focused on Eastern Baffin whales and provide context about the other stocks (e.g. Northern Hudson Bay, High Arctic, in Greenland). DFO indicated that they had a similar consultation tour in the Northern Hudson Bay and High Arctic regions.

CITES / Exporting of Tusks Outside of Canada:

- The community felt it was not informed about tusk export restrictions in the past.
- Last year, some community members noticed that tusk measurements were wrong on some of the tags, potentially because of changes to the tusks (from breaking, carving). People expressed that they need to know ahead of time if DFO wants to confiscate tusks because of incorrect measurements. DFO indicated that a tusk certification process is being developed and help to address this problem.
- The certification or tag requirements for export of tusks (whole and in pieces) were clarified.
    - Community members were concerned about whether pieces of carved tusked required tags or certificates (for found tusks) for sale. DFO clarified that cut pieces did not require tags or certificates, but entire carved tusks did.

    - Sometimes hunters want to keep the tusk and the skull intact. DFO indicated that this could be accommodated and noted on the tag and the certification of tusk. DFO will have to ensure tags and certificates do not impact carving.
- The community expressed concern that CITES would consider only science and not IQ.

Harvest Limits / Total Allowable Harvest / Quotas:

- Qikiqtarjuaq residents harvest in spring, summer and fall.
- There was concern that the number of whales the Qikiqtarjuaq could harvest would be reduced with the new management plan. There was also confusion about what the DFO's Total Allowable Landed Catch number recommendation for the management unit would mean in terms of actual allowed harvest numbers for the community. DFO indicated that the number of whales assigned to each community could in fact increase but would depend on the results of the RWO/HTO allocation model workshops in January, which would account for the migratory and summer harvests in each community. DFO indicated that the complicated harvest allocation model was an attempt to maximize the harvest in each community by taking into account the migratory harvest, while still being precautionary about overharvesting. A simpler alternative would for communities to just harvest in the summer (i.e. no migratory harvest) with only one colour of tag.
- There was also concern that increased harvests of whales in northern Baffin communities could reduce the allowed harvest numbers in more southern communities (e.g. there was concern regarding Pond Inlet, a larger community, taking some of Qikiqtarjuaq's quota). DFO indicated that if northern Baffin communities overharvest, it would not affect the quota of more southern communities. Unused tags could be used to make up for the overharvest, or the communities that overharvested would be penalized in the following hunt season.
- Some community members were concerned that Pangnirtung and Iqaluit rarely reach their quotas, but their quota still affect Qikiqtarjuaq's Total Allowable Landed Catch, and they suggested that perhaps these communities' allocations are too high. DFO indicated that the RWO could make some decisions on allocations to different communities with the allocation model and proposed January workshops.
- There was some confusion over whether DFO had previously instructed residents to only harvest males with tusks. DFO indicated that there is no restriction that specifies harvesting only males, and it encourages harvest of females as well.

Population Size / Factors Affecting Population Size:

- Community members indicated that stocks of narwhal that are harvested locally appear to be increasing, and many new narwhals (i.e. black young) are being observed.
- Narwhals with different colours and markings are being observed around the community.
- The human population in the communities is also increasing.
- There was concern that the science used in the surveys was old. The community was also interested in reviewing where the surveys in the area were flown. DFO has the information on the survey tracks, but did not have it handy at the meeting.
- Killer whale predation on narwhal is on the increase. Killer whales were not seen in the Qikiqtarjuaq area previously. They may kill more narwhal than humans, and community members have seen narwhals killed by killer whales. Non-human predation on narwhals is a threat and a concern.

Tagging / Reporting:

- There was concern about what would happen if tags from one year were not all used by the end of the year. DFO indicated that the Tag Transfer Policy would address carry-overs.
- There were questions on whether tags were required not only for tusks, but also for maqtaaq that is sold. DFO indicated that commercial harvest of narwhal is not permitted, but subsistence harvesting is. DFO stated that no tag is required for maqtaaq that is sold. The tusks are incidental to the harvest for maqtaaq, and therefore the tusks can be sold. Export of maqtaaq is banned, but intercommunity trade is permitted. There is demand for maqtaaq from other communities.
- DFO clarifies that harvest of both tusked and untusked whales requires a tag.
- There was interest in how long satellite tags stay attached to tagged narwhals. DFO indicated they can stay attached for up to a year.
- There were many questions and confusion about the different colours of tags for harvest in different seasons (migratory and summer), and whether the tags can be transferred between different seasons. Some community members saw the different seasons and colours of tags as an extra complicating burden on the management system which may slow down the administration of the hunt and limit its current opportunistic nature. Many felt they could lose out on harvesting whales because of seasonal limits on the harvests. Many felt that the old management system, or just reporting where and when whales are harvested, should be sufficient. DFO indicated that the new management system was proposed to address the CITES export ban concerns, as well as to maximize the harvest of each community based on better science on summering stocks and giving more power to the HTOs and RWOs as per the NLCA. DFO indicated that the transfer between seasons cannot happen after the HTO decides on the number of tags for each season.
- However, a Tag Transfer Policy is being proposed. Clyde and Qikiqtarjuaq would be able to exchange summer tags under the first phase of the Tag Transfer Policy. DFO also emphasized that the HTO would propose the dates for each season.
- There were questions about whether the tags could be used all over Nunavut. Baffin Bay tags could only be used in the Baffin Bay management unit. DFO indicated that for Aqvaqtuuq (or Home Bay) summer or migratory tags would be used, depending on the season when the harvest takes place.
- Community members felt that limiting travel and harvest between communities may cause problems. This would only be allowed if the communities were within the same management unit, but enforcement will be an issue.
- Pangnirtung and Iqaluit have asked to come to Qikitarjuaq to hunt narwhal, and community members can hear on their CB radios that Clyde River residents are harvesting in other areas.
- Community members noted that travel distances and financial consequences are not necessarily a barrier for Inuit in harvesting food. DFO had concerns that this could lead to overharvest.
- Community members were still concerned that they don't always know when the narwhals will arrive each year. Weather can limit travel for the spring and fall harvest.
- There were also questions about how to account for wounded whales. DFO indicated that if a whale is wounded and not captured, it would be counted as wounded and not require a tag.
- Some community members felt there needed to be a system that would make reporting non-tusked whales more attractive. The HTA meets and talks about who caught the whales. The HTA keeps track of numbers, and puts aside tags for people who have not picked them up. They exchange the tags for whales with tusks later.

- There were questions about what happens if a dead narwhal with a tusk is found and if a tag is needed to show legal possession. DFO indicated that they are looking to establish a new system where a certificate is issued instead of a tag, and that this certificate could be used for trade.
- The community was concerned if whales entrapped in the ice required tags. DFO indicated that for entrapments, if the decision was to go ahead and humanely harvest the whales, DFO would work with local HTO to manage that local harvest with either tags or an authorization to hunt and tusk possession letter. Whales harvested from entrapments would not reduce communities' harvests. These situations would need to be addressed on a case-by-case basis.

Distribution / Stock Boundaries / Migration:

- HTA members indicated that the migratory paths of narwhals presented by DFO were pretty accurate, but there was concern that whales from East Baffin have not be tagged with satellite tags that help to show where all of the whales in the area are coming from and going to.
- The concept of different summering stocks was pretty clear.
- A summering stock in an area called Aqvaqtuuq (or Home Bay) between Qikiqtarjuaq and Clyde River appears to be a different stock according to the hunters' observations. Whales appear to stay in that area, but there is migration from the area in the fall (perhaps from whales heading to the high Arctic). The whales in that area are increasing based on observations. Only a few narwhals are harvested in the area, and Qikitarjuaq harvests there in the spring and summer. There is concern that Aqvaqtuuq (Home Bay) is not currently considered a summering stock in the narwhal management plan with a separate Total Allowable Landed Catch Recommendation; it is part of the larger Baffin Baffin management unit. The community would like it recognized as a separate summing stock or management unit, even if the science is not currently available to support this. DFO Science recorded the community's observation regarding Aqvaqtuuq (Home Bay) on the last consultation tour. DFO indicated that a separate management area would not be created unless survey work supported it.
- There is no reason to believe narwhals are decreasing in the area.
- There was also concern about movement of whales between Canada and Greenland. Some satellite tagged whales have recently been found to move from the high Arctic to Greenland. However, Canada's official position is currently that they are separate stocks.
- Some community members were concerned that survey times were too short and did not accurately represent narwhal movements. Narwhals do not have specific calving areas like belugas; they can calve anywhere.
- Migratory season may start in August in Qikiqtarjuaq. Hunters are not always sure what whales they are harvesting at that time.
- There was also concern that the tagging data indicating summering stock areas and migratory paths may be inaccurate on the coloured maps that DFO presented. Many people were uncomfortable with the concept of animals staying within boundaries.

Community Management:

- The community was unclear about whether it was still operating under the Community Based Management System. Some said that Community Based Management was no longer working. DFO indicated that they are trying to bring management more in line with the NLCA, which would better respect community powers and turn more of the harvest regulation over to the RWOs and HTOs.
- Qikiqtarjuaq is still using the community harvest rules established under Community Based Management. Harpoons can be used to reduce struck and loss as part of the community rules.

Hunters try to minimize losses. Whales sometimes sink quickly and are lost, especially in the summer. No young can be harvested under the community rules. A copy of the community rules are in the HTO office.

- There were concerns about the community's ability to enforce rules and regulations (e.g. quotas or harvest limits), either from DFO or the HTO.
- It was also noted that methods for hunting and reducing hunting losses differ a lot between communities.
- Some community members were very much of favour of only community based management and minimal involvement from DFO, and were frustrated with the level of community knowledge and involvement in the current management plan, but were willing to work together on the management plan if necessary.

<u>Other Comments and Concerns:</u>

- DFO noted that on samples that are submitted for testing, narwhals appear to be healthy (i.e. no disease issues).
- Community members noted that the Marine Mammal Regulation bullet and muzzle force specifications are not practical or easy to interpret (e.g. foot pound specification). A soft tipped bullet will just get stuck in the narwhal's skin. You cannot kill a narwhal with the specified strength.
- It was noted that last summer there few whales in the fiords in the area where they are usually abundant.
- Community members commented that there is room to improve stuck and lost reporting. Whales are often difficult to kill (especially the big bulls; younger ones are easier). Whales are often reported as struck and lost, but often they do not die and are harvested later by another boat.
- Younger whales are often preferable for eating.
- Qikiqtarjuaq did not traditionally harvest narwhals.
- The community had questions about how IQ would be incorporated into the management plan.
- HTA members would like honoraria. They have raised their own money for honoraria.

Summary of Community Consultations conducted on March 23-24, 2012 about the Department of Fisheries and Oceans Integrated Fisheries Management Plan for Narwhal in the Nunavut Settlement Area

Prepared by: Nunavut Wildlife Management Board Staff

Management Unit: East Baffin
Host Community: Clyde River
HTO Representatives: Clyde River
Other Organizations: Nunavut Tunngavik Inc., Qikiqtaaluk Wildlife Board, Government of Nunavut, Nunavut Wildlife Management Board

Administration / Logistics:

- Some community members thanked DFO for coming to the community to meet and felt that the efforts were intended to help. Some noted that this was the first time this sort of collaboration was happening. Some community members were also positive about what they were learning from the DFO science on narwhal movements and summering and wintering areas.

CITES / Exporting of Tusks Outside of Canada:

- Community members noted that the money from selling tusks is used to buy tools, but it is not a big profit margin.
- Community members also indicated that tusks were not traditionally sold, but used to make tools (e.g. harpoons) or carvings. Narwhals were harvested for subsistence. That changed when Qallunaat arrived.
- Some community members noted that if Inuit or the community do not feel the international tusk trade and providing information CITES is important, then perhaps the new management plan is not needed.
- There was concern that CITES does not consider IQ and that efforts need to be made to encourage CITES take it in to account. DFO emphasized that CITES cannot prevent hunting, but they can prevent the international export of tusks.

Harvest Limits / Total Allowable Harvest / Quotas:

- The community's main concern was that the quota would decrease for East Baffin. The community has been trying to get an increase in quota for a long time.
- Community members felt the narwhal population is not decreasing, the harvest is not endangering the population, and the quota should be increased.
- There was some confusion regarding how Total Allowable Landed Catch would be shared among the East Baffin communities, and how the migratory catch would be accounted for between different management units. DFO explained that the harvest allocation model would help with this.
- HTA members explained that hunters from Clyde River harvest from Aqvaqtuuq (or Home Bay) in the spring and summer. People living in Aqvaqtuuq (Home Bay) moved to Clyde River so there is a connection to this area.
- The HTA expressed concern that the new management system would like harvest rights of Inuit to harvest up to their full social, economic and cultural needs under the NLCA. However, the NWMB also has the right to establish harvest limits and non-quota limitations like seasonal restrictions on harvesting, especially when there is a conservation concern.

- The community emphasized that traditional values promote sustainability in harvesting and discourage overharvesting.
- Clyde River negotiates with Resolute Bay for more quota in some years.

Population Size / Factors Affecting Population Size:

- There was concern about the date of the last East Baffin survey and the schedule for conducting new surveys.
- Community members were interested in different methods for conducting surveys (e.g. in winter at flow edge instead of summering stock surveys). There was also interest in potential NWMB Wildlife Studies Fund monies.
- Community members felt that the number of narwhals was higher than the stated population size.
- Community members felt the narwhal population is increasing.
- Community members were concerns about the impacts of mines, oil and gas exploration on animals.
- Some participants indicated that narwhals can calve at any time of year.
- Clyde River hunters see many narwhal with scars and wounds from the Pond Inlet area. Hunters try to minimize struck and lost animals, but they have seen a lot that were struck.

Tagging / Reporting:

- There was some confusion over the new tag system, with seasonality and colours, and when different tags could be used. Many felt that current management of narwhals in the community is good, and the new proposed system will unnecessarily complicate management, and that harvesters will not obey the seasonal restrictions, which may result in court cases.
- There were questions about when seasonal allocations would be made, and DFO explained that this would happen at the January RWO/HTO allocation model workshop.
- There were questions about carrying over tags to the next year. DFO indicated that there is potential for this, but more science advice is needed to make sure this is sustainable and defensible to outside critics.
- Sometimes hunters travel from Clyde River to Arctic Bay to Hunt narwhal. DFO clarified that under the new system, Clyde River residents would need a tag specifically for the Arctic Bay management unit to hunt there (i.e. they could not use their East Baffin tag), and that this would need to be arranged through the RWO.
- There were questions about whether tags were needed for found tusks. DFO explained that it is proposing a system where a certificate would be issued instead of using a tag for found tusks.
- Sometimes there is overlap of the work of the government renewable resource officers and the HTOs. If new government regulations are put in place with the management plan, the government should administer and enforce them.

Distribution / Stock Boundaries / Migration:

- Some community members did not agree with the management unit and stock boundaries.
- The community asked questions about satellite tagging of whales. DFO discussed how the satellite tags give information on whale movements, and that only limited number of whales were tagged and tracked.
- There was concern about how the movements of whales between Greenland and Canada were considered. Community members proposed that harpoon scars on whales (from Greenland) indicate that the whales move between the two areas. DFO spoke about recent information

from satellite tagging which suggests that narwhals may travel between Canada and Greenland. However, DFO stated that this is new information and Canada maintains that the stocks are separate for the time being.

- Some participants emphasized that new surveys should focus on Home Bay.
- There was also concern about Inuit involvement in surveys. DFO assured that there would be increasing community involvement in surveys.
- Some suggested that IQ was preferable to tagging and survey methods where vehicles (e.g. airplanes) could frighten animals, especially around Pond Inlet.

Community Management:

- The HTO already divides up tags seasonally; some tags are set aside for the spring floe edge hunt, other are set aside for summer. The HTO does not communicate this to DFO currently.
- Some community members felt that external government management was not necessary in the community, and they were in favour of the community managing its own hunt.

Other Comments and Concerns:

- Participants indicated that physical characteristics of the narwhal can vary from year to year. Sometimes there are many young black ones in the area, sometimes there are old narwhal. Two years ago, there were many big ones with tusks.
- New whale species have been noticed recently during the turbot fishery in the area.
- Around Clyde River, there used to be more walrus and killer whales and less narwhals, and now it is the opposite
- Community members were concerned about the inclusion of IQ in the management plan.

Summary of Community Consultations conducted on March 26-27, 2012 about the Department of Fisheries and Oceans Integrated Fisheries Management Plan for Narwhal in the Nunavut Settlement Area

Prepared by: Nunavut Wildlife Management Board Staff

Management Unit: Eclipse Sound
Host Community: Pond Inlet
HTO Representatives: Pond Inlet
Other Organizations: Nunavut Tunngavik Inc., Qikiqtaaluk Wildlife Board, Government of Nunavut, Nunavut Wildlife Management Board

Administration / Logistics:

- Community members felt that they wanted to contribute to the management plan to make it better because DFO indicated that it was just in a draft stage and would be an evergreen document that would change with community input.
- Some community members felt that it would be useful to have seen the allocation model so the HTO members could see it and understand it. DFO indicated that they did not present the model to the community because of time constraints. Some community members were concerned that this would hurt the community in the end because they were not fully involved and that the process was too rushed.
- Some community members felt that discussion with the community about hunting techniques, how harvest numbers are decided, and how harvests numbers (for maqtaaq and tusks) are allotted is necessary. Teaching the younger generation is important for implementing new management measures at a harvester level.

CITES / Exporting of Tusks Outside of Canada:

- The community had questions about CITES' members, powers and rules and how they can affect the hunts in Nunavut. There was a feeling that the community needed a better understanding of who CITES is and why it is necessary to follow its rules. DFO clarified that CITES only has power to impose restrictions on the international sale of tusks. Hunts for maqtaaq or trade of tusks within Canada are not affected by CITES.
- Community members were concerned about whether CITES would be satisfied with the new management measures or whether there would continue to be restrictions. DFO indicated that they cannot guarantee what CITES will do, but ensuring that the populations are not decreasing and obtaining a Non-Detriment Finding is key.
- DFO emphasized that CITES concerns are driving some of the short term work but the long-term goal is sustainability of narwhal stocks.
- Some community members were interested in whether Greenland was undertaking similar management measures. DFO indicated that Greenland has also been going through a similar process, but it withdrew from CITES and decided to not export tusks until better management systems were in place.
- Community members saw the sale of tusks as an important source of income for hunters.
- Some hunters were also concerned about situations where they wanted to keep the skull and the tusk attached and how that would affect DFO's new proposed certification of the tusk. DFO said that this would not be a problem and it could still be certified.
- Community members also had questions about how found tusks should be report. DFO indicated a possession certificate could be issues instead of using a tag. They did not think that

inspection of found tusks would be necessary, but indicated that the HTO could make this a local hunting rule if they wanted to.

Harvest Limits / Total Allowable Harvest / Quotas:

- It was noted that Pond Inlet residents only harvest narwhal during a 4-month period. Most of the harvest takes place in May-July. There is some harvest in August and September as well, but the autumn harvest is especially difficult. For the rest of the year there are no whales in the area.
- Subsistence hunting and the income from tusks is important to community members. Food is expensive, and resources are limited in the community.
- Current quotas were compared to the new recommended Total Allowable Catches for the management unit. Pond Inlet is the only community that harvests in the Eclipse Sound management unit. There was some confusion and concern about the final numbers that Pond Inlet would be able to hunt under the new management system. DFO emphasized because the migratory hunt numbers needed to be accounted for, this could not be decided until the harvest allocation model workshop in January with the RWO and HTOs.
- There was concern about whether the Total Allowable Landed Catch number was the exact number that Pond Inlet would be permitted to harvest. DFO indicated that no, it was not, and the exact number would depend on the results of the allocation model workshop in January with the HTOs and RWO deciding on seasonal harvest allocations. DFO indicated that the HTA must decide whether this more complicated system and dividing the summer and migratory allocations is worth the possibility of more whales to harvest. It was acknowledged that it was a complicated system to understand, and that the HTA must understand it before making a recommendation on whether or not to accept the proposed management plan.
- There was some discussion of assignment of harvest rights from an Inuk to a Qallunaat. If the new management system is established and Total Allowable Harvests are established, under the Nunavut Land Claims Agreement, RWOs and HTOS could assign the Inuk right to harvest to a Qallunaat.
- Community members were concerned whether ice entrapment harvests would affect their quota. DFO said they would not.

Population Size / Factors Affecting Population Size:

- The community does not see the local whale numbers are being endangered at this point.
- Community members indicated that in the past, the community lost fewer whales when hunting because they waited until the last minute to strike. Narwhals are difficult to kill, and although better hunting equipment is available now, the community must do its best to limit losses. Some community members indicated that harpooning first can cause problems when hunting from the floe edge, and felt the need for a focused discussion about minimizing loss in hunting.
- The need for training new hunters on effective hunting techniques and how to minimize loss was noted.
- Community members emphasized that killer whale and polar bear predation need to be considered.
- The community did not know whether there were more calves or not.

Tagging / Reporting:

- There was concern over the division of tags between different seasons. DFO clarified that HTOs will decide on the dates of the seasons. The number of tags allocated for each season will be

decided at the January harvest allocation model workshop by the RWOs and HTOs. DFO may give some advice in the first few years of this process.

- The community was also concerned about whether they could use leftover summer tags in the fall. DFO indicated that tags from one season (e.g. summer) cannot be carried over into another season (e.g. fall). However, DFO said they are in the process of working on a flexible quota system and that they would like to work with the HTO on it.
- Pond Inlet already has a system for distributing tags. Currently, the HTO estimates how many whales will be taken on the floe edge hunt when it starts, and it gives out tags accordingly (often about 20). More narwhals are taken in the summer. The fall harvest is smaller – there may or may not be tags left at that point in time. It would be best to check with community members about how many whales they could catch in each season. Some community members noted that the number of whales taken in each season can vary substantially from year to year.
- Community members were concerned that under the new system, the community would not have enough flexibility in moving tags between seasons and could miss opportunities to hunt. A number of people wondered if there was a better system that could be suggested that would work better for hunters.
- There was concern and confusion over the roles of the RWO and HTOs under the proposed new system. The RWO would sub-allocate the basic needs level that the NWMB sets to the HTOs.
- There were questions about attaching tags to untusked narwhals (e.g. should the tag be attached to the maqtaaq? Or the skeleton?). DFO indicated that a portion of the tag should be left with the whale; this is stated in the Marine Mammal Regulations. A separate portion must be returned to the HTO to cancel the tag. DFO acknowledged that this might not be the best system, and that they were open to suggestions about what to do with the tag for untusked narwhals.
- Some community members felt that only science advice and not input from co-management partners was being considered in developing the tag transfer policy.
- Some participants question how good the existing system for exchanging tags between communities was (e.g. between Pond Inlet and Arctic Bay if one community goes over its quota)? DFO indicated that instead of having to go to the NWMB for approval of the transfer, under the new system RWOs and HTOs would decide, which should be quicker.
- There were also questions about using Pond Inlet tags in another community. DFO reemphasized that under the new management system, you would only be able to use a tag in the management unit that was stated on the tag. For example, a hunter from Pond Inlet could not get a tag from Clyde River or Arctic Bay and use it to hunt around Pond Inlet. This is different than the current system. This is a non-quota limitation being proposed to the NWMB.
- The community also wondered how DFO decided which hunt Fisheries Officers would monitor. DFO indicated that this is decided at the Iqaluit office.
- The community has run into problems before where no Fisheries Officer or Conservation Officer is available to take a report or measure a tusk. DFO acknowledged that this is an issue in many communities and that they need to find a solution.
- Some community members felt that there should be reimbursement for hunters for recording harvest data because of the extra work it requires. Some felt that some harvesters might not report that they lost an animal because it might reflect badly on their hunting skills. DFO indicated that they could fill out the hunt reports anonymously.

<u>Distribution / Stock Boundaries / Migration:</u>

- There was interest in the high Arctic stock (e.g. the whales that are seen around Alexander Fiord in the spring and summer) and whether DFO has information on their wintering areas. DFO indicated that there has never been a survey in the high Arctic so this information is not available. However, there have been successful hunts in the area.
- Community members met previously in Clyde River with someone who does tagging work, and would like whales near Grise Fiord to be tagged and the high Artic area surveyed.
- Community members also indicated that whales from Greenland go up to the high Arctic and summer there.
- A participant who grew up new Grise Fiord indicated that there are whales north of Grise Fiord.
- It was noted that whales from the high Arctic are larger and their tusks are wider and longer than the ones harvested around Pond Inlet. Sometimes these bigger whales are seen near the floe edge, but they generally are not harvested around Pond Inlet.
- There was an indication from community members that the whales that summer around Somerset Island, Eclipse Sound, Admiralty Inlet, and the high Arctic are different stocks. Community members noted that Admiralty Inlet narwhals pass by Eclipse Sound and Pond Inlet residents harvest them periodically. They also noted that whales in Clyde River were different from those in Pond Inlet. There are differences in their tusks.
- Some community members were opposed to the idea that narwhal would stay within boundaries (e.g. management unit boundaries) and belong to a specific community. This was based on IQ.
- It was noted that large migrations (especially in the spring) of narwhals have been observed on the far side of Bylot Island, but not every year.
- Community members were interested in survey techniques. DFO indicated that fixed wing aircraft are used and they try to fly at a height allows for observing the whales but minimizes disturbance.
- Community members were also interested in the summering stock divisions and the suggestion that during migration, Pond Inlet residents may he hunting narwhals from Somerset Island, Admiralty Inlet, and Eclipse Sound. Some community members indicated that they only hunt whales from Low Point Inlet (Nunasiak (sp?)).
- Scientists and IQ suggest that the narwhals travel around either side of Bylot Island.
- It was noted that if narwhals encounter killer whales while migrating, they go into the fiords for a period of time. It was noted the killer whales may be driving narwhals closer to shore.
- It is thought that various influences (noise from mining ship traffic, oil and gas exploration, underwater tracking devices, habitat changes, etc.) have driven narwhals away from their regular habitats. Noise from shipping was thought to be especially harmful to the whales and has driven narwhals away from some areas. Milne Inlet and Lancaster Sound were areas of particular concern. Some residents noted that ships have gone into narwhal calving areas, which reduced the number of whales in these areas. DFO indicated that they cannot address these issues at the moment, but would note the disruption in an Environmental Impact Assessments for the area. Changes in movements and distribution of narwhals away from Milne Inlet would also have to be taken into account in future surveys of the area.
- The past year of harvesting on the floe edge was different from other years. There were more whales, and darker whales that had not been seen in the area previously. They also return more quickly after hearing gunshots (about 15 minutes as opposed to the usual 12 hours). Some thought this was linked to oil and gas exploration off of Greenland. It was also noted that there were less whales in the fiords in the summer, and this was thought to be due to ship traffic (from mining operations). Thus, both the spring and summer hunts were affected in Milne Inlet.

- There are fewer whales observed in the summer now than there was in the past, perhaps because they are going to other areas.

Community Management:

- In 1997 in Pond Inlet, a local management plan was developed and the community has been using that since. The community was interested in whether this management plan would be used or incorporated into the one being proposed by DFO. DFO was interested in obtaining a copy of the management plan but stressed that they were trying to develop a plan for all of Nunavut and for the information of CITES. However, DFO indicated there was an option to tailor the plan to specific communities or management units.
- Currently, the HTO measures tusk length in Pond Inlet.

Other Comments and Concerns:

- Harvest patterns have changed over time. In the past, there were smaller camps in the Eclipse Sound area that harvest the same animals; now there is only one community (Pond Inlet).
- Some residents were concerned about the use of satellite tags, anesthetics and nets for studying narwhal.
- Community members were concerned about how IQ was being incorporated into the management plan and the decision making process. NWMB indicated that it would be considered in the NWMB's decision making process. DFO indicated that they would write a "What we heard" document from the community consultation tour.

Summary of Community Consultations conducted on March 28-29, 2012 about the Department of Fisheries and Oceans
Integrated Fisheries Management Plan for Narwhal in the Nunavut Settlement Area
Prepared by: Nunavut Wildlife Management Board Staff

Management Unit: Admiralty Inlet
Host Community: Arctic Bay
HTO Representatives: Arctic Bay
Other Organizations: Nunavut Tunngavik Inc., Qikiqtaaluk Wildlife Board, Government of Nunavut, Nunavut Wildlife Management Board

Administration / Logistics:

- Some community members were thankful to the consultation team for coming to the community.
- Some communities liked the idea of having a management plan to which they could refer.
- Community members were also thankful for NTI's court case and the additional opportunity to comment on the management plan.

CITES / Exporting of Tusks Outside of Canada:

- Community members did not think the tusk certification scheme proposed by DFO was adequate because the community does not have a Conservation Officer or Fisheries Officer permanently in the community. They suggested that perhaps the HTO could certify the tusk. DFO indicated that they would need to find a solution.
- The HTA described a case where 11 or 12 salvaged tusks were seized by DFO and are still locked up by the Wildlife Office. The HTA has asked for tags, but is still waiting. The HTA Chair had two meetings with DFO in Iqaluit about it, but the community is still waiting for a response about how to deal with salvaged tusks (and this case in particular). DFO indicated that they are working on a certificate system for salvaged tusks to help improve management in these types of situations with salvaged tusks. DFO indicated that the issue will be reviewed with the senior fisheries officer in Iqaluit after the consultation tour, and that they want a resolution of this case soon.
- Tusks have become a source of income in the community (e.g. for buying hunting equipment), and hunters look for tusked narwhal. However, narwhals are also an important food source. Community members wanted this point understood at CITES.
- The community has lost revenue for tusks outside of Canada.
- Community members had questions about how and why the sale of tusks was stopped last year. DFO indicated that CITES can regulate international trade of wildlife products (but not within Canada). Canada is a member of CITES. Only older survey data was available two years ago, and based on that data DFO could not issue a Non-Detriment Finding for the area (i.e. a statement saying that the population levels were healthy and the harvest was sustainable). The new survey information since then has indicated that the harvest is sustainable, and now there is no more ban on international trade.

Harvest Limits / Total Allowable Harvest / Quotas:

- Community members believed that community harvest number increased after the introduction of quotas. After the quota of 130 whales was introduced, the community tried to use all of the

tags each year. Some community members felt that the community would harvest less if there were no tags. Thus, harvest practices changed.

- Some community members expressed that they just want enough narwhals for food, and that and increase in quota might not be beneficial for the community – it might only promote waste.
- Other community members felt that they could harvest more narwhals if the limit was increased, and were happy about the potential for increasing the harvest limit by accounting for the migratory whales. However, they were not happy about other aspects of the plan (e.g. seasonal harvest limits).
- The community is concerned with sustainable harvesting of narwhal; this is a value in harvesting.
- Community members were concerned over the division of tags between different seasons. Sometimes whales do not come early enough and there is no floe edge hunt, and whales are only harvested in the summer and potentially the fall (if there are any tags left). DFO clarified that HTOs will decide on the dates of the seasons. The number of tags allocated for each season will be decided at the January harvest allocation model workshop by the RWOs and HTOs. DFO may give some advice in the first few years of this process. DFO also clarified that a hunter can only use a tag to hunt in the season that the tag specifies (i.e. he can't use a spring (migratory) tag to hunt in the summer).
- In general, there was opposition to the seasonal division of the harvest in the community. Community members and HTO felt that administration and enforcement of the seasonal division of the harvest and two types of tags will be difficult, and that the proposed system will not work well. Predicting when the whales will arrive is difficult, and weather conditions have changed. People preferred the present system and only having one type of tag instead of two.
- There were also questions about using Arctic Bay tags in another community. DFO reemphasized that under the new management system, you would only be able to use a tag in the management unit that was stated on the tag. For example, a hunter from Arctic Bay could not got to Igloolik with an Admiralty Inlet management unit tag and get a tag and use it to hunt around Igloolik. This is different than the current system. This is a non-quota limitation being proposed to the NWMB.
- Current quotas were compared to the new recommended Total Allowable Landed Catches for the management unit. Arctic Bay is the only community that harvests in the Admiralty Inlet management unit. There was some confusion and concern about the final numbers that Arctic Bay would be able to hunt under the new management system. DFO emphasized because the migratory hunt numbers needed to be accounted for, this could not be decided until the harvest allocation model workshop in January with the RWO and HTOs.

<u>Population Size / Factors Affecting Population Size:</u>

- Community wanted narwhal predation (harvest) by poplar bears and especially killer whales to also be considered. Some community members even suggested culling killer whales.
- Community members feel that the narwhal population numbers are healthy in the area.
- Some community members questions whether there were declining numbers in other areas. DFO indicated that this depends on the area.
- Community members also had questions about the population data that was available for the East Baffin management unit. DFO indicated that survey data (population numbers are available), although the numbers are quite old, but there is not satellite tag data from that area.
- Community member felt that the IQ indicated that the population numbers were healthy, but that this information was not believed by outside groups.

Tagging / Reporting:

- Hunters are currently required to bring tusks and tags to the HTO office.

Distribution / Stock Boundaries / Migration:

- Community members were interested in where narwhals were tagged for satellite tracking work. DFO indicated that they did not have the information immediately available but could send it to the HTO.
- Community members were also interested in survey methods. DFO indicated that the surveys were done with fixed-wing aircraft over specific routes (line transects). Some community members felt that the study periods were too short and the survey data was not accurate.
- Community members wanted more input in the satellite tagging and surveys (e.g. timing, employment, location), and for DFO to come back and report on the information after the tagging and surveys were completed. DFO indicated they are working more and more with communities in designing and conducting surveys.
- Community members reported that whales from the high Arctic are bigger and lighter in colour, with long, wide, straight tusks. They have white spots and bellies. There were more of these narwhals in the past and few now. The community determined there were from another area and a different stock or population.
- Many community members did not agree with the idea that narwhals would stay within certain boundaries, as displayed on DFO's map with summering stock locations and migration routes.
- There was concern about how the movements of whales between Greenland and Canada were considered. Many narwhals with harpoon scars are observed, which the community believes is an indication that some whales are traveling between the two countries. There may also be ties to Igloolik. DFO spoke about recent information from satellite tagging which suggests that narwhals may travel between Canada and Greenland. However, DFO stated that this is new information and Canada maintains that the stocks are separate for the time being.

Community Management:

- The HTO has local hunting rules and has a copy of the rules in their office.
- The HTO indicated that the HTO currently divides up the tags in a public meeting before the start of the spring season according to the floe edge (spring) and summer hunts. When the spring hunt is opened, there is uncertainty about how many whales will be harvested – the number really depends on the weather and ice conditions. When the ice conditions become too dangerous, the floe edge hunt is shut down. Then the HTO holds another meeting before the summer harvest opens to decide on summer tag numbers, and the HTO must monitor that the number of tags is not exceeded in the summer hunt. Hunters and the HTO currently communicate over the phone or radio on harvest numbers. When the community gets close to the limit, the HTO stops the hunt and picks names for whom gets the remaining tags. Fall harvests are difficult and dangerous because of stormy weather conditions and waves.
- The HTO does its best during harvest times to monitor the hunts. Sometimes two managers are hired to help out.
- Community members noted that struck and loss is a concern for the HTO and hunters. Younger harvesters are educated on how to minimize loss. They are instructed to use a sufficiently powerful rifle and bring a hook and long rope (especially when hunting on the leads). Narwhals are hard to catch.

Other Comments and Concerns:

- Community members were also concerned about injuries to and deaths of narwhals when satellite tags had been used in the past. They reported that 3-4 narwhals were under distress and died while being netted and tagged. They were also concerned about the effect of satellite tags on whale behaviour.
- Shipping appears to be increasing on the east side of Baffin Island.
- The community was concerned about oil and gas exploration in Lancaster Sound.
- Community members were interested on where oil and gas drilling was happening in the area. DFO said they would check and get back to the community.
- Some feel that marine conservation areas would be useful in this area in the future.
- Community members indicated that narwhals enter the inlet in the spring to feed and calve in shallower water.
- Community members indicated that Admiralty Inlet is deep and that the whales can go to shallow waters, where their tusks and maqtaaq may be chipped or damaged. Ice conditions used to allow hunting of these narwhals in August, but now ice conditions have changed and there are more ice-free areas. Whales can migrate right through these passages instead of just past the flow edge.
- For entrapments, community members suggested that harpoons were the best for harvesting. This is IQ for how to harvest entrapped whales. Rifles could scare the whales, cause them to dive under the ice and drown. Thus, hunting with harpoons in entrapment events maximizes the harvest and minimizes the number of whales lost due to drowning, injury, etc. The community suggested that his could go in the new management plan.
- Community members reported changing ice conditions and increasingly stormy weather in the area.
- The community asked whether nets were an option for harvesting narwhal, since it might reduce the number of struck and lost whales. DFO indicates that nets are not discussed in the Marine Mammal Regulations, but this harvest method will need to be considered in the management plan, and DFO will look into the issue. NTI felt that there was currently no regulation prohibiting narwhals, so it was a possibility.
- Hunts have changed over time – the community members did not used to hunt on the floe edge, only in the open water.

Summary of Community Consultations conducted on March 30, 2012 about the Department of Fisheries and Oceans Integrated Fisheries Management Plan for Narwhal in the Nunavut Settlement Area

Prepared by: Nunavut Wildlife Management Board Staff

Management Unit:	East Baffin
Host Community:	Iqaluit
HTO Representatives:	Amarok HTA (Iqaluit), Pangnirtung HTA, Nattivak HTA (Qikiqtarjuaq), Nangmautaq HTA (Clyde River), Mittimatalik HTA (Pond Inlet), Ikajutit HTA (Arctic Bay)
Other Organizations:	Nunavut Tunngavik Inc., Qikiqtaaluk Wildlife Board, Government of Nunavut, Nunavut Wildlife Management Board

Administration / Logistics:

- All of the East Baffin HTAs that harvest narwhal were represented in this regional meeting. Amarok (Iqaluit) HTA had not yet received the DFO presentation on the IFMP, and it was suggested that a shorter version of the presentations would be given for their benefit.
- NTI indicated that even if there was not 100% agreement on the plan, they felt it was beneficial to go ahead so a document is prepared to present to CITES. As well, they suggested there would be a good possibility for increases in the numbers of tags under the new management system. They noted there would also be time for additional review and comments on the plan in June when DFO brings a proposal to the NWMB for decision.
- Some participants emphasized that the discussion could focus on what participants would like to see in the management plan, since it was only a draft.
- Some participants expressed that they were not happy with the consultations in their communities, and felt like they were not given the opportunity to negotiate and provide input to the management plan from the community level as equals. They felt that DFO was pushing through measures that were not wanted.

CITES / Exporting of Tusks Outside of Canada:

- Participants asked if the most recent survey data would be used for the 2013 CITES meeting? DFO indicated that it will use the numbers that it is presenting now, but will collect new data (and that this is priority for DFO Science). DFO indicated that the TALC recommendation for Northern Hudson Bay will stay at 57 whales; the survey has been done and it is being analyzed.

Harvest Limits / Total Allowable Harvest / Quotas:

- Participants were interested in what percentage of the overall population was being harvested by communities.
- Participants expressed concern that there was serious underestimation by science of narwhals in certain areas.
- Some participants re-enforced that they felt that there was not enough scientific information for the East Baffin area, and notably Home Bay. As a result the suggested harvest limits are too low.
- Some participants felt they might be supportive of the management plan if their harvests would go up. Others felt nervous that their harvests would go down.
- Participants thought it would be useful to have a demonstration of the harvest allocation model in order to clear up confusion about how it worked and potential harvest limits for each community. Participants expressed that they wanted to see how the allocation model works.

Representatives from NTI gave some background information on the model and ran through different harvest level scenarios. They were able to find scenarios where all of the communities would receive more narwhals than they were currently allowed. Many participants found this to be a useful demonstration.

Population Size / Factors Affecting Population Size:

- Participants relayed that they believe that narwhal populations are healthy. DFO indicated that they had heard this in most communities, but there was some concern due to shipping and oil and gas exploration.
- Participants shared that even though there is no survey or tagging information from around Grise Fiord, from their observations of offshore whales and what they hear, that narwhals are not decreasing in that area.
- Some participants noted that the summering stock approach was very dependent on survey numbers.
- There was some concern regarding bycatch of narwhal in shrimp and Greenland halibut (turbot) fisheries off of South Baffin. This information was from IQ, and DFO indicated that there was no tagging information from the Baffin region. DFO also noted that there had been a closed area established in Division 0A to help protect narwhal habitat.

Tagging / Reporting:

- Some participants were interested in whether they could still harvest narwhals for food after the quota was used up. There was a suggestion that this has not always been reported.
- Participants wanted to clarify how many whales they would be allowed to harvest under the new system, and whether this would be an increase from their present quota. DFO explained that the tendency is to receive more quota by accounting for the migratory catch. The seasonal and summer tags (two colours) will help to manage this seasonal division of the hunt in some areas. The all-season tags are used in other areas where this division is not needed. Pangnirtung and Iqaluit were given all-season tags because their harvests are very small. Migratory mixing was not taken into account in these cases as a way to simplify the harvest allocation model.
- Some participants wondered what was wrong with the old system. DFO emphasized that the new science suggests a summering stock approach.
- Some participants were confused about how seasons are set for the tags. DFO indicated that HTOs indicate the season dates, then DFO issues the tags. NTI suggested that setting summer dates, and then having the rest of the year as “migratory” may be a useful way to think about it.
- Participants were also concerned about whether hunters from other communities could still harvest in their community. Usually hunters bring tags from their home community into another community to harvest. DFO indicated that under the new system, a hunter would only be able to hunt in the management unit and season that their tags states.

Distribution / Stock Boundaries / Migration:

- Participants relayed that in Pond Inlet on the flow edge, Baffin Bay narwhals had been observed recently.
- Participants were interested in whether East Baffin narwhal stock would be subdivided into smaller stocks once new science data is collected. DFO indicated that this would depend on the science and IQ information that is received, and there would need to be a good reason supporting this change.

- Participants were interested in movements of whales between Admiralty Inlet and Eclipse Sound. Most information indicates that these are two separate summering stocks. However, from satellite tagging data, it appeared that there have been some whales moving between the two areas. These two areas are considered separate management units under the new management plan.
- It was noted that the wide variation was noted in Admiralty Inlet surveys and the resulting Total Allowable Landed Catch recommendations was not helpful for management.
- It was also noted that the area of the Eastern Baffin survey was not the entire East Baffin area. There is a concern that this may have produced a severe underestimate of narwhal numbers in East Baffin. DFO added that the survey area was mainly between Qikiqtarjuaq and Clyde River.
- Members from Arctic Bay expressed that they were not happy with the Admiralty Inlet Boundaries. They think that Admiralty Inlet and Eclipse Sound are almost one population. Admiralty Inlet in the summer, floats that are attached by Pond Inlet harvesters are observed, so there appears to be some exchange of whales between Admiralty Inlet and Eclipse Sound. They felt that the two areas could maybe be combined into one management unit. Some felt that if these were divided into two stocks, harvesters would be fighting over the same whales. They felt there also may be exchange with Foxe Basin and Admiralty Inlet (and potentially Eclipse Sound – this was not clear from the statement in the meeting). Proper assessments of Igloolik and Resolute Bay were suggested.
- It was stressed that the area between Clyde River and Pond Inlet really needs to be re-assessed, and suggested that even temporarily, another subpopulation should be considered for the area. Some participants felt there would be numerous summering stocks identified in East Baffin.

<u>Community Management:</u>

- Participants noted that each community has its own hunting rules. Some communities still use the Community Based Management rules. DFO suggested that there should be an IQ section in the plan on hunting rules, etc. Some participants suggested they have many of the rules written down and could send them to DFO. Some participants noted that local hunting rules are not publicized to other communities, and that this could be a helpful change. Some participants did not like the idea of putting community hunting rules in the IFMP, and argued that it was just directed at CITES. NTI suggested that putting community hunting rules in the IFMP may give the impression that they are enforceable regulations, and this is not the intent. NWMB indicated that if need be, there may be a way to include the rules in an appendix with a disclaimer.

<u>Other Comments and Concerns:</u>

- There was also concern about the lack of research in Lancaster Sound.
- Participants noted that narwhals are an important food source.
- Some participants emphasized that the Polar Bear Technical Committee considers surveys that are over 10 years old to be outdated, and considers IQ in place of harvest numbers. It mainly considered science, but also include IQ information.
- Participants suggested that submerged whale correction factors are severe underestimates (based on their experience with harvesting entrapped whales), and recommended that this be a topic for future discussion.



FINAL REPORT

OF THE INUIT BOWHEAD KNOWLEDGE STUDY

NUNAVUT, CANADA

NUNAVUT WILDLIFE MANAGEMENT BOARD

By Inuit Study Participants from:

Arctic Bay, Arviat, Cape Dorset, Chesterfield Inlet, Clyde River, Coral Harbour, Grise Fiord, Hall Beach, Igloolik, Iqaluit, Kimmirut, Kugaaruk, Pangnirtung, Pond Inlet, Qikiqtarjuaq, Rankin Inlet, Repulse Bay, and Whale Cove

Principal Researchers:

Keith Hay (Study Coordinator) and

Members of the Inuit Bowhead Knowledge Study Committee:

David Aglukark (Chairperson), David Igutsaq, Joannie Ikkidluak, Meeka Mike

MARCH, 2000



FINAL REPORT

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NUNAVUT, CANADA

Nunavut Wildlife Management Board
PO Box 1379
Iqaluit, Nunavut
X0A 0H0

MARCH, 2000

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Illustration on cover, inside of cover, title page, dedication page, and used as a report motif: “Arvanniaqtut (Whale Hunters)”, sc 1986, Simeonie Kopapik, Cape Dorset Print Collection.

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March, 2000

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Table 1. Summary of Inuit hunts of bowhead whales from about 1917 to 1975 in Nunavut, as revealed by informants in this Study, but not in the compilation of Mitchell and Reeves (1982). 61

Figure 1. Map of the Study Area in the eastern Canadian Arctic. 5

Maps of distribution and migration of bowheads (six maps in a pocket on the inside back cover)

The Final Report of the Inuit Bowhead Knowledge Study is dedicated to our ancestors and elders, whose knowledge, wisdom, and spirit continue to guide and inform us. This report is also dedicated to the memory of the elders who participated in this Study and have since passed away.

As mandated by the Nunavut Land Claims Agreement of 1993, Inuit knowledge of bowhead whales in Nunavut, Canada was collected by means of 257 individual interviews with 252 Inuit hunters and elders in 18 communities during 1995 and 1996. During 1996 and 1997, follow-up workshops were held in eight of these communities where bowheads appear to be most numerous and seasonally predictable in their occurrence. The interviews and workshops were tape-recorded and were of an informal and semi-directive nature, with trained community interviewers and workshop facilitators employing questionnaires or an agenda consisting of open-ended questions or specific topics. We sought information from interviewees and workshop participants on bowhead whale distribution and migrations, changes in frequency of sightings and distribution since about 1915, behaviour and ecology, and the cultural and traditional importance of the bowhead whale to Inuit. Information on Inuit hunting and Euro-American commercial whaling of bowheads was also collected.

We analysed the transcripts of 175 translated interviews and the eight workshops to produce a compendium of informants' quotations pertaining to 1) Population Ecology of Bowheads and 2) Cultural and Traditional Importance of Bowheads to Inuit. Quotations or parts thereof were then catalogued within a detailed topical framework comprising these two main topics. This topical framework of quotations formed the basis for further analysis and the structure of this report.

Inuit testimony indicated that the number of bowhead whales seasonally occurring in the marine waters of Nunavut has increased significantly in recent decades, generally since the 1950s, 1960s, or 1970s, with the reported years and extent of increase varying among communities and among different informants from the same community. Informants documented the cultural and traditional importance of bowhead whales and whaling for the Inuit of Nunavut, and many argued on cultural and societal grounds for the renewal and re-vitalization of the bowhead hunt.

Okoa havakhaotikakmata atokoyaovlotik Nunavutmi Nunataagotini Angigotini 1993-mi, Inuit elihimayait okoa akviit Nunavutmi, Kanata katitigivaktot emakak 257 inuknik apikhoivakmata ema okoa 252 Inuit angoniakpaktot okoalo inutokait ovani 18 inukaknini talvani 1995 ovanilo 1996-mi. Talvani 1996 ovanilo 1997-mi, naonaikhakhotik meetikpaktot eeni inukaknini homi akviit takoyaolikpaktot amigaitot ovalo homi taggiomiitpatut. Okoa apikhogamikik inuit ovalo meetikatigivlogit nippiliokpagait okaktot ovalo hokot piomayut inuit, ayoikhimayut apikhoikataktot inuknk ovalo meetiktitivaktot apikhoivlotik naliak inuit naonaikhakvigivlogit akviknik apikhoktait. Talvani kemilgoktavut inuit ehomayait okaotaitlo ema kanok homi takovakpat akviknik ovalo homiitpagiakhainik, ovalo homot ahinot takokhaolikpaktot ovalo amligaitot elihimayaovat 1915-mi, kanogilitpakpat ovalo amigaitigivat, ovalo elitkohikot ovalo pitkohikot atoktaovaktot akviit Inuknit. Naonaikhakvioyut Inuit angoniakpaktot ovallo Kablonat maniliokhotik akvikhiokpaktot naonaikhakvioyut titigaktaovlotik.

Ovagut ehivgioktavut titigait 175 numiktikhimayut onipkangit inuit ova eengoyut meetiotit kanok naonaikhaktavut okoa 1) Kafffiovat Akviit ovalo 2) Elitkohikot ovalo Pitkohikot Hivitovat Akviit Inuknot. Inuit onipkangit titigaktaovaktot naiak naliak elait onipkangit titigaktot naonaitkotikhat okoa malgok ehomagiyaoyuk titigaktot. Ona onipkak titigak naonaitkotaoniaktok kanok kakogo ehivgiofagotikhat ovalo kanok titigakhimaniaktok.

Inuit onipkaktait tohakhaoliktot kaffit akviit takokhoavaktot taggiomi hamani Nunavut amigaikpaliayungok taya, hamani taya 1950-ni, 1960-ni, naliak 1970-ni, okoa onipkaktaovaktot okioni ovalo akviingok amigailigonakhigamik takokhaokataliktot nunani inukaknit haniani. Inuit onipkangit titigaktaoyut atokpagait elitkohimigot ovalo pitkohimigut akviit atokpagait nikikhat ovalo akvikhiokpagiantini inuit Nunavutmi, ovalo inuit atoktotokagigamikik akviit atogoilimaitait ovalo akvikhiokpaligiangitni inuit.

1

Introduction

1.1 RATIONALE AND BACKGROUND FOR THE STUDY

Article 5, part 5 of the Nunavut Land Claims Agreement (NLCA) required that the Nunavut Wildlife Management Board (NWMB) carry out an Inuit Knowledge Study of bowhead whales (*arviq*; *arviit* – pl.) in the Nunavut Settlement Area (NSA).

Through the NLCA, Inuit have expressed an interest in resuming a limited hunt for bowheads in Nunavut. Section 5.5.2 states (in part) that 'The NWMB shall conduct an Inuit knowledge study to record sightings, location and concentrations of bowhead whales in the Nunavut Settlement Area. The study shall be completed within five years of the date of ratification of the Agreement.' The Inuit Bowhead Knowledge Study (IBKS) Committee set up to manage the study expanded the scope of the IBKS to include the cultural and traditional importance of bowhead hunting for Inuit, and Inuit knowledge of various aspects of bowhead ecology and behaviour in the NSA. An important part of the study is the documentation of changes and trends in relative abundance and distribution of bowheads from the end of commercial whaling (about 1915) to the present time.



Bowhead tail. Photo by Sue Cosens, Department of Fisheries and Oceans

Inuit knowledge of bowhead whales in the NSA was documented by means of semi-directed interviews with elders and senior hunters in 18 communities whose marine hunting areas are seasonally visited by bowhead whales. In addition, small-group workshops were held in eight of these communities, which have reported the largest seasonal concentrations of bowhead whales.

Two interim reports of the study are available from the NWMB (NWMB 1995; Hay 1997).

1.2 TRADITIONAL ECOLOGICAL KNOWLEDGE AND SCIENCE

Traditional ecological knowledge (TEK) has in recent years come to be recognized as an important source of long-term and detailed data about wildlife resources and ecological processes on lands and waters used and occupied by indigenous peoples for millennia. This is especially so in remote areas where modern scientific studies, while providing indispensable data and interpretations, are often constrained in time and space by logistical and economic considerations. As a result, TEK and modern science are increasingly being utilized in a complementary fashion which allows the advantages of both to be brought into play, at the same time allowing the shortcomings of one to be overcome by the advantages of its complement. This approach is advocated by institutions of co-management (such as the NWMB) and other agencies, for its potential in enhancing the management of wildlife and ecological systems, in land use planning and management, and in other resource and planning activities.

…scientific work is basically simply an estimation, and I never totally believe scientists with their estimations. …The scientists' estimations tend to contradict the knowledge of the Inuit – Inuit rely on wildlife for food and they deal with wildlife on a daily basis all year round – while on the other hand scientists come up here and do a 3- to 4- day study and then they do a report, and they try to convince everybody of their findings and because of that they always contradict with Inuit knowledge. This study that we are doing is to collect the Traditional Knowledge of the Inuit [on bowhead whales] and we will also be using scientific documents. Inuit traditional knowledge has never been taken into account prior to the Land Claims Agreement. …it has been like this simply because we didn't have our knowledge documented. But today Inuit are working together collecting these kinds of information for the future generations. If in fact we had documents to back us up, I am sure that scientists would have believed what we were saying all along. [Joannie Ikkidluak, speaking at an IBKS workshop]

2

Methodology

2.1 PLANNING AND DESIGN

The study was guided by the Inuit Bowhead Knowledge Study Committee, formed in early 1994, which consisted of four members of the NWMB. The Committee decided that initial planning and design of the study would be carried out by a Planning Group consisting of representatives of the three Regional Wildlife Organizations of Nunavut and the IBKS Committee Chairperson.



Inuit Bowhead Knowledge Study Workshop, Coral Harbour, February 1996. Photo by Keith Hay

After two meetings and several Tele-conferences in December 1994 and January 1995, this Planning Group had devised a draft questionnaire and methodology for the study (*see* Appendix IV for the questionnaire). This questionnaire was pre-tested with five Inuit elders in Iqaluit, resulting in a few minor changes to some questions and the methodology. The methodology and questionnaire were also improved through consultations with staff from: Central and Arctic Region of the Department of Fisheries and Oceans, the Sanikiluaq-based Hudson Bay Traditional Ecological Knowledge and Management Systems Study, and the Department of Resources, Wildlife and Economic Development of the Government of the Northwest Territories.

There are about 18 to 20 eastern arctic communities in Nunavut within seasonal bowhead range. The IBKS Committee decided that interviews would be done in ten communities during 1995: Igloolik, Hall Beach, Coral Harbour, Repulse Bay, Kimmirut, Cape Dorset, Kugaaruk (formerly Pelly Bay), Pangnirtung, Qikiqtarjuaq, and Clyde River (*see* Figure 1).

These communities were chosen for a number of reasons. The Committee wanted to carry out the study in a limited number of communities during 1995, the first year of the IBKS. In addition, the first six communities listed are near migration routes and/or summering range of bowhead whales comprising a possible sub-population or stock in Northern Hudson Bay and Foxe Basin, thus the study in 1995 focused on a possible sub-population/stock of bowheads. The three eastern Baffin Island communities were selected because recent scientific studies and observations by Inuit indicate that a considerable number of whales migrate through and/or summer in the coastal waters of eastern Baffin Island. Kugaaruk, within the Kitikmeot administrative region of Nunavut, was also selected for the first year of the IBKS, having reported an unusual occurrence of summering bowheads in the early to mid1990s.

The Hunters and Trappers Organization (HTO) in each community was asked to select a community interviewer (in 1995) or a guide (in 1996), and to provide a list of up to 20 elders and hunters (informants or respondents) who were knowledgeable about bowhead whales and past whaling activities.

In February 1995, ten community interviewers assembled in Iqaluit for a two-day training workshop during which they were familiarized with the questionnaire and methodology for the study. The workshop was facilitated by the Study Coordinator, the IBKS Chairperson, and one other Committee member. After the workshop, community interviewers returned to their home communities and began interviewing the elders

and hunters recommended by the HTO, according to the protocol and guidelines established at the workshop. IBKS Committee Members and the Study Coordinator visited particular communities (excluding Repulse Bay) in early to mid March, 1995, in order to guide and assist interviewers during the first few interviews in each community.



Inuit Bowhead Knowledge Study Workshop, Qikiqtarjuaq, May 1996. Photo by Keith Hay

2.2 THE STUDY AREA

The Study Area for the Inuit Bowhead Knowledge Study comprises most of the central and eastern marine waters of Nunavut (Figure 1). All Nunavut communities whose marine-use areas are usually visited seasonally by bowhead whales of the tentative Hudson Bay/ Foxe Basin and/or Baffin Bay/Davis Strait stocks are included in the study. For purposes of data analysis and conclusions, the 18 participating communities were assigned to one of four regions which may reflect bowhead stock or population units: Foxe Basin, Hudson Strait, Hudson Bay, and Baffin Bay (*see* section 2.4).

2.3 INTERVIEW TECHNIQUES AND THE QUESTIONNAIRE

The IBKS Planning Group decided that one-on-one (individual) interviews would be conducted during the first year of the study (1995), although it was recognized that there are alternate approaches to collection of traditional knowledge information, e.g., the small-group interview or workshop, as used by the Hudson Bay Program's Traditional Ecological Knowledge and Management Systems Study (McDonald *et al.*1997). During 1996, the final set of individual interviews was conducted in communities in the High Arctic (Pond Inlet, Arctic Bay, and Grise Fiord) and in South Kivalliq (Rankin Inlet, Chesterfield Inlet, Whale Cove, and Arviat). A few additional interviews were held in 1996 in Repulse Bay and Coral Harbour, in association with the workshops held in these communities. A total of 257 individual interviews (with 252 different informants) was carried out in 1995 and 1996 in 18 communities (Appendix I). Five of the informants from Repulse Bay who were interviewed in 1996 (in association with the Repulse Bay workshop) had previously been interviewed in 1995 (one in Kugaaruk and the remainder in Repulse Bay).

In 1996, the interview methodology was the same as that used for the individual interviews conducted in 1995, but with two differences: the questionnaire was modified slightly from that used in 1995, with some questions being simplified and clarified, and one experienced, trained interviewer (always accompanied by a local guide) conducted all interviews in 1996, as opposed to having separate interviewers for each community in 1995. This latter change was necessitated by the variability in quality and degree of detail of the interviews carried out by the ten interviewers employed during 1995, and resulted in a higher degree of consistency in the methodology and comparability among communities for the 1996 set of interviews. The interviewer employed in 1996 had been one of the ten interviewers employed in 1995.

During March and April 1995, 177 interviews were conducted in the ten selected communities (Appendix I). The number of interviews ranged from 15 to 21 per community, except for Coral Harbour where only two interviews were conducted. Including the five test interviews in Iqaluit, the 182 interviews had an average duration of 45 minutes, varying from 15 minutes to 2 hours. In 1996, 75 interviews were conducted in the High Arctic and Kivalliq regions (Appendix I). The interviews in Pond Inlet and Rankin Inlet were video-taped for archival purposes.

The 257 tape-recorded individual interviews (including the five in Iqaluit) were conducted on a one-on-one basis in a semi-directed manner, whereby the informants were asked open-ended questions and were encouraged to speak freely about their experiences and knowledge concerning bowhead whales and whaling. Each informant was asked at

Figure 1. (on the next page) Map of the Study Area in the eastern Canadian Arctic, showing how communities which participated in interviews and workshops were grouped into one of four regions for the purpose of data analysis (BB – Baffin Bay, FB – Foxe Basin, HS – Hudson Strait, HB – Hudson Bay). These groupings as shown on the map do not indicate seasonal distribution of bowhead whales, but may reflect population or sub-population groupings of bowheads which occur in the marine waters of their constituent communities. Kugaaruk (Pelly Bay) was grouped with the Baffin Bay communities for bowhead population analyses, while this community was grouped with Hudson Bay for cultural analyses. Kugaaruk may host summering bowhead whales of the Baffin Bay/Davis Strait stock (*see* Maps 1 to 6, Section 3.1.2. iv) while its cultural affinities are with the community of Repulse Bay in northern Hudson Bay.

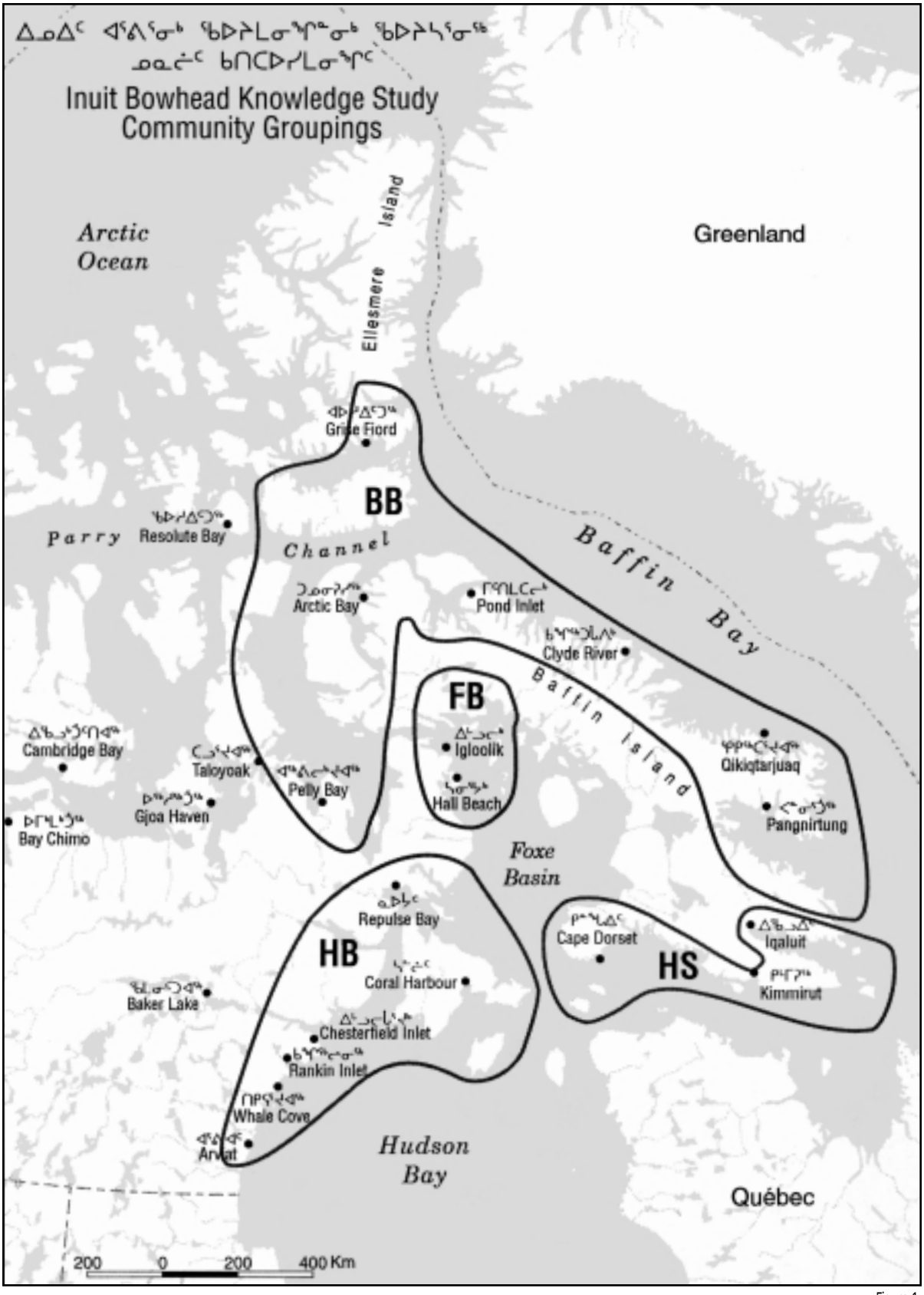

Inuit Bowhead Knowledge Study
Community Groupings
Arctic Ocean
Greenland
Ellesmere Island
Grise Fiord
BB
Parry Channel
Resolute Bay
Arctic Bay
Pond Inlet
Baffin Bay
Clyde River
Baffin Island
FB
Igloolik
Hall Beach
Qikiqtarjuaq
Pangnirtung
Cambridge Bay
Taloyoak
Pelly Bay
Gjoa Haven
Bay Chimo
Foxe Basin
Repulse Bay
HB
Coral Harbour
Cape Dorset
HS
Iqaluit
Kimmirut
Baker Lake
Chesterfield Inlet
Rankin Inlet
Whale Cove
Arviat
Hudson Bay
Québec
200 0 200 400 Km

Figure 1

the beginning of the interview whether or not he/she wanted his/her identity to be confidential, and signed a consent form to that effect (Appendix VI). Each informant indicated on regional maps (1:2,000,000) the locations of past whaling activities and the seasonal distribution and migrations of bowhead whales in recent years, according to his/her knowledge, observations and experience.

The main topics investigated by means of the Questionnaire were:

- Inuit whaling before Qallunaat* whalers arrived
- Commercial (Qallunaat) whaling
- Inuit whaling after the Qallunaat whalers departed
- Location, migration routes, and behaviour of bowheads during:
  - ukiuq (winter)
  - upirngassaaq (early spring)
  - upirngaaq (spring)
  - aujaq (summer)
  - ukiassaaq (early fall)
  - ukiaq (fall)
- Presence of calves, immatures, and adults
- Changes in numbers, distribution, and group size of bowheads over time
- Annual variations in occurrence, seasonality, numbers, and distribution
- Killer whales and bowheads
- Effect of lunar/tidal cycles on bowheads
- Effects of human-caused disturbance on bowheads
- Cultural and traditional importance of the bowhead to Inuit

The Questionnaire used in the study (during 1996) is presented in Appendix IV. Inuit, especially elders, will place their testimony and information within the time framework of the Inuit seasons, which are defined on the basis of environmental conditions and which vary (in terms of calendar months) from community to community, year to year, etc. The six Inuit seasons used in this Study are defined and related to calendar months in Appendix III (Stewart *et al*. 1995). The example given in Appendix III is for the High Arctic communities of Igloolik, Hall Beach, Arctic Bay, and Grise Fiord. The English equivalents (e.g., early spring, fall, etc.) provided beside the Inuktitut names for the seasons have no relevance to the Inuktitut epistemology and are provided for convenience or reference only.

In 1996 and 1997, the IBKS held small group workshops in eight communities (Appendix II), one year after individual interviews had been done, in order to assess and verify the information and map data that had been collected. The number of workshop participants varied from three to eight, and was usually six or seven. These two-day long, tape-recorded workshops were facilitated by one or two IBKS Committee members and the Study Coordinator. The HTO-selected participants (most of whom had been interviewed in their community about one year prior to the workshop) had an opportunity to discuss and verify the maps showing distribution and migrations of whales, which were a product of the individual interviews conducted in these communities one year earlier. The workshops also allowed participants to contribute their knowledge and experiences regarding bowhead whales and whaling, following an agenda which was the Study's 1996 questionnaire in a revised form (*see* Appendix V). Appendix II provides details for the workshops, such as community, dates, names of participants and the interpreter. The workshop held in Igloolik included participants from both Igloolik and Hall Beach. The IBKS workshop methodology was similar to that employed by Huntington (1998) in his study of TEK of beluga whales in Alaska. The workshops held in Igloolik and Pangnirtung were video-taped for archival purposes (Appendix II).

2.4 METHODS OF DATA ANALYSIS

In 1995, five taped interviews, selected at random from each community, were translated and transcribed into English by qualified interpreter-translators. Additional tapes from 1995 were translated in 1996 and 1997. Based on the judgment of the interviewer, the 'best' 50% of the 1996 interviews have been translated and transcribed (Appendix I). All eight workshop proceedings have been translated and transcribed.

The one interview translated and transcribed for Arviat was with Jimmy Muckpah, a former resident of Pond Inlet. His interview and the accompanying mapped data have been included with the Pond Inlet interviews for documentation purposes. Therefore, Appendix I shows that there are no interviews from Arviat contributing to the Study.

Editing of the interview and workshop transcripts was generally very minor, consisting mainly of correcting spelling errors and grammatical errors, and changing punctuation to ensure clarity of meaning. The Study Coordinator's workshop notes were added to the workshop transcripts (in square brackets) where clarification or additions were needed. A concerted effort was made to map Inuit place names during the 1996 individual interviews and at all eight workshops, so that Inuit place names in the transcripts could be associated with English language equivalents (where known, as taken from the 1:2,000,000 map, 'Yukon and Northwest Territories (East Half)', Energy, Mines, and Resources Canada 1989) which are shown in the text with a separating slash after an Inuktitut place name. More specifically, in the referenced quotations used throughout this report, editing additionally took the form of eliminating repetitious and unnecessary words or phrases, and frequently paraphrasing passages (in square brackets) to ensure brevity, clarity of

* Qallunaat (singular, Qallunaaq) is an Inuktitut word referring to people of European origin.

meaning and contextual accuracy. The use of three periods (…) to indicate deleted text is extensive. Care has been taken to ensure retention of the original meaning of every quotation. Throughout the text, Inuktitut words (except personal names) are italicized.

Using an electronic publishing software, Lotus SmarText Release 3, all translated interview and workshop text transcripts were compiled into four large documents based on geographic regions which may reflect different stocks of bowhead whales: Foxe Basin, Hudson Bay, Hudson Strait, and Baffin Bay (*see* Figure 1). The text transcripts from 175 individual interviews (68 percent of a total of 257 interviews carried out in 18 communities) and from the eight community workshops comprise this database. Of the 1995 interviews, 137 out of 182 have been translated and transcribed; for 1996, 38 of 75 interviews have been translated and transcribed (Appendix I).

The SmarText program, using prepared outlines, indexes, and a search function, was used to analyse these four regional text documents to produce a compendium of informants' quotations pertaining to two main subject areas: 1) population ecology of bowheads, and 2) the cultural importance of the bowhead to Inuit. This compendium (called 'Source Book of Quotations') was studied and analysed further, such that (on a regional basis) all referenced quotations were sorted and assigned to the appropriate subtopics within the main topics, Population and Culture, giving another intermediate product called 'Comprehensive Results Document'. The Final Report was based upon reading and analysis of the Comprehensive Results Document. The 'Source Book of Quotations', available only in English, is a large and detailed supporting document for this report and is available from the NWMB upon request.

Each topic or subtopic in the Results and Discussion section of this report comprises an analytical summary or overview based on a reading of all informants' quotations classified under that topic/subtopic in the 'Comprehensive Results Document', supported and illustrated by excerpts from a small number of these quotations (in italics). Furthermore, each topic/subtopic is footnoted to indicate which quotations from the 'Source Book of Quotations' contain information relevant to that topic/subtopic; all footnotes from the Results and Discussion are numbered sequentially and appear at the end of the report in Appendix VII. Entries in the 'Source Book of Quotations' are numbered by geographical area and consecutive numbers, i.e., FB1 to FB112, HS1 to HS157, HB1 to HB303, and BB1 to BB529. In the Source Book, each regional section is subdivided into 'Population' and 'Culture', although the numbering system for quotations from a particular region is sequential. Using the system of footnotes, readers who are interested in pursuing a particular topic in greater depth can consult the relevant quotations in the 'Source Book of Quotations'.

Quotations in this report and in the 'Source Book of Quotations' are referenced by quotation number, name and community code of the informant, and source of information (/ws = community workshop, otherwise from an individual interview). Anon. (n) indicates an informant who wished to be anonymous (these informants were assigned an identification number, n). Community codes are as follows:

AB – Arctic Bay; AV – Arviat; CD – Cape Dorset;
CI – Chesterfield Inlet: CR – Clyde River;
CH – Coral Harbour; GF – Grise Fiord; HB – Hall Beach;
IG – Igloolik; IQ – Iqaluit; KM – Kimmirut; PA – Pangnirtung;
PB – Kugaaruk; PI – Pond Inlet; QK – Qikiqtarjuaq;
RI – Rankin Inlet; RB – Repulse Bay; WC – Whale Cove.

From the maps prepared during the individual interviews and as verified/corrected during the community workshops, community and total (composite) maps were prepared showing:

1. Location of Inuit whaling activities, whale bones, and whaling camps before commercial whaling.
2. Location of whaling activities, whale bones, and whaling camps during the commercial whaling period.
3. Location of Inuit whaling activities, whale bones, and whaling camps after commercial whaling.
4. Location and migration routes of bowheads during each of the six Inuktitut seasons, during recent years.

The maps presented in this report (Maps 1 to 6, section 3.1.2. iv) are composites of the individual and community maps showing distribution and migration routes of bowheads during the six Inuit seasons (*see* Appendix III); they combine the information of all informants in the study who had observations pertaining to the particular season. We did not incorporate into this report the Inuit maps dealing with whaling for several reasons: these maps strongly reflect whaling patterns as written and interpreted by the commercial whalers and whaling historians, and thus seem superfluous; in many instances and for some communities we have the impression that information for the three whaling eras (*see* 1, 2, and 3 above) may have been assigned incorrectly and that there was likely some confusion as to the distinction of the three eras; and finally, Inuit knowledge of bowhead distribution is integral to the initial perceived mandate of the IBKS, and takes precedence over the whaling information. Nonetheless, maps showing distribution of whaling during the three eras collectively reflect those displaying Inuit knowledge of seasonal bowhead distribution at the present time.

We did not attempt to quantify or statistically analyse any results in this report. Our questionnaire used open-ended questions, unlike the highly-structured consumer surveys commonly carried out and which are amenable to statistical analysis. Informant responses to our questions usually took the form of lengthy narratives or stories, from which quotations were extracted and assigned to one or more topics/subtopics in accordance with the process described above. Readers who wish to

obtain an indication of the frequencies of informants' responses, especially with regard to the 13 sub-topics under Section 3.1.1 (Trends in Abundance), may refer to Appendix VII which lists the quotation numbers relevant to each topic or subtopic.

From the text transcripts, we gathered Inuktitut words relating to bowheads and whaling, hunting, the environment, and related categories. A preliminary glossary of more than 300 words has been assembled, but its release or publication must await verification by Inuit elders. Similarly, the collection of Inuit place names (from the 1996 interviews and the eight community workshops) must be verified, although these place names are used in this report and in the 'Source Book of Quotations'.

There is a vast historical, whaling, archival, and scientific literature dealing with bowhead whales. However, as this report is intended to be a documentary record of Inuit knowledge of bowhead whales in Nunavut, we have not attempted (with one main exception) to relate the findings of the Inuit Bowhead Knowledge Study to this literature.

Transcripts of the interviews or workshops for any community are available upon request from the NWMB, pending written approval from the HTO for that community.

3

Results and Discussion

3.1 INUIT KNOWLEDGE OF POPULATION ECOLOGY OF BOWHEADS

3.1.1 Trends in Abundance

i) Depletion of bowheads by commercial whalers [1]

Many informants pointed out that commercial whalers had depleted the stocks of bowhead whales in the eastern Canadian Arctic by the early 1900s.

Before the advent of commercial whaling, ancestral Inuit whaling had little impact on the large bowhead populations that existed at that time:

… before the Whalers ever came to the North – I am sure that there were lots of bowhead whales as our ancestors used to harvest bowhead whales based on the large number of bowhead whales present. …once the Whalers came they killed off lots of bowhead whales, thus the very evident decrease in population among the bowhead whales… [Mikitok Bruce, CH] HB91



A bunch of dead [beluga] whales after the 'big kill,' Mu-loo-ah-lee Fiord, Cumberland Gulf, Baffin Island, NWT, c.a. 1924-1927. Thomas Henry Tredgold/National Archives of Canada/PA-143671

…I assume that, before the arrival of the commercial whalers, the bowhead whale was in great abundance. The bowhead whale population was so high before, for there are whalebones littered around the old [Inuit] sod houses, where no one today can spot a bowhead whale in that area. …the great bowhead whale was drastically reduced in numbers, since the commercial whalers arrived. [and is today still not nearly as numerous as in the time before commercial whaling] [Pauloosie Kooneeliusie, QK] BB232

The legacy of the European and American commercial whalers has not been lost on Inuit, who wish to emphasize that Inuit were not responsible for over-harvesting:

… I do not want the Inuit to be blamed for the depletion of the bowhead stock… … for they did not harvest bowheads in great numbers, they may have caught a few after the Qallunaat whalers had left, but the Qallunaat whalers are responsible for the over-hunting of the bowhead… [Ben Ell, IQ] HS34

There are eye-witness accounts of the scarcity of bowheads after the end of commercial whaling:

…there were a lot of bowhead whales in the past. And bowhead whales decreased drastically for awhile after the Qallunaat Whalers were around. …when I was a child there was hardly any – it may be that whalers may have been the cause of the decrease in numbers. [Emile Immariutok, IG] FB27

…I remembered the times when there were so few bowhead whales, this is after the extensive bowhead whale hunting era – it may be that they [commercial whalers] harvested young bowhead whales. [Jaco Evic, PA] BB127

…[the whalers] used to hunt for bowhead whales way down at the floe edge [near Qikiqtan/ Kekerten], also back then [when I took part] there were not too many bowhead whales and they harvested one once in a while – I remember

one spring when four bowhead whales were harvested. [This would have been around 1917-1920 – he was born in 1901] [Aksayuk Etuangat, PA] BB346

…as well as orally-transmitted accounts:

That white guy [Capt. George Comer or another Qallunaaq harpooner, Qirnayaaq] used to get mad that when my uncle became old enough to shoot the bowhead without a trunk to boost him up, the bowhead whales were no longer around to be seen. [Felix Pisuk, RI] HB266

[My father] used to tell me that the bowhead whales were very few in numbers, as the whalers would hunt them. He had been born at the time of the whalers… …my father was not yet able to hunt but he remembered them. My father used to say that the bowhead whales were almost gone… [Ham Kadloo, PI] BB167

This depleted state of bowhead whales led to reduced opportunities for Inuit to harvest them, and ultimately to a Federal Government regulation prohibiting the harvest of this species:

After the Qallunaat whalers had gone, the Inuit would only kill a bowhead whale once in a long while, because there were not enough bowhead whales around. …wildlife officers had [later] put a freeze on hunting the bowhead whale. [Martha Kutiutikku, PB] HB163

…[in 1901/03 there were still a few bowheads being taken at Sanirut/Button Point] The Whaling era was coming to a halt by 1910-1911. By 1922-1923 when the Hudson Bay Company began to establish their trading posts, the Inuit were prohibited to hunt bowhead whales. [Kooneeloosie Nutarak, Sr., PI/ws] BB180

Inuit are thus cognizant of the fact that their ancestors had hunted bowheads for a long time without significant impact on the population, and that the commercial whalers had depleted the population by the early twentieth century. After the end of commercial whaling, Inuit harvested only small numbers of bowheads (until about the 1970s), mostly in Foxe Basin and northern Hudson Bay. Inuit believe that this low harvest reflects both a scarcity of whales at the end of commercial whaling, as well as a perceived government ban on the taking of bowhead whales. In fact, the ban was not enacted by the Federal Government until 1979.

ii) Voluntary cessation of Inuit harvesting[2]

Several informants pointed out that Inuit refrained from hunting bowheads owing to a perceived prohibition on harvesting, in spite of harvesting opportunities. After the end of commercial whaling, Inuit continued to harvest bowheads very sporadically, until the institution of the ban prohibiting whaling in 1979:

…after the Qallunaat whalers had left, the Inuit had the [Qallunaat] bowhead hunting equipment… So the Inuit were able to hunt for the bowhead whale whenever they wanted to catch one; although they did not catch them in large numbers, they hunted for it when they wanted to get some food supply after the Qallunaat whalers had left. …after the bowhead hunting was banned, they stopped hunting for the bowhead, although they always killed a bowhead before that… …that is how it was in Coral Harbour with my ancestors. [Ben Ell, IQ] HS36

After the ban came into effect, Inuit were still capable of harvesting bowheads; although opportunities to do so were numerous, Inuit exercised restraint as they did not want to break the law (many Inuit believed that the official ban came into effect much earlier than 1979):

…I am sure that they [Inuit] could easily harvest bowhead whales if they really wanted to – but because there was plenty of food around they didn't go after the bowhead whales. [Anon. 29, RB] HB30

…since then [1964-65, when Mikitok attempted to harvest a bowhead] the prohibition on bowhead whales has been in place, thus I never attempted to get another one. [Mikitok Bruce, CH] HB90

….we could have easily harvested another one [after the last harvest in 1975] but due to the restriction imposed we never again made any attempts to harvest another one… [Participant, RB/ws] HB216

I was born when they [bowheads] were an endangered species… …because of rough estimations we are not allowed to harvest them. And if in fact the actual facts were used, I would probably have seen bowhead whales being harvested. [Gamailee Nookiguak, QK/ws] BB208

They [had] intended to get more bowhead whales [in addition to the one they got] and I remember that this was in 1945, back then they had access to radios, that's when we learned that bowhead whales were not to be harvested anymore. Consequently they had to stop. Since then there has been no harvesting of bowhead whales. [Jaco Evic, PA] BB393

After the ban came into effect, some hunters even 'acted out' the hunt without harming the whale:

There was even an occasion where hunters were driving a bowhead whale to a cove as [this is] a method used when hunting for bowhead whales. There are number of hunters that have done that. [Atsiaq Alasuaq, CD] HS14

iii) Long-term population increase: first-hand observations[3]

Many elders and senior hunters testified, that when they were children or younger adults, they saw bowheads only rarely or in very small numbers, but in recent years or decades they have seen greater numbers of bowheads.

FOXE BASIN

In the Northern Foxe Basin area near the communities of Igloolik and Hall Beach and particularly in the mouth of *Ikiq*/Fury and Hecla Strait, Inuit provided strong evidence for an increase in the number of bowhead whales during recent decades, particularly since about the mid 1960s, when several bowheads were harvested in the area (FB22; Mitchell and Reeves 1982). This evidence comes from elderly informants and senior hunters who, as children or younger adults, reported seeing few bowheads; in recent years and decades, they have seen greater numbers of bowhead whales:

…as a child I never saw any bowhead whales – for sure there are much more bowhead whales today as compared to the times when I was a child. …during the time when we were seal hunting [not long ago], I saw lots of bowhead whales in large groups. [Terry Irqittuq, HB/ws] FB17

After I have grown and matured was the time that bowhead whales were beginning to come back and were seen on occasion. Looking at the present situation as opposed to the past, there are a lot of bowhead whales now. …Last summer [1994] when I went caribou hunting towards the Tasiujaq/Murray Maxwell Bay area, at that time there were a lot of bowhead whales. Throughout the day I was counting every bowhead whale that we saw, and at the end of the day I had counted well over 100. [Anon. 19, IG] FB23

…[after] not seeing a bowhead whale for a long time, they [bowheads] started to arrive again – this was during the time when we lived at Kapuivik/Jens Munk Island. They started to venture into our waters… …and after that they really became evidently present – there used to be a mother with her calf… [Noah Piugattuk, IG] FB41

…in the 1960s I was in Hall Beach and in 1964 I came to Igloolik before there were too many bowheads in and around Igloolik. …It seemed that from 1964 onward the bowhead whales seemed to be increasing annually in numbers in our waters. …when you look at the year 1964 and compare it to today there are so many bowhead whales close by. We even on occasion see bowhead whales at the floe edge during the month of May and June between Baffin Island and Igloolik. …before that time you wouldn't dream of ever seeing a bowhead whale at the floe edge. [Simon Iyyiriaq, IG] FB46

Semi Maliki of Repulse Bay (HB71, 259) is originally from the Igloolik area. He stated that while in Igloolik, he saw no bowhead whales (*see also* HB66, 70).

The increase in numbers of bowhead whales in northern Foxe Basin around the mid 1960s corresponds with increased harvesting of bowheads at Igloolik, Hall Beach and *Kapuivik*/Jens Munk Island (Mitchell and Reeves 1982). Since that time, informants report a generally steady increase in the number of bowheads frequenting Foxe Basin in spring, summer, and early fall (FB4, FB22).

HUDSON STRAIT

In the *Sullualuk*/Hudson Strait area, informants from Iqaluit and Cape Dorset reported that sightings of bowheads have increased in their community's land-use regions as compared with earlier times (HS38). However, some informants seem somewhat uncertain that the increase in sightings reflects a real population increase (HS5 – increased hunter mobility may be a factor; HS20 – redistribution of bowheads may be a factor).

In summer time we are seeing more of them [nowadays] as compared to the time I was a child – they simply don't come this close to the community as they are traveling mostly through Hudson Bay. …we only see bowhead whales that come around these parts as they are traveling to Igloolik. [Atsiaq Alasuaq, CD] HS15

…when I first moved to Iqaluit [about 1960] there were hardly any bowhead whales around, but today they are increasing in numbers, because we see more bowhead whales more frequently. [Josie Papatsie, IQ] HS41

This testimony and that covered in later sections (*see* below) seem to indicate that the increase in sightings in the *Sullualuk*/Hudson Strait area is not as marked as the increase noted for other areas of Nunavut.

HUDSON BAY

Only Repulse Bay and Chesterfield Inlet residents commented on the changes in the number of bowheads they have sighted in recent years or decades as compared to when they were children or younger adults. Bowhead numbers began to increase in the Repulse Bay area around the time the community was established (about 1965: HB29, 46, 71, 259). Prior to that time, when people lived in camps outside Repulse Bay, informants remarked that outpost residents took especial note of bowhead sightings, expressing surprise or a feeling of awe (HB41, 48). One informant (HB56) noted that bowheads began to be seen more frequently in the Repulse Bay area around 1974. Peter Katokra of Repulse Bay (HB65) indicated that the increase occurred sometime after 1965 (*see also* HB33, 64).

We used to travel by boat when I was a child but I have not seen one [bowhead]. But recently, when I became an adult and got older, I have seen some bowhead whales in our community. We see a bowhead whale every summer around our community. [Joe Issaluk, CI] HB22

…I am pretty sure that bowhead whales' population is increasing based on what I have seen in the past and what I am seeing today. As a child and as I grew older I have seen bowhead whales – before there were houses we lived in a traditional camp away from the existing community of Repulse Bay – there used to be lots of bowhead whales and I used to see lots of them back then. And from that time on we seem to be seeing much more bowhead whales as opposed to the time of my childhood. [Abraham Tagornak, RB] HB29

BAFFIN BAY

Arctic Bay

Many Arctic Bay elders related that bowheads were rarely seen during their childhood and early adulthood, but that bowhead sightings have been increasingly frequent in recent decades. Some informants place the time when the increase became noticeable as about the date the community of Arctic Bay was established, or about 1965 (BB1, 4, 18, 26, 27). Other dates for noticing an increase are given: 1973-74 (near Yeoman Is.) with an accelerating rate of increase in the 1990s (BB11); or the 1970s (BB22). Philip Oingoon (BB27) testified that bowheads have been especially numerous in more recent years (i.e., early 1990s). Andrew Oyukuluk (BB1) mentioned that killer whales were present before bowheads started to become more numerous in the 1960s. A bowhead sighting during the time of their scarcity (pre-1960s) tended to elicit much excitement and curiosity among Inuit, but nowadays bowheads hardly arouse much notice (BB20). Olayuk Naqitarvik (BB26) believed that the increased abundance of bowheads near Arctic Bay may be due to changes in their distribution.



Bowhead hunt crew, Repulse Bay, August 1996. Photo by Ben Kovic

…back in the 1960s and 1970s there were hardly any bowhead whales, even though we used to see the odd bowhead whale, and there were times that we didn't even see a single bowhead whale for the entire summer. But today we see them every summer… [Mucktar Akumalik, AB/ws] BB22

I recall hardly ever seeing any bowhead whales when I was a child. And I started to hunt not too long ago [about early 1960s], and that was the time that I began to see bowhead whales. Again there were no bowhead whales before that, but now the bowhead whales are increasing in numbers. [Koonoo Oyukuluk, AB/ws] BB18

…They [bowheads] seem more numerous [nowadays], perhaps it is because they are traveling more. Since childhood, I have seen bowhead whales. …I would go on the boat while people were hunting for belugas and we would see bowhead whales once in a while [when I was a child, in the 1950s]. We also lived over here as I was growing up and becoming a young man [in the early 1960s], every year the bowhead whales were here. …[this was] in the summer time. As soon as the ice went, the bowhead whales would appear. On the floe edge, bowhead whales would be very common. [Olayuk Naqitarvik, AB] BB26

The testimony from Arctic Bay elders and senior hunters, those who were direct witness to bowhead abundance over much of their lives, is fairly consistent, indicating a substantial increase in numbers of bowheads in the *Tununirusiup Kangiq&ua**/Admiralty Inlet area dating from the early 1960s.

Clyde River

Elders from Clyde River pointed out that bowheads were rarely seen at their outpost camps (e.g., *Igaliqtuuq*/Isabella Bay) prior to re-settlement at Clyde River in the early 1960s, when sightings of bowheads started to become more frequent throughout the Clyde River resource-use area (BB41,68). However, Ashevak Palituq (BB41) referred to a time (the early 1950s) *'that there were so many bowhead whales'.*

… when I was just a young lad, there were hardly any bowheads around, even when I traveled to the deeper waters, no bowheads could be seen at that time, but nowadays when you go down there [Igaliqtuuq/Isabella Bay] during the fall time you can't miss the bowheads now, for the population had increased since then. [James Jaypoody, CR] BB59

I recall when I first moved here [Clyde River] we seldom saw bowhead whales; even at Talirujalik (Taliruujaq/Aulitiving Is. in Igaliqtuuq/Isabella Bay) we didn't have or very seldom saw bowhead whales when I was full grown… …there are much more bowhead whales now than there used to be. Same thing in our community, as well as in Igaliqtuuq and other surrounding locations, people are seeing much more now than they used to. [Nauja Tassugat, CR/ws] BB68

When we were doing a study on bowhead whales [at Igaliqtuuq/Isabella Bay]… …we used to observe lots of bowhead whales… I remember there used to be a smell unlike any smell that I am used to smelling, perhaps this was due to the large number of bowhead whales and [the] seagulls [that] used to follow them. This was the first time that I experienced something like that. I remember

* The ampersand symbol (&) represents a unique sound in Inuktitut, roughly approximated by *kl.*

as a child [at Igaliqtuuq] I used to see lots of bowhead whales but not like the ones that I saw [more recently] – it was almost like looking at narwhals in a group. [Solomonie Natanine, CR/ws] BB87

Elders and senior hunters from Clyde River, who have first-hand observational experience with bowheads over most of their lives, report that bowhead numbers began to increase at the time Clyde River was established, i.e. about the early 1960s.

Pangnirtung

In recent decades, elders and hunters have noticed more bowheads at the floe edge (in May/June) south of Pangnirtung (BB121, 123, 135).

When I first started going to the floe edge in 1967-68, when I was able to hunt on my own – back then you could see two or three in a group or sometimes one… And in the years 1992 and 1993 it was noticeable that indeed the bowhead whales were increasing in numbers in our community. The gradual increase was noticeable in 1982 and 1983 but looking at the year 1994 there seemed to be more than ever . Being a hunter that I am and I am always hunting at the floe edge, I can tell that there are more whales than ever before. [Adamee Veevee, PA/ws] BB99

…I remember the times when there were so few bowhead whales, this is after the extensive bowhead whale hunting era… …it seemed to me that the population of the bowhead whale has been continually increasing and you could see a lot more of them [nowadays] at the floe edge. [Jaco Evic, PA] BB127

In their childhood or young adulthood, informants saw whales only infrequently but in recent decades they have sighted more and more whales in *Tinnujivik*/Cumberland Sound (BB100, 106, 118, 121,135, 141, 395).

When we were [living] in the outpost camps, we had been more aware of the movement and the numbers of the bowhead whales. Today, we do not study the bowhead whales. We are not around them as much as we would have been in the past. At that time [in the outpost camps], there did not seem to be as many whales [as nowadays]. [Anon. 23, PA] BB113

We lived in Sauniqjuak [near Imigen Islands], a camp just across Tinnujivik/Cumberland Sound, we never saw too many bowhead whales during those early years – however, in the last number of years and later on in our camp life we started to see more bowhead whales… [Towkie Maniapik, PA/ws] BB435

Apak Qaqqasiq (BB123), who as a young man saw bowheads only occasionally, now reports that large numbers frequent the Pangnirtung area, as well as *Igaliqtuuq*/Isabella Bay where he had participated in biological studies of the bowhead whale. Elders and hunters with lifetime experience of bowheads indicate that there are many more bowheads nowadays than in the past. Large numbers of whales are especially evident at the floe edge in May and June before they disperse in the summer. The testimony suggests that bowheads were still scarce in *Tinnujivik*/Cumberland Sound before the expansion of Pangnirtung in the mid 1960s (BB113) and during the 1960s (BB141), with the increase becoming detectable by the 1980s (BB99).

Pond Inlet

As children or younger adults, Pond Inlet informants saw bowheads infrequently, but in recent years or decades they have seen bowheads in larger numbers (BB162, 173, 174, 195).

Personally I begin to notice the increase [in bowhead numbers] when Siarnaaq came very close to a fatal accident [with a bowhead] and I think it began to change by 1969-1972. [Elijah Panipakoocho, PI/ws] BB165

When we moved over here [to Pond Inlet, about 1970], there did not seem to be many [bowheads] around here. Today, you see more of them. …We see them all the time. I have not seen them in [big] groups. When I see a whale, it is usually alone. …It seems to me that I saw more bowhead whales last summer [1995] than at any other time. [Ishmail Katsak, PI] BB169

I only began to notice it [the population increase] not too long ago. …it was the time that I was seeing a bowhead whale every day. …I do believe it could have been in 1992. [saw a great increase near Saviit, Milne Inlet] …I could say for sure that the population has been growing from the time we have been children to date. Reason being that sightings of bowhead whales are increasing every single year… [Joanasie Arreak, PI/ws] BB175

I was brought up on the land as a child. …They [bowheads] were completely gone [at the end of commercial whaling], but now we see more of them. When we saw them as they were coming around again it was a wonderful sight to see. [Simon Akpaliapik, PI] BB197

Jimmy Muckpah (BB170) related that he noticed an increase in bowhead numbers in the Pond Inlet area, before he moved from Pond Inlet to Arviat in 1970. Before bowheads became more common in recent decades, the rarity of a sighting created much excitement among the people; nowadays, bowhead sightings do not create as much of a stir (BB173, 175,191, 195).

At the Pond Inlet floe edge, sightings have also increased, especially from about 1942 (BB183). Sam Arnakallak (BB191) dates the increase from 1976, when he saw a bowhead for the first time. He added (BB192) that the few bowheads seen about that time always seemed to be swimming away from killer whales.

The time when the increase in sightings of bowheads near Pond Inlet became detectable varied widely (1942 to 1992) among informants. However, an increase in bowhead numbers starting to be noticeable in

the late 1960s to mid 1970s seems highly probable from the testimony given.

Qikiqtarjuaq

Similar to other communities in northern and eastern Baffin Island, residents of Qikiqtarjuaq also reported increased numbers of bowhead whales in recent times as compared to when they were children or younger adults (BB204, 224). Jaycopie Audlakiak (BB219) reported a similar increase, but added that bowheads were more much more abundant in 1994 than in 1993.

Jacobie Koksiak (BB213) has noted a recent increase in bowhead numbers in the Qikiqtarjuaq area, but asks the question, *"are they once again increasing in population, or did they wait until their food had become abundant again?"* He has also noted a correlation between bowhead occurrence and presence of killer whales:

…when I was a child in Palligvik/Padloping Island, I don't remember seeing that many bowhead whales – and there were more killer whales (aarluit) back then; but later on in time as the aarluit begin to diminish in number, that's when I began to notice more bowhead whales as opposed to the past. [Jacobie Koksiak, QK/ws] BB215

iv) Long-term population increase: first- and second-hand observations in combination [4]

Many elders and senior hunters testified, that when they were children or younger adults, they saw bowheads only rarely or in very small numbers, but they have heard from other hunters that bowheads have become more numerous in recent decades. This section is similar to the previous section in that elders and senior hunters provided observations indicating the scarcity of bowheads during their childhood and/or early adulthood. However, these informants have not been able to travel out to the camps much in their later years, and have relied in large part on information from active hunters concerning the more recent abundance of bowheads.

HUDSON STRAIT

Informants from Cape Dorset (HS11, 13), Iqaluit (HS48), and Kimmirut (HS64) provided similar testimony:

When I was young and when I was a child they [bowheads] were nowhere to be spotted, and we never used to hear about people spotting them, but nowadays we hear more about the sightings anywhere, and I have also seen a bowhead whale not too long ago. [Lucassie Nutaraaluk, IQ] HS48

HUDSON BAY

Coral Harbour

Coral Harbour informants reported that they rarely saw bowheads at the floe edge in the past, but that bowheads are now abundant at the floe edge during May and June:

I have lived in Salliit/Coral Harbour all my life and I have never ever seen one in this area [the floe edge] in the spring time and I have never ever heard of one being sighted – but now recently hunters are sighting them in the spring while there is still solid ice. [Mikitok Bruce, CH/ws] HB3

Mikitok Bruce (HB4) further reported that floe edge sightings of bowheads have become especially common since about the late 1980s.

… I have seen some bowhead whales [when I was a child]… …in our outpost camps. As I get older they are seen more, it is obvious there are more of them now. …they are increasing. In this area [Coral Harbour] there was hardly any before. …especially now, I have seen them on the floe edge [in spring]. Others too have seen them while the ice is still around, they are seen a lot more now. [Tooma Netser, CH] HB18

Chesterfield Inlet

Informants (HB23, 28) reported that bowheads were scarce or absent in the area a long time ago (at least until about 1950 – *see* HB28), but hunters have been seeing more bowheads in recent years:

I've lived in Chesterfield Inlet for a very long time and for a long time there were no bowhead whales, but recently people continue to see bowhead whales around here. …You can see a lot more bowhead whales around the Chesterfield Inlet area. For example, last summer some men saw some bowhead whales… People say that they see bowhead whales once in a while. [Leo Mimialik, CI] HB23

Repulse Bay

As children or younger adults, informants (HB30, 51, 52, 53) infrequently saw bowheads; they have heard that hunters have seen larger numbers of bowheads in recent years:

… in the 1970s we seldom saw bowhead whales at the floe edge. Since that year we are beginning to see them on a more regular basis at the floe edge. I have heard of people seeing them at the floe edge and I also have seen some at the floe edge. [Participant, RB/ws] HB53

…When I was a child we did not use motorized boats… [even so], we used to travel longer distances back then, and I recall not ever seeing any bowhead whales… …back then only very few if any were seen during the summer… Now you hear hunters going out seal hunting and without fail it is guaranteed that they will definitely see a bowhead whale. [Octave Sivanertok, RB] HB51

There is some ambivalence about the reality of an increase in the Hudson Bay bowhead population. Octave Sivanertok, while stating that hunters see more bowheads nowadays than in the past, and that population size has increased over the years, noted that:

…people say they [bowheads] travel more now. …Earlier when we used to go out to our [outpost] camps we would be out for days, sometimes weeks, and we would not see any [bowheads] at all. Now when we go out for less than a day we see them. Maybe it is because we are traveling with our faster outboard motors that we see more of them now. We see them sometimes, but we do not see them all the time. [Octave Sivanertok, RB] HB52

BAFFIN BAY

Informants from Arctic Bay (BB10, 29), Pangnirtung (BB101,119, 346, 353, 411), and Pond Inlet (BB168,181) provided testimony.

Arctic Bay

Atagootak Ipellie of Arctic Bay (BB10) saw very few bowheads as a young woman, and related that hunters nowadays frequently see bowheads at the floe edge of *Tununirusiup Kangiq&ua*/Admiralty Inlet. She believes that increased sightings may partly reflect modern, faster transportation methods, such as snowmobiles and motorboats. She concluded, however, that the bowhead population is increasing. Philip Qamanirq (BB29) recalled, as a child in the late 1930s, that bowheads were frequently seen at the floe edge in spring:

There would be lots of bowhead whales around the cracks, in Qaqulluk/Elwin Inlet, [and] around Umiarjuanguaq… Today I have not gone out to a camp for many years now and I do not know of them [bowheads] too much. The hunters say there are more bowhead whales now than there have been in past times when I would go out and camp with my family. [Philip Qamanirq, AB] BB29

Pangnirtung

Aksayuk Etuangat (BB101, 346, 353) was born about 1900 and raised at *Qikiqtan*/Kekerten Island in *Tinnujivik*/Cumberland Sound. He was involved with the final phase of commercial whaling activities there as a young man (around 1918-1920):

They [the whalers] used to hunt for bowhead whales way down at the floe edge [near Qikiqtan/Kekerten], also back then there were not too many bowhead whales and they harvested one once in a while – I remember one spring when four bowhead whales were harvested. …It was also very seldom that they [whalers at Kekerten] spotted a bowhead whale down at the floe edge – back then there were very few bowhead whales. But now from what I hear, there are a lot of bowhead whales now especially in the spring time. [Aksayuk Etuangat, PA] BB346

The scarcity of whales at *Qikiqtan*/Kekerten by 1915 is echoed by Pauloosie Angmarlik:

…[Before I was able to shoot a rifle on my own] he [my father] had taken me [about 1915-17, at age 4 to 6] on one of the [whale] hunts [at Qikiqtan/Kekerten]… Unfortunately we did not spot a bowhead whale… …when the bowhead whale hunt was being halted it may have been that there were less bowhead whales. …[During this hunt] there were four boats involved separated into two groups… But they did not harvest a whale that year. [Pauloosie Angmarlik, PA/ws] BB411

This testimony (*see also* BB119), combined with that of hunters and elders with lifetime experience regarding bowheads (section 3.1.1.iii), along with recent observations of bowheads by hunters (section 3.1.1.vi), provides strong evidence of a post-commercial whaling recovery of bowheads in Cumberland Sound.

Pond Inlet

…[in the Pond Inlet/Clyde River areas], I have heard that there are more now than when I was a child. [Kooneeloosie Nutarak, Sr., PI] BB181 (*see also* BB168)

v) Recent, annual population increase: first-hand observations [5]

Seven informants representing all four regions of the Study Area, in addition to their testimony regarding overall population increase of bowheads, testified that they have observed increases in bowhead numbers on an annual basis:

It is evident that each year there are more than the previous year, so basically they are increasing on an ongoing and annual basis. [Albert Nuvviaq, HB] FB4

…here is the place [outer Frobisher Bay] where the bowhead whales are now being spotted more frequently practically every summer, it seems that the bowhead whales are increasing in numbers every year here. [Josie Papatsie, IQ] HS38

We do move around in the water [Repulse Bay area] when it's open and based on our observations, we could even compare the population from last year, as I could safely say that there are more now than last year. [Participant, RB/ws] HB64

…I could say for sure that the population has been growing from the time we have been children to date. Reason being that sightings of bowhead whales are increasing every single year as we see them more and more each year. [Joanasie Arreak, PI/ws] BB175

vi) Present-day abundance: first-hand observations [6]

FOXE BASIN

Hunters from Igloolik have sighted large concentrations of bowheads near their community in recent years or decades, and they believe that the bowhead population has been increasing:

…we know for a fact that they [bowheads] are multiplying in numbers, and I am sure that there is a [unknown] place that they bear their young… …it is evident that when you travel by boat you see them more and more, it does not matter where you travel near Igloolik. It is evident that bowhead whales are getting more plentiful in Igloolik. [Simon Iyyiriaq, IG] FB45

HUDSON STRAIT

Informants from Cape Dorset (HS1, 8) and Kimmirut (HS62) report sightings of large numbers of bowheads in their respective areas:

I have not noticed the bowhead whale increasing. I have only seen more bowhead whales when we travel by boat around Tikiraq and around Cape Dorset. This would be during spring. [Anon. 10, CD] HS1

I could say that there are much more bowhead whales since the time the whalers stopped hunting bowhead whales. [Nujaliaq Qimirpiq, KM] HS62

Ben Ell and Josie Papatsie (both of Iqaluit) have provided observations of bowheads for Coral Harbour (HS33) and Pangnirtung (HS40), where they lived the earlier parts of their lives, respectively. These observations have been included in the following two sections (Hudson Bay and Baffin Bay, respectively).

HUDSON BAY

Ben Ell of Iqaluit (HS33) witnessed an abundance of bowheads (in groups of 10 to 20) in the Coral Harbour area when he resided there in 1955-56. Two informants from Chesterfield Inlet provided their observations of bowhead abundance near their community. Andre Tautu (HB20) reported that many bowheads are sighted annually in the *Silumiut*/Daly Bay area (north of Chesterfield Inlet); and "*…around Nanuujumaaq [Fairway Is., just SE of Chesterfield Inlet] people continue to see some bowhead whales.*" Joe Issaluk (HB22) reported that people see good numbers of bowheads every summer in the Chesterfield Inlet area nowadays, as compared to his mother's stories of the absence of bowheads at the end of the commercial whaling period.

Seven informants testified that bowheads are numerous in the Repulse Bay area from spring to fall, and that the population has likely or apparently increased:

…People are seeing more than one near our shore here. I have heard that they are seen in a group of three. This is right in front of our shore [at Repulse Bay]. As well, in Ittirjuk/Gore Bay people saw the bowhead whales. This was not that recent. [Anon. 30, RB] HB33

…we see them [bowheads] every year, especially at Maluksitaq/Lyon Inlet as we used to live in that area when I was a child. …for sure we can say that we see a lot of bowhead whales in this [Repulse Bay] region. It may also be that we see more bowhead whales than we used to in the past. …we do see them [whales] on a continual basis. [David Tuktudjuk, RB] HB39

John Ignirjuk (HB46) has encountered many bowheads at the floe edge off Repulse Bay in spring and adds: "*I am in no way trying to undermine Repulse Bay, but I have only seen very few of them in Repulse Bay*". John Kaunak (HB48) also noted that whales are concentrated and numerous at the floe edge in June, but that after ice break-up, they disperse and are seen in fewer numbers. Whales then gather inshore in August (*see also* HB51).

BAFFIN BAY

Arctic Bay

Arctic Bay hunters report an abundance of bowhead whales in their community's resource-use area. Koonoo Oyukuluk (BB18) reported a large concentration of bowheads amongst the ice of central *Tununirusiup Kangiq&ua*/Admiralty Inlet in summer 1996, while Olayuk Naqitarvik (BB26) stated: "*…there has always been bowhead whales, every year [during my lifetime]. Sometimes they are more in numbers, sometimes they come in groups of three. …there are a lot of bowhead whales*".

I have made every effort to travel to [the] inlet [Tununirusiup Kangiq&ua/Admiralty Inlet] every summer… …when you travel through the inlet you see them [bowheads] constantly… For example, when you travel to Ikpikituarjuk, there is no end to seeing bowhead whales. I could optimistically and sincerely say that indeed the population of bowhead whales is forever increasing in the Arctic Bay area. [Mucktar Akumalik, AB/ws] BB24

Clyde River

Clyde River informants mentioned the large numbers of bowheads seasonally occurring within the community's marine-use area (BB91), including the large feeding aggregation that occurs at *Igaliqtuuq*/Isabella Bay in late summer and fall (BB50, 55, 123). They also reported large numbers of south-bound migrants and/or feeding whales off Clyde River during fall (BB50, 53, 55), and a large number of late summering animals off the *Kuugaaluk*/Kogalu River to the north of Clyde River (BB55, 57). Considering the large number of whales that they see, some informants believe that the population has grown (BB53). Seeing such large numbers of bowheads has been likened to viewing herds of narwhals or belugas (BB50, 53).

I had seen all these bowhead whales together in Kuugaaluk/Kogalu River …there were very many whales together and I thought that they would not be gone if they were hunted because there were so many of them. [Jacobie Panipak, CR] BB57

…we used to live in Nuvuttiapik/Cape Raper at Igaliqtuuq/Isabella Bay and a lot of bowheads would get together …It is a wonderful sight. Sometimes there are lots of them together. I have never thought of counting them at the time I had seen them all together. [Joannasie Apak, CR] BB65



Inuit Bowhead Knowledge Study Workshop, Clyde River, May 1996. Photo by Keith Hay

Apak Qaqqasiq of Pangnirtung referred to his participation in bowhead studies at *Igaliqtuuq* /Isabella Bay:

…Following the time I took part in a survey of bowhead whales [at Igaliqtuuq/Isabella Bay] I could say now that there are lots of bowhead whales. [Apak Qaqqasiq, PA] BB123

Pangnirtung

Josie Papatsie of Iqaluit (HS40) moved from Pangnirtung to Iqaluit about 1960. He prefaced his observations: "*…I used to see bowhead whales there [in the Pangnirtung area] too, although they were not in great numbers they were spotted annually.*" He used to hunt off the community's floe edge, where he observed many bowhead whales.

Many informants from Pangnirtung emphasized that they frequently sight large numbers of whales in the Pangnirtung area (BB102, 104, 112, 131, 133, 144). The floe edge southwest and south of Pangnirtung has been occupied by increasing numbers of bowheads in recent decades during the months of May and June (often in March and April as well), and the bowheads tend to be concentrated or occur in large groups (BB102, 104, 106, 108, 122). Hunters pursue narwhals and belugas at the floe edge off *Qikiqtan*/Kekerten Island, where large numbers of bowheads are seen in May and June every year (BB114). After ice break-up, the whales seem to disperse widely in small groups and the overall rate of sightings decreases (BB102, 144). Based on reports of elders that bowheads were sighted infrequently several decades ago, many of these informants concluded that the population of bowhead whales in *Tinnujivik*/Cumberland Sound has increased (BB102, 106, 108, 112, 122, 131, 133, 362, 392).

I hear that there weren't that many bowhead whales in and around Pangnirtung [a long time ago]. …I go seal hunting at the floe edge in the spring around the month of May, and we see a lot of bowhead whales at the floe edge in one place… So basically I could say that there are more bowhead whales around Pangnirtung… [Amosee Angnakak, PA] BB102

During the time of the baby seals, in the month of March, we have seen a lot of bowhead whales. This would be in Qimmirsut [island in the mouth of Chidliak Bay]. …They definitely have increased [in numbers since the end of whaling]. Anon. 21 and I had gone hunting on the floe edge and we had to go around them [bowheads] when we were coming back to town. [Anon. 22, PA] BB108

Lypa Pitsiulak, who has resided in Opingivik Outpost Camp in *Tinnujivik* /Cumberland Sound for about the past 25 years, has also seen many bowhead whales in recent years:

Nowadays we see large numbers of bowhead whales and [according to my father] the Whalers had never encountered this many bowhead whales while whaling at Ummanagjuaq /Blacklead Island. Today I have observed a lot of bowhead whales in groups going into the Fjord in the summer and early spring. I have even seen a good number of surfaced bowhead whales in one group and you see them everywhere and my father tells me that there weren't this many bowhead whales [after commercial whaling]. [Lypa Pitsiulak, PA] BB131

The fathers of Anon. 23 (BB362) and Jaco Evic (BB392) were whalers at *Qikiqtan*/Kekerten Island. They related to their sons that bowheads were very scarce during the last stage of whaling at the island (*see also* BB131).

Pond Inlet

One informant reported an annual occurrence of bowheads at the floe edges off Pond Inlet, Navy Board Inlet, and *Tallurutiit*/Lancaster Sound (BB163). Other informants (BB 164, 174, 177) have reported that bowhead whales occur in large numbers in the Pond Inlet area during summer.

…[at Nallua/Low Point, during late spring to summer 1996] my wife began to count the number of bowheads we saw… …there were groups of 4, 3 and in some cases only one was seen at one time. … the last count in all was

approximately 74 bowhead whales. They were something to look at… They were moving southward – though we did see a few of them moving northward. …Chances are that there were much more than what my wife counted as she did not include those that were traveling across the way [further offshore]. [Elijah Panipakoocho, PI/ws] BB164

Ham Kadloo's father, as a child during the last stage of whaling in the Pond Inlet area, observed that whales had become very scarce at that time: *"…My father used to say that the bowhead whales were almost gone, and then they starting coming back."* [Ham Kadloo, PI] BB167

Qikiqtarjuaq

Many informants from Qikiqtarjuaq reported that they see large numbers of bowheads in summer and fall within the community's resource-use area (BB206, 212, 217, 226, 228, 231, 234, 235). Large numbers are sighted at *Qivittuuq*/Kivitoo every year (BB198, 202, 209, 210, 211, 212, 219, 234), and at *Palligvik*/Padloping Island (BB211, 217). As a child many years ago, *"at the time the loud outboard motors were in use"*, Jaycopie Audlakiak (BB217, 219) observed, in the vicinity of *Palligvik*/Padloping Island, *"so many bowheads you could hardly see the water. So I thought maybe these bowhead whales were seen again last year [1994 – when there were lots of killer whales (and bowheads) in this area]"*. He also saw (BB219) many whales near *Qivittuuq*/Kivitoo when he was a child.

…some years ago, we passed by Qivittuuq/Kivitoo, [there was] the air stench of bowhead whales, and there were lots of young calves at that time – so that was one time that I saw so many bowhead whales. [Adamie Nookiguak, QK/ws] BB198

When we did the [aerial] survey there were over 70 bowhead whales in one spot at Ittillialuk… [It is] about the fall time around October that the bowhead whale starts to come from the north, that is the time they pass through [our area]. [Elaiya Qaqulluk, QK] BB206

…the ones that I observed towards Palligvik/Padloping Island, there were so many of them in a group… …there were quite a few groups at one time… [Gamailee Nookiguak, QK/ws] BB211

…this past summer (1995) there were much more bowhead whales than usual [at Qivittuuq/Kivitoo]. Over the years when I traveled to that region, I used to observe one or two bowhead whales at a time. [Gamailee Nookiguak, QK/ws] BB212 (*see also* BB218)

Hunters reported many more bowhead whales in Qikiqtarjuaq's waters in summer/fall of 1994 than in 1993 (BB217, 219). Initially, bowheads occurred in large numbers at the floe edge, and in summer/fall they were numerous in nearshore waters in many localities (e.g., Qikiqtarjuaq, *Qivittuuq*/Kivitoo, *Nuluit* and others). Killer whales came into Qikiqtarjuaq's waters also in the summer of 1994 (*see* section 3.1.5. i).

Some of the informants believe, on the basis of the large numbers of whales seen in the area in recent years, that the bowhead whale population has been increasing from the low number present at the end of commercial whaling (BB210, 226, 228, 235).

…[at the time peterhead boats began to be used] there were many, many bowhead whales, I do not feel that they are decreasing now, for I have seen many bowhead whales way after the whaling was banned… [Markosie Audlakiak, QK] BB228

vii) Abundance/population increase: second-hand information [7]

Many informants have heard from other community members that bowheads are very numerous nowadays, or that bowhead numbers have increased in recent years/decades.

FOXE BASIN

Informants from Igloolik and Hall Beach have heard from other hunters about the abundance of bowhead whales in northern Foxe Basin nowadays.

What happens is that bowhead whales start congregating around Siorarjuk area [Siorarsuk Peninsula] till the ice is gone on the left side of Igloolik, then they go into [Murray] Maxwell Bay [Tasiujaq]; thus, we hear that there are so many bowhead whales in that area. [Albert Nuvviaq, HB] FB3

…with that in mind [the reluctance nowadays of Inuit to go boating when bowheads are nearby] I suspect that there are much more bowhead whales now. [Rachel Uyarasuk, IG] FB43

HUDSON STRAIT

Informants from Cape Dorset (HS18, 21, 24), Iqaluit (HS47, 49), and Kimmirut (HS53) have heard about the large numbers of bowheads that seasonally visit their areas. All who commented on this matter suggested that the bowhead population is increasing.

There are more [bowheads] now than there used to be, hunters are seeing more than usual, but I really don't know as there are not usually that many around Cape Dorset and the immediate surroundings. [Timoon Toonoo, CD] HS24

…I have not seen too many [bowheads] for I rarely travel out now. …but I have heard that the bowhead population had increased [since I moved to Iqaluit]. [Lucassie Nutaraaluk, IQ] HS47

…the Inuit who are hunters are aware that there are more bowhead whales now. …they say that the bowhead whales are increasing and people continue to report sightings. …they [bowheads] usually are together [in groups] too like other animals. [Anon. 20, KM] HS53

HUDSON BAY

Informants from Coral Harbour (HB11), Chesterfield Inlet (HB27), Repulse Bay (HB37, 42, 45, 55, 59, 62, 63), and Whale Cove (HB82, 85) stated that hunters have recently sighted many bowheads in their respective community areas. As a result, many have concluded that bowhead numbers have increased since the end of commercial whaling (HB27, 37, 42, 45, 55, 59, 62, 82, 85).

They have spotted lots of them [at the floe edge off Coral Harbour], maybe about 14 but there were lots. …I am sure that there are some that have been observed but not reported. [Participant CH/ws] HB11

You can spot bowhead whales annually now [in the Chesterfield Inlet area, up to Qatittalik/Cape Fullerton]… Although they are not in great numbers, the frequency of spotting the bowhead whale is very regular in this area now. [this area is likely a migration area rather than for summering; perhaps the regular occurrence reflects population increase?] …during the spring when there is a floe edge in front of our community, you can spot bowhead whales there. [Murice Kukkiak, CI] HB27

We are now seeing more bowhead whales than we used to, as people when they are out hunting or camping, we always carry CB radios . Hunters in different locations are seeing much more than before. When we are hunting we are not looking for bowhead whales. [Participant, RB/ws] HB62

Some men now say they see more bowhead whales… People have not seen them for a long time but they say they see more today. [Guy Enuapik, WC] HB82

Although residing in Whale Cove, Jackie Napayok's (HB85) sightings of bowhead whales were mainly made off the southeast coast of *Salliit*/Southampton Island. He concluded: *"I think the bowhead whales have increased from the earlier days. …I have not seen too many bowhead whales around here [Whale Cove]"*

BAFFIN BAY

Informants from Arctic Bay (BB7, 29), Clyde River (BB43, 59, 67, 68), Pangnirtung (BB140), Pond Inlet (BB180, 181, 196), and Qikiqtarjuaq (BB209) have heard about the large numbers of bowheads encountered by local hunters in recent years. Many relate these observations to population increase (BB7, 29, 67, 68, 140, 180, 196).

…the men around here say the bowhead whales have been increasing. …When I came back to live over here [Arctic Bay] and did not go out to hunt myself, I have always heard from the people who hunted narwhal that the bowhead whales were always around, I have not gone down there personally. …Right now people say that there are more bowhead whales around, they come around here and stay here. [Philip Qamanirq, AB] BB29

…[our son] had reported that he had seen a lot of bowhead whales when he is traveling by boat. They relay information to us through short-wave radios that there are a lot of bowhead whales… [Elisapee Arreak, CR/ws] BB43

I have heard that there usually are many bowheads there [Igaliqtuuq/Isabella Bay] at one time [in August and September], so that is where they usually go… …I have heard that there used to be many bowheads there [Arviqtujuq/Eglinton Fiord]… [James Jaypoody, CR] BB59

…looking at the present day you see more bowhead whales in large numbers. …I haven't been in that area [Milurialik – at head of Isuittuq/Clearwater Fiord] for a long time but, from what I hear they [bowheads] are still frequenting that area. I think we could all say that compared to the time after the whalers left, the population of the bowhead whales has multiplied in great numbers. [Pauloosie Angmarlik, PA] BB140

The Whaling era was coming to a halt by 1910-1911. Personally I began to hear about more sightings of bowhead whales during the 1950s. …It was also presumed that the growth became noticeable from 1950s onward. This is also based on what our elders were saying back then. [refers to Kidlaapik of Clyde River, who noticed that the bowheads started to increase in the 1950s] [Kooneeloosie Nutarak, Sr., PI/ws] BB180

I've heard from people who took part in shrimp fishing in the waters of Greenland, that there are plenty of wildlife, such species as: bowhead whales, narwhals, beluga and other larger species, I hear there is lots of them in the open waters. [Gamailee Nookiguak, QK/ws] BB209

viii) Assumption of population increase due to cessation of whaling [8]

Many informants from all regions associated the large numbers of bowheads seen in recent times with the effective cessation of whaling at the end of the commercial whaling era. Although many informants appeared to be assuming that bowhead numbers must have increased because of the absence of whaling, many of these same informants provided substantial evidence of bowhead abundance and/or increase in population size (*see* previous sections).

…there are a lot of bowhead whales now compared to the past. It may be that no one was harvesting them for a long spell. As there are a lot of bowhead whales now in this part of the North. It seemed that they are establishing themselves in our seas. As they are not being harvested they are frequenting our seas in large numbers. [Rebecca Arnardjuaq, HB] FB14

The changes that I have noticed is that there seemed to be more bowheads since no one had harvested bowhead whales for such a long time. I don't think there has been any harvesting since the Whalers left. Today I've never heard of bowhead whales being harvested, consequently I feel that because there was no harvesting of bowhead whales for so long, that the population of bowhead whales must be increasing. [Eqaluk Nungutsuitok, CD] HS18

…now we hear and see that the population of bowhead whales is increasing, this may have a lot to do with Inuit not harvesting bowhead whales for a prolonged period of time. [Louis Oksokitok, RB] HB49

I could say that there are more bowhead whales than usual [in Qivittuuq/Kivitoo], and we all know that sea mammals when they are not being harvested tend to increase in numbers. It has been many years since the harvesting of bowhead whales was banned, even before I was born. …I am convinced [for this reason] that their populations have gone up drastically. [Gamailee Nookiguak, QK/ws] BB212

ix) Abundance/population increase: unsubstantiated statements [9]

A fair number of informants from all four regions of the Study Area believe that bowhead numbers have increased in recent times, but did not provide substantiating evidence in the immediate context of their remarks. However, many of the same informants, in other parts of their testimony, have provided more substantial evidence for population growth of bowheads (*see* previous sections).

Presently the population [of bowheads] has increased very drastically and there are a lot of people who have never tasted maktak… [Noah Piugattuk, IG] FB40

…there are a lot of bowhead whales today, it would be better to tell us that we are allowed to harvest a bowhead whale, instead of asking too many questions. [Ben Ell, IQ] HS31

I have noticed that there are more bowhead whales now. …As well, in Arviat, there are some bowhead whales. They see some once in a while. …It seems like they are increasing. [Rhoda Karetak, RI] HB78

…I don't know what year it might have been [when bowheads started to increase]. But I remember seeing lots of bowhead whales in this area in 1952. We were living in Mituksujuk. [Elisapee Arreak, CR/ws] BB44

It is very obvious that there are so many bowhead whales now. Also there are times that I have difficulty believing what researchers are saying, also that mostly they could make predictions based on their studies – but they could never be precise all the time. Perhaps it should be noted that what we are hearing here [of an increase in bowhead numbers] is exactly what we know it to be. [Solomonie Natanine, CR/ws] BB88

x) Decrease of population [10]

A few informants from the Hudson Bay and Baffin Bay regions provided evidence of a local or short-term decrease in bowhead numbers. Mark Nakoolak of Coral Harbour (HB1, 2) lived at *Nuvualuk*/Terror Point on the Bell Peninsula of Southampton Island in the 1960s. He recalls seeing small numbers of feeding bowheads mainly in June and July at *Nuvualuk*; the whales were migrating southward towards *Aningannaaq*/Leyson Point where he has also observed bowheads. However,

Based on my observation I seem to detect that they are less in numbers [now] at least at Nuvualuk/Terror Point – I seem to recall seeing much more than I do now. [Mark Nakoolak, CH] HB2

Koonoo Oyukuluk of Arctic Bay (BB18) noted a specific inter-annual reduction in bowhead numbers: *"I also noticed that there were fewer bowhead whales this year [1996] as opposed to last year [1995]."* A Pangnirtung informant (Anon. 26, BB377) stated that bowheads were numerous in 1946 (when a whale was harvested, *see* Mitchell and Reeves 1982); but after 1946, killer whales began to appear in *Tinnujivik*/Cumberland Sound and the bowhead population declined. Josephee Keenainak of Pangnirtung (BB129) also correlated a recent decline and/or dispersal of bowheads and other marine mammals in Cumberland Sound with the presence of killer whales [he seemed to be referring to the *Isuittuq*/Clearwater Fiord area]. He added:

My parents knew of the time of the Inuit [with the whalers] hunting the bowhead whales. During this time, there were lots of bowhead whales. After some time, the number of bowhead whales had declined. During the time of my parents, they were more plentiful. [Josephee Keenainak, PA] BB400

xi) Stability of bowhead numbers [11]

A small number of informants (Hudson Strait – 2, Hudson Bay – 2, Baffin Bay – 4) suggested that bowhead numbers have been stable over recent decades.

At least around this area – you do see bowhead whales on an on-going basis and it has been like that quite steadily. [Anon. 3, CD] HS2

Around here in the Kivalliq/Keewatin region, I do not think they [bowheads] have greatly increased in numbers, because it is not very frequent that people see one, down near Uqsuriaq/Marble Island. …[my uncle Ugjuk] used to say that if whaling ever came back to go there [Maluksitaq/Lyon Inlet] and hunt for one, for they said if and when the bowhead whales start to increase, you will be able to see more than one in a day over there. [Felix Pisuk, RI] HB76

…I have not noticed any change in the bowhead whales [in their numbers] but as a child I used to see many bowhead whales. …At one time I had seen many, many bowhead whales. I have never seen them that many before… [Jacobie Panipak, CR] BB57

…It is never really like there are a lot, or there are very few, there are always the same number [from year to year]. We see them around all the time, every year we see them over here. …although they are not in many numbers, we see them every summer, every year. [Simon Qamanirq, AB] BB30

xii) Population changes: no information [12]

Although they may see bowheads frequently, many informants from all four regions could not comment on changes in abundance of bowhead whales:

I'm not sure if they have increased because people as they go out in their boats have been afraid of the amount of bowhead whales that they see. …I'm not sure if they are increasing or if they are coming over to this area more. [Anon. 16, HB] FB8

I don't know if there is any changes among the bowhead whales, but I have seen a lot of bowhead whales and I could indicate on the map, but as to the changes of bowhead whales I cannot say. [Lucassie Ikkidluak, KM] HS60

…now the bowhead whale population seems to be increasing… …you can even spot them now around our caribou hunting area around the other side, I do not know if there have been any drastic changes… [James Jaypoody, CR] BB61

Some hunters (HB50; BB49, 64, 106, 234) deemed themselves unable to comment on population changes because they did not know what population numbers were in the past:

I do see bowhead whales every summer. I honestly can't see the change in bowhead whale population as I don't know what the population was in the past. [Luke Angotialuk, RB] HB50

Because bowheads are not hunted and hunters tend to focus their efforts on other species, some informants (FB9, HS10, BB198) are not cognizant of population changes (*see also* section 3.2.4. i):

We do not hunt them so we do not know [if the population has changed]. [Ben Arnaryoark, HB] FB9

The bowhead whale is not hunted so we do not seem to notice it as much. I can not say there are more bowhead whales or less bowhead whales. [Anon. 8, CD] HS10

Because some community areas (Cape Dorset – HS24, Kimmirut – HS52, 57, 61) are not host to many bowhead whales, some informants have no knowledge of population changes:

…I really don't know [about population changes] as there are not usually that many around Cape Dorset and the immediate surroundings. [Timoon Toonoo, CD] HS24

Non-hunters (HS51, 63; BB119, 184) may not have this kind of knowledge either:

I do not even pay attention to it [changes in bowhead population] for I am not a hunter myself. By hearsay from the renewable resources is that they are increasing in numbers… [Naki Ekho, IQ] HS51

The community of Grise Fiord was established in the 1950s. Although bowheads are often sighted near the community, hunters (BB93, 95) were not aware of bowhead population changes.

xiii) Abundance near other communities: second-hand information [13]

Several informants have heard through the local community radio station, portable CB radio, and/or other sources, that bowhead numbers have increased or that bowheads are now quite numerous, in other areas of Nunavut.

The abundance of bowheads near Igloolik in summer and fall is well known to many informants. Philip Kripanik (HB66, 70) and Semi Maliki (HB71), both of Repulse Bay, lived in the Igloolik area a long time ago, and they rarely saw bowheads there:

…Perhaps because they [bowheads] increased that is the reason why a lot of people see them now. Myself, I think the reason why they are over there [Igloolik] is because they are running away from the killer whales. I think the killer whales are many, and the bowhead whales are very afraid of them. [Philip Kripanik, RB] HB70

Two Arctic Bay informants expressed the opinion that the abundance of bowheads in Igloolik in recent years is due to emigration from Arctic Bay. Andrew Oyukuluk (BB3) and Atagootak Ipellie (BB5) believe that the emigration is related to excessive disturbance at the *Tununirusiup Kangiq&ua*/Admiralty Inlet floe edge by hunters shooting narwhals, and that many narwhals have similarly moved to the Igloolik area because of disturbance:

I think there were no bowhead whales in the Igloolik area [about 1951-57]. I recall that there is a camp called Kapuivik/Jens Munk Is. …And [the elders] were surprised to see a bowhead whale – which they mistook for a submarine… That shows that there were no bowhead whales in the Igloolik area [in the 1950s]… …as for the narwhals and bowhead whales, they are now plentiful in that region [having emigrated from the Arctic Bay region]… [Atagootak Ipellie, AB/ws] BB5

Ham Kadloo of Pond Inlet (BB167) suggested that bowheads have emigrated from Pond Inlet to the Igloolik area in pursuit of better feeding grounds, while Simon Akpaliapik (BB196) suggested a similar emigration but for a different reason:

… they [bowheads] most likely went towards Igloolik to get away [from Pond Inlet commercial whalers] …a long time ago. We hear of many bowhead whales and narwhals that are spotted over there [at Igloolik], they have so much more of them than here [Pond Inlet]. We know now that they [bowheads] have increased… [Simon Akpaliapik, PI] BB196

Clyde River and nearby *Igaliqtuuq*/Isabella Bay are well known for hosting large numbers of bowheads:

Today I hear that Northern/Central part of Baffin Island has a large population of bowhead whales – while there is less in the southern part of Baffin. …it is obvious that they are not declining, they are increasing in numbers… [Takealook Temela, KM] HS65

…the people of Clyde River had no more [bowheads] around there before, but there are a lot more of them now. …Any of this area here [Clyde River], I have heard that there are more now than when I was a child. [Kooneeloosie Nutarak, Sr., PI] BB181

Many informants referred more generally to the high frequency of sightings of bowheads throughout eastern and central Nunavut, which they attribute to population growth:

After the mining exploration [nickel mine at Rankin Inlet, 1957-62] started down there, it seems like the bowhead whales have been spotted more around the communities now. …After the mine was established, it seems like the bowhead whales have increased. …because people see them around all the time now…. [Simon Inuksaq, PB] BB157

To summarize, informants referred mainly to Clyde River, Igloolik, and Pangnirtung as places of significant bowhead abundance, with fewer mentioning Qikiqtarjuaq, Repulse Bay, and Coral Harbour. They generally attribute this abundance to growth of the bowhead population. The abundance of whales near Igloolik has also been attributed to killer whales (one informant), and emigration from Pond Inlet or Arctic Bay (four informants).

3.1.2 Distribution and Migration

i) General observations [14]

This section summarizes informants' observations and comments on the seasonal distribution and migration patterns and behaviour of bowhead whales in the Study Area. These observations are complementary to the maps of seasonal distribution and migrations (section 3.1.2.iv), which are composites of the mapped data contributed by all informants in the Study.

HUDSON STRAIT

The informants' observations and remarks give the impression that bowheads are not very numerous in the *Sullualuk*/Hudson Strait region (HS17, 19, 33, 54, 64, 65).

…we do see bowhead whales on occasion. [Eqaluk Nungutsuitok, CD] HS17

…every summer, I have seen some bowheads [in Frobisher Bay area] but they were not in large numbers, perhaps I have seen three bowheads in one summer sometimes… [Ben Ell, IQ] HS33

I have not seen the bowhead whale in many numbers around here…[Anon. 20, KM] HS54

On the other hand, one informant suggested that bowheads use the south coast of Baffin Island mostly for migration. This, and a possible offshore distribution of migrants, could explain the irregularity and/or scarcity of sightings:

For sure the area near Kimmirut is used mainly as a passage / migrating route [by bowheads]. …I know that they are not seen on a regular basis – instead they are seen more on occasion in this area, that is from what I hear and from what I have seen. Perhaps in the fall they are seen [more] in open waters compared to belugas and narwhals. [Sandy Akavak, KM] HS64

HUDSON BAY

Repulse Bay residents emphasized that bowhead whales frequent the following areas every summer: *Maluksitaq*/Lyon Inlet; *Kuugaarjuk*/Barrow River; Repulse Bay; *Aqiarunnak*/Duke of York Bay; and *Itirjuk*/Gore Bay. The floe edge of Repulse Bay is frequented by bowheads in July of every year. Philip Kripanik (HB253) reported that *Maluksitaq*/Lyon Inlet hosts more bowheads than the waters of Repulse Bay, at least it did during the 1930s and 1940s. In August, bowheads approach the land most closely (John Kaunak, HB48). Generally speaking, Repulse Bay informants sight bowheads in small numbers in summer, only one, two, or three at a time (e.g., HB65). Peter Katokra (HB65) speculated that bowheads come to the Repulse Bay area from Baffin Island or Greenland:

I remember back in I think it was in 1983, I was traveling from Hall Beach [to Repulse Bay along the coast] on a canoe at the beginning of August… During the whole time I saw bowhead whales every single day. The bowhead whales became more plentiful as I got further away from Hall Beach… So based on that I suspect that bowhead whales that frequent our waters do come from the waters of Baffin Island/Qikiqtaaluk and perhaps the waters between Greenland and Baffin Island. And when the fall time comes they travel back to the same areas where they spent the winter season. [Peter Katokra, RB] HB65

Mary Nangmalik of Whale Cove (HB86,87) grew up in the Repulse Bay area, where as a child she saw bowhead whales every year.

Chesterfield Inlet informants reported seeing bowheads in the following locations: the floe edges off Chesterfield Inlet (HB27) and *Qatiktalik*/Cape Fullerton (HB20); from Chesterfield Inlet all the way to Repulse Bay (HB24); and the Chesterfield Inlet area in general (HB25, 27). Murice Kukkiak (HB27) pointed out that bowheads occur regularly on migration along the coastline from Chesterfield Inlet to *Qatiktalik*.

The testimony suggests that bowheads are regularly sighted every year in the area but in small numbers (e.g., HB27).

Informants from Rankin Inlet and Whale Cove apparently do not sight many bowheads in their communities' hunting territories:

Right in the Hudson Bay there are not too many bowhead whales… [Jack Angoo, WC] HB83

Another Whale Cove informant, Mary Nangmalik (HB86), believes that the absence of bowheads in the Whale Cove area is due to an absence of their preferred food, copepods (*iglirait*).

Informants from Coral Harbour mentioned two nearshore areas where bowheads regularly occur in late summer and autumn: *Aqiarunnaq*/Duke of York Bay and the Bell Peninsula of southeastern Southampton Island (HB6). Several Rankin Inlet and Whale Cove informants also referred to the occurrence of bowheads in these same two areas (HB73, 79, 85). Many informants in the south Kivalliq region (Chesterfield Inlet and southwards) are originally from the Coral Harbour or Repulse Bay areas; these informants contributed much of the mapped data for the latter two regions (section 3.1.2.iv).

BAFFIN BAY

Arctic Bay

Bowheads occur at the *Tununirusiup Kangiq&ua*/Admiralty Inlet floe edge in June and July (BB11, 14, 28, 29). They may leave the floe edge for awhile but will return in July at the time of break-up, when substantial numbers will enter the inlet via the widening cracks and open areas (BB28; *see also* BB11,14,18). Summer (July to September) will find bowheads in Admiralty Inlet (BB14), often reaching the southern portion of the inlet (BB18). Bowheads are seen every year in the inlet (BB26); but no sightings are reported during winter (BB28). In summer, adults, family groups (including calves), and solitary juveniles are seen (BB14, 26).

…down there in what is referred to as Sinaasiurvik [NW corner of Elwin Inlet], I would see any age group [of bowheads]. But as we moved to Qaggitalik [mouth of Baillarge Bay], down there as well, I would see a family group. [Philip Qamanirq, AB] BB29

Koonoo Oyukuluk (BB15) reported that bowheads without calves are the first to arrive at the floe edge in June and July; at that time calves are not present, and bowheads generally occur as solitary animals or in pairs. (However, one informant (BB14) reported a juvenile/mother pair at the floe edge). Bowheads with calves arrive at the inlet in mid-summer. The month of October and freeze-up will find the whales leaving the inlet (BB3).

Clyde River

Clyde River informants provided a wealth of detail on the seasonal distribution, migrations, and activities of bowhead whales in the Clyde River marine-use area.

Bowheads are generally sighted in the following areas/locations in most years:

– the floe edge in June and July (BB38, 51, 67, 90)

– near the community of Clyde River in summer (BB31, 38, 58, 61, 65)

– the Clyde River region generally from August until freeze-up (BB31, 42, 58, 61, 64, 81, 83, 280)

– *Igaliqtuuq*/Isabella Bay during August and September (BB31, 34, 37, 38, 55, 58, 59, 61, 65, 66, 70, 73, 79, 85, 86, 287, 337)

– *Arvaaqtuq* from July on (BB34, 37, 58, 85)

– *Arviqtujuuq*/Eglinton Fiord from July on (BB34, 59, 60, 297)

– *Taaqtualuk*/Dexterity Island in the fall (BB46)

– *Pinguarjuit*/Cape Christian in late fall (BB55)

– Kogalu River in late summer/fall (BB55)

– *Piniraq* – near mouth of Inugsuin Fiord (BB58)

– *Natsiqsujuq* at the northeast corner of Scott Inlet (BB58, 70)

Bowheads can occur in many areas around Clyde River, but these areas are probably linked through bowheads' seasonal movements and migrations.

There are fewer observations on migrations in the area. Nauja Tassugat (BB70) reported that whales migrate northwards every summer to *Natsiqsujuq* (at the mouth of Scott Inlet) where they feed and cavort, after which they head south to *Igaliqtuuq*/Isabella Bay. En route to Isabella Bay from the north in late summer and fall, they are observed offshore from Clyde River (BB31, 34, 55, 58, 59, 61). Some informants reported that bowheads move around a lot in late summer/fall, heading north and/or south (BB61, 66). The whales leave Isabella Bay by the time of freeze-up in late fall (BB31, 73, 287), and return to their wintering areas (via Qikiqtarjuaq – BB85) as the weather becomes colder (BB63, 65). One informant suggested that bowheads winter in ice-free waters between Baffin Island and Greenland (BB65). Bowheads consistently return to Isabella Bay (BB73).

The behaviours and activities of bowheads in *Igaliqtuuq*/Isabella Bay include feeding (BB31, 59, 70, 73, 85); calving (BB31, 38, 85); mating/breeding (BB34, 38, 59, 73, 85, 86); and playing* in groups in

* Play, playing, etc. are subjective words describing observed bowhead behaviour. What is viewed as play (splashing, breaching, rolling, etc.) may in fact be highly functional behaviour (e.g., mating).

shallow water (BB31, 34, 38, 59, 73, 85, 86). Bowheads feed in the deeper parts of the bay (BB73). Anon. 14 (BB38) suggested that bowheads frequent Isabella Bay owing to an absence of killer whales there, and reported that bowheads may leave the bay but return a short time later. The number of bowheads visiting the bay varies from year to year (BB38, 59); Anon. 14 (BB38) stated that bowheads were numerous there in 1976-79. Bowheads prefer the sheltered, shallow parts of Isabella Bay (BB58, 65, 79, 287), especially when the water is rough (BB66). The following size classes of bowheads are present: large adults (BB31, 34, 66); weaned, solitary juveniles in the shallow waters (BB31, 34); and all size classes, with the larger whales forming groups (BB38). Although some informants believe that calving occurs there, calves are rarely sighted (BB34, 66).

At *Arviqtujuuq*/Eglinton Fiord, bowheads are involved in mating (BB34) and in playing and feeding (BB60), while they feed and play in the waters near *Natsiqsujuq* – mouth of Scott Inlet (BB70).

Several informants reported that, throughout the Clyde River marine-use area, bowheads are involved in one or more of a variety of activities: play, feeding, calving, and mating. These activities take place in nearshore, sheltered, shallow waters (BB64, 65). Two informants stated that bowheads also moult and grow a new skin (maktak) during the summer (BB48, 63).

We had an occasion to tag a bowhead whale near Qikiqtarjuaq and from that we learned they stay in one place for a day or two and then move on. Their migration is similar to the beluga and narwhals. [Ashevak Palituq, CR/ws] BB42

…the habitat areas are Arviqtujuuq [Eglinton Fiord], and they say that many bowheads could be found there at one time… …even the big rock there is called "unajaagaluk" because the bowhead would circle around the rock, perhaps playing or feeding… [James Jaypoody, CR] BB60

…we used to live in Nuvuttiapik/Cape Raper and a lot of them [bowheads] would get together [Igaliqtuuq/Isabella Bay]. They looked very good. It is a wonderful sight. Sometimes there are lots of them together. I have never thought of counting them at the time I had seen them all together. [Joannasie Apak, CR] BB65

…especially in the area of Taliruujaq [Aulitiving Is. in Igaliqtuuq/Isabella Bay] where they usually go to, they would play there in large numbers and they would stay in that area in the summer time. …they [bowheads] keep coming back there [to Igaliqtuuq]… …They come to feed, mate and breed at the park [Igaliqtuuq] and they really enjoy themselves, they go there to have leisure time. …they play around the shallower waters right here. They stay around here [Igaliqtuuq] going back and forth during the whole summer, and they feed… …where it is really deep… [Nauja Tassugat, CR] BB73

…the bowheads play a lot any where in the summer time, I have been mesmerized by them, they would slap their fins and flippers on the water and they make very loud noises, I think that they were actually applauding… [Pauloosie Arnakak, CR] BB83

…the bowhead whales usually are around the mouth of Igaliqtuuq/Isabella Bay and the area around Taliruujaq/Aulitiving Is. and Nuvuttiapik/Cape Raper… …They are usually here around August and then stay until fall. …we put some radio-tags on some of the bowhead whales and we've been tracking them down and they have gone down as far as Qikiqtarjuaq [in the fall]. …And you can see the bowhead whales playing. They come over here for their holidays, like we do as human beings. …As a child I had been brought up around Igaliqtuuq/Isabella Bay and I saw a lot of bowhead whales then. And there are lots of bowhead whales [at Igaliqtuuq]. …They play and you can hear their fins flapping [louder than a rifle-shot] on the water and it's a nice sound to listen to… …And sometimes you see them go up in mid-air. [Solomonie Natanine, CR] BB85

…sometimes they [bowheads] would chase one another but always in separate groups. …in the area where we did our study [Igaliqtuuq/Isabella Bay], I had an occasion to observe this particular whale, where it would rush out of the water and literally get up into the air, and then it would begin to slap its front flipper on the water [and] the other whales began to show up. …Based on my knowledge they seem to begin to group up closer to the fall (Ukiassaaq). For example, it may be that they are mating earlier in the fall -you notice their large penises in the early fall when they begin to group. …In Igaliqtuuq you see them in groups of one, two or three. Even when they are moving, you could see them in large numbers [groups] just like the belugas/narwhals. [Solomonie Natanine, CR/ws] BB86

Grise Fiord

I do not know the migration route [of bowheads] but the people of Greenland have said before that they have seen the bowhead whale along the floe edge. The Greenland hunters are usually around the floe edge in the spring time. [presumably the floe edge off Qanaaq, NW Greenland – so some bowheads could winter in the High Arctic/North Water Polynya] [Anon. 15, GF] BB94

Pangnirtung

Bowheads are rarely seen during winter at the floe edge (BB102, 105, 120, 126, 128, 130), but one adult has been seen in February (BB120).

Bowheads enter the upper part of *Tinnujivik*/Cumberland Sound in the spring. They aggregate in large numbers at the floe edge in May and June, and they may stay around the general area for some time (BB102, 105, 108, 116, 120, 126, 128, 130). People see them the most at the floe edge off *Qikiqtan*/Kekerten Island (BB117, 118). Bowheads may be seen as early as March – April when the floe edge is farther offshore (BB117, 120, 126). They have also been seen at the floe edges off

Millijjuat/Wareham Island (BB117) and off *Mitligaajuit*/Miliakdjuin Island (BB134).

After ice break-up, the bowheads which had aggregated at the floe edge disperse in smaller groups in the Sound, so that they are not seen as often as during the spring (BB102, 105, 108, 116, 117, 120, 126, 134). One informant explained the rarity of summer sightings in terms that hunters don't go boating much to the area where the floe edge used to be (BB117). However, informants did provide indications of where bowheads are seen in the open-water summer season: anywhere in the *Tinnujivik*/Cumberland Sound (BB116, 397); in the 'beluga hunting areas' (BB117); in the offshore, deeper regions of the Sound (BB126); in Pangnirtung Fiord (BB105, 116, 122); at *Nuvuja* – an island off Ikpit Bay (BB108); offshore from Pangnirtung Fiord (BB120) and at *Qikiqtan*/Kekerten (BB118); and in *Isuittuq*/Clearwater Fiord (BB105, 138, 401). At *Isuittuq* bowheads occurred in larger numbers in 1946 (BB401) than they do nowadays (BB105). They are present in *Milurialik*, a small bay near the head of *Isuittuq*, in the company of belugas (BB138):

…I know that they [bowheads] like to frolic/play around Milurialik [at head of Clearwater Fiord]. I had personally observed bowhead whales playing and leaping out of the water like fish, and there was this whale that was slapping his fins on the surface of the water and you could hear the echo of the slap around the mountains… [Pauloosie Angmarlik, PA] BB139

The frequency of bowhead sightings decreases greatly in the fall (BB117, 120, 126, 134). Most informants who commented on this believe that whales are leaving the fiords and bays and heading out to open water in the Sound (BB117, 122, 126). This reduction in number of whales sighted was attributed by one informant to boating being restricted to the shoreline while the whales are in the deeper, offshore waters (BB117). However, Anon. 22 (BB108) reported seeing bowheads at Kipisa in the fall.

General migration patterns were described by Inuit informants. After reaching the floe edge in May (BB102, 108), some bowheads migrate to inner bays and fiords during and after ice break-up (BB116). They leave the bays and fiords in fall before or at the time of freeze-up (BB102, 116, 134, 136), often at the same time as belugas and narwhals (BB119, 130). Apak Qaqqasiq (BB122) provided a wider perspective on bowhead migrations:

…Once the ice break up occurs… …you could see them at the mouth of the Pangnirtung Fiord nowadays. … I think in the early fall they are migrating back, and you do see them in these waters. I think they spend the summer in the northern part [to the north] of Pangnirtung [in eastern or northern Baffin Island]. …In the spring they are moving northward [along the east coast of Baffin], exactly where I don't know, and in the fall they are migrating back [south]. In our observations during the survey [at Igaliqtuuq/Isabella Bay] we noticed that when they are migrating back [in fall] there are usually smaller bowhead whales with them. We suspect these are calves and for sure there is a calving area somewhere up North. [Apak Qaqqasiq, PA] BB122

Springtime bowhead activities include mating (BB102, 108, 120), feeding (BB108, 120), playing (BB108) and calving (BB120). At the spring floe edge, informants reported seeing immature (BB102, 117) as well as large mature bowheads (BB102, 116, 117), or all sizes (BB120). Large mature whales are also seen in summertime (BB116, 117), although one informant (BB120) stated that smaller whales are common in summertime and that different-sized whales form up into groups. In summer, bowheads feed (BB120) and play (BB111), but mating is not likely to occur because bowheads are more dispersed than during the spring (BB108). Fall sightings are mostly of large bowheads in groups (BB120, 136). Jaco Evic (BB127) reported that large, stationary aggregations of bowheads tend to be engaged in play and do not seem to be feeding.

Kugaaruk

[I grew up in Repulse Bay area] …for sure the bowheads are closer to land in summer time… …when it freezes in winter time there are no sightings of bowheads, in the Repulse Bay area; when the ice is gone, there are usually sightings, perhaps they [bowheads] are searching for food. …my mother used to see whales in summer time, the hunters used to wait for them to go near the land. …they only used to hunt whales in summer time, perhaps you could see them in springtime at the floe edge; around Repulse Bay the weather warms up faster than in the Kugaaruk area. [Guy Kakkianiun, PB] BB148

…[according to my mother] as the bowhead whale is spotted, they have often been mistaken for a small island or a rock in the water… [Martha Kutiutikku, PB] BB154

Pond Inlet

During June-July, some bowheads migrate towards the west along the north coast of Bylot Island (BB188, 194), heading to the floe edge of Navy Board Inlet and *Nallua*/Low Point (BB178). Bowhead whales occur at the Pond Inlet floe edge near *Sanirut*/Button Point from May to July (BB178, 179, 194). In late July as the sea ice breaks up, they enter the inlets, bays and fiords, where they feed (BB179, 189). During the summer open-water season, bowheads occur at *Qaurnak* in western Eclipse Sound (BB167), in Milne Inlet (BB190), and in the Pond Inlet area generally (BB178). The majority of whales leave the fiords in September before freeze-up (BB176, 189); however, there is a smaller out-migration in October as the sea ice is starting to form (BB176). There are no winter sightings of bowheads in the area (BB178). Bowheads will vary in numbers and location from year to year (BB159, 167, 178).

John Tongak (BB178) reported that the bowheads he has seen in the Pond Inlet area are mother/calf pairs and large adults.

One informant elaborated on the relationship between bowhead migrations and the hatching of snow buntings:

…[an Inuk whaler who raised me] told [me that]… …there was a certain season that bowhead whales started to penetrate deeper into the inlets to start feeding. This would be late into July when the ice is breaking up. …The snow buntings had a part to play in the timing of bowhead whales going into the fiords to feed. [when the chicks hatch, then bowheads will be entering the fiords to feed (in late July)]. …[then] the hunters used to go whale hunting further into the land. [Kooneeloosie Nutarak, Sr., PI/ws] BB179

Qikiqtarjuaq

Few informants mentioned sightings of bowheads during springtime. Bowheads may be seen at *Qivittuuq*/Kivitoo in late spring (BB202). Pauloosie Kooneeliusie (BB232) reported seeing bowheads occasionally at the floe edge of Qikiqtarjuaq.

In summer and early fall (August/September), bowhead whales annually frequent the nearshore waters of *Qivittuuq*/Kivitoo in considerable numbers (BB199, 201, 202, 206, 209, 210, 219, 221, 229, 234). They remain in the shallow waters around Kivitoo for an extended period of time before leaving the area to head south. Another summering area is Home Bay to the north of Kivitoo (BB209). Leah Newkingak (BB509) reported that bowheads never used to occur at *Palligvik*/Padloping Island; they now seem to occur in the area (Map 4, section 3.1.2.iv). In the shallow waters around Qikiqtarjuaq (Island), bowheads are not often observed in summer (BB199, 202). However, other informants indicated that bowheads may be seen frequently around the island during the summer (BB219, 229, 232). Several informants (BB224, 225, 229, 231, 232) referred to an apparent summertime abundance of bowheads in the Qikiqtarjuaq region generally, especially in the shallow waters. In fall (September/October) bowheads frequent *Qivittuuq*/Kivitoo (BB206) and are numerous around Qikiqtarjuaq (BB228).

Once on our way back home from caribou hunting, we went to the other side of Qivittuuq/Kivitoo… …All that ocean area had a lot of white caps from the bowhead whales swimming through there, there were many bowhead whales up there. They stay in very shallow waters… …I personally have seen bowhead whales around near Qivittuuq, every summer nearer to autumn, and every late spring…[Adamie Nookiguak, QK] BB202

When we are out caribou hunting around Qivittuuq/Kivitoo, we usually see the bowhead whales [every summer]… …I have not seen them in other places as much. …I usually see them right around our community [Qikiqtarjuaq] as well as farther away from our community. We always see the bowhead whales around… …during the summer time [August and September]. …They probably just stay around the floe edge [before ice break-up]. [Mary Alookie, QK] BB229

Koalie Kooneeliusie (BB221) has seen very few bowheads north of *Qivituuq*/Kivitoo, and therefore believes that whales remain at Kivitoo for the duration of the summer. Whales arrive at Qikiqtarjuaq in October from the north (BB206). Gamailee Nookiguak (BB209) stated that southbound fall migrants occur in large numbers on the north side of Qikiqtarjuaq in September. Other informants reported that bowheads leave the Qikiqtarjuaq area in fall (BB219, 231) or in September/October (BB224).

Bowheads usually occur in small groups of one, two, or three animals (BB203, 219) but play activity is associated with larger gatherings of whales (BB203). Play activity is common among the large groupings at *Qivittuuq* in August (BB234). Only one informant (BB221) suggested that mating may be occurring among large groups of mature whales which are swimming and writhing over each other (he observed such an instance in 1995). Feeding and play activity occur in large, relatively stationary groupings of bowheads during August in the Qikiqtarjuaq area (BB224, 232).

ii) Stock identity/site fidelity [15]

A small number of informants from Hudson Bay and Baffin Bay stated that bowheads return to the same locations every year for feeding and other activities (BB14, 121, 126, 204, 216, 234). A few informants (HB39, BB38, 73, 74, 137, 219) explicitly indicated that the same whales are involved (site fidelity). Some informants (BB120) speculated that the bowheads seen in spring at the floe edge are also seen later on (in summer) along with smaller whales. Informants did not present observations or speculations on stock identity/discreteness.

…some [bowheads] you can recognize because they have been seen every year for many years, they keep coming back to the same area [Igaliqtuuq/Isabella Bay] every summer. Some Inuit have even seen the same bowhead for many years… [Anon. 14, CR] BB38

…[yearling bowheads] would just follow their mothers to the place where they always went again and again, although they were no longer suckling… [Nauja Tassugat, CR] BB74

…If it were the same stock that I have seen during the spring time earlier [at the floe edge], I have seen them again during the summer time with smaller bowhead whales. [Anon. 27, PA] BB120

…bowheads seem to frequent certain and specific places where they feed. [Jacobie Koksiak, QK/ws] BB216

There's also one bowhead whale that is usually around Ikirasak [on Qikiqtarjuaq]. People continue to see this one bowhead whale. We know it is the same one. [Jaycopie Audlakiak, QK] BB219

iii) Changes in distribution and migration patterns[16]

Inuit informants from all regions reported the occurrence of bowheads in areas where they were not seen before, and this was often related to or attributed to an increase in the population.

FOXE BASIN

Anon. 16 of Hall Beach (FB8) is uncertain if bowhead whales are *"…increasing or if they are coming over to this area more."* Simon Iyyiriaq (FB46) implied that the occurrence of bowheads at the Igloolik floe edge is a recent phenomenon.

HUDSON STRAIT

…For sure in the past bowhead whales were sighted, but as time passes we now see bowhead whales in areas that we have never seen them before. [Anon. 5, CD] HS5

Nujaliaq Qimirpiq of Kimmirut (HS62) related these 'new' occurrences to population increase, although he admits that *"…I could say that they travel on different routes [from one year to the next], perhaps some may travel always on the same route…"*.

HUDSON BAY

Coral Harbour informants have reported a relatively recent occurrence of bowheads at the floe edge (HB10, HB14) and some other locations. Some have attributed this to population growth of bowhead whales (HB10). One informant (HB14) added this caveat:

The community structure is such that we no longer live in Outpost Camps, thus we don't get around as much. …we really haven't been observing bowhead whales, where they are now going that they never used to go – this lack of knowledge is due to that we haven't been allowed to harvest for a long time. [Tooma Netser, CH/ws] HB14

Murice Kukkiak of Chesterfield Inlet (HB27) believes that the relatively recent, regular annual occurrence of small numbers of migrating bowheads in the Chesterfield Inlet to *Qatiktalik*/Cape Fullerton area may also reflect a population increase.

Repulse Bay residents have also noted changes in bowhead distribution. One informant (HB63) reported the recent occurrence of large numbers of bowheads at the *Kuugaluk*/Barrow River area.

I also think that in the olden days bowhead whales were never very close to the land but now you can see them very close to the land. [Octave Sivanertok, RB] HB51

And bowhead distribution may be strongly influenced in the short term by the presence of killer whales:

….before there was a community [prior to about 1965] I hear that there were lots of killer whales in the [Repulse] Bay. Narwhals and seals used to gather in the shallow waters near the land… Possibly since then the bowhead whales left Repulse Bay area. …I suspect that whales temporarily avoided Repulse Bay but after that they started to come back. [Participant, RB/ws] HB61

BAFFIN BAY

One Arctic Bay informant linked the appearance of bowheads in the Arctic Bay area with population increase and/or immigration of bowheads:

They seem more numerous, perhaps it is because they are traveling more [to our area]. …maybe because they have increased in numbers, it seems that they are traveling over here [more]… [Olayuk Naqitarvik, AB] BB26

Philip Oingonn (BB27) reported the occurrence of bowheads in the last couple of years in one particular area in the Arctic Bay region, but according to another informant:

…[I haven't seen bowheads in any new places], the bowhead whales were always around. [Simon Qamanirq, AB] BB30

Near Clyde River, changes in bowhead distribution have occurred in conjunction with an increase in population number:

…now the bowhead whale population seems to be increasing, and we tend to see them more often on the ocean, you can even spot them now around our caribou hunting area around the other side… [James Jaypoody, CR] BB61

I have noticed bowheads in places where there never used to be bowhead whales… I am basically saying that there are more bowhead whales now… [Solomonie Natanine, CR/ws] BB87

Joannasie Apak (BB64) stated that he has not been to *Igaliqtuuq*/Isabella Bay *"…since the bowhead whales started going over there. I can not say there has been much change in the way they travel to this location."*

In the Pangnirtung area also, bowheads are now seen in locations where in earlier years none had been sighted (BB116, 121, 123, 124, 133, 137). These changes are often related to population increase (BB116, 124, 137).

…nowadays there are many bowhead whales right in front of the mouth of the bay [Pangnirtung Fiord], which never used to be the case back then. That's why we know that the bowhead whale population has been increasing in numbers… [Anon. 24, PA] BB116

…I have noticed the whales being around Mitligaajuit/Miliakdjuin Is. I have also gone to another location with other hunters, and we have noticed that the bowhead whales have been around this area where they normally were not seen before. [Manasee Maniapik, PA] BB133

Mosesee Qiyuakjuk (BB137), who intermittently lives at an outpost camp (*Qaniraluk*) in *Tinnujivik*/Cumberland Sound, noted that bowheads are seen more around the communities nowadays, and not so much in areas that were favoured by whales in the past. He thinks that there has been a population increase among bowheads in the Pangnirtung region.

Kugaaruk residents sighted bowheads during the early 1990s in their hunting area, previous to which bowheads were apparently not seen in the area (BB146, 147, 150, 151). All sightings from 1992-94 have been in the same general area (BB146), and one informant seemed to infer that increased hunter mobility may be involved:

I think we all know that there always have been some bowhead whales around here. In the earlier days we did not use our outboard motors but today we have outboard motors and we tend to travel further. [Charlie Niptayok, PB] BB146

Two Pond Inlet informants (BB159, 175) reported more bowheads being sighted in certain areas in recent years, while two others (BB178, 181) have not noticed changes in distribution.

…I do believe it [noticeable population increase] could have been in 1992. [saw a great increase in the Saviit area, Milne Inlet] [Joanasie Arreak, PI/ws] BB175

With respect to the Qikiqtarjuaq area, Jacobie Koksiak (BB213) raised the possibility that the increase in sightings in recent years could be due to either population increase or a change in distribution (immigration):

…are they once again increasing in population [in the Qikiqtarjuaq area], or did they wait until their food had become abundant again? [Jacobie Koksiak, QK/ws] BB213

iv) Seasonal distribution and migration

Inuit traditionally related their observations of wildlife and other natural and human phenomena to the Inuit calendar, consisting of six (or sometimes more) seasons. Each of the Inuit seasons can be recognized as a suite of specific and observable environmental conditions, which an Inuk observer integrates into his/her recognition of a particular season. In this Study, the six Inuit seasons were utilized to provide an annual time framework for the observations and knowledge of informants with respect to seasonal occurrence, concentrations, and migrations of bowhead whales in the marine waters of Nunavut. The Inuit seasons are defined and described according to local/regional environmental and climatic conditions. This is shown in Appendix III using the High Arctic (including Grise Fiord, Arctic Bay, Hall Beach, and Igloolik) as the example. Also given in Appendix III are the calendar months corresponding to the Inuit seasons for the High Arctic, after Stewart *et al*. (1995).

Interpretation of a given seasonal map covering the entire Study Area (*see* Maps 1 – 6) is complicated by differences in timing of the Inuit seasons among localities and/or regions, such differences depending upon latitude, climate, oceanographic conditions, influences of topographic features, and other factors. Therefore, the map for a particular season may not provide a simultaneous picture of all observations throughout the Study Area. This complicates comparison of distribution and migration of bowheads both within and (possibly to a lesser extent) between seasonal maps.

In addition, the timing of an Inuit season (in a particular locality/region) may vary naturally from year to year, sometimes by up to one month. Nonetheless, an Inuit season in a given locality/region may be assigned to certain months of the calendar year, considering these as an average for that season.

It is clear that hunters relate their observations and activities to the Inuit calendar, and that traditionally this has had cognitive importance as well as great survival and predictive value. Inuit seasonal maps provide much additional information that the calendar months can not give, such as the local/regional environmental conditions which determine the behaviour of wildlife and the activities of humans. The use of Inuit seasons in this Study was deemed necessary because it provided a familiar time framework within which Inuit observe, classify, and record the natural phenomena around them.

We prepared maps showing the distribution and migration routes of bowhead whales, using the information contributed by all informants in the Study, including information from interviews that have not been translated, and as corrected or modified by participants at the eight workshops. Six maps were prepared, one for each Inuit season. The transcribed observations of informants regarding bowhead distribution and migration are given in section 3.1.2.i, which can be read in conjunction with the maps. These maps, included with this report, are as follows:

Map 1: Distribution and migration routes of bowheads during *UKIUQ* (winter).

Map 2: Distribution and migration routes of bowheads during *UPIRNGASSAAQ* (early spring).

Map 3: Distribution and migration routes of bowheads during *UPIRNGAAQ* (spring).

Map 4: Distribution and migration routes of bowheads during *AUJAQ* (summer).

Map 5: Distribution and migration routes of bowheads during *UKIASSAAQ* (early fall).

Map 6: Distribution and migration routes of bowheads during *UKIAQ* (fall).

***Ukiuq* (winter; Map 1):** A few informants reported sighting bowheads at the floe edges off Igloolik, Repulse Bay, Cape Dorset, Kimmirut, Pangnirtung, and southwestern Southampton Island in winter. However, the testimony indicates that few bowheads likely winter in the nearshore waters of Nunavut.

***Upirngassaaq* (early spring; Map 2):** Bowheads can be found near many communities, migrating through *Sullualuk*/Hudson Strait into Foxe Basin, into *Tinnujivik*/Cumberland Sound, and northward along the east coast of Baffin Island. Bowheads also occur at the floe edges off *Tununirusiup Kangiq&ua*/Admiralty Inlet and Pond Inlet in this season, as well as migrating northward through Baffin Bay in early spring. Bowheads are reported to occur northeast of Coats Island, off southwestern Southampton Island, and off the floe edges of Chesterfield Inlet, Rankin Inlet, Repulse Bay, *Maluksitaq*/Lyon Inlet, and Igloolik/Hall Beach. Most of the early spring sightings of bowheads are at the floe edge or in offshore waters. *Upirngassaaq* is clearly a season of initial bowhead migration northwards and into nearshore waters.

***Upirngaaq* (spring; Map 3):** *Upirngaaq* presents a picture similar to that of *Upirngassaaq* (Map 2), showing much the same migration routes but a deeper shoreward penetration of whales in *Tinnujivik*/Cumberland Sound and near the communities in northern Foxe Basin and northern Hudson Bay. In the High Arctic, bowheads are still on migration at this time; some informants indicated that whales occur at the floe edges, while others indicated that some whales reach deep into the bays, fiords, and sounds of northern Baffin Island at this time. Between Cumberland Sound and Pond Inlet (mostly in offshore waters of Home Bay to the north of Qikiqtarjuaq), bowheads are migrating northwards. There is also movement of bowheads through *Tallurutiit*/Lancaster Sound and into Prince Regent Inlet and the Gulf of Boothia, via which bowheads sometimes reach Kugaaruk. The overall picture is an intensification of bowhead migrations northward and into nearshore waters, and the occurrence of bowheads off the floe edges of most communities.

***Aujaq* (summer; Map 4):** Bowheads have many different summering areas, with whales being widely but patchily distributed in inshore waters. Informants indicated that some whales are still migrating to their summering areas at this time. The patchy distribution of bowheads is to some extent a reflection of observer effort, as most sightings and reported concentrations are within the marine-use zones of the communities. Observer effort may also be a factor in the distribution of sightings for other seasons. In Foxe Basin, northern Hudson Bay, and northeast Baffin Island some whales are beginning their southward/offshore migrations. In the High Arctic, *Aujaq* presents a picture similar to that of *Upirngaaq*, with indications that whales are concentrating in the inshore waters and fiords of North Baffin Island. As in *Upirngaaq*, there is some migration of whales through Prince Regent Inlet and the Gulf of Boothia in *Aujaq*. Bowhead whales also occur near Kugaaruk during this season. Also in summer, bowheads occur along the west coast of Hudson Bay from Arviat, through Roes Welcome Sound, to the Repulse Bay area. There are also sightings in the Coral Harbour area and the Bell Peninsula of southeastern Southampton Island. Informants presented a variable and complex picture of bowhead migrations in western and northwestern Hudson Bay and around Southampton Island.

***Ukiassaaq* (early fall; Map 5):** Bowheads are still distributed in nearshore waters but the southward/offshore migrations have clearly commenced. Bowheads are still present in inshore waters of the High Arctic, and some occur in *Tallurutiit*/Lancaster Sound and near the community of Grise Fiord. At this time of year in the High Arctic, bowhead whales are moving to the outer parts of their inshore summering habitat and commencing their southward/offshore migrations. There is a migration of bowheads south along the east coast of Baffin Island, where bowheads are seen in some scattered localities in this season. They are also reported to leave *Tinnujivik*/Cumberland Sound at this time. Bowheads are reported in the nearshore waters of Repulse Bay and Igloolik/Hall Beach in early fall, but are also indicated to be heading south from these areas towards northeastern Hudson Bay and *Sullualuk*/Hudson Strait.

***Ukiaq* (fall; Map 6):** Bowhead whales occur in only a few scattered locations at this time, as the southward/offshore migration continues. Few whales are seen in inshore waters of the Study Area in this season. Only the communities of Igloolik, Kimmirut, and Qikiqtarjuaq seem to have any bowheads in their vicinity at this time.

At any given season except winter (*Ukiuq*), some bowheads are migrating to or from, while others are appearing and concentrating in, nearshore areas. For example, in spring (*Upirngaaq*) bowheads are concentrating near Igloolik and Hall Beach and at the same time bowheads are migrating through Foxe Basin towards those two communities (Map 3). A similar pattern is evident for northern Hudson Strait/*Sullualuk* and northern and eastern Baffin Island at this time of the year. A number of explanations may be offered: 1) bowhead migrations may be extremely protracted, with whales traveling in small, well-separated groups; 2) different informants may have different interpretations of bowhead behaviour for the same season, and/or 3) different informants may assign a slightly different period of the calendar year to a particular Inuit season.

Aujaq (summer) is the season of maximum extent of open water and the time when bowheads are most widely distributed in the bays, fiords, inlets, and coastal waters of eastern Nunavut (Map 4). The pattern of bowhead distribution and migration in *Upirngaaq* (spring) is similar to that during *Aujaq*, except that in *Upirngaaq* (Map 3) the inshore distribution of whales is not as prevalent and widespread as during *Aujaq*.

Upirngaaq is the time of sea ice melt and break-up, with widening cracks and enlarging holes; thus whales could penetrate into the bays, sounds, and fiords during this season. This would produce a distribution pattern similar to that of *Aujaq* (Map 4).

3.1.3 Recent Changes in Group Size [17]

One informant from the Hudson Bay region (Repulse Bay) and six informants in the Baffin Bay region (Arctic Bay, Clyde River, Pangnirtung, and Pond Inlet) reported an increase in group size of bowheads in recent years. Most informants related this change to a concurrent increase in population size (BB41, 67, 118, 128, 162).



Aerial view of bowheads (notice small calf at left). Photo by Andries Blouw, Department of Fisheries and Oceans

From what I hear they seem to be traveling in groups more now. [Anon. 30, RB] HB33

When I was young I would see only one and not very often. Today they are in groups, together. [Philip Oingonn, AB] BB27

I have never seen bowhead whales [before] in large groups, right now at the present time we can see large groups of bowhead whales anywhere… [Nauja Tassugat, CR] BB75

…Currently the bowhead whale population has increased for sure. For we can see them around more frequently, some in large groups, and when I was a child, we never used to see bowhead whales in groups. [Anon. 25, PA] BB118

…I could say for sure that there are much more bowhead whales now than there used to be when we were children. Where today you now could see a single whale, 2, 3 or 4 whales in one group. While in the olden days we used to only observe single bowhead whales and never more than one… [Elijah Panipakoocho, PI/ws] BB162

* In Inuktitut, a small calf accompanied by its mother is referred to as *arvaaq; ingutuq* is a larger, one- to two-year old bowhead which may be solitary or still accompanying its mother. See section 3.1.5.vi for definitions of bowhead age/size categories.

3.1.4 Occurrence of Bowhead Calves*

i) Observations of calves and juveniles [18]

FOXE BASIN

Bowheads seen in summer north of Igloolik in northern Foxe Basin are mostly juveniles and females with newborn calves, suggesting that this area is a bowhead nursery area (Cosens and Blouw 1999). Observations of informants from Igloolik provide support for this conclusion.

… they seem to be having more calves, as you seldom see bowheads by themselves, they always seem to be with their young. [sees many female/calf groups in Igloolik area] [David Irngaut, IG/ws] FB24

David Irngaut (FB25) witnessed a female bowhead giving birth in the Igloolik area at *Siorat* (near west side of Murray Maxwell Bay) and believes that the area could be a bowhead calving area.

I don't recall ever seeing a bowhead whale with its arvaaq/calf [when he was young]. But now I am hearing that bowhead whales are being seen with arvaaq. [George Kappianaq, IG/ws] FB34

Noah Piugattuk (FB99) provided details about a mother/calf pair seen at *Kapuivik*/Jens Munk Island, in the 1960s: *"Even after it (calf) had grown it still remained with its mother and they feed on small crustaceans and it remained with its mother until it had learned to harvest, then he would gradually leave its mother."*

HUDSON STRAIT

Two Iqaluit informants commented on calves:

That [changes in calf population] is totally unknown to me today… …the Inuit are not studying the bowhead today, even the elders are not paying attention to them… [Ben Ell, IQ] HS35

[Last summer(1994)] I kind of thought that I had seen a bowhead with a calf for one was much smaller than the other one, the other was very huge… …they were pretty close… [Josie Papatsie, IQ] HS42

Josie (HS42) is uncertain about this observation, as Frobisher Bay is an area "…*where bowheads hardly go*". Atsiaq Alasuaq of Cape Dorset reported that in spring of 1994, he saw five calves in the *Taliiruat* Islands.

HUDSON BAY

There are no informant reports of calves from Chesterfield Inlet as usually only solitary adults are seen (HB 25). Tooma Saumik of Rankin Inlet (HB81) has seen what to him were mother/calf pairs, but he did not mention the location. Calves may occur around the southeastern Southampton Island area:

Some of them are a mother and a calf team [among the bowheads he saw at Nuvualuk/Terror Point, SE Southampton Is. many years ago]. [Jackie Napayok, WC] HB85

There are very few reports of calves south of the Repulse Bay area. Several informants (HB38, 52, 54, 57, 58, 198) reported a number of sightings (by their own observation or oral transmission) of bowhead calves in Repulse Bay and the surrounding area.

I also had seen calves in the past – in those days we only used to use sails for boating. At one time we spotted a calf and we the younger people wanted to harvest it but our elders told us that we shouldn't harvest young bowhead whales. The story is that if the calf is harvested the mother would keep coming back to the spot where her calf was killed, year after year. Personally I had seen only one whale with a calf. I suspect that they raise their young in the waters of Repulse Bay. [David Tuktudjuk, RB/ws] HB38

One mother/calf pair has been observed at the floe edge off Repulse Bay (HB54).

BAFFIN BAY

Only Kugaaruk informants did not report calf sightings; all other communities from the Baffin Bay region reported sightings of bowhead calves.

Arctic Bay

Calves are frequently sighted in the Arctic Bay area. The spring migration of mothers with calves is later than that of other bowheads; thus, calves are rarely spotted at the floe edge, and it is during summer that females with calves enter *Tununirusiup Kangiq&ua*/Admiralty Inlet and can be seen at places like *Qattiaq*/Kakiak Point (BB15, 18). However, ice may still be present in summer in the areas inhabited by calves (BB27).

When people went out on the boat and I went for a walk here in my community, I would see a mother and a baby whale. …[This was] in the summer, closer to spring. [Philip Qamanirq, AB] BB29

Further evidence of calves in the northwest Baffin Island area comes from the whale bones left behind by commercial whalers in the last century:

…[on Somerset Island] there are lots of bones including skulls of bowhead whales. There are skull remains of calves of bowhead whales. …apparently they [Whalers] were killing small calves of bowhead whales. Even though the skulls are of calves of bowhead whales, they are still very large. [Andrew Oyukuluk, AB/ws] BB239

Clyde River

Informants offered many observations and thoughts about calves and calving in the Clyde River area. Mothers with calves are occasionally seen in late summer/early fall at *Igaliqtuuq*/Isabella Bay (BB31, 34, 65, 68, 85, 122), and some informants surmised that calving occurs here (BB31, 65, 85, 122). Some informants reported not seeing calves at *Igaliqtuuq* (BB66) or elsewhere (BB80, 82). The locations of calving areas for the bowhead whales seem to be unknown (BB70, 82, 122). Ipellie Qillaq (BB52) provided some information on the physical process of calving in the bowhead whale.

…I think a calf was just born recently in August [at Igaliqtuuq/Isabella Bay], so that is why I think that they have their calves in August. …it is very rare to see a bowhead whale with a calf… …at first the big bowhead whale seemed to be alone, but within the same month the same bowhead had a calf …at the same place where I had previously seen it… …I know for a fact that they deliver their calves in August, because I have seen a newborn in August, but I have [also] seen the young [juveniles] when they are alone in the fall time. [Anon. 11, CR] BB31

….The younger newborn calves that we think we see [at Igaliqtuuq/Isabella Bay] are more reddish in color. The skin is different from their adult skin color. I think they change their skin color as well after they have been newborn as they get older, just like any animal… [Joannasie Apak, CR] BB65

…We seldom see them [calves], but they are seen, and we called the calves of bowhead whales "ingutuq" – they used to recognize bowhead whales with calves… [Nauja Tassugat, CR/ws] BB68

…As I have been involved in the study of the bowhead whales, I have noticed the calves when they are around. They are already very big, even young calves, and Igaliqtuuq/Isabella Bay is a favourite spot for the bowhead whales. …The bowhead whales come over to this area [Isabella Bay] to give birth to their calves. [Solomon Natanine, CR] BB85

In our observations during the study [Igaliqtuuq/Isabella Bay] we noticed that when they are migrating back [in the fall] there are usually smaller bowhead whales with them. Perhaps this is due to calving. …we suspect these are calves and for sure there is a calving area somewhere up North. … it is in that area [Igaliqtuuq] that I have seen two calves being born, they are a similar size as

beluga and once they were born they surfaced right away… They took a long time to bear their calves and when they are in labour the other bowhead whales are very protective of the female who is about to bear a calf. [Apak Qaqqasiq, PA] BB122

Females with calves have been sighted elsewhere in small numbers in the Clyde River hunting area: location not specified (BB49, 89, 305); *Pinguarjuit*/Cape Christian (BB56); *Qakijaaq*, near *Kuugaajuk*/Kogalu R. (BB58); and Patricia Bay (just off the community) (BB61).

…[I have seen] many bowhead whales around Qakijaaq. …this would be before Kuugaajuk/Kogalu River. I had noticed a couple of calves, I think they were just newborn calves because they were sort of a reddish brownish color. There were lots of bowhead whales over there and I think they were giving birth to their calves. These two small whales were …smaller than the narwhal… …I think their mother[s] had just given birth to them. These two small calves were around the more shallow part of the water and they never went down into the water so I thought they were just newborn. …there would also be two big bowhead whales around them and I thought they might have been the mothers. …As well I have seen an older calf [in Aavaatuuq] …we had seen this smaller [solitary] bowhead whale by the shore and it had been running away from something. [This one] was very small. [Jacobie Panipak, CR] BB58

Pangnirtung

Many informants reported the occurrence of mothers with calves (BB98, 105, 107, 111, 116, 117, 120, 126, 128, 130, 135, 136) in the Pangnirtung resource-use area. Calf sightings occur mostly in spring and early summer (BB107, 111, 116, 117, 120, 126, 128, 130) rather than in late summer or fall (BB107, 136). Some informants believe that calving may occur in the area (in late July, BB116, 136; in spring, BB130) while others cannot say where calving occurs (BB126). Informants reported the occurrence of red-coloured calves, probably newborns (BB107), as did a few informants from Clyde River (previous section).

…I have never seen a baby [newborn] bowhead whale – but I do see small ones with their mothers when there is a large number in a group. …it could be that they were born the previous year as they are not that big and they are usually hanging around a larger whale. [Anon. 21, PA] BB105

The bowhead whales go to safety, away from the killer whales, to deliver their calves, inside our bay here. …It was during the spring time, in July, [when] I have seen calves more than once, for they are a lot smaller than the mother. …The immature bowhead whales tend to be loners and sometimes they are still with the mother bowhead, they are quite small in size. [Anon. 24, PA] BB116

Few informants (BB130, 136) reported seeing the birth of a bowhead and/or direct evidence of a very recent birth. Josephee Keenainak (BB130) observed a newborn bowhead shortly after its birth in the Pangnirtung region.

There was one [bowhead] whale that had given birth to its calf just before the month of August [probably in Isuittuq/Clearwater Fiord]. I had seen this same cow [before] who had given birth to its calf, and the second time I had seen it was in August. The calf was [then] a little bit bigger. …The calf had changed its skin colour. It was more white. …I had been around this cow and the calf as I was working with the Qallunaat whalers [probably the Hudson Bay Co. (HBC) beluga whalers?]… …The calves are usually pretty big by [the following] spring, and I have seen a calf during the spring time. During this time, it seemed like the calves would be travelling by themselves [year-old calves?]. The mothers are still aware of their calves and where they are, but they are further apart. …I have not seen a small calf during the spring. I had seen one during the fall. This would be in Nasaujaq [at the mouth of Pangnirtung Fiord]. [Mosesee Qiyuakjuk, PA] BB136

Many informants reported the occurrence of generally solitary yearlings/*ingutuit* (BB98, 107, 111, 116, 134, 136, 138, 142, 231) in the Pangnirtung region. *Ingutuit* may also be seen with older whales (BB116, 126, 136, 142). Pauloosie Angmarlik (BB138) saw (in summer) one solitary, dark reddish *ingutuq* at *Illunngajunni* [headland to east of Kangilo Fiord] where he resided many years ago.

My father would talk about these lone bowhead whales. …Usually, their skin is very thick. The Inuit refer to them as lone bowhead whales… These would be whales that were a year old—calves that were a year old. Their skins would be layered much like the narwhals. [Anon. 23, PA] BB111

It seems that young calves [ingutuit/yearlings] tend to be on their own separated from the rest of the group. It seems to be that they are more comfortable on their own. …I think they like to wander off away from the group for a time but normally they will get back to the group in time sometimes during the day. [Peteroosie Karpik, PA/ws] BB142

Apak Qaqqasiq of Pangnirtung (BB122) provided some details about calf sightings from *Igaliqtuuq*/Isabella Bay (*see* previous section).

Pond Inlet

Informants reported seeing mother/calf pairs within the community's marine-use area (BB159, 160, 167, 178, 193). John Tongak (BB178) has seen mother/calf pairs at the floe edge at *Sanirut*/Button Point, and believes that calving may occur in the area.

…I think it was in 1995, me and Laimikie were camping in Kugluktuk/Koluktoo Bay and we did see three whales with calves. [thought one mother had a calf plus yearling]. The last one was a huge one [male?] and he used to slap his flipper onto the water creating a large splash of water [and scaring the narwhals towards shore]. … the reason why we do not fully believe that they [only] bear calves every three years [according to scientists] is that it seemed to me that the calves that we saw were born one after the other. I am sure that if people leave them alone, I am pretty sure that there could be calves on a more regular basis. [Elijah Panipakoocho, PI/ws] BB160

[Sam believes that, seeing a mother bowhead with a newborn and an older calf discredits the 3- or 4- year calving interval derived from Alaskan scientific data] [Sam Arnakallak, PI/ws] BB193

Qikiqtarjuaq

Many informants reported mother/calf pairs in the Qikiqtarjuaq community marine-use area (BB198, 203, 204, 209, 210, 211, 212, 219, 221, 224, 232, 234). Gamailee Nookiguak (BB209, 210, 211, 212) reported a small number of sightings of mother/calf pairs (in separate groups) in the shallow waters off *Qivittuuq*/Kivitoo, which he believes could be a calving area. Calving may also occur in the waters around Qikiqtarjuaq (BB219).

I remember some years ago, we happened by Qivittuuq/Kivitoo, the air stench of bowhead whales, and there were lots of young calves at that time… [Adamie Nookiguak, QK/ws] BB198

…I had observed young calves in that area [Qivittuuq/Kivitoo], and I have seen a lot of bowhead whales in Qangiqliqpak and Koaniluk, these are in fact the areas where I have seen a lot of bowhead whale calves and they stick around their mothers. [Gamailee Nookiguak, QK/ws] BB212

…I seem to see bowhead whales with calves every year. …there are many mature adults and smaller ones… [Pauloosie Kooneeliusie, QK] BB232

One informant believes he has seen evidence of actual calving:

We were on the boat and we saw this dark bowhead whale. …we had gone to the area where it had surfaced and it seemed very oily and it was very calm… …we thought that the bowhead whale was giving birth to a calf. …I have seen these types of bowhead whales [mothers with calves] …around our community. …They probably get a calf every year too. It's just my guess. [Jaycopie Audlakiak, QK] BB219

Older, solitary *ingutuit* are also seen (BB206, 228):

…I have seen one [calf] but I've never really tried to investigate them, and I've never seen an adult with a calf though. [Elaiya Qaqulluk, QK] BB206

…I have suspected that the one I have seen before stuck across from us, was a [yearling?] calf [a bowhead once got stuck in shallow water across from Qikiqtarjuaq]. [Markosie Audlakiak, QK] BB228

ii) The presence of calves and population increase [19]

Although many informants reported the presence of calves and small juveniles, only a few informants representing all four regions commented on the connection between the presence of calves (or juveniles) and the growth of the bowhead population:

Because of the population increase you could occasionally see a school of young bowhead whales gathered in one group. This also tells that indeed the population of the bowhead whales is increasing. [Noah Piugattuk, IG] FB38

I know for a fact that the population had increased for sure, if they did not have any calves they would be extinct now. The only way they grow in population is by having calves… [Ben Ell, IQ] HS35

…we also notice that we see more calves in groups of bowhead whales and that signifies the population rise. We also see a lot more young bowhead whales even though they might be very large in size. [John Kaunak, RB] HB48

The bowhead population is increasing, for they are breeding [producing calves]… [Pauloosie Kooneeliusie, QK] BB233

3.1.5 Ecology and Behaviour

i) Killer whales and bowheads [20]

Inuit often refer to killer whales as 'wolves of the sea', owing to their habit of attacking, killing, and consuming other marine mammals. Inuit informants reported the occurrence of killer whales during the summer in all regions of the Study Area. They have documented through first-hand knowledge and the oral tradition the interactions between killer whales and bowheads, including predation and the effects of killer whales on bowhead behaviour, distribution, and migrations. Bowheads and other marine mammals often exhibit a pronounced fright reaction to the presence of killer whales. This reaction, called '*aarlirijuk*' in the South Baffin dialect of Inuktitut, involves the movement of marine mammals into areas of broken sea ice or shallow inshore waters, which may provide some measure of protection from the killer whales.

FOXE BASIN

The Igloolik region apparently had few visits from killer whales prior to the increase in numbers of bowhead whales which dates from the 1960s.

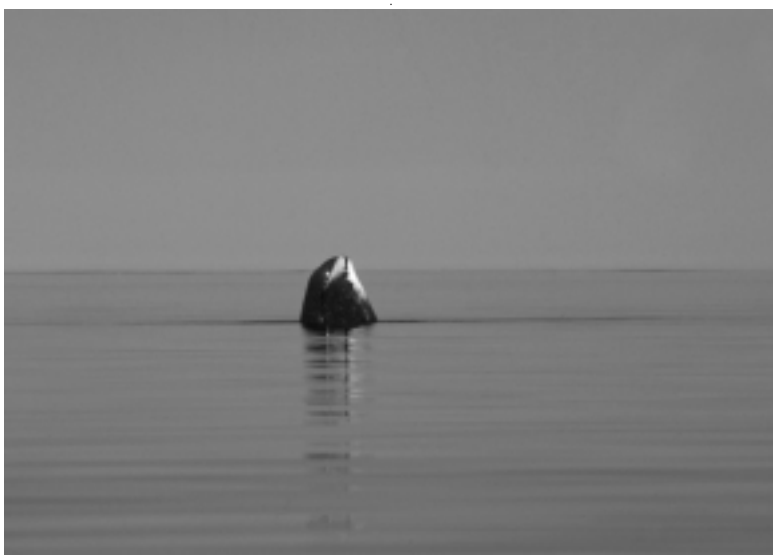
…as the bowhead whales are also hunted by killer whales for food. This area [Igloolik area] had no killer whales when there were no bowhead whales. As the population of the bowhead whales increases, so did the killer whales following the bowhead whales. [Noah Piugattuk, IG] FB39

…And the killer whales are the wolves of the sea as we have wolves on the land. All sea mammals fear the killer whale. [Gemma Piallaq, HB] FB62

HUDSON STRAIT

Lucassie Nutaraaluk of Iqaluit (HS46, 50) is well aware of the fear that marine mammals have of the killer whale, and the impact of the killer whale on the bowhead:

The only ones hunting for the bowhead [since the ban on whaling] were the killer whales… Like most of all the animals on land are scared of wolves, it is like that too in the ocean with the killer whales. When the mammals are scared of killer whales they tend to go very close to the land, that even happens to beluga whales, perhaps the killer whales are very noisy for they travel at a great speed. Since they live off all the mammals of the sea, they can kill a bowhead whale, that is very well known by the Inuit. [Lucassie Nutaraaluk, IQ] HS46



A bowhead whale pierces the water's surface. Photo by Sue Cosens, Department of Fisheries and Oceans

HUDSON BAY

Killer whales have been reported by Inuit throughout much of Hudson Bay (within the Study Area). Leo Mimialik of Chesterfield Inlet (HB23) reported that hunters continue to sight these whales near the community, and that killer whales kill narwhals and bowhead whales:

…I think there are a lot of killer whales around now. Somehow the killer whales have to be killed or moved so that there are less killer whales around here. [Leo Mimialik, CI] HB23

…for the killer whales are predators, they hunt any animal, and they should be the one blamed for over-hunting, for a fact. They just play with the mammals… [Murice Kukkiak, CI] HB26

Jack Angoo (HB84) of Whale Cove had been told how three killer whales attacked and killed a bowhead, presumably by suffocation or drowning, in the Chesterfield Inlet area.

Tooma Saumik of Rankin Inlet (HB81) has heard of killer whales hunting a narwhal, but not a bowhead whale. Felix Pisuk (HB265), also of Rankin Inlet, stated that *"…if there was a killer whale [around], the bowhead whale would go as near as the beach, bypassing the rocks that could land them and get [them] stuck, actually deflated by letting all the air out, then that is the best opportunity to start the attack [by hunters] on the bowhead whale."* [Felix Pisuk, RI] HB265

Most of the comments and information about killer whales (*aarluit*) in the Hudson Bay region came from informants living in the community of Repulse Bay. Informants reported that killer whales occur in summer in the Repulse Bay area but not every year (HB48, 70, 179, 252); however, one informant (HB36) stated that killer whales are seen very infrequently nowadays in Repulse Bay waters. Although informants know that *aarluit* do occasionally attack and kill bowheads and other marine mammals (HB36, 42, 55, 70, 179, 208), only a few actually referred to an eye-witness or second-hand account of a killer whale attack on a bowhead:

…two killer whales were swimming back and forth criss-crossing its air spout [blowhole], cutting [off its] air. We were not able to harvest one [killer whale], but we did harvest one bowhead whale. [referring to a 1940 harvest of a bowhead at Maluksitaq/Lyon Inlet- see Section 3.3] [Philip Kripanik, RB] HB252

Some informants reported observing killer whales hunting narwhals and/or belugas (HB48). There are observations of bowheads and other marine mammals fleeing into very shallow waters when killer whales are about (HB36, 61, 65):

…I remember seeing two bowhead whales getting very close to the land… …this was in the place called Itirjuk/Gore Bay and also at the same time other species such as belugas/narwhals, seals, and others were also sticking very close to the land, obviously they were afraid of something. [Peter Katokra, RB] HB65

Although there is natural mortality of bowheads not due to killer whales (dead bowheads have been seen out at sea – HB205), some informants attributed many of the recently-found dead, beached bowheads (*siluit*) to killer whale predation (HB55, 179, 208):

…the dead carcasses of bowhead whales that are found may well be the results of killer whales. A large number of dead carcasses of bowhead whales are found near Maluksitaq/Lyon Inlet and at Nagjuktuk/Vansittart Island, for sure these bowhead whales were not killed by Inuit, most likely they were killed by killer whales. [Anon. 29, RB] HB179

Perhaps these [beached] bowhead whale carcasses [about six in the Repulse Bay area since the 1960s] are the results of killer whale attacks – because we can tell from the carcass that they were not very old bowhead whales… …the latest one was a large bowhead whale. I think the guilty party for killing off bowhead whales are aarluit. [John Kaunak, RB] HB208

Some informants believe that there is a connection between absence of killer whales and abundance of bowheads and vice-versa (HB36, 42, 61,

70). Killer whales were more abundant in Repulse Bay in about the mid-1960s, when bowheads were less abundant than they are today (HB61) :

….before there was a community [prior to about 1965] I hear that there were lots of killer whales in the [Repulse] Bay. Narwhals and seals used to gather in the shallow waters near the land… Possibly since then the bowhead whales left Repulse Bay area. …I suspect that whales temporarily avoided Repulse Bay but after that they started to come back. [Participant, RB/ws] HB61

Philip Kripanik (HB70) believes that bowheads are now abundant in the Igloolik area because they are avoiding the killer whales elsewhere in their range:

…I think the reason why they [bowheads] are over there [Igloolik] is because they are running away from the killer whales. I think the killer whales are many, and the bowhead whales are very afraid of them. [Philip Kripanik, RB] HB70

BAFFIN BAY

Arctic Bay

Killer whales occur in the Arctic Bay area during summer (BB29). Bowheads, narwhals, belugas, and seals (all prey of the feared killer whales) will go very close to shore when killer whales are around; this can be a blessing for marine mammal hunters (BB25, 29). One informant (BB9) advocated the hunting of killer whales by Inuit in the north Baffin region, due to the killer whales' depredations on narwhals, belugas, and bowheads. As a little girl, she heard stories of killer whales killing calves of bowheads and full-grown narwhals.

My feeling is that if the bowhead whales and narwhals [and harp seals] are no longer disturbed by killer whales, they probably wouldn't bother going into various inlets up here, instead they would remain in the open water. [Mucktar Akumalik, AB/ws] BB25

The feared whales referred to as killer whales are around here all the time… The narwhal and other sea mammals [and the bowhead] will go to the shore… …as the killer whales get closer to shore. [We see the sea mammals] because of the killer whales, they would be driven to shore because they were afraid. [Philip Qamanirq, AB] BB29

Clyde River

Clyde River informants provided much information about bowheads and killer whales. There is direct evidence of killer whale predation on bowheads – people very infrequently see dead bowheads floating at sea which may be victims of predation by killer whales (BB32). One informant (BB64) reported hearing about people finding stranded carcasses of bowheads having broken bones, such as the ribs, but no other wounds; these are also assumed to be victims of predation by the killer whale (BB64). These stranded , dead whales (*siluit*) were often used as food by Inuit and their dogs in times past (BB64).

Some Inuit suspect that killer whales may kill quite a few bowheads, in spite of the bowhead population increasing (BB38). In addition to predation by killer whales, disease may be another source of mortality in this growing bowhead population:

…because there's so many of them [bowheads] I think they can get diseases and get sick and die off this way. As well, the killer whales will kill them, and people have continued to see many more bowhead whales. I would be concerned about the types of diseases that they can pass on to each other. [Solomonie Natanine, CR] BB91

How killer whales attack and kill bowheads was not much mentioned by informants. Killer whales hunt in packs (BB38). Stranded carcasses of bowheads found with broken ribs and other bones (BB64) were perhaps killed by killer whales using head blows to the bowhead's body.

Informants had much information on the behaviour of bowheads in respect to killer whales, during the time of spring migration as well as in summer. Much of the information and observations pertain to *Igaliqtuuq*/Isabella Bay. Bowheads may avoid or abandon *Igaliqtuuq* in summer/early fall if killer whales happen to go there as well (BB38, 83). However, bowheads more often will react in specific ways to the arrival or presence of killer whales along the migration route or in the summering areas. According to one informant (BB40), bowheads migrate close to the shore to avoid killer whales, which are generally found in deeper offshore waters. When killer whales appear at bowhead summering areas such as *Igaliqtuuq*, bowheads will swim into shallow coastal waters near *Nuvuttiapik*/Cape Raper, thereby obtaining some measure of protection (BB34, 37, 38, 50, 64, 67). This has been observed in other areas as well, e.g., at Clyde River (BB81).

…even though bowhead whales prefer deep waters [at Igaliqtuuq/Isabella Bay], but because of killer whales (aarluit) they go into peninsulas to avoid aarluit. [Nauja Tassugat, CR/ws] BB67

The killer whale is a formidable adversary of almost all marine mammals. However, at *Igaliqtuuq*, Inuit have observed a sophisticated system of detection and avoidance of killer whales by bowheads (BB40, 71, 73):

…once they reached their goal where they will be feeding and mating, that's in and near Taliruujaq/Aulitiving Is. in Isabella Bay – they always have a mature bowhead on the look-out by staying a little ways out in the deep water. And once the look-out notices any killer whales he/she would let the other bowhead whales know immediately. …[the bowheads] would move up right close to the land and stay still. And [they would] wait for the look-out whale to signal them that the killer whales are clear… …[then] they return to their normal routine – that's the way they are. [Ashevak Palituq, CR/ws] BB40

…look-out bowhead whales [called silaaq] …are the leaders of the school of bowhead whales… The leader, once he realizes that there are aarluit (killer whales) around, he takes in a deep breath of air and then sinks to the bottom of the sea and stays there, and watches, until such time that he needs air – usually once the killer whales have passed he would then surface again for air and then go back down to the floor of the ocean and remain there until the killer whales have passed again, going back to wherever they came from, and only then he will surface to let the other whales know that the killer whales have passed. …In Inuktitut it's [the leader] called "uatsingat" – modern day people call it 'Aallaaluk' [Nauja Tassugat, CR/ws] BB71

When they [the elder bowhead look-outs] find any danger they make whistling noises to let the others know… …[the bowheads] would start scurrying towards the land to get away from the killer whales and the older bowhead whales would follow behind the younger ones and keep watch to see if they are being followed…. …when the bowhead whales are in small numbers, the elder bowheads would surround the younger ones, and when the killer whale tries to attack from either side, it would be hit on the ribcage by the bowhead whales, and they [bowheads] can kill by breaking the ribs, that's why they keep watch at a lower level. …when the bones start to break they [killer whales] start getting immobilized after being hit so many times by the bowhead whale, [so] that's how the bowhead whale can kill a killer whale. The elder bowhead whales are the ones that are capable of killing the killer whales, that's why they are the protectors down lower than the younger ones. …that's how they are, and they can kill killer whales, when they are not in great numbers. [Nauja Tassugat, CR] BB73

Pangnirtung

Informants provided much testimony about bowheads and killer whales. As in the Clyde River testimony, beached carcasses (*siluit*) of bowheads were reported to have broken ribs, evidence of a killer whale attack (BB109). Another informant reported a bowhead *silu* but didn't know the cause of death (BB127).

The testimony demonstrates that killer whales do kill bowheads, at least occasionally, in the Pangnirtung area. One informant (BB113) learned from his father that bowheads are hunted by killer whales which form a group or pack, led and directed by one whale which is the oldest and biggest in the pack. This informant provided a description of how the killer whales attack and kill bowheads. Jaco Evic (BB127) observed a group of killer whales herd a bowhead out to deep water, where they killed it. Jaco was uncertain if or how much of the whale was consumed, but it soon sank. An informant (BB137) saw a killer whale chasing a bowhead, and as it did so the killer whale was often 'in mid air'. After the killer whale submerged for some time, the informant noticed a lot of oil on the water and assumed that the bowhead had been killed.

Informants reported that marine mammals (including the bowhead) often head to shallow inshore waters when killer whales make an appearance (BB116, 127). They may go to the land even before their predators can be seen, as the marine mammals can detect the killer whales by the sound of their dorsal fins slicing through the water (BB113). This fear reaction to the presence of *aarluit* is called '*aarlungajut*' (BB118).

Could it be that in the past they [bowheads] more or less frequented that area [Isuittuq/Clearwater Fiord] to keep away from killer whales? Presently there are virtually no more killer whales, that could be one of the reasons why bowheads are not frequenting that area [as much as before]. [Peteroosie Karpik, PA/ws] BB143

…[at Kipisa two hunters] noticed a bowhead whale in pretty shallow water where it was almost right on the bottom. …it was there all day… However, it was gone the next day… …probably there had been killer whales around and in the process of escaping he [bowhead] got into shallow water and it stayed there until high tide. [Towkie Maniapik, PA/ws] BB434

Many Inuit believe that killer whales had a significant impact on bowheads in the Pangnirtung region. Elders have seen killer whale attacks on bowheads in the past (BB114, 118).

The killer whales are killing off the bowhead whales too, so the animal rights activists should do something about the killer whales too. [Anon. 24, PA] BB114

Bowheads may be impacted by their predators not only as individuals, but also at the level of the group or population. Josephee Keenainak (BB129, 397) believes that an influx of killer whales into the region [year not provided] resulted in bowhead whales decreasing their use of the area at the head of *Tinnujivik*/Cumberland Sound:

This area where we lived before [when I was a child] once had a lot of bowhead whales. After the killer whales started coming here, the bowhead whales did not come around as much any more. …[also] you do not see too many narwhals or beluga whales. To me, it seems like the narwhal have declined ever since that time. [Josephee Keenainak, PA] BB129

Some informants reported that this increase/influx of killer whales caused a decline in the number of bowheads and other marine mammals in the Sound (BB112, 113, 377). This began to happen after 1946 when Inuit harvested one bowhead at *Isuittuq*/Clearwater Fiord (BB377).

…The killer whales have killed a lot of bowhead whales. The older people in our community are aware of this. The killer whales are predators, so they have been part of the cause to make the bowhead whale decline to its low number today. [Anon. 23, PA] BB113

The above observations which indicate an inverse relationship between bowhead and killer whale abundance may be compared with observations of changes in abundance of killer whales over the past few decades. There are fewer killer whales today than in the past (BB113, 143). The 'past' referred to may be the years after 1946, when

killer whales began to appear in the Sound in greater numbers (BB129, 377, 397).

Kugaaruk

One informant mentioned the threat that killer whales pose to bowheads:

I have heard of the killer whale hunting the bowhead whale by letting it suffocate… …the killer whales chase and hunt the bowhead whales. If the killer whales were human, the wildlife officers would have stepped in a long time ago, so I think it's about time they do something with the killer whales. [Anon. 28, PB] BB145

Pond Inlet

Pond Inlet informants believe that bowheads enter the bays and fiords at ice break-up not only to find good feeding areas, but also to avoid killer whales (BB179, 189):

…bowhead whales started to penetrate deeper into the inlets to start feeding… …late into July when the ice is breaking up. That was also the time that they would be feeding without fear of predators such as killer whales. [Kooneeloosie Nutarak, Sr., PI/ws] BB179

Sam Arnakallak (BB192) reminisced about earlier times when all marine mammals seemed terrified of the killer whales:

I remember years ago when I first saw a bowhead whale, how frightened I was. Because the ones that we seldom saw always were swimming away from killer whales… …first we saw the bowhead whales, and shortly after we saw narwhals… …and after awhile we saw the killer whales chasing the [bowhead] whales [and narwhals]. …they [bowheads] seemed more scared than the narwhals and belugas. [this was at Nallua/Low Point] …I remember years ago when we only had dinghies, I saw killer whales chasing after seals, bearded seals and whales. I also recall shooting at them [the seals] and they didn't even seem to notice the shots that were aimed at them. But lately I haven't heard of killer whales being seen, perhaps it's due to that there are too many boats. [too much noise nowadays (for the killer whales), seals are not as often scared ashore by killer whales] [Sam Arnakallak, PI/ws] BB192

Qikiqtarjuaq

Pauloosie Angmarlik of Pangnirtung (BB417, 420) reported that in about the year 1920, Inuit at *Qivittuuq*/Kivitoo (north of Qikiqtarjuaq) harvested a bowhead that had been injured by killer whales (*see* section 3.3; *see also* FB101).

Many informants expressed the view that killer whales may have a significant impact on bowhead populations. Killer whales are feared by almost all marine mammals (BB200), and in arctic waters they do subsist on several species (BB202). Since the end of commercial whaling, killer whales have been the only predators of bowheads in the Qikiqtarjuaq area (BB504, 505). Even with some predation by killer whales, the bowhead population is growing (BB210). Jacobie Koksiak (BB215) believes that there is an inverse relationship between the numbers of these two species:

…when I was a child in Palligvik/Padloping Island, I don't remember seeing that many bowhead whales – and there were more killer whales/aarluit back then, but later on in time as the aarluit begin to diminish in number, that's when I began to notice more bowhead whales as opposed to the past. [Jacobie Koksiak, QK/ws] BB215

Levi Nutaralak (BB226) and Mosesie Qappik (BB231) believe that killer whale predation is a major source of mortality of bowheads:

I think the killer whales are the major cause of the bowhead whales dying. It is obvious that the killer whales do hunt the bowhead whales and kill them. The killer whales are the only ones that hunt the bowhead whales. They probably kill a young bowhead whale very quickly because they gang up on it. [Levi Nutaralak, QK] BB226

…since the whalers came, they said that they [bowheads] were depleting in numbers and I am sure that we can't just blame the whalers for that, because the killer whales prey on them too and kill them. [Mosesie Qappik, QK] BB231

Many informants in this Study stated that bowheads frequent shallow waters to avoid killer whales. A Qikiqtarjuaq informant (BB226) observed a bowhead fleeing into shallow waters as it was being chased and attacked by *aarluit* in fall of 1994 (but the bowhead was killed by its attackers – *see below*). Around *Qivittuuq*/Kivitoo, bowheads seem to prefer the shallowest waters (BB202).

Informants from Qikiqtarjuaq reported a dramatic encounter between killer whales and bowheads during September 1994, in the mouth of Merchants Bay, in the vicinity of *Palligvik*/Padloping Island (BB209, 217, 222, 226, 236). As many as one hundred killer whales were in the area over several days, and at least one bowhead was killed and partly consumed. A detached entire flipper of a bowhead was seen floating, and informants noted an oil slick and floating blubber which attracted hundreds of sea birds.

…a bowhead whale was hunted by the killer whales. People said that the fin [flipper] had been taken right off the bowhead whale by the killer whales. As well people said there were lots of northern fulmars which were perhaps eating the blubber of the bowhead whale. People thought that the killer whales were eating the bowhead whale. As well, last year [1994] my brother Levi [BB226] had gone down towards Palligvik/Padloping where the [commercial] whalers would have occupied a camp and they said that they were watching a killer whale hunting a bowhead whale. They were saying that you could see the fins

[flippers] of the bowhead whale as the killer whales were trying to kill it. [Jaycopie Audlakiak, QK] BB217

During [September] 1994… …I was on the boat when the killer whales were chasing a bowhead whale. We did not see the dead bowhead whale but we had seen the killer whales chasing and trying to kill the bowhead whale. …You could just see the side fin [flipper] of the bowhead whale as it was being hunted by the killer whales. …it had gone towards the shallower part of the water but the killer whales were ganging up on it and we thought for sure that was the end of the bowhead whale. …If we had gone back we would have found out for sure whether it was killed or not. I think the bowhead whale was killed for sure. …but it got windy and we were on a bigger boat so we did not go to the shallower part of the water. So we did not see the bowhead whale… [Levi Nutaralak, QK] BB226

Another informant (BB234) observed killer whales attacking bowheads near Qikiqtarjuaq but he did not provide the date.

ii) Sea ice and bowheads[21]

Bowheads seem to prefer areas where there is some ice cover (HB36), or the edge of the ice or floe edge – *sinaa* (HS135):

…we seem to see fewer bowhead whales when there is ice around… ….[but this could be because] we are usually not looking for bowhead whales between ice pans, and normally we travel [by boat] where there is no ice. Last summer [1995] when the research team from Fisheries and Oceans were in town the ice accumulated in the bay and I presumed that they [bowheads] would be in areas where there is no ice but I was wrong, instead they went further into the water where there is ice. [David Tuktudjuk, RB/ws] HB36

Bowheads will enter fiords and bays as the ice is breaking up, melting and dispersing in the spring (HS28; BB75, 178). They leave Nunavut's nearshore waters and bays in late fall as fast ice begins to form (BB31, 59, 116, 231, 349), and they are sighted hardly ever in Nunavut during winter (HS28, 47; BB130, BB349; *see also* Map 1). One bowhead and several narwhals spent the winter of 1998/99 at the floe edge off Igloolik (Ammie Kipsigak, Hall Beach, *pers. comm.*). In *Tinnujivik*/Cumberland Sound, some bowheads over-winter at the floe edge and will even make breathing holes (*aglu*) in thinner ice which forms seaward of the floe edge in very cold weather (BB116). However, bowheads may leave the Sound during the very cold weather of mid-winter (BB116). Some informants interpret that sea ice does not seem to be a significant problem for the bowhead whale (e.g., BB13, 116).

Bowheads over-winter in loose pack ice or in open water (HS28), probably in several areas including Davis Strait, Hudson Bay, and *Sullualuk*/Hudson Strait. However, bowheads avoid areas where the ice cover is very extensive or apparently continuous (HS 28, 47; HB115; BB85, 130, 178).

They [bowheads] do not come as soon if the ice is still around, or if there's too much ice [at Igaliqtuuq/Isabella Bay]. [Solomon Natanine, CR] BB85

Adamee Veevee (BB99) pointed out that bowheads are generally more numerous at Pangnirtung's floe edge when there is more open water off the floe edge in spring (*see also* BB117).

Mortality due to ice-entrapment may occur (*see also* section 3.1.5. vii):

My brother-in-law found a dead bowhead whale at the beach in Siurakjuk [Siorarsuk Peninsula, N. of Igloolik] during spring time when there was still land fast ice. This particular bowhead whale didn't seem to have any wounds. Chances are that it may have gotten stuck in pack ice and died from that. [Philip Kripanik, RB/ws] HB236

I have also heard that there were bowheads that got caught in the ice in Arviqtujuq/Eglinton Fiord before. [James Jaypoody, CR] BB59

I have seen a dead bowhead whale that was frozen in on the ice, that was during the winter time, out in Pangnirtung, back when I was just a child… [Adamie Nookiguak, QK] BB489

iii) Tides, currents, and bowhead feeding ecology[22]

This section documents Inuit observations on bowhead foods and feeding, and how the moon and tides may affect the general activity and feeding of bowhead whales and other wildlife. The information presented was provided by informants from the Hudson Bay and Baffin Bay regions.

HUDSON BAY

Bowheads and other marine mammals are strongly influenced by the tidal cycle and the tide-induced sea currents. '*Piturnirtuq*' is the time around the full moon when tidal variation is greatest and the tidal currents are strongest. During *piturniq*, bowhead whales are very active and feed heavily in areas where the currents are strongest:

…I know that the current is very strong in between the islands [near Repulse Bay] when it's high tide. We had observed during piturniq [full moon] season, four bowhead whales within that area and they may have been feeding. When the low tide is coming, they were moving out into the deeper waters, and when the high tide comes they would go back to the area where there is a strong current and start feeding again. [Donat Milortok, RB] HB40

When it's "piturniq" they come much closer to the land away from the strong currents and they seem to frequent small bays and peninsulas. [John Kaunak, RB] HB48

During spring and summer in the Repulse Bay area, bowheads will gather and remain in places where their food is most abundant as long as they are not disturbed (HB65, 68).

…you could see them [bowheads] at Avatuqpatiak/Haviland Bay every summer when they are not being disturbed, they simply stay in one location for a long time and I am sure that they are feeding. [Peter Katokra, RB] HB65

Jackie Napayok of Whale Cove (HB85) stated that when their food supply becomes depleted, the bowheads will move on to other feeding areas. During the 1930s to 1950s, Mikitok Bruce of Coral Harbour (HB93) reported that bowheads fed in groups of up to six animals near his home at *Kuuk* (near Leyson Point, Southampton Island), during September. The whales remained in the same location for extended periods of time, often surfacing with open mouths.

BAFFIN BAY

Arctic Bay

Bowheads feed in the Arctic Bay community resource-use area during summer (BB16, 18, 239):

There is plenty of food for bowhead whales up here – for example, during strong current tides, it is almost impossible to see the bottom of the sea because of plankton. [Koonoo Oyukuluk, AB/ws] BB16

[American commercial whaling] was at the floe edge [near Somerset Is.] a long time ago, and I also remember people inspecting the stomach contents [of the bowheads] and it contains crustaceans. [Andrew Oyukuluk, AB/ws] BB239

Clyde River

In late summer and fall, bowheads feed in the Clyde River area. *Igaliqtuuq*/Isabella Bay is an important and well-known bowhead concentration and feeding area (BB38, 50, 73, 85). Bowheads feed in the deeper offshore areas (BB34, 73, 287), where they may dive deep for a long time, and re-surface close to the same spot (BB31). At *Igaliqtuuq*, the main food of bowhead whales is *iglirait*/copepods (BB37, 50, 58, 73). Bowheads form smaller, separate groups within the larger feeding aggregation (BB86). How bowheads feed is well described by Nauja Tassugat (*see also* BB37, 50):

Bowheads feed on iglirait/copepods… …they feed on them by opening their mouths and waiting, the mouth is full of suqqaq/baleen and they are just like hair… [in this way] the bowhead collects its food; I guess when they feel that they have collected enough [on the hairy fringes of the baleen] then they close their mouths and eat it. …the tips of the baleen are quite hairy, and they stand up like teeth all the way to the back of the mouth… [Nauja Tassugat, CR] BB73

…Taliruujaq/Aulitiving Is. [in Igaliqtuuq/Isabella Bay]… …is where they go to feed, perhaps there are lots of crustaceans in that particular area. Apparently when they are feeding, they are swimming with their mouth wide open. [Ipellie Qillaq, CR/ws] BB50

There may be annual variations in the abundance and/or location of the bowheads' food, which directly affects the distribution and abundance of the whales:

Their food, the krill or the copepods, when they are more plentiful during some springs and summers, the whales are around in greater numbers, and in some summers they are less; so people would know that there are more bowhead whales if they have seen a lot more krill or copepods. [Jacobie Panipak, CR] BB58

Nauja Tassugat (BB70) reported another location where bowheads feed before they head south to *Igaliqtuuq*:

…there used to be a fair number in a group [at Natsiqsujuq- NW point of Scott Inlet], and I think that's where they used to feed… …then next you notice they are traveling to Igaliqtuuq/Isabella Bay where they feed; I think they get into larger groups once they are feeding. …just like belugas/narwhals [Nauja Tassugat, CR/ws] BB70

Pangnirtung

Bowhead whales feed off the floe edge in *Tinnujivik*/Cumberland Sound during spring (BB106, 108, 117), sometimes forming large feeding aggregations (BB120). However, their behaviour and movements near the floe edge seem to be strongly influenced by the tides (BB102, 106):

…I think they are feeding [at the floe edge] and sometimes you could tell that they are feeding. After they have been feeding they usually gather in one area where they seemed to be playing, then they disappear. …At the floe edge their actions seem to be related to the tides, where when it's high tide they seemed to be more plentiful… [Anon. 21, PA] BB106

Bowheads also feed during the summer at various locations in *Tinnujivik*/Cumberland Sound (BB117, 126).

…there are a lot of crustaceans that bowheads feed on, in and around these waters. Most likely they are here to feed. I am sure that their feeding habits are similar to those of belugas/narwhals where they take time to build up their fat. [Jaco Evic, PA] BB126

At any time of the year, the movements of the bowheads are influenced by the lunar/tidal cycles and currents (BB110, 114):

The bowhead whales will go to a certain spot when the current is stronger. It is because they like to travel during this time. …you tend to see more sea mammals when the current is stronger. [Anon. 23, PA] BB110

… during the full moon, the bowheads tend to go inside the bay, where the beluga goes, to the place called Isuqturjuaq/Clearwater Fiord, the bowhead whales too follow moon cycles, inside our big bay here. [Anon. 24, PA] BB114

Some hunters may be unaware of these influences as bowheads are a non-harvested and hence often ignored animal (*see also* section 3.2.4.i):

From what I have seen bowhead whales seem to occur at anytime regardless of current or high tides. [Peteroosie Karpik, PA/ws] BB429

Kugaaruk

One informant commented on the feeding method of the bowhead whale:

The bowhead whale uses the tips [of the baleen] to gather their food [iglirait/copepods]. …People used to say that a man could stand inside the mouth of the bowhead whale… [Anon. 30, PB] HB144

Pond Inlet

Bowheads also feed in the Pond Inlet area. They probably have specific feeding locations (BB167, 178), although one informant proposed that many of these grounds are not known because of lack of surveys (BB173). When bowheads are heading to their feeding grounds, they do so in large groups (BB173). A bowhead that dives for a long time, then re-surfaces (also for a long time) near the same spot, is feeding (John Tongak, BB178). Kooneeloosie Nutarak, Sr. (BB179) observed a bowhead feeding:

An Inuk whaler who raised me told [me] of one incident down at the floe edge, when they were watching for bowhead whales. …bowhead whales started to penetrate deeper into the inlets to start feeding late in July when the ice is breaking up. That was also the time that they would be feeding without fear of predators such as killer whales. …I also had an occasion to see a bowhead whale feeding [at Ivisat on S. Bylot Island]. …[I heard a crunching sound, ice was still present] …there was this huge bowhead whale just floating – as it was very close I started to observe it, you could tell that his back [and head] were covered with mud. Then it submerged, and resurfaced after about an hour, and he repeated the same thing time after time… [I observed this for a few hours]. …I went down to our tent and explained this to my older brother… …he told me that this bowhead whale had been feeding in front of our camp [he/she lay on the bottom of the sea on his/her back and fed on bottom creatures – krill]. And I later learned that once they leave the floe edge and go into fiords and inlets, that that's the way they feed. [Kooneeloosie Nutarak, Sr., PI/ws] BB179

Qikiqtarjuaq

Bowheads feed in the Qikiqtarjuaq area in summer and fall. There are certain specific locations where bowheads usually feed (BB216); however, these areas may not be used by many bowheads in years of low prey [crustacean] abundance (BB207). They will generally be found in greater numbers in locations where there is the most food for them (BB198, 200, 207). Annual fluctuations in bowhead numbers (in any given location) are often due to variations in the abundance of their prey (BB200, 207):

…the populations of wildlife fluctuate from one year to the next, this is because of their needs, food-wise. …As they [bowheads] start coming up from June to August, that's when their food is plentiful, that is at least in Qikiqtarjuaq. [Adamie Nookiguak, QK/ws] BB200

I am sure that because there is plenty of food around, that's the reason why they always come up here, naturally the abundance of food fluctuates as well, one year there is more than the previous and so on. [Gamailee Nookiguak, QK/ws] BB207

Informants reported that bowheads usually feed during August and September in the immediate vicinity of the community of Qikiqtarjuaq (BB219, 224, 225, 229, 231).

…around here [Qikiqtarjuaq area], you can really notice them feeding here… …when they all group-up like that, when they are feeding and playing and staying in that one spot in August… [Koalie Kooneeliusie, QK] BB224

…I have watched bowhead whales feeding, here in Qikiqtarjuaq… I figured they were feeding, because… …after being under water for awhile they would surface at the same spot… [Leah Newkingak, QK] BB225

iv) Impacts of environmental disturbance on bowheads [23]

Impacts of noise from snowmobiles and small water-craft

Many informants reported that bowheads do not seem to be adversely affected by canoes or small boats powered by powerful outboard engines (FB48, HS5, HS146, HB51), even when hunters are shooting at other species (HB51). Because bowheads are not an object of hunting and hence not always closely observed, some informants were uncertain about impacts of noise on bowheads (FB86). As bowheads are not hunted any more, they may readily habituate to the presence of skidoos and boats (FB86; HS146; BB16, 227). Belugas and narwhals are more sensitive to noise than are bowheads (HS146).

Some of them [bowheads] don't seem to be bothered by anything. Even if you're going on your boat they just continually stay where we have seen them. Some of them are even close to our boats. Perhaps it is because they are not hunted. [Levi Nutaralak, QK] BB227

In the late commercial/post-commercial whaling days, bowhead hunters had to be very quiet and make no sudden noises in their sail or row boats when pursuing a whale, lest the whale hear the noise and submerge and flee (FB88; HB51, 75, 96, 234, 253; BB403). According to Philip Kripanik of Repulse Bay (HB234), on windy days bowheads could be approached without being "*…disturbed in the slightest*". One should not

approach a bowhead with the sun behind him or her so as not to spook the whale with the boat's shadow (HB234, 253). Even during the kayak hunts of ancestral times, the hunter had to be quiet and not form a shadow as he approached the whale (HB265).

…apparently in the olden days, when they were hunting for bowhead whales, hunters were not even allowed to urinate into the sea; but nowadays here we are using powerful and noisy motors on our boats and the whales are right nearby. Even down at the floe edge we are using ski-doos which are quite noisy and you still see bowhead whales right at the floe edge. [David Irngaut, IG/ws] FB88

When we used to hunt for the bowhead whale, we made sure that we sneaked up on the bowhead whale and made sure that we were very quiet [using whaling boats with oar and sail]. If the outboard motors are used, the bowhead whale will know right away. [Arsene Paniuq, RI] HB75

Mikitok Bruce (HB96) mentioned that the bowhead hunters had to urinate inside the boat so as not to disturb their quarry: *'…if bowheads become aware of human beings around they will submerge and travel a long distance away just like belugas and narwhals.'* [Mikitok Bruce, CH] HB96

On the other hand, some hunters perceive that bowheads do react negatively to skidoos and/or small vessels. Atsiaq Alasuaq (HS15) believes that the use of outboard engines is a possible explanation for the relative scarcity of bowheads near Cape Dorset. Some informants believe that many species of sea mammal avoid areas that they used to frequent, owing to vessel, boat, and other sources of noise (HS26, 45). Akakak Saata (HS 26) believes that noise may be an explanation for the low number of bowhead sightings in the Frobisher Bay area. Banging on something inside your boat can cause the whale to flee towards the land (HB76). Motor boats tend to frighten or disturb the whales (BB76, 92, 127, 132, 143, 435), although they may be closely approached in kayaks or boats with the engines turned off (Anon.14 of Clyde River, BB38).

…[when disturbed by noise] they [sea mammals] go to areas that they do not usually frequent and where there is less noise… When I first came here to Iqaluit, Frobisher Bay had more [sea] mammals frequenting it, for there were less motorized boats being used at that time, no wonder they do not like the sound of motors and they go close to the land to run away, that happens especially to the seals and the beluga for they have acute hearing… …they can hear the people walking on ice on the floe edge even when they [people] are trying to be very quiet. [Lucassie Nutaraaluk, IQ] HS45

…And I am sure that bowhead whales were not particularly disturbed by noise [in the time before the Whalers]- as opposed to today. [Mikitok Bruce, CH] HB91

They [bowheads] seem to start their other activities [such as playing] after the hunters have gone home from hunting and there is no more sound of engines in the water…[John Kaunak, RB] HB48

…bowhead whales had been increasing around Taliruujalik/Aulitiving Island [in Igaliqtuuq/Isabella Bay] because nobody usually goes there by motorized boats… [Nauja Tassugat, CR] BB76

Since motorized boats have been introduced bowhead whales that used to be around and in the [Pangnirtung] Fjord seemed to have moved into deeper waters and the floe edge – this is the results of noise made by motorized boats. [Jaco Evic, PA] BB127

Peteroosie Karpik of Pangnirtung (BB143) has noted a decrease in the number of bowheads at *Isuittuq*/Clearwater Fiord since motorized boats started to frequent that area for beluga hunting. However, the bowhead whales' infrequent use of this area today could be due as well to the lower number of killer whales that enter *Tinnujivik*/Cumberland Sound as compared to the past (BB143).

Bowheads may be disturbed by snowmobile noise at the floe edge or in the breaking ice:

We know that the noise from the ski-doos are disturbing to bowheads. That is why they do not come here. Before the ski-doo when we lived down there, when people spotted the narwhals, everyone was careful not to make any holes in the ice so that they would not make any noise. As well, the first narwhal they saw, they would not kill them. They would only kill the ones that came after the first ones had appeared. …so that they will not go back to where they came from for a while. …if some hunter tried to kill [the first group of migrating narwhals] the rest of the narwhals would not follow, knowing there is danger. They would come around again only after a long period of time had passed. That is what the Inuit have come to know in the Inuit way. Right now they [sea mammals] are staying away because of the ski-doos. The sea mammals in particular are very easily frightened; all of them. [Simon Akpaliapik, PI] BB197

Impacts of large-vessel noise

Some Inuit believe that bowheads may be disturbed by large vessels (HS44, HS50, HS126, HS147; HB77; BB16, 92, 132, 360). Although sea mammals may have been disturbed by large ocean-going ships in the past (when large-vessel traffic first started to increase), due to habituation they may now not be very affected or disturbed by large ships (HS32; BB453). Although uncertain about the impacts of large vessel traffic on bowheads and other marine mammals, some elders do not worry a lot about this as most large ships are necessary for today's Inuit economy (HS101). One informant (HB16) suggested that the non-harvested status of bowheads has led to a lack of knowledge as well as concern about the potential impacts of large vessels on bowhead whales. In the Hudson Bay area, ship traffic may not be a big problem for bowheads because of the relatively low number of bowheads in this area (Jack Angoo, Whale Cove, HB83). This same lack of concern applies to the Kugaaruk area (BB150). On the other hand, two Qikiqtarjuaq informants believe that increasing ship traffic is not a concern because

there are so many bowheads now and they are increasing in numbers (BB233, 235).

I am sure that they [bowheads] would be forced to move somewhere else if shipping and oil exploration are increased within Nunavut. Sea mammals are much more easily disturbed by activities than land mammals- they are unlike caribou. [Lucassie Ikkidluak, KM] HS147

I'm not only worried about bowhead whales, I think the ships might have an impact on sea mammals in Tallurutiit/Lancaster Sound and Barrow Strait. …starting in 1966, the seals and the harp seals would go up onto the shore as the ships would start arriving to our community. The way I think is that the sea mammals are bothered by the ships. [Anon. 15, GF] BB92

Large vessels might displace bowheads from prime habitat into marginal areas where food may not be adequate:

…[the sea mammals] would be traveling to places where they have never been, trying to get as far away as possible from the noise that the ships are making. …the other smaller species like seals, ringed seals, and belugas may be frightened for a short while and come back to the same location. …if there is too much shipping activities bowhead whales will surely move somewhere else. …it would be preferable that they not be disturbed on the basis that they go and frequent areas where there is food. Food that helps their young and only by eating a sufficient amount could they bear their young. …it is also evident that sea mammals do not like to be near large communities where it is populated. [Lypa Pitsiulak, PA] BB132

Potential impacts of oil spills/pollution from ocean-going tankers and drilling

Many hunters fear the negative impacts that oil spills may pose for bowheads and other sea mammals (HS32; HB77, 164; BB273, 382, 519).

I would be concerned about an oil spill for this bay [Rankin Inlet] is quite small, and it could be filled with oil, and if that happens the animals in the water would disappear. The outsiders might think that it is a vast land, but the oil could spoil the land very easily. As long as they treat the land and the water with respect, I would not have any concern. [Felix Pisuk, RI] HB77

I do not want the Nunavut environment to be destroyed [by the mineral or oil and gas exploration vessels] …perhaps if the Inuit are involved and actually participate in the surveys, the environmental damage that is occurring can be less. The Inuit should be respected, because they do not want to be in an environment that is polluted… [Philip Qamanirq, AB] BB273

…if there are too many activities in the waters inhabited by sea mammals, there is a good possibility that accidents could easily occur in the ocean and pollute the water and that would for sure destroy the wildlife. [Inusiq Nashalik, PA/ws] BB382

I would only worry about the fuel [spill from a ship]. I am not too concerned about the impact that the ships might have on the sea mammals as long as we continue to hunt the sea mammals and as long as there is enough wildlife left over for our children [to hunt]. That is all I care about as long as we live in peace. [Martha Kutiutikku, PB] HB164

…if the bowhead whale is wiped out by any kind of pollution while we are still not allowed to hunt them, (there are so many chemicals nowadays that are pollutants to the world), if the animals are killed by, like any kind of pollutant spills, like oil, I would be very sorrowful. [Mosesie Qappik, QK] BB519

Impacts of other sources of water-borne noise

The bowhead and other marine mammals are sensitive to land-based explosive charges and may avoid areas of such disturbance (HS45; BB333).

…also at the time when they were blowing up the point down there… …that is when the beluga stopped coming here, but now they are starting to come back for they no longer use the explosives as much. I also think the drills have scared the mammals too… [Lucassie Nutaraaluk, IQ] HS45

Impacts of hunting activities

Some Arctic Bay hunters believe that, during the recent decade, some bowhead whales and narwhals have been disturbed by hunting activity at the *Tununirusiup Kangiq&ua*/Admiralty Inlet floe edge and have re-located to the Igloolik area (BB3). One informant from Pond Inlet believes that the present-day abundance of bowheads near Igloolik is due to emigration from the Pond Inlet area where bowheads were heavily hunted until about 1920 (Simon Akpaliapik, BB196).

When searching for bowhead whales, hunters were not allowed to shoot into the water, make unnecessary noises, or even pursue a herd of migrating belugas, as bowheads were sure to be coming behind the belugas (Lypa Pitsiulak, Pangnirtung, BB403).

v) Bowheads as a hazard to small-boat traffic[24]

FOXE BASIN

Numerous hunters from Igloolik (FB23, 25, 29, 30, 31, 36, 43, 46, 47, 48, 49) and Hall Beach (FB3, 4, 6, 8) are concerned about possible accidents occurring between hunters' boats and bowheads, within the bowhead concentration area(s) of northern Foxe Basin, as bowheads are nowadays quite numerous and have increased in number in this region during the past few decades (section 3.1.1).

…we hear hunters fear possible accidents with bowhead whales, i.e. whale surfacing on a boat, or bumping into bowhead whales; basically hunters are concerned with bowhead whales and their abundance. I've heard of a near

accident with a canoe where the bowhead whale almost surfaced on a canoe. [Albert Nuvviaq, HB] FB3

There was an occasion that one [bowhead] went by us at a very rapid speed. [Ammie Kipsigak, HB/ws] FB6

Now when one is going caribou hunting by boat [towards Tasiujaq/Murray Maxwell Bay], because there are so many bowhead whales we have to detour around them. [Anon. 19, IG] FB23

Our outboard motor had come right off our boat because of a bowhead whale. Our driver had hung on to the motor so that was the reason we did not completely lose our outboard motor. [Felix Alaralak, IG] FB30

Those of us who travel on our boats, we usually are very careful as we travel because there are too many bowhead whales around so we travel only in the shallower part of our water as we go out on our boats. [Felix Alaralak, IG] FB31

About 2 years ago I took part in traveling to Baffin area by boat in the fall when it was getting dark. When we were traveling back home, it was very calm and we ran out of gas and had to fill up our tank – as we were filling up our tank we could hear bowhead whales everywhere and we got concerned that we might accidentally hit a bowhead whale in the dark because there were so many. [Simon Iyyiriaq, IG] FB46

If the bowhead whale will continue to increase, I think they will become more and more dangerous especially during the springtime in Ikiq [mouth of Fury and Hecla Strait]. During the springtime the boats continue to go across our water all the time and the bowhead whales don't seem to be bothered by the outboard motors of the boats. They do not swim away from the noise. It seems like they can be very dangerous because the bowhead whales continue to surface very close to the boats. Perhaps they are used to the outboard motor noise by now or maybe because there are so many of them they don't swim away. …it is becoming more and more dangerous if you are going to ride your boat. It is obvious today that they might cause an accident with the boat because there are too many of them. You see a lot of them during spring as well as during summer time and they are even more towards the fall weather. [Victor Aqatsiaq, IG] FB48

HUDSON BAY

Two Repulse Bay informants (HB46, 64) and one from Whale Cove (HB87) commented on the threat to boaters from bowhead whales in the Hudson Bay region. In the last few years, the increasing numbers of whales have been causing hunters to be more fearful and attentive of bowheads when they are out boating (HB46, 64). There have been near collisions with bowheads (HB64, 87).

Even when you are boating on a calm day you have to be constantly on the look-out for bowhead whales – I even almost rammed into whales on more than one occasion. Also, when you are boating alone it gets a little frightening at times as they seem to be everywhere. For sure we can say that there is more of them around. [Participant, RB/ws] HB64

Recently we almost ran into a bowhead whale. We had seen the bubbles from the bowhead whale and moved away from the bubbles by our boat. [Mary Nangmalik, WC] HB87

BAFFIN BAY

Most of the communities in the Baffin Bay region of the Study Area reported that boaters are quite fearful of collisions with bowhead whales which have been increasing in numbers for the last few decades (*see* section 3.1.1).

Four informants from Arctic Bay (BB10, 19, 22, 29) mentioned the danger that bowheads may pose to boaters, based on the increased numbers of whales now using the area in summer.

I also recall Andrew Oyukuluk's younger brother was traveling across the way to hunt for belugas/narwhals; their boat was completely lifted off the water and sat on the back of a bowhead whale. He said that it was a very frightening experience to have such an encounter with a bowhead whale… This would have been about 1969. [Lazarus Aola, AB/ws] BB19

…very recently, I was told, as I do not go out to camps anymore, a boat from here almost had a run-in with a bowhead whale. Apparently, the boat went right over the bowhead whale, when the boat was traveling through a swell, but the motor of the boat was not damaged, so the boat did not tip over. [Philip Qamanirq, AB] BB29

Clyde River informants (BB38, 43, 45, 85, 87, 89) expressed similar fears and had similar experiences with respect to the abundance of bowheads in the summer:

…It even comes to a point where we can't even go boating due to too many bowhead whales coming around here, it gets too scary to go boating… This does not happen every season, it only happens occasionally. …there were a lot of bowhead whales around 1976-79, that's the last time that I have ever seen that many bowhead whales around here, we were unable to move on our boat because there were so many bowhead whales around; when the bowhead whales were reaching the land it got pretty scary to go boating. [Anon. 14, CR] BB38

…[our son] had reported that he had seen a lot of bowhead whales when he is traveling by boat. …Because when they go out caribou hunting in the summer they have to go a long way, and you do worry about them because of the abundance of bowhead whales. [Elisapee Arreak, CR/ws] BB43

Although, according to Solomon Natanine (BB85), bowheads at *Igaliqtuuq*/Isabella Bay "*…don't do anything to the boats. They are harmless…*", he also notes:

[there are more bowheads nowadays compared to the past] …hunters have to be constantly on the look-out for whales when they are hunting with boats – there have been some incidents where accidents have occurred caused by bowhead whales. [Solomonie Natanine, CR/ws] BB87

[At Igaliqtuuq/Isabella Bay] some bowheads [are aware of motorboats]… …there was one incident where a bowhead whale surfaced right near my boat and I could be a little bit frightened. I think some of them are quite dangerous and curious… …[so] I started the motor and moved away, [but] they were still on the surface… They are a little bit frightening when they are up real close…[Solomonie Natanine, CR/ws] BB89

Pangnirtung informants (BB108, 112, 113, 114, 380) also expressed concern about potential collisions between boats and the numerous bowhead whales:

ANON 21 and I had gone hunting on the floe edge and we had to go around them [bowheads] when we were coming back to town. [Anon. 22, PA] BB108

I have seen many bowhead whales, down in front of Qikiqtan/Kekerten, more to the west of Qikiqtan. We had to get out of the water, on to a piece of ice for safety, for there were too many bowhead whales around, for it was getting too dangerous to keep on boating. They were passing us by all day long, so we literally stayed on the piece of ice all day for safety. There was more than one boat, so the other crew, Etuangat and his step son, Palluq, had to go to safety too on to a different piece of ice. [Anon. 24, PA] BB114

Pond Inlet informants (BB161, 170, 171, 193) also fear boat-bowhead collisions:

I think I also heard that there was a boat that had to literally speed away from a bowhead whale. [The Game Officer sped away quickly because a bowhead was circling their boat] [Elijah Panipakoocho, PI/ws] BB161

Two informants documented a serious collision between a small boat and a bowhead in the Pond Inlet area, which fortunately did not result in loss of life or serious injury:

…[in 1970] in this area [Pond Inlet], my son-in-law and some other men lost their outboard motor. It was wrecked, their boat was almost capsized. They were trying to see if they could get a little adventure, all they tried to do was just take a look [at a bowhead]. The bowhead whales are dangerous, they will attack. They were thrown off to the side. There is a man named Siarnaaq… …he was the man in the boat thrown off to the side of his canoe. As well in Igloolik, we heard the same kind of thing happened, also in Clyde River we heard that a local guide had taken some tourists out and a bowhead whale had capsized their boat. You can ask Nataaq [of Igloolik], he was also thrown clear off his boat [after an encounter with a bowhead]. [Jimmy Muckpah, PI] BB170

…there was one here [boat-whale collision], I do believe that it was Siarnaaq and his boat companions, apparently the bowhead whale surfaced right from under them. Their engines broke during that incident. It was a very near-death accident. …He never actually fell in the water, he later said that the boat almost capsized. [Joanasie Arreak, PI/ws] BB171

Qikiqtarjuaq informants (BB203, 227, 228, 234, 235) are afraid to go boating when there are many bowheads around:

When we travel by boat they [bowheads] don't seem to be bothered at all. Some of them get very close to us. We get scared at times because there are so many of them, because we think that we might drive over them with our boats. They are not very fierce animals and they are usually very close to our boats. That's the way they are. [Levi Nutaralak, QK] BB227

Around here [Qikiqtarjuaq] after we started using Peterheads, during the fall time it used to be covered with bowhead whales. …so that is the area where it gets scary to move [with a small boat], especially scary when they come up for air right near the boat, even the boats were very slow moving. …it was too scary to go out for when you did the splashes would come up right by the boat for there were many bowheads. [Markosie Audlakiak, QK] BB228

…it became quite scary there [near Qivittuuq/Kivitoo], there were so many bowhead whales, on our way home, the route we were going to take was full of bowhead whales, we had to travel by the land to get to Qikiqtarjuaq. …[this occurred] in August. [Stevie Audlakiak, QK] BB234

vi) Aggressive behaviour and different types of bowheads [25]

Many informants provided information on aggression in bowhead whales and about the various age classes and other categories or types of bowheads found in Nunavut waters. Most of this information is traditional knowledge in its strictest sense, in that it was passed down orally to the informants by their own elders or even earlier ancestors.

Aggression in bowhead whales

Traditionally, Inuit hunters recognized bowheads of two types with respect to ease or difficulty of hunting: those that tended to be aggressive and retaliatory and very difficult or dangerous to hunt, and those that tended to be more docile and easier or less dangerous to hunt. Inuit bowhead hunters usually sought out and pursued the more docile bowheads. The aggressive bowheads have a high, pointed, prominent protuberance on top of the head on which the blowhole is located, while the more peaceful, docile bowheads have much less of a raised protuberance so that the blowhole is located on a rather flattened area on top of the head. The quotations suggest that these bodily and behavioural differences are age-related, with the aggressive whales being younger than the docile ones (*see* HB253; BB69, 362, 372, 383, 403, 418, 434, 464, 479, 486, 496, 507, 514, 521).

If a bowhead whale is a young whale, the blowhole will be pointed [the blowhole is situated on a rise on the top of the head]. If it is flat it is an older whale. They say it is qinngaujjariktuq because it is a young whale. If people are going to kill a bowhead whale I would like them to kill one that is full grown. You can tell which of them are full grown and adults. [Philip Kripanik, RB] HB253

…[according to my elders]… …if the long bump from the nostrils to the front [of the head] is narrow in width it means that you cannot get near that particular bowhead… But if the bump from the nostrils to the front is almost smooth it means that that particular bowhead is not aggressive and could be approached… …when hunters used to hunt with kayaks, if a bowhead whale is harpooned and if it has a bumpy nostril, it would mean that it would take a long time to kill the bowhead. …on the other hand, if the nostrils were smooth the hunter could go right beside it and harpoon it, being reassured that this bowhead whale is not aggressive. [Nauja Tassugat, CR/ws] BB69

[according to my father] …when the bowhead whale has a pointy nose [blowhole], and roundish body, it would be very hard to catch [and aggressive], and sometimes lost; even when they put many lines to it, the bowhead whale would not even slow down with a heavy drag, and the boats would not be able to catch up to them, for they are very fast swimmers. The more docile ones, would require only two lines, then it would slow down… Then they would use a penetrating lance or exploding dart to kill it. [Anon. 26, PA] BB372

The whales with high and pointy nostrils were called "arviqunungittut" literally meaning that they should not be harvested [because they are retaliatory]. While on the other hand bowhead whales with flat nostrils were known as "arviqunuqtut", these were the preferred for harvesting as they were not dangerous and they don't retaliate. [Pauloosie Angmarlik, PA/ws] BB418

…[my father] would say the bowhead whales that had sharper snouts [raised blowhole area] were known as more aggressive whales [qinautjattiariktuq]. …this one is qinautjattiarinngittuq, the one that is not aggressive. When they say piqunnirtuq, they mean that they are non-aggressive. …we say piqunninngittuq, for the ones that are aggressive, the ones that would be dangerous. [Kooneeloosie Nutarak, Sr., PI] BB464

…the ones that had the more visible [higher] snouts [blowhole] were difficult to hunt and kill [these are called qinngaujjattiariktuq]. The ones that could be killed easily had less visible [flatter] snouts. The hunters from their kayaks picked the ones they wanted by looking at their snouts. …The bowhead whales were hunted in the same way as they hunted for walruses. The bowhead whales were easier to kill as they got old. They got weaker and slower as they aged just as we do. [Simon Akpaliapik, PI] BB479

I had an occasion to observe a bowhead whale with a pointy/bumpy nostril – this particular bowhead whale actually went after us. …we knew that it was intending to frighten us and it was going right along side our boat, and we could even observe its lice… For some reason when we went to an area where ice was just forming that's when it left us alone. [Jacobie Koksiak, QK/ws] BB496

Hunters could use other bodily features to distinguish aggressive and docile bowheads:

…the whales with flat body (back) are easier to harvest, however the ones with a slight hump are very difficult to harvest because they retaliate when being sought after. [Towkie Maniapik, PA/ws] BB434

…during the time of the whalers… …some bowhead whales would face the ships, these would be aggressive whales. Their flippers can reach up to the corner of their mouths. There was one incident where one of these aggressive bowhead whales attacked [a whaling vessel]. [Kooneeloosie Nutarak, Sr., PI] BB464

Hunters should never approach or attempt to hunt a bowhead asleep at the surface:

…my elders said that one should never harpoon a sleeping bowhead whale because it could be very dangerous… …such a harpooned whale would thrash with its flukes… My younger brother (Tagornak) told of bowhead whales when they are sleeping – it doesn't even look like a bowhead whale and they remained that way for an entire day; there was one time that I wanted to harpoon one that apparently was sleeping, but my avanukutuk (namesake) told me that if a sleeping bowhead whale is harpooned it could be very dangerous. Only a few of the fearless, learned and knowledgeable hunters were able to harvest and harpoon a sleeping bowhead whale… [Philip Kripanik, RB/ws] HB234

If a bowhead splashed the water a lot with its tail flukes/*sarpik*, it was deemed wise to avoid hunting such a whale which was considered to be aggressive (Tooma Saumik, HB81, 148). If such a whale was to be hunted, the hunter would harpoon the whale in its tail area, hoping to damage the tendons and thus stop the tail movement and splashing (HB148). Jackie Napayok (HB288; *see also* Jimmy Muckpah, BB170 and Mathias Awa, BB473) described an attack by a bowhead on a Peterhead boat (probably in the Coral Harbour area):

…the bowhead whale was chasing the Peterhead boat. And the boat started moving towards the shallow part of the water… The bowhead whale rammed into the Peterhead boat, six of the ribs of the Peterhead boat were broken and the Peterhead was sunk. I think some of the bowhead whales are very vicious. My older brother [Ben Ell, Siusaarnaat] was on this trip. [Jackie Napayok, WC] HB288

But some bowheads are certainly more gentle than others:

My father told us a story about their boat being on top of a bowhead whale. The water was very calm. …they tried to move by poking their paddles on the bowhead whale. But they wouldn't budge because it was just impossible to move away. So the bowhead whale eventually just went down into the water and did not upset the boat… [Mary Nangmalik, WC] HB293

Large, older bowheads with much white on their bodies may be aggressive (*see below*, the description of *silaat* in Other categories of bowheads):

…I have seen a large bowhead whale down at the floe edge, this one was somewhat white in color due to its age perhaps. When it surfaced it was facing the people at the floe edge, it may be that he was hearing the skidoos… …it was almost white in color. [Anon. 21, PA] BB105

Certain whales, when they were being pursued by ancestral Inuit hunters, sometimes gave an indication of their aggression by the way they were breathing, and the hunters would then abandon the chase:

…if its breath is a cracking sound with breaks in between, this is an indication that the bowhead whale is warning [the hunters], as the bowhead whales are capable of striking at the kayaks or umiat [large skin boats]. The hunters were able to detect the mood of the bowhead whale by the way it was breathing. [Lypa Pitsiulak, PA] BB403

…People say that they [some bowheads] breathe differently… They say that the bowhead whales that make a lot of noise would be very difficult to kill. I guess they would be fierce, vicious. [Levi Nutaralak, QK] BB514

Mothers with calves

In traditional times, female bowheads and their calves were usually avoided by Inuit whalers (HB162, 234, 251, 268; BB13, 403). If a calf is hunted or killed, the female bowhead may become very aggressive and vicious and go after the kayak or small boat from which the calf was hunted. The mothers are very protective of their young. If a hunter in a kayak or *umiaq* (larger boat) was going after a calf, the mother would attack the kayak with her tail flukes from an upside-down or side-down position (Felix Pisuk, HB268; Lypa Pitsiulak, BB403). If the calf has been killed or separated from its mother in any other way, the female bowhead will linger around the area where it lost contact with its calf. In the succeeding summer, the mother would return to this same general area and be seen to grieve the loss of its calf and emit sad-sounding mourns, cries, or calls suggesting that she was still looking for her calf. This elicited a great deal of sympathy from the Inuit (HB268) and is one reason why Inuit did not hunt bowhead calves (in addition to the possible aggression of the mother). This is in sharp contrast to the early commercial whalers, who sometimes killed the calf first and then the mother who stayed around trying to protect her calf. (*see also* HB146, 153, 162; BB153, 231, 294)

…[in traditional times] the hunters would make sure that the bowhead whale they are hunting had no calves before they actually started to hunt for it, and they used to get more excited when they saw a bowhead whale without calves, because the calves could be as large as the mother bowhead, for they grow pretty fast. When they accidentally killed a calf, when the mother is feeding off somewhere else, the mother would keep coming back to the same location the next year, at the date when the young was killed; the Inuit said that it was mourning its young, with cries, which the Inuit would be able to hear from under water very loud, that is what I heard, and my late uncle confirmed that; he said that it is very sad to watch them mourning; and the traditional law was that you were not supposed to kill the calves of the bowhead whale… [Felix Pisuk, RI] HB268

The calf of the bowhead whale should not be killed. The mother will come back every year if her calf is killed. We care for our children very much as human beings; the bowhead whale too cares for their young just like we do. They are dangerous. It is obvious that the bowhead whale will nurture their young… [Philip Kripanik, RB] HB251

[This is a story told by Sappa] …there were lots of bowhead whales at the floe edge. …a bowhead calf was approached by the hunting party [which was on the ice]… …they were faced with a lot of water [splashing]… …the bowhead whale mother was circling the area and causing a lot of turbulence, because she was protecting her calf. The young people and others at that time were warned not to get too close to a calf… …they say they [mother bowheads] are very dangerous as they protect their calves. Even after so many years, the bowhead mother will continue to go to the same spot, the same area where the calf was [if the calf had been harvested]. [Joseph Oqallak, AB] BB13

[if her calf is killed]… …the mother will always know what area and what kayak has killed the calf. I think it is because they have souls, too, that they would know which kayak had killed their calf. [Martha Kutiutikku, PB] BB153

If hunters want to harvest a calf, the mother must be killed first (HB184, 234; BB153). But Inuit and the commercial whalers did not usually hunt a mother with a calf, because her calf would then starve (Nauja Tassugat, BB74; Martha Kutiutikku, BB153).

They [elders] would say that it is wise to try to kill the mother rather than the calf. It is very dangerous to kill the calf. The adult would have to be killed first before the calf is killed. If you kill the calf first you can come across a very vicious animal. The boats that you see around here can be overturned. When it [mother] starts to come towards the whalers because they killed a calf, the men would have to fend for themselves by running away from it. [Anon. 30, RB] HB184

…one particular bowhead whale [which had a calf] went chasing us. [Ipellie Panipak, CR/ws] BB294

Age categories of bowheads

Inuit recognize several age/size categories of bowhead whales (*arviq*; *arviit* -plural):

arvaaraq	Calf (newborn)
arvaaq	Calf (older, still being nursed by the mother)
ingutuq	One to two year old bowhead (small; with mother or alone)
aktuarjuk, mikinisaarjuk	Juvenile or immature (not full-grown; mid-size)
arvaaralik, arvaalik	Adult female with a calf
tiggalluk	Male, medium-size
akturjuaq, aktualuk	Adult male (large)
arviq, aktut	Adult bowhead (with white patches and spots); full-grown

Usually when they are immature their maktak is usually lighter in color, while the mature bowhead whales are bright black in color. [Andrew Oyukuluk, AB/ws] BB237

…the bull (male) ones can be identified by their [white] spots, the ones with no spots are younger than the spotted ones, and they say that they are the females… [Ipellie Panipak, CR] BB49

…at an age of one year, they [bowheads, called ingutuq] would just follow their mother [to the place where they always went again and again], before they become completely independent from their mother. …although they were no longer suckling… …a [newborn] calf would be called arvaaraq and the mother would be called arvaaralik. [Nauja Tassugat, CR] BB74

I guess it was the elder whales that had the white mark on the corner of their mouths. [Pauloosie Arnakak, CR] BB81

…The ones referred to as inutui [ingutuq] were the ones that had been calves. …they still tasted like milk… These are the ones that were born last year [now one year old], they are referred to as being alone… [Kooneeloosie Nutarak, Sr., PI] BB464

…I seem to see bowhead whales with calves every year. …there are many mature adults and smaller ones, but it seems like there are more mature adults of younger ages, kind of in mid-age. …I assume that the largest ones in a group are the bull bowhead whales, for the female bowhead whales with calves are not as large as the bulls. [Pauloosie Kooneeliusie, QK] BB232

See also: HB146; BB107, 111, 130, 134, 138, 203, 223, 229, 347, 464, 484, for further descriptions of bowhead age/size classes.

Other categories of bowheads

Repulse Bay workshop informants distinguished between two categories of bowhead based on size, degree of fatness and tastiness or desirability of the animal's maktak and meat (HB196, HB 219). There is *kivaaqi* – fatter, larger bowhead, and *papijjuk* – thinner, smaller bowhead. The elders preferred the fatter *kivaaqi*. *Kivaaqi* refers to a large mature female bowhead in the Pond Inlet area, or merely bowhead in Igloolik; *papijjuk* is a medium-sized bowhead (Pond Inlet). This distinction appears to be one based on size and age, with the larger, older, fatter ones (*kivaaqi*) being preferred for eating.

Bowhead whales are categorized or called differently: a) kivaaqi [fatter bowhead] b) papijjuk [thinner bowhead]; using this categorization we could choose which bowhead whale we should harvest… Personally I would choose kivaaqi as it is large and wide. The categorization of bowhead whales is the same as sculpins. [Participant, RB/ws] HB219

Some bowhead whales, when harpooned, will head toward the shore while others will head out to sea. The whale's behaviour, after being harpooned, is believed to depend on the particular hunter (HB102, 104, 242; BB503). Hunters whose harpooned whales head toward the land are desired as harpooners, while those whose whales move farther offshore are discouraged from being harpooners. A bowhead may want to select its hunter; if harpooned by an undesired hunter, it will struggle and resist and pull the kayak or boat at great speed (Joanasie Kakka, BB503).

…I hear that different hunters have different pull, in that some hunters, if they harpooned a whale, the whale could pull towards the land and others not. I honestly don't know why it is like that or if it based on the character and up-bringing of a hunter… [Participant, CH/ws] HB102

…different hunters are different in the way they harpoon bowhead whales and belugas… …some whales have a very strong pull when harpooned by certain hunters and some have very little… …say by chance that they are harpooned by a hunter with a strong pull, chances are the whale could go straight for land. [Participant, CH/ws] HB104

[There were] hunters with strong pull and weak pull. Apparently my grandfather Annunguak harpooned one here in the [Repulse] bay. And it was attached to the boat once he harpooned it, because of the strong pull the sail and the mast were knocked down, and the whale pulled the boat so fast towards the open water… The elder and the driver of the boat were raising hell with the harpooner, saying that he should never again harpoon a bowhead whale because the pull was too strong. …when I saw a bowhead whale and we were going after it, while it's on the surface I am O.K., but the moment it submerges my heart begins to throb with anxiety and I think this goes for all the hunters. [Philip Kripanik, RB/ws] HB242

A large bowhead at the surface may remind one of a rock or small island:

…when the Inuit traveled [by boat] they would say that they came across a large black hill. This is the largest bowhead whale; because it's so black they think it's a rock or part of the rock. This would be the largest bowhead whale of all the bowhead whales. [Prime Okalik, WC] HB302

Nauja Tassugat (BB71, 73) tells of the look-out or leader bowhead – *silaaq* (*see also* section 3.2.1):

…look-out bowhead whales [called silaaq] …are the leaders of the school of bowhead whales, and their duty is to oversee the whales within their pod. [and to warn them of the presence of killer whales] …In Inuktitut it's called "uatsingat" – modern day people call it Aallaaluk – 'the stranger' [Nauja Tassugat, CR/ws] BB71

…the elder bowhead whales would keep watch over the younger ones. …these whales have white spots and they are the real old ones. These old ones are not as active as the younger ones, like us human beings. The adult whales and the younger ones would be grouped up in one spot and the older whales would be down lower keeping watch to see if there were any killer whales around… …then they notify the others as soon as there was any danger (killer whales) lurking around or coming. [Nauja Tassugat, CR] BB73

This [white] bowhead whale is very huge and it's different from the other bowhead whales. People continue to see this whale every year. This bowhead whale has been given the name Stranger [Aallaaluk]… …it would be in Igaliqtuuq/Isabella Bay. [Solomonie Natanine, CR] BB91

vii) Strandings, net-entanglements, and ice-entrapments [26]

Many informants reported the occurrence of beached (stranded) and occasionally ice-entrapped bowhead whales. *See also* sections 3.1.5.i (dealing with killer whales and bowheads) and 3.1.5.ii (dealing with the impacts of ice on bowheads). Several strandings and ice-entrapments of bowheads in Nunavut, documented in Table 1 of Mitchell and Reeves (1982), were also reported by informants in this study .

FOXE BASIN

In September-October 1999, four dead bowheads were found by Inuit in the vicinity of Igloolik and Hall Beach. Inuit had previously reported the occurrence of killer whales in the area, and two of the carcasses had scratches or marks suggesting killer whale predation. Three whales had lengths ranging from 24 feet (7.3 metres) to 30 feet (9.1 metres). (Patrice Simon, Department of Fisheries and Oceans, Iqaluit, *pers. comm.*).

Since I have been here in 1964, I have learned that there had been two bowhead whales found beached [a dead, beached sea mammal is called silu] , we've never learned as to how they were killed. [Simon Iyyiriaq, IG] FB46

My brother-in-law prior to coming to Repulse Bay found a dead bowhead whale at the beach in Siurakjuk [Siorarsuk Peninsula, north of Igloolik] during spring time when there was still land-fast ice. This particular bowhead whale didn't seem to have any wounds. Chances are that it may have gotten stuck in pack ice and died from that. [Philip Kripanik, RB/ws] HB236

HUDSON STRAIT

Informants (mostly from Cape Dorset) reported a few instances of stranded bowheads in that region. Carcasses were sometimes used for dog food, and for human consumption or other human use if fresh enough (HS16, 78, 92, 115).

Naturally you do see beached bowhead whales and we never know how they were killed. …Those that are beached perhaps were attacked by other species; they may not have died right away but gradually died and floated to the coast line. [Atsiaq Alasuaq, CD] HS16

There was a dead bowhead whale near a lake or on a lake near Cape Dorset. I had seen this, and taken some of the meat out of the lake so the dogs had some of it for food. …I had brought it up on the land but the dogs started eating it and I had let it sink again in the lake… [Mangitak Kellypalik, CD] HS92

Around Nuvutjuaq, people had found a dead bowhead whale that had surfaced, so we were eating maktak, when I was a child they sent a big piece to my father… [Lucassie Nutaraaluk, IQ] HS115

HUDSON BAY

Over the last few decades, a few strandings have occurred in the Hudson Bay area, especially in the Coral Harbour (HB79, 100, 208, 288, 303) and Repulse Bay (HB179, 181, 205, 208, 212) regions. Often the carcass was utilized for dog feed (HB288), human food (HB79, 100, 288), and for the bones and baleen (HB79, 303). Some informants suggested that killer whales had been involved in the death of some stranded bowheads (HB179, 181, 208, 212). Others suggested that some whales may die from natural causes, rather than human- or killer whale-caused mortality (HB181, 205). Dead whales have been found floating out at sea (John Ignirjuk, Repulse Bay, HB205). Some stranded carcasses attract polar bears, foxes, and wolves, providing hunting opportunities for Inuit (Octave Sivanertok of Repulse Bay, HB212; HB288). A stranded bowhead was found at Native Point, Southampton Island, in September 1999 and had a body length of 31 feet (9.4 metres) (Patrice Simon, Department of Fisheries and Oceans (DFO), Iqaluit, *pers. comm.*).

Some people had found a dead carcass (silu) on the beach down there [Coral Harbour area]. I was given some of the maktak at the bottom, it was not rotten at all. As I ate some of it I felt better because I remembered how it tasted; my craving was gone. [Naleopa Kadlak, CH] HB100

…sometimes killer whales come up here [to Repulse Bay] in [a] pack. And the dead carcasses of bowhead whales that are found may well be the results of killer whales' attacks. [Anon. 29, RB] HB179

It would be rather ridiculous to continue the ban on bowhead whale harvesting when we are finding dead carcasses of bowhead whales, which is the result of other species hunting them or when they die of natural causes… [Anon. 29, RB] HB181

John Kaunak of Repulse Bay provided the locations in the Repulse Bay area where several stranded dead bowheads were found over the last 30 or so years:

…in 1965, a carcass of a bowhead whale was found at Nagjuktuk/Vansittart Island and in 1968 a huge carcass of a bowhead was found right at the bay of Repulse Bay at a place called Siuruqtujuk, and later on in years a bowhead whale carcass was found again right at the point of Tulukaat/Blake Bay. And again at Nagjuktuk a carcass of a bowhead whale was found and this was very recent – you could still see the jaws of that whale. And again, about 2 years ago [about 1993], a carcass was found at Qajugvik/Cape Martineau and it seems that bowhead whales in that area are slowly dying off. So from 1968 to date, a total of 6 carcasses of bowhead whales have been found. And just about 2 years ago [about 1993] there was also a dead carcass of a bowhead whale on an island near Salliit/Southampton Is. Perhaps these bowhead whale carcasses are the results of killer whale attacks – we can tell from the carcass that they were not very old bowhead whales… [but] the latest one was a large bowhead whale. [John Kaunak, RB] HB208

We did not see any wound on this stranded bowhead. We did not know how it died. …The maktak was eaten by us. The meat was used for dog food……and the blubber was used as food. This dead bowhead whale was very fresh. …This was near Nuvualuk/Terror Point [on Bell Peninsula, Southampton Island] in 1954… …the dead bowhead whale was [then] eaten by foxes and we didn't eat it anymore. …We did not cache any of the meat because the polar bears had already eaten most of it. [Jackie Napayok, WC] HB288

Some stranded whales may be the victims of human-caused mortality:

There's a large dead carcass of a bowhead whale down in Aqiarunnaq/Duke of York Bay. …Some men had harpooned this bowhead whale with a dart gun but it had escaped. …This [whale] was harpooned in Repulse Bay. [likely the 1947 kill at Taijarniit/Beach Point that drifted to Duke of York Bay, not listed in Mitchell and Reeves 1982 – see section 3.3] [Prime Okalik, WC] HB303

BAFFIN BAY

Ice entrapments of bowheads appear to occur infrequently. However, one bowhead was discovered entrapped on March 20, 1997 in a polynya (an area of open water maintained by swift currents) in Easter Sound, just before the Inuit Bowhead Knowledge Study workshop was held in Arctic Bay. Easter Sound is at the head of *Tununirusiup Kangiq&ua*/Admiralty Inlet, about 250 km from the floe edge and open water at the Sound's mouth into *Tallurutiit*/Lancaster Sound. The young whale must have gotten trapped there at freeze-up in October or November of 1996; the whale was still alive and in apparent good condition when last seen just before the time of ice break-up. Although it was not seen after break-up when it could finally escape its icy prison, no carcass was ever found in Easter Sound or elsewhere in Admiralty Inlet, suggesting that the whale survived (Don Moors, Arctic Bay, *pers. comm.*). Elders at the workshop were confident that the whale would be finding food in the polynya and would survive until break-up.

From what we hear whales are suspected to be in the Greenland waters in winter time. This is the first time that we have a bowhead whale stuck in the open water in winter time [in the Arctic Bay region]. [Atagootak Ipellie, AB/ws] BB8

Pond Inlet informants stated that they had not seen or heard of an ice-entrapped bowhead in their region (*see* BB189 – Sam Arnakallak).

Informants from the Baffin Bay study region (except those from Kugaaruk and Arctic Bay) reported occurrences of stranded bowheads over the past few decades (BB32, 36, 64, 109, 127, 202, 293, 411, 433, 436, 439, 447, 448, 478, 509, 521). Killer whales are often implicated in these bowhead deaths (BB32, 64, 109, 127, 436, 478). Elders told informant Joanasie Apak of Clyde River (BB64) that they had found beached bowhead carcasses with broken bones but no other wounds; the deaths were attributed by his elders to killer whale attacks. Similarly, elders told a Pangnirtung informant (BB109) that a beached bowhead carcass had broken and cracked rib bones (especially the smaller, thinner ribs) due to predation by *aarluit*/killer whales.

[a long time ago]… I had not had any children, yet; and my grandparents and I and some other people had found a dead bowhead whale carcass [silu] beached up on the shore, in Igaliqtuuq/Isabella Bay. They were saying that it was a small bowhead whale… [Anon. 13, CR] BB36

We had found a bowhead whale carcass that only had a very small section eaten and the rest was fine. …This was not that recent, as my first daughter was born. [Ashevak Palituq, CR/ws] BB293

…they had also found a dead bowhead, this one was not the fault of the Inuit, and I took some of the meat for dog feed. [this was on an island in the Nettilling Fiord, probably in the 1950s] [Pauloosie Angmarlik, PA/ws] BB411

…from this bowhead whale carcass, we were able to get some meat for our dogs. Iqalukjuaq found that carcass. …I was much too young to actually participate. [this whale washed ashore in the 1950s on an island at the mouth of Livingstone Fiord] [Towkie Maniapik, PA/ws] BB433

I can even remember my father finding a dead bowhead whale during early winter [probably in the Pangnirtung area], they salvaged the jaw bone for [sled] runners. [Mosesie Qappik, QK] BB521

Inuit found a dead stranded whale at Imigen Island [Pangnirtung region] around 1985. [Pangnirtung workshop, March 1996, Study Coordinator's notes]

Several Pond Inlet informants (BB436, 447, 448, 478) told of a carcass found at *Nunasiaq* (to the north of *Nallua*/Low Point on the west side of Navy Board Inlet). This carcass was found in the early 1950s by Manasie

Qamanirq, and it was fresh enough to be used as food for Inuit and their dogs (especially the blubber). It was an old animal, as the bones were fused [had stopped growing before death], soft, and appeared to be in poor condition. Inuit at the time suspected that this whale had been killed by *aarluit*. This beached whale may be the same whale reported as no. 24 in Table 1 of Mitchell and Reeves 1982:

…Some people ran across a washed up carcass… Perhaps this was during 1952 or 1953. It was over here in Tununiq/Pond Inlet area. …it was a full-grown one. The maktak did not have miqquq/fur [epidermis] upon it, because it was so old. …the blubber was used as I went to feed my dogs at the spot where the washed up carcass was located. …we [also] liquefied the blubber and ate it that way. [Alain Mucktar, PI] BB436

…a stranded dead bowhead was [found] about 20 miles from Nunasiaq… …It was rather old as some portion of the whale was deteriorated. And my father assumed that it was killed by killer whales. I even attempted to collect some of its bones for carving but they were way too soft. The bowhead died due to old age, its bones were fused [had stopped growing before death] and deteriorated. …this happened around 1950… …the blubber was still very good for usage. …we were about to go without food for a long time, because at that time the ice conditions were very bad, when we came upon the carcass of the bowhead whale – even though the meat was inedible the fat was very well utilized. The meat was used for dogs. [Sam Arnakallak, PI/ws] BB478

Another, probably old bowhead carcass was described by Ham Kadloo (BB439):

I have seen one washed-up carcass or silu… …it is at Ipiutalik [on SE side of Milne Inlet] … it is very old. All the bones are still there intact and have not been scattered or damaged at all, so I thought that it had died of a natural cause. It is not a recent carcass… The blubber and the maktak and the miqquq/fur [epidermis] are still on [the carcass] …it was on the beach, the high tide could reach it. …we were awed by this… [Ham Kadloo, PI] BB439

Informants (BB202, 509) have observed or heard about dead, stranded bowheads in the Qikiqtarjuaq region:

…when we were in Palligvik/Padloping Island, the people in the camp called Qivittuuq/Kivitoo found a dead bowhead that had surfaced, that is what I have heard; although we lived very close to them while in Palligvik, they never came to give us some of the maktak… [she was born in 1933] [Leah Newkingak, QK] BB509

In *Tinnujivik*/Cumberland Sound, bowheads sometimes swim into nets set for belugas or narwhals (or even fish) and they damage or carry the nets away:

Bowhead whales just destroy beluga nets without even seeming to notice them. The nets are usually attached to the floe edge, at the beginning of June. [Adamee Veevee, PA/ws] BB97

An elder was saying that he used to set nets for beluga at the floe edge but the bowhead whales used to destroy them. The net [mesh] size was 16" x 32". [Peteroosie Karpik, PA/ws] BB144

…and the bowhead whales have been caught in fish nets or tangled with fish nets. [Mosesee Qiyuakjuk, PA] BB410

viii) Bowheads and species other than killer whales [27]

A small number of informants from the Baffin Bay region commented on the interactions of bowheads with species other than their predators and prey. Narwhals and/or belugas are sometimes seen in company of bowheads at the floe edge or moving into inlets at the time of ice break-up (BB6, 122, 194); or on migration to and from the summering areas (BB113, 130, 134, 136, 167, 189). The bowheads may be followed by the narwhals (BB136, 167).

…narwhals/belugas are very friendly to bowhead whales. [Andrew Oyukuluk, AB/ws] BB3

They [bowheads] go away during the fall just before the ice forms—just like the narwhal. When the narwhal goes away, they go away at the same time. [Josephee Keenainak, PA] BB130

This area here [Qaurnak – western Eclipse Sound]; as I was a child I noticed that a lot of bowhead whales would be chased by narwhals. The narwhals would follow the bowhead whales… [Ham Kadloo, PI] BB167

I would like to refer to the smallest [bowhead] whale, that these particular whales are not feared by even the seals. This is from my observation. [Adamie Nookiguak, QK/ws] BB200

3.2 CULTURAL AND TRADITIONAL IMPORTANCE OF BOWHEADS TO INUIT

3.2.1 Inuit Values and Beliefs Regarding Wildlife [28]

During the time of their ancestors, the survival and well being of Inuit depended on wildlife. The Inuit believed that all animals were put on earth for them to harvest and utilize. They had strict guidelines and rules regarding harvesting wildlife, which were transmitted to subsequent generations through oral culture and traditions.

The Inuit have observed and been taught that wildlife tend to have natural cycles of abundance and distribution. These cycles will be reflected in local occurrence and/or number of animals harvested:

…the animals vary from one year to the next, sometimes they are more abundant, and sometimes they just seem to disappear, and that is the same with

all the animals and that is how it was when I was growing up. Some years the Inuit were starving and some years were plentiful, that is what it was like back then in my time. [Akakak Saata, IQ] HS103

…Of course there will be times when there is hardly any wildlife around but sooner or later they will come back. [David Irngaut, IG/ws] FB87



Inuit Bowhead Knowledge Study Workshop, Pangnirtung, March 1996. Photo by Keith Hay

The Inuit were convinced that wildlife populations would remain healthy and abundant only if they were harvested and treated with respect. Species that are harvested in a disrespectful manner, or not harvested at all (a sign of disrespect), may decline in numbers or disappear altogether. Arguing and fighting over wildlife, or talking badly about wildlife in any way, are considered as being offensive to the wildlife; this also includes harming, mistreating, and abusing wildlife, or causing wildlife to suffer. Such displays of disrespect may also lead to the disappearance of wildlife.

…We used to be told that if we fight over certain animals and talk about animals in a derogatory way, that the animal that we hunted would no longer be around, or there would not be enough to hunt any more… [Levi Nutaralak, QK] BB513

It was also stipulated that harvested animals must be utilized to the maximum extent possible, with minimal waste; this is another means of respecting wildlife. In the Inuit traditional way of living, everything was utilized and nothing was thrown away. Anything from the animal that was left over would be cached for later use, and Inuit would harvest only what they needed.

…Back then the law was not to waste food, and to never leave the meat behind, but they [Inuit] used to leave meat behind to be picked up on a later date. We would cache the meat when we were leaving it behind even in the spring time. The dogs can usually eat aged meat, so that is how we saved the meat for dog food… They cached most of it, even the part that is not too good to eat, for human and dog use later on, the bowhead whale meat was never thrown away… [Lucassie Nutaraaluk, IQ] HS114

Failure to share wildlife with other members of the community also constituted disrespectful treatment of wildlife. Sharing of food is one of the basic and vital foundations of Inuit society. Harvested wildlife must be shared with family and community.

…if you share among everyone, it [wildlife] will always be around to be shared again. They wanted to share the kill so that it will be replaced quicker. …If the Inuit share the kill among themselves and do not fight among themselves, there will always be plenty of wild game to hunt anywhere. [Levi Nutaralak, QK] BB513

Besides these traditional laws, Inuit have a belief referring to the respect that should be granted to animal leaders. The leader of a group of animals is called *Silaaq*, or the 'beloved of the weather'. *Silaat* are very special and unique animals. They are hatched from eggs 'born of the earth', and are destined to become leaders of an animal herd or group. These eggs should not be disturbed or harvested. If a *silaaq* is killed, the weather will turn bad. (Ashevak Palituq, BB286; Ipellie Qillaq, BB300)

…on land, if you see an egg all white in colour, we were always told not to break these eggs. I also had an occasion to see an egg standing up on the sandy beach – apparently it was called "Silaaqsuq", and apparently it was going to become a sea mammal, that's why it was so close to the sea. And the Silaat that are found in the mainland will turn to land mammals once they hatch. …No matter what the Silaaq/earth's egg will become, whether it will become a caribou or other land mammal, and the egg near the sea whether it will become a beluga, seal or whatever, the earth/sila loves these eggs. That is why we have always been told never to break earth's egg…. [Ashevak Palituq, CR/ws] BB286

3.2.2 The Value of the Bowhead Whale to Ancestral Inuit[29]

Among all the wildlife available to the Inuit, the bowhead whale was certainly one of the most sought after. The bowhead whale was an important part of the Inuit traditional way of life. The Inuit ancestors would follow all the traditional laws, in order to ensure that the whales stayed around. They would hunt the whale with respect and would share their catch with everyone in the camp. No part of the whale was wasted. Every part was used immediately or saved for future use.

…once a bowhead whale was harvested, the hunters and Inuit in that camp all felt relaxed, reassured that there will be food for the entire year. That's the reason why bowhead whales were harvested and every part of the bowhead whale was utilized, from the meat, maktak and bones. [John Kaunak, RB] HB208

The maktak and the meat were very good food as well as the blubber, which was also used as a dip for dried meat (Martha Ittimangnak, HB161). During these earlier times, there were more dog teams than nowadays. The bowhead meat also provided food for the dogs, which were essential to the Inuit.



Whaling activities, Pangnirtung, NWT. A.G. McKinnon/National Archives of Canada/PA-101938

The blubber was not only an important source of food, but also an excellent source of oil for light and heat.

…The blubber of the bowhead whale is very excellent. If we were to go out on the land and build two igloos, and my igloo had seal oil for my lamp, and your igloo had bowhead oil for your lamp, in the morning when we start to get ready to go again on our trip my igloo would have blackened snow. Your igloo would remain pure white. This is the reason why the oil from the bowhead is an excellent oil. As long as the lamp is lit properly smoke will not rise from the oil lamp of a bowhead whale. The light also is very high. [Mathias Awa, PI] BB471

The elders interviewed did not provide much information regarding medicinal uses of bowhead products. One informant said that the blubber could be used as a Band-Aid for deep cuts. They would have to chew the blubber first to completely get rid of the liquid (Mathias Awa, BB471). Another informant described the benefits of eating bowhead maktak:

…I will use as an example – we see on TV, Qallunaat advertising the effectiveness of the cough syrup and once he takes it he/she is feeling wonderful. Some years ago I observed an older person, as I was visiting him when he ate some maktak. …when he started to eat maktak his face was pouring with sweat and right then and there I knew he was going to get better. It was just like the commercial on cough medicine… [Jackie Nanordluk, RB/ws] HB201

Although it does not seem that there were many specific uses of bowhead as a medicine, bowhead food was considered excellent for general health.

…The older people consider the bowhead whale meat as a delicacy, and they crave for the bowhead whale meat. After the older people have eaten something they have not eaten for a long time, their spirits seem to lift up; and they seem to be more alive. [Josephee Keenainak, PA] BB396

The bones were also very useful. They were utilized to make various tools such as the *ulu* (semi-circular woman's knife), scraper, scraping platform and skin softener (Pauloosie Angmarlik, BB426). As the bones aged, Inuit would have recourse to the ribs and the jawbones to build frames for sod houses and tents. The jawbones were also used for sled runners. They would make very smooth runners, so people would have to avoid going on the rocks with them (Naleopa Kadlak, HB98). These runners made out of jawbones would be preferably used in the winter (Jackie Napayok, HB288). After they spent some years lying on the land, the bones would be dry and clean, suitable for carving as well.

The baleen was also valuable to Inuit. Since the baleen was flexible but not elastic, Inuit used it to make ties, by splitting the baleen plates. They were utilized to tie kayak frames and dog sleds (*qamutiik*), and to make harpoon lines, drags and floats and other equipment. Some informants mentioned that baleen could be used to tie up husky dog booties in the spring (Nauja Tassugat, BB316).

…I think the suqqaq [baleen] used to have significant uses and it was used for ties [for harpoons, drags, and floats] and other hunting equipment. The jawbones were used for the sled runners. …The ribs were used for the structure of sod houses and tents. The meat was also used by humans and dog teams. [some kids used baleen to make toys.] [Lazarus Aola, AB/ws] BB261

3.2.3 Whaling

i) Ancestral (pre-commercial) Inuit whaling [30]

Through oral tradition, many informants have a good knowledge of bowhead whale hunting by their ancestors. This section gives a brief outline of Inuit whaling prior to the arrival of the commercial whalers.

The bowhead whale hunt was an important part of Inuit culture and tradition and played a vital role in the survival of the Inuit. One whale could provide enough food, oil and building material for an entire camp, for the whole year.

Hunting a bowhead whale required a good knowledge of the animal's behaviour, combined with excellent hunting skills and techniques on the part of the hunters. They also needed the ability and skills to read the weather and ice conditions, which could affect the hunt.

…The hunters knew the weather, thus when the weather is in a certain condition then it was time to harvest a bowhead whale. It also depends on which way the wind is blowing from – say that the wind is blowing towards the land, then it was the right time to harvest a bowhead whale, as once it's killed the wind would blow it towards the land. [Mikitok Bruce, CH/ws] HB91

The ancestors of the Inuit would also have to make their own hunting equipment taking advantage of the resources available to them. They were very good craftsmen. Their knowledge and skills allowed them to make sharp weapons and harpoon heads, especially designed to kill and retrieve the bowhead whale. The weapons were made of animal bones, ivory and stone.

…the harpoon head would be made out of caribou antler or walrus tusk or narwhal tusk, and the sharp part [blade] of the harpoon head would be made out of stone, this is how it used to be. [Philip Qamanirq, AB] BB270



Jaco Evic and Simeonie Keenainak, displaying shoulder gun used in the bowhead hunt at *Qikiqtan*/Kekerten Island, July 1998. Photo by Keith Hay

Although Inuit had the *umiaq* (large skin boat), they would use kayaks to hunt the whale. Making a kayak for whale hunting would require special care (Felix Pisuk, HB265). The hunters had to manoeuvre their kayak very quietly and would approach the whale as it surfaced. They used to go around the head and avoided the main part of the body (Rebecca Arnardjuaq, FB67). They harpooned the whale with large weapons, and they used floats and drags to slow it down and to enable following it to make the kill.

…As the men would hunt the bowhead whale, they would go to the bowhead whale as it surfaced above water. There would be no more than one kayak [near the whale]… The rest of the kayaks would watch out for the one that would go to the bowhead whale. …As one man would go to the bowhead whale, he would aim at the head and the neck area because this would be the only spot that was exposed above the water. The man would harpoon the whale with a large harpoon-type weapon. …As the bowhead whale would be harpooned, the kayak would quickly go away because they were afraid they might get capsized by the movement of the bowhead whale. As they go away, an avataq [seal skin float] would be attached to the whale. This is what my mother would tell me. [Martha Kutiutikku, PB] HB167

The most common float used was the *avataq*. It was used as a marker and to slow down the whale. The *avataq* was made of sealskin [usually from a yearling seal] and was attached to the harpoon line. The line was short so the float would not reach the tail [Pauloosie Kooneeliusie, BB522]. In the *Sullualuk*/Hudson Strait and *Tinnujivik*/Cumberland Sound areas, some hunters used rocks instead of floats. Attaching rocks [to the harpoon line] would make the whale go into very shallow water and/or encourage it to stay at the surface to compensate for being pulled down by the rock (Eqaluk Nungutsuitok, HS90). Informants also mentioned the use of the circular drag called '*niutaq*' (Anon. 30, HB185). However, some people referred to the drag as '*kiniutaq*' (Nauja Tassugat, BB322).

Once the whale was harpooned with floats and drags, it could go under water for a long time. When it surfaced, the hunters used penetrating lances, called *anguvigaq*, *qalugiaq* or *iputujuq*, to kill the animal. The hunters would walk on top of the whale and lance it through the vital organs.

…Then when the bowhead had already been harpooned with floats and the draggers put on, then it would go under water for a long time, then when it comes up for air, it will not go down again, for sure. Then the people who would do the kill would prepare themselves, they would go to the bowhead whale, which had already been struck with floats; when they reached it, the kayaks would gather together to tie the bowhead whale using their oars throwing the ropes on top of the bowhead, and some of the Inuit would be walking on top of the bowhead whale to kill the bowhead, at first they would tie their kayaks to themselves before they killed the bowhead whale, by using penetrating lances to stab it… They would kill them through the vital organs, like through the lungs, because even if you stab it all over the meat it will not die quickly unless you hit it on the lungs… …by making holes on them you kill them, like when you shoot a beluga through the lungs, they die. That is how the bowhead whales are too, they stab them at the lungs. [Pauloosie Kooneeliusie, QK] BB522

After the whale was dead, the kayaks would line up and would drag the whale towards the land. Once ashore, the Inuit would climb on top of the whale and butcher it by cutting the skin and blubber in strips:

… they would butcher the bowhead whale with these types of knives that were made from animal bones. They would use polar bear bones for knives as well so as they cut the skin of the bowhead whale they would make sure that it [each piece] was as big as the snow block that would be used to build igloos. It would

be the same size unless they cut it. They would cut towards the ground, so as they cut a piece, it would fall off down to the ground, and because the bowhead whale is such a large animal, the men would get on top of each other and climb up on top of the bowhead whale… [Martha Kutiutikku, PB] HB167



"Whale Hunter's Boat," Pudlo Pudlat, Cape Dorset

Inuit would often establish their camps where they killed a whale, even if they had to move from a previous location (Josephee Keenainak, BB397). Old sod houses (*qarmait*) containing whale bones are widely distributed on islands and on the mainland. Inuit hunters used to hunt bowhead whales mostly in the summer months when open water permitted the use of kayaks and *umiat*.

The Inuit ancestors were probably not successful in harvesting a whale every year. Their impact on the bowhead whale population was likely negligible in comparison to commercial whaling.

ii) Commercial whaling [31]

The commercial whaling era is well documented in numerous books and articles. Consequently, this section provides an overview of commercial whaling as it was reported by the elders who were interviewed. Eber (1989) documented the stories and reminiscences of the elderly descendants of the Inuit whalers who worked with the commercial whalers around the turn of the century.

With the arrival of the Qallunaat whalers and their sophisticated equipment, the number of whales harvested increased dramatically. Inuit were involved in the later years of commercial whaling (generally after 1850). A few informants had witnessed or participated in bowhead hunts during the last years of commercial whaling (e.g., Pauloosie Angmarlik, BB423; Aksayuk Etuangat, BB345; Naki Ekho, HS130). However, several informants were able to provide interesting information that was passed to them by oral tradition (Atsiaq Alasuaq, HS87; Ben Ell, HS105; Andre Tautu, HB128; Pauloosie Arnakak, BB331; Abraham Pijamini, BB339).

During the time of the bowhead commercial whaling, the Arctic was invaded by ships from several different countries. The whalers initially used large sailing ships made of wood. Later, after 1850, steam-powered whaling ships came into use. Inuit were hired for their knowledge of the area and to hunt and process the bowhead whales. When a whale was killed, the Qallunaaq leader would get credit for the hunt and the Inuit would get paid with hunting equipment (rifles, boats, knives, binoculars, ammunition, etc.) and various commodities (tobacco, flour, needles, clothing, etc.). The whalers were mainly interested in the blubber and the baleen and occasionally, the bones. The meat and the maktak would be given to the Inuit, but much of the bowhead was still wasted. Before Inuit became involved in commercial whaling, the whalers cast adrift the whole carcass after processing. The whale could be towed for a long time to the ship or the shore, resulting in spoilage of the meat. The fact that the whalers were using explosive guns also contributed to the loss of some meat. Lots of meat was left behind since so many whales were killed.

By the time Inuit got involved in commercial whaling (about 1850), most whaling was conducted from shore stations and over-wintering ships. Whaling started in early spring, at the floe edge, and lasted until late summer. Some of the informants talked about the whaling that occurred at the floe edge (Pauloosie Kooneeliusie, BB526; Pauloosie Arnakak, BB331). Others referred mainly to whaling stations, and how the whalers used shelters made out of stones on top of the hills to spot whales (Martha Kutiutikku, HB166). Many elders gave details on how the whaling was done from small sailboats. They said that the whalers were well prepared and very well organized. Everyone involved had a specific task. When a whale was spotted, the whalers would go after it in a small sailboat and attempt to harpoon it. As soon as the whale was harpooned, they would take the sail down. The harpoon line, made of rope, would be kept cool by continuously pouring sea water on it, to prevent it from smoking or catching on fire as it spun around the post in the bow of the boat. They would have to tie on a second line if the first line became entirely used up. This was because the whale could dive deeply and drag the boat very fast, sometimes for a very long distance.

…the boat would start to travel towards the water. Their hair was flying in the air and the boat would be almost upright like it had a motor. [Philip Kripanik, RB] HB254

The whale could stay under water for up to 3 or 4 hours. The whalers would kill the whale when it surfaced, using an explosive harpoon gun or

darting gun. This shot was usually taken from a second boat. In later years, it was more common to use the explosive harpoon gun or darting gun, in the initial strike of the whale. The whalers would do the butchering beside the ship, on the shore, or at the floe edge.

Because of their efficient equipment and the help of Inuit hunters, the Qallunaat whalers over-hunted the bowhead whale populations in the Eastern Arctic. The Inuit have emphasized that they were not responsible for the decline of this species. (*See* section 3.1.1. i for more details on this topic.)

iii) Post-commercial Inuit whaling: specific hunts and techniques [32]

After the end of commercial whaling, the Inuit kept hunting the bowhead sporadically until about 1975. In 1979, the Canadian government formally protected bowheads. Bowheads were designated endangered in 1980 by the Committee on the Status of Endangered Wildlife in Canada. The bowhead is protected under the International Convention for the Regulation of Whaling, by the International Whaling Commission of which Canada was a member until 1982.



Whale boats landing at Pangnirtung, NWT. A.G. McKinnon/National Archives of Canada/PA-101936

Many informants, through the oral tradition, direct observation, or participation, reported on specific bowhead hunts undertaken by Inuit since the end of commercial whaling. Many post-commercial Inuit hunts were documented by Mitchell and Reeves (1982) from historical, archival, and other written records. However, these authors, as they surmised, did not document all post-commercial Inuit hunts. Inuit testimony in our Study has provided evidence of 12 Inuit bowhead hunts in Nunavut since about 1915, not reported in Mitchell and Reeves (1982). These hunts are documented in section 3.3.

Informants also provided comments regarding hunting methods adopted by Inuit since the end of the commercial whaling. It is interesting to see how the ancestral way of whaling has been combined with new techniques and the modern equipment available to the hunters.

…Apparently my grandfather and my father harvested a bowhead whale way after the Whalers had left the North, this harvest took place at Qayukvik/Cape Martineau, between Gore Bay and Lyon Inlet in northwest Hudson Bay. However, at this time they used the modern hunting equipment, such equipment as whale guns and other modern equipment – of course they used traditional equipment, i.e. harpoons, floats and the mainline [rope]. Apparently the time they caught the bowhead whale was during the year I was born, during the summer of 1941. [John Kaunak, RB] HB207

3.2.4 The Bowhead Whale and Inuit Society, Today and Tomorrow

i) Concern about losing Inuit knowledge of the bowhead [33]

The bowhead whale was very important to the ancestors of today's Inuit. They were very knowledgeable about it. Nowadays, Inuit do not look at the bowhead with such great elation as their ancestors probably did. Nowadays, they do not pay any particular attention to the bowhead. This lack of interest and attention is attributed to the fact that Inuit have not hunted the bowhead whale for a long time. As a result, many Inuit fear that people now possess less-detailed ecological and behavioural knowledge about the bowhead, and that eventually there could be an overall diminution or loss of knowledge about the species.

…the Inuit are not studying the bowhead today, even the elders are not paying attention to them, because we do not even deal with them today; because we were not allowed to hunt them, we did not even pay attention to the population growth, because we were not allowed to hunt them period, even when we still wanted to hunt them… [Ben Ell, IQ] HS35

…The community structure is such that we no longer live in Outpost Camps, thus we don't get around as much. … And we really haven't been observing bowhead whales, where they are now going that they never used to go – this lack of knowledge is due to that we haven't been allowed to harvest [bowheads] for a long time. [Tooma Netser, CH/ws] HB14

…during my ancestors' time it [bowhead] was considered very important. Today the older people are almost gone and when the Qallunaat introduced their regulations and hunting regulations, we sort of lost the traditional importance and cultural importance of this. [Jackie Napayok, WC] HB287

*ii) The importance of resuming the bowhead whale hunt**

The bowhead hunt was an important part of Inuit culture and traditions. The whale was a vital element of Inuit survival.

The majority of informants in this Study indicated that they would like the bowhead hunt to be resumed in order to preserve this aspect of Inuit culture for future generations. There are also many people who would like to satisfy the wishes of elders to be able to taste bowhead whale one more time before they die. Many elders were raised on the maktak and meat of the bowhead whale, and still crave for it. Many informants believe that a renewed harvest could also have positive social and cultural implications for Inuit.



Crew, whaleboat and Era at Fullerton, NWT, 1903-04. A.P. Low/National Archives of Canada/PA-053568

There are some uses for future-harvested whales, especially as food. The Inuit think that it is physically and mentally beneficial to eat food from the bowhead. The hunt should be resumed as soon as possible to take advantage of the knowledge and skills of the few remaining elders.

The bowhead hunt: a vital element of Inuit culture [34]

Many Inuit pointed out that their forefathers survived in large part because they were able to harvest bowheads. Thus, they believe that bowhead whales and whaling are important aspects of Inuit culture and tradition. For this reason, they would like to see the tradition of bowhead hunting renewed. They would like future generations to have a taste of the bowhead whale:

…I would support the hunting of the bowhead whale. It was used as food by our ancestors and I would like Inuit to continue to use it as food. I do not want them to forget how the bowhead whale maktak and the meat taste like. [Tookilkee Kiguktak, GF] BB341

A renewed bowhead hunt would also be a means of showing respect to the Inuit ancestors whose whaling activities and hence very survival enabled the perpetuation of Inuit life and culture in the arctic.

…I feel that the bowhead whale is very important to the Inuit, for our ancestors, even before we were born, survived from the bowhead and in turn that is why we are here today. …[because of] their hard work and endurance, and for their survival from the animals, way back then. So therefore the bowhead whale is very important to the Inuit, and our elders had survived from them also, so it is very important to our culture, and that should be known, by especially the future generation. [Markosie Audlakiak, QK] BB516

In order for the hunting of bowhead whales to be successfully resumed and maintained, it will be necessary to tap the knowledge of the elders and to involve Inuit youth in the planning, carrying out, and follow-up of bowhead hunts.

Wishes of the elders [35]

Many elders who were involved in bowhead whaling in the past crave to eat bowhead maktak once again. In Inuit culture, it is customary to acknowledge and respect elders who have accumulated knowledge and wisdom about Inuit cultural values and beliefs, and/or have extensive and detailed knowledge about specific cultural practices. Many informants declared their desire to see bowhead harvesting resumed in order to satisfy the wishes of the elders and as a means of showing renewed respect and affection to the elders in a society whose values and activities have changed greatly in recent decades.

…The elders of today are living and always longing to eat what they were raised with. For example, we had a grandmother who was very old and she used to repeat saying "I wish a bowhead whale could be harvested while I am still alive" and this was because she missed the maktak of bowhead whale, but she died before a bowhead whale was ever harvested. And my feeling has always been that if she was able to eat maktak of the bowhead whale I am sure that she would have lived longer. Elders must be respected and provided with food that they had grown up with… [John Kaunak, RB] HB208

…I'm sure that they [the elders] are craving for it [bowhead] since they grew up on it, and I'm sure that they love to eat it again while they are still alive, so,

* Since all interviews and most workshops were completed prior to the initiation of a bowhead hunt in Nunavut in August 1996, transcripts usually referred to a hunt being initiated or resumed in Nunavut. However, there have been two bowhead hunts conducted in Nunavut under authority of a Total Allowable Harvest (TAH) established by the Nunavut Wildlife Management Board: 1996 in Repulse Bay, and 1998 in Pangnirtung.

we Inuit think that they should try and harvest one as soon as possible. Especially the elders think like that, the elders who are left would like to have bowhead whale meat again before they die, they should be given their wishes… [Nauja Tassugat, CR] BB324

Modern day utility of the bowhead [36]

At the time of the Inuit ancestors, all parts from a harvested bowhead were useful. Today, new materials and technology have replaced the bones, the blubber and the baleen. However, there are some valuable uses for the products of future harvests, which would certainly provide Inuit with a highly valued source of country food.

…The sea mammals and all the animals are good for us. They are good nutritious food for us. They give us good blood, and they keep us healthy. [Anon. 23, PA] BB364

In the old days, almost everything (other than the bones and baleen) from the whale was considered as food by the Inuit or as food for their dogs. Nowadays, the people are most interested in the meat and especially crave for maktak (Arsene Paniuq, HB75). Extra meat could be used for dog teams which are becoming more evident in many arctic communities (Mucktar Akumalik, BB265).



People consuming flipper of bowhead harvested at *Qikiqtan*/Kekerten Island, July 1998. Photo by Keith Hay

Some informants recommended that sled runners could be made from bowhead bones instead of plastic, which tends to wear out very quickly (John Tongak, BB458). However, many informants suggested that the bones could be mainly used by carvers, after they had dried for a few years.

…and today I am sure that Inuit could utilize the bones for carvings. As the bones are quite large like the head and other large parts, carvers nowadays have very sophisticated tools that they would use them for carving. For sure the bones would not be discarded. [Ashevak Ezekial, CD] HS86

It was also mentioned that the bowhead could be used for educational purposes:

…they [the bones] could be used in the schools for educational purposes. …If we could put it [the bowhead] together… I have often thought about other animals too like the caribou and the polar bear. If we could have these in a museum I would definitely like to see the bones of the bowhead whale if it was put together like this. …For the things that we are not aware of, if people could come to learn what they could be used for. This could be very interesting for our younger generation and for the children today [referring to various parts of the bowhead for educational and scientific purposes]. [Tony Manernaluk, RI] HB276

Nutritive value, edibility, and taste [37]

The ancestors of today's Inuit considered that almost all the soft parts of the bowhead were edible. None of these parts were considered distasteful. The meat, maktak, blubber, heart, tongue, liver, stomach and intestines were used as food. The cartilage at the base of the baleen was eaten, as well as the upper palate cartilage. This cartilage was considered very delicious especially for anyone who had a full set of teeth (Anon. 30, HB147). Some informants declared that the only parts not edible were the kidneys and the anal passage (Lucassie Nutaraaluk, HS114).

Bowhead whale meat is apparently better-tasting than beluga meat, which could taste a bit like the cod on which they feed. Bowhead meat is not black like narwhal meat (Arsene Paniuq, HB73). In the past, the tendons and muscles around the joints made very good food once they were fermented and eaten with blubber (Jacobie Panipak, BB306). In order to age the meat it was stored in a closed seal bag which was left in a cache for several months.

…By storing it [bowhead maktak and meat] into these [seal] skins they [Inuit] would age the meat and make it fermented. When the people would come and get the meat out of the skin bags, they would say that it looked very much like cooked meat being taken out of the pot, and they say this makes very good food and very good meat. [Levi Nutaralak, QK] BB512

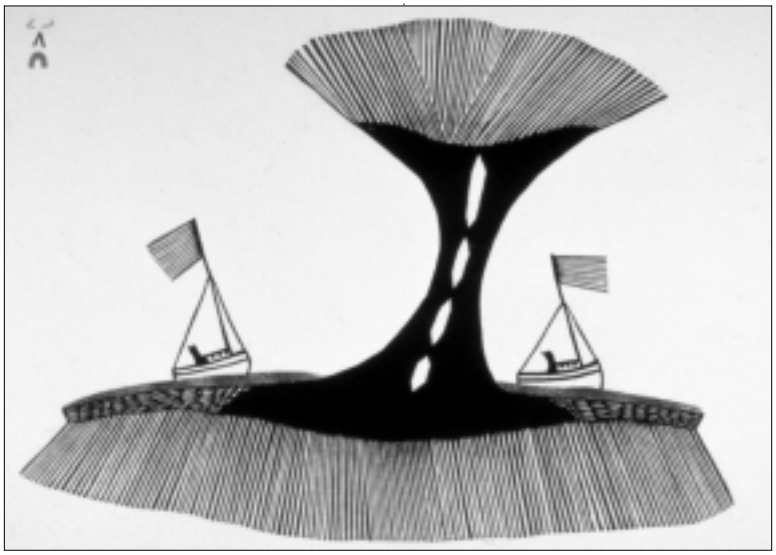
…when it [aged meat] looks really yucky, when it starts to seep old blood and oil, that's when it tastes the best. [Mosesie Qappik, QK] BB521

The maktak was certainly one of the favourite parts as well as the tongue (Octave Sivanertok, HB213). The maktak is quite thick (compared to that of the beluga and narwhal) and has a soft inner tissue (possibly the inner-most dermis layer which is quite tough to eat in narwhal and beluga) (Lucassie Nutaraaluk, HS111).

…What the elders stated was very true; the first time you bite the whale skin, it will have a strong taste to it. The second time you eat it, it will be all right. The third time you eat it, the true taste will finally come out, it will be delicious. [Kooneeloosie Nutarak, Sr., PI] BB470

But the maktak is not for everybody…

…I was given some of the maktak after the men in Igloolik killed a bowhead whale [in 1994]; it tasted awful to me. They are very tough, if you have no teeth. [Simon Akpaliapik, PI] BB482



"A Whaler's Dream," Pudlo Pudlat, Cape Dorset

Informants suggested that one should eat an equal amount of blubber and maktak to avoid constipation (Arsene Paniuq, HB75; Noah Piugattuk, FB99). The maktak boiled with the blubber is considered to be delicious (Atsiaq Alasuaq, HS87). Even if it is fresh, the elders say that it is not possible to get tired of eating maktak (Napatchie Pitsiulak, HS150).

…the maktak of the bowhead whale certainly is better than narwhal maktak. It tastes better. [Simon Inuksaq, PB] HB174

Bowhead blubber by itself is very good too. After boiling, the liquefied blubber is discarded, and the Inuit would only eat the solids (Andrew Oyukuluk, BB242). The blubber also makes very good food when it is dried, after the liquid had been pounded out of it.

…after the blubber was pounded it was hung up over the oil lamps to dry… …then they said it makes very good food. …When they prepare the blubber this way they call it qurlursiaq. [Martha Ittimangnak, PB] HB161

iii) Dissent or ambivalence with respect to resuming the bowhead hunt [38]

Although acknowledging the traditional value and importance of the bowhead to past generations of Inuit, some informants did not see its relevance to today's Inuit:

…looking at the present situation, young people today may not be particularly concerned with bowhead whales as our elders are. … Presently elders are in favour of harvesting bowhead whales and they miss eating maktak – but the present generation of Inuit I feel are not going to be concerned with bowhead whales. [Simon Iyyiriaq, IG] FB105

Some informants were ambivalent regarding the resumption of bowhead whale hunting. They said that it could be good for future generations but does not seem necessary today, as whaling has not been carried out for a long time and Inuit societal values, objectives, and practices have changed a lot.

…We do not kill bowhead whales. I cannot tell you how important it really is. If the bowhead whale is killed and hunted, then it would be considered very important. The Qallunaat put a freeze on the bowhead whale… …therefore, we cannot hunt the bowhead whale and I cannot say that it's culturally and traditionally important to the Inuit. [Joe Issaluk, CI] HB132

Some informants stated that they would like to see the hunt resumed but only under certain conditions. Because the hunt has been forbidden for so long, they are concerned that today's Inuit do not possess the knowledge and skills to hunt the whale.

…perhaps in some ways we are getting behind with our knowledge on bowhead whales, simply because we have not been involved with bowhead whale harvesting for a long time and we don't talk about it often enough. It is unfortunate that this workshop is only starting now… . …[because] Inuit who are knowledgeable in whaling are no longer with us – they could have relayed information on what is needed and what needs to be done when actually harvesting a bowhead whale. As there was a special technique when harvesting a bowhead whale unlike when hunting for common wildlife. Because of their large size and [as] they were hunted traditionally where it could not be killed just like that, there were specific areas in the body that were targeted to kill the bowhead whale. [Jaco Evic, PA/ws] BB387

There is a common conviction that to resume bowhead hunting, it would be necessary to obtain some help and training in order to re-learn how to hunt the whale successfully.

… we are not bowhead hunters, although we were born in the time of bowhead hunting, but when one is a child at that time it is hard to know about them too much, we only know about what we have heard… …I do not think the Inuit should say that they are professional bowhead whale hunters, the bowhead whale is such a large mammal and they are not easy to kill when you do not know them, so that is why I would like to see some kind of training before we

can actually go out and hunt one for the first time, perhaps getting people from different communities to hunt for the bowhead…. [Ben Ell, IQ] HS10

3.2.5 Traditional Inuit Customs and Legends relating to Bowhead Hunting [39]

Bowhead whales were an integral part of the traditional way of life of the Inuit. Inuit life was intimately linked to the bowhead whale. Bowheads had a vital influence on Inuit survival, culture and traditions. Inuit had special laws, rules and customs related to hunting the bowhead whale. They had to respect these traditions in order to increase their chances of having a successful hunt. They also had several beliefs that had to be honoured.

One important belief was that whales would always be available if they were harvested with respect. As already discussed (*see* section 3.2.1), Inuit believed that all wildlife species were put on earth to be utilized. Not harvesting wildlife, including the bowhead, might cause a species to decrease in number and eventually disappear.

…The bowhead whale too, if it is not hunted anymore will become less and less. With regards to the one that was recently killed [at Igloolik in 1994], people are saying some of the maktak was very rough and it didn't seem to be very healthy. People say that the animals have to be hunted continuously… [Sabina Issigaitok, HB] FB70

Hunting a bowhead whale required much courage on the part of the hunters. However, hunters were not supposed to praise themselves or think that they were especially powerful (Kooneeloosie Nutarak Sr., BB467).

The bowhead was considered to be a strong animal and difficult to hunt. Several rituals and customs were meant to increase the chances of a successful hunt.

…Inuit had a lot of rituals and these were mainly to ease the work required, and perhaps that ritual [when they are hunting for bowhead whales in kayaks, that they had to undo their kamik [boot] laces to relax the bowhead whale] was also to ease the hunt. [Participant CH/ws] HB110

In the Hudson Bay area, according to traditional custom, the women had to lie down in their tents and not move while a bowhead was being hunted. They would have to do this to ensure that the whale would not be too strong so that the hunters, their husbands among them, would be successful (Martha Kutiutikku, HB167; Simon Inuksaq, HB170; Participant/ws, HB103). This custom, among others, is reminiscent of customs which are part of traditional Inupiat (Alaskan) bowhead hunting (*see* Lowenstein 1993).

…there is a person who came from Labrador, whose name was Joe; when he killed a bowhead whale by kayak, at the time of the commercial whalers, when he started to kill the bowhead whale, at the time when they were still following the traditional law, the wife started to sew land caribou skin socks, while her husband was killing the bowhead whale, which was a taboo to do, such that she can kill her husband by doing that; perhaps she thought he was too mighty, and sometimes the men would have protection against such things; and then after he landed the bowhead whale, with the help of others, and the wife who wanted her husband dead, would look like she liked him; and then they went to sleep but she never woke up the next day and they didn't know what killed her so instantly, so they used a shaman to investigate, and the shaman found out what had caused her death. That is what happened to her when she wanted her husband dead on purpose, by sewing a land animal, like the caribou skin, for her husband, while he was killing the bowhead whale. But instead it back-fired on her because of the [husband's] protection, and at that time when the men were hunting bowhead whales they had to follow many traditional laws, by not being allowed to do certain things, and this went on just until recently. [Felix Pisuk, RI] HB264

When it was time to harpoon the whale, it was believed that the bowhead could be very selective regarding the hunter who was chosen. The bowheads would manifest their preferences regarding the hunter designated to harpoon them. Their wishes had to be respected (Joanasie Kakka/ws, BB503).

Another belief was that happiness or joy should not be expressed during the hunt, until the whale is dead and landed, otherwise the whale could be lost (Participant /ws, HB231; Philip Kripanik/ws, HB243).

Some informants mentioned that showing too much happiness before the whale is dead could result in a '*pelurqtuuq*' [or '*pilluktuk*'] (Participant/ws, HB221; Abraham Tagornak, HB178). '*Pelurqtuuq*' is a transformation of one species into another. Traditional Inuit believed that bowhead whales could sometimes turn into narwhals (Participant/ws, HB222).

…The bowhead whale was harpooned right in front of our camp by my father, as my father was still using kayaks back then. The three kayaks consisted of my father, Kuttiq and Javagiaq. We could see the whale being harpooned and the float was set onto the water. Then they started going after it – waiting for it to surface, then going after it, more or less trying to keep up with the whale, and they used anguviak (round shaped drag) [anguvigaq = lance or spear], and finally when they were able to go right up to it they started to jab it with spears [lances]. After it was jabbed with anguvigaq (lance) it went under and after a little while it surfaced again as a little young narwhal with a small tusk… [Participant, RB/ws] HB221

Inuit culture possesses numerous legends that have been passed from generation to generation through the oral tradition. The following story, which has many variants, is one example of those stories handed down from the past:

…before my parents were ever born there were lots of bowhead whales. …there was a very capable man [in many versions of this story his name is

Tapatai]… – I think he was physically well built and strong, and during the summer months when the wind was blowing from the open water he used to travel [by kayak] towards the open water before the wind got too strong and stayed for sometime, apparently he wanted to harvest a bowhead whale… He was away for quite sometime and by the time he arrived back at the camp it was quite windy. …When he arrives he goes to bed and stayed in bed for most of the day – the wind was blowing strongly from the open sea. …As the afternoon falls he started saying "avataqjuk qinniktauqataklii taimma tiktaunajaktuq tammaunga" ("Look for the float, it should be floating this way"). As it turns out, the float (made from young ringed seal) was attached to a dead bowhead whale. Meanwhile he remained in bed as he was quite tired and by the time he started to get better people sighted the float. When the float was sighted he got up and beached the bowhead whale and cut it up. [Noah Piugattuk, IG] FB97

Legends often had a moral value. The stories told would generally provide a message or a lesson…

…The wildlife are very sacred to us and we had to respect them. I have heard of one incident in which someone found a raven caught in a fox trap. [the hunter got upset at the raven for taking the bait] Then he proceeded to take the feathers off the raven, but he left the feathers on the wings, and let it take off into the air without any feathers with the exception of the wings. When the fox hunting season came, instead of foxes he was catching ravens, and he got upset over that, and later on in time we hear that one of his children died from losing all of his body [skin] and consequently he [the child] died as a result. Those things were told to us to help us understand that we have to respect the wildlife the way we respect other people. [Joanasie Arreak, PI/ws] BB451



Cutting up bowhead harvested at *Qikiqtan*/Kekerten Island, July 1998. Photo by Johnny Nowdlak

…There was also an occasion hunters harvested a bowhead whale out in the open sea and they were cutting up the bowhead whale out in the open seas in front of Arviqsiurvik [near Hall Beach] – he [the hunter] was pushed into the water and kept there till he died – this may have been related to some other person trying to get his wife. Quligaujak was the bowhead whale harvester who was pushed into the water and he was the provider for the camp. Panisuaq was the one who pushed him into the water while they were cutting up the bowhead whale in the open water in front of Arviqsiurvik. From that day on the bowhead whales left the seas and there were no more bowhead whales to be seen and this was the result of someone using the bowhead whale for wrongful reasons and the consequence was that there were no more bowhead whales in our entire waters. Wildlife of the seas should never be used to take vengeance, or to be harmed for no purpose. [Noah Piugattuk, IG] FB97

3.3 INUIT HUNTS OF BOWHEADS AFTER 1915 [40]

Inuit informants provided details of many bowhead hunts conducted during the decades following the end of commercial whaling (*see* section 3.2.3.iii). Although in many cases the years reported by Inuit were somewhat at variance, many of these hunts could be confidently matched with hunts reported in Mitchell and Reeves (1982) who obtained their data from the historical and archival literature. Their Table 1 indicates that 18 bowheads were harvested and/or found dead by Inuit in Northern Hudson Bay/Foxe Basin between 1919 and 1975, while six bowheads were harvested and/or found dead by Inuit in the Baffin Bay/Davis Strait region between 1922 and 1975. The Mitchell and Reeves (1982) compilation indicates that most post-commercial harvests of bowheads were in Northern Hudson Bay until about 1940, while after 1960 most catches were in Northern Foxe Basin. This accords well with the notable increase in the number of bowheads frequenting Northern Foxe Basin in the early 1960s (section 3.1.1).

Informants provided much additional information on the hunts tabulated in Mitchell and Reeves (1982), including hunting techniques, names of hunters involved, disposition of the harvest, etc. *See* section 3.2.3.iii which provides an overview of post-commercial Inuit whaling and a list of quotation numbers which refer to post-commercial Inuit bowhead hunts quoted in the 'Source Book of Quotations'. Where possible, the quotations are cross-referenced to the corresponding hunt as given by Mitchell and Reeves' (1982) Table 1. A few other hunts could not be confidently matched nor definitely recognized as 'new' hunts. However, we believe that our Study has revealed 12 'new' hunts (eight bowheads landed) documented by Inuit that are not in the Mitchell and Reeves compilation. It is highly likely that there have been other post-commercial Inuit hunts, in addition to those compiled by Mitchell and Reeves and besides the 12 'new' hunts which are summarized in Table 1.

Table 1. Summary of Inuit hunts of bowhead whales from about 1917 to 1975 in Nunavut, as revealed by informants in this Study, but not in the compilation of Mitchell and Reeves (1982).

Number landed/ Number struck	Year(s)	Location	Hunted by	Details/Comments (with quotation references)
1/1	Ca. 1917-1918	*Igarjuaq* (Mount Herodier), near Pond Inlet (summer, open-water season)	Inuit of Pond Inlet	Workshop participants from Arctic Bay and Pond Inlet agreed closely on this hunt – there were two Inuit bowhead hunts earlier in the century. Bowhead was small. Nutaraajuk and Pauloosie Akumalik harpooned it from kayaks, then the whale stranded on a sandbar where it was killed. It may have initially been driven close to shore by killer whales. The whale was well-utilized. (BB77, 259, 262, 266, 444, 460, 466, 468, 475)
1/1	Ca. 1920	*Qivittuuq*/Kivitoo (North of Qikiqtarjuaq)	Inuit of Kivitoo	Initially wounded and driven shoreward by killer whales. Killed by Naujarbic with whalers' equipment. (One informant said the Inuit used guns). (FB50; BB278, 417, 420, 529)
3/3	Ca. 1939 – 1942	*Kuuk*, a camp between Leyson and Seahorse Points, SE Southampton Island	Inuit of Southampton Island (Mikitok Bruce and others)	All fall (September) kills. Generally used explosive harpoons/darting guns. According to M. Bruce (HB95), there were 3 successive harvests, one per year over a 3-year period. Another whale may have been lost due to harpoon line breakage (HB93). (HB5, 73, 93, 94, 95, 97, 100, 101, 104, 113, 114, 116, 123)
1/1	Ca. 1947	*Tajarniit*/Beach Point, Repulse Bay	Katuquq of Repulse Bay	Whale harpooned but lost (line broke due to ice); carcass drifted and was recovered by Mikitok Bruce at *Arvialuktalik*/Cape Bylot (near *Aqiarunnaq*/Duke of York Bay, N. Southampton Island); harpoon head returned to Katuquq. (HB5, 91, 134, 288, 303)
0/1	'recently' when hunting was not allowed	Kimmirut area, near *Kangarjuaq*	Inuit of Kimmirut	Many boats involved; springtime; whale shot with rifles but no blood seen. It had been harpooned twice using 5 gallon drums for floats but the line kept breaking; the whale escaped. (HS140, 153)
0/1	Uncertain, but likely some time after 1960	At the community of Cape Dorset	Usuittuqpaujaq, Usutsiaq Pudlat, and Mangitak Kellypalik	Young bowhead near shore, perhaps scared by killer whales; harpooned and possibly lanced many times; whale lost/escaped. (HS19)
0/1	Likely in the 1940s or 1950s	*Nursarnaajuk*/Foster Bay (north of Hall Beach)	Grandfather of Mary Nangmalik of Whale Cove	Whale harpooned and killed, but lost (HB289)
1/1	Unknown (possibly in the 1940s)	Repulse Bay area	Angutinguaq of Repulse Bay along with Prime Okalik (now of Whale Cove)	Darting gun was used, whale killed with a shot to the head (HB301)
1/1	Unknown (probably before 1960)	Near Pangnirtung	Hunters from an outpost camp (*Iqalulik*)	Bowhead calf shot, killed, and sank. Observed by Mosesie Qappik as a child (BB231)
0/1	1975	*Arviarjuaq*, near Arviat	Hunters of Arviat	Bowhead shot by hunters; it escaped but its fate was unknown (BB446)

Interview and workshop transcript excerpts in support of some of these 12 hunts are given below, region-by-region. Quotation reference numbers in Table 1 will refer the reader to these excerpts or to the longer, more-detailed quotations in the Source Book of Quotations.

FOXE BASIN

The most recent bowhead hunt (not licensed) occurred in September 1994 at Igloolik, where Inuit harvested a young, 9-metre female using rifles, harpoons, and lances. Approximately 200 kg of maktak was utilized and shared among the three regions of Nunavut. Some meat was used for local dog teams, and the baleen was collected.

I have seen and heard of one bowhead whale that was killed in Hall Beach [at a place called Nursarnaajuk/Foster Bay]. This was when I was a child. I'm the oldest in my family and my grandfather had harpooned and killed a bowhead whale near Hall Beach, but something happened and they were not able to get the bowhead whale. Perhaps the harpoon line broke and the whale escaped or drowned. [does not appear to be in the Mitchell and Reeves 1982 compilation; this would probably be in the 1940s or 1950s, considering the year of birth of this informant] [Mary Nangmalik, WC] HB289

HUDSON BAY

The most recent hunt (approved by the Nunavut Wildlife Management Board and licensed by the Federal Department of Fisheries and Oceans) occurred in mid August 1996 at Repulse Bay, where Inuit hunters took a 16-metre male bowhead whale using rifles and harpoons. Most of the maktak was utilized and shared among the three regions of Nunavut. None of the meat was utilized because the wounded whale dove during the hunt and the carcass did not surface until two days later, by which time it had bloated. The baleen was collected.

How the bowhead whale died was simply by someone harpooning it [1947 harvest – see Table 1], and obviously no one should shoot a bowhead whale if they don't intend to harvest it – for one basic fundamental reason, once the meat has been damaged, no matter how small, it will eventually die from the wound. In this particular situation no explosives were used – he just harpooned the bowhead whale and the harpoon head did touch the meat and consequently it died from the wound. The meat of the bowhead whale should never be touched by any means – if you only wound it by the blubber I don't think it would do any real damage, but if you wound it by the meat it will die. [Mikitok Bruce, CH] HB5

…Actually we used to use explosive-tipped harpoons to harvest bowhead whales. There was an incident where Samson's father harpooned a bowhead whale with an explosive-tipped harpoon and he forgot to set the trigger in the harpoon and it failed to explode inside the bowhead whale… When it finally died we started to drag-float the whale but it got pretty windy from the sea – and we decided to let it go – believing that the wind would blow it towards the land, and it was very windy the next day so we didn't bother trying to salvage it. The next day the wind had died down, it was found floating and we cut the front portion off the bowhead whale as the two boats were loaded to the till and we left it. [Mikitok Bruce, CH] HB5

As we lived in the Aqiarunnaq/Duke of York Bay, they [Inuit] had gone to hunt for the Bowhead Whale. But they were not successful. [may or may not be a 'new hunt', not enough information] [Rhoda Karetak, RI] HB79

…I did attempt to harvest one in 1964-65 [near Coral Harbour] but due to too much wind I was not able to harvest one… …since then the prohibition on bowhead whales has been in place, thus I never attempted to get another one. [the whale was not struck – Coral Harbour Workshop, 1996] [Mikitok Bruce, CH] HB90

The only ones that were involved with bowhead whale hunting were the people that I grew up with, people like Qajagjuaq, Aulanaaq [John Ell], Pamiulik and my father. Including myself and Satiana, there used to be only six of us that did actual bowhead whale hunting, using two boats. [Mikitok Bruce, CH] HB96

We had attempted to get one at the floe edge [near Coral Harbour] but the bowhead whale got wise and left before we had a chance to do anything. This would have been around 1975. …at that time I readied my equipment for the harvest that was not successful. [Tooma said that the whale was not struck] [in the Mitchell and Reeves 1982 Table 1, there is reference to Coral Harbour Inuit striking and losing at least one whale in the vicinity of Coral Harbour in 1975.] [Tooma Netser, CH/ws] HB119

…I had this weapon [a darting gun with explosive device, given to me by my father-in-law] but Angutinguaq from Repulse Bay used it on a bowhead whale and the bowhead whale drowned.… …the harpoon line got tangled with the very heavy dart gun and as it got tangled it broke the harpoon line. …the whale drowned just before it was facing the boat. …it was shared among everybody in the camp. During those times, that was the only food that they had so they shared the animal that was killed. The meat of the bowhead whale was also used as food. If you butcher the bowhead whale shortly after it is killed, the meat will not spoil …I remember eating some of the bowhead whale… …It was very delicious. [this occurred in the Repulse Bay area; given the year of birth of the informant and the fact that the darting gun was used, it does not appear to be in Mitchell and Reeves 1982] [Prime Okalik, WC] HB301

BAFFIN BAY

The most recent licensed hunt occurred on July 21, 1998, at *Qikiqtan*/Kekerten Island in *Tinnujivik*/Cumberland Sound, carried out by hunters from Pangnirtung. Harpoons and a shoulder gun were used in this hunt. The maktak, meat, and tongue were utilized and shared with other communities in Nunavut. The baleen and most of the skeleton were collected.

…[as a child] we were still living in our outpost camp near Pangnirtung called "Iqalulik" [on outer headland between Kangilo and Nettilling Fiords]. …when

we were near Pangnirtung, they saw a bowhead calf [no mother] from the land. …the men left the women on the land and the men went rowing down to the calf by the boat, it was really close… …it was a very small calf. …the Inuit tried to catch the calf, by shooting it but it just sank. … it died right away when it was shot [Mosesie Qappik, QK] BB231

I have also heard in Qivittuuq/Kivitoo when people were living there, I have heard killer whales went after a bowhead whale and quit before they killed it – and Inuit harvested it [bowhead] with guns. [this happened around 1920 at Kivitoo] [Pauloosie Angmarlik, PA/ws] BB417

3.4 MANAGEMENT AND POSSIBLE FUTURE RATES OF HARVESTING OF BOWHEAD WHALES [41]

Informants expressed concern that bowhead populations should be carefully and properly managed, so that the number of bowheads in Nunavut's waters may continue to increase well into the future. This will require strict control and management of any future harvesting. However, they also believe that bowheads are sufficiently numerous at this time to sustain a limited but on-going harvest. Generally, one harvested bowhead would not provide for the needs of all Inuit in Nunavut, and regionally-based harvesting (with meat and maktak provided only to one region) would be preferable.

Suggestions for an appropriate rate of harvesting, considering both regional needs and the current abundance of bowheads, varied from a high of three bowheads per year (one per region) to one every second year. The most frequent suggestions were: one per year or one per two years (three informants); one per year with the regions alternating (three informants); and two per year, one for each of Baffin and Kivalliq (four informants). Informants believed that these rates of harvesting would be sustainable, given the abundance of bowheads nowadays and the increase in bowhead numbers in recent decades.

…and they (bowhead population) will not be affected if we were to catch one, due to the bowhead stock becoming healthy like it was back then here in our land, they are increasing… [Ben Ell, IQ] HS36

…each year a regionally-based community [should] harvest a bowhead whale… …each region [should] take turns harvesting a bowhead whale every year. I also find important the need to establish and maintain the management of bowhead whales, that way harvesting of bowhead whales could go on for a long time… [Donat Milortok, RB] HB41

…one bowhead whale is going to be killed [at Repulse Bay in 1996], so the people [of Nunavut] will share it amongst themselves, but there's not going to be enough. [Leo Mimialik, CI] HB133

…it wouldn't make any difference to me if there is no quota for Netilikmeot [east Kitikmeot] communities, I fully support a quota for Baffin Region or Keewatin/Kivalliq because elders in those regions are craving for maktak. Since the bowhead whale population has increased, I don't think one whale would really hurt the population. [Jose Angutingungniq, PB] HB156

It would be so nice if the Baffin Region and the Keewatin Region would be given one bowhead whale each to kill because there would be enough to go around then. [Mary Nangmalik, WC] HB292

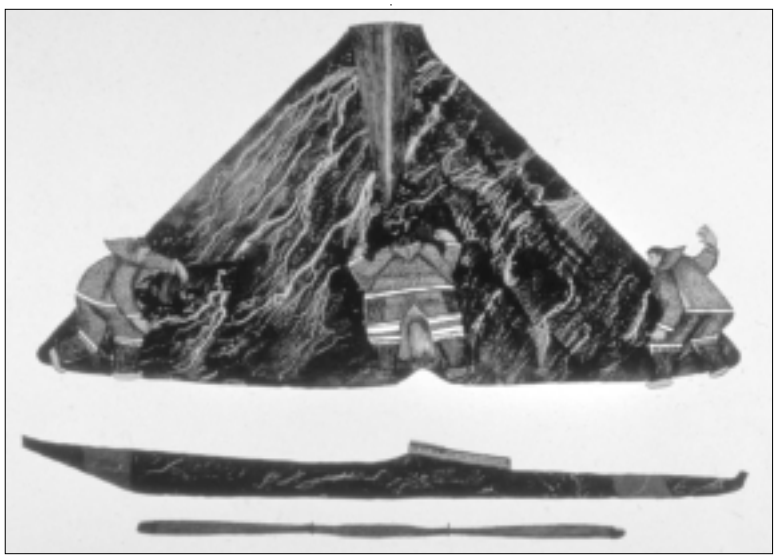
I would be in support of the hunting of the bowhead whale to be managed properly. …if they hunt one bowhead whale every year, then I cannot see the bowhead whale declining. If the bowhead whale could be hunted every year I would be in support of this, or even if it could be hunted every two years… [Jaycopie Audlakiak, QK] BB499

4

Summary and Conclusions

4.1 INUIT KNOWLEDGE OF POPULATION ECOLOGY OF BOWHEADS

1. Inuit recognize that bowhead whales were numerous prior to commercial whaling, citing as evidence the abundance of old whale bones in many localities where ancestral Inuit whaled and made their homes. They believe that ancestral Inuit whaling did not have any significant impact on bowhead whale populations. Many elders (e.g., the late Aksayuk Etuangat of Pangnirtung) testified that bowheads were very scarce in the decades following the cessation of commercial whaling, and many others reported hearing about this from their elders as well. Inuit, realizing that commercial whaling depleted these stocks, pointed out that Inuit were not responsible for over-harvesting. They believe that the infrequent harvesting of bowheads by Inuit after about 1915 reflected both the low abundance of bowhead whales as well as a common notion that a ban on the taking of bowheads was in effect. Inuit stated that they generally refrained from harvesting bowheads after the end of commercial whaling in spite of at least some continuing opportunities to do so.



"Measuring the Whale's Tail," Oshoochiak Pudlat, Cape Dorset

2. Many elders, who are still active in hunting and traveling, and some senior hunters from throughout the Study Area testified that, when they were children or younger adults, they saw bowheads only rarely or in very small numbers, but in recent years or decades they have seen greater numbers of bowheads.

In northern Foxe Basin (particularly in the mouth of *Ikiq*/Fury and Hecla Strait), Inuit provided evidence for an increase in the number of bowhead whales during recent decades, particularly since about the mid 1960s, when several bowheads were harvested in this area. Elderly informants and senior hunters, as children or younger adults, reported seeing few bowheads; in recent decades, they have seen greater numbers. Some reported that the increase since the 1960s has been fairly steady.

In the Hudson Strait area, informants reported that sightings of bowheads have increased in comparison with earlier times. However, some informants were uncertain if this reflects a real population increase, suggesting instead that increased hunter mobility and redistribution of bowheads might be contributing factors. The testimony suggests that the increase in sightings in the *Sullualuk*/Hudson Strait area is not as marked as the increases observed in other parts of Nunavut.

In the Hudson Bay area, Repulse Bay and Chesterfield Inlet residents also noted changes in the number of bowheads they have sighted in recent years or decades as compared to when they were children or younger adults. Bowhead numbers began to increase in the Repulse Bay area around 1965. Prior to that time, the residents of small settlements

outside Repulse Bay took especial note of any bowhead sightings, expressing surprise or a feeling of awe.

In the Baffin Bay region, many Arctic Bay elders related that bowheads were rarely seen during their childhood and early adulthood, but that bowhead sightings have been increasingly frequent in recent decades, particularly since the early 1960s. Some informants provided other dates for noticing an increase: 1973-1974 with an accelerating rate of increase in the 1990s; the 1970s; or the early 1990s. A bowhead sighting before the 1960s tended to elicit much excitement and curiosity, but not so nowadays. One informant suggested that the increasing abundance of bowheads near Arctic Bay may be due to changes in their distribution.

Elders from Clyde River pointed out that bowheads were rarely seen near their settlements (e.g., *Igaliqtuuq*/Isabella Bay) prior to re-settlement at Clyde River in the early 1960s. At that time, sightings of bowheads started to become more frequent throughout the Clyde River resource-use area.

In recent decades, Inuit have noticed more bowheads at the floe edge (in May/June) south of Pangnirtung. At the time of their childhood or young adulthood, elders saw whales only infrequently, but in recent decades they have sighted more and more whales in *Tinnujivik*/Cumberland Sound. The testimony suggests that bowheads were still scarce in the Sound during the 1960s, with the increase becoming detectable by the 1980s.

As children or younger adults, Pond Inlet informants saw bowheads infrequently, but in recent years or decades they have seen bowheads in larger numbers. While the rarity of a sighting had created much excitement among the people, this is not so nowadays. At the Pond Inlet floe edge, sightings have increased, especially from about 1942. The reported time when the increase in sightings of bowheads in the Pond Inlet area became detectable varied widely (1942 to 1992) among informants, with most suggesting that this occurred in the late 1960s to mid 1970s.

Elders of Qikiqtarjuaq also reported increased numbers of bowhead whales in recent times as compared to when they were children or younger adults. At least one person, however, wondered if there had been a real population increase or merely a change in feeding distribution.

3. Many elders testified that, as children or younger adults, they saw bowheads only rarely or in very small numbers, but have heard from other hunters that bowheads have become more numerous in recent decades. These elderly informants, no longer active in hunting and traveling in recent years, have relied largely on information from active hunters.

In the Hudson Strait region, several informants provided testimony of this general nature.

From Hudson Bay, Coral Harbour informants reported that they rarely saw bowheads at the floe edge in the past, and that hunters now relate to them that bowheads are abundant at the floe edge during May and June. This increase in sightings at the floe edge began in the late 1980s. Informants from Chesterfield Inlet reported that bowheads were scarce or absent in the area until about 1950, but hunters have been seeing more bowheads in recent years. As children or younger adults, Repulse Bay informants infrequently saw bowheads; they have heard that hunters have been seeing more bowheads in recent years, beginning in the 1970s, especially at the floe edge. Prior to the 1960s and the extensive utilization of motorboats, hunters traveled extensively by sail boat, yet reported seeing few bowheads. One informant, maintaining that bowhead numbers have increased, also suggested that increased frequency of sightings could be attributed to changes in bowhead distribution and/or increased hunter mobility.

In the Baffin Bay region, one elder from Arctic Bay saw very few bowheads when she was a young woman, and related that hunters nowadays frequently see bowheads at the floe edge. While suggesting that increased sightings may partly reflect modern, faster transportation methods, she concluded that the bowhead population is increasing. Another informant, recalling that bowheads were frequently seen at the floe edge during the late 1930s, stated that "*The hunters say there are more bowhead whales now than there have been in past times when I would go out and camp with my family*".

Aksayuk Etuangat of Pangnirtung was born about 1900 and was raised at *Qikiqtan*/Kekerten Island in *Tinnujivik*/Cumberland Sound. He was involved with the final phase of commercial whaling there around 1918-1920, and reported that at that time bowheads were infrequently seen and harvested at Kekerten. He has heard from hunters about the increased numbers of bowheads in recent times at *Qikiqtan*/Kekerten. The scarcity of whales at *Qikiqtan*/Kekerten by 1920 was confirmed by Pauloosie Angmarlik. This testimony, combined with that of Inuit with lifetime experience regarding bowheads (section 3.1.1.iii), along with recent observations of bowheads by hunters (section 3.1.1.vi), provides strong evidence for a post-commercial increase of bowheads in Cumberland Sound.

Kooneeloosie Nutarak, Sr. of Pond Inlet contrasted his infrequent childhood observations of bowheads with hunters' recent reports of abundance of bowheads in the Clyde River and Pond Inlet areas.

4. Active hunters from throughout the Study Area have reported seeing large numbers of bowhead whales within their communities' resource-use areas. In spite of not having the benefit of their own base-line observations from earlier parts of the 1900s, many have concluded that bowhead populations have increased in numbers over the past few

decades. However, many of these same hunters do refer, in other parts of their testimony, to elders' observations of the scarcity of bowheads in earlier times.

In Foxe Basin, hunters from Igloolik have sighted large concentrations of bowheads near their community in recent decades, and they believe that the bowhead population has been increasing.

In Hudson Strait, informants from Cape Dorset and Kimmirut report sightings of large numbers of bowheads in their respective areas.

In Hudson Bay, Ben Ell (now residing in Iqaluit) witnessed an abundance of bowheads (in groups of 10 to 20) in the Coral Harbour area when he resided there in 1955-56. People see good numbers of bowheads every summer in the Chesterfield Inlet area nowadays, as compared to elders' accounts of the absence of bowheads at the end of the commercial whaling period.

Bowheads are numerous in the Repulse Bay area from spring to fall, and the population has increased according to informants. John Kaunak noted that whales are concentrated and numerous at the floe edge in June, but that after ice break-up, they disperse and are seen in smaller numbers. Whales then gather inshore in August.

In the Baffin Bay region, Arctic Bay hunters have reported an abundance of bowhead whales in their community's resource-use area, and they believe that the population has increased.

Clyde River informants mentioned the large numbers of bowheads seasonally occurring and migrating/feeding within the community's marine-use area, including the large feeding aggregation that occurs at *Igaliqtuuq*/Isabella Bay in late summer and fall. Considering the large number of whales that they see, some informants believe that the bowhead population in this area has grown.

Many informants from Pangnirtung emphasized that they frequently sight large numbers of whales. The floe edge southwest and south of Pangnirtung (off *Qikiqtan*/Kekerten Island) has been occupied by increasing numbers of bowheads in recent decades during the months of May and June (sometimes as early as March and April), and the bowheads tend to be concentrated or occur in large groups. After ice break-up, the whales disperse widely in small groups, so that the overall rate of sightings decreases during the summer. Based on reports of elders (some of whom were present at the whaling stations of *Qikiqtan*/Kekerten and *Ummanagjuaq*/Blacklead Island during or just after the last days of whaling) that bowheads were sighted infrequently several decades ago, many informants have concluded that the population of bowhead whales in *Tinnujivik*/Cumberland Sound has increased since the end of commercial whaling.

One informant from Pond Inlet reported an annual occurrence of bowheads at the floe edges off Pond Inlet, Navy Board Inlet, and *Tallurutiit*/Lancaster Sound. Others have reported that bowhead whales occur in large numbers in the Pond Inlet area during summer. One informant reported that his wife counted a minimum of 74 bowheads on migration in Navy Board Inlet during summer 1996. Some informants reported that their elders had seen very few bowheads in the Pond Inlet area at the conclusion of commercial whaling in the early 1900s.

Many informants from Qikiqtarjuaq reported seeing large numbers of bowheads in summer and fall within the community's resource-use area. As a child many years ago, Jaycopie Audlakiak observed, in the vicinity of *Palligvik*/Padloping Island and near *Qivittuuq*/Kivitoo, *"so many bowheads you could hardly see the water."* Hunters reported many more bowhead whales in Qikiqtarjuaq's waters in summer/fall of 1994 than in 1993. In 1994, bowheads occurred in large numbers at the spring floe edge, and in summer/fall they were numerous in nearshore waters in many localities. Killer whales came into Qikiqtarjuaq's waters also in the summer of 1994. Some informants believe, on the basis of the large numbers of whales seen in the area in recent years, that the bowhead whale population has been increasing.

5. Several informants did not provide their own observations of bowhead abundance and/or changes in abundance, and instead have cited the observations of other hunters that bowheads are very numerous nowadays, or that bowhead numbers have increased in recent years/decades. Informants from Igloolik and Hall Beach have heard from other hunters about the abundance of bowhead whales in northern Foxe Basin. In Hudson Strait, informants have heard about the large numbers of bowheads that seasonally visit their areas. While they suggested that the bowhead population is increasing, their testimony indicates that increases have been quite modest in the *Sullualuk*/Hudson Strait area. In Hudson Bay, informants from Coral Harbour, Chesterfield Inlet, Repulse Bay, and Whale Cove stated that hunters have recently sighted many bowheads in their respective community areas. As a result, they have also concluded that bowhead numbers have increased since the end of commercial whaling. In the Baffin Bay region, some informants from Arctic Bay, Clyde River, Pangnirtung, Pond Inlet, and Qikiqtarjuaq have heard about the large numbers of bowheads encountered by local hunters in recent years. Many related these observations to population increase. One Pond Inlet informant related that an elder from Clyde River noticed that the increase in bowhead numbers began in the 1950s.

6. Seven active hunters, representing all four regions of the Study Area, testified that they have observed, in recent years, steady increases in bowhead numbers from year to year.

7. Many informants from all regions associated the large numbers of bowheads seen in recent times with the effective cessation of whaling after 1900. Although many merely assumed that bowhead numbers must have increased because of the absence of whaling, many of these same informants did provide substantial evidence of bowhead abundance and/or increase in population size.

8. A fair number of informants from all four regions of the Study Area believe that bowhead numbers have increased in recent times, but they did not provide substantiating evidence in the immediate context of their remarks. However, many of the same informants, in other parts of their testimony, have provided more substantial evidence for population growth of bowheads.

9. One informant from the Hudson Bay region provided evidence of a local decrease in bowhead numbers. This informant, an elder from Coral Harbour, reported that bowheads seem less numerous nowadays at *Nuvualuk*/Terror Point (on southeastern Southampton Island) compared to the 1960s. In the Baffin Bay region, an elder from Pangnirtung stated that bowheads were numerous in 1946 (when a bowhead whale was harvested); but after 1946, killer whales began to appear in *Tinnujivik*/Cumberland Sound and the bowhead population declined. Another elder from Pangnirtung also related a recent decline and/or dispersal of bowheads and other marine mammals in Cumberland Sound to the presence of killer whales, especially in *Isuittuq*/Clearwater Fiord. He also related that bowheads were plentiful at the time Inuit (including his parents) worked with the commercial whalers, and that the population later declined. Several informants reported that bowhead numbers and their distribution may fluctuate from year to year within the marine-use regions of their communities, but that such fluctuations are normal aspects of bowhead population ecology.

10. A small number of informants from Hudson Strait, Hudson Bay, and Baffin Bay suggested that bowhead numbers have been stable over recent decades. One informant stated that bowhead whales are infrequently sighted near *Uqsuriaq*/Marble Island (off the mouth of Rankin Inlet), and suggested that bowhead whales have not greatly increased in numbers in the Kivalliq/Keewatin region.

11. Although they may see bowheads frequently, many informants from all four regions could not comment on changes in their abundance. In Foxe Basin, one informant thought that increased numbers of bowheads in the area could be due to immigration or a population increase. Some informants deemed themselves unable to comment on population changes because they did not know what population numbers were in the past. Because bowheads are not hunted and hunters tend to focus their efforts on other species, some informants stated that they were not able to comment on population changes. In Hudson Strait, a few informants from Cape Dorset and Kimmirut attributed their lack of knowledge of bowhead population changes to a relative scarcity of bowheads in the region. In Baffin Bay, informants from Grise Fiord could not comment on population changes, perhaps because this community was only recently established, i.e. in the early 1950s.

12. Several informants stated that they had heard through the local community radio station, portable CB radio, and/or other sources, that bowhead numbers have increased or that bowheads are now quite numerous, in certain parts of Nunavut. The abundance of bowheads near Igloolik in summer and fall is well known to many informants. Two elderly informants from Repulse Bay had spent their childhood/early adulthood in the Igloolik area, and had rarely seen bowheads there. One believed that recent bowhead abundance near Igloolik is due to an immigration of bowheads as they are trying to get away from killer whales. Two Arctic Bay informants expressed the opinion that the abundance of bowheads near Igloolik in recent years is due to emigration from the Arctic Bay area, in particular because of disturbance at the *Tununirusiup Kangiq&ua*/Admiralty Inlet floe edge by hunters shooting narwhals. One of the informants from Arctic Bay suggested that this influx of bowheads into the Igloolik region began after the 1950s. Similarly, two Pond Inlet informants suggested that bowheads have moved from Pond Inlet to the Igloolik area, because of either better feeding opportunities or the disturbance due to commercial whaling in the Pond Inlet region earlier in the century. One in fact stated that Igloolik hosts many more bowheads than Pond Inlet and that bowheads have increased in numbers in the Igloolik region.

Clyde River and nearby *Igaliqtuuq*/Isabella Bay are well known for hosting relatively large numbers of bowheads; informants have attributed these large numbers to population growth. An informant from Kimmirut stated that bowheads are not as numerous in south Baffin Island as in the Clyde River area.

Many informants referred more generally to the high frequency of sightings of bowheads throughout eastern and central Nunavut, which they attributed to population growth. An informant from Kugaaruk noted that this population growth seems to have become noticeable in the late 1950s. Inuit informants from Hudson Strait frequently mentioned increases in numbers of bowheads in other areas, such as Clyde River and Igloolik.

Informants referred mainly to Clyde River, Igloolik, and Pangnirtung as places of significant bowhead abundance, with fewer mentioning Qikiqtarjuaq, Repulse Bay, and Coral Harbour. They generally attributed this abundance to growth of the bowhead population.

13. Informants from nearly all communities provided detailed observations and comments on the seasonal distribution, migrations, and behaviour of bowhead whales in the Study Area. These transcribed

observations (section 3.1.2.i) are complementary to the six maps of seasonal distribution and migration (section 3.1.2.iv), which are composites of the mapped data contributed by all informants in the Study.

In Foxe Basin, bowheads tend to concentrate during summer in the mouth of *Ikiq*/Fury and Hecla Strait after aggregating at the floe edge off Igloolik and Hall Beach.

In Hudson Strait, informants' observations and remarks give the impression that bowheads are not very numerous in this region. Bowheads apparently use the south Baffin Island coast mainly as a migration route. This, and a possible offshore distribution of migrants, could partly explain the irregularity and/or scarcity of sightings.

In Hudson Bay, Repulse Bay informants sight bowheads in small numbers in summer, only one to three at a time. The testimony of informants from Chesterfield Inlet suggests that bowheads are regularly sighted every year in their area, but only in small numbers. Informants from Rankin Inlet and Whale Cove apparently do not sight many bowheads in their communities' hunting territories.

Informants from all Baffin Bay communities provided a wealth of information on the seasonal distribution, migrations, and activities of bowhead whales in their marine-use areas. Bowheads are very rarely seen in winter, but they are often seen in spring at the floe edge, where large aggregations may occur (e.g., at Pangnirtung). During and after ice break-up, they move into nearshore waters where they engage in activities such as feeding, playing, mating, and occasionally calving. This inshore movement into shallow waters could also be related to avoidance of killer whales. In summer, bowheads tend to be more dispersed as they seek out the best feeding locations, although summer aggregations are also reported. In the fall, bowheads group up and begin their migrations back to wintering areas before or at the time of freeze-up. Superimposed on this general pattern, many informants reported annual variations in the occurrence, distribution, and number of bowhead whales in their communities' resource-use areas, which they generally attribute to variations in availability of the bowhead whales' food.

Informants also gave a great deal of information on the size/age composition and number of whales seen in groups at different seasons, and often attempted to relate this information to the behaviour and activities of the whales.

14. A small number of informants from Hudson Bay and Baffin Bay stated that bowheads return to the same locations every year for feeding and other activities. A few informants indicated that the same whales are involved and thus demonstrate site fidelity; e.g., the same whales return every year to *Igaliqtuuq*/Isabella Bay. Some informants speculated that the bowheads seen in spring at the floe edge are also seen later on (in summer) along with smaller whales. Informants did not present observations or speculations on stock identity and discreteness.

15. Many informants from all regions reported the relatively new occurrence of bowheads in areas where they were not seen before, and this was often related to or attributed to an increase in the population. However, some informants raised the possibility that a new occurrence of bowheads in an area may reflect a re-distribution of animals and not an actual population increase. One informant suggested that Inuit may lack this kind of knowledge, since bowheads have not been harvested and utilized for a long time. Informants also suggested that killer whales may cause bowheads to temporarily abandon traditional and favoured areas. Kugaaruk residents sighted bowheads during the early 1990s in their hunting area, previous to which bowheads were apparently rarely seen in the area. All sightings from 1992 through 1994 have been in the same general area near Kugaaruk. However, one informant inferred that increased hunter mobility may be involved in the increase of reported sightings in the Kugaaruk region.

16. Only a very few informants explicitly reported an increase in group size of bowheads in recent years. Most of them related this to concurrent increases in frequency of sightings and in the overall numbers of bowheads. Several informants stated that in earlier times bowheads usually were solitary, but that they now occur in groups.

17. Informants from all four regions of the Study Area reported the occurrence of bowhead calves with their mothers. Many calves are seen near Igloolik (Foxe Basin area) in summer, suggesting that this is a nursery area for bowhead whales. One informant witnessed a female bowhead giving birth at *Siorat* in the Igloolik area, and believes that this could be a bowhead calving area. Another informant reported that mother/calf pairs were not seen in this area when he was young. In Hudson Strait, only a few sightings of bowhead calves were reported. One informant suggested that the lack of attention paid to bowheads nowadays accounts for the lack of sightings of calves and observations of trends in their abundance. Informants from Hudson Bay have reported calf sightings, especially around southeastern Southampton Island and in the Repulse Bay area. One informant suggested that Repulse Bay may be a bowhead nursery area. In the Baffin Bay region, only Kugaaruk informants did not report sightings of calves. Calves are frequently sighted in the vicinity of Arctic Bay, where the spring migration and arrival of mothers with calves occur later compared to other bowheads. In the Clyde River area, mothers with calves are occasionally seen in late summer/early fall at *Igaliqtuuq*/Isabella Bay, and some informants surmised that calving occurs here. A few informants have observed or otherwise provided evidence of calving in Isabella Bay and at other locations, while other informants reported not seeing calves at *Igaliqtuuq* or elsewhere. The locations of calving areas for the bowhead whales in this region seem to be unknown. Newborn calves are described as being reddish in colour, while solitary juveniles

(*ingutuit*) are also seen during fall at Isabella Bay. One informant reported that southbound, fall-migrating bowheads had many calves with them as they passed Isabella Bay. Near Pangnirtung, informants reported mother/calf sightings mostly in spring (when whales are concentrated at the floe edge) and early summer, rather than in late summer or fall; calving may occur in the area, as a few informants reported seeing the birth of a bowhead and/or direct evidence of a very recent birth. Similar to the situation at Clyde River, Pangnirtung informants reported the occurrence of red-coloured calves, probably newborns. Many informants also reported the occurrence of solitary *ingutuit*/yearlings in the Pangnirtung region. Pond Inlet informants reported seeing mother/calf pairs at the floe edge at *Sanirut*/Button Point, where it is believed that calving may occur. Informants also reported seeing a female bowhead with a newborn and an older calf. Qikiqtarjuaq informants reported seeing mother/calf pairs in the shallow waters off *Qivittuuq*/Kivitoo (which may be a calving area), and calving was also suggested to occur in the waters around Qikiqtarjuaq. One informant indicated that he had seen evidence of actual calving. As in other communities, the older, solitary *ingutuit* are also seen.

Although many informants from all regions reported the presence of calves and small juveniles, only a few informants representing all four regions commented on the connection between the presence of calves and juveniles and the growth of the bowhead population. Only one informant from Repulse Bay and two from Igloolik reported that more calves are seen nowadays compared to times past. As noted previously, the reduced interest and lack of attention paid nowadays to bowheads could be responsible for the paucity of information about increases in number of calves and other particulars about bowhead whales.

18. An important question with regard to increased sightings of bowheads in recent decades relates to possible changes in 'observer effort' over this time period. Many informants pointed out that Inuit knowledge of bowheads has been diminishing in recent years, especially regarding certain details such as presence of calves and changes in bowhead distribution. In good measure, this is because the bowhead has not been regularly harvested for many decades. Furthermore, Inuit no longer live in widely-dispersed settlements (as they did before the 1960s), and thus may have less opportunity today to observe these specific and more subtle changes. On the other hand, hunters nowadays can travel great distances by snowmobile or boat to reach various distant hunting areas (where the Inuit population used to live), and they could have the opportunity to observe bowheads, trends in their abundance, and other changes. However, the hunters tend to ignore bowheads because they are looking for other wildlife. 'Observation effort' is difficult to describe and quantify. The factors involved are many, and some of the most significant of these factors at either end of a particular time series (e.g., pre-1960 versus the present time) probably tend to balance out. Thus, the dispersed nature of Inuit settlement within a present-day community's marine-use territory would tend to be offset by the ability of hunters and their families to travel with speed to these outlying regions. The result may be a fairly constant level of 'observer effort' since the 1960s, when the move to new communities began.

19. Notwithstanding the quantification of 'observer effort' or changes in effort, it is not possible, from the Inuit testimony, to quantify the magnitude of bowhead population changes in any region of Nunavut. There is a tendency for increases in bowhead numbers to have become noticeable during the 1950s or later, especially the 1960s and early 1970s. Increases appear to be greatest in northern Foxe Basin (Igloolik and Hall Beach) and along the western coast of Baffin Bay (Clyde River, Pangnirtung, Qikiqtarjuaq, Pond Inlet, and Arctic Bay). Bowhead whales have been sighted in the Kugaaruk area in small numbers only since the early 1990s, while Grise Fiord residents have reported the summer/fall occurrence of small numbers of bowheads in their region. Inuit testimony from the Hudson Strait communities (Kimmirut, Cape Dorset, and Iqaluit) suggests that bowheads have increased in numbers only modestly in Frobisher Bay and along the northern shore of *Sullualuk*/Hudson Strait. In Hudson Bay, communities of the South Kivalliq region (Arviat, Whale Cove, Rankin Inlet, and Chesterfield Inlet) do not appear to host large numbers of bowhead whales. However, sightings have become more regular in the Chesterfield Inlet area in recent years, and some informants from this community believe that the bowhead population is growing. In northwestern Hudson Bay, informants from both Repulse Bay and Coral Harbour reported substantial increases in the numbers of bowheads, both at the floe edge in spring and in open water during summer. The collective testimony indicates that the number of bowhead whales seasonally visiting Nunavut's nearshore waters has increased significantly since the end of commercial whaling, and especially since the 1950s and 1960s.

20. Inuit informants reported on the occurrence of killer whales during the summer in all regions of the Study Area. They have documented through observation and the oral tradition the interactions between killer whales and bowheads, including predation and the effects of killer whales on bowhead behaviour, distribution, and migrations. Stranded bowhead whales have been found by Inuit over the past few decades; in some of these cases the evidence suggests that killer whales were fundamentally responsible. Many informants reported on an inverse relationship between the occurrence of bowheads and killer whales. Sightings of killer whales have declined in some parts of the Study Area since the 1950s to 1960s, coincident with increased bowhead sightings in these areas. Bowheads and other marine mammals often exhibit a pronounced fright reaction to the presence of killer whales. This reaction, called '*aarlirijuk*' in the South Baffin dialect of Inuktitut, involves the movement of marine mammals into areas of broken sea ice or shallow inshore waters, which may provide some measure of protection from the killer whales. Inuit hunters in the past

have taken advantage of this fright reaction, which enabled them to more easily harvest the frightened bowheads and other marine mammals.

Repulse Bay informants stated that there was an influx of killer whales into the Repulse Bay area in the mid 1960s, and a concurrent decrease in the bowhead population. In recent years, killer whales have been only rarely seen in the area, and bowheads are now more numerous. One informant from Repulse Bay suggested that the recent increase in the number of bowheads near Igloolik since the 1950s is due to two factors: growth of the population and an avoidance reaction to killer whales. On the other hand, some Arctic Bay and Pond Inlet informants suggested that the increase at Igloolik was actually due to an emigration of whales from their respective community areas. Killer whales were numerous and bowheads were scarce in *Tinnujivik*/Cumberland Sound in the 1950s and 1960s, but fewer killer whales have been visiting the Sound in recent decades, coincident with an increase in bowhead numbers. A similar situation has been reported for the area around *Palligvik*/Padloping Island on the east coast of Baffin Island. Killer whales appear to have a significant impact on the distribution of bowheads during summer and fall in much of eastern Nunavut, but their impact on the population numbers of bowhead whales is unknown.

21. Bowheads seem to prefer areas where there is some ice cover, or the edge of the ice or floe edge. Bowheads enter fiords and bays as the ice is breaking up, melting and dispersing in the spring. They leave Nunavut's nearshore waters and bays in late fall as fast ice begins to form, and they are infrequently sighted at the floe edge near communities during winter. Some informants interpret that sea ice does not seem to be a significant problem for the bowhead whale. However, bowheads avoid areas where the ice cover is very extensive or apparently continuous. Informants only infrequently reported on bowheads found dead due to ice-entrapment.

22. Informants from communities in the Hudson Bay and Baffin Bay regions reported on the foods and feeding of bowhead whales, noting also that bowheads and other marine mammals are strongly influenced by the tidal cycle. '*Piturnirtuq*' is the time around the full moon when tidal variation is greatest and the tidal currents are strongest. During *piturniq*, bowhead whales are very active and feed heavily in areas where the currents are strongest. Movements of bowheads are also related to the daily tidal cycle; whales move inshore as the tide rises and offshore as the tide ebbs. Feeding occurs throughout much of the Study Area during spring at the floe edge and during summer and early fall in nearshore waters. Although bowheads show strong fidelity to some specific inshore areas for feeding, they also exhibit year-to-year variation in their distribution and abundance which informants attribute to variation in the distribution of bowhead prey. Some informants have witnessed and described bowhead feeding behaviour. The prey of bowhead whales is predominately *iglirait*/copepods.

23. Informants expressed a diversity of observations and opinions regarding the effects of noise on bowhead whales. Many informants reported that bowheads do not seem to be adversely affected by canoes or small boats powered by outboard engines, even when hunters are shooting at other species. Because bowheads are no longer an object of hunting and hence not always closely observed, some informants were uncertain about impacts of noise on bowheads. As bowheads are not hunted any more, some informants believe that they may readily habituate to the presence of skidoos and boats. On the other hand, in the late commercial/post-commercial whaling days, bowhead hunters had to be very quiet and make no sudden noises in their sail boats or row boats when pursuing a whale, lest the whale hear the noise, submerge and flee.

However, some hunters perceive that bowheads can be disturbed by skidoos and/or small vessels, which cause the whales to flee the source of the noise or to move towards the shore. The use of outboard engines was given as a possible explanation for the relative scarcity of bowheads near Cape Dorset and in Frobisher Bay. Several informants perceive that marine mammals nowadays avoid the immediate vicinity of communities because of a variety of land- and marine-based noises.

Some Inuit believe that bowheads may be disturbed by large vessels which could displace them from important habitat into marginal areas where food may not be adequate. Other informants believe that, although sea mammals may have been disturbed by large ocean-going ships in the past (when large-vessel traffic first started to increase), due to habituation they may now not be very affected or disturbed by large ships. Although uncertain about the impacts of large vessel traffic on bowheads and other marine mammals, some elders do not worry a lot about this as most large ships are necessary for today's economy. In the Hudson Bay region as well as at Kugaaruk, ship traffic may not be a big concern because of the relatively low number of bowheads in these two areas. On the other hand, two Qikiqtarjuaq informants believe that increasing ship traffic is not a concern because there are so many bowheads now and they are increasing in numbers.

Inuit fear that oil spills (from oil tankers and drilling) could have negative impacts on bowheads and other marine mammals. They believe that bowheads and other marine mammals would have to leave the area of an oil spill, lest they be damaged or killed by contact with oil.

The bowhead and other marine mammals are sensitive to land-based and marine explosive (seismic) charges and may avoid areas of such disturbance.

General hunting activity could disturb bowhead whales. Some Arctic Bay hunters believe that, during the 1990s, some bowhead whales and narwhals were disturbed by hunting activity at the *Tununirusiup Kangiq&ua*/Admiralty Inlet floe edge and have re-located to the Igloolik area. One informant from Pond Inlet expressed the belief that the present-day abundance of bowheads near Igloolik is due to emigration from the Pond Inlet area where bowheads were heavily hunted until about 1910. During the late stages of commercial whaling in *Tinnujivik*/Cumberland Sound, bowhead hunters were not allowed to shoot into the water, make unnecessary noises, or even pursue a herd of migrating belugas, as bowheads were deemed certain to be coming behind the belugas.

24. Informants from several communities noted that collisions and/or near-collisions between hunters' boats and bowhead whales have occurred in recent years; however, there were no explicit indications that the incidence of actual collisions/near-collisions has changed over the years. Some informants reported that Inuit hunters are often fearful or anxious when boating through or near groups of whales, or are reluctant to go boating when bowheads are around. The frequencies of collisions/near-collisions and hunter anxiety seem to be greatest in northern Foxe Basin (Igloolik and Hall Beach) and along the western shore of Baffin Bay (Pangnirtung, Qikiqtarjuaq, Clyde River, Arctic Bay, and Pond Inlet). All these areas have reported more bowheads in recent decades. Although Hudson Bay (Coral Harbour and Repulse Bay) informants have reported increases in bowhead population, only a very few commented on bowheads as a hazard to small boats.

25. Inuit hunters traditionally recognized bowheads of two types with respect to ease or difficulty of hunting: those that tended to be aggressive, retaliatory and very difficult or dangerous to hunt, and those that tended to be more docile and easier or less dangerous to hunt. Inuit bowhead hunters usually sought out and pursued the more docile bowheads. The aggressive bowheads were identified by a high, pointed, prominent protuberance on top of the head on which the blowhole is located, while the more peaceful, docile bowheads have much less of a raised protuberance so that the blowhole is located on a rather flattened area on top of the head. The testimony suggests that these bodily and behavioural differences are age-related, with the aggressive whales being younger than the docile ones. Hunters also tended to avoid bowheads asleep at the surface; those that were splashing with their tail flukes; and those whose breathing had a noisy, cracking sound. Bowheads with these and other characteristics were considered to be aggressive and were not hunted.

26. In traditional times, female bowheads and their calves were usually avoided by Inuit hunters. If the hunters wanted to harvest a calf, the mother would have to be killed first. If a calf is hunted or killed first, the female bowhead may become very aggressive and vicious and attack the kayak or small boat from which the calf was hunted. The mothers are very protective of their young. If the calf was killed or separated from its mother in any other way, the female bowhead would linger around the area where it lost contact with its calf. In the succeeding summer, the mother would return to this same general area and be seen to grieve the loss of its calf and emit sad-sounding mourns, cries, or calls suggesting that she was still looking for her calf. This elicited a great deal of sympathy from the Inuit and is one additional reason why Inuit did not hunt bowhead calves.

27. Inuit recognize and have specific names for several age/size categories of bowhead whales (*arviq*; *arviit* -plural), from newborn calves to large adults.

28. Workshop informants at Repulse Bay distinguished two categories of bowhead whales based on size, fatness, and tastiness or desirability of the maktak and meat. These categories are: *kivaaqi* (the larger, fatter animals) and *papijjuk* (the smaller, thinner specimens). The elders preferred the fatter *kivaaqi*. However, it should be noted that in the Pond Inlet area, *kivaaqi* refers to any large mature female bowhead, and *papijjuk* refers to any medium-sized bowhead. This distinction appears to be one based on size and age, with the larger, older, fatter animals (*kivaaqi*) being preferred for eating. At Igloolik, *kivaaqi* refers to any bowhead.

29. Some bowhead whales, when harpooned, will head toward the shore while others will head out to sea. The whale's behaviour, after being harpooned, is believed to depend on the identity of the particular harpooner. According to this belief, a bowhead may desire to select its hunter; if harpooned by an undesired hunter, it will struggle and resist and pull the kayak or boat at great speed.

30. Clyde River informants described the look-out or leader bowhead – *silaaq*. This very large and apparently old bowhead has much white on its body, and keeps watch over the remainder of the herd, in particular warning the group of the presence of killer whales. The *silaaq* of *Igaliqtuuq*/Isabella Bay was named *Aallaaluk* (the Stranger). For at least several decades and until about the late 1990s, *Aallaaluk* returned every year to Isabella Bay.

31. Informants reported the occurrence, since about 1950, of beached (stranded) and ice-entrapped dead bowhead whales in several locations in the Study Area. The deaths of stranded bowheads were often attributed to killer whales. In September-October 1999, four dead bowheads (three with body lengths ranging from 7.3 to 9.1 metres) were found by Inuit in northern Foxe Basin in the vicinity of Igloolik and Hall Beach. Inuit had previously reported the occurrence of killer whales in the area, and at least two of the carcasses had scratches or marks suggesting killer whale attacks. Informants reported only two stranded and one dead ice-entrapped whale in the Igloolik area in past years. Hudson Strait informants (most from Cape Dorset) reported a few instances of stranded bowheads in that region. Over the last few

decades, a few strandings have occurred in the Hudson Bay area, especially in the Coral Harbour and Repulse Bay regions. Since about 1965, approximately six stranded whales have been found in the Repulse Bay region, and all but one were described as being 'young' whales. Some informants suggested that killer whales were involved in the deaths of some of these bowheads, while others suggested that some whales may have died from other natural causes. A stranded bowhead (body length of 9.4 metres) was found at Native Point, Southampton Island, in September 1999. In Baffin Bay, ice entrapments of bowheads appear to occur very infrequently. However, one bowhead was discovered entrapped on March 20, 1997 in a *polynya* (an area of open water maintained by rapid currents) in Easter Sound, which is at the head of *Tununirusiup Kangiq&ua*/ Admiralty Inlet. The whale was alive and in apparent good condition until the time of ice break-up, and is believed to have survived. Pond Inlet informants stated that they had not seen or heard of an ice-entrapped bowhead in their region. Ice entrapment appears to occur very rarely and is probably not a significant source of mortality at the population level. Informants from the Baffin Bay study region (except those from Kugaaruk and Arctic Bay) reported occurrences of stranded bowheads over the past few decades, and they often implicated killer whales in these bowhead deaths. Elders from Clyde River and Pangnirtung have found beached bowhead carcasses with broken bones but no other wounds and attributed the deaths to killer whale attacks. Several stranded bowheads have been reported in the Pangnirtung area in recent decades, and at least two in the Pond Inlet area. Informants have observed or heard about dead, stranded bowheads in the Qikiqtarjuaq region as well. At the floe edge in *Tinnujivik*/Cumberland Sound, bowheads sometimes swim into nets set for belugas or narwhals (or fish) and they damage or carry the nets away. However, no bowhead deaths due to contact with nets have been reported.



A bowhead undulates through the water. Photo by Susannah Weins, Department of Fisheries and Oceans

32. A small number of informants from the Baffin Bay region commented on the interactions between bowheads and species other than their predators and prey. Narwhals and/or belugas are sometimes seen in the company of bowheads at the floe edge or moving into inlets at the time of ice break-up, or on migration to and from the summering areas.

4.2 CULTURAL AND TRADITIONAL IMPORTANCE OF BOWHEADS TO INUIT

In former times as now, Inuit survival and well-being depended on wildlife. The Inuit strongly believed that wildlife was put on the earth to be used by them. They had strict guidelines and laws regarding harvesting of wildlife. Their beliefs and values required them to respect the animals in order to ensure that the wildlife would always be available to them.

The bowhead whale was one of the most important species harvested by Inuit. As with all other species, the Inuit had to respect the whale. Whaling was an important part of Inuit life. The Inuit ancestors developed specific tools and techniques to hunt the bowhead. At that time, all parts of this marine mammal were used; there was no waste. With the arrival of the commercial whalers, Inuit lifestyles began to change. The commercial whalers were only interested in the blubber, baleen, and sometimes the bones of the bowhead whale. With the help of Inuit, they over-hunted the bowhead whale populations. By the time the whalers left the Arctic, the Inuit way of life had totally changed. Their hunting techniques and equipment were no longer the same. Later on, since the whale populations were so low, the government prohibited the bowhead hunt. These developments deeply affected the Inuit traditional way of living, to the extent that it was originally based on whale hunting.

Most Inuit would like to see the bowhead hunt resumed on a limited but continuing basis. There is a concern about losing Inuit knowledge of the bowhead whale and techniques for hunting it. The Inuit have a strong desire to preserve their culture, so intimately linked with bowheads and whaling. Many Inuit would like to respect and satisfy the wishes of many elders to once again have access to bowhead maktak. The bones from any bowhead whales harvested in future would have some modern uses, such as providing raw material for carvings and jewelry. However, future harvests would mostly be providing a highly valued source of country food. Most of the soft parts of the bowhead whale are edible, tasty and nutritious.

A few Inuit are reluctant to endorse the resumption of bowhead whale hunting. They believe that today's Inuit, based on their modern life styles

and new goals, do not need to harvest bowheads, and that they no longer demonstrate particular interest in hunting them. In addition, there is general concern about the state of knowledge and ability to actually hunt the bowhead whale. Bowhead whales have not been hunted for so long that today's generation of hunters does not have specific expertise in the matter. Consequently, several elders recommended that hunters should get thorough training before further bowhead hunting occurs. This would involve obtaining the knowledge, expertise, and advice of the elders, coupled with confirmation of a deep interest and commitment on the part of younger hunters and youth. With the help of elders, the traditional and cultural importance of the bowhead whale and the whale hunt, and the underlying system of values and beliefs, could be made part of the educational system.



Inuit Bowhead Knowledge Study Workshop, Repulse Bay, February 1996. Photo by Keith Hay

Many informants believe that Inuit knowledge about bowhead whales and about techniques for hunting them is being eroded, in large part as a result of hunters no longer paying much attention to bowheads which have not been a regularly hunted species for several decades. Some informants are concerned that this lack of attention and erosion of knowledge could lead to a general lack of concern and respect for and valuation of the bowhead, which in turn could lead to situations promoting abuse of this animal. Some view a renewed, ongoing limited hunt as a means of enhancing and restoring concern and respect for, and intimate knowledge about, this species. In this way, a renewed, sustainable hunt for bowhead whales may comprise one important element of a successful conservation strategy for the bowhead whale in Nunavut. Some Inuit also consider that a renewed hunt would contribute to the re-vitalization and preservation of a vanishing part of Inuit culture and identity, and of Inuit socio-cultural values and functioning, in the face of significant external forces of change in recent decades.

4.3 INUIT HUNTS OF BOWHEADS AFTER 1915

From examination of historical and archival records and the literature, Mitchell and Reeves (1982) obtained evidence that 24 bowhead whales had been harvested and/or found dead by Inuit in the Hudson Bay/Foxe Basin and Baffin Bay/Davis Strait regions, between 1919 and 1975 (*see* their Table 1). Through the Inuit Bowhead Knowledge Study (IBKS), good evidence has been obtained of 12 bowhead hunts (with eight animals landed) that are not included by Mitchell and Reeves (1982). We believe, along with Mitchell and Reeves (1982), that the hunts, kills, and strandings uncovered in the historical and archival literature and in the IBKS represent only a portion of all the hunts, kills and strandings of bowheads that have actually occurred in the post-commercial whaling period (up to 1979). The information documented by Mitchell and Reeves (1982) and the IBKS indicates that most post-commercial Inuit whaling occurred in northern Hudson Bay until about 1940, and in northern Foxe Basin in later years.

The 12 'new' hunts documented from the IBKS were distributed regionally as follows: Baffin Bay (3), Hudson Strait (2), Hudson Bay (6), and Foxe Basin (1).

4.4 MANAGEMENT AND POSSIBLE FUTURE RATES OF HARVESTING OF BOWHEAD WHALES

Many Inuit expressed the view that a limited and on-going harvest of bowheads is feasible and would be sustainable, given the evidence of present abundance and growth of the bowhead population in recent decades. However, many Inuit also pointed out that one bowhead can not provide for the needs of all Inuit in Nunavut in any given year. A regionally-based system of harvesting is generally favoured, with meat and maktak from a particular region remaining within that region. Considering both regional needs and the currently-perceived abundance of bowheads, the most frequent suggestions for an appropriate rate of harvesting were: one per year; one per two years; and two per year, one for each of Baffin and Kivalliq regions. Inuit would like to see bowhead populations properly and carefully managed, in order to ensure population growth and sustainable hunting well into the future.

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Literature Cited

Cosens, S. E. and A. Blouw. 1999. Age classes of bowhead whales summering in northern Foxe Basin. Canadian Stock Assessment Secretariat, Research Document 99/135.

Eber, D. 1989. When the whalers were up north: Inuit memories from the Eastern Arctic. McGill-Queen's University Press, Kingston, Montreal, London, xvii + 187 p.

Hay, K. 1997. Inuit Bowhead Knowledge Study. Interim Report, Northwest Hudson Bay and High Arctic. Report Presented at the Meeting of the Nunavut Wildlife Management Board, Pangnirtung, NU, February, 1997.

Huntington, H. P. 1998. Observations on the utility of the semi-directive interview for documenting traditional ecological knowledge. Arctic 51: 237 – 242.

Lowenstein, T. 1993. Ancient Land: Sacred Whale. The Inuit Hunt and Its Rituals. Farrar, Straus, and Giroux, New York: xxvi + 189 p.

McDonald, M., L. Arragutainaq, and Z. Novalinga. 1997. Voices from the bay: traditional ecological knowledge of Inuit and Cree in the Hudson Bay bioregion. Canadian Arctic Resources Committee and the Environmental Committee of Municipality of Sanikiluaq, xiv + 98 p.

Mitchell, E. D. and R.R. Reeves. 1982. Factors affecting abundance of bowhead whales *Balaena mysticetus* in the eastern arctic of North America, 1915 – 1980. Biological Conservation 22: 59 – 78.

Nunavut Wildlife Management Board. 1995. Nunavut Bowhead Traditional Knowledge Study. Preliminary Report Based on Interviews Conducted During 1995. Report Presented at the Meeting of the Nunavut Wildlife Management Board, Rankin Inlet, NU, November 14 – 16, 1995.

Stewart, D. B., A. Akeeagok, R. Amarualik, S. Panipakutsuk, and A. Taqtu. 1995. Local knowledge of beluga and narwhal from four communities in Arctic Canada. Can. Tech. Rep. Fish. Aquatic Sci. 2065: viii + 48 p. + Appendices on disk.

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Acknowledgements

A great number of individuals and organizations contributed in numerous ways to the Inuit Bowhead Knowledge Study (IBKS).

The Inuit Bowhead Knowledge Study Committee of the NWMB provided overall guidance and directed the Study. Our thanks are expressed to Andy Theriault, who was a member of the NWMB and of the IBKS Committee for the first year of the Study until his retirement from government service in 1995.

For help in planning and designing the Study, thanks are due to: David Aglukark, Andy Theriault and David Igutsaq (IBKS Committee Members), Joannie Ikkidluak and Meeka Kilabuk (Qikiqtaaluk Wildlife Board), Ovide Allakanuark (Kitikmeot Hunters and Trappers Association), George Kuksuk and Andreasi Siutinuar (Kivalliq Wildlife Federation), Dr. Stuart Innes and Laura Anderson (Department of Fisheries and Oceans, Winnipeg), and Dr. Mike Ferguson (Department of Sustainable Development, Government of Nunavut). Their contributions helped set the basic course for the Study. We also thank John MacDonald (Nunavut Research Institute, Igloolik) who provided several transcripts dealing with Inuit bowhead hunting, from the archives of the Igloolik Traditional Knowledge Project.

During the Study Coordinator's visit to Sanikiluaq in May 1995, Miriam McDonald, Brian Fleming, Lucassie Arragutainaq, and Zack Novalinga freely shared their knowledge and expertise relating to a large study they were conducting at the time, the Hudson Bay Traditional Ecological Knowledge and Management Systems Study. The information and training received and various discussions were very helpful to the on-going interviews, workshops, data analysis and reporting of the IBKS.

The community-based interviewers are thanked for their efforts in carrying out individual interviews during 1995: Catherine Piugatuk (Igloolik), Eric Oogark (Kugaaruk), Beatrice Ikkidluak (Kimmirut), Gordon Kukkuvak (Repulse Bay), Seetee Paniloo (Clyde River), Ikkummak Ivvaluajuk (Coral Harbour), Noah Metuq (Pangnirtung), David Curley (Hall Beach), Johnny Manning (Cape Dorset), Jonah Audlakiak (Qikiqtarjuaq), and Nuvualia Davidee (Iqaluit). The Hunters and Trappers Organizations (HTOs) assisted by selecting community interviewers and by providing a list of potential interviewees with knowledge of bowhead whales and whaling.

In 1996, Johnny Manning of Cape Dorset capably carried out all of the individual interviews on behalf of the NWMB, with the exception of those in Repulse Bay. He was assisted by a guide in each community selected by the Hunters and Trappers Organization which also selected the interviewees. We thank all the community HTOs for their cooperation, assistance, and support. Community guides in 1996 were: Mary Tatatoapik (Arctic Bay), Samson Erkloo (Pond Inlet), Lymieky Pijamini (Grise Fiord), Lino Amarok (Chesterfield Inlet), Catherine Okpatauyak (Rankin Inlet), Jimmy Qiyuk (Whale Cove), and Emil Arnalak (Arviat).

Community workshops were held in eight communities in 1996 and 1997. Thanks are extended to the HTOs and their Chairpersons for hosting and helping to organize workshops in their respective communities. The HTOs selected workshop participants and interpreters, all of whom are listed in Appendix II. IBKS Committee Members David Aglukark, Joannie Ikkidluak, and David Igutsaq each helped to facilitate one or more community workshops.

The work and assistance of Interpreter/Translators were vital to the IBKS. They included Mary Nashook, Nick Arnatsiaq, Nick Amautinuar and Juliana Boychuk who translated and transcribed interview and workshop tapes, and Blandina Tulugarjuk and Evie Amagoalik who carried out other translation duties. Evie diligently and patiently translated this report. We are deeply indebted to all these people.

We extend our appreciation to Gary Kohlruss and Johnny Manning for their diligent work in transferring and synthesizing individual informants' mapped information onto community and/or regional maps, prior to digitization of the information and the preparation of the maps in this report.

For valuable support and assistance in varied ways, thanks are extended to Ben Kovic, Dan Pike, Jim Noble, Dr. Michelle Wheatley, Carol Churchward, Johnny McPherson, Pierre Chartrand, Gordon Tomlinson, Malachi Arreak, Isabel Simpson and Leonie Erkidjuk, all of whom are present or former employees or Members of the NWMB. We are especially grateful to Dan, Jim, Ben, and Michelle for their support and encouragement.

We owe a special debt of gratitude to Catherine Filion, who capably and diligently analysed and wrote up the section of the report dealing with the importance of the bowhead to Inuit culture (Section 3.2). Catherine was also an enduring source of support and encouragement.

Our gratitude is expressed to Drs. Milton Freeman and Marc Stevenson (Canadian Circumpolar Institute, University of Alberta, Edmonton), Dr. Tim D. Smith (Northeast Fisheries Science Center, Woods Hole, MA, USA), Drs. Stuart Innes and Sue Cosens (Department of Fisheries and Oceans, Winnipeg), and Dr. Peter Ewins and Sarah Climenhaga (World Wildlife Fund Canada, Toronto), all of whom had reviewed the 1995 interim report of the IBKS. Their comments, ideas, and suggestions helped the Study Coordinator to reflect on the Study to that point in time and to improve the conduct of the Study in subsequent years, as well as the analysis of Study transcripts and the writing of this Final Report.

A first draft of this report was kindly reviewed by Ben Kovic and Gordon Koshinsky, whose comments, criticisms, and suggestions have greatly improved the document.

Very special thanks go out to all Inuit who were interviewed or participated in the workshops, for sharing their personal knowledge, life experiences, and wisdom, which form the basis of this report. We owe a special debt of gratitude and respect to all Inuit who participated in the Study. Many if not most of them are named in this report. This is their report, and the Study Coordinator and the IBKS Committee assume responsibility for any errors of fact, omission, or interpretation.

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Appendices

APPENDIX I

STATISTICAL SUMMARY OF INDIVIDUAL INTERVIEWS AND WORKSHOPS

REGION:	BAFFIN BAY		FOXE BASIN		HUDSON BAY		HUDSON STRAIT	
COMMUNITIES IN THE STUDY (NUMBER OF INDIVIDUAL INTERVIEWS TRANSCRIBED)	Grise Fiord	(3)	Igloolik	(12)	Repulse Bay	(25)	Iqaluit	(5)
	Kugaaruk	(12)	Hall Beach	(11)	Coral Harbour	(4)	Kimmirut	(14)
	Arctic Bay	(5)			Chesterfield Inlet	(5)	Cape Dorset	(14)
	Pond Inlet	(8)			Rankin Inlet	(5)		
	Clyde River	(14)			Whale Cove	(5)		
	Qikiqtarjuaq	(14)			Arviat	(0)		
	Pangnirtung	(19)						
COMMUNITIES HOSTING WORKSHOPS	Arctic Bay Pond Inlet Clyde River Qikiqtarjuaq Pangnirtung		Igloolik/Hall Beach		Repulse Bay Coral Harbour			

COMMUNITY	NO. INTERVIEWS	NO. TRANSCRIBED	INTERVIEW DATES
Arctic Bay	10	5	April 1996
Arviat	9	0	February 1996
Qikiqtarjuaq	20	14	March 1995
Cape Dorset	20	14	March – April 1995
Coral Harbour	4	4	March 1995 and February 1996
Chesterfield Inlet	10	5	February 1996
Clyde River	20	14	March – April 1995
Grise Fiord	5	3	April – May 1996
Hall Beach	15	11	March – April 1995
Igloolik	20	12	March – April 1995
Iqaluit	5	5	January – February 1995
Kimmirut	21	14	March 1995
Kugaaruk	19	12	March 1995
Pangnirtung	20	19	March 1995
Pond Inlet	15	8	April 1996
Repulse Bay	25	25	March – April 1995 and Feb. 1996
Rankin Inlet	9	5	February 1996
Whale Cove	10	5	February 1996
TOTALS	**257**	**175**	**January 1995 to May 1996**

SCHEDULE OF WORKSHOPS: COMMUNITIES, DATES, AND PARTICIPANTS

ARCTIC BAY (MARCH 21 – 22, 1997)

PARTICIPANTS:
Simon Qamanirq (Chairman); David Issuqangituq (Day 2 only); Andrew Oyukuluk; Atagootak Ipellie; Koonoo Oyukuluk; Isaac Shooyuk; Mucktar Akumalik; Lazarus Aola; Keith Hay (NWMB)

INTERPRETER:
Mary Tatatuapik

CLYDE RIVER (MAY 2 – 3, 1996)

PARTICIPANTS:
Solomonie Natanine (Chairman); Ipellie Qillaq; Ashevak Palituq; Elisapee Arreak; Nauja Tassugat; Ipellie Panipak; Seetee Paniloo; David Igutsaq, Joannie Ikkidluak, Keith Hay (NWMB)

INTERPRETER:
Jaypeetee Arnakak

CORAL HARBOUR (FEBRUARY 7 – 8, 1996)

PARTICIPANTS:
Tooma Netser; Mikitok Bruce; Kanayuk Bruce; Louie Bruce; Keith Hay, Johnny Manning, David Aglukark (NWMB)

INTERPRETERS:
Emily Beardsall and Mona Netser

IGLOOLIK and HALL BEACH (MAY 29 – 30, 1996; the workshop was held in Igloolik)

PARTICIPANTS:
Igloolik: David Irngaut (Day 1 only -Workshop Chairman on Day 1); Abraham Ulayuruluk (Day 2 only – Workshop Chairman on Day 2); Eugene Ipkanark; George Kappianaq; Rachel Uyarasuk. Hall Beach: Ammie Kipsigak; Jopie Kaernerk; Terry Irqittuq; Keith Hay, Joannie Ikkidluak (NWMB)

INTERPRETER:
Nick Arnatsiaq

VIDEO-TAPING:
Pacome Qulaut (Igloolik Isuma Productions)

PANGNIRTUNG (MARCH 13-14, 1996)

PARTICIPANTS:
Adamee Veevee (Chairman); Pauloosie Angmarlik; Towkie Maniapik; Inusiq Nashalik; Peteroosie Karpik; Jaco Evic; Joannie Ikkidluak, Keith Hay (NWMB)

INTERPRETER:
Adamee Komoartok

VIDEO-TAPING:
David Poisey (Inuit Communications Systems Limited)

POND INLET (MARCH 17 – 18, 1997)

PARTICIPANTS:
Manasie Qamanirq (Chairman); Kooneeloosie Nutarak, Sr.; Joanasie Arreak; Moses Koonark; Sam Arnakallak; Elijah Panipakoocho; Panoely Okango; Keith Hay, Malachi Arreak (NWMB)

INTERPRETER:
Titus Arnakallak

QIKIQTARJUAQ (MAY 6 – 7, 1996)

PARTICIPANTS:
Koalie Kooneeliusie (Chairman); Gamailee Nookiguak; Jacobie Koksiak; Jacopie Newkingnak; Joanasie Kakka; Adamie Nookiguak; Joannie Ikkidluak, David Igutsaq, Keith Hay (NWMB)

INTERPRETER:
Billy Arnaquq

REPULSE BAY (FEBRUARY 12 – 13, 1996)

PARTICIPANTS:
David Tuktudjuk (Chairman); Jackie Nanordluk; Abraham Tagornak; John Tinashlu; Philip Kripanik; Michel Akkuardjuk; Semi Maliki; David Aglukark, Keith Hay (NWMB)

INTERPRETER:
Steve Mapsagak

THE INUIT SEASONS: EXAMPLE FOR HIGH ARCTIC*

Ukiuq (winter)

-early January to mid-March

-extensive sea ice, continues to thicken and coalesce

-snow on land and ice

-short daylight, sun returning

-very cold

Upirngassaaq (early spring)

-mid-March to late May

-maximum sea ice cover and thickness

-snow on land and ice

-daylight period long and increasing

Upirngaaq (spring)

-late May to mid-July

-progressive snow melt on land

-widening of ice leads, disappearance of ice

-24 hour daylight

Aujaq (summer)

-mid-July to early September

-open water, some drifting ice

-daylight period long but decreasing

Ukiassaaq (early fall)

-early September to late October

-open water

-ice starting to form late in the season along the shore

-snow on the land, lake ice, daylight period short and decreasing

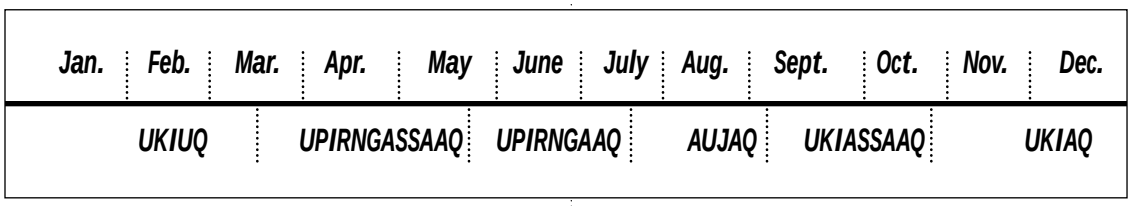
Ukiaq (fall)

-late October to early January

-new ice hardens and thickens to form extensive areas of land-fast or drifting pack ice

-snow on land and ice

-24 hour darkness



* After Stewart *et al*. (1995). Communities for this example include Hall Beach, Igloolik, Arctic Bay and Grise Fiord.

QUESTIONNAIRE USED FOR INDIVIDUAL INTERVIEWS

A. PERSONAL DATA

1. Interviewee ID _____

2. Interviewer _____

3. Community _____

4. Date of interview _____

5. Place of birth (mark on Map 'A') _____

INTERVIEWER: PLEASE USE MAP 'A' TO RECORD INUIT PLACE NAMES OF BAYS, FJORDS, POINTS, CAMPSITES, ETC. ALSO USE MAP 'A' TO MARK THE PLACE OF BIRTH OF EACH INFORMANT. USE ONLY ONE COPY OF MAP 'A' FOR ALL INFORMANTS FROM THIS COMMUNITY.

B. BOWHEAD WHALING

(Refer to Interviewer's Guide/Checklist)

In this section of the questionnaire, we would like you to tell us about hunting of bowheads during three time periods : Inuit hunting before the Qallunaat whalers arrived; the commercial hunt of bowheads by the Qallunaat; and Inuit hunting of bowheads after the end of commercial whaling.

I) Inuit Hunting of Bowheads Before the Qallunaat Whalers Arrived

1. Do you have knowledge (from your parents, grandparents, and other elders) of Inuit hunting of bowheads before the Qallunaat whalers arrived? Please tell me about your knowledge of Inuit hunting of bowheads before the Qallunaat whalers arrived.

1A. Do you know of anyone else in the community who might have knowledge of Inuit hunting of bowheads before the Qallunaat whalers arrived?

II) The Commercial Hunt of Bowheads by Qallunaat

2. Do you have personal recollection of or knowledge (from your parents, grandparents and other elders) of the commercial (Qallunaat) hunt of bowhead whales? Please tell me about your recollections and knowledge regarding the commercial (Qallunaat) hunt of bowhead whales.

2A. Do you know of anyone else in the community who might have information on hunting of bowheads by the commercial (Qallunaat) whalers?

III) Inuit Hunting of Bowheads After the End of Commercial Whaling

3. Do you have personal recollection of or knowledge (from your parents, grandparents and other elders) of Inuit hunting of bowheads after the end of commercial (Qallunaat) whaling for bowheads? Indicate on Map 3 the location and year where whale hunts occurred, and provide any details about these hunts (success of hunt, loss of the whale, size and sex, utilization, etc.).

3A. Do you know of anyone else in the community who might have information on hunting of bowheads by Inuit after the end of commercial (Qallunaat) whaling?

C. KNOWLEDGE OF BOWHEAD WHALES

(Refer to Interviewer's Guide/Checklist)

1. Please tell me about your observations of bowhead whales over your lifetime. Where are these whales located at different seasons, what are their migration routes and patterns, and what are the whales doing in these areas? Please use the maps provided.

2. From the end of commercial whaling to the present time, describe the changes in numbers of bowheads, including the numbers of females with calves, that you have noticed:

    a) What did you observe as a young person?

    b) What did you observe in middle age?

    c) What have you observed in recent years?

3. From the end of commercial whaling to the present time, describe any changes you have noticed in the locations where bowheads concentrate in your area. In recent years, have bowheads been sighted in locations where they are not normally sighted?

4. Have you noticed any changes in the number of whales in a group over the years?

5. Have you noticed year-to-year variation in numbers and/or location of bowheads, or in the time of year (season) that they appear in your area?

6. Please describe any attacks you have seen or heard about by killer whales or other animals on bowhead whales.

7. Have you observed any influence of the tidal and moon cycles on the bowhead whale? Please explain.

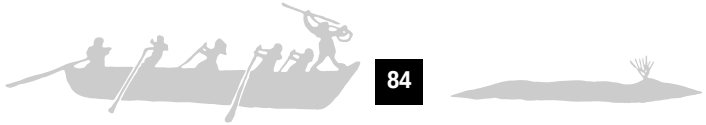
8. Do you have any concerns that bowheads could be affected by exploration for and development of non-renewable resources, including ship and tanker traffic? Please explain.

9. Can you please comment on the importance of the bowhead whale to Inuit culture and traditional values.

10. Do you have any further comments to make regarding bowhead whales?

SECTION B *Interviewer's Guide/Checklist*

	I) Inuit Hunting before Qallunaat Whaling	II) Commercial (Qallunaat) Whaling	III) Inuit Hunting after Qallunaat Whaling
1. Methods and techniques used in hunting bowheads (spotting, pursuing, killing, securing and towing)			
2. Equipment used in hunting bowheads (kinds of boats, killing, securing, towing, flensing, and butchering)			
3. Variation in hunting methods and equipment according to location and season			
4. Methods of sharing out various parts of the whale			
5. Uses of various edible and non-edible parts of the bowhead whale			
6. Storage of whale parts and methods of storage			
7. Seasons or months of hunting			
8. Description of hunts at the floe edge			
9. Locations where bowheads were hunted and landed	Map 1 – Black Pencil	Map 2 – Black Pencil	Map 3 – Black Pencil
10. Locations where bowhead bones were found on shore	Map 1 – Blue Pencil	Map 2 – Blue Pencil	Map 3 – Blue Pencil
11. Locations of bowhead whaling camps	Map 1 – Red Pencil	Map 2 – Red Pencil	Map 3 – Red Pencil



SECTION C, Question 1 *Interviewer's Guide/Checklist*

	UKIUQ	UPIRNGASSAAQ	UPIRNGAAQ	AUJAQ	UKIASSAAQ	UKIAQ
1. Location of bowheads	Use Map 4, red pencil	Use Map 5, red pencil	Use Map 6, red pencil	Use Map 7, red pencil	Use Map 8, red pencil	Use Map 9, red pencil
2. Migration routes	Use Map 4, blue pencil	Use Map 5, blue pencil	Use Map 6, blue pencil	Use Map 7, blue pencil	Use Map 8, blue pencil	Use Map 9, blue pencil
3. What do you see bowheads doing in these areas at this season?						
4. At this season have you seen: Bowheads with calves – Immatures – Adults –						

INTERVIEWER: ASK YOUR INTERVIEWEE TO CORRELATE THE INUIT SEASONS WITH THE CALENDAR MONTHS, ON THE PROVIDED CHART (OR TO CONFIRM/CORRECT THE CHART YOU SHOW THE INTERVIEWEE)

AGENDA FOR WORKSHOPS

1. Opening prayer and introduction of participants

2. Introduction to the Workshop

3. Whaling Areas, Whale Bone Locations, and Whaling Camps
   - review maps based on last year's community interviews

4. Distribution and Migration
   - review seasonal maps based on last year's community interviews
   - update whale sighting locations and migrations
   - seasonal bowhead behaviour

5. Have bowhead populations changed in size since the end of commercial whaling?
   - changes in numbers of mothers with calves?

6. Changes in distribution of bowheads
   - are whales now seen in areas where they did not occur many years ago?

7. Changes in group size
   - do bowheads occur in larger groups now as opposed to a long time ago?

8. Factors affecting bowheads:
   - ice conditions and weather
   - currents and tides
   - food availability
   - killer whales
   - human activities (motorboats, skidoos, ships, pollution, etc.)

9. Inuit Culture and Traditions
   - significance of the bowhead whale to Inuit culture

10. Place names (Map 1)
    - Inuit geographical place names (i.e.- bays, islands, fjords, camps, points, headlands)

11. Inuit hunting of bowheads in the past 80 years
    - location (Map 2) and year of hunt
    - hunt success, methods and equipment
    - how the whale was used
    - size and sex of the whale
    - location of old bones on shore (Map 2)
    - whaling camps after 1915 (Map 2)

12. Inuit names of seasons – correlate with months of the year

13. Open Discussion – any topics or issues of concern

CONSENT FORM FOR INDIVIDUAL INTERVIEWS

I have been fully informed of the objectives of this Study being conducted by the Nunavut Wildlife Management Board. I understand these objectives and consent to being interviewed for this Study, for the Inuit Bowhead Knowledge Study Committee.

Consent to be interviewed and tape-recorded

Name (please print): _____

Signature: _____

Date: _____

___ I desire that my identity and the information I provide be confidential.

OR

___ I desire that my identity be non-confidential and that the information I provide be attributed to me.

FOOTNOTE SOURCES PERTINENT TO SECTION 3:

RESULTS AND DISCUSSION

(See document 'Source Book of Quotations' for unabridged informants' quotations)

[1] (FB1, 7, 27,42); (HS3, 6, 7, 9, 12, 21, 23, 27, 30, 31, 34, 36, 37, 48, 49, 65, 127, 157); (HB12, 13, 15, 17, 22, 25, 32, 39, 43, 46, 49, 54, 65, 72, 85, 91, 127, 159, 163, 174, 227, 233, 266); (BB2, 27, 34, 35, 54, 56, 62, 68, 77, 78, 83, 103, 112, 115, 123, 124, 127, 140, 146, 150, 151, 153, 155, 156, 167, 170, 180, 181, 197, 202, 206, 224, 231, 232, 238, 277, 280, 323, 340, 343, 346, 350, 353, 362, 370, 373, 379, 411, 448, 462, 467, 497, 521, 525)

[2] (HS14, 36); (HB12, 30, 70, 71, 81, 90, 123, 140, 216, 252); (BB77, 208, 377, 387, 393, 401)

[3] (FB2, 3, 4, 17, 22, 23, 25, 27, 36, 41, 46, 47, 97, 99); (HS5, 15, 20, 38, 41); (HB19, 20, 22, 29, 41, 46, 48, 56, 65, 71, 259); (BB1, 4, 11, 12, 14, 18, 19, 20, 21, 22, 23, 25, 26, 27, 41, 54, 56, 59, 68, 72, 75, 87, 99, 100, 106, 113, 118, 121, 123, 127, 135, 141, 162, 165, 169, 170, 173, 174, 175, 183, 191, 192, 195, 197, 204, 213, 215, 219, 224, 395, 435)

[4] (HS11, 13, 48, 64); (HB3, 4, 18, 23, 28, 30, 51, 52, 53); (BB10, 29, 101, 119, 168, 181, 346, 353, 411)

[5] (FB4); (HS5, 38); (HB43, 64); (BB27, 175)

[6] (FB26, 31, 37, 45, 85); (HS1, 8, 33, 40, 62); (HB20, 22, 33, 34, 39, 46, 48, 51, 64); (BB17, 18, 24, 26, 50, 53, 55, 57, 65, 91, 102, 104, 106, 108, 112, 114, 122, 123, 131, 133, 144, 163, 164, 167, 174, 177, 198, 202, 206, 209, 210, 211, 212, 217, 218, 219, 226, 228, 231, 234, 235, 362, 392)

[7] (FB3, 16, 43); (HS18, 21, 24, 47, 49, 53); (HB11, 27, 37, 42, 45, 55, 59, 62, 63, 82, 85); (BB7, 29, 43, 59, 67, 68, 140, 180, 181, 196, 209)

[8] (FB14, 18, 35); (HS 8, 18, 29, 31, 35, 36, 44, 48, 55, 65); (HB9, 23, 25, 49, 66, 70, 72, 85, 91); (BB14, 32. 34, 68, 78, 112, 123, 133, 157, 166, 168, 169, 181, 193, 204, 210, 212, 219, 226, 229)

[9] (FB3, 12, 14, 21, 28, 32, 33, 38, 40, 43, 44); (HS13, 29, 31, 34, 44, 58); (HB5, 8, 15, 54, 60, 76, 78, 81); (BB2, 34, 38, 44, 73, 85, 88, 149, 155, 168, 208, 224, 231, 235, 238, 370)

[10] (HB1, 2); (BB18, 129, 377, 400)

[11] (HS2, 8); (HB74, 76); (BB30, 48, 57, 128)

[12] (FB8, 9, 11); (HS10, 24, 51, 52, 57, 59, 60, 61, 63); (HB50, 70, 88); (BB29, 33, 35, 49, 61, 64, 66, 79, 93, 95, 106, 119, 157, 178, 184, 198, 205, 218, 225, 226, 234)

[13] (FB10); (HS9, 44, 50, 53, 56, 62, 65); (HB 21, 22, 46, 52, 66, 70, 71, 80, 88, 265); (BB3, 5, 68, 140, 150, 152, 157, 158, 167, 168, 181, 184, 196, 211, 230)

[14] (HS4, 9, 17, 19, 25, 33, 43, 54, 64, 65, 116); (HB5, 6, 20, 24, 25, 27, 30, 33, 42, 44, 48, 52, 54, 65, 72, 73, 79, 83, 85, 86, 87, 89, 187, 198, 234, 253); (BB3, 11, 14, 15, 17, 18, 26, 27, 28, 29, 31, 34, 37, 38, 42, 46, 48, 51, 55, 58, 59, 60, 61, 63, 64, 65, 66, 67, 70, 73, 79, 81, 83, 84, 85, 86, 90, 94, 102, 105, 108, 111, 116, 117, 118, 119, 120, 122, 125, 126, 127, 128, 130, 134, 136, 138, 139, 148, 154, 159, 167, 176, 178, 179, 188, 189, 190, 194, 199, 201, 202, 203, 206, 209, 210, 219, 221, 224, 225, 228, 229, 231, 232, 234, 280, 287, 297, 337, 358, 393, 397, 401, 509)

[15] (HB39); (BB14, 38, 73, 74, 120, 121, 126, 137, 204, 216, 219, 234)

[16] (FB8, 46); (HS5, 62); (HB10, 14, 27, 51, 61, 63, 87); (BB26, 27, 30, 61, 64, 87, 116, 121, 123, 124, 133, 137, 146, 147, 150, 151, 159, 175, 178, 181, 213)

[17] (HB33); (BB27, 41, 67, 75, 118, 128, 162)

[18] (FB 24, 25, 34, 99); (HS35, 42); (HB25, 38, 52, 54, 57, 58, 81, 85, 198); (BB15, 18, 27, 29, 31, 34, 49, 52, 56, 58, 61, 65, 66, 68, 70, 80, 82, 85, 89, 98, 105, 107, 111, 116, 117, 120, 122, 126, 128, 130, 134, 135, 136, 138, 142, 159, 160, 167, 178, 193, 198, 203, 204, 206, 209, 210, 211, 212, 219, 221, 224, 228, 229, 231, 232, 234, 239, 305)

[19] (FB7, 8, 38); (HS35, 55, 65); (HB48, 66); (BB212,233)

[20] (FB39, 62); (HS46, 50); (HB23, 26, 36, 42, 48, 55, 61, 65, 70, 81, 84, 179, 205, 208, 252, 265); (BB9, 25, 29, 32, 34, 37, 38, 40, 50, 64, 67, 71, 73, 81, 83, 91, 109, 112, 113, 114, 116, 118, 127, 129, 137, 143, 145, 179, 189, 192, 200, 202, 209, 210, 215, 217, 222, 226, 231, 234, 236, 377, 397, 417, 420, 434, 504, 505)

[21] (HS28, 47, 135); (HB36, 115, 236); (BB13, 31, 59, 75, 85, 99, 116, 117, 130, 178, 231, 349, 489)

[22] (HB40, 48, 65, 68, 85, 93, 144); (BB16, 18, 31, 34, 37, 38, 50, 58, 70, 73, 85, 86, 102, 106, 108, 110, 114, 117, 120, 126, 167, 173, 178, 179, 198, 200, 207, 216, 219, 224, 225, 229, 231, 239, 287, 429)

[23] (FB48, 86, 88); (HS5, 15, 26,32, 44, 45, 50, 101, 126, 146, 147); (HB16, 48, 51, 75, 76, 77, 83, 91, 96, 164, 234, 253, 265); (BB3, 16, 38, 76, 92, 127, 132, 143, 150, 196, 197, 227, 233, 235, 273, 333, 360, 382, 403, 435, 453, 519)

[24] (FB3, 4, 6, 8, 23, 25, 29, 30, 31, 36, 43, 46, 47, 48, 49); (HB46, 64, 87); (BB10, 19, 22, 29, 38, 43, 45, 85, 87, 89, 108, 112, 113, 114, 161, 170, 171, 193, 203, 227, 228, 234, 235, 380)

[25] (HB81, 102, 104, 146, 148, 153, 162, 184, 196, 219, 234, 242, 251, 253, 268, 288, 293, 302); (BB13, 39, 49, 69, 71, 73, 74, 81, 91, 105, 107, 111, 130, 134, 138, 153, 170, 203, 223, 229, 231, 232, 237, 294, 347, 362, 372, 383, 403, 418, 434, 464, 473, 479, 484, 486, 496, 503, 507, 514, 521)

[26] (FB46); (HS16, 78, 92, 115); (HB79, 100, 179, 181, 205, 208, 212, 236, 288, 303); (BB8, 32, 36, 64, 97, 109, 127, 144, 189, 202, 293, 410, 411, 433, 436, 439, 447, 448, 478, 509, 521)

[27] (BB3, 6, 113, 122, 130, 134, 136, 167, 189, 194, 200)

[28] Wildlife exist to be utilized: (FB35, 70, 73, 81); (HS34, 81, 126, 127, 132, 146); (HB25, 29, 140, 159, 177, 188, 195, 208, 209, 233, 247); (BB279, 305, 342, 382, 390)
Minimum waste: (FB51, 52, 53, 58, 66, 67, 81, 91, 92, 106, 107); (HS69, 71, 73, 79, 92, 106, 109, 114, 116, 117, 122, 123, 137, 138, 143, 146, 148, 150, 156); (HB91, 106, 120, 135, 139, 144, 148, 152, 157, 158, 159, 167, 168, 169, 170, 178, 181, 187, 192, 197, 208, 213, 234, 260, 270, 271, 281, 283, 287, 290, 291, 297, 299); (BB248, 255, 263, 267, 270, 272, 274, 281, 284, 295, 296, 311, 314, 315, 338, 359, 362, 368, 397, 404, 437, 451, 474, 475, 502, 506, 508, 513, 523)
Sharing: (FB51, 57, 59, 60, 67, 69, 83); (HS51, 66, 69, 82, 84, 94, 92, 114, 123, 132, 143); (HB101, 126, 132, 133, 137, 141, 143, 144, 163, 213, 214, 217, 233, 247, 271, 275, 278, 282, 289, 295, 296, 301); (BB166, 252, 268, 269, 270, 272, 284, 326, 330, 357, 368, 371, 372, 374, 391, 393, 422, 434, 455, 458, 461, 463, 490, 492, 512, 513)
Populations healthy when respected: (FB35, 55, 56, 70, 71, 73, 78, 79, 81, 84, 87, 90, 95, 97, 100, 103, 109, 110); (HS17, 37, 111, 119, 132); (HB52, 133, 191, 205, 210, 217, 233, 247); (BB12, 19, 202, 273, 280, 313, 342, 382, 436, 451, 464, 513)
Natural cycles: (FB9, 56, 87, 89, 93, 95, 102); (HS37, 39, 103, 107, 119); (HB23 ,25, 50, 52, 59, 85, 87, 102, 133, 153, 234, 247, 259); (BB17, 27, 48, 57, 83, 84, 124, 159, 167, 178, 181, 184, 197,198, 200, 206, 209, 212, 218, 219, 220, 228, 231, 513)
'Silaaq': (BB286, 294, 300, 318, 335)

[29] (FB51, 57, 58, 60, 62, 76, 77, 92, 97, 99); (HS71, 78, 79, 83, 85, 86, 88, 91, 98, 100, 109, 122, 132, 137, 139, 144, 146, 148, 150, 151, 152, 155, 156); (HB12, 32, 46, 73, 75, 79, 98, 101, 107, 120, 126, 127, 129, 130, 133, 134, 135, 139, 144, 147, 148, 150, 151, 152, 157, 161, 166, 167, 172, 177, 197, 201, 203, 205, 208, 211, 212, 213, 220, 230, 247, 255, 257, 260, 261, 263, 264, 265, 266, 270, 279, 283, 284, 288, 289, 290, 291, 296); (BB103, 242, 248, 249, 261, 264, 267, 269, 270, 271, 272, 276, 277, 280, 281, 285, 295, 299, 303, 304, 306, 309, 310, 311, 313, 314, 316, 322, 326, 329, 338, 348, 355, 356, 359, 362, 364, 365, 368, 370, 371, 372, 373, 375, 378, 379, 380, 397, 398, 401, 403, 404, 405, 408, 409, 410, 426, 433, 436, 438, 440, 441, 447, 450, 456, 458, 461, 463, 465, 471, 472, 474, 478, 480, 485, 488, 491, 495, 498, 499, 502, 506, 508, 510, 513, 515, 516, 518, 520, 521, 523, 524)

[30] (FB67, 97); (HS3, 5, 14, 46, 48, 68, 70, 71, 75, 76, 80, 88, 90, 91, 92, 93, 98, 99, 100, 102, 103, 106, 111, 112, 113, 116, 121, 133, 134, 135, 136, 139, 157); (HB12, 26, 32, 51, 73, 91, 102, 121, 122, 126, 130, 135, 148, 153, 155, 160, 161, 162, 167, 170, 175, 178, 185, 197, 199, 206, 209, 213, 216, 225, 227, 232, 234, 242, 254, 262, 265, 268, 270, 273, 278, 281, 283, 290); (BB28, 69, 81, 112, 153, 232, 240, 257, 258, 267, 270, 278, 281, 282, 296, 298, 307, 312, 322, 329, 330, 340, 351, 354, 356, 357, 363, 365, 371, 373, 376, 394, 397, 400, 403, 404, 405, 406, 422, 448, 452, 453, 463, 469, 479, 480, 486, 497, 498, 503, 509, 515, 518, 522, 523, 525, 526)

[31] Commercial whaling (witnessed/participated): (HS95, 125, 127, 130); (BB239, 345, 346, 349, 350, 353, 411, 421, 423, 424, 426)
Commercial whaling (oral tradition): (FB1, 13, 57, 67, 106); (HS3, 6, 7, 22, 27, 30, 31, 36, 37, 43, 45, 46, 48, 49, 63, 65, 67, 72, 73, 74, 80, 81, 87, 89, 93, 94, 96, 105, 92, 106, 109, 113, 114, 118, 122, 124, 125, 127, 130, 132, 133, 135, 139, 150, 157); (HB15, 73, 75, 76, 89, 91, 122, 125, 128, 130, 158, 163, 166, 172, 178, 182, 185, 213, 233, 253, 254, 265, 266, 269, 272, 285, 288, 294); (BB36, 50, 103, 106, 112, 115, 123, 148, 151, 153, 179, 180, 181, 202, 217, 229, 237, 238, 243, 244, 246, 251, 256, 258, 260, 266, 273, 275, 277, 281, 283, 287, 288, 291, 292, 297, 306, 307, 308, 317, 319, 321, 322, 326, 328, 329, 331, 334, 337, 338, 339, 340, 343, 350, 351, 354, 362, 366, 369, 372, 376, 379, 381, 392, 397, 399, 400, 402, 403, 404, 407, 409, 411, 432, 448, 449, 455, 462, 464, 465, 467, 487, 497, 500, 509, 511, 514, 515, 517, 521, 523, 525, 526)

[32] Specific hunts: (FB22, 25, 50, 57, 60, 66, 67, 69, 81, 97, 99, 101, 104); (HS17, 19, 74, 90, 91, 127, 128, 140, 153, 154); (HB5, 47, 50, 51, 73, 75, 79, 90, 91, 93, 94, 95, 96, 97, 100, 101, 104, 109, 113, 114, 116, 119, 123, 126, 131, 132, 134, 135, 136, 137, 141, 144, 145, 163, 178, 182, 183, 187, 193, 198, 200, 202, 204, 206, 207, 208, 212, 214, 216, 221, 234, 238, 239, 242, 244, 251, 252, 253, 258, 259, 266, 271, 278, 281, 282, 288, 289, 298, 300, 301, 303); (BB108, 125, 133, 231, 237, 247, 254, 256, 259, 262, 266, 270, 278, 279, 280, 302, 320, 347, 348, 349, 359, 367, 377, 387, 388, 393, 401, 403, 406, 411, 414, 417, 420, 423, 430, 431, 444, 446, 448, 451, 452, 458, 460, 461, 466, 468, 470, 473, 475, 482, 483, 488, 492, 501, 504, 509, 510, 514, 529, 521)
Hunting techniques: (FB72, 99); (HS14, 36, 46, 74, 104, 112, 117, 122, 140, 153, 154); (HB3, 5, 35, 41, 47, 51, 65, 73, 75, 91, 92, 93, 94, 102, 104, 113, 114, 116, 119, 126, 134, 137, 144, 148, 160, 163, 167, 174, 178, 182, 183, 184, 185, 193, 200, 202, 204, 207, 212, 219, 221, 234, 242, 247, 250, 251, 252, 253, 264, 265, 268, 269, 272, 278, 279, 281, 282, 287, 289, 300, 301); (BB237, 254, 257, 278, 304, 312, 321, 348, 351, 352, 359, 365, 367, 377, 385, 393, 401, 405, 410, 412, 419, 444, 445, 453, 473, 475, 483, 492, 503, 511, 521, 529)

[33] (FB74, 75, 77, 84, 96, 104, 105); (HS10, 14, 17, 34, 35, 51, 63, 73, 104, 145, 149, 153, 155); (HB14, 16, 19, 22, 25, 26, 58, 65, 91, 96, 105, 115, 122, 132, 139, 167, 180, 187, 190, 216, 286, 287, 290, 301); (BB12, 26,

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[34] (FB61, 78, 80, 83, 98, 104, 105, 111); (HS12, 29, 31, 34, 44, 86, 103, 152, 137, 141); (HB41, 52, 132, 133, 140, 150, 159, 165, 174, 176, 181, 186, 187, 195, 197, 208, 211, 224, 246, 247, 253, 255, 274, 290); (BB72, 108, 166, 250, 253, 269, 275, 280, 336, 340, 341, 342, 344, 358, 360, 370, 378, 395, 405, 428, 461, 474, 494, 498, 499, 513, 516, 528)

[35] (FB62, 63, 68, 76, 104, 105); (HS12, 29, 78, 86, 91, 97, 108, 132, 141, 144, 149, 151, 156); (HB12, 70, 126, 140, 141, 154, 156, 165, 174, 175, 181, 187, 197, 208, 210, 214, 215, 233, 246, 255, 256, 260, 261, 263, 272, 279, 284, 287, 290); (BB29, 112, 149, 253, 275, 279, 323, 324, 336, 341, 381, 396, 405, 458, 493, 513, 516, 520, 524, 528)

[36] (FB99, 112); (HS77, 78, 83, 85, 86, 97, 155); (HB75, 106, 107, 108, 112, 117, 137, 138, 140, 245, 257, 272, 276, 280, 287); (BB265, 271, 274, 275, 341, 356, 364, 395, 458, 461, 476, 477, 478)

[37] (FB57, 58, 64, 70, 76, 99, 106); (HS12, 14, 78, 87, 111, 132, 139, 142, 150, 155, 156); (HB73, 75, 99, 101, 111, 123, 124, 126, 135, 136, 144, 147, 148, 149, 152, 161, 165, 167, 168, 172, 173, 174, 183, 186, 190, 196, 200, 201, 210, 212, 213, 226, 230, 235, 244, 245, 246, 247, 249, 252, 255, 261, 264, 267, 270, 272, 275, 277, 282, 284, 287, 288, 289, 295, 301); (BB7, 29, 36, 108, 242, 255, 265, 268, 274, 277, 280, 284, 296, 301, 304, 305, 306, 308, 311, 326, 330, 331, 338, 340, 351, 359, 362, 364, 367, 370, 396, 402, 405, 418, 419, 425, 430, 431, 441, 443, 445, 447, 448, 456, 457, 461, 465, 470, 471, 482, 484, 485, 488, 490, 501, 508, 510, 512, 521, 523, 528, 529)

[38] (FB65, 82, 94, 96, 105); (HS10, 97); (HB132, 169) ; (BB323, 387, 389)

[39] Beliefs, customs & taboos: (FB27, 67, 70, 79, 81, 87, 95, 97); (HS103, 126, 132); (HB42, 96, 103, 109, 110, 118, 132, 134, 167, 170, 178, 191, 199, 218, 221, 222, 223, 231, 240, 243, 264, 267, 268, 290); (BB281, 394, 450, 453, 456, 464, 465, 467, 503) Legends: (FB67, 97); (HS87, 102, 134, 135); (HB89, 91, 114, 128, 135, 145, 148, 155, 162, 178, 218, 221, 235, 264, 270); (BB245, 517)

[40] (FB50); (HS19, 140, 153); (HB5, 73, 79, 90, 91, 93, 94, 95, 96, 97, 100, 101, 104, 113, 114, 116, 119, 123, 134, 288, 289, 301, 303); (BB77, 231, 237, 247, 259, 262, 266, 270, 278, 417, 420, 444, 446, 460, 466, 468, 475, 483, 529)

[41] (FB19, 95); (HS36); (HB31, 41, 127, 132, 133, 142, 156, 181, 186, 210, 211, 215, 255, 260, 274, 292); (BB62, 224, 269, 275, 391, 499, 513)

THE NUNAVUT WILDLIFE HARVEST STUDY

FEB 2004

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NUNAVUMI UMAYUKHIUKHIMAYUT IHIVGIUGUTAIT

FEBRUARY 2004

PREPARED BY/ᐊᑐᐃᓐᓇᕈᑎᓪᓗᑦ/PAKNAIYAKHIMAYAA

Heather Priest
Harvest Study Coordinator
Nunavut Wildlife Management Board

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Heather Priest
Umayukhiuktut Ihivgiuktut Munagiyinga
Nunavumi Umayuligiyit Katimayiit

Box 1379 Iqaluit, NU X0A 0H0

AND/ᐊᒻᒪᓗ/OVALO

Peter J. Usher
P.J. Usher Consulting Services

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Peter J. Usher
P.J. Usher Consulting Services

Box 4815, Station E, Ottawa, ON K1S 5H9

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Executive Summary

Study history

The Nunavut Wildlife Harvest Study (NWHS) was mandated by the Nunavut Lands Claim Agreement (NLCA) and carried out under the direction of the Nunavut Wildlife Management Board (NWMB). Harvest data were collected monthly from Inuit hunters for a total of five years covering the harvest months from June 1996 to May 2001. The purpose of the Harvest Study was to determine current harvesting levels and patterns of Inuit use of wildlife resources. The results of the Harvest Study are to be used by the NWMB to aid in the management of wildlife resources of Nunavut including the calculation of basic needs levels (BNLs). This purpose guided the design and implementation of the study as well as the analysis and reporting of the study results. This document is the Final Report of the results of this important study.

The NWHS was carried out under the direction of a Harvest Study Coordinator, with the assistance of Regional Liaison Officers (RLOs), who coordinated the study in each region of Nunavut, and Fieldworkers in each community. Funding for the survey was provided by the Department of Indian Affairs and Northern Development under the Nunavut Implementation Contract.

The Harvest Study covered the entire Nunavut Settlement Area (NSA) involving participants from 28 communities in all of the three administrative regions: Baffin, Kitikmeot and Kivalliq regions. In 1999, mid-way through the study, the total population of Nunavut was about 27,000, 85% of whom are Inuit. Non-Inuit residents of Nunavut were not registered in the study. During the course of the Harvest Study 6018 hunters were registered to participate.

Data collection

Hunters were stratified according to their hunting activity as occasional, active or intensive hunters. Fieldworkers in each community contacted hunters on a monthly basis to record their harvest during the preceding month. Information collected included the species of animal harvested, the number harvested, and for some species, the location, sex and age class of the animal. Harvest was defined as animals struck and retrieved. A species list developed during the design phase of the study and displayed on the Harvest Study calendar guided Fieldworkers and hunters in the data collection process. The calendar was intended as a recall aid on which the hunters would record their harvest on a day to day basis and ensure accurate reporting to the Fieldworker each month. Calendar use varied from community to community and even within communities, making this function more successful in some areas than in others.

In 21 communities an attempt was made at full census coverage of hunters; all hunters were to be contacted to provide their harvest data. Due to population size, in the remaining communities of Arviat, Baker Lake, Cambridge Bay, Cape Dorset, Gjoa Haven, Kugluktuk and Rankin Inlet, all active and intensive hunters were to be contacted and only a sample of the occasional hunters were to be interviewed. Harvest estimates were then calculated to account for the harvest of the non-sampled occasional hunters. The confidentiality of individual hunters' data was maintained throughout the study with only aggregated totals being released unless written permission was received from the hunter. This was a requirement of the NLCA and will continue to be enforced for as long as the harvest data are available for use.

Communications

Communication with participants of the study was recognized as being crucial to ensure adequate participation rates, accurate reporting and feedback on the results. Communication with participants was accomplished in many ways during the study including through posters, training of local Fieldworkers, and preliminary data reports. At the conclusion of the study, the Harvest Study Coordinator also visited each community to present the five-year preliminary results and to obtain feedback on the results and on the study in general. Communication with other organizations and government departments involved in wildlife management in Nunavut was accomplished through presentations, preliminary data reports and individual contacts by the Coordinator throughout the study. These consultations were important for promoting the study and verifying study results. Feedback from both the community visits and from other wildlife management organizations/departments are detailed in Section 6 of this report accompanying the data tables for each community.

Hunter response

The Harvest Study was a voluntary survey and as such there were some hunters who did not wish to participate. These hunters were registered in the study but were not interviewed as per their wishes. The rates of intentional non-response varied among communities; the rates ranged from 0% in many communities including Arctic Bay and Hall Beach to 32.7% in Baker Lake by the end of the study. In addition some hunters were difficult to contact and not all hunters who were willing to participate were interviewed each month resulting in variable response rates over the course of the study. Response rates during the five years of the study varied both among communities and among months. Mean annual response rates ranged from 98% in Arctic Bay and Nanisivik to 64% in Baker Lake and Coral Harbour, with an overall mean response rate for all Nunavut communities of 82%. Given these response rates, reported harvests will necessarily be lower than actual harvest levels since not all hunters were contacted. Harvest estimates were derived from reported harvests for each species and each community using a straight proportional projection method (Section 4); the objective being to obtain five consecutive annual harvest estimates by species by community to be used by the NWMB to calculate BNLs as required by the NLCA. Monthly and annual harvest estimates and response rates can be viewed in the data tables by community (Tables 11 – 650) and as combined totals for all Nunavut (Tables 651- 674).

Reliability of harvest estimates: sources of error

Since a full census coverage was rarely achieved throughout the study the sampling error was estimated and is displayed as the 95% confidence interval of the annual estimates for each species. Other sources of error affecting the estimates were also investigated during the analysis phase of the study. These errors were categorized in the areas of:

- the survey frame;
- survey coverage and non-response bias; and,
- measurement issues and response error.

The evaluation of the survey frame assessed whether the sample frame fully and accurately represented the hunter population. Errors involving the survey frame included both under-enumeration and over-enumeration. It was determined during the community visits that some hunters were never registered in the Harvest Study. This under-enumeration will cause a downward bias of the harvest estimates since these hunters were unaccounted for in the harvest estimation procedure. An assessment of this source of error was carried out for each community and is discussed in Section 6. It was determined that the degree of downward bias introduced by this error varied from non-existent to very small in communities like Arctic Bay, Igloolik, Kugluktuk and Arviat but was estimated to be more significant in communities such as Grise Fiord, Pangnirtung, Kugaaruk and Whale Cove. There is also evidence that over-enumeration, caused by non-hunters being registered in the study, took place in some communities. The effect of this error could be either an upwards or a downwards bias of the estimates and was therefore difficult to quantify; it was considered to be relatively insignificant.

Survey coverage and non-response bias were also assessed to determine whether there was any significant difference in harvest levels and patterns between those who responded to the survey and those who did not. The potential for non-response bias increases as response rates drop and as intentional non-response rates rise. For this reason it was determined that the potential for this bias was small when response rates were relatively high (over 75%) and intentional non-response rates were relatively low (under 5%). Again, these rates varied among communities and within communities from month to month. The overall intentional non-response rate for all of Nunavut was 4.5%. Section 6 contains an assessment of this source of error for each community individually and cautions readers where appropriate.

An assessment of measurement issues and response error was done to determine whether the survey responses are valid, i.e. measure the true harvests of responding individuals. Although it was reported by Fieldworkers and participants that hunters were generally truthful in

their responses, there were some key problems identified which may have led to measurement error. These problems included an under-reporting of certain species such as eggs, eider down and shellfish in many communities due to the fact that many hunters were unaware they were to report these harvests and because many hunters do not keep track of the number harvested and thus had difficulty reporting their harvest at the time of the interview.

It was also discovered that commercial harvests were inconsistently reported among communities. It was intended that harvests sold for use or consumption within Nunavut be recorded during the study and that those sold outside of Nunavut be recorded but removed from the database for the purpose of calculating BNLs. This practice was not strictly followed for various reasons and resulted in inconsistent reporting of commercial harvests.

The NWHS was designed as a monthly survey in order for respondents to be able to recall their harvests accurately; the Harvest Study calendar was also produced with this aim in mind. However, for a variety of reasons, including Fieldworker staffing difficulties and hunter unavailability, sometimes many months would pass between the harvest and the interview. This period was referred to as the recall period and was measured during data analysis to assess for the potential for recall error. Recall periods for all of Nunavut were generally small with 88% of the harvest information being collected within 3 months of the harvest date. However readers are cautioned in Section 6 when a large number of the harvests were collected over 6 months after the harvest date.

Lastly, strategic bias was investigated as a possible source of measurement error. Were there reasons for hunters to purposely under or over report their harvest and was it likely that this occurred? Several comments regarding strategic bias were received during the community visits. All of the comments referred to under-reporting of harvests for various reasons including: a misunderstanding of the study purpose and a fear that results would be used to limit harvesting; a tendency for Inuit hunters to under-report since they do not like to brag; and a reluctance to report some species since historically they have been illegal to hunt (for example tundra swans). Exaggeration of harvests was thought to be very unlikely and was assumed not to have occurred.

The ultimate question asked during the analysis of Harvest Study data was: how reliable are the harvest estimates? Do they provide an accurate record of the harvesting levels and patterns of Inuit over the study period? At the conclusion of the data analysis the answer to this question is in some cases yes and in other cases no. The size and complexity of the NWHS resulted in data reliability issues that differ not only among communities but also among the years of the study and among the species. As a result, readers are urged to refer to Section 6: Community Results Discussion, when using Harvest Study data. This section includes an assessment of the sources of error listed above for each community and provides community feedback on the data as well as other sources of harvest data for further verification of the results.

This Final Report marks the completion of the NWHS and provides readers with a comprehensive record of the study and its results. Harvest location data can be viewed by using the Nunavut Wildlife Harvest Study GIS Viewer, included on a CD with this report. The NWMB is currently reviewing options for the long-term storage of the Harvest Study data. The storage system will allow access to further data not presented in this report. Administration charges may be applied. In the interim, any readers wishing access to data not provided in this report may apply to NWMB with their request. Fulfillment of each data request will be at the discretion of the NWMB and may be dependent on factors such as staff availability and the complexity of the request and will be decided on a case-by-case basis.

1. Introduction

1.1 Purpose of report

The Nunavut Wildlife Harvest Study (NWHS or Harvest Study) was mandated by the Nunavut Land Claims Agreement (NLCA) to determine how many animals were harvested by Inuit in each community in Nunavut over a specified five-year period. The Nunavut Wildlife Management Board (NWMB) was assigned responsibility for the study. During the five-year study, 6018 hunters were registered for the survey in 28 communities, and harvest data were collected by month for over 60 species of wildlife. Harvest data included kill location, sex and age-class for selected species.

The purpose of this report is to:

- Describe the methods of the harvest survey;
- Report the results of the survey;
- Assess the reliability of the results;
- Report on the implementation of Article 5, part 4, of the NLCA (see Appendix l), which formed the basis for the Terms of Reference (NLCA, 1993, Schedule 5-5) for the NWHS.

The specific requirements of the NLCA (see excerpts in Section 2.1), as well as practice established in several other harvest surveys conducted since the 1970s in northern Canada, have resulted in the following distinguishing features of the NWHS:

- The study consisted of 28 separate community surveys using a standard design. Participation was voluntary.
- The study took a census approach (with limited exceptions) in which it was attempted to interview every participating harvester.
- Individual hunters were interviewed monthly, for 60 consecutive months (June 1996 – May 2001).
- Annual harvest estimates for each species were generated as the sum of the monthly estimates, which were in turn derived from the reported harvest and the survey response rate using a straight proportional projection method. The objective was to obtain five consecutive annual (June through the following May) estimates by species by community.

Monthly and annual harvest data in the form of projected or estimated harvests are presented in the data tables (Tables 11 – 674). A software application, the Nunavut Wildlife Harvest Study GIS Viewer, is provided with this report and may be used to display maps of the harvest location data.

The study spanned the period of time that saw the creation of the Territory of Nunavut, in 1999. Accordingly, throughout the text reference is made both to the Government of the Northwest Territories and the Government of Nunavut, and their relevant departments, depending on the context and timing of the reference.

1.2 Acronyms

BNL – Basic needs level
BQCMB – Beverly Qamanirjuaq Caribou Management Board
CWS – Canadian Wildlife Service
DEC – Data Entry Clerk
DIAND – Department of Indian Affairs and Northern Development
DFO – Department of Fisheries and Oceans
DIO – Designated Inuit Organization
DRR – Department of Renewable Resources (NWT)
DRWED – Department of Resources Wildlife and Economic Development (NWT)
DSD – Department of Sustainable Development (Nunavut)
FW – Fieldworker
GHL – General Hunting Licence
HTA – Hunters and Trappers Association
HTO – Hunters and Trappers Organization
IQ – Inuit Qaujimajatuqangit
NLCA – Nunavut Land Claims Agreement
NOCIR – Notification of change in registration
NSA – Nunavut Settlement Area
NWHS – Nunavut Wildlife Harvest Study, Harvest Study, Study
NWMB - Nunavut Wildlife Management Board
RLO – Regional Liaison Officer
RWO – Regional Wildlife Organization
TAH – Total allowable harvest
TEK – Traditional ecological knowledge
UTM – Universal Transverse Mercator

1.3 Acknowledgements

The Nunavut Wildlife Harvest Study is one of the largest ever undertaken in Canada. In addition to over 35 individuals working directly for the Harvest Study at any one time, a great number of people both with NWMB and with other organizations and government departments provided critical assistance during the course of the study. It must be stressed however, that the success of the Harvest Study was directly related to its participants. The harvesters of Nunavut, who took part in the Harvest Study by sharing their data every month for five years, deserve great praise and recognition for their part in this important study.

The following people and organizations have also done a great deal of hard work during the course of the Harvest Study and provided critical input and feedback as the study progressed:

Fieldworkers:

Arctic Bay and Nanisivik: Pauloosie Muckpa

Arviat: Frank Nutarasungnik

Baker Lake: Basil Aptanik, Andrew Parker, Charles Tarraq, Jonathan Tugak, Betsy Aksawnee, Lucy Mautaritnaaq

Bathurst Inlet: Connie Kapolak

Cambridge Bay: Ruby Haniliak

Cape Dorset: Joe Ittidlui, Salomoni Etulu, Sakiassie Pudlalik, Alice Samayuallie, Numa Ottokie, Ragee Killiktee

Chesterfield Inlet: Peter Autut, Gary Ippiak, Gloria Mimialik, Ursula Innukshuk, Bradley Aggark

Clyde River: Seetee Paniloo, Levi Illingayuk

Coral Harbour: Susie Eetuk, Heather Kolit, Molly Eetuk, Ben Ell, Tina Netser, Johnny Alogut

Gjoa Haven: Elizabeth Aglukkaq, Teddy Eleeheetook, Sarah Kegeak, Elijah Takkiruq

Grise Fiord: Leah Kalluk, Parnee Noah

Hall Beach: Joe Curley, Judah Innraluk, George Innuksuk, Martha Okalik, Bruno Immaroitok, Josie Irquttuq, Neomi Kaernerk

Igloolik: Eugene Ipkarnak

Iqaluit: Levi Nowdluk, Salamonie Shoo, Adamie Ipeelie, Tony Ulikatar, Eelaya Pitseolak, Eyalah Ineak, Jarloo Nowdluk, Micheal Immaroitok, Jamesie Pudloo, Moses Qillaq, Nathan Tigullaraq

Kimmirut: Hannah Oolayou, Josehphie Eyeevodluk, Terry Lee, Eric Tikivik, Atsaina Kolola, Olittua Judea

Kugaaruk: Eric Ammautinuar, Isabella Inuksaq, Tom Kayaitok, Charlie Niptayok, Gerald Tigvareak

Kugluktuk: Ida Kapakatoak

Pangnirtung: Josephie Kilabuk

Pond Inlet: Martha Maktar, Paul Hauli, Jonah T. Paniloo, Jollie Enoogoo, Joanasie Anaviapik, Timothy Qamaniq

Qikiqtarjuaq: Imoona Natsiapik, Jonas Audlaqiaq, Lucy Newkingnak, Jerry Kakka, Monica Nuqingaq

Rankin Inlet: Albert Kimmaliardjuk, Pierre Kolit, Pierre Okoktok, Andy Tugak, Lucy Kalukjak, Peter Autut

Repulse Bay: David Ammaq

Resolute Bay: Philip Manik, Saromie Manik, Deborah Ikaluk

Sanikiluaq: Johnny Kudluarok, Louisa Meeko, Luccassie Arragutainak, Winnie Arragutainak, Caroline Arragutainak

Taloyoak: Steve Aqqaq, Peter Mannilaq, David Nanook, Joseph Quqqiaq

Umingmaktok: Martina Kapolak, George Panegyuk, Connie Kapolak

Whale Cove: John Angoo, Ron Alikashuak, Lewis Voisey Jr., Jackie Napayok, Gunner Tugak, Louie Oklaga

Data Entry Clerks:

Qikiqtaaluk (Baffin) Region: Taqialoo Stokes

Kivalliq Region: Janet Akat, Angie Okatsiak, Elizabeth Issakiark, Sally Waah, Susan Arloo, Debbie Arualak

Kitikmeot Region: Dawn Ayalik, Edith Anablak, Mary-Jean Anablak, Susan Atatahak, Ann Klengenberg, Michelle Klengenberg

Regional Liaison Officers:
Qikiqtaaluk (Baffin) Region: Tom Demcheson

Kivalliq Region: Phillipe diPizzo, Janet Akat

Kitikmeot Region: Todd Roche

Database Managers:
Daniel Kulugutuk, Josée Galipeau, Leanne Pugh

Past Harvest Study Coordinators:
Carol Churchward, Johnny McPherson, Jordan DeGroot

Harvest Study Steering Committee:
Ovide Allakanuark, Adrian D'Hont, Jim Hines, Moses Koonoo, Gordon Koshinsky, Roger Peet, Simeoni Sammurtok

Harvest Study Committee:
David Alagalak, Nick Amautinuar, Harry Flaherty, Pauloosie Keeyotak, Moses Koonoo, Gordon Koshinsky, Kevin J. McCormick, Robert Moshenko, Makabe Nartok, David Tagoona

NWMB Staff:
Dan Pike, Director of Wildlife Management

Michelle Wheatley, Director of Wildlife Management

Billy Shaw, Harvest Study Assistant

Translation Services:
Evie Amagoalik, Betty Brewster, Edna Elias, Helen Klengenberg, Allen Maghagak, Rebecca Mike, Mary Nashook, Jacopoosie Peter.

Contractors:
Fikret Berkes, Mina Berkes, Helen Fast, Natural Resources Institute, University of Manitoba (study design)

Falcon Consulting Services (FoxPro database design)

Geomatics International Inc. (map conversion program)

Wayne Johnson (MS Access database design)

GeoArctic International Ltd. (database and mapping application)

Peter J. Usher, P.J. Usher Consulting Services (data assessment and report editing)

Jack Kruse, Professor emeritus of public policy, University of Alaska, Anchorage (data assessment)

Jamie deJong, Abdellatif Demnati, Hew Gough, Statistical Consultation Group, Statistics Canada (data assessment)

We would also like to thank staff and Board Members of the Regional Wildlife Organizations and the Hunters and Trappers Organizations as they were involved with many aspects of the Harvest Study, including administration and community consultations. In addition, the staff members with the Department of Sustainable Development (DSD), Nunavut Bureau of Statistics, Department of Fisheries and Oceans (DFO) and Canadian Wildlife Service (CWS) provided additional information and advice as the study progressed.

Heather Priest, in her role as the Harvest Study Coordinator, prepared this final report along with Peter Usher. Peter Usher provided critical input on data analysis, including the writing of Section 5 (Reliability of Harvest Study Estimates: sources and estimation of error) and also contributed to the writing and editing of other sections of the final document. Michelle Wheatley performed a great deal of editing of the Final Report and provided significant input into Section 6 (Community Results Discussion).

Brian Wheatley and Margaret Wheatley reviewed a draft version of this Final Report. A review of the final manuscript was also done by Fikret Berkes, Cynthia Wentworth and Jim Simon. We appreciate their comments and feedback.

We would like to express our appreciation for all the people who were involved in the various stages of the study. We apologize if we have neglected to mention anyone who contributed.

2. Study History

2.1 Requirement for and objectives of the NWHS

The Nunavut Land Claims Agreement (NLCA) requires that:

> *"A Nunavut Wildlife Harvest Study (Study) shall be undertaken in, and cover, each of the three Regions of the Nunavut Settlement Area"* (NLCA, 1993, Article 5.4.1);
>
> and *"shall begin in each of the three Regions on or before the first anniversary of the date of ratification of the Agreement"* (NLCA, 1993, Article 5.4.2); and
>
> *"shall be undertaken over a period of five years"* (NLCA, 1993, Article 5.4.4).

The purpose of the study is stated as being:

> *"to furnish data, to establish current harvesting levels, to assist the NWMB in establishing levels of total allowable harvest and, in general, to contribute to the sound management and rational utilization of wildlife resources in the Nunavut Settlement Area. To this end, the study shall:*
>
> *(a) document the levels and patterns of Inuit use of wildlife resources for the purpose of determining the basic needs level [BNL]; and*
>
> *(b) gather, review and analyze existing biological, ecological and harvest data pertinent to the management of wildlife in the Nunavut Settlement Area."* (NLCA, 1993, Article 5.4.5)

BNLs are to be calculated, "for each stock or population", "according to either:

> *(a) the aggregate of the greatest amount harvested in any one year during the study, and the average annual amount harvested over the five years of the Study, which aggregate is then divided by two: or*
>
> *(b) the amount harvested in any year during the Study that is nominated by an HTO at the conclusion of the Study, and the nominated year shall apply to all species subject to a total allowable harvest at the commencement of the Study." (NLCA, 1993, Article 5.6.21).*

(The formulas are slightly different for populations subject to a total allowable harvest at the beginning of the study and those that may become subject to a total allowable harvest [TAH] at a later date).[1]

The terms of reference for the study specified (among other things) that it "gather data from specific settlements for defined geographical regions over specified periods of time" (NLCA, 1993, Schedule 5-5). It is also a requirement of the study that "research, data collection, and fieldwork ... shall be designed to promote maximum harvester participation" (NLCA, 1993, Article 5.4.3).

Based on its mandate and terms of reference, the objective of the study was to produce annual estimates of wildlife harvests by Inuit, by species and by community, and to provide information on the location of these harvests.

2.2 Administration and organization

The NLCA specified that:

> "the Study be carried out under the direction of the NWMB" (NLCA, 1993, Article 5.4.2);
>
> "the research, data collection and fieldwork associated with the Study ... be contracted to an appropriate DIO" [Designated Inuit Organization] (NLCA, 1993, Article 5.4.3); and
>
> "be fully funded by Government" (NLCA, 1993, Article 5.4.4).

The study was therefore structured with a Headquarters function attached to the NWMB office in Iqaluit, three regional operations managed by the DIOs, which were the Regional Wildlife Organizations (RWOs), and Fieldworkers in each of the 27 communities. Figure 1 provides an organization chart of the overall operation.

As noted above, the study was headquartered at the NWMB office in Iqaluit. The study was headed by the Harvest Study Coordinator, a position established by the NWMB at the outset of the study. The Coordinator played an integral role in the start-up phase of the Harvest Study through consultations with the study design contractors and the Harvest Study Steering Committee. As the study progressed to the collection phase, the Coordinator was responsible for directing the technical and administrative aspects of the study, maintaining a basic level of standardization across the regions, and ensuring that the study fulfilled its purpose as stated in the NLCA. The Coordinator managed

[1] *"total allowable harvest" for a stock or population means an amount of wildlife able to be lawfully harvested as established by the NWMB* (NLCA, 1993, Article 5.1.1)

the Harvest Study budget, received and compiled the data from each of the regional offices, and analyzed and reported the Harvest Study results. The Coordinator worked closely with the RWOs and the Harvest Study Committee to complete these tasks. Updates on the progress of the Harvest Study were given at each NWMB Meeting and as required on other occasions. Once the data collection phase was complete the Coordinator took the lead role in the analysis and reporting of the study results. These activities included a community tour to present the preliminary data to local participants, and working with consultants for both data analysis and the writing of the Harvest Study Final Report. There were four Coordinators during the course of the study.

A Database Manager was hired in March 2000 to assist the Coordinator with the intake and verification of data. The Database Manager reported directly to the Harvest Study Coordinator and was responsible for managing, logging, and verifying incoming data. This position was discontinued in January 2002 after all incoming data had been received and processed.

Several committees were created by the NWMB to supervise and provide advice on the project over its life. The first was the Harvest Study Steering Committee, established to assist and advise the Coordinator in the initial set up of the Harvest Study (NWMB, 1995a). The Steering Committee consisted of representatives appointed by the three Regional Wildlife Organizations (RWOs), the Canada Department of Fisheries and Oceans (DFO), the Canada Department of Environment and the GNWT Department of Renewable Resources (DRR). It was chaired by a member of the NWMB. The Steering Committee was terminated by the NWMB in November 1997 and replaced by the Harvest Study Committee, consisting entirely of NWMB members, to oversee the data collection phase of the study (NWMB, 1997).

The three Regional Wildlife Organizations were approved as Designated Inuit Organizations for the purpose of NLCA Article 5.4.3, in September 1995 (NWMB, 1995c), and were contracted to carry out the NWHS in their regions in January and February 1996 (NWMB, 1996). They are:

- Qikiqtaaluk Wildlife Board, in Iqaluit (Baffin Region);
- Kivalliq Wildlife Board (formerly Keewatin Wildlife Federation), in Arviat (Kivalliq Region);
- Kitikmeot Hunters and Trappers Association, in Kugluktuk (Kitikmeot Region)

The NWHS was organized similarly in each region. Each regional operation was coordinated by a Regional Liaison Officer (RLO), who was employed jointly by the NWMB and the RWO. As such, his or her time was shared between Harvest Study business and RWO operations. RLO Harvest Study duties included the management of the regional Harvest Study budget, and the hiring, training and supervision of the regional Data Entry Clerk and the community Fieldworkers. Updates on the progress of data collection and other issues were given on a regular basis to the Study Coordinator.

Data entry clerks (DECs) were employed by the RWOs to work exclusively on the Harvest Study with each RLO. This work entailed the logging of incoming datasheets, entry of harvest data using a custom-designed data entry program, initial verification of the incoming data, and tracking of the change in registration status of hunters. Each month the DEC sent a digital file of data from each community in his or her region to NWMB headquarters and faxed copies of any Notification of Change in Registration forms received from the Fieldworkers.

Each RWO employed a Fieldworker in each of its communities. Some larger communities required more than one worker. The Fieldworker had the important task of collecting the harvest data from registered hunters on a monthly basis. At the outset of the study the Fieldworkers also helped with the registration of hunters, and throughout the study they updated their registration lists and supplied the regional office with any pertinent changes. Fieldworkers in each community generally worked out of office space provided by the local HTO.

Fieldworker training was accomplished with the use of a training manual and a combination of workshops, newsletters and individual training sessions.

At any given time during the data collection phase the Harvest Study employed approximately 35 people, spread among NWMB headquarters in Iqaluit, the three regional offices, and the 28 communities.

At the community level, the local Hunters and Trappers Organizations were asked to participate in the administration of the Harvest Study by recommending individuals for the Fieldworker positions and by providing administrative support to the Fieldworkers once they were hired. The HTOs also played an important role in community feedback and consultations on the Harvest Study results.

The Harvest Study was funded entirely by the Federal Department of Indian Affairs and Northern Development (DIAND), as provided for by the NLCA (NLCA, 1993, Article 5.4.4), and carried out under the direction of the NWMB (NLCA, 1993, Article 5.4.2).

2.3 Study history

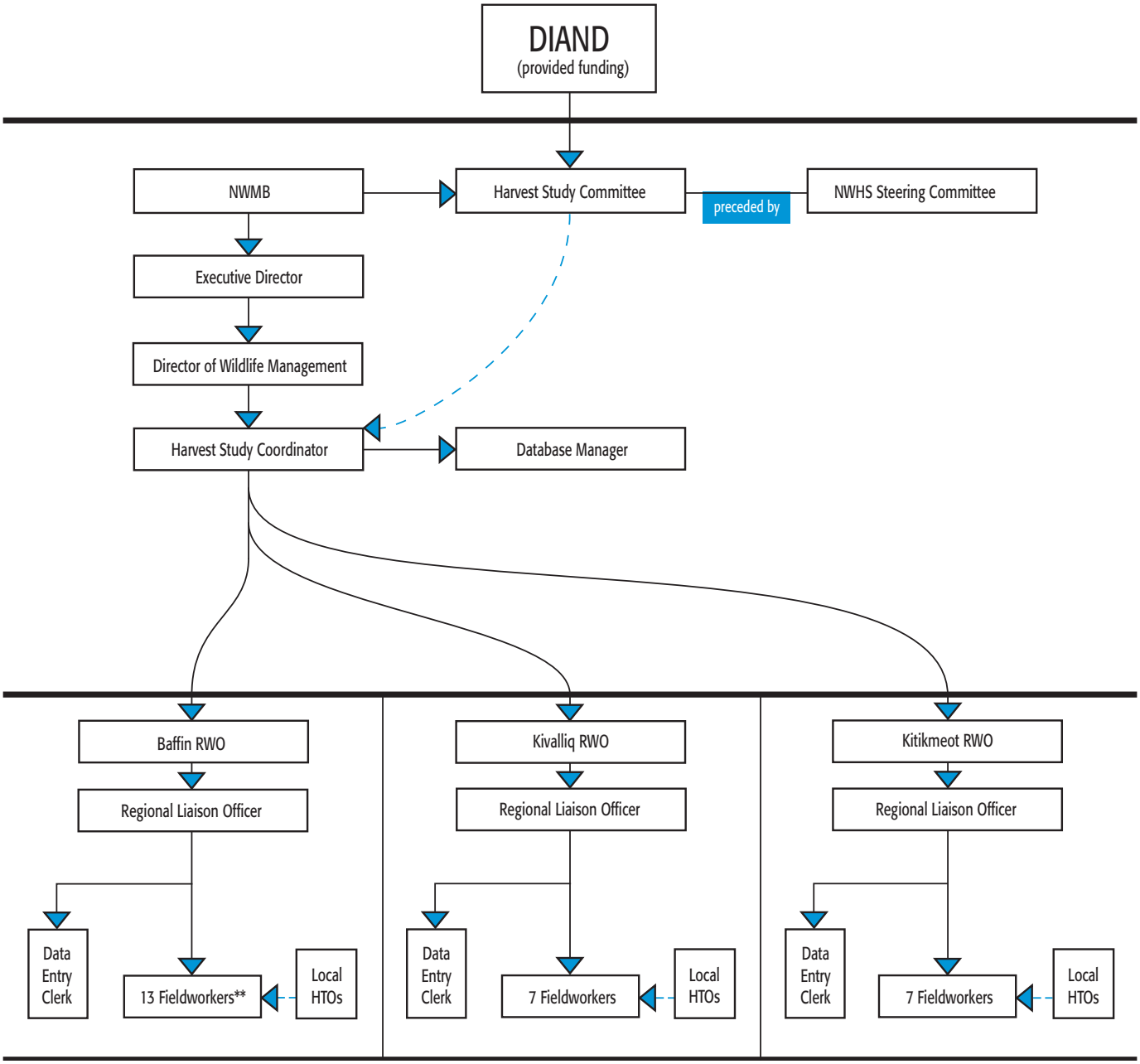
The Harvest Study was conducted over a period of just over ten years, consisting of the following phases:

1) Startup (design and preparation) –1993-1996
2) Data collection – 1996-2001
3) Final analysis and reporting - 2001-2004

The total cost of the study was approximately $7.3 million. Average annual expenditure during the five-year data collection phase was approximately $1.065 million.

The Nunavut Wildlife Harvest Study began in November 1993 with the hiring of a Harvest Study Coordinator, within the time specified by the NLCA. During the first year of the study, the NWMB established the Harvest Study Steering Committee and solicited comprehensive proposals for the design of the NWHS. The Natural Resources Institute at the

Figure 1: Administration and Staffing Flow Chart for the Nunavut Wildlife Harvest Study



** 1 Fieldworker collected data in Arctic Bay and Nanisivik

University of Manitoba under the leadership of Dr. Fikret Berkes was selected in November 1994 (NWMB, 1994). Dr. Berkes' team worked with the Harvest Study Coordinator and the Harvest Study Steering Committee to develop the design of the Harvest Study over the next several months.

The Steering Committee made several key decisions based on its interpretation of the NLCA study mandate in early 1995. The Steering Committee felt that:

> *"Attention to previous/existing biological, ecological and harvest data (as per Article 5.4.5(b) of the Agreement) is an open-ended matter which will significantly involve the Board, its staff, and co-management agencies throughout the future. A comprehensive focus on these matters is outside the Terms of Reference for (the present aspect of) the Harvest Study as set out in Schedule 5-5 of the Agreement."* (NWMB, 1995b: 2)

Therefore, it was decided that the primary focus of the Harvest Study would be on documenting *"the levels and patterns of Inuit use of wildlife resources for the purpose of determining the basic needs level"* (NLCA, 1993, Article 5.4.5 a). This would be accomplished through a number of features of the study design, including the five-year time frame of the study and the collection of kill-location data (NWMB, 1995b).

The Steering Committee also decided that additional information would be collected, but with the caveat that it not jeopardize the primary focus or increase study costs (NWMB, 1995b). As a result, the gathering, review and analysis of existing biological, ecological and harvest data have been addressed in the study to the extent practicable. Subject to funding constraints, the NWMB intends to continue to gather, review and analyze such data into the future, and to report on the results of its efforts.

An especially important component of existing data is Inuit Qaujimajatuqangit - Inuit traditional ecological knowledge (TEK). TEK was incorporated into the Study in several ways. The collection of place name information has created a Nunavut–wide repository of traditional place names and their approximate geographic locations. Hunters were also asked to provide the Fieldworkers with comments on the general health and abundance of wildlife during the monthly interviews. This information was recorded in the comments field of the harvest data table and although it is not analyzed or summarized in this report, it is available for reference by interested individuals. TEK also contributed to the community review of, and comment on, preliminary results (Section 2.5 and Section 6).

Although there were previous harvest studies in the Nunavut Settlement Area, including those commissioned during claims negotiations for implementation purposes (Donaldson, 1983; 1984; Gamble, 1984; Jingfors 1986), none were as comprehensive as that required by the NLCA.

Other preparations that were necessary to move on to the next phase of the Harvest Study included:

- the hiring of three RLOs to coordinate the collection of data in each region;
- the hiring of three Data Entry Clerks, to work with each RLO;
- the hiring and training of Fieldworkers for each community;
- the production of a Harvest Study Calendar and data collection forms for the recording of data by the Hunters and Fieldworkers;
- the purchase and setup of equipment for input, storage and analysis of the harvest data, and
- ongoing communications with RWOs and HTOs.

The calendar, data collection forms, and training manual were pre-tested by means of a pilot study in three communities (Arctic Bay, Kugaaruk, and Chesterfield Inlet) in May 1996.

Data collection began in July 1996 and ended in June 2001, although the collection of backfill data continued through the fall of 2001.

The final phase of the Harvest Study, the analysis and reporting, began after the conclusion of the data collection and once all data had been verified and tabulated. This stage included a methodological and statistical assessment of the data for reliability, and community consultations to examine the data. The results of both of these exercises are contained in Sections 4, 5 and 6 of this report. The production of this report marks the completion of this final phase of the Harvest Study.

2.4 Privacy and access policies

The NLCA stipulated that:

> *"raw and interpreted data produced from the Study shall be fully and freely available to the Government of Canada, the Territorial Government and Inuit"* (NLCA, 1993, Article 5.4.6); and
>
> *"The NWMB shall ensure that the names of individual harvesters are not revealed when making available data pursuant to Section 5.4.6"* (NLCA, 1993, Article 5.4.7); and
>
> *"Without the prior written permission of the DIO and affected individuals, evidence obtained through the Study relating to an individual shall not be admissible in any proceeding where the individual may be held civilly or criminally liable"* (NLCA, 1993, Article 5.4.8).

The NLCA further specifies that:

> *"the NWMB shall in obtaining and disclosing information be subject to laws of general application relating to confidentiality of and access to information as if it were a government department"* (NLCA, 1993, Article 5.2.31).

As unprocessed harvest data accumulated during the course of the study, the NWMB became concerned that the requirement to make "raw data" available to other parties could result in the unauthorized or inadvertent release of preliminary harvest information not yet properly verified and assessed. Accordingly, in 1998, the NWMB prepared data sharing agreements with the Department of Resources Wildlife and Economic Development (DRWED), DFO, CWS, and the Beverly Qamanirjuaq Caribou Management Board (BQCMB). These agreements established protocols for data storage, data access, and data release (specifically, the use of NWHS data in government documents or publications). Once a data-sharing agreement was signed with a government department or organization, a copy of the database (with hunter names removed) was supplied to a designated individual within that department who managed the database and dealt with internal data requests. Copies of all interim reports were forwarded to each government department and Inuit organization involved in wildlife management in Nunavut.

In order to fulfill obligations pursuant to Article 5.4.7 of the NLCA relating to the release of any names of individual harvesters, the Harvest Study database was designed in such a way that any harvest data, whether it be in hard-copy form (datasheet) or within a computerized table, referred to hunters only by alpha-numeric code, not by name. The hard-copy lists and computerized tables containing hunters' names and codes were held only by Harvest Study staff who required this information to track registrants and perform necessary interviews.

Requests for access to harvest data by individuals or organizations not identified in Article 5.4.6 in the NLCA were assessed on a case-by-case basis by the Harvest Study Committee. Most requests were for aggregated data not yet released. Individual harvest data were never released unless written permission was received from the hunter. Several hunters requested in writing that their data be released to the Workers' Compensation Board in order to facilitate claims. These requests were granted and illustrate one of the many un-mandated functions the Harvest Study can fulfill.

It is anticipated that this Final Report will satisfy the ongoing harvest data needs of most individuals or organizations. The NWMB is currently reviewing options for the long-term storage of the Harvest Study data. The storage system will allow access to further data not presented in this report. Administration charges may be applied. In the interim, any readers wishing access to data not provided in this report may apply to NWMB with their request. Fulfillment of each data request will be at the discretion of the NWMB and may be dependent on factors such as staff availability and the complexity of the request and will be decided on a case-by-case basis.

2.5 Community consultations, communication and reporting

2.5.1 Consultation and communication

Consultation with Inuit communities about the study began during the claims negotiation process. Continuing communication of the purpose, ongoing status, and results of the Harvest Study, during its implementation, was widely recognized as essential for maximizing participation and validating results. Communications about the study included its purpose, how it would be conducted, how the information would be used, and the confidentiality provisions of the NLCA.

Communications in a variety of forms and media were used over the course of the Harvest Study:

- *Posters* were distributed in each community in both English/Inuktitut and English/Inuinnaqtun in 1996. Three posters were done promoting the purpose of the study, the benefits to Inuit and the confidentiality of the study.
- *Radio interviews* on CBC and local radio were done over the course of the Harvest Study to promote the study to the public.
- *Advertisements* in both *Above and Beyond* and *Up Here* magazines, from 1998 to 2000 promoted the Harvest Study.
- A *newsletter*, the *Harvest Study Informer*, created by the Coordinator with contributions from each of the regional offices, was sent out to Harvest Study Fieldworkers. The *Informer* provided information about the Harvest Study, tips for species identification, data collection, general updates on the study and contact information for all the offices. The *Informer* was produced every 1-2 months in 1997. Starting in 1998 separate newsletters were produced by the RLOs in each of the three regions.
- *Promotional items* for the participants. Harvest Study travel mugs were distributed to participants in 1998. In 2000 Harvest Study pocket knives were produced and were given to each participant in recognition of their past and ongoing participation in the study.
- *Harvest Study Calendars* were distributed annually to every harvester. Although the main purpose of the calendar was to serve as a data collection tool (Section 3.7), the calendar also functioned as a promotional item. Members of the community submitted photographs depicting harvesting and wildlife in Nunavut. These photographs, displayed on the front and back covers of the calendar and on each month's page, promoted both the Harvest Study and Nunavut harvesting in general.
- *Presentations to the NWMB.* The Coordinator updated the NWMB on the NWHS at each Meeting, and briefed the Board on matters requiring their decision.
- *Other presentations.* Many presentations were given to government departments and agencies, RWOs, and other organizations, during the course of the study.

2.5.2 Reporting

The NLCA required that *"The NWMB shall report annually on the progress of the Study. Upon completion of the Study, the NWMB shall publish a comprehensive summary of the findings of the research."* (NLCA, 1993, Article 5.4.9)

The production of annual reports proved impossible due to staffing changes and early problems with the database. Interim community reports were produced summarizing the first three years of Harvest Study data in the summer and fall of 2001. Copies of the reports were forwarded to each HTO and to other organizations and government departments involved in wildlife management in Nunavut. The reports were also presented by the Coordinator at various RWO and HTO meetings. HTO Managers were asked to discuss the reported harvest numbers with their Board Members and with the hunters in their communities, for the purpose of preliminary verification. Individuals and organizations were asked to comment on any of the harvest estimates in the reports, indicating if they thought the estimates looked too high or too low. Other feedback on the results was also welcome for the purpose of detecting any errors in data collection or data entry. Comment forms were circulated with the reports to allow individuals to comment on the numbers. Follow up phone calls were made to the HTOs to further discuss the results and community comments. Interviews were also done in English and Inuktitut on CBC Radio announcing the release of the reports and their availability to the public at the HTO office. Very little feedback was received during this process. Understanding the importance of community feedback on the results, the Coordinator planned a community tour in order to deliver subsequent reports to each community. Below is a description of this process, which was much more successful in obtaining comments on the Harvest Study data.

Five-Year Preliminary Reports summarizing all five years of Harvest Study data, by community, were released in November 2002. Community visits were then organized, during which the Coordinator and the RLO visited each community to present and discuss the Harvest Study data. These visits took place between January and May 2003. The communities of Bathurst Inlet, Umingmaktok and Nanisivik were not visited due to their small size; results from these communities were presented and discussed during the Cambridge Bay and Arctic Bay visits respectively.

Prior to the public meeting in each community, the Coordinator met with the HTO Board to present the data and address any questions that arose. A public meeting was then held to present the harvest data and their geographic locations to the community as a whole, using a custom computer application to display this information graphically[2]. This community tour was thus the principal occasion for community assessment, comment, and verification of the results of the study.

Comments from all community consultations on Harvest Study data are summarized in Section 6: Community Results Discussion.

2.5.3 Study products

The Harvest Study produced several reports over its life. All are available in the NWMB Resource Centre. Also available in the NWMB Resource Center are the unpublished documents cited in the references section of this report.

Reports relating to study design, quality control, and data reliability assessment:

Designing the Nunavut Wildlife Harvest Study – Interim Report
Fikret Berkes, Mina Berkes and Helen Fast, February 1995
Interim report outlining the proposed design of the Nunavut Wildlife Harvest Study.

Designing the Nunavut Wildlife Anguyanik (Harvest) Study – Draft final report
Fikret Berkes, Mina Berkes and Helen Fast, April 1995
Outlines the recommendations, budget and implementation plan for the Harvest Study

Technical Review of the Nunavut Wildlife Harvest Study
William Kemp, Lorraine Brooke and Valter Blazevic, January 2000
Results of a technical review of the Harvest Study contracted by the NWMB in June 1999.

Nunavut Wildlife Harvest Study - Interim Community Reports
Heather Priest, Harvest Study Coordinator, June – September 2001
A report was produced for each Nunavut community summarizing the first three years of Harvest Study data. Reports were released in the summer and fall of 2001.

Nunavut Wildlife Harvest Study – Five-Year Preliminary Reports
Heather Priest, Harvest Study Coordinator, October 2002
A follow-up to the Interim Community Reports, these reports summarize all five years of Harvest Study data. They contain participation rates in the communities and yearly harvest estimates for wildlife species harvested. Again, a report was produced for each Nunavut community.

The Nunavut Wildlife Harvest Study – Final Report
Heather Priest and Peter J. Usher, August 2004
This final report was prepared as a comprehensive record of the NWHS, including a summary of the study history, methods, data products and the reliability of these data.

A *Nunavut Wildlife Harvest Study GIS Viewer* was written to display GIS data collected during the study. This custom computer application was designed in the spring of 2002 to verify the geographic data in the database and to serve as a query and display tool for all users of the Harvest Study data.

[2] Public meetings were not held in Cape Dorset, Qikiqtarjuaq, Hall Beach and Iqaluit.

3. Methods and implementation

The Terms of Reference for the NWHS specified the following with respect to research, methodology, design and reporting:

> *"The study shall be conducted primarily by means of a diary/calendar record kept by harvesters of all wildlife harvested daily. The records shall be kept in prepared diary/calendars which shall be given to community interviewers. The community interviewers shall interview respondents, and translate and transcribe the harvest records onto tabulation sheets for processing. The results of the study shall be reported and portrayed geographically. In particular, the specific location, where possible, of wildlife harvest shall be recorded. The study shall gather data from specific settlements for defined geographical regions over specified periods of time."* (NLCA, 1993, Schedule 5-5)

This section describes the methods actually adopted by the study in fulfillment of the above specifications, and the implementation of those methods over the course of the study. Schedule 5-5 of the NLCA was negotiated in the early 1980s and confirmed in the final agreement of 1993. In the meantime, substantial experience of evolving best practice had been gained in previous and ongoing Aboriginal harvest surveys, both prior to the commencement of the NWHS and during its 10-year course. These developments influenced NWHS methods and their implementation significantly.

3.1 Study area and duration

The NLCA specified that the study cover the entire Nunavut Settlement Area (NSA) (Figure 2) for a period of five years. The area of the NSA is approximately 1,900,000 km2, and is subdivided into three administrative regions: Baffin (Qikiqtaaluk), Kitikmeot, and Kivalliq (formerly Keewatin). During the NWHS, there were 28 communities in the three regions (Table 1). As the community of Nanisivik was subsequently abandoned due to the closure of the mine there, the data for Nanisivik have been amalgamated with those for Arctic Bay. In this Section, which deals with the conduct of the study, reference is made to the 28 communities. However Section 4 (results) refers only to 27 communities. Hunters living at outpost camps were registered in the closest community to which they traveled for supplies or in which they resided for part of the year. Data were collected from these individuals either by radio or in person when they returned to the community.

The population of the NSA was approximately 27,000, 85% of whom are Inuit. Table 1 shows the Inuit population of each of the 28 communities, as of 1999, mid-way through the study (Government of Nunavut, 2002).

Data collection began in July 1996 and continued through June 2001. Delays were encountered in some communities due to difficulties in retaining Fieldworkers and in registering hunters. These problems were overcome in a matter of months (Section 3.7), however the decision was made by the NWMB (supported by Nunavut Implementation Panel) that the study period for the entire NSA would cover the harvest period 1 June 1996 to 31 May 2001, with the effect that the survey in some communities would last slightly less than five years, rather than have asynchronous surveys in each community. Harvest data collected in the communities of Iqaluit and Cape Dorset prior to August 1997 were deemed unreliable and were not used. In the community of Rankin Inlet problems encountered during data collection also resulted in missing data for June 1996 and from September 1997 to February 1998. Results for missing months were inferred as the mean monthly harvest for the other three or four years in order to display annual totals.[3]

[3] Details are provided in Section 6: Community Results Discussion for the relevant communities.

Figure 2: The Nunavut Settlement Area: its regions and communities

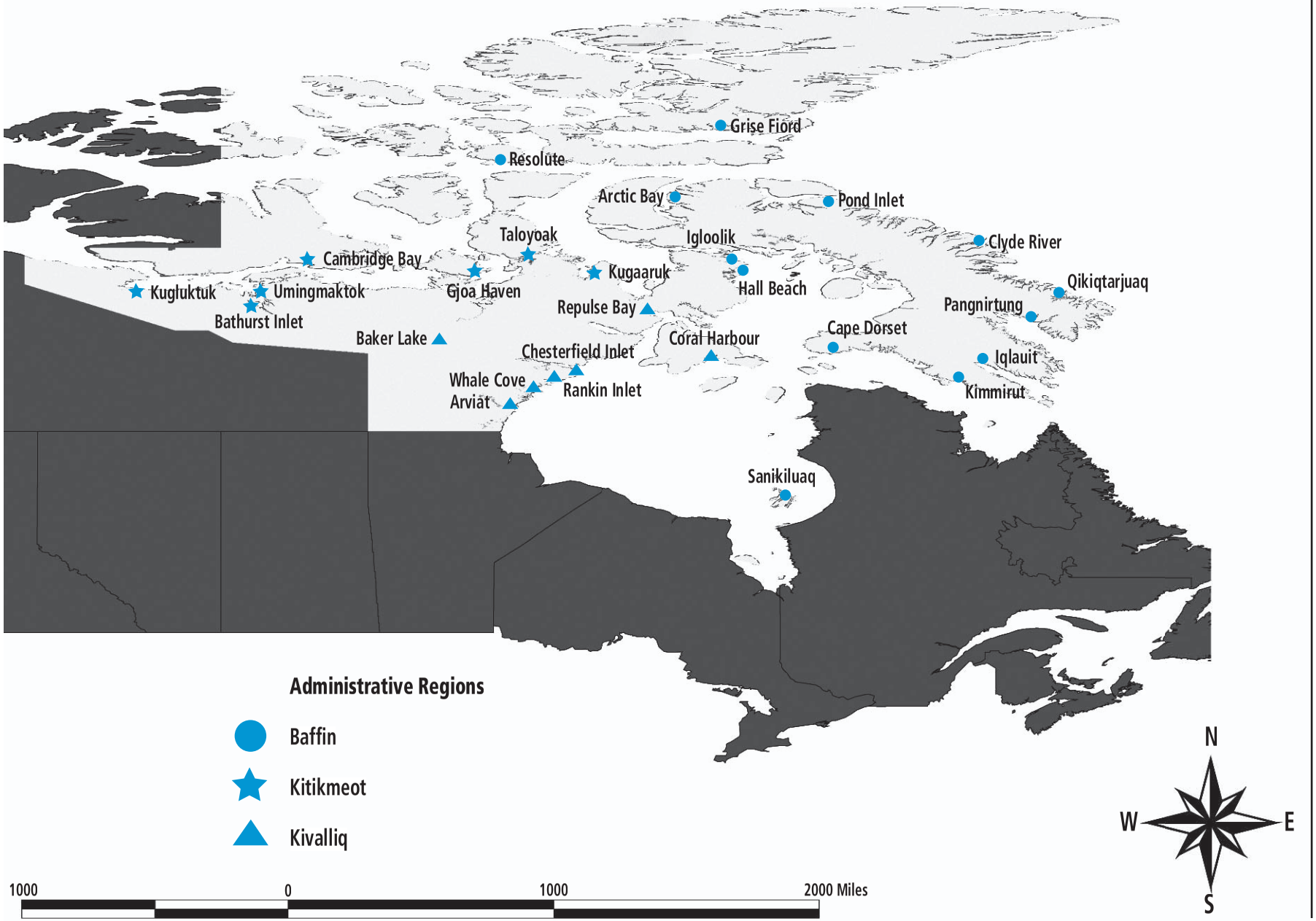


Table 1: Nunavut Population Statistics

Community	Inuit Population*
Baffin Region	
Arctic Bay	627
Cape Dorset	1,130
Clyde River	737
Grise Fiord	145
Hall Beach	585
Igloolik	1,246
Iqaluit	2,956
Kimmirut	408
Nanisivik	23
Pangnirtung	1,354
Pond Inlet	1,240
Qikiqtarjuaq	508
Resolute Bay	174
Sanikiluaq	631
Kitikmeot Region	
Bathurst Inlet	16
Cambridge Bay	1,110
Gjoa Haven	920
Kugaaruk	549
Kugluktuk	1,210
Taloyoak	714
Umingmaktok	47
Kivalliq Region	
Arviat	1,568
Baker Lake	1,349
Chesterfield Inlet	335
Coral Harbour	775
Rankin Inlet	1,730
Repulse Bay	567
Whale Cove	293
Nunavut Total	22,947

* Population estimates for 1999 provided by the Evaluation and Statistics Division, Department of Intergovernmental Affairs, Government of Nunavut (2002).

3.2 Definition of Harvest

The survey was designed to record the quantity of all species of mammals, birds (and their eggs), fish, and shellfish, harvested for local use. The species list for each region was determined on a preliminary basis, but reports of other species were recorded occasionally. The list included such species as polar bear,[4] narwhal, beluga and walrus, whose harvest numbers are documented independently through quota and tagging systems. The Steering Committee considered that these independent data would provide a reliability check on the Harvest Study results.

[4] Fieldworkers were instructed not to obtain data on polar bears in year one, although they did in fact do so in the Kitikmeot region in that year.

Table 2: Species List

Common Names			Scientific Names	Additional Data Collected
Big Game	Caribou	Barren-ground caribou	*Rangifer tarandus groenlandicus*	L, S, A
		Peary caribou	*Rangifer tarandus pearyi*	L, S, A
		Reindeer	*Rangifer tarandus tarandus*	L, S, A
		Island caribou	*Rangifer tarandus groenlandicus* *Rangifer tarandus pearyi*	L, S, A
	Musk-ox		*Ovibos moschatus*	L, S
	Moose		*Alces alces*	
	Polar bear		*Ursus maritimus*	L, S
	Tundra grizzly		*Ursus acrtos*	
	Black bear		*Ursus americanus*	
Fur-bearers	Wolf		*Canis lupus*	
	Arctic fox	White phase	*Alopex lagopus*	
		Blue phase		
	Colored fox	Red phase	*Vulpes vulpes*	
		Silver fox		
		Cross fox		
		Black fox		
	Muskrat		*Ondatra zibethicus*	
	Wolverine		*Gulo gulo*	
	Lynx		*Lynx canadensis*	
Small Game	Arctic hare		*Lepus arcticus*	
	Arctic ground squirrel		*Spermophilus parryii*	
Marine Mammals	Seals	Ringed seal	*Pusa hispida*	
		Bearded seal	*Erignathus barbatus*	
		Harp seal	*Pagophilus groenlandicus*	
		Harbor seal	*Phoca vitulina*	
		Hooded seal	*Cystophora cristata*	
	Walrus		*Odobenus rosmarus*	L, S
	Whales	Narwhal	*Monodon monoceros*	L, S
		Beluga	*Delphinapterus leucas*	L, S
		Bowhead	*Balaena mysticetus*	

Common Names			Scientific Names	Additional Data Collected
Waterfowl	Geese	Snow goose	*Chen caerulescens*	
		Canada goose	*Branta canadensis*	
		Ross's goose	*Chen rossii*	
		White-fronted goose	*Anser albifrons*	
	Ducks	King eider	*Somateria spectabilis*	L, S
		Common eider	*Somateria mollissima*	L, S
		Old squaw	*Clangula hyemalis*	
		Pintail	*Anas acuta*	
		Mallard	*Anas platyrhynchos*	
		Common merganser	*Mergus merganser*	
		Red breasted merganser	*Mergus serrator*	
		Greater scaup	*Aythya marila*	
		Lesser scaup	*Aythya affinis*	
		Black scoter	*Melanitta nigra*	
		White-winged scoter	*Melanitta fusca*	
		Surf scoter	*Melanitta perspicillata*	
	Tundra swan		*Cygnus columbianus*	
Other Birds	Loons	Common loon	*Gavia immer*	
		Arctic loon	*Gavia arctica*	
		Red-throated loon	*Gavia stellata*	
		Yellow-billed loon	*Gavia adamsii*	
	Black guillemot		*Cepphus grylle*	
	Thick-billed murre		*Uria lomvia*	
	Ptarmigan		*Lagopus lagopus* *Lagopus mutus*	
	Sandhill crane		*Grus canadensis*	
	Snowy owl		*Nyctea scandiaca*	
Eggs	Goose eggs	Snow goose eggs		
		Canada goose eggs		
		Ross's goose eggs		
		Brant goose eggs		
		White-fronted goose eggs		
	Duck eggs	King eider eggs		L
		Common eider eggs		L
	Tundra swan eggs			
	Arctic tern eggs			
	Seagull eggs			
	Thick-billed murre eggs			
	Black guillemot eggs			
Feathers	Eider down			L

Common Names		Scientific Names	Additional Data Collected
	Arctic char sea-run	*Salvelinus alpinus* anadromous	L
	Arctic char landlocked	*Salvelinus alpinus* non-anadromous	
	Lake trout	*Salvelinus namaycush*	L
	Northern pike	*Esox lucius*	
	Arctic grayling	*Thymallus arcticus*	
	Whitefish	*Coregonus clupeaformis*	
	Burbot	*Lota lota*	
	Arctic cisco	*Coregonus autumnalis*	
	Least cisco	*Coregonus sardinella*	
	Inconnu	*Stenodus leucichthys*	
	Cod	*Gadus ogac* *Boreogadus saida* *Gadus morhua*	
	Sculpin	*Myoxocephalus spp.*	
	Turbot	*Reinhardtius hippoglossoides*	
	Clams	*Mya spp.*	
	Mussels	*Mytilus edulis*	

(American Ornithologists' Union, 1998; Jones et al., 1997; McClane, 1978) L = Location of harvest; S = Sex of animal; A = Age-class of animal

Species identification was normally at the species level for mammals, birds, and fish. Exceptions were subspecies identification of caribou[5], and generic level identification of ptarmigan, cod, sculpin and clams. Occasionally a species not on the list was reported. This information was usually entered in the database as a similar animal and notes were put in the comments field. These records were found and removed from the database. A summary of these records can be viewed in Table 3.

Table 3: Other Species Reported During the Harvest Study

Community	Species	Study Year	Number Harvested
Bathurst Inlet	Herring	2	16
		3	2
		5	3
	Flounder	2	151
		3	1
Umingmaktok	Capelin	2	732
Sanikiluaq	Harlequin Duck	1	1
		2	4
Pond Inlet	Weasel	5	1

[5] Caribou harvests are amalgamated at the species level in the data tables.

Harvest was defined as animals struck and retrieved. This is both consistent with the definition of "harvest" in the NLCA, and the most practical measure to apply in a survey. The Steering Committee decided that it would not be appropriate to collect data on number of animals struck and lost, or otherwise killed and not retrieved (NWMB, 1995b).

Although harvest quantities were normally recorded as the number of animals struck and retrieved, eider down was reported as the number of nests from which the down was collected (data tables displaying eider down harvests are footnoted accordingly). Hunters occasionally reported their fish and shellfish catches by weight rather than number. In such cases, the Data Entry Clerks applied a locally appropriate conversion factor to determine the number of fish harvested.

Data on sex and age-class of harvests were collected for some species (Table 2). These ancillary data are not included in this report.

The Steering Committee considered that the primary application of the Harvest Study results was for the calculation of basic needs levels. Although the NLCA does not explicitly define the basic needs level, the Committee concluded that:

> *"the context of the Agreement does indicate that the basic needs level is that amount of harvest which is currently taken for domestic and cultural purposes. .... Harvesting or gathering for the purpose*

of obtaining skins, feathers, dog food, craft materials etc. would all be acknowledged "basic needs" components as long as the end use occurred in the hunter's community or entered into inter-settlement trade. Apparently not eligible for consideration as an item of "basic need" would be material harvested or gathered for commercial sale as food outside the Nunavut Settlement Area." (NWMB, 1995b: 2)

The key exception was the fur harvest, which was always included. In practice, each region adopted differing approaches to implementing this directive. In the Baffin and Kivalliq regions, Fieldworkers were instructed to obtain data on commercial harvests but record such harvests in the comments section of the data sheet. These harvests consisted mainly of arctic char, and some caribou. In the Kitikmeot region, animals taken in large scale commercial musk-ox and caribou harvests were not normally recorded, whereas commercial harvesting of arctic char were included in many cases. Given the inconsistencies in the recording of commercial data between communities and even within communities between different Fieldworkers it was challenging to separate commercial and subsistence harvests using the guidelines set out by the Steering Committee. The methods used when dealing with commercial harvests are outlined below.

The following commercial data were removed from the database:

- records from large scale commercial harvests such as the musk-ox harvest in Cambridge Bay;
- records whose comments indicated that the harvest had been sold to a fish or meat plant or indicated that the harvest had been 'sold' or was 'commercial'.

The following commercial data were retained in the database and are included in the harvest estimates:

- records of all fur-bearer harvests;
- records whose comments indicated that the harvest had been sold for local consumption, for example to the local HTO or one of the local stores.

On examination, only 86 records (out of a total of over 145,000) were found to indicate that the harvest had been sold. Of these records only 43 met the criteria for removal noted above and were removed from the database. A summary of these records can be viewed in Table 4. Unfortunately, many harvests were not recorded as commercial within the record comments, so there was no reliable way to differentiate these from subsistence harvests. Section 6 contains a description of the commercial harvesting in each community (if applicable) during the study and a brief discussion on whether or not it was thought to be included in the harvest estimates. This information was based on comments received during the community visits, interviews with Fieldworkers and commercial data collected from other sources.

Harvests were assigned to the hunter's community of residence (i.e. the community in which the hunter was registered), even if the hunter may have harvested in the area of another community.

Table 4: Commercial Harvests Removed from Harvest Study Database

Community	Species	Study Year	Number Harvested
Arctic Bay	Arctic Char	1	185
Arviat	Arctic Char	1	174
		2	60
Baker Lake	Caribou	1	6
Cambridge Bay	Arctic Char	3	9075
		5	1000
	Caribou	1	50
	Musk-ox	1	40
Clyde River	Arctic Char	4	111
Gjoa Haven	Caribou	1	1
Hall Beach	Arctic Char	5	15
Iqaluit	Arctic Char	4	120
Kugluktuk	Caribou	1	2
Pangnirtung	Arctic Char	3	3075
		4	740
	Cod	3	320
	Turbot	3	200
Pond Inlet	Arctic Char	3	134
Rankin Inlet	Arctic Char	1	310
	Caribou	1	7

3.3 Definition of Hunters

The study population was originally defined as Inuit residents of the Nunavut Settlement Area, plus any non-Inuit members of Nunavut communities designated by the communities as harvesting wildlife in order to meet subsistence and/or cultural needs in the Nunavut Settlement Area (NWMB, 1995b). In principle this included those individuals assigned Inuit harvesting rights under Article 5.7.34 of the NLCA, and it also included women. The working definition of "hunter" as implemented was a beneficiary of the NLCA, who is 16 years of age or older, and who participates in hunting, fishing or trapping of animals at any time during the year (NWMB, 1998). Harvests by beneficiaries under 16 were to be reported by a parent. In practice, the direction to include non-Inuit harvesters with assigned rights was inconsistently

followed. During the analysis phase of the study the local HTOs and Wildlife Officers provided an estimate of the number of hunters with assigned rights harvesting in their community during the study. This number is shown in Table 10 and is discussed in Section 6 following the data tables of the relevant communities. Other sources of error relating to the definition of hunters are discussed in Section 5.2.1.

3.4 Hunter registration

The NWHS did not attempt to survey all Inuit beneficiaries, but rather the particular class of Inuit defined as hunters (Section 3.3). This required the creation of a "master registration list" of all hunters as defined that would constitute the sampling frame for the survey. This involved a three-stage process. The first was to draw on existing administrative lists to create a preliminary list of persons having the required characteristics relating to status, age, and residence. These lists were, chiefly: the Census of Canada household counts; Inuit beneficiary enrollment lists as created pursuant to the NLCA; and the lists of General Hunting Licence (GHL) holders. The second stage was to determine, based on local (Fieldworker and community) knowledge, which of these individuals had actually hunted in the last year. Each hunter registered on the list was given a unique alpha-numeric code, with the alpha portion serving to identify community of residence. The third step in this process, unique to the NWHS, was the stratification of the hunter list into occasional, active and intensive hunters. This process is discussed in more detail in Section 3.5 but is mentioned here since the stratification of the hunter list was done at the time of registration.

Fieldworkers were responsible for keeping the lists up to date for each monthly survey wave, by tracking persons becoming or ceasing to be eligible, or moving from one community to another. Changes in registration could result from any one of the following:

- new registration (e.g. a young hunter who just turned 16)
- change in hunting activity
- death
- incarceration
- movement in or out of the community

The procedure for tracking these changes was for the Fieldworker to file a Notification of Change in Registration (NOCIR) form (Appendix II) and fax it to the regional office. The form was reviewed by the RLO or DEC in the region then faxed to the NWMB office where the registration list was updated and the revised form was faxed back to the region for their records. There were times when changes were made to the registration table during the verification process without the completion of a NOCIR form. In these instances, a note was made in the comments field of the registration table that detailed when the change was made, by whom and why.

The Study Coordinator or Database Manager changed the registration lists accordingly (by assigning new alpha-numeric codes and re-coding hunters not eligible to be surveyed that month), and advised Fieldworkers of inter-community transfers.

The effect of this procedure was to update the original master registration list each month. These updates were then used to create a monthly hunter list in which persons not eligible to be surveyed for that month were not included and new hunters were added. The current monthly registration list for any month is thus equal to the number of persons eligible to be surveyed for that month. The number of hunters listed in the master registration list only increased throughout the study since although hunters were added, they were never deleted from the master list (only coding changes were made).

The RLO in each region was asked to provide information on how the master registration lists were actually created. This information can be seen in Table 5. In most communities, especially in the Baffin and Kivalliq regions, it was done door to door by the Fieldworker. The beneficiary lists were still under compilation and incomplete when the study began. In the outcome, this method was used in only two communities (Arctic Bay and Cape Dorset in the Baffin region). In the Kitikmeot Region, the lists were created primarily by using GHL lists, except in Kugaaruk where the list was created by the Fieldworker based on his own knowledge. In Bathurst Inlet, the GHL list was supplemented by local knowledge to add hunters to the registration list.

The need for change in registration status for any particular hunter was usually discovered during the course of the monthly interviews, although confirming the permanence of such changes, especially of inter-community migration, might take several months. If a hunter was not interviewed for one or more months, it was important to determine if he or she were no longer in the community or simply difficult to contact. Generally, if a move was for longer than two months the hunter was removed from the list in his or her community of origin and added to the list in the new community (as long as the move was within Nunavut) to ensure continuity of interviews. There were some occasions when this process was followed for a hunter who was absent from the community for only one month. This usually occurred when the Fieldworker was told that the hunter had moved, when he or she actually had only been visiting in the other community. These situations were uncommon and are not felt to have a significant effect on the results. Notes explaining any movements were entered in the comments field of the registration table.

The number of hunters registered each year by community is given in Table 6. The total number of persons registered for the study (i.e. the total number in the sampling frame at any time during the five years in all of the 28 communities) was 6018. Since some hunters hunted and consequently were registered in more than one community the total number of persons registered for the study is less than the sum of each community total.

Table 5: Community Hunter Registration Procedure

Community		Hunter Registration Method	Who determined which individuals registered	Who classified the hunters
Baffin	Arctic Bay and Nanisivik	Beneficiary list (Arctic Bay), Door to door (Nanisivik)	Field Worker (FW)	FW with advice of hunter
	Cape Dorset	Beneficiary list	FW	FW with advice of HTO Chair and of hunters in some cases
	Clyde River	Door to door	FW	FW with advice of hunter
	Grise Fiord	Door to door	FW	FW with advice of hunter in some cases
	Hall Beach	Door to door	FW	FW with advice of hunter in some cases
	Igloolik	Door to door	FW	FW with advice of hunter in some cases
	Iqaluit	Door to door	FW	FW with advice of hunter in most cases
	Kimmirut	Door to door	FW	Unknown
	Pangnirtung	Door to door	FW	FW with advice of hunter in some cases
	Pond Inlet	Door to door	FW	Unknown
	Qikiqtarjuaq	Door to door	FW	Unknown
	Resolute Bay	Door to door	FW	FW with advice of hunter
	Sanikiluaq	Door to door	FW	FW with advice of hunter and HTO Manager
Kitikmeot	Bathurst Inlet	GHL lists, added to with FW, RLO and HTO input	FW, Hunter, RLO, HTO	FW, Hunter, RLO, HTO
	Cambridge Bay	GHL lists	FW, Hunter, RLO, HTO	FW, Hunter, RLO, HTO
	Gjoa Haven	GHL lists	FW, Hunter, RLO, HTO	FW, Hunter, RLO, HTO
	Kugaaruk	FW created list with own knowledge	FW, Hunter, RLO, HTO	FW, Hunter, RLO, HTO
	Kugluktuk	GHL lists	FW, Hunter, RLO, HTO	FW, Hunter, RLO, HTO
	Taloyoak	GHL lists	FW, Hunter, RLO, HTO	FW, Hunter, RLO, HTO
	Umingmaktok	GHL lists	FW, Hunter, RLO, HTO	FW, Hunter, RLO, HTO
Kivalliq	Arviat	Door to door/on the street	FW and Hunter	FW with advice of hunter
	Baker Lake	Door to door/on the street	FW and Hunter	FW with advice of hunter
	Chesterfield Inlet	Unknown	Unknown	Unknown
	Coral Harbour	Door to door/on the street	FW and Hunter	FW with advice of hunter
	Rankin Inlet	Unknown	Unknown	Unknown
	Repulse Bay	Door to door/on the street	FW and Hunter	FW with advice of hunter
	Whale Cove	Door to door/on the street/radio	FW and Hunter	FW with advice of hunter

Table 6: Total Hunter Registration by Community, by Year

Community		Year 1	Year 2	Year 3	Year 4	Year 5	Total
Baffin	Arctic Bay and Nanisivik	267	254	250	245	257	310
	Cape Dorset	n/d	504	481	472	423	510
	Clyde River	198	213	214	223	218	245
	Grise Fiord	40	43	55	61	58	73
	Hall Beach	137	147	146	142	165	181
	Igloolik	212	233	246	259	273	307
	Iqaluit	n/d	350	400	406	415	540
	Kimmirut	96	99	102	104	97	114
	Pangnirtung	184	191	194	197	194	224
	Pond Inlet	263	277	294	331	355	408
	Qikiqtarjuaq	114	116	124	163	157	192
	Resolute Bay	51	64	65	70	68	75
	Sanikiluaq	133	155	159	166	171	181
Kitikmeot	Bathurst Inlet	18	17	17	18	17	21
	Cambridge Bay	332	347	338	347	332	391
	Gjoa Haven	344	347	337	344	338	368
	Kugaaruk	63	80	80	86	88	102
	Kugluktuk	276	273	266	269	263	294
	Taloyoak	235	231	222	221	212	249
	Umingmaktok	31	30	21	17	11	31
Kivalliq	Arviat	379	380	387	395	393	410
	Baker Lake	327	324	315	302	299	341
	Chesterfield Inlet	72	79	80	77	85	92
	Coral Harbour	256	254	266	244	226	283
	Rankin Inlet	379	372	367	364	362	424
	Repulse Bay	169	163	157	152	146	180
	Whale Cove	50	50	47	50	49	61
	Nunavut	4578	5451	5468	5528	5529	6018

3.5 Stratification of the hunter list

The study design called for a stratified hunter list, in order to produce a more accurate estimate of the harvests of those hunters who were not included on the interview list (in sub-sampled communities) or who could not be reached or did not wish to participate in a given month.

The registration list was stratified at the time of registration according to three predefined classes of harvesting intensity, as follows:

- Intensive: *"A hunter who repeatedly and regularly engages in all or nearly all of the various types of hunting activities during the annual cycle. There is always country food in the household."* (NWMB, 1998, tab 3)
- Active: *"A hunter who regularly engages in some, but a limited number, of the major harvesting activities during the annual cycle (e.g. ice-edge seal hunting, char fishing, or caribou hunting). Participation in the activity may be short but intense; time commitment is more than day-trips or an occasional weekend."* (NWMB, 1998, tab 3)
- Occasional: *"A hunter who occasionally, but not regularly, participates in hunting activities (e.g. a day or two of caribou hunting or waterfowl hunting, or rod-and-reel fishing every now and then). Participation is usually short-term, such as day-trips or weekend outings."* (NWMB, 1998, tab 3)

A non-hunter was defined as an individual who does not (or did not in the past year) participate in hunting or fishing activities. Non-hunters were not registered in the Harvest Study (Berkes et al., 1995a).

It was the responsibility of the Fieldworker in each community to classify each hunter on the registration list. As Table 5 indicates (for the 23 communities for which there is a record) the Fieldworker classified hunters in several ways:

- with the advice of the hunter (in all communities, wholly or in part);
- with the advice of the HTO (in nine communities, including all of those in the Kitikmeot);
- on the basis of his or her own knowledge (in five communities, all in the Baffin).

The NWHS did not establish any objective or numerical test of these categories. Classification was done on the basis of the judgement of either the Fieldworkers or the hunters themselves as to how the criteria applied to them.

Table 7 shows the breakdown of registered hunters by stratum, by community and by year. In some communities the intensive stratum did not have a sufficient number of hunters for the purpose of estimating total harvest. For example if there were only 1 or 2 intensive hunters registered and those hunters were not interviewed for a given month, no harvest could be estimated. For this reason intensive strata which comprised 5% or less of the total number of hunters were joined with the active strata. Also due to the relatively small number of hunters in Bathurst Inlet and Umingmaktok all strata were joined in these communities. The shading shown in Table 7 identifies strata amalgamated for the purposes of estimating total harvest (Section 4).

Table 7: Hunters Registered by Strata, Community and Year

Community		1			2			3			4			5		
		O	A	I	O	A	I	O	A	I	O	A	I	O	A	I
Baffin	Arctic Bay and Nanisivik	221	46	0	208	45	1	207	42	1	201	43	1	212	44	1
	Cape Dorset	n/d	n/d	n/d	399	67	38	381	63	37	372	63	37	324	61	38
	Clyde River	168	22	8	181	23	9	179	26	9	187	27	9	182	27	9
	Grise Fiord	19	21	0	24	20	0	37	18	0	42	18	1	39	16	3
	Hall Beach	57	56	24	64	60	23	61	61	24	61	57	24	81	58	26
	Igloolik	107	54	51	124	57	52	130	61	55	145	60	54	162	58	53
	Iqaluit	n/d	n/d	n/d	198	121	31	240	126	34	236	133	37	244	135	36
	Kimmirut	60	21	15	61	23	15	64	24	14	65	25	14	62	21	14
	Pangnirtung	86	72	26	95	70	26	98	70	26	107	65	25	108	62	24
	Pond Inlet	133	85	45	143	91	43	163	91	40	200	90	41	229	86	41
	Qikiqtarjuaq	81	32	1	83	32	1	91	32	1	128	33	2	125	29	3
	Resolute Bay	21	23	7	33	24	7	34	24	7	39	24	7	38	24	6
	Sanikiluaq	57	55	21	71	62	22	75	62	22	81	64	21	85	65	21
Kitikmeot	Bathurst Inlet	12	3	3	11	3	3	11	3	3	11	4	3	10	4	3
	Cambridge Bay	259	58	15	272	60	15	262	61	15	268	61	18	255	60	17
	Gjoa Haven	300	41	3	298	43	6	289	42	6	294	42	8	289	41	8
	Kugaaruk	23	24	16	25	37	18	28	36	16	29	40	17	32	38	18
	Kugluktuk	177	99	0	174	99	0	168	98	0	172	97	0	168	95	0
	Taloyoak	189	36	10	185	36	10	178	35	9	174	38	9	170	33	9
	Umingmaktok	23	8	0	23	7	0	15	6	0	13	4	0	9	2	0
Kivalliq	Arviat	309	64	6	309	65	6	312	69	6	315	74	6	312	74	7
	Baker Lake	264	62	1	263	60	1	252	62	2	240	60	2	234	63	2
	Chesterfield Inlet	40	21	11	45	23	11	46	23	11	43	24	10	47	29	9
	Coral Harbour	113	110	33	112	111	31	124	110	32	105	108	31	94	104	28
	Rankin Inlet	238	86	55	240	80	52	235	80	52	228	82	54	226	83	53
	Repulse Bay	108	55	6	105	52	6	103	48	6	103	43	6	96	44	6
	Whale Cove	32	16	2	32	16	2	31	16	0	32	18	0	30	18	1
	Nunavut	3070	1159	357	3681	1364	422	3699	1361	423	3771	1357	432	3776	1339	428

3.6 Random sampling in large communities

The objective of the survey was to achieve full census coverage of the entire registration list in each community. However, due to budget limitations, it was not possible to hire sufficient Fieldworkers to cover the entire registration list in the larger communities. The Steering Committee therefore decided to sample two-thirds of the hunters on a random basis in these communities, to ensure a manageable workload for one Fieldworker. The original study design recommended this procedure for Iqaluit, Rankin Inlet, and Cambridge Bay (Berkes et al., 1995a). Prior to the commencement of data collection, this procedure was extended to the communities of Cape Dorset, Kugluktuk, Gjoa Haven, Arviat, and Baker Lake (all of which were communities with >275 persons on the registration list in year 1). However, it was never implemented in Iqaluit, due to delays there in hunter registration, and ongoing concerns regarding under-enumeration. Baker Lake was subsequently removed from the list of sub-sampled communities in January 1999 due to low participation rates.

The initial sampling strategy was to include all hunters in the intensive and active strata, and a random selection of however many hunters in the occasional stratum were required to make up the 2/3 sample (random selection was done separately in each region). This new list of the sampled hunters was called the "interview list" (in contrast to the "registration list"). In the "registration list" the hunters on the "interview list" were given a value of True and the hunters not to be interviewed were assigned a value of False.

In 1997, the interview lists for the communities of Arviat and Rankin Inlet needed to be revised, due to inconsistencies found between the regional lists and the lists kept at headquarters. A new stratification procedure was adopted in which all of the active and intensive hunters and one-third of the occasional hunters would be surveyed. This resulted in a new "interview list" which was used for the duration of the study in those communities. The effect of these two strategies is compared in Table 8.

Table 8 Sampling strategies

Example 1 (1996 – 1997):	Registration list	Interview list
total	120	80 (2/3)
intensive	10	10
active	20	20
occasional	90	50

Example 2 (1997 – 2001):	Registration list	Interview list
total	120	60
intensive	10	10
active	20	20
occasional	90	30 (1/3)

The original intent was to reconstitute the "interview list" each year with a new random selection of hunters in the occasional stratum. In the outcome, the "interview list" was never reorganized, and those selected in the first round remained in the survey for the entire duration (with the above-noted partial exception of the Kivalliq communities).

As new occasional hunters were registered in the seven communities, they were not added to the "interview list" but registered and assigned a value of False. Later, in year 4 of the study, all new hunters including those in the occasional stratum were added to the interview list. The great majority of these were hunters new to the community but previously registered in another community.

3.7 Data collection procedures

3.7.1 Interview protocol

The NWHS was designed as a door to door survey, in which the community Fieldworker would interview each registered hunter each month. Fieldworkers contacted the hunters either in person or by telephone. The interviewer first ascertained whether the hunter had harvested anything during the previous month, and if so, recorded the number, location, and other details of the harvest of each species taken.

If telephone contact had been made the Fieldworker would arrange to visit the hunter in person to collect his or her harvest data. In-person interviews were almost always required in order to map harvest locations. The Fieldworker filled in a harvest data collection form (Nunavut Wildlife Harvest Study Data Sheet – Appendix III) for each hunter contacted each month. However, when a hunter could not be contacted, data sheets were not consistently filed for those persons.

Although the possibility of collecting information on hunter effort was discussed in the design stage, this information was not collected in any detail by the survey. The original response codes included "hunted but not successful", but this was discontinued as inappropriate and unworkable.

3.7.2 Reporting period (monthly interval), backfill procedures

The survey was conducted monthly, with the reference period for each survey wave being the calendar month prior to the interview. Fieldworkers had, for example, the entire month of July to interview all registered hunters about their harvests during the month of June. When a hunter could not be reached in a particular month, the Fieldworker would enquire about previous months' harvests when he or she was finally contacted in a subsequent month. This process, known as backfilling, would sometimes be done for several months, if necessary. However, backfill of information more than six months old was generally discouraged. The period of time (expressed in number of months) between the harvest and the interview was called the recall period and was used as a measure of the extent of backfilling throughout the study. The recall period was calculated for each harvest record in the database. Included with the data tables are tables which display the recall periods of the collected harvest data indicating on a monthly basis the percentage of harvest records which were backfilled by 3 months or less, 4-6 months and by more than 6 months.

Harvest Study Calendars were produced and distributed to all registered hunters at the beginning of each calendar year. The last four pages of the calendar listed the animals on the species list along with a picture of each animal. Hunters recorded their harvest data on their calendar and each month the Fieldworker contacted them for this information. Calendar use varied from community to community.

3.7.3 Survey response categories and rates

Initially, monthly response of each individual on the "interview list" was recorded as one of nine different categories:

1 – Hunted
2 – Did not hunt
3 – Hunted, but not successful
4 – Still out hunting
5 – Moved
6 – Out of town
7 – Could not contact
8 – Did not want to be interviewed
9 – Other

In 1998, these categories were collapsed as follows, and reorganized in the existing database accordingly:

1 – harvested	(replaced old code 1)
2 – did not harvest	(replaced old code 2 and 3)
3 – could not contact	(replaced old code 4, 6, 7 and 8)
4 – no longer hunting community in the(moved, incarcerated, deceased, no longer hunting)	(replaced old code 5)

New category 4 consists of persons not eligible to be surveyed for any particular monthly survey wave and is omitted from the calculation of response rate. New category 3 includes both those who could not be contacted, and those who refused to be interviewed. However, if a hunter consistently did not want to participate in the study, the registration table was updated to indicate 'DWTBI' (does not want to be interviewed) and the month and year this information was received was noted. This information was retained in the registration table and referred to as consistent non-response; the number of those persons is noted in Table 9. Every person reporting code 1 has an associated record of harvest; all other reporting codes do not.

The eligible survey population in any month is the sum of codes 1-3. The response rate, expressed as a percentage, is thus the sum of codes 1-2 divided by the sum of codes 1-3 or can be expressed as: $\Sigma_{1,2}/\Sigma_{1,2,3}$ X 100%. Monthly response rates for each community are provided in the data tables.

Table 9: Consistent Intentional Non-response by Community

Community		Total Number of Hunters*	DWTBI**	% DWTBI
Baffin	Arctic Bay and Nanisivik	310	0	0.0
	Cape Dorset	243	2	0.8
	Clyde River	245	3	1.2
	Grise Fiord	73	1	1.4
	Hall Beach	181	0	0.0
	Igloolik	307	3	1.0
	Iqaluit	540	7	1.3
	Kimmirut	114	2	1.8
	Pangnirtung	224	7	3.1
	Pond Inlet	408	8	2.0
	Qikiqtarjuaq	192	10	5.2
	Resolute Bay	75	2	2.7
	Sanikiluaq	181	7	3.9
Kitikmeot	Bathurst Inlet	21	0	0.0
	Cambridge Bay	246	1	0.4
	Gjoa Haven	246	1	0.4
	Kugaaruk	102	0	0.0
	Kugluktuk	201	1	0.5
	Taloyoak	249	1	0.4
	Umingmaktok	31	0	0.0
Kivalliq	Arviat	310	1	0.3
	Baker Lake	336	110	32.7
	Chesterfield Inlet	92	5	5.4
	Coral Harbour	283	13	4.6
	Rankin Inlet	324	48	14.8
	Repulse Bay	180	1	0.6
	Whale Cove	61	3	4.9
Nunavut		5255	237	4.5

* Total number of hunters on the interview list at least once during the study.
** DWTBI: Does not want to be interviewed. Hunters consistently refusing to participate.

3.7.4 Harvest location

Schedule 5-5 of the NLCA required that harvest data be portrayed geographically. A list of selected animals on the species list was designated as requiring the recording of harvest locations (Table 2).

Fieldworkers were provided with the 1:250 000 scale topographic maps for the hunting areas used by the members of their community. With the help of the Fieldworker, the hunter was to locate the area in which he/she harvested the animal. The Fieldworker would then use the Universal Transverse Mercator (UTM) grid coordinates on the map to mark the location of harvest and the place name of that location on the datasheet. These grid coordinates were overlaid on each map and the method for designating a location is described on the margin of each map. Figure 3 describes the procedure that was to be used. The resultant two-letter, four-digit code would be entered on the datasheet as the map code of the harvest. This method would identify a grid square 1km X 1km in which the harvest took place. This would translate to an accuracy of recording of 1km. However, in some cases the hunter would only point to the general area of the harvest and in these cases an accuracy of 1 km cannot be assumed. As well, it was reported to us by Fieldworkers and participating hunters that in many cases hunters would only refer to the place name of the location and it would be up to the Fieldworker to choose the grid coordinates for the harvest. In some communities Fieldworkers had developed a list of common place names and their associated grid coordinates. Again this reduces the accuracy of the harvest location data. The result of these practices is that the accuracy of geographic data cannot be assumed to be 1 km. This must be considered when using the harvest location and place name information. However, the NLCA does not state any minimum requirements for the accuracy of harvest location data and the resultant maps of harvest locations still document the patterns of Inuit use of wildlife resources as required by Article 5.4.5 (a) of the Agreement.

Harvest location data can be viewed by using the Nunavut Wildlife Harvest Study GIS Viewer, included with this report. Readers should consult the metadata file included with this viewer before using any of the GIS data provided. The metadata file includes a full characterization of the GIS data and details such as how the data were collected, processed and verified.

Figure 3: Harvest Location Collection

The map code was always determined by first noting the two letter grid coordinate (WH in this example).

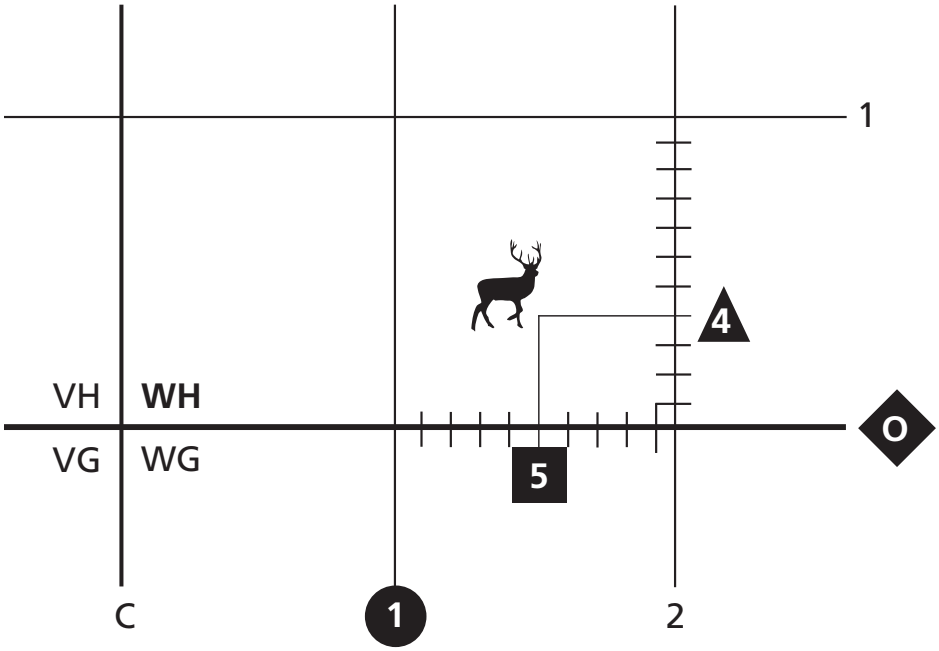
The letters would be followed by the easting coordinate:

● ■

and then by the northing coordinate:

◆ ▲

So in this case the map code would be **WH1504.**



4. Harvest Data (Results)

This report contains 27 sections of harvest data tables (one for each community, counting Arctic Bay and Nanisivik as one community combined) and a Nunavut-wide section containing similar tables combining results from all communities. There are a total of 664 harvest data tables (Table 11 – 674) included in this report throughout Section 6: Community Results Discussion. The tables are organized by study year so that each community section contains a group of tables for each of the five years of the study and a group of tables summarizing the annual totals for all five years. A Community Results Discussion concludes each community section. Each group of annual tables consists of:

1. *Monthly harvest estimates* – This table provides the estimated monthly harvest by species[6], and an annual total for each species, calculated as the sum of the monthly totals, with the 95% confidence interval for the annual total. Some species from the original species list (Table 2) were aggregated when calculating harvest estimates and confidence intervals. This was done to simplify reporting and because in some cases hunters had reported the species group rather than the specific species or sub-species. Species aggregations are as follows:
   - Caribou: includes barren-ground caribou, island caribou, Peary caribou and reindeer, comments in the Community Results Discussion section indicate which type are harvested by each community
   - Arctic fox: includes white and blue color phases
   - Coloured fox: includes red, silver, cross and black color phases
   - Eider duck: includes both king eider and common eider
   - Goose eggs: includes eggs of snow goose, Canada goose, Ross's goose, brant goose and white-fronted goose
   - Duck eggs: includes eggs of king eider and common eider
   - Arctic char: includes both landlocked and sea-run char

2. *Monthly hunter response* – This table provides the number of hunters eligible to be surveyed (monthly hunter list), the number on the interview list (for sub-sampled communities only), the number interviewed and the number who harvested each month, and shows the monthly response rate (for all strata combined) based on these numbers. When calculating harvest estimates, each stratum was considered separately and estimates were first calculated for each stratum of hunters, then all strata were totaled to achieve a community estimate for each month of the study.

3. *Recall period between harvest and interview* – Summarizes the period between the harvest and the interview to collect the harvest. Shown in the tables are the percentages of harvest records collected with recall periods of 3 months or less, between 4 and 6 months and over 6 months. Percentages were rounded to the nearest whole number resulting in the sum of the three categories being 99% in selected cases. Recall periods give readers an indication of the extent of backfill by Fieldworkers and the potential for recall error (discussed in detail in Section 5.4.2).

4. *Number of hunters harvesting each species* – This table provides the number of hunters who harvested each species in each month of the study and the total number of hunters who harvested the species during that study year. Readers will note that the total column is not always the sum of the monthly columns since the same hunter may hunt a given species in more than one month of the year.

The five-year summary tables for each community contain the same four tables as described above but display annual results instead of monthly results. As noted above the data tables for each community are followed by a Community Results Discussion. This section summarizes the reliability of harvest estimates specific to each community, expanding on the information presented in Section 5 and contains community feedback and other sources of harvest data. Selected species in the harvest estimate table are footnoted and refer readers to related comments and data found in this discussion section.

[6] Polar bear data displayed are not harvest estimates; harvest numbers were provided by DSD.

4.1 Harvest Estimates

The NWHS uses a simple proportional projection in which the reported harvest is multiplied by the inverse of the response rate, expressed most simply as:

$$Y = y(N/n)$$

where Y = estimated harvest
y = reported harvest
N = the population or sample frame (in this case the monthly registration list)
n = the number of hunters responding

This method assumes that the respondents can be treated as a random sample of the population. Each month is treated as an independent survey and each stratum is calculated separately.

The harvest estimate and variance analysis calculations which follow were adopted from those developed by the Statistical Consultation Group, Statistics Canada, for the Inuvialuit Harvest Study (Joint Secretariat, 2003). In order to verify the application of these calculations to the NWHS data, this Group was contracted to confirm the calculation of harvest estimates and confidence intervals for a sample of the NWHS data.

The detailed calculation method is as follows:

The estimated monthly harvest by stratum is calculated as:

$$Y_{mcs} = \frac{N_{mcs}}{n_{mcs}} \sum_i y_{mcsi}$$

Where: Y_{mcs} = estimated harvest for month *m*, community *c*, and stratum *s*
N_{mcs} = number of hunters registered in month *m*, community *c* and stratum *s*
n_{mcs} = number of hunters interviewed in month *m*, community *c* and stratum *s*
y_{mcsi} = harvest reported by the reporting hunter *i* in month *m*, community *c* and stratum *s*

The variance for the estimated monthly harvest for each stratum was then calculated by:

$$Var(Y_{mcs}) = \frac{N^2_{mcs}}{n_{mcs}} (1-f_{mcs}) s^2_{mcs}$$

where,

$$f_{mcs} = \frac{n_{mcs}}{N_{mcs}}$$

$$s^2_{mcs} = \sum_i (y_{mcsi} - \bar{y}_{mcs})^2/(n_{mcs} - 1)$$

Since each stratum is treated as an independent survey group the total monthly estimated harvest for month m and community c is calculated by:

$$Y_{mc} = \sum_s Y_{mcs}$$

Similarly, the variance of this monthly estimated harvest is calculated by:

$$Var(Y_{mc}) = \sum_s Var(Y_{mcs})$$

The annual harvest estimate for each community is then calculated as the sum of the monthly estimated harvests:

$$Y_c = \sum_m Y_{mc}$$

and the variance of the annual estimate is calculated by:

$$Var(Y_c) = \sum_m Var(Y_{mc}) = \sum_s \sum_m \frac{N^2_{mcs}}{n_{mcs}} (1-f_{mcs}) s^2_{mcs}$$

The 95% confidence limits are then simply the square root of the variance calculated above multiplied by 2 or $2\sqrt{Var(Y_c)}$. These limits determine the upper and lower values of the 95% confidence interval and are shown in the far right column of the harvest estimate tables. The 95% confidence interval defines the range in which we can be 95% certain that the true harvest lies. For example, in Table 11 the annual harvest estimate for caribou for the community of Arctic Bay is 1246 animals +/- 96. Translated to plain language this means that the annual harvest of caribou by Arctic Bay hunters is estimated to be 1246 animals, being 95% confident that the true annual caribou harvest is in the range of 1150 to 1342 animals.

4.2 Response Rates

As seen above in Section 4.1 the number of hunters interviewed in relation to the number of hunters registered (response rates) is critical in the calculation of harvest estimates. Response rates were calculated for each stratum, community and month using the hunter response codes outlined in Section 3.7.3. The response categories shown in the hunter response tables are as follows:

Hunter response category	Study codes
Monthly hunter list	sum of code 1, 2, 3 and occasional hunters not included in the sub-sample (for sub-sampled communities)
Interview list	sum of code 1, 2 and 3
Hunters interviewed	sum of code 1 and 2
Harvested	number of code 1
Response rate (%)	$\sum_{1-2}/\sum_{1-3}$ X 100%, OR hunters interviewed/interview list X 100%.

Where the study codes were:
Code 1: Harvested
Code 2: Did not harvest
Code 3: Could not contact

All hunters on the monthly hunter list for a given month were considered to be potential harvesters and were included in the harvest estimate calculations. A master registration list for the entire study period was held at headquarters and included all hunters who were registered in the study at any time during the five year span. Readers will note that in the seven sub-sampled communities, the occasional hunters not included in the sub-sample, although included in the calculation of harvest estimates, were not included in the response rate calculations. The reason for this was that the response rates were intended to show the number of hunters interviewed in relation to the number of hunters who were intended to be interviewed. It was never intended that occasional hunters not included in the sub-sample be interviewed during the study.

The far right 'Total' column in each of the monthly hunter response tables indicates the following:

Monthly Hunter List: hunters on the monthly hunter list in at least one month of the year

Interview List[7]*:* hunters on the interview list in at least one month of the year

Hunters Interviewed: hunters who were interviewed in at least one month of the year

Harvested: hunters who harvested in at least one month of the year

Response Rate: the mean monthly response rate

Similarly, the 'Total' column of the annual hunter response table indicates the number of hunters registered, on the interview list, interviewed and having harvested in at least one month of the whole study. The total response rate is then the mean of the five mean monthly response rates.

The hunter response tables in the Nunavut-wide section differ in the fact that the 'Total' column in both the monthly hunter response and the annual hunter response tables will not be the same as the sum of the 'Total' columns for each community. The reason for this is that some hunters were registered in more than one community in one year (they may have moved to a new community part way through the year). Consequently, the sum of the community 'Totals' are often higher than the Nunavut-wide 'Totals' since some hunters would be counted more than once.

[7] Interview list was only included in the tables in communities where occasional hunters were randomly sampled.

5. Reliability of Harvest Estimates: Sources and Estimation of Error

The purpose of this section is to assess the strength of the data collected by the NWHS for the purpose of establishing current harvesting levels, and determining basic needs levels, as required by the NLCA. Inevitably, due to survey limitations, the harvest levels actually reported to the survey are incomplete. It is therefore necessary to estimate *"the amount harvested in any one year"* (NLCA, 1993, Article 5.6.21) for the purpose of calculating a BNL, on the basis of reported harvests.

It is crucial that these estimates of total harvests be credible to Inuit beneficiaries, to the NWMB, and to wildlife management agencies. This credibility depends on a clear statement of survey methods, along with an assessment of both the qualitative and statistical integrity of data.

The harvest estimation procedure described in Section 4.1 will produce a reliable estimate of total harvest and its associated sampling error if:

1) *N* fully and accurately represents the hunter population.
2) The *n* respondents constitute a sufficiently representative sample of the *N* hunters, by virtue of adequate response rate and appropriate assessment of non-response bias.
3) The survey responses are valid, i.e. measure the true harvests of responding individuals.

This section assesses whether each of these conditions was met by the NWHS for the purpose of estimating BNLs, and if not, identifies and, if possible, estimates the degree of bias or error.

For each condition we consider:

- how the survey was designed and conducted,
- the potential sources of error associated with each element of the design and conduct of the survey,
- the extent to which these errors actually occurred, in each community, (where this is already known),
- the direction and magnitude of these errors, and
- appropriate means of testing the significance of these errors, in order to account for them and if possible to remedy them.

This section identifies the general, survey-wide issues. Particular problems for each community are identified in the Community Results Discussion section following each community's five-year summary tables.

This chapter does not consider errors or other issues arising from geo-referencing kill locations.

5.1 Approach

Three main problems arise in a survey of this type.

First, the entire Inuit population was not surveyed, but instead a sampling frame consisting of a hunter list was drawn up at the outset of the study, based on a set of personal characteristics which were applied to certain administrative lists on the basis of local (Fieldworker and community) knowledge. This procedure introduces the possibility of incomplete or inconsistent enumeration, and thus that the sampling frame was not in fact fully representative of the intended survey group.

Secondly, the study was voluntary, and for this as well as logistical reasons, 100% (full census) coverage of the hunter list was rarely if ever achieved in any community in any month. In effect, a very large but nonetheless incomplete sample was drawn from the sampling frame. The reported harvest (sum of all responses) is thus necessarily somewhat less than the true harvest, which must be estimated. Incomplete coverage introduces the possibility that the sample is non-random. If there is a significant difference between the characteristics of those surveyed and those not surveyed, then there is non-response bias in the resulting estimate. The higher the response rate, the lower is the potential for non-response bias.

Thirdly, measurement error may occur. Either the interview protocol is misunderstood and elicits incorrect responses, or respondents choose not to answer correctly (strategic bias).

No minimum levels of precision were formally specified in either the design stage of the NWHS or by the steering or advisory committees. Nor, in a survey conducted at the end of the data collection phase, did potential data users specify such levels (Usher and Brooke, 2001:13-14). For reasons explained in Section 2, total harvest estimates were not generated at the end of each survey year, nor were the results

communicated to Inuit hunters. Partly as a result of this, there was little mid-course correction during the survey, and what follows is a post-survey assessment of the integrity of the NWHS data for estimating BNLs.

The methods for this assessment have been selected primarily on the basis that they are simple and understandable. In any event, more sophisticated assessment methods were beyond the resources of the study in its final stage. The reader should also keep in mind that this is an administrative decision-making database, not primarily a research database. Persons with a research interest may wish to apply different reliability criteria and procedures for harvest estimation.

5.2 The survey frame: identification and enumeration

This section considers condition 1: whether the sample frame (N) fully and accurately represents the hunter population.

5.2.1 Sources of enumeration error

As noted in 3.4, the creation of the registration list was, in practice, a three-stage process. The first was to draw on existing administrative lists to create a preliminary list of persons having the essential characteristics relating to status, age, and residence. The second was to determine, based on local (Fieldworker and community) knowledge, which of these individuals had actually hunted in the last year. The third step was the stratification of the hunter list into occasional, active and intensive hunters. The first two stages introduce several possibilities for incomplete or inconsistent enumeration, and thus that the sampling frame was not in fact fully representative of the defined universe. Several potential problems arise with this procedure.

One problem is that when the survey began, the beneficiary lists were still under compilation and incomplete, and therefore did not necessarily generate a complete list of Inuit beneficiaries 16 and over. On the other hand, the lists may also have included Inuit not actually resident in their home communities. With respect to the GHL lists, these did not routinely include women, as under the old GHL system, a licensee could hunt for his family. The GHL list would thus likely under-enumerate women, and possibly some teen-age boys. As a consequence these lists needed to be augmented by the Fieldworker to include hunters under-represented on these lists.

A second problem arises from the Fieldworker's determination of whether the individuals enumerated initially actually harvested in the year prior to the start of the NWHS (and thus conformed to the definition of hunter). This gave rise to two possible sources of error, both arising from incomplete or inconsistent application of the definition of a 'hunter':

- The first source is a failure to confirm that people who qualified on the grounds of status, age, and residence, actually hunted, possibly because of a cultural reluctance to directly question a person's status as a hunter. The effect would be to over-enumerate. There is some evidence that this was the case in communities where many hunters (especially in the occasional stratum) consistently reported not hunting at all (code 2 in each month).
- The second source is the possibility that a Fieldworker did not consistently apply the survey-prescribed definition of who is a hunter, but substituted, for example, his or her own cultural perception of who is a hunter. Although the NWHS intended to include anybody who harvested anything, for many Inuit, "hunter" means something more than an individual who might occasionally fish, or shoot the odd goose or caribou. It denotes for them certain important personal attributes and characteristics, not simply personal activities. Thus some Fieldworkers could have applied a more rigorous definition of hunter than was intended by the survey. This would necessarily lead to under-enumeration for the purposes of the survey.

The problem of under-enumeration was thought to be significant in some communities based on discussions with community members and on screening tests completed during the data analysis phase of the study. Based on this preliminary analysis, the survey coordinator reexamined the hunter list with HTOs during the community visits. Table 10 shows communities' assessment of under-enumeration based on these consultations. Under-enumeration of these hunters would have led to a downward bias of the harvest estimates in all cases since these non-registered hunters were known to be hunting in the community during the study but were never interviewed and a harvest was never estimated for them. The extent of this bias is dependent on the number of eligible hunters who were not registered in the study and their classification. For instance the effect of the under-enumeration of five occasional hunters would be less than that of five active hunters on the community harvest estimates. Harvest estimates for the unregistered hunters can be estimated using mean harvest quantities for each species by strata. However, these estimates, having their own sources of error and bias, are beyond the scope of this Final Report. Readers may apply to NWMB to obtain the results of these calculations. Since the effect of under-enumeration will vary from community to community readers are urged to consult Table 10 and Section 6: Community Results Discussion for relevant comments regarding each community.

Table 10: Estimate of Hunter Under-enumeration by Commuinty

Community		Total # of registered hunters	Estimated # of unregistered hunters with assignment rights	HTO Board estimate of unregistered hunters	Estimated total # of unregistered hunters	Estimated percent of hunters unregistered
Baffin	Arctic Bay and Nanisivik	310	6 O and 2 A	Registration number acceptable	8	3
	Cape Dorset	510	1 O and 1 A	13 O and 13 A and 1 I missing	29	5
	Clyde River	245	1 O	Registration number acceptable	1	0
	Grise Fiord	73	1 O and 2 A	12 O and 2 A missing	17	19
	Hall Beach	181	3 O	Registration number acceptable	3	2
	Igloolik	307	None	Registration number acceptable	0	0
	Iqaluit	540	48 O and 2 A	51 O, 12 A and 1 I	114	17
	Kimmirut	114	1 O	51 O missing	52	31
	Pangnirtung	224	1 O	61 O and 7 A missing	69	24
	Pond Inlet	408	1 A	Registration number acceptable	1	0
	Qikiqtarjuaq	192	None	4 O, 7 A and 5 I missing	16	8
	Resolute Bay	75	None	Registration number acceptable	0	0
	Sanikiluaq	181	3 O	11 O and 3 A missing	17	9
Kitikmeot	Bathurst Inet	21	None	Registration number acceptable	0	0
	Cambridge Bay	391	16 O and 2 A	37 O missing	55	12
	Gjoa Haven	368	4 O	18 O missing	22	6
	Kugluktuk	294	3 O and 1 A	Registration number acceptable	4	1
	Kugaaruk	102	1 O	62 O and 5 A missing	68	40
	Taloyoak	249	3 O	Registration number acceptable	3	1
	Umingmaktok	31	None	Registration number acceptable	0	0
Kivalliq	Arviat	410	5 O	Registration number acceptable	5	1
	Baker Lake	341	1 O and 1 A	65 O missing	67	16
	Chesterfield Inlet	92	2 O	12 O missing	14	13
	Coral Harbour	283	5 O	Registration number acceptable	5	2
	Rankin Inlet	424	13 O	Registration number acceptable	13	3
	Repulse Bay	180	None	31 O and 8 A missing	39	18
	Whale Cove	61	None	44 O missing	44	42

O = occasional hunter
A = active hunter
I = intensive hunter

The effect of over-enumeration was more difficult to estimate since results may be biased either upwards or downwards depending on the participation of the over-enumerated hunters. If non-hunters were registered and response rates were consistently high in that community, there will be very little effect on the harvest estimates. However, if the response rate of non-hunters was higher than that of actual hunters in the community then estimates will be biased downwards since the inclusion of the non-hunters in the responding group will result in a lower overall mean harvest and lower harvest estimates for the non-responding hunters. If, on the other hand, the response rate of the hunters was higher than that of the non-hunters then the opposite would occur, and the estimates would be biased upwards. This is a form of non-response bias (Section 5.3) caused by over-enumeration of hunters. A final complicating factor of this issue is that some of these participants who consistently reported no harvest may have been doing so as a method to avoid sharing their harvest data. This is a form of hidden non-response and is discussed further in Section 5.3.2. The result of this assessment is that there is evidence that over-enumeration of hunters did occur during the study. Given the potential for hidden non-response masquerading as over-enumeration, it is difficult to estimate the extent of the problem. Considering this and the uncertainty of the direction of bias, an estimation of the effect of this source of error was not possible. However, given the likelihood that the bias occurred in both directions in many instances it can be said that the overall effect on harvest estimates is likely small.

The preceding discussion relates only to the initial registration process. However, over the life of the survey it was necessary for Fieldworkers to monitor the registration status of hunters and modify their status should it become necessary. Modifications were made to the registration lists based on hunter movements, deaths or changes in hunting activity. New hunters were also added to the lists as they became eligible for the survey. Examination of the cumulative survey record, and the post-survey community verification process indicated that tracking errors were few, and unlikely to have biased reported harvest totals in any particular direction or to any significant degree.

5.2.2 Summary

Does the sample frame fully and accurately represent the hunter population? The answer would appear to be no in many communities. Due to several issues including the administrative lists used in the initial registration process and the application of a Fieldworker's cultural perceptions of a hunter as opposed to the intended definition of a hunter, it appears that these enumeration errors did occur in the NWHS. Under-enumeration of hunters seems to be the more significant problem and will cause a downward bias of harvest estimates. The extent of this bias is discussed further in Section 6: Community Results Discussion. Over-enumeration likely occurred to a smaller extent but since it was more difficult to measure and could bias estimates in either direction it was not quantified and is considered to be relatively insignificant. Therefore, condition 1 cannot always be met.

5.3 Survey coverage and non-response bias

This section considers condition 2: whether the n respondents to the survey form a representative sample of the N hunters, in other words, that there is no significant difference in harvest levels and patterns between those who responded to the survey and those who did not. A significant difference between the two may arise from under-sampling the population (sampling error), or because there is some systematic difference between those who responded and those who did not (non-response bias). The higher the response rate, the less will be the impact of both sampling error and non-response bias on the harvest estimates.

5.3.1 Survey coverage

Survey coverage was generally over 75%. If coverage were purely random, the achieved coverage rates would for the most part be sufficiently high to produce reliable estimates of total harvest, especially if variance in actual harvest levels is relatively low. However, this is not so for all species. First, some species are taken in very low numbers, only occasionally, by relatively few harvesters (e.g. polar bears, narwhal, walrus). In fact, recording systems exist for some of these species that will almost certainly produce better harvest estimates than a comprehensive harvest survey. For this reason, the NWHS has relied on DSD records rather than the study counts for polar bear totals.

Secondly, in some cases a very small number of harvesters may take a highly disproportionate share of the total harvest, because they specialize in that species or because they are "super-harvesters", who hunt for other households besides their own. These persons were generally classed as active or intensive hunters. Low reporting rates in those strata are therefore of special concern. Where survey coverage was less than 75% by stratum, this is noted and discussed in Section 6: Community Results Discussion.

Included in each set of data tables is a table indicating the number of hunters who harvested each species. Readers are advised that, for species that are harvested by only a small proportion of hunters, the confidence intervals for the harvest estimates should be treated with caution.

5.3.2 Non-response

There are three main reasons for non-response in surveys:

1. Some members of the target population will not participate;
2. Some members of the target population cannot be contacted by the Fieldworker;
3. Some Fieldworkers will not contact some members of the target population.

The NWHS was a voluntary survey and in any such survey, some people may choose not to participate. This may be due to:

- lack of appreciation or understanding of the reasons for the survey and what benefits will result;
- lack of confidence or trust in whether the survey data might be used, or become available to others, for unintended and potentially adverse purposes;
- lack of trust in, or dislike of, the Fieldworker who, given community size and stability, is known personally by the respondent.

Deliberate non-response to the NWHS is considered to have occurred in two ways. The first is declared non-response. Some hunters consistently declined to participate in the survey. The monthly reporting code for this response was removed during the study (Section 3.7.3), after which it was no longer possible to differentiate between hunters who were not available for interview versus hunters who refused to be interviewed on a monthly basis. However, since the hunters who consistently declined to participate were designated as such in the registration table, it is possible to identify these hunters. Table 9 shows the number of hunters who consistently declined to participate in the study by community and is discussed further in Section 5.3.4.

The second form of non-response is covert or hidden non-response. Because the first question in the monthly interview is a screen, to ascertain whether the individual actually hunted the previous month, the remainder of the interview can be avoided by responding “no”, without appearing to refuse the interview outright.

The issue of failure to contact the entire survey population is due primarily to the fact that everyone eligible to be surveyed was not accessible in every month at the time of survey. Although Fieldworkers were instructed to contact everyone on the monthly hunter list (or interview list, as the case may be) each month, some people were out of town (in some cases out hunting) or not at home. While Fieldworkers were instructed to obtain previous months’ data for such persons when finally contacted, this was not always achieved.

Finally, Fieldworkers may consciously or unconsciously have placed a lower priority on reaching certain members of the target population, or avoided contacting them altogether. Reasons could include personal likes and dislikes, or convenience of access to any particular residence. Thus some people may have been consistently less likely to be contacted. Fieldworkers and hunters alike confirmed that this did occur throughout the study in many communities.

All of these reasons for non-response are potentially, if not actually, non-random.

When sampling a small proportion of a large population, there is little if any way of knowing anything about the non-respondents, and most importantly, how they might be different from the surveyed population. However, where a large proportion of a small population is surveyed (as in the case of the NWHS), certain characteristics of non-respondents may be sufficiently known that one can make at least a descriptive assessment of the likelihood and degree of non-response bias.

5.3.3 Effects of non-response

Unwillingness to participate in the study does not necessarily mean there is any particular non-response bias, because there could be many reasons for it. However, lack of confidence or trust in the uses of or access to the study data, and particularly personal information, may result in a desire to conceal harvest levels. In the context of the NWHS, there are probably more reasons for people to want to conceal high harvest levels than low ones. For example, hunters may have believed that if they were seen to be harvesting too many animals that new quotas may be established or existing quotas reduced.

Consistent failure to contact certain hunters may also indicate non-response bias. Hunters who are not available for interviews may have different characteristics than those who are. For example hunters who are often out on the land harvesting may be more difficult to reach. On the other hand, hunters who work full time and may travel for their job may also be more difficult to reach.

Consistent failure by Fieldworkers to attempt to contact certain individuals seems unlikely to have any obvious connection to non-response bias.

5.3.4 Degree of non-response bias

Individuals who consistently refused to participate in the study were designated as such in the master registration table. Table 9 shows the number of these hunters in each community and indicates that this may have been an issue in the following communities where recorded rates of intentional non-response are over 5%:

- Qikiqtarjuaq
- Baker Lake
- Chesterfield Inlet
- Rankin Inlet

The possibility of covert non-response was tested for by examining the consistency of participation rates (code 1 response as a proportion of code 1 plus code 2 responses) over a five year period, on the basis that declining rates might indicate "hunter fatigue" with the survey over time. The only communities that showed noticeable declines in participation over the life of the survey were Qikiqtarjuaq, Iqaluit, and Repulse Bay. Otherwise there is no noticeable evidence of hidden non-response, unless it was widely employed as an avoidance strategy right from the outset of the survey, which seems highly unlikely.

5.3.5 Summary

Do the *n* respondents constitute a sufficiently representative sample of the *N* hunters? On the whole, although it is likely that some non-response bias is present, and may especially affect the estimation results in communities where response rates were relatively low (e.g. less than 75%), the effect of this bias (upward or downward) on the harvest estimates is difficult to calculate. Therefore condition 2 is met in most communities where response rates are relatively high. Exceptions may occur for those communities where declared non-response rates were above 5%.

5.4 Measurement issues and response error:

This section considers condition 3: whether the survey responses are valid, i.e. measure the true harvests of responding individuals.

Survey measurement refers to questionnaire design and administration, and interview format, intended to elicit accurate responses to survey questions. The validity of the results of a survey depends on minimizing the opportunities for response error. Response error refers to the difference between the "true" answer to a question and the answer the respondent provides to that question. Response error can result when a hunter gives a harvest quantity that is higher or lower than the actual number harvested or it can result when a hunter omits a harvest of one species (or certain attributes of that harvest such as gender, age or location) while reporting the harvest of other species. This latter occurrence is referred to as item non-response and differs from the non-response bias discussed in Section 5.3.

Response error may arise from a misunderstanding of the question, or recall failure, or it may be strategic. A successful harvest survey requires the following conditions be fulfilled:

- Parameters or variables must be properly identified and the questions made comprehensible to the respondent (measurement and questionnaire design).
- Respondents must know and remember the "true" answer (minimize recall failure).
- Respondents should have an interest in answering the questions truthfully and accurately (minimize incentives to strategically bias their responses upward or downward).

In general, response error cannot be quantified but it can be identified and described, and the direction and magnitude of bias acknowledged and accounted for.

5.4.1 Measurement and questionnaire design

Over 60 species or sub-species were reported to the NWHS (Table 2). Although participants in the study were given a list of these species in their Harvest Study Calendar, it was rare for Fieldworkers to prompt hunters for each species during the interview. The majority of Fieldworkers interviewed the hunters by first asking if they had harvested during the month. The hunters were then asked: "what did you catch?" This may have resulted in hunters forgetting to report some species. Also if hunters did not carefully read through the species list they may not have been aware they were to report certain species. This would have the effect of causing hunters to under-report some of their harvest. This situation was reported by many hunters during our community visits, particularly relating to the harvest of eggs, eider down and shellfish.

The main problem in questionnaire comprehension, by both Fieldworkers and harvesters, was in the consistent treatment of commercial harvests. Harvest was defined as animals or fish killed and retrieved. It was intended to include commercial harvests only if the end use was within Nunavut (Section 3.2). Fieldworkers were instructed to collect commercial harvest data from hunters but to record it as such on the datasheet. This way these harvests could be used for verification purposes but could be removed from the database for the calculation of harvest estimates and BNLs (Section 3.2). Several problems arose with the collection of data on commercial harvests.

First, Fieldworkers were not informed to differentiate between harvest sold for use within Nunavut and harvest sold to be exported outside of Nunavut. In reality this may be difficult for hunters to report since they may not be aware of where their harvest ends up once they have sold it. Therefore some of the commercial harvests reported as such may have been sold within Nunavut and should be included in the BNL calculation. The result of this will be an under-estimation of the harvest. However, there were relatively few commercial records removed from the database (Table 4) and as such it is thought that this effect was minimal.

Secondly, the hunters in some cases reported their commercial harvest along with their subsistence harvest and in these cases there is no way to separate the two. The result of these problems relating to Fieldworker training and communication with hunters is that in some communities commercial harvests intended for sale outside of Nunavut were reported along with the subsistence harvests. This error will result in an over-estimation of harvesting for these species. Since the significance of this problem varies between species and between communities, it is dealt with in more detail in Section 6: Community Results Discussion following the data tables for each community.

5.4.2 Recall failure

In keeping with practice in other Aboriginal harvest surveys, the survey was conducted monthly in order to minimize recall failure, and harvesters were given harvest calendars as a recall aid. If a hunter could not be contacted in any particular month, the Fieldworker would request information on the harvest for missing months, when contact was finally established. This backfill procedure was normally done within the first three months. However in some communities recall periods of over 6 months were encountered. Included in the data tables for each community are monthly recall period tables. The recall period was calculated as the number of months between the harvest and the interview for each harvest record in the database. The recall period tables summarize this information by displaying the percentage of records having recall periods of 3 months or less, 4-6 months and more than 6 months.

From these tables it appears that long recall periods may have been a problem in the following communities: Baker Lake, Qikiqtarjuaq, Cambridge Bay, Coral Harbour, Hall Beach, Iqaluit, Kugaaruk, Rankin Inlet and Whale Cove. The effect of this extended recall was quite possibly less accurate or less complete recall. If the latter, the result would be some degree of under-reporting.

Regardless of the recall period, the events must be significant to the respondent in order to be recalled. The experience with harvest surveys is generally that recall of actual harvest numbers will be better for large mammals or unusually harvested species, than for species which are routinely or commonly taken in large numbers. In the latter case, the actual numbers may never have been considered and committed to memory by the harvester. During the community visits hunters repeatedly reported that they often did not count the number of eggs, down or shellfish that they harvested. They then found it difficult to estimate their harvest when the Fieldworker interviewed them. The use of recall aids such as the calendar was intended to help with this.

Calendar use during the Study did vary from community to community ranging from most hunters using their calendar in communities like Sanikiluaq, Bathurst Inlet and Igloolik to very few making use of them in Iqaluit, Kugaaruk, Repulse Bay and Cambridge Bay. In some communities we were informed that calendar use varied within the community and in general the older hunters used the calendar more and the younger hunters relied more on their memory (Chesterfield Inlet and Kugaaruk). In Pond Inlet we were told that the active and intensive hunters made more use of their calendars as a recall aid.

5.4.3 Strategic response bias

Strategic response bias refers to the conscious decision by the respondent to exaggerate, minimize, or fail to disclose his or her harvest levels. Reasons could include fear of prosecution under wildlife legislation, or fear of income investigation or loss of program entitlements. While the NLCA itself prohibits the release of personal data for such purposes, it is possible that not all hunters understood this feature of the study, or were fully confident of it. There was no provision for individual informed consent forms to be administered at the outset of the study.

The following comments relating to strategic response bias were made during the community consultations:

- Historically it has been illegal to hunt certain species (for example some waterfowl species like tundra swans), so many hunters are still reluctant to report these species.
- Most Inuit hunters do not like to brag and will often under-report their catch.
- Many hunters did not understand the purpose of the study and felt that the data could be used against them in the future. This may have influenced the reporting of some species.

Exaggeration of harvests for the simple purpose of enhancing BNLs is unlikely to be a significant factor, because it would have had to be done by a lot of respondents and with substantial exaggeration. This is generally thought to be unlikely due to cultural norms, and because it would probably have been detected and commented on by study personnel.

One aspect of strategic response bias is interviewer induced bias, i.e. where the respondent does not like or trust or feel comfortable with the interviewer. As there was normally only one Fieldworker per community, the use of an alternative interviewer in these cases was not an option.

There were a few instances in some communities where personal issues between the Fieldworker and some of the hunters had an impact on the interviews. In some cases it was a gender issue where some male hunters were reluctant to report their data to a female Fieldworker. In other instances it was an issue of age, it was suggested in some communities that an older Fieldworker with more harvesting knowledge would have been more successful during monthly interviews. It was also mentioned that some personal or family politics would affect how a hunter reported to a certain Fieldworker.

5.4.4 Summary

Are the survey responses valid, i.e. do they measure the true harvests of responding individuals? The answer would appear to be yes in most cases, especially for large mammals or unusually harvested species, and when recall periods were low. However, it has been determined that an under-reporting of certain species occurred. These species include shellfish, eggs and eider down. It is also suspected that an over-reporting of the harvest of some species took place as commercial harvests were included in some records. The degree and direction of bias these errors introduced vary by community and by species. Readers should refer to the Section 6: Community Results Discussion for specific examples of these errors and their effects. Therefore condition 3 is met in most cases.

5.5 Summary of Reliability of Harvest Estimates

Providing a short, concise summary of the reliability of the Harvest Study data is a difficult task. The NWHS was a study which involved staff and participants in 28 communities taking part in the collection of data on the harvest of over 60 different species of animals, from over 5000 harvesters, over a five-year period. The size and complexity of the study resulted in data reliability issues that differ not only among communities but also among the years of the study and among the species.

It is recommended that anyone using the Harvest Study data should first identify their data of interest. The user should determine whether they are interested in data from one particular community; or for one particular species; or whether they can further narrow their needs to a particular time period during the study. Once the user has made these determinations, the reliability of the data they are interested in can be assessed by reading Section 5 and by referring to Section 6 for the community and species of interest, paying close attention to the Community Results Discussion including community comments and other sources of data. Armed with all of this information readers will be able to come to a conclusion regarding the reliability of the data of interest to them and will be able to determine whether that level of reliability will be sufficient for their intended use of the data.

The main purpose of the NWHS was to provide the NWMB with the information needed to calculate basic needs levels if a total allowable harvest is put in place or kept in place for a particular species. Given the above discussion, the NWMB will need to follow a similar process of assessing data reliability when basic needs levels are to be calculated. The harvest estimates displayed in this Final Report along with the analysis and discussion of the data will provide the NWMB with the necessary tools to complete this task. The primary purpose of the NWHS should also be kept in mind by those who use the information in this report for other purposes.

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ᐊᖏᓇᓯᐊᖅᑎᑦ ᑭᐅᓂᖏᑦ

ᐊᖏᔪᓂᒃ ᖃᐅᔨᓴᓂᖅ ᑭᓇᐅᔭᓕᕆᓂᖅᓯᒪᔪᓂᒃᑐᖅ ᐊᓪᓚᑦ ᑕᐃᒪᓐᓇᖅᑐᓂᒃ ᐃᓕᓴᕐᓂ ᐊᖏᓇᓯᐊᖅᑎᑦ ᐃᓕᓴᕐᔪᓐᓇᖅᑎᓪᓗᒍ. ᑕᒪᔭᐊᔪ ᐊᖏᓇᓯᐊᖅᑎᑦ ᑎᑎᖅᑕᐅᓯᒪᔪᓂᒃᑐᖅᑐᑦ ᖃᐅᔨᓴᓂᖅᓯᒪᔪᓂᒃᑐᖅᑐᑦ ᐊᐱᖅᓯᕐ

ᖃᐅᔨᓴᓕᕐᓂᖅ ᑭᓇᐅᔭᓕᕆᔨᒪᔭᖅᑎᑦ ᐊᖏᓚᐅᔪᓂᑦ ᑎᖃᐅᔨᖏᖅᓯᓕᕐᓂᖅ ᐅᓂᒃᑳᖅᑐᑦ ᐊᖏᓚᐅᔪᓂᑦ ᐅᓂᒃᑳᖅᑐᑦ ᐊᑐᓕᕐᓂᖅ ᐊᓯᔾᔨᕐᓂᖅ

1. ᓇᓗᓇᐃᒋᐊᕐᓂᖅ

1.1 ᐅᓂᒃᑳᓕᕐᓂᐊᓪᓚᑦ ᖃᓄᐃᒍᑕᐅᓇᓱᑦᑐᖅ

ᓄᓇᕗᒻ ᓂᕆᔨᒃ ᐃᓕᓴᖅᑕᐅᔪᓂᖅ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ (ᑎᑭᓗ ᐃᓕᓴᖅᑕᐅᔪᓂᖅ ᖃᐅᔨᓴᕐᓂᖅ) ᐱᓕᕆᔨᐅᑎᑕᐅᓚᐅᖅᑯᓯᒪᔪᖅ ᓄᓇᕗᒻ ᓄᓇᕕᒻᒥᐅ ᐊᖏᕕᑎᖓᓚᒥᒃ ᓱᖅᓄᐊᖅᑕᐅᖅᑯᓯᓗᓂ ᖃᓂᒃ ᐃᓕᓴᖅᑕᐅᔪᑎᑭᖓᓂᖅ ᐃᓐᓇᕐᓂ ᐊᒃᑐᐅ ᓄᓇᕗᒻ ᐅᑭᐅᓂ ᑕᒪᓕᓐᓂ ᓇᓗᓇᐃᖅᑕᐅᓚᐅᑎᒍᑦ. ᓄᓇᕗᒻ ᐃᓕᓴᕆᓇᕐᔪᐊᖅᑯᓂ ᑲᑎᒪᔨᖏᑦ ᖃᓚᐅᔨᒪᓂᖅᑐᑦ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ. ᐅᑭᐅᓂ ᑕᒪᓕᓂᒃ ᖃᐅᔨᓴᕐᓂᖃᖅᑎᑦᓯᒪᔪᓂᒃ ᐅᑭᐅᓂ ᓄᓇᕗᒻ ᐅᑭᐅᓂ 6018 ᐊᖏᓚᐅᖅᑎᓂ ᐊᑎᓂᐅᖅᓯᒪᖃᑕᐅᓚᐅᖅᑐᑦ ᖃᐅᔨᓴᕐᓂᔪᓂ ᓄᓇᕕᐅᔪᓂ 28ᓂᒃ, ᐊᓚᓗ ᐃᓕᓴᖅᑕᐅᔪᓂᖅ ᑎᑎᖅᑕᐅᓚᐅᖅᑐᑦ ᓄᓇᕕᐅᔪᓂᖅ ᑕᖅᑭᑦᑕᑦ 60ᓂᒃ ᐊᔪᓕᐊᖏᑦᑐᓂᒃ ᓂᕆᔨᑎᒃ. ᐃᓕᓴᖅᑕᐅᔪᓂ ᐱᖃᓐᓂᕆᓚᐅᖅᑐᑦ ᓇᑭᒃ ᐱᓕᐅᓂᓪᓚᖅᑐᑦ, ᐃᓗᓕᕆᓂ ᒪᓕᒐᔪᓂ ᐊᔪᓕᐊᖏᑦᑐᓂᒃ ᐊᑎᓪᓗᒍ ᓂᕆᔨᑎᒃ ᓄᓇᕗᒻ ᐃᓕᓴᖅᑕᐅᔪᓂᖅ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᐃᓕᓴᖅᑕᐅᔪᓂᖅ ᐃᓕᓴᖅᑕᐅᔪᓂᖅ ᐃᓕᓴᖅᑕᐅᔪᓂ

1.3 ᐃᓕᓴᕆᐃᓪᓚᑦ

ᓄᓇᕗᒻᒥ ᓂᕆᔨᒃ ᐅᒪᔪᖅᑕᐅᔪᑦᑐᑐᓂᓗᓄᖅ ᖃᐅᔨᓴᖅᓄᐅᔪᖅ ᐊᖏᕈᓐᓇᕐᓂᖅᑕᐅᓕᕆᔨᒋᖅ ᑲᓇᑕᒥ. ᖃᐅᖅᖢᓂᐊᒍᑦᑕᐅᖅ ᐱᓕᓴᐅᖅᑐᑦᑕᐃᑦ 35ᖏᓚᐅᑦ ᐃᓄᐃᑦ ᖃᐅᔨᓴᕐᓂᖃᖅᑎᑦᓄᑐᒍ ᖃᖏᓐᓄᓕᕆᓂᐊᖅᐸᑦ, ᐅᓄᖅᑐᓴᒪᓕᑦ ᓄᓇᕗᒻᒥ ᐅᒪᔪᓕᓴᐅᓇᓱᐊᕐᓂᑦ ᐊᒪᓚᓗ ᐊᓯᖏᓐᓂᑦ ᑎᑎᕋᐅᓕᖅᑐᓂ ᐊᑐᓂᖅᑎᑐᐊᓕᓚᓕᐅᕐᓂᖅᑐᑦ ᖃᐅᔨᓴᕐᑐᖃᖏᓐᓄᐅᔪᖅ. ᑭᓯᐊᓂ ᐅᖃᐅᔨᐅᑎᐊᖃᖏᓐᓄᑦ ᑕᒪᓐᓇ ᑲᓇᓯᑎᐊᑭᖃᓄᖅᑐᑦ ᐱᓕᓕᒫ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᑕᐃᒪᐃᒍᓐᓇᓕᖅᑭᓯᐅᓕᐅᕐᓂᖅᑐᑦ ᐃᓕᓴᐅᔪᓂ ᐱᓕᕆᔨᐅᓂᖅᑐᑦ ᑕᐃᒪᐃᒍᓐᓇᓕᖅᑭᓯᐅᓕᐅᕐᓂᖅᑐᑦ ᐃᓕᓴᐅᔪᓂ ᑕᖅᑭᑕᒥᑦ ᐅᑭᐅᓂᑦ ᑕᓪᓕᒪᓂᑦ ᐅᐱᒋᔭᐅᓇᐅᓚᖅᑐᖃᖏᓐᓄᑦ ᐃᓕᓴᕆᔨᐅᓂᓕᓕᒫᑦ ᐃᓕᓴᐅᔪᖅᑐᑦ ᑕᐃᒪᓐᓇᓕᖅᑭᓯᐅᓕᐅᕐᓂᖅᑐᑦ ᑕᒪᒍᒪᔪᓂᖅ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᐱᓕᕆᔨᐅᓂᖅᑐᑦ ᐊᒪᓚᓗ ᐱᓕᕆᔨᐅᓂᖅᑐᑦ ᐊᑐᑎᖃᐅᔨᓴᖅᑐᑦ ᐅᓪᓗᒥ ᐃᓕᓴᐅᔪᖅᑐᑦ ᐃᓕᓴᐅᔪᓂ ᐃᓕᓴᕆᔨᐅᓂᖅᑐᑦ ᐃᓕᓴᐅᔪᖅᑐᑦ

ᓱᕐᓂᕈᒪᔪᑦ ᖃᐅᔨᓴᖅᓯᒪᔨᑦ ᑐᑭᓯᐊᖅᑎᓯᔨᐅᒥᓂᕐ:
ᑭᐅᑭᑦ ᓱᓯᑦᓴᐃᓯᓂᑦ, ᓴᓂ ᒪᑲᔪᓯᖓᓪ, ᓴᐃᑐᓪ ᑎᒍᑭᑦ

ᐊᐅᑲᖅᑎᑦ ᑲᑎᒪᓵᕆᓯᒪᑦ ᖃᐅᔨᓴᖅᓯᒪᔪᑦ:
ᐅᐃᒪᑎ ᐊᓂᖃᓄᐊᖅᓱᖅ, ᐊᐃᑐᑦᓯᓪ ᑎᕼᑦᑐᑦ, ᓴᒻ ᕼᐊᐃᓪᓕᑦ, ᔪᑭᒍᑦ ᓂᓴᓴᑭ, ᑎᓴ ᐱᑦ, ᓴᒥᐅᓂ ᓴᒧᐳᑐᖅ

ᖃᐅᔨᓴᖅᓯᒪᔪᑦ ᑲᑎᒪᓵᕆᓚᐅᔪᑦ:
ᑎᐃᑦ ᐊᓂᕆᓂᖃ, ᓂᖃ ᐊᒪᐅᑎᓄᐃᓱᖅ, ᕼᐊᓇᓪ ᕿᓂᐅᔭᑎᑎ, ᐸᐅᓂᓴ ᖃᓴᑦᑕᑦᖅ, ᔪᑭᒍᑦ ᓂᓴᓴᑭ, ᓴᓴᒥᑦ ᐅᓂᖃᖅ, ᑭᐃᐃᑦ ᐃᓂᓴᓴᑭ, ᐊᒪᓴᖅ ᐃᓂᖃᖅ, ᑕᐃᐃᑦ ᑕᔪᓇᖅ

ᓄᓇᕗᑦ ᐅᒪᔨᓂᓱᔨᔪᐃᓂᑦ ᐃᖅᑲᐃᐅᖅᑎᑎᑦ:
ᑕᓐ ᐸᐃᖅ, ᐅᒪᔨᓂᓂᒪᑦ ᐊᐅᓂᓴᓂ

ᒥᓂᐅᑦ ᖃᐃᑦᓂ, ᐅᒪᔨᓂᓂᒪᑦ ᐊᐅᓂᓴᓂ

ᐱᓂ ᓴ, ᖃᐅᔨᓴᖅᓯᒪᑦ ᐃᑲᔪᖅᑎᑐ

ᑐᑭᓂᐅᓇᓕᑦ:
ᐃᐃᓕ ᐊᒪᒥᐊᓂᖅ, ᐱᐊᑎᑐ ᕗᑎᑐᑐᓴ, ᐃᑦᓓ ᐃᓂᐃᐊᓴ, ᕼᐃᓂᓐ ᑭᓂᖏᓐᓇᓴᓕ, ᐊᓪᓚᐃᓕᓴᖅ ᐃᓂᓴᓴᑭ (ᖃᐅᔨᓴᖅᓯᒪᔪᑦ ᐃᓂᓪᓚᕐᓗᓂᓴᓴᑭ)

ᕿᐅᑲᓐ ᐱᔨᑦᓴᖅᑎᑦ (FoxPro ᖃᓇᑕᐅᔭᐃᑦ ᐊᓪᓚᖅᑐᖃᖅᓯᒪᔪᑦ ᐊᖅᑭᑦᑐᐃᔨᑦ)

ᔨᐅᒪᑎᓐ Geomatics International Inc. (ᓄᓇᕐᓴᐊᓪᓚᐅᑎᑎ ᖃᓇᑕᐅᔭᐃᑦ)

ᐅᐃᓐ ᕆᕐᓴᓐ (MS Access ᐊᓪᓚᖅᑐᖃᖅᓯᒪᔪᑦ ᓴᓇᒪᓕᕐᓴᓂᓴᓐ)

ᔨᐅᐊᖅᑎᓐ GeoArctic International Ltd. (ᐊᑦᓚᖅᑐᑎᓄᑦ ᓄᓇᕐᓴᐊᓪᓚᓕᒫᓂᓪᓚᑦᓴ ᐱᓪᓚᕐᓴᑎᓄᑦ)

ᐱᑕ ᔪ. ᐊᓯᔪ, P.J. Usher Consulting Services (ᐊᑦᓚᑕᐅᓯᒪᔪᓂᓴ ᑐᑭᓯᓴᓕᕐᓴᓂᓴ ᐊᓯᒪᒃ ᐅᓂᖅᑲᓕᕐᓴᐳᓯᒪᔪᓂᓴ ᐊᖅᑭᑭᐊᓚᓂᓴᖅ)

ᕆᓴ ᓂᑦᑐᔪ, ᖃᐅᔨᓴᒪᔪᓚᓕᖅ ᑭᖑᓂᒪᓚᓂᓴᒧᑦ, ᐊᓂᔪᒃᒥ ᓯᓚᑐᓴᓕᖅᖃᖅ, ᐊᖅᓂᓚᕐ (ᐊᑦᓚᑕᐅᓯᒪᔪᓂᓴ ᑐᑭᓯᓴᓕᖅᖃᖅ)

ᕿᐃᒥ ᑎᓂᖓ, ᐊᔪᑎᒪᑎᐟ ᑎᓪᓗᐃᑎ, ᕼᐃᐅᐅ ᔪ, ᓇᓴᐅᑎᓂᓴ ᖃᐅᔨᓴᓓᓯᑎᑦ, ᑲᓓᒪᑦ ᓇᓴᐅᓯᓓᓂᓴ (ᐊᑦᓚᑕᐅᓯᒪᔪᓂᓴ ᑐᑭᓯᓴᓕᖅᖃᖅ)

ᖃᓄᐃᓓᓕᐅᕆᔨᑦ ᐃᖅᑲᐃᐅᖅᑎᑎᑦ ᑲᑎᒪᓵᕆᓚ ᐊᐃᔭᑐᖅᑭᓕᕐᓂᓴᓐ ᐅᒪᔨᓂᓚᓇᓴᕐᓂᓴᓐ ᐊᓯᒪᒃ ᐅᓂᖅᑲᓕᕐᓴᐳᓯᒪᔪᓂᓴ ᐅᒪᔨᓂᓚᓇᓴᕐᓂᓴᓐ ᐃᓂᓴᓴᑭ ᐊᖅᑭᑭᐊᓚᓂᓴᖅ ᐱᓕᕐᓂᓴᓐ ᐃᓂᓴᓴᑭ ᐊᓯᒪᒃ ᐅᓂᖅᑲᓕᕐᓴᐳᓯᒪᔪᓂᓴ ᐅᒪᔨᓂᓚᓇᓴ

2. ᖃᐅᔨᓴᓂᖏᑦ ᐱᐅᓯᐅᖃᕐᕕᖏᓐᓄᑦ

2.1 ᓄᓇᕗᒻᒥ ᐅᒪᔪᖅᑕᐅᔪᓐᓇᒃ ᖃᐅᔨᓴᓂᖃᕆᐊᖃᖅᖢᓂᖅᓯᒪᓂᖅᓱᓕᕐᓂᓪ ᑐᑭᒧᐊᑎᑎᓄᑦᓴᑦᑐᓪ

ᓄᓇᕗᒻᒥ ᓄᓇᕈᑎᒧᑦ ᐊᖏᕈᑎᐅᐅᔪᖅ ᒪᓕᒃᓴᐃ ᐃᒪᒪᑭᐊᖅᖢᓂᒪᓕᒫᓂ:

"ᓄᓇᕗᒻᒥ ᓂᕆᔨᓂ ᐅᒪᔪᖅᑕᐅᔪᓐᓇᒃ ᖃᐅᔨᓴᓂᖅᖢᓂᖅᓴᖅᓱᓂᒃ ᐊᑐᓂ ᐊᐱᕐᑐᖅᖢᓪᓕᔪᓂ ᓄᓇᕗᒻᒥ ᓄᓇᕈᑎᑎᐅᔪᓕᒪᓂᕐ" (ᓄᓇᕈᑎᓂ, 1993, ᐃᓕᓴᕐᔪᑐᓂ 5.4.1); ᐊᖏᓪᓗ

"ᐱᒋᐊᖅᓯᐊᖅᓴᖅ ᐊᑐᓂ ᐱᖓᓱᓕᔪᓂᒃ ᐊᐱᕐᑐᖅᖢᓪᓕᔪᓂ ᐅᓪᓴᖓᓂ ᓯᑲᓇᐅᔭᓐᓄᓪᓕ ᓇᓪᓕᐅᓂᖅᖢᓂᐅᔪᖅᖢᓂᐅᓪᓚᑦᑎᓐᓄᑦ ᐊᖏᕈᑎᑎᐅᔪᓕᒪᓂᕐ ᐊᐱᓕᐅᖅᑕᐅᓂᖅᓚᑦ" (ᓄᓇᕈᑎᓂ, 1993, ᐃᓕᓴᕐᔪᑐᓂ 5.4.2); ᐊᖏᓪᓗ

"ᐱᓕᓇᖅᓯᐅᓇᖅᑐᓴᖅ ᐅᐸᐅᓂ ᑕᓪᓕᒪᓂᑦ" (ᓄᓇᕈᑎᓂ, 1993, ᐃᓕᓴᕐᔪᑐᓂ 5.4.4).

ᖃᐅᔨᓴᓂᓪᓕᑦ ᖃᓄᐃᒍᑎᓕᖅᓯᑐᓂᖅ ᐅᖃᖅᑕᐅᔪᖅᓯᒪᔪᖅ ᐃᓚᒃ:

"ᐊᑦᖁᑭᐅᖅᖢᓯᒪᓕᑎᑦᓴᖅᓱᓂᑦᑎᓂᒃ ᐊᓪᓚᕈᑎᔪᓂ ᓴᖅᑭᖅᑐᑦᖃᖅᓱᓪᓚᒍᓗ ᐅᒪᔪᖅᑕᐅᔪᓐᓇᑦᑐᑦ ᑭᓯᐅᑎᓕᖅᖢᓂᖅ, ᐃᐅᔨᖅᑕᐅᖅᓱᓂᑦᑎᓂᒃ ᐅᒪᔪᖅᑕᐅᔪᓐᓇᑦᑐᑦ ᑭᓯᐅᑎᓕᖅᖢᓂᖅᓴᖅᓯᐅᑦ ᐅᒪᔪᖅᑕᐅᔪᓐᓇᑦᑐᑦ ᐊᖏᓪᓗ, ᑕᒪᐃᔨᔪᑦᑐᓂ ᐊᐅᓚᑦᑎᓐᓄᑦᓴᑦᑐᓂ ᐃᓄᐃᑦᑎᓂᒃᑯᑦ ᐊᐅᓚᑦᑎᓐᓄᑦᓴᑦᑐᓂ ᐃᓄᐃᑦᑎᓂᒃᑯᑦ ᐃᓕᓴᕐᔪᑐᓂ ᐊᖏᓪᓗ ᓄᓇᕗᒻᒥ ᓄᓇᕈᑎᑎᐅᔪᓕᒪᓂᕐ ᐃᓚᖓᔪᓂ. ᑕᒪᑐᒧᖓ, ᖃᐅᔨᓴᓂᖅ ᐃᓕᐃᓐᓇᖅᑐᑦ:

(ᐃ) ᑎᑎᕋᐅᑎᑦᓯᓚᐅᔪᓂ ᑭᓚᓕᐅᔨᔪᓂ ᖃᓄᐃᓕᐅᓂᖅᓴᓂᓪ ᐃᓄᐃᓪ ᐊᐱᖓᓂᓪᓚᑦᑎᓐᓄᑦᓴᑦᑐᓂ ᓂᕆᔨᓂᒃ ᓯᖏᐃᐃᖅᑕᐅᓇᖅᓯᒪᔪᓂᓪ ᐱᓕᕐᓂᐊᓇᓄᑦᓴᖅᑐᓂ; ᐊᖏᓪᓗ

(ᐱ) ᓄᐊᔪᓂᓪ, ᕿᒥᖅᑭᓂᓪᓕ ᐊᖏᓪᓗ ᓯᖏᐃᐃᕆᔨᓂᓪᓕ ᐅᓪᓴᐃᓪ, ᐊᓯᓪᒥᑎᔪᓪᓕ ᐊᖏᓪᓗ ᐅᓪᓴᐃᓪ ᓄᓇᕗᒻᒥ ᐃᓄᐃᑦᑎᓂᒃᑯᑦ ᐊᐱᕐᑐᖅᖢᓪᓕᔪᓂ ᓄᓇᕗᒻᒥ ᓄᓇᕈᑎᑎᐅᔪᓕᒪᓂᕐ ᐃᓚᖓᔪᓂ." (ᓄᓇᕈᑎᓂ, 1993, ᐃᓕᓴᕐᔪᑐᓂ5.4.5).

ᐱᓕᕐᓂᐊᓇᐃᓐᓇᖅᑐᓂ ᐊᖏᕈᑎᑕᐅᓯᐅᓇᖅᓴᓂ "ᐊᑐᓂ ᓂᕆᔨᑎᓂ ᐊᑎᑕᐅᔨᓪᓕᑦᓂᓪᓕ, ᐅᔪᐊ ᓇᓕᕐᓂᐊᓇᓄᑦᓴᑦᑐᓂ:

(ᐃ) ᑲᑎᓂᑎᓂ ᐅᓄᓭᖅᓂ ᐃᓚᔪᖅᑕᐅᔨᓯᒋᓂ ᓇᓪᓕᐊᓯᓄᐃᓇᖅ ᐅᓱᐅᑦ ᖃᐅᔨᓴᓂᖅᓴᖅᖢᓂᓗᔪ, ᐊᖏᓪᓗ ᐊᖑᓕᔪᓯᑦ ᖃᓂᑎᐅᑦᓴᓂᖅᓯᒪᓂ ᐅᓱᐅᑦ ᑕᓪᓕᒪᓂᑦ ᖃᐅᔨᓴᓂᖅᓴᖅᖢᓂᓗᔪ, ᑲᑎᓂᓂ ᐊᐳᖅᑕᐅᓕᕆᓂᑐᑎᑦ ᒪᕐᕉᒪᓐᓇᖅᓂᓪ; ᑭᓯᓪ

(ᐱ) ᖃᓄᐃᓂ ᐃᓚᔪᖅᑕᐅᔨᔨᓯᒋᓂ ᓇᓪᓕᐊᓯᓄᐃᓇᖅ ᐅᓱᐅᑦ ᖃᐅᔨᓴᓂᖅᓴᖅᖢᓂᓗᔪ ᓂᕆᔨᓂᒃᑯᑦ ᓴᓇᔨᓂᓗᔪ ᐃᓚᔪᖅᑕᐅᔨᓪᓕᑦᓂᓪᓕ ᖃᐅᔨᓴᓂᖅ ᐃᓗᓕᑐᐊᖅᑎᓂ, ᐊᖏᓪᓗ ᐅᓱᐅᑦ ᐊᐱᕐᑐᖅᖢᓪᓕᔪᓂ ᐊᑐᓂᖃᐅᔨᓴᓂᖅᓴᖅᖢᓂᐅᔪᖅᖢᓂᐅᓪᓚᑦᑎᓐᓄᑦ ᓂᕆᔨᓂᒃᑯᑦ ᐊᖏᕈᑎᑎᐅᔪᓕᒪᓂᕐ ᖃᐅᔨᓴᓂᖅ ᐱᓗᐊᓕᐊᖅᑎᓂ." (ᓄᓇᕈᑎᓂ, 1993, ᐃᓕᓴᕐᔪᑐᓂ 5.6.21).

(ᓇᓴᐃᔪᓗᐅᔪᐃᓪᓕ ᐊᐳᖅᑕᐅᓯᐊᕐᓂᕆᔨᓂᖅᓴᖅᖢᓂᓪᓕ ᑭᓚᓕᐅᔨᓴᓂᖅᓴᖅᖢᓂᐅᓪᓚᑦᑎᓐᓄᑦᓴᑦᑐᓂ ᖃᐅᔨᓴᓂᖅᓴᖅᖢᓂᐅᓪᓚᑦᑎᓐᓄᑦᓴᑦᑐᓂ ᐊᖏᓪᓗ ᐱᓕᕐᓂᐊᓇᓄᑦᓴᖅᑐᓂ ᐅᓱᐅᑦ ᑭᓚᓕᐅᔨᓴᓂᖅᓴᖅᖢᓂᐅᓪᓚᑦᑎᓐᓄᑦᓴᑦᑐᓂ ᑭᓚᓕᐅᔨᓴᓂᖅᓴᖅᖢᓂᐅᓪᓚᑦᑎᓐᓄᑦᓴᑦᑐᓂ ᐃᓚᖓᔪᓂ ᐱᓕᕐᓂᐊᓇᓄᑦᓴᖅᑐᓂ ᐅᓱᐅᑦ ᐊᐱᕐᑐᖅᖢᓪᓕᔪ

ᐊᐅᓪᓚᑎᐅᕐᓂᖅ ᑭᓇᐅᖅᑐᑎᓴᐅᓂᒃ ᖃᐅᔨᓴᓂᐸᓪ, ᖃᐃᓕᖏᓴᐅᑉᐳᓪᓚᕐᓂᒃ ᑲᑎᖅᓯᕐᓗᓂᑦ ᐊᓂᒍᓴᕐᓚᐃᓕᓴᐃᓪᓚᕐᓂᒃ ᐊᑐᓂ ᐊᐃᕐᓇᖅᑐᓂᒃ ᐊᓯᖏᓪᓕᐊᓂᒃ ᖃᐅᔨᓴᓂᐸᓪ ᖃᐅᔨᓴᓂᐸᓪ ᐃᓕᓴᕐᓂᒃ ᐊᑐᓂ ᐊᐃᕐᓇᖅᑐᓂᒃ

ᓇᓗᓇᐃᒪᓕᒃ 1: ᐊᓯᖏᓐᓄᑦᑎᓪᓗᒍ ᐃᖅᑲᓇᐃᒪᓕᖅᐸᑎᓐᓂᒃ ᓇᓗᓇᐃᒪᓕᒃ ᓄᓇᕗᒻᒥ ᐅᒪᔨᖅᑕᐅᔪᓂᖓᓂᒃ ᖃᐅᔨᓴᖅᓯᒪᓂᖅ

** 1 ᐊᓕᕐᖃᖅᑎᑦ ᓄᐊᑎᒋᓕᐅᖅᑐᓂᖅ ᐃᓕᓴᕐᓂᖓᓗ ᓇᓂᓱᑦᓗᓪ

ᓄᓇᕗᒻᒥ ᓂᕆᔨᒃᑯᓂ ᐃᓕᓴᖅᑕᐅᔪᓂᒃ ᖃᐅᔨᓴᖅᑕᐅᓂᖅᓯᒪᔨᖅ ᐱᒋᐊᓕᓕᒫᖅᓯᒪᔨᖅ ᐆᒃᑐᒃ 1993ᒥ ᐃᓅᖅᑲᓇᕐᓂᖅᑎᑦᑎᓐᓄᑦ ᑐᑭᓯᐊᖅᑎᓂᕐᔪᓐᓇᕐᓂᖅ, ᖃᓄᐃᓕᖅᑐᓂᓴᐅᓂᖅᓱᒃ ᓇᓗᓇᐃᔨᖅᑕᐅᓕᕆᔨᓗᓂ ᓄᓇᕗᒻᒥ ᐅᖃᓕᒫᓂᖅ. ᐅᑭᐅᓂ ᓯᔪᓐᓇᖅᑐᒃᓱᒃ, ᓄᓇᕗᒻᒥ ᐃᓕᓴᕐᓂᓴᓪᓚᕐᒪᖑᓪᓚᕆᒃ ᓇᖅᑭᒪᔨᖅᓯᒪᔨᓂ ᐊᐅᔨᖅᑐᐃᓐᓇᓂ ᑲᑎᒪᔨᓴᖅᑎᓂᒃ ᐃᓄᓐᓂᒪᓂᕐᓂᖅᓱᒃ ᖃᐅᔨᓴᖅᓄᑦ. ᐊᐅᓚᑎᑕᐅᓂᒃ ᐱᓇᓱᒋᓂ ᒪᓂᑐᒍᑦ ᐅᓂᕐᓂᖃᖅᑎᖅᓱᒃ ᓯᔪᓐᓇᖅᑐᐃᓐᓇᓂᖅᓯᒪᔨᖅᓄᑦ ᓄᓇᕗᒻᒥ ᐃᓕᓴᕐᓂᓴᓪᓚᕐᒪᖑᓪᓚᕆᒃ, 1994ᒥ (ᓄᓇᕗᒻᒥ ᐃᓕᓴᕐᓂᓴᓪᓚᕐᒪᖑᓪᓚᕆᒃ, 1994). ᓄᖅᓱᒃ ᐱᓕᕐᓂᐊᕐᓇᖅᑐᒃᑯᓂᖅ ᐱᓇᓱᒋᓂᖅᓯᒪᔨᖅᓄᑦ ᖃᐅᔨᓴᖅᓄᑦ ᑐᓴᐹᒪᓴᖅᓄᑦ ᐃᓄᓐᓂᒪᓂᕐᓂᖅᓱᒃ ᖃᐅᔨᓴᖅᓄᑦ ᑕᓴᐹᒪᓴᖅᓄᑦ.

ᐊᒃᑲᖅᑐᐃᓐᓇᓂᓕ ᐊᑕᐅᓯᐅᖏᑦᑐᓂᓗᓂᖅ ᐊᑐᑎᖃᖅᑕᓗᖅᑐᓂᖅ ᐃᓱᒪᓕᐅᓚᓕᒫᖅᑐᓂ ᑐᐱᓯᒪᔪᓂᒃ ᓇᓂᕐᔪᐊᓂᖅᑕᐅᓂᖅᓯᒪᓕᕐᓂᖅ 1995 ᐱᑎᐊᓂᖃᑦᓴᖅᓯᒪᓂ. ᐊᒃᑲᖅᑐᐃᓐᓇᓂᓕ ᐃᓱᒪᒋᔭᖅᖃᓚᒫᖅᑐᓂ ᐃᓗᑦ:

> *"ᐅᓴᓚᓱᖅᑐᓂ ᓴᖅᑭᑕᐅᔾᔨᖅᓱᒪᔨᐃᓪᓚ ᐊᐅᓚᑎᑕᐅᑕᐅᓂᒃ ᐅᓪᓚᒥᑕᐅᓂᖅᓴᐅᑎᓪᓗᓂ ᐊᐅᓚᑎᑕᐅᓂᖅᑐᑐᒃᓯᒪᓂ (ᓚᓪᓕᑐᔪ ᐃᓚᒦᓐᓇᓕᖅ 5.4.5(ᐱ) ᐊᖏᕐᑭᓂᓂ) ᒪᑐᐃᖏᓂᖅᓯᒪᓕᖅᑐᓂᒃ ᐃᓚᒦᐃᓕᓴᕆᔨᓴᓂᓗᖅ ᑲᑎᒪᔨᓴᖅ, ᐃᖅᑲᓇᐃᔨᖅᑕᐅᓂᖅᓯᒪᓕᖅᑐᓂᒃ ᐊᑐᓚᓕᖅ ᐊᐅᓚᓕᕆᔨᖅᑕᐅᓚᓕᖅ ᑎᑎᕐᓯᒪᓕᖅ ᓴᓇᔨᓴᖅᑕᐅᓚᓕᖅ. ᑕᒪᓐᓇᐅᔪᓂᒃ ᐃᓚᒦᐃᓕᓴᕆᔨᓴᓂᓗᖅ ᐊᐅᓚᑎᑕᐅᓂᖅᓯᒪᓕᖅᑐ

2.5 ᓄᓇᕗᑦ ᑐᓴᕐᓯᖏᓐᓄᑦᑎᓪᓗᒍᑦ, ᑐᓴᐅᒪᑎᑦᓴᓕᕆᓂᖅ, ᐊᒻᒪ ᐅᓂᒃᑳᓕᐅᕆᓂᖅ

2.5.1 ᑐᓴᕐᓯᖏᓐᓄᑦᑎᓪᓗᒍᑦ ᑐᓴᐅᒪᑎᑦᓴᓕᕆᓂᖅ

ᐅᖃᖅᑎᑕᐅᓂᐅᔪᑦ ᐃᓄᐃᑦ ᓄᓇᕗᑦ ᖃᐅᔨᓴᓂᖅ ᐱᒻᒪᔪᒍ ᐱᑎᒋᖅᑎᑕᓕᕆᓂᖅᓯᒪᔪᖅ ᓄᓇᕈᑎᑦ ᐊᐃᕐᓂᕐᕕᐅᓂᖅᓯᒪᓂᒃ. ᑐᓴᐅᒪᑎᑦᓴᓕᕆᓂᖅ ᖃᓄᐃᒍᑕᐅᓇᓱᑦᑐᒥ ᖃᓄᐃᓕᒫᒥᒃ ᐃᓕᓴᕐᓂᖅᓯᒪᓂᖅ ᑕᒪᐃᔨᑦᑐᖅᓯᒪᓂᖅ ᐃᓕᓴᕐᓂᖅᓯᒪᓂᖅ ᐊᒻᒪᓗ ᓴᖅᑭᑕᕐᕕᐊᓂᖅ ᐃᓄᐃᑦ ᓄᓇᕗᑦ

2.5.2 ᐅᓂᒃᑲᐅᓕᕐᓂᖅ

ᐱᔭᕇᖏᖅᑐᓂᒃ ᓄᓇᑦᑕᑎᑎᔪᑦ "ᓄᓇᕗᑦ ᐅᒪᔨᓪᓚᕆᔨᕐᓂᖅ ᐅᓂᒃᑲᓕᐅᕙᒃᓴᓪᓗᕈᕙᒃᓴᑦ ᐊᕐᕌᔪᒥᒃᑦ ᖃᐅᔨᓴᖅᓂᐅᑦ ᐱᓕᕐᓂᖅ. ᖃᐅᔨᓴᖅᓂᖅ ᐱᔭᕆᖏᑕᐅᔪᓂ, ᐅᒪᔨᓪᓚᕆᔨᕐᓂᖅᓂᒃ ᓴᓇᓂᕈᕙᒃᓴᑦ ᐊᓕᕐᓂᖏᑐᓂᒃᑲᑦ ᐅᓂᒃᑲᖏᓐᓂᒃ ᖃᐅᔨᓴᖅᓂᖃᖅᓯᓂᓗᔪ."
(ᓄᓇᑦᑕᑎᓂ, 1993, ᐃᓕᓴᕐᓂᐅ 5.4.9)

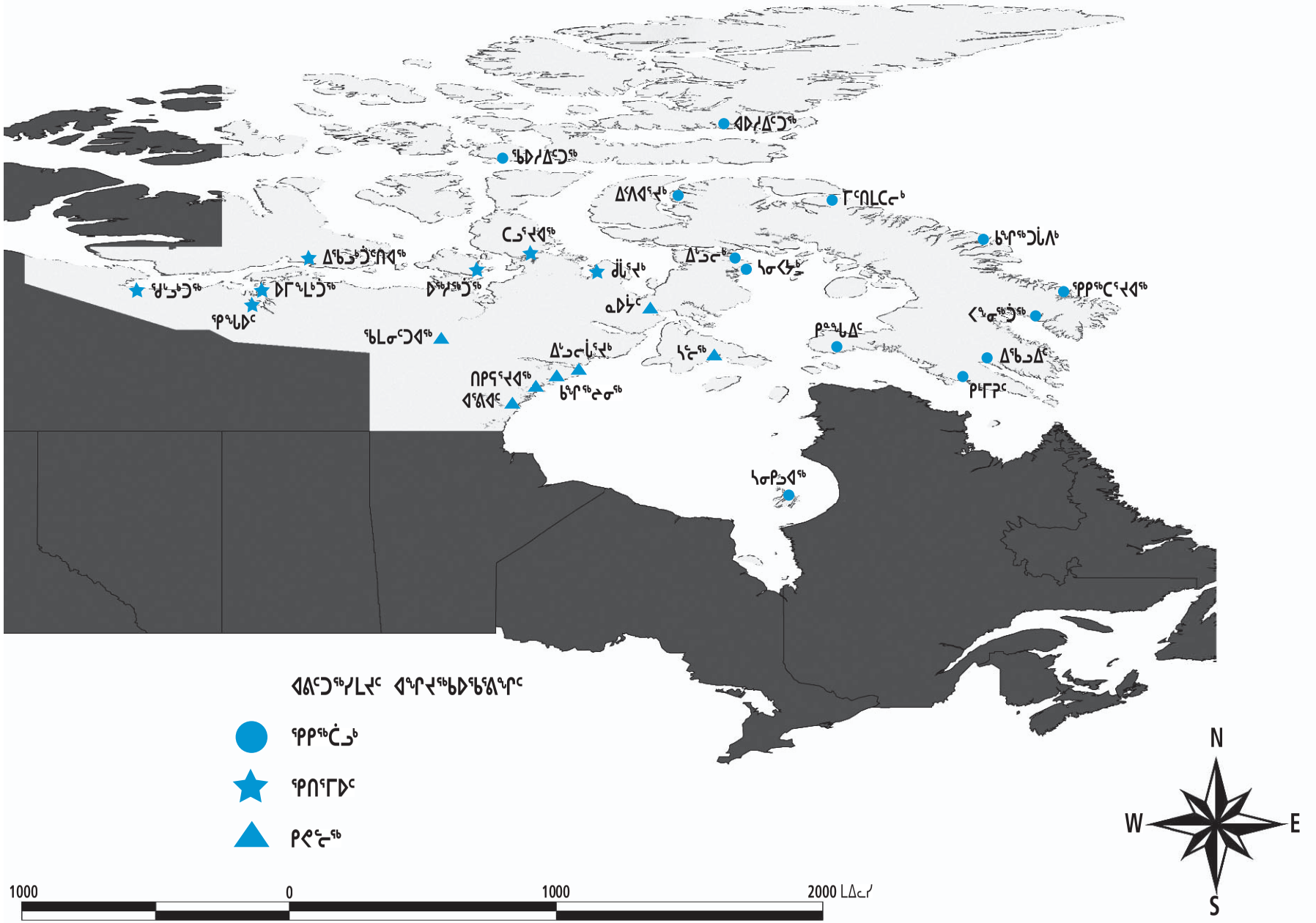
ᐊᖏᔪᒥᒃᑎᓕᕐᓂᑦ ᐅᓂᒃᑲᓕᐅᕙᒃᓴᖅᓯᓂᖅᓂᑦ ᐊᔨᓴᓕᓂᐊᕆᓚᐅᓕᕐᓂᖅᓂᒃ ᐊᓯᔾᔨᓴᖅᓂᖅᓂᓐᓂᑦ ᐊᒪᒪ ᐊᑲᐅᖅᓴᓕᐅᕙᒃᓴᖅᓂᒃ ᐃᓕᓴᕐᓂᐊᕆᓚᐅᓕᕐᓂᖅ ᐱᓕᕐᓂᐊᕆᓚᐅᓕᕐᓂᖅ. ᓄᓇᕗᑦᓂ ᐅᓂᒃᑲᓕᐅᕙᒃᓴᓕᐅᕙᒃᓴᖅᓂᒃ ᓇᐃᓇᖅᑐᓕᐅᕙᒃᓴᖅᓂᒃ ᐅᐱᒪᓂ ᐱᖓᓱᓕᓂᖅᓂᒃ ᐅᓪᓗᕈᓘᔪᒃᑯᑦ ᐱᓕᕐᓂᐊᕆᓚᐅᓕᕐᓂᖅᓂᒃ ᐊᒪᓂᖅᓯᒪᔪᓂᒃ ᐊᑐᐊᓕᕐᓂᖅᓂᒃ 2001ᒥ. ᐅᓂᒃᑲᑦ ᐊᑦᑐᖏᑦ ᑐᓂᔨᐅᓕᕐᓂᖅᓂᒃ ᐊᖏᔪᒥᒃᑎᓕᕐᓂᖅᓂᒃ ᐊᓯᔾᔨᓴᖅᓂᖅᓂᓐᓂᑦ ᐊᑐᐊᓕᕐᓂᖅᓂᒃ ᐱᓕᕐᓂᐊᕆᓚᐅᓕᕐᓂᖅᓂᒃ

3. ᐱᓕᕆᔨᒋᑎᒃᑲᒪᔨᑦ ᐊᑐᓕᖅᑎᑕᐅᓂᖏᓐᓄᑦ

ᒪᓕᒋᐊᓂᑦ ᖃᐅᔨᓴᓂᖓᓪᓗ ᓇᓗᓇᐃᓕᓴᕐᓂᐊᕐᓗᒍ ᐅᓂᓇᖅ ᖃᐅᔨᓴᐅᑎᖃᖅᓂᖓᓪᓗᑎᑦ, ᐱᓕᕆᔨᒋᑎᓴᖅᑐᒍᓐᓇᑦ, ᐳᓚᒪᓂᕐᓴᖅᓯᓐᓇᑦ ᐊᒪᒪ ᐅᓂᒃᑲᓕᑕᕐᓂᖓᓪᓗᑎᑦ:

> “ᖃᐅᔨᓴᓂᖅ ᐱᓕᕆᔨᒋᐊᓂᕐᓂᖅ ᐊᑐᓪᓚᑦᑎᓯᒪᓂ ᐅᓪᓗᖓᓂᒃᑯᑦ ᑎᑎᖅᑯᑉᐱᒍᒪᔪᑦ ᐊᑎᖓᔪᓂᒃᑯᑦᑐᓂ ᖃᐅᔨᒪᑦ ᐅᒪᔨᖅᑕᐅᓂᒃᑯᑦᑐᓂᒻᒪᓂᓂᒃ. ᐊᑎᖓᔪᓂᒃᑯᑦᑐᓂ ᐅᓪᓗᖓᓂᒃᑯᑦ ᐅᓪᓗᖓᓂᒃᑯᑦᑐᓂᒻᒪᓂᓂᒃ ᐊᑎᖓᔪᓂᒃᑯᑦᑐᓂ ᐊᑐᓂᓯᒪᓂᒃ ᐅᓪᓗᖓᓂᒃᑯᑦᑐᓂᒻᒪᓂᓂᒃ ᐊᑎᖓᔪᓂᒃᑯᑦᑐᓂ ᐊᑐᓂᓯᒪᓂᒃ ᐅᒪᔨᖅᑕᐅ

ᑕᒪᔭᕐᓂᓂ 2: ᓄᓇᕗᒻᒥ ᓄᓇᑕᑎᑎᔨᓪᓗ ᐃᓚᐋᓂ: ᐊᐃᑉᑐᖅᓯᒪᔪᖏᑦ ᓄᓇᓕᖏᓐᓂ


ᐊᐃᑉᑐᖅᓯᒪᔪᑦ ᐊᖏᔪᔪᖅᑲᐅᖅᑎᖏᓐᓂ
ᖃᑉᓗᒃᑖᖅ
ᖃᑎᖅᑕᐅᓂ
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1000
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ᐊᐅᓚᖅᑎᑦ
ᑲᓇᑕᒥ
ᓴᓇᓕᒃ
ᐱᖓᓱᓕᒃ
ᐃᓚᖅᑎᑦ
ᑐᓴᕐᓗᒃ
ᐃᓕᓴᕐᓂᖅ
ᐊᑐᖅᑕᐅᓯᒪᔪᖅ
ᐃᓚᖅᑎᑦ
ᐊᑐᖅᑕᐅᓯᒪᔪᖅ
ᐃᓚᖅᑎᑦ
ᐃᓚᖅᑎᑦ
ᐃᓚᖅᑎᑦ

ᓇᓕᖅᑲᖅ 1: ᓄᓇᕗᑦ ᐃᓄᒃᑎᑐᑎᒍᖏᑦ

ᓄᓇᓕ	ᐃᓄᐃᑦ ᐃᓄᒃᑎᖅᑎᕆᔨᑦ*	
ᖃᐅᔨᒪᔭᒃ		
	ᐃᓕᓴᕐᔪᒃ	627
	ᑭᖑᓪᓗᐃᑦ	1,130
	ᖁᕕᖅᑐᒍᓱᓕᒃ	737
	ᐊᐅᔾᔨᐃᑦᑐᖅ	145
	ᓴᓂᕆᒃ	585
	ᐃᒡᓗᓂᒃ	1,246
	ᐃᖅᑲᓇᐃᑦ	2,956
	ᑭᒡᒥᕈᑦ	408
	ᓇᓂᔨᐃᒃ	23
	ᕿᖑᓂᖅᑐᒍᖅ	1,354
	ᒥᑎᑎᒪᑕᓂᒃ	1,240
	ᖃᕆᕕᑕᕐᔪᐊᖅ	508
	ᖃᐅᔨᐃᑦᑐᖅ	174
	ᓴᓂᑭᓗᐊᖅ	631
ᖃᑎᖅᑎᐅᑦ		
	ᖃᑭᖑᓪᓕᐅᑦ	16
	ᐃᖅᑲᓇᑐᑕᕐᔪᐊᖅ	1,110
	ᐅᓴᔨᖅᑐᒍᖅ	920
	ᔪᒻᖅᓴᒃ	549
	ᖃᔨᓇᓇᑐᒍᖅ	1,210
	ᑕᓕᕐᔪᐊᖅ	714
	ᐅᒥᖑᓚᓇᑐᒍᖅ	47
ᑭᓪᓕᖅ		
	ᐊᖃᐊᑦ	1,568
	ᖃᓚᓂᑐᐊᖅ	1,349
	ᐃᒡᓗᓂᒻᓴᒃ	335
	ᓴᓐᓂᖅ	775
	ᖁᕕᖅᑐᓄᖅ	1,730
	ᓇᐅᔭᑦ	567
	ᑎᑭᕐᕕᐊᖅ	293
ᓄᓇᕗᒻᒥᐅᑦ ᖁᑎᑐᑦ		22,947

* ᐃᓄᒥᐊᓂᕐᑕ ᖃᕐᑎᐅᓂᕐᑦ 1999ᒧᑦ ᓴᖅᑭᑕᐅᓯᒪᔪᑦ ᑭᒥᑐᖅᓴᓄᑦ, ᓄᓇᒪᓂᓴᓄᒻᒧᑦ, ᓄᓇᕗᑦ ᓴᓇᒪᓚᑦ (2002).

3.2 ᑐᑭᓯᐅᑎᑎᑕᐅᔪᖅ ᐅᒪᔪᕐᓯᐊᓂᖅ

ᖃᐅᔨᓴᓂᖅ ᐃᓂᒋᒪᓂᖅᓴᐅᑎᖅ ᑎᑎᖅᑕᐅᑭᓐᓂᒋᐊᕐᓂᑦ ᐊᐃᔨᓂᒍᑦ ᖃᕐᓯᐅᑎᑎᓂᕐᓂᓐᓄᑦ, ᑎᒥᖅᓯᓂᑦ (ᒪᓂᕐᓂᔪ), ᐃᖅᓴᓄᐃᑦ, ᐊᒻᒪᓗ ᓴᐅᓂᒋᑦ ᐃᖅᖃᕐᑎᑕᐅᑦ, ᓂᑭᓴᓇᓄᐅᑭᑐᑦ. ᓂᔪᐊᑎᑦ ᓇᓕᓴᖅᑭᑦ ᐊᑐᓂ ᐊᐅᓪᓚᖅᓴᐅᑕᐅᓪᓗᑎᒃ ᐊᖅᑭᑦᑕᐅᓇᐅᖅᓴᓇᕐᓂ, ᑭᓯᐊᓂᕈᑦ ᐅᓂᒃᓴᓕᖅᓴᓇᕐᓂᒃ ᐱᒋᐊᖅᓯᒪᔪᓂᒃ ᐊᓯᖏᓐᓂᒃ ᑎᑎᖅᑕᐅᓇᐅᖅᓴᓇᕐᓂᒃ. ᓇᓕᖅᑲᓂᖅᓴᓇᕐᓂᑦ ᓂᔪᐊᑎᑦ ᓴᓇᑦ ᓇᓂᐃᑦ,[4] ᑐᑦᓚᓂᑦ, ᖃᓇᓗᓂᐃᑦ ᐊᒻᒪᓗ ᐊᐃᐃᓐᓇ, ᐅᓚᔨᖅᑕᐅᓯᒪᔪᖅ ᐃᓕᓴᖅ ᑎᑎᖅᑕᐅᓯᕐᓂᑦ ᐃᓕᓴᕐᓂᑦ ᐊᑐᓂᒍᓱᓕᔪᓄᑦ ᓂᐊᓚᑦᓴᓇᓕᖅᑎᑎᓄᑦ ᖃᐅᔨᓴᓂᖅᓴᐅᑎᖅ ᖃᐅᔨᓴᓂᖅᓴᓇᕐᓂᑦ ᓴᖅᑭᑕᐅᔪᓐᓇᕐᓂᑦ.

[4] ᐱᓕᕆᔨᑦ ᐊᓕᓴᐅᓚᐅᑦᑐᓂᑦ ᓇᓱᑦᓴᓇᓂᑦ ᑎᑎᖅᑕᐅᓯᒪᔪᓐᓇ ᓇᓄᐃᑦ ᒥᑦᓴᓂᖅᓴᐅᓚᑦᓴᐅᑦ, ᑕᐃᒪᐃᓚᐅᑦᓴᓇᖅᑎᑎᓄᑦᓯᓂᑦ ᖃᑎᖅᑕᐅᓂ ᑕᐃᒪᓕᕐᓂᓐ ᐅᑭᐅᖅᓴᒃ.

ᓇᓕᖅᑲᖅ 2: ᓂᕐᔪᐃᑦ ᐱᑎᖅᓯᒪᔪᑦ

ᐊᑎᓚᓗᐅᒪᔪᓐᓇᑦ			ᖃᐅᔨᓴᖅᑎᓄᑦ ᐊᑦᑎᖅᑕᐅᓯᖏᑦ	ᓄᐊᑕᐅᓴᒃᖢᖅᓇᑦ ᐊᓯᖏᑦ
ᐅᒪᔪᐸᐅᔨᐃᑦ	ᑐᓴᑦ	ᓄᓇᕗᒻᒥ ᑐᓴᐃᑦ	*Rangifer tarandus groenlandicus*	ᓇ, ᐊ, ᐅ
		ᖃᓄᓯᔪᑦ ᑐᑐᖏᑦ	*Rangifer tarandus pearyi*	ᓇ, ᐊ, ᐅ
		ᑐᓴᐳᐃᐃᑦ	*Rangifer tarandus tarandus*	ᓇ, ᐊ, ᐅ
		ᖁᑭᖅᑕᐃᑦ ᑐᓴᑐᖏᑦ	*Rangifer tarandus groenlandicus*	ᓇ, ᐊ, ᐅ
			Rangifer tarandus pearyi	
	ᐅᒥᖏᒪᐃᑦ		*Ovibos moschatus*	ᓇ, ᐊ
	ᑐᓴᕐᓴᖅ		*Alces alces*	
	ᓇᓄᖅ		*Ursus maritimus*	ᓇ, ᐊ
	ᐊᑲᑕᐃᑦ ᓇᐸᖅᑐᖃᖏᓕᒥᓕᑐᑦ		*Ursus acrtos*	
	ᐊᑲᑕᐃᑦ ᖁᓐᓂᖅᑐᑦ		*Ursus americanus*	
ᒥᖅᓄᓕᑦ	ᐊᒪᒋᑦ		*Canis lupus*	
	ᑎᓚᓴᓂᐊᑦ	ᖃᓄᖅᑎᑦᓗᒋᑦ	*Alopex lagopus*	
		ᖃᓄᖅᑎᖏᓪᓚᒋᑦ		
	ᑎᓚᓴᓂᐊᖅᐸᐃᑦ	ᐊᐅᐸᖅᑐᑦ	*Vulpes vulpes*	
		ᖁᓐᓇᖏᓱᑦ		
		ᐊᓄᓕᓵᒋᑐᑦ		
		ᖁᕐᓂᖅᑐ		
	ᐊᐃᓐᖏᓴᕐᔪᐊᑦ		*Ondatra zibethicus*	
	ᖃᓄᐃᓕᑦ		*Gulo gulo*	
	ᐱᖅᑐᖅᓯᕐᖅ		*Lynx canadensis*	
ᓂᕐᔪᐊᑎᑦ ᒥᑭᓂᖅᓴᑦ	ᐅᖃᓕᑦ		*Lepus arcticus*	
	ᓯᓴᓯᖃ		*Spermophilus parryii*	
ᐳᐃᓕᑦ	ᓯᖅᓄᓄᓕᑦ	ᓇᑦᑎᑦ	*Pusa hispida*	
		ᐅᓴᔪᑦ	*Erignathus barbatus*	
		ᖃᐃᑭᓕᑦ	*Pagophilus groenlandicus*	
		ᖃᓄᕈᐊᑦ	*Phoca vitulina*	
		ᓇᑦᓯᓪᓕᐃᑦ	*Cystophora cristata*	
	ᐊᐃᐃᓴᑦ		*Odobenus rosmarus*	ᓇ, ᐊ
	ᓴᖅᐱᓕᑦ	ᐊᑦᓯᐊᔭᐊᑦ	*Monodon monoceros*	ᓇ, ᐊ
		ᖁᓭᓗᓴᐃᑦ	*Delphinapterus leucas*	ᓇ, ᐊ
		ᐊᖁᓴᑦ	*Balaena mysticetus*	

ᐊᑎᓇᓴᐅᓚᓵᑐᑦ			ᖃᐅᔨᓴᖅᑎᓄᑦ ᐊᑦᑎᖅᑕᐅᓯᖏᑦ	ᓄᐊᑕᐅᐸᖃᓂᖅᑐᑦ ᐊᓯᖏᑦ
ᐃᓚᒋᑕᐅᑦ ᑎᒋᒥᐊᑦ	ᓄᓪᓗᑦ	ᖃᖓᐃᐃᑦ	*Chen caerulescens*	
		ᓄᓪᓗᑦ ᐅᓗᐊᔪᓪᓗᑦ	*Branta canadensis*	
		ᖁᖃᖅᓱᐃᐃᑦ	*Chen rossii*	
		ᓄᓪᓗᑦ	*Anser albifrons*	
	ᒥᑎᑦ	ᖃᖏᓗᓪᓗᑦ	*Somateria spectabilis*	ᓇ, ᐊ
		ᒥᑎᑦ	*Somateria mollissima*	ᓇ, ᐊ
		ᐊᖏᐊᖅᓱᐃᐃᑦ	*Clangula hyemalis*	
		ᖁᔭᒪᐊᓘᔪᑦ	*Anas acuta*	
		ᒥᑎᓯᑦ	*Anas platyrhynchos*	
	ᖁᔨᓱᐃᐃᑦ		*Cygnus columbianus*	
	ᕿᐃᑦ		*Mergus merganser*ᑭ	
	ᖃᐅᓂᖏᓐᓇᑦ		*Mergus serrator*	
	ᐊᖏᕐᓂᖏᓐᓇᑦ ᒥᑎᑦ ᐊᐃᑦᕿᖏᑦ		*Aythya marila*	
	ᒥᑭᓂᖏᓐᓇᑦ ᒥᑎᑦ ᐊᐃᑦᕿᖏᑦ		*Aythya affinis*	
	ᐱᓕᕆᔨᖏᓐᓇᑦ		*Melanitta nigra*	
	ᖁᔪᖏᑕᓐᓄ ᐃᓚᒋᐊ ᐱᓕᕆᔨᖏᓐᓇᑦ		*Melanitta fusca*	
	ᓯᓚᑐᖏᑐᒥ ᐱᓕᕆᔨᖏᓐᓇᑦ		*Melanitta perspicillata*	
ᐊᓯᖏᑦ ᑎᒋᒥᐊᑦ	ᑐᑦᓪᓗᑦ	ᑐᑦᓪᓗᑦ	*Gavia immer*	
		ᖃᑎᓪᓗᑦ	*Gavia arctica*	
		ᖁᖏᓘᕆᑦ	*Gavia stellata*	
		ᑐᑎᓕᐅᖅᑐᑦ	*Gavia adamsii*	
	ᐱᓕᕆᔨᑦ		*Cepphus grylle*	
	ᐊᑦᕿᐃᑦ		*Uria lomvia*	
	ᐊᖏᕐᕋᑦ		*Lagopus lagopus*	
			Lagopus mutus	
	ᑕᑎᓚᖅᓱᐃᐃᑦ		*Grus canadensis*	
	ᐅᔪᓘᔨᓱᐃᐃᑦ		*Nyctea scandiaca*	
ᓚᐅᓂᑦ	ᓄᓪᓗᑦ ᓚᐅᖏᑦ	ᖃᖓᐃᐃ ᓚᐅᖏᑦ		
		ᓄᓪᓗᑦ ᐅᓗᐊᔪᓪᓗᑦ ᓚᐅᖏᑦ		
		ᖁᖃᖅᓱᐃᐃᑦ ᓚᐅᖏᑦ		
		ᓇᓕᓴᓇᐃᑦ ᓚᐅᖏᑦ		
		ᓄᓪᓗᑦ ᓚᐅᖏᑦ		
	ᒥᑎᑦ ᓚᐅᖏᑦ	ᖏᖓᐃᓪᓗᑦ ᓚᐅᖏᑦ		ᓇ
		ᒥᑎᑦ ᓚᐅᖏᑦ		ᓇ
	ᖁᔨᓱᐃᐃᑦ ᓚᐅᖏᑦ			
	ᐃᒥᖓᔪᑕᐃᓕᐃᑦ ᓚᐅᖏᑦ			
	ᓇᐅᔭᐃᑦ ᓚᐅᖏᑦ			
	ᐊᖏᕐᕋᑦ ᓚᐅᖏᑦ			
	ᐱᓕᕆᔨᑦ ᓚᐅᖏᑦ			
ᖁᓂᑭᐃᑦ	ᒥᑎᑦ ᖁᓂᑭᖏᑦ			ᓇ

ᐊᑎᓚᓗᐃᓚᓂᔪᒃᑐᑦ		ᖃᐅᔨᓴᖅᑎᓄᑦ ᐊᑎᖅᑕᐅᓯᖏᑦ	ᓄᓇᑕᐅᓂᖃᖅᑐᑦ ᐊᓯᖏᑦ
	ᐃᖃᓗᐃᑦ ᑎᓯᓴᖅᑐᑦ	*Salvelinus alpinus* anadromous	ᓇ
	ᐃᖃᓗᐃᑦ ᑎᓯᓴᐃᑦᑐᑦ	*Salvelinus alpinus* non-anadromous	
	ᐃᓯᔪᖅᐃᑦ	*Salvelinus namaycush*	ᓇ
	ᓯᓚᔪᓂᑦ	*Esox lucius*	
	ᓴᓄᕐᕉᒪᐃᑦ	*Thymallus arcticus*	
	ᑲᐃᕐᓂᑦ	*Coregonus clupeaformis*	
	ᑎᑭᒋᓂᑦ	*Lota lota*	
	ᐅᑭᐅᑦᑕᑐᒥ ᑲᐃᕐᓂᑦ	*Coregonus autumnalis*	
	ᒥᑭᓂᖅ ᑲᐃᕐᓂᑦ	*Coregonus sardinella*	
	ᑲᐃᕐᓂᖅᑕᐃᑦ	*Stenodus leucichthys*	
	ᐃᓚᐃᑦ	*Gadus ogac* *Boreogadus saida* *Gadus morhua*	
	ᑲᓇᐋᐃᑦ	*Myoxocephalus spp.*	
	ᖃᓄᖅᓂᑦ	*Reinhardtius hippoglossoides*	
	ᐊᓗᒍᒪᓕᐊᑦ	*Mya spp.*	
	ᐅᐃᓗᐃᑦ	*Mytilus edulis*	

(American Ornithologists' Union, 1998; Jones et al., 1997; McClane, 1978) ᓇ = ᓇᒥ ᐃᓕᓴᖅᑕᐅᔪᒥᓂᖅ; ᐊ = ᐊᖏᓪᓗ ᐊᖑᓚᑦᓗ; ᐅ = ᐅᑭᐅᖓ ᐃᓕᓴᑦ

ᓂᕆᔨᑎᑦ ᓇᓗᓇᐃᒪᓐᓂᑦ ᓇᓕᐹᓐᓂᑉᑕᕆᓚᐅᖅᑐᑦ ᖃᐃᐅᓂᓕᒥᓂᑦ, ᑎᓕᒥᐃᓂᕐᒥᓂᑦ, ᐊᓕᒪ ᐸᐱᓕᓂᓕᒥᓂᑦ. ᐱᖓᓱᐊᕈᑎᓐᓂᑦᑐᑦ ᐃᓕᒥᑲᔪᖓᓕᖅᑐᑦ ᑐᑦᑐᐃᑦᑦ, ᐊᓕᒪᓗ ᑕᒪᐃᓂᓕᕆᓚᑦᑐᒥᑲ ᓇᓗᓇᐃᒪᓕᕆᖓᖅᑐᑦ ᐊᖏᕐᕋᑦ, ᐅᐃᓗᐃᑦ, ᑲᓇᐋᐃᑦ ᐊᓕᒪᓗ ᓴᐅᓂᓕᑦ ᐃᖅᑲᖏᒥᑕᑦ. ᐃᓕᓐᓂᔪᒃᑯᑦ ᓂᕆᔨᑎᑦ ᑎᑎᖅᑭᒪᔾᔪᓂᖅᓂᑦᑐᑦ ᐊᑦᓚᑕᐅᓕᕆᓂᖅᑐᑦ. ᑕᒪᐃᔪᐊ ᐊᑦᓚᑕᖅᑭᒪᐅᓕᕆᓂᖅᑐᑦ ᓂᕆᔨᑎᖅᑕᐅᓂᕐᒧᑦᓯᓂᒥᓂᑦ ᐊᓕᒪᓗ ᐅᖅᑲᐅᔪᓐᓇᑎᑦ ᐅᖅᑲᐅᓂᓴᒪᓂᑦ ᐃᖅᑲᖏᒥᑕᑦ ᐊᑦᓚᑕᐅᓕᕆᓂᖅᑐᑦ. ᐅᓪᓗᐊᓂᒃ ᓇᓂᐅᐃᖅᑐᒪᑦ ᐱᓴᖅᑕᐅᓕᕆᓂᖅᑐᑦ ᐊᑦᓚᑕᐅᔪᒪᔪᓂ. ᓇᓕᖅᑲᐃᑦ ᑕᒪᐃᔪᐊ ᐊᓂᐅᐃᖅᑐᒪᑦ ᐱᓴᖅᑕᐅᓕᕆᓂᖅᑐᑦ ᐊᑦᓚᑕᐅᔪᒪᔪᓂ. ᓇᓕᖅᑲᐃᑦ ᑭᒥᑦᕈᓴᐅᔾᔨᓂᖅᓯᒪᓂᖅ ᐊᑦᓚᑕᐅᔪᒪᔪᓂ ᓇᓕᖅᑲᒥ 3.

ᓇᓕᖅᑲᖅ 3: ᐊᔪᖏᑦ ᓂᕆᔨᑎᑦ ᐅᖅᑲᐅᔪᐅᔪᒪᑦ ᖃᐅᔨᓴᓂᖅᖃᖅᑎᑦᓗᔪᑐ

ᓄᓇᓕᑦ	ᓂᕆᔨᑎᑦ	ᐅᑭᐅᒥ	ᖃᖏᔪᑦ ᐅᒪᓴᖅᑕᐅᔪᑦ
ᖃᓄᖅᓱᒪᐅᑦ	Herring	2	16
		3	2
		5	3
	Flounder	2	151
		3	1
ᐅᒥᖅᓱᒋᔭᖅ	Capelin	2	732
ᓴᓂᑭᔭᐊᖅ	ᐃᐃᓴᖅ	1	1
		2	4
ᒥᑎᒪᒐᓂᒃ	ᑎᓚᐊᖅ	5	1

[5] ᑐᓴᖏᑕᐅᓕᕆᑦᑐᑦ ᐃᖅᓯᓂᖃᓕᐅᑎᓕᒪᔪᑦ ᓂᕆᔨᑎᑎᑦ ᓇᓪᓂᓂ ᓇᓕᖅᑲᓂᑐᓂ.

ᐅᓴᓕᖅᑕᐅᓂᕆᖅᑕᐅᕈᓪᓕᐅᖅᑐᑦ ᐅᒪᓕᑦ ᑐᔾᔨᑕᐅᓕᑦ ᐊᖏᓪᓗᐅᓕᒫᑦ. ᑕᒪᓐᓇ ᒪᓂᒋᑐᓂᖅᑐᑦᑐᒥᒃ "ᐅᒪᔪᖅᑕᓄᑦ" ᓄᓇᕈᑎᓂ, ᐊᓕᒪᓗ ᐃᓗᐊᓂᖃᓯᒪᔪᑦ ᐊᑐᖅᑕᐅᓕᕆᓂᖅᑐᒥᒃ ᖃᐅᔨᓴᓂᒥᑦ. ᐊᖏᐅᖅᑐᑐᐃᓐᓇᑦ ᑲᑎᒪᔨᖏᓪᓗᑎᑦ ᐃᓯᒪᓂᐅᓕᕆᓂᖅᑐᑦ ᓴᓇᔨᓴᒪᓕᒃᑯᑦ ᓄᓇᕗᒻᒥᐅᑦ ᐊᑐᖅᑕᐅᓕᕆᓂᖅᑐᑦ (ᓄᓇᕗᑦ ᐅᒪᔪᖅᑕᓄᑦ ᐊᑐᖅᑕᐅᓕᕆᓂᖅᑐᑦ, ᐅᕐᓂᓪ ᑐᔾᔨᑕᐅᓕᕆᓂᖅᑐᑦ (ᓄᓇᕗᒻᒥ ᐅᒪᔪᓂᓯᔪᒪᓂᖅ, 1995ᐱ).

ᐅᒪᔪᖅᑕᐅᓕᕆᓂᖅ ᖃᓄᖅᓱᒪᐅᑦ ᑎᑎᖅᑭᒪᔨᓯᓂᐅᔪᓐᓇᖅᑎᑦᓯᓂᑦ ᖃᓄᖅᓱᒪᐅᑦ ᐊᖏᓪᓗᐅᓕᕆᓂᖅᑐᑦ ᒪᓂᒋᑐᓂᑦ, ᒥᑎᑦ ᖃᓄᐅᖅᑐᑦ ᒪᓂᔪᓂᑦᑐᑦ ᐃᓕᓐᓂᖅᑐᑦ ᖃᓄᖅᓱᒪᐅᑦ ᐱᓕᕆᔨᒪᔪᑦ ᐊᑐᖅᑕᐅᓕᕆᓂᖅᑐᑦ ᐃᓕᓐᓂᖅᑐᑦ ᐊᑦᓚᑕᐅᓕᕆᓂᖅᑐᑦ ᖃᓄᖅᓱᒪᐅᑦ ᐃᓕᓐᓂᖅᑐᑦ ᐊᑦᓚᑕᐅᓕᕆᓂᖅᑐᑦ ᐊᑐᖅᑕᐅᓕᕆᓂᖅᑐ

*"ᐱᓕᕆᔨᑕᐅᓴᕆᔨᑕᓐᓄᑦ" ᑕᐃᒪᐃᓐᓂᖅᐳᑎᑦ ᐊᖏᔪᓯᕐᒥᔨᓪ ᓄᓇᕗᓂ ᑭᓴᓐ ᑕᐅᖅᓯᒪᔭᕐᑎᑦᑐᓂᖅᐳᑎᑦ ᓄᓇᓕᓪ. ᐃᓕᓴᐅᑎᖅᑕᐅᔪᓐᓇᖅᑐᑎᓪᓗᒍᖅ ᑭᓯᐊᓂ "ᐱᖁᑦᓯᕆᔨᑕᖏᓐᓄᓂᓐᓇ" ᐅᒪᔨᖅᑕᐅᔨᒪᓂᖅ ᓄᕆᑕᐅᑎᖅᑕᐅᔨᓯᓪᓚᑦ ᓂᐅᑦᑎᐅᓂᕆᔨᓗᒃ ᓄᓇᓕᓪ ᓯᓚᑦᓂᓪ." (ᓄᓇᕗᑦ ᐅᒪᔨᓴᓇᕐᔪᐊᖅᓱᑦ, 1995ᐱ: 2)

ᐊᐅᑭᓴᐅᓇᖅᑐᓂᑐᑦᓯᓚᐅᖅᑐᖅ ᒥᖅᓱᓪᓂ ᐅᒪᔨᖅᑕᐅᓕᖅᑐᑦ ᐱᖅᓯᐅᑎᐅᓇᖅᑭᖅᑕᕐᓂᐊᕐᓕᕆᓪᓚᒪᑦ. ᐱᓇᕐᓂᖅᓱᑦ, ᐊᑐᓂ ᐊᐃᑦᑐᖅᓯᓯᒪᔨᐃᑦ ᐊᐅᑭᐅᖅᑐᖅᑐᑦᓂᓗᓂ ᐱᓕᓴᐅᓯᖅᓱᒪᓕᐅᖅᑐᖅᑐᓂ ᐊᑐᓂᖅᑎᓇᓯᓐᓂᒃᑯᑦ. ᖃᐅᖅᑕᒪᓂᖅᒥ ᑭᓛᓕᕐᓂᓪ ᓯᓚᑦᓂᓪ ᐅᓇᓯᓂᓪᓕᕆᔨᑕᖅᑐᑦᓂ ᐅᒪᔨᖅᑕᐅᔨᓕᕆᓂᖅᓄᑦ ᓂᐅᑦᑎᐅᓂᕆᔨᐅᓂᖅᓄᑦ ᐊᑐᓂᖅᑎᓇᓯᓐᓂᒃᑯᑦ ᑭᓛᓕᕐᓂᓪ ᑭᓯᐊᓂ ᐅᖃᓕᒫᓂ ᐊᐃᑦᑐᖅᓯᓯᒪᔨᐃᑦ. ᐱᓇᕐᓂᓪ ᑭᓯᐊᓂ ᐅᖃᓕᒫᓂ ᐊᐃᑦᑐᖅᓯᓯᒪᔨᐃᑦ ᐊᑐᓂᖅᑎᓇᓯᓐᓂᒃᑯᑦ ᐱᓇᕐᓂᖅᓱᑦ

ᐃᓄᖅᑎᑦ ᐊᖏᓚᓯᑎᑦ ᐊᖏᓚᓯᓗᓇᐃᑎᒃ ᑐᓂᐃᔨᓄᖅᓴᖅ ᑕᐃᒪᐃᑦᓴᐃᖅᓯᓚᐃᖅᑎᑦ. ᕿᒥᖅᑭᐃᓇᐃᖅᓴᖅ ᖃᐅᔨᓴᕿᑎᒋᓂᑦ ᓄᓇᓕ ᐅᒪᔨᓄᖅᓴᖅᑎᑦ ᐅᒪᔨᓄᓇᖅᑐᑦ ᐊᑐᐃᓐᖏᓐᓂᖅᑎᓯᓚᐃᖅᑎᑦ ᒥᑎᓯᖏᓐᓄᑦ ᖃᑦᑭ ᐊᖏᓚᓯᑎᑦ ᐊᖏᓚᓯᓗᓇᐃᑎᓂᑦ ᑐᓂᐃᔨᓄᖅᓴᖅᓴᖅᑎᑦ. ᖃᑦᑭᐅᓂᖅᑎᑦ ᑕᔪᕆᐃᑎᑕᐅᔪᓂ ᓇᓕᓕᒥᓂ 10 ᐊᖏᓚᓕ ᐅᖃᐅᔨᓯᓚᐃᖅᓯᓚᐃᖅᑐᑎᑦ 6 ᓇᓕᓕᒥᓂ ᐊᖏᓚᓯᓗᓇᐃᑎᒃ ᐃᓕᐅᑎᑦ ᑭᓚᓕᕆᔨᖏᓐᓄᑦ ᐃᓕᓴᐅᔪᓂᒃᑯᑦ ᐊᖏᓚᓯᓗᓇᐃᑎᓂᑦ ᐊᖏᓚᓯᓗᓇᐃᑎᒃ ᐃᓕᐅᑎᑦ 5.2.1.

3.4 ᐊᖏᓚᓯᑎᐅᑉ ᐊᑎᓕᐅᖅᑕᐅᔪᓐᓇᖅ

ᖃᐅᔨᓴᖅᑐᐃᓪᓗ ᐱᔨᐅᓚᓯᑎᑐᐃᓐᓇᓕᐅᕕᖏᓂᑦ ᐃᓄᐃᑦ ᐃᓄᖓᑕᐅᔪᓚᒥᑦ, ᑭᔪᐊᓂ ᐊᐅᑦᑎᓐᓄᑦᓯᓂᑦ ᐃᓄᐃᑦ ᐊᖏᓚᓯᑎᑎᐅᓂᖅᑕᐅᓂᕐᒥᑦ (ᐃᓴᔨᑎᓂ 3.3). ᑕᒪᓐᓇ ᓴᖅᑭᐅᔪᒍᑎᓕᕆᔨᖅᑐᒃ "ᐊᑎᓕᐅᖅᑕᐃᓐᓇᐊᑕᒥᖅ" ᐊᖏᓚᓯᑎᑎᐅᔪᓚᒦᓂ ᓇᓗᓇᐃᖅᑕᐅᓂᕐᒥᔪᑦ ᐃᓄᓕᓴᓚᑎᑎᐅᓂᐊᕐᓗᓐᓂᑎᑦ ᖃᐅᔨᓴᖅᑎᑎᐅᑭᑦᓯᓄᑦ ᖃᐅᔨᓴᖅᑎᑦ. ᑕᒪᓐᓇ ᐱᖓᓱᓕᕆᓂᑕᐅᓚᐃᖅᑎᓯᓚᐃᖅᑐᑦ ᐱᓕᕆᔨᓄᖅᑐᑦ ᐅᔾᔨᒋᑦ ᓇᓕᓕᒥᓂ ᐃᓕᓴᐅᔪᓂᒃᑯᑦ ᐱᓕᕆᔨᓄᖅᑐᑦ ᐊᑐᐃᓐᖏᓐᓂᖅᑎᓯᓚᐃᖅᑐᑦ ᐊᑐᐃᓐᖏᓐᓂᖅᑎᓯᓚᐃᖅᑐᑦ ᐊᖏᓚᓯᑎᑎᐅᓂᖅᑕᐅᓂᕐᒥᑦ ᐃᓄᐃᑦ ᐊᖏᓚᓯᑎᑎᐅᓂᖅᑕᐅᓂᕐᒥᑦ ᐃᓄᐃᑦ ᐊᖏᓚᓯᑎᑎᐅᓂᖅᑕᐅᓂᕐᒥᑦ ᐊᖏᓚᓯᑎᑎᐅᓂᖅᑕᐅᓂᕐᒥᑦ ᐃᓄᐃ

ᓇᓕᖅᑲᖅ 5: ᐱᖅᓯᓯᐅᑉᑐᑎᖅ ᐊᖏᓚᓯᓴᐃᑦ ᐊᑎᓕᐅᖅᑕᐅᑎᓪᓗᑎᑦ, ᓄᓇᕗᒻᒥᔪᑦ

ᓄᓇᓕᑦ		ᐊᖏᓚᓯᑎᒥᐅᑦ ᐊᑎᓕᐅᓴᕐᓯᐅᔪᖅ	ᑭᓇ ᐃᓯᒪᓕᐅᓇᓱᖅᓴᓐᖏᑦ ᑭᖑᓪᓕ ᐊᑎᓕᐅᖅᑐᑦᓴᐃᐅᓂᖏᓱᐅᑦ	ᑭᓇ ᓇᓗᓇᐃᖅᓯᕐᓇᐅᖅᓴᓐᖏᑦ ᐊᖏᓚᓯᑎᒥᐅᓂᖅᑕᓂᑦ
ᖃᓄᖅᑕᒃᓴᑦ	ᐃᓕᐊᐊᖅᓴᑦ ᐊᒻᒪ ᓇᓂᓯᐃᑦ	ᐃᓇᒥᖅᐅᔪᓂᑦ (ᐃᓕᐊᐊᖅᓴᑦ), ᓴᓇᖅᑐᑎᑦ (ᓇᓂᓯᐃᖅᑎᒥ)	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑎ ᐃᓇᒥᓗᔪ ᐊᖏᓚᓯᖅᑎᑦ
	ᑭᓇᖏᐃᑦ	ᐃᓇᒥᖅᐅᓴᐊᑎᓂᓐᓂᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑎ ᐃᓇᒥᓗᔪ ᐃᑭᓯᐅᑦᑕᖅ ᐊᖏᓚᓯᓂᑕᓚᓐᓄᑦ ᐊᖏᓚᓯᖅᑎᑦᓴ ᐃᓇᖅᑭᓐᓂ
	ᑲᖏᖅᑐᐃᓚᐱᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑎ ᐃᓇᒥᓗᔪ ᐊᖏᓚᓯᖅᑎᑦ
	ᐊᐅᓯᐃᑦᑐᖅ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑎ ᐃᓇᒥᓗᔪ ᐊᖏᓚᓯᖅᑎᑦ ᐃᓇᖅᑭᓐᓂ
	ᓴᓂᕆᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑎ ᐃᓇᒥᓗᔪ ᐊᖏᓚᓯᖅᑎᑦ ᐃᓇᖅᑭᓐᓂ
	ᐃᖏᓇᐃᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑎ ᐃᓇᒥᓗᔪ ᐊᖏᓚᓯᖅᑎᑦ ᐃᓇᖅᑭᓐᓂ
	ᐃᖃᓗᐃᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑎ ᐃᓇᒥᓗᔪ ᐊᖏᓚᓯᖅᑎᑦ ᐃᓇᖅᑭᓐᓂ
	ᑭᓚᐅᒃ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑎ ᐃᓇᒥᓗᔪ ᐊᖏᓚᓯᖅᑎᑦ ᐃᓇᖅᑭᓐᓂ
	ᑲᓇᖅᑐᖓᓄᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑎ ᐃᓇᒥᓗᔪ ᐊᖏᓚᓯᖅᑎᑦ
	ᓴᐅᓯᐃᑦᑐᖅ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑎ ᐃᓇᒥᓗᔪ ᐊᖏᓚᓯᖅᑎᑦ
	ᓴᓂᒧᓇᐊᖅ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑎ	ᓴᓇᖅᑎ ᐃᓇᒥᓗᔪ ᐊᖏᓚᓯᖅᑎᑦ ᐃᓇᖅᑭᓐᓂ
	ᒥᑎᑐᒪᑕᓂᒃ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑎ	ᓴᓇᖅᑎ ᐃᓇᒥᓗᔪ ᐊᖏᓚᓯᖅᑎᑦ
	ᓴᓂᒧᓇᐊᖅᓴᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑎ	ᓴᓇᖅᑎ ᐃᓇᒥᓗᔪ ᐊᖏᓚᓯᖅᑎᑦ
	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑎ	ᓴᓇᖅᑎ ᐃᓇᒥᓗᔪ ᐊᖏᓚᓯᖅᑎᑦ
	ᓴᓇᓕᓚᐅᖅᓴᑦ	ᓴᓇᖅᑐᑎᑦ	ᓴᓇᖅᑎ	ᓴᓇᖅᑎ ᐃᓇᒥᓗᔪ ᐊᖏᓚᓯᖅᑎᑦ
	ᓴᓇᖅᑐᑎ

ᓇᓕᖅᑲᖅ 6: ᑲᑎᒪᔨᑦ ᐊᖏᓚᓯᕐᓂᑦ ᐊᑎᓕᐅᖅᑕᐅᓯᒪᔪᑦ ᓄᓇᓕᒥᑎᒍᑦ, ᐅᑭᐅᒥᓪᓗ

ᓄᓇᓖᑦ		ᐅᑭᐅᖅ 1	ᐅᑭᐅᖅ 2	ᐅᑭᐅᖅ 3	ᐅᑭᐅᖅ 4	ᐅᑭᐅᖅ 5	ᑲᑎᒪᔨᑦ
ᖃᑭᖅᓴᒃ	ᐃᓱᒪᒋᔭᐅᒃ ᐊᓪᒪ ᓇᓂᓴᒃ	267	254	250	245	257	310
	ᑭᓇᓐᓄᑦ	n/d	504	481	472	423	510
	ᖃᖅᑳᖅᑐᒍᓐᓇᒃ	198	213	214	223	218	245
	ᐊᐅᓚᐱᑦᑐᖅ	40	43	55	61	58	73
	ᓴᓂᕆᒃ	137	147	146	142	165	181
	ᐃᓐᓇᓂᒃ	212	233	246	259	273	307
	ᐃᖅᑲᓇᐃᑦ	n/d	350	400	406	415	540
	ᑭᒪᒥᑦ	96	99	102	104	97	114
	ᕿᓐᓂᖅᑐᖅ	184	191	194	197	194	224
	ᒥᑎᑕᒪᓂᒃ	263	277	294	331	355	408
	ᖃᖅᑭᑦᕿᐊᖅ	114	116	124	163	157	192
	ᖃᐅᓚᐱᑦᑐᖅ	51	64	65	70	68	75
	ᓴᓂᑭᓗᖅ	133	155	159	166	171	181
ᖃᑎᖅᑎᐅᑦ	ᖃᓄᖅᓴᐅᑦ	18	17	17	18	17	21
	ᐃᖃᓗᓯᑦᕿᐊᖅ	332	347	338	347	332	391
	ᐅᖃᓕᖅᑐᖅ	344	347	337	344	338	368
	ᐆᒃᑎᕐᓂ	63	80	80	86	88	102
	ᖃᓕᓴᓗᖅ	276	273	266	269	263	294
	ᑕᔪᕐᐊᖅ	235	231	222	221	212	249
	ᐅᒥᖅᓴᑐᖅ	31	30	21	17	11	31
ᑭᓀᓂᖅ	ᐊᖃᐊᑦ	379	380	387	395	393	410
	ᖃᓚᓂᑕᐊᖅ	327	324	315	302	299	341
	ᐃᓐᓇᓕᒃᑎᕐᓂ	72	79	80	77	85	92
	ᓴᓐᓂᖅ	256	254	266	244	226	283
	ᖃᓄᖅᓄᓂᖅ	379	372	367	364	362	424
	ᓇᐅᑦᓴ	169	163	157	152	146	180
	ᑎᑭᕐᔪᐊᖅ	50	50	47	50	49	61
	ᓄᓇᕗᑦ	4578	5451	5468	5528	5529	6018

3.5 ᐊᓕᑐᖅᑕᐅᓂᑦ ᓇᓕᖅᑲᐃᑦ ᐊᖏᓂᐊᖅᑎᓂᒃ

ᖃᐅᔨᓴᓂᐅᑦ ᓴᓇᒪᓂᖏᓪᓗ ᐊᖏᓚᓯᓕᑎᓂᒃ ᓇᓕᖅᑲᐃᑦ ᐊᓕᑐᖅᓴᕐᓗᒍᓇᖅᑕᐅᖅᑕᐅᑐᑦ ᒥᑦᓴᐅᓯᓂᖅᓴᒥᒃ ᓵᓴᐃᓯᒪᓂᖅᓴᐅᑎᒍᓪᓚᑦ ᐅᒪᔪᖅᑕᐅᓕᕆᓂᑐᓂᒃ ᑕᒪᓐᓇᓐᓂᒃ ᐊᖏᓚᓯᓕᑎᓂᒃ ᐊᐱᕆᓂᖅᑕᐅᓕᕆᓂᑐᓂᒃ ᓇᓕᖅᑲᓵᓂᖏᑕᓂᒃ (ᖃᐅᔨᓴᑦᓴᖅᑲᖅᕿᓕᑐᓂᒃ ᓄᓇᓕᓂᒃ) ᐅᕐᓇᓗ ᐊᑲᐅᓇᖅᓯᒪᓂᕐᑕᖅᑐᑦᑕᓚᓇᓂᓕᒃᑐᓂᒃ ᐅᕐᓇᓗ ᑕᖅᑭᑦ ᓇᓕᖅᑭᓂᒃ ᐃᓚᐅᐸᒪᓂᑕᑐᓂᐅᑎᖅᑕᓂᒃ.

ᐊᑎᓐᓂᑦ ᓇᓕᖅᑲᐃᑦ ᐊᖏᔪᖅᑕᐅᒪᓂᖅᑕᓚᐅᖅᑕᑦ ᐊᑎᓕᐅᖅᓯᒥᓂ ᒪᓕᑕᑎᑦ ᐱᖓᓱᑦ ᓇᓗᓇᐃᒪᕆᐅᑉᑎᓕᓕᖅᑕᑦ ᐊᖏᓚᓯᓕᑎᓂᒃᑐᓂᑕᓕᖅᑎᓂᒃᑐᓂᑕᓂᒃ, ᐅᐊᔪᖏᖅᑐᑦ:

- ᐊᐱᖓᓪᓚᒃ: *“ᐊᖏᓚᓯᓕᑎᓂ ᐱᓇᓱᓂᖅᐳᓇᖅᑐᓂ ᑕᒪᐃᓂᓪ ᐊᖏᓂᐊᖅᑕᐅᓕᕆᓂᑐᓂᒃ ᑕᒪᓕᕈᑎᖅᓴᓂᒃᓯᒪᓂᑦ ᐅᑭᐅᖅ ᒪᓂᓕᑐᐃ. ᓂᕈᑦᓴᖅᑲᐃᓇᕐᓂᑐᓂᓪ.”* (ᓄᓇᕗᑦ ᐅᒪᔪᓂᓇᓴᕐᓗᒍᔪᓂᑦ, 1998, ᐊᐃᑦᑐᖅᓴᖅᓯᒪᔪᓂ 3)
- ᐱᓱᒋᑦᑐᖅ: *“ᐊᖏᓚᓯᓕᑎᓂ ᐱᓚᓯᓂᐅᖅᓯᓇᖅᑐᓂ ᑕᒪᓐᓇᓐᓂᒃ ᑕᒪᓕᕈᑎᖅᓴᓂᒃᓯᒪᓂᑦ ᐅᑭᐅᖅ ᒪᓂᓕᑐᐃ. ᓂᕈᑦᓴᖅᑲᐃᓇᕐᓂᑐᓂᓪ.”* (ᓄᓇᕗᑦ ᐅᒪᔪᓂᓇᓴᕐᓗᒍᔪᓂᑦ, 1998, ᐊᐃᑦᑐᖅᓴᖅᓯᒪᔪᓂ 3)

ᑭᓇ ᐊᖏᓚᓯᓕᑎᓂᐅᓂᖅᑕᐅᓕᕆᓂᑐᓂᒃ ᑐᑭᖃᖅᑎᑕᐅᓕᕆᓂᑐᓂᒃ ᐱᖃᑕᐅᓕᕆᓂᑐᓂᒃ (ᐅᑭᐅᓕᒪᓐᓇᓐᓂᒃ) ᐊᖏᓚᓯᓕᑎᓂᒃ ᐃᖅᑲᓇᐃᓕᓐᓂᒃ. ᐊᖏᓚᓯᓂᐊᓂᕐᓂᑐᓂᒃ ᐊᑎᖃᖅᑎᑕᐅᓕᕆᓂᑐᓂᒃ ᖃᐅᔨᓴᑦᓴᖅᑲᖅᕿᓕᑐᓂᒃ (Berkes et al., 1995a).

ᐊᓕᖅᑎᑦ ᐱᓕᓴᐃᓇᖅᑐᒃᑐᑦ ᓄᓇᓕᒃ ᐊᑐᓂ ᓇᓗᓇᐃᔨᐅᓪᓚᑦ ᐊᖏᓪᓗᓂᑦᑎᐊᓕᒃ ᐊᑐᓂ ᐊᑎᖏᖅᑕᐅᔪᐃᑦ ᓇᓕᖅᑲᖏᓐᓄᑦ. ᑕᐃᑎᕐᓯᒪᒐᑦ ᓇᓕᖅᑲᒥ 5 (ᓄᓇᓕᓄᑦ 23ᓄᑦ ᐅᓪᓚᕐᓯᒪᔪᖏᖅᑐᓂ) ᐊᓕᖅᑎᑦ ᓇᓗᓇᐃᓚᐅᑦᑐᒃᑐᑦ ᐊᖏᓪᓗᓂᑦᑎᓂᒃ ᐱᖓᓱᐊᖏᖅᑐᓂᒃ ᐊᑕᐅᓯᐅᑦᑐᓂᒃ:

- ᐅᖏᖅᑎᑎᒋᔭᐅᒃᑐᓂᑦ ᐊᖏᓪᓗᓂᑦᑎᓂ (ᓄᓇᕗᑦᓯᓂ, ᑕᒪᐸᐅᓪᓕᑎᒃ ᐃᓚᐃᖓᑎᓪᓗᓂᑦ);
- ᐅᖏᖅᑎᑎᒋᔭᐅᒃᑐᓂᑦ ᐊᖏᓪᓗᓂᑐᓪᓚᕆᔭᐅᑦ (ᓄᓇᓕᒃ 9ᓄᑦ, ᐱᖁᓯᐅᑐᓂᑦ ᖃᑎᒌᒋᐊᓪᓕᑦᑐᓂ);
- ᑐᓴᖏᓐᓂᒃᑐᓂᑦ ᓇᒥᓂᖅ ᖃᐅᔨᒪᓂᓚᓐᓂᒃ (ᓄᓇᓕᒃ ᑕᓕᒪᓂᒃ, ᖃᑭᖅᑕᒍᓐᓇᒥ).

ᓄᓐᓴᒥ ᐅᓚᔨᖅᑕᐅᔪᑎᑐᒃ ᖃᐅᔨᓴᓂᐸᓗᑦ ᐊᑦᖃᓱᔨᖅᑕᐅᔪᖏᑐᑎᖅ ᑐᑭᓯᐊᖃᖅᑎᑦᑎᓂᒃ ᓇᓚᐅᑎᑎᓕᔪᓐᓇᖅᑐᓂᒃ ᐅᑕᖅᑑᓂ ᓇᓕᖅᑲᒥ. ᓇᓗᓇᐃᔨᐅᓚᓂᖅ ᐱᓕᓴᐃᓇᖅᑐᓂᒃ ᐊᖏᓪᓗᓂᑦᑎᓂᒃ ᐃᓕᓴᕐᓂᖅᓴᓂᒃ ᐅᑕᖅᑑᓂ ᐊᑎᖏᖅᑕᐅᔪᖏᑐᑎᖅ

3.6 ᖃᐅᔨᓴᐅᑎᖃᓕᕆᔨᒃᑯᓂᖅ ᓄᓇᕗᑦᔨᐅᓂᖅᓴᓂ

ᖃᐅᔨᓴᓂᒻᒪᑦ ᑐᑭᒧᐊᖅᑎᕐᕕᓕᕆᓂᖅᑐᖅ ᑕᒪᐃᓐᓂᐅ ᐊᑎᖅᑲᑎᒪᓐᓂᖅᖃᖅᑕᒪᓕᒫᑦᑎᓂᑦ ᐊᑎᖅᑲᕐᒪᐅᕙᓕᕆᓂᐅ ᓄᓇᕗᓂᐅ ᐊᑐᓂ. ᑭᓯᐊᓂ, ᑭᓇᐅᔨᖅᑕᖃᓕᕆᓂᓐᓂᒃᓴᓂ, ᓇᓚᒋᑦᓴᐃᓐᓇᖅᑕᖃᓕᕆᓂᑦᑐᑦ ᓴᓇᖅᑯᑦ ᑲᒪᒋᔭᐅᓇᖅᑕᖃᓕᕆᓂᑦᑐᑦ ᐊᑎᖅᑲᐃᓐᓇᑦ ᓄᓇᕗᑦᔨᐅᓂᖅᓴᓂ. ᐊᑦᑐᖅᑎᑦ ᑲᑎᒪᔨᖁᔭᓂᑦ ᑕᒪᒪᐃᓚᑦ ᐃᓱᒪᓕᐅᓇᓱᓕᖅᑐᑦ ᖃᐅᔨᓴᓕᖅᖢᐊᒍᑎᓪᓗᒃ 66% ᖃᓄᐃᓂᐅᓂ (⅔) ᐊᓱᓕᖅᑎᑦ ᓄᓇᕗᓂ Ċᓴᒪᓂ ᐱᓕᕆᐃᒪᓐᓇᑦ ᑲᒪᒋᔭᐅᓇᓱᓕᖅᑐᑦᑎᓂᑦ ᓴᓇᖅᑯᑦᑎᒍ ᐊᑕᐅᓯᒪᓕᕆᔨᒃᑯᓂᖅᑐᖅ ᑕᒪᓐᓇ ᐃᖃᓗᓐᓂᑦ, ᑲᑎᕐᓂᔪᓂᒪᓕ ᐊᒪᒪ ᐃᖃᓗᓐᑖᓱᐊᖅᒍᑦ (ᑖᓐᓇ, 1995ᐃ). ᓄᐊᑦᓱᓱᐊᓕᕆᔨᖃᑎᒌᓂᓐᓂᒃ ᐱᖃᓱᐅᑎᓕᕆᔨᑦᓯᒪᓂ ᑭᓐᓇᒐᓂ, ᖃᓄᐃᓕᓐᓂᒃ, ᐊᖏᔪᓂ ᐊᒪᒪᓗ ᖃᒪᓂᑕᐊᖅ (ᑖᓱᐊᓕᒫᑦᓴ 275ᓂᒃ ᐊᑎᓕᕆᔨᓱᒪᖃᓕᕆᓂᑎᒃ ᑎᑭᑦ ᓱᑦᓯᖅᑕᖏᓐᓇᓂ). ᑭᓱᐊᓂᓗ, ᐊᑐᓕᖅᑎᑕᓕᕆᔨᑎᑦᑐᖅ ᐃᖃᓗᓐᓂ ᑭᖑᓪᓚᖅᓱᒪᓕᐃᓐᓇᑎᓐᓂᒃ ᐊᖏᔪᓂᑦ ᐊᑎᖅᑲᑎᒪᓂ ᐊᒪᒪᓗ ᐃᓱᒪᓕᐅᓇᓱᓕᖅᑐᑦ. ᖃᒪᓂᑐᐊᖅ ᐱᖓᑕᑎᓕᕆᔨᖅᑐᑦ ᖃᐅᔨᓴᐅᑎᖅᑲᐃᓐᓇᖅᑐᑦ ᐅᑭᐅᓂᖅ 1999ᒥ ᐃᓕᓴᕐᖃᑎᒌᓕᕆᔨᑭᓐᓂᒃᓴᓂ.

ᖃᐅᔨᓴᕐᖃᖅᓯᒪᓂᒪᑦ ᖃᓄᖅᑐᑭᑎᑎᓂᖅ ᐱᖃᓱᐅᑎᑦᑎᓕᕆᔨᖅᑐᑦ ᐊᖏᔪᓄᓕᒫᓂᒃ ᐊᖑᔪᖅᑕᐅᓂᖃᖅᑐᓂ ᐊᖏᔪᓄᓕᓴᕐᕕᓂ ᐊᑦᑐᖅᑎᑦ ᑕᑭᓪᓕᔅᓴᓂᒃ, ᐊᖏᔪᓄᓕᓴᕐᕕᓂ ᐊᑦᑐᖅᑎᑦ ᐃᓱᒪᓕᐅᓇᓱᓕᖅᑐᑦ ᐊᑎᖅᑲᑎᒪᓂ ᐊᒪᒪᓗ ᐃᓱᒪᓕᐅᓇᓱᓕᖅᑐᑦ

ᑕᑯᑎᓂᑦ ᐊᐱᖏᓪᓗᖅᑐᖅᓯᒪᔪᓕᒫᑦ ᓄᓇᕗᑦᐃᓗᐊᑎᑦ ᑎᑎᖅᑕᐅᔪᖅᑐᕐᓇᐅᔭᓕᒫᑦ ᐅᓪᓗᓂᑦ ᐅᓪᓗᓂᑦ ᐊᑐᖅᑐᕐᓂᖅ. ᐊᓯᖏᓐᓂᑦ ᐃᓕᓴᖏᓪᓕᐊᓯᔪᖅᑐᑎᑦ ᑕᑎᑎᓚᐊᓂᖅᐹᖅ ᐅᓪᓗᓂᑦᑕᐅᔪᖅᑐᑎᓄᑦ (ᓄᓇᕗᒻᒥ ᓂᕆᔨᒃᑯᑦ ᐅᓪᓗᓂᑦᑕᐅᔪᖅᑐᑎᓄᑦ ᖃᐅᔨᓴᓂᒪᓕᒫᑦ ᑕᑎᑎᓚᐊᓕᓂᑦ - ᐅᐃᒍᖏᓐᓂᖅ III) ᑐᓴᕐᐃᐅᔨᓂᑦ ᐊᖏᓪᓗᓂᐅᓂᑦ ᑕᖅᑭᑕᒥᑦ. ᑭᓯᐊᓂᑦ, ᐊᖏᓪᓗᓂᑎᐅᔨᑦ ᑐᓴᕐᐃᐅᔨᓴᓐᖏᓐᓂᒃ, ᑕᑎᑎᓚᐊᓂᑦ - ᐅᐃᒍᖏᓐᓂᖅ III) ᑐᓴᕐᐃᐅᔨᓴᓐᖏᓐᓂᒃ, ᑕᑎᑎᓚᐊᓂᑦ ᑎᑎᖅᑕᐅᔪᖅᑐᑎᓄᑦ ᑕᖅᑭᑕᒥᑦ. ᑭᓯᐊᓂᑦ, ᐊᖏᓪᓗᓂᑎᐅᔨᑦ

ᓇᓕᖅᑲᖅ 9: ᐱᓱᓪᓗᓂᑎᒃ ᑭᐅᖃᕐᓂᐊᕐᓇᖅᓯᒪᔪᓕᒃ ᓄᓇᕗᑎᒍᑦ

ᓄᓇᓕᒃ		ᑲᑎᕐᓗᑎᓕ ᖃᓄᐃᑦ ᐊᖏᔪᓂᖅᐹᒃᑐᑦ*	ᐊᐱᖅᓯᖅᑕᐅ-ᕕᒡᕕᕐᓂᑦ**	ᐊᐱᖅᓯᖅᑕᐅ-ᕕᒡᕕᕐᓂᑦ %
ᖃᑭᖅᑕᒃᓴᒃ	ᐃᓕᓴᕐᕕᒃ ᐊᓪᒪᒃ ᓇᓂᓯᕐᒪᒃ	310	0	0.0
	ᑭᓇᖏᓚᐃᑦ	243	2	0.8
	ᑲᖏᖅᑐᑐᒍᓱᒃ	245	3	1.2
	ᐊᐅᓯᓚᐃᓪᑐᖅ	73	1	1.4
	ᓴᓂᕆᕐᒃ	181	0	0.0
	ᐃᓐᓄᓕᒃ	307	3	1.0
	ᐃᖅᑲᓇᐃᑦ	540	7	1.3
	ᑭᓪᒥᑭᑦ	114	2	1.8
	ᐸᖏᓂᖅᑐᑐᖅ	224	7	3.1
	ᒥᑦᑎᒪᒐᓂᒃ	408	8	2.0
	ᖃᑭᖅᑕᕐᕕᐊᖅ	192	10	5.2
	ᖃᐅᔨᓚᐃᑦᑐᖅ	75	2	2.7
	ᓴᓂᕈᓕᐊᖅ	181	7	3.9
ᖃᑎᖅᑎᐅᑦ	ᖃᑭᖏᓚᐅᖅ	21	0	0.0
	ᐃᖅᑲᓇᑐᑦᓯᐊᖅ	246	1	0.4
	ᐅᖅᓯᖅᑐᑦ	246	1	0.4
	ᔪᒃᖏᕐᕕᒃ	201	1	0.5
	ᖃᓄᐃᓕᑐᖅ	102	0	0.0
	ᑕᓕᕐᕕᖅ	249	1	0.4
	ᐅᒥᖏᓚᐅᑐᖅ	31	0	0.0
ᑭᓪᓗᓂᖅ	ᐊᖏᖅᐊᑦ	310	1	0.3
	ᖃᓚᓂᑦᑐᐊᖅ	336	110	32.7
	ᐃᓐᓇᓂᒃᑖᕐᒃ	92	5	5.4
	ᓴᖏᖅᑐ	283	13	4.6
	ᑲᖏᖅᑐᓂᓂᖅᑐ	324	48	14.8
	ᓇᐅᔭᑦ	180	1	0.6
	ᑎᑭᕐᓂᕕᐊᖅ	61	3	4.9
ᓄᓇᕗᑦ		5255	237	4.5

* ᑲᑎᕐᓗᑎᓕ ᖃᓄᐃᑦ ᐊᖏᔪᓂᖅᐹᒃᑐᑦ ᐊᐱᖅᓯᖅᑕᐅᓂᒃ ᓇᓂᖅᑲᓚᕐᓂᑦ ᐊᐅᔨᓂᕕᐊᖅᓯᒪᓂᑦ ᖃᐅᔨᓴᓂᖅᑕᐅᓚᓂᒃ.

** ᐊᐱᖅᓯᖅᑕᐅᓂᒪᖅᓂᑦ. ᐊᖏᔪᓂᖅᐹᒃᑐᑦ ᐃᓕᐅᓂᒪᓕᒃᑲᖅᓂᑦ.

3.7.4 ᐅᓚᐋᕐᐳᓪᓗᒍᓂᖅ ᓇᒥᓐᓂᖅ

ᓄᓇᕗᑦᑎᓂ ᐃᓕᐅᑎᖏᓐᓂ 5-5 ᒪᓕᒡᑐᓂ ᖃᐅᔨᓴᕈᑎᒋᓕᒃ ᑕᐃᑎᓯᓯᐊᕐᖁᓯᒪᔪᖅᑐᓂ ᓄᓇᕗᑦᑎᓂ. ᓇᓗᓇᐃᖅᑕᓂ ᐅᓚᐋᓂ ᓇᓕᖅᑲᓂ ᐱᔪᑎᖃᓕᕐᓂᖅᖁᓯᒪᔪᖅᑐᓂ ᐊᑦᓭᒡᒐᕐᓂᑦᔪᓐᓇᑦᑎᓂᓐᓂᒃ (ᓇᓕᖅᑲᖅ 2).

ᐊᓪᓚᖅᑎᓂ ᓄᓇᖏᐊᖃᖅᑎᑕᐅᓕᕐᓂᖅᑐᓂ 1:250 000ᒥᒃ ᐊᖏᓂᖅᑲᖅᑐᒥᒃ ᐅᓚᔨᓯᖃᐃᓕᓴᓕᕐᓂᓂᒃ ᓄᓇᖅᑲᑎᒥᓂ. ᐃᑲᔪᖅᑕᐅᔭᓂᑎᒃ ᐊᓪᓚᖅᑎᓂ ᐊᑐᐊᓯᑎᓂ ᑎᑎᕐᓯᓂᖅᑕᐅᓕᕐᓂᖅᑐᓂ ᐅᓚᔨᖃᒥᓂᖅᓯᒃ. ᐊᓪᓚᖅᑎᓂ ᓇᓕᖅᑭᒧᑎᖅᑲᓕᕐᓂᖅᑐᑦ ᓄᓇᖅᑲᐃᑦ ᐃᓗᐊᓂᖅᑎᒍᑦ ᐅᓚᔨᖃᐅᔨᓴᕐᓂᒃ ᓄᓇᖅᑲᐃᑦ ᐊᑐᐊᓯᑎᓂ ᑎᑎᕐᓯᓂᖅᑕᐅᓕᕐᓂᖅᑐᓂ. ᐅᓚᔨᖃᐃᓕᓴᓕᕐᓂᖅᑐᑦ ᑎᑎᕐᓯᓂᖅᑕᐅᓕᕐᓂᖅᑐᓂ ᓄᓇᖅᑲᐃᑦ ᐊᑐᐊᓯᑎᓂ ᓄᓇᖅᑲᐃᑦ ᐊᑐᐊᓯᑎᓂ ᖃᐅᔨᓴᕐᓂᖅᑐᓂ ᓄᓇᖅᑲᐃᑦ ᐊᑐᐊᓯᑎ

4. ᑐᓴᕐᓴᓴᑦ ᐅᒪᔾᔪᖅᑕᐅᔪᑦᑐᑐᒃᓱᒃ (ᓴᖅᑭᑕᐅᔾᔪᑦ)

ᐅᔾᔨᐊ ᐅᓂᒃᑲᓂ 27ᓱᒃ ᐃᓕᓴᕆᐊᖅᓴᑦ ᐅᒪᔾᔪᖅᑕᐅᔪᑦᑐᑐᒃᓱᒃ ᓇᓴᖅᑲᓱᒃ (ᓄᓇᕗᓂ ᐊᑐᓂ, ᐊᑕᐅᓯᒪᔪᓂ ᐃᓴᖅᓯᐅᑦᓴᐅᑎᒃ ᐃᓗᐊᖏᓪᓗᑎᑦᑕᐅᑦ ᓇᓂᕈᕐᓗᖏᓪᓕᐅᑦ) ᐊᓪᓚᓗ ᐃᓕᓴᕆᓂᕐᓄᓱᒃ ᓄᓇᕗᑦᑕᓪᓚᑦ ᓴᖅᑭᑕᐅᔾᔪᒪᔪᑦ ᓄᓇᓕᒫᓂᓪ. ᑲᑎᑦᑐᑦ 664ᖃᓄᐃᔪᑦ ᐅᒪᔪᖅᑕᐅᔪᑦᑐᑐᒃᓱᒃ ᓇᓴᖅᑲᐃᓪᓕ (ᓇᓴᖅᑲᓂ 11ᒥᑦ 674ᒧᑦ) ᐅᑦᓄᓇᕆᑦᑐᑦ ᓴᐃᓴᐅᑎᑦ 6: ᓄᓇᕗᓱᒃ ᓴᖅᑭᑕᐅᔾᔪᓱᒃ ᐅᖃᖅᑎᑯᓚᖅᑐᑦ. ᓇᓴᖅᑲᐃᓪᓕ ᐃᓂᒋᔭᐅᓂᖃᖅᑐᑦ ᖃᐅᔨᓴᕕᓂᑦ ᐅᑭᐅᑦ ᒪᓕᒐᑦᑐᑦ, ᓄᓇᕗᓱᒃ ᐊᑐᐅᓂᒪᓕᒃ ᐃᓕᓴᕆᐊᖅᓴᑦ ᐅᑭᐅᑦ ᑕᒥᓪᓚᑦ. ᐊᓪᓚᑦ ᓇᓴᖅᑲᐃᓪᓕᖅᑎᑦᑕᑦ ᓇᐃᖅᒋᔨᓱᒃ ᐊᖏᓪᓗᑎᒍᑦ ᐃᓴᖅᓯᐅᑦᓴᐅᑎᒃ ᐅᑭᐅᑦ ᓄᓇᕗᒻᒥᓂᖅᓱᒃ. ᐊᑐᓂ ᐊᖏᓪᓗᑎᒍᑦ ᐃᓴᖅᓯᐅᑦᓴᐅᑎᒃ ᐃᓗᐊᖏᓪᓗᑎᑦᑕᑦ ᐊᐅᖃᓕᒫᓂ ᐊᑐᓂ ᐊᓪᓚᑦ ᐃᓴᖅᑲᐃᓪᓕᖅᑎᑦᑕᑦ ᐃᓗᐊᖏᓪᓗᑎᒍᑦ ᐅᑭᐅᑦ ᓄᓇᕗᒻᒥᓂᖅᓱᒃ. ᐊᑐᓂ ᐊᖏᓪᓗᑎᒍᑦ ᐃᓴᖅᓯᐅᑦᓴᐅᑎᒃ ᐃᓕᓴᕆᐊᖅᓴᑦ ᐅᑭᐅᑦ ᓄᓇᕗᒻᒥᓂᖅᓱᒃ ᐃᓕᓴᕆᐊᖅᓴᑦ ᐅᑭᐅᑦ ᐊᑐᓂ, ᐃᓗᐊᖏᑕᐃᓇᓚᑦᓯᑦ

4.1 ᐅᓪᓗᕈᓯᐅᑎᓂᖅ ᖃᓄᐃᓕᓴᖅᑎᑦ

ᓄᓇᕗᒻᒥ ᖃᐅᔨᓴᕐᓂᐊᕐᓇᖅ ᐊᑐᓕᕐᓂᑦ ᒥᑦᓴᐅᓯᕐᓂᐊᕐᓂᖅ ᐱᓕᒪᓂᓚᖅᑎᑦ ᑕᓚᐅᕐᓇᖅᑐᑦ ᐅᖃᐅᓯᐅᓂᐊᕐᓂᖅ ᐅᓪᓗᕈᓯᕐᓂᐊᕐᓇᖅ ᐊᓪᓚᖅᑕᐅᓯᐅᑎᓂᖅ ᑭᓯᐅᓂᖅᑐᓂᖅ ᑭᐅᔾᔨᒋᑦᓴᐅᔪᓂᒃ ᐅᖃᓕᒫᓂᖅ ᐊᑐᓕᕐᓂᐊᕐᓇᖅ ᐊᓪᓚᖅᑕᐅᓯᐅᑎᓂᖅ ᑭᓯᐅᓂᖅᑐᓂᖅ ᐃᓚᖃᖅᑐᑦ

4.2 ᐁᐅᔨᐃᑎᒋᓐᓂᖅ

ᑕᐃᒪᓗᒪᒃ ᑕᑯᓪᓕᖅ ᓇᓴᐅᒻᒥ 4.1 ᐊᖏᓇᓱᑎᑦ ᐊᐱᖅᓱᑕᐅᓱᒪᔪᑦ ᓴᓂᐊᓂ ᐊᑎᓕᐅᖅᑕᐅᓱᒪᔪᓯᐅᑦ (ᐁᐅᓪᓚᑎᓂᓐᓂᖅᑐᑦ) ᐱᓴᓇᐊᖅᑐᒪᒪᓕᕐᓂᖅ ᓇᓴᐋᓂᓐᓂᕐᓂᓪᓚᕐᓂᖅ ᐅᓪᓗᒥᒃ ᐃᒪᓐᓇᐅᑎᓪᓗᒍ ᐅᒃᑐᓂᖅᑐᑦ ᐊᑐᓂ ᐊᓱᔪᖅᑕᐅᓂᖅᖃᖅᑐᓂᒃ, ᓄᓇᕗᒻᒥᔪᓐᓇ ᐊᒻᒪ ᑕᖅᑭᑎᔪᑦ ᐊᑐᐊᖅᑕᐅᓪᓕᐊᑎᒃ ᐁᓪᓚᑦᑎᓂᖅᑐᑦ ᓇᓇᕗᒻᒥᔪᑦ ᐊᑐᓂ ᓇᓇᕗᒻᒥᔪᑦ 3.7.3. ᐁᐅᓪᓚᑦ ᐊᐃᑦᑐᖅᓱᒪᔪᐅᓂᖅᑐᑦ ᑕᑯᓴᓇᓪᓚᑦ ᐁᐅᓪᓚᑦ ᓇᓪᖅᖃᓂᓂᒃ ᐅᔨᐊᖅᐱᔪᓐᓇᖅ:

ᐊᖏᓇᓱᑎᑦ ᐁᐅᓪᓚᑦ ᐊᐃᑦᑐᖅᓱᒪᓂᖅᑐᑦ	ᖃᐅᔨᓴᓂᒪᑦ ᓇᓚᐅᔭᓕᑦ
ᑕᖅᑭᑕᒪᖅᓱᐅᑎᑦ ᐊᖏᓇᓱᑎᑦ	ᓇᓪᓂᑦ ᓇᓚᐅᔭᓕᐅᑎᖅᑐᑕᓐᓇᑦ 1, 2, 3 ᐊᖏᓇᓱᑦᑐᑎᓐᓇᑦ ᖃᐅᔨᓴᓂ ᐱᖅᓱᐅᑎᐅᑎᒪᓕᕐᑐᓂᒃ ᓴᓇᐋᑦ ᖃᐅᔨᓴᖃᐅᔨᓪᓚᕆᓂ (ᓄᓇᕗᓐᓇᑦ ᓴᓇᐋᑦ ᖃᐅᔨᓴᖃᐅᔨᐁᑐᓂᒃ)
ᐊᐱᖅᓱᖅᑕᐅᓱᒪᓕᖅ	ᑲᑎᑎᑦ ᓇᓚᐅᔭᓕᑦ 1, 2, ᐊᒻᒪ 3
ᐊᖏᓇᓱᑎᑦ ᐊᐱᖅᓱᖅᑕᐅᓱᑦ	ᑲᑎᑎᑦ ᓇᓚᐅᔭᓕᑦ 1 ᐊᒻᒪ 2
ᐅᒪᔨᖅᑕᐅᓱᑦ	ᖃᐅᔨᓴᓂᒪᑦ ᓇᓚᐅᔭᓕᒻᒥ 1
ᐁᐅᓪᓚᑦ 950	$\sum_{1-2}/\sum_{1-3}$ X 100%, ᑎᑭᓗ ᐊᖏᓇᓱᑎᑦ ᐊᐱᖅᓱᖅᑕᐅᓱᒪᓕᕐᓂᓪᓚᕆᓂ/ᐊᐱᖅᓱᖅᓴᖅᓯᑦ X 100%.

ᓇᓚᐅᔭᓕᑦ ᐃᒪᐃᑦᑐᑎᓂᑐᖅ:
ᓇᓚᐅᔭᓕᑦ 1: ᐅᒪᔨᓕᐅᖅᑐᖅ
ᓇᓚᐅᔭᓕᑦ 2: ᐅᒪᔨᓕᐅᖅᑎᑦᑐᖅ
ᓇᓚᐅᔭᓕᑦ 3: ᑐᓴᖏᐅᔨᖃᓕᐅᖅᑎᑦᑐᖅ

ᐊᖏᓇᓱᑎᒋᓕᒃ ᑕᖅᑭᑕᒪᖅᓱᐅᑎᓂ ᓇᓕᐊᖃᓐ ᑕᖅᑭᒧᑦ ᐃᓱᒪᓴᖅᓱᐅᑦᑕᑎᓕᐅᖅᑐᑦ ᐅᒪᔨᓴᓱᑎᑐᒥᓂᓕᐅᖅᑐᑦ ᐊᒻᒪ ᐱᖅᓱᐅᑎᐅᑎᐅᔭᓐᓇᑦ ᐅᒪᔨᓴᖅᑕᐅᓱᒪᓕᕐᓂᖅ ᓇᓕᐋᓂᓐᓂᕐᓂᒃ. ᐊᑎᖏᓇᖅᑐᓕᐊᑦᑕᐅᓱᖅ ᖃᐅᔨᓴᓂᒪᑦ ᐊᖏᓇᓱᑎᑦ ᐊᑎᖏᓇᖅᑕᐅᓱᒪᓕᕐᓂᖅ ᐊᐱᖅᓱᖅᑕᐅᓱᒪᓕᕐᓂᖅ ᐊᑐᐊᖅᑕᐅᓱᒪᓕᕐᓂᖅ ᐊᑐᐊᖅᑕᐅᓱᒪᓕᕐᓂᖅ ᐊᒻᒪ ᐃᓱᒪᓴᖅᓱᐅᑦᑕᑎᓕᐅᖅᑐᑦ ᐊᑎᖏᓇᖅᑕᐅᓱᒪᓕᕐᓂᖅ ᐊᑐᐊᖅᑕᐅᓱᒪᓕᕐᓂᖅ ᐊᑎᖏᓇᖅᑕᐅᓱᒪᓕᕐᓂᖅ ᐊᒻᒪ ᐱᖅᓱᐅᑎᐅᑎᐅᔭᓐᓇᑦ ᐊᖏᓇᓱᑎᑦ ᐊᑎᖏᓇ

5. ᑐᓴᖏᓚᕋᐅᑎᓂᓂᒋᑦ ᐅᒪᓲᖅᑕᐅᔪᑦᑐᑦ ᖃᑦᑎᐅᓂᒋᑦ ᖃᑦᑎᐅᔨᓗᓂᒋᑦᓗ ᑕᒪᖅᑕᐅᔪᑦᑐᑦ

ᐅᑯᓇᓂ ᑐᑭᓯᐅᓇᓱᑦᑐᑦ ᓄᐊᑕᐅᓯᒪᔪᐃᑦ ᐊᑦᓚᑕᐅᓯᒪᔪᑦ ᓯᓚᔪᓐᓇᑎᑦᓂᒋᒃᑯᓂᒋᑦ ᖃᐅᔨᓴᓂᒋᑦ ᐊᑦᕿᑭᒋᓐᓂᑦᑐᑦ, ᐊᒪᒪ ᓯᖅᑯᐃᖅᑕᐅᓇᓱᒋᖅᑎᓂᑦᑐᑦ ᓇᒥᓂᑦ ᐅᒪᓲᖅᑕᐅᓕᕐᓂᐊᖅᑐᑦ, ᒪᓕᒃᑐᑦ ᓄᓇᑕᑭᑎᐅᓯᒪᔪᑦ. ᖃᐅᔨᒪᔭᓂᖅ ᐱᑎᑦᓚᐃᖃᒪᐊᖏᓪᓕᐅᕈᑎᑦᓂᓕᒃᑐᓂᒃ, ᐅᒪᓲᖅᑕᐅᔪᑦᑐᑦᑎᒍᑦ ᐅᖃᐅᔨᕈᓐᓇᕐᓂᖅᑐᑦᑎᒍᑦ ᓯᓚ ᐱᓕᕆᓂᖅᓯᒪᔪᖅᑐᑦ. ᑕᐃᒪᐃᓐᓂᓕᒃ ᖃᑦᓯᐅᓂᓕᒃ ᐅᖃᐅᔨᓴᖅᑎᑦᑎᓂᒃᑯᑦ ᐊᑦᓚᑕᐅᓯᒪᔪᑦ ᐅᖃᐅᔨᓴᖅᑎᑦᑎᓂᒃᑯᑦ "ᐅᓪᓗᓂ ᐅᒪᓲᖅᑕᐅᓯᒪᔪᑦ ᖃᑦᑎᐅᓂᒋᑦ ᖃᓄᐅᓕᐅᔨᓴᖅᑎᑦᑎᓂᒃᑯᑦ ᐅᖃᐅᔨᓴᖅᑎᑦᑎᓂᒃᑯᑦ ᐅᑭᐅᖅᑕᕐᓗᒍ" (ᓄᓇᕗᑦᓂ, 1993, ᐃᓕᓴᕐᕕᖅᓂ 5.6.21) ᓇᓗᐃᓇᓱᓐᓂᒋᖅᑎᓂᑦᑐᑦ ᓇᒥᓂᑦ ᐅᒪᓲᖅᑕᐅᓯᒪᔪᖅᓂᖅ, ᑐᓴᖏᓚᕋᐅᑎᓂᑦᑐᑦ ᐅᖃᐅᔨᓴᖅᑎᑦᑎᓂᒃᑯᑦ.

ᐱᓕᕆᖃᖏᓐᓇᓵᔪᖅ ᑕᒪᓐᓇᐃ ᓇᓗᐊᑎᑦ ᐅᒪᓲᖅᑕᐅᓯᒪᔪᖅᓂᖅ ᓯᓚᔪᓐᓇᑎᑦᑎᓂᒃᑯᑦᖃᑦᓯᐅᓂᒋᑦ ᐃᓚᖓᑦ ᓄᓇᕗᑦᖃᑕᐅᓯᒪᔪᑦᓂᓕᒃ, ᓄᓇᕗᒻᒥ ᐅᒪᓲᖅᓯᓚᕐᓇᕐᓂᐊᖅᑐᑦ, ᐊᒪᓚᓗ ᐅᒪᓲᖅᓯᓚᐅᔨᓴᖅᑐᑦ ᑎᑎᕋᖅᑕᑦ. ᑕᒪᓐᓇ ᓯᓚᔪᓐᓇᑎᑦᑎᓂᖏᓐᓇ ᐱᖅᑭᒃᓴᓂᖃᕐᓂᐊᖅᑎᑦᑎᓂᒃᑯᑦᓂᖅ ᐅᖃᐅᔨᓴᐅᓯᒪᔪᑦᑎᓂᒃᑯᑦᑎᓂᑦᑐᑦ ᖃᐅᔨᓴᐅᓯᒪᔪᑦᑐᑦ ᐊᑦᓚᑕᐅᓯᒪᔪᑦ ᐃᓚᖓᑎᑎᒍᑦ.

ᐅᒪᓲᓂᓗᓂ ᐱᖅᔪᐅᔨᓴᖅᑕᐅᓯᒪᔪᖅ ᓇᓗᓇᐃᔨᖅᑕᐅᓯᒪᔪᖅ ᐃᓚᖓᑎᑎ 4.1 ᑐᓴᖏᓚᕋᐅᔨᓴᒋᑦᓯᐊᑎᒍᑦᑐᑦ ᒥᑦᓴᐅᓯᑎᑎᐅᑦᑐᓗᓂ ᐅᒪᓲᖅᑕᐅᓯᒪᔪᓂᒃ ᑕᒪᓯᑕᖅᓯᒪᓂᖏᓐᓄᓗ:

1) ᐊᐱᖅᓯᖅᓴᐃᑦ ᐊᑕᖏᖅᑐᒥᑦ ᓇᓪᔨᔪᑦᑎᓂᒃᑯᒥᓐᓂ ᑕᓯᑎᑦᓯᔪᖅ ᐊᖏᔪᓯᑦᑎᓴᑦ ᖃᑦᑎᐅᑎᑎᓂᖏᓐᓄᑦ.
2) ᐊᐱᖅᓯᕐᓴᐅᓕᕐᓂᑦ ᒥᑦᓴᐅᑎᑎᒍᖅᑐᑦ ᐊᑎᖃᖅᖃᑕᐅᔨᓄᑦ, ᓇᓚᐅᔭᑎᑦ ᑭᐅᓕᕐᑎᑎᓂᖏᓐᓄᑦ ᐊᒪᓚᓗ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔪᑦᑐᑦᑎᒍᑦᑎᓂᖏᓐᓄᑦ ᑭᐅᓕᕐᖏᖅᑐᓂᖏᓐᓄᑦ ᐃᓕᓴᕐᕕᖅᑕᐅᓯᒪᔪᑦᑐᑦᓂᖏᓐᓄᑦ ᑭᐅᓕᕐᓂᑦᑐᑦ ᐃᓕᓴᕐᕕᖅᑕᐅᓯᒪᔪᑦᑐᑦ.
3) ᑭᐅᓕᕐᓂᑦ ᐊᑐᑎᖃᖅᑐᑦ, ᓯᓂᔭᐃᑦᑐᓴᓂᒃ ᐅᒪᓲᖅᑕᐅᓕᕐᓂᐊᖅᑐᑦᑎᓂᑦᑐᑦ ᑭᐅᓕᕐᓂᑦ.

ᐅᑯᓇᓂᒋᑦ ᖁᒥᑦᑭᓇᓱᒋᑦ ᑕᒪᔭᐃᓕᓚᖅ ᒪᓕᑎᓇᓚ ᐊᑐᐊᖅᑕᐅᓯᓂᔪᓐᓇᖅᑎᑦᑎᓂᒃᑯᑦᓂᖅᑐᑦ ᖃᐅᔨᓴᐳᑎᐅᓯᒪᔪᓕᒫᑦ ᐊᑦᕿᑭᓇᓱᒋᖅᑐᓂᖅᑐᑦ ᓇᓚᐅᔭᑦ ᐅᒪᓲᖅᑕᐅᓯᒪᔪᖅᓂᖅᑐᑦ, ᐱᑕᖃᖅᑐᒥᓂᖅ ᐅᒪᓲᖅᑕᐅᓯᒪᔪᑦᑐᑦ ᐊᑐᐊᖅᑕᐅᓯᒪᔪᑦᑐᑦ ᐱᓕᕆᓂᖅᓯᒪᔪᖅᑐᑦ ᐅᒪᓲᖅᑕᐅᓯᒪᔪᑦᑐᑦ ᐊᑐᐊᖅᑕᐅᓯᒪᔪᑦᑐᑦ ᐅᒪᓲᖅᑕᐅᓯᒪᔪᑦᑐᑦ ᐅᒪᓲᖅᑕᐅᓯᒪᔪᑦᑐᑦ.

ᐊᑐᐊᖅᑕᐅᓯᒪᔪᑦ ᐊᑐᐊᖅᑕᐅᓯᒪᔪᑦ ᐅᒪᓲᖅᑕᐅᓯᒪᔪᑦᑐ

ᑭᓯᓂᐅᓚᓯᒪᔪᒥᑦ ᒥᑦᓴᐅᓯᒪᓕᕐᓂᖅᓴᑐᒥᑦ ᓇᓗᓇᐃᓚᔪᖏᓚᓯᓂᐅᕐᓂᖅᓴᑦ ᐃᓄᓐᓂᑦᑕᓐᓇᖅᑐᑦ ᓴᖅᑭᑦᓯᐅᑉᐳᖅᑎᓂᓪᓗ ᖃᖅᑐᓵᑦᓯᐅᑉᐳᖅᑎᓂᓪᓗ ᓴᖅᑭᑦᓯᐅᑉᐳᖅᑎᓂᓪᓗ ᐊᑐᓂᑦᑎᓂᓪᓗ ᐃᓄᓐᓂᑦᑕᓐᓇᖅᑐᑦ

ᓇᓕᖅᖃᖅ 10: ᖃᓂᑎᐅᓂᖏᑦ ᐊᖏᓇᓱᑎᑦ ᐊᑎᓕᐅᖅᑕᐅᓱᒪᖏᑦᑐᑦ ᓄᓇᓕᒥᑎᒍᑦ

ᓄᓇᑦ		ᑲᑎᑦᑐᑦ # ᐊᑎᓕᐅᖅᓱᒪᓂᑦ ᐊᖏᓇᓱᑎᑦ	ᖃᓂᑎᐅᓂᖏᑦ # ᐊᑎᓕᐅᖅᓱᒪᖏᑦᑐᑦ ᐊᖏᓂᓗᖅᑐᓂᑦ ᑐᓂᓗᓯᓚᐅᕙᓪᓕᐊᓂᑦ	ᐊᖏᓇᓱᑎᑦᑕᓕᒫᓂᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ ᒥᓵᔅᓴᕐᑕᐅᓱᒪᓂᑦ ᐊᖏᓇᓱᑎᑦ	ᖃᓂᑎᐅᓂᖏᑦ ᑲᑎᑦᑐᑦ # ᐊᑎᓕᐅᖅᓱᒪᖏᑦᑐᑦ ᐊᖏᓇᓱᑎᑦ	ᐊᑎᓕᐅᖅᓱᒪᖏᑦᑐᑦ ᒥᓵᔅᓴᕐᑕᐅᓱᒪᓂᑦ ᖃᓂᑎᐅᓂᖏᑦ ᐊᖏᓇᓱᑎᑦ ᑕᐃᒃᑐᓂᑦ
ᖁᑭᖅᑕᓗᒃ	ᐃᓱᐊᑦᓴᒃ ᓇᓂᓯᐃᓪᓗ	310	6 % ᐊᒻᒪ 2 ᑕ	ᐊᑎᖏᖅᑕᐅᔪᓂ ᓇᒻᒪᑎᓂᑦ ᓂᒻᒪᑎᐅᔪᓂ	8	3
	ᑭᓇᐃᐃᑦ	510	1 % ᐊᒻᒪ 1 ᑕ	13 % ᐊᒻᒪ 13 ᑕ ᐊᒻᒪ 11 ᐱᑕᖏᑦᑐᑦ	29	5
	ᖃᖏᓇᑐᒍᒪᕗᖅ	245	1 %	ᐊᑎᖏᖅᑕᐅᔪᓂ ᓇᒻᒪᑎᓂᑦ ᓂᒻᒪᑎᐅᔪᓂ	1	0
	ᐊᐅᓯᐃᑦᑐᖅ	73	1 % ᐊᒻᒪ 2 ᑕ	12 % ᐊᒻᒪ 2 ᑕ ᐱᑕᖏᑦᑐᑦ	17	19
	ᓴᓂᕆᒃ	181	3 %	ᐊᑎᖏᖅᑕᐅᔪᓂ ᓇᒻᒪᑎᓂᑦ ᓂᒻᒪᑎᐅᔪᓂ	3	2
	ᐃᓱᓗᓂᒃ	307	ᐱᑕᖏᑦᑐᑦᓴᖅ	ᐊᑎᖏᖅᑕᐅᔪᓂ ᓇᒻᒪᑎᓂᑦ ᓂᒻᒪᑎᐅᔪᓂ	0	0
	ᐃᖅᓗᐃᑦ	540	48 % ᐊᒻᒪ 2 ᑕ	51 %, 12 ᑕ ᐊᒻᒪ 11	114	17
	ᑭᒻᒥᑉᑕ	114	1 %	51 % ᐱᑕᖏᑦᑐᑦ	52	31
	ᐸᖕᓂᖅᑐᓴᖅ	224	1 %	61 % ᐊᒻᒪ 7 ᑕ ᐱᑕᖏᑦᑐᑦ	69	24
	ᒥᑦᑎᒪᒪᓕᓂᒃ	408	1 ᑕ	ᐊᑎᖏᖅᑕᐅᔪᓂ ᓇᒻᒪᑎᓂᑦ ᓂᒻᒪᑎᐅᔪᓂ	1	0
	ᖁᑭᖅᑕᒥᔪᐊᖅᓴᖅ	192	ᐱᑕᖏᑦᑐᑦᓴᖅ	4 %, 7 ᑕ ᐊᒻᒪ 51 ᐱᑕᖏᑦᑐᑦ	16	8
	ᖃᐅᔨᓴᐃᑦᑐᓴᖅ	75	ᐱᑕᖏᑦᑐᑦᓴᖅ	ᐊᑎᖏᖅᑕᐅᔪᓂ ᓇᒻᒪᑎᓂᑦ ᓂᒻᒪᑎᐅᔪᓂ	0	0
	ᓴᓂᑭᓗᐊᖅᓴᖅ	181	3 %	11 % ᐊᒻᒪ 3 ᑕ ᐱᑕᖏᑦᑐᑦ	17	9
ᖁᑎᖅᑎᑦᑕᑦ	ᖁᓕᖏᑦᑐᑦ	21	ᐱᑕᖏᑦᑐᑦᓴᖅ	ᐊᑎᖏᖅᑕᐅᔪᓂ ᓇᒻᒪᑎᓂᑦ ᓂᒻᒪᑎᐅᔪᓂ	0	0
	ᐃᖅᓗᓂᑐᓯᐊᑦᑐᑦ	391	16 % ᐊᒻᒪ 2 ᑕ	37 % ᐱᑕᖏᑦᑐᑦ	55	12
	ᐅᓴᔨᓴᑐᓴᖅ	368	4 %	18 % ᐱᑕᖏᑦᑐᑦ	22	6
	ᖃᔪᓂᓂᑐᓴᖅ	294	3 % ᐊᒻᒪ 1 ᑕ	ᐊᑎᖏᖅᑕᐅᔪᓂ ᓇᒻᒪᑎᓂᑦ ᓂᒻᒪᑎᐅᔪᓂ	4	1
	ᔫᑦᓴᐃᓐ	102	1 %	62 % ᐊᒻᒪ 5 ᑕ ᐱᑕᖏᑦᑐᑦ	68	40
	ᑕᔭᑦᓴᐊᖅᓴᖅ	249	3 %	ᐊᑎᖏᖅᑕᐅᔪᓂ ᓇᒻᒪᑎᓂᑦ ᓂᒻᒪᑎᐅᔪᓂ	3	1
	ᐅᒥᖏᓚᑐᓴᖅ	31	ᐱᑕᖏᑦᑐᑦᓴᖅ	ᐊᑎᖏᖅᑕᐅᔪᓂ ᓇᒻᒪᑎᓂᑦ ᓂᒻᒪᑎᐅᔪᓂ	0	0
ᑭᕿᓂᖅ	ᐊᖏᖅᑎᑦ	410	5 %	ᐊᑎᖏᖅᑕᐅᔪᓂ ᓇᒻᒪᑎᓂᑦ ᓂᒻᒪᑎᐅᔪᓂ	5	1
	ᖃᓚᓂᑕᒃᑐᓴᖅ	341	1 % ᐊᒻᒪ 1 ᑕ	65 % ᐱᑕᖏᑦᑐᑦ	67	16
	ᐃᓱᓕᓚᑦᓴᐃᒃ	92	2 %	12 % ᐱᑕᖏᑦᑐᑦ	14	13
	ᓴᖅᓂᓴᖅ	283	5 %	ᐊᑎᖏᖅᑕᐅᔪᓂ ᓇᒻᒪᑎᓂᑦ ᓂᒻᒪᑎᐅᔪᓂ	5	2
	ᖃᖏᓇᓄᓂᓴᖅ	424	13 %	ᐊᑎᖏᖅᑕᐅᔪᓂ ᓇᒻᒪᑎᓂᑦ ᓂᒻᒪᑎᐅᔪᓂ	13	3
	ᓇᐅᔨᓂ	180	ᐱᑕᖏᑦᑐᑦᓴᖅ	31 % ᐊᒻᒪ 8 ᑕ ᐱᑕᖏᑦᑐᑦ	39	18
	ᑎᑭᑦᓴᐊᖅᓴᖅ	61	ᐱᑕᖏᑦᑐᑦᓴᖅ	44 % ᐱᑕᖏᑦᑐᑦ	44	42

% = ᖃᓄᐃᓕᓂᑦ ᐊᖏᓇᓱᑎᑦ
ᑕ = ᑕᒪᕐᓗᒃ ᐊᖏᓇᓱᑎᑦ
ᐊᒻᒪ = ᐊᓯᖏᓐᓂᒃ ᐊᖏᓇᓱᑎᑦ

ᐊᔾᓇᓂᖅᓴᐅᓕᐅᕐᓂᖅᓂᒃ ᒥᑦᓴᐅᓇᓱᐊᕐᓂᒃ ᐊᑎᓕᐅᓇᓱᒪᓕᐊᖅᓂᕆᑎᒃ ᓴᖅᑭᑎᐅᔾᔨ ᖃᐅᔨᓴᕆᑎᒃ ᓄᓕᒻᒥᓂᖅᓱᒪᓕᐊᖅᓱᒪᓕᓂᑎᒃ ᑐᖓᓴᐅᓂᓱᐊᖅᓱᒪᓕᓂᑎᒃ ᑐᖓᓴᐅᓂᓱᐊᖅᓱᒪᓕᓂᓐᓂᕆᓂᒃ ᖃᓄᐃᑎ ᐃᓕᐅᑎᑎᓂᕐᒥᒃ ᐊᑎᓕᐅᓇᖅᑕᐅᓱᒪᓕᐊᖅᓂᓐᓂᒃ ᐊᖓᔪᓇᓂᕐᒥᒃ. ᐊᖓᔪᓇᓂᑦᑎᓂᒃᑐᒃ ᐊᖓᖃᖅᖢᑎᒃ ᐊᓂᒪᓗ ᑭᐅᓂᒃ ᓄᓇᓕᒻᒥ ᑲᓇᖅᑐᑐᓂᓐᓂᒃᑐᒃ, ᐊᑐᖅᑕᐅᓕᐊᔪᖅᑐᑎᓇᓕᐊᒃ ᐅᒃᑐᓕᕐᓂᖅᓄᓇᓕᒃ ᐃᓕᓴᖅᑕᐅᓂᖅᓄᓇᓕᒃ. ᑭᓯᐊᓂ, ᑭᐅᓂᒃᑐᒃ ᐊᖓᖃᖅᖢᑎᒃ ᐊᖓᔪᓇᓂᑦᑎᓂᒃᑐᒃ ᓄᓇᓕᒻᒥ ᑕᐃᒪ ᒥᑦᓴᐅᓂᓱᐊᖅᓱᒪᓕᐊᓂᒃ ᐊᖓᔪᓇᓂᖅᓄᑦᑎᓂᒃᑐᒃ ᓄᓇᓕᒻᒥ ᑕᐃᒪ ᐊᖓᔪᓇᓂᑦᑎᓂᒃᑐᒃ ᐊᑐᐊᓕᖅᑐᓂᒃ

5.3.2 ᐅᐃᓕᖏᑦ

ᐱᖓᓱᓪᓗᐊᑎᐅᔪᓂ ᐱᔨᑎᐅᔪᓂ ᐅᐃᓕᖏᑦ ᐃᓗᒪᑉᓴᐅᑎᐊᖅᖢᖏᑦ ᖃᐅᔨᓴᓂᕐᒥᖅᑎᑎᓪᓗᒍ:

1. ᐃᓕᖏᑦ ᑕᐃᔨᑕᐅᓇᓱᑎᑦ ᐃᓄᖅᑎᑎᕐᓴᐅᔪᓂ ᐃᓕᐅᔪᓇᖅᓯᒪᖏᑦᒪᒪᑕ;
2. ᐃᓕᖏᑦ ᑕᐃᔨᑕᐅᓇᓱᑎᑦ ᐃᓄᖅᑎᑎᕐᓴᐅᔪᓂ ᑐᓴᖅᑎᐅᔪᓂᖅᓯᒪᖏᑦᑎᑎᓪᓗᑎᑦ ᓴᓇᕐᓂᑎᐅᔪᓂ;
3. ᐃᓕᖏᑦ ᓴᓇᕐᓂᑦ ᑐᓴᖅᑎᑦᑎᓇᐹᒃᓴᖏᑦᑎᑦ ᐃᓕᖏᓂᒃ ᐃᓄᖅᑎᑎᕐᓴᐅᔪᓂᒃ.

ᓄᓇᕗᒻᒥ ᖃᐅᔨᓴᖅᑎᐅᔪᖅ ᐊᐱᓕᕆᔨᑕᐅᔪᓇᖅᖢᖏᑦᑎᑦ ᐃᓕᐅᖃᑕᐅᔪᓂ ᑕᐃᒪᐃᓕᑕᕐᓂᖅᓯᒪᔪᓕᒃ ᐃᓕᖏᑦ ᐃᓕᐅᔪᓚᖏᑦᑎᓂᑐᐱᓗᒍᓕᓂᒃ. ᑕᒪᓐᓇ ᑕᐃᒪᐃᓱᒪᓕᖅᑐᑦ ᐅᓪᓗᒥᒃ ᖃᐅᔨᓴᖅᖃᖅᓯᒪᓂᖅ ᑭᓱᓕᖅᑐᑦ ᐃᓄᖅᑎᑎᕐᓴᐅᔪᓂ ᐊᐅᓚᑦᑎᐊᖅᑐᑦ ᐅᓇᓗᒍ ᐱᓪᓚᑦ ᐃᓄᖅᑎᑎᕐᓴᐅᔪᓂ:

- ᐱᖓᔪᓱᓂᐊᖅᑐᓂᒪᓕᒍᑦ ᑐᐱᓱᐅᒪᓕᑎᐊᖅᑐᓂᒪᓕᒍᓪᓗᒍᑦ ᓱᒪᑦ ᖃᐅᔨᓴᖅᖃᖅᓯᒪᔾᔪᑎᑦ ᑭᓱᓕᖅᑐᑦ ᐃᓕᐅᖅᑕᐅᓂᖅᑐᑎᓪᓗᒍᑦ ᐃᓄᖅᑎᑎᕐᓴᐅᔪᓂᒃᑯᓚᖏᑦᑎᓂᑦ;
- ᓱᓕᔨᓚᐅᑦᑎᐊᖅᑐᖓᔪᓂ ᖃᐅᔨᓴᐳᑎᑎᓂᒃ ᐊᑐᖅᑕᐅᑲᓕᖅᑐᖓᔪᖅᑲᐊᖅᖢᖏᑦᑎᓂᑦᑯᓚᖏᑦᑎᓂᑦ, ᐅᕙᓪᓕᐊᓂᒃ ᐊᑐᐃᓐᓇᕐᓂᐊᕐᓂᖅᑐᓂᒃ ᐊᓱᖓᓐᓂ ᐱᔭᖅᓯᒪᓂ ᐃᓗᐊᖅᑐᓂᒃᑐᐱᓱᐅᒪᓕᑎᐊᖅᑐᓂᒃᑐᐱᓗᒍᓕᓂᒃ;
- ᑕᑎᑭᓴᖅᖃᓂᐊᖅᓯᒪᔪᓕ, ᐱᐅᓪᓛᖅᑐᓂᓯᓚᑦᑎᓂᒃ, ᓴᓇᕐᓂᑎᑦ ᖃᐅᔨᓴᐅᒪᓕᐅᔪᓂᖅᑐᑎᓪᓗᒍᑦ ᓄᓇᓕᒻᒥ ᓄᓇᕗᑦ ᐊᖓᓂᓚᖅᓴᖓ ᒪᓕᓐᔭᒍ ᖃᐅᔨᓴᖅᑐᐃᓐᓇᕐᓂᐊᕐᓂᖅᑐᓂᒃ.

ᖃᐅᔨᓴᖅᖃᖅᑎᓪᓗᒍ ᐱᔭᓚᓗᑎᒃ ᑭᐅᓪᓕᓚᓯᓪᓚᐅᔪᓂ ᒪᓕᑭᐅᓚᓚᓯᓪᓚᐅᔪᓄᑦ. ᓯᑲᓪᓕᒥ ᖃᐅᔨᓴᐅᒪᓕᖅᑐᑦ ᑭᐅᔪᓚᖏᑦᑎᓂᑦ. ᐃᓕᖏᑦ ᐊᖓᔪᓇᓯᑎᑦ ᐃᓕᐅᔪᓚᒪᑕᐃᓚᓕᐅᖏᑦᑎᓂᑐᐱᓗᒍᓕᓂᒃ ᖃᐅᔨᓴᖅᓯᒪᔪᓕ. ᑕᖅᑭᑦᒪᓕᖅᓯᐅᑎᓂ ᓇᓗᓇᐃᑭᑎᑦᑎᓂᒃᑐᐱᓗᒍᓕᓂᒃ ᖃᐅᔨᓴᖅᖃᖅᑎᖅᓯᒪᔪᓕ (ᐃᓘᓐᓃᖅ 3.7.3), ᑭᖑᓪᓕᒪᓂ ᓯᓚᐅᑎᓪᓕᐊᔪᓂᖅᑐᑎᓪᓗᒍᑦ ᐊᖓᔪᓇᓯᑎᑦ ᓇᓕᐊᔪᓂᖅᑐᓂᒃ ᐊᑐᐃᓐᓇᕐᓂᖅᑐᓂᒃᑐᐱᓗᒍᑦ ᐊᑎᖅᓯᒪᔨᖅᑐᓂᒃᑐᐱᓗᒍᓕᓂᒃ ᑕᖅᑭᑦᒪᓕᖅᑐᑦ, ᑭᓱᓕᖅᑐᑦ, ᐊᖓᔪᓇᓯᑎᑦ ᐃᓕᐅᔪᓚᒪᑕᐃᓚᓕᐅᖏᑦᑎᓂᑦᑯᓚᖏᑦᑎᓂᑦ ᓇᓗᓇᐃᑭᑎᖅᓯᒪᔪᓕᒃᑯᓚᖏᑦᑎᓂᑦ ᐃᓄᖅᑎᑎᕐᓴᐅᔪᓂᒃᑯᓚᖏᑦᑎᓂᑦ ᐃᓄᖅᑎᑎᕐᓴᐅᔪᓂᒃᑯᓚᖏᑦᑎᓂᑦ ᓇᓗᓇᐃᑭᑎᖅᓯᒪᔪᓕ

5.3.5 ᐅᖃᐅᓯᖏᑦ ᓇᐃᔭᖑᑎᑦ

ᑭᐅᔾᔨᖏᑦᑐᑦ ᑕᐃᑎᖏᓪᓗᕆᓂᖅ ᐊᓯᔾᔨᖏᖅᖢᖏᑦᑐᓂᓐᓄᑦ? ᐃᓕᓴᐃᓗᒍ, ᑭᐅᔾᔨᖏᖅᖢᖏᑦᑐᑦ ᐃᓕᖏᑦ ᐃᓕᓴᐅᖏᖅᑕᐅᔾᔨᖏᖅᖢᖏᑦᑐᓂᓐᓄᑦ ᐱᓪᓚᑦᑐᖅᑕᐅᖏᖅᖢᖏᑦᑐᓂᓐᓄᑦ, ᐊᓪᓚᓐ ᐊᑦᑐᐃᓂᕐᓂᖏᓪᓗᓂᑕᓪᓚᖅᑐᐃᓐᓇᖅᑐᑦ ᓇᒃᖢᑎᐅᔪᓐᓇᖅᑐᑦ (ᓄᓇᓕ 75% ᑐᓴᐃᓗᒍ), ᖃᓄᐃᒍᑎᐅᔪᑦ ᐃᓕᓴᐅᓚᐅᖏᓕᒫᑦ (ᐅᖃᓗᑎᐅᔭᒍᑎᑐᓂᓐᓄᑦ ᑐᓴᐃᓗᒍ) ᐅᓪᓚᑦᑐᖅᑕᐅᑐᐃᑦ ᖃᓄᐅᔨᓴᕐᓂᖏᓐᓄᑦ ᓇᓴᖏᑦᓴᐅᔪᓐᓇᖅᑐᓂᓐᓄᑦ. ᑕᐃᓚᐃᓚᑦ ᒪᓕᕆᔨᓂᖅ 2 ᒪᓕᑎᐅᓂᖅᓴᐅᔨᓚᖅ ᓄᓇᓕᓂᓄᑦ ᐅᓄᓂᖅᓴᐅᔨᓄᑦ ᑭᐅᔾᔨᑦᑐᓂ ᐅᓄᖅᑐᓴᐅᔨᓄᑦ ᐅᖃᓕᒫᑦ 5% ᐅᖅᑎᒋᔨᓴᕐᓂᖅᑐᓂ.

5.4 ᓯᖅᓯᐃᓕᓴᕐᓂᖅᓯᒪᔨᑦ ᐊᓚᒪ ᑭᐅᔾᔨᑎᑦ ᑕᓚᖅᓯᒪᓕᖅᑐᑦ:

ᐅᓄᓇᓕᒋᑦ ᐃᓗᒪᓴᖅᓯᐅᑭᐅᖅᑐᖅᑐᑦ ᐊᑐᕆᓚᓪᓕᑦᖢᓄᑦ ᖃ: ᑭᐅᔾᔨᑎᑎᐅᑭᐅᔨᓚᑦ ᓯᓚᑎᑎᓄᖅᑐᑦ, ᓯᓗᓕ ᓇᓕᖅᑭᓯᐊᖃᓐᓇᑦᑐᓂ ᐅᒪᔨᖅᑕᐅᓕᓪᓕᒋᓚᒋᒐᓕᑦᑐᓂ ᑭᐅᔾᔨᑦᑐᖅ.

ᖃᐅᔨᓴᓂᖏᓪᓕᐊᑦ ᓯᓂᓄᐃᓕᖅᓯᓄᓂᖅ ᐱᒍᑎᖃᖅᑐᖅ ᐊᑎᖅᓄᖅᑐᖅ ᖃᓄᐃᓕᓂᓴᖅᑐᓄᓂᖅᓂᓄᑦ ᐊᓚᒪᓗ ᐊᑦᓯᐃᓚᓕᓴᐅᑎᑦ, ᖃᓄᐃᓗ ᐃᓂᓕᖅᓱᓚᒋᓚᒋᒐᓕ ᐊᑎᖅᓯᓂᐅᓂᖅᑐᓂᓐᓄᑦ ᑭᐅᔭᒍᑎᓕᐅᖅᓯᓄᓂᖅᓂᓄᑦ ᓄᓯᖅᑭᑦᓯᐊᓕᐅᖅᓯᓄᓂᖅᓂᓄᑦ. ᖃᐅᔨᓴᓂᖏᓪᓕᐊᑦ ᓴᖅᑭᑕᐅᔾᔨᑦ ᓯᓚᔾᔨᓄᖅᑐᓄᓂᖅᓂᓄᑦ ᐱᖓᓱᖃᖅᑐᓄᓂᖅᓂᓄᑦ ᐊᓂᓄᖅᑐᓄᓂᖅᓂᓄᑦ ᐃᓗᒪᓴᖅᓯᐅᑭᐅᖅᑐᖅᑐᑦ ᐱᓕᕆᔨᓂᖅᓂᓄᑦ ᖃᓄᐃᓗ ᐊᑦᓯᐃᓚᓕᓴᐅᑎᑦ ᐊᓚᒪᓗ ᑭᐅᔭᒍᑎᓕᐅᖅᓯᓄᓂᖅᓂᓄᑦ ᐊᑎᖅᓯᓂᐅᓂᖅᑐᓂᓐᓄᑦ ᐊᓚᒪᓗ ᑭᐅᔭᒍᑎᓕᐅᖅᓯᓄᓂᖅᓂᓄᑦ. ᑕᐃᓚᐃᓚᑦ ᒪᓕᕆᔨᓂᖅ 3.2). ᐊᓕᖅᓯᓂᓐᓄᑦ ᐱᓕᕆᔨᓂᖅᓂᓄᑦ ᐊᓚᒪᓗ ᐊᑦᓯᐃᓚᓕᓴᐅᑎ

5.4.2 ᐃᓅᖅᓴᓇᖅᑐᑦ

ᒪᓕᒃᑎᑦ ᐱᐅᓯᓴᐅᔪᖅᑐᑦ ᖃᐅᔨᓴᖅᓯᖅᑎᓕᔭᒍ ᓄᓇᖅᓱᖅᑐᓕᓂᖅ ᐅᒪᓐᖅᑕᐅᔪᖅᑐᓂᓚᐅᓂᖅ, ᖃᐅᔨᓴᖅᓯᖅᓴᓇᐅᔪᖅᑐᖅ ᑕᖅᑭᑕᒡᑦ ᐊᐃᔪᖅᑐᖅᓱᖅᑐᓂᓚᐅᓂᖅ ᐊᒪᓚᓂ ᐅᒪᓐᖅᑕᒥᓯᑦᑕᐃᓕᓂᖅ ᖃᐅᔨᓴᖅᓯᖅᑐᓂᓚᐅᓂᖅ ᐅᓐᓴᓯᐅᑎᓂᖅ ᐃᓅᖅᓴᖅᖃᓄᑦᑎᐊᖅᓂᖅ. ᐊᖏᔪᓱᓯᑎᐅᔪᖅ ᑐᓴᐃᓐᓇᖅᑐᓂᖅ ᐃᓕᓴᕐᓂᖅ ᑐᓴᐃᓐᓇᖅᑐᓂᖅ ᐊᑐᖅᑐᓂᖅ ᐃᓕᓴ

5.4.4 ᐅᖃᐅᓯᖏᑦ ᓇᐃᔭᖅᑐᑦ

ᖃᐅᔨᓴᓂᒃᓯᑦ ᑭᐅᔾᔨᒋᑦ ᐊᑐᖅᖃᖅᑐᑦ, ᓯᑦᓗ ᓯᖅᓯᐃᕐᓴᐅᑎᑦᑎᐊᖅᑐᑦ ᐅᓪᓗᓕᒫᑦ ᐊᑐᖅᖃᖅᑐᑦ ᐊᑐᖅᖃᖅᑐᑦ ᐊᑐᖅᖃᖅᑐ

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Naitumik Titigagutait

Ihivgiuktut Hivuningit

Nunavumi Umayukhiukhimayut Ihivgiugutait (NWHS) pitkuhimayut Nunavumi Nunataagutit Angigutaanit (NLCA) ovalo havakhimayait ataani Nunavumi Umayuligiyit Katimayiinit (NWMB). Umayukhiukhimayut katitigutait katitikhimayut talimanik ukiunik Inuit umayukhiuktinit umayukhiugutainit Junemi 1996mit Maymut 2001mut. Pitjutait umayukhiukhimayut ihivgiugutait naunaiyanahualugit ublumi umayukhiugutait ovalo kanuk atulikpaktait pitkutingit umayut. Iniktigutait umayukhiukhimayut ihivgiugutait atuniaktangit NWMBkut ikayugutigilugit munagitjutikhainik umayut pitkutait ovalo naunaiyautikhainik umayut atugutikhainik naunaiyautainik (BNL). Hamna maligutingit atuinakhimayut hanauyautainik ovalo iniktigutainik ihivgiuktut ovalo ihivgiufaagutikhainik ovalo tuhaktititjutikhainik ihivgiukhimayut iniktigutait. Hamna makpigaak iniktigutaa tuhaktakhak iniktigutainik hamna ikpinaktuk ihivgiukhimayuk.

Ihivgiugutingit havaktauhimayut ataani Umayukiukhimayut Ihivgiuktit Munagiyiinit, ikayuktaupluni Aviktukhimayut Tuhaktituiyinit, munagiyut aviktukhimayuni Nunavumi ovalo Nunani Havaktit, nunamini havaktut. Kinauyakhangit pihimayut Kanatami Inuligiyinit ataanit Nunavumi Iniktiligiyit Katrakmit.

Umayukhiukhimayut Ihivgiugutait pihimayut tamamik Nunavumi Nunataagutit Iluanit (NSA) ilauplutik tamamik 28nik nunani tamamiklu pingahut aviktukhimayunit; Qikiqtaaluk, Kivalliq ovalo Kitikmeot. 1999mi kitkaniilikhuni ihivgiuktut, Nunavumiutait 27,000kuyut ovalo 85%kuyut Inuit. Inuinaungitut nunakatigiit Nunavumi ilaungitut ihivgiuktuni. Umayukhiukhimayut Ihivgiuktitlugit, 6,018kuyut umayukhiuktit ilauhimayut.

Katitigutit Katitigutait

Umayukhiuktit kaligiiktitihimayut; ilaani umayukhiukpaktut, umayukhiuktaktut ovalo umayukhiukatainaktut. Nunani havaktit takukatakpaktait umayukhiuktit tatkikhiut tamaat titigakhugit umayukpaktainik aipaani tatkikhiutini. Tuhagutikhat titigakpaktut kanugitunik umayukpaktut, kafinik umayukpaktut ovalo ilanginik kanugitut umayut, angnauyaakhaita ovaluniit angutauyaakhaita, ukiungit ovalo nani umayukhimayut. Umayukhimayut naunaiyakhimayut tukutihimayait ovalo pivaktait. Umayut katitigutait hanahimayut hivulimi kanugitunik umayukataktut tatkikhiutimut pihimayut ikayugiagani havaktit ovalo umayukhiuktit katitiktitlugit umayukhiukhimayunik. Tatkikhiutit atukpaktut puigugiyaami kanugitunik ovalo kafinik umayukpaktut aipaani tatkikhiutimi, tuhaktitiyaminik havaktinut ihuaktumik. Tatkikhiutit atugutait aatjikiingitut nunanit ovalo ilaani iluani nunat. Ilaani nakuutiaktumik atukpaktut ilangani nunani ilanginit.

21ni nunani uktukhimayut tamaat ukakatiginahualugit tamamik umayukhiuktit; Tamamik umayukiuktit takuyauyukhat katitilugit umayukhiukhimayaminik. Malikhugit inugiagutainik amigaitjutait Arviami, Kamanituak, Ikaluktutiak, Kinngait, Ukhuktuuq, Kugluktuk ovalo Kangiklinik, tamamik umayukhiukataktut ovalo umayukiukatainaktut takuyauyukhat ovalo ilangiinak ilaani umayukhiuktaktut ilaukatauyukhat. Umayukhiukhimayut naunaiyautait katitikhimayut ilaani umayukiukataktut kafinik umayugiagani naunaiyakafukhugit. Takupkalaitjutit inminik umayukhiuktit katitikhimayait pihimayut kihimi kafiuyaakhaita umayukhimayut tamaat ihivgiuktitlugit apigihimakpata kihimi umayukhiuktit titigakhimakpata pitkuhimayainik. Hamna malikhimayavut ataani NLCAmit ovalo atuinaniaktait maligutikhait umayukhiukhimaut katitigutait atuktitlugit pilaaktaini.

Tuhaktituitjutikhat

Tuhaktituitjutingit ilauyunut ihivgiuktuni ilitagihimayut ikpinaktut ilaupkaiyaami nakuuyumik, nakuuyumik tuhaktitiyaami ovalo kiuyauyaami nakuuyumik iniktigutaani. Tuhaktituitjutit pivaktut amigaitunik ilauyunut ihivgiuktitlugit ovalo takupkaivluta, ayoikhaivluta nunani havaktinik ovalo hivulimi katitikhimayunik tuhaktitivluta. Iniktigutaani ihivgiuktut, Nunavumi Ihivgiuktit Munagiyi pulaaktakhimayuk tamamik nunani takupkaivluni iniktigutainik ihivgiukhimayut talimanik ukiuni katitikhimayut ovalo kinikhuni kiuyukhanik iniktigutainik ihivgiukhimayut tuhaktititjutainik. Tuhaktituihimayut aalanik havakvinik ovalo kavamatkut munagiyinut havaktut umayukhiugutinik munagiyunutlu Nunavumi tuhaktituiplutik, hivulimi katitikhimayut tuhaktitivluni ovalo inminik takukatakhugit Nunavumi Umayukhiukhimayut Ihivgiuktinit. Hapkoa ukakatigitjutit ikpinaktut iniktigutainik ihivgiukhimayut ovalo naunaiyanahualugit iniktigutait

ihivgiukhimayut naamagiagani. Kiutjutait tamamik nunani pulaakatagutit ovalo aalanit umayuligiyit ovalo kavamatkut munagiyinit titigakhimayut ilangani 6 hamani tuhaktakhami ilauyut ikpatauyaini nunat tamamik.

Umayukhiuktit Kiutjutait

Umayukhiukhimayut ihivgiugutait inminik pihimayut, taimaimat ilangit umayukhiuktit ilaungitut. Hapkoa umayukhiuktit titigakhimayuugaluit kihimi apikhuktauyuitut piyumanginmata. Naunaiyautait kiuyuitut aatjikiingitut nunani; naunaiyautait ilaani 0%kuyut nunani; Ikpiarjuqmi ovalo Sanigayaqmi, ilaani 32.7%kuyut Kamanituaqmi iniktigutaani ihivgiuktut. Ilaanilu ilangit umayukhiuktit takulaitut, ilangit ukakatigingitut umayukhiuktit tamamik tatkikhiutini pipkaivluni aalatkiitunik naunaiyautainik pilikpakhuni ilaani tatkikhiutini ihivgiuktitlugit. Kiutjutit naunaiyautait aalatkiiktut talimani ukiuni nunanit ilaani tatkikhiutini. Anginikhaangit naunaiyautait ilangit pivaktut 98%mik Ikpiarjuqmi ovalo Nanisivikmi ovalo ilaani 64%mik Kamanituaqmi ovalo Salliqmi, tamamik naunaiyautikakhuni Nunavumi nunaini anginikhaak 82%mik. Pihimamata hapkoa naunaiyautit, tuhaktitihimayut umayukhiukhimayut mikitkiyauniaktut ilaa tamamik umayukhiuktit takuyauhimaimata. Umayukhiukhimayut naunaiyautait pihimayut tamamik umayukhimayunit ovalo tamamik nunat atukhutik atuinaktunik atugutaini (ilangani 4); pinahuakhutik talimanik piinaktunik ukiuk tamaat naunaiyautainik umayukhimayaminik nunamini atuktakhainik NWMBkut naunaiyagiami atuktakhainik umayut ataani NLCAmi. Tatkikhiutini ovalo Ukiuk tamaat naunaiyautit ovalo kiutjutit takulaaktut katitikhimayut ikpatauyaini nunat (Ikpatauyak 11 – 650) ovalo tamamik katitikhimayut Nunavumi (Ikpatauyami 651 – 674).

Naamagutait Umayukhiukhimayut Naunaiyautait: Nani Ihuinaakhimayut

Ilaa tamamik apikhunahuaktut pilaimata inminiigamik tamaat ihivgiuktitluta, ihuinaagutait pihimayut 95%mik tamaat umayunit ukiuk tamaat pihimayunit. Aipait ihuinaalaaktut pihimayut ikpinagutigilaaktait naunaiyautit ihivgiukhimayut ihivgiufaamata hamna ihivgiuguti. Hapkoa ihuinagutit ilaupkaihimayut hamani aviktukhimayuni:

- Ihivgiugutit Atugutaini
- Ihivgiugutini ovalo Kiuyuitut ihumagiyaini; ovalo
- Atugutaini ihumagiyait ovalo kiuhimayut ihuinaagutaini

Ihivgiufaagutait ihivgiukhimayut atugutait takuhimayut naamagiagani atuktangit tamamik ovalo ihuaktumik takupkakhimayait umayukhiuktit. Ihuinaakhimayut ilauyut ihivgiugutit atugutait tamamik ataani apigiyauhimayut ovalo kaagani apigiyauhimayut. Takuhimayuk ilangit umayukhiuktit titigaktauhimaitut umayukhiukhimayut ihivgiukvimi. Hamna ataani apigiyauhimayut kataktitiniaktuk hamani naunaiyautini hapkoa umayukhiuktit titigaktauhimaimata umayuktaminik naunaiyautaini. Ihivgiufaagutait hamna ihuinaakhimayuk tamamik nunani ovalo titigakhimayuk ilangani 6. Naunaiyakhimayuk hapkoa ihuinaakhimayut mikiyut, piitunik ilaani ovalo mikikpiakhutik nunani ilangani; Ikpiarjuk, Igloolik, Kugluktuk ovalo Arviami kihimi naunaiyakhimayut ilanganilu amigaitut nunani; Ausuituq, Pangnirtung, Kugaaruk ovalo Salliqmi. Nalunaituklu, ilaani kaagani apigiyauhimayut titigaktauvamata umayukhiungitunik ihivgiuktuni pivaktut ilangani nunani. Ikpinagutait hamna ihuinaakhimayut pilaaktut kaaganut ovaluniit ataanut apigiyhauhimayunut tamaat naunaiyautaini ovalo ayonaktuk kanuk ikpinagiyait; kihimi ihumagiyauyut mikiyut tamaat naunaiyautainut.

Ihivgiugutingit kiuyuitut naunaiyautait ihivgiufaakhimayut naunaiyanahuahugit ikpinagiyaulaagani aalangugutait nunani umayukhimayut ovalo atugutingit kiuvaktut ovalo kiuyuitut. Pilaaktait kiuyuitut ihuinaagutait angililaaktut kiukataktut katagaagata kiuyuitut naunaiyautait angikligaagata. Taimaimat, nalunaituk mikiyuk hamna kiukatagutit angiyuumata (avataanut 75%mik) Kiuyuitut naunaiyautait mikiyuugaagata (ataani 5%mik). Ilaa, hapkoa aalatkiiktut nunanit ovalo ilaani tatkikhiutini. Tamamik Nunavumi kiuyuitut naunaiyautait Nunavumi 4.5%kuyut. Ilangani 6 pihimayut ihivgiufaagutiginik hamna ihuinaagutini tamamik nunani ovalo ihumakuplugit taiguaktut takugaagamik.

Ihivgiufaagutait atugutaini ihumagiyaini ovalo kiuhimayut ihuinaagutaini pihimayut naunaiyagiami ihivgiukhimayut nakuuyaakhaita; ilaa naunaiyagiami umayukhimayainik umayukhiuktit naamagiagani. Tuhaktitihimayut tamamik Nunani havaktinit ovalo umayukiuktinit, nakuuyumik kiulikpaktut, kihimi ilaani ihuinaakpaktut naunaiyakhimayut mikhaanut. Hapkoa ayonagutait naunaiyakhimayut ilaani ukayuitait; manikhiugutit ovalo kiviut tinmianit, uviluvaluit ilangit nunani pivaktut ukayuitait umayukhiuktit nalugaluagamik tuhaktitiyakhainik ovalo ilangit umayukhiuktit naunaiyayuimagit ilangit umayuktainik hapkonanik ovalo ilaani puigulikpaktait hapkoa umayuktaminik apikhuktauligaagamik.

Takuvaktugutlu kinauyaliugutait umayukhiuktut ilaani titigatiayuitut tuhaktititjutini nunani. Piyukhaugaluamata umayut niuviktauhimayut ovalo nigiyauhimayut iluani Nunavumi, titigakhimayukhat ihivgiugutini ovalo tahapkoa niuviktauhimayut hilataani Nunavut titigaktukhat kihimi unguvaktukhat naunaiyaligumik inminiigutinik atuktakhaminik umayunik naunaiyaligaagamik (BNL). Hamna atutiayuituk hunmatkia ovalo pipkaihimayuk aalatkiinik tuhagutikhanik umayukhiukhimayunik kinauyaliuktuni.

Ihivgiuguti hanahimayuk tatkikhiutini tamaat kiukataktut nalugiyaami umayuktaminik ihuaktumik; umayukhiukhimayut ihivgiuktit tatkikhiutaa hanahimayuk taimaatut ikayugutigiyaami ihumagivlugu. Kihimi, hunmatkia, ilaani nunani havaktit ayokhagutainik ovaluniit umayukhiuktit takuyaukatayuimata ilaani amigaitut tatkikhiuktit kaagikpaktut ukakatigihimaitumik. Hapkoa taivaktut utiktitjutit apigiyautikhat naunaiyautauvakhutik katitigutit ihivgiufaagagamik naunaiyagiami ihuinaalaaktunik. Utiktigutit apigiyautikhat mikiyut Nunavumi, 88%kuplutik umayukhiuhimayut tuhagutikhait katitikhimayut iluani pingahut tatkikhiutit umayukhimayaminit. Kihimi taiguaktut ukautihimayut ihumagilugit ilangani 6mi amigaitut umayukhiukhimayut katitigaagata avataanut siksinik tatkikhiutini umayukhiuktaminik.

Kingulimi, uktugutinik ihumagiyainik ihivgiuktauhimayuk piyunakhihimamat atugutaini ihuinaagutinik. Pivakpaat umayukhiuktit ataani ovaluniit kaagani naunaiyakpaktut umayukhiukhimayaminik ovalo pikatainakpakpaat? Amigaivyaktut ukakhimayut mikhaanut uktugutikhat ihumaiyainit pihimayut nunanut pulaakataktitluta. Ukakhimayut mikhaanut uktugutinik ihumagiyainik nalvaakhimayut nunanut pulaaktakhimatitluta. Tamamik ukakimayut ataanik naunaiyakpaktut umayukhiukhimayainik hunmat ukahutik ilangit; naluvyakhimagamik hunmat ihivgiuktut ovalo ikhivlutik mikhipkaniaktait umayukataktainik; pikatainamata umayukhiuktut ataani naunaiyalutik umayuktaminik; ukagumanginaminik ilaani umayuktaminik kingulimi pilaikaluamata (Kukyuit ilangit). Ukakpalaayuitut umayuktaminik ovalo ihumayugut piyuitut taimaatut.

Kingulimi, apigiyaukataktut Umayukhiukhimayut Ihivgiuktuni: Hapkoa naunaiyautit nakuuvaat umayukhiuguini naunaiyautait? Pikatakaat naunaiyautititianik titigakhimayunik umayukhiukhimayut atugutainik ovalo naunaiyautainik Inuit ihivgiuktautitlugit ukiungini? Iniktigutainik hamna katitigutit ihivgiufaagutaini, kiutjutait iihik ovalo ilangani iik. Angitjutaa ovalo ayonagutaa Nunavumi Umayukhiukhimayut Ihivgiugutait katitikhimayut atugutihait aalatkiiktut nunani, ovalo ukiungini ihivgiuktut ovalo ilagnit umayuni. Taimaimat, taiguaktut pitkuhimayut ihumalutik ilangani 6mi: Nunani Iniktigutait Ukauhiit atuligaagamik umayukhiukhimayut ihivgiugutait katitigutainik. Hamna ilauyuk ihivgiufaagutainik nani ihuinaakhimayut titigakhimayut nunani inminik hamani ovalo nunat kiuyumakpata ukauhiinik katitikhimayunik ovalo aalanik umayukhiukhimayut katitikhimayunik naunaiyafaagumaguvit iniktigutainik.

Hamna Iniktiguti Tuhaktakhak iniktigutainik hamna NWHSmi, tuniyut taiguaktunut inikpiakhimayumik tuhaktakhamik ihivgiukhimayumi ovalo iniktigutainik. Umayukhimayut katitigutait nani takulaaktut atulutik Nunavumi Umayukhiukhimayut Ihivgiugutait GISkut kungiagutinut, ilauyut CDkut ovalo hamani tuhaktakhami. NWMBkut ihivguliktut piyakhainik ungahiktumut tutkukvikhainik hamna ihivgiukhimayut katitikhimayunik. Tutkuktuitjutit atuniaktut pilaagiagata atugumayut katitifaakhimayuni pihimaituni kihimi kingulimi tutkuktauhimakpata. Titigakvimi munagiyut akiliktipkainiagunakhiyut atugutikhainik. Hatja kihimi taiguagumayut piyumayut katitikhimayunik apigilaaktut NWMBkunit. Pipkainiaktut NWMBkut inminik apigiyunit kihimi havaktikakkatlu ovalo ayonangitpat apigiyauyut pikatalutik apigiyauyunik inminut.

1. Hivuliit Tuhaktakhat

1.1 Hunauyut Tuhaktakhat

Nunavumi Umayut Umayukhiuktauhimayut Ihivgiugutait (NWHS) maligutilik Nunavumi Nunataagutit Angigutaanit (NLCA) naunaiyagiami kafiuyut umayut umayukhiuktauvaktut Inunit tamamik nunamini Nunavumi avataanut talimat ukiut. Nunavumi Umayuligiyit Katimayiit (NWMB) tuniyauhimayut munagilugit ihivgiugutikhat. Talimani ukiuni 6,018kuyut umayukhiuktut titigaktauhimayut ihivgiuktauyukhat 28ni nunanit ovalo umayukhiukhimayait katitilugit tatkikhiut tamaat avataanut 60kuyut umayut. Umayukhiuktauhimayut katitihimayut ilauyut nani tukutauhimayut, naunaiyautait angnauyaakhaita ovaluniit angutauyaakhaita ilangit umayut.

Hunauyukhak hamna tuhaktakhak piniaktuk:

- Ukaluni atugutingit umayukhiukhimayut ihivgiugutait;
- Tuhaktiniaktait iniktigutiat ihivgiukhimayut;
- Naunaiyalugit nakuutjutait inikhimayut;
- Tuhaktitilugit iniktigutait ilangani 5, ilauyut 4 NLCAmi (takulugu Ilangani I) ilaupkakhimamata atugutingit maligutihait (NLCAmi, 1993, ilangani 5-5) NWHSmi.

Atuktangit NLCAmi (takulugu ukauhiit ilangani 2.1), ovalo atukataktangit ilihimayut amigaivyaktuni umayukhiukhimayut ihivgiugutaini 1970'snit ukiuktaktumi Kanatami, pihimayut hapkonani naunaikhimayuni NWHSni:

- Ihivgiugutit pihimayut 28nik aalatkiinit nunanit ihivgiugutinik atukhutik aatjikiinik atugutainik. Ilauyut inminiikhimayut.
- Ihivgiuguti pihimayuk tamatkiinahuakhugit atugutainik (Keelinikakhuni kihimi) pinahuakhimaplutik ukakatigilugit tamamik ilauyut umayukhiuktut.
- Inminik umayukhiuktut ukakatigihimayavut tamaat tatkikhiutinit, 60nik tatkikhiutini (June 1996mit – May 2001mut).
- Ukiuk tamaat umayukhiuktauhimayut naunaiyautait tamamik umayut ilauyut tatkikhiutini naunaiyautaini, piplugit pihimayut tuhaktitihimayut umayukhiuktauhimayut ovalo ihivgiukhimayut naunaiyautaini ilihimayut atukhutik atuktaminik naunaiyautinik. Pinahuakhugit pilugit talimat tamaat ukiuni (Junemit Maymut) naunaiyautait umayut tamamik nunanit.

Tatkikhiut ovalo ukiut tamaat umayukhiukhimayut katitigutait uktukhimayut ovalo naunaiyakhimayut umayukhiukhimayut takulaaktut ikpatauyami (ikpatauyat 11 – 674). Kagitauyakut atugutingit, Nunavumi umayukhiukhimayut ihivgiugutait GISkut kungialaat, pilaaktut hamani tuhagutikhami ovalo atulaaktut nunauyait umayukhiukvigihimayait naunaiyautait katitihimayuni.

Ihivgiukhimayut atukhimayut ublunik amigaitunik ovalo takupluni hanatjutaainik Nunavumi 1999mi. Taimaimat, tamaat titigakhimayuni ukautingit tamamik Nunatiami Kavamatkut ovalo Kavamatkut Nunavumi ovalo atugutingit munagiyiit, atugiagani kanuk ovalo ubluit ukakhimayut atukhimayainit.

1.2 Ukautinguangit titikat

BNL – Mikinikhaat atuniaktait umayut
BQCMB – Beverly Qamanirjuaq Tuktuni Munagiyit Katimayiit
CWS – Kanatami Umayuligiyit
DEC – Katitigutinik Titigakti
DIAND – Kanatami Inuligiyit
DFO – Munagiit Ikalukhiuktuni ovalo Tagiuni
DIO – Tikuaktuhimayut Inuit Havakviit
DRR – Munagiyiit Umayunik (Nunatiami)
DRWED – Munagiyiit Umayunik ovalo Hanatiligiyini (Nunatiami)
DSD – Munagiyiit Hanatiligiyini (Nunavut)
FW – Nunami Havaktiit
GHL – Umayukhiuktut Laisinsiit
HTA – Nunani Umayuligiyiit
HTO – Nunani Umayukhiuktut ovalo Nanigiakhiuktut Havakviit
IQ – Inuit Kauyimayatukangit
NLCA – Nunavumi Nunataagutit Angigutaa
NOCIR – Tuhaktititjutait aalangukhimayut titigagutait
NSA – Nunavumi Nunataagutit Angigutaani Iluani
NWHS – Nunavumi Umayukhiukhimayut Ihivgiugutait, Umayukhiukhimayut Ihivgiugutait, Ihivgiugutait
NWMB – Nunavumi Umayuligiyit Katimayiit
RLO – Aviktukhimayuni Tuhaktituiyit Havaktiit
RWO – Aviktukhimayuni Umayuligiyiit
TAH – Tamaat pilaaktut umayut
TEK – Inuit Kauyimayatukangit Nunani
UTM – Umayuni naalautit naunaitkutait

1.3 Ilitagiyumayavut

Nunavumi Umayukhiukhimayut Ihivgiugutait anginikhaat Kanatami. Ovalo avataanut 35kuyut Inuit havakhimayut mikhaanut Umayukhiukhimayut Ihivgiugutaanik tamaat ukiuni, amigaitut Inuit tamamik NWMBkut ovalo aalat havakviit ovalo kavamatkut munagiyiit ikayukhimayut ihivgiuktitluta. Kihimi, nakuutjutait Umayukhiukhimayut Ihivgiugutait tikuakhimayukhat Umayukhiuktut ilauyunut. Umayukhiuktut Nunavumi ilauhimayut Umayukhiukhimayuni Ihivgiugutaani ilaukatauhimamata katitikhimatitlugit tamaat tatkikhiutini talimani ukiuni, ilitagiyauyukhat ilaukatauhimamata ikpinaktumik ihivgiugutimi.

Hapkoa Inuit ovalo havakviit akhut havakpiakhimayut ihivgiuktilugit umayukhiukhimayunik ovalo tunihimamata kiutjutinik ihivgiugutit havakhimatilugit:

Nunami Havaktiit:

Ikpiarjumi ovalo Nanisivik: Pauloosie Muckpa

Arviat: Frank Nutarasungnik

Kamanituaq: Basil Aptanik, Andrew Parker, Charles Tarraq, Jonathan Tugak, Betsy Aksawnee, Lucy Mautaritnaaq

Kingauk: Connie Kapolak

Ikaluktutiak: Ruby Haniliak

Kinngait: Joe Ittidlui, Salomoni Etulu, Sakiassie Pudlalik, Alice Samayuallie, Numa Ottokie, Ragee Killiktee

Igluligaarjuk: Peter Autut, Gary Ippiak, Gloria Mimialik, Ursula Innukshuk, Bradley Aggark

Kangiktugaapik: Seetee Paniloo, Levi Illingayuk

Salliq: Susie Eetuk, Heather Kolit, Molly Eetuk, Ben Ell, Tina Netser, Johnny Alogut

Ukhuktuuq: Elizabeth Aglukkaq, Teddy Eleeheetook, Sarah Kegeak, Elijah Takkiruq

Aujuituq Fiord: Leah Kalluk, Parnee Noah

Sanigayaq: Joe Curley, Judah Innraluk, George Innuksuk, Martha Okalik, Bruno Immaroitok, Josie Irquttuq, Neomi Kaernerk

Igloolik: Eugene Ipkarnak

Iqaluit: Levi Nowdluk, Salamonie Shoo, Adamie Ipeelie, Tony Ulikatar, Eelaya Pitseolak, Eyalah Ineak, Jarloo Nowdluk, Micheal Immaroitok, Jamesie Pudloo, Moses Qillaq, Nathan Tigullaraq

Kimmirut: Hannah Oolayou, Josehphie Eyeevodluk, Terry Lee, Eric Tikivik, Atsaina Kolola, Olittua Judea

Kugaaruk: Eric Ammautinuar, Isabella Inuksaq, Tom Kayaitok, Charlie Niptayok, Gerald Tigvareak

Kugluktuk: Ida Kapakatoak

Pangnirtung: Josephie Kilabuk

Mitimatalik: Martha Maktar, Paul Hauli, Jonah T. Paniloo, Jollie Enoogoo, Joanasie Anaviapik, Timothy Qamaniq

Qikiqtarjuaq: Imoona Natsiapik, Jonas Audlaqiaq, Lucy Newkingnak, Jerry Kakka, Monica Nuqingaq

Kangiklinik: Albert Kimmaliardjuk, Pierre Kolit, Pierre Okoktok, Andy Tugak, Lucy Kalukjak, Peter Autut

Naujaat: David Ammaq

Qaujuituq: Philip Manik, Saromie Manik, Deborah Ikaluk

Sanikiluaq: Johnny Kudluarok, Louisa Meeko, Luccassie Arragutainak, Winnie Arragutainak, Caroline Arragutainak

Taloyoak: Steve Aqqaq, Peter Mannilaq, David Nanook, Joseph Quqqiaq

Umingmaktok: Martina Kapolak, George Panegyuk, Connie Kapolak

Tikigaqjuaq: John Angoo, Ron Alikashuak, Lewis Voisey Jr., Jackie Napayok, Gunner Tugak, Louie Oklaga

Katitikhimayut Titigaktiit:

Qikiqtaaluk: Taqialoo Stokes

Kivalliq: Janet Akat, Angie Okatsiak, Elizabeth Issakiark, Sally Waah, Susan Arloo, Debbie Arualak

Kitikmeot: Dawn Ayalik, Edith Anablak, Mary-Jean Anablak, Susan Atatahak, Ann Klengenberg, Michelle Klengenberg

Aviktukhimayuni Tuhaktituiyit Havaktiit:
Qikiqtaaluk: Tom Demcheson

Kivalliq: Phillipe diPizzo, Janet Akat

Kitikmeot: Todd Roche

Katitikhimayuni Munagiyiit:
Daniel Kulugutuk, Josée Galipeau, Leanne Pugh

Kingulimi Umayukhiukhimayuni Ihivgiuktit Munagiyiit:
Carol Churchward, Johnny McPherson, Jordan DeGroot

Umayukhiukhimayut Ihivgiuktit Munagiyit Katimayigalaat:
Ovide Allakanuark, Adrian D'Hont, Jim Hines, Moses Koonoo, Gordon Koshinsky, Roger Peet, Simeoni Sammurtok

Umayukhiukhimayuni Ihivgiuktit katimayigalaat:
David Alagalak, Nick Amautinuar, Harry Flaherty, Pauloosie Keeyotak, Moses Koonoo, Gordon Koshinsky, Kevin J. McCormick, Robert Moshenko, Makabe Nartok, David Tagoona

NWMBkuni Havaktiit:
Dan Pike, Atanguyak Umayuligiyini

Michelle Wheatley, Atanguyak Umayuni Munagiyiit

Billy Shaw, Umayukhiukhimayuni Ihivgiuktit Ikayukti

Ukautinik Himuktitihimayut:
Evie Amagoalik, Betty Brewster, Edna Elias, Helen Klengenberg, Rebecca Mike, Mary Nashook, Allen Maghagak and Jacopoosie Peter.

Katraktiligiyit:
Fikret Berkes, Mina Berkes, Helen Fast, Natural Resources Institute, University of Manitoba (Ihivgiugutit Hanauyautainik)

Falcon Consulting Services (Kagitauyakut FoxPro katititjutainik hanauyautainik)

Geomatics International Inc. (Nunauyaliuktut Pilihimayut)

Wayne Johnson (MS Access kagitauyakut hanauyaautainik)

GeoArctic International Ltd. (katitigutainik ovalo nunauyaliugutainik atuktainik)

Peter J. Usher, P.J. Usher Consulting Services (katitikhimayunik ihivgiukhimayuk ovalo tuhaktakhanik titigakhimayuk)

Jack Kruse, Professor emeritus of public policy, University of Alaska, Anchorage (Katitikhimayunik ihivgiukfaakhimayut)

Jamie deJong, Abdellatif Demnati, Hew Gough, Statistical Consultation Group, Statistics Canada (Katitikhimayunik Ihivgiukfaakhimayut)

Koyagiyumayavutlu havaktiit ovalo katimayiit Aviktukhimayuni Umayuligiyiit ovalo Nunani Umayuligiyiit ilauhimamata ilangani hamna Umayukhiukhimayut Ihivgiugutaaini, ovalo titigakvini munagivlutik ovalo nunani ukakatigivlutik. Ovalo havaktiit Munagiyit Hanatiligiyini (DSD), Nunavumi Havakviit Katitiligiyini, Munagiyiit Ikalukhiuktuni ovalo Tagiuni (DFO) ovalo Kanatami Umayuligiyit (CWS) ilahimayut tuhagutikhanik ovalo ikayukhutik ihivgiugutaani havaktilugit.

Heather Priest, havakhuni Umayukhiukhimayunik Ihivgiuktuni Munagiyiupluni, paknaiyakhimayait hamna tuhaktakhak ovalo Dr. Peter Usher ovalo Dr. Michelle Wheatley. Dr. Peter Usher angiyumik ilihimayuk katitigutainik ihivgiukfaagutainik ovalo titigakhimapluni Ilangani 5 (Nakuutjutait Umayukhiukhimayut Ihivgiugutait Naunaiyautait: nakiit ovalo naunaiyautait ihuinaakhimayut) ovalo ikayukhuni titigakhimaplugit ovalo ihuakhihimaplugit aalat ilangit iniktikhimayut makpigaat. Dr. Michelle Wheatley havakhimayuk akhut ihuakhakhimaplugit Iniktikhimayuk Tuhaktakhak ovalo ikayukhimapluni ilangani 6 (Nunani Iniktikhimayut Ukautaini).

Brian Wheatley ovalo Michelle Wheatley ihivgiukhimayuk hivulimi hamna Iniktiguti Tuhaktakhak. Ihivgiukhimayuklu iniktigutaanik Fikret Berkes, Natural Resources Institute, University Manitobami, Cynthia Wentworth ovalo Jim Simon, tamamik Alaskami Munagiyit Ikalukhiuktini ovalo Umayuligiyinit, kungiakhimayait iniktikhimayut ihivgiugutit. Ukauhiit ovalo kiutjutait angiyumik ikpigiyavut katitikhimatitlugit hamna iniktigutaa tuhaktakhak.

Koangikpiagumayavut tamamik Inuit ilauhimayut hamna havaktilugu ihivgiugutikhak. Mamiana puigukhimaniguptigu Inuit ikayukhimayut, kihimi amigaitpiamata.

2. Ihivgiugutit Naunaiyautait Kingulimi

2.1 Piyakhait ovalo maliktakhait NWHSmi

Nunavumi Nunataagutit Angigutaa (NLCA) piyakhait imaatut:

"Nunavumi Umayut Umayukhiukhimayut Ihivgiugutait (Ihivgiugutit) piniaktut iluani ovalo kaagani tamamik pingahut aviktukhimayut Nunavumi Nunataagutit Angigutaani Iluani" (NLCAmi, 1993, Ilangani 5.4.1);

ovalo "piliniaktut tamamik pingahuni aviktukhimayuni tikitinagu ovaluniit atuliktinagu hivumik ukiungani ublua iniktigutaaini angigutaa" (NLCAmi 1993, Ilangani 5.4.2); ovalo

"piniaktut havaklutik talimani ukiuni" (NLCAmi, 1993, Ilangani 5.4.4.).

Hunauniaktuk ihivgiuguti ukakhimayut imaatut:

"katitilutik ilihimayunik ublumi umayukhiukataktunik naunaiyautainik, ikayugiagita NWMBkut iliyaagani naunaiyautainik tamaat umayukhiulaaktut ovalo ilaani, ikayugiagani nakuuyunik munagitjutikhanik ovalo nakuuyunik atugutikhainik umayut Nunavumi Nunataagutit Angigutaini Iluani. Taimaimat, ihivgiuktut piniaktut imaatut:

(a) Titigaklutik naunaiyautait ovalo kanuk atukpaktait Inuit atugutinik umayut atugutihait naunaiyagiagani mikinikhaa atuniaktait umayut (BNL); ovalo

(b) Katitilugit, ihivgiulugit ovalo ihivgiukfaalugit ublumi kanugitut, nunat atuktangit ovalo umayukhiukhimayut katitigutait mikhaanut munagiyaagani umayut Nunavumi Nunataagutit Angigutaini Iluani." (NLCAmi, 1993, Ilangani 5.4.5)

BNLni naunaiyakhimayukhat, "tamamik umayut ovaluniit amigiatjutait", "malilugu:

(a) katitihimatjutait naunaiyautaini angitkiyat amigaitjutait umayukhiukhimayut atauhimi ukiumi ihivgiukhimatitlugit ovalo kitkani ukiuk tamaat naunaiyautait umayukhiukhimayut avataani talimat ukiuni ihivgiukhimayuni, katitihimatjutait aviktukhimalugu malgunik: ovaluniit

(b) naunaiyautait umayukhiukhimayut ukiuni kitunikiak ihivgiukhimayuni tikuaktauhimayut HTOkunit iniktigutaani ihivgiuguti ovalo tikuakhimayuk ukiuk atuktauniaktuk tamamik umayunik atuklugu tamaat umayukhiulaaktut pilihaaktilugu ihivgiuguti." (NLCAmi, 1993, Ilangani 5.6.21)

(Atugutingit aalatkiiktut amigaitjutainik umayut maliklunik tamaat umayukhiulaaktut pilihaaktilugu ihivgiuguti ovalo tahapkoa pilaaktut tamaat umayukhiulaaktut ubluini avataanut).[1]

Maligutikhait ihivgiuktukhat naunaiyakhimayuk (amigaituniklu) "katitiniaktut katitigutikhanik naunaiyakhimayunik nunanit aviktukhimayunit ubluni naunaiyakhimayuni" (NLCAmi, 1993, Ilangani 5-5). Piyukhatlu ihivgiuktut "ihivgiulutik, katitilutik naunaiyautikhainik ovalo nunani havaklutik…piniaktut tuhaktitainahualutik anginikhaanik umayukhiutunit ilaulutik" (NLCAmi, 1993, Ilangani 5.4.3).

Atuklugit maligutikhait ovalo maliktakhait, pinahuaniaktut ihivgiuktut hanalutik ukiuk tamaat naunaiyautainik kafit umayut umayukhiukpaktait Inuit, kanugitut ovalo nunanut ovalo pilutik tuhagutikhanik nani hapkoa umayukhimayait.

2.2 Titigakvimi Munagiyiit ovalo Havagutait

NLCAmi titigakhimayuk imaatut:

"Ihivgiuguti piniaktuk ataani malilugu NWMBkut" (NLCAmi, 1993, Ilangani 5.4.2);

"ihivgiuguti, katitigutit ovalo nunani havaktukhat mikhaanut ihivgiuguti… katraktiliniaktuk kitumutkiak DIOnut (NLCAmi, 1993, Ilangani 5.4.3); ovalo

"akiliktauluni kinauyakhait Kavamatkunit" (NLCAmi, 1993, Ilangani 5.4.4).

Ihivgiuguti hanahimayuk hivuliktini havaktikakhutik ilauyunut NWMBkunut titigakviani Iqaluni, pingahut aviktukhimayut havakviit munagivlutik DIOkunit, hapkoa Aviktukhimayut Umayuligiyinit (RWO) ovalo nunani havaktiit tamamik 27ni nunani. Naunaiyautaa 1 pihimayuk havagutait tamaat havagutigiyavut.

[1] *"tamaat umayukhiulaaktut" umayunut ovaluniit amigaitjutainik umayut ukakhimayuk umayut umayukhiulaaktait ilihimayait NWMBkut (NLCA, 1993, Ilangani 5.1.1)*

Ukakhimayuk hamani, ihivgiuktut hivuliktinga NWMBkut titigakvia Iqaluni. Ihivgiuktut munagiyauyuk Umayukhiukhimayut Ihivgiuktut Munagiyinit, inia ilihimayuk NWMBkunit autlalihaaktilugu ihivgiuktut. Munagiyi angiyumik havakhimayuk autlaktititjutaani ilanga Umayukhiukhimayut Ihivgiugutaani ukakatigivlugit ihivgiugutikhat hanauyautainik katraktiligiyinit ovalo Umayukhiukhimayut Ihivgiuktit Katimayigalaanut. Ihivgiuktut pitilugit katitigutainik munagiyi munagihimayuk maliktipkaipluni ayonaktunik ovalo titigakvimi munagivluni ilangani ihivgiuktuni, pipkaipluni mikinikhaanik aatjikutainik atuktakhainik tamaat Nunavumi aviktukhimayaini ovalo pinahuakhuni ihivgiuktut iniktinahuatitlugit ukakhimayait NLCAmi. Munagiyi munagihimayuk Umayukhiukhimayut Ihivgiugutait kinauyakhait, pikatakhuni ovalo katitikhimapluni katitikhimayunit tamamik aviktukhimayunit titigakviinit ovalo ihivgiukfaakhuni ovalo tuhaktitipluni Umayukhiukhimayut Ihivgiugutait iniktigutainik. Munagiyi havakhimayuk RWOkunik oval Umayukhiukhimayut Ihivgiuktit Katimayigalaat iniktikhugit hapkoa havaktakhait. Tuhaktitikataktait havaagit Umayukhiukhimayut Ihivgiugutait katimagaagata NWMBkut ovalo ilaani aalani katimagaagata. Katitikhimayut katitihimalimata, munagiyi hivuliuyuk ihivgiukfaagutainik ovalo tuhaktakhainik ihivgiugutit iniktigutait. Hapkoa havaat ilauyut nunani pulaaktakhutik tuniyaami hivuliit katitihimayut nunani ilauyunut ovalo havakatigivlugit katraktiligiyit tamamik katitikhimayut ihivgiukfaagutainik ovalo titigagutainik Umayukhiukhimayut Ihivgiugutit Iniktigutaa Tuhaktakhak. Hitamauyut munagiyut hamna ihivgiuktautitlugu.

Katitikhimayuni Munagiyi havaktihimayuk March 2000mi ikayugiagani Munagiyi pikataktilugu ovalo ihuakhaitilugu katitihimayunik. Katitikhimayuni Munagiyi havakhimayuk Munagiyimut Umayukhiukhimayunik Ihivgiuktini ovalo munagivluni munagitjutainik, titigakkhuni ovalo ihuakhaipluni tikikataktunik katitigutinik. Hamna inia unguvakhimayuk January 2002mi katitigutit inikmata ovalo havaktaunmata.

Amigaivyaktut katimayigalaat ilihimayutlu NWMBkunit munagiyukhat ovalo ikayuktukhat hanatjutini ihivgiuktilugit. Hivulik, Umayukhiukhimayut Ihivgiuktit Munagiyut Katimayigalaat, ilihimayut ikayugiagani munagiyumut hivulimi piliktilugit umayukhiukhimayut ihivgiugutaaini (NWMB, 1995a). Munagiyit katimayigalaat ilauyut tikuaktitauhimaplutik pingahunit aviktukhimayunit umayuligiyinit (RWO), Kanatami Munagiyit Ikalukhiuktunit ovalo Tagiunik (DFO), Kanatami Munagiyit Hilakyuamit ovalo Nunatiamit Kavamatkut Munagiyit Umayuligiyinit (DRR). Ikhivautauyuk ilauyunit NWMBkunit. Munagiyit Katimayigalaat iniktikhimayut NWMBkunit November 1997mi ovalo himautaupluni Umayukhiukhimayut Ihivgiuktit Katimayigalaat, ilauyut tamaat NWMBkunit katimayiinit, munagiyaami katitikhimayut iniktigutait ihivgiuktuni (NWMB 1997).

Pingahut Aviktukhimayut Umayuligiyiit angiktauhimayut DIOkulutik atuklugu NLCAmi Ilangani 5.4.3mi Septembermi 1995 (NWMB 1995c) ovalo katraktilitauplutik havaakhainik NWHSnik aviktukhimayamini Januarymi ovalo Februarymut 1996mi (NWMB 1996). Hapkoa munagiyut aviktukhimayamini:

- Qikiqtaalumi Umayuligiyit, Iqaluni (Qikiqtaalumi;
- Kivalliqmi Umayuligiyit Katimayiit, Arviami (Kivalliqmi);
- Kitikmeoni Umayuligiyit, Kugluktumi (Kitikmeoni)

NWHSnik ilihimayut aatjikutaanik tamamik aviktukhimayuni. Tamamik aviktukhimayut havakviit munagiyauyut Aviktukhimayut Tuhaktituiyit havaktianik (RLO), havakhimayut tamamik NWMBkunit ovalo RWOkunit. Taimaimat, havaktait ilaani ihivgiuktunut Umayukhiuhimayunik ovalo RWOkut havaktainik. RLOkut Umayukhiukhimayut Ihivgiuktait havaagit ilauyut, munagivlugit aviktukhimayut Umayukhiukhimayut Ihivgiuktut kinauyainik ovalo havaktipluni, ayoikhaipluni ovalo munagivluni aviktukhimayut Katitigutinik Titigaktiit ovalo nunani havaktiit. Tuhaktituiyait kanuk havaktait katitigutimini pivaktait pilaagumi, Ihivgiuktit Munagiyiinit.

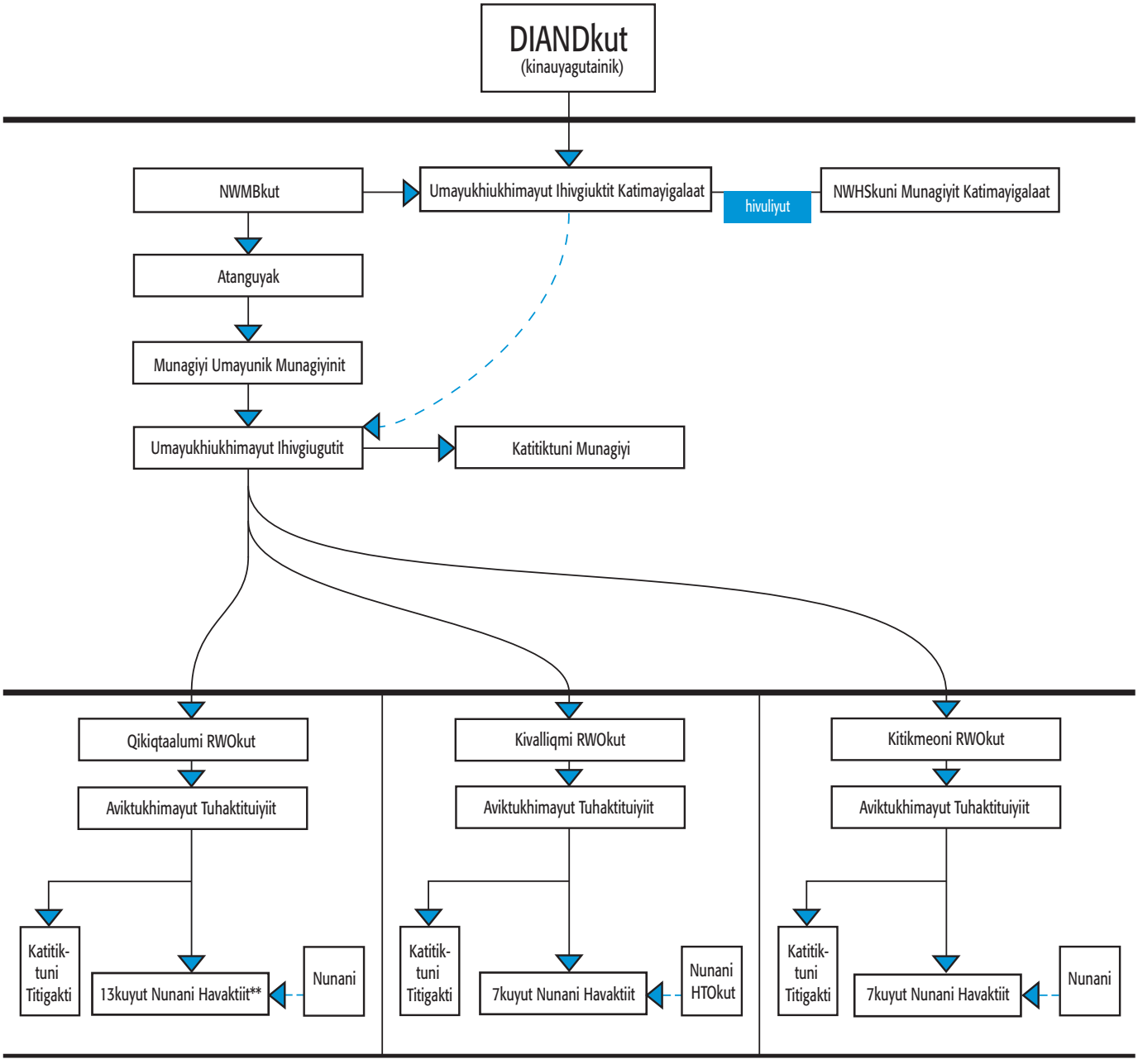
Katitigutinik Titigaktiit (DED) havaktitauhimayut RWOkunit havalutik Umayukhiukhimayunik Ihivgiugutainik tamamik RLOkutlu. Hamna havaak titigakhugit tikihimayut katitikhimayut, ilivlugit umayukhiukhimayut katitihimayait atukhutik hanauyakhimayaminik katitigutit pilihimayunit, titigalugit pihimayait kaihimayut katitikhimayut ovalo ihuakhakatakhugit aalangukhimayut titigagutait umayukhiuktut. Tatkikhiut tamaat DECkut tuyukpaktut kagitauyakut katitihimayut tamamik nunanit aviktukhimayaminit NWMBkut titigakvianut ovalo sukatukut naunaiyautainik aalangukhimayut titigagutait makpigaat nunanit havaktinit.

Tamamik RWOkut havaktihimayut nunani havaktinik tamamik nunani. Ilangit angitkiyut nunat pihimavaktut amigaitkiyanik havaktinik. Nunani havaktiit ikpinaktumik havaakaktut katitivlutik umayukhiukhimayut katititjutikhainik umayukhiutunit tatkikhiut tamaat. Pilihaaktilugu ihivgiuktut, nunani havaktit ikayukhimayut titigakhugit umayukhiuktut ovalo tamaat ihivgiuktilugit, ihuakhakatakhimayait titigakhimayut katitigutait umayukhiuktunik ovalo tunikatakhugit aviktukhimayut titigakviit aalangukhimayunik. Nunani havaktiit tamamik nunamini havakataktut titigakviani Nunani Umayuligiyinit (HTO).

Nunani Havaktiit ayoikhagutait inikhimayut atukhutik ayoikhagutit atugutainik ovalo ilangit katimaplutik ayoikhaitjutit, tuhagutinit ovalo inminik ayoikhakhimaplutik ilaani.

Havaktilugit katitihimayunik Umayukhiukhimayut Ihivgiuktiit havaktihimayut 35nik Inunik, havaktut NWMBkut havakviani hivulimi Iqaluni, pingahut aviktukhimayut havakviit ovalo 28ni nunani.

Ilangani 1: Munagiyit ovalo havaktiit naunaiyautait Nunavumi Umayukhiukhimayut Ihivgiuktit



** Atauhik Nunani havakti katitikhimayuk Ikpiarjuqmi ovalo Nanisivikmi

Nunani, Umayukhiuktit apigiyauhimayut ilaupkuplugit munagilugit titigakvimini Umayukhiukhimayut Ihivgiugutainik pitkuiplutik inunik havaktukhanik nunamini ovalo ikayukhutik titigakvini nunani havaktunut havaligamik. HTOkut ilauyut ikpinaktumik nunamini, ilaa kiukatakhutik ovalo ukakatigivlugit Umayukhiukhimayut Ihivgiugutaat iniktigutaanik.

Umayukhiukhimayut Ihivgiugutaa kinauyait alikhiayut tamaat Kanatami Inuligiyinit (DIAND), malikhugu NLCAmi (NLCAmi, 1993, Ilangani 5.4.4) ovalo havakhugit ataani malikhugu NWMBkunit (NLCAmi, 1993, Ilangani 5.4.2).

2.3 Ihivgiugutit tuhagutikhait kinguliminit

Umayukhiukhimayut Ihivgiugutait pihimayut kulinik ukiunik, ilauplutik hapkoa havakhimayavut:

1) Havalihaagit (haunauyak ovalo paknaiyak) – 1993-1996
2) Katitiktakhanik katitigutit – 1996-2001
3) Iniktigutait ihivgiufaagutit ovalo tuhaktitakhait - 2001-2004

Tamaat akia ihivgiuktut $7.3millionkuyuk. Kitkani ukiuk tamaat akilikatakhimayut hivulimi talimani ukiuni katitiktakhanik katitigutit ilanga 1.065millionkuyuk.

Nunavumi Umayut Umayukhiukhimayut Ihivgiugutait pilikhimayut November 1993mi havaktilikhugu Umayukhiukhimayut Ihivgiuktit Munagiyukhamik ukakhimayaini NLCAmi. Hivulimi ukiumi ihivgiuktut, NWMBkut ilihimayut Umayukhiukhimayut Ihivgiuktut Munagiyukhat katimayigalaanik ovalo apigivlutik inikpiakhimayumik uktugutikhamik hanauyautainik NWHSnik. Natural Resources Institute, Universitimi Manitobami ataani havaktut Dr. Fikret Berkes ilauliktut November 1994mi (NWMB 1994). Dr. Berkes ilaukatigiyait havakatigihimayut Umayukhiukhimayut Ihivgiuktit Munagiyiinut ovalo Umayukhiukhimayut Ihivgiuktit Munagiyit Katimayigalaat hanaplutik haunauyautainik Umayukhiukhimayut Ihivgiugutainik avataanut tatkikhiutini.

Munagiyit Katimayigalaat amigaivyaktunik angikhimayut atukhutik ukauhiit NLCAmi ihivgiugutit maliktakhainik 1995mi. Munagiyit Katimayigalaat ihumayut imaatut:

> *"Ihumagiyakhait hivuliit/pihimayut umayut, nunani ovalo umayukhiukhimayut katitihimayait (malikhugu ilangani 5.4.5(b) angigutimi) angmaumayuk ihumagiyauyuk piniamat ilaupkalugit katimayiit, havaktiit ovalo ilaukatauyut munagiyut havakviit tamaat hivunikhaptini. Akhut havakumik hapkoa havaakhat hilataaniimat Maligutikhaini piyakhait (ublumi mikhaanut) Umayukhiukhimayut Ihivgiugutaani ilihimayut ilangani 5-5 angigutimi." (NWMB 1995b: 2)*

Taimaimat, phimayut hivulimi havalutik Umayukhiukhimayut Ihivgiugutait titigalutik *"kanuk ovalo atuktaktangit Inut atugutaini umayut mikhaanut naunaiyakhutik mikinikhaat atuniaktainik umayut"* (NLCAmi, 1993, ilangani 5.4.5(a). Hamna inilaaktuk atulugit iluaniitut ihivgiugutit hanauyautaini, ilangit talimat ukiuni atulaaktait ihivgiuktut ovalo katitigutaini umayukhimayut nunagani katitihimayukhat (NWMB 1995b).

Munagiyit Katimayigalaat angikhimayut ilangit tuhagutikhat katitilaaktut kihimi ihuinaagilugu hivulimi havaktakhait ovaluniit angililugu akikhait ihivgiunahuat (NWMB 1995b). Taimaimat, katitigutait ihivgiukhimayut ovalo ihivgiufaagutait pihimayut umayut, nunait ovalo umayukhiukhimayut katitigutait ukakhimayut ihivgiukhimayuni pilaakata. Kinauyakakat, NWMBkut pikataniaktut katitilutik, ihivgiulutik ovalo ihivgiufaalutik katitihimayunik hivunikhaptini ovalo tuhaktitiluta nalvaakhimayunik piyaptini.

Nalunangituk ikpinakpiaktulu pihimayunit katitihimayunit, ilaa Inuit Kauyimayatukangit – Inuit nunani kauyimayainik (TEK). TEK ilaulikhimayuk ihivgiuktunut imaatut: Katitigutainik Inuit atiit nunait tuhagutikhait hanahimayut Nunavumi tamaat katitikvimi kauyimayait atiit ovalo naunaiyagutait naniitaakhait nunauyani. Umayukhiuktut apigiyauhimayut nunani havaktinit kanugitaakhait aniagutikagiagita ovalo amigaitaakhaita umayut tatkikhiutini ukakatigigaagata. Hamna tuhagutikhak titigakpaktut ukauhiini umayukhikhimayut katitigutaini ovalo kihimi ihivgiufaakhimaitut ovaluniit naitumik ukakhimaitut hamani tuhaktakhami, pilaaktut naunaiyakhimamata atugumayunit. TEK ilaupkaihimayuk nunani ihivgiugutaini ovalo ukauhiini hivuliit nalvaakhimayut ihivgiuktuni (ilangani 2.5 ovalo ilangani 6).

Pikakhimayuugaluak umayukhiukhimayut ihivgiugutainik Nunavumi Nunataagutit Angigutaani Iluani, ovalo tahapkoa havakhimayut avaktilugit nunataagutikhat iniktigutaini mikhaanut (Donaldson, 1983; 1984; Gamble, 1984; Jingfors 1986), pihimaitut inikpiakhimayutut pihimayait NLCAmi.

Aalat paknaiyakhimayukhat piyukhat aipaanut nuuniakat Umayukhiukhimayut Ihivgiugutaani hapkoa:

- Havaktilikhutik pingahunik RLOnik munaiyaami katitigutinik aviktukhimayunit;
- Havaktilikhutik pinahunik Katitigutinik Titigaktiinik havakatigiyakhainik RLOkut;
- Havaktilikhutik ovalo ayoikhaiplutik Nunani Havaktiinik tamamik nunani;
- Hanaplutik Umayukhiukhimayut Ihivgiuktit tatkikhiutikhainik ovalo katitiyukhat katitigutikhainik makpigaanik titigagiami katitikhimayut umayukhiuktunit ovalo nunani havaktunit;
- Niuvikhutik ovalo ilivlugu hanalgutikhat atugutikhanik, tutkumavikhainik ovalo ihivgiufaagutikhainik umayukhiukhimayut katitihimayunit, ovalo
- Ukakatigiinakhugit RWOkut ovalo HTOkut.

Tatkikhiutit, katitigutit makpigaat ovalo ayoikhautikhat atugutikhait uktukhimayut pingahuni nunani (Ikpiarjuk, Kugaaruk ovalo Igluligaarjuk) Maymi 1996.

Katitigutit pilikhimayut Julymi 1996 ovalo inikhutik Junemi 2001, kihimi katitigutait kinguvakhimayut katitigutikhanik pikatainaktut ukiakhami 2001.

Iniktigutait Umayukhiukhimayut Ihivgiugutit, ihivgiufaakhugit ovalo tuhaktitivlugit pilihimayut iniktigutaini katitikhimayut ovalo tamamik katitihimayut naunaiyamata ovalo ihuakhakhimaplugit. Hamna havaak ilauyuk, atugutikhainik ovalo naunaiyakhimaplugit ihivgiufaagutit katitihimayut naamagiagani ovalo nunani ukakatigivlugit ihivgiukhugit katitikhimayut. Naunaiyakhimayuk tamamik hapkoa havakhimayut iluaniitut ilangani 4, 5 ovalo 6 hamani tuhaktakhami. Havagutait hamna iniktigutaa tuhaktakhak naunailiktuk iniktilikhuni Umayukhiukhimayut Ihivgiugutini.

2.4 Inminiigutit takulaaktut ovalo pilaaktut pikuyait

NLCAmi ukakhimayut imaatut:

> *"Nutaat ovalo ukakhimayut katitikhimayut hanahimayut ihivgiukhimayunit tamaat ovalo pilaaniaktait Kavamatkut Kanatami, Nunavumi Kavamatkuni ovalo Inuit" (NLCAmi, 1993, Ilangani 5.4.6); ovalo*

> *"NWMBkut piniaktut atiit Inuit umayukhiuktut takupkalaitait pipkalaaligumiuk katitikhimayut malulugu ilangani 5.4.6" (NLCAmi, 1993, ilangani 5.4.7); ovalo*

> *"Titigaktauhimaitumik apikhutikhainik DIOkut ovalo umayukhiuktumit, naunaitkutait pihimayut mikhaanut ihivgiuktut, umayukhiuktunit atulaitut kitunikaak naalaktitiyunit umayukhiuktuk akigaktuktaulailuni" (NLCAmi, 1993, Ilangani 5.4.8).*

NLCAmi Ukakhimayuklu imaat:

> *"NWMBkut pigumik ovalo takupkaigumik tuhagutikhanik maliniaktut akigaktuitjutinik atuktainik mikhaanut takupkailaitunik ovalo pilaitunik tuhagutikhanik aatjikutaatut kavamatkut munagiyiit" (NLCAmi, 1993, Ilangani 5.2.31).*

Inikpiakhimaitunit umayukhiukhimayut katitikhimayut pivaktut ihivgiuktitlugit, NWMBkut ihumaaluligaluamata pipkagiagita "nutaat katitikhimayut" pipkalaagiagani aalanut ilauyunut pilaamat atukuyaungitunik ovaluniit ihuinaakhimayunik tuniyaulaamata hivuliit umayukhiukhimayut tuhagutikhat ihuakhihimaitunit ovalo ihivgiufaakhimaitunit. Taimaimat 1998mi, NWMBkut paknaiyakhimayut katitikhimayunik atukatigiigutikhanik angigutinik Munagiyinut Umayukhiuktut ovalo Hanatiligiyinut (DRWED), DFOkut ovalo CWSkut ovalo Beverly Qamanirjuaq Tuktunik Munagiyit katimayiinut (BQCMB). Hapkoa angigutit ilihimamata maliktautjutikhainik katitikhimayut tutkuumayut, katitikhimayut atukatigiigutit ovalo katitikhimayut pipkalaagutainik (ilaa, atugutikhainik NWHSni katitikhimayunik kavamatkuni makpigaani ovaluniit titigagutaini). Pikpat katitikhimayut atukatigiigutikhat angigutait atiktaukpata kavamatkut munagiyiinit ovaluniit havakviit, aatjikutait katitikhimayut (umayukhiuktut atiit unguvakhimaplutik) tuniyauvaktut naunaiyakhimayumut havaktimut iluani munagiyiit munagiyunut katitikhimayunik ovalo munagiyait iluani havakvimini katitikhimayunik apigiyaugaagat. Aatjikutait tamamik hivuliit tuhaktakhat tunivaktut tamamik kavamatkut munagiyiinut ovalo Inuit havakviinut ilauyut umayunik munagiyunut Nunavumi.

Malinahuakhugu piyakhait malikhugu Ilangani 5.4.7 NLCAmi mikhaanut tukupkailaaktait atiit umayukhiuktut, Umayukhiukhimayut Ihivgiuktut katitikhimayaini hanahimayut kitutkia umayukhiukhimayut katitikhimayut, titigamiluunit ovaluniit kagitauyakut katitikhimayut mikhaanut umayukhiuktunut atukhugit naamaligutit, atia atungilugit. Titikani katitikhimayut ovalo kagitauyakut katitikhimayut pihimakpat umayukhiuktut atiinik ovalo naunaiyautainik pihimavaktait Umayukhiukhimayut Ihivgiuktit havaktiinut atuniakagit tuhagutikhat naunaiyagiami titigaktauhimayut ovalo piniagumik piyakhanik ukakatiginiagumiuk.

Apikutingit takulaagumiuk umayukhiukhimayut katitikhimayunik inunit ovaluniit havakvinit naunaiyakhimaitunit Ilangani 5.4.6.mi NLCAmi ihivgiukhimayut inminik Umayukhiukhimayut Ihivgiuktit Katimayigalaanit. Amigaitut apigiyauyut naunaiyakhimayut katitikhimayut kihimi angiktauhimaitut. Inminik umayukhiukhimayut katitikhimayut tuniyauyuitut kihimi titigaktaakhimatilugu umayukhiuktinit. Amigaitut umayukhiuktit apigivaktut titigakhutik katitikhimayainik tunilaaktut Havaktiit Ikayuktiit Katimayiinut (WCB) ihuakhagiagani ikayugutikhait. Hapkoa apikhuutit tunivaktut ovalo takukhauyuk amigaitut pingitainik havaat atukpaktut Umayukhiukhimayut Ihivgiugutit atulaaktainik.

Pinahuanuaktut hamna Iniktigutaa Tuhaktakhak naamaginiaktait havainaktut umayukhiukhimayut katitikhimayut piyumayait Inuit ovalo havakviit. NWMBkut ublumi ihivgiuliktut piyakhaminik tutkuktuivikhaminik Umayukhiukhimayut Ihivgiugutait katitikhimayut. Tutkuktuiviit atugutingit takupkainialaak amigaitkiyanik katitikhimayunik hamaniingitunit tuhaktakhami. Titigakvimi munagitjutaini akilitipkainiaktut. Hatja, taiguagumayut piyumakpakta takuyaaminik katitikhimayut hamaniingituni tuhaktakhami apigilaaktut NWMBkunut. Munagilaaktangit apikhugutit atugumayunik pilaaktut pipkaikpat NWMBkut munaginmata ovalo havaktikakata munagiyukhamik ovalo ayonakpalaangitpat apikhuguti ovalo piniaktut inminik nanminiigutiginut.

2.5 Nunani Ukakatigigutit, tuhaktituitjutit ovalo tuhaktakhat

2.5.1 Ukakatigitjutit ovalo tuhaktituitjutit

Ukakatigitjutait Inuit nunangini ihivgiugutikhanik pilihimayut aivaktilugit. Pikatagutait tuhaktituitjutikhainik mikhaanut, kanugitaakhait ovalo iniktigutait Umayukhikhimayut Ihivgiugutait, iniktiktilugit, ilitagiyauhimayuk piyukhat angikhagiami ilautjutikhavut ovalo nakuuyakhait iniktigutait. Tuhaktituitjutit ihivgiugutini ilauyut; hunakhat, kanuk piniaktut, kanuk tuhagutikhat atuktauniaktut ovalo inminiigutut takupkalaitjutait iluaniitumi NLCAmi.

Tuhaktituitjutit amigaitunik atukhimayugut ovalo naalautikut atukhimayut havaktiluta Umayukhiukhimayut Ihivgiugutaani:

- *Takuyakhat* tuniyauhimayut tamamik nunanut tamamik Kablunaatitut/Inuktitut ovalo Kablunaatitut/Inuinaqtut 1996mi. Pingahut takuyakhat hanahimayut tuhaktituinahuakhuni ihivgiugutikhanik, ikayugutikhait Inuit ovalo inminiigutut takupkailaitait ihivgiukhimayuni.
- *Naalautikut ukaktut* CBCkuni ovalo nunani naalautikut pihimayut Umayukhiukhimayut Ihivgiuktitlugit tuhaktinahuakhugit ihivgiutainik Inunut.
- *Takuyakhanik* tamamik *Above and Beyond* ovalo *Up Here* makpigaani, 1998mit 2000mut tuhaktitinahuakhuta Umayukhiukhimayut Ihivgiugutimik.
- *Makpigaaliugutinik, Harvest Study Informermik,* hanahimayuk munagiyi ikayuktaupluni aviktukhimayut titigakviinit tuyuktauvaktut Umayukhiukhimayut Ihivgiuktit havaktiinut. *Informer* tuhaktituivaktuk hunauyut Umayukhiukhimayut Ihivgiuktut, ayoigutinik umayut naunaiyautainik, katitikhimayut katitigutainik, tuhakatagutikhainik ihivgiuktut ovalo tuhafaagumaguvit tikuagutainik tamamik titigakviit. *Informer* hanavaktut atauhimi ilaani malguni tatkikhiutini 1997mi. 1998mi aalat makpigaat hanahimayut RLOkunit tamamik aviktukhimayuni.
- *Tuhakataktakhait* ilauyunut. Umayukhiukhimayut Ihivgiuktut autlaagutit kalutinik tunivaktugut ilauyunut 1998mi. Ukiumi 2000mi Umayukhiukhimayut Ihivgiuktut havinik hanahimayut ovalo tuniyauplutik tamamik ilauyunut ilitagiyumaplugit kinguliit ovalo ilaukatigiyait ihivgiuktuni.
- *Umayukhiukhimayut Ihivgiuktit Tatkikhiutait* tunikhakhimayut ukiuk tamaat tamamik umayukhiuktunut. Kihimi atugutikhait tatkikhiutit takupkailugit katitikhimayut katitigutait atuktut (ilangani 3.7), tatkikhiutit atukhimayut tuhagutikhanik mikhaanut. Ilauyut nunanit tunihimayut piksanik takuyaagani umayukhiugutit ovalo umayut Nunavumi. Hapkoa piksat takupkaihimayut hivuani ovalo kinguani tatkikhiutit ovalo tamaat tatkikhiutit makpigaagani, tuhaktituinahuakhuta tamamik Umayukhiukhimayut Ihivgiugutait ovalo Nunavumi Umayukhiugutit pivaktut.
- *Tuhaktituivaktut NWMBkunut.* Munagiyi tuhaktitainaktuk NWMBkunut tamamik katimagaagata ovalo tuhaktivakhugit katimayiit mikhaanut angiktauyukhanik.
- *Aalat tuhaktituivaktut.* Amigaitunik tuhaktituivaktugut kavamatkut munagiyinut ovalo aalat havakviinut, RWOkunut ovalo aalat havakviit pitiluta ihivgiugutinik.

2.5.2 Tuhaktakhat

NLCAmi piyukhat *"NWMBkut tuhaktituiyukhat ukiuk tamaat havagutainik ihivgiuktut. Inikata ihivgiuktut, NWMBkut titigaktukhat inikpiakhimayumik nalvaakhimayainik ihivgiukhimayaini."* (NLCAmi, 1993, Ilangani 5.4.9)

Hanatjutingit ukiuk tamaat tuhaktakhat pingitut havaktivut aalangukatamata ovalo ayokhagutit hivuani katitiknahuahugit katitiktukhat. Hivulimi nunat tuhaktakhait hanahimayut naitumik hivulimi pingahut ukiut Umayukhiukhimayut Ihivgiugutaini katitkhimatitlugit auyami ovalo ukiakhami 2001. Aatjikutait tuhaktakhat tunihimayut HTOkunut ovalo aalat havakviit ovalo kavamatkut munagiyiinut ilauyut umayunik munagiyut Nunavumi. Tuhaktakhat tunihimayait munagiyit RWOkunut ovalo HTOkunut katimagaagata. HTOkut munagiyiit apigiyauhimayut ukakatigilugit tuhaktakhak umayukhiukhimayut naunaitkutait katimayiminut ovalo umayukhiuktunut nunamini, naunaiyagiagani naamaktutk iniktigutait. Inuit ovalo havakviit apigaiyauhimayut kiulutik umayukhiukhimayut naunaiyautait tuhaktakhami ukalutik ihumagiyaminik amigiatpalaat ovaluniit mikivalaat naunaiyautait. Aalat kiutjutit iniktigutaani tungagiyavut naunaiyagiami ihuinaakhimakakat katitikhimayunik katitigutainik ovaluniit katitikhimayunik. Ukagutikhat makpigaat tunikhaihimayut tuhaktakhami ilauplutik pipkagiagit ihumagiyainik inminik naunaiyautainik. Fonikatakhugit HTOkunut ukautigifaalugit iniktigutait ovalo nunait ukakhimayut. Ukakatigihimayut kablunaatitut ovalo Inuktitut CBCkuni naalautini ukaktivlugit inikhimaliktuk tuhaktakhak ovalo pilaaktut Inuit HTOkuni titigakvianit. Mikiyumik kiuyauhimayugut hamani atuktaptini, taimaimat, ikpinaktuk nunanit tuhagiami iniktigutaanik, Munagiyi paknaiyakhimayuk nunanut pulaakataluni piyaami tunilugit tuhaktakhat nunanut. Hamani titigagutait hamna atuktaptinik, nakuutkiyak pihimayugut ukautainik Inuit umayukhiukhimayut ihivgiugutait katitikhimayunit.

Talimani Ukiuni Hivuliit Tuhaktakhat naituukhimayut tamamik talimani ukiuni Umayukhiukhimayut Ihivgiugutait katitikhimayut nunanit tunihimayut Novembermi 2002. Nunanut pulaaktakhimayut, Munagiyi ovalo RLO pulaaktakhimayut tamamik nunat tunivlugit ovalo ukakatigivlugit Umayukhiukhimayut Ihivgiugutait katitikhimayut. Hapkoa pulaakatagutit pihimayut Januarymit Maymut 2003. Nunat; Kingauk, Umingmaktok ovalo Nanisivik pulaangitut ilaa, mikivalaamata nunat, iniktigutait hapkoa nunat tunihimayut ovalo ukautigivlugit Ikaluktutiami ovalo Ikpiarjumi pulaamata.

Pitinagit Inuit katimakatigivlugit tamamik nunani, munagiyi katimakatigihimayait HTOkut katimayiit tuniyaami katitikhimayut ovalo ukautigilugit ihumagiyait ovalo apikhuutikhat. Inuit katimakatigihimayait tunivlugit umayukhiukhimayut katitikhimayut ovalo nani nunani pihimayut nunanit, atukhutik kagitauyakut atugutainik takuyaami hamna tuhagutikhat piksatut[2]. Hamna nunanut pulaakataguti atukhimayuk nunanit ihivgiufaagutinik, ukautiinik ovalo naunaiyautainik iniktigutait ihivgiukhimayut.

Ukautait tamamik nunanit ukakatigitjutait Umayukhiukhimayut Ihivgiugutait katitikhimayut naitumik titigakhimayut ilangani 6: Nunanit iniktigutainik Ukautiit.

2.5.3 Ihivgiukhimayut hanahimayut

Umayukhikhimayut Ihivgiugutait hanahimayut amigaivyaktunik tuhaktakhanik pitilugit. Tamamik pilaaktut NWMBkut Pitkutainik Havakviani. Ovalo pilaaktut NWMBkut Pitkutainik Havakvianit tunikhaihimaitut titigakhimayut makpigaat ukakhimayut ilangani hamna tuhaktakhami.

Tuhaktakhat mikhaanut ihivgiugutait hanauyautait, munagitjutait ovalo katitikhimayut ihivgiufaagutait atulaaktut:

Designing the Nunavut Wildlife Harvest Study – Hivulimi Tuhaktakhak
Fikret Berkes, Mina Berkes ovalo Helen Fast, Februarymi 1995
Hivulimi tuhaktakhat titigakhimayut uktugutikhait hanauyautikhait Nunavumi Umayut Umayukhiukhimayut Ihivgiugutaini.

Designing the Nunavut Wildlife Anguyanik (Harvest) Study – Hivulimi Iniktigutait Tuhaktakhat
Fikret Berkes, Mina Berkes ovalo Helen Fast, Aprilmi 1995
Titigakhimayut pitkutiyavut, kinauyait atukhimayut ovalo iniktigutaini paknaiyautait Umayukhiukhimayut Ihivgiugutaini.

Technical Review of the Nunavut Wildlife Harvest Study
William Kemp, Lorraine Brooke ovalo Valter Blazevic, Januarymi 2000
Iniktigutait ayongitut ihivgiugutainik Umayukhiukhimayut Ihivgiugutait katraktilihimayut NWMBkunit Junemi 1999.

Nunavut Wildlife Harvest Study – Hivulimi Nunait Tuhaktakhat
Heather Priest, Umayukhiukhimayut Ihivgiugutait Munagiyi, Junemit Septembermut 2001
Tuhaktakhak hanahimayuk tamamik nunanit titigakhimayut hivulimi pingahut ukiut Umayukhiukhimayut Ihivgiugutait katitikhimayut. Tuhaktakhat tunihimayut auyami ovalo ukiakhami 2001.

Nunavut Wildlife Harvest Study – Talimani ukiut Hivuliit Tuhaktakhat
Heather Priest, Umayukhiukhimayut Ihivgiugutait Munagiyi, Octobermi 2002
Malikhimayait hivulimi nunanit tuhaktakhat, hapkoa tuhaktakhat titigakhimayut tamamik talimani ukiuni Umayukhiukhimayut Ihivgiugutait katitikhimayunit. Pihimayut ilauyut naunaiyaitait nunanit ovalo ukiuni umayukhiukhimayut naunaiyaitait umayut kanugitut umayukhiukhimayut. Ilaa, tuhaktakhak hanahimayut tamamik Nunavumi nunait.

The Nunavut Wildlife Harvest Study – Iniktigutaa Tuhaktakhak
Heather Priest ovalo Peter J. Usher, Augustmi 2004
Hamna tuhaktakhak paknaiyakhimayuk iniktikpiagutikhaini katitikhimayut NWHSmi ovalo titigakhimayut ihivgiuktut pitkutainit, atuktainik, katitikhimayut hunauyut ovalo nakuuyaakhata hapkoa katitikhimayut.

A *Nunavut Wildlife Harvest Study GIS Viewer* titigakhimayut takukhauyaani GISkut katitigutit katitikhimayut ihivgiuktitlugit. Hamna kagitauyakut atuktuk hanauyakhimayuk upingaami 2002 naunaiyagiami nunani katitikhimayut kagigitutini ovalo atukhimayuk apikhutikaktunik ovalo takuyakhainik atugutiupluni tamamik atuktunut Umayukhiukhimayut Ihivgiugutait katitikhimayunut.

[2] Inuit katimakatigingitavut Kinngani,, Qikiqtarjuaqni, Sanigajaqmi ovalo Iqaluni.

3. Atuktangit ovalo Iniktigutait

Maligutinga NWHSkut pihimayut hapkoninga mikhaanut ihivgiuktut, atuktangit, hanuaykatangit ovalo tuhaktitakhait:

> *"Ihivgiuktut piniaktut hivulimi atulutik titigauyagutit/tatkikhiutit katitigutainik pihimayulik umayukhiuktunit tamamik umayut umayukhiukhimayut ubluk tamaat. Katitikhimayut pihimaniaktut paknaiyakhimayuni titigauyagutit/tatkikhiutit tuniaktait nunanit apikhuktut havaktunut. Nunani apikhuktut apikhuniaktait kiuyauyukhat ovalo ukalugit ovalo titigalugit umayukhiukhimayut katitikhimayut naunaiyahainalaanik makpigaanut hanayaami. Iniktigutait ihivgiuktut tuhaktitiniaktut ovalo takulaalugit nunaini. Ilaa, nani nunani umayukhimayut pilaakat titigaktauniaktut. Ihivgiuktut katitiniaktut katitikhimayunik naunaiyakhimayunit nunanit naunaiyakhimayuni aviktukhimayunit tatkikhiutini naunaiyakhimayuni."* (NLCAmi, 1993, Ilangani 5-5).

Hamna ilanga titigakhimayuk atugutait atukhimayut ihivgiuktilugit maligiagani hamani pihimayut ovalo iniktigutikagutikhat atugutikhat pitilugit ihivgiuktut. Ilangani 5-5 NLCAmi aivakhimayut 1980ni ovalo angikhimayut iniktigutaani nunataagutit angigutaani 1993mi. Hatja, angiyumik naluhuilikhimayugut nakuutkiyanik atuktahaptinik piyugut hivulimi ovalo pikataktuni nunakakaakhimayut umayukhiukhimayut ihivgiugutainik, tamamik pitinagit NWHSkut ovalo atukhugu kulinik ukiuni. Hapkoa hanahimayut pipkakhimayait NWHSkut atuktanginik ovalo iniktigutainik akhut.

3.1 Ihivgiuktut nunaini ovalo ubluit

NLCAmi titigakhimayut ihivgiuktut piyukhat tamaat Nunavumi Angigutaani Iluani (NSA) (naunaiyaut 2) ukiuni talimani. Nunat NSAni anginikhaaguyuk 1,900,000 km2, ovalo aviktukhimayut pingahunik munagivinik aviktuutaanut: Qikiqtaaluk, Kitikmeot ovalo Kivalliq. Pitilugit NWHSkut, 28nik nunakaktuk pingahuni aviktukhimayuni (Ikpatauyak 1) Nuna Nanisivik, umiktitauhimamat uyagakhiuvik umingmat, katitikhimayut ilaukatauhimayut tahapkononga Ikpiarjumut. Hamani ilangani, pihimayut atugutingit ihivgiuktut, ukauhiit pihimayut 28nik nunakaktuk. Kihimi ilangani 4, (iniktigutait) ukakhimayut 27nik nunakaktuk. Umayukhiuktut inuuyut nunaligalaani titigakhimayut kanitkiyaanut nunanut autlaakpaktut niuvigiakatakhutik umayukhiutjutikhaminut ovaluniit inuuvaktut ilaani ukiuni ilangani. Katitigutit katitikhimayut tahapkonanga Inunit naalautikut ovaluniit ukakatigivlugit inminik pulaagaagata nunanut.

Inugiagitautait NSAmi tikivyaktuk 27,000nik inunik, 85%kuyut Inuit. Ikpatauyak1mi takukhauyuk Inuit inugiagitautait, tamamik 28ni nunani 1999mi, kitkani ihivgiuktut pitilugit (Kavamatkut Nunavumi 2002).

Katitigutit katitikhimayut pilikhimayut Julymi 1996 ovalo pivlutik Junemut 2001. Kiguvakhimayut ilangini nunani ayokhakhimagamik nunani havaktukhanik ovalo titigagutainik umayukhiuktut. Hapkoa ayokhagutit naamakhihimayut tatkikhiutini kilamik (ilangani 3.7) kihimi angikhimayut NWMBkut (ikayuktauplutik Nunavumi Iniktiligiyit Katimayigalaanit) ihivgiuktut ubluit tamaat NSAmi piniaktut umayukhiukviit June 1mit, 1996 – May 31mut, 2001 ikpianagutait ihivgiugutit ilangani nunani naitkiyauniaktut talimani ukiuni pihimaitumik angivalaaktunik ihivgiugutinik ilangit nunani. Umayukhiukhimayut katitigutait katitikhimayut nunani Iqaluit ovalo Kinngait pitinagu Augustmi 1997 naamagiginamiuk atungitut. Kangiklinikmi ayokhagutit pihimayut katitigutit katitikhimatilugit pitjutiplugu pihimaitut katitigutait Junemi 1996 ovalo Septembermit 1997 – Februarymut 1998. Iniktigutait pihimaitut tatkikhiutini titigakhimayut anginikhait tatkikhiutit umayukhiukhimayut aalani pingahuni ovaluniit hitamani ukiuni takuyaami ukiuk tamaat naunaiyautaini.[3]

[3] Iniktigutait takulaaktut ilangani 6: nunanit iniktigutait ukautingit mikhaanut nunanut.

Ilangani 2: Nunavumi Nunataagutit Angigutaani Iluani: Aviktukhimayut ovalo Nunait



Ikpatauyak 1: Nunavumi Inugiagitautait Naunaiyautait

Nunat	Inuit Inugiagitauyait*	
Qikiqtaaluk		
	Ikpiarjuk	627
	Kinngait	1,130
	Kangiktugaapik	737
	Aujuituq	145
	Sanigayaq	585
	Igloolik	1,246
	Iqaluit	2,956
	Kimmirut	408
	Nanisivik	23
	Pangnirtung	1,354
	Mitimatalik	1,240
	Qikiqtarjuaq	508
	Qaujuituq	174
	Sanikiluaq	631
Kitikmeot		
	Kingauk	16
	Ikaluktutiak	1,110
	Ukhuktuuq	920
	Kugaaruk	549
	Kugluktuk	1,210
	Taloyoak	714
	Umingmaktok	47
Kivalliq		
	Arviat	1,568
	Kamanituaq	1,349
	Igluligaajuk	335
	Salliq	775
	Kangiklinik	1,730
	Naujaat	567
	Tikigaqjuaq	293
Nunavumi Tamaat Inuit	22,947	

* Inugiagitauyait 1999mi pihimayut Ihivgiuaaktiligiyit ovalo Katitiligiyit Munagiyiit, Munagiyit Kavamakatigiiligiyit, Kavamatkut Nunavui (2002).

3.2 Naunaiyautait Umayukhiukhimayut

Ihivgiuktut hanauyakhimayut titigalugit amigaitjutait tamamik nunani umayut, tingmiat (ovalo maniit), ikaluit ovalo ikaluvaluit pivaktut Inuit atuktakhait. Umayut titigakhimayut tamamik aviktukhimayuni naunaiyakhimayut hivuliminut atukhugit kihimi tuhaktakhat aalat umayut titigakhimayut ilaani.Titigakhimayut katitikhugit ilauyut hapkoa; nanuit,[4] tugaat kilaugait ovalo aiviit, umayukhiukhimayut naunaiyautait titigakpamatat inminik kotakut ovalo naunaiyautakagamik atukhutik. Katimayigalaat ihimavaktut hapkoa inminik katitikhimayut tunilaamata nakuuyunik naunaiyautikhainik Umayukhiukhimayut Ihivgiugutait iniktigutaani.

[4] Nunani havaktiit ukaktauhimayut pingilutik katitigutainik nanuit hivulimi ukiumi, kihimi piyut Kitikmeoni ukiungani.

Ikpatauyak 2: Umayut Katitigutait Naunaiyautaitlu

Atiit Atukpaktut			Kablunaat kauyimayatukangit atiit	Ilangit katitigutait katitikhimayut
Angiyut Umayut	Tuktut	Nunani Tukut	*Rangifer tarandus groenlandicus*	L, S, A
		Kananami Kikiktani tuktut	*Rangifer tarandus pearyi*	L, S, A
		Tuktuvaluit	*Rangifer tarandus tarandus*	L, S, A
		Kikiktani tuktuit	*Rangifer tarandus groenlandicus* *Rangifer tarandus pearyi*	L, S, A
	Umingamait		*Ovibos moschatus*	L, S
	Tuktuvait		*Alces alces*	
	Nanuit		*Ursus maritimus*	L, S
	Akhait		*Ursus acrtos*	
	Kiniktut Akhait		*Ursus americanus*	
Nuyakaktut Umayut	Amaguit		*Canis lupus*	
	Ukiuktaktumi Tigiganiat	Kakuktut	*Alopex lagopus*	
		Kiniktut		
	Kalaliit tigiganiat	Kaalaat	*Vulpes vulpes*	
		Kipliktut		
		Aupayaavyaktut		
		Kiniktut		
	Kivgaluit		*Ondatra zibethicus*	
	Kalviit		*Gulo gulo*	
	Pamiuktuuk		*Lynx canadensis*	
Mikiyut	Ukaliit		*Lepus arcticus*	
	Hikhiit		*Spermophilus parryii*	
Tagiumi Umayut	Natiit	Natiit	*Pusa hispida*	
		Ukyuit	*Erignathus barbatus*	
		Qairulik	*Pagophilus groenlandicus*	
		Qanigiaq	*Phoca vitulina*	
		Nahakakatutut Natiit	*Cystophora cristata*	
	Akviit		*Odobenus rosmarus*	L, S
	Kilalugait	Tuugaat	*Monodon monoceros*	L, S
		Kilalugait	*Delphinapterus leucas*	L, S
		Aiviit	*Balaena mysticetus*	

Atiit Atukpaktut			Kablunaat kauyimayatukangit atiit	Ilangit katitigutait katitikhimayut
Tingmiat	Uluaguliit	Kanguit	*Chen caerulescens*	
		Uluaguliit	*Branta canadensis*	
		Kakat	*Chen rossii*	
		Niklivik	*Anser albifrons*	
	Tingmiat	Kingaliit	*Somateria spectabilis*	L, S
		Mitiit	*Somateria mollissima*	L, S
		Aahangiit	*Clangula hyemalis*	
		Aknaviat	*Anas acuta*	
		Mitiit	*Anas platyrhynchos*	
		Nuyaralik	*Mergus merganser*	
		Red breasted merganser	*Mergus serrator*	
		Greater scaup	*Aythya marila*	
		Lesser scaup	*Aythya affinis*	
		Black scoter	*Melanitta nigra*	
		White-winged scoter	*Melanitta fusca*	
		Surf scoter	*Melanitta perspicillata*	
	Kukyuk		*Cygnus columbianus*	
Aalat Tingmiat	Maligiit	Maligiit	*Gavia immer*	
		Ukiuktatumi maligiit	*Gavia arctica*	
		Akhaaluit	*Gavia stellata*	
		Tuulik	*Gavia adamsii*	
	Black guillemot		*Cepphus grylle*	
	Akpa		*Uria lomvia*	
	Akilgiit		*Lagopus lagopus* *Lagopus mutus*	
	Tatilgait		*Grus canadensis*	
	Ukpiit		*Nyctea scandiaca*	
Maniit	Uluaguliit maniit	Kanguit maniit		
		Uluaguliit maniit		
		Kakaat maniit		
		Nikliknat maniit		
		Nikliviit maniit		
	Tingmiat maniit	Kingaliit maniit		L
		Mitiit maniit		L
	Kukyuit maniit			
	Ihungat maniit			
	Nauyait maniit			
	Akpait maniit			
	Black guillemot eggs			
Aomauyaotait	Kiviut			L

Atiit Atukpaktut		Kablunaat kauyimayatukangit atiit	Ilangit katitigutait katitikhimayut
	Ikaliviit	*Salvelinus alpinus* anadromous	L
	Ikaliviit	*Salvelinus alpinus* non-anadromous	
	Ikalupiit	*Salvelinus namaycush*	L
	Northern pike	*Esox lucius*	
	Arctic grayling	*Thymallus arcticus*	
	Kapihilik	*Coregonus clupeaformis*	
	Siulik	*Lota lota*	
	Kapihilik	*Coregonus autumnalis*	
	Eetuuk	*Coregonus sardinella*	
	Aanakhiik	*Stenodus leucichthys*	
	Ugak	*Gadus ogac* *Boreogadus saida* *Gadus morhua*	
	Kanayuk	*Myoxocephalus spp.*	
	Turbot	*Reinhardtius hippoglossoides*	
	Uviluit	*Mya spp.*	
	Uviluvaluit	*Mytilus edulis*	

Pihimayut hamanga: (American Ornithologists' Union, 1998; Jones et al., 1997; McClane, 1978), L = Nani umayukhimayut, S = Naunaiyautaa aknauyaakhait ovaluniit angutauyaakhait umayut, A = Ukingit umayut

Umayut naunaiyakhimayut umayukataini; nunani umayut, tingmiat ovalo ikaluit. Kihimi ataani umayut naunaiyautait ilangit; tuktuit[5], ovalo kanugituutait naunaiyautait akilgiit, uugat, kanayuit ovalo uviluit. Ilaani umayut ilihimaitut katitikhimayunut tuhaktitivaktut. Hamna tuhagutikhait ilivaktut katitigutini aatjikutaatut umayunut ovalo titigakpaktut aatjikutaani ilanganut. Hapkoa katitikhimayut nalvaaktaugaagamik unguvaktauvaktut katitikhimayunit. Naitumik titigakhimayut hamani katitikhimayuni takulaaktut ikpaauyakmi 3mi.

Ikpatauyak 3: Aalat umayut titigakhimayut Umayukhiukhimayut Ihivgiuktunit

Nunani	Umayut	Ihivgiuktut ukiungani	Kafiit Umayukhiukhimayut
Kingauk	Herring	2	16
		3	2
		5	3
	Flounder	2	151
		3	1
Umingmaktok	Capelin	2	732
Sanikiluaq	Harlequin Duck	1	1
		2	4
Mitimatalik	Tigiak	5	1

[5] Tuktut umayukhiukhimayut ilauyut ilangani umayut naunaiyautaani katitikhimayuni ikpatauyani

Umayukhiukhimayut naunaiyakhimayut umayut tukutauhimayut ovalo pihimayut. Hamna tamamik aatjikutaa naunaiyautaini "umayukhiukhimayut" NLCAmi ovalo nakuutkiyait atukhimayut ihivgiuktuni. Katimayigalaat angikhimayut naamangituk pigumi katitilugit katitikhimayut umayunut tukuhimayut kihimi tamaihimayut ovaluniit tukutauyut ovalo pihimaitut (NWMB, 1995b).

Ilaa umayukhimayut amigaitjutait titigakhimayuugaluit pihimayut umayut tukuhimayut ovalo pihimayait, kiviut tuhaktitihimayut amigaitjutainik ivaviit maninut kiviut katitikhimayut (katitikhimayut ikpatauyait takupkaihimayut kiviunik katitikhimayut titigakhimayut taimaatut). Umayukhiuktut ilaani tuhaktitivaktut ikaluktaminik ovalo ikaluvaluit ukumaiyautainut pingithutik amigaitjutainut. Taimaitpat, katitiligiyit titigaktiit atulikpaktuk nunanit atuktainik kafiuyaakhaita ikaluit pivaktut.

Naunaiyautait aknauyaakhaita ovaluniit angutauyaakhaita ovalo ukiungit umayukhimayut katitikhimayut ilangini umayuni (Ikpatauyak 2). Hapkoa katitikhimayut ilaungitut hamani tuhaktakhami kihimi pilaaktut apigilutit NWMBkunit.

Ikayuktut Katimayigalaat ihumavaktut hivulimi atugutikhait Umayukhiukhimayut Ihivgiugutait iniktigutaini naunaiyalugit hivulimi piyumayait naunaiyautainik. Kihimi NLCAmi titigatiakhimaitaagaluanga huna hivulimi piyumayait naunaiyautainik, Katimayigalaat ukakhimayut imaatut:

> *"Titigakhimayuk angigutaani pihimayut hivulimi piyumayait naunaiyautainik amigaitjutait umayut pivaktait inminik ovalo inuuviniit atuktakhainik. ...Umayukhiuktut ovaluniit katitiktut atuni-*

agumigit amiit, aomaoyaotait, kingminut nikikhainik, hanauyauliugutiginiaktait ilangitlu, ilitagiyauniaktut "hivulimi piyumayait" ilanganut, pihimakpata kinguliani atuniaktut umayukiuktit nunaini ovaluniit ilaugumi nunakatigiinut niuvikataktakhaini. Ilangit pilaitut ihumagiyauyut ilangit "hivulimi piymayait" ilangit umayukhiukhimayut ovaluniit katitikhimayut kinauyaliuniagutinik niuvilaat nikikhat hilataani Nunavumi Nunataagutit Angigutaani Iluanit." (NWMB, 1995b: 2)

Kitkaniituk kihimi nuyaliit umayut ilaunginaktut. Pikatagamik tamamik aviktukhimayut atukpaktut aalatkiinik atuktainik iniktigutaini hamna atuguti. Qikiqtaalumi ovalo Kivalliqmi, nunani havaktiit ukaktitauhimayut pilutik katitikhimayunik kinauyaliugutinik umayunik kihimi titigalugit umayukhimayut ukautiani ilangani katitikhimayut makpigaani. Hapkoa umayukhimayut ilauyut; ikaliviit ovalo ilangit tukut. Kitikmeoni, umayut pivaktut amigaitunik kinauyaliuktuni umingmait ovalo tuktuit umayukpaktut titigaktauyuitut, kihimi kinauyaliukhimayut umayukhiuktuni ikaliviit ilauhimayut amigaituni katitikhimayunut. Pihimamat aatjikiingitut titigagutaini kinauyaliuktut katitikhimayuni nunanit ovalo nunat iluanit havaktaini aalatkiit nunani havaktut ayonavyakpaktuk aviktunahuakhugit kinauyaliuktut ovalo inminik atuktakhainik umayut atukhugit maligutikhat ilihimayait Ikayuktut Katimayigalaat. Atugutait atukhimayut munagivlugit kinauyaliuktut umayukhiuktuni titigakhimayut hamani.

Hapkoa kinauyaliukhimayut katitikhimayut unguvakhimayut katitikhimayunit:

- Titigakhimayut angiyunit kinauyaliukhimayut umayukhimayut; umingmait Ikaluktutiamit;
- Titigakhimayut ukakhimayut naunaiyakhimaplutik umayukhimayut niuviktauhimayut ikalukhiukvimi ovaluniit uyunik hanavianut ovaluniit naunaiyakhimayut umayukhiukhimayut "niuviktauhimayut" ovaluniit kinauyaliugutigihimayut.

Hapkoa kinauyaliukhimayut katitikhimayut pihimayut katitikhimayunit ovalo ilauyut umayukhiuhimayunit ilanganut:

- Titigakhimayut tamamik nuyaliit umayukhimayut;
- Titigakhimayut ukakhimayut naunaiyakhimaplutik umayukhiukhimayut niuviktauhimayut nunani nigiyakhaini, ilaa; nunani HTOkunut ovaluniit atauhimut niuvikvimut nunamini.

Ihivgiukhimapluni, 86kuyut talvatuak titigakhimayut (145,000nitt tamaat) nalvaakhimayut naunaiyakhimayut umayukhimayait niuviktauhimayut. Hapkonanga titigakhimayunit 43kuyut talvatuak pihimayut maligutikhainut unguvagiani titigakhimayut hamani ovalo unguvakhimayut katitikhimayunit. Naitumik titigakhimayut hapkoa tuhaktakhat takulaaktut ikpatauyakmi 4. Mamiana, amigaitut umayukhiuktut titigaktauhimaitut kinauyaliukhimayut iluani ukautaini ilangani ihivgiugutini, taimaimat, nalunaktuk kanuk aalatkiiktut hapkoa piyumayaini umayukhiugutinit. Ilangani 6mi pihimayut naunaiyautait kinauyaliuktut umayukhiuktaminik tamamik nunanit (pilaakat) ihivgiuktilugit ovalo naitumik ukakhimayut ihumagiyait umayukhiukhimayut ilauyaakhaita naunaiyautaini. Hamna tuhagutikhak atuktuk ukautainit pihimayut nunanut pulaakhimatitlugit, ukakatigiyaptini nunanit havaktinit ovalo kinauyaliukhimayut katitigutinit katitikhimayut aalanit pihimayunit.

Umayukhimayut tunihimayut umayukhiuktut nunainut (ilaa, nuna umayukhiuktup titigakvigihimayainut), umayukhiuktuk umayukhiugalualuni nunani aalani nunaini.

Ikpatauyak 4: Kinauyaliukhimayut umayut unguvakhimayut Umayukhiukhimayut Ihivgiugutaani Katitikhimayunit

Nunani	Umayut	Ihivgiukhimayut Ukiungani	Amigaitjutait Umayukhimayut
Ikpiarjuk	Ikaliviit	1	185
Arviat	Ikaliviit	1	174
		2	60
Kamanituaq	Tuktut	1	6
Ikaluktutiak	Ikaliviit	3	9075
		5	1000
	Tuktut	1	50
	Umingmait	1	40
Kangiktugaapik	Ikaliviit	4	111
Ukhuktuuq	Tuktut	1	1
Sanigayaq	Ikaliviit	5	15
Iqaluit	Ikaliviit	4	120
Kugluktuk	Tuktut	1	2
Pangnirtung	Ikaliviit	3	3075
		4	740
	Uugait	3	320
	Turbot	3	200
Mitimatalik	Ikaliviit	3	134
Kangiklinik	Ikaliviit	1	310
	Tuktut	1	7

3.3 Naunaiyautait Umayukhiuktut

Ihivgiuktut inugiagutait hivulimi naunaiyakhimayuugaluit "Inuit nunakatigiit Nunavumi Nunataagutit Angigutaani Iluani" ovalo inuinaungitut Nunavumi nunaini ilitagiyauhimayut nunanit umayukhiuktut umayunik piyaamini atuktakhaminik inminik ilakatimilu ovalo ovaluniit inuuviviniit atuktakhainik Nunavumi Nunataagutit Angigutaani Iluani (NWMB, 1995b). Malikhugu hamna ilauyut tahapkoa inuinaungitut tuniyauhimayut Inuit Umayukhiugutit inminiigutainik ataani ilan-

gani 5.7.34 NLCAmi ovalo ilauyut aknait. Havaguti naunaiyaitaa "Umayukhiuktuk" iniktigutaani ilaa Ilauyuk NLCAmut, ukiulik 16nik avataanutlu ovalo ilauyuk umayukhiukhuni, ikalukhiukhuni ovaluniit nanigiakhiukhuni umayunik ukiuni (NWMB, 1998). Umayukhimayut ilauyunut ataani ukiukaktunut 16nik titigakpaktut angayukaaganut. Atukhugu, maligutait ilauyaami inuinaungitut tuniyauhimayut inminiigutikhainik umayukhiugiami aatjikiingitut. Ihiaviufaakhuni ihivgiugutini nunanit HTOkunit ovalo umayuligiyit pihimayait naunaiyaitait amigaitjutait umayukhiuktut tuniyauhimayut iniminiigutinik umayukhiulaat nunamini ihivgiuktitlugit. Hamna naunaiyautaa takulaaktuk ikpatauyami 10 ovalo ukakhimayut ilangani 6 malikhugu katitikhimayut ikpatauyat kitumikiak nunamit. Aalat pilaaktut ihuinaakhimayut mikhaanut naunaiyautait umayukhiuktut ukakhimayut ilangani 5.2.1.

3.4 Umayukhiuktut titigagutait

NWHSkut ihivgiungitut tamamik Inuit Ilauyunik kihimi tahapkoa Inuit naunaiyakhimayut "Umayukhiuktit" (ilangani 3.3). Hamna hanahimaygut "Atuktakhamik Titigagutainik Katitikhimayunik" tamamik umayukhiuktit naunaiyakhimayut atuniaktami uktugutikhat ilangani ihivgiuktuni. Hamna ilauyuk pingahuni atuktauptini. Hivulimi atukhuta pihimayuni munagiyut katitihimayainit hanagiami hivulimi katitikhimayut Inuit pihimayut naunaitunik mikhaanut kinauyut, ukiungit ovalo nunait. Hamna katitikhimayut pihimayut, Katitiktuiyit Kanatami ikluniitut naunaiyautait; Inuit Ilauyut titigakhimayut malikhugu NLCAmut; ovalo katitikhimayut Umayukhiuktit Laisinsiinut (GHL) tiguhimayut. Aipaani, pihimayut, atukhugit nunanit (nunani havaktit ovalo nunait) nalungitait, kitut Inuit umayukhiukhimayut ukiumi. Tamamik umayukhiuktut titigakhimayut katitikhimayunut tunihimaplugit naunaiyautainik namanik (alpha-numeric code), naunaiyautait atukhugit naunaiyautait nunait nunakatigiigiyainut. Pingahuani, pihimayut nutaat NWHSmut, naunaiyautaitakhainut umayukhiuktit katitikhimayut ilaani umayukhiuyuktut, umayukhiukatainaktut ovalo umayukhiukpiaktut. Hamna atuktuk ukakhimayuk ilangani 3.5mi kihimi ukakhimayuk hamani naunaiyautait umayukhiuktit katitikhimayunut pihimamata aatjikutaani titigaktautitlugit.

Nunani havaktiit munagiyut pihimaplutik katitikhimayunik ublumi tamaat tamaatlu tatkikhiutini ihivgiukhimayut, malikhugit Inuit piliktut ovaluniit pihuiktut pilaagiamini ovaluniit nuutitihimayut aalanut nunanut. Aalangukhimayut titigagutait pilaaktut kitumikiak hapkonanit:

- Nutaat titigakhimayut (ilaa; inuulgamiit umayukhiuktit 16nik ukiulikaliktut)
- Aalangukhimayut umayukhiugutait
- Tukuhimayut
- Itiktauhimayut
- Nuutitikhimayut iluanut ovaluniit hilataanut nunaminit

Maliktangit kanugitaakhait hapkoa aalangukhimayut nunani havaktiit titigalutik, Naunaiyautikhainik Aalangukhimayut Titigagutait (NOCIR) makpigaat (ilangani II) ovalo sukatukut tuyuklugit aviktukhimayut titigakvianut. Makpigaat ihivgiuktauhimayut RLOnit ovaluniit DECnit aviktukhimayumi, tuniplugit sukatukut NWMBkut titigakvianut titigakhimayut katitikhimamata ublumianut ihuakhalaagiami ovalo ihivgiugutit makpigaat sukatukut utiktivaktut aviktukhimayut katitikvianut. Ilaani, aalangukhimayut titigakhimayut ikpatauyait ihivgiufaaktuni atuktaini pihimaitumik iniktigutainik NOCIR makpigaat. Taimatkaagat, titigakpaktut ukautaini titigagutait ikpatauyaini titigakhimaplugit kanga aalangukhimayut, kinamit ovalo humat.

Ihivgiuktut Munagiyiit ovaluniit Katitikhimayut Munagiyiit aalangukhimayait titigagutait katitikhimayut malikhugit (tuniplugit nutaanik namakhainik, alpha-numeric codes ovalo naunaiyafaakhugit umayukhiuktit pilaitut ihivgiugiagani tatkikhiutimi) ovalo ukautiplugit nunani havaktiit nunanut aalanut nuutitihimayut.

Ikpinagutait hamna atuktut ihuakhakhimayut hivulimit atuktakhainik titigagutaini katitikhimayut tamamik tatkikhiutini. Hapkoa ihuakhautit atukpaktut hanaplutik tamaat tatkikhiutini umayukhiuktit katitigutait Inuit pilaitut ihivgiuktaungilutik talvani tatkikhiutimi ilaungitut ovalo nutaat umayukhiuktit ilavlugit. Ublumi tatkikhiutimi titigagutaini katitikhimayut kitumikiak tatkikhiutini aatjikiiktuk amigaitjutainik Inuit pilaaktut ihivgiutaulaalutik tatkikhiumi. Amigaitjutait umayukhiuktit katitikhimayut atuktakhami titigagutaini amigaikhimayut ihivgiuktilugit, ilaa umayukhiuktit ilagalualugit, unguvaktitauhimainamik atuktakhami titigagutaini (namanik naunaiyatikafumik pihimayut).

RLOkut tamamik aviktukhimayuni apigiyauhimayut tunilutik tuhagutikhainik kanuk atuktakhat titigagutaini hanahimayut. Hamna tuhagutikhak takulaaktuk Ikpatauyami 5. Amigaituni nunani, ilaa, Qikqtaalumi ovalo Kivalliqmi, pulaakataktut iklunut nunani havaktinit. Ilauyut katitiguait havaktauhimamata ovalo inikhimaitilugit ihivgiuktut pilihaaliktitlugit. Pingmata, hamna maliguti atukhimayuk malguni nunani (ikpiarjuk ovalo Kinngait Qikiqtaalumi). Kitikmeoni, katitikhimayut hanahimayut atukhutik GHLnik katitikhimayunit kihimi Kugaarukmi, katitikhimayut hanahimayait nunani havaktiit atukhuni nalungitaminik. Kingaumi, GHLnik katitikhimayunit ilauhimayut nunaminik nalungitaiminit ilavlugit umayukiuktit titigagutainut katitikhimayunut.

Piyumayait aalangugutait titigagutait naunaitkutaini ilaa, umayukhiukti nalvaakhimayut tatkikhiutini ukakatigigaagamigit, kihimi pilikpaktut autakhimaliktut aalangukhimanialutik nunanut aalanut autlagaagamik ilaani naluhuikpaktut tatkikhiutini amigaituni. Umayukhiukti ukakatigingitpat atauhimik ovaluniit malgunik tatkikhiutini, ikpinaktuk naunaiyagiami inuuhuiktuk nunamini ovaluniit ayokhaktut takuyaami. Ilaani, nuutitiyut amigaitkiyanik malgunik tatkikhiutini, umayukhiukti unguvaktauvaktuk katitikhimayunit nunaminit ovalo ilavakhuni nutaamut nunaminut (nuutitihimakpat Nunavumut nunainut) pigiagani ukakatigiyakhait. Ilaani hamna

atukpaktuk umayukhikti autakhimayuk nunaminit atauhimik tatkikhiutini. Hamna pivaktuk nunani havaktit ukaktaugaagami umayukhiukti nuutitihimayuk, pulaakafukhimatitlugu aalamut nunamut. Hamna pikatangituk ovalo ikpinaituk angiyumik piyangani. Titigakhimayut ukautait nuutitikhimayut titigakpaktut ukautaini ilangani ihivgiuktut titigagutaini ikpatautaini.

Amigaitjutait umayukhiuktut titigakhimayut tamamik ukiuni nunanit takulaaktut ikpatauyami 6mi. Tamaat amigaitjutait Inuit titigaktauhimayut ihivgiukhimayuni (ilaa, tamaat amigaitjutait uktukhimayut iluani talimani ukiuni tamamik 28ni nunanit) 6,018kuyut. Ilangit umayukhiuktit umayukhuyumata ovalo hunauva titigaktauhimayut amigaituni nunani, tamaat amigaitjutait Inuit titigaktauhimayut ihivgiuktuni mikitkiyauniaktuk tamaini tamamik nunanit amigaitjutainit.

Ikpatauyak 5: Nunani Umayukhiuktit Titigagutaini Maligutait

Nunani		Umayukhiuktit titigagutait atuktut	Kina naunaiyakhimayuk Inuit titigakhimayut	Kina titigakhimayaa umayukhiukti
Qikiqtaaluk	Ikpiarjuk ovalo Nanisivik	Ilauyut katitigutaini (Ikpiarjuk), pulaakatakhuni (Nanisivik)	Nunani Havakti (FW)	FW ukautaupluni
	Kinngait	Ilauyut Katitigutaini	FW	FW ukautaupluni HTIOkut ikhivautaanit ovalo umayukhiuktit ilaani
	Kangiktugaapik	Pulaakatakhutik iklunut	FW	FW ukautaupluni umayukhiuktinit
	Aujuituq	Pulaakatakhutik iklunut	FW	FW ukautaupluni umayukhiuktinit ilaani
	Sanigayaq	Pulaakatakhutik iklunut	FW	FW ukautaupluni umayukhiuktinit ilaani
	Igloolik	Pulaakatakhutik iklunut	FW	FW ukautaupluni umayukhiuktinit ilaani
	Iqaluit	Pulaakatakhutik iklunut	FW	FW ukautaupluni umayukhiuktinit ilaani
	Kimmirut	Pulaakatakhutik iklunut	FW	Naunaktuk
	Pangnirtung	Pulaakatakhutik iklunut	FW	FW ukautaupluni umayukhiuktinit ilaani
	Mitimatalik	Pulaakatakhutik iklunut	FW	Naunaktuk
	Qikiqtarjuaq	Pulaakatakhutik iklunut	FW	Naunaktuk
	Qaujuituq	Pulaakatakhutik iklunut	FW	FW ukautaupluni umayukhiuktinit
	Sanikiluaq	Pulaakatakhutik iklunut	FW	FW ukautaupluni umayukhiuktinit ovalo HTOkut munagiyiit
Kitikmeot	Kingauk	GHLni katitihimayut ilahimaplutik FW, RLO ovalo HTOkunit	FW, umayukhiukti, RLO, HTO	FW, umayukhiukti, RLO, HTO
	Ikaluktutiak	GHLni katitihimayut	FW, umayukhiukti, RLO, HTO	FW, umayukhiukti, RLO, HTO
	Ukhuktuuq	GHLni katitihimayut	FW, umayukhiukti, RLO, HTO	FW, umayukhiukti, RLO, HTO
	Kugaaruk	FW hanahimayuk katitihimayunik inminik nalungitaminit	FW, umayukhiukti, RLO, HTO	FW, umayukhiukti, RLO, HTO
	Kugluktuk	GHLni katitihimayut	FW, umayukhiukti, RLO, HTO	FW, umayukhiukti, RLO, HTO
	Taloyoak	GHLni katitihimayut	FW, umayukhiukti, RLO, HTO	FW, umayukhiukti, RLO, HTO
	Umingmaktok	GHLni katitihimayut	FW, umayukhiukti, RLO, HTO	FW, umayukhiukti, RLO, HTO
Kivalliq	Arviat	Pulaakatakhutik iklunut ovalo takuplugit	FW ovalo umayukhiukti	FW ukautaupluni umayukhiuktinit
	Kamanituaq	Pulaakatakhutik iklunut ovalo takuplugit	FW ovalo umayukhiukti	FW ukautaupluni umayukhiuktinit
	Igluligaajuk	Naunaktuk	Naunaktuk	Naunaktuk
	Salliq	Pulaakatakhutik iklunut ovalo takuplugit	FW ovalo umayukhiukti	FW ukautaupluni umayukhiuktinit
	Kangiklinik	Naunaktuk	Naunaktuk	Naunaktuk
	Naujaat	Pulaakatakhutik iklunut ovalo takuplugit	FW ovalo umayukhiukti	FW ukautaupluni umayukhiuktinit
	Tikigaqjuaq	Pulaakatakhutik iklunut ovalo takuplugit, naalautikutlu	FW ovalo umayukhiukti	FW ukautaupluni umayukhiuktinit

Ikpatauyak 6: Tamaat umayukhiuktit titigakhimayut nunainut, ukiumi

Nunani		Ukiumi 1	Ukiumi 2	Ukiumi 3	Ukiumi 4	Ukiumi 5	Tamaat
Qikiqtaaluk	Ikpiarjuk ovalo Nanisivik	267	254	250	245	257	310
	Kinngait	n/d	504	481	472	423	510
	Kangiktugaapik	198	213	214	223	218	245
	Aujuituq	40	43	55	61	58	73
	Sanigayaq	137	147	146	142	165	181
	Igloolik	212	233	246	259	273	307
	Iqaluit	n/d	350	400	406	415	540
	Kimmirut	96	99	102	104	97	114
	Pangnirtung	184	191	194	197	194	224
	Mitimatalik	263	277	294	331	355	408
	Qikiqtarjuaq	114	116	124	163	157	192
	Qaujuitq	51	64	65	70	68	75
	Sanikiluaq	133	155	159	166	171	181
Kitikmeot	Kingauk	18	17	17	18	17	21
	Ikaluktutiak	332	347	338	347	332	391
	Ukhuktuuq	344	347	337	344	338	368
	Kugaaruk	63	80	80	86	88	102
	Kugluktuk	276	273	266	269	263	294
	Taloyoak	235	231	222	221	212	249
	Umingmaktok	31	30	21	17	11	31
Kivalliq	Arviat	379	380	387	395	393	410
	Kamanituaq	327	324	315	302	299	341
	Igluligaajuq	72	79	80	77	85	92
	Salliq	256	254	266	244	226	283
	Kangiklinik	379	372	367	364	362	424
	Naujaat	169	163	157	152	146	180
	Tikigaqjuaq	50	50	47	50	49	61
	Nunavut	4578	5451	5468	5528	5529	6018

3.5 Aviktukhimatjutait umayukhiuktit katitikhimayait

Ihivgiuktut hanauyakhimayut pulutik aviktukhimalugit umayukhiuktit katitikhimayut, piyaami hanayakhainik nakuutikiyanik naunaiyautait umayukhimayait umayukhiuktit ilaungitut ukakatigihimayunit (ataani uktukhimayut nunanit) ovaluniit takuyaungitut ovaluniit ilauyumangitut tatkikhiutini ukakatigiligamik.

Titigagutait katitikhimayut aviktukhimayut titigaktaugamik pinghunut naunaiyakhimayunut umayukhiukpaktut kanuk, hamungatut:

- Umayukhiunginaktuk: *"Umayukhiukti ubluk tamaat ovalo pikatakhuni umayukhiukataktuk tamaat ovaluniit tamaavyak ukiuni kanukiak umayukhiuyuktuk ukiuk tamaat. Nunanit nikikainaktuk iklumini."* (NWMB, 1998, naunaiyautimi 3)
- Umayukhiukataktuk: *"Umayukhiukti umayukhiukataktuk kihimi ukiuk tamaagungitumik kihimi ukiungani tamaat (hikumi natikhiuktuk, ikalivinik ikalukhiuktuk ovaluniit tuktuhiukataktuk). Ilaukatauyut pikataktuk naituugaluakhuni kihimi akhuutuk, pivaktut ublunik autlaakhuni ovaluniit havanaitumi."* (NWMB, 1998, naunaiyautimi 3)
- Ilaani Umayukhikataktuk: *"Umayukhiukti ilaani, pikatainakhimapluni, ilauyuk umayukhiugutini pivaktuk (ublumi ovaluniit malgunik ublunik tuktuhiukpaktuk ovaluniit tingmiakhiupluni ovaluniit ikalukhiuhuni ikaktuuyakut ilaani). Ilauyut naitumik pivaktut ilaani ublumi atauhikmik ovaluniit hananaitumi pivaktut."* (NWMB, 1998, naunaiyautimi 3)

Umayukhiuyuitut naunaiyakhimayut Inuit ilaungitut (pingitut ukiumi) umayukhiuktuni ovalo ikalukhiuktuni pikataktainik. Umayukhiuyuitut titigaktauhimaitut Umayukhiukhimayut Ihivgiugutaini (Berkes et al., 1995a).

Munagiyaini nunani havaktiit tamamik nunani naunaiyalugit tamamik umayukhiuktit titigagutait katitikhimayuni. Ikpatauyami 5 pihimayut (23nut nunani titigakhimayuni) nunani havaktiit naunaiyakhimayait umayukhiuktit imaatut:

- Ikayuktaupluni umayukhiuktinit (tamamik nunanit, tamaat ovalunii ilangit);
- Ikayuktaupluni HTOkunit (9ni nunanit, ilauplutik tamamik Kitikmeoni);
- Atukhuni nalungitaminik (talimat nunat, tamamik Qikiqtaqlumi).

NWHSkut ilingitut maligutikhainik ovaluniit naunaiyautikhainik hapkoa naunaiyautit. Naunaiyakhimayut atukhugit nalungitaminik nunani havaktiit ovaluniit umayukhiuktit inminik kanuk ilauniaktut inminut.

Ikpatauyak 7mi takukhauyuk aviktukhimayait titigakhimayut umayukiuktit aviktugutaanut, nunanut ovalo ukiungani. Ilangit nunat umayukhiunginaktut ikinmata amigaitjutait umayukhiuktut mikhaanut tamaat umayukhiukhimayut. Ilaa, atauhiukpat ovaluniit malguuk umayukhiukpiakpaktut titigakhimayunit ovalo tahapkoa umayukhiuktit ukakatigiyaungitut tatkikhiutini, umayukhiukhimayut naunaiyalaitut. Taimaimat aviktugutait umayukhiukpiakpaktut ilauyut 5%mik ovaluniit ikinikhait tamaat naunaiyaitait umayukhiuktit ilauhimayut pikataktunut aviktukhimayunut. Ovalo ikinmata umayukhiuktit Kingaumi ovalo Umingmaktokmi tamamik aviktugutait katitikhimayut tamani nunani. Kalakatumik ikpatauyami 7mi naunaiyakhimayut aviktugutait katitikhimayut atugiagani naunaiyautait tamaat umayukhimayut (ilangani 4).

Ikpatauyak 7: Umayukhiuktit titigakhimayut aviktukhimayuni, nunaini ovalo ukiungani

Nunat		1			2			3			4			5		
		O	A	I	O	A	I	O	A	I	O	A	I	O	A	I
Qikiqtaaluk	Ikpiarjuk ovalo Nanisivik	221	46	0	208	45	1	207	42	1	201	43	1	212	44	1
	Kinngait	n/d	n/d	n/d	399	67	38	381	63	37	372	63	37	324	61	38
	Kangiktugaapik	168	22	8	181	23	9	179	26	9	187	27	9	182	27	9
	Aujuituq	19	21	0	24	20	0	37	18	0	42	18	1	39	16	3
	Sanigayaq	57	56	24	64	60	23	61	61	24	61	57	24	81	58	26
	Igloolik	107	54	51	124	57	52	130	61	55	145	60	54	162	58	53
	Iqaluit	n/d	n/d	n/d	198	121	31	240	126	34	236	133	37	244	135	36
	Kimmirut	60	21	15	61	23	15	64	24	14	65	25	14	62	21	14
	Pangnirtung	86	72	26	95	70	26	98	70	26	107	65	25	108	62	24
	Mitimatalik	133	85	45	143	91	43	163	91	40	200	90	41	229	86	41
	Qikiqtarjuaq	81	32	1	83	32	1	91	32	1	128	33	2	125	29	3
	Qausuituq	21	23	7	33	24	7	34	24	7	39	24	7	38	24	6
	Sanikiluaq	57	55	21	71	62	22	75	62	22	81	64	21	85	65	21
Kitikmeot	Kingauk	12	3	3	11	3	3	11	3	3	11	4	3	10	4	3
	Ikaluktutiak	259	58	15	272	60	15	262	61	15	268	61	18	255	60	17
	Ukhuktuuq	300	41	3	298	43	6	289	42	6	294	42	8	289	41	8
	Kugaaruk	23	24	16	25	37	18	28	36	16	29	40	17	32	38	18
	Kugluktuk	177	99	0	174	99	0	168	98	0	172	97	0	168	95	0
	Taloyoak	189	36	10	185	36	10	178	35	9	174	38	9	170	33	9
	Umingmaktok	23	8	0	23	7	0	15	6	0	13	4	0	9	2	0
Kivalliq	Arviat	309	64	6	309	65	6	312	69	6	315	74	6	312	74	7
	Kamanituaq	264	62	1	263	60	1	252	62	2	240	60	2	234	63	2
	Igluligaajuq	40	21	11	45	23	11	46	23	11	43	24	10	47	29	9
	Salliq	113	110	33	112	111	31	124	110	32	105	108	31	94	104	28
	Kangiklinik	238	86	55	240	80	52	235	80	52	228	82	54	226	83	53
	Naujaat	108	55	6	105	52	6	103	48	6	103	43	6	96	44	6
	Tikigaqjuaq	32	16	2	32	16	2	31	16	0	32	18	0	30	18	1
	Nunavut	3070	1159	357	3681	1364	422	3699	1361	423	3771	1357	432	3776	1339	428

3.6 Pikatakhimayut uktugutit angiyuni nunani

Pinahuaktait ihivgiuktuni tikinahuakhugu tamaat katitigutikhainik tamamik titigakhimayut katitikhimayuni tamamik nunani. Kihimi, kinauyakaluangimat, pingitut havaktikhanik pigiagani tamaat titigakhimayut katitikhimayut angiyuni nunani. Ikayuktit katimayigalaat angikhimayut uktulutik 2/3nik umayukhiuktit pikatakhimalugit atuklugit hapkonani nunani, piyaami munagilaaktainik atauhik nunani havaktihat. Hivulimi ihivgiuktukhat hanauyakhimayut pitkuhimayait hamna atuklugu Iqaluni, kangiklinikmi ovalo Ikaluktutiami (Berkes et al., 1995a). Pitinagit katitigutit katitikhimayukhat, hamna maligutikhak angiklihimayuk nunanut Kinngaini, Kugluktukmi, Ukhuktuuqmi, Arviami ovalo Kamanituaqmi (tamamik nunat 275nik umayukhiuktinik titigakhimayut hivulimi ukiumi). Kihimi iniktikhimaitut Iqaluni, kiguvakhimamat umayukhiuktinik titiganahuagutaini ovalo ihumaalugigamiuk mikhaanut ataaniimat atiktuitjutikhait ilauyukhanik. Kamanituaq unguvaktauhimayuk katitiktunit uktugutikhani nunani Januarymi 1999 ikitpalaamata ilauyukhat.

Hivulimi uktunahuat uktugutini ilaulutik tamamik umayukhiuktit umayukhiukpiayuktunit ovalo umayukhiukataktunit aviktugutaani, ovalo pikatalugit kafiuyaakhait umayukhiuktit ilaani umayukhiukpaktunit piyakhat 2/3mi uktunahuagutini (pikatalugit pikataktaini pihimayut aviktuhimaplugit tamamik aviktukhimayunit). Hamna nutaak katitikhimayuk uktukhimayut umayukhiuktit taivaktuk “ukakatiginiaktait katitikhimayut” (ilaa titigakhimayunit katitikhimayut). “Titigakhimayuni katitikhimayut” umayukhiuktit “ukakatiginiaktait katitikhimayut” tunihimayut pitkutitiaktanganit ovalo umayukhiuktit ukakagilaitait tunihimayut pilaitut naunaitkutaanik.

1997mi, ukakatiginiaktait katitikhimayut nunani Arviami ovalo Kangiklinikmi ihuakhihimayukhat ilaa ihuinaakhimamata nalvaakhimayut kitkani aviktukhimayunit ovalo katitikhimayut pihimayait hivunikhaini titigakviit. Nutaat aviktugutikhait maligutikhait atulikhimayut tamamik umayukhiunginaktut ovalo umayukhiukpiayuktut ovalo 1/3mi ilaani umayukhiuyuktut ihivgiuktauniaktut. Hamna pihimayuk nutaamik “ukakatiginiaktut katitikhimayut” atukhimayuk ihivgiuktitlugit tahapkonani nunani. Ikpinaguaa tahapkoa malguk uktugutit nalvaalaaktuk ikpatauyami 8mi.

Ikpatauyak 8: Uktunahuaktut uktugutikhat

Pinguaktuk 1 (1996 – 1997):	Titigagutait Katitikhimayut	Ukakatiginiaktut katitikhimayut
Tamaat	120	80 (2/3)
Umayukhiukpiayuktut	10	10
Umayukhiukataktut	20	20
Ilaani umayukhiuyuktut	90	50

Pinguaktut 2 (1997 – 2001):	Titigagutait Katitikhimayut	Ukakatiginiaktut Katitikhimayut
total	120	60
intensive	10	10
active	20	20
occasional	90	30 (1/3)

Hivulimi pinahuat ilifaalugit “ukakatiginiaktait katitikhimayut” tamamik ukiuni nutaamik pikatalutik umayukhiuktinik ilaani umayukhiuyuktut aviktugutaanut. Inikmat, Ukakatiginiaktait katitikhimayut” ihuakhakhimaitut ovalo tahapkoa piyauhimayut talvaniiginaktut ihivgiugutini tamaat ihivgiuktiluta (kihimi titigakhimayuk ilangani Kivalliqmi nunaini).

Nutaat ilaani umayukhiukpaktut titigaktaumata 7ni nunani, ilaukataungitut “ukakatiginiaktait katitikhimayunut” kihimi titigakhimayut ovalo tuniyauhimayut pingitut. Aipaani, ukiumi hitamini ihivgiuktuni, tamamik nutaat umayukhiuktit ilauyutlu tahapkoa ilaani umayukhiukyuktut aviktugutaanut ilahimayut ukakatiginiaktaini katitikhimayunut. Amigaitkiyait tahapkoa umayukhiuktit nutaaguyut nunaminut kihimi hivulimi titigaktauhimayut aalani nunanut.

3.7 Katitikhimayut katitigutaini maligutait

3.7.1 Ukakatiginiaktait maligutikhat

NWHSkut hanauyakhimayut pulaakatalutik iklunut ihivgiugutit, nunani havaktiit ukakatiginiaktait tamamik titigaktauhimayut umayukhiuktit tamaat tatkikhiutini. Nunani havaktiit takuvaktait umayukhiuktit inminik ovaluniit fonikut. Nunani havaktiit naunaiyakhimapluni umayukhiukti umayukhiugiagani aipaani tatikikhiutimi ovalo pihimakpat, titigalugit kafinik, nani ovalo aalat tuhagutikhait umayukhiukhi-

mayait tamamik umayut piyainik. Fonikhimakpat, nunani havakti pulaaniaktait umayukhiuktit katitinahualugit umayukhimayait katitigiagani. Takulugit ukakatigiyut piyukhat naunaiyagiami nunauyami umayukhimayait. Nunani havaktiit umayukhimayut katitikhimayainik makpigaanut (Nunavumi Umayut Umayukhiukhimayut Ihivgiugutait Katitigutaini makpigaani – Ilangani III) tamamik umayukhiuktit takuyauyut tamaat tatkikhiutini. Kihimi, umayukhiuktit takuyaungitkaagata, katitiktukhat makpigaat titigaktauyuitut tahapkoa umayukhiuktunut.

Ilaa pilaaktainik katitigiami tuhagutikhanik umayukhiuktinit uktukhimayainik ukakatigihimayuugaluit hanauyaktuni pitilugit, hamna tuhagutikhak katitikhimaituk ihivgiuktitlugit. Hivulimi kiutjutikhait naunaiyaitaini ilauyuugaluit "umayukhiuktuugaluak kihimi umayungituk", kihimi hamna pikatangituk ihuimat ovalo havatiangimat.

3.7.2 Tuhaktakhat ubluit (tatkikhiutini aipaini), kinguvaktut maligutikhait

Ihivgiuktut pihimayut tatkikhiutini tamaat, naunaiyautikakhutik tamamik ihivgiuktit tatkikhiutini ukakatigitinagit. Nunani havaktiit pihimayut, tamaat Julymi ukakatigilugit tamamik titigakhimayut umayukhiuktit umayukhiukhimayainik Junemi. Umayukiuktit takungitkaagata ilaani tatkikhiutini, nunani havaktit apigivaktut aipaani tatikikhiutini umaykhimayainik. Hamna naluyaungituk "kingulimi piyait" pilaaktait amigaivyaktut tatkikhiutit, pilaakata. Kihimi, kingulimi piyait tuhagutikhanik amigaitkiyani siksini tatkikhiutini pitkuyaungitut. Ubluit (ukakhimayut tatkikhiutini) umayukhiuktaminik ovalo ukakatigihimayaini taivaktuk utiktihimayut ubluit ovalo atukpaktuk naunaiyautimik keelininga kingulimi piyait tamaat ihivgiuktuni. Utiktihimayut ubluit naunaiyakhimayuk tamamik umayukhiukhimayut titigagutaini katitikhimayuni. Ilauyut katitikhimayut ikpatauyami takuyauvaktut utiktihimayut ubluit katitihimayuni umayukhiukhimayut katitikhimayuni naunaiyakhimayut tatkikhiutini tamaat ilangit umayukhimayut titigakhimayuni kingulikhimayunit talimani tatkikhiutini ataanilu ovalo avataanut siksiit tatkikhiutit.

Umayukhiukhimayut Ihivgiugutit Tatkikhiutit hanahimayut ovalo tunikhauplutik tamamik titigakhimayut umayukhiuktit atulihaagaagat ukiuk. Kinguliit hitamat makpigaat tatkikhiutini katitikhimayut umayut aalatkiit piksakakhutik tamamik umayut. Umayukhiuktit titigakpaktut umayukhiukhimayaminik katitigutainik tatkikhiutimini ovalo tamamik tatkikhiutini nunani havaktiit takuvaktait hamani tuhagutikhanik. Tatkikhiutit atugutait aalauyut nunanit aalanut.

3.7.3 Ihivgiugutit kiutjutait ilangit ovalo iniktigutait

Hivulimi, tatkikhiutini kiuhimayut tamamik Inuit "ukakatiginiaktut katitihimayuni" titigakhimayut atauhik 9nit aalatkiit ilangit:

1 – Umayukhiukhimayuk
2 – Umayukhiukhimangituk
3 – Umayukhiukhimayuk kihimi umayungituk
4 – Umayukhiugaaktuk
5 – Nuuhimayuk
6 – Autlakhimayuk
7 – Takuyaungituk
8 – Ukakatauyumangituk
9 – aalat

1998mi, hapkoa ilauyut atugunaitut hamani ovalo ihuakhakhimayut pihimayuni katitikhimayuni imaatut:

1 – Umayukhiukhimayuk	(Himautihimayuk utukamut naunaiyautak 1)
2 – Umayukhiungituk	(Himautihimayuk utukamut naunaiyautaanit 2 ovalo 3)
3 – Takuyaungituk	(Himautihimayuk utukamut naunaiyautanut 4, 6, 7 ovalo 8)
4 – Umayukhiuguiktuk nunamini (nuunami, itiktaugami, tukutnami, umayukhiuguigami)	(Himautihimayuk utukamut naunaiyautak 5)

Nutaat naunayauti 4 pihimayuk Inuit pilaitut ihivgiutaulutik kitimikiak tatkikhiutini ihivgiuktuni ovalo titigangitut naunaiyautaini kiuhimayuni. Nutaat naunaiyauti 3 ilauyut tamamik tahapkoa takuyaungitut ovalo tahapkoa ukagumangitut. Kihimi umayukhiuktit piyumangitpata ilaukataulutik ihivgiuktuni, titigagutait ikpatauyat ihuakhakhimayut titigalugit "DWTBI" (Ukagumangitut) ovalo tatkikhiutit ovalo ukiungit hamna tuhagutikhait pihimayut titigakhugit. Hamna tuhagutikhak pihimayut titigagutini ikpatauyaini ovalo ukakhugit piyumangitut kiuyumangithutik; amigaitjutait tahapkoa Inuit titigakhimayut ikpatauyami 9mi. Tamamik Inuit tuhaktakhait naunaiyautait 1mi pikaktut titigainik umayukhiukhimayut, tamamik aalat tuhaktakhat naunaiyaitait pikangitut.

Pilaaktut ihivgiukhimayut inugiagutait tatkikhiutini tamaat naunaiyautait 1-3. Kiutjutait ukakhimayut %ni, tamaat naunaiyautait 1-2 aviktukhugu tamaat naunaiyautaani 1-3 ukalaaktuk $\sum_{1,2}/\sum_{1,2,3}$ X 100%. Tatkikhiutini kiuhimayut naunaiyautaani tamamik nunat takulaaktut katitikhimayuni ikpatauyami.

Ikpatauyak 9: Piinaktut kiuyumangitut nunainit

Nunat		Tamaat amigaitjutait umayukhiuktit*	DWTBI**	% DWTBI
Qikiqtaaluk	Ikpiarjuk ovalo Nanisivik	310	0	0.0
	Kinngait	243	2	0.8
	Kangiktugaapik	245	3	1.2
	Ausuituq	73	1	1.4
	Sanigayaq	181	0	0.0
	Igloolik	307	3	1.0
	Iqaluit	540	7	1.3
	Kimmirut	114	2	1.8
	Pangnirtung	224	7	3.1
	Mitimatalik	408	8	2.0
	Qikiqtarjuaq	192	10	5.2
	Qausuituq	75	2	2.7
	Sanikiluaq	181	7	3.9
Kitikmeot	Kingauk	21	0	0.0
	Ikaluktutiak	246	1	0.4
	Ukhuktuuq	246	1	0.4
	Kugaaruk	102	0	0.0
	Kugluktuk	201	1	0.5
	Taloyoak	249	1	0.4
	Umingmaktok	31	0	0.0
Kivalliq	Arviat	310	1	0.3
	Kamanituaq	336	110	32.7
	Igluligaajuq	92	5	5.4
	Salliq	283	13	4.6
	Kangiklinik	324	48	14.8
	Naujaat	180	1	0.6
	Tikigaqjuaq	61	3	4.9
Nunavut		5255	237	4.5

* Tamaat amigaitjutait umayukhuktit ukakatiginiaktut katitikhimayuni atauhimi ihivgiuktuni.
** DWTBI: Ukakatauyumangituk. Umayukhiuktit piyumaitut ilaulutik.

3.7.4 Umayukhimayut nani nunani

Ilangani 5-5 NLCAmi piyukhat umayukhimayut katitikhimayait takuyukhat nunanit. Katitikhimayut ilangit umayut kanugituni umayunit katitikhimayuni tikuaktukhimayut piyukhat titigakhimayuni umayukhimayut nani nuani (Ikpatauyak 2).

Nunani havaktiit tuniyauhimayut 1:250 000nik naunaiyakaktunik nunauyanik umayukhiuktut nunat atukhimayut umayukhiuktunit nunaminit. Ikayuktauplutik nunani havaktinit, umayukhiuktit naunaiyakhimayakhait nani nunami umayukhimayait umayut. Nunani havaktiit atuniaktut hilaligiyini nunani nanilgutit (UTM) tikuaktaagutit takuyaami nunauyani nani umayukhimayut ovalo nunat atiit katitikhimayuni makpigaanut. Tahapkoa tikuaktaagutit takuyaami kaaganiitivaktut tamamik nunauyani ovalo atuktangit naunaiyautait nunat nani ukakhimayut haniani nunauyat. Ilangani 3 ukakhimayut maliguait atukniaktut. Malgunik titigaliit, hitamanik naunaiyautikakhutik iliniaktut katitikhimayuni makpigaat nunauyani naunaitkutainik umayukhimayaini. Hamna atuniak naunaiyaniaktuk titigaani 1 kilometreni tamaat umayukhimayut pihimayaini. Hamna ukaniaktuk nakuutiaktumik titigakhimalugit 1 kilometrenit X 1 kilometrenut umayukhimayut pihimayaini nunani. Hamna ukaniaktuk nakuuyumik titigakhimaluni 1 kilometrenut. Kihimi ilaani, umayukhiuktit tikuaktitivaktut ilaani nunani umayukhimayaini naluvyakhutik ovalo hapkoa ilangit nakuutjutait 1 kilometremi pilaitut. Ovalo tuhaktitihimayut nunani havaktinit ovalo ilauyunit umayukhiuktit ukakafuniaktuk nunat atiit nani nunamit pihimayut ovalo nunani havaktit pilutik naunaitkutaini umayukhimayut. Ilangit nunat nunani havaktiit hanahimayut katitikhimayunik atukataktut nunat atiit ovalo aatjikutait naunaitkutaini umayukhimayuni. Ilaa hamna mikhivaktait nakuutjutait umayukhimayait nunat katitkhimayaini. Iniktigutait hapkoa atuktut nakuutjutait nunauyani katitikhimayut atulaitut 1 kilometreni. Hamna ihumagiyauyukhak atuniagumi umayukhiukhimayut nunait ovalo nunat atiit tuhagutikhaini. Kihimi NLCAmi ukakhimaitut mikinikhainik atuktukhat nakuuyumik umayukhiukviit nunat katitikhimayuni ovalo titigakhimayut nunauyani umayukhimayut nunat titigakhimayut takulaaktuni Inuit atukpaktut umayunik malikhugu Ilangani 5.4.5 (a) angigutaani.

Umayukhimayut nunait katitikhimayut kungialaaktut atulutik Nunavumi Umayut Umayukhiukhimayut Ihivgiuktit GISkut kungiagutikut ilauyut hamani tuhaktakhami. Taiguaktut atuktakhait katitikpiakhimayut katitigutit ilauyut hamna kungiagutikhamut atuktinagit GISmi katitikhimayut hamani. Katitikpiakhimayut ilangit ilauyut tamaat takuyaaktuni GISkut katitikhimayut ovalo titigakhimayut kanuk katitigutit katitikhimayut, hanahimayut ovalo ihivgiukhimayut.

Ilangani 3: Umayukhimayut nani nunat katitikhimayut

Nunauyani naunaitkutait atuinaktut hivulimi takulugit malguk titikait naunaiyautit (WHmik hamani atunguaktut).

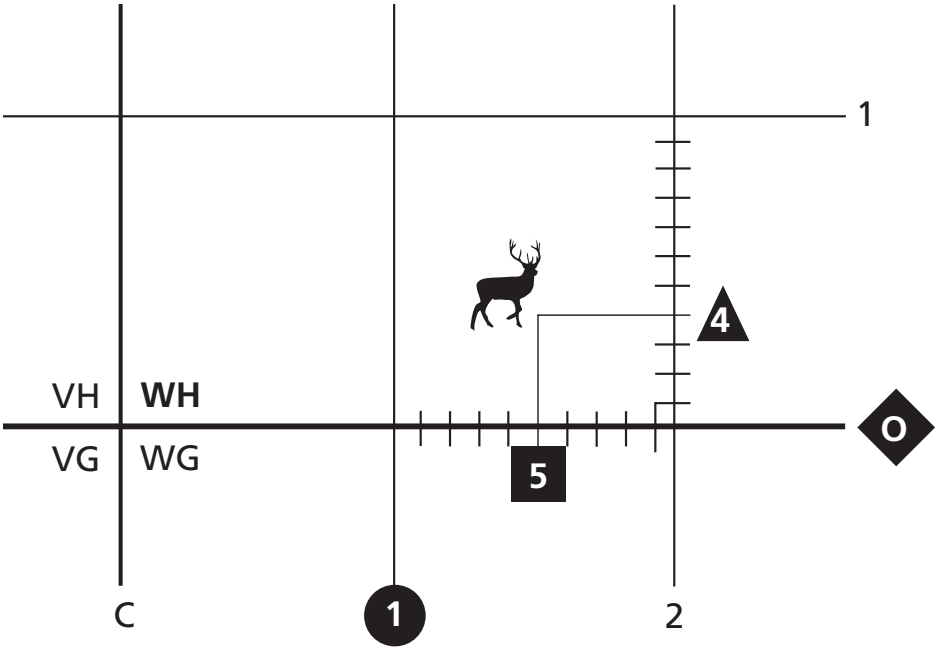
Titigait malilutik kivataanut naunaitkutait:

● ■

Ovalo kananakut naunaitkutait:

◆ ▲

Taimaimat hamani nunauyami naunaitkutait pihimaniaktut hamani **WH1504.**



4. Umayukhimayut Katitigutait (Iniktigutait)

Hamna tuhaktakhak pihimayuk 27nik ilanik umayukhiukhimayut katitikhimayunik ikpatauyanik (atauhik tamamik nunanut, piplugit Ikpiarjuk ovalo Nanisivik atauhimik nunamik katitikhimaplutik) ovalo Nunavumi tamaat ilanganik pihimayut aatjkitait ikpatauyat katitikhimayut iniktigutait tamamik nunanit. Tamamik 664nik umayukhimayut katitikhimayut ikpatauyami (Ikpatauyat 11mit – 674mut) ilauyut hamani tuhaktakhami tamaat ilangani 6mi: Nunani Iniktigutait Ukautingit. Ikpatauyat ihuakhakhimayut ihivgiukhimayuni ukiunganut tamamik nunat ilangit pihimayut ilauyuni ikpatauyani tamamik talimani ukiuni ihivgiukhimayuni ovalo ilauyut ikpatauyat titigakhimayut ukiuk tamaat iniktigutait tamamik talimat ukiut. Nunanit Iniktigutait Ukauhiit inikhimayut tamamik nunat ilangani. Tamamik ilauyut ukiuk tamaat ikpatauyait pihimayut imaatut:

1. *Tatkikhiutini umayukhimayut naunaiyautait* – Hamna ikpatauyak pihimayuk naunaiyautait tatkikhiutini umayukhimayut umayuinut[6] ovalo ukiuk tamaat tamamik umayut, naunaiyakhimayut tamaat tatkikhiutini tamaita, pihimaplutik 95%mik nakuuyut pikataktut ukiuk tamaat tamaitaini. Ilangit umayut hivulimit umayut katitikhimayunit (ikpatauyak 2) katitikhimayut naunaiyakhimagamik umayukhimayut naunaiyautait ovalo nakuutjutait atukataktait. Hamna pihimayuk ayonailugu tuhaktakhak ovalo ilaa, ilaani umayukhiuktit tuhaktitihimamata umayut ilangit pingithutik kitut umayut ovaluniit ataani umayut. Umayut katitikhiamayut imaatut:
   - Tuktut: ilauyut, nunani tuktut, kikiktami tuktut, kananamit tukut ovalo tuktuvaluit, ukauhiit Nunanit Iniktigutait Ukauhiit ilakakhutik naunaiyakhimayut kitut umayukhimayut tamamik nunani.
   - Ukiuktaktumi Tigiganiat: ilauyut kakuktut ovalo kalaliit tigiganiat
   - Kalaliit tigiganiat: ilauyut aupayaaktut, kipliktut, aalatkiit ovalo kiniktut tigiganiat
   - Tingmiat: ilauyut kingaliit ovalo mitiit
   - Uluaguliit maniit: ilauyut maniit kanguit, uluaguliit, nikliniit ovalo nikliknait
   - Tingmiat maniit: ilauyut kingaliit ovalo mitiit maniit
   - Ikaliviit: ilayut tahini ovalo tagiuni ikaliviit
2. *Tatkikhiutini umayukhiuktit kiutjutait* – Hamna ikpatauyak tunihimayuk amigaitjutait umayukhiuktit pilaaktu ihivgiuktuni (tatkikhiutini umayukhiuktit katitigutait), amigaitjutait ukakatigihimayut katitigutait (ataani uktukhimayut nunat talvatuak), amigaitjutait ukakatigihimayut ovalo amigaitjutait umayukhiukhimayut tamamik tatkikhiutini ovalo takuyut tatkikhiutini kiuhimayut naunaitkutait (tamamik aviktukhimayut katitkhimayumik) atukhugit hapkoa amigaitjutait. Naunaiyaligami umayukhiukhimayut naunaiyautait tamamik aviktukhimayut ihumagiyauhimayut avaliitumik ovalo naunaiyakhimayut hivulimi naunaiyakhimayut tamamik aviktukhimayumi umayukhiuktinik, taimaimat tamamik aviktukhimayut tamatkiikhimayut pinahuakhugit nunani naunaitkutait tamamik tatkikhiutini ihivgiuktuni.
3. *Utiktihimayut umayukhiukhimayut ovalo ukakatigihimayut* – Naitumik titigakhimayut umayukhimayuni ovalo ukakatigihimayuni katitihimayut umayukhimayunik. Takulaaktut ikpatauyani %git umayukhimayut titigakhimayut katititjutait utikhimayut pingahuni tatkikhiutini mikinikhaanutlu, kitkani hitamat ovalo siksiit tatkikhiutini ovalo avataanut siksinit. %git hanianut namanut pihimayut piplutik tamaat pingahut ilaukatigiit 99%guplutik pihimayut ilangit. Utikhimayut tunivaktait taiguaktut naunaiyakhutik kanuk utiktivaktait nunani havaktiit ovalo pilaaktut utiktigutini ihuinaakhimayuni (ukakhimayut ilangani 5.4.2).
4. *Amigaitjutait umayukhiuktit umayukhiuktut tamamik umayunik* – Hamna ikpatauyak tunihimayuk amigaitjutainik umaukhiuktit umayukhiukhimayut tamamik umayunik tamamik tatkikhiutini ihivgiukhimayuni ovalo tamaat amigaitjutait umayukhiuktit umayukhiukhimayut umayunik ihivgiuktitlugit ukiungani. Taiguaktut nalungitukhat tamaat iniktigutaini ilaani aalauyut iniktigutainut tatkikhiutinit iniktigutaini ilaani umayukhiuktit aatjikutaumata umayukhiulaamat umayumik amigaitkiyaini tatkikhiutimi ukiungani.

[6] Nanuit katitigutait takukhuyut naunaiyautaungitut; umayukhiuhimayut naunaiyautait pihimayut DSDkunit

Talimani ukiuni titigakhimayut ikpatauyani tamamik nunat pihimayut aatjikutait hitamat ikpatauyat titigakhimayut hamani kihimi takukhauyut ukiuk tamaat iniktigutainik pingithutik tatkikhiutini iniktigutainit. Titigakhimayuk hamani katitikhimayuni ikpatauyaini tamamik nunat maliktangit Nunani Iniktigutait Ukauhiit. Hamna ilanga titigakhimayuk nakuutkiyainik umayukhiukhimayut naunaiyautait mikhaanut tamamik nunat, angilivlugit tuhagutikhaini tunihimayut ilangani 5mi ovalo pihimayut nunanit kiutjutait ovalo aalat atulaat umayukhiukhimayuni katitikhimayuni. Ilangit umayut umayukhiukhimayuni naunaiyautaini ikpatauyat titigakhimayut ovalo ukakhimayut taiguaktunut mikhaanut ukagiagani ovalo katitikhimayut nalvaakhimayut hamani ukautini ilaini.

4.1 Umayukhiukhimayut Naunaitkutait

NWHSkut atukpaktut ayonaitunik ilangani piyakhanik tuhaktakhaini umayukhiukhimayut amigaiyakhugit utigutainut kiuhimayut naunaitkutainut, ukakhimayut imaatut:

$$Y = y(N/n)$$

Imaitpat Y = Naunaitkutaa umayukhimayut
y = Tuhakhimayut umayukhimayut
N = Amigaitjutait ovaluniit uktugutait atuktut (hamani tatkikhiutini titigagutait katitikhimayut)
n = amigaitjutait umayukhiuktit kiuhimayut

Hamna atuktuk ihumayuk kiuhimayut pihimayut pikataktaini uktugutini amigaitjutaini. Tamamik tatkikhiutini pihimayut inminik ihivgiukhimayut ovalo tamamik aviktukhimayut naunaiyakhimayut inminik.

Umayukhimayut naunaiyautait ovalo ihuakhimayait naunaiyakhimayut malihugit atukhimayait tahapkoa hanahimayait; Katitiktuiyit Ikayuktut ilagiit, Katitiktuiyit Kanatami, Inuvialunut Umayukhiukhimayut Ihivgiuktinit (ilaukatigiit katimayigalaat 2003). Pigiami ihivgiukhimayut atukhimayut hapkoa naunaiyakhimayuni NWHSmi katitikhimayut, hamna ilauyut katraktilihimayut pihimayut naunaiyakhimayut umayukhiukhimayut naunaiyautaini ovalo nalungitut utiktigutait uktukhimayut NWHSmi katitikhimayuni.

Pihimayut naunaiyautait atukhimayut hamani:

Ihumagiyait tatkikhiutini umayukhimayut aviktukhimayuni naunaiyakhimayut imaatut:

$$Y_{mcs} = \frac{N_{mcs}}{n_{mcs}} \sum_i y_{mcsi}$$

Imaitpat: Y_{mcs} = ihumagiyait umayukhimayut tatkikhiutikut *m*, nunakut *c*, ovalo aviktukhimayut *s*
N_{mcs} = Amigaitjutait umayukhiuktit titigakhimayut tatkikhiutikut *m*, Nunakut *c* ovalu aviktukhimayut *s*
n_{mcs} = Amigaitjutait umayukhiuktit ukakatigihimayut tatkikhiutikut *m*, nunakut *c* ovalo aviktukhimayut *s*
y_{mcsi} = Umayukhimayut tuhaktitihimayut umayukhiuktinit *i* tatkikhiutini *m*, nunakut *c* ovalo aviktukhimayut *s*

Ihuakhagutait naunaiyakhimayut tatkikhiutit umayukhimayuni tamamik aviktukhimayuni naunaiyakhimayuk imaatut:

$$Var(Y_{mcs}) = \frac{N^2_{mcs}}{n_{mcs}} (1-f_{mcs}) s^2_{mcs}$$

Imaitpat:

$$f_{mcs} = \frac{n_{mcs}}{N_{mcs}}$$

$$s^2_{mcs} = \sum_i (y_{mcsi} - \bar{y}_{mcs})^2/(n_{mcs} - 1)$$

Tamamik aviktukhimayut pihimamata inminik ihivgiukhimayut ilauyunut tamaat tatkikhiutini naunaiyautaanut umayukhimayut tatkikhiutini m ovalo nunakut c naunaiyakhimayut imaatut:

$$Y_{mc} = \sum_s Y_{mcs}$$

Aatjikutaatut, ihuakhakhimayut hamna tatkikhiutini naunaitkutaini umayukhimayut naunaiyakhimayut imaatut:

$$Var(Y_{mc}) = \sum_s Var(Y_{mcs})$$

Ukiuk tamaat umayukhimayut naunaiyakhimayut nunani, ilaukataupluni ilangani tatkikhiutini naunaiyakhimayuni umayukhimayut:

$$Y_{mc} = \sum_s Y_{mcs}$$

Ovalo ihuakhakhimayut ukiuk tamaat naunaiyakhimayut imaatut:

$$\begin{aligned} Var(Y_c) &= \sum_m Var(Y_{mc}) \\ &= \sum_s \sum_m \frac{N^2_{mcs}}{n_{mcs}} (1-f_{mcs}) s^2_{mcs} \end{aligned}$$

95%kuyut nalungitut keeliniit pihimayut square rootmi ihuakhakhimayut naunaiyautaini hamani malguiktulugit ovaluniit $2\sqrt{Var(Yc)}$. Hapkoa keeliniit pihimayut kaagani ovalo ataanu naunaiyautaini 95%kuyut nalungitut ilauyunut ovalo takukhauyut talikpini titigakhimayuni umayukhimayut naunaiyautaini ikpatauyami. 95%kuyut nalungitut ilauyunut titigakhimayut mikhaanut pilaakat 95%nik pihimayuni pitiakhimakpat umayukhimayut ikuyut. Ilaa, Ikpatauyak 11mi ukiuk tamaat umayukhimayut naunaiyautait tuktunut nunani Ikpiarjuqmi 1,246kuyut umayut +/- 96. Ukakhimayuk ukautikut, hamna ukakhimayuk ukiuk tamaat umayukhimayut tukut Ikpiarjuqmi umayukhiuktinit naunaiyakhimayut 1,246nik umayunik, pikpat 95%mik nalungitut pihimayut ukiumi tuktut umayukhiukhimayut kitakaniitut 1,150nit 1,342mut umayut.

4.2 Kiuhimayut naunaiyautait

Takuhimayut hamani ilangani 4.1mi amigaitjutait umayukhiuktit ukakatigihimayut mikhaanut amigaitjutait umayukhiuktit titigakhimayut (kiuhimayut naunaiyautait) ikpinaktuk naunaiyagiami umayukhiukhimayut naunaiyautait. Kiuhimayut naunaiyautait naunaiyakhimayut tamamik aviktukhimayut, nunani ovalo tatkikhiutini atukhutik umayukhiuktit kiutjutait maligutainik titigakhimayut ilangani 3.7.3mi. Kiuhimayut ilanganiitut takukhauyut umayukhiuktit kiutjutait ikpatauyat imaatut:

Umayukhiuktit kiuhimayut	Ihivgiukhimayut maligutait
Tatkikhiutini umayukhiuktut	ilangit maligutaini 1, 2, 3 ovalo ilaani umaukhiuktit ilaungitut ataani uktugutini (ataani uktugutini nunait)
Ukakatigihimayut	ilangit maligutaini 1, 2 ovalo 3
Umayukhiuktit ukakatigihimayut	ilangit maligutaini 1 ovalo 2
Umayukhimayut	amigaitjutait maligutaini 1
Kiuhimayut naunaiyautait (%)	$\sum_{1-2}/\sum_{1-3}$ X 100%, OVALUNIIT umayukhiuktit ukakatigihimayut katitihimayunutlu X 100%.

Pikpata ihivgiukhimayut maligutai pihimakpata:
Maligutait 1: Umayukhiukhimayut
Maligutait 2: Umayukhiungituk
Maligutait 3: Takuyaungituk

Tamamik umayukhiuktit tatkikhiutini umayukhiuktini katitikhimayut tatkikhiutimi ihumagiyauyut pilaaktut umayukhiukhimayut ovalo ilauyut umayukhiukhimayuni naunaiyautaini. Hivulik titigagutait katitikhimayut tamaat ihivgiukhimayut ubluini pihimayait hivulimi titigakvimi ovalo ilauyut tamamik umayukhiuktit titigakhimayut ihivgiukhimayuni kangani talimani ukiuni. Taiguaktut nalungitukhat 7ni ataani uktukhimayuni nunani, ilaani umayukhiuktit ilaungitut ataani uktugutini kihimi ilauyut naunaiyautaini umayukhiukhimayut naunaiyautait ilaungitut kiuhimayuni naunaiyautaini. Pihimamat hamna kiuhimayut naunaiyautait atukhimayut takupkailugit amigaitjutait umayukhiuktit ukakatigihimayut mikhaanut amigaitjutait umayukhiuktit pinahuaktut ukakatigilugit. Pinahuakhimaitut ilaani umayukhiuktit ilaungilutik ataani uktugutini ukakatigilugit ihivgiuktuni. Talikpiangani "tamaaat" naunaiyautait tamamik tatkikhiutimi umayukhiuktit kiuhimayut ikpatauyaani titigakhimayut imaatut:

Tatkikhiutini Umayukhiuktit katitikhimayut: Umayukhiuktit tatkikhiutini umayukhiuktit katitikhimayuni atauhimi tatkikhiutimi ukiumi

Ukakatigihimayut katitikhimayut[7]*:* Umayukhiuktit ukakatigihimayut katitikhimayuni atauhimi tatkikhiutimi ukiumi

Umayukhiuktit ukakatigihimayut: Umayukiuktit ukakatigihimayut atauhimi ukiumi

Umayukhiukhimayut: Umayukhiuktit umayukhiukhimayut atauhimi tatkikhiutimi ukiumi

Kiutjutit naunaiyautait: Anginikhaat tatkikhiutimi kiuhimayut naunaiyautait

Aatjikutaumat, "tamaat" naunaiyakhimayut ukiuk tamaat umayukhiuktit kiuhimayut ikpatauyaini naunaiyakhimayut amigaitjutait umayukhiuktit titigakhimayut, ukakatigihimayuni katitikhimaniituk, ukakatigihimayut ovalo umayukhiukhimayut atauhimi tatkikhiutimi tamaat ihivgiuktitlugit. Tamaat kiuhimayut naunaiyautait pihimayut anginikhaaganut talimat anginikhaat tatkikhiutini kiuhimayut naunaiyautaini.

Umayukhiuktit kiuhimayuni ikpatauyait Nunavumi tamaat ilangani aalanguniaktut pihimamat "tamaat" naunaiyakhimayuni tamamik tatkikhiutini umayukhiuktit kiuhimayaini ovalo ukiuk tamaat umayukhiuktit kiuhimayuni ikpatauyaini aalauniaktuk iniktigutaanut "tamaat" naunaiyakhimauni tamamik nunani. Pihimamat hamna ilangit umayukhiuktit titigakhimamata amigaitkiyani nunani atauhimi ukiumi (nuutitihimagamik nutaamut nunamut ilangani ukiumi). Taimaimat, iniktigutait nunani "tamaat" anginikhaaguvaktut Nunavumi tamaini "tamaat" ilaa ilangit umayukhiuktit titigaktauhimalaagamik amigaitkiyanik atauhimit.

[7] Ukakatigihimayuni katitikhimaniitut ilauhimayut ikpatauyamut nunani ilaani umayukhiuktit tamaat uktukhimayut.

5. Atutialaagutait Umayukhiukhimayut Naunaiyautait: Nakit ovalo Naunaiyautait ihuinaakhimayunit

Atuktangit hamani ilangani ihivgiulugit hakugigutikhat katitigutit katitikhimayut NWHSkunit mikhaanut iliyaami ublumi umayukhiukhimayut naunaiyautaini ovalo pilutik naunaiyaklutik hivulimi piyumayait naunaiyautainut, malilugu NLCAmik. Taimaimat, ihivgiuktut keelinakamata, umayukhiukhimayut naunaiyautait tuhaktakhami ihivgiuktuni iniktiakhimaitut. Taimaimat piyukhat naunaiyautait *"angitjutait umayukhiukhimayut atauhimi ukiungani"* (NLCAmi, 1993mi, ilangani 5.6.21) mikhaanut naunaiyautaini BNLmi atuklugit tuhaktakhat umayukhiukhimayuni.

Ikpinaktuk hapkoa naunaiyautit tamaat umayukhiukhimayut nakuuyukhat Inuit Ilauyunut, NWMBkunut ovalo umayunik munagiyunut havakviinut. Hamna nakuutjutikhait piniaktut nalungitpat ukautingit ihivgiukhimayut atuktangini, ilanganilu ihiviufaakhimayut tamamik nakuutjutait ovalo naunaiyautait ihuaktut katitikhimayuni.

Umayukhiukhimayut naunaiyautait maligutait titigakhimayut ilangani 4.1mi piniaktut nakuuyunik naunaiyautinik tamaat umayukhiukhimayut ovalo atukatigit uktugutit ihuinaagutait pihimakpata:

1) *Nmi* tamaat ovalo ihuaktumik pihimayut umayukhiuktit ilangit.
2) *nmi* kiuhimayut pihimayut nakuutjutikhaini pihimayut uktugutini Nmi umayukhiuktini, taimaimat nakuuyunik kiuhimayut naunaiyautaini ovalo nakuuyuni ihivgiufaagutaini kiukatangitut ihumainik.
3) Ihivgiuktut kiuhimayait nakuuyut, ilaa atugutingit nakuuyuni umayukhiukhimayuni kiuhimaut Inuit.

Hamna ilanga ihivgiukhimayuk piyaagani tamamik hapkoa maligutikhat pihimayut NWHSmi mikhaanut naunaiyautait BNLmi ovalo pingitpat, naunaiyaklugit ovalo pilaakata, naunaiyautait kanuk ihumagiyauyut ovaluniit ihuinaakhimayuni.

Tamamik pihimayunut ihumayugut:

- Kanuk ihivgiuguti hanahimayuk ovalo atukhimayuk,
- Pilaaktuni pihimayut ihuinaalaaktut mikhaanut tamamik ilangit hanahimayaini ovalo atukniaktaini ihivgiugutit,
- Keelininga hapkoa ihuinaakhimayut pihimayut, tamamik nunani, (nalungitpata),
- Maliniaktait ovalo angitjutait hapkoa ihuinaakhimayut, ovalo
- Nakuuyunik atugutikhait uktugutikhat angitjutait hapkoa ihuinaakhimayut pigiami ihuakhagiami ovalo pilaakat ihuakhalugit.

Hamna ilanga naunaiyakhimayuk, ihivgiukhimayuni tamaat ihumagiyainik. Ayonaktut tamamik nunani naunaiyakhimayuni Nunani Iniktigutait Ukauhiini ilangani malikhugit tamamik nunat talimani ukiuni titigakhimayni ikpatauyaini.

Hamna ilanga ihumangituk ihuinaagutikhainik ovaluniit aalanik ihumagiyainik nunani naunaiyautaini tukutihimayut nunait.

5.1 Atugutikhat

Pingahuuyut ayonaktut pivaktut ihivgiuktuni hamani aatjikutaani.

Hivulimik, tamamik Inuit inugiagutait ihivgiuktauhimaitut kihimi uktukhimayut atuktait pihimayut umayukhiuktit katitikhimayut hanahimayut hilataani ihivgiukhimayunit atukhutik ilihimayut inminik atukhutik atukhimayut ilangit munagiyukhat katitikhimayut atukhugit nunani (havaktiit ovalo nunani) nalungitainik. Hamna maligutikhak takupkaiyuk pilaaktaini inikhimaitut ovaluniit aatjikiingitut katitigutit ovalo taimaimat uktugutit atugutait tamaat ilaukataungituk piyakhaini ihivgiuktut ilauyunut.

Aipaani, ihivgiukhimayut inminiikhimayut ovalo taimaimat havagutaini ihumagihimayut, 100%mik (tamaat ukakatigihimayut) pihimayut umayukhiuktit katitihimayuni pihimaituk pilainami nunanit tatkikhiutini. Taimaimat angiyut kihimi inikhimaituni uktugutini hanahimayut uktukhimayunit atuktainit. Tuhaktakhat umayukhiukhimayut (iniktigutait tamamik kiuhimayut) piyukhat ilaani mikinikhaaguluni naunaiyakhimayuni umayukhiukhimayunit naunaiyakhimayukhani. Inikhimaitut pihimayut takulaaktut pilaaktainik uktukhimayut malikatangituk. Angiyunik aalangukakat kitkani piyakhaini tahapkoa ihivgiukhimayunit ovalo tahapkoa ihivgiuktauhimaitunit, kiuyauhimaitut ihumayainit iniktigutaani naunaiyautaini. Angitkiyaukpat kiuyauhimayut naunaiyautait, mikinikhaaguniaktuk pilaaktu kiuyaungitut ihumagiyainik.

Pingahuani, atugutit ihuinaakhimayut pilaaktut. Ilaa apikhutit atuktait kangikhiyaungituk ovalo pitkuhimayut ihuitunik kiutjutikhanik ovaluniit apikhutauyuk kiuhimaituk (uktugutini ihumagiyaini).

Mikinikhaat naunaiyautit pitiakhimayuni ukakhimaitut hanauyakhimayuni pitilugit NWHSmi ovaluniit katimayigalaanit. Ovaluniit, ihivgiuktut pihimayut kinguani katitigutit katitikhimayuni ilangani, pilaaktut katitikhimayuni atulaat naunaiyakhimaitut naunaiyautikhainik (Usher ovalo Brooke, 2001mi: 13-14). Ukakhimayut ilangani 2mi, tamaat umayukhiukhimayut naunaiyautait ukakatigihimaiatut inikmat tamamik ihivgiukhimayuni ukiungani, ovaluniit iniktigutait tuhaktitihimaitut Inuit umayukhiuktinut. Ilangani pihimanmat hamna, kitkani ihuakhakhimayut ihivgiuktitlugit ovalo hunat malikhimayuk, inikhimayuni ihivgiuktuni ihivgiufaagutait nakuutjutikhainik NWHSni katitikhimayut naunaiyakhimayaami BNLkut.

Atuktangit hamani ihivgiufaakhimayuni pihimayut hivulimi atukhugit ayonaitut ovalo naluhuiyaulaaktuk. Taimaitpat, ayonatkiyat ihivgiufaagutit atugutait pilaimata pitkutikangithuni ihivgiuktut iniktigutaani. Taiguaktut ihumayukhat hamna munagiyunut angikhimayut katitikhimayunut, pingithuni hivulimi ihivgiuktut katitikhimayainik. Inuit ihivgiuktuni ihumayut pilaaktut atuklugit aalat pilaaktunik maligutikaktunik ovalo maliktakhakaktunik umayukhiukhimayut naunaiyautaini.

5.2 Ihivgiuktut atuktait: naunaiyautit ovalo katitigutit

Hamna ilanga ihumahimaut ilangani 1: piniakat uktugutit atugutait (N) tamaat ovalo nakuuyumik ilaupkaiyuk umayukhiuktinut amigaitjutainut.

5.2.1 Pihimayut katitigutini ihuinaalaaktut

Titigakhimayni 3.4mi, hanatjutait titigagutait katitikhimaut pihimayut, atukhugit pingahut atukhimayut atugutit. Hivulimi, atuklugit munagiyikhat katitigutait hanagiami hivulimi katitikhimaykhanik Inuit pihimayut mikhaanut kinautjutait, ukiungit ovalo nunait. Aipaani, naunaiyakluni, atuklutik nunamini (havaktiit ovalo nunait) kauyimayainik kitut Inuit umayukhiukhimayut aipaagani ukiumi. Pingahuani, aviktukhimayut umayukhiuktit katitikhimayuni, ilaani umayukhiukpaktut, umayukhiukataktut ovalo umayukhiukatainaktut umayukhiuktit. Hivulimi takuyaulaak ilangit pilaaktut inikhimaitut ovaluniit aatjikutaungitut katitigutit ovalo taimaimat, uktugutit atuktait pihimaituk tamaat ilaupluni naunaiyakhimayuni hilaini. Amigaivyaktut pilaaktut ayonalaatut hamani maligutikhami.

Atauhik ayonaktuk ihivgiuktut pilihaamata, ilauyut katitigutait hanauaylihaamata ovalo inikhimaititlugit ovalo pingitut hanahimaitkaluamata inikhimayumik katitikhimayukhanik Inuit Ilauyunik 16nik ukiukaktunik avataanutlu. Aipaani, katitikhimayut ilauhimalaamata Inuit nunakaktut hiltaani Nunavumi nunaini. Ikpigivlugu GHLnik katitikhimayut, hapkoa pihimaiyugaluamata angnanik, ataani utukait GHLni atugutaini, laisinsikaktut umayukhiuyugaluamata ilakatigiminut. GHLni katitikhimayut pilaamata ataani katitilugit angnait ovalo ilangit inuulgamiit angutit. Taimaimat hapkoa katitikhimayut piyukhat ilauyukhat nunanit havaktiinit ilaulugit umayukhiuktit ataani ilauyunut hamani katitikhimayuni.

Aipaani ayokhaguti takuhimayuk nunani havaktiit naunaiyakhimagamik kitut Inuit katitikhimayut hivulimi umayukhiukhimayaakhaita ukiumi autlaktitihimatilugu NWHS (maligiagani naunaiyautait umayukhiuktit). Hamna pihimayut malgunik pilaaktunik ihuinaalaaktunik, tamamik pihimayut initiakhimaitunik ovalo ihuinaakhimayunik uktugutinik naunaiyakhimayainik “umayukhiuktit.”

- Hivulimi pihimayut pingitunik naunaiyakhimayut Inuit pilaaktut naunaiyaktauhimagamik, ukiungit ovalo nunakatigiinut umayukhiugiagata ilaa, inuuviviniit pinginmata apikhulugit Inuit kanugitaakhaita umayukhiuktiuyut. Ikpinagutaa avataanungalaaktut katitiktuni. Naunaiatuk hamna pihimayuk nunani amigaitut umayukhiuktit (ilaa ilangani ilaani umayukhiukpaktut aviktugutaini) pikatakpaktut tuhaktakhanik umayukhiuyuitut (maligutait 2 tamamik tatkikhiutini).
- Aipaagani pihimayut piyunakhimata nunani havaktiit atuinakhimatunakhiyut ihivgiugutit titigakhimayut naunaiyautainik kina umayukhiuktit, kihimi himautigiyut, ilaani, inminik inuuviviminut ihumagiyainik kina umayukhiukti. Ilaa NWHSni pinahuaktuugaluit ilaulutik kitutkiak umayukhiukhimayut hunanik amigaitunut Inuit umayukhiuktiuyut ukakhimagamik Inuit ilaani ikalukhiukpaktut, ovaluniit hikukpaktut ilaani uluagulinik ovaluniit tuktunik. Pihimamata inminut ikpinaktunik inminiigutit ihumagiyainik ovalo inuuhitjutait inminiingitut pikataktainik. Ilangit nunani havaktiit atukhimayut akhuutkiyanik naunaiyautinik umayukhiuktit pinahuaktainit ihivgiuktunit. Hamna pilaaktuk ataani katitikhimayuni atuktakhainik ihivgiuktut.

Ayonagutait ataani katitigaagata ihumagiyauvaktuk angiyumik ilangini nunani atukhugit ukakatigihimayait nunani ilauyut ovalo ihivgiufaakhugit inikhimayut katitikhimayut ihivgiufaakhimatitlugit ihivgiuktuni. Atukhugit hamna hivulimi ihivgiugaaguti, ihivgiuktut munagiyi kungiafaakhimayait umayukhiuktit katitigutait HTOkunut nunanut pulaakhimapluni. Ikpatauyami 10mi takulaaktuk nunani ihivgiufaagutait ataani katitigutait atukhutik hapkoa ukakatigitjutainut. Ataani katitigutait hapkoa umayukhiuktit pipkalaamata ikitkiyanik ukautikhainik umayukhiukhimayut naunaiyautait tamamik hapkoa titigaktauhimayaitut umayukiuktit naluyaungitut umayukhiukpaktut nunamini ihivgiuktitlugit kihimi ukakatigiyaungitut ovalo umayukhimayait naunaiyakhimaimata. Angitjutaa hamna ihumagiyait piniamat amigaitjutait umayukhiuktit titigaktauhimaitut ihivgiuktuni ovalo naunaiyakhimaimata. Ilaa, ikpinagutait ataani katitikhimayut talimat ilaani umayukhiuktit mikitkiyauniamat talimanit umayukhiukataktunit

Ikpatauyak 10: Naunaiyautait umayukhiuktit ataani naunaiyakhimayut nunanut

Nunat		Tamamik Amigaitjutait titigakhimayut umayukhiuktits	Kafiuyut amigaitjutait titigaktauhimaitut umayukhiuktit tuniyauhimayut inminiigutinik umayukhigutikliits	HTOkut katimayiit naunaiyautaini titigaktauhimaitut umayukhiuktits	Kafiuyut tamamik amigaitjutait titigaktauhimaitut umayukhiuktit	Kafiuyut ilangit umayukhiuktut titigaktauhimaitut
Qikiqtaaluk	Ikpiarjuk ovalo Nanisivik	310	6 O ovalo 2 A	Titigakhimayut namait naamaktut	8	3
	Kinngait	510	1 O ovalo 1 A	13 O ovalo 13 A ovalo 1 I pihimaitut	29	5
	Kangiktugaapik	245	1 O	Titigakhimayut namait naamaktut	1	0
	Auyuituq	73	1 O ovalo 2 A	12 O ovalo 2 A pihimaitut	17	19
	Sanigayaq	181	3 O	Titigakhimayut namait naamaktut	3	2
	Igloolik	307	piitut	Titigakhimayut namait naamaktut	0	0
	Iqaluit	540	48 O ovalo 2 A	51 O, 12 A ovalo 1 I	114	17
	Kimmirut	114	1 O	51 O piitut	52	31
	Pangnirtung	224	1 O	61 O ovalo 7 A piitut	69	24
	Mitimatalik	408	1 A	Titigakhimayut namait naamaktut	1	0
	Qikiqtarjuaq	192	piitut	4 O, 7 A ovalo 5 I piitut	16	8
	Qaujuituq	75	piitut	Titigakhimayut namait naamaktut	0	0
	Sanikiluaq	181	3 O	11 O ovalo 3 A piitut	17	9
Kitikmeot	Kingauk	21	piitut	Titigakhimayut namait naamaktut	0	0
	Ikaluktutiak	391	16 O ovalo 2 A	37 O piitut	55	12
	Ukhuktuuq	368	4 O	18 O piitut	22	6
	Kugluktuk	294	3 O ovalo 1 A	Titigakhimayut namait naamaktut	4	1
	Kugaaruk	102	1 O	62 O ovalo 5 A piitut	68	40
	Taloyoak	249	3 O	Titigakhimayut namait naamaktut	3	1
	Umingmaktok	31	piitut	Titigakhimayut namait naamaktut	0	0
Kivalliq	Arviat	410	5 O	Titigakhimayut namait naamaktut	5	1
	Kamanituaq	341	1 O ovalo 1 A	65 O piitut	67	16
	Igluligaajuk	92	2 O	12 O piitut	14	13
	Salliq	283	5 O	Titigakhimayut namait naamaktut	5	2
	Kangiklinik	424	13 O	Titigakhimayut namait naamaktut	13	3
	Naujaat	180	piitut	31 O ovalo 8 A piitut	39	18
	Tikigarjuaq	61	piitut	44 O piitut	44	42

O = Ilaani Umayukhiukpaktut
A = Umayukhiukataktut
I = Umayukhiukatainaktut

nunanut umayukhiukhimayut naunaiyautaini. Umayukhiukhimayut naunaiyautait titigaktauhimaitut umayukhiuktit naunaiyalaat atulutik anginikhaat umayukhimayut amigaitjutait tamamik umayut aviktukhimalugit. Kihimi hapkoa naunaiyautait pihimagamik inminik ihuinaalaagutainik ovalo ihumagiyainik avataanuummata atuktakhait hamna iniktigutaa tuhaktakhak. Taiguaktut apigilaaktut NWMBkunut piyumagumik inikhimayut hapkoa naunaitjutait. Ikpinagutait ataani katitigutait aatjikiingitut nunanit, taiguaktut pitkuyauyut takulugu ikpatauyami 10mi ovalo ilangani 6mi: Nunani Iniktigutait Ukautingit nakuutjutainik ukautainik mikhaanut tamamik nunat.

Ikpinagutait avataanut katitigutait ayonatkiyat naunaiyagiami ilaa, iniktigutait ihumaniamata amigaitkuyanut ovaluniit ikitkiyanut ilauyut avataanut katitikhimayunut umayukhiuktinut. Umayukhiungitut titigaktauhimakpata ovalo kiuhimayut naunaitkutait angitkiyaukpata tamaat nunani, mikiniaktut ikpingutait umayukhimayut naunaiyautaini. Kihimi kiuhimayut naunaitkutait umayukhiungitut angitkiyaukpat umayukhiukataktunit nunani, naunaiyautait ihumaniaktut ataanut ilauniamata umayukhiuyuitut kiuhimayuni ilangini ikitkiyauniamata tamaat umayukhimayut ovalo ikitkiyaulutik umayukhimayut naunaiyautait kiungitunit umayukhiuktinit. Kihimilu, kiuhimayut naunaiyautait umayukhiuktit amigaitkiyaukpat umayukhingitunit, aipaanut piniamat ovalo naunaiyautait ihumaniaktut kaaganut. Hamna atukpaktuk kiuyaungitut ihimagiyauniak (ilangani 5.3) avataanut katitigutaini umayukhiuktinik. Kingulimi ayonalaat hamna ihumagiyauyuni ilangit ilauyut tuhaktitikataktut umayungitut pihimalaamata atukagitiyumanginamigik umayukhimayaminik katitikhimayuni. Hamna pivaktut takuyaungitut kiuyaungitjutit ovalo ukakhimayuk ilangani 5.3.2mi. Iniktigutait hamani ihivgiufaagutini naunaituk avataanut katitikpaktut umayukhiuktinik pihimayut ihivgiuktitlugit. Pilaakata, takuyaulaitumik kiungitunik pinguaktut avataanut katitigutiyunut, ayonaktuk naunaiyagiami kanugituk ayonagutit. Ihumagivlugit hapkoa ovalo naluvlugit namungauyuk ihumagiyait, naunaiyautait ikpinagutait haman ihuinaakhimayuni pingituk. Kihimi pilaamata ihumagiyait pihimayut tamamik namungautjutaanut amigaituni, ukalaaktuk tamaat ikpinagutait umayukhiukhimayut naunaiyautaini mikiniaktuk.

Hamani ukauhiit piyut talvatuak hivulimi titigaktautitlugit atuktaini. Kihimi ihivgiuktitlugit, nunani havaktiit kungiakhimayait titigaktitauyut naunaiyautainik umayukhiuktit ovalo ihuakhakhugit naunaiyautait pilaakata. Ihuakhautjutit pihimayut titigagutaini katitikhimayut atukhugit umayukhiuktit nuukatautjutait, tukuhimayut ovaluniit aalangukhimayut umayukhiuktut piyaini. Nutaa umayukiuktit ilahimayutlu katitikhimayunut pilaalimata ihivgiuktuni. Ihivgiufaakhugit katitikhimayut ihivgiuktut titigagutait ovalo inikhimayut ihivgiugutaini nunani naunaiyakhimamata takukhauyut kungiagutiit ihuinaakhimayut ikitut ovalo pingitut ihumagiyaini tuhaktakhami umayukhiukhimayut tamaat namutkiak ovaluniit angiyunik ihumaalugiyakhanik.

5.2.2 Naitumik titigakhimayut

Uktukhimayut atuktangit tamaat ovalo nakuuyumik takutiakhimayait umayukiuktit amigaitjutait? Kiutjutaa takukhauyuk pingitut amigaituni nunani. Amigaivyaktuni ihumaiyaini ilauyutlu munagiyit katitigutait atukhimayuni hivulimi titigaktitihimayuni atuktainik ovalo atuktangit nunani havaktiit inuuviviniit ihumagiyait umayukhiuktit akianut atuktakhat naunaiyautaini umayukhiuktit, takukhauyuk hapkoa katitigutit ihuinaagutit pihimayut NWHSmi. Ataanu katitigutit umayukhiuktini takukhauyuk angitkiyak ayonagutit ovalo piniaktuk ataanut ihumagiyainik umayukhiukhimayut naunaiyautaini. Keelininga hamna ihumagiyait ukakhimayut Ilangani 6: Nunani Iniktigutait Ukauhiit. Avataanut katitigutait piyunakhiyut mikiyumik kihimi naunamat naunaiyagiami ovalo pilaaktut ihumagiyaini naunaiyautini namutkiak naunaiyakhimaimata ovalo ihumagiyauyuk mikiyut. Taimaimat, piyakhait 1mi pilaituk tikinahualugit.

5.3 Ihivgiukhimayut pihimayut ovalo kiungitut ihumayait

Hamna ilanga ihumayuk piyakhait 2mi: Pihimakpata nmi kiuhimayut ihivgiugutini makpigaani naunaiyakhimayut uktugutaini Nmi umayukhiuktit, ilaa, angingitut aalatkiigutait umayukhiukhimayut naunaiyautaini ovalo pikataktait kitkani tahapkoa kiuhimayut ihivgiuktunut ovalo tahapkoa pingitut. Angiuyut aalatkiit kitkani malguuk pilaaktu ataani uktugutaini inugiagutaini (uktugutit ihuinaagutit) ovaluniit pikakat atuktaini aalatkiigutait kitkani tahapkoa kiuhimayut ovalo kiungitut (kiungitut ihumagiyait). Angitkiyaukpat kiuhimayut naunaiyautait, mikinikhauniaktut ikpinagutait tamamik uktukhimayut ihuinaagutait ovalo kiungitut ihumayait umayukhiukhimayut naunaiyautaini.

5.3.1 Ihivgiukhimayut Pihimayait

Ihivgiukhimayut pihimayait avataanuinaktut 75%nik. Pihimayait pikatainakafugumik, iniktigutait pihimayaini naunaiyautaini ilangani angitkiyauniaktuk nakuuyunik naunaiyautini tamaat umayukhiukhimayut, ilaa, ihuakhihimagumik pihimayut umayukhiukhimayuni naunaiyautaini mikinikhauniaktut. Kihimi hamna pinginmat tamamik umayunut. Hivulimi, ilangit umayut pivaktait mikiyunik amigaitjutainik, talvatuak ilaani ikitunit umayukhiuktinit (ilaa, nanuit, tugaaliit kilalugait ovalo aiviit). Taimaimat, titigagutit atuktangit pihimayut ilangit hapkoa umayut pilaamata nakuutkiyanik umayukpaktainik naunaiyautaini inikhimayunit umayukhiukhimayut ihivgiuktunit. Taimaimat, NWHSkut atukpaktut DSDkunit titigakhimayainik atungithugit ihivgiukhimayut naunaiyautait nanunut tamaitainik.

Aipaani, ilaani ikitkiyait umayukhiuktit pivaktut angitkiyainik ilangani tamaat umayukhimayuni, ilaa nalunginamik talvani umayunik ovaluniit “umayukhiutiakpiaktuigamik” umayukhiuyukamik aalanut Inunut inminutlu. Tahapkoa Inuit iliyauvaktut ‘umayukhiukataktut’ ovaluniit ‘umayukhiukpiakpaktut’ umayukhiuktit. Mikihiyut

tuhaktakhait naunaiyautait tahapkoa aviktukhimayuni ihumaalugiyavut. Ihivgiukhimayut pigaagata ikitkiyaukpat 75%nit aviktukhimayuni titigakpaktut ovalo ukakhimayut ilangani 6: Nunani Iniktigutait Ukauhiit.

Ilauyut tamamik katitikhimayut ikpatauyami naunaiyakhimayut amigaitjutait umayukhiuktit umayukhimayut tamamik umayunik. Taiguaktut ukautauhimayut umayut umayukhiukhimayait ikitut umayukhiuktinit, iniktigutait umayukhimayut naunaiyaita piyakhait ihumagilugit.

5.3.2 Kiuyauhimaitut

Pingahuuyut pivaktut kiuyuitut ihivgiuktunut:

1. Ilangit ilauyut piyukhat Inuit ilauyuitut;
2. Ilangit ilauyut Inuit takuyaulaitut nunani havaktinit;
3. Ilangit nunani havakiit takulaitait ilangit Inuit ilauyut.

NWHSkut ilauyumayunut ihivgiuktut ovalo taimaimat ihivgiuktut, ilangit Inuit ilauyumalaaktut. Hapkoninga pihimagamik:

- Ihumagitiaginamigit ovaluniit nalugamigit hunmat ihivgiuktut ovalo kanuk ikayuktaulaaktut iniktigutait;
- Ihumagitiaginamigit ovaluniit ukpigivlugit ihivgiukhimayut katititjutait atuniamagit ovaluniit takuyaulaamata aalanut inunut atungitaminik ovalo pilaaktunik atugutikhainik;
- Ukpiginginamigit ovaluniit nakuuginamigit nunani havaktiit, nunat angigalualutik ovalo havatiaktuugaluit nalunginamiuk inminik kiuyukhat.

Pivaktut kiuyuitut NWHSmi ihumagiyait pivaktut malguni. Hivulimi ukakhimayut kiuyumangitut. Ilangit umayukhiuktit piyumainakpaktut ilaulutik ihivgiuktuni. Tatkikhiutini tuhaktakhat naunaiyautait hamani kiuyukhani unguvakhimayut ihivgiuktitlugit (ilangani 3.7.3.), pilimaigamik kanugitaakhait kitkani umayukhiuktit pilaitut ukakatigiyaami akianut umayukhiuktit piyumangitut ukakatigiyaulutik tatkikhiutini tamaat. Kihimi umayukhiuktit kingihimayut ilaulutik, naunaiyakhimayut titigagutini ikpatauyani, naunaiyalaaktut hapkoa umayukhiuktit. Ikpatauyami 9mi takukhauyut amigaitjutait umayukhiuktit kingikataktut ilaulutik ihivgiuktuni nunanit ovalo ukakhimayut ilangani 5.3.4mi.

Aipaani piyut kiuyuitut piyumanginamik ovaluniit takupkaiyumanginamik kiuyuitut. Taimaimat, hivulimi apikhugutait tatkikhiutini ukakatigiyait kiulaitut, pihimagamik Inuk umayukhiukhimayaamini aipaani tatkikhiutimi, ilangani ukakatigivlugit pilikpaktut kiukatakhutik “Iik” piplutik angingitut ukakatiutitlugu.

Ihumagiyait pingitut takulugit tamaat ihivgiuktukhat Inuit pihimavamata ilaa, Inuit tamamik ihivgiuktaulaaktu takulaimata tamaat tatkikhiutini ihivgiuktitlugit. Kihimi nunani havaktiit ukaktitauhimayut takulugit tamamik Inuit tatkikhiutini umayukhiuktit katitihimayuni (ovaluniit ukakatigiyakhat katitigutaini) ovaluniit angilgauhimaitut. Nunani havaktiit ukatitauhimayut pilutik aipaani tatkikhiutini katitikhimayut Inunit takuyaugaagamik, hamna pikatainayuituk.

Ilaa, nunani havaktiit ihumaplutik ovaluniit ihumangithutik ilivaktait ihumalupalaaktukhaungitut takulugit ilangit ilauyut Inuit ovaluniit takungilugit tamaat. Ihumagiyait ilauyut, inminik nakuugiyait ovaluniit nakuugingitait ovaluniit takulainamiuk taamna Inuk. Taimaimat ilangit Inuit pikataktut ilaani takulaitait. Nunani havaktiit ovalo umayukhiuktit aatjikiitut pivaktut hamani ilaani pivaktut ihivgiuktuni amigaituni nunani.

Tamamik hapkoa ihumagiyait kiuyuitut pilaamata, pihimayutlu, pikatainagitut.

Uktugaagamik mikiyuni ilangini angiyut inugiagutinit, nalunaktut kiuyuitut ovalo ikpinaktuk kanuk aalanguyut ihivgiuktauhimayunit. Kihimi angiyut ilangini mikiyuni inugiagutinit ihivgiukhimayut (NWHSkutut), ilangit naunailikpaktut kiuyuitut nalunailaaktut, havaktut pilaaktut naunaiyalugit hunmat ovalo kanuk kiulaitut ihumagiyainik.

5.3.3 Ikpinagutait kiuyuikaagami

Piyumangitut ilaulutik ihivgiuktuni pingitut hunmat kiungitut ihimagiyaminik, ilaa, amigailaamata hunmat ilaungitut. Kihimi, piyumangitut ovaluniit ukpigingitut atugutainik ovaluniit takulainamik ihivgiukhimayuni katitikhimayuni ovalo mikhaanut inminik tuhagutikhainik pilaamata takupkaiyumangithutik umayuktaminik naunaiyautainik. Taimaimat, NWHSkut amigaitunakhimayut hunmat Inuit takupkaiyumangitut angiyunik umayukhiukhimayait naunaiyautainik ikitkiyainit. Ukangualugu, umayukhiuktit ukpigiyukamik, takuyaugumik umayukhiukpaktut amigaitunik umayunik, nutaat kotat ilitaulaaktut ovaluniit pihimayut kotat mikhiniaktut.

Pikataktut takuyauyuitut ilangit umayukhiuktit pihimalaaktut kiuyuituni ihimagiyainik. Umayukhiuktit takulaitut ukakatigilugit aalatkiimata tahapkoninga ukakatigilaaktunut. Ukangualuni, umayukhiuktit nunamiiginaktut umayukhiukhutik ayonaniaktut takuyaami. Ovalo, umayukhiuktit havaktut tamaat autlaakatakhutik havaamini ayonaniaktut takuyaami.

Pikataktuni pingitut nunani havaktiit taklugit ilangit Inuit pingitut ilaukatauyaini kiuyuitut ihumagiyainik.

5.3.4 Kanugitut kiuyuitut Ihumaiyait

Inuit ilauyumangitut ihivgiuktuni titigakhimayut taimaatut hivulimi titigagutini ikpatauyaani. Ikpatauyak 9mi takukhauyut amigaitjutait hapkoa umayukhiuktit tamamik nunanit ovalo naunaiyakhimayut hapkoa ihumaalugiyauyuugaluit hapkonani nunani titigakhimayut naunaiyautaini piktaktut kiuyalaithutik avataanut 5%kuyut.

- Qikiqtarjuaq
- Kamanituaq
- Igluligaajuk
- Kangiklinik

Pihimayunakhiyuk kiuyauyuitut ihivgiukhugit pikatainaktut ilaukatauyuni naunaiyautaini (piyakhait 1mi ovalo piyakhait 2mi kiuhimayut) avataani talimat ukiuni, taimaimat, mikhiliktut naunaiyautait ilauyunut piligunakhigamik "umayukhiuktit unagugutainik" ihivgiukataktunit. Nunat takukhauyut mikinikhanguliktut ihivgiuktuni Qikiqtarjuaq, Iqaluit ovalo Naujaat. Takukhaungituk takupkaiyumangitut kiungitkaagamik kihimi atugamigit takuyumangitut uktugutigivlugu ihivgiuliktitlugit, ilaa taimaituugitunakhiyut.

5.3.5 Naitumik Titigakhimayut

Pivaat *nmi* kiuvaktut ilauvat amigaituni ilauyuni uktukhimayut *Nmi* umayukhiuktit? Tamaat, piyunakhimata ilangit kiuyuitut ihimayait hamaniitut ovalo ikpinagilaaktut naunaiyautait iniktigutini nunani kiuvaktut naunaiyautait mikiyut (mikitkiyait 75%nik), ikpinaguait hamna ihumaiyaini (kaaganut ovaluniit ataanut) umayukiuhimayut naunaiyautait ayonaktut katitigiami. Taimaimat piyakhait 2mi pihimayut tamamivyak nunani kiukataktut naunaiyautait angiyut. Kihimi pilaaktut tahapkoa nunat kiuyuitut naunaiyautait angitkiyauyut 5%mik.

5.4 Naunaiyautait ihumagiyut ovalo kiuvaktut ihuinaagutait:

Hamna ilanga ihumavaktut piyakhait 3: piyaakhaita ihivgiukhimayut kiutjutait naamagiagani, ilaa, naunaiyautait pitiakhimayut umayukhiukhimayuni kiukataktunit Inunit.

Ihivgiugutit naunaiyautait ukaktut apikhuutit hanauyagutainik ovalo munagitjutainik atuktaini, pinahuamata nakuuyunik ihivgiuktuni apikhuutainik. Nakuutjutait iniktikhimayut ihivgiukhimayut mikhinahualugit pilaaktut kiuhimayut ihuinaagutait. Kiuhimayut ihuinaagutit ukaktut aalanguyaini kitkani "Nakuuyut" kiuhimayut apikhuutimut ovalo kiuhimayait apikhutauyut tunivaktainik apikhuutimut. Kiutjutit ihuinaagutait pilaaktut umayukhiuktit umayuktaminik kafinik angitkiyanik mikinikhaamit piyaminit amigaitjutaini umayunik ovaluniit pilaaktut umayukhiuktit ukangitkumiuk umayuktaminik ilangit umayunik (ovaluniit tuningitut kanugitut umayut, angnauyaakhaita ovaluniit angutauyaakhaita, ukiungit ovaluniit nani umayukhimayait) tuhaktitivluni umayuktainik aalanik umayunik. Hamna kingulik pivaktut titigakhimayut kiungitut ovalo aalauyut kiungitumit ihimagiyainik ukakhimayut ilangani 5.2mi.

Kiuhimayut ihuinaagutait pilaaktut ilitagingitkumiuk apikhguti ovaluniit utiktihimayut ovaluniit pihaktainik. Nakuuyumik umayukhiukhimayuni ihivgiuktut piyukhat hapkoninga maligutikhat pikpagit:

- Ilangit ovaluniit aatjikiigutait naunaiyatiakhimayukhat ovalo apikhgutit ayonaihimalugit kiuyunut (naunaiyautait ovalo apikhugit hanauyautait).
- Kiuyut nalungitukhat ovalo puigugilutik "nakuutiaktut" kiutjutit (mikhinahualugit utitikhimayut ihuinaakhimayut).
- Kiuyut ihumagiyakhait kiuyaminik apikhuutinut nakuuyumik ovalo inminik (mikhinahualugit ihumagiyainik kiuhimayut uktugutaini kaaganut ovaluniit ataanut).

Ilaa, kiuhimayut ihuinaakhimayut ihuakhilaitut kihimi naunaiyalaat ovalo titigalaat ovalo maliktakhait ovalo angitjutait ihumagiyaini ilitagilugit ovalo ilautilugit.

5.4.1 Naunaiyautait ovalo Apikhugutit Hanauyautait

Avataani 60tiuyut umayut ovalo ataani umayut tuhaktitihimayut NWHSmi (Ikpatauyak 2). Ilauyut ihivgiuktuni tuniyauhimayut katitigutainik hapkoa umayut umayukhiuktaini ihivgiugutit tatkikhiutini, pivaktait nunani havaktiit apigivalugit umayukhiuktit tamamik umayut apikhuktitlugit. Amigaitkiyaut nunani havaktiit apigilikpaktait umayukhiuktit hivulimi apigivlugit umayukhiugiagani tatkikhiunmi. Umayukhiuktit apigiyauyut: "hunamik umayukit?" Hamna pivagunakhiyait umayukhiuktit puigukhutik tuhaktiyakhaminik ilangit umayut. Ovalo umayukhiuktit taiguatiahimaitkumik umayut katitiguaini, naluyunakhimayut tuhaktitakhait ilangit umayut. Hamna ikpinagilaaktait umayukhiuktit ataanut tuhaktitiyut umayukhiukhimayainik. Hamna pivaktut tuhaktitauvaktut amigaitunik umayukhiuktinit nunanut pulaaktakhuta, ilaa, mikhaanut pikatakpaktait maniit, tingmiat kiviungit ovalo ikaluvaluit.

Kitkaniituk ayonagiyauvaktuk apikhugutini hunauyut, tamamik nunani havakgiit ovalo umayukhiuktit, pikataktait atugutainik kinauyaliugutit umayukhimayuni. Umayukhimayut naunaiyakhimayut umayut ovalo ikaluit tukuhimayut ovalo pivaktait. Pinahuakhimayut ilaulugit kinauyaliugutit umayukhimayuni talvatuak atukagu iluani Nunavumi (ilangani 3.2). Nunani havaktiit ukaktitauhimayut katitiklugit kinauyaliukhimayut umayunut katitikhimayuni umayukhiuktinit kihimi titigaklugit taimaatut katitikhimayuni. Taimaatut hapkoa umayukhimayut atulaaktut naunaiyautaini mikhaanut kihimi unguvaktaulaaktut katitikhimayunit naunaiyautaini umayukhiukhimayut naunaiyautaini ovalo BNLmit (ilangani 3.2.). Amigaivyaktut ayonaktut pivaktut katitigutainik katitikhimayut kinauyaliugutaini umayukhimayut.

Hivulimi, Nunani havaktiit tuhaktitauhimaitut aalatkiit kitkani umayut niuviktauhimayut atugutaini iluani Nunavumi ovalo umayut niuviktauyut hilataanut Nunavumit. Taimaimat, hamna ayonakpaktuk umayukhiuktit tuhaktitilugit nalugamik namut umayuktangit niuviktauvaktut niuviktigaagamik. Taimaimat, ilangit kinauyaliukhimayut umayugit tuhaktitivaktut niuviktauvaktut iluani Nunavumi ovalo ilauyukhat BNLmi naunaiyautaini. Iniktigutait hamani ataanut naunaiyakhimalikpaktut umayuktaminik. Kihimi ikitut kinauyakhiukpaktait titigagutait unguvakhimayut katitikhimayunit (ikpatauyak 4) ovalo taimaimat ihumayugut hamna ikpinaluangituk.

Aipaani, umayukhiuktit ilaani tuhaktitivaktut kinauyaliuktaminik umayukhiukhimayainit ilangani atuktakhaminik umayunut ovalo hapkoa ilangit aviktukhimaitut kanugitaakhait. Iniktigutait hapkoa ayokhagutit mikhaanut nunani havaktiit ayoikhaitjutaini ovalo tuhaktituitjutaini umayukhiuktinut pivakatut ilangini nunani kinauyakhiugutit umayut niuviktauhimayut hilataanut Nunavumit tuhaktitauvaktut ilauplutik atuktakhamini umayunut. Hamna ihuinaakhimayut naunaiyaniaktuk avataanut naunaiyautini umayukhiukhimayut hapkoa umayut.

Angiyuumata hapkoa ayonaktut aalatkiimata kitkani umayut ovalo kitkani nunat, ukautauyut ilangani 6mi: Nunat Iniktigutait Ukauhiit hamani katitikhimayuni ikpatauyaini tamamik nunani.

5.4.2 Utiktihimayut Pingitut

Piplutik atuktainik aalat nunakakaakhimayuni umayuikhimayut ihivgiugutaini, ihivgiugutit pihimayut tatkikhiutini piyaami mikhinahualugit utiktihimayut pingitut ovalo umayukhiuktit tuniyauhimayut umayukhiukhimayunik tatkikhiutinik utiktihimayut ikayugutikhainik. Umayukhiuktit takuyaungitpata tatkikhiutini , nunani havaktit apigilaaktut tuhagutikhanik umayukhiukhimayainik pihimaitut tatkikhiutini, takugumiuk. Hamna kigulikhimayut maligutait pivaktut iluani pingahut tatkikhiutini. Kihimi ilangini nunani utikhimayut avataanut siksini tatkikhiutini pivaktut ilaani. Ilauyut katitikhimayuni ikpatauyani tamamik nunani tatkikhiutini utiktihimayut ikpatauyait. Utiktihimayut naunaiyakhimayut amigaitjutait tatkikhiutit kitkani umayukhiukhimayut ovalo ukakatigihimayait tamamik umayukhiukhimayut titigakhimayait katitikhimayuni. Utiktihimayut ikpatauyait naitumik titigakhimayut hamna tuhagutikhak takuyaulaaktut ilangit titigakhimayut utiktihimayut talimani tatkikhiutini ovaluniit ataani, 4nit 6nut tatkikhiutini ovalo avataanut siksiit tatkikhiutit.

Ikpatauyanit takuyaulaat ungahiktunut utiktihimaitut ayokhagivaktait hapkonani nunani: Kamanituaq, Qikiqtarjuaq, Ikaluktutiak, Salliq, Sanigayaq, Iqaluit, Kugaaruk, Kangiklinik ovalo Tikigakjuaq. Ikpinagutait hamna ungahiktigaagat utiktihimayut ilaani iniktialaitut ovaluniit ihuatialaitut. Hivuliukpat, iniktigutait ilaani ataani iniktialaitut.

Pigalualuni utiktihimayut, piyait angiyuuyukhat umayukhiuktiyut piyaami utiktihimayukhat. Nalungitut umayukhiukhimayut ihivgiukhimayut ilaani utiktihimavaktut umayukhimayait amigaitjutait nakuutkiyat angiyunut umayunut ovaluniit umayukataktait umayut, tahapkonanga umayut pikatainaktait ovaluniit pivaktait umayut amiagitunik. Kinguani, amigaitjutait naunaiyalaitunakhiyait ovalo ihumagilaitunakhiyait umayukhiuktit. Nunanut pulaakatakhuni umayukhiuktit tuhaktikatainaktut naunaiyakatayuitait kafiit maniit, kiviut ovaluniit ikaluvaluit umayukhimayait. Nalvaalikpaktut ayonaktumik kafiuyut amigaitjutait nunani havaktiit apigigaagata. Atugutait utiktihimayut ikayuutait tatkikhiutit ikayugutigilaaktait hamani.

Tatkikhiutit atugutait ihivgiuktuni aalatkiiktut nunanit, piplutik amigaitut umayukhiuktit atulikpaktait tatkikhiutini nunani: Sanikiluaq, Kingauk ovalo Igloolik ikitunut atugutaini; Iqaluni, Kugaarukmi, Naujaatni ovalo Ikaluktutiami. Ilangini nunat tuhaktauhimayugut tatkikhiutit atukpaktut aalatkiit iluani nunat ovalo inikniuyuni umayukhiuktit atuinaktait tatkikhiutit amigaitkiyanik ovalo inuulgamiit umayukhiuktit atukpaktut ihimaminik (Igluligaajuk ovalo Kugaaruk). Mitimatalimi ukautauyugut umayukiukataktut ovalo umayukhiunginaktut atulikpaktait tatkikhiutit utiktihimayuni atugutainik.

5.4.3 Uktugutit Kiuhimayut Ihimagiyait

Uktukgutit kiuhimayut ihmagiyait ukakhimayut ihumagiyainik umayukhiuktit ukakpialutik, ikinikhaalugit ovaluniit ukangilugit umayukhimayainik. Ihumagiyait ilauyut ikhiplutik apikhuktauyaami ataani umayut maligaliugutaini ovaluniit ikhiyut kinauyaliuktainik apikhugutainik ovaluniit tamaiyaamini pilihimayunit pilaaktaminit. NLCAmi pitkuhimaituk tunilugit inminik katitikhimayut atugutinik, piyunakhigamik tamamik umayukhiuktit naluyunakhigamiuk hapkoa ilangit ihivgiuktunit, ovaluniit ukpigiginamiuk angigutait. Pingangimat ilangani Inuit tuhaktakhainik atiktuitjutaini munagiyaami pilihimagami ihivgiuktut.

Hapkoa ukakhimayut mikhaanut uktugutit kiuhimayut ihumgiyait nunani ukakatigivlugit:

- Ilaa, kingulimi umayukhiulaitut ilangit umayut (hapkoa; tingmiat ilangit kukyuit), taimaimat umayukhiuktit tuhaktitiyuitait tahapkoa umayut.
- Amigaitut Inuit umayukhiuktit ukakpalaayuitut ovalo ataani tuhaktitilikpaktut umayuktaminik.
- Amigaitut umayukhiuktit nalugamik hunauyut ihivgiuktut ovalo ihumayut katitikhimayut atulaaktut akianut umayukhiuktit hivunikhaini. Hamna piyunakhimayut piyait tuhaktitihimayuni ilangit umayut.

Ukakpalaagiami umayukhiukhimayuni pinahuakhuni angililugit BNLmi pilaitut angiyumik, ilaa, piyaunialaamat amigaitunit umayukhiuktunit ovalo angiyunik ukakpalaalutik. Hamna ihimagiyauyuk pilaitut inuuviviniit atugamiuk ovalo takuyaulaamat tuhaktaulunilu ovalo ukatauluni ihivgiuktinit.

Atatuhik ilanga uktugutit kiuhimayut ihimagiyait nunani havaktiit pivaktait ihimagiyaini, ilaa, umayukhiukti aliagingitait ovaluniit ukpigigingitait ovaluniit ihumaalugiyait apikhukti. Pikainamat atauhimik nunani havaktini nunani, atugutikhait aalat apikhuktit hamani pilainmat.

Pivaktut ilangini nunani inminiigutit ihumagiyauvaktut kitkani nunani havaktit ovalo ilangit umayukhiuktit ikpigiyauvaktuk apikhuktitlugit. Ilangit kinauyut ihumagiyauvaktut, ilaani angutit umayukhiuktit tuhaktitiyumangitut katitikhimayaminik angnamut havaktimut. Aalani ihumagiyauyuk, ukiungit, ihumagiyauvaktut ilangit nunani inikniuvyaktut havaktiit nalungitkiyat umayunik nakuutkiyamik pilaaktut tatkikhiutini apikhuktauyunit. Ukakhimayutlu, ilangit inminiigutit ovaluniit ilakatigiit palitiksnik ikpinagiyauyut kanuk umayukhiuktit tuhaktitiyait ilangainut havaktinut.

5.4.4 Naitumik Titigakhimayut

Ihivgiuktut kiutjutait nakuuvaat, ilaa, pivakpat nakuuyumik umayukhiukhimayut kiuvaktait Inuit? Kiutjutaa takukhauyuk Iihik tamamivyak ilauyuni, ilaa, angiyunik umayunik ovaluniit pitaktakpaktait umayukhiukhimayut umayut ovalo utiktihimayut mikigaagata. Kihimi pivaktut ataani tuhaktitivaktut ilangit umayuni pigaagata. Hapkoa umayut ilangit; ikaluvaluit, maniit ovalu tingmiat kiviungit. Ihumagiyauyutlu, kaaganut tuhaktitilikpaktut umayukhiukhimayut ilangit umayut pivaktut kinauyaliuktuni umayunik ilauvaktut ilanganut titigakhimayunut. Naunaitjutait ovalo namungauniaktut ihumagiyait hapkoa ihuinaalaaktut aalatkiiktut nunani ovalo umayukhimayuni. Taiguaktut takuyukhat Ilangani 6mi: Nunani Iniktigutait Ukauhiit mikhaanut hapkoa ihuinaakhimayut ovalo ikpinagutainik. Taimaimat, pigiyait 3mi pivaktut tamamivyak pihimayaini.

5.5 Naitumik titigakhimayut Naamaguyaakhait Umayukhiukhimayut Naunaiyautait

Pipluni naitunik, titigatiakhimayunik titigakhimayut naamguyaakhait Umayukhiukhimayut Ihivgiukhimayuni katitikhimayut ayonaktuk. NWHS ilaa ihivgiuktitiumat ilauyut havaktiit ovalo ilauyut 28ni nunani pikatauyut katitiktilugit katitigutit umayukhiukhimayunik avataanut 60nik aalatkiit umayut 5,000nit umayukhiuktinit talimani ukiuni. Angitjutait ovalo ayonagutait ihivgiukhimayut pihimayut katitkhimayunik naamaktunik ihumagiyaini aalauyut nunanit, ukiuni ihivgiukhimayuni ovalo ilangini umayuni.

Pitkuyauyut Inuit atugumayut Umayukhiukhimayunik Ihivgiugutait katitikhimayut hivulimi naunaiyaluni katitikhimayainik piyumayainut. Atuktut piyukhat piyumayainik katitikhimayut kitumit nunanit ovaluniit kitumik umayumik ovaluniit katitilaaktait piyumayait kitumut ubluini ihivgiukhimayuni. Atuktut naunaigumik naamagutainik katitikhimayut atugumayainik ihivgiufaalaaktut taigualugit Ilangani 5mi ovalo takulugit ilangani 6mi nunani ovalo umayut piyumayainik, kungialugit Nunani Iniktigutait Ukauhiit ilauyut nunat ukakhimayait ovalo aalat atulaat katitikhimayuni. Pihimalutik tamamik hapkoa tuhagutikhat, taiguaktut ihumagilaaktut mikhaanut naamagiagani katitikhimayut ihumagiyait mikhaanut ovalo naunaiyaniaktut tahapkoa naamagiagani nakuuyut atugutikhaini katitikhimayut.

Kitkani atugutait NWHSmik tunilutik NWMBkunut tuhagutikhainik piyakhainik naunaiyagiami hivulimi atuktakhait naunaiyautainik tamaat pilaaktut umayukhiulaaktunik ilihimayukhat ovaluniit pihimalutik ilanginik umayunik. Pihimanmat hamani ukakhimayuni, NWMBkut maliktukhat aatjkutaanik atuktainik ihivgiufaagiani katitikhimayut naamagutait pikpata naamagiagani hivulimi atuktakhait naunaiyautait katitikhimalikata. Umayukhiukhimayut naunaiyautait takulaaktut hamani Inikhimayumi Tuhaktakhami ihivgiufaakhimayunik ovalo ukauhiit katitikhimayut tuniniaktut NWMBmut atugutikaluni iniktigiami hamna havaktakhak. Hivulimi atuktakhait NWHSmi pihimayukhat ihumagiyaini tahapkoa atuniaktut tuhagutikhainik hamani tuhaktakhani aalanut atugutikhanik.

6. Community Results Discussion

As explained in Section 5.5, data reliability issues differ not only among communities but also among the years of the study and among the species. So in order to provide readers with the necessary tools to assess these issues we have included a Community Results Discussion for every community that participated in the Harvest Study. Since each discussion is tied so closely with the Harvest Study results, data tables 11 through 674 are included in this section of the report with each individual Community Results Discussion following the five year summary table for each community. Tabs are used to separate the data and discussion for each community to allow quick and easy reference to specific data.

Each community tab contains the following:

Annual data tables (Section 4)

- Monthly harvest estimates
- Monthly hunter response
- Recall period between harvest and interview
- Number of hunters harvesting each species

Five-year summary tables (Section 4)

- Annual harvest estimates and five-year mean (with footnotes)
- Annual hunter response
- Recall period between harvest and interview
- Number of hunters harvesting each species

Community Results Discussion

This section:

- Summarizes data reliability issues and discusses whether the three conditions identified in Section 5 were met.
  - The survey frame: *Does N fully and accurately represent the hunter population?*
  - Survey coverage and non-response bias: *Do the n respondents constitute a sufficiently representative sample of the N hunters, by virtue of adequate response rate and appropriate assessment of non-response bias?*
  - Measurement issues and response error: *Are the survey responses valid, i.e. do they measure the true harvests of responding individuals?*
- Cautions readers, where appropriate, regarding the reliability of harvest estimates. During the analysis phase of the Harvest Study the review of the data indicated some potential problems with respect to the reliability of the estimates. Although rigorous statistical tests using numerical criteria were not run, a certain amount of subjective analysis was done by means of identifying data with certain key problems:
  - *Under-enumeration of hunters* – will result in an underestimate of community harvest; the effect ranging from being small where relatively few hunters were unregistered (less than 5%) to being potentially large in communities where a large number of eligible hunters were not registered in the study (over 10%). The classification of the unregistered hunters must also be considered given that unregistered active or intensive hunters would be of greater concern than a similar number of unregistered occasional hunters.
  - *Low response rates* – increase the potential for both sampling error and non-response bias. Generally response rates of less than 75% were considered to be problematic. Caution is recommended when several months during a study year have rates below 75%, when any month drops below 50% or when rates for the active or intensive strata are consistently below 75%. Readers should refer to response rates and confidence intervals when using the harvest estimates shown in the data tables.
  - *High rates of intentional non-response* – increase the potential for non-response bias. Generally rates of over 5% were considered to be high and a potential problem.
  - *Long recall periods* – increase the potential for measurement error. The measurement error introduced by long recall periods would likely result in underestimation of harvests since Inuit hunters are more likely to under-report than to over-report their harvest. Caution is recommended when several months during the study year have high recall periods, indicating that many of the harvest records were collected more than three months after the harvest.
  - *Community feedback and an assessment of commercial harvest reporting* were also included in some cases to caution readers on other sources of measurement error.
- Includes footnotes from the five-year summary table: *Annual harvest estimates and five-year mean*. These footnotes contain relevant community comments on the annual harvest estimates and other sources of harvest data. The following details the sources used for these footnotes and how the sources are identified in the text:
  - **C.F.:** Community feedback obtained during the community visits from January to May 2003. Feedback was obtained from HTO Board members during the HTO workshop and/or from members of the public during the public meeting.

◦ **DSD PB:** Polar bear harvest data were provided for all Nunavut harvests from 1996 to 2001 as unpublished data in electronic format by the DSD Polar Bear Harvest Program. Polar bear harvesting is managed using a quota or tag system. The data received listed, for each tag used: the season or year of harvest, the community, the reason or type of harvest, the date of the kill and other associated information. The Harvest Study Coordinator then separated out the subsistence harvests and summarized the data by community and Harvest Study year (June – May). Given the difficulty in accurately estimating the harvest of species which are taken in relatively small numbers and the more accurate recording system of DSD, these numbers were used in place of those collected during the Harvest Study. Note that the following hunts were NOT included in these totals: sport, illegal, problem or miscellaneous.

◦ **DSD MXa:** Musk-ox harvest data for Arctic Bay, Grise Fiord and Resolute Bay were provided as unpublished data in electronic format by the DSD regional office in Pond Inlet. Musk-ox harvesting is managed using a quota or tag system. The data received listed, for each tag used: the season or year of harvest, the hunter's community, the type of harvest (domestic or sport) and the date of the kill. The Harvest Study Coordinator used the data to separate out the subsistence (domestic) harvests and summarized the data by community and Harvest Study year (June – May).

◦ **DSD MXb:** Musk-ox harvest data for Cambridge Bay were provided as unpublished data in electronic format by the DSD regional office in Kugluktuk. The data received included the tag return data from 1997 to 2003. Musk-ox harvesting is managed using a quota or tag system. The data received listed, for each tag used: the season or year of harvest, the type of harvest (domestic, commercial or sport), the date of the kill and other associated information. The Study Coordinator separated out the subsistence (domestic) harvest and summarized the data by Harvest Study year (June – May).

◦ **DSD MXc:** Musk-ox harvest data for Gjoa Haven were provided as unpublished data by the DSD Wildlife Officer in the community. Musk-ox harvesting is managed using a quota or tag system. Harvest data collected under this system were provided by email and summarized by harvest season which was from July 1st to April 15th for Inuit hunters. This season falls within the Harvest Study year of June to May so that harvest quantities can be directly compared with respect to date. However, it was not possible to separate out the subsistence harvest from the sport hunts so quantities are not directly comparable with respect to type of harvest.

◦ **DSD MXd:** Musk-ox harvest data for Kugluktuk were provided as unpublished data by the DSD Wildlife Officer in the community. Musk-ox harvesting is managed using a quota or tag system. Data were provided by email and were given as estimated yearly harvests for each management zone not actual harvest summaries.

◦ **DFO N/B:** The narwhal and beluga harvest data for all Nunavut communities were provided by the DFO Area Office in Iqaluit. The source of the data supplied was given as: Annual Summaries of Fish and Marine Mammals for the Northwest Territories, Volume 1-8; DSD/DRWED; and Hunters and Trappers Associations. Some of the beluga data were reported to be estimates provided by Wildlife Officers, HTO's and hunters. The data were provided in an electronic format summarized by fiscal year (April - March). Since monthly harvest data were not available we could not summarize the data by Harvest Study years (June - May). Therefore, harvest quantities are not directly comparable with respect to the date of harvest. However, given that most narwhal are harvested between May and November (based on Harvest Study data), we have compared the DFO 1996 (April 1996 – March 1997) data to the year 1 (June 1996 – May 1997) Harvest Study data for verification purposes. Similarly this was done with the other four years of data. However, some differences are to be expected between Harvest Study estimates and DFO harvest records.

◦ **DFO F:** Commercial and experimental fisheries data for all Nunavut communities were provided as unpublished data by the DFO Area Office in Iqaluit. The data, in two electronic files, summarized the licences issued for commercial and experimental fisheries between 1992 and 2002 and contained limited catch data relating to these licences. The Harvest Study Coordinator summarized the arctic char data in this file by Harvest Study year (June – May).

◦ **DSD FB:** Fur-bearer (seal, fox, wolf, wolverine, marten and bear) data for all Nunavut communities for the 1999/2000 and 2000/2001 seasons were provided as unpublished data in electronic format by DSD Headquarters in Iqaluit. The files display the number of pelts purchased from hunters in each community in 1999/2000 (July 99 – June 00) and in 2000/2001 (July 00 – June 01). Since monthly records were not available we could not summarize the data by Harvest Study year (June – May). The effect being that some differences are to be expected between Harvest Study estimates and DSD records. Differences will also result because not all pelts are sold by hunters; in some communities and for some species only a fraction of the harvested pelts are sold. For these reasons these data should be considered with caution and were only used in data verification for certain communities and certain species.

◦ **DSD WV:** Additional data were provided on the wolverine harvests for the communities of Kugluktuk and Cambridge Bay. DSD runs a wolverine carcass collection program in which hunters are paid $25.00 to return the carcasses of their harvests. The numbers of carcasses returned during this program from 1986 to 2002 were provided as unpublished data from DSD, summarized by season (July – April). This season falls within the Harvest Study year of June to May so that harvest quantities can be directly compared with respect to date. However, not all carcasses are returned, so numbers provided would be an under-estimate of the total community harvest.

6. ᓄᓇᕗᑦ ᓴᖅᑭᑕᐅᔨᓂᖅ ᐅᖃᖅᑎᑐᒃᓯᒪᓂᖅ

ᐅᖃᐅᓯᐅᓴᒪᓪᓚᑦ ᐊᓴᐅᑎᒥᑦ 5.5, ᐊᑐᓕᓯᒪᓪᓚᑦ ᓯᓚᔨᖏᓪᓕᐅᑎᓂᕐᓂᖅᓯᓐᓂᑦ ᐱᔨᑦᑕᐅᔨᐃᐅᑦ ᐊᔪᐊᕐᓂᑦᑐᖓᓂᖅ ᓄᓇᓕᖕᒥᖅᑐᖓᓂᖅ ᑭᓯᓚᕆᔨᒪᔨᓂᖅ ᐅᑭᐅᖅᓯᓯᒪᓪᓚᖅᑐᓂᖅᓴᖅ ᐊᓴᐅᑎᒥᑦ ᐊᔪᐊᕐᓂᑦᑐᖓᓂᖅᓴᖅ. ᑕᐃᒪᐃᓴᓪᓚᑦ ᐅᖃᓕᓴᖅᑐᑦ ᓇᓂᕐᑭᓂᖅᑐᑎᓪᓗᒍᓪᓚᑦ ᑕᒪᐅᓄᖅᓱᓪᓗ ᐱᔨᑦᑕᐅᔨᐃᐅᑦ ᐃᓕᓴᕐᓂᐅᕙᓪᓕᐊᓂᖅᓴᖅ ᓄᓇᓕᖕᒥ ᓴᖅᑭᑕᐅᔨᐃᐅᑦ ᐅᖃᖅᑎᑐᒃᓯᒪᓂᖅᓯᓐᓂᑦ ᓄᓇᓕᖕᒥᓂᒃᓄᑦ ᓄᓇᓕᖕᒥᓂᒃᓄᑦ ᐃᓕᓴᕐᓂᐅᕙᓪᓕᐊᓂᖅᓴᖅ ᐊᑐᓂ ᐅᖃᖅᑎᑐᒃᓯᒪᓂᖅᓯᓐᓂᑦ ᐊᑐᑐᕆᐊᖃᓪᓚᕆᓂᖅᓴᖅ ᓴᖅᑭᑕᐅᔨᐃᐅᑦ, ᓇᓕᖕᒥᐃᓪᓚᑦ 11ᒥᑦ 674ᒧᑦ ᐱᖓᓱᐅᑎᔨᓕᕆᔨᑦ ᐅᓂᓚᒃᑲᓪᓕᐅᑎᓂᒃ ᐊᑐᓂ ᓄᓇᕗᑦ ᐅᖃᖅᑎᑐᒃᓯᒪᓂᖅᓯᓐᓂᑦ ᑭᓇᐅᔭᓕᕆᓂᖅᓴᖅ ᐅᓂᓚᒃᑲᓪᓕᐅᑎᓂᒃ ᐊᑐᓂ ᓄᓇᕗᑦ. ᐊᐃᑦᑐᕐᓂᖅ ᐊᑐᓂ ᓄᓇᕗᑦ ᐅᖃᖅᑎᑐᒃᓯᒪᓂᖅᓯᓐᓂᑦ ᐊᑐᓂ ᓄᓇᕗᑦ ᐊᑐᓂ ᕿᓪᓕᒥᓂᖅ ᐅᖃᖅᑎᑐᒃᓯᒪᓂᖅᓯᓐᓂᑦ ᐊᑐᓂ ᓄᓇᕗᑦ ᐊᑐᓂ ᓄᓇᕗᑦ ᐊᑐᓂ ᓄᓇᕗ

◁▷ᓚᑕᐅᔪᓐᓇᒃ ᔫᑕᖅᑎᑕᐅᔪᓕᓐᓂᒃ ᓂᕆᖅᓯᒪᓕᒫᓕᕐᓂᖅᓄᑦ. ᐊᓪᓚᓱᒪᔨᓚᐅᕐᖓᓄᑦ ᐊᑐᓂ ᓂᕆᖅᓯᒪᒍᓂ ᐅᓚᔨᖅᑕᐅᔪᕐᓂᓄ ᐅᔪᓴᑦ: ᖃᖅᓱᔪᓂᑦ ᐅᑭᐅᑦ ᓇᓂᑕᐅᔪᕐᓂᖅᓄᑦ, ᓄᓇᕐᖓᓂᒃ, ᐱᔨᑕᐅᔪᕐᒃ ᖃᓄᐃᑖᓄᖅᓯᓂᒃᓂᓂᒃ ᐅᓚᔨᖅᑕᐅᔪᕐᔪᖅ, ᐅᓪᓗᖅᓄᓂᒃ ᓇᓂᑕᐅᔪᕐᓂᕐᔪᓂᒃ ᐊᓯᖏᓐᓂᓗ ᑐᓴᕐᖁᐅᔪᓂᒃ. ᖃᐅᔨᓴᓂᑦᑐᑦ ᑐᑭᓯᒪᓕᕐᓂᖅᓄᑦ ᐊᐃᑎᑐᓪᓚᕆᔨᓕᓂᒃ ᓂᕆᑎᖅᓯᒪᔪᖅᑐᑦ ᐊᓚᑦ ᒥᔅᓴᓕᕐᓂᖅᓄᑦ ᐊᑐᓚᓕᕐᓂᖅᓄᑦ ᐊᓚᑦ ᓇᓂᑕᐅᔪᕐᓂᖅᓄᑦ ᓇᓂᑕᐅᔪᕐᓂᖅᓄᑦ ᐊᓚᑦ ᐅᐱᒪᑎᓪᓗᒍ


Ilangani 6mi

6. Nunani Iniktigutait Ukauhiit

Ukakhimayut Ilangani 5.5mi, katitikhimayut naamagutait ihumagiyait aalatkiiktut nunanit kihimi ukiunilu ihivgiuktuni ovalo umayunit. Piniagumi taiguaktunut atulaaktainik ihivgiugiagani hapkoa ihumagiyauyut ilauhimayavut Nunani Iniktiguait Ukauhiit tamamik nunanut ilauhimayut Umayukhiukhimayuni Ihivgiuktuni. Tamamik ukauhiit ilaunmata kanitumik Umayukhiukhimayut Ihivgiugutaanut, katitikhimayut ikpatauyat 11mit 674mut ilauyut hamani ilangani tuhaktakhami tamamik Nunani Iniktigutait Ukauhiini malikhugit talimani ukiuni naitumik titigakhimayuni ikpatauyani naunanut. Naunaitkutait atukpaktut aviktuhimaplugit katitikhimayut ovalo ukauhiit tamamik nunat piyaami ihuaktut taigualaat kitumut katitikhimayunut.

Tamamik nunat naunaitkutait pihimayut hapkoninga:

Ukiuk tamaat katitikhimayut ikpatauyait (Ilangani 4)

- Tatkikhiutit tamaat umayukhiukhimaut naunaiyautait
- Tatkikhiutit tamaat umayukhiuktit kiutjutait
- Utiktihimayut kitkani umayukhimayut ovalo ukakatigiit
- Amigaitjutait umayukhiuktit umayukhiuktut tamamik umayunik

Talimani ukiuni naitumik titigakhimayut ikpatauyat (Ilangani 4)

- Ukiuk tamaat umayukhiukhimayut naunaiyautait ovalo talimat ukiut anginikhait (titigauyakhimakakhutik)
- Ukiuk tamaat umayukhiuktit kiutjutait
- Utiktihimayut kitkani umayukhimayut ovalo ukakatigiit
- Amigaitjutait umayukhiuktit umayukhiuktut tamamik umayunik

Nunani Iniktigutait Ukauhiit

Hamna ilangani:

- Titigakhimayut katitikhimayut naamagiagani ihumagiyait ovalo ukauhiit pingahut pigiyait naunaiyakhimayut ilagani 5mi pihimayut.
  - Ihivgiukhimayut atugutait: *Pihimavaa Nmi tamaat ovalo nakuuyumik takuyauvakpa umayukhiuktit?*
  - Ihivgiukhimayut pihimayait ovalo kiungitut ihumagiyaut: *Pihimavaa nmi kiuhimayut ukautauvaa nakuuyumik ilangani ihivgiukhimayut Nmi umayukhiuktit, nakuuyunik kiuhimayainik naunaiyautaini ovalo naamaktunik ihivgiufaagutinik kiuhimaitut ihumagiyainik?*
  - Kanugitjutait ihumagiyauyut ovalo kiuhimayut ihumagiyait: *Ihivgiukhimayut kiuhimayait naamakpaat, ilaa, naunaiyakhimavaat nakuuyunik umayukhiukhimayut kiutjutainik Inuit?*
- Ihumakuyait taiguaktut, nanikiak, mikhaanut naamagiagani umayukhiukhimayut naunaiyautait. Ihivgiufaakhimatitlugit Umayukhiukhimayut Ihivgiugutaini ihivgiukhimayut katitikhimayut ukakhimayut pilaaktut ayokhagutit mikhaanut naamagutaini naunaiyautaini. Ihivgiufaakhimayut Umayukhiukhimayut Ihivgiugutaini ihivgiuhiukhimayut katitikhimayut naunaiyakhimayut ilangit pilaaktut ayokhagutait mikhaanut naamagiagani naunaiyautait. Kihimi uktukhimayut naunaiyakhimayut atukhutik namaligutini maligutainik atungitut, ilangit naunaiyautait ihumagiyainik ihivgiufaagutit pihimayut ilitagivlugit katitikhimayut ilangit kitkaniitut ayonagutit:
  - *Ataani titigakhimayut umayukiuktit* – piniaktut ataani naunaiyakhimayunik nunani umayukiukhimayut, ikpinagutait angitjutainik mikiyunit ikitut umayukhiuktit titigakhimaitut (ikitkiyait 5%mik) pilaaktunik anginikhaat nunat amigaitut amigatjutait pilaaktut umayukhiuktit titigakhimaitut ihivgiuktuni (avataani 10%mik). Naunaiyautait titigakhimaitut umayukhiuktit ihumagiyauyukhat pihimakpat titigakhimaitut umayukhiukataktut ovalo umayukhiunginaktut umayukhiuktit ihumaalugiyauniaktut aatjikutaanit amigaitjutait titigakhimaitut ilaani umayukhiukpaktut.
  - *Mikiyut kiuhimayut naunaiyautait* – angilivaktut pilaaktunik tamamik uktukhimayut ihuinaagutait ovalo kiungitut ihumagiyainik. Kiutjutit naunaiyautait mikitkiyait 75%nit ihumagiyut ayonautauniaktut. Ihumagiyakhat pitkuhimayut amigaivyaktut tatkikhiutit ihivgiuktuni ukiungit naunaiyautikakata ataani 75%nit, tatkikhiutit katakpata ataanut 50%mut ovaluniit naunaiyautait umayukhiukataktunik ovalo umayukhiunginaktunik aviktugutait pikatainakata ataani 75%mik. Taiguaktut takuyukhat kiuhimayut naunaiyautainik ovalo naamagiyait atukataktaini atukata umayukhiukhimayut naunaiyautait takulaaktut katitikhimayut ikpatauyaani.
  - *Angiyut naunaiyautait pikataktut kiuyuitut* – angilivaktut pilaaktut kiuyuitut ihimagiyait. Naunaiyautait avataanut 5%ni ihumagiyait angiyut ovalo pilaaktut ayonalaat.
  - *Ungahiktumut utiktihimayut ubluit* – angilivaktut pilaaktut naunaiyautait ihuinaalaat. Naunaiyautait ihuinaagutit pivaktut ungahiktumut utiktihimayut ubluit pilaaktut ataani naunaiyautainik umayukhiukhimayut Inuit umayukhiuktit pilaamata ataanut tuhaktitilutik pingilunik avataanut tuhaktitilutik umayukhimayaminik. Ihumagiyakhait pitkuhimayut amigaivyaktut tatkikhiutit ihivgiuktitlugit ukiuni angiyuukpata utiktiutait ubluit, naunaiyakhimakpata amigaitut umayukhimayut titigakhimayut katitikhimakpata amigaitkiyaini talimat tatkikhiutini umayukhiuktaakata.

- *Nunanit ukakhimayut ovalo ihivgiufaakhimayut kinauyaliukhimayut umayukhiukhimayut tuhaktakhaini* – ilauhimayut ilangani ihivgiukhimayuni ihumatkuplugit taguaktut aalanik pilaaktainit nanaiyauttit ihuinaagutainik.

• Ilauyut titigagutainik talimanit ukiunit titigagutaini ikpatauyait: *Ukiuk tamaat umayukhiukhimayut naunaiyautait ovalo talimani ukiuni anginikhait.* Hapkoa titigagutait pihimayut nakuuyunik nunani ukakhimayait ukiuk tamaat umayukhimayut naunaiyautait ovalo aalat atulaaktut umayukhiukhimayut katitikhimayuni. Hapkoa titigakhimayut nanit atukhimayut hapkoa titigakhimayuni ovalo kanuk atukhimayut naunaiyakhimayut titigakhimayuni:

- **C.F.:** Nunanit ukakhimayut pihimayut nunani pulaaktakhimatitlugit Januarymit Maymut 2003. Ukakhimayut pihimayut HTOkut katimayiit katimatitlugit ovalo ayoikhakhimatitlugit ovalo/ovaluniit Inunit Inuit katimatitlugit.
- **DSD PB:** Nanuit umayukhimayut katitigutait pivaktut tamamik Nunavumi umayukhimayut 1996mit 2001mut titigakhimaitut katitikhimayuni kagitauyakut DSDkut Nanuit Umayukhiukhimayut Pilihimayunit. Nanuligiyit havakviani Iqaluni. Nanut umayukhimayut munagiyauhimayut atukhutik kotanik ovaluniit makpigaanik atukhutik. Katitikhimayut pihimayut katitikhimayut, tamamik makpigaat atukhimayut: ukingani ovaluniit ukiungani umaykhimayut, nunait, hunmat ovaluniit kanuk umayukhimayut, ubluit tukutikhimayut ovalo aalat mikhaanut tuhagutikhat. Umayukhiukhimayut Ihivgiugutait Munagiyiit aviktukhimavaktait atuktakhaini umayukhiukhimayut ovalo titigakhimayut katitikhimayut nunanut ovalo Umayukhiukhimayut Ihivgiugutait ukiungit (Junemit Maymut). Ayonamata nakuuyumik naunaiyautait umayukhimayut umayut pivaktut mikiyunik amigaitjutaini ovalo nakuutkiyanik titigakhimayut atugutaini DSDkuni, hapkoa amigaitjutait atukhimayut himautaani tahapkoa katitikhimayut Umayukhiukhimayut Ihivgiutuni. Nalungilutit hapkoa umayukhiukhimayut ilaungitut tamatkiutjutaini: kablunaat umayukhiuktut, pilaitut, ayonagutit ovalo ilangit naunaiyakhimayut.
- **DSD MXa:** Umingmait umayukhimayut katitikhimayut Ikpiarjumi, Ausuituqmi ovalo Qausuituqmi pihimayut titigakhimaitut katitikhimayut kagitauyakut DSDkunit aviktukhimayut titigakviani Mitimatalikmi. Umingamait umayukhimayut munagiyauyut atukhutik kotanik ovaluniit makpigaanik atukhutik. Katitikhimayut pihimayut katitikhimayut, tamamik makpigaat atukhimayut: ukiungani ovaluniit ukiuk umaykhimayait, umayukhiuktit nunait, kanuk umaykhimayut (kablunaat umayukhiuktut ovaluniit atuktakhainik) ovalu ubluit tukuhimayut. Umayukhiukhimayut Ihivgiuktut Munagiyiit atukhimayait katitikhimayut aviktukhimaplugit atuktakhainik umayukhimayut ovalo titigakhimayut katitikhimayut nunanut ovalo Umayukhiukhimayut Ihivgiuktuni (Junemit Maymut).
- **DSD MXb:** Umingamait umayukhiukhimayut katitikhimayut Ikaluktutiami pihimayut titigakhimaitut katitikhimayut kagitauyakut DSDkunit aviktukhimayut titigakviani Kugluktumi. Katitikhimayut pihimayut ilauyut makpigaat utiktihimayut katitikhimayut 1997mit 2001mut. Umingait umayukhimayut munagiyauyut atukhutik kotanik ovaluniit makpigaanik atukhutik. Katitikhimayut pihimayut katitikhimayut, tamamik makpigaat atukutik: ukiungani ovaluniit ukiuk umayukhiukhimayut, kanuk umayukhiukhimayut (atuktakhainik, kinauyaliugutainik ovaluniit kablunaat umayukhiuktut), ubluit tukuhimayut ovalo aalat mikhaanut tuhagutikhat. Ihivgiuktut Munagiyiit aviktukhimayait atuktakhainik umayukhimayut ovalo titigakhimaplugit katitikhimayut Umayukhiukhimayut ihivgiuktuni ukiungani (Junemit Maymut).
- **DSD MXc:** Umingmait umayukhimayut katitikhimayut Ukhuktuumi pihimayut titigakhimaitut katitikhimayut DSDkuni umayuliginit nunani. Umingamait umayukimayut munagiyauyut atukhutik kotanik ovaluniit makpigaanik atukhutik. Umayukhiukhimayut katitikhimayut katitiguait ataani hamna atuktaini tunihimayut sukatukut ovalo titigakhimayut umayukhimayuni ukiungit July 1mit April 15mut Inuit umayukhiuktunut. Hamna ukiuk pihimayuk iluani Umayukhiukhimayut Ihivgiugutaani ukiungani Junemit Maymut umayukhiukhimayut amigaitjutait mikhaanut naunaiyagiami ikpinagutait ubluit. Kihimi, pingitut aviktukhimaplugit atuktakhait umayukhiukhimayut kablunaat umayukhiukhimayunit, taimaimat amigaitjutait naunaiyakhimaitut mikhaanut kanugitut umayukhiukhimayait.
- **DSD MXd:** Umingmait umayukhimayut katitikhimayut Kugluktumit pihimayut titigakhimaitut katitikhimayut DSDmit umayuligiyit nunanit. Umingmait umayukhimayut munagiyauyut kotanik ovalo makpigaanik atukhutik. Katitikhimayut pihimayut sukatukut ovalo pihimaut naunaiyautikut ukiuk tamaat umayukhimayut tamamik munagivini, pingitut umayukhimayut naunaitjutaini.
- **DFO N/B:** Tugaaliit kilalugait ovalo kilalugait umayukhimayut katitikhimayut tamamik Nunavumi nunaini pihimayut DFOkuni titigakviani Iqaluni. Pihimayut katitikhimayut pihimayut tunihimayut imaatut: Ukiuk tamaat titigakhimayut Ikaluit ovalo Tagiumi umayut Nunatiami, Makpigaat 1-8; DSD/DRWED; ovalo nunanit umayuligiyit (HTA). Ilangit kilalugat katitikhimayut tuhaktitihimayut naunaiyautaini pihimayut umayuligiyinit, HTOkunit ovalo umayukhiuktinit. Katitikhimayut pihimayut kagitauyakut titigakhimaplutik ukiunganut (Aprilmit Marchmut). Tatkikhiutini umayukhiukhimayut katitikhimayut pihimaitut, titigakhimaitavut katitikhimayunut Umayukhiukhimayut Ihivgiuktuni ukiungani (Junemit Maymut). Taimaimat, umayukhimayut amigaitjutait pingitut aatjikutaatut mikhaanut ubluit umayukhimayut. Kihimi amigaitut tugaaliit

kilalugait umayukhimavamata kitkani Maymit Novembermut (atukhugit Umayukhiukhimayut Ihivgiukhimayut katitikhimayuni), pihimayugut aatjikutaliukhimayut DFOkunit 1996mi (Aprilmit 1996 Marchmut 1997mut) katitikhimayuni ukiunganut 1 (Junemit 1996 Maymut 1997mut) Umayukhiukhimayut Ihivgiukhimayuni katitikhimayunut naunaiyakhimaplugit mikhaanut. Aatjikutaatut hamna pihimayuk aipainut hitamat ukiut katitikhimayuni. Kihimi, ilangit aalanguyut pilaaktut kitkani Umayukhiukhimayut Ihivgiugutaini naunaiyautait ovalo DFOkuni umayukhimayut titigakhimayaini.

- **DFO F:** Kinauyaliuktut ovalo uktukhimayut ikalukhiuktut katitikhimayut tamamik Nunavumi nunaini pihimayut titigakhimaitut katitikhimayunit DFOkunit titigakvianit Iqaluni. Katitikhimayut, malguni kagitauyakut titigakhimayut laisinsiit tunihimayut kinauyaliuktut ovalo utukhimayut ikalukhiukhimayut kitkani 1992mit 2002mut ovalo pihimayut keelinikaktunik ikalukpaktait katitikhimayuni mikhaanut hapkoa laisinsikhimayut. Umayukhiukhimayut Ihivgiuktut Munagiyiit titigakhimayait ikaliviit katitikhimayut hamani titigakhimayuni Umayukhiukhimayut Ihivgiuktut ukingani (Junemit Maymut).
- **DSD FB:** Nuyaliit umayut (natiit, tigiganiat, amaguit, kalviit, tigiat ovalo nanuit/akhait) katitikhimayut tamamik Nunavumi nunainit 1999/2000 ukiuni ovalo 2000/2001 ukiuni pihimayut titigakhimaitut katitikhimayut kagitauyakut DSDkunit titigakvianit Iqaluni. Katitikhimayut takuyaulaat amigaitjutait amiit niuviktauhimayut umayukhiuktinit tamamik nunanit 1999/2000 ukiuni (Julymit 1999 Junemut 2000) ovalo 2000/2001 ukiuni (Julymit 2000 Junemut 2001). Tatkikhiutit titigagutait pihimaimata titigakhimaitavut katitikhimayut Umayukhiukhimayut Ihivgiuktut ukiungani (Junemit Maymut). Ikpinagutait ilangit aalauniaktut pilaaktut kitkani Umayukhiukhimayut Ihivgiuktuni naunaiyautaini ovalo DSDkuni titigakhimayaini. Aalatkiit pilaaktut ilaa, tamamik amiit niuviktautivanmata umayukhiuktinit; ilangit nunat ovalo ilangit umayut, ilangit amiit umayukhimayut niuviktitauvaktut. Taimaimat hapkoa katitikhimayut piyukhat ihumagilugit ovalo talvatuak atukhimayut katitikhimayuni naunaiyautaini ilangani nunani ovalo ilangit umayut.
- **DSD WV**: Ilahimayut katitikhimayut pihimayut kalviit umayukhimayut nunanit Kugluktumit ovalo Ikaluktutiamit. DSDkut pivaktut kalviit ukpatait katitikhimayut pilihimayunik umayukhiuktit akiliktauvaktut $25nik utiktigumik ukpatainik umayukhimayainik. Amigaitjutait ukpatit utiktihimayut hamani pilihimayuni 1986mit 2002mut pihimayut titigakhimaituni katitikhimayuni DSDkunit, titigakhimayut ukiungani (Julymit Aprilmut). Hamna ukiumi pivaktut iluani Umayukhiukhimayut Ihivgiukhimayuni Ukiungani Junemit Maymut umayukhiukhimayut amigaitjutait aatjiktaulaaktut mikhaanut ubluit. Kihimi, tamamik ukpatait utiktitauyuitut, taimaimat amigaitjutait pihimayut ataani naunaiyalaaktut tamamik nunanit umayukhimayunit.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 11

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓱᓚᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᑲᐅᒍ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᑕᒪᑦ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᓴᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᓇᓵᓇ	DEC ᑎᓯᓴᓇ	JAN ᔮᖏᓇᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᓕᔪ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	66	20	234	97	59	111	113	118	128	124	88	88	1,246 ± 49
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait				1									1 ± 1
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡	1				1	4				7			13
Wolf	ᐊᒪᓗᐃᑦ	Amagut			1			1				1		4	7 ± 2
Arctic fox	ᑎᓕᓴᖅᐊᑦ	Tigiganiat						72	61	26	13	23	5		200 ± 32
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓕᓴᖅᐊᑦ	Kalaliit tigiganiat									1				1 ± 0
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	1		16	30	21	8	4	9	22	65	22	9	207 ± 13
Ringed seal	ᓇᖏᓪᓗᑦ	Natiinat	469	170	135	202	116	116	34	51	62	65	60	64	1,544 ± 66
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		2	5	5	3								15 ± 4
Harp seal	ᖃᐃᐳᓪᓚᑦ	Qairulik		2	3	1	2								8 ± 2
Walrus	ᐊᐃᐃᓴᑦ	Akvik		1		2									3 ± 2
Narwhal	ᑐᒻᓪᓚᑦ ᖁᓕᓗᑦ	Tuugaak	1	76											77 ± 7
Beluga	ᖃᐅᕆᑦ ᖁᓕᓗᑦ	Kilalugak	1	23										3	27 ± 4
Snow goose	ᑲᖏᐃᑦ	Kanguq	357	48	197	1								32	635 ± 51
Canada goose	ᓄᕐᓪᓚᑦ	Nikliknik				1									1 ± 1
Eider duck	ᒥᑎᑦ	Kingalik				10	9								19 ± 6
Red-throated loon	ᖃᖏᓗᐅᑦ	Qaqhuaq			2	1									3 ± 2
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	5			18	117	56	32	14	107	226	77	66	718 ± 34
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓇᖅᑐᑦ	Uluaguliit manniit	629												629 ± 102
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓐᓇᖅᑐᑦ	Nauyat manniit	14												14 ± 5
Arctic char	ᐃᖃᓗᐊᓚᑦ	Ikaliviit	1,927	57	1,231	271	1,616	1,941	654	60	30	256	286	545	8,874 ± 617
Lake trout	ᐃᓕᓴᐃᑦ	Ikalukpik												4	4 ± 2
Cod	ᐅᓚᐃᑦ	Ugak	157												157 ± 53
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk	18	2	47										67 ± 27

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᓴᑦ ᑎᑎᕋᐅᒪᔨᑦ ᑐᓂᔨᖏᑦ ᐅᑯᐊ ᐃᑯᐱᔪᓕᓇᓵᓴᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓄᓗᓄᐃᔭᐅᑦ/NAUNAIKUTA 12

6.1.1

Monthly hunter response

ᑕᖃᑦᒪᑦ ᐊᖏᔪᓄᑦᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᒻᒋᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᒻᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᓄᐃᒻᐱᓗ	DEC ᑎᓯᒻᐱᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᐃᖏᐅᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓄᑦᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᒪᑦ ᐊᖏᔪᓄᑦᑎᑦ	Tatkitaman angunahuktut titigait	261	253	254	253	251	250	249	245	245	243	243	240	267*
Hunters interviewed	ᐊᖏᔪᓄᑦᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	238	241	235	237	241	231	241	240	236	242	242	233	256*
Harvested	ᐊᖏᔪᓄᑦᑐᒋᓐᓂ	Angujaujut	112	80	67	46	54	52	42	42	50	55	48	63	162*
Response Rate (%)	ᑭᐅᔭᑦ ᖃᓕᑎᓂᖏᑦ (%)	Kiujut (%)	91	95	93	94	96	92	97	98	96	100	100	97	96**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓄᑦᑎᑦ ᐊᑎᓕᑦᑐᒻᒪᓴᖅᑐᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᔪᓄᑦᑐᒋᓐᓂ ᐊᑕᐅᓯᐊᔪᓪᓚᑦᑎᑐᑦ ᐊᒻᒋᔪᒍ.
** ᐊᓕᒍᓂᓕᕆᓂᒪᓴᖅ ᑕᖃᑦᒪᑦ ᑭᐅᔭᑦ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓄᓗᓄᐃᔭᐅᑦ/NAUNAIKUTA 13

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔭᑦ ᐊᑯᖏᓚᓂ ᐊᖏᔪᓄᑦᓯᓂᖓᓚᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓚᑕ, ᓄᓗᓄᐃᕐᑦ ᐃᒧᑲ % ᑲᑎᑦᑎᓂᑦ ᐊᖏᔪᓄᑦᑕᑦ ᑎᑎᕐᑦᑕᐅᒪᔭᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᒻᒋᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᒻᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᓄᐃᒻᐱᓗ	DEC ᑎᓯᒻᐱᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᐃᖏᐅᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔭᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	100	99	100	100	100	100	100	100	100	100	100	99	100
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	0	1	0	0	0	0	0	0	0	0	0	1	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 14

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓯᓛᒋᑦ ᐊᖏᔪᓯᓛᓕᕆᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 1 (June 1996 - May 1997)

ᐊᒻᒋᒍ 1 (ᔪᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

6.1.1

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᓚᔅᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᐊᓕᐱᓇ	DEC ᑎᓯᓚᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᓯ	APR ᐃᓴᓇᓗ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	36	13	34	15	27	26	29	35	42	40	33	34	94
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait				1									1
Polar bear[#]	ᓇᓄᐃᑦ[#]	Nanuit[#]	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᖏᐃᑦ	Amagut			1			1				1		1	4
Arctic fox	ᑎᓗᒃᑯᓂᐊᑦ	Tigiganiat						7	10	5	4	6	3		14
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓗᒃᑯᓂᐊᑦ	Kalaliit tigiganiat									1				1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	1		6	10	9	5	4	7	13	18	10	7	46
Ringed seal	ᓇᓕᓱᑦ	Natiinat	87	53	41	34	29	26	16	16	20	20	16	23	126
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		1	3	2	3								7
Harp seal	ᖃᐃᖅᓚᓪᓚᑦ	Qairulik		2	2	1	2								6
Walrus	ᐊᐃᐃᓴᑦ	Akvik		1		1									2
Narwhal	ᑐᒻᓚᓪᓚᑦ ᖁᓪᓗᓴᑦ	Tuugaak	1	33											33
Beluga	ᖃᐅᔨᑦᑕ ᖁᓪᓗᓴᑦ	Kilalugak	1	14										2	17
Snow goose	ᑲᖏᐃᑦ	Kanguq	38	7	26	1								2	55
Canada goose	ᓂᑦᓚᓪᓚᑦ	Nikliknik				1									1
Eider duck	ᑎᑎᑦ	Kingalik				3	2								5
Red-throated loon	ᖃᖅᓗᐅᑦ	Qaqhuaq			1	1									1
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	3			4	14	10	6	5	11	21	10	16	50
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓇᖅᑎᑦ	Uluaguliit manniit	15												15
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓐᓇᖅᑎᑦ	Nauyat manniit	4												4
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	50	4	21	8	21	25	10	4	1	9	9	30	95
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik												1	1
Cod	ᐅᓗᐃᑦ	Ugak	5												5
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	4	1	2										7

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᒪᔪᓂᖅ ᐱᕕᖃᖏᑐᖃᖅ ᐱᔪᔨᑎᓕᓂᖅ ᐊᖏᔪᒃ ᖃᖏᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᕆᐅᒪᔪᓄᑦ ᐊᖏᔪᓄ ᓇᓕᐅᖏᓐᓄᑦᑐᖅ ᑐᓂᐅᖏᓐᓄᓂᖅ ᐃᑯᐱᔾᔪᑎᒃᓴᓕᕆᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓄᓗᓄᐃᔭᐅᑦ/NAUNAIKUTA 15

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓄᓪᑎᑦᓱᓕᕆᑦ

Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)

ᐊᑦᖁᔪ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

6.1.1

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᓚᔅᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑦᑐᓗ	NOV ᓄᐱᒃᓗ	DEC ᑎᓯᒃᓗ	JAN ᔮᖏᓂᓗ	FEB ᐃᖅᑐᓂᓗ	MAR ᒪᓯ	APR ᐃᓪᓚᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓕᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	40	34	77	73	45	134	51	79	86	112	57	67	855 ± 19
Polar bear‡	ᓄᓂᐃᑦ‡	Nanuit‡					6					5		1	12
Wolf	ᐊᒪᓗᐃᑦ	Amagut						1					9	3	13 ± 2
Arctic fox	ᑎᓕᓴᖏᐊᑦ	Tigiganiat						81	43	31	3	2			160 ± 25
Coloured fox	ᖃᐅᖏᑦᑐᑦ ᑎᓕᓴᖏᐊᑦ	Kalaliit tigiganiat							1						1 ± 1
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik			6	32	14	4	1	4	7	24	11	5	108 ± 5
Ringed seal	ᓄᓯᓪᑦ	Natiinat	283	163	107	193	129	99	48	51	16	48	34	28	1,199 ± 28
Bearded seal	ᐅᑉᔪᐃᑦ	Ukyuk	1	3	7	6	1					1	2		21 ± 1
Harp seal	ᖃᐃᕐᓂᑦ	Qairulik		3	1	4									8 ± 1
Walrus	ᐊᐃᐸᑦ	Akvik												5	5 ± 0
Narwhal	ᑐᒻᓂᑦ ᖁᓪᓗᓴᑦ	Tuugaak	9	32	21	4								1	67 ± 3
Beluga	ᖃᐅᑦᑕ ᖁᓪᓗᓴᑦ	Kilalugak		1		1								1	3 ± 0
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	126	18	85	5								9	243 ± 10
Canada goose	ᓄᑉᓂᑦ	Nikliknik		1											1 ± 0
Brant goose	ᓄᑉᓕᑉᓪᐃᑦ	Nirlirnaq			2	2									4 ± 1
Old squaw	ᐊᑲᐱᑉᔪᐃᑦ	Aahangik				2	1								3 ± 1
Eider duck	ᒥᑎᑦ	Kingalik	10		2	4	5								21 ± 2
Common loon	ᑐᑦᓂᑦ	Tuulik	1			1									2 ± 0
Thick-billed murre	ᐊᑦᕕᐃᑦ	Thick-billed murre	3												3 ± 0
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	8			97	161	42	14	20	18	165	265	41	831 ± 52
Goose eggs	ᑲᖏᐃᑦ ᒪᓕᓂᖅ	Uluaguliit manniit	108												108 ± 5
Seagull eggs	ᓄᐅᓴᐃᑦ ᒪᓕᓂᖅ	Nauyat manniit	4												4 ± 1
Arctic char	ᐃᖅᓗᑲᐱᑦ	Ikaliviit	1,492	67	871	2,494	1,371	2,866	193	103		24	861	759	11,101 ± 384
Lake trout	ᐃᓯᕋᐃᑦ	Ikalukpik												6	6 ± 0
Cod	ᐅᒪᐃᑦ	Ugak	160												160 ± 8
Sculpin	ᑲᓪᔪᐃᑦ	Kanayuk	18												18 ± 1
Clams	ᐊᑦᒧᒪᔪᑦ	Uviluq		29											29 ± 6

‡ Polar bear data supplied by DSD.

‡ ᓄᓂᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᖅᖢᑦ ᐅᑦᑐᓗ ᐃᐃᓱᕐᓂᓚᓵᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 16

Monthly hunter response
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᒻᒋᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᒻ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᕕᓂ	OCT ᐅᑐᕕᓂ	NOV ᐃᓚᒻᕕᓂ	DEC ᑎᓯᒻᕕᓂ	JAN ᒎᓄᐊᓂ	FEB ᓄᖅᐅᐊᓂ	MAR ᒪᑉ	APR ᐃᑦᓂᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓚᓂᔪᑦ ᑭᐅᓂᖅᑕᑦ ᐊᑲᓯᒪᓂᖅᑕᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᖏᒻᒪᑦ ᐊᖏᓚᓂᔪᑦ	Tatkitaman angunahuktut titigait	240	239	241	244	244	245	245	243	244	246	244	241	254*
Hunters interviewed	ᐊᖏᓚᓂᔪᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	239	237	237	238	240	241	240	236	238	244	240	240	253*
Harvested	ᐊᖏᓚᓂᔪᑐᒋᓐᓂᑦ	Angujaujut	102	65	57	66	58	47	25	29	27	44	44	52	143*
Response Rate (%)	ᑭᐅᔭᑦ ᖃᓄᐅᓂᖅᑕᑦ (%)	Kiujut (%)	100	99	98	98	98	98	98	97	98	99	98	100	98**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓂᔪᑦ ᐊᑎᓕᐅᕐᑕᒪᓐᓇᖅᑐᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᓚᓂᔪᑐᒋᓐᓂᑦ ᐊᑕᐅᓯᐊᖓᔪᓂᑦᑎᑦ ᐊᒻᒋᒎᑦ.
** ᐊᓕᒍᓂᓕᕆᓂᖅᓯᒪᔪᑦ ᑕᖅᖏᒻᒪᑦ ᑭᐅᔭᑦ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 17

Recall period between harvest and interview, expressed as % of total harvest records
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)
ᐊᒻᒋᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᒻ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᕕᓂ	OCT ᐅᑐᕕᓂ	NOV ᐃᓚᒻᕕᓂ	DEC ᑎᓯᒻᕕᓂ	JAN ᒎᓄᐊᓂ	FEB ᓄᖅᐅᐊᓂ	MAR ᒪᑉ	APR ᐃᑦᓂᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᐃᐅᔭᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑭᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	98	100	100
4-6 months	4-6 ᑕᖅᑭᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑭᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	2	0	0

TABLE/ᓄᓇᓕᐃᖅᑐᑦ/NAUNAIKUTA 18

Number of hunters harvesting each species

ᖃᑦᕕᐅᓂᖏᑦ ᐊᖏᔪᓕᒃᑎᑦ ᐊᖏᔪᓕᒃᐸᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu

Year 2 (June 1997 - May 1998)

ᐊᑲᒧᒍ 2 (ᔪᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

6.1.1

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᒃᔨᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᓄᐱᒃᐱᓗ	DEC ᑎᓴᒃᐱᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᓴ	APR ᐃᓴᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	23	10	24	24	9	30	18	27	25	31	28	26	78
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut						1					3	3	5
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat						6	6	6	2	2			10
Coloured fox	ᖃᐅᖅᖢᑎᑦ ᑎᓕᓴᖅᓂᐊᑦ	Kalaliit tigiganiat							1						1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik			4	12	10	4	1	2	3	9	5	3	34
Ringed seal	ᓄᓯᓪᓚᑦ	Natiinat	78	53	34	34	26	28	11	9	6	17	17	17	108
Bearded seal	ᐅᑉᔪᐃᑦ	Ukyuk	1	3	6	5	1					1	1		12
Harp seal	ᖃᐃᕐᓂᑦ	Qairulik		3	1	2									6
Walrus	ᐊᐃᐸᑦ	Akvik												5	5
Narwhal	ᑐᒻᓂᑦ ᖁᓪᓗᓴᑦ	Tuugaak	7	23	9	2								1	29
Beluga	ᖃᐅᖅᑕ ᖁᓪᓗᓴᑦ	Kilalugak		1		1								1	3
Snow goose	ᑲᖏᐃᑦ	Kanguq	32	7	10	1								6	42
Canada goose	ᓂᖅᓂᑦ	Nikliknik		1											1
Brant goose	ᓂᖅᓕᖅᓇᐃᑦ	Nirlirnaq			1	1									1
Old squaw	ᐋᑭᐊᖅᔪᐃᑦ	Aahangik				1	1								1
Eider duck	ᒥᑎᑦ	Kingalik	2		2	3	3								8
Common loon	ᑐᓪᓂᑦ	Tuulik	1			1									2
Thick-billed murre	ᐊᑦᕿᐃᑦ	Thick-billed murre	1												1
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	4			13	17	5	1	4	4	8	6	4	40
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	5												5
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	1												1
Arctic char	ᐃᖅᓗᑉᐱᑦ	Ikaliviit	43	5	19	33	24	22	3	1		1	16	24	84
Lake trout	ᐃᓯᕋᐃᑦ	Ikalukpik												2	2
Cod	ᐅᒪᐃᑦ	Ugak	5												5
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk	4												4
Clams	ᐊᑦᒧᒪᐊᖅ	Uviluq		1											1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᕈᖅᖢᖏᑕᖅ ᐱᑦᔪᒡᓕᖅᓂᒃ ᐊᖏᔪᒃ ᖃᕋᓴᐅᓂᖏᓐᓄᓕᐅᑦ ᐊᓕᔪᖅᓄᓕᐅᑦ ᓇᓕᕆᔨᒪᔪᓕᐅᑦ ᐊᐅᓚᑦᑎᓂᒃ ᑐᓴᕐᓂᖅᓂᒃ ᐃᓕᓴᕐᓂᖅᓂᒃ ᐃᓄᐃᑦᑕᓕᕆᔨᓕᐅᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 19

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᒻᒋᔪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᓕ	OCT ᐅᑲᐃᓕ	NOV ᐅᓇᓵᓕ	DEC ᑎᓯᓵᓕ	JAN ᔮᖏᓇᐊᓕ	FEB ᓄᖕᐅᐊᓕ	MAR ᒪᕐᓯ	APR ᐃᑦᓗᓪ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	12	57	151	116	36	82	37	79	75	33	34	48	760 ± 9
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait			1									1	2 ± 0
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡					1	2		2					
Wolf	ᐊᒪᓗᐃᑦ	Amagut										13	1	1	15 ± 0
Arctic fox	ᑎᓕᑦᓂᓂᐊᑦ	Tigiganiat						7	6	3	6	1			23 ± 1
Arctic hare	ᖃᓄᖅᑭᑦ ᑎᓕᑦᓂᐊᑦ	Ukalik			8	30	18	4	1	10	28	19	13		131 ± 1
Ringed seal	ᓇᕆᑦ	Natiinat	479	134	139	108	70	77	91	76	63	49	36	44	1,366 ± 9
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		1	3	1	1								6 ± 0
Harp seal	ᖃᐃᓗᓕᑦ	Qairulik			14	4									18 ± 3
Walrus	ᐊᐃᐸᑦ	Akvik			1									1	2 ± 0
Narwhal	ᑐᒻᓓᑦ ᖁᓕᓗᑦ	Tuugaak	4	14	46	7									71 ± 4
Beluga	ᖃᐃᑦᑕ ᖁᓕᓗᑦ	Kilalugak	4	1	3										8 ± 1
Snow goose	ᑲᖏᐃᑦ	Kanguq	197	40	20									47	304 ± 5
Brant goose	ᓄᑦᓕᑦᓇᐃᑦ	Nirlirnaq	8											1	9 ± 0
Eider duck	ᒥᑎᑦ	Kingalik	1	2	2	3	2								10 ± 0
Black guillemot	ᐱᑦᓂᐅᓪᓚᑦ	Black guillemot			1		2								3 ± 0
Thick-billed murre	ᐊᑦᐸᐃᑦ	Thick-billed murre	4												4 ± 0
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	2			13	64	30	8	102	175	53	5	9	461 ± 5
Sandhill crane	ᑕᑎᓴᕐᔪᐊᑦ	Tatilgaq												1	1 ± 0
Goose eggs	ᑲᖏᐃᑦ ᓚᒃᓄᖅᑦ	Uluaguliit manniit	1,241												1,241 ± 0
Seagull eggs	ᓇᐅᓂᐃᑦ ᓚᒃᓄᖅᑦ	Nauyat manniit	21												21 ± 0
Arctic char	ᐃᖃᓗᒃᑲᑦ	Ikaliviit	772	676	930	1,146	1,205	1,188	1,266		56	381	167	792	8,579 ± 136
Lake trout	ᐃᓚᖅᑐᑦ	Ikalukpik												32	32 ± 4
Cod	ᐅᒐᑦ	Ugak	72												72 ± 0
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	52												52 ± 0
Clams	ᐊᓗᒍᒪᔪᑦ	Uviluq			25										25 ± 5

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓄᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᖅᖏᑦ ᐅᑯᐊᓕ ᐃᓄᐃᑦᑎᓕᓵᕆᔨᓕᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓄᓗᓄᐃᔭᐅᑦ/NAUNAIKUTA 20

6.1.1

Monthly hunter response

ᑕᖃᑕᒪᑦ ᐊᖏᔪᓄᑦᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᒻᒋᔪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖃᖏᑐᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓱᑎᒻᒪᓗ	OCT ᐅᑲᐃᓗ	NOV ᐅᓇᒻᒪᓗ	DEC ᑎᓯᒻᒪᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᓇᖕᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓄᑦᑎᑦ ᑭᐅᓂᖏᑦ ᐋᒍᕐᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᒪᓕᒃ ᐊᖏᔪᓄᑦᑎᑦ	Tatkitaman angunahuktut titigait	241	243	241	236	239	237	237	237	233	233	231	234	250*
Hunters interviewed	ᐊᖏᔪᓄᑦᑎᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	241	243	238	236	238	235	236	236	233	232	230	232	249*
Harvested	ᐊᖏᔪᓄᑦᑐᒥᓂᓪᓕ	Angujaujut	112	56	69	55	48	40	40	35	41	35	28	62	148*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓕᑭᐅᓂᖏᑦ (%)	Kiujut (%)	100	100	99	100	100	99	100	100	100	100	100	99	100**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓄᑦᑎᑦ ᐊᑎᓕᑦᑕᒪᓕᕆᓂᖅ/ᐊᐱᕐᓯᑦ/ᐊᖏᔪᓄᑦᑐᒥᓂᓪᓕ ᐊᑕᐅᓯᐊᖓᔪᓂᑦᑎᑦ ᐊᒻᒋᒪᑎ.
** ᐃᓕᓴᕐᓂᑎᓯᒪᓕᕆᓂ ᑕᖃᒪᓕᒃ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓄᓗᓄᐃᔭᐅᑦ/NAUNAIKUTA 21

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᖏᓐᓄ ᐊᖏᔪᓄᑦᓯᓂᖏᓐᓇᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓯᑦᑕᐅᓂᖏᓐᓇᑕ, ᓄᓗᓄᐃᕐᑕᑦ ᐃᒪᓐᵇ % ᑲᑎᑕᑎᑦ ᐊᖏᔪᓄᑦᑕᑦ ᑎᑎᕐᕕᑦᑕᐅᒪᔾᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐊᒻᒋᔪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖃᖏᑐᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓱᑎᒻᒪᓗ	OCT ᐅᑲᐃᓗ	NOV ᐅᓇᒻᒪᓗ	DEC ᑎᓯᒻᒪᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᓇᖕᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔾᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 22

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓇᓯᕗᑎᑦ ᐊᖏᓇᓯᕗᒡᓕᕐᒧᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu

Year 3 (June 1998 - May 1999)
ᐊᒃᑭᒍ 3 (ᔪᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᓂᐱᓇ	DEC ᑎᓯᐱᓇ	JAN ᒍᖏᓂᓇ	FEB ᐃᖅᑲᓇ	MAR ᒪᓯ	APR ᐃᓕᓴ	MAY ᒪᐃ	Total ᑲᑎᒪᓂᖅ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᔭᐃᑐᐃᑦ	Tuktut	10	20	32	27	11	18	15	23	21	12	11	22	67
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait			1									1	2
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᖏᐃᑦ	Amagut										3	1	1	5
Arctic fox	ᑎᓕᑦᓂᐊᑦ	Tigiganiat						2	3	2	4	1			6
Arctic hare	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓕᑦᓂᐊᑦ	Ukalik			7	17	8	3	1	4	14	9	6		43
Ringed seal	ᓇᓯᓪᑦ	Natiinat	96	41	41	35	19	27	25	21	21	14	14	16	120
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		1	3	1	1								6
Harp seal	ᖃᐃᖅᓵᑦ	Qairulik			6	3									9
Walrus	ᐊᐃᐅᒃᑦ	Akvik			1									1	2
Narwhal	ᑐᒻᓵᑦ ᖁᓕᓗᒡᑦ	Tuugaak	3	8	12	4									22
Beluga	ᖃᐅᖅᑦ ᖁᓕᓗᒡᑦ	Kilalugak	2	1	1										4
Snow goose	ᑲᖕᒪᐃᑦ	Kanguq	30	10	8									9	40
Brant goose	ᓂᖅᓕᖅᓇᐃᑦ	Nirlirnaq	2											1	3
Eider duck	ᒥᑎᑦ	Kingalik	1	2	2	2	2								7
Black guillemot	ᐱᖅᓯᐅᓪᑦ	Black guillemot			1		2								3
Thick-billed murre	ᐊᖅᓴᐃᑦ	Thick-billed murre	2												2
Ptarmigan	ᐊᕐᑭᓂᑦ	Akilgik	1			6	10	8	4	13	18	11	3	5	46
Sandhill crane	ᑕᑎᓚᖅᓴᐊᑦ	Tatilgaq												1	1
Goose eggs	ᑲᖕᒪᐃᑦ ᓚᒃᓂᖏᑦ	Uluaguliit manniit	18												18
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᒃᓂᖏᑦ	Nauyat manniit	3												3
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	21	19	21	15	21	13	12		1	5	5	47	92
Lake trout	ᐃᓱᖅᑕᐃᑦ	Ikalukpik												9	9
Cod	ᐅᒪᐃᑦ	Ugak	3												3
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	9												9
Clams	ᐊᑦᒧᒪᔪᑦ	Uviluq			1										1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓪᒪᔪᓂᒃ ᐱᑕᖃᖕᒥᕐᓂᖅ ᐱᑦᔨᑎᓕᓂᒃ ᐊᖏᓪᓕᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᓪᓕᑦ ᐊᓪᓚᕆᔨᓕᓪᓕᑦ ᐊᖏᓪᓕᐅ ᓇᓪᔨᐸᑦᓴᑎᓂ ᑐᓂᓯᖏᓐᓄᓪ ᐃᑯᐱᕐᓇᓕᓪᓕᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

TABLE/ᓄᓗᓄᐃᔨᐅᑦ/NAUNAIKUTA 23

6.1.1

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓄᓪᐅᑦᓴᖅᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)

ᐊᓕᕐᒍ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔫᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᓚᑦᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑦᔨᓗ	NOV ᐅᓇᓕᓗ	DEC ᑎᓯᓕᓗ	JAN ᔮᖏᓂᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᓯ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᖅ Tamakiklugin ± 95% CI
Species	ᐅᒪᓕᒃ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	26	21	90	67	47	58	44	51	42	33	39	50	568 ± 18
Polar bear‡	ᓄᓂᐃᑦ‡	Nanuit‡					3	2	1	20					
Wolf	ᐊᒪᓱᐃᑦ	Amagut									2		11	3	16 ± 4
Arctic fox	ᑎᓗᓚᖓᐊᑦ	Tigiganiat	1					2	1	4					8 ± 1
Arctic hare	ᐅᑲᓪᓕ	Ukalik				18	16	2	6	1	11	36	9	5	104 ± 6
Ringed seal	ᓄᓯᓗ	Natiinat	274	171	106	146	149	71	69	85	142	101	112	76	1,502 ± 42
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk		1	4	4	7		1				1		18 ± 2
Harp seal	ᖃᐃᓱᓪᓕ	Qairulik			6	8									14 ± 4
Walrus	ᐊᐃᐅᓴᑦ	Akvik					1								1 ± 0
Narwhal	ᑐᒃᓪᓕ ᖁᓕᓗᒡᓗᑦ	Tuugaak	2	7	31	40	2								82 ± 7
Beluga	ᖃᓄᖅᑕ ᖁᓕᓗᒡᓗᑦ	Kilalugak	1	3			2								6 ± 1
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	120	4	13									23	160 ± 12
Canada goose	ᓂᖅᓪᑦ	Nikliknik	1			1									2 ± 1
Brant goose	ᓂᖅᓪᖅᓚᐃᑦ	Nirlirnaq		1											1 ± 0
Eider duck	ᒥᑎᑦ	Kingalik				7	2						2		11 ± 3
Arctic loon	ᑐᑉᓪᓕ	Maliriq	1												1 ± 1
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	9	3	2	42	84	22	33	16	48	186	32	16	493 ± 26
Goose eggs	ᑲᖏᐃᐃᑦ ᒪᓐᓇᖅᑦ	Uluaguliit manniit	83												83 ± 34
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓐᓇᖅᑦ	Nauyat manniit	12												12 ± 1
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	2,181	94	1,225	439	1,695	1,340	398		610	1,022	668	1,170	10,842 ± 488
Cod	ᐅᓚᐃᑦ	Ugak	67	303											370 ± 62
Sculpin	ᑲᓇᓕᐃᑦ	Kanayuk	19	13											32 ± 7
Clams	ᐊᓲᒧᒪᓕᒃ	Uviluq		203											203 ± 41

‡ Polar bear data supplied by DSD.

‡ ᓄᓂᑦᓂ ᑎᑎᕋᐅᒪᓕᒃ ᑐᓴᕐᕋᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓴᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓄᓗᓄᐃᔨᐅᑦ/NAUNAIKUTA 24

Monthly hunter response
ᑕᖏᑕᒪᑦ ᐊᖏᔪᓄᖅᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᒃᕿᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑐᕐᓇ	NOV ᓄᐃᒪᓇ	DEC ᑎᓯᒪᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᐃᖏᐅᐊᓇ	MAR ᒪᕐᔪ	APR ᐃᕐᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓄᖅᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒪᑦ ᐊᖏᔪᓄᖅᑎᑦ	Tatkitaman angunahuktut titigait	226	234	229	226	223	222	226	226	227	231	231	235	245*
Hunters interviewed	ᐊᖏᔪᓄᖅᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	221	231	222	223	222	220	224	224	225	227	226	230	242*
Harvested	ᐊᖏᔪᓄᖅᑐᒥᓂᓂᑦ	Angujaujut	89	58	55	56	52	36	22	28	34	40	33	62	138*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓕᑭᐅᓂᖏᑦ (%)	Kiujut (%)	98	99	97	99	100	99	99	99	99	98	98	98	99**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓄᖅᑎᑦ ᐊᑎᓕᐅᕐᑕᒪᓐᓇᖅᑐᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᔪᓄᖅᑐᒥᓂᓂᑦ ᐊᑕᐅᓂᐊᖅᓯᐅᑎᑦ ᐊᒃᕿᒍᒥ.
** ᐊᐅᓚᑦᓂᑎᒥᓪᓚᔨᑦ ᑕᖏᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓄᓗᓄᐃᔨᐅᑦ/NAUNAIKUTA 25

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓄᖅᓯᓂᖓᓪᓕᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓪᓕᑕ, ᓄᓗᓄᐃᕐᑕᑦ ᐃᒪᒃ % ᑲᑎᑐᑦ ᐊᖏᔪᓄᖅᑕᑦ ᑎᑎᕐᑕᐅᒪᔨᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

ᐊᒃᕿᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑐᕐᓇ	NOV ᓄᐃᒪᓇ	DEC ᑎᓯᒪᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᐃᖏᐅᐊᓇ	MAR ᒪᕐᔪ	APR ᐃᕐᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑭᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑭᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑭᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓄᓗᓄᐃᔨᐅᑦ/NAUNAIKUTA 26

Number of hunters harvesting each species

ᖃᑦᔪᐅᓂᖏᑦ ᐊᖏᔪᓂᓴᑎᑦ ᐊᖏᔪᓂᓴᕐᕕᒃᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu

Year 4 (June 1999 - May 2000)

ᐊᒡᖏᒍ 4 (ᔪᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

6.1.1

Month/ᑕᖃᖏᓐ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᓕ	AUG ᐊᐅᓚᔨᑎ	SEP ᔨᑎᑦᓴᓗ	OCT ᐅᑲᓴᓗ	NOV ᐅᓂᓴᓗ	DEC ᑎᔨᓴᓗ	JAN ᒎᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᔨ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	18	9	23	17	16	20	11	16	16	11	17	20	63
Polar bear#	ᓇᓄᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut									1		2	3	6
Arctic fox	ᑎᓗᓚᖓᐊᑦ	Tigiganiat	1					2	1	3					7
Arctic hare	ᐅᑲᓪᓕ	Ukalik				10	6	2	2	1	4	11	6	3	27
Ringed seal	ᓇᓕᔪᑦ	Natiinat	64	43	30	26	32	18	15	17	21	23	22	27	104
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk		1	3	4	6		1				1		12
Harp seal	ᖃᐃᓕᓪᓕᑦ	Qairulik			2	3									4
Walrus	ᐊᐃᐸᑦ	Akvik					1								1
Narwhal	ᑐᒻᓪᓕᑦ ᖁᓕᓂᒃᑦ	Tuugaak	1	5	16	14	1								27
Beluga	ᖃᐅᕐᑦ ᖁᓕᓂᒃᑦ	Kilalugak	1	3			1								4
Snow goose	ᑲᖏᐃᑦ	Kanguq	29	2	5									8	35
Canada goose	ᓄᕐᓪᓕᑦ	Nikliknik	1			1									2
Brant goose	ᓄᕐᓕᕐᓇᐃᑦ	Nirlirnaq		1											1
Eider duck	ᒥᑎᑦ	Kingalik				2	2						1		4
Arctic loon	ᑐᑦᓪᓕᑦ	Maliriq	1												1
Ptarmigan	ᐋᖅᓯᑦ	Akilgik	4	2	1	6	14	4	2	5	10	19	5	7	38
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓇᕐᑦ	Uluaguliit manniit	8												8
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓐᓇᕐᑦ	Nauyat manniit	2												2
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	55	9	16	15	21	20	5		6	7	8	41	90
Cod	ᐅᓴᐃᑦ	Ugak	4	1											5
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	3	5											7
Clams	ᐋᓯᒧᒪᔪᑦ	Uviluq		1											1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓯᒪᔪᓂᒃ ᐱᑕᖃᖓᑎᑐᖃᖅ ᐱᓕᕆᓕᓵᓂᒃ ᐊᖏᔪᒃᑐᑦ ᖃᑦᔪᐅᓂᖏᓐᓄᓕᑦ ᐊᓕᖁᐅᒪᔪᓂᒃ ᐊᑐᐅᓂᑦ ᓇᓕᐅᖏᓐᓄᓕᑦ ᑐᓂᐅᖏᓐᓄᑐᓂ ᐃᓕᓴᕐᓂᐊᕐᓂᖅᑕᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 27

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)
ᐊᒻᒋᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

6.1.1

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᕆ	OCT ᐅᑦᔪᕆ	NOV ᐅᓇᓱᕆ	DEC ᑎᓯᓱᕆ	JAN ᔮᖏᓇᐊᕆ	FEB ᓇᖅᑐᐊᕆ	MAR ᒪᓕᒃ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	24	6	84	22		51	55	48	54	44	30	45	463 ± 18
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait				2								1	3 ± 1
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					4					4			8
Wolf	ᐊᒪᖅᐃᑦ	Amagut			1		1	2				7	4		15 ± 3
Arctic fox	ᑎᓕᓴᓂᐅᐊᑦ	Tigiganiat						3	76	79	17	2	1		178 ± 20
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓕᓴᓂᐅᐊᑦ	Kalaliit tigiganiat						2							2 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik			4	25	33	7	2	2	15	21	12	8	129 ± 8
Ringed seal	ᓇᓂᓪᓕᑦ	Natiinat	520	159	98	134	164	128	68	85	73	61	57	92	1,639 ± 56
Bearded seal	ᐅᑭᐊᐃᑦ	Ukyuk				2	4	1	1				1	1	10 ± 2
Harp seal	ᖃᐃᖅᓚᓪᓕᑦ	Qairulik			2										2 ± 1
Walrus	ᐊᐃᓴᒃᑦ	Akvik			1								2		3 ± 1
Narwhal	ᑐᐊᓚᓪᓕᑦ ᖁᓪᓗᑎᑦ	Tuugaak	4	49	19	1									73 ± 6
Beluga	ᖃᐅᕐᑦ ᖁᓪᓗᑎᑦ	Kilalugak		6	18										24 ± 4
Snow goose	ᑲᖏᐃᑦ	Kanguq	288	81	195									46	610 ± 39
Brant goose	ᓄᕐᓕᖅᓴᐃᑦ	Brant goose	9												9 ± 4
Eider duck	ᒥᑎᑦ	Kingalik	5		1	9	4								19 ± 5
Thick-billed murre	ᐊᕐᕕᐃᑦ	Thick-billed murre	2												2 ± 1
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	12			34	95	23	14	20	80	47	16	10	351 ± 26
Sandhill crane	ᑕᑎᓴᕐᔪᐊᑦ	Tatilgaq	2												2 ± 1
Goose eggs	ᑲᖏᐃᑦ ᓚᖓᓂᑦ	Uluaguliit manniit	570	147											717 ± 88
Duck eggs	ᒥᑎᑦ ᓚᖓᓂᑦ	Tinmiat manniit		1											1 ± 0
Seagull eggs	ᓇᐅᔭᐃᑦ ᓚᖓᓂᑦ	Nauyat manniit	71	41											112 ± 30
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	3,624	171	629	613	1,219	2,649	698	467	236	228	621	634	11,789 ± 483
Cod	ᐅᓘᐃᑦ	Ugak	3												3 ± 1
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	1	1											2 ± 0

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕐᒃᑲᒪᔪᑦ ᑐᓂᓯᖓᑦ ᐅᑉᐳᖓᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᕆᔨᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓄᓗᓄᐃᔾᐅᑦ/NAUNAIKUTA 28

Monthly hunter response

ᑕᖅᑕᒪᒃᑯᑦ ᐊᖏᔪᓄᕆᑦ ᑭᐅᓂᖅᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᒻᕿᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

6.1.1

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒍᑎᑕ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᐊᓂ	NOV ᓄᐃᒻᒪᓂ	DEC ᑎᓯᒪᓂ	JAN ᔮᖏᓐᓄᓂ	FEB ᐃᖅᑲᓂ	MAR ᒪᕐᕿ	APR ᐃᕐᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᕐᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓄᕆᑦ ᑭᐅᓂᖅᑎᑦ ᐊᑐᕐᓯᒪᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑯᑦ ᐊᖏᔪᓄᕆᑦ	Tatkitaman angunahuktut titigait	232	239	243	238	239	241	239	240	243	244	245	246	257*
Hunters interviewed	ᐊᖏᔪᓄᕆᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	226	232	235	230	229	234	232	234	233	235	234	234	247*
Harvested	ᐊᖏᔪᓄᕆᑐᒃᓯᒪᓂᖅ	Angujaujut	97	65	54	52	47	44	32	35	30	44	27	68	151*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖅᑎᑦ (%)	Kiujut (%)	97	97	97	97	96	97	97	98	96	96	96	95	97**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓄᕆᑦ ᐊᑎᓕᐅᕐᑕᒪᓪᓚᕆᑦ/ᐊᐱᕐᓯᑦ/ᐊᖏᔪᓄᕆᑐᒃᓯᒪᓂᖅ ᐊᑕᐅᓯᐊᖅᓗᓂᑦ ᐊᑲᕐᒥ.
** ᐊᐅᓚᑦᓂᑎᓯᒪᓪᓚᕆᑦ ᑕᖅᑕᒪᒃᑯᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓄᓗᓄᐃᔾᐅᑦ/NAUNAIKUTA 29

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᓱᓂ ᐊᖏᔪᓄᖅᓯᓂᖅᓯᒪᑦ ᐊᒻᒪᓗ ᐊᐱᕐᓯᑎᐅᓂᖅᓯᒪᑦ, ᓄᓗᓄᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᕐᑎᑦ ᐊᖏᔪᓄᕆᑦ ᑎᑎᕐᑎᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᒻᕿᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒍᑎᑕ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᐊᓂ	NOV ᓄᐃᒻᒪᓂ	DEC ᑎᓯᒪᓂ	JAN ᔮᖏᓐᓄᓂ	FEB ᐃᖅᑲᓂ	MAR ᒪᕐᕿ	APR ᐃᕐᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᕐᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲ	≤ tatkin pingahut	99	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑲ	tatkin hitaman 6nut	1	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑲ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 30

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓯᓛᒃᑎᑦ ᐊᖏᔪᓯᓛᒃᑯᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖏᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu

Year 5 (June 2000 - May 2001)
ᐊᒻᒋᒍ 5 (ᔪᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᓄᐊᒻᐱᓗ	DEC ᑎᓯᒻᐱᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓄᖕᕐᐊᓗ	MAR ᒪᔪ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	14	4	20	10		15	13	12	13	17	8	17	58
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait				1								1	2
Polar bear[#]	ᓇᓄᐃᑦ[#]	Nanuit[#]	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut			1		1	1				2	4		7
Arctic fox	ᑎᓗᓚᖓᓂᐊᑦ	Tigiganiat						2	9	7	3	1	1		14
Coloured fox	ᖃᐅᖕᖏᑎᑦ ᑎᓗᓚᖓᓂᐊᑦ	Kalaliit tigiganiat						1							1
Arctic hare	ᐅᑲᓪᓕ	Ukalik			3	15	11	4	1	2	6	12	5	4	38
Ringed seal	ᓇᓕᓪᓕ	Natiinat	83	49	29	29	20	25	19	28	19	18	11	25	110
Bearded seal	ᐅᑭᔭᐃᑦ	Ukyuk				2	4	1	1				1	1	10
Harp seal	ᖃᐃᕐᓂᑦ	Qairulik			2										2
Walrus	ᐊᐃᐃᒐᑦ	Akvik			1								2		3
Narwhal	ᑐᒻᓂᓪᑦ ᖁᓪᓗᑎᑦ	Tuugaak	3	26	7	1									29
Beluga	ᖃᐅᕆᑦ ᖁᓪᓗᑎᑦ	Kilalugak		4	6										10
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	34	8	20									14	54
Brant goose	ᓄᕐᓕᕐᓇᐃᑦ	Brant goose	3												3
Eider duck	ᒥᑎᑦ	Kingalik	4		1	3	2								9
Thick-billed murre	ᐊᕐᕿᐃᑦ	Thick-billed murre	2												2
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	3			9	13	5	5	5	9	10	3	5	38
Sandhill crane	ᑕᑎᓴᕐᔪᐊᑦ	Tatilgaq	2												2
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᖓᓄᑦ	Uluaguliit manniit	11	1											12
Duck eggs	ᒥᑎᑦ ᓚᖓᓄᑦ	Tinmiat manniit		1											1
Seagull eggs	ᓇᐅᔨᐃᑦ ᓚᖓᓄᑦ	Nauyat manniit	3	1											4
Arctic char	ᐃᖅᓱᖅᐸᑦ	Ikaliviit	65	10	17	16	19	21	11	7	3	4	14	44	106
Cod	ᐅᓚᐃᑦ	Ugak	1												1
Sculpin	ᑲᓇᔭᐃᑦ	Kanayuk	1	1											2

[#] No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

[#] ᑎᑎᕋᓯᒪᔭᓂᒃ ᐱᕈᖅᖏᓂᑐᖅ ᐱᓕᔪᑎᓕᓂᒃ ᐊᖏᔪᑦ ᖃᐅᕐᐅᓂᖏᓐᓂᑦ ᐊᓯᖏᑦ ᐃᓕᓴᕐᓂᒃ ᐊᖏᔪᑦ ᓇᓕᐅᕐᓯᒪᓂᖅ ᑐᓂᓯᖏᓐᓂᒃ ᐃᓅᓯᕐᓂᓕᕆᓂᖅ.

[#] Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓄᓗᓄᐃᔨᐅᑦ/NAUNAIKUTA 31

6.1.1

Annual harvest estimates and five-year mean

All Years (June 1996 - May 2001)

ᐊᒻᕿᔪᑦᒪᑦ ᐊᖏᔪᓄᑦ ᓄᓇᐅᑦᓯᕐᔪᐊᑦ ᐊᒻᒪᓗ ᑕᒪᓕᓄᑦ-ᐊᒻᕿᔪᒍᓄᑦ ᐊᐅᔨᓕᕆᓂᖅᓯᒪᔪᑦ 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᒻᕿᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ

Study Year/ᖃᐅᔨᓴᖅᑎᑦ ᐊᒻᕿᔪ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Mean ᐊᐅᔨᓕᕆᓂᖅᓯᒪᔪᑦ Amigaitkiyait
			96/97	97/98	98/99	99/00	00/01	
Species	ᐅᒪᔪᑦ	**Umajuin**						
Caribou[1]	ᑐᖅᑐᐃᑦ[1]	Tuktut[1]	1,246	855	760	568	463	778
Musk-ox[2]	ᐅᒥᖓᒪᐃᑦ[2]	Umingmait[2]	1	0	2	0	3	1
Polar bear[3]	ᓄᓂᐃᑦ[3]	Nanuit[3]	13	12	12	10	8	11
Wolf	ᐊᒪᕈᐃᑦ	Amagut	7	13	15	16	15	13
Arctic fox[4]	ᑎᓕᓴᓂᐊᑦ[4]	Tigiganiat[4]	200	160	23	8	178	114
Coloured fox[5]	ᖃᐊᓐᖏᑦᑐᑦ ᑎᓕᓴᓂᐊᑦ[5]	Kalaliit tigiganiat[5]	1	1	0	0	2	1
Arctic hare	ᐅᑲᓪᓕ	Ukalik	207	108	131	104	129	136
Ringed seal[6]	ᓇᕆᓪᓚ[6]	Natiinat[6]	1,544	1,199	1,366	1,502	1,639	1,450
Bearded seal	ᐅᓗᐊᐃᑦ	Ukyuk	15	21	6	18	10	14
Harp seal[7]	ᖃᐃᕈᓕᓪᓕ[7]	Qairulik[7]	8	8	18	14	2	10
Walrus[8]	ᐊᐃᐱᒃ[8]	Akvik[8]	3	5	2	1	3	3
Narwhal[9]	ᑐᒍᓪᓕ ᖃᓪᓗᓂᑦ[9]	Tuugaak[9]	77	67	71	82	73	74
Beluga[10]	ᖃᐅᔨᑦ ᖃᓪᓗᓂᑦ[10]	Kilalugak[10]	27	3	8	6	24	14
Snow goose[11]	ᑲᖏᐃᑦ[11]	Kanguq[11]	635	243	304	160	610	390
Canada goose	ᓄᓕᓪᓕ ᐅᓇᐊᒍᓪᓕ	Nikliknik	1	1	0	2	0	1
Brant goose	ᓄᓕᓕᓄᐃᑦ	Nirlirnaq	0	4	9	1	9	5
Old squaw	ᐊᐱᕈᓕᐊᐃᑦ	Aahangik	0	3	0	0	0	1
Eider duck[12]	ᑎᑎᑦ[12]	Kingalik[12]	19	21	10	11	19	16
Common loon	ᑐᑦᓕᓕᐊᑦ	Tuulik	0	2	0	0	0	< 1
Arctic loon	ᒪᑐᓪᓗ	Maliriq	0	0	0	1	0	< 1
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq	3	0	0	0	0	1
Black guillemot	ᐱᓕᕈᐅᓪᓕ	Black guillemot	0	0	3	0	0	1
Thick-billed murre	ᐊᑦᑕᐃᑦ	Thick-billed murre	0	3	4	0	2	2
Ptarmigan	ᐊᕐᓗᓂᑦ	Akilgik	718	831	461	493	351	571
Sandhill crane	ᑕᑎᓴᓕᐊᑦ	Tatilgaq	0	0	1	0	2	1
Goose eggs[13]	ᑲᖏᐃᑦ ᓚᒃᓂᕐᑦ[13]	Uluaguliit manniit[13]	629	108	1,241	83	717	556
Duck eggs[13]	ᑎᑎᑦ ᓚᒃᓂᕐᑦ[13]	Tinmiat manniit[13]	0	0	0	0	1	< 1
Seagull eggs[13]	ᓄᐅᔨᐃᑦ ᓚᒃᓂᕐᑦ[13]	Nauyat manniit[13]	14	4	21	12	112	33
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	8,874	11,101	8,579	10,842	11,789	10,237
Lake trout[14]	ᐃᓯᕆᐃᑦ[14]	Ikalukpik[14]	4	6	32	0	0	8
Cod[15]	ᐅᓴᐃᑦ[15]	Ugak[15]	157	160	72	370	3	152
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	67	18	52	32	2	34
Clams	ᐊᒻᒧᒪᔪᑦ	Uviluq	0	29	25	203	0	51

[1-15]: See page 155 for community feedback and other sources of data.

[1-15]: ᑕᐃᓗ ᒪᓴᐃᓗᖃ 157 ᓄᓇᓕᑦ ᑭᐅᔭᓈᑎᑦ ᐊᒻᒪᓗ ᐊᓯᖏᑦ ᐱᖁᔭᓈᑎᓯᒪᔪᑦ ᓇᓴᐅᑎᓂᖅ.

[1-15]: Takulugu makpigaak 159 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 32

Annual hunter response
ᐊᓚᖏᔪᒡᒐᑦ ᐊᖓᔪᓇᓱᐊᑦ ᑭᐅᓂᖅᑎᑦ
Angujauvaktu

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓇᑦ ᐊᓚᖏᔪᓇᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Hunter Response Categories	ᐊᖓᔪᓇᓱᐊᑦ ᑭᐅᓂᖅᑎᑦ ᐊᔪᕐᓚᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᖅᑕᒋᒪᑦ ᐊᖓᔪᓇᓱᐊᑦ	Tatkitaman angunahuktut titigait	267	254	250	245	257	310*
Hunters interviewed	ᐊᖓᔪᓇᓱᐊᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	256	253	249	242	247	300*
Harvested	ᐊᖓᔪᓇᓱᒋᑎᓂᒃ	Angujaujut	162	143	148	138	151	240*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓕᑭᐅᓂᖅᑎᑦ (%)	Kiujut (%)	96	98	100	99	97	98**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖓᔪᓇᓱᐊᑦ ᐃᑎᓕᐅᔾᔨᒃᑯᑦ/ᐊᐱᕐᓯᑦᑐᑦ/ᐊᖓᔪᓇᓱᒋᑎᓂᒃ ᐊᑕᐅᓯᐊᖏᑐᓕᕐᒥᑎᒃ ᖃᐅᔨᓴᖅᓯᒪᔪᖅ.
** ᐊᔪᓀᓕᓐᓂᔾᔪᑎᒃ ᐊᓚᖏᔪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 33

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᖏᓐᓄᓕᒐᓂᖅ ᐊᖓᔪᓇᓱᓐᓂᖓᓕᒐᑦ ᐊᒻᒪᓗ ᐊᐱᕐᓯᕐᑕᐅᓂᖓᓕᒐᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᕐᔪᑦ ᐊᖓᔪᓇᓱᒐᑦ ᑎᑎᕐᑕᐅᒪᔾᔨᑦ
Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓇᑦ ᐊᓚᖏᔪᓇᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	0	0	0

TABLE/ᓄᓗᓄᐃᕐᐳᑦ/NAUNAIKUTA 34

Number of hunters harvesting each species

ᖃᓄᓴᐅᓂᖏᑦ ᐊᖏᔪᓴᒃᑎᑦ ᐊᖏᔪᓴᒃᓯᕐᔪᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖏᓂᒃ

Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᑦᔪᔭᓂᑦ (ᔨᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

6.1.1

Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᔪᔭ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**						
Caribou	ᑐᑐᐃᑦ	Tuktut	94	78	67	63	58	131
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait	1		2		2	5
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut	4	5	5	6	7	17
Arctic fox	ᑎᓇᓚᒃᓂᐊᑦ	Tigiganiat	14	10	6	7	14	31
Coloured fox	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓇᓚᒃᓂᐊᑦ	Kalaliit tigiganiat	1	1			1	1
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	46	34	43	27	38	82
Ringed seal	ᓇᕐᓯᑦ	Natiinat	126	108	120	104	110	195
Bearded seal	ᐅᑭᔭᐃᑦ	Ukyuk	7	12	6	12	10	26
Harp seal	ᖃᐃᐳᓕᓪᓕᑦ	Qairulik	6	6	9	4	2	22
Walrus	ᐊᐃᐃᓴᑦ	Akvik	2	5	2	1	3	10
Narwhal	ᑐᒻᓕᓪᓕᑦ ᕿᓪᓗᓂᑦ	Tuugaak	33	29	22	27	29	75
Beluga	ᖃᐅᕐᑕᑦ ᕿᓪᓗᓂᑦ	Kilalugak	17	3	4	4	10	31
Snow goose	ᑲᖏᐃᑦ	Kanguq	55	42	40	35	54	105
Canada goose	ᓄᑦᓕᓪᓕᑦ ᐅᓚᐊᒍᓕᓪᓕᑦ	Nikliknik	1	1		2		4
Brant goose	ᓄᑦᓕᕐᓇᐃᑦ	Nirlirnaq		1	3	1	3	6
Old squaw	ᐋᕿᑭᑦᔭᐃᑦ	Aahangik		1				1
Eider duck	ᒥᑦᑎᑦ	Kingalik	5	8	7	4	9	20
Common loon	ᑐᑦᓕᑦᔪᐊᑦ	Tuulik		2				2
Arctic loon	ᑲᑎᓚᓗᒃ	Maliriq				1		1
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq	1					1
Black guillemot	ᐱᑦᓯᐅᓪᓕᑦ	Black guillemot			3			3
Thick-billed murre	ᐊᑦᑕᐃᑦ	Thick-billed murre		1	2		2	4
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	50	40	46	38	38	96
Sandhill crane	ᑕᑎᓴᑦᔪᐊᑦ	Tatilgaq			1		2	3
Goose eggs	ᑲᖏᐃᑦ ᓴᓐᓂᖏᑦ	Uluaguliit manniit	15	5	18	8	12	43
Duck eggs	ᒥᑦᑎᑦ ᓴᓐᓂᖏᑦ	Tinmiat manniit					1	1
Seagull eggs	ᓇᐅᓴᐃᑦ ᓴᓐᓂᖏᑦ	Nauyat manniit	4	1	3	2	4	12
Arctic char	ᐃᖃᓗᓴᐱᑦ	Ikaliviit	95	84	92	90	106	175
Lake trout	ᐃᓱᒪᓕᐃᑦ	Ikalukpik	1	2	9			10
Cod	ᐅᓴᐃᑦ	Ugak	5	5	3	5	1	12
Sculpin	ᑲᓇᔭᐃᑦ	Kanayuk	7	4	9	7	2	22
Clams	ᐊᒻᒧᒪᔭᑦ	Uviluq		1	1	1		3

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔭᑲᓂᒃ ᐱᑕᖃᖏᑐᑐᓄᑦ ᐱᓕᔪᑎᓐᓂᑲᓂᒃ ᐊᖏᔪᑦ ᖃᕋᐅᓂᖏᓐᓂᒃᓂᑦ ᐊᓪᓚᕆᐊᓂᑦ ᐊᖏᔪᓂᑦ ᓇᓪᓕᐊᓂᖅ ᑐᓂᐅᖏᓐᓂᒃ ᐃᓅᓯᕐᓂᓕᕆᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1 Baffin Region

6.1.1 Community Results Discussion: Arctic Bay and Nanisivik

The survey frame:

An assessment of under-enumeration during the community visit indicated that there were very few Inuit hunters who were not registered in the Harvest Study. However, it is estimated that there were eight non-Inuit hunters with assigned hunting rights who were not registered – six occasional and two active hunters. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. However, the extent of the bias is likely very small since the missing hunters only represent three percent of the total hunter population (Table 10).

Due to the relatively small number of intensive hunters registered in Arctic Bay, the intensive classification was joined with the active classification for the purpose of calculating harvest estimates.

Survey coverage and non-response bias:

Response rates remained high throughout the course of the Harvest Study. As seen in Table 9 the consistent intentional non-response rate in Arctic Bay was nil, and therefore was not a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough in all years to ensure that n did in fact constitute a sufficiently representative sample of N hunters.

Measurement issues and response error:

Although it is felt that most hunters were interviewed during the course of the Harvest Study, as demonstrated by the high response rates and low number of non-registered hunters, it was suggested during the community visit that hunters may not have reported all their harvest. We were informed that if hunters did not record their harvest in their calendar they would need to estimate their harvest at the time of the interview and that Inuit hunters are more likely to underestimate their catch resulting in lower harvest estimates. Fear of further harvesting limitations was also given as a reason some hunters may under-report their harvests. As is evident from the discussion below, the community felt that some estimates were low. These measurement errors are suspected to have played a role in this. However the community agreed that most of the estimates are within the right range.

As seen in the recall period tables, the vast majority of harvest records were collected within three months of the harvest, thereby minimizing recall error. However, as noted above there appears to have been some recall error despite the shorter recall periods.

There were relatively small numbers of arctic char harvested commercially during the study. Some of that harvest may have been reported along with the subsistence harvest but it is not felt to have had a large effect on the harvest estimates. Other harvest records indicated that the char harvest was commercial, and were removed from the database. These can be seen in Table 4.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou. Caribou were abundant around the community early in the study resulting in a higher harvest during this time period (C.F.).
2. **Musk-ox:** The community quota was 4 per year. Musk-oxen are only harvested on Devon Island and only when ice conditions are favorable (C.F.). Records obtained from DSD show similar harvest numbers, a harvest of 1 animal in year 3 and 4 animals in year 5 (DSD MXa).
3. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by the Government of Nunavut, Department of Sustainable Development (DSD PB).
4. **Arctic fox:** Estimates may be low in some years but the community indicates that the large drop in years 3 and 4 is related to the implementation of humane trapping standards (C.F.).
5. **Coloured fox:** The estimates appear low (C.F.).
6. **Ringed seal:** The estimates seem low; the community depends on the seal harvest. They feel that some hunters may not have reported all of their harvest (C.F.).
7. **Harp seal:** The estimates seem low; there was a market for the pelts during the study (C.F.).
8. **Walrus:** The community reported that the estimates seem accurate and that they remember a higher harvest in year 2. The community also indicated that meat is often ordered from Igloolik due to a higher need than local harvesting can support (C.F.).

[9] **Narwhal:** Some estimates appear too low as the narwhal quota of 100 was used each year (C.F.). DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May)(DFO N/B):

96/97	97/98	98/99	99/00	00/01
99	66	103	101	100

[10] **Beluga:** The community reports that some estimates (years 1 and 5) seem too high whereas the year 2 estimate seems somewhat low. However, there was general agreement that the overall estimates were in the right range (C.F.). DFO reports the following harvest numbers for beluga (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
1	1	2	0	n/d

[11] **Snow goose:** The year 4 estimate seems a little low; however other years appear to be in the right range (C.F.).

[12] **Eider duck:** The overall harvest estimates for eider ducks seem low. Both king eider and common eider ducks are harvested by the community. King eiders are taken close to the community and common eiders are harvested further south (C.F.).

[13] **Eggs:** Egg harvest estimates appear low for all species; some hunters were not aware that they were to report their egg harvests and others may have underestimated their harvest (C.F.).

[14] **Lake trout:** The estimates appear accurate; harvesting takes place when hunters travel to Hall Beach (C.F.).

[15] **Cod:** Cod are primarily harvested by children. Although children under 16 years were not registered in the Harvest Study, their harvest was reported by their parents (C.F.).

6.1 ᖃᑭᖅᑕᒃ

6.1.1 ᓄᓇᓕᒃ ᓴᖅᑭᑕᐅᔪᓂᒃ ᐅᖃᖅᑎᑎᑭᑦᑐᑎᑦ: ᐃᓕᐊᑦᓴᒃ ᐊᓪᓚᓗ ᓇᓂᔪᓐᓇᒃ

ᖃᐅᔨᓴᓂᐅᑦ ᐊᑲᖅᑭᐅᒪᓂᖅᓱᒃ:

ᖃᑎᖅᑭᓂᖅᑎᑦᓗᒍ ᐊᑎᓕᐅᓐᖓᔪᐊᖅᓴᕐᓂᑦ ᒥᑦᓴᓇᓂᖅᓱᓂᒃ ᓄᓇᓕᑦ ᓯᓚᖃᖅᑕᑭᐅᑎᑦᓗᒍᑦ ᖃᐅᔨᓴᓂᐅᑦ ᐅᓄᖅᑭᑐᔭᓕᐅᔪᓐᓇᖅᓯᒪᒐᑦ ᐃᓄᓕᑦ ᐊᑎᓕᐅᖅᑕᑭᓕᔪᖅᑭᑐᑐᒃᓴᑦ ᖃᐅᔨᓴᓂᐅᑦ. ᐱᔪᐊᓂ, ᐃᓕᓴᕆᔨᐅᓕᔪᖅ 8ᖓᔪᓕᐅᓂᖓᓂᓂᒃ ᐃᓇᓐᖓᑦᑐᑦ ᐊᔪᓐᖓᑦᑐᑦ ᐊᔪᓂᖅᑎᖃᓕᐅᓂᖓᓂᓂᒃ ᐱᓪᓐᓇᒃᑎᒥᒃ ᑐᓂᓯᒪᖃᑕᓕᐅᔪᖅᑐᑐᒃ - ᐊᖏᓂᓂ ᖃᓄᐃᑲᔫᑦᓴᕐᑐᑎᑦ ᐊᑎᓕᖅᓯᒪᖃᑕᓕᐅᔪᖅᑭᑐᑐᒃ ᓴᓐᓂ ᑕᒪᒃᑯᓗᒃ. ᐅᖃᐅᔾᔨᒪᓕᐅᔪᖅ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓚᖓᔪᓐᓇᐅᑉᐸᑎᓕᑦ ᐱᓪᓐᓇᒃᑎᒥᒃ ᐊᔪᓐᖓᑦᑐᑦ ᖃᐅᔨᓴᓂᐅᑦ ᐊᑎᓕᖅᓯᒪᖃᑕᓕᐅᔪᖅᑭᑐᑐᒃᓴᑦ. ᐱᔪᐊᓂ, ᖃᓄᐃᑦᑐᑎᑦ ᐃᓕᓴᕆᔨᐅᓕᔪᖅ ᐃᓚᖓᑎᑦ ᐊᑎᓕᖅᓯᒪᖃᑕᓕᐅᔪᖅᑭᑐᑐᒃᓴᑦ ᐃᓕᓴᕆᔨᐅᓕᔪᖅ



[10] **ᖃᐅᔨᓴᖅᑕᕐ:** ᓄᓇᕗᑦ ᐅᖃᖅᖢᓂᐅᔪᖅᑐᑦ ᑕᒪᐃᐸᐊ ᐃᓕᖅᑎᑦ ᓇᓴᖅᑕᐅᓱᒪᓕᕐᓂ (ᐅᑭᐅᖅᑎᓂᓄᑦ 1 ᐊᒻᒪ 5) ᖃᐅᑎᓗᖅᓯᐅᓴᖅᑎᓂᓄᑦ ᐊᒻᒪᓗ ᐅᑭᐅᖅᑎᓄᑦ 2 ᐊᑎᑐᓗᖅᓯᐅᓴᐃᓚᖅᓴᓗᑎᑐᑎᒃ, ᑭᓱᐊᓂ, ᐊᖏᖅᖃᑎᒌᑦᑐᐃᓐᓇᐅᔪᓂᓕᐅᖅᑐᑦ ᑕᒪᒋᐊᑦ ᒥᑦᓴᐅᑕᐅᓂᖅᑎᓂᓄᑦ ᓇᓗᓂᓗᐊᔪᓕᓐᓄᑦᓂᓄᑦ (C.F.). ᐃᒪᒋᒥᐅᑕᓚᓕᓴᐃᓐᓄᑦ ᐅᓯᐊ ᑎᑎᖅᑕᐅᓱᒪᓕᕐᓂ ᓇᓴᐅᑎᓂ ᖃᓪᓗᓈᖅᑕᐅᓱᐊᕐᓂᑐᑦ (ᖃᐅᓴᒪᓂᑦ ᐃᒪᒋᒥᐅᑕᓚᓕᓴᐃᓐᓄᑦ ᓇᓗᓂᓗᐊᔪᓕᓐᓄᑦ ᒪᓕᒐᓱᐃᓐᓇᖅᑐᑦᑕᒥᑦ ᐅᑭᐅᖅᑎᓄᑦ, ᐅᒪᔨᖅᑕᐅᓱᐊᕐᓂᐅᑦᓂᓕᕐᓂ ᐊᓯᓪᓚᕐᓂᑦ ᒪᓕᒐᓱᒪᓕᕐᓂ ᐱᓕᕆᔨᖅᑐᑎᒃ ᐊᑎᖅᑐᑦ ᐊᒻᒪᓗ ᐊᓯᖅᓯᐅᑦ ᑐᓴᐅᒪᔪᓂᒃ ᒪᓕᒐᓱᐃᓐᓇᖅᑐᑦ) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
1	1	2	0	n/d

[11] **ᖃᖓᐃᑦ:** ᐅᑭᐅᖓᓂ 4 ᓇᓗᐅᑎᑦ ᐊᖏᓗᖅᑐᑦᑎᓂᓄᑦ; ᑭᓱᐊᓂ ᐊᓯᖏᓐᓂ ᐅᑭᐅᓂ ᒥᑦᓯᖃᑦᓯᐊᖅᑐᑦᑎᓂᓄᑦ (C.F.).

[12] **ᒥᑎᑦ:** ᑕᒪᑭᓐᓄᑦ ᒥᑎᖅᑕᐅᔪᓕᑦᑐᑦ ᐊᖏᓗᐊᖅᑐᑦᑎᓂᓄᑦ. ᖃᓄᖅᓯᑦ ᐊᒻᒪᓗ ᒥᑎᑦ ᐱᓕᐅᔪᓕᒪᓚᑕ ᓄᓇᓕᓐᓄᑦ ᖃᓄᖅᓯᑦ ᖃᓄᐅᓂᖅᓴᖅᓂᓂᓄᑦ ᓄᓇᕗᐅᑦ ᐱᓕᐅᔪᓕᔪᓂᒃᑐᑎᒃ ᐊᒻᒪᓗ ᒥᑎᑦ ᐅᖓᓯᓂᒃᑐᑎᒃ ᑲᑎᖅᑎᓯᓂᖅᓴᖅᓂᓂᓄᑦ (C.F.).

[13] **ᒪᓐᓂ:** ᒪᓐᓇᖅᑕᐅᔪᓕᑦᑐᑦ ᓇᓗᐅᑎᓂᑦ ᐊᖏᓗᐅᑎᓂᑦ ᐃᓗᐊᓂᖅᑐᑦᑎᓂᓄᑦ ᐅᓂᒃᑳᖅᑐᑦ ᑎᒥᖏᓕᓪᓕᒃᑐᑦ; ᐃᓕᓐᓂᑦ ᐊᖓᔪᓚᓯᑎᓂᑦ ᖃᐅᔨᓴᓕᐅᑎᓂᖅᑐᑦᑎᓂᓄᑦ ᐅᖃᐅᓯᖃᖅᑕᐅᔪᓕᐊᔪᐅᓂᖅᓂᓄᑦ ᒪᓐᓇᖅᑕᐅᓕᕐᓂᕐᓂᓄᑦ ᐊᒻᒪᓗ ᐊᓯᖏᓂᑦ ᑐᖓᔪᓕᐊᖅᑕᐅᔪᓕᐊᔪᐅᓂᖅᓴᖅᓂᓂᓄᑦ ᒪᓐᓇᖅᑕᐅᓕᕐᓂᕐᓂᓄᑦ (C.F.).

[14] **ᐃᓯᕐᓇᐃᑦ:** ᓇᓗᐅᑎᓂᑦ ᓇᓴᐅᓕᓯᖅᑐᑦᑎᓂᖅᑐᑦ; ᐃᓯᕐᓇᐃᑦ ᐱᓕᐅᓗᖅᑕᓕᑦᑐᑦ ᖃᐅᔨᓴᓯᓂᑦ ᓴᓂᕐᓴᓕᐊᖅᑕᓕᕐᓯᓚᕐᒥᑦ (C.F.).

[15] **ᐅᓴᐃᑦ:** ᐅᐸᖃᑎᕐᓄᖅᓴᐅᔪᓕᑦᑐᑦ ᓯᑭᓯᑦ. ᐅᑭᐅᖅᑲᖅᑐᑦ 16 ᑐᖓᓚᓂᑦ ᐊᑎᓕᐅᖅᓯᓚᖃᐅᔪᖅᑲᓕᖅᑎᓂᖅᑐᑦ ᖃᐅᐅᔨᓴᓕᐅᑎᓂᖅᑐᑦ, ᐅᓚᖅᕿᑦᑕᖅᑐᑦ ᐅᖅᑲᐅᓯᐅᔪᓕᐅᖅᑐᑦ ᐊᖓᔪᓂᖅᐳᒥᓂ (C.F.).

6.1 Qikiqtaaluk

6.1.1 Nunani Iniktikhimayut Ukauhiit: Ikpiarjuk ovalo Nanisivik

Ihivgiukhimayut iniktitugait:
Ihivgiufaakhimayut ataani katitikhimayut nunani pulaaktakhimatitlugit naunaiyakhimayuk ikitut Inuit umayukhiuktit titigakhimaitut Umayukhiukhimayut Ihivgiuktuni. Kihimi, naunaiyakhimayuk 8nik inuinaungitunik umayukhiutikaktuk tuniyauhimayut umayukhiugutinik inminiigutinik titigaktauhimaitut – siksiit ilaani umayukhiukpaktut ovalo malguk umayukhiukataktut. Ukakhimayut ilangani 5.2.1. ikpinaguait hamani ataani katitikhimayut pihimayut ataanut ihumagiyainik umayukhiukhimayut naunaiyautaini. Kihimi avataani ihumagiyait mikiyut ilaungitut umayukhiuktit 3%kumata tamaat umayukhiuktinit (ikpatauyak 10).

Mikiyuumata amigaitjutait umayukhiunginaktut titigakhimayut Ikpiarjumi, umayukhiunginaktut naunaiyautait ilauhimaliktut umayukhiukataktunut naunaiyautainut hamani katitiguatini umayukhiukhimayut naunaiyautaini.

Ihivgiukhimayut pihimayut ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait angiyut tamaat Umayukhiukhimayut Ihivgiuktitlugit. Takulaaktuk ikpatauyami 9mi pikataktut kiuyuitut naunaiyautait Ikpiarjumi pikangituk ovalo taimaimat pilaituk kiuyuituni ihimagiyaini.

Kiuhimayut naunaiyautait ihumagiyut angiyut ovalo kiuyuitut mikiyut tamamik ukiuni piyaami nmi pihimayut nakuuyumik naunaiyautaini pihimayuni Nni umayukhiuktini.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Ilaa, ihumagiyait tamamivyak umayukhiuktit ukakatigihimayut Umayukhiukhimayut Ihivgiuktitlugit, takuyaulaat angiyut kiuvaktut naunaiyautaini ovalo mikiyut amigaitjutait titigakhimaitut umayukhiuktit, ihumayut nunani pulaaktaktitlugit umayukhiuktit tuhaktitihimangitait tamamik umayukhimayut. Tuhaktitauhimayugut umayukhiuktit titigangitut umayukhimayaminik tatkikhiutiminut, piyukhat naunaiyalugit umayuktaminik ukakatigiyaugumik ovalo Inuit umayukhiuktit pivaktut ataani naunaiyautaini umayuktainik pitivanmat mikitkiyanik umayukhiukhimayut naunaiyautaini. Ikhiyut umayukhiukhimayainik keelininganik tunihimayut hunmat ilangit umayukhiuktit ataani tuhaktitivaktut umayuktaminik. Naunaituk ukauhiini hamani, nunat ihumavaktut ilangit naunaiyautait mikiyut. Hapkoa atugutingit ihuinaakhimayut ihumagiyait pivaktut hamani. Kihimi nunani angikhimayut amigaitkiyait naunaiyautit naamaktut.

Takuhimayut utiktihimayuni ubluit ikpatauyait, amigaitut umayukhiukhimayut titigakhimayut katitikhimayut iluani pingahut tatkikhiutini umayukhimayaminik, taimaimat mikinikhaangukpaktut utiktihimayut ihuinaagutaini. Kihimi titigakhimayuk hamani takukhauyuk pivaktut mikiyunik utiktihimayunik ihuinaakhimayunik naituugaluakhuni utiktihimayut ubluini.

Pihimayut mikiyunik amigaitjutainik ikaliviit umayukhiukhimayut kinauyaliuktuni ihivgiukhimatitlugit. Ilangit umayukhiukhimayut tuhaktitiyauhimaitut ilanganut atuktakhainik umayukhiukhimayaini kihimi ihumagiyait angivalaangitut ikpinagiyaami umayukhiukhimayut naunaiyautaini. Aalat umayukhiukhimayut titigakhimayut naunaiyakhimayut ikaliviit umayukhiukhimayut kinauyaliukhimayunut ovalo unguvakhimayut katitikhimayunit. Hapkoa takulaaktut ikpatauyami 4mi.

Nunanit ukakhimayut ovalo aalat pihimayaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhimaut ilauyut nunani tuktut. Tuktut amigaitut haniani nunat pilihaaliktitulgu ihivgiuktut amigaitut umayukhimayut hamani ihivgiuktitlugit (C.F.).
2. **Umingmait:** Nunani kotakaktut hitamanik ukiumi. Umingmait umayukhiukpaktait Devonmi kikiktaani ovalo kihimi hikut nakuugaagata (C.F.). Titigakhimayut pihimayut DSDkunit takukhauyut aatjikutait umayukhimayut amigaitjutait, umayukhimayut atauhimik ukiungani 3 ovalo hitamat ukiungani 5 (DSD Mxa).
3. **Nanuit:** Amigaitjutait takuhimayut naunaiyautaungitut kihimi pihimayut umayukhiukhimayut amigaitjutait tunihimayait Kavamakut Nunavumi, Munagiyit hanatiligiyit (DSD PB).
4. **Tigiganiat:** Naunaiyauta mikiyuugaluit ilangani ukiuni kihimi nunani ukakhimayut angiyut katakhimayut ukiungani 3 ovalo 4 atulimata iniktigutainik nutaat nanigiat atuktukhat (C.F.).
5. **Kalaliit tigiganiat:** Naunaiyautait takukhauyut mikiyut (C.F.).
6. **Natinat:** Naunaiyautait mikiyut; nunani atuinaktut natiit umayuktaminik; ihumayut ilangit umayukhiuktit tuhaktitingitut tamamik umayuktaminik (C.F.).
7. **Qairulik:** Naunaiyautait mikiyut; niuviktaulaaktut amiit ihivgiuktitlugit (C.F.).
8. **Akviit:** Nunani tuhaktitiyait naunaiyautit naamaktut ovalo ihumavaktut angitkiyauyut umayukhimayut ukiumi 2. Nunani ukakhimayut uyut akuitukpaktut Igloolikmit angitkiyaumat piyumayait nunani umayukhimayainit (C.F.).

[9] **Tuugaat:** Ilangit naunaiyautait mikiyut tugaaliit kilalugait kotakanmata 100nik atukpaktait tamaat ukiuni (C.F.). DFOkut tuhaktitihimayut hapkoa umayukhiukhimayainik amigaitjutait tugaaliit kilalugait (nalungilutit DFOkut katitikhimayut pivaktut ukiungit atuktaminik kihimi Umayukhiukhimayut Ihivgiugutait katitikhimayut atukhimamata umayukhiukhimayut ukiungit pivaktut Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
99	66	103	101	100

[10] **Kilalugait:** Nunani tuhaktitiyait ilangit naunaiyautait (ukiuni 1 ovalo 5) angivyaktut kihimi ukiuni 2 naunaiyautait mikiyut. Kihimi angikhimayut tamaat naunaiyautait nakuuyut (C.F.). DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait (nalungilutit DFOkut katitikhimayut atuktangit aalauyut, kihimi Umayukhiukhimayut Ihivgiuktut katitikhimayait atuktut umayukhiukhimayut ukiunginik pihimayut Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
1	1	2	0	n/d

[11] **Kanguq:** Ukiuni 4 naunaiyautait mikiyut; kihimi aipait umiut naamaktut (C.F.).

[12] **Tingmiat:** Tamaat umayukhiukhimayut naunaiyautait tingmiat mikiyut. Tamamik kingaliit ovalo mitiit umayukhimayut nunani. Kingaliit pivaktut haniani nunat ovalo mitiit umayukhiuvaktut nigiaganit (C.F.).

[13] **Maniit:** Maniit katitikpaktut naunaiyautait mikiyut; ilangit umayukhiuktit naluyut tuhaktitiyakhait maniit katitigaagamik ovalo aalat ataani naunaiyakhimayait katitikhimayaini (C.F.).

[14] **Ikalukpik:** Naunaiyautait nakuuyut; umayukhiukhimayut pivaktut umayukhiuktit autlaagaagata Sanigayaqmut (C.F.).

[15] **Ugat:** Ugat umayukhiuvaktait nutakat. Nutakat ataani 16ni titigaktauhimaituugaluit Umayukhiukhimayut Ihivgiuktuni kihimi umayuktangit tuhaktitihimayait angayukaaginit (C.F.).

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 35

Monthly harvest estimates
ᑕᖅᑕᒫᑦ ᐊᓐᔪᔨᓄᑦ ᓇᓕᐅᑦᓱᓂᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᑎᖏᔪ 2 (ᔫᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

6.1.2

Month/ᑕᖅᓴᒃ/Tatkia			JUN† ᔫᓂ	JUL† ᔪᓕᐃ	AUG ᐊᐅᒡᒎᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓄᒡᐹᓗ	DEC ᑎᓯᒡᐹᓗ	JAN ᔨᓐᓄᐊᓗ	FEB ᓄᖅᐅᐊᓗ	MAR ᒪᕆᓕ	APR ᐃᑦᓗᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	n/d	n/d	149	37	19	45	87	99	60	55	27	29	607 ± 60
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d						1		3	2		6
Wolf	ᐊᒪᓕᐅᐃᑦ	Amagut	n/d	n/d										1	1 ± 1
Arctic fox	ᑎᓗᒃᑖᓂᐊᑦ	Tigiganiat	n/d	n/d		4		33	55	36	13	2			143 ± 55
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓗᒃᑖᓂᐊᑦ	Kalaliit tigiganiat	n/d	n/d							2		1		3 ± 1
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik	n/d	n/d	14	12	15	3	2	8	2	4	6	5	71 ± 16
Ringed seal	ᓇᓂᐩᑦ	Natiinat	n/d	n/d	228	239	311	142	49	40	10	18	24	30	1,091 ± 78
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	n/d	n/d	5	15	8				5	2	2		37 ± 6
Harp seal	ᖃᐃᓕᓚᑦ	Qairulik	n/d	n/d		2	5	6	2						15 ± 2
Harbour seal	ᖃᓂᒋᐊᑦ	Qanigiaq	n/d	n/d				1			1	1			3 ± 0
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	n/d	n/d			1	3							4 ± 5
Walrus	ᐊᐃᓴᒃ	Akvik	n/d	n/d			1	11		1	8	8	2		31 ± 2
Beluga	ᖃᐅᖅᑕ ᖁᓪᓗᑎᐃᑦ	Kilalugak	n/d	n/d	1	3	14	8							26 ± 3
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	n/d	n/d	85	162								2,202	2,449 ± 475
Canada goose	ᓂᕆᓚᑦ	Nikliknik	n/d	n/d	2	38								206	246 ± 63
Ross's goose	ᖃᖏᕐᔪᐃᑦ	Kakat	n/d	n/d		4								1	5 ± 2
Brant goose	ᓂᕆᓕᓴᐃᑦ	Nirlirnaq	n/d	n/d										1	1 ± 1
Eider duck	ᒥᑎᑦ	Kingalik	n/d	n/d	21	47	102	34		3	9	6	79	269	570 ± 93
Common loon	ᑐᕆᓚᑦ	Tuulik	n/d	n/d	3										3 ± 5
Red-throated loon	ᖃᖓᓴᐅᑦ	Qaqhuaq	n/d	n/d		3									3 ± 5
Thick-billed murre	ᐊᕐᕕᐃᑦ	Thick-billed murre	n/d	n/d		3						30	199	11	243 ± 71
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	n/d	n/d	13	27	3	21	60	50	53	32	127	577	963 ± 111
Arctic char	ᐃᖃᓗᐸᐃᑦ	Ikaliviit	n/d	n/d	2,738	142	616	129	1,116	876	627	628	839	1,203	8,914 ± 744
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	n/d	n/d		54		29	10	7					100 ± 21
Cod	ᐅᒪᐃᑦ	Ugak	n/d	n/d									72	107	179 ± 190
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	n/d	n/d	13									3	16 ± 22
Clams	ᐊᓗᒧᒪᔪᑦ	Uviluq	n/d	n/d	9,736	3,883	366								13,985 ± 3,451

† No data were collected in June and July 1997. Consequently, the total harvest listed above is a 10 month total (August 1997 - May 1998), not an annual total. Similarly, the confidence intervals shown were calculated only for the 10 months in which data were collected.
‡ Polar bear data supplied by DSD.

† ᓇᓕᐅᑎᓂᓗ ᓄᐊᕋᓯᖅᑕᓇᒃᑐᑎᑲᓐᓂᖅ ᐅᕐᓂ ᔫᓂ ᐊᓕᒐ ᔪᓚᐃ 1997. ᑕᐃᒪᓕᓇᓂᖓᓂᑦ, ᑲᑎᑐᑎᑦ ᐊᖏᔪᑦ ᑎᑎᕋᑕᐅᒪᔪᑦ ᖃᐅᔨᓂᓗ ᐊᑐᓂᓂ ᖃᐅᔨᓂᑦ ᑕᖅᓄᑦ (ᐊᐅᒡᒎᑎ 1997- ᒪᐃ 1998), ᐊᓯᔪᓚᒪᓕᖅᑐᒍᓗᒋᑦ. ᑕᐃᒪᓐᓚᓚᑕᐅᑉ, ᓯᓚᐅᖅᓴᓂᖅᑎᑦ ᐊᐅᓇᓂᖅᑎᑦ ᖃᐅᔨᓴᕐᕕᒃᓯᒪᔪᑦ ᐊᑐᓂᓂ ᖃᐅᔨᓴᓇᓂᓗ ᑕᖅᓄᑦ ᓇᓗᐅᑎᓂᓗ ᓄᐊᖏᓪᓗᐊᓂᓗᓐᓂᑦ.
‡ ᓇᓂᓂᑦ ᑎᑎᕋᑕᐅᒪᔪᑦ ᑐᓂᓯᖏᑦ ᐅᐊᐃ ᐃᐊᐱᕐᓚᓂᓗᓐᓂᑦ.

† Katikhiktaumaimata June Julylu 1997. Taimalu, tamakikhugit tahapkuan angujauvakhimajut kulinut tatkinut (August 1997 – May 1998), iluitumungituk tamna ukiumnun. Taimanahainaktauk, katikhiktaumavut tahapkuan angujauhimajut kulinut tatkinun katikhiktaumajut malikhugit.
‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.1.2

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 36

Monthly hunter response
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᒃᓴᒍ 2 (ᔨᓂᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔨᓂᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᓴᓇ	OCT ᐅᑐᐱᓇ	NOV ᐅᐊᓚᓴᓇ	DEC ᑎᓯᓴᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᐃᕐᕿᐊᓇ	MAR ᒪᕆ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓇᓂᑦ ᑭᐅᓂᖅᑎᑦ ᐊᑲᔪᒪᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃ ᐊᖏᓇᓂᑦ	Tatkitaman angunahuktut titigait	n/d	n/d	500	484	483	481	480	479	474	474	476	476	504*
Interview list	ᐊᐱᕆᔭᖏᒪᒋᓐᓂᑦ	Apikiktan	n/d	n/d	234	221	219	218	217	219	214	215	217	217	237*
Hunters interviewed	ᐊᖏᓇᓂᑦ ᐊᐱᕆᔭᑦ	Angunahuktin apikhuktan	n/d	n/d	223	217	215	213	213	215	213	212	204	200	233*
Harvested	ᐊᖏᓇᓂᑦᑐᓐᓂᑦ	Angujaujut	n/d	n/d	120	84	71	55	49	54	47	39	42	110	170*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᑦᑕᐅᓂᖅᑎᑦ (%)	Kiujut(%)	n/d	n/d	95	98	98	98	98	98	100	99	94	92	97**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓇᓂᑦ ᐊᑎᓕᐅᔾᔨᒪᔭᑦ/ᐊᐱᕆᔭᖏᒪᒋᓐᓂᑦ/ᐊᐱᕆᔭᑦ/ᐊᖏᓇᓂᑦᑐᓐᓂᑦ ᐊᑕᐅᓯᐊᓗᓂ% ᐊᑐᑎᑦ ᐊᒃᓴᒍᒥ.
** ᐊᓕᒋᓕᓐᑎᓪᓚᔭᑦ ᑕᖅᑕᒪᒃ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 37

Recall period between harvest and interview, expressed as % of total harvest records

Year 2 (June 1997 - May 1998)

ᐅᑎᕐᕕᐅᔨᑦ ᐋᑯᖏᓂᓂ ᐊᖏᓇᓂᑲᓐᖏᑕ ᐊᒻᒪᓗ ᐊᐱᕆᔭᖏᑕᐅᓂᖏᑕ, ᓇᓗᓇᐃᑦᑕ ᐃᒪᒃ % ᑲᑎᑕᑐᑦ ᐊᖏᓇᓂᑦᑕ ᑎᑎᕐᕕᑕᐅᒪᔨᑦ

ᐊᒻᒪᓗᒍ 2 (ᔨᓂᓂ 1997 - ᒪᐃ 1998)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔨᓂᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᓴᓇ	OCT ᐅᑐᐱᓇ	NOV ᐅᐊᓚᓴᓇ	DEC ᑎᓯᓴᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᐃᕐᕿᐊᓇ	MAR ᒪᕆ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕᑦ	≤ tatkin pingahut	n/d	n/d	100	100	99	100	100	100	100	100	99	99	100
4-6 months	4-6 ᑕᖅᑕᑦ	tatkin hitaman 6nut	n/d	n/d	0	0	1	0	0	0	0	0	1	1	0
> 6 months	> 6 ᑕᖅᑕᑦ	> 6 tatkin	n/d	n/d	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 38

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᖅᑎᑦ ᐊᖏᔪᓚᐱᖅᓯᒋᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu

Year 2 (June 1997 - May 1998)

ᐊᒃᑭᒍ 2 (ᔪᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

6.1.2

Month/ᑕᑭᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᓚᔨᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓚᐱᓗ	DEC ᑎᓯᓚᐱᓗ	JAN ᒍᖏᓄᐊᓗ	FEB ᓇᖑᐅᐊᓗ	MAR ᒪᓯ	APR ᐃᓴᓕ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑲᐃᐃᑦ	Tuktut	n/d	n/d	55	18	7	13	28	35	23	16	12	12	94
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut	n/d	n/d										1	1
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat	n/d	n/d		2		6	12	10	6	2			19
Coloured fox	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓕᓴᖅᓂᐊᑦ	Kalaliit tigiganiat	n/d	n/d							2		1		3
Arctic hare	ᐅᒃᓪᓕ	Ukalik	n/d	n/d	4	4	7	2	1	4	2	4	3	3	26
Ringed seal	ᓇᓯᓪᑦ	Natiinat	n/d	n/d	59	47	61	32	11	14	6	9	11	10	94
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	n/d	n/d	5	13	6				3	2	2		24
Harp seal	ᖃᐃᓱᓪᓕ	Qairulik	n/d	n/d		2	5	4	2						12
Harbour seal	ᖃᓯᑎᐊᑦ	Qanigiaq	n/d	n/d				1			1	1			3
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	n/d	n/d			1	1							2
Walrus	ᐊᐃᐅᓴᑦ	Akvik	n/d	n/d			1	10		1	6	6	2		16
Beluga	ᖃᐅᑦᑕ ᖁᓪᓗᓴᐃᑦ	Kilalugak	n/d	n/d	1	2	8	4							13
Snow goose	ᑲᖓᐃᑦ	Kanguq	n/d	n/d	10	22								76	85
Canada goose	ᓄᑦᓪᓕ	Nikliknik	n/d	n/d	2	9								36	44
Ross's goose	ᖃᑲᑦᔪᐃᑦ	Kakat	n/d	n/d		1								1	1
Brant goose	ᓄᑦᓂᑦᓭᐃᑦ	Nirlirnaq	n/d	n/d										1	1
Eider duck	ᒥᑎᑦ	Kingalik	n/d	n/d	5	9	21	8		1	1	2	7	11	43
Common loon	ᑐᓪᓕ	Tuulik	n/d	n/d	1										1
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq	n/d	n/d		1									1
Thick-billed murre	ᐊᑦᐸᐃᑦ	Thick-billed murre	n/d	n/d		1						1	6	2	9
Ptarmigan	ᐊᖏᓚᑎᑦ	Akilgik	n/d	n/d	1	5	1	4	10	7	6	5	15	47	62
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	n/d	n/d	41	8	10	10	24	18	22	17	16	42	91
Lake trout	ᐃᓱᔪᕐᐃᑦ	Ikalukpik	n/d	n/d		2		4	1	2					7
Cod	ᐅᒪᐃᑦ	Ugak	n/d	n/d									1	1	2
Sculpin	ᖁᓕᔪᐃᑦ	Kanayuk	n/d	n/d	1									1	2
Clams	ᐊᒃᒧᒪᔪᑦ	Uviluq	n/d	n/d	42	22	4								55

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᓕᕐᕋᓐᓂᒃ ᐱᒃᔪᑎᓕᕐᓂᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓕᓴᖅᑐᓂᒃ ᐊᖏᔪᓄᑦ ᓄᓇᕗᒻᒥᒃ ᐃᓄᐃᑦᑐᓕᕐᓂᖅᑐᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 39

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)
ᐊᓐᓴᒍ 3 (ᔫᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

6.1.2

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔫᓂ	JUL ᐊᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᓕᓇ	OCT ᐅᑲᐃᓇ	NOV ᓄᓇᓕᓇ	DEC ᑎᑭᓕᓇ	JAN ᔮᖏᓄᐊᓇ	FEB ᓄᖕᐅᐊᓇ	MAR ᒪᑦᓯ	APR ᐃᑦᓇᓪ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	10	39	84	20	4		43	52	100	42	51	29	474 ± 95
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					1		3	1	2				7
Wolf	ᐊᒪᓱᐃᑦ	Amagut										1			1 ± 0
Arctic fox	ᑎᓗᒃᑯᐊᑦ	Tigiganiat								2	2				4 ± 3
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				26	4			4	16	10	31	5	96 ± 41
Ringed seal	ᓇᓯᓂᑦ	Natiinat	119	119	145	214	87	66	28	4	26	23	19	31	881 ± 200
Bearded seal	ᐅᓘᔪᐃᑦ	Ukyuk	23	8		9						1		4	45 ± 16
Harp seal	ᖃᐃᓱᓪᓚᑦ	Qairulik	3												3 ± 5
Harbour seal	ᖃᓯᕆᐊᑦ	Qanigiaq					1								1 ± 1
Walrus	ᐊᐃᐃᓴᑦ	Akvik		8				1	3		6	3	6	2	29 ± 10
Beluga	ᖃᐅᑦᑕᑦ ᖁᓪᓗᓴᑦ	Kilalugak	3	2			24	8							37 ± 17
Snow goose	ᑲᖏᐃᑦ	Kanguq	1,899		23	37							77	1,515	3,551 ± 694
Canada goose	ᓀᓯᓪᓚᑦ	Nikliknik	53	12	2								1	47	115 ± 31
Eider duck	ᒥᑎᑦ	Kingalik	68	76	75	53	23	9				4	82	78	468 ± 110
Red-throated loon	ᖃᖓᓗᐅᑦ	Qaqhuaq		4											4 ± 7
Black guillemot	ᐱᑦᓯᐅᓪᓚᑦ	Black guillemot										1	2		3 ± 1
Thick-billed murre	ᐊᑦᐸᐃᑦ	Thick-billed murre	5									3	11		19 ± 6
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	43		9	352	7	12	29	35	53	126	892	961	2,519 ± 546
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᓚᒃᓂᖏᑦ	Manniit	1												1 ± 1
Goose eggs	ᑲᖏᐃᑦ ᓚᒃᓂᖏᑦ	Uluaguliit manniit	1												1 ± 1
Duck eggs	ᒥᑎᑦ ᓚᒃᓂᖏᑦ	Tinmiat manniit	220	218											438 ± 162
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	1,835	2,903	1,155		82		74	521	475	1,107	1,655	1,489	11,296 ± 1,632
Cod	ᐅᓚᐃᑦ	Ugak	23												23 ± 38
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	7	21											28 ± 32
Clams	ᐊᓱᒧᒪᔪᑦ	Uviluq	650	1,258	3,472	970	656								7,006 ± 3,296
Mussels	ᐅᐃᓗᐃᑦ	Uviluvaloet		526											526 ± 762

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᖅᖏᑦ ᐅᑉᓯᓚᓇᓕᒫᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 40

Monthly hunter response

ᑕᖏᑕᒪᑦ ᐊᖏᔪᓕᕆᔨᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐱᓕᕆᔨᒃ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖏᖓ/Tatkia			JUN ᔮᓂ	JUL ᔮᓪᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᓴᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᐊᓚᓴᓇ	DEC ᑎᓯᓚᓴᓇ	JAN ᒍᓐᓄᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᕿ	APR ᐃᕐᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᕆᔨᑦ ᑭᐅᓂᖏᑦ ᐊᑎᔨᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒪᑦ ᐊᖏᔪᓕᕆᔨᑦ	Tatkitaman angunahuktut titigait	473	473	468	468	464	461	462	461	461	461	463	460	481*
Interview list	ᐊᐱᕐᓂᖅᓯᒪᔪᓕᑦ	Apikiktan	216	217	213	213	209	206	207	207	207	207	209	206	224*
Hunters interviewed	ᐊᖏᔪᓕᕆᔨᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	194	133	130	71	170	194	191	166	198	201	198	197	223*
Harvested	ᐊᖏᔪᓕᕆᔨᑐᓕᑦ	Angujaujut	94	36	32	18	16	18	17	15	37	36	58	90	157*
Response Rate (%)	ᑭᐅᔾᔨ %ᑲᓂᐅᓂᖏᑦ (%)	Kiujut (%)	90	61	61	33	81	94	92	80	96	97	95	96	81**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓕᕆᔨᑦ ᐊᑎᓕᐅᔾᔨᓚᕐᔪᑦ/ᐊᐱᕐᓂᖅᓯᒪᔪᓕᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓕᕆᔨᑐᓕᑦ ᐊᑕᐅᓂᓚᓄ% ᐊᑐᑎᑦ ᐊᓐᔪᒻᒥ.
** ᐊᐅᔾᓂᑎᓂᒪᓚᓕᑦ ᑕᖏᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 41

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓕᕆᔨᓂᓪᓚᑕ ᐊᒪᓚᓗ ᐊᐱᕐᓂᖅᑕᐅᓂᓴᓚᑕ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓱ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓕᕆᔨᑦᑕ ᑎᑎᕐᕿᑕᐅᒪᔾᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐱᓕᕆᔨᒃ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖏᖓ/Tatkia			JUN ᔮᓂ	JUL ᔮᓪᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᓴᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᐊᓚᓴᓇ	DEC ᑎᓯᓚᓴᓇ	JAN ᒍᓐᓄᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᕿ	APR ᐃᕐᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑦ	≤ tatkin pingahut	99	100	81	64	0	100	100	100	50	49	28	96	77
4-6 months	4-6 ᑕᖅᑦ	tatkin hitaman 6nut	1	0	16	36	100	0	0	0	47	51	72	4	22
> 6 months	> 6 ᑕᖅᑦ	> 6 tatkin	0	0	3	0	0	0	0	0	3	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 42

Number of hunters harvesting each species — **Year 3 (June 1998 - May 1999)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓪᓚᓯᖅᑎᑦ ᐊᖏᓪᓚᓯᖅᓯᒪᔪᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒃᑭᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)**

Amigaitiginigin angunahukpaktun anguvaktaitlu — **Ukiunga 3 (June 1998 - May 1999)**

6.1.2

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓵᐱᓗ	DEC ᑎᓯᓵᐱᓗ	JAN ᔮᖅᓇᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᔨᓯ	APR ᐃᔨᓀᓪ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Species	**ᐅᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᑲᐃᐃᑦ	Tuktut	4	10	15	3	1		11	9	18	17	13	9	65
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut										1			1
Arctic fox	ᑎᓗᓚᖓᓂᐊᑦ	Tigiganiat								1	2				3
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik				3	1			2	4	3	7	3	19
Ringed seal	ᓇᓯᓰᑦ	Natiinat	30	17	15	8	12	12	9	1	8	10	9	12	64
Bearded seal	ᐅᓚᔪᐃᑦ	Ukyuk	9	2		3						1		2	13
Harp seal	ᖃᐃᓗᓪᓕᑦ	Qairulik	1												1
Harbour seal	ᖃᓯᕈᐊᑦ	Qanigiaq					1								1
Walrus	ᐊᐃᐃᓴᑦ	Akvik		2				1	2		3	3	4	1	13
Beluga	ᖃᑯᑦᑕ ᖁᓕᓵᓗᐃᑦ	Kilalugak	1	1			6	4							11
Snow goose	ᑲᖏᐃᑦ	Kanguq	43		3	3							2	49	74
Canada goose	ᓂᓪᓕᓂ	Nikliknik	13	2	1								1	10	23
Eider duck	ᒥᑎᑦ	Kingalik	10	11	3	4	4	2				1	7	7	32
Red-throated loon	ᖃᖇᓗᐅᑦ	Qaqhuaq		1											1
Black guillemot	ᐱᑦᓯᐅᓪᓕᑦ	Black guillemot										1	1		2
Thick-billed murre	ᐊᕐᕿᐃᑦ	Thick-billed murre	1									2	1		3
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	7		1	6	1	2	5	5	10	7	34	32	60
Eggs (unspecified)	ᐊᓯᖅᑎᑦ ᑎᒥᐊᑦ ᒪᓂᓂᖅᑎᑦ	Manniit	1												1
Goose eggs	ᑲᖏᐃᑦ ᒪᓂᓂᖅᑎᑦ	Uluaguliit manniit	1												1
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᖅᑎᑦ	Tinmiat manniit	9	6											13
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	65	17	8		1		2	6	12	17	29	48	104
Cod	ᐅᒪᐃᑦ	Ugak	1												1
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	1	2											2
Clams	ᐊᑦᒧᒪᔪᑦ	Uviluq	7	9	9	3	3								24
Mussels	ᐅᐊᓗᐃᑦ	Uviluvaloet		1											1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᒪᔪᓂᒃ ᐱᑕᖃᖓᑎᑐᖃᖅ ᐱᓪᔭᒍᓐᓂᒃ ᐊᖏᓴᑦ ᖃᕋᓴᐅᓂᖓᓂᒃᓂᑦ ᐊᓯᖏᓴᑦ ᓇᓪᓕᐅᑦ ᐊᐃᓴᐅᓂᒃᓂᑦ ᑐᓴᖅᑎᖓᓂ ᑐᓂᓴᖓᓂᒃ ᐃᑯᐊᕐᓂᓗᓀᓪᓕᓐᓂᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 43

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᓯᖏᔪ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

6.1.2

Month/ᑕᖅᖢᓗ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᓄᓇᓕᓗ	DEC ᑎᓯᓕᓗ	JAN ᔮᖏᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕆᔪ	APR ᐃᑦᓀᓪ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	**ᐅᒪᓲᑦ**	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	8	65	143	49	15		31	32	72	28	39	31	513 ± 57
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡								5	1				6
Wolf	ᐊᒪᓗᐃᑦ	Amagut						1			2	1	3	2	9 ± 1
Arctic fox	ᑎᓕᓴᐅᓂᐊᑦ	Tigiganiat					1	4	6	11	14	11		1	48 ± 5
Coloured fox	ᖃᐃᐦᑭᑦᑐᑦ ᑎᓕᓴᐅᓂᐊᑦ	Kalaliit tigiganiat						2						1	3 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik		14	1	43	3	1	1	16	3	26	25	19	152 ± 45
Seals (unspecified)	ᓯᖃᐃᓪᓚᑦ	Natiit						1							1 ± 0
Ringed seal	ᓇᓯᓪᑦ	Natiinat	33	174	120	340	295	102	51	14	10	8	23	29	1,199 ± 150
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	4	37	6	24	4	4	1	3		2	9	1	95 ± 23
Harp seal	ᖃᐃᕈᓪᓚᑦ	Qairulik	2	1		1	2	2	1						9 ± 1
Walrus	ᐊᐃᐸᑦ	Akvik	2	2			6	22	1	4	3	12	3	2	57 ± 7
Narwhal	ᑐᐊᓪᓚᑦ ᕿᓕᓗᒡᓗᑦ	Tuugaak					1								1 ± 1
Beluga	ᖃᐃᖅᑦ ᕿᓕᓗᒡᓗᑦ	Kilalugak	6	3			25	28							62 ± 13
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	1,208	21	4	2								747	1,982 ± 488
Canada goose	ᓄᑦᓚᓪᑦ	Nikliknik	36		3	7								124	170 ± 64
Old squaw	ᐊᑭᒋᑦᓱᐃᑦ	Aahangik												10	10 ± 18
Eider duck	ᒥᑎᑦ	Kingalik	137	195	21	38	75	26		26	7		146	150	821 ± 74
Black guillemot	ᐱᑦᓯᐅᓪᓚᑦ	Black guillemot				1				1		2			4 ± 1
Thick-billed murre	ᐊᑦᐸᐃᑦ	Thick-billed murre	5			2	1			20	6	27	166	31	258 ± 76
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	18		1	64	56	3	3	37	19	62	92	1,389	1,744 ± 180
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᑦ	Tinmiat manniit	1,274	3,145											4,419 ± 1,381
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓂᓂᑦ	Nauyat manniit	16												16 ± 6
Eider down∅	ᒥᑎᑦ ᖃᓄᕈᓂᑦ∅	Mitiit qiviungit∅		21											21 ± 9
Arctic char	ᐃᖃᓗᓴᐃᑦ	Ikaliviit	1,629	1,780	1,286	89	1,051	388	744	875	643	1,239	1,597	2,630	13,951 ± 1,123
Cod	ᐅᑦᒪᐃᑦ	Ugak												7	7 ± 0
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk		6	98	3			4		3				114 ± 103
Clams	ᐊᑦᒧᒪᔪᑦ	Uviluq	200	1,943	1,368	1,908									5,419 ± 1,704

‡ Polar bear data supplied by DSD.
∅ Number of nests harvested.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᓴᖏᑦ ᐅᑎᕕᒃ ᐃᓄᐃᖑᓇᓗᒍᑦ.
∅ ᖃᓄᐅᓂᖏᑦ ᐱᐅᑦ ᓄᐊᑕᐅᔪᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.
∅ Amigaitiginit maniktagauhimajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 44

Monthly hunter response

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)

ᐊᑦᖁᔪ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

6.1.2

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᔪᓂ	NOV ᐅᓇᒡᕕᓂ	DEC ᑎᓯᒡᕕᓂ	JAN ᔮᖏᓕᓂ	FEB ᓄᖅᐳᓂ	MAR ᒪᑦᔪ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐋᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	462	463	462	415	416	416	416	418	418	416	416	417	472*
Interview list	ᐊᐱᕐᓂᖅᓯᒪᔭᓄᑦ	Apikiktan	208	209	208	163	164	164	164	166	166	164	164	165	217*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	200	196	203	155	150	148	153	153	161	154	157	158	212*
Harvested	ᐊᖏᔪᓂᒃᑐᔭᓄᑦ	Angujaujut	84	100	87	73	64	51	41	35	37	45	64	106	162*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᓂᖏᑦ (%)	Kiujut (%)	96	94	98	95	91	90	93	92	97	94	96	96	94**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᔾᔨᒃᑯᓂᑦ/ᐊᐱᕐᓂᖅᓯᒪᔭᓄᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑐᔭᓄᑦ ᐊᑕᐅᓯᐊᕐᓗᓂ% ᐊᑐᑎᒃ ᐊᑦᖁᔪᒥ.
** ᐊᐅᔨᓪᓕᑎᓯᒪᔨᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 45

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᓂᓂ ᐊᖏᔪᓂᒃᑐᓂᖓᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑕᑦ ᑎᑎᕐᕐᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)

ᐊᑦᖁᔪ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᔪᓂ	NOV ᐅᓇᒡᕕᓂ	DEC ᑎᓯᒡᕕᓂ	JAN ᔮᖏᓕᓂ	FEB ᓄᖅᐳᓂ	MAR ᒪᑦᔪ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕᑦ	≤ tatkin pingahut	100	100	100	100	100	99	100	100	99	99	100	100	100
4-6 months	4-6 ᑕᖅᑕᑦ	tatkin hitaman 6nut	0	0	0	0	0	1	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑕᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	1	1	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 46

Number of hunters harvesting each species
ᖃᑦᕿᐅᓂᖏᑦ ᐊᖏᔪᓕᓴᐃᓯᒋᑦ ᐊᖏᔪᓕᓴᐃᓕᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu

Year 4 (June 1999 - May 2000)
ᐊᓗᖅᔪᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

6.1.2

Month/ᑕᖏᖅᑐᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᐱᓗ	NOV ᐅᓇᓚᐱᓗ	DEC ᑎᓴᓚᐱᓗ	JAN ᔮᖏᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᓴ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	6	24	49	20	4		9	13	22	11	18	17	87
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut						1			1	1	2	2	6
Arctic fox	ᑎᓗᓚᖓᓂᐊᑦ	Tigiganiat					1	2	3	4	3	2		1	10
Coloured fox	ᖃᐃᖓᕐᑐᑦ ᑎᓗᓚᖓᓂᐊᑦ	Kalaliit tigiganiat						1						1	2
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik		2	1	16	3	1	1	4	2	8	7	4	38
Seals (unspecified)	ᓴᖃᐃᓪᓕᑦ	Natiit						1							1
Ringed seal	ᓇᕐᓴᑦ	Natiinat	19	48	43	57	51	32	14	6	7	6	12	14	96
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	3	15	4	8	4	4	1	3		2	8	1	38
Harp seal	ᖃᐃᕈᓪᓕᑦ	Qairulik	1	1		1	2	2	1						6
Walrus	ᐊᐃᐸᑦ	Akvik	1	2			6	4	1	3	3	7	3	2	15
Narwhal	ᑐᐃᓪᓕᑦ ᕿᓚᓗᒃ	Tuugaak					1								1
Beluga	ᖃᐃᖅᑕᑦ ᕿᓚᓗᒃ	Kilalugak	4	2			12	12							25
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	34	1	1	2								38	57
Canada goose	ᓂᑦᓪᓕᑦ	Nikliknik	5		1	2								23	28
Old squaw	ᐊᑭᕈᐊᑦᔪᐃᑦ	Aahangik												1	1
Eider duck	ᒥᑎᑦ	Kingalik	16	23	2	6	19	7		3	2		18	16	60
Black guillemot	ᐱᑦᓯᐅᓪᓕᑦ	Black guillemot				1				1		1			2
Thick-billed murre	ᐊᑦᑐᐃᑦ	Thick-billed murre	1			1	1			3	1	3	11	3	20
Ptarmigan	ᐊᕈᑦᑎᑦ	Akilgik	3		1	9	5	2	1	3	6	11	17	60	71
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	12	25											35
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓕᓂᖏᑦ	Nauyat manniit	1												1
Eider down	ᒥᑎᑦ ᖁᓂᕈᖏᑦ	Mitiit qiviungit		1											1
Arctic char	ᐃᖃᓗᐸᐱᑦ	Ikaliviit	51	44	37	2	17	10	19	16	14	22	30	68	116
Cod	ᐅᒪᐃᑦ	Ugak												1	1
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk		1	3	1			1		1				6
Clams	ᐊᓚᒧᒪᔪᑦ	Uviluq	6	12	12	11									32

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᕈᖃᖏᑎᑐᖃᓂᒃ ᐱᓱᐊᑎᓕᖅᓂᒃ ᐊᖏᔪᑦ ᖃᕋᓯᐅᓂᖏᖅᓄᑦ ᐊᓕᓴᐅᒪᔪᓄᑦ ᐊᔪᔨᑦᑕᐅᓂ ᑐᓂᔭᖏᖅᓂ ᐃᓄᐃᑦᑐᓕᕆᓂᖅᑕᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 47

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᖅᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᓪᓴᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

6.1.2

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᕆ	OCT ᐅᑲᐃᕆ	NOV ᐅᓇᓚᕆ	DEC ᑎᓯᓚᕆ	JAN ᒍᖏᓇᓕ	FEB ᐃᖅᐅᓕ	MAR ᒪᓯ	APR ᐃᓴᓂᓗ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	6	64	138	81	11	14	23	16	5	4	7	4	373 ± 61
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					2	3	2	1		2			10
Wolf	ᐊᒪᓕᐃᑦ	Amagut	1							2				1	4 ± 1
Arctic fox	ᑎᓗᓚᖏᓂᐊᑦ	Tigiganiat					2	3	25	22	10	4	2	1	69 ± 7
Coloured fox	ᖃᐅᖏᑦᑐᑦ ᑎᓗᓚᖏᓂᐊᑦ	Kalaliit tigiganiat							3						3 ± 1
Wolverine	ᖃᓕᕐᓂᑦ	Kalvik												1	1 ± 0
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik				28	16	5	10	8	10	12	21	4	114 ± 21
Seals (unspecified)	ᓯᖏᐅᓪᓕᑦ	Natiit						1							1 ± 0
Ringed seal	ᓇᓯᓪᓕᑦ	Natiinat	58	148	134	126	188	92	24	11	12	13	17	29	852 ± 110
Bearded seal	ᐅᓚᔾᔪᐃᑦ	Ukyuk	9	25	2	3	14	2		4	1	1	8	2	71 ± 21
Harp seal	ᖃᐃᕐᓕᑦ	Qairulik					9	20							29 ± 20
Walrus	ᐊᐃᐃᓴᑦ	Akvik		10	5		6		2	2	11	8	2		46 ± 16
Narwhal	ᑐᒍᓕᑦ ᖁᓕᓗᓂᑦ	Tuugaak				1									1 ± 0
Beluga	ᖃᐅᕐᑦ ᖁᓕᓗᓂᑦ	Kilalugak		1		3	33	33				1			71 ± 5
Snow goose	ᑲᖏᐃᑦ	Kanguq	1,655	35	2	48								1,296	3,036 ± 546
Canada goose	ᓂᕐᓕᑦ	Nikliknik	120	4		10								142	276 ± 50
Brant goose	ᓂᕐᓕᕐᓇᐃᑦ	Nirlirnaq	1												1 ± 0
Old squaw	ᐊᒻᑭᐊᕐᓚᐃᑦ	Aahangik	3												3 ± 1
Eider duck	ᒥᑎᑦ	Kingalik	144	175	5	37	121	9		5		7	333	188	1,024 ± 229
Tundra swan	ᖃᓚᔾᔪᐃᑦ	Kukyuk												1	1 ± 0
Black guillemot	ᐱᕐᓯᐅᓕᑦ	Black guillemot						1		9					10 ± 2
Thick-billed murre	ᐊᕐᕕᐃᑦ	Thick-billed murre	6	8	14	4					58	23	127	8	248 ± 52
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	3			23	2	35	57	25	14	22	32	627	840 ± 248
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓂᖅᑎᑦ	Uluaguliit manniit	20												20 ± 5
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖅᑎᑦ	Tinmiat manniit	155	4,710											4,865 ± 2,344
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓐᓂᖅᑎᑦ	Nauyat manniit	31												31 ± 27
Eider down∅	ᒥᑎᑦ ᖃᓄᖅᖏᑦ∅	Mitiit qiviungit∅		10											10 ± 3
Arctic char	ᐃᖃᓗᒃᓯᑦ	Ikaliviit	2,619	2,453	1,092	432	1,141	140	1,628	1,424	622	464	813	3,383	16,211 ± 1,833
Cod	ᐅᓘᐃᑦ	Ugak											50		50 ± 68
Clams	ᐊᓕᒍᒪᔾᔪᑦ	Uviluq		603	1,009	739	185								2,536 ± 1,702

‡ Polar bear data supplied by DSD.
∅ Number of nests harvested.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᓕᖅᑎᑦ ᑐᓄᔨᖏᑦ ᐅᑉᐳᐊ ᐃᓄᐃᕐᕕᓐᓂᐅᓕᑦ.
∅ ᖃᕋᐅᓂᖏᑦ ᐱᑭᑦ ᓄᐊᑕᐅᓕᖅᑎᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.
∅ Amigaitiginit maniktagauhimajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 48

Monthly hunter response

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓕᓴᒃᑎᑦ ᑭᐅᓂᖅᑎᑦ

ᐊᓐᖏᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐅᕕ	OCT ᐅᑦᔪᕕ	NOV ᐃᓄᐅᕕ	DEC ᑎᓯᕕ	JAN ᔮᓐᓄᐊᕕ	FEB ᐃᖅᑲᐊᕕ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᓴᒃᑎᑦ ᑭᐅᓂᖅᑎᑦ ᐊᑎᓯᒪᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓕᓴᒃᑎᑦ	Tatkitaman angunahuktut titigait	416	415	414	413	412	406	407	409	411	409	409	410	423*
Interview list	ᐊᐱᕐᓯᖏᓐᓂᒃᑯᑦ	Apikiktan	164	163	163	162	161	155	156	158	160	158	158	159	171*
Hunters interviewed	ᐊᖏᔪᓕᓴᒃᑎᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	157	156	155	156	152	148	147	150	150	151	151	151	167*
Harvested	ᐊᖏᔪᓕᓴᒃᑐᒃᑯᑦ	Angujaujut	100	82	61	56	57	43	42	36	31	37	40	95	144*
Response Rate (%)	ᑭᐅᔾᔨᐅᓂᖅᑎᑦ (%)	Kiujut (%)	96	96	95	96	94	95	94	95	94	96	96	95	95**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓕᓴᒃᑎᑦ ᐊᑎᓕᐅᔾᔨᒪᔪᑦ/ᐊᐱᕐᓯᖏᓐᓂᒃᑯᑦᑐᑦ/ᐊᐱᕐᓯᑦᑕᑦ/ᐊᖏᔪᓕᓴᒃᑐᒃᑯᑦ ᐊᑕᐅᓴᐊᔪᓗ% ᐊᑎᕐᒪᑦ ᐊᓐᖏᒍ.
** ᐊᐅᔾᔨᓕᑎᓴᒪᔪᑦ ᑕᖃᑦᑕᒪᑦ ᑭᐅᔾᔨᑦ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 49

Recall period between harvest and interview, expressed as % of total harvest records

Year 5 (June 2000 - May 2001)

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓐᓄᓂ ᐊᖏᔪᓕᓴᐅᓂᖓᓂᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓯᑦᑕᐅᓂᖓᓂᑕ, ᓇᓗᓇᐃᖏᑦᑕ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓕᓴᒃᑕᑦ ᑎᑎᖏᑦᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

ᐊᓐᖏᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐅᕕ	OCT ᐅᑦᔪᕕ	NOV ᐃᓄᐅᕕ	DEC ᑎᓯᕕ	JAN ᔮᓐᓄᐊᕕ	FEB ᐃᖅᑲᐊᕕ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕐᑯᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᕐᑯᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᕐᑯᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 50

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᑎᑦ ᐊᖏᔪᓚᐱᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu

Year 5 (June 2000 - May 2001)

ᐊᒡᖏᒍ 5 (ᔪᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

6.1.2

Month/ᑕᑭᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒡᒍᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᖏᐱᓗ	NOV ᐅᓇᒡᐱᓗ	DEC ᑎᓯᐱᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᕐᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᕐᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	5	28	38	27	9	6	10	8	3	3	5	3	77
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut	1							2				1	4
Arctic fox	ᑎᓕᓴᖅᐊᑦ	Tigiganiat					1	2	7	6	2	3	1	1	14
Coloured fox	ᖃᐅᖕᖏᑦᑐᑦ ᑎᓕᓴᖅᐊᑦ	Kalaliit tigiganiat							2						2
Wolverine	ᖃᑦᕃᑦ	Kalvik												1	1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				10	6	2	6	7	7	6	8	2	31
Seals (unspecified)	ᓴᖅᑯᓪᓚᑦ	Natiit						1							1
Ringed seal	ᓇᕐᓂᑦ	Natiinat	22	41	34	38	42	25	13	8	8	8	9	15	87
Bearded seal	ᐅᓚᐊᕆᑦ	Ukyuk	9	15	2	3	5	2		3	1	1	4	2	32
Harp seal	ᖃᐅᕐᓪᓚᑦ	Qairulik					6	7							13
Walrus	ᐊᐃᐅᓴᑦ	Akvik		5	1		6		1	2	7	7	2		21
Narwhal	ᑐᒍᓪᓚᑦ ᖁᓕᓗᒡᓗᑦ	Tuugaak				1									1
Beluga	ᖃᐅᕐᑦ ᖁᓕᓗᒡᓗᑦ	Kilalugak		1		3	14	14				1			22
Snow goose	ᑲᖏᐃᑦ	Kanguq	62	1	1	5								61	91
Canada goose	ᓂᕐᓪᓚᑦ	Nikliknik	24	1		6								27	48
Brant goose	ᓂᓕᕐᓇᐃᑦ	Nirlirnaq	1												1
Old squaw	ᐊᑭᓱᕐᓚᐃᑦ	Aahangik	1												1
Eider duck	ᒥᑎᑦ	Kingalik	13	20	2	14	23	4		2		1	15	18	58
Tundra swan	ᖃᓚᓚᐃᑦ	Kukyuk												1	1
Black guillemot	ᐱᕐᓯᐅᓪᓚᑦ	Black guillemot						1		3					3
Thick-billed murre	ᐊᕐᕿᐃᑦ	Thick-billed murre	1	3	2	1					6	4	12	2	19
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	1			6	1	7	13	8	4	8	7	35	53
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓂᖅᑎᑦ	Uluaguliit manniit	2												2
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖅᑎᑦ	Tinmiat manniit	4	30											33
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓐᓂᖅᑎᑦ	Nauyat manniit	3												3
Eider down	ᒥᑎᑦ ᖃᓄᖕᖏᑦ	Mitiit qiviungit		1											1
Arctic char	ᐃᖃᓗᓵᐱᑦ	Ikaliviit	70	56	25	10	15	5	20	17	16	18	13	59	116
Cod	ᐅᓘᐃᑦ	Ugak											2		2
Clams	ᐊᓗᒧᒪᓕᕐᑦ	Uviluq		4	3	5	1								11

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔨᓄᑦ ᐱᑕᖃᖕᖏᑐᖃᖅ ᐱᕐᔨᐊᑎᓕᓂᓄᑦ ᐊᖏᔪᒃ ᖃᑦᓯᐅᓂᖏᑦᓄᑦ ᐊᓪᓚᕆᒪᒪᔨᓄᑦ ᐊᖏᔪᓄᑦ ᓇᓪᓕᖅᑐᓄᑦ ᑐᓴᕐᕕᖏᓂᒃ ᐃᓕᓴᕐᕕᓂᒃ ᐃᓕᓴᕐᕕᖏᓂᒃ ᐱᓕᕆᔨᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 51

Annual harvest estimates and five-year mean

ᐊᖏᔪᒍᒪᑦ ᐊᓯᔪᓄᑦ ᓇᓕᐅᑦᓴᓐᓂᑦ ᐊᒻᒪᓗ ᑕᒻᓕᓄᑦ-ᐊᖏᔪᔪᓄᑦ ᐊᐅᔨᓕᕐᓂᓱᒪᓴᑦ 2001)

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᒍ/Ihivgiukimayut Ukiumi			1	2†	3	4	5	Mean ᐊᐅᔨᓕᕐᓂᓱᒪᓴᑦ Amigaitkiyait
			96/97	97/98	98/99	99/00	00/01	
Species	**ᐅᒪᓴᑦ**	**Umajuin**						
Caribou[1]	ᑐᖅᑐᐃᑦ[c1]	Tuktut[1]	n/d	671	474	513	373	508
Polar bear[2]	ᓇᓄᐃᑦ[c2]	Nanuit[2]	n/d	6	7	6	10	7
Wolf[3]	ᐊᒪᕐᐃᑦ[c3]	Amagut[3]	n/d	1	1	9	4	4
Arctic fox[4]	ᑎᓚᖓᓂᐊᑦ[c4]	Tigiganiat[4]	n/d	143	4	48	69	66
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓚᖓᓂᐊᑦ	Kalaliit tigiganiat	n/d	3	0	3	3	2
Wolverine	ᖃᖏᕕᖅ	Kalvik	n/d	0	0	0	1	< 1
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik	n/d	76	96	152	114	110
Seals (unspecified)	ᓯᖏᐅᓪᓕᑦ	Natiit	n/d	0	0	1	1	1
Ringed seal	ᓇᓂᓪᓕᑦ	Natiinat	n/d	1,308	881	1,199	852	1,060
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk	n/d	72	45	95	71	71
Harp seal[5]	ᖃᐃᕐᓪᓕᑦ[c5]	Qairulik[5]	n/d	17	3	9	29	15
Harbour seal	ᖃᓂᕐᐊᑦ	Qanigiaq	n/d	3	1	0	0	1
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	n/d	4	0	0	0	1
Walrus[6]	ᐊᐃᐃᓴᑦ[c6]	Akvik[6]	n/d	39	29	57	46	43
Narwhal[7]	ᑐᒪᓪᓕᑦ ᖁᓕᓗᓂᑦ[c7]	Tuugaak[7]	n/d	0	0	1	1	1
Beluga	ᖃᐅᔨᑦ ᖁᓕᓗᓂᑦ	Kilalugak	n/d	31	37	62	71	50
Snow goose[8]	ᑲᖏᔪᐃᑦ[c8]	Kanguq[8]	n/d	4,055	3,551	1,982	3,036	3,156
Canada goose[8]	ᓂᓪᓕᑦ ᐅᓗᐊᔪᓪᓕᑦ[c8]	Nikliknik[8]	n/d	321	115	170	276	221
Ross's goose[8]	ᖃᕆᓪᓚᐃᑦ[c8]	Kakat[8]	n/d	5	0	0	0	1
Brant goose[8]	ᓂᓪᓕᓪᓇᐃᑦ[c8]	Nirlirnaq[8]	n/d	1	0	0	1	1
Old squaw	ᐊᕐᓂᐊᓚᐃᑦ	Aahangik	n/d	1	0	10	3	4
Eider duck	ᒥᑎᓄᑦ	Kingalik	n/d	835	468	821	1,024	787
Tundra swan	ᖃᓄᓚᐃᑦ	Kukyuk	n/d	0	0	0	1	< 1
Common loon	ᑐᓪᓕᐊᓚᐊᑦ	Tuulik	n/d	3	0	0	0	1
Red-throated loon	ᖃᖏᓴᐅᑎ	Qaqhuaq	n/d	4	4	0	0	2
Black guillemot	ᐱᓕᕐᐅᓪᓕᑦ	Black guillemot	n/d	0	3	4	10	4
Thick-billed murre	ᐊᕐᐸᐃᑦ	Thick-billed murre	n/d	251	19	258	248	194
Ptarmigan	ᐊᕈᑦᓂᑦ	Akilgik	n/d	984	2,519	1,744	840	1,522
Eggs (unspecified)[9]	ᓚᒃᓄᑦ[c9]	Manniit[9]	n/d	0	1	0	0	< 1
Goose eggs[9]	ᑲᖏᔪᐃᑦ ᓚᒃᓂᕐᓂᑦ[c9]	Uluaguliit manniit[9]	n/d	7	1	0	20	7
Duck eggs[9]	ᒥᑎᓄᑦ ᓚᒃᓂᕐᓂᑦ[c9]	Tinmiat manniit[9]	n/d	3,241	438	4,419	4,865	3,241
Seagull eggs[9]	ᓇᐅᓴᐃᑦ ᓚᒃᓂᕐᓂᑦ[c9]	Nauyat manniit[9]	n/d	16	0	16	31	16
Eider down[Ø10]	ᒥᑎᓄᑦ ᖃᓄᐅᕐᓂᑦ[cØ10]	Mitiit qiviungit[Ø10]	n/d	10	0	21	10	10
Arctic char[11]	ᐃᖃᓗᐊᑦ[c11]	Ikaliviit[11]	n/d	13,321	11,296	13,951	16,211	13,695
Lake trout	ᐃᓱᖏᐃᑦ	Ikalukpik	n/d	100	0	0	0	25
Cod	ᐅᓚᐃᑦ	Ugak	n/d	187	23	7	50	67
Sculpin[12]	ᑲᓇᐊᐃᑦ[c12]	Kanayuk[12]	n/d	27	28	114	0	42
Clams[13]	ᐊᒡᒧᒪᐊᑦ[c13]	Uviluq[13]	n/d	15,536	7,006	5,419	2,536	7,624
Mussels[14]	ᐅᐱᓗᐃᑦ[c14]	Uviluvaloet[14]	n/d	175	526	0	0	175

† No data were collected in June and July 1997. Annual harvest estimates for year 2 were obtained by using the average of the harvest estimates for the corresponding months in the three years in which data were collected.

Ø Number of nests harvested.

[1-14]: See page 176 for community feedback and other sources of data.

† ᓇᓕᐅᑎᓂ ᓄᐊᓕᓴᐅᓇᓕᕐᓂᑐᖅ ᐅᐸᓂ ᔦᓂ ᐊᒻᒪᓗ ᔨᓪᓚᐃ 1997. ᐊᖏᔪᒍᒪᑦ ᐊᐅᔨᓕᕐᓂᓱᒪᓴᑦ ᓇᓕᐅᑦᓴᓐᓂᑦ ᐊᖏᔪᒍ 2-ᒪᑦ ᐱᐅᐅᓕᐅᑎᑦᑐᑦ ᐊᑐᑦᑐᑦ ᐊᐅᔨᓕᕐᓂᓱᒪᓴᑦ ᐊᖏᔪᒍᒪᑦ ᓇᓕᐅᑦᓴᓐᓂᑦ ᑕᒪᓐᓇᐃᓐᓇᖅᑐᑦ ᓄᐊᓕᓴᐅᓇᓕᕐᓂᑐᖅᓂᑦ.

Ø ᖃᕆᐅᓂᖓᑦ ᐱᐸᑦ ᓄᐊᑕᐅᔪᑦ.

[1-14]: ᑕᐃᒪᐅ ᒪᓴᐊᑐᒐᖅ 178 ᓄᓇᓕᑦ ᑭᐅᔨᔪᑎᖓᑦ ᐊᒻᒪᓗ ᐊᓯᖓᑦ ᐱᒃᓴᐅᔨᔪᑦ ᓇᓕᐅᑎᓂᓪᓗ.

† Katihiktauhimagitut nahaktauhimaitut June Julylu 1997. Ukiuktamat angujauvaktun maliktauplutik angunahukpaktut kihuimajut tapkuningan tatkit maliktumi pingahunut ukiunun katikhiktaumajut maliktauplutik.

Ø Amigaitiginit maniktagauhimajut.

[1-14]: Takulugu makpigaak 180 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

TABLE/ᐊᓗᐊᐃᔨᐅᑦ/NAUNAIKUTA 52

Annual hunter response

ᐊᓚᖏᔪᑕᒻᒥᑦ ᐊᖏᔪᓂᓴᑦ ᑭᐅᓂᖏᑦ

Angujauvaktu

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓚᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

6.1.2

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᓴᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔪᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᖅᑕᒪᒃᑐᑦ ᐊᖏᔪᓂᓴᑦ	Tatkitaman angunahuktut titigait	n/d	504	481	472	423	510*
Interview list	ᐊᐱᕐᓂᖅᓱᐃᑦ	Apikiktan	n/d	237	224	217	171	243*
Hunters interviewed	ᐊᖏᔪᓂᓴᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	n/d	233	223	212	167	241*
Harvested	ᐊᖏᔪᓂᔾᔪᑎᒃᓯᑦ	Angujaujut	n/d	170	157	162	144	208*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	n/d	97	81	94	95	92**

* Hunters registered/on interview list/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖏᔪᓂᓴᑦ ᐊᑎᓕᐅᕈᓐᓇᕐᓂᖅᓯᒪᔪᑦ/ᐊᐱᕐᓂᖅᓱᐃᑦᑐᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᔾᔪᑎᒃᓯᑦ ᐊᑕᐅᓂᐊᖅᓯᒪᓂᖅ ᐊᑎᑎᑦ ᖃᐅᔨᓴᖅᑎᒃ.
** ᐱᓕᕆᓂᖅᑎᓪᓗᒍ ᐊᓚᖏᔪᓂᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut taipfumuna tahapkuan kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᐊᓗᐊᐃᔨᐅᑦ/NAUNAIKUTA 53

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓂᓕᓂᓴᒃᑐᑦ ᐊᓚᒐ ᐊᐱᕐᓂᑦᑕᐅᓂᓴᒃᑐᑦ, ᐊᓗᐊᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᕐᔪᑦ ᐊᖏᔪᓂᑦ ᑎᑎᕐᑦᑕᐅᒪᔪᑦ

Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓚᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᕆᓂ	≤ tatkin pingahut	n/d	100	77	100	100	96
4-6 months	4-6 ᑕᕆᓂ	tatkin hitaman 6nut	n/d	0	22	0	0	4
> 6 months	> 6 ᑕᕆᓂ	> 6 tatkin	n/d	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 54

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᒃᑎᑦ ᐊᖏᔪᓚᒃᓴᕐᔪᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ

Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᑦᕿᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᕿᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᑐᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**						
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	n/d	94	65	87	77	129
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕈᐃᑦ	Amagut	n/d	1	1	6	4	11
Arctic fox	ᑎᓕᖅᓂᐊᑦ	Tigiganiat	n/d	19	3	10	14	32
Coloured fox	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓕᖅᓂᐊᑦ	Kalaliit tigiganiat	n/d	3		2	2	6
Wolverine	ᖃᑦᕃᓴ	Kalvik	n/d				1	1
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik	n/d	26	19	38	31	68
Seals (unspecified)	ᓯᖏᐅᓪᓕᑦ	Natiit	n/d			1	1	2
Ringed seal	ᓇᓯᓪᑦ	Natiinat	n/d	94	64	96	87	130
Bearded seal	ᐅᓗᔾᐊᐃᑦ	Ukyuk	n/d	24	13	38	32	64
Harp seal	ᖃᐃᕈᓪᓕᑦ	Qairulik	n/d	12	1	6	13	28
Harbour seal	ᖃᓯᕆᐊᑦ	Qanigiaq	n/d	3	1			4
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	n/d	2				2
Walrus	ᐊᐃᐃᓵᑦ	Akvik	n/d	16	13	15	21	33
Narwhal	ᑐᒪᓪᓕᑦ ᖁᓕᓗᒡᓗᑦ	Tuugaak	n/d			1	1	2
Beluga	ᖃᐅᔨᑦ ᖁᓕᓗᒡᓗᑦ	Kilalugak	n/d	13	11	25	22	43
Snow goose	ᑲᖏᐃᑦ	Kanguq	n/d	85	74	57	91	129
Canada goose	ᓄᓪᓕᑦ ᐅᓗᐊᒍᓪᓕᑦ	Nikliknik	n/d	44	23	28	48	86
Ross's goose	ᖃᑦᓴᐃᑦ	Kakat	n/d	1				1
Brant goose	ᓄᓪᓕᓪᓇᐃᑦ	Nirlirnaq	n/d	1			1	2
Old squaw	ᐊᑭᕆᐊᓪᓴᐃᑦ	Aahangik	n/d			1	1	2
Eider duck	ᒥᑎᑦ	Kingalik	n/d	43	32	60	58	89
Tundra swan	ᖃᓄᓴᐃᑦ	Kukyuk	n/d				1	1
Common loon	ᑐᓪᓗᓴᐊᑦ	Tuulik	n/d	1				1
Red-Throated loon	ᖃᖏᓴᐅᑎ	Qaqhuaq	n/d	1	1			2
Black guillemot	ᐱᕆᐅᓪᓕᑦ	Black guillemot	n/d		2	2	3	5
Thick-billed murre	ᐊᑦᐸᐃᑦ	Thick-billed murre	n/d	9	3	20	19	37
Ptarmigan	ᐊᕈᓕᑦ	Akilgik	n/d	62	60	71	53	105
Eggs (unspecified)	ᓚᖏᓪᓕᑦ	Manniit	n/d		1			1
Goose eggs	ᑲᖏᐃᑦ ᓚᖏᓂᖅ	Uluaguliit manniit	n/d		1		2	2
Duck eggs	ᒥᑎᑦ ᓚᖏᓂᖅ	Tinmiat manniit	n/d		13	35	33	62
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᖏᓂᖅ	Nauyat manniit	n/d			1	3	4
Eider down	ᒥᑎᑦ ᖃᓄᓕᓂᖅ	Mitiit qiviungit	n/d			1	1	2
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	n/d	91	104	116	116	169
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	n/d	7				7
Cod	ᐅᓘᐃᑦ	Ugak	n/d	2	1	1	2	5
Sculpin	ᑲᓇᔾᐃᑦ	Kanayuk	n/d	2	2	6		10
Clams	ᐋᓕᒧᒪᔾᔪᑦ	Uviluq	n/d	55	24	32	11	84
Mussels	ᐅᐊᓗᐃᑦ	Uviluvaloet	n/d		1			1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓱᒪᔾᓂᖅ ᐱᑕᖃᓐᖏᑦᑐᖃᖅ ᐱᔾᔪᑎᓕᓐᓂᖅ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᕆᐊᓂᖅ ᐊᖏᔪᒃᓄ ᓇᓕᕆᔨᒃᑯᓂᖅ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ ᑐᓂᓯᔪᖅᑐᑦ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ ᐃᓄᐃᑦᑎᓕᕐᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.



6.1.2 Community Results Discussion: Cape Dorset

Although data collection in most communities began in July 1996, in Cape Dorset delays were encountered due to difficulties in retaining fieldworkers and in registering hunters. Data prior to August 1997 were deemed unreliable and were not used. In April 2001, a letter was written to the Nunavut Implementation Panel and cc'ed to the relevant RWOs and HTOs informing them of the missing data. The letter also demonstrated the NWMB's approach to the problem, detailing the use of collected data to estimate for the missing months. The Nunavut Implementation Panel accepted the NWMB's approach to the issue in June 2001. As such, there are no data (n/d) displayed for year 1 in Cape Dorset. In order to estimate the total yearly harvest in year 2, estimates for June and July 1997 were obtained by calculating the mean harvest for the corresponding months in the three years in which data were collected.

The survey frame:
An assessment of under-enumeration during the community visit revealed that there were approximately 29 hunters who were not registered in the Harvest Study. Twenty-seven of these were Inuit - 13 occasional, 13 active and one intensive hunter. It is estimated that there were two non-Inuit hunters with assigned hunting rights who were not registered – one occasional and one active hunter. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. Over half of the unregistered hunters were thought to be active or intensive hunters. As a result, although these hunters represent only five percent of the total hunter population (Table 10), the effect of this bias on harvest estimates could be significant. Harvest estimates for the unregistered hunters can be estimated using mean harvest quantities for each species by strata. However, these estimates, having their own sources of error and bias, are beyond the scope of this Final Report. Readers may apply to NWMB to obtain the results of these calculations.

Survey coverage and non-response bias:
Response rates were good to excellent in most months during the four years of the Harvest Study. The exception to this was the summer of year 3 where response rates were significantly lower and dropped below 50% in the active and intensive strata for several months. As seen in Table 9 the consistent intentional non-response rate in Cape Dorset was low, at 0.8%, and was not thought to be a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough during all years of the study, with the exception of some months in year 3, to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should exercise caution when using the data collected during the summer of 1998 (year 3) since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:
It was reported during the community consultations that some harvests, such as clams and mussels were under-reported. Further details are provided in the community feedback and other sources of data section below. Section 5.4 also contains a thorough discussion of this issue.

As seen in the recall period tables, with the exception of about five months in year 3, the vast majority of harvest records were collected within three months of the harvest, thereby minimizing recall error.

As noted in the comments associated with arctic char, below, there was commercial harvesting of char during the study. These fish would have been sold locally through the HTO or local store and were therefore included in the Harvest Study database.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou.
2. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
3. **Wolf:** Harvest estimates in years 2 and 3 seem a little low. Estimates in years 4 and 5 look more accurate. Wolves are getting closer to the community; there is a summer den very close to the community (C.F.).
4. **Arctic fox:** Harvest estimates look accurate. Estimates were lower in year 3, because of the implementation of humane trapping standards (C.F.). DSD reports indicate that 27 arctic fox pelts were purchased from Cape Dorset hunters in 1999/2000 (year 4) and 47 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). Harvest estimates that are somewhat higher than these numbers are felt to be accurate, given that not all pelts are sold.
5. **Harp seal:** There were very few harp seals around during the Harvest Study (C.F.).
6. **Walrus:** The mean harvest estimate seems low. The HTO Board felt that the average walrus harvest should be closer to 60 (C.F.).
7. **Narwhal:** Few narwhal were harvested during the study since there were very few around the community. Many more narwhal were harvested in the years prior to the study when they were more abundant (C.F.).
8. **Geese:** Harvest estimates for snow geese seem a little low in the latter years of the study. The number of geese (most species) seems to be increasing each year and harvest numbers should also be going up from year to year. Harvest estimates for Ross' and brant geese also appear low and the HTO Board speculated that hunters likely reported these species as Canada geese. Canada geese estimates seem more accurate (C.F.).
9. **Eggs:** *Goose and seagull eggs*: harvest estimates may be a little low but seem to be in the right range. These birds don't lay eggs near the community, so hunters do not harvest many (C.F.). *Duck eggs*: Again estimates may be a little too low but are in the right range. This harvest follows the ice conditions; explaining the low estimate in year 3. Common eider eggs are gathered to the east of the community (Saqva area) and sometimes hunters have difficulty accessing the area due to poor ice conditions (C.F.).
10. **Eider down:** People do harvest eider down; the estimates appear to be much too low. It is felt that many hunters did not report this harvest. It is not unusual for hunters to gather down from at least 100 nests, leaving some of the down in place in each nest. Down is not sold; it is used by local people (C.F.).
11. **Arctic char:** There was some commercial fishing during the Harvest Study. However, the fish were sold to the HTO or to the local store. It is felt that these commercial harvests were reported with the subsistence harvest and are included in the harvest estimates. Estimates seem accurate (C.F.).
12. **Sculpin:** Sculpin are harvested each year so data in year 5 indicating no reported harvests would appear to be inaccurate (C.F.).
13. **Clams:** People go clam digging every year. Hunters are told that they need to harvest clams in a sustainable manner. The year 2 estimate of about 15,000 looks reasonable. In years 3 to 5 the HTO Board suspects that the harvest was similar to year 2 but that some hunters stopped reporting since they were concerned that officials might limit this harvest (C.F.).
14. **Mussels:** Similar to the clam harvest, the mussel harvest should be consistent from year to year (C.F.).

6.1.2 ᓄᓇᕗᒻ ᓴᖅᑭᑕᕐᕕᖏᓂᒃ ᐅᖃᖅᑎᑐᑦᑎᓯᒪᔪᖅ: ᑭᓯᓚᐃᓪ

ᐊᓪᓚᑦᑎᓴᓂᒃ ᓄᐊᕐᑎᓕᖅᓯᓕᕆᓂᖅ ᓄᓇᓕᓪᓚᒃᓴᖅ ᐱᑎᕐᓯᑕᐅᓴᖅᓯᒪᓕᕆᖅᑎᑦᓴᐅᔪ ᐊᓪᓚᑕ 1996ᒥ, ᑭᖑᓪᓕᖅᑕᐅᓯᓪᓚᑕᐅᓴᖅᑐᖅ ᑭᓯᓚᖅᓴᖅ ᑎᒍᑎᖅᑕᐅᓴᕐᓚᐃᔨᓐᓇᖅᑐᖅᓴᖅᓄᓪᓕ ᕆᓚᖅᑎᑦ ᐊᓗᒪᓂ ᐊᑎᓕᐅᔾᔨᕐᓯᒪᖅᑎᑦ ᐊᓯᓪᓚᖅᑎᑦ. ᐊᓪᓚᓪᓕᐅᓯᒪᔪᑦ ᐊᓗᒍᓯᓴ ᓯᑐᓂᐅᔾᔨᖅᑐᑦᑎᓂᒃ ᐊᓯᓪᓚᖅᑎᑦ ᑐᑭᓯᓚᖅᑎᑦ ᐊᓪᓚᓪᓕᐅᓯᒪᔪᑦ ᐊᑐᖅᑕᐅᓯᓪᓚᑕᐅᓴᖅᑎᑦᓯᒪᒪᑦ. ᐃᐱᓗᓇ 2001ᒥ, ᑎᑎᖅᑲᒥᐸ ᑐᓂᓯᔾᔪᑎᖅᑕᐅᓴᖅᑐᖅᓴᖅᑐᑦ ᐊᑐᖅᑕᐅᓯᓪᓚ

ᓄᓇᕗᒻᒥ ᑭᐅᔾᔨᒌᖅ ᐊᒻᒪᓗ ᐊᓯᖏᓐ ᐊᑦᓯᑕᐅᓯᒪᔪᖅ:

[1] **ᑐᑦᑐᐃᓵᖅ:** ᑐᑦᑐᐃᓪ ᓇᓴᖅᑐᖏᖅᑐᒥᑎᐅᑦᑕᖅ

[2] **ᓇᓂᐃᓵᖅ:** ᐊᓴᐅᑎᖅ ᑕᐃᓂᐅᓴᐃᔨᓴ ᒥᑦᓴᐅᓯᑎᑐᐃᓇᖅᑐᖏᖅᑐᑦ ᑭᓯᐊᓂ ᐊᓴᖅᑕᐅᓯᒪᓕᑦᑕᖅᑐᑦ ᓄᓇᑦ ᓴᓐᒪᓗᓂ ᐃᓂᐊᖅᓯᓕᓇᓂᔨᐅᖏᖅᓂᓄᑦ (DSD PB).

[3] **ᐊᒪᒋᖅ:** ᐅᒪᔨᖅᑕᐅᓂᖅᑐᑦ ᖃᓄᐅᑎᓂᖅᑐᖏᖅ ᐅᑭᐅᖏᓐᓂ 2 ᐊᒻᒪ 3 ᐊᑎᓗᐊᖅᑎᓯᔨᒍᔨᓴᑦ. ᖃᓄᐅᑎᓂᖅᑐᖏᖅ ᐅᑭᐅᖏᓐᓂ 4 ᐊᒻᒪ 5 ᒥᑎᖃᓄᐊᖅᒍᒍᔨᓪᓗᑎᒃ. ᐊᒪᖅᒍᓂ ᖃᓂᓪᓚᕐᓇᓂᖅᑕᐅᔨᑦ ᓄᓇᕗᒻᒧᑦ; ᐊᐅᔾᔨᒍᓂ ᑎᓯᖃᖅᑎᑦᔨᓴ ᖃᓄᖅᓱᓓᔨᐅᓂᓄᑦ ᓄᓇᕗᑦ (C.F.).

[4] **ᑎᓕᖁᓂᐊᖅ:** ᐅᒪᔨᖅᑕᐅᓚᕐᓂᖅᑐᑦ ᖃᓄᐅᑎᓂᖅᑐᖏᖅ ᓇᓕᒧᑎᐊᖅᑐᕆᔭᖅᑐᑦ. ᓴᓇᖅᑕᐅᓯᒪᔨᑦ ᐊᑎᓂᖅᑲᐃᓕᓂᖅᓯᒪᔨᑦ ᐅᑭᐅᖏᓐᓂ 3 ᐊᑐᓂᖅᑎᑕᐅᓕᓂᖅᑐᖏᖅᓂᓄᑦ ᒥᑭᑎᐅᔨᓯᒪᔪᓕᓂᖅᑐᑦ (C.F.). ᐃᓄᐊᕐᓇᓕᓕᒫᑦ ᐅᓂᖅᑲᐃᓕᓂᖅᑐᖏᖅᓂ ᓇᓗᓇᐃᓕᓕᒫᑦ 27ᓂᓄ ᑎᓚᓂᐊᕐᓂᓄ ᓂᐅᐃᖁᖏᓐᓇᕐᓂᖅᑐᓄ ᑭᖑᓂᓕ ᐊᖏᓚᓯᒪᔨᑎᐅᔨᓴᑦ 1999-2000ᒥ (ᐅᑭᐅᖏᓐᓂ 4) ᐊᒻᒪ 47ᓂᓄ ᓂᐅᐃᖁᑐᑎᓄ 2001-2002ᒥ (ᐅᑭᐅᖏᓐᓂ 5) (ᖃᓄᐅᔨᒪᓕᑦ ᐃᓄᐃᖅᓚᕐᓇᓂᔨᓄᑦ ᐊᓴᐅᑎᖅ ᒪᓂᒪᒪᑦ ᐱᓕᕆᔨᐃᖁᖏᓐᓇᖅᑐᑦ ᐊᓯᐊᖁᖃᖅᑐᓄᑦ ᓴᓇᔨᓕᒪᓂᖅ ᓴᓇᔨᓕᒪᓂᖅ, ᖃᓄᐅᔨᓴᓕᒫᑦ ᓴᓇᔨᓕᒪᓂᖅᑐᑦ ᒪᓂᒪᒪᑦ ᐊᓯᐊᖁᖃᖅᑐᓄᑦ ᓴᓇᔨᓕᒪᓂᖅᑐᑦ ᐊᓯᐊᖁᖃᖅᑐᓄᑦ 2001-2002ᒥ (ᐅᑭᐅᖏᓐᓂ 5) (ᖃᓄᐅᔨᒪᓕᑦ ᐃᓄᐃᖅᓚᕐᓇᓂᔨᓄᑦ ᐊᓴᐅᑎᖅ ᒪᓂᒪᒪᑦ ᐱᓕᕆᔨᐃᖁᖏᓐᓇᖅᑐᑦ ᐊᓯᐊᖁᖃᖅᑐᓄᑦ ᓴᓇᔨᓕᒪᓂ

6.1.2 Nunani Iniktikhimayut Ukauhiit: Kinngait

Katitikhimayut katitiguait tamamivyak nunani pilikhimayut Julymi 1996mi, Kinngaini kinguvakhimayut ayokhakhimagamik nunani havaktikhaminik ovalo titigaktakhainik umayukhiuktit. Katitikhimayut pitinagit Augustmi 1997mi naamagiyaungitut ovalo atungitut. Aprilmi 2001, titikamik titigakhimayut Nunaumi Iniktiligiyit Katimayigalaanut ovalo aatjikutaanik tunihimayut RWOkunut ovalo HTOkunut tuhaktitivlugit pihimaitut katitikhimayut. Titigak takuyauhimayuk NWMBkut piyait ayokhagutimik, titigakhimaplutik atugutikhainik katitigutainik katitikhimayunik naunaiyakhimayut pihimaitut tatkikhiutini. Nunavumi Iniktiligiyit Katimayigalaat angikhimayut NWMBkut atuniaktait ihumagiyaminut Junemi 2001. Taimaimat, pikangituk katitikhimayunik (n/d) takuyauhimayut ukiungani 1 Kinngaini. Pinahuakhuni naunaiyautainik tamaat ukiuni umayukhiukhimayut ukiumi 2mi, naunaiyautait Junemi ovalo Julymi 1997 pihimayut naunaiyakhugit angitkiyait umayukhiukhimayut aatjikutaini tatkikhiutini pingahuni ukiuni katitikhimayut katitigutaini.

Ihivgiukhimayut Iniktigutait:
Ihivgiufaakhimayut ataani naunaiyakhimayut nunani pulaakhimatitlugit takuhimayut 29kuyut umayukhiuktit titigaktauhimaitut Umayukhiukhimayut Ihivgiugutaini. 27kuyut tahapkoa Inuinauyut – 13kuyut ilaani umayukhiukpaktut 13kuyut umayukhiukataktut ovalo atauhik umayukhiunginaktuk. Naunaituk malguuk Inuinaungituk umayukhiuktit tuniyauhimayut umayukhiugutnik inminiigutinik titigaktauhimaitut – atauhik ilaani umayukhiukpaktuk ovalo atauhik umayukhiukataktuk. Ukakhimayut ilangani 5.2.1, ikpinaguait hamna ataani naunaiyakhimayut pivaktuk ataanut ihumagiyaini umayukhiukhimayut naunaiyautaini. Kitkani titigaktauhimaitut umayukhiuktit umayukhiuktaktut ovaluniit umayukhiukatainaktut. Taimaimat, hapkoa umayukhiuktit ilauyut 5%mik tamaat umayukhiuktinit (ikpatauyak 10), ikpinagutait hamna ihumagiyaini umayukhiukhimayut naunaiyautaini angiyuuyut. Umayukhiukhimayut naunaiyautait titigakhimaitut umayukhiuktit naunaiyakhimayut angiyunik umayukhimayainik amigaitjutaini tamamik umayunik aviktukhimayuni. Kihimi hapkoa naunaiyautit pihimayut ihuinaagutainik ovalo ihumagiyainik avataaniimatat hamani Iniktigutaani Tuhaktakhat. Taiguaktut pilaaktut NWMBkunit piyumagumik iniktigutait hapkoa naunaiyautainik.

Ihivgiukhimayut pihimayut ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait nakuuyut ilangit nakuukpiakhutik ilangini tatkikhiutini hitamani ukiuni Umayukhiukhimayut Ihivgiuktitlugit. Kihimi auyami ukiumi 3mi kiuhimayut naunaiyautait mikhihimayut ovalo katakhutik ataanut 50%mut umayukhiukataktuni ovalo umayukhiukatainaktuni aviktugutaini amigaivyaktut tatkikhiutini. Takuyaulaaktut ikpatauyami 9mi, pikataktut kiuyuitut naunaiyautaini Kinngaini ataanungakhimayuk 0.8%mut ovalo ihumagiyaungituk pilaaktuni pihimayuni kiuyuitut ihimagiyaini.

Kiuhimayut naunaiyautait ihumayut angiyuuyut ovalo kiuyuitut ihimagiyait mikiyut tamamik ukiuni ihivgiuktitlugit, kihimi ilangit tatkikhiutini ukiumi 3mi, piplutik nmi pihimayut naamaktut naunaiyautaini Nmi umayukhiuktini. Taiguaktut atuktukhat ihumagilugit atuligumik katitikhimayut katitiguait auyami 1998mi (ukiumi 3) pilaamata tamamik uktugutit ihuinaagutait ovalo kiuyuitut ihumagiyait angilivamata kiuhimayut naunaiyautait katagaagata.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Tuhaktitihimayut nunani ukakatihimaplugit ilangi umayukhiukhimayut, ilangi uvilut ovalo uviluvaluit ataani tuhaktitihimayut. Titigakhimayut tuhagutikhait nunani ukakhimayaini ovalo aalat atukhimayut katitikhimayuni ilangani hamani. Ilangani 5.4 pihimayut ukautitiagutaini hamani ihumagiyauyuni.

Takuyaulaat utiktihimayuni ikpatauyami, kihimi talimat tatkikhiutit ukiumi 3, amigaitut umayukhiukhimayut titigakhimayut katitikhimayuni iluani pingahut tatkikhiutini umayukhimayut, taimaimat mikinikhaaaguyut utiktihimayut ihuinaagutaini.

Titigakhimayuni ukakhimayuni mikhaanut ikaliviit hamani, kinauyaliugutauyut umayukhiukhimaut ikaliviit ihivgiukhimatitlugit. Hapkoa ikaluit niuviktauhimayut nunamini HTOkunut ovaluniit nunamini niuvikvimi ovalo ilauhimayut Umayukhiukhimayut Ihivgiukhimayut katitikhimayuni.

Nunanit Ukakhimayut ovalo aalat pihimayaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukhimayut nunani tuktuit.
2. **Nanuit:** Amigaitjutait takuyauhimayut naunaiyautaungitut kihimi pihimayut amigaitjutait pihimayut DSDkunit (DSD PB).
3. **Amagut:** Umayukhimayut naunaiyautait ukiumi 2mi ovalo 3mi mikiyut. Naunaiyautait ukiumi 4mi ovalo 5mi naamaktut. Amaguit kaliliktut nunamut, auyami ivavikaligamik haniani nunami (C.F.).

[4] **Tigiganiat:** Umayukhiukhimayut naunaiyautait naamaktut. Naunaiyautait mikiyut ukiumi 3mi, atulikhimagamik nutaanik nanigianik (C.F.). DSDkut tuhaktitihimayut 27kuyut tigiganiat amiit niuviktauhimayut Kinngainit umayukhiuktinit 1999/2000mi (ukiumi 4) ovalo 47kuyut niuviktauhimayut 2000/2001mi (ukiumi 5) (nalungilutit DSDkut katitikhimayut atukhimayut umayukhiukhimayut ukiungit Julymit Junemut, Umayukhiukhimayut Ihivgiukhimayut pivaktut Junemit Maymut (DSD FB). Umayukhiukhimayut naunaiyautait angiyut tahapkonanga amigatjutainit ihumayut naamaktut, nalunginami tamamik amiit niuvitauyuitut.

[5] **Qairulik:** Ikitpiaktuk tikhait natiit umayukhiukhimayut ihivgiutitlugit (C.F.).

[6] **Akviit:** Angitjutait umayukhiukhimayut naunaiyautait mikiyut. HTOkut katimayiit ihumayut kitkaniitut aiviit umayukhiukhimayut 60nut kanitkiyauyukhat (C.F.).

[7] **Tugaaliit kilalugat:** Ikitut tugaaliit kilalugat umayukhiukpaktut ihivgiuktitlugit ikitpiamata haniani nunami. Amigaitut umayukhiukhimayut ukiuni pitinagit ihivgiuktut amigaituugaluamata. (C.F.).

[8] **Uluaguliit:** Umayukhiukhimayut naunaiyautait kanguni mikiyut iniktiligutaini ukiut ihivgiuktuni. Amigaitjutait uluaguliit (tamamivyak uluaguliit) amigailiktut tamaat ukiuni ovalo umayukhiukhimayut amigaitjutait amigailiktukhat ukiuk tamaat. Umayukhiukhimayut naunaiyautait nikliniit ovalo niklinavaluit mikiyut ovalo HTOkut katimayiit ihumayut umayukhiuktit tuhaktitihimayut hapkoa tingmiat uluagulinik. Uluaguliit naunaiyautait naamaktut (C.F.).

[9] **Maniit:** Uluaguliit ovalo nauyat maniit: katitikhimayut naunaiyautait mikiyut kihimi naamakhiliktut. Hapkoa tingmiat manikayuitut haniani nunaini, taimaimat umayukhiuktit katitiyuitut amigaitunik (C.F.). *Tingmiat maniit:* Ilaa naunaiyautait mikiyut kihimi naamakhiliktut. Hamna umayukhiukhimayut malikpaktut hikumik kanugitaakhainik, ukakhimayut ikitut naunaiyautait ukiumi 3mi. Mitiit maniit katitikpaktut kivataani nunamit (Saqvami) ovalo ilaani umayukhiuktit ayokhakpaktut tikitaami nunat hikut nakuugitkaagat (C.F.).

[10] **Tingmiat kiviungit:** Inuit katitikpaktait tingmiat kiviungit, naunaiyautait mikivalaaktut. Ihumayut amigaitut umayukhiuktit tuhaktitiyuitait katitigutainik. Nalunaituk umayukhiuktit katitivaktut kiviunik 100nit ivavinit, kimakpakhutik ilanganik kiviunik ivavini. Kiviut niuviktauyuituk; atuktauvaktut nunani Inuni (C.F.).

[11] **Ikaliviit:** Ilaani kinauyaligutinik ikalukhiukpaktut Umayukhiukhimayut Ihivgiukhimatitlugit. Kihimi, ikaluit niuviktauvaktut HTOkunut ovalo nunamini niuvikvinut. Ihumayut hapkoa kinauyaliugutit ikalukhiutuni tuhaktitihimayut atuktaktaini umayukhiukhimayunut ovalo ilauyut umayukhiukhimayuni naunaiyautainut. Naunaiyautit naamaktut (C.F.).

[12] **Kanayuit:** Kanayuit umayukhiukpaktut tamamik ukiuni, katitikhimayut ukiumi 5mi titigakhimayut umayukhiungitut tuhaktitiyuni ihuinaakhimayuk (C.F.).

[13] **Uviluit:** Inuit uvilukhilikpaktut tamaat ukiuni. Umayukhiuktit ukautauvaktut umayukhiuktakhait uvilut atuktakhaini pilutik. Ukiumi 2mi naunaiyautait 15,000nik pihimayut naamaktuk. Ukiui 3mit 5mut, HTOkut katimayiit ihumayut umayukhiukhimayait aatjikutauyuk ukiumi 2mut kihimi ilangit umayukhiuktit nutkakhimayut tuhaktitihimayunik ihumaligamik maligaliuktit keelininianahuakhimaplutik hamna umayukhiutaktainik (C.F.).

[14] **Uviluvaluit:** Aatjikutaatut uviluni umayukhiukhimayut, aomauyaktut umayukhiukhimayut aatjikiiktukhat ukiuni tamaat (C.F.).

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 55

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᑎᒋᔪ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᓂᓚᓇ	DEC ᑎᓯᓚᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᓄᖕᐅᐊᓇ	MAR ᒪᕆᔪ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	36	1	31	2		31	13	21	27	75	78	66	381 ± 26
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡										9	1	1	11
Wolf	ᐊᒪᓗᐃᑦ	Amagut												2	2 ± 1
Arctic fox	ᑎᓕᓴᖅᐊᑦ	Tigiganiat			1		2	32	16	14	3	3	18	3	92 ± 16
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓕᓴᖅᐊᑦ	Kalaliit tigiganiat										2			2 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	4		3	6		3			2	3	4	15	40 ± 5
Seals (unspecified)	ᓂᖃᓯᓪᓚᑦ	Natiit										8			8 ± 2
Ringed seal	ᓇᕐᓂᑦ	Natiinat	505	294	120	112	265	246	152	275	248	141	98	308	2,764 ± 117
Bearded seal	ᐅᑭᐊᕆᑦ	Ukyuk	1		14	7	3	1							26 ± 4
Harp seal	ᖃᐅᓯᓪᓚᑦ	Qairulik				5	3			1					9 ± 2
Walrus	ᐊᐅᓴᒃᑦ	Akvik		1											1 ± 1
Narwhal	ᑐᓗᓪᓚᑦ ᖃᓪᓗᓐᓄᑦ	Tuugaak			3		5								8 ± 2
Snow goose	ᑲᖕᒍᐅᑦ	Kanguq	30	6	44	19								1	100 ± 19
Canada goose	ᓄᖕᓪᓚᑦ	Nikliknik	13	1		1								9	24 ± 4
Eider duck	ᒥᑎᑦ	Kingalik			38	90	119	2						1	250 ± 40
Common loon	ᑐᑦᓪᓚᑦ	Tuulik					1								1 ± 1
Red-throated loon	ᖃᓐᓗᐅᑦ	Qaqhuaq		19											19 ± 6
Ptarmigan	ᐊᕐᓕᑦ	Akilgik	143			4	209	258	83	35	38	28	95	266	1,159 ± 80
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᓚᖕᓂᖏᑦ	Manniit		1											1 ± 0
Goose eggs	ᑲᖕᒍᐅᑦ ᓚᖕᓂᖏᑦ	Uluaguliit manniit	409	14											423 ± 65
Arctic tern eggs	ᐃᒥᖕᔪᑕᐃᒪᐃᑦ ᓚᖕᓂᖏᑦ	Emitkutailat manniit		24											24 ± 14
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᖕᓂᖏᑦ	Nauyat manniit	20												20 ± 6
Arctic char	ᐃᖃᓗᓴᒪᑦ	Ikaliviit	976	362	971	52	618	1,719		77	138	671	717	650	6,951 ± 414
Cod	ᐅᒪᐃᑦ	Ugak	16	15	2										33 ± 11
Sculpin	ᑲᓇᕆᐃᑦ	Kanayuk	289	182	89			3						26	589 ± 71
Turbot	ᖃᓕᓴᓪᓚᑦ	Nataarnak								27	13	10	16	43	109 ± 31
Clams	ᐊᓚᒧᒪᕐᓂᖅ	Uviluq		614	155	143	63	5,961	35						6,971 ± 875

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᓴᑦ ᑎᑎᕋᐅᒪᓕᖅᑐᑦ ᑐᓂᓯᖏᑦ ᐅᑉᓯᐊ ᐃᑯᐊᕋᓕᓚᓂᓴᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 56

Monthly hunter response

ᑕᖏᑕᒪᑦ ᐊᖑᓚᓗᓂᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᒃᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

6.1.3

Month/ᑕᖏᖑᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑲᐃᓂ	NOV ᐃᓕᒃᓗᓂ	DEC ᑎᓯᕐᓗᓂ	JAN ᒎᓄᐊᓂ	FEB ᕕᖕᒧᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖑᓚᓗᓂᑦ ᑭᐅᓂᖏᑦ ᐊᑎᔪᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒪᑦ ᐊᖑᓚᓗᓂᑦ	Tatkitaman angunahuktut titigait	144	149	152	152	166	173	177	176	175	185	191	192	198*
Hunters interviewed	ᐊᖑᓚᓗᓂᑦ ᐊᐱᔪᓪᓚᑦ	Angunahuktin apikhuktan	131	141	143	142	154	165	133	165	161	180	181	186	194*
Harvested	ᐊᖑᓚᓗᓂᑐᓂᓕᓂ	Angujaujut	110	65	67	51	81	83	37	62	66	56	58	75	171*
Response Rate (%)	ᑭᐅᔭᓂ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	91	95	94	93	93	95	75	94	92	97	95	97	93**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖑᓚᓗᓂᑦ ᐊᑎᓕᐅᑉᐳᒪᓕᕐᓂᑦ/ᐊᐱᔪᓪᓚᑦ/ᐊᖑᓚᓗᓂᑐᓂᓕᓂ ᐊᑕᐅᓯᐊᔪᓪᓗᑎᑎᓂᑦ ᐊᒃᔪᒍ.
** ᐊᐅᔨᓕᓪᓚᕐᒪᓕᕐᓂ ᑕᖏᑕᒪᑦ ᑭᐅᔭᓂ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 57

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔭᑦ ᐊᑯᕐᖏᓂ ᐊᖑᓚᓗᓂᒋᑦᑐᖓᓂᒃᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᑦᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖑᓚᓗᓂᒋᑦᑕ ᑎᑎᕐᑦᑕᐅᒪᔭᑦ

Year 1 (June 1996 - May 1997)

ᐊᒃᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖏᖑᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑲᐃᓂ	NOV ᐃᓕᒃᓗᓂ	DEC ᑎᓯᕐᓗᓂ	JAN ᒎᓄᐊᓂ	FEB ᕕᖕᒧᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔭᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	100	99	100	100	100	100	100	88	100	100	100	100	99
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	0	1	0	0	0	0	0	12	0	0	0	0	1

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 58

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓚᖅᑎᑦ ᐊᖓᔪᓚᖅᓯᕐᒧᑦ ᐊᑐᓂᖅ ᐅᒪᔨᖏᓂᖅ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 1 (June 1996 - May 1997)

ᐊᒃᑯᒍ 1 (ᔪᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖃᖅ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒃᔨᑎᑎ	SEP ᓯᑎᐱᓗᓂ	OCT ᐅᑲᐱᓗᓂ	NOV ᐅᓇᒃᐱᓗᓂ	DEC ᑎᓯᒃᐱᓗᓂ	JAN ᒍᖏᓇᐊᓗᓂ	FEB ᓇᖕᖏᐊᓗᓂ	MAR ᒪᓯᓕ	APR ᐃᓴᓚᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓕᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃ	Tuktut	7	1	11	2		10	2	4	8	18	16	22	62
Polar bear‡‡	ᓇᓄᐃᓴᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᓴᑦ	Amagut												2	2
Arctic fox	ᑎᓗᓚᖓᓂᐊᑦ	Tigiganiat			1		2	8	6	5	3	1	2	1	16
Coloured fox	ᖃᐃᖏᕐᒡᒍᑦ ᑎᓗᓚᖓᓂᐊᑦ	Kalaliit tigiganiat										2			2
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik	2		2	3		2			2	2	3	8	21
Seals (unspecified)	ᓂᖃᐃᓪᓕᑦ	Natiit										3			3
Ringed seal	ᓇᕐᓂᑦ	Natiinat	77	42	48	41	46	61	29	57	57	34	30	37	138
Bearded seal	ᐅᑦᔪᐃᓴᑦ	Ukyuk	1		9	6	3	1							14
Harp seal	ᖃᐃᕈᓪᓕᑦ	Qairulik				5	3			1					9
Walrus	ᐊᐃᐅᓵᑦ	Akvik		1											1
Narwhal	ᑐᙵᓪᓕᑦ ᕈᓪᓗᓕᑦ	Tuugaak			1		5								6
Snow goose	ᑲᖏᐃᓴᑦ	Kanguq	14	4	7	2								1	27
Canada goose	ᓂᖅᓪᓕᑦ	Nikliknik	8	1		1								6	15
Eider duck	ᒥᑎᑦ	Kingalik			13	15	28	1						1	41
Common loon	ᑐᑦᓪᓕᑦ	Tuulik					1								1
Red-throated loon	ᖃᖕᓗᐅᑦ	Qaqhuaq		3											3
Ptarmigan	ᐊᕈᓕᑦ	Akilgik	19			1	19	26	5	4	7	9	21	35	72
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᒪᓕᓂᖏᑦ	Manniit		1											1
Goose eggs	ᑲᖏᐃᓴᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit	24	4											28
Arctic tern eggs	ᐃᒥᖕᔪᑕᓚᓴᑦ ᒪᓕᓂᖏᑦ	Emitkutailat manniit		2											2
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓕᓂᖏᑦ	Nauyat manniit	6												6
Arctic char	ᐃᖕᓄᑲᓕᑦ	Ikaliviit	45	21	29	4	36	17		1	2	9	9	32	112
Cod	ᐅᒪᐃᑦ	Ugak	3	6	1										9
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	14	14	6			1						3	31
Turbot	ᖃᓕᕆᓪᓕᑦ	Nataarnak								1	1	1	1	1	1
Clams	ᐊᒃᒍᒪᔪᑦ	Uviluq		2	2	1	2	19	1						23

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕆᒪᔪᓂᖅ ᐱᑕᖖᖏᑐᖅ ᐱᓴᔪᑎᓕᓂᖅ ᐊᖓᔪᖅᑕ ᖃᖏᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᖅᓄᑦ ᐊᖓᔪᖅᓄᑦ ᓇᓄᐃᓕᓐᓂᒃᑯᑦ ᑐᓂᓴᖏᓐᓂᒃ ᐃᓄᐃᕐᓂᓕᓕᒫᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.3

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 59

Monthly harvest estimates

ᑕᖏᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓱᓕᕆᑦ

Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)

ᐊᑎᕐᒍ 2 (ᔮᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

6.1.3

Month/ᑕᖏᖓ/Tatkia			JUN ᔮᓂ	JUL ᔮᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓚᐱᓗ	DEC ᑎᓯᓚᐱᓗ	JAN ᔨᖏᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᓯ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	7		20	7	2	29	17	15	53	104	80	53	387 ± 21
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡							6	3		3	1		13
Wolf	ᐊᒪᓗᐃᑦ	Amagut									2	2	1	1	6 ± 1
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat				3	2	9	10	3	4	6	1		38 ± 3
Coloured fox	ᖃᐅᖕᖏᑦᑐᑦ ᑎᓕᓴᖅᓂᐊᑦ	Kalaliit tigiganiat			1			1		1	2				5 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	3	1	2	6	2	1	1	5	1	6	12	15	55 ± 5
Ringed seal	ᓇᕆᑦ	Natiinat	691	165	107	99	103	195	219	289	121	94	43	109	2,235 ± 75
Bearded seal	ᐅᑉᐊᐃᑦ	Ukyuk	1	5	5	4	2	1							18 ± 2
Harp seal	ᖃᐃᓕᓪᓚᑦ	Qairulik			1	2	4	1							8 ± 1
Narwhal	ᑐᒻᓪᓚᑦ ᖁᓪᓗᓴᑦ	Tuugaak				9	1	1							11 ± 1
Beluga	ᖃᐅᕆᑦ ᖁᓪᓗᓴᑦ	Kilalugak			1										1 ± 1
Snow goose	ᑲᖏᐃᑦ	Kanguq	14	58	72	5									149 ± 19
Canada goose	ᓂᕆᓪᑦ	Nikliknik	13	10										13	36 ± 5
Brant goose	ᓂᕆᓪᓇᐃᑦ	Nirlirnaq	2			1									3 ± 1
Eider duck	ᒥᑎᑦ	Kingalik	2	14	19	23	13	5							76 ± 8
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq	1		3	3									7 ± 2
Thick-billed murre	ᐊᕐᕿᐃᑦ	Thick-billed murre					1								1 ± 0
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	9		2	3	382	582	192	202	82	155	32	177	1,818 ± 93
Goose eggs	ᑲᖏᐃᑦ ᒪᓂᖅᑦ	Uluaguliit manniit	302	16											318 ± 55
Duck eggs	ᒥᑎᑦ ᒪᓂᖅᑦ	Tinmiat manniit		12											12 ± 3
Arctic tern eggs	ᐃᒥᖃᑯᓪᓚᐃᑦ ᒪᓂᖅᑦ	Emitkutailat manniit		11											11 ± 2
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓂᖅᑦ	Nauyat manniit	22												22 ± 4
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	809	535	301	122	403	178	1,840	545	592	1,996	953	408	8,682 ± 537
Least cisco	ᒥᑭᓂᖏᖅ ᑲᕕᓯᓗᒃ	Eetuuk									1				1 ± 1
Cod	ᐅᒪᐃᑦ	Ugak	135			2						4		2	143 ± 47
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk	1,311	3,857	99	27						20	32	30	5,376 ± 1341
Turbot	ᖃᓕᕆᓪᑦ	Nataarnak											91	98	189 ± 97
Clams	ᐊᑉᒧᒪᔪᑦ	Uviluq		6,397			57	7,612							14,066 ± 2,018

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᐃᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᓴᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓚᕆᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 60

Monthly hunter response

ᑕᖏᑕᒪᑦ ᐊᖓᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)

ᐊᑦᕿᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᑦᔪᑎ	SEP ᓯᑎᑦᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᐊᑦᐱᓗ	DEC ᑎᓯᑦᐱᓗ	JAN ᒍᖃᓄᓗ	FEB ᐃᖏᐅᓗ	MAR ᒪᕐᔪ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᐅᑦ Tamakiklugin
Hunter Response Categories	ᐊᖓᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᔪᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒪᑦ ᐊᖓᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	194	191	191	191	193	198	201	202	201	201	200	202	213*
Hunters interviewed	ᐊᖓᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	189	187	187	185	186	194	194	197	195	195	192	193	211*
Harvested	ᐊᖓᔪᓂᒃᑐᒥᓂᓂ	Angujaujut	103	61	35	40	55	60	70	70	55	54	43	60	171*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	97	98	98	97	96	98	97	98	97	97	96	96	97**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖓᔪᓂᒃᑎᑦ ᐊᑎᓂᐅᑦᑕᒪᓕᕐᓂᑦ/ᐊᐱᕐᓂᑦᑕᑦ/ᐊᖓᔪᓂᒃᑐᒥᓂᓂ ᐊᑕᐅᓂᐊᖅᓗᓂᑎᑦ ᐊᑦᕿᒧᑦ.
** ᐊᑦᓴᒋᓂᑎᓂᒪᓕᕐᓂᑦ ᑕᖏᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 61

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᕐᓂᑦ ᐊᑯᕐᖃᓄ ᐊᖓᔪᓂᒃᑎᖓᓂᒃᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓂᒃᑕ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᑕᐅᑦ ᐊᖓᔪᓂᒃᑎᖓᑕᑦ ᑎᑎᕐᑎᑦᑕᐅᓂᖏᓂᒃ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)

ᐊᑦᕿᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᑦᔪᑎ	SEP ᓯᑎᑦᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᐊᑦᐱᓗ	DEC ᑎᓯᑦᐱᓗ	JAN ᒍᖃᓄᓗ	FEB ᐃᖏᐅᓗ	MAR ᒪᕐᔪ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᐅᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᕐᓂᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	99	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	1	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔾᔨᐅᑦ/NAUNAIKUTA 62

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓯᒃᑎᑦ ᐊᖓᔪᓯᒃᑭᕐᒍᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 2 (June 1997 - May 1998)

ᐊᒃᑲᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

6.1.3

Month/ᑕᖏᖅ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᐃ	AUG ᐊᐅᓚᔅᑎᑎ	SEP ᓱᑎᕕᓗ	OCT ᐅᑦᔪᓗ	NOV ᐅᓇᕕᓗ	DEC ᑎᓯᕕᓗ	JAN ᔮᖅᓇᐊᓗ	FEB ᓇᖏᐅᐊᓗ	MAR ᒪᓯ	APR ᐃᑦᓂᓪ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	3		6	3	1	8	5	5	15	18	15	17	54
Polar bear#	ᓇᓄᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓱᐃᑦ	Amagut									1	1	1	1	4
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat				1	2	6	6	2	3	5	1		19
Coloured fox	ᖃᐅᖅᖏᑦᑐᑦ ᑎᓕᓴᖅᓂᐊᑦ	Kalaliit tigiganiat			1			1		1	1				4
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik	3	1	2	3	1	1	1	3	1	4	6	8	27
Ringed seal	ᓇᕆᑦ	Natiinat	79	35	26	22	30	41	56	60	40	22	13	25	138
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	1	4	5	4	1	1							14
Harp seal	ᖃᐃᓱᓪᓕᑦ	Qairulik			1	2	3	1							6
Narwhal	ᑐᒻᓪᓕᑦ ᖁᓪᓗᓕᑦ	Tuugaak				9	1	1							11
Beluga	ᖃᐅᕐᑦ ᖁᓪᓗᓕᑦ	Kilalugak			1										1
Snow goose	ᑲᖏᐃᑦ	Kanguq	7	10	8	2									22
Canada goose	ᓂᕆᓪᑦ	Nikliknik	9	2										6	14
Brant goose	ᓂᕆᓪᓇᐃᑦ	Nirlirnaq	1			1									2
Eider duck	ᒥᑎᑦ	Kingalik	2	7	9	10	7	1							29
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq	1		1	1									3
Thick-billed murre	ᐊᕐᕕᐃᑦ	Thick-billed murre					1								1
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	8		1	2	26	34	17	15	6	15	9	21	71
Goose eggs	ᑲᖏᐃᑦ ᒪᓕᓂᖅᑦ	Uluaguliit manniit	10	2											11
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖅᑦ	Tinmiat manniit		1											1
Arctic tern eggs	ᐃᒥᖏᑯᓪᓚᐃᑦ ᒪᓕᓂᖅᑦ	Emitkutailat manniit		2											2
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓕᓂᖅᑦ	Nauyat manniit	4												4
Arctic char	ᐃᖏᓄᐸᐃᑦ	Ikaliviit	28	26	12	12	18	4	9	4	5	22	11	22	89
Least cisco	ᒥᑭᓂᖏᖅ ᑲᕕᓯᓕᓄ	Eetuuk									1				1
Cod	ᐅᒪᐃᑦ	Ugak	8			1						2		1	12
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	21	10	3	2						2	4	4	33
Turbot	ᖃᓕᕆᓪᑦ	Nataarnak											1	1	1
Clams	ᐊᑦᒧᒪᔨᑦ	Uviluq		5			1	10							14

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕆᓯᒪᔨᓄᑦ ᐱᑕᖃᖏᕐᑐᖅ ᐱᓵᐊᑎᓪᓂᓄᑦ ᐊᖏᔪᑦ ᖃᕆᑲᓂᖏᖅᓄᑦ ᐊᓚᔪᓄᑦ ᓇᓪᓕᖅᐳᒪᔨᓄᑦ ᐃᓕᓴᕐᓂᐊᕐᓇᖅᑐᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 63

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ

Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)

ᐊᓕᖅᔪᒍ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔮᓂ	JUL ᔮᓕᐃ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑦᐱᓇ	NOV ᐅᓂᐱᓇ	DEC ᑎᓯᐱᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᓯ	APR ᐃᓪᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	39	22	23	8		17	61	20	72	34	45	13	354 ± 15
Wolf	ᐊᒪᓕᐅᐃᑦ	Amagut										1		1	2 ± 1
Arctic fox	ᑎᓇᓚᖅᓂᐊᑦ	Tigiganiat						2	2	2					6 ± 1
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓇᓚᖅᓂᐊᑦ	Kalaliit tigiganiat					1	1				1			3 ± 1
Arctic hare	ᐅᖃᓕᑦ	Ukalik	12		1	8	6	6	1	5	3	8	5	8	63 ± 3
Ringed seal	ᓇᕆᔨᑦ	Natiinat	425	135	165	72	71	109	120	138	63	45	35	59	1,437 ± 41
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk		7	10									3	20 ± 2
Harp seal	ᖃᐃᓕᓂᑦ	Qairulik		3	10	4	5	4							26 ± 2
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit												1	1 ± 1
Narwhal	ᑐᐊᓕᑦ ᕿᓕᓗᑦ	Tuugaak		2	4	12	2								20 ± 2
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	37			3								1	41 ± 5
Canada goose	ᓂᖅᓕᑦ	Nikliknik	41											6	47 ± 6
Eider duck	ᒥᑎᑦ	Kingalik	4	14	20	4	8	19	4					13	86 ± 9
Red-throated loon	ᖃᖓᓚᐅᑦ	Qaqhuaq		4											4 ± 1
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre					4								4 ± 1
Ptarmigan	ᐊᕕᓚᑦ	Akilgik	75	1			12	177	330	416	218	96	35	74	1,434 ± 50
Sandhill crane	ᑕᑎᖏᖅᔨᐊᖐ	Tatilgaq												1	1 ± 1
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓂᓂᖅᑦ	Uluaguliit manniit	48												48 ± 5
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᖅᑦ	Tinmiat manniit		25											25 ± 5
Arctic tern eggs	ᐃᒥᖏᑕᒪᓕᐃᑦ ᒪᓂᓂᖅᑦ	Emitkutailat manniit			3										3 ± 1
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓂᓂᖅᑦ	Nauyat manniit	33												33 ± 5
Arctic char	ᐃᖏᓗᐸᐃᑦ	Ikaliviit	1,569	617	926	28	504	1,036	981	190	1,356	583	2,081	571	10,442 ± 549
Burbot	ᑎᐢᑕᓖᑲ	Tiktaaliq	1												1 ± 0
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᕐᓂᓕᑦ	Kapihilik					40								40 ± 7
Cod	ᐅᒪᐃᑦ	Ugak	59	14										168	241 ± 26
Sculpin	ᑲᓇᔨᐃᑦ	Kanayuk	1,019	148	67	55								36	1,325 ± 85
Turbot	ᖃᓕᕆᓂᑦ	Nataarnak									46	43			89 ± 31
Clams	ᐊᒡᒧᒪᔪᑦ	Uviluq	1	944	51			8,256	543						9,795 ± 1,077

6.1.3

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 64

Monthly hunter response

ᑕᖏᑕᒪᑦ ᐊᖏᔪᓇᖅᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᒃᕿᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

6.1.3

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑲᕐᓗ	NOV ᓄᐊᕐᓗ	DEC ᑎᓯᕐᓗ	JAN ᔮᖅᓄᓘ	FEB ᐃᖏᐅᓘ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓪᓚ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᖅᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᔨᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒪᑦ ᐊᖏᔪᓇᖅᑎᑦ	Tatkitaman angunahuktut titigait	208	206	206	205	206	204	202	202	204	204	205	205	214*
Hunters interviewed	ᐊᖏᔪᓇᖅᑎᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	202	202	200	201	203	201	200	200	200	198	201	201	210*
Harvested	ᐊᖏᔪᓇᖅᑐᒥᓂᓪᓂ	Angujaujut	110	56	65	45	45	58	45	47	45	26	46	55	161*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	97	98	97	98	99	99	99	99	98	97	98	98	98**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᖅᑎᑦ ᐊᑎᓕᐅᕐᑕᒪᓕᕐᓂᑦ/ᐊᐱᕐᓯᑦᑐᑦ/ᐊᖏᔪᓇᖅᑐᒥᓂᓪᓂ ᐊᑕᐅᓯᐊᕆᔨᑐᑎᓪᓗᒍ ᐊᒃᕿᒍ.
** ᐊᐅᔪᓂᓕᕐᒪᓚᕐᔪᑦ ᑕᖏᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 65

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᕐᖏᓂ ᐊᖏᔪᓇᓚᐅᖓᓂᒃᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓯᑦᑕᐅᓂᖏᓂᒃ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓇᓚᑦᑕᑦ ᑎᑎᕐᕕᑦᑕᐅᒪᔪᑦ

Year 3 (June 1998 - May 1999)

ᐊᒃᕿᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑲᕐᓗ	NOV ᓄᐊᕐᓗ	DEC ᑎᓯᕐᓗ	JAN ᔮᖅᓄᓘ	FEB ᐃᖏᐅᓘ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓪᓚ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑕᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑕᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 66

Number of hunters harvesting each species — **Year 3 (June 1998 - May 1999)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᒃᑎᑦ ᐊᖏᔪᓚᒃᓴᒍᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒃᑭᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 3 (June 1998 - May 1999)**

Month/ᑕᖅᖑᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓱᑎᕕᓗ	OCT ᐅᑲᕕᓗ	NOV ᐅᓇᒃᕕᓗ	DEC ᑎᓯᕕᓗ	JAN ᒍᖏᓄᓗ	FEB ᓇᖅᑐᓗ	MAR ᒪᔪ	APR ᐃᔪᓚ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	12	4	11	3		5	10	5	19	9	18	6	53
Wolf	ᐊᒪᓗᐃᑦ	Amagut										1		1	2
Arctic fox	ᑎᓗᓚᖏᓂᐊᑦ	Tigiganiat						2	2	2					4
Coloured fox	ᖃᓄᖏᑦᑐᑦ ᑎᓗᓚᖏᓂᐊᑦ	Kalaliit tigiganiat					1	1				1			3
Arctic hare	ᐅᖃᓕᑦ	Ukalik	7		1	6	5	4	1	5	3	5	4	6	36
Ringed seal	ᓇᕆᑦ	Natiinat	77	38	48	34	28	40	27	41	18	11	11	18	126
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk		7	9									3	18
Harp seal	ᖃᐃᓕᓂᑦ	Qairulik		3	6	4	4	4							19
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit												1	1
Narwhal	ᑐᐊᓂᑦ ᖁᓪᓗᓕᑦ	Tuugaak		2	4	11	2								16
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	15			2								1	18
Canada goose	ᓂᖅᓂᑦ	Nikliknik	12											3	13
Eider duck	ᒥᑎᑦ	Kingalik	3	4	6	2	1	4	1					3	19
Red-throated loon	ᖃᖓᓚᐅᑦ	Qaqhuaq		3											3
Thick-billed murre	ᐊᕐᐸᐃᑦ	Thick-billed murre					3								3
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	14	1			4	18	17	15	20	9	10	16	59
Sandhill crane	ᑕᑎᓚᕋᐊᖐ	Tatilgaq												1	1
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᐟᓂᖏᑦ	Uluaguliit manniit	9												9
Duck eggs	ᒥᑎᑦ ᓚᐟᓂᖏᑦ	Tinmiat manniit		2											2
Arctic tern eggs	ᐃᒥᖕᓂᑕᓚᐃᑦ ᓚᐟᓂᖏᑦ	Emitkutailat manniit			1										1
Seagull eggs	ᓇᐅᐅᐃᑦ ᓚᐟᓂᖏᑦ	Nauyat manniit	6												6
Arctic char	ᐃᖕᓄᑦᐲᑦ	Ikaliviit	44	21	21	4	14	9	5	1	7	7	26	32	96
Burbot	ᑎᑦᒋᓕᒃ	Tiktaaliq	1												1
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᔪᓂᑦ	Kapihilik					3								3
Cod	ᐅᒪᐃᑦ	Ugak	8	1										7	16
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk	40	13	4	1								4	52
Turbot	ᖃᓕᕆᓂᑦ	Nataarnak									1	1			1
Clams	ᐊᑦᒧᒪᓚᑦ	Uviluq	1	4	1			10	2						14

6.1.3

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 67

Monthly harvest estimates

ᑕᕿᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᕿᑎᑦ

Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)

ᐊᓐᖁᔭᒍ 4 (ᔮᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

6.1.3

Month/ᑕᕿᖓ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᔨᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᑐᓗ	NOV ᐅᓇᓚᐱᓗ	DEC ᑎᓯᓚᐱᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓇᕐᑐᐊᓗ	MAR ᒪᓕᓴ	APR ᐃᓕᓴ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	8	4	3	22		71	44	11	112	46	37	42	400 ± 18
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡					11					1			12
Wolf	ᐊᒪᓱᐃᑦ	Amagut										1			1 ± 0
Arctic fox	ᑎᓗᒃᑖᐊᑦ	Tigiganiat						1	5	7	3	5			21 ± 4
Coloured fox	ᖃᐅᓐᖓᑦ ᑎᓗᒃᑖᐊᑦ	Kalaliit tigiganiat						2		1					3 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	11	2		8	3			1	3	9	3	13	53 ± 4
Seals (unspecified)	ᓂᖃᓪᓚᑦ	Natiit					1								1 ± 0
Ringed seal	ᓇᓂᓪ	Natiinat	269	501	135	158	151	111	101	110	61	43	44	200	1,884 ± 72
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		2	10	3	4		1	2					22 ± 2
Harp seal	ᖃᐃᓱᓪᓚᑦ	Qairulik				5	5								10 ± 2
Narwhal	ᑐᒍᓪᓚᑦ ᖁᓪᓗᒍᑦ	Tuugaak					4							1	5 ± 1
Snow goose	ᑲᖏᐃᑦ	Kanguq	18	2	10									1	31 ± 4
Canada goose	ᓄᑦᓪᓚᑦ	Nikliknik	19	4	4	2								5	34 ± 3
Eider duck	ᑎᑎᑦ	Kingalik		3	23	5	44		3					1	79 ± 9
Red-throated loon	ᖃᖅᓗᐅᑦ	Qaqhuaq		2											2 ± 0
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	46	2			59	119	70	41	31	72	49	42	531 ± 25
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓇᖏᑦ	Uluaguliit manniit	31	10											41 ± 5
Duck eggs	ᑎᑎᑦ ᒪᓐᓇᖏᑦ	Tinmiat manniit		5											5 ± 1
Arctic tern eggs	ᐃᒥᖃᓂᑕᓪᓕᐃᑦ ᒪᓐᓇᖏᑦ	Emitkutailat manniit		1											1 ± 1
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓐᓇᖏᑦ	Nauyat manniit	67	6											73 ± 13
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	702	728	315	116	1,644	451	2,112		933	924	658	799	9,382 ± 501
Arctic cisco	ᑭᐳᑦᑐᒥ ᑲᐱᓂᑦ	Kapihilik						3							3 ± 1
Cod	ᐅᒪᐃᑦ	Ugak	28	95	2									588	713 ± 108
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	92	583	146	16						11		60	908 ± 57
Turbot	ᖃᓕᕆᓪᓚᑦ	Nataarnak									12				12 ± 6
Clams	ᐊᒃᒍᒪᔪᑦ	Uviluq		5,945	154		395	8,563							15,057 ± 1,228

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᓴᑦ ᑎᑎᕐᑕᒪᓚᔪᑦ ᑐᓂᖅᑭᑦ ᑭᐳᐃᑦ ᐃᑯᐊᕐᓂᓕᕆᓂᖅᑕᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 68

Monthly hunter response
ᑕᖏᑕᒪᑦ ᐊᖏᔪᓇᒃᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᑦᖁᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖏᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᑎ	SEP ᓯᑎᕐᓚᓪ	OCT ᐅᑐᕐᓚᓪ	NOV ᐃᓇᒪᕐᓚᓪ	DEC ᑎᓯᒪᕐᓚᓪ	JAN ᔮᖅᓄᐊᓪ	FEB ᓇᖕᐅᐊᓪ	MAR ᒪᕐᔾ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑲᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒪᑦ ᐊᖏᔪᓇᒃᑎᑦ	Tatkitaman angunahuktut titigait	208	210	210	208	208	208	211	214	212	210	208	210	223*
Hunters interviewed	ᐊᖏᔪᓇᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	206	206	206	198	203	204	206	207	204	203	203	205	220*
Harvested	ᐊᖏᔪᓇᒃᑎᑐᓄᑦ	Angujaujut	49	64	60	49	66	56	42	34	39	40	32	87	161*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	99	98	98	95	98	98	98	97	96	97	98	98	97**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᒃᑎᑦ ᐊᑎᓕᐅᑎᒪᔨᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓇᒃᑎᑐᓄᑦ ᐊᑕᐅᓂᐊᕐᓗᑎᑎᓪ ᐊᑦᖁᒥ.
** ᐱᖓᓂᒃᑎᓂᒪᓕᒃᑎᑦ ᑕᖏᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 69

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᖏᓂ ᐊᖏᔪᓇᓐᓂᖏᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓇᒃᑦ ᑎᑎᕐᑦᑕᐅᒪᔨᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)
ᐊᑦᖁᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖏᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᑎ	SEP ᓯᑎᕐᓚᓪ	OCT ᐅᑐᕐᓚᓪ	NOV ᐃᓇᒪᕐᓚᓪ	DEC ᑎᓯᒪᕐᓚᓪ	JAN ᔮᖅᓄᐊᓪ	FEB ᓇᖕᐅᐊᓪ	MAR ᒪᕐᔾ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑲᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑲᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 70

Number of hunters harvesting each species — **Year 4 (June 1999 - May 2000)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓕᓴᒃᑎᑦ ᐊᖏᔪᓕᓴᒃᑲᓪᓕᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ — **ᐊᒃᖏᔪᒍ 4 (ᔦᓂ 1999 - ᒪᐃ 2000)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 4 (June 1999 - May 2000)**

6.1.3

Month/ᑕᖑᖏᑦ/Tatkia			JUN ᔦᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᔅᑎᑎ	SEP ᓯᑎᐱᓗᓂ	OCT ᐅᑦᑐᓗᓂ	NOV ᓄᓇᒃᓱᓂ	DEC ᑎᓯᒃᓱᓂ	JAN ᔮᖅᓄᐊᓂ	FEB ᓇᖕᖏᐊᓂ	MAR ᒪᓯᓗ	APR ᐃᓕᓴᕐ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	2	2	2	9		18	8	4	16	11	11	11	52
Polar bear##	ᓇᓄᐃᑦ##	Nanuit##	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐅᐃᑦ	Amagut										1			1
Arctic fox	ᑎᓗᓚᖓᓂᐊᑦ	Tigiganiat						1	3	2	2	3			6
Coloured fox	ᖃᐅᖓᑖᑦ ᑎᓗᓚᖓᓂᐊᑦ	Kalaliit tigiganiat						2		1					2
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik	5	1		4	3			1	2	7	2	8	27
Seals (unspecified)	ᓱᖏᑦᓪᓚᑦ	Natiit					1								1
Ringed seal	ᓇᓱᑦ	Natiinat	38	45	44	38	40	37	26	27	18	18	13	32	122
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		2	6	3	4		1	2					15
Harp seal	ᖃᐃᕐᓪᓚᑦ	Qairulik				4	5								8
Narwhal	ᑐᒻᓪᓚᑦ ᕈᓕᓗᓚᑦ	Tuugaak					4							1	4
Snow goose	ᑲᖏᒍᐃᑦ	Kanguq	11	1	2									1	12
Canada goose	ᓂᑦᓪᓚᑦ	Nikliknik	7	4	2	2								5	19
Eider duck	ᒥᑎᑦ	Kingalik		1	6	5	12		1					1	22
Red-throated loon	ᖃᖅᓗᐅᑦ	Qaqhuaq		1											1
Ptarmigan	ᐊᕈᓂᑦ	Akilgik	7	1			9	13	13	7	9	15	9	16	45
Goose eggs	ᑲᖏᒍᐃᑦ ᒪᓕᓂᕐᑦ	Uluaguliit manniit	4	2											6
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᕐᑦ	Tinmiat manniit		2											2
Arctic tern eggs	ᐃᒥᖏᑯᒪᓪᓚᑦ ᒪᓕᓂᕐᑦ	Emitkutailat manniit		1											1
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓕᓂᕐᑦ	Nauyat manniit	3	1											4
Arctic char	ᐃᖅᓗᑲᓂᑦ	Ikaliviit	20	26	20	4	24	9	11		6	10	17	58	105
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᐱᓂᓕᒃ	Kapihilik						1							1
Cod	ᐅᒪᐃᑦ	Ugak	3	5	2									12	19
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	11	22	11	1						1		9	40
Turbot	ᖃᓕᕆᓪᓚᑦ	Nataarnak									1				1
Clams	ᐊᒃᒍᒪᔪᑦ	Uviluq		7	2		1	14							20

No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

ᑎᑎᕆᓯᒪᔪᓂᒃ ᐱᑕᖃᖏᑦᑐᖅ ᐱᓱᐊᑎᓐᓂᓂᒃ ᐊᖏᔪᑦ ᖃᕆᑭᐅᓂᖏᓐᓄᓪᓕᑦ ᐊᓕᔪᓂᓪᓕᑦ ᐅᓇᓱᖏᓐᓂᒃ ᐃᓕᑭᐅᒪᔪᓂᓪᓕᑦ.

Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 71

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᓐᖁᒍ 5 (ᔮᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔮᓂ	JUL ᔮᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐃᓄᐹᓗ	DEC ᑎᓯᓚᓗ	JAN ᔨᖏᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑕᒥᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	8	1	29	11		24	66	18	22	13	6	24	222 ± 12
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					5						5		10
Wolf	ᐊᒪᓗᐃᑦ	Amagut							1			2		1	4 ± 1
Arctic fox	ᑎᓘᑦᓂᐊᑦ	Tigiganiat						14	6	1	1				22 ± 4
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓘᑦᓂᐊᑦ	Kalaliit tigiganiat							1	1	1				3 ± 1
Arctic hare	ᐅᒃᓪᓕ	Ukalik	9	1	3	6	11	1	4	1	2	13	5	9	65 ± 4
Ringed seal	ᓇᓯᓪᓕ	Natiinat	400	219	85	35	63	68	78	246	154	266	20	66	1,700 ± 43
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		3	1	3	3								10 ± 1
Harp seal	ᖃᐃᓗᓪᓕ	Qairulik		1		1	4	3	1				1		11 ± 1
Narwhal	ᑐᓗᓪᓕ ᖁᓪᓚᑦ	Tuugaak		17	35	2	1								55 ± 3
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	23	13	82									3	121 ± 18
Canada goose	ᓂᑦᓪᓕ	Nikliknik	28			5								20	53 ± 6
Old squaw	ᐋᑭᐊᑦᔪᐃᑦ	Aahangik				4									4 ± 1
Eider duck	ᒥᑎᑦ	Kingalik		2	11	20	114	24						1	172 ± 9
Red-throated loon	ᖃᖏᓚᐅᑦ	Qaqhuaq		2											2 ± 0
Black guillemot	ᐱᑦᐳᐅᓪᓕᑦ	Black guillemot					1								1 ± 0
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	18			8	139	399	386	73	36	26	37	7	1,129 ± 55
Sandhill crane	ᑕᑎᓴᑦᔪᐊᖏ	Tatilgaq												1	1 ± 0
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᒃᓂᖏᑦ	Uluaguliit manniit	784	3											787 ± 127
Arctic tern eggs	ᐃᒥᖕᓂᑕᓚᓪᓕᑦ ᓚᒃᓂᖏᑦ	Emitkutailat manniit		8											8 ± 1
Seagull eggs	ᓇᐅᔨᐃᑦ ᓚᒃᓂᖏᑦ	Nauyat manniit	18												18 ± 7
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	855	249	905	33	401	20	1,733	732	513	236	770	413	6,860 ± 505
Cod	ᐅᓴᐃᑦ	Ugak	90	13					1					228	332 ± 54
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	226	320	98	12			12		13			13	694 ± 40
Turbot	ᖃᓂᕆᓪᓕ	Nataarnak									22			21	43 ± 11
Clams	ᐋᓗᒍᓚᔪᑦ	Uviluq		709				57							766 ± 69

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᓚᔪᑦ ᑐᓂᔨᖏᑦ ᐅᑉᐹᐊ ᐃᑯᐱᕐᓂᐅᓕᕆᓂᖅᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 72

Monthly hunter response

ᑕᖏᑕᒻᒪᑦ ᐊᖓᔪᓚᖅᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᒡᕐᔪᒍ 5 (ᔨᓂᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

6.1.3

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒡᒍᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑯᕐᕕᓂ	NOV ᐃᓚᒡᕕᓂ	DEC ᑎᓯᕐᕕᓂ	JAN ᔮᖅᓄᐊᓂ	FEB ᕕᕙᐊᓂ	MAR ᒪᕐᔾ	APR ᐃᔨᓂᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖓᔪᓚᖅᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔨᓪᓚᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒻᒪᑦ ᐊᖓᔪᓚᖅᑎᑦ	Tatkitaman angunahuktut titigait	209	205	204	202	202	201	204	208	207	208	209	208	218*
Hunters interviewed	ᐊᖓᔪᓚᖅᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	203	203	202	198	200	197	200	204	203	206	203	205	213*
Harvested	ᐊᖓᔪᓚᖅᑐᒥᓂᑦ	Angujaujut	95	77	47	30	39	41	50	51	40	36	18	46	156*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	97	99	99	98	99	98	98	98	98	99	97	99	98**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖓᔪᓚᖅᑎᑦ ᐊᑎᓕᐅᕐᑕᒪᓕᕆᔨᑦ/ᐊᐱᕐᓂᑦ/ᐊᖓᔪᓚᖅᑐᒥᓂᑦ ᐊᑕᐅᓯᐊᕐᓗᓂᑎᑦ ᐊᒡᕐᔪᒍ.
** ᐊᐅᔨᓂᓕᕆᓚᓕᕆᔨᑦ ᑕᖏᑕᒻᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 73

Recall period between harvest and interview, expressed as % of total harvest records

Year 5 (June 2000 - May 2001)

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᓴᖅ ᐊᖓᔪᓚᖅᓯᓂᖏᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᑕ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖓᔪᓚᖅᑕᑦ ᑎᑎᕐᕕᑦᑐᒪᓕᔨᑦ

ᐊᒡᕐᔪᒍ 5 (ᔨᓂᓂ 2000 - ᒪᐃ 2001)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒡᒍᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑯᕐᕕᓂ	NOV ᐃᓚᒡᕕᓂ	DEC ᑎᓯᕐᕕᓂ	JAN ᔮᖅᓄᐊᓂ	FEB ᕕᕙᐊᓂ	MAR ᒪᕐᔾ	APR ᐃᔨᓂᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑭᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑭᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑭᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 74

Number of hunters harvesting each species — **Year 5 (June 2000 - May 2001)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓕᒃᑎᑦ ᐊᖓᔪᓕᒃᑭᕐᒃᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒻᒪᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 5 (June 2000 - May 2001)**

Month/ᑕᖑᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᔅᑎᑎ	SEP ᓯᑎᐱᓗᓂ	OCT ᐅᑲᐃᓗᓂ	NOV ᔅᓄᐱᓗᓂ	DEC ᑎᓯᐱᓗᓂ	JAN ᔭᖕᓄᐊᓂ	FEB ᓇᖕᑐᐊᓂ	MAR ᒪᕐᓯ	APR ᐃᓕᓴᕐ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	4	1	10	4		7	11	3	5	5	1	6	29
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut							1			2		1	4
Arctic fox	ᑎᓕᓴᖕᓂᐊᑦ	Tigiganiat						3	6	1	1				10
Coloured fox	ᖃᓄᖕᖏᑦᑐᑦ ᑎᓕᓴᖕᓂᐊᑦ	Kalaliit tigiganiat							1	1	1				3
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik	8	1	1	5	6	1	3	1	2	5	3	4	28
Ringed seal	ᓇᕆᑦ	Natiinat	60	47	29	17	17	22	30	46	34	32	6	19	119
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		3	1	3	2								8
Harp seal	ᖃᐃᕐᓪᓕᑦ	Qairulik		1		1	4	3	1				1		10
Narwhal	ᑐᓴᓪᓕᑦ ᖁᓪᓗᓴᑦ	Tuugaak		13	18	1	1								25
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	11	4	6									3	19
Canada goose	ᓂᖅᓪᓕᑦ	Nikliknik	12			1								9	20
Old squaw	ᐊᕆᑕᖅᓴᖅ	Aahangik				1									1
Eider duck	ᑎᑎᑦ	Kingalik		2	6	10	19	7						1	31
Red-throated loon	ᖃᖏᓗᐅᑦ	Qaqhuaq		1											1
Black guillemot	ᐱᖅᑭᐅᓪᓕᑦ	Black guillemot					1								1
Ptarmigan	ᐊᖑᓂᑦ	Akilgik	9			5	8	26	20	11	7	2	5	5	55
Sandhill crane	ᑕᑎᓘᔪᐊᖏᖅ	Tatilgaq												1	1
Goose eggs	ᑲᖏᐃᐃᑦ ᓚᖓᓂᖅᑐᑦ	Uluaguliit manniit	26	1											27
Arctic tern eggs	ᐃᒥᖕᑯᑕᓪᓕᐃᑦ ᓚᖓᓂᖅᑐᑦ	Emitkutailat manniit		1											1
Seagull eggs	ᓇᐅᔨᐃᑦ ᓚᖓᓂᖅᑐᑦ	Nauyat manniit	4												4
Arctic char	ᐃᖏᓕᒃᐲᑦ	Ikaliviit	34	16	18	6	11	3	15	4	3	4	6	20	82
Cod	ᐅᓗᐃᑦ	Ugak	6	3					1					17	26
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	22	17	4	1			1		1			5	37
Turbot	ᖃᓕᕆᓪᓕᑦ	Nataarnak									1			1	1
Clams	ᐊᒃᒪᒻᒪᔪᑦ	Uviluq		5				1							6

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕐᓯᒪᔪᓂᒃ ᐱᑕᖃᖕᖏᑦᑐᖅ ᐱᒃᔪᑎᓕᖕᓂᒃ ᐊᖓᔪᑦ ᖃᖏᓕᓂᖕᖏᓐᓄᑦ ᐊᓕᔪᖅᑕᐃᓕᓴᐅᓂᒃ ᐊᖓᔪᓄᑦ ᓇᓕᐅᕐᓇᓐᓂᒃᑯᑦ ᑐᓴᒃᖏᖕᓂᒃ ᐃᓄᐃᕐᓇᓕᓕᓐᓂᒃᑯᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 75

Annual harvest estimates and five-year mean

ᐊᓐᔪᔨᑦᑕᒡᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᑕᓴᓐᓂᑦ ᐊᓚᓗ ᑕᒻᓭᓚᓄᑦ-ᐊᓐᔪᔨᓄᑦ ᐊᐅᓐᓂᓕᕐᓂᓱᒪᓴᑦ

Aragutamat angujauvaktun tatlman araguit iluani

All Years (June 1996 - May 2001)

ᑕᒪᐃᒃᓄᑦ ᐊᓐᔪᔨᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᓐᔪᔭᓕᖅ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᓐᓂᕐᒥᓱᒪᓴᑦ Amigaitkiyait
Species	ᐅᒪᔪᑦ	**Umajuin**						
Caribou[1]	ᑐᑐᐃᐃᑦ[1]	Tuktut[1]	381	387	354	400	222	349
Polar bear[2]	ᓇᓄᐃᑦ[2]	Nanuit[2]	11	13	0	12	10	9
Wolf	ᐊᒪᓗᐃᑦ	Amagut	2	6	2	1	4	3
Arctic fox[3]	ᑎᓕᖅᓂᐊᑦ[3]	Tigiganiat[3]	92	38	6	21	22	36
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓕᖅᓂᐊᑦ	Kalaliit tigiganiat	2	5	3	3	3	3
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik	40	55	63	53	65	55
Seals (unspecified)	ᓴᖅᓄᓪᓕᑦ	Natiit	8	0	0	1	0	2
Ringed seal[4]	ᓇᕐᓂᑦ[4]	Natiinat[4]	2,764	2,235	1,437	1,884	1,700	2,004
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	26	18	20	22	10	19
Harp seal	ᖃᐃᕈᓪᓕᑦ	Qairulik	9	8	26	10	11	13
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	0	0	1	0	0	<1
Walrus	ᐊᐃᐃᓵᑦ	Akvik	1	0	0	0	0	<1
Narwhal[5]	ᑐᒡᓪᓕᑦ ᕿᓕᓚᑦ[5]	Tuugaak[5]	8	11	20	5	55	20
Beluga	ᖃᓄᖅᑕᑦ ᕿᓕᓚᑦ	Kilalugak	0	1	0	0	0	<1
Snow goose[6]	ᑲᖏᐃᐃᑦ[6]	Kanguq[6]	100	149	41	31	121	88
Canada goose	ᓂᕆᓪᓕᑦ ᐅᓗᐊᔪᓪᓕᑦ	Nikliknik	24	36	47	34	53	39
Brant goose	ᓂᕆᕐᓇᐃᑦ	Nirlirnaq	0	3	0	0	0	1
Old squaw	ᐊᑭᐊᕐᔾᔨᐃᑦ	Aahangik	0	0	0	0	4	1
Eider duck[7]	ᒥᑎᑦ[7]	Kingalik[7]	250	76	86	79	172	133
Common loon	ᑐᓪᓕᕐᔾᔨᐃᑦ	Tuulik	1	0	0	0	0	<1
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq	19	7	4	2	2	7
Black guillemot	ᐱᕐᐅᓪᓕᑦ	Black guillemot	0	0	0	0	1	<1
Thick-billed murre	ᐊᕐᐸᐃᑦ	Thick-billed murre	0	1	4	0	0	1
Ptarmigan	ᐊᖑᓂᑦ	Akilgik	1,159	1,818	1,434	531	1,129	1,214
Sandhill crane	ᑕᑎᓴᕐᔾᔨᐃᑦ	Tatilgaq	0	0	1	0	1	<1
Eggs (unspecified)	ᓚᖏᓪᓕᑦ	Manniit	1	0	0	0	0	<1
Goose eggs	ᑲᖏᐃᐃᑦ ᓚᖏᓂᖅᑕᑦ	Uluaguliit manniit	423	318	48	41	787	323
Duck eggs	ᒥᑎᑦ ᓚᖏᓂᖅᑕᑦ	Tinmiat manniit	0	12	25	5	0	8
Arctic tern eggs	ᐃᒥᖏᑯᓕᐃᑦ ᓚᖏᓂᖅᑕᑦ	Emitkutailat manniit	24	11	3	1	8	9
Seagull eggs	ᓇᐅᔨᐃᑦ ᓚᖏᓂᖅᑕᑦ	Nauyat manniit	20	22	33	73	18	33
Arctic char[8]	ᐃᖏᓗᒃᐸᑦ[8]	Ikaliviit[8]	6,951	8,682	10,442	9,382	6,860	8,463
Burbot	ᑎᑭᓪᓗᒃ	Tiktaaliq	0	0	1	0	0	<1
Arctic cisco[9]	ᐅᑭᐅᖅᑐᒥ ᑲᕐᓂᓪᓕᑦ[9]	Kapihilik[9]	0	0	40	3	0	9
Least cisco	ᒥᑭᓂᖓᑦ ᑲᕐᓂᓪᓕᑦ	Eetuuk	0	1	0	0	0	<1
Cod	ᐅᓗᐃᑦ	Ugak	33	143	241	713	332	292
Sculpin[10]	ᑲᓇᔾᐃᑦ[10]	Kanayuk[10]	589	5,376	1,325	908	694	1,778
Turbot	ᖃᓕᕆᓪᓕᑦ	Nataarnak	109	189	89	12	43	88
Clams	ᐊᓗᒧᒪᔾᔨᑦ	Uviluq	6,971	14,066	9,795	15,057	766	9,331

[1-10]: See page 201 for community feedback and other sources of data.

[1-10]: ᑕᐃᒪᐅᑉ ᒪᓕᐊᑐᓗᖕᓂ 202 ᓄᓇᓕᓪᓕᑦ ᑭᐅᔾᔨᓂᖅᑕᑦ ᐊᓚᓗᓪ ᐊᓯᖏᓂᖅᑕᑦ ᐱᓕᐅᐅᔾᔨᐃᑦ ᓇᓚᐅᑎᓪᓗᒃ.

[1-10]: Takulugu makpigaak 203 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

TABLE/ᐅᓗᐅᐃᕆᐅᑦ/NAUNAIKUTA 76

Annual hunter response

ᐊᓗᖏᔪᒪᒃ ᐊᖓᔪᓂᖅᑎᑦ ᑭᐅᓂᖏᑦ

Angujauvaktu

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓗᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Hunter Response Categories	ᐊᖓᔪᓂᖅᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑦᔪᓪᓚᓂᖏᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᖀᑦᓚᒃ ᐊᖓᔪᓂᖅᑎᑦ	Tatkitaman angunahuktut titigait	198	213	214	223	218	245*
Hunters interviewed	ᐊᖓᔪᓂᖅᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	194	211	210	220	213	240*
Harvested	ᐊᖓᔪᓂᖅᑐᒥᓂᑦ	Angujaujut	171	171	161	161	156	217*
Response Rate (%)	ᑭᐅᖅ ᖃᓕᕐᐅᓂᖏᑦ (%)	Kiujut (%)	93	97	98	97	98	97**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖓᔪᓂᖅᑎᑦ ᐊᑎᓕᐅᔨᓪᓚᑦ/ᐊᐱᕐᓂᑦ/ᐊᖓᔪᓂᖅᑐᒥᓂᑦ ᐊᑕᐅᓪᓗᓂᑎᒃ ᖃᐅᔨᓴᖅ.
** ᐊᑦᔨᒋᓕᑎᓪᓚᑦ ᐊᓗᖏᔪᑦ ᑭᐅᖅ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᐅᓗᐅᐃᕆᐅᑦ/NAUNAIKUTA 77

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᖏᓐᓄᓂᑦ ᐊᖏᔪᓂᓐᓂᖏᓐᓂᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᓂᑕ, ᐅᓗᐅᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᕐᔪᑦ ᐊᖓᔪᓂᖅᑐᑦ ᑎᑎᕐᑦᑕᐅᒪᔨᑦ

Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓗᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᖅᑕᑦ	≤ tatkin pingahut	99	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑕᑦ	tatkin hitaman 6nut	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑕᑦ	> 6 tatkin	1	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 78

Number of hunters harvesting each species
ᖃᑦᔪᐅᓂᖏᑦ ᐊᖏᔪᓇᓱᒋᑦ ᐊᖏᔪᓇᓱᒃᑯᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ
Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓂᑦ ᐊᒃᑭᒍᓂᑦ (ᔨᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᑭᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**						
Caribou	ᑐᑐᐃᑦ	Tuktut	62	54	53	52	29	106
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut	2	4	2	1	4	10
Arctic fox	ᑎᓕᖅᓂᐊᑦ	Tigiganiat	16	19	4	6	10	36
Coloured fox	ᖃᐅᖏᑦᑐᑦ ᑎᓕᖅᓂᐊᑦ	Kalaliit tigiganiat	2	4	3	2	3	10
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik	21	27	36	27	28	74
Seals (unspecified)	ᓴᖅᑯᓪᓚᑦ	Natiit	3			1		4
Ringed seal	ᓇᓕᓪᓚᑦ	Natiinat	138	138	126	122	119	190
Bearded seal	ᐅᑭᐊᐃᑦ	Ukyuk	14	14	18	15	8	47
Harp seal	ᖃᐃᕕᓪᓚᑦ	Qairulik	9	6	19	8	10	43
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit			1			1
Walrus	ᐊᐃᓴᒃ	Akvik	1					1
Narwhal	ᑐᒍᓪᓚᑦ ᖁᓪᓗᓂᑦ	Tuugaak	6	11	16	4	25	37
Beluga	ᖃᐅᓕᑦ ᖁᓪᓗᓂᑦ	Kilalugak		1				1
Snow goose	ᑲᖏᐃᑦ	Kanguq	27	22	18	12	19	63
Canada goose	ᓂᕐᓪᓚᑦ ᐅᓗᐊᔪᓪᓚᑦ	Nikliknik	15	14	13	19	20	54
Brant goose	ᓂᕐᕕᓴᐃᑦ	Nirlirnaq		2				2
Old squaw	ᐊᑭᐊᕐᕕᐃᑦ	Aahangik					1	1
Eider duck	ᒥᑎᑦ	Kingalik	41	29	19	22	31	81
Common loon	ᑐᓕᕐᕕᐊᑦ	Tuulik	1					1
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq	3	3	3	1	1	7
Black guillemot	ᐱᑦᔪᐅᓪᓚᑦ	Black guillemot					1	1
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre		1	3			4
Ptarmigan	ᐊᖑᓂᑦ	Akilgik	72	71	59	45	55	131
Sandhill crane	ᑕᑎᓚᕕᐊᑦ	Tatilgaq			1		1	2
Eggs (unspecified)	ᓚᖅᓂᑦ	Manniit	1					1
Goose eggs	ᑲᖏᐃᑦ ᓚᖅᓂᖅᑦ	Uluaguliit manniit	28	11	9	6	27	57
Duck eggs	ᒥᑎᑦ ᓚᖅᓂᖅᑦ	Tinmiat manniit		1	2	2		5
Arctic tern eggs	ᐃᒥᖏᑎᓕᐃᑦ ᓚᖅᓂᖅᑦ	Emitkutailat manniit	2	2	1	1	1	6
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᖅᓂᖅᑦ	Nauyat manniit	6	4	6	4	4	19
Arctic char	ᐃᖏᓕᒃᐱᑦ	Ikaliviit	112	89	96	105	82	174
Burbot	ᑎᑭᓪᓚᒃ	Tiktaaliq			1			1
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᐱᓪᓚᑦ	Kapihilik			3	1		4
Least cisco	ᒥᑭᓂᖓᑦ ᑲᐱᓪᓚᑦ	Eetuuk		1				1
Cod	ᐅᓗᐃᑦ	Ugak	9	12	16	19	26	59
Sculpin	ᑲᓚᔪᐃᑦ	Kanayuk	31	33	52	40	37	109
Turbot	ᖃᓕᕆᓪᓚᑦ	Nataarnak	1	1	1	1	1	1
Clams	ᐊᒃᒍᒪᔪᑦ	Uviluq	23	14	14	20	6	51

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᒪᔪᓂᒃ ᐱᑕᖃᖏᑦᑐᖃᖅ ᐱᓕᕆᑐᓂᒃ ᐊᖑᒍᑦ ᖃᕋᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᒍᓂᑦ ᓇᓂᐅᑦᓴᑎᓂᒃ ᐊᖑᒍᓂᑦ ᐊᓂᐅᔪᓐᓇᖅᑐᑦ ᐃᓄᐃᑦᓴᓕᓚᓐᓇᕐᓂᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.3 Community Results Discussion: Clyde River

The survey frame:

An assessment of under-enumeration during the community visit indicated that there were very few hunters who were not registered in the Harvest Study. It is estimated that there was one non-Inuit hunter with assigned hunting rights who was not registered, an occasional hunter. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. However, the extent of the bias is likely very small since the missing hunter represents less than one percent of the total hunter population (Table 10).

Due to the relatively small number of intensive hunters registered in Clyde River, the intensive classification was joined with the active classification for the purpose of calculating harvest estimates.

Survey coverage and non-response bias:

Response rates remained high throughout the course of the Harvest Study. As seen in Table 9 the consistent intentional non-response rate in Clyde River was 1.2%, and was not thought to contribute to potential non-response bias.

Response rates were felt to be high enough and non-response bias low enough in all years to ensure that n did in fact constitute a sufficiently representative sample of N hunters.

Measurement issues and response error:

There were no specific incidents of measurement error brought up during the community visit. However, readers should refer to Section 5.4 for a thorough discussion of this issue.

As seen in the recall period tables, the vast majority of harvest records were collected within three months of the harvest, thereby minimizing recall error.

As noted in the comments associated with arctic char below, there was commercial harvesting of char during the study. Most of these fish were reported along with the subsistence harvest and are thought to be included in the harvest estimates. However, any harvests which indicated that they were commercial were removed from the database and can be seen in Table 4.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou.
2. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
3. **Arctic fox:** The decline in harvest in year 3 was likely due to the implementation of humane trapping standards (C.F.).
4. **Ringed seal:** Harvest estimates seem accurate; harvesting will vary from year to year with weather/ice conditions and pelt prices. Seal harvesting has likely increased since the Harvest Study ended due to increasing pelt prices (C.F.).
5. **Narwhal:** Harvest estimates seem accurate (C.F.). The narwhal quota was 50 animals annually. DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
10	15	27	4	51

   There is variation from year to year with ice conditions. Fewer animals are harvested in years when ice break up is late (C.F.).
6. **Snow goose:** Harvest estimates seem accurate. The lower harvests in years 3 and 4 were likely due to poor spring weather. When weather is poor birds do not stop in the area, they just pass by (C.F.).
7. **Eider duck:** There are more king eiders around Clyde River than common eiders. Although both are harvested, king eiders are taken in larger numbers (C.F.).
8. **Arctic char:** Harvest estimates seem accurate (C.F.). There was commercial harvesting of char during the study. The community Fieldworker reported that these harvests were reported and recorded with the subsistence harvest. Harvest estimates therefore do include some of the commercial harvests in this community.
9. **Arctic cisco:** Although there are no arctic cisco in the area, hunters travel to the Kivalliq region to harvest this species (C.F.).
10. **Sculpin:** These fish are caught inadvertently when fishing for other species. Harvest estimates seem accurate (C.F.)

6.1.3 ᓄᓇᕗᑦ ᓴᖅᑭᑕᐅᔭᓂᒃ ᐅᖃᖅᑎᑐᑎᑦ: ᑲᑎᖅᑐᓕᕆᓂ

ᖃᐅᔨᓴᓂᐅᕙᑦ ᐊᖅᑭᐹᒪᓂᖅᓱ:

ᖃᑎᖅᑭᓂᖅᓯᒪᔭᒃ ᐊᑎᓕᐅᖅᑭᒪᔭᖅᓴᕐᕕᐊᓂᑦ ᐱᓕᕆᑦ ᓄᓇᓕ ᐊᓯᖅᑕᑭᐅᑎᓯᒪᔭᑦ ᖃᐅᔨᓴᕐᕕᖏᓂᑦ ᖃᓄᐃᓐᓇᔨᓴᕐᕕᖏᓐᓂᖅᓂᒃ ᐊᑎᖃᖅᖃᑭᐅᖅᑭᑐᑦᑕᐃᑦ ᖃᐅᔨᓴᓂᖃᖅᑎᑎᓯᒪᔭᒃ. ᐃᓕᓴᕐᕕᐊᓂᒃᑯᑦ ᐊᑕᐅᓯᕐᕕᖏᓐᓂᖅᓂᒃ ᐱᓕᕆᓂᖅᓴᓂᒃ ᐊᑎᖃᖅᖃᑭᐅᖅᑭᑐᑦᑕᐅᑉ ᐅᓪᓗᒥᒃ ᐊᑎᖃᖅᖃᑭᐅᖅᑭᑐᑦᑕᐅᑉ ᐱᓕᕆᓂᖅᓴᓂᒃ ᖃᐅᔨᓴᕐᕕᖏᓐᓂᖅᓂ

6.1.3 Nunani Iniktikhimayut Ukauhiit: Kangiktugaapik

Ihivgiukhimayut iniktigutait:
Ihivgiufaakhimayut ataani ihivgiukhimayuni nunani pulaaktakhimapluni naunaiyakhimayuk ikitut umayukhiuktit titigaktauhimaitut Umayukhiukhimayut Ihivgiugutaini. Naunaiyakhimayuk atauhik inuinaugituk umayukhiukti tuniyauhimayuk umayukhiulaagutinik inminigutinik, ilaani umayukhiukpaktuk. Ukahimayut ilangani 5.2.1 ikpinaguait hamani ataani ihivgiukhimayuk pilaaktuk ataani ihimagiyaini umayukhiukhimayut naunaiyautaini. Kihimi naunaiyautaa ihimagiyaini mikikpiaktu ilaungitut umayukhiuktit ikitkiyaumat 1%mik tamaat umayukhiuktinit (ikpatauyak 10).

Pihimanmat mikiyut amigaitjutait umayukhiunginaktut titigakhimayut Kangiktugaapikmi, umayukhiuginaktut naunaiyautait ilauhimayut umayukhiukatakunut naunaiyautainut atugutaini naunaiyakhimayut umayukhiukhimayut naunaiyautaini.

Ihivgiukhimayut pihimayut ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait angiyut tamaat pitilugit Umayukhiukhimayut Ihivgiuhimatitlugit. Takulaaktut ikpatauyami 9mi aatjikutait pikataktut kiuyuitut naunaiyautait Kangikugaapikmi 1.2%kuyut ovalo ihumagiyaungituk ilauyuk kiuyuituni ihimagiyaini.

Kiuhimayut naunaiyautait ihimagiyauyut angiyut ovalo kiuyuitut ihimagiyait mikiyut tamamik ukiuni piyaami nni pipkakhimayut naunaiyautaini Nni umayukhiuktini.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Pikangituk pihimayunit atugutingini ihuinaakhimayuni ukakhimayut nunani pulaakhimatitlugit. Kihimi taiguaktut takuyukhat ilangani.5.4 ukautigini hamna ihumagiyaini.

Takuhimayuni uktiktihimayut ubluit ikpatauyami, amigaitut umayukhiukhimayut titigakhimayut katitikhimayut iluani pingahut tatkikhiutini, taimaimat mikiyut utiktihimayut ihuinaagutait.

Titigakhimayumi ukautini mikhaanut ikaliviit hamani, kinauyaliukhimayut umayukhiuktuni ikalivinik ihivgiuktitlugit. Amigaitkiyait hapkua ilaukhimayut tuhaktitihimayut ilangani atuktakhaini ikalukhiuhimayainut ovalo ihumagiyauyut umayukhiukhimayuni naunaiyautaini. Kihimi umayukhiukhimayut titigakhimayut kinauyaliukhimayuni, unguvakhimayut katitikhimayunit ovalo takulaaktut ikpatauyami 4mi.

Nunanit ukakhimayut ovalo aalat pihimayaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukhimayut pihimayut nunani tuktut.
2. **Nanuit:** Amigaitjutait takuhimayut naunaiyautaungitut kihimi pihimayut umayukhiukhimayut amigaitkutait pihimayut DSDkunit (DSD PB).
3. **Tigiganiat:** Mikhilihimayut umayukhiukhimayuni ukiumi 3mi atulikhimagamik nutaanik nanigianik (C.F.).
4. **Natinat:** Umayukhiukhimayut naunaiyautait naamaktut; umayukhiukhimayut aalangukataniaktut ukiuni hilamut/hikumut naamagutainik ovalo amiit akiinut. Natiit umayukhiukhimayut amigailikhimayut Umayukhiukhimayut Ihivgiuktut inikmata, angiklilimatalu amiit akiit (C.F.).
5. **Tuugaat:** Umayukhiukhimayut naunaiyautait naamaktut (C.F.) Tugaaliit kilalugait kotait 50kuyut umayut ukiuk tamaat. DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait tugaaliit kilalugait (nalungilutit DFOkut katitikhimayait atukhimayut ukiungini atuktainit, Umayukhiukhimayut Ihivgiukhimayut katitikhimayait atukhimanmata umayukhiukhimayut ukiungit Junemit Maymut (DFO N/B):

96/97	97/98	98/99	99/00	00/0
10	15	27	4	51

   Naunaiyautait aalatkiitut ukiuni hikut kanugitaakhainut. Ikitkiyait umayut umayukhiukpaktut hikut ahiguktigaagat kinguvakhimapluni (C.F.).
6. **Kanguq:** Umayukhiukhimayut naunaiyautait naamaktut. Mikitkiyait umayukhiukhimayut ukiuni3mi ovalo 4mi nakuuluangimat upingaami hila. Hilaa nakuugitkaagat tingmiat nutkayuitut nunami kihimi kagiinakpaktut (C.F.).
7. **Tingmiat:** Amigaitkiyauliktut kingaliit Kangiktugaapikmi mitinit. Tamamik umayukhiugaluakhugit, kingaliit pivaktut amigaitkiyainik (C.F.).
8. **Ikaliviit:** Umayukhiukhimayut naunaiyautait naamaktut (C.F.). Kinauyaliukhimayut umayukhiuktuni ikalivini ihivgiuhimatitlugit. Nunani havaktiit tuhaktitihimayuk hapkoa umayukhiukhimayut tuhaktitihimayut ovalo titigakhimayut ilangani atuktakhaini umayukhiukhimayunut. Umayukhiukhimayut naunaiyautait ilauhimayut ilangit kinauyaliuktunut umayukhiukhimayuni hamani nunani.
9. **Kapihiliit:** Pikangitkaluakhuni arctic cisconik nunami, umayukhiuktit autlaakpaktut Kivalliqmut umayukhiukhugit hapkoa umayut (C.F.).
10. **Kanayuit:** Hapkoa ikaluit pivaktut ilaani ikalukhiuktitlugit aalanik ikalunik. Umayukhiukhimayut naunaiyautait naamaktut (C.F.).

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 79

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᓐᓴᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓚᐹᓗ	DEC ᑎᓯᓚᐹᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᒥᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut				19					5	9			33 ± 14
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait					2				9	8			19 ± 9
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡					6	1		2	2	6	4	2	23
Arctic fox	ᑎᓗᒃᑯᐊᑦ	Tigiganiat						16	1	10	7	4	1		39 ± 8
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	10	1							1	11			23 ± 19
Ringed seal	ᓇᓯᓕᑦ	Natiinat	163	77	54	147	101	57	46	77	18	70	23	42	875 ± 122
Bearded seal	ᐅᓘᔪᐃᑦ	Ukyuk			2	18	9					1		1	31 ± 8
Harp seal	ᖃᐃᓱᓪᓚᑦ	Qairulik		1	11	42	14								68 ± 19
Walrus	ᐊᐃᐃᓴᑦ	Akvik			8	3	2					1	3		17 ± 8
Narwhal	ᑐᒃᓪᑦ ᖁᓪᓗᑦ	Tuugaak					1								1 ± 0
Beluga	ᖃᓄᖅᑕ ᖁᓪᓗᑦ	Kilalugak		1											1 ± 1
Snow goose	ᑲᖏᐃᑦ	Kanguq	19	1		3									23 ± 36
Canada goose	ᓄᖅᓪᓕ	Nikliknik	38												38 ± 72
Eider duck	ᒥᑎᑦ	Kingalik		1		13	5								19 ± 8
Ptarmigan	ᐊᖏᓚᑦ	Akilgik				41					12	113		128	294 ± 60
Arctic char	ᐃᖃᓗᐊᓴᑦ	Ikaliviit	271	140	167	54	47	9					9	42	739 ± 294
Sculpin	ᑲᓕᔪᐃᑦ	Kanayuk	27	17											44 ± 41

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᐃᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᖅᖏᑦ ᐅᑎᓕᐅᑦ ᐃᓕᓴᕆᓂᖅᓱᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 80

Monthly hunter response

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᒃᓴᔪ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒃᔪᑎ	SEP ᓯᑎᒃᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ	Tatkitaman angunahuktut titigait	40	40	40	38	38	38	38	39	39	40	40	40	40*
Hunters interviewed	ᐊᖏᔪᓇᓱᒋᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	12	31	17	21	35	32	33	34	32	33	33	35	39*
Harvested	ᐊᖏᔪᓇᓱᒋᑐᓂᒃ	Angujaujut	11	21	10	18	21	13	13	20	6	20	8	15	38*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓕᑎᓂᖏᑦ (%)	Kiujut (%)	30	78	43	55	92	84	87	87	82	83	83	88	74**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᒋᑦ ᐊᑎᓕᐅᑦᑕᒪᓪᓚᕆᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓇᓱᒋᑐᓂᒃ ᐊᑕᐅᓯᐊᖃᓗᑎᑎᑦ ᐊᓕᖁᒥ.
** ᐊᐅᔨᓕᓪᓕᐅᓪᓚᕆᑦ ᑕᖅᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 81

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᖃᐃᐅᔪᑦ ᐊᑯᖃᖏᓂ ᐊᖏᔪᓇᓯᓂᖏᓐᓄᑦ ᐊᓚᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᓄᑦ, ᓇᓗᓇᐃᖃᑦᑕ ᐃᒪᓖ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓇᓱᒋᑦ ᑎᑎᖃᑦᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᒃᓴᔪ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒃᔪᑎ	SEP ᓯᑎᒃᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᖃᐃᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	100	98	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	2	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 82

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓯᖅᑎᑦ ᐊᖓᔪᓯᖅᓯᕐᒥᑦ ᐊᑐᓂᖅ ᐅᒪᔨᓂᖅ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 1 (June 1996 - May 1997)
ᐊᒻᒪᒍ 1 (ᔪᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒻᐱᓗ	DEC ᑎᓯᒻᐱᓗ	JAN ᒍᓐᓇᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᓯ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut				3					1	2			4
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait					1				1	3			3
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓗᓚᓄᐊᑦ	Tigiganiat						4	1	6	2	2	1		10
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	1	1							1	3			5
Ringed seal	ᓇᓯᓪᓚᑦ	Natiinat	10	18	8	16	21	12	13	19	5	16	7	14	38
Bearded seal	ᐅᓘᔪᐃᑦ	Ukyuk			1	8	6					1		1	15
Harp seal	ᖃᐃᓱᓪᓚᑦ	Qairulik		1	3	13	4								17
Walrus	ᐊᐃᐃᓴᑦ	Akvik			3	2	2					1	1		6
Narwhal	ᑐᒃᓪᓚᑦ ᕿᓪᓕᒪᑦ	Tuugaak					1								1
Beluga	ᖃᐅᓂᑦ ᕿᓪᓕᒪᑦ	Kilalugak		1											1
Snow goose	ᑲᖏᐃᑦ	Kanguq	1	1		2									4
Canada goose	ᓄᓕᓪᓚᑦ	Nikliknik	1												1
Eider duck	ᒥᑎᑦ	Kingalik		1		4	2								6
Ptarmigan	ᐊᕿᓚᑦ	Akilgik				2					1	9		9	16
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	4	1	3	1	3	2					2	2	14
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	1	4											5

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓚᔪᓂᖅ ᐱᑕᖃᖏᑦᑐᖃᖅ ᐱᓵᐊᒥᓪᓂᓂᖅ ᐊᖏᔪᑦ ᖃᕋᔪᐅᓂᖏᓐᓄᑦ ᐊᓚᔪᖃᒪᒐᓚᓂᖅ ᐊᖏᔪᓄᑦ ᓇᓚᐅᑦᑎᓐᓄᑎᑦ ᑐᓂᓴᖏᓐᓂ ᐃᑯᐱᕐᓚᓂᖅᑐᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.4

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 83

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓐᑎᑦ

Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)

ᐊᓕᖅᔪᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

6.1.4

Month/ᑕᖅᖏᓐᓄ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᔪᑎᑦᐱᓇ	OCT ᐅᑦᐸᓇ	NOV ᐅᓂᓴᓇ	DEC ᑎᕐᓴᓇ	JAN ᒍᖏᓂᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᕿ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓕᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᑦ	Tuktut	4	1			21		5		9				40 ± 5
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait					1						1	2	4 ± 1
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡					5	3		3	3	4	2	1	21
Wolf	ᐊᒪᓗᐃᑦ	Amagut						1							1 ± 0
Arctic fox	ᑎᓕᓴᐃᓂᐊᑦ	Tigiganiat						9	10	1	3		3		26 ± 5
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	13	3	1	1			1		5	1		5	30 ± 11
Ringed seal	ᓇᕆᔨᑦ	Natiinat	86	104	89	101	102	69	54	36	57	50	61	71	880 ± 54
Bearded seal	ᐅᑉᔾᐃᑦ	Ukyuk		6	10	4	1	1							22 ± 4
Harp seal	ᖃᐃᓗᓪᓚᑦ	Qairulik		3	11	11									25 ± 4
Walrus	ᐊᐃᐅᒃᑦ	Akvik									1				1 ± 0
Narwhal	ᑐᒻᓪᓚᑦ ᖁᓪᓗᓂᑦ	Tuugaak			1										1 ± 0
Beluga	ᖃᓄᖅᑕ ᖁᓪᓗᓂᑦ	Kilalugak				2	3								5 ± 1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	36	3	3										42 ± 14
Brant goose	ᓂᖅᓕᖅᓇᐃᑦ	Nirlirnaq	1												1 ± 1
Old squaw	ᐊᑲᕈᐊᖅᓴᐃᑦ	Aahangik	1												1 ± 1
Eider duck	ᒥᑎᑦ	Kingalik	6			10									16 ± 6
Black guillemot	ᐱᖅᓗᐅᓪᓕᑦ	Black guillemot	1												1 ± 2
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre	1												1 ± 1
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	1			111	13				23	264	122	6	540 ± 28
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	310	139									1	271	721 ± 139
Sculpin	ᑲᓇᔨᐃᑦ	Kanayuk			12										12 ± 5

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓄᑦ ᑎᑎᕋᐅᒪᔨᖅ ᑐᓂᒃᑯᑦ ᐅᑉᐳᖅᑎᑦ ᐅᑯᐊ ᐃᑯᓴᖅᓯᓕᕆᔨᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 84

Monthly hunter response

ᑕᖃᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)

ᐊᑦᔪᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᑲᔨᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑦᔪᓇ	NOV ᐃᓚᕐᓇ	DEC ᑎᓯᕐᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᕕᒡᒐᐊᓇ	MAR ᒪᔪ	APR ᐃᔪᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓕᒃ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ ᐊᑲᔪᓕᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ	Tatkitaman angunahuktut titigait	39	39	40	40	40	40	40	40	39	39	39	38	43*
Hunters interviewed	ᐊᖏᔪᓇᓱᒋᑦ ᐊᐱᔪᒪᑦ	Angunahuktin apikhuktan	28	26	39	35	38	35	36	36	39	39	38	37	42*
Harvested	ᐊᖏᔪᓇᓱᒋᑐᓂᓪᓂ	Angujaujut	17	16	25	22	27	23	20	15	20	19	22	27	40*
Response Rate (%)	ᑭᐅᔾ ᖃᓕᐅᓂᖏᑦ (%)	Kiuju (%)	72	67	98	88	95	88	90	90	100	100	97	97	90**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᒋᑦ ᐊᑎᓕᐅᑦᑕᒪᓕᔾᔪᑎᑦᑕᑦ/ᐊᐱᔪᒪᑦᑕᑦ/ᐊᖏᔪᓇᓱᒋᑐᓂᓪᓂ ᐊᑕᐅᓂᐊᖅᓗᓂᑐᑦ ᐊᑦᔪᒍᒥ.
** ᐊᓕᒍᓕᔾᔪᑎᓂᒪᓕᔾᔨ ᑕᖃᑕᒪᑦ ᑭᐅᔾ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 85

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓇᓱᓂᓂᖓᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓇᕐᑕᐅᓂᓂᖓᑕ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᑦᑎᓕᒃ ᐊᖏᔪᓇᓱᒋᑦ ᑎᑎᕐᕕᐅᒪᔾᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)

ᐊᑦᔪᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᑲᔨᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑦᔪᓇ	NOV ᐃᓚᕐᓇ	DEC ᑎᓯᕐᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᕕᒡᒐᐊᓇ	MAR ᒪᔪ	APR ᐃᔪᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓕᒃ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑳᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑳᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑳᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 86

Number of hunters harvesting each species — **Year 2 (June 1997 - May 1998)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᓴᒋᑦ ᐊᖏᔪᓚᓴᒃᑯᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒃᑦᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 2 (June 1997 - May 1998)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒃᔨᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓴᐱᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᓇᖏᐅᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑲᑐᐃᑦ	Tuktut	3	1			5		2		4				10
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait					1						1	1	3
Polar bear#	ᓇᓄᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut						1							1
Arctic fox	ᑎᓚᒃᓄᓂᐊᑦ	Tigiganiat						3	6	1	2		1		9
Arctic hare	ᐅᑲᓪᓂᑦ	Ukalik	3	1	1	1			1		3	1		3	9
Ringed seal	ᓇᓯᓪᑦ	Natiinat	14	15	21	19	27	22	18	14	13	18	20	19	38
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		4	10	4	1	1							17
Harp seal	ᖃᐃᓕᓪᓂᑦ	Qairulik		1	8	6									12
Walrus	ᐊᐃᐅᒃᑦ	Akvik									1				1
Narwhal	ᑐᒻᓪᓂᑦ ᖁᓕᓕᒐᑦ	Tuugaak			1										1
Beluga	ᖃᓄᖅᑕ ᖁᓕᓕᒐᑦ	Kilalugak				2	2								3
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	8	1	2										11
Brant goose	ᓄᖅᓕᖅᓇᐃᑦ	Nirlirnaq	1												1
Old squaw	ᐊᑲᕈᐊᖅᔪᐃᑦ	Aahangik	1												1
Eider duck	ᒥᑎᑦ	Kingalik	4			2									5
Black guillemot	ᐱᑦᓯᐅᓪᓚᑦ	Black guillemot	1												1
Thick-billed murre	ᐊᑦᑕᐃᑦ	Thick-billed murre	1												1
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	1			7	1				3	14	10	1	23
Arctic char	ᐃᖅᓗᑲᐱᑦ	Ikaliviit	9	3									1	23	28
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk			1										1

6.1.4

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓪᒪᓇᓂᒃ ᐱᑕᖅᓯᕋᑐᖅ ᐱᐅᔨᑎᓕᓂᓂᒃ ᐊᖏᔪᒃ ᖃᓄᐅᓂᓯᓂᓚᓂᑦ ᐊᓚᖅᒪᓪᓚᓇᓂᑦ ᐊᖏᔪᓚᓂ ᓇᓪᑭᕋᓕᒃᑐᓂ ᑐᓂᓅᕋᓂᓂ ᐃᑯᐱᕋᓕᓂᓕᒫᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 87

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓚᑦ

Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)

ᐊᒻᒪᓗᒍ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᔨᒻ	SEP ᓱᑎᓚᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓚᑦᓗ	DEC ᑎᓯᓚᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᔪ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut			10	4		18	2						34 ± 7
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait			1							3	1		5 ± 1
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡					2	1	3	1	3	6	4		20
Arctic fox	ᑎᓗᒃᖁᐊᑦ	Tigiganiat						4	8	2					14 ± 5
Arctic hare	ᐅᑲᓪᓕ	Ukalik			8	4			2		4	4	13	6	41 ± 7
Ringed seal	ᓇᓂᓱ	Natiinat	109	91	159	74	39	38	71	39	57	29	32	22	760 ± 32
Bearded seal	ᐅᒡᕆᐃᑦ	Ukyuk		9	7	8	1								25 ± 2
Harp seal	ᖃᐃᓱᓪᓕ	Qairulik		4	22	15	3								44 ± 5
Walrus	ᐊᐃᐸᒃ	Akvik		1	5	1	1								8 ± 1
Narwhal	ᑐᒃᓪᓕ ᕿᓪᓗᒍ	Tuugaak		1	1	1									3 ± 1
Beluga	ᖃᓄᖅᑕ ᕿᓪᓗᒍ	Kilalugak			1	11	1							5	18 ± 3
Snow goose	ᑲᖏᐃᑦ	Kanguq	12	24	1									1	38 ± 1
Eider duck	ᑎᑎᑦ	Kingalik			1		2								3 ± 1
Ptarmigan	ᐊᖏᓂᑦ	Akilgik					28		1		98	92	19	10	248 ± 24
Arctic char	ᐃᖃᓗᐲᒃ	Ikaliviit			42	36						87	2	64	231 ± 36
Cod	ᐅᒪᐃᑦ	Ugak											31		31 ± 19
Sculpin	ᑲᓇᐃᑦ	Kanayuk			12	12									24 ± 0

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦ ᑎᑎᕐᑐᒪᓪᓚᑦ ᑐᓂᖅᖏᑦ ᐅᑉᐳᖏᑦ ᐅᑉᐸᓂᖅ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 88

Monthly hunter response

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᓕᖅᔪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᓴᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᐊᓚᓴᓇ	DEC ᑎᓯᓴᓇ	JAN ᔮᖏᓇᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᕿ	APR ᐃᓕᓴᕐ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ ᐋᔪᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ	Tatkitaman angunahuktut titigait	39	39	37	37	37	37	37	38	37	37	47	50	55*
Hunters interviewed	ᐊᖏᔪᓇᓱᒋᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	37	38	34	35	33	35	30	37	37	36	42	43	53*
Harvested	ᐊᖏᔪᓇᓱᒋᑐᓂᓕ	Angujaujut	24	23	26	18	17	16	18	15	24	21	15	13	42*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	95	97	92	95	89	95	81	97	100	97	89	86	93**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᒋᑦ ᐊᑎᓕᐅᑎᒪᒪᓪᓗᑎᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓇᓱᒋᑐᓂᓕ ᐊᑕᐅᓯᐊᖅᓗᑐᑎᑦ ᐊᓕᖅᔪᒍ.
** ᐃᓅᓪᓕᓐᓂᓴᒪᓪᓚᓕᒃ ᑕᖅᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 89

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓐᓂ ᐊᖏᔪᓇᓱᓂᖓᓐᓂᑕ ᐊᓚᓗ ᐊᐱᕐᓂᑕᐅᓂᖓᓐᓂᑕ, ᓇᓗᓇᐃᖏᑦ ᐃᒪᓐ % ᑲᑎᑦᑎᑦ ᐊᖏᔪᓇᓱᑦ ᑎᑎᕐᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐊᓕᖅᔪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᓴᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᐊᓚᓴᓇ	DEC ᑎᓯᓴᓇ	JAN ᔮᖏᓇᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᕿ	APR ᐃᓕᓴᕐ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	96	85	0	3	87
4-6 months	4-6 ᑕᖅᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	13	100	97	12
> 6 months	> 6 ᑕᖅᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	4	2	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 90

Number of hunters harvesting each species — **Year 3 (June 1998 - May 1999)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓯᓗᒃᑎᑦ ᐊᖏᔪᓯᓗᒃᑲᓪᓚᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ — **ᐊᒃᑭᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 3 (June 1998 - May 1999)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓕ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓇᕐᑲᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut			3	1		3	1						7
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait			1							2	1		4
Polar bear#	ᓇᓄᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓗᒃᖏᓂᐊᑦ	Tigiganiat						2	2	1					4
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik			6	3			1		3	3	3	2	12
Ringed seal	ᓇᓂᓪᓕ	Natiinat	24	23	24	18	13	14	17	13	20	14	10	6	38
Bearded seal	ᐅᓗᔪᐃᑦ	Ukyuk		8	6	6	1								15
Harp seal	ᖃᐃᓐᓇᓪᓚᑦ	Qairulik		2	13	7	2								15
Walrus	ᐊᐃᐱᒃ	Akvik		1	2	1	1								3
Narwhal	ᑐᒻᓪᓚᑦ ᕿᓪᓕᒃ	Tuugaak		1	1	1									3
Beluga	ᖃᐅᑦᑕᑦ ᕿᓪᓕᒃ	Kilalugak			1	9	1							4	13
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	3	4	1									1	7
Eider duck	ᑎᑎᑦ	Kingalik			1		1								2
Ptarmigan	ᐊᑭᓐᑦ	Akilgik					3		1		9	9	3	2	18
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit			3	1						2	1	5	10
Cod	ᐅᒪᐃᑦ	Ugak											1		1
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk			1	1									1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓯᒪᔪᓂᒃ ᐱᑕᖃᖕᖏᑐᖃᖅ ᐱᓵᐋᑎᓕᓂᒃ ᐊᖏᔪᑦ ᖃᕐᓯᐅᓂᖏᖕᓂᑦ ᐊᓕᕆᔨᑦ ᐊᑐᐅᑉᐳᒪᔪᓂᒃ ᓇᓕᑦᑎᐊᕐᓂᖅᑐᑦ ᐃᑯᐱᕐᓚᓕᕆᓂᖅᑐᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

6.1.4

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 91

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓐᑦ

Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)

ᐊᓐᖁᒍ 4 (ᔪᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

6.1.4

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔨᒻ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᔨᓗ	NOV ᐅᓇᓚᓗ	DEC ᑎᓯᓚᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᓯ	APR ᐃᑦᓀᓪ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut		1	10		18	6				11	5	3	54 ± 2
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait						1			1		3	1	6 ± 1
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					3	2	1	4	3	4		1	18
Wolf	ᐊᒪᓕᐃᑦ	Amagut						1					1	2	4 ± 0
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	3			2					5		3		13 ± 2
Ringed seal	ᓇᓯᓂᑦ	Natiinat	63	30	57	72	25	16	48	28	24	15	12	10	400 ± 32
Bearded seal	ᐅᓘᔪᐃᑦ	Ukyuk		2	4	5									11 ± 1
Harp seal	ᖃᐃᓕᓪᓚᑦ	Qairulik			38	32	2								72 ± 0
Walrus	ᐊᐃᐸᑦ	Akvik			2	2		1						1	6 ± 0
Narwhal	ᑐᒻᓚᓪᑦ ᖁᓕᓴᒻᑦ	Tuugaak			8										8 ± 0
Beluga	ᖃᓄᖅᑦ ᖁᓕᓴᒻᑦ	Kilalugak				3									3 ± 0
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	21	2	2										25 ± 9
Brant goose	ᓂᕆᓕᓐᓇᐃᑦ	Nirlirnaq	3												3 ± 2
Eider duck	ᑎᑎᑦ	Kingalik			5	15									20 ± 0
Red-throated loon	ᖃᖓᓴᐅᑦ	Qaqhuaq				1									1 ± 0
Black guillemot	ᐱᑦᓯᐅᓪᓚᑦ	Black guillemot					2								2 ± 1
Ptarmigan	ᐊᖏᓴᑦ	Akilgik				1	14				5	75		20	115 ± 10
Arctic char	ᐃᖃᓗᓴᑦ	Ikaliviit	140	130	23	2								175	470 ± 53
Cod	ᐅᓚᐃᑦ	Ugak		469	20										489 ± 21
Sculpin	ᑲᓇᓘᐃᑦ	Kanayuk		10	11	1									22 ± 1
Clams	ᐊᓴᒧᒪᓘᑦ	Uviluq			150										150 ± 0

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᓘᑦ ᑐᓂᓴᖏᑦ ᐅᑉᓴᖏᓐᓄᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 92

Monthly hunter response
ᑕᖅᑕᒪᒃᑯ ᐊᖏᓚᓂᕆᑦ ᑭᐅᓂᖓᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᑦᖁᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓯᑎᕐᓚᓂ	OCT ᐅᑐᐃᓚᓂ	NOV ᐅᓇᒃᓚᓂ	DEC ᑎᓯᒪᓚᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᓇᖑᐅᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᖃᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓚᓂᕆᑦ ᑭᐅᓂᖓᑦ ᐊᑎᓯᒪᓂᖓᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑯ ᐊᖏᓚᓂᕆᑦ	Tatkitaman angunahuktut titigait	48	46	45	53	54	53	54	55	55	53	53	53	61*
Hunters interviewed	ᐊᖏᓚᓂᕆᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	44	45	45	53	53	51	51	52	54	52	52	52	57*
Harvested	ᐊᖏᓚᓂᕆᑐᒃᓗᑦ	Angujaujut	10	19	25	25	8	12	14	12	13	13	8	17	44*
Response Rate (%)	ᑭᐅᔾ ᖃᕐᓂᐅᓂᖓᑦ (%)	Kiujut (%)	92	98	100	100	98	96	94	95	98	98	98	98	97**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓂᕆᑦ ᐊᑎᓕᐅᑎᒪᔨᖏᑦ/ᐊᐱᕐᓯᑦ/ᐊᖏᓚᓂᕆᑐᒃᓗᑦ ᐊᑕᐅᓯᐊᕐᓇᖅᑐᒃᓗᑦ ᐊᑦᖁᒍᑦ.
** ᐊᓕᓴᕆᓂᕐᒪᒪᔨᑦ ᑕᖅᑕᒪᒃᑯ ᑭᐅᔾ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 93

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᖏᓂ ᐊᖏᓚᓂᕆᓚᖓᑕ ᐊᒪᒐ ᐊᐱᕐᓯᑦᑕᐅᓂᖓᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑐᑎᑦ ᐊᖏᓚᓂᕆᑦᑕ ᑎᑎᕐᑦᑕᐅᒪᔨᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)
ᐊᑦᖁᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓯᑎᕐᓚᓂ	OCT ᐅᑐᐃᓚᓂ	NOV ᐅᓇᒃᓚᓂ	DEC ᑎᓯᒪᓚᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᓇᖑᐅᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᖃᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑭᑦ	≤ tatkin pingahut	76	100	100	100	100	100	100	100	97	100	100	100	98
4-6 months	4-6 ᑕᖅᑭᑦ	tatkin hitaman 6nut	24	0	0	0	0	0	0	0	3	0	0	0	2
> 6 months	> 6 ᑕᖅᑭᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 94

Number of hunters harvesting each species — **Year 4 (June 1999 - May 2000)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᓕᕆᔨᑦ ᐊᖏᔪᓚᓕᕆᔨᒃᑯᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒡᖏᒍ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 4 (June 1999 - May 2000)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔫᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓱᑎᐹᓗ	OCT ᐅᑲᐅᓗ	NOV ᐅᓇᒃᐹᓗ	DEC ᑎᓯᒃᐹᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut		1	3		4	1				2	2	1	10
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait						1			1		1	1	3
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓪᐃᑦ	Amagut						1					1	1	2
Arctic hare	ᐅᑲᓪᓕ	Ukalik	2			2					4		1		6
Ringed seal	ᓇᓕᓂᑦ	Natiinat	7	10	20	20	5	9	14	11	8	6	5	4	36
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		2	3	4									7
Harp seal	ᖃᐃᓪᓗᓕ	Qairulik			13	12	2								17
Walrus	ᐊᐃᐸᑦ	Akvik			2	2		1						1	5
Narwhal	ᑐᒻᓕᓪᓕ ᖁᓪᓚᑦ	Tuugaak			8										8
Beluga	ᖃᓄᖅᑕ ᖁᓪᓚᑦ	Kilalugak				3									3
Snow goose	ᑲᖏᐃᑦ	Kanguq	3	1	1										5
Brant goose	ᓂᓪᓕᓐᓇᐃᑦ	Nirlirnaq	1												1
Eider duck	ᒥᑎᑦ	Kingalik			3	4									5
Red-throated loon	ᖃᖓᓴᐅᑦ	Qaqhuaq				1									1
Black guillemot	ᐱᑦᓯᐅᓪᓕᑦ	Black guillemot					1								1
Ptarmigan	ᐊᖏᓴᑦ	Akilgik				1	4				2	7		1	11
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	3	3	3	1								11	18
Cod	ᐅᓴᐃᑦ	Ugak		11	1										12
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk		2	2	1									4
Clams	ᐊᓕᒍᒪᔪᑦ	Uviluq			2										2

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᕐᒪᔪᓂᒃ ᐱᑕᖃᖏᑦᑐᖃᖅ ᐱᓪᔪᑎᓕᓐᓂᒃ ᐊᖏᓴᑦ ᖃᖏᓂᖏᑦᓂᓄᑦ ᐊᓕᕆᑲᒪᔪᓂᑦ ᐊᖏᓴᓄᑦ ᓇᓕᑦᓴᖏᑦᓂᖅᓯᒪᔪᓂᑦ ᑐᓂᓴᖏᑦᓂᒃ ᐃᑯᐱᕐᓇᓕᓂᖅᓯᒪᔪᓂᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.4

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 95

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᓯᔪᒍ 5 (ᔮᓄ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᓐᓂ/Tatkia			JUN ᔮᓄ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᓇᓴᐱᓇ	DEC ᑎᓵᐱᓇ	JAN ᔨᖏᓄᐊᓇ	FEB ᓄᖅᑲᐊᓇ	MAR ᒪᑉᓯ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut			15	8	4	7	1		2	3	2	1	43 ± 5
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait			1										1 ± 1
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					2				1	3	4	3	13
Wolf	ᐊᒪᓱᐃᑦ	Amagut										2			2 ± 2
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat						1	9	11		2			23 ± 3
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	3		1		3				2	25			34 ± 8
Seals (unspecified)	ᓂᖏᑯᓪᓚᑦ	Natiit				1									1 ± 1
Ringed seal	ᓇᓂᓱᑦ	Natiinat	51	58	45	62	21	20	36	16	4	5	15	16	349 ± 21
Bearded seal	ᐅᑭᔪᐃᑦ	Ukyuk	1	3	3		1	1			1				10 ± 2
Harp seal	ᖃᐃᕐᓪᓚᑦ	Qairulik			10	8	2								20 ± 3
Walrus	ᐊᐃᐸᓴᑦ	Akvik	2		1										3 ± 2
Narwhal	ᑐᐃᓪᓚᑦ ᖁᓕᓗᓴᑦ	Tuugaak			12	1									13 ± 1
Beluga	ᖃᐅᑦᑕᑦ ᖁᓕᓗᓴᑦ	Kilalugak				14									14 ± 2
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq			2										2 ± 1
Canada goose	ᓄᑦᓪᓚᑦ	Nikliknik			5										5 ± 0
Eider duck	ᒥᑎᑦ	Kingalik			6	24									30 ± 8
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	4		3	78	6					99			190 ± 28
Arctic char	ᐃᖃᓗᐱᐸᑦ	Ikaliviit	93											184	277 ± 60
Cod	ᐅᓴᐃᑦ	Ugak			22										22 ± 0
Sculpin	ᑲᓕᔪᐃᑦ	Kanayuk	58	30	11	14									113 ± 28
Clams	ᐊᓴᒧᒪᔪᑦ	Uviluq			2										2 ± 1

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᓯᖏᑦ ᐅᑉᓯᒪᓂᖅ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 96

Monthly hunter response

ᑕᖅᑕᒪᒃ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᓕᕐᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᓚᐃ	AUG ᐊᐅᓚᔭᑎ	SEP ᓯᑎᕐᓚᓪ	OCT ᐅᑲᐃᓪ	NOV ᐅᐊᓕᕐᓚᓪ	DEC ᑎᓯᕐᓚᓪ	JAN ᔮᖏᓂᓚᓪ	FEB ᐃᖅᑲᐊᓪ	MAR ᒪᕐᔾ	APR ᐃᕐᓇᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᕐᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	52	51	49	48	49	49	51	51	55	55	55	55	58*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	45	44	47	45	48	48	50	51	49	48	50	50	53*
Harvested	ᐊᖏᔪᓂᒃᑐᒋᓐᓂᑦ	Angujaujut	21	19	20	21	9	11	9	9	2	6	7	24	46*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓕᑎᓂᖏᑦ (%)	Kiujut (%)	87	86	96	94	98	98	98	100	89	87	91	91	93**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᑦᑕᒪᓪᓚᔨᑦ/ᐊᐱᕐᓯᑦ/ᐊᖏᔪᓂᒃᑐᒋᓐᓂᑦ ᐊᑕᐅᓕᐊᖅᓗᑐᑦ ᐊᑦᕿᒪᑉ.
** ᐊᐅᓚᑦᓯᑎᓕᓚᔨᑦ ᑕᖅᑕᒪᒃ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 97

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᖃᓄ ᐊᖏᔪᓂᒃᑎᑦᑎᒍ ᐊᒻᒪᓗ ᐊᐱᕐᓯᑦᑕᐅᓂᖏᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑕᑦ ᑎᑎᕐᑦᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᓕᕐᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᓚᐃ	AUG ᐊᐅᓚᔭᑎ	SEP ᓯᑎᕐᓚᓪ	OCT ᐅᑲᐃᓪ	NOV ᐅᐊᓕᕐᓚᓪ	DEC ᑎᓯᕐᓚᓪ	JAN ᔮᖏᓂᓚᓪ	FEB ᐃᖅᑲᐊᓪ	MAR ᒪᕐᔾ	APR ᐃᕐᓇᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕐᑯᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	73	100	99
4-6 months	4-6 ᑕᕐᑯᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	27	0	1
> 6 months	> 6 ᑕᕐᑯᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

6.1.4

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 98

Number of hunters harvesting each species — **Year 5 (June 2000 - May 2001)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓯᖅᑎᑦ ᐊᖏᔪᓯᖅᓯᒪᔪᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒡᖏᔪ 5 (ᔦᓂ 2000 - ᒪᐃ 2001)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 5 (June 2000 - May 2001)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔦᓂ	JUL ᔨᓪᐃ	AUG ᐊᐅᒃᔪᑎ	SEP ᓯᑎᒃᐱᓪ	OCT ᐅᑲᐱᓪ	NOV ᐅᓇᒃᐱᓪ	DEC ᑎᓯᒃᐱᓪ	JAN ᒎᓐᓄᐊᓪ	FEB ᓇᖑᐅᐊᓪ	MAR ᒪᔨ	APR ᐃᔨᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut			5	3	1	3	1		1	1	1	1	9
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait			1										1
Polar bear#	ᓇᓄᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut										1			1
Arctic fox	ᑎᓪᓚᖅᓂᐊᑦ	Tigiganiat						1	1	1		2			5
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	1		1		1				1	2			3
Seals (unspecified)	ᓂᖏᑯᓪᓕᑦ	Natiit				1									1
Ringed seal	ᓇᓂᓪᑦ	Natiinat	17	18	16	16	8	8	9	9	2	2	6	6	36
Bearded seal	ᐅᑭᓴᐃᑦ	Ukyuk	1	2	3		1	1			1				8
Harp seal	ᖃᐃᓕᓪᓕᑦ	Qairulik			7	5	1								9
Walrus	ᐊᐃᐅᓵᑦ	Akvik	2		1										3
Narwhal	ᑐᒍᓪᑦ ᖁᓪᓗᒡᑦ	Tuugaak			10	1									11
Beluga	ᖃᐅᖅᑦ ᖁᓪᓗᒡᑦ	Kilalugak				10									10
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq			2										2
Canada goose	ᓂᖅᓪᑦ	Nikliknik			1										1
Eider duck	ᒥᑎᑦ	Kingalik			2	4									5
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	1		1	6	1					5			12
Arctic char	ᐃᖃᓗᐸᐱᑦ	Ikaliviit	5											20	23
Cod	ᐅᓴᐃᑦ	Ugak			1										1
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	3	3	1	3									10
Clams	ᐊᓲᒧᒪᔪᑦ	Uviluq			1										1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓪᒪᔪᓂᒃ ᐱᑕᖃᖅᖢᑎᑐᖃ ᐱᓕᔭᒥᓕᓂᓂᒃ ᐊᖏᔪᒃᑕ ᖃᑕᕋᐅᓂᖅᓂᓄᑦ ᐊᓪᓚᖅᓄᑦ ᐃᓕᑲᐅᒪᔪᓂᒃ ᐊᖏᔪᒃᓄᑦ ᓇᓪᑕᕋᓕᖅᑐᓂ ᑐᓂᓴᖅᓂᓄ ᐃᓂᒋᔭᖅᓂᓂᒃ ᐃᓂᒪᕐᓇᓕᓪᓕᖅᓂᒃ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓄᓇᓕᐊᔪᐅᑦ/NAUNAIKUTA 99

Annual harvest estimates and five-year mean

All Years (June 1996 - May 2001)

ᐊᖏᕐᒍᒪᒃᑕ ᐊᖑᓚᓄᑦ ᓄᓇᐅᑦᑕᕐᓂᑦ ᐊᒻᒪᓗ ᑕᒻᓕᓄᑦ-ᐊᖏᕐᕕᓄᑦ ᐊᐅᓚᑦᓯᒋᓕᕆᑦ 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᖏᕐᕕᓄᑦ (ᔦᓂ 1996 - ᒪᐃ

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᕐᕕᒋ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Mean ᐊᐅᓚᑦᓯᒋᓕᕆᑦ Amigaitkiyait
			96/97	97/98	98/99	99/00	00/01	
Species	ᐅᒪᔪᑦ	**Umajuin**						
Caribou[1]	ᑐᓴᐃᓇᑦ[1]	Tuktut[1]	33	40	34	54	43	41
Musk-ox[2]	ᐅᒥᖅᒪᐃᓇᑦ[2]	Umingmait[2]	19	4	5	6	1	7
Polar bear[3]	ᓄᓇᐃᓇᑦ[3]	Nanuit[3]	23	21	20	18	13	19
Wolf[4]	ᐊᒪᓕᐊᓇᑦ[4]	Amagut[4]	0	1	0	4	2	1
Arctic fox[5]	ᑎᓕᑦᓂᓕᕆᑦ[5]	Tigiganiat[5]	39	26	14	0	23	20
Arctic hare[6]	ᐅᑲᓪᓚᑦ[6]	Ukalik[6]	23	30	41	13	34	28
Seals (unspecified)[7]	ᓴᖅᑯᓪᓚᑦ[7]	Natiit[7]	0	0	0	0	1	< 1
Ringed seal[7]	ᓄᓕᓴᑦ[7]	Natiinat[7]	875	880	760	400	349	653
Bearded seal[7]	ᐅᑦᔾᐊᓇᑦ[7]	Ukyuk[7]	31	22	25	11	10	20
Harp seal[7]	ᖃᐃᓕᓪᓚᑦ[7]	Qairulik[7]	68	25	44	72	20	46
Walrus[8]	ᐊᐃᐱᒃ[8]	Akvik[8]	17	1	8	6	3	7
Narwhal[9]	ᑐᐃᓪᓚᑦ ᕿᓕᓂᒃ[9]	Tuugaak[9]	1	1	3	8	13	5
Beluga[10]	ᖃᐅᑦᑕᑦ ᕿᓕᓂᒃ[10]	Kilalugak[10]	1	5	18	3	14	8
Snow goose	ᑲᖏᐃᓇᑦ	Kanguq	23	42	38	25	2	26
Canada goose[11]	ᓄᑦᓪᓚᑦ ᐅᓂᐊᒍᓪᓚᑦ[11]	Nikliknik[11]	38	0	0	0	5	9
Brant goose	ᓄᑦᓪᓕᓴᐃᓇᑦ	Nirlirnaq	0	1	0	3	0	1
Old squaw	ᐊᑭᐊᑦᔾᐃᓇᑦ	Aahangik	0	1	0	0	0	< 1
Eider duck[12]	ᒥᑎᑦ[12]	Kingalik[12]	19	16	3	20	30	18
Red-throated loon	ᖃᖅᓱᐅᑦ	Qaqhuaq	0	0	0	1	0	< 1
Black guillemot	ᐱᑦᓯᐅᓪᓚᑦ	Black guillemot	0	1	0	2	0	1
Thick-billed murre	ᐊᑦᐸᐃᓇᑦ	Thick-billed murre	0	1	0	0	0	< 1
Ptarmigan	ᐊᑭᖏᑎᑦ	Akilgik	294	540	248	115	190	277
Arctic char[13]	ᐃᖃᓗᒃᐱᑦ[13]	Ikaliviit[13]	739	721	231	470	277	488
Cod[14]	ᐅᓴᐃᑦ[14]	Ugak[14]	0	0	31	489	22	108
Sculpin[15]	ᐅᓇᔾᐃᓇᑦ[15]	Kanayuk[15]	44	12	24	22	113	43
Clams[16]	ᐊᑦᒧᒪᔾᔪᑦ[16]	Uviluq[16]	0	0	0	150	2	30

6.1.4

[1-16]: See page 223 for community feedback and other sources of data.

[1-16]: ᑕᐃᒃ ᒪᔪᐊᑐᖃᖅ 225 ᓄᓇᓕᓂᑦ ᑭᐅᔾᔨᒌᖏᑦ ᐊᒻᒪᓗ ᐊᓯᖏᑦ ᐱᖃᓐᓇᐅᔭᖅ ᓇᓗᐅᑎᓂᖅ.

[1-16]: Takulugu makpigaak 227 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 100

Annual hunter response

ᐊᑦᓴᔪᑦᒪᒃ ᐊᖏᓇᓂᕆᑦ ᑭᐅᓂᖏᑦ

Angujauvaktu

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓇᑦ ᐊᑦᓴᔪᓇᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᓴᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓇᓂᕆᑦ ᑭᐅᓂᖏᑦ ᐊᑦᔪᓪᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᓇᓂᕆᑦ	Tatkitaman angunahuktut titigait	40	43	55	61	58	73*
Hunters interviewed	ᐊᖏᓇᓂᕆᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	39	42	53	57	53	67*
Harvested	ᐊᖏᓇᓂᕐᒥᓂᓄᑦ	Angujaujut	38	40	42	44	46	62*
Response Rate (%)	ᑭᐅᔾ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	74	90	93	97	93	89**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖏᓇᓂᕆᑦ ᐊᑎᓕᐅᔾᔨᒃᑯᑦ/ᐊᐱᕐᓂᑦᑯᑦ/ᐊᖏᓇᓂᕐᒥᓂᓄᑦ ᐊᑕᐅᓂᐊᔪᓂᑎᑦ ᖃᐅᔨᓴᖅᓯᒪᔪᑦ.
** ᐃᓕᓴᕐᑎᑦᒪᒃᑯᑦ ᐃᓴᔪᑦᑕᒪᑦ ᑭᐅᔾ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 101

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᖏᓐᓄᓕᒃ ᐊᖏᓇᓂᓐᓂᓕᒃ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓕᒃ, ᓇᓗᓇᐃᖏᑦ ᐃᒪᓐ % ᑲᑎᒪᔨᑦ ᐊᖏᓇᓂᒃᑯᑦ ᑎᑎᕐᑎᑕᐅᒪᔾᔨᑦ

Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓇᑦ ᐊᑦᓴᔪᓇᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᓴᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᖅᑕᑦ	≤ tatkin pingahut	100	100	87	98	99	97
4-6 months	4-6 ᑕᖅᑕᑦ	tatkin hitaman 6nut	0	0	12	2	1	3
> 6 months	> 6 ᑕᖅᑕᑦ	> 6 tatkin	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 102

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓯᐸᒋᑦ ᐊᖏᔪᓯᐸᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓂᑦ ᐊᑦᑭᔪᓂᑦ (ᓄᓇ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅᓯᒃ ᐊᑦᑭᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᑎᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**						
Caribou	ᑐᑐᐃᑦ	Tuktut	4	10	7	10	9	18
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait	3	3	4	3	1	11
Polar bear[‡‡]	ᓇᓂᐃᑦ[‡‡]	Nanuit[‡‡]	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᖅᐃᑦ	Amagut		1		2	1	4
Arctic fox	ᑎᓚᖓᓂᐊᑦ	Tigiganiat	10	9	4		5	19
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	5	9	12	6	3	22
Seals (unspecified)	ᓴᖏᑯᓪᓕᑦ	Natiit					1	1
Ringed seal	ᓇᓴᓪᑦ	Natiinat	38	38	38	36	36	54
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	15	17	15	7	8	35
Harp seal	ᖃᐃᕈᓪᓕᑦ	Qairulik	17	12	15	17	9	35
Walrus	ᐊᐃᐸᒃᑦ	Akvik	6	1	3	5	3	12
Narwhal	ᑐᐊᓪᓕᑦ ᕿᓕᓚᒃ	Tuugaak	1	1	3	8	11	17
Beluga	ᖃᐅᕐᑦ ᕿᓕᓚᒃ	Kilalugak	1	3	13	3	10	24
Snow goose	ᑲᖏᐃᑦ	Kanguq	4	11	7	5	2	19
Canada goose	ᓄᑦᓪᓕᑦ ᐅᓗᐊᔪᓪᓕᑦ	Nikliknik	1				1	2
Brant goose	ᓄᑦᓕᑦᓇᐃᑦ	Nirlirnaq		1		1		2
Old squaw	ᐊᑭᐊᑦᔪᐃᑦ	Aahangik		1				1
Eider duck	ᒥᑎᑦ	Kingalik	6	5	2	5	5	13
Red-throated loon	ᖃᖅᓚᐅᑦ	Qaqhuaq				1		1
Black guillemot	ᐱᑦᓯᐅᓪᓕᑦ	Black guillemot		1		1		2
Thick-billed murre	ᐊᑦᕿᐃᑦ	Thick-billed murre		1				1
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	16	23	18	11	12	36
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	14	28	10	18	23	51
Cod	ᐅᓚᐃᑦ	Ugak			1	12	1	13
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	5	1	1	4	10	17
Clams	ᐊᒃᒧᒪᔪᑦ	Uviluq				2	1	3

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓪᒪᔪᓂᒃ ᐱᑕᖃᖏᑦᑐᖅ ᐱᒃᔨᑎᓕᓐᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᓐᓂᑦ ᐊᓕᕐᔪᓂᑦ ᓇᓕᐅᐸᒪᔪᓂᑦ ᐊᑐᐅᓂᒃ ᐃᓐᔨᖏᓐᓂᒃ ᐃᓄᐃᑦᑐᓕᕆᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.4 Community Results Discussion: Grise Fiord

The survey frame:
An assessment of under-enumeration during the community visit revealed that there were approximately 17 hunters who were not registered in the Harvest Study. Fourteen of these were Inuit - 12 occasional and two active hunters. It is estimated that there were three non-Inuit hunters with assigned hunting rights who were not registered – one occasional and two active hunters. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. Given that these unregistered hunters represent 19 percent of the total hunter population (Table 10) the effect of this bias on harvest estimates could be significant. Harvest estimates for the unregistered hunters can be estimated using mean harvest quantities for each species by strata. However, these estimates, having their own sources of error and bias, are beyond the scope of this Final Report. Readers may apply to NWMB to obtain the results of these calculations.

Due to the relatively small number of intensive hunters registered in Grise Fiord, the intensive classification was joined with the active classification for the purpose of calculating harvest estimates.

The HTO Board felt that there were more than three intensive hunters in the community. Given that all the unregistered hunters identified were occasional or active hunters it is likely that some intensive hunters were misclassified rather than un-registered. The effect of this should be minimal since, as discussed above, we have joined the active and intensive classifications for the estimate calculations.

Survey coverage and non-response bias:
Response rates in year 1 of the study were quite low in some months in Grise Fiord, dropping below 50% in two of these months. As seen in Table 10 the consistent intentional non-response rate in Grise Fiord was low, at 1.4%, and was not thought to contribute to potential non-response bias.

Response rates were felt to be high enough and non-response bias low enough during years 2 to 5 to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should exercise caution when using the data collected during the first few months of year 1 since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:
It was suggested during the community visit that hunters may not have reported all their harvest. Several reasons were given to explain this. Many hunters were difficult to contact since they were out hunting. Often several months would pass before they were reached for their interview, at which time they would need to estimate their catch since many had not written it down. Some hunters were told by the Fieldworker that they did not need to report the quota species they harvested, such as narwhal, polar bear and musk-ox, since this information could be obtained from other sources. This was a communication error between the Fieldworker and Headquarters which resulted in under-reporting of some quota species. Some hunters did not understand the purpose of the study and were reluctant to report their total catch for fear that it may result in harvesting limitations. Readers are urged to consider these issues and the comments below, collected during the community visit, when using the harvest estimates provided. Where appropriate and available other sources of harvest data have been provided to assist readers with this task.

As seen in the recall period tables, the majority of harvest records were collected within three months of the harvest. Exceptions to this were found only in selected months in years 3, 4 and 5 when longer recall periods (four to six months) were seen. As a result of the low recall periods in most months it would seem that measurement error due to recall failure would be minimal. However, given the comments noted above it appears that recall failure did in fact occur on some occasions and should be considered when assessing harvest estimates.

The community indicated that there was no commercial harvesting during the study.

Community feedback and other sources of data:

1. **Caribou:** The caribou harvest consisted of Peary caribou only.
2. **Musk-ox:** Harvest estimates seem low. Hunters were told by the Fieldworker that data would be collected from DSD so many did not report their musk-ox harvest (C.F.). DSD records indicate the following subsistence harvests during the course of the Harvest Study (DSD MXa):

Year 1	Year 2	Year 3	Year 4	Year 5
18	12	13	14	17

DSD records also indicated a total of 13 harvests (4 in year 1, 1 in year 2, 5 in year 4 and 3 in year 5) during the study period where the type of harvest was not recorded. These harvests may have been subsistence but were not included above since this could not be ascertained.

[3] **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).

[4] **Wolf:** Harvest estimates seem too low. It is thought that some wolf harvests were not reported; wolves are harvested every year (C.F.).

[5] **Arctic fox:** There was no reported harvest of arctic fox in year 4 but the HTO Board reports that some are harvested every year (C.F.).

[6] **Arctic hare:** Arctic hare are abundant on Ellesmere Island and are harvested in larger numbers than shown by the harvest estimates. Hunters may not have thought to report some of the smaller species since they are not as significant to the hunter as the big game and marine mammal species (C.F.).

[7] **Seals:** The harvest estimates show a decline in seal harvesting over the five year study period. The community reported that a drop in seal harvesting has occurred in the last four years since there have been fewer seals in the area to hunt. However, they feel that seal harvesting did not drop as significantly as the harvest estimates indicate (C.F.).

[8] **Walrus:** Harvest estimates in years 2 to 5 seem too low. Year 1 estimates look to be more accurate (C.F.).

[9] **Narwhal:** Harvest estimates seem too low (C.F.). The annual quota was 20 animals. DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
1	1	10	16	17

[10] **Beluga:** Harvest estimates seem too low (C.F.). DFO reports the following harvest numbers for beluga (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
1	2	40	23	22

[11] **Canada goose:** Canada geese are only seen in small numbers around Grise Fiord. The harvest estimate of 38 in year 1 seems too high (C.F.). This harvest took place in June 1996 when response rates were below 50%. It is likely that the harvest estimate is too high due to a large degree of non-response bias. The reported harvest for this month was only 4 geese.

[12] **Eider duck:** Both king and common eider ducks are harvested around Grise Fiord. Harvest estimates seem a little low. Sometimes the hunters will estimate how many they harvested; most hunters would tend to under-estimate as opposed to over-estimate (C.F.).

[13] **Arctic char:** It was suggested by the community members that the lower harvest estimates in some years may have been due to poor conditions on the trail to Kane basin (C.F.).

[14] **Cod:** Cod are often harvested when they are washed ashore by large waves. Hundreds are harvested when this occurs. The community suspects that many of these fish were not reported (C.F.).

[15] **Sculpin:** Harvest estimates seem too low. Many hunters were not aware they were to report this species (C.F.).

[16] **Clams:** Clams are harvested every year. As with some of the other smaller species, hunters were often not aware they were to report or did not think to report these species (C.F.).

Egg harvesting was rarely reported by Grise Fiord hunters. The following eggs are gathered every year: seagull, king and common eider duck, brant goose, loon, black guillemot, thick-billed murre and old squaw (C.F.).

6.1.4 ᓄᓇᕗᑦ ᓴᖅᑭᑕᕐᕕᖏᓂᖅ ᐅᖃᖅᑎᑐᑦᑕᑎᑦ: ᐊᐅᓚᐅᔪᓐᓇᖅ

ᖃᐅᔨᓴᓂᐅᕙᓪᓕ ᐊᑲᖅᑭᐅᒪᓂᖅᓱ:

ᖃᒥᖅᑭᔨᐅᑎᓯᓚᑦ ᐊᑎᓕᐅᓇᖅᑐᐊᖅᓴᖅᑕᓂᐅᕕᕐᓂ ᓄᓇᓕ ᐊᓪᓚᖅᑎᑦᑎᓯᓚᑦ ᑕᐃᑎᖅᓯᓚᐅᖅᓯᒪᔪᓂ ᑕᐃᓕᓴ 17 ᐊᖏᓇᓚᖅᑎᑦ ᐊᑎᖃᖅᑕᐅᓚᐅᖅᑎᑦᑐᓂᓗᓂᒃ ᖃᐅᔨᓴᓂᖅᓱᒪᔪᓂ. 14ᖏᓚᐅᖅᓯᒪᔪᓂ ᐃᓄᐃᑦ - 12 ᖃᐅᔨᓴᒋᐊᕐᓯᓂᑦ ᐊᓪᓚᓗ ᓯᑭᒃ ᑕᐃᒪᓕᓴᐅᓪᓚᕆᔨ. ᐃᓚᒋᑦᑕᐅᓚᕐᓂᖅᓱᒪᔪᓂ ᐱᖓᓱᓚᐅᓇᓚᖅᓴᖅᑭᑐᓂᒃ ᐃᓄᓕᕐᓂᑦ ᐊᖏᓇᓚᖅᑎᑦ ᐱᔭᕐᓇᐃᓐᓚᐅᖅ ᑐᓂᐅᑦᑐᒋᔭᓂᒃ - ᐊᑕᐅᓱᖅ ᖃᐅᔨᓴᒋᐊᕐᓯᓂᑦ ᐊᓪᓚᓗ ᓯᑭᒃ ᑕᐃᒪᓕᓴᐅᓪᓚᕆᔨ. ᐅᖃᐅᓯᒪᓕᒃ ᓇᐃᑎᐅᑎ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓇᖅᑐᐊᖅᓴᖅᑕᓂᐅᕕᕐᓂᐊᕐᓂᒃ ᐱᔪᑎᑦᓯᓚᐅᖅᓯᒪᓕᓴᐅᓪᓚᕆᔨ ᐃᓕᓴᖅᑕᐅᓴᕐᓂᑦ ᖃᓄᐃᓕᓴᐅᓪᓚᕆᔨ. ᐃᓕᓴᐅᓂᓗᓂᒃ ᑕᒪᓐᓇᑦ ᐊᑎᖃᖅᑕᐅᓚᕐᓂᑦ 19%ᓇᓕᒥᓂᒃ ᐊᖏᓇᓕᐊᓪᓚᒋᓕᒃ ᑲᑎᑦᑐᓂᒃ (ᓇᓂᖅᑲᒥ 10) ᐃᓚᓕᐅᓇᖅᑐᓂᐊᖅᓯᒪᓕᐅᓪᓚᐊᓕ ᐊᑦᑐᐃᓚᐅᓪᓕᒪᓕᖅᓱᒃᑲ ᐊᐅᓪᓚᕆᔨᑕᐅᓪᓚᐊᓕᓚᖅᑐᓂᒃ. ᐃᓕᓴᖅᑕᐅᓴᕐᓂᑐᒥᓂᒃ ᐊᑎᖃᖅᑕᐅᓚᕐᓂᑐᓄᓇ ᒥᑦᑐᓚᐊᖅᑕᐅᓴᖅᑕᐅᓚᕐᓂᑦ ᐊᑐᐃᓂᒃ ᐃᓕᓴᖅᑕᐅᓵᒋᐊᕐᓂᑦ ᖃᓄᐃᓕᓴᐅᓪᓚᕆᔨᓂᖅᓱᒃᑲ ᐊᑐᓂ ᓂᕆᔨᒪᓂ ᐊᓯᖏᓐᓂᖅᓱᒃᑲ. ᐅᓱᐊᓂ ᑕᒪᓐᓇᑦ ᒥᑦᑐᓚᐊᖅᑕᐅᓴᖅᑕᐅᓚᕐᓂᑦ, ᐊᓯᖏᓐᓂᖅᓱᒃᑲ ᓴᓇᕐᓂᑦ ᑕᑯᓯᖏᓐᓂᖅᓱᒃᑲ ᐃᓕᓴᖅᑕᐅᓴᕐᓂᑦ ᐅᓇᓱᐊᕐᓂᖅᓱᒃᑲ ᐊᑐᐃᓂᒃ ᐃᓕᓴᖅᑕᐅᓵᒋᐊᕐᓂᑦ ᖃᓄᐃᓕᓴᐅᓪᓚᕆᔨᓂᖅᓱᒃᑲ ᐊᑐᐃᓂᒃ ᐃᓕᓴᖅᑕᐅᓵᒋᐊᕐᓂᑦ ᐊᑐᐃᓂᒃ ᐃᓕᓴᖅᑕᐅᓴ

6.1.4

[3] **ᓇᓂᐃᑦ:** ᐊᓴᐅᑎᑦ ᑕᒍᔭᖏᓴᓂᐊᓪᓚᐅᑎᓂᑎᑐᑦ ᑭᓯᐊᓂ ᐊᓴᖏᑕᐅᓯᒪᓪᓕᑦᑕᖏᑐᑦ ᓂᓀᓪᓚᐃᓂᑦ ᐃᑯᐱᓐᓇᓕᔭᐃᖏᓐᓂᓪᓚᑦ (DSD PB).

[4] **ᐊᒪᒪᖅ:** ᐱᔾᐅᓐᓂᑎᑦ ᖃᓄᐅᓂᖏᑦ ᐊᑎᑕᓚᖅᑐᑎᑦ. ᐃᓗᒪᑎᔾᐅᓂᔾᔪᖅ ᐃᓪᓕᖏᑦ ᐊᒪᒪᖅᑕᐅᔨᒥᑦ ᐅᖃᐅᓯᐅᓂᓪᓕᐅᖏᓐᓂᖏᓐᓂᒃ; ᐊᒪᒪᐃᑦ ᐊᑎᖏᔪᒡᒐᑦ ᐱᔾᐅᓐᓂᑎᑦ (C.F.).

[5] **ᑎᓕᖃᓂᐊᖅ:** ᐅᑭᐅᖃᓂ 4 ᐅᖃᐅᓯᐅᔨᖃᓕᐅᖏᑎᑐᖅ ᑎᓕᓚᓂᐊᖅᑐᖃᓂᓕᖅᓂᒡᓗᑦ ᑭᓯᐊᓕᓯᑐᓪᓚᔾᔪᒃᓯᑦ ᑲᑎᒪᓂ ᐊᖅᓯᓇᓯᑐᓪᓚᔾᔪᒃᓯᑦ ᐱᔭᕆᐊᖃᖅᑐᑦ ᐱᖓᓱᐊᕐᓂᖅ ᐅᖃᖅᑭᒃᓴᓕᖅ ᐱᔭᕆᐊᖃᖅᑐᑦ ᐊᖅᓯᓇᓯᑐᓪᓚᔾᔪᒃᓯᑦ (C.F.).

[6] **ᐅᖃᓕᑦ:** ᐅᖃᓕᖅᐳᑎᐊᖅᑐᖅ ᐊᐅᓯᐊᓂᑦ ᖃᐅᖅᑕᒧᓕᓴᐅᓂ ᐊᓴᒪᓗ ᐅᓇᖅᑐᑦ ᐱᔭᕆᐊᖃᓪᓚᑎᑦ ᓴᓂᐊᖅ ᐃᒪᓕᖅᑕᐅᔨᒥᑦ ᖃᓄᐅᓂᖏᓐᓂᖅ. ᐊᓇᓕᑦ ᐅᖃᐅᓯᖃᓕᖅᑐᑦ ᐱᔭᕆᐊᖃᖅᑐᓂᒃᑯᑦᓴᐅᓂᖏᓐᓂᖅ ᐃᓕᓐᓂᖅ ᒥᔪᒪᓂᖅᑐᑦ ᐃᒪᓕᓂ ᐱᔭᕆᐊᖃᖅᑐᓂᒃᑯᑦᓴᐅᓂᖏᓐᓂᖅ ᐃᓕᓐᓂᖅ ᒥᔪᒪᓂᖅᑐᑦ ᐃᓕᓴᐅᓂ ᐃᓚᒋᔭᐅᓂᖏᓐᓂᖅ ᐊᓯᐊᓂ ᐊᒪᓗᓂ ᑲᑎᒪᓂ ᐊᑐᐃᓐᓇᖅᑐᑦ (C.F.).

[7] **ᓇᓯᓂᑦ:** ᓇᓕᖅᑕᐅᔨᓕᑦᑕᑦ ᖃᓄᐅᓰᓇᔪᖅᓯᓕᖅᑐᓂᓕᐅᔨᖅᑐᑦ ᐅᑭᐅᑦ ᑕᓕᓗᒡᓗᑦ ᖃᐅᔨᓴᓂᖃᖅᓂᓗᓂ. ᓄᓇᓕᑦ ᐅᖃᐅᓯᖃᓕᖅᑐᑦ ᐱᔭᕆᐊᖃᖅᑐᔪᓐᓇᓂᕆᔨᐅᔨᓂᖏᓐᓂᖅ ᓇᓕᑎᑕᓕᐅᓯᓗᓂᔾᔪᓂᓗᓂᒃ ᐅᑭᐅᑦ ᑎᐊᒡᓕᖅ ᑭᓇᐅᔭᓕᖅᑐᖅᓂᖅ. ᑭᓯᐊᓕᓯᑐᓪᓚᔾᔪᒃᓯᑦ, ᐃᓗᒪᑎᔾᐅᓂᔾᔪᖅ ᓇᓕᑎᑕᓕᐅᓯᓗᓂᔾᔪᓂᓗᓂᒃ ᑕᐃᒪᒃ ᑕᐃᓐᓇᖅᑐᓂᒃᑯᑦᓴᐅᓂᖏᓐᓂᖅ ᖃᓄᐅᓂᖏᓐᓂᖅ (C.F.).

[8] **ᐊᐃᐃᓂᑦ:** ᐊᐃᖅᑭᑕᐅᔨᖅᑐᑦ ᖃᓄᐅᓂᖏᓐᓂᖅ ᐅᑭᐅᖃᓂᑭᖅ 2ᒥ 5ᒧᑦ ᐊᑎᑎᓕᐊᖃᓪᓚᔾᔪᒃᓯᑦ. ᐅᑭᐅᖃᓂᑭᖅ 1 ᒥᑦᓴᐅᓯᓚᑎᐊᓂᖃᓪᓚᔾᔪᒃᓯᑦ ᖃᓄᐅᓂᖏᓐᓂᖅ (C.F.).

[9] **ᔅᑎᓂᑦ:** ᐱᔾᐅᓐᓂᑎᑦ ᖃᓄᐅᓂᖏᓐᓂᖅ ᐊᑎᑎᓕᐊᖅᑐᖅᓂᖅ (C.F.). ᐊᑎᖅᑭᒃᓴᓕᖅ ᔨᑕᖃᓕᖅᑐᑦ 20ᓂᑦ. ᐃᓚᒋᑐᑕᓕᓴᐅᓪᓚᖅ ᐊᑎᓕᑕᐅᓯᒪᔪᐃᑦ ᐅᓂᐊ ᓴᓇᐅᓂᑦ ᔅᑎᓂᖅᑕᒥᓂᑦ (ᖃᐅᔨᓴᒥᑦ ᐃᓚᒋᑐᑕᓕᓴᐅᓪᓚᖅ ᓴᓇᐅᓂᑦ ᒪᓕᒪᓗᑦ ᑭᓇᐅᔭᓕᖅᑐᖅᓂᖅ ᐃᓚᒋᑐᑕᓕᓴᐅᓪᓚᖅ ᓴᓇᐅᓂᖏᓐᓂᖅ ᒪᓕᒪᓗᑦ ᑭᓇᐅᔭᓕᖅᑐᖅᓂᖅ ᐃᓚᒋᑐᑕᓕᓴᐅᓪᓚᖅ ᓴᓇᐅᓂᖏᓐᓂᖅ ᒪᓕᒪᓗᑦ ᑭᓇᐅᔭᓕᖅᑐᖅᓂᖅ ᐅᖃᐅᓯᖃᓕᖅᑐᑦ, ᐃᓗᒪᑎᔾᐅᓂᔾᔪᖅ ᓇᓕᑎᑕᓕᐅᓯᓗᓂᔾᔪᓂᓗᓂᒃ ᑕᐃᒪᒃ ᑕᐃᓐᓇᖅᑐᓂᒃᑯᑦᓴᐅᓂᖏᓐᓂᖅ ᒪᓕᒪᓗᑦ ᐱᔾᐅᓐᓂᑎᑦ ᐊᑎᖅᑭᒃᓴᓕ

6.1.4 Nunani Iniktikhimayut Ukauhiit: Ausuituq

Ihivgiukhimayut iniktigutait:
Ihivgiufaahimayut ataani ihivgiukhimayuni nunani pulaaktakhimatitluni takupkakhimayut 17kuyut umayukhiuktit titigakhimaitut Umayukhiukhimayut ihivgiukhimatitlugu. 14kuyut Inuinait – 12kuyut ilaani umayukhiukpaktut ovalo malguuk umayukhiukataktut. Naunaiyakhimayuk pingahut inuinaungitut umayukhiuktit tuniyauhimayut umayukhiutinik inminiigutinik titigaktauhimaitut – atauhik ilaani umayukhiukpaktuk ovalo malguk umayukhiukataktut. Ukahimayut ilangani 5.2.1 ikpinagutait hamna ataani ihivgiukhimayuk pilaaktuk ataanut ihumagiyaini umayukhiukhimayut naunaiyautaini. Pihimamat hapkoa titigakhimaitut umayukhiuktit pihimamat 19%nik tamaat umayukhiuktunit (ikpatauyak 10) ikpinagutait hamna ihumagiyaini umayukhiukhimayut naunaiyautit angiyuuniaktuk. Umayukhiukhimayut naunaiyautait titigakhimaitut umayukhiuktit naunaiyakhimalaat atuklugit anginikhaat umayukhiukhimayut naunaiyautaini tamamik umayut aviktukhimayuni. Kihimi hapkoa naunaiyautit pihimamata inminik pihimayaini ihuinaakhimayuni ovalo ihumagiyaini avataaniimat atuktangit hamna Iniktigutini Tuhaktakhani. Taiguaktut apigilaat NWMBkunit piyumagumik iniktigutait hapkoa naunaiyakhimayut.

Pikamata mikiyunik amigaitjutaini umayukhiuginaktut titigakhimayut Ausuituqmi, umayukhiunginaktut naunaiyautait ilauhimayut umayukhiukataktunut naunaiyautainut atukhugit naunaiyauhimayut umayukhiukhimayut naunaiyautaini.

HTOkut katimayiit ihumayut amigaitkiyaumat pingahut umayukhiuginaktut nunami. Taimaimat tamamik titigaktauhimaitut umayukhiuktit naunaiyakhimayut ilaani umayukhiukpakatut ovaluniit umayukhiukataktut, piyunakhihimayut ilangit umayukhiunginaktut ihuitumik naunaiyakhimayut pingithuni titigakhimaitunut. Ikpinagutait hamna mikiniaktuk, ukakhimapluni hamani, ilaukatigihimayavut umayukhiukataktut ovalo umayukhiunginaktut naunaiyautaini naunaiyautini ihuakhakhimayuni.

Ihivgiukhimayut pihimayut ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait ukiumi 1mi ihivgiukhimayuni mikiyut ilangini tatkikhiutini Ausuituqmi, katakhimapluni ataanut 50%mut malguni hapkonanit tatkikhiutinit. Takulaaktut ikpatauyami 10 pikaktut kiuyuitut naunaiyautait Ausuituqmi mikitkiyak 1.4%mik ovalo ihumagiyauyuk pivakhuni pilaaktunik kiuyuitunut ihumagiyaini.

Kiuhimayut naunaiyautait ihumagiyauyut angitkiyait ovalo kiuyuitut ihimagiyait mikitkiyat ukiuni 2mit 5mut piyaami nni pipkaihimayuk nakuuyumik pihimayuni naunaiyautaini Nni umayukhiuktini. Taiguaktut ihumayukhat atugumik katitikhimayunik hivulimi tatkikhiutini ukiumi 1mi pilaamata tamamik naunaiyautait ihuinaakhimayut ovalo kiuyuitut ihimagiyait angiklilaamata kiuhimayut naunaiyautait katalikata.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Pitkuhimayuk nunanut pulaaktakhimatitlugit umayukhiuktit tuhaktitihimaitunakhiyut tamamik umayukhimayaminik. Amigaivyaktut ihumgiyait ukautitiplugit hamna. Amigaitut umayukhiuktit ayonaktut takuyaami autlaakhimamata umayukhiukhutik. Ilaani amigaivyaktut tatkikhiutit kaagikpaktut takuyautinagit ukakatigiyukhani, talvani piyukhat naunaiyalutit umayukhimayaminik titigakhimainamiuk. Ilangit umayukhiuktit ukautauhimayut nunani havaktinit tuhaktitigitkalualugit kotaliit umayut umayukhiukhimayait , ilangit tugaaliit kilalugait, nanuit ovalo umingmait, hapkoa tuhagutikhait pilaamata aalanit pilaaktainit. Hamna tuhaktituiyit ihuinaakhimayut nunani havaktinit ovalo hivulimi havakvinit pipkaihimayuk ataani tuhaktitiyakhani ilangit kotakaktut umayut. Ilangit umayukhiuktit naluvaktut hunauyut ihivgiuktut ovalo tuhaktitiyumangitut tamaat umayuktaminik ikhivlutik pilaanahugivlugu umayukhiukhimayut keelinikatiniaktut ukagumik. Taiguaktut pitkuhimayut ihumagilugit hapkoa ihumagiyauyut ovalo ukakhimayut hamani, katitikhimayut nunanut pulaakhimatitlugit, atuliguni umayukhiukhimayut naunaiyautait tunihimayut. Pilaakat ovalo naamakpat, aalat atulaat umayukhiukhimayut katitikhimayut tunihimayut ikayugiagani taiguaktut hamani havakhimayuni.

Takuhimayut utiktihimayuni ubluit ikpatauyani, amigaktut umayukhiukhimayut titigagutait katitikhimayut iluani pingahut tatkikhiutini umayukhiukhimayaini. Kihimi hamani nalvaakhimaut ilangini tatkikhiutini ukiuni 3mi,4milu ovalo 5milu takitkiyat utiktihimayut ubluit (hitamani siksinitlu tatkikhiutini) takuhimayut. Taimaimat mikiyut utiktihimayut ubluit amigaivyaktuni tatkikhiutini piyunakhimayut atugutingit ihuinaakhimayut pigamik utiktihimayut pingitut mikiniakatuk. Kihimi, ukakhimamata titigakhimayut hamani piyunakhiyut utiktihimayut pingitut ilaa pihimayut ilaani ovalo ihumagiyauyukhak ihivgiufaaligumik umayukhiukhimayut naunaiyautait.

Nunat ukakhimayut kinauyaliugutinik umayukhiukhimaitut ihivgiuktitlugit.

Nunanit ukakhimayut ovalo aalat pihimayaini katitikhimayuni:

1 **Tuktut:** Tuktut umayukhiukhimayut Kananamit kikiktaini tukut talvatuak.

2 **Umingmait:** Umayukhiukhimayut mikiyut. Umayukhiuktit ukautauhimayut nunani havaktinit katitikhimayut katitiktauniaktut DSDkunit, taimaimat amigaitut tuhaktitingitut umingmait umayukhimayainik (C.F.). DSDnit titigakhimayut naunaiyakhimayut hapkoa atuktakhait umayukhiukhimayut Umayukhiukhimayut Ihivgiuktitlugit (DSD Mxa):

Year 1	Year 2	Year 3	Year 4	Year 5
18	12	13	14	17

DSDkuni titigakhimayut pihimayut tamaat 13kuyut umayukhiukhimayut (hitamat ukiumi1mi, atauhik ukiumi 2mi, talimat ukiumi 4mi ovalo pingahut ukiumi 5mi) ihivgiukhimatitlugit pihimagaluamat kanugitut umayukhiukhimayut titigakhimaimat. Hapkoa umayukhiukhimayut piyunakhiyut atuktakhainik umayut kihimi ilaungitut hamani ilaa hamna nalunaiyakhimaimata.

3 **Nanuit:** Amigaitjutait takuhimayut naunaiyautaingitut kihimi pihimayut umayikhiukhimayut amigaitjutait tunihimayut DSDkunit (DSD PB)

4 **Amagut:** Umayukhiukhimayut naunaiyautait mikiyut. Ihumagiyut ilangit amagut umayukhimayut tuhaktitihimaitut; amagut umayukhiukataktut ukiuk tamaat (C.F.).

5 **Tigiganiat:** Tuhaktitikangituk umayukhiukhimayait tigiganiat ukiuni 4mi kihimi HTOkut katimayiit tuhaktitihimayut ilangit umayukhiukhimayut ukiuk tamaat (C.F.).

6 **Ukaliit:** Ukaliit amigaitut Ellesmeremi kikiktani ovalo umayukhiukpaktait amigaitunik takukhauyunit umayukhiukhimayut naunaiyautainit. Umayukhiuktit ihumagihimaitait tuhaktitilugit mikiyut umayut ilaa, angiyuumat umayukhiuktinut angiyut umayut ovalo tagiuni umayut (C.F.).

7 **Natiit:** Umayukhiukhimayut naunaiyautait takuhimayut ikililiktut natiit umayukhiukhimayut talimani ukiuni ihivgiuktut atuktaini. Nunat tuhaktitihimayut katakhimayut natinik umayukhiukhimayuni piliktut hitamani ukiuni iklilikmata natiit umayukhiukviani. Kihimi ihumayut natiit umayukhiugutit katangitut akhut umayukhiukhimayut naunaiyautaini ukakhimayaini (C.F.).

8 **Akviit:** Umayukhiukhimayut naunaiyautait ukiuni 2mit 5mut mikiyut. Ukiumi 1mi naunaiyautait naamaktut (C.F.).

9 **Tuugaat:** Umayukhiukhimayut naunaiyautait mikiyut (C.F.) Ukiuk tamaat kotangit 20kuyut umayut. DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitajutait tugaaliit kilalugat (nalungilutit DFOkut katitikhimayait atukhimayut iniktigutaini ukiut, Umayukhiukhimayut Ihivgiugutait katitikhimayut pihimavanmat umayukhiukhimayut ukiungit Junemit Maymut (DFO N/B):

96/97	97/98	98/99	99/00	00/01
1	1	10	16	17

10 **Kilalugait:** Umayukhiukhimayut naunaiyautait mikiyut (C.F.). DFOkut tuhaktakhait hapkoa umayukiukhimayut amigaitjutait kilalugait (nalunggukytut DFOkut katitikhimayait atukhimayut iniktigutaini ukiut, Umayukhiukhimayut Ihivgiugutait Ktitikhimayut pihimavanmata umayukhiukhimayut ukiungit Junemit Maymut (DFO N/B):

96/97	97/98	98/99	99/00	00/01
1	2	40	23	22

11 **Uluaguliit:** Uluaguliit takuyauvaktut ikitumik amigaitjutaini haniani Ausguituq. Umayukhiukhimayut naunaiyautait 38kuyut ukiumi 1mi angiyut (C.F.). Hamna umayukhimayut pihimayut Junemi 1986 kiuyauvaktut naunaiyautait ataaniitilugu 50%mik. Piyunakhigami umayukhiukhimayut naunaiyautait angiyut amigaituumata kiuyuitut ihumagiyainit. Tuhaktakhak umayukhiukhimayuni hamani tatkikhiutini talvatuak hitamauyut uluaguliit.

12 **Tingmiat:** Tamamik kingaliit ovalo mitiit umayukhiukhimavaktut haniani Ausuituq. Umayukhiukhimayut naunaiyautait mikiyut. Ilaani umayukhiuktit naunaiyakhimavaktut kafinik umayukhiukhimayainik; amigaitut umayukhiuktit pivaktut ataanut naunaiyakhutik mikhaanit kaaganut naunaiyakhimagutainit (C.F.).

13 **Ikaliviit:** Ukakhimayut nunanit ilauyunit mikinikhaaguyut umayukhiukhimayut naunaiyautaini ilangit ukiuni nakuuluangimat apkotit kane Basinmut (C.F.).

14 **Ugat:** Ugat umayukhiukpaktait hinaanugaagata malikyuanit. Amigaitpiaktut umayukhiukpaktait pigaagata hamna. Nunani ihumayut amigaitut hapkoa ugat tuhaktitiyauyuitut (C.F.).

15 **Kanayuit:** Umayukhimayut naunaiyautait mikiyut. Amigaitut umayukhiuktit naluyut tuhaktitiyakhait hapkoa umayut (C.F.).

16 **Uviluit:** Uviluit umayukhiukpaktut tamaat ukiut. Aatjikutaatut aalat mikiyut umayut, umayukhiuktit naluvaktut tuhaktitiyaani ovaluniit ihumagilugit tuhaktitiyukhat hapkoa umayut (C.F.).

Pikiutaktut maninik ukayuitait umayukhiuktit Ausuituqmiunit. Hapkoa maniit pikiutaktauvaktut ukiuk tamaat; Nauyat, Kingaliit ovalo mitiit, brant ovalo uluaguliit, maligiit, Black guillemot, thick billed murre ovalo aahangiit (C.F.).

6.1.4

TABLE/ᓇᓗᓇᐃᔨᐅᐅᑦ/NAUNAIKUTA 103

Monthly harvest estimates
ᑕᕆᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᓕᕐᒧ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᕆᖏᖅ/Tatkia			JUN ᔮᓂ	JUL ᔭᓪᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᓄᐱᓕᓇ	DEC ᑎᓯᓕᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓪᓗ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	50	119	303	41	148		38	44	39	156	49	68	1,055 ± 266
Musk-ox	ᐅᒥᖕᒪᐃᑦ	Umingmait											1		1 ± 0
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					2	2				1	1		6
Wolf	ᐊᒪᓗᐃᑦ	Amagut											7	1	8 ± 2
Arctic fox	ᑎᓕᓴᐅᓂᐊᑦ	Tigiganiat						78	161	42	42	4	7		334 ± 69
Wolverine	ᖃᐅᔨᑦ	Kalvik											1		1 ± 0
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik						41	4	2		3	11	9	70 ± 32
Arctic ground squirrel	ᓱᖅᓯᑦ	Hikhik												1	1 ± 0
Ringed seal	ᓇᓯᓚᑦ	Natiinat	265	115	213	101	21	9	18	1	2	62	14	16	837 ± 207
Bearded seal	ᐅᖏᕐᕕᐃᑦ	Ukyuk		11	19	14			1	1		4	1	1	52 ± 23
Harp seal	ᖃᐃᐳᓪᓕᑦ	Qairulik				13									13 ± 13
Walrus	ᐊᐃᐅᔨᑦ	Akvik	3	40	3	17	14				2	2	4	3	88 ± 35
Narwhal	ᑐᒍᓪᓕᑦ ᖃᓪᓗᓂᑦ	Tuugaak			3										3 ± 6
Geese (unspecified)	ᓄᖅᓪᓕᑦ	Kanguk	721	2											723 ± 144
Snow goose	ᑲᖏᐃᑦ	Kanguq		52	14										66 ± 62
Canada goose	ᓄᖅᓪᓕᑦ ᐅᓗᐊᔪᓪᓕᑦ	Nikliknik	3												3 ± 4
Eider duck	ᒥᑎᑦ	Kingalik	194	10	34	3								3	244 ± 289
Black guillemot	ᐱᖏᐅᓪᓕᑦ	Black guillemot						5							5 ± 8
Ptarmigan	ᐊᖑᓚᑦ	Akilgik		7	3	18	39	526	32				4	57	686 ± 424
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᓕᐊᑦ	Manniit	947												947 ± 1,644
Fish (unspecified)	ᐃᖃᓗᐃᑦ (ᓇᓗᓇᐃᑦᑕᐅᖏᑦᑐᑦ)	Ikaluit	320	122											442 ± 348
Arctic char	ᐃᖃᓗᐊᖅᑕᑦ	Ikaliviit	308	1,134	483	370	1,548	3,185	482	564	396	557	289	208	9,524 ± 3,042
Lake trout	ᐃᓕᖅᑕᐃᑦ	Ikalukpik			41	17	292	105	17			3	4	138	617 ± 564

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᑕᐅᒪᔨᑦ ᑐᓂᔭᖏᑦ ᐅᑉᐊᒃ ᐃᑯᐱᕕᓂᖅᑕᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 104

Monthly hunter response

ᑕᕈᑕᒪᑦ ᐊᖏᔪᓇᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐃᓕᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᕈᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᐹᓕ	OCT ᐅᑲᐃᓕ	NOV ᓄᓇᕗᓕ	DEC ᑎᓯᕗᓕ	JAN ᒎᓐᓄᐊᓕ	FEB ᓇᖑᐊᓕ	MAR ᒪᕐ	APR ᐃᕐᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔪᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᕈᑕᒪᑦ ᐊᖏᔪᓇᒃᑎᑦ	Tatkitaman angunahuktut titigait	111	111	112	112	112	112	110	110	110	111	122	135	137*
Hunters interviewed	ᐊᖏᔪᓇᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	24	30	30	37	17	31	110	110	110	31	120	132	136*
Harvested	ᐊᖏᔪᓇᒃᑐᒥᓂᓂᑦ	Angujaujut	24	28	26	15	10	17	17	11	14	15	32	76	104*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	22	27	27	33	15	28	100	100	100	28	98	98	56**

6.1.5

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᒃᑎᑦ ᐊᑎᓕᐅᖅᑕᒪᓐᓇᖅᑐᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᔪᓇᒃᑐᒥᓂᓂᑦ ᐊᑕᐅᓂᐊᖅᓯᐅᑎᑉ ᐊᓕᔪᒪᒥ.
** ᐊᓕᒍᓂᓕᕆᓂᒪᓐᓇᔨᑦ ᑕᕈᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 105

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᓂᑦ ᐊᑯᕐᓂᖅ ᐊᖏᔪᓇᓂᓕᓂᖅᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓂᖅᑕ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓇᓂᑦ ᑎᑎᕐᓂᑦᑕᐅᒪᓂᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐃᓕᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᕈᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᐹᓕ	OCT ᐅᑲᐃᓕ	NOV ᓄᓇᕗᓕ	DEC ᑎᓯᕗᓕ	JAN ᒎᓐᓄᐊᓕ	FEB ᓇᖑᐊᓕ	MAR ᒪᕐ	APR ᐃᕐᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᓂᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕈᑦ	≤ tatkin pingahut	100	100	100	100	100	100	0	0	0	100	100	100	86
4-6 months	4-6 ᑕᕈᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	55	92	0	0	0	6
> 6 months	> 6 ᑕᕈᑦ	> 6 tatkin	0	0	0	0	0	0	100	45	8	0	0	0	8

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 106

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓚᓯᖅᑎᑦ ᐊᖏᓚᓯᖅᓯᕐᓂᑦ ᐊᑐᓂᖅ ᐅᒪᔨᓂᖅ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 1 (June 1996 - May 1997)
ᐊᒃᒡᒍ 1 (ᔪᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᕐᖏᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒡᒎᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑦᑐᕆ	NOV ᐅᓇᒃᕆᓗ	DEC ᑎᓯᒃᕆᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᖏᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	6	11	19	2	3		6	8	8	5	17	19	61
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait											1		1
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut											4	1	5
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat						6	6	2	2	1	1		13
Wolverine	ᖃᑦᕙᓵᑦ	Kalvik											1		1
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik						6	1	1		1	6	5	16
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik												1	1
Ringed seal	ᓇᑦᓱᑦ	Natiinat	18	10	16	10	2	2	5	1	1	8	8	5	45
Bearded seal	ᐅᓗᐊᕐᐃᑦ	Ukyuk		3	5	4			1	1		1	1	1	13
Harp seal	ᖃᐃᕐᓪᓕᑦ	Qairulik				2									2
Walrus	ᐊᐃᐅᓵᑦ	Akvik	1	8	1	5	2				2	1	3	3	17
Narwhal	ᑐᒍᓪᓕᑦ ᖃᓕᓴᒃ	Tuugaak			1										1
Geese (unspecified)	ᓄᑦᓪᓕᑦ	Kanguk	12	1											12
Snow goose	ᑲᖏᐃᑦ	Kanguq		3	1										3
Canada goose	ᓄᑦᓪᓕᑦ ᐅᓗᐊᒍᓪᓕᑦ	Nikliknik	1												1
Eider duck	ᒥᑎᑦ	Kingalik	5	1	2	1								1	10
Black guillemot	ᐱᑦᓯᐅᓪᓕᑦ	Black guillemot						1							1
Ptarmigan	ᐊᖏᓴᑦ	Akilgik		1	1	2	4	9	1				2	15	30
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᓕᐊᑦ	Manniit	3												3
Fish (unspecified)	ᐃᖃᓗᐃᑦ (ᓇᓗᓇᐃᑦᑕᐅᖏᑦᑐᑦ)	Ikaluit	4	2											6
Arctic char	ᐃᖃᓗᒃᑑᑦ	Ikaliviit	1	11	8	2	2	8	6	4	6	3	5	22	53
Lake trout	ᐃᓕᑦᓴᐃᑦ	Ikalukpik			1	1	1	1	1			1	2	45	49

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓯᒪᔨᓂᒃ ᐱᕈᖅᖏᑦᑐᖅ ᐱᓕᔨᑎᓪᓗᒃ ᐊᖏᓴᑦ ᖃᖏᐅᓂᖏᑦᓂᓄᑦ ᐊᓪᓚᖅᓄᑦ ᓇᓪᓕᐅᒪᒪᔨᓂᓄᑦ ᐊᖏᓴᓂᑦ ᓇᓪᓕᐅᒪᒪᔨᓂᓄᑦ ᑐᓴᐅᑎᖅᓄᑦ ᑐᓂᓯᖏᓐᓂ ᐃᑯᐱᕐᓇᓕᓐᓂᒃᑕᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 107

Monthly harvest estimates
ᑕᕆᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᑎᓂᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᑐᖏᔪ 2 (ᔨᓄ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

6.1.5

Month/ᑕᕆᖏᓐᓄᑦ/Tatkia			JUN ᔨᓄ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᑦᐱᓇ	OCT ᐅᑦᔪᐱᓇ	NOV ᐅᓇᓚᐱᓇ	DEC ᑎᓯᓚᐱᓇ	JAN ᔮᖏᓐᓇᐊᓇ	FEB ᐃᕐᕉᐊᓇ	MAR ᒪᑦᓯ	APR ᐃᑦᓇᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin ± 95% CI
Species	**ᐅᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	50	44	211	46	80	15	59	38	63	39	81	65	791 ± 18
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡					3	1		1		1	1		7
Arctic fox	ᑎᓕᓴᕐᓂᐊᑦ	Tigiganiat						147	73	5	19	31	7		282 ± 7
Wolverine	ᖃᑦᕃᓵᑦ	Kalvik											2		2 ± 0
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik	3				2				2	2	5	2	16 ± 1
Ringed seal	ᓇᓯᓗᑦ	Natiinat	108	96	140	111	80	19	9	10	33	19	24	41	690 ± 26
Bearded seal	ᐅᓘᔪᐃᑦ	Ukyuk	7	19	24	9	3	1		2	1	1			67 ± 4
Harp seal	ᖃᐃᓱᓪᓕᑦ	Qairulik				12	6								18 ± 3
Walrus	ᐊᐃᓴᑦ	Akvik	8	52	9	7	14	3	5	1	2	1	3	3	108 ± 6
Narwhal	ᑐᑎᓪᓕᑦ ᖃᓪᓗᓂᑦ	Tuugaak			1								2		3 ± 0
Beluga	ᖃᓄᖅᑕᑦ ᖃᓪᓗᓂᑦ	Kilalugak			3	5							2		10 ± 2
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq	48	2	70	6							2	5	133 ± 13
Canada goose	ᓄᖅᓪᓕ ᐅᓗᐊᔪᖅᓪᓕᑦ	Nikliknik	1											2	3 ± 1
Brant goose	ᓄᖅᓪᓕᓴᐃᑦ	Nirlirnaq	31												31 ± 13
Eider duck	ᒥᑎᑦ	Kingalik	132	12	40	10	12						8	3	217 ± 17
Tundra swan	ᖃᓄᐊᔪᐃᑦ	Kukyuk	2												2 ± 1
Red-throated loon	ᖃᖓᓴᐅᑦ	Qaqhuaq			7										7 ± 3
Black guillemot	ᐱᕐᓂᐅᓪᓕᑦ	Black guillemot		1											1 ± 1
Ptarmigan	ᐊᕕᓂᑦ	Akilgik	49	2	5	5	31	16	5				28	89	230 ± 20
Goose eggs	ᑲᖏᔪᐃᑦ ᓚᒃᓂᕐᑦ	Uluaguliit manniit	313												313 ± 71
Duck eggs	ᒥᑎᑦ ᓚᒃᓂᕐᑦ	Tinmiat manniit	117											21	138 ± 37
Arctic tern eggs	ᐃᒥᖏᑕᓚᐃᑦ ᓚᒃᓂᕐᑦ	Emitkutailat manniit	38												38 ± 7
Seagull eggs	ᓇᐅᔨᐃᑦ ᓚᒃᓂᕐᑦ	Nauyat manniit	6												6 ± 3
Black guillemot eggs	ᐱᕐᓂᐅᓪᓕᑦ ᓚᒃᓂᕐᑦ	Black guillemot eggs		4											4 ± 3
Arctic char	ᐃᖏᓄᖅᐱᑦ	Ikaliviit	308	2,121	1,020	12	1,176	295	340	25	30		394	113	5,834 ± 281
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	63	2		2	56	8	11		9		11	201	363 ± 19
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᐱᓂᓪᓕᑦ	Kapihilik	240		6	17	54							1	318 ± 33
Clams	ᐋᓗᒍᓚᐅᑦ	Uviluq				13									13 ± 4

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᔪᓂᑦ ᑎᑎᕋᐅᒪᓚᐅᑦ ᑐᓂᔨᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕋᓂᓚᓐᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 108

Monthly hunter response
ᑕᖅᑕᒪᑦ ᐊᖏᓚᓂᕆᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᒃᓴᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᓴᓕ	OCT ᐅᑲᐃᓕ	NOV ᐅᓇᓴᓕ	DEC ᑎᓯᓴᓕ	JAN ᒍᖏᓇᓕ	FEB ᓇᖕᐅᔪᓕ	MAR ᒪᕐᓯ	APR ᐃᑦᓗᓪ	MAY ᒪᐃ	Total ᑲᑎᑕᐅᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓚᓂᕆᑦ ᑭᐅᓂᖏᑦ ᐊᑎᔨᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᓚᓂᕆᑦ	Tatkitaman angunahuktut titigait	134	135	136	133	132	130	130	132	130	135	137	142	147*
Hunters interviewed	ᐊᖏᓚᓂᕆᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	128	126	132	129	128	129	129	131	130	134	135	136	146*
Harvested	ᐊᖏᓚᓂᕆᑐᒃᑦ	Angujaujut	91	91	90	36	41	30	31	19	26	24	37	89	131*
Response Rate (%)	ᕿᑦᓱᐅᓂᖏᑦ (%)	Kiujut (%)	96	93	97	97	97	99	99	99	100	99	99	96	98**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓂᕆᑦ ᐊᑎᓂᐅᑦᑕᐅᒪᓕᖅᑎᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᓚᓂᕆᑐᒃᑦ ᐊᑕᐅᓂᐊᖅᑐᑎᑦ ᐊᑲᔪᒥ.
** ᐊᐅᔨᓂᑎᓂᓕᒪᓕᖅ ᑕᖅᑕᒪᑦ ᑭᐅᓂᖅ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 109

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᓂᑦ ᐊᑯᖏᓐᓂ ᐊᖏᓚᓂᕆᓂᖓᑕ ᐊᒪᒐ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᓂᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᓚᓂᕆᑦᑕᑦ ᑎᑎᕐᑦᑕᐅᒪᓕᖅᑎᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)
ᐊᒃᓴᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᓴᓕ	OCT ᐅᑲᐃᓕ	NOV ᐅᓇᓴᓕ	DEC ᑎᓯᓴᓕ	JAN ᒍᖏᓇᓕ	FEB ᓇᖕᐅᔪᓕ	MAR ᒪᕐᓯ	APR ᐃᑦᓗᓪ	MAY ᒪᐃ	Total ᑲᑎᑕᐅᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᓂᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑦ	≤ tatkin pingahut	100	100	95	96	100	100	100	100	100	100	95	93	98
4-6 months	4-6 ᑕᖅᑦ	tatkin hitaman 6nut	0	0	5	4	0	0	0	0	0	0	5	7	2
> 6 months	> 6 ᑕᖅᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 110

Number of hunters harvesting each species

ᖃᑦᕿᐅᓂᖏᑦ ᐊᖏᔪᓕᓴᐃᒋᑦ ᐊᖏᔪᓕᓴᐅᔪᖅᑕᕐᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 2 (June 1997 - May 1998)

ᐊᑲᒧᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᑐᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᐱᓗ	DEC ᑎᓯᐱᓗ	JAN ᒍᖏᓇᓗ	FEB ᐃᖅᑲᓇᓗ	MAR ᒪᕐᓯ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᕐᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐸ	Tuktut	15	19	53	18	16	4	12	7	12	12	21	25	88
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓗᒃᑖᓪᓕᐊᑦ	Tigiganiat						14	9	3	4	3	3		18
Wolverine	ᑲᕐᕕᒃ	Kalvik											2		2
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	3				1				1	2	1	2	9
Ringed seal	ᓇᓯᓂᑦ	Natiinat	40	42	40	20	19	7	6	6	9	11	7	17	81
Bearded seal	ᐅᓘᔪᐃᐸᑦ	Ukyuk	7	15	19	6	3	1		2	1	1			40
Harp seal	ᖃᐃᐳᓪᓚᑦ	Qairulik				5	5								9
Walrus	ᐊᐃᕕᒃᑦ	Akvik	7	26	8	6	9	2	3	1	1	1	2	3	45
Narwhal	ᑐᒻᓪᓕ ᖁᓪᓗᓕᑦ	Tuugaak			1								1		2
Beluga	ᖃᐅᕐᑦ ᖁᓪᓗᓕᑦ	Kilalugak			2	2							1		4
Snow goose	ᑲᖏᐃᐸᑦ	Kanguq	13	1	14	3							1	3	30
Canada goose	ᓄᕐᓕᑦ ᐅᓄᐊᔪᓕᓕᑦ	Nikliknik	1											1	2
Brant goose	ᓄᕐᓕᕐᓇᐃᑦ	Nirlirnaq	1												1
Eider duck	ᒥᑎᑦ	Kingalik	24	4	2	1	2						2	2	34
Tundra swan	ᑭᓯᔪᐃᐸᑦ	Kukyuk	1												1
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq			2										2
Black guillemot	ᐱᕐᐅᓪᓕᑦ	Black guillemot		1											1
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	5	1	2	2	5	3	1				3	15	23
Goose eggs	ᑲᖏᐃᐸᑦ ᒪᓂᓂᖏᑦ	Uluaguliit manniit	11												11
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᖏᑦ	Tinmiat manniit	4											1	5
Arctic tern eggs	ᐃᒥᖅᑯᑕᓚᐃᑦ ᒪᓂᓂᖏᑦ	Emitkutailat manniit	5												5
Seagull eggs	ᓇᐅᐳᐃᑦ ᒪᓂᓂᖏᑦ	Nauyat manniit	1												1
Black guillemot eggs	ᐱᕐᐅᓪᓕᑦ ᒪᓂᓂᖏᑦ	Black guillemot eggs		1											1
Arctic char	ᐃᖅᓗᓴᐱᑦ	Ikaliviit	30	53	36	3	15	11	9	4	3		9	19	87
Lake trout	ᐃᓯᕋᐃᑦ	Ikalukpik	19	1		1	5	2	3		2		6	58	72
Arctic cisco	ᐅᑭᐅᑦᑐᑐᒥ ᑲᐱᓯᓪᓚᑦ	Kapihilik	13		1	2	2							1	18
Clams	ᐊᒻᒧᒪᓕᕐᑦ	Uviluq				1									1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᖏᑦᑐᖅ ᐱᓕᕆᔨᒪᓂᒃ ᐊᖏᔪᑦ ᖃᕋᐅᓂᖏᓐᓄᑦ ᐊᓕᔪᖅᓯᒪᔪᓄᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᑎᓐᓂᒃᑐᑦ ᑐᓂᔭᖏᓐᓄᑦ ᐃᓕᓴᕐᓂᐊᕐᓂᒃᑐᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 111

Monthly harvest estimates
ᑕᕋᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᑎᓯᑎᑦ
Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᓐᔪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᕋᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓱᑎᐱᕆ	OCT ᐅᑦᑐᕆ	NOV ᓄᐱᕆ	DEC ᑎᓯᕆ	JAN ᔭᖏᓇᕆ	FEB ᓇᖅᑐᕆ	MAR ᒪᓯ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓴᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	37	18	193	103	23	55	65	65	84	62	58	75	838 ± 34
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					1	2		3	1			1	8
Wolf	ᐊᒪᓗᐃᑦ	Amagut											2		2 ± 0
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat					2	22	24	13	13	55	46		175 ± 10
Wolverine	ᖃᕐᕿᓵᑦ	Kalvik				1						1		2	4 ± 2
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik		1		1		1			1				4 ± 0
Arctic ground squirrel	ᓱᖅᓯᑦ	Hikhik			2										2 ± 0
Ringed seal	ᓇᓯᓚᑦ	Natiinat	152	104	160	66	53	12		8	4	23	23	17	622 ± 25
Bearded seal	ᐅᑭᔭᐃᑦ	Ukyuk	7	25	26	4	6		1	6	1	4	1		81 ± 2
Harp seal	ᖃᐃᓕᓪᓚᑦ	Qairulik			2	3	3								8 ± 0
Walrus	ᐊᐃᐱᕐᓴᑦ	Akvik	3	21	11	16	18	2		3	2	2		2	80 ± 4
Narwhal	ᑐᐊᓪᓚᑦ ᕿᓚᓴᑦ	Tuugaak		1	6										7 ± 1
Beluga	ᖃᓄᖅᑦ ᕿᓚᓴᑦ	Kilalugak			1	1									2 ± 0
Snow goose	ᑲᖕᒪᐃᑦ	Kanguq	81	23	28									17	149 ± 16
Canada goose	ᓄᖅᓪᓚᑦ ᐅᓗᐊᔪᓪᓚᑦ	Nikliknik	15		1										16 ± 0
Old squaw	ᐊᑭᕐᐊᖅᐃᐃᑦ	Aahangik	4												4 ± 0
Eider duck	ᒥᑎᑦ	Kingalik	94	72	5		2	1					5	19	198 ± 23
Arctic loon	ᑲᑦᓗᓪᓚᑦ	Maliriq	8												8 ± 2
Red-throated loon	ᖃᖓᓴᐅᑦ	Qaqhuaq	2		1										3 ± 0
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	11	5	4	12	29	14	4		7		1	41	128 ± 29
Goose eggs	ᑲᖕᒪᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	809												809 ± 115
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit	70	400	382										852 ± 74
Arctic tern eggs	ᐃᒥᖅᑯᐊᓪᓚᑦ ᒪᓐᓂᖏᑦ	Emitkutailat manniit		8	12										20 ± 3
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit		49											49 ± 0
Arctic char	ᐃᖅᓗᓵᓴᑦ	Ikaliviit	640	1,109	1,471	71	503	253	237	154	87	251	961	344	6,081 ± 387
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	22	20	4	37	16	26	14	8	4	50	24	279	504 ± 146
Arctic cisco	ᐅᑭᐅᖏᑐᒥ ᑲᐱᓯᓪᓚᑦ	Kapihilik	9												9 ± 2

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᓴᑦ ᑐᓂᖏᑦ ᐅᑲᓴᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᐅᓪᓚᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.1.5

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 112

Monthly hunter response

ᑕᖃᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐃᓕᖕᒧ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒻᒪᓕ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᓂᓗ	NOV ᐃᓚᒻᓂᓗ	DEC ᑎᓯᒻᓂᓗ	JAN ᔮᖏᓚᓂᓗ	FEB ᐃᖅᑲᓇᓗ	MAR ᒪᕐᕕ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᐅᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᕐᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᒪᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	143	142	140	141	141	141	139	138	137	138	137	135	146*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	141	142	138	139	139	136	137	138	134	131	131	74	144*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ	Angujaujut	74	79	81	50	33	29	27	26	29	23	35	42	128*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓕᑭᐅᓂᖏᑦ (%)	Kiujut (%)	99	100	99	99	99	96	99	100	98	95	96	55	94**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᑎᒪᔨᓯᑦ/ᐊᐱᕐᓯᑦ/ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ ᐊᑕᐅᓯᐊᕆᓪᓕᐊᑎᑐᑦ ᐊᑦᕿᒧᑦ.
** ᐊᑦᓴᒋᓕᑎᓯᒪᔨᑦ ᑕᖃᒪᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 113

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᖏᓂ ᐊᖏᔪᓂᒃᓴᓂᖅᑕ ᐊᒪᓗ ᐊᐱᕐᓯᑦᑕᐅᓂᖏᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑕᑦ ᑎᑎᕐᑦᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐃᓕᖕᒧ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒻᒪᓕ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᓂᓗ	NOV ᐃᓚᒻᓂᓗ	DEC ᑎᓯᒻᓂᓗ	JAN ᔮᖏᓚᓂᓗ	FEB ᐃᖅᑲᓇᓗ	MAR ᒪᕐᕕ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᐅᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	42	31	45	45	73	91	100	100	100	52	43	18	53
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	27	65	50	55	27	9	0	0	0	0	0	0	30
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	30	5	5	0	0	0	0	0	0	48	57	82	17

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 114

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐸᑎᑦ ᐊᖏᔪᓚᐸᓪᓕᐊᓪᑦ ᐊᑐᓂᐳ ᐅᒪᔨᓂᐳ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 3 (June 1998 - May 1999)

ᐊᒃᑭᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᐃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓯᑎᐹᓪ	OCT ᐅᑦᐹᓪ	NOV ᓄᐊᒃᐹᓪ	DEC ᑎᓯᒃᐹᓪ	JAN ᔮᖏᓄᐊᓪ	FEB ᓇᖕᐅᐊᓪ	MAR ᒪᔨᓯ	APR ᐃᑦᓗᓪ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	9	7	36	19	6	8	14	15	19	14	17	13	79
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut											2		2
Arctic fox	ᑎᓗᓚᖓᐊᑦ	Tigiganiat					1	6	4	4	3	3	4		13
Wolverine	ᖃᑦᕃᓵᑦ	Kalvik				1						1		1	3
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik		1		1		1			1				4
Arctic ground squirrel	ᓂᖅᓂᑦ	Hikhik			1										1
Ringed seal	ᓇᕐᓂᑦ	Natiinat	43	36	40	26	14	4		7	4	7	9	2	81
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	6	14	14	2	3		1	4	1	3	1		32
Harp seal	ᖃᐃᓕᓪᓕᑦ	Qairulik			1	2	2								4
Walrus	ᐊᐃᐃᓵᑦ	Akvik	2	15	7	7	11	2		2	2	1		1	35
Narwhal	ᑐᐊᓪᑦ ᕿᓪᓗᒡᑦ	Tuugaak		1	5										6
Beluga	ᖃᐅᕐᑦ ᕿᓪᓗᒡᑦ	Kilalugak			1	1									2
Snow goose	ᑲᖏᐃᑦ	Kanguq	17	5	7									3	27
Canada goose	ᓂᕐᓪᑦ ᐅᓗᐊᔪᓪᑦ	Nikliknik	2		1										2
Old squaw	ᐊᑭᓕᕐᔾᐃᑦ	Aahangik	1												1
Eider duck	ᒥᑎᑦ	Kingalik	10	9	2		1	1					3	3	23
Arctic loon	ᑲᑦᓗᓪᑦ	Maliriq	2												2
Red-throated loon	ᖃᖅᓴᐅᑦ	Qaqhuaq	1		1										2
Ptarmigan	ᐊᕈᑦᑎᑦ	Akilgik	3	2	3	2	5	5	2		1		1	4	20
Goose eggs	ᑲᖏᐃᑦ ᓚᓐᓂᖏᑦ	Uluaguliit manniit	6												6
Duck eggs	ᒥᑎᑦ ᓚᓐᓂᖏᑦ	Tinmiat manniit	3	1	2										5
Arctic tern eggs	ᐃᒥᖅᑯᑕᐃᑦ ᓚᓐᓂᖏᑦ	Emitkutailat manniit		1	1										2
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᓐᓂᖏᑦ	Nauyat manniit		1											1
Arctic char	ᐃᖅᓗᑦᐸᑦ	Ikaliviit	35	50	32	6	11	10	8	8	4	6	9	14	93
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	7	3	1	4	1	7	3	3	3	5	8	23	46
Arctic cisco	ᐅᑭᐅᑦᑐᑐᒥ ᑲᐱᓱᓕᑦ	Kapihilik	1												1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓱᒪᔪᓂᑦ ᐱᑕᖃᖅᑐᑐᒃ ᐱᑦᔪᑎᓕᖅᓂᑦ ᐊᖏᔪᑦ ᖃᕋᓱᓂᖅᓄᓪᓕᐊᓂᑦ ᐊᖏᔪᓂᑦ ᓇᓕᕆᐅᒪᔪᓂᑦ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ ᑐᓴᕆᖅᓯᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.5

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 115

Monthly harvest estimates

ᑕᕆᑦᑐᒃᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᑎᓯᑦ

Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)

ᐊᓐᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᕆᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᔪᓗ	NOV ᐅᓇᓕᓗ	DEC ᑎᓯᓗ	JAN ᔮᖏᓇᓗ	FEB ᐃᖅᑐᓇᓗ	MAR ᒪᑉ	APR ᐃᑦᓀᓪ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᔭᑐᐃᐃᑦ	Tuktut	45	20	237	71	29	28	51	19	50	35	62	52	699 ± 45
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡		1			3	1				1			6
Wolf	ᐊᒪᓕᐃᑦ	Amagut										2	1		3 ± 0
Arctic fox	ᑎᓗᓚᖅᓂᐊᑦ	Tigiganiat					2	5	18	2					27 ± 7
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik						1	2					6	9 ± 1
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik			2									1	3 ± 1
Ringed seal	ᓇᑉᓱᑦ	Natiinat	142	122	153	175	48	16	4	3	5	4	5	25	702 ± 75
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk	2	17	25	17	6		1	2	3			1	74 ± 7
Harp seal	ᖃᐃᓕᓪᓚᑦ	Qairulik		1		7	1								9 ± 2
Walrus	ᐊᐃᐸᑦ	Akvik	3	48	16	25	12	2	2	1	1	2		1	113 ± 8
Beluga	ᖃᓄᑦᑕ ᖁᓪᓗᒡᓗᑦ	Kilalugak			1	5									6 ± 2
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	38	23	1									4	66 ± 26
Canada goose	ᓄᓪᓕᓂᑦ ᐅᓚᐊᔪᓕᓂᑦ	Nikliknik	9	16											25 ± 14
Brant goose	ᓄᓪᓕᓪᓇᐃᑦ	Nirlirnaq		1											1 ± 1
Eider duck	ᒥᑎᑦ	Kingalik	22	74		2							14	4	116 ± 21
Red-throated loon	ᖃᖓᓗᐅᑦ	Qaqhuaq	7	11											18 ± 12
Ptarmigan	ᐊᕈᓚᑦ	Akilgik	96	1	1		5	12	17	2	1		6	116	257 ± 99
Goose eggs	ᑲᖏᐃᐃᑦ ᒪᓐᓂᕐᑦ	Uluaguliit manniit	325	534											859 ± 321
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᕐᑦ	Tinmiat manniit	61	210											271 ± 81
Arctic tern eggs	ᐃᒥᖅᑕᐃᓪᓚᑦ ᒪᓐᓂᕐᑦ	Emitkutailat manniit		434											434 ± 68
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓐᓂᕐᑦ	Nauyat manniit		26											26 ± 8
Black guillemot eggs	ᐱᑦᓭᐅᓪᓛ ᒪᓐᓂᕐᑦ	Black guillemot eggs		48											48 ± 18
Arctic char	ᐃᖅᓗᖏᐱᑦ	Ikaliviit	754	1,448	1,065	294	783	483	130	175	303	255	170	291	6,151 ± 478
Lake trout	ᐃᓯᕋᐃᑦ	Ikalukpik	101	6		1	84	114	27	9	14	44	30	322	752 ± 70
Cod	ᐅᒪᐃᑦ	Ugak		130											130 ± 49
Clams	ᐋᓚᒧᒪᓕᖅᑦ	Uviluq				90									90 ± 11
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet				69									69 ± 19

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᑦᓄᑦ ᑎᑎᕋᐅᒪᓕᖅᑦ ᑐᓂᓯᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕋᓱᓕᓂᕐᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 116

Monthly hunter response
ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᑐᕐᔪᒍ 4 (ᔦᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔦᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᓚᔅᑎ	SEP ᓯᑎᕐᓇᓪ	OCT ᐅᑲᐃᓇᓪ	NOV ᐅᓇᕐᓇᓪ	DEC ᑎᓯᕐᓇᓪ	JAN ᔮᖅᓄᐊᓪ	FEB ᓇᖕᐅᐊᓪ	MAR ᒪᕐᔾ	APR ᐃᔅᓪᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔅᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	135	135	135	134	136	139	140	138	137	137	138	137	142*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	51	130	132	130	128	133	133	136	136	136	137	136	140*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ	Angujaujut	32	67	78	55	43	26	20	17	20	26	36	90	120*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	38	96	98	97	94	96	95	99	99	99	99	99	92**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᑦᑕᒪᓐᓇᖅᑐᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ ᐊᑕᐅᓯᐊᖅᓗᓂᑎᑦ ᐊᑐᕐᔪᒍ.
** ᐊᑲᓴᓂᓕᕆᓚᓐᓇᓕᒃ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.1.5

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 117

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᕐᓂᒃᓴᓂ ᐊᖏᔪᓂᒃᑐᓂᒃᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓂᒃᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑕᑦ ᑎᑎᕐᑦᑕᐅᒪᔾᔨᑦ

Year 4 (June 1999 - May 2000)
ᐊᑐᕐᔪᒍ 4 (ᔦᓂ 1999 - ᒪᐃ 2000)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔦᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᓚᔅᑎ	SEP ᓯᑎᕐᓇᓪ	OCT ᐅᑲᐃᓇᓪ	NOV ᐅᓇᕐᓇᓪ	DEC ᑎᓯᕐᓇᓪ	JAN ᔮᖅᓄᐊᓪ	FEB ᓇᖕᐅᐊᓪ	MAR ᒪᕐᔾ	APR ᐃᔅᓪᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲᑦ	≤ tatkin pingahut	14	47	63	59	64	24	17	0	40	98	100	100	61
4-6 months	4-6 ᑕᖅᑲᑦ	tatkin hitaman 6nut	0	25	6	5	18	52	83	94	60	2	0	0	17
> 6 months	> 6 ᑕᖅᑲᑦ	> 6 tatkin	86	27	31	36	18	24	0	6	0	0	0	0	22

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 118

Number of hunters harvesting each species
ᖃᑦᕿᐅᓂᖏᑦ ᐊᖏᔪᓕᓴᐃᒋᑦ ᐊᖏᔪᓕᓴᐅᕙᓪᓕᒋᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 4 (June 1999 - May 2000)
ᐊᒡᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᕐᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᓂ	SEP ᓴᑎᐱᓗᓂ	OCT ᐅᑲᐱᓗᓂ	NOV ᐅᓇᒡᐱᓗᓂ	DEC ᑎᓴᐱᓗᓂ	JAN ᔮᖅᓄᐊᓗᓂ	FEB ᓇᕐᑐᐊᓗᓂ	MAR ᒪᓴ	APR ᐃᓴᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑲᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**													
Caribou	ᑐᑲᐃᐃᑦ	Tuktut	4	6	44	19	8	4	12	7	11	15	21	27	78
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut										2	1		3
Arctic fox	ᑎᓗᓚᓄᓕᑦ	Tigiganiat					1	3	2	1					6
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik						1	1					4	5
Arctic ground squirrel	ᓂᖅᓂᑦ	Hikhik			2									1	3
Ringed seal	ᓇᕆᓂᑦ	Natiinat	13	30	40	32	13	5	3	3	4	3	4	13	71
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk	1	13	16	12	3		1	2	3			1	34
Harp seal	ᖃᐃᓕᓪᓚᑦ	Qairulik		1		5	1								6
Walrus	ᐊᐃᐅᓵᑦ	Akvik	1	25	8	20	6	2	1	1	1	2		1	42
Beluga	ᖃᓄᖅᑕ ᖁᓪᓗᑎᑦ	Kilalugak			1	3									4
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	6	6	1									3	14
Canada goose	ᓄᖅᓪᓚ ᐅᓗᐊᔪᓪᓚ	Nikliknik	2	1											3
Brant goose	ᓄᖅᓕᖅᓇᐃᑦ	Nirlirnaq		1											1
Eider duck	ᒥᑎᑦ	Kingalik	4	14		1							4	4	22
Red-throated loon	ᖃᖏᓚᐅᑦ	Qaqhuaq	1	2											3
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	6	1	1		2	2	2	1	1		1	17	27
Goose eggs	ᑲᖏᐃᐃᑦ ᓚᓐᓂᖏᑦ	Uluaguliit manniit	3	10											12
Duck eggs	ᒥᑎᑦ ᓚᓐᓂᖏᑦ	Tinmiat manniit	2	7											9
Arctic tern eggs	ᐃᒥᖅᑯᐃᓪᓕᐃᑦ ᓚᓐᓂᖏᑦ	Emitkutailat manniit		8											8
Seagull eggs	ᓇᐅᓚᐃᑦ ᓚᓐᓂᖏᑦ	Nauyat manniit		2											2
Black guillemot eggs	ᐱᑦᓂᐅᓪᓕᑦ ᓚᓐᓂᖏᑦ	Black guillemot eggs		1											1
Arctic char	ᐃᖅᓗᑲᐱᑦ	Ikaliviit	15	33	32	10	21	16	5	4	6	9	9	38	87
Lake trout	ᐃᓯᕋᐃᑦ	Ikalukpik	8	2		1	11	11	3	1	3	3	11	62	70
Cod	ᐅᓚᐃᑦ	Ugak		1											1
Clams	ᐋᓚᒧᒪᓕᕐᑦ	Uviluq				5									5
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet				1									1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᒪᓕᐅᓂᒃ ᐱᑕᖃᖅᑎᑐᖅ ᐱᒃᐊᑎᓕᓂᒃ ᐊᖏᔪᑦ ᖃᖏᔪᓕᓴᐅᕙᓪᓕᒋᑦ ᐊᓕᔪᔨᓂᑦ ᐊᖏᔪᓂᒃ ᓇᓕᐅᖅᑐᓂᒃ ᑐᓂᔭᖅᑎᓂ ᑐᓴᕐᕕᖅᓂ ᐃᑯᐱᖅᓯᓕᓕᒃᑐᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 119

Monthly harvest estimates

ᑕᕆᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓕᔪᑦ

Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)

ᐊᓐᖏᔪ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕆᖏᓐᓄ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑦᔪᐹᓗ	NOV ᐅᓇᓚᐹᓗ	DEC ᑎᓯᓚᐹᓗ	JAN ᔮᖏᓂᐊᓗ	FEB ᓄᖅᐱᐊᓗ	MAR ᒪᕆᔪ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓐᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	56	28	197	64	16		89	40	21	42	70	42	665 ± 8
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					1	2	1			1			5
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat					2	53	64	33	18	21	3	1	195 ± 3
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓕᓴᓂᐊᑦ	Kalaliit tigiganiat						1	1		1	1			4 ± 0
Wolverine	ᖃᕐᕿᓵᑦ	Kalvik											1		1 ± 0
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik			1	1	1		2	1	1	3	5	3	18 ± 1
Arctic ground squirrel	ᓱᓴᓪᓚᑦ	Hikhik			2									3	5 ± 0
Ringed seal	ᓇᕐᓚᑦ	Natiinat	99	81	55	59	33	14	3	6	21	16	17	31	435 ± 6
Bearded seal	ᐅᑭᐊᐃᑦ	Ukyuk		25	10	3	6	1		3	11	3		1	63 ± 1
Harp seal	ᖃᐃᕐᓂᓪᓚᑦ	Qairulik				2	1								3 ± 0
Walrus	ᐊᐃᐅᓵᑦ	Akvik	2	47	6	9	13		1	1		2	1	5	87 ± 1
Narwhal	ᑐᒻᓂᓪᓚᑦ ᕿᓪᓗᓴᑦ	Tuugaak			2	1									3 ± 0
Beluga	ᖃᐃᕐᑦ ᕿᓪᓗᓴᑦ	Kilalugak			8	3									11 ± 0
Snow goose	ᑲᖏᐃᑦ	Kanguq	176	11	26	11								25	249 ± 12
Canada goose	ᓂᕐᓂᓪ ᐅᓪᐊᒍᓂᓪᓚᑦ	Nikliknik	4	5	6									5	20 ± 0
Brant goose	ᓂᕐᓂᕐᓇᐃᑦ	Nirlirnaq				3									3 ± 0
Old squaw	ᐊᑎᐊᕐᓴᐃᑦ	Aahangik	8		1										9 ± 0
Eider duck	ᒥᑎᑦ	Kingalik	83	17	1	4	15	2		1			2	29	154 ± 7
Tundra swan	ᖁᓕᓴᐃᑦ	Kukyuk	1			2									3 ± 0
Greater scaup	ᐊᖏᑭᓂᓴᖅ ᓱᒃᑦ	Greater scaup		10											10 ± 0
Red-throated loon	ᖃᖅᓴᐅᑦ	Qaqhuaq	11		2										13 ± 0
Black guillemot	ᐱᕐᓱᐅᓪᓚᑦ	Black guillemot									1				1 ± 0
Ptarmigan	ᐊᖏᓕᒋᑦ	Akilgik	3		12	5	32	35	3	2	3	3		51	149 ± 4
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓂᕐᑦ	Uluaguliit manniit	1,418	65										130	1,613 ± 56
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᕐᑦ	Tinmiat manniit	415	145											560 ± 10
Arctic tern eggs	ᐃᒥᖅᑯᓪᓚᓪᑦ ᒪᓐᓂᕐᑦ	Emitkutailat manniit	89	61											150 ± 9
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓐᓂᕐᑦ	Nauyat manniit	90												90 ± 0
Black guillemot eggs	ᐱᕐᓱᐅᓪᓚᑦ ᒪᓐᓂᕐᑦ	Black guillemot eggs		16											16 ± 0
Arctic char	ᐃᖅᓗᒃᑲᐃᑦ	Ikaliviit	559	684	586	39	1,147	868	247	308	115	188	478	230	5,449 ± 75
Lake trout	ᐃᓱᕐᓴᐃᑦ	Ikalukpik	125	17	13	9	87	28	5	9	6	5	12	223	539 ± 9
Arctic cisco	ᐅᑭᐅᑦᑕᐅᒥ ᑲᕐᓱᓪᓚᑦ	Kapihilik					1								1 ± 0
Cod	ᐅᓚᐃᑦ	Ugak	1	77											78 ± 0
Clams	ᐊᒃᒍᒪᔪᓂᑦ	Uviluq				108	111								219 ± 11
Mussels	ᐅᕙᓗᐃᑦ	Uviluvaloet				42									42 ± 11

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᔪᓂᑦ ᑐᓂᓯᖅᑎᑦ ᐅᑭᐅᖅᑕᖅ ᐅᑯᐊ ᐃᑯᐊᕙᓚᐅᓇᓕᒫᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓄᓗᓄᐃᕐᐅᑦ/NAUNAIKUTA 120

Monthly hunter response

ᑕᕋᑕᒻᒪᑦ ᐊᖏᔪᓄᕆᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᒡᕐᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕋᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᕐᕕᓇ	OCT ᐅᑯᐊᓇ	NOV ᓄᕙᒡᕕᓇ	DEC ᑎᓯᒡᕕᓇ	JAN ᒎᓐᓄᐊᓇ	FEB ᕕᕐᒪᐊᓇ	MAR ᒪᕐᓯ	APR ᐃᖏᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓄᕆᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᔨᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᕋᑕᒻᒪᑦ ᐊᖏᔪᓄᕆᑎᑦ	Tatkitaman angunahuktut titigait	137	157	153	149	150	154	155	156	155	157	158	159	165*
Hunters interviewed	ᐊᖏᔪᓄᕆᑎᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	136	157	153	148	150	154	155	155	154	156	154	156	164*
Harvested	ᐊᖏᔪᓄᕆᑐᒍᓐᓇᓂᑦ	Angujaujut	87	90	80	44	53	38	32	23	28	27	33	85	145*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	99	100	100	99	100	100	100	99	99	99	97	98	99**

6.1.5

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓄᕆᑎᑦ ᐊᑎᓕᐅᕐᑕᒪᓕᕐᓂᑦ/ᐊᐱᕐᓯᑦᑕᑦ/ᐊᖏᔪᓄᕆᑐᒍᓐᓇᓂᖅ ᐊᑕᐅᓯᐊᕐᓗᓂᑎᑦ ᐊᒡᕐᔪᒍ.
** ᐊᓕᒍᓂᓕᕆᓂᒪᓕᕐᓂᑦ ᑕᕋᑕᒻᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓄᓗᓄᐃᕐᐅᑦ/NAUNAIKUTA 121

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕿᐅᔾᔨᑦ ᐋᑯᕐᖏᓂ ᐊᖏᔪᓄᕆᑐᓂᖏᓐᖏᑦ ᐊᒪᓗᓗ ᐊᐱᕐᓯᑦᑕᐅᓂᖏᓐᖏᑦ, ᓄᓗᓄᐃᕐᑕᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓄᕆᑦᑕᑦ ᑎᑎᕐᕿᐅᒪᔾᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᒡᕐᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕋᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᕐᕕᓇ	OCT ᐅᑯᐊᓇ	NOV ᓄᕙᒡᕕᓇ	DEC ᑎᓯᒡᕕᓇ	JAN ᒎᓐᓄᐊᓇ	FEB ᕕᕐᒪᐊᓇ	MAR ᒪᕐᓯ	APR ᐃᖏᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕿᐅᔾᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕋᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	99	100	100	100
4-6 months	4-6 ᑕᕋᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	1	0	0	0
> 6 months	> 6 ᑕᕋᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 122

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓚᐸᒍᑦ ᐊᖓᔪᓚᐸᓕᕐᓂᑦ ᐊᑐᓂᐳ ᐅᒪᔨᕐᓂᐳ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 5 (June 2000 - May 2001)

ᐊᒡᖏᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖃᓪᓚᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓕ	AUG ᐊᐅᓚᔅᑎ	SEP ᓱᑎᐹᓗ	OCT ᐅᑦᑐᓗ	NOV ᐅᐊᓚᐹᓗ	DEC ᑎᓴᐹᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᓴ	APR ᐃᑦᓀᓪ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	23	16	54	15	6		16	9	7	13	17	20	81
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat					2	15	9	7	7	6	2	1	21
Coloured fox	ᖃᓄᖕᖏᑦ ᑎᓕᓴᓂᐊᑦ	Kalaliit tigiganiat						1	1		1	1			4
Wolverine	ᖃᑦᕃᑦ	Kalvik											1		1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik			1	1	1		2	1	1	3	3	2	12
Arctic ground squirrel	ᓱᓴᓪᓚᑦ	Hikhik			2									1	3
Ringed seal	ᓇᖏᓪᓚᑦ	Natiinat	41	39	26	20	15	5	2	5	8	8	10	13	80
Bearded seal	ᐅᑭᓪᓗᐃᑦ	Ukyuk		16	9	3	4	1		2	6	2		1	28
Harp seal	ᖃᐃᕐᓂᓪᓚᑦ	Qairulik				1	1								2
Walrus	ᐊᐃᐅᓴᑦ	Akvik	2	30	5	8	10		1	1		1	1	5	43
Narwhal	ᑐᒻᓂᓪᓕ ᖁᓪᓗᒡᓕᑦ	Tuugaak			2	1									3
Beluga	ᖃᐅᕐᑕ ᖁᓪᓗᒡᓕᑦ	Kilalugak			3	2									4
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	23	3	10	5								12	40
Canada goose	ᓂᕐᓂᓪ ᐅᓗᐊᔪᓂᓪ	Nikliknik	3	3	1									3	8
Brant goose	ᓂᕐᓂᕐᓄᐃᑦ	Nirlirnaq				1									1
Old squaw	ᐊᑭᐊᕐᓗᐃᑦ	Aahangik	1		1										2
Eider duck	ᒥᑎᑦ	Kingalik	18	7	1	1	4	1		1			2	7	29
Tundra swan	ᖃᓄᓕᐃᑦ	Kukyuk	1			1									2
Greater scaup	ᐊᖏᓂᔪᖅ ᓱᓴᑲ	Greater scaup		1											1
Red-throated loon	ᖃᖅᓘᐅᑦ	Qaqhuaq	3		1										4
Black guillemot	ᐱᑦᓱᐅᓪᓚᑦ	Black guillemot									1				1
Ptarmigan	ᐊᑭᒃᑎᑦ	Akilgik	3		4	2	9	7	2	1	3	2		15	34
Goose eggs	ᑲᖏᐃᐃᑦ ᓚᒃᓂᖏᑦ	Uluaguliit manniit	25	2										1	28
Duck eggs	ᒥᑎᑦ ᓚᒃᓂᖏᑦ	Tinmiat manniit	11	5											15
Arctic tern eggs	ᐃᒥᖅᑯᑕᓪᓕᑦ ᓚᒃᓂᖏᑦ	Emitkutailat manniit	6	3											9
Seagull eggs	ᓇᐅᓕᐃᑦ ᓚᒃᓂᖏᑦ	Nauyat manniit	3												3
Black guillemot eggs	ᐱᑦᓱᐅᓪᓚᑦ ᓚᒃᓂᖏᑦ	Black guillemot eggs		2											2
Arctic char	ᐃᖅᓗᑲᐱᑦ	Ikaliviit	43	40	29	3	30	19	8	8	4	4	8	32	99
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	26	8	5	2	12	8	4	2	4	3	3	58	78
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᖃᕕᓱᓂᑦ	Kapihilik					1								1
Cod	ᐅᒪᐃᑦ	Ugak	1	2											2
Clams	ᐊᒃᒍᒪᓕᕐᓂᑦ	Uviluq				5	3								7
Mussels	ᐅᕙᓗᐃᑦ	Uviluvaloet				1									1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓱᒪᓂᖅ ᐱᑕᖃᖏᑦᑐᖅ ᐱᓕᐊᓕᓐᓂᖅ ᐊᖓᔪᓂᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᕆᐊᓕᒫᑦ ᐊᐅᓚᐅᒪᒪᓂᓕᒫᑦ ᐊᐅᓚᔨᕐᓂᐅᑎᓂᒃ ᐃᓕᓴᕐᓂᐊᕐᓗᒋᑦ ᐃᓄᐃᑦᑎᓪᓗᒍ ᐃᓄᐃᑦᑎᓪᓗᒍ ᑐᓂᔭᖏᓐᓄᑦ ᐃᓄᐃᑦᑎᓪᓗᒍ ᐃᓄᐃᑦᑎᓪᓗᒍᓐᓇᖅᑐᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 123

Annual harvest estimates and five-year mean

All Years (June 1996 - May 2001)

ᐊᓐᔪᔨᑦᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓕᑦᑐᑦ ᐊᓚᓗ ᑕᒻᓕᓂᑦ-ᐊᓐᔪᔨᓂᑦ ᐊᐅᑎᓕᕐᑎᓯᒪᓕᐅᑦ ᑕᒪᐃᓐᓂᑦ ᐊᓐᔪᔨᓂᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᓐᔪᔨ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Mean ᐊᐅᑎᓕᕐᑎᓯᒪᓕᐅᑦ Amigaitkiyait
			96/97	97/98	98/99	99/00	00/01	
Species	**ᐅᒪᓕᐅᑦ**	**Umajuin**						
Caribou[1]	ᑐᖅᑐᐃᑦ[1]	Tuktut[1]	1,055	791	838	699	665	810
Musk-ox[2]	ᐅᒥᓴᒪᐃᑦ[2]	Umingmait[2]	1	0	0	0	0	<1
Polar bear[3]	ᓇᓄᐃᑦ[3]	Nanuit[3]	6	7	8	6	5	6
Wolf	ᐊᒪᓗᐃᑦ	Amagut	8	0	2	3	0	3
Arctic fox[4]	ᑎᓕᖅᑐᓂᐊᑦ[4]	Tigiganiat[4]	334	282	175	27	195	203
Coloured fox	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓕᖅᑐᓂᐊᑦ	Kalaliit tigiganiat	0	0	0	0	4	1
Wolverine	ᖃᕐᕕᒃ	Kalvik	1	2	4	0	1	2
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	70	16	4	9	18	23
Arctic ground squirrel	ᓱᖅᓯᒃ	Hikhik	1	0	2	3	5	2
Ringed seal	ᓇᑦᓯᒃ	Natiinat	837	690	622	702	435	657
Bearded seal	ᐅᑭᐊᐃᑦ	Ukyuk	52	67	81	74	63	67
Harp seal	ᖃᐃᕈᓪᓚᑦ	Qairulik	13	18	8	9	3	10
Walrus	ᐊᑕᐃᒃ	Akvik	88	108	80	113	87	95
Narwhal[5]	ᑐᐃᓪᓚᑦ ᖃᓪᓗᓂᑦ[5]	Tuugaak[5]	3	3	7	0	3	3
Beluga	ᖃᐅᕐᑦ ᖃᓪᓗᓂᑦ	Kilalugak	0	10	2	6	11	6
Geese (unspecified)[6]	ᓄᖅᓯᓄᑦ[6]	Kanguk[6]	723	0	0	0	0	145
Snow goose	ᑲᖏᐅᑦ	Kanguq	66	133	149	66	249	133
Canada goose	ᓄᖅᓯᓄᑦ ᐅᓪᐊᒍᑦᓯᓄᑦ	Nikliknik	3	3	16	25	20	13
Brant goose	ᓄᖅᓭᖅᓇᐃᑦ	Nirlirnaq	0	31	0	1	3	7
Old squaw	ᐊᕿᑎᖅᓴᐃᑦ	Aahangik	0	0	4	0	9	3
Eider duck	ᒥᑎᑦ	Kingalik	244	217	198	116	154	186
Tundra swan	ᖁᓕᓴᐃᑦ	Kukyuk	0	2	0	0	3	1
Greater scaup	ᐊᖏᑎᓂᖅᑎᑦ ᐊᐃᑦᓴᖏᑦ ᒥᑎᑦ	Greater scaup	0	0	0	0	10	2
Arctic loon	ᑲᒡᓚᓄᑦ	Maliriq	0	0	8	0	0	2
Red-Throated loon	ᖃᖓᓴᐅᑦ	Qaqhuaq	0	7	3	18	13	8
Black guillemot	ᐱᓕᐅᓪᓗᑦ	Black guillemot	5	1	0	0	1	1
Ptarmigan	ᐊᑭᓱᑦ	Akilgik	686	230	128	257	149	290

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Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᔨᓕᕐᕋᒪᓕᒃ Amigaitkiyait
Species	ᐅᒪᓕᒃ	**Umajuin**						
Eggs (unspecified)[7]	ᓚᐅᒋᑦ[7]	Manniit[7]	947	0	0	0	0	189
Goose eggs[7]	ᑲᖏᐃᑦ ᓚᐅᖏᑦ[7]	Uluaguliit manniit[7]	0	313	809	859	1,613	719
Duck eggs[7]	ᒥᑎᑦ ᓚᐅᖏᑦ[7]	Tinmiat manniit[7]	0	138	852	271	560	364
Arctic tern eggs[7]	ᐃᒥᖅᑯᐃᓕᐃᑦ ᓚᐅᖏᑦ[7]	Emitkutailat manniit[7]	0	38	20	434	150	128
Seagull eggs[7]	ᓇᐅᔨᐃᑦ ᓚᐅᖏᑦ[7]	Nauyat manniit[7]	0	6	49	26	90	34
Black guillemot eggs[7]	ᐱᒋᔭᐅᓪᓗᑦ ᓚᐅᖏᑦ[7]	Black guillemot eggs[7]	0	4	0	48	16	14
Fish (unspecified)	ᐃᖅᓗᐃᑦ	Ikaluit	442	0	0	0	0	88
Arctic char[8]	ᐃᖅᓗᓂᐸᑦ[8]	Ikaliviit[8]	9,524	5,834	6,081	6,151	5,449	6,608
Lake trout	ᐃᓱᒋᕐᐃᑦ	Ikalukpik	617	363	504	752	539	555
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᖃᕐᓯᓪᓕᑦ	Kapihilik	0	318	9	0	1	66
Cod[9]	ᐅᒪᐃᑦ[9]	Ugak[9]	0	0	0	130	78	42
Clams[10]	ᐊᓚᒧᒪᓂᐸ[10]	Uviluq[10]	0	13	0	90	219	64
Mussels[10]	ᐅᕙᓗᐃᑦ[10]	Uviluvaloet[10]	0	0	0	69	42	22

[1-10]: See page 248 for community feedback and other sources of data.

[1-10]: ᑕᑯᓚ ᒪᔪᐃᑐᖅ 250 ᓄᓇᓕᑦ ᑭᐅᔨᔪᑎᖏᑦ ᐊᓚᒪᓗ ᐊᓯᖏᑦ ᐱᖃᐅᔨᓪᓗᑦ ᓇᒪᐅᓂᒃ.

[1-10]: Takulugu makpigaak 252 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

6.1.5

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 124

Annual hunter response

ᐊᓗᕐᔪᑕᒪᓕᑦ ᐊᖏᔪᓂᓴᐃᑦ ᑭᐅᓂᖏᑦ

Angujauvaktu

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓗᕐᔪᓄᑦ (ᓄᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᓂᖅ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᓴᐃᑦ ᑭᐅᓂᖏᑦ ᐊᑎᔨᓕᓂᖏᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᑭᑕᒪᓕᑦ ᐊᖏᔪᓂᓴᐃᑦ	Tatkitaman angunahuktut titigait	137	147	146	142	165	181*
Hunters interviewed	ᐊᖏᔪᓂᓴᐃᑦ ᐊᐱᕐᓂᖏᑦ	Angunahuktin apikhuktan	136	146	144	140	164	179*
Harvested	ᐊᖏᔪᓂᓴᐅᑎᓄᑦ	Angujaujut	104	131	128	120	145	164*
Response Rate (%)	ᑭᐅᐊᑦ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	56	98	94	92	99	88**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖏᔪᓂᓴᐃᑦ ᐊᑎᓕᐅᔨᓪᓗᑦ/ᐊᐱᕐᓂᖏᑦ/ᐊᖏᔪᓂᓴᐅᑎᓄᑦ ᐊᑕᐅᓂᐊᕐᓵᔭᑐᑎᒃ ᖃᐅᔨᓴᓪᓗᑎᒃ.
** ᐊᐅᔨᓕᕐᕋᒪᓕᒃ ᐊᖏᔪᓂᓴᐃᑦ ᑭᐅᔨᑦ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 125

Recall period between harvest and interview, expressed as % of total harvest records

All Years (June 1996 - May 2001)

ᐅᑎᕐᕕᐅᔪᑦ ᐊᒻᒪᓗᓂ ᐊᖏᓪᓗᓂᓂᓗᒡᓗ ᐊᒪᓪᓗ ᐊᐱᕐᓯᕐᒥᐅᓂᓗᒡᓗ, ᓇᓗᓇᐃᕐᒡᓗ ᐃᒪᓐᓄ % ᑲᑎᕐᔅᑭᑦ ᐊᖏᓪᓗᓂᒃᑕᑦ ᑎᑎᕐᕋᐅᒪᔪᑦ

ᑕᒪᐃᓐᓄᑦ ᐊᑲᐅᔭᕆ (ᐋᓐ 1996 - ᒪᐃ 2001)

Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐱᖁᔭᐃᓕᓴᐅᑉ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔅᑭᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᕐᑭᑦ	≤ tatkin pingahut	86	98	53	61	100	81
4-6 months	4-6 ᑕᕐᑭᑦ	tatkin hitaman 6nut	6	2	30	17	0	10
> 6 months	> 6 ᑕᕐᑭᑦ	> 6 tatkin	8	0	17	22	0	8

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 126

Number of hunters harvesting each species

All Years (June 1996 - May 2001)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓪᓗᓂᐸᑎᑦ ᐊᖏᓪᓗᓂᐸᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

ᑕᒪᐃᓐᓄᑦ ᐊᑲᐅᔭᕆ (ᐋᓐ 1996 - ᒪᐃ 2001)

Angunahuktin angutivaktun umajunik

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐱᖁᔭᐃᓕᓴᐅᑉ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔅᑭᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**						
Caribou	ᑐᑐᐃᑦ	Tuktut	61	88	79	78	81	128
Musk-ox	ᐅᒥᒪᐃᑦ	Umingmait	1					1
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#		8	4	6	9	23
Wolf	ᐊᒪᖅᐃᑦ	Amagut	5		2	3		9
Arctic fox	ᑎᓚᖓᓂᐊᑦ	Tigiganiat	13	18	13	6	21	47
Coloured fox	ᖃᐅᓕᖅᑐᑦ ᑎᓚᖓᓂᐊᑦ	Kalaliit tigiganiat					4	4
Wolverine	ᖃᕐᐃᒃ	Kalvik	1	2	3		1	7
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	16	9	4	5	12	34
Arctic ground squirrel	ᓱᓱᑦ	Hikhik	1		1	3	3	7

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Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᕿᔪᓂᖅᓯᒪᔪᑦ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᖅ Tamakiklugin
Species	**ᐅᒪᔪᑦ**	**Umajuin**						
Ringed seal	ᓇᕐᓂᑦ	Natiinat	45	81	81	71	80	125
Bearded seal	ᐅᑭᐊᕐᑦ	Ukyuk	13	40	32	34	28	77
Harp seal	ᖃᐅᕈᓐᓇᑦ	Qairulik	2	9	4	6	2	18
Walrus	ᐊᐃᓕᒃᑦ	Akvik	17	45	35	42	43	82
Narwhal	ᑐᐃᓐᓇᑦ ᖁᓪᓗᒡᑦ	Tuugaak	1	2	6		3	11
Beluga	ᖃᐅᔨᑦ ᖁᓪᓗᒡᑦ	Kilalugak		4	2	4	4	11
Geese (unspecified)	ᓄᑉᓐᓇᑦ	Kanguk (unspecified)	12					12
Snow goose	ᑲᖏᐃᐅᑦ	Kanguq	3	30	27	14	40	67
Canada goose	ᓄᑉᓐᓇᑦ ᐅᓕᐊᒍᓐᓇᑦ	Nikliknik	1	2	2	3	8	14
Brant goose	ᓄᑎᓪᓗᐃᑦ	Nirlirnaq		1		1	1	3
Old squaw	ᐋᑭᐅᑉᐊᐃᑦ	Aahangik			1		2	3
Eider duck	ᒥᑎᑦ	Kingalik	10	34	23	22	29	70
Tundra swan	ᖃᓚᐊᐃᑦ	Kukyuk		1			2	3
Greater scaup	ᐊᖏᓂᓕᕆᑦ ᐊᐃᑉᐸᖏᑦ ᒥᑎᑦ	Greater scaup					1	1
Arctic loon	ᑲᓪᓗᓐᓇᑦ	Maliriq			2			2
Red-Throated loon	ᖃᖅᓴᐅᑦ	Qaqhuaq		2	2	3	4	11
Black guillemot	ᐱᑦᐅᑉᓀᑦ	Black guillemot	1	1			1	3
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	30	23	20	27	34	71
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᓚᒃᓂᖏᑦ	Manniit (unspecified)	3					3
Goose eggs	ᑲᖏᐃᐅᑦ ᓚᒃᓂᖏᑦ	Uluaguliit manniit		11	6	12	28	38
Duck eggs	ᒥᑎᑦ ᓚᒃᓂᖏᑦ	Tinmiat manniit		5	5	9	15	23
Arctic tern eggs	ᐃᒥᖅᑯᑕᓚᐃᑦ ᓚᒃᓂᖏᑦ	Emitkutailat manniit		5	2	8	9	21
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᒃᓂᖏᑦ	Nauyat manniit		1	1	2	3	6
Black guillemot eggs	ᐱᑦᐅᑉᓀᑦ ᓚᒃᓂᖏᑦ	Black guillemot eggs		1		1	2	3
Fish (unspecified)	ᐃᖅᓗᐃᑦ (ᓇᓗᓇᐃᑦᑕᐅᖏᑦᑐᑦ)	Ikaluit (unspecified)	6					6
Arctic char	ᐃᖅᓗᒃᐸᑦ	Ikaliviit	53	87	93	87	99	143
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	49	72	46	70	78	126
Arctic cisco	ᐅᑭᐅᑦᑐᑐᒥ ᑲᐱᓯᓀᑦ	Kapihilik		18	1		1	20
Cod	ᐅᒪᐃᑦ	Ugak				1	2	3
Clams	ᐋᒃᒧᒪᓕᕐᑦ	Uviluq		1		5	7	10
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet				1	1	2

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ tᑎᕋᕈᒪᔪᓂᒃ ᐱᑕᖃᓄᖅᑐᑐᒃ ᐱᓕᕆᓕᓂᓂᒃ ᐊᖏᖅᑐᑦ ᖃᕋᓴᐅᓂᖏᓂᒃᓄᑦ ᐊᓪᓚᖅᑎᒪᔪᓄᑦ ᐊᓪᓚᖅᓄᑦ ᓇᓪᓕᐊᓂᒃᓴᖅᓯᒪᓂᖅ ᑐᓂᓴᖏᓂᓂ ᐃᓄᐃᕐᓱᓕᓕᓚᓐᓇᖅᑐᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

6.1.5 Community Results Discussion: Hall Beach

The survey frame:
An assessment of under-enumeration during the community visit indicated that there were very few Inuit hunters who were not registered in the Harvest Study. It is estimated that there were three non-Inuit hunters with assigned hunting rights who were not registered, all occasional hunters. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. However, the extent of the bias is likely very small since the missing hunters only represent two percent of the total hunter population (Table 10).

Survey coverage and non-response bias:
Response rates in some months of year 1 of the study were quite low in Hall Beach, dropping below 50% in 7 of the 12 months. With the exception of an occasional month, response rates in all other years were very high (over 90%). As seen in Table 9 the consistent intentional non-response rate in Hall Beach was nil, and therefore was not a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough during most months of years 2 to 5 to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should exercise caution when using the data collected during year 1 of the study since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:
It was reported during the community consultations that some species, such as cod and shellfish were under-reported. Further details are provided in the community feedback and other sources of data section below. Section 5.4 also contains a thorough discussion of this issue.

As seen in the recall period tables, years 2 and 5 had short recall periods with the majority of harvest records having been collected within three months of the harvest, minimizing measurement error due to recall failure. However, recall periods were much longer, over six months in some cases, during the last few months of year 3 and continuing into the first half of year 4 and during selected months of year 1. Recall errors in these instances are more likely.

As noted in the comments associated with arctic char below, there was commercial harvesting of char during the study. However, it is unlikely that much of this harvest was reported to the Fieldworker and harvest estimates are thought to include primarily the subsistence harvest of Hall Beach hunters.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou.
2. **Musk-ox:** The musk-ox was harvested by a Hall Beach hunter who had traveled to the Kitikmeot region (C.F.).
3. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
4. **Arctic fox:** Hunters reported that the change to the humane trapping standard caused a drop in fox trapping. DSD reports indicate that 8 arctic fox pelts were purchased from Hall Beach hunters in 1999/2000 (year 4) and 243 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are

based on harvest years that run from June to May) (DSD FB). This information indicates that the harvest estimate in year 5 of 195 animals is likely a little low.

5 **Narwhal:** The quota for Hall Beach was 10 animals annually. Although the quota was not reached every year, the HTO Board reported that it was reached in year 3 and the harvest estimate of 7 during this year is too low (C.F.). DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
1	2	10	0	1

6 **Geese:** In year 1 many hunters did not identify the species of goose they had harvested resulting in a large number of unidentified geese being reported. The majority of these geese were likely snow geese (C.F.).

7 **Eggs:** In year 1, hunters were not asked to identify the species of egg they gathered resulting in all eggs being reported in one category. *Goose eggs:* Snow goose eggs are the most abundant goose eggs collected in the area, although some Canada goose and brant goose eggs are also collected. Harvest estimates for goose eggs seem a little low. *Duck eggs:* Although both king eider and common eider eggs are collected, king eider eggs being more abundant are harvested in larger numbers. *Arctic tern eggs:* Harvest estimates seem accurate in year 4 but too low in other years. *Black guillemot eggs*: These eggs are harvested each year. In addition to the species of eggs reported old squaw and red-throated loon eggs are also collected around the community (C.F.).

8 **Arctic char:** There was a commercial quota of 25,000 lbs of arctic char from Hall Lake during the study (DFO F). Although the entire quota was not harvested the hunters feel that the fish caught for commercial purposes are not included in the harvest estimates for most years during the study (year 1 estimate may contain some of the commercial harvest). However, these numbers are a good indication of fish caught for personal use by the hunters and their families (C.F.).

9 **Cod:** Cod are harvested by children, but they were often not recorded; they should have been counted through their parent's harvest. Harvest estimates in years 1 to 3 seem low, whereas estimates in other years are likely in the right range (C.F.).

10 **Clams/mussels:** Harvesting is often related to weather since they are gathered from the beach after high winds and waves. However, it was reported during the community visit that many hunters did not know to report these species indicating that harvest estimates may be low (C.F.).

6.1.5 ᓄᓇᕗᑦ ᓴᖅᑭᑕᐅᔪᓂᒃ ᐅᖃᖅᑎᑐᑦᑕᑎᑦ: ᓴᓇᔨᒃ

ᖃᐅᔨᓴᓂᐅᓪᓗᒍ ᐊᖏᖅᑭᒪᓂᖅ:

ᑐᑭᓯᐊᕐᓇᓱᒋᑎᓪᓗᒍ ᐊᑎᓕᐅᓚᖓᔪᓚᐊᖏᓂ ᓄᓇᕗᑦ ᐳᓕᖅᑕᐅᑎᓪᓗᒍ ᑕᐃᑎᕋᓱᐊᕐᓂᖓ ᖃᖅᑎᐊᓄᑦᓯᐅᓂᖅᓯᓂᒃ ᐊᖏᖅᓯᓂᖅ ᐊᑎᖃᖅᑕᐅᔪᓂᑐᐃᑦ ᖃᐅᔨᓴᖏᓪᓗᒍ. ᐃᓕᓴᕐᕕᐅᓕᕐᓂᖅ ᐱᖓᓱᓂ ᐃᓄᖅᑎᑐᑦ ᐊᖏᖅᓯᓂᖅ ᐱᔪᓐᓇᐅᔭᒥᒃ ᑐᓂᔨᐅᓯᓕᕐᓂᖅ ᐊᑎᖃᖅᑕᐅᓕᕐᓂᖅᓯᓂᒃ, ᑕᒪᓐᓇᒃ ᖃᓄᐃᒋᑦ ᐊᖏᖅᓯᓕᕐᑎᑐᑎᒃ. ᐅᖃᐅᓯᐅᓕᒪᓂ ᓴᓇᔨᒃᑐᑎ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓚᖓᔪᓚᐊᑭᑎᑦᑎᓂᑦ ᐱᒋᑕᐅᓂᖅ ᐊᖏᖅᑭᒃᓴᓕᕐᓂᑐᐊᓕᓚᖅᑐᑕᐃᓕᓂ ᐅᓪᓗᕈᓯᕐᓂᖅᓯᓂᒃ ᖃᖅᑎᐊᓄᑦᓯᐅᓂᖅᓯᓂᒃ. ᐅᖃᐅᓯᐅᓕᒪᓂ ᓴᓇᔨᒃᑐᑎ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓚᖓᔪᓚᐊᑭᑎᑦᑎᓂᑦ ᐱᒋᑕᐅᓂᖅ ᐊᖏᖅᑭᒃᓴᓕᕐᓂᑐᐊᓕᓚᖅᑐᑕᐃᓕᓂ ᐅᓪᓗᕈᓯᕐᓂᖅᓯᓂᒃ ᖃᖅᑎᐊᓄᑦᓯᐅᓂᖅᓯᓂᒃ. ᐅᖃᐅᓯᐅᓕᒪᓂ ᓴᓇᔨᒃᑐᑎ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓚᖓᔪᓚᐊᑭᑎᑦᑎᓂᑦ ᐱᒋᑕᐅᓂᖅ ᐊᖏᖅᑭᒃᓴᓕᕐᓂᑐᐊᓕᓚᖅᑐᑕᐃᓕᓂ ᐅᓪᓗᕈᓯᕐ

ᓂᐅᐃᕐᖁᐃᐅᓪᓚᕐᓂᖅᓱᓂᐅᓴ ᐊᖏᓚᓯᖏᑦ ᓴᓂᕆᖅᑎᒥ 1999/2000ᒥ (ᐅᑭᐅᖅᑎᓂᓱ 4) ᐊᑦᓚᓗ 243 ᓂᐅᐃᖅᑕᐅᓪᓗᑎᓴ 2000/2001 (ᐅᑭᐅᖅᑎᓂᓱ 5) (ᖃᐅᔨᒪᒋᑦ ᐃᓄᓯᖓᓕᓚᓱᓯᑦ ᓇᓴᐅᑎᖅᑎᑦ ᒪᓕᒐᒪᑦ ᐱᒋᐊᖓᖅᖃᓄᑦᑐᓴ ᓱᓕᐃᒥᑦ ᓱᓂᒧᑦ, ᖃᐅᔨᓴᓂᒧᑦ ᖁᓕᑕᐅᔪᓚᐃᑦ ᒪᓕᒐᒪᑦ ᐱᒋᐊᖓᖅᖃᓄᑦᑐᓴ ᓱᓂᒧᑦ ᒪᐃᔅᑭ) (DSD FB). ᑕᒪᓐᓇ ᑕᓄᑎᓯᔪᖅ 195 ᑎᓚᑦᓂᐊᖅᑕᐅᔪᒥᓂᑦ ᖃᑎᖅᐅᓂᖅᑎᑦ ᐅᑭᐅᖅᑎᓂᓱ ᐊᑎᕐᓗᐊᖅᓯᓂᖏᓐᓂᖅ.

5 **ᔦᐃᓂᑦ:** ᓴᓂᕆᖅᑎᑕᐅᑦ ᕿᑕᖃᓚᐅᖅᑐᑦ ᖃᓄᐅᓂᓴ 10 ᐊᑦᕿᔪᑕᒪᒃᑯᑦ. ᕿᑕᖅᓚ ᐊᑕᖏᖅᑕᐅᕕᐊᑭᖅᑎᓂᓕᖅᓴᓂᑦᓗᔪᓐ ᐅᑭᐅᑕᒪᒃᑯᑦ, ᐊᖏᓚᓯᖏᑐᓕᓚᓯᑦ ᑲᑎᒪᔨᖅᑎᑦ ᐅᖏᓪᓗᓂᑦᑐᓕᕐᓂᖅᓯᒪᓂᖅᓴᓂᖅ ᐅᑭᐅᖅᑎᓂᓱ ᑕᒪᐃᓐᓇᐅᑭᐅᖅᑎᓂᓱᓕᕐᓂᖅᓯᒪᓂᖅᓴᓂᖅ ᐅᑭᐅᖅᑎᓂᓱ 3 ᐊᑦᓚᓗ ᔦᓚᓱᖅᑕᐅᓂᖃᖅᑕᒥᓂᑦ 7 ᐅᑭᐅᖅ ᑕᐃᑲᓂ ᐊᑦᑎᓗᐊᖅᑯᑦᑐᓂ (C.F.). ᐃᒪᒋᑎᐅᑕᓚᓪᓚᕆᐊᖃᓂᑦ ᐊᑦᓚᐅᑕᐅᓯᒪᔪᑕᒪᑦ ᐅᔨᓪ ᓇᓴᐅᑎᑦ ᔦᓚᓱᖅᑕᒥᓂᖅᓴᓂᑦ ᐃᒪᒋᑎᐅᑕᓚᓪᓚᕆᐊᖃᓂᑦ ᖃᖓᓕᕆᓂᖅᑎᑦ ᒪᓕᒐᒪᑦ ᑭᓇᐅᔭᖅᑎᑎᑦᑕᒥᑕ ᐅᑭᐅᖅᑎᓂᓱᐅᓂᖅ, ᐅᒪᔪᓕᖅᑕᐅᑦᑎᐅᓂᑦ ᐊᑦᓚᐅᓯᒪᔪᖅᑎᑦ ᒪᓕᒐᒪᑦ ᐱᒋᐊᖓᖅᖃᓄᑦᑐᓴ ᓱᓂᒧᑦ ᒪᐃᔅᑭ) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
1	2	10	0	1

6 **ᑲᖏᐃᐦᑦ/ᓂᓪᓕᑦ:** ᐅᑭᐅᖅ 1 ᐊᑦᓚᐅᓯᒪᓂᑦ ᐅᓄᖅᑐᑦ ᓇᓗᓇᐃᓚᐅᓂᖓᓂᑐᑦ ᓇᓕᐊᖏᓂᖓᓂᓂᓱ ᑕᒪᔨᐊᐃ ᑎᑎᕈᑦ ᐱᓕᐅᑦᑐᐃᓐᓇᑦ ᐅᓇᓗᐊᖅᑯᑦᑐᓂ ᓇᓗᓇᐃᖅᓯᓕᒫᓂᖓᓂᑐᑦ ᐅᖃᐅᓯᐅᓕᐃᓐᓇᑦ. ᐅᓇᓂᖅᓴᐃᓐᓇᑦ ᑕᒪᔨᐊᐃᑦᑐᑦ ᐅᖃᐅᓯᐅᓕᐃᓐᓇᑦ. (C.F.).

7 **ᒪᓂᓪᓕᑦ:** ᐅᑭᐅᖅ 1, ᐊᑦᓚᐅᓯᒪᓂᑦ ᐊᐱᓚᓕᐅᑭᓂᖓᓂᑐᑦ ᓇᓗᓇᐃᓚᔪᐅᓂᖅᑎᓂᓱ ᓇᓕᐊᖓᔪᖃᑕᓚᐊᖏᓂᓂᓱ ᒪᓂᑕᖅᑕᒥᓂᓱ ᐅᖃᐅᓯᐅᑭᐅᑦᑐᑦ ᐊᑕᐅᑦᔪᔪᖅᑕᐅᑐᓂᓱ. ᓂᓪᓕᓴᓂᖅᓱᐃᓐᓇᑦ ᒪᓂᑕᖅᑕᒥᓂᑦ: ᑲᖏᐃᑦ ᒪᓂᖓᓂᑦ ᐊᑐᐃᓐᓇᐅᑦᑎᐅᓂᑦᓴᓂᑦ ᓱᓂᒧᑦ ᐅᓗᐊᔪᓂᒪᓂᑦ ᖃᓄᐅᓂᓴ ᐃᓕᓴᖅ, ᐃᓕᖓᓂᑦ ᒪᓂᑕᖅᑕᐅᑭᐅᖅᑲᓗᖅᑎᓂᓱ ᓂᓪᓕᓴᓂᖅᓱᐃᓐᓇᑦ ᐅᓗᐊᔪᓂᒪᓂᑦ ᑕᒪᔨᐊᐃ ᓂᓪᓕᓴᓂᖅᓱᐃᓐᓇᑦ. ᖃᓄᐅᓂᓴ ᑕᒪᐃᓐᓇᐅᑭᐅᖅᑎᓂᓱ ᓱᓂᒧᑦ ᐊᑦᓚᐅᓯᒪᓂᑦ ᐊᑦᑎᓗᐊᖅᑯᑦᑐᓂ (C.F.). *ᒥᑎᑦ ᒪᓂᖓᓂᑦ:* ᑕᒪᔨᐊᐃ ᕿᑭᓂᑦ ᒥᑎᑦ ᐊᐱᓚᓕᐅᑭᐅᖅᑎᓂᓱ ᐊᓕᐅᑭᖅᑲᓗᖅᑎᓂᓱ, ᕿᑭᓂᑦ ᒪᓂᖓᓂᑦ ᐊᑐᐃᓐᓇᐅᑦᑎᐅᓂᑦᓴᓂᑦ ᐅᓇᓗᐊᖅᑯᑦᑐᓂᓱᓕᕐᓂᖅᓯᒪᓂᖅᓴᓂᖅ ᐊᑦᓚᐅᓯᒪᓂᑦ ᐊᑐᐃᓐᓇᐅᑦᑎᐅᓂᑦᓴᓂᑦ ᐅᖃᐅᓯᐅᑭᐅᑦᑐᑦ ᐊᑦᓚᐅᓯᒪᓂᑦ ᐊᑦᑎᓗᐊᖅᑯᑦᑐᓂ

6.1.5 Nunani Iniktikhimayut Ukauhiit: Sanigayaq

Ihivgiukhimayut Iniktigutait:
Ihiviufaagutait ataani-ihivgiukhimayut nunani pulaakhimatitluni pihimayut ikitut Inuit umayukhiuktit titigaktauhimaitut Umayukhiukhimayut Ihivgiugutaani. Nunaiyakhimayut pingahuuyut inuinaungitut umayukhiuktit tuniyauhimayut umayukhiuktinik inminigutinik titigakhimaitut, tamamik ilaani umayukhiukpaktut. Ukakhimayut ilangani 5.2.1 ikpinagutait hamani ataani ihiviukhimayut pilaaktut ataani ihumagiyaini umayukhiukhimayut naunaiyautaini. Kihimi angitjutait ihimagiyait mikiyut ilaungitut umayukhiuktit naunaiyakhimamata 2%mik tamaat umayukhiuktunit (ikpatauyak 10).

Ihivgiukhimayut pihimayut ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait ilangini tatkikhiutit ukiumi 1mi ihivgiukhimayuni mikiyut Sanigayaqmi, katakhimaplutik ataanut 50%mik 7nit tatkikhiutinit 12nut. Ilangani ilaani tatkikhiutini, kiuhimayut naunaiyautait tamaat aipait ukiut angiyut (avataanut 90%mik). Takukhauyut ikpatauyami 9mi, pikataktut kiuyuitut naunaiyautait Sanigayaqmi piituk ovalo pingituk pilaaktunik kiuyuituk ihumagiyaini.

Kiuhimayut naunaiyautait ihumayut angiyut ovalo kiuyuitut mikiyut amigaitkiyaini tatkikhiutini ukiuni 2mit 5mut pigiagani nni piyut nakuuyumik ilaupkaihimayut uktugutini Nni umayukhiuktini. Taiguaktut nalungitukhat atuligumik katitikhimayut ukiumi 1mi ihivgiuktuni pilaamata tamamik uktugutit ihuinaagutikhainik ovalo kiuyuitut ihumagiyaini angiklilaaktuk kiuhimayut naunaiyautait katagaagata.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Tuhaktitihimayut nunani ukakatigivlugit ilangit umayut, ilaa, ugait ovalo ikaluvaluit ataanut tuhaktitihimayut. Titigatiakhimayut tunihimayut nunani ukagutaini ovalo aalat pihimayut katitikhimayuni ilangani hamani. Ilangani 5.4 pihimayut inikpiakhimayunik ukauhiinik haman ihumagiyainik.

Takuhimayut utiktihimayut ubluit ikpatauyani, ukiuni 2mi ovalo 5mi naitunik utiktihimayut ubluit amigaitut umayukhiukhimayut titigagutaini katitikhimayut iluani pingahut tatkikhiutini umayukhiukhimayunit, mikinikhaagulikhugu atugutait ihuinaagutait pigamik utiktitihimayut pihimaituni. Kihimi, utiktitihimayut ubluit takitkiyait, avataanut siksit tatkikhiutit ilangini, kinguani ikitkiyait tatkikhiutini ukiumi 3mi ovalo pikataktut hivuani kitkani ukiumi 4mi ovalo pihimayuni tatkikhiutit ukiumi 1mi. Utiktitihimayut ihuinaakhimayut hamani piyunakhimayut.

Titigakhimayut ukautaini mikhaanut ikaliviit hamani, kinauyaliuktut umayukhiuktuni ikalivinik ihivgiuktitlugit. Kihimi, pingitunakhiyut hapkoa umayukhiukhimayut tuhaktitauhimayut nunani havaktinut ovalo umayukhiukhimayut naunaiyautait ihumagiyauyut ilauyut hivulimi atuktakhaini umayukhiukhimayut Sanigayaqmi umayukhiuktinit.

Nunanit ukakhimayut ovalo aalat pihimayaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukhimayut nunanit tuktut.
2. **Umingmait:** Umingmak umayukhiutauhimayuk Sanigayaqmit umayukhiuktinit autlaakhimayuk Kitikmeonut (C.F.).
3. **Nanuit:** Amigaitjutait takuhimayut naunaiyautaungitut kihimi pihimayut umayukhiukhimayut tunihimayait DSDkut (DSD PB).
4. **Tigiganiat:** Umayukhiuktit tuhaktitihimayut aalangugutait nanigiakhiuktut atugutait katakhimayut tigiganiat nanigiakhiutuni. DSDkut tuhaktitihimayut pihimayut 8nik tigiganianik niuviktauhimayut Sanigayaqnit umayukhiuktinit 1999/2000mi

(ukiumi 4mi) ovalo 243nik niuviktauhimayut 2000/2001mi (ukiumi 5mi) (nalungilutit DSDkut katitikhimayait atukhimayut umayukhiukhimayut ukiungit pihimavaktut Julymit Junemut, Umayukhiukhimayut Ihivgiuktut katitikhimayut pihimayut umayukhimayut ukiungit pihimayut Junemit Maymut) (DSD FB). Hamna tuhagutikhak pihimayut umayukhiukhimayut naunaiyautait ukiuni 5mi 195kuyut umayut mikiyunakhiyut.

5 **Tuugaat:** Kotangit Sanigayaqmi kuliuyut umayut ukiuk tamaat. Kihimi kotait tikiyuitut tamaat ukiuni, HTOkut katimayiit tuhaktitihimayut tikihimayut ukiumi 3mi ovalo umayukhiukhimayut naunaiyautait 7nik hamani ukiumi mikiyuk (C.F.). DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait tugaaliit kilalugait (nalungilutit DFOkut katitikhimayut atukpaktut atugutaini ukiuni, Umayukhiukhimayut ihivgiugutait katitikhimayut pihimayut umayukhiukhimayuni ukiuni pihimayut Junemit Maymut) DFO N/B):

96/97	97/98	98/99	99/00	00/01
1	2	10	0	1

6 **Uluaguliit:** Ukiumi 1mi amigaitut umayukhiuktit naunaiyakhimaitait umayut uluaguliit umayukhiukhimayainik, pipkaihimayut angiyumik amigaitjutait naunaiyakhimaitut uluaguliit tuhaktitihimayut. Amigaitkiyait hapkoa uluaguliit kanguuyunakhiyut (C.F.).

7 **Maniit:** Ukiumi 1mi, umayukhiuktit apigiyaungitut naunaiyalugit umayut maniit katitikhimayait, pipkakhimayait tamamik maniit tuhaktitihimayut atauhimi ilauyunut. *Uluaguliit maniit:* Kanguit maniit amigaitkiyauyut maniit katitikhimayut hamani nunami, kihimi ilangit uluaguliit ovalo nikliniit maniit katititauvaktut Umayukhiukhimayut naunaiyautait uluaguliit maniit mikiyut. *Tingmiat maniit:* Ilaa, tamamik kingaliit ovalo mitiit maniit katitikpaktut kingaliit maniit amigaitkiyauyut katitikpaktut angitkiyaani. *Ihungait maniit:* Katitikhimayut naunaiyautait naamaktut ukiumi 4mi mikiyut aipainit ukiunit. *Black guillemot maniit:* Hapkoa maniit katitikpaktut ukiuk tamaat. Ilagitlu umayu maniit tuhaktitivaktut aahangiit ovalo maligiit maniit katitiktauvaktut haniani nunat (C.F.).

8 **Ikaliviit:** Kinauyaliuktuni kotakakhimayuk 25,000 paunik ikaliviknik Hallmi tahiani ihivgiuktitlugit (DFO F). Tamaat kotat umayuktaungituk, umayukhiuktit ihumayut ikaluit pihimayut kinauyaliugutini mikhaanut ilaungitut umayukhiukhimayut naunaiyautaini amigaituni ukiuni ihivgiuktitlugit (ukiumi 1mi naunaiyautit pihimayunakhiyut ilangit kinauyaliukhimayut umayukhiukhimayuni). Kihimi hapkoa amigaitjutait nakuuyut naunaiyautait ikaluit pivaktut inminik atuktakhainik umayukhiuktinit ovalo ilakatiminutlu (C.F.).

9 **Ugat:** Ugat umayukhiukhimayut nutakanit, kihimi titigakhimaitut, naunaiyakhimayukhauyuugaluit angayukaaganit umayukhiugutaini. Umayukhiukhimayut naunaiyautait ukiuni 1mit 3mut mikiyut, kihimi naunaiyautait aipaini ukiuni naamaktut (C.F.).

10 **Uviluit/Uviluvaluit:** Umayukhiukhimayut pivaktut angitiagiagaagat katitikpanmata hinaanit anokhiyuagaagat ovalo malikyuagaagat. Kihimi tuhaktitihimayut nunani pulaakhimatitlugu amigaitut umayukhiuktit naluyut tuhaktitilugit hapkoa umayut pihimayut umayukhiukhimayut naunaiyautait mikiyut (C.F.).

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 127

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᑦᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᐹᓗ	OCT ᐅᑦᔪᐹᓗ	NOV ᓄᕕᐹᓗ	DEC ᑎᓴᐹᓗ	JAN ᔮᖏᓂᐊᓗ	FEB ᓄᖅᑐᐊᓗ	MAR ᒪᓴ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᖅ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	140	13	269	181	186	136	230	197	149	171	138	106	1,916 ± 138
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡			1		2	6	1				122		
Wolf	ᐊᒪᓗᐃᑦ	Amagut									2		11		13 ± 3
Arctic fox	ᑎᓚᖃᓄᐊᑦ	Tigiganiat						36	85	21	23	74	9		248 ± 49
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	5			13	9	1			1	21	25	5	80 ± 14
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik												3	3 ± 2
Ringed seal	ᓇᑦᓱᑦ	Natiinat	712	158	190	229	169	111	12	40	81	119	190	127	2,138 ± 186
Bearded seal	ᐅᖏᓪᓗᐃᑦ	Ukyuk		8	27	18	7	1		6	6	3	1		77 ± 16
Harp seal	ᖃᐃᕈᓕᓪᓕ	Qairulik				7									7 ± 3
Walrus	ᐊᐃᓴᓵᑦ	Akvik		73	30	35	12		3		4	1	1		159 ± 28
Narwhal	ᑐᐃᓕᓪᓕ ᕿᓪᓗᒡᑦ	Tuugaak			2										2 ± 3
Beluga	ᖃᓄᖅᑕ ᕿᓪᓗᒡᑦ	Kilalugak			2	4	8								14 ± 6
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	297	53	18	15								2	385 ± 117
Canada goose	ᓂᑦᓕᓪᓕ	Nikliknik	41	3		1									45 ± 25
Pintail	ᖁᓚᒧᐊᓱᑦ	Arnaviaq	3	1											4 ± 4
Eider duck	ᒥᑎᑦ	Kingalik	215	17		22	5	3							262 ± 96
Tundra swan	ᖁᓚᔪᐃᑦ	Kukyuk			2										2 ± 3
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	44			4	205	304	38	16	19	37	34	76	777 ± 161
Arctic char	ᐃᖅᓗᒃᐲᑦ	Ikaliviit	1,453	1,077	1,253	272	1,004	683	456	524	1,130	767	517	1,179	10,315 ± 1,138
Lake trout	ᐃᓱᕐᓴᐃᑦ	Ikalukpik			2		5	3						15	25 ± 10
Clams	ᐊᓕᒍᒪᔪᑦ	Uviluq				114									114 ± 116

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᖅᓄᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᒃᑯᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᖅᓴᓕᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.1.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 128

Monthly hunter response

ᑕᖅᑕᒪᑦ ᐊᖏᓚᓱᒃᑎᑦ ᑭᐅᓂᖅᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᒡᖏᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓱᑎᒃᐱᓗ	OCT ᐅᑦᐸᓗ	NOV ᐅᓇᒡᒪᓗ	DEC ᑎᓯᒡᒪᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓚᓱᒃᑎᑦ ᑭᐅᓂᖅᑕᑦ ᐊᒃᔪᓕᒪᓂᖅᑕᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᓚᓱᒃᑎᑦ	Tatkitaman angunahuktut titigait	162	161	168	169	179	179	198	201	201	202	204	207	212*
Hunters interviewed	ᐊᖏᓚᓱᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	65	94	79	133	136	138	163	193	192	189	191	186	204*
Harvested	ᐊᖏᓚᓱᒃᑐᒥᓂᒃ	Angujaujut	58	51	52	53	58	54	51	62	63	78	84	93	167*
Response Rate (%)	ᑭᐅᔪᓂᖅᑕᑦ (%)	Kiujut (%)	40	58	47	79	76	77	82	96	96	94	94	90	77**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓱᒃᑎᑦ ᐊᑎᓕᐅᕐᑐᒍᓐᓇᖅᑐᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᓚᓱᒃᑐᒥᓂᒃ ᐊᑕᐅᓂᐊᖅᓯᒪᔨᑎᑦ ᐊᒃᔪᒥ.
** ᐃᓕᓴᕐᓂᕐᓂᒪᓂᖅ ᑕᖅᑕᒪᑦ ᑭᐅᔪᓂ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.1.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 129

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓐ ᐊᖏᓚᓱᓂᓐᖓᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓐᖓᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᓚᓱᒃᑦᑕ ᑎᑎᕐᕿᑦᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᒡᖏᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓱᑎᒃᐱᓗ	OCT ᐅᑦᐸᓗ	NOV ᐅᓇᒡᒪᓗ	DEC ᑎᓯᒡᒪᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔪᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑦ	≤ tatkin pingahut	99	100	100	100	100	100	94	100	100	100	100	100	99
4-6 months	4-6 ᑕᖅᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑦ	> 6 tatkin	1	0	0	0	0	0	6	0	0	0	0	0	1

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 130

Number of hunters harvesting each species — **Year 1 (June 1996 - May 1997)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓚᓯᒃᑎᑦ ᐊᖏᓚᓯᒃᓴᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒻᒋᒍ 1 (ᔪᓂ 1996 - ᒪᐃ 1997)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 1 (June 1996 - May 1997)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒻᐹᓗ	DEC ᑎᓯᒻᐹᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	16	5	33	23	17	19	39	48	43	42	43	29	121
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut									1		5		5
Arctic fox	ᑎᓗᓚᖅᓂᐊᑦ	Tigiganiat						6	6	5	5	7	3		16
Arctic hare	ᐅᑲᓪᓂᑦ	Ukalik	1			3	3	1			1	9	12	2	27
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik												1	1
Ringed seal	ᓇᑦᓱᑦ	Natiinat	47	22	28	38	33	24	6	16	26	38	50	29	121
Bearded seal	ᐅᓚᕆᐃᑦ	Ukyuk		5	9	11	5	1		5	6	3	1		33
Harp seal	ᖃᐃᕈᓪᓂᑦ	Qairulik				4									4
Walrus	ᐊᐃᐃᓴᑦ	Akvik		23	9	13	6		3		4	1	1		42
Narwhal	ᑐᒻᓂᓪᑦ ᖁᓪᓗᑎᑦ	Tuugaak			1										1
Beluga	ᖃᐅᕐᑦ ᖁᓪᓗᑎᑦ	Kilalugak			1	2	4								6
Snow goose	ᑲᖏᐃᑦ	Kanguq	22	5	3	4								1	28
Canada goose	ᓄᕐᓂᓪᑦ	Nikliknik	8	1		1									9
Pintail	ᕿᓚᒍᓴᑦ	Arnaviaq	1	1											2
Eider duck	ᑎᑎᑦ	Kingalik	16	2		4	1	1							23
Tundra swan	ᑭᓚᓴᐃᑦ	Kukyuk			1										1
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	5			1	15	16	7	5	5	7	10	17	49
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	20	19	21	8	29	20	12	9	14	16	13	63	123
Lake trout	ᐃᓕᕐᓴᐃᑦ	Ikalukpik			1		1	1						3	5
Clams	ᐊᓚᒧᒪᓴᑦ	Uviluq				1									1

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕐᓯᒪᓴᓂᖅ ᐱᑕᖃᖕᖏᑐᖃᖅ ᐱᐅᔨᑎᓕᖅᓂᖅ ᐊᖏᓚᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᖃᓂᑦ ᐊᖏᓚᓯᒃᓴᑦᑐᑦ ᓄᓇᕗᒻᒥᔪᖅᑐᑦ ᐃᓅᓚᖏᓐᓄᑦ ᐃᑯᐱᖏᓐᓂᒃᓴᖅᑐᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.6

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 131

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᑎᖏᔪ 2 (ᔮᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᔨᑎ	SEP ᓱᑎᑦᐱᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᓇᑦᐱᓇ	DEC ᑎᓯᑦᐱᓇ	JAN ᔮᖏᓇᐊᓇ	FEB ᓇᖅᑲᐊᓇ	MAR ᒪᔾᔪ	APR ᐃᔾᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᖅ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᑦ	Tuktut	59	35	306	117	68	221	96	128	131	108	134	83	1,486 ± 54
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡					3	3		2					
Wolf	ᐊᒪᓕᐃᑦ	Amagut				1								4	5 ± 2
Arctic fox	ᑎᓗᓚᖓᐊᑦ	Tigiganiat					5	85	105	36	29	4	2		266 ± 35
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik				2		1		3			6		12 ± 3
Ringed seal	ᓇᓕᔪᑦ	Natiinat	325	101	127	156	218	80	71	103	128	175	184	122	1,790 ± 54
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk	2	15	13	23	7			6	1	1			68 ± 7
Harp seal	ᖃᐃᓕᓪᓕᑦ	Qairulik			2		1								3 ± 1
Walrus	ᐊᐃᐸᑦ	Akvik	5	84	4	22	12		1	1	4	4		2	139 ± 10
Beluga	ᖃᓄᖅᑕ ᖁᓕᓴᒃ	Kilalugak			3	7									10 ± 3
Snow goose	ᑲᖏᐃᑦ	Kanguq	134	34	99	2								6	275 ± 32
Canada goose	ᓂᖅᓪᓕ	Nikliknik	29		3										32 ± 12
Old squaw	ᐊᑭᐊᖅᓴᐃᑦ	Aahangik	1												1 ± 1
Eider duck	ᒥᑎᑦ	Kingalik	62	7		3								1	73 ± 13
Tundra swan	ᖃᓄᓴᐃᑦ	Kukyuk				2									2 ± 1
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	46	4	1	2	6	11	11	1		10	10	92	194 ± 28
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓇᖅᑕ	Uluaguliit manniit	2,257												2,257 ± 241
Duck eggs	ᒥᑎᑦ ᒪᓐᓇᖅᑕ	Tinmiat manniit	206	251											457 ± 118
Arctic tern eggs	ᐃᒥᖃᑕᒪᓕᐃᑦ ᒪᓐᓇᖅᑕ	Emitkutailat manniit	591	47											638 ± 138
Seagull eggs	ᓇᐃᔨᐃᑦ ᒪᓐᓇᖅᑕ	Nauyat manniit	3												3 ± 2
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	2,543	1,490	1,740	234	1,079	756	1,065	570	290	758	1,714	926	13,165 ± 577
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik					18							13	31 ± 8

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓂᑦ ᑎᑎᕋᕆᔨᒃᑯᑦ ᑐᓂᔭᖅᑕ ᐅᑉᐳᒪᔪᓂᒃ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.1.6

TABLE/ᐅᓗᐅᐃᕆᐅᑦ/NAUNAIKUTA 132

Monthly hunter response
ᑕᖏᑕᒻᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᒃᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑲᕐᓗ	NOV ᓄᐊᕐᓗ	DEC ᑎᓯᕐᓗ	JAN ᒎᓄᐊᓗ	FEB ᐃᖏᐊᓗ	MAR ᒪᕆ	APR ᐃᑦᓂᓚ	MAY ᒪᐃ	Total ᑲᑎᑲᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐱᒍᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒻᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	214	216	218	216	213	214	215	216	224	225	224	224	233*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	196	200	198	196	201	202	200	201	201	214	211	208	221*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᑦ	Angujaujut	110	83	94	72	67	57	43	48	56	55	59	82	174*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓕᕐᐅᓂᖏᑦ (%)	Kiujut (%)	92	93	91	91	94	94	93	93	90	95	94	93	93**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᕐᑕᒪᓐᓇᖅᑐᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᔪᓂᒃᑐᒥᓂᑦ ᐊᑕᐅᓯᐊᖅᓯᒪᔪᑎᑦ ᐊᒃᖁᒥ.
** ᐊᒃᓴᓂᓕᕆᓂᒪᓐᓇᔪᑦ ᑕᖏᑕᒻᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.1.6

TABLE/ᐅᓗᐅᐃᕆᐅᑦ/NAUNAIKUTA 133

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᕐᖃᓂ ᐊᖏᔪᓯᓂᖃᖅᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖃᖅᑕ, ᐅᓗᐅᐃᕐᑕᑦ ᐃᒪᒃ % ᑲᑎᑲᑦ ᐊᖏᔪᓂᒃᑕᑦ ᑎᑎᕐᑕᐅᒪᔪᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)
ᐊᒃᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑲᕐᓗ	NOV ᓄᐊᕐᓗ	DEC ᑎᓯᕐᓗ	JAN ᒎᓄᐊᓗ	FEB ᐃᖏᐊᓗ	MAR ᒪᕆ	APR ᐃᑦᓂᓚ	MAY ᒪᐃ	Total ᑲᑎᑲᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔪᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	100	100	100	100	95	97	94	100	98	100	100	100	99
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	0	0	0	0	5	3	6	0	2	0	0	0	1
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 134

Number of hunters harvesting each species — **Year 2 (June 1997 - May 1998)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᒃᑎᑦ ᐊᖏᔪᓚᒃᓴᖅᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒃᑭᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 2 (June 1997 - May 1998)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒃᔪᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᒍᖏᓄᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	22	14	58	26	10	40	21	29	29	28	33	26	118
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐅᐃᑦ	Amagut				1								3	4
Arctic fox	ᑎᓗᓚᖏᓂᐊᑦ	Tigiganiat					1	9	9	7	6	3	1		26
Arctic hare	ᐅᑲᓪᓂᑦ	Ukalik				2		1		2			3		7
Ringed seal	ᓇᓂᓱᑦ	Natiinat	65	33	43	47	51	23	18	24	31	40	38	36	133
Bearded seal	ᐅᓚᔪᐃᑦ	Ukyuk	2	9	8	13	5			6	1	1			35
Harp seal	ᖃᐃᓕᓪᓂᑦ	Qairulik			2		1								3
Walrus	ᐊᐃᐃᓴᑦ	Akvik	3	45	3	15	8		1	1	4	3		2	56
Beluga	ᖃᑯᑦᑕᑦ ᖁᓕᓗᒡᑦ	Kilalugak			3	4									6
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	25	3	12	2								2	39
Canada goose	ᓄᑦᓪᓂᑦ	Nikliknik	6		2										8
Old squaw	ᐊᑭᑐᑦᔪᐃᑦ	Aahangik	1												1
Eider duck	ᒥᑎᑦ	Kingalik	13	1		1								1	16
Tundra swan	ᖁᓱᔪᐃᑦ	Kukyuk				1									1
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	3	3	1	1	2	5	4	1		1	4	13	25
Goose eggs	ᑲᖏᐃᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	39												39
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit	6	3											9
Arctic tern eggs	ᐃᒥᖅᑯᐃᓚᐃᑦ ᒪᓐᓂᖏᑦ	Emitkutailat manniit	19	2											21
Seagull eggs	ᓇᐃᐅᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	1												1
Arctic char	ᐃᖅᓗᑲᐱᑦ	Ikaliviit	54	44	32	10	22	12	10	9	5	12	13	47	128
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik					1							3	4

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓱᒪᔪᓂᒃ ᐱᑕᖅᓴᖏᑐᖅ ᐱᔨᔪᑎᓐᓂᑲᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᖅᑕᒪᔪᓂᑦ ᐊᖏᔪᓄᑦ ᓇᓪᓕᐅᖏᓐᓄᑦ ᑐᓂᐅᖏᓐᓄᑦ ᐃᓕᓴᕐᓂᐊᓕᒫᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 135

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᓐᔪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔾᔪᑎ	SEP ᓱᑎᐱᓇ	OCT ᐅᑦᔪᓇ	NOV ᐅᓇᓕᓇ	DEC ᑎᓯᓚᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᓄᖅᑐᐊᓇ	MAR ᒪᕆ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᔭᐅᐃᑦ	Tuktut	45	45	375	231	100	71	140	289	188	103	171	139	1,897 ± 53
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡				1		2		1	6				
Wolf	ᐊᒪᓱᐃᑦ	Amagut				2					3	1	2	10	18 ± 2
Arctic fox	ᑎᓗᓚᖅᓂᐊᑦ	Tigiganiat							7	8	3	14	7	1	40 ± 6
Wolverine	ᖃᕐᕆᓵᑦ	Kalvik							1						1 ± 1
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	1		2		7	2			2	8	8	12	42 ± 7
Ringed seal	ᓇᕆᓯᑦ	Natiinat	490	108	110	85	137	99	42	50	106	129	91	91	1,538 ± 51
Bearded seal	ᐅᓚᔪᐃᑦ	Ukyuk		13	25	1	6	2	2	1	8	3	1	1	63 ± 4
Harp seal	ᖃᐃᓱᓪᓕᑦ	Qairulik					2								2 ± 1
Walrus	ᐊᐃᓴᑦ	Akvik	1	77	8	4	5	2	3	2	5	12		2	121 ± 9
Narwhal	ᐅᔨᓪᓕᑦ ᖁᓪᓗᑎᑦ	Tuugaak		4	2	7	10								23 ± 3
Beluga	ᖃᐅᕐᑦ ᖁᓪᓗᑎᑦ	Kilalugak		5	5	31									41 ± 5
Snow goose	ᑲᖕᒪᐃᑦ	Kanguq	236	18	43	22								4	323 ± 33
Canada goose	ᓄᕐᓪᓕᑦ	Nikliknik	2	2	6	4									14 ± 3
Old squaw	ᐋᖅᑭᕐᔪᐃᑦ	Aahangik		1											1 ± 1
Pintail	ᕿᓚᒍᔪᓯᑦ	Arnaviaq	2												2 ± 1
Eider duck	ᒥᑎᑦ	Kingalik	98	7			3							23	131 ± 17
Tundra swan	ᕿᓘᔪᐃᑦ	Kukyuk	2												2 ± 1
Red-throated loon	ᖃᖓᓚᐅᑦ	Qaqhuaq		4	2										6 ± 3
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	7		7	8	18	50	22	15	26	3	3	65	224 ± 22
Sandhill crane	ᑕᑎᓚᕐᔪᐊᑦ	Tatilgaq	1												1 ± 1
Goose eggs	ᑲᖕᒪᐃᑦ ᓚᖓᓯᑦ	Uluaguliit manniit	3,663	151											3,814 ± 448
Duck eggs	ᒥᑎᑦ ᓚᖓᓯᑦ	Tinmiat manniit	393	89											482 ± 80
Arctic tern eggs	ᐃᒥᖕᑯᑕᓚᐃᑦ ᓚᖓᓯᑦ	Emitkutailat manniit	12	259											271 ± 111
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᖓᓯᑦ	Nauyat manniit	34												34 ± 15
Arctic char	ᐃᖃᓗᒃᐸᑦ	Ikaliviit	3,092	1,462	1,299	231	606	3,263	854	759	504	430	1,090	650	14,240 ± 540
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	19											30	49 ± 14
Cod	ᐅᓴᐃᑦ	Ugak	131	153											284 ± 107
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk			128	208									336 ± 86

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓂᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᓯᖏᑦ ᐅᑯᐊ ᐃᑯᓴᕕᓂᓚᐅᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.1.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 136

Monthly hunter response

ᑕᕝᕕᒻᒥᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᓐᖏᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᕝᕕᒻᒥᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᕐᓱᓗ	OCT ᐅᑦᔨᓱᓗ	NOV ᓄᕐᓚᕐᓱᓗ	DEC ᑎᓯᕐᓱᓗ	JAN ᔮᖏᓪᓗᓇ	FEB ᐃᕙᐅᓇ	MAR ᒪᑉᔪ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᔨᓕᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᕝᕕᒻᒥᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	225	224	229	228	228	228	227	227	227	231	231	235	246*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	204	205	221	214	214	214	210	214	217	216	220	218	235*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂ	Angujaujut	125	89	95	79	52	70	47	66	60	53	68	73	188*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	91	92	97	94	94	94	93	94	96	94	95	93	94**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᕐᒪᓪᓚᕆᔨᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑐᒥᓂ ᐊᑕᐅᓂᐊᓕᔪᐃᑎᑉ ᐊᓐᖏᒍᒥ.
** ᐊᓕᒍᓂᓕᕆᓂᓪᓚᕆᔨᑦ ᑕᕝᕕᒻᒥᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.1.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 137

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕋᐅᔨᑦ ᐊᑯᕋᖅᓂ ᐊᖏᔪᓂᒃᓂᖅᓯᒪᓕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖅᓯᒪᓕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑦ ᑎᑎᕋᕐᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐊᓐᖏᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᕝᕕᒻᒥᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᕐᓱᓗ	OCT ᐅᑦᔨᓱᓗ	NOV ᓄᕐᓚᕐᓱᓗ	DEC ᑎᓯᕐᓱᓗ	JAN ᔮᖏᓪᓗᓇ	FEB ᐃᕙᐅᓇ	MAR ᒪᑉᔪ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕋᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕝᕕᒃ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	99	100
4-6 months	4-6 ᑕᕝᕕᒃ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	1	0
> 6 months	> 6 ᑕᕝᕕᒃ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 138

Number of hunters harvesting each species
ᖃᑦᕈᐅᓂᖏᑦ ᐊᖏᔪᓚᐸᑎᑦ ᐊᖏᔪᓚᐸᓕᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 3 (June 1998 - May 1999)
ᐊᒃᑭᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᕐᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᐃ	AUG ᐊᐅᒍᑎᑐ	SEP ᕈᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᕐᐱᓗ	JAN ᒍᓐᓇᐊᓗ	FEB ᓇᕐᑐᐊᓗ	MAR ᒪᕐᓴ	APR ᐃᑦᓗᓪ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	13	15	65	46	6	17	26	52	45	27	47	38	128
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐅᐃᑦ	Amagut				2					3	1	2	4	9
Arctic fox	ᑎᓗᓚᖓᓂᐊᑦ	Tigiganiat							2	3	2	3	3	1	7
Wolverine	ᖃᕐᕿᓵᑦ	Kalvik							1						1
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	1		2		1	2			2	2	4	4	14
Ringed seal	ᓇᕐᓂᑦ	Natiinat	87	36	42	29	36	23	13	19	32	39	26	33	140
Bearded seal	ᐅᑉᐊᐃᑦ	Ukyuk		10	17	1	4	2	1	1	8	3	1	1	36
Harp seal	ᖃᐃᓕᓪᓕᑦ	Qairulik					2								2
Walrus	ᐊᐃᓴᒃ	Akvik	1	37	6	1	4	2	3	2	4	7		2	48
Narwhal	ᑐᐊᓪᓕᑦ ᖁᓪᓗᒡᓗᑦ	Tuugaak		3	1	5	7								13
Beluga	ᖃᓄᖅᑕ ᖁᓪᓗᒡᓗᑦ	Kilalugak		5	5	15									23
Snow goose	ᑲᖏᐃᑦ	Kanguq	32	4	10	5								2	43
Canada goose	ᓄᖅᓪᓕᑦ	Nikliknik	2	1	1	1									2
Old squaw	ᐋᕿᐊᖅᓴᐃᑦ	Aahangik		1											1
Pintail	ᖃᓚᒍᓴᑦ	Arnaviaq	2												2
Eider duck	ᒥᑎᑦ	Kingalik	19	2			1							5	26
Tundra swan	ᖃᓗᓴᐃᑦ	Kukyuk	2												2
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq		1	1										2
Ptarmigan	ᐊᕈᓕᓴᑦ	Akilgik	2		2	2	2	11	5	1	5	2	1	9	30
Sandhill crane	ᑕᑎᓘᑦᓴᐊᑦ	Tatilgaq	1												1
Goose eggs	ᑲᖏᐃᑦ ᓚᒃᓂᖏᑦ	Uluaguliit manniit	57	1											58
Duck eggs	ᒥᑎᑦ ᓚᒃᓂᖏᑦ	Tinmiat manniit	18	2											20
Arctic tern eggs	ᐃᒥᓄᑯᑕᓚᐃᑦ ᓚᒃᓂᖏᑦ	Emitkutailat manniit	2	3											4
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᒃᓂᖏᑦ	Nauyat manniit	4												4
Arctic char	ᐃᖏᓗᒃᓵᑦ	Ikaliviit	65	42	37	6	12	44	17	7	9	8	19	34	133
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	1											3	4
Cod	ᐅᓚᐃᑦ	Ugak	1	3											3
Sculpin	ᑲᓇᓴᐃᑦ	Kanayuk			2	1									2

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓪᒪᓴᑐᒃ ᐱᑕᖏᓐᓂᑐᒃ ᐱᓱᒋᑎᓕᓐᓂᒃ ᐊᖏᔪᑦ ᖁᕋᐅᓂᖏᓐᓄᓕᑦ ᐊᓕᓴᖏᓐᓄᓕᑦ ᐊᖏᔪᓕᑦ ᓇᓕᐅᑦᓴᑎᓂᒃ ᑐᓂᓴᖏᓐᓄᑐᒃ ᐃᑯᐱᕐᓴᐅᓐᓂᒃ ᐃᓕᓴᕐᓂᖅᓯᒪᔪᖅᑕ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.6

TABLE/ᓇᓗᓇᐃᔾᔨᐅᑦ/NAUNAIKUTA 139

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓐᓂᑦ

Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)

ᐊᓕᖏᔪ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖢᓂ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᐹᓗ	OCT ᐅᑦᑐᕆᓗ	NOV ᐅᓇᓕᕆᓗ	DEC ᑎᓯᓚᕆᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓇᖅᐅᐊᓗ	MAR ᒪᓯ	APR ᐃᓘᓐᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	90	34	255	190	74	151	114	212	144	222	140	159	1,785 ± 56
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					2	2		410					
Wolf	ᐊᒪᓱᐃᑦ	Amagut	3	1	2								8	10	24 ± 4
Arctic fox	ᑎᓗᒃᖃᓕᑦ	Tigiganiat						19	24	14	6	17		1	81 ± 12
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	2	3		2	1						3	2	13 ± 2
Ringed seal	ᓇᓯᓕᑦ	Natiinat	443	235	159	200	316	95	22	57	72	83	111	101	1,894 ± 57
Bearded seal	ᐅᓗᔾᐃᐃᑦ	Ukyuk	1	33	20	31	3			1	4	3	5	2	103 ± 7
Harp seal	ᖃᐃᓱᓪᓚᑦ	Qairulik			2	11	16								29 ± 5
Walrus	ᐊᐃᐃᓴᑦ	Akvik	2	74	12	27	36	6	6	4	5		2		174 ± 9
Narwhal	ᑐᒻᓚᓪᑦ ᖁᓪᓗᒡᓗᑦ	Tuugaak				3	1				2			1	7 ± 1
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	82	40										1	123 ± 15
Canada goose	ᓂᑦᓚᓪᑦ	Nikliknik	30	14											44 ± 8
Old squaw	ᐊᑭᕐᑦᔾᐃᐃᑦ	Aahangik	1												1 ± 1
Eider duck	ᒥᑎᑦ	Kingalik	104	75										7	186 ± 26
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq	7	6											13 ± 6
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	87	7	1	8	68	66	3		12	21	20	113	406 ± 52
Goose eggs	ᑲᖏᐃᐃᑦ ᒪᓐᓇᖅᑦ	Uluaguliit manniit	110	225											335 ± 65
Duck eggs	ᒥᑎᑦ ᒪᓐᓇᖅᑦ	Tinmiat manniit	71	444											515 ± 82
Arctic tern eggs	ᐃᒥᖃᑕᒪᓕᐃᑦ ᒪᓐᓇᖅᑦ	Emitkutailat manniit	16	388											404 ± 78
Seagull eggs	ᓇᐃᔾᐃᑦ ᒪᓐᓇᖅᑦ	Nauyat manniit	6												6 ± 4
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	2,477	2,314	2,197	1,264	1,066	2,020	817	422	529	729	603	1,057	15,495 ± 641
Lake trout	ᐃᓂᕋᐃᑦ	Ikalukpik												183	183 ± 22
Cod	ᐅᓚᐃᑦ	Ugak	1	126										13	140 ± 42
Sculpin	ᑲᓇᔾᐃᑦ	Kanayuk	6	55											61 ± 15

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᔾᔪᑦ ᑐᓂᓯᖅᑦ ᐅᑯᐊ ᐃᑯᐊᕐᓂᓕᕆᓂᖅᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 140

Monthly hunter response
ᑕᖃᑦᑕᒻᒥᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᓯᖏᔪ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖃᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᒪ	SEP ᓱᑎᐱᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᓇᓱᐱᓇ	DEC ᑎᓯᓱᐱᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᓇᖕᐅᐊᓇ	MAR ᒪᕐᓯ	APR ᐃᓴᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐋᔪᓯᓚᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᑕᒻᒥᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	239	241	237	233	234	233	233	245	244	242	242	241	259*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓯᑦᑕᑦ	Angunahuktin apikhuktan	211	226	221	216	218	214	220	227	227	225	221	225	246*
Harvested	ᐊᖏᔪᓂᒃᑐᒋᓐᓂᖅ	Angujaujut	114	118	94	91	82	58	45	57	54	68	60	94	186*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	88	94	93	93	93	92	94	93	93	93	91	93	93**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᑦᑕᒪᓐᓇᖅᑐᑦ/ᐊᐱᕐᓯᑦᑕᑦ/ᐊᖏᔪᓂᒃᑐᒋᓐᓂᖅ ᐊᑕᐅᓯᐊᖃᓕᕐᓂᖅ ᐊᓯᖏᒻᒪ.
** ᐊᓴᒋᓕᕐᓂᓯᒪᓕᐅᑦ ᑕᖃᑦᑕᒻᒥᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.1.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 141

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᕐᐊᑦ ᐊᑯᖏᓐᓄᓂ ᐊᖏᔪᓂᒃᑐᓂᓐᓂᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓯᑦᑕᐅᓂᓐᓂᑕ, ᓇᓗᓇᐃᖏᑦᑕ ᐃᒪᒃ % ᑲᑎᑕᑎᑦ ᐊᖏᔪᓂᒃᑐᑦᑕ ᑎᑎᖏᑦᑕᐅᒪᐊᕐᓂᖅ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)
ᐊᓯᖏᔪ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖃᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᒪ	SEP ᓱᑎᐱᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᓇᓱᐱᓇ	DEC ᑎᓯᓱᐱᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᓇᖕᐅᐊᓇ	MAR ᒪᕐᓯ	APR ᐃᓴᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᕐᐊᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑕᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑕᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 142

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᒃᑎᑦ ᐊᖏᔪᓚᒃᓴᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 4 (June 1999 - May 2000)

ᐊᒡᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓕ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᔅᓄᐱᓗ	DEC ᑎᓯᐱᓗ	JAN ᒎᖅᓄᐊᓗ	FEB ᓄᖕᐅᐊᓗ	MAR ᒪᓯ	APR ᐃᓪᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**													
Caribou	ᑐᑲᐃᐃᑦ	Tuktut	28	13	51	42	17	17	26	42	33	53	39	44	122
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut	1	1	1								6	5	11
Arctic fox	ᑎᓗᓚᖓᐊᑦ	Tigiganiat						3	7	4	2	6		1	12
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	2	2		2	1						3	1	11
Ringed seal	ᓇᓕᔪᑦ	Natiinat	92	74	55	62	57	27	10	20	23	33	31	31	145
Bearded seal	ᐅᓴᐊᐃᑦ	Ukyuk	1	22	15	18	2			1	4	3	3	1	51
Harp seal	ᖃᐃᓕᓴᓪᓕᑦ	Qairulik			1	5	4								9
Walrus	ᐊᐃᐅᓴᑦ	Akvik	2	42	8	15	23	4	4	4	4		1		64
Narwhal	ᑐᒻᓂᓪᑦ ᖁᓪᓗᒍᑦ	Tuugaak				3	1				2			1	6
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	24	10										1	31
Canada goose	ᓂᕆᓪᓕᑦ	Nikliknik	9	5											13
Old squaw	ᐋᕿᑲᕆᐊᐃᑦ	Aahangik	1												1
Eider duck	ᒥᑎᑦ	Kingalik	19	14										1	28
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq	1	1											2
Ptarmigan	ᐋᖏᓯᑦ	Akilgik	11	2	1	2	8	5	1		2	3	6	14	35
Goose eggs	ᑲᖏᐃᐃᑦ ᓚᒃᓂᖅᑦ	Uluaguliit manniit	8	8											14
Duck eggs	ᒥᑎᑦ ᓚᒃᓂᖅᑦ	Tinmiat manniit	5	18											23
Arctic tern eggs	ᐃᒥᖃᑯᑕᓪᓕᑦ ᓚᒃᓂᖅᑦ	Emitkutailat manniit	3	13											15
Seagull eggs	ᓇᐃᐅᐃᑦ ᓚᒃᓂᖅᑦ	Nauyat manniit	1												1
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	60	53	55	22	32	33	17	5	12	16	15	33	135
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik												37	37
Cod	ᐅᓘᐃᑦ	Ugak	1	2										1	4
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk	1	4											5

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓪᒪᓇᓂᖅ ᐱᑕᖃᖅᖏᑦᑐᖃᖅ ᐱᓕᕆᓕᓐᓂᖅ ᐊᖏᔪᑦ ᖃᖏᐅᓂᖏᓐᓂᓄᑦ ᐊᓪᓚᖅᒪᓪᓕᐊᓂᑦ ᐊᐅᓚᖅᓂᓕᕆᓂᖅ ᐃᓄᐃᑦᑎᓯᒪᔪᓂᒃ ᐃᓄᐃᑦᑎᓯᒪᔪᓂᒃ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 143

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᓐᔅᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓚᐱᓗ	DEC ᑎᓴᓚᐱᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓇᖕᖏᐊᓗ	MAR ᒪᕆ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓴᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	50	35	214	208	42	118	184	126	86	190	84	84	1,421 ± 41
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					1	7	2	1					11
Wolf	ᐊᒪᓗᐃᑦ	Amagut			1		1	1			1		2	2	8 ± 2
Arctic fox	ᑎᓗᒃᖠᓂᐊᑦ	Tigiganiat						104	123	49	37	22	11		346 ± 37
Wolverine	ᑲᖏᐃᑦ	Kalvik							1						1 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	1									11	12		24 ± 7
Ringed seal	ᓇᓯᓪᑦ	Natiinat	467	157	119	103	102	29	19	83	119	213	81	141	1,633 ± 53
Bearded seal	ᐅᓗᔪᐃᑦ	Ukyuk	3	34	24	13	12			4	5	1	1		97 ± 6
Walrus	ᐊᐃᐃᑦ	Akvik	3	99	11	15	18	1		11	8	2			168 ± 10
Narwhal	ᑐᒻᓚᓪᑦ ᖃᓪᓗᓂᑦ	Tuugaak	1	1											2 ± 1
Beluga	ᖁᔨᑦᑕ ᖃᓪᓗᓂᑦ	Kilalugak	1				3								4 ± 1
Snow goose	ᑲᖕᐃᐃᑦ	Kanguq	234	17	87	11								28	377 ± 34
Canada goose	ᓂᑦᓚᑦ	Nikliknik	32	4		2								1	39 ± 15
Eider duck	ᒥᑎᑦ	Kingalik	153	55		14	2							10	234 ± 38
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	23		1	1	8	65	29	13	3	2	4	60	209 ± 22
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᓕᐊᑦ ᒪᓐᓂᖏᑦ	Manniit	20												20 ± 12
Goose eggs	ᑲᖕᐃᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	4,537	1,557											6,094 ± 630
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit	286	400											686 ± 102
Arctic tern eggs	ᐃᒥᖅᑕᐃᓪᓚᑦ ᒪᓐᓂᖏᑦ	Emitkutailat manniit	69	421											490 ± 86
Seagull eggs	ᓇᐃᔨᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	119	3											122 ± 55
Black guillemot eggs	ᐱᖏᔨᓪᓚᑦ ᒪᓐᓂᖏᑦ	Black guillemot eggs		27											27 ± 16
Arctic char	ᐃᖅᓚᖅᐱᑦ	Ikaliviit	3,475	2,333	2,760	623	1,059	949	478	903	629	1,191	822	775	15,997 ± 678
Lake trout	ᐃᓯᕐᐃᑦ	Ikalukpik	4				74	2						201	281 ± 41
Cod	ᐅᒪᐃᑦ	Ugak	7											24	31 ± 20

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᑦᓄᑦ ᑎᑎᕋᐅᒪᔨᑦ ᑐᓂᔭᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᐅᓕᕆᓂᖅᑎᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 144

Monthly hunter response

ᑕᕝᕙᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᒻᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕝᕙᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒍᑎᒃ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᔨᓗᓂ	NOV ᐃᓄᒃᓗᓂ	DEC ᑎᓯᒪᓂ	JAN ᔮᖅᓄᐊᓂ	FEB ᓄᕿᐅᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᕝᕙᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	240	240	238	237	235	232	233	257	259	256	255	257	273*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᓯᒋᑦ	Angunahuktin apikhuktan	206	224	226	228	225	219	217	241	248	239	233	232	265*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᑦ	Angujaujut	121	115	100	89	60	62	49	61	56	66	53	90	193*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑎᓂᖏᑦ (%)	Kiujut (%)	86	93	95	96	96	94	93	94	96	93	91	90	93**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᔾᔨᒋᑦᑐᒃᑐᑦ/ᐊᐱᓯᒋᑦᑐᑦ/ᐊᖏᔪᓂᒃᑐᒥᓂᑦ ᐊᑕᐅᓯᐊᖓᔪᓂᑎᑦ ᐊᒻᔪᒍᒥ.
** ᐊᓕᒍᓂᓕᕆᓂᒪᓕᒃ ᑕᕝᕙᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.1.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 145

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕋᐅᓕᒃ ᐊᑯᖏᓐᓄᓂ ᐊᖏᔪᓂᒃᑐᓂᖏᓐᓄᑕ ᐊᒪᓗᓗ ᐊᐱᓯᒋᑦᑕᐅᓂᖏᓐᓄᑕ, ᓇᓗᓇᐃᕋᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑐᑦ ᑎᑎᕋᑦᑕᐅᒪᓕᒃ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᒻᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕝᕙᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒍᑎᒃ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᔨᓗᓂ	NOV ᐃᓄᒃᓗᓂ	DEC ᑎᓯᒪᓂ	JAN ᔮᖅᓄᐊᓂ	FEB ᓄᕿᐅᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕋᐅᓕᒃ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕐᑯᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	99	100	100	100	100
4-6 months	4-6 ᑕᕐᑯᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᕐᑯᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	1	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 146

Number of hunters harvesting each species — **Year 5 (June 2000 - May 2001)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓚᓯᒃᑎᑦ ᐊᖏᓚᓯᒃᓴᖅᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒡᖏᒍ 5 (ᔫᓂ 2000 - ᒪᐃ 2001)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 5 (June 2000 - May 2001)**

Month/ᑕᖅᑳᖅ/Tatkia			JUN ᔫᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᐹᓗᓂ	OCT ᐅᑦᐹᓗᓂ	NOV ᐅᓇᒃᐹᓗᓂ	DEC ᑎᓯᒃᐹᓗᓂ	JAN ᔮᖏᓇᐊᓗᓂ	FEB ᓇᖕᖏᐊᓗᓂ	MAR ᒪᓯᓂ	APR ᐃᑦᓇᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	21	13	53	46	12	19	37	38	26	37	23	26	122
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut			1		1	1			1		2	2	6
Arctic fox	ᑎᓗᓚᖓᐊᑦ	Tigiganiat						11	10	8	7	5	3		20
Wolverine	ᑲᖏᐃᑦ	Kalvik							1						1
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	1									1	3		4
Ringed seal	ᓇᕆᑦ	Natiinat	89	49	46	41	36	14	12	28	34	44	27	40	136
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk	3	22	17	10	10			3	4	1	1		48
Walrus	ᐊᐃᐃᑦ	Akvik	2	51	5	9	13	1		7	5	2			60
Narwhal	ᑐᒻᓪᓕᑦ ᖃᓪᓗᓚᑦ	Tuugaak	1	1											2
Beluga	ᖁᔪᑦᑕ ᖃᓪᓗᓚᑦ	Kilalugak	1				2								3
Snow goose	ᑲᖕᐃᐃᑦ	Kanguq	41	4	16	4								6	56
Canada goose	ᓂᕆᓪᓕᑦ	Nikliknik	5	2		1								1	9
Eider duck	ᒥᑎᑦ	Kingalik	21	10		4	2							2	30
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	2		1	1	6	18	9	3	1	1	2	14	38
Eggs (unspecified)	ᐊᓯᖕᑦ ᑎᑎᒋᑦ ᓚᓐᓂᖕᑦ	Manniit	2												2
Goose eggs	ᑲᖕᐃᐃᑦ ᓚᓐᓂᖕᑦ	Uluaguliit manniit	57	25											75
Duck eggs	ᒥᑎᑦ ᓚᓐᓂᖕᑦ	Tinmiat manniit	14	11											23
Arctic tern eggs	ᐃᒥᖁᑕᓚᐃᑦ ᓚᓐᓂᖕᑦ	Emitkutailat manniit	6	9											15
Seagull eggs	ᓇᐃᐅᐃᑦ ᓚᓐᓂᖕᑦ	Nauyat manniit	4	1											5
Black guillemot eggs	ᐱᑦᓂᐅᓪᓕᑦ ᓚᓐᓂᖕᑦ	Black guillemot eggs		1											1
Arctic char	ᐃᖃᓗᐊᓘᑦ	Ikaliviit	64	60	63	18	24	27	10	14	8	16	14	33	133
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	1				6	1						32	40
Cod	ᐅᒪᐃᑦ	Ugak	1											1	2

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕆᔨᒪᔪᓂᑦ ᐱᑕᖃᖕᒋᑐᖃᖅ ᐱᓕᕆᔨᓂᖅ ᐊᖏᓚᑦ ᖃᑦᓯᐅᓂᖕᒋᓂᑦ ᐊᓪᓚᔨᑦ ᐊᐅᓚᑦᑎᓂᒃ ᐊᑐᐱᖁᓂᒃ ᐃᓕᓴᕐᕕᐅᑎᓂᒃ ᐃᓄᐃᑦᑐᓕᕆᔨᓂᒃ ᐃᓄᐃᑦᑐᓕᕆᓂᖅ ᐃᓕᓴᕐᕕᐅᑎᓂᒃ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 147

Annual harvest estimates and five-year mean

ᐊᒡᕕᒍᒫᑦ ᐊᓐᔪᒃᓄᑦ ᓇᓕᐅᑦᓱᓕᔨᑦ ᐊᒡᒪᓗ ᑕᓪᓕᓚᑦ-ᐊᒡᕕᒍᓄᑦ ᐊᐅᔨᓪᓕᖅᑭᒪᓕᕆᑦ

Aragutamat angujauvaktun tatlman araguit iluani

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᒡᕕᒍᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᕕᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᔨᓪᓕᖅᑭᒪᓕᕆᑦ Amigaitkiyait
Species	ᐅᒪᔪᑦ	**Umajuin**						
Caribou[1]	ᑐᖅᑕᐃᑦ[1]	Tuktut[1]	1,916	1,486	1,897	1,785	1,421	1,701
Polar bear[2]	ᓇᓄᐃᑦ[2]	Nanuit[2]	12	9	6	10	11	10
Wolf	ᐊᒪᓗᐃᑦ	Amagut	13	5	18	24	8	14
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat	248	266	40	81	346	196
Wolverine	ᖃᑦᕿᓴᑦ	Kalvik	0	0	1	0	1	<1
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik	80	12	42	13	24	34
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik	3	0	0	0	0	1
Ringed seal[3]	ᓇᓯᓂᑦ[3]	Natiinat[3]	2,138	1,790	1,538	1,894	1,633	1,799
Bearded seal[3]	ᐅᑉᔪᐃᑦ[3]	Ukyuk[3]	77	68	63	103	97	82
Harp seal[3]	ᖃᐃᕈᓪᓕᑦ[3]	Qairulik[3]	7	3	2	29	0	8
Walrus	ᐊᐃᕕᒃ	Akvik	159	139	121	174	168	152
Narwhal[4]	ᑐᙵᓪᓕᑦ ᕿᓪᓗᒡᓚᑦ[4]	Tuugaak[4]	2	0	23	7	2	7
Beluga	ᖃᐅᑦᑕᑦ ᕿᓪᓗᒡᓚᑦ	Kilalugak	14	10	41	0	4	14
Snow goose	ᑲᖏᐃᑦ	Kanguq	385	275	323	123	377	297
Canada goose	ᓂᖅᓪᓕᑦ ᐅᓄᐊᔪᓪᓕᑦ	Nikliknik	45	32	14	44	39	35
Old squaw	ᐊᖏᐊᖅᔪᐃᑦ	Aahangik	0	1	1	1	0	1
Pintail	ᖃᓄᒧᐊᔨᑦ	Arnaviaq	4	0	2	0	0	1
Eider duck[5]	ᒥᑎᑦ[5]	Kingalik[5]	262	73	131	186	234	177
Tundra swan	ᖃᓄᔪᐃᑦ	Kukyuk	2	2	2	0	0	1
Red-Throated loon	ᖁᓐᓚᐅᑦ	Qaqhuaq	0	0	6	13	0	4
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	777	194	224	406	209	362
Sandhill crane	ᑕᑎᓚᖅᔪᐊᖓ	Tatilgaq	0	0	1	0	0	<1
Eggs (unspecified)[6]	ᓚᐃᓂᑦ[6]	Manniit[6]	0	0	0	0	20	4
Goose eggs[6]	ᑲᖏᐃᑦ ᓚᐃᓐᖏᑦ[6]	Uluaguliit manniit[6]	0	2,257	3,814	335	6,094	2,500
Duck eggs[6]	ᒥᑎᑦ ᓚᐃᓐᖏᑦ[6]	Tinmiat manniit[6]	0	457	482	515	686	428
Arctic tern eggs[6]	ᐃᒥᖁᑯᑕᓪᓕᑦ ᓚᐃᓐᖏᑦ[6]	Emitkutailat manniit[6]	0	638	271	404	490	361
Seagull eggs[6]	ᓇᐃᔨᐃᑦ ᓚᐃᓂᑦ[6]	Nauyat manniit[6]	0	3	34	6	122	33
Black guillemot eggs[6]	ᐱᑦᓭᐅᓪᓕᑦ ᓚᐃᓐᖏᑦ[6]	Black guillemot eggs[6]	0	0	0	0	27	5
Arctic char[7]	ᐃᖁᓗᒃᐱᑦ[7]	Ikaliviit[7]	10,315	13,165	14,240	15,495	15,997	13,842
Lake trout[8]	ᐃᓯᕋᐃᑦ[8]	Ikalukpik[8]	25	31	49	183	281	114
Cod[9]	ᐅᒪᐃᑦ[9]	Ugak[9]	0	0	284	140	31	91
Sculpin[9]	ᑲᓇᔪᐃᑦ[9]	Kanayuk[9]	0	0	336	61	0	79
Clams[10]	ᐊᒃᒧᒪᔪᑦ[10]	Uviluq[10]	114	0	0	0	0	23

[1-10]: See page 273 for community feedback and other sources of data.

[1-10]: ᑕᐃᒃ ᒪᕐᕉᒃᓴᖅ 274 ᓄᓇᓕᑦ ᑭᐅᔪᓂᖅᑭᑦ ᐊᒪᓗ ᐊᓯᖅᑦ ᐱᓕᐅᓂᒃ ᓇᓗᐅᑎᓂᒃ.

[1-10]: Takulugu makpigaak 275 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

6.1.6

TABLE/ᐅᓗᐅᐃᕐᐅᑦ/NAUNAIKUTA 148

Annual hunter response
ᐊᓚᕐᔪᑎᒪᑦ ᐊᖏᓐᓂᔪᓂᑦ ᑭᐅᓂᖏᑦ
Angujauvaktu

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓄᑦ ᐊᓚᕐᔪᓄᑦ (ᓴᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᕐᓂᖅ ᐊᕐᔪᔭ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓐᓂᔪᓂᑦ ᑭᐅᓂᖏᑦ ᐊᔪᕐᓚᓂᖏᑦ**	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᖅᑕᒪᒃ ᐊᖏᓐᓂᔪᓂᑦ	Tatkitaman angunahuktut titigait	212	233	246	259	273	307*
Hunters interviewed	ᐊᖏᓐᓂᔪᓂᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	204	221	235	246	265	292*
Harvested	ᐊᖏᓐᓂᔪᒃᑐᒋᓂᑦ	Angujaujut	167	174	188	186	193	254*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑎᓂᖏᑦ (%)	Kiujut (%)	77	93	94	93	93	90**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖏᓐᓂᔪᓂᑦ ᐊᑎᓕᐅᔾᔪᑎᓕᕐᒥᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᓐᓂᔪᒃᑐᒋᓂᑦ ᐊᑕᐅᓂᐊᖅᑐᑎᓂᑦ ᖃᐅᔨᓴᕐᓂᖅᓯᒪᔪᑦ.
** ᐊᓕᒍᓂᓕᕆᓂᖅᓴᕐᔪᑦ ᐊᕐᔪᑎᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

6.1.6

TABLE/ᐅᓗᐅᐃᕐᐅᑦ/NAUNAIKUTA 149

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᕐᓴᓂ ᐊᖏᓐᓂᔪᓂᖓᓪᓕᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓪᓕᑕ, ᐅᓗᐅᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᕐᔪᑦ ᐊᖏᓐᓂᔪᓂᑦ ᑎᑎᕐᑕᐅᒪᔪᑦ
Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓄᑦ ᐊᓚᕐᔪᓄᑦ (ᓴᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᕐᓂᖅ ᐊᕐᔪᔭ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔪᑦ**	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	99	99	100	100	100	100
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	1	0	0	0	0
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	1	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 150

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓕᒃᑎᑦ ᐊᖏᔪᓕᒃᓴᕐᔪᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ

Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᑲᕼᒍᓂᑦ (ᔨᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᕼᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**						
Caribou	ᑐᑐᐃᑦ	Tuktut	121	118	128	122	122	205
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut	5	4	9	11	6	27
Arctic fox	ᑎᓕᓴᕐᓂᐊᑦ	Tigiganiat	16	26	7	12	20	42
Wolverine	ᖃᑦᕿᓵᑦ	Kalvik			1		1	2
Arctic hare	ᐅᒃᓪᓂᑦ	Ukalik	27	7	14	11	4	42
Arctic ground squirrel	ᓂᖅᓂᑦ	Hikhik	1					1
Ringed seal	ᓇᓂᓕᑦ	Natiinat	121	133	140	145	136	210
Bearded seal	ᐅᑭᓂᐃᑦ	Ukyuk	33	35	36	51	48	102
Harp seal	ᖃᐃᕐᓂᓂᑦ	Qairulik	4	3	2	9		17
Walrus	ᐊᐃᐱᓵᑦ	Akvik	42	56	48	64	60	117
Narwhal	ᑐᐃᓂᓂᑦ ᖁᓪᓗᓂᑦ	Tuugaak	1		13	6	2	21
Beluga	ᖃᐅᕐᑦ ᖁᓪᓗᓂᑦ	Kilalugak	6	6	23		3	31
Snow goose	ᑲᖏᐃᑦ	Kanguq	28	39	43	31	56	106
Canada goose	ᓂᕐᓂᑦ ᐅᓪᐊᒍᓂᓂᑦ	Nikliknik	9	8	2	13	9	29
Old squaw	ᐊᕿᕈᕐᓴᐃᑦ	Aahangik		1	1	1		3
Pintail	ᖃᓄᒪᐊᓴᑦ	Arnaviaq	2		2			4
Eider duck	ᒥᑎᑦ	Kingalik	23	16	26	28	30	76
Tundra swan	ᖃᓄᓴᐃᑦ	Kukyuk	1	1	2			4
Red-Throated loon	ᖁᖃᓴᐅᑦ	Qaqhuaq			2	2		4
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	49	25	30	35	38	86
Sandhill crane	ᑕᑎᓴᕐᔪᐊᖅ	Tatilgaq			1			1
Eggs (unspecified)	ᓚᐅᓂᑦ	Manniit					2	2
Goose eggs	ᑲᖏᐃᑦ ᓚᐅᓄᑦ	Uluaguliit manniit		39	58	14	75	122
Duck eggs	ᒥᑎᑦ ᓚᐅᓄᑦ	Tinmiat manniit		9	20	23	23	58
Arctic tern eggs	ᐃᒥᖁᑕᓪᓕᐃᑦ ᓚᐅᓄᑦ	Emitkutailat manniit		21	4	15	15	40
Seagull eggs	ᓇᐃᔨᐃᑦ ᓚᐅᓂᑦ	Nauyat manniit		1	4	1	5	10
Black guillemot eggs	ᐱᑦᓯᐅᓪᓂᑦ ᓚᐅᓄᑦ	Black guillemot eggs					1	1
Arctic char	ᐃᖁᓗᒃᐱᑦ	Ikaliviit	123	128	133	135	133	213
Lake trout	ᐃᓯᕐᓴᐃᑦ	Ikalukpik	5	4	4	37	40	67
Cod	ᐅᒪᐃᑦ	Ugak			3	4	2	8
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk			2	5		6
Clams	ᐊᒃᒧᒪᓇᐊᑦ	Uviluq	1					1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᖏᑕᐅᖅ ᐱᓕᐊᑎᓕᓂᒃ ᐊᖏᔪᒃ ᖁᕋᐅᓂᖏᓐᓄᓕᑦ ᐊᓕᖏᔪᓂᑦ ᐊᐅᓚᐅᒪᒪᔪᓕᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᕐᓴᐅᓂ ᑐᓂᔅᓴᖏᓐᓂ ᐃᑯᐱᕐᓂᓕᕆᔨᓂᖅᓂᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.6

6.1.6 Community Results Discussion: Igloolik

The survey frame:
An assessment of under-enumeration during the community visit indicated that there were very few hunters who were not registered in the Harvest Study.

Survey coverage and non-response bias:
Response rates in the first three months of year 1 of the study were quite low in Igloolik, dropping below 50% in two of these months. As seen in Table 9 the consistent intentional non-response rate in Igloolik was low, at 1%, and was not thought to be a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough during years 2 to 5 to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should exercise caution when using the data collected during the first three months of the study since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:
It was reported during the community visit that some hunters were reluctant to report their entire harvest, especially in the first year of the study. Some of these hunters did not clearly understand the purpose of the study and were fearful that the results may be used to limit harvesting. With further communication as the study progressed, this was apparently less of a factor. It was also reported that for some species, particularly arctic char, hunters may not have counted large catches and would have needed to estimate their harvest. The community indicated that Inuit hunters are more likely to under-estimate as opposed to over-estimate their harvest. These factors may have resulted in the reported harvests being lower than actual harvests.

As seen in the recall period tables, the vast majority of harvest records were collected within three months of the harvest, thereby minimizing recall error.

There was some commercial harvesting of arctic char during the Harvest Study but not in all years. It is thought that some of this commercial harvest was reported with the subsistence harvest in some years of the study.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou.
2. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
3. **Seals:** DSD reports indicate that 611 seal pelts were purchased from Igloolik hunters in 1999/2000 (year 4) and 502 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). As not all pelts will be sold, the harvest estimates being higher than these numbers are felt to be accurate.
4. **Narwhal:** The narwhal quota was 25 animals annually. DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
5	3	29	4	3

5. **Eider duck:** Eider duck harvesting consists mainly of king eiders, with very few common eiders being taken (C.F.).
6. **Eggs:** Hunters were not aware they were to report their egg harvest in year 1, therefore none were reported. Harvest estimates for eggs in other years were thought to be a little too low, particularly in year 4 for goose eggs and seagull eggs. King eider eggs are much more abundant than common eider eggs and would make up the majority of the duck egg harvest (C.F.).
7. **Arctic char:** There were times when commercial fishing was done but not each year. The community Fieldworker reported that the commercial harvest when it occurred was reported along with the subsistence harvest and would be included in the harvest estimates. It was commented that people were hesitant to report their whole catch the first year of the study and numbers may be low for that year. Harvest estimates in other years were thought to be more accurate. It was also indicated that harvesters did not always remember exactly how many char they caught and so would need to estimate the number (C.F.).
8. **Lake trout:** There is a yearly fishing derby in Hall Beach that started in 1992. Many of the fish were likely caught during this derby (C.F.).
9. **Cod/sculpin:** These fish are mainly caught by children. In years where 0 were recorded there were likely some caught, but not reported (C.F.).
10. **Clams:** It was reported during the community visit that people do go clam digging when the tide is very low. It is suspected that the lack of reported harvest of clams in the last four years of the study is due to a lack of reporting, not a lack of harvesting (C.F.).

6.1.6 ᓄᓇᕗᑦ ᓴᖅᑭᑕᐅᔭᓄᑦ ᐅᖃᖅᑎᑐᑦᑕᑎᑦ: ᐃᓚᓕᑦ

ᖃᐅᔨᓴᓂᐅᑦ ᐊᖏᖅᑭᒪᓂᖅᓱᒃ:
ᖃᒥᖅᑭᔨᐅᑎᓪᓗᑎᑦ ᐊᑎᓕᐅᖅᓯᒪᔭᕆᐊᒃᑲᓇᐊᖏᖅᓯᓄᑦ ᓴᓇᕐᓂᖅᑎᓪᓗᑎᑦ ᓄᓇᕗᒻᒥᑦ ᖃᐅᔨᓴᓇᕐᓂᖅᓵᓐᓂ ᐅᓄᖑᓕᕐᓂᑦ ᐊᑐᐊᓯᔪᓂᑦ ᐊᑎᖃᖅᖃᓕᕐᓇᓇᕐᓂᖅᓯᓄᑦ ᖃᐅᔨᓴᓂᒍᑦ.

ᖃᐅᔨᓴᖅᑕᐅᔪᑦ ᐊᒻᒪ ᐃᓕᓴᕆᓚᐅᕙᓪᓕᖅᖢᓂᑦᑐᑦ ᑭᐅᖅᑭᑦᑐᑦ:
ᑭᐅᕙᑎᑎᓄᖅᑭ ᑕᖅᑭᑦ ᐱᖓᓱᑦ ᓯᑉᓴᓕᖅᖢᖅᓄᓄ ᐅᑭᐅᖅᑎᓄ 1 ᖃᐅᔨᓴᓂᒍᑦ ᐊᑎᑎᓕᐊᖅᑲᓕᕐᓂᖅᑐᑦ ᐃᓚᓕᓐᓂᒥ, ᑲᑎᕐᓯᒪᓕᓂᑎᑦ ᓇᒃᖢᓕᕐᓂᖅᑐᑦ 50% ᒪᑭᒃᖢᓄᓄ ᑕᖅᑭᑦ ᒐᕐᐴᐊᖅ. ᑕᐃᑎᖅᓯᒪᒪᑦ ᓇᓕᖅᑲᒥ 9 ᐱᓕᕆᓂᑎᑦ ᑭᐅᖅᑕᐃᓕᓴᐃᓇᖅᑎᑦᑕᑦ ᐃᓚᓕᓐᓂᒥ ᐅᓇᖅᑎᑦᑕᐅᔪᓕᕐᓂᖅᑐᓂᖅᓴᖅ, 1%ᒥᑦᑐᑎᑦ, ᐊᒻᒪᓗ ᐃᓱᒪᒋᔭᐅᓕᖅᖢᓂᑦᑐᖅ ᐱᔪᑕᐅᐃᓐᓇᓕᖅᖢᓄᓄᑦ ᐅᑭᐅᖅᑕᐅᓂᑦ ᐃᓕᓴᐅᓇᖅᑐᓕᖅᑐᑦ.

ᑭᐅᖅᑎᑎᓄᖅᑭ ᐊᒥᓱᓕᑎᐊᓱᒋᔭᐅᓕᖅᖢᑦᑐᑦ ᐊᒻᒪᓗ ᑭᐅᖅᑭᖅᑎᑦᑐᑦ ᐅᓇᓗᐊᖏᓂᖅ ᐅᑭᐅᖅᑭᖅᑐᓄ 2ᒥᑦ 5ᒧᑦ ᒐᕐᐸᐊ ᐊᐱᖅᓯᖅᑕᐅᔪᓕᕐᓂᑦ ᖃᓂᐅᓂᖅᑭᑦ ᒥᑦᑎᐅᓂᖅᑭ ᐊᑎᖃᖅᑐᓕᕐᓂᖅᓯᒪᔭᕆᐊᒃᑲᓇᐊᖏᖅᓯᓄᑦ ᐊᑐᖅᑭᖅᓯᒪᓂᖅᑐᑦ. ᐅᖃᓕᓴᕐᓂᑦ ᐅᓴᓇᖅᑐᒥᔪᓐᓇᖅᑐᑦ ᐊᑐᐊᓯᔪᓂᑦ ᐊᑎᖃᖅᑐᓕᕐᓂᖅᓯᒪᔭᕆᐊᒃᑲᓇᐊᖏᖅᓯᓄᑦ ᓄᓇᕗᒻᒥᑦ ᓴᓇᕐᓂᖅᑎᑦᑕᑦ ᐃᓚᓕᓐᓂᒥ ᑕᒪᓐᓇᖅᑐᓂᒃ ᑕᒪᓐᓇᖅᑐᓂᒃ ᐊᑐᐊᓯᔪᓂᑦ ᐃᓚᓕᓐᓂᒥ ᑭᐅᖅᑭᖅᑎᑦᑐᑦ ᐃᓕᓴᐅᓇᖅᑐᓕᖅᑐᑦ ᐱᔪᑕᐅᐃᓐᓇᓕᖅᖢᓄᓄᑦ ᐅᑭᐅᖅᑕᐅᓂᑦ ᐃᓕᓴᐅᓇᖅᑐᓕᖅᑐᑦ ᐊᑐᐊᓯᔪᓂᑦ ᓄᓇᕗᒻᒥᑦ ᑭᐅᖅᑭᖅᑎᑦᑐᑦ ᐃᓕᓴᐅᓇᖅᑐᓕᖅᑐᑦ ᐊᒻᒪᓗ

6.1.6 Nunani Iniktihimayut Ukauhiit: Igloolik

Ihivgiukhimayut Atugutait:
Ihivgiuaakhimayuni ataani ihivgiukhimayut nunanut pulaakhimatitluta takuhimayut ikitut umayukhiuktit titigaktauhimaitut Umayukhiukhimayut Ihivgiukhimayumi.

Ihivgiukhimayut pihimayut ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait hivulimi pingahut tatkikhiutit ukiumi 1mi mikiyut Igloolikmi, katakhimayut ataanut 50%mik malguni hapkoa tatkikhiutini. Takuyauhimayut ikpatauyani 9mi piktaktut kiuyuitut naunaiyautait Igloolikmi mikiyut 1%mi ovalo ihumayut pilaaktut pihimayait kiuyuitut ihimagiyaini.

Kiuhimayut naunaiyautait ihumagiyut angiyut ovalo kiuyuitut ihimagiyait mikiyut ukiuni 2mit 5mut piyaami nni pihimayut ilaupkaivluni uktukhimayut Nni umayukhiuktini. Taiguaktut ihumayukhat atuligumik katitikhimayut katitigutait hivulimi pingahut tatkikhiutit ihivgiukhimayuni pilaamata tamamik uktukhimayut ihuinaagutikhat ovalo kiuyuitjutait ihimagiyait angiklilaamata kiuhimayut naunaiyautait katakpata.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Tuhaktitihimayut nunani pulaakhimatitlugit ilangit umayukhiuktit piyumangitut tuhaktitilugit tamamik umayukhimayainik, ilaa hivulimi ukiumi ihvgiuliktitlugit. Ilangit umayukhiuktit nalugaluagamik hunauyut ihivgiuktut ovalo ikhivlutik iniktigutait atuniaktut mikhilugit umayukhiulaat. Tuhaktitikatakhugit ihivgiuktut pitilugit, hamna ihumaalugiyauhuiktuk. Tuhaktitauhimayutlu ilangit umayut, ilaa ikaliviit, umayukhiuktit naunaiyakhimaitait amigaitut pihimayut ovalo pihimavaktut naunaiyakafulugit umayukhiukhimayainik. Nunani ukakhimayut Inuit umayukhiuktit pivaktut ataani naunaiyakpaktut pingithutik kaaganut naunaiyautivlutik umayuktaminik. Hapkoa pihimayut piyunakhiyut tuhaktitihimayut umayukhiukhimayut mikinikhaaguyut umayuktaminit.

Takuhimayut utiktihimayut ubluit ikpatauyaini, amigaitut umayukhiukhimayut titigagutait katitikhimayut iluani pingahut tatkikhiutini umayukhiukhimayuni, taimaimat mikinihaaguplugit utiktihimayut ihuinaagutait.

Pivaktut kinauyaliuhimayunik umayukhiukhimayuni ikalivinik Umayukhiukhimayut Ihivgiuktitlugit kihimi tamamiungituk ukiuni. Ihumagiyauyuk ilangit hamna kinauyaliukhimayut umayukhiuktuni tuhaktitihimayut ilanganut atuktakhaini umayukhiukhimayun ilaani ukiuni ihivgiuktitlugit.

Nunanit Ukakhimayut ovalo aalat pihimayaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukhimayut pihimayut nunanit tuktut.
2. **Nanuit:** Amigaitjutait takuhimayut naunaiyautaungitut kihimi pihimayut umayukhimayut amigaitjutait tunihimayut DSDnit (DSD PB).
3. **Natiit:** DSDkut tuhaktihimayut pihimayut 611kuyut natiit amiit niuviktauhimayut Iglookmit umayukhiuktinit 1999/2000mi (ukiumi4mi) ovalo 502kuyut niuviktauhimayut 2000/2001mi (ukiumi 5mi) (nalungilutit DSDkut katitikhimayut pivaktut umayukhiukhimayut ukiungit pihimayut Julymit Junemut, Umayukhiukhimayut Ihivgiuktut katitikhimayut pivaktut umayukhiukhimayut ukiungit pihimayut Junemit Maymut) (DSD FB). Tamamik amiit niuviktauyuitut, umayukhiukhimayut naunaiyautait angitkiyauyut hamani amigaitjutait ihumayut naamaktut.
4. **Tuugaat:** Tugaaliit kilalugait kotangit 25kuyut umayut ukiuk tamaat. DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait tugaaliit kilalugait (nalungilutit DFOkut katitikhimayait atukpaktut atuktaini ukiuni, Umayukhiukhimayut Ihivgiukhimayut katitikhimayut pihimayut ukiuni pivaktut Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
5	3	29	4	3

[5] **Tingmiat:** Tingmiat umayukhiukpaktut amigaitkiyait kingaliit, ikitut mitiit pivaktait (C.F.).

[6] **Maniit:** Umayukhiuktit naluhimavaktut tuhaktitlutik maniit katitihimayainik ukiumi 1mi, taimaimat tuhaktitihimaitut. Umayukhiukhimayut naunaiyautait maninut aipaini ukiuni ihumagiyauyut mikiyut, ilaa ukiumi 4mi uluaguliit maniit ovalo nauyat maniit. Kingaliit maniit amigaitkiyauyut mitiknit maniinit ovalo pilaaktait amigaikhimalugit tingmiat maniit katitikhimayut (C.F.).

[7] **Ikaliviit:** Pivaktut ilaani kinauyalikhimayut ikalukhiukhutik kihimi tamakmiungituk ukiuni. Nunani havaktiit tuhaktitihimayut kinauyaliuktut ikalukhiukhutik pigaagamik tuhaktitivaktut ilauplugit atuktakhaini umayukhiuktaini ovalo ilauvaktut umayukhiukhimayut naunaiyautaini. Ukakhimayut Inuit piyumahiukpaktut tuhaktitilugit ikaluktaminik tamaat hivulim ukiumi ihivgiukliktitlugit ovalo amigaitjutait mikiyut talvani ukiungani. Umayukhiukhimayut naunaiyautait aipaini ukiuni ihumagiyauyut naamaktut. Nalungitutlu umayukhiuktut ilaani puigukpaktut kafinik ikalukpaktut ovalo pivaktut naunaiyakafukhugit amigaitjutait (C.F.).

[8] **Ikalukpik:** Ukiuk tamaat ikalukhiukpaktut takhinahuakhutik Sanigayaqmi pilihimayut 1992mi. Amigaitut ikaluit pivaktut hamani takhimahuaktitlugit (C.F.).

[9] **Ugat/kanayuit:** Hapkoa ikaluit piyauvaktut nutakanit. Ukiuni titigakhimayut pingitut (0) piyunakhiyuugaluit kihimi titigakhimaitut (C.F.).

[10] **Uviluit:** Tuhaktitihimayuk nunani pulaakhimatitlugu, Inuit uvilikhiulikpaktut imaitigaagat. Ihumagiyut pikatangitut tuhaktakhanik umayukhiukhimayut uvilunik hitamani ukiuni ihivgiukhimatitlugu pivaktut tuhaktitinginamik, piktaktitlugit umayukhiukhimayut (C.F.).

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Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᑦᔪᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN† ᔨᓂ	JUL† ᔨᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐃᓗ	NOV ᓄᓇᓚᓗ	DEC ᑎᓯᓚᓗ	JAN ᔮᖏᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕆᔪ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᐅᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	n/d	n/d	283	167	163	222	220	253	189	204	176	117	1,994 ± 63
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d						7	1	5		4	17
Wolf	ᐊᒪᓗᐃᑦ	Amagut	n/d	n/d	1			1	4	1		1	2		10 ± 2
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat	n/d	n/d			4	23	5	3	3		2		40 ± 9
Coloured fox	ᖃᐅᖅᖢᖅᑐᑦ ᑎᓕᓴᓂᐊᑦ	Kalaliit tigiganiat	n/d	n/d					3	2			1		6 ± 2
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	n/d	n/d	2	6	1	2	6	18	3	2	13	3	56 ± 11
Ringed seal	ᓇᕆᑦ	Natiinat	n/d	n/d	543	316	304	126	105	94	80	128	199	167	2,062 ± 106
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	n/d	n/d	18	8	15	14	6						61 ± 10
Harp seal	ᖃᐃᓗᓪᓚᑦ	Qairulik	n/d	n/d	71	73	74	40	19						277 ± 41
Harbour seal	ᖃᓕᑭᐊᑦ	Qanigiaq	n/d	n/d					4						4 ± 3
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	n/d	n/d	2	4	15	9	2						32 ± 7
Walrus	ᐊᐃᐸᑦ	Akvik	n/d	n/d	2	3	13	2				1		1	22 ± 6
Beluga	ᖃᐅᖅᑕᑦ ᖁᓕᓄᑐᑦ	Kilalugak	n/d	n/d	9										9 ± 4
Snow goose	ᑲᖕᒪᐃᑦ	Kanguq	n/d	n/d										7	7 ± 3
Canada goose	ᓂᕆᓪᓚᑦ	Nikliknik	n/d	n/d	2								3	67	72 ± 11
Eider duck	ᒥᑎᑦ	Kingalik	n/d	n/d	44	55	41	20							160 ± 35
Black guillemot	ᐱᕐᓂᐅᓪᓚᑦ	Black guillemot	n/d	n/d		7									7 ± 6
Thick-billed murre	ᐊᕐᐸᐃᑦ	Thick-billed murre	n/d	n/d				2							2 ± 2
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	n/d	n/d	11	28	140	167	143	112	168	155	1,632	1,259	3,815 ± 313
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	n/d	n/d	2,021	451	500	271	307	115	92	222	539	267	4,785 ± 739
Cod	ᐅᓘᐃᑦ	Ugak	n/d	n/d	17					49					66 ± 28
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	n/d	n/d	47	15									62 ± 26
Clams	ᐊᓴᒧᓚᔪᑦ	Uviluq	n/d	n/d	2,178	850	842								3,870 ± 882

† No data were collected in June and July 1997. Consequently, the total harvest listed above is a 10 month total (August 1997 - May 1998), not an annual total. Similarly, the confidence intervals shown were calculated only for the 10 months in which data were collected.
‡ Polar bear data supplied by DSD.

† ᓇᓘᐅᑎᓂᖅ ᓄᐊᖏᔪᓐᖓᓕᐅᕐᖓᑎᑐᖅ ᐅᕐᓂ ᔨᓂ ᐊᓚᓗ ᔪᓕᐃ 1997. ᑕᐃᒪᓐᓂᖓᓄᑦ, ᑲᑎᑕᐅᑦ ᐊᖏᔪᑦ ᑎᑎᖏᑕᐅᒪᔪᑦ ᐊᓂᓪᓂᓂ ᐊᓕᓂᓂ ᑕᑭᓂ ᑲᑎᑭᒪᔪᖅ (ᐊᐅᓚᔪᑎ 1997- ᒪᐃ 1998), ᐊᑦᔪᒍᓕᒫᖅᖢᖅᑐᒍᑦ. ᑕᐃᒪᓕᓕᑕᐅᖅ, ᓱᓕᔪᓐᓇᓂᖓᓄᑦ ᐊᐅᓂᖓᓄᑦ ᖃᐅᔨᓴᖅᑎᑐᑦᑐᒃᑯᑦ ᐊᐅᓂᖓᓄᑦ ᐊᐅᓚᔪᑎᓂᖅ ᓄᐊᖏᔪᓐᖓᓕᐅᕐᖓᑎᑐᖅ ᐊᐅᓂᖓᓄᑦ ᓄᐊᖏᔪᓐᖓᓕᐅᕐᖓᑎᑐᖅ ᑕᑭᓂ ᐃᓕᑕᐅᑦ ᐊᐅᓂᖓᓄᑦ ᓄᐊᖏᔪᓐᖓᓕᐅᕐᖓᑎᑐᖅ.
‡ ᓇᓂᑦᓂ ᑎᑎᖏᑕᐅᒪᔪᑦ ᑐᓂᓴᖏᑦ ᐅᓄᐊ ᐃᓄᐊᕐᓚᓂᓕᒫᑦ.

† Katikhiktaumaimata June Julylu 1997. Taimalu, tamakikhugit tahapkuan angujauvakhimajut kulinut tatkinut (August 1997 – May 1998), iluitumungituk tamna ukiumnun. Taimanahainaktauk, katikhiktaumavut ahapkuan angujauhimajut kulinut tatkinun katikhiktaumajut malikhugit.
‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.1.7

TABLE/ᐅᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 152

Monthly hunter response

ᑕᖃᑕᒻᒪᑦ ᐊᖏᓐᓇᓕᕆᔨᑦ ᑭᐅᓂᖅᑕᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)

ᐊᓕᖁᔪᒍ 2 (ᔦᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔦᓂ	JUL ᔦᓪᓗ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᐊᓂ	NOV ᓄᓇᕗᓂ	DEC ᑎᓯᕗᓂ	JAN ᒍᓐᓄᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓐᓇᓕᕆᔨᑦ ᑭᐅᓂᖅᑕᑦ ᐊᑎᔨᓪᓚᓂᖅᑕᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒻᒪᑦ ᐊᖏᓐᓇᓕᕆᔨᑦ	Tatkitaman angunahuktut titigait	n/d	n/d	282	293	296	298	302	301	316	320	318	310	350*
Hunters interviewed	ᐊᐱᔨᓪᓴᓚᒥᓂᓕᑦ	Angunahuktin apikhuktan	n/d	n/d	246	222	232	250	256	267	287	285	284	271	315*
Harvested	ᐊᖏᓐᓇᓕᕆᔨᑐᓂᓕᑦ	Angujaujut	n/d	n/d	147	94	80	90	84	97	79	79	108	76	233*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᓂᖅᑕᑦ (%)	Kiujut (%)	n/d	n/d	87	76	78	84	85	89	91	89	89	87	86**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓐᓇᓕᕆᔨᑦ ᐊᑎᓕᐅᔪᑎᒪᒪᓕᖅᑕᑦ/ᐊᐱᔨᓪᓴᓚᒥᓂᓕᑦ/ᐊᖏᓐᓇᓕᕆᔨᑐᓂᓕᑦ ᐊᑕᐅᓪᓚᔨᓂᑎᑦ ᐊᑎᖏᒻᒥ.
** ᐊᑎᒋᓕᖅᑎᓪᓗᒪᓕᖅ ᑕᖃᑕᒻᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.1.7

TABLE/ᐅᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 153

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᕐᓴᓂ ᐊᖏᓐᓇᓕᕆᓂᖓᓂᒃ ᐊᓚᓗ ᐊᐱᕐᓂᑕᐅᓂᖓᓂᒃ, ᐅᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᓐᓇᓕᕆᓂᑦ ᑎᑎᕐᓂᑕᐅᓚᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)

ᐊᓕᖁᔪᒍ 2 (ᔦᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔦᓂ	JUL ᔦᓪᓗ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᐊᓂ	NOV ᓄᓇᕗᓂ	DEC ᑎᓯᕗᓂ	JAN ᒍᓐᓄᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔾᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲᑦ	≤ tatkin pingahut	n/d	n/d	43	36	53	64	83	86	85	74	38	22	56
4-6 months	4-6 ᑕᖅᑲᑦ	tatkin hitaman 6nut	n/d	n/d	25	58	39	33	16	11	6	7	14	36	25
> 6 months	> 6 ᑕᖅᑲᑦ	> 6 tatkin	n/d	n/d	32	6	8	2	1	3	9	19	48	42	19

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 154

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓚᓯᖅᑎᑦ ᐊᖏᓚᓯᖅᓯᒋᑦ ᐊᑐᓂᖅ ᐅᒪᔨᓂᖅ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 2 (June 1997 - May 1998)
ᐊᒃᑭᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᐃ	AUG ᐊᐅᑲᔪᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᓇᐱᓇ	DEC ᑎᓯᐱᓇ	JAN ᒍᖏᓂᔪᓇ	FEB ᓇᖕᐅᔨᓇ	MAR ᒪᔨᔪ	APR ᐃᔨᓪᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	n/d	n/d	108	56	51	67	69	79	66	63	62	43	195
Polar bear#	ᓇᓄᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut	n/d	n/d	1			1	4	1		1	2		8
Arctic fox	ᑎᓕᓴᕐᓂᐊᑦ	Tigiganiat	n/d	n/d			2	6	2	3	3		2		13
Coloured fox	ᖃᓄᖕᖏᑦᑐᑦ ᑎᓕᓴᕐᓂᐊᑦ	Kalaliit tigiganiat	n/d	n/d					2	2			1		5
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	n/d	n/d	2	2	1	2	1	6	3	2	8	3	25
Ringed seal	ᓇᓯᓪᑦ	Natiinat	n/d	n/d	119	61	39	22	18	25	20	22	35	29	159
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	n/d	n/d	12	6	9	8	1						28
Harp seal	ᖃᐃᓗᓚᑦ	Qairulik	n/d	n/d	20	16	14	8	6						42
Harbour seal	ᖃᓯᒋᐊᑦ	Qanigiaq	n/d	n/d					1						1
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	n/d	n/d	2	2	8	6	1						16
Walrus	ᐊᐃᐸᑦ	Akvik	n/d	n/d	1	3	4	1				1		1	10
Beluga	ᖃᓄᖅᑕᑦ ᖁᓪᓗᓴᐃᑦ	Kilalugak	n/d	n/d	6										6
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	n/d	n/d										2	2
Canada goose	ᓂᖅᓚᑦ	Nikliknik	n/d	n/d	1								2	21	24
Eider duck	ᒥᑎᑦ	Kingalik	n/d	n/d	9	8	4	5							22
Black guillemot	ᐱᕐᓂᐅᓪᓚᑦ	Black guillemot	n/d	n/d		1									1
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre	n/d	n/d				1							1
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	n/d	n/d	1	3	10	17	16	18	17	21	60	47	108
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	n/d	n/d	34	9	7	7	7	4	8	9	15	14	72
Cod	ᐅᓕᐃᑦ	Ugak	n/d	n/d	1					1					2
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	n/d	n/d	2	1									2
Clams	ᐊᓚᒧᒪᔪᑦ	Uviluq	n/d	n/d	11	5	3								15

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓯᒪᔪᓂᒃ ᐱᑕᖃᖕᖏᑦᑐᖃᖅ ᐱᓵᖅᑎᓂᓕᓂᒃ ᐊᖏᓴᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᓂᑦ ᐊᓂᓴᐅᔪᓂᑦ ᓇᓂᐅᑦᑐᖅᑐᑦ ᐃᓄᐃᑦᑐᓂᒃᑯᓐᓂᒃ ᐃᓄᐃᑦᑐᓂᒃᑯᓐᓂᒃ ᐃᓄᐃᑦᑐᓂᒃᑯᓐᓂᒃ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 155

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᓯᔾᔪ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓂ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑦᔪᓇ	NOV ᐅᓇᓵᓇ	DEC ᑎᓯᓚᓇ	JAN ᔮᖏᓇᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᓕᕐ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᑦ	Tuktut	63	89	131	134	92	197	236	251	214	170	166	143	1,886 ± 84
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡			2					3	2	4	2		13
Wolf	ᐊᒪᓴᐃᑦ	Amagut	1			5			1	1	2	2	4	2	18 ± 6
Arctic fox	ᑎᓗᒃᑖᐊᑦ	Tigiganiat									1	5	1	2	9 ± 4
Coloured fox	ᖃᐅᖏᑦᑐᑦ ᑎᓗᒃᑖᐊᑦ	Kalaliit tigiganiat							1			4			5 ± 3
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik				8			2				10	10	30 ± 9
Seals (unspecified)	ᓂᖃᓯᓪᓕᑦ	Natiit						1							1 ± 1
Ringed seal	ᓇᓂᓱᑦ	Natiinat	198	198	305	183	110	168	46	71	33	46	123	143	1,624 ± 108
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	1	7	6	12	5	9	1	1					42 ± 7
Harp seal	ᖃᐃᓴᓪᓕᑦ	Qairulik		2	21	23	15	12	7	1					81 ± 13
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit		1											1 ± 1
Walrus	ᐊᐃᓵᓴᑦ	Akvik			1	11	9								21 ± 7
Narwhal	ᑐᒻᓪᓕᑦ ᖁᓪᓗᓴᑦ	Tuugaak		1											1 ± 1
Beluga	ᖃᐅᖏᑦ ᖁᓪᓗᓴᐃᑦ	Kilalugak		10	2			1							13 ± 3
Snow goose	ᑲᖏᐃᑦ	Kanguq	1											7	8 ± 5
Canada goose	ᓂᖅᓪᓕᑦ	Nikliknik	45		2								1	93	141 ± 32
Eider duck	ᒥᑎᑦ ᖃᓂᒋᖏᑦ	Kingalik	56	12	52	43	4					4		28	199 ± 46
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	23			8	12	14	104	63	119	41	776	3,132	4,292 ± 615
Goose eggs	ᑲᖏᐃᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit	2												2 ± 2
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	348	23											371 ± 259
Arctic char	ᐃᖃᓗᒃᓴᑦ	Ikaliviit	268	2,301	1,135	271	110	262	320	214	148	155	402	915	6,501 ± 642
Cod	ᐅᒐᐃᑦ	Ugak	24												24 ± 19
Clams	ᐊᓚᒧᓕᑦ	Uviluq		499	4,323	4,822	1,795	650							12,089 ± 1,813

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᓕᑦ ᑐᓂᒃᖏᑦ ᐅᑯᐊ ᐃᑯᕐᓴᐅᓂᒃᑲᓂᕐᒃᑐᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 156

Monthly hunter response
ᑕᖃᑕᒪᑦ ᐊᖏᔪᓇᒃᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)
ᐱᓕᕆᔨ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑯᐊᓂ	NOV ᐃᓅᓚᕐᓇ	DEC ᑎᓯᓚᕐᓇ	JAN ᒍᓐᓄᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐱᔪᓐᓇᕐᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᒪᒪᑦ ᐊᖏᔪᓇᒃᑎᑦ	Tatkitaman angunahuktut titigait	306	306	317	329	330	331	333	344	361	333	336	334	400*
Hunters interviewed	ᐊᐱᕐᓂᖅᓯᒪᔭᓂᑦ	Angunahuktin apikhuktan	260	256	259	262	268	266	259	274	284	248	244	231	327*
Harvested	ᐊᖏᔪᓇᒃᑐᒥᓂᑦ	Angujaujut	50	72	100	89	48	63	67	73	61	59	73	91	206*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	85	84	82	80	81	80	78	80	79	74	73	69	79**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᒃᑎᑦ ᐊᑎᓕᐅᑉᑕᒪᓕᕆᔨᑦ/ᐊᐱᕐᓂᖅᓯᒪᔭᓂᑦ/ᐊᖏᔪᓇᒃᑐᒥᓂᑦ ᐊᑕᐅᓂᐊᖅᓯᓂᑦᑎᑦ ᐊᑲᕐᒪᑦ.
** ᐊᑦᓴᒋᓐᓂᑲᓕᕆᔨᑦ ᑕᖃᒪᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.1.7

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 157

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓇᒃᑎᓂᖓᓄᑦ ᐊᒻᒪᓗ ᐊᐱᕐᓂᖅᓯᒪᔭᓂᖓᓄᑦ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᒪᔨᑦ ᐊᖏᔪᓇᒃᑐᑦ ᑎᑎᕐᓯᒪᔭᓕᔨᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)
ᐱᓕᕆᔨ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑯᐊᓂ	NOV ᐃᓅᓚᕐᓇ	DEC ᑎᓯᓚᕐᓇ	JAN ᒍᓐᓄᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	6	14	47	61	83	99	94	83	67	96	88	78	68
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	61	74	51	32	16	1	4	11	31	0	1	13	25
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	33	12	1	7	1	0	2	6	2	4	11	9	7

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 158

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐸᒋᑦ ᐊᖏᔪᓚᐸᓕᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 3 (June 1998 - May 1999)

ᐊᒃᑭᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓕ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐃᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᒍᖏᓄᓗ	FEB ᐃᖅᑲᓗ	MAR ᒪᔨ	APR ᐃᔨᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	24	31	52	49	29	53	57	67	53	49	42	46	167
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut	1			1			1	1	2	2	2	1	9
Arctic fox	ᑎᓗᓚᖓᓂᐊᑦ	Tigiganiat									1	2	1	2	5
Coloured fox	ᖃᐅᖏᑦᑐᑦ ᑎᓗᓚᖓᓂᐊᑦ	Kalaliit tigiganiat							1			2			3
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik				4			1				4	6	14
Seals (unspecified)	ᓂᖏᐅᓪᓕᑦ	Natiit						1							1
Ringed seal	ᓇᓂᓕᑦ	Natiinat	29	40	63	49	23	18	12	18	9	13	20	23	112
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	1	6	6	6	2	5	1	1					19
Harp seal	ᖃᐃᓕᓪᓕᑦ	Qairulik		2	11	9	5	3	2	1					30
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit		1											1
Walrus	ᐊᐃᐧᐋᒃᑦ	Akvik			1	3	3								7
Narwhal	ᑐᒻᓪᓕᑦ ᖁᓕᓗᒡᑦ	Tuugaak		1											1
Beluga	ᖃᐅᖏᑦ ᖁᓕᓗᒡᐃᑦ	Kilalugak		8	2			1							11
Snow goose	ᑲᖏᒍᑦ	Kanguq	1											3	4
Canada goose	ᓂᖅᓪᓕᑦ	Nikliknik	9		1								1	20	27
Eider duck	ᒥᑎᑦ ᖃᓂᔪᖏᑦ	Kingalik	5	4	7	9	3					1		2	24
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	1			1	2	2	9	9	10	8	42	72	93
Goose eggs	ᑲᖏᒍᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit	1												1
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	1	1											2
Arctic char	ᐃᖃᓗᐸᐃᑦ	Ikaliviit	9	43	27	4	4	7	4	5	6	10	24	37	104
Cod	ᐅᒪᐃᑦ	Ugak	1												1
Clams	ᐊᓚᒧᓪᓕᑦ	Uviluq		6	32	27	7	2							50

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓪᓕᔪᓂᒃ ᐱᑕᖃᖏᑦᑐᖃᓕᒃ ᐱᓱᔪᑎᓕᓂᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᓕᒃ ᐊᓕᓴᐅᒪᔪᓕᑦ ᐊᑐᓴᐅᓚᖓᓂᒃ ᐃᓕᓴᕐᓂᐅᓂ ᐃᓄᐃᑦᑕᓕᕐᓂᓂᒃ ᐃᓄᐃᑦᑕᓕᕐᓂᓂᓕᒃ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 159

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)
ᐊᓐᖁᒍ 4 (ᔪᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒡᒎᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᓂᐱᓇ	DEC ᑎᓯᐱᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᓄᖅᐅᐊᓇ	MAR ᒪᓯ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓴᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	72	48	183	130	42	56	116	199	153	139	164	144	1,446 ± 117
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡			2					9	2	3	1		17
Wolf	ᐊᒪᓗᐃᑦ	Amagut							5	3		4		1	13 ± 7
Arctic fox	ᑎᓕᓴᒃᓂᐊᑦ	Tigiganiat						11	10		10	3	1		35 ± 16
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓕᓴᒃᓂᐊᑦ	Kalaliit tigiganiat					2	2							4 ± 4
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik		2	5	5	7			1	13	8	13	24	78 ± 20
Ringed seal	ᓇᓯᓪᓚᑦ	Natiinat	192	152	222	181	81	36	23	68	72	149	160	254	1,590 ± 164
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		1	8	5	3							7	24 ± 8
Harp seal	ᖃᐃᓗᓪᓚᑦ	Qairulik		7	47	44	27	15		4					144 ± 52
Harbour seal	ᖃᓄᑭᐊᑦ	Qanigiaq	2				2								4 ± 3
Walrus	ᐊᐃᐃᓴᑦ	Akvik	2				14								16 ± 10
Narwhal	ᑐᒻᓚᓪᓚᑦ ᖁᓪᓗᓂᑦ	Tuugaak	1												1 ± 1
Beluga	ᖃᐅᑦᑕᑦ ᖁᓪᓗᓂᑦ	Kilalugak	6	74	21	3									104 ± 20
Geese (unspecified)	ᓄᑦᓚᓪᓚᑦ ᐃᓪᖅᖃᖏᑦ	Kanguk												15	15 ± 18
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	29											3	32 ± 17
Canada goose	ᓄᑦᓚᓪᓚᑦ	Nikliknik	83			24							27	64	198 ± 70
Eider duck	ᒥᑎᑦ	Kingalik	70	15	7	68	19						38	31	248 ± 105
Red breasted merganser	ᑲᑦᓴᑐᑦ	Red breasted merganser					3								3 ± 5
Black guillemot	ᐱᑦᓯᐅᓪᓚᑦ	Black guillemot			1									18	19 ± 21
Ptarmigan	ᐊᖏᕐᓂᑦ	Akilgik	154						2	58	83	127	620	567	1,611 ± 267
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	2,992	341											3,333 ± 3,918
Arctic char	ᐃᖃᓗᑲᒪᑦ	Ikaliviit	99	892	2,167	266	68		24	54	431	250	730	796	5,777 ± 961
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk		7	92	67									166 ± 115
Clams	ᐊᓕᒧᒪᔪᑦ	Uviluq		359	1,218	3,807	396								5,780 ± 3,400

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᓴᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᖅᖢᑦ ᑲᑎᒪᔨᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕕᓂᕐᓂᖅᓴᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 160

Monthly hunter response

ᑕᖏᑕᒪᑦ ᐊᖏᓐᓇᓂᑦᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)

ᐊᓯᖏᔪ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖏᖑᒻ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑲᐃᓂ	NOV ᓄᓇᕗᓂ	DEC ᑎᓯᕗᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᓇᖑᐅᐊᓂ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓐᓇᓂᑦᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᔨᓪᓚᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒪᑦ ᐊᖏᓐᓇᓂᑦᑎᑦ	Tatkitaman angunahuktut titigait	338	343	349	355	360	363	362	360	365	369	374	365	406*
Hunters interviewed	ᐊᐱᔨᓪᓕᐊᒥᓂᓕᒃ	Angunahuktin apikhuktan	219	220	219	211	193	181	130	246	249	251	251	246	314*
Harvested	ᐊᖏᓐᓇᓂᑦᑐᓂᓕᒃ	Angujaujut	36	60	82	55	27	18	21	51	42	61	70	68	175*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	65	64	63	59	54	50	36	68	68	68	67	67	61**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓐᓇᓂᑦᑎᑦ ᐊᑎᓕᐅᔪᒪᔨᖏᑦ/ᐊᐱᔨᓪᓚᓂᖏᑦ/ᐊᖏᓐᓇᓂᑦᑐᓂᓕᒃ ᐊᑕᐅᓪᓚᔨᐊᑐᑎᑦ ᐊᓕᔭᒥ
** ᐃᓕᓴᕐᓂᑎᓪᓚᔨᓕ ᑕᖏᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.1.7

TABLE/ᐅᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 161

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᓴᓂ ᐊᖏᓐᓇᓂᑦᑐᓂᓗᒡᒐ ᐊᓚᓗ ᐊᐱᕐᓯᑕᐅᓂᖏᓐᓇᑕ, ᐅᓗᓇᐃᕐᑕᑦ ᐃᒪᓱ % ᑲᑎᑕᑎᑦ ᐊᖏᓐᓇᓂᑦᑐᓂᓕᒃ ᑎᑎᕐᑕᐅᒪᔨᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)

ᐊᓯᖏᔪ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖏᖑᒻ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑲᐃᓂ	NOV ᓄᓇᕗᓂ	DEC ᑎᓯᕗᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᓇᖑᐅᐊᓂ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	4	50	75	68	67	75	6	21	26	39	33	26	43
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	81	29	16	13	27	25	91	23	10	1	1	0	19
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	16	21	9	19	6	0	3	55	64	60	67	74	39

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 162

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐸᑎᑦ ᐊᖏᔪᓚᐸᓕᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 4 (June 1999 - May 2000)
ᐊᒡᖏᒍ 4 (ᔪᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᓕ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒡᐱᓗ	DEC ᑎᓯᒡᐱᓗ	JAN ᒍᖏᓄᓗ	FEB ᐃᖅᑲᓗ	MAR ᒪᓯ	APR ᐃᓕᓴ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	15	22	43	35	11	14	15	44	36	38	46	37	130
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut							2	2		3		1	7
Arctic fox	ᑎᓗᓚᖓᓂᐊᑦ	Tigiganiat						2	4		3	2	1		10
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓗᓚᖓᓂᐊᑦ	Kalaliit tigiganiat					1	1							2
Arctic hare	ᐅᑲᓪᓕ	Ukalik		1	2	3	2			1	5	5	5	8	27
Ringed seal	ᓇᕆᑦ	Natiinat	24	36	50	34	14	2	2	12	13	25	25	30	108
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		1	4	3	2							3	11
Harp seal	ᖃᐃᕐᓂᑦ	Qairulik		3	11	15	4	1		1					23
Harbour seal	ᖃᓗᑎᐊᑦ	Qanigiaq	1				1								2
Walrus	ᐊᐃᐸᒃᑦ	Akvik	1				4								5
Narwhal	ᑐᒻᓪᓕᑦ ᖁᓪᓗᓂᑦ	Tuugaak	1												1
Beluga	ᖃᐅᑦᑕ ᖁᓪᓗᓂᑦ	Kilalugak	3	27	10	2									37
Geese (unspecified)	ᓄᑦᓪᓕ ᐃᓪᓕᖅᖏᑦ	Kanguk												1	1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	5											1	6
Canada goose	ᓄᑦᓪᓕᑦ	Nikliknik	10			1							1	14	24
Eider duck	ᒥᑎᑦ	Kingalik	5	2	3	5	3						2	3	16
Red breasted merganser	ᑲᐅᓴᑎᑦ	Red breasted merganser					1								1
Black guillemot	ᐱᑦᓯᐅᓪᓕᑦ	Black guillemot			1									1	2
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	2						1	3	7	11	33	29	61
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	2	2											4
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	3	23	39	5	4		1	3	3	6	17	14	73
Sculpin	ᑲᓇᐋᑦ	Kanayuk		1	2	1									3
Clams	ᐊᒃᒧᒪᔪᑦ	Uviluq		4	19	10	2								33

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᓄᖅᑐᓄᑦ ᐱᒃᔨᑎᓕᓄᑦ ᐊᖏᔪᒃᑦ ᖃᑦᓯᐅᓂᖏᓄᑦ ᐊᓕᕆᔨᓂᒃ ᐊᖏᔪᓂᒃ ᓇᓕᐅᒪᔪᓂᒃ ᐊᓕᕆᔨᓂᒃ ᐃᓕᓴᕐᓂᐊᕐᓂᖅᑕᑦ ᑐᓂᓯᖏᓄᓂ ᐅᓂᒃᖏᓄᓂ ᐃᓕᓴᕐᓂᐊᕐᓂᖅᑕᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 163

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᓐᔅᔪᒍ 5 (ᔮᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐅᕕᓇ	OCT ᐅᑦᑐᕕᓇ	NOV ᐅᓇᓵᕕᓇ	DEC ᑎᓯᓚᕕᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᓯᓗ	APR ᐃᓴᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	104	139	273	145	92	160	230	188	153	142	142	69	1,837 ± 132
Moose	ᑐᑦᑐᕐᐃᑦ	Tuktuvait								2					2 ± 2
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡								5	7	5			17
Wolf	ᐊᒪᓗᐃᑦ	Amagut		3					2	3	4		2		14 ± 8
Arctic fox	ᑎᓘᑦᓂᐊᑦ	Tigiganiat						1	5	5	4				15 ± 10
Coloured fox	ᖃᐅᓪᓗᒋᑦ ᑎᓘᑦᓂᐊᑦ	Kalaliit tigiganiat									2				2 ± 3
Arctic hare	ᐅᒃᓪᑦ	Ukalik	12		6	15	3	6	42	33	12	8	11		148 ± 37
Seals (unspecified)	ᓂᖏᔪᓪᑦ	Natiit						3							3 ± 4
Ringed seal	ᓇᓂᓪ	Natiinat	329	385	332	241	136	89	123	75	103	67	127	132	2,139 ± 199
Bearded seal	ᐅᑭᔾᐊᑦ	Ukyuk	1	18	15	6	14	8	2						64 ± 16
Harp seal	ᖃᐃᕆᓪᑦ	Qairulik		12	77	53	35	47	5						229 ± 54
Harbour seal	ᐊᐸᐃᑦ	Qanigiaq		3	2										5 ± 4
Walrus	ᐊᐃᐅᓴᑦ	Akvik		2			15		2						19 ± 10
Beluga	ᖃᐅᖅᑕ ᖁᓕᓵᓚᐃᑦ	Kilalugak		7	7	4	2								20 ± 10
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	4												4 ± 5
Canada goose	ᓄᖅᓪᑦ	Nikliknik	27	3	3									9	42 ± 18
Eider duck	ᒥᑎᑦ	Kingalik	58	146	39	94	2	17							356 ± 90
Black guillemot	ᐱᕐᓂᐅᓪᓕᑦ	Black guillemot					9								9 ± 10
Thick-billed murre	ᐊᖏᔪᐊᐃᑦ	Thick-billed murre						5							5 ± 6
Ptarmigan	ᐊᖑᓚᑦ	Akilgik	136	48	53		33	34	519	381	321	60	134	281	2,000 ± 455
Duck eggs	ᒥᑎᑦ ᒪᓐᓇᖅᑦ	Tinmiat manniit	95	83											178 ± 128
Eider down∅	ᒥᑎᑦ ᖃᓄᓂᖅᑦ∅	Mitiit qiviungit∅	24	157											181 ± 177
Arctic char	ᐃᖃᓗᓴᒃ	Ikaliviit	446	1,496	2,445	162	147	548	312	116	200	6	71	210	6,159 ± 1,155
Cod	ᐅᒪᐃᑦ	Ugak							34				78		112 ± 77
Sculpin	ᑲᓇᔾᐊᑦ	Kanayuk					43								43 ± 48
Clams	ᐊᓚᒧᒪᔨᑦ	Uviluq		238	924	1,118	202								2,482 ± 915

‡ Polar bear data supplied by DSD.
∅ Number of nests harvested.

‡ ᓇᓄᑦᓄᑦ ᑎᑎᕋᐅᒪᔨᑦ ᑐᓂᖅᑦᑐᑦ ᐅᑯᐊ ᐃᓄᐃᑦᑕᓇᓵᒃᑦ.
∅ ᖃᕐᐅᓂᖅᑦ ᐱᐅᑦ ᓄᐊᑕᐅᔨᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.
∅ Amigaitiginit maniktagauhimajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 164

Monthly hunter response
ᑕᖃᑕᒪᑦ ᐊᖏᓐᓇᓂᕆᑦ ᑭᐅᓂᖅᑎᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)
ᐊᓕᕐᒧ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᕐᓇᓪ	OCT ᐅᑯᐊᓪ	NOV ᐅᐊᓚᕐᓇᓪ	DEC ᑎᓯᕐᓇᓪ	JAN ᔮᓐᓄᐊᓪ	FEB ᐃᕙᐅᐊᓪ	MAR ᒪᕐᔪ	APR ᐃᕐᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᕐᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓐᓇᓂᕆᑦ ᑭᐅᓂᖅᑎᑦ ᐱᒋᔨᒪᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒪᑦ ᐊᖏᓐᓇᓂᕆᑦ	Tatkitaman angunahuktut titigait	367	368	378	385	385	385	385	392	393	393	385	385	415*
Hunters interviewed	ᐊᐱᔨᔪᖅᓯᒪᔪᓂᑦ	Angunahuktin apikhuktan	247	240	241	246	252	252	236	239	227	220	202	138	291*
Harvested	ᐊᖏᓐᓇᓂᕆᔨᒃᑯᓂᑦ	Angujaujut	53	70	99	56	46	47	56	47	42	32	34	19	165*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᓂᖅᑎᑦ (%)	Kiujut (%)	67	65	64	64	65	65	61	61	58	56	52	36	60**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓐᓇᓂᕆᑦ ᐊᑎᓕᐅᑎᒪᔨᑦ/ᐊᐱᔨᔪᖅᓯᒪᔪᓂᑦ/ᐊᖏᓐᓇᓂᕆᔨᒃᑯᓂᑦ ᐊᑕᐅᓂᔪᓐᓇᖅᑎᑦ ᐊᓕᕐᒪᑉ.
** ᐊᓕᒍᓂᓪᓕᐊᓂᒪᓕᕆᑦ ᑕᖃᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.1.7

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 165

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᕆᔨᑦ ᐊᑯᕐᖏᓂ ᐊᖏᓐᓇᓂᕆᓕᒃ ᐊᒪᓗ ᐊᐱᔨᔪᑕᐅᓂᖏᓕᒃ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓗ % ᑲᑎᕐᑐᑦ ᐊᖏᓐᓇᓂᕆᒃᑯᑦ ᑎᑎᕐᑕᐅᒪᔨᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)
ᐊᓕᕐᒧ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᕐᓇᓪ	OCT ᐅᑯᐊᓪ	NOV ᐅᐊᓚᕐᓇᓪ	DEC ᑎᓯᕐᓇᓪ	JAN ᔮᓐᓄᐊᓪ	FEB ᐃᕙᐅᐊᓪ	MAR ᒪᕐᔪ	APR ᐃᕐᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᕐᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᕆᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	0	0	0	9	17	45	45	37	44	80	86	74	25
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	6	18	43	41	47	27	54	54	46	11	5	5	33
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	94	82	57	50	36	28	1	9	10	9	9	21	42

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 166

Number of hunters harvesting each species — **Year 5 (June 2000 - May 2001)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓯᓗᒃᑎᑦ ᐊᖏᔪᓯᓗᒃᑐᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ — **ᐊᒻᒋᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 5 (June 2000 - May 2001)**

Month/ᑕᖅᖢᓪ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᓄᐃᓚᐱᓗ	DEC ᑎᓯᓚᐱᓗ	JAN ᔮᖏᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᓯᔪ	APR ᐃᓯᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	27	42	67	34	25	38	46	38	30	28	21	10	135
Moose	ᑐᖅᑐᕋᐃᑦ	Tuktuvait								1					1
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᖁᐃᑦ	Amagut		2					1	1	1		1		5
Arctic fox	ᑎᓕᒃᓂᐊᑦ	Tigiganiat						1	1	1	1				4
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓕᒃᓂᐊᑦ	Kalaliit tigiganiat									1				1
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik	4		3	1	2	3	9	8	4	3	3		32
Seals (unspecified)	ᓴᖅᐊᓪᓕᑦ	Natiit						1							1
Ringed seal	ᓇᖁᓪᓗᑦ	Natiinat	33	51	54	39	26	12	16	16	19	10	14	12	109
Bearded seal	ᐅᓚᕋᐃᑦ	Ukyuk	1	9	9	3	5	2	1						24
Harp seal	ᖃᐃᖁᓪᓕᑦ	Qairulik		4	18	12	7	6	1						31
Harbour seal	ᐊᐸᐃᑦ	Qanigiaq		1	1										1
Walrus	ᐊᐃᐅᓵᑦ	Akvik		1			5		1						7
Beluga	ᖃᐅᖏᑦ ᖁᓪᓗᓴᐃᑦ	Kilalugak		4	2	2	1								9
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	1												1
Canada goose	ᓂᖅᓪᓕᑦ	Nikliknik	6	1	2									2	10
Eider duck	ᑎᑎᑦ	Kingalik	5	14	5	11	1	3							28
Black guillemot	ᐱᖏᔪᐅᓪᓕᑦ	Black guillemot					1								1
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre						1							1
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	5	1	2		5	4	19	13	13	5	8	6	50
Duck eggs	ᑎᑎᑦ ᒪᓂᓂᖏᑦ	Tinmiat manniit	1	4											5
Eider down	ᑎᑎᑦ ᖃᓄᖁᖏᑦ	Mitiit qiviungit	1	2											3
Arctic char	ᐃᖃᓗᐊᓴᑦ	Ikaliviit	16	15	31	5	4	5	6	3	4	1	3	5	66
Cod	ᐅᒪᐃᑦ	Ugak							1				3		4
Sculpin	ᑲᓇᕋᐃᑦ	Kanayuk					1								1
Clams	ᐊᓚᒧᒪᕋᑦ	Uviluq		1	5	5	4								10

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᓕᕐᓂᒃ ᐱᕈᖃᖏᑦᑐᖃᖅ ᐱᓱᐊᑎᓵᓄᓂᒃ ᐊᖏᔪᑦ ᖃᕋᓯᐅᓂᖏᓐᓄᑦ ᐊᓕᔪᓄᑦ ᐊᓕᔪᓂᒃ ᓇᓕᐅᕐᓂᖅᓱᓂᒃ ᐊᑐᓂᒃ ᓇᓕᐅᕐᓂᖅᓱᓂᒃ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 167

Annual harvest estimates and five-year mean

ᐊᓐᖁᔭᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᕆᓚᑭᑦ ᐊᓚᓗ ᑕᒻᓕᒪᓂᑦ-ᐊᓐᖁᔭᓂᑦ ᐊᐅᔨᓕᕐᒥᓱᒪᔪᑦ 2001)

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᓐᖁᔭᓂᑦ (ᔦᓂ 1996 - ᒪᐃ

Study Year/ᖃᐅᔨᓴᖅ ᐊᓐᖁᔭᐅᑎᖅ/Ihivgiukimayut Ukiumi			1	2†	3	4	5	Mean ᐊᐅᔨᓕᕐᒥᓱᒪᔪᑦ Amigaitkiyait
			96/97	97/98	98/99	99/00	00/01	
Species	**ᐅᒪᔪᑦ**	**Umajuin**						
Caribou[1]	ᑐᖅᑐᐃᑦ[1]	Tuktut[1]	n/d	2,166	1,886	1,446	1,837	1,834
Moose	ᑐᖅᑐᕐᐃᑦ	Tuktuvait	n/d	0	0	0	2	1
Polar bear[2]	ᓇᓄᐃᑦ[2]	Nanuit[2]	n/d	17	13	17	17	16
Wolf[3]	ᐊᒪᓗᐃᑦ[3]	Amagut[3]	n/d	11	18	13	14	14
Arctic fox	ᑎᓇᓚᖓᓂᑦ	Tigiganiat	n/d	40	9	35	15	25
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓇᓚᖓᓂᑦ	Kalaliit tigiganiat	n/d	6	5	4	2	4
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	n/d	61	30	78	148	79
Seals (unspecified)	ᓯᖃᐅᓪᓚᑦ	Natiit	n/d	0	1	0	3	1
Ringed seal	ᓇᓯᓪᓚᑦ	Natiinat	n/d	2,547	1,624	1,590	2,139	1,975
Bearded seal[4]	ᐅᑌᓘᐃᑦ[4]	Ukyuk[4]	n/d	71	42	24	64	50
Harp seal	ᖃᐃᕈᓪᓚᑦ	Qairulik	n/d	284	81	144	229	185
Harbour seal	ᖃᓯᕆᐊᑦ	Qanigiaq	n/d	6	0	4	5	4
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	n/d	32	1	0	0	8
Walrus	ᐊᐃᐃᓴᑦ	Akvik	n/d	24	21	16	19	20
Narwhal[5]	ᑐᒪᓪᓕᑦ ᖃᓪᓗᓂᑦ[5]	Tuugaak[5]	n/d	0	1	1	0	1
Beluga[6]	ᖃᐅᔨᑦ ᖃᓪᓗᓂᑦ[6]	Kilalugak[6]	n/d	41	13	104	20	45
Geese (unspecified)	ᓄᖅᓪᓚᑦ	Kanguk	n/d	0	0	15	0	4
Snow goose	ᑲᖏᐃᑦ	Kanguq	n/d	18	8	32	4	16
Canada goose[7]	ᓄᖅᓪᓕᑦ ᐅᓇᐊᒍᓪᓕᑦ[7]	Nikliknik[7]	n/d	125	141	198	42	127
Eider duck	ᒥᑎᑦ	Kingalik	n/d	279	199	248	356	271
Red breasted merganser	ᑲᐅᔨᑐᑦ	Red breasted merganser	n/d	0	0	3	0	1
Black guillemot	ᐱᖏᓂᐅᓪᓚᑦ	Black guillemot	n/d	7	0	19	9	9
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre	n/d	2	0	0	5	2
Ptarmigan	ᐊᕐᓗᒋᑦ	Akilgik	n/d	3,935	4,292	1,611	2,000	2,960
Goose eggs[8]	ᑲᖏᐃᑦ ᒪᓕᓂᕐᒥᑦ[8]	Uluaguliit manniit[8]	n/d	1	2	0	0	1
Duck eggs[9]	ᒥᑎᑦ ᒪᓕᓂᕐᒥᑦ[9]	Tinmiat manniit[9]	n/d	1,294	371	3,333	178	1,294
Eider down[Ø]	ᒥᑎᑦ ᖁᓂᑭᕐᒥᑦ[Ø]	Mitiit qiviungit[Ø]	n/d	60	0	0	181	60
Arctic char[10]	ᐃᖃᓗᐊᓴᑦ[10]	Ikaliviit[10]	n/d	6,619	6,501	5,777	6,159	6,264
Cod	ᐅᒪᐃᑦ	Ugak	n/d	74	24	0	112	53
Sculpin[11]	ᑲᓇᐊᐃᑦ[11]	Kanayuk[11]	n/d	64	0	166	43	68
Clams[12]	ᐊᓚᒧᒪᓕᕐᑦ[12]	Uviluq[12]	n/d	4,235	12,089	5,780	2,482	6,147

† No data were collected in June and July 1997. Annual harvest estimates for year 2 were obtained by using the average of the harvest estimates for the corresponding months in the three years in which data were collected.

Ø Number of nests harvested.

[1-12]: See page 292 for community feedback and other sources of data.

† ᓇᓕᐅᑎᓂ ᓄᐊᕐᓯᐊᖃᓇᓐᖏᑦᑐᓐᖓᓄᑦ ᐅᐊᓂ ᐋᓐᓚᓗ ᐋᓕᓇ 1997. ᐊᖏᔪᒧᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᕆᓚᑭᑦ ᐊᖏᔪᒧᑦ 2-ᒧᑦ ᐱᕈᐅᓕᐅᑎᑦ ᐊᑐᑎᑦ ᐊᐅᔨᓕᕐᒥᓱᒪᔪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᕆᓚᑭᑦ ᑕᒪᓐᖓᐊᖅᓭᖅ ᑕᕐᓂ ᐱᖃᓗᓂ ᐊᖏᔪᓂ ᓇᓕᐅᑎᑦ ᓄᐊᑕᐅᓴᐃᖅᓯᓂᓄᑦ.

Ø ᖃᓄᐅᓂᖅᑎᑦ ᐱᕈᐅᑦ ᓄᐊᑕᐅᓴᐃᖅᓯᓂᓄᑦ.

[1-12]: ᑕᐃᓄᖅ ᒪᓴᐃᑐᖃᖅ 294 ᓄᓇᓕᑦ ᑭᐅᔭᓴᑎᖅᑎᑦ ᐊᓚᓗ ᐊᓂᖅᑎᑦ ᐱᒃᓴᐅᔪᓐᓇᖅᑑᑦ ᓇᓕᐅᑎᑦ.

† Katihiktauhimagitut nahaktauhimaitut June Julylu 1997. Ukiuktamat angujauvaktun maliktauplutik angunahukpaktut kihuimajut tapkuningan tatkit maliktumi pingahunut ukiunun katikhiktaumajut maliktauplutik.

Ø Amigaitiginit maniktagauhimajut.

[1-12]: Takulugu makpigaak 296 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

6.1.7

TABLE/ᐅᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 168

Annual hunter response

ᐊᓚᖏᔪᑕᒻᒥᑦ ᐊᖓᔪᓂᖅᑐᑦ ᑭᐅᓂᖏᑦ

Angujauvaktu

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓚᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Hunter Response Categories	ᐊᖓᔪᓂᖅᑐᑦ ᑭᐅᓂᖏᑦ ᐊᑎᕿᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᖃᒧᑦ ᐊᖓᔪᓂᖅᑐᑦ	Tatkitaman angunahuktut titigait	n/d	350	400	406	415	540*
Hunters interviewed	ᐊᖓᔪᓂᖅᑐᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	n/d	315	327	314	291	442*
Harvested	ᐊᖓᔪᓂᖅᑐᒥᓂᑦ	Angujaujut	n/d	233	206	175	165	331*
Response Rate (%)	ᑭᐅᔾ ᖃᓕᑯᓂᖏᑦ (%)	Kiujut (%)	n/d	86	79	61	60	71**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖓᔪᓂᖅᐳᑎᑕᐅᓪᓚᕆᐊᓕᒃ/ᐊᐱᕐᓂᑦ/ᐊᖓᔪᓂᖅᑐᒥᓂᑦ ᐊᑕᐅᓯᐊᓘᑎᒃᑐᑦ ᖃᐅᔨᓴᖅ.
** ᐊᑦᑎᓂᓕᕆᓚᐅᖅ ᐊᓚᖏᔪᑕᒻ ᑭᐅᔾ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

6.1.7

TABLE/ᐅᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 169

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᑦ ᐊᑯᖏᓐᓄ ᐊᖓᔪᓂᓐᓂᖏᓐᓂᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᓂᑕ, ᐅᓗᓇᐃᖏᑦ ᐃᒪᒃ % ᑲᑎᕐᔪᑦ ᐊᖓᔪᓂᖅᑐᑦ ᑎᑎᕐᑦᑕᐅᒪᔾᔪᑦ

Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓚᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	n/d	56	68	43	25	51
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	n/d	25	25	19	33	25
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	n/d	19	7	39	42	24

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 170

Number of hunters harvesting each species
ᖃᑦᔪᐅᓂᖏᑦ ᐊᖏᔪᓇᓱᒋᑦ ᐊᖏᔪᓇᓱᕐᕉᑦᑐᑦ ᐊᑐᓂᓱ ᐅᒪᔨᑦᓂᓱ
Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓄᑦ ᐊᑲᕽᒧᓄᑦ (ᒋᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᕽᒍ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Total ᑲᑎᕐᑐᑦ Tamakiklugin
			96/97	97/98	98/99	99/00	00/01	
Species	**ᐅᒪᔪᑦ**	**Umajuin**						
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	n/d	195	167	130	135	287
Moose	ᑐᑦᑐᓴᐃᑦ	Tuktuvait	n/d				1	1
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut	n/d	8	9	7	5	23
Arctic fox	ᑎᓇᓚᖅᓂᐊᑦ	Tigiganiat	n/d	13	5	10	4	30
Coloured fox	ᖃᓄᖅᑭᑦᑐᑦ ᑎᓇᓚᖅᓂᐊᑦ	Kalaliit tigiganiat	n/d	5	3	2	1	9
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik	n/d	25	14	27	32	75
Seals (unspecified)	ᓴᖏᓄᓪᓕᑦ	Natiit	n/d		1		1	2
Ringed seal	ᓇᕐᓯᑦ	Natiinat	n/d	159	112	108	109	246
Bearded seal	ᐅᑉᕙᐃᑦ	Ukyuk	n/d	28	19	11	24	65
Harp seal	ᖃᐃᕈᓪᓕᑦ	Qairulik	n/d	42	30	23	31	95
Harbour seal	ᖃᓴᒋᐊᑦ	Qanigiaq	n/d	1		2	1	4
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	n/d	16	1			17
Walrus	ᐊᐃᐃᓵᑦ	Akvik	n/d	10	7	5	7	21
Narwhal	ᑐᒻᓂᓪᑦ ᖁᓪᓗᓕᑦ	Tuugaak	n/d		1	1		2
Beluga	ᖃᓄᖅᑐᑦ ᖁᓪᓗᓕᑦ	Kilalugak	n/d	6	11	37	9	51
Geese (unspecified)	ᓄᖅᓂᑦ	Kanguk	n/d			1		1
Snow goose	ᑲᖏᐃᑦ	Kanguq	n/d	2	4	6	1	11
Canada goose	ᓄᖅᓂᑦ ᐅᓪᓗᐊᔪᓂᑦ	Nikliknik	n/d	24	27	24	10	59
Eider duck	ᒥᑎᑦ	Kingalik	n/d	22	24	16	28	69
Red breasted merganser	ᑲᐅᑦᑐᑦ	Red breasted merganser	n/d			1		1
Black guillemot	ᐱᖏᐅᓯᑦ	Black guillemot	n/d	1		2	1	3
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre	n/d	1			1	2
Ptarmigan	ᐊᖮᓱᑦ	Akilgik	n/d	108	93	61	50	181
Goose eggs	ᑲᖏᐃᑦ ᒪᓕᓄᖏᑦ	Uluaguliit manniit	n/d		1			1
Duck eggs	ᒥᑎᑦ ᒪᓕᓄᖏᑦ	Tinmiat manniit	n/d		2	4	5	11
Eider down	ᒥᑎᑦ ᖃᓄᖅᓄᖏᑦ	Mitiit qiviungit	n/d				3	3
Arctic char	ᐃᖃᓗᐸᐱᑦ	Ikaliviit	n/d	72	104	73	66	181
Cod	ᐅᒪᐃᑦ	Ugak	n/d	2	1		4	7
Sculpin	ᑲᓇᕈᐃᑦ	Kanayuk	n/d	2		3	1	5
Clams	ᐊᑉᒧᒪᕈᑦ	Uviluq	n/d	15	50	33	10	84

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓪᒪᔪᓂᑦ ᐱᑕᖃᖏᑐᒃ ᐱᑦᔨᐊᓕᓄᑦ ᐊᖏᔪᑦ ᖃᕋᓱᓂᖏᓄᑦ ᐊᐅᓚᓄᑦ ᐊᖏᔪᓄᑦ ᓇᓕᕆᔨᒃᑯᓂᖓᓄᑦ ᑐᓴᕆᔨᒃᑯᓂᖓᓄᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.7

6.1.7 Community Results Discussion: Iqaluit

Although data collection in most communities began in July 1996, in Iqaluit delays were encountered due to difficulties in retaining Fieldworkers and in registering hunters. Data prior to August 1997 were deemed unreliable and were not used. In April 2001, a letter was written to the Nunavut Implementation Panel and cc'ed to the relevant RWOs and HTOs informing them of the missing data. The letter also demonstrated the NWMB's approach to the problem, detailing the use of collected data to estimate for the missing months. The Nunavut Implementation Panel accepted the NWMB's approach to the issue in June 2001. As such, there are no data (n/d) displayed for year 1 in Iqaluit. In order to estimate the total yearly harvest in year 2, estimates for June and July 1997 were obtained by calculating the mean harvest for the corresponding months in the three years in which data were collected.

The survey frame:
Unique challenges were encountered during the Harvest Study in Iqaluit. Due to the large and ever changing population of this community, the territorial capital, it continued to be very difficult to register and track hunters within the community. For similar reasons it was also difficult to retain Fieldworkers in Iqaluit. An assessment of under-enumeration during the community consultations revealed that there were approximately 114 hunters who were not registered in the Harvest Study. Sixty-four of these were Inuit - 51 occasional hunters, 12 active and one intensive hunter. It is estimated that there were 50 non-Inuit hunters with assigned hunting rights who were not registered– 48 occasional and two active hunters. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. Given that these unregistered hunters represent 17 percent of the total hunter population (Table 10) the effect of this bias on harvest estimates could be significant. Harvest estimates for the unregistered hunters can be estimated using mean harvest quantities for each species by strata. However, these estimates, having their own sources of error and bias, are beyond the scope of this Final Report. Readers may apply to NWMB to obtain the results of these calculations.

Survey coverage and non-response bias:
Response rates in years 2 and 3 were very good in most months; however rates began to decline at the end of year 3 and were very low in years 4 and 5, below 75% in all months. As seen in Table 9 the consistent intentional non-response rate in Iqaluit was 1.3%, and was not thought to be a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough during years 2 and 3 to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Unfortunately due to declining response rates the same cannot be said for the other years of the study. Readers should exercise caution when using the data collected during years 4 and 5 of the study since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:
Due to difficulties encountered retaining Fieldworkers in the final two years of the study hunters were often interviewed several months to a year after their harvest. This would require many hunters to estimate their harvest if they did not record their data, which many did not. As seen in the recall period tables, long recall periods were also seen in many months during the earlier years of the study resulting in a similar source of error.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou. Caribou are the main source of country food, the estimates look too low. Caribou migration patterns will affect harvest numbers as well; some years there are fewer close to the community and fewer are harvested in these years (C.F.).
2. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
3. **Wolf:** Hunters travel to Natsuluk lake to go fishing and will often harvest wolves there. Estimates look accurate. Wolf numbers have been increasing since the study and the harvest numbers have likely increased since the study ended (C.F.).
4. **Bearded seal:** Estimates seem too high, especially in year 2 (C.F.).

[5] **Narwhal:** Estimates seem accurate (C.F.). DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DSD N/B):

96/97	97/98	98/99	99/00	00/01
0	0	1	0	0

[6] **Beluga:** Estimates seem fairly accurate. The estimate of 104 is thought to be correct since there were more animals near the community in that year (year 4) (C.F.). Prior to 1999 the quota had been 35 beluga per year after which time Iqaluit joined a three year trial community-based management system and no longer was given a set quota. DFO reports the following harvest numbers for beluga (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
35	23	17	70	22

[7] **Canada goose:** Estimates look to be in the right range. The migration routes seem to have changed and numbers seem to be decreasing near the community (C.F.).

[8] **Goose eggs:** Estimates appear to be low (C.F.).

[9] **Duck eggs:** Estimates appear to be accurate. Harvesting is very dependent on the weather and when break up is late it is difficult to get out to the where the eggs are found. Higher harvest years would represent years where break-up was earlier and boats could get out to the collection areas (C.F.).

[10] **Arctic char:** The total arctic char harvest estimates look about right (C.F). There was one harvest reported to have been sold commercially during the Harvest Study; it was removed from the database and can been seen in Table 4.

[11] **Sculpin:** Sculpin are harvested every year; likely some were taken in year 3 but none were reported (C.F.).

[12] **Clams:** The average seems correct. Weather will affect the harvest of clams; in some years bad weather resulted in lower harvests (C.F.).

6.1.7 ᓄᓇᕗᑦ ᓴᖅᑭᑕᐅᔪᓂᒃ ᐅᖃᖅᑎᑐᑦᑕᑎᑦ: ᐃᖅᓗᐃᑦ

ᐊᑦᓯᓚᕐᓴᓂᒃ ᓄᐊᕋᑎᓯᒋᐊᕐᓂᖅ ᓄᓇᕗᑦᓯᒪᓕᕆᓴᑦ ᐱᑎᕐᓯᐅᑦᓴᓪᓗᕋᖅᑎᑦᓯᓗᒍ ᐅᓪᓗᒃ 1996ᒥ, ᑭᖑᓪᓕᐊᖅᑕᐅᓯᒋᔭᐅᑦᓴᑦ ᐃᖅᓗᓂᓄ ᐱᓯᒪᔨᐅᑦᓴᐃᓐᓇᑭᓐᓂᖅᓂᓄᑦ ᐊᓐᓂᒃᑯᓂᓄᑦ ᐅᓇᓱᐊᕐᓂᖅ. ᐊᑦᓯᑕᐅᓯᒪᔪᑦ ᐊᐅᔪᓄᑦ ᓯᑲᓂᓄᑦ ᐊᑎᓕᓗ ᐊᑎᓕᐅᔪᓯᑦᓯᒋᐊᕐᓂᖅ ᐊᓯᖏᓐᓂᖅ. ᐊᑦᓯᑕᐅᓯᒪᔪᑦ ᐊᐅᔪᓄᑦ ᓯᑲᓂᓄᑦ ᐊᑐᖅᑕᐅᓯᒪᔪᓂᑦ ᑐᖓᓯᖅᑐᓂᑦ ᑐᓴᖅᓴᓕᐅᑎᓯᒪᓂᖅᑐᓂᑦ ᐊᑐᖅᑕᐅᓯᒪᔪᓂᑦ. ᐃᐱᓇ 2001ᒥ, ᑎᑎᖅᑲᒥᑦ ᑐᓂᓯᖅᑐᓂᑦ ᓄᓇᕗᑦ ᐊᑐᓂᖅᑎᓯᓂᒧᑦ ᑲᑎᒪᔨᖅ ᐊᐅᔾᖅᓂᒃ ᑐᓴᕐᓯᐅᑦᓴᐃᓐᓇᑭᓐᓂᖅᓂᓄᑦ ᐊᐃᑎᑐᖅᑕᐅᓯᒪᔪᑦ ᐅᓪᓗᒥᐅᑦᓴᐃᓐᓇᑭᓐᓂᖅᓂᓄᑦ ᐃᓕᓴᕐᓂᓕᕆᓴᖅᑐᑦ ᓄᓇᕗᑦᓯᐅᑦ ᐊᐅᓚᑦᓯᐊᕐᓂᖅᓂᓄᑦ ᑐᓴᖅᑎᑎᕋᖅᑐᓂᑦ ᐊᑦᓯᑕᐅᓯᒪᔪᑦ ᐱᓕᕆᔨᒃᑯᑦ. ᐱᓕᕆᔨᒃᑯᑦ ᐊᑦᓯᑕᐅᓯᒪᔪᑦ ᐊᑐᖅᑕᐅᓯᒪᔪᓂ

[4] **ᐅᓴᐊᐃᐦ:** ᖃᓄᐃᓕᓂᒃ ᐊᓯᑎᓕᖅᑐᑦᓴᓐᓇᐅᑦ, ᐱᓕᕆᖅᑐᒥᒃ ᐅᑭᐅᖏᑦᓂ 2 (C.F.).

[5] **ᔨᐱᓪᓕᐊᓂᐦ:** ᖃᓄᐃᓕᓂᒃ ᓇᓕᐅᔪᓂᑎᕆᖅᑐᑦᓴᓐᓇᐅᑦ (C.F.). ᐃᒪᒋᑕᐅᑕᓂᓚᕐᓴᒃᑯᑦ ᐅᑯᓂᖏᓐ ᐊᓪᓚᓯᒪᓴᖏᖅᑐᐃᓪᓗᑦ ᖃᓄᐃᑦ ᐊᓪᓚᖏᓐᓇᐃᑦ ᐅᐱᓴᖅᑕᐅᓂᖏᖅᓯᒪᓕᒃ (ᖃᐅᔨᓴᒪᓂᑦ ᐃᒪᒋᑕᐅᑕᓂᓚᕐᓴᒃᑯᑦ ᓇᓴᐃᑎᓂᒃ ᒪᓕᒪᒪᑕ ᑭᓇᐅᔭᖅᑐᐃᓐᓇᕐᓂᑕᒥᑦ ᐅᑭᐅᖏᓐᓄᑦ, ᐅᒪᓴᖅᑕᐅᓵᕐᓂᓪᓕᓐ ᐊᓪᓚᓯᓂᖏᓐ ᒪᓕᓐᓄᖏᓐᓇᖅᑐᒃᑯᐃᓐ ᔪᓄᑦ ᒪᐃᔪᑦ) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
0	0	1	0	0

[6] **ᖃᓪᓚᕆᐃᐦ:** ᖃᓄᐃᓕᓂᒃ ᒥᖏᐅᓯᒪᓂᐊᓕᖅᑐᑦᓴᓐᓇᐅᑦ. ᖃᓪᓚᕆᖅᑕᒥᓂᑦ 104ᖏᔪᐊᑦ ᓯᓚᓇᓯᓚᐅᔨᖅᑐᒃ ᖃᓪᓚᕆᖃᓄᖅᓴᐅᓕᕐᓂᖏᓐᓇᓂᑦ ᓄᓇᓕᑦ ᖃᓄᐸᖏᓐᓇᓂ ᐊᖏᖅᔪᒥ ᑕᐃᑲᓂ (ᐅᑭᐅᖏᓐᓂᓂ 4) (C.F.). 1999 ᓯᕐᓂᐊᓂ ᑯᑕᖃᓕᕐᓴᓯᓚᑦᓴᐊᖅᑐᒃ 35ᓂᒃ ᖃᓪᓚᕆᖏᓴᒃ ᐊᖏᖅᔪᒧᑦᑕ ᑕᐃᒋᓯᒪᓂ ᐃᖃᓗᓂ ᐃᓚᐅᑎᑎᕐᓂᒪᑕ ᐅᑭᐅᓂᓂ ᐱᖓᓱᓯᓂ ᐅᑕᖅᑭᐅᑎᓂᐅᓴᖅᑐᒃ ᖃᓪᓚᓂᓚᓂᕐᒥᒃ ᓄᓇᓕᑦ ᐊᐅᓚᓯᓯᐊᓕᖅᑐᓂᑐᒃ ᑯᑕᖃᓚᐅᔪᓂᓕᕆᓂᖅ. ᐃᒪᒋᑕᐅᑕᓂᓚᕐᓴᒃᑯᓐᓂᑦ ᐅᑯᐊ ᑎᑎᖅᑕᐅᓯᒪᓂᑦ ᐃᓚᐅᑎᑦ ᖃᓪᓚᕆᖅᑕᐅᓯᖅᑐᓂᑐᒃ (ᖃᐅᔨᓴᒪᓂᑦ ᐃᒪᒋᑕᐅᑕᓂᓚᕐᓴᒃᑯᑦ ᐃᓚᐅᑎᑦ ᒪᓕᒪᒪᑕ ᑭᓇᐅᔭᖅᑐᐃᓐᓇᕐᓂᑕᒥᑦ ᐅᑭᐅᖏᓐᓄᑦ, ᐅᒪᓴᖅᑕᐅᓵᕐᓂᓪᓕᓐ ᐊᓪᓚᓯᓂᖏᓐ ᒪᓕᓐᓄᖏᓐᓇᖅᑐᒃᑯᐃᓐ ᔪᓄᑦ ᒪᐃᔪᑦ) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
35	23	17	70	22

[7] **ᓂᓪᓕ:** ᖃᓄᐃᓕᓂᒃ ᓇᓕᒧᑦᑎᐊᕆᖅᑐᑦᓴᓐᓇᐅᑦ. ᑐᓴᐃᒪᓕᕐᓂᑕᒥᑦ ᐊᐱᔨᑦᓴᓐᓇᐅᑦ ᐊᐃᒪᓗ ᖃᓄᐃᓕᓂᒃ ᑲᑕᔨᓯᒪᓕᖅᓯᒪᔪᓐᓇᖅᑐᒃ ᓄᓇᓕᑦ ᖃᓄᐸᖏᓐᓇᓂ (C.F.).

[8] **ᑲᖏᔪᑦ ᒪᓂᓂᒋᑦ:** ᖃᓄᐃᓕᓂᒃ ᐊᑎᑐᓕᖅᑐᑦᓴᓐᓇᐅᑦ (C.F.).

[9] **ᒥᑎᑦ ᒪᓂᓂᒋᑦ:** ᖃᓄᐃᓕᓂᒃ ᒥᖏᐅᓯᒪᓂᐊᓕᖅᑐᑦᓴᓐᓇᐅᑦ. ᒪᓂᑕᖅᑕᐅᓵᕐᓂᓂᒋᑦ ᒪᓕᓪᓗᐊᑐᐃᓐᓇᕐᓂᖅ ᓯᓚᑦ ᐊᐃᒪᓗ ᑐᓴᐃᓐᓇᓕᖅᑐᒃᑯᐃᓐᓇᕐᓂᑕᒧᑦ ᐊᐱᖏᓐᓇᐃᑦ ᒪᓂᑕᖏᓐᓇᐃᓐᓇᕐᓂᑕ. ᐅᓂᓂᖅᓴᐃᑦ ᐱᖃᓐᓇᐅᑎᓂᓕᕆᓂᖅ ᐅᑭᐅᓂᓂ ᓇᓗᓇᓯᓄᑦᓯᖅᑐᒃᑯᐃᓐ ᐅᓪᓚᓯᖅᑐᒃᑯᐃᓐᓇᕐᓂᑕᒧᑦ ᐅᒥᐊᖅᑐᒃᑯᐃᓐᓇᕐᓂᑕᒥᑦ ᐅᑭᐅᓂᓂ ᐱᖓᓱᓯᓂ (C.F.).

[10] **ᐃᖅᓚᐃᑦ:** ᑲᑎᑐᑎᑦ ᐃᖅᓚᑦᑕᐅᔪᒥᑦ ᒥᖏᐅᖅᑎᐊᕆᖅᑐᑦᓴᓐᓇᐅᑦ (C.F). ᐊᑕᐅᓯᖏᑦ ᐅᖅᑲᓯᐅᔪᖅᓴᓚᐅᑦᓴᖅ ᓂᐅᐃᐊᑦᓴᓚᐊᒥᓂᑦ ᖃᐅᔨᓴᓂᖅᓴᖅᑎᑦᓗᔪᑉ; ᐊᑦᓚᑕᐅᓯᒪᔪᓂ ᐱᖅᑕᐅᓚᐅᑦᓴᖅ ᑕᐃᓕᐅᔪᖅᓯᒥᓂᒥᑦ ᓄᓇᖅᑲᒥ 4.

[11] **ᑲᓇᔪᐃᑦ:** ᑲᓇᔪᐃᑦ ᐱᓕᐅᖏᓐᓇᔪᑦᑐᑦ ᐊᖏᖅᔪᒥᑦ; ᓇᓗᓇᕐᓂᖅᓴᖅ ᐱᔪᖅᓴᑦᑐᒥᐅᓂᖅᓴᓂᒃ ᐅᑭᐅᖏᓐᓄᑦ 3 ᑭᓯᐊᓂ ᐅᖅᑲᓕᓯᔪᖅᓴᖅᑎᒪᓕᒃ (C.F.).

[12] **ᐊᓱᒍᒪᔪᐃᑦ:** ᖃᓄᐃᓕᓂᒃ ᒥᖏᐅᖅᑎᐊᕆᖅᑐᑦᓴᓐᓇᐅᑦ. ᓯᓚ ᐊᑐᐃᓂᖅᓴᖅᑎᑦᓗᒪᓕᒃ ᐊᓱᒍᒪᔪᖅᓴᖅᑕᐅᔪᑦᑐᑦᓴᓐᓇᐅᑦ; ᐊᖏᖅᔪᒧᑦ ᐃᓚᐅᑦ ᓯᓚᓂᓪᓗᐊᑦᑐᐃᓐᓇᕐᓂᑕᒧᑦ ᖃᓄᐃᑦᓇᐅᓂᖅᓴᐃᓐᓇᕐᓂᑕᒥᑦ ᐊᓱᒍᒪᔪᖅᓴᖅᑕᐅᔪᑦᑐᑦᓴᓐᓇᐅᑦ (C.F.).

6.1.7 Nunani Iniktikhimayut Ukauhiit: Iqaluit

Katitikhimayut katitilikhimayuugaluit amigaivyaktuni nunani Julymi 1996, Iqaluni kinguvakhimayut ayokhakatagamik nunani havaktikhanik ovalo titigagutainik umayukhiuktinik. Katitikhimayut Augustmi 1997 naamagiyaungitut ovalo atuktaungitut. Aprilmi 2001, titigak, titigakhimayuk Nunavumi Iniktiligiyit Katimayigalaanut ovalo aatjikutaanik tunihimayut RWOkunut ovalo HTOkunut tuhaktitivlugit pihimaitut katitikhimayut. Titigak takupkaihimayut NWMBkut atuniaktait ayokhagutiminik, pilutik atugutikhainik katitihimayut katitigutit naunaiyagiami pihimaitut tatkikhiutit. Nunaumi Iniktiligiyit Katimayigalaat angikhimayut NWMBkut atuniaktainik ihumagiyainik Junemi 2001. Taimaimat katitikangituk takuyakhanik ukiumi 1mi Iqaluni. Naunaiyagiami tamaat ukiumi umayukhimayut ukiumi 2mi, naunaiyakhimayut Junemi ovalo Julymi 1997 pihimayut naunaiyautait anginikhait umayukhimayut aatjikutaani tatkikhiutit pingahuni ukiuni katitigutit katitikhimayut.

Ihivgiugutit atugutait:
Nutaat akhuugutiginiaktut Umayukhiukhimayut Ihivguktitlugit Iqaluni. Angiyuk ovalo aalanguiginaktuk inugiagitait hamna nunami, Nunavumi hivuliuyuk, ayonainaktuk titigalugit ovalo nalvaalugit umayukhiuktit iluani nunami. Aatjikutainut ihumagiyait ayokhakhimayut pihimalugit nunani havaktiit Iqaluni. Ihivgiufaagutit ataani naunaiyakhimayut nunani ukakatigivlugit takuhimayut 114nik umayukhiutikaktut titigakhimaitut Umayukhiukhimayut Ihivgiuktuni. 64kuyut tahapkoa Inuinauyut – 51kuyut ilaani umayukhiukpaktut, 12kuyut umayukhiukataktut ovalo atauhik umayukhiunginaktuk. Pikaktutlu 50nik inuinaungitunik umayukhiuktinik tuniyauhimayut umayukhiuktinik inminiigutinik titigaktauhimaitut – 48nik ilaani umayukhiukpaktut ovalo malguk umayukhiuktaktut. Ukakhimayut ilangani 5.2.1 ikpinagutait hamna ataani naunaiyakhimayut pilaaktuk ataanut ihumagiyainik umayukhiukhimayut naunaiyautaini. Pihimanmat hapkoa titigaktauhimaitut umayukhiuktit 17%kuyut tamaat umayukhiuktinit (ikpatauyak 10) ikpinagutait ihimagiyait umayukhiukhimayut naunaiyautaini anginiaktuk. Umayukhiukhimayut naunaiyautait titigakhimaitut umayukhiuktit naunaiyalaaktut atulutik anginikhaanik umayukhimayut amigaitjutaini tamamik umayut aviktukhimayunik. Kihimi hapkoa naunaiyautait pihimalutik inminik ihuinaalaaktunik ovalo ihumagiyainik avataaniitut iniktihimayuni tuhaktakhami. Taiguaktut apigilaat NWMBkunit pilugit iniktigutait hapkoa naunaiyakhimayut.

Ihivgiukhimayut pihimayut ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait ukiuni 2mi ovalo 3mi nakuutiaktut amigaivyaktuni tatkikhiutini; kihimi naunaiyautait katalikhimayut iniktiguaani ukiumi 3mi ovalo mikiyut ukiuni 5mi ovalo 5mi, ataani 75%mik tamamik tatkikhiutini. Takulaaktut ikpatauyami 9mi pikatainaktut kiuyuitut naunaiyautait Iqaluni 1.3%kuyuk ovalo ihumgiyaungituk pilaaktuni pihimayuni kiuyuituni ihimagiyaini.

Kiuhimayut naunaiyautait ihumagiyauyut angiyut ovalo kiuyuitut ihimagiyait mikiyut ukiuni 2mi ovalo 3mi piyaami nni pihimayut nakuuyumik ilaukataauyut uktugutini Nni umayukhiuktini. Mamiani kataliktuni kiuhimayut naunaiyautait ukalaitut aipait ukiut ihivgiuhimayuni. Taiguaktut piyukhat atuligumik katitikhimayut katitigutait ukiuni 4mi ovalo 5mi ihivgiukhimayuni pilaamata tamamik uktukhimayut ihuinaagutait ovalo kiuyuitut ihimagiyait kiuhimayut naunaiyautait katakpata.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Ayokhagutait pihimayut mikhaanut nunani havaktit iniktigutaini malguni ukiuni ihivgiukhimayut umayukhiuktit ukakatigihimayut amigaituni tatkikhiutini ilaani ukiumut umayukhiuktaakhimatitlugit. Hamna pipkakpaktait amigaitut umayukhiuktit naunaiyaklutik umayukhimayait titigakhimaitkumik katitikhimayait amigaitut pilikpaktait. Takuyauhimayut utiktihimayuni ubluit ikpatauyaini, ungahiktut utiktihimayut ubluit takuyauhimayut amigaituni tatkikhiutini hivulimi ukiuni ihivgiuktuni pivaktut aatjikutainik pihimayainik ihuinaakhimayut.

Nunanit ukakhimayut ovalo aalat pihimayaini katitikhimayuni:

1 **Tuktut:** Tuktut umayukhiukhimayut nunani tuktuit. Tuktut kitkaniitut pihimayut nunanit nikikhat, naunaiyautait mikiyut. Tukut pihugutait atukpaktait ikpinagilaaktait umayukhiukhimayut amigaitjutaitlu; ilangit ukiut ikitut kaniani nunat ovalo ikituuniaktut umayukhimaniaktut tahapkonani ukiuni (C.F.).

2 **Nanuit:** Amigaitjutait takuhimayut naunaiyautaungitut kihimi pihimayut umayukhimayut amigaitjutait tunihimayut DSDkunit (DSD PB).

3 **Amagut:** Umayukhiuktit autlaakpaktut Natsulukmut tahianut ikalukhiugiahutik voalo umayukhiuniaktut amagunik tahamani. Naunaiyauttit naamaktut. Amagut amigaitjutait angililiktut ihivgiukhimatitlugu ovalo umayukhimayut amigaitjutait angililikhunakhiyut ihivgiuktut inikhimatitlugit (C.F.).

4 **Ukyuit:** Naunaiyautait angiyut, ilaa ukiumi 2mi (C.F.).

5 **Tuugaat:** Naunaiyautait naamaktut (C.F.). DFOkut tuhaktitivaktut hapkoa umayukhiukhimayut amigaitjutait tugaaliit kilalugait (nalungilutit DFOkut katitikhimayait atukpaktut atuktaini ukiungit, Umayukhiukhimayut Ihivgiugutait pihimayut umayukhiukhimayut katitikhimayait piplutik umayukhiukhimayut ukiungit Junemit Maymut) (DSD N/B):

96/97	97/98	98/99	99/00	00/01
0	0	1	0	0

6 **Kilalugait:** Naunaiyautait naamaktut. Naunaiyautit 104nik ihumagiyauyut naamaktut amigaitpamata umayut haniani nunat ukiungani (ukiumi 4mi) (C.F.). Pitinagu 1999mi kotangit 35kuyut kilalugait ukiuk tamaat pihimaliktinagit Iqaluit ilaulikhimayut pingahuni ukiuni uktugutinik nunani mikhaanut munagitjutit atugutikhaini ovalo tuniyauhuikhimayut ilihimayunik kotanik. DFOkut tuhaktitihimayut hapkonani umayukhimayut amigaitjutait kilaluganik (nalungilugit DFOkut katitikhimayait pihimayut atuktaini ukiuni, Umayukhiukhimayut Ihivgiugutait katitikhimayut pihimayut umayukhiukhimayut ukiunganik Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
35	23	17	70	22

7 **Uluaguliit:** Naunaiyautait naamaktut. Nuutitigutait malikpaktait aalanguliktut ovalo amigaitjutait mikhiliktut haniani nunat (C.F.).

8 **Uluaguliit maniit:** Naunaiyautait mikiyut (C.F.).

9 **Tinmiat maniit:** Naunaiyautait naamaktut. Umayukhiukhimayut pivaktut hila nakuukpat ovalo hikut ahiguktinga kinguvakat ayonaniaktuk autlaagiami nunainut maniit nalvaakhimavaktainut. Angitkiyait katitigutait maninik ukiungit hikut ahiguktihainagaagat ovalo kayatulaagaagat nalvaakhiukvinmut katitigiagani nunaini (C.F.).

10 **Ikaliviit:** Tamaita ikaliviit umayukhiukhimayut naunaiyautait naamaktut (C.F.). Atauhik umayukhiukhimayuk tuhaktitihimayuk niuviktihimayuk kinauyaliukhimapluni Umayukhiukhimayut Ihivgiuktitlugit; unguvakhimayuk katitikhimayunit ovalo takulaaktuk ikpatauyami 4mi.

11 **Kanayuit:** Kanayuit umayikhiukhimayut tamaat ukiuni; piyunakhihimayut ukiumi 3mi kihimi tuhaktitihimaituk (C.F.).

12 **Uviluit:** Kitkaniitut naamaktut. Hila ikpinagilaaktait umayukhiugutait uviluit; ilaani hila nakuungitkaagat mikhivaktut umayukhiukhimayait (C.F.).

TABLE/ᐅᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 171

Monthly harvest estimates

ᑕᖅᑕᒫᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ

Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)

ᐊᒻᒋᔪ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᔨᓗ	NOV ᐅᓇᓱᓗ	DEC ᑎᓯᓱᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᓯ	APR ᐃᑦᓇᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᑦ	Tuktut	26	12	17	70	15	4	14	50	28	52	23	21	332 ± 25
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					1	1		1[illegible]2					
Wolf	ᐊᒪᓗᐃᑦ	Amagut									1		3		4 ± 1
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat					10	14	14	4	2	1	5		50 ± 7
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓕᓴᖅᓂᐊᑦ	Kalaliit tigiganiat					10	3	3	2	3				21 ± 5
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				2	3	1				2	2		10 ± 2
Ringed seal	ᓇᓯᓪᓚᑦ	Natiinat	99	63	106	176	77	113	46	25	38	43	34	85	905 ± 54
Bearded seal	ᐅᑉᔪᐃᑦ	Ukyuk	5	7	7		2	12		2		6	1	1	43 ± 6
Harp seal	ᖃᐃᓗᓪᓚᑦ	Qairulik			2	9	17	21		1		1			51 ± 12
Walrus	ᐊᐃᓴᒃᑦ	Akvik			1			1				3			5 ± 2
Beluga	ᖃᐅᖅᑕᑦ ᖃᓪᓗᓂᑦ	Kilalugak	5				2	1							8 ± 4
Snow goose	ᑲᖕᒪᐃᑦ	Kanguq	100											2	102 ± 17
Canada goose	ᓄᖅᓪᓕ ᐅᓗᐊᒍᓪᓚᑦ	Nikliknik	77										15	144	236 ± 19
Pintail	ᖁᓕᒪᐊᓱᒋᑦ	Arnaviaq		1	1										2 ± 1
Eider duck	ᑎᑎᑦ	Kingalik	132	36		46	126	85				8		4	437 ± 49
Common loon	ᑐᓪᓕᖅᓴᐊᑦ	Tuulik		2	1										3 ± 2
Black guillemot	ᐱᖅᐅᓪᓚᑦ	Black guillemot				7									7 ± 6
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre	43	24	1	19	3								90 ± 36
Ptarmigan	ᐊᖏᓴᑦ	Akilgik				2	26	484	248	246	221	45	90	80	1,442 ± 88
Duck eggs	ᑎᑎᑦ ᒪᓂᓐᖏᑦ	Tinmiat manniit	103												103 ± 131
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	197	570	396	167	514	343	28	1,095	70	61	411	1,204	5,056 ± 383
Inconnu	ᐅᐱᓯᓕᖅᐸᑦ	Aanakhiik							4		12				16 ± 8
Cod	ᐅᒪᐃᑦ	Ugak		24	219	228	47	302	365	43		20	9	18	1,275 ± 255
Sculpin	ᐅᓚᔪᐃᑦ	Kanayuk		6		2									8 ± 6
Clams	ᐊᒻᒧᒪᔪᑦ	Uviluq		876	5,660	3,034	1,624	118							11,312 ± 1,728
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet					265								265 ± 119

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᖕᓂᑦ ᑎᑎᕐᑕᐅᒪᔪᓂᑦ ᑐᓂᓴᖅᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓚᖕᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 172

Monthly hunter response

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᒻᒪᓕᒐ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔮᓂ	JUL ᔮᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑲᐅᓗ	NOV ᐅᐊᒻᐹᓗ	DEC ᑎᓯᒻᐹᓗ	JAN ᔨᓐᓄᐊᓗ	FEB ᓇᖅᐳᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓇᓱᒋᑦ	Tatkitaman angunahuktut titigait	66	67	66	67	69	79	84	84	85	84	93	93	96*
Hunters interviewed	ᐊᖏᔪᓇᓱᒋᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	57	57	59	57	60	75	79	79	81	82	92	91	96*
Harvested	ᐊᖏᔪᓇᓱᒍᒥᓂᓕ	Angujaujut	34	17	23	36	41	48	27	32	28	36	33	59	81*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑦᐅᓂᖏᑦ (%)	Kiujut (%)	86	85	89	85	87	95	94	94	95	98	99	98	92**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᒋᑦ ᐊᑎᓕᐅᑦᑕᒪᒪᓕᕆᔨᒃᑯᑦ/ᐊᐱᕐᓂᑦᑕᑦ/ᐊᖏᔪᓇᓱᒍᒥᓂᓕ ᐊᑕᐅᓂᐊᖑᓪᓚᑐᑎᒃ ᐊᒻᒪᓗᒥ.
** ᐊᐅᔨᓴᓕᕐᓂᓕᕆᔨ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.1.8

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 173

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᕆᔨᑦ ᐊᒋᕐᖏᓂ ᐊᖏᔪᓇᓴᓂᖏᓐᖓᑕ ᐊᓚᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᖓᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐᵇ % ᑲᑎᒪᔨᑦ ᐊᖏᔪᓇᓱᑕᑦ ᑎᑎᕐᕕᑕᐅᒪᕆᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᒻᒪᓕᒐ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔮᓂ	JUL ᔮᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑲᐅᓗ	NOV ᐅᐊᒻᐹᓗ	DEC ᑎᓯᒻᐹᓗ	JAN ᔨᓐᓄᐊᓗ	FEB ᓇᖅᐳᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᕆᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑲᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑲᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔾᐅᐅᑦ/NAUNAIKUTA 174

Number of hunters harvesting each species — **Year 1 (June 1996 - May 1997)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓚᓴᒋᑎᑦ ᐊᖓᔪᓚᓴᒃᑲᓕᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖏᓂᒃ — **ᐊᒃᑭᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 1 (June 1996 - May 1997)**

Month/ᑕᖅᖃᓐᓇ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᔅᑎᑎ	SEP ᓯᑎᐱᕆ	OCT ᐅᑲᐱᕆ	NOV ᐅᓇᐱᕆ	DEC ᑎᓯᐱᕆ	JAN ᒎᓐᓄᐊᕆ	FEB ᓇᖕᐅᐊᕆ	MAR ᒪᓯ	APR ᐃᔨᓪᓚ	MAY ᒪᐃ	Total ᑲᑎᑕᑦ Tamakiklugin
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	11	7	6	22	1	2	4	12	9	16	11	11	45
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut									1		2		3
Arctic fox	ᑎᓕᑦᓂᐊᑦ	Tigiganiat					4	5	4	3	2	1	1		11
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓕᑦᓂᐊᑦ	Kalaliit tigiganiat					5	2	3	2	2				12
Arctic hare	ᐅᒃᓪᓕ	Ukalik				2	2	1				2	2		7
Ringed seal	ᓇᕆᑦ	Natiinat	19	16	17	31	26	27	12	11	11	17	16	32	62
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	3	5	5		2	6		2		4	1	1	19
Harp seal	ᖃᐃᓗᓪᓕᑦ	Qairulik			1	6	10	4		1		1			16
Walrus	ᐊᐃᐃᒃᑦ	Akvik			1			1				2			3
Beluga	ᖃᓄᖅᑕ ᖁᓕᓗᒡᑦ	Kilalugak	3				1	1							4
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	14											2	16
Canada goose	ᓂᖅᓪᓕ ᐅᓗᐊᔪᓪᓕᑦ	Nikliknik	15										5	39	47
Pintail	ᖃᓚᒧᐊᓪᒡᑦ	Arnaviaq		1	1										1
Eider duck	ᒥᑎᑦ	Kingalik	12	6		15	16	8				1		1	34
Common loon	ᑐᓪᓕᖅᔪᐊᑦ	Tuulik		1	1										1
Black guillemot	ᐱᖅᐅᓪᓪᑦ	Black guillemot				2									2
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre	3	2	1	5	3								12
Ptarmigan	ᐊᖏᓚᑦ	Akilgik				1	7	29	11	14	18	9	14	8	52
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᖅᑦ	Tinmiat manniit	1												1
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	10	10	8	5	7	10	1	4	2	2	7	35	51
Inconnu	ᐅᐱᓯᓪᓕᖅᑦ	Aanakhiik							1		1				1
Cod	ᐅᓚᐃᑦ	Ugak		1	1	1	2	5	8	3		1	1	1	15
Sculpin	ᐅᓇᔪᐃᑦ	Kanayuk		1		1									2
Clams	ᐊᒃᒪᒻᒪᔪᑦ	Uviluq		6	11	13	10	1							25
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet					1								1

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕆᓯᒪᔪᓂᒃ ᐱᕈᖅᓂᕆᔨᖅ ᐱᕐᔪᑎᓂᓂᒃ ᐊᖏᔪᑦ ᖃᕆᑲᓂᖅᓂᓄᑦ ᐊᓪᓚᔨᓂᑦ ᐊᓪᓚᔨᑦ ᓇᓪᓕᐅᓂᑦ ᐃᓄᐃᕆᓂᓂᒃ ᐃᓄᐃᕆᓂᓂᒃ ᐃᓄᐃᕆᓂᓂᒃ

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 175

Monthly harvest estimates
ᑕᕈᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᒃᓴᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᕈᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᑦᐱᓇ	OCT ᐅᑦᔪᐱᓇ	NOV ᐅᓇᒃᐱᓇ	DEC ᑎᓯᒃᐱᓇ	JAN ᔮᖏᓇᐊᓇ	FEB ᓇᖅᑐᐊᓇ	MAR ᒪᑦᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓕᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓴᑦ	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	20	45	60	30	25	29	43	27	17	23	20	2	341 ± 27
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡							13	10					
Wolf	ᐊᒪᓗᐃᑦ	Amagut								1					1 ± 0
Arctic fox	ᑎᓚᓱᓐᓂᐊᑦ	Tigiganiat					3	3	19	8	3		1		37 ± 2
Coloured fox	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓚᓱᓐᓂᐊᑦ	Kalaliit tigiganiat					2	3			1				6 ± 0
Arctic hare	ᐅᒃᓪᓗᑦ	Ukalik				9	8	4	4	11	13	10	22		81 ± 5
Ringed seal	ᓇᕆᑦ	Natiinat	96	65	163	117	126	111	59	33	47	27	34	69	947 ± 49
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	8	7	10	5	2	1		2	3		1	1	40 ± 8
Harp seal	ᖃᐃᓴᓪᓗᑦ	Qairulik	2		2	17	14	3							38 ± 3
Harbour seal	ᖃᓕᑕᐊᑦ	Qanigiaq						1							1 ± 0
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit						1							1 ± 0
Walrus	ᐊᐃᓵᒋᑦ	Akvik				1						1			2 ± 1
Beluga	ᖃᐅᑦᑕ ᖁᓪᓗᒍᑦ	Kilalugak	1	2			2							1	6 ± 2
Snow goose	ᑲᖏᐃᑦ	Kanguq				2								5	7 ± 1
Canada goose	ᓂᑦᓪᓕ ᐅᓪᐊᒍᓪᓕ	Nikliknik	19			2								141	162 ± 7
Eider duck	ᒥᑎᑦ	Kingalik	116	44	7	28	50	22						26	293 ± 46
Black guillemot	ᐱᕕᐅᓪᓕᑦ	Black guillemot				1						6			7 ± 0
Thick-billed murre	ᐊᐸᐊᐃᑦ	Thick-billed murre	91	4	15		5	2						5	122 ± 16
Ptarmigan	ᐊᖏᓕᑦ	Akilgik				3	71	275	421	353	478	82	1,569	308	3,560 ± 124
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᑦ	Tinmiat manniit	501	5											506 ± 6
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓂᓂᑦ	Nauyat manniit	72												72 ± 0
Eider down∅	ᒥᑎᑦ ᖃᓄᖅᓂᑦ∅	Mitiit qiviungit∅	2												2 ± 0
Arctic char	ᐃᖃᓗᓴᐃᑦ	Ikaliviit	508	439	1,080	153	93	356	4	417	117	46	537	871	4,621 ± 802
Inconnu	ᐊᕕᓂᓕᐸᑦ	Aanakhiik	1												1 ± 0
Cod	ᐅᓚᐃᑦ	Ugak	3				12	138	61	58		51	11	43	377 ± 23
Sculpin	ᓴᓇᔪᐃᑦ	Kanayuk									10				10 ± 0
Clams	ᐋᒻᒧᒪᔪᑦ	Uviluq	982	828	3,365		241								5,416 ± 1,661

‡ Polar bear data supplied by DSD.
∅ Number of nests harvested.

‡ ᓇᓂᓄᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᓴᖏᑦ ᐅᓂᒃᑳᑦ ᐃᓄᐊᕐᓇᓕᓪᓚᕆᑦ.
∅ ᖃᕋᐅᓂᖏᑦ ᐱᑭᐅᑦ ᓄᐊᑕᐅᔪᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.
∅ Amigaitiginit maniktagauhimajut.

6.1.8

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 176

Monthly hunter response
ᑕᕿᑕᒻᒪᑦ ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᒃᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᕿᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑯᐊᓇ	NOV ᐅᐸᒃᓇ	DEC ᑎᓯᒃᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᐃᕙᐅᐊᓇ	MAR ᒪᕐᕿ	APR ᐃᖅᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᐅᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ ᐋᑦᔨᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᕿᑕᒻᒪᑦ ᐊᖏᔪᓂᕆᑦ	Tatkitaman angunahuktut titigait	93	93	90	90	91	92	92	90	91	92	95	95	99*
Hunters interviewed	ᐊᖏᔪᓂᕆᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	93	47	40	90	88	91	92	87	89	89	90	92	97*
Harvested	ᐊᖏᔪᓂᕆᑐᒃᓯᒪᓂᑦ	Angujaujut	43	27	33	47	43	43	41	43	40	26	45	45	74*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᑦᔨᐅᓂᖏᑦ (%)	Kiujut (%)	100	51	44	100	97	99	100	97	98	97	95	97	89**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᕆᑦ ᐊᑎᓕᐅᑦᑕᐅᒪᓕᕆᓂᖅ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᕆᑐᒃᓯᒪᓂᑦ ᐊᑕᐅᔨᐊᖏᓗᐊᑎᑐᑦ ᐊᓕᕐᒧ.
** ᐊᐅᔨᓕᓐᓂᔨᒪᓕᕆᔨᑦ ᑕᕿᑕᒻᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 177

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᐃᐅᔾᔨᑦ ᐊᑯᖏᓐᓄᓕᒃ ᐊᖏᔪᓂᕆᓚᓐᓄᓕᒃ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓕᒃ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑕᐅᑦ ᐊᖏᔪᓂᕆᒃᑕᑦ ᑎᑎᕐᑦᑕᐅᒪᔨᑦ

Year 2 (June 1997 - May 1998)
ᐊᒃᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᕿᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑯᐊᓇ	NOV ᐅᐸᒃᓇ	DEC ᑎᓯᒃᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᐃᕙᐅᐊᓇ	MAR ᒪᕐᕿ	APR ᐃᖅᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᐅᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᐃᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕿᑦ	≤ tatkin pingahut	100	100	100	95	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᕿᑦ	tatkin hitaman 6nut	0	0	0	5	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᕿᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔾᐅᐅᑦ/NAUNAIKUTA 178

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓚᐱᐅᒋᐊᑦ ᐊᖓᔪᓚᐱᐅᔨᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔪᐸᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 2 (June 1997 - May 1998)
ᐊᒃᑭᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᕐᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᔨᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᔨᓗ	NOV ᐅᓇᓱᐱᓗ	DEC ᑎᓯᓱᐱᓗ	JAN ᒍᓐᓇᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᔭᑐᐃᐃᑦ	Tuktut	8	17	14	18	11	15	17	15	13	6	9	2	50
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut								1					1
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat					2	2	6	6	3		1		14
Coloured fox	ᖃᐅᖅᖏᑦᑐᑦ ᑎᓕᓴᖅᓂᐊᑦ	Kalaliit tigiganiat					1	1			1				3
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				6	3	3	3	8	7	4	6		28
Ringed seal	ᓇᓂᓪᓚᑦ	Natiinat	33	17	27	38	32	35	14	15	15	11	15	26	64
Bearded seal	ᐅᓴᐊᐃᑦ	Ukyuk	7	3	6	4	1	1		2	3		1	1	17
Harp seal	ᖃᐃᕐᓂᑦ	Qairulik	2		1	5	5	3							9
Harbour seal	ᖃᓂᒋᐊᑦ	Qanigiaq						1							1
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit						1							1
Walrus	ᐊᐃᓴᓴᑦ	Akvik				1						1			2
Beluga	ᖃᑯᑦᑕ ᖁᓪᓗᓴᑦ	Kilalugak	1	1			2							1	4
Snow goose	ᑲᖓᐃᐃᑦ	Kanguq				1								4	5
Canada goose	ᓂᑦᓱᓪᑦ ᐅᓗᐊᔪᓱᓪᑦ	Nikliknik	7			1								35	37
Eider duck	ᒥᑎᑦ	Kingalik	19	5	1	7	9	8						6	34
Black guillemot	ᐱᕐᓂᐅᓪᓚᑦ	Black guillemot				1						1			2
Thick-billed murre	ᐊᐸᐸᐃᑦ	Thick-billed murre	12	1	2		5	2						2	21
Ptarmigan	ᐊᖏᓚᑦ	Akilgik				1	7	18	28	29	26	11	40	16	55
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᑦ	Tinmiat manniit	5	1											6
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓂᓂᑦ	Nauyat manniit	4												4
Eider down	ᒥᑎᑦ ᖃᓄᖅᓂᑦ	Mitiit qiviungit	1												1
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	7	9	11	3	3	5	1	6	3	3	13	16	32
Inconnu	ᐊᐱᓪᓚᐸᑦ	Aanakhiik	1												1
Cod	ᐅᓴᐃᑦ	Ugak	1				1	3	4	3		2	1	3	10
Sculpin	ᑲᓇᓴᐃᑦ	Kanayuk									1				1
Clams	ᐊᓕᒍᒪᓴᑦ	Uviluq	6	4	9		3								20

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᒪᔪᓄᒃ ᐱᑕᖃᖏᑦᑐᒃ ᐱᒃᔪᑎᓕᓐᓄᒃ ᐊᖓᔪᒃ ᖃᕋᐅᓂᖏᓐᓄᑦ ᐊᓕᓴᐅᒪᔪᓄᑦ ᐊᖓᔪᓄᑦ ᓇᓕᐅᕙᓪᓕᐊᓂᒃ ᑐᓂᓴᖏᓐᓄᑦ ᐃᑯᐱᕐᓗᓂᒃᓴᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 179

Monthly harvest estimates
ᑕᖅᑕᒫᒃ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓕᕆᑦ
Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᒻᒪᒋᔭᒃ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᐱᓗ	NOV ᐅᓇᒻᐱᓗ	DEC ᑎᓯᒻᐱᓗ	JAN ᔮᖏᓂᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin ± 95% CI
Species	**ᐅᒪᔨᑦ**	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	12	18	39	46	10	26	89	46	31	13	9	7	346 ± 6
Polar bear‡	ᓄᓂᐃᑦ‡	Nanuit‡					2	1		21					
Wolf	ᐊᒪᓗᐃᑦ	Amagut											4	1	5 ± 0
Arctic fox	ᑎᓚᖓᓂᐊᑦ	Tigiganiat								2	1	4			7 ± 0
Coloured fox	ᖃᐅᖏᑦᑐᑦ ᑎᓚᖓᓂᐊᑦ	Kalaliit tigiganiat								2					2 ± 0
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik				24		8	1	5	1	8	2	1	50 ± 1
Ringed seal	ᓄᕆᓪᓕ	Natiinat	166	124	268	194	165	91	77	24	23	24	38	64	1,258 ± 9
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk	12	5	6	3	3	3		5		1	1	2	41 ± 2
Harp seal	ᖃᐃᓕᓪᓕᑦ	Qairulik		3	9	7	4	4		1					28 ± 0
Harbour seal	ᖃᓯᕈᐊᑦ	Qanigiaq			1	1									2 ± 0
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit		1	1										2 ± 0
Walrus	ᐊᐃᐅᓴᑦ	Akvik						2				1	1		4 ± 0
Beluga	ᖃᐅᕆᑦ ᖁᓪᓗᓚᑦ	Kilalugak	11	2			8	5						10	36 ± 1
Snow goose	ᑲᖕᒪᐃᑦ	Kanguq												22	22 ± 1
Canada goose	ᓂᕐᓪᓕᑦ ᐅᓪᐊᒧᓪᓪᓕᑦ	Nikliknik	3			7								185	195 ± 8
Old Squaw	ᐊᓕᕈᐊᕐᓴᐃᑦ	Aahangik							1	4					5 ± 2
Eider Duck	ᒥᑎᑦ	Kingalik	204	1		7	66	48						2	328 ± 5
Black guillemot	ᐱᕐᓂᐅᓪᓕᑦ	Black guillemot				11	1	1		6					19 ± 0
Thick-billed murre	ᐊᕐᐸᐃᑦ	Thick-billed murre	58	12								15	5		90 ± 1
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	1			5	15	245	418	270	324	154	226	452	2,110 ± 38
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᓚᓐᓄᑦ	Manniit	207												207 ± 0
Duck eggs	ᒥᑎᑦ ᓚᓐᓄᑦ	Tinmiat manniit	347												347 ± 5
Arctic char	ᐃᖅᑲᓱᐊᑦ	Ikaliviit	211	462	330	30	186	543	162	486	120	323	703	394	3,950 ± 65
Cod	ᐅᓗᐃᑦ	Ugak					11	202	114	77	5	7			416 ± 40
Sculpin	ᑲᓕᓴᐃᑦ	Kanayuk						48							48 ± 11
Clams	ᐊᓗᒧᒪᓴᑦ	Uviluq	292	2,946	1,103	1,935	317	504	400						7,497 ± 108
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet	54	589	866										1,509 ± 73

‡ Polar bear data supplied by DSD.

‡ ᓄᓂᐃᑦ ᑎᑎᕋᐅᒪᓴᑦ ᑐᓂᖅᖏᑦ ᐅᑉᓄᓴᐃᑦ ᐅᑉᓄᓴᐃᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓚᐅᓂᒃᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 180

Monthly hunter response

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓕᕆᔨᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐱᓕᕆᔨ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔮᓂ	JUL ᔭᒥᐃ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑦᑐᕕᓂ	NOV ᐅᐊᕐᕕᓂ	DEC ᑎᓯᕐᕕᓂ	JAN ᔨᖅᓄᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᑉᓯ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᕆᔨᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓕᕆᔨᑦ	Tatkitaman angunahuktut titigait	95	96	96	95	96	96	96	96	98	98	100	100	102*
Hunters interviewed	ᐊᖏᔪᓕᕆᔨᑦ ᐊᐱᓯᓂᑦ	Angunahuktin apikhuktan	94	95	95	95	94	94	94	94	97	98	100	98	101*
Harvested	ᐊᖏᔪᓕᕆᔨᑐᒋᓐ	Angujaujut	48	46	43	44	44	43	44	35	28	27	41	54	85*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑦᑐᓂᖏᑦ (%)	Kiujut (%)	99	99	99	100	98	98	98	98	99	100	100	98	99**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓕᕆᔨᑦ ᐊᑎᓕᐅᑦᑕᒪᓕᕐᓂᑦ/ᐊᐱᓯᓂᑦ/ᐊᖏᔪᓕᕆᔨᑐᒋᓐᓂᑦ ᐊᑕᐅᓯᐊᖅᓗᓂᑎᒃ ᐊᑲᔪᒥ.
** ᐊᓕᒍᓕᑎᑎᓯᒪᓕᕐᓂᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.1.8

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 181

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕋᐅᔪᑦ ᐊᑯᖏᓐᓂ ᐊᖏᔪᓕᕆᓂᖅᓱᒃᑐᑦ ᐊᒪᓗ ᐊᐱᓯᓂᑦᐅᓂᖅᓱᒃᑐᑦ, ᓇᓗᓇᐃᓕᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓕᕆᔨᑦ ᑎᑎᕋᑦᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐱᓕᕆᔨ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔮᓂ	JUL ᔭᒥᐃ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑦᑐᕕᓂ	NOV ᐅᐊᕐᕕᓂ	DEC ᑎᓯᕐᕕᓂ	JAN ᔨᖅᓄᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᑉᓯ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕋᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑭᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	99	100
4-6 months	4-6 ᑕᖅᑭᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	1	0
> 6 months	> 6 ᑕᖅᑭᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 182

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓚᓴᒋᑦ ᐊᖓᔪᓚᓴᒃᑯᑦᑐᑦ ᐊᑐᓂ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 3 (June 1998 - May 1999)
ᐊᒃᑭᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖃᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᑐᓗ	NOV ᐅᓇᐱᓗ	DEC ᑎᓯᐱᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᓯ	APR ᐃᑦᓀᓪ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	6	11	14	22	6	11	23	12	9	7	6	7	52
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut											3	1	4
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat								1	1	3			3
Coloured fox	ᖃᓄᖕᖏᑦᑐᑦ ᑎᓕᓴᖅᓂᐊᑦ	Kalaliit tigiganiat								2					2
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				10		4	1	3	1	3	1	1	17
Ringed seal	ᓇᕆᔨᑦ	Natiinat	36	35	36	37	36	24	23	10	9	8	16	27	70
Bearded seal	ᐅᓪᓛᐃᑦ	Ukyuk	10	4	5	2	3	2		3		1	1	2	20
Harp seal	ᖃᐃᓗᓪᓚᑦ	Qairulik		3	8	5	3	3		1					13
Harbour seal	ᖃᓕᑭᐊᑦ	Qanigiaq			1	1									2
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit		1	1										1
Walrus	ᐊᐃᐸᓴᑦ	Akvik						1				1	1		3
Beluga	ᖃᑯᖅᑕ ᖁᓪᓗᓴᑦ	Kilalugak	7	2			4	3						5	15
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq												5	5
Canada goose	ᓂᖅᓚᑦ ᐅᓪᓗᐊᔪᓚᑦ	Nikliknik	2			2								25	26
Old Squaw	ᐋᑎᐊᖅᓴᐃᑦ	Aahangik							1	1					2
Eider Duck	ᒥᑎᑦ	Kingalik	26	1		1	9	3						1	34
Black guillemot	ᐱᕈᓕᐅᓪᓚᑦ	Black guillemot				1	1	1		1					4
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre	6	2								2	1		9
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	1			2	4	19	28	20	21	16	24	26	59
Eggs (unspecified)	ᐊᓂᖕᑦ ᑎᑎᒥᐊᑦ ᓚᓐᓄᖕᑦ	Manniit	2												2
Duck eggs	ᒥᑎᑦ ᓚᓐᓄᖕᑦ	Tinmiat manniit	5												5
Arctic char	ᐃᖅᓱᒃᐲᑦ	Ikaliviit	9	14	13	2	5	8	5	8	2	8	19	15	42
Cod	ᐅᓗᐃᑦ	Ugak					1	5	9	3	1	1			15
Sculpin	ᑲᓕᓛᐃᑦ	Kanayuk						3							3
Clams	ᐊᒡᒧᒪᓕᖅᓴ	Uviluq	3	17	9	14	3	5	1						27
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet	1	2	2										4

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓯᒪᓕᓂᒃ ᐱᑕᖃᖕᖏᑐᖃᖅ ᐱᓱᐊᓕᓐᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓕᖁᐅᒪᓕᓂᒃᑯᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᕐᓴᐳᓗᒥᑦ ᑐᓂᓴᖏᓐᓄᑦ ᐃᓕᑎᕐᓴᓕᓕᓵᓂᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 183

Monthly harvest estimates
ᑕᖅᑕᒫᒃ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)
ᐊᓯᖏᔪ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᔪᓗ	NOV ᐅᓇᓵᓗ	DEC ᑎᓯᓵᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᐃᖅᐅᐊᓗ	MAR ᒪᑉᓯ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᔭᑐᐃᑦ	Tuktut	15	15	45	49	10	25	26	43	37	52	26	10	353 ± 24
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡						1	1						
Wolf	ᐊᒪᓗᐃᑦ	Amagut							1	10	2	6			19 ± 5
Arctic fox	ᑎᓕᓴᖏᐊᑦ	Tigiganiat						5	3	5	8	2	1	1	25 ± 6
Coloured fox	ᖃᐅᖏᑦᑐᑦ ᑎᓕᓴᖏᐊᑦ	Kalaliit tigiganiat						11	4	2	2		1		20 ± 8
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	6		2	29	16	9	7	13	11	12			105 ± 13
Ringed seal	ᓇᕆᑦ	Natiinat	109	142	113	102	48	34	25	15	12	20	15	25	660 ± 31
Bearded seal	ᐅᓪᓗᐊᑦ	Ukyuk	2	4	4	7	4	5		1	2	1	1		31 ± 4
Harp seal	ᖃᐃᓕᓪᓚᑦ	Qairulik			3	11	10								24 ± 9
Harbour seal	ᖃᓂᒋᐊᑦ	Qanigiaq		3	6										9 ± 3
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit					1								1 ± 1
Walrus	ᐊᐃᓴᒃᑦ	Akvik										1			1 ± 1
Beluga	ᖃᐅᕆᑦ ᖁᓪᓗᑦ	Kilalugak	3	1	1		9								14 ± 4
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	17		1									1	19 ± 2
Canada goose	ᓄᕆᓪᓚᑦ ᐅᓪᐊᒍᓪᓚᑦ	Nikliknik	87			6	1						13	139	246 ± 27
Eider duck	ᒥᑎᑦ	Kingalik	56			47	72	55							230 ± 49
Black guillemot	ᐱᕐᓂᐅᓪᓚᑦ	Black guillemot				7									7 ± 0
Thick-billed murre	ᐊᐸᐊᐃᑦ	Thick-billed murre	9	6	12	16	17						6		66 ± 17
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	72					114	85	122	116	139	104	49	801 ± 93
Duck eggs	ᒥᑎᑦ ᒪᓐᓄᕐᑦ	Tinmiat manniit	55												55 ± 0
Arctic char	ᐃᖃᓗᓴᑦ	Ikaliviit	890	305	262	77	32	145	435	430	207	220	65	564	3,632 ± 384
Cod	ᐅᓚᐃᑦ	Ugak					46	105		85	73	30	61	21	421 ± 90
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk		10											10 ± 0
Clams	ᐊᑦᒧᒪᐊᑦ	Uviluq	276	649	2,340	1,952	1,273	122							6,612 ± 879

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᐊᑦ ᑐᓂᖅᖏᑦ ᐅᓂᒃᑳᖅᑎᓂᓕᕆᓂᖅᑎᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 184

Monthly hunter response
ᑕᖅᑕᒪᒡᑦ ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᒻᕿᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑦᔪᓗ	NOV ᐅᓇᒻᓗ	DEC ᑎᓯᒻᓗ	JAN ᔮᖏᓇᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ ᐱᒍᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒡᑦ ᐊᖏᔪᓂᕆᑦ	Tatkitaman angunahuktut titigait	101	95	95	95	92	93	93	94	94	93	91	91	104*
Hunters interviewed	ᐊᖏᔪᓂᕆᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	100	93	85	80	75	76	73	87	85	85	82	81	103*
Harvested	ᐊᖏᔪᓂᕆᑐᒃᓗᓂᑦ	Angujaujut	50	41	41	41	17	19	12	24	21	27	23	33	83*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑐᓂᖏᑦ (%)	Kiujut (%)	99	98	89	84	82	82	78	93	90	91	90	89	89**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᕆᑦ ᐊᑎᓕᐅᕐᒪᒪᓪᓚᕆᔨᒃ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᕆᑐᒃᓗᓂᑦ ᐊᒡᒐᓯᐊᖅᓗᐅᑎᒃ ᐊᒻᕿᒍ.
** ᐊᓕᔾᓂᖅᓂᓯᒪᔪᑦ ᑕᖅᑕᒪᒡᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 185

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓐᓄᑦ ᐊᖏᔪᓂᖅᓄᑦ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᑦ, ᓇᓗᓇᐃᖏᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᖅᑕᑦ ᑎᑎᕐᑦᑕᐅᒪᔪᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)
ᐊᒻᕿᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑦᔪᓗ	NOV ᐅᓇᒻᓗ	DEC ᑎᓯᒻᓗ	JAN ᔮᖏᓇᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔪᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑭᑦ	≤ tatkin pingahut	100	100	64	82	49	95	93	73	17	37	54	61	71
4-6 months	4-6 ᑕᖅᑭᑦ	tatkin hitaman 6nut	0	0	21	8	51	5	0	21	51	27	13	0	15
> 6 months	> 6 ᑕᖅᑭᑦ	> 6 tatkin	0	0	15	10	0	0	7	6	32	36	33	39	14

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 186

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓚᐸᑎᑦ ᐊᖓᔪᓚᐸᓕᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 4 (June 1999 - May 2000)
ᐊᒃᑦᒍ 4 (ᔪᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᓚᔨᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᔨᓗ	NOV ᐅᓇᓱᐱᓗ	DEC ᑎᓯᓱᐱᓗ	JAN ᒍᖏᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕆ	APR ᐃᑦᓀᓪ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	8	6	20	20	4	5	6	11	12	13	10	7	42
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut							1	3	2	2			7
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat						2	1	2	2	2	1	1	6
Coloured fox	ᖃᐅᖕᖏᑦᑐᑦ ᑎᓕᓴᖅᓂᐊᑦ	Kalaliit tigiganiat						2	2	2	1		1		5
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	1		1	10	5	5	1	5	5	5			22
Ringed seal	ᓇᓂᓪᑦ	Natiinat	32	34	31	28	13	8	5	5	4	7	5	6	62
Bearded seal	ᐅᓴᓐᔪᐃᑦ	Ukyuk	2	4	4	5	3	3		1	1	1	1		18
Harp seal	ᖃᐃᓕᓪᓚᑦ	Qairulik			3	4	2								8
Harbour seal	ᖃᓂᒋᐊᑦ	Qanigiaq		2	3										4
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit					1								1
Walrus	ᐊᐃᓵᓴᑦ	Akvik										1			1
Beluga	ᖃᐅᖏᑦ ᖁᓕᓗᒡᑦ	Kilalugak	3	1	1		4								8
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	9		1									1	11
Canada goose	ᓄᖅᓚᓪᑦ ᐅᓗᐊᔪᓚᓪᑦ	Nikliknik	26			2	1						4	23	40
Eider duck	ᒥᑎᑦ	Kingalik	7			12	4	3							20
Black guillemot	ᐱᕆᐅᓪᓚᑦ	Black guillemot				1									1
Thick-billed murre	ᐊᖏᐸᐃᑦ	Thick-billed murre	3	1	1	4	2						2		12
Ptarmigan	ᐊᖓᓕᑦ	Akilgik	7					9	4	11	10	11	8	6	33
Duck eggs	ᒥᑎᑦ ᒪᓂᓄᖕᑦ	Tinmiat manniit	1												1
Arctic char	ᐃᖃᓗᓴᐃᑦ	Ikaliviit	15	12	11	3	3	6	3	5	2	5	5	12	34
Cod	ᐅᒪᐃᑦ	Ugak					2	3		3	4	2	3	1	13
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk		1											1
Clams	ᐊᓗᒍᒪᔪᑦ	Uviluq	2	7	12	11	5	1							27

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᒪᔪᓂᒃ ᐱᑕᖃᖕᖏᑐᖃᖅ ᐱᓯᔪᑎᓕᖕᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᖕᓂᓄᑦ ᐊᓕᖏᔪᓄᑦ ᐊᖏᔪᓄᑦ ᓇᓕᑦᑎᔪᕐᓂᓄᑦ ᑐᓂᔅᓯᖏᖕᓂᒃ ᐃᓕᐊᖏᓕᓕᒫᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 187

Monthly harvest estimates
ᑕᖅᑕᒻᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓕᕆᑦ
Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᒻᒋᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᔪᓗ	NOV ᐅᓇᓚᓗ	DEC ᑎᓯᓚᓗ	JAN ᔮᖏᓇᓗ	FEB ᐃᖅᑲᓇᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	**ᐅᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	9	25	27	25	15	55	46	31	19	16	22	3	293 ± 40
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡							4						
Wolf	ᐊᒪᓕᐃᑦ	Amagut							11	1	2				14 ± 11
Arctic fox	ᑎᓗᓚᖓᓂᐊᑦ	Tigiganiat					3				1				4 ± 3
Coloured fox	ᖃᐅᖕᖏᑦᑐᑦ ᑎᓗᓚᖓᓂᐊᑦ	Kalaliit tigiganiat						3		1					4 ± 3
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				18	14	24	14	1	1	6		10	88 ± 29
Ringed seal	ᓇᓯᓕᑦ	Natiinat	105	54	91	62	80	63	20	8	1	11	24	35	554 ± 56
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk	7	2	8	6	2	4		3		2	1	2	37 ± 9
Harp seal	ᖃᐃᓴᓪᓚᑦ	Qairulik		1	2	4	14	2	3						26 ± 9
Harbour seal	ᖃᓕᑭᐊᑦ	Qanigiaq					1								1 ± 1
Beluga	ᖃᐅᖅᑕᑦ ᖁᓪᓗᓚᑦ	Kilalugak	1		5								2	1	9 ± 8
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq												4	4 ± 6
Canada goose	ᓄᖅᓪᓕ ᐅᓗᐊᔪᓪᓕᑦ	Nikliknik	55	1	14	8								114	192 ± 46
Brant goose	ᓄᖅᓕᖅᓇᐃᑦ	Nirlirnaq												2	2 ± 3
Eider duck	ᒥᑎᑦ	Kingalik	52	46	2	15	16	5						6	142 ± 41
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre	29	11		2	3								45 ± 17
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	18			1	46	315	598	187	251	187	159	271	2,033 ± 371
Duck eggs	ᒥᑎᑦ ᒪᓕᖕᖏᑦ	Tinmiat manniit	233												233 ± 176
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	445	85	296	115	223	302	353	230	161	451	227	724	3,612 ± 597
Cod	ᐅᓚᐃᑦ	Ugak				11	81	233	22	35	47	36	118	84	667 ± 259
Clams	ᐊᓚᒧᓕᖅ	Uviluq			1,333	1,160	930	474							3,897 ± 1,201

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᓕᖅᑐᑦ ᑐᓂᒃᖏᑦ ᐅᑯᐊ ᐃᑯᐊᕐᓇᓕᕆᓂᖅᑐᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 188

Monthly hunter response

ᑕᖅᑕᒫᑦ ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᒻᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑐᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᔪᓂ	NOV ᓄᓇᕗᓂ	DEC ᑎᓯᕗᓂ	JAN ᔮᖅᓄᐊᓂ	FEB ᓇᖕᖏᐊᓂ	MAR ᒪᔪ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒫᑦ ᐊᖏᔪᓂᕆᑦ	Tatkitaman angunahuktut titigait	90	89	89	90	89	91	90	88	91	91	90	90	97*
Hunters interviewed	ᐊᖏᔪᓂᕆᑦ ᐊᐱᓯᒪᑦ	Angunahuktin apikhuktan	82	74	65	67	66	68	49	62	63	53	51	50	89*
Harvested	ᐊᖏᔪᓂᕆᑐᒋᓐ	Angujaujut	26	24	31	26	26	31	19	16	17	13	15	23	64*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑦᑐᓂᖏᑦ (%)	Kiujut (%)	91	83	73	74	74	75	54	70	69	58	57	56	70**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᕆᑦ ᐊᑎᓕᐅᔾᑕᒪᓕᕆᔨᑦ/ᐊᐱᓯᒪᑦ/ᐊᖏᔪᓂᕆᑐᒋᓐ ᐊᑕᐅᓯᐊᖓᔪᓕᐅᑎᒃ ᐊᒻᔪᒍᒥ.
** ᐊᒻᔨᑦᓴᑎᓯᒪᓕᕆᔨᑦ ᑕᖅᑕᒫᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 189

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᓕᑦ ᐊᑯᖏᓂ ᐊᖏᔪᓂᓐᓂᖏᑕ ᐊᒪᓗ ᐊᐱᓯᒪᑕᐅᓂᖏᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᒪᔨᑦ ᐊᖏᔪᓂᖏᑦ ᑎᑎᕐᕕᐅᒪᓕᕆᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᒻᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑐᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᔪᓂ	NOV ᓄᓇᕗᓂ	DEC ᑎᓯᕗᓂ	JAN ᔮᖅᓄᐊᓂ	FEB ᓇᖕᖏᐊᓂ	MAR ᒪᔪ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᓕᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑦ	≤ tatkin pingahut	71	0	0	0	40	75	89	53	66	26	55	100	50
4-6 months	4-6 ᑕᖅᑦ	tatkin hitaman 6nut	0	36	72	75	56	24	10	14	34	74	45	0	34
> 6 months	> 6 ᑕᖅᑦ	> 6 tatkin	29	64	28	25	4	1	2	33	0	0	0	0	16

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 190

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐸᑎᑦ ᐊᖏᔪᓚᐸᓕᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 5 (June 2000 - May 2001)
ᐊᒡᖏᒍ 5 (ᔪᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᐱᓗ	DEC ᑎᓯᐱᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	4	9	12	10	6	14	12	8	7	3	5	1	42
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᒪᐃᑦ	Amagut							3	1	1				5
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat					2				1				3
Coloured fox	ᖃᐅᖅᖢᖅᑐᑦ ᑎᓕᓴᖅᓂᐊᑦ	Kalaliit tigiganiat						2		1					3
Arctic hare	ᐅᒃᓪᓕ	Ukalik				5	4	5	3	1	1	3		2	16
Ringed seal	ᓇᕐᓯ	Natiinat	21	17	21	15	20	12	4	5	1	3	7	10	46
Bearded seal	ᐅᑉᐊᐃᑦ	Ukyuk	2	2	5	4	1	1		2		1	1	1	15
Harp seal	ᖃᐃᕐᓪᓕᑦ	Qairulik		1	1	3	5	1	1						9
Harbour seal	ᖃᓕᕐᐊᑦ	Qanigiaq					1								1
Beluga	ᖃᐅᖅᑕᑦ ᖁᓪᓗᑦ	Kilalugak	1		1								1	1	4
Snow goose	ᑲᖏᐃᑦ	Kanguq												1	1
Canada goose	ᓄᖅᓪᓕ ᐅᓗᐊᔪᓪᓕᑦ	Nikliknik	7	1	3	1								12	19
Brant goose	ᓄᖅᓕᖅᓇᐃᑦ	Nirlirnaq												1	1
Eider duck	ᒥᑎᑦ	Kingalik	8	4	1	2	2	1						1	16
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre	3	2		1	2								7
Ptarmigan	ᐊᖏᒻᒋᑦ	Akilgik	2			1	3	13	15	9	14	7	8	9	36
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᑦ	Tinmiat manniit	1												1
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	9	6	8	3	3	6	2	3	3	6	5	11	28
Cod	ᐅᒪᐃᑦ	Ugak				1	3	5	1	2	1	3	1	3	14
Clams	ᐊᒻᒧᒪᓕᖅᑦ	Uviluq			6	7	7	2							11

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᒪᖅᓂᒃ ᐱᑕᖃᖅᖢᑎᒃ ᐱᓴᐊᓕᓐᓂᒃ ᐊᖏᔪᑦ ᖃᕋᐅᓂᖅᓂᓄᑦ ᐊᓕᓴᐅᓂᓄᑦ ᐊᖏᔪᓄᑦ ᓇᓪᑐᕐᒪᖅᓂᓄᑦ ᑐᓂᔭᖅᑎᓂᐅ ᐃᑯᐱᖅᓯᓚᓇᔪᓪᓕᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 191

Annual harvest estimates and five-year mean

All Years (June 1996 - May 2001)

ᐊᖏᕐᒍᒫᑦ ᐊᖓᔪᓂᑦ ᓇᓕᐅᑦᓴᓐᓂᑦ ᐊᒻᒪᓗ ᑕᒡᓕᒪᓂᑦ-ᐊᖏᕐᒍᓂᑦ ᐊᐅᓚᑦᓯᕐᓂᓱᒪᔪᑦ 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᖏᕐᒍᓂᑦ (ᓯᓂ 1996 - ᒪᐃ

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᕐᒍ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Mean ᐊᐅᓚᑦᓯᕐᓂᓱᒪᔪᑦ Amigaitkiyait
			96/97	97/98	98/99	99/00	00/01	
Species	ᐅᒪᔪᑦ	**Umajuin**						
Caribou[1]	ᑐᑐᐃᐃᑦ[1]	Tuktut[1]	332	341	346	353	293	333
Polar bear[2]	ᓇᓂᐃᑦ[2]	Nanuit[2]	12	10	11	11	4	10
Wolf	ᐊᒪᓗᐃᑦ	Amagut	4	1	5	19	14	9
Arctic fox	ᑎᓕᖅᓂᐊᑦ	Tigiganiat	50	37	7	25	4	25
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓕᖅᓂᐊᑦ	Kalaliit tigiganiat	21	6	2	20	4	11
Arctic hare	ᐅᒃᓪᓕ	Ukalik	10	81	50	105	88	67
Ringed seal[3]	ᓇᕆᓵ[3]	Natiinat[3]	905	947	1,258	660	554	865
Bearded seal[4]	ᐅᑦᔪᐃᑦ[4]	Ukyuk[4]	43	40	41	31	37	38
Harp seal[5]	ᖃᐃᓗᓪᓕᑦ[5]	Qairulik[5]	51	38	28	24	26	33
Harbour seal[6]	ᖃᓯᒋᐊᑦ[6]	Qanigiaq[6]	0	1	2	9	1	3
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	0	1	2	1	0	1
Walrus[7]	ᐊᐃᐸᒃᑦ[7]	Akvik[7]	5	2	4	1	0	2
Beluga[8]	ᖃᓄᖅᑕ ᖃᓪᓗᓂᑦ[8]	Kilalugak[8]	8	6	36	14	9	15
Snow goose	ᑲᖏᐃᑦ	Kanguq	102	7	22	19	4	31
Canada goose	ᓂᕆᓪᓕ ᐅᓗᐊᔪᓪᓕᑦ	Nikliknik	236	162	195	246	192	206
Brant goose	ᓂᕆᓕᓐᓇᐃᑦ	Nirlirnaq	0	0	0	0	2	<1
Old squaw	ᐊᒥᐊᖅᔪᐃᑦ	Aahangik	0	0	5	0	0	1
Pintail	ᔭᓚᒧᐊᓪᓚᑦ	Arnaviaq	2	0	0	0	0	<1
Eider duck	ᒥᑎᑦ	Kingalik	437	293	328	230	142	286
Common loon	ᑐᑦᓕᖅᔪᐊᑦ	Tuulik	3	0	0	0	0	1
Black guillemot	ᐱᕐᓂᐅᓪᓕᑦ	Black guillemot	7	7	19	7	0	8
Thick-billed murre	ᐊᑦᐸᐃᑦ	Thick-billed murre	90	122	90	66	45	83
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	1,442	3,560	2,110	801	2,033	1,989
Eggs (unspecified)[9]	ᓚᖅᑯᓪ[9]	Manniit[9]	0	0	207	0	0	41
Duck eggs[9]	ᒥᑎᑦ ᓚᖅᓂᖏᓪ[9]	Tinmiat manniit[9]	103	506	347	55	233	249
Seagull eggs[9]	ᓇᐅᐳᐃᑦ ᓚᖅᓂᖏᓪ[9]	Nauyat manniit[9]	0	72	0	0	0	14
Eider down[Ø10]	ᒥᑎᑦ ᕿᓂᓕᖏᓪᑕ[Ø,10]	Mitiit qiviungit[Ø10]	0	2	0	0	0	<1
Arctic char	ᐃᖃᓗᐊᓕᑦ	Ikaliviit	5,056	4,621	3,950	3,632	3,612	4,174
Inconnu	ᐊᓂᔪᓐᓇᐸᐃᑦ	Aanakhiik	16	1	0	0	0	3
Cod	ᐅᒪᐃᑦ	Ugak	1,275	377	416	421	667	631
Sculpin	ᐅᓇᔪᐃᑦ	Kanayuk	8	10	48	10	0	15
Clams	ᐊᓕᒧᒪᔪᑦ	Uviluq	11,312	5,416	7,497	6,612	3,897	6,947
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet	265	0	1,509	0	0	355

Ø Number of nests harvested.
[1-10]: See page 317 for community feedback and other sources of data.

Ø ᖃᓕᐅᓂᖏᑦ ᐱᒋᐅᑦ ᓄᐊᑕᐅᔪᑦ.
[1-10]: ᑕᐃᓕᒃ ᒪᔪᐃᑐᒃ 318 ᓄᓇᓕᑦ ᑭᐅᔪᒥᑎᖏᑦ ᐊᒻᒪᓗ ᐊᓯᖏᑦ ᐱᔭᐃᐅᔪᓐ ᓇᒧᐅᑎᓂᒃ.

Ø Amigaitiginit maniktagauhimajut.
[1-10]: Takulugu makpigaak 319 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 192

Annual hunter response
ᐊᓚᖏᔪᑕᒻᒪᑦ ᐊᖓᔪᓂᖅᑎᑦ ᑭᐅᓂᖏᑦ
Angujauvaktu

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓇᑦ ᐊᓚᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᐊᖅ Tamakiklugin
Hunter Response Categories	**ᐊᖓᔪᓂᖅᑎᑦ ᑭᐅᓂᖏᑦ ᐊᒻᔪᕆᓚᓂᖏᑦ**	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᑭᑕᒪᒃ ᐊᖓᔪᓂᖅᑎᑦ	Tatkitaman angunahuktut titigait	96	99	102	104	97	114*
Hunters interviewed	ᐊᖓᔪᓂᖅᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	96	97	101	103	89	109*
Harvested	ᐊᖓᔪᓂᖅᑐᒥᓂᑦ	Angujaujut	81	74	85	83	64	102*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓕᕐᐳᓂᖏᑦ (%)	Kiujut (%)	92	89	99	89	70	88**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖓᔪᓂᖅᑎᑦ ᐊᑎᓕᐅᔾᔪᑎᒃ/ᐊᐱᕐᓂᑦ/ᐊᖓᔪᓂᖅᑐᒥᓂᑦ ᐊᑕᐅᓯᐊᔪᑕᒻᒪᑉ ᖃᐅᔨᓴᖅᓂᒃ.
** ᐱᔨᑦᓯᑎᓕᒪᔪᑦ ᐊᓚᖏᔪᑕᒻᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

6.1.8

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 193

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᕐᓴᓂ ᐊᖓᔪᓂᒃᓴᓂᖓᓪᓗᒋ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓪᓗᒋ, ᓇᓗᓇᐃᕐᑎᑦ ᐃᒪᒃ % ᑲᑎᕐᔪᐊᖅᑎᑦ ᐊᖓᔪᓂᖅᑎᑦᑕ ᑎᑎᕐᑕᐅᒪᔪᑦ
Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓇᑦ ᐊᓚᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᐊᖅ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔪᑦ**	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	100	100	100	71	50	88
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	0	0	15	34	7
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	14	16	4

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 194

Number of hunters harvesting each species

ᖃᑦᕿᐅᓂᖏᑦ ᐊᖏᔪᓕᒃᑎᑦ ᐊᖏᔪᓕᒃᓯᕐᔪᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ

Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᑦᕿᔪᓂᑦ (ᓄᓇ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᕿᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᑎᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**						
Caribou	ᑐᑐᐃᑦ	Tuktut	45	50	52	42	42	82
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut	3	1	4	7	5	17
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat	11	14	3	6	3	24
Coloured fox	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓕᓴᓂᐊᑦ	Kalaliit tigiganiat	12	3	2	5	3	18
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	7	28	17	22	16	47
Ringed seal	ᓇᕆᔨᑦ	Natiinat	62	64	70	62	46	89
Bearded seal	ᐅᑉᐊᐃᑦ	Ukyuk	19	17	20	18	15	42
Harp seal	ᖃᐃᓗᓐᓂᑦ	Qairulik	16	9	13	8	9	34
Harbour seal	ᖃᓯᕈᐊᑦ	Qanigiaq		1	2	4	1	8
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit		1	1	1		3
Walrus	ᐊᐃᐸᒋᑦ	Akvik	3	2	3	1		6
Beluga	ᖃᐅᕆᑦ ᖁᓪᓗᑎᑦ	Kilalugak	4	4	15	8	4	20
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	16	5	5	11	1	30
Canada goose	ᓂᕆᓪᓕ ᐅᓪᐊᒍᓪᓕᑦ	Nikliknik	47	37	26	40	19	72
Brant goose	ᓂᕆᓕᓇᐃᑦ	Nirlirnaq					1	1
Old squaw	ᐋᑭᐊᖏᑦᔪᐃᑦ	Aahangik			2			2
Pintail	ᔾᔪᒧᒋᐊᓪᓚᑦ	Arnaviaq	1					1
Eider duck	ᒥᑎᑦ	Kingalik	34	34	34	20	16	60
Common loon	ᑐᓕᖏᔪᐊᑦ	Tuulik	1					1
Black guillemot	ᐱᖏᐅᓪᓗᑦ	Black guillemot	2	2	4	1		7
Thick-billed murre	ᐊᖏᐸᐃᑦ	Thick-billed murre	12	21	9	12	7	37
Ptarmigan	ᐊᖑᓚᑦ	Akilgik	52	55	59	33	36	83
Eggs (unspecified)	ᒪᓐᓂᑦ	Manniit			2			2
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit	1	6	5	1	1	11
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit		4				4
Eider down	ᒥᑎᑦ ᖃᓂᕐᖏᑦ	Mitiit qiviungit		1				1
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	51	32	42	34	28	73
Inconnu	ᐊᕿᓯᓂᐸᐃᑦ	Aanakhiik	1	1				2
Cod	ᐅᒪᐃᑦ	Ugak	15	10	15	13	14	42
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk	2	1	3	1		6
Clams	ᐋᒡᒧᒪᓕᐊᑦ	Uviluq	25	20	27	27	11	51
Mussels	ᐅᕙᓗᐃᑦ	Uviluvaloet	1		4			4

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᓐᖏᑦᑐᖅ ᐱᐅᔪᑎᓐᓂᒃ ᐊᖑᓚᑦ ᖃᕋᓯᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᖅᑕᒪᔪᓂᑦ ᐊᖑᓚᐅᓄᑦ ᓇᓪᑕᐅᖏᓐᓄᑦ ᑐᓂᓯᔪᓐᓇᖅᑐᑦ ᐃᓕᓴᕐᓂᐊᕆᔨᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.8 Community Results Discussion: Kimmirut

The survey frame:

An assessment of under-enumeration during the community visit revealed that there were approximately 52 hunters who were not registered in the Harvest Study. All of these were occasional hunters, 51 Inuit and one non-Inuit with assigned hunting rights. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. Given that these unregistered hunters represent 31 percent of the total hunter population (Table 10) the effect of this bias on harvest estimates could be significant. However, the effect would be lessened by the fact that all unregistered hunters were thought to be occasional hunters. Harvest estimates for the unregistered hunters can be estimated using mean harvest quantities for each species by strata. These estimates, having their own sources of error and bias, are beyond the scope of this Final Report. Readers may apply to NWMB to obtain the results of these calculations.

Survey coverage and non-response bias:

Response rates were high in most years throughout the study in Kimmirut. Lower rates were encountered in the summer of 1997 (year 2) and rates dropped to below 60% in the final months of the study (year 5). As seen in Table 9 the consistent intentional non-response rate in Kimmirut was low at 1.8% and was not thought to be a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough during years 1 to 4 to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should exercise caution when using the data collected during the latter months of the study and from the summer of 1997 since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:

It was reported during the community consultations that some harvests, such as eggs and eider down were under-reported. Further details are provided in the community feedback and other sources of data section below. Section 5.4 also contains a thorough discussion of this issue.

As seen in the recall period tables, years 1 to 3 had short recall periods with the majority of harvest records having been collected within three months of the harvest, minimizing measurement error due to recall failure. However, recall periods were much longer, over six months in some cases, during several months in years 4 and 5. Recall error in these instances is more likely.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou.
2. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
3. **Ringed seal:** Harvest estimates seem low in the last 2 years of the study since pelt prices have increased resulting in increased harvesting of ringed seals (C.F.).
4. **Bearded seal:** Harvest estimates seem too high. The community reports harvests are rarely higher than 20 per year (C.F.).
5. **Harp seal:** The harvest estimates seem high in some years as pelts nor meat were sought after. The community reports that harvests are rarely higher than 10 per year (C.F.).
6. **Harbour seal:** The year 5 harvest estimate seems low. During the community visit one hunter reported that he harvested 2 in year 5. Harvest estimates in other years seem accurate (C.F.).
7. **Walrus:** The community reports that harvest estimates seem low in years 2, 4 and 5. They migrate close to the community in March and some are taken every year (C.F.).
8. **Beluga:** Harvest estimates seem a little high in year 3 and a little low in year 5 but overall they are in the right range. However, members of the public commented that the year 3 estimate was likely accurate (C.F.). Prior to 1999 the quota had been 35 beluga per year after which time Kimmirut joined a three year trial community-based management system and no longer was given a set quota. DFO reports the following harvest numbers for beluga (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
8	4	20	19	27

9. **Eggs:** Most of the harvest estimates for eggs seem too low. Many hunters were not reporting their egg harvests. Unidentified eggs may have been goose eggs; goose eggs were not reported, but Canada goose eggs are harvested by Kimmirut hunters (C.F.).
10. **Eider down:** Harvest estimates seem much too low. Down is harvested when collecting eggs; therefore there should be some down harvest every year. Many hunters reported that they were not aware they were to report their eider down harvest (C.F.).
11. **Arctic char:** Harvest estimates seem to be in the right range. However, it is suspected that estimates may be low in the last few years due to declining interest in the study (C.F.).
12. **Mussels:** Mussels were harvested each year; hunters did not always count their catch and often did not report them to the Fieldworker (C.F.).

6.1.8 ᓄᓇᕗᑦ ᓴᖅᑭᑕᕐᕕᖏᓂᖅ ᐅᖃᖅᑎᑕᐅᑎᑦ: ᑭᒃᑭᑦ

ᖃᐅᔨᓴᓂᐅᑦ ᐊᖏᖅᑭᒪᓂᖅ:

ᖃᒥᖅᑭᔨᐅᑎᓯᓂᑦ ᐊᑎᓕᐅᓇᖅᑐᐊᕐᓂᕆᓂᐅᕐᕕᒃ ᓄᓇᕗᑦ ᐊᓪᓚᕆᓂᑦ ᑕᑯᑎᕋᓚᐅᕐᓂᑦ ᑕᐃᓐ 52ᖓᓕᒃ ᐊᖓᔪᓇᓗᑎᑦ ᐊᑎᖃᖅᑕᕐᓂᕆᕕᒃᑐᖅᓯᓂᐅᓂᖅᐳᖅ ᖃᐅᔨᓴᓂᐅᕐᕕᒃ. ᑕᒪᒃᓯᒪᓕᖅ ᖃᐅᑎᐅᒃ ᐊᖓᔪᓇᖅᑎᑎᕐᓂᕐᒃᑐᑦ, 51%ᔪᓯᓗᑎᒃ ᐃᓄᐃᑦ ᐊᓪᓚᒃ ᐊᑕᐅᓯᐅᓪᓗᓂ ᐃᓄᖅᑎᑦᑐᖅ ᐱᓕᕐᓂᐊᖅᑐᑦ. ᑐᖅᑐᓯᐅᑎᒃ ᐃᓕᓴᕐᕕᖏᓂᖅ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓇᖅᑐᐊᕐᓂᕆᕕᒃᑐᑦ ᐱᔪᓐᓇᖅᑐᖅ ᐊᖓᔪᖅᑎᑦᑎᓂᒃᑯᑦ ᐃᓕᓴᕐᕕᖏᓂᖅ ᐊᑎᖃᖅᑕᕐᓂᕆᓚᐅᖏᓐᓂᖅᑐᑦ ᐃᓕᓴᖅᑕᕐᕕᒋᑦᑐᑦ ᑭᓯᐅᖅᑕᕐᓂᕆᓂᐅᕐᓂᖅᐳᖅ. ᐃᓗᓕᓕᓐᓂᑦ ᑕᒪᐃᓐᓇ ᐊᑎᖃᖅᑕᕐᓂᕆᓂᐅᕐᓂᑦ 31%ᔪᓯᓗᒃᑐᑦ ᐊᖓᔪᓇᓂᑎᑎᓕᐅᓇᓂᒃ (ᓇᓕᖅᑲᖅ 10) ᐊᑐᐃᓚᒥᔪᖅᑕᕐᓂᑦ ᐅᓪᓚᕆᑕᕐᕕᒃᑐᑦᑐᓂᒃ ᒥᑦᓴᕐᕕᖏᓂᖅᐳᖅ ᐊᖓᔪᖅᑎᑦᑎᓂᒃᑯᑦ ᐊᑎᖃᖅᑕᕐᓂᕆᕕᒃᑐᑦ ᐃᓕᓴᖅᑕᕐᕕᒋᑦᑐᑦ ᐊᑎᖃᖅᑕᕐᓂᕆᕕᒃᑐᑦ ᐊᑎᖃᖅᑕᕐᓂᕆᓂᐅᕐᓂᖅᐳᖅ. ᐅᓪᓗᒥ, ᐊᑐᐃᓚᒋᔭᐅᓄᑦᓯᐊᕐᓂᑦ ᑕᒪᓐᓇᖅᑐᖅ ᐊᑎᖃᖅᑕᕐᓂᕆᕕᒃᑐᑦ ᐊᑎᖃᖅᑕᕐᓂᕆᓂᐅᕐᓂᖅᐳᖅ. ᐅᓪᓗᒥ, ᐊᑐᐃᓚᒋᔭᐅᓄᑦᓯᐊᕐᓂᑦ ᑕᒪᓐᓇᖅᑐᖅ ᐊᑎᖃᖅᑕᕐᓂᕆᕕᒃᑐᑦ ᐊᑎᖃᖅᑕᕐᓂᕆᓂᐅᕐᓂᖅᐳ

6.1.8 Nunani Iniktikhimayut Ukauhiit: Kimmirut

Ihivgiugutit atugutait:
Ihivgiufaakhimayuni ataani naunaiyakhimayut nunanut pulaakhimatitluni takuhimayuk 52nik umayukhiuktinik titigakhimaitut Umayukhiukhimayut Ihivgiukhimayuni. Tamamik tahapkoa ilaani umayukhiukataktut, 51kuyut Inuit ovalo atauhik inuinaungituk tuniyauhimayuk umayukhiutinik inminiigutainik. Ukakhimayuk ilangani 5.2.1 ikpinagutait hamna ataani naunaiyakhimayut pihimayut ataanut ihumagiyaini umayukhiukhimayut naunaiyautaini. Pihimamat hapkoa titigakhimaitut umayukhiuktit pihimamat 31%nik tamaat umayukhiuktunut (ikpatauyak 10) ikpinagutait hamna ihumaiyait umayukhiukhimayut naunaiyautaini angiyut. Kihimi ikpinagutait mikhilaat nalungitut tamamik titigakhimaitut umayukhiuktit ihumagiyauyut ilaani umayukhiukpaktut. Umayukhiukhimayut naunaiyautait titigakhimaitut umayukhiuktit naunaiyakhimayut atukhutik anginikhaani umayukhiukhimayut amigaitjutait tamamik umayut aviktukhimalutik. Hapkoa naunaiyautit pihimayut inminik ihumagiyainik ovalo ihuinaagutainik avataaniitut pihimayunit hamna iniktikhimayuk tuhaktakhak. Taiguaktut apigilaaktut NWMBkunut piyumagumik iniktigutainik hapkoa naunaiyautit.

Ihivgiukhimayut pihimayut ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait angiyut tamami ukiuni tamaat ihiuktitlugit Kimmirutmi. Mikitkiyaut naunaiyautit pihimayut auyami 1997mi (ukiumi 2) ovalo naunaiyautait katakhimayut ataanut 60%nut iniktigutaani tatkikhiutimi ihivgiuhimatitlugit (ukiumi 5). Takulaaktut ikpatauyami 9mi pikatainaktut kiuyuituni naunaiyautait Kimmirutmi mikiyut 1.8%mik ovalo ihumagiyaungituk pilaaktuni pihimayaini kiuyuitut ihumagiyain.

Kiuhimayut naunaiyautait ihumagiyauyut angiyut ovalo kiuyuitut ihumagiyait mikiyut ukiuni 1mit 4mut piyaami nni pivaktut nakuuyumik ilaukatigiyaami uktukhimayut Nni umayukhiuktini. Taiguaktut ihimagiyakhait atugumik katitikhimayut katitiguait kinguani tatkikhiutini ihivgiuktitlugit ovalo auyami 1997mi pilaamata tamamik ihuinaakhimayut ovalo kiuyuitut ihumagiyait angiklilaamata kiuhimayuni naunaiyaitait katakpata.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Tuhaktitihimayuk nunani ukakatihimaplugit ilangit umayukhiukhimayut, ilaa, maniit ovalo tingmiat kiviungit ataanut tuhaktitihimayut. Titigakhimayut tunihimayut nunani kiutjutaini ovalo aalat pihimayut katitikhimayuni ilangani hamani. Ilangani 5.4 pihimayut ukauhiinik hamna ihumagiyauyut.

Takuhimayut utiktihimayuni ubluit ikpatauyani, ukiuni 1mit 3mut naitunik utiktikakhimayut ubluit amigaitut umayukhiukhimayut titigagutait katitikhimayut iluani pingahut tatkikhiutini umayukhiukhimayuni, mikhinaakhimayait atugutit ihuinaagutait pihimakpata utiktigutit pingitpata. Kihimi, utiktiguti ubluit angitkiyait ovataanut siksit tatkikhiutini ilaani, amigaivyaktuni tatkikhiutini ukiuni 4mi ovalo 5mi. Utiktihimayut ihuinaagutait hamani pihimayut piyunakhimayut.

Nunanit ukakhimayut ovalo aalat pihimayaini katitikhimayuni:

1. **Tuktuit:** Tuktut umayukhiukhimayut nunani tuktuit.
2. **Nanuit:** Amigaitjutait takuvaktut naunaiyakhimaitut kihimi pihimayut umayukhiukhimayut amigaitjutait tunihimayut DSDkunit (DSD PB).
3. **Natiit:** Umayukhiukhimayut naunaiyautait mikiyut kinguani malguk ukiuni ihivgiukhimayuni, amiit akiit angilihimamata amigailikhimata umayukhiukpaktait ukuit (C.F.).
4. **Ukyuit:** Umayukhiukhimayut naunaiyautait angiyut. Nunanit tuhaktitivaktut umayuktauvaktut angitkiyaungitut 20nit ukiuk tamaat (C.F.)
5. **Qairulik:** Umayukhiukhimayut naunaiyautait angiyut ilangit ukiuni, amiit ovalo uyuit piyumayauvamata. Nunani tuhaktakhait umayukhiukhimayut angitkiyauyuituk kulinik ukiuni (C.F.).
6. **Qanigiaq:** Ukiuni 5mi umayukhiukhimayut naunaiyautait mikiyut. Nunani pulaaktakhimapluni atauhik umayukhiukti tuhaktitihimayuk umayukhiukhimayuk malgunik ukiumi 5mi. Umayukhiukhimayut naunaiyautait aipaini ukiuni naamaktut (C.F.).
7. **Akviit:** Nunani tuhaktakhaini umayukhiukhimayut naunaiyautait mikiyut ukiuni 2mi, 4mi ovalo 5mi. Nuutitivamata haniani nunami Marchmi ovalo ilangit pivaktut tamaat ukiuni (C.F.).

[8] **Kilalugait:** Umayukhiukhimayut naunaiyautait angiyut ukiuni 3mi ovalo mikiyut ukiuni 5mi kihimi tamaat naamaktut. Kihimi Inuit ukakhimayut ukiuni 3mi naunaiyautait nakuuyut (C.F.). Pitinagu 1999mi kotat 35kuyut kilalugat ukiuk tamaat pihimamata Kimmirut ilauhimayuk pingahuni ukiuni uktukhimayunut nunani munagitjutit atugutaini ovalo kotakaguiktut. DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait kilaluganik (nalungilutit DFOkut katitikhimayut atukpaktut atugutaini ukiuginik, Umayukhiukhimayut Ihivgiugutait katitikhimayut atukpaktut umayukhiukhimayut ukiungit Junemit Maymut (DFO N/B):

96/97	97/98	98/99	99/00	00/01
8	4	20	19	27

[9] **Maniit:** Amigaitut umayukhiukhimayut naunaiyautait katitigutaini maninik mikiyut. Amigaitut umayukhiuktit tuhaktitiyuitut maniit katitigutainik. Nalunaktut maniit nikliniit manigiyunakhiyait, nikliniit maniit tuhaktitihimaitut, kihimi uluaguliit maniit katitikhimavaktut Kimmirutmi umayukhiuktinit (C.F.).

[10] **Tingmiat kiviut:** Umayukhiukhimayut naunaiyautait mikiyut. Kiviut katitilikpaktut katitiligaagata maniit; taimaimat pihimayukhat kiviunik katitigutainik ukiuk tamaat. Amigaitut umayukhiuktit tuhaktitihimayut naluyut tuhaktitiyaami tingmiat kiviut katitigutait (C.F.).

[11] **Ikaliviit:** Umayukhiukhimayut naunaiyautait naamaktut. Kihimi, ihumayut naunaiyautait mikiyut kinguani ukiuni ihumagihuimata ihivgiuktitlugit (C.F.).

[12] **Uviluvaluit:** Aomauyautit umayukhiukpaktait ukiuk tamaat; umayukhiuktit naunaiyakhimayuitait ilaani piyainik ovalo tuhaktitiyuitaitlu nunani havaktinut (C.F.).

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 195

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᑦᔦᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᑲᔪᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᓄᐃᑲᓗ	DEC ᑎᓯᑲᓗ	JAN ᔮᖏᓄᓗ	FEB ᐃᖅᐅᓄᓗ	MAR ᒪᓯ	APR ᐃᑦᓇᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	113	100	250	496	6		54	143	248	223	128	79	1,840 ± 296
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡											13	2	15
Wolf	ᐊᒪᓗᐃᑦ	Amagut			3	4					2			1	10 ± 8
Arctic fox	ᑎᓕᓴᒃᑐᐊᑦ	Tigiganiat						5	8	10	6				29 ± 12
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓕᓴᒃᑐᐊᑦ	Kalaliit tigiganiat						6	6						12 ± 11
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik			3	13			4	4	2	4			30 ± 15
Seals (unspecified)	ᓯᖏᓄᓪᓚᑦ	Natiit	195												195 ± 381
Ringed seal	ᓇᓯᓂᑦ	Natiinat	1,784	595	362	700	617	588	233	287	509	524	677	822	7,698 ± 950
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	101	26	28	24	11	19	2		1	1			213 ± 149
Harp seal	ᖃᐃᕐᓂᑦ	Qairulik	329	281	66	298	246	70	19						1,309 ± 555
Walrus	ᐊᐃᐸᒃᑦ	Akvik		8	7										15 ± 13
Narwhal	ᑐᐊᓂᓪ ᖁᓪᓗᒡᑦ	Tuugaak	24	15	17	8	4								68 ± 50
Beluga	ᖃᐅᖅᑕᑦ ᖁᓪᓗᒡᑦ	Kilalugak		34	16	4									54 ± 17
Canada goose	ᓄᖅᓂᓪ	Nikliknik	294			7								47	348 ± 187
Eider duck	ᒥᑎᑦ	Kingalik	438	229	136	637	613	638	61						2,752 ± 531
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre					4								4 ± 6
Ptarmigan	ᐊᖏᓚᑦ	Akilgik				2	6	196	564	365	381	89	5		1,608 ± 356
Eggs (unspecified)	ᐊᓯᖏᑕ ᑎᑎᒥᐊᑦ ᒪᓕᓂᖏᑦ	Manniit		276											276 ± 166
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	937	1,947											2,884 ± 1,054
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	2,132	7,910	9,661	3,206	2,135	3,436	821	2,126	1,373	2,622	3,896	4,689	44,007 ± 5,823
Cod	ᐅᒪᐃᑦ	Ugak									306	106	81		493 ± 369
Sculpin	ᑲᓚᔪᐃᑦ	Kanayuk		2											2 ± 2
Turbot	ᖃᓕᕆᓂᑦ	Nataarnak									869	4,501	2,175	355	7,900 ± 2,022
Clams	ᐊᓚᒧᓚᔪᑦ	Uviluq		1,632	2,866	217									4,715 ± 3,803

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕐᑕᒪᓚᔪᑦ ᑐᓂᓯᖏᑦ ᐅᑯᐊ ᐃᓄᐃᕐᓂᐊᕐᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 196

Monthly hunter response

ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᒃᓴᔪ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒡᒎᑎ	SEP ᓯᑎᕐᓇᓕ	OCT ᐅᑯᐊᓕ	NOV ᐅᓇᒃᓇᓕ	DEC ᑎᓯᒃᓇᓕ	JAN ᔮᖅᓄᐊᓕ	FEB ᓇᖕᐅᐊᓕ	MAR ᒪᕐᕿ	APR ᐃᓴᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓕ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ ᐊᑐᓵᓚᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ	Tatkitaman angunahuktut titigait	168	168	168	170	171	173	176	176	178	181	180	180	184*
Hunters interviewed	ᐊᖏᔪᓇᓱᒋᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	20	118	69	42	106	35	141	136	146	161	167	158	178*
Harvested	ᐊᖏᔪᓇᓱᒋᑎᓄᑦ	Angujaujut	19	74	49	41	41	20	41	62	79	91	129	116	168*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	12	70	41	25	62	20	80	77	82	89	93	88	62**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᒋᑦ ᐊᑎᓕᐅᕐᒪᒪᓕᕐᓂᑦ/ᐊᐱᕐᓂᑦᑕᑦ/ᐊᖏᔪᓇᓱᒋᑎᓄᑦ ᐊᑕᐅᓂᐊᖅᓯᐅᑎᑦ ᐊᑲᕐᒥᑦ.
** ᐊᑲᓴᓂᓕᕆᓂᒪᓕᒃ ᑕᖃᑦᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 197

6.1.9

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕋᐃᐅᔾᔨᑦ ᐊᑯᕋᖅᓱᓂ ᐊᖏᔪᓇᓯᓂᖅᓱᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖅᓱᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑎᓕ ᐊᖏᔪᓇᓱᑕᑦ ᑎᑎᕋᑦᑕᐅᒪᔾᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᒃᓴᔪ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒡᒎᑎ	SEP ᓯᑎᕐᓇᓕ	OCT ᐅᑯᐊᓕ	NOV ᐅᓇᒃᓇᓕ	DEC ᑎᓯᒃᓇᓕ	JAN ᔮᖅᓄᐊᓕ	FEB ᓇᖕᐅᐊᓕ	MAR ᒪᕐᕿ	APR ᐃᓴᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓕ Tamakiklugin
Recall Period	ᐅᑎᕋᐃᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲᑦ	≤ tatkin pingahut	100	99	98	98	96	100	100	100	100	100	100	100	99
4-6 months	4-6 ᑕᖅᑲᑦ	tatkin hitaman 6nut	0	0	0	2	4	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑲᑦ	> 6 tatkin	0	1	2	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 198

Number of hunters harvesting each species — **Year 1 (June 1996 - May 1997)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓚᓯᖅᑎᑦ ᐊᖏᓚᓯᖅᓴᓕᒃ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒻᒪᒍᒍ 1 (ᔪᓂ 1996 - ᒪᐃ 1997)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 1 (June 1996 - May 1997)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒻᐱᓗ	DEC ᑎᓯᒻᐱᓗ	JAN ᔮᖏᓇᓗ	FEB ᐃᖅᑲᓇᓗ	MAR ᒪᓯ	APR ᐃᓴᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	6	28	35	30	1		13	28	43	48	33	27	123
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut			1	1					2			1	5
Arctic fox	ᑎᓗᓚᖓᓂᐊᑦ	Tigiganiat						1	4	5	2				9
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓗᓚᖓᓂᐊᑦ	Kalaliit tigiganiat						1	4						5
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik			1	3			3	2	2	4			13
Seals (unspecified)	ᓂᖏᐅᓪᓚᑦ	Natiit	1												1
Ringed seal	ᓇᓂᓂᑦ	Natiinat	18	64	44	41	40	17	22	35	62	65	97	96	153
Bearded seal	ᐅᑭᔾᔪᐃᑦ	Ukyuk	7	12	9	6	6	2	1		1	1			36
Harp seal	ᖃᐃᕐᓪᓚᑦ	Qairulik	4	18	10	15	16	7	5						55
Walrus	ᐊᐃᐅᓴᑦ	Akvik		2	1										2
Narwhal	ᑐᒻᓚᓪᑦ ᖁᓕᓴᓗᑦ	Tuugaak	1	8	6	2	2								15
Beluga	ᖃᐅᖅᑦ ᖁᓕᓴᓗᑦ	Kilalugak		20	4	1									23
Canada goose	ᓄᖅᓪᓚᑦ	Nikliknik	10			1								9	17
Eider duck	ᒥᑎᑦ	Kingalik	12	25	11	18	29	15	3						73
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre					1								1
Ptarmigan	ᐊᖏᓴᑦ	Akilgik				1	1	4	25	24	22	11	2		63
Eggs (unspecified)	ᐊᓯᖏᑐᑦ ᑎᒥᐊᑦ ᒪᓕᓂᖏᑦ	Manniit		5											5
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	6	20											26
Arctic char	ᐃᖃᓗᐳᐱᑦ	Ikaliviit	10	53	28	16	14	11	12	27	29	38	93	75	149
Cod	ᐅᒪᐃᑦ	Ugak									1	2	1		3
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk		1											1
Turbot	ᖃᓄᕐᓪᓚᑦ	Nataarnak									3	8	6	1	12
Clams	ᐊᒃᒧᒪᔪᑦ	Uviluq		2	3	1									6

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓯᒪᔪᓂᒃ ᐱᑕᖃᖏᑐᑐᖃᖅ ᐱᓕᕆᓕᓐᓂᒃ ᐊᖏᓴᑦ ᖃᑦᓯᐅᓂᖏᑐᓂᒃ ᐊᓪᓴᒃᓂ ᓇᓄᐃᑦᓯᓂᒃ ᐃᓕᓴᕐᓂᒃ ᐃᓕᓴᕐᓂᒃ ᐅᓂᒃᑳᖏᑐᓂᒃ ᐃᓂᓯᖏᑐᓂᓕᕆᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 199

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᑦᓴᒍ 2 (ᔪᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᐸᓗ	OCT ᐅᑲᐃᓗ	NOV ᐅᓇᓚᐸᓗ	DEC ᑎᓱᓚᐸᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᓱ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᐊᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	105	102	232	154	157	18	67	152	206	274	154	212	1,833 ± 102
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡							**12**						
Wolf	ᐊᒪᓗᐃᑦ	Amagut	6								4	2	1		13 ± 5
Coloured fox	ᖃᓄᖕᖏᑦ ᑎᓕᓴᓂᐊᑦ	Kalaliit tigiganiat							4						4 ± 5
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik				1	2	10	26		3	1			43 ± 26
Ringed seal	ᓇᓂᐧᐃᑦ	Natiinat	914	579	405	572	487	317	320	568	450	582	664	709	6,567 ± 411
Bearded seal	ᐅᓴᐊᐃᑦ	Ukyuk	7	11	7	15	17	8	7	1	2			3	78 ± 14
Harp seal	ᖃᐃᓗᓐᓂᑦ	Qairulik	5	5	16	49	44	59	10						188 ± 33
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit				16	29	69	49						163 ± 67
Walrus	ᐊᐃᐅᓵᑦ	Akvik	5		6	13							1		25 ± 12
Narwhal	ᑐᒻᓚᓪᑦ ᖁᓪᓗᓂᑦ	Tuugaak		4											4 ± 3
Beluga	ᖃᓄᖅᑕ ᖁᓪᓗᓂᑦ	Kilalugak	3	26	12										41 ± 14
Canada goose	ᓄᖅᓚᑦ	Nikliknik	14	13	1									47	75 ± 19
Eider duck	ᒥᑎᑦ	Kingalik	446	337	55	245	419	85	11					9	1,607 ± 208
Ptarmigan	ᐊᖏᓴᑦ	Akilgik			8	48	138	332	1,363	597	297	135	73	16	3,007 ± 472
Eggs (unspecified)	ᐊᓯᖏᑕ ᑎᒥᐊᑦ ᒪᓐᓂᖏᑦ	Manniit		114											114 ± 97
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit	2,458	965											3,423 ± 656
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	1,950	5,188	3,685	775	1,421	1,481	881	4,256	1,697	3,246	1,620	6,454	32,654 ± 3,119
Cod	ᐅᒪᐃᑦ	Ugak										883	222	155	1,260 ± 418
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk									163				163 ± 93
Turbot	ᖃᓕᓴᓪᓚᑦ	Nataarnak									583	1,270	1,156	1,170	4,179 ± 1,723

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᖅᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓚᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 200

Monthly hunter response

ᑕᖃᑕᒪᑦ ᐊᖏᔪᓕᕆᔨᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)

ᐊᒻᒋᔪᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑲᐃᓂ	NOV ᓄᐊᒻᒪᓂ	DEC ᑎᓯᒻᒪᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᕕᖕᒧᐊᓂ	MAR ᒪᓯ	APR ᐃᓴᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᕆᔨᑦ ᑭᐅᓂᖏᑦ ᐋᔪᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒪᑦ ᐊᖏᔪᓕᕆᔨᑦ	Tatkitaman angunahuktut titigait	182	182	180	180	178	177	178	177	179	181	182	182	191*
Hunters interviewed	ᐊᖏᔪᓕᕆᔨᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	142	129	142	144	124	134	110	148	152	157	156	160	179*
Harvested	ᐊᖏᔪᓕᕆᔨᑐᑉᓂ	Angujaujut	81	64	78	94	59	43	53	76	82	103	99	122	173*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓕᔾᔨᓂᖏᑦ (%)	Kiujut (%)	78	71	79	80	70	76	62	84	85	87	86	88	79**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓕᕆᔨᑦ ᐊᑎᓕᐅᑦᑕᐅᒪᔨᓪᓚᕆᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓕᕆᔨᑐᑉᓂ ᐊᑕᐅᓯᐊᖅᓗᐊᑎᒃ ᐊᒻᒋᔪᒍ.
** ᐊᒃᓵᓂᓕᕆᓯᒪᔨᓪᓚᕆᑦ ᑕᖃᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 201

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᖅᓄᓂ ᐊᖏᔪᓕᓐᓂᖅᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖅᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐᒃ % ᑲᑎᑐᑦ ᐊᖏᔪᓕᕆᑦ ᑎᑎᕐᑦᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)

ᐊᒻᒋᔪᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑲᐃᓂ	NOV ᓄᐊᒻᒪᓂ	DEC ᑎᓯᒻᒪᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᕕᖕᒧᐊᓂ	MAR ᒪᓯ	APR ᐃᓴᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	98	100	99	100
4-6 months	4-6 ᑕᖅᑲ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	1	0
> 6 months	> 6 ᑕᖅᑲ	> 6 tatkin	0	0	0	0	0	0	0	0	0	2	0	0	0

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 202

Number of hunters harvesting each species — **Year 2 (June 1997 - May 1998)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓚᓯᖅᑎᑦ ᐊᖏᓚᓯᖅᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒃᑭᒍ 2 (ᔪᓂ 1997 - ᒪᐃ 1998)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 2 (June 1997 - May 1998)**

Month/ᑕᕝᕕᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᔅᑎᑎ	SEP ᓯᑎᐱᕆᓗ	OCT ᐅᑲᐱᕆᓗ	NOV ᐅᓇᐱᕆᓗ	DEC ᑎᓯᐱᕆᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᔨᓯ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑲᐃᐃᑦ	Tuktut	31	25	53	36	24	3	9	33	43	60	45	47	129
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut	2								2	2	1		6
Coloured fox	ᖃᓄᖕᖏᑦᑐᑦ ᑎᓕᒃᓂᐅᔪᑦ	Kalaliit tigiganiat							1						1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				1	1	4	3		3	1			8
Ringed seal	ᓇᓕᓂᑦ	Natiinat	76	42	59	87	55	37	33	51	54	84	78	80	163
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	5	7	5	9	9	5	2	1	1			2	33
Harp seal	ᖃᐃᓐᓂᓪᓚᑦ	Qairulik	3	3	6	18	13	16	1						43
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit				4	11	9	3						22
Walrus	ᐊᐃᐃᓵᑦ	Akvik	2		2	3							1		8
Narwhal	ᑐᒻᓚᓪᓚᑦ ᖁᓕᓴᓗᑦ	Tuugaak		2											2
Beluga	ᖃᐅᕆᑦ ᖁᓕᓴᓗᑦ	Kilalugak	3	12	7										21
Canada goose	ᓂᕆᓪᓚᑦ	Nikliknik	7	1	1									17	21
Eider duck	ᒥᑎᑦ	Kingalik	35	18	6	17	24	7	1					2	71
Ptarmigan	ᐊᖏᓚᑦ	Akilgik			1	3	5	15	34	25	22	11	6	1	69
Eggs (unspecified)	ᐊᓯᖏᑕ ᑎᒥᐊᑦ ᒪᓂᖏᑦ	Manniit		2											2
Duck eggs	ᒥᑎᑦ ᒪᓂᖏᑦ	Tinmiat manniit	33	14											42
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	30	46	32	9	8	10	10	15	7	16	29	85	133
Cod	ᐅᒪᐃᑦ	Ugak										4	1	1	4
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk									1				1
Turbot	ᖃᓕᕆᓪᓚᑦ	Nataarnak									1	4	2	1	7

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᖏᑕᒍᖃᖅ ᐱᒃᔪᒍᓕᓂᓂᒃ ᐊᖏᓴᑦ ᖃᑕᐅᓂᖏᓐᓂᓗᑦ ᐊᓕᓴᐅᒪᔪᓂᒃ ᐊᖏᓴᓗᑦ ᓇᓕᐅᕐᓴᐳᓐᓂᑦ ᑐᓂᓴᖏᓐᓂᓗ ᐃᓄᐊᕋᓕᓚᓇᓗᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᒃᐳᐅᑦ/NAUNAIKUTA 203

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ

Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)

ᐊᑦᔪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐸᓗᓇ	OCT ᐅᑦᔪᓗᓇ	NOV ᐅᓇᓚᐸᓗᓇ	DEC ᑎᓯᓚᓗᓇ	JAN ᔮᖏᓇᐊᓗᓇ	FEB ᓇᖅᑐᐊᓗᓇ	MAR ᒪᓕᒃ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓕᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᐃᑦ	Tuktut	23	44	309	208	88	71	190	362	439	361	338	207	2,640 ± 68
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡								1	2	8	1	2	14
Wolf	ᐊᒪᓗᐃᑦ	Amagut								1	1	2	2		6 ± 2
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik			3	2		3	5	6	9	4	4		36 ± 6
Ringed seal	ᓇᑦᓯᑦ	Natiinat	794	483	563	517	491	517	547	416	397	354	547	622	6,248 ± 152
Bearded seal	ᐅᑭᐊᐃᑦ	Ukyuk	6	16	17	16	9	10	2						76 ± 7
Harp seal	ᖃᐃᓗᓕᓪᓕᑦ	Qairulik	3	4	3	48	32	19	10					6	125 ± 20
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit					1		1						2 ± 1
Walrus	ᐊᐃᐃᓴᑦ	Akvik	5	2	5										12 ± 6
Narwhal	ᑐᒻᓪᓕᑦ ᖁᓕᓂᒃ	Tuugaak		1				2						9	12 ± 5
Beluga	ᖃᓄᖅᑕ ᖁᓕᓂᒃ	Kilalugak	4	6										2	12 ± 3
Bowhead	ᐃᖃᕆᑲ	Aivik		1											1 ± 1
Canada goose	ᓄᖅᓪᓕᑦ	Nikliknik	6		1									3	10 ± 3
Eider duck	ᒥᑎᑦ	Kingalik	291	121	58	110	249	122	88						1,039 ± 111
Ptarmigan	ᐃᖏᓱᑦ	Akilgik						37	55	168	135	66	8		469 ± 59
Duck eggs	ᒥᑎᑦ ᒪᓂᖅᑦ	Tinmiat manniit	1,382	812											2,194 ± 268
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	825	5,235	503	139	1,172	992	1,402	7,966	2,717	2,182	5,950	4,814	33,897 ± 2,133
Turbot	ᖃᓕᕆᓪᓕᑦ	Nataarnak										2,157			2,157 ± 971

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓄᑦ ᑎᑎᕋᐅᒪᓕᖅᑐᑦ ᑐᓂᓴᖏᑦ ᐅᑉᐊᐃ ᐃᑯᐊᕐᓂᓕᕆᔨᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 204

Monthly hunter response

ᑕᖏᑕᒪᑦ ᐊᖏᔪᓚᐱᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐱᓕᕆᔨ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖏᖓ/Tatkia			JUN ᔮᓂ	JUL ᔭᓪᓗ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑯᐊᓂ	NOV ᐃᓕᓴᕐᕕᓂ	DEC ᑎᓯᕐᕕᓂ	JAN ᔨᖅᓄᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᔾᔪ	APR ᐃᔾᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓚᐱᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᔾᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒪᑦ ᐊᖏᔪᓚᐱᑎᑦ	Tatkitaman angunahuktut titigait	180	181	179	179	180	178	182	179	177	177	178	183	194*
Hunters interviewed	ᐊᖏᔪᓚᐱᑎᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	156	166	160	157	156	156	159	161	164	160	158	159	185*
Harvested	ᐊᖏᔪᓚᐱᑐᒃᓯᑦ	Angujaujut	108	115	109	95	99	84	93	101	107	98	118	103	180*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	87	92	89	88	87	88	87	90	93	90	89	87	89**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓚᐱᑎᑦ ᐊᑎᓕᐅᑕᒪᓐᓇᖅ/ᐊᐱᕐᓯᑦ/ᐊᖏᔪᓚᐱᑐᒃᓯᑦ ᐊᑕᐅᓯᐊᖅᓯᑎᕐᕕᐅᓂᖅ ᐊᓕᕐᔪᒥ.
** ᐱᓕᕆᓂᖅᓯᒪᔪᑦ ᑕᖏᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 205

6.1.9

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕆᐅᔨᑦ ᐊᑯᖏᓐᓄ ᐊᖏᔪᓚᐱᓂᓐᓇᑦ ᐊᒪᓗ ᐊᐱᕐᓯᑦᑕᐅᓂᓐᓇᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓚᐱᑦ ᑎᑎᕐᕆᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

ᐱᓕᕆᔨ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖏᖓ/Tatkia			JUN ᔮᓂ	JUL ᔭᓪᓗ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑯᐊᓂ	NOV ᐃᓕᓴᕐᕕᓂ	DEC ᑎᓯᕐᕕᓂ	JAN ᔨᖅᓄᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᔾᔪ	APR ᐃᔾᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕆᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	98	100	99	100	100	100	100	99	99	100	100	100	100
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	2	0	1	0	0	0	0	1	1	0	0	0	0
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 206

Number of hunters harvesting each species — **Year 3 (June 1998 - May 1999)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓚᓯᖅᑎᑦ ᐊᖏᓚᓯᖅᕿᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒃᑭᒍ 3 (ᔪᓂ 1998 - ᒪᐃ 1999)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 3 (June 1998 - May 1999)**

Month/ᑕᖅᖢᓪ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᔨᑎ	SEP ᓯᑎᐅᕆᓚᓂ	OCT ᐅᑦᔨᕆᓚᓂ	NOV ᐅᓐᐊᒃᕆᓚᓂ	DEC ᑎᓯᒃᕆᓚᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᓇᖅᑐᐊᓂ	MAR ᒪᓯ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓪᓗ Tamakiklugin
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	11	17	70	52	19	23	44	75	90	89	94	61	156
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓪᐃᑦ	Amagut								1	1	1	1		4
Arctic hare	ᐅᑲᓕᑦ	Ukalik			2	2		2	2	4	4	1	2		14
Ringed seal	ᓇᑭᓕᑦ	Natiinat	104	92	106	94	95	83	82	77	68	59	68	83	171
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	6	13	11	14	7	9	2						43
Harp seal	ᖃᐃᓕᓂᑦ	Qairulik	1	2	2	13	12	4	3					1	26
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit					1		1						2
Walrus	ᐊᐃᐸᒃᑦ	Akvik	3	2	1										5
Narwhal	ᑐᒻᓂᓪᑦ ᖁᓪᓗᑦ	Tuugaak		1				2						4	6
Beluga	ᖃᓄᖅᑦ ᖁᓪᓗᑦ	Kilalugak	4	6										2	11
Bowhead	ᐋᖅᕆᒃ	Aivik		1											1
Canada goose	ᓄᖅᓂᓪᑦ	Nikliknik	3		1									2	6
Eider duck	ᒥᑎᑦ	Kingalik	26	13	5	10	13	9	3						58
Ptarmigan	ᐋᖏᓱᑦ	Akilgik						3	5	12	10	3	2		21
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖅᑦ	Tinmiat manniit	26	15											38
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	18	82	8	2	18	12	13	39	24	30	90	81	154
Turbot	ᖃᓕᕆᓪᓕᑦ	Nataarnak										3			3

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕆᔨᒪᔪᓂᒃ ᐱᑕᖃᓐᓂᖅᓱᒃ ᐱᓕᐊᑎᓕᓐᓂᓂᒃ ᐊᖏᓱᑦ ᖃᕆᐅᓂᓐᓂᖅᓂᓕᑦ ᐊᓕᖁᐅᒪᒪᓕᒃᑐᓕᑦ ᐊᑐᖁᑦ ᓇᓕᐅᕆᓚᑎᓂᓐᓂᒃ ᑐᓂᓗᐅᓐᓂᖅᓂ ᐃᑯᐱᕆᐊᓕᓕᓐᓂᒃᑕᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 207

Monthly harvest estimates
ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓚᐅᑦ
Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)
ᐊᓱᖏᔪ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᑕᒪᒃ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒡᒎᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒡᐱᓗ	DEC ᑎᓯᒡᐱᓗ	JAN ᔮᖏᓇᓗ	FEB ᓇᖅᑐᓇᓗ	MAR ᒪᓯ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᑦ	Tuktut	49	61	192	240	13	5	91	246	366	326	102	99	1,790 ± 73
Polar bear‡	ᓄᓇᐃᑦ‡	Nanuit‡							1						
Wolf	ᐊᒪᓗᐃᑦ	Amagut								1		2	3	5	11 ± 6
Arctic fox	ᑎᓘᑦᓂᐊᑦ	Tigiganiat						5							5 ± 4
Coloured fox	ᖃᐅᖅᑭᑦ ᑎᓘᑦᓂᐊᑦ	Kalaliit tigiganiat						4	3	2	1				10 ± 4
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				17		10	12	18	14	14			85 ± 15
Ringed seal	ᓇᕆᑦ	Natiinat	800	604	471	497	483	337	301	290	303	380	308	594	5,368 ± 231
Bearded seal	ᐅᑉᐊᐃᑦ	Ukyuk	1	2	10	10	2	2	2		3				32 ± 6
Harp seal	ᖃᐃᕐᓚᑦ	Qairulik				6	2	1	2						11 ± 4
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit				1									1 ± 1
Walrus	ᐊᐃᐅᒃᑦ	Akvik	2	11		2									15 ± 5
Narwhal	ᑐᒻᓚᓪᑦ ᖃᓪᓗᓂᑦ	Tuugaak	15	2			17							1	35 ± 7
Beluga	ᖃᐅᖅᑦ ᖃᓪᓗᓂᑦ	Kilalugak	4	28	1		1							1	35 ± 4
Canada goose	ᓄᖅᓚᓪᑦ	Nikliknik	1											11	12 ± 9
Eider duck	ᒥᑎᑦ	Kingalik	132	517		31	8	8	13						709 ± 55
Ptarmigan	ᐊᖏᓴᑦ	Akilgik					27	74	71	184	140	86			582 ± 86
Duck eggs	ᒥᑎᑦ ᒪᓂᕐᑦ	Tinmiat manniit	525	1,985											2,510 ± 246
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	2,316	3,304	4,545	173	2,039	1,389	1,665	2,920	4,011	2,869	2,320	3,641	31,192 ± 1,842
Cod	ᐅᓴᐃᑦ	Ugak									61		943		1,004 ± 913
Turbot	ᖃᓕᕆᓪᑦ	Nataarnak									116	7,738	4,484		12,338 ± 5,245
Clams	ᐊᑊᒧᒪᓕᕐᑦ	Uviluq			238	54									292 ± 193

‡ Polar bear data supplied by DSD.

‡ ᓄᓇᑦᓂᑦ ᑎᑎᕋᐅᒪᓕᕐᑦ ᑐᓂᓴᖏᑦ ᐅᑉᐊᐃ ᐃᑯᐊᕐᓂᓕᕆᔨᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 208

Monthly hunter response
ᑕᖏᑕᒪᑦ ᐊᖓᔪᓚᖅᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᒡᕐᔪᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᓕ	SEP ᓯᑎᕆᓚᓗ	OCT ᐅᑐᕆᓚᓗ	NOV ᐅᓇᒡᕆᓚᓗ	DEC ᑎᓯᒡᕆᓚᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᐃᖏᐅᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓀᓪᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖓᔪᓚᖅᑎᑦ ᑭᐅᓂᖏᑦ ᐋᔪᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒪᑦ ᐊᖓᔪᓚᖅᑎᑦ	Tatkitaman angunahuktut titigait	183	184	186	184	183	185	185	185	184	185	187	188	197*
Hunters interviewed	ᐊᖓᔪᓚᖅᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	157	163	163	160	151	143	150	146	156	147	153	154	185*
Harvested	ᐊᖓᔪᓚᖅᑐᒥᓂᑦ	Angujaujut	107	109	98	92	72	63	62	76	92	89	95	103	175*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓕᔭᐅᓂᖏᑦ (%)	Kiujut (%)	86	89	88	87	83	77	81	79	85	79	82	82	83**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖓᔪᓚᖅᑎᑦ ᐊᑎᓕᐅᑦᑕᐅᒪᔨᖏᑦ/ᐊᐱᕐᓂᑦᑕᑦ/ᐊᖓᔪᓚᖅᑐᒥᓂᑦ ᐊᑕᐅᓯᐊᖃᓗᑎᒃ ᐊᒡᕐᔪᒍ.
** ᐃᓕᓴᕐᓂᓯᒪᔨᖏᑦ ᑕᖏᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 209

Recall period between harvest and interview, expressed as % of total harvest records

Year 4 (June 1999 - May 2000)

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᓴᓂ ᐊᖓᔪᓚᓯᓂᖓᓂᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓂᑕ, ᓇᓗᓇᐃᕐᑕ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖓᔪᓚᖅᑦᑕ ᑎᑎᕐᑦᑕᐅᒪᔨᔨᑦ

ᐊᒡᕐᔪᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᓕ	SEP ᓯᑎᕆᓚᓗ	OCT ᐅᑐᕆᓚᓗ	NOV ᐅᓇᒡᕆᓚᓗ	DEC ᑎᓯᒡᕆᓚᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᐃᖏᐅᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓀᓪᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	100	100	100	100	100	100	96	100	100	100	99	100	100
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	4	0	0	0	1	0	0
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

6.1.9

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 210

Number of hunters harvesting each species — **Year 4 (June 1999 - May 2000)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓕᓴᒃᑎᑦ ᐊᖏᔪᓕᓴᒃᑲᓪᓚᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒡᖁᒍ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 4 (June 1999 - May 2000)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔫᓂ	JUL ᐊᓕᐃ	AUG ᐊᐅᒡᒎᑎ	SEP ᓯᑎᐱᕆ	OCT ᐅᑲᐱᕆ	NOV ᐅᓇᒡᐱᕆ	DEC ᑎᓯᒡᐱᕆ	JAN ᔭᓐᓄᐊᕆ	FEB ᓇᖑᐊᕆ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᖅ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**													
Caribou	ᑐᑲᐃᐃᑦ	Tuktut	22	32	63	78	5	3	25	52	80	73	30	21	146
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut								1		2	1	2	6
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat						1							1
Coloured fox	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓕᓴᓂᐊᑦ	Kalaliit tigiganiat						1	1	1	1				2
Arctic hare	ᐅᑲᓪᓗ	Ukalik				3		3	3	3	6	4			10
Ringed seal	ᓇᖏᑦ	Natiinat	89	79	80	85	69	56	47	46	50	49	49	67	151
Bearded seal	ᐅᓗᐊᐃᑦ	Ukyuk	1	2	8	7	2	1	1		1				18
Harp seal	ᖃᐃᓕᓪᓗ	Qairulik				2	2	1	1						4
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit				1									1
Walrus	ᐊᐃᐅᓴᑦ	Akvik	1	5		1									7
Narwhal	ᑐᓗᓪᓕ ᕿᓪᓚᑦ	Tuugaak	7	1			14							1	19
Beluga	ᖃᐅᖏᑦ ᕿᓪᓚᑦ	Kilalugak	3	24	1		1							1	26
Canada goose	ᓄᖏᓪᓗ	Nikliknik	1											2	3
Eider duck	ᒥᑎᑦ	Kingalik	14	55		4	2	1	1						66
Ptarmigan	ᐊᕿᓴᑦ	Akilgik					2	4	7	10	10	4			20
Duck eggs	ᒥᑎᑦ ᒪᓂᖅᑦ	Tinmiat manniit	14	58											63
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	51	69	60	8	13	10	22	32	42	35	63	70	153
Cod	ᐅᓴᐃᑦ	Ugak									1		1		1
Turbot	ᖃᓕᕆᓪᓗ	Nataarnak									1	6	10		12
Clams	ᐊᓚᒧᒪᓕᐊᑦ	Uviluq			1	1									2

6.1.9

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᓗ ᐱᕕᖃᖅᖢᑎᒃ ᐱᓕᕆᔨᒃᓂᓗ ᐊᖏᔪᑦ ᖃᕋᓯᐅᓂᖏᓐᓄᑦ ᐊᓯᖏᓐᓂᒃ ᓇᓗᓇᐃᔨᐅᑦ ᐃᓚᖓᔪᖅᓂᒃ ᐃᓄᐃᑦᑐᕐᓂᖅ ᐃᓄᐃᕐᓯᒪᓕᕆᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 211

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓚᑦ

Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)

ᐊᓗᖕᒍ 5 (ᔮᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖢᓗ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᓴᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓚᓴᓗ	DEC ᑎᓯᓚᓴᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	21	33	245	279	25	19	230	333	413	244	297	248	2,387 ± 92
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡						1	1						
Wolf	ᐊᒪᓕᐃᑦ	Amagut								1	1	4			6 ± 5
Coloured fox	ᖃᓄᖅᑎᑦ ᑎᓕᒃᓂᐊᑦ	Kalaliit tigiganiat							1	11	4				16 ± 11
Arctic hare	ᐅᒃᓪᓗᑦ	Ukalik				3	14	76	57	27	6	3			186 ± 48
Seals (unspecified)	ᓂᖏᓄᓪᓗᑦ	Natiit					1	1							2 ± 2
Ringed seal	ᓇᓂᓱᑦ	Natiinat	533	607	543	562	315	291	131	295	294	262	335	440	4,608 ± 148
Bearded seal	ᐅᒃᔪᐃᐃᑦ	Ukyuk		11	2	4	1		1				1		20 ± 4
Harp seal	ᖃᐃᐳᓪᓗᑦ	Qairulik				2	4	18							24 ± 8
Walrus	ᐊᐃᓇᒃᑦ	Akvik		8		7									15 ± 5
Narwhal	ᑐᒧᓪᓗᑦ ᖃᓪᓚᒃᑦ	Tuugaak		50										1	51 ± 4
Beluga	ᖃᓄᖅᑦ ᖃᓪᓚᒃᑦ	Kilalugak		29	6										35 ± 5
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	7												7 ± 6
Canada goose	ᓂᖅᓪᓗᑦ	Nikliknik	2			3								6	11 ± 4
Eider duck	ᒥᑎᑦ	Kingalik	90	11	43	64	56	115							379 ± 61
Ptarmigan	ᐊᖃᓕᑦ	Akilgik					77	399	782	141	37	8			1,444 ± 162
Duck eggs	ᒥᑎᑦ ᒪᓂᖏᑦ	Tinmiat manniit	316	44											360 ± 81
Arctic char	ᐃᖃᓗᒃᐸᑦ	Ikaliviit	2,879	10,179	3,778	349	372	520	2,706	2,080	1,746	1,224	2,679	5,062	33,574 ± 1,350
Cod	ᐅᓗᐃᑦ	Ugak			71				3						74 ± 55

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᓪᓂᑦ ᑎᑎᕋᐅᒪᓕᖅᑐᑦ ᑐᓂᓯᖏᑦ ᐅᑯᐊᖏᓪᓕᓇᓂᒃᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 212

Monthly hunter response

ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓕᕆᔨᑦ ᑭᐅᓂᖓᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᒻᒋᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒍᑎᓪ	SEP ᓯᑎᕐᓴᓗ	OCT ᐅᑦᔪᓴᓗ	NOV ᓄᐊᕐᓴᓗ	DEC ᑎᓯᕐᓴᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᑉᓯ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᕆᔨᑦ ᑭᐅᓂᖓᑦ ᐊᑐᓯᒪᓂᖓᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓕᕆᔨᑦ	Tatkitaman angunahuktut titigait	187	189	188	185	186	186	188	189	188	187	188	188	194*
Hunters interviewed	ᐊᖏᔪᓕᕆᔨᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	162	170	164	162	151	151	151	152	157	148	156	157	184*
Harvested	ᐊᖏᔪᓕᕆᔨᑐᑉᓂ	Angujaujut	108	142	119	95	59	69	85	70	87	69	93	107	176*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖓᑦ (%)	Kiujut (%)	87	90	87	88	81	81	80	80	84	79	83	84	84**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓕᕆᔨᑦ ᐊᑎᓕᐅᑕᒪᓕᕐᓂᑦ/ᐊᐱᕐᓂᑦᑕᑦ/ᐊᖏᔪᓕᕆᔨᑐᑉᓂ ᐊᑕᐅᓯᐊᖅᓯᒪᔪᑦ ᐊᒻᒋᒍ.
** ᐃᓕᓴᕐᓂᑎᓕᐊᓂᑦ ᑕᖃᑦᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.1.9

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 213

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕋᐃᐅᔾᔨᑦ ᐊᑯᖏᓐᓄᓂ ᐊᖏᔪᓕᕆᓂᖓᓐᓂᒃᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓐᓂᒃᑕ, ᓇᓗᓇᐃᖏᑦᑕ ᐃᒪᓐᒃ % ᑲᑎᑦᑎᓂᑦ ᐊᖏᔪᓕᕆᒃᑕᑦ ᑎᑎᖏᑦᑕᐅᒪᔾᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᒻᒋᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒍᑎᓪ	SEP ᓯᑎᕐᓴᓗ	OCT ᐅᑦᔪᓴᓗ	NOV ᓄᐊᕐᓴᓗ	DEC ᑎᓯᕐᓴᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᑉᓯ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᑦ Tamakiklugin
Recall Period	ᐅᑎᕋᐃᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	98	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	2	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 214

Number of hunters harvesting each species — **Year 5 (June 2000 - May 2001)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓕᓴᐅᑎᑦ ᐊᖏᔪᓕᓴᐅᕐᓂᑦ ᐊᑐᓂᒃ — **ᐊᒃᑦᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 5 (June 2000 - May 2001)**

Month/ᑕᖅᖢᓪᓕ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᑲᔨᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑦᐹᓗ	NOV ᐅᓇᕆᐹᓗ	DEC ᑎᓴᐹᓗ	JAN ᔮᖅᓇᐊᓗ	FEB ᓇᖏᐅᐊᓗ	MAR ᒪᓴ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	9	14	69	65	5	5	49	57	80	51	70	67	146
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut								1	1	1			3
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓕᒃᓂᐊᑦ	Kalaliit tigiganiat							1	1	1				2
Arctic hare	ᐅᒃᓪᓂᑦ	Ukalik				2	4	11	11	6	1	1			16
Seals	ᓯᖏᓄᓪᓂᑦ	Natiit					1	1							1
Ringed seal	ᓇᕆᑦ	Natiinat	79	99	103	89	53	53	24	43	54	33	41	66	143
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		9	1	4	1		1				1		15
Harp seal	ᖃᐃᓗᓪᓂᑦ	Qairulik				1	1	7							8
Walrus	ᐊᐃᐃᒍᑦ	Akvik		3		2									5
Narwhal	ᑐᒻᓪᓂᑦ ᕿᓪᓗᓂᑦ	Tuugaak		40										1	41
Beluga	ᖃᓄᑦᑕ ᕿᓪᓗᓂᑦ	Kilalugak		23	2										24
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	1												1
Canada goose	ᓂᑦᓪᓂᑦ	Nikliknik	1			1								3	4
Eider duck	ᒥᑎᑦ	Kingalik	9	1	4	4	4	10							25
Ptarmigan	ᐊᑭᓚᑦ	Akilgik					6	19	43	8	2	1			47
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᑦ	Tinmiat manniit	9	1											10
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	66	127	69	7	5	6	31	23	28	32	64	88	159
Cod	ᐅᒃᐃᑦ	Ugak			1				1						2

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓕᓴᐅᓗᑦ ᐱᒋᖃᖏᑦᑐᖅ ᐱᓕᕆᓂᓐᓂᓗᑦ ᐊᖏᔪᒃᑯᑦ ᖃᓄᐅᓂᖏᓐᓄᑦ ᐊᓂᔭᖅᑐᓂᒃᑯᑦ ᐊᖏᔪᓄᑦ ᓇᓂᐊᖏᓪᓗᓂᒃᑯᑦ ᑐᓴᔭᖏᓐᓂᒃ ᐃᑯᐸᖏᓐᓂᒃ ᐃᑲᓗᐊᖏᑦᑐᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 215

Annual harvest estimates and five-year mean

All Years (June 1996 - May 2001)

ᐊᓐᖁᔭᒧᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓐᔅᓴᑦ ᐊᓚᓗ ᑕᒻᓕᓂᑦ-ᐊᓐᖁᔭᓂᑦ ᐊᐅᔨᓕᕐᒪᓕᐊᑦ ᑕᒪᐃᖏᓂᑦ ᐊᓐᖁᔭᓂᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᓐᖁᔭ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Mean ᐊᐅᔨᓕᕐᒪᓕᐊᑦ Amigaitkiyait
			96/97	97/98	98/99	99/00	00/01	
Species	ᐅᒪᓕᑦ	**Umajuin**						
Caribou[1]	ᑐᖅᑐᐃᑦ[1]	Tuktut[1]	1,840	1,833	2,640	1,790	2,387	2,098
Polar bear[2]	ᓇᓂᐃᑦ[2]	Nanuit[2]	15	12	14	11	9	12
Wolf[3]	ᐊᒪᓗᐃᑦ[3]	Amagut[3]	10	13	6	11	6	9
Arctic fox	ᑎᓘᓐᓂᐊᑦ	Tigiganiat	29	0	0	5	0	7
Coloured fox	ᖃᓄᐖᕐᑐᑦ ᑎᓘᓐᓂᐊᑦ	Kalaliit tigiganiat	12	4	0	10	16	8
Arctic hare	ᐅᒃᓪᓕ	Ukalik	30	43	36	85	186	76
Seals (unspecified)	ᓂᖏᓄᓪᓕ	Natiit	195	0	0	0	2	39
Ringed seal[4]	ᓇᕐᓂᑦ[4]	Natiinat[4]	7,698	6,567	6,248	5,368	4,608	6,098
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	213	78	76	32	20	84
Harp seal[5]	ᖃᐃᕐᓪᓕᑦ[5]	Qairulik[5]	1,309	188	125	11	24	331
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	0	163	2	1	0	33
Walrus[6]	ᐊᐃᐸᒃᑦ[6]	Akvik[6]	15	25	12	15	15	16
Narwhal[7]	ᑐᒡᓪᓕᑦ ᖁᓕᓴᑦ[7]	Tuugaak[7]	68	4	12	35	51	34
Beluga[8]	ᖃᓄᖅᑦ ᖁᓕᓴᑦ[8]	Kilalugak[8]	54	41	12	35	35	35
Bowhead	ᐋᕕᒃ	Aivik	0	0	1	0	0	<1
Snow goose	ᑲᖏᐃᑦ	Kanguq	0	0	0	0	7	1
Canada goose[9]	ᓄᖅᓪᓕᑦ ᐅᓪᐊᒍᓪᓕᑦ[9]	Nikliknik[9]	348	75	10	12	11	91
Eider duck[10]	ᒥᑎᑦ[10]	Kingalik[10]	2,752	1,607	1,039	709	379	1,297
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre	4	0	0	0	0	1
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	1,608	3,007	469	582	1,444	1,422
Eggs (unspecified)	ᓚᐅᓪᓕᑦ	Manniit	276	114	0	0	0	78
Duck eggs	ᒥᑎᑦ ᓚᐅᖏᑦ	Tinmiat manniit	2,884	3,423	2,194	2,510	360	2,274
Arctic char[11]	ᐃᖃᓗᐃᑦ[11]	Ikaliviit[11]	44,007	32,654	33,897	31,192	33,574	35,065
Cod	ᐅᖃᐃᑦ	Ugak	493	1,260	0	1,004	74	566
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	2	163	0	0	0	33
Turbot[12]	ᖃᓄᕆᓪᓕᑦ[12]	Nataarnak[12]	7,900	4,179	2,157	12,338	0	5,315
Clams	ᐊᑦᒍᒪᔪᑦ	Uviluq	4,715	0	0	292	0	1,001

[1-12]: See page 339 for community feedback and other sources of data.

[1-12]: ᑕᐃᖅ ᒪᐸᕐᒉᖅ 341 ᓄᓇᓕᓂᑦ ᑭᐅᔭᕆᐊᖃᖅᑎᑦ ᐊᓚᓗ ᐊᓯᖏᑦ ᐱᖁᐅᔪᓂᑦ ᓇᓗᐅᑎᓂᖅ.

[1-12]: Takulugu makpigaak 343 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

TABLE/ᓄᓇᓕᐃᒃᑐᑦ/NAUNAIKUTA 216

Annual hunter response
ᐊᓚᖏᔪᒡᒐᒃ ᐊᖓᔪᓕᕆᔨᒃ ᑭᐅᓂᖓᑦ
Angujauvaktu

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓄᑦ ᐊᓚᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᓚᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Hunter Response Categories	ᐊᖓᔪᓕᕆᔨᒃ ᑭᐅᓂᖓᑦ ᐊᓚᔪᒍᓂᖓᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᑭᑕᒪᑦ ᐊᖓᔪᓕᕆᔨᒃ	Tatkitaman angunahuktut titigait	184	191	194	197	194	224*
Hunters interviewed	ᐊᖓᔪᓕᕆᔨᒃ ᐊᐱᕐᓂᖅᑕᑦ	Angunahuktin apikhuktan	178	179	185	185	184	218*
Harvested	ᐊᖓᔪᓕᕆᔨᑐᓗᓂᒃ	Angujaujut	168	173	180	175	176	214*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᓂᖓᑦ (%)	Kiujut (%)	62	79	89	83	84	79**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖓᔪᓕᕆᔨᒃ ᐊᑎᓕᐅᕐᓗᒍ/ᐊᐱᕐᓂᖅᑕᑦ/ᐊᖓᔪᓕᕆᔨᑐᓗᓂᒃ ᐊᑕᐅᓯᐊᔪᓕᐅᑎᓪᓗᒍ ᖃᐅᔨᓴᖅᑎᑦᑎᓂᖅ.
** ᐱᔭᕇᓂᕐᒥᒪᔨᑦ ᐊᓚᔪᒍᓂᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᓄᓇᓕᐃᒃᑐᑦ/NAUNAIKUTA 217

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᓴᓂ ᐊᖓᔪᓕᕆᓂᖓᓂᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᖅᑕᐅᓂᖓᓂᑕ, ᓄᓇᓕᐃᕐᑕ ᐃᓱᒪᑦ % ᑲᑎᕐᔪᑦ ᐊᖓᔪᓕᕆᔨᑕ ᑎᑎᕐᑕᐅᒪᔨᑦ
Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓄᑦ ᐊᓚᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᓚᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᑭᑦ	≤ tatkin pingahut	99	100	100	100	100	100
4-6 months	4-6 ᑕᑭᑦ	tatkin hitaman 6nut	0	0	0	0	0	0
> 6 months	> 6 ᑕᑭᑦ	> 6 tatkin	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 218

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᒃᑎᑦ ᐊᖏᔪᓚᒃᓴᓕᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᑦᑭᔪᓂᑦ (ᔨᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᑭᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᓪᓗᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**						
Caribou	ᑐᓴᐃᑦ	Tuktut	123	129	156	146	146	203
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut	5	6	4	6	3	15
Arctic fox	ᑎᓇᓚᖅᓂᐊᑦ	Tigiganiat	9			1		10
Coloured fox	ᖃᐅᖅᖢᑎᑦ ᑎᓇᓚᖅᓂᐊᑦ	Kalaliit tigiganiat	5	1		2	2	9
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	13	8	14	10	16	40
Seals (unspecified)	ᓱᖃᐅᓪᓕᑦ	Natiit (unspecified)	1				1	2
Ringed seal	ᓇᓂᓱᑦ	Natiinat	153	163	171	151	143	208
Bearded seal	ᐅᑭᓪᓗᐃᑦ	Ukyuk	36	33	43	18	15	91
Harp seal	ᖃᐃᕐᓪᓕᑦ	Qairulik	55	43	26	4	8	92
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit		22	2	1		24
Walrus	ᐊᐃᓵᓴᑦ	Akvik	2	8	5	7	5	21
Narwhal	ᑐᒻᓪᓚᑦ ᖁᓪᓗᑎᑦ	Tuugaak	15	2	6	19	41	61
Beluga	ᖃᓄᖅᑦ ᖁᓪᓗᑎᑦ	Kilalugak	23	21	11	26	24	74
Bowhead	ᐋᕕᒃ	Aivik			1			1
Snow goose	ᑲᖏᒍᐃᑦ	Kanguq					1	1
Canada goose	ᓄᕐᓚᑦ ᐅᓗᐊᒍᓚᓪᓚᑦ	Nikliknik	17	21	6	3	4	44
Eider duck	ᒥᑎᑦ	Kingalik	73	71	58	66	25	128
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre	1					1
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	63	69	21	20	47	116
Eggs (unspecified)	ᒪᓰᓂᑦ	Manniit (unspecified)	5	2				7
Duck eggs	ᒥᑎᑦ ᒪᓰᓄᖅᑦ	Tinmiat manniit	26	42	38	63	10	104
Arctic char	ᐃᖏᓗᒃᐲᑦ	Ikaliviit	149	133	154	153	159	208
Cod	ᐅᓚᐃᑦ	Ugak	3	4		1	2	8
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk	1	1				2
Turbot	ᖃᓕᕆᓪᓕᑦ	Nataarnak	12	7	3	12		20
Clams	ᐊᑦᒧᒪᓇᐊᑦ	Uviluq	6			2		8

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᖅᖢᑎᒃ ᐱᓕᐊᓕᓪᓂᒃ ᐊᖏᓴᑦ ᖃᑦᓯᐅᓂᖏᓪᓂᑦ ᐊᓪᓚᖅᑕᒪᒪᔪᓂᑦ ᐊᖏᓴᓄᑦ ᓇᓪᓕᐅᑦᓱᑎᓂᒃ ᑐᓂᓴᖏᓪᓂ ᐃᓕᐴᖅᑎᓪᓗᓂᒃ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.9 Community Results Discussion: Pangnirtung

The survey frame:
An assessment of under-enumeration during the community visit revealed that there were approximately 69 hunters who were not registered in the Harvest Study. Sixty-eight of these were Inuit - 61 occasional hunters and seven active hunters. Many of these unregistered hunters were women. It is estimated that there was one non-Inuit occasional hunter with assigned hunting rights who was not registered. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. Given that these unregistered hunters represent 24 percent of the total hunter population (Table 10) the effect of this bias on harvest estimates could be significant. Harvest estimates for the unregistered hunters can be estimated using mean harvest quantities for each species by strata. However, these estimates, having their own sources of error and bias, are beyond the scope of this Final Report. Readers may apply to NWMB to obtain the results of these calculations.

Survey coverage and non-response bias:
Response rates in year 1 of the study were quite low in some months in Pangnirtung, dropping below 50% in four of these months and below 20% in two of these months. Response rates in other years were generally much higher. However response rates of the intensive stratum were lower than the other two strata in many months and dropped below 50% from October to December 1997 (year 2). As seen in Table 9 the consistent intentional non-response rate in Pangnirtung was relatively low, at 3.1%, and was not thought to be a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough during most months of years 2 to 5 to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should exercise caution when using the data collected during year 1 of the study and during the winter of year 2 since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:
There were no specific incidents of measurement error brought up during the community visit. However, readers should refer to Section 5.4 for a thorough discussion of this issue.

As seen in the recall period tables, the vast majority of harvest records were collected within three months of the harvest, thereby minimizing recall error.

As noted in the comments associated with arctic char and turbot below, there was commercial harvesting of both of these species during the study. It appears that harvest estimates for char do include some of the commercial harvest and should be considered too high if only considering the subsistence harvest of the community. However, since the turbot fishery is primarily commercial and there is very little subsistence harvest, it is felt that most of the harvest shown in the data tables represents commercial fishing. There were some records of char, cod and turbot recorded as commercial by the Fieldworker. These records were removed from the database and can be viewed in Table 4.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou. Harvest estimates seem accurate (C.F.).
2. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
3. **Wolf:** Harvest estimates seem too low, only a small number of hunters harvest wolves, so if some of these hunters were not interviewed harvest estimates would be low. DSD records show only 1 wolf pelt purchased in 1999/2000 (year 4) of the study (DSD FB).
4. **Ringed seal:** Although harvest estimates for ringed seal declined throughout the study, the HTO Board reported that the actual harvest of ringed seals increased over this time period and that these latter estimates seem too low (C.F.). DSD records show that in 1999/2000 (year 4), 1393 pelts were purchased from Pangnirtung hunters; in 2000/2001 (year 5), 1010 pelts were purchased indicating a decline in the number of pelts purchased from year 4 to year 5 (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based harvest years that run from June to May) (DSD FB).

[5] **Harp seal:** The harvest estimate in year 1 seems high (C.F.) and may be related to the very low participation rates early in this study year.

[6] **Walrus:** With the exception of year 2 which seems accurate, other harvest estimates appear too low (C.F.).

[7] **Narwhal:** The community annual quota was 40 animals. The harvest estimate in year 1 seems too high (C.F.) which again may be related to the low response rates early in this year resulting in a high degree of non-response bias. DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
19	2	2	41	50

[8] **Beluga:** The community annual quota was 35 animals. The harvest estimate in year 1 seems too high (C.F.), again this is likely related to low response rates early in the year. Harvest estimates in years 3 and 4 seem too low but estimates in years 2 and 5 appear to be accurate (C.F.). DFO reports the following harvest numbers for beluga (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
41	47	35	50	37

[9] **Canada goose:** Although the harvest estimate in year 1 seems too high, estimates in other years appear somewhat low (C.F.).

[10] **Eider duck:** Common eiders are more abundant in the area and are harvested in larger numbers than king eiders. Harvest estimates in years 4 and 5 seem low (C.F.).

[11] **Arctic char:** There is a significant amount of commercial char fishing in lakes around Pangnirtung (DFO F). It is felt that some of the commercial harvest was likely reported during the Harvest Study but that the majority was not. The harvest estimates shown are thought to include most of the subsistence harvest and a small portion of the commercial harvest. This is based on an assessment of the harvest estimates and on the fact that only a small number of the commercial fishermen in the community reported during the study (C.F.).

[12] **Turbot:** Most turbot fishing is commercial so the majority of the harvest estimates shown would represent commercial fishing. It is felt that, for the reasons discussed above relating to arctic char, these estimates represent only a small portion of the actual commercial harvest of turbot taken each year (C.F.).

6.1.9 ᓄᓇᕗᑦ ᓴᖅᑭᑕᐅᔪᓂᖅ ᐅᖃᖅᑎᑐᑦᑕᑎᑦ: ᕿᓂᖅᑐᖅ

ᖃᐅᔨᓴᓂᐅᕐᓂ ᐊᑐᖅᑭᒪᓂᖅᓗ:

ᖃᒥᖅᑭᔨᐅᑎᓪᓗᑎᑦ ᐊᑎᓕᐅᓇᖅᑐᓴᖅᓯᓂᐅᕐᓂ ᓄᓇᕗᑦ ᐅᓪᓗᖅᑕᐅᑎᓪᓗᑎᑦ ᑕᐃᑎᖅᓯᓪᓚᐅᖅᑐᑐᑦ ᑕᒧᐊ 69%ᔪᓂᑦ ᐊᖏᓇᓯᑎᑦ ᐊᑎᖃᖅᑕᓪᓚᐅᖅᑭᓂᐅᖅᑭᓂᐅᓕ ᖃᐅᔨᓴᖅᓯᔪᓂ. 68%ᔪᓪᓗᑎᑦ ᐃᓄᐃᑦ - 61%ᑦᑎ ᖃᐃᑎᐅᑦ ᐊᖏᓇᓯᑎᐅᓪᓗᑎᑦ ᐊᒻᒪ 7%ᔪᓪᓗᑎᑦ ᐊᖏᓇᓯᑎᑎᓪᓗᒃ ᐊᐅᓚᕐᓇᒃ. ᐅᓄᖅᑐᑦ ᑕᒪᐅᕼᐊ ᐊᖃᐃᑎᐅᓪᓚᐅᖅᑐᑦ. ᐃᓯᒪᓕᐅᑦᓯᓚᖅ ᐊᑕᐅᓯᐅᓪᓚᐅᖅᑐᓂᖅᓱᓂᓕ ᐃᓄᐃᓕᓴᐅᓯᓚᖅᑐᑦ ᐊᑎᖃᖅᑕᐅᑎᓪᓗᑎᑦ ᑐᓴᐅᑦᓯᓚᐅᖅᑐᑦ ᐊᖏᓇᓯᓕᕆᓪᓗᑎᑦ ᐊᑎᖃᖅᑕᐅᑎᓪᓗᑎᑦ ᖃᐅᔨᓴᖅᓯᔪᓂ. ᐅᖃᖅᑎᑐᑦᑕᑎᑦ ᐊᑎᖃᖅᑕᐅᑎᓪᓗᑎᑦ ᐊᑎᖃᖅᑕᐅᑎᓪᓗᑎᑦ ᐃᓄᐃᓕᓴᐅᓯᓚᖅᑐ

[5] **ᖃᐃᕐᓂᖅ:** ᖃᐃᕐᓱᒃᑐᒃᑯᐊᓂᖅ ᖃᓄᐃᓕᖅᑎᑦ ᐅᑭᐅᒥ 1 ᕿᓂᓗᐊᖅᑐᑦᓯᖅᑐᑦ (C.F.) ᐊᒻᒪ ᐱᒍᑎᖃᖅᔪᖅᑐᖅ ᖃᓄᐃᑦᓴᐃᓕᓴᕆᔨᖅᑎᓪᓗᓂ ᐃᓕᓴᐸᐃᑦ ᐅᑭᐅᒥ ᑕᐃᒃᑯᓂ ᖃᐅᔨᓴᕆᓕᕆᔨᖅᓯᒪᔪᑎᒥ.

[6] **ᐊᐃᐃᑦ:** ᐱᖃᓯᐅᑎᖑᓂᑐᒍ ᐅᑭᐅᖅ 2 ᒥᑦᓴᐅᓯᒪᓂᐊᖅᔪᖅᓯᒪᓂ, ᐊᓯᖏᓂ ᐅᒪᔪᖅᑕᐅᔨᓂᑐᓄᓪ ᒥᑦᓴᐅᑕᐅᓯᒪᔪᑦ ᐊᑎᓗᐊᖅᑐᑦᓯᖅᑐᑦ (C.F.).

[7] **ᑐᐃᓂᑦ:** ᓄᓇᓕ ᐊᑎᖃᔨᒪᒧᑦ ᔨᐱᖅᑲᕈᐃᖅᑐᑦ 40ᓂᒃ. ᐊᓕᓴᖓᐊᖅᑕᒥᓂᑦ ᖃᓄᐃᓕᖅᑎᑦ ᐅᑭᐅᒥ 1 ᕿᓂᓗᐊᖅᑐᑦᓯᖅᑐᑦ (C.F.) ᐊᑐᐊᔪᑦᓴᐅᓕᕆᔨᖅᑐᖅ ᑭᐅᑎᑦᑐᓂᖅᑐᑦ ᐊᑎᑦᑐᓄᖅᑐᓂᓪ ᐅᑭᐅᖅ ᐱᑎᐊᓕᓴᓂᓕᕆᔨᖅᑕᖏᓪᓗᓂ ᐃᓕᓕᐅᓇᓴᖅᑭᐊᖅᑕᐅᓕᖅᑐᓂᓪ ᑭᐅᓂᐅᓂᖅᓴ

6.1.9 Nunanit Iniktigutait Ukauhiit: Pangnirtung

Ihivgiuktit atugutait:
Ihivgiufaakhimayuni ataani naunaiyakhimayut nunani pulaakatakhimatitlugu takuhimayut 69nik umayukhiuktini titigakhimaitut Umayukhiukhimayut Ihivgiuhimayuni. 68kuyut tahapkoa Inuit – 61kuyut ilaani umayukhiukpaktut ovalo 7kuyut umayukhiukataktut. Amigaitut hapkoa titigakhimaitut aknauyut. Naunaiyakhimayuk atauhik Inuinaungituk ilaani umayukhiukpaktuk tuniyauhimayuk umayukhiugutinik inminiigutinik titigaktauhimaituk. Ukakhimayuk ilangani 5.2.1 ikpinagutait hamna ataani naunaiyautaini pilaaktuk ataani ihumagiyaini umayukhiukhimayut naunaiyautaini. Pihimamat hapkoa titigakhimaitut umayukhiuktit pihimamat 24%mik tamaaat umayukhiuktinit (ikpatauyak 10) ikpinagutait hapkoa ihumagiyait umayukhiukhimayut naunaiyautaini angiyut. Umaykhiukhimayut naunaiyautait titigakhimaitut umayukhiuktit naunaiyakhimalaat atuklugit anginikhait umayukhiukhimayut amigaitjutait tamamik umayuni aviktukhimalugit. Kihimi hapkoa naunaiyautait inminik pihimayut ihuinaagutait ovalo ihumagiyait avataaniitut hamani Iniktikhimayuni Tuhaktakhani. Taiguaktut apigilaat NWMBkunit piyumagumik iniktigutainik hapkoa naunaiyautainik.

Ihivgiukhimayut pihimayait ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait ukiumi 1mi ihivgiukhimayut mikiyut ilangit tatkikhiutini Pangniruumi, katakhimapluni ataanut 50%mik hitamani hapkoa tatkikhiutaini ovalo ataani 20%mik malguk hapkoa tatkikhiutaini. Kiuhimayut naunaiyautait aipaini ukiut angitkiyauyut. Kihimi kiuhimayut naunaiyautait umayukhiuginaktut aviktukhimayuni mikiyut aipainit malgunit aviktukhimayunit amigaituni tatkikhiutinit voalo katakhimayut ataani 50%mik Octobermit Decembermut 1997mi (ukiumi 2). Takukhauyut ikpatauyami 9mi pikataktut kiuyuitut naunaiyautait Pangnirtuumi mikiyut, 3.1%mik ovalo ihumagiyaungituk pilaaktuni pihimayut kiuyuitut ihumagiyaini.

Hiuhimayut naunaiyautait ihumgiyait angiyut ovalo kiuyuitut ihumagiyait mikiyut tatkikhiutini ukiuni 2mi ovalo 5mi piyaami nni pihimayut nakuuyunik ilaukatauyaami Nni umayukhiuktini. Taiguaktut piyukhat atugumik katitikhimayunik katitigutaini ukiumi 1mi ihivgiukhimayuni ovalo ukiumi ukiungani 2mi pilaamata tamamik uktukhimayut ihuinaagutaini ovalo kiuyuitut ihumagiyaini angiklivaktut kiuhimayut naunaiyautait katakpata.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Pihimaitut atugutingini ihuinaakhimayunik ukakhimaitut nunani pulaakhimatitlugit, Kihimi, taiguaktut takuyukhat ilangani 5.4 ukakatigiiniakat hamna ihumagiyauyut.

Takuhimayut utiktitihimayuni ubluit ikpatauyani, amigaitut umayukhiukhimayut titigakhimayuni katitikhimayut iluani pingahut tatkikhiutini umayukhiukhimayuni, taimaimat mikiyut utiktihimayut ihuinaagutait.

Titigakhimayut ukakhimayuni mikhaanut ikaliviit ovalo turbot hamani, kinauyaliugutit umayukhiukhimayuni tamamik hapkoa umayut ihivgiukhimatitlugu. Takukhauyuk umayukhiukhimayut naunaiyautait ikaliviit ilauhimayut ilangit kinauyaliukhimayut umayukhiukhimayuni ovalo piyukhat angiyut ihumagiligumiuk atuktakhaini umayukhiuktaminik nunamini. Kihimi turbotni ikalukhiuktut kinauyaliugutaumat ovalo mikiyuumata atuktakhaminik umayukhiugutaini, ihumagiyut amigaitut takuyauhimayut katitikhimayuni ikpatauyami pihimayut kinauyaliukhimayut ikalukhiuktut. Pihimayut ilangit titigakhimayut ikaliviit, ugait ovalo turbot titigakhimayut kinauyaliugutauyut nunani havaktinit. Hapkoa titigakhimayut unguvakhimayut katitikhimayunit ovalo takulaaktut ikpatauyami 4mi.

Nunanit ukakhimayut ovalo aalat pihimayaini katitikhimayuni:

1. **Tuktuit:** Tuktut umayukhiukhimayut ilauyut nunani tuktut. Umayukhiukhimayut naunaiyautait nakuuyut (C.F.).
2. **Nanuit:** Amigaitjutait takukhauyut naunaiyautaungitut kihimi pihimayut umayukhimayut amigaitjutait tunihimayut DSDkunit (DSD PB).
3. **Amagut:** Umayukhiukhimayut naunaiyautait mikiyut, ikitut umayukhiuktit umayukhiuvaktut amagunik, taimaitpat ilangi hapkoa umayukhiuktit ukakatigingitpata umayukhiukhimayut naunaiyautait mikiniaktut. DSDkut titigakhimayait takuhimayut atauhik amaguk amia niuviktauhimayuk 1999/2000mi (ukiumi 4) ihivgiukhimayuni (DSD FB).
4. **Natiinat:** Umayukhiukhimayut naunaiyautait natiit katakhimayuk ihivgiukhimatitlugu, HTOkut katimayiit tuhaktitihimayut umayukhiukhimayut natiit amigaikhimayuk hamani ubluini ovalo hapkoa kinguliit naunaiyakhimayut mikiyut (C.F.). DSDkut titigagutait takuhimayut 1999/2000mi (ukiumi 4), 1,393nik aminik niuviktauhimayut Pangnirtuumit umayukhiuktinit; 2000/2001mi (ukiumi 5), 1,010nik aminik niuviktauhimayut naunaiyakhimayuk kataktitihimayut amigaitjutait amiit niuviktauhimayut ukiumi 4mit ukiumut 5mut (nalungilutit DSDkut katitikhimayait pihimayut umayukhiukhimayut ukiungit pivaktut Julymit Junemut, Umayukhiukhimayut Ihivgiugutait katitikhimayut pihimayut umayukhiukhimayuni ukingit pivaktut Junemit Maymut (DSD FB).

[5] **Qairulik:** Umayukhiukhimayut naunaiyautait ukiumi 1mi angiyut (C.F.) ovalo pihimayunakhiyut ikitut ilaukatauyuni naunaiyautait pilihaaliktitlugu hamna ihivgiuktut ukiungani.

[6] **Akviit:** Kihimi ukiumi 2mi nakuuyut, aipait umayukhiukhimayut naunaiyautait mikiyut (C.F.).

[7] **Tuugaat:** Nunani ukiuk tamaat kotangit 40kuyut umayut. Umayukhiukhimayut naunaiyautait ukiumi 1mi angiyut (C.F.) pihimayunakhinmat ikitut kiuhimayut naunaiyautait pilihaaliktitlugu hamna ukiuk pipkakhimayait angiyut kiuyuitut ihumagiyani. DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait tugaaliit kilalugait (nalungilutit DFOkut katitikhimayait atukhimayut atuktaini ukiungini, Umayukhiukhimayut Ihivgiugutait katitikhimayut pihimayut umayukhiukhimayuni ukiungani pivaktut Junemit Maymut (DFO N/B).

96/97	97/98	98/99	99/00	00/01
19	2	2	41	50

[8] **Kilalugait:** Nunai ukiuk tamaat kotangit 35kuyut umayut. Umayukhiukhimayut naunaiyautait ukiumi 1mi angiyut (C.F.), ilaa hamna pihimamat mikhaanut ikitut kiuhimayut naunaiyautait pilihaaliktitlugu ukiuk. Umayukhiukhimayut naunaiyautait ukiumi 3mi ovalo 4mi mikiyut kihimi naunaiyaytait ukiumi 2mi ovalo 5mi nakuuyut (C.F.). DFOkut tuhaktitiyait hapkoa umayukhiukhimayut amigaitjutait kilaluganik (nalungilutit DFOkut katitikhimayait pihimayut atuktaini ukiuni, Umayukhiukhimayut Ihivgiukhimayuni katitikhimayut pihimayut umayukhiukhimayuni ukiungani pivaktut Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
41	47	35	50	37

[9] **Uluaguliit:** Umayukhiukhimayut naunaiyautait ukiumi 1mi angiyut, naunaiyautait aipaini ukiuni naamaktut (C.F.).

[10] **Tingmiat:** Mitiit amigaitut nunani ovalo umayukhiukpaktit amigaitunik kingalinit. Umayukhiukhimayut naunaiyautait ukiumi 4mi ovalo 5mi mikiyut (C.F.).

[11] **Ikaliviit:** Amigaitut kinauyaliuktut ikaliviit ikalukhiukpaktuni tahini haniani Pangirtuumi (DFO F). Ihumavaktut ilangit kinauyaliugutit umayukhiuktut tuhaktitihimayut umayukhiukhimayut ihivgiuhimayuni kihimi amigaitut tuhaktitingitut. Umayukhiukhimayut naunaiyautait takukhauyut ihumagiyauyut ilauyut amigaitkiyaut atuktakhaini umayukhiukhimayaini ovalo mikiyut ilangit kinauyaliuktut umayukhiuktuni. Hamna pihimayuk ihivgiufaakhimayuni umayukhiukhimayut naunaiyautaini ovalo taimaimat mikiyut amigaitjutait kinauyaliuktut ikalukhiuktuni nunani tuhaktitivaktut ihivgiukhimatitlugit (C.F.).

[12] **Nataarnak:** Amigaitut turbot ikalukhiugutait kinauyaliuktut, amigaitkiyait umayukhiukhimayut naunaiyautait takukhauut pihimayut kinauyaliuktunik ikalukhiuktunit. Ihumagiyut, pihimaut ukakhimayut hamani mikhaanut ikaliviit, hapkoa naunaiyautait takukhauyut mikiyut ilangit kinauyaliuktuni umayukhiukhimayut turbotni pivaktut tamaat ukiuni (C.F.).

6.1.9

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 219

Monthly harvest estimates
ᑕᕆᑦᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᕐᔪᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᓐᔾᔨᒍ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᕆᖏᖅ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᕕ	OCT ᐅᑲᐱᕕ	NOV ᐅᓇᓚᕕ	DEC ᑎᓯᓚᕕ	JAN ᔮᖏᓇᐊᕕ	FEB ᐃᖏᕐᐊᕕ	MAR ᒪᓯ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᔭᐅᑐᐃᑦ	Tuktut	61	37	268	68	142	318	21	231	278	301	226	218	2,169 ± 208
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡						3				7	2	4	16
Wolf	ᐊᒪᓱᐃᑦ	Amagut						3			6	7	1	3	20 ± 11
Arctic fox	ᑎᓕᓴᐅᐊᑦ	Tigiganiat					2	14	2		74	51	5	2	150 ± 86
Coloured fox	ᖃᐅᖏᑦᑐᑦ ᑎᓕᓴᐅᐊᑦ	Kalaliit tigiganiat						14			11	7			32 ± 13
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik			2	7	13	10		8	25	29	37	8	139 ± 29
Ringed seal	ᓇᓯᓪᓚᑦ	Natiinat	553	266	170	194	320	134	11	101	112	175	119	156	2,311 ± 337
Bearded seal	ᐅᑭᔪᐃᑦ	Ukyuk		4	7	2	10								23 ± 9
Harp seal	ᖃᐃᓱᓪᓚᑦ	Qairulik		4		4	15								23 ± 19
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit			1										1 ± 2
Walrus	ᐊᐃᐃᓴᑦ	Akvik		6	1										7 ± 6
Narwhal	ᑐᓗᓪᓕ ᖃᓪᓗᓂᑦ	Tuugaak	14	45	55	10								3	127 ± 34
Beluga	ᖃᐅᖅᑕᑦ ᖃᓪᓗᓂᑦ	Kilalugak		4		2									6 ± 5
Snow goose	ᑲᔪᐃᐃᑦ	Kanguq	212	48	245	71								58	634 ± 186
Eider duck	ᑎᑎᑦ	Kingalik		2	3	19	18	11							53 ± 33
Black guillemot	ᐱᕐᓂᐅᓪᓚᑦ	Black guillemot				2	3								5 ± 5
Ptarmigan	ᐊᖏᓴᑦ	Akilgik		14		4	184	172	3	68	540	155	62	67	1,269 ± 391
Sandhill crane	ᑕᑎᓴᖅᔪᐊᑦ	Tatilgaq			3										3 ± 3
Goose eggs	ᑲᔪᐃᐃᑦ ᓚᒃᓂᖏᑦ	Uluaguliit manniit	391	53											444 ± 473
Thick-billed murre eggs	ᐊᑦᐸᐃᑦ ᓚᒃᓂᖏᑦ	Thick-billed murre eggs	453	2,212											2,665 ± 2,038
Arctic char	ᐃᖃᓗᒃᓴᑦ	Ikaliviit	32	1,289	2,660	28	1,046	3,493			536	481	504	275	10,344 ± 3,029
Cod	ᐅᓚᐃᑦ	Ugak	5												5 ± 8
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	36	2											38 ± 64
Clams	ᐊᒃᒍᒪᔪᑦ	Uviluq			3										3 ± 3

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕐᑕᒪᓕᔪᑦ ᑐᓂᒃᖏᑦ ᑭᓇᐅᔭᖏᑦ ᐅᑯᐊᖁᓕᓕᒫᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᐅᐃᔨᐅᑦ/NAUNAIKUTA 220

Monthly hunter response

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓄᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᓕᕐᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑲᕐᓗ	NOV ᓄᐃᕐᓗ	DEC ᑎᓯᕐᓗ	JAN ᒍᖏᓂᓗ	FEB ᐃᖅᐳᓂ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᒥᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓄᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᕐᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓄᑎᑦ	Tatkitaman angunahuktut titigait	216	249	246	245	243	243	244	243	246	250	250	250	263*
Hunters interviewed	ᐊᖏᔪᓄᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	47	120	166	137	91	120	103	85	89	224	218	209	258*
Harvested	ᐊᖏᔪᓄᑎᑐᓂᒃ	Angujaujut	22	49	71	40	46	42	8	28	41	80	67	81	183*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓂᐅᓂᖏᑦ (%)	Kiujut (%)	22	48	67	56	37	49	42	35	36	90	87	84	54**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓄᑎᑦ ᐊᑎᓕᐅᑕᒪᓪᓚᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓄᑎᑐᑐᓂᒃ ᐊᑕᐅᓯᐊᖅᓗᑐᑎᑦ ᐊᓕᕐᒪᑦ.
** ᐃᓅᔨᓕᕐᓯᒪᓚᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᐅᐃᔨᐅᑦ/NAUNAIKUTA 221

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᕐᖏᓂ ᐊᖏᔪᓄᑎᓐᓇᑕ ᐊᒪᓗ ᐊᐱᕐᓯᑕᐅᓂᖏᑕ, ᐅᓗᐅᐃᕐᑕᑦ ᐃᒪᓖ % ᑲᑎᑕᒥᑦ ᐊᖏᔪᓄᑎᑕᒥᑦ ᑎᑎᕐᓯᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᓕᕐᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑲᕐᓗ	NOV ᓄᐃᕐᓗ	DEC ᑎᓯᕐᓗ	JAN ᒍᖏᓂᓗ	FEB ᐃᖅᐳᓂ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᒥᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔪᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑦ	≤ tatkin pingahut	88	97	96	100	100	100	91	68	60	22	73	79	77
4-6 months	4-6 ᑕᖅᑦ	tatkin hitaman 6nut	12	3	4	0	0	0	0	28	34	59	17	21	18
> 6 months	> 6 ᑕᖅᑦ	> 6 tatkin	0	0	0	0	0	0	9	4	5	19	9	0	4

TABLE/ᓇᓗᓇᐃᔾᐅᐅᑦ/NAUNAIKUTA 222

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓚᓯᖅᑎᑦ ᐊᖏᓚᓯᖅᓯᕐᒥᑦ ᐊᑐᓂᖅ ᐅᒪᔨᓂᖅ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 1 (June 1996 - May 1997)
ᐊᖑᒍᑉ 1 (ᔪᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᕐᖏᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᔨᒃ	SEP ᓯᑎᐅᕆᓚ	OCT ᐅᑲᐅᕆᓚ	NOV ᐅᓇᓱᕆᓚ	DEC ᑎᓯᓱᕆᓚ	JAN ᔮᖅᓇᐊᓚ	FEB ᐃᖏᑲᐊᓚ	MAR ᒪᕐᕿ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	7	8	40	16	20	35	4	24	28	65	47	56	147
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut						1			1	4	1	1	8
Arctic fox	ᑎᓚᖓᓂᐊᑦ	Tigiganiat					1	2	1		4	10	2	2	17
Coloured fox	ᖃᓄᖕᖏᑦᑐᑦ ᑎᓚᖓᓂᐊᑦ	Kalaliit tigiganiat						5			4	5			11
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik			2	4	4	4		3	5	11	14	3	35
Ringed seal	ᓇᕆᑦ	Natiinat	20	33	33	27	19	23	2	15	22	34	34	37	128
Bearded seal	ᐅᑉᐊᐃᑦ	Ukyuk		2	5	1	4								12
Harp seal	ᖃᐃᓕᓪᓚᑦ	Qairulik		2		2	2								6
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit			1										1
Walrus	ᐊᐃᓴᒃᑦ	Akvik		2	1										3
Narwhal	ᑐᒻᓪᓗᑦ ᖁᓕᓚᒃᑦ	Tuugaak	3	14	11	3								3	27
Beluga	ᖃᐅᖏᑦ ᖁᓕᓚᒃᑦ	Kilalugak		2		1									3
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	9	6	17	9								9	43
Eider duck	ᑎᑎᑦ	Kingalik		1	2	2	3	1							7
Black guillemot	ᐱᖏᐅᓪᓗᑦ	Black guillemot				1	1								1
Ptarmigan	ᐊᖓᓴᑦ	Akilgik		1		1	15	11	1	6	12	17	5	8	57
Sandhill crane	ᑕᑎᓴᕐᔪᐊᑦ	Tatilgaq			1										1
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓂᓂᖏᑦ	Uluaguliit manniit	3	1											4
Thick-billed murre eggs	ᐊᑦᐸᐃᑦ ᒪᓂᓂᖏᑦ	Thick-billed murre eggs	1	6											7
Arctic char	ᐃᖃᓗᒃᐸᑦ	Ikaliviit	1	17	34	2	13	7			2	12	7	11	76
Cod	ᐅᒪᐃᑦ	Ugak	1												1
Sculpin	ᑲᓇᐋᐃᑦ	Kanayuk	1	1											2
Clams	ᐊᑉᒧᒪᐅᑦ	Uviluq			1										1

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓯᒪᔨᓂᒃ ᐱᑕᖃᖕᖏᑦᑐᖃ ᐱᓕᕆᔨᒥᓂᒃ ᐊᖏᓂᑦ ᖃᕋᓯᐅᓂᖏᓐᓂᑦ ᐊᓕᓴᐅᓂᑦ ᓇᓕᑲᐅᕐᓂᐸᓂᑦ ᑐᓂᓴᖏᓐᓂ ᐃᓕᐱᖏᓪᓕᓕᒫᓂᐸᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓄᓇᓕᐃᔨᐅᑦ/NAUNAIKUTA 223

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓄᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᑲᒍ 2 (ᔮᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᓐᓂ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᕕ	OCT ᐅᑲᐱᕕ	NOV ᐅᓇᓱᐱᕕ	DEC ᑎᓯᓱᐱᕕ	JAN ᔮᖏᓄᐊᕕ	FEB ᓇᖕᐅᐊᕕ	MAR ᒪᔭ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	**ᐅᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	76	44	247	230	275	328	285	236	300	263	162	88	2,534 ± 91
Polar bear‡	ᓄᓂᐃᑦ‡	Nanuit‡			1		1	6	1		3	7	2	1	22
Wolf	ᐊᒪᓗᐃᑦ	Amagut			2							2	3	1	8 ± 1
Arctic fox	ᑎᓕᓴᖅᐊᑦ	Tigiganiat						3	7	5		3			18 ± 4
Coloured fox	ᖃᐅᖕᖏᑦᑐᑦ ᑎᓕᓴᖅᐊᑦ	Kalaliit tigiganiat				1		3	1	1	1	2			9 ± 3
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	5		2	5	16	15	7	2	15	23	18	2	110 ± 9
Ringed seal	ᓄᕆᓪᓚᑦ	Natiinat	421	201	254	373	136	117	64	54	70	75	113	60	1,938 ± 84
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk		7	17	14	7	1							46 ± 6
Harp seal	ᖃᐃᓗᓪᓚᑦ	Qairulik		1	7	37	5								50 ± 8
Hooded seal	ᐊᕐᐃᑦ	Nahakakaktutut ittut natiit	1	1		4	1								7 ± 2
Walrus	ᐊᐃᐸᓵᑦ	Akvik	1			1									2 ± 1
Narwhal	ᑐᓚᓪᓚᑦ ᕿᓪᓗᓂᑦ	Tuugaak	6	20	40	2								3	71 ± 10
Beluga	ᖃᐅᖏᑦ ᕿᓪᓗᓂᑦ	Kilalugak					1								1 ± 1
Snow goose	ᑲᖕᐃᐃᑦ	Kanguq	333	120	249	51								32	785 ± 81
Canada goose	ᓄᖅᓚᑦ	Nikliknik												4	4 ± 2
Eider duck	ᒥᑎᑦ	Kingalik	5	1	2	7	7								22 ± 5
Black guillemot	ᐱᕐᓂᐅᓪᓚᑦ	Black guillemot				2									2 ± 1
Thick-billed murre	ᐊᖏᕐᐃᑦ	Thick-billed murre	9												9 ± 3
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	2	1		85	182	192	39	78	165	220	42	33	1,039 ± 79
Sandhill crane	ᑕᑎᓴᖅᔪᐊᑦ	Tatilgaq	1											1	2 ± 0
Goose eggs	ᑲᖕᐃᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	1,556	282											1,838 ± 530
Arctic char	ᐃᖃᓗᓴᑦ	Ikaliviit	2,218	1,192	2,342	518	601	1,741	733	477	47	182	216	365	10,632 ± 994
Cod	ᐅᒪᐃᑦ	Ugak			3										3 ± 2
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	18												18 ± 5

‡ Polar bear data supplied by DSD.

‡ ᓄᓂᒃᓂᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᓯᖏᑦ ᐅᑯᐊᖏᑦ ᐃᑲᐱᕐᓂᓴᓂᒃᑯᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 224

Monthly hunter response
ᑕᖃᑕᒪᑦ ᐊᖏᔪᓄᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᑦᓱᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑐᕐᓗ	NOV ᐅᐊᒪᕐᓗ	DEC ᑎᓯᒪᕐᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᔪ	APR ᐃᓱᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓄᑎᑦ ᑭᐅᓂᖏᑦ ᐋᒍᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒪᑦ ᐊᖏᔪᓄᑎᑦ	Tatkitaman angunahuktut titigait	251	251	248	250	250	248	247	245	249	251	253	259	277*
Hunters interviewed	ᐊᖏᔪᓄᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	234	228	219	230	226	211	203	228	239	239	239	247	268*
Harvested	ᐊᖏᔪᓄᑎᑐᓂᒃ	Angujaujut	120	94	118	105	86	75	49	65	76	80	73	65	201*
Response Rate (%)	ᑭᐅᔾ ᖃᓂᐅᓂᖏᑦ (%)	Kiujut (%)	93	91	88	92	90	85	82	93	96	95	94	95	91**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓄᑎᑦ ᐊᑎᓕᐅᑕᒪᓐᓇᖅᑐᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓄᑎᑐᓂᒃ ᐊᑕᐅᓯᐊᓘᓚᐅᑎᑉ ᐊᑦᓴᒻᒥ.
** ᐃᓕᓴᕆᓂᑎᒋᓪᓗᒍ ᑕᖃᑕᒪᑦ ᑭᐅᔾ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 225

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᓪᓚᑦ ᐊᑯᕐᖏᓂ ᐊᖏᔪᓄᑕᖅᓂᖏᑦ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᑦ, ᐅᓗᐅᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓄᑎᑦ ᑎᑎᕐᓂᑦᑕᐅᒪᓪᓚᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)
ᐊᑦᓱᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑐᕐᓗ	NOV ᐅᐊᒪᕐᓗ	DEC ᑎᓯᒪᕐᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᔪ	APR ᐃᓱᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᓪᓚᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲᑦ	≤ tatkin pingahut	83	85	94	95	83	83	86	40	70	88	93	84	83
4-6 months	4-6 ᑕᖅᑲᑦ	tatkin hitaman 6nut	9	9	1	1	6	10	14	56	26	8	1	15	11
> 6 months	> 6 ᑕᖅᑲᑦ	> 6 tatkin	9	6	5	4	11	7	1	3	4	4	6	1	5

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 226

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖅᑐᑦ ᐊᖏᓚᓯᓗᒋᑦ ᐊᖏᓚᓯᓱᕐᕆᑦᑐᑦ ᐊᑐᓂᓗ ᐅᒪᔨᓂᓗ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 2 (June 1997 - May 1998)

ᐊᓕᒻᒋᒍ 2 (ᔪᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑦᑐᓇ	NOV ᐅᓂᓴᐱᓇ	DEC ᑎᓯᐱᓇ	JAN ᒍᖏᓂᐊᓇ	FEB ᓇᖕᑐᐊᓇ	MAR ᒪᓯ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᔭᑐᐃᑦ	Tuktut	35	19	65	56	65	54	43	59	67	59	50	33	161
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut			2							1	2	1	5
Arctic fox	ᑎᓕᓴᖅᐊᑦ	Tigiganiat						2	3	5		3			11
Coloured fox	ᖃᐅᖕᖏᑦᑐᑦ ᑎᓕᓴᖅᐊᑦ	Kalaliit tigiganiat				1		2	1	1	1	2			8
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	3		2	5	6	9	3	1	7	15	10	2	39
Ringed seal	ᓇᕆᑦ	Natiinat	95	62	62	72	35	41	15	14	24	28	36	25	152
Bearded seal	ᐅᓴᐊᐃᑦ	Ukyuk		6	14	9	4	1							28
Harp seal	ᖃᐃᕐᓂᑦ	Qairulik		1	5	17	5								22
Hooded seal	ᐊᕐᐃᑦ	Nahakakaktutut ittut natiit	1	1		4	1								7
Walrus	ᐊᐃᐸᒃᑦ	Akvik	1			1									2
Narwhal	ᑐᙵᓂᑦ ᕿᓪᓗᒡᑦ	Tuugaak	4	12	17	2								3	32
Beluga	ᖃᐅᕐᑦ ᕿᓪᓗᒡᑦ	Kilalugak					1								1
Snow goose	ᑲᖏᐃᑦ	Kanguq	32	15	38	9								10	75
Canada goose	ᓄᕐᓂᑦ	Nikliknik												2	2
Eider duck	ᑎᑎᑦ	Kingalik	3	1	2	3	2								10
Black guillemot	ᐱᕐᐅᓪᓚᑦ	Black guillemot				1									1
Thick-billed murre	ᐊᕐᕿᐃᑦ	Thick-billed murre	2												2
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	1	1		10	20	14	5	7	21	21	6	12	63
Sandhill crane	ᑕᑎᓴᕐᔪᐊᑦ	Tatilgaq	1											1	2
Goose eggs	ᑲᖏᐃᑦ ᒪᓕᓂᖅᑦ	Uluaguliit manniit	10	1											11
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	45	26	44	16	20	15	4	5	1	5	7	15	121
Cod	ᐅᓗᐃᑦ	Ugak			1										1
Sculpin	ᑲᓇᐃᑦ	Kanayuk	2												2

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓯᒪᔪᓂᖅ ᐱᑕᖃᖕᖏᑦᑐᖃᖅ ᐱᓕᕆᓕᓐᓂᖅ ᐊᖏᓴᑦ ᖃᕐᓯᐅᓂᖕᖏᓐᓄᑦ ᐊᓕᓴᕐᓂᐊᕐᓂᖅ ᐃᓕᓴᕐᓂᐊᕐᓂᑦ ᐊᖏᓴᓄᑦ ᓇᓕᐅᕐᓂᐊᕐᓂᖅ ᑐᓴᕐᖏᖕᓂᑦ ᐃᓂᖏᕐᓂᖅ ᐃᓂᓴᕐᓂᐊᕐᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 227

Monthly harvest estimates
ᑕᕆᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᕐᔪᑦ
Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᒻᒪᓗ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᕆᖏᑐᑦ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑦᔨᓇ	NOV ᐅᓇᓱᐱᓇ	DEC ᑎᓯᓱᐱᓇ	JAN ᔮᖏᓄᐊᓇ	FEB ᓇᖕᒪᐊᓇ	MAR ᒪᓯ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	20	27	118	172	81	235	145	214	266	234	166	169	1,847 ± 34
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait											2		2 ± 0
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡			4			1		4	5	6			20
Wolf	ᐊᒪᕐᐃᑦ	Amagut									3	9	3	5	20 ± 2
Arctic fox	ᑎᓗᓚᓐᓂᐊᑦ	Tigiganiat					1	1	2		1	1	1		7 ± 1
Coloured fox	ᖃᐃᓕᖅᑐᑦ ᑎᓗᓚᓐᓂᐊᑦ	Kalaliit tigiganiat					1	1	5		2	4	1		14 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik			4	7	7	4	2	3	12	53	18	37	147 ± 6
Ringed seal	ᓇᕆᑦ	Natiinat	445	148	97	103	125	76	172	202	71	92	77	94	1,702 ± 45
Bearded seal	ᐅᑉᔪᐃᑦ	Ukyuk			1		3	3						3	10 ± 2
Harp seal	ᖃᐃᕐᓂᑦ	Qairulik				3	11	5							19 ± 2
Walrus	ᐊᐃᓴᒃ	Akvik	4	1										3	8 ± 1
Narwhal	ᑐᒻᓂᑦ ᕈᓪᓗᑦ	Tuugaak	8	8	53	2								4	75 ± 8
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	174	3	105	20								30	332 ± 23
Eider duck	ᑎᑎᑦ	Kingalik	1	1		3	4	1						3	13 ± 2
Black guillemot	ᐱᑦᓗᐅᓪᓚᑦ	Black guillemot					2								2 ± 0
Thick-billed murre	ᐊᑦᑕᐃᑦ	Thick-billed murre	1				1								2 ± 1
Ptarmigan	ᐊᕈᒻᒋᑦ	Akilgik	3		5	10	27	50	24	58	183	257	108	135	860 ± 30
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓇᖅᑎᑦ	Uluaguliit manniit	1,155												1,155 ± 198
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓐᓇᖅᑎᑦ	Nauyat manniit	10												10 ± 6
Thick-billed murre eggs	ᐊᑦᑕᐃᑦ ᒪᓐᓇᖅᑎᑦ	Thick-billed murre eggs	264												264 ± 155
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	450	509	507	302	589	2,775	2,825	348	418	1,189	305	1,152	11,369 ± 864
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk						4							4 ± 2

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᓯᖏᑦ ᐅᑉᓴᐃᑦ ᐃᓄᐃᑦᑎᓕᕆᓂᖅᓴᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᐅᐃᔭᐅᑦ/NAUNAIKUTA 228

Monthly hunter response

ᑕᖃᑕᒪᑦ ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐱᓕᕆᔨ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᑐᓗᓂ	NOV ᐃᓄᕐᓗᓂ	DEC ᑎᓯᕐᓗᓂ	JAN ᔮᖅᓄᐊᓂ	FEB ᓇᖕᐅᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔨᓕᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒪᑦ ᐊᖏᔪᓂᕆᑦ	Tatkitaman angunahuktut titigait	259	266	265	267	268	270	272	272	273	273	274	284	294*
Hunters interviewed	ᐊᖏᔪᓂᕆᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	249	251	255	261	255	254	260	265	266	269	269	279	290*
Harvested	ᐊᖏᔪᓂᕆᑐᒃᓯᑦ	Angujaujut	91	55	52	56	60	71	78	100	84	92	84	108	224*
Response Rate (%)	ᑭᐅᔭᖅ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	96	94	96	98	95	94	96	97	97	99	98	98	97**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᕆᑦ ᐊᑎᓕᐅᕐᑕᒪᓕᕐᓂᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᔪᓂᕆᑐᒃᓯᑦ ᐊᑕᐅᓂᔪᓐᓇᖅᑐᑦ ᐊᑦᕿᒧᑦ.
** ᐊᓕᒍᓂᓕᕆᓂᒪᓕᕐᓂᑦ ᑕᖃᑕᒪᑦ ᑭᐅᔭᑦ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᐅᐃᔭᐅᑦ/NAUNAIKUTA 229

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᖏᓂ ᐊᖏᔪᓂᖅᓂᖓᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᑕ, ᐅᓗᐅᐃᕐᑕᑦ ᐃᒪᓗ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᕆᑦᑕᑦ ᑎᑎᕐᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐱᓕᕆᔨ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᑐᓗᓂ	NOV ᐃᓄᕐᓗᓂ	DEC ᑎᓯᕐᓗᓂ	JAN ᔮᖅᓄᐊᓂ	FEB ᓇᖕᐅᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲᑦ	≤ tatkin pingahut	64	54	95	81	90	91	92	85	97	100	96	100	89
4-6 months	4-6 ᑕᖅᑲᑦ	tatkin hitaman 6nut	35	46	5	17	10	9	8	15	3	0	4	0	11
> 6 months	> 6 ᑕᖅᑲᑦ	> 6 tatkin	1	0	0	3	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 230

Number of hunters harvesting each species — **Year 3 (June 1998 - May 1999)**

ᖃᐅᔨᐅᓂᖏᑦ ᐊᖏᓚᓯᒃᑎᑦ ᐊᖏᓚᓯᒃᓴᖅᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ — **ᐊᒃᑭᒍᒍ 3 (ᔪᓂ 1998 - ᒪᐃ 1999)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 3 (June 1998 - May 1999)**

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᓂᒃᑳᓇ	DEC ᑎᓯᒃᓇ	JAN ᔮᖏᓐᓄᓇ	FEB ᐃᖅᑲᓇ	MAR ᒪᓕᕐ	APR ᐃᓕᓴᕐ	MAY ᒪᐃ	Total ᑲᑎᒪᓂᖅ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᔭᑐᐃᑦ	Tuktut	11	10	22	35	26	50	39	66	69	60	51	56	153
Musk-ox	ᐅᒥᖕᒪᐃᑦ	Umingmait											2		2
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᖅᐃᑦ	Amagut									2	4	2	2	7
Arctic fox	ᑎᓕᓴᐅᐊᑦ	Tigiganiat					1	1	2		1	1	1		7
Coloured fox	ᖃᑯᐊᖏᑦᑐᑦ ᑎᓕᓴᐅᐊᑦ	Kalaliit tigiganiat					1	1	1		2	4	1		9
Arctic hare	ᐅᑲᓪᓕ	Ukalik			2	6	5	4	1	2	7	21	11	13	54
Ringed seal	ᓇᓂᓯ	Natiinat	82	42	27	30	38	27	55	60	25	33	31	47	164
Bearded seal	ᐅᓗᔪᐃᑦ	Ukyuk			1		2	1						2	5
Harp seal	ᖃᐃᐳᓪᓕᑦ	Qairulik				3	9	4							15
Walrus	ᐊᐃᓴᒃ	Akvik	3	1										2	5
Narwhal	ᑐᒻᓪᓕᑦ ᕈᓪᓚᑦ	Tuugaak	6	6	22	2								4	37
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	18	2	13	8								8	40
Eider duck	ᒥᑎᑦ	Kingalik	1	1		1	2	1						1	7
Black guillemot	ᐱᑦᓯᐅᓪᓗᑦ	Black guillemot					2								2
Thick-billed murre	ᐊᓴᐸᐃᑦ	Thick-billed murre	1				1								2
Ptarmigan	ᐊᕈᓚᑦ	Akilgik	1		1	2	5	13	7	10	23	32	13	11	71
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᖓᓂᑦ	Uluaguliit manniit	16												16
Seagull eggs	ᓇᐅᔨᐃᑦ ᓚᖓᓂᑦ	Nauyat manniit	1												1
Thick-billed murre eggs	ᐊᓴᐸᐃᑦ ᓚᖓᓂᑦ	Thick-billed murre eggs	3												3
Arctic char	ᐃᖅᓗᑲᐱᒃ	Ikaliviit	7	16	14	7	15	19	15	6	8	16	5	46	109
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk						1							1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓪᒪᔪᓂᑲᓂᖅ ᐱᕈᖅᓯᒪᔨᑐᖅ ᐱᔨᔪᑎᓕᖅᓂᖅ ᐊᖏᔪᒃ ᖃᑯᐅᓂᖓᓂᒃᓄᑦ ᐊᓪᓚᕆᒪᓪᓗᑦ ᐊᑐᐅᓂᑦ ᓇᓪᓕᐊᓂᖅᓂᑦ ᐊᖏᔪᓄᑦ ᐊᓪᓚᕆᒪᓪᓗᑦ ᑐᓴᕐᕕᖏᓐᓂᒃ ᐃᓕᓴᕐᓂᖅᓂᑦ ᐃᓚᖓᔪᖅᑐᑦ

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 231

Monthly harvest estimates
ᑕᖅᑕᒫᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)
ᐊᓐᖁᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖢᓂ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᓕᓇ	OCT ᐅᑦᔨᓇ	NOV ᐅᓇᓕᓇ	DEC ᑎᓱᓕᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓪᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	60	3	121	100	79	254	65	184	195	136	164	105	1,466 ± 22
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡			2	2	2	3	2	2	4				17
Wolf	ᐊᒪᓗᐃᑦ	Amagut	1						5	2	1	3	2	2	16 ± 2
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat						1							1 ± 0
Coloured fox	ᖃᐅᖅᖢᑎᑦ ᑎᓕᓴᖅᓂᐊᑦ	Kalaliit tigiganiat					1	3	1	1	2	3	1		12 ± 1
Arctic hare	ᐅᑲᓪᓚ	Ukalik		1	1	6	2	1		1	9	25	14	3	63 ± 4
Seals (unspecified)	ᓴᖃᑯᓪᓚ	Natiit						1							1 ± 0
Ringed seal	ᓇᓱᓪᓚ	Natiinat	570	248	232	182	164	161	126	109	149	124	201	170	2,436 ± 31
Bearded seal	ᐅᑭᐊᐃᑦ	Ukyuk		4	10	2	9			1				3	29 ± 2
Harp seal	ᖃᐃᕐᓚᑦ	Qairulik			1		10								11 ± 1
Walrus	ᐊᐃᓴᒃ	Akvik									1				1 ± 0
Narwhal	ᑐᙵᓚᑦ ᕿᓪᓗᒡᓗᑦ	Tuugaak	7	12	105	18								3	145 ± 8
Snow goose	ᑲᖏᐃᑦ	Kanguq	200	18	46									54	318 ± 11
Canada goose	ᓄᑦᓚᑦ ᐅᓪᐊᒍᑦᓚᑦ	Nikliknik	9										1		10 ± 1
Brant goose	ᓄᑦᓪᑦᓇᐃᑦ	Nirlirnaq			2										2 ± 0
White-fronted goose	ᓄᑦᓚᑦ	Nirlivik	5												5 ± 1
Old squaw	ᐋᕿᐊᑦᔪᐃᑦ	Aahangik	1												1 ± 0
Eider duck	ᒥᑎᑦ	Kingalik	3	2	1	8	14						1	1	30 ± 2
Red breasted merganser	ᑲᓕᔭᑦ	Red breasted merganser			1										1 ± 0
Red-throated loon	ᖃᖏᓗᐅᑦ	Qaqhuaq		2	2										4 ± 1
Thick-billed murre	ᐊᑦᐸᐃᑦ	Thick-billed murre	1	2										1	4 ± 1
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	5			12	51	60	12	54	233	143	43	32	645 ± 24
Sandhill crane	ᑕᑎᓚᑦᔪᐊᑦ	Tatilgaq	1											2	3 ± 1
Goose eggs	ᑲᖏᐃᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit	1,224												1,224 ± 76
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	3												3 ± 0
Thick-billed murre eggs	ᐊᑦᐸᐃᑦ ᒪᓕᓂᖏᑦ	Thick-billed murre eggs	1,856	8,221											10,077 ± 599
Arctic char	ᐃᖃᓗᒃᐸᑦ	Ikaliviit	2,638	1,780	2,304	550	900	4,354	772		818	371	474	1,051	16,012 ± 389
Cod	ᐅᒪᐃᑦ	Ugak	19												19 ± 3
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	72	60											132 ± 13

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓄᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᖅᖏᑦ ᐅᑯᐊ ᐃᑯᐊᕐᓂᐊᓕᒫᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 232

Monthly hunter response
ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖅᑎᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᓐᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑕ	SEP ᓯᑎᐹᓗ	OCT ᐅᑲᐃᓗ	NOV ᓄᐊᖅᐹᓗ	DEC ᑎᓯᖅᐹᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᕕᖕᒧᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᓴᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖅᑎᑦ ᐊᑲᓱᓪᓚᕐᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	298	297	300	299	294	292	290	292	301	302	300	299	331*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	290	288	287	286	283	280	279	281	296	296	295	293	325*
Harvested	ᐊᖏᔪᓂᒃᑐᒃᓗᓂ	Angujaujut	173	104	122	93	71	89	52	71	95	80	83	83	245*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖅᑎᑦ (%)	Kiujut (%)	97	97	96	96	96	96	96	96	98	98	98	98	97**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓂᐅᑦᑕᒪᓕᕐᓂᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑐᒃᓗᓂ ᐊᑕᐅᓯᐊᕐᓗᓂᑎᒃ ᐊᓐᖏᒍᒥ.
** ᐃᓅᓂᓪᓕᐹᓪᓚᕐᓂᖅ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 233

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᖃᓄᖅ ᐊᖏᔪᓂᒃᑯᓂᖅᑐᓄ ᐊᓚᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖅᑎᑦᑕ, ᐅᓗᐅᐃᕐᑦ ᐃᒪᓱ % ᑲᑎᒪᔨᑦ ᐊᖏᔪᓂᒃᑎᑦᑕ ᑎᑎᕐᓂᑦᑕᐅᒪᔨᔨᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)
ᐊᓐᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑕ	SEP ᓯᑎᐹᓗ	OCT ᐅᑲᐃᓗ	NOV ᓄᐊᖅᐹᓗ	DEC ᑎᓯᖅᐹᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᕕᖕᒧᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᓴᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑦ	≤ tatkin pingahut	97	97	97	93	94	96	100	100	100	89	60	76	92
4-6 months	4-6 ᑕᖅᑦ	tatkin hitaman 6nut	3	3	3	6	6	4	0	0	0	9	32	18	6
> 6 months	> 6 ᑕᖅᑦ	> 6 tatkin	0	0	0	1	0	0	0	0	0	2	8	6	1

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 234

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓚᐱᖅᑎᑦ ᐊᖓᔪᓚᐱᖅᓯᒋᑦ ᐊᑐᓂᖅ ᐅᒪᔨᓂᖅ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 4 (June 1999 - May 2000)

ᐊᒃᑭᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖃᖏᑐᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᔅᑎᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᒋᐱᓇ	NOV ᐅᓇᐱᕆᓇ	DEC ᑎᓯᐱᓇ	JAN ᐅᖏᓪᓗᐊᓇ	FEB ᐃᖏᕐᐊᓇ	MAR ᒪᓯᓗ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᒋᑎᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	27	3	29	31	19	41	12	50	58	39	48	33	140
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut	1						1	1	1	3	2	1	8
Arctic fox	ᑎᓗᓚᖏᓂᐊᑦ	Tigiganiat						1							1
Coloured fox	ᖃᓄᖕᖏᑦᑐᑦ ᑎᓗᓚᖏᓂᐊᑦ	Kalaliit tigiganiat					1	1	1	1	2	3	1		7
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik		1	1	5	2	1		1	6	15	7	3	33
Seals (unspecified)	ᓱᖏᓄᓪᓕᑦ	Natiit (unspecified)						1							1
Ringed seal	ᓇᕆᑦ	Natiinat	137	76	79	59	42	54	40	34	37	37	43	54	209
Bearded seal	ᐅᑭᔪᐃᑦ	Ukyuk		2	10	2	5			1				1	18
Harp seal	ᖃᐃᕐᓪᓕᑦ	Qairulik			1		7								8
Walrus	ᐊᐃᓴᒃ	Akvik									1				1
Narwhal	ᑐᒻᓪᓕᑦ ᕈᓪᓗᓚᑦ	Tuugaak	5	10	37	11								3	55
Snow goose	ᑲᖏᐃᑦ	Kanguq	50	3	10									14	65
Canada goose	ᓂᕐᓪᓕᑦ ᐅᓗᐊᔨᓪᓕᑦ	Nikliknik	4										1		5
Brant goose	ᓂᕐᓕᕐᓇᐃᑦ	Nirlirnaq			1										1
White-fronted goose	ᓂᕐᓪᓕᑦ	Nirlivik	2												2
Old squaw	ᐊᒻᑭᐊᕐᔪᐃᑦ	Aahangik	1												1
Eider duck	ᒥᑎᑦ	Kingalik	2	1	1	6	5						1	1	16
Red breasted merganser	ᑲᓕᔭᑦ	Red breasted merganser			1										1
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq		1	1										2
Thick-billed murre	ᐊᕐᕕᐃᑦ	Thick-billed murre	1	1										1	3
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	3			3	14	11	2	9	32	23	8	10	67
Sandhill crane	ᑕᑎᓚᕐᔪᐊᑦ	Tatilgaq	1											1	2
Goose eggs	ᑲᖏᐃᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit	14												14
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	1												1
Thick-billed murre eggs	ᐊᕐᕕᐃᑦ ᒪᓕᓂᖏᑦ	Thick-billed murre eggs	9	19											28
Arctic char	ᐃᖃᓗᒃᑑᑦ	Ikaliviit	71	42	46	14	22	30	8		10	11	12	20	148
Cod	ᐅᒪᐃᑦ	Ugak	2												2
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	5	2											7

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᒪᔪᓂᖅ ᐱᑕᖃᖏᑐᖅ ᐱᓵᐊᒋᓐᓂᖅ ᐊᖓᔪᖅᑕ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᖅᑲᒪᔪᓄᑦ ᐊᓪᓚᖅᑕᐅᓯᒪᔪᖅ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐃᓚᐅᕐᓱᒋᐅᓂ ᑐᓂᓴᖏᓐᓂᒃ ᐃᓕᓴᕐᓂᒃᑯᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓄᓇᓕᐃᓗᐅᑦ/NAUNAIKUTA 235

Monthly harvest estimates
ᑕᕆᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓄᓪᑎᑦᓴᕐᔪᑎᑦ
Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᓗᖏᔪ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕆᖏᓐᓄ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᓕ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᓂᐱᓇ	DEC ᑎᓯᐱᓇ	JAN ᔮᖏᓄᓇ	FEB ᓄᕿᐅᓄᓇ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓪ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᖏᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	17	14	164	94	10	294	150	115	148	63	34	20	1,123 ± 69
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait										2			2 ± 2
Polar bear‡	ᓄᓚᐃᑦ‡	Nanuit‡				3			3	1		2	3	3	15
Wolf	ᐊᒪᖅᐃᑦ	Amagut						1							1 ± 0
Arctic fox	ᑎᓗᓚᓄᐊᑦ	Tigiganiat							2	6	2	2	3		15 ± 7
Coloured fox	ᖃᑯᓄᖓᑦ ᑎᓗᓚᓄᐊᑦ	Kalaliit tigiganiat					1	13		3	2	1			20 ± 3
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	6		1	1		1	1	1	19	24	7	3	64 ± 21
Ringed seal	ᓇᓂᓪᓕ	Natiinat	727	199	171	185	267	82	134	150	130	82	29	22	2,178 ± 71
Bearded seal	ᐅᑭᔪᐃᑦ	Ukyuk		6	5	8	7	3	1						30 ± 1
Harp seal	ᖃᐃᖅᓕᓪᓕᑦ	Qairulik		2	3	8	26	4							43 ± 2
Walrus	ᐊᒃᐃᓴᑦ	Akvik	1	1										3	5 ± 5
Narwhal	ᑐᐊᓪᓕᑦ ᖃᓪᓗᓂᑦ	Tuugaak	23	46	98	9									176 ± 5
Snow goose	ᑲᖏᐃᑦ	Kanguq	339	112	123	6								30	610 ± 27
Canada goose	ᓄᕐᓕᑦ ᐅᓇᐊᔪᓕᓪᓕᑦ	Nikliknik	1			1									2 ± 0
White-fronted goose	ᓄᕐᓕᑦ	Nirlivik	52												52 ± 13
Eider duck	ᒥᑎᑦ	Kingalik	1		1	11	16	4							33 ± 4
Black guillemot	ᐱᕐᓂᐅᓪᓕᑦ	Black guillemot			1		1								2 ± 1
Thick-billed murre	ᐊᕐᕕᐃᑦ	Thick-billed murre		2											2 ± 1
Ptarmigan	ᐊᖏᓕᑦ	Akilgik	4			5	21	186	83	94	208	140	67	9	817 ± 123
Sandhill crane	ᑕᑎᓕᕐᔪᐊᑦ	Tatilgaq	1												1 ± 0
Goose eggs	ᑲᖏᐃᑦ ᒪᓂᓂᖅᑦ	Uluaguliit manniit	2,811												2,811 ± 121
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᖅᑦ	Tinmiat manniit		1											1 ± 0
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	623	1,471	2,328	607	1,414	3,839	1,129	55	47	369	260	72	12,214 ± 657
Cod	ᐅᒪᐃᑦ	Ugak	1												1 ± 0
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk	39	4											43 ± 6

‡ Polar bear data supplied by DSD.

‡ ᓄᓚᐃᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᖏᖅᑦ ᐅᑎᕐᓂᒃ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᐅᐃᔨᐅᑦ/NAUNAIKUTA 236

Monthly hunter response

ᑕᖃᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᓐᖁᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑦᔪᕕᓂ	NOV ᐃᓄᓚᕕᓂ	DEC ᑎᓯᓚᕕᓂ	JAN ᔮᖏᓄᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᔪᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	302	307	309	308	309	309	306	329	337	335	339	339	355*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	297	299	301	300	303	299	294	293	264	239	206	200	342*
Harvested	ᐊᖏᔪᓂᒃᑐᒋᓂᓂ	Angujaujut	158	103	126	83	74	88	70	63	50	35	14	10	229*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	98	97	97	97	98	97	96	89	78	71	61	59	87**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᕐᒪᓕᕆᓂᖅ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑐᒋᓂᓂ ᐊᑕᐅᓯᐊᖅᓗᓂᑎᒃ ᐊᓐᖁᒍ.
** ᐊᐅᔨᓂᓕᕆᓕᕆᔨᑦ ᑕᖃᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᐅᐃᔨᐅᑦ/NAUNAIKUTA 237

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᖅᐱᐅᔨᑦ ᐊᑯᖅᓴᓂ ᐊᖏᔪᓂᒃᑐᒋᑕ ᐊᒻᒪᓗ ᐊᐱᖅᓯᕐᕕᐅᓂᒋᑕ, ᐅᓗᐅᐃᖅᑕᑦ ᐃᒪᓐ % ᑲᑎᑦᔪᑦ ᐊᖏᔪᓂᒃᑐᑦ ᑎᑎᖅᑕᕐᕕᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᓐᖁᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑦᔪᕕᓂ	NOV ᐃᓄᓚᕕᓂ	DEC ᑎᓯᓚᕕᓂ	JAN ᔮᖏᓄᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᔪᑦ Tamakiklugin
Recall Period	ᐅᑎᖅᐱᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	79	65	74	93	94	100	100	98	95	99	93	90	87
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	13	30	26	7	6	0	0	1	3	1	0	10	11
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	7	5	0	0	0	0	0	1	1	0	7	0	2

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 238

Number of hunters harvesting each species — **Year 5 (June 2000 - May 2001)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓂᓕᒫᑦ ᐊᖏᔪᓂᓕᒫᖅᑐᑦ ᐊᑐᓂᖅ ᐅᒪᔨᖅ — **ᐊᒡᖏᒍ 5 (ᔫᓂ 2000 - ᒪᐃ 2001)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 5 (June 2000 - May 2001)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔫᓂ	JUL ᐊᓪᓚ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᐱᓇ	OCT ᐅᑦᔨᓇ	NOV ᐅᓇᒡᓕᓇ	DEC ᑎᓯᒡᓕᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᔪ	APR ᐃᔨᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᑦ	Tuktut	10	9	35	26	5	49	33	28	26	11	5	2	123
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait										1			1
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut						1							1
Arctic fox	ᑎᓚᑉᓂᓄᑦ	Tigiganiat							2	3	1	1	1		7
Coloured fox	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓚᑉᓂᓄᑦ	Kalaliit tigiganiat					1	9		2	1	1			13
Arctic hare	ᐅᑲᓪᓕ	Ukalik	2		1	1		1	1	1	9	6	3	1	25
Ringed seal	ᓇᓕᓱ	Natiinat	126	60	69	58	44	23	34	30	23	17	6	4	183
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		5	3	7	7	3	1						20
Harp seal	ᖃᐃᕐᓂᑦ	Qairulik		2	3	7	12	3							20
Walrus	ᐊᐃᓴᒃ	Akvik	1	1										1	3
Narwhal	ᑐᒻᓂᑦ ᖁᓪᓗᓚᑦ	Tuugaak	12	23	41	8									60
Snow goose	ᑲᖏᐃᑦ	Kanguq	63	12	16	5								6	82
Canada goose	ᓂᕐᓂᑦ ᐅᓇᐊᒋᓂᑦ	Nikliknik	1			1									2
White-fronted goose	ᓂᕐᓂᑦ	Nirlivik	1												1
Eider duck	ᒥᑎᑦ	Kingalik	1		1	5	5	2							11
Black guillemot	ᐱᕐᐅᓪᓚᑦ	Black guillemot			1		1								2
Thick-billed murre	ᐊᑦᕿᐃᑦ	Thick-billed murre		1											1
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	2			4	7	23	13	12	23	10	6	3	65
Sandhill crane	ᑕᑎᓴᕐᔪᐊᑦ	Tatilgaq	1												1
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	42												42
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit		1											1
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	39	56	43	15	32	35	9	1	1	4	1	1	130
Cod	ᐅᓴᐃᑦ	Ugak	1												1
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	4	1											5

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓯᒪᔪᓂᒃ ᐱᕈᖅᖢᒋᑐᖅ ᐱᓵᐋᒋᓐᓂᒃ ᐊᖏᔪᑦ ᖃᕐᓯᐅᓂᖏᓐᓄᑦ ᐊᓕᕆᔨᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᐃᖅᓂᐅ ᑐᓂᔭᖏᓐᓂ ᐃᑯᐱᖏᓐᓂᒃᑯᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 239

Annual harvest estimates and five-year mean

ᐊᓐᔪᔨᑦᑕᒡᑦ ᐊᓐᔭᔪᓄᑦ ᓇᓕᐅᑦᓱᓐᓂᑦ ᐊᓐᒪᓗ ᑕᒻᓕᓚᓄᑦ-ᐊᓐᔪᔨᓄᑦ ᐊᐅᑎᓕᖅᑎᓂᒪᓕᕆᑦ

Aragutamat angujauvaktun tatlman araguit iluani

All Years (June 1996 - May 2001)

ᑕᒪᐃᒃᓄᑦ ᐊᓐᔪᔨᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅᓯᒪᔪᑦ ᐊᓐᔪᔨ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᑎᓕᖅᑎᓂᒪᓕᕆᑦ Amigaitkiyait
Species	**ᐅᒪᔪᑦ**	**Umajuin**						
Caribou[1]	ᑐᙵᐃᐃᑦ[1]	Tuktut[1]	2,169	2,534	1,847	1,466	1,123	1,828
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait	0	0	2	0	2	1
Polar bear[2]	ᓇᓄᐃᑦ[2]	Nanuit[2]	16	22	20	17	15	18
Wolf[3]	ᐊᒪᔭᐃᑦ[3]	Amagut[3]	20	8	20	16	1	13
Arctic fox	ᑎᓚᖓᓂᐊᑦ	Tigiganiat	150	18	7	1	15	38
Coloured fox	ᖃᐃᓐᖏᑦᑐᑦ ᑎᓚᖓᓂᐊᑦ	Kalaliit tigiganiat	32	9	14	12	20	17
Arctic hare	ᐅᖃᓕᑦ	Ukalik	139	110	147	63	64	105
Seals (unspecified)	ᓯᖏᑦᓕᑦ	Natiit	0	0	0	1	0	0
Ringed seal	ᓇᓂᒃ	Natiinat	2,311	1,938	1,702	2,436	2,178	2,113
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk	23	46	10	29	30	28
Harp seal	ᖃᐃᕐᓕᑦ	Qairulik	23	50	19	11	43	29
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	1	7	0	0	0	2
Walrus	ᐊᐃᐸᒃᑦ	Akvik	7	2	8	1	5	5
Narwhal[4]	ᑐᒪᓕᑦ ᖁᓪᓗᒍᑦ[4]	Tuugaak[4]	127	71	75	145	176	119
Beluga	ᖃᐅᔨᑦ ᖁᓪᓗᒍᑦ	Kilalugak	6	1	0	0	0	1
Snow goose	ᑲᖏᒍᐃᑦ	Kanguq	634	785	332	318	610	536
Canada goose	ᓄᓕᓕᑦ ᐅᓪᓚᒍᒃᓕᑦ	Nikliknik	0	4	0	10	2	3
Brant goose	ᓄᓕᓐᓇᐃᑦ	Nirlirnaq	0	0	0	2	0	<1
White-fronted goose	ᓄᓕᓕᑦ	Nirlivik	0	0	0	5	52	11
Old squaw	ᐊᑭᐊᓕᓴ	Aahangik	0	0	0	1	0	<1
Eider duck[5]	ᑎᑎᑦ[5]	Kingalik[5]	53	22	13	30	33	30
Red breasted merganser	ᑲᐅᔨᔪᖅ	Red breasted merganser	0	0	0	1	0	<1
Red-throated loon	ᖃᖅᓴᐅᑦ	Qaqhuaq	0	0	0	4	0	1
Black guillemot	ᐱᓕᐅᓕᑦ	Black guillemot	5	2	2	0	2	2
Thick-billed murre	ᐊᓯᐸᐃᑦ	Thick-billed murre	0	9	2	4	2	3
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	1,269	1,039	860	645	817	926
Sandhill crane	ᑕᑎᓴᔦᐊᑦ	Tatilgaq	3	2	0	3	1	2
Goose eggs	ᑲᖏᒍᐃᑦ ᓚᒃᓂᖏᑦ	Uluaguliit manniit	444	1,838	1,155	1,224	2,811	1,494
Duck eggs	ᑎᑎᑦ ᓚᒃᓂᖏᑦ	Tinmiat manniit	0	0	0	3	1	1
Seagull eggs	ᓇᐅᔨᐃᑦ ᓚᒃᓂᖏᑦ	Nauyat manniit	0	0	10	0	0	2
Thick-billed murre eggs[6]	ᐊᓯᐸᐃᑦ ᓚᒃᓂᖏᑦ[6]	Thick-billed murre eggs[6]	2,665	0	264	10,077	0	2,601
Arctic char[7]	ᐃᖃᓗᒃᐲᑦ[7]	Ikaliviit[7]	10,344	10,632	11,369	16,012	12,214	12,114
Cod[8]	ᐅᓴᐃᑦ[8]	Ugak[8]	5	3	0	19	1	6
Sculpin[8]	ᑲᓇᐊᐃᑦ[8]	Kanayuk[8]	38	18	4	132	43	47
Clams[9]	ᐊᓱᒧᒪᓕᐊᑦ[9]	Uviluq[9]	3	0	0	0	0	1

[1-9]: See page 363 for community feedback and other sources of data.

[1-9]: ᑕᐃᒃ ᒪᓕᕐᒧᖅ 364 ᓄᓇᓕᑦ ᑭᐅᔨᐊᑎᖏᑦ ᐊᓚᓗ ᐊᓯᖏᑦ ᐱᓕᐅᐊᓪᓚᕆᑦ ᓇᓴᐅᑎᓂᒃ.

[1-9]: Takulugu makpigaak 365 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

TABLE/ᓄᓇᓕᐃᔨᐅᑦ/NAUNAIKUTA 240

Annual hunter response
ᐊᓗᖏᔪᒋᒪᑦ ᐊᖏᔪᓕᓴᐃᔪᑦ ᑭᐅᓂᖅᑎᑦ
Angujauvaktu

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓄᑦ ᐊᓗᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᓴᐃᔪᑦ ᑭᐅᓂᖅᑎᑦ ᐊᔪᓕᒪᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᑭᑕᒻᒪᑦ ᐊᖏᔪᓕᓴᐃᔪᑦ	Tatkitaman angunahuktut titigait	263	277	294	331	355	408*
Hunters interviewed	ᐊᖏᔪᓕᓴᐃᔪᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	258	268	290	325	342	395*
Harvested	ᐊᖏᔪᓕᓴᐅᑎᓂᑦ	Angujaujut	183	201	224	245	229	312*
Response Rate (%)	ᑭᐅᐯ ᖃᓕᑭᐅᓂᖅᑎᑦ (%)	Kiujut (%)	54	91	97	97	87	85**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖏᔪᓕᓴᐃᔪᑦ ᐊᑎᓕᐅᔨᓪᓚᕐᓂᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᔪᓕᓴᐅᑎᓂᑦ ᐊᑕᐅᓯᐊᖓᔪᓂᑦᑐᑦ ᖃᐅᔨᓴᖅᑎᓂᖅ ᖃᐅᔨᓴᖅᓯᒪᔪᖅ.
** ᐊᓕᕆᓕᖅᑎᓯᒪᓪᓚᕐᓂᑦ ᐊᑭᐊᔪᒪᑦ ᑭᐅᐯ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᓄᓇᓕᐃᔨᐅᑦ/NAUNAIKUTA 241

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᓪᓚᕐᓂᑦ ᐊᑯᓕᖅᓂ ᐊᖏᔪᓕᓴᓐᓂᒃᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖅᓂᒃᑕ, ᓄᓇᓕᐃᔨᑦᑕ ᐃᒪᖅ % ᑲᑎᒪᔨᑦ ᐊᖏᔪᓕᓴᐃᔪᑕᑦ ᑎᑎᕐᓂᑦᑕᐅᒪᓪᓚᕐᓂᑦ
Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓄᑦ ᐊᓗᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᓪᓚᕐᓂᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᑭᑦ	≤ tatkin pingahut	77	83	89	92	87	86
4-6 months	4-6 ᑕᑭᑦ	tatkin hitaman 6nut	18	11	11	6	11	11
> 6 months	> 6 ᑕᑭᑦ	> 6 tatkin	4	5	0	1	2	3

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 242

Number of hunters harvesting each species

ᖃᑦᔪᐅᓂᖅᑐᑦ ᐊᖏᔪᓕᒃᑎᒋᑦ ᐊᖏᔪᓕᒃᓴᕐᔪᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᑲᐅᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᑕᔪᑦ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**						
Caribou	ᔭᑐᐃᑦ	Tuktut	147	161	153	140	123	240
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait			2		1	3
Polar bear[##]	ᓇᓂᐃᑦ[##]	Nanuit[##]	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕈᐃᑦ	Amagut	8	5	7	8	1	21
Arctic fox	ᑎᓘᑲᓂᓂᐊᑦ	Tigiganiat	17	11	7	1	7	35
Coloured fox	ᖃᑯᐦᖏᑐᑦ ᑎᓘᑲᓂᓂᐊᑦ	Kalaliit tigiganiat	11	8	9	7	13	41
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	35	39	54	33	25	109
Seals (unspecified)	ᓴᖑᑯᓪᓕᑦ	Natiit				1		1
Ringed seal	ᓇᓕᓗᑦ	Natiinat	128	152	164	209	183	270
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	12	28	5	18	20	59
Harp seal	ᖃᐃᕈᓪᓕᑦ	Qairulik	6	22	15	8	20	49
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	1	7				8
Walrus	ᐊᐃᐧᐋᑦ	Akvik	3	2	5	1	3	13
Narwhal	ᑐᒍᓪᓕᑦ ᖁᓪᓗᓴᑦ	Tuugaak	27	32	37	55	60	110
Beluga	ᖃᑯᖅᑦ ᖁᓪᓗᓴᑦ	Kilalugak	3	1				4
Snow goose	ᑲᖏᐃᑦ	Kanguq	43	75	40	65	82	157
Canada goose	ᓄᖅᓪᓕᑦ ᐅᓪᐊᒍᒃᓪᓕᑦ	Nikliknik		2		5	2	7
Brant goose	ᓄᖅᓕᖅᓇᐃᑦ	Nirlirnaq				1		1
White-fronted goose	ᓄᖅᓪᓕᑦ	Nirlivik				2	1	3
Old squaw	ᐊᑲᑎᐊᖅᓴᖅ	Aahangik				1		1
Eider duck	ᒥᑎᑦ	Kingalik	7	10	7	16	11	38
Red breasted merganser	ᑲᐅᔨᔪᖕᖓ	Red breasted merganser				1		1
Red-throated loon	ᖃᖓᓘᐅᑦ	Qaqhuaq				2		2
Black guillemot	ᐱᖅᑭᐅᓪᓕᑦ	Black guillemot	1	1	2		2	6
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre		2	2	3	1	8
Ptarmigan	ᐊᖏᑭᑎᑦ	Akilgik	57	63	71	67	65	157
Sandhill crane	ᑕᑎᓘᔦᐊᑦ	Tatilgaq	1	2		2	1	6
Goose eggs	ᑲᖏᐃᑦ ᓚᒃᓂᖅᑦ	Uluaguliit manniit	4	11	16	14	42	65
Duck eggs	ᒥᑎᑦ ᓚᒃᓂᖅᑦ	Tinmiat manniit				1	1	2
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᒃᓂᖅᑦ	Nauyat manniit			1			1
Thick-billed murre eggs	ᐊᖅᐸᐃᑦ ᓚᒃᓂᖅᑦ	Thick-billed murre eggs	7		3	28		33
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	76	121	109	148	130	244
Cod	ᐅᓚᐃᑦ	Ugak	1	1		2	1	4
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	2	2	1	7	5	15
Clams	ᐊᒃᒧᒪᔪᑦ	Uviluq	1					1

No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

ᑎᑎᕋᓪᒪᔪᓂᒃ ᐱᑕᖃᖕᖏᑐᖃᖅ ᐱᓴᐊᓕᓐᓂᒃ ᐊᖏᔪᑦ ᖃᑦᔪᐅᓂᖅᓄᓂᒃ ᐊᓕᓴᐃᓂᖅᑐᑦ ᐊᓕᓴᐃᔨᓂᒃ ᐃᓕᓴᕐᓂᖅᑐᑦ ᓇᓂᐊᔪᓂᒃ ᐃᓕᓴᕐᓂᖅᑐᑦ ᐃᓚᖓᔪᖅ ᐊᓕᓴᐃᔨᓂᒃ ᐊᓕᓴᐃᓂᖅᑐᑦ ᐊᓂᔪᓂᒃ ᐊᓕᓴᐃᓂᖅᑐᑦ

6.1.10 Community Results Discussion: Pond Inlet

The survey frame:

An assessment of under-enumeration during the community visit indicated that there were very few Inuit hunters who were not registered in the Harvest Study. It is estimated that there was one non-Inuit hunter with assigned hunting rights who was not registered, an active hunter. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. However, the extent of the bias is likely very small since the missing hunter represents less than one percent of the total hunter population (Table 10).

Survey coverage and non-response bias:

Response rates in some months of year 1 of the study were quite low in Pond Inlet, dropping below 50% in 7 of the 12 months. Response rates in years 2 to 4 were excellent; however the rates did decline in the last few months of year 5. As seen in Table 9 the consistent intentional non-response rate in Pond Inlet was low, at 2.0%, and was not thought to be a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough during years 2 to 4 to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should exercise caution when using the data collected during year 1 and during the latter months of the study since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:

There were no specific incidents of measurement error brought up during the community visit. However, readers should refer to Section 5.4 for a thorough discussion of this issue.

As seen in the recall period tables, during most months of the study the majority of harvest records were collected within three months of the harvest. However, there were several months in each year of the study where there was an increase in the percentage of records with recall periods of four to six months. These months should be noted since there is a greater potential for measurement error due to recall failure as recall periods increase.

As noted in the comments associated with arctic char, below, there was commercial harvesting of char during the study. It appears that harvest estimates do include some of the commercial harvest and should be considered too high if only considering the subsistence harvest of the community.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou. Harvest estimates seem accurate; caribou were abundant around the community in the first two years of the study (C.F.).
2. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
3. **Wolf:** The harvest estimate in year 5 seems too low. Estimates in other years look more accurate (C.F.).
4. **Narwhal:** Harvest estimates in years 2 and 3 seem somewhat low. The annual narwhal quota was 100 animals. Hunters report that the harvests will vary from year to year and this variation is often related to killer whales in the area. The killer whales drive the narwhal closer to the community (C.F.). DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
100	75	108	130	166

5. **Eider duck:** Both king and common eiders are harvested by Pond Inlet hunters (C.F.).
6. **Thick-billed murre eggs:** Hunters reported that ice conditions were poor in year 2 when there was an early break-up; hunters were unable to get to the eggs. There should have been eggs reported in year 5, the lack of harvest during this year seems inaccurate (C.F.).
7. **Arctic char:** There was commercial harvesting of char throughout the Harvest Study (DFO F). One of the Fieldworkers reported that some commercial harvest was reported along with the subsistence harvest. Some hunters reported that the harvest estimates are too low if all commercial harvesting was reported. Therefore harvest estimates are thought to include the subsistence harvest and only some of the commercial harvest (C.F.).
8. **Cod/sculpin:** Harvested in nets along with arctic char (C.F.).
9. **Clams:** Although harvest estimates seem accurate, numbers have increased since the Harvest Study due to local divers who are now harvesting clams. It is necessary to dive for clams since the tides are not sufficient to allow for digging of clams at the shoreline (C.F.).

6.1.10 ᓄᓇᕗᑦ ᓴᖅᑭᑕᐅᔪᓂᖅ ᐅᖃᖅᑎᑐᑦᑕᖅ: ᒥᑎᒪᒋᓪᓗᒃ

ᖃᐅᔨᓴᓂᐅᕙᓂ ᐊᖅᑭᑦᑐᒪᔪᓂᖅ:

ᑐᑭᓯᐊᕐᓇᓯᓂᒥᓪᓗᒃ ᐊᑎᓕᐅᓚᖓᔪᓚᐅᖅᓄᑦ ᓄᓇᕗᑦ ᑯᓘᔾᔪᑎᑕᐅᑎᓪᓗᒥᑦ ᑕᐃᑎᕐᓯᓚᐅᖅᑐᑦ ᖃᖅᑎᖓᓇᓕᐅᓚᐅᖅᑐᑦ ᐊᑐᖅᑕᐅᓯᒪᔪᓂᖅ ᐊᑎᖃᖅᑕᐅᓚᐅᖅᑐᑦᑕᐅᓂᖅᓴᓂᖅ ᖃᖅᑎᖓᓇ

6.1.10 Nunanit Iniktigutait Ukauhiit: Mitimatalik

Ihivgiuktit Atugutait:
Ihivgiufaahimayut ataani naunaiyakhimayut nunani pulaakatakhimapluta ukakhimayut ikitut Inuit umayukhiuktit titigakhimaitut Umayukhiukhimayuni Ihivgiuhimayuni. Nalunangituk atauhimik inuinaungitumik umayukhiuktikaktuk tuniyauhimayut umayukhiugutimik inmiigutihimayumik titigaktauhhimaituk, umayukhiukataktuk. Ukauhimayut ilangani 5.2.1 ikpinagiyait hamna ataani naunaiyakhimayuk pilaaktuk ataanut ihumagiyait umayukhiukhimayut naunaiyautaini. Kihimi pihimayuk ihumagiyait mikiyuk pihimaitut umayukhiuktit mikinikhaamik 1%mik tamaat umayukhiuktinit (ikpatauyak 10).

Ihivgiukhimayut pihimayait ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait ilangini tatkikhiutini ukiumi 1mi ihivgiuktuni mikiyut Mitimatalikmi, katakhuni 50%mik 7nut 12nit tatkikhiutini. Kiuhimayut naunaiyautait ukiumi 2mi ovalo 4mi nakuuyut, kihimi naunaiyautait katakhimayut kinguliutaini tatkikhiutini ukiumi 5mi. Takuhimayut ikpatauyami 9mi pikataktut kiuyuitut naunaiyautait Mitimatalikmi mikiyut, 2%mik ovalo ihumagiyaungituk pilaaktuni ilainik kiuyuitut ihumagiyaini.

Kiuhimayut naunaiyautait angiyut ovalo kiuyuitut ihumagiyait mikiyut ukiumi 2mit 4mut pigiagani nni pihimayuk nakuuyumik naunaiyautaini Nni umayukhiuktit. Taiguaktut piyukhat atugumik katitikhimayunik katitigutaini ukiumi 1mi ovalo kinguani tatkikhiutit ihivgiuktitlugit pilaakhutik tamamik uktukhimayut ihuinaagutaini ovalo kiuyuitut ihumagiyaini angiklihimayut kiuhimayut naunaiyautait katanmata.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Pikangituk atugutingit ihuinaakhimayuni ukaktunit nunani pulaaktakhimatitlugit, Kihimi taiguaktut takuyuhat ilangnai 5.4 ukauhiinik hapkoa ihumagiyauyunit.

Takuhimayuni utiktihimayut ubluit ikpatauyani ihivgiuktitlugit amigaitut umayukhimayut titigagutaini katitikhimayut iluani pingahut tatkikhiutini umayukhiukhimayuni. Kihimi, amigaivyaktut tatkikhiutini tamamik ukiuni ihivgiuktitlugit angilihimayut ilangit titigakhimayut utiktitihimakyut ubluit hitamat siksinut tatkikhiutini. Hapkoa tatkikhiutit nalunaikhimayukhat pilaaktunik atugutingit ihuinaalaaktunik utiktihimayut pingitpata utiktihimayakhait ubluit angiklikpat.

Titigakhimayuni ukauhiinik mikhaanut ikaliviit haman, kinauyaliuhimayut umayukhiugutaini ikaliviit ihivgiuktitlugit. Takukhauyut umayukiukhimayut naunaiyautait ilauyut ilangit kinauyaliuktut umayukhiuktuni ovalo ihumaiyakhait angiyut talvatuak ihumagiliktainik atuktakhainik umayukhiukhimayut nunani.

Nunanit ukakhimayut ovalo aalat pihimayaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukhimayut ilauyut nunani tuktut. Umayukhiukhimayut naunaiyautait nakuuyut; Tuktut amigaitpaktut haniani nunat hivulimi malguk ukiuni ihivgiuktitlugit (C.F.).
2. **Nanuit:** Amigaitjutait takuhimayut naunaiyautaungitut kihimi pihimayut umayukhiukhimayut amigaitjutait tunihimayut DSDkunit (DSD PB).
3. **Amagut:** Umayukhiukhimayut naunaiyautait ukiumi 5mi mikiyut. Naunaiyautait aipaini ukiuni naamaktut (C.F.).
4. **Tuugaat:** Umayukhiukhimayut naunaiyautait ukiumi 2mi ovalo 3mi mikiyut. Ukiuk tamaat tugaaliit kilalugait 100kuyut umayut. Umayukhiuktit tuhaktitihimayut umayukhiukhaiyit aalaukataniaktuk ukiunit ovalo hamna aalagugutait pihimavaktut mikhaanut kiniktut kilalugakpakyuit (killer whale) nunani. Kilalugakpakyuit kimaatkakpaktait tugaaliit kilalugait hanianut nunat (C.F.). DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait tugaaliit kilalugait (nalungilutit DFOkut katitikhimayait atuktaini atukhimayut ukiungit, Umayukhiukhimayut ihivgiugutait umayukhiukhimayut ukiungit pivaktut Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
100	75	108	130	166

5. **Tingmiat:** Tamamik kingaliit ovalo mitiit umayukhiukpaktut Mitimatalikmi umayukhiuktinit (C.F.).
6. **Akpait maniit:** Umayukhiuktit tuhaktitihimayut hikut naamagutait nakuungitut ukiumi 2mi hikut ahiguktinagimata; umayukhiuktit pingitut maninut. Piyukhat maniit tuhaktitihimayut ukiumi 5mi, Pingitut umayukhiukhimayuni hamani ukiumik nakuuyut (C.F.).
7. **Ikaliviit:** Kinauyaliukhutik ikalukhiukpaktut tamaat Umayukhiukhimayut Ihivgiuktitlugit (DFO F). Atauhik nunani havakti tuhaktitihimayuk ilangit kinauyaliugutait umayukhiukhimayait ilauhimayut atuktakhaminik umayukhiukhimayaminut. Ilangit umayukhiuktit tuhaktitihimayut umayukhimayut naunaiyautait mikiyut tamamik kinauyaliukhimayaini umayukhimayaini tuhaktitihimakpat. Taimaimat, umayukhiukhimayut naunaiyautait ilauyut atuktakhaminik umayunik ovalo ilangiinak kinauyaliugutigihimayainik umayukhimayaini. (C.F.).
8. **Ugat/kanayuit:** umayukhiukhimayut kuvyakut ilauplutik ikalivinut (C.F.).
9. **Uviluit:** Umayukhiukhimayait naunaiyautait naamaktut, amigaitjutait angilihimayut Umayukhiukhimayut Ihivgiukliktitlugit nunanit imami ataani naluuyaktut umayukhiukatalimata uvilunik. Naluuyakataktut uvilukhiukhutik ilaa imaukatautait angiyuugimata uvilukhiugiagani hinaani tagiup. (C.F.).

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 243

Monthly harvest estimates
ᑕᖅᑕᒪᒃ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᓐᖁᒍ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᓄᐊᓚᓗ	DEC ᑎᓯᓚᓗ	JAN ᔮᖏᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	30		15	14				65	9	39	36	19	227 ± 34
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					4	1		29					
Wolf	ᐊᒪᓗᐃᑦ	Amagut	1												1 ± 1
Arctic fox	ᑎᓘᑌᐦᐅᐊᑦ	Tigiganiat						1		6	1	1			9 ± 4
Coloured fox	ᖃᐅᐦᖏᑦᑐᑦ ᑎᓘᑌᐦᐅᐊᑦ	Kalaliit tigiganiat						1	1						2 ± 2
Arctic hare	ᐅᑲᓪᓕ	Ukalik	7		1	5	6	7	6	1	5	12	1	1	52 ± 8
Ringed seal	ᓇᕆᑦ	Natiinat	1,137	468	264	272	429	171	119	153	210	189	192	353	3,957 ± 178
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	2	7	7	5	5	3		1					30 ± 7
Harp seal	ᖃᐃᓴᓪᓕᑦ	Qairulik	1	5	25	29	42	1							103 ± 17
Walrus	ᐊᐃᐸᑦ	Akvik	1	1	1	1	2	7							13 ± 6
Narwhal	ᑐᒻᓪᓕᑦ ᖁᓪᓗᓂᑦ	Tuugaak	5	6	10	4	8								33 ± 7
Snow goose	ᑲᖕᒪᐃᑦ	Kanguq	9	1	1										11 ± 3
Canada goose	ᓂᕐᓪᓕᑦ	Nikliknik	74	4									5	29	112 ± 20
Eider duck	ᒥᑎᑦ	Kingalik	66	78		52	160	38					5	4	403 ± 75
Tundra swan	ᑲᓱᔪᐃᑦ	Kukyuk	2												2 ± 1
Black guillemot	ᐱᕐᓯᐊᓪᓕᑦ	Black guillemot	2					5							7 ± 3
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	89	3				40	1	15	31	58	55	60	352 ± 60
Goose eggs	ᑲᖕᒪᐃᑦ ᒪᓐᓂᖅᑕᑦ	Uluaguliit manniit	65											12	77 ± 21
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖅᑕᑦ	Tinmiat manniit	77	248	27										352 ± 157
Arctic tern eggs	ᐃᒥᖅᑯᑕᓪᓕᐃᑦ ᒪᓐᓂᖅᑕᑦ	Emitkutailat manniit	493	62											555 ± 110
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓐᓂᖅᑕᑦ	Nauyat manniit	50												50 ± 20
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	1,788	960	1,598	83	413	261	184	294	161	1,152	824	1,184	8,902 ± 1,636
Cod	ᐅᓚᐃᑦ	Ugak	64			1		43							108 ± 43
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	119	9	22										150 ± 42
Clams	ᐊᒃᒪᒪᓇᔪᑦ	Uviluq	577	351	172	59	114	95							1,368 ± 559
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet			2,857										2,857 ± 3,130

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᖅᑐᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᔨᖏᑦ ᐅᑯᐊ ᐃᑯᐱᖅᓯᓂᓕᕆᓂᖅ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 244

Monthly hunter response

ᑕᖃᑦᒪᒃᑦ ᐊᖏᔪᓚᐱᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᒻᒋᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓯᑎᒻᒪᓗ	OCT ᐅᑯᐊᓗ	NOV ᐅᐸᒻᒪᓗ	DEC ᑎᓯᒻᒪᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᓱᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓚᐱᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᒪᒃᑦ ᐊᖏᔪᓚᐱᑎᑦ	Tatkitaman angunahuktut titigait	113	113	113	112	111	110	107	106	107	107	107	108	114*
Hunters interviewed	ᐊᖏᔪᓚᐱᑎᑦ ᐊᐱᓯᒪᑦ	Angunahuktin apikhuktan	104	82	79	94	90	93	81	76	86	91	80	89	114*
Harvested	ᐊᖏᔪᓚᐱᑐᒋᓐ	Angujaujut	104	58	35	42	52	26	22	30	25	37	34	49	113*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑲᓂᖏᑦ (%)	Kiujut (%)	92	73	70	84	81	85	76	72	80	85	75	82	80**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓚᐱᑎᑦ ᐊᑎᓕᐅᕆᔨᒃᑯᓘᑦ/ᐊᐱᓯᒪᑦᑐᑦ/ᐊᖏᔪᓚᐱᑐᒋᓐᓂᒃ ᐊᑕᐅᓯᐊᖓᔪᓂᒃᑯᑦ ᐊᑭᖏᑎ.
** ᐊᑲᓴᓕᖅᑎᓯᒪᔨᑦ ᑕᖃᑦᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 245

Recall period between harvest and interview, expressed as % of total harvest records

6.1.11

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᖏᓂᒃ ᐊᖏᔪᓚᐱᓂᓂᒃᑕ ᐊᒪᓗᓗ ᐊᐱᓯᒪᑦᑕᐅᓂᒃᑕ, ᐅᓗᓇᐃᖏᑦ ᐃᒪᒃ % ᑲᑎᑕᑎᑦ ᐊᖏᔪᓚᐱᑦᑕ ᑎᑎᖏᑦᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᒻᒋᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓯᑎᒻᒪᓗ	OCT ᐅᑯᐊᓗ	NOV ᐅᐸᒻᒪᓗ	DEC ᑎᓯᒻᒪᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᓱᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲ	≤ tatkin pingahut	95	99	100	100	100	98	100	86	100	61	89	86	94
4-6 months	4-6 ᑕᖅᑲ	tatkin hitaman 6nut	0	0	0	0	0	2	0	10	0	39	11	12	4
> 6 months	> 6 ᑕᖅᑲ	> 6 tatkin	5	1	0	0	0	0	0	4	0	0	0	3	2

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 246

Number of hunters harvesting each species — **Year 1 (June 1996 - May 1997)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓕᓴᐃᒋᑦ ᐊᖓᔪᓕᓴᐅᕐᕆᔨᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᓐᓴᒍ 1 (ᔫᓂ 1996 - ᒪᐃ 1997)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 1 (June 1996 - May 1997)**

Month/ᑕᖅᑳᖅ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑉᐱᓗ	NOV ᐅᓇᓚᓗ	DEC ᑎᓯᓚᓗ	JAN ᔮᖅᓇᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓕᓐ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	13		6	4				10	2	8	5	3	38
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐅᑦ	Amagut	1												1
Arctic fox	ᑎᓗᓚᖓᓂᐊᑦ	Tigiganiat						1		2	1	1			4
Coloured fox	ᖃᐃᖕᖏᑦᑐᑦ ᑎᓗᓚᖓᓂᐊᑦ	Kalaliit tigiganiat						1	1						2
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	2		1	2	4	4	4	1	3	7	1	1	21
Ringed seal	ᓇᓕᓵᑦ	Natiinat	92	52	28	41	49	24	19	28	22	26	24	41	106
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk	2	4	4	4	4	3		1					17
Harp seal	ᖃᐃᕐᓪᓕᑦ	Qairulik	1	3	10	11	16	1							33
Walrus	ᐊᐃᐅᒃᑦ	Akvik	1	1	1	1	2	2							7
Narwhal	ᑐᒻᓪᓕᑦ ᕿᓪᓗᓂᑦ	Tuugaak	4	4	5	4	5								14
Snow goose	ᑲᖕᒪᐃᑦ	Kanguq	5	1	1										7
Canada goose	ᓂᕐᓪᓕᑦ	Nikliknik	16	2									1	10	27
Eider duck	ᒥᑎᑦ	Kingalik	20	10		10	18	2					1	1	47
Tundra swan	ᑲᓱᓚᐃᑦ	Kukyuk	2												2
Black guillemot	ᐱᑦᓯᐅᓪᓕᑦ	Black guillemot	2					1							3
Ptarmigan	ᐊᕐᓚᑦ	Akilgik	12	1				4	1	4	4	9	7	5	29
Goose eggs	ᑲᖕᒪᐃᑦ ᓚᒃᓂᖏᑦ	Uluaguliit manniit	5											2	7
Duck eggs	ᒥᑎᑦ ᓚᒃᓂᖏᑦ	Tinmiat manniit	5	4	2										11
Arctic tern eggs	ᐃᒥᖕᑯᑕᓪᓕᑦ ᓚᒃᓂᖏᑦ	Emitkutailat manniit	10	2											11
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᒃᓂᖏᑦ	Nauyat manniit	5												5
Arctic char	ᐃᖕᓄᒃᐲᑦ	Ikaliviit	48	24	19	3	2	3	2	1	1	5	3	14	81
Cod	ᐅᓗᐃᑦ	Ugak	6			1		1							8
Sculpin	ᑲᓇᓚᐃᑦ	Kanayuk	7	2	1										10
Clams	ᐋᒃᒪᒻᒪᓚᑦ	Uviluq	3	1	1	3	2	1							9
Mussels	ᐅᐱᓄᐃᑦ	Uviluvaloet			1										1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᒪᓚᓂᒃ ᐱᑕᖖᖕᖏᑐᖅ ᐱᓱᐊᓕᓐᓂᒃ ᐊᖓᔪᑦ ᖃᑦᓯᐅᓂᖏᓐᓂᑦ ᐊᓕᖏᒃᑐᓂᑦ ᐊᖓᔪᓄᑦ ᓇᓕᐅᐊᓗᐊᓂᓐᓂᒃᑐᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 247

Monthly harvest estimates
ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᐃᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᑎᖃᒍ 2 (ᔫᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᑦᐱᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᓇᓵᐱᓇ	DEC ᑎᓯᓵᐱᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐅᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut								8	31	30	24	25	118 ± 29
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡					7			28					
Arctic fox	ᑎᓘᑉᓂᐊᑦ	Tigiganiat								16	8	8			32 ± 16
Coloured fox	ᖃᐅᖕᖏᑦᑐᑦ ᑎᓘᑉᓂᐊᑦ	Kalaliit tigiganiat								1	1				2 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	2		3		1			5			9	9	29 ± 11
Ringed seal	ᓇᕆᑦ	Natiinat	726	179	243	383	122	78	33	290	171	173	220	267	2,885 ± 306
Bearded seal	ᐅᑉᐊᐃᑦ	Ukyuk			7	1	3				2				13 ± 6
Harp seal	ᖃᐃᓱᓪᓚᑦ	Qairulik		2	2	10	6	3							23 ± 8
Narwhal	ᑐᒃᓪᓚᑦ ᖁᓕᓴᒃᑦ	Tuugaak		5	4		4								13 ± 6
Beluga	ᖃᐅᖅᑕᑦ ᖁᓕᓴᒃᑦ	Kilalugak				4									4 ± 4
Snow goose	ᑲᖕᒪᐃᑦ	Kanguq			3									12	15 ± 7
Canada goose	ᓂᖅᓪᓚᑦ	Nikliknik	15	3	23	67	1							2	111 ± 36
Eider duck	ᒥᑎᑦ	Kingalik	19	3	2										24 ± 17
Yellow-billed loon	ᑐᑦᓕᑉᐸᐊᑦ	Tuulik		3											3 ± 4
Thick-billed murre	ᐊᑦᐸᐃᑦ	Thick-billed murre					1								1 ± 2
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	13		2		1			63	122	35	73	27	336 ± 123
Goose eggs	ᑲᖕᒪᐃᑦ ᒪᓂᓂᑦ	Uluaguliit manniit												51	51 ± 23
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᑦ	Tinmiat manniit	43												43 ± 62
Arctic tern eggs	ᐃᒥᖏᑯᐊᓗᐃᑦ ᒪᓂᓂᑦ	Emitkutailat manniit	9												9 ± 12
Arctic char	ᐃᖃᓗᒃᐸᑦ	Ikaliviit	627	320	543	11				6,827	4,821	201	6,204	393	19,947 ± 3,773
Clams	ᐊᒻᒧᒪᑦ	Uviluq										2			2 ± 1

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦ ᑎᑎᕋᐅᒪᓂᑦ ᑐᓂᓯᖏᑦ ᐅᑲᐃᖏᑦ ᐅᑯᐊ ᐃᑯᐊᕕᓕᓂᒃᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 248

Monthly hunter response
ᑕᖅᑕᒪᒃᑦ ᐊᖏᓚᓱᓕᒃᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᑦᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓱᑎᕐᓚᓪ	OCT ᐅᑲᐃᓚᓪ	NOV ᐅᓇᕐᓚᓪ	DEC ᑎᓱᕐᓚᓪ	JAN ᒍᖏᓇᓪ	FEB ᓇᖕᐅᔨᓪ	MAR ᒪᕆ	APR ᐃᓪᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓚᓱᓕᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐱᒍᕆᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᓚᓱᓕᒃᑎᑦ	Tatkitaman angunahuktut titigait	107	109	110	109	109	107	107	105	105	108	108	109	116*
Hunters interviewed	ᐊᖏᓚᓱᓕᒃᑎᑦ ᐊᐱᕆᔨᑦ	Angunahuktin apikhuktan	54	69	66	80	78	81	70	86	87	90	92	99	115*
Harvested	ᐊᖏᓚᓱᓕᒃᑐᒋᓐ	Angujaujut	22	28	38	35	21	14	8	34	30	34	37	64	101*
Response Rate (%)	ᑭᐅᔪᓂᖏᑦ ᖃᓄᐃᐅᓂᖏᑦ (%)	Kiujut (%)	50	63	60	73	72	76	65	82	83	83	85	91	74**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓱᓕᒃᑎᑦ ᐊᑎᓕᐅᑦᑕᐅᒪᔪᑦ/ᐊᐱᕆᔨᑦ/ᐊᖏᓚᓱᓕᒃᑐᒋᓐ ᐊᑕᐅᔨᐊᔭᐃᑐᑎᑦ ᐊᑦᖁᒪᒥ.
** ᐊᓕᒍᓕᓪᓗᒪᓚᔪᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔪᑦ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 249

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓐᓄ ᐊᖏᓚᓱᓖᓄᑦ ᐊᒪᓗ ᐊᐱᕆᔨᑦᑕᐅᓂᖏᓐᓄᑦ, ᓇᓗᓇᐃᖏᑦ ᐃᒪᓐ % ᑲᑎᑕᑎᑦ ᐊᖏᓚᓱᓕᒃᑐᑦ ᑎᑎᕐᑕᐅᒪᔪᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)
ᐊᑦᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

6.1.11

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓱᑎᕐᓚᓪ	OCT ᐅᑲᐃᓚᓪ	NOV ᐅᓇᕐᓚᓪ	DEC ᑎᓱᕐᓚᓪ	JAN ᒍᖏᓇᓪ	FEB ᓇᖕᐅᔨᓪ	MAR ᒪᕆ	APR ᐃᓪᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔪᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕐᓴᑦ	≤ tatkin pingahut	100	100	98	100	100	100	100	0	6	37	62	93	74
4-6 months	4-6 ᑕᕐᓴᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	50	49	17	25	4	13
> 6 months	> 6 ᑕᕐᓴᑦ	> 6 tatkin	0	0	2	0	0	0	0	50	45	46	13	2	13

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 250

Number of hunters harvesting each species
ᖁᑦᓱᐅᓂᖏᑦ ᐊᖏᔪᓕᒃᑎᑦ ᐊᖏᔪᓕᒃᓯᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin,

Year 2 (June 1997 - May 1998)
ᐊᒃᑭᒍ 2 (ᔪᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᒻᒪᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓯᐱᓗ	JAN ᒍᓐᓇᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᓯ	APR ᐃᓪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑕᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut								2	4	4	2	6	15
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓘᑓᓂᐊᑦ	Tigiganiat								3	2	1			3
Coloured fox	ᖃᓄᖕᖏᑦᑐᑦ ᑎᓘᑓᓂᐊᑦ	Kalaliit tigiganiat								1	1				2
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	1		1		1			1			3	4	9
Ringed seal	ᓇᓯᓕᑦ	Natiinat	22	25	36	35	21	13	8	30	23	22	31	38	87
Bearded seal	ᐅᓗᔪᐃᑦ	Ukyuk			3	1	2				1				6
Harp seal	ᖃᐃᓱᓕᓪᓚᑦ	Qairulik		1	1	6	1	1							10
Narwhal	ᑐᒃᓪᓚᑦ ᖁᓕᓴᓕᑦ	Tuugaak		2	2		3								7
Beluga	ᖃᐅᖏᑦ ᖁᓕᓴᓕᑦ	Kilalugak				1									1
Snow goose	ᑲᖕᒪᐃᑦ	Kanguq			1									2	3
Canada goose	ᓂᖏᓪᓚᑦ	Nikliknik	3	1	3	8	1							1	14
Eider duck	ᒥᑎᑦ	Kingalik	4	1	1										6
Yellow-billed loon	ᑐᑦᓕᓗᔪᐊᑦ	Tuulik		1											1
Thick-billed murre	ᐊᖏᔪᐃᑦ	Thick-billed murre					1								1
Ptarmigan	ᐊᖑᓱᑦ	Akilgik	2		1		1			3	5	5	7	7	26
Goose eggs	ᑲᖕᒪᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit												1	1
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit	1												1
Arctic tern eggs	ᐃᒥᓴᑕᐃᓪᓚᑦ ᒪᓐᓂᖏᑦ	Emitkutailat manniit	1												1
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	9	8	6	1				6	6	3	5	46	65
Clams	ᐊᓚᒧᒪᔪᑦ	Uviluq										1			1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᒪᔪᓂᒃ ᐱᑕᖃᓄᖕᖏᑐᖃᓄᑦ ᐱᓕᔪᑎᓐᓂᓂᒃ ᐊᖏᔪᑦ ᖁᑦᓱᐅᓂᖏᓐᓄᓪᓕ ᐊᓪᓚᖃᐅᒪᔪᓪᓕ ᐊᖏᔪᓄᑦ ᓇᓪᑕᐅᓐᓇᖅᑐᖃᓄᑦ ᑐᓂᔭᖏᓐᓂᓂ ᐃᑯᐱᕐᓇᓕᓵᓐᓇᕆᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 251

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᓐᖁᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖢᓪ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᕆ	OCT ᐅᑲᐃᕆ	NOV ᓄᐱᓴᕆ	DEC ᑎᓯᓴᕆ	JAN ᔮᖏᓂᐊᕆ	FEB ᐃᖅᑲᐊᕆ	MAR ᒪᑉᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᒥᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	10	8	15	8				11	43	6	43	28	172 ± 30
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					1	1		3‡2					
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat								2					2 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik									1				1 ± 1
Ringed seal	ᓇᑦᓯᑦ	Natiinat	1,398	379	293	230	323	264	231	147	93	74	140	193	3,765 ± 288
Bearded seal	ᐅᓗᔪᐃᑦ	Ukyuk		8	14	6	3	4		1					36 ± 9
Harp seal	ᖃᐃᐳᓪᓚᑦ	Qairulik		3	11	9	18								41 ± 9
Walrus	ᐊᐃᐃᓴᑦ	Akvik		4											4 ± 2
Narwhal	ᑐᒃᓪᑦ ᖁᓪᓗᑦ	Tuugaak		4	12		21								37 ± 8
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	2												2 ± 2
Canada goose	ᓄᖅᓪᓚᑦ	Nikliknik	24	6	11	4								8	53 ± 20
Eider duck	ᒥᑎᑦ	Kingalik		19	14	13	78	4		19					147 ± 44
Thick-billed murre	ᐊᑦᐸᐃᑦ	Thick-billed murre		15											15 ± 17
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	18					64	63	72	81	51	22		371 ± 103
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit		225	43										268 ± 95
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓕᓂᖏᑦ	Nauyat manniit	155												155 ± 137
Arctic char	ᐃᖃᓗᓴᑦ	Ikaliviit	910	1,006	119		237		1,025	1,423	805	282	888	208	6,903 ± 1,330
Clams	ᐊᓚᒧᒪᔪᑦ	Uviluq			435	21	1,416	2,019				129			4,020 ± 2,045

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᔨᖏᑦ ᐅᑲᐃᖏᑦ ᐅᑯᐊ ᐃᑯᕐᓴᐅᓕᕆᓂᖅᓴᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 252

Monthly hunter response

ᑕᖅᑕᒪᑦ ᐊᖏᒍᓱᓕᕆᑦ ᑭᐅᓂᖅᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᓕᖕᒧᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐅᓕᓇ	OCT ᐅᑦᔪᓕᓇ	NOV ᐃᓄᐅᓕᓇ	DEC ᑎᓯᓕᓇ	JAN ᔮᓐᓄᔪᓇ	FEB ᐃᖏᐅᔪᓇ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᕐᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᒍᓱᓕᕆᑦ ᑭᐅᓂᖅᑎᑦ ᐊᑎᓯᒪᓂᖅᑎᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᒍᓱᓕᕆᑦ	Tatkitaman angunahuktut titigait	108	107	106	105	111	116	116	119	118	118	116	115	124*
Hunters interviewed	ᐊᖏᒍᓱᓕᕆᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	81	90	90	89	89	84	80	104	97	92	87	87	109*
Harvested	ᐊᖏᒍᓱᓕᕆᑐᐊᓂ	Angujaujut	52	35	40	37	46	28	27	33	26	24	34	41	89*
Response Rate (%)	ᑭᐅᔪᓂ ᖃᓄᐅᓂᖅᑎᑦ (%)	Kiujut (%)	75	84	85	85	80	72	69	87	82	78	75	76	79**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᒍᓱᓕᕆᑦ ᐊᑎᓕᐅᕐᑕᒪᒪᓂᖅᑐᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᒍᓱᓕᕆᑐᐊᓂᒃ ᐊᑕᐅᓯᐊᖓᔪᓕᕐᓂᖅ ᐊᓕᖕᒪᑉ.
** ᐊᓗᓕᓂᓕᕐᓯᒪᔪᑦ ᑕᖅᑕᒪᑦ ᑭᐅᔪᓂ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 253

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓐᓄᓂ ᐊᖏᒍᓱᓂᓐᓂᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓯᕐᑕᐅᓂᓐᓂᑕ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᕐᑐᑦ ᐊᖏᒍᓱᓂᑕᑦ ᑎᑎᕐᕕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐊᓕᖕᒧᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐅᓕᓇ	OCT ᐅᑦᔪᓕᓇ	NOV ᐃᓄᐅᓕᓇ	DEC ᑎᓯᓕᓇ	JAN ᔮᓐᓄᔪᓇ	FEB ᐃᖏᐅᔪᓇ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᕐᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔪᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕐᑯᑦ	≤ tatkin pingahut	0	46	99	95	99	98	100	87	84	84	73	81	75
4-6 months	4-6 ᑕᕐᑯᑦ	tatkin hitaman 6nut	97	53	1	5	1	2	0	9	14	16	21	15	23
> 6 months	> 6 ᑕᕐᑯᑦ	> 6 tatkin	3	1	0	0	0	0	0	4	2	0	6	5	2

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 254

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᓇᓯᓴᒋᑦ ᐊᖓᓇᓯᓴᕐᕕᒋᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 3 (June 1998 - May 1999)
ᐊᒃᑭᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᐃ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓯᐱᓗ	JAN ᒍᖏᓇᓗ	FEB ᓇᖕᐅᓇᓗ	MAR ᒪᑦᓯ	APR ᐃᑦᓂᓪ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	2	2	6	3				1	8	2	13	6	29
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓘᓴᓂᐊᑦ	Tigiganiat								1					1
Arctic hare	ᐅᑲᓪᓂᑦ	Ukalik									1				1
Ringed seal	ᓇᑦᔪᑦ	Natiinat	47	32	35	37	44	27	26	23	15	15	23	24	81
Bearded seal	ᐅᑭᔨᐃᑦ	Ukyuk		4	7	5	3	3		1					15
Harp seal	ᖃᐃᖅᓂᑦ	Qairulik		2	7	5	10								21
Walrus	ᐊᐃᐃᓴᑦ	Akvik		3											3
Narwhal	ᑐᒻᓂᓪᑦ ᖁᓪᓗᒍᑦ	Tuugaak		2	6		12								19
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	2												2
Canada goose	ᓂᖅᓂᑦ	Nikliknik	2	1	2	3								3	10
Eider duck	ᑎᑎᑦ	Kingalik		4	3	4	8	2		1					16
Thick-billed murre	ᐊᑦᑐᐃᑦ	Thick-billed murre		1											1
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	2					4	4	9	11	10	4		23
Duck eggs	ᑎᑎᑦ ᒪᓐᓂᖅᑦ	Tinmiat manniit		4	1										5
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓐᓂᖅᑦ	Nauyat manniit	1												1
Arctic char	ᐃᖃᓗᓴᑦ	Ikaliviit	21	11	5		3		5	9	3	2	3	22	52
Clams	ᐊᓚᒧᒪᔪᑦ	Uviluq			1	1	2	3				1			5

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᖏᑕᐃᖅ ᐱᓕᕆᓚᓐᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᓐᓂᒃ ᐊᓚᖅᐳᓗᒪᔪᑦ ᓇᓚᕐᔪᐊᖑᓚᐅᖅᑐᓂᒃ ᑐᓂᔅᓴᖏᓐᓂᒃ ᐃᑯᐱᕐᓚᓚᓐᓇᕆᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 255

Monthly harvest estimates

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓕᕆᑦ

Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)

ᐊᓐᖁᒍ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᐹᓕ	OCT ᐅᑦᐸᓕ	NOV ᐅᓇᐹᓕ	DEC ᑎᓯᐹᓕ	JAN ᔮᖏᓇᐊᓕ	FEB ᓄᖅᐳᐊᓕ	MAR ᒪᕐᓂ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	17		2	3					7	2	4	7	42 ± 16
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡					4	4	1	33					
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				4		1			4		3		12 ± 9
Ringed seal	ᓇᕐᓂᑦ	Natiinat	486	153	332	313	241	142	50	68	84	72	79	183	2,203 ± 305
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk		9	2	2	5								18 ± 14
Harp seal	ᖃᐃᓕᓪᓚᑦ	Qairulik		4		6									10 ± 10
Walrus	ᐊᐃᐸᒃᑦ	Akvik	5												5 ± 6
Narwhal	ᑐᒡᓪᓚᑦ ᖁᓕᓴᒃᑦ	Tuugaak	1			3	27								31 ± 18
Canada goose	ᓄᖅᓪᓚᑦ	Nikliknik	12												12 ± 9
Eider duck	ᒥᑎᑦ	Kingalik		36			2								38 ± 34
Ptarmigan	ᐊᖏᓚᒃᑦ	Akilgik	1					12	25	33	31	2	23	4	131 ± 64
Goose eggs	ᓄᖅᓪᓚᑦ ᒪᓐᓄᖏᑦ	Uluaguliit manniit	13												13 ± 17
Duck eggs	ᒥᑎᑦ ᒪᓐᓄᖏᑦ	Tinmiat manniit		2											2 ± 3
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	50	253	105			101	785	297		18		596	2,205 ± 1,171
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk		17											17 ± 18
Clams	ᐋᓚᒧᓚᐊᑦ	Uviluq			7,727	16,826	18,298	17,500	20,526			15,500			96,377 ± 50,755

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓄᑦ ᑎᑎᕋᑕᒪᓚᐊᑦ ᑐᓄᖅᖏᑦ ᐅᑉᐸᓕ ᐃᓄᐃᑦᕿᓂᓕᕆᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 256

Monthly hunter response
ᑕᖅᑕᒪᒃᑦ ᐊᖏᓚᓯᒪᔪᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᑐᖃᒍ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓯᑎᕐᕕᓗ	OCT ᐅᑯᐊᓗ	NOV ᐅᓇᕐᕕᓗ	DEC ᑎᓯᕐᕕᓗ	JAN ᔮᖏᓇᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᕐᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᕐᑎᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓚᓯᒪᔪᑦ ᑭᐅᓂᖏᑦ ᐱᒍᓐᓇᓕᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᓚᓯᒪᔪᑦ	Tatkitaman angunahuktut titigait	117	115	117	119	119	138	137	142	142	140	141	150	163*
Hunters interviewed	ᐊᖏᓚᓯᒪᔪᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	86	77	70	58	58	93	87	110	109	101	97	98	138*
Harvested	ᐊᖏᓚᓯᒪᔪᑐᒃᑯᓂ	Angujaujut	39	24	22	16	12	19	9	11	11	12	11	53	92*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑦᑐᓂᖏᑦ (%)	Kiujut (%)	74	67	60	49	49	67	64	77	77	72	69	65	66**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓯᒪᔪᑦ ᐊᑎᓕᐅᕗᑦᑕᒪᓕᕆᔨᒃᑯᑦ/ᐊᐱᕐᓂᑦᑕᑦ/ᐊᖏᓚᓯᒪᔪᑐᒃᑯᓂ ᐊᑕᐅᓂᐊᖅᓯᑎᑐᑦ ᐊᑐᖅᔪᒥ.
** ᐊᑐᔨᓂᑎᑦᓯᒪᓕᕆᔨᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 257

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᕆᑦ ᐊᑯᖏᓐᓄᓂ ᐊᖏᓚᓯᒪᔭᓂᖏᓐᓄᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᓄᑕ, ᐅᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᕐᑎᑦ ᐊᖏᓚᓯᒪᓕᑦ ᑎᑎᕐᑎᑦᑕᐅᒪᕆᕆᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)
ᐊᑐᖃᒍ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

6.1.11

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓯᑎᕐᕕᓗ	OCT ᐅᑯᐊᓗ	NOV ᐅᓇᕐᕕᓗ	DEC ᑎᓯᕐᕕᓗ	JAN ᔮᖏᓇᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᕐᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᕐᑎᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᕆᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕᑦ	≤ tatkin pingahut	84	95	52	81	100	57	100	94	86	64	43	46	72
4-6 months	4-6 ᑕᖅᑕᑦ	tatkin hitaman 6nut	16	5	48	19	0	43	0	6	0	21	36	53	25
> 6 months	> 6 ᑕᖅᑕᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	14	14	21	1	2

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 258

Number of hunters harvesting each species — **Year 4 (June 1999 - May 2000)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᖅᑎᑦ ᐊᖏᔪᓚᐱᖅᓯᒪᔪᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒡᖏᒍ 4 (ᕿᓂ 1999 - ᒪᐃ 2000)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 4 (June 1999 - May 2000)**

Month/ᑕᖅᑳᖑᓪᓗ/Tatkia			JUN ᕿᓂ	JUL ᕿᓕᐃ	AUG ᐊᐅᑲᔪᑎ	SEP ᓯᑎᐱᕆ	OCT ᐅᑦᑐᕆ	NOV ᐅᓇᑲᕆ	DEC ᑎᓯᑲᕆ	JAN ᒍᓐᓇᐊᕆ	FEB ᓇᖅᑐᐊᕆ	MAR ᒪᔨ	APR ᐃᔨᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓪᓗ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	6		1	1					2	1	1	2	10
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic hare	ᐅᖃᓕᑦ	Ukalik				1		1			1		1		4
Ringed seal	ᓇᕐᓂᑦ	Natiinat	37	22	20	15	11	15	5	10	9	10	9	17	67
Bearded seal	ᐅᓪᓗᐃᑦ	Ukyuk		1	1	1	2								5
Harp seal	ᖃᐃᓗᓕᑦ	Qairulik		2		1									3
Walrus	ᐊᐃᐃᒃᑦ	Akvik	1												1
Narwhal	ᑐᒡᓕᑦ ᖁᓕᓴᒃᑦ	Tuugaak	1			1	8								9
Canada goose	ᓄᖅᓕᑦ	Nikliknik	3												3
Eider duck	ᒥᑎᑦ	Kingalik		3			1								4
Ptarmigan	ᐊᖏᓚᒃ	Akilgik	1					1	2	4	2	1	2	1	12
Goose eggs	ᓄᖅᓕᑦ ᒪᓐᓄᖏᑦ	Uluaguliit manniit	1												1
Duck eggs	ᒥᑎᑦ ᒪᓐᓄᖏᑦ	Tinmiat manniit		1											1
Arctic char	ᐃᖃᓗᐊᒃ	Ikaliviit	4	8	2			1	3	1		1		46	55
Sculpin	ᑲᓇᐋᑦ	Kanayuk		1											1
Clams	ᐊᑦᒧᒪᐋᑦ	Uviluq			1	1	1	1	1			1			2

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᒪᐋᓂᒃ ᐱᑕᖃᓄᖏᑐᖃᓂᒃ ᐱᓕᕆᓚᓂᓂᒃ ᐊᖏᔪᒃᑐᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓚᖃᐅᒪᒪᐋᓂᒃ ᐊᖏᔪᒃᓴᑦ ᓇᓚᕐᔪᐊᖅᑐᓄᑦ ᑐᓂᓴᖏᓐᓄᑦ ᐃᓂᒋᔭᐅᓂᖅᓯᒪᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 259

Monthly harvest estimates
ᑕᖅᑕᒪᒃ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᓪᓚᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑦᑎ	SEP ᓱᑎᑦᕕᓂ	OCT ᐅᑦᔨᕕᓂ	NOV ᐃᓄᓚᕕᓂ	DEC ᑎᓯᕕᓂ	JAN ᔮᖏᓄᓂ	FEB ᐃᖅᑲᓂ	MAR ᒪᓕᒃ	APR ᐃᓪᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin ± 95% CI
Species	**ᐅᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	19		3		16			3					41 ± 31
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡						4	21						
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik				1	9	9	5						24 ± 24
Ringed seal	ᓇᕆᑦ	Natiinat	515	246	252	154	54	56	102	124	44	62	136	195	1,940 ± 444
Bearded seal	ᐅᓚᔪᐃᑦ	Ukyuk		7		4	2	2							15 ± 13
Narwhal	ᑐᓴᓪᓕᑦ ᖁᓕᓴᒃ	Tuugaak				9	3								12 ± 6
Canada goose	ᓂᕐᓪᓕᑦ	Nikliknik	4												4 ± 5
Eider duck	ᒥᑎᑦ	Kingalik		14			9	6							29 ± 26
Ptarmigan	ᐊᖏᓚᑦᑎᑦ	Akilgik			1		15	9	64	3		16		3	111 ± 98
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit		57											57 ± 62
Arctic char	ᐃᖃᓗᒃᐸᑦ	Ikaliviit	616	195	134			664	1,033	896				253	3,791 ± 2,447
Sculpin	ᑲᓕᐊᕐᑦ	Kanayuk		9											9 ± 7

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓂ ᑎᑎᕋᑕᒪᓕᐊᑦ ᑐᓂᓐᖏᑦ ᐅᑯᐊᖏᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 260

Monthly hunter response
ᑕᖅᑕᒪᒃ ᐊᖏᓕᓂᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)
ᐊᓪᓚᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑦᑎ	SEP ᓱᑎᑦᕕᓂ	OCT ᐅᑦᔨᕕᓂ	NOV ᐃᓄᓚᕕᓂ	DEC ᑎᓯᕕᓂ	JAN ᔮᖏᓄᓂ	FEB ᐃᖅᑲᓂ	MAR ᒪᓕᒃ	APR ᐃᓪᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓕᓂᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃ ᐊᖏᓕᓂᑎᑦ	Tatkitaman angunahuktut titigait	147	146	146	152	151	152	152	154	154	153	151	151	157*
Hunters interviewed	ᐊᖏᓕᓂᑎᑦ ᐊᐱᓯᕐᓂᑦ	Angunahuktin apikhuktan	100	90	88	94	83	86	83	90	82	77	54	44	118*
Harvested	ᐊᖏᓕᓂᑎᑐᓗᓂᑦ	Angujaujut	42	19	18	18	7	3	9	4	1	2	5	20	72*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᖏᑦ (%)	Kiujut (%)	68	62	60	62	55	57	55	58	53	50	36	29	54**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓕᓂᑎᑦ ᐊᑎᓕᐅᑦᑎᓕᕐᓂᑦ/ᐊᐱᓯᕐᓂᑦ/ᐊᖏᓕᓂᑎᑐᓗᓂᑦ ᐊᑕᐅᓯᐊᓘᑐᑎᑦ ᐊᓪᓚᒍᒥ.
** ᐊᐅᔨᓂᓕᕆᓯᒪᓕᐊᑦ ᑕᖅᑕᒪᒃ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.1.11

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 261

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕿᐅᔪᑦ ᐊᑯᕐᓴᓂ ᐊᖓᔪᓇᓯᓂᖓᓐᓂᑦ ᐊᒻᒪᓗ ᐊᐱᕐᓯᕐᑕᐅᓂᖓᓐᓂᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑐᑎᑦ ᐊᖓᔪᓇᓱᑦ ᑎᑎᕐᕿᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᒻᒪᔪᒍ 5 (ᔫᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕐᖏᓐᓄᑦ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓱᑎᐱᓕ	OCT ᐅᑲᐃᓕ	NOV ᐅᓇᓚᐱᓕ	DEC ᑎᓯᓚᐱᓕ	JAN ᔮᖏᓇᐊᓕ	FEB ᓇᖕᐅᐊᓕ	MAR ᒪᔪ	APR ᐃᔪᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕿᐅᔪᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑎᑦ	≤ tatkin pingahut	79	83	95	88	29	44	100	88	0	0	40	93	78
4-6 months	4-6 ᑕᖅᑎᑦ	tatkin hitaman 6nut	19	17	5	12	29	56	0	12	100	100	60	7	19
> 6 months	> 6 ᑕᖅᑎᑦ	> 6 tatkin	2	0	0	0	41	0	0	0	0	0	0	0	4

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 262

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖓᓂᑦ ᐊᒻᒪᓗᓂᒃᑎᑦ ᐊᒻᒪᓗᓂᒃᓴᓪᓗᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓯᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

ᐊᒻᒪᔪᒍ 5 (ᔫᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕐᖏᓐᓄᑦ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓱᑎᐱᓕ	OCT ᐅᑲᐃᓕ	NOV ᐅᓇᓚᐱᓕ	DEC ᑎᓯᓚᐱᓕ	JAN ᔮᖏᓇᐊᓕ	FEB ᓇᖕᐅᐊᓕ	MAR ᒪᔪ	APR ᐃᔪᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	4		1		1			1					5
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik				1	1	1	1						2
Ringed seal	ᓇᕆᔨᑦ	Natiinat	33	15	16	15	5	3	8	3	1	2	5	9	54
Bearded seal	ᐅᑌᔭᐃᑦ	Ukyuk		1		2	1	1							4
Narwhal	ᑐᒻᓪᓕᑦ ᖃᓪᓗᓂᑦ	Tuugaak				4	2								5
Canada goose	ᓄᑦᓪᓕᑦ	Nikliknik	2												2
Eider duck	ᒥᑎᑦ	Kingalik		1			2	1							3
Ptarmigan	ᐊᖏᓚᑎᑦ	Akilgik			1		3	1	3	1		1		1	8
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit		1											1
Arctic char	ᐃᖃᓗᒃᐸᑦ	Ikaliviit	19	7	3			1	1	2				17	38
Sculpin	ᑲᓇᐃᑦ	Kanayuk		2											2

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓯᒪᔪᓂᒃ ᐱᑕᖃᖏᑐᓕᖅ ᐱᓕᕆᓕᓐᓂᓂᒃ ᐊᖏᔪᒃᑕᑦ ᖃᖅᑎᐅᓂᖏᓐᓂᒃᓂᑦ ᐊᓕᖁᔭᒃᑕᑦ ᐊᒻᒪᔪᓂᑦ ᓇᓕᐅᑎᓪᓗᒍ ᐃᓄᐃᑦᑐᓕᕆᓂᖅᓂᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓄᓇᓕᐊᔪᐅᑦ/NAUNAIKUTA 263

Annual harvest estimates and five-year mean

All Years (June 1996 - May 2001)

ᐊᓐᖏᔪᒪᒃᑕ ᐊᖏᔪᓄᑦ ᓄᓇᐅᑦᓴᓗᑎᑦ ᐊᓚᓗ ᑕᒻᓕᓚᓄᑦ-ᐊᓐᖏᔪᔭᓄᑦ ᐊᐅᔨᑎᓕᕐᒥᓪᓗᒡᓗᑦ 2001)

ᑕᒪᐃᖅᓯᓄᑦ ᐊᖏᔪᓄᑦ (ᔫᓂ 1996 - ᒪᐃ

Study Year/ᖃᐅᔨᓴᖅ ᐊᓐᖏᔪ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Mean ᐊᐅᔨᑎᓕᕐᒥᓪᓗᒡᓗᑦ Amigaitkiyait
			96/97	97/98	98/99	99/00	00/01	
Species	**ᐅᒪᔪᑦ**	**Umajuin**						
Caribou[1]	ᑐᖅᑐᐃᑦ[1]	Tuktut[1]	227	118	172	42	41	120
Polar bear[2]	ᓄᓇᐃᑦ[2]	Nanuit[2]	9	18	12	13	11	13
Wolf[3]	ᐊᒪᓗᐃᑦ[3]	Amagut[3]	1	0	0	0	0	<1
Arctic fox	ᑎᓇᓚᒋᓂᐊᑦ	Tigiganiat	9	32	2	0	0	9
Coloured fox	ᖃᓄᐊᖏᑦᑐᑦ ᑎᓇᓚᒋᓂᐊᑦ	Kalaliit tigiganiat	2	2	0	0	0	1
Arctic hare[4]	ᐅᑲᓪᓚᑦ[4]	Ukalik[4]	52	29	1	12	24	24
Ringed seal[5]	ᓄᕆᓪᓚᑦ[5]	Natiinat[5]	3,957	2,885	3,765	2,203	1,940	2,950
Bearded seal	ᐅᓗᐊᕐᓂᑦ	Ukyuk	30	13	36	18	15	22
Harp seal	ᖃᐃᓕᓴᓂᑦ	Qairulik	103	23	41	10	0	35
Walrus[6]	ᐊᐃᐃᓴᑦ[6]	Akvik[6]	13	0	4	5	0	4
Narwhal[7]	ᑐᒻᓂᓪᓂᑦ ᖁᓪᓗᓚᑦ[7]	Tuugaak[7]	33	13	37	31	12	25
Beluga	ᖃᐅᑉᑕᑦ ᖁᓪᓗᓚᑦ	Kilalugak	0	4	0	0	0	1
Snow goose[8]	ᑲᖏᔪᐃᓐᓴᑦ[8]	Kanguq[8]	11	15	2	0	0	6
Canada goose[8]	ᓄᑦᓂᓪ ᐅᓗᐊᔪᓂᓪᓂᑦ[8]	Nikliknik[8]	112	111	53	12	4	58
Eider duck[9]	ᑎᑎᑦ[9]	Kingalik[9]	403	24	147	38	29	128
Tundra swan	ᑲᐅᓕᐊᕐᓂᑦ	Kukyuk	2	0	0	0	0	<1
Yellow-billed loon	ᑐᓪᓕᑦᓴᐊᑦ	Tuulik	0	3	0	0	0	1
Black guillemot	ᐱᑦᐳᓪᓕᑦ	Black guillemot	7	0	0	0	0	1
Thick-billed murre	ᐊᑦᐸᐃᑦ	Thick-billed murre	0	1	15	0	0	3
Ptarmigan	ᐊᖏᒪᑦ	Akilgik	352	336	371	131	111	260
Goose eggs[10]	ᑲᖏᔪᐃᑦ ᓚᒃᓂᖏᑦ[10]	Uluaguliit manniit[10]	77	51	0	13	0	28
Duck eggs[10]	ᑎᑎᑦ ᓚᒃᓂᖏᑦ[10]	Tinmiat manniit[10]	352	43	268	2	57	144
Arctic tern eggs[10]	ᐃᒥᖃᑯᓕᓗᐃᑦ ᓚᒃᓂᖏᑦ[10]	Emitkutailat manniit[10]	555	9	0	0	0	113
Seagull eggs[10]	ᓄᐅᐳᐃᑦ ᓚᒃᓂᖏᑦ[10]	Nauyat manniit[10]	50	0	155	0	0	41
Arctic char[11]	ᐃᖃᓗᒃᓴᑦ[11]	Ikaliviit[11]	8,902	19,947	6,903	2,205	3,791	8,350
Cod[12]	ᐅᒪᐃᑦ[12]	Ugak[12]	108	0	0	0	0	22
Sculpin[13]	ᑲᓕᐊᐃᑦ[13]	Kanayuk[13]	150	0	0	17	9	35
Clams[14]	ᐊᓗᒍᒪᕐᑦ[14]	Uviluq[14]	1,368	2	4,020	96,377	0	20,353
Mussels[15]	ᐅᐃᓗᐃᑦ[15]	Uviluvaloet[15]	2,857	0	0	0	0	571

[1-15]: See page 384 for community feedback and other sources of data.

[1-15]: ᑕᐃᓕ ᒪᓴᐃᑐᖃ 386 ᓄᓇᓕᑦ ᑭᐅᔨᐊᑎᖏᑦ ᐊᓚᓗ ᐊᓂᖏᑦ ᐱᓕᕆᓂᖅᓴᓕᐅᔪᑦ ᓇᓗᓇᐅᔪᑦ.

[1-15]: Takulugu makpigaak 388 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

6.1.11

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 264

Annual hunter response

ᐊᓚᖏᔪᑦᒪᑦ ᐊᖓᔪᓂᖅᑎᑦ ᑭᐅᓂᖓᑦ

Angujauvaktu

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓇᑦ ᐊᓚᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᓚᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖓᔪᓂᖅᑎᑦ ᑭᐅᓂᖓᑦ ᐊᔪᕐᓗᒋᓂᖓᑦ**	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᕿᑕᒻᒪᑦ ᐊᖓᔪᓂᖅᑎᑦ	Tatkitaman angunahuktut titigait	114	116	124	163	157	192*
Hunters interviewed	ᐊᖓᔪᓂᖅᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	114	115	109	138	118	183*
Harvested	ᐊᖓᔪᓂᖅᑐᒥᓂᑦ	Angujaujut	113	101	89	92	72	163*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖓᑦ (%)	Kiujut (%)	80	74	79	66	54	70**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖓᔪᓂᖅᑎᑦ ᐊᑎᓕᐅᕗᒻᒥᓕᕐᓂᑦ/ᐊᐱᕐᓂᑦᑐ/ᐊᖓᔪᓂᖅᑐᒥᓂᑦ ᐊᑕᐅᓯᐊᔪᑎᑎᒃ ᖃᐅᔨᓴᖅᓯᒪᔪᖅ.
** ᐊᓕᒍᓕᕆᓂᖅᓯᒪᓕᕐᓂᑦ ᐊᔪᕐᓗᒋᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 265

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᓕᑦ ᐊᑯᑦᖃᓄ ᐊᖓᔪᓂᓐᖓᓕᒃ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓕᒃ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᒃ % ᑲᑎᕐᔪᑦ ᐊᖓᔪᓂᖅᑎᑦ ᑎᑎᕐᑕᐅᒪᔪᑦ

Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓇᑦ ᐊᔪᕐᓗᒋᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

6.1.11

Study Year/ᖃᐅᔨᓴᖅ ᐊᓚᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᓕᑦ**	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᕿᑦ	≤ tatkin pingahut	94	74	75	72	78	82
4-6 months	4-6 ᑕᕿᑦ	tatkin hitaman 6nut	4	13	23	25	19	14
> 6 months	> 6 ᑕᕿᑦ	> 6 tatkin	2	13	2	2	4	4

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 266

Number of hunters harvesting each species
ᖁᑦᓱᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᐅᒋᐊᑦ ᐊᖏᔪᓚᐱᐅᔨᓪᓗᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ
Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓂᑦ ᐊᑲᕐᔪᓂᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖁᐅᐴᖃᕐᕕᒃ ᐊᑲᕐᔪᐃ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**						
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	38	15	29	10	5	58
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕈᐃᑦ	Amagut	1					1
Arctic fox	ᑎᓕᖅᓂᐊᑦ	Tigiganiat	4	3	1			7
Coloured fox	ᖁᑯᖏᑦᑐᑦ ᑎᓕᖅᓂᐊᑦ	Kalaliit tigiganiat	2	2				4
Arctic hare	ᐅᖃᓕᑦ	Ukalik	21	9	1	4	2	31
Ringed seal	ᓇᕆᑦ	Natiinat	106	87	81	67	54	138
Bearded seal	ᐅᑉᐊᐃᑦ	Ukyuk	17	6	15	5	4	38
Harp seal	ᖁᐃᕈᓕᑦ	Qairulik	33	10	21	3		51
Walrus	ᐊᐃᐸᒃ	Akvik	7		3	1		10
Narwhal	ᑐᒻᓕᑦ ᖃᓪᓗᓇᑦ	Tuugaak	14	7	19	9	5	38
Beluga	ᖁᑯᕐᑦ ᖃᓪᓗᓇᑦ	Kilalugak		1				1
Snow goose	ᑲᖏᐃᑦ	Kanguq	7	3	2			12
Canada goose	ᓄᖅᓕᑦ ᐅᓗᐊᔪᓕᑦ	Nikliknik	27	14	10	3	2	43
Eider duck	ᒥᑎᑦ	Kingalik	47	6	16	4	3	60
Tundra swan	ᖁᐊᑉᐃᐃᑦ	Kukyuk	2					2
Yellow-billed loon	ᑐᓕᖅᓴᐊᑦ	Tuulik		1				1
Black guillemot	ᐱᕐᐅᓭᓕᑦ	Black guillemot	3					3
Thick-billed murre	ᐊᑦᕿᐃᑦ	Thick-billed murre		1	1			2
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	29	26	23	12	8	56
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓄᖅᑎᑦ	Uluaguliit manniit	7	1		1		8
Duck eggs	ᒥᑎᑦ ᒪᓐᓄᖅᑎᑦ	Tinmiat manniit	11	1	5	1	1	17
Arctic tern eggs	ᐃᒥᖁᑯᐊᓕᐃᑦ ᒪᓐᓄᖅᑎᑦ	Emitkutailat manniit	11	1				12
Seagull eggs	ᓇᐅᐳᐃᑦ ᒪᓐᓄᖅᑎᑦ	Nauyat manniit	5		1			6
Arctic char	ᐃᖁᓗᒃᐱᑦ	Ikaliviit	81	65	52	55	38	139
Cod	ᐅᒪᐃᑦ	Ugak	8					8
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk	10			1	2	13
Clams	ᐊᒃᒧᒪᐊᑦ	Uviluq	9	1	5	2		14
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet	1					1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔨᓂᒃ ᐱᑕᖃᖏᑕᐅᖅ ᐱᒃᐊᑎᓕᖅᓂᒃ ᐊᖏᔪᑦ ᖁᑦᓱᐅᓂᖏᖅᓄᑦ ᐊᓕᕆᔨᒪᔨᓂᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᕐᓂᐊᕐᓂᒃᑐᑦ ᑐᓂᔭᖏᖅᓂ ᐃᓄᐃᖏᓕᓕᕆᓂᖅᑐᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.11 Community Results Discussion: Qikiqtarjuaq

The survey frame:

An assessment of under-enumeration during the community visit revealed that there were approximately 16 hunters who were not registered in the Harvest Study. All of these were Inuit - four occasional, seven active and five intensive hunters. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. Given that these unregistered hunters represent eight percent of the total hunter population (Table 10) and that the majority of these hunters were thought to be active or intensive hunters the effect of this bias on harvest estimates could be significant. Harvest estimates for the unregistered hunters can be estimated using mean harvest quantities for each species by strata. These estimates, having their own sources of error and bias, are beyond the scope of this Final Report. Readers may apply to NWMB to obtain the results of these calculations.

Due to the relatively small number of intensive hunters registered in Qikiqtarjuaq, the intensive classification was joined with the active classification for the purpose of calculating harvest estimates.

Survey coverage and non-response bias:

Response rates in years 4 and 5 were quite low, dropping below 50% in several months towards the end of the study. Low response rates were also encountered during several months in other years of the study. As seen in Table 9 the consistent intentional non-response rate in Qikiqtarjuaq was relatively high, at 5.2%. Given this and the low response rates, particularly in the last two years of the study, there was potential for both sampling error and non-response bias.

An examination of the consistency of participation rates (code 1 response as a proportion of code 1 plus code 2 responses) over a five year period was done in order to detect hidden non-response. The basis for this is that declining rates of harvesting (code 1) might indicate "hunter fatigue" with the survey over time. The community of Qikiqtarjuaq did show a noticeable decline in participation over the life of the survey indicating that hidden non-response may have occurred in this community.

Response rates, being higher in the first three years of the study, were felt to be high enough in most months to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should refer to hunter response tables indicating which months had lower response rates. Caution should be exercised when using the data collected during these months and during the final two years of the study when response rates dropped and hidden non-response may have been introduced.

Measurement issues and response error:

There were no specific incidents of measurement error brought up during the community visit. However, readers should refer to Section 5.4 for a thorough discussion of this issue.

As seen in the recall period tables, the majority of harvest records were collected within three months of the harvest in most years of the study. However, there were some months, particularly in years 2 and 4 when many of the recall periods were beyond six months. Measurement error is more likely in months with longer recall periods since hunters may not have been able to accurately remember what they had harvested. However, over the course of the entire study over 80% of the total harvest records were collected within three months of the harvest.

As indicated in the comments below, there was commercial harvesting of arctic char and of clams throughout the Harvest Study. It is thought that some of this commercial harvest was reported with the subsistence harvest in some years of the study. In particular given the large harvest estimates for clams in year 4, it is likely that much of this harvest was commercial. Similarly, the arctic char harvest in year 2 likely contains some fish sold commercially.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou. In 1996-1997 there were community hunts, explaining the higher harvest estimates early in the study. However, even in the absence of these community hunts, the estimates in years 4 and 5 seem too low (C.F.).
2. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
3. **Wolf:** Some wolf harvests were not reported, hunters harvest wolves every year (C.F.).
4. **Arctic hare:** The year 3 estimate seems too low, it appears that some harvests were not reported (C.F.).
5. **Ringed seal:** In year 1, the sewing center was operating and hunters were selling pelts to the center, explaining the higher harvest estimate in that year. There were fewer seals around the community in the latter years of the study resulting in lower harvest estimates. The estimates seem accurate (C.F.).
6. **Walrus:** Estimates in year 1 seem accurate; however, walrus are harvested each year so in years with no harvest recorded there were likely some caught but not reported (C.F.).
7. **Narwhal:** Estimates seem too low. The community was harvesting under a community-based management program since 1999, during which the HTO kept track of the number of animals taken (C.F.). Prior to this program the annual quota was 50 animals. The following numbers which were collected prior to and during this program and should be considered when using narwhal harvest estimates (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
23	50	50	81	137

8. **Geese:** Harvest estimates seem accurate. Geese harvesting is dependent on ice conditions which have made it very difficult to harvest geese in the last few years (C.F.).
9. **Eider duck:** Although both king and common eiders are harvested, common eiders are more abundant in the area and harvested in larger numbers (C.F.).
10. **Eggs:** Each species of egg displayed in the data tables are harvested each year. Estimates in the latter years of the study were noted to be too low. Year 1 estimates appeared to be in the right range for most species (C.F.).
11. **Arctic char:** There was commercial harvesting of arctic char during the Harvest Study. It is felt that some of this harvest was likely included with the subsistence harvest in the first few years of the study (C.F.).
12. **Cod:** Cod are harvested every year. The year 1 estimate seems to be in the right range (C.F.).
13. **Sculpin:** Sculpin are harvested every year. The year 1 estimate seems to be in the right range (C.F.).
14. **Clams:** There was a lot of clam harvesting that was not reported. The HTO Board reports that the community harvests at least 5000 kg per year which would equate to approximately 125 – 150,000 clams. However, much of this would have been sold commercially (C.F.).
15. **Mussels:** The year 1 estimate looks accurate. Mussels are harvested when people go berry picking; some are taken each year (C.F.).

6.1.11 ᓄᓇᕗᑦ ᓴᖅᑭᑕᐅᔪᓂᖅ ᐅᖃᖅᑎᑐᑦᑎᓂᑦ: ᖃᑭᖅᑕᕐᔪᐊᖅ

ᖃᐅᔨᓴᓂᐅᑦ ᐊᖅᑭᑦᑐᒪᓂᖅ:

ᖃᑎᖅᑭᐅᑎᓪᓗᓂ ᐊᑎᓕᐅᓇᖅᑐᒪᕕᖅᑕᓂᐅᔪᓂ ᓄᓇᕗᑦ ᓯᓚᖅᑕᑕᐅᑎᓪᓗᓂ ᑕᐃᑎᖏᓚᐅᖅᑐᑦ ᑕᒪᓕ 16 ᐊᖏᔪᓚᑦᑎᓂ ᐊᑎᖅᖄᖅᑕᕐᓚᐅᕐᓂᖅᓂᕐᓂᓄᑦ ᖃᐅᔨᓴᓂᐅᔪᓚᐅᖅ. ᑕᒪᒋᑦᑐ ᐃᓄᓚᐅᕙᖅᑐᑦ - ᑎᕆᒪᑦ ᖃᐃᑎᖏᓚᑦ, 7 ᐊᖏᖅᑎᓪᓗ ᐊᑎᒪᓗ ᑕᑦᓚᑦ ᑕᒪᓕᔭᖅᑐᑦ ᐊᖏᔪᓚᑦᑎᓂᐅᓪᓗᓂᑦ. ᑎᖃᐅᔨᐅᓴᒪᒪᑕ ᓇᓴᐅᑎᑦ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓇᖅᑐᓕᕆᑎᑎᐅᓴ ᐱᒍᑕᐅᓂᖅ ᐊᑎᑎᑦᓭᓕᓴᕐᓗᐃᑦ ᐃᒪᓕᕕᖅᑕᕐᓂᑦ ᖃᑦᔨᐅᓂᖅᓂᕐᓂᖅ. ᐃᓕᓴᕐᓗᒪᓂᓗᒍ ᑕᒪᖅᔪᓄ ᐊᑎᖃᖅᖄᖅᑕᕐᓂᑦ 8%ᓴᓗᒪᒪᑕ ᑲᑎᕐᓂᑦ ᐊᖏᔪᓚᑦᑎᓕᒪᑦ (ᓇᓕᖅᑲᖅ 10) ᐊᑎᒪᓗ ᑕᒪᐸᑲᓴ ᒎᐅᓇᓂ ᐅᖏᔪᓚᑦᑎᐅᓇᓚᕐᓚᐅᕐᓂᖅᓗᑎᑦ ᐊᖏᖅᑎᓪᓗ ᑕᐃᑦᓪᓗ, ᐊᑦᑐᐃᓂᓗᓴᖅᑎᓂ ᐃᒪᓕᕕᖅᑕᕐᓂᑦ ᖃᑦᔨᐅᓂᖅᓂᕐᓂᓄᑦ ᐊᒍᑦᓗᓂᓴᖅᑕᕐᓂᑦ. ᐃᒪᓕᕕᖅᑕᕐᓂᑦ ᐊᑎᖃᖅᖄᖅᑕᕐᓂᑕᓂᓕ ᒥᑦᑐᒪᑦᑎᓂᑦ ᐊᑐᓂᑦ ᐃᒪᓕᕕᖅᑕᕐᔪᐊᖅ

ᓄᓇᓕᒥ ᑭᐅᔾᔨᒌᑦ ᐊᓚᓗ ᐊᓯᖏᑦ ᐊᓪᓚᑕᐅᓯᒪᔪᑦ:

[1] **ᑐᑦᑐᐃᓪᓕ:** ᑐᑦᑐᐃᓪᓕ ᓇᓴᖅᑐᖅᖢᖏᑦᑐᒥᐅᑕᑦ. 1996-1997ᒥ ᓄᓇᓕ ᐊᖏᓚᓯᓂᓯᓚᑦᓯᒪᔪᑦ ᑕᐃᒪᐃᓚᒪᑦ ᐅᓄᖅᓴᐃᓚᓯᑎᓯᒪᔪᑦ ᑐᑦᑐᑕᐅᔨᒥᓂᑦ ᖃᐅᔨᓴᖅᖢᓂᑐᐃᓗᒍ. ᑭᓯᐊᓂ, ᓄᓇᓖᓂ ᐊᖏᓚᓯᑎᓯᓂᓯᓚᐅᔨᐃᓪᓕᑦ ᑕᕐᕋᐅᓴᖅᑭᖅᑲᓚᐊᑭᑎᑦ, ᒥᑦᓴᐅᓯᖅᑕᐅᓯᒪᔪᑦ ᐅᑭᐅᓂ 4 ᐊᓚᒪ 5 ᐊᑎᑐᐊᖅᑐᑦᑐᖅᑦ (C.F.).

[2] **ᓇᓄᐃᓪᓕ:** ᐃᓕᓴᐅᑎᑦ ᑕᐃᔨᖅᓴᐅᔨᑦ ᒥᑦᓴᐅᓯᑭᑎᑐᐃᓪᓕᐅᓴᖅᑭᑦᑐᑦ ᑭᓯᐊᓂ ᐃᓕᖅᑕᐅᓯᒪᓕᒫᑦᑕᖅᑐᑦ ᓄᓇᖕᓂ ᓴᕐᓕᒃᔪᑦ ᐃᑯᐱᕐᓚᓕᔪᓐᓇᖅᑐᓄᑦ (DSD PB).

[3] **ᐊᒪᓪᓐᖏᑦ:** ᐃᓕᓴᖅᑦ ᐊᒪᓪᓐᖅᑕᐅᔨᑦᑐᑦ ᐅᖃᐅᓯᐅᔨᓕᐅᕕᓴᖅᑭᑦᑐᑦ, ᐊᖏᓚᓯᓂᑎᑦ ᐊᒪᓴᖅᑭᓚᔨᑦᑐᑦ ᐊᓯᖏᑦᑐᒍᑦ (C.F.).

[4] **ᐅᖃᓕᑦ:** ᐅᑭᐅᖓᓚᓂ 3 ᖃᓄᖅᑐᓂᖅᑦ ᐊᑎᑐᓚᐊᖅᑐᑎᓴᖅᑐᑦ, ᐃᓕᖅᑦ ᐅᖃᐅᓯᐅᔨᓕᓕᕕᓂᖅᑐᑦ (C.F.).

[5] **ᓇᓯᓪᓕ:** ᐅᑭᐅᖓᓚᓂ 1, ᒥᖅᓯᖓᓴ ᐊᐅᓕᑎᓪᓗᒍ ᐊᖏᓚᓯᓂᑦ ᓂᐅᐃᐃᑎᖃᖅᖢᓕᓴᖅᑭᑦᑐᑦ ᖃᓯᓂᓂᑦ ᒥᑦᓴᖓᓕᒫᑦ, ᑕᐃᒪᐃᓚᒪᑦ ᓇᓯᓴᖅᑕᐅᔨᑦᑐᑦ ᐅᓇᓂᖅᓴᐃᓚᓯᕕᓴᖅᑭᑦᑐᑦ ᐅᑭᐅᑎ ᑕᐃᑲᓂ. ᐅᑭᐅᓪᓗ ᑭᖑᓪᓕᖅᑭᓂᓂ ᖃᐅᔨᓴᖅᑭᓂᓯᓚᐅᔨᓕᓕᕕᓪᓗᒍᓂ ᓄᓇᓕᐅᑦ ᖃᓄᐅᓴᖅᓂ. ᐅᒪᔨᖅᑕᐅᔨᑦᑐᑦ ᖃᓄᖅᑐᓂᖅᑦ ᓇᓕᒧᑎᐊᖅᑐᓂᖅᑦ (C.F.).

[6] **ᐊᐃᐃᑦ:** ᖃᓄᖅᑐᓂᖅᑦ ᐅᑭᐅᖓᓚᓂ 1 ᒥᑦᓴᐅᓯᒪᔪᑎᑎᐊᖅᑐᓂᖅᑦ; ᑭᓯᐊᓂ, ᐊᐃᐃᓕᓚᓯᑦᑐᑦ ᐊᓯᖏᑦᑐᒍᑦ ᑕᕐᕋᐅᓴᖅᑭᑦᑐᑦ ᑕᐃᑦᑭᓚᐅᔨᓕᓕᕕᓂᖅᑐᑦ ᐅᑭᐅᓂᖅᑐᑦ ᐊᐃᑉᐅᓂᓯᓚᐅᔨᓕᓕᕕᓂᖅᑐᑦ ᐊᓯᖏᑦᑐᒍᑦ ᐃᓕᓴᖅᑭᑦᑐᑦ ᐊᑎᓕᓴᖅᑭᑦᑐᑦ ᐃᓕᓴᖅᑭᑦᑐᑦ ᐊᓯᖏᑦᑐᒍᑦ ᐅᖃᐅᓯᐅᔨᓕᓕᕕᓂᖅᑐᑦ (C.F.).

[7] **ᔅᐃᓂᓪᓕ:** ᖃᓄᖅᑐᓂᖅᑦ ᐊᒥᓱᓚᐊᖅᑐᑎᓴᖅᑐᑦ, ᓄᓇᓕ ᔅᐃᓂᓱᖅᑕᓚᓯᕕᓴᖅᑐᑦ ᒪᓕᓐᓂᑦ ᓄᓇᓕᒥ ᐊᑦᑕᐳᑕᐅᔨᓕᓕᒫᑦ ᐅᒪᒃᓯᓚᓂᓯᒪᑦ 1999ᒥᓂ, ᑕᐃᑦᓯᒪᓂ ᓄᓇᓕ ᐊᖏᓚᓯᑎᓯᓚᓂᓚᖅᖢᓂᑦ ᓇᐅᑦᓯᖅᑐᑎᓴᖅᑭᓯᒪᒪᑦ ᖃᓄᐃᑦ ᐅᒪᔨᖅᑕᐅᔨᑦᑐᑦᓂᑦ (C.F.). ᑕᒪᑐᒪ ᓯᑲᓂᐊᒍᑦ 50 ᔅᐃᓂᓱᖅᑕᐅᔨᓕᓕᕕᓴᖅᑐᑦ. ᐊᓪᓚᑕᐅᓯᒪᔪᑦ ᐅᓇᐃ ᓇᓴᐅᓂᑦ ᔅᐃᓂᓱᖅᑕᒥᓂᓕᑦ ᐱᓚᓂᖏᓚᔪᑦ ᓯᑲᓂᐊᒍᑦ ᐊᐃᓴᖏᓚᐅᔪᖅᑐᓕᖅᑎᓴᖅᑐᑦ ᐊᑐᖏᓂᐊᐊᖅᑐᑦ ᔅᐃᓂᓱᖅᑕᒥᓂᑦ (ᖃᐅᔨᓴᒥᑦ ᐃᒪᓕᒥᐅᑕᓚᓯᓄᓐᓇᖅᑐᓂᑦ ᓇᓴᐅᓂᖅᑦ ᒪᓚᓪᓕᒪᑦ ᑭᓇᐅᔨᓴᖅᑭᓐᓂᑕᖅᑐᑦ ᐅᑭᐅᖓᓚᓂ, ᐅᒪᔨᖅᑕᐅᔨᑦᑐᑦᓂᓚ ᐊᓪᓚᑕᐅᓯᒪᔪᑦ ᓯᑲᓂᐊᒍᑦ ᒪᓚᓪᓕᒪᑦ ᑭᓇᐅᔨᓴᖅᑭᓐᓂᑕᖅᑐᑦ ᓯᑲᓂᐊᒍᑦ ᒪᓚᓪᓕᒪᑦ ᐱᓚᓂᖏᓚᔪᑦ ᐊᑐᖏᓂᐊᐊᖅᑐ

6.1.11 Nunanit Iniktigutait Ukauhiit: Qikiqtarjuaq

Ihivgiuktit Atugutait:
Ihivgiufaakhimagami ataani naunaiyagutaini pulaakhimatitlugu nuna takuhimayuk 16nik umayukhiuktinik titigaktauhimaitut Umayukhiukhimayuni Ihivigiuktuni. Tamamik hapkoa Inuinauyut – hitamat ilaani umayukhiukpaktut, 7nik umayukhiuktaktut ovalo talimat umayukhiukatainaktut. Ukakhimayut hamani ilangani 5.2.1 ikpinaguait hamna ataani naunaiyakhimagaagat pipkainiaktuk ataanut ihumagiyainik umayukhiukhimayut naunaiyautaini. Taimaimat, hapkoa titigaktauhimaitut umayukhiuktit 8%kumata tamaat umayukhiuktinit. (ikpatauyak 10) ovalo amigaitut hapko umayukhiuktit ihumagiyauyut umayukhiukataktut ovaluniit umayukhiukatainaktut ikpinaginiaktait ihumagiyaini umayukhiukhimayut naunaiyautait titigaktauhimaitut umayukhiuktit naunaiyalaaktut anginikhaanik umayukhiukhimayainik atuklutik amigaitjutait tamamik umayut aviktukhimalugit. Hapkoa naunaiyautit pihimamata inminik atuktaminik ihuinaagulaaktunik ovalo ihumagiyaminik avataanuttut iniktigutaini tuhaktakhami. Taiguaktut apigilaaktut NWMBkunut piyumagumik iniktiguainik hapkoa naunaiyautit. Naunaiyautait anginiaktut. Umayukhiukhimayut naunaiyait.

Mikinmata amigaitjutait umayukhiukatainaktut titigaktauhimayut Qikqtarjuaqmi, umayukhiukatainaktut naunaiyautait ilauhimayut umayukhiuktaktut naunaiyautainut mikhaanut naunaiyagutainut umayukhiukhimayut naunaiyautainut.

Ihivgiukhimayut Pihimayait ovalo Kiuyuitut Ihumagiyait:
Kiuhimayut naunaiyautait ukiuni 4mi oval 5mi mikiyut ataani 50%mut ilangit tatkikhiutini iniktilikhuni ihivgiuktut. Mikiyut kiuhimayut naunaiyautait pikatakpaktut ilangit tatkikhiutit ilangani ukiuni ihivgiuktuni. Takukhauyuk ikpatauyami 9mi, pikatainaktuk kiuyuitut naunaiyautaini Qikiqtarjuaqmi angiyut 5.2%mik ovalo pihimalaaktut kiuyuitut ihumagiyaini. Taimaimat, hamna ovalo mikiyut kiuhimayut naunaiyautaini, ilaa kingulimi malguuk ukiuni ihivgiuktitlugit, pilaaktuk tamamik ihuinaakhimayut ovalo kiuyuitut ihumagiyainik.

Ihivgiufaagutaini pikataktut ilauyut naunaiyautaini (naunaiyaut 1 kiuhimayut ilangani naunaiyaut 1 ilalugu naunaiyaut 2 kiuhimayut) talimani ukiuni pihimayut nalvaanahualugu takukhaungitut kiuyuitut. Atuktangit hamna mikhiliktut naunaiyautit umayukhiukhimayut (naunaiyaut 1) piyunakhihimayut “Umayukhiuktit Unagugunakhihimagamik” ihivgiukhimatitlugit. Nunani Qikiqtarjuaqmi takukhauyuk mikhihimayut ilaunut ihivgiukataktitlugit pihimayut kiuyuitut piyunakhiyut haman nunami.

Kiutjutit naunaiyautait angivlutik hivulimi pingahut ukiuni ihivgiuktitlugit, ihumagiyauyut angitkiyait tamamivyak tatkikhiutini pigiami nni pihimayut naamaktunik ilauyunik uktukhimayut Nni umayukhiuktini. Taiguaktut takuyukhat umayukhiuktit kiutjutaini ikpatauyanut naunaiyakhimayuni tatkikhiutini mikiyuni kiuhimayuni naunaiyautaini. Ihumagiyakhait atuktukhat atuligumik katitikhimayut katitigutaini hapkoa tatkikhiutini ovalo iniktigutaini malguk ukiungani ihivgiukhimayut kiuhimayut naunaiyautait katakhimamata ovalo takukhaungitut kiuyuitut atulimata.

Atugutingit Ihumagiyait ovalo Kiuhimayut Ihuinaagutait:
Pikangituk naunaiyautaini ihuinaakhimayunik nunani pulaaktakhimatitlugu. Kihimi taiguaktut takuyukhat ilangani 5.4 ukakatigiyuagumik hamna ihumagiyainik.

Takukhuyut utiktihimayut ubluit ikpatauyami, amigaitut umayukhiukhimayut titigakhimayut katitikhimayuni pingahut tatkikhiutit umayukhiukhimayuni amigaivyaktuni ukiuni ihivgiuktitlugit. Kihimi ilangini tatkikhiutini, ilaa ukiuni 2mi ovalo 4mi amigaitut utiktihimayuni ubluit avataanungakhimayut siksinik tatkikhiutini. Naunaiyautit ihuinaagutait pihimayunakhihimayut tatkikhiutini angitkiyait utiktihimayut ubluit umayukhiuktit naamaktumik ihumalimatunakhimata umayukhimayaminik. Kihimi tamaat ihivgiukhimatitlugit avataanut 80%mik tamaat umayukhiukhimayut titigagutaini katitikhimayut iluani pingahut tatkikhiutini umayukhiukhimatjutaini.

Titigakhimayuk ukagutaini hamani, kinauyaliukhutik umayukhiukpaktut ikalivinik ovalo uvilunik tamaat Umayukhiukhimayut Ihivgiugutini. Ihumahimayut ilangit kinauyaliukhimayut umayunik tuhaktitihimayuk atuktakhainik atuktakhaini umayukkhiukhimayunut ilangaini ukiuni ihivgiuktuni. Ilaa, pihimamata amigaitunik umayukhimayut naunaiyautaini uvilunik ukiumi 4mi, piyunakhihimayut amigaitkiyait hamna umayukhimayut kinauyaliugutihimayut. Aatjikutaanut, ikaliviit pihimayut ukiumi 2mi pihimayut ikalunik niuviktauhimayut kinauyaliugutini.

Nunanit ukakhimayut ovalo aalat Pihimayaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhimayut nunani tuktut. 1996mit 1997mut nunakatigiit umayukhiukatakpaktut, taimaimat angitkiyait umayukhiukhimayut naunaiyautait pilihaaliktitlugu ihivgiuktut. Kihimi hapkoa nunakatigiit umayukhiukatakpaktut, naunaiyautait ukiuni 4mi ovalo 5mi mikiyut (C.F.).
2. **Nanuit:** Amigaitjutait takukhauyut naunaiyautaungitut kihimi pihimayait umayukhimayut amigaitjutait tunihimayait DSDkut (DSD PB).
3. **Amaguit:** Ilangit amagukhimayut umayukhiukhimayait tuhaktitihimaitut tamaat ukiuni (C.F.).

[4] **Ukaliit:** Ukiumi 3mi naunaiyautit mikiyut, takukhauyuk ilangit umayukhimayut tuhaktitihimaitut (C.F.).

[5] **Natiinat:** Ukiumi 1mi, mikhukvik hanavaktut ovalo umayukhiuktit niuviktikatakhimayait amiinik mikhukvikmut, taimaimat amigaitkiyait umayukhiukhimayut naunaiyautait talvani ukiumi. Ikitut natiit haniani nunami kinguani ukiut ihivgiuktitlugit pipkakhimayait ikitkiyait umayukhiukhimayut naunaiyautait. Naunaiyautait naamaktut (C.F.).

[6] **Aiviit:** Naunaiyautait ukiumi 1mi naamaktut; kihimi aiviit umayukhiukatainaktait ukiuk tamaat, ukiut umayukhiukhimayut titigakhimaikaagata aivikhimayunakhiyuugaluit kihimi tuhaktitihimaitut (C.F.).

[7] **Tuugaat:** Naunaiyautit mikiyut. Nunat umayukhiukatakhimayut ataani nunani atukhugit munagitjutit pilihimayut 1999mit, HTOkut naunaiyakatakhimayut amigaitjutainik pikataktainik (C.F.). Pilitinagu pihimayuk, ukiuk tamaat kotanga 50kuyut umayut. Hapkoa amigaitjutait katitikhimayut pitinagu ovalo piliktitlugit hamna pilihimayuk ovalo ihumagiyakhait atuligumik tugaaliit kilalugait umayukhiukhimayut naunaiyautait (nalungilugit DFOkut katitikhimayut ukiuminik atuktaminik, Umayukhiukhimayut Ihivgiugutait katitikhimayut atukpaktut umayukhiukhimayut ukiunginik pivaktut Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
23	50	50	81	137

[8] **Uluaguliit:** Umayukhiukhimayut naunaiyautait naamaktut. Uluaguliit umayukhiugutait pivaktut hiku nakuugaagat, ilaani ayokhagutigilikpaktait umayukhiugiami uluaguliit kingulimi ukiuni (C.F.).

[9] **Tinmiat:** Ilaa tamamik kingaliit ovalo mitiit umayukhiukataktait, mitiit amigaitkiyauyut nunami ovalo umayukhiukataktait amigaitkiyainik (C.F.).

[10] **Maniit:** Tamamik umayut maniit takukhauyut katitikhimayut ikpatauyami katitilikpaktait ukiuk tamaat. Naunaiyautit kinguani ukiuni ihivgiuktitlugit mikiyut. Ukiumi 1mi, naunaiyautit takukhauyut naamaktut tamamik umayunik (C.F.).

[11] **Ikaliviit:** Pihimayut kinauyaliugutit umayukhiuktuni ikalivinik Umayukiukhimayut Ihivgiuktitlugu. Ihumayut ilangit hamna umayukhimayut ilauyut atuktakhainik umayunik hivulimi ukiuni ihivgiuktuni (C.F.).

[12] **Ugat:** Ugat umayukhiukatainaktait ukiuk tamaat. Ukiumi 1mi naunaiyautit naamaktut (C.F.).

[13] **Kanayuit:** Kanayut umayukhiuktaktait ukiuk tamaat. Ukiumi 1mi naunaiyautit naamaktut (C.F.).

[14] **Uviluit:** Amigaitunik uvilunik umayukhiukataktait kihimi tuhaktitihimaitut. HTOkut katimayiit tuhaktitihimayut nunani umayukhiukataktait 5,000nik kilogramsnik ukiuk tamaat, pihimayukhat 125nit – 150,000nut uvilunik. Kihimi amigaitkiyait hapkoa niuviktaukataktut kinauyaliugutinik (C.F.).

[15] **Uviluvaluit:** Ukiumi 1mi naunaiyautit namaaktut. Ikaluvaluit umayukhiuktaukataktut Inuit paungakhiuligaagamik; ilaani pikataktut tamaat ukiuni (C.F.).

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Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᓯᔾᔪᔪ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᐹᓗ	OCT ᐅᑦᑐᕆᓗ	NOV ᓄᕕᓚᕆᓗ	DEC ᑎᓴᓚᕆᓗ	JAN ᔨᖏᓂᐊᓗ	FEB ᓄᖅᐳᐊᓗ	MAR ᒪᑉᓴ	APR ᐃᑦᓇᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓭᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐃᑦ	Tuktut			1			5							6 ± 2
Musk-ox	ᐅᒥᓴᒪᐃᑦ	Umingmait					12	2	3				2		19 ± 1
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡							8						
Wolf	ᐊᒪᓗᐃᑦ	Amagut	1						1						2 ± 0
Arctic fox	ᑎᓚᓱᓄᐊᑦ	Tigiganiat						6	10	4					20 ± 4
Arctic hare	ᐅᑲᓪᓕ	Ukalik	2						1				1	3	7 ± 0
Ringed seal	ᓇᕆᑦ	Natiinat	73	30	32	22	62	24	21	30	60	69	17	61	501 ± 28
Bearded seal	ᐅᓴᐊᐃᑦ	Ukyuk	6	3	5	2	4					1			21 ± 3
Harp seal	ᖃᐃᓗᓪᓕ	Qairulik		2		3	5								10 ± 3
Walrus	ᐊᐃᓴᒃ	Akvik	4	10	1										15 ± 4
Narwhal	ᑐᒻᓪᓕ ᕿᓪᓚᒃ	Tuugaak			2										2 ± 0
Beluga	ᖃᐅᕆᑦ ᕿᓪᓚᒃ	Kilalugak		2	1										3 ± 1
Snow goose	ᑲᖏᐃᑦ	Kanguq	5	7	4										16 ± 4
Brant goose	ᓂᕆᓕᓇᐃᑦ	Nirlirnaq	10	7	1										18 ± 5
Eider duck	ᑎᑎᑦ	Kingalik	28				22								50 ± 2
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq		2											2 ± 1
Ptarmigan	ᐊᕐᓱᒋᑦ	Akilgik	78		1	399	259						1	44	782 ± 129
Arctic char	ᐃᖃᓗᐊᒃ	Ikaliviit	210	132	81									57	480 ± 67
Inconnu	ᑲᐱᓪᓕᕐᓂᐃᑦ	Aanakhiik		95											95 ± 62
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk												3	3 ± 0
Turbot	ᖃᓕᕋᓪᓕ	Nataarnak											1		1 ± 0

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᐊᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᓴᕐᑦ ᐅᑉᓴᐃᓐᓇᓕᒫᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 268

Monthly hunter response

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᒃᓴᔪ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑲᐱᓗ	NOV ᐃᓄᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᒍᖏᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕆ	APR ᐃᕆᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔪᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ	Tatkitaman angunahuktut titigait	44	44	44	42	42	41	41	43	43	44	43	46	51*
Hunters interviewed	ᐊᖏᔪᓇᓱᒋᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	42	40	41	31	42	39	40	41	39	40	41	44	51*
Harvested	ᐊᖏᔪᓇᓱᒍᒥᓂᓕᓂ	Angujaujut	25	23	18	17	23	13	11	7	12	15	8	21	42*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑎᓂᖏᑦ (%)	Kiujut (%)	95	91	93	74	100	95	98	95	91	91	95	96	93**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᒋᑦ ᐊᑎᓕᐅᔾᑕᒪᓐᓇᖅᑐᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᔪᓇᓱᒍᒥᓂᓕᓂ ᐊᑕᐅᓂᐊᖅᑐᓂᑦᑎᓐ ᐊᒃᓴᒥ.
** ᐊᐅᔨᓂᓕᑎᓂᒪᓕᒃ ᑕᖅᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 269

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᕐᓴ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓂᓕᓂᖅᓱᓂᑦ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓴᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓇᓱᒋᑦ ᑎᑎᕐᑦᑕᐅᒪᓕᐅᕐᓴ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᒃᓴᔪ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑲᐱᓗ	NOV ᐃᓄᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᒍᖏᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕆ	APR ᐃᕆᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᕐᓴ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 270

Number of hunters harvesting each species — **Year 1 (June 1996 - May 1997)**

ᖃᑦᔨᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᑎᑦ ᐊᖏᔪᓚᐱᖅᑕᕐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᑦᓂᒃ — **ᐊᒃᑭᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 1 (June 1996 - May 1997)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᐱᕆ	OCT ᐅᑲᐱᕆ	NOV ᐅᓇᒃᐱᕆ	DEC ᑎᓯᐱᕆ	JAN ᒍᓐᓄᐊᓕ	FEB ᐃᖅᑲᐊᓕ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᑦ Tamakiklugin
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut			1			4							5
Musk-ox	ᐅᒥᖃᒪᐃᑦ	Umingmait					6	2	3				2		11
Polar bear#	ᓇᓄᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut	1						1						2
Arctic fox	ᑎᓗᒃᖠᓂᐊᑦ	Tigiganiat						1	1	1					1
Arctic hare	ᐅᑲᓪᓂᑦ	Ukalik	1						1				1	1	4
Ringed seal	ᓇᓂᓱᑦ	Natiinat	15	15	11	6	14	11	8	6	12	14	6	18	33
Bearded seal	ᐅᑉᐊᐃᑦ	Ukyuk	3	2	4	2	3					1			10
Harp seal	ᖃᐃᓕᓪᓂᑦ	Qairulik		2		1	2								5
Walrus	ᐊᐃᓴᒃᑦ	Akvik	3	3	1										5
Narwhal	ᑐᒻᓪᓂᑦ ᖁᓪᓗᓚᑦ	Tuugaak			1										1
Beluga	ᖃᓄᖅᑕ ᖁᓪᓗᓚᑦ	Kilalugak		2	1										3
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	3	2	1										5
Brant goose	ᓄᖅᓪᓗᓇᐃᑦ	Nirlirnaq	4	1	1										5
Eider duck	ᑎᑎᑦ	Kingalik	5				1								6
Red-throated loon	ᖃᖓᓴᐅᑦ	Qaqhuaq		1											1
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	4		1	14	13						1	9	24
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	10	10	3									7	19
Inconnu	ᑲᐱᓯᓪᓕᐃᑦ	Aanakhiik		1											1
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk												1	1
Turbot	ᖃᓕᕋᓪᓂᑦ	Nataarnak											1		1

No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

ᑎᑎᕋᓯᒪᔪᓂᓴ ᐱᑕᖃᖓᑦᑐᖃᓴ ᐱᓕᐊᓕᓐᓂᓂᓴ ᐊᖏᔪᑦ ᖃᑦᔨᐅᓂᖏᓐᓄᑦ ᐊᓇᓴᐅᒪᔪᓂᑦ ᐊᖏᔪᓴᐅᓂ ᓇᓄᑦᑐᓕᕆᓂᖅᓂᑦ ᑐᓂᓴᖏᓐᓂᓴ ᐃᑯᐊᕐᓂᖅᓂᑦ.

Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 271

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓐᓂᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᑦᖁᔪ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᐹᓗ	NOV ᐅᓇᓚᐱᓗ	DEC ᑎᓯᓚᐱᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᐃᑦ	Tuktut			8		2			1				3	14 ± 2
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait											1		1 ± 0
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡					2			10					
Wolf	ᐊᒪᕐᕈᐃᑦ	Amagut						1				2			3 ± 1
Arctic fox	ᑎᓗᓚᖓᓂᐊᑦ	Tigiganiat								10	4	11	5		30 ± 6
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				4									4 ± 0
Ringed seal	ᓇᕆᑦ	Natiinat	99	141	49	108	56	57	8	34	42	40	6	16	656 ± 9
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		3	6	13	2								24 ± 1
Harp seal	ᖃᐃᕈᓪᓚᑦ	Qairulik			1	16									17 ± 0
Walrus	ᐊᐃᐸᑦ	Akvik		1	1										2 ± 0
Narwhal	ᑐᒻᓪᓚᑦ ᖁᓪᓗᓚᑦ	Tuugaak			8										8 ± 0
Beluga	ᖃᓄᖅᑕ ᖁᓪᓗᓚᑦ	Kilalugak			17										17 ± 3
Snow goose	ᑲᖕᒪᐃᑦ	Kanguq	15	5											20 ± 4
Canada goose	ᓄᖅᓪᓚ ᐅᓗᐊᒍᓪᓚᑦ	Nikliknik												1	1 ± 0
Brant goose	ᓄᖅᓕᖅᓇᐃᑦ	Nirlirnaq	4												4 ± 2
Old squaw	ᐊᒃᑭᐊᖅᔪᐃᑦ	Aahangik		1											1 ± 0
Eider duck	ᑎᑎᑦ	Kingalik	2		10										12 ± 4
Common loon	ᑐᑦᓕᖅᔪᐊᖏᖅ	Tuulik		1											1 ± 0
Ptarmigan	ᐊᖏᒃᑦ	Akilgik	37			123	20							62	242 ± 13
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᒪᓂᓂᑦ	Manniit		2											2 ± 0
Goose eggs	ᑲᖕᒪᐃᑦ ᒪᓂᓂᑦ	Uluaguliit manniit		2											2 ± 0
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᑦ	Tinmiat manniit	7	3											10 ± 0
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓂᓂᑦ	Nauyat manniit	2	5											7 ± 0
Arctic char	ᐃᖃᓗᒃᓕᑦ	Ikaliviit	326	103	169	34								200	832 ± 45
Arctic cisco	ᐅᑭᐅᖅᑕᑐᒥ ᑲᕐᓂᓪᓚᑦ	Kapihilik	133	158	53										344 ± 20

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᐃᑦ ᑎᑎᕋᐅᒪᓕᒃᑐᑦ ᑐᓂᓴᖅᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓕᕆᓂᖅᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 272

Monthly hunter response

ᑕᖅᑕᒪᑦ ᐊᖏᓚᓂᕆᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)

ᐊᑦᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᖅ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑲᕐᓗ	NOV ᓄᕙᕐᓗ	DEC ᑎᓯᕐᓗ	JAN ᒎᖅᓄᐊᓗ	FEB ᕕᖕᐊᓗ	MAR ᒪᓯ	APR ᐃᓴᓚ	MAY ᒪᐃ	Total ᑲᑎᑲᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓚᓂᕆᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᓚᓂᕆᑦ	Tatkitaman angunahuktut titigait	60	60	62	60	59	58	59	61	62	62	62	61	64*
Hunters interviewed	ᐊᖏᓚᓂᕆᑦ ᐊᐱᓯᓂᑦ	Angunahuktin apikhuktan	58	60	61	60	58	58	56	58	61	59	59	57	63*
Harvested	ᐊᖏᓚᓂᕆᑐᒋᓐ	Angujaujut	40	31	28	22	17	16	6	13	12	19	8	31	55*
Response Rate (%)	ᑭᐅᔭ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	97	100	98	100	98	100	95	95	98	95	95	93	97**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓂᕆᑦ ᐊᑎᓕᐅᕐᑕᒪᓐᓇᖅᑐᑦ/ᐊᐱᓯᓂᑦ/ᐊᖏᓚᓂᕆᑐᒋᓐ ᐊᑕᐅᓯᐊᓘᔪᓐᓇᕐᓂᖅ ᐊᑦᖁᒪᑦ.
** ᐊᓕᒋᓕᑎᒥᓯᒪᔨᑦ ᑕᖅᑕᒪᑦ ᑭᐅᔭ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 273

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᐃᐅᔨᑦ ᐊᑯᖏᓐ ᐊᖏᓚᓂᓕᓐᓂᖓᑕ ᐊᒪᓗᓗ ᐊᐱᓯᓂᑦᑕᐅᓂᖓᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᓚᓂᕆᑕᑦ ᑎᑎᕐᓂᑦᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)

ᐊᑦᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᖅ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑲᕐᓗ	NOV ᓄᕙᕐᓗ	DEC ᑎᓯᕐᓗ	JAN ᒎᖅᓄᐊᓗ	FEB ᕕᖕᐊᓗ	MAR ᒪᓯ	APR ᐃᓴᓚ	MAY ᒪᐃ	Total ᑲᑎᑲᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᐃᐅᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑦ	≤ tatkin pingahut	100	100	100	1	0	50	100	100	100	100	100	100	74
4-6 months	4-6 ᑕᖅᑦ	tatkin hitaman 6nut	0	0	0	99	100	50	0	0	0	0	0	0	26
> 6 months	> 6 ᑕᖅᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 274

Number of hunters harvesting each species — **Year 2 (June 1997 - May 1998)**

ᖃᑦᔨᐅᓂᖏᑦ ᐊᖏᔪᓚᐸᑎᑦ ᐊᖏᔪᓚᐸᓕᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒃᑭᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 2 (June 1997 - May 1998)**

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᔨᒃ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut			3		1			1				2	7
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait											1		1
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut						1				2			3
Arctic fox	ᑎᓚᒋᓐᓂᐊᑦ	Tigiganiat								1	1	2	1		2
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik				1									1
Ringed seal	ᓇᕆᔨᑦ	Natiinat	27	19	19	17	15	16	6	12	11	16	5	9	37
Bearded seal	ᐅᓪᔪᐃᑦ	Ukyuk		2	5	4	2								10
Harp seal	ᖃᐃᓕᓪᓕᑦ	Qairulik			1	3									4
Walrus	ᐊᐃᐱᒃᑦ	Akvik		1	1										2
Narwhal	ᑐᒻᓪᓕᑦ ᖁᓕᓄᑦ	Tuugaak			1										1
Beluga	ᖃᓄᖅᑕ ᖁᓕᓄᑦ	Kilalugak			8										8
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	4	2											5
Canada goose	ᓄᖅᓪᓕ ᐅᓄᐊᒍᓪᓕᑦ	Nikliknik												1	1
Brant goose	ᓄᖅᓕᖅᓇᐃᑦ	Nirlirnaq	2												2
Old squaw	ᐊᒻᑭᐊᖅᔪᐃᑦ	Aahangik		1											1
Eider duck	ᑎᑎᑦ	Kingalik	1		1										2
Common loon	ᑐᓪᓕᖅᔪᐊᖏᖅ	Tuulik		1											1
Ptarmigan	ᐊᖏᒻᑦ	Akilgik	11			7	4							8	23
Eggs (unspecified)	ᐊᓂᖅᑦ ᑎᒥᐊᑦ ᒪᓂᓂᖅᑦ	Manniit		1											1
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓂᓂᖅᑦ	Uluaguliit manniit		1											1
Duck eggs	ᑎᑎᑦ ᒪᓂᓂᖅᑦ	Tinmiat manniit	1	1											2
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓂᓂᖅᑦ	Nauyat manniit	1	4											5
Arctic char	ᐃᖃᓗᓴᑦ	Ikaliviit	18	12	6	3								19	35
Arctic cisco	ᐅᑭᐅᖅᑕᑐᒥ ᑲᕕᓂᓪᓕᑦ	Kapihilik	11	4	2										13

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕆᓪᒪᔪᓂᒃ ᐱᕈᖃᖕᖏᑕᖃᓄ ᐱᓴᔨᑎᓕᓂᒃ ᐊᖏᔪᑦ ᖃᕆᐅᓂᖏᖅᓂᓄᑦ ᐊᖏᔪᓄᑦ ᓇᓕᓴᐅᒪᔪᓂᑦ ᐊᓕᓴᐅᓂᓴᓂᒃ ᑐᓴᓴᖏᖅᓂ ᐃᑯᐱᕕᓕᓕᓚᓂᓴᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 275

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᓐᔨᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᔪᒃ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓕᐱᓗ	DEC ᑎᓯᓚᐱᓗ	JAN ᒍᖏᓇᐊᓗ	FEB ᓇᖕᖅᐊᓗ	MAR ᒪᑉᓯ	APR ᐃᑦᓀᓪᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut			20										20 ± 8
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait											3	5	8 ± 3
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡					2			60					
Wolf	ᐊᒪᕈᐃᑦ	Amagut								1					1 ± 1
Arctic fox	ᑎᓗᒃᖏᓂᐊᑦ	Tigiganiat								1	5		3		9 ± 5
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik					2							1	3 ± 1
Ringed seal	ᓇᓯᓪᓚ	Natiinat	57	41	28	11	16	25	23	86	73	23	32	46	461 ± 44
Bearded seal	ᐅᑉᔪᐃᑦ	Ukyuk		4	10	1	2				1				18 ± 5
Harp seal	ᖃᐃᕈᓪᓚᑦ	Qairulik			3	4									7 ± 3
Walrus	ᐊᐃᐸᒃᑦ	Akvik		4	1										5 ± 2
Narwhal	ᑐᒻᓪᓚᑦ ᖁᓪᓗᑎᑦ	Tuugaak			4	1									5 ± 3
Beluga	ᖃᐅᓂᑦ ᖁᓪᓗᑎᑦ	Kilalugak		21	23	6									50 ± 10
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq		1	15										16 ± 7
Canada goose	ᓄᓯᓪᓚᑦ ᐅᓄᐊᔪᓪᓚᑦ	Nikliknik	1												1 ± 1
Brant goose	ᓄᓯᓕᓪᓇᐃᑦ	Nirlirnaq				7									7 ± 5
Eider duck	ᒥᑎᑦ	Kingalik	1	21	48										70 ± 22
White-winged scoter	ᖃᐅᓂᒋᓕᒃ ᐃᓕᕈᐊ ᐱᑦᓯᐅᓪᓚᓂᑦᓴᒃ	White-winged scoter	2												2 ± 2
Thick-billed murre	ᐊᑦᐸᐃᑦ	Thick-billed murre		6											6 ± 3
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	4			28	10					1	5	24	72 ± 18
Duck Eggs	ᒥᑎᑦ	Tinmiat manniit		7											7 ± 4
Arctic tern eggs	ᐃᒥᖅᑯᒋᐃᓕᑦ ᒪᓕᓂᖏᑦ	Emitkutailat manniit	10	7											17 ± 9
Arctic char	ᐃᖅᓄᒃᐱᑦ	Ikaliviit	510	73	145	19	13						1	33	794 ± 147
Clams	ᐊᓚᒧᒪᓕᑦ	Uviluq		90											90 ± 104

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓂᑦ ᑎᑎᕐᑕᒪᓕᑦ ᑐᓂᓯᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓴᓐᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 276

Monthly hunter response

ᑕᖅᑕᒪᒃᑯ ᐊᖏᔪᓇᐱᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᑦᖁᔪ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᑦᔪᑎ	SEP ᓯᑎᑦᕕᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᐊᑦᕕᓇ	DEC ᑎᓯᑦᕕᓇ	JAN ᒍᖏᓄᓇ	FEB ᐃᖅᑲᐃᓇ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᐱᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑯ ᐊᖏᔪᓇᐱᑎᑦ	Tatkitaman angunahuktut titigait	61	61	62	61	62	62	62	62	63	63	63	64	65*
Hunters interviewed	ᐊᖏᔪᓇᐱᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	52	50	56	56	57	57	57	50	51	58	55	57	64*
Harvested	ᐊᖏᔪᓇᐱᑐᒋᓐ	Angujaujut	25	20	19	10	12	6	5	11	12	6	18	17	46*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑦᑐᓂᖏᑦ (%)	Kiujut (%)	85	82	90	92	92	92	92	81	81	92	87	89	88**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᐱᑎᑦ ᐊᑎᓕᐅᑦᑕᐅᒪᔨᖅᑕᑦ/ᐊᐱᕐᓂᑦᑕᑦ/ᐊᖏᔪᓇᐱᑐᒋᓐ ᐊᑕᐅᓂᐊᓕᔭᑎᑎᑉ ᐊᑦᖁᒧᑦ.
** ᐊᑦᓴᒋᓕᑎᓗᒪᔨᖅ ᑕᖅᑕᒪᒃᑯ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 277

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᖏᓐᓂ ᐊᖏᔪᓇᓴᓂᓐᓇᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓐᓇᑕ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓇᓴᑦᑕᑦ ᑎᑎᕐᕿᑦᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐊᑦᖁᔪ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

6.1.12

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᑦᔪᑎ	SEP ᓯᑎᑦᕕᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᐊᑦᕕᓇ	DEC ᑎᓯᑦᕕᓇ	JAN ᒍᖏᓄᓇ	FEB ᐃᖅᑲᐃᓇ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕᑦ	≤ tatkin pingahut	100	100	26	89	52	76	100	100	100	15	100	100	84
4-6 months	4-6 ᑕᖅᑕᑦ	tatkin hitaman 6nut	0	0	60	11	48	24	0	0	0	85	0	0	14
> 6 months	> 6 ᑕᖅᑕᑦ	> 6 tatkin	0	0	15	0	0	0	0	0	0	0	0	0	2

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 278

Number of hunters harvesting each species — **Year 3 (June 1998 - May 1999)**

ᖃᑦᔪᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᖅᑎᑦ ᐊᖏᔪᓚᐱᖅᓯᒪᔪᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ — **ᐊᒃᑭᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 3 (June 1998 - May 1999)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᓂ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓴᐱᓗ	JAN ᒎᖓᓄᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut			3										3
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait											2	3	4
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᖏᐃᑦ	Amagut								1					1
Arctic fox	ᑎᓗᒃᖖᓄᐊᑦ	Tigiganiat								1	1		1		2
Arctic hare	ᐅᑲᓪᓕ	Ukalik					2							1	3
Ringed seal	ᓇᓕᔪᑦ	Natiinat	11	13	9	6	7	6	5	11	11	5	11	9	30
Bearded seal	ᐅᓚᐃᑦ	Ukyuk		1	4	1	2				1				6
Harp seal	ᖃᐃᖏᓪᓕ	Qairulik			2	1									3
Walrus	ᐊᐃᐸᒃ	Akvik		3	1										3
Narwhal	ᑐᒻᓪᓕ ᖁᓪᓗᓂᑦ	Tuugaak			1	1									2
Beluga	ᖃᐅᑦᑕ ᖁᓪᓗᓂᑦ	Kilalugak		9	6	4									14
Snow goose	ᑲᔪᐃᑦ	Kanguq		1	3										3
Canada goose	ᓄᑦᓪᓕ ᐅᓗᐊᔪᓪᓕᑦ	Nikliknik	1												1
Brant goose	ᓄᑦᓕᑦᓇᐃᑦ	Nirlirnaq				1									1
Eider duck	ᒥᑎᑦ	Kingalik	1	3	4										6
White-winged scoter	ᖃᐅᑦᑕᓕᒃ ᐃᓕᓴᐊ ᐱᑦᓴᐅᓭᓪᓕᒃ	White-winged scoter	1												1
Thick-billed murre	ᐊᑦᕿᐃᑦ	Thick-billed murre		3											3
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	2			3	4					1	2	5	15
Duck Eggs	ᒥᑎᑦ	Tinmiat manniit		2											2
Arctic tern eggs	ᐃᒥᖃᐅᑕᓚᐃᑦ ᒪᓐᓂᖏᑦ	Emitkutailat manniit	1	1											1
Arctic char	ᐃᖃᓪᓚᐱᑦ	Ikaliviit	17	5	7	1	2						1	6	28
Clams	ᐊᓕᒧᓚᓴᑦ	Uviluq		1											1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᖖᑦᑐᖃ ᐱᓪᔦᑎᓕᓐᓂᒃ ᐊᖏᔪᑦ ᖃᕋᓯᐅᓂᖏᓐᓄᑦ ᐊᓕᓴᐅᒪᔪᓚᐃᑦ ᐊᖏᔪᓄᑦ ᓇᓕᑲᖏᕐᕋᓂᖅᓄᑦ ᑐᓂᓴᖏᓐᓂ ᐃᑯᐱᕐᓂᓚᓂᖅᑕᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 279

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓐᓂᑦ
Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)
ᐊᓐᖏᒍ 4 (ᔪᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔾᔪᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑦᔨᓇ	NOV ᐅᓇᓚᐱᓇ	DEC ᑎᓯᓚᐱᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕆ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᔭᑐᐃᑦ	Tuktut		3	22									2	27 ± 8
Musk-ox	ᐅᒥᓚᒪᐃᑦ	Umingmait										1		2	3 ± 1
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡					4	4				1	7	2	18
Wolf	ᐊᒪᕐᐃᑦ	Amagut											1		1 ± 0
Arctic fox	ᑎᓕᓴᖅᓄᐊᑦ	Tigiganiat									1				1 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	1											1	2 ± 0
Ringed seal	ᓇᕆᑦ	Natiinat	117	23	16	34	42	41	39	99	65	89	45	15	625 ± 37
Bearded seal	ᐅᑉᐊᐃᑦ	Ukyuk	5		8	5	5		2		1			3	29 ± 4
Harp seal	ᖃᐃᕐᓚᑦ	Qairulik				1									1 ± 0
Walrus	ᐊᐃᓴᒃ	Akvik			2					1					3 ± 2
Narwhal	ᑐᒻᓚᑦ ᕿᓪᓗᓂᑦ	Tuugaak		8	8	1									17 ± 2
Beluga	ᖃᓄᖅᑕ ᕿᓪᓗᓂᑦ	Kilalugak		3	7	1									11 ± 3
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	1	4											5 ± 2
Brant goose	ᓂᖅᓪᓕᐃᑦ	Nirlirnaq	4	3	1	3									11 ± 3
Old squaw	ᐊᓯᐊᖅᓴᐃᑦ	Aahangik			1										1 ± 1
Eider duck	ᒥᑎᑦ	Kingalik	1	19	4	22	4								50 ± 16
Ptarmigan	ᐊᖏᓱᑦ	Akilgik				66	117						20	10	213 ± 53
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓂᓂᑦ	Uluaguliit manniit	11												11 ± 4
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᑦ	Tinmiat manniit		74											74 ± 53
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓂᓂᑦ	Nauyat manniit	36												36 ± 29
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	290	205	191	5	10							25	726 ± 100
Clams	ᐊᓚᒧᒪᓴᑦ	Uviluq			360	343									703 ± 71

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓂᑦ ᑎᑎᕋᐅᒪᓴᑦ ᑐᓂᔭᖏᑦ ᐅᑯᐊ ᐃᑯᐱᔪᓐᓇᓕᒫᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 280

Monthly hunter response
ᑕᖅᑕᒪᒃᑯᑦ ᐊᖏᓚᓱᓕᕆᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᑐᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᐊᒡᓇ	DEC ᑎᓯᒡᓇ	JAN ᒎᓐᓄᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᓯ	APR ᐃᕐᓗᓯ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓚᓱᓕᕆᑦ ᑭᐅᓂᖏᑦ ᐋᔪᓕᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑯᑦ ᐊᖏᓚᓱᓕᕆᑦ	Tatkitaman angunahuktut titigait	66	67	66	65	65	63	62	64	64	65	65	66	70*
Hunters interviewed	ᐊᖏᓚᓱᓕᕆᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	61	63	60	61	60	60	59	60	61	55	62	64	70*
Harvested	ᐊᖏᓚᓱᓕᕆᑐᒃᓯ	Angujaujut	31	18	22	23	12	10	11	19	13	14	21	16	51*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑦᑐᓂᖏᑦ (%)	Kiujut (%)	92	94	91	94	92	95	95	94	95	85	95	97	93**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓱᓕᕆᑦ ᐊᑎᓕᐅᕐᑕᒪᓐᓇᖅᑐᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᓚᓱᓕᕆᑐᒃᓯ ᐊᑕᐅᓂᐊᖅᑐᑎᑦ ᐊᑐᕐᕕᒃ.
** ᐊᓕᒍᓂᖅᓯᒪᓂᖅ ᑕᖅᑕᒪᒃᑯᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 281

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓐᓄᓕ ᐊᖏᓚᓱᓕᕆᓂᖓᓄᑦ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓄᑦ, ᓇᓗᓇᐃᖏᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᓚᓱᓕᕆᑦᑕᑦ ᑎᑎᖏᑦᑕᐅᒪᔪᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

ᐊᑐᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᐊᒡᓇ	DEC ᑎᓯᒡᓇ	JAN ᒎᓐᓄᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᓯ	APR ᐃᕐᓗᓯ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔪᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕐᑯᑦ	≤ tatkin pingahut	100	100	98	100	100	100	100	100	100	100	0	0	89
4-6 months	4-6 ᑕᕐᑯᑦ	tatkin hitaman 6nut	0	0	2	0	0	0	0	0	0	0	10	96	6
> 6 months	> 6 ᑕᕐᑯᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	90	4	5

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 282

Number of hunters harvesting each species — **Year 4 (June 1999 - May 2000)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓯᓗᒃᑎᑦ ᐊᖏᔪᓯᓗᒃᑲᓕᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ — **ᐊᒡᖏᔪ 4 (ᔦᓂ 1999 - ᒪᐃ 2000)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 4 (June 1999 - May 2000)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔦᓂ	JUL ᔨᓪᐃ	AUG ᐊᐅᒡᔪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᓄᐱᒡᐱᓗ	DEC ᑎᓯᒡᐱᓗ	JAN ᒍᖏᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᔨᔪ	APR ᐃᔨᓪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut		1	5									1	7
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait										1		1	2
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐅᐃᑦ	Amagut											1		1
Arctic fox	ᑎᓗᒃᑲᓂᐊᑦ	Tigiganiat									1				1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	1											1	2
Ringed seal	ᓇᓯᓪᑦ	Natiinat	26	9	6	13	9	7	11	19	13	14	13	6	38
Bearded seal	ᐅᑉᐊᐃᑦ	Ukyuk	2		5	4	2		2		1			2	11
Harp seal	ᖃᐃᓕᓪᓚᑦ	Qairulik				1									1
Walrus	ᐊᐃᐅᓴᑦ	Akvik			1					1					2
Narwhal	ᑐᒻᓪᓚᑦ ᖁᓕᓕᒃᑦ	Tuugaak		3	4	1									5
Beluga	ᖃᐅᔨᑦ ᖁᓕᓕᒃᑦ	Kilalugak		3	5	1									9
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	1	2											3
Brant goose	ᓂᕆᔨᓇᐃᑦ	Nirlirnaq	1	1	1	1									4
Old squaw	ᐋᕿᐊᖅᓴᐃᑦ	Aahangik			1										1
Eider duck	ᑎᑎᑦ	Kingalik	1	1	2	2	1								6
Ptarmigan	ᐊᖏᓱᑦ	Akilgik				6	5						3	3	13
Goose eggs	ᑲᖏᐃᐃᑦ ᒪᓂᕐᕿᑦ	Uluaguliit manniit	1												1
Duck eggs	ᑎᑎᑦ ᒪᓂᕐᕿᑦ	Tinmiat manniit		1											1
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓂᕐᕿᑦ	Nauyat manniit	1												1
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	10	5	10	1	1							8	25
Clams	ᐊᓚᒧᒪᓕᑦ	Uviluq			1	8									9

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᓕᕆᓂᒃ ᐱᑕᖃᓄᖅᑐᑐᖃᖅ ᐱᓕᕆᔨᒋᓂᒃ ᐊᖏᔪᒃᑯᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓯᖏᓐᓂᒃᑯᑦ ᐊᐅᓚᓕᕆᓂᖅᑐᑦ ᐃᓄᐃᑦᑎᓯᒋᐊᕐᓂᖅᑐᑦ ᐃᓕᓴᕐᕕᒃᓴᓂ ᐃᓄᐃᑦᑎᓯᒋᐊᕐᓂᖅᑐᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 283

Monthly harvest estimates
ᑕᕿᑕᒫᑦ ᐊᖑᔭᓄᑦ ᓇᓚᐅᑦᓴᕈᑏᑦ,
Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᒻᕋᒍ 5 (ᔪᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒻᒍᑎ	SEP ᓱᑎᒻᐱᕆ	OCT ᐅᑦᑐᐱᕆ	NOV ᓄᕕᒻᐱᕆ	DEC ᑏᓯᒻᐱᕆ	JAN ᔭᓐᓄᐊᕆ	FEB ᕕᕐᕗᐊᕆ	MAR ᒫᑦᓯ	APR ᐃᑦᕆᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut			8			5				3			16 ± 3
Musk-ox	ᐅᒥᒃᒪᐃᑦ	Umingmait										1		5	6 ± 3
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					3			4					
Arctic fox	ᑎᕆᒐᓐᓂᐊᑦ	Tigiganiat					10	12	6	8	56		1	3	96 ± 24
Arctic hare	ᐅᑲᓖᑦ	Ukalik	2												2 ± 0
Ringed seal	ᓇᑦᓯᑦ	Natiinat	86	48	47	72	55	34	16	47	24	74	45	20	568 ± 22
Bearded seal	ᐅᒻᔪᐃᑦ	Ukyuk			1	6	2						1		10 ± 1
Harp seal	ᖃᐃᕈᓖᑦ	Qairulik				2									2 ± 0
Walrus	ᐊᐃᕕᑦ	Akvik		1											1 ± 0
Narwhal	ᑑᒐᓖᑦ ᕿᓚᓗᒐᑦ	Tuugaak			8										8 ± 0
Beluga	ᖃᑯᕐᑕᑦ ᕿᓚᓗᒐᑦ	Kilalugak			23	2									25 ± 1
Snow goose	ᑲᖑᐃᑦ	Kanguq	13	7	8	2									30 ± 2
Brant goose	ᓂᕐᓕᕐᓇᐃᑦ	Nirlirnaq			2	3									5 ± 0
Eider duck	ᒥᑏᑦ	Kingalik		35	15	6									56 ± 0
Ptarmigan	ᐊᕿᒻᒋᑦ	Akilgik	34			318	181				3		5	41	582 ± 43
Duck eggs	ᒥᑏᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit	8	79											87 ± 0
Arctic tern eggs	ᐃᒥᖅᑯᑕᐃᓚᐃᑦ ᒪᓐᓂᖏᑦ	Emitkutailat manniit	21	6											27 ± 4
Seagull eggs	ᓇᐅᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	83												83 ± 0
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	271	91	274	136	75							28	875 ± 36
Cod	ᐆᒐᐃᑦ	Ugak				66									66 ± 0
Clams	ᐊᒻᒧᒪᔪᑦ	Uviluq				23									23 ± 0

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᕐᓄᑦ ᑎᑎᕋᕐᑕᐅᒪᔪᑦ ᑐᓂᔭᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᕕᓕᕆᔨᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 284

Monthly hunter response

ᑕᖅᑕᒪᑦ ᐊᖏᓚᓯᖏᑎᑦ ᑭᐅᓂᖓᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᒡᕐᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᓐᓂᖅ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᓪᓗ	SEP ᓯᑎᕐᓚᓪᓗ	OCT ᐅᑐᐱᓪᓗ	NOV ᓄᓇᕐᓚᓪᓗ	DEC ᑎᓯᕐᓚᓪᓗ	JAN ᒎᓕᓄᓪᓗ	FEB ᓇᖕᐅᐊᓪᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓚᓯᖏᑎᑦ ᑭᐅᓂᖓᑦ ᐊᑎᓯᒪᓂᖓᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᓚᓯᖏᑎᑦ	Tatkitaman angunahuktut titigait	66	66	66	65	64	64	64	64	65	65	66	66	68*
Hunters interviewed	ᐊᖏᓚᓯᖏᑎᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	65	65	65	63	62	62	62	61	60	56	61	48	67*
Harvested	ᐊᖏᓚᓯᖏᑐᒥᓂᑦ	Angujaujut	30	25	32	24	19	13	9	13	10	18	18	13	51*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑦᑐᓂᖓᑦ (%)	Kiujut (%)	98	98	98	97	97	97	97	95	92	86	92	73	93**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓯᖏᑎᑦ ᐊᑎᓕᐅᕐᓯᒪᔪᑦ/ᐊᐱᕐᓯᑦ/ᐊᖏᓚᓯᖏᑐᒥᓂᑦ ᐊᑕᐅᓯᐊᖅᓯᒪᔪᖅ ᐊᒡᕐᔪᒍ.
** ᐊᐅᔨᓂᕐᑎᓯᒪᔪᑦ ᑕᖅᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 285

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓐᓄᓂ ᐊᖏᓚᓯᖏᓐᓄᖓᓕᒃ ᐊᒻᒪᓗ ᐊᐱᕐᓯᑦᑕᐅᓂᖓᓕᒃ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᓚᓯᖏᓐᓂᑦ ᑎᑎᕐᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᒡᕐᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᓐᓂᖅ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᓪᓗ	SEP ᓯᑎᕐᓚᓪᓗ	OCT ᐅᑐᐱᓪᓗ	NOV ᓄᓇᕐᓚᓪᓗ	DEC ᑎᓯᕐᓚᓪᓗ	JAN ᒎᓕᓄᓪᓗ	FEB ᓇᖕᐅᐊᓪᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑐᑦ	≤ tatkin pingahut	37	89	98	100	100	100	100	100	100	100	100	0	84
4-6 months	4-6 ᑕᖅᑐᑦ	tatkin hitaman 6nut	61	11	2	0	0	0	0	0	0	0	0	100	16
> 6 months	> 6 ᑕᖅᑐᑦ	> 6 tatkin	1	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 286

Number of hunters harvesting each species — **Year 5 (June 2000 - May 2001)**

ᖃᑦᔪᐅᓂᖏᑦ ᐊᖏᔪᓕᒃᑎᑦ ᐊᖏᔪᓕᒃᑲᓪᓚᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒡᕆᒍ 5 (ᔦᓂ 2000 - ᒪᐃ 2001)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 5 (June 2000 - May 2001)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔦᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᐱᓕᓂ	OCT ᐅᑲᐱᓂ	NOV ᐅᓇᒃᐱᓂ	DEC ᑎᓯᒃᐱᓂ	JAN ᒍᓐᓇᐊᓂ	FEB ᓇᖅᑲᐊᓂ	MAR ᒪᔨᓯ	APR ᐃᔨᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut			2			2				1			4
Musk-ox	ᐅᒥᖃᒪᐃᑦ	Umingmait										1		4	5
Polar bear#	ᓇᓄᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓗᓚᓐᓂᐊᑦ	Tigiganiat					2	3	2	1	1		1	1	5
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	1												1
Ringed seal	ᓇᓕᔪᑦ	Natiinat	19	18	19	15	12	9	7	12	8	16	16	6	38
Bearded seal	ᐅᑭᔪᐃᑦ	Ukyuk			1	3	2						1		6
Harp seal	ᖃᐃᓱᓪᓕᑦ	Qairulik				2									2
Walrus	ᐊᐃᐃᓴᑦ	Akvik		1											1
Narwhal	ᑐᒻᓪᓕᑦ ᖃᓪᓗᓂᑦ	Tuugaak			2										2
Beluga	ᖃᐅᕐᑦ ᖃᓪᓗᓂᑦ	Kilalugak			15	2									15
Snow goose	ᑲᖏᐃᑦ	Kanguq	3	2	4	1									9
Brant goose	ᓄᕐᓕᕐᓇᐃᑦ	Nirlirnaq			1	1									2
Eider duck	ᒥᑎᑦ	Kingalik		3	1	2									6
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	2			12	7				1		2	4	18
Duck eggs	ᒥᑎᑦ ᒪᓐᓄᖅᑦ	Tinmiat manniit	1	2											3
Arctic tern eggs	ᐃᒥᖏᑯᓚᓪᐃᑦ ᒪᓐᓄᖅᑦ	Emitkutailat manniit	3	1											4
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓐᓄᖅᑦ	Nauyat manniit	5												5
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	16	6	8	4	3							3	23
Cod	ᐅᓴᐃᑦ	Ugak				2									2
Clams	ᐊᓚᒧᒪᓕᑦ	Uviluq				1									1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᒪᓕᔪᓂᖅ ᐱᑕᖃᖏᑦᑐᖃᖅ ᐱᔨᔪᑎᓐᓂᓂᖅ ᐊᖏᔪᒃ ᖃᑦᔪᐅᓂᖏᑦᓂᓄ ᐊᓕᓴᐅᒪᓕᔪᓂᑦ ᐊᖏᔪᓂᒃ ᓇᓕᑭᔪᓐᓇᖅᑐᓂᒃ ᐃᓕᓴᕐᓂᐊᕐᓂᖅᓂᑦ ᐃᓄᐃᕐᓇᖅᑐᓂ ᐃᓄᐃᑦᑕᓚᓐᓇᕆᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 287

Annual harvest estimates and five-year mean

ᐊᖏᖁᔨᒪᑦ ᐊᖑᓚᓄᑦ ᓇᓕᐅᑦᓱᓀᑦᑐᑦ ᐊᖏᒪᓗ ᑕᒻᓕᓄᑦ-ᐊᖏᖁᔨᓄᑦ ᐊᐅᓀᓕᖅᑎᓂᒪᓕᕆᑦ

Aragutamat angujauvaktun tatlman araguit iluani

All Years (June 1996 - May 2001)

ᑕᒪᐃᖅᓄᑦ ᐊᖏᖁᔨᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᖁᔨ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᓀᓕᖅᑎᓂᒪᓕᕆᑦ Amigaitkiyait
Species	ᐅᒪᔪᑦ	**Umajuin**						
Caribou[1]	ᑐᒃᑐᐃᓕᑦ[c1]	Tuktut[1]	6	14	20	27	16	17
Musk-ox[2]	ᐅᒥᓴᒪᐃᓕᑦ[c2]	Umingmait[2]	19	1	8	3	6	7
Polar bear[3]	ᓇᓂᐃᓕᑦ[c3]	Nanuit[3]	18	20	19	18	14	18
Wolf	ᐊᒪᓗᐃᓕᑦ	Amagut	2	3	1	1	0	1
Arctic fox[4]	ᑎᓚᓱᓐᓂᐊᑦ[c4]	Tigiganiat[4]	20	30	9	1	96	31
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	7	4	3	2	2	4
Ringed seal[5]	ᓇᕆᓂᑦ[c5]	Natiinat[5]	501	656	461	625	568	562
Bearded seal[5]	ᐅᑦᔪᐃᐃ5[c5]	Ukyuk[5]	21	24	18	29	10	20
Harp seal[5]	ᖃᐃᓗᓪᓕᑦ[c5]	Qairulik[5]	10	17	7	1	2	7
Walrus[5,6]	ᐊᐃᐃᕆᑦ[c5,6]	Akvik[5,6]	15	2	5	3	1	5
Narwhal[5,7]	ᑐᒻᓪᓕᑦ ᖁᓪᓗᓚᑦ[c5,7]	Tuugaak[5,7]	2	8	5	17	8	8
Beluga[5,8]	ᖃᐅᑦᑕᑦ ᖁᓪᓗᓚᑦ[c5,8]	Kilalugak[5,8]	3	17	50	11	25	21
Snow goose	ᑲᖏᐃᓕᑦ	Kanguq	16	20	16	5	30	17
Canada goose	ᓄᕐᓕᑦ ᐅᓄᐊᔪᓕᓕᑦ	Nikliknik	0	1	1	0	0	<1
Brant goose	ᓄᕐᕆᓪᓇᐃᓕᑦ	Nirlirnaq	18	4	7	11	5	9
Old squaw	ᐊᑭᑎᐊᓐᓴ	Aahangik	0	1	0	1	0	<1
Eider duck	ᒥᑎᑦ	Kingalik	50	12	70	50	56	48
White-winged scoter	ᖃᐃᕐᑕᓕᒃ ᐃᓕᓐᐊ ᐱᕐᐅᓪᓕᕐᕆᐃᓕᑦ	White-winged scoter	0	0	2	0	0	<1
Common loon	ᑐᓪᓕᒃᔪᐊᖏᖅ	Tuulik	0	1	0	0	0	<1
Red-throated loon	ᖃᖅᓚᐅᑦ	Qaqhuaq	2	0	0	0	0	<1
Thick-billed murre	ᐊᑦᕕᐃᓕᑦ	Thick-billed murre	0	0	6	0	0	1
Ptarmigan[9]	ᐊᖏᓱᒋᑦ[c9]	Akilgik[9]	782	242	72	213	582	378
Eggs (unspecified)[10]	ᓚᒃᓂᑦ[c10]	Manniit[10]	0	2	0	0	0	<1
Goose eggs[10]	ᑲᖏᐃᓕᑦ ᓚᒃᓂᕐᒧᑦ[c10]	Uluaguliit manniit[10]	0	2	0	11	0	3
Duck eggs[10]	ᒥᑎᑦ ᓚᒃᓂᕐᒧᑦ[c10]	Tinmiat manniit[10]	0	10	7	74	87	36
Arctic tern eggs[10]	ᐃᒥᖏᑯᑕᓚᐃᓕᑦ ᓚᒃᓂᕐᒧᑦ[c10]	Emitkutailat manniit[10]	0	0	17	0	27	9
Seagull eggs[10]	ᓇᐅᐅᐃᓕᑦ ᓚᒃᓂᕐᒧᑦ[c10]	Nauyat manniit[10]	0	7	0	36	83	25
Arctic char[11]	ᐃᖏᓱᒃᐲᑦ[c11]	Ikalivvit[11]	480	832	794	726	875	741
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᕕᓪᓕᑦ	Kapihilik	0	344	0	0	0	69
Inconnu	ᑲᕕᓪᓕᕐᕆᐃᓕᑦ	Aanakhiik	95	0	0	0	0	19
Cod[12]	ᐅᒪᐃᓕᑦ[c12]	Ugak[12]	0	0	0	0	66	13
Sculpin	ᑲᓇᔪᐃᓕᑦ	Kanayuk	3	0	0	0	0	1
Turbot	ᖃᓕᕐᓪᓕᑦ	Nataarnak	1	0	0	0	0	<1
Clams[13]	ᐊᖓᒧᒪᔪᑦ[c13]	Uviluq[13]	0	0	90	703	23	163

[1-13]: See page 409 for community feedback and other sources of data.

[1-13]: ᑕᐃᒪᖅ ᒪᓴᕐᔪᒪᖃᖅ 411 ᓄᓇᓕᓪᓕᑦ ᑭᐅᓴᐱᑎᕐᓂᑦ ᐊᖏᒪᓗ ᐊᓯᖏᓂᑦ ᐱᓴᐃᐅᔪᓂᒃ ᓄᓇᓕᖕᓂᖅ.

[1-13]: Takulugu makpigaak 413 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 288

Annual hunter response
ᐊᓚᖏᔪᒋᒪᑦ ᐊᖓᔪᓂᒃᑎᑦ ᑭᐅᓂᖅᑎᑦ
Angujauvaktu

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓇᑦ ᐊᓚᖏᔪᓇᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅᓯᒃ ᐊᓚᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖓᔪᓂᒃᑎᑦ ᑭᐅᓂᖅᑎᑦ ᐊᓚᔨᓕᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᕝᑕᒋᒪᑦ ᐊᖓᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	51	64	65	70	68	75*
Hunters interviewed	ᐊᖓᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	51	63	64	70	67	74*
Harvested	ᐊᖓᔪᓂᒃᑐᒋᓂᓕᓂᑦ	Angujaujut	42	55	46	51	51	66*
Response Rate (%)	ᑭᐅᔭᖅ ᖃᓕᑭᐅᓂᖅᑎᑦ (%)	Kiujut (%)	93	97	88	93	93	93**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖓᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᔨᓪᓚᕐᓂᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖓᔪᓂᒃᑐᒋᓂᓕᓂᑦ ᐊᑕᐅᓂᐊᖏᓪᓗᒋᑎᒃ ᖃᐅᔨᓴᖅᓯᒪᔪᖅ.
** ᐊᐅᒋᓕᑎᒋᓂᖅᓚᓪᓘᑦ ᐊᓚᖏᔪᓇᑦ ᑭᐅᔭᖅ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 289

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔭᑦ ᐊᑯᖏᓐᓄᓂᖓᓂᒃᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓂᒃᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᒪᔨᑦ ᐊᖓᔪᓂᒃᑕᒋᑦ ᑎᑎᕐᑦᑕᐅᒪᔭᑦ
Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓇᑦ ᐊᓚᖏᔪᓇᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅᓯᒃ ᐊᓚᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔭᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᕝᑕᑦ	≤ tatkin pingahut	100	74	84	89	84	86
4-6 months	4-6 ᑕᕝᑕᑦ	tatkin hitaman 6nut	0	26	14	6	16	13
> 6 months	> 6 ᑕᕝᑕᑦ	> 6 tatkin	0	0	2	5	0	1

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 290

Number of hunters harvesting each species

ᖃᑦᔪᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᒋᑦ ᐊᖏᔪᓚᐱᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ

Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᑦᕿᔪᓂᑦ (ᔨᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᕆᔨᒃ ᐊᑦᕿᔪᑎ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**						
Caribou	ᑐᑐᐃᑦ	Tuktut	5	7	3	7	4	15
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait	11	1	4	2	5	17
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut	2	3	1	1		7
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat	1	2	2	1	5	6
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	4	1	3	2	1	9
Ringed seal	ᓇᓯᔪᑦ	Natiinat	33	37	30	38	38	52
Bearded seal	ᐅᑉᔨᐃᑦ	Ukyuk	10	10	6	11	6	20
Harp seal	ᖃᐃᕐᓂᑦ	Qairulik	5	4	3	1	2	9
Walrus	ᐊᐃᐅᒃᑦ	Akvik	5	2	3	2	1	8
Narwhal	ᑐᒻᓂᑦ ᖁᓪᓗᓴᑦ	Tuugaak	1	1	2	5	2	8
Beluga	ᖃᐅᓯᑦ ᖁᓪᓗᓴᑦ	Kilalugak	3	8	14	9	15	32
Snow goose	ᑲᖏᐃᑦ	Kanguq	5	5	3	3	9	19
Canada goose	ᓄᓯᓂᑦ ᐅᓄᐊᔪᓐᓂᑦ	Nikliknik		1	1			1
Brant goose	ᓄᓯᓕᓐᓇᐃᑦ	Nirlirnaq	5	2	1	4	2	14
Old squaw	ᐋᑉᕈᐊᓕᖅ	Aahangik		1		1		2
Eider duck	ᒥᑎᑦ	Kingalik	6	2	6	6	6	19
White-winged scoter	ᖃᐃᓯᓪᓗᒃ ᐃᓕᕈᐊ ᐱᓯᕈᐅᓭᓯᐸᐃᑦ	White-winged scoter			1			1
Common loon	ᑐᓪᓗᓴᐊᖃᖅ	Tuulik		1				1
Red-throated loon	ᖃᖅᓴᐅᑦ	Qaqhuaq	1					1
Thick-billed murre	ᐊᑦᐸᐃᑦ	Thick-billed murre			3			3
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	24	23	15	13	18	39
Eggs (unspecified)	ᒪᓐᓂᑦ	Manniit		1				1
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓄᖅᑦ	Uluaguliit manniit		1		1		2
Duck eggs	ᒥᑎᑦ ᒪᓐᓄᖅᑦ	Tinmiat manniit		2	2	1	3	6
Arctic tern eggs	ᐃᒥᖃᑕᓕᐃᑦ ᒪᓐᓄᖅᑦ	Emitkutailat manniit			1		4	5
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓐᓄᖅᑦ	Nauyat manniit		5		1	5	9
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	19	35	28	25	23	50
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᐱᓂᓪᓂ	Kapihilik		13				13
Inconnu	ᑲᐱᓂᓕᕐᐸᐃᑦ	Aanakhiik	1					1
Cod	ᐅᒪᐃᑦ	Ugak					2	2
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk	1					1
Turbot	ᖃᓕᕆᓂᑦ	Nataarnak	1					1
Clams	ᐊᑦᒧᒪᓕᐊᑦ	Uviluq			1	9	1	10

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᓕᕐᓂᑐᖃᖅ ᐱᓱᐊᓕᓐᓂᓂᒃ ᐊᖏᔪᑦ ᖃᕋᐅᓂᖏᓐᓄᑦ ᐊᓕᕗᑦ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᑎᐊᓂᒃ ᐃᓅᓴᖏᓐᓄᑦ ᐃᑯᐱᕐᓂᓕᕆᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.12 Community Results Discussion: Resolute Bay

The survey frame:
An assessment of under-enumeration during the community visit indicated that there were very few hunters who were not registered in the Harvest Study.

Survey coverage and non-response bias:
With the exception of a few months, response rates were high throughout the study. As seen in Table 9 the consistent intentional non-response rate in Resolute Bay was 2.7%, and was not thought to be a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough in all years to ensure that n did in fact constitute a sufficiently representative sample of N hunters.

Measurement issues and response error:
It was reported that some hunters did not always report their children's harvest. Hunters also reported that they were not always interviewed every month. This can be seen in the recall period tables. These tables show that while the majority of harvest records were collected within three months of the harvest there were some months of the study where there was an increase in the percentage of records with recall periods of four to six months. There were however only four months during the study where records with recall periods of over six months were found. The longer recall periods in some months may have introduced some measurement error due to a reduced ability of hunters to remember their harvests. Hunters would then need to estimate their harvest and would often under-estimate.

It was also reported that at the start of the study many hunters did not understand why it was being done and were afraid that it was going to cause further limits to harvesting. They would then be reluctant to report their full harvest. All of these issues may have resulted in an under-reporting of the community harvest and should be considered by readers using the harvest data provided.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting near the community consisted of Peary caribou. The HTO banned community hunts for conservation reasons in 1994 and received recognition for this. This is the reason the numbers are low; not due to lack of need. The community has ordered caribou from other communities to make up for lack of meat available locally. Harvest estimates include some barren-ground and island caribou from other areas and seem accurate (C.F.).
2. **Musk-ox:** The community feels that although sport hunts were not recorded during the Harvest Study they should be considered since the meat from these hunts is kept and consumed in the community (C.F.). Some years the harvest estimates look too low, others seem close to the subsistence harvests. DSD reports the following subsistence harvest numbers for musk-ox (DSD MXa):

96/97	97/98	98/99	99/00	00/01
16	n/d	14	7	6

3. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
4. **Arctic fox:** Harvest estimates in years 3 and 4 seem too low. The higher estimate in year 5 looks accurate since fur prices were higher in that year (C.F.).
5. **Marine mammals:** Hunters report that in year 3 the bay was open and conditions were favorable for harvesting. In years 1 and 2 there were patches of ice which impaired harvesting. This effect was discussed for both whales and walrus (C.F.).
6. **Walrus:** As discussed, walrus have been less abundant in some years due to ice conditions. Harvest estimates seem a little high in year 1 but look accurate in other years (C.F.).
7. **Narwhal:** The annual quota was 32 animals. Not all were taken each year but harvest estimates in years 1, 2, 3 and 5 still appear to be low (C.F.). DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
2	7	9	1	12

[8] **Beluga:** The harvest estimate in year 1 seems too low. Estimates in other years look more accurate (C.F.). DFO reports the following harvest numbers for beluga (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
11	20	21	7	0

[9] **Ptarmigan:** There is a lot of variation from year to year and although hunters recall year 3 being a bad year for ptarmigan, it is still felt that the harvest estimate for this year is somewhat low (C.F.).

[10] **Eggs:** Many eggs were not reported by hunters. In year 1 no eggs were reported since hunters were not asked about their eggs. Other eggs that are harvested in large numbers are: eider duck eggs and arctic tern eggs. There is an arctic tern colony near the community where many young people go to gather eggs. Since children were not registered in the study and many did not report through their parents in this community many of these eggs were not reported (C.F.).

[11] **Arctic char:** The harvest estimate in year 1 seems low. Estimates in other years look more accurate (C.F.).

[12] **Cod:** Cod are often harvested when they are washed ashore. Most of these fish were not reported resulting in low harvest estimates (C.F.).

[13] **Clams:** Some hunters have been diving for clams since 1987 so there are some taken each year. Data from years 1 and 2 with no reported harvests appear to be inaccurate. Harvest estimates in years 3 and 5 also appear to be low (C.F.).

6.1.12 ᓄᓇᕗᑦ ᓴᖅᑭᑕᐅᔪᓂᖅ ᐅᖃᖅᑎᑐᑦᑕᑎᑦ: ᖃᐅᔨᓴᕐᔪᖅ

ᖃᐅᔨᓴᓂᐅᕙᑦ ᐊᖅᑭᑭᐅᒪᓂᖅᓱ:
ᑐᑭᓯᐅᓄᓇᕗᑦᓯᓚᑦ ᐊᑎᓕᐅᓇᖅᑐᓚᐅᖅᓴᖅᑕ ᓄᓇᕗᑦ ᓴᓪᓕᖅᑕᑭᐅᑎᓯᓚᑦ ᑕᐃᑎᖅᓯᓪᓚᕐᔪᐊᖅᑐᑦ ᐊᖅᑭᐊᓇᓂᖅᓯᒪᔪᑦ ᐊᑎᖃᖅᑎᑕᐅᓇᖅᑐᑦᑕᑐᐃᓐᓇᑦ ᖃᐅᔨᓴᕐᓂᖓᓪᓕᐊᑦ.

ᖃᐅᔨᓴᖅᑕᐅᔪᑦ ᐊᒻᒪ ᐃᓕᓴᐅᓇᓚᐅᑭᖅᑎᑦᑕᑦ ᑭᐅᖅᑭᑦᑕᑦ:
ᑕᖅᑭᑦ ᖃᓄᐃᑦᓯᓕᑦ ᐱᖃᓐᓇᖅᑎᑦᑕᑦᑎᑦ, ᑭᐅᑦᑎᑎᓂᖅᑎᑦ ᐅᓇᖅᑐᓂᑕᕐᓂᐊᕐᓇᖅᑐᖅᑕᑦ ᖃᐅᔨᓴᓂᖃᖅᓯᒪᓂᖅ. ᑕᐃᑎᑦᓯᒪᒪᑕ ᓇᓕᖅᑲᒥ 9 ᐱᓕᕆᓚᑎᑎᑯ ᑭᐅᑦᑕᐃᓕᓴᐃᓐᓇᕐᓂᑦᑕᑦ ᖃᐅᔨᓴᐃᑦᑐᒥ 2.7%ᒥᓪᓚᐅᖅᑐᑦᖅ, ᐊᒻᒪᓚᑕ ᐃᓕᓴᒪᑭᓚᐅᖅᑭᑦᑕᖅᖃᖅᑐᖅ ᐱᔪᑕᐅᑐᐃᓐᓇᖅᑐᖅᑕᑦ ᑭᐅᖅᑭᑦᑕᑐᓂᖅᑐᑦ ᐃᓪᓕᖅᑕᐅᓇᖅᑐᓂᖅᓱᒪᓂᖅ

[8] **ᖃᓪᓗᓂᐃᑦ:** ᖃᓪᓗᓂᑲᑕᐅᔪᓂᒃ ᑲᑎᒪᔨᐃᓐᓇᖅ 1 ᐊᑦᑎᓗᐊᖅᑐᑐᖅᑐᑦ. ᒥᖅᓴᑲᑕᐅᓕᒫᑦ ᑲᑎᒪᔨᐃᓐᓇᖅ ᐊᓕᓚᖅᑐᖅ ᐊᓕᓚᖅᑐᖅ ᓇᓕᒧᑦᑎᐊᓂᖅᓴᓴᐅᖅᑐᑐᖅᑐᑎᒃ (C.F.). ᐃᓚᒥᑕᑲᑕᓪᓚᐅᖅᓯᓐᓂ ᑲᑉᐊᐊ ᑎᑎᖅᑕᑲᑕᐅᒪᔨᑦ ᓇᓴᐅᑎᓂᑦ ᖃᓪᓗᓂᖅᑕᑲᑕᐅᔪᓐᓇᓕᒃ (ᖃᓄᐅᓚᒥᑦ ᐃᓚᒥᑕᑲᑕᓪᓚᐅᖅᓯᓐᓂ ᓇᓴᐅᑎᓂᑦ ᒪᓕᒡᒪᒃ ᑭᓇᐅᔭᖅᑐᑎᑎᑦᑕᒥᑕ ᑲᑎᒪᔨᐅᖅᑐᓂᒃ, ᐅᖓᓚᖅᑕᑲᑕᐅᔪᓂᓕᓂ ᐊᓐᓇᓯᒪᔨᖅᑎᓂ ᒪᓕᓐᓄᑦᒪᒃ ᐱᒋᐊᖏᖅᖢᖅᑐᑎᒃ ᐋᑎᒥᑦ ᒪᐃᒍᒧᑦ) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
11	20	21	7	0

[9] **ᐊᖏᖅᑎᑦ:** ᐊᐅᔨᑲᖅᓂᖅᓱᖃᓕᓚᑕᖅᑐᖅ ᑲᑎᒪᔨᐃᓐᓇᖅ ᐊᒻᒪᓗ ᐊᖓᔪᓚᓵᖅᑎᑦ ᐊᑐᓚᓂᓂᕆᐊᖅᑐᑎᒃ ᑲᑎᒪᔨᐃᓐᓇᖅ ᐱᖓᓱᓴᖓᓂ ᐊᖅᑭᒡᓕᑎᐊᓚᑦᑎᓂᖅᓂᖅᓯᓂᖅ, ᐃᓗᒪᑎᕐᓚᐅᖅ ᐊᖅᑭᒡᓕᑕᑲᑕᐅᔪᓂᑦ ᑕᐃᒃᓂ ᑲᑎᒪᔨᐃᓐᓇᖅ ᖃᓄᐅᓕᖅᑐᑦᓯᓚᐅᖅᓯᓂᖅᓂᖅᓯᓂᖅ (C.F.).

[10] **ᒪᓂᑦ:** ᑲᓂᖅᑐᑦ ᒪᓂᑦ ᑲᖏᑲᓗᐊᑦᓚᑲᓂᖅᑐᑦ ᐊᖓᔪᓂᐊᖅᑎᓂᑦ. ᑲᑎᒪᔨᐃᓐᓇᖅ 1 ᒪᓂᕆᖅᑕᒥᓂᕆᑦᒃ ᑲᖏᑲᓗᐊᑦᓚᑦᓯᓂᓗ ᐊᐱᓴᒪᑲᑦᓂᖅᓂᑦᒪᒃ ᐊᖓᔪᓂᐊᖅᑎᓂᑦ ᒪᓂᕆᖅᑕᒥᓂᕆᓂᖅᒃ. ᐊᓗᖅᑎᑦ ᒪᓂᑦ ᐱᓕᑲᐃᔨᐊᖅᑐᖅᑕᑦᑐᑦ ᑲᒧᐊᖓᔪᓚᑦ: ᒥᑎᑦ ᒪᓂᖅᑎᑦ ᐃᒥᖅᓯᑕᐃᓕᓚᐃᓪᓗᓗ. ᖃᓄᑦᓴᖅᓴᓂ ᐃᒥᖅᓯᑕᐃᓕᓚᐃᓪᓗᑦ ᐃᓕᑲᐃᔨᐊᖅᑐᖅᑐᖅᑐᑦ ᒪᓕᓐᓄᑦᒪᒃ ᐃᓐᓇᐅᑉᓯᓚᐅᖅᑐᖅᑐᑦ ᓇᐃᓕᓴᖅᑐᓂᒃ ᐊᐱᓴᒪᑲᑦᓂᖅᓂᑦᒪᒃ ᑲᑎᒪᔨᐃᓐᓇᖅ ᐊᖓᔪᓂᐊᖅᑎᓂᑦ ᑲᑎᒪᔨᐃᓐᓇᖅ ᐊᖓᔪᓂᐊᖅᑎᓂᑦ ᐊᑐᓚᓂᓂᕆᐊᖅᑐᑎᒃ ᑕᓪᓕᐅᓂᖅᓴᓂᖅᓯᓂᖅᓂᖅᓯᓂᖅ ᓄᓇᓕᒫᑦ ᐅᓂᖅᑐᑦ ᑕᒪᓐᓇᑦ ᒪᓕᓐᓄᑦᒪᒃᑕᓪᓕᐅᓂᖅᓯᓂᖅᑐᑦ ᑲᑎᒪᔨᐃᓐᓇᖅ ᐊᖓᔪᓂᐊᖅᑎᓂᑦ ᑲᑎᒪᔨᐃᓐᓇᖅ ᐊᖓᔪᓂᐊᖅᑎᓂᑦ ᐊᑐᓚᓂᓂᕆᐊᖅᑐᑎᒃᑲᑎᒪᔨᐃᓐᓇᖅ ᐊᖓᔪᓂᐊᖅᑎᓂᑦ ᑲᑎᒪᔨᐃᓐᓇᖅ ᐊᖓᔪᓂᐊᖅᑎᓂᑦ ᐊᑐᓚᓂᓂᕆᐊᖅᑐᑎᒃ (C.F.).

[11] **ᐃᖃᓗᐃᑦ:** ᐃᖃᓗᓕᑕᑲᑕᐅᔪᓂᒃ ᑲᑎᒪᔨᐃᓐᓇᖅ 1 ᐊᑦᑎᓗᐊᖅᑐᑐᖅᑐᑦ. ᐊᓯᖏᓐᓂᒃ ᑲᑎᒪᔨᐃᓐᓇᖅ ᐊᖓᔪᓂᐊᖅᑎᓂᑦ ᐊᑐᓚᓂᓂᕆᐊᖅᑐᑎᒃ (C.F.).

[12] **ᐅᑎᐃᑦ:** ᐅᑎᐃᑦ ᐱᓕᐅᒪᔨᓯᖏᓐᓇᖅᑐᑦ ᓯᓚᓯᓚᐅᑎᐃᒪᓕᒡᒪᒃ. ᐅᓇᓂᖅᓴᐃᑦ ᐅᑎᐃᑦ ᐱᓕᐅᔨᑦᑐᑦ ᑲᖏᑲᓗᐊᑦᓚᑦᓯᓂᖅᓂᖅᓯᓂᖅᓂᑦ ᖃᓄᑎᖅᓓᑲᐅᓚᐊᖅᓯᒪᔨᑦ ᐅᑎᖅᑕᒥᐊᔪᓂᓇᓕᒃ ᓇᓕᑎᖅᑕᒥᐅᓂᖅᓴᐃᑦ (C.F.).

[13] **ᐊᓯᒧᒪᔪᐃᑦ:** ᐃᓕᖏᑦ ᐊᖓᔪᓚᓯᓂᑦ ᐊᖅᖄᑲᐅᒪᓕᓚᑎᒃ ᐊᓯᒧᒪᔪᖅᑕᖃᓕᑕᖅᑐᓕᓚᖅᑐᑦ 1987ᒥᓂᑦ ᑕᕐᕋ ᐊᑦᑕᔭᒋᑦ ᐱᓕᐅᔨᑦᑐᖅᓴᓕᑦ. ᐊᓪᓕᓯᒪᔪᓂ ᑲᑎᒪᔨᐃᓐᓇᖅ 1 ᐊᒻᒪ 2 ᑲᖄᐅᓯᐅᖏᑕᒥᐅᓂᖅᑐᑦ ᐊᓯᒧᒪᔪᖅᑐᖃᖅᖢᓂᒃᑲᓇᑕᓯᓯᓚᐅᖅᑐᑦᓴᖅ. ᐊᓯᒧᒪᔪᖅᑕᒥᓂᔪᓂ ᑲᑎᒪᔨᐃᓐᓇᖅ 3 ᐊᒻᒪ 5 ᖃᓄᑎᖅᓓᑲᐅᓚᐊᖅᑐᑎᒃᑎᑦᓯᓚᐅᖅᑐᑦ (C.F.).

6.1.12 Nunanit Iniktigutait Ukauhiit: Qausuituq

Ihivgiuktit Atugutait:
Ihivgiufaakhimayut ataani nauyaiyagutaini nunani pulaakhimatitlugit takukhauyut ikitut umayukhiuktit titigakgaktauhimaitut Umayukhiukhimayut Ihivgiuktitlugit.

Ihivgiuktauhimayut ovalo kiuyuitut ihumagiyait:
Kihimi ikitut tatkikhiutit, kiuhimayut naunaiyautait angiyut tamaat ihivgiuktuni. Takulaaktuk ikpatauyami 9mi pikatainaktut kiuyuitut naunaiyautait Qausituqmi 2.7%kuyut ovalo ihumagingitait anginiaktut kiuyuitut naunaiyautaini.

Kiuhimayut naunaiyautait naamakhutik ovalo kiuyuitut ihumagiyait mikivlutik piyaami nni pihimanmata nakuuyumik uktugutaini Nni umayukhiuktini.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Tuhaktaitauhimayugut ilangit umayukhiuktit tuhaktitihimangitait nutakaminik umayukhimayainik. Umayukhiuktit tuhaktitihimayut ilaani ukakatigiyauyuitut ilaani tatkikhiutini. Hamna takulaaktuk utiktitihimayuni ukafaakhimayut ikpatauyuami. Hapkoa ikpatauyat takukhauyut amigaitut umayukhiukhimayut titigagutait katitikhimayut iluani pingahuni tatkikhiutini umayukhiukhimayut, ilaani tatkikhiutit ihivgiukhimayuni amigaikhimayut ilangani titigakhimayut utiktitihimayut ukafaakhimayut hitamanit siksinut tatkikhiutini. Kihimi hitamauyut tatkikhiutit ihivgiuktitlugit titigakhimayut utiktitihimayut ukakatigifaakhimayut avataanut siksinik tatkikhiutinik nalvaakhimayut. Ungahitkiat utiktitikhimayut ilangit tatkikhiutit piyunakhiyut ilangit atugutingit ihuinaakhimayut puigukhimavamata umayukhiuktit umayukhimayaminik. Umayukhiuktit ilaani ihumalikpaktut umayugunakhimayaminik ovalo ilaani ataanut pivagunakhiyut.

Tuhaktitihimayugut autlaktitihimatitlugu ihivgiuktut amigaitut umayukhiuktit nalugaluamata hunmat hamna ihivgiuktauliktuk ovalo ikhivlutik mikinikhaaliniaktut umayukhiuktaminik. Tuhaktititiayuitut tamamik umayuktaminik. Tamamik hapkoa ihumagiyait pipkaihimayut ataani tuhaktitihimayunik nunani umayukhimayut ovalo ihumaiyukhat taiguaktut atuligumik umayukhiukhimayut katitiguait hamani.

Nunanit ukakhimayut ovalo aalat pihimayaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukataktait nunaini haniani kikiktani tuktuit. HTOkut nutkaktitihimayait nunani umayukhiulugit ikitlikhimanmata 1994mi ovalo ilitagiyauhimayut hamanik. Taimaimat, amigaitjutait umayukhimayut mikiyut, piyumayaugaluakhutik. Nunanit akuiktukatakhimayut aalanit nunanit uyukhanik pigiagani nunamini. Umayukhiukhimayut ilauyut ilangit nunanit tuktut ovalo kikiktanit tuktut ilanganit nunainit ovalo naamaktut (C.F.).
2. **Umingmait:** Nunanit ihumayut kablunaat umayukhiukataktait titigakhimaitut umayukhiukhimayut ihivgiuktitlugit ilauyukhat uyuit atukatamagit, nigiyaukatakhutik nunami (C.F.). Ilangit ukiuni umayukhiuktaktut mikiyut, ilangit naamaktut atuktakhanik umayukhiuktaktainik. DSDkut tuhaktitihimayait hapkoa atuktakhainik umayukhiukhimayut amigaitjutait umingmait (DSD Mxa):

96/97	97/98	98/99	99/00	00/01
16	n/d	14	7	6

3. **Nanuit:** Amigaitjutait takuhimayut naunaiyautikafungitut kihimi pivaktait umayukhiukhimayut amigaitjutait tunihimayut DSDkunit (DSD PB).
4. **Tigiganiat:** Umayukhiukhimayut naunaiyautait ukiumi 3 ovalo 4 mikiyut. Angitkiyat naunaiyautait ukiumi 5 naamaktut amiit akiit angiyuugaluamata ukiungani. (C.F.).
5. **Tagiumi Umayut:** Umayukhiuktit tuhaktitihimayut ukiumi 3, kangikhuk angmaumainamat ovalo nakuuyuk umayukhiugiami. Ukiumi 1 ovalo 2 hikukainamat umayukhiutiangitut. Hamna ikpinagutaa ukakhimayut tamamik aiviikhiugutini ovalo kilalugakhiugutini (C.F.).
6. **Akviit:** Akukakhimataaktuk, aiviit ikitpaktut ilangini ukiuni hikukainamat. Umayukhiukhimayut naunaiyautait angivaktut ukiumi 1 kihimi naamaktut ilangini ukiuni (C.F.).
7. **Tuugaat:** Ukiuk tamaat kotangit 32kuyut umayut. Tamakmiikatangitut ukiuk tamaat kihimi umayukhiukhimayut naunaiyautait ukiumi 1, 2, 3 ovalo 5 mikiyut. (C.F.). DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut naunaiyautait tuugaaliit kilalugait (nalungilutit DFOkut katitikhimayait atukhimayut ukiungit iniktigaagata, Umayukhiukhimayut Ihivgiuktut katitigutait umayukhiukhimayunik ukiugini atukpanmata Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
2	7	9	1	12

[8] **Kilalugait:** Umayukhiukhimayut naunaiyautait ukiumi 1 mikiyut. Naunaiyautait aipaini ukiuni naamaktut (C.F.). DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut naunaiyautait kilaluganik (nalungilutit DFOkut katitikhimayait atukhimayut ukiungit iniktigaagata, Umayukhiukhimayut Ihivgiuktut katitigutait umayukhiukhimayunik ukiugini atukpanmata Junemit Maymut) (DFO N/B/):

96/97	97/98	98/99	99/00	00/01
11	20	21	7	0

[9] **Akilgiit:** Aalatkiiginaktut akilgikataktait ukiuni ukiunut ovalo umayukhiuktit ukakpaktut ukiumi 3 akilgikhiukluangitut, kihimi umayukhiukhimayut naunaiyautait talvani ukiumi mikiyut (C.F.).

[10] **Maniit:** Amigaitut maniit tuhaktitihimaitut umayukhiuktinit. Ukiumi 1, manikhiukhimayut tuhaktitiyaungitut umayukhiuktit apigiyaungimata manikhiukhimayainik. Manikhiukataktait amigaitunik hapkoa: mitiit maniit ovalo imitkutailat maniit. Imitkutailat amigaimata nunamini haniani inuulgamiit manikhiulikpaktainik. Nutakat titigaktauhimaimata ihivgiuktitlugit ovalo angayukaagit tuhaktitihimangitait, amigaitut maniit tuhaktitiyauhimaitut (C.F.).

[11] **Ikaliviit:** Umayukhiukhimayut naunaiyautait ukiumi 1 mikiyut. Naunaiyautait aipaini ukiuni naamaktut (C.F.).

[12] **Ugat:** Ugait umayukhiukataktait hinaanungagaagata. Amigaitut hapkoa ikaluit tuhaktitiyauhimaitut talvuuna umayukhiukhimayait mikiyut (C.F.).

[13] **Uviluit:** Ilangit umayukhiuktit imamik naluuyakatakhutik uvilukhiukataktut 1987mit, taimaimat uvilukataktut tamamik ukiuni. Katitikhimayut ukiuni 1 ovalo 2 tuhaktitihimayut uvilikhiungitut ihuinaakhimayutut ituk. Umayukhiukhimayut naunaiyautait ukiumi 3 ovalo 5 mikiyut (C.F.).

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 291

Monthly harvest estimates
ᑕᖅᑕᒪᒃ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᑦᔪᒍ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᑎᑎ	SEP ᓱᑎᐱᕆ	OCT ᐅᑦᑐᕆ	NOV ᓄᐃᑦᕆ	DEC ᑎᓯᑦᕆ	JAN ᒍᖏᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᓯ	APR ᐃᑦᓇᓪ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut		6			17	6		3					32 ± 10
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡									19	6			25
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat						9			34				43 ± 44
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓕᓴᓂᐊᑦ	Kalaliit tigiganiat						5		1					6 ± 3
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik	3												3 ± 4
Ringed seal	ᓇᕆᔨᑦ	Natiinat	31	37	33	173	41	20	24	70	139	103	63	38	772 ± 194
Bearded seal	ᐅᓗᔪᐃᑦ	Ukyuk		3	7	12	7	1		1	4	1	3		39 ± 21
Walrus	ᐊᐃᐃᓴᑦ	Akvik					2								2 ± 2
Beluga	ᖃᐅᔨᑦ ᖁᓪᓗᓴᑦ	Kilalugak		6	2	4									12 ± 9
Snow goose	ᑲᖏᒍᐃᑦ	Kanguq	11			13	11						4	177	216 ± 107
Canada goose	ᓂᔨᓪᓚᑦ	Nikliknik	289	273	265	10	7						35	551	1,430 ± 365
Old squaw	ᐋᕿᐊᔨᔪᐃᑦ	Aahangik	5		14		90	6			2	28			145 ± 58
Eider duck	ᑎᑎᑦ	Kingalik	111	120	38	50	323	230	10	22	3	13	14	3	937 ± 148
Tundra swan	ᖃᓗᔪᐃᑦ	Kukyuk					1								1 ± 1
Common merganser	ᑲᐅᓴᑦ	Nuyaralik	2	29	16	9	5								61 ± 28
Black scoter	ᐱᕐᐅᔨᓪᓴᑦ	Black scoter					5								5 ± 4
Common loon	ᑐᑦᓚᓪᓚᑦ	Tuulik			2										2 ± 2
Arctic loon	ᑲᑦᓗᓪᓚᑦ	Maliriq			4										4 ± 5
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq				4									4 ± 7
Black guillemot	ᐱᕐᐅᔨᓪᓚᑦ	Black guillemot			38										38 ± 57
Ptarmigan	ᐊᒃᓯᑦ	Akilgik					6				4	7	11	2	30 ± 15
Goose eggs	ᑲᖏᐃᑦ ᓚᑦᓂᕐᑦ	Uluaguliit manniit	44	139										8	191 ± 166
Duck eggs	ᑎᑎᑦ ᓚᑦᓂᕐᑦ	Tinmiat manniit	26	208	23										257 ± 156
Tundra swan eggs	ᖃᓗᔪᐃᑦ ᓚᑦᓂᕐᑦ	Kukyut manniit		2											2 ± 2
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᑦᓂᕐᑦ	Nauyat manniit		35											35 ± 42
Arctic char	ᐃᖏᓄᐸᑦ	Ikaliviit	1,080	1,560	1,817	1,417	81	236				187	672	1,974	9,024 ± 2,160
Whitefish	ᑲᐱᓯᓪᓚᑦ	Kapihiliit						22						2	24 ± 22
Cod	ᐅᓗᐃᑦ	Ugak		9	62	255	173	2			213	16			730 ± 387
Sculpin	ᑲᓪᔪᐃᑦ	Kanayuk	59	69	182	240	66							13	629 ± 362
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet									846	3,614	194		4,654 ± 3,834

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᑦᓄᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᓯᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓚᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 292

Monthly hunter response

ᑕᖃᑕᒪᑦ ᒪᖏᐃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᑦᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑲᐅᓗ	NOV ᐃᓄᒃᓗ	DEC ᑎᓯᕐᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᔨᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓚᓂᖅᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔨᓪᓚᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒪᑦ ᒪᖏᐃᑎᑦ	Tatkitaman angunahuktut titigait	123	129	129	129	130	131	130	130	129	129	130	130	133*
Hunters interviewed	ᒪᖏᐃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	76	90	70	33	107	112	121	121	78	83	86	78	132*
Harvested	ᒪᖏᐃᒃᑐᓂᓚᑦ	Angujaujut	47	37	27	14	30	13	4	8	15	15	27	36	103*
Response Rate (%)	ᑭᐅᔭ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	62	70	54	26	82	85	93	93	60	64	66	60	68**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓂᖅᑎᑦ ᐊᑎᓕᐅᖅᑕᒪᓐᓇᖅᑐᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᓚᓂᖅᑐᑐᒃᓴᑦ ᐊᑕᐅᓂᐊᖅᓯᒪᔪᑎᑦ ᐊᑦᔪᒍ.
** ᐊᑦᔨᒋᓕᕐᓂᒪᓚᐅᑦ ᑕᖃᑕᒪᑦ ᑭᐅᔭᑦ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 293

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓂᓂᑦ ᒪᖏᐃᓐᓂᖏᑦ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑐᐅᓂᖏᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓖ % ᑲᑎᑦᑐᑦ ᒪᖏᐃᑦ ᑎᑎᕐᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᑦᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑲᐅᓗ	NOV ᐃᓄᒃᓗ	DEC ᑎᓯᕐᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᔨᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	100	100	90	98	100	100	67	71	0	5	99	100	90
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	0	10	2	0	0	33	29	100	95	1	0	10
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 294

Number of hunters harvesting each species — **Year 1 (June 1996 - May 1997)**

ᖃᑦᓯᐅᓂᖏᑦ ᒪᖃᐃᑎᑦ ᐊᖏᔪᓇᓯᕐᓴᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ — **ᐊᑦᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 1 (June 1996 - May 1997)**

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᔅᑎᑎ	SEP ᓯᑎᐱᕆ	OCT ᐅᑦᔪᕆ	NOV ᐅᓇᐱᕆ	DEC ᑎᓯᐱᕆ	JAN ᒍᖏᓇᕆ	FEB ᓇᖕᐅᐊᕆ	MAR ᒪᓯ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut		1			6	3		1					10
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓕᖏᓂᐊᑦ	Tigiganiat						1			1				2
Coloured fox	ᖃᐅᖕᖏᑦᑐᑦ ᑎᓕᖏᓂᐊᑦ	Kalaliit tigiganiat						3		1					4
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik	1												1
Ringed seal	ᓇᕆᔨᑦ	Natiinat	7	8	8	8	11	3	4	8	12	13	7	8	49
Bearded seal	ᐅᑭᔪᐃᑦ	Ukyuk		2	1	2	3	1		1	1	1	1		9
Walrus	ᐊᐃᐃᓴᑦ	Akvik					2								2
Beluga	ᖃᐅᖅᑕᑦ ᖃᓪᓚᓕᑦ	Kilalugak		2	1	1									3
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq	2			2	3						1	13	18
Canada goose	ᓂᖅᓚᑦ	Nikliknik	18	10	12	1	1						5	23	51
Old squaw	ᐊᒻᒪᐊᖅᐃᐃᑦ	Aahangik	1		2		9	2			1	1			14
Eider duck	ᑎᑎᑦ	Kingalik	6	9	4	3	18	9	1	1	1	2	1	1	38
Tundra swan	ᖃᓗᐃᐃᑦ	Kukyuk					1								1
Common merganser	ᑲᔪᓐᓇᑦ	Nuyaralik	1	4	3	2	2								10
Black scoter	ᐱᒋᐅᓪᓴᖅᑕᑦ	Black scoter					1								1
Common loon	ᑐᑦᓚᓂᑦ	Tuulik			1										1
Arctic loon	ᑲᑦᓗᓚᓂᑦ	Maliriq			2										2
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq				1									1
Black guillemot	ᐱᒋᐅᓪᓴᑦ	Black guillemot			1										1
Ptarmigan	ᐊᒋᓴᑦ	Akilgik					2				1	1	4	1	8
Goose eggs	ᑲᖏᔪᐃᑦ ᒪᑦᓂᖏᑦ	Uluaguliit manniit	1	2										1	4
Duck eggs	ᑎᑎᑦ ᒪᑦᓂᖏᑦ	Tinmiat manniit	1	3	1										5
Tundra swan eggs	ᖃᓗᐃᐃᑦ ᒪᑦᓂᖏᑦ	Kukyut manniit		1											1
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᑦᓂᖏᑦ	Nauyat manniit		1											1
Arctic char	ᐃᖅᓗᓴᐱᑦ	Ikaliviit	35	25	18	8	3	7				1	18	26	80
Whitefish	ᑲᐱᓯᓂᑦ	Kapihiliit						1						1	2
Cod	ᐅᓴᐃᑦ	Ugak		2	7	4	10	1			2	1			21
Sculpin	ᑲᓇᐃᐃᑦ	Kanayuk	6	4	6	2	4							1	22
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet									1	2	2		3

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔨᓂᖅ ᐱᑕᖃᖕᖏᑦᑐᖃ ᐱᓕᔨᑎᓕᓂᖅ ᐊᖏᔪᑦ ᖃᕋᐅᓂᖏᖕᓂᓄᑦ ᐊᓕᔪᖅᓄᑦ ᓇᓕᐅᖏᓐᓂᒃᑯᑦ ᐊᐅᔪᓂᑦ ᓇᓕᑭᖏᑦᑐᖅᓂᒃ ᑐᓴᐅᒪᔪᖅᓂᒃ ᐃᓕᓴᕐᓂᐊᓕᕆᔨᒃᑯᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 295

Monthly harvest estimates
ᑕᖅᑕᒫᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓱᓂᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᑦᓯᔪ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᓄᐃᑦᐱᓗ	DEC ᑎᓯᐱᓗ	JAN ᔮᖏᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᓯ	APR ᐃᓴᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut							1		21				22 ± 7
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡									1	23			24
Arctic fox	ᑎᓕᓴᒃᓂᐊᑦ	Tigiganiat					2	29	21	32	2	5	5		96 ± 13
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓕᓴᒃᓂᐊᑦ	Kalaliit tigiganiat			7	1	15	44	12	6	1	2			88 ± 18
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik				1		10		1	2	3			17 ± 5
Ringed seal	ᓇᕆᑦ	Natiinat	19	28	116	123	83	85	77	225	119	153	95	101	1,224 ± 84
Bearded seal	ᐅᑉᔪᐃᑦ	Ukyuk			4	2	1			3	4			3	17 ± 3
Walrus	ᐊᐃᐃᓵᑦ	Akvik					2								2 ± 2
Beluga	ᖃᐅᔨᑦᑐ ᖃᓪᓗᓂᑦ	Kilalugak	8	9	3		2							25	47 ± 13
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq	28			185	17							104	334 ± 53
Canada goose	ᓂᔨᓪᓚᑦ	Nikliknik	137	344	184	178	9						203	1,314	2,369 ± 247
Brant goose	ᓂᓪᓕᔨᓇᐃᑦ	Nirlirnaq	4			63	4								71 ± 28
Old squaw	ᐊᑭᐊᔨᔪᐃᑦ	Aahangik			7		43	17		14	13				94 ± 20
Mallard	ᒥᑎᓴᖅ	Mitik												1	1 ± 1
Eider duck	ᒥᑎᑦ	Kingalik	55	211	35	64	461	737	475	194	74	17	82	85	2,490 ± 248
Common merganser	ᕿᐃᖅ	Nuyaralik			119	19	12								150 ± 42
Red breasted merganser	ᑲᐳᔨᑦ	Red breasted merganser			1										1 ± 1
Scaup (unspecified)	ᓭᑲᑦ	Scaup		1											1 ± 2
Black scoter	ᐱᑦᓭᐅᓴᑦᕿᐃᑦ	Black scoter			1	7									8 ± 5
Common loon	ᑐᑦᓕᖅ	Tuulik				1									1 ± 1
Arctic loon	ᑲᑦᑐᓴᓪᑲᒃ	Maliriq					1								1 ± 1
Red-throated loon	ᖃᖅᓚᐅᑦ	Qaqhuaq	8	1											9 ± 8
Yellow-billed loon	ᑐᑦᓕᓪᔨᐊᖅ	Tuulik		2										1	3 ± 2
Black guillemot	ᐱᑦᓭᐅᓴᑦ	Black guillemot		164		9									173 ± 237
Ptarmigan	ᐊᖏᓕᑦ	Akilgik	2					9	4	5	13	46	60	25	164 ± 39
Snowy owl	ᐅᑲᐱᔨᐊᑦ	Ookpik								2					2 ± 0
Goose eggs	ᑲᖏᔪᐃᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit	9											411	420 ± 92
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	47	173	79										299 ± 159
Seagull eggs	ᓇᐅᐳᐃᑦ ᒪᓕᓂᖏᑦ	Nauyat manniit		83											83 ± 94
Black guillemot eggs	ᐱᑦᓭᐅᓴᑦ ᒪᓕᓂᖏᑦ	Black guillemot eggs		12											12 ± 13
Eider down∅	ᒥᑎᑦ ᖁᓂᓀᖏᑦ∅	Mitiit qiviungit∅		233											233 ± 227
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	671	1,657	1,279	698	419	933	1,421	86	114	236	1,057	1,880	10,451 ± 1,008
Whitefish	ᑲᐱᓯᓪᓚᑦ	Kapihiliit				20	75	49	405	2					551 ± 283
Cod	ᐅᒪᐃᑦ	Ugak			92	71	7	24	30	335	368	215	29	18	1,189 ± 148
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk		31	159	4	12		1					20	227 ± 72
Clams	ᐊᒻᒧᒪᔪᑦ	Uviluq			19	603	295								917 ± 572
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet						345				186	307		838 ± 500

‡ Polar bear data supplied by DSD.
∅ Number of nests harvested.

‡ ᓇᓄᑦᓂᑦ ᑎᑎᕋᑕᒪᔪᑦ ᑐᓂᒃᖏᑦ ᐅᑉᐳᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓚᕆᑦ.
∅ ᖃᕋᐅᓂᖏᑦ ᐱᑭᐅᑦ ᓄᐊᑕᐅᔪᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.
∅ Amigaitiginit maniktagauhimajut.

TABLE/ᓇᓗᓇᐃᔨᐅᐅᑦ/NAUNAIKUTA 296

Monthly hunter response
ᑕᖃᑕᒪᑦ ᒪᖏᐃᑎᑦ ᑭᐅᓂᖅᑎᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᑦᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᕕ	OCT ᐅᑯᕕ	NOV ᐃᓄᒃᕕ	DEC ᑎᓯᕕ	JAN ᔮᓐᓄᐊᓕ	FEB ᐃᖃᑯᐊᓕ	MAR ᒪᕐᓂ	APR ᐃᓴᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᖅ Tamakiklugin
Hunter Response Categories	ᐊᖏᓚᓂᖅᑎᑦ ᑭᐅᓂᖅᑕᑦ ᐊᑎᓯᒪᓂᖅᑕᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒪᑦ ᒪᖏᐃᑎᑦ	Tatkitaman angunahuktut titigait	130	148	148	148	148	148	149	155	155	155	156	154	155*
Hunters interviewed	ᒪᖏᐃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	80	99	128	125	132	130	129	153	148	109	111	146	154*
Harvested	ᒪᖏᐃᒃᑐᓂᓕᓂᑦ	Angujaujut	28	38	49	48	39	46	33	56	43	34	44	86	115*
Response Rate (%)	ᑭᐅᔪᓂ ᖃᕐᓂᐅᓂᖅᑕᑦ (%)	Kiujut (%)	62	67	86	84	89	88	87	99	95	70	71	95	83**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓂᖅᑎᑦ ᐊᑎᓕᐅᖅᑕᒪᔨᑦ/ᐊᐱᕐᓂᑦᑕᒪᔨᑦ/ᐊᖏᓚᓂᖅᑐᑦᓂᓕᓂᑦ ᐊᑕᐅᓯᐊᖃᓗᑎᒃ ᐊᑦᖁᒍ.
** ᐊᑦᓴᒋᓕᑎᓯᒪᔨᑦ ᑕᖃᑕᒪᑦ ᑭᐅᔪᓂ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᐅᑦ/NAUNAIKUTA 297

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᖏᓂ ᒪᖏᐃᒡᓗᓂᒃᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓂᒃᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑎᓂᖅ ᒪᖏᐃᑦ ᑎᑎᕐᑦᑕᐅᒪᔨᔨᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)
ᐊᑦᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᕕ	OCT ᐅᑯᕕ	NOV ᐃᓄᒃᕕ	DEC ᑎᓯᕕ	JAN ᔮᓐᓄᐊᓕ	FEB ᐃᖃᑯᐊᓕ	MAR ᒪᕐᓂ	APR ᐃᓴᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᖅ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑭᑦ	≤ tatkin pingahut	100	100	26	4	55	98	100	100	100	92	100	37	67
4-6 months	4-6 ᑕᖅᑭᑦ	tatkin hitaman 6nut	0	0	61	96	37	2	0	0	0	8	0	61	30
> 6 months	> 6 ᑕᖅᑭᑦ	> 6 tatkin	0	0	13	0	8	0	0	0	0	0	0	2	3

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 298

Number of hunters harvesting each species
ᖃᑦᕿᐅᓂᖏᑦ ᒪᖃᐃᑎᑦ ᐊᖏᔪᓇᓯᕐᓴᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 2 (June 1997 - May 1998)
ᐊᑦᓱᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᑦᔪᑎ	SEP ᓯᑎᐱᓗᓂ	OCT ᐅᑦᔪᓗᓂ	NOV ᓄᐃᑦᐱᓗᓂ	DEC ᑎᓯᑦᐱᓗᓂ	JAN ᔮᓐᓄᐊᓗᓂ	FEB ᓄᖅᑐᐊᓗᓂ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᔭᑦᑐᐃᑦ	Tuktut							1		6				6
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓚᖓᓂᐊᑦ	Tigiganiat					1	11	8	9	2	1	1		24
Coloured fox	ᖃᓄᖕᖏᑦᑐᑦ ᑎᓚᖓᓂᐊᑦ	Kalaliit tigiganiat			1	1	4	10	4	1	1	1			15
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				1		4		1	2	2			9
Ringed seal	ᓇᕆᔨᑦ	Natiinat	4	6	23	18	15	17	16	46	26	23	18	22	65
Bearded seal	ᐅᓪᔪᐃᑦ	Ukyuk			4	2	1			3	4			1	11
Walrus	ᐊᐃᐃᓴᑦ	Akvik					1								1
Beluga	ᖃᐅᔨᑦᑕ ᖁᓪᓗᓚᑦ	Kilalugak	3	2	2		1							8	12
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq	3			16	2							19	33
Canada goose	ᓂᔨᓪᑦ	Nikliknik	12	9	11	17	2						18	58	76
Brant goose	ᓂᓪᓕᔨᓇᐃᑦ	Nirlirnaq	1			4	1								5
Old squaw	ᐊᑭᐊᖅᔪᐃᑦ	Aahangik			1		4	3		2	3				13
Mallard	ᒥᑎᓪᖃᖅ	Mitik												1	1
Eider duck	ᒥᑎᑦ	Kingalik	4	10	8	9	28	31	13	12	10	3	5	9	61
Common merganser	ᐸᐃᖅ	Nuyaralik			12	3	5								17
Red breasted merganser	ᑲᐳᔨᑦ	Red breasted merganser			1										1
Scaup (unspecified)	ᓭᑲᑦ	Scaup (unspecified)		1											1
Black scoter	ᐱᑦᓭᐅᓪᓚᐃᑦ	Black scoter			1	2									3
Common loon	ᑐᑦᓕᖅ	Tuulik				1									1
Arctic loon	ᑲᑦᒐᓪᓗᒃ	Maliriq					1								1
Red-throated loon	ᖃᖅᓴᐅᑦ	Qaqhuaq	2	1											2
Yellow-billed loon	ᑐᑦᓕᓪᔪᐊᖅ	Tuulik		2										1	3
Black guillemot	ᐱᑦᓭᐅᓪᓚᑦ	Black guillemot		1		1									2
Ptarmigan	ᐊᕐᓱᑦ	Akilgik	1					3	4	2	5	9	9	6	24
Snowy owl	ᐅᑲᐱᔪᐊᑦ	Ookpik								2					2
Goose eggs	ᑲᖏᔪᐃᑦ ᒪᓂᓂᖓᑦ	Uluaguliit manniit	1											17	18
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᖓᑦ	Tinmiat manniit	1	5	1										7
Seagull eggs	ᓇᐅᒃᐃᑦ ᒪᓂᓂᖓᑦ	Nauyat manniit		2											2
Black guillemot eggs	ᐱᑦᓭᐅᓪᓚᑦ ᒪᓂᓂᖓᑦ	Black guillemot eggs		1											1
Eider down	ᒥᑎᑦ ᖁᓂᓀᖓᑦ	Mitiit qiviungit		2											2
Arctic char	ᐃᖃᓗᑲᐱᑦ	Ikaliviit	20	26	29	22	10	15	15	2	2	5	26	58	93
Whitefish	ᑲᐱᓯᓪᓚᑦ	Kapihiliit				2	2	3	3	1					5
Cod	ᐅᓘᐃᑦ	Ugak			5	5	3	2	3	15	8	8	2	2	33
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk		2	5	2	1		1					2	12
Clams	ᐊᒻᒧᒪᔪᑦ	Uviluq			1	1	1								2
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet						1				1	1		2

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓪᒪᔪᓂᒃ ᐱᕕᖃᖏᑐᖅ ᐱᓪᔪᑎᓕᓂᒃ ᐊᖏᔪᑦ ᖃᕋᓴᓕᖏᓂᓄᑦ ᐊᓪᓚᓂᒃ ᓇᓕᓴᒪᒪᓪᓕᔪᓂᒃ ᐊᖏᔪᓂᒃ ᓇᓄᐃᑦᑐᓕᖏᓂᒃ ᑐᓂᓯᔪᓐᓇᖅᑐᑦ ᐃᓄᐃᑦᑕᓕᕆᓂᖅ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 299

Monthly harvest estimates
ᑕᖅᑕᒪᒃ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓱᓕᑎᑦ
Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᑦᔪᒍ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᐹᓗᓂ	OCT ᐅᑦᔪᓗᓂ	NOV ᐅᓇᕆᓗᓂ	DEC ᑎᓯᓗᓂ	JAN ᔮᖏᓄᐊᓗᓂ	FEB ᓇᖕᖏᐊᓗᓂ	MAR ᒪᓕᓴ	APR ᐃᓕᓴᕐ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᔭᑐᐃᐃᑦ	Tuktut				5			12		19	2			38 ± 6
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡										25			25
Arctic fox	ᑎᓗᓚᖏᓂᐊᑦ	Tigiganiat					1	7	6	2	13	1	2		32 ± 4
Coloured fox	ᖃᐅᖏᑦᑐᑦ ᑎᓗᓚᖏᓂᐊᑦ	Kalaliit tigiganiat				1	8	1	4	4	19	5			42 ± 5
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik				4	8	2		7	3	5	7	1	37 ± 4
Ringed seal	ᓇᓱᓕ	Natiinat	46	60	68	65	79	148	58	121	93	70	74	27	909 ± 36
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk		1	6	9	8	1	3	7	16	4			55 ± 7
Walrus	ᐊᐃᐃᓴᑦ	Akvik	1			14	5								20 ± 6
Beluga	ᖃᐅᓂᑦ ᖁᓪᓗᓚᑦ	Kilalugak	14	5	6	3	1							2	31 ± 5
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq	4		4	140	92						1	132	373 ± 48
Canada goose	ᓂᓴᓪᓚᑦ	Nikliknik	218	481	112	201	31						151	955	2,149 ± 177
Brant goose	ᓂᓪᓕᓴᓇᐃᑦ	Nirlirnaq				20	19								39 ± 14
Old squaw	ᐊᑭᕈᓐᓇᐃᑦ	Aahangik					39	28		1		26		3	97 ± 13
Eider duck	ᒥᑎᑦ	Kingalik	124	70	24	170	624	1,481	499	144	186	108	1	25	3,456 ± 156
Tundra swan	ᖁᓚᐊᐃᑦ	Kukyuk			6	1									7 ± 4
Common merganser	ᐸᐃᑦ	Nuyaralik	2	21		11	10	19						1	64 ± 9
Red breasted merganser	ᑲᐅᔨᔪᑦ	Red breasted merganser	1	14	1										16 ± 6
Black scoter	ᐱᓕᕆᐅᓪᓗᐃᐃᑦ	Black scoter		7		5									12 ± 4
White-winged scoter	ᖃᐅᓕᓂᒃ ᐃᓕᓴᖅᓚᖅ ᐱᓕᕆᐅᓪᓗᒃ	White-winged scoter					3								3 ± 2
Arctic loon	ᔭᑦᓂᖅ	Maliriq			1										1 ± 0
Red-throated loon	ᖃᖅᓗᐅᑦ	Qaqhuaq	1												1 ± 1
Yellow-billed loon	ᔭᑦᓂᓪᔪᐊᖅ	Tuulik		1											1 ± 1
Ptarmigan	ᐊᕕᒃᓱᑦ	Akilgik		4			10	30	33	79	15	114	123	3	411 ± 26
Goose eggs	ᑲᖏᔪᐃᑦ ᓚᒃᓂᕐᑦ	Uluaguliit manniit	409										8	905	1,322 ± 279
Duck eggs	ᒥᑎᑦ ᓚᒃᓂᕐᑦ	Tinmiat manniit	258	62									15		335 ± 106
Seagull eggs	ᓇᐅᐳᐃᑦ ᓚᒃᓂᕐᑦ	Nauyat manniit		249										13	262 ± 83
Thick-billed murre eggs	ᐊᑦᐸᐃᑦ ᓚᒃᓂᕐᑦ	Thick-billed murre eggs		35											35 ± 20
Black guillemot eggs	ᐱᓕᕆᐅᓪᓗᓂ ᓚᒃᓂᕐᑦ	Black guillemot eggs		610											610 ± 333
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	1,344	1,493	1,202	370	182	406	1,093	127	51	924	1,657	1,394	10,243 ± 473
Whitefish	ᑲᐱᕆᓪᓚᑦ	Kapihiliit					5	119	87	20			1		232 ± 44
Cod	ᐅᓘᐃᑦ	Ugak	11	12	9	66	157	64	4	9	21	33	382	1	769 ± 104
Sculpin	ᑲᓇᓚᐃᑦ	Kanayuk	1	65	24	6	26	117		2		10	21	53	325 ± 47
Mussels	ᑲᐱᕆᓪᓚᑦ	Uviluvaloet						2,547	100	14,141	22,619	2,958	11,044	174	53,583 ± 7,209

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᓐᓂᑦ ᑎᑎᕋᐅᒪᓚᓕᑦ ᑐᓂᒃᑯᑦ ᐅᑯᐊ ᐃᑯᐱᕋᓕᓂᓱᓐᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 300

Monthly hunter response

ᑕᖃᑦᑕᒪᑦ ᓚᖏᐃᔪᑦ ᑭᐅᓂᖅᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᓐᓴᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᐱᓗ	OCT ᐅᑦᑐᐱᓗ	NOV ᐅᐊᓚᕐᐱᓗ	DEC ᑎᓯᕐᐱᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᔪ	APR ᐃᑦᓇᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓚᓂᖅᑎᑦ ᑭᐅᓂᖅᑎᑦ ᐊᑐᔪᒪᓂᖅᑎᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᑕᒪᑦ ᓚᖏᐃᔪᑦ	Tatkitaman angunahuktut titigait	154	154	154	154	153	153	152	150	151	156	153	153	159*
Hunters interviewed	ᓚᖏᐃᔪᑦ ᐊᐱᕐᓂᖅᑕᑦ	Angunahuktin apikhuktan	141	145	145	144	144	149	147	149	146	145	142	133	157*
Harvested	ᓚᖏᐃᓕᒥᓂᓪᓕᑦ	Angujaujut	59	55	45	57	54	75	56	48	46	53	94	91	134*
Response Rate (%)	ᑭᐅᔭᑦ ᖃᓄᐅᓂᖅᑎᑦ (%)	Kiujut (%)	92	94	94	94	94	97	97	99	97	93	93	87	94**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓂᖅᑎᑦ ᐊᑎᓕᐅᑉᓯᒪᓕᕆᓂᖅ/ᐊᐱᕐᓂᖅᑕᑦ/ᐊᖏᓚᓂᖅᑐᒥᓂᓪᓕᑦ ᐊᑕᐅᓯᐊᖃᓕᕆᑎᒃ ᐊᓐᓴᒍ.
** ᐊᐅᔨᓂᓕᑎᓯᒪᓕᕐᓂᑦ ᑕᖃᑦᑕᒪᑦ ᑭᐅᔭᑦ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 301

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓂᓂᖅᑐᑦ ᐊᓚᓗ ᐊᐱᕐᓂᑕᐅᓂᖅᑐᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᓚᖏᐃᑦᑐᑦ ᑎᑎᕐᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐊᓐᓴᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᐱᓗ	OCT ᐅᑦᑐᐱᓗ	NOV ᐅᐊᓚᕐᐱᓗ	DEC ᑎᓯᕐᐱᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᔪ	APR ᐃᑦᓇᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔪᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	7	11	100	100	100	100	100	97	100	100	100	100	86
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	93	89	0	0	0	0	0	3	0	0	0	0	14
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 302

Number of hunters harvesting each species
ᖃᑦᕿᐅᓂᖏᑦ ᓚᖅᐃᑎᑦ ᐊᖏᔪᓇᓱᕐᓴᑦ ᐊᑐᓂᒃ ᐅᓚᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 3 (June 1998 - May 1999)
ᐊᒃᑭᒍ 3 (ᔪᓂ 1998 - ᓚᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᐸᓗᓂ	OCT ᐅᑦᑐᓗᓂ	NOV ᐅᓇᐸᓗᓂ	DEC ᑎᓯᓗᓂ	JAN ᔮᖅᓇᐊᓗᓂ	FEB ᓇᖕᖏᐊᓗᓂ	MAR ᒪᕐᓯ	APR ᐃᑦᓂᓚ	MAY ᓚᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut				3			3		4	2			11
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓗᓕᖅᓂᐊᑦ	Tigiganiat					1	4	5	2	4	1	2		14
Coloured fox	ᖃᓄᖕᖏᑦᑐᑦ ᑎᓗᓕᖅᓂᐊᑦ	Kalaliit tigiganiat				1	2	1	3	4	6	5			12
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				2	3	2		5	3	4	4	1	16
Ringed seal	ᓇᕆᔨᑦ	Natiinat	14	17	17	21	24	29	17	31	28	22	20	15	66
Bearded seal	ᐅᓪᔪᐃᑦ	Ukyuk		1	3	4	6	1	2	6	4	4			19
Walrus	ᐊᐃᐃᓴᑦ	Akvik	1			2	1								4
Beluga	ᖃᓄᖅᑕᑦ ᖁᓪᓗᓚᑦ	Kilalugak	7	3	4	2	1							2	14
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq	2		1	20	10						1	22	40
Canada goose	ᓂᖅᓪᓚᑦ	Nikliknik	24	24	14	22	5						32	47	80
Brant goose	ᓂᖅᓕᖅᓇᐃᑦ	Nirlirnaq				3	1								4
Old squaw	ᐊᑭᑲᖅᔪᐃᑦ	Aahangik					6	7		1		3		1	17
Eider duck	ᒥᑎᑦ	Kingalik	14	9	4	15	43	57	26	16	14	12	1	6	71
Tundra swan	ᖃᓚᔪᐃᑦ	Kukyuk			1	1									1
Common merganser	ᕿᐃᑦ	Nuyaralik	1	5		3	3	5						1	16
Red breasted merganser	ᑲᐅᔨᓴᑦ	Red breasted merganser	1	1	1										2
Black scoter	ᐱᖏᐅᓭᖅᕿᐃᑦ	Black scoter		2		1									3
White-winged scoter	ᖃᓄᖏᓕᓂᒃ ᐃᓕᓴᖃᓗ ᐱᖏᐅᓭᓂᒃ	White-winged scoter					1								1
Arctic loon	ᑐᑦᓕᓐ	Maliriq			1										1
Red-throated loon	ᖃᓐᓇᐅᑦ	Qaqhuaq	1												1
Yellow-billed loon	ᑐᑦᓕᖅᔪᐊᓐ	Tuulik		1											1
Ptarmigan	ᐊᕐᓂᑦ	Akilgik		1			4	6	11	17	7	18	19	2	45
Goose eggs	ᑲᖏᐃᑦ ᓚᓐᓇᕐᑦ	Uluaguliit manniit	4										3	26	29
Duck eggs	ᒥᑎᑦ ᓚᓐᓇᕐᑦ	Tinmiat manniit	2	3									1		6
Seagull eggs	ᓇᐅᐅᐃᑦ ᓚᓐᓇᕐᑦ	Nauyat manniit		4										2	6
Thick-billed murre eggs	ᐊᑦᕿᐃᑦ ᓚᓐᓇᕐᑦ	Thick-billed murre eggs		1											1
Black guillemot eggs	ᐱᖏᐅᓭᑦ ᓚᓐᓇᕐᑦ	Black guillemot eggs		2											2
Arctic char	ᐃᖅᓗᓕᑦ	Ikaliviit	38	37	31	14	8	27	38	8	3	25	63	64	111
Whitefish	ᑲᐱᓯᓭᑦ	Kapihiliit					1	5	8	1			1		11
Cod	ᐅᒪᐃᑦ	Ugak	3	3	2	6	11	5	2	3	3	3	8	1	34
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	1	2	2	3	4	3		1		3	4	5	21
Mussels	ᑲᐱᓯᓭᑦ	Uviluvaloet						2	1	5	5	4	5	1	16

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᓕᕐᓂᑐᖅ ᐱᓱᐊᑎᓕᓂᒃ ᐊᖏᔪᒃ ᖃᕋᓴᐅᓂᖓᓂᓄᑦ ᐊᓕᖏᔪᓄᑦ ᓇᓕᕆᔨᒪᔪᓂᓄᑦ ᐊᐅᓚᑦᑎᓂᖅ ᑐᓴᕆᔨᖓᓂᒃ ᐃᓕᓴᕐᓂᖅ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 303

Monthly harvest estimates
ᑕᖅᑕᒫᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)
ᐊᓐᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓕ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᔪᓗ	NOV ᐅᓇᓱᓗ	DEC ᑎᓯᓱᓗ	JAN ᔮᖏᓄᐊᓗ	FEB ᓄᖕᐅᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᓚᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓕᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut								1			3		4 ± 2
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡										23			23
Arctic fox	ᑎᓕᓴᒃᑐᑦ	Tigiganiat				1	10	24	36	21	25	3	5	2	127 ± 25
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓕᓴᒃᑐᑦ	Kalaliit tigiganiat					5	23	9	18	13	1	1	1	71 ± 17
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik				6	10	1	3	6	3	10	7	2	48 ± 9
Ringed seal	ᓇᕆᔨᑦ	Natiinat	10	41	57	59	77	63	50	151	90	64	64	37	763 ± 67
Bearded seal	ᐅᓗᔪᐃᑦ	Ukyuk		11	1	6	1			2		2	3		26 ± 6
Beluga	ᖃᐃᕐᑕ ᖁᓪᓚᑦ	Kilalugak	26	5										7	38 ± 6
Snow goose	ᑲᖏᐃᑦ	Kanguq	7		1	62								62	132 ± 47
Canada goose	ᓂᕆᓪᓚᑦ	Nikliknik	246	579	123	86	24			1			301	1,720	3,080 ± 256
Old squaw	ᐊᑭᑲᖅᔪᐃᑦ	Aahangik		1		3	7	2	32	1	3	8		4	61 ± 29
Eider duck	ᒥᑎᑦ	Kingalik	113	72	73	119	620	1,004	553	165	531	234	11	14	3,509 ± 360
Tundra swan	ᖃᓗᔪᐃᑦ	Kukyuk			1			1							2 ± 1
Common merganser	ᐸᐃᑦ	Nuyaralik	3	86	32	2	1							4	128 ± 32
Red breasted merganser	ᑲᓕᔪᑦ	Red breasted merganser			1										1 ± 0
Greater scaup	ᐊᖏᓂᖅᓱᒃ ᓂᑲᑦ	Greater scaup	1	4											5 ± 2
White-winged scoter	ᖃᓄᖅᑕᓐᒃ ᐃᓕᓴᖅ ᐱᕆᐅᓪᓚᒃᑲᒃ	White-winged scoter				1									1 ± 1
Surf scoter	ᖃᓄᖅᓪᓚᑦ ᖃᐅᖏᒍᑦ ᐱᕆᐅᓪᓚᕐᑐᑦ	Surf scoter	4	27	11	10									52 ± 17
Yellow-billed loon	ᑐᑦᓂᔪᐊᑦ	Tuulik				10									10 ± 8
Black guillemot	ᐱᕆᐅᓪᓚᑦ	Black guillemot		6	4										10 ± 5
Ptarmigan	ᐊᖑᓂᑦ	Akilgik				5	6	6	10	21	9	16	66	135	274 ± 34
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᒪᓕᓂᖏᑦ	Manniit	48	350											398 ± 80
Goose eggs	ᑲᖏᐃᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit												262	262 ± 56
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	100	115											215 ± 82
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓕᓂᖏᑦ	Nauyat manniit												13	13 ± 11
Eider down∅	ᒥᑎᑦ ᖃᓂᒋᖏᑦ∅	Mitiit qiviungit∅	56	521											577 ± 329
Arctic char	ᐃᖃᓗᓴᐃᑦ	Ikaliviit	817	1,010	674	395	335	667	1,935	180	108	559	1,307	2,310	10,297 ± 687
Whitefish	ᑲᐱᓯᓪᓚᑦ	Kapihiliit							439	1					440 ± 307
Cod	ᐅᒪᐃᑦ	Ugak	2	16	28	147	186	67	6		9	136	6	6	609 ± 90
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk		24	93	51	6					18		36	228 ± 50
Clams	ᐊᓚᒧᒪᔪᑦ	Uviluq												17	17 ± 14
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet	407	579	1,034	732	73	73	1,291	6,505	1,263	6,153	479	165	18,754 ± 2,454

‡ Polar bear data supplied by DSD.
∅ Number of nests harvested.

‡ ᓇᓂᑦᓂ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᖅᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓚᑦ.
∅ ᖃᕋᐅᓂᖅᑦ ᐱᑭᐅᑦ ᓄᐊᑕᐅᔪᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.
∅ Amigaitiginit maniktagauhimajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 304

Monthly hunter response
ᑕᖅᑕᒪᒃ ᒪᖏᐃᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᑐᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᓂᓗ	NOV ᓄᓇᕐᓗᓂ	DEC ᑎᓯᕐᓗᓂ	JAN ᔮᓐᓄᐊᓗ	FEB ᓄᕿᐅᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᖏᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᐅᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓕᕆᔨᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃ ᒪᖏᐃᑎᑦ	Tatkitaman angunahuktut titigait	153	153	156	157	157	157	157	158	158	158	158	162	166*
Hunters interviewed	ᒪᖏᐃᑎᑦ ᐊᐱᕐᓂᖏᑦ	Angunahuktin apikhuktan	147	145	151	136	136	135	135	149	148	147	147	136	160*
Harvested	ᒪᖏᐃᒃᑐᓂᒃ	Angujaujut	59	67	40	43	42	44	46	39	33	50	70	94	128*
Response Rate (%)	ᑭᐅᔾ ᖃᓂᐅᓂᖏᑦ (%)	Kiujut (%)	96	95	97	87	87	86	86	94	94	93	93	84	91**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓕᕆᔨᑦ ᐊᑎᓂᐅᑦᑕᐅᒪᔨᖏᑦ/ᐊᐱᕐᓂᖏᑦᑕᑦ/ᐊᖏᔪᓕᕆᔨᑐᑎᒃ ᐊᑕᐅᓂᐊᖅᓯᓕᕐᑎᑦ ᐊᑦᕿᒧᑦ.
** ᐊᓕᒋᓂᑎᓂᒪᓕᒃ ᑕᖅᑕᒪᒃ ᑭᐅᔾ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 305

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᖏᓂᒃ ᒪᖏᐃᓐᓂᖏᓐᓂᑦ ᐊᒪᓗ ᐊᐱᕐᓂᖏᑦᑕᐅᓂᖏᓐᓂᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓱ % ᑲᑎᑕᐅᑦ ᒪᖏᐃᑦ ᑎᑎᕐᑕᐅᒪᔨᔨᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)
ᐊᑐᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᓂᓗ	NOV ᓄᓇᕐᓗᓂ	DEC ᑎᓯᕐᓗᓂ	JAN ᔮᓐᓄᐊᓗ	FEB ᓄᕿᐅᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᖏᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᐅᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲ	≤ tatkin pingahut	100	100	0	0	11	93	96	95	99	82	97	96	77
4-6 months	4-6 ᑕᖅᑲ	tatkin hitaman 6nut	0	0	93	96	89	7	4	0	0	0	0	0	20
> 6 months	> 6 ᑕᖅᑲ	> 6 tatkin	0	0	7	4	0	0	0	5	1	18	3	4	3

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 306

Number of hunters harvesting each species
ᖃᑦᕿᐅᓂᖏᑦ ᓚᖃᐃᑎᑦ ᐊᖏᔪᓇᓴᕐᓂᑦ ᐊᑐᓂᒃ ᐅᓚᔨᖅᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 4 (June 1999 - May 2000)
ᐊᒡᖏᒍ 4 (ᔨᓂ 1999 - ᓚᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖃᖅᓴᖅ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᓪᓗ	SEP ᓯᑎᐸᓗ	OCT ᐅᑦᐸᓗ	NOV ᐅᓇᐹᓗ	DEC ᑎᓯᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᓪᓚᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut								1			1		2
Polar bear‡‡	ᓇᓀᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓗᒃᑐᐊᑦ	Tigiganiat				1	2	9	8	4	4	1	1	2	19
Coloured fox	ᖃᐅᖕᖏᑦᑐᑦ ᑎᓗᒃᑐᐊᑦ	Kalaliit tigiganiat					3	5	3	5	4	1	1	1	17
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik				1	5	1	1	2	2	4	6	2	18
Ringed seal	ᓇᕆᔨᑦ	Natiinat	7	21	15	14	11	8	10	31	27	16	21	13	60
Bearded seal	ᐅᓪᔪᐃᑦ	Ukyuk		6	1	2	1			1		2	3		12
Beluga	ᖃᐅᖏᑦ ᖁᓕᓴᓚᑦ	Kilalugak	9	5										6	12
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	2		1	7								5	15
Canada goose	ᓂᖏᓪᑦ	Nikliknik	23	33	15	14	2			1			27	54	81
Old squaw	ᐊᒻᑭᖏᔪᐃᑦ	Aahangik		1		2	3	2	1	1	1	1		1	11
Eider duck	ᒥᑎᑦ	Kingalik	16	10	5	13	32	33	23	17	10	11	2	4	60
Tundra swan	ᖁᓕᔪᐃᑦ	Kukyuk			1			1							2
Common merganser	ᐸᐃᑦ	Nuyaralik	2	12	5	2	1							1	18
Red breasted merganser	ᑲᓕᔨᑐᑦ	Red breasted merganser			1										1
Greater scaup	ᐊᖕᓂᓂᖅᓱᖅ ᓂᑲᑦ	Greater scaup	1	1											2
White-winged scoter	ᖃᐅᖏᑕᓚᒃ ᐃᓕᓴᖅᓱᒃ ᐱᖏᔨᐅᓪᓚᒃ	White-winged scoter				1									1
Surf scoter	ᖃᐅᖏᓪᓀᑦ ᖃᐅᖅᓱᒍᑦ ᐱᖏᔨᓀᖏᑦ	Surf scoter	2	3	2	2									7
Yellow-billed loon	ᑐᑦᓂᖏᔪᐊᑦ	Tuulik				1									1
Black guillemot	ᐱᖏᔨᓀᑦ	Akilgik		1	1										2
Ptarmigan	ᐊᖓᓂᑦ	Akilgik				1	2	2	3	4	3	7	14	22	41
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᒪᓕᓂᖏᑦ	Manniit	1	4											5
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit												18	18
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	2	2											4
Seagull eggs	ᓇᐅᒃᐃᑦ ᒪᓕᓂᖏᑦ	Nauyat manniit												1	1
Eider down	ᒥᑎᑦ ᖁᓂᕐᖏᑦ	Mitiit qiviungit	3	4											7
Arctic char	ᐃᖃᓗᓴᒃ	Ikaliviit	34	49	25	18	11	19	33	4	4	14	42	66	107
Whitefish	ᑲᐱᓯᓪᑦ	Kapihiliit							4	1					4
Cod	ᐅᒪᐃᑦ	Ugak	1	1	5	9	8	5	2		1	16	2	2	35
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk		1	2	2	2					2		5	13
Clams	ᐊᒻᒧᒪᔪᑦ	Uviluq												1	1
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet	1	1	1	2	1	1	4	4	3	8	1	1	17

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᖕᖏᑐᖃᖅ ᐱᐅᔪᑎᓪᓂᓂᒃ ᐊᖏᖓᑦ ᖃᐅᕋᐅᓂᖕᖏᓐᓄᑦ ᐊᓪᓚᖃᖅᓄᑦ ᐊᓪᓚᖅᓄᑦ ᓇᓪᑐᐅᖏᖕᖏᓂᒃ ᐃᓄᐃᑦᑐᓗᓂᒃ ᐃᓕᓴᕐᓂᐅᑎᓪᓗᒍ

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 307

Monthly harvest estimates
ᑕᖅᑕᒧᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᓘᖏᔪ 5 (ᔪᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐸᓗ	OCT ᐅᑦᑐᓗ	NOV ᐅᓇᓘᓗ	DEC ᑎᓯᓗ	JAN ᔮᖏᓄᓗ	FEB ᓇᖕᖏᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓀᓪ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut			2				14				4	1	21 ± 5
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡									2	6			8
Arctic fox	ᑎᓕᖃᓐᓂᐊᑦ	Tigiganiat				1		10	6	16	7	4	3		47 ± 6
Coloured fox	ᖃᐅᖏᑦᑐᑦ ᑎᓕᖃᓐᓂᐊᑦ	Kalaliit tigiganiat						9	2	7	1	1	2		22 ± 3
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik				1	3		5	2	2	2	4	6	25 ± 4
Ringed seal	ᓇᕆᔨᑦ	Natiinat	21	65	35	38	36	9	45	86	89	127	45	44	640 ± 45
Bearded seal	ᐅᓗᔪᐃᑦ	Ukyuk		6	4		1	2	1						14 ± 4
Walrus	ᐊᐃᐃᓴᑦ	Akvik		1											1 ± 1
Beluga	ᖃᐅᓂᑦ ᖁᓪᓗᓚᑦ	Kilalugak	14	3					4	11				27	59 ± 13
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq				347	166						1	32	546 ± 67
Canada goose	ᓄᓕᓪᓚᑦ	Nikliknik	396	184	6	90	11						134	754	1,575 ± 198
Ross's goose	ᖃᕆᓕᔪᐃᑦ	Kakat				2									2 ± 1
Brant goose	ᓄᓪᓕᓕᓇᐃᑦ	Nirlirnaq				13	14								27 ± 7
Old squaw	ᐊᒻᑭᐊᓕᔪᐃᑦ	Aahangik				1	7		2	2	1				13 ± 2
Pintail	ᖃᓚᒧᔪᓕᒃ	Arnaviaq												1	1 ± 1
Eider duck	ᒥᑎᑦ	Kingalik	44	30	1	72	114	523	540	169	274	69		29	1,865 ± 101
Tundra swan	ᖃᓚᔪᐃᑦ	Kukyuk	3												3 ± 3
Common merganser	ᓄᐃᑦ	Nuyaralik	4	49	53	51			3						160 ± 42
Red breasted merganser	ᑲᐅᓴᑦ	Red breasted merganser			9	1									10 ± 11
White-winged scoter	ᐱᓕᕆᐅᓭᓄᐃᑦ	White-winged scoter	1	16	14	3									34 ± 18
Surf scoter	ᖃᐃᓕᓭᑦ ᖃᐅᖏᒍᑦ ᐱᓕᕆᐅᓭᓄᑦ	Surf scoter					1								1 ± 0
Red-throated loon	ᖃᖏᒪᐅᑦ	Qaqhuaq			2										2 ± 2
Yellow-billed loon	ᑐᑦᓕᓚᔪᐊᖏ	Tuulik					1								1 ± 0
Black guillemot	ᐱᓕᕆᐅᓭᑦ	Black guillemot		3		1									4 ± 3
Ptarmigan	ᐊᖑᓂᑦ	Akilgik	16	4	2		6		4	6	9	54	85	16	202 ± 26
Snowy owl	ᐅᓴᐳᔪᐊᑦ	Ookpik										1			1 ± 1
Goose eggs	ᑲᖏᔪᐃᑦ ᒪᓐᓇᖅᑐᑦ	Uluaguliit manniit	181	20										627	828 ± 166
Duck eggs	ᒥᑎᑦ ᒪᓐᓇᖅᑐᑦ	Tinmiat manniit	57												57 ± 73
Seagull eggs	ᓇᐅᒃᐃᑦ ᒪᓐᓇᖅᑐᑦ	Nauyat manniit												1	1 ± 1
Eider down∅	ᒥᑎᑦ ᖃᓄᖅᑐᑦ∅	Mitiit qiviungit∅		43											43 ± 36
Arctic char	ᐃᖃᓗᓴᑦ	Ikaliviit	877	835	682	606	181	133	705	173	71	1,101	2,067	1,401	8,832 ± 685
Whitefish	ᑲᐱᓕᓪᓚᑦ	Kapihiliit						20	87	28	19	4	6		164 ± 14
Cod	ᐅᓘᐃᑦ	Ugak	3	54		94	401	71		1	15	3,619	191	124	4,573 ± 2,253
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	70	37	17	6	30			1				178	339 ± 82
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet	1,950	372			72	1,078	2,100		6,757	14,123	9,552	525	36,529 ± 6,891

‡ Polar bear data supplied by DSD.
∅ Number of nests harvested.

‡ ᓇᓂᑦᓂᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᒃᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓚᓵᑦ.
∅ ᖃᕆᐅᓂᖏᑦ ᐱᑭᑦ ᓄᐊᑕᐅᔪᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.
∅ Amigaitiginit maniktagauhimajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 308

Monthly hunter response

ᑕᖃᑦᒪᒃ ᒪᖏᐃᑎᑦ ᑭᐅᓂᖅᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᓐᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑯᓇ	NOV ᓄᐊᕐᓇ	DEC ᑎᓯᕐᓇ	JAN ᒍᓐᓄᐊᓇ	FEB ᐃᖃᐅᐊᓇ	MAR ᒪᕐᓯ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓕᓂᑦ ᑭᐅᓂᖅᑕᑦ ᐊᑐᔪᒪᓂᖅᑎᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᒪᒃ ᒪᖏᐃᑎᑦ	Tatkitaman angunahuktut titigait	163	162	162	163	168	167	166	165	168	167	167	167	171*
Hunters interviewed	ᒪᖏᐃᑎᑦ ᐊᐱᔪᓪᑕᑦ	Angunahuktin apikhuktan	113	123	121	144	160	156	160	160	158	151	150	143	167*
Harvested	ᒪᖏᐃᔅᑐᒥᓂᑦ	Angujaujut	48	34	25	53	54	38	48	43	34	45	69	99	137*
Response Rate (%)	ᑭᐅᔪᓂ ᖃᓕᔪᐅᓂᖅᑕᑦ (%)	Kiujut (%)	69	76	75	88	95	93	96	97	94	90	90	86	88**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓕᓂᑦ ᐊᑎᓕᐅᑦᑕᒪᒍᓐᓇᖅᑐᓂᑦ/ᐊᐱᔪᓪᑕᑦᑐᓂᑦ/ᐊᖏᓕᓂᑦᑐᒥᓂᓗᑦ ᐊᑕᐅᓯᐊᔨᓗᑎᒃᑐᑦ ᐊᐳᔪᒥᑦ.
** ᐊᓕᒍᓂᓕᕆᓯᒪᔭᑦ ᑕᖃᑦᒪᒃ ᑭᐅᔪᓂ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 309

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕋᐃᐅᔪᑦ ᐊᑯᖏᓂ ᒪᖏᐃᓐᓂᖅᑕ ᐊᒪᓗ ᐊᐱᕋᕐᑕᐅᓂᖅᑕ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᒪᖏᐃᑕᑦ ᑎᑎᕋᕐᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᓐᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑯᓇ	NOV ᓄᐊᕐᓇ	DEC ᑎᓯᕐᓇ	JAN ᒍᓐᓄᐊᓇ	FEB ᐃᖃᐅᐊᓇ	MAR ᒪᕐᓯ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕋᐃᐅᔪᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	99	71	79	98	90	94	96	100	93	100	100	100	95
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	1	29	21	2	10	6	4	0	7	0	0	0	5

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 310

Number of hunters harvesting each species — **Year 5 (June 2000 - May 2001)**

ᖃᑦᓯᐅᓂᖏᑦ ᒪᖃᐃᑎᑦ ᐊᖏᔪᓇᓯᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ — **ᐊᒡᖏᔪ 5 (ᔦᓂ 2000 - ᒪᐃ 2001)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 5 (June 2000 - May 2001)**

Month/ᑕᖃᖏᓐᓄᑦ/Tatkia			JUN ᔦᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗᓇ	OCT ᐅᑦᔪᓗᓇ	NOV ᐅᓇᓱᐱᓇ	DEC ᑎᓯᓱᐱᓇ	JAN ᒍᖓᓄᐊᓇ	FEB ᐃᖏᑲᐊᓇ	MAR ᒪᕆᔪ	APR ᐃᑦᓇᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut			1				2				1	1	4
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat				1		4	5	6	5	2	3		15
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓕᓴᓂᐊᑦ	Kalaliit tigiganiat						4	2	5	1	1	2		11
Arctic hare	ᐅᖃᓕᑦ	Ukalik				1	3		3	2	2	2	2	3	15
Ringed seal	ᓇᕆᔨᑦ	Natiinat	6	10	8	16	13	5	17	27	22	22	16	14	55
Bearded seal	ᐅᓪᔪᐃᐃᑦ	Ukyuk		4	2		1	2	1						7
Walrus	ᐊᐃᐃᓴᑦ	Akvik		1											1
Beluga	ᖃᓄᖅᑕᑦ ᖁᓕᓗᓚᑦ	Kilalugak	5	1					2	6				8	17
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq				24	14						1	11	35
Canada goose	ᓂᖅᓕᑦ	Nikliknik	22	14	2	15	7						28	54	78
Ross's goose	ᖃᕆᖅᐃᐃᑦ	Kakat				1									1
Brant goose	ᓂᑦᓕᖅᓇᐃᑦ	Nirlirnaq				4	4								8
Old squaw	ᐊᒻᑭᐊᖅᐃᐃᑦ	Aahangik				1	4		1	1	1				8
Pintail	ᖃᓚᒧᐊᓪᓚᑦ	Arnaviaq												1	1
Eider duck	ᑎᑎᑦ	Kingalik	7	6	1	7	24	30	25	7	8	8		6	61
Tundra swan	ᖃᓚᐃᐃᑦ	Kukyuk	2												2
Common merganser	ᑐᐃᑦ	Nuyaralik	2	7	7	10			1						20
Red breasted merganser	ᑲᔨᓴᑦ	Red breasted merganser			1	1									2
White-winged scoter	ᐱᑦᓯᐅᓪᓗᑦᑐᐃᑦ	White-winged scoter	1	2	3	2									7
Surf scoter	ᖃᓄᖅᑕᓪᓗᑦ ᖃᐅᖏᓚᔪᑦ ᐱᑦᓯᐅᓪᓗᑦᑐᑦ	Surf scoter					1								1
Red-throated loon	ᖃᖏᓚᐅᑦ	Qaqhuaq			1										1
Yellow-billed loon	ᑐᑦᓕᓪᓚᐃᐊᖏᑦ	Tuulik					1								1
Black guillemot	ᐱᑦᓯᐅᓪᓗᑦ	Black guillemot		1		1									2
Ptarmigan	ᐃᖏᓱᑎᑦ	Akilgik	5	2	1		3		1	5	4	11	18	5	31
Snowy owl	ᐅᓴᐱᓪᓚᐃᑦ	Ookpik										1			1
Goose eggs	ᑲᖏᔪᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	6	1										28	30
Duck eggs	ᑎᑎᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit	1												1
Seagull eggs	ᓇᐅᐳᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit												1	1
Eider down	ᑎᑎᑦ ᖃᓂᓕᖏᑦ	Mitiit qiviungit		1											1
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	29	27	16	21	14	10	24	10	5	21	40	60	101
Whitefish	ᑲᐱᓯᓂᑦ	Kapihiliit						2	4	2	2	2	2		6
Cod	ᐅᒪᐃᑦ	Ugak	1	5		7	20	6		1	1	13	10	8	49
Sculpin	ᑲᓇᐃᐃᑦ	Kanayuk	4	2	1	3	4			1				9	20
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet	1	1			1	1	2		4	5	4	2	13

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕆᓯᒪᔨᓂᖅ ᐱᑕᖃᖏᓐᓄᑦᑐᖅ ᐱᓕᔪᓐᓇᓂᖅ ᐊᖏᔪᑦ ᖃᓯᐅᓂᖏᓐᓄᓕᒃ ᐊᓕᖏᔪᓂᖅ ᐊᐅᓚᑲᒪᔨᓂᖅ ᐊᐅᓚᔪᓂᑦ ᓇᓕᐅᖏᓐᓄᑦᑐᑦ ᑐᓂᓴᖏᓐᓂᓂᒃ ᐃᑯᐱᕐᓂᕐᓂᒃ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 311

Annual harvest estimates and five-year mean

ᐊᓐᔪᔨᑦᑕᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ ᐊᓚᓗ ᑕᒥᓚᓂᑦ-ᐊᓐᔪᔨᓂᑦ ᐊᐅᑎᓕᖁᑎᓯᒪᔪᑦ

Aragutamat angujauvaktun tatlman araguit iluani

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᓐᔪᔨᓂᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᔪᔨ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᑎᕕᖁᑎᓯᒪᔪᑦ Amigaitkiyait
Species	**ᐅᒪᔪᑦ**	**Umajuin**						
Caribou[1]	ᑐᑐᐃᐃᑦ[1]	Tuktut[1]	32	22	38	4	21	23
Polar bear[2]	ᓇᓂᐃᑦ[2]	Nanuit[2]	25	24	25	23	8	21
Arctic fox[3]	ᑎᓘᖏᓂᐊᑦ[3]	Tigiganiat[3]	43	96	32	127	47	69
Coloured fox	ᖃᐊᖏᕐᕕᑦ ᑎᓘᖏᓂᐊᑦ	Kalaliit tigiganiat	6	88	42	71	22	46
Arctic hare	ᐅᒃᓪᓕ	Ukalik	3	17	37	48	25	26
Ringed seal[4]	ᓇᕆᔨᑦ[4]	Natiinat[4]	772	1,224	909	763	640	862
Bearded seal[4]	ᐅᑦᔪᐃᑦ[4]	Ukyuk[4]	39	17	55	26	14	30
Walrus[5]	ᐊᐃᐃᓴᑦ[5]	Akvik[5]	2	2	20	0	1	5
Beluga[6]	ᖃᐊᖏᑦ ᖁᓪᓗᓴᑦ[6]	Kilalugak[6]	12	47	31	38	59	37
Snow goose[7]	ᑲᖕᒍᐃᑦ[7]	Kanguq[7]	216	334	373	132	546	320
Canada goose[8]	ᓂᕐᓪᓕ ᐅᓪᐊᒍᓪᓕᓴᑦ[8]	Nikliknik[8]	1,430	2,369	2,149	3,080	1,575	2,121
Ross's goose[9]	ᑲᖃᕐᔪᐃᑦ[9]	Kakat[9]	0	0	0	0	2	<1
Brant goose	ᓂᕆᕐᓇᐃᑦ	Nirlirnaq	0	71	39	0	27	27
Old squaw	ᐊᒻᑭᐊᕐᔪᐃᑦ	Aahangik	145	94	97	61	13	82
Pintail	ᖃᓚᒧᐊᓱᑦ	Arnaviaq	0	0	0	0	1	<1
Mallard	ᒥᑎᓪᓕ	Mitik	0	1	0	0	0	<1
Eider duck[10]	ᒥᑎᑦ[10]	Kingalik[10]	937	2,490	3,456	3,509	1,865	2,451
Tundra swan	ᖃᓚᔪᐃᑦ	Kukyuk	1	0	7	2	3	3
Common merganser	ᓄᐃᖅ	Nuyaralik	61	150	64	128	160	113
Red breasted merganser[11]	ᑲᐅᓂᔪᑦ[11]	Red breasted merganser[11]	0	1	16	1	10	6
Scaup (unspecified)	ᒥᑎᑦ ᐊᐃᑦᑕᖅᑦ	Scaup	0	1	0	0	0	<1
Greater scaup	ᐊᖅᑭᓂᖏᒥ ᒥᑎᑦ ᐊᐃᑦᑕᖅᑦ	Greater scaup	0	0	0	5	0	1
Black scoter[12]	ᐱᕐᓯᐅᓪᓚᑦᑕᐃᑦ[12]	Black scoter[12]	5	8	12	0	0	5
White-winged scoter[12]	ᖃᐊᑦᓭᓄᖅ ᐃᓕᓴᐊ ᐱᕐᓯᐅᓪᓚᑦᑕᐃᑦ[12]	White-winged scoter[12]	0	0	3	1	34	8
Surf scoter	ᖃᐅᔨᒃ ᖃᐊᑦᓭᓄᖅ ᐱᕐᓯᐅᓪᓚᑦᑕᑦ	Surf scoter	0	0	0	52	1	11
Common loon	ᑐᓪᓕᔪᐊᑦ	Tuulik	2	1	0	0	0	1
Arctic loon	ᒪᑉᓗᓪᓕ	Maliriq	4	1	1	0	0	1
Red-throated loon	ᖃᖓᓴᐅᑦ	Qaqhuaq	4	9	1	0	2	3
Yellow-billed loon[13]	ᑐᓪᓕᔪᐊᑦ[13]	Tuulik[13]	0	3	1	10	1	3
Black guillemot	ᐱᕐᓯᐅᓪᓚᑦ	Black guillemot	38	173	0	10	4	45

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Study Year/ᖃᐅᔨᓴᖅ ᐊᒻᒋᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᔨᒋᑦᑎᓯᒪᓕᒃ Amigaitkiyait
Species	**ᐅᒪᓕᒃ**	**Umajuin**						
Ptarmigan	ᐊᖏᓂᒃ	Akilgik	30	164	411	274	202	216
Snowy owl	ᐅᓴᐱᓪᓚᐊᒃ	Ookpik	0	2	0	0	1	1
Eggs (unspecified)[14]	ᓚᖅᑯᑦ[14]	Manniit[14]	0	0	0	398	0	80
Goose eggs	ᑲᖕᒍᐃᒃ ᓚᖅᑯᖏᑦ	Uluaguliit manniit	191	420	1,322	262	828	605
Duck eggs	ᒥᑎᑦ ᓚᖅᑯᖏᑦ	Tinmiat manniit	257	299	335	215	57	233
Tundra swan eggs	ᖁᓗᓪᓚᐃᒃ ᓚᖅᑯᖏᑦ	Kukyut manniit	2	0	0	0	0	<1
Seagull eggs	ᓇᐅᔨᐃᒃ ᓚᖅᑯᖏᑦ	Nauyat manniit	35	83	262	13	1	79
Thick-billed murre eggs	ᐊᑦᑕᐃᒃ ᓚᖅᑯᖏᑦ	Thick-billed murre eggs	0	0	35	0	0	7
Black guillemot eggs	ᐱᕐᓂᐅᓪᓗᑦ ᓚᖅᑯᖏᑦ	Black guillemot eggs	0	12	610	0	0	124
Eider down[Ø15]	ᒥᑎᑦ ᖁᓂᖏᖏᑦ[Ø15]	Mitiit qiviungit[Ø15]	0	233	0	577	43	171
Arctic char	ᐃᖃᓗᓴᐃᑦ	Ikaliviit	9,024	10,451	10,243	10,297	8,832	9,769
Whitefish	ᑲᐱᓯᓪᓕᑦ	Kapihiliit	24	551	232	440	164	282
Cod	ᐅᒪᐃᒃ	Ugak	730	1,189	769	609	4,573	1,574
Sculpin	ᑲᓇᓴᐃᒃ	Kanayuk	629	227	325	228	339	350
Clams	ᐊᓕᒻᒪᓴᑦ	Uviluq	0	917	0	17	0	187
Mussels[16]	ᐅᐱᓗᐃᒃ[16]	Uviluvaloet[16]	4,654	838	53,583	18,754	36,529	22,872

Ø Number of nests harvested.
[1-16]: See page 434 for community feedback and other sources of data.

Ø ᖃᓕᐅᓂᖏᑦ ᐱᑭᐅᑦ ᓄᐊᑕᐅᓴᖅ.
[1-16]: ᑕᐃᒪᐃ ᒪᓴᐃᑐᖃ 436 ᓄᓇᓕᑦ ᑭᐅᔨᔪᑎᖏᑦ ᐊᓚᓗ ᐊᓯᖏᑦ ᐱᓕᐅᐅᔨᓴ ᓇᓴᐅᑎᓂᓪᓕ.

Ø Amigaitiginit maniktagauhimajut.
[1-16]: Takulugu makpigaak 438 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 312

Annual hunter response

ᐊᓕᖁᔨᑕᒪᑦ ᐊᖏᔪᓯᓴᒋᑦ ᑭᐅᓂᖏᑦ

Angujauvaktu

All Years (June 1996 - May 2001)

ᑕᒪᐃᖅᓄᑦ ᐊᓕᖁᔨᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

6.1.13

Study Year/ᖃᐅᔨᓴᖅ ᐊᒻᒋᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓯᓴᒋᑦ ᑭᐅᓂᖏᑦ ᐊᔪᕐᓗᓂᖏᑦ**	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᑭᒋᒪᑦ ᐊᖏᔪᓯᓴᒋᑦ	Tatkitaman angunahuktut titigait	133	155	159	166	171	181*
Hunters interviewed	ᐊᖏᔪᓯᓴᒋᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	132	154	157	160	167	180*
Harvested	ᐊᖏᔪᓯᓴᑐᓂᒃ	Angujaujut	103	115	134	128	137	171*
Response Rate (%)	ᑭᐅᖅ ᖃᓕᐅᓂᖏᑦ (%)	Kiujut (%)	68	83	94	91	88	85**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖏᔪᓯᓴᒋᑦ ᐊᑎᓕᐅᔪᓕᒃ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓯᓴᑐᓂᒃ ᐊᑕᐅᓯᐊᓇᑐᑎᓪ ᖃᐅᔨᔪᓕᒃᑐᑦ.
** ᐊᓕᒋᑦᑎᓯᒪᓕᒃ ᐊᒻᒋᔪᑕᒪᑦ ᑭᐅᓕᒃ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 313

Recall period between harvest and interview, expressed as % of total harvest records — All Years (June 1996 - May 2001)

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᕐᖓᓂ ᐊᖑᓇᓱᓐᓂᖓᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓱᕐᑕᐅᓂᖓᑕ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒫᒃ % ᑲᑎᑦᑐᒋᑦ ᐊᖑᓇᓱᒃᑕᑦ ᑎᑎᕋᕐᑕᐅᒪᔪᑦ — ᑕᒪᐃᓐᓄᑦ ᐊᒃᕌᒍᓄᑦ (ᔫᓂ 1996 - ᒪᐃ 2001)

Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut — Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᕐᕕᒃ ᐊᒃᕌᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔪᑦ**	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᕿᑦ	≤ tatkin pingahut	90	67	86	77	95	82
4-6 months	4-6 ᑕᕿᑦ	tatkin hitaman 6nut	10	30	14	20	0	16
> 6 months	> 6 ᑕᕿᑦ	> 6 tatkin	0	3	0	3	5	2

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 314

Number of hunters harvesting each species — All Years (June 1996 - May 2001)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖑᓇᓱᒃᑏᑦ ᐊᖑᓇᓱᒃᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐆᒪᔪᕐᓂᒃ — ᑕᒪᐃᓐᓄᑦ ᐊᒃᕌᒍᓄᑦ (ᔫᓂ 1996 - ᒪᐃ 2001)

Angunahuktin angutivaktun umajunik — Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᕐᕕᒃ ᐊᒃᕌᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin
Species	**ᐆᒪᔪᑦ**	**Umajuin**						
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	10	6	11	2	4	26
Polar bear#	ᓇᓄᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᕆᒐᓐᓂᐊᑦ	Tigiganiat	2	24	14	19	15	40
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᕆᒐᓐᓂᐊᑦ	Kalaliit tigiganiat	4	15	12	17	11	34
Arctic hare	ᐅᑲᓖᑦ	Ukalik	1	9	16	18	15	41
Ringed seal	ᓇᑦᓯᑦ	Natiinat	49	65	66	60	55	102
Bearded seal	ᐅᒡᔪᐃᑦ	Ukyuk	9	11	19	12	7	38
Walrus	ᐊᐃᕕᑦ	Akvik	2	1	4		1	8
Beluga	ᖃᑯᕐᑕᑦ ᕿᓚᓗᒐᑦ	Kilalugak	3	12	14	12	17	30
Snow goose	ᑲᖑᐃᑦ	Kanguq	18	33	40	15	35	72
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓖᑦ	Nikliknik	51	76	80	81	78	127
Ross's goose	ᖃᕌᕐᔪᐃᑦ	Kakat					1	1
Brant goose	ᓂᕐᓕᕐᓇᐃᑦ	Nirlirnaq		5	4		8	15

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Study Year/ᖃᐅᔨᓴᓂᖅ ᐱᖁᔪᓐ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᖅ Tamakiklugin
Species	**ᐅᓪᓗᒥᒃ**	**Umajuin**						
Old squaw	ᐊᑭᐊᖏᔪᐃᓪᓕᒃ	Aahangik	14	13	17	11	8	39
Pintail	ᖃᓄᓕᒫᔪᒃ	Arnaviaq					1	1
Mallard	ᒥᑎᓪᓕᒃ	Mitik		1				1
Eider duck	ᑭᙵᒃ	Kingalik	38	61	71	60	61	106
Tundra swan	ᖃᓄᔪᐃᓪᓕᒃ	Kukyuk	1		1	2	2	6
Common merganser	ᓄᐃᓐᖅ	Nuyaralik	10	17	16	18	20	53
Red breasted merganser	ᑲᓕᔾᔨᒋᒃ	Red breasted merganser		1	2	1	2	4
Scaup (unspecified)	ᑭᙵᒃ ᐊᐃᓐᓇᖏᒃ	Scaup		1				1
Greater scaup	ᐊᖏᑐᓴᓚᒥ ᑭᙵᒃ ᐊᐃᓐᓇᖏᒃ	Greater scaup				2		2
Black scoter	ᐱᓕᕆᔨᖅᓂᐃᓪᓕᒃ	Black scoter	1	3	3			7
White-winged scoter	ᖃᓄᑦᑕᓐᓄᒃ ᐃᓕᓴᐊ ᐱᓕᕆᔨᖅᓂᐃᓪᓕᒃ	White-winged scoter			1	1	7	9
Surf scoter	ᖃᐅᔨᖓ ᖃᓄᑦᑕᓐᓄᒃ ᐱᓕᕆᔨᖅᓂᐃᓪᓕᒃ	Surf scoter				7	1	8
Common loon	ᑐᓪᓗᖅᓯᐊᒃ	Tuulik	1	1				2
Arctic loon	ᒪᑦᓗᓕᒃ	Maliriq	2	1	1			4
Red-throated loon	ᖃᖏᓴᐅᒃ	Qaqhuaq	1	2	1		1	5
Yellow-billed loon	ᑐᓪᓗᖅᓯᐊᒃ	Tuulik		3	1	1	1	5
Black guillemot	ᐱᓕᕆᔨᓪᓕᒃ	Black guillemot	1	2		2	2	7
Ptarmigan	ᐊᖏᓚᒃ	Akilgik	8	24	45	41	31	71
Snowy owl	ᐅᑲᐱᓴᐊᒃ	Ookpik		2			1	3
Eggs (unspecified)	ᓚᖅᑉᓪᓕᒃ	Manniit				5		5
Goose eggs	ᑲᖕᒍᐃᓪᓕᒃ ᓚᖅᑐᖓᒃ	Uluaguliit manniit	4	18	29	18	30	58
Duck eggs	ᑭᙵᒃ ᓚᖅᑐᖓᒃ	Tinmiat manniit	5	7	6	4	1	21
Tundra swan eggs	ᖃᓄᔪᐃᓪᓕᒃ ᓚᖅᑐᖓᒃ	Kukyut manniit	1					1
Seagull eggs	ᓇᐅᓴᐃᓪᓕᒃ ᓚᖅᑐᖓᒃ	Nauyat manniit	1	2	6	1	1	11
Thick-billed murre eggs	ᐊᑦᑕᐃᓪᓕᒃ ᓚᖅᑐᖓᒃ	Thick-billed murre eggs			1			1
Black guillemot eggs	ᐱᓕᕆᔨᓪᓕᒃ ᓚᖅᑐᖓᒃ	Black guillemot eggs		1	2			3
Eider down	ᑭᙵᒃ ᖃᓄᖅᖓᒃ	Mitiit qiviungit		2		7	1	10
Arctic char	ᐃᖕᓗᓴᐱᒃ	Ikaliviit	80	93	111	107	101	154
Whitefish	ᑲᐱᓯᔨᒃ	Kapihiliit	2	5	11	4	6	21
Cod	ᐅᓘᐃᒃ	Ugak	21	33	34	35	49	86
Sculpin	ᑲᓇᔪᐃᓪᓕᒃ	Kanayuk	22	12	21	13	20	57
Clams	ᐊᑦᒧᒪᔪᒃ	Uviluq		2		1		3
Mussels	ᐅᐱᓗᐃᓪᓕᒃ	Uviluvaloet	3	2	16	17	13	38

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᓴ ᐱᑕᖃᖕᒥᑐᓂᓴ ᐊᓴᐋᑎᓐᓂᓂᓴ ᐊᖏᔪᒃ ᖃᕋᓯᐅᓂᖕᒥᓄᑦ ᐊᓪᓚᕆᐅᒪᔪᓄᑦ ᐃᓐᓇᕐᓂᖅᓂ ᑐᓴᕆᖕᒥᓂ ᐃᑯᐱᖓᓪᓕᓯᒪᓕᖅᑕᓂᓕᒃ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.1.13 Community Results Discussion: Sanikiluaq

The survey frame:

An assessment of under-enumeration during the community visit revealed that there were approximately 17 hunters who were not registered in the Harvest Study. It is estimated that three of these were non-Inuit occasional hunters with assigned hunting rights, 14 were Inuit hunters, 11 of whom hunted occasionally and three were more active hunters. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. However, the extent of the bias is likely small since although the missing hunters represent nine percent of the total hunter population, they are mostly occasional hunters (Table 10). Harvest estimates for the unregistered hunters can be estimated using mean harvest quantities for each species by strata. However, these estimates, having their own sources of error and bias, are beyond the scope of this Final Report. Readers may apply to NWMB to obtain the results of these calculations.

Survey coverage and non-response bias:

Response rates were consistently low during the first year of the Harvest Study with the majority of months having response rates under 75%. The month of September was the most problematic being under 30% in all strata. Response rates in years 2 to 5 were much higher, with only a few months during which rates dropped below 75%. As seen in Table 9 the consistent intentional non-response rate in Sanikiluaq was moderate, at 3.9%, and there is some potential non-response bias as a result. Given this and the low response rates in year 1 of the study, the potential for both sampling error and non-response bias is high in some months of the study.

Response rates were felt to be high enough in years 2 to 5 and non-response bias low enough during these years to ensure that n did in fact constitute a sufficiently representative sample of N hunters. However, this may not be the case for year 1 data where response rates were consistently lower. Readers should consider this information when using the harvest estimates and should exercise appropriate caution when using year 1 data.

Measurement issues and response error:

Hunters reported during the community visit that they did not know they were supposed to report certain species such as mussels, eider down and eggs. The community considers harvest estimates to be much too low for these species since the harvests were not accurately reported by responding hunters.

Recall periods were generally low in Sanikiluaq, meaning that harvest data provided were collected within six months of the actual harvest date. However there were selected months where backfilling of harvest data took place over six months after the harvest dates. The significance of these longer recall periods is lessened by the fact that many hunters used their calendars to record their harvests in this community (C.F.).

There was no commercial harvesting during the Harvest Study (C.F.). A commercial harvest of eider down took place after the Harvest Study had concluded (Flemming, 2002).

Feedback from the community also indicated that during the first year some hunters were reluctant to report their harvest which may explain the low response rates during this year but also may have resulted in under-reporting of some harvests. The main example of this situation is the beluga harvest in year 1; it is thought that some hunters may not have reported their full catch since they were concerned that the data would be used to limit harvesting in the future (C.F.).

In conclusion, not all survey responses were valid for all species. There appears to be some under-reporting of certain species: mussels, eider down and eggs. There may also have been some under-reporting of beluga harvests in the first year of the study.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvests in Sanikiluaq consisted of mostly reindeer and some barren-ground caribou. A community hunt around December usually yields around 30-35 reindeer. The year 4 estimate appears to be much too low (C.F.).
2. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
3. **Arctic fox:** Harvesting decreased when pelt prices dropped. Now prices are increasing and harvesting has increased since the completion of the NWHS (C.F.).

[4] **Seals:** Pelt prices have increased since the completion of the NWHS resulting in higher harvest numbers since the study ended (C.F.).

[5] **Walrus:** Lower harvests in years 4 and 5 were due to mechanical problems with the community boat (C.F.).

[6] **Beluga:** The year 1 estimate appears low; some hunters were reluctant to report their harvests (C.F.). DFO reports the following harvest numbers for beluga (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
30	19	n/d	32	23

[7] **Snow goose:** Snow goose harvesting depends on wind; they will often fly over and not stop in the area, giving lower harvest numbers (C.F.).

[8] **Canada goose:** The community considers the estimates to be low (C.F.).

[9] **Ross' goose:** The community reported that they are not harvested in the area. The recorded harvest may have been of snow goose (C.F.).

[10] **Eider duck:** Common eiders are harvested in larger numbers than king eiders. Large numbers of common eiders are harvested each year. The year 1 estimate appears too low (C.F.).

[11] **Red breasted merganser:** Estimates seem too low; they should be in the 100's (C.F.).

[12] **Black scoter and white-winged scoter:** Only surf scoters are harvested in the area (C.F.).

[13] **Yellow-billed loon:** Most of the loons harvested are common loons; yellow-billed loons are not seen in the area (C.F.).

[14] **Eggs:** The egg harvest estimates appear to be much too low. It was reported that each year 1000's of goose eggs (mostly Canada goose eggs) are taken, as well as approximately 350 eider eggs (mostly common eider eggs), approximately 250 black guillemot eggs and over 100 seagull eggs are also harvested. The following are also collected but were not reported during the NWHS: arctic tern eggs, snowy owl eggs and pintail eggs (C.F.).

[15] **Eider down:** The harvest estimates are considered to be very, very low. Many people did not know they were to report their down harvests. One hunter commented that he collects down every year, 577 (the year 4 harvest estimate) would be less than one island's worth of down; some islands have over 700 nests (C.F.). A commercial eider down harvest took place in the summer of 2001 (after completion of the NWHS). During this summer it is estimated that approximately 5070 nests were harvested. It is also estimated that down from approximately 1690 nests was harvested before the summer of 2001 (likely during the NWHS) and was sold commercially at the same time (Flemming, 2002). This information supports the claim by the community that eider down harvesting was poorly recorded during the NWHS and harvest estimates are very low.

[16] **Mussels:** All estimates appear too low. Some hunters did not know to report their mussel harvests and others mentioned that nobody counts their catch and often do not wish to estimate their harvests. All harvest estimates should be in the five figure range (C.F.).

6.1.13 ᓄᓇᕗᑦ ᓴᖅᑭᑕᐅᔪᓂᖅ ᐅᖃᖅᑎᑐᑦᑕᑎᑦ: ᓴᓂᓕᕆᖅ

ᖃᐅᔨᓴᓂᐅᓕᒃ ᐊᖅᑭᐹᒪᓂᖏᓐ:

ᕿᒥᖅᑭᔨᐃᑎᓯᓕᒥᑦ ᐊᑎᓂᐅᓐᓂᖏᓕᖅᓴᓂᐅᔪᓂ ᓄᓇᕗᑦ ᗅᓪᓕᖅᑕᐅᑎᓯᓕᒥᑦ ᑕᐃᑎᖏᓪᓕᐅᔭᖅᑐᑦ ᑕᒪᓐᓂ 17ᖏᓚᐅᑦ ᐊᖏᓚᐅᔪᖅᑎᑦ ᐊᑎᖃᖅᑕᐅᓪᓕᐅᔭᕆᑕᑦ ᖃᐅᔨᓴᓂᔪᓐᓇᑦ. ᐃᓗᒪᑦᑎᐅᓪᓕᒪᓕᕐᓂᖅ ᐱᖏᓪᓗᓪᓕᐅᓇᖅᓴᖅᑎᓂᖅ ᐃᓄᖅᑎᑦᑕᑦ ᖃᐅᔨᑎᖅᓯᑦ ᐊᖏᓚᐅᔪᓂᑦ ᑐᓂᔨᐅᓪᓕᐅᒪᓕᕐᓂᖅ, 14ᖏᓚᓕᑎᑎᑦ ᐃᓄᐃᑦ ᐊᖏᓚᐅᔪᖅᑎᑦ, 11ᖅᑭᑦ ᐊᖏᓚᐅᔪᓕᕐᓂᑎᑦ ᖃᐅᔨᑎᖅᓯᑦ ᐊᓪᓚᓗ ᐱᖏᓪᓗᓪᓕᖅᑕᒪᔨᖅ. ᐅᖃᖅᑎᑦᑕᒪᓕᒃ ᓄᓕᐊᑎᑦ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓂᐅᓐᓂᖏᓕᖅᓴᓂᐅᔪᓐᓇᑦ ᐱᒋᑕᐅᓂᖏᓐ ᐊᑎᑎᓕᓂᕐᓗᒪᓚᖅᑐᐃᓐᓇᑦ ᐅᓪᓚᕆᑕᐅᔨᓕᕐᓂᑦ ᖃᓄᖅᑭᑐᓂᖅ. ᑭᓪᓕᖅᑕᐅᔨᓕᕐᓂᖅ, ᖃᓄᑎᑦ ᐃᓕᓴᕐᓂᐅᓂᖏᓐᓂᖅ ᑕᐃᓐᓇᑦ ᐱᖏᓪᓗᓪᓕᖅᑕᐅᔨᓕᕐᓂᑦ ᐅᓪᓚᕆᑕᐅᔨᓴᕆᔨᖅᑐᐃᓐᓇᑦ ᐊᑎᖃ

[4] **ᓇᓗᓂ:** ᖃᓄᐃ ᐊᑭᑐᑕᐊᖅᓯᒪᓂᖅᓴᐅᓕᖅᑎᓪᓗᒍ ᑕᐃᒪᐃᓐᓇᓂᒃ ᐃᓗᓕᓕᐅᕐᓯᒪᓂᒃ ᖃᐅᔨᓴᖅᓂᖅ ᐅᓇᓂᖅᓴᖅᓯᐅᑦ ᐊᒻᐅᓂᖅᓴᖅᐅᓕᕆᓚᐅᑎᒃ ᖃᐅᔨᓴᖅᓂᖅ ᐃᓗᓕᓴᒥᓂᒃ (C.F.).

[5] **ᐊᐃᐃᓂ:** ᖃᓄᐊᓐᓇᐅᓂᖅᓴᓂ ᐱᓕᐅᔪᓐᓇᒥᓂᒃ ᐅᑭᐅᓂ 4 ᐊᓪᓚ 5 ᐊᐅᓕᐅᑦᑐᐊᖃᑎᒌᓚᓂᒃ ᓄᓇᓕ ᐅᒥᐊᖅᓴᖓᓂᒃ (C.F.).

[6] **ᖃᓕᓴᓗᐃᓂ:** ᐅᑭᐅᒃ 1 ᖃᓄᖅᐅᓂᖅᓂ ᐊᓄᓂᑐᐃᓐᓇᖅᑐᑦ; ᐃᓕᖅᓂ ᐊᖏᔪᐊᖅᑎᓂ ᐅᖃᖅᓯᒪᓄᖅᓴᕆᓕᐅᖅᓯᒪᓚᒃᑕ ᖃᓕᓴᓴᖅᑕᒥᓂᒥᓂᒃ (C.F.). ᐃᓚᒥᑎᐅᑕᓂᓱᐃᓐᓄᑦ ᓄᓇᓕᓂᒃ ᖃᓕᓴᓴᖅᑕᐅᑦᑐᓂᒃ (ᖃᐅᔨᓴᒥᓂ ᐃᓚᒥᑎᐅᑕᓂᓱᐃᓐᓄᑦ ᓄᓇᓕᓂᒃ ᒪᓕᓚᒃ ᑭᓇᐅᔨᓴᖅᑐᓕᕆᓚᐅᑎᒃᓴᖅᑐᓂᒃ ᐅᓪᓗᒥᒃ ᐅᓂᖅᓴᖅᑐᓂᒃ ᐊᐅᓚᓕᕆᓚᐅᑎᒃᓴᖅᑐᓂᒃ ᐊᓐᓂᖅᓴᖅᑐᓂᒃ ᓴᖅᑭᑐᓂᒃ ᐃᓚᒋᔭᐅᓂᖅᓴᖅᑐᓂᒃ ᐊᓐᓂᖅᓴᖅ

6.1.13 Nunanit Iniktiguait Ukauhiit: Sanikiluaq

Ihivgiuktit Atugutait:
Ihivgiufaakhimayut ataani apigiyaukataktut nunanut pulaaktakhimapluni takuhimayut 17kuyt umayukhiuktit titigaktauhimaitut Umayukhiukhimayut Ihivgiuktitlugit. Naunaiyakhimayuk pingahut inuinaungitut ilaani umayukhiuktaktut tuniyauhimayut umayukhiugutikhainik inminiigutinik, 14kuyut Inuit umayukhiuktit, 11kuyut ilaani umayukhiukataktut ovalo pingahut umayukhiukatainaktut. Ukakhimayut ilangani 5.2.1 ikpinagutait ataani apigikataktut ataanut ihumagiyauniaktut umayukhiukhimayut naunaiyautaini. Kihimi angitjutait ihumagiyaini mikiyut umayukhiuktut titigaktauhimaitut 9%kuyut tamaat umayukhiuktaktunit tamainit amigaivyamata ilaani umayukhiukatamata (Ikpatauyak 10). Umayukhiukhimayut naunaiyautait titigaktauhimaitut umayukhiuktit naunaiyalaaktut angitjutainik umayukhiukhimayunit atulugit tamamik umayukhimayunik. Kihimi hapkoa naunaiyautit pihimalaamata inminik ovalo ihuinaalaagutaini, avataanuumat hamna Iniktigutit Tuhaktakhani. Taiguaktut apigilaaktut NWMBkunut piyumagumik iniktiguatinik naunaiyautaini.

Ihivgiuktauhimayut ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait mikiyut hivulimi ukiumi Umayukhiukhimayut Ihivgiuktitlugit amigaitut tatkikhiutit kiukataktut naunaiyautait ataaniimata 75%mit. Tatkikhiutit Septembermi ayokhautigikpiaktakut ataaniimat 30%mik tamamik umayukhimayunut. Kiuhimayut naunaiyautait ukiumi 2 ovalo 5 angiyut, kihimi ilangivyak tatkikhiutit naunaiyautait katakhimamata ataanut 75%nit. Takukhauyut ikpatauyami 9 piktakhimayut kiuyuitut naunaiyautait Sanikiluaqmi naamaktut 3.9%mik ovalo pilaamatalu kiuyuitut ihumagiyait pihimayut. Taimaimat, ovalo mikiyut kiuhimayut naunaiyautait ukiumi 1 ihivgiuktitlugit, pilaaktut tamamik ihivgiukhimayut ihuinaakhimayunakhiyut ovalo kiuyuitut ihimagiyaini angiyut ilangaini tatkikhiutini ihivgiuktitlugit.

Kiuhimayut naunaiyautait angiyuuvlutik naamanmata ukiuni 2 ovalo 5 ovalo kiuyuitut ihumagiyaini mikiyuumata hapkoa ukiuni piyaami nni naamaktuk ilauyunut uktukhimayuni Nni umayukhiuktini. Kihimi hamna pihimaituk ukiuni 1 katitikhimayuni kiuhimayut naunaiyautaini mikivaktut. Taiguaktut ihumayukhat hapkoa tuhagutikhat atuligumiuk umayukhiukhimayut naunaiyautait ovalo atulutik ihumagiyakhainik atugutaini ukiumi 1 katitikhimayuni.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Umayukhiuktit tuhaktitihimayut nunani pulaakhimatitlugit nalugamik tuhaktitiyukhat ilangit umayut ilangit; uviluvaluit, mitiit kiviungit ovalo maniit. Nunanit ihumayut umayukhiukhimayut naunaiyautait mikiyut hapkoa umayunik umayukhiukhimayut naamangimata tuhaktitihimayuni kiuhimayunit umayukhiuktinit.

Utiktihimayut apikhugutit mikiyut Sanikiluaqmi, ukakhimayut umayukhiukhimayut katitikhimayut pihimayut iluani siksini tatkikhiutini umayukhimait umayukhiukhimayut ihivgiuktaini. Kihimi ilangit tatkikhiutit katitifaakhimayut umayukhiukhimayut katitigutaini pihimayut avataani siksit tatkikhiutini umayukhiukhimayaini ubluini. Angiyutjutait hapkoa utiktihimayut ubluit mikhihimayut amigaitut umayukhiuktit atukpamata tatkikhiutiminik titigakhugit umayukhimayaminik nunamini (C.F.).

Kinauyaliuktunik umayukhiukhimaitut Umayukhiukhimayut Ihivgiuktitlugit (C.F.). Kinauyaliuktut mitiit kiviunginik pilikatakhimayut inikhimalimata Umayukhiukhimayut Ihivgiutitlugit. (Flemming, 2002).

Kiuhimayut nunanit takukhauyut hivulimi ukiumi ilangit umayukhiuktit piyumangitut tuhaktitilutik umayukhimayaminik, taimaimat mikiyut kiuhimayut naunaiyautait hamani ukiumi kihimi piyukhakhiyut ataaniitut tuhaktitihimayunik ilanginik umayukhimayaminik. Ilaa, hapkoa pihimayut kilaluganik umayukhiukhimayait ukiumi 1mi; ihumagiyavut ilangit umayukhiuktit tuhaktitihimaitut tamaat umayukhimayainik ihumaalugaluagamik katitikhimayut atuktaunianagugivlugit keelinikalugit umayukhimayaminik hivunikhaini (C.F.).

Iniktiguatini, ihivgiukhimayut kiutjutait naamangitut tamamik umayunik. Takukhauyuk ilangit ataani tuhaktitihimayut ilanginik umayunik; uviluvaluit, mitiit kiviungit ovalo maniit. Piyukhakhiyutlu ilangini ataani tuhaktitihimayut kilaluganik hivulimi ukiumi ihivgiuktitlugit.

Nunanit ukakhimayut oval aalat pihimayaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukhimayut Sanikiluaqmi tuktuvaluit ovalo nunanit tuktut. Nunani umayukhiukatigihimayut December pivaktut 30nik 35nut tuktuvaluinik. Ukiumi 4 naunaiyautait mikiyut (C.F.).
2. **Nanuit:** Amigaitjutait takukhauyut naunaiyakafuungitut kihimi pihimayait umayukhimayut amigaitjutait pihimayut DSDkunit (DSD PB).

[3] **Tigiganiat:** Nanigikhiakataktut ikitlihimayut amiit akiit katakhimamata. Ublumi akiit angililimata ovalo nanigikhiakataktut amigailiktut inikhimaliktitlugu umayukhiukhimayut ihivguktitlugit (C.F.).

[4] **Natiit:** Amiit akiit angilihimaliktut inikhimalititlugu umayukhiukhimayut ihivgiukhimatitlugit pihimaligutainik amigailiktut umayukhiukataliktaini inikhimatitlugu ihivgiugutit (C.F.).

[5] **Akviit:** Mikiyut umayukhiukhimayut ukiuni 4 ovalo 5 ayokhakhimagamik inikutainik nunami kayakminik (C.F.).

[6] **Kilalugat:** Ukiumi 1 naunaiyautait mikiyut, ilaa umayukhiuktit ihumaalugaluagamik tuhaktitiyakhainik umayukhimayaminik (C.F.). DFOkut tuhaktitihimayait hapkoa umayukhiukhimayut amigaitjutait kilalugat (nalungilutit DFOkut katitikhimayait atukatamata ukiunganik iniktigutaini, Umayukhiukhimayut ihivgiuktit katitikhimayait atukhimata umayukhiukhimayut ukiunginik atuktaini Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
30	19	n/d	32	23

[7] **Kanguq:** Kangunik umayukhiugutit atukpaktut anugit kanugitkaagat; tinmiinamata avataanut ovalo nutkakhimaitumik nunamini, taimaimat mikiyut umayukhiukhimayut amigaitjutait (C.F.).

[8] **Uluaguliit:** Nunanit ihumayut naunaiyautait mikiyut (C.F.).

[9] **Kakat:** Nunanit tuhaktitihimayut umayukhiuyuitait nunamini. Tuhaktitihimayut kanguuyunakhiyut (C.F.).

[10] **Mitiit:** Mitiit umayukhiukhimayut amigaitkiyait kingalinit. Amigaitut mitiit umayukhiukataktait ukiuk tamaat. Ukiumi 1 mikiyut (C.F.).

[11] **Red breasted merganser:** Naunaiyautait mikiyut, amigaitukhauyut 100nik (C.F.).

[12] **Black scoter and white-winged scoter:** Talvatuak surf scoters umayukhiukpaktut nunani (C.F.).

[13] **Tuliit:** Amigaitkiyait umayukhiukataktait maligiit, tuliit takuyauyuitut nunai (C.F.).

[14] **Maniit:** Maniit pikukhimayut naunaiyautait mikiyut. Tuhaktitihimayut tamamik ukiumi 1,000nik uluaguniit maniinik pivaktut (uluaguliit maniinik), ovalo 350nik mitinik (Mitiit maniinik), ovalo black guillemot maniinik ovalo 100nik nauyat maniinik pikukpaktut. Hapkoa maniit pikuktauvaktut kihimi tuhaktitauyuitut umayukhiukhimayut ihivgiuktitlugit; imitkutailat maniit, okpiit maniit ovalo aahangiit maniit (C.F.).

[15] **Mitiit kiviut:** Kiviut katitikhimayut naunaiyautait mikikpiaktut. Amigaitut Inuit nalugaluamata tuhaktitilugit katitikpaktait kiviut ivavinit. Atauhik umayukhiukti ukakhimayut katitikpaktuk ukiuk tamaat 577nik ivavinit (ukiumi 4mi umayukhiukhimayut naunaiyautait) mikitkiyait atauhik kikiktamit katitiligivaktait; ilangit kikiktat 700nik ivavikaktut (C.F.). Kinauyaliugutit mitiit kiviungit katitikhimayut auyami 2001mi (inikhimatitlugu umayukhiukhimayut ihivgiukhimatltlugit). Auyami 5,070nik ivavinit katitikviuhimayut. Kiviut 1,690nit ivavinit katitikhimayut auyaktinagu 2001mi (katitiktitlugit umayukhiukhimayunik ihivgiuktitlugit) ovalo niuviktititauhimayut kinauyaliugutauplutik aatjikutaanit auyami (Flemming 2002). Hamna tuhagutikhak ikayuktuk pihimayunit nunanit mitiit kiviungit katitiktauvaktut titigatiakhimaitut umayukhiukhimayut ihivgiuktitlugit ovalo katitikhimayut mikiyut.

[16] **Uviluvaluit:** Tamamik naunaiyautait mikiyut. Ilangit umayukhiuktit nalvamata tuhaktitilugit uviluvaluit pivaktainik ovalo aalat ukakhimayut Inuit naunaiyayuimagit pivaktaminik ovalo piyumanginmata naunaiyautainik pivaktainik. Tamamik katitikhimayut 1,000snik pihimayukhat (C.F.).

6.2 Kitikmeot/ᕿᑎᕐᒥᐅᑦ

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 315

Monthly harvest estimates

ᑕᖃᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓚᑦ

Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)

ᐊᑦᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓚ	OCT ᐅᑦᔪᓚ	NOV ᐅᓇᓱᓚ	DEC ᑎᓯᓱᓚ	JAN ᔮᖏᓇᐊᓚ	FEB ᐃᖃᐅᐊᓚ	MAR ᒪᕐᕿ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓴᑦ	**Umajuin**													
Caribou	ᑐᕐᔅᐃᐃᑦ	Tuktut	28	3	12	8		1	7	8	2		25	23	117 ± 21
Wolf	ᐊᒪᓗᐃᑦ	Amagut									1		11		12 ± 6
Arctic fox	ᑎᓗᓚᖅᓂᐊᑦ	Tigiganiat								2		1			3 ± 1
Coloured fox	ᖃᐃᖏᕐᒋᑦ ᑎᓗᓚᖅᓂᐊᑦ	Kalaliit tigiganiat					1		5	10	3	7	1		27 ± 5
Wolverine	ᖃᕐᕿᓵᑦ	Kalvik						3	5	2		1	2		13 ± 2
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik						7	5	4		9			25 ± 9
Arctic ground squirrel	ᓱᓴᓕᑦ	Hikhik	38	13	32	74							22	16	195 ± 92
Seals (unspecified)	ᓱᖃᐃᓪᓕᑦ	Natiit					3								3 ± 2
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq												2	2 ± 2
Canada goose	ᓄᕐᓪᓕᑦ ᐅᓗᐊᒍᓪᓕᑦ	Nikliknik												13	13 ± 9
Ross's goose	ᖃᐅᕐᕿᐃᑦ	Kakat												1	1 ± 1
White-fronted goose	ᓄᕐᓪᓕᑦ	Nirlivik												11	11 ± 9
Tundra swan	ᖁᓕᕿᐃᑦ	Kukyuk												2	2 ± 2
Arctic loon	ᑲᒡᓗᓪᓕᑦ	Maliriq	5												5 ± 3
Ptarmigan	ᐊᖏᓕᒃᑦ	Akilgik						38	2				15		55 ± 12
Duck eggs	ᒥᑎᑦ ᓚᐅᓂᖅᑦ	Tinmiat manniit	17												17 ± 6
Seagull eggs	ᓇᐅᔨᐃᑦ ᓚᐅᓂᖅᑦ	Nauyat manniit	89												89 ± 22
Arctic char	ᐃᖅᓗᒃᕕᑦ	Ikaliviit	202		42	151	160	24	26	95				11	711 ± 228
Lake trout	ᐃᓱᕐᓴᐃᑦ	Ikalukpik	30	5	34		12	3	3	11				12	110 ± 13
Whitefish	ᑲᐱᓱᓪᓕᑦ	Kapihiliit	16		18	6	31	16	8	2				10	107 ± 22
Arctic cisco	ᐅᑭᐅᕐᒋᒥ ᑲᐱᓱᓪᓕᑦ	Kapihilik				2	1								3 ± 3
Cod	ᐅᒪᐃᑦ	Ugak	1		8		105	175							289 ± 49
Sculpin	ᑲᓇᕿᐃᑦ	Kanayuk					1	42						2	45 ± 2

6.2.1

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 316

Monthly hunter response

ᑕᖃᑕᒪᑦ ᐊᖏᔪᓕᕆᔨᑦ ᑭᐅᓂᖅᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᑐᕐᒍ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔮᓂ	JUL ᔮᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐱᕆ	OCT ᐅᑲᐱᕆ	NOV ᓄᐃᓚᕆ	DEC ᑎᓯᓚᕆ	JAN ᔪᓐᓇᐊᕆ	FEB ᐃᖅᑲᐊᕆ	MAR ᒪᕐᕿ	APR ᐃᕐᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᕆᔨᑦ ᑭᐅᓂᖅᑎᑦ ᐊᑐᔪᒪᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒪᑦ ᐊᖏᔪᓕᕆᔨᑦ	Tatkitaman angunahuktut titigait	17	17	17	17	17	17	16	16	16	17	17	17	18*
Hunters interviewed	ᐊᖏᔪᓕᕆᔨᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	16	17	16	9	15	17	16	16	16	13	14	14	18*
Harvested	ᐊᖏᔪᓕᕆᔨᑐᓗᓂ	Angujaujut	13	3	8	3	9	7	5	4	2	3	7	12	17*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᓂᖅᑎᑦ (%)	Kiujut (%)	94	100	94	53	88	100	100	100	100	76	82	82	89**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓕᕆᔨᑦ ᐊᑎᓕᐅᕐᑕᒪᒪᓪᓚᕐᒥᑦ/ᐊᐱᕐᓂᑦᑕ/ᐊᖏᔪᓕᕆᔨᑐᓗᓂᑦ ᐊᑕᐅᓂᐊᖅᓯᒪᔪᑦ ᐊᑲᕐᒍᒥ.
** ᐊᓕᔾᔨᓕᓐᓂᓕᒪᓂᑦ ᑕᑭᑕᒪᑦ ᑭᐅᓂᖅ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 317

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᕐᖏᓂ ᐊᖏᔪᓕᓐᓂᖅᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖅᑕ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓕᕆᑦᑕ ᑎᑎᕐᑦᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᑐᕐᒍ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔮᓂ	JUL ᔮᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐱᕆ	OCT ᐅᑲᐱᕆ	NOV ᓄᐃᓚᕆ	DEC ᑎᓯᓚᕆ	JAN ᔪᓐᓇᐊᕆ	FEB ᐃᖅᑲᐊᕆ	MAR ᒪᕐᕿ	APR ᐃᕐᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖃᑦ	≤ tatkin pingahut	100	100	100	77	98	100	100	100	100	100	100	100	99
4-6 months	4-6 ᑕᖃᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖃᑦ	> 6 tatkin	0	0	0	23	2	0	0	0	0	0	0	0	1

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 318

Number of hunters harvesting each species — Year 1 (June 1996 - May 1997)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖑᓇᓱᒃᑏᑦ ᐊᖑᓇᓱᒃᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐆᒪᔪᕐᓂᒃ — ᐊᒡᕋᒍ 1 (ᔪᓂ 1996 - ᒪᐃ 1997)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒡᒍᑎ	SEP ᓱᑎᒻᐱᕆ	OCT ᐅᑦᑐᐱᕆ	NOV ᓄᕕᒻᐱᕆ	DEC ᑏᓱᒻᐱᕆ	JAN ᔮᓐᓄᐊᕆ	FEB ᕕᕐᕗᐊᕆ	MAR ᒪᑦᓯ	APR ᐃᕐᕆᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	4	1	3	1		1	3	1	1		4	5	8
Wolf	ᐊᒪᕈᐃᑦ	Amagut									1		3		4
Arctic fox	ᑎᕆᒐᓐᓂᐊᑦ	Tigiganiat								1		1			2
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᕆᒐᓐᓂᐊᑦ	Kalaliit tigiganiat					1		2	3	2	2	1		5
Wolverine	ᖃᕐᕕᑦ	Kalvik						2	1	1		1	2		4
Arctic hare	ᐅᑲᓖᑦ	Ukalik						4	3	1		1			6
Arctic ground squirrel	ᓯᒃᓱᑦ	Hikhik	2	1	1	2							3	1	4
Seals (unspecified)	ᓯᖅᑯᓖᑦ	Natiit					1								1
Snow goose	ᑲᖑᐃᑦ	Kanguq												1	1
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik												3	3
Ross's goose	ᖃᕋᕐᔪᐃᑦ	Kakat												1	1
White-fronted goose	ᓂᕐᓖᑦ	Nirlivik												1	1
Tundra swan	ᕐᑯᒡᔪᐃᑦ	Kukyuk												1	1
Arctic loon	ᑲᒡᓗᓖᑦ	Maliriq	1												1
Ptarmigan	ᐊᕿᒡᓱᑦ	Akilgik						1	1				1		1
Duck eggs	ᒥᑏᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit	2												2
Seagull eggs	ᓇᐅᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	5												5
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	9		2	1	2	1	2	1				8	14
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	7	1	6		2	1	2	1				8	15
Whitefish	ᑲᕕᓯᓖᑦ	Kapihiliit	3		1	1	3	1	2	1				1	7
Arctic cisco	ᐅᑭᐅᕐᑕᕐᑐᒥ ᑲᕕᓯᓖᑦ	Kapihilik				1	1								2
Cod	ᐆᒪᐃᑦ	Ugak	1		3		5	5							9
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk					1	5						1	6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 319

Monthly harvest estimates — Year 2 (June 1997 - May 1998)

ᑕᕿᑕᒫᑦ ᐊᖑᔭᓄᑦ ᓇᓚᐅᑦᓴᕈᑏᑦ — ᐊᒃᕋᒍ 2 (ᔪᓂ 1997 - ᒪᐃ 1998)

Tatkiktamat nahaktauvaktun — Ukiunga 2 (June 1997 - May 1998)

6.2.1

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒡᒍᑎ	SEP ᓱᑎᒃᐱᓇ	OCT ᐅᑦᑐᐱᓇ	NOV ᓈᕕᒃᐱᓇ	DEC ᑏᓱᒃᐱᓇ	JAN ᔭᓐᓄᐊᓇ	FEB ᕕᕐᖓᐊᓇ	MAR ᒫᑦᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	20	3		22			18			7	7	6	83 ± 31
Moose	ᑐᒃᑐᕙᐃᑦ	Tuktuvait								2					2 ± 3
Wolf	ᐊᒪᕈᐃᑦ	Amagut										1	6		7 ± 1
Arctic fox	ᑎᓇᒐᓐᓂᐊᑦ	Tigiganiat							6	10	2				18 ± 16
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᓇᒐᓐᓂᐊᑦ	Kalaliit tigiganiat					2	2	11	8	3				26 ± 17
Wolverine	ᖃᕐᕕᑦ	Kalvik						1		4	5		1		11 ± 6
Arctic hare	ᐅᑲᓖᑦ	Ukalik						2			2	1			5 ± 3
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			9	21							7	6	43 ± 22
Seals (unspecified)	ᓱᖅᑯᓖᑦ	Natiit	1												1 ± 1
Ringed seal	ᓇᑦᓱᑦ	Natiinat					4	1							5 ± 3
Geese (unspecified)	ᓂᕐᓖᑦ	Kanguk												2	2 ± 0
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik	3												3 ± 1
Tundra swan	ᖁᒃᔪᐃᑦ	Kukyuk												1	1 ± 0
Red-throated loon	ᖃᖅᓴᐅᑦ	Qaqhuaq	1												1 ± 1
Ptarmigan	ᐊᕿᒡᒋᑦ	Akilgik							20		3				23 ± 28
Duck eggs	ᒥᑏᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit	3												3 ± 2
Seagull eggs	ᓇᐅᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	20												20 ± 8
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	82	42		182	119	232	75		29	41		42	844 ± 269
Lake trout	ᐃᓱᕐᕋᐃᑦ	Ikalukpik	38	20		19	9	16	4		57	26	10	14	213 ± 41
Whitefish	ᑲᕕᓱᓖᑦ	Kapihiliit	12	1		72	127	57	11		14	31		1	326 ± 127
Cod	ᐆᒐᐃᑦ	Ugak	3				194	1,307	438					1	1,943 ± 622
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	2				34	125	13					1	175 ± 45
Turbot	ᖃᓕᕐᓖᑦ	Nataarnak	1												1 ± 1

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 320

Monthly hunter response

ᑕᖃᑦᒪᒃᑦ ᐊᖏᓚᓱᖅᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)

ᐊᒻᒪᓗᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓱᑎᒻᒪᓕ	OCT ᐅᑯᐊᓕ	NOV ᓄᐊᒻᒪᓕ	DEC ᑎᓱᒻᒪᓕ	JAN ᔮᓐᓄᐊᓕ	FEB ᓇᖕᐅᐊᓕ	MAR ᒪᕆ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓚᓱᖅᑎᑦ ᑭᐅᓂᖏᑦ ᐊᒻᒪᓗᓯᓚᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᒪᒃᑦ ᐊᖏᓚᓱᖅᑎᑦ	Tatkitaman angunahuktut titigait	17	16	16	11	11	11	11	12	12	13	15	16	17*
Hunters interviewed	ᐊᖏᓚᓱᖅᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	16	16	9	8	9	9	6	6	7	11	15	16	17*
Harvested	ᐊᖏᓚᓱᖅᑐᒥᓂᑦ	Angujaujut	10	4	1	3	8	8	4	3	4	4	8	10	16*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	94	100	56	73	82	82	55	50	58	85	100	100	78**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓱᖅᑎᑦ ᐊᑎᓕᐅᕐᑕᒪᓕᕆᔨᒃ/ᐊᐱᕐᓂᑦ/ᐊᖏᓚᓱᖅᑐᒥᓂᑦ ᐊᑕᐅᓯᐊᖅᑐᑎᒃ ᐊᓂᕐᒧᑦ.
** ᐊᓕᔾᔨᓕᕆᓂᒪᓕᕆᔨᑦ ᑕᖃᑦᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 321

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᕆᔨᑦ ᐊᑯᐊᖅᓱᓂ ᐊᖏᓚᓱᓕᓂᖓᓄᑦ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓄᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑕᑎᑦ ᐊᖏᓚᓱᖅᑦ ᑎᑎᕐᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)

ᐊᒻᒪᓗᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓱᑎᒻᒪᓕ	OCT ᐅᑯᐊᓕ	NOV ᓄᐊᒻᒪᓕ	DEC ᑎᓱᒻᒪᓕ	JAN ᔮᓐᓄᐊᓕ	FEB ᓇᖕᐅᐊᓕ	MAR ᒪᕆ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᕆᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑭᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑭᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑭᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 322

Number of hunters harvesting each species — Year 2 (June 1997 - May 1998)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖑᓇᓱᒃᑏᑦ ᐊᖑᓇᓱᒃᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐆᒪᔪᕐᓂᒃ — ᐊᒃᕌᒍ 2 (ᔪᓂ 1997 - ᒪᐃ 1998)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — Ukiunga 2 (June 1997 - May 1998)

6.2.1

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒡᒍᑎ	SEP ᓱᑎᒻᐱᓇ	OCT ᐅᑦᑐᐱᓇ	NOV ᓈᕕᒻᐱᓇ	DEC ᑏᓱᒻᐱᓇ	JAN ᔭᓐᓄᐊᓇ	FEB ᕕᕐᕗᐊᓇ	MAR ᒪᑦᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	4	2		2			1			1	2	3	7
Moose	ᑐᒃᑐᕙᐃᑦ	Tuktuvait								1					1
Wolf	ᐊᒪᕈᐃᑦ	Amagut										1	3		4
Arctic fox	ᑎᓇᒐᓐᓂᐊᑦ	Tigiganiat							1	1	1				2
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᓇᒐᓐᓂᐊᑦ	Kalaliit tigiganiat					1	2	1	2	2				6
Wolverine	ᖃᕐᕕᑦ	Kalvik						1		2	2		1		4
Arctic hare	ᐅᑲᓖᑦ	Ukalik						1			1	1			2
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			1	2							1	2	4
Seals (unspecified)	ᓱᖅᑯᓖᑦ	Natiit	1												1
Ringed seal	ᓇᑦᓱᑦ	Natiinat					1	1							2
Geese (unspecified)	ᓂᕐᓖᑦ	Kanguk												1	1
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik	3												3
Tundra swan	ᕐᑯᒻᔪᐃᑦ	Kukyuk												1	1
Red-throated loon	ᖃᖅᓴᐅᑦ	Qaqhuaq	1												1
Ptarmigan	ᐊᕿᒻᒋᑦ	Akilgik							1		1				1
Duck eggs	ᒥᑏᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit	1												1
Seagull eggs	ᓇᐅᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	2												2
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	5	2		1	3	6	2		1	2		4	10
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	5	2		1	3	4	1		4	4	4	6	12
Whitefish	ᑲᕕᓯᓖᑦ	Kapihiliit	3	1		1	3	4	1		1	2		1	9
Cod	ᐆᒐᐃᑦ	Ugak	1				6	7	2					1	9
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	1				5	7	1					1	9
Turbot	ᖃᓕᕋᓖᑦ	Nataarnak	1												1

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 323

Monthly harvest estimates — Year 3 (June 1998 - May 1999)

ᑕᕿᑕᒫᑦ ᐊᖑᔭᓄᑦ ᓇᓚᐅᑦᓴᕈᑏᑦ — ᐊᒃᕋᒍ 3 (ᔪᓂ 1998 - ᒪᐃ 1999)

Tatkiktamat nahaktauvaktun — Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒃᒍᑎ	SEP ᓱᑎᒃᐱᓇ	OCT ᐅᑦᑐᐱᓇ	NOV ᓈᕕᒃᐱᓇ	DEC ᑏᓯᒃᐱᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᕕᕐᕗᐊᓇ	MAR ᒫᑦᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	14		2	4	12			5	9		3	49	98 ± 19
Wolf	ᐊᒪᕈᐃᑦ	Amagut									3	2		6	11 ± 4
Arctic fox	ᑎᓇᒐᓐᓂᐊᑦ	Tigiganiat								1	1				2 ± 0
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᓇᒐᓐᓂᐊᑦ	Kalaliit tigiganiat							2	7	11	1			21 ± 2
Wolverine	ᖃᕐᕕᑦ	Kalvik							1	3	6	4	2	1	17 ± 1
Arctic hare	ᐅᑲᓖᑦ	Ukalik								1	7		1		9 ± 0
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			20	22						1	26	45	114 ± 27
Snow goose	ᑲᖑᐃᑦ	Kanguq												5	5 ± 3
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik	1											29	30 ± 20
Brant goose	ᓂᕐᓕᕐᓇᐃᑦ	Nirlirnaq												12	12 ± 8
Ptarmigan	ᐊᕿᒃᑏᑦ	Akilgik						7		6	11	15	60	19	118 ± 17
Seagull eggs	ᓇᐅᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	4												4 ± 0
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	77			36		194	202		34	15		28	586 ± 95
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	5	1	3	29		10	80		30	5	17	4	184 ± 51
Arctic grayling	ᓱᓗᒃᐸᐅᒐᐃᑦ	Hulupaugaq	3												3 ± 0
Whitefish	ᑲᕕᓯᓖᑦ	Kapihiliit	40			8		356	135					10	549 ± 68
Cod	ᐆᒐᐃᑦ	Ugak						352	104	14					470 ± 56
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk						43	1				4	4	52 ± 3

6.2.1

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 324

Monthly hunter response

ᑕᖅᑕᒫᑦ ᐊᖏᔪᓕᕆᔨᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᒃᑲᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᒃᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᐊᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᒍᖏᓂᐊᓗ	FEB ᓄᖕᐳᐊᓗ	MAR ᒪᑉᓯ	APR ᐃᑦᓀᓪ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᕆᔨᑦ ᑭᐅᓂᖏᑦ ᐋᔪᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒫᑦ ᐊᖏᔪᓕᕆᔨᑦ	Tatkitaman angunahuktut titigait	16	16	10	10	9	8	8	8	8	8	9	15	17*
Hunters interviewed	ᐊᖏᔪᓕᕆᔨᑦ ᐊᐱᓯᓂᑦ	Angunahuktin apikhuktan	16	16	10	9	9	8	7	8	8	8	9	12	17*
Harvested	ᐊᖏᔪᓕᕆᔨᑐᒋᓐ	Angujaujut	6	1	3	6	2	7	4	5	7	3	6	10	14*
Response Rate (%)	ᑭᐅᔭᓂᖏᑦ %ᑲᓯᐅᓂᖏᑦ (%)	Kiujut (%)	100	100	100	90	100	100	88	100	100	100	100	80	96**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓕᕆᔨᑦ ᐊᑎᓕᐅᕐᑕᒪᓕᕐᓂᖅ/ᐊᐱᓯᓂᑦ/ᐊᖏᔪᓕᕆᔨᑐᒋᓐᓂᑦ ᐊᑕᐅᓯᐊᖓᔪᓐᓇᖅ ᐊᒃᑲᒍ.
** ᐊᓂᔨᓕᓐᓂᔭᓕᕐᓂᑦ ᑕᖅᑕᒫᑦ ᑭᐅᔭᓂ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 325

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᕐᔪᑦ ᐊᑯᖏᓐᓂ ᐊᖏᔪᓕᕆᓂᖓᓄᑦ ᐊᓚᓗ ᐊᐱᓯᓂᑦᑕᐅᓂᖓᓄᑦ, ᓇᓗᓇᐃᖏᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓕᕆᑦᑕᑦ ᑎᑎᖏᑦᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐊᒃᑲᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᒃᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᐊᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᒍᖏᓂᐊᓗ	FEB ᓄᖕᐳᐊᓗ	MAR ᒪᑉᓯ	APR ᐃᑦᓀᓪ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᕐᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 326

Number of hunters harvesting each species — Year 3 (June 1998 - May 1999)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖑᓇᓱᒃᑏᑦ ᐊᖑᓇᓱᒃᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐆᒪᔪᕐᓂᒃ — ᐊᒃᕋᒍ 3 (ᔪᓂ 1998 - ᒪᐃ 1999)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒡᒍᑎ	SEP ᓱᑎᒻᐱᓇ	OCT ᐅᑦᑐᐱᓇ	NOV ᓈᕕᒻᐱᓇ	DEC ᑏᓱᒻᐱᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᕕᕐᕗᐊᓇ	MAR ᒪᑦᓯ	APR ᐃᕐᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	1		1	2	2			2	2		2	6	8
Wolf	ᐊᒪᕈᐃᑦ	Amagut									2	2		2	5
Arctic fox	ᑎᓇᒐᓐᓂᐊᑦ	Tigiganiat								1	1				2
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᓇᒐᓐᓂᐊᑦ	Kalaliit tigiganiat							1	2	4	1			4
Wolverine	ᖃᕐᕕᑦ	Kalvik							1	1	2	3	2	1	5
Arctic hare	ᐅᑲᓖᑦ	Ukalik								1	2		1		3
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			1	1						1	4	4	7
Snow goose	ᑲᖑᐃᑦ	Kanguq												2	2
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik	1											2	3
Brant goose	ᓂᕐᓕᕐᓇᐃᑦ	Nirlirnaq												2	2
Ptarmigan	ᐊᕿᒡᒋᑦ	Akilgik						1		1	1	1	2	1	4
Seagull eggs	ᓇᐅᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	1												1
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	4			3		2	2		2	1		5	9
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	3	1	2	4		2	2		4	1	3	2	8
Arctic grayling	ᓱᓗᒃᐸᐅᒐᐃᑦ	Hulupaugaq	1												1
Whitefish	ᑲᕕᓯᓖᑦ	Kapihiliit	2			1		2	2					1	4
Cod	ᐆᒐᐃᑦ	Ugak						4	2	2					5
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk						4	1				2	2	6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 327

Monthly harvest estimates — Year 4 (June 1999 - May 2000)

ᑕᕿᑕᒫᑦ ᐊᖑᔭᓄᑦ ᓇᓚᐅᑦᓴᕈᑏᑦ — ᐊᒃᕋᒍ 4 (ᔪᓂ 1999 - ᒪᐃ 2000)

Tatkiktamat nahaktauvaktun — Ukiunga 4 (June 1999 - May 2000)

6.2.1

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒡᒍᑎ	SEP ᓱᑎᒃᐱᓇ	OCT ᐅᑦᑐᐱᓇ	NOV ᓈᕕᒃᐱᓇ	DEC ᑏᓯᒃᐱᓇ	JAN ᔭᓐᓄᐊᓇ	FEB ᕕᕐᕗᐊᓇ	MAR ᒫᑦᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	6	1	3	13		4	23				3	22	75 ± 17
Wolf	ᐊᒪᕈᐃᑦ	Amagut										2	3	1	6 ± 4
Arctic fox	ᑎᓇᒐᓐᓂᐊᑦ	Tigiganiat							5	1	3				9 ± 5
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᓇᒐᓐᓂᐊᑦ	Kalaliit tigiganiat							7		3				10 ± 6
Wolverine	ᖃᕐᕕᑦ	Kalvik						3	2	1	1		2		9 ± 4
Arctic hare	ᐅᑲᓖᑦ	Ukalik								10					10 ± 7
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			12	24							12	5	53 ± 17
Ringed seal	ᓇᑦᓱᑦ	Natiinat		1	2	1									4 ± 1
Bearded seal	ᐅᒡᔪᐃᑦ	Ukyuk										2			2 ± 2
Snow goose	ᑲᖑᐃᑦ	Kanguq												1	1 ± 1
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik												5	5 ± 4
Ptarmigan	ᐊᕿᒡᒋᑦ	Akilgik							10			11			21 ± 15
Seagull eggs	ᓇᐅᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	23												23 ± 0
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	51	16	64	96	286	43	155					7	718 ± 188
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	4	3	10	13	21	16	28					8	103 ± 29
Whitefish	ᑲᕕᓯᓖᑦ	Kapihiliit	12		21	135	129	11	20						328 ± 76
Cod	ᐆᒐᐃᑦ	Ugak				21	109		134				163		427 ± 184
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk					5		11				57		73 ± 62

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 328

Monthly hunter response

ᑕᖃᑦᒪᒃᑯ ᐊᖏᓚᓱᖅᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)

ᐊᑐᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖃᖏᑐᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒍᑎᑕ	SEP ᓯᑎᒪᓕᕆ	OCT ᐅᑦᔪᓕᕆ	NOV ᐃᓇᒪᓕᕆ	DEC ᑎᓯᒪᓕᕆ	JAN ᔮᖅᓄᐊᓕ	FEB ᓇᑲᐅᐊᓕ	MAR ᒪᕐᕿ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓚᓱᖅᑎᑦ ᑭᐅᓂᖏᑦ ᐋᒍᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᒪᒃᑯ ᐊᖏᓚᓱᖅᑎᑦ	Tatkitaman angunahuktut titigait	15	14	12	9	10	11	12	11	10	11	12	14	18*
Hunters interviewed	ᐊᖏᓚᓱᖅᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	15	13	11	9	8	8	10	8	7	7	7	12	18*
Harvested	ᐊᖏᓚᓱᖅᑐᒥᓂᑦ	Angujaujut	6	2	4	4	5	3	5	2	2	2	4	5	14*
Response Rate (%)	ᑭᐅᔾ ᖃᑦᔨᐅᓂᖏᑦ (%)	Kiujut (%)	100	93	92	100	80	73	83	73	70	64	58	86	81**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓱᖅᑎᑦ ᐊᑎᓕᐅᑦᑕᐅᒪᔪᑦ/ᐊᐱᕐᓂᑦᑕᑦ/ᐊᖏᓚᓱᖅᑐᒥᓂᑦ ᐊᑕᐅᓯᐊᖅᓯᒪᔪᖅ ᐊᑦᑐᒍ.
** ᐊᐅᔨᓕᖅᑎᓯᒪᔪᑦ ᑕᖃᑦᒪᒃᑯ ᑭᐅᔾ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 329

Recall period between harvest and interview, expressed as % of total harvest records

Year 4 (June 1999 - May 2000)

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓚᓂ ᐊᖏᓚᓱᓕᓂᓚᑕ ᐊᒻᒪᓗ ᐊᐱᖏᓪᓕᐅᓂᓚᑕ, ᓇᓗᓇᐃᖏᑦ ᐃᒪᓐ % ᑲᑎᑦᑎᓂᑦ ᐊᖏᓚᓱᓚᑦ ᑎᑎᖏᓪᓕᐅᒪᔪᑦ

ᐊᑐᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖃᖏᑐᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒍᑎᑕ	SEP ᓯᑎᒪᓕᕆ	OCT ᐅᑦᔪᓕᕆ	NOV ᐃᓇᒪᓕᕆ	DEC ᑎᓯᒪᓕᕆ	JAN ᔮᖅᓄᐊᓕ	FEB ᓇᑲᐅᐊᓕ	MAR ᒪᕐᕿ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᑦ Tamakiklugin
Recall Period	**ᐅᑎᖅᑕᐅᔾ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑲ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑲ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 330

Number of hunters harvesting each species — Year 4 (June 1999 - May 2000)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖑᓇᓱᒃᑏᑦ ᐊᖑᓇᓱᒃᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐆᒪᔪᕐᓂᒃ — ᐊᒃᕋᒍ 4 (ᔪᓂ 1999 - ᒪᐃ 2000)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — Ukiunga 4 (June 1999 - May 2000)

6.2.1

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒡᒍᑎ	SEP ᓱᑎᒻᐱᓇ	OCT ᐅᑦᑐᐱᓇ	NOV ᓈᕕᒻᐱᓇ	DEC ᑏᓱᒻᐱᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᕕᕐᕗᐊᓇ	MAR ᒪᑦᓯ	APR ᐃᕐᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	2	1	2	3		1	2				1	3	8
Wolf	ᐊᒪᕈᐃᑦ	Amagut										1	2	1	4
Arctic fox	ᑎᓇᒐᓐᓂᐊᑦ	Tigiganiat							1	1	2				2
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᓇᒐᓐᓂᐊᑦ	Kalaliit tigiganiat							1		2				2
Wolverine	ᖃᕐᕕᑦ	Kalvik						2	1	1	1		1		3
Arctic hare	ᐅᑲᓖᑦ	Ukalik								2					2
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			1	1							1	1	1
Ringed seal	ᓇᑦᓱᑦ	Natiinat		1	1	1									3
Bearded seal	ᐅᒡᔪᐃᑦ	Ukyuk										1			1
Snow goose	ᑲᖑᐃᑦ	Kanguq												1	1
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik												1	1
Ptarmigan	ᐊᕿᒡᒋᑦ	Akilgik							1			1			2
Seagull eggs	ᓇᐅᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	1												1
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	5	2	1	1	2	2	3					1	8
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	3	2	1	2	2	2	2					2	7
Whitefish	ᑲᕕᓯᓖᑦ	Kapihiliit	2		1	2	3	2	3						6
Cod	ᐆᒐᐃᑦ	Ugak				1	3		3				3		9
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk					2		2				2		5

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 331

Monthly harvest estimates — Year 5 (June 2000 - May 2001)

ᑕᕿᑕᒫᑦ ᐊᖑᔭᓄᑦ ᓇᓚᐅᑦᓴᕈᑏᑦ — ᐊᒃᕋᒍ 5 (ᔪᓂ 2000 - ᒪᐃ 2001)

Tatkiktamat nahaktauvaktun — Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒃᒍᕐᑎ	SEP ᓱᑎᒃᐱᓇ	OCT ᐅᑦᑐᐱᓇ	NOV ᓄᕕᒃᐱᓇ	DEC ᑏᓯᒃᐱᓇ	JAN ᔭᓐᓄᐊᓇ	FEB ᕕᕐᕗᐊᓇ	MAR ᒫᑦᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	33		2	6	16	7	8	13		8		1	94 ± 41
Musk-ox	ᐅᒥᒃᒪᐃᑦ	Umingmait								4					4 ± 4
Wolf	ᐊᒪᕈᐃᑦ	Amagut	8				2	5			2	3	3		23 ± 11
Arctic fox	ᑎᓇᒐᓐᓂᐊᑦ	Tigiganiat						1	8	27	15	8			59 ± 26
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᓇᒐᓐᓂᐊᑦ	Kalaliit tigiganiat				1		8	9	13	4	3			38 ± 13
Wolverine	ᖃᕐᕕᑦ	Kalvik							7	3	2	4	3		19 ± 7
Arctic Hare	ᐅᑲᓖᑦ	Ukalik						3		3	3				9 ± 5
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			28	15	23					3	8		77 ± 35
Ringed seal	ᓇᑦᓱᑦ	Natiinat					2								2 ± 2
Bearded seal	ᐅᒡᔪᐃᑦ	Ukyuk					1								1 ± 1
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik												4	4 ± 2
Ptarmigan	ᐊᕿᒡᕆᑦ	Akilgik							19	16			17		52 ± 30
Seagull eggs	ᓇᐅᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	132												132 ± 112
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	117		18	94	325	19	35					2	610 ± 220
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	40	7	4	4	6		5				8	4	78 ± 27
Whitefish	ᑲᕕᓯᓖᑦ	Kapihiliit	17		4	80	36		1						138 ± 67
Least cisco	ᒥᑭᓂᕐᓴᑦ ᑲᕕᓯᓖᑦ	Eetuuk						3							3 ± 3
Cod	ᐆᒪᐃᑦ	Ugak			39	1		311	231						582 ± 205
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk						3							3 ± 3

6.2.1

TABLE/ᓇᓗᓇᐃᔭᐅᖅ/NAUNAIKUTA 332

Monthly hunter response

ᑕᑭᑕᒫᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᒡᕐᔪᒍ 5 (ᔨᓂᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᑭᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓱᑎᒥᕕᓗ	OCT ᐅᑦᑐᕕᓗ	NOV ᓄᐊᒥᕕᓗ	DEC ᑎᓯᒥᕕᓗ	JAN ᒍᖏᓄᐊᓗ	FEB ᓅᖏᐅᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓗᓚ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᒃᔨᓱᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᑭᑕᒫᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	14	15	10	10	12	12	12	12	12	12	12	12	17*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓱᑦᑕᑦ	Angunahuktin apikhuktan	9	13	8	8	10	9	9	9	8	8	9	10	17*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ	Angujaujut	5	2	4	3	4	7	6	3	2	3	4	4	13*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᓂᖏᑦ (%)	Kiujut (%)	64	87	80	80	83	75	75	75	67	67	75	83	76**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᑦᑕᐅᒪᔨᖅᑕᑦ/ᐊᐱᕐᓱᑦᑕᑦ/ᐊᒡᕐᔪᒍᑐᒥᓂᓂᑦ ᐊᑕᐅᓯᐊᖓᔪᓂᑎᑦ ᐊᑦᕿᔪᒥ.
** ᐊᑦᓴᒋᓕᑎᓯᒪᔨᖅ ᑕᑭᑕᒫᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᖅ/NAUNAIKUTA 333

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕋᐅᔨᑦ ᐊᒻᒪᕋᓂ ᐊᖏᔪᓂᓐᓂᒃᑕ ᐊᒪᒪᓗ ᐊᐱᕐᓱᕐᑕᐅᓂᒃᑕ, ᓇᓗᓇᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑦ ᑎᑎᕋᕐᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᒡᕐᔪᒍ 5 (ᔨᓂᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᑭᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓱᑎᒥᕕᓗ	OCT ᐅᑦᑐᕕᓗ	NOV ᓄᐊᒥᕕᓗ	DEC ᑎᓯᒥᕕᓗ	JAN ᒍᖏᓄᐊᓗ	FEB ᓅᖏᐅᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓗᓚ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕋᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	92	67	0	96
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	33	0	1
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	0	0	0	0	0	0	8	0	100	3

TABLE/ᓇᓗᓇᐃᔾᔨᐅᖅ/NAUNAIKUTA 334

Number of hunters harvesting each species — **Year 5 (June 2000 - May 2001)**

ᖃᓄᖅᑐᓂᖏᑦ ᐊᖏᔪᓕᓴᐃᒋᑦ ᐊᖏᔪᓕᓴᐅᕕᒃᓴᖅᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ — **ᐊᓕᖅᔪᒍ 5 (ᔫᓂ 2000 - ᒪᐃ 2001)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 5 (June 2000 - May 2001)**

Month/ᑕᖃᖏᓐᓄ/Tatkia			JUN ᔫᓂ	JUL ᐊᓪᓚᐃ	AUG ᐊᐅᓚᑦᑎᑎ	SEP ᓯᑎᐱᓇᓂ	OCT ᐅᑦᑐᓇᓂ	NOV ᐅᓇᓱᐱᓇᓂ	DEC ᑎᓯᓱᐱᓇᓂ	JAN ᔮᖏᓄᐊᓇᓂ	FEB ᐃᖏᑲᐊᓇᓂ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓕᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	2		1	2	2	1	3	1		1		1	6
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait								1					1
Wolf	ᐊᒪᓪᐃᑦ	Amagut	1				1	3			1	1	1		5
Arctic fox	ᑎᓕᓴᖏᐊᑦ	Tigiganiat						1	3	3	1	1			5
Coloured fox	ᖃᐃᖏᕐᑐᑦ ᑎᓕᓴᖏᐊᑦ	Kalaliit tigiganiat				1		2	4	2	1	1			4
Wolverine	ᖃᖅᐸᐃᑦ	Kalvik							2	1	1	2	1		4
Arctic Hare	ᐅᑲᓪᓕᑦ	Ukalik						1		1	1				3
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik			1	1	1					1	1		1
Ringed seal	ᓇᕐᓱᑦ	Natiinat					1								1
Bearded seal	ᐅᓗᕆᐃᑦ	Ukyuk					1								1
Canada goose	ᓄᕐᓗᑦ ᐅᓪᐊᔪᓕᓗᑦ	Nikliknik												2	2
Ptarmigan	ᐊᖏᓚᑦ	Akilgik							1	1			1		1
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓐᓄᕐᑦ	Nauyat manniit	2												2
Arctic char	ᐃᖃᓗᐲᐸᑦ	Ikaliviit	4		1	2	2	1	1					2	7
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	4	2	1	2	1		1				2	2	7
Whitefish	ᑲᐱᓯᓕᓗᑦ	Kapihiliit	2		1	2	2		1						3
Least cisco	ᒥᑭᓄᖕᑦ ᑲᐱᓯᓕᓗᑦ	Eetuuk						1							1
Cod	ᐅᓚᐃᑦ	Ugak			3	1		3	5						9
Sculpin	ᑲᓇᕆᐃᑦ	Kanayuk						1							1

TABLE/ᓇᓗᓇᐃᔭᐅᖅ/NAUNAIKUTA 335

Annual harvest estimates and five-year mean

ᐊᓐᔪᒍᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓱᓕᑎᑦ ᐊᓚᓗ ᑕᓪᓕᓄᑦ-ᐊᓐᔪᒍᓄᑦ ᐊᐅᔨᓕᕐᒥᓪᓚᕆᑦ

Aragutamat angujauvaktun tatlman araguit iluani

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓐᔪᒍᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

6.2.1

Study Year/ᖃᐅᔨᓴᖅᓯᒪᔪᑦ ᐊᓐᔪᒍ/Ihivgiukhimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᔨᓕᕐᒥᓪᓚᕆᑦ Amigaitkiyait
Species	**ᐅᒪᔪᑦ**	**Umajuin**						
Caribou	ᑐᑐᐃᓄᑦ	Tuktut	117	83	98	75	94	93
Musk-ox	ᐅᒥᖅᒪᐃᓄᑦ	Umingmait	0	0	0	0	4	1
Moose	ᑐᑐᓂᐃᓄᑦ	Tuktuvait	0	2	0	0	0	<1
Wolf	ᐊᒪᓗᐃᓄᑦ	Amagut	12	7	11	6	23	12
Arctic fox	ᑎᓘᑲᓐᓂᐊᑦ	Tigiganiat	3	18	2	9	59	18
Coloured fox	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓘᑲᓐᓂᐊᑦ	Kalaliit tigiganiat	27	26	21	10	38	24
Wolverine	ᖃᕐᕕᒃ	Kalvik	13	11	17	9	19	14
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	25	5	9	10	9	12
Arctic ground squirrel	ᓱᖅᓯᒃ	Hikhik	195	43	114	53	77	96
Seals (unspecified)	ᓴᖃᐅᓪᓚᑦ	Natiit	3	1	0	0	0	1
Ringed seal	ᓇᓱᒃ	Natiinat	0	5	0	4	2	2
Bearded seal	ᐅᓗᔪᐃᓄᑦ	Ukyuk	0	0	0	2	1	1
Geese (unspecified)	ᓂᕐᓚᑦ	Kanguk	0	2	0	0	0	<1
Snow goose	ᑲᖏᒍᓄᑦ	Kanguq	2	0	5	1	0	2
Canada goose	ᓂᕐᓚᑦ ᐅᓪᓴᒍᓐᓚᑦ	Nikliknik	13	3	30	5	4	11
Ross's goose	ᑲᑦᕕᐃᓄᑦ	Kakat	1	0	0	0	0	<1
Brant goose	ᓂᕐᓕᕐᓇᓄᑦ	Nirlirnaq	0	0	12	0	0	2
White-fronted goose	ᓂᕐᓚᑦ	Nirlivik	11	0	0	0	0	2
Tundra swan	ᖁᓗᔪᐃᓄᑦ	Kukyuk	2	1	0	0	0	1
Arctic loon	ᑲᓗᓪᓚᑦ	Maliriq	5	0	0	0	0	1
Red-throated loon	ᖃᖏᕆᐅᑦ	Qaqhuaq	0	1	0	0	0	<1
Ptarmigan	ᐊᖑᓂᑦ	Akilgik	55	23	118	21	52	54
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	17	3	0	0	0	4
Seagull eggs	ᓇᐅᔨᐃᓄᑦ ᒪᓕᓂᖏᑦ	Nauyat manniit	89	20	4	23	132	54
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	711	844	586	718	610	694
Lake trout	ᐃᓱᕋᐃᓄᑦ	Ikalukpik	110	213	184	103	78	138
Arctic grayling	ᓱᓗᒃᐸᐅᓚᐃᓄᑦ	Hulupaugaq	0	0	3	0	0	1
Whitefish	ᑲᐱᓴᓪᓚᑦ	Kapihiliit	107	326	549	328	138	290
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᐱᓴᓪᓚᑦ	Kapihilik	3	0	0	0	0	1
Least cisco	ᒥᑭᓂᖓᑦ ᑲᐱᓴᓪᓚᑦ	Eetuuk	0	0	0	0	3	1
Cod	ᐅᓚᐃᓄᑦ	Ugak	289	1,943	470	427	582	742
Sculpin	ᑲᓇᔪᐃᓄᑦ	Kanayuk	45	175	52	73	3	70
Turbot	ᖃᓕᕋᓪᓚᑦ	Nataarnak	0	1	0	0	0	<1

TABLE/ᓄᓇᓕᐅᑦ/NAUNAIKUTA 336

Annual hunter response

ᐊᓗᖅᔪᑦᓯᒃ ᐊᖏᓐᓇᓕᕆᔨᑦ ᑭᐅᓂᖏᑦ

Angujauvaktu

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓗᖅᔪᓄᑦ (ᓱᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᓗᖅᔪᑎᒃ/Ihivgiukhimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓐᓇᓕᕆᔨᑦ ᑭᐅᓂᖏᑦ ᐊᑎᔪᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᑭᑕᒪᑦ ᐊᖏᓐᓇᓕᕆᔨᑦ	Tatkitaman angunahuktut titigait	18	17	17	18	17	21*
Hunters interviewed	ᐊᖏᓐᓇᓕᕆᔨᑦ ᐊᐱᕐᓂᖅᑕᑦ	Angunahuktin apikhuktan	18	17	17	18	17	21*
Harvested	ᐊᖏᓐᓇᓕᕆᔭᑐᓂᒃ	Angujaujut	17	16	14	14	13	20*
Response Rate (%)	ᑭᐅᔪᑦ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	89	78	96	81	76	84**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖏᓐᓇᓕᕆᔨᑦ ᐊᑎᓕᐅᔪᓐᓇᖅᑐᑦ/ᐊᐱᕐᓂᖅᑕᑦ/ᐊᖏᓐᓇᓕᕆᔭᑐᓂᒃ ᐊᑕᐅᓯᐊᖅᓯᔭᖓᓄᑦ ᖃᐅᔨᓴᖅᓯᒪᔪᖅ.
** ᐊᓕᐅᑎᓪᓗᒥᓐᓇᖅ ᑕᑭᑕᒪᑦ ᑭᐅᔪᑦ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓄᓇᓕᐅᑦ/NAUNAIKUTA 337

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓐ ᐊᖏᓐᓇᓕᕆᓂᖓᓂᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᖅᑕᐅᓂᖓᓂᑕ, ᓄᓇᓕᐅᕐᑕ ᐃᒪᓐ % ᑲᑎᒪᔨᑦ ᐊᖏᓐᓇᓕᕆᓂᑦ ᑎᑎᕐᑕᐅᒪᔪᑦ

Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓗᖅᔪᓄᑦ (ᓱᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᓗᖅᔪᑎᒃ/Ihivgiukhimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᑭᑦ	≤ tatkin pingahut	99	100	100	100	96	99
4-6 months	4-6 ᑕᑭᑦ	tatkin hitaman 6nut	0	0	0	0	1	0
> 6 months	> 6 ᑕᑭᑦ	> 6 tatkin	1	0	0	0	3	1

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 338

Number of hunters harvesting each species

ᖃᓄᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᒃᑎᑦ ᐊᓐᔪᓚᒃᓴᖅᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᑦᑭᔪᓂᑦ (ᔨᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

6.2.1

Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᑭᔪ/Ihivgiukhimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**						
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	8	7	8	8	6	13
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait					1	1
Moose	ᑐᑦᑐᓀᐃᑦ	Tuktuvait		1				1
Wolf	ᐊᒪᓗᐃᑦ	Amagut	4	4	5	4	5	9
Arctic fox	ᑎᓕᑲᓄᐊᑦ	Tigiganiat	2	2	2	2	5	6
Coloured fox	ᖃᐃᓐᖏᑦᑐᑦ ᑎᓕᑲᓄᐊᑦ	Kalaliit tigiganiat	5	6	4	2	4	9
Wolverine	ᖃᑦᕃᑦ	Kalvik	4	4	5	3	4	9
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	6	2	3	2	3	8
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik	4	4	7	1	1	9
Seals (unspecified)	ᓴᖃᐃᓪᓚᑦ	Natiit	1	1				2
Ringed seal	ᓇᑦᓱᑦ	Natiinat		2		3	1	6
Bearded seal	ᐅᓗᐊᕐᓇᑦ	Ukyuk				1	1	1
Geese (unspecified)	ᓄᑦᓚᑦ	Kanguk		1				1
Snow goose	ᑲᖏᔪᓇᑦ	Kanguq	1		2	1		4
Canada goose	ᓄᑦᓚᑦ ᐅᓗᐊᔪᓚᑦ	Nikliknik	3	3	3	1	2	7
Ross's goose	ᖃᐅᑦᕈᐊᓇᑦ	Kakat	1					1
Brant goose	ᓄᑦᓀᑦᓇᐃᓇᑦ	Nirlirnaq			2			2
White-fronted goose	ᓄᑦᓚᑦ	Nirlivik	1					1
Tundra swan	ᑭᓗᕐᓇᑦ	Kukyuk	1	1				1
Arctic loon	ᒪᓗᓪᓚᑦ	Maliriq	1					1
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq		1				1
Ptarmigan	ᐊᑭᓚᑦ	Akilgik	1	1	4	2	1	4
Duck eggs	ᒥᑎᑦ ᓚᓐᓂᑦ	Tinmiat manniit	2	1				3
Seagull eggs	ᓇᐅᔨᐃᑦ ᓚᓐᓂᑦ	Nauyat manniit	5	2	1	1	2	8
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	14	10	9	8	7	16
Lake trout	ᐃᓕᑦᕃᐃᑦ	Ikalukpik	15	12	8	7	7	18
Arctic grayling	ᓗᓗᒃᐸᐅᓚᐃᑦ	Hulupaugaq			1			1
Whitefish	ᑲᐱᓕᓪᓚᑦ	Kapihiliit	7	9	4	6	3	11
Arctic cisco	ᐅᑭᐅᑦᑕᔾᒥ ᑲᐱᓕᓪᓚᑦ	Kapihilik	2					2
Least cisco	ᒥᑭᓂᖓᑦ ᑲᐱᓕᓪᓚᑦ	Eetuuk					1	1
Cod	ᐅᓚᐃᑦ	Ugak	9	9	5	9	9	16
Sculpin	ᑲᓇᕐᓇᐃᑦ	Kanayuk	6	9	6	5	1	11
Turbot	ᖃᓕᕕᓪᓚᑦ	Nataarnak		1				1

6.2 Kitikmeot Region

6.2.1 Community Results Discussion: Bathurst Inlet

The survey frame:
An assessment of under-enumeration indicated that there were very few hunters who were not registered in the Harvest Study.

Given the small size of this community there were only three hunters registered in the active and intensive classifications in most years. All classifications were joined and harvest estimates were calculated for all hunters together; there was no stratification used.

Survey coverage and non-response bias:
There was a lot of month to month variation in response rates during the study. In general years 2, 4 and 5 were more problematic having rates below 75% in two to four months of the year. As the study progressed many of the hunters moved to other communities, such as Cambridge Bay or Kugluktuk, for the winter months. Unlike the practice in most other communities when this occurred (see Section 3.2), hunters were not always added to registration lists in their new community but continued to be interviewed as Bathurst Inlet hunters since they would return there every summer. Many of the months with low responses were during the winter when hunters were living in other communities either for work or for school and were not reached for interview. As seen in Table 9 the consistent intentional non-response rate in Bathurst Inlet was nil and therefore was not a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough in most months in all years to ensure that n did in fact constitute a sufficiently representative sample of N hunters. However, with the exception of year 3 there were months with low response rates during each year of the study. Readers should exercise caution when using the data collected during these months since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:
During the time of the community visits held in the Kitikmeot region in the winter of 2003 most hunters from Bathurst Inlet were living in other communities and the HTO was not active. It was not possible to hold consultations on the data. However, the Fieldworker did report that most hunters in the community used their calendar during the study and reported their harvests accurately.

6.2 ᖃᑎᖏᑦ

6.2.1 ᓄᓇᓕᒃ ᓴᖅᑭᑕᐅᔪᓂᒃ ᐅᖃᖅᑲᐅᑎᒋᔭᑎᑦ: ᖃᓄᖅᓱᐅᑦ

ᖃᐅᔨᓴᓂᐅᑦ ᐊᖅᑭᐅᒪᓂᖅᓱ:

ᖃᒥᖅᑭᓂᖅᑎᑦᓯᔭᒍ ᐊᑎᓕᐅᖅᓯᒪᔭᖅᓵᕐᕕᑦ ᒥᑦᓴᓇᓕᖅᓱᓂᒃ ᖃᐅᔨᓴᓂᐅᑦᑐᑦ ᖃᓄᐃᖅᓯᐅᔪᓄᑦ ᐊᑎᖃᖅᑲᓂᐅᖅᓯᒪᓕᐅᖅᑎᑦᓯᓚᒃᑐᑦ ᐊᖅᓱᓕᓂᑦ ᖃᐅᔨᓴᓂᐅᑦᑎᑦᓯᔭᒍ.

ᐃᓗᒪᓕᑦᓯᔭᒍ ᒥᑭᔪᓕᓐᓄᖅᓱᒃ ᓄᓇᓕᐅᑦ ᐱᖅᑲᓇᐃᖅᑲᐅᓕᐅᖅᑎᑦᓯᑦ ᐊᖅᓱᓕᓂᑦᑐᑦ ᐊᑎᖃᖅᑲᐅᑎᒋᔭᐅᓂᖅ ᓇᓗᓇᐃᔨᒥᖅᑎᖅᑐᓂᖅᓱᓂᒃ ᐊᖅᓱᓕᓂᑦᑐᐃᓐᓇᕐᓂᖅᓱᒃ ᐊᖅᓱᖅᓴᓕ ᐊᑎᒪ ᑕᐃᔨᓴᒃ ᐅᑭᐅᓂ ᑕᒪᐃᔪᒃᖠᓂ, ᓇᓗᓇᐃᔨᒥᖅᑎᐅᔨᓕᐃᑦ ᑲᑎᑕᐅᓕᐅᖅᑎᑦᓯᑦ ᐊᑎᒪᓗ ᐅᒪᔨᖅᑕᐅᓯᒋᐅᑦᑎᑦᓯᑦ ᒥᑦᓯᓂᑦ ᓴᐃᖅᑕᐅᓯᑎᓂᓄᑦ ᑕᒪᐃᔪᓂᑦ ᐊᖅᓱᓕᓂᑦᑎᓂᓗ; ᐊᑐᑐᖅᑕᐅᓂᖅᓴᓕᐅᖅᑎᑦᓯᑦ.

ᖃᐅᔨᓴᖅᑕᐅᔨᓂᑦ ᐊᑎᒪ ᐃᓕᓴᐅᓇᓱᐅᓕᖅᓯᒋᐅᑦᑎᑦᓯᑦ ᑭᐅᖅᑭᑦᓯᑦ:

ᑕᖅᑭᑦ ᐊᑐᓂ ᐊᐅᔾᔨᖅᓯᒪᓂᖅᓴᖃᓕᓕᐅᖅᑎᑦᓯᑦ ᑭᐅᓕᑎᑎᓂᖅᓯᓂᒃ ᖃᐅᔨᓴᓂᐅᑦᖃᖅᑎᑦᓯᔭᒍ. ᑕᒪᐃᔪᑦ ᐅᑭᐅᓂᖅ 2, 4 ᐊᒪᓪᓚ 5 ᐊᖏᐅᖅᓯᓕᐅᑎᖅᓯᓂᖅᓴᓕᐅᖅᑎᑦᓯᑦ ᑭᐅᓕᓕᑦᓯᑦ 75% ᑐᖓᔾᔪᖅᑭᑕᖅᑐᑎᒃ ᑕᖅᑭᓇᑦ ᒪᑉᐸᓇᑦ ᑎᑎᒪᓇᓕᓐ ᐊᖅᑭᐊᑕᒪᑦ. ᖃᐅᔨᓴᓂᖅᓱᖅ ᐱᓕᕆᓕᐊᓂᖅᓴᓂ ᐅᓇᖅᑐᑦ ᐊᖅᓱᓕᓂᑦᑎᑦ ᐊᐅᓚᓕᑎᒥᓕᐅᖅᓯᒪᓕᐅᖅᑎᒃ ᐊᓯᖏᓐᓇᑦ ᓄᓇᓕᓇᑦ, ᓯᑎᓗ ᐃᖅᓴᐅᑉᐳᓯᐊᒧᑦ ᖃᐅᔨᓴᓂᐅᑦᑎᑦᓯᔭᒍ, ᐅᑭᐅᓂᖅᓴᓕᐅᖅᑎᑦᓯᑦ. ᐊᓯᒥᑎᑦ ᓄᓇᓕᓇᑦ ᐱᐅᓯᐅᓴᓯᑦᑕᑐᓂᒃ ᑕᐃᒪᐃᓕᑦᑐᖅᓴᖃᓕᓕᐅᖅᑎᑦᓯᑦ (ᑕᐃᒍᒃ ᓇᓴᐅᑦ 3.2), ᐊᖅᓱᓕᓂᑦᑎᑦ ᐃᓕᓴᐅᓂᖅᐳᓴᐃᓐᓇᖅᑕᓯᐅᖅᑎᑦᓯᑦ ᐊᑎᖃᖅᓯᓄᑦ ᓄᓇᓕᓇᑦᑕᒥᓂ ᐅᓯᐊᓂᓂ ᐊᐱᖅᓯᖅᑕᐅᑦᑕᐃᓐᓇᑕᑦᑑᓂᒃ ᓯᑎᓗ ᐊᖅᓱᓕᓂᑦᑎᑦᓯᐅᓂᖅᓴᖃᓕᓕᐅᖅᑎᑦᓯᑦ ᖃᐅᔨᓴᓂᐅᑦᖃᖅᑎᑦᓯᔭᒍ ᐅᑎᓂᓕᓕᐅᖅᑎᑦᓯᑦ ᐊᐅᓚᑦᑕᒪᑦ. ᑕᖅᑭᒪᓴᐃᑦ ᑭᐅᔨᖅᑎᑎᐊᖅᑕᓯᐅᖅᑎᑦᓯᑦᑐᖅᓴᓂ ᐅᑭᐅᓂᖅᓴᓂᐅᑦ ᐊᖅᓱᓕᓂᑦᑎᑦ ᐊᓯᖏᓐᓇᑦ ᓄᓇᖕᖏᓐᓇᖅᓱᒃ ᐃᖅᖢᓇᐃᓕᖅᓯᒪᓂᖅᓱᒃ ᐅᑭᐅᓂ ᐃᓕᓴᐅᓂᖅᓯᒪᓕᐅᖅᑎᑦᓯᑦᑐᖅᓴᓂ ᐊᐱᖅᓯᖅᑕᐅᔨᓴᐅᓯᒋᐅᑦᑎᑦᓯᑦ ᐅᑭᐅᓂ ᐃᓕᓴᐅᓂᖅᓯᒪᓕᐅᖅᑎᑦᓯᑦᑐᖅᓴᓂ ᐊᐱᖅᓯᖅᑕᐅᔨᓴᐅᓯᒋᐅᑦᑎᑦᓯᑦ ᐅᑭᐅᓂᖅᓴᓂᐅᑦ ᐃᓕᓴᐅᓂᖅᓯᒪᓕᐅᖅᑎᑦᓯᑦ. ᑕᒥᒃᑭᓂᑦ ᓇᓕᖅᖢᒥ 9 ᐱᓵᓕᓂᑦᑎᒃ ᑭᐅᑦᑕᐃᓕᓴᐅᓇᓱᐅᑦᑎᑦᓯᑦ ᖃᓄᖅᓱᓕᓂᑦ ᐱᐅᓯᐅᓴᓯᑦᑕᑐᓂᒃ ᐊᑎᖃᖅᑲᓂᐅᖅᓯᒪᓂᖅᓱᒃ ᐃᓕᓴᐅᓂᖅᓯᒪᓕᐅᖅᑎᑦᓯᑦᑐᖅᓴᓂ ᐃᓕᓴᐅᓇᓱᐅᓕᖅᓯᒋᐅᑦᑎᑦᓯᑦ.

ᓇᓗᓇᐃᔨᒥᖅᑎᑦᓯᑦ ᑭᐅᔪᓂᑦ ᐊᖅᓱᓕ ᑭᐅᔪᓄᑦᓯᑦ ᖃᓄᐃᖅᓯᐅᔪᓄᑦᓯᒃᑐᑦ ᑭᐅᔪᓂᑦᑎᑦᓯᐅᓂᖅᓴᖃᓕᓕᐅᖅᑎᑦᓯᑦ ᑕᓯᐅᔪᓂᑦᑎᑦᓯᐅᓂᖅᓴᖃᓕᓕᐅᖅᑎᑦᓯᑦ ᐱᓕᕆᓕᐊᓂᖅᓴᓂ ᐅᑭᐅᓂᖅᓴᓂᐅᑦ ᐃᓕᓴᐅᓂᖅᓯᒪᓕᐅᖅᑎᑦᓯᑦ ᐃᓕᓴᐅᓇᓱᐅᓕᖅᓯᒋᐅᑦᑎᑦᓯᑦ ᐊᑎᖃᖅᑲᓂᐅᖅᓯᒪᓂᖅᓱᒃ ᐃᓕᓴᐅᓂᖅᓯᒪᓕᐅᖅᑎᑦᓯᑦᑐᖅᓴᓂ ᐊᐱᖅᓯᖅᑕᐅᔨᓴᐅᓯᒋᐅᑦᑎᑦᓯᑦ ᐅᑭᐅᓂᖅᓴᓂᐅᑦ ᐃᓕᓴᐅᓂᖅᓯᒪᓕᐅᖅᑎᑦᓯᑦ.

ᓱᖅᓯᐊᖅᑭᓱᓕᒫᓂᖅᓱᓂᒃ ᐊᑎᒪ ᑭᐅᔾᔨᓴᓂᑦ ᑕᑎᖅᑭᓱᓕᐅᖅᑎᑦᓯᑦ:

ᓄᓇᓕᑦ ᐳᓕᖅᑕᑕᐅᑎᑦᓯᑦ ᖃᐅᔨᒥᐅᓂ ᑭᐅᔪᓂᑦᑎᑦᓯᐅᓂ 2003ᒥ ᐊᖅᓱᓕᓂᑦᑎᑦ ᐅᓂᖅᓴᓂᐊᖅᑎᑦ ᖃᓄᖅᓱᓕᓂᑦ ᓄᓇᖅᑐᓂᒃᑯᓂᖅᓴᖃᓕᓕᐅᖅᑎᑦᓯᑦ ᐊᓯᖏᓐᓇᑦ ᓄᓇᓕᐅᔨᓂ ᐊᑎᒪᓗ ᐊᖅᓱᓕᓂᑦᑎᑦᓯᐅᓂᖅᓴᓕᐅᖅᑎᑦᓯᑦᑐᖅᓴᓂ ᐊᐅᓚᑦᑕᒪᑦ. ᐊᐱᖅᓯᖅᑕᐅᑦᑕᐃᓐᓇᑕᑦᑑᓂᒃ ᐅᑭᐅᓂᖅᓴᓂᐅᑦ ᐃᓕᓴᐅᓂᖅᓯᒪᓕᐅᖅᑎᑦᓯᑦ ᐅᓂᖅᓴᓂᐊᖅᑎᑦ ᖃᐅᔨᒥᐅᓂ ᓄᓇᓕᓇᑦ ᐊᑎᖃᖅᑲᓂᐅᖅᓯᒪᓂᖅᓱᒃ ᓄᓇᓕᓇᑦᑕᒥᓂ ᐊᑎᒪᓗ ᐃᓕᓴᐅᓂᖅᓯᒪᓕᐅᖅᑎᑦᓯᑦᑐᖅᓴᓂ ᐊᐱᖅᓯᖅᑕᐅᔨᓴᐅᓯᒋᐅᑦᑎᑦᓯᑦ ᐅᑭᐅᓂᖅᓴᓂᐅᑦ ᐃᓕᓴᐅᓂᖅᓯᒪᓕᐅᖅᑎᑦᓯᑦ ᐃᓕᓴᐅᓇᓱᐅᓕᖅᓯᒋᐅᑦᑎᑦᓯᑦ ᐊᑎᖃᖅᑲᓂᐅᖅᓯᒪᓂᖅᓱᒃ ᐃᓕᓴᐅᓂᖅᓯᒪᓕᐅᖅᑎᑦᓯᑦᑐᖅᓴᓂ ᐊᐱᖅᓯᖅᑕᐅᔨᓴᐅᓯᒋᐅᑦᑎᑦᓯᑦ ᐅᑭᐅᓂᖅᓴᓂᐅᑦ ᐃᓕᓴᐅᓂᖅᓯᒪᓕᐅᖅᑎᑦᓯᑦ.

6.2 Kitikmeot

6.2.1 Nunanit Iniktigutait Ukauhiit: Kingauk

Ihivgiuktit Atugutait:
Ihivgiufaakhimayuni ataani naunaiyakhimayut Kingaumut pulaakhimapluni nalunaiyakhimayuk ikitut umayukhiuktit titigaktauhimaitut Umayukhiukhimayut Ihivgiuktini.

Mikiyuuplutik nunaa pinghuuyut umayukhiuktit titigaktauhimayut umayukhiukataktut ovalo umayukhiukatainaktut naunaiyautaini tamamivyak ukiuni. Tamamik naunaiyautait katitikhimayut ovalo umayukhiukhimayut naunaiyautait katitikhimayut tamamik umayukhiuktit katitihimaplugit, atungitut aviktugutainik.

Ihivgiuktauhimayut ovalo kiuyuitut ihumagiyait:
Amigaitut tatkikhiutinit aalatkiit kiukatakhimayut naunaiyautait ihivgiuktitlugit. Ukiut 2, 4, ovalo 5 ayonavyaktuk naunaiyautait ataanungakhimata 75%nit malgunit hitamanut tatkikhiutini ukiungani. Ihivgiuktut pitilugit amigaitut umayukhiuktit nuutitikatamata aalanut nunanut; Ikaluktutiamut ovalo Kugluktumut ukiugaagat tatkikhiutini. Aatjikutaatut atuktainik aalani nunani hamna pigaagata (takulugu ilangani 3.2), umayukhiuktit ilauyuitut titigagutainut katitihimayunut nutaami nunainut kihimi pikatainaktut apikhutauplutik Kingaumiutat umayukhiuktit utikatainagamik tamaat auyagaagat. Amigaitut tatkikhiutit mikiyut kiuhimayut ukiugaagat umayukhiuktit nuuhimagaagata aalanut nunanut havakhutik ovaluniit ilihagiaktukhimaplutik ovalo takuyauyuitut ukakatigiyaami. Takukhauyut ikpatauyami 9 pikatainaktut kiuyuitut naunaiyautait Kingaumi pikangituk ovalo ihumaalugiyaungitut ayonaniagutainik kiuyuitut ihumagiyainut.

Kiuhimayut naunaiyautait ihumagiyauyut angiyuumata ovalo kiuyuitut ihumagiyait mikiyuuplutik tamakmivyak tatkikhiutini tamamik ukiuni pigiagani nni pihimayut naamaktumik uktugutini Nni umayukhiuktini. Kihimi ukiumi pingahuani, ilangit tatkikhiutit mikiyut kiukatakhimayut tamamik ukiuni ihivgiuktitlugit. Taiguaktut ihumayukhat atugutainik katitikhimayut katimatjutaini hapkoa tatkikhiutaini pilaamata tamamik uktugutit ihuinaagutikhainik ovalo kiuyuitut ihumagaiyainik angililaamata kiuhimayut naunaiyautait katagaagata.

Atugutingit ihumaiyait ovalo kiuhimayut ihuinaagutait:
Nunanmut pulaakhimagapta Kitikmeoni ukiumi 2003, amigaitut umayukhiuktit Kingaumit inuuligaluamata aalani nunani ovalo HTOkut havangitkaluamat. Pilaitkaluamt ukakatigilugit Inuit katitikhimayunik. Kihimi nunani havakti tuhaktitihimayuk amigaitut umayukhiuktit nunami atukatakhimamata tatkikhiutiminik ihivgiuktitlugit ovalo tuhaktitihimayut umayukhimayaminik nakuuyumik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 339

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ

Tatkiktaman nahaktauvaktun

Year 1 (June 1996 - May 1997)

ᐊᑦᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᓚᓇ	OCT ᐅᑯᐃᓇ	NOV ᐅᐊᓚᓇ	DEC ᑎᓱᓚᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᕕᖕᐅᐊᓇ	MAR ᒪᕐᓂ	APR ᐃᑦᓂᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓐᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	146	24	95	96	376	135	295	223	78	36	19	130	1,653 ± 362
Musk-ox	ᐅᒥᓴᒪᐃᑦ	Umingmait				10		11	10	11	10	12	13		77 ± 43
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡							2						
Wolf	ᐊᒪᓱᐃᑦ	Amagut						2	8		8	5	5		28 ± 18
Arctic fox	ᑎᓚᖏᓂᐊᑦ	Tigiganiat								88	50			6	144 ± 116
Coloured fox	ᖃᐅᖕᖏᑦᑐᑦ ᑎᓚᖏᓂᐊᑦ	Kalaliit tigiganiat							2						2 ± 3
Wolverine	ᖃᒡᐸᑦ	Kalvik											3	3	6 ± 6
Arctic ground squirrel	ᓱᖅᓯᑦ	Hikhik												6	6 ± 9
Ringed seal	ᓇᑦᓯᑦ	Natiinat	13	14	12										39 ± 27
Geese (unspecified)	ᓄᖅᓵᓂᑦ	Kanguk	203											35	238 ± 146
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	116												116 ± 175
Canada goose	ᓄᖅᓵᓂᑦ ᐅᓗᐊᔪᓵᓂᑦ	Nikliknik	18	30		15							3	28	94 ± 57
Eider duck	ᒥᑎᑦ	Kingalik	44	69	50										163 ± 117
Ptarmigan	ᐊᖏᓚᑦ	Akilgik												58	58 ± 68
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓕᓄᖕᑦ	Uluaguliit manniit	23												23 ± 35
Arctic char	ᐃᖃᓗᓴᐃᑦ	Ikaliviit	205	2,601	1,155	25	43	64	313					38	4,444 ± 1,646
Freshwater fish (unspecified)	ᑕᓚᐅᖕᒍᓄᖕᑦᑐᒥ ᐃᖃᓗᐃᑦ	Tahinik Ikaluit												19	19 ± 31
Lake trout	ᐃᓱᒋᕐᐃᑦ	Ikalukpik	880	25	49		60	64	344			83		138	1,643 ± 843
Arctic grayling	ᓱᓗᓴᐅᒪᐃᑦ	Hulupaugaq			3										3 ± 4
Whitefish	ᑲᐱᓱᓂᑦ	Kapihiliit			73		192								265 ± 302
Ocean fish (unspecified)	ᐃᒪᐃᖏᒥ ᐃᖃᓗᐃᑦ	Tagiumi ikaluit												53	53 ± 84

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᒃᓄᑦ ᑎᑎᕋᐅᒪᓕᒃᑐᑦ ᑐᓂᔭᖕᑦ ᐅᑯᐊ ᐃᑯᐊᕐᓇᓕᓴᐅᓕᕆᓂᖅᓯᓐᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 340

Monthly hunter response

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓇᓱᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᒻᒋᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

6.2.2

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᒻᔪᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᓇᒻᓇ	DEC ᑎᓯᒻᓇ	JAN ᒍᖏᓄᓇ	FEB ᐃᖅᑲᓇ	MAR ᒪᕐᓯ	APR ᐃᓕᓴᕐ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓕ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᑎᑦ ᑭᐅᓂᖏᑦ ᐋᔪᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓇᓱᑎᑦ	Tatkitaman angunahuktut titigait	331	332	331	330	330	330	331	330	330	329	328	328	332*
Interview list	ᐊᐱᕐᓂᖅᓴᐃᑦ	Apikiktan	216	217	216	215	215	215	216	215	215	214	213	213	217*
Hunters interviewed	ᐊᖏᔪᓇᓱᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	125	136	155	151	122	129	132	129	135	129	122	120	205*
Harvested	ᐊᖏᔪᓇᓱᐅᒋᔭᖅᑎᑦ	Angujaujut	24	18	19	7	17	12	10	9	9	11	9	18	51*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑦᑐᓂᖏᑦ (%)	Kiujut (%)	58	63	72	70	57	60	61	60	63	60	57	56	61**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᑎᑦ ᐊᑎᓕᐅᔾᔪᑎᓪᓗᒍ/ᐊᐱᕐᓂᖅᓴᐃᑦᑐᖅᑎᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓇᓱᐅᒋᔭᖅᑎᑦ ᐊᑕᐅᓯᐊᓕ%
ᐊᑐᑎᑦ ᐊᒻᒋᒪᑉ.
** ᐊᐅᔾᓀᓐᓯᒪᔪᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 341

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓂᓂ ᐊᖏᔪᓇᓱᓂᓂᒃᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓂᒃᑕ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᑦᑎᓕ ᐊᖏᔪᓇᓱᑦᑕᑦ ᑎᑎᕐᑦᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

ᐊᒻᒋᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᒻᔪᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᓇᒻᓇ	DEC ᑎᓯᒻᓇ	JAN ᒍᖏᓄᓇ	FEB ᐃᖅᑲᓇ	MAR ᒪᕐᓯ	APR ᐃᓕᓴᕐ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓕ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᑯᑦ	≤ tatkin pingahut	0	0	0	0	0	0	24	23	83	100	100	100	28
4-6 months	4-6 ᑕᑯᑦ	tatkin hitaman 6nut	0	0	0	17	73	58	76	77	17	0	0	0	25
> 6 months	> 6 ᑕᑯᑦ	> 6 tatkin	100	100	100	83	27	42	0	0	0	0	0	0	47

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 342

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓚᓯᒃᑎᑦ ᐊᖏᓚᓯᒃᓴᓕᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 1 (June 1996 - May 1997)
ᐊᒻᒋᒍ 1 (ᔪᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

6.2.2

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒍᑐᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒻᐱᓗ	DEC ᑎᓯᒻᐱᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᑉᓯ	APR ᐃᑦᓗᓚ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	9	3	11	5	17	10	7	8	6	7	6	9	39
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait				1		1	1	1	1	2	1		3
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut						1	2		1	2	1		6
Arctic fox	ᑎᓕᑦᓂᓪᓕᐊᑦ	Tigiganiat								2	1			1	3
Coloured fox	ᖃᐅᓪᓗᒋᑦ ᑎᓕᑦᓂᓪᓕᐊᑦ	Kalaliit tigiganiat							1						1
Wolverine	ᖃᑦᓴᓕᑦ	Kalvik											1	1	2
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik												1	1
Ringed seal	ᓇᓗᓱᑦ	Natiinat	2	1	2										4
Geese (unspecified)	ᓂᕐᓂᓪ	Kanguk	6											4	8
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	1												1
Canada goose	ᓂᕐᓂᓪ ᐅᓗᐊᔪᓂᓪ	Nikliknik	3	3		1							1	1	7
Eider duck	ᒥᑎᑦ	Kingalik	2	2	1										4
Ptarmigan	ᐊᖏᓴᑦ	Akilgik												2	2
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓂᓂᖏᑦ	Uluaguliit manniit	1												1
Arctic char	ᐃᖃᓗᓴᐃᑦ	Ikaliviit	6	14	9	1	2	1	1					3	23
Freshwater fish (unspecified)	ᑕᓕᐅᖕᒪᓂᖏᑐᒥ ᐃᖃᓗᐃᑦ	Tahinik Ikaluit												1	1
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	8	1	2		2	1	2			2		1	14
Arctic grayling	ᓱᓗᓴᐅᓕᐃᑦ	Hulupaugaq			1										1
Whitefish	ᑲᐱᓱᓂᑦ	Kapihiliit			2		1								2
Ocean fish (unspecified)	ᐃᒪᐃᖏᒥ ᐃᖃᓗᐃᑦ	Tagiumi ikaluit												1	1

No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

ᑎᑎᕋᕐᒪᔪᓂᒃ ᐱᑕᖃᖕᒥᕐᖃᖅ ᐱᓕᕆᓚᖕᓂᒃ ᐊᖏᓴᑦ ᖃᕋᐅᓂᖕᓂᖅᓂᑦ ᐊᓚᑲᒃᑲᒪᒋᔭᓂᑦ ᐊᖏᓴᓂᑦ ᓇᓚᐅᑉᓯᔪᓂᑦ ᑐᓂᔅᓯᖅᓂ ᑐᓂᔅᓯᖅᓂ ᐃᑯᐊᕐᓚᓂᓕᒃ.

Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔾᔨᐅᑦ/NAUNAIKUTA 343

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓐᓂᑦ

Tatkiktaman nahaktauvaktun

Year 2 (June 1997 - May 1998)

ᐊᑦᖁᔪ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

6.2.2

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᐱᓗ	DEC ᑎᓯᐱᓗ	JAN ᔮᖏᓇᓗ	FEB ᐃᖅᑲᓇᓗ	MAR ᒪᓯ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	32		26	38	107	59	7	9	1		21	59	359 ± 39
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait	1		2	1	1		1			1	1		8 ± 3
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡							1						
Wolf	ᐊᒪᕐᐃᑦ	Amagut								10	2	5	4		21 ± 5
Arctic fox	ᑎᓚᖅᓄᐊᑦ	Tigiganiat						2	7			46	44		99 ± 31
Wolverine	ᖃᑦᕿᑦ	Kalvik								2		1	1		4 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				2									2 ± 2
Seals (unspecified)	ᓴᖅᑯᓪᓚᑦ	Natiit	1	9	3										13 ± 13
Geese (unspecified)	ᓄᑦᓪᓚᑦ	Kanguk	141	13	48	16								193	411 ± 90
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	60												60 ± 49
Canada goose	ᓄᑦᓪᓚᑦ ᐅᓗᐊᔪᓪᓚᑦ	Nikliknik	16												16 ± 12
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	44	38											82 ± 48
Eider duck	ᒥᑎᑦ	Kingalik			43	34									77 ± 59
Ptarmigan	ᐊᖏᓴᑦ	Akilgik					14								14 ± 6
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓄᖅᑦ	Uluaguliit manniit	181												181 ± 148
Duck eggs	ᒥᑎᑦ ᒪᓐᓄᖅᑦ	Tinmiat manniit	12												12 ± 10
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	194	668	328	110	35		22					80	1,437 ± 403
Lake trout	ᐃᓱᖏᕐᐃᑦ	Ikalukpik	170		178	55	2				42	88	286	295	1,116 ± 266
Whitefish	ᑲᐱᓱᓪᓚᑦ	Kapihiliit			10	8			135						153 ± 74
Cod	ᐅᒪᐃᑦ	Ugak									31	60			91 ± 96

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᔪᓂᑦ ᑎᑎᕐᑕᐅᒪᓕᖅᑐᑦ ᑐᓂᒃᖏᕐᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓚᒋᓪᓕᒋᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 344

Monthly hunter response
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᒃᓴᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑐᕐᓗ	NOV ᐅᐊᒃᓗ	DEC ᑎᓯᕐᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᔪ	APR ᐃᓴᓚ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓪᓕᓯᒪᓂᖅ ᑭᐅᓂᖓᑦ ᐱᒋᓯᒪᓂᖓᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑭᒪᑦ ᐊᖏᓪᓕᓯᒪᓂᖅ	Tatkitaman angunahuktut titigait	325	322	316	322	323	321	321	324	325	323	325	320	347*
Interview list	ᐊᐱᕐᓂᖅᓴᐃᑦ	Apikiktan	210	206	199	202	203	200	199	200	201	201	206	200	221*
Hunters interviewed	ᐊᖏᓪᓕᓯᒪᓂᖅ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	179	174	152	189	195	192	183	190	190	188	199	193	210*
Harvested	ᐊᖏᓪᓕᓯᒫᑐᓂᖅ	Angujaujut	19	14	13	13	17	9	6	5	4	6	23	29	60*
Response Rate (%)	ᐱᐅᓴ ᖃᓄᐅᓂᖓᑦ (%)	Kiujut (%)	85	84	76	94	96	96	92	95	95	94	97	97	92**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓪᓕᓯᒪᓂᖅ ᐊᑎᓕᐅᔾᔪᑎᒃᓴᓂᑦ/ᐊᐱᕐᓂᖅᓴᐃᓐᓇᓂᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᓪᓕᓯᒫᑐᓂᖅ ᐊᑕᐅᓯᐊᓗᓄᑦ ᐊᑐᑎᑦ ᐊᒃᕿᒧᑦ.
** ᐊᒃᓴᓴᓕᓐᓂᓯᒪᔨᑦ ᑕᖅᑭᒪᑦ ᐱᐅᓴ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 345

Recall period between harvest and interview, expressed as % of total harvest records
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)
ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᓴᓂᓂᖅᑕ ᐊᖏᓪᓕᓯᒧᓂᓂᖅᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓂᖅᑕ, ᐅᓗᐅᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᓪᓕᓯᒪᑦ ᑎᑎᕐᑦᑕᐅᒪᔨᑦ
ᐊᒃᓴᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑐᕐᓗ	NOV ᐅᐊᒃᓗ	DEC ᑎᓯᕐᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᔪ	APR ᐃᓴᓚ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑭᑦ	≤ tatkin pingahut	100	50	83	71	90	100	100	100	100	100	96	100	92
4-6 months	4-6 ᑕᖅᑭᑦ	tatkin hitaman 6nut	0	18	17	29	10	0	0	0	0	0	4	0	6
> 6 months	> 6 ᑕᖅᑭᑦ	> 6 tatkin	0	32	0	0	0	0	0	0	0	0	0	0	2

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 346

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓇᓴᓕᒃᑎᑦ ᐊᖓᔪᓇᓴᓕᒃᑯᑦᑐᑦ ᐊᑐᓂᓵ ᐅᒪᔨᓂᓵ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 2 (June 1997 - May 1998)

ᐊᓕᖅᔪᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

6.2.2

Month/ᑕᖅᖢᓕ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓕ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᕐᓇᓪ	OCT ᐅᑲᐃᓇᓪ	NOV ᐅᓇᓕᕐᓇᓪ	DEC ᑎᓯᕐᓇᓪ	JAN ᔮᖏᓇᐊᓪ	FEB ᓇᖏᐅᐊᓪ	MAR ᒪᓯ	APR ᐃᓴᓪᓗ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	7		7	10	17	8	3	3	1		8	20	40
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait	1		1	1	1		1			1	1		6
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut								3	1	1	1		4
Arctic fox	ᑎᓗᒃᖓᐊᑦ	Tigiganiat						1	1			2	1		4
Wolverine	ᖃᑦᓴᑦ	Kalvik								2		1	1		3
Arctic hare	ᐅᑲᓪᓕ	Ukalik				1									1
Seals (unspecified)	ᓂᖏᑯᓪᓕ	Natiit	1	1	2										4
Geese (unspecified)	ᓄᑦᓪᓕ	Kanguk	9	2	1	2								18	29
Snow goose	ᑲᖕᐃᑦ	Kanguq	1												1
Canada goose	ᓄᑦᓪᓕ ᐅᓗᐊᔪᓪᓕ	Nikliknik	2												2
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	5	1											6
Eider duck	ᒥᑎᑦ	Kingalik			1	1									2
Ptarmigan	ᐊᖏᓴᑦ	Akilgik					1								1
Goose eggs	ᑲᖕᐃᑦ ᓚᒃᓄᖓᑦ	Uluaguliit manniit	1												1
Duck eggs	ᒥᑎᑦ ᓚᒃᓄᖓᑦ	Tinmiat manniit	1												1
Arctic char	ᐃᖕᓗᒃᐲᑦ	Ikaliviit	12	14	11	5	1		1					5	33
Lake trout	ᐃᓯᕐᓇᑦ	Ikalukpik	12		1	5	1				3	3	19	17	34
Whitefish	ᑲᐱᓯᓪᓕ	Kapihiliit			1	1			2						4
Cod	ᐅᒪᐃᑦ	Ugak									1	1			1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓯᒪᔪᓂᒃ ᐱᑕᖕᖏᑎᐅᖕ ᐱᓴᐊᑎᓕᓂᒃ ᐊᖓᔪᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᕆᒃᐴᒪᔪᓄᑦ ᐊᖓᔪᓄᑦ ᓇᓪᑐᐊᖏᑦᑐᓂ ᑐᓂᓴᖏᓐᓂ ᐃᑯᐊᖏᓪᓕᓪᓕᕆᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 347

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktaman nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᓐᔪᒍ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

6.2.2

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔮᓂ	JUL ᔮᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓱᐱᓗ	DEC ᑎᓯᓱᐱᓗ	JAN ᔮᖏᓂᐊᓗ	FEB ᓄᖅᐅᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᓕᓴᕐ	MAY ᒪᐃ	Total ᑲᑎᑕᒥᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᙵᑐᐃᑦ	Tuktut	13	6	28	49	154	106	18	53	78	69	24	56	654 ± 63
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait	1		1		2					1	4		9 ± 1
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡							3						
Wolf	ᐊᒪᓗᐃᑦ	Amagut					6	9	4		20	6			45 ± 28
Arctic fox	ᑎᓚᒃᓂᐊᑦ	Tigiganiat						28	2		28	43			101 ± 18
Wolverine	ᖃᑦᓴᑦ	Kalvik								1	1	2			4 ± 0
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik				16	2	2				5	11		36 ± 7
Seals (unspecified)	ᓄᖏᑯᓪᓕᑦ	Natiit	14		2	28	2					2			48 ± 14
Ringed seal	ᓇᓂᓱᑦ	Natiinat		1	8									4	13 ± 3
Geese (unspecified)	ᓂᕐᓪᓕᑦ	Kanguk	12												12 ± 5
Canada goose	ᓂᕐᓪᓕᑦ ᐅᓗᐊᔪᓪᓕᑦ	Nikliknik	101	17	15									177	310 ± 55
White-fronted goose	ᓂᕐᓪᓕᑦ	Nirlivik	2		8										10 ± 4
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	22												22 ± 21
Eider duck	ᒥᑎᑦ	Kingalik	11	3											14 ± 4
Loon (unspecified)	ᑐᑦᓪᓕᑦ	Maligik			2										2 ± 1
Ptarmigan	ᐊᖏᓚᑦ	Akilgik				17			4		7	12	22	76	138 ± 33
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	93	21											114 ± 40
Arctic char	ᐃᖃᓗᓴᐱᑦ	Ikaliviit	813	1,084	1,416	1,235	26	168				1		2	4,745 ± 964
Lake trout	ᐃᓱᓪᓕᐃᑦ	Ikalukpik	669	159		196	170	216		2	90	121	420	449	2,492 ± 309
Whitefish	ᑲᐱᓱᓪᓕᑦ	Kapihiliit		41	12	33		308							394 ± 124
Cod	ᐅᓴᐃᑦ	Ugak			17										17 ± 8

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᓪᓂᑦ ᑎᑎᕋᐅᒪᓴᑦ ᑐᓂᔭᖏᑦ ᐅᑯᐊ ᐃᑯᐊᖏᓕᓂᓴᓪᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 348

Monthly hunter response

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᒻᒋᔪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

6.2.2

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᒻᓇᓗ	OCT ᐅᑯᐊᓗ	NOV ᐅᓇᒻᓇᓗ	DEC ᑎᓯᒻᓇᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓇᓱᒋᑦ	Tatkitaman angunahuktut titigait	324	323	324	321	321	325	323	325	323	323	321	320	338*
Interview list	ᐊᐱᕐᓂᖅᓱᐃᑦ	Apikiktan	202	201	199	195	193	196	194	196	194	194	192	191	209*
Hunters interviewed	ᐊᖏᔪᓇᓱᒋᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	189	193	189	190	187	182	185	192	188	183	184	183	204*
Harvested	ᐊᖏᔪᓇᓴᑐᓂᓕᓂᑦ	Angujaujut	33	17	20	26	20	19	8	10	22	23	22	27	68*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑎᓂᖏᑦ (%)	Kiujut (%)	94	96	95	97	97	93	95	98	97	94	96	96	96**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᒋᑦ ᐊᑎᓕᐅᔾᔪᑎᒃᓴᓕᒋᑦ/ᐊᐱᕐᓂᑦᓴᓕᒋᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓇᓴᑐᓂᓕᓂᑦ ᐊᑎᐅᓂᐊᓗᓂ% ᐊᑎᑐᑦ ᐊᒻᒪᔪᒥ.
** ᐊᐅᔨᓂᒃᓯᒪᔾᔪᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 349

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᖏᓂᓂ ᐊᖏᔪᓇᓴᓂᓂᒃᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓂᒃᑕ, ᓇᓗᓇᐃᕐᑦᑕ ᐃᒪᓐ % ᑲᑎᑦᑎᑦ ᐊᖏᔪᓇᓱᒋᑦ ᑎᑎᕐᕕᑦᑕᐅᒪᔾᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐊᒻᒋᔪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᒻᓇᓗ	OCT ᐅᑯᐊᓗ	NOV ᐅᓇᒻᓇᓗ	DEC ᑎᓯᒻᓇᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕆᑦ	≤ tatkin pingahut	100	100	100	57	83	100	100	100	100	100	95	98	93
4-6 months	4-6 ᑕᕆᑦ	tatkin hitaman 6nut	0	0	0	43	17	0	0	0	0	0	5	0	7
> 6 months	> 6 ᑕᕆᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	2	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 350

Number of hunters harvesting each species

ᖃᑦᔪᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᖅᑎᑦ ᐊᖏᔪᓚᐱᖅᓯᒪᔭᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 3 (June 1998 - May 1999)

ᐊᒻᒪᒍ 3 (ᔪᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

6.2.2

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᔅᑎᑎ	SEP ᓯᑎᐅᓚᓇ	OCT ᐅᑲᐃᓚᓇ	NOV ᐅᓇᓕᕐᓚᓇ	DEC ᑎᓯᓕᕐᓚᓇ	JAN ᔮᖅᓇᐊᓇ	FEB ᓄᖁᐊᓇ	MAR ᒪᓯ	APR ᐃᓴᓇᓗ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	4	4	9	16	18	16	6	9	17	18	9	20	53
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait	1		1		2					1	3		5
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut					1	1	1		4	4			6
Arctic fox	ᑎᓗᒃᑖᐊᑦ	Tigiganiat						1	1		2	3			4
Wolverine	ᖃᑦᕿᐃᑦ	Kalvik								1	1	2			3
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik				6	1	1				3	5		14
Seals (unspecified)	ᓴᖅᑯᓪᓕᑦ	Natiit	10		1	10	1					1			18
Ringed seal	ᓇᓴᓪᓕ	Natiinat		1	4									2	6
Geese (unspecified)	ᓄᖅᓪᓕᑦ	Kanguk	3												3
Canada goose	ᓄᖅᓪᓕᑦ ᐅᓗᐊᔪᓪᓕᑦ	Nikliknik	9	3	2									15	24
White-fronted goose	ᓄᖅᓪᓕᑦ	Nirlivik	1		1										2
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	3												3
Eider duck	ᒥᑎᑦ	Kingalik	4	1											5
Loon (unspecified)	ᑐᑦᓪᓕᑦ	Maligik			1										1
Ptarmigan	ᐊᖏᓴᑦ	Akilgik				1			1		1	1	1	3	4
Goose eggs	ᑲᖕᒍᑦ ᒪᓐᓄᖅᑦ	Uluaguliit manniit	4	1											5
Arctic char	ᐃᖃᓗᓴᐅᑦ	Ikaliviit	27	14	14	14	3	4				1		2	40
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	16	3		18	8	4		1	7	9	15	12	46
Whitefish	ᑲᕕᓱᓪᓕᑦ	Kapihiliit		1	2	3		3							8
Cod	ᐅᓴᐃᑦ	Ugak			1										1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓪᒪᓂᖅ ᐱᑕᖃᖕᒋᐊᖅ ᐱᓴᓂᓕᓄᖅ ᐊᖏᔪᒃ ᖃᑦᔪᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᕆᐅᓂᖏᓐᓄᑦ ᐊᖏᔪᓄᑦ ᓇᓪᑕᐅᓕᖅᑐᑦ ᑐᓂᔭᖏᓐᓄᑦ ᐃᑯᐱᕋᓂᓗᒍᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 351

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓀᑦ

Tatkiktaman nahaktauvaktun

Year 4 (June 1999 - May 2000)

ᐊᓐᖁᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

6.2.2

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓐᐱᓗ	DEC ᑎᓴᐱᓗ	JAN ᔮᖏᓇᓗ	FEB ᓄᖅᐳᓇᓗ	MAR ᒪᕐᓴ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓴᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	5	2	18	48	227	76	44	51	46	34	51	113	715 ± 65
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait			1	9	1	7							18 ± 10
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡							1						
Wolf	ᐊᒪᓗᐃᑦ	Amagut								2		1		1	4 ± 1
Arctic fox	ᑎᓚᒃᓄᐊᑦ	Tigiganiat						94	17	23	37	65	29		265 ± 59
Wolverine	ᖃᕐᕿᑦ	Kalvik										1	2		3 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				2		6							8 ± 2
Seals (unspecified)	ᓴᖅᑯᓪᓚᑦ	Natiit											2		2 ± 2
Ringed seal	ᓇᕐᓴᑦ	Natiinat	10	45	29	2								4	90 ± 16
Geese (unspecified)	ᓄᕐᓚᑦ	Kanguk												36	36 ± 23
Canada goose	ᓄᕐᓚᑦ ᐅᓗᐊᔪᓚᑦ	Nikliknik	259	17	104	4									384 ± 93
Eider duck	ᒥᑎᑦ	Kingalik	190		4	1									195 ± 58
Ptarmigan	ᐊᖏᓴᑦ	Akilgik												99	99 ± 63
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓄᖅᑦ	Uluaguliit manniit	131												131 ± 55
Arctic char	ᐃᖃᓗᓴᐅᑦ	Ikaliviit	977	4,087	3,063	965	129	21							9,242 ± 1,422
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	440	86	317	51	32	6	9	11	93	265	167	99	1,576 ± 414
Whitefish	ᑲᐱᓱᓚᑦ	Kapihiliit			28		139		39						206 ± 73
Cod	ᐅᒪᐃᑦ	Ugak		22											22 ± 14

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᑦᓂᑦ ᑎᑎᕐᒥᒪᓴᑦ ᑐᓂᓴᖏᑦ ᐅᑯᐊ ᐃᑯᓴᖅᓭᓐᓂᒃᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 352

Monthly hunter response

ᑕᖅᑕᒪᒃ ᐊᖏᔪᓇᓱᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)

ᐊᑐᖃᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑐᕐᓇ	NOV ᐅᐊᒻᓇ	DEC ᑎᓯᒻᓇ	JAN ᒍᖏᓂᓇ	FEB ᐃᖅᑲᓇ	MAR ᒪᕐᓯ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓇᓱᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃ ᐊᖏᔪᓇᓱᑎᑦ	Tatkitaman angunahuktut titigait	318	322	322	326	325	323	319	321	323	321	321	321	347*
Interview list	ᐊᐱᕐᓂᖅᓱᐃᑦ	Apikiktan	192	195	194	193	194	194	193	194	196	195	195	195	209*
Hunters interviewed	ᐊᖏᔪᓇᓱᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	168	184	188	182	183	188	190	189	185	182	180	173	198*
Harvested	ᐊᖏᔪᓇᓱᑐᒋᓐᓂᑦ	Angujaujut	17	28	43	25	29	15	9	12	14	13	17	26	67*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑦᑐᓂᖏᑦ (%)	Kiujut (%)	88	94	97	94	94	97	98	97	94	93	92	89	94**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᑎᑦ ᐊᑎᓕᐅᕐᒥᓪᓗᑎᒃ/ᐊᐱᕐᓂᖅᓱᐃᑦᑐᓂᒃ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓇᓱᑐᒋᓐᓂᑦ ᐊᑕᐅᓯᐊᓗᓄᑦ ᐊᑐᐃᑦ ᐊᑎᔪᒥ.
** ᐊᐅᔨᓂᕐᓂᓯᒪᔨᑦ ᑕᖅᑕᒪᒃ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 353

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᖏᓂᓂ ᐊᖏᔪᓇᓱᓂᓂᓪᓗᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓂᑕ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓚᑲ % ᑲᑎᑕᑎᑦ ᐊᖏᔪᓇᓱᑦᑕ ᑎᑎᕐᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)

ᐊᑐᖃᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑐᕐᓇ	NOV ᐅᐊᒻᓇ	DEC ᑎᓯᒻᓇ	JAN ᒍᖏᓂᓇ	FEB ᐃᖅᑲᓇ	MAR ᒪᕐᓯ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	0	93	96	100	100	100	100	100	100	100	100	100	88
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	82	7	4	0	0	0	0	0	0	0	0	0	10
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	18	0	0	0	0	0	0	0	0	0	0	0	2

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 354

Number of hunters harvesting each species

ᖃᑦᕿᐅᓂᖏᑦ ᐊᖏᔪᓕᓴᐃᑎᑦ ᐊᖏᔪᓕᓴᐅᕐᕕᒋᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 4 (June 1999 - May 2000)

ᐊᒡᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

6.2.2

Month/ᑕᖃᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓯᑎᒻᒪᓗ	OCT ᐅᑦᔪᓗ	NOV ᐅᓇᒻᒪᓗ	DEC ᑎᓯᒻᒪᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	1	1	5	18	29	14	7	8	8	6	11	22	50
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait			1	4	1	2							6
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut								1		1		1	3
Arctic fox	ᑎᓗᒃᑯᐊᑦ	Tigiganiat						1	1	1	1	1	1		1
Wolverine	ᖃᑦᕿᓵᑦ	Kalvik										1	2		2
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				1		2							3
Seals (unspecified)	ᓴᖅᑯᓪᓚᑦ	Natiit											1		1
Ringed seal	ᓇᓴᓪᓚ	Natiinat	4	14	11	2								1	25
Geese (unspecified)	ᓄᖅᓪᓚᑦ	Kanguk												3	3
Canada goose	ᓄᖅᓪᓚᑦ ᐅᓗᐊᔪᓪᓚᑦ	Nikliknik	11	3	8	1									20
Eider duck	ᒥᑎᑦ	Kingalik	11		1	1									13
Ptarmigan	ᐊᕿᒻᒪᑦ	Akilgik												5	5
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓄᖅᑦ	Uluaguliit manniit	10												10
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	17	26	36	10	5	1							50
Lake trout	ᐃᓱᒋᔭᐃᑦ	Ikalukpik	6	2	5	3	4	1	1	3	5	6	9	6	27
Whitefish	ᑲᐱᓱᓪᓚᑦ	Kapihiliit			3		1		1						4
Cod	ᐅᒪᐃᑦ	Ugak		1											1

No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

ᑎᑎᕋᓪᒪᔨᓄᖅ ᐱᒋᐊᑎᓕᓐᓄᖅ ᐊᖏᔪᑦ ᖃᑦᕿᐅᓂᖏᓐᓄᓪᓕᑦ ᐊᓪᓚᕆᑦ ᐊᖏᔪᓄᑦ ᓇᓪᑕᐅᑎᓪᓗᒍ ᐃᓄᐃᑦᑎᓪᓗᒍ ᐃᓕᓴᕐᓂᐊᓕᒫᑦ.

Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 355

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktaman nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᓐᔅᔪᒍ 5 (ᔮᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

6.2.2

Month/ᑕᖅᖏᓐᓄ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᐹᓗ	OCT ᐅᑦᔪᓗ	NOV ᐅᓇᓴᓗ	DEC ᑎᓯᓴᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᑉᓯ	APR ᐃᑦᓀᓪ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᐃᑦ	Tuktut	40	9	34	60	278	42	26	25	16	17	74	51	672 ± 42
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait			2	2	1	3	1	2					11 ± 1
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡							2						
Tundra grizzly	ᐊᖏᓪᓚᐃᑦ	Akhait	1		1										2 ± 0
Wolf	ᐊᒪᕐᕕᐃᑦ	Amagut						1	14			9	36	7	67 ± 32
Arctic fox	ᑎᓗᒃᑲᓂᐊᑦ	Tigiganiat						43	120	144	83	114	16		520 ± 58
Wolverine	ᖃᐅᓴᑦ	Kalvik						1	1			1	3		6 ± 3
Arctic hare	ᐅᑲᓕᑦ	Ukalik	2		4	13	9			9	14				51 ± 16
Arctic ground squirrel	ᓱᖏᓕᑦ	Hikhik											21		21 ± 11
Seals (unspecified)	ᓱᖃᐊᓕᑦ	Natiit	1	13	14								2		30 ± 7
Ringed seal	ᓇᑦᓱᑦ	Natiinat	18	74	53	32	6	1					1	62	247 ± 56
Geese (unspecified)	ᓂᐅᓕᑦ	Kanguk	365	96	70										531 ± 87
Canada goose	ᓂᐅᓕᑦ ᐅᓗᐊᔪᓕᑦ	Nikliknik		67	40								2	342	451 ± 130
Pintail	ᖃᐃᒪᒋᐊᖅ	Arnaviaq	1												1 ± 0
Eider duck	ᒥᑎᑦ	Kingalik	173	87	50										310 ± 66
Loon (unspecified)	ᑐᑦᓕᑦ	Maligik		8											8 ± 5
Arctic loon	ᒪᑦᓗᓂᒃ	Maliriq			1										1 ± 0
Yellow-billed loon	ᑐᓪᓂᒃᓴᐊᑦ	Tuulik			1	2									3 ± 0
Ptarmigan	ᐊᖏᓕᑎᑦ	Akilgik				12		7						29	48 ± 27
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit	10												10 ± 3
Arctic char	ᐃᖃᓗᐊᖅᑕᑦ	Ikaliviit	915	2,956	5,309	2,009	522	11	129				54	530	12,435 ± 1,250
Lake trout	ᐃᓱᒋᕆᐃᑦ	Ikalukpik	393	39	118	18	118	6	3	114	241	121	245	134	1,550 ± 376
Whitefish	ᑲᐱᓱᓂᑦ	Kapihiliit					10	15	123						148 ± 42
Cod	ᐅᒪᐃᑦ	Ugak		72	8						70				150 ± 61

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᓴᑦ ᑎᑎᕋᐅᒪᓕᖅ ᑐᓂᔨᖏᑦ ᐅᑯᐊ ᐃᑯᕐᓴᓪᓕᐊᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 356

Monthly hunter response

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᒡᕐᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

6.2.2

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒡᔨᑎ	SEP ᓱᑎᒻᒪᓗ	OCT ᐅᑲᐃᓗ	NOV ᐅᓇᒡᒻᒪᓗ	DEC ᑎᓯᒻᒪᓗ	JAN ᒍᖏᓇᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓕ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓇᓱᒋᑦ	Tatkitaman angunahuktut titigait	317	317	315	317	319	319	318	316	317	319	319	319	332*
Interview list	ᐊᐱᕐᓂᕐᒪᐃᑦ	Apikiktan	191	191	189	191	194	194	193	191	192	194	194	194	206*
Hunters interviewed	ᐊᖏᔪᓇᓱᒋᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	185	171	187	188	188	181	183	185	186	184	184	178	200*
Harvested	ᐊᖏᔪᓇᓴᑐᓂᓕᓂᑦ	Angujaujut	31	32	43	31	31	10	10	10	9	13	32	27	64*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑦᑐᓂᖏᑦ (%)	Kiujut (%)	97	90	99	98	97	93	95	97	97	95	95	92	95**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᒋᑦ ᐊᑎᓕᐅᔾᔪᑕᒪᓂᖅ/ᐊᐱᕐᓂᕐᓵᓂᖅ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓇᓴᑐᓂᓕᓂᑦ ᐊᑕᐅᓯᐊᓗᓂ% ᐊᑐᓂᖅ ᐊᒡᕐᔪᒍ.
** ᐊᐅᔾᔨᓕᑎᓯᒪᔪᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 357

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓇᓯᓂᖓᓴᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓴᑕ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓵ % ᑲᑎᑦᑎᓕᑦ ᐊᖏᔪᓇᓱᑕᑦ ᑎᑎᕐᕕᑦᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᒡᕐᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒡᔨᑎ	SEP ᓱᑎᒻᒪᓗ	OCT ᐅᑲᐃᓗ	NOV ᐅᓇᒡᒻᒪᓗ	DEC ᑎᓯᒻᒪᓗ	JAN ᒍᖏᓇᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓕ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	93	100	87	100	100	94	100	100	100	100	87	99	96
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	7	0	13	0	0	6	0	0	0	0	13	1	4
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 358

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓚᖅᑎᑦ ᐊᖓᔪᓚᖅᓴᓐᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 5 (June 2000 - May 2001)

ᐊᒡᒋᒍ 5 (ᔪᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᓕ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᒍᓐᓇᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᕆ	APR ᐃᕐᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᕐᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	12	4	14	14	28	8	5	7	4	6	22	13	54
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait			2	1	1	2	1	1					5
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒃᓪᓚᐃᑦ	Akhait	1		1										1
Wolf	ᐊᒪᕐᐃᑦ	Amagut						1	3			2	5	1	9
Arctic fox	ᑎᓗᒃᑲᓂᐊᑦ	Tigiganiat						1	4	4	4	3	1		6
Wolverine	ᖃᑦᓴᑦ	Kalvik						1	1			1	2		5
Arctic hare	ᐅᑲᓪᓕ	Ukalik	1		1	4	2			1	2				8
Arctic ground squirrel	ᓂᕆᔨᑦ	Hikhik											1		1
Seals (unspecified)	ᓂᖏᐊᓪᓕᑦ	Natiit	1	3	3								1		7
Ringed seal	ᓇᑦᓂᑦ	Natiinat	4	10	12	8	1	1					1	7	28
Geese (unspecified)	ᓄᑦᓯᓪᓕ	Kanguk	16	3	4										20
Canada goose	ᓄᑦᓯᓪᓕ ᐅᓗᐊᒍᓪᓕᑦ	Nikliknik		1	2								1	16	20
Pintail	ᖃᐅᓕᐊᓪᓚᖅ	Arnaviaq	1												1
Eider duck	ᒥᑎᑦ	Kingalik	7	3	2										11
Loon (unspecified)	ᑐᑦᓯᓪᓕ	Maligik		2											2
Arctic loon	ᑲᒡᓗᓂᒃ	Maliriq			1										1
Yellow-billed loon	ᑐᑦᓂᒡᔪᐊᑦ	Tuulik			1	1									1
Ptarmigan	ᐊᖏᒡᑎᑦ	Akilgik				1		1						2	4
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit	2												2
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	22	29	37	20	10	1	2				2	8	55
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	9	3	6	1	6	1	1	1	2	3	11	7	29
Whitefish	ᑲᐱᓱᓪᓕᑦ	Kapihiliit					1	1	1						3
Cod	ᐅᒪᐃᑦ	Ugak		1	1						2				3

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓪᒪᔪᓂᒃ ᐱᑕᖃᖕᒋᑐᖅ ᐱᓕᔪᓕᓐᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᑦᓂᑦ ᐊᓕᓴᐅᒪᓪᓕᑦ ᐊᖏᔪᓂᑦ ᓇᓪᓕᕐᓂᐸᒋᑐᓂ ᑐᓂᓴᖏᑦᓂ ᐃᑯᐱᖏᓪᓕᓚᐲᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 359

Annual harvest estimates and five-year mean

ᐊᓐᖁᔭᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᑭᑦ ᐊᓘᓗ ᑕᒻᓕᓂᑦ-ᐊᓐᖁᔭᓂᑦ ᐊᐅᑎᓕᖅᑐᓕᕐᒪᑦ

Aragutamat angujauvaktun tatlman araguit iluani

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᓐᖁᔭᓂᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

6.2.2

Study Year/ᖃᐅᔨᓴᖅ ᐊᓐᖁᔭ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᑎᓕᖅᑐᓕᕐᒪᑦ Amigaitkiyait
Species	ᐅᒪᔪᑦ	**Umajuin**						
Caribou[1]	ᑐᑐᐃᐃᑦ[1]	Tuktut[1]	1,653	359	654	715	672	811
Musk-ox[2]	ᐅᒥᖅᒪᐃᑦ[2]	Umingmait[2]	77	8	9	18	11	25
Polar bear[3]	ᓇᓂᐃᑦ[3]	Nanuit[3]	4	3	4	1	2	3
Tundra grizzly	ᐊᑲᓪᓚᑦ	Akhait	0	0	0	0	2	<1
Wolf[4]	ᐊᒪᕐᐃᑦ[4]	Amagut[4]	28	21	45	4	67	33
Arctic fox[5]	ᑎᓚᖓᓂᐊᑦ[5]	Tigiganiat[5]	144	99	101	265	520	226
Coloured fox	ᖃᑯᖏᑦᑐᑦ ᑎᓚᖓᓂᐊᑦ	Kalaliit tigiganiat	2	0	0	0	0	<1
Wolverine[6]	ᖃᓘᐃᑦ[6]	Kalvik[6]	6	4	4	3	6	5
Arctic hare	ᐅᑲᓪᓕ	Ukalik	0	2	36	8	51	19
Arctic ground squirrel	ᓱᑲᓱᑦ	Hikhik	6	0	0	0	21	5
Seals (unspecified)[7]	ᓴᖃᑯᓪᓕᑦ[7]	Natiit[7]	0	13	48	2	30	19
Ringed seal[7]	ᓇᕆᑦ[7]	Natiinat[7]	39	0	13	90	247	78
Geese (unspecified)[8]	ᓄᖅᓪᓕᑦ[8]	Kanguk[8]	238	411	12	36	531	246
Snow goose[8]	ᑲᖕᒍᐃᑦ[8]	Kanguq[8]	116	60	0	0	0	35
Canada goose[8]	ᓄᖅᓪᓕᑦ ᐅᓗᐊᒍᓪᓕᑦ[8]	Nikliknik[8]	94	16	310	384	451	251
White-fronted goose[8]	ᓄᖅᓪᓕᑦ[8]	Nirlivik[8]	0	0	10	0	0	2
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	0	82	22	0	0	21
Pintail	ᖁᓕᒍᐊᓱᑦ	Arnaviaq	0	0	0	0	1	<1
Eider duck[9]	ᒥᑎᑦ[9]	Kingalik[9]	163	77	14	195	310	152
Loon (unspecified)	ᑐᓪᓕᑦ	Maligik	0	0	2	0	8	2
Arctic loon	ᑲᑦᓗᓕᑦ	Maliriq	0	0	0	0	1	<1
Yellow-billed loon	ᑐᓪᓕᕐᕿᐊᑦ	Tuulik	0	0	0	0	3	1
Ptarmigan[10]	ᐊᖏᓴᓂᑦ[10]	Akilgik[10]	58	14	138	99	48	71
Goose eggs[11]	ᑲᖕᒍᐃᑦ ᒪᓂᖅᑯᑦ[11]	Uluaguliit manniit[11]	23	181	114	131	10	92
Duck eggs[11]	ᒥᑎᑦ ᒪᓂᖅᑯᑦ[11]	Tinmiat manniit[11]	0	12	0	0	0	2
Arctic char[12]	ᐃᖃᓗᐃᓴᑦ[12]	Ikaliviit[12]	4,444	1,437	4,745	9,242	12,435	6,461
Freshwater fish (unspecified)	ᑕᓚᖕᒍᓂᖅᑐᒥ ᐃᖃᓗᐃᑦ	Tahinik Ikaluit	19	0	0	0	0	4
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	1,643	1,116	2,492	1,576	1,550	1,675
Arctic grayling	ᓱᓗᐸᐅᓚᐃᑦ	Hulupaugaq	3	0	0	0	0	1
Whitefish[13]	ᑲᐱᓂᓪᓕᑦ[13]	Kapihiliit[13]	265	153	394	206	148	233
Ocean fish (unspecified)[14]	ᐃᒪᐃᖏᒥ ᐃᖃᓗᐃᑦ[14]	Tagiumi ikaluit[14]	53	0	0	0	0	11
Cod[15]	ᐅᓚᐃᑦ[15]	Ugak[15]	0	91	17	22	150	56

[1-15]: See page 481 for community feedback and other sources of data.

[1-15]: ᑕᐃᒪ ᒪᕐᐱᔪᑐᖃ 483 ᓄᓇᓪᓕᑦ ᑭᐅᔭᓕᕐᒪᑦ ᐊᓘᓗ ᐊᓯᖏᑦ ᐱᓚᐅᓂᒃ.

[1-15]: Takulugu makpigaak 485 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

TABLE/ᐅᓗᐅᐃᓕᐅᑦ/NAUNAIKUTA 360

Annual hunter response
ᐊᓚᖏᔪᑦᒪᑦ ᐊᖓᔪᓂᕆᔨᑦ ᑭᐅᓂᖏᑦ
Angujauvaktu

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓄᑦ ᐊᓚᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᓂᖅ Tamakiklugin
Hunter Response Categories	**ᐊᖓᔪᓂᕆᔨᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᑭᑕᒪᑦ ᐊᖓᔪᓂᕆᔨᑦ	Tatkitaman angunahuktut titigait	332	347	338	347	332	391*
Interview list	ᐊᐱᕐᓂᖅᓯᒪᑦ	Apikiktan	217	221	209	209	206	246*
Hunters interviewed	ᐊᖓᔪᓂᕆᔨᑦ ᐊᐱᕐᓂᖅᓯᑦ	Angunahuktin apikhuktan	205	210	204	198	200	233*
Harvested	ᐊᖓᔪᓂᕆᐢᑐᒃᑯᓪᓗᑦ	Angujaujut	51	60	68	67	64	117*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑦᑐᖓᓂᖏᑦ (%)	Kiujut (%)	61	92	96	94	95	88**

* Hunters registered/on interview list/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖓᔪᓂᕆᔨᑦ ᐊᑎᓕᐅᑎᒃᓴᑦ/ᐊᐱᕐᓂᖅᓯᓂᒃᑯᓐᓂᒃ/ᐊᐱᕐᓂᖅᓯᑦ/ᐊᖓᔪᓂᕆᐢᑐᒃᑯᓪᓗᑦ ᐊᑕᐅᓂᐊᕐᓇᖅᑐᑦ ᓗᐊᖅᑎᑦ ᖃᐅᔨᓴᖅᑎᒍ.
** ᐊᑦᑎᓂᓕᕆᓂᖅᓱᒃᑲᓪᓚᑦ ᐊᓚᖏᔪᑦᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut taipfumuna tahapkuan kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᐅᓗᐅᐃᓕᐅᑦ/NAUNAIKUTA 361

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔾᔨᑦ ᐋᒋᐊᖏᓂ ᐊᖓᔪᓂᕆᓕᖓᓂᒃᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑕᐅᓂᖏᓂᒃᑕ, ᐅᓗᐅᓴᖅᑕᑦ ᐃᓚᒃ % ᑲᑎᒪᓂᖅᑕᑦ ᐊᖓᔪᓂᕆᓂᖅᑕᑦ ᑎᑎᕐᕋᐅᒪᔾᔨᑦ

ᑕᒪᐃᓐᓄᑦ ᐊᓚᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᓂᖅ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔾᔨᑦ**	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᑯᓪ	≤ tatkin pingahut	28	92	93	88	96	86
4-6 months	4-6 ᑕᑯᓪ	tatkin hitaman 6nut	25	6	7	10	4	9
> 6 months	> 6 ᑕᑯᓪ	> 6 tatkin	47	2	0	2	0	6

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 362

Number of hunters harvesting each species
ᖃᑦᔪᐅᓂᖏᑦ ᐊᖓᔪᓇᓱᒋᑦ ᐊᖓᔪᓇᓱᐊᕐᓂᑦ ᐊᑐᓂ ᐅᒪᔨᓂᒃ
Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓂᑦ ᐊᑦᑐᒍᓂᑦ (ᔨᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

6.2.2

Study Year/ᖃᐅᔨᓴᖅᓯᒪᔪᑦ ᐊᖏᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᒃᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**						
Caribou	ᑐᑐᐃᑦ	Tuktut	39	40	53	50	54	92
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait	3	6	5	6	5	17
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒃᓪᓚᐃᑦ	Akhait					1	1
Wolf	ᐊᒪᕈᐃᑦ	Amagut	6	4	6	3	9	16
Arctic fox	ᑎᓘᓴᒃᓂᐊᑦ	Tigiganiat	3	4	4	1	6	12
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᓘᓴᒃᓂᐊᑦ	Kalaliit tigiganiat	1					1
Wolverine	ᖃᑦᐃᓚᑦ	Kalvik	2	3	3	2	5	11
Arctic hare	ᐅᖃᓪᓗᑦ	Ukalik		1	14	3	8	20
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik	1				1	2
Seals (unspecified)	ᓇᕆᑦ	Natiit		4	18	1	7	27
Ringed seal	ᓇᕆᑦ	Natiinat	4		6	25	28	43
Geese (unspecified)	ᓂᕐᓗᓪᓗᑦ	Kanguk	8	29	3	3	20	47
Snow goose	ᖃᖏᐃᑦ	Kanguq	1	1				1
Canada goose	ᓂᕐᓗᓪᓗᑦ ᐅᓪᐊᔪᓪᓗᓪᓗᑦ	Nikliknik	7	2	24	20	20	48
White-fronted goose	ᓂᕐᓗᓪᓗᑦ	Nirlivik			2			2
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat		6	3			9
Pintail	ᖃᓚᒧᐊᓱᑦ	Arnaviaq					1	1
Eider duck	ᒥᑎᑦ	Kingalik	4	2	5	13	11	26
Loon (unspecified)	ᑐᓪᓗᓪᓗᑦ	Maligik			1		2	3
Arctic loon	ᑲᒡᓗᓪᓗᑦ	Maliriq					1	1
Yellow-billed loon	ᑐᓪᓕᕐᔪᐊᑦ	Tuulik					1	1
Ptarmigan	ᐊᕈᓚᑦ	Akilgik	2	1	4	5	4	13
Goose eggs	ᖃᖏᐃᑦ ᒪᓂᓂᖅᑦ	Uluaguliit manniit	1	1	5	10	2	16
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᖅᑦ	Tinmiat manniit		1				1
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	23	33	40	50	55	86
Freshwater fish (unspecified)	ᑕᓚᕐᒧᓂᖅᑐᒥ ᐃᖃᓗᐃᑦ	Tahinik Ikaluit	1					1
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	14	34	46	27	29	67
Arctic grayling	ᓭᓗᒃᑕᐅᓚᐃᑦ	Hulupaugaq	1					1
Whitefish	ᑲᐱᓱᓪᓗᑦ	Kapihiliit	2	4	8	4	3	14
Ocean fish (unspecified)	ᐃᒪᓕᕐᒥ ᐃᖃᓗᐃᑦ	Tagiumi ikaluit	1					1
Cod	ᐅᓴᐃᑦ	Ugak		1	1	1	3	4

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓭᒪᔪᓂᒃ ᐱᑕᖃᓂᒋᑐᖅ ᐱᒃᔪᐊᑎᓐᓂᒃ ᐊᖏᔪᒃ ᖃᑦᔪᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᕆᐅᒪᔪᓂᑦ ᐊᖏᔪᓄᑦ ᓇᓪᔨᐅᖏᓐᓄᑦ ᑐᓂᔭᖏᓂᖅ ᐃᑯᕋᓱᓪᓗᓂᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.2.2 Community Results Discussion: Cambridge Bay

The survey frame:

An assessment of under-enumeration during the community visit revealed that there were approximately 55 hunters who were not registered in the Harvest Study. Thirty-seven of these were Inuit – all occasional hunters. It is estimated that there were 18 non-Inuit hunters with assigned hunting rights who were not registered – 16 occasional and two active hunters. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. However, the extent of the bias is likely small since although the missing hunters represent 12 percent of the total hunter population, they are mostly occasional hunters (Table 10). Harvests for the unregistered hunters can be estimated using mean harvest quantities for each species by strata. However, these estimates, having their own sources of error and bias, are beyond the scope of this Final Report. Readers may apply to NWMB to obtain the results of these calculations.

Due to the relatively small number of intensive hunters registered in Cambridge Bay, the intensive classification was joined with the active classification for the purpose of calculating harvest estimates.

Survey coverage and non-response bias:

Response rates in year 1 of the study were low with all months below 75%. However, response rates in years 2 to 5 were very good. As seen in Table 9 the consistent intentional non-response rate in Cambridge Bay was low, at 0.4%, and was not thought to be a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough during years 2 to 5 to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should exercise caution when using the data collected during year 1 of the study since the potential for both sampling error and for non-response bias increases as response rates fall.

Measurement issues and response error:

It was reported during the community consultations that egg harvests were under-reported. Further details are provided in the community feedback and other sources of data section below. Section 5.4 also contains a thorough discussion of this issue.

As seen in the recall period tables, recall periods were long during the first year of the study, particularly during the first six months when the majority of the harvest records were collected over six months after the harvest. However, recall periods improved in subsequent years when the vast majority of the harvest records were collected within three months of the harvest. The longer recall periods in year 1 may have introduced some measurement error due to a reduced ability of hunters to remember their harvests.

Throughout the study there were commercial harvests of musk-ox, arctic char and some caribou. Most of these harvests were never reported during the Harvest Study or were removed from the database before calculating harvest estimates (see Table 4). Harvest estimates should be viewed as an indication of the subsistence harvest only.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of both barren-ground caribou and island caribou. Also, some hunters did not specify the type of caribou harvested. For the purpose of calculating harvest estimates they were combined into one category.
2. **Musk-ox:** As well as a subsistence harvest, there is also commercial harvesting of musk-ox and musk-ox sport hunts in Cambridge Bay. The Harvest Study set out to collect subsistence harvest data only. The harvest estimate in year 1 however, may contain some commercial or sport hunt data (C.F.). DSD reports the following subsistence harvest numbers for musk-ox (DSD MXb):

Year 1	Year 2	Year 3	Year 4	Year 5
n/d	20	15	17	14

   These numbers are thought to be accurate and indicate that study harvest estimates are a little low in some years but are in the right range.
3. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).

[4] **Wolf:** Harvest estimates seem too low (C.F.). Data were obtained from DSD detailing the number of pelts sold by hunters. DSD reports were available for years 4 and 5 and indicate that 28 wolf pelts were purchased in 1999/2000 (year 4) and 9 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). Based on this information the harvest estimate for year 4 does appear low however the estimate in year 5 may be high.

[5] **Arctic fox:** Hunters sell most of their harvest, so to verify the harvest estimates data were obtained from DSD detailing the number of pelts sold by hunters (C.F.). Again, DSD provided reports for 1999/2000 and 2000/2001 (years 4 and 5) which indicated that 260 arctic fox pelts were purchased in year 4 and 489 were purchased in year 5 (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). This information confirms that Harvest Study estimates seem to be in the right range.

[6] **Wolverine:** Harvest estimates may be somewhat low but comments were also received during the community visit which indicated that estimates seemed reasonable (C.F.). A total of 6 carcasses were submitted from 2000 to 2001 to DSD for their ongoing monitoring program. However, not all carcasses are submitted for this program (DSD WV).

[7] **Seals:** Seal harvesting consists of mainly ringed seals but some bearded seals are also harvested. The harvest estimate for ringed seals in year 5 seems high (C.F.).

[8] **Geese:** Harvest estimates for snow geese are thought to be low and it was suggested that many of the unidentified geese may be snow geese. However, Ross' geese and brant geese are also harvested in the area but none were reported. The Canadian Wildlife Service had a program in place in year 5 to encourage snow goose harvesting, so it is suspected that most of the unidentified geese in year 5 were actually snow geese (C.F.).

[9] **Eider duck:** The community harvests both king and common eider ducks each year (C.F.).

[10] **Ptarmigan:** The harvest estimate in year 2 seems too low. Estimates in other years look more accurate (C.F.).

[11] **Eggs:** There are many eggs harvested each year. Eggs were not reported by hunters; one hunter commented that the Fieldworker never asked about eggs and many hunters did not think to report them. A person can easily collect over 200 eggs in a day. All egg estimates seem too low (C.F.).

[12] **Arctic char:** Commercial fishing of arctic char took place in about five lakes during the Harvest Study (DFO F). Some of these data were reported by hunters but were removed from the subsistence harvest in the database and can be viewed in Table 4. If the hunter did not specify that the harvest was commercial these data would be retained in the database and included in the harvest estimates. In general though it is thought that the harvest estimates represent the subsistence harvest of the community (C.F.).

[13] **Whitefish:** The harvest estimate in year 5 seems too low, as does the mean annual harvest (C.F.).

[14] **Ocean fish:** The species of fish was not identified but hunters report that they were likely cod (C.F.).

[15] **Cod:** Harvest estimates seem low. Estimates should be closer to the 1000 fish range (C.F.).

6.2.2 ᓄᓇᕗᑦ ᓴᖅᑭᑕᒃᓴᓂᑦ ᑲᖏᖅᑐᑎᑦ: ᐃᖅᓱᓕᕆᓂᖅᓯᒪᔪᖓ

ᖃᐅᔨᓴᓂᒃ ᐊᑲᖅᑭᒪᓂᖅ:

ᖃᒥᖅᓯᒪᔨᑎᓪᓗᑎᑦ ᐊᑎᓕᑕᓇᖅᑐᓴᕐᓂᖅᓴᓕᕆᓂᒃᑕᓂᕐᓂᑦ ᓄᓇᕗᑦ ᐊᓪᓚᖅᑎᑕᒪᓪᓗᑎᑦ ᑕᐃᑎᖅᓯᒪᔨᖅᑐᑎᑦ ᑕᒪᓐᓂ 55%ᓄᓇᕗᑦ ᐊᖏᓇᓯᒥᑎᑦ ᐊᑎᖅᖃᖅᑕᐅᓕᕆᓂᖅᓂᖅᓂᒃ ᖃᐅᔨᓴᖅᓂᒧᑦ. 37%ᑎᑦ ᐃᓄᓕᕐᓂᑐᑎᑦ - ᑕᒪᓕᒥᒃ ᖃᐅᔨᓴᓇᖅᑐᑦ ᐊᖏᓇᓯᑦᓯᑕᒪᓕᖅ. ᐃᓯᒪᓕᕆᔨᓴᖅ ᐃᓇᖅᑐᓕᕐᓂᑦ 18%ᓄᓇᕗᑦᓂᑦ ᐱᓕᖓᐃᓕᒥᒃ ᑐᓂᔨᐅᓯᒪᓕᑦ ᐊᑎᖅᖃᖅᑕᐅᓕᕆᓂᖅᓂᑐᓂᒃ - 16%ᔪᓐᓇᑎᑦ ᖃᐅᔨᓴᒋᓴᖅᓯᑦᓂᑦ ᑐᓴᒪᓂ ᒪᓕᒐᒃ ᑕᒪᓕᒐᓴᓕᖅᑐᑎᑦ. ᐅᖃᐅᓯᐅᓕᒪᓂ ᓄᓇᕗᑦ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᑕᓇᖅᑐᓴᕐᓂᖅᓯᒪᔪᖓᓂᒃ ᐱᔭᕇᓂᖅ ᐊᔪᕐᓇᖅᑐᖓ ᐊᑎᑎᒋᔭᐅᓂᖅᓯᒪᓕᖅᓴᖅᑐᑦ ᐅᓪᓗᓕᕆᓂᖅᓂᖅᓂᒃ. ᑭᓯᐅᓂ, ᖃᓄᐃᑎ ᐃᓚᓕᕆᓇᖅᑐᓂᖅᓄᖅᓯᒪᓕᖅᑐᑦ ᐊᑦᑐᒋᔭᐅᓂᖅᓄᖅᓯᒪᓕᖅᑐᑦ ᑕᒪᓐᓇ ᐱᔭᕇᓂᖅ ᐊᑦᑐᒋᔭᐅᓂᖅᓄᖅᓯᒪᓕᖅᑐᑦ ᐃᓚᖓᔾᔪᑎᑦᑎᓂᖅᓂᑦ ᐊᑎᖅᖃᖅᑕᐅᓕᕆᓂᖅᓂᖅᓂᒃ ᐊᑎᖅᖃᖅᑕᐅᓕᕆᓂᖅᓂᑐ

[5] **ᑎᓚᖑᓂᐊᖅ:** ᐊᖏᔪᓕᐊᖅᑎᑦ ᓂᐅᕗᑎᖅᑲᕐᖓᑦᑐᑦ, ᑕᒪᓐᓇ ᓇᓂᓇᐃᖅᑕᐅᔨᓐᔪᑎᓂᒃ ᐊᖏᔪᓕᒪᔪᓐᓇᒃᑯᓂᒃ ᐱᑎᖅᑲᐃᖅᑐᑦ ᐃᓯᐱᖏᓚᓕᓐᓂᒃᑯᓂᒃ ᓇᓂᓇᐃᔨᐃᓕᓴᐅᑦ ᐊᒥᓱᓕᖅᑯᓂᒃ ᐊᒥᓗ ᓂᐅᕗᑎᑎᕐᓂᐅᕐᐳᑦ ᐊᖏᔪᓕᐊᖅᑎᖅᑎᓂᒃ. (C.F.). ᐊᓪᓚᓕᓂᒃᑲᓂᖅ, ᐃᓯᐱᖏᓚᓕᓐᓂᒃᑯᓗ ᐅᓂᒃᑲᓕᐅᕐᓂᖅᓯᒪᓕᒥᐊᐃᑦ 1999/2000-ᒧᑦ ᐊᓪᓚ 2000/2001-ᒥ (ᐊᖅᑎᒍ 4 ᐊᓪᓚ 5) ᓇᓂᓇᐃᖅᓯᐊᐃᑦ 260 ᐊᒋᐊᓗ ᓂᐅᐃᐊᓇᓴᐅᓕᐅᕐᖓᓕᑦ ᐊᖅᑎᒍ 4-ᒥ ᐊᓪᓚ 489 ᓂᐅᐃᐊᓇᓴᐅᓕᓐᓂᑎᒃ ᐊᖅᑎᒍ 5-ᒥ (ᖃᐅᔨᓴᓪᑦ ᐃᓯᐱᖏᓚᓕᓐᓂᒃᑯᓂᒃ ᓴᓇᐅᑎᑎᓪᓗᖓᓪᓚᑦ ᒪᓕᓪᓚᒪᑦ ᐱᐅᐊᖅᖃᖅᑐᒃ ᓱᓚᐃᒥᑦ, ᖃᐅᔨᓴᓐᓄᓕᒫᑦ ᐊᓕᓚᐅᕐᓂᒪᓕᐊᓂᒃ ᒪᓕᓪᓚᒪᑦ ᐱᐅᐊᖅᖃᖅᑎᓕᓐᓂᒃ ᓱᓚᐃᒥᑦ, ᒪᓕᓪᓚᒪᑦ ᐱᐅᐊᖅᖃᖅᑎᓕᓐᓂᒃ ᓱᓚᐃᒥᑦ) (DSD FB). ᑕᐅᔪᐊ ᑐᑭᓯᑲᓂᕐᓂᑕᑎᓪᓗᒍᑎᓂᒃ ᓇᓂᓇᐃᖅᓯᐊᐃᑦ ᐊᖏᔪᓕᐊᖅᑎᖅᑎᓂᒃ ᖃᐅᔨᓴᓐᓄᓕᒫᑦ ᓇᓂᓇᐃᖅᑕᐅᔨᓴᓐᓂᒃ ᑕᒥᓐᓇᐃᓕᓐᓂᒃᑯᓗᒃᑐᖓ.

[6] **ᖃᓄᖅᓱᑦ:** ᐊᖏᔪᓕᐊᖅᑎᓕᓐᓂᑦ ᓇᓂᑎᖅᑕᐅᓂᖓᓐᓂᑦ ᐱᑦᑕᓯᓕᑐᑎᓕᓐᓂᑦᑐᓗᒃᑐᑦ ᑭᓯᐅᓂ ᐅᖃᖅᑐᖅᖃᖅᑕᓯᐅᕐᓂᖅᓴᖅ ᓄᓇᓕᓂᑦ ᐊᓯᖏᓐᓂᒃᑯᓕᒫᖅᑐᑦ. (C.F.). ᑲᑎᑦᑐᑦ 6 ᖃᓄᐃᒥᓂᑦ ᑐᓂᓯᓕᐅᖅᑎᓕᓐᓂᑦ 2000-ᒥᑦ 2001-ᒧᑦ ᐃᓕᓴᐃᓚᓯᓚᐅᖅᓯᒪᓕᐊᓂᑦ ᐊᑐᖅᑕᐅᓂᐅᕐᓂᓗᓂᒃ ᖃᐅᔨᓴᓐᓄᓕᐊᓕᖅᖢᓂᖓᓐᓂᑦ. ᑭᓯᐊᓂᓕ, ᖃᓄᐃᒥᓂᒪᓕᐊᓂᒃ ᑐᓂᓯᓕᐅᖅᑎᓕᓐᓂᒃᑯᓂᒃ ᑕᒪᓐᓇ ᑐᓂᓯᓕᐅᖅᑎᓕᓐᓂᒃᑯᓂᒃ ᑲᑎᒪᔨᖅ ᐱᓕᕆᔨᒃᑯᑦ ᑲᑎᒪᔨᖅ ᐱᓕᕆᔨᒃᑯᑦ ᐃᓚᖓ

6.2.2 Nunanit Iniktigutait Ukauhiit: Ikaluktutiak:

Ihivgiuktut Atugutait:
Ihivgiufaakhimayuni ataani naunaiyakhimayut nunanut pulaaktakhimatitluta takupkaihimayut 55kuyut umayukhiuktit titigaktauhimaitut Umayukhiukhimayut Ihivgiuktitlugit. 37kuyut Inuinait – tamamik ilaani umayukhiukataktut. 18kuyut Inuinaungitut umayukhiuktit tuniyauhimayut inminiigutiminik titigaktauhimaitut – 16kuyut ilaani umayukhiukataktut ovalo malguk umayukhiukataktut. Ukakhimaut ilangani 5.2.1 ikpinagutait hapkoa ataani naunaiyakhimayut ataanungaktitiyut ihumaiyainik umayukhiukhimayut naunaiyautainik. Kihimi ihumagiyait mikiyut piyauhimaitut umayukhiuktit 12%nik amigaitjutaumata tamamik umayukhiuktinit, amigaitkiyait ilaani umayukhiuyumata (ikpatauyak 10). Umayukhiukhimayut titigakgauhimaitut umayukhiuktit naunaiyalaaktut angitjutainik umayukhiukhimayunik amigaitjutainik tamamik umayunik atulutik aviktukhimatjutainik. Kihimi hapkoa naunaiyautit inminik ihuinaagutikamata ovalo ihumagiyainik avataaniimata iniktigutait hamna inikpiagutit tuhaktakhat. Taiguaktut apigilaaktut NWMBkunut piyumagumik iniktigutait hapkoa naunaiyagutit.

Mikiyuumata umayukhukatainaktut naunaiyautait umayukhiuktit ilaukatauhimayut umayukhiukataktut naunaiyautainut hamna naunaiyautini umayukhiukhimayut naunaiyautaini.

Ihivgiuktauhimayut ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait ukiumi 1 ihivgiukhimayuni mikiyut tamamik tatkikhiutit ataanitut 75%mik. Kihimi kiuhimayut naunaiyautait ukiumi 2 ovalo 5 nakuukpiaktut. Takuhimayumi ikpatauyami 9, pikataktut kiuyuitut naunaiyautait Ikaluktutiami mikiyut, 0.4%kuyut ovalo ihumaiyaungitut pilaaktunik kiuyuitunit ihumagiyaini.

Kiuhimayut naunaiyautit ihumagiyut angiyuumata ovalo kiuyuitut ihumagiyait mikiyuumata ukiuni 2 ovalo 5 pigiagani nni pihimayut naamaktumik ilauyut uktukhimayuni Nni umayukhiuktinut. Taiguaktut ihumayukhat atuligumiuk katitikhimayut katitigutait ukiumi 1mi ihivgiukhimayut pilaaktainik tamamik uktugutit ihuinaagutait ovalo kiuyuitut ihumagiyait angililaamata kiuhimayut naunaiyautait katakpata.

Atugutingit ihumaiyait ovalo kiuhimayut ihuinaagutait:
Tuhaktitiyauhimayut nunanut pulaaktakhimatitlugit manikhiugutit ataani tuhaktitihimayut. Titigatiakhimayut pilaaktut nunani ukautihimayaini ovalo aalat atulaat katitikhimayut hamani. Ilangani 5.4 pihimayutlu ukautitiaganik hamna ihumagiyauyunut.

Takuyaulaaktuk utiktitihimayut ukautingit ikpatauyami, utiktitihimayut ubluit angiyut hivulimi ukiumi ihivgiuktitlugit, ilaa hivulimi siksini tatkikhiutini amigaitkiyait umayukhiukhimayut titigagutait katitigutait avataani siksit tatkikhiutini umayukhiukhimatitlugit. Kihimi uktiktitihimayut naamakhiyut aipain ukiuni amigaitut umayukhiukhimayut titigaktauhimayut katitikhimaplutik iluani pingahuni tatkikhiutini umayukhiukhimayainik. Ungahitkiyat utiktitjutit ubluit ukiumi 1 piyunakhiyut ilanginik atugutaini ihuinaagutinik umayukhiuktit puigukpamata umayuktaminik.

Tamaat ihivgiukhimayuni kinauyaliuktut umingmanik, ikalivinik ovalo ilangit tuktunik. Amigaitkiyait hapkoa umayukhiukhimayut tuhaktitauyuitut Umayukhiukhimayut Ihivgiuktuni ovaluniit unguvaktauyuitut katitikhimayunit naunaiyaktinagit umayukhiukhimayut naunaiyautainit (takulugu Ikpatauyak 4). Umayukhiukhimayut naunaiyautait takuyakhat pihimayut atuktakhaminik umayukhiuktaminik talvatuak.

Nunanit ukakhimayut ovalo aalanit pihimayaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukhimayut tamamik nunani tuktut ovalo kikiktanit tuktuit. Ovalo, ilangit umayukhiuktit naunaiyakhimaitut kanugitunik tuktuhimayut. Atugutainut naunaiyautingit umayukhiukhimayut naunaiyautait katitikhimayut atauhimut.
2. **Umingamait:** Ilauyuni atuktakhainik umayukhiukhimayut, kinayaliugutit umayukhiukhimayut umingmait ovalo umingmakhiuktut kablunaat Ikaluktutiami. Umayukhiukhimayut Ihivgiugutait katitikhimayut atuktakhainik umayukhiukhimayut katitigutaini talvatuak. Umayukhiukhimayut naunaiyautait ukiumi 1 kihimi pihimayunakhiyut ilangit kinauyaliutuni ovaluniit kablunaat umayukhiukhimayaini katitikhimayuni (C.F.). DSDkut tuhaktitihimayut hapkoa atuktakhainik umayukhiukhimayut amigaitjutait umingmait (DSD MXb):

Year 1	Year 2	Year 3	Year 4	Year 5
n/d	20	15	17	14

Hapkoa amigaitjutit ihumagiyauyut naamaktut ovalo takukhauyut ihivgiukhimayut umayukhiukhimayut naunaiyautit mikiyut ilangini ukiuni kihimi naamaktut.

[3] **Nanuit:** Amigaitjuttit takukhauyut naunaiyautaungitut kihimi pihimayut umayukhiukhimayut tunihimayait DSDkunit (DSD PB).

[4] **Amagut:** Umayukhiukhimayut naunaiyautit mikiyut (C.F). Katitikhimayut pihimayut DSDkunit titigakhimayut amigaitjutait amiit niuviktaitauhimayut umayukhiuktinit. DSDkut tuhaktitihimayut pihimayut ukiuni 4 ovalo 5 ovalo naunaiyakhimayut 28nik amagunik amiit niuviktauhimayut 1999/2000mi (ukiumi 4) ovalo 9nik niuviktauhimayut 2000/2001mi (ukiumi 5) (nalungilutit DSDkut katitikhimayut umayukhiukhimayut ukiungani atuktut Julymit Junemut, Umayukhiukhimayut Ihivgiugutait katitikhimayut atukhimayut umayukhiukhimayut ukiungit Junemit Maymut) (DSD FB). Atukhugit hamna tuhagutikhat umayukhiukhimayut naunaiyautait ukiumi 4 mikiyut kihimi naunaiyautait ukiumi 5 angiyut.

[5] **Tigiganiat:** Umayukhiuktit niuviktivaktait tamamivyak nanigiakhimayaminik taimaimat, umayukhiukhimayait katitikhimayut pihimayut DSDkunit titigakhimayut amigaitjutait amiit niuviktauhimayut umayukhiuktinit (C.F.). DSDkut tunihimayut tuhaktakhanik 1999/2000mi ovalo 2000/2001mi (ukiuni 4 ovalo 5) takukhauyut 260nik tigiganiat amiit niuviktauhimayut ukiumi 4 ovalo 489nik niuviktauhimayut ukiumi 5 (nalungilutit DSDkut katitikhimayait atukhimayut umayukhiukhimayut ukiungit Julymit Junemut, Umayukhiukhimayut Ihivgiugutait katitikhimayut atukhimayut umayukhiukhimayut ukingit Junemit Maymut) (DSD FB). Hamna tuhagutikhat pihimayut Umayukhiukhimayut Ihivgiugutit naunaiyautait angiyut.

[6] **Kalviit:** Umayukhiukhimayut naunaiyautait mikiyut kihimi ukakhimayut nunani pulaakhimagapta ukakhimayut naunaiyautait naamaktut (C.F.). Tamamik siksi kalviit pihimayut 2000mit 2001mut DSDkunut piktaktainik kungiagutini pilihimayuni. Kihimi kalviit tunihimaitut pilihimayumut (DSD WV).

[7] **Natiit:** Natiit umayukhiukhimayut ilauyut natiit kihimi ilangit ukyuit umayukhiukhimayutlu. Umayukhiukhimayut naunaiyautait natiinik ukiuni 5mi angiyut (C.F.).

[8] **Uluaguliit:** Umayukhiukhimayut naunaiyautait kangunik ihumagiyauyut mikiyut ovalo ukakhimayut amigaitut naunaiyakhimaitut uluaguliit kanguuyunakhiyut. Kihimi kakat ovalo niklinat umayukhiukataktut nunami kihimi tuhaktitihimaitut. Kanatami Umayuligiyit pihimayukaktut ukiumi 5mi pitkuiplutik kangunik umayukhiuktukhanik, taimaimat piyunakhiyut amigaitut naunaiyakhimaitut uluaguliit ukiumi 5mi kanguuyut (C.F.).

[9] **Tinmiat:** Nunami umayukhiukataktut tamamik kingaliit ovalo mitiit tamamik ukiumi (C.F.).

[10] **Akilgit:** Umayukhiukhimayut naunaiyautait ukiumi 2 mikiyut. Naunaiyautait aalani ukiuni naamaktut (C.F.).

[11] **Maniit:** Amigaitut maniit pikutauhimayut ukiuk tamaat. Maniit tuhaktitiyauyuitut umayukhiuktinit; atauhik umayukhiukti ukakhimayuk nunani havaktit apigiyuimata maninik ovalo amigaitut umayukhiuktit ihumagiyuitait tuhaktitilugit. Inuk atauhik katitilaaktuk 200nik maninik ublumi atauhimi. Tamaik maniit naunaiyautait mikiyut (C.F.).

[12] **Ikaliviit:** Kinauyaliuktut ikalukhiukhimayut ikalivinik talimani tahini Umayukhiukhimayut Ihivgiukhimatitlugit (DFO F). Ilangit hapkoa katitikhimayut tuhaktitihimayut umayukhiuktinit kihimi unguvaktauhimayut atuktakhaini umayukhiukhimayunit katitikhimayunit ovalo takulaaktut ikpatauyami 4mi. Umayukhiuktit naunaiyakhimaitpata kanugitumik umayukhimayuminik kinauyaliugutini hapkoa katitikhimayut pihimaniaktut katitikhimayuni ovalo ilaulutik umayukhiukhimayuni naunaiyautaini. Taimaimat ihumayut umayukhiukhimayut naunaiyautait atuktakhaini umayukhiukhimayait nunamini (C.F.).

[13] **Kapihiliit:** Umayukhiukhimayut naunaiyautait ukiumi 5 mikiyut, ovalo anginikhaagit ukiumi tamaat umayukhiukhimayut (C.F.).

[14] **Tagiumi Ikaluit:** Kanugitut ikaluit naunaiyakhimaitut kihimi umayukhiuktit tuhaktitihimayut ugauyunakhiyut (C.F.).

[15] **Ugat:** Umayukhiukhimayut naunaiyautait mikiyut. Naunaiyautait kangitukhat 1,000nik uganik (C.F.).

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 363

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓗᑎᑦ

Tatkiktaman nahaktauvaktun

Year 1 (June 1996 - May 1997)

ᐊᓕᕐᒧᑐ 1 (ᔫᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖢᓕ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓕ	OCT ᐅᑦᑐᓕ	NOV ᐅᐊᓚᐱᓕ	DEC ᑎᓯᓚᐱᓕ	JAN ᔮᖏᓂᐊᓕ	FEB ᐃᖅᑲᐊᓕ	MAR ᒪᕐᕿ	APR ᐃᓘᓐᓂ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᐃᑦ	Tuktut	225	132	155	14	49	23	15	12			36	37	698 ± 131
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait						11	2		2	2			17 ± 5
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡							3						
Wolf	ᐊᒪᓗᐃᑦ	Amagut												12	12 ± 15
Arctic fox	ᑎᓚᒃᖅᓂᐊᑦ	Tigiganiat						81	84	47	21	21			254 ± 62
Wolverine	ᖃᑦᕃᑦ	Kalvik												1	1 ± 1
Arctic hare	ᐅᑲᓪᓕ	Ukalik						2				1	1		4 ± 3
Arctic ground squirrel	ᓱᖅᓯᑦ	Hikhik												1	1 ± 1
Ringed seal	ᓇᕐᓯᑦ	Natiinat	46	60	18	4	21	2		14				4	169 ± 46
Geese (unspecified)	ᓂᕐᓗᕐ	Kanguk												27	27 ± 33
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	103	14										6	123 ± 84
Canada goose	ᓂᕐᓗᕐ ᐅᓗᐊᔪᓗᕐ	Nikliknik	140			10								3	153 ± 98
Eider duck	ᒥᑎᑦ	Kingalik	39												39 ± 34
Ptarmigan	ᐊᖏᓴᑦ	Akilgik						2							2 ± 1
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	2,634	2,776	1,248	1,992	2,759	1,334	231	600		48		315	13,937 ± 3,371
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik				8	38	1	106	11			24	49	237 ± 73
Whitefish	ᑲᐱᓯᓂᕐ	Kapihiliit	362	14			95	1,852	75						2,398 ± 810

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓂᑦ ᑎᑎᕋᐅᒪᓕᖅ ᑐᓂᓯᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓇᓚᖅᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.2.3

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 364

Monthly hunter response

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓯᓚᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᒃᓴᔪ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

6.2.3

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒃᔪᑎ	SEP ᓯᑎᒃᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᐊᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᒍᖕᓄᐊᓗ	FEB ᐃᖅᑐᐊᓗ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓯᓚᑦ ᑭᐅᓂᖏᑦ ᐊᑦᔪᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᔪᓯᓚᑦ	Tatkitaman angunahuktut titigait	343	342	342	342	343	337	337	337	337	337	337	337	344*
Interview list	ᐊᐱᕐᓂᖅᓱᐃᑦ	Apikiktan	226	225	225	225	226	220	220	220	220	220	220	220	227*
Hunters interviewed	ᐊᖏᔪᓯᓚᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	145	149	147	165	188	207	210	216	203	202	195	193	225*
Harvested	ᐊᖏᔪᓯᖁᑎᒋᓕᓪᓕᑦ	Angujaujut	39	39	26	5	15	16	8	6	2	2	8	23	89*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑦᑐᓂᖏᑦ (%)	Kiujut (%)	64	66	65	73	83	94	95	98	92	92	89	88	83**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓯᓚᑦ ᐊᑎᓕᐅᔾᔨᒪᔭᕐᓂᑦ/ᐊᐱᕐᓂᕆᔨᖅᑕᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓯᖁᑎᒋᓕᓪᓕᑦ ᐊᑕᐅᓯᐊᓕᓄᑦ ᐊᑐᑎᑦ ᐊᒃᔪᒪᑦ.
** ᐊᐅᔨᓕᓐᓂᓯᒪᔭᑦ ᑕᖅᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 365

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔭᑦ ᐊᑯᖏᓂᓂ ᐊᖏᔪᓯᓴᓂᓗᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑕᐅᓂᓗᑕ, ᓇᓗᓇᐃᕐᑕ ᐃᒪᓵ % ᑲᑎᑕᐅᑦ ᐊᖏᔪᓯᒃᑕ ᑎᑎᕐᑕᐅᒪᔭᑦ

Year 1 (June 1996 - May 1997)

ᐊᒃᓴᔪ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒃᔪᑎ	SEP ᓯᑎᒃᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᐊᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᒍᖕᓄᐊᓗ	FEB ᐃᖅᑐᐊᓗ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔭᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	51	100	100	100	100	94	100	100	100	100	100	100	89
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	49	0	0	0	0	0	0	0	0	0	0	0	11
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	0	0	6	0	0	0	0	0	0	1

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 366

Number of hunters harvesting each species — **Year 1 (June 1996 - May 1997)**

ᖁᑦᓯᐅᓂᖏᑦ ᐊᖏᓚᓯᓗᒋᑦ ᐊᖏᓚᓯᓗᒃᑰᔪᑦ ᐊᑐᓂᓗ ᐅᒪᔨᓂᓗ — **ᐊᓕᕆᔨ 1 (ᐅᓂ 1996 - ᒪᐃ 1997)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 1 (June 1996 - May 1997)**

Month/ᑕᖅᖢᓕ/Tatkia			JUN ᔅᓂ	JUL ᔅᓪᓗ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑦᔪᓇ	NOV ᐅᓇᐱᓇ	DEC ᑎᓯᐱᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᓇᖏᐅᐊᓇ	MAR ᒪᑦᓯ	APR ᐃᑦᓀᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	22	15	17	2	8	5	3	1			8	10	54
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait						6	1		1	1			8
Polar bear[#]	ᓇᓂᐃᑦ[#]	Nanuit[#]	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut												2	2
Arctic fox	ᑎᓗᒃᖠᓂᐊᑦ	Tigiganiat						6	4	2	1	2			8
Wolverine	ᖁᑦᓴᑦ	Kalvik												1	1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik						1				1	1		3
Arctic ground squirrel	ᓱᒃᓯᑦ	Hikhik												1	1
Ringed seal	ᓇᓯᓗᑦ	Natiinat	10	9	3	1	2	1		4				2	26
Geese (unspecified)	ᓄᖅᓚᓪᓚ	Kanguk												2	2
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	4	1										1	6
Canada goose	ᓄᖅᓚᓪᓚ ᐅᓗᐊᔪᓚᓪᓚ	Nikliknik	6			1								1	8
Eider duck	ᒥᑎᑦ	Kingalik	3												3
Ptarmigan	ᐊᖏᓴᑦ	Akilgik						1							1
Arctic char	ᐃᖁᓗᒃᐱᑦ	Ikaliviit	17	25	9	3	10	4	1	1		1		14	60
Lake trout	ᐃᓯᕐᕆᐃᑦ	Ikalukpik				1	1	1	2	1			2	6	13
Whitefish	ᑲᐱᓯᓚᓪᓚ	Kapihiliit	1	1			1	5	1						8

6.2.3

[#] No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

[#] ᑎᑎᕋᓯᒪᔪᓂᖅ ᐱᑕᖃᖅᖢᑎᒃ ᐱᒃᔪᑎᓕᓐᓂᖅ ᐊᖏᓴᑦ ᖁᕋᐅᓂᖅᖢᓂᖅ ᐊᓪᓚᖅᑕᒪᔪᓂᑦ ᐊᖏᓴᐅᓂᑦ ᓇᓪᑐᐅᖅᑕᐅᓂᖅ ᐃᓕᓴᕐᓂᓗᓐᓂᑦ.

[#] Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 367

Monthly harvest estimates — Year 2 (June 1997 - May 1998)

ᑕᕿᑕᒫᑦ ᐊᖑᔭᓄᑦ ᓇᓚᐅᑦᓴᕈᑏᑦ — ᐊᒻᕋᒍ 2 (ᔪᓂ 1997 - ᒪᐃ 1998)

Tatkiktaman nahaktauvaktun — Ukiunga 2 (June 1997 - May 1998)

6.2.3

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒻᒍᑎ	SEP ᓱᑎᒻᐱᕆ	OCT ᐅᑦᑐᐱᕆ	NOV ᓄᕕᒻᐱᕆ	DEC ᑏᓱᒻᐱᕆ	JAN ᔭᓐᓄᐊᕆ	FEB ᕕᕐᕗᐊᕆ	MAR ᒫᑦᓯ	APR ᐃᑦᕆᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	4	105	127	34	80	13	5		3	14	70	114	569 ± 52
Musk-ox	ᐅᒥᒃᒪᐃᑦ	Umingmait			3		1	1							5 ± 4
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡							2						
Wolf	ᐊᒪᕈᐃᑦ	Amagut					7						12	3	22 ± 18
Arctic fox	ᑎᕆᒐᓐᓂᐊᑦ	Tigiganiat					1				23	11	3		38 ± 20
Wolverine	ᖃᕐᕕᑦ	Kalvik						2						1	3 ± 3
Arctic hare	ᐅᑲᓖᑦ	Ukalik				1	4							2	7 ± 4
Seals (unspecified)	ᓯᖅᑯᓖᑦ	Natiit	11												11 ± 6
Ringed seal	ᓇᑦᓱᑦ	Natiinat	26	70	4		20	7	3		7	3	1	8	149 ± 18
Bearded seal	ᐅᒻᔪᐃᑦ	Ukyuk												1	1 ± 1
Snow goose	ᑲᖑᐃᑦ	Kanguq	77	5											82 ± 61
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik		23										7	30 ± 7
Eider duck	ᒥᑏᑦ	Kingalik												1	1 ± 1
Ptarmigan	ᐊᕿᒻᒋᑦ	Akilgik				1								12	13 ± 13
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	194	2,584	1,119	710	249	35						107	4,998 ± 964
Lake trout	ᐃᓱᕐᐃᑦ	Ikalukpik			27	40	384	9	154			80	196	729	1,619 ± 271
Whitefish	ᑲᕕᓯᓖᑦ	Kapihiliit	181	1,287	78	75	4,687	4,961		35					11,304 ± 1,624

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᕐᓄᑦ ᑎᑎᕋᕐᑕᐅᒪᔪᑦ ᑐᓂᔭᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᕕᓕᕆᔨᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 368

Monthly hunter response

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)

ᐊᒃᓴᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᓄᐊᒻᐱᓗ	DEC ᑎᓯᒻᐱᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᓯ	APR ᐃᓴᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᕆᑦ	Tatkitaman angunahuktut titigait	336	334	336	336	336	335	333	332	331	331	329	332	347*
Interview list	ᐊᐱᓯᓂᖅᓴᐃᑦ	Apikiktan	219	217	219	219	219	217	215	213	212	212	210	212	226*
Hunters interviewed	ᐊᖏᔪᓂᕆᑦ ᐊᐱᓯᓂᑦ	Angunahuktin apikhuktan	196	217	219	219	219	209	208	208	191	188	185	187	223*
Harvested	ᐊᖏᔪᓂᖅᑎᒋᓐᓂᑦ	Angujaujut	13	39	35	11	35	18	8	2	5	8	18	40	97*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᓂᖏᑦ (%)	Kiujut (%)	89	100	100	100	100	96	97	98	90	89	88	88	95**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᕆᑦ ᐊᑎᓕᐅᔾᔪᓕᒃᑯᑦ/ᐊᐱᓯᓂᖅᓴᓐᓂᑦ/ᐊᐱᓯᓂᑦ/ᐊᖏᔪᓂᖅᑎᒋᓐᓂᑦ ᐊᑕᐅᓂᐊᖅᓗᓂ% ᐊᑎᑎᖅ ᐊᒃᓴᒍ.
** ᐊᒃᓵᓴᓕᒥᓪᓚᔪᑦ ᑕᖅᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 369

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᕐᖏᓂ ᐊᖏᔪᓂᓐᓂᖏᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᕐᑕᐅᓂᖏᑕ, ᓇᓗᓇᐃᕐᑕ ᐃᒪᓐ % ᑲᑎᑕᑎᑦ ᐊᖏᔪᓂᖅᑕ ᑎᑎᕐᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)

ᐊᒃᓴᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᓄᐊᒻᐱᓗ	DEC ᑎᓯᒻᐱᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᓯ	APR ᐃᓴᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	100	0	55	100	100	29	100	100	0	50	100	98	68
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	100	45	0	0	71	0	0	100	50	0	2	32
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 370

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓇᓯᒍᑦ ᐊᖏᔪᓇᓯᓴᕐᕋᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 2 (June 1997 - May 1998)

ᐊᒃᑭᒍ 2 (ᔪᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

6.2.3

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᒻᒪᑎ	SEP ᓱᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᓇᐱᓇ	DEC ᑎᓯᐱᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᓇᖕᐅᐊᓇ	MAR ᒪᓯ	APR ᐃᓴᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	1	16	23	8	13	5	2		1	5	17	25	58
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait			1		1	1							2
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut					1						2	2	5
Arctic fox	ᑎᓗᒃᑲᓂᐊᑦ	Tigiganiat					1				2	2	1		5
Wolverine	ᖃᑦᕿᒋᑦ	Kalvik						1						1	2
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				1	3							1	5
Seals (unspecified)	ᓯᖏᑯᓪᓚᑦ	Natiit	5												5
Ringed seal	ᓇᓯᓗᑦ	Natiinat	10	24	2		5	4	3		3	2	1	4	33
Bearded seal	ᐅᒃᕿᐃᑦ	Ukyuk												1	1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	2	1											3
Canada goose	ᓄᓪᓚᑦ ᐅᓗᐊᔪᓚᑦ	Nikliknik		2										2	4
Eider duck	ᒥᑎᑦ	Kingalik												1	1
Ptarmigan	ᐊᖏᒃᑭᑦ	Akilgik				1								2	3
Arctic char	ᐃᖕᓂᒃᐱᑦ	Ikaliviit	5	22	21	5	10	2						12	53
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik			2	1	11	1	6			2	6	22	35
Whitefish	ᑲᐱᓯᓚᑦ	Kapihiliit	1	9	3	1	17	11		2					32

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔨᓂᒃ ᐱᑕᖃᖅᑎᑐᖃᖅ ᐱᒃᔨᐸᑎᓕᖅᓂᒃ ᐊᖏᔪᒃ ᖃᑦᓯᐅᓂᖏᖅᓂᓄᑦ ᐊᓕᔪᖅᓂᓄᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓇᓄᓂ ᑐᓂᔪᖅᓂᖅ ᐃᑯᐱᕐᓚᓕᔪᓂᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 371

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktaman nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᓚᖅᔪᒍ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᑕᒪᑦ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᓴᓕ	OCT ᐅᑦᔪᓕ	NOV ᐅᓇᓚᓕ	DEC ᑎᓱᓕ	JAN ᔮᖏᓇᐊᓕ	FEB ᓇᖅᐳᐊᓕ	MAR ᒪᑉᓴ	APR ᐃᑦᓗᓪ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓪᓕᖅᑕᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	15	46	134	39	5	67	32	27	10	24	127	119	645 ± 144
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait		6	4			4	5		2	2			23 ± 15
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡							4						
Wolf	ᐊᒪᓗᐃᑦ	Amagut											3	3	6 ± 5
Arctic fox	ᑎᓚᒃᓂᐅᔪᑦ	Tigiganiat						1							1 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik							1						1 ± 1
Seals (unspecified)	ᓴᖅᑯᓪᓚᑦ	Natiit	19					11	2						32 ± 24
Ringed seal	ᓇᓕᓴᑦ	Natiinat											4	17	21 ± 13
Bearded seal	ᐅᒃᔾᔨᐃᑦ	Ukyuk												3	3 ± 3
Harp seal	ᖃᐃᐳᓪᓚᑦ	Qairulik												4	4 ± 5
Snow goose	ᑲᖏᒍᐃᑦ	Kanguq	15										9	47	71 ± 61
Canada goose	ᓄᕐᓚᑦ ᐅᓇᐊᒍᓪᓚᑦ	Nikliknik											9	78	87 ± 90
Eider duck	ᒥᑎᑦ	Kingalik	15												15 ± 26
Ptarmigan	ᐊᖏᒃᑭᑦ	Akilgik										4			4 ± 5
Goose eggs	ᑲᖏᒍᐃᑦ ᒪᓂᓂᖅᑦ	Uluaguliit manniit												673	673 ± 1,001
Arctic char	ᐃᖃᓗᒃᑕᑦ	Ikaliviit	343	2,348	431		277	3,234	700	381	2	271	797	484	9,268 ± 3,656
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	47	17				381	70		101		606	284	1,506 ± 458
Whitefish	ᑲᕕᓯᓪᓚᑦ	Kapihiliit						2,234	459	346	381			29	3,449 ± 1,303
Least cisco	ᒥᑭᓂᖅᑦ ᑲᕕᓯᓪᓚᑦ	Eetuuk						47							47 ± 36

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᐊᑦ ᑎᑎᕋᐅᒪᓕᒃ ᑐᓂᒃᑯᑦ ᐅᑯᐊ ᐃᑯᕐᓴᕐᓇᓕᒋᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 372

Monthly hunter response

ᑕᕝᑕᒧᑦ ᐊᖏᔪᓯᓴᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᒻᒋᔪ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

6.2.3

Month/ᑕᕝᖏᖅ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᔪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑐᐱᓂ	NOV ᐅᓇᒻᒪᓂ	DEC ᑎᓯᒻᒪᓂ	JAN ᒍᖏᓇᓂ	FEB ᐃᖅᑲᓇᓂ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓯᓴᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔪᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᕝᑕᒧᑦ ᐊᖏᔪᓯᓴᑦ	Tatkitaman angunahuktut titigait	331	329	328	329	330	328	327	325	325	329	326	323	337*
Interview list	ᐊᐱᕐᓂᖅᓱᐃᑦ	Apikiktan	211	209	208	209	210	208	207	205	205	209	206	204	217*
Hunters interviewed	ᐊᖏᔪᓯᓴᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	145	141	144	140	139	200	200	173	174	170	165	155	212*
Harvested	ᐊᖏᔪᓯᖏᑐᒃᑯᑦ	Angujaujut	7	6	6	3	1	35	12	4	5	6	26	37	78*
Response Rate (%)	ᑭᐅᔾ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	69	67	69	67	66	96	97	84	85	81	80	76	78**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓯᓴᑦ ᐊᑎᓕᐅᕐᓯᒪᔪᑦ/ᐊᐱᕐᓂᖅᓱᓕᕆᓂᖅ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓯᖏᑐᒃᑯᑦ ᐊᑕᐅᓯᐊᓗᓂ% ᐊᑐᑎᑦ ᐊᒻᒋᒥ.
** ᐊᐅᔨᓕᓐᓂᓯᒪᔪᑦ ᑕᕝᑕᒧᑦ ᑭᐅᔾ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 373

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᐃᐅᔪᑦ ᐊᑯᖏᓂᒃ ᐊᖏᔪᓯᓂᖏᓐᓄᑦ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᓄᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑎᑦ ᐊᖏᔪᓯᓴᑦ ᑎᑎᕐᓗᒋᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐊᒻᒋᔪ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᕝᖏᖅ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᔪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑐᐱᓂ	NOV ᐅᓇᒻᒪᓂ	DEC ᑎᓯᒻᒪᓂ	JAN ᒍᖏᓇᓂ	FEB ᐃᖅᑲᓇᓂ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᐃᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕝᑦ	≤ tatkin pingahut	100	54	62	75	100	100	100	100	100	100	8	6	57
4-6 months	4-6 ᑕᕝᑦ	tatkin hitaman 6nut	0	46	38	25	0	0	0	0	0	0	25	94	31
> 6 months	> 6 ᑕᕝᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	67	0	12

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 374

Number of hunters harvesting each species

ᖃᑦᓭᐅᓂᖏᑦ ᐊᖏᔪᓚᒃᑎᑦ ᐊᖏᔪᓚᒃᓴᖅᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 3 (June 1998 - May 1999)

ᐊᒻᒪᒍ 3 (ᔪᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒻᐹᓗ	DEC ᑎᓯᐹᓗ	JAN ᐅᓐᓄᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᓯ	APR ᐃᓯᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑕᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	2	6	5	3	1	11	4	2	2	3	19	16	40
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait		1	1			2	1		1	1			5
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut											1	2	3
Arctic fox	ᑎᓪᓚᖓᓂᐊᑦ	Tigiganiat						1							1
Arctic hare	ᐅᑲᓪᓂᑦ	Ukalik							1						1
Seals (unspecified)	ᓄᖅᑯᓪᓂᑦ	Natiit	2					3	1						6
Ringed seal	ᓇᓂᓪᑦ	Natiinat											3	4	7
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk												1	1
Harp seal	ᖃᐃᕈᓪᓂᑦ	Qairulik												1	1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	1										1	2	4
Canada goose	ᓄᑦᓪᓂᑦ ᐅᓗᐊᔪᓪᓂᑦ	Nikliknik											1	2	3
Eider duck	ᑎᑎᑦ	Kingalik	1												1
Ptarmigan	ᐊᕈᑦᑎᑦ	Akilgik										1			1
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓄᖅᑦ	Uluaguliit manniit												1	1
Arctic char	ᐃᖃᓗᒃᑕᑦ	Ikaliviit	6	4	2		1	19	4	1	1	1	4	15	43
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	2	1				9	1		1		10	6	24
Whitefish	ᑲᕕᓱᓪᓂᑦ	Kapihiliit						10	2	1	1			1	13
Least cisco	ᒥᑭᓄᖓᑦ ᑲᕕᓱᓪᓂᑦ	Eetuuk						1							1

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓱᒪᔪᓂᖅ ᐱᕈᖖᓄᑐᖅ ᐱᓕᔪᑎᓕᓐᓂᖅ ᐊᖏᔪᑦ ᖃᕋᐅᓂᖓᓄᓐᓂᑦ ᐊᓪᓚᖅᑕᒪᒪᒪᔪᓂᑦ ᐊᖏᔪᓂᒃ ᓇᓗᐅᑦᑐᖓᓂ ᑐᓂᓯᖓᓄᑦ ᐃᓄᐃᖕᓇᓗᓂᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.2.3

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 375

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓐᓂᑦ

Tatkiktaman nahaktauvaktun

Year 4 (June 1999 - May 2000)

ᐊᓐᖁᔭᒍ 4 (ᔨᓂᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

6.2.3

Month/ᑕᖅᑕᒃ/Tatkia			JUN ᔨᓂᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑦᔨᓇ	NOV ᐅᓇᓕᓇ	DEC ᑎᓯᓕᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᓯ	APR ᐃᑦᓇᓪᓗ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	48	30	123	50	35	4	21		28	31	69	163	602 ± 101
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait					2		4	5	3	23	3		40 ± 17
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡						1	3						
Tundra grizzly	ᐊᑦᓕᐃᑦ	Akhait												2	2 ± 3
Wolf	ᐊᒪᖅᐃᑦ	Amagut										4	9	4	17 ± 12
Arctic fox	ᑎᓗᒃᑯᓕᐊᑦ	Tigiganiat									16	12		2	30 ± 16
Wolverine	ᖃᑦᕿᐃᑦ	Kalvik										2			2 ± 3
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik											2		2 ± 3
Seals (unspecified)	ᓴᖅᑯᓪᓚᑦ	Natiit									24	6	3	13	46 ± 18
Ringed seal	ᓇᓴᓪᓚ	Natiinat	33	3	3	2		6	3						50 ± 24
Bearded seal	ᐅᒃᔪᐃᑦ	Ukyuk	2											10	12 ± 8
Snow goose	ᑲᖏᐃᑦ	Kanguq	107	87	36										230 ± 126
Canada goose	ᓄᑦᓚᑦ ᐅᓗᐊᔪᓚᑦ	Nikliknik	71											4	75 ± 89
White-fronted goose	ᓄᑦᓚᑦ	Nirlivik												4	4 ± 4
Eider duck	ᒥᑎᑦ	Kingalik	24	2	9										35 ± 37
Ptarmigan	ᐊᖏᒃᑭᑦ	Akilgik									1	36			37 ± 29
Arctic char	ᐃᖃᓗᐲᐸᑦ	Ikaliviit	1,762	2,322	3,195	837	647	3,063	900		1,330	404	238	21	14,719 ± 3,079
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	247	1,139	313	134	901	520	140	32	75	308	360	415	4,584 ± 1,354
Whitefish	ᑲᐱᓯᓚᑦ	Kapihiliit		218			2,082	380							2,680 ± 1,389

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦ ᑎᑎᕋᐅᒪᓕᖅ ᑐᓂᔭᕐᑎᑦ ᐅᑉᐊᒃ ᐃᓄᐃᖕᓂᖅᓱᓐᓂᒃ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 376

Monthly hunter response

ᑕᖅᑕᒪᑦ ᐊᖏᒍᓱᑎᑦ ᑭᐅᓂᖅᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)

ᐊᒻᔪᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒻᔪᑎ	SEP ᓯᑎᒻᒪᓗ	OCT ᐅᑐᒻᒪᓗ	NOV ᐅᓇᒻᒪᓗ	DEC ᑎᓯᒻᒪᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓕ Tamakiklugin
Hunter Response Categories	ᐊᖏᒍᓱᑎᑦ ᑭᐅᓂᖅᑎᑦ ᐋᔪᔨᓕᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᒍᓱᑎᑦ	Tatkitaman angunahuktut titigait	325	326	326	319	317	316	322	325	330	334	333	332	344*
Interview list	ᐊᐱᕐᓂᖅᓴᐃᑦ	Apikiktan	205	206	206	199	197	196	202	205	210	214	213	212	224*
Hunters interviewed	ᐊᖏᒍᓱᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	157	158	155	153	152	165	201	194	188	193	182	148	209*
Harvested	ᐊᖏᒍᓱᓕᒃᑐᓂᑦ	Angujaujut	42	23	33	15	25	7	17	3	17	29	23	32	110*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖅᓂᑦ (%)	Kiujut (%)	77	77	75	77	77	84	100	95	90	90	85	70	83**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᒍᓱᑎᑦ ᐊᑎᓕᐅᔾᔨᒪᔪᑦ/ᐊᐱᕐᓂᕆᓂᖅᓯᒪᔪᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᒍᓱᓕᒃᑐᓂᑦ ᐊᑕᐅᓯᐊᖅᓗ% ᐊᑐᑎᑦ ᐊᒻᔪᒪᑦ.
** ᐊᓕᔾᔨᓂᕐᓂᒪᔪᑦ ᑕᖅᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 377

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᖅᐳᐅᔪᑦ ᐊᑯᖅᓴᓂ ᐊᖏᒍᓱᓐᓂᓴᒃᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓴᒃᑕ, ᓇᓗᓇᐃᖅᑕᑦ ᐃᒪᓱᑲ % ᑲᑎᑦᑎᓕ ᐊᖏᒍᓱᑦᑕ ᑎᑎᖅᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

ᐊᒻᔪᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒻᔪᑎ	SEP ᓯᑎᒻᒪᓗ	OCT ᐅᑐᒻᒪᓗ	NOV ᐅᓇᒻᒪᓗ	DEC ᑎᓯᒻᒪᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓕ Tamakiklugin
Recall Period	ᐅᑎᖅᐳᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑦ	≤ tatkin pingahut	13	49	100	100	100	100	100	100	100	100	100	100	84
4-6 months	4-6 ᑕᖅᑦ	tatkin hitaman 6nut	87	51	0	0	0	0	0	0	0	0	0	0	16
> 6 months	> 6 ᑕᖅᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 378

Number of hunters harvesting each species — **Year 4 (June 1999 - May 2000)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᓕᒃᑎᑦ ᐊᖏᔪᓚᓕᒃᑭᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒡᖁᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 4 (June 1999 - May 2000)**

Month/ᑕᖅᖢᓗ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓕ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓚᐱᓗ	DEC ᑎᓴᐱᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᔨᔪ	APR ᐃᔨᓀᓪ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	10	5	20	7	6	2	6		8	8	16	20	57
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait					1		2	2	1	6	1		13
Polar bear#	ᓇᓄᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᑦᓪᓗᐃᑦ	Akhait												1	1
Wolf	ᐊᒪᕈᐃᑦ	Amagut										3	2	1	5
Arctic fox	ᑎᓗᒃᑲᓂᐊᑦ	Tigiganiat									3	1		1	4
Wolverine	ᖃᑦᐸᐃᑦ	Kalvik										1			1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik											1		1
Seals (unspecified)	ᓯᖏᑯᓪᓚᑦ	Natiit									3	3	1	4	8
Ringed seal	ᓇᓯᓕᑦ	Natiinat	9	2	2	1		1	2						16
Bearded seal	ᐅᓘᔪᐃᑦ	Ukyuk	1											4	5
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	4	1	2										7
Canada goose	ᓂᖅᓪᓚᑦ ᐅᓗᐊᔨᓪᓚᑦ	Nikliknik	3											2	5
White-fronted goose	ᓂᖅᓪᓚᑦ	Nirlivik												2	2
Eider duck	ᒥᑎᑦ	Kingalik	1	1	1										3
Ptarmigan	ᐊᖏᓘᑦ	Akilgik									1	4			5
Arctic char	ᐃᖅᓗᑲᐲᐃᑦ	Ikaliviit	20	15	16	3	5	5	3		4	4	1	2	53
Lake trout	ᐃᓯᕆᐃᑦ	Ikalukpik	6	4	6	4	14	2	6	1	2	9	14	19	59
Whitefish	ᑲᐱᓯᓪᓚᑦ	Kapihiliit		3			6	1							9

6.2.3

ᐊᑐᓂᒃ ᐅᒪᔨᑦ

Umajuin

Species

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᖅᑎᑉᓱᖅ ᐱᔨᔭᑎᓕᓐᓂᒃ ᐊᖏᔪᑦ ᖃᓯᐅᓂᖓᓄᓪᓗᓂ ᐊᓪᓚᕆᒪᒪᔪᓂ ᐊᑐᔪᓂ ᓇᓕᕆᔨᖅᑐᓂᒃ ᐊᑐᔪᓂ ᓇᓕᕆᔨᖅᑐᓂᒃ ᐃᓅᔪᖓᓄᑦ ᐃᓄᐃᑦᑎᓐᓇᓕᒃ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 379

Monthly harvest estimates — Year 5 (June 2000 - May 2001)

ᑕᕿᑕᒫᑦ ᐊᖑᔭᓄᑦ ᓇᓚᐅᑦᓴᕈᑏᑦ — ᐊᒃᕋᒍ 5 (ᔪᓂ 2000 - ᒪᐃ 2001)

Tatkiktaman nahaktauvaktun — Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒃᒍᑎ	SEP ᓱᑎᒃᐱᕆ	OCT ᐅᑦᑐᐱᕆ	NOV ᓈᕕᒃᐱᕆ	DEC ᑏᓱᒃᐱᕆ	JAN ᔭᓐᓄᐊᕆ	FEB ᕕᖅᐳᐊᕆ	MAR ᒫᑦᓯ	APR ᐃᑦᕆᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	96	4	16	32	125	16	13	7	11	5	14	59	398 ± 107
Musk-ox	ᐅᒥᒃᒪᐃᑦ	Umingmait					1						3		4 ± 1
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡							2						
Wolf	ᐊᒪᕈᐃᑦ	Amagut										1	1		2 ± 1
Arctic fox	ᑎᕆᒐᓐᓂᐊᑦ	Tigiganiat									2	1			3 ± 3
Arctic hare	ᐅᑲᓖᑦ	Ukalik									1		1		2 ± 1
Seals (unspecified)	ᓯᖅᑯᓖᑦ	Natiit	26												26 ± 23
Ringed seal	ᓇᑦᓯᑦ	Natiinat	12	1	1		3	6		5				9	37 ± 13
Bearded seal	ᐅᒃᔪᐃᑦ	Ukyuk	2												2 ± 4
Harp seal	ᖃᐃᕈᓖᑦ	Qairulik	26												26 ± 24
Geese (unspecified)	ᓂᕐᓖᑦ	Kanguk	2												2 ± 4
Snow goose	ᑲᖑᐃᑦ	Kanguq	527	2	12	2								193	736 ± 314
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik	66			4								11	81 ± 47
White-fronted goose	ᓂᕐᓖᑦ	Nirlivik	25												25 ± 35
Eider duck	ᒥᑏᑦ	Kingalik	35											8	43 ± 25
Ptarmigan	ᐊᕿᒃᑏᑦ	Akilgik	28				9								37 ± 43
Goose eggs	ᑲᖑᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	91											927	1,018 ± 1,263
Duck eggs	ᒥᑏᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit	156												156 ± 219
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	214	221	676	349	245	329	688		63		33	655	3,473 ± 831
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	1,951	172	125	1		1,025	511	44		245	22	95	4,191 ± 1,071
Whitefish	ᑲᕕᓯᓖᑦ	Kapihiliit		24	110	1		344		44					523 ± 386

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᕐᓄᑦ ᑎᑎᕋᑦᑕᒪᔪᑦ ᑐᓂᔭᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᕕᓕᕆᔨᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 380

Monthly hunter response

ᑕᖅᑕᒪᒃ ᐊᖏᔪᓯᓂᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᓕᕐᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐸᓗᓂ	OCT ᐅᑐᐱᓗᓂ	NOV ᐃᓕᓴᐸᓗᓂ	DEC ᑎᓯᐸᓗᓂ	JAN ᒍᓐᓄᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᕐᓯ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓯᓂᑦ ᑭᐅᓂᖏᑦ ᐊᑭᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃ ᐊᖏᔪᓯᓂᑦ	Tatkitaman angunahuktut titigait	333	334	334	333	333	331	334	334	332	331	331	329	338*
Interview list	ᐊᐱᕐᓂᖅᓱᐃᑦ	Apikiktan	213	214	214	213	213	211	214	214	212	211	211	209	218*
Hunters interviewed	ᐊᖏᔪᓯᓂᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	143	198	202	199	198	200	200	200	198	200	201	190	214*
Harvested	ᐊᖏᔪᓯᑐᑎᒋᓐᓂᑦ	Angujaujut	49	7	10	10	5	11	9	4	5	7	6	11	80*
Response Rate (%)	ᑭᐅᓂ ᖃᓂᐅᓂᖏᑦ (%)	Kiujut (%)	67	93	94	93	93	95	93	93	93	95	95	91	91**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓯᓂᑦ ᐊᑎᓕᐅᔨᒪᔪᓕᐊᑦ/ᐊᐱᕐᓂᕆᔨᓐᓂᒋᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓯᑐᑎᒋᓐᓂᑦ ᐊᑕᐅᓂᐊᓕᓄᖅ% ᐊᑐᕐᑎᑦ ᐊᑭᓚᒥ.
** ᐊᐅᔨᓂᓕᒪᔪᑦ ᑕᖅᑕᒪᒃ ᑭᐅᔪᑦ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 381

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓐᓄ ᐊᖏᔪᓯᓂᖓᓐᓂᑕ ᐊᒪᓗᓄ ᐊᐱᕐᓂᑕᐅᓂᖓᓐᓂᑕ, ᓇᓗᓇᐃᕐᑕ ᐃᒪᓚ % ᑲᑎᑕᑎᑦ ᐊᖏᔪᓯᓂᑕ ᑎᑎᕐᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᓕᕐᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐸᓗᓂ	OCT ᐅᑐᐱᓗᓂ	NOV ᐃᓕᓴᐸᓗᓂ	DEC ᑎᓯᐸᓗᓂ	JAN ᒍᓐᓄᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᕐᓯ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

6.2.3

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 382

Number of hunters harvesting each species
ᖁᑦᓱᐅᓂᖏᑦ ᐊᖏᓚᓭᓴᐃᑦ ᐊᖏᓚᓭᓴᕿᓕᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 5 (June 2000 - May 2001)
ᐊᒡᖏᒍ 5 (ᔪᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᓄᓇᒃᓗ	DEC ᑎᓴᒃᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᓇᖅᑲᐊᓗ	MAR ᒪᕆ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	17	2	4	7	5	4	4	1	3	1	3	10	41
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait					1						2		3
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᖏᐃᑦ	Amagut										1	1		2
Arctic fox	ᑎᓗᒃᑯᓂᐊᑦ	Tigiganiat									1	1			2
Arctic hare	ᐅᑲᓪᓂᑦ	Ukalik									1		1		2
Seals (unspecified)	ᓂᖅᑯᓪᓂᑦ	Natiit	5												5
Ringed seal	ᓇᓂᓪᑦ	Natiinat	4	1	1		1	2		2				3	11
Bearded seal	ᐅᓗᓴᐃᑦ	Ukyuk	1												1
Harp seal	ᖁᐃᕈᓪᓂᑦ	Qairulik	4												4
Geese (unspecified)	ᓄᖅᓪᓂᑦ	Kanguk	1												1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	14	1	2	1								4	22
Canada goose	ᓄᖅᓪᓂᑦ ᐅᓗᐊᒍᓪᓂᑦ	Nikliknik	6			1								2	8
White-fronted goose	ᓄᖅᓪᓂᑦ	Nirlivik	2												2
Eider duck	ᒥᑎᑦ	Kingalik	6											1	6
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	1				1								2
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓄᖓᑦ	Uluaguliit manniit	2											1	3
Duck eggs	ᒥᑎᑦ ᒪᓐᓄᖓᑦ	Tinmiat manniit	2												2
Arctic char	ᐃᖕᓗᑲᐱᑦ	Ikaliviit	5	4	7	6	2	3	3		1		2	5	24
Lake trout	ᐃᓯᕐᕿᐃᑦ	Ikalukpik	30	2	1	1		3	5	1		4	3	3	43
Whitefish	ᑲᐱᓂᓪᓂᑦ	Kapihiliit		1	3	1		2		1					8

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓂᒪᓕᕆᓂᖅ ᐱᕈᖕᖏᕐᕋᖅ ᐱᓵᐊᑎᓪᓂᖅ ᐊᖏᓴᑦ ᖁᕐᓂᐅᓂᖏᖕᓄᑦ ᐊᓪᓚᖅᑎᒪᓕᕆᓂᑦ ᐊᖏᓴᓄᑦ ᓇᓪᑐᕐᕿᓂᐅᔪᓐᓇᖅᑐᑦ ᑐᓂᔭᕐᕋᖕᓂᒃ ᐃᑯᐱᕐᓚᓪᓕᐊᓪᓚᓪᓕᐅᑉ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.2.3

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 383

Annual harvest estimates and five-year mean

ᐊᓐᔪᒍᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓱᓀᑦ ᐊᓚᓗ ᑕᒥᓴᓄᑦ-ᐊᓐᔪᒍᓄᑦ ᐊᐅᓀᑦᓯᑎᓂᒪᓕᕆᑦ

Aragutamat angujauvaktun tatlman araguit iluani

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓐᔪᒍᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

6.2.3

Study Year/ᖃᐅᔨᓴᖅ ᐊᓐᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᓀᑦᓯᑎᓂᒪᓕᕆᑦ Amigaitkiyait
Species	ᐅᒪᔪᑦ	**Umajuin**						
Caribou[1]	ᑐᑐᐃᐃᑦ[1]	Tuktut[1]	698	569	645	602	398	582
Musk-ox[2]	ᐅᒥᖅᒪᐃᑦ[2]	Umingmait[2]	17	5	23	40	4	18
Polar bear[3]	ᓇᓂᐃᑦ[3]	Nanuit[3]	4	5	4	4	4	4
Tundra grizzly	ᐊᑲᓪᓚᑦ	Akhait	0	0	0	2	0	<1
Wolf[4]	ᐊᒪᕐᐃᐃᑦ[4]	Amagut[4]	12	22	6	17	2	12
Arctic fox[5]	ᑎᓗᒃᑑᓕᑦ[5]	Tigiganiat[5]	254	38	1	30	3	65
Wolverine[6]	ᖃᐅᕕᑦ[6]	Kalvik[6]	1	3	0	2	0	1
Arctic hare[7]	ᐅᖃᓪᓚᑦ[7]	Ukalik[7]	4	7	1	2	2	3
Arctic ground squirrel[7]	ᓱᑲᓪᓚᑦ[7]	Hikhik[7]	1	0	0	0	0	<1
Seals (unspecified)	ᓱᖏᑯᓂᑦ	Natiit	0	11	32	46	26	23
Ringed seal	ᓇᑦᓱᑦ	Natiinat	169	149	21	50	37	85
Bearded seal[8]	ᐅᑦᔪᐃᑦ[8]	Ukyuk[8]	0	1	3	12	2	4
Harp seal	ᖃᐃᕐᓂᑦ	Qairulik	0	0	4	0	26	6
Geese (unspecified)	ᓄᑦᓂᑦ	Kanguk	27	0	0	0	2	6
Snow goose[9]	ᑲᖏᐃᑦ[9]	Kanguq[9]	123	82	71	230	736	248
Canada goose	ᓄᑦᓂᑦ ᐅᓗᐊᔪᓂᑦ	Nikliknik	153	30	87	75	81	85
White-fronted goose	ᓄᑦᓂᑦ	Nirlivik	0	0	0	4	25	6
Eider duck	ᒥᑎᑦ	Kingalik	39	1	15	35	43	27
Ptarmigan[10]	ᐊᖏᓚᑦᑐᑦ[10]	Akilgik[10]	2	13	4	37	37	19
Goose eggs[11]	ᑲᖏᐃᑦ ᒪᓕᓂᖅᑐᑦ[11]	Uluaguliit manniit[11]	0	0	673	0	1,018	338
Duck eggs[11]	ᒥᑎᑦ ᒪᓕᓂᖅᑐᑦ[11]	Tinmiat manniit[11]	0	0	0	0	156	31
Arctic char[12]	ᐃᖃᓗᒃᐲᑦ[12]	Ikaliviit[12]	13,937	4,998	9,268	14,719	3,473	9,279
Lake trout[13]	ᐃᓱᒋᐃᑦ[13]	Ikalukpik[13]	237	1,619	1,506	4,584	4,191	2,427
Whitefish	ᑲᐱᓱᓂᑦ	Kapihiliit	2,398	11,304	3,449	2,680	523	4,071
Least cisco[14]	ᒥᑭᓂᖅᑐᑦ ᑲᐱᓱᓂᑦ[14]	Eetuuk[14]	0	0	47	0	0	9

[1-14]: See page 505 for community feedback and other sources of data.

[1-14]: ᑕᐃᒃ ᒪᕐᐱᑐᖅ 507 ᓄᓇᓕᑦ ᑭᐅᔭᓐᓄᑦ ᐊᓚᓗ ᐊᓯᖏᑦ ᐱᒻᔨᐊᑎᖏᑦ.

[1-14]: Takulugu makpigaak 509 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 384

Annual hunter response

ᐊᓚᖏᔪᒋᒪᑦ ᐊᖏᔪᓇᓴᐃᑦ ᑭᐅᓂᖏᑦ

Angujauvaktu

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓚᖏᔪᓄᑦ (ᓱᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᔪᑦ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Species	**ᐅᒪᔪᑦ**	**Umajuin**						
Monthly hunter list	ᑕᑭᑕᒪᑦ ᐊᖏᔪᓇᓴᐃᑦ	Tatkitaman angunahuktut titigait	344	347	337	344	338	368*
Interview list	ᐊᐱᕐᓂᖅᓴᑦ	Apikiktan	227	226	217	224	218	246*
Hunters interviewed	ᐊᖏᔪᓇᓴᐃᑦ ᐊᐱᕐᓂᖅᑕᑦ	Angunahuktin apikhuktan	225	223	212	209	214	244*
Harvested	ᐊᖏᔪᓇᓴᐅᒥᓂᑦ	Angujaujut	89	97	78	110	80	180*
Response Rate (%)	ᑭᐅᑦ ᖃᓕᑭᐅᓂᖏᑦ (%)	Kiujut (%)	83	95	78	83	91	86**

* Hunters registered/on interview list/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖏᔪᓇᓴᐃᑦ ᐊᑎᓕᐅᕐᒪᓕᕐᓂᑦ/ᐊᐱᕐᓂᖅᓴᓐᓂᑦ/ᐊᐱᕐᓂᖅᑕᑦ/ᐊᖏᔪᓇᓴᐅᒥᓂᑦ ᐊᑕᐅᓂᐊᕐᓂᖅ ᓄᓇᕗᑦ ᖃᐅᔨᓴᖅᓯᒪᔪᑦ.
** ᐱᓕᕆᓂᖅᓯᒪᓕᖅ ᐃᓚᖏᔪᒋᒪᑦ ᑭᐅᑦ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut taipfumuna tahapkuan kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 385

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᕐᓴᑦ ᐊᑯᓂᖅᓄᑦ ᐊᖏᔪᓇᓴᓂᖅᓯᒪᑦ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖅᓯᒪᑦ, ᓇᓗᓇᐃᔨᑦᑕᑦ ᐃᒪᓐ % ᑲᑎᒪᔨᑦ ᐊᖏᔪᓇᓴᑦᑕᑦ ᑎᑎᕐᓂᑦᑕᐅᒪᓕᕐᓂᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓚᖏᔪᓄᑦ (ᓱᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᓚᖏᔪᔪᑦ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᕐᓴᑦ**	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᖅᑲᑦ	≤ tatkin pingahut	89	68	57	84	100	80
4-6 months	4-6 ᑕᖅᑲᑦ	tatkin hitaman 6nut	11	32	31	16	0	18
> 6 months	> 6 ᑕᖅᑲᑦ	> 6 tatkin	1	0	12	0	0	2

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 386

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓯᖅᑎᑦ ᐊᖏᔪᓯᖅᓯᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ

Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᒃᑲᒍᓂᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅᓯᒃ ᐊᒃᑲᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᒥᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**						
Caribou	ᑐᑐᐃᑦ	Tuktut	54	58	40	57	41	107
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait	8	2	5	13	3	27
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒃᓪᓚᐃᑦ	Akhait				1		1
Wolf	ᐊᒪᕈᐃᑦ	Amagut	2	5	3	5	2	13
Arctic fox	ᑎᓗᒃᑲᓂᐊᑦ	Tigiganiat	8	5	1	4	2	17
Wolverine	ᖃᑦᕃᑦ	Kalvik	1	2		1		4
Arctic hare	ᐅᒃᓪᓗᑦ	Ukalik	3	5	1	1	2	10
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik	1					1
Seals (unspecified)	ᓱᖅᑯᓪᓗᑦ	Natiit		5	6	8	5	17
Ringed seal	ᓇᕐᓱᑦ	Natiinat	26	33	7	16	11	56
Bearded seal	ᐅᒃᔪᐃᐃᑦ	Ukyuk		1	1	5	1	8
Harp seal	ᖃᐃᕈᓪᓗᑦ	Qairulik			1		4	5
Geese (unspecified)	ᓄᖅᓪᓗᑦ	Kanguk	2				1	3
Snow goose	ᑲᖏᐃᑦ	Kanguq	6	3	4	7	22	34
Canada goose	ᓄᖅᓪᓗᑦ ᐅᓕᐊᔪᓪᓗᑦ	Nikliknik	8	4	3	5	8	26
White-fronted goose	ᓄᖅᓪᓗᑦ	Nirlivik				2	2	4
Eider duck	ᒥᑎᑦ	Kingalik	3	1	1	3	6	13
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	1	3	1	5	2	10
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓄᖅᑦ	Uluaguliit manniit			1		3	4
Duck eggs	ᒥᑎᑦ ᒪᓐᓄᖅᑦ	Tinmiat manniit					2	2
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	60	53	43	53	24	125
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	13	35	24	59	43	101
Whitefish	ᑲᐱᓱᓪᓗᑦ	Kapihiliit	8	32	13	9	8	43
Least cisco	ᒥᑭᓄᖓᑦ ᑲᐱᓱᓪᓗᑦ	Eetuuk			1			1

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓱᒪᔪᓂᒃ ᐱᕈᖅᓄᖓᑐᖅ ᐱᔨᔪᑎᓕᓂᒃ ᐊᖏᔪᑦ ᖃᖅᑲᐅᓂᖓᓂᓗᑦ ᐊᓕᖅᑲᐅᒪᒪᓕᒃᑐᑦ ᐊᖏᔪᓂᑦ ᓇᓕᑲᕐᓗᑎᒃ ᑐᓂᔭᖓᓂᓗ ᐃᓄᐃᖅᑲᓇᕐᓂᖅᑕᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.2.3 Community Results Discussion: Gjoa Haven

The survey frame:

An assessment of under-enumeration during the community visit revealed that there were approximately 22 hunters who were not registered in the Harvest Study. Eighteen of these were Inuit – all were occasional hunters. It is estimated that there were four non-Inuit hunters with assigned hunting rights who were not registered, also all occasional hunters. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. However, the extent of the bias is likely very small since the missing hunters are all occasional hunters and only represent six percent of the total hunter population (Table 10).

Due to the relatively small number of intensive hunters registered in Gjoa Haven, the intensive classification was joined with the active classification for the purpose of calculating harvest estimates.

The HTO Board felt that there were more than eight intensive hunters in the community. Given that all the un-registered hunters identified were occasional hunters it is likely that some intensive hunters were misclassified rather than un-registered. The effect of this should be minimal since, as discussed above, we have joined the active and intensive classifications for the estimate calculations.

Survey coverage and non-response bias:

Response rates although good in most months, were lower in the first few months of the study and in the summer and fall of 1998 (year 3), with five months below 75%. As seen in Table 9 the consistent intentional non-response rate in Gjoa Haven was low, at 0.4%, and was not thought to be a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough during most years to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should exercise caution when using the data collected during the summer and fall of years 1 and 3 of the study since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:

During the community visit it was reported that in following Inuit tradition, hunters do not reveal exact counts of harvests – since it is against tradition to count and report their harvest. It was suggested that some hunters may have underestimated and under-reported their harvest, especially for some species such as birds and small game. Readers should also refer to Section 5.4 for a thorough discussion of this issue.

As seen in the recall period tables, the vast majority of the harvest records in years 1, 4 and 5 were collected within three months of the harvest. In years 2 and 3 there were several months with longer recall periods, however most were still under six months. The ability of a hunter to remember their harvest would tend to decrease as the recall period lengthens suggesting that some measurement error may have occurred where recall periods were longer.

As noted in the comments associated with arctic char, below, there was some commercial harvesting of arctic char during the study. It is thought that some of this commercial harvest may have been reported with the subsistence harvest.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted almost entirely of barren-ground caribou, however some island caribou and even a few Peary caribou were reported during the study. For the purpose of calculating harvest estimates they were combined into one category.
2. **Musk-ox:** Harvest estimates seem low (C.F.). DSD reports the following harvest numbers for musk-ox (DSD MXc):

Year 1	Year 2	Year 3	Year 4	Year 5
n/d	34	n/d	n/d	30

   The above data provided by DSD did not specify whether the hunts were subsistence or sport hunts, however we were informed that there are usually 3 to 5 sport hunts per year. This would indicate that the subsistence harvest for years 2 and 5 should be at least 29 and 25 respectively. These data indicate that harvest estimates in years 2 and 5 appear to be low.
3. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
4. **Wolf:** Harvest estimates seem a little low (C.F.). Data were obtained from DSD detailing the number of pelts sold by hunters. DSD reports were available for 1999/2000 and 2000/2001 (years 4 and 5) and indicate that 6 wolf pelts were purchased in 1999/2000 (year 4) and 5 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). Based on this information the harvest estimate for year 5 does appear low however the estimate for year 4 looks to be in the right range.

[5] **Arctic fox:** Harvest estimates in years 3 and 5 seem too low (C.F.). Again DSD reports were consulted and they showed that 6 pelts were purchased from Gjoa Haven hunters in 1999/2000 (year 4) and 54 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). Given the harvest estimates shown it appears that the estimate in year 5 is low.

[6] **Wolverine:** Harvest estimates seem low (C.F.). DSD reports were consulted but did not show any records of pelts purchased in years 4 or 5 (DSD FB).

[7] **Small game:** Hunters indicated that many were not reporting small game harvests to the Fieldworker so estimates seem very low. Many hunters did not think to report these species (C.F.).

[8] **Bearded seal:** In years where 0 were recorded there were likely some caught but not reported (C.F.).

[9] **Geese:** Harvest estimates for snow geese seem accurate. CWS supported hunts in years 4 and 5 resulting in more harvesting during these years. However, estimates for all other waterfowl seem low (C.F.).

[10] **Ptarmigan:** Harvest estimates seem low. Hunters reported that they were not specifically asked how many animals they harvested of each species. They were only asked what they caught. Many hunters did not think to report their small game and bird harvests (C.F.).

[11] **Eggs:** Again, harvest estimates appear low. Large numbers of eggs are gathered each year but again many hunters did not report them to the Fieldworker (C.F.).

[12] **Arctic char:** Harvest estimates seem to be in the right range (C.F.). Hunters reported that there was some commercial fishing early in the study and some may have been reported. There were no records in the database which indicated that the catch was commercial, however some commercial catches may have been reported. DFO records confirm that there was commercial fishing of arctic char during the study (DFO F).

[13] **Lake trout:** The year 1 harvest estimate seems low since there are many trout caught each year in the spring. Estimates in the other years look accurate (C.F.).

[14] **Least cisco:** Harvest estimates seem too low; some are taken every year. It was reported that most people did not record these fish. They are caught in nets and when checking nets there can easily be 50 in one day alone (C.F.).

Although no beluga whales were reported to the Harvest Study Fieldworker, DFO records show a harvest of 3 animals in 1999/2000 (DFO N/B).

6.2.3 ᓄᓇᕗᑦ ᓴᖅᑭᑕᐅᔭᓂᖅ ᐅᖃᖅᑎᑐᑎᑦᑕᑎᑦ: ᐅᕝᕙᓘᑐᖅ

ᖃᐅᔨᓴᓂᐅᕙᑦ ᐊᖅᑭᑦᑐᒪᓂᖅ:

ᖃᒥᖅᑭᔨᐅᑎᓪᓗᑎᑦ ᐊᑎᓕᐅᓇᖅᑐᓴᕐᓂᐅᔭᕐᓂᖅ ᓄᓇᕗᑦ ᐳᓵᕆᖅᑕᐅᑎᓪᓗᑎᑦ ᑕᐃᑎᖏᓪᓕᐅᕈᖅᑐᑦ ᑕᒪᓐᓇ 22ᖓᔪᓂᑦ ᐊᖏᔪᓂᖅᑎᑦ ᐊᑎᖃᖅᑕᕐᓕᐅᕈᑎᒃᓴᖅᓯᒃᓴᑦ ᖃᐅᔨᓴᖅᓯᓐᔪᑦ. 18 ᐃᓚᖓᑎᑉ - ᑕᒪᒋᒥᑦ ᐊᖏᔪᓄᑦᑕᑎᑦ ᖃᐃᑎᖅᔪᑦ. ᐃᓕᓴᕆᔨᕐᓕᕐᓂᖅ ᑎᑎᒪᔨᐅᓕᕐᓂᖅᓯᒃᓴᑦ ᐃᓚᖓᑕᑦᑐᑦ ᐊᖏᔪᓄᑦᑕᑎᑦ ᑐᓂᔭᐅᔪᓂᑦ ᐊᖏᔪᓄᑦᑕᐃᓐᓇᕐᒥᑦ ᐊᑎᖃᖅᑕᖃᖅᓯᕐᓂᑎᑦ, ᐊᒪᓪᓗ ᑕᒪᒋᒥᑦ ᖃᐃᑎᖅᔪᓂᖅ ᐊᖏᔪᓄᑦᑕᑎᑦᑎᓪᓗᑎᑦ. ᐅᖃᐅᓯᒪᓕᖅ ᐃᓕᓴᕆᔨᕐᓕᕐᓂᖅ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓇᖅᑐᓴᕐᓂᐅᔭᕐᓂᑦ ᐱᔭᕇᖅ ᐊᖏᔪᓄᑦᑕᑎᑦᑎᓪᓗᑎᑦ ᐅᖃᐅᓯᒪᓕᖅᑐᑦ ᐊᑎᖃᖅᑕᕐᓕᐅᕈᑎᒃᓴᖅᓯᒃᓴᑦ ᖃᐃᑎᖅᔪᓂᖅᑎᑦ. ᐅᖃᐅᓯᒪᓕᖅ ᐃᓕᓴᕆᔨᕐᓕᕐᓂᖅ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓇᖅᑐᓴᕐᓂᐅᔭᕐᓂᑦ ᐱᔭᕇᖅ ᐊᖏᔪᓄᑦᑕᑎᑦ ᐊᑎᖃᖅᑕᕐᓕᐅᕈᑎᒃᓴᖅᓯᒃᓴᑦ ᐅᖃᐅᓯᒪᓕᖅᑐ

[4] **ᐊᒪᒃᖁ:** ᐊᒪᒃᑭᕐᑕᐅᔪᓂᑦ ᖃᓄᐃᓕᓂᖅᓯᒪᔪᑦ ᐊᑎᓕᐊᖏᖅᓯᒪᔪᑦ (C.F.). ᐊᓪᓚᓯᒪᓪᓚᑦ ᖃᐅᔨᓴᕐᓂᖅᑐᑦ ᐃᓚᐋᑦᑎᓚᓕᕆᓂᖅ ᓴᓇᔨᓂ ᐊᒪᒃᖁᐃᓪᓗ ᓂᐅᔨᓂᖅᑐᑦ ᐊᑎᓕᐊᖏᖅᓯᒪᔪᑦ ᓂᐅᐃᓕᐊᓂᖅᑐᑦ ᐊᑐᐃᓐᓇᕐᓂᖅᑐᑦ ᐊᑐᐊᓘᓂᒃᑯᓐᓂᒃᑯᑦ. ᐃᓚᐋᑦᑎᓚᓕᕆᓂᖅᑐᑦ ᐊᑐᐃᓐᓇᕐᓂᖅᑐᑦ ᐊᑐᐊᓘᓂᒃᑯᓐᓂᒃᑯᑦ ᐊᓯᖏᓐᓂᒃᑯᑦ ᐃᓚᐋᑦᑎᓚᓕᕆᓂᖅᑐᑦ ᐊᑐᐊᓘᓂᒃᑯᓐᓂᒃᑯᑦ ᐊᑐᐊᓘᓂᒃᑯ

6.2.3 Nunanit Inikhimayut Ukauhiit: Ukhuktuuq

Ihivgiuktit Atugutait:
Ihivgiufaakhimayuni ataani naunaiyakhimaut nunani pulaakhimatitluni takuhimayut 22kuyut umayukhiuktit titigaktauhimaitut Umayukhiukhimayuni Ihivgiuktuni. 18kuyut hapkoa Inut – tamamik ilaani umayukhiukataktut. Naunaiyakhimayuk hitamat Inuinaungitut umayukhiuktit tuniyauhimayut inminiigutiminik titigaktauhimaitut, ovalo tamamik ilaani umayukhiukpaktut. Ukakhimayut ilangani 5.2.1 ikpinagutait hapkoa ataani naunaiyakhimayut pilaaktut ataanut ihumagiyainik umayukhiukhimayut naunaiyautaini. Kihimi angitjutait ihimagiyait mikiyut ilauhimaitut umayukhiuktit tamamik ilaani umayukhiukatamata ovalo tukuhimamata 6%nik tamaat umayukhiuktunit (Ikpatauyak 10).

Ikituumata amigaitjutait umayukhiukatainaktut titigakhimayut Ukhutuumi, umayukhiuktainaktut naunaiyautait ilautihimayut umayukhiukataktunut naunaiyautainut hamna atugutaini umayukhiukhimayut naunaiyautaini.

HTOkut katimayiit ihumayut amigaitkiyait 8nik umayukiukatainaktunik nunami. Taimaimat tamamik titigakhimaitut umayukhiuktit naunaiyakhimayut ilaani umayukhiukataktut pihimayunakhiyuk ilangit umayukhiukatainaktut ihuitumik naunaiyakhimayut kihimi titigaktauhimaitumik. Ikpinagutait hamna mikiyut, ukakhimayut hamani katitikhimamata umayukhiuktaktut ovalo umayukhiukatainaktut naunaiyautait naunaiyakhimayuni.

Ihivgiuktauhimayut ovalo kiuyuitut ihimagiyait:
Kiuhimayut naunaiyautait naamaktuugaluit tamamivyak tatkikhiutini mikiyut ikituni tatkikhiutini ihivgiuktuni ovalo auyami ovalo ukiakhami 1998mi (ukiumi 3), talimat tatkikhiutit ataani 75%mik. Takukhauyut ikpatauyami 9mi pikataktut kiuyuitut naunaiyautait Ukhuktuuqmi mikiyut 0.4%mik ovalo ihumagiyauyut pilaaktuni atuktaini kiuyuituni ihumagiyaini.

Kiuhimayut naunaiyautait ihumagiyauyut naamaktut ovalo kiuyuitut ihimagiyait mikiyut amigaivyaktuni ukiuni piyaami nni pihimayut naamaktumik ilauyuni uktukhimayunit Nni umayukhiuktini. Taiguaktut atuktukhat ihumagilugit atugutaini katitikhimayut katitigutaini auyami ovalo ukiakhami ukiumi 1 ovalo 3 ihivgiuktuni pihimamat pilaaktunik tamamik uktukhimayut ihuinaagutait ovalo kiuyuitut ihimagiyait angililaamat kiuhimayut naunaiyautait katagaagata.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Nunani pulaaktakhimapluta tuhaktitiyauhimayugut malikhugit Inuit kauyimatukagini, umayukhiuktit naunaiyatiayuitait umayukhimayaminik – ilaa piyuimata kauyimatukagini naunaiyaklugit ovalo tuhaktitilugit umayuktaminik. Ihumayut ilangit umayukhiuktit ataani naunaiyakhimayut ovalo ataani tuhaktitihimayut umayukhimayaminik, ilaa ilangit umayut; tinmiat ovalo mikiyut umayut. Taiguaktut takuyukhat ilangani 5.4 inikpiakhimayunik ukauhimayunik hamani ihumagiyauyumik.

Takuhimayut utiktitihimayuni ubluit ikpatauyami, amigaktut umayukhiukhimayut titigagutait ukiuni 1, 4 ovalo 5 katitikhimayut iluani pingahut tatikhiutini umayukhiukhimayainik. Ukiumi 2 ovalo 3 amigaivyaktut tatkikhiutit takiyut utiktitihimayut tatkikhiutit, kihimi amigaivyaktut ataaniitut siksinik tatkikhiutinik. Pilaaktainik umayukhiuktit puigugilutik umayukhiukhimayaminik angililaaktuk utiktitihimayut ubluit ungahikhigaagata, ukakhimayut ilangit naunaiyautait ihuinaakhimayut piyunakhihimayut utiktitihimayut ubluit takiligaagata.

Nalunaituk ukakhimayuni mikhaanut ikaliviit hamani, kinauyaliukhimayut ikaliviit ihivgiuktitlugit. Ihumagiyauyut ilangit hapkoa kinauyaliugutit umayukhiukhimayut tuhaktitihimayut atuktakhainik umayukhiukhimayainut.

Nunanit ukakhimayut ovalo aalanit atukhimayaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukhimayut tamamivyak nunani tuktut, kihimi ilangit kikiktanit tuktut ovalo kananamit tuktut tuhaktitihimayut ihivgiukhimayuni. Atukhimaut naunaiyagutini umayukhiukhimayut naunaiyautait katitikhimayut atauhimut.
2. **Umingmait:** Umayukhiukhimayut naunaiyautait mikiyut (C.F.) DSDkut tuhaktitihimayut hapkoa umayukiukhimayut amigaitjutait umingmait (DSD MXc):

Year 1	Year 2	Year 3	Year 4	Year 5
n/d	34	n/d	n/d	30

Hapkoa katitikhimayut pihimayut DSDkunit ukatiakhimaitut kanugitumik umayukhiukhimayut atuktakhaminik ovaluniit kablunaat umayukhiukhimayainut, kihimi tuhaktitauhimayugut pikataktut pingahunik ovalo talimanik kablunaat umayukhiukhimayainik ukiuk tamaat. Taimaitpat atuktakhait umayukhiukhimayut ukiuni 2 ovalo 5 piyakhait 29kuyut ovalo 25kuyut ukiungini. Hapkoa katitikhimayut nalungitut umayukhiukhimayut naunaiyautait mikiyut.

[3] **Nanuit:** Amigaitjuttit takukhauyut naunaiyakafuungitut kihimi pihimayut umayukhiukhimayut amigaitjutait tunihimayut DSDkunit (DSD PB).

[4] **Amagut:** Umayukhiukhimayut naunaiyautait mikiyut (C.F.). Katitikhimayut pihimayut DSDkunit titigakhimayut amiit niuviktauhimayut umayukhiuktinit. DSDkut tuhaktitihimayut pihimayut 1999/2000mit ovalo 2000/2001mit (ukiuni 4 ovalo 5) ovalo titigakhimayut siksiit amagut amiit niuviktauhimayut 1999/2000mi (ukiumi 4) ovalo talimat niuviktauhimayut 2000/2001mi (ukiumi 5) (nalungilutit DSDkut katitikhimayait atuktut umayukhiukhimayut ukiungit Julymit Junemut, Umayukhiukhimaut Ihivgiugutit katitigutait atukhimayut Junemit Maymut) (DSD FB). Atukhugit hamna tuhagutikhat umayukhiukhimayut naunaiyautait ukiumi 5mi mikiyut kihimi naunaiyautait ukiumi 4mi naamaktut.

[5] **Tigiganiat:** Umayukhiukhimayut naunaiyautait ukiumi 3 ovalo 5 mikiyut (C.F.). DSDkut tuhaktititjutait atukhimayut ovalo takukhauyut siksit amiit niuviktauhimayut Ukhutuumiunit umayukhiuktinit 1999/2000mi (ukiumi 4) ovalo 54nik niuviktauhimayut 2000/2001mi (ukiumi 5) (nalungilutit DSDkut katitigutait atukhimayut umayukhiukhimayuni ukinginik Julymit Junemut, Umayukhiukhimayut Ihivgiugutait katitigutait atukpamata umayukhiukhimayut ukiungini Junemit Maymut) (DSD FB). Pihimamat umayukhiukhimayut naunaiyautait takukhauyut naunaiyautait ukiumi 5mi mikiyut.

[6] **Kalviit:** Umayukhiukhimayut naunaiyautait mikiyut (C.F.). DSDkut tuhaktitihimyait atukhimayut kihimi takukhaungitut titigagutinik amiit niuviktauhimaitut ukiumi 4mi ovalo 5mi (DSD FB).

[7] **Mikiyut umayut:** Umayukhiuktit ukakhimayut amigaitut tuhaktitihimayuitait mikiyut umayut nunani havaktinut, taimaimat naunaiyautit mikiyut. Amigaitut umayukhiuktit ihumayuimata tuhaktitilugit hapkoa umayut (C.F.).

[8] **Ugyuit:** Ukiuni pingitut titigakhimayuni, pivagunakhiyut ugyunik kihimi tuhaktitiyauyuitut (C.F.).

[9] **Uluaguliit:** Umayukhiukhimayut naunaiyautait kangunik naamaktut. CWSkut ikayukhimayut umayukhiukhugit ukiuni 4mi ovalo 5mi pihimaplugit umayukhiukhimayut hapkoa ukiungani. Kihimi naunaiyautait tamaki aalat tinmiat mikiyut (C.F.).

[10] **Akilgiit:** Umayukhiukhimayut naunaiyautait mikiyut. Umayukhiuktit tuhaktitihimayut apigiyauyuitut kafinik umayunik umayukhiukpaktut tamamik umayunik. Apigiyauhimayut kanugitunik umayukhimayut talvatuak. Amigaitut umayukhiuktit ihumayuimata tuhaktitilugit mikiyut umayut ovalo tinmiat umayukhiukhimayainik (C.F.).

[11] **Maniit:** Ilaa, manikhiugutait naunaiyautait mikiyut. Amigaitut maniit pikiutaukataktut ukiuk tamaat kihimi amigaitut umayukhiuktit tuhaktitiyuitait nunani havaktinut (C.F.).

[12] **Ikaliviit:** Umayukhiukhimayut naunaiyautait naamaktut (C.F.). Umayukhiuktit tuhaktitihimayut ilangit kinauyaliugutit ikalukhiukhimayut pilihaaktitlugu ihivgiuktut ovalo ilangit tuhaktitauhimayunakhiyut. Titigakangituk katitikhimayuni naunaiyautait kitut kinauyaliugutihimayut ikaluktaini kihimi ilangit ilangit kinauyaliugutit ikalukhimayut tuhaktititauhimayunakhiyut. DFOkut tuhaktitihimayut kinauyaliukhimayunik ikalukhiukpaktut ikalivinik ihivgiuktitlugit (DFO F).

[13] **Ikalukpik:** Ukiumi 1mi umayukhiukhimayut naunaiyautait mikiyut, amigaitut ihuut ikaluktauvamata tamamik ukiuk upingaami. Naunaiyautait aipaini ukiuni naamaktut (C.F.).

[14] **Eetuuk:** Umayukhiukhimayut naunaiyautait mikiyut, pivaktut ukiuk tamaat. Tuhaktitihimayut amigaktut Inuit tuhaktitiyuitait hapkoa ikaluit. Pilikpaktait kuvyani ovalo kuvyanik takuyaktugaagamik pilikpaktut 50nik ubluk tamaat (C.F.).

Kilalukat tuhaktitihimaitut Umayukhiukhimayuni Ihivgiuktitlugit, nunani havaktit, DFOkut titigait takukhauyut umayukhiukhimayut talimanik kilaluganik 1999/2000mi (DFO N/B).

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 387

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᓯᖏᔪ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᑕᒪᑦ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑦᑐᓗ	NOV ᐅᓇᓚᓗ	DEC ᑎᓴᓚᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᓴ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	11	39	54	21	11	2	11	38	43	11	26	7	274 ± 35
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait										5			5 ± 3
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡			3	2	7				2		15		
Tundra grizzly	ᐊᒪᓱᐃᑦ	Akhait		1											1 ± 1
Wolf	ᑎᓚᒃᓂᐊᑦ	Amagut				1						3			4 ± 4
Arctic fox	ᐅᑲᓪᓕ	Tigiganiat						2	24	9	46	13			94 ± 44
Arctic hare	ᓯᖏᑯᓪᓕ	Ukalik												2	2 ± 2
Arctic ground squirrel	ᓇᓯᓕ	Hikhik											3	5	8 ± 9
Seals (unspecified)	ᐅᓚᐊᐃᑦ	Natiit	50	34	47	15		20	18	6	18	39	6	14	267 ± 36
Ringed seal	ᖃᐃᓱᓪᓕ	Natiinat		3											3 ± 2
Bearded seal	ᓄᖅᓪᓕ	Ukyuk		8	9										17 ± 5
Narwhal	ᑲᖏᒍᐃᑦ	Tuugaak				1									1 ± 1
Geese (unspecified)	ᓄᖅᓪᓕ ᐅᓗᐊᔪᖅᓪᓕ	Kanguk		1											1 ± 1
Canada goose	ᓄᖅᓪᓕ	Nikliknik	2												2 ± 0
Black guillemot	ᒥᑎᑦ	Black guillemot				1									1 ± 1
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	6								1	2			9 ± 2
Goose eggs	ᑲᖏᒍᐃᑦ ᒪᒃᓂᖏᑦ	Uluaguliit manniit	15												15 ± 0
Arctic char	ᒥᑎᑦ ᒪᒃᓂᖏᑦ	Ikaliviit	579	2,755	1,641	1,298	10,955	458		47	68	178	24	75	18,078 ± 4,280
Freshwater fish (unspecified)	ᐃᖃᓗᓕᐱᑦ	Tahinik Ikaluit		4											4 ± 3
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	222	8		4	7			2			30	12	285 ± 187

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᖏᖅᑦ ᐅᑎᖅ ᐃᓄᖕᓂᐊᓕᓂᒃᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 388

Monthly hunter response

ᑕᕝᑕᒧᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᒃᑭᒍ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᕝᕕᒃ/Tatkia			JUN ᔮᓂ	JUL ᔮᓪᐃ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑐᓇ	NOV ᐅᐊᒃᓇ	DEC ᑎᓯᒃᓇ	JAN ᒎᖅᓄᓇ	FEB ᐃᖃᐅᓇ	MAR ᒪᑦᓯ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujai**													
Monthly hunter list	ᑕᕝᑕᒧᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	33	40	60	60	60	60	60	60	60	61	61	61	63*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	29	34	52	42	39	36	35	45	43	39	26	20	59*
Harvested	ᐊᖏᔪᓂᒃᑎᒋᓂᖅ	Angujaujut	25	27	27	19	21	14	11	19	18	18	10	10	58*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	88	85	87	70	65	60	58	75	72	64	43	33	67**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᑎᒃᓴᖅᓯᒪᔪᑦ/ᐊᐱᕐᓯᑦᑕᒃᑐᖅ ᐊᑕᐅᓯᐊᖃᓕᕆᔨᑦ ᐊᑭᖏᑎ.
** ᐊᑲᓴᓕᕐᑎᓯᒪᔪᑦ ᑕᕝᑕᒧᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 389

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᓪᓚᓂ ᐊᖏᔪᓂᓄᓪᓕᐊᑦ ᐊᒪᒐ ᐊᐱᕐᓯᑦᑕᐅᓂᓕᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑎᑦ ᐊᖏᔪᓂᒃᑦ ᑎᑎᕐᑦᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᒃᑭᒍ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᕝᕕᒃ/Tatkia			JUN ᔮᓂ	JUL ᔮᓪᐃ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑐᓇ	NOV ᐅᐊᒃᓇ	DEC ᑎᓯᒃᓇ	JAN ᒎᖅᓄᓇ	FEB ᐃᖃᐅᓇ	MAR ᒪᑦᓯ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕝᕕᒃ	≤ tatkin pingahut	100	98	100	100	100	100	100	100	100	100	92	100	99
4-6 months	4-6 ᑕᕝᕕᒃ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	8	0	0
> 6 months	> 6 ᑕᕝᕕᒃ	> 6 tatkin	0	2	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 390

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐸᒋᑦ ᐊᖏᔪᓚᐸᓕᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 1 (June 1996 - May 1997)

ᐊᒡᒋᔪ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᐃ	AUG ᐊᐅᒡᔪᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᓄᐱᒡᐱᓗ	DEC ᑎᓴᒡᐱᓗ	JAN ᒍᖏᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᓴ	APR ᐃᓴᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	6	17	17	8	7	2	5	11	10	5	5	2	50
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait										3			3
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒪᕐᐃᑦ	Akhait		1											1
Wolf	ᑎᓗᒃᖁᓂᐊᑦ	Amagut				1						1			2
Arctic fox	ᐅᑲᓪᓂᑦ	Tigiganiat						1	1	2	6	3			11
Arctic hare	ᓯᖏᑯᓪᓂᑦ	Ukalik												1	1
Arctic ground squirrel	ᓇᕆᓯᑦ	Hikhik											1	1	2
Seals (unspecified)	ᐅᖅᓴᐃᑦ	Natiit	17	14	8	4		9	5	4	5	8	2	4	43
Ringed seal	ᖃᐃᕐᓪᓂᑦ	Natiinat		2											2
Bearded seal	ᓂᕆᓂᑦ	Ukyuk		6	4										10
Narwhal	ᑲᖕᒍᐃᑦ	Tuugaak				1									1
Geese (unspecified)	ᓂᕆᓂᑦ ᐅᓗᐊᔪᓂᓂᑦ	Kanguk		1											1
Canada goose	ᓂᕆᓂᑦ	Nikliknik	1												1
Black guillemot	ᒥᑎᑦ	Black guillemot				1									1
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	2								1	1			3
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓂᓂᑦ	Uluaguliit manniit	1												1
Arctic char	ᒥᑎᑦ ᒪᓂᓂᑦ	Ikaliviit	10	14	13	6	18	3		2	2	3	2	2	42
Freshwater fish (unspecified)	ᐃᖅᓄᑲᐱᑦ	Tahinik Ikaluit		1											1
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	7	2		1	2			1			3	1	12

No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖅᓂᖏᑐᖅ ᐱᓕᐊᒥᓂᓂᒃ ᐊᖏᔪᒃ ᖃᕋᓯᐅᓂᖏᓂᓄᑦ ᐊᓂᒃᑲᐃᒪᔪᓂᑦ ᐊᓂᔪᓂᑦ ᓇᓂᑭᑐᓂᒃᑯᑦ ᐃᓄᐃᕋᓱᐊᕆᔨᓂᖅᑕᑦ.

Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.2.4

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 391

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᑲᒋᔪ 2 (ᔮᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

6.2.4

Month/ᑕᖅᑲᓪᓚᑦ/Tatkia			JUN ᔮᓂ	JUL ᔮᓕᐃ	AUG ᐊᐅᑲᔪᑎᑎ	SEP ᓱᑎᑦᐱᓇ	OCT ᐅᑦᔪᓇ	NOV ᐅᓇᑲᓇ	DEC ᑎᓱᑲᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᓄᖅᐅᐊᓇ	MAR ᒪᕐᕕ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓪᓗᑎᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	53	79	119	121	62	17	9	14	36	14	28	37	589 ± 62
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait											1		1 ± 0
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡			2		2		1			1		2	8
Wolf	ᐊᒪᕐᐃᐃᑦ	Amagut						10	1		1		4	2	18 ± 2
Arctic fox	ᑎᓕᓴᐅᓪᓕᐊᑦ	Tigiganiat					38	36	8	5	1				88 ± 6
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik												5	5 ± 0
Seals (unspecified)	ᓱᖏᑯᓚᑦ	Natiit	106	8	5										119 ± 54
Ringed seal	ᓇᑦᓱᑦ	Natiinat		100	93	51	4	3	1	23	9	8	8	19	319 ± 30
Bearded seal	ᐅᑲᔪᐃᑦ	Ukyuk		5	12	1									18 ± 4
Narwhal	ᑐᒍᓚᑦ ᖁᓕᓴᒡᓚᑦ	Tuugaak			5	5									10 ± 4
Snow goose	ᑲᖏᒍᐃᑦ	Kanguq		6		3									9 ± 7
Canada goose	ᓂᕐᓚᑦ ᐅᓗᐊᔪᓚᑦ	Nikliknik			3	6									9 ± 7
Red-Throated loon	ᖃᖏᒪᐅᑦ	Qaqhuaq			3										3 ± 3
Yellow-Billed loon	ᑐᓴᓗᔪᐊᖏᖅ	Tuulik		1											1 ± 1
Ptarmigan	ᐊᖏᒪᑦᑎᑦ	Akilgik				1									1 ± 1
Sandhill crane	ᑕᑎᒪᓕᔪᐊᑦ	Tatilgaq	2												2 ± 2
Goose eggs	ᑲᖏᒍᑦ ᒪᓂᓂᕐᑦ	Uluaguliit manniit	32												32 ± 46
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓂᓂᕐᑦ	Nauyat manniit	5												5 ± 7
Arctic char	ᐃᖃᓗᒃᑕᑦ	Ikaliviit	1,516	2,606	3,527	3,149	3,247	331	51	57	98	16	500	36	15,134 ± 2,397
Lake trout	ᐃᓱᕐᓴᐃᑦ	Ikalukpik		497	20	62	59	4				3	22	132	799 ± 265
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk		346	222	208									776 ± 485

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᐅᑦ ᑎᑎᕐᑕᒪᒪᔪᑦ ᑐᓂᖅᑎᑦ ᐅᑉᐳᖅᑎᑦ ᐅᑯᐊ ᐃᑯᐊᕐᓂᓕᕆᓂᖅᑎᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 392

Monthly hunter response
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᒃᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚᐃ	AUG ᐊᐅᒡᒎᑎ	SEP ᓯᑎᒡᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᐊᒡᒪᓗ	DEC ᑎᓯᒡᒪᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓅᖑᐊᓗ	MAR ᒪᕆ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐋᒡᔪᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	61	78	77	77	77	77	77	77	77	77	75	75	80*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	25	64	64	64	75	76	76	73	70	70	75	75	80*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᓕ	Angujaujut	12	41	45	38	32	17	7	12	14	14	21	31	65*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	41	82	83	83	97	99	99	95	91	91	100	100	88**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᕐᑕᒪᓪᓚᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑐᒥᓂᓕ ᐊᑕᐅᓂᐊᖅᓯᒪᔪᑎᑐᑦ ᐊᑲᔪᒥ.
** ᐊᐅᔨᓂᑎᑦᓯᒪᓪᓚᑦ ᑕᖅᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 393

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᕐᖏᓂ ᐊᖏᔪᓂᓐᓂᒃᑕ ᐊᒡᒐᓗ ᐊᐱᕐᓂᕐᑕᐅᓂᒃᑕ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᑕᑎᑦ ᐊᖏᔪᓂᒃᑕᑦ ᑎᑎᕐᕕᐅᒪᔾᔨᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)
ᐊᒃᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚᐃ	AUG ᐊᐅᒡᒎᑎ	SEP ᓯᑎᒡᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᐊᒡᒪᓗ	DEC ᑎᓯᒡᒪᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓅᖑᐊᓗ	MAR ᒪᕆ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕐᑯᑦ	≤ tatkin pingahut	100	60	100	100	100	100	100	100	100	100	100	100	93
4-6 months	4-6 ᑕᕐᑯᑦ	tatkin hitaman 6nut	0	40	0	0	0	0	0	0	0	0	0	0	7
> 6 months	> 6 ᑕᕐᑯᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 394

Number of hunters harvesting each species
Year 2 (June 1997 - May 1998)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐸᑎᑦ ᐊᖏᔪᓚᐸᓱᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
ᐊᒃᑭᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin
Ukiunga 2 (June 1997 - May 1998)

6.2.4

Month/ᑕᖃᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒃᔨᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐃᓗ	NOV ᐅᐊᒃᐱᓗ	DEC ᑎᓱᒃᐱᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᐃᖏᑲᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑕᒥᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	4	22	29	24	18	9	4	6	12	9	12	17	53
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait											1		1
Polar bear#	ᓇᓄᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᖅᐃᑦ	Amagut						4	1		1		2	2	5
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat					5	5	3	1	1				11
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik												1	1
Seals (unspecified)	ᓱᖏᑯᓪᓗᑦ	Natiit	9	3	2										12
Ringed seal	ᓇᑦᓱᑦ	Natiinat		23	22	14	2	2	1	4	3	6	4	9	42
Bearded seal	ᐅᓪᔪᐃᑦ	Ukyuk		5	8	1									14
Narwhal	ᑐᒍᓐᓂᑦ ᖃᓕᓴᒡᓗᑦ	Tuugaak			4	3									7
Snow goose	ᑲᖏᒍᐃᑦ	Kanguq		1		1									2
Canada goose	ᓂᑦᓯᓂᑦ ᐅᓕᐊᔪᓯᓂᑦ	Nikliknik			1	1									2
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq			1										1
Yellow-billed loon	ᑐᓪᓕᓪᔪᐊᖏᖅ	Tuulik		1											1
Ptarmigan	ᐊᖏᓪᓂᑦ	Akilgik				1									1
Sandhill crane	ᑕᑎᓴᑦᔪᐊᑦ	Tatilgaq	1												1
Goose eggs	ᑲᖏᐃᑦ ᓚᒃᓂᖏᑦ	Uluaguliit manniit	1												1
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᒃᓂᖏᑦ	Nauyat manniit	1												1
Arctic char	ᐃᖃᓗᓕᑦ	Ikaliviit	3	18	22	18	23	5	1	2	2	1	3	3	43
Lake trout	ᐃᓕᓴᐃᑦ	Ikalukpik		14	2	3	10	2				1	7	14	34
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk		1	1	1									1

No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

ᑎᑎᕋᒪᔪᓂᖅ ᐱᑕᖃᓄᖅᑐᑎᓂᖅ ᐱᓕᔪᑎᓕᓴᐅᓂᖅ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓕᖅᓴᓂᑦ ᐊᓕᖅᑲᐅᒪᔪᓂᑦ ᐊᑐᔪᓂᑦ ᓇᓕᐅᑦᓴᕐᓗᒍ ᑐᓂᓴᖏᓐᓄᑦ ᐃᑯᐊᕕᓕᓚᓕᓐᓂᑦ.

Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 395

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓪᑐᑦᓱᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᓕᕐᒧ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - 1999)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔮᓂ	JUL ᔮᓪᒪ	AUG ᐊᐅᒡᔨᑎ	SEP ᔨᑎᒡᕕ	OCT ᐅᑐᕕ	NOV ᐅᐊᒡᕕ	DEC ᑎᓯᒡᕕ	JAN ᒍᓐᓄᐊᓕ	FEB ᐃᖅᐊᓕ	MAR ᒪᕐ	APR ᐃᑦᓂᓪ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᐃᐃᑦ	Tuktut	25	34	74	37	31	23	14	40	22	19	96	34	449 ± 47
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait						4	1						5 ± 1
Polar bear‡	ᓇᓄᐃᑫ‡	Nanuit‡			3	1	7	1					13		
Wolf	ᐊᒪᕈᐃᑦ	Amagut						7	2	2	5	3	2	1	22 ± 4
Arctic fox	ᑎᓘᓴᓐᓂᐊᑦ	Tigiganiat				3		3	2			1			9 ± 3
Wolverine	ᖃᓪᓴᒃ	Kalvik										1		1	2 ± 1
Seals (unspecified)	ᓯᖏძᓪᓕᑦ	Natiit	3												3 ± 2
Ringed seal	ᓇᑲᓱᑦ	Natiinat	82	76	119	38	12	2	3	2	9	3	1	17	364 ± 50
Bearded seal	ᐅᒡᕿᐃᑦ	Ukyuk		8	4	2									14 ± 4
Narwhal	ᑐᒍᓐᑦ ᖃᓪᓗᓂᑦ	Tuugaak			4										4 ± 2
Canada goose	ᑲᖏᐃᑦ	Nikliknik		4											4 ± 3
Ptarmigan	ᐊᖏᒻᑦ	Akilgik			2			2							4 ± 2
Arctic char	ᐃᖏᓗᒃᐸᑦ	Ikaliviit	254	1,495	758	1,410	3,333	656		51	61	526	161	213	8,918 ± 884
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	41	61		5						7	82	30	226 ± 95

‡ Polar bear data supplied by DSD.
‡ ᓇᓄᐃᑫ ᑎᑎᕋᐅᒪᓕᒃ ᑐᓂᓴᖏᑦ ᐅᑉᓴᐃᑦ ᐃᑯᐊᕐᕕᓂᓕᒃ.
‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 396

Monthly hunter response
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓕᕆᔨᒃᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)
ᐊᓕᕐᒧ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔮᓂ	JUL ᔮᓪᒪ	AUG ᐊᐅᒡᔨᑎ	SEP ᔨᑎᒡᕕ	OCT ᐅᑐᕕ	NOV ᐅᐊᒡᕕ	DEC ᑎᓯᒡᕕ	JAN ᒍᓐᓄᐊᓕ	FEB ᐃᖅᐊᓕ	MAR ᒪᕐ	APR ᐃᑦᓂᓪ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᕆᔨᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑲᓱᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᔪᓕᕆᔨᒃᑎᑦ	Tatkitaman angunahuktut titigait	77	77	76	76	76	77	77	77	77	78	78	78	80*
Hunters interviewed	ᐊᖏᔪᓕᕆᔨᒃᑎᑦ ᐊᐱᓱᓴᖅᑕᑦ	Angunahuktin apikhuktan	68	71	61	72	70	72	71	75	71	68	55	71	79*
Harvested	ᐊᖏᔪᓕᕆᐳᒥᔅᓯᑦ	Angujaujut	19	21	22	22	19	15	9	14	14	13	19	21	53*
Response Rate (%)	ᑭᐅᑦ ᖃᓕᓂᐅᓂᖏᑦ (%)	Kiujut (%)	88	92	80	95	92	94	92	97	92	87	71	91	89**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.
* ᐊᖏᔪᓕᕆᔨᒃᑎᑦ ᐊᑎᓕᐅᑦᑕᐅᒪᓕᒃᑐᑦ/ᐊᐱᓱᓴᖅᑕᑦ/ᐊᖏᔪᓕᕆᐳᒥᔅᓯᑦ ᐊᑕᐅᓱᐊᓘᔪᐃᑎᑎᑦ ᐊᓕᕐᒧᒥ.
** ᐊᓂᔨᒋᓐᓂᓱᒪᓕᒃ ᑕᖅᑕᒪᑦ ᑭᐅᓂᖏᑦ.
* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.2.4

TABLE/ᐊᓗᐊᕕᐅᑉᑐᑦ/NAUNAIKUTA 397

Recall period between harvest and interview, expressed as % of total harvest records

Year 3 (June 1998 - May 1999)

ᑐᑎᖏᐅᐅᕐᑦ ᐊᑯᖏᓂᓂ ᐊᖏᔪᓕᓂᓂᖓᑕ ᐊᒻᒪᓗ ᐊᐱᖏᓪᓕᐅᓂᖓᑕ, ᐊᓗᐊᓕᖏᑦ ᐃᒧᑲ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓕᕆᑦ ᑎᑎᖏᑦᑕᐅᒪᕐᑦ

ᐊᒻᒡᒍ 3 (ᕿᓂ 1998 - ᒪᐃ 1999)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᕿᓂ	JUL ᕕᒪᐃ	AUG ᐊᐅᒻᒪᑦ	SEP ᓯᑎᕐᓇᓗ	OCT ᐅᑦᑐᓇᓗ	NOV ᓄᐃᒻᓇᓗ	DEC ᑎᓯᒻᓇᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᐃᖅᕿᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᖏᐃᐅᕐᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲᑦ	≤ tatkin pingahut	0	0	0	0	3	100	100	100	100	100	91	100	45
4-6 months	4-6 ᑕᖅᑲᑦ	tatkin hitaman 6nut	0	0	100	98	91	0	0	0	0	0	9	0	32
> 6 months	> 6 ᑕᖅᑲᑦ	> 6 tatkin	100	100	0	2	6	0	0	0	0	0	0	0	22

6.2.4

TABLE/ᐊᓗᐊᕕᐅᑉᑐᑦ/NAUNAIKUTA 398

Number of hunters harvesting each species

Year 3 (June 1998 - May 1999)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓕᓂᐅᑎᑦ ᐊᖏᔪᓕᓂᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖏᓂᒃ

ᐊᒻᒡᒍ 3 (ᕿᓂ 1998 - ᒪᐃ 1999)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᕿᓂ	JUL ᕕᒪᐃ	AUG ᐊᐅᒻᒪᑦ	SEP ᓯᑎᕐᓇᓗ	OCT ᐅᑦᑐᓇᓗ	NOV ᓄᐃᒻᓇᓗ	DEC ᑎᓯᒻᓇᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᐃᖅᕿᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑭᑐᐃᑦ	Tuktut	5	11	16	15	9	9	5	8	6	7	13	12	41
Musk-ox	ᐅᒥᓴᐃᑦ	Umingmait						2	1						3
Polar bear‡	ᓄᓇᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᓚᖏᐃᑦ	Amagut						3	1	2	2	2	1	1	6
Arctic fox	ᑎᓗᒃᑲᓕᑦ	Tigiganiat				1		1	1			1			3
Wolverine	ᖃᑦᐃᑦ	Kalvik										1		1	2
Seals (unspecified)	ᓂᖏᑯᓕᑦ	Natiit	1												1
Ringed seal	ᓄᑦᓂᑦ	Natiinat	17	18	15	11	2	1	2	2	6	1	1	6	31
Bearded seal	ᐅᒃᔪᐃᑦ	Ukyuk		4	2	2									6
Narwhal	ᑐᐊᓕᓪᓕ ᕈᓪᓗᓕᑦ	Tuugaak			2										2
Canada goose	ᖃᖏᐃᑦ	Nikliknik		1											1
Ptarmigan	ᐊᖏᒻᒋᑦ	Akilgik			1			1							2
Arctic char	ᐃᖅᓚᒃᐱᑦ	Ikaliviit	8	13	9	9	15	8		3	2	6	4	5	35
Lake trout	ᐃᓕᔪᐃᑦ	Ikalukpik	3	3		1						2	3	2	11

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕐᓯᒪᔪᓂᒃ ᐱᑕᖅᖏᑦᑐᖅ ᐱᒃᔨᑎᓪᓂᒃ ᐊᖏᔪᑦ ᖃᖏᐅᓂᖏᓪᓂᑦ ᐊᓪᓚᖅᑕᒪᔪᓂᑦ ᐊᖏᔪᓂᑦ ᓇᓪᑐᖏᑦᑐᓄᑦ ᑐᓂᒃᖏᑦᓂ ᐃᑯᐱᕐᓗᓂᓕᕆᓂᖅᑎᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᐅᓂᐅᐃᔨᐅᑦ/NAUNAIKUTA 399

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᐅᓪᐅᑦᑎᓯᑎᑦ
Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)
ᐊᓐᖁᒍ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔫᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓱᑎᐹᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᐊᓐᓗ	DEC ᑎᓴᓐᓗ	JAN ᔮᖏᓂᓗ	FEB ᐃᖅᑲᓂᓗ	MAR ᒪᓕᒃ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑕᒥᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓂᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	25	51	55	27	25	22	6	18	46	45	48	57	425 ± 31
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait						4					3		7 ± 2
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡			3		5		1			4	14		
Wolf	ᐊᒪᕐᐃᑦ	Amagut										5	5	6	16 ± 3
Arctic fox	ᑎᓗᒃᑯᓂᐊᑦ	Tigiganiat						5	6	2	2			1	16 ± 5
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓗᒃᑯᓂᐊᑦ	Kalaliit tigiganiat											1		1 ± 1
Wolverine	ᖃᕐᕕᒃ	Kalvik										1	1		2 ± 1
Seals (unspecified)	ᓴᖅᑯᓪᓗᑦ	Natiit										14	13	21	48 ± 5
Ringed seal	ᓇᓱᓪᓗ	Natiinat	87	93	100	30	1	12	5	12	17	13	4	3	377 ± 64
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk		3	5	4									12 ± 4
Harbour seal	ᖃᓄᓂᐊᑦ	Qanigiaq	2												2 ± 0
Canada goose	ᓄᕐᓕᑦ ᐅᓗᐊᔪᓕᑦ	Nikliknik	2	1										3	6 ± 0
Eider duck	ᒥᑎᑦ	Kingalik	13	7											20 ± 4
Goose eggs	ᑲᖕᐃᐃᑦ ᒪᖅᓄᖅᑦ	Uluaguliit manniit	1												1 ± 0
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	14	48	136		3,893	481			36	20	7	76	4,711 ± 674
Lake trout	ᐃᓱᕐᓴᐃᑦ	Ikalukpik	1	82	9		6				3		27	242	370 ± 63

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᐃᑦ ᑎᑎᕋᐅᒪᓕᕐᑦ ᑐᓂᓴᖅᑦ ᐅᓄᓴᖅᑦ ᐅᐊᓂᕐᓇᓕᓪᓚᕆᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 400

Monthly hunter response

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)

ᐱᓕᕆᔨ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔫᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᔨᓗᓂ	NOV ᐃᓄᒃᓗᓂ	DEC ᑎᓯᒪᓂ	JAN ᒍᓐᓄᔪᓂ	FEB ᐃᖅᕼᔪᓂ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᐊᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	78	79	79	79	82	82	82	79	76	76	78	78	86*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	77	68	69	68	76	74	76	68	74	73	75	74	86*
Harvested	ᐊᖏᔪᓂᒃᑎᑐᓂ	Angujaujut	25	16	26	12	16	20	4	16	21	28	32	46	73*
Response Rate (%)	ᑭᐅᔭᓂ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	99	86	87	86	93	90	93	86	97	96	96	95	92**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᑕᐅᒪᔨᖅ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑎᑐᓂ ᐊᑕᐅᓯᐊᓗᓯᑎᑎᑲ ᐊᑭᖏᑎᒥ.
** ᐊᑲᑎᓕᕆᔨᒪᔨᖅ ᑕᖅᑕᒪᑦ ᑭᐅᔭᓂ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 401

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓂᒍᓂᖓᓂᑦ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓂᑦ, ᐅᓗᐅᐃᕐᑦ ᐃᒪᓱ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑎᑎᕐᑦᑕᐅᒪᔨᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)

ᐱᓕᕆᔨ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔫᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᔨᓗᓂ	NOV ᐃᓄᒃᓗᓂ	DEC ᑎᓯᒪᓂ	JAN ᒍᓐᓄᔪᓂ	FEB ᐃᖅᕼᔪᓂ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑐᑦ	≤ tatkin pingahut	98	13	100	100	0	3	100	100	0	0	0	0	36
4-6 months	4-6 ᑕᖅᑐᑦ	tatkin hitaman 6nut	2	87	0	0	100	97	0	0	0	0	35	100	41
> 6 months	> 6 ᑕᖅᑐᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	100	100	65	0	23

TABLE/ᓇᓗᓇᐃᔾᐅᐅᑦ/NAUNAIKUTA 402

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᒋᑦ ᐊᖏᔪᓚᐱᕐᓯᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖏᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 4 (June 1999 - May 2000)
ᐊᒃᖏᒍ 4 (ᔪᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᒃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓱᑎᕕᓗ	OCT ᐅᑦᑐᕕᓗ	NOV ᐅᓇᒃᕕᓗ	DEC ᑎᓯᕕᓗ	JAN ᒍᓐᓇᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᔨᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑭᐃᐃᑦ	Tuktut	10	8	15	9	7	9	3	9	14	14	21	23	56
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait						3					1		4
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕈᐃᑦ	Amagut										2	3	3	6
Arctic fox	ᑎᓚᒃᓂᐊᑦ	Tigiganiat						2	1	2	1			1	6
Coloured fox	ᖃᓄᖕᖏᑦ ᑎᓚᒃᓂᐊᑦ	Kalaliit tigiganiat											1		1
Wolverine	ᖃᐸᐃᑦ	Kalvik										1	1		2
Seals (unspecified)	ᓯᖏᓄᓪᑦ	Natiit										5	7	12	15
Ringed seal	ᓇᕐᓂᑦ	Natiinat	20	11	15	6	1	7	2	8	4	4	2	1	45
Bearded seal	ᐅᓪᓛᐃᑦ	Ukyuk		3	3	1									6
Harbour seal	ᖃᓕᒋᐊᑦ	Qanigiaq	1												1
Canada goose	ᓄᖅᓕᓪᑦ ᐅᓗᐊᔪᓕᓪᑦ	Nikliknik	1	1										1	2
Eider duck	ᒥᑎᑦ	Kingalik	2	1											3
Goose eggs	ᑲᖏᐃᑦ ᒪᓂᓄᑦ	Uluaguliit manniit	1												1
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	3	2	5		13	4			4	3	1	4	31
Lake trout	ᐃᓕᕐᔪᐃᑦ	Ikalukpik	1	2	1		1				1		6	20	23

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓕᓴᓂᑲᓂᖅ ᐱᑕᖃᖓᑎᑐᖃᓂᒃ ᐱᒃᓴᑎᓪᓂᒃᓂᒃ ᐊᖏᔪᒃ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓕᕆᐅᓕᓴᓂᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᖏᓐᓄᑦᓂᒃ ᑐᓂᒃᑯᖏᓐᓂᒃ ᐃᑯᐱᖏᓕᓕᓐᓂᐸᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 403

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᓐᖏᔪᒍ 5 (ᔫᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

6.2.4

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᓴᓕ	OCT ᐅᑦᔨᓕ	NOV ᐅᓇᓚᓕ	DEC ᑎᓵᓕ	JAN ᔭᖏᓂᐊᓕ	FEB ᓄᖅᐅᐊᓕ	MAR ᒪᑉᓴ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	23	26	104	85	1	7	24	20	38	35	34	14	411 ± 16
Musk-ox	ᐅᒥᓚᐃᑦ	Umingmait						4			6				10 ± 2
Polar bear‡	ᓇᓂᐃᑉ‡	Nanuit‡					4	1		3		4	1		13
Wolf	ᐊᒪᕈᐃᑦ	Amagut								2		6	6	1	15 ± 3
Arctic fox	ᑎᓚᖓᓂᐊᑦ	Tigiganiat						6	14	6	6	2	7		41 ± 7
Coloured fox	ᖃᐅᓱᒋᑦ ᑎᓚᖓᓂᐊᑦ	Kalaliit tigiganiat						2							2 ± 0
Wolverine	ᖃᓴᐃᑦ	Kalvik						1	1			3			5 ± 1
Seals (unspecified)	ᓂᖅᓄᓪᓕᑦ	Natiit	147	71	73	28	3								322 ± 22
Ringed seal	ᓇᓂᑦ	Natiinat	13	13	20	13	8	4	3	19	10	11	25	25	164 ± 13
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk			6		1								7 ± 1
Narwhal	ᑐᒧᓐᑦ ᖁᓕᓚᑦ	Tuugaak			1	14									15 ± 2
Ptarmigan	ᐊᖏᓱᑦ	Akilgik							2		1				3 ± 1
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓂᓂᖏᑦ	Uluaguliit manniit		49											49 ± 28
Arctic char	ᐃᖅᓗᓂᕆᑦ	Ikaliviit	280	585	437	60	2,255	586	65	52	136	46	23	106	4,631 ± 479
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	246	241	6	5							9	121	628 ± 39

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑉᓂᑦ ᑎᑎᕋᐅᒪᓂᑦ ᑐᓂᓯᖏᑦ ᐅᑯᐊ ᐃᑯᐊᕐᓇᓂᓕᒃᑐᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓄᓇᓕᐃᒃᐳᐅᑦ/NAUNAIKUTA 404

Monthly hunter response
ᑕᖃᑦᒪᑦ ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)
ᐊᓕᖅᔪᒍ 5 (ᔫᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᔭᔨᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑦᔨᓇ	NOV ᐅᓇᕐᓇ	DEC ᑎᓯᕐᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᐃᖅᕿᐊᓇ	MAR ᒪᕐᕿ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᒪᑦ ᐊᖏᔪᓂᕆᑦ	Tatkitaman angunahuktut titigait	78	78	78	78	78	79	78	85	85	84	85	86	88*
Hunters interviewed	ᐊᖏᔪᓂᕆᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	75	74	75	75	69	77	76	78	76	80	79	79	86*
Harvested	ᐊᖏᔪᓂᕆᑐᒃᓗᓂ	Angujaujut	48	37	44	38	36	18	12	16	18	18	27	45	72*
Response Rate (%)	ᑭᐅᔾᔭ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	96	95	96	96	88	97	97	92	89	95	93	92	94**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᕆᑦ ᐊᑎᓕᐅᔨᑕᒪᓕᕆᔨᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᕆᑐᒃᓗᓂ ᐊᑕᐅᓂᐊᓗᐊᕐᑎᑎᑉ ᐊᓕᖅᔪᒥ.
** ᐃᓕᓴᕆᓕᑎᒥᓪᓗᕆᑦ ᑕᖃᑦᒪᑦ ᑭᐅᔾᔭ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓄᓇᓕᐃᒃᐳᐅᑦ/NAUNAIKUTA 405

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕄᐅᔾᔨᑦ ᐊᑯᖏᓐᓄᓂᖓᓪᓚᑕ ᐊᓚᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓪᓚᑕ, ᓄᓇᓕᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑎᑦ ᐊᖏᔪᓂᕆᑦ ᑎᑎᕐᑦᑕᐅᒪᔾᔨᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)
ᐊᓕᖅᔪᒍ 5 (ᔫᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᔭᔨᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑦᔨᓇ	NOV ᐅᓇᕐᓇ	DEC ᑎᓯᕐᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᐃᖅᕿᐊᓇ	MAR ᒪᕐᕿ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕄᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕᑦ	≤ tatkin pingahut	0	18	100	100	100	100	100	100	100	100	100	100	79
4-6 months	4-6 ᑕᖅᑕᑦ	tatkin hitaman 6nut	100	82	0	0	0	0	0	0	0	0	0	0	21
> 6 months	> 6 ᑕᖅᑕᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 406

Number of hunters harvesting each species — **Year 5 (June 2000 - May 2001)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐸᑎᑦ ᐊᖏᔪᓚᐸᓯᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ — **ᐊᒡᖏᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 5 (June 2000 - May 2001)**

Month/ᑕᖅᖑᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓱᑎᕕᓚᓗ	OCT ᐅᑦᔪᕕᓚᓗ	NOV ᐅᐅᒃᕕᓚᓗ	DEC ᑎᓯᕕᓚᓗ	JAN ᒍᓐᓇᐊᓚᓗ	FEB ᐃᖏᑐᐊᓚᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	9	13	27	25	1	4	6	6	12	11	15	7	51
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait						4			3				7
Polar bear[#]	ᓇᓂᐃᑦ[#]	Nanuit[#]	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕈᐃᑦ	Amagut								2		3	2	1	6
Arctic fox	ᑎᓗᒃᑑᓂᐊᑦ	Tigiganiat						4	4	3	3	1	2		11
Coloured fox	ᖃᓄᖅᑭᑦᑐᑦ ᑎᓗᒃᑑᓂᐊᑦ	Kalaliit tigiganiat						2							2
Wolverine	ᖃᐅᐃᑦ	Kalvik						1	1			3			4
Seals (unspecified)	ᓴᖅᓄᓪᓕᑦ	Natiit	28	14	20	8	2								41
Ringed seal	ᓇᓴᓪᑦ	Natiinat	3	3	5	3	1	3	2	7	6	5	9	9	25
Bearded seal	ᐅᓚᐋᐃᑦ	Ukyuk			5		1								6
Narwhal	ᑐᒧᓕᑦ ᖃᓪᓗᓂᑦ	Tuugaak			1	9									10
Ptarmigan	ᐊᖏᓂᑦ	Akilgik							1		1				2
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit		1											1
Arctic char	ᐃᖃᓗᓴᐃᑦ	Ikaliviit	12	11	13	6	34	6	2	2	2	2	2	1	45
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	9	14	1	1							3	35	40

6.2.4

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᒪᓪᓚᐅᓂᒃ ᐱᑕᖃᖏᑐᓕᖅ ᐱᓵᐋᒋᓐᓂᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᑦᓂᓄᑦ ᐊᓕᕆᔨᒪᓪᓚᐅᓂᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓯᐊᕐᓂᒃ ᑐᓂᔅᓴᖏᑦᓂ ᐃᑯᐱᕐᓚᓕᕆᓂᖅᑕᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᐅᓗᐅᐃᔭᐅᑦ/NAUNAIKUTA 407

Annual harvest estimates and five-year mean

ᐊᖏᖃᒍᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓐᓂᑦ ᐊᐃᒪᓗ ᑲᑎᓪᓗᓂᑦ-ᐊᖏᖃᔪᓄᑦ ᐊᐅᓐᓂᑦᓯᑎᓯᒪᔨᑦ 2001)

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᖏᖃᓄᑦ (ᔦᓂ 1996 - ᒪᐃ

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᖃᓕᕆᔨᒃᑯᑦ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᓐᓂᑦᓯᑎᓯᒪᔨᑦ Amigaitkiyait
Species	**ᐅᒪᔨᑦ**	**Umajuin**						
Caribou[1]	ᑐᑐᐃᐅᑦ[1]	Tuktut[1]	274	589	449	425	411	430
Musk-ox[2]	ᐅᒥᓴᒪᐃᑦ[2]	Umingmait[2]	5	1	5	7	10	6
Polar bear[3]	ᓇᓂᐃᑦ[3]	Nanuit[3]	15	8	13	14	13	13
Tundra grizzly[4]	ᐊᖅᓪᓚᐃᑦ[4]	Akhait[4]	1	0	0	0	0	<1
Wolf[5]	ᐊᒪᕐᒪᐃᑦ[5]	Amagut[5]	4	18	22	16	15	15
Arctic fox[6]	ᑎᓘᓐᓄᐊᑦ[6]	Tigiganiat[6]	94	88	9	16	41	50
Coloured fox	ᖃᑯᖏᑦᑐᑦ ᑎᓘᓐᓄᐊᑦ	Kalaliit tigiganiat	0	0	0	1	2	1
Wolverine	ᖃᓪᓚᑦ	Kalvik	0	0	2	2	5	2
Arctic hare	ᐅᑲᓪᓕ	Ukalik	2	0	0	0	0	<1
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik	8	5	0	0	0	3
Seals (unspecified)[7]	ᓱᖏᑯᓪᓕᑦ[7]	Natiit[7]	267	119	3	48	322	152
Ringed seal[7]	ᓇᕆᑦ[7]	Natiinat[7]	3	319	364	377	164	245
Bearded seal[7]	ᐅᓘᔪᐃᑦ[7]	Ukyuk[7]	17	18	14	12	7	14
Harbour seal[7]	ᖃᓯᕈᐊᑦ[7]	Qanigiaq[7]	0	0	0	2	0	<1
Narwhal[8]	ᑐᒃᓪᓕᑦ ᕿᓪᓚᓗᒃ[8]	Tuugaak[8]	1	10	4	0	15	6
Geese (unspecified)	ᓄᖅᓪᓕᑦ	Kanguk	1	0	0	0	0	<1
Snow goose[9]	ᑲᖏᐃᐃᑦ[9]	Kanguq[9]	0	9	0	0	0	2
Canada goose[10]	ᓄᖅᓪᓕᑦ ᐅᓚᐊᒍᓪᓕᑦ[10]	Nikliknik[10]	2	9	4	6	0	4
Eider duck[11]	ᑎᑎᑦ[11]	Kingalik[11]	0	0	0	20	0	4
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq	0	3	0	0	0	1
Yellow-billed loon	ᑐᓪᓕᖅᓴᑦ	Tuulik	0	1	0	0	0	<1
Black guillemot	ᐱᖅᐅᓪᓕᑦ	Black guillemot	1	0	0	0	0	<1
Ptarmigan	ᐊᕐᓗᓂᑦ	Akilgik	9	1	4	0	3	3
Sandhill crane	ᑕᑎᓘᖅᓴᑦ	Tatilgaq	0	2	0	0	0	<1
Goose eggs[12]	ᑲᖏᐃᐃᑦ ᒪᓕᓂᖏᑦᑕ[12]	Uluaguliit manniit[12]	15	32	0	1	49	19
Seagull eggs[12]	ᓇᐅᐅᐃᑦ ᒪᓕᓂᖏᑦᑕ[12]	Nauyat manniit[12]	0	5	0	0	0	1
Arctic char[13]	ᐃᖃᓗᐸᐱᑦ[13]	Ikaliviit[13]	18,078	15,134	8,918	4,711	4,631	10,294
Freshwater fish (unspecified)	ᑕᓂᐅᖏᖏᑐᒥ ᐃᖃᓗᐃᑦ	Tahinik Ikaluit	4	0	0	0	0	1
Lake trout[14]	ᐃᓕᕐᐃᑦ[14]	Ikalukpik[14]	285	799	226	370	628	462
Sculpin[15]	ᑲᓇᔪᐃᑦ[15]	Kanayuk[15]	0	776	0	0	0	155

[1-15]: See page 528 for community feedback and other sources of data.

[1-15]: ᑫᒧᐧ ᒪᔪᐊᑐᖃᐧ 530 ᓄᓇᓕᑦ ᑭᐅᔪᓂᖏᑦᑕ ᐊᒪᓗᓗ ᐊᓯᖏᑦᑕ ᐱᖃᓐᓇᐅᔭᖅ ᓇᓱᐅᑎᓂᖅ.

[1-15]: Takulugu makpigaak 532 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

6.2.4

TABLE/ᐅᓗᐅᐃᔭᐅᑦ/NAUNAIKUTA 408

Annual hunter response

ᐊᒡᕎᔪᑎᒻ ᐊᖏᔪᓂᖅᑎᑦ ᑭᐅᓂᖏᑦ

Angujauvaktu

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᒡᕎᔪᓄᑦ (ᓴᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᕆᔨᖅ ᐊᒡᕎᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᖅᑎᑦ ᑭᐅᓂᖏᑦ ᐊᒡᔪᓪᓚᓂᖏᑦ**	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᖀᑦᓯᒪᑦ ᐊᖏᔪᓂᖅᑎᑦ	Tatkitaman angunahuktut titigait	63	80	80	86	88	102*
Hunters interviewed	ᐊᖏᔪᓂᖅᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	59	80	79	86	86	99*
Harvested	ᐊᖏᔪᓂᖃᑎᒌᓂᑦ	Angujaujut	58	65	53	73	72	96*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑎᓂᖏᑦ (%)	Kiujut (%)	67	88	89	92	94	86**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖏᔪᓂᖅᑎᑦ ᐊᑎᒥᐅᔾᔨᒃᑯᓂᑦ/ᐊᐱᕐᓂᑦᑯᓂ/ᐊᖏᔪᓂᖃᑎᒌᓂᓪ ᐊᑕᐅᓯᐊᓕᕐᓂᑎᑦ ᖃᓄᐃᑎᓂᖏᑦ.
** ᐱᔨᑦᓯᑎᓯᒪᔨᑦ ᑕᖀᑦᓯᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᐅᐃᔭᐅᑦ/NAUNAIKUTA 409

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᖃᐃᐅᔨᑦ ᐊᑯᖃᖏᓂ ᐊᖏᔪᓂᓐᓂᖏᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᑕ, ᐅᓗᐅᐃᖃᑦᑕ ᐃᓕᑲ % ᑲᑎᕐᔪᑦ ᐊᖏᔪᓂᖅᑕ ᑎᑎᖃᑦᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᒡᕎᔪᓄᑦ (ᓴᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᕆᔨᖅ ᐊᒡᕎᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᑦ Tamakiklugin
Recall Period	**ᐅᑎᖃᐃᐅᔨᑦ**	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᖀᑦ	≤ tatkin pingahut	99	93	45	36	79	73
4-6 months	4-6 ᑕᖀᑦ	tatkin hitaman 6nut	0	7	32	41	21	19
> 6 months	> 6 ᑕᖀᑦ	> 6 tatkin	0	0	22	23	0	8

6.2.4

TABLE/ᐅᓗᐅᐃᔭᐅᑦ/NAUNAIKUTA 410

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓕᓴᕆᑎᑦ ᐊᖏᔪᓕᓴᕆᕐᕕᒋᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓄᑦ ᐊᒃᑲᒍᓄᑦ (ᔨᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᒃᑲᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᓂᖅ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**						
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	50	53	41	56	51	89
Musk-ox	ᐅᒥᒃᒪᐃᑦ	Umingmait	3	1	3	4	7	15
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᖅᓪᓗᐃᑦ	Akhait	1					1
Wolf	ᐊᒪᖏᐃᑦ	Amagut	2	5	6	6	6	13
Arctic fox	ᑎᓇᓚᒋᔭᐊᑦ	Tigiganiat	11	11	3	6	11	27
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓇᓚᒋᔭᐊᑦ	Kalaliit tigiganiat				1	2	3
Wolverine	ᖃᑦᕃᓵᑦ	Kalvik			2	2	4	8
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik	1					1
Arctic ground squirrel	ᓱᖅᓯᑦ	Hikhik	2	1				3
Seals (unspecified)	ᓯᖏᑦᓴᓪᓚᑦ	Natiit	43	12	1	15	41	67
Ringed seal	ᓇᓯᓯᑦ	Natiinat	2	42	31	45	25	63
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	10	14	6	6	6	33
Harbour seal	ᖃᓂᕆᐊᑦ	Qanigiaq				1		1
Narwhal	ᑐᐃᓪᓚᑦ ᕿᓪᓗᓂᑦ	Tuugaak	1	7	2		10	17
Geese (unspecified)	ᓄᑦᓪᓚᑦ	Kanguk	1					1
Snow goose	ᑲᖏᐃᑦ	Kanguq		2				2
Canada goose	ᓄᑦᓪᓚᑦ ᐅᓗᐊᒍᓪᓚᑦ	Nikliknik	1	2	1	2		6
Eider duck	ᒥᑎᑦ	Kingalik				3		3
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq		1				1
Yellow-billed loon	ᑐᑦᓚᑦᔪᐊᑦ	Tuulik		1				1
Black guillemot	ᐱᑦᓯᐅᓪᓚᑦ	Black guillemot	1					1
Ptarmigan	ᐊᒋᖏᓂᑦ	Akilgik	3	1	2		2	7
Sandhill crane	ᑕᑎᓴᑦᔪᐊᑦ	Tatilgaq		1				1
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓄᖅᑦ	Uluaguliit manniit	1	1		1	1	4
Seagull eggs	ᓇᐅᒃᐃᑦ ᒪᓐᓄᖅᑦ	Nauyat manniit		1				1
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	42	43	35	31	45	75
Freshwater fish (unspecified)	ᑕᓇᐅᖏᓄᑦᑐᒥ ᐃᖃᓗᐃᑦ	Tahinik Ikaluit	1					1
Lake trout	ᐃᓱᓴᐃᑦ	Ikalukpik	12	34	11	23	40	64
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk		1				1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᒪᔪᓂᒃ ᐱᑕᖃᓄᑦᑐᖃᖅ ᐱᒃᔪᑎᓕᓂᒃ ᐊᖏᔪᑦ ᖃᕋᐅᓂᖓᓂᓕᒃ ᐊᓕᖏᔪᓂ ᐊᑐᐅᓂ ᓇᓕᐅᕐᓴᐳᓂ ᑐᓂᓴᖏᓐᓂ ᐃᓂᒋᔭᐅᓂ ᐃᑲᔪᖏᓐᓂ ᐃᑯᐱᐃᓕᓚᓇᓵᓕᒃ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

6.2.4



6.2.4 Community Results Discussion: Kugaaruk

The survey frame:

An assessment of under-enumeration during the community visit revealed that there were approximately 68 hunters who were not registered in the Harvest Study. Sixty-seven of these were Inuit - 62 occasional and five active hunters. It is estimated that there was one non-Inuit hunter with assigned hunting rights who was not registered – an occasional hunter. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. Given that these unregistered hunters represent forty percent of the total hunter population and that five of the hunters were active hunters (Table 10) the effect of this bias on harvest estimates is likely very significant and could have caused an under-estimation of the community harvest of up to 50%. Harvest estimates for the unregistered hunters can be estimated using mean harvest quantities for each species by strata. However, these estimates, having their own sources of error and bias, are beyond the scope of this Final Report. Readers may apply to NWMB to obtain the results of these calculations.

Survey coverage and non-response bias:

Response rates although good in most months, were lower in year 1, when rates dropped below 50% in a few months, and in the first month of year 2. In years 3 to 5 response rates were high in almost all months, with only the occasional month below 75%. As seen in Table 9 the consistent intentional non-response rate in Kugaaruk was nil, and therefore was not a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough during years 2 to 5, with the exception of the first month in year 2, to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should exercise caution when using the data collected during year 1 and during the first month of year 2 (June 1997) since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:

It was reported during the community consultations that some egg harvests were under-reported. Further details are provided in the community feedback and other sources of data section below. Section 5.4 also contains a thorough discussion of this issue.

As seen in the recall period tables, years 1, 2 and most of year 5 had short recall periods with the majority of harvest records having been collected within three months of the harvest, minimizing measurement error due to recall failure. However, recall periods were much longer, over six months in many cases, during several months in years 3 and 4. Recall error in these instances is more likely.

As noted in the comments associated with arctic char, below, there was commercial harvesting of char during the study. It appears that harvest estimates do include some of the commercial harvest early in the study and should be considered too high if only considering the subsistence harvest of the community. However, in the latter years of the study harvest estimates are thought to be too low to include both subsistence and commercial harvests.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of both barren-ground caribou and island caribou. Also, some hunters did not specify the type of caribou harvested. For the purpose of calculating harvest estimates they were combined into one category. All harvest estimates appear too low (C.F.).
2. **Musk-ox:** The community was issued 15 tags per year but not all were taken. The HTO Board estimates about 5 per year were used. Although the year 2 estimate seems too low, some others seem a little high. The annual mean appears to be in the right range (C.F.).
3. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
4. **Tundra grizzly:** The community generally harvests about 1 bear annually, so data from years with no reported harvest may be incorrect (C.F.).

[5] **Wolf:** Harvest estimates seem a little low. Data were obtained from DSD detailing the number of pelts sold by hunters. DSD reports were available for 1999/2000 and 2000/2001 (years 4 and 5) and indicate that 40 wolf pelts were purchased in 1999/2000 (year 4) and 27 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). Based on this information the harvest estimates do appear to be low in the last two years of the study.

[6] **Arctic fox:** Again, DSD provided reports for 1999/2000 and 2000/2001 (years 4 and 5) which indicated that 28 arctic fox pelts were purchased in 1999/2000 (year 4) and 48 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). Based on this information the harvest estimates may also be somewhat low.

[7] **Seals:** Most of the unidentified seals were likely ringed seals. Harvest estimates may be a little low in some years but are in the right range. However, hunters reported that harbour seals are not hunted by the community and they questioned the report of this harvest in year 4 (C.F).

[8] **Narwhal:** Some of the harvest estimates seem too low (C.F). The community had an annual quota of 10 but had harvested over quota on some occasions. However, there was one year in which no narwhal were harvested, so the data indicating no narwhal harvests in year 4 is accurate. DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DSD N/B):

96/97	97/98	98/99	99/00	00/01
7	15	8	0	30

These data indicate that harvest estimates appear low in four years of the study.

[9] **Snow goose:** Harvest estimates seem low. Approximately 15-20 snow geese are harvested every year (C.F.).

[10] **Canada goose:** As per the snow goose comments above, about 15-20 Canada geese are harvested annually (C.F.).

[11] **Eider duck:** Both king and common eiders are harvested around the community, however neither are very abundant (C.F.).

[12] **Eggs:** Harvest estimates appear too low. Hunters commented that they did not know to report eggs. Eggs are harvested every year; mostly seagull eggs but some goose and eider duck eggs are also gathered (C.F.).

[13] **Arctic char:** Harvest estimates in years 4 and 5 seem too low. Arctic char were fished commercially in about 12 places around the community. It appears that in years 1 and 2 some of these commercially caught fish were reported, whereas estimates in the later years are thought to be too low and not to include commercial fishing (C.F.). DFO records confirm that commercial quotas were issued during each year of the study (DFO F).

[14] **Lake trout:** The HTO Board estimates that the community harvests between 600 and 700 annually. Based on this information estimates in some years may be low (C.F.).

[15] **Sculpin:** The estimate in year 2 seems high, but harvesters often catch them in nets when fishing for other species – they are usually thrown back in the water though (C.F.).

6.2.4 ᓄᓇᕗᑦ ᓴᖅᑭᑕᐅᔭᓂᒃ ᐅᖃᖅᑎᑦᑕᑎᑦ: ᐃᒪᓐᓴᒃ

ᖃᐅᔨᓴᓂᐅᕐᓂᒃ ᐊᖅᑭᐹᒪᓂᖅ:

ᖃᑎᖅᑭᔨᐅᑎᓪᓗᑎᑦ ᐊᑎᓕᐅᓚᐅᖅᑐᖅᑕᐅᔭᓂᒃ ᓄᓇᕗᑦ ᐳᓪᓕᖅᑕᑕᐅᑎᓪᓗᑎᑦ ᑕᐃᑎᖅᓯᒪᔨᖅᑐᑦ ᑕᒪᓐᓇ 68%ᓂᓕᕆᑦ ᐊᖏᔪᐊᖅᑎᑦ ᐊᑎᖃᖅᑕᐅᔭᐅᖅᑕᑐᓂᒃ ᖃᐅᔨᓴᓂᔪᒥᑦ. 67%ᓂᑦ ᐃᓄᓐᓇᑎᒃ - 62 ᖃᐅᑎᒃᓯᑦ ᐊᖏᓚᓗ ᑕᓪᓚᒥᑦ ᑕᒪᐃᓚᑦ ᐊᖏᔪᐊᖅᑎᑦ ᐃᓄᓐᓇᑎᒃ. ᐃᓕᓴᕐᕕᐅᔨᖅ ᐊᑕᐅᓯᐅᓕᕆᔨᖏᓐᓂᒃ ᐃᓄᖅᑭᑐᖅ ᐊᖏᔪᐊᖅᑎᑎᒃ ᐊᖏᓇᓯᔪᖅᓴᐅᒥᑦ ᑐᓂᕈᓯᓚᐅᖅ ᐊᑎᖃᖅᑕᐅᓕᕆᔨᖅᑐᑦᑐᓂ - ᖃᐅᑎᒃᓯᑦ ᐊᖏᔪᐊᖅᓵᕐᑐᓂ. ᐅᖃᖅᑎᐅᔨᓚᒪᑕ ᓇᓴᐅᑎᒥ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓚᐅᖅᑐᒥᐅᑦ ᐱᔪᑕᐅᓂᒃ ᐊᖏᔪᐊᖅᑎᑦᑎᓂᖅᑐᑦᑐᓂᒃ ᐅᓪᓗᕈᓯᓚᐅᖅᑐᑦ ᐃᓚᖅᑕᐅᔨᓴᖅᑐᑦ ᖃᓄᖅᑭᑐᓂᒃᑯᓯᓚᖅᑐᑦ ᐊᖏᔪᐊᖅᑎᑦ 40%ᓯᓚᑦᑕ ᑲᑎᑕᐃᓇᐅᔪᑎᒃ ᐊᖏᔪᓂᕿᑎᓪᓗᒥᑦ ᐊᓚᓗ ᑕᓪᓚᒥᑦᑐᓂᒃ ᑕᒪᐃᓚᑦ ᐊᖏᔪᐊᖅᑎᑦ (ᓇᓕᒃᖃᖅ 10) ᐊᑦᑐᐃᓂᓚᑦᑕᖅᑕᖏᓐ ᐅᓚᓴᕐᑕᐅᔨ ᓇᓴᖅᑭᑐᐅᔭᓂᒃ ᐊᓯᖏᓪᓕᖅᑕᐅᓕᕆᔨᖅᑐᑦᑐᓂᒃ ᐊᖏᔪᓂᒃᑯᓯᐅᓕᕆᓂᖅᑐᒥᑦ ᐊᓚᓗ ᑐᖓᓚᐅᑎᓗᐊᖅᑕᐅᑦᓯᐅᖅᑐᖅᑐᓂ ᓄᓇᕗᓂ ᐅᓚᓴᕐᑕᐅᔨᓴᖅᑐᑦ ᓇᓴᐅᑎᒥ ᐊᖏᔪᐊᖅᑎᑦ ᓇᓴᐅᑎᒥ 50%. ᐅᓚᔨᖅᑕᐅᔭᐅᑦᑐᓂ ᐊᑎᖃᖅᑕᐅᔭᖅᑎᑦᑐᓂᒃ ᒥᑦᓴᐅᔭᖅᑕᐅᔨᖏᓐᓇᖅᑐᓂ ᐊᑐᓂᑦ ᑎᑦᓴᐅᑎᒥ ᐊᖏᔪᐊᖅᑎᑦ ᐅᓚᔨᖅᑕᐅᔪᓚᐅᖅᑐᑦ ᓇᓴᐅᑎᒥ ᐃᓚᖅᑕᐅᔨᓴᖅᑐᑦᑐᓂᒃ ᐊᑐᓂ ᑎᑦᓴᐅᑎᒥ ᐊᖏᔪᐊᖅᑎᑦ. ᑭᓯᐊᓂ, ᑕᒪᐃᓚᑦ ᓴᓇᖅᑕᐅᓕᕆᔨᑦ, ᐃᓕᒥᑦ ᑕᒪᓚᖅᑕᐅᓕᕆᔨᖅᑎᓪᓗᑎᑦ ᐃᓕᓴᕐᕕᐅᔨᖏᓐᓇᖅᑐᑦᑐᓂᒃ ᐃᓄᖅᑭᑐᖅᑐᓂᒃ ᐃᓕᓴᕐᕕᐅᔨᓴᖅᑐᑦᑐᓂᒃ, ᐱᓕᕆᑐᐊᖅᑐᑦᑕ ᐅᔪᓴᓐ ᑭᖑᓪᓕᖅᑐᓂᖅᑐᑦ ᐅᓂᒃᑲᖅᑭᖓᓂᒃ. ᐅᖃᓕᓴᖅᑐᑦ ᑐᓪᓕᖅᑕᐅᓕᕆᔨᖅᑐᑦ ᐅᓚᔨᖅᑕᐅᔭᓕᕆᓂᖅᑐᑦᑐᓂᒃ ᐱᓕᕆᔨᖅᑕᐅᔨᓴᖅᑐᑦ ᐊᓚᐅᖅᑎᓂᒃ.

ᖃᐅᔨᓴᖅᑕᐅᔨᓂᒃ ᐊᒻᒪ ᐃᓕᓴᐅᓚᐅᔨᐅᖏᓪᓕᑐᓂᒃ ᑭᐅᖏᓪᓕᑐᓂᒃ:

ᑭᐅᖅᑕᐅᓂᓚᖏᓪᓕᑦ ᐱᐅᓚᐃᖅᑎᓪᓗᒍ ᑕᖅᑭᓕᒫᓚᖅᓱᓂ, ᐊᑦᑕᓯᓂᖅᓴᐅᓕᐅᖅᑐᑦ ᐊᖏᔪᒍ 1-ᒥ, ᐊᒥᓱᓂᖏᓪᓕᑦ ᑲᑕᖅᑎᓪᓗᑎᑦ ᐊᑕᐃᓂ 50% ᖃᓄᖅᑭᐅᔨᓂ ᑕᖅᑭᓂ, ᐊᒻᒪ ᓯᑲᓪᓕᑦᓯᓚᓂ ᑕᖅᑭᑦᑕᒃ ᐊᖏᔪᒍ 2-ᒥ. ᐊᖏᔪᓂ 3 ᐊᒻᒪ 5 ᑭᐅᖅᑕᐅᓂᓚᖏᓪᓕᑦ ᖃᓄᐃᓯᓂᑎᓪᓗᒍ ᑕᖅᑭᓕᒫᓚᖅᓱᓂᒃ, ᐃᓐᓇᓯᓚᐅᖅᓄᓪ ᑕᖅᑭᐅᔨᓂ ᐊᑕᐃᖃᖅᑕᑕᒃ 75%. ᑕᐃᑎᖅᓯᒪᓕᒃ ᓇᓕᖅᑲᒥ 9 ᐱᓴᓪᓗᑎᒃ ᑭᐅᑦᑕᐃᓕᓴᐅᓚᕐᓇᖅᑐᑦ ᐃᓕᓴᒃ ᐱᑕᖅᑕᓚᐅᖅᑐᖅᑐᑦ, ᐊᒻᒪ ᑕᒪᓐᓇ ᐱᓪᓗᒍ ᑭᐅᑦᑕᐃᓕᓴᐅᓚᕐᓇᖅᑐᑦᑐᓂᒃ ᐅᓂᒃᑲᖅᑭᖓᓂᒃ.

ᑭᐅᔪᓄᖏᓪᓕᑦ ᐊᒥᓱᓕᑎᓯᓕᐅᓚᐅᖅᑐᑦ ᐊᒻᒪᓗ ᑭᐅᔪᓄᖏᓪᓕᑦᑐᓂ ᐅᓂᓗᐊᖏᑎᒃ ᐊᖏᔪᒍ 2-ᒥᑦ 5-ᒧᑦ, ᐱᖓᑕᑐᐊᓪᓗᒍ ᓯᔪᓚᓱᓂᖅ ᑕᖅᑭᑦ ᐊᖏᔪᒍ 2-ᒥ, ᒡᓕᔪᐊ ᐊᐱᕆᔪᖅᑕᐅᔪᓚᐅᖅᑐᑦ ᖃᓄᐅᓂᖏᓪᓕᑦ ᒥᑦᓴᐅᔭᓯᓚᑎᑦᑎᐊᖅᓄᖅᑐᓂᒃ ᐊᖏᔪᓯᓚᑎᓂᒃ ᐊᑎᖃᖅᑕᐅᔨᓴᖅᑐᑦ. ᐅᖃᓕᓴᖅᑐᑦ ᐅᔾᔨᖅᑐᑎᖏᓪᓕᖅᑐᖅ ᐊᑦᑕᓯᓂᖅᑐᑦ ᐅᓂᒃᑲᖅᑭᖓᓂᒃ ᐊᖏᔪᐊᖅᑎᑦ ᐊᖏᔪᒍ 1-ᒥ ᐊᒻᒪ ᓯᑲᓪᓕᑦᓯᓚᓂ ᑕᖅᑭᑦ ᐊᖏᔪᒍ 2-ᒥ (ᓄᓇ 1997) ᓄᐊᑕᐅᓯᒪᔪᑦ ᑕᒥᓴᓯᓚᐅᖅᑐᑦ ᐊᒻᒪᓗ ᑭᐅᔪᓄᖏᓪᓕᑐᓂᒃ ᐃᓕᓴᐅᓚᐅᖅᑐᖅᑕᐅᓪᓗᑎᑦᑕ ᐱᔪᓐᓇᕐᓂᖅᓴᐅᒥᓪᓚᑦ ᑭᐅᔪᓄᖏᓪᓕᑐᓂᒃ ᖃᑦᑕᖅᑭᑐᓂᖅᑐᑦ ᐅᓂᒃᑲᖅᑭᖓᓂᒃ.

ᓯᓚᐃᓴᖅᓯᓚᐅᖅᑐᑦᑐᓂᒃ ᐊᒻᒪ ᑭᐅᔪᓄᖏᓪᓕᑦ ᑕᒥᓴᓯᓚᐅᖅᑐᑦ:

ᐅᖃᖅᑐᖅᑐᓂᒃ ᓄᓇᕗᓯᓚᐅᖅᑐᑦ ᐅᖃᖅᑐᖅᑐᓂᒃ ᐃᓕᖅᑕᐅᔨᓴᖅᑐᑦ ᐅᓂᒃᑲᖅᑭᖓᓂᒃ ᐊᑎᖃᖅᑕᐅᔨᓴᖅᑐᑦ ᐊᖏᔪᒍ 1-ᒥ, ᐊᒥᓱᓂᖏᓪᓕᑦ ᑲᑕᖅᑎᓪᓗᑎᑦ ᐊᑕᐃᓂ 50% ᖃᓄᖅᑭᐅᔨᓂ ᑕᖅᑭᓂ, ᐊᒻᒪ ᓯᑲᓪᓕᑦᓯᓚᓂ ᑕᖅᑭᑦᑕᒃ ᐊᖏᔪᒍ 2-ᒥ. ᐊᖏᔪᓂ 3 ᐊᒻᒪ 5 ᑭᐅᖅᑕᐅᓂᓚᖏᓪᓕᑦ ᖃᓄᐃᓯᓂᑎᓪᓗᒍ ᑕᖅᑭᓕᒫᓚᖅᓱᓂᒃ, ᐃᓐᓇᓯᓚᐅᖅᓄᓪ ᑕᖅᑭᐅᔨᓂ ᐊᑕᐃᖃᖅᑕᑕᒃ 75%. ᑕᐃᑎᖅᓯᒪᓕᒃ ᓇᓕᖅᑲᒥ 9 ᐱᓴᓪᓗᑎᒃ ᑭᐅᑦᑕᐃᓕᓴᐅᓚᕐᓇᖅᑐᑦ ᐃᓕᓴᒃ ᐱᑕᖅᑕᓚᐅᖅᑐᖅᑐᑦ, ᐊᒻᒪ ᑕᒪᓐᓇ ᐱᓪᓗᒍ ᑭᐅᑦᑕᐃᓕᓴᐅᓚᕐᓇᖅᑐᑦᑐᓂᒃ ᐅᓂᒃᑲᖅᑭᖓᓂᒃ.

ᑭᐅᔪᓄᖏᓪᓕᑦ ᐊᒥᓱᓕᑎᓯᓕᐅᓚᐅᖅᑐᑦ ᐊᒻᒪᓗ ᑭᐅᔪᓄᖏᓪᓕᑦᑐᓂ ᐅᓂᓗᐊᖏᑎᒃ ᐊᑦᑕᓯᓂᖅᓴᐅᓕᐅᖅᑐᑦ 2-ᒥᑦ 5-ᒧᑦ, ᐱᖓᑕᑐᐊᓪᓗᒍ ᓯᔪᓚᓱᓂᖅ ᑕᖅᑭᑦ ᐊᖏᔪᒍ 2-ᒥ, ᒡᓕᔪᐊ ᐊᐱᕆᔪᖅᑕᐅᔪᓚᐅᖅᑐᑦ ᖃᓄᐅᓂᖏᓪᓕᑦ ᒥᑦᓴᐅᔭᓯᓚᑎᑦᑎᐊᖅᓄᖅᑐᓂᒃ ᐊᖏᔪᓯᓚᑎᓂᒃ ᐊᑎᖃᖅᑕᐅᔨᓴᖅᑐᑦ. ᐅᖃᓕᓴᖅᑐᑦ ᐅᔾᔨᖅᑐᑎᖏᓪᓕᖅᑐᖅ ᐊᑦᑕᓯᓂᖅᑐᑦ ᐅᓂᒃᑲᖅᑭᖓᓂᒃ ᐊᖏᔪᐊᖅᑎᑦ ᐊᖏᔪᒍ 1-ᒥ ᐊᒻᒪ ᓯᑲᓪᓕᑦᓯᓚᓂ ᑕᖅᑭᑦ ᐊᖏᔪᒍ 2-ᒥ (ᓄᓇ 1997) ᓄᐊᑕᐅᓯᒪᔪᑦ ᑕᒥᓴᓯᓚᐅᖅᑐᑦ ᐊᒻᒪᓗ ᑭᐅᔪᓄᖏᓪᓕᑐᓂᒃ ᐃᓕᓴᐅᓚᐅᖅᑐᖅᑕᐅᓪᓗᑎᑦᑕ ᐱᔪᓐᓇᕐᓂᖅᓴᐅᒥᓪᓚᑦ ᑭᐅᔪᓄᖏᓪᓕᑐᓂᒃ ᖃᑦᑕᖅᑭᑐᓂᖅᑐᑦ ᐅᓂᒃᑲᖅᑭᖓᓂᒃ.

ᓄᓇᕗᑦ ᑭᐅᔪᓄᖏᓪᓕᑦᑐᓂᒃ ᐊᒻᒪᓗ ᐊᓯᖏᓂ ᐊᑦᓚᑕᐅᓯᒪᔪᑦ:

1. **ᑐᓴᐃᓚᐅᖅ:** ᑐᑦᑕᑎᑦᑕᖅᑕᐃᓚᐅᖅ ᐃᓚᖅᑕᐅᔨᓴᖅᑐᑦ ᐊᑐᓂᒃ ᓄᓇᕗᐃᓚᐅᖅᑐᒥᑦ ᐊᒻᒪᓗ ᖁᑭᖅᑕᒥ ᑐᑦᑕᑎᑦᑕᖅᑕᐃᓚᐅᖅᑐᑦ. ᐊᒻᒪᓚᑕᐅᖅ, ᐃᓚᖅᑐᒃ ᐊᖏᔪᐊᖅᑎᑦᑎᓂᒃ ᓄᓇᓕᕆᔨᖅᑕᐅᓯᒪᔪᑦᑐᓂᒃ ᖃᓄᐃᓕᓴᐅᓚᐅᖅᑐᑦ ᑐᑦᑕᑎᑦᑕᖅᑕᐃᓚᐅᖅᑐᑦ. ᐱᓕᕆᔨ ᖃᓄᐃᓯᓂᑎᓪᓗᒍ ᑐᑦᑕᑎᑦᑕᖅᑕᐃᓚᐅᖅᑐᑦ ᐅᓂᒃᑲᖅᑭᖓᓂᒃ ᐊᑐᓂᒃ ᓄᓇᕗᐃᓚᐅᖅᑐᒥᑦ ᐊᒻᒪᓗ ᐊᓯᖏᓂ ᐊᑦᓚᑕᐅᓯᒪᔪᑦ ᐊᖏᔪᐊᖅᑎᑦᑎᓂᒃ ᓄᓇᓕᕆᔨᖅᑕᐅᓯᒪᔪᑦᑐᓂᒃ ᐃᓚᖅᑕᐅᔨᓴᖅᑐᑦ

[5] **ᐊᒪᒪᖅ:** ᐊᒪᒪᖅᑕᐅᖏᑦᑕᖅᑐᓂᒃ ᓇᓗᐅᑦᑎᐅᓯᒪᔪᓂᒃ ᐊᑦᑕᓯᔭᐊᖅᑐᑦᓯᖅᑐᖅ. ᑎᑎᖏᓐᓂᒃ ᐱᓕᐅᔪᓂᒃ ᐃᓄᐃᖏᓐᓇᓕᓴᐅᒋᐊᖅᓂᒃ ᐊᑎᓯᓂᖅᓂᒃ ᐊᒪᒪᓂᒃ ᓂᐅᑦᑎᑕᐅᓇᓗᖅᑐᑦᓯᒃ. ᐃᓄᐃᖏᓐᓇᓕᓴᐅᒋᐊᖅᓂᒃ ᐅᓂᒃᑲᓪᓚᕆᐅᓇᓗᖅᑐᑦᓯᒃ 1999/2000-ᒧᑦ ᐊᒻᒪ 2000/2001-ᒧᑦ (ᐊᖏᔪᖅ 4 ᐊᒻᒪ 5) ᐊᒻᒪ ᓇᓗᐃᖅᓯᔪᓂᒃ 40 ᐊᒪᒪᓂᒃ ᐊᑎᖅᑐᖅ ᓂᐅᐃᐊᖅᓯᒪᓕᕆᔨᑦᑎᐊᕐᓗᓐᓄ 1999/2000ᒥ (ᐅᑭᐅᖓᓂᒃ 4) ᐊᒻᒪ 27 ᓂᐊᐃᖓᓯᒪᓕᐅᖅᑐᓂᒃ 2000/2001-ᒥ (ᐅᑭᐅᖓᓂᒃ 5) (ᖃᐅᔨᒪᑦᑐᖅ ᐃᓄᐃᑦᑐᓴᓂᒃ ᓄᓇᕗᑦ ᒪᓕᒻᒪᒃ ᐱᒋᐊᖃᖅᖢᓂᒃ ᐅᓇᑦᑐᖅᑐᑦ ᐃᓄᐃᑦᑐᓴᓂᒃ ᒪᓕᒻᒪᒃ ᐱᒋᐊᖃᖅᓯᓕᖅᑐᑦ ᐅᓇᑦᑐᖅᑐᑦ ᒪᓕᒻᒪᒃ ᓄᓇᕗᑦ ᒪᐃᑐᑦ) (DSD FB)

[6] **ᑎᓇᖓᓂᐊᖅ:** ᐊᒻᒪᓕᓯᓂ, ᐃᓄᐃᖏᓐᓇᓕᓴᐅᒋᐊᖅᓂᒃ ᐅᓂᒃᑲᓪᓚᕆᐅᓇᓗᖅᑐᑦᓯᒃ 1999/2000-ᒧᑦ ᐊᒻᒪ 2000/2001-ᒧᑦ (ᐊᖏᔪᖅ 4 ᐊᒻᒪ 5) ᐊᒻᒪ ᓇᓗᐃᖅᓯᔪᓂᒃ 28 ᑎᓇᓂᐊᖅ ᐊᒪᒪᓂᒃ ᓂᐅᐃᐊᖅᓯᒪᓕᕆᔨᑦᑎᐊᕐᓗᓐᓄ 1999/2000ᒥ (ᐅᑭᐅᖓᓂᒃ 4) ᐊᒻᒪ 48 ᓂᐊᐃᖓᓯᒪᓕᐅᖅᑐᑦᓯᒃ 2000/2001-ᒥ (ᐅᑭᐅᖓᓂᒃ 5) (ᖃᐅᔨᒪᑦᑐᖅ ᐃᓄᐃᖏᓐᓇᓕᓴᐅᒋᐊᖅᓂᒃ ᓄᓇᕗᑦ ᒪᓕᒻᒪᒃ ᐱᒋᐊᖃᖅᖢᓂᒃ ᐊᒻᒪᓕᓯᓂ ᐊᑦᑕᓯᔭᐊᖅᑐᑦᓯᒃ ᒪᓕᒻᒪᒃ ᐱᒋᐊᖃᖅᓯᓕᖅᑐᑦ ᐅᓇᑦᑐᖅᑐᑦ ᒪᓕᒻᒪᒃ ᓄᓇᕗᑦ ᒪᐃᑐᑦ) (DSD FB). ᐃᓕᓴᐃᓪᓗ ᒥᐅᔪᓂᒃᓴᖅᓄᓕᓂ ᑎᓇᓂᐊᖅᑕᐅᖏᑦᑕᖅᑐᓂᒃ ᓇᓗᐅᑦᑎᐅᓯᒪᔪᓂᒃ ᐊᑦᑕᓯᔭᐊᖅᑐᑦᓯᖅᑐᖅ.

[7] **ᓇᓯᓂᑦ:** ᐊᑕᖏᑦᓯᑐᑎᑎᒃ ᓇᓗᐃᖅᑕᐅᓯᒪᔪᓕᖏᑦᑕᖅᑐᓂᒃ ᓇᓯᓂᒃ ᓇᑎᑐᖅᐃᓇᐅᖅᑐᖅᓇᓗᓇᓕᖅᑐᖅᑐᓂᒃ. ᓇᑎᑎᑕᐅᖏᑦᑕᖅᑐᓂᒃ ᐊᑦᑕᓯᔭᐊᖅᑐᑦᓯᖅᑐᖅᓇᓗᖅᑐᑦᓯᒃ ᐃᓕᖏᓐᓄ ᐊᑦᑭᔪᓄ ᑭᓱᓂᐊᖅᑐᖅᓂᒃ. ᑭᓱᓂᐊᖅ, ᐊᒻᒪᓕᓯᓂᒃᑎᓂᒃ ᐅᖏᖓᑕᓯᐅᖅᑐᖅᓂᒃ ᖃᓄᖅ ᐊᑎᖅᑐᖅᓂᒃ ᐊᑦᑭᔪᓄ ᑭᓱᓂᐊᖅᑐᖅᓂᒃ ᐊᑦᑕᓯᔭᐊᖅᑐᑦᓯᖅᑐᖅᓇᓗᖅᑐᑦᓯᒃ ᐊᒻᒪᓕᓯᓂ



6.2.4 Nunanit Inikhimayut Ukauhiit: Kugaaruk

Ihivgiuktit Atugutait:
Ihivgiufaakhimayut ataani naunaiyakhimayut nunani pulaakhimapluta takuhimayut 68kuyut umayukhiuktit titigakhimaitut umayukhiukhimayut ihivgiugutini. 67kuyut hapkoa Inuinait – 62kuyut ilaani umayukhiukpaktut ovalo talimat umayukhiukataktut. Naunaiyakhimayuk atauhik Inuinaungituk umayukhiukti tuniyauhimayut inminiigutiminik titigakhimaituk – ilaani umayukhiukataktuk. Ukakhimayuk ilangani 5.2.1 ikpinagutait hamna ataani naunaiyakhimayut ataanungalaaktuk ihumagiyaini umayukhiukhimayut naunaiyautaini. Taimaimat hapkoa titigakhimaitut umayukhiuktit pihimamata 40%nik tamaat umayukhiuktinit ovalo talimat umayukhiukatamata (ikpatauyak 10), ikpinagutait ihumagiyaini umayukhiukhimayut naunaiyautaini angiyut ovalo piyunakhiyut ataani naunaiyautini nunani umayukhiukhimayuni 50%mik. Umayukhiukhimayut naunaiyautait titigakhimaitut umayukhiuktit naunaiyalaaktut atulugit anginikhaat umayukhiukhimayut amigaitjutait tamamik umayut aviktukhimalugit. Kihimi hapkoa naunaiyautit avataaniimat iniktigutait hamna iniktiguti tuhaktakhak. Taiguaktut apigilaaktut NWMBkunut pilutik iniktigutainik hapkoa naunaiyautainik.

Ihivgiugutait ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait naamaktuugaluit amigaituni tatkikhiutini, mikiyut ukiumi 1mi, naunaiyautit katakhimamata ataanut 50%mit ikituni tatkikhiutini ovalo hivulimi tatkikhiutini ukiumi 2mi. Ukiumi 3mi ovalo 5mi kiuhimayut naunaiyautait angiyut tamamivyak tatikikhiutini, ilangit tatkikhiutit ataanut 75%mit. Takuhimayut Ikpatauyami 9 kiuyuitut naunaiyautait Kugaarukmi pikangitut ovalo pikangituk pilaaktunik pihimayaini kiuyuitut ihumagiyaini.

Kiuhimayut naunaiyautait ihumagiyauyut angiyut ovalo kiuyuitut ihumagiyait mikiyut ukiuni 2 ovalo 5, kihimi hivulimi tatkikhiutimi ukiumi 2mi, piyaamini nni pihimayut naamaktumik naunaiyautini uktukhimayuni Nni umayukhiuktini. Taiguaktut piyukhat ihumagilugit atugumik katitikhimayunik katitigutainik ukiumi 1mi ovalo hivulimi tatkikhiutimi (Junemi 1997) pilaaktuni tamamik uktukhimayut ihuinaagutaini ovalo kiuyuitut ihumagiyaini angiklilaamat kiuhimayut naunaiyautait katakaagata.

Atugutaini ihumagiyut ovalo kiuhimayut ihuinaagutait:
Tuhaktitihimayut nunani pulaakhimagapta ilangit maniit pikiutakhimayut ataani tuhaktitihimayut. Titigatiakhimayuk pihimayut nunanit ukakhimayaini ovalo aalani atuktaini katitikhimayuni ilangani hamani. Ilangani 5.4 pihimayutlu ukautitiagit hamna ihumagiyauyuk.

Takuhimayut utiktihimayut ubluini ikpatauyami, ukiut 1. 2 ovalo amigaitkiyaut ukiumi 5 naitumik utiktitikhimayut ubluit amigaktut umayukhiukhimayut titigakhimayut katitikhimayut iluani pingahut tatkikhiutini umayukhiukhimayaini, mikinikhaakhimayut atugutaini ihuinaagutini pihimagaagata utiktitihimayut pingitkaagata. Kihimi, utiktitihimayut ubluit takiyut, avataanut siksit tatkikhiutit amigaituni, tatkikhiutini ukiuni 3 ovalo 4. Utiktitihimayut ihuinaagutait hapkoa piyunakhivaktut ilaani.

Titigakhimayut ukautini mikhaanut ikaliviit hamani, kinauyaliukhimayut umayukhiugutit ikalivinik ihivgiuktitlugit. Takukhauyuk umayukhiukhimayut naunaiyautait ilauyut kinauyaliugutit umayukhiukhimayuni pilihaaliktitlugit ihivgiuktut ovalo ihumagiyauyukhat angiyut pivakpata atuktakhainik umayukhukhimayut nunani. Kihimi kinguliit ukiut ihivgiukhimayut umayukhiukhimayut naunaiyautaini ihumagiyauyut mikiyut ilaukpata tamamik atuktakhat ovalo kinauyaliukhimayut umayukhiukhimayut.

Nunanit ukakhimayut ovalo aalani atukhimayaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukhimayut pihimayut tamamik nunani tuktut ovalo kikiktani tuktut. Ovalo ilangit umayukhiuktit ukatiakhimaitut kanugitunik tuktut umayukhiukhimayait. Atukhimayut naunaiyautaini umayukhiukhimayut naunaiyautait katitikhimayut atauhimut. Tamamik umayukhiukhimayut naunaiyautait mikiyut (C.F.).
2. **Umingmait:** Nunani tuniyauhimayut 15nik atugutikhainik ukiuk tamaat kihimi atuyuitut tamamik. HTOkut katimayiit naunaiyakhimayut 5nik ukiuk tamaat atukpaktut. Kihimi ukiumi 2 naunaiyautait mikiyut, ilangit ukiut kihimi angiyut. Ukiuk tamaat angitjutait atukpaktut naamaktut (C.F.).
3. **Nanuit:** Amigaitjutait takuhimayut naunaiyautaungitut kihimi pihimayut umayukhiukhimayut amigaitjutait tunihimayait DSDkut (DSD PB).
4. **Akhat:** Nunami umayukataktut atauhimik akhamik ukiuk tamaat, taimaimat katitikhimayut ukiut tuhaktitihimaitut umayukhimaitunik ihuitunakhiyut (C.F.).

[5] **Amagut:** Umayukhiukhimayut naunaiyautait mikiyut. Katitikhimayut pihimayut DSDkunit titigakhimayut amigaitjutait amiit niuviktauhimayut umayukhiuktinit. DSDkut tuhaktitihimayut pihimayut ukiuni 1999/2000 ovalo 2000/2001 (ukiuni 4 ovalo 5) ovalo titigakhimayut 40nik amagut amiit niuviktauhimayut 1999/2000mi (ukiumi 4) ovalo 27nik niuviktauhimayut 2000/2001mi (ukiumi 5) (nalungilutit DSDkut katitigutait atukpaktut umayukhiukviit ukiungit Julymit Junemut, Umayukhiukhimayut ihivgiugutait katitikhimayut atukhimayut Junemit Maymut) (DSD FB). Atukhugit hamna tuhagutikhat umayukhiukhimayut naunaiyautait mikiyut kingulimi malguni ukiuni ihivgiuktuni.

[6] **Tigiganiat:** Ilaa, DSDkut tuhaktitihimayut 1999/2000 ovalo 2000/2001 (ukiuni 4 ovalo 5) titigakhimayut 28nik tigiganiat amiit niuviktauhimayut 1999/2000mi (ukiumi 4) ovalo 48nik niuviktauhimayut 2000/2001mi (ukiumi 5) (nalungilutit DSDkut katitikhimayait atukhimayut umayukhiukhimayut ukingit Julymit Junemut, Umayukhiukhimayut Ihivgiuktut katitikhimayait umayukhiukhimayut ukiungit Junemit Maymut) (DSD FB). Atukhugit hamna tuhagutikhatk umayukhiukhimayut naunaiyautait mikiyut.

[7] **Natiit:** Amigaitkiyait naunaiyakhimaitut natiit natinaaguyunakhiyut. Umayukhiukhimayut naunaiyautait mikiyut ilangaini ukiuni kihimi naamaktutut itut. Kihimi umayukhiuktit tuhaktitihimayut Qanigiat umayukhiuktauyuitut nunani ovalo apigihimayut tuhaktakhani hamna umayukhimayuk ukiumi 4mi (C.F.).

[8] **Tuugaat:** Ilangit umayukhiukhimayut naunaiyautait mikiyut (C.F.). Nunani ukiuk tamaat kotakaktut kulinik kihimi umayukhiukhimayut avataanut kotaminik ilaani. Kihimi atauhimi ukiumi tuugaakhimaitut, taimaimat katitikhimayut titigagutait tuugaakhimaitut ukiumi 4mi nakuuyuk. DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait tuugaat (nalungilutit DFOkut katitikhimayait atukhimayut ukiuminik, Umayukhiukhimayut ihivgiukhimayut katitikhimayait atukhimayut umayukhiukhimayut ukiungit Junemit Maymut) (DSD N/B):

96/97	97/98	98/99	99/00	00/01
7	15	8	0	30

Hapkoa katitikhimayut takukhauhimayut umayukhiukhimayut naunaiyautait mikiyut hitamani ukiuni ihivgiukhimayuni.

[9] **Kanguq:** Umayukhiukhimayut naunaiyautait mikiyut. Ilaani 15nit 20nut kanguit pivaktut ukiuk tamaat (C.F.).

[10] **Uluaguliit:** Aatjikutaatut kanguini, ukauhiit hamani 15nit 20nut uluaguliit pivaktut ukiuk tamaat (C.F.).

[11] **Tinmiat:** Tamamik kingaliit ovalo mitiit pivaktut haniani nunami, kihimi tamamik ikitut (C.F.).

[12] **Maniit:** Umayukhiukhimayut naunaiyautait mikiyut. Umayukhiuktit ukakhimayut nalugamik tuhaktitilugit maniit. Maniit pikiuktauhimayut ukiuk tamaat; amigaitut nauyat mainiit kihimi ilangit uluaguliit ovalo mitiit maniit pikiutakpaktut (C.F.).

[13] **Ikaliviit:** Umayukhiukhimayut naunaiyautait ukiumi 4 ovalo 5 mikiyut. Ikaliviit kinauyaliukhutik ikalukhiukpaktut 12ni haniani nunamini. Takukhauyuk ukiumi 1 ovalo2 ilangit hapkoa kinauyaliugutit pihimayut ikaluit tuhaktitauhimayut, kihimi naunaiyautait kinguani ukiut ihumagiyauyuk mikiyut ovalo ilaungitut kinauyaliukhimayuni ikalukhiuktunit (C.F.). DFOkut titihakhimayut kinauyaliukhimayuni kotanik tunihimayut tamamik ukiuni ihivgiuktitlugit (DFO F).

[14] **Ikalukpiit:** HTOkut katimayiit naunaiyakhimayut nunat umayukhiukataktait 600ni5 700nut ukiuk tamaat. Atukhugit hamna tuhagutikhat naunaiyautait ilangit ukiut mikiyut (C.F.).

[15] **Kanayut:** Naunaiyautait ukiumi 2 angiyut, kihimi umayukhiuktit pilikpaktait kuvyamini ikalukhiugaagamik aalanik ikalunik – igifaalikpaktait kihimi (C.F.).

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 411

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓚᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᓐᖁᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᓄᐊᓴᐱᓇ	DEC ᑎᓵᓴᐱᓇ	JAN ᔮᖏᓄᐊᓇ	FEB ᓄᖑᐅᐊᓇ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓪᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓕᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᑦ	Tuktut	48	48	207	53	246	185	94	72	93	194	212	109	1,561± 156
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait					2					3			5± 3
Moose	ᑐᓴᕐᕆᐃᑦ	Tuktuvait									1				1± 0
Tundra grizzly	ᐊᑦᓪᓗᐃᑦ	Akhait				1									1± 2
Wolf	ᐊᒪᖅᐃᑦ	Amagut						5		7	12	13	5	6	48± 9
Arctic fox	ᑎᓗᒃᑯᓂᐊᑦ	Tigiganiat						134	27	70	26	33	28		318± 108
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓗᒃᑯᓂᐊᑦ	Kalaliit tigiganiat						32	24	25	47	63	16		207± 70
Wolverine	ᖃᓪᓚᑦ	Kalvik					3	6	1	7	15	17	2		51± 8
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik						6		8		3			17± 9
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik			211	213							9		433± 350
Seals (unspecified)	ᓱᖃᐅᓪᓕᑦ	Natiit												5	5± 6
Ringed seal	ᓇᑦᓱᑦ	Natiinat	10	2	16	151	3		18		18		3		221± 110
Bearded seal	ᐅᓗᐊᔪᑦ	Ukyuk		2											2± 2
Beluga	ᖃᐅᑦᑕ ᖁᓪᓚᓗᑦ	Kilalugak		5											5± 4
Snow goose	ᑲᖏᒍᑦ	Kanguq	5											14	19± 16
Canada goose	ᓄᑦᓪᓕᑦ ᐅᓪᐊᒍᓪᓕᑦ	Nikliknik	486		76	66								794	1,422± 315
White-fronted goose	ᓄᑦᓪᓕᑦ	Nirlivik			2									9	11± 8
Old squaw	ᐊᓕᑎᐊᑦᔪᐃᑦ	Aahangik				6									6± 7
Pintail	ᖃᓄᓕᔪᐊᓪᓚᑦ	Arnaviaq	1												1± 1
Eider duck	ᒥᑎᑦ	Kingalik	8		6		47								61± 58
Tundra swan	ᖃᓄᔪᔪᐃᑦ	Kukyuk			15									13	28± 24
Arctic loon	ᑲᓚᓪᓕᑦ	Maliriq				15	2								17± 14
Ptarmigan	ᐊᖏᓂᑦ	Akilgik										21			21± 8
Goose eggs	ᑲᖏᒍᐃᑦ ᓚᒃᓄᖏᑦ	Uluaguliit manniit	901												901± 316
Duck eggs	ᒥᑎᑦ ᓚᒃᓄᖏᑦ	Tinmiat manniit	207												207± 150
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	912	755	1,387	322	992	642						43	5,053± 872
Lake trout	ᐃᓱᖁᕐᐃᑦ	Ikalukpik	36		224	6	30	22		3		75	73	415	884± 271
Arctic grayling	ᓱᓗᒃᐸᐅᒪᐃᑦ	Hulupaugaq	66		2										68± 28
Whitefish	ᑲᐱᓴᓪᓕᑦ	Kapihiliit	139	17	162	101	387	433		51	56	4	4		1,354± 740
Cod	ᐅᒪᐃᑦ	Ugak		34	31	9	164	651					32		921± 522

6.2.5

TABLE/ᐅᓗᐅᕕᐅᑦ/NAUNAIKUTA 412

Monthly hunter response

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᒻᒋᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓕ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᒻᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᐊᒻᐱᓗ	DEC ᑎᓯᒻᐱᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᐃᖅᐳᐊᓗ	MAR ᒪᑦᓯ	APR ᐃᑦᓇᓪᓗ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐋᒍᑦᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	273	270	270	270	271	272	273	273	274	274	273	271	276*
Interview list	ᐊᐱᕐᓂᖅᓴᐃᑦ	Apikiktan	187	184	184	184	185	186	186	186	187	187	186	184	189*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	155	115	115	123	122	113	132	131	181	182	179	135	187*
Harvested	ᐊᖏᔪᓂᒃᑐᒋᓐᓂᒃ	Angujaujut	52	29	57	26	40	35	18	13	29	55	34	37	129*
Response rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᓂᖏᑦ (%)	Kiujut (%)	83	63	63	67	66	61	71	70	97	97	96	73	76**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᔾᔪᑉᓴᒃ/ᐊᐱᕐᓂᖅᓴᐃᓕᒃᑐᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑐᒋᓐᓂᒃ ᐊᑕᐅᓂᔾᔪᓕᒃ ᐃᓕᓴᕐᓂᒃ ᐊᒻᒋᒍᒥ.
** ᐊᐅᔾᓂᓕᕆᔨᒃᓴᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᐅᕕᐅᑦ/NAUNAIKUTA 413

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐋᑯᕐᓂᓂ ᐊᖏᔪᓂᒃᑎᓕᓂᖅᓯᒪᓂᒃᑐᑦ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓂᒃᑎᑦ, ᐅᓗᐅᕕᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑎᑎᕐᓂᑦᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᒻᒋᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓕ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᒻᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᐊᒻᐱᓗ	DEC ᑎᓯᒻᐱᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᐃᖅᐳᐊᓗ	MAR ᒪᑦᓯ	APR ᐃᑦᓇᓪᓗ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑐᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑐᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑐᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

6.2.5

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 414

Number of hunters harvesting each species — **Year 1 (June 1996 - May 1997)**

ᖃᓄᐃᓕᓴᕐᓂᑦ ᐊᖏᔪᓚᐱᑎᑦ ᐊᖏᔪᓚᐱᖅᑕᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒻᒪᒍ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 1 (June 1996 - May 1997)**

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔮᓂ	JUL ᐊᓪᓚᐃ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑦᑐᓗ	NOV ᐅᓇᓵᕆᓗ	DEC ᑎᓯᕆᓗ	JAN ᔮᖅᓇᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᔪ	APR ᐃᔨᓪᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	22	14	35	11	33	22	16	8	21	38	25	17	106
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait					1					2			3
Moose	ᑐᑦᑐᕐᐃᑦ	Tuktuvait									1				1
Tundra grizzly	ᐊᑦᓪᓗᐃᑦ	Akhait				1									1
Wolf	ᐊᒪᖁᐃᑦ	Amagut						3		2	4	5	3	2	15
Arctic fox	ᑎᓗᒃᑑᐊᑦ	Tigiganiat						6	2	6	4	7	2		20
Coloured fox	ᖃᐅᓐᖑᑦᑐᑦ ᑎᓗᒃᑑᐊᑦ	Kalaliit tigiganiat						6	2	5	4	8	2		21
Wolverine	ᖃᑦᕃᑦ	Kalvik					1	4	1	2	4	12	2		18
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik						2		2		2			5
Arctic ground squirrel	ᓱᖅᓯᑦ	Hikhik			4	3							1		6
Seals (unspecified)	ᓱᖓᐅᓪᓕᑦ	Natiit												2	2
Ringed seal	ᓇᑦᓯᑦ	Natiinat	4	1	6	8	2		2		3		1		17
Bearded seal	ᐅᓘᔪᐃᑦ	Ukyuk		1											1
Beluga	ᖃᐅᑦᑕ ᖁᓪᓚᑦ	Kilalugak		3											3
Snow goose	ᑲᖏᒍᑦ	Kanguq	2											1	3
Canada goose	ᓄᑦᓪᓕᑦ ᐅᓪᐊᒍᓪᓕᑦ	Nikliknik	22		5	3								25	37
White-fronted goose	ᓄᑦᓪᓕᑦ	Nirlivik			1									2	3
Old squaw	ᐊᓕᑭᐊᑦᔪᐃᑦ	Aahangik				1									1
Pintail	ᖃᓄᓕᒋᐊᓪᓚᑦ	Arnaviaq	1												1
Eider duck	ᑎᑎᑦ	Kingalik	5		1		1								7
Tundra swan	ᖃᓄᔪᐃᑦ	Kukyuk			2									3	5
Arctic loon	ᑲᓘᓪᓕᑦ	Maliriq				2	1								2
Ptarmigan	ᐊᖏᓂᑦ	Akilgik										1			1
Goose eggs	ᑲᖏᒍᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit	9												9
Duck eggs	ᑎᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	1												1
Arctic char	ᐃᖅᓗᓂᐲᑦ	Ikaliviit	33	15	29	12	10	5						1	68
Lake trout	ᐃᓕᕋᐃᑦ	Ikalukpik	2		5	1	2	2		1		8	7	8	25
Arctic grayling	ᓕᓗᓂᐸᐅᒪᐃᑦ	Hulupaugaq	3		1										4
Whitefish	ᑲᐱᓕᓪᓕᑦ	Kapihiliit	7	1	3	6	10	3		1	1	1	1		24
Cod	ᐅᒪᐃᑦ	Ugak		1	1	2	3	6					1		12

6.2.5

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 415

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᑦᓴᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑦᔪᓗ	NOV ᐅᓇᓱᓗ	DEC ᑎᓯᓱᓗ	JAN ᔮᖏᓇᓗ	FEB ᐃᖅᑐᓇᓗ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓪᓕ Tamakiklugin ± 95% CI
Species	ᐅᒪᐊᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	15	86	93	46	117	151	54	101	225	163	277	134	1,462 ± 137
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait				1	2	3							6 ± 6
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡							3						
Tundra grizzly	ᐊᑦᓪᓚᐃᑦ	Akhait	6												6 ± 7
Wolf	ᐊᒪᕐᕈᐃᑦ	Amagut						1	3	7	28	11	7		57 ± 18
Arctic fox	ᑎᓗᒃᑲᓂᐊᑦ	Tigiganiat						4	55	11	60	1			131 ± 67
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓗᒃᑲᓂᐊᑦ	Kalaliit tigiganiat						32	18	22	39	14	6		131 ± 31
Muskrat	ᐊᐱᖓᒃᓴᓪᓚᐊᑦ	Kivgaluk					1								1 ± 0
Wolverine	ᖃᑦᕕᒃ	Kalvik					2	11	14	45	20	6	6		104 ± 30
Arctic hare	ᐅᖃᓕᑦ	Ukalik					3				1				4 ± 2
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			18	37								82	137 ± 37
Seals (unspecified)	ᓱᖅᑯᓕᑦ	Natiit	3	4	181	115	15	9	5		3		22	15	372 ± 185
Bearded seal	ᐅᓚᐊᕐᓴᑦ	Ukyuk			2										2 ± 2
Geese (unspecified)	ᓄᖅᓕᑦ	Kanguk						14 ± 16							
Snow goose	ᑲᖏᒍᑦ	Kanguq	11											3	14 ± 16
Canada goose	ᓄᖅᓕᑦ ᐅᓗᐊᒍᓕᑦ	Nikliknik	102		26									843	971 ± 238
White-fronted goose	ᓄᖅᓕᑦ	Nirlivik	7	2	7									7	23 ± 18
Eider duck	ᒥᑎᑦ	Kingalik	19											3	22 ± 26
Tundra swan	ᖁᓘᓕᐃᑦ	Kukyuk												27	27 ± 40
Common loon	ᑐᓪᓗᓕᐊᑦ	Tuulik				24									24 ± 35
Arctic loon	ᑲᓗᓗᓐ	Maliriq				1									1 ± 1
Yellow-billed loon	ᑐᓪᓗᓕᐊᑦ	Tuulik				3									3 ± 2
Thick-billed murre	ᐊᑦᕿᐃᑦ	Thick-billed murre				1									1 ± 1
Ptarmigan	ᐊᖏᓚᑦ	Akilgik					14	7	3		16	15		43	98 ± 70
Goose eggs	ᑲᖏᒍᑦ ᒪᓂᖅᖢᑦ	Uluaguliit manniit	19											107	126 ± 88
Tundra swan eggs	ᖁᓘᓕᐃᑦ ᒪᓂᖅᖢᑦ	Kukyut manniit	11												11 ± 15
Arctic char	ᐃᖃᓗᒃᑕᑦ	Ikaliviit	116	616	1,194	599	5,742	692							8,959 ± 1,378
Lake trout	ᐃᓱᖁᔭᐃᑦ	Ikalukpik	11				33	58		6	8	43	112	145	416 ± 135
Arctic grayling	ᓱᓗᒃᐸᐅᒪᐃᑦ	Hulupaugaq			160	55	1								216 ± 249
Whitefish	ᑲᐱᓂᓕᑦ	Kapihiliit			157	80	1,329	964	13		57		87	21	2,708 ± 534
Burbot	ᑎᒃᑕᓗᒃ	Tiktaaliq					1								1 ± 0
Arctic cisco	ᐅᑭᐅᖅᑐᒥ ᑲᐱᓂᓕᑦ	Kapihilik			7										7 ± 10
Cod	ᐅᒪᐃᑦ	Ugak			24	3		305	23		78	71	31		535 ± 189

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᐃᑦ ᑎᑎᕋᐅᒪᓂᑦ ᑐᓂᓯᖏᑦ ᐅᓂᒃᑳᖓᓂᒃᑯᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 416

Monthly hunter response

ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓚᑲᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)

ᐊᒻᒪᓗᒍ 2 (ᔮᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᓐ/Tatkia			JUN ᔮᓂ	JUL ᔮᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᕐᓇᓗ	OCT ᐅᑐᐃᓇᓗ	NOV ᐅᐊᕐᓇᓗ	DEC ᑎᓯᕐᓇᓗ	JAN ᔨᖏᓚᐃᓇᓗ	FEB ᐃᖅᑲᐃᓇᓗ	MAR ᒪᕐᓯ	APR ᐃᓴᓕᓂ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓚᑲᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔨᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓚᑲᑎᑦ	Tatkitaman angunahuktut titigait	269	269	268	255	250	250	250	254	255	255	250	249	273*
Interview list	ᐊᐱᕐᓂᖅᓱᐃᑦ	Apikiktan	182	182	181	168	163	164	165	169	170	171	166	166	186*
Hunters interviewed	ᐊᖏᔪᓚᑲᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	107	110	109	160	158	127	123	142	133	147	130	130	182*
Harvested	ᐊᖏᔪᓚᑲᑎᑐᒋᓐ	Angujaujut	14	32	32	30	49	47	17	25	41	28	38	47	118*
Response rate (%)	ᑭᐅᔭᓂ ᖃᓄᐃᑐᓂᖏᑦ (%)	Kiujut (%)	59	60	60	95	97	77	75	84	78	86	78	78	77**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓚᑲᑎᑦ ᐊᑎᓕᐅᑦᑕᒪᓕᕆᓂᖅ/ᐊᐱᕐᓂᑦᑕᒪᓕᕆᓂᖅ/ᐊᖏᔪᓚᑲᑎᑐᒋᓐᓂᑦ ᐊᑕᐅᓯᐊᓘᓕᐅᑎᑦ ᐊᒻᒪᔪᑎ.
** ᐊᐅᔨᓂᑎᓯᒪᓕᕆᑦ ᑕᖃᑦᑕᒪᑦ ᑭᐅᔭᓂ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 417

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔭᑦ ᐊᑯᑦᖏᓂ ᐊᖏᔪᓯᓂᖓᓪᓚᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓪᓚᑕ, ᓇᓗᓇᐃᕐᑕ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓚᑲᑎᑦᑕ ᑎᑎᕐᑦᑕᐅᒪᔭᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)

ᐊᒻᒪᓗᒍ 2 (ᔮᓂ 1997 - ᒪᐃ 1998)

Ukiunga (June 1997 - May 1998)

Month/ᑕᖃᖏᓐ/Tatkia			JUN ᔮᓂ	JUL ᔮᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᕐᓇᓗ	OCT ᐅᑐᐃᓇᓗ	NOV ᐅᐊᕐᓇᓗ	DEC ᑎᓯᕐᓇᓗ	JAN ᔨᖏᓚᐃᓇᓗ	FEB ᐃᖅᑲᐃᓇᓗ	MAR ᒪᕐᓯ	APR ᐃᓴᓕᓂ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔭᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 418

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓚᐸᑎᑦ ᐊᖓᔪᓚᐸᓯᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᑦᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 2 (June 1997 - May 1998)
ᐊᒃᑭᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓱᑎᐹᓗ	OCT ᐅᑦᐹᓗ	NOV ᐅᓇᒃᐸᓗ	DEC ᑎᓯᐹᓗ	JAN ᒍᖏᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᑉᓯ	APR ᐃᑦᓇᓪᓚ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	4	26	20	18	26	27	11	19	35	23	35	26	88
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait				1	1	1							3
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᑦᓪᓚᐃᑦ	Akhait	2												2
Wolf	ᐊᒪᕐᐃᑦ	Amagut						1	1	1	6	5	2		10
Arctic fox	ᑎᓗᒃᑑᓕᐊᑦ	Tigiganiat						3	4	4	5	1			13
Coloured fox	ᖃᐅᓕᖅᑐᑦ ᑎᓗᒃᑑᓕᐊᑦ	Kalaliit tigiganiat						9	3	4	10	2	1		18
Muskrat	ᐊᒪᓕᖅᓴᓪᔪᐊᑦ	Kivgaluk					1								1
Wolverine	ᖃᑦᕕᒃ	Kalvik					2	6	4	7	7	3	2		21
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik					1				1				2
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik			1	2								24	
Seals (unspecified)	ᓱᓕᔪᓚᑦ	Natiit	1	1	8	8	3	3	2		1		2	4	20
Bearded seal	ᐅᓗᔪᐃᑦ	Ukyuk			1										1
Geese (unspecified)	ᓂᔨᓚᑦ	Kanguk												1	1
Snow goose	ᑲᖏᒍᐃᑦ	Kanguq	1											1	2
Canada goose	ᓂᔨᓚᑦ ᐅᓪᐊᒍᓚᑦ	Nikliknik	2		1									32	33
White-fronted goose	ᓂᔨᓚᑦ	Nirlivik	1	1	1									1	4
Eider duck	ᒥᑎᑦ	Kingalik	1											1	2
Tundra swan	ᖁᓗᔪᐃᑦ	Kukyuk												2	2
Common loon	ᑐᓪᓚᓗᔪᐊᑦ	Tuulik				1									1
Arctic loon	ᒪᓗᓪᓚᒃ	Maliriq				1									1
Yellow-billed loon	ᑐᓪᓚᓗᔪᐊᑦ	Tuulik				1									1
Thick-billed murre	ᐊᑦᔪᐃᑦ	Thick-billed murre				1									1
Ptarmigan	ᐊᖏᓕᑦ	Akilgik					1	1	1		1	1		1	4
Goose eggs	ᑲᖏᒍᐃᑦ ᒪᓕᓂᖅᑦ	Uluaguliit manniit	1											2	3
Tundra swan eggs	ᖁᓗᔪᐃᑦ ᒪᓕᓂᖅᑦ	Kukyut manniit	1												1
Arctic char	ᐃᖃᓗᒃᓴᑦ	Ikaliviit	3	11	20	14	39	7							56
Lake trout	ᐃᓱᒡᕆᐃᑦ	Ikalukpik	1				4	3		3	1	4	2	4	17
Arctic grayling	ᓱᓗᒃᐸᐅᒪᐃᑦ	Hulupaugaq			2	1	1								4
Whitefish	ᑲᐱᓯᓂᑦ	Kapihiliit			4	4	18	17	1		2		1	1	38
Burbot	ᑎᒃᑕᓗᒃ	Tiktaaliq					1								1
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᐱᓯᓂᑦ	Kapihilik			1										1
Cod	ᐅᓴᐃᑦ	Ugak			4	1		6	1		4	2	1		16

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔨᓂᒃ ᐱᑕᖃᖅᑐᑐᒃ ᐱᓪᔨᐊᑎᓕᓂᒃ ᐊᖏᔪᒃ ᖃᑦᓯᐅᓂᖏᓕᓂᑦ ᐊᓕᖁᐅᒪᔨᔨᓂᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᕐᓂᒃ ᑐᓂᓯᖅᑐᓂ ᑐᓂᓯᖅᑐᓂ ᐃᑯᐱᕐᓚᓂᓵᓪᓕᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.2.5

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 419

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓕᒃᑎᑦ
Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᓐᓴᒍ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᓗᓂ	OCT ᐅᑲᐱᓗᓂ	NOV ᐅᓇᓚᐱᓗᓂ	DEC ᑎᓱᓚᐱᓗᓂ	JAN ᔮᖏᓇᐊᓗᓂ	FEB ᓇᖕᖏᐊᓗᓂ	MAR ᒪᕐᓱ	APR ᐃᑲᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	107	128	112	108	138	108	103	128	271	254	287	169	1,913 ± 155
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait		1			7	2							10 ± 6
Moose	ᑐᑐᓂᐃᑦ	Tuktuvait										1	1		2 ± 1
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡							1						
Tundra grizzly	ᐊᑦᓯᐃᑦ	Akhait		3										1	4 ± 2
Wolf	ᐊᒪᕐᐃᑦ	Amagut					5	12	5	7	7	30	27		93 ± 14
Arctic fox	ᑎᓚᖏᓂᐊᑦ	Tigiganiat						16	2	21	7	7			53 ± 26
Coloured fox	ᖃᓄᖕᖏᑐᑦ ᑎᓚᖏᓂᐊᑦ	Kalaliit tigiganiat						5	13	7	21	9	2		57 ± 14
Wolverine	ᖃᓴᐃᑦ	Kalvik						9	2	9	27	22	9		78 ± 16
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik		116	132	9		1					16	89	363 ± 292
Seals (unspecified)	ᓱᖃᓄᑦ	Natiit	2	29	140	23	52	6			1				253 ± 103
Ringed seal	ᓇᕐᓱᑦ	Natiinat										1	2	4	7 ± 5
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		1											1 ± 1
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit					1								1 ± 1
Geese (unspecified)	ᓄᖅᓯᑦ	Kanguk	32												32 ± 39
Snow goose	ᑲᖏᐃᑦ	Kanguq	10											9	19 ± 18
Canada goose	ᓄᖅᓯᑦ ᐅᓗᐊᔪᓯᑦ	Nikliknik	35	2										1,121	1,158 ± 328
White-fronted goose	ᓄᖅᓯᑦ	Nirlivik												112	112 ± 82
Old squaw	ᐊᑎᐊᖅᔪᐃᑦ	Aahangik	18												18 ± 21
Eider duck	ᒥᑎᑦ	Kingalik	56	3		4									63 ± 39
Tundra swan	ᖁᓕᔪᐃᑦ	Kukyuk	7											36	43 ± 29
White-winged scoter	ᖃᓄᖅᓯᓗᒃ ᐃᓕᓴᐊ ᐱᖅᓱᐅᓯᖅᓯᒃ	White-winged scoter				4									4 ± 3
Arctic loon	ᑲᑦᓗᓗᒃ	Maliriq		1											1 ± 1
Ptarmigan	ᐊᖏᓚᑦ	Akilgik					26		21	31	149	24	62	1	314 ± 151
Goose eggs	ᑲᖏᐃᑦ ᒪᓂᖅᑦ	Uluaguliit manniit	48												48 ± 58
Duck eggs	ᒥᑎᑦ ᒪᓂᖅᑦ	Tinmiat manniit	51												51 ± 62
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓂᖅᑦ	Nauyat manniit	2												2 ± 2
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	665	618	987	518	2,813	2,439		2					8,042 ± 1,688
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	4	126			73	94	15		6	208	305	122	953 ± 202
Whitefish	ᑲᐱᓱᓂᓪ	Kapihiliit	69	170	122	98	1,611	342	236	260	418	6	6		3,338 ± 1,152
Burbot	ᑎᑦᑕᓗᒃ	Tiktaaliq										6			6 ± 4
Cod	ᐅᒪᐃᑦ	Ugak		31	92	9		66	157	60	138	8	49		610 ± 204

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᓄᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᔨᖏᑦ ᐅᓂᒃᑖᓄᑦ ᐃᓄᐃᕐᓂᐊᕐᓂᖅᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᐅᐃᓕᐅᑦ/NAUNAIKUTA 420

Monthly hunter response

ᑕᖅᑕᒧᑦ ᐊᖏᓐᓇᓂᑦ ᑭᐅᓂᖅᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᑦᖁᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᑐᒃᑐᑎ	SEP ᓯᑎᕆᐊᓕ	OCT ᐅᑲᐃᓕ	NOV ᐅᓇᑦᐊᓕ	DEC ᑎᓯᕆᐊᓕ	JAN ᔮᓐᓇᐊᓕ	FEB ᐃᖅᑲᐊᓕ	MAR ᒪᕐᕿ	APR ᐃᑦᓗᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓐᓇᓂᑦ ᑭᐅᓂᖅᑎᑦ ᐋᑦᔨᓯᒪᓂᖅᑎᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑯᑦ ᐊᖏᓐᓇᓂᑦ	Tatkitaman angunahuktut titigait	252	252	249	249	251	252	253	253	254	251	252	250	266*
Interview list	ᐊᐱᕐᓂᖓᓐᓇᐃᑦ	Apikiktan	167	167	163	163	164	163	164	164	165	162	163	163	177*
Hunters interviewed	ᐊᖏᓐᓇᓂᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	124	139	132	139	139	136	131	140	126	135	135	122	176*
Harvested	ᐊᖏᓐᓇᓂᑐᒋᓐ	Angujaujut	35	49	47	40	52	35	27	39	50	45	48	57	123*
Response rate (%)	ᑭᐅᔾᔨ ᖃᑦᑕᐅᓂᖅᑎᑦ (%)	Kiujut (%)	74	83	81	85	85	83	80	85	76	83	83	75	81**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓐᓇᓂᑦ ᐊᑎᓕᐅᑦᑕᐅᒪᓕᒃᑲᓂᖅ/ᐊᐱᕐᓂᑦᑕᑦ/ᐊᖏᓐᓇᓂᑐᒋᓐ ᐊᑕᐅᓯᐊᖃᓕᕐᑎᑐᖅ ᐊᓂᖁᒍ.
** ᐊᓂᔨᓕᓐᓂᓯᒪᓕᒃ ᑕᖅᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᐅᐃᓕᐅᑦ/NAUNAIKUTA 421

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᓕᒃ ᐊᑯᕐᓂᑐᖓᓐᓂᑕ ᐊᓚᓗ ᐊᐱᕐᓂᑕᐅᓂᖅᑎᑕ, ᐅᓗᐅᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᒪᔨᑦ ᐊᖏᓐᓇᓂᖅᑕ ᑎᑎᕐᕕᐅᒪᓕᒃᑲᓂᖅ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐊᑦᖁᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1998)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᑐᒃᑐᑎ	SEP ᓯᑎᕆᐊᓕ	OCT ᐅᑲᐃᓕ	NOV ᐅᓇᑦᐊᓕ	DEC ᑎᓯᕆᐊᓕ	JAN ᔮᓐᓇᐊᓕ	FEB ᐃᖅᑲᐊᓕ	MAR ᒪᕐᕿ	APR ᐃᑦᓗᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᓕᒃ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑲ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑲ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 422

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓚᓯᓴᒋᑦ ᐊᖏᓚᓯᓴᕿᓯᑦ ᐊᑐᓂᓵ ᐅᒪᔨᓂᓵ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 3 (June 1998 - May 1999)
ᐊᓐᔪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓕ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐃᓄᐃᓗ	DEC ᑎᓯᓗ	JAN ᒍᖏᓄᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᔨ	APR ᐃᔨᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	27	39	29	30	34	22	19	29	39	38	44	32	104
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait		1			4	2							7
Moose	ᑐᑦᑐᓀᐃᑦ	Tuktuvait										1	1		2
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᑦᓯᐃᑦ	Akhait		2										1	3
Wolf	ᐊᒪᖏᐃᑦ	Amagut					2	5	3	1	3	9	10		18
Arctic fox	ᑎᓗᒃᑑᐊᑦ	Tigiganiat						2	1	6	3	2			9
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓗᒃᑑᐊᑦ	Kalaliit tigiganiat						2	5	2	6	3	1		12
Wolverine	ᖃᐅᕕᑦ	Kalvik						3	2	4	9	9	5		20
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik		1	2	1		1					2	1	8
Seals (unspecified)	ᓱᖃᓄᓪᓕᑦ	Natiit	1	3	6	5	6	1			1				18
Ringed seal	ᓇᑦᓱᑦ	Natiinat										1	2	2	5
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		1											1
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit					1								1
Geese (unspecified)	ᓂᕐᓂᑦ	Kanguk	1												1
Snow goose	ᑲᖏᐃᑦ	Kanguq	1											3	4
Canada goose	ᓂᕐᓂᑦ ᐅᓗᐊᔨᓂᑦ	Nikliknik	4	1										43	46
White-fronted goose	ᓂᕐᓂᑦ	Nirlivik												7	7
Old squaw	ᐊᑭᑎᖅᔪᐃᑦ	Aahangik	1												1
Eider duck	ᒥᑎᑦ	Kingalik	3	1		1									5
Tundra swan	ᖁᓕᔪᐃᑦ	Kukyuk	2											7	8
White-winged scoter	ᖃᓄᖅᓯᓕᒃ ᐃᓕᓴᐊ ᐱᕐᓂᐅᓯᕐᓂᒃ	White-winged scoter				1									1
Arctic loon	ᑲᑦᓗᓕᒃ	Maliriq		1											1
Ptarmigan	ᐊᖏᑭᑦ	Akilgik					2		1	2	5	2	3	1	9
Goose eggs	ᑲᖏᐃᑦ ᓚᒃᓂᖅᑦ	Uluaguliit manniit	1												1
Duck eggs	ᒥᑎᑦ ᓚᒃᓂᖅᑦ	Tinmiat manniit	1												1
Seagull eggs	ᓇᐅᔨᐃᑦ ᓚᒃᓂᖅᑦ	Nauyat manniit	1												1
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	13	23	27	18	26	16		1					67
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	2	5			2	5	1		1	9	9	6	27
Whitefish	ᑲᐱᓯᓂᕐ	Kapihiliit	3	5	6	4	13	6	3	5	7	1	1		34
Burbot	ᑎᑭᓪᓗᒃ	Tiktaaliq										1			1
Cod	ᐅᒪᐃᑦ	Ugak		2	3	1		3	3	2	4	3	2		17

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᒪᔪᓂᒃ ᐱᕕᖃᖅᑐᑎᒃ ᐱᓕᕆᓚᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᕆᑦ ᐊᖏᔪᓄᑦ ᓇᓪᓕᐅᑎᓪᓗᒍ ᑐᓂᔭᖏᓐᓄᓕᒫᑦ ᐃᓄᐃᑦᓯᒪᓕᕆᓂᖅᓴᓕᒃ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 423

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)
ᐊᓐᖁᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

6.2.5

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᐱᓇ	OCT ᐅᑦᔪᓇ	NOV ᐅᓇᓱᓇ	DEC ᑎᓯᓱᓇ	JAN ᔮᖏᓐᓇᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	70	99	239	73	106	131	33	191	174	78	150	240	1,584 ± 134
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait					1	1				3			5 ± 4
Moose	ᑐᑐᔾᐃᑦ	Tuktuvait		1							1				2 ± 2
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡							1						
Tundra grizzly	ᐊᑦᓕᐃᑦ	Akhait			3										3 ± 4
Wolf	ᐊᒪᔪᐃᑦ	Amagut					3	15	7		7	18	31	2	83 ± 24
Arctic fox	ᑎᓗᒃᑑᓕᑦ	Tigiganiat						6	1	2	1	2			12 ± 6
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓗᒃᑑᓕᑦ	Kalaliit tigiganiat						13	19	11	15				58 ± 12
Muskrat	ᐊᐱᖅᓴᕐᔪᐊᑦ	Kivgaluk	3			1								44	48 ± 56
Wolverine	ᖃᕐᕕᐃᑦ	Kalvik					1	5	12	12	14	6	10		60 ± 10
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik						1		1			1		3 ± 2
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			23	286	15						44	65	433 ± 350
Seals (unspecified)	ᓱᖏᑦᓚᓪᓚᑦ	Natiit											1		1 ± 2
Ringed seal	ᓇᓱᑦ	Natiinat	10	5	118	100	19	3	2						257 ± 108
Bearded seal	ᐅᓘᔪᐃᑦ	Ukyuk	1	1											2 ± 1
Geese (unspecified)	ᓄᖅᓚᑦ	Kanguk												12	12 ± 19
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq				3								8	11 ± 8
Canada goose	ᓄᖅᓚᑦ ᐅᓗᐊᔪᓚᑦ	Nikliknik	440	10	3	13								780	1,246 ± 385
Ross's goose	ᖃᕆᖅᔪᐃᑦ	Kakat	3												3 ± 4
Brant goose	ᓄᖅᓕᖅᓴᐃᑦ	Nirlirnaq	5			3									8 ± 5
White-fronted goose	ᓄᖅᓚᑦ	Nirlivik	9			1								27	37 ± 31
Pintail	ᖁᓕᒪᐊᔨᑦ	Arnaviaq												3	3 ± 4
Eider duck	ᒥᑎᑦ	Kingalik	19				13							3	35 ± 17
Tundra swan	ᖁᓕᔪᐃᑦ	Kukyuk	2											31	33 ± 31
Common merganser	ᐸᐃᖅ	Nuyaralik		19											19 ± 18
Red breasted merganser	ᑲᐅᓕᖕᒍᑦ	Red breasted merganser			11										11 ± 10
Lesser scaup	ᒥᑭᓂᖏᑦ ᒥᑎᑦ ᐊᐃᐸᔨᖏᑦ	Lesser scaup				3									3 ± 2
Loon (unspecified)	ᑐᓴᓪᓚᑦ	Maligik				5									5 ± 4
Common loon	ᑐᓴᓕᔪᐊᑦ	Tuulik	5												5 ± 8
Arctic loon	ᑲᓕᓂᓵ	Maliriq					13								13 ± 13
Yellow-billed loon	ᑐᓴᓕᔪᐊᑦ	Tuulik	2												2 ± 2

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Month/ᑕᕆᔨ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐸᕆ	OCT ᐅᑐᐱᕆ	NOV ᐅᓇᓚᕆ	DEC ᑎᓯᐱᕆ	JAN ᔭᓐᓄᐊᕆ	FEB ᓇᖏᐊᕆ	MAR ᒪᕐᓯ	APR ᐃᖅᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᒃ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᒃ	**Umajuin**													
Ptarmigan	ᐊᖏᓚᒃ	Akilgik				10	11	42	16	24	7	13		20	143 ± 57
Sandhill crane	ᑕᑎᓚᖅᓴᐊᒃ	Tatilgaq				3								7	10 ± 7
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᓕᐊᒃ ᒪᓐᓂᖏᑦ	Manniit												32	32 ± 53
Goose eggs	ᐅᖕᒪᐃᒃ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	159												159 ± 182
Duck eggs	ᒥᑎᒃ ᒪᓐᓂᖏᑦ	Tinmiat manniit	112	37											149 ± 128
Arctic char	ᐃᖅᓗᓵᓴᒃ	Ikaliviit	560	927	941	574	7,810	645						20	11,477 ± 3,125
Lake trout	ᐃᓯᕐᓴᒃ	Ikalukpik		57	57		52	145	10	30	14	176	536	137	1,214 ± 317
Northern pike	ᓯᖏᔪᓪᒃ	Hiulik	3												3 ± 4
Arctic grayling	ᓯᓗᓵᐸᐅᒪᐃᒃ	Hulupaugaq					3								3 ± 3
Whitefish	ᖃᐱᓯᓪᓚᒃ	Kapihiliit	49	14	219	101	850	871			1				2,105 ± 621
Burbot	ᑎᑦᑕᓗᒃ	Tiktaaliq			1										1 ± 1
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᖃᐱᓯᓪᓚᒃ	Kapihilik					3								3 ± 5
Least cisco	ᒥᑭᓂᖅᑐ ᖃᐱᓯᓪᓚᒃ	Eetuuk				3									3 ± 2
Inconnu	ᖃᐱᓯᓪᓴᐸᐃᒃ	Aanakhiik			264										264 ± 260
Cod	ᐅᓚᐃᒃ	Ugak		84	83	17	178	666	7		155				1,190 ± 422

‡ Polar bear data supplied by DSD.

‡ ᓇᓕᔪᓂᒃ ᑎᑎᕐᑕᒪᓴᑦ ᑐᓂᓯᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓚᓵᓕᒃ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.2.5

TABLE/ᓇᓗᓇᐃᔅᐅᑦ/NAUNAIKUTA 424

Monthly hunter response

ᑕᕆᑕᒻᒥᑦ ᐊᖏᔪᓂᓴᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)

ᐊᓐᖏᒍ 4 (ᔪᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᕆᔨ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐸᕆ	OCT ᐅᑐᐱᕆ	NOV ᐅᓇᓚᕆ	DEC ᑎᓯᐱᕆ	JAN ᔭᓐᓄᐊᕆ	FEB ᓇᖏᐊᕆ	MAR ᒪᕐᓯ	APR ᐃᖅᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᒃ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᓴᑦ ᑭᐅᓂᖏᑦ ᐊᓚᔨᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᕆᑕᒻᒥᑦ ᐊᖏᔪᓂᓴᑦ	Tatkitaman angunahuktut titigait	253	256	257	252	252	253	253	252	252	250	248	249	269*
Interview list	ᐊᐱᔨᓯᕐᓴᐃᒃ	Apikiktan	166	169	169	164	164	165	165	164	164	162	160	162	181*
Hunters interviewed	ᐊᖏᔪᓂᓴᑦ ᐊᐱᔨᓯᕐᑕ	Angunahuktin apikhuktan	143	137	133	142	125	137	150	134	141	105	112	108	173*
Harvested	ᐊᖏᔪᓂᓴᑐᑎᓂᓪᓕ	Angujaujut	54	55	64	44	60	52	15	37	36	20	33	54	128*
Response rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	86	81	79	87	76	83	91	82	86	65	70	67	79**

* Hunters registered/interviewed/harvested at least once during the year.

** Mean monthly response rate.

* ᐊᖏᔪᓂᓴᑦ ᐊᑎᓕᐅᑦᑕᐅᒪᓕᕆᓂᖅ/ᐊᐱᔨᓯᕐᑕᑦ/ᐊᖏᔪᓂᓴᑐᑎᓂᓪᓕ ᐊᑕᐅᓯᐊᓗᐃᑎᒃ ᐊᑭᔪᒥ.

** ᐊᓕᔅᓯᓂᖅᒪᓕᕆᓂᖅ ᑕᕆᑕᒻᒥᑦ ᑭᐅᓂᖏᑦ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.

** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 425

Recall period between harvest and interview, expressed as % of total harvest records — Year 4 (June 1999 - May 2000)

ᐅᑎᕆᐃᐅᔪᑦ ᐊᑯᖏᓐᓂ ᐊᖓᔪᓚᐅᖏᓐᓇᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓯᑦᑕᐅᓂᖏᓐᓇᑕ, ᓇᓗᓇᐃᑦᑕ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖓᔪᓚᕆᑦ ᑎᑎᕆᑦᑕᐅᒪᔪᑦ — ᐊᒻᒪᓕᒐ 4 (ᔦᓂ 1999 - ᒪᐃ 2000)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut — Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔦᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒧᑎ	SEP ᓯᑎᒻᒪᓕ	OCT ᐅᑲᐃᓕ	NOV ᐅᐊᒻᒪᓕ	DEC ᑎᓯᒻᒪᓕ	JAN ᔮᖅᓄᐊᓕ	FEB ᐃᕐᑲᐊᓕ	MAR ᒪᕐ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕆᐃᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	99	96	94	94	99	99
4-6 months	4-6 ᑕᖅᑲᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	4	0	0	0	0
> 6 months	> 6 ᑕᖅᑲᑦ	> 6 tatkin	0	0	0	0	0	0	0	1	0	6	6	1	1

6.2.5

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 426

Number of hunters harvesting each species — Year 4 (June 1999 - May 2000)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᒻᒪᓗᓯᒃᑎᑦ ᐊᒻᒪᓗᓯᒃᓴᓪᓗᑦ ᐊᑐᓂᒃ ᐅᒪᔪᑦᓂᒃ — ᐊᒻᒪᓕᒐ 4 (ᔦᓂ 1999 - ᒪᐃ 2000)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔦᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒧᑎ	SEP ᓯᑎᒻᒪᓕ	OCT ᐅᑲᐃᓕ	NOV ᐅᐊᒻᒪᓕ	DEC ᑎᓯᒻᒪᓕ	JAN ᔮᖅᓄᐊᓕ	FEB ᐃᕐᑲᐊᓕ	MAR ᒪᕐ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑭᐃᑦ	Tuktut	26	34	49	24	26	28	7	33	30	13	23	43	105
Musk-ox	ᐅᒥᓴᒪᑦ	Umingmait					1	1				1			3
Moose	ᑐᑭᓯᐃᑦ	Tuktuvait		1							1				2
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐸᑦᓪᐃᑦ	Akhait			1										1
Wolf	ᐊᒪᕐᐃᑦ	Amagut					2	3	1		4	6	7	1	14
Arctic fox	ᑎᓗᒃᑐᓂᐊᑦ	Tigiganiat						1	1	2	1	1			4
Coloured fox	ᖃᓄᖕᖏᑦᑐᑦ ᑎᓗᒃᑐᓂᐊᑦ	Kalaliit tigiganiat						5	5	3	5				12

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Month/ᑕᕐᖑᓱ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐸᓗᓇ	OCT ᐅᑦᐃᓗᓇ	NOV ᓄᓇᕗᓗᓇ	DEC ᐱᓯᕗᓗᓇ	JAN ᒍᓐᓄᐊᓇ	FEB ᐃᕐᕿᐊᓇ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Muskrat	ᐊᐱᓐᖏᓪᓗᔪᐊᑦ	Kivgaluk	1			1								1	3
Wolverine	ᖃᑦᕃᑦ	Kalvik					1	3	5	7	9	4	5		16
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik						1		1			1		3
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			2	4	1						2	3	9
Seals (unspecified)	ᓱᖏᑯᓪᓚᑦ	Natiit											1		1
Ringed seal	ᓇᓕᓱᑦ	Natiinat	4	1	4	5	3	1	1						14
Bearded seal	ᐅᓗᔪᐃᑦ	Ukyuk	1	1											2
Geese (unspecified)	ᓄᓪᓚᓪᑦ	Kanguk												1	1
Snow goose	ᑲᖏᐃᑦ	Kanguq				1								3	4
Canada goose	ᓄᓪᓚᓪᑦ ᐅᓗᐊᔪᓚᓪᓚᑦ	Nikliknik	21	2	1	2								25	42
Ross's goose	ᖃᑦᓪᔪᐃᑦ	Kakat	1												1
Brant goose	ᓄᓪᓕᓪᓇᐃᑦ	Nirlirnaq	2			1									3
White-fronted goose	ᓄᓪᓚᓪᑦ	Nirlivik	2			1								2	3
Pintail	ᓴᓗᒪᐊᓪᓴᑦ	Arnaviaq												1	1
Eider duck	ᒥᑎᑦ	Kingalik	2				1							1	4
Tundra swan	ᑭᓗᔪᐃᑦ	Kukyuk	2											3	4
Common merganser	ᓴᐃᖅ	Nuyaralik		1											1
Red breasted merganser	ᑲᓕᖅᑐᑦ	Red breasted merganser			1										1
Lesser scaup	ᒥᑭᓂᖏᑦ ᒥᑎᑦ ᐊᐃᓪᓴᖏᑦ	Lesser scaup				1									1
Loon (unspecified)	ᑐᑦᓚᓪᑦ	Maligik				2									2
Common loon	ᑐᑦᓕᓗᔪᐊᑦ	Tuulik	1												1
Arctic loon	ᑲᓗᓕᓚᒃ	Maliriq					1								1
Yellow-billed loon	ᑐᑦᓕᓗᔪᐊᑦ	Tuulik	1												1
Ptarmigan	ᐊᕕᓱᑦ	Akilgik				1	1	2	1	2	1	1		2	6
Sandhill crane	ᑕᑎᓴᓪᔪᐊᑦ	Tatilgaq				1								2	2
Eggs (unspecified)	ᐊᓂᕐᖏᑦ ᑎᓗᒥᐊᑦ ᒪᓐᓂᕐᖏᑦ	Manniit												1	1
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓂᕐᖏᑦ	Uluaguliit manniit	4												4
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᕐᖏᑦ	Tinmiat manniit	2	1											3
Arctic char	ᐃᖃᓗᕆᐊᑦ	Ikaliviit	19	33	29	22	43	8						1	83
Lake trout	ᐃᓱᖅᓇᑦ	Ikalukpik		4	4		5	4	1	1	5	3	14	5	25
Northern pike	ᓴᓚᔪᓪᑦ	Hiulik	1												1
Arctic grayling	ᓱᓗᕆᐸᐅᒪᐃᑦ	Hulupaugaq					1								1
Whitefish	ᑲᐱᓴᓪᑦ	Kapihiliit	2	3	7	3	16	16			1				37
Burbot	ᑎᕆᓪᓗᒃ	Tiktaaliq			1										1
Arctic cisco	ᐅᑭᐅᑦᑐᔭᒥ ᑲᐱᓴᓪᑦ	Kapihilik					1								1
Least cisco	ᒥᑭᓂᖏᑦ ᑲᐱᓴᓪᑦ	Eetuuk				1									1
Inconnu	ᑲᐱᓴᓪᑦᐸᐃᑦ	Aanakhiik			1										1
Cod	ᐅᓘᐃᑦ	Ugak		5	6	2	5	9	1		3				24

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓴᓪᓚᓂᓐ ᐱᕈᖅᖏᑦᑐᖅ ᐱᓪᓯᑎᓪᓗᓂᓐ ᐊᖏᔪᑦ ᖃᖏᐅᓂᖏᓐᓂᑦ ᐊᓪᓚᕆᐅᒪᓪᓚᑦ ᐊᖏᔪᓂ ᓇᓪᑕᐊᓕᒫᓐᓂᑦ ᑐᓂᓴᖏᓐᓂ ᐃᓄᐃᕐᓂᓗᓂᒃ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 427

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᑎᓯᑎᑦ
Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᓐᖁᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

6.2.5

Month/ᑕᖅᑕᒪᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒡᒎᑎ	SEP ᓱᑎᑦᓴᓗ	OCT ᐅᑦᔪᓴᓗ	NOV ᐅᓇᓵᓴᓗ	DEC ᑎᓱᓴᓗ	JAN ᔮᖏᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	79	108	153	92	84	99	52	105	80	57	142	304	1,355 ± 125
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait				1	1				5	6			13 ± 4
Moose	ᑐᑐᕆᐃᑦ	Tuktuvait									1				1 ± 1
Tundra grizzly	ᐊᑦᓪᓗᐃᑦ	Akhait	7												7 ± 11
Wolf	ᐊᒪᖅᐃᑦ	Amagut						10	2	4		2	10	1	29 ± 8
Arctic fox	ᑎᓗᒃᑑᐊᑦ	Tigiganiat						72	139	162	73	2	14		462 ± 176
Coloured fox	ᖃᓄᖅᑭᑐᑦ ᑎᓗᒃᑑᐊᑦ	Kalaliit tigiganiat						10	26	16		1			53 ± 18
Muskrat	ᐊᐱᖅᓯᓪᓚᐊᑦ	Kivgaluk	1												1 ± 1
Wolverine	ᖃᐸᐃᑦ	Kalvik					2	21	12	4	11	29	8	1	88 ± 22
Arctic hare	ᐅᖃᓪᓗᑦ	Ukalik						1			7		3		11 ± 7
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik			120	177						7	10	37	351 ± 184
Seals (unspecified)	ᓱᖃᑯᓪᓗᑦ	Natiit		2	100	29		5		4					140 ± 39
Ringed seal	ᓇᕆᑦ	Natiinat			4	91	25	20			1		5	3	149 ± 43
Bearded seal	ᐅᑉᔪᐃᑦ	Ukyuk		1		1								1	3 ± 1
Snow goose	ᑲᖏᒍᑦ	Kanguq	14											7	21 ± 12
Canada goose	ᓄᕐᓪᓕ ᐅᓗᐊᒍᓪᓕ	Nikliknik	456	5	4									510	975 ± 202
White-fronted goose	ᓄᕐᓪᓕ	Nirlivik	7											124	131 ± 108
Eider duck	ᒥᑎᑦ	Kingalik	41			17								31	89 ± 56
Tundra swan	ᖁᑲᔪᐃᑦ	Kukyuk	9											4	13 ± 6
Common merganser	ᕿᐃᖅ	Nuyaralik		4											4 ± 3
Lesser scaup	ᒥᑭᓄᖅᑦ ᒥᑎᑦ ᐊᐃᑦᕿᖅᑦ	Lesser scaup				3									3 ± 1
Loon (unspecified)	ᑐᑦᓪᓕᑦ	Maligik	4												4 ± 3
Common loon	ᑐᑦᓪᓗᔪᐊᑦ	Tuulik				58									58 ± 24
Arctic loon	ᑲᑉᓗᓪᓴ	Maliriq				41	18								59 ± 17
Ptarmigan	ᐊᖏᓱᑦ	Akilgik						47		18	19	146	31	15	276 ± 161
Sandhill crane	ᑕᑎᓯᔪᐊᑦ	Tatilgaq	6												6 ± 3
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᒋᐊᑦ ᒪᓕᓂᖏᑦ	Manniit	352												352 ± 206
Goose eggs	ᑲᖏᒍᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit	124												124 ± 189
Arctic char	ᐃᖃᓗᒃᑲᑦ	Ikaliviit	486	880	1,002	570	5,346	608	1			9	1	158	9,061 ± 2,134
Freshwater fish (unspecified)	ᑕᓚᐅᖏᓪᓕᑐᒥ ᐃᖃᓗᐃᑦ	Tahinik Ikaluit	22												22 ± 14
Lake trout	ᐃᓱᕐᓴᑦ	Ikalukpik	12	148			69	55			5	147	363	231	1,030 ± 189
Arctic grayling	ᓱᓗᑦᐸᐅᒪᐃᑦ	Hulupaugaq			6	6	32								44 ± 22
Whitefish	ᑲᐱᓯᓂᑦ	Kapihiliit	14	65	110	75	2,329	342		194	346	101	196	13	3,785 ± 1,636
Burbot	ᑎᑦᑕᓂᑦ	Tiktaaliq					3								3 ± 4
Cod	ᐅᒪᐃᑦ	Ugak		94	71	2	3	76	40	89	60	29	121		585 ± 173

TABLE/ᐅᓗᐅᐃᓴᐅᐅᑦ/NAUNAIKUTA 428

Monthly hunter response

ᑕᖃᑦᒪᒃᑦ ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᓐᔦᒍ 5 (ᔨᓂᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᓱᓪ	OCT ᐅᑦᑐᓱᓪ	NOV ᐅᐊᕐᓱᓪ	DEC ᑎᓯᕐᓱᓪ	JAN ᔮᖅᓄᐊᓪ	FEB ᐃᖃᑲᐊᓪ	MAR ᒪᑉᕿ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᒪᒃᑦ ᐊᖏᔪᓂᕆᑦ	Tatkitaman angunahuktut titigait	254	252	250	249	248	245	247	250	249	250	252	249	263*
Interview list	ᐊᐱᕐᓂᖅᓱᐃᑦ	Apikiktan	167	165	162	161	160	157	159	162	161	162	164	161	175*
Hunters interviewed	ᐊᖏᔪᓂᕆᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	152	138	154	153	137	134	133	142	132	138	137	128	170*
Harvested	ᐊᖏᔪᓂᕐᒥᓂᓕᓂ	Angujaujut	45	53	68	39	51	32	18	38	32	23	35	59	126*
Response rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	91	84	95	95	86	85	84	88	82	85	84	80	86**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᕆᑦ ᐊᑎᓕᐅᕐᓯᒪᔪᑦ/ᐊᐱᕐᓂᖅᓱᓂᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᕐᒥᓂᓕᓂ ᐊᑕᐅᓯᐊᓗᓂ ᐊᑐᓂᑭ ᐊᓐᔦᒍ.
** ᐊᑭᓕᓕᑎᒋᓯᒪᔪᑦ ᑕᖃᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᐅᐃᓴᐅᐅᑦ/NAUNAIKUTA 429

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐋᑯᖏᓂᓄ ᐊᖏᔪᓂᖓᓂᒃᑕ ᐊᒪᒐᓗ ᐊᐱᕐᓂᑕᐅᓂᖏᓂᒃᑕ, ᐅᓗᐅᐃᖅᑕᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᕐᒥᑦ ᑎᑎᕐᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᓐᔦᒍ 5 (ᔨᓂᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᓱᓪ	OCT ᐅᑦᑐᓱᓪ	NOV ᐅᐊᕐᓱᓪ	DEC ᑎᓯᕐᓱᓪ	JAN ᔮᖅᓄᐊᓪ	FEB ᐃᖃᑲᐊᓪ	MAR ᒪᑉᕿ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑭᑦ	≤ tatkin pingahut	97	99	95	96	100	95	100	100	100	100	100	100	98
4-6 months	4-6 ᑕᖅᑭᑦ	tatkin hitaman 6nut	0	1	5	4	0	0	0	0	0	0	0	0	1
> 6 months	> 6 ᑕᖅᑭᑦ	> 6 tatkin	3	0	0	0	0	5	0	0	0	0	0	0	1

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 430

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓚᓯᒃᑎᑦ ᐊᖏᓚᓯᒃᓴᓕᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 5 (June 2000 - May 2001)

ᐊᒻᒋᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

6.2.5

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᒍᑎᒃ	SEP ᓯᑎᐹᓗ	OCT ᐅᑦᑐᓗ	NOV ᐅᓇᒻᐹᓗ	DEC ᑎᓯᒻᐹᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	23	31	45	20	19	15	9	25	15	11	24	35	100
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait				1	1				2	2			5
Moose	ᑐᑦᑐᕐᐃᑦ	Tuktuvait									1				1
Tundra grizzly	ᐊᑦᓕᐃᑦ	Akhait	1												1
Wolf	ᐊᒪᕈᐃᑦ	Amagut						3	1	2		1	3	1	7
Arctic fox	ᑎᓗᒃᑲᓂᐊᑦ	Tigiganiat						5	2	3	5	1	1		10
Coloured fox	ᖃᑯᓐᖑᑎᑦ ᑎᓗᒃᑲᓂᐊᑦ	Kalaliit tigiganiat						4	2	8		1			11
Muskrat	ᐊᐱᓐᖓᓕᔪᐊᑦ	Kivgaluk	1												1
Wolverine	ᖃᐅᕙᑦ	Kalvik					2	9	7	4	5	2	4	1	19
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik						1			3		1		4
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik			4	4						1	2	2	9
Seals (unspecified)	ᓱᖏᑯᓪᓚᑦ	Natiit		2	7	1		1		2					12
Ringed seal	ᓇᓱᑦ	Natiinat			1	9	4	3			1		1	1	15
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		1		1								1	3
Snow goose	ᑲᖏᒍᑦ	Kanguq	5											3	8
Canada goose	ᓄᖕᓪᓚᑦ ᐅᓗᐊᒍᓐᓪᓚᑦ	Nikliknik	18	1	3									27	37
White-fronted goose	ᓄᖕᓪᓚᑦ	Nirlivik	1											6	6
Eider duck	ᒥᑎᑦ	Kingalik	5			2								1	6
Tundra swan	ᖁᑲᔪᐃᑦ	Kukyuk	3											2	5
Common merganser	ᕿᐃᖅ	Nuyaralik		1											1
Lesser scaup	ᒥᕈᓂᖏᑦ ᒥᑎᑦ ᐊᐃᑦᕿᖓᑦ	Lesser scaup				1									1
Loon (unspecified)	ᑐᑦᓪᓚᑦ	Maligik	1												1
Common loon	ᑐᑦᓕᓗᔪᐊᑦ	Tuulik				2									2
Arctic loon	ᑲᑦᓗᓕᒃ	Maliriq				3	2								4
Ptarmigan	ᐊᖏᓚᑦ	Akilgik						1		1	1	4	3	2	9
Sandhill crane	ᑕᑎᓚᖁᔪᐊᑦ	Tatilgaq	1												1
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᓚᖕᓂᖏᑦ	Manniit	2												2
Goose eggs	ᑲᖏᒍᑦ ᓚᖕᓂᖏᑦ	Uluaguliit manniit	1												1
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	18	29	30	18	34	9	1			1	1	2	69
Freshwater fish (unspecified)	ᑕᓀᐅᖏᓂᕐᑐᒥ ᐃᖃᓗᐃᑦ	Tahinik Ikaluit	1												1
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	2	3			6	4			2	2	14	6	25
Arctic grayling	ᓱᓗᒃᐸᐅᒪᐃᑦ	Hulupaugaq			1	1	1								2
Whitefish	ᑲᐱᓱᓪᓚᑦ	Kapihiliit	2	9	6	5	21	9		4	7	3	2	1	39
Burbot	ᑎᑭᒡᓪᓚᑦ	Tiktaaliq					1								1
Cod	ᐅᒪᐃᑦ	Ugak		5	3	1	2	5	1	4	4	1	4		20

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 431

Annual harvest estimates and five-year mean

All Years (June 1996 - May 2001)

ᐊᓐᖁᔨᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓕᔾᔪᑎᑦ ᐊᓚᓗ ᑕᒻᓕᒪᓂᑦ-ᐊᓐᖁᔭᓂᑦ ᐊᐅᔾᔨᓕᕐᓂᓴᒪᓕᕆᑦ 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᓐᖁᔭᓂᑦ (ᔦᓂ 1996 - ᒪᐃ

Study Year/ᖃᐅᔨᓴᖅ ᐊᓐᖁᔭ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᔾᔨᕐᓂᓴᒪᓕᕆᑦ Amigaitkiyait
Species	ᐅᒪᓕᑦ	**Umajuin**						
Caribou[1]	ᑐᑐᐃᐸᑦ	Tuktut[1]	1,561	1,462	1,913	1,584	1,355	1,575
Musk-ox[2]	ᐅᒥᖓᒪᐃᐸᑦ	Umingmait[2]	5	6	10	5	13	8
Moose[3]	ᑐᑐᓂᐃᐸᑦ	Tuktuvait[3]	1	0	2	2	1	1
Polar bear[4]	ᓇᓂᐃᐸᑦ	Nanuit[4]	0	3	1	5	0	2
Tundra grizzly[5]	ᐊᒃᓪᐃᐸᑦ	Akhait[5]	1	6	4	3	7	4
Wolf[6]	ᐊᒪᖅᐃᐸᑦ	Amagut[6]	48	57	93	83	29	62
Arctic fox[7]	ᑎᓚᖏᓂᐊᑦ	Tigiganiat[7]	318	131	53	12	462	195
Coloured fox[8]	ᖃᑯᖏᑦᑐᑦ ᑎᓚᖏᓂᐊᑦ	Kalaliit tigiganiat[8]	207	131	57	58	53	101
Muskrat[9]	ᐅᐱᖏᓪᓗᐊᑦ	Kivgaluk[9]	0	1	0	48	1	10
Wolverine[10]	ᖃᓕᒃᑦ	Kalvik[10]	51	104	78	60	88	76
Arctic hare	ᐅᑲᓪᓕ	Ukalik	17	4	0	3	11	7
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik	433	82	363	433	351	332
Seals (unspecified)[11]	ᓴᖑᑯᓪᓕᑦ	Natiit[11]	5	372	253	1	140	154
Ringed seal	ᓇᓕᓱᑦ	Natiinat	221	0	7	257	149	127
Bearded seal	ᐅᑦᔪᐃᐸᑦ	Ukyuk	2	2	1	2	3	2
Hooded seal	ᐊᐸᐃᐸᑦ	Nahakakaktutut ittut natiit	0	0	1	0	0	< 1
Beluga	ᖃᑯᕆᑦ ᖃᓪᓗᓂᑦ	Kilalugak	5	0	0	0	0	1
Geese (unspecified)	ᓄᕐᓪᓕ	Kanguk	0	14	32	12	0	12
Snow goose	ᑲᖕᒍᐃᐸᑦ	Kanguq	19	14	19	11	21	17
Canada goose	ᓄᕐᓪᓕ ᐅᓗᐊᔪᓪᓕ	Nikliknik	1,422	971	1,158	1,246	975	1,154
Ross's goose	ᖃᑦᕐᔪᐃᐸᑦ	Kakat	0	0	0	3	0	1
Brant goose	ᓄᓪᓕᕐᓇᐃᐸᑦ	Nirlirnaq	0	0	0	8	0	2
White-fronted goose	ᓄᕐᓪᓕ	Nirlivik	11	23	112	37	131	63
Old squaw	ᐊᑭᐊᕐᔪᐃᐸᑦ	Aahangik	6	0	18	0	0	5
Pintail	ᕐᒪᓕᐊᓂᒃ	Arnaviaq	1	0	0	3	0	1
Eider duck[12]	ᒥᑎᑦ[12]	Kingalik[12]	61	22	63	35	89	54
Tundra swan	ᕐᒪᔪᐃᐸᑦ	Kukyuk	28	27	43	33	13	29
Common merganser	ᐸᐃᖅ	Nuyaralik	0	0	0	19	4	5
Red breasted merganser	ᑲᑦᔨᖏᑦ	Red breasted merganser	0	0	0	11	0	2

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Study Year/ᖃᐅᔨᓴᓂᖅ ᐊᑦᓯᔪᓐᓇᖅ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᒃᓵᒋᓕᒃᑎᓯᒪᓕᕆᓂ Amigaitkiyait
Species	**ᐅᒪᓕᕆᓂ**	**Umajuin**						
Lesser scaup	ᒥᑭᓂᖓᓂ ᒥᑎᓂ ᐊᐃᓪᓚᕐᓂᖅ	Lesser scaup	0	0	0	3	3	1
White-winged scoter	ᖃᐅᓂᒃᓴᖅ ᐃᓕᓴᐊ ᐱᓂᓗᐅᓪᓚᕐᓂᐃᓪᓂ	White-winged scoter	0	0	4	0	0	1
Loon (unspecified)	ᑐᓴᓂ	Maligik	0	0	0	5	4	2
Common loon[13]	ᑐᓴᓪᓚᐊᑲᑦ[13]	Tuulik[13]	0	24	0	5	58	17
Arctic loon	ᑲᒡᓗᓴᓂ	Maliriq	17	1	1	13	59	18
Yellow-billed loon[13]	ᑐᓴᓪᓚᐊᑲᑦ[13]	Tuulik[13]	0	3	0	2	0	1
Thick-billed murre	ᐊᑦᐸᐃᓪ	Thick-billed murre	0	1	0	0	0	< 1
Ptarmigan	ᐊᖏᕆᑦ	Akilgik	21	98	314	143	276	170
Sandhill crane[14]	ᑕᑎᓴᓪᓚᐊᑲᑦ[14]	Tatilgaq[14]	0	0	0	10	6	3
Eggs (unspecified)[15]	ᓚᒃᓂᑦ[15]	Manniit[15]	0	0	0	32	352	77
Goose eggs[15]	ᑲᖕᒍᐃᓪ ᓚᒃᓂᖏᑦ[15]	Uluaguliit manniit[15]	901	126	48	159	124	272
Duck eggs[15]	ᒥᑎᓂ ᓚᒃᓂᖏᑦ[15]	Tinmiat manniit[15]	207	0	51	149	0	81
Tundra swan eggs[15]	ᖁᓕᓪᓚᐃᓪ ᓚᒃᓂᖏᑦ[15]	Kukyut manniit[15]	0	11	0	0	0	2
Seagull eggs[15]	ᓇᐅᐳᐃᓪ ᓚᒃᓂᖏᑦ[15]	Nauyat manniit[15]	0	0	2	0	0	< 1
Arctic char[16]	ᐃᖏᓗᒃᓵᑦ[16]	Ikaliviit[16]	5,053	8,959	8,042	11,477	9,061	8,518
Freshwater fish (unspecified)	ᑕᓚᐅᖕᒪᖏᑦᑐᒥ ᐃᖏᓗᐃᓪ	Tahinik Ikaluit	0	0	0	0	22	4
Lake trout[17]	ᐃᓱᒋᕆᐃᓪᑦ[17]	Ikalukpik[17]	884	416	953	1,214	1,030	899
Northern pike	ᓂᓗᔪᓂ	Hiulik	0	0	0	3	0	1
Arctic grayling	ᓄᓗᑦᐸᐅᒪᐃᓪ	Hulupaugaq	68	216	0	3	44	66
Whitefish	ᑲᕕᓄᓂ	Kapihiliit	1,354	2,708	3,338	2,105	3,785	2,658
Burbot	ᑎᑭᓂ	Tiktaaliq	0	1	6	1	3	2
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᕕᓄᓂ	Kapihilik	0	7	0	3	0	2
Least cisco	ᒥᑭᓂᖓᓂ ᑲᕕᓄᓂ	Eetuuk	0	0	0	3	0	1
Inconnu[18]	ᑲᕕᓄᓪᓚᐃᓪᑦ[18]	Aanakhiik[18]	0	0	0	264	0	53
Cod[19]	ᐅᒪᐃᓪ[19]	Ugak[19]	921	535	610	1,190	585	768

[1-19]: See page 556 for community feedback and other sources of data.

[1-19]: ᑕᐃᓕ ᒪᓴᐅᑎᖅ 558 ᓄᓇᓕᑦ ᑭᐅᔭᕆᑎᖓᑦ ᐊᒻᒪᓗ ᐊᓯᖏᑦ ᐱᖁᓇᓂᕐᓂᐃᓪᓂ ᓇᒪᐅᔭᓕᑦ ᓇᓗᐅᓂᓄᑦ.

[1-19]: Takulugu makpigaak 560 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

6.2.5

TABLE/ᓄᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 432

Annual hunter response

ᐊᓱᔪᒋᒪᑦ ᐊᖏᓇᓂᑎᑦ ᑭᐅᓂᖏᑦ

Angujauvaktu

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓱᔪᒍᑦ (ᔨᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖁᐅᓵᖅᓯᒪᔪᑦ ᐊᓱᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓇᓂᑎᑦ ᑭᐅᓂᖏᑦ ᐊᓱᔪᒋᓚᓂᖏᑦ**	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᑭᑕᒪᑦ ᐊᖏᓇᓂᑎᑦ	Tatkitaman angunahuktut titigait	276	273	266	269	263	294*
Interview list	ᐊᐱᕐᓂᖅᓯᒪᑦ	Apikiktan	189	186	177	181	175	201*
Hunters interviewed	ᐊᖏᓇᓂᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	187	182	176	173	170	197*
Harvested	ᐊᖏᓇᖅᑐᒥᓂᑦ	Angujaujut	129	118	123	128	126	175*
Response Rate (%)	ᑭᐅᔭᑦ ᖁᓕᓂᐅᓂᖏᑦ (%)	Kiujut (%)	76	77	81	79	86	80**

* Hunters registered/on interview list/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖏᓇᓂᑎᑦ ᐊᑎᓕᐅᔨᒪᔭᕐᓗᓂᑦ/ᐊᐱᕐᓂᖅᓯᒪᓂᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᓇᖅᑐᒥᓂᑦ ᐊᑕᐅᓂᐊᓗᓂ% ᐊᑎᓂᑦ ᖁᐅᔨᕐᓂᖅᓴᓂᖓ.
** ᐊᓕᒍᓕᑎᓂᒪᒪᔭᑦ ᐊᓱᔪᒋᒪᑦ ᑭᐅᔭᑦ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut taipfumuna tahapkuan kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᓄᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 433

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔭᑦ ᐊᑯᖏᓐᓄᓪᓕᐊᑦ ᐊᖏᓇᓂᒃᑯᓐᓄᑦ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᓄᑦ, ᓄᓗᓇᐃᔨᑦ ᐃᒪᓐ % ᑲᑎᒪᔨᑦ ᐊᖏᓇᓂᒃᑯᑦ ᑎᑎᕐᑕᐅᒪᔭᑦ

Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓱᔪᒍᑦ (ᔨᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖁᐅᓵᖅᓯᒪᔪᑦ ᐊᓱᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔭᑦ**	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᑭᑦ	≤ tatkin pingahut	100	100	100	99	98	99
4-6 months	4-6 ᑕᑭᑦ	tatkin hitaman 6nut	0	0	0	0	1	0
> 6 months	> 6 ᑕᑭᑦ	> 6 tatkin	0	0	0	1	1	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 434

Number of hunters harvesting each species — All Years (June 1996 - May 2001)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖑᓇᓱᒃᑏᑦ ᐊᖑᓇᓱᒃᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐆᒪᔪᕐᓂᒃ — ᑕᒪᐃᓐᓄᑦ ᐊᒃᕌᒍᓄᑦ (ᔫᓂ 1996 - ᒪᐃ 2001)

Angunahuktin angutivaktun umajunik — Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᕐᕕᒃ ᐊᒃᕌᒍ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Total ᑲᑎᑦᑐᑦ Tamakiklugin
			96/97	97/98	98/99	99/00	00/01	
Species	**ᐆᒪᔪᑦ**	**Umajuin**						
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	106	88	104	105	100	146
Musk-ox	ᐅᒥᒃᒪᐃᑦ	Umingmait	3	3	7	3	5	20
Moose	ᑐᒃᑐᕙᐃᑦ	Tuktuvait	1		2	2	1	4
Polar bear#	ᓇᓄᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒃᓚᐃᑦ	Akhait	1	2	3	1	1	7
Wolf	ᐊᒪᕈᐃᑦ	Amagut	15	10	18	14	7	37
Arctic fox	ᑎᕆᒐᓐᓂᐊᑦ	Tigiganiat	20	13	9	4	10	32
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᕆᒐᓐᓂᐊᑦ	Kalaliit tigiganiat	21	18	12	12	11	39
Muskrat	ᐅᕕᓐᖓᕐᔪᐊᑦ	Kivgaluk		1		3	1	4
Wolverine	ᖃᕐᕕᑦ	Kalvik	18	21	20	16	19	48
Arctic hare	ᐅᑲᓖᑦ	Ukalik	5	2		3	4	12
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik	6	4	8	9	9	20
Seals (unspecified)	ᓱᖅᑯᓖᑦ	Natiit	2	20	18	1	12	37
Ringed seal	ᓇᑦᓱᑦ	Natiinat	17		5	14	15	34
Bearded seal	ᐅᒡᔪᐃᑦ	Ukyuk	1	1	1	2	3	4
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit			1			1
Beluga	ᖃᑯᕐᑕᑦ ᕿᓚᓗᒐᑦ	Kilalugak	3					3
Geese (unspecified)	ᓂᕐᓖᑦ	Kanguk		1	1	1		3
Snow goose	ᑲᖑᐃᑦ	Kanguq	3	2	4	4	8	18
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik	37	33	46	42	37	97
Ross's goose	ᖃᕌᕐᔪᐃᑦ	Kakat				1		1
Brant goose	ᓂᕐᓕᕐᓇᐃᑦ	Nirlirnaq				3		3
White-fronted goose	ᓂᕐᓖᑦ	Nirlivik	3	4	7	3	6	16
Old squaw	ᐊᒋᐊᕐᔪᐃᑦ	Aahangik	1		1			1
Pintail	ᖁᒻᒧᐊᔫᑦ	Arnaviaq	1			1		2
Eider duck	ᒥᑏᑦ	Kingalik	7	2	5	4	6	15
Tundra swan	ᖁᒻᔪᐃᑦ	Kukyuk	5	2	8	4	5	14
Common merganser	ᐸᐃᖅ	Nuyaralik				1	1	1
Red breasted merganser	ᑲᔾᔨᕐᑑᑦ	Red breasted merganser				1		1
Lesser scaup	ᒥᑭᓂᕐᓴᑦ ᒥᑏᑦ ᐊᐃᑉᐸᖏᑦ	Lesser scaup				1	1	2

6.2.5

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Study Year/ᖃᐅᔨᓴᖅ ᐱᖁᔭᐅᓂᖅᐸᑦ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᖅ Tamakiklugin
Species	**ᐅᒪᔪᑦ**	**Umajuin**						
White-winged scoter	ᖃᓄᖅᑕᓐᓄᑦ ᐃᓕᓴᐅ ᐱᖅᓯᐅᓪᓗᑎᒃ	White-winged scoter			1			1
Loon (unspecified)	ᑐᓴᓂᑦ	Maligik				2	1	3
Common loon	ᑐᓴᕐᔪᐊᑦ	Tuulik		1		1	2	4
Arctic loon	ᑲᑎᓂᓪᓂᑦ	Maliriq	2	1	1	1	4	7
Yellow-billed loon	ᑐᓴᕐᔪᐊᑦ	Tuulik		1		1		1
Thick-billed murre	ᐊᕐᕕᐃᒃ	Thick-billed murre		1				1
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	1	4	9	6	9	22
Sandhill crane	ᑕᑎᓚᔪᐊᑦ	Tatilgaq				2	1	2
Eggs (unspecified)	ᓚᖓᓂᑦ	Manniit				1	2	3
Goose eggs	ᑲᖕᒍᐃᒃ ᓚᖓᖏᑦ	Uluaguliit manniit	9	3	1	4	1	17
Duck eggs	ᒥᑎᑦ ᓚᖓᖏᑦ	Tinmiat manniit	1		1	3		4
Tundra swan eggs	ᖁᓗᔪᐃᒃ ᓚᖓᖏᑦ	Kukyut manniit		1				1
Seagull eggs	ᓇᐅᓴᐃᒃ ᓚᖓᖏᑦ	Nauyat manniit			1			1
Arctic char	ᐃᖃᓗᓴᐸᑦ	Ikaliviit	68	56	67	83	69	123
Freshwater fish (unspecified)	ᑕᓇᐅᖕᒪᖏᑦᑐᒥ ᐃᖃᓗᐃᒃ	Tahinik Ikaluit					1	1
Lake trout	ᐃᓱᒋᐃᒃ	Ikalukpik	25	17	27	25	25	56
Northern pike	ᓱᓚᔪᓂᑦ	Hiulik				1		1
Arctic grayling	ᓯᓗᓴᐅᑲᓚᐃᒃ	Hulupaugaq	4	4		1	2	8
Whitefish	ᑲᐱᓯᓂᑦ	Kapihiliit	24	38	34	37	39	90
Burbot	ᑎᓴᒋᓂᑦ	Tiktaaliq		1	1	1	1	4
Arctic cisco	ᐅᑭᐅᖏᑐᒥ ᑲᐱᓯᓂᑦ	Kapihilik		1		1		2
Least cisco	ᒥᑭᓂᖓᑦ ᑲᐱᓯᓂᑦ	Eetuuk				1		1
Inconnu	ᑲᐱᓯᓂᖏᑦᐃᒃ	Aanakhiik				1		1
Cod	ᐅᓗᐃᒃ	Ugak	12	16	17	24	20	51

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᓴ ᐱᑕᖃᖕᒪᖏᑐᒍᖅ ᐱᓴᔪᑎᓐᓂᓴ ᐊᖏᔪᒃ ᖃᕋᓴᐅᓂᖓᖕᒪᓄᑦ ᐊᓪᓚᕆᐅᒪᔪᔪᓄᑦ ᐊᖏᔪᓄᑦ ᓇᓪᑕᐅᖏᓐᓇᖅᑐᓂ ᑐᓂᓴᖏᖕᒪᓂ ᐃᑯᐱᖏᓪᓕᓚᓕᕆᓂᖅᓴᓕᒃ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.2.5 Community Results Discussion: Kugluktuk

The survey frame:

An assessment of under-enumeration during the community visit indicated that there were very few Inuit hunters who were not registered in the Harvest Study. However it is estimated that there was one active hunter and three occasional hunters with assigned hunting rights who were not registered. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. However, the extent of the bias is likely very small since the missing hunters only represent one percent of the total hunter population (Table 10).

There were no intensive hunters registered in Kugluktuk. Harvest estimates were calculated based on two classifications of hunters: occasional and active.

Survey coverage and non-response bias:

Response rates although good in most months, were lower in year 1 and in the first few months of year 2. In years 3 to 5 response rates were high in almost all months, with only the occasional month below 75%. As seen in Table 9 the consistent intentional non-response rate in Kugluktuk was low, at 0.5%, and was not thought to be a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough during years 2 to 5, with the exception of the first few months in year 2, to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should exercise caution when using the data collected during year 1 and the first few months of year 2 (June - August 1997) since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:

It was reported during the community consultations that egg harvests were often under-reported. Further details are provided in the community feedback and other sources of data section below. Section 5.4 also contains a thorough discussion of this issue.

As seen in the recall period tables, the vast majority of harvest records were collected within three months of the harvest, thereby minimizing recall error.

As noted in the comments relating to arctic char, below, there was commercial fishing of char during the Harvest Study. The Fieldworker reported that most hunters did report their commercial harvests but that she was aware of one hunter in particular who fished commercially for arctic char but who was not on the interview list (this person was not selected during the sub-sampling in this community). Harvest estimates should be considered to include the subsistence harvest and most of the commercial harvest.

There was also one harvest of caribou that was reported to be sold commercially. This entry was removed from the database and can be viewed in Table 4.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of both barren-ground caribou and island caribou. Also, some hunters did not specify the type of caribou harvested. For the purpose of calculating harvest estimates they were combined into one category.
2. **Musk-ox:** Harvest estimates seem too low. The HTO Board estimates that the subsistence harvest was closer to about 40 per year (C.F.). DSD was contacted for more information on quotas and annual harvests. The local Wildlife Officer confirmed that in the three management zones for musk-ox Kugluktuk hunters would usually take at least 40 animals annually for subsistence (DSD MXd).
3. **Moose:** Harvest estimates seem too low. The community reports that hunters usually take between 5 and 7 animals annually (C.F.).
4. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
5. **Tundra grizzly:** Harvest estimates seem to be in the right range. DSD was contacted for more information with regards to the grizzly harvest. They confirmed that the harvest was approximately 3 bears per year over the five years of the Harvest Study.

6 **Wolf:** Harvest estimates seem a little low (C.F.). Wolves tend to be more abundant when there are more caribou around. Readers will note that the highest harvest year for caribou corresponds with higher harvesting of wolves as well. Data were obtained from DSD detailing the number of pelts sold by hunters. DSD reports were available for 1999/2000 and 2000/2001 (years 4 and 5) and indicate that 92 wolf pelts were purchased in 1999/2000 (year 4) and 33 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). Based on this information the harvest estimates do appear a little low but are in the right range.

7 **Arctic fox:** Harvest estimates seem a little low (C.F.). Again, DSD provided reports for 1999/2000 and 2000/2001 (years 4 and 5) which indicated that 168 arctic fox pelts were purchased in 1999/2000 (year 4) and 246 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). This information indicates that the harvest estimates for year 4 appear low but that the year 5 estimate may be too high. When both years are considered together harvest estimates appear to be in the right range.

8 **Coloured fox:** Similar to arctic fox, estimates seem to be a little low (C.F.). DSD reports indicate that 196 coloured fox pelts were purchased in 1999/2000 (year 4) and 128 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). Both of these figures are higher than harvest estimates and indicate that estimates are likely low.

9 **Muskrat:** Some are taken every year so data from years with little or no harvest seem inaccurate (C.F.).

10 **Wolverine:** Some estimates appear too low. The community reported that they usually harvest about 100 animals annually (C.F.). There is an ongoing monitoring program run by DSD where hunters are paid for their wolverine carcasses. Kugluktuk hunters were very cooperative and it is thought that they submitted 75% to 90% of their harvested carcasses. The number of carcasses collected annually during the Harvest Study varied between 89 and 103 (DSD WV), confirming the communities' estimate of a mean annual harvest of around 100 animals. Given this information it appears that Harvest Study estimates are in the right range in some years but low in others.

11 **Seals:** Most of the unidentified seals were likely ringed seals (C.F.).

12 **Eider duck:** Both king and common eiders are harvested by Kugluktuk hunters (C.F.).

13 **Loons:** Common loons are only seen occasionally, whereas yellow-billed loons are more common to the area. Harvest estimates should reflect this but do not, since common loons are shown to be taken in larger numbers (C.F.).

14 **Sandhill crane:** Harvest estimates seem low. Some are taken every year (C.F.).

15 **Eggs:** Egg harvest estimates look too low in most years for most species. Hunters reported that many people did not realize they were to report their egg harvests (C.F.).

16 **Arctic char:** Harvest estimates look accurate. The HTO Board reports that commercial fishing was done in about four areas during the study (C.F.). DFO records confirm that quotas were issued for experimental fisheries in these areas but did not indicate amounts caught (DFO F). Some commercial harvests were likely reported during the study but not all.

17 **Lake trout:** Harvest estimates seem accurate. The increase in harvesting in year 4 was due to fishing derbies being initiated (C.F.).

18 **Inconnu:** Hunters commented that these fish are not found in the area. They suspect that another fish was harvested that was not on the species list (C.F.).

19 **Cod:** Harvest estimates seem accurate. The increase in harvesting in year 4 was due to fishing derbies being initiated (C.F.).

6.2.5 ᓄᓇᕗᑦ ᓴᖅᑭᑕᕐᕕᖏᓐᓄᑦ ᐅᖃᖅᑎᑕᐅᑎᓪᓗᒍ: ᐊᓯᓕᑐᖅ

ᖃᐅᔨᓴᓂᐅᕙᑦ ᐊᖏᖅᑭᒪᓂᖅᓱ:

ᑐᑭᓯᐅᑦᓴᕐᓗᑎᑦ ᐊᑎᓕᐅᓚᖓᔪᓐᓇᖅᑐᑦ ᓄᓇᕗᑦ ᐊᓪᓚᕆᕐᕕᑎᓪᓗᑎᑦ ᑕᒧᑎᓯᓪᓚᕆᓂᖅ ᖃᖅᑎᖑᕐᓂᖅᓱᒃ ᐃᓄᐃᑦ ᐊᖏᓪᓕᐊᓂᖅᑎᑦ ᑎᑎᕋᖅᑕᐅᓯᒪᔪᓕᐅᑦᑐᒃ ᐊᖏᓪᓚᐅᑦᑐᖅᓯᒪᓂᖅᓱᑦ ᖃᖅᑎᖑᕐᓂᖅᓯᒪᓕᐅᑦᑐᖅᓯᒪᓂᖅᓱᑦ ᐊᖏᓪᓕᐊᓂᖅᑎᑦ ᐃᓕᓴᕐᕕᑕᐅᓯᒪᓂᖅᓱᑦ ᐊᖏᓪᓕᐊᓂᖅᑐᓄᓪᓗᑎᑦ ᐊᖏᓪᓕᐊᓂᖅᑐᓄᓪᓗᑎᑦ ᐃᓄᐃᑦ ᐊᖏᓪᓕᐊᓂᖅᑎᑦ ᐊᖏᓪᓚᐅᑦᑐᖅᓯᒪᓂᖅᓱᑦ ᐊᖏᓪᓕᐊᓂᖅᑐᓄᓪᓗᑎᑦ ᐃᓄᐃᑦ ᐊᖏᓪᓕᐊᓂᖅᑐᓄᓪᓗ

ᐃᑲᕆᕐᓚᓗᒃᑯᓄᑦ ᐅᓂᒃᑲᓪᓕᖅᑎᑦ ᐊᑐᐃᓐᓇᐅᓪᓚᕆᔨᖅᑐᑐᒃᓴᑦ 1999/2000-ᒧᑦ ᐊᒻᒪ 2000/2001-ᒧᑦ (ᐊᖏᖅᓯᒍ 4 ᐊᒻᒪ 5) ᐊᒻᒪ ᓇᓗᓇᐃᖅᓯᕐᓴᐃᓐᓇᑦ 92 ᐊᒪᓕᐃᓐᑦ ᐊᒥᖅᑎᑦ ᓂᐅᐃᐊᓕᕆᓚᐅᓪᓚᕆᔨᖅᑐᒃ 1999/2000Γ (ᐅᑭᐅᖅᑕᐅᓂᒃ 4) ᐊᒻᒪ 33 ᓂᐊᐃᐊᖅᓯᒪᔨᖅᑐᒃᓴᓄᑦ 2000/2001-Γ (ᐅᑭᐅᖅᑕᐅᓂᒃ 5) (ᖃᐅᔨᓴᓕᒥᑦ ᐃᑲᕆᐃᓐᓇᕐᓚᓗᒃᑯᓄᑦ ᓇᓴᐅᑎᑎᑦ ᒪᓕᒻᒪᒃ ᐱᑎᐊᖃᖅᑐᒃᑐᑦ ᓱᓚᐃᒥᑦ ᓱᓂᒧᑦ, ᖃᐅᔨᓴᓂᒧᑦ ᐊᓕᕐᑕᐅᓚᓪᓕᐊᓂᒃᑯᑦ ᒪᓕᒻᒪᒃ ᐱᑎᐊᖃᖅᑐᒃᓯᒪᓂᖅᑐᒥᑦ ᓱᓂᒧᑦ ᒪᐃᑐᑦ) (DSD FB). ᐃᓕᓴᓗᓂᓂ ᒡᓗᑲᓐᓂ ᑐᑭᓯᓚᐅᖅᑐᓂᓕᕆᔨᓂᒃ ᐊᖏᓴᐅᑉᐳᓪᓚᕆᔨᖅᑐᑐᒃᓴᑦ ᐊᑦᑕᓯᓕᕆᔨᖅᑐᑐᒃᓴᑦ ᐅᓯᐊᓂ ᑕᒪᓐᓇᐅᑉᐳᓪᓚᕆᔨᖅᑐᑐᒃᓴᑦ.

[7] **ᐱᓇᒫᓂᐊᖅ:** ᐊᖏᓴᐅᑎᓪᓕᖅᑐᑐᒃᓴᑦ ᓇᓕᐅᑦᑕᓪᓕᐅᓂᖅᑐᑦ ᐊᑦᑕᓯᓕᕆᔨᖅᑐᑐᒃᓴᓐᖅ. (C.F.). ᐊᒻᒪᓗᓂ, ᐃᑲᕆᐃᓐᓇᕐᓚᓗᒃᑯᓄᑦ ᐅᓂᒃᑲᓪᓕᖅᑎᑦ ᐊᑐᐃᓐᓇᕐᓚᓗᒃᑯᓄᑦ 1999/2000-ᒧᑦ ᐊᒻᒪ 2000/2001-ᒧᑦ (ᐊᖏᖅᓯᒍ 4 ᐊᒻᒪ 5) ᐊᒻᒪ ᓇᓗᓇᐃᖅᓯᕐᓴᐃᓐᓇᑦ 168 ᐱᓇᓱᓂᐊᖅ ᐊᒥᖅᑎᑦ ᓂᐅᐃᐊᓕᕆᓚᐅᓪᓚᕆᔨᖅᑐᒃ 1999/2000Γ (ᐅᑭᐅᖅᑕᐅᓂᒃ 4) ᐊᒻᒪ 246 ᓂᐊᐃᐊᖅᓯᒪᔨᖅᑐᒃᓴᓄᑦ 2000/2001-Γ (ᐅᑭᐅᖅᑕᐅᓂᒃ 5)(ᖃᐅᔨᓴᓕᒥᑦ ᐃᑲᕆᐃᓐᓇᕐᓚᓗᒃᑯᓄᑦ ᓇᓴᐅᑎᑎᑦ ᒪᓕᒻᒪᒃ ᐱᑎᐊᖃᖅᑐᒃᑐᑦ ᓱᓚᐃᒥᑦ ᓱᓂᒧᑦ, ᖃᐅᔨᓴᓂᒧᑦ ᐊᑦᑕᓯᓕᕆᔨᖅᑐᑐᒃᓴᑦ ᒪᓕᒻᒪᒃ ᐱᑎᐊᖃᖅᑐᒃᑐᑦ ᓱᓚᐃᒥᑦ ᓱᓂᒧᑦ ᒪᐃᑐᑦ) (DSD FB). ᒡᓗᐊᑯ ᐅᐱᕆᑲᓂᐅᓚᓪᓕᐊᓂᒃᑯᑦ ᓇᓗᓇᐃᖅᓯᕐᓴᐃᓐᓇᑦ ᑎᓕᐅᑦᑕᓪᓕᐅᓂᖅᑐᑦ ᐊᑦᑕᓯᓕᕆᔨᖅᑐᑐᒃᓴᑦ ᐊᑦᑕᓯᓕᕆᔨᖅᑐᑐᒃᓴᓄᑦ 4-ᒧᑦ ᐊᑦᑕᓯᓕᕆᔨᖅᑐᑐᒃᓴᓐᖅ ᐱᓯᐊᓂ ᐊᖏᖅᑎᑦ 5-Γ ᓇᓕᐅᑦᑕᓪᓕᐅᓂᖅᑐᓗᒃ ᖃᓄᖅᓯᓯᓗᐃᑦᓇᓕᕐᓗᒃ. ᐊᑐᓂ ᐊᖏᖅᑲᑦ ᐊᑎᐅᓂᒋᖃᑎᒌᓕᕆᔨᖅᑐᓗᒃ ᓇᓕᐅᑦᑕᓪᓕᐅᓂᖅᑐᓗᒃ ᑕᒪᓂᑎᐊᖅᓴᖅᑐᒃᓴᓐᖅ.

[8] **ᐱᓇᒫᓂᐊᖅᓴᐃᓐᓇᑦ:** ᑎᓇᒫᓂᐊᑎᑐᓐ, ᓇᓕᐅᑦᑕᓪᓕᐅᓂᖅᑐᑦ ᐊᑦᑕᓯᓕᕆᔨᖅᑐᑐᒃᓴᓐᖅ (C.F.). ᐃᑲᕆᐃᓐᓇᕐᓚᓗᒃᑯᓄᑦ ᐅᓂᒃᑲᓪᓕᖅᑎᑦ ᓇᓗᓇᐃᖅᓯᕐᓴᐃᓐᓇᑦ 196 ᑕᐅᑦᑐᓄᑦ ᑎᓇᒫᓂᐊᖅ ᐊᒥᖅᑎᑦ ᓂᐅᐃᐊᓕᕆᓚᐅᓪᓚᕆᔨᖅᑐᓴᓪᓚᑕ 1999/2000-Γ (ᐊᖏᖅᓯᒍ 4) ᐊᒻᒪ 128 ᓂᐅᐃᐊᖅᓯᒪᔨᓗᑎᑦ 2000/2001-Γ (ᐅᑭᐅᖅᑕᐅᓂᒃ 5) (ᖃᐅᔨᓴᓕᒥᑦ ᐃᑲᕆᐃᓐᓇᕐᓚᓗᒃᑯᓄᑦ ᓇᓴᐅᑎᑎᑦ ᒪᓕᒻᒪᒃ ᐱᑎᐊᖃᖅᑐᒃᑐᑦ ᓱᓚᐃᒥᑦ ᓱᓂᒧᑦ, ᖃᐅᔨᓴᓂᒧᑦ ᐊᑦᑕᓯᓕᕆᔨᖅᑐᑐᒃᓴᑦ ᒪᓕᒻᒪᒃ ᐱᑎᐊᖃᖅᑐᒃᑐᑦ ᓱᓚᐃᒥᑦ ᓱᓂᒧᑦ ᒪᐃᑐᑦ) (DSD FB). ᐊᑐᓂ ᓇᓗᓇᐃᖅᓯᒪᔭᒃ ᖃᓄᖅᓯᓯᓂᓄᖅᓯᒪᔭᒃ ᐊᖏᖅᓯᒍᑦᑕᓪᓕᐅᓂᖅᑐᑦ ᓇᓕᐅᑦᑕᓪᓕᐅᓂᖅᑐᓂᓐᖅ ᒪᓕᒻᒪᒃ ᓇᓗᓇᐃᖅᓯᕐᓴᓐᖅ ᓇᓕᐅᑦᑕᓪᓕᐅᓂᖅᑐᓴᓐᖅ ᐊᑦᑕᓯᓕᕆᔨᖅᑐᑐᒃᓴᓐᖅᓂᓐᓂ.

[9] **ᐊᐃᓐᖓᓱᓕᕆᓂ:** ᐃᓕᖏᓴᐅᑎᓪᓕᖅᑐᑐᒃᓴᑦ ᐊᑦᑕᓯᒍᒥᓐᖅ ᑕᒪᓐᓇ ᐱᓪᓗᒍ ᑎᑎᖅᑲᑦ ᐊᑦᑕᓯᓂ ᖃᓄᐃᓇᐃᓐᖅ ᐱᒋᖃᖅᑐᓂᓕᕆᔨᖅᑐᑐᒃᓴᓐᖅ (C.F.).

[10] **ᖃᓄᐃᓕᑦ:** ᐊᖏᖅᑎᑦ ᐊᑦᑕᓯᓕᕆᔨᖅᑐᑐᒃᓴᑦ ᓇᓕᐅᑦᑕᓪᓕᐅᓂᖅᑐᑦ ᐊᑦᑕᓯᓕᕆᔨᖅᑐᑐᒃᓴᓐᖅ. ᓄᓇᕗᑦᑕᓴᑦ ᐅᖃᖅᓯᒪᓕᕐᓂ 100-ᓴᓇᓐᓂ ᖃᓄᐃᖃᓕᕐᒥᑦ ᐊᑦᑕᓯᒍᒥᓐᖅ (C.F.). ᖃᐅᔨᓴᓇᐃᓐᓇᑦ ᐃᑲᕆᐃᓐᓇᕐᓚᓗᒃᑯᓄᑦ ᐊᖏᖅᓯᒪᔨᖅᑐᑐᒃᓴᑦ ᐊᒻᒪᓗᓂᐊᖅᑎᑦ ᐊᑭᓐᓄᑦᑕᓪᓕᐅᓂᖅᑐᑦ ᐊᑦᑕᓯᓕᕆᔨᖅᑐᑐᒃᓴᓐᖅᓂᓐᓂ ᖃᓄᐃᓇᐃᓐᓇᕐᓚᓗᒃᑯᓄᑦ ᐊᑦᑕᓯᒍᒥᓐᖅ ᐊᑦᑕᓯᓕᕆᔨᖅᑐᑐᒃᓴᑦ ᐃᓕᖏᓴᐅᑎᓪᓕᖅᑐᑐᒃᓴᑦ ᐊᑦᑕᓯᓕᕆᔨᖅᑐᑐᒃᓴᓐᖅ ᐊᑦᑕᓯᓕᕆᔨ

6.2.5 Nunanit Iniktigutait Ukauhiit: Kugluktuk

Ihivgiuktit Atugutait:
Ihiviufaakhimayut ataani naunaiyakhimayut nunani pulaakhimapluta pihimayut ikitpiaktut Inuit umayukhiuktit titigakhimaitut Umayukhiukhimayut Ihivgiuktitlugit. Kihimi naunaiyakhimayuk atauhik umayukhiukataktuk ovalo pingahut ilaani umayukhiukataktut tunihimayut inminiigutinik umayukhiugutikhainik titigaktauhimaitut. Ukakhimayut ilangani 5.2.1 ikpinagutait hamani ataani naunaiyakhimayut ataanut ihumagiyaini umayukhiukhimayut naunaiyautaini. Kihimi angitjutait ihumagiyaini mikiyunakhiyut ilaungitut umayukhiuktit 1%kumata tamaat umayukhiuktinit (ikpatauyak 10).

Pikangituk umayukiukatainaktumik titigakhimayuni Kugluktumi. Umayukhiukhimayut naunaiyautait titigakhimaut atukhugit malguuk naunaiyautit umayukhiuktinik: ilaani umayukhiuktaktut ovalo umayukhiukataktut.

6.2.5

Ihivgiugutait ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait nakuuyuugalut amigaivyaktuni tatkikhiutini ukiumi 1 ovalo hivuliit tatikikhiutit ukiumi 2. Ukiuni 3 ovalo 5 kiuhimayut naunaiyautait angiyut tamamivyak tatkikhiutini, avaliituk tatkikhiuti ataani 75%mit. Takukhauyuk ikpatauyami 9 pikataktut kiuyuitut naunaiyautait Kugluktumi mikiyut 0.5%mik ovalo ihumagiyaungitut pilaaktuni atuktaini kiuyuitut ihumagiyaini.

Kiuhimayut naunaiyautait ihumagiyauyut angiyut ovalo kiuyuitut ihumagiyait mikiyut ukiuni 2 ovalo 5, kihimi hivulimi tatkikhiutit ukiumi 2, piyaami nni pihimayut naamaktumik uktugutini Nni umayukhiuktini. Taiguaktut ihumayukhat atugumik katitikhimayut katitiguatini ukiumi 1 ovalo hivulimi tatkikhiutini ukiuni 2 (Junemit Augustmut 1997) pilaaktuni tamamik uktukhimayut ihuinaagutaini ovalo kiuyuitut ihumagiyaini angiklilaaktut kiuhimayut naunaiyautait katakpata.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Tuhaktitihimayut nunani ukakatihimaplugit maniit pikiutakhimayut pivaktut ataani tuhaktitihimayuni. Titigakhimayut tunihimayait nunanit ukakhimayaini ovalo aalata atukhimayut katitikhimayut ilangani hamani. Ilangani 5.4 pihimayutlu ukautikpiakhimayut hamani ihumagiyaini.

Takuhimayuk utiktitihimayuni ubluit ikpatauyani, amigaitut umayukhiukhimayut titigakhimayut katitikhimayut iluani pingahut tatikikhiutini, taimaimat mikiyut utiktitihimayut ihuinaagutait.

Nalunaikhimayuk ukautaini mikhaanut ikaliviit, hamani, kinauyaliugutit ikalukhiukhimayut ikalivinik Umayukhiukhimayut ihivgiuktitlugit. Nunani havaktit tuhaktitihimayuk amigaitut umayukhiuktit tuhaktitihimayut kinauyaliugutainik ikalukhiukhimayuni kihimi nalungituk atauhik umayukhiukti ikalukhiukpaktuk kinauyaliuhuni ikalivinik kihimi ilaungituk ukakatigihimayut katitigutaini (una Inuk ilauhimaituk ataani uktugutaini hamani nunami). Umayukhiukhimayut naunaiyautait pihimayukhat ilaulugit atukataktaini umayukhiukhimayut ovalo amigaivyaktut kinauyaliugutit umayukhiugutit.

Umayukhimayuklu tuktu tuhaktitihimayuk niuviktauhimayuk kinauyaliukhimayumut. Hamna titigakhimayut unguvakhimayut katitikhimayunit ovalo takuyaulaaktuk ikpatauyami 4.

Nunanit ukakhimayut ovalo aalat atukhimayaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukhimayut ilauyut tamamik nunani tuktut ovalo kikiktanit tuktut. Ovalo ilangit umayukhiuktit naunaiyakhimaitut kanugitunik tuktuhimayut. Atukhimayut hamani naunaiyakhimayuni umayukhiukhimayut naunaiyautaini katitikhimayut atauhimut.
2. **Umingmait:** Umayukhiukhimayut naunaiyautait mikiyut. HTOkut katimayiit naunaiyakhimayut atuktakhainik umayukhiuktaini kanitkiyak 40nut ukiuk tamaat (C.F.). DSDkut takuyauhimayut tuhagutikhainik kotanik ovalo ukiuk tamaat umayukhiukhimayainik. Nunani umayuligiyi ukakhimayuk pingahuni munagitjutini umingmait Kugluktumi umayukhiuktit pikataktut 40nik umingmanik ukiuk tamaat atuktakhaminik (DSD MXd).
3. **Tuktuvait:** Umayukhiukhimayut naunaiyautait mikiyut. Nunani tuhaktitihimayut talimanit 7nut umingmait pikataktut ukiuk tamaat (C.F.).
4. **Nanuit:** Amigaitjutait takuhimayut naunaiyautaungitut kihimi pivaktait umayukataktut tunihimayut DSDkunit (DSD PB).
5. **Akhut:** Umayukhiukhimayut naunaiyautait naamaktut. DSDkut takuyauhimayut tuhagutikhainik mikhaanut akhait umayukhiukpaktut. Pivaktait umayukhiukhimayut pingahuuyut akhait ukiuk tamaat talimani ukiuni Umayukhiukhimayut Ihivgiuktitlugit.
6. **Amagut:** Umayukhiukhimayut naunaiyautait mikiyut (C.F.). Amagut amigaikpaktut tuktut amigaitkaagata. Taiguaktut nalungitukhat anginikhaat umayukhiukpaktut ukiungani tuktut aatjikutait angitjutaini umayukhiukpaktaini amagut. Katitikhimayut pihimayut DSDkunit titigakhimayut amigaitjutainik amiit niuviktauhimayut umayukhiuktinit. DSDkut tuhaktitihimayut pihimayut ukiuni 1999/2000 ovalo 2000/2001 (ukiuni 4 ovalo 5) ovalo naunaiyakhimayut 92nik amagut amiit niu-

vuktauhimayut 1999/2000mi (ukiumi 4) ovalo 33nik niuviktauhimayut 2000/2001mi (ukiumi 5) (nalungilutit DSDkut katitikhimayut atukpaktut umayukhiukhimayut ukinginik Julymit Junemut, Umayukhiukhimayut Ihivgiukhimayut katitikhimayut atukpaktut umayukhiukhimayut ihivgiugutait ukiungit Junemit Maymut) (DSD FB). Atukhugit hapkoa tuhagutikhat umayukhiukhimayut naunaiyautait mikivyaktut kihimi naamaktut.

7 **Tigiganiat:** Umayukhiukhimayut naunaiyautait mikiyut (C.F.). Ilaa, DSDkut tunihimayut tuhaktitikhanik 1999/2000mi ovalo 2000/2001milu (ukiumi 4 ovalo 5) takukhauyut 168nik tigiganiat amiit niuviktauhimayut 1999/2000mi (ukiumi 4) ovalo 246nik niuviktauhimayut 2000/200lmi (ukiumi 5) (nalungilutit DSDkut katitikhimayait atukhimayut umayukhiukhimayut ukiungini atuktut Julymit Junemut, Umayukhiukhimayut Ihivgiuktit katitikhimayut atukhimayut umayukhiukhimayut ukiungani Junemit Maymut) (DSD FB). Hamna tuhagutikhak pihimayut umayukhiukhimayut naunaiyautaini ukiumi 4mi mikiyut kihimi ukiumi 5mi angiyut. Tamamik ukiut ihumagigaagata katitihimaplugit umayukhiukhimayut naunaiyautait naamaktut.

8 **Kalaliit Tigiganiat:** Aatjikutaatut tigiganiat, nanaiyautait mikiyut (C.F.). DSDkut tuhaktitihimayut 196nik kaalat titiganiat amiit niuviktauhimayut 1999/2000mi (ukiumi 4) ovalo 128nik niuviktauhimayut 2000/2001mi (ukiumi 5). (nalungilutit DSDkut katitikhimayait atukhimayut umayukhiukhimayut ukiuginik Julymit Junemut, Umayukhiukhimayut Ihivgiugutait katitikhimayut atukhimaplutik umayukhiukhimayut ukiunganik Junemit Maymut) (DSD FB). Tamamik hapkoa amigaitjutait angiyut umayukhiukhimayut naunaiyautaini ovalo pihimayukhakhiyut naunaiyautait mikiyut.

9 **Kivgaluit:** Ilangit pikatainaktut ukiuk tamaat, taimaimat katitikhimayut ukiuni ikitut ovaluniit umayukhiuhimaitut naamangitut (C.F.).

10 **Kalviit:** Ilangit naunaiyautit mikiyut. Nunani tuhaktitihimayut pikatainaktut 100nik kalvinik ukiuk tamaat (C.F.). Pikatainaktut kungiagutinik pilihimayunik pipkaktainik DSDkunit umayukhiuktit akiliktauvaktut kalviit ukpatainik. Kugluktukmiut umayukhiuktiit ilaukataunginaktut ovalo ihumagiyauyut tunivaktut 75%nit 90%nut umayukhimayaminik ukpatainik. Amigaitjutait ukpatait katitikhimayut ukiuk tamaat umayukhiukhimayut ihivguktitlugit kitkaniitut 89nit 103nut (DSD WV), pihimayait nunanit naunaiyautait anginikhaat ukiuk tamaat umayukhiukhimayut 100nik kalvinik. Pihimanmat hamna tuhagutikhak takukhauyuk Umayukhiukhimayut Ihivgiugutait naunaiyautait naamaktut ilangit ukiuni kihimi mikiyut ilangini.

11 **Natiit:** Amigaitkiyait naunaiyakhimaitut natiit natinaaguyunakhiyut (C.F.). .

12 **Tinmiat:** Tamamik kingaliit ovalo mitiit umayukhiuktaktait Kugluktukmiut umayukhiuktiinit (C.F.).

13 **Maligit:** Maligiit takuyaulikpatut ilaani, kihimi tuuliit amigaitkiyait nunani. Umayukhiukhimayut naunaiyautait takuhimayukhat taimaatut kihimi pingitut, maligiit takukhauyut piktaktauyut amigaitkiyanik (C.F.).

14 **Tatilgak:** Umayukhiukhimayut naunaiyautait mikiyut. Pikatainaktut ukiuk tamaat (C.F.).

15 **Maniit:** Maniit pikiutaukataktut naunaiyautait mikiyut ilangini ukiuni tamamivyak tinmianut. Umayukhiuktit tuhaktitihimayut amigaktut Inuit naluhimamata tuhaktitihimayukhat maniit pikiutaktaktainik (C.F.).

16 **Ikaliviit:** Umayukhiukhimayut naunaiyautait naamaktut. HTOkut katimayiit tuhaktitihimayut kinauyaliugutit ikalugutait pihimayut hitamani tahini ihivgiuktitlugit (C.F.). DFOkut titigakhimayut pihimayut kotanik atuktakhainik uktugutikhainik ikalukhiuktakhanik hamani tahini kihimi amigaitjutait naunaiyakhimaitut ikalukhimayunik (DFO F). Ilangit kinauyaliugutit ikalukhimayut tuhaktitihimayunakhiyut ihivgiuktitlugit kihimi tamakmiungitut.

17 **Ihuut:** Umayukhiukhimayut naunaiyautait naamaktut. Angilihimayut ikalukhiugutait ukiumi 4mi, takhinahuaktut ikalukhiuktitauhimamata (C.F.).

18 **Aanahiit:** Umayukhiuktit ukakhimayut hapkoa ikaluit takuyauyuitut nunani haniani. Ihumayut aalat ikaluit ikaluktauvaktut ilaungitut ikaluni katitigutainit (C.F.).

19 **Ugat:** Umayukhiukhimayut naunaiyautait naamaktut. Angilihimayut ikalukhiugutait ukiumi 4mi, takhinahuaktut ikalukhiutitauhimamata (C.F.).

TABLE/ᓄᓇᓕᐃᒃᐳᐅᑦ/NAUNAIKUTA 435

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓄᓇᐅᑦᑎᓯᑎᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᑦᕿᒍ 1 (ᔪᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑦᑐᓇ	NOV ᐅᓂᐱᓇ	DEC ᑎᓯᐱᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᓕᒃ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᑦ	Tuktut	29	22	98	163	181			12	19	6	42	64	636 ± 168
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait		11											11 ± 11
Polar bear‡	ᓄᓇᐃᑦ‡	Nanuit‡						2	1	3	2		7	2	17
Wolf	ᐊᒪᓗᐃᑦ	Amagut								6		1			7 ± 1
Arctic fox	ᑎᓇᓚᖅᓂᐊᑦ	Tigiganiat						4		13	5	39	16		77 ± 20
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓇᓚᖅᓂᐊᑦ	Kalaliit tigiganiat												2	2 ± 2
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				3	8	3				14	1	2	31 ± 12
Seals (unspecified)	ᓴᖅᑯᓪᓚᑦ	Natiit												17	17 ± 13
Ringed seal	ᓄᖅᓱᑦ	Natiinat	36	8	61	37	46	10		5	2	26	33		264 ± 72
Bearded seal	ᐅᓗᐊᕐᓄᑦ	Ukyuk			3	8				2			1		14 ± 11
Narwhal	ᑐᒍᓪᓚᑦ ᖃᓄᐊᓕᑦ	Tuugaak			1										1 ± 1
Snow goose	ᑲᖏᒍᓄᑦ	Kanguq	18		3										21 ± 22
Canada goose	ᓄᓕᓪᓚᑦ ᐅᓄᐊᔪᓪᓚᑦ	Nikliknik	34	2	7									20	63 ± 59
Eider duck	ᒥᑎᑦ	Kingalik	25	7	23	14	4							27	100 ± 78
Ptarmigan	ᐊᖏᓚᑦ	Akilgik					8			6		9	13		36 ± 16
Arctic char	ᐃᖃᓗᐊᖅᑦ	Ikaliviit	852	5,755	2,010	2,323	1,526	27	11	7		22	22	574	13,129 ± 9,151
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	4,317	1,153	563		828	97	45	3	5	403	258	777	8,449 ± 4,795
Whitefish	ᑲᐱᓱᓪᓚᑦ	Kapihiliit			48		182								230 ± 172

‡ Polar bear data supplied by DSD.

‡ ᓄᓇᓕᑦ ᑎᑎᕋᐅᒪᓕᖅᑐᑦ ᑐᓂᓯᖏᑦ ᐅᑉᐳᖓᑦ ᐃᓄᐃᑦᑐᓕᕆᓂᖅᓴᓕᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.2.6

TABLE/ᐅᓗᐅᐃᔨᐅᑦ/NAUNAIKUTA 436

Monthly hunter response

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᓕᕐᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒡᒎᑎ	SEP ᓯᑎᒡᐸᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᐊᒡᐸᓗ	DEC ᑎᓯᒡᐸᓗ	JAN ᒎᓂᔪᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᑦᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐋᒍᑎᓕᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	228	228	225	226	226	230	230	230	228	231	229	228	235*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	88	120	166	156	172	212	215	227	213	206	171	115	232*
Harvested	ᐊᖏᔪᓂᒃᑐᒋᓐᓂᑦ	Angujaujut	12	16	30	18	30	9	4	20	15	37	24	43	120*
Response Rate (%)	ᑭᐅᔭᓂ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	39	53	74	69	76	92	93	99	93	89	75	50	75**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᑦᑐᒪᒪᓪᓚᑦᑎᓯᑦ/ᐊᐱᕐᓂᑦᑎᓯᑦ/ᐊᖏᔪᓂᒃᑐᒋᓐᓂᑦ ᐊᑕᐅᓂᐊᖅᓗᑐᑎᑦ ᐊᓕᕐᒪᑦ.
** ᐊᑦᔨᒋᓕᑎᓂᒪᓪᓚᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔭᓂ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.2.6

TABLE/ᐅᓗᐅᐃᔨᐅᑦ/NAUNAIKUTA 437

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓂᒃᓴᓂᖅᑕ ᐊᓚᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᑕ, ᐅᓗᐅᐃᕐᑦ ᐃᒪᓱ % ᑲᑎᑐᑎᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑎᑎᕐᓂᑦᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᓕᕐᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒡᒎᑎ	SEP ᓯᑎᒡᐸᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᐊᒡᐸᓗ	DEC ᑎᓯᒡᐸᓗ	JAN ᒎᓂᔪᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᑦᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔪᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	100	100	100	100	100	48	100	7	5	100	100	100	91
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	0	0	0	0	52	0	93	95	0	0	0	9
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 438

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓚᓯᖅᐱᑦ ᐊᖓᔪᓚᓯᖅᓯᕐᒧᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 1 (June 1996 - May 1997)
ᐊᒻᒪᒍ 1 (ᔪᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖃᖅ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑦᑐᓗ	NOV ᐅᓇᕆᐹᓗ	DEC ᑎᓯᕆᐹᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖏᐅᐊᓗ	MAR ᒪᓯᓗ	APR ᐃᓚᓕᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	2	6	20	13	18			6	10	2	11	13	61
Musk-ox	ᐅᒥᖕᒪᐃᑦ	Umingmait		3											3
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᖁᐃᑦ	Amagut								4		1			4
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat						2		8	3	8	3		16
Coloured fox	ᖃᐅᖅᑭᑦᑐᑦ ᑎᓕᓴᓂᐊᑦ	Kalaliit tigiganiat												1	1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				1	2	1				4	1	1	6
Seals (unspecified)	ᓴᖅᑯᓪᓚᑦ	Natiit												4	4
Ringed seal	ᓇᕆᔨᑦ	Natiinat	2	3	16	7	13	2		4	2	16	8		45
Bearded seal	ᐅᓗᓪᓕᐃᑦ	Ukyuk			1	2				2			1		6
Narwhal	ᑐᐃᓪᓚᑦ ᖃᓪᓗᓂᑦ	Tuugaak			1										1
Snow goose	ᑲᖏᐃᑦ	Kanguq	2		1										3
Canada goose	ᓄᕐᓚᑦ ᐅᓇᐊᒧᓚᑦ	Nikliknik	2	1	3									2	7
Eider duck	ᑎᑎᑦ	Kingalik	1	1	1	4	1							1	8
Ptarmigan	ᐊᖃᓗᓯᑦ	Akilgik					2			1		3	1		6
Arctic char	ᐃᖃᓗᐲᐱᑦ	Ikaliviit	2	9	12	5	17	2	1	1		4	2	3	39
Lake trout	ᐃᓯᕐᐃᑦ	Ikalukpik	9	10	5		17	8	3	1	1	16	9	38	76
Whitefish	ᑲᐱᓯᓚᑦ	Kapihiliit			1		1								2

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕐᓯᒪᔪᓂᒃ ᐱᑕᖃᖅᑭᑐᖃᖅ ᐱᓪᔪᑎᓕᓂᓂᒃ ᐊᖓᔪᖅ ᖃᖅᑲᓂᓂᓕᓂ ᐊᓕᖁᐅᒪᔪᓂᓕᓂ ᐊᖓᔪᖅᓂ ᓇᓕᑲᕐᓗᒋᑦ ᑐᓂᓯᖅᓂᓂ ᐃᑯᐱᐊᓕᓚᓐᓇᕐᓂᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.2.6

TABLE/ᐅᓂᐅᓐᖏᑦᑐᑦ/NAUNAIKUTA 439

Monthly harvest estimates
ᑕᕝᑕᒧᑦ ᐊᖏᔪᓂᑦ ᐅᓪᑐᒥᓴᕐᔪᑎᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᑲᒍᒍ 2 (ᔮᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᕝᑕᒧᑦ/Tatkia			JUN ᔮᓂ	JUL ᔭᓪᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑦᑐᕆᓗ	NOV ᓄᕕᑲᓗ	DEC ᑎᓯᑲᓗ	JAN ᔮᖏᓂᓗ	FEB ᐃᖅᑐᓂᓗ	MAR ᒪᓯ	APR ᐃᑦᓀᓪ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᙵᑐᐃᑦ	Tuktut	97	43	114	359	12					2	2	8	637 ± 69
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait	5	3											8 ± 5
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡						3	1			4	5	2	15
Arctic fox	ᑎᓗᒃᑯᓂᐊᑦ	Tigiganiat			1			19	19	4					43 ± 5
Wolverine	ᖃᕐᕿᓵᑦ	Kalvik			1		2	2							5 ± 1
Arctic hare	ᐅᑲᓪᓕ	Ukalik								2	1				3 ± 2
Seals (unspecified)	ᓴᖅᑯᓪᓕ	Natiit		13	181	18	2	23				54	23	2	316 ± 67
Ringed seal	ᓇᓴᓪᓕ	Natiinat	70	18	73	200	19	10	30	25	14				459 ± 90
Bearded seal	ᐅᑭᔭᐃᑦ	Ukyuk	3		8	1									12 ± 5
Narwhal	ᑐᐊᓪᓕ ᖃᓪᓗᓐᓇᑦ	Tuugaak			2										2 ± 1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	117	10	5										132 ± 116
Canada goose	ᓄᑦᓕᓪᓕ ᐅᓗᐊᔪᓕᓪᓕ	Nikliknik	371	47										16	434 ± 223
Brant goose	ᓄᑦᓕᑦᓇᐃᑦ	Nirlirnaq	2												2 ± 2
White-fronted goose	ᓄᑦᓕᓪᓕ	Nirlivik	2												2 ± 2
Old squaw	ᐊᑭᓕᑦᔪᐃᑦ	Aahangik	3												3 ± 4
Eider duck	ᒥᑎᑦ	Kingalik	201	41	12	13									267 ± 166
Common loon	ᑐᓪᓚᔪᐊᑦ	Tuulik	5												5 ± 9
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	2		5	68						19			94 ± 43
Arctic char	ᐃᖕᓴᕆᐱᑦ	Ikaliviit	863	525	5,581	5,452	554	467	269			31		6	13,748 ± 2,057
Lake trout	ᐃᓕᖅᐃᑦ	Ikalukpik	4,365	2,267	1,184	615	413	23	195	115	284	68	250	459	10,238 ± 1,488
Whitefish	ᑲᐱᓕᓪᓕ	Kapihiliit		13					2			17	10		42 ± 27
Cod	ᐅᒪᐃᑦ	Ugak						26	37						63 ± 19

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓂᑦ ᑎᑎᕋᑕᒪᔪᑦ ᑐᓂᖅᑎᑦ ᐅᑯᐊ ᐃᑯᕐᓴᐅᓕᕆᓂᕐᒧᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 440

Monthly hunter response — **Year 2 (June 1997 - May 1998)**

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ — **ᐊᑦᕿᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)**

Tatkiktaman pijauhimajut angunahuktinun — **Ukiunga 2 (June 1997 - May 1998)**

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑯᕐᕕᓂ	NOV ᐃᓄᒻᕕᓂ	DEC ᑎᓯᒻᕕᓂ	JAN ᒎᓄᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᕐᓂ	APR ᐃᕐᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	229	229	228	229	228	227	227	226	225	221	215	214	231*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	138	186	210	203	224	223	223	214	210	103	96	96	228*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ	Angujaujut	62	41	65	64	32	23	23	13	19	8	9	12	126*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	60	81	92	89	98	98	98	95	93	47	45	45	78**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᕐᑕᒪᓐᓇᖅᑐᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ ᐊᑕᐅᓂᔪᓐᓇᖅᑐᑦ ᐊᑦᕿᒍᒥ.
** ᐊᑦᓴᒋᓕᕐᓂᒪᓗᓂᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.2.6

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 441

Recall period between harvest and interview, expressed as % of total harvest records — **Year 2 (June 1997 - May 1998)**

ᐅᑎᕋᐅᓂᔾᔪᑦ ᐊᑯᕋᓂ ᐊᖏᔪᓂᓄᓕᕐᓂᖓᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓂᖓᑕ, ᐅᓗᐅᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑎᑎᕋᕐᑕᐅᒪᔾᔨᑦ — **ᐊᑦᕿᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)**

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut — **Ukiunga 2 (June 1997 - May 1998)**

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑯᕐᕕᓂ	NOV ᐃᓄᒻᕕᓂ	DEC ᑎᓯᒻᕕᓂ	JAN ᒎᓄᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᕐᓂ	APR ᐃᕐᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕋᐅᓂᔾᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	21	100	100	99
4-6 months	4-6 ᑕᖅᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	79	0	0	1
> 6 months	> 6 ᑕᖅᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 442

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᓴᒃᑎᑦ ᐊᖏᔪᓚᓴᒃᑯᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 2 (June 1997 - May 1998)
ᐊᒃᑭᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᐱᓚ	OCT ᐅᑐᐱᓚ	NOV ᓄᐱᒃᐱᓚ	DEC ᑎᓯᒃᐱᓚ	JAN ᔮᖅᓄᐊᓚ	FEB ᓄᖅᑐᐊᓚ	MAR ᒪᓯ	APR ᐃᓴᓪᓗ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	23	18	27	47	6					1	1	2	72
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait	2	2											4
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓗᓚᓄᓕᐊᑦ	Tigiganiat			1			4	6	1					10
Wolverine	ᖃᕐᕿᓵᑦ	Kalvik			1		2	1							4
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik								1	1				1
Seals (unspecified)	ᓴᖅᑯᓪᓚᑦ	Natiit		3	29	4	1	10				5	4	1	43
Ringed seal	ᓇᓴᓪᓚᑦ	Natiinat	15	5	17	22	10	5	12	12	7				57
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk	1		4	1									6
Narwhal	ᑐᐃᓪᓚᑦ ᖁᓪᓗᓚᑦ	Tuugaak			1										1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	6	2	1										9
Canada goose	ᓄᓕᓪᓚᑦ ᐅᓂᐊᒍᑦᓪᓚᑦ	Nikliknik	22	6										1	27
Brant goose	ᓄᓕᓚᓇᐃᑦ	Nirlirnaq	1												1
White-fronted goose	ᓄᓕᓪᓚᑦ	Nirlivik	1												1
Old squaw	ᐊᒻᑭᐊᓕᐊᐃᑦ	Aahangik	1												1
Eider duck	ᒥᑎᑦ	Kingalik	13	1	3	3									15
Common loon	ᑐᓪᓚᓕᐊᑦ	Tuulik	1												1
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	1		1	8						1			10
Arctic char	ᐃᖅᓴᒃᐲᑦ	Ikaliviit	19	10	28	20	9	8	5			1		1	59
Lake trout	ᐃᓱᕐᕃᐃᑦ	Ikalukpik	50	22	13	8	11	2	5	4	14	2	4	8	83
Whitefish	ᑲᐱᓱᓪᓚᑦ	Kapihiliit		1					1			2	1		4
Cod	ᐅᓗᐃᑦ	Ugak						1	1						2

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓯᒪᔪᓂᒃ ᐱᕈᖅᖢᕐᕋᓂᒃ ᐱᓴᐊᓕᓐᓂᓂᒃ ᐊᖏᓴᑦ ᖃᕐᕿᐅᓂᖏᓐᓄᑦ ᐊᓕᓴᐅᒪᔪᓕᑦ ᐊᖏᓴᑦᓂ ᓇᓕᐅᖏᓐᓄᑦᓂ ᑐᓂᓴᖏᓐᓂ ᐃᑯᐱᕐᓂᓚᓵᓕᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 443

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᑦᔪᒍ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔮᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐹᓕ	OCT ᐅᑦᑐᕆᓕ	NOV ᐅᓇᓱᕆᓕ	DEC ᑎᓯᕆᓕ	JAN ᔮᖏᓇᓕ	FEB ᐃᖏᐅᓇᓕ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓂᒃ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᐃᑦ	Tuktut		4	43	44	88				26	16	34	33	288 ± 86
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait									3				3 ± 2
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡						1			5	6	2		14
Wolverine	ᖃᐅᕙᓵᑦ	Kalvik								2					2 ± 2
Arctic hare	ᐅᖃᓕᑦ	Ukalik												3	3 ± 5
Seals (unspecified)	ᓄᖓᑯᓕᑦ	Natiit	18	8	18		6	1	8						59 ± 30
Ringed seal	ᓇᓕᓂᑦ	Natiinat					2			2	4	7	10	41	66 ± 42
Bearded seal	ᐅᑭᔪᐃᑦ	Ukyuk			3	3									6 ± 6
Beluga	ᖃᑯᕆᑦ ᖃᓕᓚᒃ	Kilalugak			2										2 ± 2
Geese (unspecified)	ᓄᕐᓕᑦ	Kanguk	123												123 ± 225
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq												561	561 ± 876
Tundra swan	ᑳᓴᔪᐃᑦ	Kukyuk												88	88 ± 159
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᐅᓐᖏᑦ	Uluaguliit manniit												808	808 ± 1,463
Arctic char	ᐃᖃᓗᒃᑕᒃ	Ikaliviit	50	31	827		1,075	683	182	303				1,446	4,597 ± 2,262
Lake trout	ᐃᓱᕐᓴᐃᑦ	Ikalukpik	752	470		203	69				15			312	1,821 ± 919
Whitefish	ᑲᐱᓱᓕᑦ	Kapihiliit			237										237 ± 303

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓂᑦ ᑎᑎᕋᐅᒪᔨᑦ ᑐᓂᒃᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓇᓂᒃᑎᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 444

Monthly hunter response

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐱᓕᕆᔨ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔮᓂ	JUL ᔮᓪᐃ	AUG ᐊᐅᒃᔪᑎ	SEP ᓯᑎᒃᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᓕᓴᕐ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᒃ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ ᐊᑦᔪᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᕆᑦ	Tatkitaman angunahuktut titigait	214	215	214	215	213	213	212	210	210	209	210	215	222*
Hunters interviewed	ᐊᖏᔪᓂᕆᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	92	92	134	141	166	192	185	186	193	184	190	65	218*
Harvested	ᐊᖏᔪᓂᕆᑐᒋᓐ	Angujaujut	13	9	10	6	16	4	5	2	12	4	14	8	48*
Response Rate (%)	ᑭᐅᐊᓂᖏᑦ (%)	Kiujut (%)	43	43	63	66	78	90	87	89	92	88	90	30	72**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᕆᑦ ᐊᑎᓕᐅᑎᑕᒪᓕᕐᓂᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᕆᑐᒋᓐ ᐊᑕᐅᓂᐊᖅᓯᑎᐅᑉ ᐊᑦᔪᙱᑦ.
** ᐊᐅᔨᓂᕐᑎᓂᒪᓕᕐᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᐊᓂ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.2.6

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 445

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᐱᐅᓕᕐᑦ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓂᕆᓕᖅᓴᓂᖓᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᑕ, ᐅᓗᐅᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᕆᑕᑦ ᑎᑎᕐᓂᑦᑕᐅᒪᓕᕐᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐱᓕᕆᔨ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔮᓂ	JUL ᔮᓪᐃ	AUG ᐊᐅᒃᔪᑎ	SEP ᓯᑎᒃᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᓕᓴᕐ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᒃ Tamakiklugin
Recall Period	**ᐅᑎᕐᐱᐅᓕᕐᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑦ	≤ tatkin pingahut	0	100	100	100	100	80	83	100	100	100	100	100	90
4-6 months	4-6 ᑕᖅᑦ	tatkin hitaman 6nut	100	0	0	0	0	20	0	0	0	0	0	0	9
> 6 months	> 6 ᑕᖅᑦ	> 6 tatkin	0	0	0	0	0	0	17	0	0	0	0	0	1

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 446

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᑎᑦ ᐊᖏᔪᓚᐱᖅᑕᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 3 (June 1998 - May 1999
ᐊᒃᑭᒍ 3 (ᔪᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑦᑐᐱᓗ	NOV ᐅᓇᓴᐱᓗ	DEC ᑎᓯᐱᓗ	JAN ᒍᓐᓇᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᓯ	APR ᐃᓪᓚᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut		1	7	5	8				6	3	9	2	21
Musk-ox	ᐅᒥᓴᒪᐃᑦ	Umingmait									2				2
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolverine	ᖃᓘᕕᑦ	Kalvik								1					1
Arctic hare	ᐅᑲᓕᑦ	Ukalik												1	1
Seals (unspecified)	ᓂᖏᑯᓕᑦ	Natiit	4	2	4		2	1	3						12
Ringed seal	ᓇᓂᓂᑦ	Natiinat					1			1	3	2	7	4	15
Bearded seal	ᐅᓴᐊᐃᑦ	Ukyuk			2	1									2
Beluga	ᖃᑯᖅᑕᑦ ᖁᓕᓗᓚᑦ	Kilalugak			1										1
Geese (unspecified)	ᓄᖅᓕᑦ	Kanguk	1												1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq												2	2
Tundra swan	ᖁᓕᐊᐃᑦ	Kukyuk												1	1
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓄᑦ	Uluaguliit manniit												1	1
Arctic char	ᐃᖃᓗᐱᑦ	Ikaliviit	2	1	3		11	4	3	1				3	18
Lake trout	ᐃᓱᖏᐃᑦ	Ikalukpik	7	6		1	2				1			4	15
Whitefish	ᑲᕕᓱᓕᑦ	Kapihiliit			1										1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓱᒪᓕᕐᓂᖅ ᐱᑕᖃᖏᑕᒧᖃᖅ ᐱᒃᓴᑎᓪᓗᓂᖅ ᐊᖏᔪᒃ ᖃᑦᓯᐅᓂᖏᓐᓄᓪᓗ ᐊᓪᓚᖃᐅᔪᓪᓗ ᐊᐃᔪᓂᓪᓗᓂᒃ ᐊᖏᔪᓂᒃ ᓇᓪᑕᐅᑦᓯᐊᓂᖅ ᑐᓂᓯᔪᓐᓇᖅᑐᓂᒃ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.2.6

TABLE/ᐅᓗᐅᓇᕆᐅᑦ/NAUNAIKUTA 447

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᐅᓪᑐᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)
ᐊᓐᔅᔪᒍ 4 (ᔮᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᑲᓐᓂ/Tatkia			JUN ᔮᓂ	JUL ᔮᓪᐃ	AUG ᐊᐅᓚᑦᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓚᐱᓗ	DEC ᑎᓴᓚᐱᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᓴ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓂᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	39	69	279	298	106	7			17	11	76	49	951 ± 193
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait			4										4 ± 3
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡						5			2			2	9
Wolf	ᐊᒪᕐᕈᐃᑦ	Amagut						1					2		3 ± 2
Arctic fox	ᑎᓗᓚᖅᓂᐊᑦ	Tigiganiat						21	1		6	8			36 ± 12
Coloured fox	ᖃᐅᖅᑭᑦᑐᑦ ᑎᓗᓚᖅᓂᐊᑦ	Kalaliit tigiganiat						1							1 ± 0
Wolverine	ᖃᖅᓴᓕᑦ	Kalvik						1					2	1	4 ± 2
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik								2	6	6	3	25	42 ± 29
Arctic ground squirrel	ᓂᖅᓂᑦ	Hikhik				10									10 ± 4
Seals (unspecified)	ᓯᖏᑯᓪᓚᑦ	Natiit				64	47	77	27	10	5	18	31	5	284 ± 24
Ringed seal	ᓇᓕᓂᑦ	Natiinat	20	24	64	2		44			2			35	191 ± 43
Bearded seal	ᐅᓘᐊᐃᑦ	Ukyuk		6	2	1	1								10 ± 6
Beluga	ᖃᑯᕐᑦ ᖃᓪᓚᓕᑦ	Kilalugak			20	1	1								22 ± 17
Snow goose	ᑲᖏᐃᑦ	Kanguq	10											10	20 ± 19
Canada goose	ᓄᕐᓪᓕ ᐅᓗᐊᔪᓪᓚᑦ	Nikliknik	161												161 ± 260
Eider duck	ᒥᑎᑦ	Kingalik	29	10											39 ± 54
Ptarmigan	ᐊᖅᓴᑦ	Akilgik						21	6		5	7	33	3	75 ± 26
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᓚᖓᖏᑦ	Manniit	978											175	1,153 ± 1,749
Goose eggs	ᑲᖏᐃᑦ ᓚᖓᖏᑦ	Uluaguliit manniit	216												216 ± 330
Arctic char	ᐃᖃᓗᓴᐃᑦ	Ikaliviit	1,346	2,462	1,213	8,088	2,324	1,892	244	59	43	103	166	356	18,296 ± 2,781
Lake trout	ᐃᓕᑦᐃᑦ	Ikalukpik	2,445	2,741	346	653	565	701	244	389	260	234	377	1,572	10,527 ± 2,364
Whitefish	ᑲᐱᓕᓪᓚᑦ	Kapihiliit				454	376	677	47			8	3		1,565 ± 154
Cod	ᐅᓴᐃᑦ	Ugak									10	67	7		84 ± 64

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᓕᒃ ᑐᓂᖖᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᐊᕐᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 448

Monthly hunter response — **Year 4 (June 1999 - May 2000)**

ᑕᖅᑕᒪᒃᑕ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ — **ᐊᑦᕿᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)**

Tatkiktaman pijauhimajut angunahuktinun — **Ukiunga 4 (June 1999 - May 2000)**

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᐹᓗᓂ	OCT ᐅᑲᐅᓗᓂ	NOV ᐅᓇᕆᐹᓗᓂ	DEC ᑎᓯᐹᓗᓂ	JAN ᔮᖏᓇᓗᓂ	FEB ᕕᕐᕿᓗᓂ	MAR ᒪᕐᓯ	APR ᐃᓕᓴᕐ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔪᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑕ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	212	209	209	206	204	204	203	208	205	202	202	205	221*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	79	120	138	195	199	197	194	199	195	146	145	139	215*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᓂ	Angujaujut	12	36	37	73	51	44	16	23	23	20	28	50	123*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	37	57	66	95	98	97	96	96	95	72	72	68	79**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᑉᑕᒪᓐᓇᖅᑎᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑐᒥᓂᓂ ᐊᑕᐅᓂᐊᖅᓗᑎᒃᑎᑦ ᐊᑦᕿᒍ.
** ᐊᑦᓴᒋᓕᑎᓂᒪᓕᕆᓂ ᑕᖅᑕᒪᒃᑕ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.2.6

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 449

Recall period between harvest and interview, expressed as % of total harvest records — **Year 4 (June 1999 - May 2000)**

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐋᑯᕐᓴᒃ ᐊᖏᔪᓂᒃᑐᓂᖏᓐᓂᒃᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᓂᒃᑕ, ᐅᓗᐅᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᒪᔨᑦ ᐊᖏᔪᓂᒃᑐᑦ ᑎᑎᕐᕕᑦᑕᐅᒪᔾᔨᑦ — **ᐊᑦᕿᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)**

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut — **Ukiunga 4 (June 1999 - May 2000)**

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᐹᓗᓂ	OCT ᐅᑲᐅᓗᓂ	NOV ᐅᓇᕆᐹᓗᓂ	DEC ᑎᓯᐹᓗᓂ	JAN ᔮᖏᓇᓗᓂ	FEB ᕕᕐᕿᓗᓂ	MAR ᒪᕐᓯ	APR ᐃᓕᓴᕐ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲᑦ	≤ tatkin pingahut	100	36	100	16	99	100	100	100	100	55	95	100	77
4-6 months	4-6 ᑕᖅᑲᑦ	tatkin hitaman 6nut	0	64	0	84	1	0	0	0	0	45	5	0	23
> 6 months	> 6 ᑕᖅᑲᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 450

Number of hunters harvesting each species — **Year 4 (June 1999 - May 2000)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓕᓴᐃᒋᑦ ᐊᖏᔪᓕᓴᐅᕐᓯᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒡᖏᔪᒍ 4 (ᔦᓂ 1999 - ᒪᐃ 2000)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 4 (June 1999 - May 2000)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔦᓂ	JUL ᔨᓪᐃ	AUG ᐊᐅᒍᑎᑐᑎ	SEP ᓱᑎᐱᓗᓂ	OCT ᐅᑲᐃᓗᓂ	NOV ᓄᓇᒡᐱᓗᓂ	DEC ᑎᓯᒡᐱᓗᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᓇᖕᐅᐊᓂ	MAR ᒪᓯᓗ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᖅ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᐃᑦ	Tuktut	3	13	15	51	21	4			5	4	14	17	70
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait			2										2
Polar bear[#]	ᓇᓄᐃᑦ[#]	Nanuit[#]	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᖏᐃᑦ	Amagut						1					1		2
Arctic fox	ᑎᓕᑦᓂᓪᓕᐊᑦ	Tigiganiat						2	1		3	1			7
Coloured fox	ᖃᐅᓐᖓᑦᑐᑦ ᑎᓕᑦᓂᓪᓕᐊᑦ	Kalaliit tigiganiat						1							1
Wolverine	ᖃᖏᕕᑦ	Kalvik						1					1	1	3
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik								2	2	4	1	2	10
Arctic ground squirrel	ᓱᓴᓪᓚᑦ	Hikhik				1									1
Seals (unspecified)	ᓱᖃᐅᓪᓚᑦ	Natiit				22	18	20	10	6	2	4	9	1	51
Ringed seal	ᓇᓱᓚᑦ	Natiinat	3	5	12	1		10			1			10	28
Bearded seal	ᐅᓘᐊᐃᑦ	Ukyuk		2	1	1	1								4
Beluga	ᖃᐅᖏᑦ ᖃᓪᓗᓕᑦ	Kilalugak			6	1	1								7
Snow goose	ᑲᖏᐃᑦ	Kanguq	1											1	2
Canada goose	ᓄᑦᓚᓪᑦ ᐅᓗᐊᔪᓚᓪᑦ	Nikliknik	3												3
Eider duck	ᒥᑎᑦ	Kingalik	1	1											2
Ptarmigan	ᐊᖏᓘᑦ	Akilgik						4	1		1	1	3	1	8
Eggs (unspecified)	ᐊᓱᖏᑦ ᑎᒥᐊᑦ ᓚᓪᓄᖏᑦ	Manniit	1											1	2
Goose eggs	ᑲᖏᐃᑦ ᓚᓪᓄᖏᑦ	Uluaguliit manniit	1												1
Arctic char	ᐃᖃᓗᓴᐃᑦ	Ikaliviit	5	16	16	29	27	17	5	4	2	3	3	8	59
Lake trout	ᐃᓱᑦᐃᑦ	Ikalukpik	7	20	7	18	25	16	6	19	14	12	17	41	85
Whitefish	ᑲᐱᓱᓪᓚᑦ	Kapihiliit				5	9	11	2			1	1		19
Cod	ᐅᓗᐃᑦ	Ugak									1	3	1		4

6.2.6

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓗᒪᔪᓂᖅ ᐱᑕᖃᖏᑦᑐᖅ ᐱᓕᔪᑎᓪᓂᓂᖅ ᐊᖏᔪᒃ ᖃᕋᓴᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᖅᑐᑦ ᐊᖏᔪᓄᑦ ᓇᓪᑕᒃᑲᓐᓂᖅᓯᒪᔪᓄᑦ ᐊᑐᐅᖏᓐᓄᑦ ᑐᓂᔭᖏᓐᓂᖅ ᐃᓕᓴᕐᓂᓗᐊᖅᑐᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 451

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᑐᕐᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᓐᓂ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐊᓗ	OCT ᐅᑲᐃᓗ	NOV ᐅᓇᓚᐃᓗ	DEC ᑎᓯᐊᓗ	JAN ᔮᖏᓄᓗ	FEB ᓇᖕᐅᓄᓗ	MAR ᒪᕐᓯ	APR ᐃᕐᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	89	97	227	344	91	1		1	5	2	19	65	941 ± 65
Musk-ox	ᐅᒥᓴᒪᐃᑦ	Umingmait			3	1			1		1				6 ± 2
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡				2		2	3	2	1	1		3	14
Wolf	ᐊᒪᖏᐃᑦ	Amagut			45		1						1	1	48 ± 52
Arctic fox	ᑎᓗᒃᑯᐊᑦ	Tigiganiat						12	3	4	1	3			23 ± 6
Coloured fox	ᖃᓄᖕᑭᑐᑦ ᑎᓗᒃᑯᐊᑦ	Kalaliit tigiganiat								1					1 ± 0
Wolverine	ᖃᕐᕕᑦ	Kalvik								1	2	1			4 ± 1
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik			2	4	2	3	1	2	8	13	9	6	50 ± 8
Seals (unspecified)	ᓂᖅᓄᓪᓚᑦ	Natiit	54	44	51										149 ± 26
Ringed seal	ᓇᕐᓂᑦ	Natiinat	15		97	109	99	53	6	14	35	65	16	38	547 ± 52
Bearded seal	ᐅᑉᐊᕐᕆᑦ	Ukyuk	5	1	7	1								3	17 ± 5
Beluga	ᖃᓄᖅᑕ ᖃᓪᓗᓂᑦ	Kilalugak			7	1									8 ± 4
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq	55	15	9	12									91 ± 44
Canada goose	ᓄᕐᓚᑦ ᐅᓪᓗᐊᔪᓚᑦ	Nikliknik	7	4										6	17 ± 7
White-fronted goose	ᓄᕐᓚᑦ	Nirlivik	2											1	3 ± 2
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	22												22 ± 10
Pintail	ᖃᐅᓱᐊᕐᔨᑦ	Arnaviaq		1											1 ± 1
Eider duck	ᒥᑎᑦ	Kingalik	27	5	9	1	1							1	44 ± 19
Tundra swan	ᖃᐅᕐᔪᐃᑦ	Kukyuk	26												26 ± 19
Common loon	ᑐᑦᓚᑉᔪᐊᖅ	Tuulik			1										1 ± 1
Arctic loon	ᒪᑉᓗᓚᒃ	Maliriq		1											1 ± 1
Red-throated loon	ᖃᖅᓴᐅᑦ	Qaqhuaq	2												2 ± 2
Ptarmigan	ᐊᕐᑭᑦ	Akilgik				32	11	4	1		5			47	100 ± 25
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᒪᓂᖏᑦ	Manniit	3,430												3,430 ± 3,844
Goose eggs	ᑲᖏᔪᐃᑦ ᒪᓂᖏᑦ	Uluaguliit manniit	408	102											510 ± 391
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓂᖏᑦ	Nauyat manniit		22											22 ± 14
Arctic char	ᐃᖃᓗᒃᓴᑦ	Ikaliviit	3,915	4,394	2,487	4,494	3,896	3,247	586	145	31	283	166	366	24,010 ± 2,112
Lake trout	ᐃᓱᕐᕿᐃᑦ	Ikalukpik	5,519	4,425	360	636	1,164	113	92	100	114		426	1,119	14,068 ± 1,613
Whitefish	ᑲᐱᓯᓚᑦ	Kapihiliit			2		651	486	108			267	5		1,519 ± 454
Cod	ᐅᒪᐃᑦ	Ugak	47									76	40		163 ± 65

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᔪᓂᑦ ᑎᑎᕐᑐᒪᓕᐊᑦ ᑐᓂᒃᖏᑦ ᐅᑯᐊ ᐃᑯᕐᓴᓕᓂᓚᓵᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.2.6

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 452

Monthly hunter response

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᓚᕐᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑯᐊᓂ	NOV ᐅᐊᓚᕐᕕᓂ	DEC ᑎᓯᕐᕕᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᕕᒻᒥᐊᓂ	MAR ᒪᕐᓯ	APR ᐃᓴᖅᓭ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᓵᓚᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	205	206	206	207	207	208	206	205	204	205	204	204	212*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	139	171	143	170	172	193	198	194	191	196	190	191	209*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᓕᓂ	Angujaujut	65	62	57	64	54	31	14	19	23	30	26	51	120*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᓂᖏᑦ (%)	Kiujut (%)	68	83	69	82	83	93	96	95	94	96	93	94	87**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᕐᑕᒪᓪᓚᕆᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑐᒥᓂᓕᓂ ᐊᑕᐅᓯᐊᕐᓗᐊᑐᑎᑦ ᐊᓚᕐᔪᒥ.
** ᐊᐅᓚᓂᕐᑎᓯᒪᓪᓚᕆᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.2.6

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 453

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓂᒃᑐᓂᖓᓄᑦ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓄᑦ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓱ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑕᑦ ᑎᑎᕐᕕᑦᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᓚᕐᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑯᐊᓂ	NOV ᐅᐊᓚᕐᕕᓂ	DEC ᑎᓯᕐᕕᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᕕᒻᒥᐊᓂ	MAR ᒪᕐᓯ	APR ᐃᓴᖅᓭ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	100	78	100	99	100	100	100	100	100	100	100	100	97
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	22	0	1	0	0	0	0	0	0	0	0	3
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 454

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᖅᑎᑦ ᐊᖏᔪᓚᐱᖅᓯᒋᑦ ᐊᑐᓂᒃ ᐅᒪᓴᕐᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 5 (June 2000 - May 2001)
ᐊᒻᒋᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑲᐹᓗ	NOV ᐅᓇᕆᐹᓗ	DEC ᑎᓯᐹᓗ	JAN ᔮᖅᓇᐊᓗ	FEB ᓇᖕᖏᐊᓗ	MAR ᒪᑉᓯ	APR ᐃᑦᓀᓪᓚ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	24	27	40	47	18	1		1	1	1	7	26	77
Musk-ox	ᐅᒥᓴᒪᐃᑦ	Umingmait			2	1			1		1				4
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᖃᐃᑦ	Amagut			1		1						1	1	3
Arctic fox	ᑎᓗᒃᑑᓪᓕᐊᑦ	Tigiganiat						4	1	1	1	1			6
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓗᒃᑑᓪᓕᐊᑦ	Kalaliit tigiganiat								1					1
Wolverine	ᖃᑦᕕᓴᑦ	Kalvik								1	1	1			2
Arctic hare	ᐅᖃᓕᑦ	Ukalik			1	1	1	1	1	2	5	5	2	2	14
Seals (unspecified)	ᓄᖅᐃᓕᑦ	Natiit	14	12	12										31
Ringed seal	ᓇᓂᓪᑦ	Natiinat	5		20	20	22	15	3	7	15	17	6	17	51
Bearded seal	ᐅᑉᐊᐃᑦ	Ukyuk	3	1	4	1								3	10
Beluga	ᖃᐃᖏᑦ ᖃᓪᓗᓂᑦ	Kilalugak			3	1									4
Snow goose	ᑲᖏᐃᑦ	Kanguq	4	1	2	2									9
Canada goose	ᓄᑦᓕᓪᑦ ᐅᓗᐊᔪᓪᓕᓪᑦ	Nikliknik	2	2										4	8
White-fronted goose	ᓄᑦᓕᓪᑦ	Nirlivik	1											1	2
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	5												5
Pintail	ᖁᓕᒪᐊᕐᓕᑦ	Arnaviaq		1											1
Eider duck	ᒥᑎᑦ	Kingalik	6	1	1	1	1							1	9
Tundra swan	ᖁᓕᕐᐃᑦ	Kukyuk	1												1
Common loon	ᑐᑦᓚᓕᐊᖅ	Tuulik			1										1
Arctic loon	ᑲᓕᓪᓚᒃ	Maliriq		1											1
Red-throated loon	ᖃᖓᒪᐅᑦ	Qaqhuaq	1												1
Ptarmigan	ᐊᕐᓕᓂᑦ	Akilgik				3	3	2	1		2			3	12
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᒪᓂᓕᑦ	Manniit	3												3
Goose eggs	ᑲᖏᐃᑦ ᒪᓂᓕᑦ	Uluaguliit manniit	3	3											6
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓂᓕᑦ	Nauyat manniit		1											1
Arctic char	ᐃᖃᓗᓴᐃᑦ	Ikaliviit	44	37	25	26	29	26	6	3	2	6	5	9	83
Lake trout	ᐃᓯᕋᐃᑦ	Ikalukpik	47	44	11	13	20	2	3	9	8		18	44	94
Whitefish	ᑲᐱᓯᓂᑦ	Kapihiliit			1		3	2	1			17	1		23
Cod	ᐅᒪᐃᑦ	Ugak	1									3	1		4

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᖅ ᐱᑕᖃᖕᖏᑦᑐᖃᖅ ᐱᓱᐊᑎᓕᓂᖅ ᐊᖏᔪᑦ ᖃᕋᓯᐅᓂᖏᖕᓂᑦ ᐊᓪᓚᖃᖅᑐᑦ ᐃᓕᓴᕐᓂᐊᕐᓂᖓᓂ ᐊᑐᐃᓐᓇᖅᑐᑦ ᐃᓕᓴᕐᓂᐊᕐᓂᖓᓂ ᐃᓚᖃᖅᑐᑦ ᐃᓕᓴᕐᓂᐊᕐᓂᖓᓂ ᐃᓕᓴᕐᓂᐊᕐᓂᖓᓂ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.2.6

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 455

Annual harvest estimates and five-year mean

ᐊᓐᔪᔨᑦᑕᒡᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᑕᓱᒋᑦ ᐊᓚᓗ ᑕᓪᓕᓂᑦ-ᐊᓐᔪᔨᓂᑦ ᐊᐅᒋᓪᓕᕆᓚᕐᓂᑦ

Aragutamat angujauvaktun tatlman araguit iluani

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᓐᔪᔨᓂᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᓐᔪᔭ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᒋᓪᓕᕆᓚᕐᓂᑦ Amigaitkiyait
Species	ᐅᒪᔪᑦ	**Umajuin**						
Caribou[1]	ᑐᙵᐃᐃᑦ[1]	Tuktut[1]	636	637	288	951	941	691
Musk-ox[2]	ᐅᒥᓴᒪᐃᑦ[2]	Umingmait[2]	11	8	3	4	6	6
Polar bear[3]	ᓇᓄᐃᑦ[3]	Nanuit[3]	17	15	14	9	14	14
Wolf	ᐊᒪᕈᐃᑦ	Amagut	7	0	0	3	48	12
Arctic fox[4]	ᑎᓚᖏᓐᓄᐊᑦ[4]	Tigiganiat[4]	77	43	0	36	23	36
Coloured fox	ᖃᐅᓐᖓᑦᑐᑦ ᑎᓚᖏᓐᓄᐊᑦ	Kalaliit tigiganiat	2	0	0	1	1	1
Wolverine	ᖃᕐᕕᐃᑦ	Kalvik	0	5	2	4	4	3
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	31	3	3	42	50	26
Arctic ground squirrel	ᓯᖅᓯᓪᓚᑦ	Hikhik	0	0	0	10	0	2
Seals (unspecified)	ᓯᖓᐅᓪᓕᑦ	Natiit	17	316	59	284	149	165
Ringed seal	ᓇᕐᓯᓚᑦ	Natiinat	264	459	66	191	547	305
Bearded seal	ᐅᓗᔪᐃᑦ	Ukyuk	14	12	6	10	17	12
Narwhal[5]	ᑐᒍᓪᓕᑦ ᖁᓪᓗᓚᑦ[5]	Tuugaak[5]	1	2	0	0	0	1
Beluga[6]	ᖃᐅᔨᑦ ᖁᓪᓗᓚᑦ[6]	Kilalugak[6]	0	0	2	22	8	6
Geese (unspecified)[7]	ᓄᕐᓪᓕᑦ[7]	Kanguk[7]	0	0	123	0	0	25
Snow goose[7]	ᑲᖏᐃᑦ[7]	Kanguq[7]	21	132	561	20	91	165
Canada goose[7]	ᓄᕐᓪᓕᑦ ᐅᓗᐊᔪᓪᓕᑦ[7]	Nikliknik[7]	63	434	0	161	17	135
Brant goose[7]	ᓄᕐᓕᕐᓇᐃᑦ[7]	Nirlirnaq[7]	0	2	0	0	0	<1
White-fronted goose[7]	ᓄᕐᓪᓕᑦ[7]	Nirlivik[7]	0	2	0	0	3	1
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	0	0	0	0	22	4
Old squaw	ᐊᖏᐊᕐᕕᐃᑦ	Aahangik	0	3	0	0	0	1
Pintail	ᕐᓄᓕᐊᔪᓪᓕᑦ	Arnaviaq	0	0	0	0	1	<1
Eider duck[8]	ᒥᑎᑦ[8]	Kingalik[8]	100	267	0	39	44	90
Tundra swan[9]	ᕐᓄᔪᐃᑦ[9]	Kukyuk[9]	0	0	88	0	26	23
Common loon	ᑐᓪᓕᕐᕕᐊᑦ	Tuulik	0	5	0	0	1	1
Arctic loon	ᑲᓗᓪᓕᑦ	Maliriq	0	0	0	0	1	<1
Red-throated loon	ᖃᖓᓕᐅᑦ	Qaqhuaq	0	0	0	0	2	<1
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	36	94	0	75	100	61
Eggs (unspecified)[10]	ᓘᓐᓃᑦ[10]	Manniit[10]	0	0	0	1,153	3,430	917
Goose eggs[10]	ᑲᖏᐃᑦ ᓘᓐᓄᑦ[10]	Uluaguliit manniit[10]	0	0	808	216	510	307
Seagull eggs[10]	ᓇᐅᔨᐃᑦ ᓘᓐᓄᑦ[10]	Nauyat manniit[10]	0	0	0	0	22	4
Arctic char[11]	ᐃᖃᓗᐊᓂᑦ[11]	Ikaliviit[11]	13,129	13,748	4,597	18,296	24,010	14,756
Lake trout	ᐃᓕᖅᖃᐃᑦ	Ikalukpik	8,449	10,238	1,821	10,527	14,068	9,021
Whitefish	ᑲᐱᓕᓪᓕᑦ	Kapihiliit	230	42	237	1,565	1,519	719
Cod[12]	ᐅᒪᐃᑦ[12]	Ugak[12]	0	63	0	84	163	62

[1-12]: See page 581 for community feedback and other sources of data.

[1-12]: ᑕᐃᒃ ᓴᖅᑐᒃᖃᑦ 583 ᓄᓇᓕᓪᓕᑦ ᑭᐅᔨᓂᖅᑐᑦ ᐊᓚᓗ ᐊᓯᖏᓪᓕᑦ ᐱᖁᔨᓕᕐᓂᖅ ᓇᓴᐅᑎᓄᑦ.

[1-12]: Takulugu makpigaak 585 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

6.2.6

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 456

Annual hunter response — **All Years (June 1996 - May 2001)**

ᐊᓚᖏᔪᒪᒻᒪᑦ ᐊᖓᔪᓂᖅᓱᑦ ᑭᐅᓂᖏᑦ — **ᑕᒪᐃᓐᓄᑦ ᐊᓚᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)**

Angujauvaktu — **Tamamik ukiuni (June 1996 - May 2001)**

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖓᔪᓂᖅᓱᑦ ᑭᐅᓂᖏᑦ ᐊᔪᕐᓗᒍᓂᖏᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᑭᑦᒪᑦ ᐊᖓᔪᓂᖅᓱᑦ	Tatkitaman angunahuktut titigait	235	231	222	221	212	249*
Hunters interviewed	ᐊᖓᔪᓂᖅᓱᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	232	228	218	215	209	244*
Harvested	ᐊᖓᔪᓂᖅᑐᒥᓂᑦ	Angujaujut	120	126	48	123	120	187*
Response Rate (%)	ᑭᐅᑦ ᖃᑦᑕᐅᓂᖏᑦ (%)	Kiujut (%)	75	78	72	79	87	78**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖓᔪᓂᖅᓱᑦ ᐊᑎᓕᐅᕐᓂᒃᑯᑦ/ᐊᐱᕐᓂᑦ/ᐊᖓᔪᓂᖅᑐᒥᓂᑦ ᐊᑕᐅᓂᔪᓐᓇᖅᓱᑦ ᖃᐅᔨᓴᖅᓯᒪᔪᖅ.
** ᐱᖓᓱᓕᕆᓂᖅᓱᒃᑲ ᐊᖏᔪᑦᒪᑦ ᑭᐅᑦ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

6.2.6

TABLE/ᐅᓗᐅᐃᓴᐅᑦ/NAUNAIKUTA 457

Recall period between harvest and interview, expressed as % of total harvest records — **All Years (June 1996 - May 2001)**

ᐅᑎᕐᕕᐅᒃᑲᑦ ᐊᑯᖏᓐᓄᓂᖅᑕ ᐊᖓᔪᓂᓐᓂᓂᖅᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑎᐅᓂᖏᓐᓄᓂᖅᑕ, ᐅᓗᐅᐃᖏᑦ ᐃᒪᒃ % ᑲᑎᒪᔨᑦ ᐊᖓᔪᓂᖅᑎᑦ ᑎᑎᕐᓂᑎᐅᒪᒃᑲᑦ — **ᑕᒪᐃᓐᓄᑦ ᐊᓚᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)**

Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut — **Tamamik ukiuni (June 1996 - May 2001)**

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᒃᑲᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᑭᑦ	≤ tatkin pingahut	91	99	90	77	97	92
4-6 months	4-6 ᑕᑭᑦ	tatkin hitaman 6nut	9	1	9	23	3	8
> 6 months	> 6 ᑕᑭᑦ	> 6 tatkin	0	0	1	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 458

Number of hunters harvesting each species
ᖃᑦᕿᐅᓂᖅᑎᑦ ᐊᖏᔪᓕᒃᑎᑦ ᐊᖏᔪᓕᒃᑲᓪᓚᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ
Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓂᑦ ᐊᑦᕿᔪᓂᑦ (ᔨᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅᓯᒃ ᐊᑦᕿᔪᒃ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**						
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	61	72	21	70	77	120
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait	3	4	2	2	4	11
Polar bear[‡‡]	ᓇᓄᐃᑦ[‡‡]	Nanuit[‡‡]	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut	4			2	3	9
Arctic fox	ᑎᓇᓚᓐᓂᐊᑦ	Tigiganiat	16	10		7	6	30
Coloured fox	ᖃᐄᕐᕋᑦᑐᑦ ᑎᓇᓚᓐᓂᐊᑦ	Kalaliit tigiganiat	1			1	1	3
Wolverine	ᖃᕐᐸᒃ	Kalvik		4	1	3	2	7
Arctic hare	ᐅᑲᓕᑦ	Ukalik	6	1	1	10	14	22
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik				1		1
Seals (unspecified)	ᓱᖃᑉᓕᑦ	Natiit	4	43	12	51	31	80
Ringed seal	ᓇᕐᓱᑦ	Natiinat	45	57	15	28	51	91
Bearded seal	ᐅᓘᔪᐃᑦ	Ukyuk	6	6	2	4	10	24
Narwhal	ᑐᒍᓕᑦ ᖁᓕᓚᑦ	Tuugaak	1	1				2
Beluga	ᖃᐄᕐᑦ ᖁᓕᓚᑦ	Kilalugak			1	7	4	12
Geese (unspecified)	ᓂᕐᓕᑦ	Kanguk			1			1
Snow goose	ᑲᖏᐃᑦ	Kanguq	3	9	2	2	9	22
Canada goose	ᓂᕐᓕᑦ ᐅᓗᐊᔪᓕᑦ	Nikliknik	7	27		3	8	40
Brant goose	ᓂᕐᓕᕐᓇᐃᑦ	Nirlirnaq		1				1
White-fronted goose	ᓂᕐᓕᑦ	Nirlivik		1			2	3
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat					5	5
Old squaw	ᐊᐱᐊᕐᕿᐃᑦ	Aahangik		1				1
Pintail	ᕐᐱᓗᐊᕿᑦ	Arnaviaq					1	1
Eider duck	ᒥᑎᑦ	Kingalik	8	15		2	9	28
Tundra swan	ᕐᐱᕿᐃᑦ	Kukyuk			1		1	2
Common loon	ᑐᓕᕐᕿᐊᑦ	Tuulik		1			1	2
Arctic loon	ᑲᓘᓗᓕᑦ	Maliriq					1	1
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq					1	1
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	6	10		8	12	26
Eggs (unspecified)	ᓘᒃᓂᑦ	Manniit				2	3	4
Goose eggs	ᑲᖏᐃᑦ ᓘᒃᓂᖅᑎᑦ	Uluaguliit manniit			1	1	6	8
Seagull eggs	ᓇᐅᔨᐃᑦ ᓘᒃᓂᖅᑎᑦ	Nauyat manniit					1	1
Arctic char	ᐃᖏᓗᒃᐲᑦ	Ikaliviit	39	59	18	59	83	117
Lake trout	ᐃᓱᕐᕋᐃᑦ	Ikalukpik	76	83	15	85	94	154
Whitefish	ᑲᐱᓯᓕᑦ	Kapihiliit	2	4	1	19	23	35
Cod	ᐅᓴᐃᑦ	Ugak		2		4	4	8

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓯᒪᔪᓂᒃ ᐱᕈᖏᓐᓄᑦᑐᓂᒃ ᐱᓕᐊᓕᓐᓂᒃ ᐊᖏᔪᑦ ᖃᕐᕿᐅᓂᖅᓄᑦ ᐊᓕᕋᐅᓂᒃ ᐊᖏᔪᓄᑦ ᓇᓕᑲᐅᕐᓂᐅᓂ ᑐᓂᔅᓴᖅᓂ ᐃᓕᓴᕐᓂᐊᕐᓂᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.2.6

6.2.6 Community Results Discussion: Taloyoak

The survey frame:
An assessment of under-enumeration during the community visit indicated that there were very few Inuit hunters who were not registered in the Harvest Study. However it is estimated that there were three occasional hunters with assigned hunting rights who were not registered. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. However, the extent of the bias is likely very small since the missing hunters were all occasional hunters and only represent one percent of the total hunter population (Table 10).

Due to the relatively small number of intensive hunters registered in Taloyoak, the intensive classification was joined with the active classification for the purpose of calculating harvest estimates.

Survey coverage and non-response bias:
Response rates in the spring and summer were consistently low throughout the study; however there was some improvement in these rates in the final year. During the community consultation it was reported that hunters were out on the land during these months and very little backfill of data was done when they returned to the community until the final year of the study. Response rates in the spring and summer months were often below 50% and harvest estimates from these months should be used with caution. As seen in Table 9 the consistent intentional non-response rate in Taloyoak was low, at 0.4%, and was not thought to be a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough during most of the fall and winter months in all years to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should exercise caution when using the data collected during the spring and summer since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:
During the community visit hunters reported that when some people were interviewed regarding their arctic char catches – especially in the spring and winter when netting – numbers would be estimated. Hunters would be more likely to underestimate than overestimate which would result in lower than actual harvest estimates. It was also reported during the community consultation that egg harvests were under-reported. Further details are provided in the community feedback and other sources of data section below. Section 5.4 also contains a thorough discussion of this issue.

As seen in the recall period tables, during most months of the study the majority of harvest records were collected within three months of the harvest. However, there were several months in each year of the study where there was an increase in the percentage of records with recall periods of four to six months. These months should be noted since there is a greater potential for measurement error due to recall failure as recall periods increase.

Commercial quotas for arctic char were issued each year for Lord Lindsay Lake and Agnew River however no catches were reported back to DFO during this period. There were also experimental fishery licences for arctic char, lake trout and whitefish issued. Catches of char from these experimental licences were reported back to DFO in year 1 of the study (DFO F). It appears that some of these catches were likely reported during the study and estimates should be assumed to include the subsistence harvest and some of the commercial harvest.

Some caribou were sold to the local HTO by hunters during the study. These animals are included in the harvest estimates.

Community feedback and other sources of data:
Readers will note that the harvest estimates in year 3 are significantly lower than other years for almost all species. When discussing this issue at the community level, hunters reported that there was not a dramatic decrease in harvesting during that year. Although the reason for this apparent decrease in harvesting was not found, readers should exercise caution when using data from year 3. Almost all estimates are felt to be too low in this year. The comments to follow relate only to the other four years of the study and should also be considered.

1. **Caribou:** Caribou harvesting consisted of both barren-ground caribou and island caribou. Also, some hunters did not specify the type of caribou harvested. For the purpose of calculating harvest estimates they were combined into one category. Harvest estimates in years 4 and 5 appear to be in the right range. Some hunters sell caribou to the local HTO (C.F.).
2. **Musk-ox:** Harvest estimates seem low in all years. The HTO Board estimates that around 25 are harvested each year (C.F.).
3. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
4. **Arctic fox:** Numbers of fox will vary from year to year, affecting harvest numbers (C.F.). DSD reports were available for 1999/2000 and 2000/2001 (years 4 and 5) and indicate that 20 arctic fox pelts were purchased in 1999/2000 (year 4) and 6 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). This information suggests that harvest estimates for these years are in the right range.

[5] **Narwhal:** Harvest estimates seem accurate. The community had an annual quota of 10 animals but did not always harvest their full quota (C.F.). DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
0	0	n/d	0	3

[6] **Beluga:** The HTO holds an annual hunt for beluga and charters a plane for this purpose. Usually approximately 17-20 animals are harvested during this hunt (C.F.). Based in this information harvest estimates seem low in all years but year 4. Hunters reported that belugas were harvested in year 1 and data indicating no reported harvests seems inaccurate. DFO reports the following harvest numbers for beluga (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
15	n/d	n/d	n/d	22

[7] **Geese:** All harvest estimates seem too low. Most harvesting takes place from mid-May to the 1st week of July. Harvesters were out on the land and not reporting. It was during this period each year where response rates in Taloyoak declined for this reason. Hunters report that estimates for all types of geese are too low but primary harvesting is of snow geese and Canada geese. There is a major nesting site for snow geese near the community in the Marcheson River area; many are harvested here (C.F.).

[8] **Eider duck:** Both king and common eiders are harvested in the area. Although they have been less abundant in recent years, harvest estimates still appear to be too low in some years (C.F.).

[9] **Tundra swan:** There are always some harvested each year so the three years with no reported harvests are misleading. However, in year 3 it is unlikely that 88 were harvested, this estimate seems too high (C.F.).

[10] **Eggs:** Harvest estimates appear to be too low in all years. Harvesters collect a large number of eggs each year. Many hunters did not report their eggs. Some reasons were suggested to explain why, including that hunters may not have been specifically asked about their egg harvests or that they did not count their eggs so found it too difficult to estimate and report after the fact (C.F.).

[11] **Arctic char:** Harvest estimates seem to be in the right range except in year 3 when estimates seem much too low (C.F.). There is commercial fishing for arctic char around the community. Harvest estimates likely include these commercial harvests. Commercial quotas were issued each year for Lord Lindsay Lake and Agnew River however no catches were reported back to DFO during this period. There were also experimental fishery licences issued (DFO F).

[12] **Cod:** Hunters report that they are abundant around the community and some are harvested each year (C.F.).

6.2.6 ᓄᓇᕗᑦ ᓴᖅᑭᑕᐅᔭᓄᑦ ᐅᖃᖅᑎᑐᑦᑕᑎᑦ: ᑕᓪᓕᐊᕐᓇᖅ

ᖃᐅᔨᓴᓂᐅᑦ ᐊᑐᖅᑭᒪᓂᖅᓱ:

ᑐᑭᓯᑦᑕᐅᓇᓱᑎᓪᓗᑎ ᐊᑎᓕᐅᓇᖅᑐᓪᓗᐊᖅᓯᓂ ᓄᓇᓕ ᐳᓚᕆᖅᑕᐅᑎᓪᓗᑎ ᑕᐃᑎᕐᓯᒪᔨᖅᑐᑦ ᖃᓄᐃᓇᐅᓂᖅᓯᓕ ᐃᓄᐃᑦ ᐊᖏᓪᓚᐃᖅᑎᑦ ᑎᑎᕆᖅᑕᐅᓯᒪᔪᑎᑦᑐᑦ ᐊᖏᔪᒥᐅᑦᑎᓂᖅᑐᑦ ᖃᐅᔨᓴᓂᐅᑦ. ᑭᓯᐊᓂ ᓇᓕᑦᑎᑦᑎᐅᔪᖅ ᐊᑕᐅᓯᖅᑕᖃᓇᖅᓱᖏᓪ ᐊᖏᓇᓚᐃᖅᑎᑦᖃᓄᖅᑐᑦ ᐊᓪᓚ ᐱᖓᓱᓂ ᐊᖏᓇᓚᐅᖃᓇᖅᑐᓂᖅᑐᑦ ᐃᓅᓕᐅᓯᒪᔪᓂ ᐊᖏᓇᓚᐅᑭᓇᓂᑦ ᐱᓕᕆᓂᖅ ᐊᑎᖅᑐᓂᑦ ᑎᑎᕆᖅᑕᐅᓯᒪᓇᑦᑎᓂᖅᑐᑦ. ᐅᖃᖅᑐᓱᒪᒪᑕ ᓇᓴᓕᑎᑦ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓇᓱᑎᓪᓗᑎᓵᓂ ᐱᒍᑕᐅᓂᖅᓱ ᐊᑎᑭᓪᓕᑎᓯᒪᓚᖅᑐᑦ ᐅᒪᔪᕐᓇᖅᑕᐅᓯᖅᑐᑦ ᖃᓄᐃᓇᐅᓂᖅᓯᓕ ᐊᖏᓇᓚᐅᖃᓇᖅᑐᓂᖅᑐᑦ. ᐅᖃᖅᑐᓱᒪᒪᑕ ᓇᓴᓕᑎᑦ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓇᓱᑎᓪᓗᑎᓵᓂ ᐱᒍᑕᐅᓂᖅᓱ ᐊᑎᑭᓪᓕᑎᓯᒪᓚᖅᑐᑦ ᐅᒪᔪᕐᓇᖅᑕᐅᓯᖅᑐᑦ ᖃᓄᐃᓇᐅᓂᖅᓯᓕ ᐊᑎᖅᑐᓂᑦ ᑎᑎᕆᖅᑕᐅᓯᒪᔪᑎᑦᑐᑦ ᐃᓅᓕᐅᓯᒪᔪᓂ ᐊᑎᖅᑐᓂᑦ ᑎᑎᕆᖅᑕᐅᓯᒪᓇᑦᑎᓂᖅᑐᑦ ᐊᑎᓕᐅᓇᓱᑎᓪᓗᑎᓵᓂ ᐱᒍᑕᐅᓂᖅᓱ ᐊᑎᑭᓪᓕᑎᓯᒪᓚᖅᑐᑦ ᐅᒪᔪᕐᓇᖅᑕᐅᓯ

[2] **ᐅᒥᖏᒪᐃᐸᑦ:** ᐱᖃᓐᓂᑦᑐᑦ ᖃᓄᐃᓕᓂᒃ ᐊᑎᓕᐊᖏᑐᒍᓱᒃ ᑕᒪᐃᓐ ᐅᐱᐅᓂ. ᐊᖏᔪᓯᑐᓕᓚᓴᑦ ᑲᑎᒪᔨᖏᑦ ᒥᑦᓴᐅᓯᓯᒪᓱᑦ 25ᓂᒃ ᐅᒥᖏᒪᔨᑐᖏᓐᓇᖅᑐᒃ ᐊᑦᕿᔪᑕᒪᑦ (C.F.).

[3] **ᓇᓂᐃᑦ:** ᓇᓴᐅᑎᑦ ᑕᓀᔨᖏᐅᓱᑦ ᒥᑦᓴᐅᓯᑎᑕᐃᓇᐃᖏᑐᑐᑦ ᑭᓯᐊᓂ ᓇᓴᖃᑕᐅᓯᒪᓕᒋᑦᑐᑦ ᓂᓇᑦ ᓴᓴᒪᐃᓂ ᐃᓀᐦᐃᓕᓚᓴᐃᖏᑐᓂ (DSD PB).

[4] **ᑎᓚᖅᑐᐊᖏᖅ:** ᑎᓚᖅᑐᐊᓕ ᐅᓂᖅᑐᑦ ᐊᔨᑦᑎᑕᐃᓇᐅᒋᑦᑐᑦ ᐊᑦᕿᔪᓂ, ᐊᑐᐃᓂᖃᖅᓯᒋᑎᑎᑦ ᖃᒋᓯ ᐱᓕᐅᑲᓂᑦᑐᑦ (C.F.). ᐃᓀᐦᐃᓚᓴᐃᖏᑦ ᐊᒋᓕᓯᒪᕐᓂᖅᓴᖅᑐᑦ 1999/2000ᒧᑦ ᐊᒪᓚ 2000/2001ᒧᑦ (ᐅᑭᐅᓂ 4 ᐊᒪᓚ 5) ᐊᒪᓚᓗ ᑕᓀᑎᓯᓕᓚᑦ 20ᓂᒃ ᑎᓚᖅᑐᐊᕐᓴᒃ ᓂᐅᐃᖅᑐᖃᓚᐅᓂᖅᓴᖅᑐᒃ 1999/2000ᒥ (ᐅᑭᐅᖅᑎᑦ 4) ᐊᒪᓚᓗ ᐊᖅᓴᓂᑦ ᓂᐅᐃᖅᑕᐅᓪᓗᑎᒃ 2000/2001ᒥ (ᐅᑭᐅᖅᑎᑦ 5) (ᖃᐅᔨᓚᒥᑦ ᐃᓀᐦᐃᓚᓴᐃᖏᑦ ᓇᓴᐅᑎᑦ ᒪᓕᒪᓚᒥᑦ ᐱᑐᐊᖅᖃᖅᑐᒃ ᓴᓪᓚᒥᑦ, ᖃᐅᔨᔪᓂᒍᓪ ᐊᑦᓪᑕᐅᓯᒪᓚᐃᑦ ᒪᓕᒪᓚᒥᑦ ᐱᑎᐊᖅᑎᓪᓗᒍ ᓴᓪᓚᒥᑦ, ᖃᐅᔨᔪᓂᒍᓪ ᐊᑦᓪᑕᐅᓯᒪᓚᐃᑦ ᑕᓀᑎᓯᓚᑦ ᑎᓚᖅᑐᐊᕐᓴᒃ ᐅᑭᐅᓂ ᑕᐅᓐᓂᖅᑐᑦ, ᐅᒪᓚᓂᖅᑐᑦ ᒪᓕᒪᓚᒥᑦ ᑲᑎᒪᔨᖏᑦ ᐊᑦᕿᔪᑕᒪᑦ (C.F.). ᑕᒪᐃᐸᑦ ᐊᑦᓪᑕᐅᓯᒪᓚᐃᑦ ᑕᓀᑎᓯᓚᑦ ᑎᓚᖅᑐᐊᕐᓴᒃ ᐅᑭᐅᓂ ᑕᐅᓐᓂᖅᑐᑦ ᐊᑦᕿᔪᑕᒪᑦ.

[5] **ᔅᑎᓪᓂᑦ:** ᐱᔨᑦᑎᑕᐃᓇᐃᖏᑐᑦ ᖃᓄᐃᓕᓂᒃ ᓇᓗᒋᑦᑐᒃᓴᖅᑐᑦ. ᓄᓇᓂᑦ ᐊᑦᕿᔪᑕᒪᑦ ᒪᓕᒪᓚᒥᑦ ᑕᓀᑎᓯᓚᑦ ᑲᑎᒪᔨᖏᑦ ᐊᑐᖅᑐᑦ ᐊᑐᖅᑕᐃᓇᐃᖏᑐᑐᑦ ᐊᑦᕿᔪᑕᒪᑦ ᐊᑐᖅᑐᑦ ᐊᑐᖅᑕᐃᓇᐃᖏᑐᑐᑦ ᐊᑦᕿᔪᑕᒪᑦ (C.F.). ᐃᓚᒋᑦᑐᑕᓚᓇᐃᓕᓚᑦ ᐊᑦᓪᑕᐅᓯᒪᓚᐃᑦ ᐅᑭᐅᓂ ᐃᓚᓐᓂᑦ ᑐᓴᐅᒪᓂᖅᑐᑦ (ᖃᐅᔨᓚᒥᑦ ᐃᓚᒋᑦᑐᑕᓚᓇᐃᓕᓚᑦ ᓇᓗᒋᑦᑐᒃᓴᖅᑐᑦ ᓇᓗᒋᑦᑐᒃᓴᖅᑐᑦ ᒪᓕᒪᓚᒥᑦ ᑭᓇᐅᔭᓕᖅᑐᑦ ᒪᓕᒪᓚᒥᑦ ᐱᓇᓱᐊᖅᑐᑦ ᒪᓕᒪᓚᒥᑦ ᐃᓚᒋᑦᑐᑕᓚᓇᐃᓕᓚᑦ ᐅᑭᐅᓂ ᐃᓚᓐᓂᑦ ᔅᑎᓪᓂᑕᒥᓂᓪᓂ (ᖃᐅᔨᓚᒥᑦ ᐃᓚᒋᑦᑐᑕᓚᓇᐃᓕᓚᑦ ᓇᓗᒋᑦᑐᒃᓴᖅᑐᑦ ᒪᓕᒪᓚᒥᑦ ᐱᓇᓱᐊᖅᑐᑦ ᒪᓕᒪᓚᒥᑦ ᐃᓚᒋᑦᑐᑕᓚᓇᐃᓕᓚᑦ ᐅᑭᐅᓂ ᐃᓚᓐᓂᑦ ᔅᑎᓪᓂᑕᒥᓂᓪᓂ

6.2.6 Nunanit Iniktigutait Ukauhiit: Taloyoak

Ihivgiuktit Atugutait:
Ihivgiufaakhimayuni ataani naunaiyakhimayut nunani pulaakhimapluta takuhimayut ikitut Inuit umayukhiuktit titigaktauhimaitut Umayukhiukhimayut Ihivgiuktuni. Kihimi naunaiyakhimayuk pingahuuyut ilaani umayukhiukataktut tuniyauhimayut inminiigutinik titigakhimaitut. Ukakhimayut ilangani 5.2.1 ikpinagutait hamna ataani naunaiyakhimayuni pilaaktut ataanut ihumagiyaini umayukhiukhimayut naunaiyautaini. Kihimi , angitjutait ihumagiyaini mikiyut ilaungitut umayukhiuktit tamamik ilaani umayukhiukatamata ovalo pihimamata 1%mik tamaat umayukhiuktinit (ikpatauyak 10).

Taimaimat ikitut amigaitjutait umayukhiukatainaktut titigakhimayut Taloyoami, umayukhiukatainaktut naunaiyautait ilauhimayut umayukhiukataktut naunaiyautainut atugutini umayukhiukhimayut naunaiyautainut.

Ihivgiugutingit ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait upingaami ovalo auyami mikiyut tamaat ihivgiuktuni; kihimi naamakhivyaktut hapkoa naunaiyautait iniktigutaini ukiumi. Nunani ukakatigivlugit tuhaktitauhimayut umayukhiuktit nunamiiyukmata hapkoa tatkikhiutini ovalo pikataluangimata uktiktitihimayunik katitikhimayunik utigaagamik nunaminut kihimi iniktigutaini ukiumi ihivgiuktuni. Kiuhimayut naunaiyautait upingaami ovalo auyami tatkikhiutait ataanitut 50%nik ovalo umayukhiukhimayut naunaiyautait hapkoa tatkikhiutit atuktauyukhat ihumagilugit. Takuyauhimayut Ikpatauyami 9, pikataktut kiuyuitut naunaiyautait Taloyoami mikiyut 0.4%mik ovalo ihumaalugiyaungitut pilaaktainik atuktaini kiuyuitut ihumagiyaini.

Kiuhimayut naunaiyautait ihumagiyauyut angiyut ovalo kiuyuitut ihumagiyait mikiyut amigaivyaktuni ukiakhani ovalo ukiukhimayuni tamamik ukiuni piyaami nni pihimayut naamaktumik uktugutaini Nni umayukhiuktini. Taiguaktut atuktukhat ihumagilugit atuligumik katitikhimayut katitigutaini upingaami ovalo auyami pilaaktut tamamik uktugutit ihuinaagutait ovalo kiuyuitut ihumagiyait angilivaktut kiuhimayut naunaiyautait katagaagata.

Atugutingit ihumagiyait ovali kiuhimayut ihuinaagutait:
Nunamut pulaaktakhimapluni umayukhiuktit tuhaktitihimayut ilangit Inuit apikhutaugaagamik mikhaanut ikaliviit piyainik – ilaa upingaami ovalo auyami kuvyaktuligaagamik – amigaitjutait naunayakhimayut. Umayukhiuktit piniaktut ataani naunaiyautainik avataanut naunaiyakhimaitumik pipkaivakhutik iniktigutait ikitkiyat pihimayainit umayukhiukhimayut naunaiyautaini. Tuhaktitauhimayutlu nunamut ukakatigiyaini maniit pikiutakhimayut ataani tuhaktitaulikpaktut. Titigakhimayutlu pihimayut nunanit ukagutaini ovalo aalat atuktaini katitikhimayut ilangani hamani. Ilangani 5.4 pihimayutlu ukautainik hamna ihumagiyaini. Takukhauyut utiktitihimayuni ubluit ikpatauyami, amigaivyaktuni tatkikhiutini ihivgiuktitlugit amigaitkiyait umayukhiukhimayut titigakhimayut katitikhimayut iluani pingahut tatkikhiutini. Kihimi amigaivyaktut tatkikhiutit tamamik ukiuni ihivgiuktitlugit amigaikhimayut %kani titigakhimayut utiktitihimayut ubluit hitamanit siksinut tatkikhiutini. Hapkoa tatkikhiutit naunaiyakhimayukhat angiyuulaamata atugutingit ihuinaalaaktuni utiktihimayut pingitpata utiktitihimayut ubluit angiligaagata.

Kinauyaliugutit kotait ikaliviit tunihimayut tamamik ukiuni Lord Lindsay tahiani ovalo Agnew kuugaani, kihimi ikaluktait tuhagutingit tuhaktititauyuitut DFOkunut ukiumi 1mi ihivgiuktitlugit (DFO F). Takukhauyut ilangit hapkoa ikalukhimayut tuhaktititauhimayunakhiyut ihivgiuktitlugit ovalo naunaiyautait ilauyunakhiyut atuktakhaini umayukhiukhimayunut ovalo ilangit kinauyaliugutit umayukhiukhimayunut.

Ilangit tuktut niuviktitauhimayut nunani HTOkunut umayukhiuktinit ihivgiuktitlugit. Hapkoa umayut ilauhimayut umayukhiukhimayut naunaiyautaini.

Nunanit ukakhimayut ovalo aalani atukhimayaini katitikhimayuni:
Taiguaktut nalungitukhat umayukhiukhimayut naunaiyautait ukiumi 3mi angiyumik mikiyut aalanit ukiunit tamamivyak umayunik. Ukakatigilikhugit hamna ihumagiyauyuk nunani, umayukhiuktit tuhaktitihimayut angiyumik katakhimaitut umayukhiukhimayunik ukiungani. Kihimi hunmat hamna mikhihimayuk umayukhiukhimayunik nalvaakhimaitut, taiguaktut atuktukhat ihumagilugit atugutait katitikhimayut ukiumi 3mi. Tamakmivyak naunaiyautait ihumagiyait mikivalaat hamani ukiumi. Ukauhiit malikhimayuni mikhaanut talvatuak aipainut hitamat ukiuginut ihivgiuktitlugit ovalo ihumagiyauyukhat.

[1] **Tuktut:** Tuktut umayukhiukhimayut tamamik nunani tuktut ovalo kikiktani tuktut. Ovalo ilangit umayukhiuktit naunaiyayuitait kanugitut tuktut pivaktaini. Atuktaini hamna umayukhiukhimayut naunaiyautait katitikhimayut atauhimayut. Umayukhiukhimayut naunaiyautait ukiuni 4 ovalo 5 takukhauyut naamaktut. Ilangit umayukhiuktit niuviktitivaktut tuktunik nunamin HTOkunut (C.F.).

[2] **Umingmait:** Umayukhiukhimayut naunaiyautait mikiyut tamamik ukiuni. HTOkut katimayiit naunaiyakhimayut 25nik umayukhiukatakhimayut ukiuk tamaat (C.F.).

[3] **Nanuit:** Amigaitjutait takuhimayut naunaiyautaungitut kihimi pihimayut umayukhiukhimayut tunihimayait DSDkunit (DSD PB).

[4] **Tigiganiat:** Amigaitjutait tigiganiat aalangukataktut ukiuni, ikpinagivaktait umayukhiukhimayut amigaitjutait (C.F.). DSDkut tuhaktitihimayut pihimayut ukiuni 1999/2000 ovalo 2000/2001 (ukiuni 4 ovalo 5) ovalo pivaktut 20nik tigiganiat amiinik niuviktauhimayut 1999/2000mi (ukiumi 4) ovalo siksit niuviktauhimayut 2000/2001mi (ukiumi 5) (nalungilutit DSDkut katitikhimayait atukhimayut umayukhiugutaini ukiungit Julymit Junemut, Umayukhiukhimayut Ihivgiugutit katitikhimayut atukhimayut umayukhiugutaini ukiungit Junemit Maymut) (DSD FB). Hamna tuhagutikhait ukakhimayut umayukhiukhimayut naunaiyautait hapkonani ukiuni naamaktut.

[5] **Tuugaat:** Umayukhiukhimayut naunaiyautait naamaktut. Nunani ukiuk tamaat kotaliit kulinik tuugaanik kihimi pikatayuitait tamamik kotangit (C.F) DFOkut tuhaktitihimayut hapkoninga umayukhiukhimayut amigaitjutait tuugaat (nalungilutit DSDkut katitikhimayait atukhimayut umayukhiukhimayut ukiungini, Umayukhiukhimayut Ihivgiugutait katitikhimayut atukhimayut Junemit Maymut) (DSD N/B):

96/97	97/98	98/99	99/00	00/01
0	0	n/d	0	3

[6] **Kilalugat:** HTOkut tiguhimayait ukiuk tamaat umayukhiuktakhait kilalugat ovalo tinmiaktut hamna pivaktait. 17nit 20nut kilalugat pivaktut hamani umayukhiugaagamik (C.F.). Atukhugit hamna tuhagutikhat umayukhiukhimayut naunaiyautait mikiyut ukiuk tamaat kihimi ukiumi 4mi. Umayukhiuktit tuhaktitihimayut kilalugat pihimayut ukiumi 1 ovalo katitikhimayut pihimaitut tuhaktitihimayuni umayukhiukhimayut ihuinaakhimayut. DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait kilalugat (nalungilutit DFOkut katitikhimayait atukhimayut ukiungini, Umayukhiukhimayut Ihivgiugutait katitikhimayait atukhutik umayukhiukhimayuni ukiungit Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
15	n/d	n/d	n/d	22

[7] **Uluaguliit:** Tamamik umayukhiukhimayut naunaiyautait pikataktut kitkani Maymit hivulimut ubluini Julymut. Umayukhiuktit nunamiitpamata ovalo tuhaktitiyuitut. Hamani ubluini tamaat ukiuni kiuhimayut naunaiyautait Taloyoami katakpaktut hamani ubluini. Umayukhiuktit tuhaktitihimayut naunaiyautait tamamik uluaguliit mikiyut kihimi hivuliit umayukhiukhimayut kanguit ovalo uluaguliit. Angiyuk ivaviit kangunik haniani nunaminit Marcheson kuugaani; amigaitut umayukhiukhimayut tahamani (C.F.).

[8] **Tinmiat:** Tamamik kingaliit ovalo mitiit umayukhiukpaktut nunami. Kihimi ikililikpaktut hatjavyak ukiuni, umayukhiukhimayut naunaiyatait mikiyut ilangani ukiuni (C.F.).

[9] **Kukyuit:** Pikatainaktut umayukhimayut ukiuk tamaat, taimaimat pingahut ukiuni tuhaktitihimayut umayukhiukhimaitut ihuinaakhimayunakhiyut. Kihimi ukiumi 3mi pihimaitunakhiyut 88nik kukyunik, hamna naunaiyautait angivalaaktut (C.F.).

[10] **Maniit:** katitikhimayut naunaiyautait mikiyut tamamini ukiuni. Umayukhiuktit katitilikpaktut amigaitpiaktunik maninik ukiuk tamaat. Amigaitut umayukhiuktit tuhaktitiyuitait maniit. Ilangit ihumagiyait hunmat, ilauyut umayukhiuktit apigiyauyuimata maninik pikiutaktautainik ovaluniit amigaitjutait naunaiyayuimagit maniit pikiutihimayainik, taimaimat ayonagivlugit naunaiyagiami ovalo tuhaktitilugit pitaakhimayainik (C.F.).

[11] **Ikaliviit:** Umayukhiukhimayut naunaiyautait naamaktut kihimi ukiumi 3mi naunaiyautait mikiyut (C.F.). Kinauyaliugutinik ikalukhiugutikaktut ikalivinik haniani nunaminit. Umayukhiukhimayut naunaiyautait ilauyunakhiyut hapkoa kinauyaliugutit ikalukhimayuni. Kinauyaliugutikhat kotagit tunihimayut tamamik ukiuni Lord Lindsay Tahiani ovalo Agnew Kuugaani kihimi pivaktait tuhaktitihimaitut DFOkunut hamani. Uktugutinik ikalukhiugutainik laisinsikaktut tuniyauhimayunit (DFO F)).

[12] **Ugat:** Umayukhiuktit tuhaktitihimayut amigaitut ugat haniani nunamini ovalo pikataktut tamamik ukiuni (C.F.).

6.2.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 459

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓕᑎᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᓕᕐᒧᑐ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔮᓂ	JUL ᔮᓕᐃ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑦᑐᓇ	NOV ᐅᓇᓱᓇ	DEC ᑎᓯᓱᓇ	JAN ᔪᖏᓂᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᕕ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᔭᑐᐃᐃᑦ	Tuktut	7	9	24	8	3	57	22	24	13	40	49	58	314 ± 28
Wolf	ᐊᒪᓗᐃᐃᑦ	Amagut							4	1		5	11		21 ± 5
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat					1	15	4	1	3	13	5		42 ± 9
Coloured fox	ᖃᐅᖅᖢᑎᑦ ᑎᓕᓴᖅᓂᐊᑦ	Kalaliit tigiganiat						8	3		1	2			14 ± 3
Wolverine	ᖃᕐᕿᓵᑦ	Kalvik					4	3	3	2	1	5	2		20 ± 5
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik					7	8			1	2			18 ± 7
Arctic ground squirrel	ᐲᖅᓯᑦ	Hikhik			130	103							44	40	317 ± 77
Ringed seal	ᓇᓯᓯᑦ	Natiinat	3	1	3	7							1	1	16 ± 4
Canada goose	ᓄᕐᓪᓕᑦ ᐅᓗᐊᔪᓪᓕᑦ	Nikliknik	7											8	15 ± 8
White-fronted goose	ᓄᕐᓪᓕᑦ	Nirlivik		6											6 ± 2
Eider duck	ᒥᑎᑦ	Kingalik	3			10	37								50 ± 21
Ptarmigan	ᐊᖏᓚᑦ	Akilgik					3	17							20 ± 13
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᖓᓂᖅᑕᑦ	Uluaguliit manniit	46												46 ± 22
Duck eggs	ᒥᑎᑦ ᓚᖓᓂᖅᑕᑦ	Tinmiat manniit	69												69 ± 35
Seagull eggs	ᓇᐅᔨᐃᑦ ᓚᖓᓂᖅᑕᑦ	Nauyat manniit	85												85 ± 41
Arctic char	ᐃᖃᓗᓴᑦ	Ikaliviit	266	100	134	11	61	377	1	20	40			8	1,018 ± 172
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	91	16	10	5	8	183	18	8				12	351 ± 95
Whitefish	ᑲᐱᓱᓪᓕᑦ	Kapihiliit	10		4	6	20	75							115 ± 40
Cod	ᐅᓚᐃᑦ	Ugak			53		869	405							1,327 ± 385
Sculpin	ᑲᓕᔪᐃᑦ	Kanayuk					7								7 ± 5

TABLE/ᓇᓗᓇᐃᔨᐅᐅᑦ/NAUNAIKUTA 460

Monthly hunter response

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐃᓐᓴᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᔪᓂ	NOV ᐅᓇᓕᕐᓂ	DEC ᑎᓯᕐᓂ	JAN ᒍᖏᓂ	FEB ᐃᖅᑲᓂ	MAR ᒪᑉᔪ	APR ᐃᑦᓀᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᕆᑦ	Tatkitaman angunahuktut titigait	30	30	30	30	30	30	30	31	30	30	30	30	31*
Hunters interviewed	ᐊᖏᔪᓂᕆᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	23	27	27	25	23	26	28	30	26	28	28	25	31*
Harvested	ᐊᖏᔪᓂᕆᑐᓂᒃ	Angujaujut	19	13	19	10	17	19	13	9	6	14	12	13	29*
Response Rate (%)	ᑭᐅᔭᑦ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	77	90	90	83	77	87	93	97	87	93	93	83	88**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᕆᑦ ᐊᑎᓕᐅᕐᑕᒪᓕᕐᓂᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᕆᑐᓂᒃ ᐊᑕᐅᓯᐊᖅᓗᓂᑎᑦ ᐊᑦᔪᒪᑉ.
** ᐊᑦᔨᒋᓕᕐᓯᒪᓕᕐᔾᔨᑦ ᑕᖅᑕᒪᑦ ᑭᐅᔭᑦ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.2.7

TABLE/ᓇᓗᓇᐃᔨᐅᐅᑦ/NAUNAIKUTA 461

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔭᑦ ᐊᑯᖏᓐᓂ ᐊᖏᔪᓯᓂᖓᓐᓇᑕ ᐊᒪᓗ ᐊᐱᕐᓯᕐᑕᐅᓂᖓᓐᓇᑕ, ᓇᓗᓇᐃᖏᑦ ᐃᒪᓐ % ᑲᑎᑦᑎᑦ ᐊᖏᔪᓂᕆᑦ ᑎᑎᕐᕕᐅᒪᔭᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐃᓐᓴᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᔪᓂ	NOV ᐅᓇᓕᕐᓂ	DEC ᑎᓯᕐᓂ	JAN ᒍᖏᓂ	FEB ᐃᖅᑲᓂ	MAR ᒪᑉᔪ	APR ᐃᑦᓀᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔭᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	90	93	92	100	100	99
4-6 months	4-6 ᑕᖅᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	10	7	8	0	0	1
> 6 months	> 6 ᑕᖅᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 462

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓯᓗᒋᑦ ᐊᖏᔪᓯᓚᐅᕐᓂᑦ ᐊᑐᓂᒃ ᐅᓪᓗᕆᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 1 (June 1996 - May 1997)
ᐊᒻᒋᒍ 1 (ᔨᓂ 1996 - ᓪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑦᐱᓇ	NOV ᐅᓂᐸᓇ	DEC ᑎᓯᐸᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕆ	APR ᐃᑦᓇᓗ	MAY ᓪᐃ	Total ᑲᑎᑦᑎᓂ Tamakiklugin
Species	ᐅᓪᓗᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	4	6	10	4	1	14	10	8	4	11	8	9	19
Wolf	ᐊᒪᓕᐃᑦ	Amagut							2	1		2	3		4
Arctic fox	ᑎᓇᓚᖓᐊᑦ	Tigiganiat					1	4	3	1	1	2	2		5
Coloured fox	ᖃᓄᖅᑭᑦᑐᑦ ᑎᓇᓚᖓᐊᑦ	Kalaliit tigiganiat						4	2		1	2			4
Wolverine	ᖃᑦᕃᓵᑦ	Kalvik					1	1	2	2	1	4	2		5
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik					1	3			1	1			3
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik			6	4							4	4	14
Ringed seal	ᓇᑭᓱᑦ	Natiinat	1	1	2	5							1	1	8
Canada goose	ᓄᑦᓕᓪᑦ ᐅᓗᐊᔪᑦᓕᓪᑦ	Nikliknik	3											1	4
White-fronted goose	ᓄᑦᓕᓪᑦ	Nirlivik		2											2
Eider duck	ᒥᑎᑦ	Kingalik	2			2	4								7
Ptarmigan	ᐊᖏᓚᑎᑦ	Akilgik					1	1							2
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᒃᓄᖅᑦ	Uluaguliit manniit	6												6
Duck eggs	ᒥᑎᑦ ᓚᒃᓄᖅᑦ	Tinmiat manniit	4												4
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᒃᓄᖅᑦ	Nauyat manniit	5												5
Arctic char	ᐃᖏᓗᒃᐲᑦ	Ikaliviit	13	9	10	1	2	6	1	1	1			2	22
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	7	1	4	1	2	8	1	1				5	18
Whitefish	ᑲᐱᓱᓕᓪᑦ	Kapihiliit	1		1	1	1	4							6
Cod	ᐅᒪᐃᑦ	Ugak			3		15	4							17
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk					2								2

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 463

Monthly harvest estimates — Year 2 (June 1997 - May 1998)

ᑕᕿᑕᒫᑦ ᐊᖑᔭᓄᑦ ᓇᓚᐅᑦᓴᕈᑏᑦ — ᐊᒃᕌᒍ 2 (ᔪᓂ 1997 - ᒪᐃ 1998)

Tatkiktamat nahaktauvaktun — Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒡᒍᑎ	SEP ᓱᑎᒃᐱᕆ	OCT ᐅᑦᑐᐱᕆ	NOV ᓈᕕᒃᐱᕆ	DEC ᑏᓱᒃᐱᕆ	JAN ᔭᓐᓄᐊᕆ	FEB ᕕᕐᕗᐊᕆ	MAR ᒫᑦᓯ	APR ᐃᑦᕆᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	6	4	47	19	3	57	6	24	33	14	10	24	247 ± 17
Wolf	ᐊᒪᕈᐃᑦ	Amagut						6	5		1		2	1	15 ± 1
Arctic fox	ᑎᕆᒐᓐᓂᐊᑦ	Tigiganiat					6	37	20	1	1				65 ± 4
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᕆᒐᓐᓂᐊᑦ	Kalaliit tigiganiat						1	1		2				4 ± 1
Wolverine	ᖃᕐᕕᑦ	Kalvik					4	5	5	6	2	2	3		27 ± 3
Arctic hare	ᐅᑲᓖᑦ	Ukalik								3			2		5 ± 2
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik		8	28	24							19	24	103 ± 22
Seals (unspecified)	ᓱᖅᑯᓖᑦ	Natiit			1									3	4 ± 1
Ringed seal	ᓇᑦᓱᑦ	Natiinat		1		3	1	1						1	7 ± 1
Bearded seal	ᐅᒡᔪᐃᑦ	Ukyuk					1								1 ± 1
Canada goose	ᓂᑦᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik	7	18	4									7	36 ± 11
Pintail	ᖁᒻᒧᐊᔪᑦ	Arnaviaq		6											6 ± 3
Tundra swan	ᖁᒻᔪᐃᑦ	Kukyuk												1	1 ± 1
Seagull eggs	ᓇᐅᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	23												23 ± 17
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	85	44	173	11	280	192	34					46	865 ± 124
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	48		16	3	27	78			14		5	83	274 ± 24
Whitefish	ᑲᕕᓱᓖᑦ	Kapihiliit	3	15	3	13	49	9							92 ± 19
Cod	ᐆᒐᐃᑦ	Ugak	43	86			248	360	129	30	2				898 ± 72
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk							2						2 ± 0

6.2.7

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 464

Monthly hunter response
ᑕᖏᑦᑕᒪᑦ ᐊᖏᔪᓇᓱᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᑦᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖏᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᑦᔪᑎ	SEP ᓱᑎᑦᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᓇᑦᐱᓗ	DEC ᑎᓯᑦᐱᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᔪ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᑎᑦ ᑭᐅᓂᖏᑦ ᐋᔪᓕᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑦᑕᒪᑦ ᐊᖏᔪᓇᓱᑎᑦ	Tatkitaman angunahuktut titigait	30	29	29	29	28	27	28	27	27	27	25	27	30*
Hunters interviewed	ᐊᖏᔪᓇᓱᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	26	27	28	28	25	27	28	27	26	18	22	24	29*
Harvested	ᐊᖏᔪᓇᓱᑐᒃᑯᓂ	Angujaujut	14	8	17	11	18	18	11	13	11	2	7	18	27*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓕᔾᐅᓂᖏᑦ (%)	Kiujut (%)	87	93	97	97	89	100	100	100	96	67	88	89	92**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᑎᑦ ᐊᑎᓕᐅᑦᑕᒪᓕᕆᓂᖅ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓇᓱᑐᒃᑯᓂ ᐊᑕᐅᓯᐊᖓᔪᓂᑦᑎᑎᒃ ᐊᑦᖁᒍ.
** ᐊᑦᔨᒋᓕᑎᓯᒪᓕᕆᓂ ᑕᖏᑦᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.2.7

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 465

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᓂᓂ ᐊᖏᔪᓇᓯᓂᖓᓂᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓂᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓇᓱᑦᑕ ᑎᑎᕐᑦᑕᐅᒪᔨᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)
ᐊᑦᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖏᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᑦᔪᑎ	SEP ᓱᑎᑦᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᓇᑦᐱᓗ	DEC ᑎᓯᑦᐱᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᔪ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 466

Number of hunters harvesting each species — Year 2 (June 1997 - May 1998)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖑᓇᓱᒃᑏᑦ ᐊᖑᓇᓱᒃᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐆᒪᔪᕐᓂᒃ — ᐊᒃᕌᒍ 2 (ᔪᓂ 1997 - ᒪᐃ 1998)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒡᒍᑎ	SEP ᓱᑎᒻᐱᕆ	OCT ᐅᑦᑐᐱᕆ	NOV ᓈᕕᒻᐱᕆ	DEC ᑏᓱᒻᐱᕆ	JAN ᔮᓐᓄᐊᕆ	FEB ᕕᕐᕗᐊᕆ	MAR ᒪᑦᓯ	APR ᐃᕐᕆᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	3	3	12	7	2	9	2	8	8	2	3	5	16
Wolf	ᐊᒪᕈᐃᑦ	Amagut						2	2		1		2	1	5
Arctic fox	ᑎᕆᒐᓐᓂᐊᑦ	Tigiganiat					1	6	4	1	1				10
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᕆᒐᓐᓂᐊᑦ	Kalaliit tigiganiat						1	1		2				4
Wolverine	ᖃᕐᕕᑦ	Kalvik					2	5	3	3	2	1	2		6
Arctic hare	ᐅᑲᓖᑦ	Ukalik								1			1		2
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik		1	4	1							2	2	7
Seals (unspecified)	ᓱᖅᑯᓖᑦ	Natiit			1									3	4
Ringed seal	ᓇᑦᓱᑦ	Natiinat		1		2	1	1						1	5
Bearded seal	ᐅᒡᔪᐃᑦ	Ukyuk					1								1
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik	2	2	1									2	5
Pintail	ᕐᑯᒻᒧᐊᔪᑦ	Arnaviaq		1											1
Tundra swan	ᕐᑯᒻᔪᐃᑦ	Kukyuk												1	1
Seagull eggs	ᓇᐅᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	1												1
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	4	4	5	2	5	5	1					5	15
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	8		3	2	4	6			2		1	12	18
Whitefish	ᑲᕕᓯᓖᑦ	Kapihiliit	1	2	2	1	5	3							7
Cod	ᐆᒐᐃᑦ	Ugak	1	1			13	7	3	5	1				15
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk							1						1

6.2.7

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 467

Monthly harvest estimates — Year 3 (June 1998 - May 1999)

ᑕᕿᑕᒫᑦ ᐊᖑᔭᓄᑦ ᓇᓚᐅᑦᓴᕈᑏᑦ — ᐊᒃᕋᒍ 3 (ᔪᓂ 1998 - ᒪᐃ 1999)

Tatkiktamat nahaktauvaktun — Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒃᒍᑎ	SEP ᓱᑎᒃᐱᕆ	OCT ᐅᑦᑐᐱᕆ	NOV ᓈᕕᒃᐱᕆ	DEC ᑏᓯᒃᐱᕆ	JAN ᔭᓐᓄᐊᕆ	FEB ᕕᕐᕗᐊᕆ	MAR ᒫᑦᓯ	APR ᐃᑦᕆᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	10	8	18	4	1	21	31	23	17	6	12	4	155 ± 15
Wolf	ᐊᒪᕈᐃᑦ	Amagut								2	9	3	2	1	17 ± 5
Arctic fox	ᑎᕆᒐᓐᓂᐊᑦ	Tigiganiat						1		5	1				7 ± 2
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᕆᒐᓐᓂᐊᑦ	Kalaliit tigiganiat						1	3	2	5	2			13 ± 3
Wolverine	ᖃᕐᕕᑦ	Kalvik						1	1		5	2	2		11 ± 2
Arctic hare	ᐅᑲᓖᑦ	Ukalik				1	4	1		2	4				12 ± 4
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			16	14	4								34 ± 11
Seals (unspecified)	ᓱᖅᑯᓖᑦ	Natiit	3			5									8 ± 4
Bearded seal	ᐅᒡᔪᐃᑦ	Ukyuk			1		1								2 ± 1
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik		5											5 ± 4
Eider duck	ᒥᑏᑦ	Kingalik				13		5							18 ± 8
Tundra swan	ᖁᒡᔪᐃᑦ	Kukyuk												1	1 ± 1
Ptarmigan	ᐊᕿᒡᒋᑦ	Akilgik						4			3		13		20 ± 2
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	154	128	143			339	6		96			4	870 ± 135
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	180	7	6		10	44			25		3	110	385 ± 97
Whitefish	ᑲᕕᓱᓖᑦ	Kapihiliit			8		14	95							117 ± 45
Cod	ᐆᒐᐃᑦ	Ugak						237	100	21					358 ± 57

TABLE/ᓇᓗᓇᐃᔨᐅᐅᑦ/NAUNAIKUTA 468

Monthly hunter response

ᑕᖏᑕᒻᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐱᓕᕆᔨ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖏᖑᓚ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᓚᔭᑎ	SEP ᓯᑎᕐᕕᓪ	OCT ᐅᑦᔪᕕᓪ	NOV ᐃᓄᓚᕕᓪ	DEC ᑎᓯᓚᕕᓪ	JAN ᒍᖏᓄᕕᓪ	FEB ᐃᖅᑲᐊᓪ	MAR ᒪᕐᔪ	APR ᐃᑦᓇᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᔨᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔨᓚᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒻᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	21	20	19	19	18	17	17	16	16	16	16	17	21*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	16	17	17	16	16	16	16	15	15	15	16	14	19*
Harvested	ᐊᖏᔪᓂᒃᑎᑐᓂ	Angujaujut	10	9	9	7	5	13	11	7	9	5	5	4	16*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓕᑐᓂᖏᑦ (%)	Kiujut (%)	76	85	89	84	89	94	94	94	94	94	100	82	90**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᔭᑦᑕᒪᓕᕆᔨᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑎᑐᓂ ᐊᑕᐅᓂᔪᓇᔭᑎᑐᑦ ᐊᓕᕐᒥᑦ.
** ᐊᓕᒍᓂᓕᕆᓚᓕᔪᑦ ᑕᖏᑕᒻᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.2.7

TABLE/ᓇᓗᓇᐃᔨᐅᐅᑦ/NAUNAIKUTA 469

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᖏᓂ ᐊᖏᔪᓂᒃᑐᓂᖏᓐᓂᑕ ᐊᓚᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᓂᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᔨᑦ ᐊᖏᔪᓂᒃᑐᑦ ᑎᑎᕐᕕᑦᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐱᓕᕆᔨ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖏᖑᓚ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᓚᔭᑎ	SEP ᓯᑎᕐᕕᓪ	OCT ᐅᑦᔪᕕᓪ	NOV ᐃᓄᓚᕕᓪ	DEC ᑎᓯᓚᕕᓪ	JAN ᒍᖏᓄᕕᓪ	FEB ᐃᖅᑲᐊᓪ	MAR ᒪᕐᔪ	APR ᐃᑦᓇᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᔨᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 470

Number of hunters harvesting each species — Year 3 (June 1998 - May 1999)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖑᓇᓱᒃᑏᑦ ᐊᖑᓇᓱᒃᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐆᒪᔪᕐᓂᒃ — ᐊᒃᕌᒍ 3 (ᔪᓂ 1998 - ᒪᐃ 1999)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒃᒍᑎ	SEP ᓱᑎᒃᐱᕆ	OCT ᐅᑦᑐᐱᕆ	NOV ᓈᕕᒃᐱᕆ	DEC ᑏᓱᒃᐱᕆ	JAN ᔮᓐᓄᐊᕆ	FEB ᕕᕐᕗᐊᕆ	MAR ᒪᑦᓯ	APR ᐃᕐᕆᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	1	4	7	2	1	5	8	7	6	2	3	1	10
Wolf	ᐊᒪᕈᐃᑦ	Amagut								1	1	3	2	1	3
Arctic fox	ᑎᕆᒐᓐᓂᐊᑦ	Tigiganiat						1		2	1				3
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᕆᒐᓐᓂᐊᑦ	Kalaliit tigiganiat						1	1	1	3	2			5
Wolverine	ᖃᕐᕕᑦ	Kalvik						1	1		3	1	1		4
Arctic hare	ᐅᑲᓖᑦ	Ukalik				1	1	1		1	2				4
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			2	2	1								4
Seals (unspecified)	ᓱᖅᑯᓖᑦ	Natiit	1			2									2
Bearded seal	ᐅᒡᔪᐃᑦ	Ukyuk			1		1								2
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik		1											1
Eider duck	ᒥᑏᑦ	Kingalik				2		1							2
Tundra swan	ᖁᒡᔪᐃᑦ	Kukyuk												1	1
Ptarmigan	ᐊᕿᒡᒋᑦ	Akilgik						2			1		1		3
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	6	8	4			5	1		2			1	12
Lake trout	ᐃᓱᕐᐃᑦ	Ikalukpik	8	2	1		2	5			3		2	3	12
Whitefish	ᑲᕕᓱᓖᑦ	Kapihiliit			2		1	4							6
Cod	ᐆᒐᐃᑦ	Ugak						6	5	1					7

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 471

Monthly harvest estimates — Year 4 (June 1999 - May 2000)

ᑕᕿᑕᒫᑦ ᐊᖑᔭᓄᑦ ᓇᓚᐅᑦᓴᕈᑏᑦ — ᐊᒃᕋᒍ 4 (ᔪᓂ 1999 - ᒪᐃ 2000)

Tatkiktamat nahaktauvaktun — Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒃᒍᑎ	SEP ᓱᑎᒃᐱᓇ	OCT ᐅᑦᑐᐱᓇ	NOV ᓈᕕᒃᐱᓇ	DEC ᑏᓱᒃᐱᓇ	JAN ᔭᓐᓄᐊᓇ	FEB ᕕᕐᕗᐊᓇ	MAR ᒫᑦᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	1	3	4	17	5	33	13	12	6	5	2	10	111 ± 11
Wolf	ᐊᒪᕈᐃᑦ	Amagut									3	8	1	1	13 ± 4
Arctic fox	ᑎᓇᒐᓐᓂᐊᑦ	Tigiganiat							1						1 ± 1
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᓇᒐᓐᓂᐊᑦ	Kalaliit tigiganiat							5						5 ± 3
Wolverine	ᖃᕐᕕᑦ	Kalvik						1	3	3	4	2			13 ± 3
Arctic hare	ᐅᑲᓖᑦ	Ukalik					1								1 ± 1
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			31	46							1	16	94 ± 22
Seals (unspecified)	ᓱᖅᑯᓖᑦ	Natiit												1	1 ± 1
Ringed seal	ᓇᑦᓱᑦ	Natiinat			1										1 ± 1
Canada goose	ᓂᑦᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik	2	21	2										25 ± 20
Eider duck	ᒥᑏᑦ	Kingalik	1				12								13 ± 6
Tundra swan	ᖁᒃᔪᐃᑦ	Kukyuk												1	1 ± 1
Ptarmigan	ᐊᕿᒃᑦ	Akilgik						11		12			11		34 ± 11
Tundra swan eggs	ᖁᒃᔪᐃᑦ ᒪᓐᓂᖏᑦ	Kukyut manniit												3	3 ± 2
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	104	89	158	38	125	120		1				13	648 ± 100
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	276				86	94		2	13	10	2	29	512 ± 63
Whitefish	ᑲᕕᓱᓖᑦ	Kapihiliit			2	17	62	17							98 ± 35
Cod	ᐆᒐᐃᑦ	Ugak				13	424	209		9					655 ± 84

6.2.7

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 472

Monthly hunter response — **Year 4 (June 1999 - May 2000)**

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᕆᔨᑦ ᑭᐅᓂᖏᑦ — **ᐊᓯᖏᔪ 4 (ᔦᓂ 1999 - ᒪᐃ 2000)**

Tatkiktaman pijauhimajut angunahuktinun — **Ukiunga 4 (June 1999 - May 2000)**

Month/ᑕᖅᖏᓐᖏᑦ/Tatkia			JUN ᔦᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔭᑎ	SEP ᓯᑎᐸᓗ	OCT ᐅᑦᔪᓗ	NOV ᐅᓇᓵᓗ	DEC ᑎᓯᓵᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᕐᔪ	APR ᐃᔨᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᕐᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᕆᔨᑦ ᑭᐅᓂᖏᑦ ᐋᓚᐅᒻᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓂᕆᔨᑦ	Tatkitaman angunahuktut titigait	17	17	16	14	14	14	14	14	14	12	11	11	17*
Hunters interviewed	ᐊᖏᔪᓂᕆᔨᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	16	13	15	13	13	13	13	13	13	11	10	10	16*
Harvested	ᐊᖏᔪᓂᕆᔨᑐᓄᑦ	Angujaujut	11	5	7	6	10	10	4	6	5	6	4	6	12*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	94	76	94	93	93	93	93	93	93	92	91	91	91**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᕆᔨᑦ ᐊᑎᓕᐅᕋᒪᔨᖏᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᕆᔨᑐᓄᑦ ᐊᑕᐅᓯᐊᖅᓗᓂᑎᑦ ᐊᓚᕐᒪᓗ.
** ᐊᑦᓴᒋᓕᑎᓯᒪᔨᖏᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.2.7

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 473

Recall period between harvest and interview, expressed as % of total harvest records — **Year 4 (June 1999 - May 2000)**

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓂᓐᓂᖏᓐᓇᑕ ᐊᓚᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᓇᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓗ % ᑲᑎᕐᑎᑦ ᐊᖏᔪᓂᕆᔨᑦ ᑎᑎᕐᕕᐅᒪᔨᔨᑦ — **ᐊᓯᖏᔪ 4 (ᔦᓂ 1999 - ᒪᐃ 2000)**

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut — **Ukiunga 4 (June 1999 - May 2000)**

Month/ᑕᖅᖏᓐᖏᑦ/Tatkia			JUN ᔦᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔭᑎ	SEP ᓯᑎᐸᓗ	OCT ᐅᑦᔪᓗ	NOV ᐅᓇᓵᓗ	DEC ᑎᓯᓵᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᕐᔪ	APR ᐃᔨᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᕐᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕐᑭᑦ	≤ tatkin pingahut	100	100	100	100	87	100	100	100	92	100	100	100	98
4-6 months	4-6 ᑕᕐᑭᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	8	0	0	0	0
> 6 months	> 6 ᑕᕐᑭᑦ	> 6 tatkin	0	0	0	0	13	0	0	0	0	0	0	0	2

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 474

Number of hunters harvesting each species — Year 4 (June 1999 - May 2000)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖑᓇᓱᒃᑏᑦ ᐊᖑᓇᓱᒃᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐆᒪᔪᕐᓂᒃ — ᐊᒃᕋᒍ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᕿᖓ/Tatkia			JUN ᔫᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒃᒍᑎ	SEP ᓱᑎᒃᐱᕆ	OCT ᐅᑦᑐᐱᕆ	NOV ᓈᕕᒃᐱᕆ	DEC ᑏᓱᒃᐱᕆ	JAN ᔮᓐᓄᐊᕆ	FEB ᕕᕐᕗᐊᕆ	MAR ᒪᑦᓯ	APR ᐃᕐᕆᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	1	2	3	4	3	6	4	5	3	2	1	2	8
Wolf	ᐊᒪᕈᐃᑦ	Amagut									2	2	1	1	3
Arctic fox	ᑎᕆᒐᓐᓂᐊᑦ	Tigiganiat							1						1
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᕆᒐᓐᓂᐊᑦ	Kalaliit tigiganiat							1						1
Wolverine	ᖃᕐᕕᑦ	Kalvik						1	1	3	2	2			3
Arctic hare	ᐅᑲᓖᑦ	Ukalik					1								1
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			2	3							1	1	6
Seals (unspecified)	ᓱᖅᑯᓖᑦ	Natiit												1	1
Ringed seal	ᓇᑦᓱᑦ	Natiinat			1										1
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik	1	1	1										3
Eider duck	ᒥᑏᑦ	Kingalik	1				1								2
Tundra swan	ᖁᒃᔪᐃᑦ	Kukyuk												1	1
Ptarmigan	ᐊᕿᒃᒋᑦ	Akilgik						1		1			1		2
Tundra swan eggs	ᖁᒃᔪᐃᑦ ᒪᓐᓂᖏᑦ	Kukyut manniit												1	1
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	10	3	7	1	2	3		1				3	11
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	9				4	4		1	2	2	2	5	11
Whitefish	ᑲᕕᓯᓖᑦ	Kapihiliit			1	1	1	3							5
Cod	ᐆᒐᐃᑦ	Ugak				1	9	5		1					9

6.2.7

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 475

Monthly harvest estimates — Year 5 (June 2000 - May 2001)

ᑕᕿᑕᒫᑦ ᐊᖑᔭᓄᑦ ᓇᓚᐅᑦᓴᕈᑏᑦ — ᐊᒃᕋᒍ 5 (ᔪᓂ 2000 - ᒪᐃ 2001)

Tatkiktamat nahaktauvaktun — Ukiunga 5 (June 2000-May 2001)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒡᒍᑎ	SEP ᓱᑎᒃᐱᓇ	OCT ᐅᑦᑐᐱᓇ	NOV ᓈᕕᒃᐱᓇ	DEC ᑏᓱᒃᐱᓇ	JAN ᔭᓐᓄᐊᓇ	FEB ᕕᕐᕗᐊᓇ	MAR ᒫᑦᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	2	2	10	10	1	8	2	4	2		5	6	52 ± 13
Tundra grizzly	ᐊᕐᓚᐃᑦ	Akhait		1											1 ± 1
Wolf	ᐊᒪᕈᐃᑦ	Amagut	1					3							4 ± 3
Wolverine	ᖃᕐᕕᑦ	Kalvik						4	3	3					10 ± 4
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			11	33									44 ± 29
Seals (unspecified)	ᓱᖅᑯᓖᑦ	Natiit			1										1 ± 1
Geese (unspecified)	ᓂᕐᓖᑦ	Kanguk	3	1											4 ± 2
Duck eggs	ᒥᑏᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit		11											11 ± 5
Tundra swan eggs	ᖁᒃᔪᐃᑦ ᒪᓐᓂᖏᑦ	Kukyut manniit	2												2 ± 1
Seagull eggs	ᓇᐅᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	2												2 ± 1
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	125	21	53	92	81	109				5	7	4	497 ± 128
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	23	7	4	1	72	22			4	16		8	157 ± 49
Whitefish	ᑲᕕᓱᓖᑦ	Kapihiliit				2	30								32 ± 19
Cod	ᐆᒐᐃᑦ	Ugak					225	135	69						429 ± 123

TABLE/ᓇᓗᓇᐃᔨᐅᐅᑦ/NAUNAIKUTA 476

Monthly hunter response

ᑕᖏᑕᒻᒪᑦ ᐊᖏᔪᓇᓂᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᓐᖁᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖏᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᐱᓇ	OCT ᐅᑦᔪᓇ	NOV ᐅᓇᓚᓇ	DEC ᑎᓯᓚᓇ	JAN ᒍᖏᓂᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕆ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓂᑦ ᑭᐅᓂᖏᑦ ᐊᑦᔪᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒻᒪᑦ ᐊᖏᔪᓇᓂᑦ	Tatkitaman angunahuktut titigait	11	11	11	11	9	9	9	9	9	7	7	7	11*
Hunters interviewed	ᐊᖏᔪᓇᓂᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	10	10	9	9	8	7	8	6	6	3	3	5	11*
Harvested	ᐊᖏᔪᓇᓂᑐᓂᓕ	Angujaujut	6	3	5	5	5	4	3	3	2	1	1	3	11*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓕᑭᐅᓂᖏᑦ (%)	Kiujut (%)	91	91	82	82	89	78	89	67	67	43	43	71	74**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓂᑦ ᐊᑎᓕᐅᖅᑕᒪᓕᕆᓂᖅ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓇᓂᑐᓂᓕ ᐊᑕᐅᓯᐊᓕᓗᑎᑎᓂᖅ ᐊᑦᖁᒍ.
** ᐊᐅᔨᓂᑎᑦᓯᒪᓕᕆᓂ ᑕᖏᑕᒻᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.2.7

TABLE/ᓇᓗᓇᐃᔨᐅᐅᑦ/NAUNAIKUTA 477

Recall period between harvest and interview, expressed as % of total harvest records

Year 5 (June 2000 - May 2001)

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᖏᓐᓄ ᐊᖏᔪᓇᓯᓂᖏᓐᓇᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᓇᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐᵇ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓇᓯᑦ ᑎᑎᕐᓂᑦᑕᐅᒪᔾᔨᑦ

ᐊᓐᖁᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖏᖏᓐ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᐱᓇ	OCT ᐅᑦᔪᓇ	NOV ᐅᓇᓚᓇ	DEC ᑎᓯᓚᓇ	JAN ᒍᖏᓂᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕆ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	0	0	0	0	0	91
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	100	3
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	0	0	0	0	0	0	0	100	100	100	100	0	7

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 478

Number of hunters harvesting each species — Year 5 (June 2000 - May 2001)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖑᓇᓱᒃᑏᑦ ᐊᖑᓇᓱᒃᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐆᒪᔪᕐᓂᒃ — ᐊᒃᕋᒍ 5 (ᔪᓂ 2000 - ᒪᐃ 2001)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒃᒍᕐᑎ	SEP ᓱᑎᒃᐱᓇ	OCT ᐅᑦᑐᐱᓇ	NOV ᓈᕕᒃᐱᓇ	DEC ᑏᓱᒃᐱᓇ	JAN ᔭᓐᓄᐊᓇ	FEB ᕕᕐᕗᐊᓇ	MAR ᒪᑦᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	2	2	3	3	1	2	1	1	1		1	2	8
Tundra grizzly	ᐊᕐᓚᐃᑦ	Akhait		1											1
Wolf	ᐊᒪᕈᐃᑦ	Amagut	1					1							2
Wolverine	ᖃᕐᕕᑦ	Kalvik						2	2	2					4
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik			1	2									2
Seals (unspecified)	ᓯᖅᑯᓖᑦ	Natiit			1										1
Geese (unspecified)	ᓂᕐᓖᑦ	Kanguk	1	1											2
Duck eggs	ᒥᑏᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit		2											2
Tundra swan eggs	ᖁᒃᔪᐃᑦ ᒪᓐᓂᖏᑦ	Kukyut manniit	1												1
Seagull eggs	ᓇᐅᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	1												1
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	4	2	2	3	3	2				1	1	1	7
Lake trout	ᐃᓱᕐᕋᐃᑦ	Ikalukpik	3	2	1	1	4	1			1	1		1	6
Whitefish	ᑲᕕᓯᓖᑦ	Kapihiliit				1	2								2
Cod	ᐆᒐᐃᑦ	Ugak					3	2	2						4

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 479

Annual harvest estimates and five-year mean

All Years (June 1996 - May 2001)

ᐊᓐᔪᒍᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓐᓂᑦ ᐊᓚᓗ ᑲᓪᓕᓄᑦ-ᐊᓐᔪᒍᓄᑦ ᐊᐅᓐᓕᓪᓕᖅᓯᒪᔪᑦ ᑕᒪᐃᓐᓄᑦ ᐊᓐᔪᒍᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᓐᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᓐᓕᓪᓕᖅᓯᒪᔪᑦ Amigaitkiyait
Species	ᐅᒪᔪᑦ	**Umajuin**						
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	314	247	155	111	52	176
Tundra grizzly	ᐊᐠᓪᐃᑦ	Akhait	0	0	0	0	1	<1
Wolf	ᐊᒪᓗᐃᑦ	Amagut	21	15	17	13	4	14
Arctic fox	ᑎᓘᑉᓂᐊᑦ	Tigiganiat	42	65	7	1	0	23
Coloured fox	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓘᑉᓂᐊᑦ	Kalaliit tigiganiat	14	4	13	5	0	7
Wolverine	ᖃᓴᕕᑦ	Kalvik	20	27	11	13	10	16
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	18	5	12	1	0	7
Arctic ground squirrel	ᓱᐠᓴᑦ	Hikhik	317	103	34	94	44	118
Seals (unspecified)	ᓴᖅᐃᓪᓕᑦ	Natiit	0	4	8	1	1	3
Ringed seal	ᓇᓴᓗᑦ	Natiinat	16	7	0	1	0	5
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk	0	1	2	0	0	1
Geese (unspecified)	ᓂᓪᓕᑦ	Kanguk	0	0	0	0	4	1
Canada goose	ᓂᓪᓕᑦ ᐅᓗᐊᔪᓕᑦ	Nikliknik	15	36	5	25	0	16
White-fronted goose	ᓂᓪᓕᑦ	Nirlivik	6	0	0	0	0	1
Pintail	ᖃᐅᒪᔪᐊᔨᑦ	Arnaviaq	0	6	0	0	0	1
Eider duck	ᒥᑎᑦ	Kingalik	50	0	18	13	0	16
Tundra swan	ᖃᐅᓚᐃᑦ	Kukyuk	0	1	1	1	0	1
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	20	0	20	34	0	15
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓂᓐᖏᑦ	Uluaguliit manniit	46	0	0	0	0	9
Duck eggs	ᒥᑎᑦ ᒪᓂᓐᖏᑦ	Tinmiat manniit	69	0	0	0	11	16
Tundra swan eggs	ᖃᐅᓚᐃᑦ ᒪᓂᓐᖏᑦ	Kukyut manniit	0	0	0	3	2	1
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓂᓐᖏᑦ	Nauyat manniit	85	23	0	0	2	22
Arctic char	ᐃᖅᑲᒃᑲᓪᓕᑦ	Ikaliviit	1,018	865	870	648	497	780
Lake trout	ᐃᓱᒋᓴᐃᑦ	Ikalukpik	351	274	385	512	157	336
Whitefish	ᑲᐱᓯᓂᑦ	Kapihiliit	115	92	117	98	32	91
Cod	ᐅᒪᐃᑦ	Ugak	1,327	898	358	655	429	733
Sculpin	ᑲᓇᓚᐃᑦ	Kanayuk	7	2	0	0	0	2

6.2.7

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 480

Annual hunter response
ᐊᓚᖁᔨᒪᑦ ᐊᖏᓇᓂᕆᑦ ᑭᐅᓂᖏᑦ
Angujauvaktu

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓄᑦ ᐊᓚᖁᔨᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖁᔨᒐᓱᐊᖅ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᖏᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓇᓂᕆᑦ ᑭᐅᓂᖏᑦ ᐊᔪᕐᓗᓂᖏᑦ**	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᖅᑭᒪᑦ ᐊᖏᓇᓂᕆᑦ	Tatkitaman angunahuktut titigait	31	30	21	17	11	31*
Hunters interviewed	ᐊᖏᓇᓂᕆᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	31	29	19	16	11	31*
Harvested	ᐊᖏᓇᓂᕐᒥᓂᓄᑦ	Angujaujut	29	27	16	12	11	31*
Response Rate (%)	ᑭᐅᔾ ᖃᑦᑐᐅᓂᖏᑦ (%)	Kiujut (%)	88	92	90	91	74	87**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖏᓇᓂᕆᑦ ᐊᑎᓕᐅᔪᓐᓇᖅ/ᐊᐱᕐᓂᑦ/ᐊᖏᓇᓂᕐᒥᓂᓄᑦ ᐊᑕᐅᓯᐊᔪᓐᓇᕐᓂᑐᖅ ᖃᐅᔨᓴᖅ.
** ᐊᓕᒍᓐᓇᑎᓯᒪᔪᑦ ᐊᖁᔨᒪᑦ ᑭᐅᔾ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

6.2.7

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 481

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᓐᖓᓂ ᐊᖏᓇᓂᓐᓂᖓᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᑕ, ᓇᓗᓇᐃᕐᑕ ᐃᒪᒃ % ᑲᑎᒪᔨᖏᑦ ᐊᖏᓇᓂᒃᑕ ᑎᑎᕐᑕᐅᒪᔪᑦ
Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓄᑦ ᐊᓚᖁᔨᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖁᔨᒐᓱᐊᖅ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᖏᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔪᑦ**	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᖅᑭᑦ	≤ tatkin pingahut	99	100	100	98	91	98
4-6 months	4-6 ᑕᖅᑭᑦ	tatkin hitaman 6nut	1	0	0	0	3	1
> 6 months	> 6 ᑕᖅᑭᑦ	> 6 tatkin	0	0	0	2	7	1

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 482

Number of hunters harvesting each species — All Years (June 1996 - May 2001)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖑᓇᓱᒃᑏᑦ ᐊᖑᓇᓱᒃᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐆᒪᔪᕐᓂᒃ — ᑕᒪᐃᓐᓄᑦ ᐊᒃᕌᒍᓄᑦ (ᔫᓂ 1996 - ᒪᐃ 2001)

Angunahuktin angutivaktun umajunik — Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᕐᕕᒃ ᐊᒃᕌᒍ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin
			96/97	97/98	98/99	99/00	00/01	
Species	**ᐆᒪᔪᑦ**	**Umajuin**						
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	19	16	10	8	8	23
Tundra grizzly	ᐊᒃᓚᐃᑦ	Akhait					1	1
Wolf	ᐊᒪᕈᐃᑦ	Amagut	4	5	3	3	2	5
Arctic fox	ᑎᓇᒐᓐᓂᐊᑦ	Tigiganiat	5	10	3	1		16
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᓇᒐᓐᓂᐊᑦ	Kalaliit tigiganiat	4	4	5	1		8
Wolverine	ᖃᕐᕕᑦ	Kalvik	5	6	4	3	4	9
Arctic hare	ᐅᑲᓖᑦ	Ukalik	3	2	4	1		7
Arctic ground squirrel	ᓱᒃᓯᑦ	Hikhik	14	7	4	6	2	15
Seals (unspecified)	ᓯᖅᑯᓖᑦ	Natiit		4	2	1	1	6
Ringed seal	ᓇᑦᓯᑦ	Natiinat	8	5		1		10
Bearded seal	ᐅᒡᔪᐃᑦ	Ukyuk		1	2			2
Geese (unspecified)	ᓂᕐᓖᑦ	Kanguk					2	2
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik	4	5	1	3		8
White-fronted goose	ᓂᕐᓖᑦ	Nirlivik	2					2
Pintail	ᕐᒃᒧᐊᔫᑦ	Arnaviaq		1				1
Eider duck	ᒥᑏᑦ	Kingalik	7		2	2		8
Tundra swan	ᕐᒃᔪᐃᑦ	Kukyuk		1	1	1		3
Ptarmigan	ᐊᕿᒡᒋᑦ	Akilgik	2		3	2		3
Goose eggs	ᑲᖑᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	6					6
Duck eggs	ᒥᑏᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit	4				2	6
Tundra swan eggs	ᕐᒃᔪᐃᑦ ᒪᓐᓂᖏᑦ	Kukyut manniit				1	1	2
Seagull eggs	ᓇᐅᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	5	1			1	6
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	22	15	12	11	7	25
Lake trout	ᐃᓱᕐᕋᐃᑦ	Ikalukpik	18	18	12	11	6	23
Whitefish	ᑲᕕᓯᓖᑦ	Kapihiliit	6	7	6	5	2	12
Cod	ᐆᒐᐃᑦ	Ugak	17	15	7	9	4	24
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	2	1				3

6.2.7

6.2.7 Community Results Discussion: Umingmaktok

The survey frame:
An assessment of under-enumeration indicated that there were very few hunters who were not registered in the Harvest Study.

The population of Umingmaktok declined over the course of the Harvest Study resulting in very low numbers of active hunters registered by the end of the study. There were no intensive hunters registered. The occasional and active classifications were joined and harvest estimates were calculated for all hunters together; there was no stratification used.

Survey coverage and non-response bias:
Response rates were very good to excellent in all years except for the last five months of year 5 where rates fell below 75% due to Fieldworker staffing difficulties. Readers should exercise caution when using the data collected during these final five months. As seen in Table 9 the consistent intentional non-response rate in Umingmaktok was nil and therefore was not a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough during years 1 to 4 to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should exercise caution when using the data collected during the latter months of the study (January – May 2001) since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:
As seen in the recall period tables, the vast majority of harvest records were collected within three months of the harvest. However, long recall periods of over six months were encountered during the last few months of the study. This was due to Fieldworker staffing difficulties. Recall error in these instances is more likely.

During the time of the community visits held in the Kitikmeot region in the winter of 2003 most hunters from Umingmaktok were living in other communities and the HTO was not active. It was not possible to hold consultations on the data. Readers will note that there is a steady decline in harvest estimates during the study. This is likely an accurate change and due to the decline in the population of this community over the five years of the study. The number of hunters registered declined from 31 to 11 over this period, a drop of over 60%.

6.2.7 ᓄᓇᕗᑦ ᓴᖅᑭᑕᕐᕕᖏᓂᑦ ᐅᖃᖅᑎᑐᑎᑦ: ᐅᒥᓱᒍᖅ

ᖃᐅᔨᓴᓂᐅᕙᑦ ᐊᖅᑭᐅᒪᓂᖅ:

ᖃᒥᖅᑭᓂᖅᑎᑦᓯᒍ ᐊᑎᓂᐅᓴᖅᑭᕐᕕᖏᓐᓂᑦ ᒥᑦᓵᓄᖅᓱᓂᖅ ᖃᐅᔨᓴᓂᐅᖅᑎᑦ ᖃᓄᐃᖅᓯᓄᑦ ᐊᑎᖃᖅᑕᐅᖅᑭᕐᕕᖏᓐᓂᑦᑕᓂᐅᕐᓚᒃ ᐊᖅᓱᓇᓗᑎᑦ ᖃᐅᔨᓴᓂᖃᖅᑎᑦᓯᒍ.

ᐃᓄᒃᑎᖅᓂᑦ ᐅᒥᓱᒪᔪᑎᑦᑐᑦ ᓄᖅᓯᕐᓴᐅᑎᖅᑭᓇᓂᐅᕙᑦᑐᑦ ᖃᐅᔨᓴᓂᖅ ᐱᓕᕆᖅᓯᒪᔪᓂᒃᓱᓂ ᖃᓄᐃᖅᓯᓇᓂᕐᓂᕐᒥᐅᑎᓂᖅ ᐊᖅᑭᐅᓇᓕᑎᑦ ᐊᑎᖃᖃᑎᖃᐅᔾᔨᖅᑐᑦ ᖃᐅᔨᓴᓂᖅ ᐃᓕᓴᕐᓂᓕᒃ. ᖃᐅᔨᒪᔭᒃ ᐊᖅᓱᓇᓕᑎᒥᓚᓐᓂᖅ ᐊᑎᓂᐅᖅᑭᓕᕆᓂᐅᕙᑦᑐᑦᑐᖅ. ᖃᐅᔨᓴᓂᖅ ᐃᓕᓴᕐᓂᕐᒥᐅᑎ

6.2.7 Nunanit Iniktigutait Ukauhiit: Umingmaktok

Ihivgiuktit Atugutait:
Ihivgiufaakhimayuni ataani naunaiyakhimayut Kingaumut pulaakhimapluni nalunaiyakhimayuk ikitut umayukhiuktit titigaktauhimaitut Umayukhiukhimayut Ihivgiuktini.

Inugiagutait Umingmaktuumi mikhivaktut pitilugit Umayukhiukhimayut Ihivgiuktitlugit pipkaihimayuk mikiyunik amigaitjutainik umayukhiukataktunik titigakhimayut iniktilimat ihivgiuktut. Pikangituk umayukhiukatainaktunik titigakhimayuni. Ilaani umayukiukataktut ovalo umayukhiukataktut katitikhimayut ovalo umayukhiukhimayut naunaiyautait tamamik umayukhiuktit katitivlugit; pikangituk aviktukhimatjutikhainik atuktainik.

Ihivgiugutingit ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait nakuukpiaktut tamamik ukiuni kihimi kinguliit talimat tatkikhiutit ukiumi 5mi naunaiyautait katakhimayut ataanut 75%mit nunani havaktit havaktukhanik ayokhagutihimamata. Taiguaktut ihumagiyukhat atuligumik katitikhimayut katitigutaini hapkoa iniktigutaini talimat tatkikhiutini. Takukhauyut ikpatauyami 9 pikatainaktut kiuyuitut naunaiyautaini Umingmaktuumi pikangituk ovalo pilaaktaini atugutait kiuyuitut ihumagiyaini.

Kiuhimayut naunaiyautait angiyut ovalo kiuyuitut mikiyut ukiuni 1mit 4mut piyaami nni pihimayut naamaktumik uktugutini Nni umayukhiuktini. Taiguaktut ihumagyukhat atugumik katitikhimayut katitigutaini kinguani tatkikhiutini ihivgiuktuni (Januarymit Maymut 2001) pilaaktuni tamamik uktugutit ihuinaagutainik ovalo kiuyuitut ihimagiyainik angiliniakat kiuhimayut naunaiyautait katakpata.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Takuhimayut utiktitihimayuni ubluit ikpatauyani, amigaktut umayukhiukhimayut titigakhimayut katitikhimayut iluani pingahuni tatkikhiutini. Kihimi takiyut utiktitihimayut ubluit avataanut siksit tatkikhiutit pikatakhimayut kingulimi tatkikhiutini ihivgiuktuni. Hamna pihimayut nunani havaktiit havaktukhanik ayokhakhimagamik. Utiktitihimayut ihuinaagutait hapkoa piyuni pilaaktut.

Nunamut pulaakhimapluni Kitikmeonut ukiumi 2003 amigaktut umayukhiuktit Umingmaktuumit inuulikhimayut aalani nunani ovalo HTOkut nutkaumahimayut. Pilaimata ukakatigilugit katitikhimayunik. Taiguaktut nalungitukhat ikilikatainaktut umayukhiukhimayut naunaiyautini ihivguktitlugit. Hamna nakuuyuk aalangugutait ovalo ikililimata inugiagutait hamani nunami talimani ukiuni ihivgiuktitlugit . Amigaitjutait umayukhiuktit titigakhimayut katakhimayuk 31nit 11mut hamani ubluini, katakhimayut avataanut 60%nik.

6.3 Kivalliq/ᑭᕙᓪᓕᕐᒃ

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 483

Monthly harvest estimates
ᑕᕐᑕᒋᒪᑦ ᐊᓐᔪᒃᓴᓄᑦ ᓇᓕᐅᑦᓱᓕᕐᓂᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᑦᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᕐᖏᓐᓄ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᐃᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᐅᐊᐃᓇ	DEC ᑎᓴᐃᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᓴ	APR ᐃᑦᓇᓗ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓕᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	88	112	140	604	572	365	171	179	216	258	608	310	3,623 ± 200
Musk-ox	ᐅᒥᓴᒪᐃᑦ	Umingmait							2						2 ± 1
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					10	10		20					
Wolf	ᐊᒪᖏᐃᑦ	Amagut					1	1	6		2	44	56	10	120 ± 27
Arctic fox	ᑎᓕᑦᓂᓪᓕᑦ	Tigiganiat					7	451	258	125	75	178	79	38	1,211 ± 142
Coloured fox	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓕᑦᓂᓪᓕᑦ	Kalaliit tigiganiat						3			1		1		5 ± 3
Wolverine	ᖃᕐᕕᑦ	Kalvik							1						1 ± 1
Lynx	ᐱᖓᖅᓯᖏᖅ	Pamiuqtuuq							1						1 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik						8	1		3	1			13 ± 10
Seals (unspecified)	ᓯᖓᐃᓪᓚᑦ	Natiit						2							2 ± 1
Ringed seal	ᓇᓯᓗᑦ	Natiinat	109	11	4	34	57	8			5	9	4	70	311 ± 63
Bearded seal	ᐅᓘᔪᐃᑦ	Ukyuk	8	3	1	7	7					1		3	30 ± 6
Harp seal	ᖃᐃᐳᓪᓚᑦ	Qairulik		2											2 ± 2
Harbour seal	ᖃᓯᕆᐊᑦ	Qanigiaq		1											1 ± 1
Beluga	ᖃᐃᖏᑦ ᖁᓪᓗᓚᑦ	Kilalugak	1	65	101	36									203 ± 51
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	256											608	864 ± 361
Canada goose	ᓂᖏᓪᓕᑦ ᐅᓗᐊᒍᑦᓚᑦ	Nikliknik	570		2	9								151	732 ± 232
Ross's goose	ᖃᕐᖏᔪᐃᑦ	Kakat												2	2 ± 3
Brant goose	ᓂᖏᓕᓴᐃᑦ	Nirlirnaq				2									2 ± 2
White-fronted goose	ᓂᖏᓪᓕᑦ	Nirlivik												36	36 ± 38
Pintail	ᖃᓚᒧᐊᓱᒃᑐᑦ	Arnaviaq	50												50 ± 44
Eider duck	ᒥᑎᑦ	Kingalik	41			4								4	49 ± 34
Tundra swan	ᖃᓚᔪᐃᑦ	Kukyuk			2										2 ± 2
Ptarmigan	ᐊᖏᓚᓂᑦ	Akilgik	32				67	11	24	14	5	26	17	10	206 ± 81
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit	991											460	1,451 ± 611
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	421											3	424 ± 416
Arctic char	ᐃᑲᓗᒃᐲᑦ	Ikaliviit	960	1,038	283	286	188	394	23			12	10	76	3,270 ± 377
Lake trout	ᐃᓱᕐᖃᐃᑦ	Ikalukpik	108	11	13	32	77	72	1	14	8	119	214	754	1,423 ± 206
Northern pike	ᓯᓘᒍᓪᓚᑦ	Hiulik												2	2 ± 3
Arctic grayling	ᓵᓗᒃᐸᐅᓘᐃᑦ	Hulupaugaq	161	133	108	377	450					4	24	89	1,346 ± 427
Whitefish	ᑲᕕᓯᓗᒃ	Kapihiliit	2			53	624		4						683 ± 181
Burbot	ᑎᒃᑕᓚᒃ	Tiktaaliq								1			1		2 ± 1
Least cisco	ᒥᑭᓂᖅᑐᑦ ᑲᕕᓯᓪᓚᑦ	Eetuuk			1										1 ± 1
Cod	ᐅᓘᐃᑦ	Ugak	2												2 ± 3
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	2												2 ± 3

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᒃᖏᑦ ᐅᑲᒃᖏᑦ ᐃᑯᐊ ᐃᑯᕕᕐᓂᐅᓕᕆᓂᖅᑕᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.3.1

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 484

Monthly hunter response

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓕᓴᐃᓐᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐃᓕᖕᒧ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐅᓇ	OCT ᐅᑦᔪᓇ	NOV ᐃᓕᓴᓇ	DEC ᑎᓯᓇ	JAN ᒍᖃᓄᓇ	FEB ᐃᖅᑲᓇ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓕᓴᐃᓐᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔨᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓕᓴᐃᓐᑦ	Tatkitaman angunahuktut titigait	364	364	362	360	361	360	361	366	365	368	371	370	379*
Interview list	ᐊᐱᕐᓯᕐᓴᒃᑦ	Apikiktan	236	236	235	234	234	233	233	234	233	232	233	233	239*
Hunters interviewed	ᐊᖏᔪᓕᓴᐃᓐᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	206	218	219	229	225	221	211	215	217	204	207	194	237*
Harvested	ᐊᖏᔪᓕᓴᐃᑐᒃᑦ	Angujaujut	90	86	65	92	87	83	49	45	42	63	92	110	181*
Response rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	87	92	93	98	96	95	91	92	93	88	89	83	91**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓕᓴᐃᓐᑦ ᐊᑎᓕᐅᔾᔨᒪᔭᓪᓗᒍᑦ/ᐊᐱᕐᓯᕐᓴᒃᑦᓯᒍᑦ/ᐊᐱᕐᓯᕐᑦ/ᐊᖏᔪᓕᓴᐃᑐᒃᑦ ᐊᑕᐅᓯᐊᓘᓐ% ᐊᑎᓂᒃ ᐊᓕᖕᒪᑐ.
** ᐊᐅᔨᓕᕆᓂᐅᒪᓕᒃᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 485

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᓪᓗᑦ ᐊᑯᓕᓂᓂ ᐊᖏᔪᓕᐢᓂᓕᒡᒐ ᐊᒪᓗᓗ ᐊᐱᕐᓯᕐᑕᐅᓂᓕᒡᒐ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑎᑦ ᐊᖏᔪᓕᒃᑦ ᑎᑎᕐᑕᐅᒪᓪᓗᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐃᓕᖕᒧ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐅᓇ	OCT ᐅᑦᔪᓇ	NOV ᐃᓕᓴᓇ	DEC ᑎᓯᓇ	JAN ᒍᖃᓄᓇ	FEB ᐃᖅᑲᓇ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᓪᓗᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑦ	≤ tatkin pingahut	83	100	100	100	100	100	98	100	100	100	100	100	99
4-6 months	4-6 ᑕᖅᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑦ	> 6 tatkin	17	0	0	0	0	0	2	0	0	0	0	0	1

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 486

Number of hunters harvesting each species
ᖃᑦᕿᐅᓂᖏᑦ ᐊᖏᔪᓕᓴᐃᒋᑦ ᐊᖏᔪᓕᓴᐅᔪᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 1 (June 1996 - May 1997)
ᐊᒃᑭᒍ 1 (ᔪᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓱᑎᐸᓇ	OCT ᐅᖁᐸᓇ	NOV ᐅᓂᐸᓇ	DEC ᑎᓴᐸᓇ	JAN ᒍᖏᓂᐊᓇ	FEB ᓇᖕᖅᐊᓇ	MAR ᒪᕐᓴ	APR ᐃᕐᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᖁᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	31	47	46	85	81	71	31	32	30	47	79	44	139
Musk-ox	ᐅᒥᓴᒪᐃᑦ	Umingmait							2						2
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut					1	1	3		1	7	18	3	24
Arctic fox	ᑎᓕᑲᓐᓂᐊᑦ	Tigiganiat					1	35	34	24	14	16	10	1	57
Coloured fox	ᖃᐃᓐᖏᑦᑐᑦ ᑎᓕᑲᓐᓂᐊᑦ	Kalaliit tigiganiat						2			1		1		4
Wolverine	ᖃᑦᕿᐃᑦ	Kalvik							1						1
Lynx	ᐱᖓᖃᓕᖅ	Pamiuqtuuq							1						1
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik						2	1		2	1			6
Seals (unspecified)	ᓯᖓᐃᓪᓚᑦ	Natiit						1							1
Ringed seal	ᓇᓯᑦ	Natiinat	15	5	1	7	14	2			2	3	3	16	37
Bearded seal	ᐅᑎᔾᐊᑦ	Ukyuk	3	2	1	4	6					1		2	14
Harp seal	ᖃᐃᐱᓪᓚᑦ	Qairulik		1											1
Harbour seal	ᖃᓯᕆᐊᑦ	Qanigiaq		1											1
Beluga	ᖃᐃᖏᑦ ᖁᓪᓗᓕᑦ	Kilalugak	1	22	23	8									39
Snow goose	ᑲᖕᒍᐊᑦ	Kanguq	7											29	35
Canada goose	ᓂᖏᓪᓚᑦ ᐅᓗᐊᒍᓪᓚᑦ	Nikliknik	20		1	2								23	39
Ross's goose	ᖃᑦᖏᔾᐃᐊᑦ	Kakat												1	1
Brant goose	ᓂᖏᓕᓴᐊᑦ	Nirlirnaq				1									1
White-fronted goose	ᓂᖏᓪᓚᑦ	Nirlivik												4	4
Pintail	ᖏᓚᒧᐊᓪᓚᑦ	Arnaviaq	1												1
Eider duck	ᒥᑎᑦ	Kingalik	2			1								2	4
Tundra swan	ᖏᓚᔾᐊᑦ	Kukyuk			1										1
Ptarmigan	ᐊᖓᓕᑦ	Akilgik	2				2	2	3	2	1	4	4	2	12
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓂᖓᑦ	Uluaguliit manniit	12											4	16
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖓᑦ	Tinmiat manniit	4											1	5
Arctic char	ᐃᑲᓚᕕᐸᑦ	Ikaliviit	52	65	23	16	7	8	2			1	4	9	100
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	12	3	2	5	8	10	1	3	2	14	24	62	90
Northern pike	ᓯᑎᒍᓪᓚᑦ	Hiulik												1	1
Arctic grayling	ᓗᓚᕕᐸᐅᓚᐃᑦ	Hulupaugaq	2	6	3	4	11					1	1	6	26
Whitefish	ᑲᓇᓯᓚᕕ	Kapihiliit	1			5	11		1						15
Burbot	ᑎᕕᒡᓚᕕ	Tiktaaliq								1			1		2
Least cisco	ᒥᑭᓂᖏᑦ ᑲᓇᓯᓪᓚᑦ	Eetuuk			1										1
Cod	ᐅᒪᐃᑦ	Ugak	1												1
Sculpin	ᑲᓪᔾᐊᑦ	Kanayuk	1												1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔾᔪᓂᕕᒃ ᐱᑕᖃᖕᖏᑐᖃᕕᒃ ᐱᓕᕆᓪᓂᔪᓂᒃ ᐊᖏᔪᓂᑦ ᖃᑦᕿᐅᓂᖏᖕᓂᓄᑦ ᐊᓪᓚᖅᑎᒪᔾᔪᑎᓄᑦ ᐊᓪᓚᖅᓄᑦ ᓇᓪᓕᐊᓂᖅᓯᒪᓂᖅ ᐃᓕᓴᕐᓂᐊᕐᓂᖅᓄᑦ ᐃᓚᖃᖅᑐᑎᒃ ᐃᓕᓴᕐᓂᐊᕐᓂᖅᓄᑦ ᐃᓚᖃᖅᑐᑎᒃᓄᑦ ᐃᓚᖃᖅᑐᑎᒃᓄᑦ ᐃᓚᖃᖅᑐᑎᒃ

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 487

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᑐᐃᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

6.3.1

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᐹᓗ	OCT ᐅᑲᐃᓗ	NOV ᓄᓇᕗᓗ	DEC ᑎᓯᕗᓗ	JAN ᔮᖏᓄᓗ	FEB ᓄᖑᐅᓗ	MAR ᒪᓯ	APR ᐃᑦᓗᓪ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	131	306	313	765	636	254	145	137	225	421	392	311	4,036 ± 376
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait									3				3 ± 5
Moose	ᑐᖅᑐᕈᐃᑦ	Tuktuvait											4	3	7 ± 8
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					3	14		17					
Tundra grizzly	ᐊᒃᓪᓚᐃᑦ	Akhait											1	1	2 ± 1
Black bear	ᕿᓐᓂᖏᑦ ᐊᒃᓪᓚᐃᑦ	Kiniktut akhait				3									3 ± 5
Wolf	ᐊᒪᔪᐃᑦ	Amagut							25	1	32	212	120		390 ± 153
Arctic fox	ᑎᓕᒃᓂᐊᑦ	Tigiganiat					4	892	367	135	72	88	24		1,582 ± 308
Coloured fox	ᖃᐅᓐᖓᑎᑐᑦ ᑎᓕᒃᓂᐊᑦ	Kalaliit tigiganiat						1		2		1	4		8 ± 4
Wolverine	ᖃᕐᕕᒃ	Kalvik										2	4		6 ± 5
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik				4	3			1		3		1	12 ± 8
Ringed seal	ᓇᓱᓪᓚᑦ	Natiinat	68	16	11	5	108			20	8	5	13	69	323 ± 82
Bearded seal	ᐅᑉᐊᕐᓗᑦ	Ukyuk	7	7	4	5	35					1	9	5	73 ± 23
Harbour seal	ᖃᓂᕈᐊᑦ	Qanigiaq			10										10 ± 17
Walrus	ᐊᐃᐃᒃᓴᑦ	Akvik	4												4 ± 5
Beluga	ᖃᐅᓱᑦ ᖃᓪᓗᓐᓚᑦ	Kilalugak	6	148	221	1									376 ± 157
Geese (unspecified)	ᓄᖅᓂᓪᑦ	Kanguk												36	36 ± 18
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	1,007											1,153	2,160 ± 849
Canada goose	ᓄᖅᓂᓪᑦ ᐅᓗᐊᒍᑉᓂᓪᑦ	Nikliknik	27										3	1,081	1,111 ± 454
Ross's goose	ᖃᐅᖅᓴᐃᑦ	Kakat	12											33	45 ± 49
White-fronted goose	ᓄᖅᓂᓪᑦ	Nirlivik	18											64	82 ± 39
Ptarmigan	ᐊᖏᓚᒋᑦ	Akilgik				56		39	101	30	54	73	96	16	465 ± 171
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	2,311											2,519	4,830 ± 2,573
Arctic char	ᐃᖃᓗᓴᒃᑐᑦ	Ikaliviit	879	989	1,686	184	170	241	152					107	4,408 ± 1,330
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	181	42	100	209	94	311	106		14	180	330	329	1,896 ± 457
Northern pike	ᓲᓗᔪᓪᓚᑦ	Hiulik				4	3							1	8 ± 4
Arctic grayling	ᓱᓕᓴᐅᑎᐃᑦ	Hulupaugaq		400	13	221								6	640 ± 350
Whitefish	ᑲᐱᓱᓪᓚᑦ	Kapihiliit			29	54	164	78	70					2	397 ± 147
Burbot	ᑎᑉᒋᓪᓚᑦ	Tiktaaliq					14	1	6			1			22 ± 15
Cod	ᐅᒪᐃᑦ	Ugak												1	1 ± 1

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᑦᓄ ᑎᑎᕋᐅᒪᓴᑦ ᑐᓂᓴᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓚᖅᑕᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 488

Monthly hunter response

ᑕᕈᑦᒪᒃ ᐊᖏᔪᓕᓴᒋᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)

ᐱᓕᕆᔨ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᕈᖏᖅ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒡᒎᑎ	SEP ᓯᑎᕐᕕᓪ	OCT ᐅᑯᕐᕕᓪ	NOV ᐃᓚᕐᕕᓪ	DEC ᑎᓯᕐᕕᓪ	JAN ᔮᓐᓄᐊᓪ	FEB ᕕᒻᒥᐊᓪ	MAR ᒪᕐᓯ	APR ᐃᕐᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᓴᒋᑦ ᑭᐅᓂᖏᑦ ᐱᒍᓕᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᕈᑦᒪᒃ ᐊᖏᔪᓕᓴᒋᑦ	Tatkitaman angunahuktut titigait	367	369	372	371	370	370	370	366	373	374	371	370	380*
Interview list	ᐊᐱᕐᓂᖅᓯᒪᑦ	Apikiktan	170	172	175	174	173	173	173	173	173	174	172	171	178*
Hunters interviewed	ᐊᖏᔪᓕᓴᒋᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	148	126	145	151	145	146	154	164	160	153	153	151	172*
Harvested	ᐊᖏᔪᓕᓴᒌᑎᓄᑦ	Angujaujut	62	67	76	71	65	53	38	33	37	61	65	97	143*
Response rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	87	73	83	87	84	84	89	95	92	88	89	88	87**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓕᓴᒋᑦ ᐊᑎᓕᐅᔾᔪᑕᒋᑦ/ᐊᐱᕐᓂᖅᓯᒪᓕᒋᑦ/ᐊᐱᕐᓂᑦᑐᒋᑦ/ᐊᖏᔪᓕᓴᒌᑎᓄᑦ ᐊᑕᐅᓂᔪᓕᒃ% ᐊᒋᑎᑦ ᐊᓕᕐᒪᑎ.
** ᐊᓂᔨᓕᓕᒫᓂᔾᔪᑎᑦ ᑕᕈᑦᒪᒃ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 489

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᖏᓐᓄ ᐊᖏᔪᓕᓴᐅᓂᖓᓪᓚᑦ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑐᐅᓂᖓᓪᓚᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓕᓴᒋᑦ ᑎᑎᕐᕕᑦᑐᒪᔾᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)

ᐱᓕᕆᔨ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᕈᖏᖅ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒡᒎᑎ	SEP ᓯᑎᕐᕕᓪ	OCT ᐅᑯᕐᕕᓪ	NOV ᐃᓚᕐᕕᓪ	DEC ᑎᓯᕐᕕᓪ	JAN ᔮᓐᓄᐊᓪ	FEB ᕕᒻᒥᐊᓪ	MAR ᒪᕐᓯ	APR ᐃᕐᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕈᑦ	≤ tatkin pingahut	99	100	97	99	97	100	100	100	100	94	99	100	99
4-6 months	4-6 ᑕᕈᑦ	tatkin hitaman 6nut	1	0	3	1	3	0	0	0	0	6	1	0	1
> 6 months	> 6 ᑕᕈᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 490

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐸᒋᑦ ᐊᖏᔪᓚᐸᓕᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 2 (June 1997 - May 1998)

ᐊᒃᑲᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

6.3.1

Month/ᑕᕕᖓ/Tatkia			JUN ᔨᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᔅᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓵᐱᓗ	DEC ᑎᓴᐱᓗ	JAN ᒍᖏᓇᓗ	FEB ᓇᕐᑲᓇᓗ	MAR ᒪᓴ	APR ᐃᓴᓕ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	31	46	54	69	57	21	21	23	26	55	49	41	117
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait									1				1
Moose	ᑐᑐᓀᐃᑦ	Tuktuvait											2	1	2
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᖅᓪᓚᐃᑦ	Akhait											1	1	1
Black bear	ᕿᓐᓂᕐᑦ ᐊᖅᓪᓚᐃᑦ	Kiniktut akhait				1									1
Wolf	ᐊᒪᔪᐃᑦ	Amagut							3	1	3	18	12		25
Arctic fox	ᑎᓗᒃᑲᓂᐊᑦ	Tigiganiat					2	36	22	15	11	8	4		52
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓗᒃᑲᓂᐊᑦ	Kalaliit tigiganiat						1		2		1	1		4
Wolverine	ᖃᕐᕕᒃ	Kalvik										2	2		4
Arctic hare	ᐅᑲᓪᓚ	Ukalik				2	1			1		1		1	5
Ringed seal	ᓇᕐᓂᑦ	Natiinat	13	4	5	3	11			4	3	3	6	14	38
Bearded seal	ᐅᑦᔾᐃᑦ	Ukyuk	3	2	3	1	9					1	4	2	19
Harbour seal	ᖃᓯᑎᐊᑦ	Qanigiaq			1										1
Walrus	ᐊᐃᐃᒃ	Akvik	2												2
Beluga	ᖃᐅᕐᑦ ᕿᓪᓗᒡᑦ	Kilalugak	1	21	34	1									47
Geese (unspecified)	ᓄᕐᓚᑦ	Kanguk												2	2
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	10											36	40
Canada goose	ᓄᕐᓚᑦ ᐅᓗᐊᒍᓪᓚᑦ	Nikliknik	3										1	42	44
Ross's goose	ᖃᒋᕐᔾᐃᑦ	Kakat	1											3	4
White-fronted goose	ᓄᕐᓚᑦ	Nirlivik	1											8	9
Ptarmigan	ᐊᕕᒪᔪᑦ	Akilgik				4		3	4	2	3	5	6	2	18
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓂᓄᖏᑦ	Uluaguliit manniit	8											12	20
Arctic char	ᐃᖃᓗᒃᑕᑦ	Ikaliviit	32	33	36	11	7	6	1					4	77
Lake trout	ᐃᓱᒋᑦ	Ikalukpik	11	5	7	6	11	10	6		3	9	25	35	65
Northern pike	ᓲᒃᒍᓚᑦ	Hiulik				1	1							1	3
Arctic grayling	ᓱᓗᒃᐸᐅᒪᐃᑦ	Hulupaugaq		5	2	7								2	13
Whitefish	ᑲᐱᓱᓚᑦ	Kapihiliit			1	3	5	1	2					1	9
Burbot	ᑎᑭᓚᑦ	Tiktaaliq					2	1	1			1			5
Cod	ᐅᒪᐃᑦ	Ugak												1	1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓱᒪᔪᓂᒃ ᐱᕈᖅᖏᑎᒍᖅ ᐱᓕᔪᑎᓕᓂᒃ ᐊᖏᔪᓂᑦ ᖃᑦᓯᐅᓂᖏᑦᓄᑦ ᐊᓕᓴᐅᒪᔪᓕᑦ ᐊᖏᔪᓂ ᓇᓕᐅᕐᓯᒋᐅᓂ ᑐᓂᓴᖏᑦᓂ ᐃᑯᐱᕐᓕᓕᓵᓕᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 491

Monthly harvest estimates
ᑕᕆᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓚᐅᑦ
Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᓕᖅᔪᒍ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᕆᖏᖅ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᓂᐱᓇ	DEC ᑎᓯᐱᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᓄᖕᐅᐊᓇ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓕᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	159	320	185	690	355	44	60	337	225	248	663	180	3,466 ± 342
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait							2						2 ± 1
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡						14	37						
Black bear	ᖃᓄᓕᕐᕆᑦ ᐊᑲᓪᓚᐃᑦ	Kiniktut akhait											1		1 ± 1
Wolf	ᐊᒪᓴᐃᑦ	Amagut					1		2		1	165	237		406 ± 199
Arctic fox	ᑎᓚᒃᓄᐊᑦ	Tigiganiat						248	205	79	36	29	5		602 ± 114
Wolverine	ᖃᕐᓴᑦ	Kalvik										10	14		24 ± 15
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik					3								3 ± 2
Ringed seal	ᓇᓕᓂᑦ	Natiinat	29	12	41	36	159	87	1	3	8	5	3	17	401 ± 88
Bearded seal	ᐅᒃᔾᐃᑦ	Ukyuk	13	1	23	24	24	2							87 ± 22
Harp seal	ᖃᐃᓴᓪᓕᑦ	Qairulik			1										1 ± 1
Beluga	ᖃᑯᕐᑕ ᖃᓪᓗᓂᑦ	Kilalugak		38	53	46									137 ± 46
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	186											1,014	1,200 ± 473
Canada goose	ᓄᕐᓪᓕ ᐅᓚᐊᒍᓪᓕ	Nikliknik	26		3									439	468 ± 313
Ross's goose	ᖃᖏᕐᔾᐃᑦ	Kakat												12	12 ± 12
Eider duck	ᒥᑎᑦ	Kingalik										6			6 ± 5
Ptarmigan	ᐊᖏᓗᑦ	Akilgik				37	32	21	15		55	3	4		167 ± 96
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓇᖅᑐᑦ	Uluaguliit manniit	185											2,746	2,931 ± 1,570
Arctic char	ᐃᖃᓗᒃᑕᑦ	Ikaliviit	1,153	1,210	394	99	186	1,215	55					21	4,333 ± 1,639
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	95	26	10	384	166	187	52	11	86	181	204	264	1,666 ± 371
Northern pike	ᓴᓗᔪᓪᓕᑦ	Hiulik					10	3							13 ± 8
Arctic grayling	ᓴᓗᓂᐸᐅᓚᐃᑦ	Hulupaugaq	48	17	139	45	339	140					10	13	751 ± 312
Whitefish	ᑲᐱᓴᓪᓕᑦ	Kapihiliit				101	21	42	38		9				211 ± 94
Cod	ᐅᓗᐃᑦ	Ugak												651	651 ± 239
Sculpin	ᑲᓚᔾᐃᑦ	Kanayuk												72	72 ± 47

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᐃᑦ ᑎᑎᕐᑕᒪᔾᔪᑦ ᑐᓂᔅᓴᕐᑦ ᐅᓂᒃᑳᖅ ᐃᓄᐃᕐᓗᒃᑖᓂᒃ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.3.1

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 492

Monthly hunter response — **Year 3 (June 1998 - May 1999)**

ᑕᕝᕙᑦᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ — **ᐃᓕᓴᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)**

Tatkiktaman pijauhimajut angunahuktinun — **Ukiunga 3 (June 1998 - May 1999)**

Month/ᑕᕝᕙᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᓇᓗ	OCT ᐅᑯᐊᓗ	NOV ᓄᓇᕗᓗ	DEC ᑎᓯᕐᓇᓗ	JAN ᔮᖏᓐᓇᖅ	FEB ᐃᕙᑲᓇᖅ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᓕᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᕝᕙᑦᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	373	377	377	378	378	377	377	378	378	379	381	382	387*
Interview list	ᐊᐱᕐᓂᖅᓯᒪᑦ	Apikiktan	174	177	177	178	178	178	178	179	178	179	180	181	183*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	146	157	149	153	163	162	170	170	165	154	148	152	174*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᑦ	Angujaujut	57	68	46	73	54	41	23	30	35	48	67	76	131*
Response rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	84	89	84	86	92	91	96	95	93	86	82	84	88**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᔾᔪᑎᓪᓗᒍᑦ/ᐊᐱᕐᓂᖅᓯᒪᓪᓗᒍᑦ/ᐊᐱᕐᓂᑦᑕᒪᓪᓗᒍᑦ ᐊᑕᐅᓂᔾᔪᑦ% ᐃᑐᑎᒃ ᐃᓕᓴᒥ.
** ᐃᓕᓴᕐᓂᑎᒋᓕᕆᔨᑦ ᑕᕝᕙᑦᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 493

Recall period between harvest and interview, expressed as % of total harvest records — **Year 3 (June 1998 - May 1999)**

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᓐᓄᓂ ᐊᖏᔪᓂᒃᓴᓂᓐᓂᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓐᓂᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑎᑎᕐᑦᑕᐅᒪᔨᑦ — **ᐃᓕᓴᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)**

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut — **Ukiunga 3 (June 1998 - May 1999)**

Month/ᑕᕝᕙᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᓇᓗ	OCT ᐅᑯᐊᓗ	NOV ᓄᓇᕗᓗ	DEC ᑎᓯᕐᓇᓗ	JAN ᔮᖏᓐᓇᖅ	FEB ᐃᕙᑲᓇᖅ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕐᑭᑦ	≤ tatkin pingahut	100	100	100	100	100	88	100	100	100	100	100	100	99
4-6 months	4-6 ᑕᕐᑭᑦ	tatkin hitaman 6nut	0	0	0	0	0	12	0	0	0	0	0	0	1
> 6 months	> 6 ᑕᕐᑭᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 494

Number of hunters harvesting each species — **Year 3 (June 1998 - May 1999)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓕᓴᐃᒋᑦ ᐊᖏᔪᓕᓴᐅᕙᓪᓕᒋᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖏᓂᒃ — **ᐊᒃᑭᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 3 (June 1998 - May 1999)**

6.3.1

Month/ᑕᖅᖢᓪ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗᓂ	OCT ᐅᑲᐱᓗᓂ	NOV ᐅᓇᓚᐱᓗᓂ	DEC ᑎᓯᓚᐱᓗᓂ	JAN ᔮᖏᓇᐊᓗᓂ	FEB ᓇᖕᐅᐊᓗᓂ	MAR ᒪᓯᔪ	APR ᐃᑦᓂᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	40	55	37	66	42	9	9	24	23	38	59	26	107
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait							2						2
Polar bear#	ᓇᓄᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Black bear	ᕿᓐᓂᕐᑕᑦ ᐋᒃᓪᓗᐃᑦ	Kiniktut akhait											1		1
Wolf	ᐊᒪᖅᐃᑦ	Amagut					1		2		1	13	17		24
Arctic fox	ᑎᓗᒃᓴᓂᐊᑦ	Tigiganiat						16	11	11	12	7	2		34
Wolverine	ᖃᕐᓇᑦ	Kalvik										2	7		9
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik					2								2
Ringed seal	ᓇᓕᓪᓕᑦ	Natiinat	9	5	6	10	20	11	1	2	2	1	1	5	43
Bearded seal	ᐅᑭᔪᐃᑦ	Ukyuk	5	1	10	7	10	2							28
Harp seal	ᖃᐃᖅᓯᓪᓕᑦ	Qairulik			1										1
Beluga	ᖃᐅᕐᑕ ᕿᓪᓚᑦ	Kilalugak		14	11	10									30
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	6											27	31
Canada goose	ᓂᕐᓯᓪᓕ ᐅᓚᐊᒍᓯᓪᓕᑦ	Nikliknik	2		1									18	21
Ross's goose	ᖃᕆᑦᔪᐃᑦ	Kakat												2	2
Eider duck	ᒥᑎᑦ	Kingalik										1			1
Ptarmigan	ᐊᖏᓴᑦ	Akilgik				3	3	1	1		4	1	1		13
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit	4											11	15
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	33	39	12	8	9	9	2					3	62
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	4	2	2	5	6	13	4	1	9	15	21	24	56
Northern pike	ᓴᓕᔨᓪᓕᑦ	Hiulik					1	1							2
Arctic grayling	ᓱᓗᓴᐅᑎᐃᑦ	Hulupaugaq	2	2	4	4	9	2					2	1	20
Whitefish	ᑲᐱᓴᓪᓕᑦ	Kapihiliit				3	2	4	2		2				12
Cod	ᐅᒪᐃᑦ	Ugak												33	33
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk												6	6

No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

ᑎᑎᕋᓕᔪᓂᒃ ᐱᑕᖃᖅᑎᑐᖃᖅ ᐱᓴᔨᓕᓪᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᓪᓂᑦ ᐊᓕᓴᐅᓂᒃ ᓇᓕᐅᖅᓯᓪᓗᓂ ᐃᓗᐊᖅᓯᓂᓗᓂᒃ ᐊᖏᔪᓂᒃ ᓇᓕᐅᖅᓯᓪᓗᓂ ᑐᓂᓯᖏᓪᓂ ᐃᓕᓴᕐᓂᓗᓂᒃ.

Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 495

6.3.1

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓐᓂᑦ

Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)

ᐊᓕᖏᔪ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᓂᐱᓇ	DEC ᑎᓯᐱᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᓄᖅᑐᐊᓇ	MAR ᒪᕆ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓴᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	102	169	131	692	616	30	26	91	30	31	219	230	2,367 ± 284
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait							3			1			4 ± 5
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡						1212							
Tundra grizzly	ᐊᐱᓪᐃᑦ	Akhait										1	3		4 ± 5
Wolf	ᐊᒪᖅᐃᑦ	Amagut	3					1	7			8	90	3	112 ± 67
Arctic fox	ᑎᓗᒃᑑᓂᐊᑦ	Tigiganiat						17	14	35	26	14	17		123 ± 32
Coloured fox	ᖃᐅᓐᖓᑦᑐᑦ ᑎᓗᒃᑑᓂᐊᑦ	Kalaliit tigiganiat											5		5 ± 3
Wolverine	ᖃᓴᐃᑦ	Kalvik										1	4		5 ± 3
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik					5	1		1			1		8 ± 5
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik				7									7 ± 5
Seals (unspecified)	ᓴᓐᐅᑦᓪᓚᑦ	Natiit				5									5 ± 3
Ringed seal	ᓇᑦᓱᑦ	Natiinat	119	42	15	53	319	19	1	2	6		7	7	590 ± 119
Bearded seal	ᐅᓪᔪᐃᑦ	Ukyuk	8	20	11	8	45			1	1				94 ± 44
Walrus	ᐊᐃᐃᓴᑦ	Akvik	7												7 ± 7
Beluga	ᖃᐅᔨᑦ ᖃᓪᓗᓂᑦ	Kilalugak		29	173	5									207 ± 76
Snow goose	ᑲᖏᒍᑦ	Kanguq	547			2								599	1,148 ± 814
Canada goose	ᓄᓕᓪᑦ ᐅᓗᐊᒍᓪᓚᑦ	Nikliknik	40											338	378 ± 331
Ross's goose	ᖃᑲᓕᔪᐃᑦ	Kakat												1	1 ± 1
Eider duck	ᒥᑎᑦ	Kingalik										1			1 ± 1
Ptarmigan	ᐊᖏᓂᑦ	Akilgik				12	7	14							33 ± 12
Goose eggs	ᑲᖏᒍᑦ ᒪᓪᓄᖅᑦ	Uluaguliit manniit	1,360												1,360 ± 1,537
Arctic tern eggs	ᐃᒥᓐᐅᑕᓚᐃᑦ ᒪᓪᓄᖅᑦ	Emitkutailat manniit	15												15 ± 25
Black guillemot eggs	ᐱᕐᐅᓪᓚᓂ ᒪᓪᓄᖅᑦ	Black guillemot eggs	25												25 ± 40
Arctic char	ᐃᖃᓗᒃᑕᑦ	Ikaliviit	1,061	1,680	1,254	268	572	506	11		14		2	12	5,380 ± 1,279
Lake trout	ᐃᓱᖁᕐᐃᑦ	Ikalukpik	20	6	14	126	208	67	46	2	16	9	120	304	938 ± 227
Northern pike	ᓱᓚᒍᓪᓚᑦ	Hiulik				1					3				4 ± 5
Arctic grayling	ᓴᓗᒃᐸᐅᓚᐃᑦ	Hulupaugaq	3	61	178	72	17	46			3			20	400 ± 174
Whitefish	ᑲᐱᓱᓪᓚᑦ	Kapihiliit				75	59	67	1						202 ± 60
Cod	ᐅᓚᐃᑦ	Ugak	208										67	1,159	1,434 ± 342

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᔪᓂᑦ ᑎᑎᕐᑕᒪᓕᖅᑦ ᑐᓂᒃᑯᑦ ᐅᑯᐊ ᐃᑯᐊᕐᓚᓕᓂᒃᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 496

Monthly hunter response
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᓐᖏᒍ 4 (ᔨᓂᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᕆᓐᓇ/Tatkia			JUN ᔨᓂᓂ	JUL ᔨᓪᓚᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗᓂ	OCT ᐅᑦᔪᓗᓂ	NOV ᐃᓄᐱᓗᓂ	DEC ᑎᓯᓗᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᓄᕐᕕᐊᓂ	MAR ᒪᕐᔪ	APR ᐃᑦᓇᓪᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᓐᖏᒍᓂᑦ ᑭᐅᓂᖅᑕᑦ ᐊᑐᔨᓴᓂᖅᑕᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᕆᓪᒪᒃ ᐊᓐᖏᒍᓂᑦ	Tatkitaman angunahuktut titigait	382	383	383	381	381	381	383	386	386	387	387	388	395*
Interview list	ᐊᐱᕐᓂᖅᓯᒪᑦ	Apikiktan	181	182	182	180	182	182	184	187	187	188	188	189	194*
Hunters interviewed	ᐊᓐᖏᒍᓂᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	165	154	141	156	169	169	170	167	169	165	160	159	176*
Harvested	ᐊᓐᖏᒍᓂᑐᓂᓕᓂᑦ	Angujaujut	51	54	52	56	70	32	13	17	14	12	42	81	134*
Response rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᓂᖅᑕᑦ (%)	Kiujut (%)	91	85	77	87	93	93	92	89	90	88	85	84	88**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᓐᖏᒍᓂᑦ ᐊᑎᓕᐅᔾᔨᓚᓐᓂᑦ/ᐊᐱᕐᓂᖅᓴᓐᓂᑦ/ᐊᐱᕐᓂᑦ/ᐊᓐᖏᒍᓂᑐᓂᓕᓂᑦ ᐊᑕᐅᓂᐊᖅᓯᓗᓂ% ᐊᑐᑎᑦ ᐊᓐᖏᒍᑐᑦ.
** ᐊᐅᑎᓂᓕᑎᓪᓚᔾᔨᑦ ᑕᕆᓪᒪᒃ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 497

Recall period between harvest and interview, expressed as % of total harvest records
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)
ᐊᓐᖏᒍ 4 (ᔨᓂᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᕆᓐᓇ/Tatkia			JUN ᔨᓂᓂ	JUL ᔨᓪᓚᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗᓂ	OCT ᐅᑦᔪᓗᓂ	NOV ᐃᓄᐱᓗᓂ	DEC ᑎᓯᓗᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᓄᕐᕕᐊᓂ	MAR ᒪᕐᔪ	APR ᐃᑦᓇᓪᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᓴᐅᔾᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕐᑯᑦ	≤ tatkin pingahut	100	100	100	100	91	100	100	100	100	100	98	100	98
4-6 months	4-6 ᑕᕐᑯᑦ	tatkin hitaman 6nut	0	0	0	0	9	0	0	0	0	0	2	0	2
> 6 months	> 6 ᑕᕐᑯᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 498

Number of hunters harvesting each species — **Year 4 (June 1999 - May 2000)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓕᕆᔨᑦ ᐊᖏᔪᓕᕆᔨᒃᑯᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒡᖏᒍ 4 (ᔦᓂ 1999 - ᒪᐃ 2000)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 4 (June 1999 - May 2000)**

6.3.1

Month/ᑕᕐᖑᒃ/Tatkia			JUN ᔦᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑐᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓕᐱᓗ	JAN ᒍᓐᓇᐊᓗ	FEB ᓇᕐᑲᐊᓗ	MAR ᒪᑉᓕ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	24	34	34	52	56	8	5	11	7	8	37	39	95
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait							1			1			2
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒃᓪᓚᐃᑦ	Akhait										1	1		2
Wolf	ᐊᒪᕐᐃᑦ	Amagut	1					1	2			1	12	1	15
Arctic fox	ᑎᓗᒃᑑᐊᑦ	Tigiganiat						2	4	6	6	3	3		13
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓗᒃᑑᐊᑦ	Kalaliit tigiganiat											3		3
Wolverine	ᖃᓪᓚᐃᑦ	Kalvik										1	2		2
Arctic hare	ᐅᒃᓪᑦ	Ukalik					2	1		1			1		5
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik				1									1
Seals (unspecified)	ᓱᖅᑯᓪᑦ	Natiit				1									1
Ringed seal	ᓇᕆᑦ	Natiinat	20	9	6	14	28	7	1	1	3		3	3	48
Bearded seal	ᐅᓪᔪᐃᑦ	Ukyuk	3	6	4	5	13			1	1				22
Walrus	ᐊᐃᐅᓴᑦ	Akvik	3												3
Beluga	ᖃᑯᑦᑕ ᖁᓪᓗᓚᑦ	Kilalugak		4	28	3									31
Snow goose	ᑲᖅᒍᐃᑦ	Kanguq	10			1								10	20
Canada goose	ᓂᕐᓪᑦ ᐅᓪᐊᒍᒃᓪᑦ	Nikliknik	6											16	20
Ross's goose	ᖃᐅᕐᔪᐃᑦ	Kakat												1	1
Eider duck	ᒥᑎᑦ	Kingalik										1			1
Ptarmigan	ᐊᖏᓂᑦ	Akilgik				1	1	1							3
Goose eggs	ᑲᖅᒍᐃᑦ ᒪᒃᓂᖏᑦ	Uluaguliit manniit	7												7
Arctic tern eggs	ᐃᒥᖅᑯᑕᓚᐃᑦ ᒪᒃᓂᖏᑦ	Emitkutailat manniit	1												1
Black guillemot eggs	ᐱᕐᐅᓪᓕᑦ ᒪᒃᓂᖏᑦ	Black guillemot eggs	1												1
Arctic char	ᐃᖅᓗᑲᐱᑦ	Ikaliviit	28	38	27	11	16	10	1		2		1	5	65
Lake trout	ᐃᓂᕋᐃᑦ	Ikalukpik	5	1	1	9	15	10	3	1	1	1	8	22	41
Northern pike	ᓱᓚᔪᓪᑦ	Hiulik				1					1				2
Arctic grayling	ᓗᓗᑲᐳᐅᓚᐃᑦ	Hulupaugaq	1	3	3	2	2	2			1			2	11
Whitefish	ᑲᐱᓗᓪᑦ	Kapihiliit				4	2	4	1						9
Cod	ᐅᓚᐃᑦ	Ugak	1										2	38	41

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓯᒪᔨᓂᒃ ᐱᑕᖃᒃᖏᑐᒃ ᐱᐅᔭᒍᓐᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᑦᓂᑦ ᐊᓪᔪᖅᓂ ᐃᓕᑴᕐᓯᒪᔨᓂᑦ ᐊᖏᔪᖅᓂ ᓇᓕᕐᔪᐊᓘᓐᓃᑦ ᐃᓂᓴᖏᑦᓂ ᐃᓕᓴᕐᓂᐊᓕᕆᓂᖅᓱᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 499

Monthly harvest estimates

ᑕᕆᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓱᕈᑎᑦ

Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)

ᐊᓐᖏᔪ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕆᖏᓐᓄ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓚᐱᓗ	DEC ᑎᓯᓚᐱᓗ	JAN ᔮᖏᓄᐊᓗ	FEB ᓇᖕᒪᐊᓗ	MAR ᒪᕐᔪ	APR ᐃᑦᓇᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	63	155	166	574	198	237	235	111	303	49	629	448	3,168 ± 352
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait							3						3 ± 5
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡						1414							
Wolf	ᐊᒪᓗᐃᑦ	Amagut						3				25	58	1	87 ± 55
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat					3	741	163	22	43	69	90	1	1,132 ± 338
Coloured fox	ᖃᓄᖕᕿᑐᑐᑦ ᑎᓕᓴᖅᓂᐊᑦ	Kalaliit tigiganiat						1					6		7 ± 9
Wolverine	ᖃᕐᕙᓪᓕᑦ	Kalvik				1						1	6		8 ± 5
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik										17			17 ± 19
Ringed seal	ᓇᓕᓐᓂᑦ	Natiinat	144	18		7	73	13	4	21	9	3	4	14	310 ± 165
Bearded seal	ᐅᓗᓪᓚᐃᑦ	Ukyuk	7	1			5	3					1		17 ± 12
Harbour seal	ᖃᓄᕐᕕᐊᑦ	Qanigiaq				2									2 ± 1
Walrus	ᐊᐃᐃᓕᑦ	Akvik	1												1 ± 1
Beluga	ᖃᓄᖅᑕ ᖁᓪᓗᓚᑦ	Kilalugak		18	55	43									116 ± 34
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq	1,075											1,561	2,636 ± 1,587
Canada goose	ᓂᕐᓪᓕ ᐅᓪᓚᔪᒻᓪᓕ	Nikliknik	224			2								579	805 ± 380
Ross's goose	ᖃᖏᕐᓚᐃᑦ	Kakat												12	12 ± 19
Tundra swan	ᕿᓘᓚᐃᑦ	Kukyuk				1									1 ± 1
Ptarmigan	ᐊᖏᓚᑦ	Akilgik				9		10	14			26			59 ± 48
Goose eggs	ᑲᖏᔪᐃᑦ ᒪᓕᓂᖅᑦ	Uluaguliit manniit	2,010											3,356	5,366 ± 2,362
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖅᑦ	Tinmiat manniit	442												442 ± 205
Arctic tern eggs	ᐃᒥᖃᑯᓪᓚᐃᑦ ᒪᓕᓂᖅᑦ	Emitkutailat manniit		10											10 ± 9
Black guillemot eggs	ᐱᕐᓯᐅᓪᓕᑦ ᒪᓕᓂᖅᑦ	Black guillemot eggs		1											1 ± 1
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	390	1,053	812	189	136	1,056	78	38	54	88		25	3,919 ± 1,072
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	56			33	96	285				49	149	233	901 ± 304
Arctic grayling	ᓱᓗᒃᑕᐅᒪᐃᑦ	Hulupaugaq				6	151								157 ± 251
Whitefish	ᑲᐱᓱᓪᓕᑦ	Kapihiliit	21			15	61	385							482 ± 170
Burbot	ᑎᒃᑕᓪᓕᑦ	Tiktaaliq						3							3 ± 5
Cod	ᐅᒪᐃᑦ	Ugak												2,260	2,260 ± 340

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᔪᓂᑦ ᑎᑎᕋᐅᒪᓕᕐᓂ ᑐᓂᒃᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓚᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.3.1

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 500

Monthly hunter response

ᑕᕝᕙᒪᒃ ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᒻᒪᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕝᕙᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᕕᓇ	OCT ᐅᑦᔪᕕᓇ	NOV ᐃᓄᕐᕕᓇ	DEC ᑎᓯᕐᕕᓇ	JAN ᒍᖏᓂᐊᓇ	FEB ᐃᕙᑲᐊᓇ	MAR ᒪᕐᔪ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ ᐋᔪᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᕝᕙᒪᒃ ᐊᖏᔪᓂᕆᑦ	Tatkitaman angunahuktut titigait	389	388	389	389	388	388	388	390	391	390	390	389	393*
Interview list	ᐊᐱᕐᓂᖅᓯᒪᑦ	Apikiktan	190	189	190	190	189	189	189	191	192	191	191	190	194*
Hunters interviewed	ᐊᖏᔪᓂᕆᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	165	157	141	168	155	167	164	171	187	183	184	177	191*
Harvested	ᐊᖏᔪᓂᖅᑐᒋᓐᓂᑦ	Angujaujut	43	45	41	60	32	56	19	14	23	23	69	122	148*
Response rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᓂᓂᖏᑦ (%)	Kiujut (%)	87	83	74	88	82	88	87	90	97	96	96	93	88**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᕆᑦ ᐊᑎᓕᐅᔾᔨᒃᑲᓐᓂᑦ/ᐊᐱᕐᓂᖅᓯᒪᓂᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᖅᑐᒋᓐᓂᑦ ᐊᑕᐅᓴᐊᓗᓂ% ᐊᑐᑎᑭ ᐊᒻᒪᔪᒍ.
** ᐊᐅᔨᓴᓕᒪᓕᔾᔨ ᑕᕝᕙᒪᒃ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 501

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᓐᓄᓂ ᐊᖏᔪᓂᖅᓴᓂᖓᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑎᓂᑦ ᐊᖏᔪᓂᕆᑦᑕ ᑎᑎᕐᑦᑕᐅᒪᔾᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, anuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᒻᒪᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕝᕙᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᕕᓇ	OCT ᐅᑦᔪᕕᓇ	NOV ᐃᓄᕐᕕᓇ	DEC ᑎᓯᕐᕕᓇ	JAN ᒍᖏᓂᐊᓇ	FEB ᐃᕙᑲᐊᓇ	MAR ᒪᕐᔪ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔾᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕝᕙᑦ	≤ tatkin pingahut	94	100	100	100	100	100	100	100	99	100	100	100	99
4-6 months	4-6 ᑕᕝᕙᑦ	tatkin hitaman 6nut	6	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᕝᕙᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	1	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 502

Number of hunters harvesting each species — **Year 5 (June 2000 - May 2001)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓚᓯᖅᑎᑦ ᐊᖏᓚᓯᖅᓯᒡᓗᑦ ᐊᑐᓂᖅ ᐅᒪᔨᓂᖅ — **ᐊᒡᖏᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 5 (June 2000 - May 2001)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᐹᓗᓂ	OCT ᐅᑦᑐᓗᓂ	NOV ᐅᓇᒃᑲᓗᓂ	DEC ᑎᓯᒃᑲᓗᓂ	JAN ᔮᖏᓇᐊᓗᓂ	FEB ᓇᖕᖏᐊᓗᓂ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᖅ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	15	37	35	59	21	31	11	9	22	9	65	58	110
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait							1						1
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᖏᐃᑦ	Amagut						1				5	8	1	11
Arctic fox	ᑎᓕᑦᓂᓕᐊᑦ	Tigiganiat					1	30	11	5	6	7	7	1	35
Coloured fox	ᖃᐅᓐᖓᑎᑦ ᑎᓕᑦᓂᓕᐊᑦ	Kalaliit tigiganiat						1					1		2
Wolverine	ᖃᑦᕿᐃᑦ	Kalvik				1						1	3		5
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik										2			2
Ringed seal	ᓇᓕᓱᑦ	Natiinat	12	5		4	14	3	3	5	1	2	2	5	33
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	2	1			4	1					1		8
Harbour seal	ᖃᓗᑭᐊᑦ	Qanigiaq				2									2
Walrus	ᐊᐃᐃᓴᑦ	Akvik	1												1
Beluga	ᖃᐅᖅᑕᑦ ᖃᓪᓗᓴᑦ	Kilalugak		8	12	13									28
Snow goose	ᑲᖏᒍᐃᑦ	Kanguq	14											19	28
Canada goose	ᓄᖅᓪᓕ ᐅᓗᐊᔪᓪᓕ	Nikliknik	11			2								11	18
Ross's goose	ᖃᐅᖅᔪᐃᑦ	Kakat												1	1
Tundra swan	ᑲᓚᔪᐃᑦ	Kukyuk				1									1
Ptarmigan	ᐊᖏᓴᑦ	Akilgik				1		1	1			1			4
Goose eggs	ᑲᖏᒍᐃᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit	14											18	25
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit	4												4
Arctic tern eggs	ᐃᒥᖃᑯᓕᐃᑦ ᒪᓕᓂᖏᑦ	Emitkutailat manniit		1											1
Black guillemot eggs	ᐱᑦᓯᐅᓪᓚᑦ ᒪᓕᓂᖏᑦ	Black guillemot eggs		1											1
Arctic char	ᐃᖅᓗᑲᕆᑦ	Ikaliviit	13	24	12	9	5	12	2	2	2	1		1	47
Lake trout	ᐃᓱᕐᓴᐃᑦ	Ikalukpik	6			4	5	11				5	14	19	42
Arctic grayling	ᓱᓗᑲᐅᒪᐃᑦ	Hulupaugaq				1	1								2
Whitefish	ᑲᐱᓱᓪᓚᑦ	Kapihiliit	2			2	3	7							10
Burbot	ᑎᑭᒃᓪᓚᑦ	Tiktaaliq						1							1
Cod	ᐅᒪᐃᑦ	Ugak												93	93

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓱᒪᔪᓂᖅ ᐱᑕᖅᖏᑦᑐᖅ ᐱᔨᔪᑎᓕᓐᓂᖅ ᐊᖏᓴᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᖅᓄᑦ ᐊᖏᓴᓄᑦ ᓇᓪᓕᐅᕐᓇᖅᑐᓂᑦ ᑐᓂᔭᖏᓐᓄᑦ ᐃᑯᐊᖏᓚᓪᓕᓇᓕᒃ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 503

Annual harvest estimates and five-year mean

ᐊᓕᖁᔭᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓐᓂᑦ ᐊᓚᓗ ᑕᒻᓕᓂᑦ-ᐊᓕᖁᔭᓂᑦ ᐊᐅᓐᓕᕐᓂᕐᓚᕐᒪᑦ

Aragutamat angujauvaktun tatlman araguit iluani

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᓕᖁᔭᓂᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

6.3.1

Study Year/ᖃᐅᔨᓴᖅ ᐊᓕᖁᔭ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᓐᓕᕐᓂᕐᓚᕐᒪᑦ Amigaitkiyait
Species	**ᐅᒪᔪᑦ**	**Umajuin**						
Caribou[1]	ᑐᑐᐃᓵᑦ[1]	Tuktut[1]	3,623	4,036	3,466	2,367	3,168	3,332
Musk-ox	ᐅᒥᖓᒪᐃᓵᑦ	Umingmait	2	3	2	4	3	3
Moose	ᑐᑐᓀᐃᓵᑦ	Tuktuvait	0	7	0	0	0	1
Polar bear[2]	ᓇᓂᐃᓵᑦ[2]	Nanuit[2]	20	17	17	12	14	16
Tundra grizzly[3]	ᐊᒃᓪᓚᐃᓵᑦ[3]	Akhait[3]	0	2	0	4	0	1
Black bear	ᕿᓐᓂᕐᑕᑦ ᐊᒃᓪᓚᐃᓵᑦ	Kiniktut akhait	0	3	1	0	0	1
Wolf	ᐊᒪᔪᐃᓵᑦ	Amagut	120	390	406	112	87	223
Arctic fox[4]	ᑎᓕᒃᓂᓂᐊᑦ[4]	Tigiganiat[4]	1,211	1,582	602	123	1,132	930
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᓕᒃᓂᓂᐊᑦ	Kalaliit tigiganiat	5	8	0	5	7	5
Wolverine[5]	ᖃᓴᐃᑦ[5]	Kalvik[5]	1	6	24	5	8	9
Lynx	ᐱᖏᑐᓯᖏᖅ	Pamiuqtuuq	1	0	0	0	0	<1
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik	13	12	3	8	17	11
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik	0	0	0	7	0	1
Seals (unspecified)	ᓯᖏᑯᓪᓕᑦ	Natiit	2	0	0	5	0	1
Ringed seal[6]	ᓇᓯᓚᑦ[6]	Natiinat[6]	311	323	401	590	310	387
Bearded seal	ᐅᑦᔪᐃᓵᑦ	Ukyuk	30	73	87	94	17	60
Harp seal	ᖃᐃᕐᓪᓕᑦ	Qairulik	2	0	1	0	0	1
Harbour seal[7]	ᖃᓂᒋᐊᑦ[7]	Qanigiaq[7]	1	10	0	0	2	3
Walrus[8]	ᐊᐃᓴᒃᑦ[8]	Akvik[8]	0	4	0	7	1	2
Beluga[9]	ᖃᑯᑦᑕ ᖃᓪᓗᓂᑦ[9]	Kilalugak[9]	203	376	137	207	116	208
Geese (unspecified)	ᓂᕐᓪᓕᑦ	Kanguk	0	36	0	0	0	7
Snow goose[10]	ᑲᖕᒍᐃᓵᑦ[10]	Kanguq[10]	864	2,160	1,200	1,148	2,636	1,602
Canada goose	ᓂᕐᓪᓕᑦ ᐅᓗᐊᒍᓪᓕᑦ	Nikliknik	732	1,111	468	378	805	699
Ross's goose	ᖃᑦᕐᔪᐃᓵᑦ	Kakat	2	45	12	1	12	14
Brant goose	ᓂᕐᓪᓕᕐᓇᐃᓵᑦ	Nirlirnaq	2	0	0	0	0	<1
White-fronted goose	ᓂᕐᓪᓕᑦ	Nirlivik	36	82	0	0	0	24

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Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᔪᙳᖅ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Mean ᐊᐅᔪᓕᕐᓂᐊᕐᓗᓂ Amigaitkiyait
			96/97	97/98	98/99	99/00	00/01	
Species	ᐅᓪᓗᒍ	**Umajuin**						
Pintail	ᖁᓕᒪᔪᖅ	Arnaviaq	50	0	0	0	0	10
Eider duck	ᑎᑎᑦ	Kingalik	49	0	6	1	0	11
Tundra swan	ᖁᓕᔪᐃᑦ	Kukyuk	2	0	0	0	1	1
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	206	465	167	33	59	186
Goose eggs[11]	ᑲᖕᒍᐃᑦ ᓚᖅᓂᖏᑦ[11]	Uluaguliit manniit[11]	1,451	4,830	2,931	1,360	5,366	3,188
Duck eggs[11]	ᑎᑎᑦ ᓚᖅᓂᖏᑦ[11]	Tinmiat manniit[11]	424	0	0	0	442	173
Arctic tern eggs[11]	ᐃᒥᖏᑯᒐᓗᐃᑦ ᓚᖅᓂᖏᑦ[11]	Emitkutailat manniit[11]	0	0	0	15	10	5
Black guillemot eggs[11]	ᐱᕐᓂᐅᓪᓚᑦ ᓚᖅᓂᖏᑦ[11]	Black guillemot eggs[11]	0	0	0	25	1	5
Arctic char[12]	ᐃᖃᓗᒃᐱᑦ[12]	Ikaliviit[12]	3,270	4,408	4,333	5,380	3,919	4,262
Lake trout[13]	ᐃᓕᖅᐃᑦ[13]	Ikalukpik[13]	1,423	1,896	1,666	938	901	1,365
Northern pike	ᓱᓚᔪᓪᓕ	Hiulik	2	8	13	4	0	5
Arctic grayling[14]	ᓕᓗᒃᑐᐅᓚᐃᑦ[14]	Hulupaugaq[14]	1,346	640	751	400	157	659
Whitefish	ᑲᐱᓕᔪᓕ	Kapihiliit	683	397	211	202	482	395
Burbot	ᑎᒃᑯᔪᓕ	Tiktaaliq	2	22	0	0	3	5
Least cisco	ᒥᑭᓂᖅᓴᑦ ᑲᐱᓕᔪᓕ	Eetuuk	1	0	0	0	0	<1
Cod[13]	ᐅᓚᐃᑦ[13]	Ugak[13]	2	1	651	1,434	2,260	870
Sculpin	ᑲᓪᔪᐃᑦ	Kanayuk	2	0	72	0	0	15

[1-14]: See page 628 for community feedback and other sources of data.

[1-14]: ᑕᐃᒪ ᓴᕐᐱᑐᖅ 630 ᓄᓇᓕᑦ ᑭᐅᔪᓂᖏᑦ ᐊᓚᓗ ᐊᓯᖏᑦ ᐱᖓᑲᓕᕐᓂᐊᕐᓗᑎᑦ.

[1-14]: Takulugu makpigaak 632 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 504

Annual hunter response

ᐊᓗᖏᔪᑕᒫᑦ ᐊᖏᔪᓇᓴᒃᑎᑦ ᑭᐅᓂᖏᑦ

Angujauvaktu

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓗᖏᔪᓄᑦ (ᓯᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᔪᙳᖅ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Total ᑲᑎᕐᑐᑦ Tamakiklugin
			96/97	97/98	98/99	99/00	00/01	
Hunter Response Categories	ᐊᖏᔪᓇᓴᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑦᔪᕐᓗᓂᖏᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᑭᑕᒪᑦ ᐊᖏᔪᓇᓴᒃᑎᑦ	Tatkitaman angunahuktut titigait	379	380	387	395	393	410*
Interview list	ᐊᐱᕐᓂᕐᓴᑦ	Apikiktan	239	178	183	194	194	310*
Hunters interviewed	ᐊᖏᔪᓇᓴᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	237	172	174	176	191	305*
Harvested	ᐊᖏᔪᓇᓴᑐᒃᓯᓕᑦ	Angujaujut	181	143	131	134	148	248*
Response Rate (%)	ᑭᐅᓂᖏᑦ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	91	87	88	88	88	89**

* Hunters registered/on interview list/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖏᔪᓇᓴᒃᑎᑦ ᐊᑎᓕᐅᕐᓗᒍᓴᑦ/ᐊᐱᕐᓂᕐᓴᓐᓂᑦ/ᐊᐱᕐᓂᕐᑕᑦ/ᐊᖏᔪᓇᓴᑐᒃᓯᓕᑦ ᐊᑕᐅᓂᕐᓴᑦ ᖃᐅᔨᓴᖅ.
** ᐊᐅᔪᓕᕐᓂᐊᕐᓗᒍᓴᑦ ᐊᑦᔪᙳᖅᑕᑦ ᑭᐅᓂᖏᑦ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut taipfumuna tahapkuan kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

6.3.1

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 505

Recall period between harvest and interview, expressed as % of total harvest records

All Years (June 1996 - May 2001)

ᐅᑎᕆᐃᐅᔪᑦ ᐊᒋᖅᓯᓂ ᐊᖏᓚᓂᓕᖅᓯᒪᑦ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑎᐅᓂᖅᓯᒪᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᓚᓂᒃᑐᑦ ᑎᑎᕐᑎᐅᒪᔪᑦ

ᑕᒪᐃᓐᓄᑦ ᐊᑲᐅᔪᓄᑦ (ᔮᓂ 1996 - ᒪᐃ 2001)

Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕆᐃᐅᔪᑦ**	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᕐᓂᑦ	≤ tatkin pingahut	99	99	99	98	99	99
4-6 months	4-6 ᑕᕐᓂᑦ	tatkin hitaman 6nut	0	1	1	2	0	1
> 6 months	> 6 ᑕᕐᓂᑦ	> 6 tatkin	1	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 506

Number of hunters harvesting each species

All Years (June 1996 - May 2001)

ᖃᓄᐅᓂᖅᑐᑦ ᐊᖏᓚᓂᒃᑎᑦ ᐊᖏᓚᓂᒃᓯᕐᔪᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ

ᑕᒪᐃᓐᓄᑦ ᐊᑲᐅᔪᓄᑦ (ᔮᓂ 1996 - ᒪᐃ 2001)

Angunahuktin angutivaktun umajunik

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	**ᐅᒪᔨᖅ**	**Umajuin**						
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	139	117	107	95	110	190
Musk-ox	ᐅᒥᓴᒪᑦ	Umingmait	2	1	2	2	1	6
Moose	ᑐᖅᑐᕋᐃᑦ	Tuktuvait		2				2
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒃᓪᓚᐃᑦ	Akhait		1		2		2
Black bear	ᕿᓐᓄᑦᑕᑦ ᐊᒃᓪᓚᐃᑦ	Kiniktut akhait		1	1			2
Wolf	ᐊᒪᕈᐃᑦ	Amagut	24	25	24	15	11	47
Arctic fox	ᑎᓘᑦᓂᐊᑦ	Tigiganiat	57	52	34	13	35	86
Coloured fox	ᖃᑯᓴᕐᑐᑦ ᑎᓘᑦᓂᐊᑦ	Kalaliit tigiganiat	4	4		3	2	12
Wolverine	ᖃᕋᐃᑦ	Kalvik	1	4	9	2	5	18
Lynx	ᐱᖓᑭᓯᕐᓴᖅ	Pamiuqtuuq	1					1
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik	6	5	2	5	2	14
Arctic ground squirrel	ᓯᕿᓕᑦ	Hikhik				1		1

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Study Year/ᖃᐅᔨᓴᖅ ᐱᖁᔭᐅᓂᖅ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᖅ Tamakiklugin
Seals (unspecified)	ᓴᖅᑯᓗᒃ	Natiit	1			1		2
Ringed seal	ᓇᓕᓐᓂ	Natiinat	37	38	43	48	33	84
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk	14	19	28	22	8	51
Harp seal	ᖃᐃᕐᓗᒃ	Qairulik	1		1			2
Harbour seal	ᖃᓄᑎᐊᑦ	Qanigiaq	1	1			2	4
Walrus	ᐊᐃᐸᓴᑦ	Akvik		2		3	1	6
Beluga	ᖃᑯᖏᑦ ᖁᓕᓗᒡᓗᑦ	Kilalugak	39	47	30	31	28	87
Geese (unspecified)	ᓄᖅᓗᒃ	Kanguk		2				2
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	35	40	31	20	28	84
Canada goose	ᓄᖅᓗᒃ ᐅᓗᐊᒍᓐᓇᒃ	Nikliknik	39	44	21	20	18	88
Ross's goose	ᖃᒋᖏᓚᐃᑦ	Kakat	1	4	2	1	1	9
Brant goose	ᓄᓕᓄᓇᐃᑦ	Nirlirnaq	1					1
White-fronted goose	ᓄᖅᓗᒃ	Nirlivik	4	9				12
Pintail	ᖁᓕᒍᐊᓱᑦ	Arnaviaq	1					1
Eider duck	ᒥᑎᑦ	Kingalik	4		1	1		5
Tundra swan	ᖁᓕᓚᐃᑦ	Kukyuk	1				1	2
Ptarmigan	ᐊᖏᓕᑦ	Akilgik	12	18	13	3	4	33
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᐢᓂᖏᑦ	Uluaguliit manniit	16	20	15	7	25	55
Duck eggs	ᒥᑎᑦ ᓚᐢᓂᖏᑦ	Tinmiat manniit	5				4	8
Arctic tern eggs	ᐃᒥᖅᑯᐊᓪᓚᐃᑦ ᓚᐢᓂᖏᑦ	Emitkutailat manniit				1	1	2
Black guillemot eggs	ᐱᓕᓂᐅᓪᓕᑦ ᓚᐢᓂᖏᑦ	Black guillemot eggs				1	1	2
Arctic char	ᐃᖅᓗᓴᐱᑦ	Ikaliviit	100	77	62	65	47	152
Lake trout	ᐃᓕᓴᐃᑦ	Ikalukpik	90	65	56	41	42	144
Northern pike	ᓯᓚᔪᓐᓇᑦ	Hiulik	1	3	2	2		7
Arctic grayling	ᓕᓗᓴᐸᐅᒪᐃᑦ	Hulupaugaq	26	13	20	11	2	47
Whitefish	ᑲᐱᓕᓐᓂᑦ	Kapihiliit	15	9	12	9	10	32
Burbot	ᑎᓴᒋᓐᓂᑦ	Tiktaaliq	2	5			1	7
Least cisco	ᒥᑭᓂᖓᑦ ᑲᐱᓕᓐᓂᑦ	Eetuuk	1					1
Cod	ᐅᒪᐃᑦ	Ugak	1	1	33	41	93	116
Sculpin	ᑲᓇᓚᐃᑦ	Kanayuk	1		6			7

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓕᓚᓂᓴ ᐱᑕᖃᖕᓂᑐᖅ ᐱᓴᔪᑎᓕᓂᓴ ᐊᖏᔪᑦ ᖃᕋᔨᑐᓂᓴᓂᓐᓂᑦ ᐊᓕᔨᓂᑦ ᓇᓕᐅᕐᓂᓕᕆᓂᖅ ᐃᓕᓴᕐᓂᖅᓴᓂ ᐃᓄᐃᑦᑕᓕᕆᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.3 Kivalliq Region

6.3.1 Community Results Discussion: Arviat

The survey frame:
An assessment of under-enumeration during the community visit indicated that there were very few Inuit hunters who were not registered in the Harvest Study. It is estimated that there were five non-Inuit hunters with assigned hunting rights who were not registered, all occasional hunters. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. However, the extent of the bias is likely very small since the missing hunters only represent one percent of the total hunter population (Table 10).

Due to the relatively small number of intensive hunters registered in Arviat, the intensive classification was joined with the active classification for the purpose of calculating harvest estimates.

Survey coverage and non-response bias:
Response rates remained high throughout the course of the Harvest Study. Non-response bias was felt to be minimal. As seen in Table 9 the consistent intentional non-response rate in Arviat was low, at 0.3%, and was not thought to be a potential source of non-response bias.

Response rates were felt to be high enough and non-response bias low enough in all years to ensure that n did in fact constitute a sufficiently representative sample of N hunters.

Measurement issues and response error:
It was reported during the community consultations that egg harvests were under-reported. Further details are provided in the community feedback and other sources of data section below. Section 5.4 also contains a thorough discussion of this issue.

As seen in the recall period tables, the vast majority of harvest records were collected within three months of the harvest, thereby minimizing recall error.

There was commercial harvesting of arctic char during the Harvest Study. As seen below in the comments relating to the char harvest, some of the commercial harvest was reported along with the subsistence harvest. Other harvest records indicated that they were commercial and were removed from the database; these can be seen in Table 4.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou.
2. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
3. **Tundra grizzly:** Harvest estimates seem to be in the right range. Arviat shared a quota of 5 animals with Rankin Inlet, Chesterfield Inlet and Whale Cove. Years with no reported harvest may be inaccurate; however the year 4 estimate of 4 may be high (C.F.).
4. **Arctic fox:** Almost all furs are sold, so in order to verify harvest estimates data were obtained from DSD detailing the number of pelts sold by hunters. DSD reports were available for 1999/2000 and 2000/2001 (years 4 and 5) and indicate that 441 arctic fox pelts were purchased in 1999/2000 (year 4) and 916 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). The harvest estimate for year 4 appears to be low whereas that for year 5 looks to be accurate.

[5] **Wolverine:** The harvest estimate for year 3 seems too high. However, the mean of 9 per year was thought to be accurate (C.F.).

[6] **Ringed seal:** Sampling took place from hunter's catches in the fall of 1998, 1999 and 2000 (Cleator, 2001). This may explain the higher numbers during these years. The mean harvest over the five years of the study looks accurate (C.F.).

[7] **Harbour seal:** In years where 0 were recorded there were likely some caught but not reported (C.F.).

[8] **Walrus:** It is suspected that some walrus were not reported; hunters harvest walrus every year but need to travel to the Rankin Inlet area to do so (C.F.).

[9] **Beluga:** The harvest estimate in year 2 seems too high (C.F.). DFO reports the following harvest numbers for beluga (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
100	100	9	58	100

[10] **Snow goose:** Harvest estimates seem a little low; the mean harvest should be closer to about 1800 to 2000 per year (C.F.).

[11] **Eggs:** Harvest estimates for eggs seem low. It is suspected that hunters were either not reporting eggs or were not counting them and under-estimating how many were gathered. It was also reported during the community visit that hunters do not normally separate out the different types of eggs gathered so the reported species of eggs may not be accurate. Both arctic tern eggs and black guillemot eggs are harvested in large numbers by Arviat residents, however very few were reported during the Harvest Study (C.F.).

[12] **Arctic char:** There was some commercial harvest of arctic char during the Harvest Study (DFO F). In assessing the harvest estimates it was thought that the estimates would represent the subsistence harvest and some of the commercial char harvest (C.F.). The Harvest Study Fieldworker reported that most hunters did report their commercial harvest and that some of this harvest would have been sold locally to stores or individuals in Arviat.

[13] **Lake trout/cod:** Many of the trout and cod reported during the Harvest Study were caught during fishing derbies. Towards the beginning of the study there were lake trout derbies and in the last few years there were cod derbies held (C.F.).

[14] **Arctic grayling:** Higher estimates in years 1 to 3 may have been due to lake trout derbies. Hunters may have caught grayling when fishing for trout (C.F.).

Some species were not reported during the Harvest Study but were harvested by Arviat hunters. The community reports that narwhal were harvested but not reported. Arviat hunters did not have a quota for narwhal but they reported that tags were obtained from other communities for this harvest. However, we were unable to obtain records on the number of narwhal taken during the study. Mussels were also harvested during the study but not reported.

6.3 ᑭᓪᓗᒍ

6.3.1 ᓄᓇᓕᒻ ᓴᖅᑭᑎᐅᔪᓂᖅ ᐅᖃᖅᑎᑕᐅᑎᑦ: ᐊᖏᕐᕋ

6.3.1

ᖃᐅᔨᓴᓂᐅᓪᓚᕆᓂ ᐊᖅᑭᐅᑎᒪᓂᖅ:

ᑐᑭᓯᐅᑎᓕᓯᕋᑎᒋᔭᓂᒃ ᐊᑎᓕᐅᓚᖓᓕᒫᖓᓂ ᓄᓇᓕᒻ ᗅᓕᕆᓂᖅᑕᐅᑎᒋᔭᓂᒃ ᑕᐃᑎᕐᓯᓚᐅᕙᓪᓕᐊᓂᒃ ᖃᓄᖅᑭᐅᓂᖓᓂᒃ ᐃᓄᐃᑦ ᐊᖏᓕᓯᕋᖅᑎᑦ ᑎᑎᕋᖅᑕᐅᓯᒪᔪᓂᑦᑐᑦ ᐊᖏᔪᐅᐅᑦᑐᑦᑕᓂᒃ ᖃᐅᔨᓴᓂᓐᓂᑦ. ᑭᓯᐊᓂᒃ ᓇᓚᑦᑕᑦᑕᐅᓪᓕᐊᖏᓐ ᐊᖏᓕᓯᕋᖅᑕᖃᓚᐅᕙᓪᓕᐊᖏᓐ ᐊᖏᔪᓯᐊᕐᓂᖓᓐᓄᑦᑕᓂᒃ ᐊᖏᓐ ᐱᖏᓯᓂᒃ ᐊᖏᔪᓯᐊᕐᐳᐃᓐᓇᖅᑐᓂᒃ ᑐᓴᐅᐅᓯᒪᔪᓂᒃ ᐊᖏᔪᓯᐊᕐᓂᓐᓂᑦᑕᓂᒃ ᐱᓕᕆᓂᖅᑎᑦ ᑎᑎᕋᖅᑕᐅᓯᒪᓚᐅᕙᕐᓂᑐᓂᒃ. ᐅᖃᐅᔨᓴᖅᓯᒪᓚᑦ ᓇᓚᑦᑕᓂᒃ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓚᖓᓕᒫᖓᓂᕐᒧᑦ ᐱᔪᑕᐅᓂᖓᓐ ᐊᖅᑭᒡᓗᑎᓯᓚᕆᖅᑕᐃᓐᓂᑦ ᐅᓚᕐᓗᑎᓯᓚᖅᑐᑦ ᑐᓴᐅᔪᓂᖓᓂᒃ. ᑭᓯᐊᓂᒃ ᖃᓄᖅᑭᐅᓂᖓᓂᒃ ᐅᐃᒪᐅᑎᓂᒃ ᐅᖃᖅᑕᖅᑭᐅᓂᖓᓂᒃ ᑕᐃᑎᕐᓯᓚᐅᕙᓪᓕᐊᓂᒃ ᐅᓚᕐᓗᑎᓯᓚᖅᑐᑦ ᑭᓯᐊᓂᒃ ᐊᖅᑭᒡᓗᑎᓯᓚᖅᑐᑦ ᐊᖏᔪᓯᐊᕐᓂᓐᓂᑦᑕᓂᒃ ᐊᖏᔪᓯᐊᕐᓂᖓᓐᓄᑦᑕᓂᒃ

[5] **ᖃᐅᖅᓴᖅ:** ᖃᐅᖅᓴᖅᑕᐅᔪᓂᒃ ᐅᑭᐅᖓᑖᓂ 3 ᐊᔪᕐᓗᒍᖏᑦᑐᖅᓯᒪᔪᓂᒃ. ᑭᓱᐊᓂ ᓇᓗᓀᑦᓯᓂᖅᓴᐃᓕᐅᕙᖏᑦᓯᒪᔪᓂᒃ 9ᓂᑦ ᐱᖃᓕᑕᑦᓴᐃᓂᕐᓂᑦ ᐅᑭᐅᑕᒪᓕ (C.F.).

[6] **ᓇᓱᑦ:** ᖃᐅᔨᓴᕿᓂᑦ ᐱᖃᓕᑕᐃᓇᓕᐅᕙᖏᓱᒪᔪᑦ ᐊᖏᔪᓯᓕᕐᓂᓇᓕ ᓇᓱᖏᑕᐅᔪᓂᒃ ᐅᑭᐊᓴᖅᓯᒪᓕ 1998ᒥ, 1999ᒥ ᐊᒻᒪᓗ 2000ᒥ, ᑭᓪᓗᖕ (Cleator, 2001). ᑕᒪᓐᓇ ᐱᔨᔪᑕᐅᕙᒍᖅᑐᖅ ᐅᓇᓂᖅᓴᐃᓚᖅᓱᒪᓂᕐᓂᑦ ᐅᑭᐅᓂ ᑕᐃᑲᓂ. ᐅᑭᐅᑦ ᑕᑦᓭᒪᑦ ᐊᓂᔪᓱᓂᓂᓇᖅᑐᓂᒃ ᖃᓄᖅᑎᓂᔨᔪᑦᓴᖅᓱᒪᓂᕐᓂᒃ ᒥᓱᑎᑦᓂᖅᓴᖅᑐᓂᒃ (C.F.).

[7] **ᖃᓄᐅᔪᑦ:** ᐅᑭᐅᓂ ᐊᑦᓭᓱᒪᖏᑎᓗᓂᑦ ᖃᓄᑎᓂᒃ ᐱᔨᖃᖅᑑᑎᓂᐊᕐᓂᕐᓂᕆᔨᒪᓗᐊᖅ ᐅᖃᖅᓯᐅᓂᖅᑑᑐᓂᒃ (C.F.).

[8] **ᐊᐃᐃᑦ:** ᑲᖏᑎᔭᐅᔨᔪᖅ ᐃᓕᓐᓂᑦ ᐊᐃᕐᓂᑕᐅᕙᕐᑕᑐᓗᒍᓂᑦ ᐅᖃᖅᓯᐅᖃᖅᑕᓂᖏᓪᓕᑕ; ᐊᓯᔪᓂᖅᑎᑦ ᐊᐃᕐᓂᖃᖅᑕᑦᓯᐅᔪᓂᑦ ᐊᖏᔪᓂᖅᑎᑦ ᐊᐃᔨᖃᖅᑕᑦᓯᐅᔪᓂᑦ ᐊᐃᓴᓇᖃᖅᓯᒪᔭᒃ (C.F.).

[9] **ᖃᓕᓚᓴᐃᑦ:** ᐊᖏᓇᐅᕙᕐᑕᑐᓗᒍᓂᑦ ᖃᓄᑎᐅᓂᖏᓪᓂᑦ ᐅᑭᐅᖓᓴᓂ 2 ᐅᓇᓚᐊᖅᑐᑦᓴᖅᑐᓗᒍᓂᑦ (C.F.). ᐃᓚᒋᑕᐅᑕᓂᓇᔭᖅᑐᓂᑦ ᐅᓇᐊ ᑎᑎᖅᑕᐅᓯᒪᔪᓂᑦ ᓇᓚᐊᑎᓂᑦ ᖃᓕᓚᓴᐃᓕᐅᕙᕐᑕᑐᓗᒍᓂᑦ (ᖃᐅᔨᓴᒪᓂᑦ ᐃᓚᒋᑕᐅᑕᓂᓇᔭᖅᑐᓂᑦ ᓇᓚᐊᑎᓂᖏᓪᓂᑦ ᒪᓕᓪᒪᓚᒪᓂᑦ ᑮᓇᐅᔭᓕᐊᑎᑕ ᐅᑭᐅᖓᓪᓗᑦ, ᐅᓚᔪᖅᑕᐅᕙᕐᑕᑐᓗᒍᓐᓇᓕᐅᕙᕐᑕᑐᓗᒍᓂᑦ ᒪᓕᓪᒪᓚᒪᓂᑦ ᐱᖁᔭᐃᖅᑲᖅᑐᓂᒃ ᔪᓂᒃᓯᒪᓕ (DFO N/B):

96/97	97/98	98/99	99/00	00/01
100	100	9	58	100

[10] **ᖃᖓᐃᑦ:** ᖃᖓᔪᖅᑕᐅᕙᕐᑕᑐᓗᒍᓂᑦ ᓇᓕᖓᓂᑦ ᐊᑎᑐᓗᒍᖏᓕᕐᓂᕆᔨᖅᑐᓗᒍᓂᑦ; ᐊᑎᓴᐃᓕᓚᑦ ᐱᔭᐅᓚᔪᓂᑦ ᑕᓚᐅᓂᖅᓴᐅᕙᕐᑕᑐᓗᒍᓂᑦ ᐱᓕᕐᓂᖅᑐᑦ 1800ᖓᓂᓂᑦ 2000ᒧᑦ (C.F.).

[11] **ᒪᓂᑦ:** ᒪᓂᕈᖅᑕᐅᕙᕐᑕᑐᓗᒍᓂᑦ ᓇᓕᖅᖃᖓᓂᑦ ᐊᑎᑐᓗᒍᖃᐃᔪᔪᓕᑦ. ᖃᖓᑎᔭᐅᔨᔪᖅ ᐊᖏᔪᓇᓯᑎᓂᑦ ᐅᖃᖅᓴᕿᓕᐅᖅᖃᖓᓂᖅᓂᖅ ᒪᓂᕈᖅᓴᕿᑕᒥᓂᖅ ᐅᕐᓂᓗ ᓇᓚᐊᑎᓂᖅᓴᕿᑕᑐᓂᑦ ᐊᒻᒪᓗ ᑐᖓᔪᖅᓴᐅᕙᕐᑕᑐᓗᒍᓂᑦ ᖃᓄᐅᑕᐅᕙᕐᑕᑐᓗᒍᓂᑦ ᒪᓂᕈᖅᑕᐅᕙᕐᑕᑐᓗᒍᓂᑦ. ᐅᖃᖅᓴᐅᕙᓕᐅᕙᖅᓴᖅᑐᓂᒃ ᖃᓄᖅᑐᓂᒃ ᒪᓂᕈᖅᑕᐅᕙᕐᑕᑐᓗᒍᓂᑦ ᑕᐃᒪᐃᓕᓴᖅᑐᓂᑦ ᐃᓕᓐᓂᑦ ᐅᖃᖅᓯᐅᓂᖅᑑᑐᓂᒃ ᒪᓂᕈᖅᑐᓂᒃ ᖃᓄᖅᑐᓂᒃ ᑕᒪᓐᓇᖅᑐᓂᒃ ᐱᔨᑦᓯᐅᓂᖅᑑᑐᓂᒃ ᐊᒻᒪᓗ ᐅᑭᐅᖓᓪᓗᑦ ᐱᔨᑦᓯᐅᓂᖅᑑᑐᓂᒃ ᐊᒻᒪᓗ ᐃᓕᓐᓂᑦ ᐅᖃᖅ

6.3 Kivalliq

6.3.1 Nunanit Iniktigutait Ukauhiit: Arviat

6.3.1

Ihivgiuktit Atugutait:
Ihivgiufaakhimayut ataani naunaiyakhimayut nunamut pulaakhimatitluni takuhimayuk ikitut Inuit umayukhiuktit titigakhimaitut Umayukhiukhimayut Ihivgiuktitlugit. Naunaiyakhimayuk talimat Inuinaungitut umayukhiuktit tuniyauhimayut inminiigutinik titigaktauhimaitut, tamamik ilaani umayukhiukataktut. Ukakhimayut ilangani 5.2.1 ikpinagutait hamna ataani naunaiyautaini pilaaktut ataanut ihumagiyainik umayukhiukhimayut naunaiyautaini. Kihimi angitjutait ihumagiyauyut mikiyut ilaungituk umayukhiuktit pihimamat 1%mik tamaat umayukhiuktinit (ikpatauyak 10).

Mikiyuumata amigaitjutait umayukhiukatainaktut titigakhimayut Arviami, umayukhiukatainaktut naunaiyautait katitikhimayut umayukhiukataktut naunaiyautait atugutaini pihimayuni umayukhiukhimayut naunaiyautaini.

Ihivgiugutingit ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait amigaiginaktut tamaat Umayukhiukhimayut Ihivgiuktitlugit. Kiuyuitut ihumagiyait ihumagiyauyut mikiyut. Takuhimapluni ikpatauyami 9 pikataktut kiuyuitut naunaiyautait Arviami ikitut 0.3%mi ovalo ihumagiyaungituk pilaaktuni pihimayaini kiuyuitut ihumagiyaini.

Kiuhimayut naunaiyautait ihumagiyauyut angiyut ovalo kiuyuitut ihumagiyait mikiyut piyaami nni pihimayut nakuuymik ilaukatautjutaini uktugutait Nni umayukhiuktinit.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Tuhaktitihimayut nunamut ukakatihimatitlugit maniit pikiutakhimayut ataani tuhaktitihimayut. Ukautingit pihimayut nunanit ukautaini ovalo aalat pihimayaini katitikhimayuni ilangani hamani. Ilangani 5.4 pihimayutlu ukautitiagutaini hamna ihumagiyauyuni.

Takuhimayut utiktitihimayuni ubluit ikpatauyani, amigaitut umayukhiukhimayut titigait katitikhimayut iluani pingahut tatkikhiutin umayukhiukhimayaini, taimaimat mikiyut utiktitihimayut ihuinaagutait.

Kinauyaliugutit umayukhiuktuni ikalivinik Umayukhiukhimayut Ihivgiuktuni. Takukhauyuk hamani ukautini mikhaanut ikaliviit pikatakhimayut, ilangit kinauyaliugutit umayukhiukhimayuni tuhaktitihimayut ilauplutik atuktakhaini umayukhiukhimayuni. Aalat umayukhiukhimayut titigait pihimayut kinauyaliukhimayut ovalo unguvakhimayut katitikhimayunit; hapkoa takulaaktut ikpatauyami 4mi.

Nunanit Ukakhimayut ovalo aalani atugutaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukataktait ilauyut nunani tuktut.
2. **Nanuit:** Amigaitjutait takukhauyut naunaiyautaungitut kihimi pihimayut umayukhiukhimayut amigaitjutait tunihimayait DSDkut (DSD PB).
3. **Akhat:** Umayukhiukhimayut naunaiyautait naamaktut. Arviat atukatigiyait kotanik talimanik akhanik Kangiklinikmut, Igluligaajukmut ovalo Titigakyuamutlu. Ukiuni tuhaktitiyauhimaitumik umayukhimayaminik ihuinaakhimayu, kihimi ukiumi 4mi hitamamik akhakhimayut angiyut (C.F.).
4. **Tigiganiat:** Tamamivyak amiit niuviktauvaktut, taimaimat naunaiyagiami umayukhiukhimayut naunaiyautait katitikhimayut pihimayut DSDkunit titigakhimayut amigaitjutait amiit niuviktauhimayut umayukhiuktinit. DSDkut tuhaktitihimayut ukini 1999/2000mit ovalo 2000/2001mit (ukiumi 4 ovalo 5) ovalo naunaiyakhimayut 441nik tigiganiat amiit niuviktauhimayut 1999/2000mi (ukiumi 4) ovalo 916nik niuviktauhimayut 2000/2001mit (ukiumi 5) (nalungilutit DSDkut katitikhimayait atukhimayut umayukhiukhimayut ukiungani Julymit Junemut, Umayukhiukhimayut Ihivgiugutait katitikhimayut atukhimayut umayukhiukhimayut ukiungani Junemit Maymut) (DSD FB). Umayukhiukhimayut naunaiyautait ukiumi 4mi takukhauyut mikiyut, kihimi ukiumi 5mi naamaktut.

[5] **Kalviit:** Umayukhiukhimayut naunaiyautait ukiumi 3 angiyut. Kihimi angitjutait 9nik ukiumi tamaat ihumagiyauyut naamaktut (C.F.).

[6] **Natinaat:** Uktugutit pihimayut umayukhiuktit piyainit ukiakhami 1998mi, 1999mi ovalo 2000mi (Cleator, 2001). Hamna pihimayunakhiyuk angitjutigiyait amigaitjutaini hapkoa ukiuni. Angitjutait umayukhiukhimayut talimani ukiuni ihivgiukhimayut naamaktut (C.F.).

[7] **Qanigiaq:** Ukiuni titigakhimayut pingitut, piyunakhiyuugaluit kihimi tuhaktitiyaungitut (C.F.).

[8] **Akviit:** Ihumagiyauyut akvikhimayut tuhaktitiyaungitut; umayukhiuktit pivaktait akviit tamaat ukiuni kihimi autlaakpaktut hanianut Kangiklinikmut piyumagumik (C.F.).

[9] **Kilalugait:** Umayukhiukhimayut naunaiyautait ukiumi 2 angiyut (C.F.). DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait kilalugat (nalungilutit DFOkut katitikhimayait atukpaktut iniktigutaini ukiungit, Umayukhiukhimayut Ihivgiukhimayut katitkhimayut atukpaktut umayukhiukhimayut ukiunganik Junemit ovalo Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
100	100	9	58	100

[10] **Kanguq:** Umayukhiukhimayut naunaiyautait mikiyut; angitjutait umayukhiukhimayut kanitunakhiyut 1,800nit 2,000mut ukiuk tamaat (C.F.).

[11] **Maniit:** Umayukhiukhimayut naunaiyautait maniini mikiyut. Ihumagiyauyuk umayukhiuktit pikatangitunakhiyut tuhaktitiyuitumik maniit ovaluniit naunaiyakhimaimata ovalo ataani naunaiyakhimayut kafit katitikpaktut. Tuhaktitihimayutlu nunani pulaakhimapluni umayukhiuktit pikatayuitut aviktuklugit aalatkiit maniit pikukhimayut, taimaimat tuhaktakhat kanugitut tinmiat maniit ihuinaakhimayunakhiyut. Tamamik Imitkutailat maniit ovalo black guillemot maniit pikukhimayut amigaitunik Arviamiunit, kihimi ikitut tuhaktitihimayut Umayukhiukhimayut Ihivgiuktitlugit (C.F.).

[12] **Ikaliviit:** Kinauyaliugutinik ikalukhiukpatut ikalivinik Umayukhiuhimayut Ihivgiuktitlugit (DFO F). Ihivgiufaakhimayuni umayukhiukhimayut naunaiyautait ihumagiyauyut naunaiyautait pihimayunakhiyut atuktakhainik umayukhiukhimayuni ovalo ilangit kinauyaliukhimayut ikalivinik ikalukhimayaini (C.F.) Umayukhiukhimayut Ihivgiuktit havaktiit tuhaktitihimayut amigaitut umayukhiuktit tuhaktitihimayut kinauyaliugutait ikalukhimayaminik ovalo ilangit ikalukhimayut niuviktauhimayut nunamini niuvikvimut ovaluniit Inunut Arviami.

[13] **Ikalukpiit/ugat:** Amigaitut ikalukpiit ovalo ugat tuhaktitihimayut Umayukhiukhimayut Ihivgiuktitlugit pihimayut takhinahuaktuni ikalukhiutuni. Pilihaaliktitlugit ihivgiuktut ikalukpiit takhinahuaktuni ovalo kingulimi ukiuni ugat takhinahuaktun uganik pivaktut (C.F.).

[14] **Hulupaugaq:** Angiyut naunaiyautait ukiumi 1mit 3mut pihimayut ikalukpinik takhinahuaktunit. Umayukhiuktit pivaktut hulupaugaq ikalukhiuktitlugit ikalukpinik (C.F.).

Ilangit umayut tuhaktitiyauyuitut Umayukhiukhimayut Ihivgiuktitlugit kihimi umayukhiukhimayut Arviamiut umayukhiuktinit. Nunani tuhaktakhat tuugaat umayukhiukpaktut kihimi tuhaktitauyuitut. Arviamiut kotakangitut tuugaanik kihimi tuhaktitihimayut atugutainik pivaktut aalanit nunanit hamna umayukhiukhimayunik. Kihimi pingitugut tuhaktakhainik amigaitjutainik tuugaat pivaktait ihivgiuktitlugit. Uviluvaluit umayukhiuhimayut ihivgiuktitlugit kihimi tuhaktititauyuitut.

TABLE/ᓇᓄᓇᕗᑦᐅᑦ/NAUNAIKUTA 507

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᑦᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

6.3.2

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᑲᔪᑎ	SEP ᓯᑎᐹᓕ	OCT ᐅᑲᐃᓕ	NOV ᐅᓇᕆᐹᓕ	DEC ᑎᓯᐹᓕ	JAN ᔮᖏᓇᓕ	FEB ᓇᖅᑐᓇᓕ	MAR ᒪᓯ	APR ᐃᓴᓗᓯ	MAY ᒪᐃ	Total ᑲᑎᑕᒥᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	141	190	490	428	435	202	178	118	144	146	167	217	2,856 ± 260
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡						2	2						
Tundra grizzly	ᐊᖏᓪᓗᐃᑦ	Akhait					1								1 ± 2
Wolf	ᐊᒪᓗᐃᑦ	Amagut	2					23	29	3		2	11	2	72 ± 36
Arctic fox	ᑎᓕᒃᓂᐊᑦ	Tigiganiat						68	72	27	19	62	66		314 ± 100
Wolverine	ᖃᕐᓇᑦ	Kalvik						1				2	2		5 ± 4
Ringed seal	ᓇᕆᑦ	Natiinat												8	8 ± 12
Snow goose	ᑲᖅᐅᐃᑦ	Kanguq	15												15 ± 12
Canada goose	ᓂᕐᓕᑦ ᐅᓗᐊᔪᓕᓕᑦ	Nikliknik	100			4								2	106 ± 39
Ptarmigan	ᐊᑭᒃᑎᑦ	Akilgik									26				26 ± 36
Goose eggs	ᑲᖅᐅᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	13	41											54 ± 60
Arctic char	ᐃᖃᓗᒃᐸᑦ	Ikaliviit	748	99	138	1	20	120					9	22	1,157 ± 289
Lake trout	ᐃᓱᕐᕋᐃᑦ	Ikalukpik	1,146	386	321	92	701	143	126	52	44	51	183	550	3,795 ± 683
Arctic grayling	ᓱᓗᒃᐸᐅᒪᐃᑦ	Hulupaugaq	8	227	287		509								1,031 ± 566
Whitefish	ᑲᐱᓯᓕᑦ	Kapihiliit			5			418	29						452 ± 464

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᕐᓂᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᔭᖏᑦ ᐅᑯᐊ ᐃᑯᐸᕐᓇᓗᓂᕐᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 508

Monthly hunter response

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓯᓱᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᒃᓴᔪ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

6.3.2

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑐᑎ	SEP ᓯᑎᐸᓇᓗ	OCT ᐅᑯᐊᓗ	NOV ᓄᓇᒃᓇᓗ	DEC ᑎᓯᒪᓇᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᓴᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓯᓱᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔪᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᔪᓯᓱᑦ	Tatkitaman angunahuktut titigait	326	326	325	325	325	324	323	321	321	321	320	319	327*
Interview list	ᐊᐱᕐᓂᖅᓯᒪᑦ	Apikiktan	218	217	216	216	216	215	214	213	213	213	212	211	218*
Hunters interviewed	ᐊᖏᔪᓯᓱᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	185	175	180	177	173	174	175	174	167	170	167	166	208*
Harvested	ᐊᖏᔪᓯᓱᒋᑎᓕᓪᓕᑦ	Angujaujut	88	41	62	56	46	35	34	27	24	30	39	43	138*
Response rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᓂᖏᑦ (%)	Kiujut (%)	85	81	83	82	80	81	82	82	78	80	79	79	81**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓯᓱᑦ ᐊᑎᓕᐅᔾᔪᓕᐊᔪᓂᑦ/ᐊᐱᕐᓂᖅᓯᒪᓂᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓯᓱᒋᑎᓕᓪᓕᑦ ᐊᑕᐅᓯᐊᔪᓗᓂ% ᐊᑎᑎᑦ ᐊᒃᓴᒪᑎ.
** ᐊᐅᔨᓕᓕᖅᓯᒪᔨᑦ ᑕᖅᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 509

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᖏᓐᓄ ᐊᖏᔪᓯᓴᓂᖓᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᑕ, ᓇᓗᓇᐃᖏᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓯᓱᑦ ᑎᑎᕐᓂᑦᑕᐅᒪᔨᑦ

Year 1 (June 1996 - May 1997)

ᐊᒃᓴᔪ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑐᑎ	SEP ᓯᑎᐸᓇᓗ	OCT ᐅᑯᐊᓗ	NOV ᓄᓇᒃᓇᓗ	DEC ᑎᓯᒪᓇᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᓴᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕐᔪᑦ	≤ tatkin pingahut	53	39	38	44	77	49	36	30	45	65	54	62	50
4-6 months	4-6 ᑕᕐᔪᑦ	tatkin hitaman 6nut	27	49	44	35	8	27	48	40	18	6	8	7	28
> 6 months	> 6 ᑕᕐᔪᑦ	> 6 tatkin	20	13	18	21	14	24	16	30	38	29	38	32	22

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 510

Number of hunters harvesting each species — **Year 1 (June 1996 - May 1997)**

ᖃᓄᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᓴᒋᑦ ᐊᖏᔪᓚᓴᒃᑯᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒻᒋᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 1 (June 1996 - May 1997)**

6.3.2

Month/ᑕᖅᖢᓗ/Tatkia			JUN ᔨᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓱᑎᐹᓗ	OCT ᐅᑦᑐᓗ	NOV ᐅᓇᒻᐹᓗ	DEC ᑎᓴᐹᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓕᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	31	28	58	54	41	22	21	21	20	25	29	28	113
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒃᓪᓚᐃᑦ	Akhait					1								1
Wolf	ᐊᒪᓗᐃᑦ	Amagut	1					5	3	1		1	4	1	10
Arctic fox	ᑎᓕᒐᓂᐊᑦ	Tigiganiat						7	8	6	2	4	4		15
Wolverine	ᖃᑦᕿᒋᑦ	Kalvik						1				1	1		2
Ringed seal	ᓇᓯᓪᑦ	Natiinat												1	1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	1												1
Canada goose	ᓂᖅᓪᑦ ᐅᓗᐊᒍᓪᓪᑦ	Nikliknik	14			1								1	16
Ptarmigan	ᐊᖏᕆᑦ	Akilgik									1				1
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	1	1											2
Arctic char	ᐃᖕᓗᒃᐲᑦ	Ikaliviit	43	7	6	1	2	1					2	3	54
Lake trout	ᐃᓯᕐᕿᐃᑦ	Ikalukpik	67	15	10	3	12	8	7	3	3	6	15	26	96
Arctic grayling	ᓭᓗᒃᐸᐅᒪᐃᑦ	Hulupaugaq	1	1	1		2								3
Whitefish	ᑲᕕᓯᓂᑦ	Kapihiliit			1			2	1						4

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᖕᕐᑐᖅ ᐱᓱᐊᒥᓂᖅᓂᒃ ᐊᖏᔪᑦ ᖃᕋᓴᐅᓂᖕᕐᓂᑦ ᐊᓪᓚᖃᑦᑕᒪᔪᓂᑦ ᐊᖏᔪᓄᑦ ᓇᓪᑕᐊᕐᓵᓕᖅᑐᓂᒃ ᑐᓴᖕᕐᓂᖅᓂ ᐃᑯᐱᕐᓚᓐᓇᓕᒃᑯᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 511

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓕᑦ

Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)

ᐊᑦᖁᔪ 2 (ᔫᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

6.3.2

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐅᓕᓐ	OCT ᐅᑲᐃᓕᓐ	NOV ᐅᓇᓱᐃᓕᓐ	DEC ᑎᓯᓚᓐ	JAN ᔮᖏᓇᐊᓕᓐ	FEB ᓇᖕᐅᐊᓕᓐ	MAR ᒪᕆ	APR ᐃᑲᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	159	162	354	322	553	295	196	137	124	192	193	159	2,846 ± 256
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡						1	1						
Wolf	ᐊᒪᓗᐃᑦ	Amagut					6	12	5	25	20	10	19		97 ± 32
Arctic fox	ᑎᓚᒋᓐᓂᐊᑦ	Tigiganiat						35	12	60			9		116 ± 62
Wolverine	ᖃᓕᕆᑦ	Kalvik												2	2 ± 2
Arctic hare	ᐅᑲᓪᓕ	Ukalik				4									4 ± 7
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	24			4									28 ± 30
Canada goose	ᓂᕆᓪᓕ ᐅᓗᐊᒍᓪᓕ	Nikliknik	30											20	50 ± 37
Ptarmigan	ᐊᖏᓴᑦ	Akilgik				51					6		98	30	185 ± 167
Sandhill crane	ᑕᑎᓴᕐᔪᐊᑦ	Tatilgaq												3	3 ± 4
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	147												147 ± 148
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	39												39 ± 62
Arctic char	ᐃᖅᓗᒃᑲᑦ	Ikaliviit	275	9		35		77					103	123	622 ± 189
Lake trout	ᐃᓱᖁᔭᐃᑦ	Ikalukpik	2,850	122	195	190	577	230	20	6	3	112	629	950	5,884 ± 2,805
Arctic grayling	ᓱᓗᒃᐸᐅᒪᐃᑦ	Hulupaugaq	26	14	9		192								241 ± 228
Whitefish	ᑲᕕᓯᓪᓕ	Kapihiliit					692	403							1,095 ± 767
Burbot	ᑎᑦᑕᓪᓕ	Tiktaaliq					3								3 ± 4

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓂᑦ ᑎᑎᕋᐅᒪᔨᑦ ᑐᓂᒃᖏᑦ ᐅᑲᐃᖏᑦ ᐅᑯᐊ ᐃᑯᐊᕐᓇᓗᓕᒃᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 512

Monthly hunter response
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᑦᕿᒍ 2 (ᔨᓂᓕ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Hunter Response Categories / ᐊᖓᔪᓕᓇᖅᑎᑦ ᑭᐅᓂᖏᑦ ᐱᔪᓐᓇᓕᓂᖏᑦ	Month/ᑕᕝᕕᖓ/Tatkia	JUN ᔨᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᑦᓴᓇ	OCT ᐅᑲᐃᓇ	NOV ᓄᓇᒡᓇ	DEC ᑎᓯᒡᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᕕᒃᖁᐊᓇ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓗ	MAY ᒪᐃ	Total ᑲᑎᑲᑦ Tamakiklugin
Monthly hunter list	ᑕᕝᕕᒃᓴᑦ ᐊᖓᔪᓕᓇᖅᑎᑦ	Tatkitaman angunahuktut titigait	319	319	318	317	315	315	314	304	304	303	306	306	324*
Interview list	ᐊᐱᕐᓂᖅᓯᒪᑦ	Apikiktan	211	211	210	210	208	208	208	198	198	198	201	200	214*
Hunters interviewed	ᐊᖓᔪᓕᓇᖅᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	130	152	159	150	134	134	115	139	139	136	139	135	186*
Harvested	ᐊᖓᔪᓕᓇᖅᑐᒃᑯᓗᒃᑐᑦ	Angujaujut	52	37	56	45	49	34	28	24	24	24	36	44	113*
Response rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᓂᖏᑦ (%)	Kiujut (%)	62	72	76	71	64	64	55	70	70	69	69	68	68**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate..

* ᐊᖓᔪᓕᓇᖅᑎᑦ ᐊᑎᓕᐅᕐᓂᒪᓕᒃᑲᓂᕐᓂᑦ/ᐊᐱᕐᓂᕐᓴᐅᑉᑲᓂᕐᓂᑦ/ᐊᐱᕐᓂᕐᓂᑦ/ᐊᖓᔪᓕᓇᖅᑐᒃᑯᓗᒃᑐᑦ ᐊᑕᐅᓂᐊᕐᓗᓂ% ᐊᑎᑎᑦ ᐊᑦᕿᒍᒥ.
** ᐊᐅᔨᓴᓕᑎᓂᒪᓕᒃᓴᑦ ᑕᕝᕕᒃᓴᑦ ᑭᐅᔾᔨ

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 513

Recall period between harvest and interview, expressed as % of total harvest records
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)
ᐅᑎᕐᕕᐅᓴᑦ ᐊᑯᖏᓐᓄᑦ ᐊᖓᔪᓕᓇᖅᓯᓄᖏᓐᓄᑦ, ᐊᓗᓇᐃᖏᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖓᔪᓕᓇᖅᑐᑦ ᑎᑎᕐᕕᐅᒪᓕᒃᓴᑦ
ᐊᑦᕿᒍ 2 (ᔨᓂᓕ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Recall Period / ᐅᑎᕐᕕᐅᓴᑦ	Month/ᑕᕝᕕᖓ/Tatkia	JUN ᔨᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᑦᓴᓇ	OCT ᐅᑲᐃᓇ	NOV ᓄᓇᒡᓇ	DEC ᑎᓯᒡᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᕕᒃᖁᐊᓇ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓗ	MAY ᒪᐃ	Total ᑲᑎᑲᑦ Tamakiklugin
≤ 3 months	≤ 3 ᑕᕝᕕᒃ	≤ tatkin pingahut	44	55	35	44	63	88	87	32	34	0	3	3	42
4-6 months	4-6 ᑕᕝᕕᒃ	tatkin hitaman 6nut	21	35	48	50	27	8	6	0	6	12	5	3	22
> 6 months	> 6 ᑕᕝᕕᒃ	> 6 tatkin	35	10	16	6	10	4	6	68	60	88	92	95	36

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 514

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᓴᒋᑦ ᐊᖏᔪᓚᓴᒃᓯᒋᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 2 (June 1997 - May 1998)

ᐊᑲᓱᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

6.3.2

Month/ᑕᖑᖏᑐᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᔅᑎ	SEP ᓱᑎᑦᓚᓗ	OCT ᐅᑲᐃᓚᓗ	NOV ᔅᓄᐱᓚᓗ	DEC ᑎᓯᓚᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᓇᖑᐅᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓗᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑲᐃᐃᑦ	Tuktut	24	33	51	43	47	28	24	19	20	22	27	26	97
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut					3	4	2	3	4	4	3		13
Arctic fox	ᑎᓗᒃᑖᓂᐊᑦ	Tigiganiat						6	2	3			1		11
Wolverine	ᖃᑦᕃᓵᑦ	Kalvik												1	1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				1									1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	2			1									3
Canada goose	ᓂᑦᓪᓚᑦ ᐅᓗᐊᒍᓪᓚᑦ	Nikliknik	3											2	5
Ptarmigan	ᐊᖏᓴᑦ	Akilgik				2					1		1	3	5
Sandhill crane	ᑕᑎᓴᒃᓭᐊᑦ	Tatilgaq												1	1
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit	3												3
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓕᓂᖏᑦ	Nauyat manniit	1												1
Arctic char	ᐃᖅᓗᒃᓵᑦ	Ikaliviit	22	1		2		1					4	10	34
Lake trout	ᐃᓱᒋᕐᐃᑦ	Ikalukpik	42	9	7	5	5	6	2	2	1	5	15	25	67
Arctic grayling	ᓭᓗᒃᐸᐅᒪᐃᑦ	Hulupaugaq	1	1	1		2								3
Whitefish	ᑲᕕᓯᓪᓚᑦ	Kapihiliit					2	2							3
Burbot	ᑎᑭᒋᓪᓚᑦ	Tiktaaliq					1								1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔨᓂᒃ ᐱᑕᖃᖑᕋᒍᖅ ᐱᓴᐊᒋᓐᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᑦᓂᑦ ᐊᓕᕆᔨᑦ ᓇᓕᐅᑦᓴᑎᓂᒃᓯᒋᑦ ᐊᑐᓂᒃ ᐃᓕᓴᕐᓂᐅᓂ ᑐᓂᓴᖏᑦᓂ ᐃᑯᐱᑦᓴᓕᓯᓂᓵᓕᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 515

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᕐᑎᑦ

Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)

ᐊᓕᖅᔪᒍ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

6.3.2

Month/ᑕᖅᖢᓕ/Tatkia			JUN ᔮᓂ	JUL ᔭᓪᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓕᕐᓗ	DEC ᑎᓯᓕᕐᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᔨ	APR ᐃᔨᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	85	163	153	272	407	254	135	137	131	99	211	222	2,269 ± 249
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait										5		2	7 ± 7
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡						1	2						
Wolf	ᐊᒪᕐᐃᑦ	Amagut					2	14	45	36	28	17	5		147 ± 56
Arctic fox	ᑎᓚᖓᓂᔨᑦ	Tigiganiat							28	21	7	8			64 ± 34
Coloured fox	ᖃᐅᓐᖓᑦᑐᑦ ᑎᓚᖓᓂᔨᑦ	Kalaliit tigiganiat							4						4 ± 5
Wolverine	ᖃᓴᐃᑦ	Kalvik							1			5	2		8 ± 5
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				3									3 ± 4
Harbour seal	ᖃᓄᐊᔪᑦ	Qanigiaq		2											2 ± 2
Snow goose	ᑲᖏᐅᑦ	Kanguq	89			2									91 ± 115
Canada goose	ᓄᓴᓪᓚᑦ ᐅᓗᐊᔪᓪᓚᑦ	Nikliknik	31											12	43 ± 36
Ptarmigan	ᐊᖏᕆᑦ	Akilgik				4	72						71	3	150 ± 151
Goose eggs	ᑲᖏᐅᑦ ᒪᓐᓇᖅᑦ	Uluaguliit manniit												8	8 ± 12
Arctic char	ᐃᖏᓕᒃᐲᑦ	Ikaliviit	235	51	5	4	3					3		51	352 ± 135
Lake trout	ᐃᓱᒋᕆᑦ	Ikalukpik	356	140	92	34	384	130	97	93	218	406	537	702	3,189 ± 586
Whitefish	ᑲᐱᓯᓪᓚᑦ	Kapihiliit					371		10						381 ± 357

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᑦᓄᑦ ᑎᑎᕋᐅᒪᓕᕐᑦ ᑐᓂᒃᖏᑦ ᐅᑉᐳᖓᑦ ᐃᑯᐊᕐᓚᓂᒃᓴᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 516

Monthly hunter response

ᑕᖅᑕᒪᒃᑯ ᐊᖏᔪᓕᕆᔨᑦ ᑭᐅᓂᖓᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐱᓕᕆᔨ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

6.3.2

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔮᓂ	JUL ᔮᓪᓗ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᕕᓪᓗ	OCT ᐅᑦᑐᕕᓪᓗ	NOV ᐅᓇᓕᕕᓪᓗ	DEC ᑎᓯᕕᓪᓗ	JAN ᔭᓐᓄᐊᓗ	FEB ᓇᖕᖏᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᕆᔨᑦ ᑭᐅᓂᖓᑦ ᐊᑎᓯᒪᓂᖓᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑯ ᐊᖏᔪᓕᕆᔨᑦ	Tatkitaman angunahuktut titigait	306	305	303	300	299	297	296	297	297	295	289	295	315*
Interview list	ᐊᐱᕐᓂᖅᓯᒪᑦ	Apikiktan	200	199	197	194	193	191	190	297	297	295	289	295	314*
Hunters interviewed	ᐊᖏᔪᓕᕆᔨᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	133	135	137	132	127	124	125	161	160	127	144	158	218*
Harvested	ᐊᖏᔪᓕᕆᔨᑐᑉᓂᑦ	Angujaujut	44	24	32	35	43	32	30	29	30	36	42	56	125*
Response rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖓᑦ (%)	Kiujut (%)	67	68	70	68	66	65	66	54	54	43	50	54	60**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓕᕆᔨᑦ ᐊᑎᓕᐅᔾᔨᓚᑦ/ᐊᐱᕐᓂᖅᓯᒪᓚᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓕᕆᔨᑐᑉᓂᑦ ᐊᑕᐅᓯᐊᖅᓗ% ᐊᑐᑎᑦ ᐊᓱᒃᑐᒥ.
** ᐊᐅᔪᓂᓕᑎᓯᒪᓚᑦ ᑕᖅᑕᒪᒃᑯ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 517

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᓚᑦ ᐊᑯᖏᓐᓄᓂ ᐊᖏᔪᓕᒫᓂᖓᓐᓂᑦ ᐊᓚᓗ ᐊᐱᕐᓂᑕᐅᓂᖓᓐᓂᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓱ % ᑲᑎᒪᔨᑦ ᐊᖏᔪᓕᒫᑦ ᑎᑎᕐᑕᐅᒪᓚᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐱᓕᕆᔨ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔮᓂ	JUL ᔮᓪᓗ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᕕᓪᓗ	OCT ᐅᑦᑐᕕᓪᓗ	NOV ᐅᓇᓕᕕᓪᓗ	DEC ᑎᓯᕕᓪᓗ	JAN ᔭᓐᓄᐊᓗ	FEB ᓇᖕᖏᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᓚᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑦ	≤ tatkin pingahut	10	3	5	0	5	27	60	52	72	100	92	2	32
4-6 months	4-6 ᑕᖅᑦ	tatkin hitaman 6nut	0	0	26	59	83	71	40	45	26	0	0	64	38
> 6 months	> 6 ᑕᖅᑦ	> 6 tatkin	90	97	69	41	12	2	0	3	2	0	8	34	29

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 518

Number of hunters harvesting each species — **Year 3 (June 1998 - May 1999)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᓴᒋᑦ ᐊᖏᔪᓚᓴᒃᑯᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒃᑭᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 3 (June 1998 - May 1999)**

6.3.2

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᔪᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓴᒃᐱᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓚᓕ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	19	20	31	33	41	25	21	26	24	23	26	32	99
Musk-ox	ᐅᒥᖃᒪᐃᑦ	Umingmait										2		1	3
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut					1	4	6	5	7	4	3		15
Arctic fox	ᑎᓕᑦᓂᐊᑦ	Tigiganiat							3	3	2	1			6
Coloured fox	ᖃᐅᓐᖓᑦᑐᑦ ᑎᓕᑦᓂᐊᑦ	Kalaliit tigiganiat							1						1
Wolverine	ᖃᑦᕿᒋᑦ	Kalvik							1			2	1		4
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik				1									1
Harbour seal	ᖃᓕᕐᐊᑦ	Qanigiaq		1											1
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq	3			1									4
Canada goose	ᓂᕐᓚᑦ ᐅᓗᐊᔪᓚᓚᑦ	Nikliknik	3											1	4
Ptarmigan	ᐊᐲᓵᑦ	Akilgik				1	1						2	2	5
Goose eggs	ᑲᖏᔪᐃᑦ ᒪᓕᓂᖅᑐᑦ	Uluaguliit manniit												1	1
Arctic char	ᐃᖃᓗᓴᒃ	Ikaliviit	12	2	1	1	1					1		4	18
Lake trout	ᐃᓕᓴᐃᑦ	Ikalukpik	23	4	3	3	7	5	4	3	6	14	19	35	69
Whitefish	ᑲᐱᓕᓚᑦ	Kapihiliit					2		1						3

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓪᒪᔪᓂᒃ ᐱᑕᖃᓄᖅᑐᑐᒃ ᐱᓕᐊᓕᓄᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᓄᓂᑦ ᐊᓪᓚᖃᑦᑕᒪᔭᖅᑐᑦ ᐊᖏᔪᓂᑦ ᓇᓪᓕᐊᓂᒃᑯᓂᒃ ᑐᓂᓴᖅᓂᓄ ᐃᓂᐱᕐᓚᓪᓕᔭᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 519

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓕᑦ

Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)

ᐊᓐᖁᔭᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

6.3.2

Month/ᑕᖅᖢᓗ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔨᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓚᐹᓗ	DEC ᑎᓯᓚᐹᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᑉᓯ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓴᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᐃᑦ	Tuktut	111	148	433	528	409	74	66	96	86	75	135	213	2,374 ± 179
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait						3				2			5 ± 4
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡						2	2						
Tundra grizzly	ᐊᐱᓪᐃᑦ	Akhait			1									2	3 ± 3
Wolf	ᐊᒪᕐᐃᑦ	Amagut					1	7	6	7	10	2	11	2	46 ± 19
Arctic fox	ᑎᓗᒃᑑᐊᑦ	Tigiganiat	2				36	37	3	9					87 ± 58
Coloured fox	ᖃᓄᖕᖏᑦ ᑎᓗᒃᑑᐊᑦ	Kalaliit tigiganiat						5							5 ± 3
Wolverine	ᖃᐅᕆᑦ	Kalvik				2		3	2		3	6	2	4	22 ± 9
Snow goose	ᑲᖏᐃᑦ	Kanguq	58												58 ± 75
Canada goose	ᑭᖅᓯᑦ ᐅᓗᐊᔪᓯᑦ	Nikliknik	34												34 ± 30
Ptarmigan	ᐊᖏᓚᖅᑦ	Akilgik	2		1		11						62	108	184 ± 134
Goose eggs	ᑲᖏᐃᑦ ᒪᒃᑭᖏᑦ	Uluaguliit manniit	99												99 ± 124
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	312	30	11	2	6							81	442 ± 187
Lake trout	ᐃᓱᒋᕆᑦ	Ikalukpik	746	100	66	78	631	1,354	197	487	172	265	653	1,157	5,906 ± 1,021
Arctic grayling	ᓚᓗᑦᐸᐅᓚᑦ	Hulupaugaq	6				39								45 ± 36
Whitefish	ᑲᐱᓴᓯᑦ	Kapihiliit		2			10	256	69	86	8				431 ± 306

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᖕᓄᑦ ᑎᑎᕋᐅᒪᓴᑦ ᑐᓂᑦᖏᑦ ᐅᑉᐊ ᐃᑯᐱᖕᓇᓗᓀᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 520

Monthly hunter response

Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)

ᑕᖃᑕᒪᑦ ᐊᖏᔪᓕᓴᒋᑦ ᑭᐅᓂᖏᑦ

ᐊᑦᖁᒍ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖃᖏᓐ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᓪᓗ	SEP ᓯᑎᕐᓴᓪᓗ	OCT ᐅᑯᐊᓪᓗ	NOV ᓄᓇᕗᓪᓗ	DEC ᑎᓯᕗᓪᓗ	JAN ᔮᓐᓄᐊᓪᓗ	FEB ᓇᖕᐅᐊᓪᓗ	MAR ᒪᕐᓯ	APR ᐃᖅᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᒪᓂᖅ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᓴᒋᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒪᑦ ᐊᖏᔪᓕᓴᒋᑦ	Tatkitaman angunahuktut titigait	295	294	295	295	295	296	295	295	295	295	291	292	302*
Hunters interviewed	ᐊᖏᔪᓕᓴᒋᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	166	167	168	168	170	165	168	167	156	158	159	152	176*
Harvested	ᐊᖏᔪᓕᓴᐅᒋᓐ	Angujaujut	56	34	79	72	66	37	12	26	18	20	47	71	147*
Response Rate (%)	ᑭᐅᔾᐅᓂᖏᑦ (%)	Kiujut (%)	56	57	57	57	58	56	57	57	53	54	55	52	56**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓕᓴᒋᑦ ᐊᑎᓕᐅᑎᒪᓕᕐᓂᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᔪᓕᓴᐅᒋᓐᓂᒃ ᐊᑕᐅᓂᐊᖅᑐᑎᑦ ᐊᑦᖁᒍ.
** ᐊᑦᔨᒋᓕᑎᓂᒪᓕᕆ ᑕᖃᑕᒪᑦ ᑭᐅᔾᐅ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 521

Recall period between harvest and interview, expressed as % of total harvest records

Year 4 (June 1999 - May 2000)

ᐅᑎᕐᕕᐅᕆᑦ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓕᓴᐅᓂᖓᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᒪᓂᖅ ᐊᖏᔪᓕᓴᒃᑐᑦ ᑎᑎᕐᓂᑦᑕᐅᒪᕆᑦ

ᐊᑦᖁᒍ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 4 (June 1999- May 2000)

Month/ᑕᖃᖏᓐ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᓪᓗ	SEP ᓯᑎᕐᓴᓪᓗ	OCT ᐅᑯᐊᓪᓗ	NOV ᓄᓇᕗᓪᓗ	DEC ᑎᓯᕗᓪᓗ	JAN ᔮᓐᓄᐊᓪᓗ	FEB ᓇᖕᐅᐊᓪᓗ	MAR ᒪᕐᓯ	APR ᐃᖅᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᒪᓂᖅ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᕆᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᑯᑦ	≤ tatkin pingahut	3	12	56	96	96	95	100	100	100	97	88	94	76
4-6 months	4-6 ᑕᑯᑦ	tatkin hitaman 6nut	80	71	40	1	3	3	0	0	0	3	12	6	20
> 6 months	> 6 ᑕᑯᑦ	> 6 tatkin	17	17	3	3	1	2	0	0	0	0	0	0	4

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 522

Number of hunters harvesting each species — **Year 4 (June 1999 - May 2000)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᑲᒋᑦ ᐊᖏᔪᓚᑲᓱᒃᑯᑦ ᐊᑐᓂᑲ ᐅᒪᔨᓂᑲ — **ᐊᒡᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 4 (June 1999 - May 2000)**

6.3.2

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑐᑎ	SEP ᓱᑎᒡᐱᓗ	OCT ᐅᑲᐃᓗ	NOV ᔾᔪᒡᐱᓗ	DEC ᑎᓯᒡᐱᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᔪᓯ	APR ᐃᔪᓕᓪᓚ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	29	26	76	69	49	18	9	18	16	15	25	38	116
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait						2				1			3
Polar bear[##]	ᓇᓂᐃᑦ[##]	Nanuit[##]	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒃᓪᓚᐃᑦ	Akhait			1									1	2
Wolf	ᐊᒪᕆᐃᑦ	Amagut					1	1	1	2	2	1	4	1	10
Arctic fox	ᑎᓗᒃᑑᓂᐊᑦ	Tigiganiat	1				1	1	1	1					4
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓗᒃᑑᓂᐊᑦ	Kalaliit tigiganiat						3							3
Wolverine	ᖃᓪᓴᑦ	Kalvik				1		2	1		2	2	1	2	10
Snow goose	ᑲᖏᐃᑦ	Kanguq	2												2
Canada goose	ᓄᓪᓕᓪᑦ ᐅᓗᐊᔪᓕᓪᑦ	Nikliknik	3												3
Ptarmigan	ᐊᖏᓚᑦ	Akilgik	1		1		1						1	3	5
Goose eggs	ᑲᖏᐃᑦ ᒪᒃᑑᖅᑦ	Uluaguliit manniit	2												2
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	12	3	2	1	1							3	17
Lake trout	ᐃᓯᕆᕐᐃᑦ	Ikalukpik	30	9	8	3	21	18	2	8	2	4	33	54	101
Arctic grayling	ᓱᓗᐸᐅᒪᐃᑦ	Hulupaugaq	1				3								4
Whitefish	ᑲᐱᓯᓪᑦ	Kapihiliit		1			2	2	1	1	1				7

No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

ᑎᑎᕋᓯᒪᔪᓂᖅ ᐱᕈᖓᖏᑎᖅ ᐱᓴᐊᓕᒃᓂᖅ ᐊᖏᔪᑦ ᖃᕋᐅᓂᖏᑎᓂᑦ ᐊᓕᓴᐅᒪᔪᓂᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᕆᑎᓂᖅ ᑐᓂᓴᖏᑎᓂᖅ ᐃᑯᐱᖏᓕᓕᓂᓗᒃᑯᑦ.

Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 523

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ

Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)

ᐊᓯᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

6.3.2

Month/ᑕᖅᖏᓐᓂ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑦᔪᓇ	NOV ᐅᓐᐱᓇ	DEC ᑎᓯᓇ	JAN ᔮᖏᓄᓇ	FEB ᐃᖅᑲᓇ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	76	187	333	309	98	186	163	150	126	146	156	127	2,057 ± 173
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait		4	2							4			10 ± 6
Moose	ᑐᑐᓴᐃᑦ	Tuktuvait									2				2 ± 2
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡						2	2						
Tundra grizzly	ᐊᒃᓪᓚᐃᑦ	Akhait					2	2							4 ± 4
Wolf	ᐊᒪᕈᐃᑦ	Amagut			1			2	19	10	9	20	29	2	92 ± 31
Arctic fox	ᑎᓗᒃᑯᐊᑦ	Tigiganiat					2	2	6	12	4	3			29 ± 15
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓗᒃᑯᐊᑦ	Kalaliit tigiganiat								1	1				2 ± 2
Muskrat	ᐊᐃᕐᖏᓪᓗᐊᑦ	Kivgaluk											2		2 ± 3
Wolverine	ᖃᓴᐃᑦ	Kalvik					2			1	4	2	13		22 ± 10
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik					2								2 ± 3
Bearded seal	ᐅᓗᔾᔪᐃᑦ	Ukyuk		4											4 ± 5
Geese (unspecified)	ᓄᖅᓪᓚᑦ	Kanguk	62												62 ± 87
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq												3	3 ± 4
Ptarmigan	ᐊᖏᓗᑎᑦ	Akilgik	4			9	101				77	29	81	23	324 ± 190
Arctic char	ᐃᖃᓗᐊᕆᑦ	Ikaliviit	31		4	30	2							120	187 ± 79
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	276	329	20	9	84	498	395	24	16	81	209	326	2,267 ± 744
Whitefish	ᑲᐱᓯᓪᓚᑦ	Kapihiliit						410	395						805 ± 700

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᓴᓄᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᔭᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓂᓕᕆᓂᖅᓴᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 524

Monthly hunter response

ᑕᖃᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖅᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᒻᒋᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

6.3.2

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᕐᓇᓗ	OCT ᐅᑯᐊᓗ	NOV ᐅᓇᒻᓇᓗ	DEC ᑎᓯᒻᓇᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᓇᖕᖏᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖅᑎᑦ ᐊᑎᓯᒪᓂᖅᑎᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	292	289	290	290	291	292	292	291	293	293	290	291	299*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	157	169	165	162	157	146	160	166	168	167	161	161	172*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᑦ	Angujaujut	40	56	51	44	27	23	32	23	26	28	39	53	126*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖅᑎᑦ (%)	Kiujut (%)	54	58	57	56	54	50	55	57	57	57	56	55	55**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᕆᔨᒃᑯᓐᓂᒃ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ ᐊᑕᐅᓯᐊᖅᓯᓯᑎᑦ ᐊᒻᒋᒪ.
** ᐊᐅᔨᓂᑎᕐᓯᒪᔨᑦ ᑕᖃᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 525

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕋᐅᔨᑦ ᐊᑯᖏᓐᓄᓕᒃ ᐊᖏᔪᓂᒃᑐᓂᓐᓄᓕᒃ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓐᓄᓕᒃ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓱ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑦᑕᑦ ᑎᑎᕋᑦᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᒻᒋᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᕐᓇᓗ	OCT ᐅᑯᐊᓗ	NOV ᐅᓇᒻᓇᓗ	DEC ᑎᓯᒻᓇᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᓇᖕᖏᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕋᐅᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	59	81	86	90	85	78	82	95	92	88	96	94	86
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	41	8	3	1	6	7	12	5	2	12	4	6	8
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	0	12	11	8	9	16	6	0	6	0	0	0	6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 526

Number of hunters harvesting each species — **Year 5 (June 2000 - May 2001)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᓴᒃᑎᑦ ᐊᖏᔪᓚᓴᒃᑯᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ — **ᐊᒃᑭᒍ 5 (ᔫᓂ 2000 - ᒪᐃ 2001)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 5 (June 2000 - May 2001)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔫᓂ	JUL ᐊᓪᓚ	AUG ᐊᐅᒍᒧᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᔨᓗ	NOV ᐅᓇᒃᓱᓗ	DEC ᑎᓯᒃᓱᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᑉᓯ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	15	45	50	43	20	22	28	21	23	21	27	26	101
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait		1	1							2			3
Moose	ᑐᑐᓴᐃᑦ	Tuktuvait									1				1
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒃᓪᓚᐃᑦ	Akhait					1	1							2
Wolf	ᐊᒪᔭᐃᑦ	Amagut			1			1	3	3	2	5	7	1	12
Arctic fox	ᑎᓘᑲᓂᐊᑦ	Tigiganiat					1	1	1	2	2	1			5
Coloured fox	ᖃᓄᖕᖏᑦᑐᑦ ᑎᓘᑲᓂᐊᑦ	Kalaliit tigiganiat								1	1				1
Muskrat	ᐊᐱᖕᖓᑦᓱᐊᑦ	Kivgaluk											1		1
Wolverine	ᖃᓴᐃᑦ	Kalvik					1			1	1	1	5		7
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik					1								1
Bearded seal	ᐅᑭᓱᐃᑦ	Ukyuk		1											1
Geese (unspecified)	ᓄᑦᓪᓕᑦ	Kanguk	1												1
Snow goose	ᑲᖏᐃᑦ	Kanguq												1	1
Ptarmigan	ᐊᖏᓚᒋᑦ	Akilgik	1			1	2				1	1	1	1	4
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	3		1	2	1							10	14
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	28	20	2	2	6	3	1	2	2	3	13	33	81
Whitefish	ᑲᐱᓱᓪᓕᑦ	Kapihiliit						1	1						1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓱᒪᔨᓂᒃ ᐱᑕᖃᖕᖏᑐᖃᓄᑦ ᐱᓕᕆᓕᓪᓂᓂᒃ ᐊᖏᔪᒃᑯᑦ ᖃᑦᓯᐅᓂᖏᖕᓂᓄᑦ ᐊᓕᖁᐅᒪᔨᓂᓄᑦ ᐊᖏᔪᒃᓄᑦ ᓇᓕᐅᕐᓇᓱᒪᓂᖅᑕᑦ ᐃᑯᐱᕐᓴᐅᓂ ᑐᓂᔨᖏᖕᓂ ᐃᑯᐱᕐᓴᐅᓂᓕᒫᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 527

Annual harvest estimates and five-year mean

ᐊᓐᔪᒍᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓕᑦᔨᑦ ᐊᓚᓗ ᑕᓪᓕᓂᑦ-ᐊᓐᔪᒍᓂᑦ ᐊᐅᔨᓪᓕᖅᑭᓚᕐᓂᑦ

Aragutamat angujauvaktun tatlman araguit iluani

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᓐᔪᒍᓂᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

6.3.2

Study Year/ᖃᐅᔨᓴᖅ ᐊᓐᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᔨᓪᓕᖅᑭᓚᕐᓂᑦ Amigaitkiyait
Species	**ᐅᒪᔪᑦ**	**Umajuin**						
Caribou[1]	ᑐᑐᐃᓄᑦ[1]	Tuktut[1]	2,856	2,846	2,269	2,374	2,057	2,480
Musk-ox[2]	ᐅᒥᓴᒪᐃᓄᑦ[2]	Umingmait[2]	0	0	7	5	10	4
Moose	ᑐᑐᓂᐃᓄᑦ	Tuktuvait	0	0	0	0	2	<1
Polar bear[3]	ᓇᓄᐃᓄᑦ[3]	Nanuit[3]	2	1	2	2	2	2
Tundra grizzly[4]	ᐊᑲᓪᓚᐃᓄᑦ[4]	Akhait[4]	1	0	0	3	4	2
Wolf[5]	ᐊᒪᕐᐃᓄᑦ[5]	Amagut[5]	72	97	147	46	92	91
Arctic fox[6]	ᑎᓚᖓᓂᐊᑦ[6]	Tigiganiat[6]	314	116	64	87	29	122
Coloured fox[7]	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓚᖓᓂᐊᑦ[7]	Kalaliit tigiganiat[7]	0	0	4	5	2	2
Muskrat	ᐊᐃᓐᖓᒃᓱᐊᑦ	Kivgaluk	0	0	0	0	2	<1
Wolverine	ᖃᓘᕕᑦ	Kalvik	5	2	8	22	22	12
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik	0	4	3	0	2	2
Ringed seal[8]	ᓇᔪᓂᖅ[8]	Natiinat[8]	8	0	0	0	0	2
Bearded seal	ᐅᒃᔾᔨᐃᑦ	Ukyuk	0	0	0	0	4	1
Harbour seal	ᖃᓄᐱᐊᑦ	Qanigiaq	0	0	2	0	0	<1
Geese (unspecified)	ᓄᖅᓪᓕᑦ	Kanguk	0	0	0	0	62	12
Snow goose[9]	ᑲᖕᒪᐃᓄᑦ[9]	Kanguq[9]	15	28	91	58	3	39
Canada goose[10]	ᓄᖅᓪᓕᑦ ᐅᓗᐊᒍᓪᓕᖅᑭᑦ[10]	Nikliknik[10]	106	50	43	34	0	47
Ptarmigan	ᐊᐱᒻᒪᓂᑦ	Akilgik	26	185	150	184	324	174
Sandhill crane	ᑕᑎᒻᓱᐊᑦ	Tatilgaq	0	3	0	0	0	1
Goose eggs[11]	ᑲᖕᒪᐃᓄᑦ ᓚᐢᓂᖓᓂᑦ[11]	Uluaguliit manniit[11]	54	147	8	99	0	62
Seagull eggs[11]	ᓇᐅᔨᐃᓄᑦ ᓚᐢᓂᖓᓂᑦ[11]	Nauyat manniit[11]	0	39	0	0	0	8
Arctic char[12]	ᐃᖃᓗᒃᓴᑦ[12]	Ikaliviit[12]	1,157	622	352	442	187	552
Lake trout	ᐃᓱᖏᓄᑦ	Ikalukpik	3,795	5,884	3,189	5,906	2,267	4,208
Arctic grayling[13]	ᓗᓗᒃᐸᐅᒪᐃᓄᑦ[13]	Hulupaugaq[13]	1,031	241	0	45	0	263
Whitefish[14]	ᑲᐱᓯᓪᓕᑦ[14]	Kapihiliit[14]	452	1,095	381	431	805	633
Burbot	ᑎᒃᑕᓪᓕᑦ	Tiktaaliq	0	3	0	0	0	1

[1-14]: See page 653 for community feedback and other sources of data.

[1-14]: ᑕᐃᒃ ᒪᓴᐅᖃᖅ 655 ᓄᓇᓪᓕᑦ ᑭᐅᔨᓴᖅᑭᓂᑦ ᐊᓚᓗ ᐊᓯᖏᓂᑦ ᐱᖃᓐᓇᖅᑐᓂᖅ ᓇᓘᐅᓂᖅ.

[1-14]: Takulugu makpigaak 657 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 528

Annual hunter response

ᐊᑦᕿᔪᑎᒻᒪᑦ ᐊᖏᓚᓕᕆᔨᑦ ᑭᐅᓂᖏᑦ

Angujauvaktu

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓇᑦ ᐊᑦᕿᔪᒪᓂᑦ (ᓱᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᕿᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓚᓕᕆᔨᑦ ᑭᐅᓂᖏᑦ ᐊᑦᔪᕿᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᓚᓕᕆᔨᑦ	Tatkitaman angunahuktut titigait	327	324	315	302	299	341*
Interview list	ᐊᐱᕐᓂᖅᓴᐃᑦ	Apikiktan	218	214	314	302	299	336*
Hunters interviewed	ᐊᖏᓚᓕᕆᔨᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	208	186	218	176	172	276*
Harvested	ᐊᖏᓚᓕᕆᓕᒃᑕᓂᒃ	Angujaujut	138	113	125	147	126	230*
Response Rate (%)	ᑭᐅᔭᑦ ᖃᓂᐅᓂᖏᑦ (%)	Kiujut (%)	81	68	60	56	55	64**

* Hunters registered/on interview list/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖏᓚᓕᕆᔨᑦ ᐊᑎᓕᐅᔾᔪᑎᓂᖅ/ᐊᐱᕐᓂᖅᓴᓐᓂᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᓚᓕᕆᓕᒃᑕᓂᒃ ᐊᑕᐅᓂᔾᔪᓂᒃ ᐊᑎᑎᒃ ᖃᐅᔨᓴᖅᓯᒪᓂᖅ.
** ᐊᓕᐸᓂᓴᓂᒪᒻᒪᓕᒃ ᐊᑦᕿᔪᒪᓂᑦ ᑭᐅᔭᑦ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut taipfumuna tahapkuan kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 529

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔭᑦ ᐊᑯᓐᖓᓂ ᐊᖏᓚᓕᕆᓂᓗᖓᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᒪᔨᑦ ᐊᖏᓚᓕᕆᑦᑕ ᑎᑎᕐᑦᑕᐅᒪᔭᑦ

Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓇᑦ ᐊᑦᕿᔪᒪᓂᑦ (ᓱᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᕿᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔭᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᖅᑕᑦ	≤ tatkin pingahut	50	42	32	76	86	57
4-6 months	4-6 ᑕᖅᑕᑦ	tatkin hitaman 6nut	28	22	38	20	8	23
> 6 months	> 6 ᑕᖅᑕᑦ	> 6 tatkin	22	36	29	4	6	19

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 530

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᒃᑎᑦ ᐊᖏᔪᓚᒃᓴᖅᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ
Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓂᑦ ᐊᑦᑭᒍᓂᑦ (ᔨᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

6.3.2

Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᑭᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᖅᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**						
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	113	97	99	116	101	187
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait			3	3	3	9
Moose	ᑐᖅᑐᓀᐃᑦ	Tuktuvait					1	1
Polar bear[‡‡]	ᓇᓂᐃᑦ[‡‡]	Nanuit[‡‡]	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒃᓪᓚᐃᑦ	Akhait	1			2	2	5
Wolf	ᐊᒪᕐᐃᑦ	Amagut	10	13	15	10	12	32
Arctic fox	ᑎᓘᒃᓂᐊᑦ	Tigiganiat	15	11	6	4	5	28
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓘᒃᓂᐊᑦ	Kalaliit tigiganiat			1	3	1	5
Muskrat	ᐊᐱᖅᖏᓪᓗᐊᑦ	Kivgaluk					1	1
Wolverine	ᖃᓪᓕᐃᑦ	Kalvik	2	1	4	10	7	16
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik		1	1		1	3
Ringed seal	ᓇᓕᓗᑦ	Natiinat	1					1
Bearded seal	ᐅᓪᓚᐃᑦ	Ukyuk					1	1
Harbour seal	ᖃᓕᑎᐊᑦ	Qanigiaq			1			1
Geese (unspecified)	ᓄᓪᓕᑦ	Kanguk					1	1
Snow goose	ᑲᖕᒪᐃᑦ	Kanguq	1	3	4	2	1	11
Canada goose	ᓄᓪᓕᑦ ᐅᓗᐊᔪᓕᑦ	Nikliknik	16	5	4	3		26
Ptarmigan	ᐊᑭᒪᓂᑦ	Akilgik	1	5	5	5	4	13
Sandhill crane	ᑕᑎᓪᓚᐊᑦ	Tatilgaq		1				1
Goose eggs	ᑲᖕᒪᐃᑦ ᒪᓐᓄᖅᑎᑦ	Uluaguliit manniit	2	3	1	2		8
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓐᓄᖅᑎᑦ	Nauyat manniit		1				1
Arctic char	ᐃᖏᓗᒃᐲᑦ	Ikaliviit	54	34	18	17	14	91
Lake trout	ᐃᓂᕐᓴᐃᑦ	Ikalukpik	96	67	69	101	81	192
Arctic grayling	ᓂᓗᒃᐸᐅᓚᐃᑦ	Hulupaugaq	3	3		4		10
Whitefish	ᑲᐱᓂᓪᓕᑦ	Kapihiliit	4	3	3	7	1	13
Burbot	ᑎᒃᑕᓪᓕᑦ	Tiktaaliq		1				1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓯᒪᔪᓂᒃ ᐱᕕᖏᓐᓄᑐᖅ ᐱᒃᐊᑎᓪᓗᒃ ᐊᖏᔪᒃ ᖃᓕᑯᓂᖏᓐᓄᑦ ᐊᓪᓚᔨᓂᒃ ᓇᓪᓕᔨᓐᓇᓂ ᑐᓂᔨᖏᓐᓄᑦ ᐃᓄᒃᖏᓐᓄᑦ ᐃᑯᐱᕐᓴᐅᓂᓗᒃᑕᒃ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.3.2 Community Results Discussion: Baker Lake

The survey frame:

An assessment of under-enumeration during the community visit revealed that there were approximately 67 hunters who were not registered in the Harvest Study. Sixty-five of these were Inuit, all occasional hunters. It is estimated that there were two non-Inuit with assigned hunting rights who were not registered – one occasional and one active hunter. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. Given that these unregistered hunters represent 16 percent of the total hunter population (Table 10) the effect of this bias on harvest estimates could be significant. Harvest estimates for the unregistered hunters can be estimated using mean harvest quantities for each species by strata. However, these estimates, having their own sources of error and bias, are beyond the scope of this Final Report. Readers may apply to NWMB to obtain the results of these calculations.

Due to the relatively small number of intensive hunters registered in Baker Lake, the intensive classification was joined with the active classification for the purpose of calculating harvest estimates.

Survey coverage and non-response bias:

Response rates in year 1 were very good but then began to decline rapidly. Originally one of the sub-sampled communities, due to declining response rates in Baker Lake, all occasional hunters not previously on the interview list were added to this list in year 3. Unfortunately rates continued to fall throughout the study and readers should consider this when using harvest data from this community. During the community visit it was reported that low response rates were due in part to high Fieldworker turnover and conflicts with the Nunavut Hunter Support Program. As seen in Table 9 the consistent intentional non-response rate in Baker Lake was high, at 32.7%, resulting in a high potential for non-response bias.

Response rates were felt to be high enough and non-response bias low enough during year 1 to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Unfortunately due to declining response rates and increasing intentional non-response the same cannot be said for the other years of the study. Readers should exercise caution when using the data collected during years 2 to 5 of the study since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:

There were no specific incidents of measurement error brought up during the community visit. However, readers should refer to Section 5.4 for a thorough discussion of this issue.

As seen in the recall period tables, during the first three years of the study recall periods were high, often over six months. This calls into question the ability of hunters to accurately remember what they had harvested and may have resulted in some measurement error. Recall periods did improve in the last two years of the study when over 75% of the records were collected within three months of the harvest.

Commercial quotas were issued by DFO for whitefish, lake trout and arctic char during the Harvest Study. A small number of char were reported caught and no harvests of whitefish or lake trout were reported back to DFO (DFO F). It is unlikely that harvest estimates contain a large number of commercially harvested fish.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou. Harvest estimates from years 3 to 5 seem low (C.F.).
2. **Musk-ox:** Baker Lake had an annual quota of 19 animals. The community reports that only approximately 8 of those tags were used per year since hunters must travel large distances to harvest musk-ox (C.F.).
3. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).

[4] **Tundra grizzly:** At least 1 to 2 per year are harvested. In years when 0 were recorded some were likely caught but not reported (C.F.). DSD staff confirmed that the annual quota for grizzlies was 5 animals and that the community usually harvests about 3 bears per year.

[5] **Wolf:** With the exception of the year 3 harvest estimates, all estimates seem too low. The mean annual harvest should be closer to 150 animals (C.F.). DSD reports indicate that 124 wolf pelts were purchased from Baker Lake hunters in 1999/2000 (year 4) and 44 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB).

[6] **Arctic fox:** Harvest estimates for years 3 to 5 seem too low (C.F.). This was confirmed for the last two years by DSD reports indicating that 312 arctic fox pelts were purchased from Baker Lake hunters in 1999/2000 (year 4) and 92 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB).

[7] **Coloured fox:** In years where 0 were recorded, there were likely some harvested but not reported (C.F.).

[8] **Ringed seal:** The Baker Lake HTO Board reports that every few years, 2 to 3 ringed seals are harvested. They feel that there were a small number of seals harvested in year 5 that were not reported (C.F.).

[9] **Snow goose:** All harvest estimates seem too low. The HTO Board reports that approximately 150 are harvested each year (C.F.).

[10] **Canada goose:** They are less abundant than snow geese. The year 1 estimate seems accurate whereas the estimates in the other years seem low. The HTO Board reports that approximately 75 are harvested each year (C.F.).

[11] **Eggs:** All harvest estimates for eggs appear too low. Many hunters did not report their egg harvests. Eggs gathered in the area include snow goose eggs (approximately 200 per year), Canada goose eggs (approximately 150 per year) and occasionally seagull eggs (approximately 30 per year) (C.F.).

[12] **Arctic char:** Harvest estimates in years 2 to 5 seem too low. The year 1 estimate of 1157 appears to be more accurate (C.F.).

[13] **Arctic grayling:** These fish are abundant in the area; some are caught every year (C.F.).

[14] **Whitefish:** Harvest estimates seem too low. Estimates should be close but not quite as high as lake trout estimates (C.F.).

6.3.2 ᓄᓇᕗᑦ ᓴᖅᑭᑕᐅᔭᓂᒃ ᑎᒍᑎᑦᑎᓂᒃᑯᑦ: ᖃᐅᔨᓴᕐᕕᖏᑦ

ᖃᐅᔨᓴᓂᐅᕙᓂ ᐊᑲᐹᑕᐅᔭᓂᒃ:

ᕿᒥᖅᑭᐅᓂᒃᑯᑦ ᐊᑎᓕᐅᓇᖅᑐᓴᕐᕕᖏᓐᓄᑦᓴᓂᐅᕙᓂ ᓄᓇᕗᑦ ᐊᓪᓚᕆᑕᐅᑎᒃᑯᑦ ᑕᐃᑎᖏᓪᓗᐊᑦ 67 ᖃᐅᓪᓚᖅᑐᒃᑕ ᐊᖏᓇᓯᐊᖅᑎᓂᑦ ᑎᑎᕋᖅᑕᐅᓯᒪᔪᑎᖃᕐᓂᖅ ᐊᖏᔪᓂᒃ ᖃᐅᔨᓴᕐᓂᖅᐱᑦ. 65-ᖃᐅᔨᒃ ᐃᓕᓴᐃᓂᖅ, ᐊᑕᐅᓯᖅᑐᑎᖅ ᐊᖏᓇᓯᐊᖅᑎᑦᑕᐃᓇᖅᑐᑦ. ᓇᓪᓕᐊᑦᑕᕐᕕᖏᓐᓄᑦ ᓯᑭᐲᓪᓚᕆᖅᖃᓄᖅ ᐃᓕᓴᐅᓂᑐᖅ ᑐᓴᕐᕕᓯᓚᐃᒃᑯᑦ ᐊᖏᓇᓯᐊᖅᐸᓇᓂᓪᓗᑦ ᐱᔨᖃᓕᕐᓂᖅ ᑎᑎᕋᖅᑕᐅᓯᓚᓪᓕᐊᓯᖅᑐᑦ - ᐊᑕᐅᓯᖅ ᐊᖏᓇᓯᐊᖅᐳᖃᐃᓇᖅᑎᑦᑕᖅᑐᖅ ᐊᒻᒪ ᐱᖁᑦ ᐊᖏᓇᓯᐊᖅᑭᖃᓕᖅᑐᖅ. ᐅᖃᐅᓯᐅᓕᒪᓕ ᓇᓴᐅᑎᓂ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓇᖅᑐᓴᕐᕕᖏᓐᓄᑦᓴᓂᐅᕙᓂ ᐱᒪᑕᐅᓂᖅ ᐊᑎᓂᓪᓕᓯᒪᓕᕐᕕᖏᓐᓄᑦ ᐃᓚᐅᖅᑕᐅᓪᓚᕆᑐᓂᒃ ᖃᖅᑎᓪᓚᕆᓯᒪᓕᖅᓯᖅᑐᓂᒃ. ᐱᓕᕕᒃ ᑕᒪᐃᓐᓇ ᑎᑎᕋᖅᑕᐅᓯᒪᔪᖅᑐᑦ ᐊᖏᓇᓯᐊᖅᑎᑦ ᑭᓱᑐᐃᓚᐅᑦ 16-ᓯᓚᖅᑭᓐᓂ ᑲᑎᓪᓗᒍ (ᓇᓴᖏᖅ 10) ᖃᓄᐃᑎᑎᒍᓐᓇ ᐅᖃᖅᑕᑭᓐᓂᐅᕙᓂ ᐊᖏᓇᓯᐊᖅᑎᑦᑕᖅᑐᓄᑦ ᓇᓪᓕᐊᑦᑕᕐᕕᒪᓕᒪᓂᑦ ᐊᑭᓐᓚᐊᖅᐸᓇᓂᖅᑐᖅ. ᐃᓚᐅᖅᑕᐅᓯᒪᔪᑦ ᐊᑎᖅᑕᖅᑕᐅᓯᒪᔪᖅᑐᓄᑦ ᒥᑦᑎᓂᒃᑯᑦ ᐊᑐᓂᑦ ᐃᓚᐅᖅᑕᐅᓯᒪᓪᓚᕆᔪᓂᒃᑯᑦ ᖃᑎᖅᑕᐅᓯᒪᓕᖅᑐᖅ ᐊᑐᓂ ᓂᓪᓕᐊᓂᓄᑦ ᐊᒻᒪᓴᖅᑕᐅᓯᒪᓕᖅᑐᒥᒃ. ᑭᓯᐊᓂ, ᑕᒪᐃᓐᓇ ᓇᓪᓕᐊᑦᑕᐅᓯᒪᓕᖅᑐᓄᑦ ᓇᓱᒪᓂᖅ ᑕᒪᒪᑉᓇᓂᖅᑐᑦ, ᐅᖃᓕᓂᐅᔪᓐᓇᖅᑐᑦ, ᐅᖃᓕᓂᐅᔪᓐᓇᖅᑐᑦ ᑭᓱᐃᓐᓇ ᑭᓯᐊᓂᓄᑦ ᐃᓚᐅᖅᑕᐅᓯᒪᓕᖅᑐᖅ ᐊᑐᓂᑦ ᓂᓪᓕᐊᓂᓄᑦ ᐊᒻᒪᓴᖅᑕᐅᓯᒪᓕᖅᑐᒥᒃ. ᑭᓯᐊᓂ, ᑕᒪᐃᓐᓇ ᓇᓪᓕᐊᑦᑕᐅᓯᒪᓕᖅᑐᓄᑦ ᐊᑎᖅᑕᖅᑕᐅᓯᒪᓕᖅᑐᒥᒃ. ᐅᖃᓕᓂᐅᔪᓐᓇᖅᑐᑦ, ᐅᖅᑎᑕᓂᐅᖅᑐᖅ, ᐅᖅᑎᑕᓂᐅᖅᑐᓄᑦ ᑕᒪᐃᓐᓇ ᐅᖃᓕᓂᐅᔪᓐᓇᖅᑐᑦ ᐊᑐᓂᑦ ᓂᓪᓕᐊᓂᓄᑦ ᐊᒻᒪᓴᖅᑕᐅᓯᒪᓕᖅᑐᒥᒃ. ᐃᓚᐅᖅᑕᐅᓯᒪᓕᖅᑐᖅ ᐊᑐᓂᑦ ᓂᓪᓕᐊᓂᓄᑦ ᐊᒻᒪᓴᖅᑕᐅᓯᒪᓕᖅᑐᒥᒃ. ᑭᓯᐊᓂ, ᑕᒪᐃᓐᓇ ᓇᓪᓕᐊᑦᑕᐅᓯᒪᓕᖅᑐᓄᑦ ᐊᒻᒪᓴᖅᑕᐅᓯᒪᓕᖅᑐᒥᒃ. ᐅᖃᓕᓂᐅᔪᓐᓇᖅᑐᑦ, ᐅᖅᑎᑕᓂᐅ

[4] **ᐊᒃᑕᑦ ᑲᔪᖅ:** ᐊᑕᐅᓯᖅ ᓴᖅᑭᓗᓂᖅ ᐊᒃᑕᐃᑕᐅᔪᑦᑐᑦ ᐊᖏᖅᑎᒍᑦ. ᑭᒃᑯᑐᖃᖅᑐᑦ ᐊᓯᖏᑦᑕᓂᐊᓕᕆᔨᓂᐊᖅᑐᑦ ᑲᑎᒪᔨᖅᑎᑦᓯᐊᓂᖅᑐᑦ ᐱᓇᓂ ᑭᖑᓂᐅᑎᖅᑐᑦᓯᐊᓂ (C.F.). ᐃᓄᐃᑦᑐᓴᓕᕆᔨᒃᑯᑦ ᓇᓗᓇᐃᓕᓴᕐᓗᑦ ᐊᖏᖅᑎᑦᓯᐊᑦ ᐊᒃᑕᓐᓂ ᐃᑎᐃᑦ ᑕᑦᓕᒪᑎᒃᓴᓂᖅᑐᓂᒃ ᑕᒃᓄᓇᖅᑐᓂ ᐱᖓᓱᑦ 3 ᐱᓕᕆᔨᒃᑯᑐᑎᒃ ᐊᒃᑕᐃᑦ ᐊᖏᖅᑎᑦᓯᐊᑦ.

[5] **ᐊᒪᒋᖅ:** ᐱᖓᓱᒃᑯᑎᑕᐊᓕᓗᔪᓄ ᑎᑭᑎᑦ 3ᒥ ᓇᐸᖅᑕᐅᓴᓴᐃᑦ, ᐊᓴᓕᒪᓂᖅ ᐊᖏᖅᑎᒍᑦᑐᖅᑐᑦ. ᐊᖏᖅᑎᑦᓯᐊᑦ ᐱᓕᕆᔨᒃᑯᐊᖅᑐᑦᑐᑦ ᑕᐃᓂ 150 ᒥᑦᓴᖅᓂᓂᕿᐱᓕᓴᖓᒍᖅᑐᒃ (C.F.). ᐃᓄᐃᑦᑐᓴᓕᕆᔨᒃᑯᑦ ᓇᓗᓇᐃᓕᓴᕐᓗᑦ 124 ᐊᒪᒋᔪᐃᑦ ᓂᐅᐃᖅᑕᐅᓕᕆᔨᖅᓴᓂᖅᓂᒃ ᖃᓄᓕᑐᐊᖏᑎᑦᑎᐅᑦ ᐊᖏᖅᑎᒍᑦᑐᓂᒃ 1999/2000ᒥ (ᐅᑭᐅᖓᓱᓂ 4) ᐊᓪᓚᓗ 44 ᓂᐅᐃᖅᑕᐅᓪᓗᑎᒃ 2000/2001ᒥ (ᐅᑭᐅᖓᓱᓂ 5) (ᖃᐅᔨᓪᓚᒥᑦ ᐃᓄᐃᑦᑐᓴᓕᕆᔨᒃᑯᑦ ᓇᐸᐅᑎᒃᑯᓂᖅ ᓚᓪᓚᒪᑕ ᐱᑎᐊᖃᖅᖢᒃᑯᒥᒃ ᓱᓕᒥᑦ, ᖃᐅᔨᓴᓂᓗᓪᓕ ᐊᖏᖅᑎᒍᑦᑐᓴᓕᐃᑦ ᓚᓪᓚᒪᑕ ᐱᑎᐊᖃᖅᑎᓪᓗᔪᓄ ᓱᓕᒥᑦ ᒪᐃᔪᑦ, ᖃᐅᔨᓴᓂᓗᓪᓕ ᐊᖏᖅᑎᒍᑦᑐᓴᓕᐃᑦ ᓚᓪᓚᒪᑕ ᐱᑎᐊᖃᖅᑎᓪᓗᔪᓄ ᓱᓕᒥᑦ ᒪᐃᔪᑦ) (DSD FB).

[6] **ᑎᓇᖃᓂᐊᖅ:** ᐅᒪᓱᖅᑕᒥᓂᑦ ᐅᑭᐅᖓᓂᓂᒃ 3ᒥᑦ 5ᒧᑦ ᐊᖏᖅᑎᒍᑦᑐᖅᑐᑦ (C.F.). ᑕᒪᒃᓴ ᓇᓗᓇᐃᖅᑕᐅᓱᓴᓕᕆᔨᖅᑐᑦ ᐃᓄᐃᑦᑐᓴᓕᕆᔨᒃᑯᑦ ᐅᓂᒃᑲᖓᑎᒃ ᑎᑎᖅᑐᓂᕐᓗᓕᕆᔨᖅᑐᑦ ᑕᑯᑎᑦᓯᐊᓂ ᑎᑎᖅᑐᓂᕐᓗᐊᖏᐃᑦ 312 ᓂᐅᐃᖅᑕᒥᓂᐅᓂᖅᓂᒃ ᖃᓄᓕᑐᐊᖏᑎᑦᑎᐅᑦ ᐊᒪᒋᔪᐃᑦ ᑎᑎᖅᑐᓂᖅᓂᒃ 1999/2000ᒥ (ᐅᑭᐅᖓᓱᓂ 4) ᐊᓪᓚᓗ 92 ᓂᐅᐃᖅᑕᒥᓂᐅᑦᑐᓂᒃ 2000/2001ᒥ (ᐅᑭᐅᖓᓱᓂ 5) (ᖃᐅᔨᓴᓂᓗᓪᓕ ᐃᓄᐃᑦᑐᓴᓕᕆᔨᒃᑯᑦ ᓇᐸᐅᑎᒃᑯᓂᖅ ᓚᓪᓚᒪᑕ ᐱᑎᐊᖃᖅᑎᓪᓗᔪᓄ ᓱᓕᒥᑦ ᒪᐃᔪᑦ, ᖃᐅᔨᓴᓂᓗᓪᓕ ᐊᖏᖅᑎᒍᑦᑐᓴᓕᐃᑦ ᓚᓪᓚᒪᑕ ᐱᑎᐊᖃᖅᑎᓪᓗᔪᓄ ᓱᓕᒥᑦ ᒪᐃᔪᑦ) (DSD FB).

[7] **ᑎᓇᖃᓂᐊᖅᓯᒪᓕᒃ:** ᐅᑭᐅᖓᓂᒃ ᐊᖏᓪᓕᓴᖃᖅᑎᑦᑕᓂᒃ, ᐱᓴᖃᖅᑕᑦᓴᐅᑦᓂᒃᑑᓂᑕᐊᖅᑐᓂᒃ ᑭᓯᐊᓂ ᐅᖃᐅᓯᐅᔪᓴᖅᑎᓚᖅᑕᑭᒡᒐᒃ (C.F.).

[8] **ᓇᓯᑦᑦ:** ᖃᓚᓕᑕᐊᑦ ᐊᖏᓚᓯᑕᓂᓇᖅᑎᑦ ᐅᖃᖅᑯᓯᓴᓕᕆᔨᑦ ᑭᑭᐅᑦ ᐃᓪᓕᖏᓂᒃ, ᓴᓰᒃᓂᒃ ᐱᖓᓱᓂᒍᓓ ᓇᓯᔪᖅᑐᑕᐃᖅᑲᓇᖏᓂᒃ. ᐃᓯᓚᐅᑦᑐᖅᑐᑦ ᖃᓄᓯᔪᓂᒃ ᓇᓯᔪᖅᑕᐅᓇᐅᓯᒪᓂᖅᓂᒃ ᑭᑭᐅᖓᓱᓂ 5 ᐅᖃᐅᔨᐅᓂᖅᑐᑕᓂᒃ (C.F.).

[9] **ᑲᖓᐃᓪᓕ:** ᐊᖏᓇᒃᑕᐅᑭᐅᑐᓚᑦ ᖃᓄᑎᐅᓂᖅᑐᑦ ᐊᒥᑎᓚᖅᑯᓴᖅᑐᑦ. ᐊᖏᖅᑎᒍᑦᑐᓴᓕᕆᔨᒃᑯᑦ ᐱᖓᓱᓂᒍᓓ 150ᖓᓂᓂᒋᔭᐅᑐᓂᒃ ᐱᓕᕐᓂᖅᓂᒃ ᐊᒥᑎᓚᖅᑯᓴᖅᑐᑦ (C.F.).

[10] **ᓂᓪᓕ ᐅᓚᐊᔪᓪᓕ:** ᐅᓇᖓᓂᖅᓴᓕᐅᔨᐃᑦ ᑲᖓᐃᓪᓕ ᓴᓂᐊᖅ. ᑭᑭᐅᖓᓱᓂ 1 ᓇᓴᐅᑎᑦ ᓇᓚᒋᑦᑐᖅᑐᑦ ᑭᑭᐅᖓᓱᓂᒍᓓ ᐊᓯᖏᓂᒃ ᐊᖏᖅᑎᒍᑦᑐᖅᑐᑦᑐᖅᑐᑦᑐᓂᒃ. ᐊᖏᖅᑎᒍᑦᑐᓴᓕᕆᔨᒃᑯᑦ ᑲᑎᒪᓴᖅᑐᑦ ᑭᑭᐅᖓᓱᓂ ᐊᖏᖅᑎᒍᑦᑐᖅᑐᑦ 75 ᒥᑦᓴᓂᒋᔭᐅᑐᓂᒃ ᐱᓕᕐᓂᖅᓂᒃ (C.F.).

[11] **ᒪᓂᓪᓕ:** ᒪᓂᑕᖅᑕᐅᓕᑐᓂᒋᔭᓕᑦ ᐊᖏᖅᑎᒍᑦᑐᖅᑐᑦᑐᖅᑐᑦ. ᐅᓇᖅᑐᑦ ᐊᖏᖅᑎᒍᑦᑐᓴᓕᕆᔨᒃᑯᑦ ᐅᖃᐅᔨᖅᑐᑦᑐᓴᓕᐅᑦᑐᓂᒃ ᒪᓂᑕᖅᑐᓪᓚᑦᑐᓂᒋᔭᓂᒃ. ᖃᓄᐃᖕᓂᓂ ᒪᓂᑕᖅᑕᐅᓕᕆᔨᒃᑯᑦ ᑲᖓᐃᓪᓕ (200 ᒥᑦᓴᓚᖅᑎᓂᒃ ᐊᖏᖅᑎᒍᑦᑐᖅᑐᑦ), ᓂᓪᓕ (150 ᒥᑦᓴᓚᖅᑎᓂᒃ ᐊᖏᖅᑎᒍᑦᑐᖅᑐᑦ) ᐊᓪᓚᓗ ᐃᓐᓇᓕᐅᔨᓂᖅᓴᓂ ᓇᐅᔨᐃᑦ ᒪᓂᖅᑐᓂᒃ (30 ᒥᑦᓴᓚᖅᑎᓂᒃ ᐊᖏᖅᑎᒍᑦᑐᖅᑐᑦ) (C.F.).

[12] **ᐃᖃᓗᐃᑦ:** ᐃᖃᓗᐊᕐᑕᐅᓂᑦ ᐅᑭᐅᖓᓂᒃ 2ᒥᑦ 5ᒧᑦ ᐊᖏᖅᑎᒍᑦᑐᖅᑐᑦ. ᐅᑭᐅᖓᓱᓂ 1 ᓇᓴᐅᑎᓂᖅᓴᖅᑕᐅᔨᓴᓕᐃᑦ 1157ᓂᒃ ᓇᓐᓂᔪᓂᓇᐅᔨᖅᑐᑦ (C.F.).

[13] **ᓴᓗᕐᕆᐅᓚᐃᑦ:** ᑕᓴᖅᑎᑦ ᓴᓗᕐᕆᐅᓚᖃᖅᑎᓴᓕᐅᑦᑐᑦ; ᐃᓕᖅᑎᑦ ᐱᖓᐅᖓᓂᖓᓕᕐᑐᑦ ᐊᖏᖅᑎᒍᑦᑐᓴᓕᐃᑦ (C.F.).

[14] **ᖃᐃᓴᓕᑦ:** ᐱᖓᐅᓕᑐᑦ ᖃᓄᑎᐅᓂᖅᑐᑦ ᐊᖏᖅᑎᒍᑦᑐᖅᑐᑦᑐᖅᑐᑦ. ᖃᓄᑎᐅᓂᖅᑐᑦ ᖃᓄᑦᑎᓚᖅᑯᓴᖅᑐᑦ ᑭᓴᓕᑎᑎᑦᑐᖅᑐᑦᑐᑦ ᐃᓴᖅᓄᑕᐅᔨᓴᓕᐃᑦ (C.F.).

6.3.2 Nunanit Inikhimayut Ukauhiit: Kamanituaq

Ihivgiuktit Atugutait:
Ihivgiufaakhimayut ataani naunaiyakhimayut nunanut pulaakhimatitlugit takuhimayut 67kuyut umayukhiuktit titigaktauhimaitut Umayukhiukhimayut Ihivgiukhimayuni. 65kuyut hapkoa Inuinauyut, tamamik ilaani umayukhiuktaktut. Naunaiyakhimayut malguk Inuinaungitut tuniyauhimayut inminiigutinik umayukhiugutinik titigaktauhimaitut – atauhik ilaani umayukhiuktaktuk ovalo atauhik umayukhiukataktuk. Ukahimayut ilangani 5.2.1 ikpinagutait hamna ataani naunaiyakhimayut pipkalaaktut ataanut ihumagiyaini umayukhiukhimayut naunaiyautaini. Taimaimat hapkoa titigaktauhimaitut umayukhiuktit 16%kuyut tamaat umayukhiukhimayunit amigaitjutaini (ikpatauyak 10) ikpinagutait hamna ihumagiyauyuk umayukhiukhimayuni naunaiyautait angiyut. Umayukhiukhimayut naunaiyautait titigakhimaitut umayukhiuktit naunaiyakhimalaat atulugit angitjutait umayukhiukhimayut amigaitjutait tamamik umayut aviktukhimalutik. Kihimi hapkoa naunaiyautit pihimayut inminik ihuinaagutainik ovalo ihumagiyainik angiyuumata atuktaini hamna Iniktigutit Tuhaktakhaini. Taiguaktut apigilaaktut NWMBkunit piyumagumik iniktigutainik hapkoa naunaiyautinik.

Mikiyuumata amigaitjutait umayukhiukataainaktut titigakhimayut Kamanituami, umayukhiukataktut naunaiyautait ilaukatauhimaliktut umayukhiukataktunut naunaiyautaini atugutaini naunaiyagutaini umayukhiukhimayut naunaiyautaini.

Ihivgiukatagutait ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait ukiumi 1mi nakuutiaktut kihimi kataktitihimayut kilamik. Hivuliuyuugalut uktugutitauhimapluni nuna, kataktitilimata kiuhimayut naunaiyautait Kamanituami, tamamik ilaani umayukhiukataktut ilaungitut ukakatigihimayuni ilaulikhimayut hamunga katitigutinut ukiumi 3mi. Mamiana naunaiyautait kataktitinalimata tamaat Ihivgiuktuni ovalo taiguaktut ihumaiyakhait atugumigit umayukhiukhimayut katitikhimayait hamani nunamini. Nunamut pulaaktaktitlugit tuhaktitihimayut mikiyut kiuhimayut naunaiyautait pihimayut nunani havaktiit havaguikatamata ovalo akigaktugutaini Nunavumi Umayukhiuktit Ikayugutit Pilihimayuni. Takukhauyut ikpatauyami 9 pikataktut kiuyuitut naunaiyautait Kamanituami angiyut, 32.7%mi, pipkaihimayut angiyumik pilaaktuni kiuyuitut ihumagiyaini.

Kiuhimayut naunaiyautait ihumagiyauyut angiyut ovalo kiuyuitut ihumagiyaini mikiyut ukiumi 1mi piyaami nni pihimayut katatitiliktuni kiuhimayut naunaiyautaini ukatugutit Nni umayukhiuktinit. Mamiani katatitihimayut kiuhimayut naunaiyautait ovalo angililiktut pikataktut kiuyuitut, aatjikutainik pilaitut ukautainik aipait ukiut ihivgiukhimayuni. Taiguaktut piyukhat ihumagilugit atuligumiuk katitikhimayut katitiguait ukiuni 2mit 5mut ihivgiuktuni pilaaktuni tamamik uktugutit ihuinaagutai ovalo kiuyuitut ihumagiyaini angiklihimavaktut kiuhimayut naunaiyautait katagaagata.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Pikangituk pihimayuni atugutingit ihuinaakhimayunik ukakhimayunik nunani pulaakhimatitluta. Kihimi, taiguaktut takuyukhat ilangani 5.4 ukautigitiagiagani hamna ihumaiyauyuk.

Takuhimayut utiktitihimayuni ubluit ikpatauyaini, hivulimi pingahut ukiuni ihivgiuktitlugit utiktitihimayuni ubluni angiyut, ilaani avataanut siksit tatkikhiutini. Hamna pitkuhiayuk apigiyaini pilaaktainik umayukhiuktit nakuuyumik puiguntilutik hunanik umayukhiukhimayut ovalo pipkaihimayunakhiyut ilanganik atugutingit ihuinaakhimayunik. Utiktitihimayut ubluit nakuuhititihimayuk kingulini malguni ukiuni ihivgiuktitlugit avataanut 75%nik titigakhimayut katitikhimalutik iluani pingahut tatkikhiutini umayukhiukhimayaini.

Kinauyaliugutit kotait tunihimayut DFOkunit kapihilinik, ikalukpinik ovalo ikalivinik pititlugit Umayukhiukhimayut Ihivgiuktuni. Ikitut amigaitjutait ikaliviit tuhaktitihimayut pihimayut ovalo pingitut kapihilinik ovaluniit ikalukpinik tuhaktitiyauyuitut DFOkunut (DFO F). Pingitunakhiyut umayukhiukhimayunik naunaiyautaini pihimayut amigaitut amigaitjutait kinauyaliugutinik ikalunik.

Nunanit ukakhimayut ovalo aalat pihimayaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukhimayut nunani tuktut. Umayukhiukhimayut naunaiyautait ukiumi 3mit 5mut mikiyut (C.F.).
2. **Umingmait:** Kamanituaq pihimayuugaluit ukiuk tamaat kotanik 19nik umingmanik. Nunanit tuhaktitihimayut ikitut 8nik tahapkoa umingmakhiugutit makpigaat atukpaktut ukiuk tamaat umayukhiuktit autlaakyuakpamata ungahiktumut umayukhiugiagani umingmanik (C.F.).
3. **Nanuit:** Amigaitjutait takukhauyut naunaiyautaungitut kihimi pihimayut umayukhiukhimayut amigaitjutait tunihimayut DSDkunit (DSD PB).

[4] **Akhait:** Atauhiit malgunut ukiuk tamaat umayukhiukpaktut. Ukiuni pingitut tutigakhimayut piyunakhihimayut kihimi tuhaktititauyuitut (C.F.). DSDkut havaktiit ukakhimayut ukiuk tamaat kotangit akhait talimauyut ovalo nunani pikatakpaktut pingahunik akhanik ukiuk tamaat.

[5] **Amagut:** Kihimi ukiumi 3mi umayukhiukhimayut naunaiyautait, tamamik naunaiyautait mikiyut. Angitjutait ukiuk tamaat umayukhiukhimayut kanitukhat 150nik amagunik (C.F.). DSD tuhaktitihimayut pihimayut 124nik amagunik amiit niuviktauhimayut Kamanituamiut umayukhiuktinit 1999/2000mi (ukiumi 4) ovalo 44nik niuviktauhimayut 2000/2001mi (ukiumi 5) (nalungilutit DSDkut katitigutait atuktut umayukhiukhimayut ukingit Julymit Junemut, Umayukhiukhimayut Ihivgiuktit katitigautait atukpaktut Junemit Maymut) (DSD FB).

[6] **Tigiganiat:** Umayukhiukhimayut naunaiyautait ukiuni 3mit 5mut mikiyut (C.F.). Hamna pihimayut kingulini malguni ukiuni DSDkunit tuhaktitihimayainit pikatakpaktut 312nik tigiganiat amiit niuviktauhimayut Kamanituamiut umayukhiuktinit 1999/2000mit (ukiumi 4) ovalo 92nik niuviktauhiayut 2000/2001mit (ukiumi 5) (nalungilutit DSDkut katitigutait atukpaktut umayukhiukhimayut ukiunginit Julymit Junemut, Umayukhiukhimayut Ihivgiuktit katitigutait atukpaktut umayukhiukhimayut ukiungit Junemit Maymut) (DSD FB).

[7] **Kalaliit Tigiganiat:** Ukiuni pingitut tuhaktitihimayuni, piyunakhiyut umayukhiukhimayaini kihimi tuhaktitihimaitut (C.F.).

[8] **Natiinat:** Kamanituami HTOkut katimayiit tuhaktitihimayut ilaani ukiuni 2nit 3nut natiinat umayukhiuktauvaktut. Ihumayut ikitut amigaitjutait natiinat pivaktut ukiuni 5mi tuhaktitihimaitut (C.F.).

[9] **Kanguq:** Tamamik umayukhiukhimayut naunaiyautait mikiyut. HTOkut katimayiit tuhaktitihimayut 150nik umayukhiukpaktut ukiuk tamaat (C.F.).

[10] **Uluaguliit:** Amigaitkiyaungitut kangunit. Ukiumi 1mi naunaiyautait naamaktut kihimi naunaiyautait aipaini ukiuni mikiyut. HTOkut katimayiit tuhaktitihimayut 75nik umayukhiuktauvaktut ukiuk tamaat (C.F.).

[11] **Maniit:** Tamamik umayukhiukhimayut naunaiyautait maninut mikiyut. Amigaitut umayukhiuktit tuhaktitiyuitait manikhiuktaminik. Maniit pikukhimayut nunani ilauyut kanguit maniit (200nik ukiuk tamaat), Uluaguliit (150nik ukiuk tamaat) ovalo ilaani nauyat maniit (30nik ukiuk tamaat) (C.F.).

[12] **Ikaliviit:** Umayukhiukhimayut naunaiyautait ukiumi 2mit 5mut mikiyut. Ukiumi 1mi naunaiyautait 1,157nik naamaktut (C.F.).

[13] **Hulupaugaq:** Hapkoa ikaluit amigaitut nunani; ikalukatainaktut ukiuk tamaat (C.F.).

[14] **Kapihiliit:** Umayukhiukhimayut naunaiyautait mikiyut. Naunaiyautait kanitukhat angitkiyaungiluni ikalukpiit naunaiyautainut (C.F.).

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 531

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᑕᕐᔪᐊᑦ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᑦᔪᒍ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔮᓂ	JUL ᔭᓪᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐹᓗ	OCT ᐅᑦᑐᕆᓗ	NOV ᐅᓇᐹᓗ	DEC ᑎᓴᐹᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᕐᓴ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᖅ Tamakiklugin ± 95% CI
Species	ᐅᒪᓕᑦ	**Umajuin**													
Caribou	ᔭᐅᐃᑦ	Tuktut	35	82	141	103	39	44	55	125	59	120	103	35	941 ± 68
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡						3	1			1	4		9
Wolf	ᐊᒪᓱᐃᑦ	Amagut							5				2	1	8 ± 4
Arctic fox	ᑎᓗᓚᖓᐊᑦ	Tigiganiat						98	101	26	17	6	2		250 ± 55
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik		5		4	1	4	2	1			2		19 ± 7
Ringed seal	ᓇᕆᓪᓕ	Natiinat	20	47	18	3	31	2	12	10	2			2	147 ± 23
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk					6								6 ± 4
Harp seal	ᖃᐃᓱᓪᓕᑦ	Qairulik			2										2 ± 2
Harbour seal	ᖃᓕᒋᐊᑦ	Qanigiaq			4										4 ± 3
Walrus	ᐊᐃᐅᕆᑦ	Akvik	1	3											4 ± 5
Beluga	ᖃᑯᑦᑕᑦ ᖁᓪᓗᒡᓗᑦ	Kilalugak		6	4	21									31 ± 11
Snow goose	ᑲᖏᐃᑦ	Kanguq	25		46	54								9	134 ± 42
Canada goose	ᓄᓪᓕᑦ ᐅᓗᐊᔪᓕᑦ	Nikliknik	24			1								16	41 ± 15
Eider duck	ᒥᑎᑦ	Kingalik	20						2						22 ± 14
Ptarmigan	ᐊᖏᓂᑦ	Akilgik					25	30	6		1		36	97	195 ± 67
Duck eggs	ᒥᑎᑦ ᒪᓐᓇᖓᑦ	Tinmiat manniit	74												74 ± 72
Arctic char	ᐃᖃᓗᐲᐸᑦ	Ikaliviit	248	853	1,060	110	281	230	169	51	51	42	56	71	3,222 ± 615
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	27		7	5	156	57					78	249	579 ± 97

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᐃᑦ ᑎᑎᕋᐅᒪᔨᑦ ᑐᓂᖅᖏᑦ ᐅᑎᕐᓂᖅ ᐃᑲᓴᕐᓂᐊᕐᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.3.3

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 532

Monthly hunter response

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᒃᕿᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

6.3.3

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᓕ	SEP ᓯᑎᕐᓚᓇ	OCT ᐅᑯᐊᓇ	NOV ᐅᓇᒃᓴᓇ	DEC ᑎᓯᒃᓴᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᓇᖕᖏᐊᓇ	MAR ᒪᕐᕿ	APR ᐃᔨᓪᓚᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ ᐊᑎᔨᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ	Tatkitaman angunahuktut titigait	66	70	69	69	70	70	70	69	70	70	70	70	72*
Hunters interviewed	ᐊᖏᔪᓇᓱᒋᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	53	41	51	52	57	55	62	61	61	52	31	56	72*
Harvested	ᐊᖏᔪᓇᓱᒋᑐᓂᓪ	Angujaujut	24	30	35	28	22	22	24	29	18	25	20	31	66*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	80	59	74	75	81	79	89	88	87	74	44	80	76**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᒋᑦ ᐊᑎᓕᐅᕐᑕᒪᓕᕐᓂᑦ/ᐊᐱᕐᓯᑦᑐᑦ/ᐊᖏᔪᓇᓱᒋᑐᓂᓪ ᐊᑕᐅᓯᐊᖃᓕᕐᑎᑦ ᐊᒃᕿᒍᒥ.
** ᐃᓅᓯᓕᑎᓯᒪᓕᕐᓂ ᑕᖅᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 533

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕋᐅᔨᑦ ᐊᑯᖏᓂ ᐊᖏᔪᓇᓯᓂᖅᑕ ᐊᒪᓗ ᐊᐱᕐᓯᑦᑕᐅᓂᖅᑕ, ᓇᓗᓇᐃᖏᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓇᓱᑦ ᑎᑎᕋᑦᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᒃᕿᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᓕ	SEP ᓯᑎᕐᓚᓇ	OCT ᐅᑯᐊᓇ	NOV ᐅᓇᒃᓴᓇ	DEC ᑎᓯᒃᓴᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᓇᖕᖏᐊᓇ	MAR ᒪᕐᕿ	APR ᐃᔨᓪᓚᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕋᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕐᑯᑦ	≤ tatkin pingahut	100	100	100	100	100	100	86	100	100	100	100	100	99
4-6 months	4-6 ᑕᕐᑯᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	2	0	0	0	0	0	0
> 6 months	> 6 ᑕᕐᑯᑦ	> 6 tatkin	0	0	0	0	0	0	12	0	0	0	0	0	1

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 534

Number of hunters harvesting each species — **Year 1 (June 1996 - May 1997)**

ᖃᑦᔪᐅᓂᖏᑦ ᐊᖓᔪᓚᓴᒋᑎᑦ ᐊᖓᔪᓚᓴᒃᑯᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒻᒪᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 1 (June 1996 - May 1997)**

Month/ᑕᖅᖢᓪ/Tatkia			JUN ᔨᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᔅᑎ	SEP ᓱᑎᕐᓚᓇ	OCT ᐅᑦᑐᓚᓇ	NOV ᐅᓇᕐᓚᓇ	DEC ᑎᓴᕐᓚᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᓄᕿᑐᐊᓇ	MAR ᒪᔪ	APR ᐃᔪᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	11	23	29	26	9	12	18	29	16	24	14	15	59
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut							3				1	1	4
Arctic fox	ᑎᓗᓚᓐᓂᐊᑦ	Tigiganiat						11	8	3	3	1	1		16
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik		2		2	1	2	2	1			1		9
Ringed seal	ᓇᓯᓕᑦ	Natiinat	8	15	8	2	8	1	3	4	1			2	26
Bearded seal	ᐅᓘᔾᐃᑦ	Ukyuk					4								4
Harp seal	ᖃᐃᓕᓪᓚᑦ	Qairulik			1										1
Harbour seal	ᖃᓯᒋᐊᑦ	Qanigiaq			2										2
Walrus	ᐊᐃᐸᒃᑦ	Akvik	1	1											2
Beluga	ᖃᓄᖅᑕᑦ ᖃᓪᓗᓂᑦ	Kilalugak		2	2	10									13
Snow goose	ᑲᖏᐃᑦ	Kanguq	4		6	6								2	14
Canada goose	ᓄᖅᓪᓕ ᐅᓗᐊᔪᓪᓕ	Nikliknik	5			1								4	7
Eider duck	ᒥᑎᑦ	Kingalik	2						2						4
Ptarmigan	ᐊᖏᓚᑦ	Akilgik					4	2	2		1		3	7	12
Duck eggs	ᒥᑎᑦ ᓚᐅᓂᖅᑦ	Tinmiat manniit	2												2
Arctic char	ᐃᖃᓗᐱᑦ	Ikaliviit	9	13	12	1	7	4	3	1	1	2	2	8	39
Lake trout	ᐃᓯᕐᐃᑦ	Ikalukpik	4		1	1	7	2					8	23	30

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᕕᖃᖅᑎᖅᓂᒃ ᐱᓕᐊᓕᓐᓂᒃ ᐊᖏᓚᑦ ᖃᕋᓯᐅᓂᖅᓂᓄᑦ ᐊᓪᓚᖃᐅᒪᔪᓄᑦ ᐊᓪᓚᖃᓗᒃᑐᓂᒃ ᓯᓚᑖᓄᑦ ᐃᓕᓴᕐᓂᖅᓯᒪᓂᖅᓴᓐᓂᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.3.3

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 535

Monthly harvest estimates — Year 2 (June 1997 - May 1998)

ᑕᕿᑕᒫᑦ ᐊᖑᔭᓄᑦ ᓇᓚᐅᑦᓴᕈᑏᑦ — ᐊᒡᕋᒍ 2 (ᔪᓂ 1997 - ᒪᐃ 1998)

Tatkiktamat nahaktauvaktun — Ukiunga 2 (June 1997 - May 1998)

6.3.3

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒡᒍᑎ	SEP ᓱᑎᒡᐱᕆ	OCT ᐅᑦᑐᐱᕆ	NOV ᓈᕕᒡᐱᕆ	DEC ᑏᓱᒡᐱᕆ	JAN ᔭᓐᓄᐊᕆ	FEB ᕕᕐᖓᐊᕆ	MAR ᒫᑦᓯ	APR ᐃᑦᕆᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	45	90	63	137	63	156	67	84	63	51	53	68	940 ± 55
Musk-ox	ᐅᒥᒃᒪᐃᑦ	Umingmait								1	1				2 ± 1
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡									3		6		9
Wolf	ᐊᒪᕈᐃᑦ	Amagut						1	13	14	10	1	3		42 ± 14
Arctic fox	ᑎᕆᒐᓐᓂᐊᑦ	Tigiganiat					11	12		22	9	6			60 ± 21
Coloured fox	ᖃᑯᓐᖏᑦᑐᑦ ᑎᕆᒐᓐᓂᐊᑦ	Kalaliit tigiganiat									1	1	1		3 ± 2
Arctic hare	ᐅᑲᓖᑦ	Ukalik				2									2 ± 2
Seals (unspecified)	ᓯᖅᑯᓖᑦ	Natiit									1		1		2 ± 1
Ringed seal	ᓇᑦᓱᑦ	Natiinat	40	15	9	11	6	2		1				13	97 ± 19
Bearded seal	ᐅᒡᔪᐃᑦ	Ukyuk	1			2	1								4 ± 2
Harp seal	ᖃᐃᕈᓖᑦ	Qairulik			8	5									13 ± 8
Harbour seal	ᖃᓯᒋᐊᑦ	Qanigiaq	1												1 ± 1
Walrus	ᐊᐃᕕᑦ	Akvik	1												1 ± 1
Beluga	ᖃᑯᕐᑕᑦ ᕿᓚᓗᒐᑦ	Kilalugak		5	9	9									23 ± 9
Snow goose	ᑲᖑᐃᑦ	Kanguq	59			6							3	40	108 ± 34
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik	73										1	60	134 ± 40
Eider duck	ᒥᑏᑦ	Kingalik		9										7	16 ± 12
Ptarmigan	ᐊᕿᒡᑏᑦ	Akilgik				28	22	4					12	116	182 ± 118
Duck eggs	ᒥᑏᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit	555	106											661 ± 404
Seagull eggs	ᓇᐃᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit												3	3 ± 2
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	142	281	572	1,104	254	88	113	119		43	42	647	3,405 ± 805
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	64	5	18	24	37	5					28	161	342 ± 74

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᕐᓄᑦ ᑎᑎᕋᕐᑕᒪᔪᑦ ᑐᓂᔭᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᕕᓕᕆᔨᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 536

Monthly hunter response
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᓐᔪᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖃᓐᓂᖅ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔭᑎ	SEP ᓯᑎᐸᓇ	OCT ᐅᑲᐃᓇ	NOV ᐃᓄᓚᐸᓇ	DEC ᑎᓯᓚᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᕕᖕᒪᐊᓇ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓚᓂᖅᑎᑦ ᑭᐅᓂᖓᑦ ᐊᑐᕐᓗᓂᖓᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃ ᐊᖏᓚᓂᖅᑎᑦ	Tatkitaman angunahuktut titigait	69	68	66	67	70	70	71	76	76	76	76	77	79*
Hunters interviewed	ᐊᖏᓚᓂᖅᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	50	45	43	49	56	67	58	65	67	60	59	63	78*
Harvested	ᐊᖏᓚᓂᖅᑐᒥᓂᒃ	Angujaujut	26	25	24	29	30	38	18	26	30	14	18	39	64*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖓᑦ (%)	Kiujut (%)	72	66	65	73	80	96	82	86	88	79	78	82	79**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓂᖅᑎᑦ ᐊᑎᓕᐅᑦᑕᒪᓐᓇᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᓚᓂᖅᑐᒥᓂᒃ ᐊᑕᐅᓯᐊᖅᓗᑎᑦ ᐊᑲᕐᒥᑎ.
** ᐊᑲᓴᓂᓕᕆᓚᒪᓕᐅᑦ ᑕᖅᑕᒪᒃ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 537

Recall period between harvest and interview, expressed as % of total harvest records
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)
ᐊᓐᔪᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖃᓐᓂᖅ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔭᑎ	SEP ᓯᑎᐸᓇ	OCT ᐅᑲᐃᓇ	NOV ᐃᓄᓚᐸᓇ	DEC ᑎᓯᓚᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᕕᖕᒪᐊᓇ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᐃᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᒪᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᒪᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᒪᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 538

Number of hunters harvesting each species — Year 2 (June 1997 - May 1998)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓯᓗᒃᑎᑦ ᐊᖏᔪᓯᓗᒃᑭᑐᑦ ᐊᑐᓂᓗ ᐅᒪᔨᕐᓂᓗ — ᐊᓚᖅᔪᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — Ukiunga 2 (June 1997 - May 1998)

6.3.3

Month/ᑕᖅᑳᖅ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔨᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᓄᐱᓚᓗ	DEC ᑎᓯᓚᓗ	JAN ᔮᖏᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᓯ	APR ᐃᓪᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	17	21	21	24	18	38	17	25	26	13	14	16	56
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait								1	1				2
Polar bear[‡‡]	ᓇᓄᐃᑦ[‡‡]	Nanuit[‡‡]	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕆᐃᑦ	Amagut						1	3	4	7	1	2		10
Arctic fox	ᑎᓗᒃᑑᓂᐊᑦ	Tigiganiat					1	1		2	3	1			5
Coloured fox	ᖃᐅᖏᑦᑐᑦ ᑎᓗᒃᑑᓂᐊᑦ	Kalaliit tigiganiat									1	1	1		2
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik				1									1
Seals (unspecified)	ᓯᖏᐅᓪᓕᑦ	Natiit									1		1		2
Ringed seal	ᓇᑦᓯᑦ	Natiinat	11	4	4	5	4	1		1				6	26
Bearded seal	ᐅᓪᓴᐃᑦ	Ukyuk	1			1	1								3
Harp seal	ᖃᐃᕆᓪᓕᑦ	Qairulik			3	3									5
Harbour seal	ᖃᓯᑎᐊᑦ	Qanigiaq	1												1
Walrus	ᐊᐃᐸᑦ	Akvik	1												1
Beluga	ᖃᐅᖏᑦ ᖁᓕᓗᒡᑦ	Kilalugak		2	3	4									6
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	7			1							1	11	16
Canada goose	ᓂᖏᓪᓕᑦ ᐅᓗᐊᒍᓪᓕᑦ	Nikliknik	7										1	9	13
Eider duck	ᒥᑎᑦ	Kingalik		1										1	2
Ptarmigan	ᐊᖏᓴᑦ	Akilgik				2	5	2					1	2	10
Duck eggs	ᒥᑎᑦ ᒪᓂᓯᑦ	Tinmiat manniit	3	1											4
Seagull eggs	ᓇᐃᐅᐃᑦ ᒪᓂᓯᑦ	Nauyat manniit												1	1
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	9	6	4	7	4	5	3	3		1	1	9	27
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	3	1	1	1	5	2					2	19	27

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᒪᓪᓚᓂᒃ ᐱᑕᖃᓯᕐᑐᖅ ᐱᓪᓴᒥᓪᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᓪᓂᓄᑦ ᐊᓪᓚᖅᓄᑦ ᓇᓪᓚᕆᐊᓪᓚᓂᓪᓕᑦ ᐊᑐᓂᓗ ᓇᓪᓚᕆᐅᑎᖃᖅᖢᓂᓪᓕᑦ ᐃᓄᐃᑦᑎᓂᓪᓗᓂᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 539

Monthly harvest estimates — Year 3 (June 1998 - May 1999)

ᑕᕿᑕᒫᑦ ᐊᖑᔭᓄᑦ ᓇᓚᐅᑦᓴᕈᑏᑦ — ᐊᒡᕋᒍ 3 (ᔪᓂ 1998 - ᒪᐃ 1999)

Tatkiktamat nahaktauvaktun — Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒡᒍᑎ	SEP ᓱᑎᒡᐱᕆ	OCT ᐅᑦᑐᐱᕆ	NOV ᓈᕕᒡᐱᕆ	DEC ᑏᓯᒡᐱᕆ	JAN ᔭᓐᓄᐊᕆ	FEB ᕕᕐᕗᐊᕆ	MAR ᒫᑦᓯ	APR ᐃᑦᕆᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	23	70	54	114	15	24	9	104	45	57	22	61	598 ± 34
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡						1				2	7		10
Wolf	ᐊᒪᕈᐃᑦ	Amagut								28	48	27	3		106 ± 9
Arctic fox	ᑎᕆᒐᓐᓂᐊᑦ	Tigiganiat								2	1				3 ± 2
Arctic hare	ᐅᑲᓖᑦ	Ukalik										1			1 ± 1
Seals (unspecified)	ᓯᖅᑯᓖᑦ	Natiit									1				1 ± 1
Ringed seal	ᓇᑦᓱᑦ	Natiinat	8	5	8	8	2			2			1		34 ± 7
Bearded seal	ᐅᒡᔪᐃᑦ	Ukyuk	1			1	3								5 ± 2
Harp seal	ᖃᐃᕈᓖᑦ	Qairulik			3	1									4 ± 3
Harbour seal	ᖃᓯᒋᐊᑦ	Qanigiaq										1			1 ± 1
Walrus	ᐊᐃᕕᑦ	Akvik	1												1 ± 0
Narwhal	ᑑᒫᓖᑦ ᕿᓚᓗᒐᑦ	Tuugaak		4											4 ± 3
Beluga	ᖃᑯᕐᑕᑦ ᕿᓚᓗᒐᑦ	Kilalugak		2	4	4									10 ± 3
Snow goose	ᑲᖑᐃᑦ	Kanguq	71											9	80 ± 22
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik	23											10	33 ± 15
Ptarmigan	ᐊᕿᒡᕆᑦ	Akilgik					30				4			18	52 ± 21
Goose eggs	ᑲᖑᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	10												10 ± 10
Duck eggs	ᒥᑏᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit		22											22 ± 13
Arctic tern eggs	ᐃᒥᖅᑯᑕᐃᓚᐃᑦ ᒪᓐᓂᖏᑦ	Emitkutailat manniit		22											22 ± 13
Black guillemot eggs	ᐱᑦᓯᐅᓛᑦ ᒪᓐᓂᖏᑦ	Black guillemot eggs		33											33 ± 20
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	344	371	392	12	26			73	6			28	1,252 ± 400
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	8	13		2	53				2			49	127 ± 30

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᕐᓄᑦ ᑎᑎᕋᕐᑕᐅᒪᔪᑦ ᑐᓂᔭᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᕕᓕᕆᔨᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.3.3

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 540

Monthly hunter response

ᑕᖃᑦᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᓕᖅᔪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

6.3.3

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᓚᔅᑎ	SEP ᓯᑎᕐᕕᓪ	OCT ᐅᑦᔨᕕᓪ	NOV ᓄᐊᕐᕕᓪ	DEC ᑎᓯᕐᕕᓪ	JAN ᔮᓐᓄᐊᓪ	FEB ᕕᒃᐅᐊᓪ	MAR ᒪᔪ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᖅ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔪᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	77	77	77	75	73	71	71	72	72	71	71	71	80*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	69	61	61	67	65	65	55	64	65	66	62	59	79*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ	Angujaujut	22	31	28	33	17	7	2	25	20	27	6	20	60*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	90	79	79	89	89	92	77	89	90	93	87	83	86**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᑉᑕᒪᓐᓇᖅᑐᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ ᐊᑕᐅᓯᐊᖓᔪᓕᐅᖏᑦᑐᖅ ᐊᓚᕐᔪᒥ.
** ᐃᓅᓯᓕᑎᓯᒪᓐᓇᓂᑦ ᑕᖃᑦᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 541

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᕐᓂᑐ ᐊᖏᔪᓂᒃᓴᓂᖏᓐᓂᑦ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᓂᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑎᓂᖅ ᐊᖏᔪᓂᒃᑦᑐᑦ ᑎᑎᕐᑦᑕᐅᓂᖏᓐᓂᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐊᓕᖅᔪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᓚᔅᑎ	SEP ᓯᑎᕐᕕᓪ	OCT ᐅᑦᔨᕕᓪ	NOV ᓄᐊᕐᕕᓪ	DEC ᑎᓯᕐᕕᓪ	JAN ᔮᓐᓄᐊᓪ	FEB ᕕᒃᐅᐊᓪ	MAR ᒪᔪ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᖅ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑭᑦ	≤ tatkin pingahut	100	100	100	100	100	0	0	100	100	100	100	100	98
4-6 months	4-6 ᑕᖅᑭᑦ	tatkin hitaman 6nut	0	0	0	0	0	100	100	0	0	0	0	0	2
> 6 months	> 6 ᑕᖅᑭᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 542

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓯᖅᑎᑦ ᐊᖏᔪᓯᖅᓯᕐᓂᑦ ᐊᑐᓂᖅ ᐅᒪᔨᓂᖅ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 3 (June 1998 - May 1999)

ᐊᒃᑭᒍ 3 (ᔪᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᓕ	AUG ᐊᐅᒍᑎᓂ	SEP ᓱᑎᐱᕆ	OCT ᐅᑲᐱᕆ	NOV ᓄᕕᐱᕆ	DEC ᑎᓯᐱᕆ	JAN ᒎᓐᓄᐊᕆ	FEB ᓇᖕᐅᐊᕆ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑲᑦ Tamakiklugin
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	11	24	23	32	7	7	2	25	15	24	6	13	53
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut								9	12	7	3		15
Arctic fox	ᑎᓕᓴᖅᐊᑦ	Tigiganiat								1	1				1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik										1			1
Seals (unspecified)	ᓯᖏᑯᓪᓚᑦ	Natiit									1				1
Ringed seal	ᓇᑦᓯᑦ	Natiinat	3	3	4	4	2			1			1		15
Bearded seal	ᐅᓴᓪᐃᑦ	Ukyuk	1			1	3								5
Harp seal	ᖃᐃᕐᓪᓚᑦ	Qairulik			2	1									3
Harbour seal	ᖃᓯᕈᐊᑦ	Qanigiaq										1			1
Walrus	ᐊᐃᐃᓴᑦ	Akvik	1												1
Narwhal	ᑐᐃᓪᓚᑦ ᕿᓪᓗᒡᓗᑦ	Tuugaak		3											3
Beluga	ᖃᐅᑦᑕᑦ ᕿᓪᓗᒡᓗᑦ	Kilalugak		2	2	2									4
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq	3											3	6
Canada goose	ᓂᑦᓪᓚᑦ ᐅᓪᓗᐊᔪᓪᓚᑦ	Nikliknik	4											2	6
Ptarmigan	ᐊᕕᒃᑦ	Akilgik					2				1			1	4
Goose eggs	ᑲᖏᔪᐃᑦ ᒪᓂᓂᕐᑦ	Uluaguliit manniit	1												1
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᕐᑦ	Tinmiat manniit		1											1
Arctic tern eggs	ᐃᒥᖏᑕᓪᓕᐃᑦ ᒪᓂᓂᕐᑦ	Emitkutailat manniit		1											1
Black guillemot eggs	ᐱᑦᓯᐅᓪᓚᑦ ᒪᓂᓂᕐᑦ	Black guillemot eggs		2											2
Arctic char	ᐃᖏᓗᒃᐱᑦ	Ikaliviit	9	14	8	2	2			1	1			2	24
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	2	1		1	5				1			8	14

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖏᓐᓇᕐᓂᖏᑐ ᐱᓱᒋᓕᓐᓂᓂᒃ ᐊᖏᔪᑦ ᖃᕋᓯᐅᓂᖏᓐᓂᓂᑦ ᐊᓕᖏᔪᓂᑦ ᐊᖏᔪᓂ ᓇᓕᑲᑎᑦᑎᓐᓂ ᑐᓂᓴᖏᓐᓂᒃ ᐃᓄᐃᕐᓚᓕᓴᐃᓐᓇᓕᒃ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 543

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓗᑎᑦ

Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)

ᐊᓐᖁᒍ 4 (ᔪᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

6.3.3

Month/ᑕᖅᑕᒪᑦ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔨᑎ	SEP ᓱᑎᐹᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓴᐹᓗ	DEC ᑎᓯᐹᓗ	JAN ᔮᖏᓇᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᒥᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	22	27	42	38	21	40	34	23	17	12	19	35	330 ± 28
Musk-ox	ᐅᒥᖃᒪᐃᑦ	Umingmait											3		3 ± 2
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡										2	6	2	10
Wolf	ᐊᒪᓕᐃᑦ	Amagut							6	10	5		1	4	26 ± 6
Ringed seal	ᓇᕐᓂᑦ	Natiinat				3	2	3	3	10			1	10	32 ± 16
Bearded seal	ᐅᑭᔪᐃᑦ	Ukyuk		1											1 ± 1
Harp seal	ᖃᐃᓕᓕᒃ	Qairulik	5												5 ± 2
Harbour seal	ᖃᓂᒋᐊᑦ	Qanigiaq			2										2 ± 0
Walrus	ᐊᐃᐸᑦ	Akvik	1	2											3 ± 0
Beluga	ᖃᑯᑦᑕᑦ ᖁᓕᓴᒃ	Kilalugak			3	16									19 ± 5
Snow goose	ᑲᖏᐃᑦ	Kanguq	3											14	17 ± 24
Canada goose	ᓄᑦᓕᒃ ᐅᓗᐊᔪᓕᒃ	Nikliknik	7												7 ± 2
Ptarmigan	ᐊᖏᕿᑦ	Akilgik					14							17	31 ± 20
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓇᖅ	Uluaguliit manniit	20												20 ± 13
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	147	204	532		62							146	1,091 ± 471
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	9				38			4				77	128 ± 55
Burbot	ᑎᑭᓕᒃ	Tiktaaliq												25	25 ± 36

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦ ᑎᑎᕐᑕᒪᓕᖅ ᑐᓂᖅᑎᑦ ᐅᑯᐊᖅᑎᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 544

Monthly hunter response
ᑕᖏᑦᒪᒃ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᑦᖁᔪ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑲᐃᕕᓂ	NOV ᓄᐃᕐᕕᓂ	DEC ᑎᓯᕐᕕᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᕕᖑᐅᐊᓂ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᔪᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑦᒪᒃ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	70	68	68	69	69	69	71	71	70	70	71	72	77*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	62	60	58	63	64	64	68	69	68	67	64	41	73*
Harvested	ᐊᖏᔪᓂᒃᑎᑐᓄᑦ	Angujaujut	12	17	18	16	12	12	11	13	7	9	9	14	52*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	89	88	85	91	93	93	96	97	97	96	90	57	89**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᑦᑕᒪᔨᖅᑕᑦ/ᐊᐱᕐᓂᑦᑕᑦ/ᐊᖏᔪᓂᒃᑎᑐᓄᑦ ᐊᑕᐅᓂᐊᖅᓯᐊᕐᑎᑐᑦ ᐊᑦᖁᒧᑦ.
** ᐊᐅᔨᓂᓕᕆᓂᒪᔨᓄᑦ ᑕᖏᑦᒪᒃ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 545

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᕐᖃᓂ ᐊᖏᔪᓂᒃᑎᓕᖅᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᑦᑕ, ᐅᓗᓇᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᑕᑎᑦ ᐊᖏᔪᓂᒃᑎᑦᑕᑦ ᑎᑎᕐᑦᑕᐅᒪᔨᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)
ᐊᑦᖁᔪ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑲᐃᕕᓂ	NOV ᓄᐃᕐᕕᓂ	DEC ᑎᓯᕐᕕᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᕕᖑᐅᐊᓂ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔾᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	100	92	100	100	100	100	100	100	100	100	100	100	99
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	8	0	0	0	0	0	0	0	0	0	0	1

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 546

Number of hunters harvesting each species
ᖃᑦᕿᐅᓂᖏᑦ ᐊᖏᔪᓕᓴᒋᑎᑦ ᐊᖏᔪᓕᓴᒃᑯᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 4 (June 1999 - May 2000)
ᐊᒡᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᕐᖏᖅ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᑐ	SEP ᓱᑎᒪᓕᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᓇᒪᓕᓇ	DEC ᑎᓴᒪᓕᓇ	JAN ᒍᓐᓄᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᓴ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	8	16	17	12	8	12	9	11	7	8	7	6	45
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait											2		2
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut							1	6	3		1	1	7
Ringed seal	ᓇᓕᓂᑦ	Natiinat				2	2	2	1	3			1	2	8
Bearded seal	ᐅᑭᔪᐃᑦ	Ukyuk		1											1
Harp seal	ᖃᐃᓕᓪᓚᑦ	Qairulik	4												4
Harbour seal	ᖃᓂᒋᐊᑦ	Qanigiaq			2										2
Walrus	ᐊᐃᐸᑦ	Akvik	1	1											2
Beluga	ᖃᑯᑦᑕᑦ ᖁᓕᓴᒡᓗᑦ	Kilalugak			1	5									6
Snow goose	ᑲᖏᐃᑦ	Kanguq	2											1	3
Canada goose	ᓄᑦᓚᑦ ᐅᓗᐊᔪᓚᑦ	Nikliknik	3												3
Ptarmigan	ᐊᖏᕿᑦ	Akilgik					1							1	2
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓄᑦ	Uluaguliit manniit	1												1
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	5	4	2		4							3	14
Lake trout	ᐃᓱᒡᕆᐃᑦ	Ikalukpik	1				2			1				6	10
Burbot	ᑎᑭᓚᓚᑦ	Tiktaaliq												1	1

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓪᒪᔪᓂᒃ ᐱᑕᖃᖅᓄᑐᖅ ᐱᓵᐊᑎᓐᓂᒃ ᐊᖏᔪᑦ ᖃᕋᐅᓂᖏᓐᓄᑦ ᐊᓕᕆᐅᒪᔪᓂᒃ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᑕᑎᓐᓂᒃ ᑐᓂᓯᖅᓯᓂ ᐃᑯᐱᕐᓂᓕᕆᓂᖅᑕᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.3.3

TABLE/ᓄᓗᓄᐃᔨᐅᑦ/NAUNAIKUTA 547

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓄᓕᐅᑦᓱᓗᑎᑦ

Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)

ᐊᓐᖏᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᑕᓐᓇ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᓴᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᓂᓴᓇ	DEC ᑎᓯᓴᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᓄᖅᐅᐊᓇ	MAR ᒪᕆ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᒥᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓕᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	17	77	69	36	27	37	31	23	41	41	36	31	466 ± 39
Polar bear‡	ᓄᓂᐃᑦ‡	Nanuit‡				1	4	3							8
Wolf	ᐊᒪᓗᐃᑦ	Amagut								1	6	11	10		28 ± 8
Arctic fox	ᑎᓗᓚᖅᓂᐊᑦ	Tigiganiat					2	42	8	5	15	21			93 ± 23
Wolverine	ᖃᕐᕕᒃ	Kalvik							1			1	1		3 ± 1
Ringed seal	ᓇᕆᑦ	Natiinat	47	24	11	1	25	2	15	7	7	2	1	8	150 ± 75
Bearded seal	ᐅᓘᔪᐃᑦ	Ukyuk			1								1	9	11 ± 5
Walrus	ᐊᐃᓵᒃ	Akvik	4												4 ± 8
Narwhal	ᑐᒻᓂᑦ ᖃᓪᓗᓂᑦ	Tuugaak		1	2										3 ± 2
Beluga	ᖃᐅᕐᑕ ᖃᓪᓗᓂᑦ	Kilalugak		3											3 ± 3
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq			4										4 ± 3
Canada goose	ᓄᕐᓂᑦ ᐅᓗᐊᒍᓂᑦ	Nikliknik	22											7	29 ± 19
Mallard	ᒥᑎᓪᖅ	Mitik									1				1 ± 0
Ptarmigan	ᐊᖏᓗᒋᑦ	Akilgik						3				2			5 ± 2
Arctic char	ᐃᖃᓗᓴᒃ	Ikaliviit	518	549	1,745	2	26	193	110	112	7			172	3,434 ± 973
Lake trout	ᐃᓱᕐᓴᐃᑦ	Ikalukpik		30				10			1		3	35	79 ± 23
Cod	ᐅᒪᐃᑦ	Ugak	42												42 ± 60

‡ Polar bear data supplied by DSD.

‡ ᓄᓂᐃᑦ ᑎᑎᕋᐅᒪᔨᑦ ᑐᓂᖅᖏᑦ ᐅᓂᒃᑯᑦ ᐃᓄᐊᕐᓇᓕᓂᒃᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.3.3

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 548

Monthly hunter response

ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᓕᕐᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᑐᓂ	NOV ᓄᐃᓕᓂ	DEC ᑎᓯᓂ	JAN ᔮᖅᓄᓗᓂ	FEB ᐃᖅᑲᓗᓂ	MAR ᒪᕐᕿ	APR ᐃᕐᓇᓪᓚ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	73	74	74	74	73	73	73	73	73	82	83	83	85*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	41	54	61	70	66	67	68	66	66	77	65	72	83*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ	Angujaujut	14	29	25	11	17	14	10	10	14	13	13	23	60*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	56	73	82	95	90	92	93	90	90	94	78	87	85**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᔾᔪᑎᒋᔭᐅᓂᖏᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ ᐊᑕᐅᓯᐊᕐᓗᐃᑎᒃ ᐊᓕᕐᒪᒥ.
** ᐊᓕᓐᓂᕐᒥᒪᔭᑦ ᑕᖃᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 549

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓂᒃᓴᓂᖅᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᑦᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓗ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑕᑦ ᑎᑎᕐᕕᑦᑕᐅᒪᔭᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᓕᕐᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᑐᓂ	NOV ᓄᐃᓕᓂ	DEC ᑎᓯᓂ	JAN ᔮᖅᓄᓗᓂ	FEB ᐃᖅᑲᓗᓂ	MAR ᒪᕐᕿ	APR ᐃᕐᓇᓪᓚ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	100	94	94	91	100	100	100	100	100	100	100	98	97
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	0	6	9	0	0	0	0	0	0	0	2	2
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	6	0	0	0	0	0	0	0	0	0	0	1

6.3.3

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 550

Number of hunters harvesting each species — **Year 5 (June 2000 - May 2001)**

ᖃᓄᓯᐅᓂᖏᑦ ᐊᖏᓚᓕᓲᕿᑎᑦ ᐊᖏᓚᓕᓲᕿᕕᒃᓴᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒻᒋᒍ 5 (ᔫᓂ 2000 - ᒪᐃ 2001)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 5 (June 2000 - May 2001)**

Month/ᑕᖅᖢᓗ/Tatkia			JUN ᔫᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒍᑎᑐᑎ	SEP ᓱᑎᒃᐱᓗ	OCT ᐅᑦᐱᓗ	NOV ᐅᐊᒃᐱᓗ	DEC ᑎᓴᒃᐱᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᖅ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	5	19	19	10	10	10	8	7	12	13	11	12	49
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut								1	3	3	2		5
Arctic fox	ᑎᓕᓴᓐᓂᐊᑦ	Tigiganiat					1	4	3	1	1	1			8
Wolverine	ᖃᕐᕿᓵᑦ	Kalvik							1			1	1		3
Ringed seal	ᓇᓂᓪᑦ	Natiinat	4	7	4	1	4	1	5	3	4	1	1	5	22
Bearded seal	ᐅᓚᐅᐃᑦ	Ukyuk			1								1	1	2
Walrus	ᐊᐃᐃᓵᑦ	Akvik	1												1
Narwhal	ᑐᒃᓐᑦ ᖁᓕᓴᒃ	Tuugaak		1	1										2
Beluga	ᖃᐅᔨᑦ ᖁᓕᓴᒃ	Kilalugak		1											1
Snow goose	ᑲᖏᒍᑦ	Kanguq			1										1
Canada goose	ᓄᔨᓐᑦ ᐅᓗᐊᔪᓐᓂᑦ	Nikliknik	5											1	6
Mallard	ᒥᑎᓪᖃᖅ	Mitik									1				1
Ptarmigan	ᐊᒥᓱᑦ	Akilgik						1				1			2
Arctic char	ᐃᖃᓗᐲᒐᑦ	Ikaliviit	8	15	10	1	1	2	1	1	1			10	35
Lake trout	ᐃᓱᒋᐊᑦ	Ikalukpik		3				1			1		1	7	11
Cod	ᐅᒪᐃᑦ	Ugak	1												1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᖅᑎᑐᖅ ᐱᓵᐊᑦᓂᓂᒃ ᐊᖏᓴᑦ ᖃᕋᓴᐅᓂᖅᓂᓄᑦ ᐊᓂᒃᑲᒪᒋᔭᐅᓂᖅ ᐊᐅᓚᑦᑐᖅᑐᑦ ᐃᓕᓴᕐᕕᒃᓴᐅᓂᖅ ᐃᓕᓴᕐᕕᒃᓴᐅᓂᖅᓂᒃ ᐃᓄᐃᑦᑎᓯᓚᐅᖅᓯᒪᓂᖅ ᐃᓕᓴᕐᕕᒃᓴᐅᓂᖅᓂᒃ ᐃᓄᐃᑦᑎᓯᓚᐅᖅᓯᒪᓂᖅ

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 551

Annual harvest estimates and five-year mean

ᐊᖏᕐᔪᒪᒃᑐᑦ ᐊᓐᔪᐅᓄᓂ ᓇᓕᐅᑦᑎᓗᒍᑦ ᐊᖏᒪᓗ ᑕᓪᓕᓚᓂᑦ-ᐊᖏᕐᔪᐊᓂᑦ ᐊᐅᒋᓕᖅᑎᓯᒪᓕᕆᑦ

Aragutamat angujauvaktun tatlman araguit iluani

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᖏᕐᔪᐊᓂᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅᓯᒪᔪᑦ ᐊᖏᕐᔪᒪ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Mean ᐊᐅᒋᓕᖅᑎᓯᒪᓕᕆᑦ Amigaitkiyait
Species	ᐅᒪᓕᑦ	**Umajuin**						
Caribou[1]	ᑐᑐᐃᓐᑦ[1]	Tuktut[1]	941	940	598	330	466	655
Musk-ox[2]	ᐅᒥᖅᒪᐃᓐᑦ[2]	Umingmait[2]	0	2	0	3	0	1
Polar bear[3]	ᓇᓄᐃᓐᑦ[3]	Nanuit[3]	9	9	10	10	8	9
Wolf[4]	ᐊᒪᕐᒃᐃᓐᑦ[4]	Amagut[4]	8	42	106	26	28	42
Arctic fox	ᑎᓇᓚᖓᓂᐊᑦ	Tigiganiat	250	60	3	0	93	81
Coloured fox	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓇᓚᖓᓂᐊᑦ	Kalaliit tigiganiat	0	3	0	0	0	1
Wolverine	ᖃᕐᕕᐃᑦ	Kalvik	0	0	0	0	3	1
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	19	2	1	0	0	4
Seals (unspecified)	ᓴᖅᑯᓪᓕᑦ	Natiit	0	2	1	0	0	1
Ringed seal[5]	ᓇᓴᓪᓕᑦ[5]	Natiinat[5]	147	97	34	32	150	92
Bearded seal	ᐅᓚᐊᐃᓐᑦ	Ukyuk	6	4	5	1	11	5
Harp seal[6]	ᖃᐃᕐᓪᓕᓕᒃ[6]	Qairulik[6]	2	13	4	5	0	5
Harbour seal[7]	ᖃᓴᑎᐊᑦ[7]	Qanigiaq[7]	4	1	1	2	0	2
Walrus[8]	ᐊᐃᐸᓕᑦ[8]	Akvik[8]	4	1	1	3	4	3
Narwhal[9]	ᑐᒍᓪᓕᑦ ᖁᓕᓚᓕᑦ[9]	Tuugaak[9]	0	0	4	0	3	1
Beluga[10]	ᖃᐅᔨᑦᑕ ᖁᓕᓚᓕᑦ[10]	Kilalugak[10]	31	23	10	19	3	17
Snow goose[11]	ᑲᖏᐃᓐᑦ[11]	Kanguq[11]	134	108	80	17	4	69
Canada goose[12]	ᓄᓪᓕᑦ ᐅᓗᐊᔪᓪᓕᑦ[12]	Nikliknik[12]	41	134	33	7	29	49
Mallard	ᒥᑎᓴᖅ	Mitik	0	0	0	0	1	<1
Eider duck	ᒥᑎᑦ	Kingalik	22	16	0	0	0	8
Ptarmigan	ᐊᒋᑭᑦ	Akilgik	195	182	52	31	5	93
Goose eggs[13]	ᑲᖏᐃᓐᑦ ᒪᓐᓄᕐᑦ[13]	Uluaguliit manniit[13]	0	0	10	20	0	6
Duck eggs[13]	ᒥᑎᑦ ᒪᓐᓄᕐᑦ[13]	Tinmiat manniit[13]	74	661	22	0	0	151
Arctic tern eggs[13]	ᐃᒥᖅᑯᑕᓚᓕᑦ ᒪᓐᓄᕐᑦ[13]	Emitkutailat manniit[13]	0	0	22	0	0	4
Seagull eggs[13]	ᓇᐅᓕᐃᑦ ᒪᓐᓄᕐᑦ[13]	Nauyat manniit[13]	0	3	0	0	0	1
Black guillemot eggs[13]	ᐱᓕᐅᓪᓕᑦ ᒪᓐᓄᕐᑦ[13]	Black guillemot eggs[13]	0	0	33	0	0	7
Arctic char[14]	ᐃᖅᓗᒃᐱᑦ[14]	Ikaliviit[14]	3222	3405	1252	1091	3434	2481
Lake trout[15]	ᐃᓕᕆᐃᓐᑦ[15]	Ikalukpik[15]	579	342	127	128	79	251
Burbot[16]	ᑎᒃᑕᓪᓕᑦ[16]	Tiktaaliq[16]	0	0	0	25	0	5
Cod[17]	ᐅᒪᐃᓐᑦ[17]	Ugak[17]	0	0	0	0	42	8

6.3.3

[1-17]: See page 677 for community feedback and other sources of data.

[1-17]: ᑕᐃᒪᐅ ᒪᓴᐊᑐᖅ 679 ᓄᓇᓪᓕᑦ ᑭᐅᔨᓴᒋᑎᖓᑦ ᐊᖏᒪᓗ ᐊᓯᖏᓪᓕᐊᓂᑦ ᐱᓴᐃᓐᓇᖅᑐᓂᖅ.

[1-17]: Takulugu makpigaak 681 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

TABLE/ᐅᓗᐅᐃᓕᐅᑦ/NAUNAIKUTA 552

Annual hunter response
ᐊᓚᕆᔨᒋᒪᑦ ᐊᖏᓐᓂᔭᕐᓂᑦ ᑭᐅᓂᖏᑦ
Angujauvaktu

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓄᑦ ᐊᓚᕆᔨᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᕆᔨᖅ ᐊᕆᔨᒐᓱᐃᓐᓇᖅ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓐᓂᔭᕐᓂᑦ ᑭᐅᓂᖏᑦ ᐊᔪᕐᓗᓂᖏᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᓐᓂᔭᕐᓂᑦ	Tatkitaman angunahuktut titigait	72	79	80	77	85	92*
Hunters interviewed	ᐊᖏᓐᓂᔭᕐᓂᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	72	78	79	73	83	91*
Harvested	ᐊᖏᓐᓂᔭᕐᔪᐊᓂᓄᑦ	Angujaujut	66	64	60	52	60	84*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	76	79	86	89	85	83**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖏᓐᓂᔭᕐᓂᑦ ᐊᑎᓕᐅᔾᔨᒋᓪᓗᒍ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᓐᓂᔭᕐᔪᐊᓂᓄᑦ ᐊᑕᐅᓯᐊᓘᔪᐊᕐᑎᑐᑦ ᖃᐅᔨᓴᕆᔨᖅ.
** ᐊᓕᒋᓕᕐᑎᓯᒪᔨᓪᓚᑦ ᐊᕆᔨᒋᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᐅᓗᐅᐃᓕᐅᑦ/NAUNAIKUTA 553

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᑦᓴᓂ ᐊᖏᓐᓂᔭᕐᓄᓪᓴᒍᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓴᒍᑕ, ᐅᓗᐅᐃᑦᑕᑦ ᐃᒪᓐ % ᑲᑎᒪᔨᑦ ᐊᖏᓐᓂᔭᕐᑕᑦ ᑎᑎᕐᑦᑕᐅᒪᔨᔨᑦ
Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓄᑦ ᐊᓚᕆᔨᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᕆᔨᖅ ᐊᕆᔨᒐᓱᐃᓐᓇᖅ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᖅᑦ	≤ tatkin pingahut	99	100	98	99	97	99
4-6 months	4-6 ᑕᖅᑦ	tatkin hitaman 6nut	0	0	2	0	2	1
> 6 months	> 6 ᑕᖅᑦ	> 6 tatkin	1	0	0	1	1	0

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 554

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓯᖅᑎᑦ ᐊᖏᔪᓯᖅᓯᕐᓕᑦ ᐊᑐᓂᖅ ᐅᒪᔨᖏᓂᖅ

Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᑦᑭᒍᓄᑦ (ᔨᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅᓯᒪᔪᑦ ᐊᑦᑭᒍ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Total ᑲᑎᕐᒥᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**						
Caribou	ᔭᑐᐃᑦ	Tuktut	59	56	53	45	49	76
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait		2		2		3
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut	4	10	15	7	5	19
Arctic fox	ᑎᓕᑦᓂᐊᑦ	Tigiganiat	16	5	1		8	23
Coloured fox	ᖃᐃᓐᖏᑦᑐᑦ ᑎᓕᑦᓂᐊᑦ	Kalaliit tigiganiat		2				2
Wolverine	ᖃᑦᕃᑦ	Kalvik					3	3
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik	9	1	1			9
Seals (unspecified)	ᓂᖏᐃᓪᓕᑦ	Natiit		2	1			3
Ringed seal	ᓇᓂᓕ	Natiinat	26	26	15	8	22	52
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	4	3	5	1	2	11
Harp seal	ᖃᐃᕐᓪᓕᑦ	Qairulik	1	5	3	4		10
Harbour seal	ᖃᓂᕈᐊᑦ	Qanigiaq	2	1	1	2		6
Walrus	ᐊᐃᐃᒃᑦ	Akvik	2	1	1	2	1	5
Narwhal	ᑐᐃᓪᓕᑦ ᕿᓪᓚᑦ	Tuugaak			3		2	4
Beluga	ᖃᐃᖏᑦ ᕿᓪᓚᑦ	Kilalugak	13	6	4	6	1	23
Snow goose	ᑲᖏᐃᑦ	Kanguq	14	16	6	3	1	27
Canada goose	ᓂᑦᓪᓕᑦ ᐅᓗᐊᒍᓪᓕᑦ	Nikliknik	7	13	6	3	6	29
Mallard	ᒥᑎᓪᖅ	Mitik					1	1
Eider duck	ᒥᑏᑦ	Kingalik	4	2				6
Ptarmigan	ᐊᕕᒃᑦ	Akilgik	12	10	4	2	2	26
Goose eggs	ᑲᖏᐃᑦ ᒪᓂᓂᖏᑦ	Uluaguliit manniit			1	1		2
Duck eggs	ᒥᑏᑦ ᒪᓂᓂᖏᑦ	Tinmiat manniit	2	4	1			7
Arctic tern eggs	ᐃᒥᖅᑯᑕᓪᓕᑦ ᒪᓂᓂᖏᑦ	Emitkutailat manniit			1			1
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓂᓂᖏᑦ	Nauyat manniit		1				1
Black guillemot eggs	ᐱᖏᐅᓪᓕᑦ ᒪᓂᓂᖏᑦ	Black guillemot eggs			2			2
Arctic char	ᐃᖅᓗᓵᐱᑦ	Ikaliviit	39	27	24	14	35	60
Lake trout	ᐃᓕᒃᖁᐃᑦ	Ikalukpik	30	27	14	10	11	46
Burbot	ᑎᐱᓪᓕᑦ	Tiktaaliq				1		1
Cod	ᐅᒪᐃᑦ	Ugak					1	1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᓂᖏᑐᖅ ᐱᔨᔪᑎᓕᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᓂᒃᓄᑦ ᐊᓕᓴᐅᒪᔪᓄᑦ ᐊᔪᖅᓄᑦ ᓇᓕᐅᕐᓯᒪᓂᖅ ᑐᓴᕐᖏᓂᒃ ᐃᑯᐱᕐᓂᓕᕆᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.3.3 Community Results Discussion: Chesterfield Inlet

The survey frame:
An assessment of under-enumeration during the community visit revealed that there were approximately 14 hunters who were not registered in the Harvest Study. Twelve of these were Inuit, all were occasional hunters. It is estimated that there were two non-Inuit with assigned hunting rights who were not registered, both also occasional hunters. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. Given that these unregistered hunters represent 13 percent of the total hunter population (Table 10) the effect of this bias on harvest estimates could be significant. However, the effect would be lessened by the fact that all unregistered hunters were thought to be occasional hunters. Harvest estimates for the unregistered hunters can be estimated using mean harvest quantities for each species by strata. These estimates, having their own sources of error and bias, are beyond the scope of this Final Report. Readers may apply to NWMB to obtain the results of these calculations.

Survey coverage and non-response bias:
In general response rates were relatively high throughout the study. However, there were some months with lower (more problematic) response rates. Also the response rates of the intensive hunters were lower than the other two strata in many months. As seen in Table 9 the consistent intentional non-response rate in Chesterfield Inlet was relatively high, at 5.4%, and there may be potential non-response bias as a result.

Response rates were felt to be high enough and non-response bias low enough during most months of the study to ensure that N did in fact constitute a sufficiently representative sample of N hunters. Readers should refer to the response rate tables when using the harvest estimates provided and exercise caution when using the data collected during months with lower response rates since the potential for both sampling error and non-response bias increases as response rates fall.

Measurement issues and response error:
It was reported during the community consultations that egg harvests were under-reported. Further details are provided in the community feedback and other sources of data section below. Section 5.4 also contains a thorough discussion of this issue.

As seen in the recall period tables, the vast majority of harvest records were collected within three months of the harvest, thereby minimizing recall error. The only exceptions were November and December 1998 (year 3) when all records were collected four to six months after the harvest.

During the Harvest Study there may have been some commercial harvests of char and of caribou. Although some of these harvests may have been reported with the subsistence harvest (see notes for caribou below), this was thought to be rare and harvest estimates should be viewed as the subsistence harvest only.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou. Harvest estimates in years 3, 4 and 5 seem low. However, in the first two years of the study hunters reported that there were tags available for the commercial harvest of caribou and some were harvested for the meat plant (C.F.).
2. **Musk-ox:** Harvest estimates are suggested not to be accurate in years with no harvest reported. The community had an annual quota of 5 animals and although they did not always use all the tags they report that most were taken each year (C.F.). The local Wildlife Officer confirmed this statement.
3. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
4. **Wolf:** The harvest estimate in year 1 seems too low (C.F.).
5. **Ringed seal:** DFO were collecting ringed seal samples from hunters from 1999 to 2001; 112 samples were submitted by Chesterfield Inlet hunters over this period (Cleator, 2001).
6. **Harp seal:** No harvests were reported in year 5. However, hunters report that there has been in increase in numbers and some would have been taken during this year (C.F.).
7. **Harbour seal:** Similar to the harp seals, hunters reported that some would have been harvested in the last year of the study (C.F.).



[8] **Walrus:** Harvest estimates appear too low in years 2 and 3. The annual mean harvest is said to be about 4 per year (C.F.).

[9] **Narwhal:** There was some doubt that there were no harvests of narwhal in year 4. However, the harvest estimates in other years were thought to be in the right range (C.F.). DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
0	0	3	5	3

[10] **Beluga:** The harvest estimate in year 5 seems low (C.F.). DFO reports the following harvest numbers for beluga (note that DFO data are based on fiscal years, whereas Harvest Study data are based on years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
20	n/d	15	n/d	1

[11] **Snow goose:** Harvest estimates in years 4 and 5 seem low. The community reports that they harvest at least 10 to 20 per year (C.F.).

[12] **Canada goose:** The harvest estimate for Canada geese in year 4 also looks low (C.F.).

[13] **Eggs:** The HTO Board reported that people did not count their eggs and did not report them – harvest estimates for almost all eggs seem too low. *Goose eggs:* Some are collected every year, data from years with no harvest are inaccurate and harvest estimates in other years look low. *Duck eggs:* The harvest estimate in year 2 appears to be in the right range but all others seem too low. *Arctic tern eggs:* Harvest estimates appear low; a harvest of over 100 per year would be more accurate. S*eagull eggs:* Harvest estimates seem low; an estimate approximately 100 per year would be reasonable. *Black guillemot eggs:* Harvest estimates should be about 50-60 per year (C.F.).

[14] **Arctic char:** Harvest estimates in years 3 and 4 seem low. Estimates from other years appear more accurate (C.F.).

[15] **Lake trout:** Lake trout are harvested during fishing derbies and some are caught in nets when fishing for arctic char. Estimates for the last three years of the study were reported to look low (C.F.).

[16] **Burbot:** Similar to the lake trout, burbot are caught both during fishing derbies and in arctic char nets. The estimate in year 4, the only year in which they were reported, looks accurate but there should have been similar harvests reported each year (C.F.).

[17] **Cod:** It was reported that cod are caught every year (C.F.).

6.3.3 ᓄᓇᕗᑦ ᓴᖅᑭᑕᕐᕕᖏᓐᓄᑦ ᐅᖃᖅᑎᑕᐅᑎᓪᓗᒍ: ᐃᓱᓕᔪᓐᓇᕐᕕᒃ

ᖃᐅᔨᓴᓂᐅᑦ ᐊᐅᓚᑦᑎᓐᓇᖅ:

ᑭᒥᖅᑭᔨᐅᑎᓪᓗᓂ ᐊᑎᓕᐅᓚᓐᓂᖅᓴᓕᕐᕕᖏᓂ ᓄᓇᕗᑦ ᕿᓚᒥᑕᐅᑎᓪᓗᓂ ᑕᐃᑎᖏᓚᐅᖅᑕᓂ ᑕᒪᓐ 14%ᔪᓂᑦ ᐊᖏᓚᓇᔪᑎᑦ ᐊᑎᖃᖅᑕᕐᕕᐅᖏᓐᓂᖅᓂᖅᓄᑦ ᖃᐅᔨᓴᓂᒍᑦ. 12%ᑦ ᐃᓅᓪᓗᑎᑦ, ᑕᒪᒋᒥᑦ ᖃᐅᔨᔪᑎᑦ. ᐃᓕᓴᕐᔨᐅᕐᓂᖅᓄᑦ ᓯᑭᓪᓚᓐᓇᖏᓐᓂᖅᓄᑦ ᐃᓅᓪᓗᖏᓪᓗᓂ ᐊᑎᖃᖅᑕᕐᕕᐅᓚᐅᖏᓪᓗᓂᖅᓄᑦ, ᑕᒪᐃᓄ ᖃᐅᔨᔪᑎᑦ. ᐅᖃᐅᔨᔪᓂ ᐃᓱᐅᑎᑦ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓚᐅᓇᖏᓪᓗᐊᖑᑎᒃ ᐱᔭᕇᐅᓂᖅ ᐊᓯᑎᓐᓴᓂᔪᒪᓚᕐᖓᓂᐊᓕ ᐅᓪᓚᕐᕕᐅᓚᐅᖅᑕᓂᑦ ᖃᓄᖅᑭᐅᖓᓂᖅᓄᑦ. ᐃᓕᓴᕐᓂᐊᒍ ᑕᒪᐃᓄᑦ ᐊᑎᖃᖅᑕᕐᕕᐅᓚᐅᖅᑕᓂᑦ 13%ᓇᓪᓕᓐᓂᑦ ᑲᑎᑕᐅᓱᓕᑎᑦ ᐊᖏᓚᓇᔪᑎᓕᒫᑦ (ᓇᓕᒃᖃᖅ 10) ᐊᑦᑐᐃᓂᓇᓱᖅᑕᕐᓂᖅ ᐅᓪᓚᕐᕕᐅᓚᐅᖅᑕᓂᑦ ᖃᓄᖅᑭᐅᖓᓂᖅᓄᑦ ᐊᔪᓚᑦᑎᓐᓂᒍ ᑕᒪᐃᓄᑦ ᐊᑎᖃᖅᑕᕐᕕᐅᓚᐅᖅᑕᓂᑦ ᖃᐅᔨᓴᓂᒍᓐᓄᑦ ᐊᑐᐊᓕᓂᖅᓄᑦ ᐊᑎᖃᖅᑕᕐᕕᐅᓚᐅᖅᑕᓂᑦ ᐊᑐᐊᓕᓂᖅᓄᑦ ᐊᑎᖃᖅᑕᕐᕕᐅᓚᐅᖅᑕᓂ

[6] **ᖃᐃᑲᓕᕆ:** ᖃᐃᑲᓕᑕᒥᔪᒃ ᑲᖏᐅᓂᖃᖅᑐᖃᓕᕆᔨᒃᑯᑦ ᐊᖏᔪᖅ 5-ᒥ. ᑭᓱᐊᓂᓕ, ᐊᖏᓚᓇᓱᖅᑎᑦ ᑲᖏᖃᑎᖅᑐᖃᓕᕆᔨᒃᑯᑦ ᐊᒥᓱᑲᓇᖅᓱᒪᓂᖅᑕᐅᔪᓂᒃ ᐊᓪᒪᒪ ᐃᓕᓴᐅᓐ ᐱᓕᐅᑐᐃᓐᓇᐊᖏᖃᖅᑐᓕᕆᓂᖅ ᑕᒪᓐᓇ ᐊᖏᖅᔪᒥ (C.F.).

[7] **ᖃᓄᑭᐊᖅ:** ᑕᐃᒪᓐᓇᑎᑐᓐ ᖃᐃᑲᓕᑎᑐᓐ, ᐊᖏᓚᓇᓱᖅᑎᑦ ᑲᖏᓕᑲᖅᑐᐃᓐ ᐃᓕᓴᑦ ᐊᖏᓴᐅᓕᐅᓚᐊᖏᓐ ᑭᖑᓪᓗᓯᓚᓐᓇᓐ ᖃᖏᖅᔪᒥ. (C.F.).

[8] **ᐊᐃᐃᕆ:** ᐊᐃᐃᖅᑕᐅᖃᑦᑕᖅᑐᓂ ᓇᓕᐅᑦᑕᑕᐅᓪᓚᐊᐅᐃᓐ ᐊᑦᑕᓪᓚᖅᑐᑦᑐᖅᑐᓐ ᐊᖏᔪᖅ 2 ᐊᒪᒪ 3. ᐊᖏᔪᒥ ᐊᐃᐃᖅᑕᐅᔾᔨᑐᖅᑐᐃᓐ ᐅᖃᐅᔾᔨᓕᕆᐃᓐ ᐃᒪᓕᓴᒍᑎᖅᓴ 4 ᓴᓂ ᐊᖏᔪᔪᑦᓱ (C.F.).

[9] **ᑐᐃᓂᓕᑦ:** ᖃᓚᓐᓇᓕᐅᖅᑐᖅ ᑐᐃᓂᓕᖅᑐᓄᓐᓂᒃᑯᓴᓐ ᐊᖏᔪᖅ 4-ᒥ. ᑭᓱᐊᓂᓕ, ᑐᐃᓂᖅᑕᐅᔨᓂᓕ ᓇᓕᐅᑦᑕᑕᐅᔨᖅ ᐊᓂᖓᓂᓐ ᐊᖏᔪᓂ ᑕᒪᓕᐊᑐᑎᓂᔨᓕᕆᖅᑐᓂᑦ. (C.F.). ᐃᒪᒋᐅᑕᑕᓚᓱᓐᓂᑦ ᐊᓪᓕᑕᐅᓂᒪᔨᐃᓐ ᐃᓕᒋᐅᑕᖅᑕᒥᔨᓕᕆᓂᖅ ᐃᓕᓴᐅᓂᖅ ᑐᐃᓂᖅᑕᐅᔨᓂᖅ (ᖃᐅᔨᓕᒥᑦ ᐃᒪᒋᐅᑕᑕᓚᓱᓐᓂᑦ ᓇᓕᐅᑦᑕᑕᐅᓪᓚᐊᐅᐃᓐ ᑕᓪᓕᒥᒪᔨᖅᑎᑦ ᑐᐃᓐᓇᑐᖅᑐᓂᖅ ᒪᓕᒪᓐᓇᖅᑐᑦᑕᑕᐅᓂᖅ ᐅᑭᐅᖅᑕᖅᑐᑦ ᐃᓕᒋᐅᑕᑕᓚᓱᓐᓂᑦ ᐊᑎᖓᔪᖅᑐᑦ ᐃᓕᓴᐅᓂᖅ ᐊᑎᖓᔪᖅᑐᑦ ᐃᓕᓴᐅᓂᖅ ᓇᓕᐅᑦᑕᑕᐅᓪᓚᐊᐅᐃᓐ

6.3.3 Nunanit Iniktigutait Ukauhiit: Igluligaajuk

Ihivgiuktit Atugutait:
Ihivgiufaakhimayut ataani naunaiyakhimayut nunamut pulaakhimatitlugit takuhimayut 14nik umayukhiuktinik titigaktauhimaitut Umayukhiukhimayut Ihivgiuktuni. 12kut hapkoa Inuinauyut, tamamik ilaani umayukhiukataktut. Naunaiyakhimayut malguk Inuinaungitut tuniyauhimayut inminiigutinik umayukhiugutinik titigaktauhimaitut, tamamik ilaani umayukhiukataktut. Ukakhimayut ilangani 5.2.1 ikpinagutait hamna ataani naunaiyakhimayut pilaaktut ataanut ihumagiyaini umayukhiukhimayut naunaiyautaini. Pihimamata hapkoa titigaktauhimaitut umayukhiuktit 13%nik tamaat umayukhiuktinit (ikpatauyak 10) ikpinagutait hamna ihumagiyauyuk umayukhiukhimayut naunaiyautaini anginiaktuk. Kihimi ikingutait mikiniaktuk pihimamata tamamik titigaktauhimaitut umayukhiuktit ilaani umayukhiukatamata. Umayukhiukhimayut naunaiyautait titigaktauhimaitut umayukhiuktit pilaaktut naunaiyautaini atulutik angitjutait umayukhiukhimayut amigaitjutait tamamik umayut aviktukhimalugit. Hapkoa naunaiyautit pikamata inminik atuktaminik ihuinaagutainik ovalo ihumagiyainik angiyuumata hamna Iniktiguti Tuhaktakhak. Taiguaktut apigilaat NWMBkunut piyumagumik iniktigutainik hapkoa naunaiyagutinik.

Ihivgiukatagutait ovalo kiuyuitut ihumagiyait:
Ilangani kiuhimayut naunaiyautait angiyut tamaat ihivgiuktuni. Kihimi ilangit tatkikhiutit mikitkiyait (ayokhagutinut) kiuhimayut naunaiyautait. Ovalo kiuhimayut naunaiyautait umayukhiukatainaktut mikitkiyaumata aipaini malguuk aviktukhimayuni amigaituni tatkikhiutini. Takukhauyut ikpatauyami 9 pikataktut kiuyuitit naunaiyautait Igluliigaajuqmi angiyut, 5.4%mik ovalo pilaaktut kiuyuitut ihumagiyait pihimamat.

Kiuhimayut naunaiyautait ihumagiyauyut angiyut ovalo kiuyuitut ihumagiyait mikiyut amigaituni tatkikhiutini ihivgiuktitlugit piyaami nni pihimayut naamaktumik ilaukatauyuni Nni umayukhiuktinit. Taiguaktut takuyukhat kiuhimayut naunaiyautaini ikpatauyamik atugumik umayukhiukhimayut naunaiyautaini pihimayut ovalo ihumagilugit atuligumik katitikhimayut katitigutaini tatkikhiutini mikiyunik kiuhimayut naunaiyautaini pilaaktut tamamik uktugutit ihiunaagutaini ovalo kiuyuitut ihumagiyaini angiklikpat kiuhimayut naunaiyautait katakpata.

Atugutingit ihumagiyait oval kiuhimayut ihuinaagutait:
Tuhaktitihimayut nunamut pulaakhimatitluni manikhiuktut ataani tuhaktitihimayut. Titigafaakhimayut pihimayut nunanit ukautaini ovalo aalat atuktaini katitikhimayuni ilangani hamani. Ilangani 5.4 pihimayutlu ukautainik hamn ihumagiyumi

Takuhimayut utiktitihimayuni ubluit ikpatauyani, amigaktut umayukhiukhimayut titigakhimayait katitikhimayut iluani pingahut tatkikhiutini umayukhiukhimayut, taimaimat mikinikhaaguhimayuk utiktitihimayut ihuinaagutait. Kihimi Novembermi ovalo Decembermi 1998mi (ukiumi 3) tamamik titigakhimayut katitikhimalimata hitamanit siksinut tatkikhiutini avataani umaukhiukhimayuni.

Umayukhiukhimayut Ihivgiugutaini piyunakhihimayut kinauyaliugutinik umayukhiukhimayuni ikalivinik ovalo tuktunik. Kihimi , ilangit hapkoa umayukhiukhimayut piyunakhiyut tuhaktitihimayut ilangini atuktakhaini umayukhiukhimayuni (takulugu titigakhimayut tuktuni hamani) hamna ihumagiyauyuk pikatainangituk ovalo umayukhiukhimayut naunaiyautait takuyukhat atuktukhanik umayukhiukhimayunik talvatuak.

Nunanit ukakhimayut ovalo aalat atugutaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukhimayut nunani tuktut. Umayukhiukhimayut naunaiyautait ukiuni 3mi, 4mi ovalo 5mi mikiyut. Kihimi hivulimi malguuk ukiuk ihivgiukhimayuni umayukhiuktit tuhaktitihimayut pikaktut makpigaakaktuk kinauyaliugutikhanik umayukhiukhimayukhanik tuktunik ovalo ilangit umayukhiukhimayut uyukakvimut (C.F.).
2. **Umingmait:** Umayukhiukhimayut naunaiyautait pihimayut ihuitut ukiuni umayukhiuhimaitut tuhaktakhani. Nunani ukiuk tamaat kotakamata talimanik umingmanik ovalo kihimi atukatainayuitait tamamik makpigaat tuhaktitihimayut pivaktut ukiuk tamaat (C.F.). Nunani umayuligiyi pihimavaktut ikayuktait hamna ukakhimayuk.
3. **Nanuit:** Amigaitjutait takuhimayut naunaiyautaungitut kihimi pihimayut umayukhiukhimayut tunihimayait DSDkut (DSD PB).
4. **Amagut:** Umayukhiukhimayut naunaiyautait ukiumi 1mi mikiyut (C.F.).

[5] **Natiinat:** DFOkut katitikhimayut natiinat ihivgiutakhainik umayukhiuktinit 1999mit 2001mut, 112kuyut ihivgiuktauhimayut tuniyauhimayut Igluligaajukmit umayukhiuktinit hamani ubluini (Cleator, 2001).

[6] **Qaitulik:** Umayukhiukhimaitut tuhaktitihimayuni ukiumi 5mi kihimi, umayukhiuktit tuhaktitihimayut angilihimayut amigaitjutait ovalo piyunakhihimayut hamani ukiumi (C.F.).

[7] **Qanigiaq:** Aatjikutaatut qaituliit, umayukhiukhimayut tuhaktitihimayut piyunakhihimayut umayukhiukhimayuni kingilimi ukiumi ihivgiuktitlugit (C.F.).

[8] **Akviit:** Umayukhiukhimayut naunaiyautait mikiyut ukiuni 2mi ovalo 3mi. Ukiuk tamaat angitjutait umayukhiukhimayut pivaktait hitamat ukuk tamaat (C.F.).

[9] **Tuugaat:** Ihumagivaktut umayukhiukhimaitut tuugaanik ukiumi 4mi. Kihimi, umayukhiukhimayut naunaiyautait aipaini ukiuni ihumagiyut naamaktut (C.F.). DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait tuugaanik (nalungilutit DFOkut katitigutait atukpaktut iniktigutaini ukiunik, Umayukhiukhimayut Ihivgiugutait katitigutait atukpaktut umayukhiukhimayut ukiungini Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
0	0	3	5	3

[10] **Kilalugait:** Umayukhiukhimayut naunaiyautait ukiumi 5mi mikiyut (C.F.). DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait kilalugat (nalungilutit DFOkut katitigutait atukpaktut iniktigutaini ukiunik, Umayukhiuktit Ihivgiuktit katitigutait atukpaktut Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
20	n/d	15	n/d	1

[11] **Kanguq:** Umayukhiukhimayut naunaiyautait ukiumi 4mi ovalo 5mi mikiyut. Nunanit tuhaktitihimayut umayukhiukataktait 10nit 20nut ukiuk tamaat (C.F.).

[12] **Uluaguliit:** Umayukhiukhimayut naunaiyautait uluaguliit ukiumi 4mi mikiyuk (C.F.).

[13] **Maniit:** HTOkut katimayiit tuhaktitihimayut Inuit naunaiyayuitait maniit pikiuhimayaminik ovalo tuhaktitiyuitait – umayukhiukhimayut naunaiyautait tamamivyak maniit mikiyut. *Uluaguliit maniit:* Ilaani katitilikpaktut tamaat ukiuni, katitikhimayut ukiunit katitiyuitut ihuinaakhimayut ovalo umayukhiukhimayut naunaiyautait aipaini ukiuni mikiyut. *Tinmiat maniit:* Umayukhiukhimayut naunaiyautait ukiumi 2mi naamaktut kihimi tamamik aipait ukiut mikiyut. *Imitkutailat maniit:* Umayukhiukhimayut naunaiyautait mikiyut; katitikhimayut 100nik ukiumi tamaat nakuutkiyak. *Nauyat maniit:* Umayukhiukhimayut naunaiyautait mikiyut; ilaani 100nik ukiuk tamaat naamatkiyat. *Black guillemot eggs:* Umayukhiukhimayut naunaiyautait pivaktut 50nit 60nut pivaktut ukiuni tamaat (C.F.).

[14] **Ikaliviit:** Umayukhiukhimayut naunaiyautait ukiumi 3mi ovalo 4mi mikiyut. Naunaiyautait aipainit ukiuni naamaktut (C.F.).

[15] **Ikalukpiit:** Ikalukpiit umayukhiukhimayut ikalukhiutuni akinahuaktuni ovalo ilangit pivaktut kuvyani ikalukhiugaagamik ikalivinik. Naunaiyautait kingulimi pingahut ukiuni ihivgiukhimatitlugit tuhaktitihimayut mikiyut (C.F.).

[16] **Tiktaalik:** Aatjikutaatut ikalukpiitut, tiktaaliit pivaktut tamamik akinahuaktuni ikalukhiuktuni ovalo kuvyani. Naunaiyautait ukiuni 4mi, talvatuak ukiuk tuhaktitihimayut, naamaktut kihimi aatjikutainik umayukhiukhimayuni tuhaktitihimayuni tamamik ukiuni (C.F.).

[17] **Ugat:** Tuhaktitihimayut ugat pikatainaktut ukiuk tamaat (C.F.).

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 555

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓂᑦ

Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)

ᐊᑦᓱᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐᓂ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᓯᑎ	SEP ᓱᑎᐹᓗ	OCT ᐅᑲᐅᓗ	NOV ᐅᓇᕆᐹᓗ	DEC ᑎᓯᕆᐹᓗ	JAN ᔮᖏᓄᐊᓗ	FEB ᓇᖑᐅᐊᓗ	MAR ᒪᓯ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	209	109	217	143	77	138	40	60	146	50	76	111	1,376 ± 131
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡						27	1	1			3	1	33
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat					14	328	241	283	71	102	12		1,051 ± 226
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik						1		4					5 ± 6
Seals (unspecified)	ᓂᖏᑯᓪᓚᑦ	Natiit	61												61 ± 22
Ringed seal	ᓇᓕᓂᑦ	Natiinat	81	32	29	62	25	69	55	71	50	40	61	58	633 ± 75
Bearded seal	ᐅᓗᔪᐃᑦ	Ukyuk	16	14	29	12	1		5	6	5	8	5	3	104 ± 26
Harp seal	ᖃᐃᕐᓪᓚᑦ	Qairulik		10	22	27	5	1							65 ± 12
Walrus	ᐊᐃᐅᒃᑦ	Akvik	3	1	13	9									26 ± 8
Beluga	ᖃᑯᑦᑕ ᖁᓪᓗᒍᑦ	Kilalugak	14	11	24	35	1								85 ± 14
Geese (unspecified)	ᓂᑦᓪᓚᑦ	Kanguk	449												449 ± 125
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	4,071	57	35	22								1,174	5,359 ± 832
Canada goose	ᓂᑦᓪᓚᑦ ᐅᓗᐊᒍᓪᓚᑦ	Nikliknik	40	97											137 ± 108
Brant goose	ᓂᑦᓕᓐᓇᐃᑦ	Nirlirnaq	1												1 ± 1
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	18											16	34 ± 29
Eider duck	ᒥᑎᑦ	Kingalik	8				26								34 ± 24
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	30			11	53	421	167	130	52	101	169	313	1,447 ± 291
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᓚᓐᓂᖏᑦ	Manniit	488												488 ± 360
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᓐᓂᖏᑦ	Uluaguliit manniit	3,677	139											3,816 ± 936
Duck eggs	ᒥᑎᑦ ᓚᓐᓂᖏᑦ	Tinmiat manniit				16									16 ± 8
Seagull eggs	ᓇᐅᓗᐃᑦ ᓚᓐᓂᖏᑦ	Nauyat manniit	33												33 ± 30
Arctic char	ᐃᖅᓗᒃᐲᑦ	Ikaliviit	330	764	998	263	781	589	31		26	187		97	4,066 ± 694
Freshwater fish (unspecified)	ᑕᓇᐅᖕᒪᖏᑦᑐᒥ ᐃᖅᓗᐃᑦ	Tahinik Ikaluit	4												4 ± 4
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik							63					13	76 ± 93
Cod	ᐅᒪᐃᑦ	Ugak	64	7											71 ± 27
Sculpin	ᑲᓇᓗᐃᑦ	Kanayuk	94												94 ± 45
Mussels	ᐅᕆᓗᐃᑦ	Uviluvaloet		201	114										315 ± 127

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᑦᓄᑦ ᑎᑎᕋᐅᒪᓂᖅ ᑐᓂᓯᖏᑦ ᐅᑉᓯ ᐃᑯᐱᕆᓚᓇᖅᑐᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 556

Monthly hunter response

ᑕᖃᑦᑕᒫᑦ ᐊᖏᓚᓯᒪᔪᑦ ᑭᐅᓂᖅᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᑐᕐᔪᒍ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᓐ/Tatkia			JUN ᔮᓂ	JUL ᔮᓪᓗ	AUG ᐊᐅᒍᑎᓪ	SEP ᓯᑎᕐᓚᓪ	OCT ᐅᑯᓚᓪ	NOV ᓄᐃᕐᓚᓪ	DEC ᑎᓯᕐᓚᓪ	JAN ᔭᓐᓄᐊᓪ	FEB ᓇᖕᐊᓪ	MAR ᒪᕐᔾ	APR ᐃᕐᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓚᓯᒪᔪᑦ ᑭᐅᓂᖅᑎᑦ ᐊᑐᔪᒪᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᑕᒫᑦ ᐊᖏᓚᓯᒪᔪᑦ	Tatkitaman angunahuktut titigait	252	254	254	255	253	252	250	250	251	250	246	246	256*
Hunters interviewed	ᐊᖏᓚᓯᒪᔪᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	189	200	200	218	190	192	169	177	177	193	155	115	253*
Harvested	ᐊᖏᓚᓯᒪᔪᑐᒥᓂᑦ	Angujaujut	100	55	59	61	41	59	34	28	32	35	32	29	163*
Response Rate (%)	ᑭᐅᔾᔨᑎᓂᖅᑎᑦ (%)	Kiujut (%)	75	79	79	85	75	76	68	71	71	77	63	47	72**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓯᒪᔪᑦ ᐊᑎᓕᐅᑦᑕᐅᒪᓕᕆᓂᖅ/ᐊᐱᕐᓂᑦ/ᐊᖏᓚᓯᒪᔪᑐᒥᓂᑦ ᐊᑕᐅᓯᐊᖓᔪᓂᑎᑦ ᐊᑲᕐᒥᑉ.
** ᐊᑲᑎᓕᑎᕐᓯᒪᓕᕆᑦ ᑕᖃᑦᑕᒫᑦ ᑭᐅᓂᖅ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 557

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᓂᑦ ᐊᑯᕐᓴᓂ ᐊᖏᓚᓯᓂᓴᓴᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓴᑕ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᓚᓯᒪᔪᑕᑦ ᑎᑎᕐᑕᐅᒪᓂᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᑐᕐᔪᒍ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᓐ/Tatkia			JUN ᔮᓂ	JUL ᔮᓪᓗ	AUG ᐊᐅᒍᑎᓪ	SEP ᓯᑎᕐᓚᓪ	OCT ᐅᑯᓚᓪ	NOV ᓄᐃᕐᓚᓪ	DEC ᑎᓯᕐᓚᓪ	JAN ᔭᓐᓄᐊᓪ	FEB ᓇᖕᐊᓪ	MAR ᒪᕐᔾ	APR ᐃᕐᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᓂᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖃᑦ	≤ tatkin pingahut	77	87	96	97	80	84	82	96	95	52	41	6	80
4-6 months	4-6 ᑕᖃᑦ	tatkin hitaman 6nut	23	6	0	1	20	12	7	0	0	14	0	0	9
> 6 months	> 6 ᑕᖃᑦ	> 6 tatkin	0	7	4	3	0	4	11	4	5	34	59	94	11

6.3.4

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 558

Number of hunters harvesting each species — **Year 1 (June 1996 - May 1997)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᑎᑦ ᐊᖏᔪᓚᐱᖅᑕᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒻᒋᔪ 1 (ᔦᓂ 1996 - ᒪᐃ 1997)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 1 (June 1996 - May 1997)**

Month/ᑕᕿᖓ/Tatkia			JUN ᔦᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔨᑎ	SEP ᓱᑎᑦᓴᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᓇᓵᓴᓇ	DEC ᑎᓯᓴᓇ	JAN ᔮᖏᓄᐊᓇ	FEB ᓇᖕᐅᐊᓇ	MAR ᒪᔪ	APR ᐃᔪᓕᓪ	MAY ᒪᐃ	Total ᑲᑎᑲᑎᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	49	36	46	43	27	29	13	12	22	17	19	14	124
Polar bear‡‡	ᓇᓗᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat					2	17	10	11	6	7	2		27
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik						1		1					2
Seals (unspecified)	ᓯᖏᑯᓪᓚᑦ	Natiit	11												11
Ringed seal	ᓇᓱᓪᓚᑦ	Natiinat	18	11	12	19	9	19	10	21	11	15	16	9	78
Bearded seal	ᐅᓗᔪᐃᑦ	Ukyuk	4	7	8	8	1		2	3	3	5	3	1	32
Harp seal	ᖃᐃᕐᓂᓪᓚᑦ	Qairulik		4	12	9	4	1							24
Walrus	ᐊᐃᐃᓴᑦ	Akvik	1	1	5	5									9
Beluga	ᖃᑯᑦᑕ ᖁᓪᓗᓴᑦ	Kilalugak	4	6	11	13	1								27
Geese (unspecified)	ᓄᑦᓂᓪᓚᑦ	Kanguk	12												12
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	69	2	3	1								13	78
Canada goose	ᓄᑦᓂᓪᓚᑦ ᐅᓗᐊᒍᓂᓪᓚᑦ	Nikliknik	5	1											6
Brant goose	ᓄᑦᓪᑦᓇᐃᑦ	Nirlirnaq	1												1
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	2											1	3
Eider duck	ᒥᑎᑦ	Kingalik	1				2								3
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	3			1	7	21	11	6	2	9	7	6	50
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᒪᓐᓂᖏᑦ	Manniit	6												6
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	38	1											39
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit				2									2
Seagull eggs	ᓇᐅᓘᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	4												4
Arctic char	ᐃᖅᓗᓴᐱᑦ	Ikaliviit	22	24	17	7	9	10	1		1	2		7	66
Freshwater fish (unspecified)	ᒡᓚᐅᖕᒪᖏᑦᑐᒥ ᐃᖅᓗᐃᑦ	Tahinik Ikaluit	1												1
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik							1					1	2
Cod	ᐅᒪᐃᑦ	Ugak	11	2											13
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	10												10
Mussels	ᐅᕆᓗᐃᑦ	Uviluvaloet		2	1										3

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓪᒪᔪᓂᖅ ᐱᑕᖃᖏᑎᖃᖅ ᐱᓴᐊᓕᓐᓂᖅ ᐊᖏᔪᑦ ᖃᕋᓴᐅᓂᖏᓐᓄᑦ ᐊᓕᔪᖅᑐᒪᔪᓂᑦ ᐊᖏᔪᓂ ᓇᓕᑦᑎᓐᓄᐅ ᑐᓂᓴᕋᖏᓐᓄᑦ ᐃᑯᐱᕋᓕᓕᓚᓐᓂᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 559

Monthly harvest estimates — Year 2 (June 1997 - May 1998)

ᑕᕿᑕᒫᑦ ᐊᖑᔭᓄᑦ ᓇᓚᐅᑦᓴᕈᑏᑦ — ᐊᒻᕌᒍ 2 (ᔪᓂ 1997 - ᒪᐃ 1998)

Tatkiktamat nahaktauvaktun — Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒻᒍᑎ	SEP ᓱᑎᒻᐱᓇ	OCT ᐅᑦᑐᐱᓇ	NOV ᓈᕕᒻᐱᓇ	DEC ᑏᓱᒻᐱᓇ	JAN ᔭᓐᓄᐊᓇ	FEB ᕕᕝᕗᐊᓇ	MAR ᒫᑦᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	104	48	263	70	85	57	72	74	124	155	82	79	1,213 ± 178
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					1	23	1		1	1			27
Arctic fox	ᑎᓇᒐᓐᓂᐊᑦ	Tigiganiat						227	108	228	341	287	37		1,228 ± 298
Arctic hare	ᐅᑲᓖᑦ	Ukalik					2		5		3	2			12 ± 9
Seals (unspecified)	ᓯᖅᑯᓖᑦ	Natiit								2	2			10	14 ± 11
Ringed seal	ᓇᑦᓱᑦ	Natiinat	88	56	31	42	31	84	31	71	45	44	54	44	621 ± 93
Bearded seal	ᐅᒻᔪᐃᑦ	Ukyuk	7	18		3	5		10	12	11	1			67 ± 21
Harp seal	ᖃᐃᕈᓖᑦ	Qairulik		5	4		7			2	2				20 ± 11
Walrus	ᐊᐃᕕᑦ	Akvik		5			2				2				9 ± 7
Beluga	ᖃᑯᕐᑕᑦ ᕿᓚᓗᒐᑦ	Kilalugak		8	52	5	4								69 ± 51
Geese (unspecified)	ᓂᕐᓖᑦ	Kanguk												34	34 ± 45
Snow goose	ᑲᖑᐃᑦ	Kanguq	2,741	304									15	1,075	4,135 ± 999
White-fronted goose	ᓂᕐᓖᑦ	Nirlivik					63								63 ± 76
Ducks (unspecified)	ᒥᑏᑦ	Tinmiat	12												12 ± 19
Ptarmigan	ᐊᕿᒻᒋᑦ	Akilgik				22	61	251	146	216	98	266	117	197	1,374 ± 299
Goose eggs	ᑲᖑᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	4,751	394											5,145 ± 1,790
Seagull eggs	ᓇᐅᔭᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	48												48 ± 74
Eider down∅	ᒥᑏᑦ ᖁᓂᕈᖏᑦ∅	Mitiit qiviungit∅	358												358 ± 337
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	861	1,147	579	40	849	486	150	35	346	588	400	228	5,709 ± 1,277
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik												10	10 ± 9
Cod	ᐆᒐᐃᑦ	Ugak	24											55	79 ± 73
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk		2											2 ± 3

‡ Polar bear data supplied by DSD.
∅ Number of nests harvested.

‡ ᓇᓄᕐᓄᑦ ᑎᑎᕋᕐᑕᐅᒪᔪᑦ ᑐᓂᔭᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᕕᓕᕆᔨᑦ.
∅ ᖃᑦᓯᐅᓂᖏᑦ ᐱᑭᐅᑦ ᓄᐊᑕᐅᔪᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.
∅ Amigaitiginit maniktagauhimajut.

TABLE/ᐅᓗᐅᐃᔨᐅᑦ/NAUNAIKUTA 560

Monthly hunter response

ᑕᖃᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)

ᐊᑦᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒻᒪᓕ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᐊᓂ	NOV ᓄᓇᕗᓂ	DEC ᑎᓯᕗᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᓇᖕᐅᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᖏᓪᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	249	250	249	250	249	249	249	248	247	245	244	247	254*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	114	111	64	112	170	117	122	167	163	161	162	128	213*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ	Angujaujut	48	31	20	21	29	33	27	39	37	50	47	50	114*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓕᑎᓂᖏᑦ (%)	Kiujut (%)	46	44	26	45	68	47	49	67	66	66	66	52	54**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᕐᒪᓕᕐᓂᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ ᐊᑕᐅᓯᐊᖓᔪᓂᑦᑎᑦ ᐊᑲᔪᒥ.
** ᐊᑦᓴᒋᓕᑎᓯᒪᓕᕐᓂᑦ ᑕᖃᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐅᓗᐅᐃᔨᐅᑦ/NAUNAIKUTA 561

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᖅᐱᐅᔨᑦ ᐊᑯᖅᓂᓂ ᐊᖏᔪᓂᓄᓂᖅᓇᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓄᓂᑕ, ᐅᓗᐅᐃᖅᑕᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑕᑦ ᑎᑎᖅᑕᐅᒪᓕᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)

ᐊᑦᖁᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒻᒪᓕ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᐊᓂ	NOV ᓄᓇᕗᓂ	DEC ᑎᓯᕗᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᓇᖕᐅᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᖏᓪᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᖅᐱᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᒫᑦ	≤ tatkin pingahut	6	0	0	0	81	32	19	0	3	41	62	65	27
4-6 months	4-6 ᑕᒫᑦ	tatkin hitaman 6nut	0	0	0	0	0	5	37	60	68	53	33	21	25
> 6 months	> 6 ᑕᒫᑦ	> 6 tatkin	94	100	100	100	19	63	44	40	29	7	5	14	48

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 562

Number of hunters harvesting each species — **Year 2 (June 1997 - May 1998)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᖅᑎᑦ ᐊᖏᔪᓚᐱᖅᓯᒪᔪᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ — **ᐊᑦᓱᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 2 (June 1997 - May 1998)**

Month/ᑕᖃᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᔅᑎᑎ	SEP ᓱᑎᐱᕕᓇ	OCT ᐅᑦᔪᕕᓇ	NOV ᐅᓇᐱᕕᓇ	DEC ᑎᓯᐱᕕᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᓇᖏᐅᐊᓇ	MAR ᒪᔪᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	18	11	15	13	17	11	17	18	23	33	25	16	79
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓕᓴᓐᓂᐊᑦ	Tigiganiat						8	8	9	11	8	3		18
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik					1		1		1	1			4
Seals (unspecified)	ᓯᖏᑯᓪᓚᑦ	Natiit								1	1			2	3
Ringed seal	ᓇᓯᓪᓚ	Natiinat	14	8	4	7	8	11	7	20	10	15	15	10	53
Bearded seal	ᐅᑭᔪᐃᑦ	Ukyuk	2	5		1	3		4	5	6	1			19
Harp seal	ᖃᐃᕐᓂᓪᓚᑦ	Qairulik		2	1		4			1	1				8
Walrus	ᐊᐃᓴᒃ	Akvik		2			1				1				4
Beluga	ᖃᑯᑦᑕ ᖁᓪᓗᒡᓗᑦ	Kilalugak		2	4	2	2								9
Geese (unspecified)	ᓄᑦᓂᓪᓚᑦ	Kanguk												1	1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	34	4									1	23	53
White-fronted goose	ᓄᑦᓂᓪᓚᑦ	Nirlivik					1								1
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	1												1
Ptarmigan	ᐊᒻᒪᓕᑦ	Akilgik				1	4	9	7	10	6	11	7	5	38
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓄᖏᑦ	Uluaguliit manniit	18	2											20
Seagull eggs	ᓇᐅᔨᐃᑦ ᒪᓐᓄᖏᑦ	Nauyat manniit	1												1
Eider down	ᒥᑎᑦ ᖁᓄᓕᖏᑦ	Mitiit qiviungit	3												3
Arctic char	ᐃᖕᓗᑲᐱᑦ	Ikaliviit	11	10	6	2	12	2	1	1	3	5	10	9	49
Lake trout	ᐃᓕᓴᐃᑦ	Ikalukpik												3	3
Cod	ᐅᒪᐃᑦ	Ugak	2											3	5
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk		1											1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓕᒪᔪᓂᒃ ᐱᑕᖃᖏᓐᓄᑐᖃᖅ ᐱᔨᔪᑎᓐᓂᓂᒃ ᐊᖏᔪᒃᑯᑦ ᖃᖏᓕᓂᓂᓐᓄᑦ ᐊᓇᕼᐅᒪᓇᔪᓂᑦ ᐊᖏᔪᒃᓴᓂ ᓇᓕᑲᖏᓐᓂᒃᑯᓐᓂᒃ ᐃᓄᐃᕐᓂᓪᓚᑦ ᐃᓄᐃᕐᓂᓪᓚᑦ ᐃᓄᐃᕐᓂᓪᓚᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.3.4

TABLE/ᐅᓗᐅᐃᔾᐅᑦ/NAUNAIKUTA 563

Monthly harvest estimates
ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓄᑦ ᐅᓪᓗᑦᑕᕐᔪᐊᑎᑦ
Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᒻᒪᔪᒍ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖃᖏᓐᓂ/Tatkia			JUN ᔮᓂ	JUL ᔭᓪᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᑐᓗ	NOV ᐅᐱᓚᓗ	DEC ᑎᓯᓚᓗ	JAN ᔮᖏᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᓯ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᔭᐅᑐᐃᑦ	Tuktut	43	147	401	192	79	137	44	135	205	372	96	89	1,940 ± 428
Polar bear‡	ᐊᓂᐃᑦ‡	Nanuit‡						26				3		1	30
Wolf	ᐊᒪᓗᐃᑦ	Amagut									2	3	10		15 ± 15
Arctic fox	ᑎᓕᓴᖏᓐᓄᑦ	Tigiganiat						1	144	458	136	142	37		918 ± 448
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik							24	3	2		10		39 ± 46
Seals (unspecified)	ᓱᖏᑯᓪᓚᑦ	Natiit	5				8								13 ± 16
Ringed seal	ᓇᓱᓕ	Natiinat	56	64	79	72	109	127	37	57	36	59	51	31	778 ± 190
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	4	5	10	6		2		22	16		19	3	87 ± 30
Walrus	ᐊᐃᐃᓴᑦ	Akvik		10	10							2			22 ± 18
Beluga	ᖃᑯᑦᑕᑦ ᖃᓪᓗᓂᑦ	Kilalugak		63	46	6								2	117 ± 41
Geese (unspecified)	ᓄᑦᓚᓪ	Kanguk											63	817	880 ± 549
Snow goose	ᑲᖕᐃᐃᑦ	Kanguq	4,027	43		9								724	4,803 ± 911
Canada goose	ᓄᑦᓚᓪ ᐅᓗᐊᒍᓚᓪ	Nikliknik	18												18 ± 20
Brant goose	ᓄᑦᓪᓕᓴᐃᑦ	Nirlirnaq	16												16 ± 23
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	16												16 ± 23
Ptarmigan	ᐊᖏᓴᑦ	Akilgik						318	80	200	134	282	360	211	1,585 ± 491
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᒪᓐᓂᖏᑦ	Manniit												7	7 ± 9
Goose eggs	ᑲᖕᐃᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	4,736	88										844	5,668 ± 1,979
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖏᑦ	Tinmiat manniit	20	7											27 ± 32
Seagull eggs	ᓇᐅᓴᐃᑦ ᒪᓐᓂᖏᑦ	Nauyat manniit	31												31 ± 51
Eider down∅	ᒥᑎᑦ ᖁᓂᔪᖏᑦ∅	Mitiit qiviungit∅	52												52 ± 68
Arctic char	ᐃᖕᓗᐱᐸᑦ	Ikaliviit	945	1,569	1,673		24	1,078		317	190	458	167	807	7,228 ± 1,791
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik												35	35 ± 37
Cod	ᐅᒐᐃᑦ	Ugak	72	8									27		107 ± 105
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	121	12											133 ± 157
Mussels	ᐅᐃᓗᐃᑦ	Uviluvaloet		517	2,410	65									2,992 ± 2,705

‡ Polar bear data supplied by DSD.
∅ Number of nests harvested.

‡ ᓇᓂᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᓴᖏᑦ ᐅᑉᐳᓴᓕᒫᓂᖅ.
∅ ᖃᕋᐅᓂᖏᑦ ᐱᑭᐅᑦ ᓇᐊᐅᔪᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.
∅ Amigaitiginit maniktagauhimajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 564

Monthly hunter response

ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐱᓕᕆᔨ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑯᓗ	NOV ᓄᐊᕐᓗ	DEC ᑎᓯᕐᓗ	JAN ᒎᓄᐊᓗ	FEB ᐃᖃᐅᓗ	MAR ᒪᕐᔪ	APR ᐃᑦᓇᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐱᒍᕆᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	249	249	264	251	252	252	249	244	243	242	241	240	266*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕆᔪᑦ	Angunahuktin apikhuktan	97	93	78	48	30	233	35	139	132	121	110	126	245*
Harvested	ᐊᖏᔪᓂᒃᑎᑐᓂᓕᓂ	Angujaujut	66	43	40	21	7	76	10	45	44	42	32	62	152*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	39	37	30	19	12	92	14	57	54	50	46	53	42**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᔪᑦᑐᒪᒃᓴᓂᖅ/ᐊᐱᕆᔪᑦᑐᑦ/ᐊᖏᔪᓂᒃᑎᑐᓂᓕᓂ ᐊᑕᐅᓯᐊᔪᓗᑐᑎᑦ ᐊᑲᕐᒥᑦ.
** ᐊᑲᓇᓕᓐᓂᕐᒪᒪᓕᕐᓂ ᑕᖃᑦᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.3.4

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 565

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓂᒃᑐᓂᖓᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓱ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑎᑎᕐᑦᑕᐅᒪᔾᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐱᓕᕆᔨ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗ	OCT ᐅᑯᓗ	NOV ᓄᐊᕐᓗ	DEC ᑎᓯᕐᓗ	JAN ᒎᓄᐊᓗ	FEB ᐃᖃᐅᓗ	MAR ᒪᕐᔪ	APR ᐃᑦᓇᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	72	86	84	0	11	99	0	15	24	18	0	0	52
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	1	0	0	0	89	1	83	4	0	11	51	38	10
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	27	14	16	100	0	0	17	81	76	70	49	62	38

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 566

Number of hunters harvesting each species — **Year 3 (June 1998 - May 1999)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᑎᑦ ᐊᖏᔪᓚᐱᖅᑕᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒻᒋᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 3 (June 1998 - May 1999)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓵᐱᓗ	DEC ᑎᓯᐱᓗ	JAN ᒍᓐᓇᐊᓗ	FEB ᓇᖑᐅᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓕᓪ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	11	26	30	17	4	49	4	30	26	25	18	18	111
Polar bear[#]	ᓇᓄᐃᑦ[#]	Nanuit[#]	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut									1	1	1		3
Arctic fox	ᑎᓗᓚᖓᐊᑦ	Tigiganiat						1	1	6	7	6	3		13
Arctic hare	ᐅᑲᓪᓕ	Ukalik							1	1	1		1		4
Seals (unspecified)	ᓯᖏᑯᓪᓕ	Natiit	1				1								2
Ringed seal	ᓇᕆᑦ	Natiinat	13	13	7	6	3	31	2	14	9	10	9	9	68
Bearded seal	ᐅᑭᔪᐃᑦ	Ukyuk	2	2	3	2		1		8	6		2	2	22
Walrus	ᐊᐃᓴᒃ	Akvik		2	2							1			4
Beluga	ᖃᑯᖅᑕ ᖃᓪᓗᓚᑦ	Kilalugak		13	9	1								1	17
Geese (unspecified)	ᓄᖅᓪᓕ	Kanguk											2	11	13
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	54	2		1								21	70
Canada goose	ᓄᖅᓪᓕ ᐅᓗᐊᒍᓪᓕ	Nikliknik	2												2
Brant goose	ᓄᖅᓕᖅᓴᐃᑦ	Nirlirnaq	1												1
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	1												1
Ptarmigan	ᐊᖏᓴᑦ	Akilgik						25	3	7	5	4	6	3	42
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᓚᖕᓂᖏᑦ	Manniit												1	1
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᖕᓂᖏᑦ	Uluaguliit manniit	17	1										2	20
Duck eggs	ᒥᑎᑦ ᓚᖕᓂᖏᑦ	Tinmiat manniit	1	1											2
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᖕᓂᖏᑦ	Nauyat manniit	1												1
Eider down	ᒥᑎᑦ ᖃᓂᒋᖏᑦ	Mitiit qiviungit	2												2
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	16	13	7		1	17		2	2	4	3	18	61
Lake trout	ᐃᓱᖏᐃᑦ	Ikalukpik												2	2
Cod	ᐅᓚᐃᑦ	Ugak	2	1									1		4
Sculpin	ᑲᓕᔪᐃᑦ	Kanayuk	3	1											4
Mussels	ᐅᐊᓗᐃᑦ	Uviluvaloet		3	6	1									10

6.3.4

[#] No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

[#] ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᖏᑦᑐᖃᓄᑦ ᐱᓱᔪᑎᓕᓂᒃ ᐊᖏᔪᒃ ᖃᑦᓯᐅᓂᖏᑦᓂᑦ ᐊᓪᓚᖃᐅᓂᑦ ᐊᖏᔪᓂᑦ ᓇᓪᓚᑎᓂᖅ ᑐᓂᓯᖏᑦᓂᒃ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ.

[#] Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓄᓇᓕᐳᐅᑦ/NAUNAIKUTA 567

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓄᓇᐅᑦᓱᓗᑎᑦ

Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)

ᐊᓗᖕᒍ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔫᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑦᔪᓇ	NOV ᐅᓇᓱᓇ	DEC ᑎᓯᓱᓇ	JAN ᔮᖏᓂᔪᓇ	FEB ᓄᖅᑐᔪᓇ	MAR ᒪᓕᒃ	APR ᐃᑦᓇᓪ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓪᓕᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	44	113	303	255	80	96	155	134	98	136	182	97	1,693 ± 107
Polar bear‡	ᓄᓂᐃᑦ‡	Nanuit‡						26		1	1	3	3	2	36
Arctic fox	ᑎᓕᓴᓐᓂᐊᑦ	Tigiganiat				2		86	202	99	80	176	30		675 ± 146
Ringed seal	ᓄᑦᓱᑦ	Natiinat	166	85	70	157	325	109	67	25	19	22	10	68	1,123 ± 136
Bearded seal	ᐅᓪᓛᐃᑦ	Ukyuk	2	3	17	12	7	4	2	8	4	7	1	5	72 ± 13
Walrus	ᐊᐃᐃᓴᑦ	Akvik		3	14	6								1	24 ± 11
Beluga	ᖃᐅᔨᑦᑕ ᖃᓪᓗᓂᑦ	Kilalugak	16	8	61	18									103 ± 24
Geese (unspecified)	ᓂᖅᓯᓪᓕᑦ	Kanguk	121												121 ± 62
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	4,173	53	106									1,035	5,367 ± 703
Canada goose	ᓂᖅᓯᓪᓕᑦ ᐅᓗᐊᒍᑦᓯᓪᓕᑦ	Nikliknik	30											1	31 ± 36
White-fronted goose	ᓂᖅᓯᓪᓕᑦ	Nirlivik												29	29 ± 22
Ptarmigan	ᐊᖏᓚᒋᑦ	Akilgik				2	101	195	153	81	187	105	150	127	1,101 ± 167
Sandhill crane	ᑕᑎᓚᖅᓴᐊᑦ	Tatilgaq												1	1 ± 1
Eggs (unspecified)	ᐊᓂᖕᒥᑦ ᑎᑎᒋᐊᑦ ᒪᓐᓂᖕᒥᑦ	Manniit	497												497 ± 303
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓂᖕᒥᑦ	Uluaguliit manniit	5,474		327										5,801 ± 1,139
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	814	506	915	102	1,132	1,528	1,734		2	604	1,403	733	9,473 ± 1,307
Lake trout	ᐃᓂᖏᐃᑦ	Ikalukpik												16	16 ± 18
Cod	ᐅᓚᐃᑦ	Ugak	26	20									1		47 ± 31
Sculpin	ᑲᓪᓛᐃᑦ	Kanayuk	15												15 ± 18
Mussels	ᐅᕕᓗᐃᑦ	Uviluvaloet			1,702	1,459									3,161 ± 2,631

‡ Polar bear data supplied by DSD.

‡ ᓄᓂᖅᓄᑦ ᑎᑎᕐᑕᒪᓪᓕᐊᑦ ᑐᓂᒃᑯᑦ ᐅᑯᐊ ᐃᑯᐊᕕᓕᓂᖅᓄᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᐅᐃᓕᐅᑦ/NAUNAIKUTA 568

Monthly hunter response

ᑕᖃᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)

ᐊᑐᖃᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᒃ	SEP ᓯᑎᕆᓗᓂ	OCT ᐅᑯᐃᓂ	NOV ᐅᓇᒪᓂ	DEC ᑎᓯᒪᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᓇᖕᐅᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᖃᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᐅᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔨᓪᓚᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	238	237	238	237	236	236	235	234	235	235	232	222	244*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	149	138	136	133	124	130	138	179	213	215	195	152	225*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ	Angujaujut	92	54	73	66	40	60	40	40	40	55	54	76	148*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓕᑭᐅᓂᖏᑦ (%)	Kiujut (%)	63	58	57	56	53	55	59	76	91	91	84	68	68**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᑉᐳᒪᓪᓚᕆᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑐᒥᓂᓂᑦ ᐊᑕᐅᓕᐊᖃᓕᑎᒃ ᐊᑐᕐᒪ.
** ᐊᐅᔨᓕᓐᓂᓕᓪᓚᕆᑦ ᑕᖃᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.3.4

TABLE/ᐅᓗᐅᐃᓕᐅᑦ/NAUNAIKUTA 569

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᐃᐅᔪᑦ ᐊᑯᕐᓂᓂ ᐊᖏᔪᓂᒃᑐᓂᓂᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓂᑕ, ᐅᓗᐅᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑕᐅᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑎᑎᕐᓂᑦᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)

ᐊᑐᖃᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᒃ	SEP ᓯᑎᕆᓗᓂ	OCT ᐅᑯᐃᓂ	NOV ᐅᓇᒪᓂ	DEC ᑎᓯᒪᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᓇᖕᐅᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᖃᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᐅᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᐃᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	2	39	28	25	4	47	91	93	96	96	83	48	49
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	27	0	30	67	88	53	9	5	1	0	9	20	26
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	71	61	43	8	8	0	0	1	2	4	8	32	25

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 570

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᓇᓂᕆᑎᑦ ᐊᖏᓇᓂᕐᕉᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 4 (June 1999 - May 2000)
ᐊᒡᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᕐᖑᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᑕ	SEP ᓱᑎᐹᓗ	OCT ᐅᑲᐹᓗ	NOV ᐅᓇᒡᐹᓗ	DEC ᑎᓴᒡᐹᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᕐᑐᐊᓗ	MAR ᒪᕆ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	16	31	46	46	16	22	23	29	28	40	45	30	109
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Arctic fox	ᑎᓗᒃᑑᓕᑦ	Tigiganiat				1		2	8	7	6	7	2		13
Ringed seal	ᓇᖅᓯᑦ	Natiinat	25	20	18	18	27	20	11	8	9	9	6	16	76
Bearded seal	ᐅᑭᔭᐃᑦ	Ukyuk	1	2	8	8	4	1	1	4	4	4	1	3	28
Walrus	ᐊᐃᐃᓴᑦ	Akvik		2	5	3								1	10
Beluga	ᖃᓄᖅᑦ ᖃᓪᓗᓂᑦ	Kilalugak	2	3	19	6									27
Geese (unspecified)	ᓄᖅᓯᓪ	Kanguk	4												4
Snow goose	ᑲᖏᐃᑦ	Kanguq	61	2	3									35	80
Canada goose	ᓄᖅᓯᓪ ᐅᓗᐊᔪᖅᓯᓪ	Nikliknik	1											1	2
White-fronted goose	ᓄᖅᓯᓪ	Nirlivik												1	1
Ptarmigan	ᐊᖏᓚᒋᑦ	Akilgik				1	5	10	8	9	12	13	14	10	50
Sandhill crane	ᑕᑎᓚᖅᓴᐊᑦ	Tatilgaq												1	1
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᒪᓐᓂᖏᑦ	Manniit	5												5
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓂᖏᑦ	Uluaguliit manniit	34		2										36
Arctic char	ᐃᖃᓗᐊᒋᑦ	Ikaliviit	23	13	22	7	9	11	15		1	7	9	30	84
Lake trout	ᐃᓯᕐᓴᐃᑦ	Ikalukpik												2	2
Cod	ᐅᓚᐃᑦ	Ugak	2	1									1		4
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk	1												1
Mussels	ᐅᐸᓗᐃᑦ	Uviluvaloet			2	3									5

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓯᒪᔨᓂᒃ ᐱᑕᖃᖏᑕᖏᓐᓄᑦ ᐱᓱᒋᓕᓐᓂᒃ ᐊᖏᔪᒃ ᖃᖏᐅᓂᖏᓐᓄᓂᑦ ᐊᓕᕆᔨᓂᒃ ᐊᖏᔪᓂᒃ ᓇᓕᔾᔪᓐᓇᖅᑐᓂᒃ ᐊᓕᕆᔨᓂᒃ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ ᐃᓕᓴᕐᓂᐊᕐᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᐅᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 571

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᐅᓪᐅᑦᑎᓯᑎᑦ
Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᓐᖏᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓚ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᑐᓗ	NOV ᐅᓇᓱᓗ	DEC ᑎᓯᓱᓗ	JAN ᔮᖏᓇᓗ	FEB ᐃᖅᑲᓇᓗ	MAR ᒪᓯ	APR ᐃᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	87	85	256	130	65	82	73	107	61	29	63	90	1,128 ± 41
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡					2	25		1			3	2	33
Wolf	ᐊᒪᓕᐃᑦ	Amagut						1						1	2 ± 1
Arctic fox	ᑎᓗᒃᖏᓂᐊᑦ	Tigiganiat					31	485	175	510	199	133			1,533 ± 214
Arctic hare	ᐅᑲᓪᓕ	Ukalik										2			2 ± 1
Ringed seal	ᓇᓕᓐᓂ	Natiinat	117	73	26	34	32	5	4	11	29	17	4	51	403 ± 40
Bearded seal	ᐅᒡᒍᐃᑦ	Ukyuk	7	14	7	1	5			2	14				50 ± 8
Harp seal	ᖃᐃᓐᓂᓪᓕ	Qairulik			4	2									6 ± 2
Harbour seal	ᖃᓄᑎᐊᑦ	Qanigiaq					1								1 ± 0
Walrus	ᐊᐃᓴᒃ	Akvik	2	2	7	5									16 ± 2
Beluga	ᖃᓄᖅᑕ ᖁᓕᓗᒡᓗᑦ	Kilalugak	2	20	46	8									76 ± 6
Bowhead	ᐊᖏᔪᒃ	Aivik			1										1 ± 0
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	4,295	16										1,484	5,795 ± 679
Canada goose	ᓄᖅᓗᑦ ᐅᓚᐊᒍᓪᓗᑦ	Nikliknik	1												1 ± 1
White-fronted goose	ᓄᖅᓗᑦ	Nirlivik	5				1							16	22 ± 12
Old squaw	ᐊᓕᕆᐊᖅᓯᐃᑦ	Aahangik				18									18 ± 8
Eider duck	ᑎᑎᑦ	Kingalik	13				31							19	63 ± 21
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	49			15	263	571	119	16		4	6	51	1,094 ± 88
Snowy owl	ᐅᓵᓴᓯᐊᑦ	Ookpik											1		1 ± 1
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᓚᒃᓂᖏᑦ	Manniit	6,676											75	6,751 ± 1,025
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᒃᓂᖏᑦ	Uluaguliit manniit	626											12	638 ± 342
Duck eggs	ᒥᑎᑦ ᓚᒃᓂᖏᑦ	Tinmiat manniit	205												205 ± 122
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᒃᓂᖏᑦ	Nauyat manniit	25												25 ± 24
Eider down∅	ᒥᑎᑦ ᖃᓄᖅᖏᑦ∅	Mitiit qiviungit∅	25												25 ± 24
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	1,638	785	1,084	201	336	713	563	170	260	481	228	357	6,816 ± 478
Lake trout	ᐃᓕᖅᐃᑦ	Ikalukpik			31	33								25	89 ± 22
Cod	ᐅᓴᐃᑦ	Ugak	2		21										23 ± 8
Sculpin	ᑲᓇᒍᐃᑦ	Kanayuk			31										31 ± 12
Mussels	ᐅᐊᓗᐃᑦ	Uviluvaloet		335	277	293									905 ± 247

‡ Polar bear data supplied by DSD.
∅ Number of nests harvested.

‡ ᓇᓂᓄᑦ ᑎᑎᕋᐅᒪᒍᑦ ᑐᓂᒃᖏᑦ ᐅᑯᐊ ᐃᑯᐊᕐᓂᓄᑦ.
∅ ᖃᕋᐅᓂᖏᑦ ᐱᑭᑦ ᓇᐊᑕᐅᒍᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.
∅ Amigaitiginit maniktagauhimajut.

6.3.4

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 572

Monthly hunter response

ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖅᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᑐᕐᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑲᐃᓇ	NOV ᓄᓇᕐᓇ	DEC ᑎᓯᕐᓇ	JAN ᔮᖏᓐᓇ	FEB ᐃᖅᑲᓇ	MAR ᒪᕐᓯ	APR ᐃᓴᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᐃᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖅᑎᑦ ᐊᑐᔪᒪᓂᖅᑎᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	221	222	219	219	217	217	216	212	213	211	212	210	226*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	152	205	203	200	200	200	202	174	164	186	181	162	211*
Harvested	ᐊᖏᔪᓂᒃᑎᑐᒃᑦ	Angujaujut	104	72	82	59	52	61	28	44	26	16	22	74	148*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑦᑐᓂᖅᑎᑦ (%)	Kiujut (%)	69	92	93	91	92	92	94	82	77	88	85	77	86**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᑎᒪᓕᕆᓂᖅ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑎᑐᒃᑦ ᐊᑕᐅᓯᐊᖅᓯᓕᕆᓂᖅ ᐊᑐᕐᔪᒍ.
** ᐊᑦᑐᒋᓐᓂᓱᒪᓕᕆᓂ ᑕᖃᑦᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 573

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᖏᓐᓂ ᐊᖏᔪᓯᓂᖓᓕᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓕᑕ, ᓇᓗᓇᐃᖏᑦᑕ ᐃᒪᓐᵇ % ᑲᑎᑕᐃᑦ ᐊᖏᔪᓇᓯᑕᑦ ᑎᑎᕐᑦᑕᐅᒪᔾᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᑐᕐᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑲᐃᓇ	NOV ᓄᓇᕐᓇ	DEC ᑎᓯᕐᓇ	JAN ᔮᖏᓐᓇ	FEB ᐃᖅᑲᓇ	MAR ᒪᕐᓯ	APR ᐃᓴᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᐃᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔾᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲᑦ	≤ tatkin pingahut	47	65	34	69	94	100	100	100	100	100	100	0	64
4-6 months	4-6 ᑕᖅᑲᑦ	tatkin hitaman 6nut	39	33	66	31	6	0	0	0	0	0	0	27	26
> 6 months	> 6 ᑕᖅᑲᑦ	> 6 tatkin	14	2	0	0	0	0	0	0	0	0	0	73	10

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 574

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓯᖅᑎᑦ ᐊᖏᔪᓯᖅᓯᕐᓂᑦ ᐊᑐᓂᖅ ᐅᒪᔨᓂᖅ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 5 (June 2000 - May 2001)

ᐊᒃᑭᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓕ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᒍᖏᓄᓗ	FEB ᓇᖕᖏᐊᓗ	MAR ᒪᓯ	APR ᐃᓪᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	30	35	60	43	28	31	20	35	15	8	20	30	113
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut						1						1	2
Arctic fox	ᑎᓕᓴᖏᓂᐊᑦ	Tigiganiat					1	22	11	15	5	8			35
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik										1			1
Ringed seal	ᓇᓕᔪᑦ	Natiinat	35	17	10	10	11	4	2	6	8	7	2	8	57
Bearded seal	ᐅᓚᔪᐃᑦ	Ukyuk	3	9	5	1	3			2	5				19
Harp seal	ᖃᐃᓗᓪᓚᑦ	Qairulik			1	1									1
Harbour seal	ᖃᓕᑎᐊᑦ	Qanigiaq					1								1
Walrus	ᐊᐃᐸᒃᑦ	Akvik	1	1	7	4									10
Beluga	ᖃᓄᖅᑕᑦ ᖁᓕᓴᒍᑦ	Kilalugak	2	10	20	3									28
Bowhead	ᐊᖏᕆᑲ	Aivik			1										1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	69	1										34	85
Canada goose	ᓄᖅᓚᓪ ᐅᓗᐊᔪᓚᓪᓚᑦ	Nikliknik	1												1
White-fronted goose	ᓄᖅᓚᓪᓚᑦ	Nirlivik	1				1							3	4
Old squaw	ᐊᒻᑭᐊᖅᓴᐃᑦ	Aahangik				1									1
Eider duck	ᒥᑎᑦ	Kingalik	4				1							1	5
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	3			3	18	28	9	4		1	2	3	49
Snowy owl	ᐅᓕᓴᓄᓴᐊᑦ	Ookpik											1		1
Eggs (unspecified)	ᐊᓯᖏᑦ ᑎᒥᐊᑦ ᓚᓐᓂᖏᑦ	Manniit	40											1	40
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᓐᓂᖏᑦ	Uluaguliit manniit	3											1	4
Duck eggs	ᒥᑎᑦ ᓚᓐᓂᖏᑦ	Tinmiat manniit	2												2
Seagull eggs	ᓇᐅᓕᐃᑦ ᓚᓐᓂᖏᑦ	Nauyat manniit	1												1
Eider down	ᒥᑎᑦ ᖃᓄᖅᖏᑦ	Mitiit qiviungit	1												1
Arctic char	ᐃᖃᓗᓴᐃᑦ	Ikaliviit	43	34	32	13	13	10	6	1	9	2	1	24	97
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik			1	2								6	9
Cod	ᐅᓴᐃᑦ	Ugak	1		1										2
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk			1										1
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet		2	3	3									8

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓱᒪᔪᓂᖅ ᐱᑕᖃᓐᓇᕐᓂᑐᖃᖅ ᐱᓕᔪᑎᓐᓂᓂᖅ ᐊᖏᔪᒃᑕ ᖃᖅᑎᓂᓐᓂᖅᓄᑦ ᐊᓇᖅᑲᒪᒪᔪᓂᑦ ᐊᖏᔪᓂᑦ ᓇᓇᑭᓐᓂᖅᓄᑦ ᐃᓄᐃᖅᑎᓂᓐᓂᖅᓄᑦ ᐃᑯᐱᕋᓱᓐᓂᕆᔨᓂᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 575

Annual harvest estimates and five-year mean

ᐊᓐᔪᒍᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓐᔾᑎᑦ ᐊᓚᓗ ᑕᒻᓕᒪᓄᑦ-ᐊᓐᔪᔭᓄᑦ ᐊᐅᑎᓕᖅᑎᓂᒪᓕᕆᑦ

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓐᔪᔭᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Study Year/ᖃᐅᔨᓴᖅᓯᒪᔪᑦ ᐊᓐᔪᔭ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᑎᓕᖅᑎᓂᒪᓕᕆᑦ Amigaitkiyait
Species	ᐅᒪᔨᑦ	**Umajuin**						
Caribou[1]	ᑐᖅᑐᐃᑦ[1]	Tuktut[1]	1,376	1,213	1,940	1,693	1,128	1,470
Polar bear[2]	ᓇᓄᐃᑦ[2]	Nanuit[2]	33	27	30	36	33	32
Wolf[3]	ᐊᒪᓗᐃᑦ[3]	Amagut[3]	0	0	15	0	2	3
Arctic fox[4]	ᑎᓚᖃᓄᐊᑦ[4]	Tigiganiat[4]	1,051	1,228	918	675	1,533	1,081
Arctic hare[5]	ᐅᑲᓪᓚᑦ[5]	Ukalik[5]	5	12	39	0	2	12
Seals (unspecified)	ᓯᖏᑦᓪᓚᑦ	Natiit	61	14	13	0	0	18
Ringed seal	ᓇᓯᓪᓚ	Natiinat	633	621	778	1,123	403	712
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	104	67	87	72	50	76
Harp seal[6]	ᖃᐃᓕᓪᓚᑦ[6]	Qairulik[6]	65	20	0	0	6	18
Harbour seal	ᖃᓄᓂᐊᑦ	Qanigiaq	0	0	0	0	1	<1
Walrus[7]	ᐊᐃᓴᒃᑦ[7]	Akvik[7]	26	9	22	24	16	19
Beluga[8]	ᖃᐅᓯᑦ ᖃᓪᓚᓗᒃᑦ[8]	Kilalugak[8]	85	69	117	103	76	90
Bowhead	ᐊᐃᕙᒃ	Aivik	0	0	0	0	1	<1
Geese (unspecified)	ᓄᖅᓪᓚᑦ	Kanguk	449	34	880	121	0	297
Snow goose[9]	ᑲᔪᐃᑦ[9]	Kanguq[9]	5,359	4,135	4,803	5,367	5,795	5,092
Canada goose[9]	ᓄᖅᓪᓚᑦ ᐅᓗᐊᔪᓪᓚᑦ[9]	Nikliknik[9]	137	0	18	31	1	37
Brant goose	ᓄᖅᓕᖅᓴᐃᑦ	Nirlirnaq	1	0	16	0	0	3
White-fronted goose[10]	ᓄᖅᓪᓚᑦ[10]	Nirlivik[10]	0	63	0	29	22	23
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	34	12	16	0	0	12
Old squaw	ᐊᐱᕐᐊᖅᓴᐃᑦ	Aahangik	0	0	0	0	18	4
Eider duck[11]	ᒥᑎᓕᑦ[11]	Kingalik[11]	34	0	0	0	63	19
Ptarmigan	ᐊᖏᓴᓕᑦ	Akilgik	1,447	1,374	1,585	1,101	1,094	1,320
Sandhill crane	ᑕᑎᓚᖅᓴᐊᑦ	Tatilgaq	0	0	0	1	0	<1
Snowy owl	ᐅᑲᐱᖅᓴᐊᑦ	Ookpik	0	0	0	0	1	<1
Eggs (unspecified)[12]	ᓚᒃᓂᓕᑦ[12]	Manniit[12]	488	0	7	497	6,751	1,549
Goose eggs[12]	ᑲᔪᐃᑦ ᓚᒃᓂᖏᓕᑦ[12]	Uluaguliit manniit[12]	3,816	5,145	5,668	5,801	638	4,214
Duck eggs[12]	ᒥᑎᑦ ᓚᒃᓂᖏᓕᑦ[12]	Tinmiat manniit[12]	16	0	27	0	205	50
Seagull eggs[12]	ᓇᐅᕆᐃᑦ ᓚᒃᓂᖏᓕᑦ[12]	Nauyat manniit[12]	33	48	31	0	25	27
Eider down[Ø13]	ᒥᑎᑦ ᖃᓄᐃᖏᓕᑦ[Ø13]	Mitiit qiviungit[Ø13]	0	358	52	0	25	87
Arctic char[14]	ᐃᖃᓗᐊᓪᓚᑦ[14]	Ikaliviit[14]	4,066	5,709	7,228	9,473	6,816	6,658
Freshwater fish (unspecified)	ᑕᓇᐅᑲᔪᖏᑦᑐᒥ ᐃᖃᓗᐃᑦ	Tahinik Ikaluit	4	0	0	0	0	1
Lake trout[15]	ᐃᓱᒋᐃᑦ[15]	Ikalukpik[15]	76	10	35	16	89	45
Cod[16]	ᐅᒪᐃᑦ[16]	Ugak[16]	71	79	107	47	23	65
Sculpin[17]	ᑲᓇᔪᐃᑦ[17]	Kanayuk[17]	94	2	133	15	31	55
Mussels[18]	ᐅᕙᓗᐃᑦ[18]	Uviluvaloet[18]	315	0	2,992	3,161	905	1,475

Ø Number of nests harvested.
[1-18]: See page 701 for community feedback and other sources of data.

Ø ᖃᓕᑲᓂᖏᓕᑦ ᐱᐅᑦ ᓄᐊᑕᐅᔪᑦ.
[1-18]: ᑕᐃᒪ ᒪᓴᐃᑐᖃᖅ 703 ᓄᓇᓕᑦ ᑭᐅᔪᓂᖏᓕᑦ ᐊᒻᒪᓗ ᐊᓯᖏᓕᑦ ᐱᓕᕐᐅᔪᓐᓇᔪᑦ ᓇᓱᐅᔪᓐᓇᖅᑐᓂᒃ.

Ø Amigaitiginit maniktagauhimajut.
[1-18]: Takulugu makpigaak 705 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

6.3.4

TABLE/ᐅᓗᐅᕕᐅᑉᑐᑦ/NAUNAIKUTA 576

Annual hunter response
ᐊᓚᖏᔪᒡᒐᓪ ᐊᖓᔪᓂᖅᐸᑦ ᑭᐅᓂᖏᑦ
Angujauvaktu

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓇᓪ ᐊᓚᖏᔪᓄᑦ (ᓄᓇ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᒥ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᖏᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖓᔪᓂᖅᐸᑦ ᑭᐅᓂᖏᑦ ᐊᑦᔪᓪᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᑭᑦᓯᒪᑦ ᐊᖓᔪᓂᖅᐸᑦ	Tatkitaman angunahuktut titigait	256	254	266	244	226	283*
Hunters interviewed	ᐊᖓᔪᓂᖅᐸᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	253	213	245	225	211	269*
Harvested	ᐊᖓᔪᓂᖅᑐᒥᓂᓕᓂ	Angujaujut	163	114	152	148	148	215*
Response Rate (%)	ᑭᐅᐃᓂᖏᑦ (%)	Kiujut (%)	72	54	42	68	86	64**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖓᔪᓂᖅᐸᑦ ᐊᑎᓕᐅᔨᓪᓗᑎᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖓᔪᓂᖅᑐᒥᓂᓕᓂ ᐊᑕᐅᓯᐊᓘᔪᐊᑎᒃ ᖃᐅᔨᓴᖅᓴᓂᒃᑐᑦ.
** ᐊᓕᒍᓂᑎᓯᒪᔨᑦ ᐊᖏᔪᒡᒐᓪ ᑭᐅᓂᖏᑦ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

TABLE/ᐅᓗᐅᕕᐅᑉᑐᑦ/NAUNAIKUTA 577

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᓐᓄᓂ ᐊᖓᔪᓂᖅᓯᓂᖓᓂᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓂᑕ, ᐅᓗᐅᕕᐅᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᒪᔨᖏᑦ ᐊᖓᔪᓂᖅᐸᒋᑦ ᑎᑎᕐᑕᐅᒪᔨᑦ
Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓇᓪ ᐊᓚᖏᔪᓄᑦ (ᓄᓇ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᒥ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᖏᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᑉᑐᑦ**	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᑭᑦ	≤ tatkin pingahut	80	27	52	49	64	57
4-6 months	4-6 ᑕᑭᑦ	tatkin hitaman 6nut	9	25	10	26	26	19
> 6 months	> 6 ᑕᑭᑦ	> 6 tatkin	11	48	38	25	10	24

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 578

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᒃᑎᑦ ᐊᖏᔪᓚᒃᓴᖅᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓂᑦ ᐊᑲᐅᔪᓂᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᓱᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**						
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	124	79	111	109	113	165
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut			3		2	4
Arctic fox	ᑎᓚᖓᓂᐊᑦ	Tigiganiat	27	18	13	13	35	60
Arctic hare	ᐅᖃᓕᑦ	Ukalik	2	4	4		1	11
Seals (unspecified)	ᓂᐲᑯᓕᑦ	Natiit	11	3	2			16
Ringed seal	ᓇᑦᓂᑦ	Natiinat	78	53	68	76	57	124
Bearded seal	ᐅᑭᓪᐃᑦ	Ukyuk	32	19	22	28	19	68
Harp seal	ᖃᐃᓗᓕᑦ	Qairulik	24	8			1	32
Harbour seal	ᖃᓂᒋᐊᑦ	Qanigiaq					1	1
Walrus	ᐊᐃᐸᓴᑦ	Akvik	9	4	4	10	10	24
Beluga	ᖃᐅᔨᑦᑐ ᖃᓪᓗᓂᑦ	Kilalugak	27	9	17	27	28	69
Bowhead	ᐊᔾᔨᒃ	Aivik					1	1
Geese (unspecified)	ᓄᖅᓕᑦ	Kanguk	12	1	13	4		28
Snow goose	ᑲᖏᐃᑦ	Kanguq	78	53	70	80	85	156
Canada goose	ᓄᖅᓕᑦ ᐅᓗᐊᔪᓕᑦ	Nikliknik	6		2	2	1	11
Brant goose	ᓄᖅᓚᖅᓇᐃᑦ	Nirlirnaq	1		1			2
White-fronted goose	ᓄᖅᓕᑦ	Nirlivik		1		1	4	6
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	3	1	1			3
Old squaw	ᐊᑲᐊᖅᓴᐃᑦ	Aahangik					1	1
Eider duck	ᒥᑎᑦ	Kingalik	3				5	7
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	50	38	42	50	49	107
Sandhill crane	ᑕᑎᓴᖅᓴᐊᑦ	Tatilgaq				1		1
Snowy owl	ᐅᑕᐱᖅᓴᐊᑦ	Ookpik					1	1
Eggs (unspecified)	ᓚᓐᓂᑦ	Manniit	6		1	5	40	50
Goose eggs	ᑲᖏᐃᑦ ᓚᓐᓂᖏᑦ	Uluaguliit manniit	39	20	20	36	4	79
Duck eggs	ᒥᑎᑦ ᓚᓐᓂᖏᑦ	Tinmiat manniit	2		2		2	6
Seagull eggs	ᓇᐅᕆᐃᑦ ᓚᓐᓂᖏᑦ	Nauyat manniit	4	1	1		1	7
Eider down	ᒥᑎᑦ ᖃᓄᖅᖏᑦ	Mitiit qiviungit		3	2		1	5
Arctic char	ᐃᖃᓗᐸᐃᑦ	Ikaliviit	66	49	61	84	97	151
Freshwater fish (unspecified)	ᑕᓚᐅᖏᓐᓂᖏᑐᒥ ᐃᖃᓗᐃᑦ	Tahinik Ikaluit	1					1
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	2	3	2	2	9	17
Cod	ᐅᓴᐃᑦ	Ugak	13	5	4	4	2	23
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	10	1	4	1	1	16
Mussels	ᐅᔭᓗᐃᑦ	Uviluvaloet	3		10	5	8	23

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓱᒪᔪᓂᒃ ᐱᑕᖃᖏᑐᑐᒃ ᐱᓵᐊᓕᓐᓂᓂᒃ ᐊᖏᔪᑦ ᖃᕋᐅᓂᖏᓐᓂᓄᑦ ᐊᓕᓴᐅᓂᒃ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓯᓚᐅᑎᓄ ᑐᓂᓴᖏᓐᓂᓄ ᐃᓄᐃᑦᓴᓕᓕᓐᓂᐅᓪᓚᓄᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

6.3.4 Community Results Discussion: Coral Harbour

The survey frame:
An assessment of under-enumeration during the community visit indicated that there were very few hunters who were not registered in the Harvest Study. It is estimated that there were five non-Inuit hunters with assigned hunting rights, all occasional hunters. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. However, the extent of the bias is likely very small since the missing hunters only represent two percent of the total hunter population (Table 10).

Survey coverage and non-response bias:
Response rates were low in several months in each year of the study with the exception of year 5 when response rates were relatively high. Data from years 2 to 4 should be used with caution since rates dropped below 50% in many of these months, some dropping as low as 14%. As seen in Table 9 the consistent intentional non-response rate in Coral Harbour was moderate, at 4.6%, and there is a potential for non-response bias as a result. Given this and the low response rates in many years of the study, the potential for both sampling error and non-response bias is high in some months of the study.

Response rates were felt to be high enough and non-response bias low enough during year 5 to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should exercise caution when using the data collected in the other years.

Measurement issues and response error:
It was reported during the community visit that some hunters did not keep track of the number of eggs harvested. Further details are provided in the community feedback and other sources of data section below. Section 5.4 also contains a thorough discussion of this issue.

As seen in the recall period tables, problems with long recall periods were encountered in some years, particularly years 2, 3 and 4. During the course of the study 24% of the harvest records had recall periods of over six months. This calls into question the ability of hunters to accurately remember what they had harvested and may have resulted in some measurement error.

As indicated in the comments below, there is an annual commercial caribou harvest. The Harvest Study did not collect information on these commercial harvests. Although some hunters may have included a commercial harvest along with their subsistence harvest this was thought to be rare and harvest estimates should be viewed as the subsistence harvest only.

DFO issued licences for commercial harvests of arctic char from Duke of York Bay and from Cleveland River; however no catch data were reported (DFO F). The harvest estimates for arctic char should also be viewed as the subsistence harvest only.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou. There was a commercial harvest of caribou each year in Coral Harbour but very few of these were thought to be reported during the Harvest Study. Harvest estimates displayed in the tables represent the subsistence harvest of the community and seem accurate (C.F.).
2. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
3. **Wolf:** The harvest estimate of 15 in year 3 seems too high. A wolf pack came over in 1998/99 and each year since then at least one is harvested (C.F.).
4. **Arctic fox:** Harvest estimates seem low (C.F.). Almost all furs are sold, so in order to verify harvest estimates, data were obtained from DSD detailing the number of pelts sold by hunters. DSD reports were available for 1999/2000 and 2000/2001 (years 4 and 5) and indicate that 1056 arctic fox pelts were purchased from Coral Harbour hunters in 1999/2000 (year 4) and 1880 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). Both of these numbers exceed the harvest estimates confirming that estimates are likely low.
5. **Arctic hare:** Harvest estimates seem too low. Some are harvested every year, so in year 4 when none were reported there were likely some hares taken (C.F.).
6. **Harp seal:** It appears that some harp seal harvests were not reported; hunters harvest harp seals every year. The harvest estimate in year 2 seems accurate (C.F.).
7. **Walrus:** The annual quota was 60 animals, but all tags were not always used. A mean harvest of about 19 animals as displayed is in the right range. It was suggested however, that the harvest estimates in the first few years seem low since there was more harvesting of walrus then (C.F.).
8. **Beluga:** The community considers the harvest estimates to be in the right range; the average harvest seems accurate (C.F.). However, DFO reports the following, much lower, harvest numbers for beluga (note that DFO data are based on fiscal years, whereas Harvest Study data are based on years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
31	30	25	50	38



[9] **Canada goose/snow goose:** Some harvest estimates seem too low. In general hunters harvest about 1 Canada goose to every 5 snow geese. Snow goose estimates were thought to be in the right range but Canada goose estimates appear to be quite low. It is possible that many of the unidentified geese harvested were actually Canada geese (C.F.).

[10] **White-fronted goose:** Similarly to the Canada geese, the harvest estimates of white-fronted geese seem too low. The community estimates that on average about 1000 are harvested each year (C.F.).

[11] **Eider duck:** Both king eider and common eiders are harvested, but common eiders are harvested in larger numbers. Harvest estimates seem low; the community feels that a more accurate estimate would be between 70 and 80 per year (C.F.).

[12] **Eggs:** Hunters do not count the eggs they gather. They may get one box but they do not count how many are in the box. Most hunters when interviewed would need to either estimate their harvest or would often not report their eggs. Harvest estimates seem low. The majority of eggs collected were snow goose eggs; harvest estimates should be higher than the number of geese harvested. There was also some harvesting of eider duck eggs and seagull eggs. These harvest estimates also appear low in the data tables (C.F.).

[13] **Eider down:** People have not kept track of the down they have harvested; estimates are too low. Some down was harvested each year. One person easily collects 2 to 3 bags of down and each bag could contain the down of over 80 nests (C.F.).

[14] **Arctic char:** Harvest estimated for char increased in year 4 since a bridge was built that made fishing areas more accessible. Fishing derbies occur annually. No commercial harvesting of char occurred during the Harvest Study. Total char numbers look fairly accurate (C.F.).

[15] **Lake trout:** Harvest estimates look to be in the right range but years 2 and 4 may be a little low. However, fishing derbies do not occur every year for trout and these years may have been without trout derbies. Weather influences whether or not there is a derby since harvesters need to go far to get to the trout lakes (C.F.).

[16] **Cod:** Harvest estimates look very low; there are cod derbies every year. It is assumed that hunters did not report their cod catch. Estimates in the range of 1000 would be more accurate (C.F.).

[17] **Sculpin:** Harvest estimates are very low for sculpin as well. For every cod caught there are probably 2-3 sculpin caught, so a catch of a few 1000 per year would be more accurate (C.F.).

[18] **Mussels:** Harvest estimates are much too low. Many are taken each year. For example in 2002 during Hamlet days the community harvested 14,000 in one day. Most are harvested by women and children; everyone eats them (C.F.).

No narwhal were reported during the study but the community had a quota of 10 whales annually and there were some harvested by Coral Harbour hunters. DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
10	9	4	0	0

Similarly, turbot are harvested by the community and none were reported during the study (C.F.).

6.3.4 ᓄᓇᕗᑦ ᓴᖅᑭᑕᕐᕕᓂᑦ ᐅᖃᖅᑎᑐᑦᑕᑎᑦ: ᓴᓪᓕᖅ

ᖃᐅᔨᓴᓂᕐᒧᑦ ᐊᖅᑭᑎᒪᓂᖅᓗ:

ᖃᑎᖅᑭᔨᐅᑎᓪᓗᑎᑦ ᐊᑎᓕᐅᓚᖅᑭᐊᓘᓂᖅᐸᓘᕐᕕᐊᓂᑦ ᓄᓇᕗᑦ ᐅᓪᓗᖅᑕᑕᐅᑎᓪᓗᑎᑦ ᑕᓯᑎᕐᓯᓚᐅᖅᑐᑦ ᑕᐃᓚᒋᑦ 14ᖓᓂᕐᒧᑦ ᐊᖅᑐᓚᕐᓂᑦ ᐊᑎᖅᖃᖅᑕᓚᐅᖅᑭᑦᑐᖅᓯᓚᖅᑐᑦ ᖃᐅᔨᓴᓂᕐᒪᑦ. 12ᖓᓂᑦ ᐃᓚᓪᓗᑎᑦ, ᑕᒪᒋᑦ ᖃᐅᑎᖅᓯᑦ ᐊᖅᑐᓚᕐᓯᒪᔪᑦ ᐅᑎᕐᓚᓚᐅᖅᑭᑦᑐᖅᓯᑦ ᐃᓚᖓᑕᒃᑯᑦ ᑎᑎᕋᖅᑕᖅᑎᑦ ᐊᑎᖅᖃᖅᑕᓚᐅᖅᑭᑦᑐᖅᓯᑦ, ᑕᒪᐃᑦ ᖃᐅᔨᓴᓂᕐᑕᖅ ᐊᖅᑐᓚᕐᓯᒪᔪᑦ. ᐃᓕᓴᕐᕕᐊᓕᕐᓂᖅ ᓯᕗᓪᓕᖅᑐᖅ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓚᖅᑭᐊᓘᓂᖅᐸᓘᕐᕕᐊᓂᑦ ᐱᒋᐊᕐᓂᖅᓗ ᐊᑎᓪᓚᕆᓂᕐᓯᒪᓕᖅᑐᖅᑕᓚᐅᖅᑭᑦ ᐅᓪᓗᒥᒃ ᐊᑎᖅᑭᑦᑐᖅᓯᒪᔪᑦ ᖃᐅᔨᓴᓂᕐᒪᑦ ᖃᐅᔨᓴᓂᕐᓯᒪᔪᑦ. ᐃᓕᓴᕐᕕᐊᓕᕐᓂᑦ ᑕᒪᒋᑦ ᐊᑎᖅᖃᖅᑕᓚᐅᖅᑭᑦᑐᖅᓯᒪᔪᑦ 13%ᓇᓗᓇᐃᑦ ᑲᑎᑎᕐᑕᐅᓂᖅᑐᑦ ᐊᖅᑐᓚᕐᓯᒪᔪᑦ (ᓇᓕᕆᓕᖅ 10)

ᖃᐅᔨᓴᖅᑕᕐᕕᐊᑦ ᐊᓗᒪ ᐃᓕᓴᕐᕕᓇᓱᐅᑉᐳᓂᑦᑐᑦ ᑭᐅᓐᓂᑦᑐᑦ:

ᑭᐅᖅᑖᑦᑕᐅᔨᓴᖅ ᐊᑦᑕᓯᓕᕐᕕᖅᑐᖅ ᐊᑎᓯᖅᑖᓕᕐᕕᓂ ᑕᖅᑭᓂ ᐊᖅᑭᐊᒍᑦ ᖃᐅᔨᓴᓂᕐᒪᑦ ᐱᓕᕆᑦᑐᐊᓘᓚᐅᖅᑕᒍ ᐊᖅᑭᒍᓂ 5 ᑭᐅᖅᑕᓂᐅᔨᓴᖅ ᖃᓄᐃᓯᑦᓯᐊᖅᑲᓕᕐᕕᐊᓂᖅ. ᑎᑎᖅᐃᓪᓕᑦ ᐊᖅᑭᒍᓂᑦ 2-ᒥᑦ 4-ᒧᑦ ᐊᑐᖅᑕᐅᓴᖅᑭᖅᑐᖅᓯᒪᔪᑦ ᑭᓪᓕᕐᓚᓂᑦ ᐊᑎᓯᖅᑖᓂᑦ ᐊᑎᓯᓂᑦ ᖃᓄᖅ ᓂ 50ᓴᓂᑦ ᐊᑎᓯᓂ ᑕᖅᑭᐅᔨᓂ, ᐃᓚᖓᑦ ᖃᑕᑐᖅᑎᑦ 14-ᓴᓂᒧᑦ. ᑕᐃᑎᑦᓯᒪᓕᒃ ᓇᓂᖅᒥ 9 ᐱᓴᓚᓂᑎᑦ ᑭᐅᑕᓪᓕᓕᓴᐃᓚᑦᑐᑦ ᓴᓇᒥ ᐊᑦᓯᓗᐊᓕᕐᕕᖅᑐᑦᑕᑦ, 4.6%ᒥᑕᑐᑎᑦ, ᑕᐃᓚᐃᓂᖅᓴᓐᓂ ᐃᓕᓴᕐᕕᓇᖅᑐᖅᓂᖅᑐᐃᓐᓇᐊᓕᓂᖅ ᑭᐅᐸᖅᑭᑦᑐᖅᓂᖅ. ᑕᒪᓐᓇ ᐃᓗᒪᒧᑦᑐᐃᓚᒃ ᑭᐅᐸᖅᑭᑦᑐᖅᓂᖅ, ᑕᒪᒋᑦ ᐃᓗᒪᒧᑦᑐᐃᓚᒃ ᑭᐅᐸᖅᑭᑦᑐᖅᓂᖅ

6.3.4

[8] **ᖃᓪᓗᓈᑦ:** ᓄᓇᕗᔪᓂᑦ ᐃᓗᓕᔪᓂ ᖃᓪᓗᓈᑎᑦᑕᕐᓂᖅᓯᒪᓂ ᓇᓕᔾᑦᑎᑕᕐᔪᓂᑦ ᓯᓚᖓᓂᖅᑕ; ᐊᐅᓚᓱᒋᑦᑐᖅ ᖃᓪᓗᓈᑎᑦᑕᕐᓂᖅᓯᒪᓂᑦ ᓯᓚᕕᒃᓯᖅᑐᖅ (C.F.). ᑭᓯᐊᓂᓕ, ᐃᓚᒥᑎᑕᓚᓇᔭᖕᓄᑦ ᑎᓄᖅᑲᓕᓯᐃᓂᑦ ᑎᑯᓂᖅᓄ, ᐊᑦᑕᓯᓚᑦᓴᑐᒃᓵᑦ, ᖃᓪᓗᓈᑎᑦᑕᕐᔪᓂᑦᑐᐃᓂᑦ ᐊᒥᓱᓚᖓᑦ (ᖃᐅᔨᓚᓗᒍ ᐃᓚᒥᑎᑕᓚᓇᔭᖕᓄᑦ ᑎᑎᖅᑲᐃᑎᖓᑦ ᐃᓕᓴᖏᓚᒪᓂ ᑭᓇᐃᓚᓂ ᖃᐅᔨᓴᖅᓯᒪᓂ ᐊᑦᑕᓱᑎᓂᑦ ᐊᑦᑕᓱᒍᓂ ᐊᑦᑕᓱᓂᓗᒍ ᐊᒥᓱᓂ ᖃᐅᔨᓴᖅᓯᒪᓂ ᐊᑦᑕᓱᑎᓂᑦ ᐊᑦᑕᓱᒍᓂ ᓴᓇᔨᓂ ᑎᑎᖅᑲᐃᑎᖓᑦ ᐊᑦᑕᓱᑎᓂᑦ ᐊᑦᑕᓱᒍᓂ ᓴᓇᔨᓂ) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
31	30	25	50	38

[9] **ᓂᓪᓕ ᖃᖓᐃᑦ:** ᐃᓕᓐᓂᓐ ᓂᓪᓕᕐᓂᐅᕐᓂᑐᓄᓪᓕ ᓇᓕᔾᑦᑕᕐᓂᐅᕐᓂᑐᓄᓪᓕ ᐊᑦᑕᓱᒍᓂᑦᑐᖅᓯᒪᓂᑦ. ᐊᖓᔪᓕᓚᖓᓂᑦ ᓂᓪᓕᖃᑦᑕᖅᑐᐃᑦ ᐊᑎᐅᓕᓚᑦ ᓂᓪᓕᓚᑦ ᑕᓕᒪᓂᑦ ᓂᓪᓕᐅᔨᓂᑦ. ᓂᓪᓕᑦ ᓇᓕᔾᑦᑕᕐᓂᐅᕐᓂᓕᖅᓂᑦ ᑕᒪᓂᑎᐊᑐᒃᑯᓕᐅᕐᓂᖅᑐᐃᓂᑦ ᑭᓯᐊᓕᓚᖓᑦᑐᖅᓯᒪᓂᑦ ᑭᓇᐃᓚᓂ ᓂᓪᓕᑦ ᓇᓕᔾᑦᑕᕐᓂᐅᕐᓂᓕᖅᓂᑦ ᐊᑦᑕᓱᒍᓂᑦᑐᖅᓯᒪᓂᑦ ᐊᑦᑕᓱᒍᓂᑦᑐᖅᓯᒪᓂᑦ. ᐃᒥᐅᓂ ᓂᓪᓕᑦ ᓇᓕᔾᑦᑕᕐᓂᐅᕐᓂᓕᖅᓂᑦ ᐊᑦᑕᓱᒍᓂᑦᑐᖅᓯᒪᓂᑦ ᐊᑦᑕᓱᒍᓂᑦᑐᖅᓯᒪᓂᑦ ᓇᓕᔾᑦᑕᕐᓂᐅᕐᓂᓕᖅᓂᑦ ᐊᒥᓱᓂ ᓇᓕᔾᑦᑕᕐᓂᐅᕐᓂᓕᖅᓂᑦ ᐊᑦᑕᓱᒍᓂᑦᑐᖅᓯᒪᓂᑦ ᐊᑦᑕᓱᒍᓂᑦᑐᖅᓯᒪᓂᑦ ᐃᓕᓴᖏᓚᒪᓂᑦ ᐊᑦᑕᓱᒍᓂᑦᑐᖅᓯ

6.3.4 Nunanit Iniktigutait Ukauhiit: Salliq

Ihivgiugutit Atugutait:
Ihivgiufaakhimayuni ataani naunaiyakhimayut nunamut pulaakhimatitlugit naunaiyakhimayut ikitpiaktut umayukhiuktit titigaktauhimaitut Umayukhiukhimayut Ihivgiuktitlugit. Naunaiyakhimayuk talimat Inuinaungitut umayukhiuktit tuniyauhimayut inminiigutinik umayukhiugutinik, tamamik ilaani umayukhiukataktut. Ukakhimayut ilangani 5.2.1 ikpinagutait hamna ataani naunaiyakhimayut pilaaktu ataanut ihumagiyainik umayukhiukhimayut naunaiyautaini. Kihimi, angitjutait ihumagiyaini mikiyunakhiyut ilaungitut umayukhiuktit 2%kuyut tamamik umayukhiuktit amigaitjutainit (Ikpatauyak 10).

Ihivgiukatagutait ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait mikiyut amigaivyaktuni tatkikhiutini tamamik ukiuni ihivgiuktitlugit kihimi ukiumi 5mi kiuhimayut naunaiyautait angiyut. Katitikhimayut ukiumi 2mit 4mut atuktukhat ihumagilugit naunaiyautait katakhimamata ataanut 50%mik amigaituni hapkoa tatkikhiutini, ilangit katakhimaplutik 14%mut. Takuhimayut Ikpatauyami 9mi pikataktut kiuyuitut naunaiyautait Salliqmi kitkaniitut 4.6%mi ovalo pilaaktuni kiuyuituni ihumagiyaini pihimayut. Taimaimat hamna ovalo mikiyut hiuhimayut naunaiyautait amigaituni ukiuni ihivgiuktitlugit, pilaaktut tamamik uktukhimayut ihuinaagutait ovalo kiuyuitut ihumagiyait angiyut ilangaini tatkikhiutini ihivgiuktitlugit.

Kiuyauhimayut naunaiyautait ihumagiyauyut angiyut ovalo kiuyuitut mikiyut ukiuni 5mi piyaami nni pihimayut naamaktunik ilauyunut ukaukhimayuni Nni umayukhiuktini. Taiguaktut ihumayukhat atugumik katitikhimayuni katitigutait aipaini ukiuni.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaakhimayut:
Tuhaktitihimayut nunamut pulaakhimatitlugit ilangit umayukhiuktit pihimayuitut kafinik maninik pikitikatakhimayut. Ukafaakhimayut nunanit ukakhimayaini ovalo aalat atukhimayut katitikhimayuni ilangani hamani. Ilangani 5.4 pihimayut ukautitiagutaini hamna ihumagiyauyut.

Takuhimayut utiktitihimayun ubluit ikpatauyani, ayokhagutait takiyut utiktitihimayut ubluit pihimavaktut ilangini ukiuni, ilaa ukiuni 2mi, 3mi ovalo 4mi. Pitilugit ihivgiuktitlugit 24%nik umayukhiukhimayut titigagutait utiktitihimayut ubluit avataanut siksinik tatkikhiutini. Hamna apigiyauhimayut pilaaktainik umayukhiuktit nakuuyumik puigukhimaitjutaini hunanik umayukhiukhimayut ovalo piyunakhiyut atugutainik ihuinaagutinik.

Pihimayut ukautaini hamani, ukiuk tamaat kinauyaliugutit tuktunik umayukhiukpaktut. Umayukhiukhimayut Ihivgiugutait katitikhimaitut tuhagutikhainik hapkoa kinauyaliugutit umayukhiukhimayuni. Kihimi ilangit umayukhiuktit ilaupkaihimayut kinauyaliugutit umayukhiukhimayut ilauplutik atuktakhaini umayukhiukhimayamini, hamna ihumagiyauyuk nutaaguyuk ovalo umayukhiukhimayut naunaiyautait takuyukhat atuktakhaini umayukhiukhimayaini talvatuak.

DFOkut tunihimayut laisinsikhanik kinauyaliugutikhainik ikalukhiukhimayunik ikalivinik Duke of York kangikhuani ovalo Cleveland Kuugaani; kihimi ikalukpaktait katitigutait tuhaktitihimaitut (DFO F). Umayukhiukhimayut naunaiyautait ikalivinut takuyauyukhat atuktakhaini umayukhiukhimayut talvatuak.

Nunanit ukakhimayut ovalo aalat atugutaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukhimayut nunani tuktut. Kinauyaliugutit umayukhiukhimayut tuktut tamamik ukiuni Salliqmi kihimi ikitut hapkoa tuhaktititauyuitut pitilugit umayukhiukhimayut ihivgiuktitlugit. Umayukhiukhimayut naunaiyautait takukhauyut ikpatauyami ilauyut atuktakhaini umayukhiukhimayuni nunamini ovalo naamaktut (C.F.).
2. **Nanuit:** Amigaitjutait takukhauyut naunaiyautaungitut kihimi pihimayut umayukhiukhimayut amigaitjutait tunihimayut DSDkunit (DSD PB).
3. **Amagut:** Umayukhiukhimayut naunaiyautait 15nik angiyut. Amagugaaluit pihukhimayut ikaakhutik kikiktamut 1998/99mi ovalo tamamik ukiuni atauhimik piyauvaktuk (C.F.).
4. **Tigiganiat:** Umayukhiukhimayut naunaiyautait mikiyut (C.F.). Tamamivyak amiit niuviktauvaktut, taimaimat naluhuigiagani umayukhiukhimayut naunaiyautait, katitikhimayut pihimayut DSDkunit titigakhimayut amigaitjutait amiit niuviktauvaktut umayukhiuktinit. DSDkut tuhaktitihimayut pilaaktut 1999/2000mit ovalo 2000/2001mit (ukiumi 4mi ovalo 5mi) ovalo pihimayut 1,056nik tigiganiat amiit niuviktauhimayut Salliqmit umayukhiuktinit 1999/2000mi (ukiumi 4) ovalo 1,880nik niuviktauhimayut 2000/2001mi (ukiumi 5) (nalungilutit DSDkut katitigutait atukpaktut umayukhiukhimayuni ukiungini Julymit Junemut, Umayukhiukhimayut Ihivgiuktit katitigutait atukpaktut umayukhiukhimayut ukiuginik Junemit Maymut) (DSD FB). Tamamik hapkoa amigaitjutait avataanungakhimayut umayukhiukhimayut naunaiyautaini pihimayut hapkoa naunaiyautait mikiyut.

[5] **Ukaliit:** Umayukhiukhimayut naunaiyautait mikiyut.ukaliit umayukhiukatainaktut ukiuk tamaat, taimaimat ukiumi 4mi pingitut tuhaktitihimayut pihimayunakhimayut ukalinik (C.F.).

[6] **Qairulik:** Takukhauyut ilangit qairulik umayukhiukhimayut tuhaktititaungitut umayukhiuktit umayukhiukataktait qairulik ukiuk tamaat. Umayukhiukhimayut naunaiyautait ukiumi 2mi naamaktut (C.F.).

[7] **Akviit:** Ukiuk tamaat kotangit 60kuyut akviit, kihimi tamamik makpigaat atuinayuitut. Angitjutait umayukhiukhimayut 19nik akvinik takukhauyut naamaktut. Ukakhimayut kihimi umayukhiukhimayut naunaiyautait hivulimi ukiuni mikiyut, ilaa amigaitkiyanik umayukhiukhimamata akviit talvani (C.F.).

[8] **Kilalugait:** Nunani ihumayut umayukhiukhimayut naunaiyautait naamaktut; kitkaniitut umayukhiukhimayut naamaktut (C.F.). Kihimi DFOkut tuhaktitihimayait hapkoa, mikitkiyait, umayukhiukhimayut amigaitjutait kilalugait (nalungilutit DFOkut katitikhimayut atukpaktait iniktigutaini ukiugit Umayukhiukhimayut Ihivgiuktit katitikhimayut atukpaktait ukiungit Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
31	30	25	50	38

[9] **Uluaguliit/Kanguq:** Ilangit umayukhiukhimayut naunaiyautait mikiyut. Tamamivyak umayukhiuktit umayukhiukpaktut atauhik ulauagulik tamamik talimat kangunit. Kanguit naunaiyautait ihumagiyauyut naamaktut kihimi uluaguliit naunaiyautait takukhauyut mikiyut. Piyunakhimamata amigaitut naunaiyakhimaitut tinmiakhimayut uluaguliuyut (C.F.).

[10] **Niklivik:** Aatjikutaatut uluaguliit, umayukhiukhimayut naunaiyautait nikliviit mikiyut. Nunani naunaiyautait kitkani 1,000nik umayukhiuktauvaktut ukiuk tamaat (C.F.).

[11] **Tinmiat:** Tamamik kingaliit ovalo mitiit umayukhiukpaktut, kihimi mitiit umayukhiukpaktut amigaitkiyainik. Umayukhiukhimayut naunaiyautait mikiyut; nunanit ihumayut nakuutkiyat naunaiyautait kitkaniitut 70nik ovalo 80nik ukiuk tamaat (C.F.).

[12] **Maniit:** Umayukhiuktit naunaiyayuitait kafinik maninik pikiutakpaktut. Pivaktut atauhimik kiukutimik kihimi naunaiyayuitait kafinik kiukutimungakpaktut. Amigaitut umayukhiuktit ukakatigigaagata naunaiyakafulutik pikiutivaktainik ovaluniit tuhaktitiyuitait maniit. Pikiutakpaktut naunaiyautait mikiyut. Amigaitkiyaut maniit katitikpaktut kangunit maniit; umayukhiukhimayut naunaiyautait angitkiyauyukhat amigaitkiyainik uluaguliit umayukhiukhimayunit. Ilangit pikiutikatakpaktait mitiit maniit ovalo nauyat maniit. Hapkoa pikiutikataktut mikiyut katitikhimayuni ikpatauyani (C.F.).

[13] **Tinmiat kiviut:** Inuit naunaiyayuitait kiviut katitikhimayainik; naunaiyautait mikiyut. Ilangit kiviut katitikpaktut ukiuk tamaat. Atauhik Inuk katitilaaktut malgunit pingahut puukatanik kiviunik ovalo atauhik puukatak pihimalaatut kiviunik avataanut 80nit ivavinit (C.F.).

[14] **Ikaliviit:** Umayukhiukhimayut naunaiyautait ikalivinik angililihimayut ukiumi 4mi ikaavikhamik hanayauhimamat pipkaihimamat ikalukhiukviit tahiit tikihalaalimata ihuaktumik. Ikalukhiuktut takhinahuat pikataktut ukiuk tamaat. Kinauyaliungitut ikalukhiuktuni ikalivinik pitilugit Umayukhiukhimayut Ihivgiuktitlugit. Tamamik ikaliviit amigaitjutait naamaktut (C.F.).

[15] **Ikalukpiit:** Umayukhiukhimayut naunaiyautait naamaktut kihimi ukiuni 2mi ovalo 4mi mikiyut. Kihimi, ikalukhiuktut takhinahuaktuni pikatangitut ukiuk tamaat ikalukpinik ovalo hapkoa ukiungit pingitunakhimata ikalukhiuktuni takhinahuaktitiyuni. Hilalu pipkaivaktut takhinahuat ikalukhigiagita ovaluniit ikalukhiungitut, umayukhiuktit ungahiktumut autakpakmata ikalupilinut tahiinut (C.F.).

[16] **Ugat:** Umayukhiukhimayut naunaiyautait mikiyut; uganik takhinahuanginaktut ukiuk tamaat. Piyunakhihimamata umayukhiuktit tuhaktitiyuitait ugaktaminik. Naunaiyautait pivaktut 1,000nik naamaktut (C.F.).

[17] **Kanayuit:** Umayukhiukhimayut naunaiyautait mikiyut kanayukhimayuni. Tamamik ugagaagat pivaktut malguk pingutluuniit kanayukpaktut, pivaktut 1,000nik ukiuk tamaat naamaniaktuk (C.F.).

[18] **Uviluvaluit:** Umayukhiukhimayut naunaiyautait mikiyut. Amigaitut pivaktut ukiuk tamaat. Ilaa, 2002mi hamletkut ubluani, nunami umayukhiukhimayut 14,000nik atauhik ubluani. Amigaitut umayukhiukpaktut angnait ovalo nutakat, Inuit tamamik nigivaktait (C.F.).

Tuugaat tuhaktititaungitut ihivgiuktitlugit kihimi nunami kotakaktut 10nik tuugaanik ukiuk tamaat ovalo umayukhiukhimayut Salliqmiut umayukhiuktinit. DFOkut tuhaktitihimayut hapkoa umayukhimayut amigaitjutait tuugaat (nalungilutit DFOkut katitigutait atukpaktait iniktigutaini ukiuni, Umayukhiukhimayut Ihivgiuktit katitigutait atukpaktut umayukhiukhimayut ukiugini Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
10	9	4	0	0

Aatjikutaatut, nataarnat umayukhiukpaktait nunani ovalo tuhaktitihimaitut ihivgiuktitlugit (C.F.).

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 579

Monthly harvest estimates
ᑕᖏᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓗᐃᑦ
Tatkiktaman nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᓐᔾᔨᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖏᖓ/Tatkia			JUN† ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔨᑎ	SEP ᓱᑎᐸᓗ	OCT ᐅᑲᐃᓗ	NOV ᐅᓇᓚᐸᓗ	DEC ᑎᓵᐸᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᓵ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	n/d	61	124	107	122	204	173	141	157	222	159	117	1,587 ± 126
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait	n/d						3						3 ± 4
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡	n/d				3	9							12
Wolf	ᐊᒪᓕᐃᑦ	Amagut	n/d								7	15	5		27 ± 14
Arctic fox	ᑎᓗᒃᑲᓂᐊᑦ	Tigiganiat	n/d					36	24	32	19	58		2	171 ± 47
Wolverine	ᖃᐅᕙᑦ	Kalvik	n/d									1			1 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	n/d			7	2		2						11 ± 6
Seals (unspecified)	ᓂᖏᑯᓪᓚᑦ	Natiit	n/d					21	2	4		6	3	42	78 ± 19
Ringed seal	ᓇᓂᓗᑦ	Natiinat	n/d	51	29	13	40	10				9	6		158 ± 41
Bearded seal	ᐅᓚᕆᐃᑦ	Ukyuk	n/d		6		7	3				5	1	1	23 ± 9
Walrus	ᐊᐃᐅᓴᑦ	Akvik	n/d		1	1								1	3 ± 3
Narwhal	ᑐᐃᓪᓚᑦ ᖃᓪᓗᓂᑦ	Tuugaak	n/d		1										1 ± 1
Beluga	ᖃᐅᖏᑦ ᖃᓪᓗᓂᑦ	Kilalugak	n/d	34	54	22									110 ± 28
Geese (unspecified)	ᓄᖕᓪᓚᑦ	Kanguk	n/d											47	47 ± 36
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq	n/d											20	20 ± 15
Canada goose	ᓄᖕᓪᓚᑦ ᐅᓗᐊᔪᓪᓚᑦ	Nikliknik	n/d	8									6	60	74 ± 29
Eider duck	ᒥᑎᑦ	Kingalik	n/d		4						2				6 ± 6
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	n/d			13	27		2		2	4	14	19	81 ± 34
Fish (unspecified)	ᐃᖃᓗᐃᑦ (ᓇᓗᓇᐃᖕᑕᐅᖏᓪᓕᖕᑐᑦ)	Ikaluit	n/d							50					50 ± 21
Arctic char	ᐃᖃᓗᓴᐱᑦ	Ikaliviit	n/d	2,003	658	363	1,111	915	452	101	128	192	112	70	6,105 ± 1,013
Lake trout	ᐃᓕᓴᐃᑦ	Ikalukpik	n/d		21	15	33	16				1	69	278	433 ± 154

† No data were collected in June 1996. Consequently, the total harvest listed above is an 11 month total (July 1996 - May 1997), not an annual total. Similarly, the confidence intervals shown were calculated only for the 11 months in which data were collected.

‡ Polar bear data supplied by DSD.

† ᓇᓕᐅᑎᓂᓴ ᓄᐊᕐᓕᖃᓇᐅᑉᓴᖕᑐᖅ ᔨᓂ 1996ᒥ. ᑕᐃᒪᐃᓐᓂᖃᓚᐅᓂᑦ, ᑲᑎᑐᑦ ᐊᖏᔪᓄᑦ ᑎᑎᕋᓕᒪᔪᑦ ᖃᓄᖅᓂᓂ 11ᓂᑦ ᑕᖏᓂᑦ ᑲᑎᓕᒪᔪᑦ (ᔪᓚᐃ 1996-ᒪᐃ 1997), ᐊᐅᔪᔾᔨᒧᐃᓐᓇᖕᑐᖅ. ᑕᐃᒫᒐᓪᓕᐊᑐᖅ, ᓱᓕᔭᓐᓄᑦ ᐊᑯᓂᖃᓂ ᐊᓪᓚᕆᐊᒃᓴᓂᑦ ᖃᓄᐃᓕᓴᐅᓕᖕᓂᒃᑯᑦ ᑲᑎᑎᖅᑐᑦ ᐅᑭᐅᖕᓂᖅ 11ᓂᑦ ᑕᖏᓂᑦ ᓇᓗᐃᓴᕐᓇᐅᔪᓂᑦ.

‡ ᓇᓂᑦᓂ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᔭᖓᑦ ᐅᑭᐊ ᐃᑯᐱᖃᓕᓴᕐᓇᓕᒃ.

† Junimi pitut 1996. Talvalu, tamakiklugin angujaumajut tatkini 11ni katitlugit (July 1996 –May 1997), tamakigitut tapkuan. Taimanatainaktauk, tapkuan nahagauhimakmata 11nut tatkinut.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 580

Monthly hunter response

ᑕᖏᑕᒪᑦ ᐊᖏᔪᓇᓱᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᓕᕐᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐹᓪ	OCT ᐅᑲᐃᓪ	NOV ᐅᐊᓕᐹᓪ	DEC ᑎᓯᐹᓪ	JAN ᔮᖅᓄᐊᓪ	FEB ᐃᖃᐅᐊᓪ	MAR ᒪᕐᕿ	APR ᐃᕐᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑕᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔪᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒪᑦ ᐊᖏᔪᓇᓱᑎᑦ	Tatkitaman angunahuktut titigait	n/d	374	375	375	373	372	371	371	371	370	368	365	379*
Interview list	ᐊᐱᕐᓂᖏᓐᓇᑦ	Apikiktan	n/d	249	249	249	247	246	245	245	245	244	242	239	253*
Hunters interviewed	ᐊᖏᔪᓇᓱᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	n/d	176	195	186	195	222	223	222	217	207	206	199	247*
Harvested	ᐊᖏᔪᓇᓱᑐᒋᓐ	Angujaujut	n/d	43	50	34	39	50	48	39	35	48	38	55	142*
Response rate (%)	ᑭᐅᕐ ᖃᓂᐅᓚᖓᑦ (%)	Kiujut (%)	n/d	71	78	75	79	90	91	91	89	85	85	83	83**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᑎᑦ ᐊᑎᓕᐅᕐᓯᒪᔪᑦ/ᐊᐱᕐᓂᖏᓐᓇᓂᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓇᓱᑐᒋᓐ ᐊᑕᐅᓯᐊᓗᓂ% ᐊᑐᑎᑊ ᐊᓕᕐᒍᒥ.
** ᐊᐅᑎᓂᑎᑭᒪᔪᑦ ᑕᖏᑕᒪᑦ ᑭᐅᔪᑦ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 581

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᕐᓴᓂ ᐊᖏᔪᓇᓱᓂᖓᑕ ᐊᓚᓗ ᐊᐱᕐᓂᑕᐅᓂᖏᓐᓇᑕ, ᓇᓗᓇᐃᕐᑕ ᐃᒪᒃ % ᑲᑎᑕᑎᑦ ᐊᖏᔪᓇᓱᑦ ᑎᑎᕐᓂᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᓕᕐᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐹᓪ	OCT ᐅᑲᐃᓪ	NOV ᐅᐊᓕᐹᓪ	DEC ᑎᓯᐹᓪ	JAN ᔮᖅᓄᐊᓪ	FEB ᐃᖃᐅᐊᓪ	MAR ᒪᕐᕿ	APR ᐃᕐᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑕᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	n/d	94	90	82	90	37	43	73	86	100	93	91	80
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	n/d	0	0	0	0	45	49	27	12	0	7	9	13
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	n/d	6	10	18	10	18	7	0	2	0	0	0	7

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 582

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐸᑎᑦ ᐊᖏᔪᓚᐸᓕᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 1 (June 1996 - May 1997)
ᐊᒻᒋᒍ 1 (ᔪᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᑎ	SEP ᓱᑎᐹᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᕆᐹᓗ	DEC ᑎᓴᐹᓗ	JAN ᒍᓐᓇᐊᓗ	FEB ᓇᖏᐅᐊᓗ	MAR ᒪᕐᓴ	APR ᐃᑦᓗᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	n/d	22	33	19	23	32	36	30	25	40	28	24	118
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait	n/d						2						2
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut	n/d								2	2	3		5
Arctic fox	ᑎᓕᑦᓂᓪᓕᐊᑦ	Tigiganiat	n/d					6	4	4	4	6		1	11
Wolverine	ᖃᑦᐃᓵᑦ	Kalvik	n/d									1			1
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	n/d			3	1		1						5
Seals (unspecified)	ᓱᖏᑯᓪᓕᑦ	Natiit	n/d					6	1	3		2	1	13	20
Ringed seal	ᓇᕐᓱᑦ	Natiinat	n/d	8	5	4	8	1				2	2		24
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	n/d		1		2	2				3	1	1	9
Walrus	ᐊᐃᐃᓵᑦ	Akvik	n/d		1	1								1	3
Narwhal	ᑐᐊᓪᓕᑦ ᕿᓪᓗᒡᓗᑦ	Tuugaak	n/d		1										1
Beluga	ᖃᐅᕐᑦ ᕿᓪᓗᒡᓗᑦ	Kilalugak	n/d	8	12	6									20
Geese (unspecified)	ᓂᕐᓪᓕᑦ	Kanguk	n/d											1	1
Snow goose	ᑲᖏᐃᑦ	Kanguq	n/d											6	6
Canada goose	ᓂᕐᓪᓕᑦ ᐅᓗᐊᒍᓪᓕᑦ	Nikliknik	n/d	1									1	9	11
Eider duck	ᒥᑎᑦ	Kingalik	n/d		1						1				2
Ptarmigan	ᐊᕿᓴᑦ	Akilgik	n/d			1	4		1		1	2	2	1	11
Fish (unspecified)	ᐃᖃᓗᐃᑦ (ᓇᓗᓇᐃᑦᑕᕐᖓᑦᑐᑦ)	Ikaluit	n/d							3					3
Arctic char	ᐃᖃᓗᓴᐱᑦ	Ikaliviit	n/d	23	11	7	19	18	13	5	7	5	5	5	66
Lake trout	ᐃᓕᑦᐃᑦ	Ikalukpik	n/d		2	1	4	2				1	5	18	29

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓕᐊᓂᒃ ᐱᕈᖅᖢᑎᒃ ᐱᓴᒪᓕᓂᓂᒃ ᐊᖏᔪᑦ ᖃᕋᐅᓂᖏᓐᓄᑦ ᐊᓕᔪᓄᑦ ᓇᓕᕆᐅᓪᓕᐊᓂᒃ ᐊᖏᔪᓄᑦ ᐊᓕᕆᔨᓴᓂ ᑐᓂᔭᖏᓐᓂ ᐃᓄᐹᑦᐃᓚᓕᓵᔨᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 583

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktaman nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᓚᕆᒍ 2 (ᔫᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᑕᒪᑦ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᔪᔨᑎ	SEP† ᓯᑎᐹᓗ	OCT† ᐅᑎᐱᓗ	NOV† ᐅᓇᓚᐹᓗ	DEC† ᑎᓯᐹᓗ	JAN† ᔮᖏᓇᐊᓗ	FEB† ᐃᖅᑲᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓀᓕ	MAY ᒪᐃ	Total ᑲᑎᑎᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓕᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	1	9		n/d	n/d	n/d	n/d	n/d	n/d	154	52	6	222 ± 35
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡						9			1		1		11
Wolf	ᐊᒪᓗᐃᑦ	Amagut				n/d	n/d	n/d	n/d	n/d	n/d		6	1	7 ± 1
Arctic fox	ᑎᓗᓚᖓᓂᐊᑦ	Tigiganiat				n/d	n/d	n/d	n/d	n/d	n/d	6			6 ± 2
Seals (unspecified)	ᓄᖅᑯᓪᓚᑦ	Natiit	4			n/d	n/d	n/d	n/d	n/d	n/d			16	20 ± 5
Ringed seal	ᓇᓕᓂᑦ	Natiinat				n/d	n/d	n/d	n/d	n/d	n/d		2	6	8 ± 7
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk				n/d	n/d	n/d	n/d	n/d	n/d		1		1 ± 0
Walrus	ᐊᐃᐃᓴᑦ	Akvik				n/d	n/d	n/d	n/d	n/d	n/d			2	2 ± 1
Beluga	ᖃᓄᖅᑕᑦ ᖃᓪᓚᑦ	Kilalugak	1			n/d	n/d	n/d	n/d	n/d	n/d				1 ± 1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq				n/d	n/d	n/d	n/d	n/d	n/d			11	11 ± 6
Canada goose	ᓂᖅᓪᓂ ᐅᓗᐊᔪᓪᓂᑦ	Nikliknik				n/d	n/d	n/d	n/d	n/d	n/d			17	17 ± 7
Ptarmigan	ᐊᖏᓱᑦ	Akilgik				n/d	n/d	n/d	n/d	n/d	n/d		3		3 ± 1
Fish (unspecified)	ᐃᖃᓗᐃᑦ (ᓇᓗᓇᐃᑦᑕᐅᖏᑦᑐᑦ)	Ikaluit				n/d	n/d	n/d	n/d	n/d	n/d			66	66 ± 13
Arctic char	ᐃᖃᓗᐊᓴᑦ	Ikaliviit	20	99		n/d	n/d	n/d	n/d	n/d	n/d				119 ± 85
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	1			n/d	n/d	n/d	n/d	n/d	n/d	8	8	125	142 ± 34

6.3.5

† No data were collected from September 1997 to February 1998. Consequently, the total harvest listed above is a 6 month total (June 1997 - August 1997 and March 1998 - May 1998), not an annual total. Similarly, the confidence intervals shown were calculated only for the 6 months in which data were collected.

‡ Polar bear data supplied by DSD.

† ᓇᓕᐃᔨᖃᐅᔨᓴᖅᑐᑦ ᐅᑉᐳᓴᒃ ᓯᑎᐹᓗ 1997 ᐅᕐᓴᒃ ᐊᖏᔪᓄᑦ 1998. ᑕᐃᒪᓐᓇᓴᓂᑦ, ᑲᑎᑎᑦ ᐊᖏᔪᓄᑦ ᑎᑎᕋᓕᒫᑦ ᖃᓄᖅᑕᓂᒃ ᐅᓂᒃ (ᔫᓂ 1997 - ᐊᐅᔪᔨᑎ 1997 ᐊᖏᒪᓗ ᒪᕐᓯ 1998 - ᒪᐃ 1998), ᐊᖏᔪᓕᒫᓴᖏᑦᑐᒍᑦ. ᑕᐃᒪᓕᓕᑕᐅᖅ, ᓯᓚᐅᑉᓴᑦ ᐊᑯᓂᒃᓴᓂ ᐊᓕᖅᑲᐃᐅᔨᓂᑦ ᖃᐅᔨᒪᔪᑦ ᐅᑉᐳᓴᖏᑦ ᐅᓂᒃ ᑕᖃᓂᑦ ᓇᓗᓴᕐᔪᐊᓂᑦ ᐅᑉᐳᓴᖏᑦ ᐅᓂᒃ ᑕᖃᓂᑦ ᓇᓗᓴᕐᔪᐊᓂᑦ.

‡ ᓇᓂᑦᓂ ᑎᑎᕋᐅᒪᔨᑦ ᑐᓂᓯᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓚᓇᓕᑦ.

† Katikhitaumaituttauk September 1997 tikitlugu 1998. Talvalutauk, katitiktauhimajut tapkuan siksini tatkikhiutin katilugin (June 1997 – August 1997 March 1998 – May 1998), ukiumun ilutumungitut. Taimanahainaktauk, siksini tatkikhiutini katitiktakhat katitikhimayut.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 584

Monthly hunter response

ᑕᖏᑕᒪᑦ ᐊᖏᔪᓕᓴᒋᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)

ᐊᒃᓱᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᐅᒻᐹᓗ	DEC ᑎᓯᒻᐹᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᓄᖕᐅᐊᓗ	MAR ᒪᑦᓯ	APR ᐃᑦᓇᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᓴᒋᑦ ᑭᐅᓂᖏᑦ ᐃᓚᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒪᑦ ᐊᖏᔪᓕᓴᒋᑦ	Tatkitaman angunahuktut titigait	357	358	358	n/d	n/d	n/d	n/d	n/d	n/d	359	360	357	372*
Interview list	ᐊᐱᕐᓂᖏᓐᓇᑦ	Apikiktan	209	210	210	n/d	n/d	n/d	n/d	n/d	n/d	209	209	207	218*
Hunters interviewed	ᐊᖏᔪᓕᓴᒋᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	172	168	144	n/d	n/d	n/d	n/d	n/d	n/d	197	200	194	210*
Harvested	ᐊᖏᔪᓕᓴᒋᑎᒋᓐ	Angujaujut	4	5	0	n/d	n/d	n/d	n/d	n/d	n/d	51	22	49	89*
Response rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	82	80	69	n/d	n/d	n/d	n/d	n/d	n/d	94	96	94	86**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓕᓴᒋᑦ ᐊᑎᓕᐅᔾᔪᓐᓇᖅᑐᑦ/ᐊᐱᕐᓂᖏᓐᓇᖅᑐᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓕᓴᒋᑎᒋᓐ ᐊᑕᐅᓯᐊᓗᓂ% ᐊᑐᑎᑦ ᐊᓱᒍᒥ.
** ᐊᐅᔨᓕᓕᑎᓯᒪᔨᑦ ᑕᖏᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 585

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔨᑦ ᐊᑯᕐᓂᓂ ᐊᖏᔪᓕᓴᒋᓂᑦ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑐᓂᓂᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓕᓴᒋᑦ ᑎᑎᕐᕕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)

ᐊᒃᓱᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᓯᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᐅᒻᐹᓗ	DEC ᑎᓯᒻᐹᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᓄᖕᐅᐊᓗ	MAR ᒪᑦᓯ	APR ᐃᑦᓇᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	100	75	0	n/d	n/d	n/d	n/d	n/d	n/d	66	71	65	68
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	0	0	0	n/d	n/d	n/d	n/d	n/d	n/d	0	0	35	13
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	0	25	0	n/d	n/d	n/d	n/d	n/d	n/d	34	29	0	18

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 586

Number of hunters harvesting each species — **Year 2 (June 1997 - May 1998)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᓗᒍᑦ ᐊᖏᔪᓚᓗᒃᑲᓐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ — **ᐊᑲᒡᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 2 (June 1997 - May 1998)**

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᔅᑎᑎ	SEP ᓱᑎᐹᓗ	OCT ᐅᑲᐃᓗ	NOV ᐅᓇᕆᐹᓗ	DEC ᑎᓯᕆᐹᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᓇᖅᑐᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	1	3		n/d	n/d	n/d	n/d	n/d	n/d	49	17	6	66
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᐃᑦ	Amagut				n/d	n/d	n/d	n/d	n/d	n/d		3	1	4
Arctic fox	ᑎᓗᓚᓄᐊᑦ	Tigiganiat				n/d	n/d	n/d	n/d	n/d	n/d	1			1
Seals (unspecified)	ᓂᖏᑯᓕᓪᓕᑦ	Natiit	1			n/d	n/d	n/d	n/d	n/d	n/d			8	9
Ringed seal	ᓇᓂᓱᑦ	Natiinat				n/d	n/d	n/d	n/d	n/d	n/d		1	2	3
Bearded seal	ᐅᓚᔪᐃᑦ	Ukyuk				n/d	n/d	n/d	n/d	n/d	n/d		1		1
Walrus	ᐊᐃᐃᓴᑦ	Akvik				n/d	n/d	n/d	n/d	n/d	n/d			2	2
Beluga	ᖃᑯᕆᑦ ᖁᓪᓗᓚᑦ	Kilalugak	1			n/d	n/d	n/d	n/d	n/d	n/d				1
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq				n/d	n/d	n/d	n/d	n/d	n/d			1	1
Canada goose	ᓄᕐᓂᑦ ᐅᓗᐊᔨᓂᑦ	Nikliknik				n/d	n/d	n/d	n/d	n/d	n/d			2	2
Ptarmigan	ᐊᖏᓚᑦ	Akilgik				n/d	n/d	n/d	n/d	n/d	n/d		1		1
Fish (unspecified)	ᐃᖃᓗᐃᑦ (ᓇᓗᓇᐃᑦᑕᐅᖏᑦᑐᑦ)	Ikaluit				n/d	n/d	n/d	n/d	n/d	n/d			15	15
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	2	2		n/d	n/d	n/d	n/d	n/d	n/d				3
Lake trout	ᐃᓕᓴᐃᑦ	Ikalukpik	1			n/d	n/d	n/d	n/d	n/d	n/d	2	1	18	22

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓗᒪᔪᓂᒃ ᐱᑕᖃᖏᑦᑐᖅ ᐱᒃᔪᑎᓕᓂᒃ ᐊᖏᔪᓂᑦ ᖃᑦᓯᐅᓂᖏᑦᓂᓄᑦ ᐊᓕᕆᐅᒪᒪᔪᓂᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᖏᑦᑐᓄᑦ ᑐᓂᔭᖏᑦᓂ ᐃᑯᐱᕐᓚᓕᓵᓴᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 587

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ

Tatkiktaman nahaktauvaktun

Year 3 (June 1998 - May 1999)

ᐊᓐᓴᒍ 3 (ᔮᓄ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖢᓂ/Tatkia			JUN ᔮᓄ	JUL ᔮᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐹᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᓚᐹᓗ	DEC ᑎᓱᓚᐹᓗ	JAN ᔨᖏᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᓴ	APR ᐃᑦᓇᓪ	MAY ᒪᐃ	Total ᑲᑎᑕᒥᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	9	23	22	94	23	16	33	229	152	171	163	47	982 ± 83
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait									1	5			6 ± 5
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡						4	9						13
Wolf	ᐊᒪᕐᐃᐃᑦ	Amagut							1	21	12	38	9	3	84 ± 21
Arctic fox	ᑎᓕᓵᖅᓄᐊᑦ	Tigiganiat							13		9	11			33 ± 19
Wolverine	ᖃᑦᐃᓪᑦ	Kalvik										5			5 ± 5
Seals (unspecified)	ᓴᖅᑯᓕᑦ	Natiit	7	2	2	1						2		1	15 ± 2
Ringed seal	ᓇᓴᓕᑦ	Natiinat	7	5	1	5	7	6		3		2	9	15	60 ± 14
Bearded seal	ᐅᑭᔪᐃᑦ	Ukyuk	1		1	3	1							1	7 ± 2
Walrus	ᐊᐃᐃᓴᑦ	Akvik	3											2	5 ± 1
Beluga	ᖃᓄᖅᑕ ᖃᓪᓗᓂᑦ	Kilalugak			4	18									22 ± 10
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	34											143	177 ± 24
Canada goose	ᓄᖅᓱᑦ ᐅᓗᐊᔨᓱᑦ	Nikliknik	4											150	154 ± 16
Ptarmigan	ᐊᖏᓚᑦ	Akilgik											165	73	238 ± 203
Fish (unspecified)	ᐃᖃᓗᐃᑦ (ᓇᓗᓇᐃᑦᑕᐅᖏᑦᑐᑦ)	Ikaluit	4												4 ± 2
Arctic char	ᐃᖃᓗᒃᑕᑦ	Ikaliviit	172	85	183	77	172	243	57	128	87	125	46	139	1,514 ± 179
Lake trout	ᐃᓕᓴᐃᑦ	Ikalukpik	23			19		38		61		70	99	245	555 ± 172
Cod	ᐅᓚᐃᑦ	Ugak											23	2	25 ± 30

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓄ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᖏᕐᖢᑦ ᐅᑉᐱᒪᓕᕆᓂᖅᓴᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐊᓗᐊᕕᐅᑉᐳᑦ/NAUNAIKUTA 588

Monthly hunter response

ᑕᖏᑕᒪᑦ ᐊᖓᔪᓂᕆᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᑦᕿᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᑦᔪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑲᐃᓂ	NOV ᓄᓇᕐᓂ	DEC ᑎᓯᕐᓂ	JAN ᔮᖅᓄᐊᓂ	FEB ᓇᖕᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖓᔪᓂᕆᑎᑦ ᑭᐅᓂᖏᑦ ᐋᔪᑦᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒪᑦ ᐊᖓᔪᓂᕆᑎᑦ	Tatkitaman angunahuktut titigait	358	354	354	353	353	354	354	342	340	342	339	339	367*
Interview list	ᐊᐱᕐᓯᖏᓐᓇᑦ	Apikiktan	208	207	208	209	210	211	211	201	201	202	201	200	215*
Hunters interviewed	ᐊᖓᔪᓂᕆᑎᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	193	193	183	181	200	199	185	190	190	191	188	190	204*
Harvested	ᐊᖓᔪᓂᕆᔨᑐᖅ	Angujaujut	37	23	18	35	25	19	18	37	34	43	44	48	114*
Response rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	93	93	88	87	95	94	88	95	95	95	94	95	92**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖓᔪᓂᕆᑎᑦ ᐊᑎᓕᐅᔾᔪᑕᓂᖅ/ᐊᐱᕐᓯᖏᓐᓇᑦᑐᓂᖅ/ᐊᐱᕐᓯᑦ/ᐊᖓᔪᓂᕆᔨᑐᖅ ᐊᑕᐅᓴᐊᓗᓂ ᐊᑎᕐᓂᑦ ᐊᑦᕿᒍᒥ.
** ᐊᐅᔾᓭᓐᓂᕆᒪᓕᐅᑦ ᑕᖏᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᐊᓗᐊᕕᐅᑉᐳᑦ/NAUNAIKUTA 589

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐋᔩᕐᓂᓂ ᐊᖓᔪᓂᕆᓕᕐᓂᖓᑕ ᐊᒻᒪᓗ ᐊᐱᕐᓯᑦᑐᐅᓂᖓᑕ, ᐊᓗᐊᕕᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᑕᑎᑦ ᐊᖓᔪᓂᕆᓂᑦ ᑎᑎᕐᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐊᑦᕿᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᑦᔪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑲᐃᓂ	NOV ᓄᓇᕐᓂ	DEC ᑎᓯᕐᓂ	JAN ᔮᖅᓄᐊᓂ	FEB ᓇᖕᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᑯᑦ	≤ tatkin pingahut	50	26	100	100	100	100	100	36	53	100	100	100	81
4-6 months	4-6 ᑕᑯᑦ	tatkin hitaman 6nut	50	74	0	0	0	0	0	64	47	0	0	0	19
> 6 months	> 6 ᑕᑯᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 590

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐸᑎᑦ ᐊᖏᔪᓚᐸᓕᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 3 (June 1998 - May 1999)
ᐊᒻᒪᒍ 3 (ᔪᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖑᖏᑐᑦ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓱᑎᐸᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᓇᕐᐸᓇ	DEC ᑎᓯᐸᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᓇᖕᐅᐊᓇ	MAR ᒪᓯ	APR ᐃᓴᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	7	14	10	26	11	4	8	34	31	31	33	18	87
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait									1	3			4
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut							1	8	4	10	4	2	20
Arctic fox	ᑎᓕᓴᖅᓄᐊᑦ	Tigiganiat							1		2	2			5
Wolverine	ᖃᑦᕕᑦ	Kalvik										3			3
Seals (unspecified)	ᓂᖏᑯᓪᓗᑦ	Natiit	5	2	2	1						2		1	11
Ringed seal	ᓇᓂᑦ	Natiinat	5	3	1	2	7	3		2		2	4	10	30
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	1		1	2	1							1	5
Walrus	ᐊᐃᕕᒃᑦ	Akvik	3											2	4
Beluga	ᖃᐅᓪᑕᑦ ᖁᓕᓗᑦ	Kilalugak			2	3									5
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	5											18	23
Canada goose	ᓂᕐᓕᑦ ᐅᓗᐊᔪᓕᑦ	Nikliknik	1											18	18
Ptarmigan	ᐊᖏᓱᑦ	Akilgik											3	2	4
Fish (unspecified)	ᐃᖃᓗᐃᑦ (ᓇᓗᓇᐃᑦᑕᐅᖏᑦᑐᑦ)	Ikaluit	1												1
Arctic char	ᐃᖃᓗᐅᒃᑦ	Ikaliviit	13	4	3	2	7	10	2	4	4	5	3	6	39
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	2			2		2		1		4	8	19	31
Cod	ᐅᓴᐃᑦ	Ugak											2	1	3

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓪᒪᔪᓂᒃ ᐱᑕᖃᖏᑐᐃᖅ ᐱᓕᕆᓚᐅᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᑦᓂᑦ ᐊᓪᓚᖅᓂᑦ ᐊᖏᔪᓂᑦ ᓇᓪᑕᐅᑦᑎᐅᑎᓂᒃ ᑐᓂᓯᒪᔪᖅᑐᑦ ᐃᓄᐃᑦᑐᓕᕆᓂᖅᑕᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 591

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓱᓗᑦ

Tatkiktaman nahaktauvaktun

Year 4 (June 1999 - May 2000)

ᐊᓐᖁᒍ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᓐᓄ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑦᑐᓗ	NOV ᐅᐊᓚᓗ	DEC ᑎᓯᓚᓗ	JAN ᔮᖏᓄᐊᓗ	FEB ᐃᖅᑲᐊᓗ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᖅ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	28	120	135	76	60	94	64	54	54	118	204	121	1,128 ± 106
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡						6						4	10
Wolf	ᐊᒪᓕᐅᑦ	Amagut											38	3	41 ± 37
Arctic fox	ᑎᓗᓚᖏᓂᐊᑦ	Tigiganiat									1		2		3 ± 2
Wolverine	ᖃᕐᕿᓵᑦ	Kalvik											4		4 ± 3
Ringed seal	ᓇᕆᑦ	Natiinat	70	66	92	52	42						2	32	356 ± 60
Bearded seal	ᐅᓚᐃᐃᑦ	Ukyuk	1	5	4	18	14								42 ± 13
Walrus	ᐊᐃᐅᓵᑦ	Akvik												5	5 ± 5
Beluga	ᖃᓄᖅᑕ ᖃᓪᓚᒃ	Kilalugak		17	74	25									116 ± 34
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	150											20	170 ± 45
Canada goose	ᓂᕆᓪᓕ ᐅᓄᐊᔪᓪᓕᓪᓕ	Nikliknik	163	1										79	243 ± 63
Goose eggs	ᑲᖏᐃᐃᑦ ᒪᓐᓂᖅᑕ	Uluaguliit manniit	135												135 ± 42
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖅᑕ	Tinmiat manniit	111												111 ± 69
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	491	876	420	71	47	143	45		68	73	61	66	2,361 ± 546
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	27		5	18						21	132	448	651 ± 215

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᔨᑦ ᑐᓴᖅᑕᑦ ᐅᑯᐊ ᐃᑯᐊᓕᓚᓇᕐᓂᖅᑎᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 592

Monthly hunter response

Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)

ᐊᑐᖏᒍ 4 (ᔨᓂᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑦᔪᕕᓂ	NOV ᐃᓄᓚᕕᓂ	DEC ᑎᓯᕕᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᐃᖅᕕᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓪᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓇᓂᑦ ᑭᐅᓂᖅᑐᑦ ᐊᑎᓯᒪᓂᖅᑐᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᒪᒻᒪᑦ ᐊᖏᓇᓂᑦ	Tatkitaman angunahuktut titigait	342	344	347	347	350	348	347	347	348	345	347	348	364*
Interview list	ᐊᐱᕐᓂᖓᓪᓗᐊᑦ	Apikiktan	202	205	208	207	209	208	208	209	209	208	209	210	221*
Hunters interviewed	ᐊᖏᓇᓂᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	184	158	155	157	153	153	151	155	158	149	132	132	200*
Harvested	ᐊᖏᓇᓂᐅᒥᓂᒃ	Angujaujut	55	48	35	25	18	15	10	11	14	22	33	49	114*
Response rate (%)	ᑭᐅᔭᓂ ᖃᓕᑎᓂᖓᓂᑦ (%)	Kiujut (%)	91	77	75	76	73	74	73	74	76	72	63	63	74**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓇᓂᑦ ᐊᑎᓕᑎᕐᓂᖅ/ᐊᐱᕐᓂᖓᓪᓗᐊᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᓇᓂᐅᒥᓂᒃ ᐊᑕᐅᓯᐊᓪᓚᖅ% ᐊᑐᑎᑦ ᐊᑦᔪᒥ.
** ᐊᑎᒋᓕᑎᓯᒪᔨᑦ ᑕᖏᒪᒻᒪᑦ ᑭᐅᔭᓂ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.3.5

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 593

Recall period between harvest and interview, expressed as % of total harvest records

Year 4 (June 1999 - May 2000)

ᐅᑎᕐᕕᐅᔭᑦ ᐊᑯᖏᓐᓄᑦ ᐊᖏᓇᓂᒃᑕᒃ ᐊᒻᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᓂᒃ, ᓇᓗᓇᐃᕐᑕᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᓇᓂᒃᑕᑦ ᑎᑎᕐᓂᑦᑕᐅᒪᔨᑦ

ᐊᑐᖏᒍ 4 (ᔨᓂᓂ 1999 - ᒪᐃ 2000)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑦᔪᕕᓂ	NOV ᐃᓄᓚᕕᓂ	DEC ᑎᓯᕕᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᐃᖅᕕᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓪᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔭᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	100	100	0	0	0	0	0	9	100	100	2	0	45
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	0	0	0	0	0	100	100	91	0	0	98	100	30
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	0	0	100	100	100	0	0	0	0	0	0	0	25

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 594

Number of hunters harvesting each species — **Year 4 (June 1999 - May 2000)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᓴᒋᑦ ᐊᖏᔪᓚᓴᒃᑯᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒃᑦᔪᒍ 4 (ᔦᓂ 1999 - ᒪᐃ 2000)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 4 (June 1999 - May 2000)**

Month/ᑕᖅᖑᒃ/Tatkia			JUN ᔦᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᒡᒎᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᐱᓗ	DEC ᑎᓴᐱᓗ	JAN ᒍᓐᓇᐊᓗ	FEB ᓇᖏᐅᐊᓗ	MAR ᒪᔪ	APR ᐃᔪᓕᓂ	MAY ᒪᐃ	Total ᑲᑎᑲᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑲᐃᐃᑦ	Tuktut	10	34	23	16	11	15	10	11	12	19	28	21	89
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut											3	1	4
Arctic fox	ᑎᓗᓚᓐᓂᐊᑦ	Tigiganiat									1		1		2
Wolverine	ᖃᕐᕿᓵᑦ	Kalvik											2		2
Ringed seal	ᓇᓂᓱᑦ	Natiinat	23	15	11	10	4						1	8	42
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk	1	2	2	4	5								8
Walrus	ᐊᐃᐃᓵᑦ	Akvik												2	2
Beluga	ᖃᑯᑦᑕᑦ ᖁᓪᓗᓚᑦ	Kilalugak		7	15	6									23
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq	15											1	16
Canada goose	ᓂᕐᓕᑦ ᐅᓕᐊᔪᓕᑦ	Nikliknik	18	1										8	26
Goose eggs	ᑲᖏᔪᐃᑦ ᒪᓂᓂᖅᑕ	Uluaguliit manniit	4												4
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᖅᑕ	Tinmiat manniit	1												1
Arctic char	ᐃᖏᓕᒃᐸᑦ	Ikaliviit	30	18	3	1	1	2	1		2	2	2	2	46
Lake trout	ᐃᓱᕐᕿᐃᑦ	Ikalukpik	3		1	1						1	7	20	29

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᓪᓚᓂᒃ ᐱᑕᖃᓂᖅᓴᖏᑦ ᐱᓕᐊᓕᓂᓂᒃ ᐊᖏᔪᒃᑯᑦ ᖃᑦᓯᐅᓂᖏᑦᓂᒃ ᐊᓂᒪᔨᓂᖏᑦ ᐊᓂᔪᓂᒃᑯᓐᓂᒃᑯᑦ. ᐃᓄᐃᑦᑐᑦᓯᐊᓂᓂ ᐃᓄᒃᖏᑦᓂᒃ ᐃᑯᐱᕐᓂᓕᓐᓂᒃᑯᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 595

Monthly harvest estimates
ᑕᖑᑦᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓱᓗᑦ
Tatkiktaman nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᓚᕐᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖑᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᑲᔪᑎ	SEP ᓱᑎᑲᓗ	OCT ᐅᑦᔪᐱᓗ	NOV ᐅᓇᑲᑲᓗ	DEC ᑎᓯᑲᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᔪ	APR ᐃᑦᓂᓚ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓕᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	72	33	55	94		33			24	35	61	4	411 ± 51
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					1								1
Ringed seal	ᓇᕐᓂᑦ	Natiinat	34	18	15	9				1	2				79 ± 24
Bearded seal	ᐅᓪᔾᔪᐃᑦ	Ukyuk	2	1	1	4									8 ± 3
Walrus	ᐊᐃᐃᓴᑦ	Akvik	5	2											7 ± 3
Narwhal	ᑐᓴᓪᓕᑦ ᖃᓪᓗᓂᑦ	Tuugaak		2	1										3 ± 1
Beluga	ᖃᐅᔨᑦ ᖃᓪᓗᓂᑦ	Kilalugak		4	28	22									54 ± 9
Snow goose	ᑲᖏᐃᑦ	Kanguq	42	17		8									67 ± 55
Canada goose	ᓄᓕᓪᓕᑦ ᐅᓪᐊᒍᓪᓕᑦ	Nikliknik	106												106 ± 83
Ptarmigan	ᐊᖏᓂᑦ	Akilgik						8							8 ± 4
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	551	407	60		71	155							1,244 ± 265
Lake trout	ᐃᓕᕐᕃᐃᑦ	Ikalukpik	114					41						562	717 ± 317

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᐃᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᓯᖏᑦ ᐅᑉᐊᓂᖅ ᐃᓄᐃᑦᑎᓕᕆᓂᖅᓴᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.3.5

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 596

Monthly hunter response
ᑕᖑᑦᒪᑦ ᐊᖏᔪᓕᓂᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)
ᐊᓚᕐᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖑᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᑲᔪᑎ	SEP ᓱᑎᑲᓗ	OCT ᐅᑦᔪᐱᓗ	NOV ᐅᓇᑲᑲᓗ	DEC ᑎᓯᑲᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᕐᔪ	APR ᐃᑦᓂᓚ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᓂᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᔾᔨᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖑᑦᒪᑦ ᐊᖏᔪᓕᓂᑎᑦ	Tatkitaman angunahuktut titigait	348	349	348	351	348	347	322	313	313	311	312	314	362*
Interview list	ᐊᐱᕐᓱᕐᓴᐃᑦ	Apikiktan	210	213	212	215	213	212	204	196	196	194	195	197	224*
Hunters interviewed	ᐊᖏᔪᓕᓂᑎᑦ ᐊᐱᕐᓱᕐᑕᑦ	Angunahuktin apikhuktan	133	190	190	189	132	185	167	121	122	119	121	119	202*
Harvested	ᐊᖏᔪᓕᓂᑎᑐᒥᓂᓪ	Angujaujut	34	31	34	37	1	7	0	1	9	7	12	24	82*
Response rate (%)	ᑭᐅᔾᔨ ᖃᓪᓗᓂᖏᑦ (%)	Kiujut (%)	63	89	90	88	62	87	82	62	62	61	62	60	72**

* Hunters registered/on interview list/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓕᓂᑎᑦ ᐊᑎᓕᐅᔾᔨᓕᕆᓂᖅ/ᐊᐱᕐᓱᕐᓴᐃᑦ/ᐊᐱᕐᓱᕐᑕᑦ/ᐊᖏᔪᓕᓂᑎᑐᒥᓂᓪ ᐊᑕᐅᓯᐊᕐᓗᓂᑦ ᐊᑎᑎᖅ ᐊᓚᕐᔪᒥ.
** ᐊᐅᓚᑦᓂᕐᒪᓕᔪᑦ ᑕᖑᑦᒪᑦ ᑭᐅᔾᔨᑦ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 597

Recall period between harvest and interview, expressed as % of total harvest records

Year 5 (June 2000 - May 2001)

ᐅᑎᕆᐃᐅᔪᑦ ᐊᑯᕆᖏᓂ ᐊᖓᔪᓇᓴᓂᖓᖏᑦᑕ ᐊᒻᒪᓗ ᐊᐱᕆᔨᑎᑕᐅᓂᖓᖏᑦᑕ, ᓇᓗᓇᐃᕆᑦᑕ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖓᔪᓇᓴᑦᑕ ᑎᑎᕆᑎᑕᐅᒪᔪᑦ

ᐊᒻᒪᓕᒐ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕿᖓᖅ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑦᑐᑎ	SEP ᓯᑎᕕᓇ	OCT ᐅᑦᑐᕕᓇ	NOV ᐅᓇᓚᕕᓇ	DEC ᑎᓴᕕᓇ	JAN ᒎᓄᐊᓇ	FEB ᓇᕿᑦᐊᓇ	MAR ᒪᕆ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕆᐃᐅᔪᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕿᑦ	≤ tatkin pingahut	32	100	100	100	100	100	0	100	100	100	100	100	89
4-6 months	4-6 ᑕᕿᑦ	tatkin hitaman 6nut	68	0	0	0	0	0	0	0	0	0	0	0	11
> 6 months	> 6 ᑕᕿᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

6.3.5

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 598

Number of hunters harvesting each species

Year 5 (June 2000 - May 2001)

ᖃᑦᓯᐅᓂᖓᑦ ᐊᖓᔪᓇᓴᒋᑦ ᐊᖓᔪᓇᓴᕐᕕᒋᑦ ᐊᑐᓂᒃ ᐅᒪᔨᔪᓂᒃ

ᐊᒻᒪᓕᒐ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕿᖓᖅ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑦᑐᑎ	SEP ᓯᑎᕕᓇ	OCT ᐅᑦᑐᕕᓇ	NOV ᐅᓇᓚᕕᓇ	DEC ᑎᓴᕕᓇ	JAN ᒎᓄᐊᓇ	FEB ᓇᕿᑦᐊᓇ	MAR ᒪᕆ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	16	14	19	26		6			7	7	12	2	57
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Ringed seal	ᓇᕐᔪᑦ	Natiinat	7	9	5	5				1	2				21
Bearded seal	ᐅᑉᔪᐃᑦ	Ukyuk	1	1	1	3									6
Walrus	ᐊᐃᐃᓴᑦ	Akvik	3	2											5
Narwhal	ᑐᓴᓂᑦ ᖃᓪᓚᑦ	Tuugaak		2	1										3
Beluga	ᖃᐅᓕᑦ ᖃᓪᓚᑦ	Kilalugak		3	14	6									20
Snow goose	ᑲᖏᐃᑦ	Kanguq	1	1		2									4
Canada goose	ᓄᑦᓂᑦ ᐅᓪᐊᒍᓂᑦ	Nikliknik	5												5
Ptarmigan	ᐊᖏᓕᑦ	Akilgik						1							1
Arctic char	ᐃᖃᓗᐊᑦ	Ikaliviit	12	12	4		1	5							27
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	1					1						22	23

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕆᓭᒪᔪᓂᒃ ᐱᑕᖃᖅᖏᑐᖅ ᐱᓕᕐᓂᓐᓂᒃ ᐊᖏᔪᑦ ᖃᕆᑦᐅᓂᖓᖏᓐᓄᑦ ᐊᓪᓚᖅᑕᒪᔪᓂᑦ ᐊᖏᔪᓄᑦ ᓇᓪᑕᐅᕆᔨᓂᖓᓂ ᑐᓂᐅᖅᑐᓂ ᐃᓕᓴᕆᔨᓂᓗᓂᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 599

Annual harvest estimates and five-year mean

ᐊᓐᓴᔪᒪᓪᓗᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓇᓕᑦ ᐊᓚᓗ ᑕᓪᓕᒪᓄᑦ-ᐊᓐᓴᔪᓄᑦ ᐊᐅᓚᑦᓯᕐᓂᓱᒪᓴᑦ 2001)

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓐᓴᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ

Study Year/ᖃᐅᔨᓴᖅᓯᒪᔪᑦ ᐊᓐᓴᔪ/Ihivgiukimayut Ukiumi			1†	2†	3	4	5	Mean ᐊᐅᔨᑦᓯᕐᓂᓱᒪᓴᑦ Amigaitkiyait
			96/97	97/98	98/99	99/00	00/01	
Species	ᐅᒪᓴᑦ	**Umajuin**						
Caribou[1]	ᑐᖅᑐᐃᑦ[1]	Tuktut[1]	1,615	724	982	1,128	411	989
Musk-ox[2]	ᐅᒥᓴᒪᐃᑦ[2]	Umingmait[2]	3	1	6	0	0	2
Polar bear[3]	ᓇᓄᐃᑦ[3]	Nanuit[3]	12	11	13	10	1	9
Wolf[4]	ᐊᒪᓗᐃᑦ[4]	Amagut[4]	27	17	84	41	0	34
Arctic fox[5]	ᑎᓚᓱᓐᓂᐊᑦ[5]	Tigiganiat[5]	171	39	33	3	0	49
Wolverine[6]	ᖃᖏᐃᑦ[6]	Kalvik[6]	1	0	5	4	0	2
Arctic hare[7]	ᐅᑲᓪᓚᑦ[7]	Ukalik[7]	11	2	0	0	0	3
Seals (unspecified)[8]	ᓴᖅᑯᓪᓚᑦ[8]	Natiit[8]	81	26	15	0	0	24
Ringed seal[8]	ᓇᓱᓪᓚᑦ[8]	Natiinat[8]	186	55	60	356	79	154
Bearded seal[8]	ᐅᓚᐊᐃᑦ[8]	Ukyuk[8]	24	14	7	42	8	20
Walrus	ᐊᐃᐅᓴᑦ	Akvik	5	2	5	5	7	5
Narwhal[9]	ᑐᓴᓪᓚᑦ ᖃᓪᓗᓂᑦ[9]	Tuugaak[9]	1	0	0	0	3	1
Beluga[10]	ᖃᐅᔨᑦ ᖃᓪᓗᓂᑦ[10]	Kilalugak[10]	110	23	22	116	54	73
Geese (unspecified)	ᓄᖅᓪᓚᑦ	Kanguk	47	0	0	0	0	9
Snow goose	ᑲᖏᐃᑦ	Kanguq	76	13	177	170	67	101
Canada goose	ᓄᖅᓪᓚᑦ ᐅᓗᐊᔪᓪᓚᑦ	Nikliknik	142	17	154	243	106	132
Eider duck	ᒥᑎᑦ	Kingalik	6	0	0	0	0	1
Ptarmigan[11]	ᐊᖏᕆᑦ[11]	Akilgik[11]	81	15	238	0	8	68
Goose eggs[12]	ᑲᖏᐃᑦ ᒪᓕᓂᖏᑦ[12]	Uluaguliit manniit[12]	34	0	0	135	0	34
Duck eggs[12]	ᒥᑎᑦ ᒪᓕᓂᖏᑦ[12]	Tinmiat manniit[12]	28	0	0	111	0	28
Fish (unspecified)	ᐃᖏᓗᐃᑦ	Ikaluit	51	78	4	0	0	27
Arctic char[13]	ᐃᖏᓗᕆᐊᑦ[13]	Ikaliviit[13]	6,413	1,227	1,514	2,361	1,244	2,618
Lake trout	ᐃᓱᓴᐃᑦ	Ikalukpik	474	202	555	651	717	521
Cod	ᐅᒪᐃᑦ	Ugak	0	0	25	0	0	5

† No data were collected in June 1996 (year 1), and from September 1997 to February 1998 (year 2). Annual harvest estimates for years 1 and 2 were obtained by using the average of the harvest estimates for the corresponding months in the three or four years in which data were collected.

[1-13]: See page 724 for community feedback and other sources of data.

† ᓇᓴᐃᖏᓐᓇᕆᐅᖓᓂᖅ ᐅᕐᓂ ᔦᓂ 1996 (ᐊᓚᔪ 1), ᐊᒪᓗ ᐅᕐᖏᓐᓂ ᓯᑎᐱᓚ 1997 ᐅᑐᖓ ᐃᓕᖅᐊᓚ 1998 (ᐊᓚᔪ 2). ᐊᓚᔪᓕᒻᒪᓂ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓇᓕᑦ ᐊᓚᔪᑲᓂᑦ 1 ᐊᒪᓗ 2 ᐱᑕᓕᐅᑐᑦ ᐊᑐᑎᓂ ᐊᐅᔨᑦᓯᕐᓂᓱᒪᓴᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓇᓕᑦ ᑕᒥᓂᕐᓂᐊᓘᓐᓃᑦ ᖃᖏᓂ ᑭᐅᓇᓂ ᐱᖓᓱᓂ ᐅᕐᓴᓗᓐᓂᑦ ᑎᑎᒪᓂ ᐊᓚᔪᓂ ᓇᓗᐃᖏᐅᔨᓂᖅ.

[1-13]: ᑕᐃᔭ ᒪᐱᑐᒃ 726 ᓄᓇᓕᑦ ᑭᐅᔨᐊᑎᑦ ᐊᒪᓚ ᐊᓯᖏᑦ ᐱᖁᐅᑦ ᓇᓗᐅᑎᓂᖅ.

† Katikhihimaitut June 1996 (ukiuk hivulik), September 1997min tikitlugu February 1998 (aipani ukiumi). Ukiungani angujaumajut ukiungani hivulikmi aipanilu tatkit atukhugin pingahunun hitamanutlunit tamna atugauluni nahaktaumajut.

[1-13]: Takulugu makpigaak 728 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 600

Annual hunter response

ᐊᓚᖏᔪᑦᒪᑦ ᐊᖓᔪᓂᕆᔨᑦ ᑭᐅᓂᖅᑎᑦ

Angujauvaktu

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓚᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖓᔪᓂᕆᔨᑦ ᑭᐅᓂᖅᑎᑦ ᐊᑐᔪᒪᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᕐᑕᒻᒥᑦ ᐊᖓᔪᓂᕆᔨᑦ	Tatkitaman angunahuktut titigait	379	372	367	364	362	424*
Interview list	ᐊᐱᕐᓂᖅᓯᑦ	Apikiktan	253	218	215	221	224	324*
Hunters interviewed	ᐊᖓᔪᓂᕆᔨᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	247	210	204	200	202	302*
Harvested	ᐊᖓᔪᓂᕆᑐᒃᑯᑦ	Angujaujut	142	89	114	114	82	200*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖅᑎᑦ (%)	Kiujut (%)	83	86	92	74	72	82**

* Hunters registered/on interview list/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖓᔪᓂᕆᔨᑦ ᐊᑎᓕᐅᔨᒪᔪᓐᓇᖅᑐᓂᑦ/ᐊᐱᕐᓂᖅᓯᒪᔪᓐᓇᖅᑐᓂᑦ/ᐊᐱᕐᓂᑦ/ᐊᖓᔪᓂᕆᑐᒃᑯᑦ ᐊᑕᐅᓂᐸᓗᓂ% ᐊᑎᑎᖅ ᖃᐅᔨᓴᖅ.
** ᐃᓕᓴᕐᓂᑎᒪᓕᕆᔨᑦ ᐊᓚᖏᔪᑦᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaujukhat/apikhiktaunikut/anguhimajut taipfumuna tahapkuan kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

6.3.5

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 601

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᕆᔨᑦ ᐊᑯᖏᓂᒃ ᐊᖓᔪᓂᕐᓂᖏᓐᓂᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᓂᑕ, ᓇᓗᓇᐃᖏᑦ ᐃᒪᓐ % ᑲᑎᒪᔨᑦ ᐊᖓᔪᓂᕆᑦᑕ ᑎᑎᕐᕕᑦᑕᐅᒪᔪᑦ

Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᓚᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᒍ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᕆᔨᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᕐᑕᑦ	≤ tatkin pingahut	80	68	81	45	89	73
4-6 months	4-6 ᑕᕐᑕᑦ	tatkin hitaman 6nut	13	13	19	30	11	18
> 6 months	> 6 ᑕᕐᑕᑦ	> 6 tatkin	7	18	0	25	0	9

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 602

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓇᓗᒍᑎᑦ ᐊᖏᔪᓇᓗᐸᓪᓕᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ
Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓂᑦ ᐊᑲᕿᒍᑦ (ᐋᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᕆᔨᒃ ᐊᑦᕿᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᑐᑦ Tamakiklugin
Species	**ᐅᒪᔨᑦ**	**Umajuin**						
Caribou	ᑐᑐᐃᑦ	Tuktut	118	66	87	89	57	166
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait	2		4			5
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut	5	4	20	4		27
Arctic fox	ᑎᓚᑦᓂᐊᑦ	Tigiganiat	11	1	5	2		15
Wolverine	ᖃᕐᕿᒋᑦ	Kalvik	1		3	2		5
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik	5					5
Seals (unspecified)	ᓯᖏᑯᓪᓕᑦ	Natiit	20	9	11			32
Ringed seal	ᓇᓕᓗᑦ	Natiinat	24	3	30	42	21	73
Bearded seal	ᐅᑭᔪᐃᑦ	Ukyuk	9	1	5	8	6	19
Walrus	ᐊᐃᐃᓴᑦ	Akvik	3	2	4	2	5	14
Narwhal	ᑐᐊᓪᓕᑦ ᕿᓪᓚᒃ	Tuugaak	1				3	4
Beluga	ᖃᐅᕐᑦ ᕿᓪᓚᒃ	Kilalugak	20	1	5	23	20	50
Geese (unspecified)	ᓄᕐᓪᓕᑦ	Kanguk	1					1
Snow goose	ᑲᖏᐃᑦ	Kanguq	6	1	23	16	4	37
Canada goose	ᓄᕐᓪᓕᑦ ᐅᓪᐊᒍᓪᓕᑦ	Nikliknik	11	2	18	26	5	52
Eider duck	ᒥᑎᑦ	Kingalik	2					2
Ptarmigan	ᐊᕐᓚᑦ	Akilgik	11	1	4		1	16
Goose eggs	ᑲᖏᐃᑦ ᒪᓐᓄᖅᑦ	Uluaguliit manniit				4		4
Duck eggs	ᒥᑎᑦ ᒪᓐᓄᖅᑦ	Tinmiat manniit				1		1
Fish (unspecified)	ᐃᖏᓪᓕᑦ (ᓇᓪᓄᐃᑦᑕᐅᖅᑎᑦ)	Ikaluit	3	15	1			19
Arctic char	ᐃᖏᓪᑲᒃᐸᑦ	Ikaliviit	66	3	39	46	27	105
Lake trout	ᐃᓱᑦᕆᑦ	Ikalukpik	29	22	31	29	23	89
Cod	ᐅᓴᐃᑦ	Ugak			3			3

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕐᓯᒪᔨᐅᓂᒃ ᐱᑕᖃᖅᑎᑦᑐᓂᒃ ᐱᓕᕆᓪᓗᓂᒃ ᐊᖏᔪᑦ ᖃᕐᓯᐅᓂᖅᑐᓄᑦ ᐊᓪᓚᕆᐅᓂᒃ ᐊᓪᓚᔪᓄᑦ ᓇᓪᓕᐊᓂᖅᓯᒪᓂᖅ ᑐᓄᓴᖅᑎᓂᒃ ᐃᓕᓴᕐᓂᖅᓯᒪᓂᖅ ᐃᓄᐃᑦᑐᓕᕆᓂᖅᓯᒪᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.3.5 Community Results Discussion: Rankin Inlet

Although data collection in most communities began in July 1996, in Rankin Inlet delays were encountered and data collection began one month late in August 1996. Further problems encountered during data collection resulted in missing data from September 1997 to February 1998. In April 2001, a letter was written to the Nunavut Implementation Panel and cc'ed to the relevant RWOs and HTOs informing them of the missing data. The letter also demonstrated the NWMB's approach to the problem, detailing the use of collected data to estimate for the missing months. The Nunavut Implementation Panel accepted the NWMB's approach to the issue in June 2001. As such, there are no data (n/d) displayed for the months in which no data were collected in Rankin Inlet. In order to estimate the total yearly harvest in years 1 and 2, estimates for the missing months were obtained by calculating the mean harvest for the corresponding months in the four years in which data were collected.

The survey frame:
An assessment of under-enumeration during the community visit indicated that there were very few Inuit hunters who were not registered in the Harvest Study. It is estimated that there were 13 non-Inuit hunters with assigned hunting rights who were not registered – all occasional hunters. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. However, the extent of the bias is likely very small since the missing hunters only represent three percent of the total hunter population (Table 10).

Survey coverage and non-response bias:
Response rates were generally very good in the first three years of the study (with the exception of the months in which no data were collected). In the final two years of the study response rates began to fall in some months with rates dropping below 75% in the final months of the study. As seen in Table 9 the consistent intentional non-response rate in Rankin Inlet was high, at 14.8%, resulting in a high potential for non-response bias. Given this and the low response rates in the final two years of the study, the potential for both sampling error and non-response bias is high.

Response rates were felt to be high enough and non-response bias low enough during years 1 to 3 (with the exception of the months in which no data were collected) to ensure that n did in fact constitute a sufficiently representative sample of N hunters. Readers should exercise caution when using the data collected during the last two years of the study.

Measurement issues and response error:
It was reported during the community visit that some hunters did not keep track of the number of eggs harvested. Further details are provided in the community feedback and other sources of data section below. Section 5.4 also contains a thorough discussion of this issue.

As seen in the recall period tables, most months in years 3 and 5 had short recall periods with the majority of harvest records having been collected within three months of the harvest, minimizing measurement error due to recall failure. However, recall periods were much longer, over six months in some cases, during some months in year 1, year 2 and several months in year 4. Recall error in these instances is more likely.

Records provided by DFO confirm that commercial quotas were issued for arctic char throughout the Harvest Study (DFO F). However, as indicated in the comments relating to arctic char, very few of these harvests were reported during the study. It is also evident when assessing the quantities of char reported by hunters that the vast majority of harvests were for subsistence and not for commercial sale.

Although there is not a large scale commercial harvest of caribou in Rankin Inlet, some animals are sold commercially to the local meat plant. These animals were designated as such in the database, and were later removed and do not make up part of the harvest estimates shown in the data tables.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou. The harvest estimate in year 5 seems too low; it was reported that the estimate in year 4 looked more typical and accurate (C.F.). Some caribou were harvested and sold to the local meat plant. These entries were removed from the database and can be viewed in Table 4.
2. **Musk-ox:** The annual quota was 5 animals; however, they were not always all taken. Hunters travel large distances to harvest musk-ox (C.F.).

[3] **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).

[4] **Wolf:** Harvest estimates seem too low, especially in year 5 when none were reported. There are wolves harvested every year (C.F.). In order to verify harvest estimates, data were obtained from DSD detailing the number of pelts sold by hunters. DSD reports were available for 1999/2000 and 2000/2001 (years 4 and 5) and indicate that 62 wolf pelts were purchased from Rankin Inlet hunters in 1999/2000 (year 4) and 25 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). Both of these numbers exceed the harvest estimates confirming that estimates are low in these years.

[5] **Arctic fox:** Similarly, arctic fox are harvested every year and the data indicating no harvests reported in year 5 seems inaccurate (C.F.). Again DSD records were consulted for 1999/2000 and 2000/2001 (years 4 and 5) and revealed that 175 arctic fox pelts were purchased from Rankin Inlet hunters in 1999/2000 (year 4) and 107 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). Both of these numbers exceed the harvest estimates confirming that estimates are low in these years.

[6] **Wolverine:** Hunters report that wolverines are harvested every year and data from years with no reported harvests appear inaccurate (C.F.). There were no records of wolverine pelts purchased from hunters by DSD (DSD FB) however DSD staff confirms yearly harvests of wolverine of up to 15 animals.

[7] **Arctic hare:** Although harvesting of hare has declined over the years it was reported that some are taken every year (C.F.).

[8] **Seals:** The seal harvest consisted of both ringed seal and bearded seal. Seals (unspecified) would be one of these two species. Harvest estimates seem accurate (C.F.).

[9] **Narwhal:** Hunters travel to the Repulse Bay area to harvest Narwhal. DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
7	0	2	2	7

[10] **Beluga:** DFO reports the following harvest numbers for beluga (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
48	48	35	n/d	45

[11] **Ptarmigan:** Although harvesting changes from year to year due to changes in abundance in the area, some are harvested every year (C.F.).

[12] **Eggs:** Nesting areas are not abundant in the area, eggs are difficult to find but people do harvest some every year. Occasionally some people harvest snow geese eggs from around the Arviat area. They also harvest some arctic tern eggs (none reported). It was reported that all egg numbers seem low since many people do not count their eggs and therefore did not report them (C.F.).

[13] **Arctic char:** There was some commercial fishing of arctic char throughout the study (DFO F). However, it is felt that much of it was not reported. There were a few entries in the Harvest Study database which indicated that the harvest was commercial. These were removed from the database and can be viewed in Table 4. Harvest estimates are thought to be fairly accurate for subsistence harvesting only (C.F.).

6.3.5 ᓄᓇᕗᑦ ᓴᖅᑭᑕᕐᕕᐊᓂᒃ ᐅᖃᖅᑎᑐᑦᑕᑎᑦ: ᑲᑎᖅᓯᓂᖅ

ᐊᑦᓯᑕᐅᔨᓴᓂᒃ ᓄᐊᕐᑎᓚᐅᑦᓯᐊᓂᖅ ᐱᑎᐊᖅᑐᓯᑕᐅᕐᓴᐊᖅᑎᑦᓯᔪᔪ ᐅᓄᓂᖅᓴᓂ ᓄᓇᕗᑦᓯᓂ ᐅᓪᓗᕆᐊᖃᓂ 1996ᒥ ᑲᑎᖅᓯᓂᕐᓂᒥ ᑭᖑᓪᓕᐊᖅᑐᓯᑕᐅᖅᑐᑦ ᐊᒻᒪᓕ ᐱᑎᐊᓕᑕᐃᓇᖅᑕᑦᑎᓂᒃ ᑕᖅᑭᓕᒫᒥ ᑭᖑᓪᓕᐊᖅᑐᑦ ᐊᒻᒪᓗ 1996ᒥ. ᐊᐅᓚᓱᑦᑐᓕᖅᓯᓕᕐᓂᕐᕋᓂᒃ ᓄᐊᕐᑎᓚᐅᑦᓯᐊᓂᖅ ᐊᑦᓯᓕᕐᓂᕐᕋᓂᒃ ᓴᓇᔨᓕᕐᓂᖅ 1997ᒥᑦ ᐃᓕᓴᐊᓕ 1998ᒧᑦ. ᐃᐱᓕ 2001ᒥ, ᑎᑎᕋᖅᑕᐅᑉᐳᓕᖅᑐᑦ ᓄᓇᕗᑦ ᐊᑐᓕᖅᑎᑎᓯᑦ ᐊᒻᒪᓗ ᑐᓂᓯᑎᑦᑎᓂᒃ ᐊᓱᓕᖅᑭᑐᓂᒃ ᐊᐃᑕᑐᖅᑐᓯᓕᕐᓂᖅᑐᑦ ᐅᓚᓕᓕᓴᕐᓂᖅᓄᑦ ᐊᒻᒪᓗ ᐊᖏᓂᖅᑐᑐᓂᓕᕐᓂᖅᓄᑦ ᑐᓴᖅᑎᑎᑕᐅᕐᓴᐊᖅᑎᑦᑎᓂᒃ ᐊᑦᓯᓕᕐᓂᕐᕋᓂᒃ ᐱᐅᓕᕐᓂᖅ. ᑎᑎᖅᑲᓂ ᑕᐃᑎᓯᓕᕐᓂᖅᑐᑦ ᓄᓇᕗᑦ ᐅᓚᓕᓕᓴᕐᓂᕐᕋᓂᒃ ᓴᓇᓐᖓᔪᓄᑦᓯᓕᕐᓂᖅᑐᑦ ᐊᐃᑕᑐᖅᑐᓯᓕᕐᓂᖅᑐᑦ ᐊᑦᓯᓕᕐᓂᕐᕋᓂᒃ ᐱᓕᕐᓂᖅ. ᑎᑎᖅᑲᓂ ᑕᐃᑎᓯᓕᕐᓂᖅᑐᑦ ᓄᓇᕗᑦ ᐅᓚᓕᓕᓴᕐᓂᕐᕋᓂᒃ ᐊᐃᑕᑐᖅᑐᓯᓕᕐᓂᖅᑐᑦ ᐊᑦᓯᓕᕐᓂᕐᕋᓂᒃ

[3] **ᓇᓂᐃᑦ:** ᐊᓴᐅᑎᑦ ᑕᒻᒃᖏᓴᐅᔪᑦ ᒥᑦᓴᐅᓯᑎᑐᐃᓐᓇᐅᖏᑦᑐᑦ ᑭᓯᐊᓂ ᐃᓴᖅᑕᐅᓯᒪᓕᕆᔨᖅᑐᑦ ᓄᓇᕐᑦ ᓴᓐᒪᖏᑦ ᐃᒻᒪᕐᓂᓕᓴᐅᖏᑎᒃᓴᑦ (DSD PB).

[4] **ᐊᒪᒪᖅ:** ᐱᔾᐅᔪᑦᑐᑦ ᖃᑎᖅᐅᓂᖏᑦ ᐊᑎᓕᐊᖅᑐᐃᒃᖅᑐᑦ, ᐱᓕᐊᖅᓯᒪ ᐅᑭᐅᒥ 5 ᐅᖃᐅᓯᐅᔪᖃᖅᓯᓂᐊᓐᓇᒍ. ᐊᒪᖅᑭᓕᓵᓐᓇᔪᑦᑐᑦ ᐊᑎᖏᓐᓇᖅᑐᑦ (C.F.). ᓄᓕᓇᐃᖅᑕᐅᑎᕐᓯᒪᓕᑦᑐᑦ ᐊᒪᒪᖅᑕᒥᓂᑦ, ᖃᑦᓕᑕᐅᓯᒪᔪᑦ ᐱᔾᐅᓕᐅᖅᑐᑦ ᐃᓯᐊᐃᓂᕐᓇᓕᖅᑐᓂᑦ ᓄᓇᕐᓇᐃᓕᔪᑦ ᖃᑎᖅᑐ ᐊᒪᒪᐃᑦ ᓂᐅᕐᑕᐅᓂᖅᓯᓂᒃᑕᒍᑦ ᐊᓯᐊᐃᓂᕐᓇᓕᖅᑐᓂᑦ 1999/2000ᒧᑦ ᐊᒻᒪ 2000/2001 (ᐅᑭᐅᓂ 4 ᐊᒻᒪ 5) ᑕᐃᑎᑦᓯᓗᑎᑐ 62ᓂᑦ ᐊᒪᒪᔾᔪᓂᑦ ᓂᐅᐃᓕᐅᓇᐊᖏᑦᓂᑦ ᑲᖏᖅᓴᓂᕐᒥ ᐊᖏᓪᓗᓯᑎᐅᔪᓂ 1999/2000ᒥ (ᐅᑭᐅᖏᑦᓂ 4) ᐊᒻᒪᓗ 25ᓂᑦ 2000/2001ᒥ (ᐅᑭᐅᖏᑦᓂ 5) (ᖃᐅᔨᒪᓂᑦ ᐃᓯᐊᐃᓕᓵᓐᓇᔪᑦ ᐃᓴᐅᑎᖏᑦᓂᑦ ᒪᓕᒻᒪᒃ ᐱᑎᐊᖃᖅᖏᓐᓂᒃᑐᑦ ᔪᓕᐊᑦ, ᖃᐅᔨᓴᓪᓕᐊᓕ ᐊᑦᓕᑕᐅᓯᒪᔪᐃᑦ ᒪᓕᒻᒪᒃ ᐱᑎᐊᖃᖅᓂᓗᒍ ᔪᓕᓂᑦ Lᐃᒧᑦ) (DSD FB). ᑕᒪᓕᒃᑐ ᐃᓴᐅᑎᑦ ᐅᖃᓕᑦᑐᐃᓯᒪᔪᑦ ᐅᖃᐅᓯᐅᓯᒪᔪᓂᒃ ᐊᒪᓕᖅᑕᐅᔪᕆᓂᖅᓂᒃ ᓇᓗᓇᐃᑭᑕᐅᓪᓗᓂ ᖃᑎᖅᑐᓂᖏᑦᓂᑦ ᐊᑎᑎᑦᑐᑭᖅᑐᖅᓂᒃ ᐅᑭᐅᓂ ᑭᓱᓕᕐᓂᒃ.

[5] **ᑎᓚᖅᓂᐊᖅ:** ᑕᐃᒪᓕᑕᐅᖅ, ᑎᓚᖅᓂᐊᓂ ᐱᔾᐅᔪᑦᑐᑦ ᐊᑎᖏᓐᓇᖅᑐᑦ ᐊᒻᒪᓗ ᐊᓂᕐᑕᐅᔪᕆᓂᓪᓂ ᐅᖃᐅᓯᐅᔪᖃᖅᑎᖅᓇᒍ ᐅᑭᐅᖏᑦᓂ 5 ᑕᒪᓕᖅᓯᒪᔪᓂᑦ (C.F.). ᓯᓚᓗ ᐃᓯᐊᐃᓕᓵᓐᓇᔪᑦ ᐊᓂᕐᓇᓯᒪᔪᖅᑎᖅᑎᖅᓇᒍ ᐅᑭᐅᖏᑦᓂ 1999/2000ᒧᑦ ᐊᒻᒪ 2000/200ᒧᑦ (ᐅᑭᐅᖏᑦᓂ 4 ᐊᒻᒪ 5) ᑕᐃᑎᑦᓯᓗᑎᖅᑐᑦ 175ᓂᑦ ᑎᓚᖅᓂᐊᖏᑦᓂᑦ ᓂᐅᐃᓕᐅᓇᐊᖏᑦᓂᑦ ᑲᖏᖅᓴᓂᕐᒥᑦ ᐊᖏᓪᓗᓯᑎᐅᔪᓂ 1999/2000ᒥ (ᐅᑭᐅᖏᑦᓂ 4) ᐊᒻᒪ 107 ᓂᐅᐃᓕᐅᓇᐊᖏᑦᓂᑦ 2000/2001ᒥ (ᐅᑭᐅᖏᑦᓂ 5) (ᖃᐅᔨᒪᓂᑦ ᐃᓯᐊᐃᓕᓵᓐᓇᔪᑦ ᐃᓴᐅᑎᖏᑦᓂᑦ ᒪᓕᒻᒪᒃ ᐱᑎᐊᖃᖅᖏᓐᓂᒃᑐᑦ ᔪᓕᐊᑦ, ᖃᐅᔨᓴᓪᓕᐊᓕ ᐊᑦᓕᑕᐅᓯᒪᔪᐃᑦ ᒪᓕᒻᒪᒃ ᐱᑎᐊᖃᖅᓂᓗᒍ ᔪᓕᓂᑦ Lᐃᒧᑦ) (DSD FB). ᑕᒪᐅᑦ ᐃᓴᖅᓯᒪᔪᑦ ᐅᖃᐅᓯᐅᓯᒪᔪᓂᑦ ᐅᖃᐅᓯᐅᔪᖃᖅᑎᖅᓇᒍ ᐅᑭᐅᖏᑦᓂ ᐅᓇᓗᓇᐃᑭᑕᐅᓪᓗᓂ ᖃᑎᖅᑐᓂᖏᑦᓂᑦ ᐊᓂᕐᑕᐅᔪᕆᓂᖅᓂᒃ ᐅᑭᐅᓂ ᑭᓱᓕᕐᓂᒃ.

[6] **ᖃᐅᔨᓴᑦ:** ᐊᖏᓪᓗᓯᑎᐅᔪᑦ ᐅᖅᓯᒪᔪᖅᑐᑦ ᖃᐅᔨᓴᑦ ᐱᔾᐅᔪᑦᑐᑭᓯᒪᓕᖅᑐᖅᓂᒃ ᐅᑭᐅᓂ ᐊᑎᖏᓐᓇᖅᑐᑦ ᐅᑭᐅᓂ ᐱᓕᕆᔨᖅᑐᑎᒃᓴᐅᓗᒍ ᑕᒪᓕᖅᓯᒪᔪᓂᑦ (C.F.). ᐊᑎᓕᐊᖅᓯᒪᔪᑦᑐᑦ ᖃᐅᔨᓴᖅᑎᑦᓴᑦ ᓂᐅᐃᓕᐅᓇᐊᖏᑦᓂᑦ ᐊᖏᓪᓗᓯᑎᐅᔪᓂ ᐊᒻᒪᓕᒫᓂᑦ ᐃᓯᐊᐃᓕᓵᓐᓇᔪᑦᑐᒍᑦ(DSD FB) ᑭᓯᐊᓂ ᐃᓯᐊᐃᓕᓵᓐᓇᔪᑦ ᓇᓗᓇᐃᖅᑐᓕᖅᓯᒪᓕᑦᑐᑦ ᐅᑭᐅᓂᑕᒥ ᖃᐅᔨᓴᖅᑎᑦᓴᑦᑐᑦ ᐊᑎᖏᓐᓇᖅᑐᑦ ᐊᒻᒪᓗ ᐊᓂᕐᑕᐅᔪᕆᓂᖅᓂᒃ ᐃᓯᐊᐃᓕᓵᓐᓇᔪᑦ ᐃᓴᐅᑎᖏᑦᓂ

6.3.5 Nunanit Iniktigutait Ukauhiit: Kangiklinik

Pihimagaluakhutik katitikhimayut katitigutait amigaituni nunani piliktut July 1996mi, Kangiklinikmi kiguvakhimavaktut pivaktut ovalo katitikhimayut katitigutait pilikpaktut atauhimik tatkikhiutini Augustmi 1996mi. Ayofaakhimayut piliktitlugit katitikhimayut katitigutaini pipkaihimayuk pihimaitunik katitikhimayunik Septembermit 1997 Februarymut 1998. Aprilmi 2001, titikamik titigakhimayut Nunavumi Iniktiligiyit Katimayigalaanut ovalo aatjikutaanik tuyukhimayut RWOkunut ovalo HTOkunut tuhaktitivlugit pihimaitut katitikhimayut. Titigak takupkaihimayuk NWMBkut atuniaktait ihumagiyainik, titigakhimaplutik atugutikhainik katitigutait katitikhimayut nanaiyagiami pihimaitut tatkikhiutit. Nunaumi Iniktiligiyit Katimayigalaat angikhimayait NWMBkut atugumayait ihumagiyainik Junemi 2001. Taimaimat pikangitut katitikhimayunik (n/d) takuyauhimayuni tatkikhiutini katitikhimayukhanik katitikhimaitut Kangiklinikmi. Piyaami naunaiyautait tamaat ukiuni umayukhiukhimayut ukiumi 1mi ovalo 2mi, naunaiyautait pihimaitut tatkikhiutini pihimayut naunaiyakhugit anginikhaat umayukhiukhimayut aatjikutaini tatkikhiutini hitamani ukiuni katitigutit katitikhimayut.

Ihivgiugutit Atugutait:
Ihivgiufaakhimayut ataani naunaiyakhimayut nunamut pulaakhimatitlugit pihimayut ikitut Inuit umayukhiuktit titigaktauhimaitut Umayukhiukhimayuni Ihivgiuktuni. Naunaiyakhimayuk 13kuyt Inuinauntitut umayukhiuktit tuniyauhimayut inminiigutinik umayukhiugutinik titigaktauhimaitut – tamamik ilaani umayukhiukataktut. Ukahimayut ilangani 5.2.1 ikpinagutait hamna ataani naunaiyakhimayut pilaakhimaut ataanut ihumagiyaini umayukhiukhimayut naunaiyautaini. Kihimi,kanugitjutait ihumagiyauyut mikiyut titigaktauhimaitut umayukhiuktit pihimamat 3%nik tamaat umayukhiuktit (ikpatauyak 10).

Ihivgiukatagutait ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait nakuuyut hivulimi pingahut ukiugini ihivgiuktini (kihimi tatkikhiutit katitingitut katitikhimayut). Iniktigutaini pingahut ukiuni ihivgiuktuni (kihimi tatkikhiutit katitikangitut katitigutini). Iniktigutait malguk ukiut ihivgiuktuni kiuhimayut naunaiyautait katakhimamata ilangit tatkikhiutini naunaiyautait katakhimayut ataanut 75%mik iniktigutait tatkikhiutit ihivgiuktuni. Takuhimayut ikpatauyani 9mi aatjikutait kiuyuitut naunaiyautaini Kangiklinik angiyut, 14.8%, pihimapkaiyut angiyunik pilaaktuni kiuyuitut ihumagiyain. Taimaimat hamna ovalo mikiyut kiuhimayut naunaiyautait iniktigutaini malguk ukiut ihivgiuktitlugit, Pilaaktut tamamik uktugutit ihuinaagutait ovalo kiuyuitut ihumagiyainik angiyut.

Kiuhimayut naunaiyautait ihumagiyauyut angiyut ovalo kiuyuitit ihumagiyait mikiyut ukiugit 1mi ovalo 3mi (kihimi tatkikhiutit pikangitut katitikhimayunik katitigutaini) piyaami nni pihimayut nakuuyumik ilauyukhanik uktugutingit Nni umayukhiuktit. Taiguaktut piyukhat atuligumik katitikhimayut katitigutaini kingulimi malguuk ukiungit ihivgiuktitlugit.

Atugutingit Ihumagiyait ovalo Kiuhimayut Ihuinaagutait:
Tuhaktitihimayut nunanut pulaakataktitluta ilangit umayukhiuktit pihimayuitait amigaitjutait maniit pikiutakhimayaminik. Ukautitiangit pihimayut nunanit ukautaini ovalo aalanit atugutaini katitikhimayut ilangani hamani. Ilangani 5.4 pihimayut ukautitiagani hamna ihumagiyauyut.

Takuhimayut utiktitihimayuni ubluit ikpatauyani, amigaitkiyait tatkikhiutit ukiuni 3m ovalo 5mi naitunik utiktitikaktunik ublukaktut amigaituni umayukhiukhimayut titigakhimayuni katitikhimayut iluani pingahut tatkikhiutini umayukhimayaini, mikinkhaalikhugit atugutingit ihuinaagutait pigaagata utiktitihimayut nakuuhuilaat. Kihimi, utiktitihimayut ubluit takivaktut, avataanut siksinik tatikikhiutinik ilangit, ilangit tatkikhiutit ukiuni 1mi, 2mi ovalo amigaivyaktut tatkikhiutit ukiumi 4mi. Utiktitihimayut ihuinaagutait hamani piyuni pivaktut ilaani.

Titigakhimaut tunihimayait DFOkunit pihimayut kinauyaliugutit kotat tuniyauvaktut ikalivinut tamaat umayukhiukhimayut ihivgiuktitlugit (DFO F). Kihimi, takuhimayut ukakhimayuni mikhaanut ikalivinik, ikitut hapkoa umayukhiukhimayut tuhaktititauvaktut ihivgiuktitlugit. Nalunangitulu ihivgiufaagaagat kafiuyut ikaliviit tuhaktitivaktait umayukhiuktit amigaitkiyait umayukhiukhimayut atuktakhainik ovalo kinauyaliugutikhaungitut niuvigutikhainik.

Ilaa angiyuungituugaluit kinauyaliugutit umayukhiugutaini tuktut Kangiklinikmi, ilangit tuktut niuviktitauvaktut nunani uyuligiyinut. Hapkoa umayut naunaiyakhimayut taimaatut katitikhimayuni ovalo kinguani unguvakhimayut ovalo ilaungitut umayukhiukhimayut naunaiyautaini takhimayuni katitikhimayut ikpatauyaini..

Nunanit ukakhimayut ovalo aalat atugutaini katitikhimayuni:

1 **Tuktut:** Tuktut umayukhiukhimayut nunani tuktut. Umayukhiukhimayut naunaiyautit ukiuni 5mi mikiyut. Tuhaktititauhimayut naunaiyautait ukiumi 4mi naamaktut ovalo aatjikutauvyaktut (C.F.). Ilangit tuktut umayukhiukhimayut ovalo niuviktitauplutik nunani uyuligiyinut. Hapkoa titigakhimayut unguvakhimayut katitikhimayunit ovalo takuyaulaaktut ikpatauyami 4mi.

2 **Umingmait:** Ukiumi tamaat kotait talimauyut umayut; kihimi tamamik atuktauyuitut. Umayukhiuktit autlaalikpaktut ungahiktumut umayukhiunahuakhugit umingmait (C.F.).

3 **Nanuit:** Amigaitjutait takukhauhimayut naunaiyautaungitut kihimi pihimayut umayukhiukhimayut amigaitjutait tunihimayut DSDkunit (DSD PB).

4 **Amagut:** Umayukhiukhimayut naunaiyautait mikiyut, ilaa ukiumi 5mi pingitut tuhaktitauhimayuni. Amagukpaktut ukiuk tamaat (C.F.). Naunaiyatianahuakhugit umayukhiukhimayut naunaiyautait, katitikhimayut pivaktavut DSDkunit titigakpamata amigaitjutainik amiit niuviktauvaktut umayukhiuktinit. DSDkut tuhaktitihimayut pihimayut 1999/2000mit ovalo 2000/2001mit (Ukiumi 4mi ovalo 5mi) ovalo takukhauyut 62nik amagut amiit niuviktauvaktut Kangiklinikmiunit umayukhiuktinit 1999/2000mi (ukiumi 4) ovalo 25nik niuviktauvaktut 2000/2001mi (ukiumi 5) (nalungilutit DSDkut katitikhimayut atukpaktait umayukhiukhimayut ukiungit Julymit Junemut, Umayukhiukhimayut Ihivgiuktit katitikhimayut atukpaktait umayukhiukhimayut ukingit Junemit Maymut) (DSD FB). Tamamik hapkoa amigaitjutait avataanungakhimayut umayukhiukhimayut naunaiyautait pihimayut naunaiyautait mikiyut hamani ukiugini.

5 **Tigiganit:** Aatjikutaitut, tigiganiat umaukhiukhimayut ukiuk tamaat ovalo katitikhimayut titigakhimayut umayukhimaitut tuhaktitihimayuni ukiumi 5mi ihuituk (C.F.). Ilaa DSDkut tuhaktititjutait atukhimayavut 1999/2000mi ovalo 2000/2001mi (ukiumi 4mi ovalo 5mi) ovalo takukhauyut 175nik tigiganit amiit niuviktauhimayut Kangiklinikmiut umayukhiuktinit 1999/2000mi (ukiumi 4mi) ovalo 107nik niuviktauhimayut 2000/2001mi (ukiumi 5mi) (nalungilutit DSDkut katitikhimayut aukpaktait umayukhiukhimayut ukungit Julymit Junemut, Umayukkhiukhimayut ihivgiuktit katitikhimayut atukpaktait umayukhiukhimayut ukiungit Junemit Maymut) (DSD FB). Tamamik hapkoa amigaitjutait avataanungakhimayut umayukhiukhimayut naunaiyautait pihimayut naunaiyautait mikiyut hamani ukiugini.

6 **Kalviit:** Umayukhiuktit tuhaktitihimayut kalviit umayukhiukatakhimayut ukiuk tamaat ovalo katitikhimayut ukiuni pingitut kalvinik ihuinaakhimayut (C.F.) Pikangituk tuhagutikhanik kalviit amiit niuviktauhimaitut umayukhiuktinit DSDkunut (DSD FB) kihimi DSD havaktiit pihimayut ukiuk tamaat umayukhiuktauvaktut kalviit 15nut umayunik.

7 **Ukaliit:** Umayukhiukhimayut ukaliit kataliktuugaluit ukiuni, tuhaktitihimayut ilangit pivaktut ukiuk tamaat (C.F.).

8 **Natiit:** Natiit umayukhiukhimayut tamamik natiinat ovalo ukyuit. Natiit (kanugitut naunaiyakhimaitut) hapkoaguyunakhiyut. Umaykhiukhimayut naunaiyautait naamaktut (C.F.).

9 **Tuugaat:** Umayukhiuktit autlaakpaktut Naujaanut umayukhiugiaktuhugit tuugaat. DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait tuugaat (nalungilutit DFOkut katitikhimayut atukpaktait iniktigutaini ukiungit, Umayukhiukhimayut Ihivgiuktit katitikhimayut atukpaktait umayukhiukhimayut ukiungit Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
7	0	2	2	7

10 **Kilalugait:** DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait kilalugait (nalungilutit DFOkut katitikhimayut atukpaktut iniktigutait ukiungit, Umayukhiukhimayut Ihiviuktit katitikhimayut atukpaktait Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
48	48	35	n/d	45

11 **Akilgiit:** Umayukhiugutit aalanguliktuugaluit ukiuni ukiunut aalangulikpanmat amigaitjutait nunani, ilangit pikatainaktut umayukhiukhimayuni ukiuk tamaat (C.F.).

12 **Maniit:** Ivaviit nunait ikitut nunat haniani, maniit ayonaktut nalvaagiami kihimi Inuit manikhiulikpaktut ukiuk tamaat. Ilaani ilangit Inuit pikiutalikpaktut kanguit maniinik haniani Arviat nunaini. Pikiutalikpaktut imitkutailat maniinik (tuhaktitauhimaitut). Tuhaktitihimayut tamamik maniit amigaitjutait mikiyut, ilaa amigaitut Inuit naunaiyayuimata kafinik manikta-likpaktut ovalo taimaimat tuhaktitiyuitut (C.F.).

13 **Ikaliviit:** Pikatakpaktut kinauyaliugutinik ikaliviinik tamaat ihivgiuktitlugit (DFO F). Kihimi ihumayut amigaitut tuhaktititauyuitut. Ikitut titigakhimayuugaluit Umayukhiukhimayut Ihivgiuktuni katitigutaini naunaiyakhimayut umayukhiukhimayut kinauyaliugutihimayut. Hapkoa unguvakhimayut katitikhimayunit ovalo takulaaktut ikpatauyami 4. Umayukhiukhimayut naunaiyautait ihumayhut naamaktut atuktakhaini umayukhiukhimayuni talvatuak (C.F.).

TABLE/ᓇᓗᓇᐃᔭᐅᖅ/NAUNAIKUTA 603

Monthly harvest estimates
ᑕᖅᑕᒪᖅ ᐊᖏᔪᓂᖅ ᓇᓕᐅᖅᓱᓐᓂᖅ
Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)
ᐊᑦᓯᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᑦᔪᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑦᔪᓗ	NOV ᓄᐱᑦᓗ	DEC ᑎᓯᑦᓗ	JAN ᔮᖏᓐᓄᓗ	FEB ᐃᖅᑲᓗ	MAR ᒪᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	78	37	114	114	149	231	95	66	92	85	65	69	1,195 ± 49
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡					3	3	1	23					
Wolf	ᐊᒪᓱᐃᑦ	Amagut						5	5	2		5	8	1	26 ± 5
Arctic fox	ᑎᓗᓚᖏᓂᐊᑦ	Tigiganiat						55	103	54	26	87	46		371 ± 44
Wolverine	ᖃᕐᕿᓵᑦ	Kalvik						1	1	1	2	1			6 ± 2
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik						1	3		1	7	1		13 ± 3
Arctic ground squirrel	ᓂᖅᓂᑦ	Hikhik											10		10 ± 6
Seals (unspecified)	ᓂᖏᓕᓪᓕᑦ	Natiit	13		2										15 ± 13
Ringed seal	ᓇᑦᓂᑦ	Natiinat	126	70	51	280	31	37	3	4	6	16	5	33	662 ± 74
Bearded seal	ᐅᓚᓛᐃᑦ	Ukyuk		6	4	3	4								17 ± 5
Walrus	ᐊᐃᐅᓵᑦ	Akvik		1	1	3	2								7 ± 3
Narwhal	ᑐᒍᓪᓕᑦ ᖃᓪᓗᓂᑦ	Tuugaak		25	3										28 ± 11
Beluga	ᖃᐅᔨᑦᑐ ᖃᓪᓗᓂᑦ	Kilalugak		2	9	25	1								37 ± 12
Bowhead	ᐊᑦᕿᖅ	Aivik			2										2 ± 2
Snow goose	ᑲᖏᒍᐃᑦ	Kanguq	21												21 ± 18
Canada goose	ᓄᑦᓪᓕᑦ ᐅᓪᐊᒍᓪᓕᑦ	Nikliknik	2											4	6 ± 4
Eider duck	ᒥᑎᑦ	Kingalik	4												4 ± 4
Black guillemot	ᐱᑦᓯᐅᓪᓕᑦ	Black guillemot				3									3 ± 3
Ptarmigan	ᐊᖏᓴᑦ	Akilgik				56	31	1	7		2	2	1		100 ± 39
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖅᑦ	Tinmiat manniit		15											15 ± 12
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	797	448	235	27	2,087	1,155	153		55		157	231	5,345 ± 727
Lake trout	ᐃᓱᕐᓇᑦ	Ikalukpik	489	81	2	10	105	2	1				35	229	954 ± 219

‡ Polar bear data supplied by DSD.

‡ ᓇᓄᑦᓂᑦ ᑎᑎᕐᑕᐅᒪᓕᒃᑐᑦ ᑐᓂᓯᖏᑦ ᐅᑯᐊ ᐃᓄᐃᑦᕕᓂᕆᔨᓕᒃᑐᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 604

Monthly hunter response

ᑕᕝᕙᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐊᓐᔾᔨᒍ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᕝᕙᖏᑦ/Tatkia			JUN ᔮᓂ	JUL ᔮᓕᐃ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑲᐃᓇ	NOV ᐃᓚᓕᕐᓇ	DEC ᑎᓯᕐᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᓄᕿᐅᐊᓇ	MAR ᒪᓯ	APR ᐃᓴᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ ᐊᑎᔨᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᕝᕙᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ	Tatkitaman angunahuktut titigait	167	167	167	166	165	165	165	163	162	163	162	162	169*
Hunters interviewed	ᐊᖏᔪᓇᓱᒋᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	91	111	125	140	154	157	159	159	153	157	142	128	165*
Harvested	ᐊᖏᔪᓇᓱᒍᒥᓂ	Angujaujut	64	48	44	53	39	55	33	25	28	33	32	52	129*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑎᓂᖏᑦ (%)	Kiujut (%)	54	66	75	84	93	95	96	98	94	96	88	79	85**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᒋᑦ ᐊᑎᓕᐅᑎᒃᓴᖅᑕᕐᓂᖅ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓇᓱᒍᒥᓂ ᐊᑕᐅᓯᐊᖓᔪᓐᓇᖅ ᐊᓐᔾᔨᒍ.
** ᐊᐅᔨᓴᓐᓂᓕᔾᔨᑦ ᑕᕝᕙᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.3.6

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 605

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᖏᓐᓄ ᐊᖏᔪᓇᓱᓂᓐᓂᑕ ᐊᓚᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᓐᓂᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓇᓱᑦ ᑎᑎᕐᑦᑕᐅᒪᔾᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐊᓐᔾᔨᒍ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᕝᕙᖏᑦ/Tatkia			JUN ᔮᓂ	JUL ᔮᓕᐃ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑲᐃᓇ	NOV ᐃᓚᓕᕐᓇ	DEC ᑎᓯᕐᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᓄᕿᐅᐊᓇ	MAR ᒪᓯ	APR ᐃᓴᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕝᕙᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	99	100	100	100	100
4-6 months	4-6 ᑕᕝᕙᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	1	0	0	0	0
> 6 months	> 6 ᑕᕝᕙᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 606

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓇᓴᖅᑎᑦ ᐊᖓᔪᓇᓴᖅᓯᒋᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 1 (June 1996 - May 1997)

ᐊᒃᑭᒍ 1 (ᔪᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᓐ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᓄᓇᒃᓇ	DEC ᑎᓯᒃᓇ	JAN ᔮᖏᓄᓇ	FEB ᐃᖕᐅᓇ	MAR ᒪᓯ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	24	18	32	32	29	50	30	17	28	28	24	27	90
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut						3	2	2		4	5	1	8
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat						10	13	13	8	12	5		24
Wolverine	ᖃᑦᕃᓴᑦ	Kalvik						1	1	1	1	1			3
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik						1	2		1	2	1		5
Arctic ground squirrel	ᓱᖅᓯᑦ	Hikhik											1		1
Seals (unspecified)	ᓯᖕᐳᓪᓕᑦ	Natiit	3		1										4
Ringed seal	ᓇᓯᑦ	Natiinat	29	24	19	33	6	17	3	4	3	6	2	16	84
Bearded seal	ᐅᓚᐋᑦ	Ukyuk		4	3	3	3								10
Walrus	ᐊᐃᐸᑦ	Akvik		1	1	2	1								5
Narwhal	ᑐᒍᓪᓚ ᖁᓪᓗᓚᑦ	Tuugaak		10	2										12
Beluga	ᖃᐅᑦᑕ ᖁᓪᓗᓚᑦ	Kilalugak		1	5	8	1								13
Bowhead	ᐊᑦᕃᖅ	Aivik			1										1
Snow goose	ᑲᖏᒍᐃᑦ	Kanguq	3												3
Canada goose	ᓄᑦᓚᓪ ᐅᓗᐊᔪᓚᓪ	Nikliknik	1											2	3
Eider duck	ᒥᑎᑦ	Kingalik	2												2
Black guillemot	ᐱᑦᓯᐅᓪᓚ	Black guillemot				1									1
Ptarmigan	ᐊᖏᓚᑦ	Akilgik				5	4	1	1		1	2	1		12
Duck eggs	ᒥᑎᑦ ᒪᓕᓂᖏᑦ	Tinmiat manniit		2											2
Arctic char	ᐃᖏᓪᑲᒃᐱᑦ	Ikaliviit	16	15	6	1	11	11	1		1		6	11	47
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	21	6	1	1	9	1	1				5	21	53

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᕐᒪᔪᓂᒃ ᐱᑕᖃᓕᕐᕋᓐᓂᒃ ᐱᒃᔪᑎᓕᓐᓂᒃ ᐊᖓᔪᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᖅᓄᑦ ᓇᓪᓕᐅᑦᓴᖅᓄᑦ ᑐᓂᒃᑯᑦᓴᖅᓄᑦ ᐃᓕᓴᕐᓂᓗᒃᑕᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 607

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᑲᒍ 2 (ᔮᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᓐ/Tatkia			JUN ᔮᓂ	JUL ᔭᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑲᐃᓗ	NOV ᐅᓇᓚᐱᓗ	DEC ᑎᓯᓚᐱᓗ	JAN ᔮᖏᓂᔾᔪᓗ	FEB ᓇᖕᖏᔪᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓀᓪᓂ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᔭᐅᐃᐃᑦ	Tuktut	54	39	105	118	103	18	50	82	69	48	27	63	776 ± 47
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡							1						
Wolf	ᐊᒪᓕᐃᑦ	Amagut						1	6			1	2	9	19 ± 6
Arctic fox	ᑎᓚᖓᓂᐊᑦ	Tigiganiat						19	54	12	23	11	6		125 ± 20
Coloured fox	ᖃᑯᐦᖏᑦᑐᑦ ᑎᓚᖓᓂᐊᑦ	Kalaliit tigiganiat									1	1			2 ± 1
Wolverine	ᖃᓴᐃᑦ	Kalvik										2		1	3 ± 2
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik				2		2							4 ± 1
Ringed seal	ᓇᓂᓱᑦ	Natiinat	103	33	67	209	43	10		6	4	5	5	4	489 ± 44
Bearded seal	ᐅᑭᔪᐃᑦ	Ukyuk		3	6	10									19 ± 4
Harp seal	ᖃᐃᕐᓂᑦ	Qairulik		1	1										2 ± 2
Walrus	ᐊᐃᓴᐃᑦ	Akvik	1	2	3	2			1						9 ± 3
Narwhal	ᑐᐊᓪᓕᑦ ᖁᓕᓗᑦ	Tuugaak	5	39	1										45 ± 8
Beluga	ᖃᑯᑦᑕ ᖁᓕᓗᑦ	Kilalugak	3	8	7	31	4								53 ± 9
Snow goose	ᑲᖕᐃᐃᑦ ᒪᓐᓂᖅᑕ	Kanguq	10											7	17 ± 6
Eider duck	ᒥᑎᑦ ᒪᓐᓂᖅᑕ	Kingalik	3												3 ± 3
Ptarmigan	ᐊᖏᓱᑦ	Akilgik				15								10	25 ± 11
Arctic char	ᐃᖃᓗᓴᐃᑦ	Ikaliviit	835	628	991	29	1,153	144	297	89	89	46	44	158	4,503 ± 856
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	1	12	5	2	48						8	96	172 ± 28

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦᓂᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᔭᖓᑦ ᐅᑯᐊᖓᓕᓇᓚᐅᖅᑕᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.3.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 608

Monthly hunter response
ᑕᖏᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᒻᒋᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᒻᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒻᐱᓗ	DEC ᑎᓯᒻᐱᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᓇᖕᖏᐊᓗ	MAR ᒪᕆ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ	Tatkitaman angunahuktut titigait	161	161	161	160	161	161	161	161	158	157	157	155	163*
Hunters interviewed	ᐊᖏᔪᓇᓱᒋᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	137	146	136	143	135	149	152	155	151	141	152	134	161*
Harvested	ᐊᖏᔪᓇᓱᑐᓂᓕᓂ	Angujaujut	39	41	34	45	22	9	24	25	23	15	12	49	101*
Response Rate (%)	ᑭᐅᔾ ᖃᓕᑎᐅᓂᖏᑦ (%)	Kiujut (%)	85	91	84	89	84	93	94	96	96	90	97	86	90**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᒋᑦ ᐊᑎᓕᐅᑕᒪᓕᕆᔨᑦ/ᐊᐱᕐᓂᑦᑐᑦ/ᐊᖏᔪᓇᓱᑐᓂᓕᓂ ᐊᑕᐅᓯᐊᖅᑐᓂᑎᒃ ᐊᒻᒪᔪᒥ.
** ᐊᓯᔾᔨᓕᖅᓯᒪᓕᕆᔨᑦ ᑕᖏᑕᒪᑦ ᑭᐅᔾ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.3.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 609

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᕐᓂ ᐊᑯᕐᓴᖅ ᐊᖏᔪᓇᓯᓂᖓᓄᑦ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓄᑦ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑕᑎᑦ ᐊᖏᔪᓇᓱᑦ ᑎᑎᕐᑕᐅᒪᔨᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 2 (June 1997 - May 1998)
ᐊᒻᒋᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᒻᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒻᐱᓗ	DEC ᑎᓯᒻᐱᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᓇᖕᖏᐊᓗ	MAR ᒪᕆ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᑎᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᕐᓂ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	100	100	100	99	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	0	0	0	1	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 610

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓚᓴᒋᑦ ᐊᖓᔪᓚᓴᒃᑯᑦᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 2 (June 1997 - May 1998)

ᐊᒃᑭᒍ 2 (ᔪᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖃᖅ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᓗ	AUG ᐊᐅᒍᑎᒃ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᔨ	APR ᐃᔨᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	21	23	23	28	14	4	18	20	20	14	10	25	68
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut						1	1			1	2	3	7
Arctic fox	ᑎᓗᓚᖓᓂᐊᑦ	Tigiganiat						3	7	5	6	2	2		14
Coloured fox	ᖃᐅᖕᖏᑦᑐᑦ ᑎᓗᓚᖓᓂᐊᑦ	Kalaliit tigiganiat									1	1			1
Wolverine	ᖃᑦᕕᑦ	Kalvik										2		1	3
Arctic hare	ᐅᒃᓪᓕᑦ	Ukalik				2		1							3
Ringed seal	ᓇᓂᓱᑦ	Natiinat	25	17	16	29	14	3		2	4	3	2	2	58
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		3	4	7									13
Harp seal	ᖃᐃᓕᓪᓕᑦ	Qairulik		1	1										1
Walrus	ᐊᐃᕕᒃᑦ	Akvik	1	2	3	2			1						7
Narwhal	ᑐᒻᓪᓕᑦ ᖁᓪᓗᑎᑦ	Tuugaak	3	17	1										18
Beluga	ᖃᐅᖅᑕ ᖁᓪᓗᑎᑦ	Kilalugak	2	4	5	11	2								19
Snow goose	ᑲᖏᐃᑦ ᒪᓕᓂᖅᑕ	Kanguq	2											3	5
Eider duck	ᒥᑎᑦ ᒪᓕᓂᖅᑕ	Kingalik	1												1
Ptarmigan	ᐊᖏᓱᑦ	Akilgik				2								2	4
Arctic char	ᐃᖃᓗᓴᒃ	Ikaliviit	14	17	17	4	8	4	4	2	2	2	3	17	54
Lake trout	ᐃᓱᒪᐃᑦ	Ikalukpik	1	1	2	1	6						3	25	32

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓱᒪᔪᓂᒃ ᐱᑕᖃᖏᑕᖅ ᐱᓕᐊᓕᓂᓂᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᓐᓂᑦ ᐊᓪᔪᖅᓂᑦ ᓇᓄᐃᑦᑐᓂᒃᑯᑦ ᐃᓄᐃᑦᑐᑎᓪᓗᒥ ᑐᓴᕐᖏᓐᓂ ᐃᓄᐃᑦᑐᑎᓪᓗᒥ ᐃᓄᐃᑦᑐᑎᓪᓗᒥ ᐃᓄᐃᑦᑐᑎᓪᓗᒥ

TABLE/ᓇᓗᓇᐃᔭᐅᖅ/NAUNAIKUTA 611

Monthly harvest estimates

ᑕᖅᑕᒪᖅ ᐊᖏᔪᓂᖅ ᓇᓕᐅᖅᓱᓐᓂᖅ

Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)

ᐊᒻᒪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᓇ	OCT ᐅᑦᑐᓇ	NOV ᐅᓇᓱᓇ	DEC ᑎᓯᓱᓇ	JAN ᔮᖏᓇᐊᓇ	FEB ᓇᖅᑐᐊᓇ	MAR ᒪᔪ	APR ᐃᔪᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	70	26	149	67	75	36	35	42	56	43	39	20	658 ± 26
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait										1			1 ± 0
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡				3	7	2				215			
Wolf	ᐊᒪᓗᐃᑦ	Amagut							1	6	9	14	4	1	35 ± 5
Arctic fox	ᖃᓄᐊᖓᑦᑐᑦ ᑎᓕᒃᓂᓕᐊᑦ	Tigiganiat						3	3	31	14	25	5		81 ± 14
Wolverine	ᖃᐅᕕᑦ	Kalvik							1	1					2 ± 1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik					4			1					5 ± 2
Ringed seal	ᓇᓂᓱᑦ	Natiinat	86	21	57	84	82	14	10	6	5	15	2	4	386 ± 27
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		2	13	6	2		1						24 ± 3
Walrus	ᐊᐃᕕᒃᑦ	Akvik	1	3	7	1	2								14 ± 3
Narwhal	ᑐᒻᓗᓪᓚᑦ ᖃᓪᓗᓂᑦ	Tuugaak		15											15 ± 5
Beluga	ᖃᐅᖅᑕ ᖃᓪᓗᓂᑦ	Kilalugak	1	2	8	5									16 ± 2
Canada goose	ᓄᖅᓪᓚ ᐅᓗᐊᔪᓪᓚᑦ	Nikliknik	10												10 ± 4
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	2			2	3				8	14			29 ± 5
Duck eggs	ᒥᑎᑦ ᓚᒃᓂᖅᑦ	Tinmiat manniit	11												11 ± 6
Seagull eggs	ᓇᐅᔨᐃᑦ ᓚᒃᓂᖅᑦ	Nauyat manniit	31												31 ± 16
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	976	567	804		357	1,159	33	107		151	55	328	4,537 ± 510
Lake trout	ᐃᓱᕐᓂᐃᑦ	Ikalukpik	97	115	12		43	14			1		12	162	456 ± 64

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᒃᓂᑦ ᑎᑎᕋᐅᒪᓕᒃᑦ ᑐᓂᔨᖏᑦ ᐅᑯᐊᖏᓐᓇᓕᒃᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.3.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 612

Monthly hunter response

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᒃᓴᔪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓂ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᐊᓂ	NOV ᓄᓇᕗᓂ	DEC ᑎᓯᕗᓂ	JAN ᒎᓕᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᕐᓂ	APR ᐃᕐᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᒋᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᔪᓇᓱᒋᑦ	Tatkitaman angunahuktut titigait	151	148	149	150	150	149	150	149	148	146	147	146	157*
Hunters interviewed	ᐊᖏᔪᓇᓱᒋᑦ ᐊᐱᓕᓂᑦ	Angunahuktin apikhuktan	137	131	142	145	145	143	144	142	136	141	143	136	148*
Harvested	ᐊᖏᔪᓇᓱᒍᒥᓂ	Angujaujut	57	31	38	18	24	22	16	20	18	23	20	50	106*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖏᑦ (%)	Kiujut (%)	91	89	95	97	97	96	96	95	92	97	97	93	95**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᒋᑦ ᐊᑎᓕᐅᑉᐳᒪᓕᔪᑦ/ᐊᐱᓕᓂᑦ/ᐊᖏᔪᓇᓱᒍᒥᓂ ᐊᑕᐅᓂᐊᖅᑐᑎᓂᑦ ᐊᒃᓴᒥ.
** ᐊᓕᒋᓕᖅᑎᓂᒪᓕᔪᑦ ᑕᖅᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.3.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 613

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓐ ᐊᖏᔪᓇᓯᓂᖓᑕ ᐊᒪᓗ ᐊᐱᓕᓂᑦᑕᐅᓂᖓᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓇᓱᑦᑕ ᑎᑎᕐᑦᑕᐅᒪᔪᑦ

Year 3 (June 1998 - May 1999)

ᐊᒃᓴᔪᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓂ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᐊᓂ	NOV ᓄᓇᕗᓂ	DEC ᑎᓯᕗᓂ	JAN ᒎᓕᐊᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᕐᓂ	APR ᐃᕐᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	100	100
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 614

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓚᐸᑎᑦ ᐊᖓᔪᓚᐸᓕᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 3 (June 1998 - May 1999)

ᐊᒃᑭᒍ 3 (ᔪᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖃᓐᓄᑦ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᓚᔅᑎ	SEP ᓱᑎᐱᓗ	OCT ᐅᑦᑐᓗ	NOV ᐅᓇᓕᓗ	DEC ᑎᓴᓗ	JAN ᔮᖅᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᔾᔪ	APR ᐃᑦᓚᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	30	17	31	15	19	8	13	15	13	17	16	11	64
Musk-ox	ᐅᒥᓴᒪᐃᑦ	Umingmait										1			1
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut							1	3	3	6	1	1	9
Arctic fox	ᖃᓄᖕᖏᑦᑐᑦ ᑎᓘᑲᖕᓂᐊᑦ	Tigiganiat						2	1	4	3	8	1		13
Wolverine	ᖃᑦᕃᑦ	Kalvik							1	1					2
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik					2			1					3
Ringed seal	ᓇᓕᓐᑦ	Natiinat	32	11	24	11	10	10	4	5	1	4	2	1	63
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk		2	9	4	2		1						16
Walrus	ᐊᐃᕃᑦ	Akvik	1	3	5	1	2								11
Narwhal	ᑐᒻᓪᓗᑦ ᖁᓪᓗᒡᓗᑦ	Tuugaak		7											7
Beluga	ᖃᓄᖅᑕ ᖁᓪᓗᒡᓗᑦ	Kilalugak	1	2	5	3									11
Canada goose	ᓄᖅᓪᓗ ᐅᓗᐊᔪᖅᓪᓗ	Nikliknik	4												4
Ptarmigan	ᐊᖏᒻᒋᑦ	Akilgik	1			1	2				2	3			8
Duck eggs	ᒥᑎᑦ ᓚᖓᓂᖅ	Tinmiat manniit	1												1
Seagull eggs	ᓇᐅᒃᐃᑦ ᓚᖓᓂᖅ	Nauyat manniit	2												2
Arctic char	ᐃᖃᓗᒃᑕᑦ	Ikaliviit	22	11	12		4	13	1	1		3	1	12	50
Lake trout	ᐃᓱᕐᓇᑦ	Ikalukpik	8	3	2		4	3			1		4	39	53

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓱᒪᓕᕆᓂᖅ ᐱᑕᖃᖕᖏᑦᑐᖅ ᐱᒃᐊᑎᓕᖅᓂᖅ ᐊᖏᔪᒃ ᖃᕋᐅᓂᖏᖕᓂᒃ ᐊᓕᔪᖅᐸᒪᓕᕆᓂᖅ ᐊᖏᔪᓂᒃ ᓇᓕᐅᖏᓐᓇᖅᑐᓂ ᑐᓂᔭᖏᖕᓂᖅ ᐃᑯᐱᒃᓚᓕᔾᔨᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 615

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓀᑦ

Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)

ᐊᓐᖁᔭᒍ 4 (ᔪᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖢᓂ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔨᑎ	SEP ᓱᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᓇᓚᐱᓇ	DEC ᑎᓴᓚᐱᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᓄᖕᐅᐊᓇ	MAR ᒪᓴ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	**ᐅᒪᓴᑦ**	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	39	50	114	82	65	49	22	51	64	41	35	19	631 ± 18
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡				2	5	5	1			25			
Wolf	ᐊᒪᓱᐃᑦ	Amagut						3	8		4	9	8	6	38 ± 5
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat					3	11	27	19	6	13	11		90 ± 8
Coloured fox	ᖃᐅᖏᑦᑐᑦ ᑎᓕᓴᖅᓂᐊᑦ	Kalaliit tigiganiat						1	2	1	2	2			8 ± 1
Wolverine	ᖃᖏᐃᑦ	Kalvik							2		1	1	2	1	7 ± 1
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik											3		3 ± 1
Ringed seal	ᓇᓂᓱᑦ	Natiinat	109	50	37	86	52	37			2			2	375 ± 28
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk		2		3									5 ± 1
Walrus	ᐊᐃᐃᓴᑦ	Akvik		1		1			1						3 ± 1
Narwhal	ᑐᒻᓪᓕᑦ ᖁᓪᓗᓴᑦ	Tuugaak	2	48	75										125 ± 11
Beluga	ᖃᐅᕆᑦ ᖁᓪᓗᓴᑦ	Kilalugak		5	1		1								7 ± 1
Geese (unspecified)	ᓄᕐᓪᓕᑦ	Kanguk	2												2 ± 1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq												2	2 ± 1
Canada goose	ᓄᕐᓪᓕᑦ ᐅᓗᐊᒍᕐᓪᓕᑦ	Nikliknik												1	1 ± 0
Eider duck	ᒥᑎᑦ ᒪᓂᖏᑦ	Kingalik		2											2 ± 2
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	4								2	2			8 ± 2
Arctic char	ᐃᖃᓗᐲᑦ	Ikaliviit	447	659	133		1,317	740	15		140	171	201	663	4,486 ± 285
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	6				4	2				11		102	125 ± 16

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᓪᓕᑦ ᑎᑎᕋᐅᒪᓴᑦ ᑐᓂᓴᖏᑦ ᐅᑯᐊᖅᑕᓗᒃᑐᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.3.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 616

Monthly hunter response
ᑕᖏᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᒻᔪᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᐊᓂ	NOV ᐅᓇᕐᓗᓂ	DEC ᑎᓯᕐᓗᓂ	JAN ᔮᖅᓇᐊᓂ	FEB ᓄᖕᐊᓂ	MAR ᒪᑉᓯ	APR ᐃᖁᓕᓪ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑐᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖏᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	147	147	147	147	144	144	143	144	145	144	143	142	152*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	137	138	143	140	140	142	140	139	139	137	133	132	147*
Harvested	ᐊᖏᔪᓂᒃᑐᒥᓂᑦ	Angujaujut	30	41	42	23	29	25	13	17	20	19	16	29	79*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	93	94	97	95	97	99	98	97	96	95	93	93	96**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᕋᒪᓕᕐᓂᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᒃᑐᒥᓂᑦ ᐊᑕᐅᓯᐊᖅᓯᒪᔪᑦ ᐊᑎᕐᒧᑦ.
** ᐊᐅᔨᓕᓐᓂᓯᒪᔪᑦ ᑕᖏᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.3.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 617

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᕐᖏᓂ ᐊᖏᔪᓂᒃᑐᓂᖏᓐᖓᑕ ᐊᒪᓗᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᖓᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓚᑲ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑕᑦ ᑎᑎᕐᑦᑕᐅᒪᔪᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)
ᐊᒻᔪᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖏᖓ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᐊᓂ	NOV ᐅᓇᕐᓗᓂ	DEC ᑎᓯᕐᓗᓂ	JAN ᔮᖅᓇᐊᓂ	FEB ᓄᖕᐊᓂ	MAR ᒪᑉᓯ	APR ᐃᖁᓕᓪ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	100	100	88	86	87	96	100	100	100	100	100	100	95
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	0	0	7	14	13	4	0	0	0	0	0	0	4
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	0	0	5	0	0	0	0	0	0	0	0	0	1

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 618

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖓᔪᓇᓴᒃᑎᑦ ᐊᖓᔪᓇᓴᒃᑯᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᕐᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 4 (June 1999 - May 2000)

ᐊᒡᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖃᖅ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓕ	AUG ᐊᐅᑐᔪᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᓇᕆᐱᓇ	DEC ᑎᓯᐱᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᓇᖕᐅᐊᓇ	MAR ᒪᔪ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	14	23	26	20	16	16	9	17	17	14	12	12	56
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓕᐃᑦ	Amagut						3	3		1	7	4	2	12
Arctic fox	ᑎᓗᓚᖓᐊᑦ	Tigiganiat					1	1	1	1	1	3	2		4
Coloured fox	ᖃᐅᖕᖏᑦᑐᑦ ᑎᓗᓚᖓᐊᑦ	Kalaliit tigiganiat						1	1	1	1	2			4
Wolverine	ᖃᖏᐃᑦ	Kalvik							2		1	1	2	1	5
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik											1		1
Ringed seal	ᓇᕆᓵᑦ	Natiinat	24	12	10	16	11	9			2			2	49
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk		2		3									5
Walrus	ᐊᐃᐃᓴᑦ	Akvik		1		1			1						3
Narwhal	ᑐᒻᓪᓕᑦ ᖁᓪᓗᓚᑦ	Tuugaak	2	19	31										36
Beluga	ᖃᐅᕆᑦ ᖁᓪᓗᓚᑦ	Kilalugak		5	1		1								7
Geese (unspecified)	ᓄᕆᓪᓕᑦ	Kanguk	1												1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq												1	1
Canada goose	ᓄᕆᓪᓕᑦ ᐅᓪᐊᒍᑦᓪᓕᑦ	Nikliknik												1	1
Eider duck	ᒥᑎᑦ ᒪᓐᓄᑦ	Kingalik		1											1
Ptarmigan	ᐊᖏᒃᑎᑦ	Akilgik	1								1	1			3
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	6	11	6		9	4	1		3	3	4	11	36
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	1				1	1				1		17	18

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᕐᒪᔪᓂᒃ ᐱᑕᖃᓄᖅᑐᖅ ᐱᒃᔪᐸᑎᓕᓂᒃ ᐊᖏᒃᑐᑦ ᖃᐅᔨᓴᖅᓄᓕᓂᑦ ᐊᓪᓚᖃᓂᒃ ᐊᖏᔨᓂᓕ ᓇᓪᔨᐅᕐᒪᖔᑦᑐᓂ ᑐᓂᔨᖅᓯᓂ ᐃᑯᐱᕋᓕᓪᓂᓪᓕᕆᓂᖅ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.3.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 619

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓐᓂᑦ

Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)

ᐊᓕᖅᔪᒍ 5 (ᔨᓂᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔨᑎ	SEP ᓯᑎᐹᓕ	OCT ᐅᑦᔪᐸᓕ	NOV ᐅᓇᓵᐹᓕ	DEC ᑎᓯᓵᐹᓕ	JAN ᔮᖏᓇᐊᓕ	FEB ᓇᖕᖏᐊᓕ	MAR ᒪᑉᓯ	APR ᐃᑦᓗᓪ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓴᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	43	18	81	44	25	45	32	30	20	21	65	40	464 ± 17
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡			8			3				2	13		
Wolf	ᐊᒪᓗᐃᑦ	Amagut				1	1	8			5	14	7		36 ± 4
Arctic fox	ᑎᓕᓴᖏᓂᐊᑦ	Tigiganiat						44	84			15	35		178 ± 31
Coloured fox	ᖃᐅᖅᖢᑎᑐᑦ ᑎᓕᓴᖏᓂᐊᑦ	Kalaliit tigiganiat						1					1		2 ± 0
Ringed seal	ᓇᓗᓕ	Natiinat	103	16	17		4	9	5	1		8	1		164 ± 17
Bearded seal	ᐅᓴᐊᐃᑦ	Ukyuk	2	1	3										6 ± 1
Harp seal	ᖃᐃᓐᓂᑦ	Qairulik			3										3 ± 1
Walrus	ᐊᐃᓴᑦ	Akvik			1										1 ± 1
Narwhal	ᑐᒻᓂᑦ ᖁᓪᓗᒡᑦ	Tuugaak	1	7	2										10 ± 2
Beluga	ᖃᐅᖅᑕᑦ ᖁᓪᓗᒡᑦ	Kilalugak				3									3 ± 0
Canada goose	ᓄᖅᓂᑦ ᐅᓗᐊᔪᖅᓂᑦ	Nikliknik	4												4 ± 1
Eider duck	ᒥᑎᑦ	Kingalik		1											1 ± 0
Arctic char	ᐃᖃᓗᐲᐱᑦ	Ikaliviit	591	343	70	38	788	378	220		3	33	72	7	2,543 ± 194
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik												77	77 ± 9

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᑦ ᑎᑎᕐᑕᒪᓐᓂᑦ ᑐᓄᖅᑎᑦ ᐅᑉᓇᐃᑦ ᐃᑉᐊᐃᓕᓴᕐᓂᐅᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.3.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 620

Monthly hunter response

ᑕᕆᑕᒪᑦ ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)

ᐊᒻᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕆᖏᑐᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᐊᓂ	NOV ᓄᓇᕗᓂ	DEC ᑎᓯᕐᓂ	JAN ᔮᖅᓄᐊᓂ	FEB ᓇᖕᐊᓂ	MAR ᒪᑉ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᓂᕆᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᔪᓂᕆᑦ ᑭᐅᓂᖏᑦ ᐊᑎᓯᒪᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᕆᑕᒪᑦ ᐊᖏᔪᓂᕆᑦ	Tatkitaman angunahuktut titigait	141	142	141	142	142	142	142	143	143	145	142	141	146*
Hunters interviewed	ᐊᖏᔪᓂᕆᑦ ᐊᐱᓯᓂᑦ	Angunahuktin apikhuktan	130	132	131	135	137	138	136	140	140	140	138	132	143*
Harvested	ᐊᖏᔪᓂᕆᑐᒋᓐ	Angujaujut	28	16	21	9	8	24	16	7	8	11	19	30	67*
Response Rate (%)	ᑭᐅᔭᖅ ᖃᓕᔭᐅᓂᖏᑦ (%)	Kiujut (%)	92	93	93	95	96	97	96	98	98	97	97	94	95**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᕆᑦ ᐊᑎᓕᐅᑦᑕᐅᒪᔨᖅ/ᐊᐱᓯᓂᑦ/ᐊᖏᔪᓂᕆᑐᒋᓐ ᐊᑕᐅᔭᐊᖓᓗᐃᑎᒃ ᐊᒻᔪᒍᒥ.
** ᐊᓕᒋᓕᑎᓂᔭᒪᔨᑦ ᑕᕆᑕᒪᑦ ᑭᐅᔭᑦ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.3.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 621

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᖃᐅᔨᑦ ᐊᑯᑦᖏᓂ ᐊᖏᔪᓂᔅᓂᖏᑕ ᐊᒪᓗᓗ ᐊᐱᓯᓂᑦᑕᐅᓂᖏᑕ, ᓇᓗᓇᐃᑦᑕ ᐃᒪᓱ % ᑲᑎᒪᓂᕆᑦ ᐊᖏᔪᓂᒃᑕ ᑎᑎᑦᑕᐅᒪᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)

ᐊᒻᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᕆᖏᑐᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑯᐊᓂ	NOV ᓄᓇᕗᓂ	DEC ᑎᓯᕐᓂ	JAN ᔮᖅᓄᐊᓂ	FEB ᓇᖕᐊᓂ	MAR ᒪᑉ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᓂᕆᑦ Tamakiklugin
Recall Period	**ᐅᑎᖃᐅᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᕆᑦ	≤ tatkin pingahut	100	100	100	100	100	100	100	100	100	100	100	0	90
4-6 months	4-6 ᑕᕆᑦ	tatkin hitaman 6nut	0	0	0	0	0	0	0	0	0	0	0	0	0
> 6 months	> 6 ᑕᕆᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	100	10

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 622

Number of hunters harvesting each species — **Year 5 (June 2000 - May 2001)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓕᓴᐃᒋᑦ ᐊᖏᔪᓕᓴᐅᔪᕐᓇᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᓚᒋᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 5 (June 2000 - May 2001)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓱᑎᐱᓇ	OCT ᐅᑲᐱᓇ	NOV ᐅᓂᐱᓇ	DEC ᑎᓴᐱᓇ	JAN ᔮᖏᓂᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᔪ	APR ᐃᔪᓕᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	18	6	18	8	8	17	12	7	7	9	19	13	49
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut				1	1	3			3	4	3		10
Arctic fox	ᑎᓕᓴᖅᑐᐊᑦ	Tigiganiat						8	6			1	2		10
Coloured fox	ᖃᐅᖏᑦᑐᑦ ᑎᓕᓴᖅᑐᐊᑦ	Kalaliit tigiganiat						1					1		2
Ringed seal	ᓇᓯᓗᑦ	Natiinat	19	5	9		2	5	3	1		3	1		31
Bearded seal	ᐅᓘᔪᐃᑦ	Ukyuk	2	1	3										5
Harp seal	ᖃᐃᕐᓂᑦ	Qairulik			2										2
Walrus	ᐊᐃᐃᓴᑦ	Akvik			1										1
Narwhal	ᑐᒻᓂᑦ ᖁᓪᓗᓕᑦ	Tuugaak	1	5	2										7
Beluga	ᖃᐅᑦᑕᑦ ᖁᓪᓗᓕᑦ	Kilalugak				2									2
Canada goose	ᓄᑦᓂᑦ ᐅᓗᐊᔪᑦᓂᑦ	Nikliknik	2												2
Eider duck	ᒥᑎᑦ	Kingalik		1											1
Arctic char	ᐃᖃᓗᐲᓴᑦ	Ikaliviit	14	5	5	1	7	5	2		1	2	3	1	28
Lake trout	ᐃᓱᒋᔭᐃᑦ	Ikalukpik												26	26

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᒪᔪᓂᒃ ᐱᑕᖃᖅᑎᑐᖅ ᐱᒋᔭᑎᓪᓗᓂᒃ ᐊᖏᔪᑦ ᖃᕐᓯᐅᓂᖏᖅᓂᓄᑦ ᐊᓪᓚᖃᖅᑐᓂᒃ ᐊᓪᓚᖃᖅᓂᓄᑦ ᓄᓇᓕᖕᒥᓄᑦ ᐃᓅᓴᖅᓯᓪᓗᓂᒃ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.3.6

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 623

Annual harvest estimates and five-year mean

ᐊᖏᔪᒍᒪᑦ ᐊᖕᒍᔨᓄᑦ ᓇᓕᐅᑦᑐᓴᐅᑦ ᐊᖏᒪᓗ ᑕᒻᓕᒪᓄᑦ-ᐊᖏᔪᔪᓄᑦ ᐊᐅᑎᓕᖅᑎᓯᒪᓕᕆᑦ

Aragutamat angujauvaktun tatlman araguit iluani

All Years (June 1996 - May 2001)

ᑕᒪᐃᓐᓄᑦ ᐊᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅᓯᒪᔪᑦ ᐊᖏᔪᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᑎᓕᖅᑎᓯᒪᓕᕆᑦ Amigaitkiyait
Species	**ᐅᒪᔪᑦ**	**Umajuin**						
Caribou[1]	ᑐᖅᑐᐃᑦ[1]	Tuktut[1]	1,195	776	658	631	464	745
Musk-ox[2]	ᐅᒥᓴᒪᐃᑦ[2]	Umingmait[2]	0	0	1	0	0	<1
Polar bear[3]	ᓇᓂᐃᑦ[3]	Nanuit[3]	13	2	15	15	13	12
Wolf[4]	ᐊᒪᓗᐃᑦ[4]	Amagut[4]	26	19	35	38	36	31
Arctic fox[5]	ᑎᓕᑉᓂᓂᐊᑦ[5]	Tigiganiat[5]	371	125	81	90	178	169
Coloured fox	ᖃᑯᐦᖏᑦᑐᑦ ᑎᓕᑉᓂᓂᐊᑦ	Kalaliit tigiganiat	0	2	0	8	2	2
Wolverine	ᖃᖏᕐᓴᑦ	Kalvik	6	3	2	7	0	4
Arctic hare	ᐅᒃᓪᓗᑦ	Ukalik	13	4	5	3	0	5
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik	10	0	0	0	0	2
Seals (unspecified)	ᓱᖁᑯᓪᓗᑦ	Natiit	15	0	0	0	0	3
Ringed seal	ᓇᑦᓱᑦ	Natiinat	662	489	386	375	164	415
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	17	19	24	5	6	14
Harp seal	ᖃᐃᕐᓯᑯᓪᓗᑦ	Qairulik	0	2	0	0	3	1
Walrus	ᐊᒃᐃᖏᕐᓴᑦ	Akvik	7	9	14	3	1	7
Narwhal[6]	ᑐᒍᓪᓗᑦ ᖃᓪᓚᕐᓂᑦ[6]	Tuugaak[6]	28	45	15	125	10	45
Beluga[7]	ᖃᑯᑦᑕ ᖃᓪᓚᕐᓂᑦ[7]	Kilalugak[7]	37	53	16	7	3	23
Bowhead	ᐃᕐᖃᕆᑦ	Aivik	2	0	0	0	0	<1
Geese (unspecified)	ᓄᑦᓯᓪᓗᑦ	Kanguk	0	0	0	2	0	<1
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq	21	17	0	2	0	8
Canada goose	ᓄᑦᓯᓪᓗᑦ ᐅᓚᐊᒍᓪᓗᑦ	Nikliknik	6	0	10	1	4	4
Eider duck[8]	ᑎᑎᑦᑕ[8]	Kingalik[8]	4	3	0	2	1	2
Black guillemot	ᐱᑦᓗᐅᓯᑦ	Black guillemot	3	0	0	0	0	1
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	100	25	29	8	0	32
Duck eggs[9]	ᑎᑎᑦ ᓚᖓᔪᖅᑕᐅᑦ[9]	Tinmiat manniit[9]	15	0	11	0	0	5
Seagull eggs[9]	ᓇᐅᔨᐃᑦ ᓚᖓᔪᖅᑕᐅᑦ[9]	Nauyat manniit[9]	0	0	31	0	0	6
Arctic char[10]	ᐃᖃᓗᒃᑑᑦ[10]	Ikaliviit[10]	5,345	4,503	4,537	4,486	2,543	4,283
Lake trout	ᐃᓕᖁᕆᑦ	Ikalukpik	954	172	456	125	77	357

[1-10]: See page 749 for community feedback and other sources of data.

[1-10]: ᑕᐃᒃ ᓚᕐᐱᑐᖅ 751 ᓄᓇᓕᑦ ᑭᐅᔨᓴᖅᑐᑦ ᐊᖏᓪᓗ ᐊᓯᖏᑦ ᐱᕕᐅᓕᕆᔨᒃᑯᓐᓂᖅ.

[1-10]: Takulugu makpigaak 753 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

6.3.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 624

Annual hunter response
ᐊᓚᖏᔪᒪᒻᒪᑦ ᐊᖓᔪᓇᓕᕆᔨᑦ ᑭᐅᓂᖅᑎᑦ
Angujauvaktu

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓇᑦ ᐊᓚᖏᔪᓇᑦ (ᓄᓇ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᒪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᐊᑦ Tamakiklugin
Hunter Response Categories	ᐊᖓᔪᓇᓕᕆᔨᑦ ᑭᐅᓂᖅᑎᑦ ᐊᓚᔪᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᑭᑕᒪᑦ ᐊᖓᔪᓇᓕᕆᔨᑦ	Tatkitaman angunahuktut titigait	169	163	157	152	146	180*
Hunters interviewed	ᐊᖓᔪᓇᓕᕆᔨᑦ ᐊᐱᕐᓂᑦᑕᑦ	Angunahuktin apikhuktan	165	161	148	147	143	176*
Harvested	ᐊᖓᔪᓇᓕᕆᔭᑐᓂᑦ	Angujaujut	129	101	106	79	67	152*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᑦᓯᐅᓂᖅᑎᑦ (%)	Kiujut (%)	85	90	95	96	95	92**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖓᔪᓇᓕᕆᔨᑦ ᐊᑎᓕᐅᔾᔪᒪᓂᕐᓂᑦ/ᐊᐱᕐᓂᑦᑕᑦ/ᐊᖓᔪᓇᓕᕆᔭᑐᓂᑦ ᐊᑕᐅᓯᐊᓘᓐᓃᑦᑐᑎᒃ ᖃᐅᔨᓴᖅᓂᒥᑦ.
** ᐱᓕᕆᓕᕆᓯᒪᔪᑦ ᐊᓚᔪᓂᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut.

6.3.6

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 625

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓐ ᐊᖓᔪᓇᓕᓐᓂᖏᑦ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᑦ, ᓇᓗᓇᕐᑦ ᐃᒪᒃ % ᑲᑎᕐᔪᐊᑦ ᐊᖓᔪᓇᓕᕆᑦ ᑎᑎᕐᑦᑕᐅᒪᔪᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓇᑦ ᐊᓚᔪᓇᑦ (ᓄᓇ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪᒪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᔪᐊᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᕐᑭᑦ	≤ tatkin pingahut	100	100	100	95	90	98
4-6 months	4-6 ᑕᕐᑭᑦ	tatkin hitaman 6nut	0	0	0	4	0	1
> 6 months	> 6 ᑕᕐᑭᑦ	> 6 tatkin	0	0	0	1	10	1

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 626

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖅᑐᑦ ᐊᖏᔪᓯᖅᑎᑦ ᐊᖏᔪᓯᖅᓯᒪᔪᑦ ᐊᑐᓂᖅ ᐅᒪᔨᕐᓂᖅ
Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓇᓂᑦ ᐊᑲᐅᔭᓂᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅᓯᒪᔪᖅ ᐊᑲᐅᔭᖅ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᕐᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**						
Caribou	ᑐᑐᐃᐃᑦ	Tuktut	90	68	64	56	49	109
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait			1			1
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut	8	7	9	12	10	22
Arctic fox	ᑎᓕᑦᓂᐊᑦ	Tigiganiat	24	14	13	4	10	38
Coloured fox	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓕᑦᓂᐊᑦ	Kalaliit tigiganiat		1		4	2	5
Wolverine	ᖃᑦᕿᓵᑦ	Kalvik	3	3	2	5		10
Arctic hare	ᐅᒃᓪᓗᑦ	Ukalik	5	3	3	1		10
Arctic ground squirrel	ᓂᖅᓂᑦ	Hikhik	1					1
Seals (unspecified)	ᓄᖃᑉᓪᓗᑦ	Natiit	4					4
Ringed seal	ᓇᑦᓂᑦ	Natiinat	84	58	63	49	31	113
Bearded seal	ᐅᓚᐊᕐᑐᑦ	Ukyuk	10	13	16	5	5	35
Harp seal	ᖃᐃᖅᓪᓗᑦ	Qairulik		1			2	3
Walrus	ᐊᑐᓵᑦ	Akvik	5	7	11	3	1	22
Narwhal	ᑐᒃᓪᓗᑦ ᖃᓪᓚᕆᑦ	Tuugaak	12	18	7	36	7	49
Beluga	ᖃᐅᔨᑦ ᖃᓪᓚᕆᑦ	Kilalugak	13	19	11	7	2	38
Bowhead	ᐃᕕᓴᖅ	Aivik	1					1
Geese (unspecified)	ᓄᔨᓪᓗᑦ	Kanguk				1		1
Snow goose	ᑲᖏᐃᑦ	Kanguq	3	5		1		9
Canada goose	ᓄᔨᓪᓗᑦ ᐅᓚᐊᒍᓪᓗᑦ	Nikliknik	3		4	1	2	9
Eider duck	ᒥᑎᑦ	Kingalik	2	1		1	1	3
Black guillemot	ᐱᑦᓯᐅᓪᓗᑦ	Black guillemot	1					1
Ptarmigan	ᐊᕐᓴᓕᑦ	Akilgik	12	4	8	3		22
Duck eggs	ᒥᑎᑦ ᒪᓐᓂᖅᑐᑦ	Tinmiat manniit	2		1			3
Seagull eggs	ᓇᐅᒃᐃᑦ ᒪᓐᓂᖅᑐᑦ	Nauyat manniit			2			2
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	47	54	50	36	28	97
Lake trout	ᐃᓕᕋᐃᑦ	Ikalukpik	53	32	53	18	26	101

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᒪᔪᓂᖅ ᐱᑕᖃᓐᖏᑦᑐᒃ ᐱᓕᕆᓂᖓᓂᖅ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖅᓯᒪᓂᑦ ᐊᓪᓚᖅᑐᑦ ᐊᑐᔪᓂ ᓇᓂᐊᖏᑦᑐᖅᓯᒪᔪᓂ ᑐᓂᓴᖏᑦᓂ ᐃᑯᐱᖏᑦᓂ ᐃᑯᐱᖏᓕᕆᓂᒃᑯᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

6.3.6 Community Results Discussion: Repulse Bay

The survey frame:
An assessment of under-enumeration during the community visit revealed that there were approximately 39 Inuit hunters who were not registered in the Harvest Study, 31 occasional and eight active hunters. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. Given that these unregistered hunters represent 18 percent of the total hunter population (Table 10) the effect of this bias on harvest estimates could be significant. However, the effect would be lessened by the fact that, as reported by the Fieldworker, many of these hunters may have reported their harvest through a family member. Harvest estimates for the unregistered hunters can be estimated using mean harvest quantities for each species by strata. However, these estimates, having their own sources of error and bias, are beyond the scope of this Final Report. Readers may apply to NWMB to obtain the results of these calculations.

Due to the relatively small number of intensive hunters registered in Repulse Bay, the intensive classification was joined with the active classification for the purpose of calculating harvest estimates.

Survey coverage and non-response bias:
Response rates in the first two months of the study (June and July 1996) were low, below 75%, and data from these months should be used with caution. However, rates in the subsequent months of year 1 and in all other years are very good. As seen in Table 9 the consistent intentional non-response rate in Repulse Bay was low, at 0.6%, and was not thought to be a potential source of non-response bias.

An examination of the consistency of participation rates (code 1 response as a proportion of code 1 plus code 2 responses) over a five year period was done in order to detect hidden non-response. The basis for this is that declining rates of harvesting (code 1) might indicate "hunter fatigue" with the survey over time. The community of Repulse Bay did show a noticeable decline in participation over the life of the survey indicating that hidden non-response may have occurred in this community.

Although some hidden non-response bias may have occurred towards the end of the study, given the high response rates during all but the first two months, it was concluded that n did in fact constitute a sufficiently representative sample of N hunters.

Measurement issues and response error:
Although it is felt that most hunters were interviewed during the course of the Harvest Study, as demonstrated by the high response rates, it was suggested during the community visit that some hunters may not have reported all their harvest. We were informed that if hunters did not record their harvest in their calendar they would need to estimate their harvest at the time of the interview. Inuit hunters are more likely to underestimate their catch resulting in lower harvest estimates. Hunters reported during the community visit that interest in the study declined in the latter years and as a result some hunters did not record their harvests as diligently. As seen in the discussion below, the community felt that some estimates were low. These measurement errors are suspected to have played a role in this, however the community agreed that most of the estimates are not seriously wrong and are in the right range.

As seen in the recall period tables, the vast majority of harvest records were collected within three months of the harvest, thereby minimizing recall error. However, as noted above there appears to have been some recall error despite the shorter recall periods.

As indicated in the comments relating to arctic char, below, some of the char harvests were sold commercially to local groups. These data are included within the harvest estimates given that the fish were sold (and most likely consumed) locally.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou.
2. **Musk-ox:** Hunters must travel far to harvest musk-ox so few are taken. However, it was reported that hunters travel to the Kitikmeot region for musk-ox and it is suspected that more than one was taken during the Harvest Study (C.F.). The Wildlife Officer confirmed that although the annual quota was 5 animals, the community usually only harvested an average of 1 per year for the reasons mentioned above.
3. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
4. **Wolf:** Hunters reported that harvest estimates seemed to be in the right range (C.F.). For further verification, data were obtained from DSD detailing the number of pelts sold by hunters. DSD reports were available for 1999/2000 and 2000/2001 (years 4 and 5) and indicate that 58 wolf pelts were purchased in 1999/2000 (year 4) and 64 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB). The harvest estimate for years 4 and 5 appear to be somewhat low based on this information.

[5] **Arctic fox:** The harvest estimates for arctic fox seemed to be close to the actual harvest numbers according to hunters (C.F.). Verification of DSD reports did show that the estimates are likely a little low given that 133 arctic fox pelts were purchased from Repulse Bay hunters in 1999/2000 (year 4) and 256 were purchased in 2000/2001 (year 5) (note that DSD data are based on harvest years that run from July to June, whereas Harvest Study data are based on harvest years that run from June to May) (DSD FB).

[6] **Narwhal:** Harvest estimates in years 4 and 5 seem too low. The community was harvesting under a community-based management program since 1999, during which the HTO kept track of the number of animals taken (C.F.). Prior to this program the annual quota was 25 animals. DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
10	35	18	156	49

[7] **Beluga:** Harvest estimates seem accurate (C.F.). DFO reports the following harvest numbers for beluga (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
20	n/d	8	4	10

[8] **Eider duck:** Harvest estimates seem too low. Both king and common eiders are harvested around Repulse Bay (C.F.).

[9] **Eggs:** All harvest estimates for eggs seem too low. It appears that most hunters did not report their egg harvests (C.F.).

[10] **Arctic char:** There was some commercial harvesting of arctic char during the study (DFO F); however most of the fish were sold locally to the HTO and Coop. These harvests were reported along with the subsistence harvest and are included in the harvest estimates shown in the data tables. It was reported that in some years the HTO and Coop store bought less fish from local hunters and this may explain the drop in the harvest estimate in year 5 (C.F.).

6.3.6 ᓄᓇᕗᑦ ᓴᖅᑭᑕᐅᔭᓂᒃ ᑎᒍᑎᑎᑦᑕᖅᑐᑦ: ᓇᐅᔨᑦ

ᖃᐅᔨᓴᓂᐅᕙᑦ ᐊᖏᖅᑭᐅᒪᓂᖅᐳ:

ᕿᒥᖅᑭᐅᑎᓯᓂᑦ ᐊᑎᓕᐅᓇᓐᓂᕐᒧᐊᖅᑐᓂᐅᕙᓪᓕᐊᑦ ᓄᓇᓕ ᓴᓇᖅᑕᑕᐅᑎᓯᓂᑦ ᑕᐃᑎᖅᓯᒪᓕᕐᓂᖅᑐᑦ ᑕᓪᓕᐊᓂ 39 ᒥᐊᓵᖅᓴᓇᓕᕐᓂᖏᓐᓂᒃ ᐊᖏᖅᓯᓯᒪᓂᑦ ᐃᓄᐃᑦ ᐊᑎᖃᖏᖅᑕᐅᓇᖅᑐᓂᑦ ᖃᐃᖅᓯᓕᕐᓂᖅᑐᑦ ᖃᐅᔨᓴᓂᖅᓯᑦ, 31ᖃᓪᓗᓂᑎᒃ ᖃᐃᑎᐳᔪᖅᑕᐅᑦ ᐊᖏᖅᓯᒪᓕᐅᑦ ᐊᖏᖅᓯᓯᒪᓂᑦ ᑕᒪᓐᓇᖅ 8ᖃᓪᓗᓂᑎᒃ ᐊᖏᖅᓯᓯᒪᓂᑦ ᑕᒪᓐᓇᖅ. ᐅᖃᐅᓯᐅᒪᒥᒃ ᓇᓴᐅᑎᒥ 5.2.1 ᑕᒪᑐᒪ ᐊᑎᓕᐅᓇᓐᓂᕐᒧᐊᖅᑐᐃᓕᐳᑦ ᐱᒍᑕᐅᓂᖏᓐ ᐊᖏᓂᔨᓕᓂᕐᓯᒪᓚᕐᓴᖅᑐᐃᓐᓇᑦ ᐃᓚᖅᑭᑕᐅᔨᓂᑦ ᖃᖅᓱᐅᔨᓂᖅᓴᖅ. ᐃᓗᒪᓕᓪᓚᐃ ᑕᒪᐃᓐᓇ ᐊᑎᖃᖏᖅᑕᐅᓇᖅᑐᓂᑦ 18%ᓇᓱᒪᓕᕐᓇᑦ ᑲᑎᑕᐅᓯᒪᓂᖅᑐᑦ ᐊᖏᖅᓯᓯᒪᓂᒪᓕᑦ (ᓇᓕᖅᑲᖅ 10) ᐊᑦᑐᐃᓂᓗᓚᕐᓴᖅᑕᖏᓐᓂᑦ ᐃᓚᖅᑭᑕᐅᔨᓂᑦ ᖃᓄᐅᑑᐅᓂᖅᑐᓂᒃ ᐊᑦᓯᐃᓚᒃᑕᓚᐅᔨᓇᖅᑐᓂᖅ. ᐱᓪᓚᐅᓂ, ᐊᑦᑐᐃᓂᓗᓚᖏᓐ ᐊᒃᓯᓚᐊᖏᖅᓯᔨᒥᔨᓇᖅᑐᓂᖅ, ᑕᐃᒪᓐᒃ ᐅᖃᐅᓯᐅᓕᕐᓂᒪᒃ ᐃᓕᓴᐅᓇᓚᐅᑎᓂᑦᑐᓂᓪᓕᓐᓂ, ᐱᓇᓱᑦᑐᓂ ᑕᓚᐅᑎᓂᑦ ᐅᖃᐅᓯᓂᖅᓯᒪᓂᑦ ᐅᖃᐅᔨᖃᖅᑎᖃᖅᑐᓂᒃ ᐃᓚᖅᑭᑕᐅᔨᓂᑦ ᐅᖃᐅᔨᖃᖅᑎᖃᖅᑐᑦ ᐃᓕᓴᐅᓇᓚᐅᑎᓂᑦ ᐱᓇᓱᑦᑐᓂ ᐅᖃᐅᔨᖃᖅᑎᖃᖅᑐᑦ ᐃᓕᓴᐅᓇᓚᐅᑎᓂᑦ ᐊᑦᑐᐃᓂᓗᓚᖏᓐ ᐃᓚᖅᑭᑕᐅᔨᓂ

1999/2000Γ (ᐅᑭᐅᖓᓱᓂ 4) ᐊᓪᒪᒪ 64ᓂᒃ ᓂᐅᐃᖏᑐᑎᒃ 2000/2001Γ (ᐅᑭᐅᖓᓱᓂ 5) (ᖃᐅᔨᒪᒋᑦ ᐃᑯᐱᐊᓕᓚᐅᖅᓯᒪᔪᑦ ᐊᔪᐅᑎᖓᑦ ᒪᓕᒫᒪᑦ ᐱᕐᓂᖅᓱᖏᓐᓂᒃ ᓴᓇᔨᓴᖅᑭᑦ ᐊᓪᓚᒃᑎᓪᓗᒍ ᐊᑐᓕᕐᓂᐊᕐᓂᖅᓱᓕᒫᑦ ᒪᓕᒫᒪᑦ ᐱᕐᓂᖅᓱᖏᓐᓄᑦᑐᓗ ᓴᓇᓪᓕᑦ ᒪᐃᔭᖅ) (DSD FB). ᐊᒪᓂᖅᑕᐅᔪᓕᐅᑦ ᐅᑭᐅᖓᓱᓂ 4 ᐊᓪᒪ 5 ᐃᓕᓴᐃᓪᓕ ᐊᑎᑐᓴᖅᓯᐅᔾᔨᓪᓕ ᑕᒃᓯᒍ ᒪᓕᑐᑎᑦ.

5 **ᑎᓴᓱᓂᐊᖅ:** ᑎᓴᓱᓂᐊᖅᑕᐅᔪᑎᑦ ᖃᓄᐅᓂᖓᑦ ᖃᓄᓕᕆᓂᖓᓂᒃᓯᓯᒪᔨᓪᓕ ᐱᔨᐅᒡᓕᑕᖅᑐᑎᓕᓪᓚᒥᑦ ᖃᓄᐅᓂᖓᓂᒃᓱᓂ ᐊᖏᓪᓕᐊᓂᑎᑦ ᑕᐅᑐᑦᑕᒥᔪᑦ (C.F.). ᓇᓗᓇᐃᒃᓯᒪᔨᐅᑎᒡᓗᑦ ᐃᓯᐊᖏᓚᐅᖅᓯᒪᔪᑦ ᑕᓯᑎᑦᓴᓕᐅᖅᑐᑦ ᒥᑦᓴᐅᓯᖅᑕᐅᓯᒪᓪᓕᑦ ᑕᓕᒃᓯᐊ ᐊᑦᑎᓗᐊᖅᑎᓪᓗᓂᒃᓱᓂᒃ ᐃᓯᒪᓕᑎᒡᓗᓕ 133 ᑎᓴᓱᓂᐊᖅᐃᐃᐃᑦ ᓂᐅᔨᓴᖅᑕᐅᓯᒪᓪᓕᑦ ᐃᓯᒪᓕᑎᒡᓗᓕ 1999/2000Γ (ᐅᑭᐅᖓᓱᓂ 4) ᐊᓪᒪᓗ 256 ᓂᐅᐃᖏᑕᐅᓯᒪᔪᓂᖏᓐᓄᑦ 2000/2001Γ (ᐅᑭᐅᖓᓱᓂ 5) (ᖃᐅᔨᒪᒋᑦ ᐃᑯᐱᐊᓕᓚᐅᖅᓯᒪᔪᑦ ᐊᔪᐅᑎᖓᑦ ᒪᓕᒫᒪᑦ ᐱᕐᓂᖅᓱᖏᓐᓂᒃᓱᓂ ᐊᓪᓚᒃᑎᓪᓗᒍ ᐊᑐᓕᕐᓂᐊᕐᓂᖅᓱᓕᒫᑦ ᒪᓕᒫᒪᑦ ᐱᕐᓂᖅᓱᖏᓐᓂᒃ ᐊᓪᓚᒃᑎᓪᓗᒍ ᐊᑐᓕᕐᓂᐊᕐᓂᖅᓱᓕᒫᑦ ᒪᓕᒫᒪᑦ ᐱᕐᓂᖅᓱᖏᓐᓄᑦᑐᓗ ᓴᓇᓪᓕᑦ ᒪᐃᔭᖅ) (DSD FB).

6 **ᑐᐃᓂᑦ:** ᐅᓪᓛᕐᓂᑕᒥᓂᑦ ᐅᑭᐅᖓᓱᓂ 4 ᐊᓪᒪ 5 ᐊᑦᑎᓗᐊᖅᑐᑦᑕᒃᑦ. ᓄᓇᓕ ᑐᐃᓚᒌᓗᒃᑲᓪᓕᐅᖅᑐᑦ ᒪᓕᑦᑎᐊᖅᑕᒃᑎᒃ ᓄᓇᓕᒥᑦ ᐊᐅᓪᓕᓗᒃᑲᓪᓕᐅᖅᑐᑦ ᐊᑦᑕᓱᒃᑐᒃ 1999Γᓂᑦ, ᑕᐃᒪᓐᓇᓂᑦ ᐊᖏᓪᓕᐊᓂᑎᑦᓴᓕᒫᑦ ᓄᓇᕗᑦᑐᑎᓪᓗᒍ ᖃᓄᑦ ᐱᓕᕆᔨᒃᑲᓪᓕᐅᖅᑐᑦ (C.F.). ᑕᒪᑐᒪ ᓗᒃᑐᓂᐊᓂ ᐊᖏᓪᓕᐊᓂᑎᑦ ᑐᓂᓯᒪᔪᑦ 25ᓂᒃ ᐊᑦᓚᖓᔪᓂᒃ. ᐃᓕᑎᐅᑕᓚᐅᖅᑐᓄᑦ ᐊᑦᓚᐅᑕᐅᓯᒪᓪᓕᐅᑎᓪᓗᒍ ᐅᐃᐊ ᓇᓴᐅᑦ ᑐᐃᓚᒌᓗᒃᑲᓪᓕᐅᖅᑐᑦᑕᒃᑦ (ᖃᐅᔨᒪᒋᑦ ᐃᓕᑎᐅᑕᓚᐅᖅᑐᓄᑦ ᓇᓴᐅᑦ ᒪᓕᑐᑎᑦ ᑭᓇᐅᔭᖓᑦ ᒪᓕᑐᑎᑦ ᐱᔨᐅᒡᓕᑕᖅᑐᑦᑕᒃᑦ ᐅᑭᐅᖓᓱᓂ, ᐅᓪᓛᕐᓂᑕᒥᓂᑦ ᐊᑦᑎᓗᐊᖅᑕᒃᑎᒃ ᓄᓇᓕᒥᑦ ᐊᐅᓪᓕᓗᒃᑲᓪᓕᐅᖅᑐᑦ ᐊᑦᑕᓱᒃᑐᒃ 1999Γᓂᑦ, ᑕᐃᒪᓐᓇᓂᑦ ᐊᖏᓪᓕᐊᓂᑎᑦᓴᓕᒫᑦ ᓄᓇᕗᑦᑐᑎᓪᓗᒍ ᖃᓄᑦ ᐱᓕᕆᔨᒃᑲᓪᓕᐅᖅᑐᑦ (C.F.). ᑕᒪᑐᒪ ᓗᒃᑐᓂᐊᓂ ᐊᖏᓪᓕᐊᓂᑎᑦ ᑐᓂᓯᒪᔪᑦ 25ᓂᒃ ᐊᑦᓚᖓᔪᓂᒃ. ᐃᓕᑎᐅᑕᓚᐅᖅᑐᓄᑦ ᐊᑦᓚᐅᑕᐅᓯᒪᓪᓕᐅᑎᓪᓗᒍ ᐅᐃᐊ

6.3.6 Nunanit Iniktigutait Ukauhiit: Naujaat

Ihivgiuktit Atugutait:
Ihivgiufaakhimayut ataani naunaiyakhimayut nunamut pulaakhimapluni takuhimayut 39nik Inuit umayukhiuktit titigaktauhimaitut Umayukhiukhimayuni Ihivgiuktuni, 31kuyut ilaani umayukhiukpaktut ovalo 8kuyut umayukhiukataktut. Ukakhimayut ilangani 5.2.1 ikpinagutait ataani naunaiyakhimayut pilaamata ataanut ihumagiyainik umayukhiukhimayut naunaiyautait. Taimaimat hapkoa titigaktauhimaitut umayukhiuktit 18%kuyut tamaat umayukhiuktinit (Ikpatauyak 10) ikpinagutait hamna ihumagiyauyut umayukhiukhimayut naunaiyautaini angiyuuniamat. Kihimi, ikpinagutait mikilaaktut tuhaktitihimayaini nunani havaktiit, amigaitut hapkoa umayukhiuktit pihimamata tuhaktitihimayut umayukhimayaminik ilakatiminut. Umayukhiukhimayut naunaiyautait titigaktauhimaitut umayukhiuktit naunaiyalaat anginikhaanut umayukhiukhimayainik amigaitjutait tamamik umayut aviktkhimalugit. Kihimi, hapkoa naunaiyautit pihimamata inminik ihuinaagutainik ovalo ihumagiyainik avataaniimata iniktigutait hamna Iniktigutit Tuhaktakhat. Taiguaktut apigilaaktut NWMBkunit piyumagumik iniktigutainik hapkoa naunaiyautait.

Mikiyuumata amigaitjutait umayukhiuginaktut umayukhiuktit titigakhimayut Naujaani, umayukhiunginaktut naunaiyautait ilauhimayut umayukhiukataktut naunaiyautainut hamna naunaiyautigutainut umayukhiukhimayut naunaiyautaini.

Ihivgiukatagutait ovalo kiuyuitut ihumagiyait:
Kiuhimayut naunaiyautait hivulimi malguk tatkikhiutini ihivgiuktini (Junemi ovalo Julymi 1996) mikiyut, ataani 75%mik ovalo katitikhimayut hapkonanga tatkikhiutinit atuktuhat ihumagilugit. Kihimi, naunaiiyautait maliktaini tatkikhiutit ukiumi 1 ovalo tamamik aipait ukiut nakuuyut. Takuhimayut ikpatauyani 9mi pikataktut kiuyuitut naunaiyautait Naujaani mikiyut, 0.6%mik ovalo ihumagiyaungituk pilaaktunik atugutaini kiuyuitut ihumagiyaini.

Kungiakhimayaini pikataktut ilauyuni naunaiyautait (code 1mi kiuhimayut ilangit code 1mi ilalugu code 2mik kiuhimayunit) avataanut talimat ukiut pihimayut naunaiyanahuakhugit takuyaungitut kiuyuitut. Atuktangit hamani ilaa, kataktingagit naunaiyautait umayukhiukataktuni (code 1mi) takukhaumata "umayukhiuktit unagugutait" ihivgiukataktuni taimaa taimaa. Nunani Naujaat takukhauyut takukhaukpiaktunik kataktitihimayunik ilauyuni pititlugit ihivgiuktut takukhaulikhuni takulaitut kiuyuitut piyunakhihimamata hamani nunami.

Ilangit takuyaungitut kiuyuitut ihumagiyait piyunakhihimamat iniktiligutaini ihivgiuktut, pihimamat angiyut kiuhimayut naunaiyautait tamamik kihimmi hivuliit malguk tatkikhiutit, inikhimayut taamna nni pihimayuk naamaktumik ilauyumik uktugutait Nni umayukhiuktini.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Ilaa ihumagiyauyuk amigaitkiyait umayukhiuktit ukakatigihimayut pititlugit Umayukhiukhimayut Ihivgiuktitlugit, takuyauhimayut angiyut kiuhimayut naunaiyautini, pitkuihimayut nunani pulaakhimatitluni ilangit umayukhiuktit tuhaktitihimaitut tamamik umayukhimayaminik. Tuhaktitauhimayugut umayukhiuktit titigakhimaitkumiuk tamamik umayukhimayaminik tatkikhiutiminut piniaktut naunaiyakafulugit umayuktaminik apikhutitauligumik. Inuit umayukhiuktit ataani naunaiyakhimayumata umayuktaminik pipkailikpamata ataani umayukhiukhimayait naunaiyautaini. Umayukhiuktit tuhaktitihimayut nunanut pulaakhimatitlugit ihumagiyauliktuk ihivgiuktuni kataktitihimayut kinguani ukiuni ovalo taimaimat ilangit umayukhiuktit titigakhimaitut umayukhiuktaminik kilamik. Takuyauhimayut ukakhimayuni hamani,nunat ihumayut ilangit naunaiyautait mikiyut. Hapkoa atugutingit ihuinaagutait ukpigiyut pihimapkaihimayut hamani, kihimi nunat angikhimayut amigaitkiyait naunaiyakhimayut ihuinaakpalaakhimaitut ovalo naamaktut.

Takuhimayut utiktitihimayuni ubluit ikpatauyaini, amigaitut umayukhiukhimayut titigait katitikhimayut iluani pingahut tatkikhiutini umayukhiukhimayaini, taimaimat mikhihimayut utiktitigutait ihuinaagutait. Kihimi, titigakhimayut hamani, piyunakhiyut ilangini utiktitihimayut ihuinaakhimayut pigaluakhutik naitumik utiktitihimayut ubluini.

Pihimayuni ukakhimayut mikhaanut ikaliviit hamani, ilangit ikaliviit umayukhiukhimayut niuviktauhimayut kinauyaliugutigivlugit nunani ilauyunit. Hapkoa katitikhiamayut ilauytut iluani umayukhiukhimayut naunaiyautaini pihimamat ikaluit niuviktaugaluakhutik (ovalo niguyauhimayunakhiplutiklu) nunani.

Nunanit ukakhimayut ovalo aalat atukhimayaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukhimayut nunani tuktut.
2. **Umingmait:** Umayukhiuktit autlaakpaktut ungahiktumut umingmakhiukhutik, taimaimat ikitut pivaktut. Kihimi, tuhaktitihimayut umayukhiuktit autlaakpaktut Kitikmeonut umingmakhiukhutik ovalo taimaimat amigaitkiyait atauhimit pivaktut umayukhiukhimayut ihivgiuktitlugit (C.F.). Umayuligiyit ukakhimayut ukiuk tamaat kotakaktut talimanik umingmanik, nunani pikataktut talvatuak umayukhiukhimayut kitkani atauhik ukiuk tamaat ukakhimayuni hamani.
3. **Nanuit:** Amigaitjutait takukhauyut naunaiyautaungitut kihimi pihimayut umingmakhimayut amigaitjutait tunihimayut DSDkunit (DSD PB).

[4] **Amagut:** Umayukhiuktit tuhaktitihimayut umayukhiukhimayut naunaiyautait naamaktut (C.F.). Naunaiyatiagumapluni katitikhimayut pihimayut DSDkunit, titigakhimayut amigaitjutait amiit niuviktauhimayut umayukhiuktinit. DSDkut tuhaktitihimayut pihimayut 1999/2000mi ovalo 2000/2001mi (ukiumi 4mi ovalo 5mi) ovalo pihimayut 58nik amagut amiinik niuviktauhimayut 1999/2000mi (ukiumi 4) ovalo 64nik niuviktauhimayut 2000/2001mi (ukiumi 5) (nalungilutit DSDkut katitikhimayut atukpaktut umayukhiukhimayut ukiungini Julymit Junemut, Umayukhiukhimayut Ihivgiuktit umayukhiukhimayut ukiungini Junemit Maymut) (DSD FB). Umayukhiukhimayut naunaiyautait ukiumi 4mi ovalo 5mi takukhauyut mikiyut atukhugit hapkoa tuhagutikhat.

[5] **Tigiganiat:** Umayukhiukhimayut naunaiyautait tigiganianut kanitut umayukhiukhimayainut amigaitjutainik ukakhimayut umayukhiuktinit (C.F.). Ihuakhitauhimayut naunaitjutait DSDkut tuhaktitihimayainik takukhauyut naunaiyautait mikivyaktut, pivamata 133nik tigiganiat amiinik niuviktauhimayut Naujaanit umayukhiuktinit 1999/2000mi (ukiumi 4) ovalo 256nik niuviktauhimayut 2000/2001mi (ukiumi 5) (nalungilutit DSDkut katitikhimayait atukpaktut umayukhiukhimayut ukiungit Julymit Junemut, Umayukhiukhimayut Ihivgiuktit katitikhimayut atukpaktut umayukhiukhimayut ukiunginit Junemit Maymut) (DSD FB).

[6] **Tuugaat:** Umayukhiukhimayut naunaiyautait ukiumi 4mi ovalo 5mi mikiyut. Nunani umayukhiukhimayut ataani nunani-atuktut munagitjutainik pilihimayuni 1999mit, HTOkut munagihimayait amigaitjutait tuugaat pivaktut (C.F.). Pitinagu hamna pilihimayuk, ukiuk tamaat kotangit 25nik tuugaat. DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait tuugaanik (nalungilutit DFOkut katitikhimayut atukpaktut iniktigutaini ukiuni, Umayukhiukhimayut Ihivgiuktit katitikhimayut atukpaktut umayukhiukhimayut ukiungit Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
10	35	18	156	49

[7] **Kilalugat:** Umayukhiukhimayut naunaiyautait naamaktut (C.F.). DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait kilalugat (nalungilutit DFOkut katitikhimayut atukpaktut iniktigutaini ukiungit, Umayukhiukhimayut Ihivgiuktit katitikhimayut atukpaktait umayukhiukhimayut ukiungini Junemit Maymut) (DFO N/B).

96/97	97/98	98/99	99/00	00/01
20	n/d	8	4	10

[8] **Tinmiat:** Umayukhiukhimayut naunaiyautait mikiyut. Tamamik kingaliit ovalo mitiit umayukhiukhimayut haniani Naujaami (C.F.).

[9] **Maniit:** Tamamik pikiutakhimayut naunaiyautait maniit mikiyut. Takukhauyut amigaitut umayukhiuktit tuhaktitiyuitait maniit pikiutakataktainik (C.F.).

[10] **Ikaliviit:** Pikataktut ilangit kinauyaliugutit umayukhiukhimayut ikalivinik ihivgiuktitlugit (DFO F); kihimi amigaitut ikaliviit niuviktauvaktut nunani HTOkunit ovalo Kuapatkunit. Hapkoa umayukhiukhimahyut tuhaktitihimayut ilauplutik atuktakhaini ikaliviit ovalo ilauyut umayukhiukhimayut naunaiyautaini takukhauyut katitikhimayut ikpatauyaini. Tuhaktitihimayut ilaani ukiut HTOkut ovalo Kuapatkut niuviktiit niuvikpaktut ikitunik ikalivinik nunanit umayukhiuktinit ovalo taimaimat ukakhimayut katakhimayut umayukhiukhimayut naunaiyautait ukiumi 5mi (C.F.).

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 627

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᖅᑎᑦ

Tatkiktamat nahaktauvaktun

Year 1 (June 1996 - May 1997)

ᐊᑦᔪᒍ 1 (ᔨᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖢᓪᓚᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓱᑎᐱᓇ	OCT ᐅᑦᔨᓇ	NOV ᐅᓇᓚᐱᓇ	DEC ᑎᓯᓚᐱᓇ	JAN ᒍᖏᓂᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓪᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	13	26	50	65	58	95	66	83	15	21	50	14	556 ± 52
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait								1					1 ± 1
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡					5	7		12					
Tundra grizzly	ᐊᑦᓪᓗᐃᑦ	Akhait			1										1 ± 1
Wolf	ᐊᒪᕐᕈᐃᑦ	Amagut						1		1					2 ± 1
Arctic fox	ᑎᓗᒃᑲᓕᐊᑦ	Tigiganiat					4	52	12	20		2			90 ± 35
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik				3	3				19	3			28 ± 24
Seals (unspecified)	ᓴᖅᑯᓪᓚᑦ	Natiit					1								1 ± 1
Ringed seal	ᓇᓕᓐᓂᑦ	Natiinat	3	3	5	2	4	3	1	2		2			25 ± 5
Bearded seal	ᐅᖏᓪᓗᐃᑦ	Ukyuk	1				1								2 ± 1
Harp seal	ᖃᐃᕈᓪᓚᑦ	Qairulik					1								1 ± 1
Beluga	ᖃᐅᕐᑕ ᖃᓪᓗᓂᑦ	Kilalugak		1	7	3									11 ± 3
Snow goose	ᑲᖏᒍᐃᑦ	Kanguq	20			5									25 ± 3
Canada goose	ᓄᖅᓚᓪᓚᑦ ᐅᓪᓗᐊᔨᓚᓪᓚᑦ	Nikliknik	21												21 ± 0
Ptarmigan	ᐊᖏᕆᑦ	Akilgik			2		1						7		10 ± 8
Arctic char	ᐃᖃᓗᐊᓴᑦ	Ikaliviit	317	394	239		210	242	67	25					1,494 ± 162
Lake trout	ᐃᓱᕐᓴᐃᑦ	Ikalukpik	2	7			38		1	22	29	64	16	2	181 ± 80
Arctic grayling	ᓱᓗᓴᐅᑎᐃᑦ	Hulupaugaq	1												1 ± 0
Whitefish	ᑲᐱᓱᓚᓪᓚᑦ	Kapihiliit	1												1 ± 0
Sculpin	ᑲᓕᔪᐃᑦ	Kanayuk		6											6 ± 0

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᓴᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᐅᖏᑦ ᐅᑉᐳᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕕᓂᓕᕆᓂᖅᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓄᓇᓕᐃᔨᐅᑦ/NAUNAIKUTA 628

Monthly hunter response

ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖅᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)

ᐃᓕᖕᒧᑐ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔮᓂ	JUL ᔮᓪᐃ	AUG ᐊᐅᒍᑐᑎ	SEP ᓯᑎᕐᕕᓪ	OCT ᐅᑯᐊᓪ	NOV ᓄᕕᒡᕕᓪ	DEC ᑎᓯᒡᕕᓪ	JAN ᔨᓐᓄᐊᓪ	FEB ᕕᖕᕋᐊᓪ	MAR ᒪᕐᕿ	APR ᐃᕐᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᒃᑎᑦ ᑭᐅᓂᖅᑎᑦ ᐱᒍᕐᒪᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᑕᒪᑦ ᐊᖏᔪᓂᒃᑎᑦ	Tatkitaman angunahuktut titigait	43	43	43	44	44	45	45	45	45	45	49	48	50*
Hunters interviewed	ᐊᖏᔪᓂᒃᑎᑦ ᐊᐱᕐᓯᑦ	Angunahuktin apikhuktan	41	40	39	40	38	39	32	37	27	27	35	27	46*
Harvested	ᐊᖏᔪᓂᒃᑎᒥᓂ	Angujaujut	12	18	24	17	20	24	11	19	4	6	7	3	41*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᕐᓂᐅᓂᖅᑎᑦ (%)	Kiujut (%)	95	93	91	91	86	87	71	82	60	60	71	56	79**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓂᒃᑎᑦ ᐊᑎᓕᐅᑉᑕᒪᓐᓇᖅᑐᑦ/ᐊᐱᕐᓯᑦᑕᑦ/ᐊᖏᔪᓂᒃᑎᒥᓂ ᐊᑕᐅᓯᐊᖓᔪᓕᐊᑎᑐᑦ ᐊᓕᖕᒪᑦ.
** ᐊᐅᔾᔨᓂᑎᓯᒪᓐᓇᔪᑦ ᑕᖃᑦᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.3.7

TABLE/ᓄᓇᓕᐃᔨᐅᑦ/NAUNAIKUTA 629

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᔪᑦ ᐋᑯᖏᓐᓄᑦ ᐊᖏᔪᓂᒃᑎᓕᕆᓂᖅᑎᑦ ᐊᓚᓗ ᐊᐱᕐᓯᑦᑕᐅᓂᖅᑎᑦ, ᓄᓇᓕᐃᕐᑦ ᐃᒪᓐᵇ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓂᒃᑎᑦ ᑎᑎᕐᑦᑕᐅᒪᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)

ᐃᓕᖕᒧᑐ 1 (ᔮᓂ 1996 - ᒪᐃ 1997)

Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔮᓂ	JUL ᔮᓪᐃ	AUG ᐊᐅᒍᑐᑎ	SEP ᓯᑎᕐᕕᓪ	OCT ᐅᑯᐊᓪ	NOV ᓄᕕᒡᕕᓪ	DEC ᑎᓯᒡᕕᓪ	JAN ᔨᓐᓄᐊᓪ	FEB ᕕᖕᕋᐊᓪ	MAR ᒪᕐᕿ	APR ᐃᕐᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑭᑦ	≤ tatkin pingahut	74	98	100	100	100	100	100	100	100	100	100	100	98
4-6 months	4-6 ᑕᖅᑭᑦ	tatkin hitaman 6nut	26	2	0	0	0	0	0	0	0	0	0	0	2
> 6 months	> 6 ᑕᖅᑭᑦ	> 6 tatkin	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 630

Number of hunters harvesting each species — Year 1 (June 1996 - May 1997)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖑᓇᓱᒃᑏᑦ ᐊᖑᓇᓱᒃᐸᑦᑐᑦ ᐊᑐᓂᒃ ᐆᒪᔪᕐᓂᒃ — ᐊᒡᕋᒍ 1 (ᔪᓂ 1996 - ᒪᐃ 1997)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᕿᖓ/Tatkia			JUN ᔪᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒡᒍᕐᑎ	SEP ᓱᑎᒡᐱᕆ	OCT ᐅᑦᑐᐱᕆ	NOV ᓈᕕᒡᐱᕆ	DEC ᑏᓯᒡᐱᕆ	JAN ᔮᓐᓄᐊᕆ	FEB ᕕᕝᕗᐊᕆ	MAR ᒪᑦᓯ	APR ᐃᕐᕆᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᒋᑦ Tamakiklugin
Species	**ᐆᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	5	13	17	15	17	21	9	18	3	3	6	3	39
Musk-ox	ᐅᒥᒃᒪᐃᑦ	Umingmait								1					1
Polar bear‡‡	ᓇᓄᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᕐᓚᐃᑦ	Akhait			1										1
Wolf	ᐊᒪᕈᐃᑦ	Amagut						1		1					2
Arctic fox	ᑎᕆᒐᓐᓂᐊᑦ	Tigiganiat					1	3	3	1		1			5
Arctic hare	ᐅᑲᓖᑦ	Ukalik				2	2				1	1			5
Seals (unspecified)	ᓯᖅᑯᓖᑦ	Natiit					1								1
Ringed seal	ᓇᑦᓯᑦ	Natiinat	2	2	3	1	3	1	1	2		1			12
Bearded seal	ᐅᒡᔪᐃᑦ	Ukyuk	1				1								2
Harp seal	ᖃᐃᕈᓖᑦ	Qairulik					1								1
Beluga	ᖃᑯᕐᑕᑦ ᕿᓚᓗᒐᑦ	Kilalugak		1	4	2									7
Snow goose	ᑲᖑᐃᑦ	Kanguq	2			1									3
Canada goose	ᓂᕐᓖᑦ ᐅᓗᐊᒍᓪᓖᑦ	Nikliknik	1												1
Ptarmigan	ᐊᕿᒡᒋᑦ	Akilgik			1		1						1		3
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	7	12	7		7	5	2	1					22
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	1	1			2		1	1	1	2	2	1	6
Arctic grayling	ᓱᓗᒃᐸᐅᒐᐃᑦ	Hulupaugaq	1												1
Whitefish	ᑲᕕᓯᓖᑦ	Kapihiliit	1												1
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk		1											1

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᓯᒪᔪᓂᒃ ᐱᑕᖃᓐᖏᑦᑐᖅ ᐱᔾᔪᑎᓕᓐᓂᒃ ᐊᖑᔭᑦ ᖃᑦᓯᐅᓂᖏᓐᓄᑦ ᐊᓚᒃᑲᐅᒪᔪᓄᑦ ᐊᖑᔭᓄᑦ ᓇᓚᐅᑦᓴᕈᑎᓂ ᑐᓂᔭᖏᓐᓂ ᐃᑯᐱᕐᕕᓕᕆᔨᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 631

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᓐᓴᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐃᓄᐊᐱᓗ	DEC ᑎᓯᐱᓗ	JAN ᔮᖏᓄᐊᓗ	FEB ᓇᖕᐳᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᓴᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᒥᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓐᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	18	12	36	25	18	23	23	43	14	26	27	79	344 ± 42
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡					1	9			2				12
Wolf	ᐊᒪᓗᐃᑦ	Amagut								1					1 ± 1
Wolverine	ᖃᖏᕕᒃ	Kalvik												1	1 ± 1
Seals (unspecified)	ᓂᖅᑯᓕᓪᓕᑦ	Natiit												4	4 ± 3
Ringed seal	ᓇᓂᓯᑦ	Natiinat							2		1			4	7 ± 3
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk					1								1 ± 2
Harp seal	ᖃᐃᐳᓕᓪᓕᑦ	Qairulik	1		15	5	3	2							26 ± 11
Beluga	ᖃᑯᕐᑕ ᖃᓪᓚᒡᒪᑦ	Kilalugak			6	1									7 ± 3
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq												9	9 ± 6
Canada goose	ᓂᕕᓕᑦ ᐅᓗᐊᔪᓕᓕᑦ	Nikliknik												18	18 ± 9
Arctic char	ᐃᖃᓗᐊᖅᑎᑦ	Ikaliviit		45								14	10	45	114 ± 53
Lake trout	ᐃᓂᕐᓴᐃᑦ	Ikalukpik										32	12	25	69 ± 28
Whitefish	ᑲᐱᓂᓕᑦ	Kapihiliit											40	123	163 ± 107

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᔾᓂᑦ ᑎᑎᕐᑕᒪᓚᕐᑦ ᑐᓂᔭᕐᑦ ᐅᑯᐊ ᐃᑯᐱᕐᓗᓂᔾᔪᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.3.7

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 632

Monthly hunter response
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓇᓂᖅᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)
ᐊᓐᓴᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐃᓄᐊᐱᓗ	DEC ᑎᓯᐱᓗ	JAN ᔮᖏᓄᐊᓗ	FEB ᓇᖕᐳᐊᓗ	MAR ᒪᕐᓂ	APR ᐃᓴᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑕᒥᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓂᖅᑎᑦ ᑭᐅᓂᖏᑦ ᐊᓚᔾᔪᓚᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᔪᓇᓂᖅᑎᑦ	Tatkitaman angunahuktut titigait	49	48	43	43	43	43	43	43	44	44	44	40	50*
Hunters interviewed	ᐊᖏᔪᓇᓂᖅᑎᑦ ᐊᐱᕐᔪᖏᑦ	Angunahuktin apikhuktan	41	29	32	39	36	42	42	40	42	39	40	34	43*
Harvested	ᐊᖏᔪᓇᓂᐅᒥᓂᑦ	Angujaujut	11	6	14	12	8	6	7	9	6	9	9	13	32*
Response Rate (%)	ᑭᐅᖅ ᖃᕐᓂᐅᓂᖏᑦ (%)	Kiujut (%)	84	60	74	91	84	98	98	93	95	89	91	85	87**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓂᖅᑎᑦ ᐊᑎᓕᐅᑦᑕᒪᓚᕐᑦ/ᐊᐱᔪᖏᑦᑕᑦ/ᐊᖏᔪᓇᓂᐅᒥᓂᑦ ᐊᑕᐅᓯᐊᖏᓪᓗᓂᑦ ᐊᓚᔾᔪᒥ.
** ᐊᓴᒋᓕᓴᐱᓚᕐᑦ ᑕᖅᑕᒪᑦ ᑭᐅᖅ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 633

Recall period between harvest and interview, expressed as % of total harvest records

Year 2 (June 1997 - May 1998)

ᐅᑎᕆᐱᐅᔪᑦ ᐊᑯᕆᖏᓂ ᐊᖏᔪᓕᓐᓂᖏᑦ ᐊᒻᒪᓗ ᐊᐱᕆᓯᑦᑕᐅᓂᖏᑦ, ᓇᓗᓇᐃᕆᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓕᒃᑕᑦ ᑎᑎᕆᑦᑕᐅᒪᔪᑦ

ᐊᒻᕆᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖏᖅ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᒻᒪᓕ	OCT ᐅᑦᒪᓕ	NOV ᓄᐃᒻᒪᓕ	DEC ᑎᓯᒻᒪᓕ	JAN ᔮᓐᓄᐊᓕ	FEB ᐃᕐᕿᐊᓕ	MAR ᒪᕆ	APR ᐃᕆᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕆᐱᐅᔪᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖏᑦ	≤ tatkin pingahut	79	100	83	94	93	79	62	100	100	38	47	0	68
4-6 months	4-6 ᑕᖏᑦ	tatkin hitaman 6nut	0	0	17	0	7	0	0	0	0	0	0	0	2
> 6 months	> 6 ᑕᖏᑦ	> 6 tatkin	21	0	0	6	0	21	38	0	0	62	53	100	29

6.3.7

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 634

Number of hunters harvesting each species

Year 2 (June 1997 - May 1998)

ᖃᑦᕿᐅᓂᖏᑦ ᐊᖏᔪᓕᒻᒧᑦ ᐊᖏᔪᓕᒻᒪᕐᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ

ᐊᒻᕆᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖏᖅ/Tatkia			JUN ᔨᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᒻᒪᓕ	OCT ᐅᑦᒪᓕ	NOV ᓄᐃᒻᒪᓕ	DEC ᑎᓯᒻᒪᓕ	JAN ᔮᓐᓄᐊᓕ	FEB ᐃᕐᕿᐊᓕ	MAR ᒪᕆ	APR ᐃᕆᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᐅᐃᑦ	Tuktut	10	6	12	11	5	5	6	9	5	9	8	10	30
Polar bear#	ᓇᓄᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕈᐃᑦ	Amagut								1					1
Wolverine	ᖃᕐᕕᐊᑦ	Kalvik												1	1
Seals (unspecified)	ᓯᖏdᓪᓕᑦ	Natiit												2	2
Ringed seal	ᓇᑭᓯᑦ	Natiinat							2		1			1	3
Bearded seal	ᐅᒡᒉᐃᑦ	Ukyuk					1								1
Harp seal	ᖃᐃᕈᓪᓕᑦ	Qairulik	1		3	1	2	1							5
Beluga	ᖃdᑦᑕ ᖃᓪᓚᒃᑦ	Kilalugak			3	1									4
Snow goose	ᑲᖏᔪᐃᑦ	Kanguq												3	3
Canada goose	ᓂᑦᓪᓕᑦ ᐅᓗᐊᔪᓪᓕᑦ	Nikliknik												4	4
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit		1								1	1	4	5
Lake trout	ᐃᓯᕐᓴᐃᑦ	Ikalukpik										2	2	4	7
Whitefish	ᑲᐱᓯᓪᓕᑦ	Kapihiliit											1	1	2

No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

ᑎᑎᕆᓯᒪᔪᓂᒃ ᐱᑕᖃᖅᑎᑐᖃᖅ ᐱᓕᕆᓚᓐᓂᒃ ᐊᖏᔪᑦ ᖃᑦᕿᐅᓂᖏᑦᓂᑦ ᐊᓚᒃᑲᓂᑦ ᓇᓚᐅᑦᓯᓐᓂᒃᓴᓐᓂᑦ. ᐃᑯᐊᖏᑦᓂᑦ ᑐᓂᓴᖅᑎᓂ ᐃᑯᐱᓕᓚᓐᓂᒃᓴᓐᓂᑦ.

Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 635

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓴᓗᑎᑦ
Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᓕᒍ 3 (ᔫᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᑲᓪᓚᑦ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓇ	OCT ᐅᑲᐃᓇ	NOV ᐅᓇᓚᐱᓇ	DEC ᑎᓯᓚᐱᓇ	JAN ᔨᖏᓂᐊᓇ	FEB ᐃᖏᑲᐊᓇ	MAR ᒪᔪ	APR ᐃᔪᓕᓪ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᐃᑦ	Tuktut	24	44	34	52	21	35	21	39	42	84	84	46	526 ± 38
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait										2			2 ± 1
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡				1		4	6	3		14			
Wolf	ᐊᒪᓕᐃᑦ	Amagut										10	1		11 ± 6
Arctic fox	ᑎᓘᑦᓂᐊᑦ	Tigiganiat							99			60			159 ± 69
Arctic ground squirrel	ᖃᐅᔨᖏᑦᑐᑦ ᑎᓘᑦᓂᐊᑦ	Hikhik												5	5 ± 4
Seals (unspecified)	ᓴᖅᐅᓪᓕᑦ	Natiit			1										1 ± 1
Ringed seal	ᓇᓴᓪᓕ	Natiinat	9	3	7	13	10	21						8	71 ± 20
Bearded seal	ᐅᑌᓛᐃᑦ	Ukyuk			2	4	2	1						1	10 ± 4
Harp seal	ᖃᐃᓕᓪᓕᑦ	Qairulik		1											1 ± 1
Beluga	ᖃᐅᕐᑦ ᖁᓪᓗᒍᑦ	Kilalugak		3	49	26									78 ± 20
Geese (unspecified)	ᓄᑦᓪᓕᑦ	Kanguk	10												10 ± 6
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	28											88	116 ± 58
Canada goose	ᓄᑦᓪᓕᑦ ᐅᓗᐊᒍᑦᓪᓕᑦ	Nikliknik	52											48	100 ± 27
White-fronted goose	ᓄᑦᓪᓕᑦ	Nirlivik	2												2 ± 2
Ptarmigan	ᐊᖏᓚᑦ	Akilgik			3	2				1	3			8	17 ± 11
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓕᓂᖏᑦ	Uluaguliit manniit	13											84	97 ± 75
Arctic char	ᐃᖕᓗᓴᐱᑦ	Ikaliviit	123	142	282	6		363	196		169	65		62	1,408 ± 202
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	7				27	34			26	11	49	87	241 ± 47
Cod	ᐅᒪᐃᑦ	Ugak												5	5 ± 4
Sculpin	ᑲᓇᓛᐃᑦ	Kanayuk												7	7 ± 5

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᐃᑦ ᑎᑎᕋᐅᒪᓛᕐᓂ ᑐᓂᓴᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕕᓂᓚᐅᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

6.3.7

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 636

Monthly hunter response
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓇᓱᑎᑦ ᑭᐅᓂᖓᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)
ᐃᓐᓴᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑐᓇ	NOV ᐅᓚᕐᓇ	DEC ᑎᓯᕐᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᕕᖑᐊᓇ	MAR ᒪᑦᓯ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓇᓱᑎᑦ ᑭᐅᓂᖓᑦ ᐋᔪᓯᒪᓂᖓᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᔪᓇᓱᑎᑦ	Tatkitaman angunahuktut titigait	40	40	40	40	40	40	40	43	43	44	45	47	47*
Hunters interviewed	ᐊᖏᔪᓇᓱᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	36	36	36	35	36	36	37	39	40	37	38	35	43*
Harvested	ᐊᖏᔪᓇᓱᑐᒃᓯᓂᑦ	Angujaujut	15	17	17	13	10	11	11	7	9	17	17	26	37*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖓᑦ (%)	Kiujut (%)	90	90	90	88	90	90	93	91	93	84	84	74	88**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᔪᓇᓱᑎᑦ ᐊᑎᓕᐅᑦᑐᒪᓐᓂᖅ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓇᓱᑐᒃᓯᓂᑦ ᐊᑕᐅᓯᐊᖅᓗᑐᑎᑦ ᐊᑲᔪᒻ.
** ᐊᐅᔨᓂᓕᕆᓚᐅᑦ ᑕᖅᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.3.7

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 637

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔨᑦ ᐋᑯᖏᓂ ᐊᖏᔪᓇᓯᓂᖓᓪᓚᑕ ᐊᒪᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖓᓪᓚᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᓱ % ᑲᑎᒪᔨᑦ ᐊᖏᔪᓇᓱᑦᑕ ᑎᑎᕐᑦᑕᐅᒪᔨᔨᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)
ᐃᓐᓴᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑐᓇ	NOV ᐅᓚᕐᓇ	DEC ᑎᓯᕐᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᕕᖑᐊᓇ	MAR ᒪᑦᓯ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔨᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	0	0	0	0	0	94	75	78	72	0	0	68	28
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	0	0	75	81	100	6	19	0	17	24	39	19	31
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	100	100	25	19	0	0	6	22	11	76	61	12	41

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 638

Number of hunters harvesting each species — **Year 3 (June 1998 - May 1999)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐸᑎᑦ ᐊᖏᔪᓚᐸᓕᕐᓂᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — **ᐊᒃᑭᒍ 3 (ᔫᓂ 1998 - ᒪᐃ 1999)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 3 (June 1998 - May 1999)**

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔫᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᐹᓗᓂ	OCT ᐅᑦᔪᓂ	NOV ᓄᓇᒃᑕᓂ	DEC ᑎᓯᒃᑕᓂ	JAN ᔮᖏᓄᐊᓂ	FEB ᓇᖕᖏᐊᓂ	MAR ᒪᔪ	APR ᐃᔨᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓂᑦ Tamakiklugin
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᓴᐃᐃᑦ	Tuktut	5	13	10	11	7	7	6	6	9	16	15	12	33
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait										1			1
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᕐᐃᑦ	Amagut										3	1		4
Arctic fox	ᑎᓕᓴᖅᐊᑦ	Tigiganiat							2			1			2
Arctic ground squirrel	ᖃᐅᓐᖓᑦᑐᑦ ᑎᓕᓴᖅᐊᑦ	Hikhik												1	1
Seals (unspecified)	ᓯᖏᑯᓪᓗᑦ	Natiit			1										1
Ringed seal	ᓇᓯᓪᓚ	Natiinat	3	2	2	3	2	1						4	10
Bearded seal	ᐅᓗᕕᐃᑦ	Ukyuk			1	2	1	1						1	3
Harp seal	ᖃᐃᕐᓂᓪᓗᑦ	Qairulik		1											1
Beluga	ᖃᐅᑦᑕᑦ ᖁᓪᓗᒃ	Kilalugak		1	7	4									8
Geese (unspecified)	ᓄᑦᓯᓪᓗᑦ	Kanguk	1												1
Snow goose	ᑲᖏᐃᐃᑦ	Kanguq	4											5	7
Canada goose	ᓄᑦᓯᓪᓗᑦ ᐅᓗᐊᓗᓪᓚᓪᓗᑦ	Nikliknik	5											6	11
White-fronted goose	ᓄᑦᓯᓪᓗᑦ	Nirlivik	1												1
Ptarmigan	ᐊᖏᓚᑦᑎᑦ	Akilgik			1	1				1	1			1	3
Goose eggs	ᑲᖏᐃᐃᑦ ᓚᒃᓄᖅᑎᑦ	Uluaguliit manniit	1											1	2
Arctic char	ᐃᖃᓗᓴᐃᑦ	Ikaliviit	8	6	5	1		6	3		2	2		2	19
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	1				2	1			1	2	7	11	17
Cod	ᐅᓴᐃᑦ	Ugak												1	1
Sculpin	ᑲᓇᕐᐃᑦ	Kanayuk												2	2

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓯᒪᔪᓂᒃ ᐱᑕᖃᖏᑕᐃᖅ ᐱᓕᕆᓚᓄᒃ ᐊᖏᔪᑦ ᖃᑦᓯᐅᓂᖏᑦᓄᑦ ᐊᓪᓚᖅᓄᑦ ᐊᐅᒃᓴᓂᑦ ᐃᓚᖃᖅᑐᑦ ᑐᓂᓴᖏᑦᓂ ᐃᑯᐱᕐᐃᓚᓪᓕᕆᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓄᓇᓕᐃᒃᐳᐅᑦ/NAUNAIKUTA 639

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓄᓪᐅᑦᓴᖅᑎᑦ
Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)
ᐊᓯᖏᔪ 4 (ᔫᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔫᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᓚᑦᑎ	SEP ᓱᑎᕐᕕᓇ	OCT ᐅᑦᔨᕕᓇ	NOV ᐅᓇᓕᕕᓇ	DEC ᑎᓯᕕᓇ	JAN ᔮᖏᓇᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᓯ	APR ᐃᓪᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᒋᑦ Tamakiklugin ± 95% CI
Species	**ᐅᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	36	64	79	68	67	65	31	41	36	23	38	34	582 ± 62
Musk-ox	ᐅᒥᖕᒪᐃᑦ	Umingmait										3			3 ± 3
Polar bear‡	ᓄᓇᐃᑦ‡	Nanuit‡					1	12							13
Wolf	ᐊᒪᓗᐃᑦ	Amagut									1	3	10		14 ± 14
Arctic fox	ᑎᓇᓚᖓᓂᐊᑦ	Tigiganiat						9	23						32 ± 33
Arctic hare	ᖃᐅᖅᖢᑎᑐᑦ ᑎᓇᓚᖓᓂᐊᑦ	Ukalik					1								1 ± 2
Ringed seal	ᓄᕆᑦ	Natiinat	19	11	15		18		2	1		1		1	68 ± 18
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	1	4		1	1								7 ± 5
Narwhal	ᑐᒻᓐᑦ ᖃᓪᓗᓕᑦ	Tuugaak		4											4 ± 5
Beluga	ᖃᐅᑉᑕ ᖃᓪᓗᓕᑦ	Kilalugak		18	51	14	2								85 ± 44
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	39	12										14	65 ± 37
Canada goose	ᓂᑦᓐᑦ ᐅᓗᐊᒍᑦᓐᑦ	Nikliknik	122											23	145 ± 52
Tundra swan	ᑭᒡᔪᐃᑦ	Kukyuk	1												1 ± 1
Ptarmigan	ᐊᖏᓕᑦ	Akilgik	6					2				5	3		16 ± 10
Sandhill crane	ᑕᑎᓴᕐᔪᐊᑦ	Tatilgaq												2	2 ± 3
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓂᓂᖅᑦ	Uluaguliit manniit	308	60											368 ± 124
Duck eggs	ᒥᑎᑦ ᒪᓂᓂᖅᑦ	Tinmiat manniit		7											7 ± 6
Arctic tern eggs	ᐃᒥᖏᑕᐃᓪᓕᑦ ᒪᓂᓂᖅᑦ	Emitkutailat manniit		12											12 ± 10
Black guillemot eggs	ᐱᕐᓗᐅᓪᓚᑦ ᒪᓂᓂᖅᑦ	Black guillemot eggs		8											8 ± 7
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	441	434	221	310	31	310	139	80	67			60	2,093 ± 480
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	52	12			24	21		3	23		16	56	207 ± 57
Arctic grayling	ᓭᓗᒃᐸᐅᒪᐃᑦ	Hulupaugaq						1							1 ± 1
Cod	ᐅᒪᐃᑦ	Ugak	2												2 ± 2
Sculpin	ᑲᓚᔪᐃᑦ	Kanayuk	13	4											17 ± 7
Mussels	ᐅᖃᓗᐃᑦ	Uviluvaloet	248		124										372 ± 244

‡ Polar bear data supplied by DSD.

‡ ᓄᓇᑦᓄᑦ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᒃᖏᑦ ᐅᑉᐳᖅᑦ ᐃᓄᐃᕐᓂᓕᕆᓂᖅᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 640

Monthly hunter response
ᑕᖅᑕᒪᑦ ᐊᖏᓚᓂᑎᑦ ᑭᐅᓂᖅᑎᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)
ᐊᑦᖁᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔫᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓚᓪ	OCT ᐅᑐᓚᓪ	NOV ᐅᓇᒡᓚᓪ	DEC ᑎᓯᒡᓚᓪ	JAN ᔮᖅᓄᐊᓪ	FEB ᓇᖕᐅᐊᓪ	MAR ᒪᕐᓯ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓚᓂᑎᑦ ᑭᐅᓂᖅᑎᑦ ᐊᑎᓕᒪᓂᖅᑎᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᑦ ᐊᖏᓚᓂᑎᑦ	Tatkitaman angunahuktut titigait	47	47	47	47	47	47	47	46	46	46	49	47	50*
Hunters interviewed	ᐊᖏᓚᓂᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	38	35	35	36	36	34	34	37	36	32	33	29	42*
Harvested	ᐊᖏᓚᓂᑎᑐᓗᓂ	Angujaujut	26	17	18	14	13	16	7	9	8	8	7	15	39*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐅᓂᖅᑎᑦ (%)	Kiujut (%)	81	74	74	77	77	72	72	80	78	70	67	62	74**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓂᑎᑦ ᐊᑎᓕᒪᓂᖅᑐᒃᑯᓪᓗᒍ/ᐊᐱᕐᓂᑦ/ᐊᖏᓚᓂᑎᑐᓗᓂᓕ ᐊᑕᐅᓯᐊᖅᓯᐅᑎᑦ ᐊᑦᖁᒍ.
** ᐊᑦᓴᒋᓕᑎᓯᓚᓪᓗᒍ ᑕᖅᑕᒪᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.3.7

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 641

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᔨᑦ ᐋᒋᖏᓂ ᐊᖏᓚᓂᓕᓂᖅᑕ ᐊᒪᒐ ᐊᐱᕐᓂᑦᑕᐅᓂᖅᑕ, ᓇᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑎᑦ ᐊᖏᓚᓂᑎᑦ ᑎᑎᕐᓂᑦᑕᐅᒪᔨᑦ

Year 4 (June 1999 - May 2000)
ᐊᑦᖁᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔫᓪᓗ	AUG ᐊᐅᒍᑎ	SEP ᓯᑎᕐᓚᓪ	OCT ᐅᑐᓚᓪ	NOV ᐅᓇᒡᓚᓪ	DEC ᑎᓯᒡᓚᓪ	JAN ᔮᖅᓄᐊᓪ	FEB ᓇᖕᐅᐊᓪ	MAR ᒪᕐᓯ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᔨᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	54	63	15	36	40	16	40	24	45	69	71	4	38
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	2	0	33	29	31	44	60	24	36	0	7	50	24
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	45	37	52	36	29	40	0	53	18	31	21	46	38

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 642

Number of hunters harvesting each species — **Year 4 (June 1999 - May 2000)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᓴᒋᑦ ᐊᖏᔪᓚᓴᒃᑯᑦ ᐊᑐᓂᒃ ᐅᒪᓴᖅᓂᒃ — **ᐊᒡᖏᔪ 4 (ᔦᓂ 1999 - ᒪᐃ 2000)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 4 (June 1999 - May 2000)**

Month/ᑕᖑᖏᑦ/Tatkia			JUN ᔦᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᑲᔨᑎ	SEP ᓱᑎᐱᓗᓂ	OCT ᐅᑲᐃᓗᓂ	NOV ᔅᓇᐱᓗᓂ	DEC ᑎᓯᐱᓗᓂ	JAN ᒍᖓᓄᓗᓂ	FEB ᓇᖕᐅᔪᓗᓂ	MAR ᒪᔪ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	10	13	14	11	10	14	7	8	7	4	6	7	35
Musk-ox	ᐅᒥᖅᒪᐃᑦ	Umingmait										2			2
Polar bear‡‡	ᓇᓂᐃᑦ‡‡	Nanuit‡‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᖏᐃᑦ	Amagut									1	1	1		3
Arctic fox	ᑎᓕᑦᓂᐊᑦ	Tigiganiat						1	1						2
Arctic hare	ᖃᐅᓐᖓᑦᑐᑦ ᑎᓕᑦᓂᐊᑦ	Ukalik					1								1
Ringed seal	ᓇᕆᑦ	Natiinat	7	4	5		3		1	1		1		1	12
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	1	1		1	1								4
Narwhal	ᑐᒻᓂᑦ ᖃᓪᓗᓕᑦ	Tuugaak		1											1
Beluga	ᖃᐅᑦᑕ ᖃᓪᓗᓕᑦ	Kilalugak		1	5	3	1								6
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	2	1										1	4
Canada goose	ᓄᑦᓂᑦ ᐅᓗᐊᒍᑦᓂᑦ	Nikliknik	8											4	11
Tundra swan	ᑭᒡᔪᐃᑦ	Kukyuk	1												1
Ptarmigan	ᐊᖏᓕᑦ	Akilgik	1					1				1	1		3
Sandhill crane	ᑕᑎᓚᑦᔪᐊᑦ	Tatilgaq												1	1
Goose eggs	ᑲᖕᒍᐃᑦ ᒪᓐᓇᖅᑎᑦ	Uluaguliit manniit	8	1											8
Duck eggs	ᒥᑎᑦ ᒪᓐᓇᖅᑎᑦ	Tinmiat manniit		1											1
Arctic tern eggs	ᐃᒥᖏᑕᒪᓪᓗᑦ ᒪᓐᓇᖅᑎᑦ	Emitkutailat manniit		1											1
Black guillemot eggs	ᐱᑦᓯᐅᓪᓚᑦ ᒪᓐᓇᖅᑎᑦ	Black guillemot eggs		1											1
Arctic char	ᐃᖃᓗᒃᐱᑦ	Ikaliviit	11	7	5	3	2	6	2	1	1			4	19
Lake trout	ᐃᓱᕐᕆᐃᑦ	Ikalukpik	2	1			2	3		1	1		2	7	14
Arctic grayling	ᓱᓕᑲᐅᒪᐃᑦ	Hulupaugaq						1							1
Cod	ᐅᒪᐃᑦ	Ugak	1												1
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	4	1											4
Mussels	ᐅᕙᓕᐃᑦ	Uviluvaloet	1		1										2

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᒪᔪᓂᒃ ᐱᑕᖃᖕᓂᑐᖃᑦ ᐱᒋᐊᓕᓐᓂᒃ ᐊᖏᔪᑦ ᖃᕋᐅᓂᖏᓐᓄᑦ ᐊᓕᕆᔨᒃᑯᑦ ᓇᓕᖅᑕᒪᔪᓂᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᕐᓂᐊᓕᒫᑦ ᑐᓂᓯᖏᓐᓄᑦ ᐃᓅᓯᕐᓂᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit piijaumajut ikupiktulikijinik.

6.3.7

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 643

Monthly harvest estimates

ᑕᖅᑕᒪᑦ ᐊᖏᔪᓂᑦ ᓇᓕᐅᑦᓱᓐᓂᑦ

Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)

ᐊᓕᖕᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖏᓐᓄᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᔪᔨᒻ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑦᔪᕐᓂ	NOV ᐅᓇᓕᕐᓂ	DEC ᑎᓯᕐᓂ	JAN ᔮᖏᓐᓇᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᕐᕿ	APR ᐃᑦᓂᓗ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	**ᐅᒪᔨᑦ**	**Umajuin**													
Caribou	ᑐᒃᑐᐃᑦ	Tuktut	19	72	53	53	72	71	67	74	62	55	60	31	689 ± 70
Polar bear‡	ᓇᓂᐃᑦ‡	Nanuit‡						2	4						
Wolf	ᐊᒪᓕᐃᑦ	Amagut											1		1 ± 1
Arctic fox	ᑎᓗᓚᖅᓂᐊᑦ	Tigiganiat					2	44	158	65	37	70	29		405 ± 268
Arctic hare	ᐅᑲᓪᓕᑦ	Ukalik								2					2 ± 2
Arctic ground squirrel	ᐦᐸᓕᑦ	Hikhik		2											2 ± 3
Ringed seal	ᓇᑦᓕᑦ	Natiinat		10	8	2	5			4	2	2	1	14	48 ± 12
Bearded seal	ᐅᑭᐊᐃᑦ	Ukyuk		1		2					1			3	7 ± 3
Beluga	ᖃᓄᖅᑕᑦ ᖁᓪᓗᒡᓗᑦ	Kilalugak		4	8	8									20 ± 9
Geese (unspecified)	ᓂᖅᓪᓂ	Kanguk												15	15 ± 16
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	10											2	12 ± 11
Canada goose	ᓂᖅᓪᓂ ᐅᓗᐊᔪᓪᓂ	Nikliknik	91											41	132 ± 91
Eider duck	ᒥᑦᑎᑦ	Kingalik												1	1 ± 1
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᒃᓂᖏᑦ	Uluaguliit manniit	138												138 ± 201
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᒃᓂᖏᑦ	Nauyat manniit	6												6 ± 9
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	161	140	86	41	103	373	82				1	19	1,006 ± 287
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	14	7	24	6						2	1	39	93 ± 27

‡ Polar bear data supplied by DSD.

‡ ᓇᓂᓪᓂᑦ ᑎᑎᕋᑐᒪᓴᑦ ᑐᓂᓴᖏᑦ ᐅᑉᓴᓐᓂᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᓄᓇᓕᐃᔨᐅᑦ/NAUNAIKUTA 644

Monthly hunter response
ᑕᖃᑦᑕᒻᒥᑦ ᐊᖏᓚᓴᕐᔪᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)
ᐊᒃᕿᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᔪᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑐᕐᓇ	NOV ᓄᓇᕐᓇ	DEC ᑎᓯᕐᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᐃᖏᕐᐊᓇ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Hunter Response Categories	**ᐊᖏᓚᓴᕐᔪᑦ ᑭᐅᓂᖏᑦ ᐊᓗᔨᓗᒐᓂᖏᑦ**	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑦᑕᒻᒥᑦ ᐊᖏᓚᓴᕐᔪᑦ	Tatkitaman angunahuktut titigait	47	47	48	47	47	47	48	47	45	45	45	44	49*
Hunters interviewed	ᐊᖏᓚᓴᕐᔪᑦ ᐊᐱᕐᓂᖏᑦ	Angunahuktin apikhuktan	29	32	39	39	37	38	20	35	36	36	36	36	39*
Harvested	ᐊᖏᓚᓴᕐᔪᑐᒃᑯᑦ	Angujaujut	10	16	19	16	14	15	6	13	12	14	11	16	34*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᓂᖏᑦ (%)	Kiujut (%)	62	68	81	83	79	81	42	74	80	80	80	82	74**

* Hunters registered/interviewed/harvested at least once during the year.
** Mean monthly response rate.

* ᐊᖏᓚᓴᕐᔪᑦ ᐊᑎᓕᐅᑦᑕᐅᒪᓕᕐᓂᖅ/ᐊᐱᕐᓂᖏᑦ/ᐊᖏᓚᓴᕐᔪᑐᒃᑯᑦ ᐊᑕᐅᓯᐊᖏᓪᓗᑎᑎᑦ ᐊᒃᕿᒍᒥ.
** ᐊᓕᐅᓕᓐᓂᓯᒪᓕᕐᓂᖅ ᑕᖃᑦᑕᒻᒥᑦ ᑭᐅᔾᔨ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.3.7

TABLE/ᓄᓇᓕᐃᔨᐅᑦ/NAUNAIKUTA 645

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᓪᓗᑦ ᐊᑯᖏᓐᓂᓕᒃ ᐊᖏᓚᓴᓐᓂᓐᓂᒃ ᐊᒻᒪᓗ ᐊᐱᕐᓂᖏᑦᑕᐅᓂᓐᓂᒃ, ᓄᓇᓕᐃᖏᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᑦ ᐊᖏᓚᓴᕐᑕᑦ ᑎᑎᕐᓇᐅᒪᓕᕐᔪᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)
ᐊᒃᕿᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᔪᑎ	SEP ᓯᑎᕐᓇ	OCT ᐅᑐᕐᓇ	NOV ᓄᓇᕐᓇ	DEC ᑎᓯᕐᓇ	JAN ᔮᖅᓄᐊᓇ	FEB ᐃᖏᕐᐊᓇ	MAR ᒪᕐᔪ	APR ᐃᕐᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Recall Period	**ᐅᑎᕐᕕᐅᓪᓗᑦ**	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑲᑦ	≤ tatkin pingahut	18	14	30	61	79	43	100	10	9	12	41	21	34
4-6 months	4-6 ᑕᖅᑲᑦ	tatkin hitaman 6nut	59	38	30	18	0	0	0	10	17	88	59	79	33
> 6 months	> 6 ᑕᖅᑲᑦ	> 6 tatkin	24	48	40	21	21	57	0	79	74	0	0	0	34

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 646

Number of hunters harvesting each species — **Year 5 (June 2000 - May 2001)**

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᖅᑎᑦ ᐊᖏᔪᓚᐱᖅᓯᒪᔪᑦ ᐊᑐᓂᒃ ᐅᒪᓕᕐᓂᒃ — **ᐊᒻᒪᔪᒍ 5 (ᔦᓂ 2000 - ᒪᐃ 2001)**

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — **Ukiunga 5 (June 2000 - May 2001)**

Month/ᑕᖃᖏᓐ/Tatkia			JUN ᔦᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᐹᓗᓂ	OCT ᐅᑦᔪᓗᓂ	NOV ᐅᓇᕐᓗᓂ	DEC ᑎᓯᕐᓗᓂ	JAN ᔮᖅᓇᐊᓗᓂ	FEB ᓇᖕᖏᐊᓗᓂ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	**ᐅᒪᔪᑦ**	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	6	12	15	12	12	13	5	11	11	12	9	6	30
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Wolf	ᐊᒪᓗᐃᑦ	Amagut											1		1
Arctic fox	ᑎᓕᓴᖅᓂᐊᑦ	Tigiganiat					2	2	2	4	2	3	2		8
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik								1					1
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik		1											1
Ringed seal	ᓇᑭᓱᑦ	Natiinat		3	5	1	2			2	1	1	1	4	11
Bearded seal	ᐅᓚᐊᐃᑦ	Ukyuk		1		2					1			1	5
Beluga	ᖃᓄᖅᑕᑦ ᖁᓕᓗᓚᑦ	Kilalugak		1	2	1									3
Geese (unspecified)	ᓂᖅᓪᓕᑦ	Kanguk												1	1
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	1											1	1
Canada goose	ᓂᖅᓪᓕᑦ ᐅᓗᐊᒍᓪᓕᑦ	Nikliknik	2											3	5
Eider duck	ᑎᑎᑦ	Kingalik												1	1
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᖓᖏᑦ	Uluaguliit manniit	1												1
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᖓᖏᑦ	Nauyat manniit	1												1
Arctic char	ᐃᖃᓗᓴᒋᑦ	Ikaliviit	3	4	3	3	2	4	1				1	3	13
Lake trout	ᐃᓱᒋᖅᐃᑦ	Ikalukpik	1	1	3	2						1	1	7	12

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᓚᐊᓂᒃ ᐱᕈᖅᖏᑦᑐᖅ ᐱᓕᒪᓐᓂᓂᒃ ᐊᖏᔪᒃ ᖃᑦᓯᐅᓂᖏᓐᓂᓄᑦ ᐊᓚᕆᐃᓚᐊᓂᑦ ᐊᐃᔨᓄ ᓇᓚᑭᓴᖅᑐᓄᑦ ᑐᓂᓴᖏᓐᓂᓂ ᐃᑯᐱᖏᓚᓕᓐᓂᕆᓪᓕᑦ.

‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᓇᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 647

Annual harvest estimates and five-year mean
ᐊᖏᖅᔪᑕᒫᑦ ᐊᖕᒍᔨᓂᐅᑦ ᓇᓕᐅᑦᓱᕈᔾᔨᑦ ᐊᒻᒪᓗ ᑕᓪᓕᓂᓪᓕᐊᖏᖅᔪᓂᐅᑦ ᐊᐅᔾᔨᓪᓗᑎᓯᒪᔪᑦ
Aragutamat angujauvaktun tatlman araguit iluani

All Years (June 1996 - May 2001)
ᑕᒪᐃᓐᓂᐅᑦ ᐊᖏᖅᔪᓂᐅᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᖅᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Mean ᐊᐅᔾᔨᓪᓗᑎᓯᒪᔪᑦ Amigaitkiyait
Species	**ᐅᒪᔪᑦ**	**Umajuin**						
Caribou[1]	ᑐᓴᐃᓪᓕᑦ[1]	Tuktut[1]	556	344	526	582	689	539
Musk-ox[2]	ᐅᒥᖅᒪᐃᓪᓕᑦ[2]	Umingmait[2]	1	0	2	3	0	1
Polar bear[3]	ᓇᓂᐃᓪᓕᑦ[3]	Nanuit[3]	12	12	14	13	4	11
Tundra grizzly	ᐊᐳᓪᓕᑦ	Akhait	1	0	0	0	0	<1
Wolf	ᐊᒪᕐᐃᓪᓕᑦ	Amagut	2	1	11	14	1	6
Arctic fox[4]	ᑎᓕᓴᓂᐊᑦ[4]	Tigiganiat[4]	90	0	159	32	405	137
Wolverine	ᖃᐸᐃᑦ	Kalvik	0	1	0	0	0	<1
Arctic hare[5]	ᐅᖃᓪᓚᑦ[5]	Ukalik[5]	28	0	0	1	2	6
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik	0	0	5	0	2	1
Seals (unspecified)	ᓴᖃᐹᓪᓚᑦ	Natiit	1	4	1	0	0	1
Ringed seal	ᓇᕆᑦ	Natiinat	25	7	71	68	48	44
Bearded seal	ᐅᑦᔪᐃᓪᓕᑦ	Ukyuk	2	1	10	7	7	5
Harp seal[6]	ᖃᐃᕐᓂᓪᓚᑦ[6]	Qairulik[6]	1	26	1	0	0	6
Narwhal[7]	ᑐᒃᓂᓪᓚᑦ ᖁᓪᓗᓂᑦ[7]	Tuugaak[7]	0	0	0	4	0	1
Beluga[8]	ᖃᐃᕐᑕᑦ ᖁᓪᓗᓂᑦ[8]	Kilalugak[8]	11	7	78	85	20	40
Geese (unspecified)	ᓄᖅᓂᓪᓚᑦ	Kanguk	0	0	10	0	15	5
Snow goose	ᑲᖕᒍᐃᓪᓕᑦ	Kanguq	25	9	116	65	12	45
Canada goose	ᓄᖅᓂᓪᓚᑦ ᐅᓗᐊᔪᓂᓪᓚᑦ	Nikliknik	21	18	100	145	132	83
White-fronted goose	ᓄᖅᓂᓪᓚᑦ	Nirlivik	0	0	2	0	0	<1
Eider duck[9]	ᒥᑎᑦ[9]	Kingalik[9]	0	0	0	0	1	<1
Tundra swan	ᖁᓕᐊᓪᓕᑦ	Kukyuk	0	0	0	1	0	<1
Ptarmigan	ᐊᖏᓱᑎᑦ	Akilgik	10	0	17	16	0	9
Sandhill crane	ᑕᑎᓱᕐᔪᐊᑦ	Tatilgaq	0	0	0	2	0	<1
Goose eggs[10]	ᑲᖕᒍᐃᓪᓕᑦ ᓚᓐᓄᕆᑦ[10]	Uluaguliit manniit[10]	0	0	97	368	138	121
Duck eggs[10]	ᒥᑎᑦ ᓚᓐᓄᕆᑦ[10]	Tinmiat manniit[10]	0	0	0	7	0	1
Arctic tern eggs[10]	ᐃᒥᖅᑯᑕᓚᓪᓕᑦ ᓚᓐᓄᕆᑦ[10]	Emitkutailat manniit[10]	0	0	0	12	0	2
Seagull eggs[10]	ᓇᐅᔾᐃᓪᓕᑦ ᓚᓐᓄᕆᑦ[10]	Nauyat manniit[10]	0	0	0	0	6	1
Black guillemot eggs[10]	ᐱᕐᓄᐅᓂᑦ ᓚᓐᓄᕆᑦ[10]	Black guillemot eggs[10]	0	0	0	8	0	2
Arctic char[11]	ᐃᖃᓗᒃᐱᑦ[11]	Ikaliviit[11]	1,494	114	1,408	2,093	1,006	1,223
Lake trout	ᐃᓰᕆᐃᓪᓕᑦ	Ikalukpik	181	69	241	207	93	158
Arctic grayling[12]	ᓱᓗᒃᐸᐅᒪᐃᓪᓕᑦ[12]	Hulupaugaq[12]	1	0	0	1	0	<1
Whitefish[13]	ᑲᐱᓯᓂᓪᓚᑦ[13]	Kapihiliit[13]	1	163	0	0	0	33
Cod[14]	ᐅᒪᐃᓪᓕᑦ[14]	Ugak[14]	0	0	5	2	0	1
Sculpin	ᑲᓇᐊᓪᓕᑦ	Kanayuk	6	0	7	17	0	6
Mussels[15]	ᐅᐱᓗᓪᓕᑦ[15]	Uviluvaloet[15]	0	0	0	372	0	74

[1-15]: See page 772 for community feedback and other sources of data.

[1-15]: ᑕᐃᓕ ᒪᐱᕐᒪᖅ 774 ᓄᓇᓂᑦ ᑭᐅᔾᔨᑎᖏᑦ ᐊᒻᒪᓗ ᐊᓯᖏᑦ ᐱᐅᓯᖅᑕᕐᓂᖅ.

[1-15]: Takulugu makpigaak 776 nunanit kiutjutinganik ovalo aalanik naunaiyautainik.

6.3.7

TABLE/ᓄᓇᓕᐃᒃᑐᑦ/NAUNAIKUTA 648

Annual hunter response — **All Years (June 1996 - May 2001)**

ᐊᑲᖏᔪᒋᒪᑦ ᐊᖏᔪᓕᓂᐅᑎᑦ ᑭᐅᓂᖏᑦ — **ᑕᒪᐃᓐᓄᑦ ᐊᑲᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)**

Angujauvaktu — **Tamamik ukiuni (June 1996 - May 2001)**

Study Year/ᖃᐅᔨᓴᖅ ᐊᑲᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᓂᐅᑎᑦ ᑭᐅᓂᖏᑦ ᐊᑲᔪᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᖅᑕᒻᒥᑦ ᐊᖏᔪᓕᓂᐅᑎᑦ	Tatkitaman angunahuktut titigait	50	50	47	50	49	61*
Hunters interviewed	ᐊᖏᔪᓕᓂᐅᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	46	43	43	42	39	52*
Harvested	ᐊᖏᔪᓕᓂᐅᑉᐳᓐᓂᑦ	Angujaujut	41	32	37	39	34	50*
Response Rate (%)	ᑭᐅᖅ ᖃᓕᑭᐅᓂᖏᑦ (%)	Kiujut (%)	79	87	88	74	74	80**

* Hunters registered/interviewed/harvested at least once during the study.
** Mean annual response rate.

* ᐊᖏᔪᓕᓂᐅᑎᑦ ᐊᑎᓕᐅᑎᒃᑕᒻᒪᔪᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓕᓂᐅᑉᐳᓐᓂᑦ ᐊᑕᐅᓯᐊᓗᐊᑎᑐᑎᒃ ᐊᓱᒍᒥ.
** ᐊᐅᒋᓕᑎᑭᒪᒪᔪᑦ ᑕᖅᑕᒻᒥᑦ ᑭᐅᖅ.

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut.

6.3.7

TABLE/ᓄᓇᓕᐃᒃᑐᑦ/NAUNAIKUTA 649

Recall period between harvest and interview, expressed as % of total harvest records — **All Years (June 1996 - May 2001)**

ᐅᑎᕐᕕᐅᔪᑦ ᐊᑯᖏᓐᓄᖏᓐᓇᑕ ᐊᓚᓗ ᐊᐱᕐᓂᑦᑕᐅᓂᖏᓐᓇᑕ, ᓄᓇᓕᐃᒃᑐᑦ ᐃᒪᓐ % ᑲᑎᒪᔨᑦ ᐊᖏᔪᓕᓂᒃᑕ ᑎᑎᕐᓂᑦᑕᐅᒪᔪᑦ — **ᑕᒪᐃᓐᓄᑦ ᐊᑲᖏᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)**

Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut — **Tamamik ukiuni (June 1996 - May 2001)**

Study Year/ᖃᐅᔨᓴᖅ ᐊᑲᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔪᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᕐᓂᑦ	≤ tatkin pingahut	98	68	28	38	34	55
4-6 months	4-6 ᑕᕐᓂᑦ	tatkin hitaman 6nut	2	2	31	24	33	18
> 6 months	> 6 ᑕᕐᓂᑦ	> 6 tatkin	0	29	41	38	34	27

TABLE/ᓇᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 650

Number of hunters harvesting each species
ᖃᓄᓯᐅᓂᖏᑦ ᐊᖏᔪᓇᓱᑎᑦ ᐊᖏᔪᓇᓱᓕᕐᓂᑦ ᐊᑐᓂᒃ ᐅᓪᓗᕆᓂᒃ
Angunahuktin angutivaktun umajunik

All Years (June 1996 - May 2001)
ᑕᓪᓕᐊᓂᒃ ᐊᓯᖏᔪᓂᒃ (ᔦᓂ 1996 - ᓪᓕᐊ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅᑎᒃ ᐊᓯᖏᔪᓂᒃ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Total
			96/97	97/98	98/99	99/00	00/01	ᑲᑎᕐᔪᑦ Tamakiklugin
Species	**ᐅᓪᓗᒥᑦ**	**Umajuin**						
Caribou	ᑐᑐᐃᑦ	Tuktut	39	30	33	35	30	49
Musk-ox	ᐅᒥᖅᓪᓗᐃᑦ	Umingmait	1		1	2		4
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᖏᓪᓚᐃᑦ	Akhait	1					1
Wolf	ᐊᓪᒪᕐᐃᑦ	Amagut	2	1	4	3	1	7
Arctic fox	ᑎᓕᓴᐃᓂᐊᑦ	Tigiganiat	5		2	2	8	13
Wolverine	ᖃᓴᕆᑦ	Kalvik		1				1
Arctic hare	ᐅᑲᓪᓚᑦ	Ukalik	5			1	1	7
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik			1		1	2
Seals (unspecified)	ᓱᖏᑯᓪᓚᑦ	Natiit	1	2	1			4
Ringed seal	ᓇᑦᓱᑦ	Natiinat	12	3	10	12	11	26
Bearded seal	ᐅᖅᔾᐊᑦ	Ukyuk	2	1	3	4	5	13
Harp seal	ᖃᐃᕈᓪᓚᑦ	Qairulik	1	5	1			6
Narwhal	ᑐᒻᓪᓚᑦ ᖁᓪᓗᓕᑦ	Tuugaak				1		1
Beluga	ᖃᓄᖅᑕᑦ ᖁᓪᓗᓕᑦ	Kilalugak	7	4	8	6	3	18
Geese (unspecified)	ᓂᖅᓪᓚᑦ	Kanguk			1		1	2
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	3	3	7	4	1	12
Canada goose	ᓂᖅᓪᓚᑦ ᐅᓗᐊᔪᓪᓚᑦ	Niklliknik	1	4	11	11	5	23
White-fronted goose	ᓂᖅᓪᓚᑦ	Nirlivik			1			1
Eider duck	ᒥᑎᑦ	Kingalik					1	1
Tundra swan	ᖁᔪᔾᔾᐃᑦ	Kukyuk				1		1
Ptarmigan	ᐊᖏᒻᑦ	Akilgik	3		3	3		6
Sandhill crane	ᑕᑎᓴᖅᓴᐊᑦ	Tatilgaq				1		1
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᒃᓂᖏᑦ	Uluaguliit manniit			2	8	1	9
Duck eggs	ᒥᑎᑦ ᓚᒃᓂᖏᑦ	Tinmiat manniit				1		1
Arctic tern eggs	ᐃᒥᖕᑯᓚᓂᐃᑦ ᓚᒃᓂᖏᑦ	Emitkutailat manniit				1		1
Seagull eggs	ᓇᐅᔨᐃᑦ ᓚᒃᓂᖏᑦ	Nauyat manniit					1	1
Black guillemot eggs	ᐱᑦᓯᐅᓪᓚᑦ ᓚᒃᓂᖏᑦ	Black guillemot eggs				1		1
Arctic char	ᐃᖕᓄᒃᐱᑦ	Ikaliviit	22	5	19	19	13	39
Lake trout	ᐃᓚᓴᐃᑦ	Ikalukpik	6	7	17	14	12	27
Arctic grayling	ᓱᓄᒃᐸᐅᒪᐃᑦ	Hulupaugaq	1			1		2
Whitefish	ᑲᐱᓯᓪᓚᑦ	Kapihiliit	1	2				3
Cod	ᐅᒪᐃᑦ	Ugak			1	1		2
Sculpin	ᑲᓇᔾᐃᑦ	Kanayuk	1		2	4		6
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet				2		2

‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡ ᑎᑎᕋᒪᔾᔪᓂᒃ ᐱᑕᖃᖕᓂᑐᖕᖏᓂᒃ ᐱᓕᕆᓪᓚᓂᒃ ᐊᖏᔪᑦ ᖃᕋᐅᓂᖕᓂᖅᓄᑦ ᐊᓪᓚᔨᓄᑦ ᓇᓪᓕᐅᑦᓯᓂᖅᓄᑦ ᐃᓕᓴᕐᓂᐊᕐᓗᒍ ᐃᓄᐃᑦᓯᓕᕐᓂᖅᓄᑦ ᐊᓪᓚᔨ

6.3.7 Community Results Discussion: Whale Cove

The survey frame:
An assessment of under-enumeration during the community visit revealed that there were approximately 45 hunters who were not registered in the Harvest Study. Forty-four of these were Inuit, all occasional hunters, while one was a non-Inuit with assigned hunting rights, also an occasional hunter. Many of the unregistered hunters were women. As discussed in Section 5.2.1 the effect of this under-enumeration would have led to a downward bias of the harvest estimates. Given that these unregistered hunters represent 42 percent of the total hunter population (Table 10) the effect of this bias on harvest estimates is likely very significant and could have caused an under-estimation of the community harvest of up to about 40%. Harvest estimates for the unregistered hunters can be estimated using mean harvest quantities for each species by strata. However, these estimates, having their own sources of error and bias, are beyond the scope of this Final Report. Readers may apply to NWMB to obtain the results of these calculations.

Due to the relatively small number of intensive hunters registered in Whale Cove, the intensive classification was joined with the active classification for the purpose of calculating harvest estimates.

Survey coverage and non-response bias:
Overall response rates for hunters from Whale Cove were good in most years of the Harvest Study. There were select months in each year where rates did decline which can be seen in the response rate tables. However, when response rates were calculated separately for the occasional and active hunters, rates were found to be low for the active classification in the last two years of the study. Although rates rarely fell below 50%, readers should consider this information when using harvest estimates from years 4 and 5.

As seen in Table 9 the consistent intentional non-response rate in Whale Cove was moderate, at 4.9%, and there is some potential for non-response bias as a result. Given this and the low response rates particularly of active hunters in final two years of the study, the potential for both sampling error and non-response bias is high in some months of the study and appropriate cautions should be used with these data.

Measurement issues and response error:
It was reported during the community consultations that some harvests, such as eggs and mussels were under-reported. Further details are provided in the community feedback and other sources of data section below. Section 5.4 also contains a thorough discussion of this issue.

As seen in the recall period tables, during the first year of the study the vast majority of the harvest records were collected within three months of the harvest. However, as the study progressed, recall periods became much longer as seen by the high percentage of records collected at least six months beyond the harvest date. This calls into question the ability of hunters to accurately remember what they had harvested and may have resulted in some measurement error.

As is discussed in the comments relating to arctic char, below, some char harvests were sold to the fish plant in Rankin Inlet throughout the study. It is felt that many of these commercial harvests were reported and would be included in the harvest estimates contained in the data tables.

Community feedback and other sources of data:

1. **Caribou:** Caribou harvesting consisted of barren-ground caribou. Harvest estimates seem accurate (C.F.).
2. **Musk-ox:** The community had an annual quota of 5 animals, but not all were taken each year. However, hunters did recall that at least 2 were harvested in year 5, indicating that although none were reported some were likely harvested (C.F.).
3. **Polar bear:** Numbers displayed are not estimates but confirmed harvest numbers supplied by DSD (DSD PB).
4. **Arctic fox:** No arctic fox harvests were reported in year 2; however hunters report that foxes were harvested each year (C.F.).
5. **Arctic hare:** The higher harvest estimate in year 1 was likely due to a contest held that year (C.F.).
6. **Harp seal:** Hunters reported that they take approximately 1 to 2 per year and that the harvest estimate in year 2 seems too high (C.F.).
7. **Narwhal:** DFO reports the following harvest numbers for narwhal (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
0	1	0	2	0

[8] **Beluga:** Hunters reported that they recall more harvesting in years 3 and 4 and that they suspected that harvest estimates are in the right range. They also stated that fewer were harvested in year 5 because of an over-harvest in the previous years (C.F.). DFO reports the following harvest numbers for beluga (note that DFO data are based on fiscal years, whereas Harvest Study data are based on harvest years that run from June to May) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
35	20	25	n/d	20

[9] **Eider duck:** Although few are harvested around the community it was reported that estimates should have been a little higher (C.F.).

[10] **Eggs:** Eggs are collected every year. Although there were no eggs reported in years 1 and 2, many were harvested. Most of the eggs are gathered by women (C.F.). Many of the women of Whale Cove were not registered in the Harvest Study which may account for the low estimates. Hunters also reported that many hunters did not realize they were to report their egg harvests. Eggs that are gathered in the Whale Cove area are as follows (the HTO Board also provided an estimate of the numbers harvested annually): *Goose eggs:* The year 4 and 5 estimates seem to be in the right range. *Duck eggs:* The year 4 estimate is in the right range, few are harvested. *Seagull eggs:* Approximately 50 or so are taken each year. *Arctic tern eggs:* Approximately 10-12 are harvested annually. *Black guillemot eggs:* Approximately 50 or so are taken each year (C.F.).

[11] **Arctic char:** The harvest estimate in year 2 seems low. The HTO Board reported that hunters did sell some of their catch to the fish plant in Rankin Inlet. Harvest estimates may contain some of these commercially sold fish (C.F.).

[12] **Arctic grayling:** Harvest estimates seem much too low. They are often caught when jigging for other fish (C.F.).

[13] **Whitefish:** Harvest estimates seem accurate. They are generally not harvested much. In year 2 a training program run by the school may have resulted in the higher catch that year (C.F.).

[14] **Cod:** Harvest estimates appear low. Several families fish for cod and estimates of about 100 per year would be more realistic (C.F.).

[15] **Mussels:** Most hunters did not know they had to report mussels so much of the harvest was not recorded. Many people harvest mussels and one person can collect over 300 in one day alone. Estimates should be in the 1000's (C.F.).

6.3.7 ᓄᓇᕗᑦ ᓴᖅᑭᑕᕐᕕᖏᓐ ᐅᖃᖅᑎᑐᑦᑕᑦ: ᐅᑭᐅᖅᑕᕐᓂᖅ

ᖃᐅᔨᓴᓂᐅᑦ ᐊᖅᑭᐹᒪᓂᖅ:

ᖃᒥᖅᑭᓂᖅᑎᑦᓯᒍ ᐊᑎᓂᐅᓕᖅᐸᐊᕐᓂᑦᑕᑦ ᒥᑦᓴᓇᓂᖅᓴᕐᓂᖅ ᖃᐅᔨᓪᓚᐅᖅᑕᑦ ᓄᓇᓕᐅᕐᒥ 45 ᒥᑦᓴᓇᕐᓂᑦᑕᑦ ᐊᖏᔪᓇᓱᓕᑦ ᐊᑎᓕᐅᖅᓯᒪᖃᑕᓕᐅᕐᓂᒪᒪᑕ ᖃᐅᔨᓴᖅᓂᔪᑦ. ᑕᐅᔭᓄᖅᓯᑦ 44ᖅᔪᓕᐅᖅᑕᑦ ᐃᓄᐃᑦ, ᑕᒪᒋᐳᖅ ᐊᓯᖏᓕᐅᖅᑕᐊᕐᓂᑦᑕᑦᑎᓐᓄᑦ, ᐃᓕᖅᓯᑦ ᐃᓇᓴᖅᓯᒪᓕᖅᑎᑦᓯᒍ ᑐᓴᐅᒃᑐᒥᓱᓕᖅ ᐱᓕᕆᓂᐊᓕᖅᐳᖅ, ᐊᓯᖏᓕᐅᖅᑕᐊᕐᓂᑦᑕᑦᓯᓂᕐᑕᖅ. ᐊᒥᓱᑦ ᐊᑎᓕᐅᖅᓯᒪᖃᑕᓕᐅᕐᓂᖅᑭᑦᑕᑦ ᐊᖏᓐᓄᓕᐅᕐᓂᖅ. ᐅᖃᐅᓯᐅᖅᖃᐅᓪᓚᑦ ᓇᓴᐅᑎᑦ 5.2.1 ᑕᕐᔪᓐ ᐊᑎᓕᐅᓚᓯᖏᓐᓄᐊᖅᓂᖓᓂ ᐊᖏᑎᕐᓯᓚᐳᑕᕐᓂᖅᓄᑦᓴᓪᓚᑦᑕ ᐱᓕᐅᕐᑕᕐᓂᑦ ᖃᓄᐃᓕᐅᕐᓂᖓᓂᖅ. ᐃᓕᓴᕐᓯᓂᑦ 42% ᖃᓄᐃᓂ ᐃᓐᓇᑎᑎᓕᐅᕐᓂ ᐊᑎᓕᐅᖅᓯᒪᖃᑕᑦ (ᓇᕐᓂᖃᒥ 10) ᐃᓚᓕᐅᓚᖏᓐᓄᐊᖅᓂᖅ ᐱᓕᔪ ᖃᓄᐃᑦ ᐅᓪᓚᓕᐅᕐᓂᑦ ᐱᓕᓂᑦ ᐊᓯᓕᓴᐊᖅᓯᒪᖃᑕᐅᓂᖅᓂᖓᓂᖅ ᖃᓄᐃᑦᓴᓂᐅ ᖃᓄᐃᓂᖅᓯᒪᓂᑦ (ᓇᕐᓂᖃᒥ 10) ᐃᓚᓕᐅᓚᖏᓐᓄᐊᖅᓂᖅ ᐱᓕᔪ ᖃᓄᐃᑦ ᐅᓪᓚᓕᐅᕐᓂᑦ ᐱᓕᓂᑦ ᐊᓯᓕᓴᐊᖅᓯᒪᖃᑕᐅᓂᖅᓂᖓᓂ

[8] **ᖃᓪᓗᓈᐃᓐᓄᑦ:** ᐊᓯᔾᔨᖏᑦ ᐊᐅᓚᓕᓂᓚᐅᕐᓂᖅᑐᑦ ᖃᓪᓗᓈᖅᑐᖅᓯᓚᐅᕐᓂᖅᑐᓂᒃᑲᓂᒃ ᐅᑎᕐᓂᐅ 3 ᐊᓗᒪ 4 ᐊᓗᒪᓕᑕᐅᖅ ᑲᖏᖅᓴᓚᐅᖅᑐᑦ ᓇᓴᐅᓕᓚᐅᖅᑐᖅᑐᓂᒃᑲᓂᒃ (C.F.). ᐃᓚᒥᑕᐅᑕᓂᓚᕕᖕᓄᑦ ᐊᓐᓚᑕᐅᓯᓚᐃᓄᑦ ᐅᔪᐊ ᓇᓴᐅᑎᑦ ᖃᓪᓗᓈᖅᑐᒥᓂᔅᓴᓂᑦ (ᖃᐅᔨᓴᒥᑦ ᐃᓚᒥᑕᐅᑕᓂᓚᕕᖕᓄᑦ ᓇᓴᐅᑎᖏᑦ ᒪᓂᓚᒪᑦ ᑭᓇᐅᔭᖅᑐᓂᒃᑲᓂᒃ ᐅᑎᕐᓂᐅᓂᒃ, ᐅᓚᔾᔪᑎᓂᖅᑐᑦ ᐊᓐᓚᑕᐅᓯᓚᐃᓄᑦ ᓴᓇᓕᒫ

6.3.7 Nunanit Iniktigutait Ukauhiit: Tikigakjuaq

Ihivgiuktut Atugutait:
Ihivgiufaakhimayut ataani naunaiyakhimayut nunanut pulaakhimapluta takuhimayut 45nik umayukhiuktit titigaktauhimaitut Umayukhiukhimayut Ihivgiuktuni. 44kuyut hapkoa Inuit, tamamik ilaani umayukhiukpaktut, talvalu atauhik Inuinaungituk tuniyauhimayuk umayukhiugutinik inminiigutimik pihimayuk ovalo ilaani umayukhiukataktuk. Amigaitut titigaktauhimaitut umayukhiuktit aknauyut. Ukakhimayuk ilangani 5.2.1 ikpinagutait hamna ataani naunaiyakhimayut pilaaktut ataani ihumagiyaini umayukhiukhimaut naunaiyautaini. Pihimamat hapkoa titigaktauhimaitut umayukhiuktit 42%kuyut tamamik umayukhiuktit amigaitjutaini (ikpatauyak10) ikpitauyait hamna ihumagiyait umayukhiukhimayut naunaiyautaini angiyut ovalo pilaaktut ataani naunaiyautaini nunani umayukhiukhimayut 40%mut. Umayukhiukhimayut naunaiyautait titigaktkauhimaitut umayukhiuktit naunaiyalaaktut angitjutaini umayukhiukhimayiut amigatjutainut tamamik umayunik aviktulugit. Kihimi, hapkoa naunaiyautait pihimayut inminik atuktaminik ihuinaagutainik ovalo ihumagiyainik, avataaniimat hamani Iniktigutimi Tuhaktakhami. Taiguaktut apigilaaktut NWMBkunut piyumagumik iniktigutainik hapkoa naunaiyautinik.

6.3.7

Mikiyuumata amigaitjutait umayukhiunginaktut titigaktauhimayut Tikigakyuami, umayukhiukatainaktut naunaiyautait ilaukatauliktut umayukhiukataktunut hamani naunaiyagaagata umayukhiukhimayut naunaiyautainut.

Ihivgiukatagutait ovalo kiuyuitut ihumagiyait:
Tamaat kiuhimayut naunaiyautait umayukhiuktit Tikigakyuami nakuuyut tamakmivyak ukiuni Umayukhiukhimayut Ihivgiuktuni. Ilangit tatkikhiutit tamamik ukiuni naunaiyautit katagaagata takulaaktut kiuhimayut naunaiyautaini ikpatauyami. Kihimi kiuhimayut naunaiyautait naunaiyakhimagaagata aviktukhimayumik ilaani ovalo umayukhiukataktuni, naunaiyautit pivaktut mikivaktut umayukhiukataktuni naunaiyautaini kinguani malguk ukiumi ihivgiuktitlugit. Naunaiyautit katakpaktut ataanut 50%mut, taiguaktut ihumagiyakhait tuhagutikhat atugumik umayukhiukhimayut naunaiyautait ukiuni 4mi ovalo 5mi.

Takuhimayut ikpatauyami 9 pikataktut kiuyuitut naunaiyautait Tikigakyuami kitkaniitut 4.9%mut ovalo pilaaktut kiuyuituni ihimagiyait pihimayut. Pihimamata hamna ovalo mikiyut kiuhimayut naunaiyautait, ilaa umayukhiukataktut iniktigutaani malguk ukiuni ihivgiuktuni, pilaaktut tamamik uktugutit ihuinaagutait ovalo kiuyuitut ihimagiyaini angiyut ilangit tatkikhiutini ihivgiuktuni ovalo ihumagiyakhait atugutainik hapkoa katitikhimayuni.

Atugutingit ihumagiyait ovalo kiuhimayut ihuinaagutait:
Tuhaktitihimayut nunamut ukakatigititlugit ilangit umayukhiukhimayut, ilangit; maniit ovalo uviluvaluit ataani tuhaktitihimayut. Titigatiakhimayut pihimayut nunani ukaktaini ovalo aalat atugutait katitikhimayuni ilangani hamani. Ilangani 5.4 pihimayutlu ukautitiagutait hamna ihumagiyauyut.

Takuhimayuk utiktitihimayut ubluit ikpatauyani, ihivulimi ukiuni ihivgiuktitlugit, amigaitkiyait umayukhiukhimayut titigagutait katitikhimayut iluani pingahut tatkikhiutini umayukhiukhimayut. Kihimi, ihivgiuktut pitilugit, utiktitihimayut ubluit takhihimayut, takuhimayut angitjutait takuhimayut angiyut ilangit titigakhimayut katitikhimayt siksini tatkikhiutini avataanut umayukhiukhimayut ubluit. Hamna apigiyauhimayuk pilaaktaini umayukhiuktit nakuuyumik ihumagilugit hunanik umayukhiukhimayut ovalo piyunakhiyut ilangit atugutaini ihuinaagutait.

Ukakhimaplugit ukautaini mikhaani ikaliviit hamani, ilangit ikaliviit niuviktitihimayut ikaluligiyinut Kangiklinikmi tamaat ihivgiuktuni. Ihumayut amigaitut hapkia kinauyaliugutit umayukhiukhimayut tuhaktitauhimayut ovalo ilauyut umayukhiukhimayut naunaiyautaini pihimayut katitikhimayut ikpatauyaini.

Nunani ukakhimayut ovalo aalat atugutaini katitikhimayuni:

1. **Tuktut:** Tuktut umayukhiukhimayut nunani tuktut. Umayukhiukhimayut naunaiyautait naamaktut (C.F.).
2. **Umingmait:** Nunani ukiuk tamaat kotakaktut talimanik umingmanik, kihimi tamamik piyuitut tamamik ukiuni. Kihimi umayukhiuktit ihumavaktut malguk umayukhiukhimayut ukiumi 5mi, pihimaplugu pihimaitut tuhaktitini titigakhimayut, pivagunakhiyut umingmait (C.F.).
3. **Nanuit:** Amigaitjutait takukhauyut naunaiyautaungitut kihimi pihimayut umayukhiukhimayut amigaitjutait tunihimayait DSDkunit (DSD PB).

4 **Tigiganiat:** Tigiganiakhimaitut umayukhiukhimayuni tuhaktitimi ukiumi 2mi; kihimi umayukhiuktit tuhaktitihimayut tigiganiakpaktut tamamik ukiuni (C.F.).

5 **Ukaliit:** Anginikhaat umayukhiukhimayut naunaiyautaini ukiumi 1mi pihimayut takhititinahakhimagamik talvani ukiumi (C.F.).

6 **Qairulik:** Umayukhiuktit tuhaktitihimayut pivaktut atauhimit malgunut ukiuk tamaat ovalo umayukhiukhimayut naunaiyautait ukiumi 2mi angiyut (C.F.).

7 **Tuugaat:** DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait tuugaanik (nalungilutit DFOkut katitikhimayut atukpaktait iniktigutaini ukiut, Umayukhiukhimayut Ihivgiugutait katitikhimayut atukpaktaini umayukhiukhimayut ukiungit Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
0	1	0	2	0

8 **Kilalugat:** Umayukhiuktit tuhaktitihimayut ihumavaktut amigaitkiyanik umayukhiukhimayut ukiuni 3mi ovalo 4mi ovalo ihumayut umayukhiukhimayut naunaiyautait naamaktut. Ukakhimaplutik ikitkiyait umayukhiukhimayut ukiumi 5mi ilaa avataanut umayukhiukhimagamik aipaani ukiumi (C.F.). DFOkut tuhaktitihimayut hapkoa umayukhiukhimayut amigaitjutait kilalugat (nalungilutit DFOkut katitikhimayut atukpaktait iniktigutait ukiungit, Umayukhiukhimayut Ihivgiugutait katitikhimayut atukpaktait Junemit Maymut) (DFO N/B):

96/97	97/98	98/99	99/00	00/01
35	20	25	n/d	20

9 **Tinmiat:** Ikitut umayukhiukhimayut haniani nunaini, tuhaktitihimayut naunaiyautait angitkiyauyukhat (C.F.).

10 **Maniit:** Maniit katitikpaktut ukiuk tamaat. Titigakhimayuugaluak manikhimaitut tuhaktitihimayuni ukiuni 1mi ovalo 2mi, amigaitut pikiutakpaktut. Amigaitkiyait maniit katitiktauvaktut aknanit (C.F.). Amigaitut angnat Tikigakjuaqmi titigaktauhimaitut Umayukhiukhimayuni Ihivgiuktuni, pihimamat amigaitjutait mikiyut naunaiyautait. Umayukhiukhimayut tuhaktitihimayutlu amigaitut umayukhiuktit naluvaktut tuhaktitiyakhait maniit pikiutakataktainik. Maniit pikiutakatakhimayut Tikigakjuaqmi hapkoa (HTOkut katimayiit tunihimayutlu naunaiyautait amigaitjutait pikiutakpaktut ukiuk tamaat): *Uluaguliit maniit:* ukiumi 4 ovalo 5 naunaiyautait naamaktut. *Mitiit maniit:* ukiumi 4 naunaiyautait naamaktutlu, ikitut manikhiukatakhimayait. *Nauyat maniit:* ilangit 50nik pikatakpaktut ukiuk tamaat. *Imitkutailat maniit*: Ilangit 10nit-12nut pikiutakpaktut ukiuk tamaat. *Black guillemot maniit*: Ilangit 50nik haniani pikiutakpaktut ukiuk tamaat (C.F.).

11 **Ikaliviit:** Umayukhiukhimayut naunaiyautait ukiumi 2mi mikiyut. HTOkut katimayiit tuhaktitihimayut umayukhiuktit niuviktitivaktut ikaluktaminik ikaluligiyinut Kangiklinikmi. Umayukhiukhimayut naunaiyautait pihimayunakhiyut ilangit kinauyaliugutigit niuviktauhimayut ikaluit (C.F.).

12 **Hulupaugaq:** Umayukhiukhimayut naunaiyautait mikiyut. Pivaktut ikalukhiugaagamik hikukut (C.F.).

13 **Kapihiliit:** Umayukhiukhimayut naunaiyautait naamaktut. Ikalukhiukluayuitait. Ukiumi 2mi, ayoikhaktut pilihimayut pihimayaini ilihakviit pipkakhimayunakhiyait angitkiyat pivaktut ukiungani (C.F.).

14 **Ugat:** Umayukhiukhimayut naunaiyautait mikiyut. Amigaivyaktut ilakatigiit ikalukhiulikpaktait ugat ovalo naunaiyautait 100nik ukiuk tamaat naamatkiyat (C.F.).

15 **Uviluvaluit:** Amigaitkiyat umayukhiuktit naluvaktut tuhaktitiyakhait uviluvaluit, taimaimat umayukhiukhimayait tuhaktititauyuitut. Amigaitut Inuit umayukhiukpaktait uviluvaluit ovalo atauhik Inuk katitilaaktuk avataanut 300nik ublumi atauhimi. Naunaiyautait pihimayukhat 1,000nik (C.F.).

6.4 Nunavut
ᓄᓇᕗᑦ/Nunavumi

TABLE/ᐊᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 651

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᕐᔪᑦ
Tatkiktamat nahaktauvaktun

Year 1† (June 1996 - May 1997)
ᐊᓚᖅᔪᒍ 1† (ᔨᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1† (June 1996 - May 1997)

Month/ᑕᖅᖏᓐᓂ/Tatkia			JUN†† ᔨᓂ††	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔨᒻ	SEP ᓱᑎᓴᓇ	OCT ᐅᑦᔨᓴᓇ	NOV ᓄᐱᓴᓇ	DEC ᑎᓯᓴᓇ	JAN ᔮᖏᓄᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᓯ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑎᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	1,580	1,202	3,309	2,915	2,891	2,293	1,705	2,033	1,988	2,339	2,403	1,966	26,624 ± 761
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait	0	11	0	11	16	24	20	12	21	30	16	0	161 ± 46
Moose	ᑐᑐᓀᐃᑦ	Tuktuvait	0	0	0	0	0	0	0	0	1	0	0	0	1 ± 0
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	1	0	4	2	44	81	5	9	34	50	50	21	301
Tundra grizzly	ᐊᖏᓪᓗᐃᑦ	Akhait	0	1	1	1	1	0	0	0	0	0	0	0	4 ± 3
Wolf	ᐊᒪᕐᐃᑦ	Amagut	4	0	4	5	1	41	58	20	41	101	136	43	454 ± 56
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat	0	0	1	0	40	1,607	1,308	934	583	776	304	51	5,604 ± 373
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓕᓴᓂᐊᑦ	Kalaliit tigiganiat	0	0	0	0	11	72	44	38	67	81	18	2	333 ± 73
Wolverine	ᖃᐅᕙᑦ	Kalvik	0	0	0	0	7	14	11	12	18	27	12	4	105 ± 12
Lynx	ᐱᖓᓐᓂᕐᕿᐃᑦ	Pamiuqtuuq	0	0	0	0	0	0	1	0	0	0	0	0	1 ± 1
Arctic hare	ᐅᒃᓪᑦ	Ukalik	32	6	25	93	73	111	32	41	82	190	108	54	847 ± 64
Arctic ground squirrel	ᓱᖅᓯᑦ	Hikhik	38	13	373	390	0	0	0	0	0	0	88	72	974 ± 370
Seals (unspecified)	ᓯᖓᑯᓪᑦ	Natiit	319	34	49	15	4	43	20	10	18	53	9	78	652 ± 384
Ringed seal	ᓇᓯᓚᑦ	Natiinat	6,238	2,575	1,925	2,921	2,476	1,730	805	1,216	1,562	1,662	1,600	2,248	26,958 ± 1,112
Bearded seal	ᐅᑦᕕᐃᑦ	Ukyuk	140	104	180	137	87	40	8	19	16	31	13	10	785 ± 157
Harp seal	ᖃᐃᓗᓪᑦ	Qairulik	330	307	131	438	350	93	19	2	0	1	0	0	1,671 ± 556
Harbour seal	ᖃᓯᕐᐊᑦ	Qanigiaq	0	1	4	0	0	0	0	0	0	0	0	0	5 ± 3
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	0	0	1	0	0	0	0	0	0	0	0	0	1 ± 2
Walrus	ᐊᐃᐸᒃᑦ	Akvik	12	145	67	71	34	8	3	0	6	7	8	4	365 ± 49
Narwhal	ᑐᓭᓪᑦ ᕈᓪᓚᑦ	Tuugaak	44	167	97	23	18	0	0	0	0	0	0	3	352 ± 63
Beluga	ᖃᐅᕐᑦ ᕈᓪᓚᑦ	Kilalugak	21	194	220	156	12	1	0	0	0	0	0	3	607 ± 66
Bowhead	ᐊᖏᒃᑦ	Aivik	0	0	2	0	0	0	0	0	0	0	0	0	2 ± 2
Geese (unspecified)	ᓂᖅᓪᑦ	Kanguk	1,373	3	0	0	0	0	0	0	0	0	0	109	1,485 ± 245
Snow goose	ᑲᖕᒍᑦ	Kanguq	5,690	287	607	203	11	0	0	0	0	0	4	2,105	8,907 ± 965
Canada goose	ᓂᖅᓪᑦ ᐅᓕᐊᔪᓪᓪᑦ	Nikliknik	2,273	418	350	125	7	0	0	0	0	0	64	1,879	5,116 ± 599
Ross's goose	ᖃᑲᖅᓴᐃᑦ	Kakat	0	0	0	0	0	0	0	0	0	0	0	3	3 ± 3
Brant goose	ᓂᓪᓂᓄᐃᑦ	Nirlirnaq	11	7	1	2	0	0	0	0	0	0	0	0	21 ± 6
White-fronted goose	ᓂᖅᓪᑦ	Nirlivik	0	6	2	0	0	0	0	0	0	0	0	56	64 ± 40
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	18	0	0	0	0	0	0	0	0	0	0	16	34 ± 29
Old squaw	ᐊᑭᓂᓴᐃᑦ	Aahangik	5	0	14	6	90	6	0	0	2	28	0	0	151 ± 58
Pintail	ᖃᓚᒧᓴᒃ	Arnaviaq	54	2	1	0	0	0	0	0	0	0	0	0	57 ± 44
Eider duck	ᒥᑎᑦ	Kingalik	1,376	569	332	970	1,514	1,007	73	22	5	21	19	46	5,954 ± 659
Tundra swan	ᖃᓚᓴᐃᑦ	Kukyuk	2	0	19	0	1	0	0	0	0	0	0	15	37 ± 25
Common merganser	ᓄᐃᑦ	Nuyaralik	2	29	16	9	5	0	0	0	0	0	0	0	61 ± 28
Black scoter	ᖃᓄᓂᑦ ᐱᓂᐅᓪᓂᑦ	Black scoter	0	0	0	0	5	0	0	0	0	0	0	0	5 ± 4

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Month/ᑕᖅᑳᑦ/Tatkia			JUN†† ᔪᓂ††	JUL ᔪᒪᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕆᕕ	OCT ᐅᑦᔨᕕ	NOV ᓄᐊᕆᕕ	DEC ᑎᓯᕆᕕ	JAN ᔨᓐᓄᐊᕕ	FEB ᓇᖅᑐᐊᕕ	MAR ᒪᕐᔪ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Common loon	ᑐᑦᓭᓗᔪᐊᑦ	Tuulik	0	2	3	0	1	0	0	0	0	0	0	0	6 ± 3
Arctic loon	ᑲᓗᓄᓪᓕᑦ	Maliriq	5	0	4	15	2	0	0	0	0	0	0	0	26 ± 15
Red-throated loon	ᖃᖏᒪᐅᑦ	Qaqhuaq	0	21	2	5	0	0	0	0	0	0	0	0	28 ± 10
Black guillemot	ᐱᑦᓯᐅᓪᓚᑦ	Black guillemot	2	0	38	13	3	10	0	0	0	0	0	0	66 ± 58
Thick-billed murre	ᐊᑦᕿᐃᑦ	Thick-billed murre	43	24	1	19	7	0	0	0	0	0	0	0	94 ± 37
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	427	24	6	572	1,266	2,556	1,209	909	1,442	923	706	1,343	11,383 ± 793
Sandhill crane	ᑕᑎᓘᑦᔪᐊᑦ	Tatilgaq	0	0	3	0	0	0	0	0	0	0	0	0	3 ± 3
Eggs (unspecified)	ᓚᖅᓂᑦ	Manniit	1,435	277	0	0	0	0	0	0	0	0	0	0	1,712 ± 1,691
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᖅᓂᖏᑦ	Uluaguliit manniit	7,204	386	0	0	0	0	0	0	0	0	0	480	8,070 ± 1,273
Duck eggs	ᒥᑎᑦ ᓚᖅᓂᖏᑦ	Tinmiat manniit	1,931	2,418	50	16	0	0	0	0	0	0	0	3	4,418 ± 1,174
Tundra swan eggs	ᑲᓐᔪᐃᑦ ᓚᖅᓂᖏᑦ	Kukyut manniit	0	2	0	0	0	0	0	0	0	0	0	0	2 ± 2
Arctic tern eggs	ᐃᒥᖕᒋᑕᓪᓚᑦ ᓚᖅᓂᖏᑦ	Emitkutailat manniit	493	86	0	0	0	0	0	0	0	0	0	0	579 ± 111
Seagull eggs	ᓇᐅᐳᐃᑦ ᓚᖅᓂᖏᑦ	Nauyat manniit	291	35	0	0	0	0	0	0	0	0	0	0	326 ± 73
Thick-billed murre eggs	ᐊᑦᕿᐃᑦ ᓚᖅᓂᖏᑦ	Thick-billed murre eggs	453	2,212	0	0	0	0	0	0	0	0	0	0	2,665 ± 2,038
Fish (unspecified)	ᐃᖕᓗᐃᑦ	Ikaluit	320	122	0	0	0	0	0	50	0	0	0	0	492 ± 349
Arctic char	ᐃᖕᓗᓴᐃᑦ	Ikaliviit	19,424	35,532	31,546	13,092	30,196	21,877	4,102	5,686	4,202	7,435	8,515	13,638	195,245 ± 13,468
Freshwater fish (unspecified)	ᑕᓂᐅᖕᒍᖏᑦᑐᒥ ᐃᖕᓗᐃᑦ	Tahinik Ikaluit	4	4	0	0	0	0	0	0	0	0	0	19	27 ± 31
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	7,348	1,692	1,287	194	2,390	768	725	126	86	799	984	3,647	20,046 ± 4,975
Northern pike	ᓱᓚᔨᓪᓕᑦ	Hiulik	0	0	0	0	0	0	0	0	0	0	0	2	2 ± 3
Arctic grayling	ᓭᓗᓴᐅᓚᐃᑦ	Hulupaugaq	236	360	400	377	959	0	0	0	0	4	24	89	2,449 ± 709
Whitefish	ᑲᐱᓱᔨᓪᓕᑦ	Kapihiliit	530	31	310	166	1,531	2,816	116	53	56	4	4	12	5,629 ± 1,255
Burbot	ᑎᑦᑕᔨᓪᓕᑦ	Tiktaaliq	0	0	0	0	0	0	0	1	0	0	1	0	2 ± 1
Arctic cisco	ᐅᑭᐅᑦᑐᑐᒥ ᑲᐱᓱᔨᓪᓕᑦ	Kapihilik	0	0	0	2	1	0	0	0	0	0	0	0	3 ± 3
Least cisco	ᒥᑭᓂᖏᑦ ᑲᐱᓱᔨᓪᓕᑦ	Eetuuk	0	0	1	0	0	0	0	0	0	0	0	0	1 ± 1
Inconnu	ᑲᐱᓱᓕᕐᕿᐃᑦ	Aanakhiik	0	95	0	0	0	0	4	0	12	0	0	0	111 ± 62
Ocean fish (unspecified)	ᐃᒪᓕᕆᒥ ᐃᖕᓗᐃᑦ	Tagiumi ikaluit	0	0	0	0	0	0	0	0	0	0	0	53	53 ± 84
Cod	ᐅᒪᐃᑦ	Ugak	309	89	375	493	1,358	1,578	365	43	519	142	122	18	5,411 ± 882
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	644	295	340	242	74	45	0	0	0	0	0	44	1,684 ± 382
Turbot	ᖃᓕᕋᓪᓕᑦ	Nataarnak	0	0	0	0	0	0	0	27	882	4,511	2,192	398	8,010 ± 2,022
Clams	ᐊᒃᒍᒪᔪᑦ	Uviluq	577	3,473	8,856	3,567	1,801	6,174	35	0	0	0	0	0	24,483 ± 4,306
Mussels	ᐅᕙᓗᐃᑦ	Uviluvaloet	0	201	2,971	0	265	0	0	0	846	3,614	194	0	8,091 ± 4,952

† No data collected in Cape Dorset and Iqaluit.
†† No data collected in Rankin Inlet.
‡ Polar bear data supplied by DSD.

† ᓇᓴᐃᔪᖃᓕᖅᑐᖅᑐᒍᖅ ᑭᖅᓴᓂ ᐊᒃᓚᓗ ᐃᖕᓗᓐᓂ.
†† ᓇᓴᐃᔪᖃᓕᖅᑐᖅᑐᒍᖅ ᑲᖏᑦᓯᓂᖓᖅᒥ.
‡ ᓇᓂᑦᓂ ᑎᑎᕋᐅᒪᔪᑦ ᑐᓂᓕᖅᑦ ᐅᓂᒃᓴᖅᑐᑦ ᐃᓂᓴᐃᓕᓴᕐᓂᓕᑦ.

† Katikhiktauhimaitut Kinnganik Iqaluknilu.
†† Katikhiktauhimaitut Kangikhinikmik.
‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

TABLE/ᐅᓗᓄᐃᕆᐅᑦ/NAUNAIKUTA 652

Monthly hunter response
ᑕᖅᑕᒪᒃᑦ ᐊᖏᓚᓱᕆᑎᑦ ᑭᐅᓂᖏᑦ
Tatkiktaman pijauhimajut angunahuktinun

Year 1 (June 1996 - May 1997)
ᐊᒻᔪᒍ 1 (ᔦᓂ 1996 - ᒪᐃ1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔦᓂ	JUL ᔦᓕᐃ	AUG ᐊᐅᒍᑐᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᐊᒻᐹᓗ	DEC ᑎᓯᒻᐹᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᐃᖅᐳᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓚᓱᕆᑎᑦ ᑭᐅᓂᖏᑦ ᐋᔪᔨᓕᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᓚᓱᕆᑎᑦ	Tatkitaman angunahuktut titigait	3,921	4,341	4,362	4,358	4,380	4,393	4,416	4,415	4,418	4,442	4,464	4,473	4,578*
Interview list	ᐊᐱᔪᓂᖅᓱᐃᑦ	Apikiktan	3,367	3,661	3,682	3,679	3,700	3,713	3,734	3,730	3,733	3,753	3,773	3,783	3,892*
Hunters interviewed	ᐊᖏᓚᓱᕆᑎᑦ ᐊᐱᔪᓂᑦ	Angunahuktin apikhuktan	2,162	2,603	2,675	2,677	2,792	2,871	3,044	3,119	3,086	3,165	3,129	2,948	3,833*
Harvested	ᐊᖏᓚᓱᕆᑐᒃᑎᓐᓂᒃ	Angujaujut	1,128	969	970	802	900	821	575	656	663	878	892	1,163	2,678*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᓂᖏᑦ (%)	Kiujut (%)	64	71	73	73	75	77	82	84	83	84	83	78	77**

* Hunters registered/on interview list/interviewed/harvested in at least one month of the year.
** Mean monthly response rate (%).

* ᐊᖏᓚᓱᕆᑎᑦ ᐊᑎᓕᐅᔾᔨᒪᔭᑦ/ᐊᐱᔪᓂᖅᓱᐃᑦᑐᒃᑎᓐᓂᑦ/ᐊᐱᔪᓂᑦ/ᐊᖏᓚᓱᕆᑎᑐᒃᑎᓐᓂᒃ ᐊᑕᐅᓂᒪᓕᓪᓚᖃᑦ ᐊᑎᒍᑎ ᐊᒻᔪᒍᒥ.
** ᐊᐅᔨᓂᓕᑎᓂᒪᓕᒃᑦ ᑕᖅᑕᒪᒃᑦ ᑭᐅᔾᔨ (%).

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut (%).

TABLE/ᐅᓗᓄᐃᕆᐅᑦ/NAUNAIKUTA 653

Recall period between harvest and interview, expressed as % of total harvest records
ᐅᑎᕐᕕᐅᓪᓚᑦ ᐊᑯᖏᓂᒃ ᐊᖏᓚᓱᓴᓂᖓᑕ ᐊᒪᓗᓗ ᐊᐱᔪᓂᑦᑕᐅᓂᖓᑕ, ᐅᓗᓄᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑐᑎᑦ ᐊᖏᓚᓱᕆᒃᑦ ᑎᑎᕐᑦᑕᐅᒪᓪᓚᑦ
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 1 (June 1996 - May 1997)
ᐊᒻᔪᒍ 1 (ᔦᓂ 1996 - ᒪᐃ 1997)
Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖏᒃ/Tatkia			JUN ᔦᓂ	JUL ᔦᓕᐃ	AUG ᐊᐅᒍᑐᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᐊᒻᐹᓗ	DEC ᑎᓯᒻᐹᓗ	JAN ᒍᓐᓄᐊᓗ	FEB ᐃᖅᐳᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᔪᓚᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᓪᓚᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	89	95	94	96	96	94	87	88	88	85	94	94	92
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	6	3	3	2	2	4	7	9	10	11	2	2	5
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	5	3	3	2	1	2	6	4	2	4	4	3	3

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 654

Number of hunters harvesting each species — Year 1 (June 1996 - May 1997)

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᖅᑎᑦ ᐊᖏᔪᓚᐱᖅᓯᒪᔪᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ — ᐊᒻᒋᒍ 1 (ᔦᓂ 1996 - ᒪᐃ 1997)

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin — Ukiunga 1 (June 1996 - May 1997)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔦᓂ	JUL ᔪᓚᐃ	AUG ᐊᐅᒍᑎᓂ	SEP ᓱᑎᕕᓚᓗ	OCT ᐅᑦᑐᓚᓗ	NOV ᐅᓇᒻᒪᓚᓗ	DEC ᑎᓯᒪᓚᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᓇᖕᐅᐊᓗ	MAR ᒪᔪ	APR ᐃᑦᓗᓪ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	322	323	559	435	386	390	299	372	380	491	471	421	1,729
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait		3		2	8	9	9	2	3	11	4		41
Moose	ᑐᑦᑐᓀᐃᑦ	Tuktuvait									1				1
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒃᓪᓚᐃᑦ	Akhait		1	1	1	1								4
Wolf	ᐊᒪᕐᐃᑦ	Amagut	3		2	2	1	16	16	11	14	30	53	16	125
Arctic fox	ᑎᓗᒃᑲᓕᐊᑦ	Tigiganiat			1		12	150	129	118	79	99	42	6	333
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓗᒃᑲᓕᐊᑦ	Kalaliit tigiganiat					6	24	15	11	15	19	4	1	73
Wolverine	ᖃᓴᒃᑦ	Kalvik					2	9	6	6	6	20	9	2	38
Lynx	ᐱᖓᓐᓂᕐᕿᐃᑦ	Pamiuqtuuq							1						1
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik	9	3	12	35	29	40	22	19	32	70	53	29	252
Arctic ground squirrel	ᓂᕆᓂᑦ	Hikhik	2	1	11	9							10	10	31
Seals (unspecified)	ᓂᖏᑉᓪᓚᑦ	Natiit	32	14	9	4	2	16	6	7	5	13	3	23	91
Ringed seal	ᓇᕐᓂᑦ	Natiinat	501	415	359	380	355	274	155	251	272	328	328	387	1,363
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	24	56	73	63	56	16	4	15	11	21	9	7	273
Harp seal	ᖃᐃᕐᓪᓚᑦ	Qairulik	5	33	39	69	60	13	5	2		1			180
Harbour seal	ᖃᓂᕈᐊᑦ	Qanigiaq		1	2										3
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit			1										1
Walrus	ᐊᐃᐃᓴᑦ	Akvik	7	44	25	30	15	3	3		6	5	5	4	109
Narwhal	ᑐᓗᓪᓚᑦ ᖁᓪᓗᓚᑦ	Tuugaak	9	69	30	10	13							3	114
Beluga	ᖃᐃᕐᑦ ᖁᓪᓗᓚᑦ	Kilalugak	9	84	64	52	7	1						2	182
Bowhead	ᐊᕐᓴᑦ	Aivik			1										1
Geese (unspecified)	ᓄᖕᓪᓚᑦ	Kanguk	30	2										7	36
Snow goose	ᑲᖏᐃᑦ	Kanguq	203	32	66	28	3						1	81	360
Canada goose	ᓄᖕᓪᓚᑦ ᐅᓗᐊᔪᖕᓪᓚᑦ	Nikliknik	160	20	21	14	1						13	159	319
Ross's goose	ᖃᐅᖕᔪᐃᑦ	Kakat												2	2
Brant goose	ᓄᖕᓕᖕᓇᐃᑦ	Nirlirnaq	5	1	1	1									7
White-fronted goose	ᓄᖕᓪᓚᑦ	Nirlivik		2	1									7	10
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	2											1	3
Old squaw	ᐊᑭᐊᖕᔪᐃᑦ	Aahangik	1		2	1	9	2			1	1			15

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Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᓕ	OCT ᐅᑦᔨᓕ	NOV ᓄᐃᓚᓕ	DEC ᑎᓯᓚᓕ	JAN ᒎᓐᓄᐊᓕ	FEB ᐃᖅᑲᐊᓕ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᔪᑦ	**Umajuin**													
Pintail	ᖃᓚᒧᐊᓪᓚᑦ	Arnaviaq	3	2	1										5
Eider duck	ᒥᑎᑦ	Kingalik	96	58	36	82	126	37	6	1	2	3	2	8	334
Tundra swan	ᖃᓚᔪᐃᑦ	Kukyuk	2		4		1							4	11
Common merganser	ᐸᐃᑦ	Nuyaralik	1	4	3	2	2								10
Black scoter	ᖃᓄᓂᒋᑦ ᐱᒋᐅᓪᓗᒍᑦ	Black scoter					1								1
Common loon	ᔅᓕᓚᔪᐊᑦ	Tuulik		1	2		1								3
Arctic loon	ᑲᓚᓂᓪᑦ	Maliriq	1		2	2	1								5
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq		4	1	2									6
Black guillemot	ᐱᒋᐅᓪᓗᑦ	Black guillemot	2		1	5	1	2							10
Thick-billed murre	ᐊᒃᑲᐃᑦ	Thick-billed murre	3	2	1	5	4								13
Ptarmigan	ᐊᖏᓚᒋᑦ	Akilgik	50	3	3	34	115	138	76	71	89	115	96	141	567
Sandhill crane	ᑕᑎᓴᒋᔪᐊᑦ	Tatilgaq			1										1
Eggs (unspecified)	ᓚᖅᓂᑦ	Manniit	9	6											15
Goose eggs	ᑲᖓᐃᑦ ᓚᖅᓂᖅᑦ	Uluaguliit manniit	116	9										7	132
Duck eggs	ᒥᑎᑦ ᓚᖅᓂᖅᑦ	Tinmiat manniit	26	29	3	2								1	61
Tundra swan eggs	ᖃᓚᔪᐃᑦ ᓚᖅᓂᖅᑦ	Kukyut manniit		1											1
Arctic tern eggs	ᐃᒥᖏᑯᒪᐃᑦ ᓚᖅᓂᖅᑦ	Emitkutailat manniit	10	4											13
Seagull eggs	ᓇᐅᔨᐃᑦ ᓚᖅᓂᖅᑦ	Nauyat manniit	29	1											30
Thick-billed murre eggs	ᐊᒃᑲᐃᑦ ᓚᖅᓂᖅᑦ	Thick-billed murre eggs	1	6											7
Fish (unspecified)	ᐃᖃᓗᐃᑦ	Ikaluit	4	2						3					9
Arctic char	ᐃᖃᓗᓴᒧᑦ	Ikaliviit	473	440	358	119	253	189	71	63	70	113	189	393	1,515
Freshwater fish (unspecified)	ᑕᓇᐅᖏᓐᓄᑦᑐᒥ ᐃᖃᓗᐃᑦ	Tahinik Ikaluit	1	1										1	3
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	145	40	40	16	72	46	22	13	7	50	82	268	534
Northern pike	ᓱᓚᔪᓂᑦ	Hiulik												1	1
Arctic grayling	ᓭᓗᓴᐅᓚᐃᑦ	Hulupaugaq	7	7	6	4	13					1	1	6	35
Whitefish	ᑲᐱᓱᓂᓪᑦ	Kapihiliit	14	2	9	13	28	16	5	2	1	1	1	2	71
Burbot	ᑎᓴᒋᓂᓪᑦ	Tiktaaliq								1			1		2
Arctic cisco	ᐅᑭᐅᖏᑐᒥ ᑲᐱᓱᓂᓪᑦ	Kapihilik				1	1								2
Least cisco	ᒥᑭᓂᖏᑦ ᑲᐱᓱᓂᓪᑦ	Eetuuk			1										1
Inconnu	ᑲᐱᓱᓂᖏᑦᐸᐃᑦ	Aanakhiik		1					1		1				2
Ocean fish (unspecified)	ᐃᒪᓕᕆᒥ ᐃᖃᓗᐃᑦ	Tagiumi ikaluit												1	1
Cod	ᐅᓴᐃᑦ	Ugak	28	12	16	8	35	22	8	3	3	4	3	1	114
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	44	29	15	3	7	6						6	101
Turbot	ᖃᓕᕆᓂᓪᑦ	Nataarnak								1	4	9	8	2	14
Clams	ᐊᒃᒧᒪᔪᑦ	Uviluq	3	11	18	19	14	21	1						65
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet		2	2		1				1	2	2		8

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓗᒪᔪᓂᑲ ᐱᑕᖃᖏᑐᓄᑲ ᐱᔨᔪᑎᓕᓐᓄᑲ ᐊᖏᓴᑦ ᖃᕋᐅᓄᖏᓐᓄᓕᑦ ᐊᓪᓚᕆᒃᑐᑦ ᐊᒪᓴᔪᓐᓄᓕᑦ ᐃᓕᓴᕐᕕᒃᓴᓕᑦ ᑐᓂᔨᖏᑦᑐᓂ ᑐᓴᐅᒪᔪᓐᓇᖅᑐᓂ ᐃᑲᓴᐃᓐᓇᕐᓂᖅᓱᓂ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijnik.

TABLE/ᐊᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 655

Monthly harvest estimates
ᑕᖅᑕᒫᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᓴᓚᑦ
Tatkiktamat nahaktauvaktun

Year 2 (June 1997 - May 1998)
ᐊᑦᖁᔪ 2 (ᔮᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Species	ᐅᒪᓐᑦ	Umajuin	Month/ᑕᖅᖏᓐᓂ/Tatkia JUN† ᔮᓂ†	JUL† ᔪᓚᐃ†	AUG ᐊᐅᑲᔪᑎ	SEP†† ᓯᑎᐱᕆᑦ††	OCT†† ᐅᑐᐱᕆᑦ††	NOV†† ᓄᓇᒡᕆᑦ††	DEC†† ᑎᓯᒡᕆᑦ††	JAN†† ᔭᓐᓄᐊᕆᑦ††	FEB†† ᓇᖕᐅᐊᕆᑦ††	MAR ᒪᓕᒃ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦᑕᑦ Tamakiklugin ± 95% CI
Caribou	ᑐᑐᐃᑦ	Tuktut	1,100	1,291	3,253	2,937	2,696	2,141	1,583	1,741	2,083	2,473	2,156	1,891	25,345 ± 558
Musk-ox	ᐅᒥᓴᒪᐃᑦ	Umingmait	6	3	5	2	5	4	1	1	4	1	4	2	38 ± 11
Moose	ᑐᑐᓂᐃᑦ	Tuktuvait	0	0	0	0	0	0	0	2	0	0	4	3	9 ± 8
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	0	0	3	0	34	72	11	20	23	75	47	19	304
Tundra grizzly	ᐊᖏᓪᓗᐃᑦ	Akhait	6	0	0	0	0	0	0	0	0	0	1	1	8 ± 7
Black bear	ᕿᓐᓂᕐᑦ ᐊᖏᓪᓗᐃᑦ	Kiniktut akhait	0	0	0	3	0	0	0	0	0	0	0	0	3 ± 5
Wolf	ᐊᒪᕐᐃᑦ	Amagut	6	0	3	1	13	35	62	60	100	250	201	26	757 ± 159
Arctic fox	ᑎᓘᑦᓂᐊᑦ	Tigiganiat	0	0	1	7	76	1,705	1,004	674	623	528	149	0	4,767 ± 448
Coloured fox	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓘᑦᓂᐊᑦ	Kalaliit tigiganiat	0	0	8	2	19	87	51	43	54	21	13	0	298 ± 41
Muskrat	ᐊᐃᓐᖓᖅᔪᐊᑦ	Kivgaluk	0	0	0	0	1	0	0	0	0	0	0	0	1 ± 0
Wolverine	ᖃᓪᓕᒃ	Kalvik	0	0	1	0	8	21	19	57	27	13	17	5	168 ± 32
Arctic hare	ᐅᒃᓪᓕ	Ukalik	26	4	30	94	73	54	53	63	60	82	104	49	692 ± 41
Arctic ground squirrel	ᓱᖅᓯᑦ	Hikhik	0	8	55	82	0	0	0	0	0	0	26	62	233 ± 49
Seals (unspecified)	ᓯᖏᑯᓪᓕᑦ	Natiit	126	34	371	133	17	32	5	2	6	54	46	50	876 ± 205
Ringed seal	ᓇᓯᓗᑦ	Natiinat	4,163	2,131	2,859	3,412	2,493	1,613	1,183	1,973	1,432	1,647	1,784	1,958	26,648 ± 581
Bearded seal	ᐅᓘᔪᐃᑦ	Ukyuk	44	109	165	141	112	27	23	26	29	7	15	13	711 ± 40
Harp seal	ᖃᐃᕈᓪᓕᑦ	Qairulik	8	20	142	243	169	114	31	2	2	0	0	0	731 ± 57
Harbour seal	ᖃᓂᕈᐊᑦ	Qanigiaq	1	0	10	0	0	2	4	0	1	1	0	0	19 ± 17
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	1	1	2	24	46	82	51	0	0	0	0	0	207 ± 68
Walrus	ᐊᐃᐸᒃᑦ	Akvik	25	144	25	49	44	16	7	3	17	15	6	13	364 ± 20
Narwhal	ᑐᓚᓪᓕᑦ ᖁᓪᓗᓕᑦ	Tuugaak	20	100	83	20	5	1	0	0	0	0	2	4	235 ± 15
Beluga	ᖃᐅᕐᑦ ᖁᓪᓗᓕᑦ	Kilalugak	22	207	344	69	30	8	0	0	0	0	2	27	709 ± 167
Geese (unspecified)	ᓂᖅᓪᓕᑦ	Kanguk	141	13	48	16	0	0	0	0	0	0	0	279	497 ± 103
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	4,840	565	671	431	17	0	0	0	0	0	20	4,680	11,224 ± 1,406
Canada goose	ᓂᖅᓪᓕᑦ ᐅᓗᐊᔪᓪᓕᑦ	Nikliknik	857	459	248	291	10	0	0	0	0	0	210	3,866	5,941 ± 619
Ross's goose	ᖃᑦᖅᔪᐃᑦ	Kakat	12	0	0	4	0	0	0	0	0	0	0	34	50 ± 49
Brant goose	ᓂᖅᓴᓇᐃᑦ	Nirlirnaq	44	0	2	66	4	0	0	0	0	0	0	1	117 ± 31
White-fronted goose	ᓂᖅᓪᓕᑦ	Nirlivik	27	2	7	0	63	0	0	0	0	0	0	71	170 ± 88
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	56	38	0	0	0	0	0	0	0	0	0	0	94 ± 51
Old squaw	ᐊᑲᑦᔪᐃᑦ	Aahangik	5	1	7	2	44	17	0	14	13	0	0	0	103 ± 21
Pintail	ᖁᓚᒧᐊᓪᓕᑦ	Arnaviaq	0	6	0	0	0	0	0	0	0	0	0	0	6 ± 3
Mallard	ᒥᑎᓪᓕᑦ	Mitik	0	0	0	0	0	0	0	0	0	0	0	1	1 ± 1
Eider duck	ᒥᑎᑦ	Kingalik	1,078	679	292	543	1,110	903	486	197	83	23	169	404	5,967 ± 387
Tundra swan	ᖁᓚᔪᐃᑦ	Kukyuk	2	0	0	2	0	0	0	0	0	0	0	29	33 ± 40

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Month/ᑕᖅᑳᑦ/Tatkia			JUN† ᔪᓂ†	JUL† ᔪᓚᐃ†	AUG ᐊᐅᓚᔪᑎ	SEP†† ᓯᑎᐸᐱᓗ††	OCT†† ᐅᑐᐃᐱᓗ††	NOV†† ᓄᓇᕗᐱᓗ††	DEC†† ᑎᓯᕗᐱᓗ††	JAN†† ᒍᓐᓄᐊᓗ††	FEB†† ᓱᖏᐅᐊᓗ††	MAR ᒪᕐᒋ	APR ᐃᖅᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓴᑦ	**Umajuin**													
Common merganser	ᐸᐃᑦ	Nuyaralik	0	0	119	19	12	0	0	0	0	0	0	0	150 ± 42
Red breasted merganser	ᑲᒃᓵᖏᑐᑦ	Red breasted merganser	0	0	1	0	0	0	0	0	0	0	0	0	1 ± 1
Scaup (unspecified)	ᒥᑎᑦ ᐊᐃᐸᐸᖏᑦ	Scaup	0	1	0	0	0	0	0	0	0	0	0	0	1 ± 2
Black scoter	ᐱᕐᓂᐅᓪᓴᐸᑦ	Black scoter	0	0	1	7	0	0	0	0	0	0	0	0	8 ± 5
Common loon	ᑐᓴᓕᓴᐋᑦ	Tuulik	6	1	3	26	0	0	0	0	0	0	0	0	36 ± 36
Arctic loon	ᒪᓕᓂᑦ	Maliriq	0	0	0	1	1	0	0	0	0	0	0	0	2 ± 1
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq	10	1	13	6	0	0	0	0	0	0	0	0	30 ± 10
Yellow-billed loon	ᑐᓴᓕᓴᐋᑦ	Tuulik	0	6	0	3	0	0	0	0	0	0	0	1	10 ± 5
Black guillemot	ᐱᕐᐅᓪᓴᑦ	Black guillemot	1	165	0	19	0	0	0	0	0	6	0	0	191 ± 237
Thick-billed murre	ᐊᑦᑕᐃᑦ	Thick-billed murre	104	4	15	4	7	4	0	0	0	30	199	16	383 ± 73
Ptarmigan	ᐊᖏᓚᒋᑦ	Akilgik	169	7	47	774	1,259	1,948	2,522	1,727	1,596	1,672	4,359	3,136	19,216 ± 744
Sandhill crane	ᑕᑎᓚᑦᓴᐋᑦ	Tatilgaq	3	0	0	0	0	0	0	0	0	0	0	4	7 ± 5
Snowy owl	ᐅᑲᓚᓴᐋᑦ	Ookpik	0	0	0	0	0	0	0	2	0	0	0	0	2 ± 0
Eggs (unspecified)	ᓚᓐᓂᑦ	Manniit	0	116	0	0	0	0	0	0	0	0	0	0	116 ± 97
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᓐᓂᖏᑦ	Uluaguliit manniit	11,986	694	0	0	0	0	0	0	0	0	0	3,088	15,768 ± 3,199
Duck eggs	ᒥᑎᑦ ᓚᓐᓂᖏᑦ	Tinmiat manniit	3,949	1,515	79	0	0	0	0	0	0	0	0	21	5,564 ± 799
Tundra swan eggs	ᑭᓗᓴᐃᑦ ᓚᓐᓂᖏᑦ	Kukyut manniit	11	0	0	0	0	0	0	0	0	0	0	0	11 ± 15
Arctic tern eggs	ᐃᒥᖅᑯᑕᓚᐃᑦ ᓚᓐᓂᖏᑦ	Emitkutailat manniit	638	58	0	0	0	0	0	0	0	0	0	0	696 ± 139
Seagull eggs	ᓇᐅᒃᐃᑦ ᓚᓐᓂᖏᑦ	Nauyat manniit	244	88	0	0	0	0	0	0	0	0	0	3	335 ± 137
Black guillemot eggs	ᐱᕐᐅᓪᓴᑦ ᓚᓐᓂᖏᑦ	Black guillemot eggs	0	16	0	0	0	0	0	0	0	0	0	0	16 ± 13
Eider down∅	ᒥᑎᑦ ᑭᓂᖅᖏᑦ∅	Mitiit qiviungit∅	360	233	0	0	0	0	0	0	0	0	0	0	593 ± 407
Fish (unspecified)	ᐃᖃᓗᐃᑦ	Ikaluit	0	0	0	0	0	0	0	0	0	0	0	66	66 ± 13
Arctic char	ᐃᖃᓗᒃᑕᑦ	Ikaliviit	17,824	23,534	33,539	17,249	20,331	11,991	9,063	14,597	8,989	8,318	16,034	15,735	197,204 ± 6,816
Lake trout	ᐃᓱᒋᐃᑦ	Ikalukpik	7,792	2,967	1,743	1,275	1,757	771	500	134	431	640	1,907	3,773	23,690 ± 3,246
Northern pike	ᓱᓚᔪᓂᑦ	Hiulik	0	0	0	4	3	0	0	0	0	0	0	1	8 ± 4
Arctic grayling	ᓭᓕᒃᑕᐅᓚᐃᑦ	Hulupaugaq	26	414	182	276	193	0	0	0	0	0	0	6	1,097 ± 486
Whitefish	ᑲᐱᓱᓂᑦ	Kapihiliit	196	1,316	277	322	7,123	6,521	636	37	71	48	137	147	16,831 ± 1,910
Burbot	ᑎᒃᑯᓂᑦ	Tiktaaliq	0	0	0	0	18	1	6	0	0	1	0	0	26 ± 15
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᐱᓱᓂᑦ	Kapihilik	373	158	66	17	54	0	0	0	0	0	0	1	669 ± 40
Least cisco	ᒥᑭᓕᖅᑦ ᑲᐱᓱᓂᑦ	Eetuuk	0	0	0	0	0	0	0	0	1	0	0	0	1 ± 1
Inconnu	ᑲᐱᓱᓂᑦᐸᐃᑦ	Aanakhiik	1	0	0	0	0	0	0	0	0	0	0	0	1 ± 0
Cod	ᐅᒪᐃᑦ	Ugak	368	86	136	76	461	2,160	718	472	479	1,284	365	382	6,987 ± 824
Sculpin	ᑲᓇᐋᐃᑦ	Kanayuk	1,349	4,236	552	254	46	125	16	0	173	20	32	54	6,857 ± 1,432
Turbot	ᖃᓂᕆᓂᑦ	Nataarnak	1	0	0	0	0	0	0	0	583	1,270	1,247	1,268	4,369 ± 1,726
Clams	ᐊᒻᒧᒪᐋᑦ	Uviluq	982	7,254	15,298	5,349	1,801	7,612	0	0	0	2	0	0	38,298 ± 4,455
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet	0	0	0	0	0	345	0	0	0	186	307	0	838 ± 500

† No data collected in Cape Dorset and Iqaluit.
†† No data collected in Rankin Inlet.
‡ Polar bear data supplied by DSD.
∅ Number of nests harvested.

† ᓇᓴᐋᖅᑲᒪᔨᖏᑦᑐᖅ ᑭᖑᓂᓕ ᐊᒻᒪᓗ ᐃᖅᓗᓂᓕ.
†† ᓇᓴᐋᖅᑲᒪᔨᖏᑦᑐᖅ ᑲᖏᑦᓂᓂᕐᒥᒃ.
‡ ᓇᓂᓕᑦ ᑎᑎᕋᑕᒪᓴᐋᑦ ᑐᓂᔨᖏᑦ ᑲᔪᐊ ᐃᑯᐱᕋᓂᓗᓴᑦ.
∅ ᖃᕋᔨᓂᖏᑦ ᐱᑭᑦ ᓄᐊᑕᒪᓴᐋᑦ.

† Katikhiktauhimaitut Kinnganik Iqaluknilu.
†† Katikhiktauhimaitut Kangikhinikmik.
‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.
∅ Amigaitiginit maniktagauhimajut.

TABLE/ᐅᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 656

Monthly hunter response

Tatkiktaman pijauhimajut angunahuktinun

Year 2 (June 1997 - May 1998)

ᐊᑲᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᕆᔨᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᑲᔪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑐᐱᓂ	NOV ᐅᐊᑲᕐᓂ	DEC ᑎᓯᕐᓂ	JAN ᒎᓐᓄᐊᓂ	FEB ᐃᕐᕿᐊᓂ	MAR ᒪᕐᔪ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᓚᓂᑎᑦ ᑭᐅᓕᕐᕆᔨᒃᑯᑦ ᐊᑐᔪᓚᓕᓕᕐᓂᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᕆᔨᒃ ᐊᖏᓚᓂᑎᑦ	Tatkitaman angunahuktut titigait	4,482	4,513	5,283	4,905	4,897	4,892	4,900	4,896	4,923	5,294	5,286	5,278	5,451*
Interview list	ᐊᐱᕐᓂᖅᓱᐃᑦ	Apikiktan	3,710	3,740	4,243	4,014	4,005	4,000	4,009	4,009	4,029	4,255	4,250	4,241	4,415*
Hunters interviewed	ᐊᖏᓚᓂᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	2,920	2,979	3,432	3,466	3,527	3,487	3,418	3,633	3,628	3,678	3,678	3,646	4,289*
Harvested	ᐊᖏᓚᓂᑎᑐᒃᑯᓗᒃ	Angujaujut	1,143	989	1,344	1,158	1,058	912	730	848	848	904	994	1,437	2,932*
Response Rate (%)	ᑭᐅᔭᓕᕐᕆᔨᒃᑯᑦ (%)	Kiujut (%)	79	80	81	86	88	87	85	91	90	86	87	86	85**

* Hunters registered/on interview list/interviewed/harvested in at least one month of the year.
** Mean monthly response rate (%).

* ᐊᖏᓚᓂᑎᑦ ᐊᑎᓕᐅᔨᒪᔭᑦ/ᐊᐱᕐᓂᖅᓱᐃᓕᒃᑯᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᓚᓂᑎᑐᒃᑯᓗᒃ ᐊᑕᐅᓯᐊᓗᓂ% ᐊᑎᑦᑐᒃ ᐊᑦᔪᒥ.
** ᐊᐅᔨᓪᓕᑎᒋᒪᔭᑦ ᑕᕆᔨᒃ ᑭᐅᔭᑦ (%).

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut (%).

TABLE/ᐅᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 657

Recall period between harvest and interview, expressed as % of total harvest records

Year 2 (June 1997 - May 1998)

ᐅᑎᕐᕕᐅᔭᑦ ᐊᑯᖏᓐᓄᓂᖓᓄᑦ ᐊᓚᒐᓄ ᐊᐱᕐᓂᑦᓂᓄᖓᓄᑦ, ᐅᓗᓇᐃᕐᑦ ᐃᒪᓐ % ᑲᑎᑦᑐᒃ ᐊᖏᓚᓂᑎᑦ ᑎᑎᕐᑦᑕᐅᓕᕐᔭᑦ

ᐊᑲᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᕆᔨᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᑲᔪᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑐᐱᓂ	NOV ᐅᐊᑲᕐᓂ	DEC ᑎᓯᕐᓂ	JAN ᒎᓐᓄᐊᓂ	FEB ᐃᕐᕿᐊᓂ	MAR ᒪᕐᔪ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔭᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	92	89	84	84	89	92	94	85	87	87	85	85	88
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	2	7	9	14	8	6	4	10	8	6	4	9	8
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	6	3	7	2	3	3	2	5	5	7	11	6	5

TABLE/ᐅᓗᓄᐃᕆᐅᑦ/NAUNAIKUTA 658

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᖅᑎᑦ ᐊᖏᔪᓚᐱᖅᓯᒪᔪᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 2 (June 1997 - May 1998)
ᐊᑦᓱᒍ 2 (ᔨᓂ 1997 - ᒪᐃ 1998)
Ukiunga 2 (June 1997 - May 1998)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒍᑎᓂ	SEP ᓯᑎᕐᓚᓪᓗ	OCT ᐅᑦᑐᓚᓪᓗ	NOV ᐅᓇᕐᓚᓪᓗ	DEC ᑎᓯᕐᓚᓪᓗ	JAN ᔮᓐᓄᐊᓪᓗ	FEB ᐃᖅᑲᐊᓪᓗ	MAR ᒪᕐᕿ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑭᐃᐅᑦ	Tuktut	308	335	733	559	440	399	351	442	484	533	505	477	1,852
Musk-ox	ᐅᒥᓴᒪᐃᑦ	Umingmait	3	2	2	2	4	2	1	1	2	1	4	1	23
Moose	ᑐᑭᓯᐅᐃᑦ	Tuktuvait								1			2	1	3
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒃᓪᓚᐃᑦ	Akhait	2										1	1	3
Black bear	ᕿᓐᓂᕐᑦ ᐊᒃᓪᓚᐃᑦ	Kiniktut akhait				1									1
Wolf	ᐊᓕᕐᐃᑦ	Amagut	2		3	1	4	17	17	15	26	38	43	18	131
Arctic fox	ᑎᓗᒃᑑᐊᑦ	Tigiganiat			1	3	18	138	125	98	75	47	23		324
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓗᒃᑑᐊᑦ	Kalaliit tigiganiat			2	2	6	27	14	14	23	8	5		77
Muskrat	ᐊᐱᖅᓱᕐᕕᐊᑦ	Kivgaluk					1								1
Wolverine	ᖃᑲᕙᑦ	Kalvik			1		6	14	7	14	11	9	10	4	51
Arctic hare	ᐅᖃᓪᓚᑦ	Ukalik	13	2	16	46	37	32	15	31	36	47	46	30	258
Arctic ground squirrel	ᓂᕆᓂᑦ	Hikhik		1	6	5							3	7	16
Seals (unspecified)	ᓂᖏᑯᓪᓚᑦ	Natiit	18	8	42	12	4	13	2	1	3	5	7	20	105
Ringed seal	ᓇᕆᓂᑦ	Natiinat	621	435	638	599	482	362	255	363	309	352	353	402	1,639
Bearded seal	ᐅᑦᓴᐃᑦ	Ukyuk	30	68	122	92	60	18	7	19	20	7	9	7	354
Harp seal	ᖃᐃᕈᓪᓚᑦ	Qairulik	6	12	54	86	58	34	9	1	1				197
Harbour seal	ᖃᓂᕈᐊᑦ	Qanigiaq	1		1			2	1		1	1			7
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	1	1	2	10	21	17	4						48
Walrus	ᐊᐃᐸᒃᑦ	Akvik	17	76	18	31	24	13	5	3	13	12	5	13	164
Narwhal	ᑐᒻᓪᓚᑦ ᕈᓪᓕᓂᑦ	Tuugaak	14	56	37	16	4	1					1	4	111
Beluga	ᖃᓄᖅᑕᑦ ᕈᓪᓕᓂᑦ	Kilalugak	11	45	79	31	18	4					1	10	169
Geese (unspecified)	ᓂᖅᓪᓚᑦ	Kanguk	9	2	1	2								23	34
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	189	47	96	59	2						3	202	490
Canada goose	ᓂᖅᓪᓚᑦ ᐅᓕᐊᔪᖅᓪᓚᑦ	Nikliknik	89	24	23	36	3						22	274	388
Ross's goose	ᖃᑲᖅᓴᐃᑦ	Kakat	1			1								4	5
Brant goose	ᓂᖅᓪᓂᓴᐃᑦ	Nirlirnaq	7		1	6	1							1	14
White-fronted goose	ᓂᖅᓪᓚᑦ	Nirlivik	3	1	1		1							9	15
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	6	1											7
Old squaw	ᐊᑭᐊᖅᓴᐃᑦ	Aahangik	3	1	1	1	5	3		2	3				18
Pintail	ᖃᓚᒧᐊᓴᓪᓚᑦ	Arnaviaq		1											1
Mallard	ᒥᑎᓪᓚᑦ	Mitik												1	1
Eider duck	ᒥᑎᑦ	Kingalik	126	49	50	74	100	60	14	13	11	5	14	34	364

6.4

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Species	Month/ᑕᖅᑳᒪ/Tatkia	Umajuin	JUN ᔪᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒡᓗᑎ	SEP ᓯᑎᕕᓇ	OCT ᐅᑐᕕᓇ	NOV ᓄᐃᒡᕕᓇ	DEC ᑎᓯᒡᕕᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᐃᖃᐅᐊᓇ	MAR ᒪᑉ	APR ᐃᑦᓀᓗ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin
Tundra swan	ᖃᓄᔪᐃᑦ	Kukyuk	1			1								4	6
Common merganser	ᐸᐃᑦ	Nuyaralik			12	3	5								17
Red breasted merganser	ᑲᓕᖏᑐᑦ	Red breasted merganser			1										1
Scaup (unspecified)	ᒥᑎᑦ ᐊᐃᑦᐸᖏᑦ	Scaup		1											1
Black scoter	ᐱᑦᓂᐅᓪᓚᑦ	Black scoter			1	2									3
Common loon	ᑐᓴᓗᔪᐊᑦ	Tuulik	2	1	1	3									7
Arctic loon	ᖃᓗᓗᓂᓴ	Maliriq				1	1								2
Red-throated loon	ᖁᖏᓴᐅᑦ	Qaqhuaq	4	1	4	2									10
Yellow-billed loon	ᑐᓴᓗᔪᐊᑦ	Tuulik		4		1								1	6
Black guillemot	ᐱᑦᓂᐅᓪᓚᑦ	Black guillemot	1	2		4						1			8
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre	16	1	2	2	7	3				1	6	4	38
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	37	5	9	75	110	133	133	123	127	139	191	215	708
Sandhill crane	ᑕᑎᓴᔪᐊᑦ	Tatilgaq	2											2	4
Snowy owl	ᐅᓴᓗᔪᐊᑦ	Ookpik								2					2
Eggs (unspecified)	ᓚᓐᓂᑦ	Manniit		3											3
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᓐᓂᖏᑦ	Uluaguliit manniit	108	6										32	145
Duck eggs	ᒥᑎᑦ ᓚᓐᓂᖏᑦ	Tinmiat manniit	56	26	1									1	79
Tundra swan eggs	ᖃᓄᔪᐃᑦ ᓚᓐᓂᖏᑦ	Kukyut manniit	1												1
Arctic tern eggs	ᐃᒥᖏᑯᒪᓪᓚᑦ ᓚᓐᓂᖏᑦ	Emitkutailat manniit	25	4											29
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᓐᓂᖏᑦ	Nauyat manniit	18	6										1	25
Black guillemot eggs	ᐱᑦᓂᐅᓪᓚᑦ ᓚᓐᓂᖏᑦ	Black guillemot eggs		2											2
Eider down	ᒥᑎᑦ ᖃᓂᔪᖏᑦ	Mitiit qiviungit	4	2											6
Fish (unspecified)	ᐃᖏᓗᐃᑦ	Ikaluit												15	15
Arctic char	ᐃᖏᓗᓚᐸᑦ	Ikaliviit	434	409	472	220	258	162	111	82	70	106	183	513	1,576
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	153	55	38	36	77	42	24	11	30	34	97	275	541
Northern pike	ᓯᓚᔨᓪᓕ	Hiulik				1	1							1	3
Arctic grayling	ᓗᓗᓵᐸᐅᓚᐃᑦ	Hulupaugaq	1	6	5	8	3							2	20
Whitefish	ᑲᐱᓗᓂᓴ	Kapihiliit	5	13	11	13	52	41	10	3	3	4	3	4	113
Burbot	ᑎᓵᔨᓴ	Tiktaaliq					4	1	1			1			7
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᐱᓗᓂᓴ	Kapihilik	24	4	4	2	2							1	32
Least cisco	ᒥᑭᓂᖅᑐ ᑲᐱᓗᓂᓴ	Eetuuk									1				1
Inconnu	ᑲᐱᓗᓪᖅᐸᐃᑦ	Aanakhiik	1												1
Cod	ᐅᒪᐃᑦ	Ugak	18	1	11	7	23	26	14	24	14	19	6	13	118
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	28	14	13	6	6	7	3		2	2	4	8	70
Turbot	ᖁᓕᕋᓂᓴ	Nataarnak	1								1	4	3	2	9
Clams	ᐊᓚᒧᒪᔪᑦ	Uviluq	6	10	63	29	12	10				1			109
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet						1				1	1		2

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᒪᔪᓂᒃ ᐱᑕᖃᖏᑕᐃᖅ ᐱᒃᔪᑎᓕᓵᓂᒃ ᐊᖏᔪᑦ ᖃᕋᓴᐅᓂᖏᓐᓄᑦ ᐊᓕᕐᓂᔪᓂᒃ ᑐᓴᐅᒪᔪᓐᓇᑦ ᐊᑐᖏᓪᓗᑎᒃ ᐃᓕᓴᕐᓂᓗᓂᒃ ᐃᓚᖃᑎᒌᖏᓐᓄᑦ ᐃᓕᓴᕐᓂᓗᓂᒃ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᐅᓗᓄᐃᕆᐅᑦ/NAUNAIKUTA 659

Monthly harvest estimates
ᑕᖅᑕᒪᑦ ᐊᖏᔪᓄᑦ ᓄᓕᐅᑦᓴᓇᔨᑦ
Tatkiktamat nahaktauvaktun

Year 3 (June 1998 - May 1999)
ᐊᒃᑭᒍ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)
Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᓂ/Tatkia			JUN ᔮᓂ	JUL ᔭᓪᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑦᔪᕕᓂ	NOV ᐅᓄᓚᕕᓂ	DEC ᑎᓯᓚᕕᓂ	JAN ᔮᖏᓄᓂ	FEB ᐃᖅᑲᐊᓂ	MAR ᒪᓯ	APR ᐃᑦᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᖅ Tamakiklugin ± 95% CI
Species	ᐅᒪᓕᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	868	1,386	2,877	2,821	1,838	1,643	1,555	2,688	2,820	2,522	2,942	1,987	25,947 ± 678
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait	1	7	7	0	9	10	8	0	6	19	10	8	85 ± 19
Moose	ᑐᑐᓀᐃᑦ	Tuktuvait	0	0	0	0	0	0	0	0	0	1	1	0	2 ± 1
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	0	0	9	6	24	64	24	20	30	83	37	14	311
Tundra grizzly	ᐊᖏᓪᐃᑦ	Akhait	0	3	0	0	0	0	0	0	0	0	0	1	4 ± 2
Black bear	ᕿᓐᓂᖅᑕ ᐊᖏᓪᐃᑦ	Kiniktut akhait	0	0	0	0	0	0	0	0	0	0	1	0	1 ± 1
Wolf	ᐊᒪᕐᐃᑦ	Amagut	1	0	0	7	14	42	61	105	153	347	321	35	1,086 ± 212
Arctic fox	ᑎᓗᒃᓂᐊᑦ	Tigiganiat	0	0	0	3	4	344	553	655	285	407	107	3	2,361 ± 471
Coloured fox	ᖃᐅᓐᖓᑦ ᑎᓗᒃᓂᐊᑦ	Kalaliit tigiganiat	0	0	0	1	10	9	32	22	58	26	3	0	161 ± 17
Wolverine	ᖃᓴᒃᑦ	Kalvik	0	0	0	1	0	10	7	16	39	52	29	4	158 ± 24
Arctic hare	ᐅᖃᓕᑦ	Ukalik	13	1	26	134	65	33	39	47	93	125	133	84	793 ± 65
Arctic ground squirrel	ᓱᖅᓯᑦ	Hikhik	0	116	170	45	4	1	0	0	0	1	42	139	518 ± 293
Seals (unspecified)	ᓯᖏᑯᓕᑦ	Natiit	71	39	163	57	68	19	10	0	2	4	0	1	434 ± 112
Ringed seal	ᓇᓯᓗᑦ	Natiinat	5,155	2,311	2,820	2,178	2,149	1,947	1,557	1,457	1,164	1,073	1,350	1,611	24,772 ± 468
Bearded seal	ᐅᑦᕿᐃᑦ	Ukyuk	68	121	188	119	80	37	10	43	42	13	22	21	764 ± 45
Harp seal	ᖃᐃᓱᓕᑦ	Qairulik	6	20	99	121	93	44	17	2	0	0	0	10	412 ± 28
Harbour seal	ᖃᓯᑭᐊᑦ	Qanigiaq	0	2	1	1	1	0	0	0	0	1	0	0	6 ± 2
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	0	2	1	0	2	0	1	0	0	0	0	1	7 ± 2
Walrus	ᐊᐃᐅᓴᑦ	Akvik	19	131	49	47	40	7	6	5	13	20	7	12	356 ± 26
Narwhal	ᑐᒍᓕᑦ ᖁᓕᓗᑦ	Tuugaak	12	55	132	30	33	2	0	0	0	0	0	13	277 ± 16
Beluga	ᖃᐅᓂᑦ ᖁᓕᓗᑦ	Kilalugak	37	160	207	157	34	14	0	0	0	0	0	21	630 ± 69
Bowhead	ᐊᑦᖃᖅ	Aivik	0	1	0	0	0	0	0	0	0	0	0	0	1 ± 1
Geese (unspecified)	ᓂᑦᓕᑦ	Kanguk	177	0	0	0	0	0	0	0	0	0	63	817	1,057 ± 594
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	7,103	152	239	233	92	0	0	0	0	0	87	4,376	12,282 ± 1,526
Canada goose	ᓂᑦᓕᑦ ᐅᓗᐊᔪᑦᓕᑦ	Nikliknik	709	529	153	216	31	0	0	0	0	0	162	3,361	5,161 ± 504
Ross's goose	ᖃᑲᑦᔾᐃᑦ	Kakat	0	0	0	0	0	0	0	0	0	0	0	12	12 ± 12
Brant goose	ᓂᑦᓂᓪᓇᐃᑦ	Nirlirnaq	24	0	0	27	19	0	0	0	0	0	0	13	83 ± 29
White-fronted goose	ᓂᑦᓕᑦ	Nirlivik	4	0	8	0	0	0	0	0	0	0	0	112	124 ± 82
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	38	0	0	0	0	0	0	0	0	0	0	0	38 ± 31
Old squaw	ᐊᑭᐊᑦᔾᐃᑦ	Aahangik	22	1	0	0	39	28	1	5	0	26	0	3	125 ± 25
Pintail	ᖃᓗᒧᐊᔾᔨᑦ	Arnaviaq	2	0	0	0	0	0	0	0	0	0	0	0	2 ± 1
Eider duck	ᒥᑎᑦ	Kingalik	1,024	422	299	423	1,065	1,690	591	163	186	122	88	191	6,264 ± 237
Tundra swan	ᖃᓗᔾᐃᑦ	Kukyuk	9	0	6	1	0	0	0	0	0	0	0	125	141 ± 162

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Species	ᐅᒪᓴᑦ	Umajuin	JUN ᔪᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒡᒍᑎ	SEP ᓯᑎᐱᕆ	OCT ᐅᑦᔨᕆ	NOV ᓄᐱᒡᕆ	DEC ᑎᓯᒡᕆ	JAN ᔮᓐᓄᐊᕆ	FEB ᐃᖅᑲᐊᕆ	MAR ᒪᓯ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓯᑦ Tamakiklugin ± 95% CI
Common merganser	ᐸᐃᑦ	Nuyaralik	2	21	0	11	10	19	0	0	0	0	0	1	64 ± 9
Red breasted merganser	ᖃᔅᓕᖅᑐᑦ	Red breasted merganser	1	14	1	0	0	0	0	0	0	0	0	0	16 ± 6
Black scoter	ᐱᓯᐅᓪᓚᑦᑐᑦ	Black scoter	0	7	0	5	0	0	0	0	0	0	0	0	12 ± 4
White-winged scoter	ᖃᓄᖅᑕᓪᓗ ᐃᓚᖏᐊ ᐱᓯᐅᓪᓚᑦᑐᑦ	White-winged scoter	2	0	0	4	3	0	0	0	0	0	0	0	9 ± 4
Loon (unspecified)	ᑐᓴᓪᓕᑦ	Maligik	0	0	2	0	0	0	0	0	0	0	0	0	2 ± 1
Arctic loon	ᑲᑎᓗᓪᓕᑦ	Maliriq	8	1	1	0	0	0	0	0	0	0	0	0	10 ± 2
Red-throated loon	ᖃᖓᓚᐅᑦ	Qaqhuaq	3	12	3	0	0	0	0	0	0	0	0	0	18 ± 8
Yellow-billed loon	ᑐᓴᓕᓴᐃᐊᑦ	Tuulik	0	1	0	0	0	0	0	0	0	0	0	0	1 ± 1
Black guillemot	ᐱᓯᐅᓪᓚᑦ	Black guillemot	0	0	1	11	5	1	0	6	0	1	2	0	27 ± 1
Thick-billed murre	ᐊᑦᑕᐃᑦ	Thick-billed murre	68	33	0	0	5	0	0	0	0	18	16	0	140 ± 18
Ptarmigan	ᐊᒻᒪᓗᑦ	Akilgik	189	10	30	498	395	1,075	1,211	1,516	1,808	1,408	2,980	5,315	16,435 ± 1,018
Sandhill crane	ᑕᑎᓚᖅᓴᐊᑦ	Tatilgaq	1	0	0	0	0	0	0	0	0	0	0	2	3 ± 1
Eggs (unspecified)	ᓚᐅᓂᑦ	Manniit	208	0	0	0	0	0	0	0	0	0	0	7	215 ± 9
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᐅᓂᖏᑦ	Uluaguliit manniit	12,413	260	0	0	0	0	0	0	0	0	8	6,068	18,749 ± 3,141
Duck eggs	ᒥᑎᑦ ᓚᐅᓂᖏᑦ	Tinmiat manniit	3,100	1,890	425	0	0	0	0	0	0	0	15	0	5,430 ± 450
Arctic tern eggs	ᐃᒥᖃᑯᓚᐃᓪᓚᑦ ᓚᐅᓂᖏᑦ	Emitkutailat manniit	22	296	15	0	0	0	0	0	0	0	0	0	333 ± 112
Seagull eggs	ᓇᐅᓴᐃᑦ ᓚᐅᓂᖏᑦ	Nauyat manniit	321	298	0	0	0	0	0	0	0	0	0	13	632 ± 170
Thick-billed murre eggs	ᐊᑦᑕᐃᑦ ᓚᐅᓂᖏᑦ	Thick-billed murre eggs	264	35	0	0	0	0	0	0	0	0	0	0	299 ± 157
Black guillemot eggs	ᐱᓯᐅᓪᓚᑦ ᓚᐅᓂᖏᑦ	Black guillemot eggs	0	643	0	0	0	0	0	0	0	0	0	0	643 ± 333
Eider down[Ø]	ᒥᑎᑦ ᖃᓄᖅᓂᖏᑦ[Ø]	Mitiit qiviungit[Ø]	52	0	0	0	0	0	0	0	0	0	0	0	52 ± 68
Fish (unspecified)	ᐃᖃᓗᐃᑦ	Ikaluit	4	0	0	0	0	0	0	0	0	0	0	0	4 ± 2
Arctic char	ᐃᖃᓗᓴᐱᑦ	Ikaliviit	18,730	27,545	18,059	6,040	13,681	22,489	11,670	13,550	7,382	9,509	17,088	16,433	182,176 ± 6,373
Lake trout	ᐃᓕᓴᐃᑦ	Ikalukpik	2,325	1,155	127	909	1,011	1,174	328	175	604	1,059	2,358	3,196	14,421 ± 1,323
Northern pike	ᓱᓗᒍᓪᓕᑦ	Hiulik	0	0	0	0	10	3	0	0	0	0	0	0	13 ± 8
Arctic grayling	ᓭᓗᓴᐅᓚᐃᑦ	Hulupaugaq	51	17	139	45	339	140	0	0	0	0	10	13	754 ± 312
Whitefish	ᑲᕕᓕᓪᓕᑦ	Kapihiliit	109	211	379	240	2,022	3,496	965	626	808	6	7	39	8,908 ± 1,810
Burbot	ᑎᑦᑕᓪᓕᑦ	Tiktaaliq	1	0	0	0	0	0	0	0	0	6	0	0	7 ± 4
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᕕᓕᓪᓕᑦ	Kapihilik	9	0	0	0	40	0	0	0	0	0	0	0	49 ± 7
Least cisco	ᒥᑭᓂᖅᑦ ᑲᕕᓕᓪᓕᑦ	Eetuuk	0	0	0	0	0	47	0	0	0	0	0	0	47 ± 36
Cod	ᐅᒪᐃᑦ	Ugak	392	218	118	75	168	921	479	181	164	48	512	827	4,103 ± 379
Sculpin	ᑲᓇᕆᐃᑦ	Kanayuk	1,200	246	231	281	26	212	1	2	0	10	25	172	2,406 ± 212
Turbot	ᖃᓕᖏᓪᓕᑦ	Nataarnak	0	0	0	0	0	0	0	0	46	2,200	0	0	2,246 ± 972
Clams	ᐊᒃᒧᒪᕆᑦ	Uviluq	943	5,737	9,409	7,748	4,184	11,429	943	0	0	129	0	0	40,522 ± 4,418
Mussels	ᐅᕕᓗᐃᑦ	Uviluvaloet	54	1,632	3,276	65	0	2,547	100	14,141	22,619	2,958	11,044	174	58,610 ± 7,738

‡ Polar bear data supplied by DSD.
Ø Number of nests harvested.

‡ ᓇᓂᑦᓂᑦ ᑎᑎᕋᐅᒪᓕᖅᑐᑦ ᑐᓂᔨᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕕᓂᓂᒃᑕᑦ.
Ø ᖃᕋᐅᓂᖏᑦ ᐱᕈᐅᑦ ᓄᐊᑕᐅᕆᓪᓕᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.
Ø Amigaitiginit maniktagauhimajut.

TABLE/ᐊᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 660

Monthly hunter response

ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓕᓴᒃᑎᑦ ᑭᐅᓂᖏᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 3 (June 1998 - May 1999)

ᐊᒃᓱᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃᑐᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒃᔪᑎ	SEP ᓱᑎᒃᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᐃᖅᐳᐊᓗ	MAR ᒪᑦᓯ	APR ᐃᑦᓀᓪᓚ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᓴᒃᑎᑦ ᑭᐅᓂᖏᑦ ᐋᑦᔪᓯᒪᓂᖏᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑕᒪᒃᑦ ᐊᖏᔪᓕᓴᒃᑎᑦ	Tatkitaman angunahuktut titigait	5,281	5,280	5,284	5,271	5,278	5,274	5,271	5,264	5,274	5,255	5,259	5,290	5,468*
Interview list	ᐊᐱᕐᓂᖅᓯᒪᔭᑦ	Apikiktan	4,242	4,244	4,246	4,234	4,239	4,233	4,230	4,332	4,343	4,323	4,328	4,361	4,542*
Hunters interviewed	ᐊᖏᔪᓕᓴᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	3,513	3,491	3,494	3,428	3,552	3,843	3,606	3,782	3,787	3,684	3,664	3,487	4,342*
Harvested	ᐊᖏᔪᓕᓴᒃᑐᓂᓕᓂ	Angujaujut	1,393	1,086	1,112	991	869	937	750	879	909	888	1,080	1,342	2,903*
Response Rate (%)	ᕈᐅᑦ ᖃᑦᑕᓂᖏᑦ (%)	Kiujut (%)	83	82	82	81	84	91	85	87	87	85	85	80	84**

* Hunters registered/on interview list/interviewed/harvested in at least one month of the year.
** Mean monthly response rate (%).

* ᐊᖏᔪᓕᓴᒃᑎᑦ ᐊᑎᓕᐅᔾᔨᓪᓚᑦ/ᐊᐱᕐᓂᖅᓯᒪᔭᑦᑐᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓕᓴᒃᑐᓂᓕᓂ ᐊᑕᐅᓂᐊᓗᓂ ᐊᑎᑎᒥ ᐊᓱᒍᒥ.
** ᐊᐅᑎᓂᓕᑎᓪᓚᑦ ᑕᖅᑕᒪᒃᑦ ᕈᐅᑦ (%).

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut (%).

TABLE/ᐊᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 661

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᑦ ᐋᑯᕐᓂᓄ ᐊᖏᔪᓕᓴᒃᑐᓂᖓᑕ ᐊᓚᓗ ᐊᐱᕐᓂᑦᑕᐅᓄᖓᑕ, ᐊᓗᓇᐃᕐᑕ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓕᓴᒃᑎᑦ ᑎᑎᕐᓂᑦᑕᐅᒪᔭᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 3 (June 1998 - May 1999)

ᐊᒃᓱᒍ 3 (ᔨᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᒃᑐᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᒃᔪᑎ	SEP ᓱᑎᒃᐱᓗ	OCT ᐅᑐᐱᓗ	NOV ᐅᓇᒃᐱᓗ	DEC ᑎᓯᒃᐱᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᐃᖅᐳᐊᓗ	MAR ᒪᑦᓯ	APR ᐃᑦᓀᓪᓚ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑐᑦ	≤ tatkin pingahut	79	75	84	83	87	96	96	89	90	90	83	85	86
4-6 months	4-6 ᑕᖅᑐᑦ	tatkin hitaman 6nut	13	19	14	13	13	4	4	7	7	4	11	9	10
> 6 months	> 6 ᑕᖅᑐᑦ	> 6 tatkin	8	6	3	4	1	0	0	4	3	6	6	6	4

TABLE/ᓇᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 662

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᖅᑎᑦ ᐊᖏᔪᓚᐱᖅᓯᒋᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 3 (June 1998 - May 1999)

ᐊᒃᑭᒍ 3 (ᔮᓂ 1998 - ᒪᐃ 1999)

Ukiunga 3 (June 1998 - May 1999)

Month/ᑕᖅᖏᓐᖓ/Tatkia			JUN ᔮᓂ	JUL ᔭᓪᐃ	AUG ᐊᐅᓚᑦᑎ	SEP ᓯᑎᕐᕕᓐ	OCT ᐅᑦᑐᕕᓐ	NOV ᐅᐊᓚᕕᓐ	DEC ᑎᓯᕕᓐ	JAN ᒍᓐᓇᐊᓐ	FEB ᐃᖅᑲᐊᓐ	MAR ᒪᓯ	APR ᐃᑦᓇᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	265	361	575	536	308	360	348	542	574	533	584	483	1,801
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait	1	2	4		6	6	4		4	11	8	5	45
Moose	ᑐᑦᑐᓀᐃᑦ	Tuktuvait										1	1		2
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒃᓪᓚᐃᑦ	Akhait		2										1	3
Black bear	ᕿᓐᓂᕐᑦ ᐊᒃᓪᓚᐃᑦ	Kiniktut akhait											1		1
Wolf	ᐊᒪᕐᐃᑦ	Amagut	1			3	5	13	16	32	48	77	57	19	175
Arctic fox	ᑎᓗᒃᑑᓂᐊᑦ	Tigiganiat				1	3	42	42	52	53	45	18	3	165
Coloured fox	ᖃᐅᓐᖓᑦᑐᑦ ᑎᓗᒃᑑᓂᐊᑦ	Kalaliit tigiganiat				1	4	6	13	11	21	18	2		51
Wolverine	ᖃᓄᐃᑦ	Kalvik				1		4	7	8	15	24	16	3	57
Arctic hare	ᐅᖃᓕᑦ	Ukalik	8	1	20	62	31	24	10	29	48	55	53	38	281
Arctic ground squirrel	ᓱᕐᓱᑦ	Hikhik		1	6	4	1	1				1	6	6	21
Seals (unspecified)	ᓱᖏᑯᓕᑦ	Natiit	25	7	14	18	10	6	4		2	3		1	73
Ringed seal	ᓇᓱᑦ	Natiinat	762	518	566	471	436	391	320	359	289	271	298	362	1,556
Bearded seal	ᐅᑉᐊᐃᑦ	Ukyuk	41	81	115	66	52	27	8	24	20	12	5	15	338
Harp seal	ᖃᐃᕐᓕᑦ	Qairulik	2	15	59	53	49	18	5	2				2	164
Harbour seal	ᖃᓯᑎᐊᑦ	Qanigiaq		1	1	1	1					1			5
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit		2	1		2		1					1	6
Walrus	ᐊᐃᐅᓵᑦ	Akvik	15	69	26	15	22	6	5	4	9	13	5	9	151
Narwhal	ᑐᓚᓕᑦ ᖁᓪᓗᓚᑦ	Tuugaak	9	35	54	24	21	2						8	137
Beluga	ᖃᐃᕐᑦ ᖁᓪᓗᓚᑦ	Kilalugak	22	67	57	54	12	8						14	194
Bowhead	ᐊᖏᕕᒃ	Aivik		1											1
Geese (unspecified)	ᓄᖏᓕᑦ	Kanguk	6										2	11	19
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	240	28	46	40	10						4	186	456
Canada goose	ᓄᖏᓕᑦ ᐅᓗᐊᔪᖏᓕᑦ	Nikliknik	105	34	24	28	5						35	217	334
Ross's goose	ᖃᑲᖏᔾᔪᐃᑦ	Kakat												2	2
Brant goose	ᓄᖏᓕᖏᓇᐃᑦ	Nirlirnaq	3			4	1							3	11
White-fronted goose	ᓄᖏᓕᑦ	Nirlivik	2		1									7	10
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	4												4
Old squaw	ᐊᑭᐊᖏᔾᔪᐃᑦ	Aahangik	2	1			6	7	1	2		3		1	22
Pintail	ᖏᓗᒧᐊᑦᔪᑦ	Arnaviaq	2												2
Eider duck	ᒥᑎᑦ	Kingalik	124	65	37	51	88	80	30	17	14	15	11	28	339

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Species	ᐅᒪᔪᑦ	Umajuin	JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᕕᓐ	OCT ᐅᑦᔪᕕᓐ	NOV ᐅᓂᒡᕕᓐ	DEC ᑎᓯᕕᓐ	JAN ᒎᓐᓄᐊᓐ	FEB ᐃᕐᖁᐊᓐ	MAR ᒪᕐᔪ	APR ᐃᑦᓗᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Tundra swan	ᖁᓚᔪᐃᑦ	Kukyuk	4		1	1								9	13
Common merganser	ᓴᐃᑦ	Nuyaralik	1	5		3	3	5						1	16
Red breasted merganser	ᖃᒃᓕᖏᑎᑦ	Red breasted merganser	1	1	1										2
Black scoter	ᐱᑦᓭᐅᓪᓗᑦ	Black scoter		2		1									3
White-winged scoter	ᖃᓄᖅᑕᓪᓕ ᐃᓕᓴᐊ ᐱᑦᓭᐅᓪᓗᑦ	White-winged scoter	1			1	1								3
Loon (unspecified)	ᑎᒃᓪᓕ	Maligik			1										1
Arctic loon	ᑲᒡᓗᓪᓕ	Maliriq	2	1	1										4
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq	2	5	2										9
Yellow-billed loon	ᑎᒃᓚᒡᔪᐊᑦ	Tuulik		1											1
Black guillemot	ᐱᑦᓭᐅᓪᓗᑦ	Black guillemot			1	1	5	1		1		1	1		11
Thick-billed murre	ᐊᕐᕌᐃᑦ	Thick-billed murre	10	6			4					4	2		23
Ptarmigan	ᐊᖏᓂᑦ	Akilgik	35	4	9	31	54	121	104	122	166	139	177	198	662
Sandhill crane	ᑕᑎᓘᔪᐊᑦ	Tatilgaq	1											2	3
Eggs (unspecified)	ᓚᐅᓂᑦ	Manniit	3											1	4
Goose eggs	ᑲᖅᐃᐃᑦ ᓚᐅᓐᖏᑦ	Uluaguliit manniit	140	3									3	43	185
Duck eggs	ᒥᑎᑦ ᓚᐅᓐᖏᑦ	Tinmiat manniit	67	38	3								1		103
Arctic tern eggs	ᐃᒥᖏᑯᓕᐃᑦ ᓚᐅᓐᖏᑦ	Emitkutailat manniit	3	6	2										9
Seagull eggs	ᓇᐅᔨᐃᑦ ᓚᐅᓐᖏᑦ	Nauyat manniit	20	5										2	27
Thick-billed murre eggs	ᐊᕐᕌᐃᑦ ᓚᐅᓐᖏᑦ	Thick-billed murre eggs	3	1											4
Black guillemot eggs	ᐱᑦᓭᐅᓪᓗᑦ ᓚᐅᓐᖏᑦ	Black guillemot eggs		4											4
Eider down	ᒥᑎᑦ ᖁᓂᓀᖏᑦ	Mitiit qiviungit	2												2
Fish (unspecified)	ᐃᖅᓗᐃᑦ	Ikaluit	1												1
Arctic char	ᐃᖅᓗᒃᐸᑦ	Ikaliviit	528	509	334	120	194	262	142	111	95	160	309	529	1,625
Lake trout	ᐃᓕᑦᕃᐃᑦ	Ikalukpik	89	34	11	39	39	56	15	9	38	61	109	208	444
Northern pike	ᓱᓗᓪᓕ	Hiulik					1	1							2
Arctic grayling	ᓭᓗᒃᐸᐅᒪᐃᑦ	Hulupaugaq	3	2	4	4	9	2					2	1	21
Whitefish	ᑲᕚᓭᓪᓕ	Kapihiliit	5	6	11	11	19	34	18	7	10	1	2	2	92
Burbot	ᑎᑭᒋᓪᓕ	Tiktaaliq	1									1			2
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᕚᓭᓪᓕ	Kapihilik	1				3								4
Least cisco	ᒥᑭᓂᖏᑦ ᑲᕚᓭᓪᓕ	Eetuuk						1							1
Cod	ᐅᒐᐃᑦ	Ugak	19	10	6	7	12	23	21	11	8	7	14	43	145
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	54	18	9	6	4	11	1	1		3	6	19	109
Turbot	ᖃᓕᕆᓪᓕ	Nataarnak									1	4			4
Clams	ᐊᒃᒍᒪᔪᑦ	Uviluq	11	37	53	45	15	20	3			1			122
Mussels	ᐅᕕᓗᐃᑦ	Uviluvaloet	1	6	8	1		2	1	5	5	4	5	1	31

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᕐᒪᔪᓂᒃ ᐱᑕᖃᖏᑐᖃᓂᒃ ᐱᓱᒋᓕᓐᓂᒃ ᐊᖏᔪᑦ ᖃᕋᓴᐅᓂᖏᓐᓄᑦ ᐊᓕᔪᓄᑦ ᓇᓕᐅᖏᓐᓄᑦ ᑐᓴᕐᖏᓐᓂ ᐃᓕᓴᕐᓂᒃ ᐃᓕᓴᕐᓂᒃ ᐃᓚᖃᕐᓂᑦ ᐊᑐᓕᕐᓂᒃ ᐃᓕᓴᕐᓂᒃ ᐃᓚᖃᕐᓂᑦ ᐃᓚᖃᕐᓂᑦ ᐃᓚᖃᕐᓂᑦ

TABLE/ᐅᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 663

Monthly harvest estimates

ᑕᖅᑕᒫᑦ ᐊᖏᔪᓂᑦ ᐅᓪᓗᐅᑦᓱᓕᑎᑦ

Tatkiktamat nahaktauvaktun

Year 4 (June 1999 - May 2000)

ᐊᓐᖁᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖅᖏᓐᖑᑦ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᓚᑐᑎ	SEP ᓱᑎᑦᐱᓇ	OCT ᐅᑦᑐᐱᓇ	NOV ᓄᐱᓕᐱᓇ	DEC ᑎᓯᓕᐱᓇ	JAN ᔮᖏᓄᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᓯ	APR ᐃᑦᓇᓪᓗ	MAY ᒪᐃ	Total ᑲᑎᒋᑦᑕ Tamakiklugin ± 95% CI
Species	ᐅᒪᔪᑦ	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	966	1,221	3,261	3,186	2,149	1,379	1,120	1,760	1,880	1,670	2,016	2,107	22,715 ± 491
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait	0	0	5	9	4	16	7	5	4	33	12	3	98 ± 22
Moose	ᑐᖅᑐᕈᐃᑦ	Tuktuvait	0	1	0	0	0	0	0	0	1	0	0	0	2 ± 2
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	0	1	7	4	43	88	8	27	19	62	25	19	303
Tundra grizzly	ᐊᑲᓪᐃᑦ	Akhait	0	0	4	0	0	0	0	0	0	1	3	4	12 ± 8
Wolf	ᐊᒪᕐᐃᑦ	Amagut	7	1	2	0	4	29	45	35	37	79	239	58	536 ± 86
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat	3	0	0	3	52	363	403	254	245	331	96	8	1,758 ± 178
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓕᓴᓂᐊᑦ	Kalaliit tigiganiat	0	0	0	0	8	67	50	36	38	6	9	2	216 ± 25
Muskrat	ᐊᐃᖅᓴᓪᓚᐊᑦ	Kivgaluk	3	0	0	1	0	0	0	0	0	0	0	44	48 ± 56
Wolverine	ᖃᓕᕆᑦ	Kalvik	0	0	0	2	1	13	21	16	23	20	29	6	131 ± 16
Arctic hare	ᐅᑲᓕᑦ	Ukalik	23	22	9	142	65	34	31	71	82	146	90	100	815 ± 63
Arctic ground squirrel	ᐲᐸᓕᑦ	Hikhik	0	0	68	373	15	0	0	0	0	0	57	87	600 ± 352
Seals (unspecified)	ᓴᖅᑯᓕᑦ	Natiit	0	0	0	69	48	79	27	10	29	38	50	40	390 ± 30
Ringed seal	ᓇᓴᓕᑦ	Natiinat	4,151	3,021	2,719	2,947	2,898	1,458	992	1,147	1,135	1,188	1,203	1,881	24,740 ± 526
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	30	168	151	168	121	15	10	21	18	17	20	32	771 ± 59
Harp seal	ᖃᐃᕐᓕᑦ	Qairulik	7	13	97	132	75	18	3	4	0	0	0	0	349 ± 54
Harbour seal	ᖃᓂᕈᐊᑦ	Qanigiaq	4	3	8	0	2	0	0	0	0	0	0	0	17 ± 4
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	0	0	0	1	1	0	0	0	0	0	0	0	2 ± 1
Walrus	ᐊᐃᐅᓴᑦ	Akvik	24	141	46	63	69	31	10	10	10	15	5	10	434 ± 23
Narwhal	ᑐᓴᓕᑦ ᕈᓕᓗᑦ	Tuugaak	28	81	227	65	52	0	0	0	2	0	0	6	461 ± 25
Beluga	ᖃᐅᖏᑦ ᕈᓕᓗᑦ	Kilalugak	62	194	414	91	41	28	0	0	0	0	0	8	838 ± 102
Geese (unspecified)	ᓂᖅᓕᑦ	Kanguk	123	0	0	0	0	0	0	0	0	0	0	63	186 ± 72
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	6,828	266	220	69	0	0	0	0	0	0	0	2,599	9,982 ± 1,194
Canada goose	ᓂᖅᓕᑦ ᐅᓗᐊᔪᓕᑦ	Nikliknik	1,864	663	239	143	25	0	0	1	0	0	342	3,297	6,574 ± 654
Ross's goose	ᖃᕆᖅᔪᐃᑦ	Kakat	3	0	0	0	0	0	0	0	0	0	0	1	4 ± 4
Brant goose	ᓂᖅᓂᔭᐃᑦ	Nirlirnaq	12	5	3	6	0	0	0	0	0	0	0	0	26 ± 6
White-fronted goose	ᓂᖅᓕᑦ	Nirlivik	14	0	0	1	0	0	0	0	0	0	0	60	75 ± 38
Old squaw	ᐊᑲᕈᖅᔪᐃᑦ	Aahangik	2	1	1	3	7	2	32	1	3	8	0	14	74 ± 34
Pintail	ᖃᓚᒧᐊᓕᑦ	Arnaviaq	0	0	0	0	0	0	0	0	0	0	0	3	3 ± 4
Eider duck	ᒥᑎᑦ	Kingalik	914	1,029	147	363	885	1,093	569	191	538	235	212	211	6,387 ± 403
Tundra swan	ᖃᓚᔪᐃᑦ	Kukyuk	3	0	1	0	0	1	0	0	0	0	0	32	37 ± 31
Common merganser	ᕿᐃᑦ	Nuyaralik	3	105	32	2	1	0	0	0	0	0	0	4	147 ± 36
Red breasted merganser	ᑲᓕᖅᑐᑦ	Red breasted merganser	0	0	13	0	3	0	0	0	0	0	0	0	16 ± 11

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Month/ᑕᕐᖑᓚ/Tatkia			JUN ᔫᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᕐᐱᓗ	OCT ᐅᑦᐃᓗ	NOV ᓄᐃᓚᐱᓗ	DEC ᑎᓯᐱᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᐃᓕᑲᐊᓗ	MAR ᒪᓕ	APR ᐃᑦᓇᓕ	MAY ᒪᐃ	Total ᑲᑎᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓲᑦ	**Umajuin**													
Greater scaup	ᐊᖏᑭᓂᖅᑕᑎᑦ ᐊᐃᑦᐸᖏᑦ	Greater scaup	1	4	0	0	0	0	0	0	0	0	0	0	5 ± 2
Lesser scaup	ᑕᑭᓂᖅᑕᑎᑦ ᐊᐃᑦᐸᖏᑦ	Lesser scaup	0	0	0	3	0	0	0	0	0	0	0	0	3 ± 2
White-winged scoter	ᖃᐅᔨᑕᓂᒃ-ᐃᓕᓴᐊ ᐱᓕᕆᐅᓪᓚᒃ	White-winged scoter	0	0	0	1	0	0	0	0	0	0	0	0	1 ± 1
Surf scoter	ᓂᐅᔭᑐᑎᒥ ᐱᓕᕆᐅᓪᓚᑦ	Surf scoter	4	27	11	10	0	0	0	0	0	0	0	0	52 ± 17
Loon (unspecified)	ᑐᓴᓂᑦ	Maligik	0	0	0	5	0	0	0	0	0	0	0	0	5 ± 4
Common loon	ᑐᓴᓗᓪᔪᐊᑦ	Tuulik	5	0	0	0	0	0	0	0	0	0	0	0	5 ± 8
Arctic loon	ᖃᓗᓗᓂᑦ	Maliriq	1	0	0	0	13	0	0	0	0	0	0	0	14 ± 13
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq	14	21	2	1	0	0	0	0	0	0	0	0	38 ± 13
Yellow-billed loon	ᑐᓴᓗᓪᔪᐊᑦ	Tuulik	2	0	0	10	0	0	0	0	0	0	0	0	12 ± 8
Black guillemot	ᐱᓕᕆᐅᓂᑦ	Black guillemot	0	6	5	8	2	0	0	1	0	2	0	18	42 ± 22
Thick-billed murre	ᐊᑦᐸᐃᑦ	Thick-billed murre	15	8	12	18	18	0	0	20	6	27	172	32	328 ± 78
Ptarmigan	ᐊᖏᓱᑦ	Akilgik	500	13	6	222	631	773	516	685	930	1,108	1,334	2,867	9,585 ± 445
Sandhill crane	ᑕᑎᓴᒃᔪᐊᑦ	Tatilgaq	1	0	0	3	0	0	0	0	0	0	0	12	16 ± 7
Eggs (unspecified)	ᓚᖏᓂᑦ	Manniit	1,523	350	0	0	0	0	0	0	0	0	0	207	2,080 ± 1,778
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᖏᖅᑭᑦ	Uluaguliit manniit	9,700	829	327	0	0	0	0	0	0	0	0	262	11,118 ± 1,988
Duck eggs	ᑎᑎᑦ ᓚᖏᖅᑭᑦ	Tinmiat manniit	5,304	6,365	0	0	0	0	0	0	0	0	0	0	11,669 ± 4,166
Tundra swan eggs	ᖁᓕᔪᐃᑦ ᓚᖏᖅᑭᑦ	Kukyut manniit	0	0	0	0	0	0	0	0	0	0	0	3	3 ± 2
Arctic tern eggs	ᐃᒥᖕᓂᑕᓚᓂᑦ ᓚᖏᖅᑭᑦ	Emitkutailat manniit	31	835	0	0	0	0	0	0	0	0	0	0	866 ± 107
Seagull eggs	ᓇᐅᒃᐃᑦ ᓚᖏᖅᑭᑦ	Nauyat manniit	160	32	0	0	0	0	0	0	0	0	0	13	205 ± 36
Thick-billed murre eggs	ᐊᑦᐸᐃᑦ ᓚᖏᖅᑭᑦ	Thick-billed murre eggs	1,856	8,221	0	0	0	0	0	0	0	0	0	0	10,077 ± 599
Black guillemot eggs	ᐱᓕᕆᐅᓂᑦ ᓚᖏᖅᑭᑦ	Black guillemot eggs	25	56	0	0	0	0	0	0	0	0	0	0	81 ± 45
Eider down[Ø]	ᑎᑎᑦ ᖁᓂᓴᖅᑭᑦ[Ø]	Mitiit qiviungit[Ø]	56	542	0	0	0	0	0	0	0	0	0	0	598 ± 329
Arctic char	ᐃᖃᓗᒃᐲᑦ	Ikaliviit	23,510	28,583	28,615	15,021	28,004	20,830	13,060	5,493	10,293	9,831	10,670	17,359	211,269 ± 6,525
Lake trout	ᐃᓱᒋᐊᑦ	Ikalukpik	4,374	4,232	1,137	1,074	2,652	3,040	701	969	683	1,343	2,420	5,167	27,792 ± 2,976
Northern pike	ᓱᓴᓂᑦ	Hiulik	3	0	0	1	0	0	0	0	3	0	0	0	7 ± 7
Arctic grayling	ᓗᓗᒃᑕᐅᓚᐃᑦ	Hulupaugaq	9	61	178	72	59	47	0	0	3	0	0	20	449 ± 178
Whitefish	ᑲᐱᓗᓂᑦ	Kapihiliit	61	234	270	782	3,707	2,279	615	87	9	8	3	0	8,055 ± 1,595
Burbot	ᑎᒃᑕᓂᑦ	Tiktaaliq	0	0	1	0	0	0	0	0	0	0	0	25	26 ± 36
Arctic cisco	ᐅᑭᐅᑦᑕᑐᒥ ᑲᐱᓗᓂᑦ	Kapihilik	0	0	0	0	3	3	0	0	0	0	0	0	6 ± 5
Least cisco	ᑕᑭᓂᖅᑕᑎᑦ ᑲᐱᓗᓂᑦ	Eetuuk	0	0	0	3	0	0	0	0	0	0	0	0	3 ± 2
Inconnu	ᑲᐱᓗᓂᑦᐸᐃᑦ	Aanakhiik	0	0	264	0	0	0	0	0	0	0	0	0	264 ± 260
Cod	ᐅᒪᐃᑦ	Ugak	353	1,265	133	198	943	1,047	147	94	308	233	1,248	1,794	7,763 ± 1,100
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	217	789	440	138	11	0	15	0	3	29	57	96	1,795 ± 185
Turbot	ᖃᓕᕆᓂᑦ	Nataarnak	0	0	0	0	0	0	0	0	128	7,738	4,484	0	12,350 ± 5,245
Clams	ᐋᓚᒧᒪᔪᑦ	Uviluq	476	9,099	13,555	24,980	20,362	26,185	20,526	0	0	15,500	0	17	130,700 ± 50,920
Mussels	ᐅᕕᓗᐃᑦ	Uviluvaloet	655	579	2,860	2,260	73	73	1,291	6,505	1,263	6,153	479	165	22,356 ± 3,606

‡ Polar bear data supplied by DSD.
Ø Number of nests harvested.

‡ ᓇᓂᑦᓂᑦ ᑎᑎᕋᐅᒪᓐᔪᑦ ᑐᓂᓯᖏᑦ ᐅᑯᐊ ᐃᑯᐱᕕᓂᕐᓂᑦ.
Ø ᖃᕋᐅᓂᖏᑦ ᐱᐅᑦ ᓄᐊᑕᐅᔪᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.
Ø Amigaitiginit maniktagauhimajut.

TABLE/ᐊᓗᓇᐃᔾᔨᐅᑦ/NAUNAIKUTA 664

Monthly hunter response

ᑕᖃᑕᒧᑦ ᐊᖏᔪᓕᓴᒃᑎᑦ ᑭᐅᓂᖅᑎᑦ

Tatkiktaman pijauhimajut angunahuktinun

Year 4 (June 1999 - May 2000)

ᐊᑐᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᕐᐱᓇ	OCT ᐅᑯᐱᓇ	NOV ᐅᐸᒡᕕᓇ	DEC ᑎᓯᒡᕕᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓕᓴᒃᑎᑦ ᑭᐅᓂᖅᑎᑦ ᐊᑐᔨᓕᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖃᑕᒪᑦ ᐊᖏᔪᓕᓴᒃᑎᑦ	Tatkitaman angunahuktut titigait	5,313	5,326	5,333	5,271	5,267	5,286	5,292	5,324	5,336	5,329	5,329	5,335	5,528*
Interview list	ᐊᐱᕐᓂᖅᓱᐃᑦ	Apikiktan	4,385	4,398	4,403	4,337	4,336	4,358	4,368	4,400	4,411	4,407	4,406	4,413	4,603*
Hunters interviewed	ᐊᖏᔪᓕᓴᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	3,549	3,626	3,609	3,582	3,542	3,577	3,603	3,796	3,853	3,719	3,670	3,539	4,308*
Harvested	ᐊᖏᔪᓕᓴᒃᑐᒋᓐ	Angujaujut	1,362	1,279	1,357	1,163	1,012	849	573	706	743	828	955	1,460	2,984*
Response Rate (%)	ᑭᐅᓂᖅᑎᑦ ᖃᓕᐅᓂᖅᑎᑦ (%)	Kiujut (%)	81	82	82	83	82	82	82	86	87	84	83	80	83**

* Hunters registered/on interview list/interviewed/harvested in at least one month of the year.
** Mean monthly response rate (%).

* ᐊᖏᔪᓕᓴᒃᑎᑦ ᐊᑎᓕᐅᔾᔪᑎᓪᓗᒍ/ᐊᐱᕐᓂᖅᓱᐃᑦᑐᒋᓐ/ᐊᐱᕐᓂᑕᑦ/ᐊᖏᔪᓕᓴᒃᑐᒋᓐ ᐊᑕᐅᓂᐊᓘᓐ ᐊᑐᑎᓪ ᐊᑦᔪᒧᒥ.
** ᐊᐅᔨᓕᓐᑎᓂᒪᔾᔨᑦ ᑕᖃᑕᒪᑦ ᑭᐅᓂᖅ (%)

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut (%).

6.4

TABLE/ᐊᓗᓇᐃᔾᔨᐅᑦ/NAUNAIKUTA 665

Recall period between harvest and interview, expressed as % of total harvest records

ᐅᑎᕐᕕᐅᓂᑦ ᐊᑯᓕᖅᓄ ᐊᖏᔪᓕᓂᐅᓕᖅᑕ ᐊᒪᒐ ᐊᐱᕐᓂᑕᐅᓂᖅᑕ, ᐊᓗᓇᐃᕐᑦ ᐃᒪᒃ % ᑲᑎᑦᑐᑦ ᐊᖏᔪᓕᒃᑦ ᑎᑎᕐᑕᐅᒪᔾᔨᑦ

Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 4 (June 1999 - May 2000)

ᐊᑐᖏᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)

Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖃᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓕᐃ	AUG ᐊᐅᒍᑎᑐ	SEP ᓯᑎᕐᐱᓇ	OCT ᐅᑯᐱᓇ	NOV ᐅᐸᒡᕕᓇ	DEC ᑎᓯᒡᕕᓇ	JAN ᔮᓐᓄᐊᓇ	FEB ᐃᖅᑲᐊᓇ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᓂᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑕ	≤ tatkin pingahut	82	86	82	80	85	88	91	89	88	87	81	84	85
4-6 months	4-6 ᑕᖅᑕ	tatkin hitaman 6nut	10	8	9	14	12	10	9	6	5	3	8	9	9
> 6 months	> 6 ᑕᖅᑕ	> 6 tatkin	8	6	8	6	3	2	0	5	7	10	11	7	6

TABLE/ᐊᓗᓇᐃᔾᐅᑦ/NAUNAIKUTA 666

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓕᒃᑎᑦ ᐊᖏᔪᓕᒃᐸᑐᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 4 (June 1999 - May 2000)
ᐊᒻᖁᒍ 4 (ᔨᓂ 1999 - ᒪᐃ 2000)
Ukiunga 4 (June 1999 - May 2000)

Month/ᑕᖑᖏᑦ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓕ	AUG ᐊᐅᒻᒪᑎ	SEP ᓯᑎᐱᓗ	OCT ᐅᑲᐱᓗ	NOV ᐅᓂᒻᐱᓗ	DEC ᑎᓯᒻᐱᓗ	JAN ᔮᓐᓄᐊᓗ	FEB ᐃᖃᑲᐊᓗ	MAR ᒪᕐ	APR ᐃᑦᓗᓕ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**													
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	300	360	678	614	346	292	225	400	448	422	491	504	1,788
Musk-ox	ᐅᒥᓴᒪᐃᑦ	Umingmait			3	4	3	9	3	2	2	12	5	2	42
Moose	ᑐᑦᑐᓀᐃᑦ	Tuktuvait		1							1				2
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒃᓯᐃᑦ	Akhait			2							1	1	2	6
Wolf	ᐊᓪᕆᐃᑦ	Amagut	3	1	1		3	11	12	16	18	39	57	29	146
Arctic fox	ᑎᓗᒃᑯᐊᑦ	Tigiganiat	2			2	6	39	50	41	42	33	12	7	142
Coloured fox	ᖃᓄᖅᑐᑦ ᑎᓗᒃᑯᐊᑦ	Kalaliit tigiganiat					5	23	15	14	16	6	7	2	64
Muskrat	ᐊᐱᖅᓯᓴᐊᑦ	Kivgaluk	1			1								1	3
Wolverine	ᖃᓴᕆᑦ	Kalvik				1	1	9	10	11	15	13	17	4	49
Arctic hare	ᐅᖃᓕᑦ	Ukalik	11	7	5	58	31	19	9	24	39	63	43	36	257
Arctic ground squirrel	ᓱᕆᔨᑦ	Hikhik			7	10	1						4	6	21
Seals (unspecified)	ᓱᖏᑯᓕᑦ	Natiit				23	19	22	10	6	5	12	19	18	81
Ringed seal	ᓇᓱᔨᑦ	Natiinat	724	621	609	559	446	335	221	262	253	261	265	358	1,636
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	18	91	98	96	60	9	8	16	15	13	17	16	336
Harp seal	ᖃᐃᕐᓕᑦ	Qairulik	5	7	31	53	29	4	2	1					101
Harbour seal	ᖃᓯᕆᐊᑦ	Qanigiaq	2	2	5		1								9
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit				1	1								2
Walrus	ᐊᐃᐸᒃᑦ	Akvik	11	78	24	42	40	11	7	9	9	10	4	7	164
Narwhal	ᑐᒍᓕᑦ ᖁᓕᓗᒃᑦ	Tuugaak	17	39	96	30	29				2			6	172
Beluga	ᖃᐅᕐᑦ ᖁᓕᓗᒃᑦ	Kilalugak	25	85	93	33	21	12						7	235
Geese (unspecified)	ᓄᖅᓕᑦ	Kanguk	5											5	10
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	271	30	27	11								126	394
Canada goose	ᓄᖅᓕᑦ ᐅᓪᐊᒍᑦᓕᑦ	Nikliknik	170	51	28	25	3			1			33	180	363
Ross's goose	ᖃᑦᖅᔪᐃᑦ	Kakat	1											1	2
Brant goose	ᓄᖅᓕᖅᓇᐃᑦ	Nirlirnaq	4	3	2	2									11
White-fronted goose	ᓄᖅᓕᑦ	Nirlivik	4			1								5	8
Old squaw	ᐊᒃᑭᐊᖅᔪᐃᑦ	Aahangik	2	1	1	2	3	2	1	1	1	1		2	15
Pintail	ᖃᓚᒧᐊᓱᑦ	Arnaviaq												1	1
Eider duck	ᒥᑎᑦ	Kingalik	102	128	24	61	83	44	25	20	12	12	28	31	358
Tundra swan	ᖃᓚᔪᐃᑦ	Kukyuk	3		1			1						4	8
Common merganser	ᑯᐃᑦ	Nuyaralik	2	13	5	2	1							1	19
Red breasted merganser	ᑲᓕᖏᑐᑦ	Red breasted merganser			3		1								4

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Month/ᑕᖅᑳᖅ/Tatkia			JUN ᔪᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒡᒎᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑦᔨᐱᓗ	NOV ᑐᓴᒡᐱᓗ	DEC ᑎᓯᒡᐱᓗ	JAN ᒎᖏᓂᐊᓗ	FEB ᐃᕐᕿᐊᓗ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓯᑦ Tamakiklugin
Species	ᐅᒪᓕᑦ	**Umajuin**													
Greater scaup	ᐊᖏᕐᓂᖅᑭᑦ ᑎᑎᑦ ᐊᐃᑦᑐᖏᑦ	Greater scaup	1	1											2
Lesser scaup	ᑎᕈᓂᖅᑭᑦ ᑎᑎᑦ ᐊᐃᑦᑐᖏᑦ	Lesser scaup				1									1
White-winged scoter	ᖃᓄᑦᑕᓂᒃ-ᐃᒪᓕᐊ ᐱᑦᓯᐅᓪᓚᑦᑐᒃ	White-winged scoter				1									1
Surf scoter	ᓯᓚᐅᑐᑐᒥ ᐱᑦᓯᐅᓪᓚᑦᑐᑦ	Surf scoter	2	3	2	2									7
Loon (unspecified)	ᑐᓴᓪᑦ	Maligik				2									2
Common loon	ᑐᓴᓗᓪᔪᐊᑦ	Tuulik	1												1
Arctic loon	ᒪᒃᓗᓪᑦ	Maliriq	1				1								2
Red-throated loon	ᖃᖓᓕᐅᑦ	Qaqhuaq	2	5	1	1									9
Yellow-billed loon	ᑐᓴᓗᓪᔪᐊᑦ	Tuulik	1			1									2
Black guillemot	ᐱᑦᓯᐅᓪᓚᑦ	Black guillemot		1	2	2	1			1		1		1	8
Thick-billed murre	ᐊᖅᑕᐃᑦ	Thick-billed murre	5	2	1	5	3			3	1	3	13	4	35
Ptarmigan	ᐊᕿᓕᒋᑦ	Akilgik	47	6	5	31	74	72	49	69	110	134	126	208	568
Sandhill crane	ᑕᑎᓚᖅᔪᐊᑦ	Tatilgaq	1			1								5	6
Eggs (unspecified)	ᓴᖅᓂᑦ	Manniit	7	4										2	13
Goose eggs	ᑲᖕᒍᐃᑦ ᓴᖅᓂᕐᒧᑦ	Uluaguliit manniit	111	21	2									18	148
Duck eggs	ᑎᑎᑦ ᓴᖅᓂᕐᒧᑦ	Tinmiat manniit	42	118											149
Tundra swan eggs	ᖁᓗᔪᐃᑦ ᓴᖅᓂᕐᒧᑦ	Kukyut manniit												1	1
Arctic tern eggs	ᐃᒥᖏᑯᒡᐃᑦ ᓴᖅᓂᕐᒧᑦ	Emitkutailat manniit	4	23											26
Seagull eggs	ᓇᐅᓕᐃᑦ ᓴᖅᓂᕐᒧᑦ	Nauyat manniit	9	3										1	13
Thick-billed murre eggs	ᐊᖅᑕᐃᑦ ᓴᖅᓂᕐᒧᑦ	Thick-billed murre eggs	9	19											28
Black guillemot eggs	ᐱᑦᓯᐅᓪᓚᑦ ᓴᖅᓂᕐᒧᑦ	Black guillemot eggs	1	2											3
Eider down	ᑎᑎᑦ ᖁᓂᓀᕐᒧᑦ	Mitiit qiviungit	3	5											8
Arctic char	ᐃᖏᓗᒃᐲᑦ	Ikaliviit	586	567	533	192	308	227	158	76	124	158	239	562	1,722
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	82	47	34	41	107	72	24	37	36	42	123	325	559
Northern pike	ᓱᓗᔪᓪᑦ	Hiulik	1			1					1				3
Arctic grayling	ᓭᓗᒃᐸᐅᒪᐃᑦ	Hulupaugaq	2	3	3	2	6	3			1			2	17
Whitefish	ᑲᐱᓱᓪᓚᑦ	Kapihiliit	4	7	12	15	40	39	12	2	2	1	1		100
Burbot	ᑎᑭᓪᓚᑦ	Tiktaaliq			1									1	2
Arctic cisco	ᐅᑭᐅᑦᑐᑎᒥ ᑲᐱᓱᓪᓚᑦ	Kapihilik					1	1							2
Least cisco	ᑎᑕᖅᑭᑦ ᑲᐱᓱᓪᓚᑦ	Eetuuk				1									1
Inconnu	ᑲᐱᓱᓕᕐᔪᐃᑦ	Aanakhiik			1										1
Cod	ᐅᒪᐃᑦ	Ugak	15	28	14	13	27	22	6	4	10	21	13	55	186
Sculpin	ᑲᓇᔪᐃᑦ	Kanayuk	25	41	20	6	4		3		1	3	2	14	97
Turbot	ᖃᓕᕆᓪᓚᑦ	Nataarnak									2	6	10		13
Clams	ᐊᒃᒍᒪᔪᑦ	Uviluq	8	31	50	47	9	16	1			1		1	134
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet	2	1	4	6	1	1	4	4	3	8	1	1	25

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕆᔨᒪᔪᓂᒃ ᐱᑕᖃᓄᖅᑐᑐᒃ ᐱᒃᔪᑎᓕᓄᑦ ᐊᖏᔪᒃ ᖃᖅᓱᑦᑐᓂᓂᒃ ᐊᓕᖁᑕᖅᓂᓂᒃ ᐊᖏᔪᓂᑦ ᓇᓕᐅᕆᓚᐅᓄᑦ ᑐᓂᔨᖅᓂᓂ ᐃᑯᐱᐊᓕᓕᓵᓴᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᐅᓗᓄᐃᕆᐅᑦ/NAUNAIKUTA 667

Monthly harvest estimates
ᑕᖅᑕᒪᒃ ᐊᓐᔪᒃᓄᑦ ᓄᓕᐅᑦᓱᓕᔪᑦ
Tatkiktamat nahaktauvaktun

Year 5 (June 2000 - May 2001)
ᐊᓚᖅᔪᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᑕᓚᒃ/Tatkia			JUN ᔨᓂ	JUL ᔪᓪᒪ	AUG ᐊᐅᒡᒎᑎ	SEP ᓯᑎᕐᕕᓂ	OCT ᐅᑦᑐᕐᕕᓂ	NOV ᐅᓇᓚᕐᕕᓂ	DEC ᑎᓯᕐᕕᓂ	JAN ᔮᓐᓄᐊᓂ	FEB ᐃᕙᑐᐊᓂ	MAR ᒪᓯ	APR ᐃᓴᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓐᓂ	**Umajuin**													
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	1,053	1,218	2,958	2,806	1,312	1,618	1,814	1,588	1,712	1,264	2,056	1,812	21,211 ± 489
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait	0	4	8	6	3	7	5	6	12	13	3	6	73 ± 11
Moose	ᑐᖅᑐᕈᐃᑦ	Tuktuvait	0	0	0	0	0	0	0	2	3	0	0	0	5 ± 3
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	0	0	8	6	29	69	14	28	13	38	27	11	243
Tundra grizzly	ᐊᖏᓪᓕᐃᑦ	Akhait	8	1	1	0	2	2	0	0	0	0	0	0	14 ± 12
Wolf	ᐊᒪᕐᕈᐃᑦ	Amagut	10	3	48	1	6	37	49	24	30	106	170	18	502 ± 91
Arctic fox	ᑎᓕᓴᓂᐊᑦ	Tigiganiat	0	0	0	1	57	1,693	1,200	1,187	631	498	215	6	5,488 ± 521
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓕᓴᓂᐊᑦ	Kalaliit tigiganiat	0	0	0	1	1	50	43	54	16	7	9	0	181 ± 27
Muskrat	ᐊᐃᖅᓴᓪᓚᐊᑦ	Kivgaluk	1	0	0	0	0	0	0	0	0	0	2	0	3 ± 3
Wolverine	ᖃᓪᓕᐃᑦ	Kalvik	0	0	0	1	4	27	26	12	19	42	35	2	168 ± 27
Arctic hare	ᐅᑲᓂᑦ	Ukalik	35	1	22	116	120	136	143	92	103	160	90	49	1,067 ± 84
Arctic ground squirrel	ᓱᖅᓱᑦ	Hikhik	0	2	161	225	23	0	0	0	0	10	39	40	500 ± 190
Seals (unspecified)	ᓱᖏᑯᓂᑦ	Natiit	228	130	239	58	4	10	0	4	0	0	2	0	675 ± 57
Ringed seal	ᓇᓱᑦ	Natiinat	4,414	2,673	2,259	2,131	1,796	1,088	836	1,315	1,163	1,367	1,006	1,487	21,535 ± 577
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	46	164	100	67	81	27	6	16	33	7	15	22	584 ± 37
Harp seal	ᖃᐃᕐᓂᑦ	Qairulik	26	16	101	82	95	94	9	0	0	0	1	0	424 ± 64
Harbour seal	ᖃᓂᕐᐊᑦ	Qanigiaq	0	3	2	2	2	0	0	0	0	0	0	0	9 ± 5
Walrus	ᐊᐃᓴᑦ	Akvik	20	173	32	36	52	1	5	14	19	12	5	8	377 ± 24
Narwhal	ᑐᐱᓂᑦ ᕿᓪᓗᓂᑦ	Tuugaak	29	173	180	38	4	0	0	0	0	0	0	1	425 ± 12
Beluga	ᖃᓄᖅᑕ ᕿᓪᓗᓂᑦ	Kilalugak	18	95	211	111	38	33	4	11	0	1	2	28	552 ± 42
Bowhead	ᐃᕙᕆᑲ	Aivik	0	0	1	0	0	0	0	0	0	0	0	0	1 ± 0
Geese (unspecified)	ᓂᕐᓂᑦ	Kanguk	432	97	70	0	0	0	0	0	0	0	0	15	614 ± 125
Snow goose	ᑲᖕᒪᐃᑦ	Kanguq	8,757	326	550	447	166	0	0	0	0	0	1	4,714	14,961 ± 1,841
Canada goose	ᓂᕐᓂᑦ ᐅᓗᐊᒍᓂᑦ	Nikliknik	1,646	277	78	125	11	0	0	0	0	0	136	2,551	4,824 ± 514
Ross's goose	ᖃᓪᓕᔪᐃᑦ	Kakat	0	0	0	2	0	0	0	0	0	0	0	12	14 ± 19
Brant goose	ᓂᓪᓕᓐᓇᐃᑦ	Nirlirnaq	10	0	2	19	14	0	0	0	0	0	0	2	47 ± 8
White-fronted goose	ᓂᓪᓂᑦ	Nirlivik	91	0	0	0	1	0	0	0	0	0	0	141	233 ± 115
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	22	0	0	0	0	0	0	0	0	0	0	0	22 ± 10
Old squaw	ᐊᐱᕐᐊᓪᔪᐃᑦ	Aahangik	11	0	1	23	7	0	2	2	1	0	0	0	47 ± 8
Pintail	ᔭᓗᒪᔪᓂᑦ	Arnaviaq	1	1	0	0	0	0	0	0	0	0	0	1	3 ± 1
Mallard	ᒥᑎᓪᓕᑦ	Mitik	0	0	0	0	0	0	0	0	1	0	0	0	1 ± 0
Eider duck	ᒥᑎᑦ	Kingalik	919	624	184	388	501	705	540	175	274	76	335	323	5,044 ± 296
Tundra swan	ᑲᓗᔪᐃᑦ	Kukyuk	39	0	0	3	0	0	0	0	0	0	0	5	47 ± 21

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Month/ᑕᖅᖢᒐ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐱᕕᓂ	OCT ᐅᑦᔨᕕᓂ	NOV ᓄᐱᓚᕕᓂ	DEC ᑎᓯᐱᕕᓂ	JAN ᒍᓐᓄᐊᓂ	FEB ᐃᕐᖁᐊᓂ	MAR ᒪᕐᓯ	APR ᐃᑦᓇᓗ	MAY ᒪᐃ	Total ᑲᑎᑦᑐᑦ Tamakiklugin ± 95% CI
Species	ᐅᒪᓕᑦ	**Umajuin**													
Common merganser	ᐸᐃᑦ	Nuyaralik	4	53	53	51	0	0	3	0	0	0	0	0	164 ± 42
Red breasted merganser	ᑲᒃᓵᖏᑦ	Red breasted merganser	0	0	9	1	0	0	0	0	0	0	0	0	10 ± 11
Greater scaup	ᐊᖏᓂᖅᑎᑦ ᒥᑎᑦ ᐊᐃᐸᐊᖏᑦ	Greater scaup	0	10	0	0	0	0	0	0	0	0	0	0	10 ± 0
Lesser scaup	ᒥᕈᓂᖅᑎᑦ ᒥᑎᑦ ᐊᐃᐸᐊᖏᑦ	Lesser scaup	0	0	0	3	0	0	0	0	0	0	0	0	3 ± 1
White-winged scoter	ᖃᐅᑦᑕᓐᓄᖅ-ᐃᓕᓴᐊ ᐱᕐᓂᐅᓪᓗᑦ	White-winged scoter	1	16	14	3	0	0	0	0	0	0	0	0	34 ± 18
Surf scoter	ᓯᐅᒃᑐᑐᒥ ᐱᕐᓂᐅᓪᓗᑦ	Surf scoter	0	0	0	0	1	0	0	0	0	0	0	0	1 ± 0
Loon (unspecified)	ᑐᑦᓂᓕ	Maligik	4	8	0	0	0	0	0	0	0	0	0	0	12 ± 6
Common loon	ᑐᑦᓚᓗᐊᑦ	Tuulik	0	0	1	58	0	0	0	0	0	0	0	0	59 ± 24
Arctic loon	ᑲᓗᓂᑦ	Maliriq	0	1	1	41	18	0	0	0	0	0	0	0	61 ± 17
Red-throated loon	ᖃᖓᓕᐅᑦ	Qaqhuaq	13	2	4	0	0	0	0	0	0	0	0	0	19 ± 3
Yellow-billed loon	ᑐᑦᓚᓗᐊᑦ	Tuulik	0	0	1	2	1	0	0	0	0	0	0	0	4 ± 0
Black guillemot	ᐱᕐᓂᐅᓂᑦ	Black guillemot	0	3	1	1	11	1	0	9	1	0	0	0	27 ± 10
Thick-billed murre	ᐊᑦᑕᐃᑦ	Thick-billed murre	37	21	14	6	3	5	0	0	58	23	127	8	302 ± 55
Ptarmigan	ᐊᖏᕆᑦ	Akilgik	352	52	72	550	1,045	2,150	2,694	995	1,067	871	674	1,541	12,063 ± 735
Sandhill crane	ᑕᑎᓴᑦᓚᐊᑦ	Tatilgaq	9	0	0	0	0	0	0	0	0	0	0	1	10 ± 4
Snowy owl	ᐅᑲᐱᓚᐊᑦ	Ookpik	0	0	0	0	0	0	0	0	0	1	1	0	2 ± 1
Eggs (unspecified)	ᓚᒃᓂᑦ	Manniit	10,478	0	0	0	0	0	0	0	0	0	0	75	10,553 ± 3,984
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᒃᓂᕆᑦ	Uluaguliit manniit	13,728	1,943	0	0	0	0	0	0	0	0	0	5,052	20,723 ± 2,827
Duck eggs	ᒥᑎᑦ ᓚᒃᓂᕆᑦ	Tinmiat manniit	2,368	5,531	0	0	0	0	0	0	0	0	0	0	7,899 ± 2,381
Tundra swan eggs	ᑭᖕᓚᐃᑦ ᓚᒃᓂᕆᑦ	Kukyut manniit	2	0	0	0	0	0	0	0	0	0	0	0	2 ± 1
Arctic tern eggs	ᐃᒥᖕᓂᑕᓚᐃᑦ ᓚᒃᓂᕆᑦ	Emitkutailat manniit	179	506	0	0	0	0	0	0	0	0	0	0	685 ± 87
Seagull eggs	ᓇᐅᒃᐃᑦ ᓚᒃᓂᕆᑦ	Nauyat manniit	577	66	0	0	0	0	0	0	0	0	0	1	644 ± 135
Black guillemot eggs	ᐱᕐᓂᐅᓂᑦ ᓚᒃᓂᕆᑦ	Black guillemot eggs	0	44	0	0	0	0	0	0	0	0	0	0	44 ± 16
Eider down[Ø]	ᒥᑎᑦ ᖁᓂᖅᖏᑦ[Ø]	Mitiit qiviungit[Ø]	49	210	0	0	0	0	0	0	0	0	0	0	259 ± 182
Arctic char	ᐃᖕᓗᒃᑕᑦ	Ikaliviit	27,314	32,576	29,752	11,884	21,511	18,409	13,579	7,901	4,894	6,403	9,393	15,890	199,506 ± 5,367
Freshwater fish (unspecified)	ᑕᓚᐅᖏᓐᓄᖏᑦᑐᒥ ᐃᖕᓗᐃᑦ	Tahinik Ikaluit	22	0	0	0	0	0	0	0	0	0	0	0	22 ± 14
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	8,773	5,422	705	755	1,770	2,085	1,011	291	387	666	1,447	3,433	26,745 ± 2,163
Arctic grayling	ᓱᓗᑲᐅᑎᐃᑦ	Hulupaugaq	0	0	6	12	183	0	0	0	0	0	0	0	201 ± 252
Whitefish	ᑲᐱᓯᓂᑦ	Kapihiliit	52	89	226	173	3,117	2,002	714	266	365	372	207	13	7,596 ± 1,886
Burbot	ᑎᑦᑕᓂᑦ	Tiktaaliq	0	0	0	0	3	3	0	0	0	0	0	0	6 ± 7
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᐱᓯᓂᑦ	Kapihilik	0	0	0	0	1	0	0	0	0	0	0	0	1 ± 0
Least cisco	ᒥᖅᓂᖅᑎᑦ ᑲᐱᓯᓂᑦ	Eetuuk	0	0	0	0	0	3	0	0	0	0	0	0	3 ± 3
Cod	ᐅᒪᐃᑦ	Ugak	196	310	232	174	710	826	400	125	192	3,760	598	2,720	10,243 ± 2,318
Sculpin	ᑲᓕᔪᐃᑦ	Kanayuk	394	401	157	32	73	3	12	1	13	0	0	191	1,277 ± 108
Turbot	ᖃᓕᕆᓂᑦ	Nataarnak	0	0	0	0	0	0	0	0	22	0	0	21	43 ± 11
Clams	ᐊᒻᒧᒪᔪᑦ	Uviluq	0	1,550	3,268	3,148	1,428	531	0	0	0	0	0	0	9,925 ± 2,277
Mussels	ᐅᐃᓗᐃᑦ	Uviluvaloet	1,950	707	277	335	72	1,078	2,100	0	6,757	14,123	9,552	525	37,476 ± 6,895

‡ Polar bear data supplied by DSD.
Ø Number of nests harvested.

‡ ᓇᓕᒃᓂᑦ ᑎᑎᕋᑕᐅᒪᔪᑦ ᑐᓂᓴᖏᑦ ᐅᑉᐳᓂᑦ ᐅᑉᐳᓂᑦ ᐃᑯᐊ ᐃᑯᐱᕋᓚᓐᓇᒃᑦ.
Ø ᖃᕋᐅᓂᖏᑦ ᐱᑭᑦ ᓄᐊᑕᐅᔪᑦ.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.
Ø Amigaitiginit maniktagauhimajut.

TABLE/ᐅᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 668

Monthly hunter response
Tatkiktaman pijauhimajut angunahuktinun

Year 5 (June 2000 - May 2001)
ᐊᓐᖏᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᔪᓂ	NOV ᓄᐃᓕᕐᓂ	DEC ᑎᓯᕐᓂ	JAN ᔮᖅᓄᓂ	FEB ᐃᖅᑲᓂ	MAR ᒪᕐᕿ	APR ᐃᓘᓐᓇ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓕᖅ Tamakiklugin
Hunter Response Categories	ᐊᖏᓚᒃᑎᑦ ᑭᐅᓂᖅᑕ ᐱᔪᓐᓇᒪᓂᖅᑕ	**Angunahukpaktun Kiujait**													
Monthly hunter list	ᑕᖅᑭᒪᑦ ᐊᖏᓚᒃᑎᑦ	Tatkitaman angunahuktut titigait	5,331	5,358	5,352	5,352	5,351	5,346	5,325	5,382	5,405	5,405	5,401	5,399	5,529*
Interview list	ᐊᐱᕐᓂᖏᓐᓇᑦ	Apikiktan	4,409	4,438	4,432	4,432	4,433	4,428	4,424	4,482	4,505	4,505	4,501	4,499	4,611*
Hunters interviewed	ᐊᖏᓚᒃᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	3,559	3,791	3,771	3,846	3,747	3,816	3,760	3,779	3,728	3,696	3,594	3,448	4,263*
Harvested	ᐊᖏᓚᒃᑐᑐᒃ	Angujaujut	1,508	1,326	1,316	1,073	887	841	693	676	637	637	742	1,241	2,868*
Response Rate (%)	ᕈᐅᖅ ᖃᕐᓂᐅᓂᖅᑕ (%)	Kiujut (%)	81	85	85	87	85	86	85	84	83	82	80	77	83**

* Hunters registered/on interview list/interviewed/harvested in at least one month of the year.
** Mean monthly response rate (%).

* ᐊᖏᓚᒃᑎᑦ ᐊᑎᓕᐅᕆᓚᕐᔪᑦ/ᐊᐱᕐᓂᖏᓐᓇᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᓚᒃᑐᑐᒃ ᐊᑕᐅᓯᐊᓗᓂ ᐊᑐᑎ ᐊᓐᖏᒍ.
** ᐊᐅᑎᓂᓕᕆᓚᕐᔪᑦ ᑕᖅᑭᒪᑦ ᕈᐅᖅ (%).

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut talvani ukiumi.
** Talvani angunahuknami kiujutaumajut (%).

TABLE/ᐅᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 669

Recall period between harvest and interview, expressed as % of total harvest records
Itkaumajaujut angunahuktunun apihijauvaktunutlu, kanuk amigaitiginit tamakiklugin angujauhimajut

Year 5 (June 2000 - May 2001)
ᐊᓐᖏᒍ 5 (ᔨᓂ 2000 - ᒪᐃ 2001)
Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖓ/Tatkia			JUN ᔨᓂ	JUL ᔨᓪᓗ	AUG ᐊᐅᓚᑐᑎ	SEP ᓯᑎᕐᓗᓂ	OCT ᐅᑦᔪᓂ	NOV ᓄᐃᓕᕐᓂ	DEC ᑎᓯᕐᓂ	JAN ᔮᖅᓄᓂ	FEB ᐃᖅᑲᓂ	MAR ᒪᕐᕿ	APR ᐃᓘᓐᓇ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᓕᖅ Tamakiklugin
Recall Period	ᐅᑎᕐᓴᐅᔭᑦ	**Pigiakvia**													
≤ 3 months	≤ 3 ᑕᖅᑭᑦ	≤ tatkin pingahut	85	82	82	90	93	94	95	92	93	95	96	91	89
4-6 months	4-6 ᑕᖅᑭᑦ	tatkin hitaman 6nut	10	9	12	6	4	3	5	4	5	5	3	3	7
> 6 months	> 6 ᑕᖅᑭᑦ	> 6 tatkin	5	8	6	4	3	3	1	4	3	1	1	6	4

TABLE/ᓇᓗᓇᐃᔾᔨᐅᑦ/NAUNAIKUTA 670

Number of hunters harvesting each species

ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᖅᑎᑦ ᐊᖏᔪᓚᐱᖅᓯᒪᔪᑦ ᐊᑐᓂᒃ ᐅᒪᔨᖅᓂᒃ

Amigaitiginigin angunahukpaktun anguvaktaitlu kanugitugiagin

Year 5 (June 2000 - May 2001)

ᐊᒻᒋᒍ 5 (ᔮᓂ 2000 - ᒪᐃ 2001)

Ukiunga 5 (June 2000 - May 2001)

Month/ᑕᖅᖢᒃ/Tatkia			JUN ᔮᓂ	JUL ᔭᓪᐃ	AUG ᐊᐅᒍᑎᓪᓗ	SEP ᓯᑎᕐᕕᓪᓗ	OCT ᐅᑦᑐᕕᓪᓗ	NOV ᐅᓇᒻᒪᕕᓪᓗ	DEC ᑎᓯᒻᒪᕕᓪᓗ	JAN ᔮᓐᓄᐊᓪᓗ	FEB ᓇᖕᖏᐊᓪᓗ	MAR ᒪᓕᕐ	APR ᐃᓚᓂᓕ	MAY ᒪᐃ	Total ᑲᑎᒪᔨᖅᑎᑦ Tamakiklugin
Species	ᐅᒪᔭᑦ	**Umajuin**													
Caribou	ᑐᑐᐃᑦ	Tuktut	315	383	717	559	243	323	342	334	331	280	392	395	1,681
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait		1	6	4	3	6	3	2	6	6	2	5	38
Moose	ᑐᑐᓀᐃᑦ	Tuktuvait								1	2				3
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᖏᓪᐃᑦ	Akhait	2	1	1		1	1							5
Wolf	ᐊᒪᕈᐃᑦ	Amagut	3	2	4	1	5	17	12	13	13	31	41	11	111
Arctic fox	ᑎᓗᒃᑑᓂᐊᑦ	Tigiganiat				1	13	124	100	82	60	49	27	4	259
Coloured fox	ᖃᓄᖅᑭᑦ ᑎᓗᒃᑑᓂᐊᑦ	Kalaliit tigiganiat				1	1	27	13	22	8	5	4		63
Muskrat	ᐊᐱᖅᓴᕐᔪᐊᑦ	Kivgaluk	1										1		2
Wolverine	ᖃᓕᕆᑦ	Kalvik				1	3	13	15	9	8	12	17	2	56
Arctic hare	ᐅᖃᓖᑦ	Ukalik	18	1	12	47	43	31	41	34	46	52	34	20	259
Arctic ground squirrel	ᐲᖅᓯᑦ	Hikhik		1	8	7	1					2	4	3	17
Seals (unspecified)	ᓯᖏᑯᓖᑦ	Natiit	48	31	43	10	3	4		2			1		101
Ringed seal	ᓇᓯᓂᑦ	Natiinat	722	573	542	469	374	253	213	294	271	251	198	298	1,502
Bearded seal	ᐅᑦᔪᐃᑦ	Ukyuk	28	104	72	52	53	15	5	12	18	5	11	11	292
Harp seal	ᖃᐃᕐᓖᑦ	Qairulik	4	8	34	33	37	27	3				1		113
Harbour seal	ᖃᓯᕆᐊᑦ	Qanigiaq		1	1	2	2								5
Walrus	ᐊᐃᐃᓴᑦ	Akvik	13	96	21	23	34	1	3	10	12	10	5	6	165
Narwhal	ᑐᓐᓖᑦ ᕿᓕᓗᓴᑦ	Tuugaak	17	111	85	26	3							1	201
Beluga	ᖃᐅᔨᑦ ᕿᓕᓗᓴᑦ	Kilalugak	9	56	80	45	17	14	2	6		1	1	9	204
Bowhead	ᐊᔾᔨᒃ	Aivik			1										1
Geese (unspecified)	ᓄᑦᓖᑦ	Kanguk	19	4	4									1	25
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	347	38	80	49	14						1	176	550
Canada goose	ᓄᑦᓖᑦ ᐅᓗᐊᔪᓖᑦ	Nikliknik	135	26	14	29	7						29	177	313
Ross's goose	ᖃᑲᑦᔪᐃᑦ	Kakat				1								1	2
Brant goose	ᓄᑦᓕᑦᓴᐃᑦ	Nirlirnaq	4		1	6	4							1	16
White-fronted goose	ᓄᑦᓖᑦ	Nirlivik	6				1							10	15
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	5												5
Old squaw	ᐊᐱᕈᑦᔪᐃᑦ	Aahangik	2		1	3	4		1	1	1				13
Pintail	ᖃᓗᒧᐊᓕᒃᑦ	Arnaviaq	1	1										1	3
Mallard	ᒥᑎᓪᓕᑦ	Mitik									1				1
Eider duck	ᒥᑎᑦ	Kingalik	114	73	28	70	90	59	25	10	8	9	17	40	351
Tundra swan	ᖃᓗᔪᐃᑦ	Kukyuk	7			2								3	12
Common merganser	ᓴᐃᑦ	Nuyaralik	2	8	7	10			1						21
Red breasted merganser	ᑲᓕᖏᑐᑦ	Red breasted merganser			1	1									2

6.4



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Month/ᑕᖅᑳᑦ/Tatkia			JUN ᔪᓂ	JUL ᔪᓕᐃ	AUG ᐊᐅᓚᔪᑎ	SEP ᓯᑎᐹᓗ	OCT ᐅᑦᔨᐱᓗ	NOV ᓄᐃᓚᐱᓗ	DEC ᑎᓯᐱᓗ	JAN ᒎᓐᓄᐊᓗ	FEB ᐃᖃᓗᐊᓗ	MAR ᒪᕆ	APR ᐃᑦᓀᓂ	MAY ᒪᐃ	Total ᑲᑎᑦᑎᑦ Tamakiklugin
Species	ᐅᒪᓴᑦ	**Umajuin**													
Greater scaup	ᐊᖏᓂᓚᑦ ᒥᑎᑦ ᐊᐃᑦᐸᖏᑦ	Greater scaup		1											1
Lesser scaup	ᒥᑭᓂᓚᑦ ᒥᑎᑦ ᐊᐃᑦᐸᖏᑦ	Lesser scaup				1									1
White-winged scoter	ᖃᑯᕆᑕᒃ-ᐃᓚᖅᐊ ᐱᕆᐅᓪᓴᒃ	White-winged scoter	1	2	3	2									7
Surf scoter	ᓯᒃᑐᑐᑐᒥ ᐱᕆᐅᓪᓴᑦᑕᑦ	Surf scoter					1								1
Loon (unspecified)	ᑐᑦᓭᑦ	Maligik	1	2											3
Common loon	ᑐᑦᓕᒃᓴᐊᑦ	Tuulik			1	2									3
Arctic loon	ᑲᒃᓗᓭᑦ	Maliriq		1	1	3	2								6
Red-throated loon	ᖃᖏᓴᐅᑦ	Qaqhuaq	4	1	2										7
Yellow-billed loon	ᑐᑦᓕᒃᓴᐊᑦ	Tuulik			1	1	1								2
Black guillemot	ᐱᕆᐅᓪᓴᑦ	Black guillemot		1	1	1	3	1		3	1				10
Thick-billed murre	ᐊᖅᐸᐃᑦ	Thick-billed murre	6	6	2	2	2	1			6	4	12	2	30
Ptarmigan	ᐊᖏᕆᑦ	Akilgik	40	3	10	55	96	158	156	82	86	71	66	113	575
Sandhill crane	ᑕᑎᓚᖅᓴᐊᑦ	Tatilgaq	4											1	5
Snowy owl	ᐅᑲᐱᒃᓴᐊᑦ	Ookpik										1	1		2
Eggs (unspecified)	ᓚᐅᓂᑦ	Manniit	47											1	47
Goose eggs	ᑲᔪᐃᐃᑦ ᓚᐅᓐᖏᑦ	Uluaguliit manniit	195	34										49	259
Duck eggs	ᒥᑎᑦ ᓚᐅᓐᖏᑦ	Tinmiat manniit	50	58											104
Tundra swan eggs	ᖁᓕᓴᐃᑦ ᓚᐅᓐᖏᑦ	Kukyut manniit	1												1
Arctic tern eggs	ᐃᒥᖅᑯᑕᓚᐃᑦ ᓚᐅᓐᖏᑦ	Emitkutailat manniit	15	15											30
Seagull eggs	ᓇᐅᐅᐃᑦ ᓚᐅᓐᖏᑦ	Nauyat manniit	27	3										1	31
Black guillemot eggs	ᐱᕆᐅᓪᓴᑦ ᓚᐅᓐᖏᑦ	Black guillemot eggs		4											4
Eider down	ᒥᑎᑦ ᖁᓂᓀᖏᑦ	Mitiit qiviungit	2	4											6
Arctic char	ᐃᖅᓗᓴᐱᑦ	Ikaliviit	680	632	512	218	304	224	164	101	93	125	186	470	1,655
Freshwater fish (unspecified)	ᑕᓇᐅᖓᓐᖏᑦᑐᒥ ᐃᖅᓗᐃᑦ	Tahinik Ikaluit	1												1
Lake trout	ᐃᓯᕐᐃᑦ	Ikalukpik	167	102	32	31	66	36	15	15	20	22	83	308	566
Arctic grayling	ᓯᓗᓴᐸᐅᒪᐃᑦ	Hulupaugaq			1	2	2								4
Whitefish	ᑲᕚᓯᓭᑦ	Kapihiliit	6	10	11	11	32	24	8	7	9	22	5	1	95
Burbot	ᑎᑭᓭᑦ	Tiktaaliq					1	1							2
Arctic cisco	ᐅᑭᐅᑦᑐᒥ ᑲᕚᓯᓭᑦ	Kapihilik					1								1
Least cisco	ᒥᖅᓂᓚᑦ ᑲᕚᓯᓭᑦ	Eetuuk						1							1
Cod	ᐅᒪᐃᑦ	Ugak	14	16	10	12	28	21	12	7	8	20	21	122	242
Sculpin	ᑲᓇᐊᐃᑦ	Kanayuk	34	26	7	7	5	1	1	1	1			14	79
Turbot	ᖃᓕᕆᓭᑦ	Nataarnak									1			1	1
Clams	ᐊᒃᒍᒪᓴᑦ	Uviluq		10	15	23	15	3							47
Mussels	ᐅᐃᓗᐃᑦ	Uviluvaloet	1	3	3	4	1	1	2		4	5	4	2	22

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕋᓪᒪᓴᐅᓂᑲᓐ ᐱᑕᖃᖏᑕᐃᖃᓂᓂ ᐊᒃᓱᒃᓂ ᖁᕋᐅᓂᖏᓐᓄᑦ ᐊᓪᓚᕐᓂᑦ ᐊᐃᒃᓴᓄᑦ ᐃᓕᑲᐅᑕᓂᓂᑦ ᐃᓄᐃᖁᓕᓕᓐᓂᒃᑕᑦ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

TABLE/ᐅᓗᓄᐃᔭᐅᑦ/NAUNAIKUTA 671

Annual harvest estimates and five-year mean

ᐊᓐᔪᔨᑦᒪᑦ ᐊᖏᔪᓂᑦ ᓄᓪᐅᑦᑐᕐᔪᑎᑦ ᐊᒪᒪᓗ ᑕᒻᓪᒪᓂᑦ-ᐊᓐᔪᔨᓂᑦ ᐊᐅᔨᓪᓕᕐᒥᒪᔪᑦ

Aragutamat angujauvaktun tatlman araguit iluani

All years (June 1996 - May 2001)

ᑕᒪᐃᓐᓂᑦ ᐊᓐᔪᔨᓂᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)

Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᓐᔪᔨ/Ihivgiukimayut Ukiumi			1†	2†	3	4	5	Mean ᐊᐅᔨᓪᓕᕐᒥᒪᔪᑦ Amigaitkiyait
			96/97	97/98	98/99	99/00	00/01	
Species	ᐅᒪᔪᑦ	**Umajuin**						
Caribou	ᑐᖅᑐᐃᑦ	Tuktut	26,652	26,083	25,947	22,715	21,211	24,522
Musk-ox	ᐅᒥᖓᒪᐃᑦ	Umingmait	161	39	85	98	73	91
Moose	ᑐᖅᑐᕋᐃᑦ	Tuktuvait	1	9	2	2	5	4
Polar bear‡	ᓇᓄᐃᑦ‡	Nanuit‡	301	304	311	303	243	292
Tundra grizzly	ᐊᒃᓕᐃᑦ	Akhait	4	8	4	12	14	8
Black bear	ᕿᓐᓂᕐᑕ ᐊᒃᓕᐃᑦ	Kiniktut akhait	0	3	1	0	0	1
Wolf	ᐊᒪᔪᐃᑦ	Amagut	454	768	1,086	536	502	669
Arctic fox	ᑎᓘᖏᓂᐊᑦ	Tigiganiat	5,604	4,800	2,361	1,758	5,488	4,002
Coloured fox	ᖃᐅᓐᖓᑦᑐᑦ ᑎᓘᖏᓂᐊᑦ	Kalaliit tigiganiat	333	298	161	216	181	238
Muskrat	ᐊᐃᕐᖏᓪᓗᐊᑦ	Kivgaluk	0	1	0	48	3	10
Wolverine	ᖃᓪᓚᑦ	Kalvik	105	168	158	131	168	146
Lynx	ᐱᖕᑐᖅᓯᖅ	Pamiuqtuuq	1	0	0	0	0	0
Arctic hare	ᐅᒃᓪᓕ	Ukalik	847	704	793	815	1,067	845
Arctic ground squirrel	ᓱᒃᓱᑦ	Hikhik	974	233	518	600	500	565
Seals (unspecified)	ᓱᖏᑯᓪᓕ	Natiit	655	882	434	390	675	607
Ringed seal	ᓇᓱᑦ	Natiinat	26,986	27,397	24,772	24,740	21,535	25,086
Bearded seal	ᐅᑦᔾᔨᐃᑦ	Ukyuk	786	769	764	771	584	735
Harp seal	ᖃᐃᕐᓪᓕ	Qairulik	1,671	740	412	349	424	719
Harbour seal	ᖃᓯᕆᐊᑦ	Qanigiaq	5	21	6	17	9	12
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	1	207	7	2	0	43
Walrus	ᐊᐃᐃᓴᑦ	Akvik	367	374	356	434	377	382
Narwhal	ᑐᒻᓪᓕ ᕿᓪᓗᓂᑦ	Tuugaak	352	235	277	461	425	350
Beluga	ᖃᐅᔨᑦ ᕿᓪᓗᓂᑦ	Kilalugak	607	768	630	838	552	679
Bowhead	ᐊᖏᓴᑦ	Aivik	2	0	1	0	1	1
Geese (unspecified)	ᓄᖕᓪᓕ	Kanguk	1,485	497	1,057	186	614	768
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	8,963	12,843	12,282	9,982	14,961	11,806
Canada goose	ᓄᖕᓪᓕ ᐅᓚᐊᒍᖕᓪᓕ	Nikliknik	5,184	6,069	5,161	6,574	4,824	5,562
Ross's goose	ᖃᐅᖕᓴᐃᑦ	Kakat	3	50	12	4	14	17
Brant goose	ᓄᖕᓂᖕᓇᐃᑦ	Nirlirnaq	21	117	83	26	47	59
White-fronted goose	ᓄᖕᓪᓕ	Nirlivik	64	170	124	75	233	133
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	34	94	38	0	22	38
Old squaw	ᐊᑭᐊᖕᓴᐃᑦ	Aahangik	151	104	125	74	47	100

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Study Year/ᖃᐅᔨᓴᖅ ᐱᓕᕆᔨ/Ihivgiukimayut Ukiumi			1† 96/97	2† 97/98	3 98/99	4 99/00	5 00/01	Mean ᐱᖅᑎᓪᓗᒍᓴᒃ Amigaitkiyait
Species	ᐅᒪᓐ	**Umajuin**						
Pintail	ᖃᓚᒧᐊᓐ	Arnaviaq	57	6	2	3	3	14
Mallard	ᒥᑎᓪ	Mitik	0	1	0	0	1	0
Eider duck	ᒥᑎᑦ	Kingalik	5,954	6,351	6,264	6,387	5,044	6,000
Tundra swan	ᖃᓚᐊᕐ	Kukyuk	37	33	141	37	47	59
Common merganser	ᓄᕐ	Nuyaralik	61	150	64	147	164	117
Red breasted merganser	ᑲᓇᖅᑐᑦ	Red breasted merganser	0	1	16	16	10	9
Scaup (unspecified)	ᒥᑎᑦ ᐊᐃᓐᓴᖅ	Scaup	0	1	0	0	0	0
Greater scaup	ᐊᖏᓂᖅ ᒥᑎᑦ ᐊᐃᓐᓴᖅ	Greater scaup	0	0	0	5	10	3
Lesser scaup	ᒥᕈᓂᖅ ᒥᑎᑦ ᐊᐃᓐᓴᖅ	Lesser scaup	0	0	0	3	3	1
Black scoter	ᐱᓕᕆᐅᓪᓴᑦ	Black scoter	5	8	12	0	0	5
White-winged scoter	ᖃᐃᑦᑕᓪᓕᐊᒪᕆᐊ ᐱᓕᕆᐅᓪᓴᑦ	White-winged scoter	0	0	9	1	34	9
Surf scoter	ᓂᓴᑐᑎᒥ ᐱᓕᕆᐅᓪᓴᑦ	Surf scoter	0	0	0	52	1	11
Loon (unspecified)	ᑎᑦᓂᑦ	Maligik	0	0	2	5	12	4
Common loon	ᑎᑦᓗᓚᐊᑦ	Tuulik	6	36	0	5	59	21
Arctic loon	ᑲᓚᓂᑦ	Maliriq	26	2	10	14	61	23
Red-throated loon	ᖃᖏᕐᐅᑦ	Qaqhuaq	28	31	18	38	19	27
Yellow-billed loon	ᑎᑦᓗᓚᐊᑦ	Tuulik	0	10	1	12	4	5
Black guillemot	ᐱᓕᕆᐅᓪᓴᑦ	Black guillemot	66	191	27	42	27	71
Thick-billed murre	ᐊᑦᑕᐃᑦ	Thick-billed murre	94	391	140	328	302	251
Ptarmigan	ᐊᖏᓴᑦ	Akilgik	11,383	19,369	16,435	9,585	12,063	13,767
Sandhill crane	ᑕᑎᓴᒃᓚᐊᑦ	Tatilgaq	3	7	3	16	10	8
Snowy owl	ᐅᓵᐱᓚᐊᑦ	Ookpik	0	2	0	0	2	1
Eggs (unspecified)	ᓚᖅᓂᑦ	Manniit	1,712	116	215	2,080	10,553	2,935
Goose eggs	ᑲᖕᒍᐃᑦ ᓚᖅᓂᖅᑎᑦ	Uluaguliit manniit	8,104	15,776	18,749	11,118	20,723	14,894
Duck eggs	ᒥᑎᑦ ᓚᖅᓂᖅᑎᑦ	Tinmiat manniit	4,446	10,099	5,430	11,669	7,899	7,909
Tundra swan eggs	ᖃᓚᐊᑦ ᓚᖅᓂᖅᑎᑦ	Kukyut manniit	2	11	0	3	2	4
Arctic tern eggs	ᐃᒥᖃᑯᓚᐃᑦ ᓚᖅᓂᖅᑎᑦ	Emitkutailat manniit	579	696	333	866	685	632
Seagull eggs	ᓇᐅᐅᐃᑦ ᓚᖅᓂᖅᑎᑦ	Nauyat manniit	326	351	632	205	644	432
Thick-billed murre eggs	ᐊᑦᑕᐃᑦ ᓚᖅᓂᖅᑎᑦ	Thick-billed murre eggs	2,665	0	299	10,077	0	2,608
Black guillemot eggs	ᐱᓕᕆᐅᓪᓴᑦ ᓚᖅᓂᖅᑎᑦ	Black guillemot eggs	0	16	643	81	44	157
Eider down∅	ᒥᑎᑦ ᖃᓂᒋᖅᑎᑦ∅	Mitiit qiviungit∅	0	663	52	598	259	314

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Study Year/ᖃᐅᔨᓴᖅ ᐊᓯᖏᒻᒪᖅᓯᐅᑉ/Ihivgiukimayut Ukiumi			1†	2†	3	4	5	Mean ᐊᒃᓵᒋᓕᒃᑎᑭᒪᔪᑦ Amigaitkiyait
			96/97	97/98	98/99	99/00	00/01	
Species	**ᐅᒪᔪᑦ**	**Umajuin**						
Fish (unspecified)	ᐃᖃᓗᐃᑦ	Ikaluit	493	78	4	0	0	115
Arctic char	ᐃᖃᓗᐊᕆᑦ	Ikaliviit	195,553	204,553	182,176	211,269	199,506	198,611
Freshwater fish (unspecified)	ᑕᓚᐅᖏᓐᓄᑦᑐᒥ ᐃᖃᓗᐃᑦ	Tahinik Ikaluit	27	0	0	0	22	10
Lake trout	ᐃᓱᖏᕐᐃᑦ	Ikalukpik	20,087	23,750	14,421	27,792	26,745	22,559
Northern pike	ᓱᓚᔪᓪᓗᑦ	Hiulik	2	8	13	7	0	6
Arctic grayling	ᓱᓕᔅᐸᐅᓚᐃᑦ	Hulupaugaq	2,449	1,097	754	449	201	990
Whitefish	ᑲᕕᓱᓪᓗᑦ	Kapihiliit	5,629	16,831	8,908	8,055	7,596	9,404
Burbot	ᑎᑦᑕᓪᓗᑦ	Tiktaaliq	2	26	7	26	6	13
Arctic cisco	ᐅᑭᐅᑦᑕᑐᒥ ᑲᕕᓱᓪᓗᑦ	Kapihilik	3	669	49	6	1	146
Least cisco	ᒥᑭᓂᓴᑦ ᑲᕕᓱᓪᓗᑦ	Eetuuk	1	1	47	3	3	11
Inconnu	ᑲᕕᓱᓂᖅᐸᐃᑦ	Aanakhiik	111	1	0	264	0	75
Ocean fish (unspecified)	ᑕᓚᐅᖏᒥ ᐃᖃᓗᐃᑦ	Tagiumi ikaluit	53	0	0	0	0	11
Cod	ᐅᒪᐃᑦ	Ugak	5,411	7,003	4,103	7,763	10,243	6,905
Sculpin	ᑲᓇᕐᐃᑦ	Kanayuk	1,684	6,870	2,406	1,795	1,277	2,806
Turbot	ᖃᓄᖅᓯᓪᓗᑦ	Nataarnak	8,010	4,369	2,246	12,350	43	5,404
Clams	ᐊᓚᒧᒪᓕᕐᓂᑦ	Uviluq	24,483	40,214	40,522	130,700	9,925	49,169
Mussels	ᐅᕙᓗᐃᑦ	Uviluvaloet	8,091	1,013	58,610	22,356	37,476	25,509

† No data were collected in some months in Cape Dorset, Iqaluit and Rankin Inlet. Annual harvest estimates for year 1 (Rankin Inlet) and year 2 (all three communities) were obtained by using the average of the harvest estimates for the corresponding months in the three years in which data were collected to impute for these missing months. Note that year 1 estimates do not include Cape Dorset and Iqaluit data.

‡ Polar bear data supplied by DSD.

Ø Number of nests harvested.

† ᓇᓴᐃᕐᖃᓕᐅᖅᓯᒪᔪᓐᓇᖅ ᐃᓕᓴᕐᓂ ᑕᕐᓂ ᑭᖑᓪᓂ, ᐃᖃᓗᐃᓂ ᐊᓚᓗ ᑲᖏᑦᓂᓂᕐᒥ. ᐊᓯᖏᔪᒪᓕᑦ ᐊᖓᔪᓂᑦ ᓇᓕᐅᓴᐃᑎᑦ ᐊᓯᖏᔪ 1ᒧᑦ (ᑲᖏᑦᓂᓂᖅ) ᐊᓚᓗ ᐊᓯᖏᔪ 2ᒧᑦ (ᑕᒪᐃᓐᓂ ᐱᖓᓱᓂ ᓄᓇᓕᓐᓂ) ᐱᐅᓕᐅᑎᑦ ᐋᑎᑐᑦ ᐃᓕᓴᕐᓂᑦᑐᒥᓘᓐᓃᑦ ᐊᖓᔪᓂᑦ ᓇᓕᐅᓴᐃᑎᑦ ᑕᒪᓐᓇᐃᓐᓇᓐᓂ ᑕᕐᓂ ᑭᐅᓂᓗ ᐱᖓᔪᓂ ᓇᓴᐃᔨᐅᓕᖅᓂ ᐱᑕᖃᓕᓴᕐᓂᑦ ᑕᕐᓂ. ᖃᐅᔨᒪᓕᕐᓂ ᐃᒪᓐ ᐊᓯᖏᔪ 1ᒧᑦ ᓇᓕᐅᓴᐃᓚᖅᓂ ᐱᑕᖃᓕᓴᕐᓂᒪᑎᑉ ᑭᖑᓪᓂ ᐊᓚᓗ ᐃᖃᓗᐃᑦ ᓇᓴᐃᔨᐅᑎᓂᖅ.

‡ ᓇᓂᓐᓂ ᑎᑎᕋᐅᒪᔨᖅ ᑐᓂᔅᓴᖅᓂ ᐅᑦᓇ ᐃᓂᐊᕋᓕᓇᖅᓂ.

Ø ᖃᕋᐅᓂᖅᓂ ᐱᑭᐅᑦ ᓂᐊᐅᔨᖅ.

† Katikhiktauhimaitut tatkini ilaini, Kinngaknik, Iqalluknik Kangikhinikmiklu. Ukutaman angujauvaktut iluakhagaumajut ukiugani hivulikmi (Kangihinikmi) aipanilu ukiumi (pingahut tapkuan nunatlat) nahaktaumanit atukhugit tapkuan iluakhagaumajut tapkunani ukiuni pingahuni tapkuatlu ilain tatkin nahagauhimaitut ilait. Tamnalu hivulik ukiuk ilaungituk tatkuak Kinngait Iqaluitlu.

‡ Nanuin nahagaumajut pijauhimajut Ikupiktulikijinik.

Ø Amigaitiginit maniktagauhimajut.

TABLE/ᐅᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 672

Annual hunter response — **All years (June 1996 - May 2001)**

ᐊᓱᖏᔪᑦᓯᒃ ᐊᖏᔪᓂᕆᑎᑦ ᑭᐅᓂᖅᑎᑦ — **ᑕᒪᐃᓐᓄᑦ ᐊᓱᖏᔪᓄᑦ (ᓴᓂ 1996 - ᒪᐃ 2001)**

Angujauvaktu — **Tamamik ukiuni (June 1996 - May 2001)**

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Hunter Response Categories	ᐊᖏᔪᓂᕆᑎᑦ ᑭᐅᓂᖅᑎᑦ ᐊᑦᔪᓪᓗᓂᖅᑎᑦ	**Angunahukpaktun Kiujait**						
Monthly hunter list	ᑕᑭᑕᒪᑦ ᐊᖏᔪᓂᕆᑎᑦ	Tatkitaman angunahuktut titigait	4,578	5,451	5,468	5,528	5,529	6,018*
Interview list	ᐊᐱᕐᓂᖅᓴᐃᑦ	Apikiktan	3,892	4,415	4,542	4,603	4,611	5,255*
Hunters interviewed	ᐊᖏᔪᓂᕆᑎᑦ ᐊᐱᕐᓂᑦ	Angunahuktin apikhuktan	3,833	4,289	4,342	4,308	4,263	5,156*
Harvested	ᐊᖏᔪᓂᕐᒥᒃᑕᓂᑦ	Angujaujut	2,678	2,932	2,903	2,984	2,868	4,347*
Response Rate (%)	ᑭᐅᔾᔨ ᖃᓄᐃᑦᑐᓂᖅᑎᑦ (%)	Kiujut (%)	77	85	84	83	83	82**

* Hunters registered/on interview list/interviewed/harvested at least once during the study.
** Mean annual response rate (%).

* ᐊᖏᔪᓂᕆᑎᑦ ᐊᑎᓕᐅᔨᒪᔭᕐᓗᓂᑦ/ᐊᐱᕐᓂᕐᓴᓂᑦ/ᐊᐱᕐᓂᑦ/ᐊᖏᔪᓂᕐᒥᒃᑕᓂᑦ ᐊᑕᐅᓯᐊᓗᓂᑦ ᐊᑎᑎᖅ ᖃᐅᔨᓴᖅᑎᓪᓗ.
** ᐱᓕᕆᓂᖅᓯᒪᔭᑦ ᐊᓱᖏᔪᓂᑦ ᑭᐅᔾᔨ (%).

* Angunahuktin atiliukhimajut/apikhiktaunikut/anguhimajut taipfumuna tahapkuan kaujihatatiplugin.
** Atjikilirhimajut ukiumun kiutjutaujut (%).

6.4

TABLE/ᐅᓗᓇᐃᔨᐅᑦ/NAUNAIKUTA 673

Recall period between harvest and interview, expressed as % of total harvest records — **All years (June 1996 - May 2001)**

ᐅᑎᕐᕕᐅᔾᔨᑦ ᐊᑯᖏᓐᓄ ᐊᖏᔪᓂᒃᓴᓂᒃᑕ ᐊᒪᓗ ᐊᐱᕐᓂᕐᑕᐅᓂᒃᑕ, ᐅᓗᓇᐃᑦᑕ ᐃᒪᓐ % ᑲᑎᒪᔨᑦ ᐊᖏᔪᓂᒃᑕ ᑎᑎᕐᕕᐅᒪᔭᑦ — **ᑕᒪᐃᓐᓄᑦ ᐊᓱᖏᔪᓄᑦ (ᓴᓂ 1996 - ᒪᐃ 2001)**

Angunahuktin apikhuktaujut, iluakhagaujutl % tamakiklugit angujauhimajut umajut — **Tamamik ukiuni (June 1996 - May 2001)**

Study Year/ᖃᐅᔨᓴᖅ ᐊᖏᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᒪᔨᑦ Tamakiklugin
Recall Period	ᐅᑎᕐᕕᐅᔾᔨᑦ	**Pigiakvia**						
≤ 3 months	≤ 3 ᑕᑭᑦ	≤ tatkin pingahut	92	88	86	85	89	88
4-6 months	4-6 ᑕᑭᑦ	tatkin hitaman 6nut	5	8	10	9	7	8
> 6 months	> 6 ᑕᑭᑦ	> 6 tatkin	3	5	4	6	4	5

TABLE/ᐅᓗᓇᐃᔭᐅᑦ/NAUNAIKUTA 674

Number of hunters harvesting each species
ᖃᑦᓯᐅᓂᖏᑦ ᐊᖏᔪᓚᐱᐊᑦ ᐊᖏᔪᓚᐱᒃᓴᑦ ᐊᑐᓂᒃ ᐅᒪᔨᓂᒃ
Angunahuktin angutivaktun umajunik

All years (June 1996 - May 2001)
ᑕᒪᐃᓐᓄᑦ ᐊᑲᐅᔪᓄᑦ (ᔦᓂ 1996 - ᒪᐃ 2001)
Tamamik ukiuni (June 1996 - May 2001)

Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᓯᔪ/Ihivgiukimayut Ukiumi			1 96/97	2 97/98	3 98/99	4 99/00	5 00/01	Total ᑲᑎᑦᑐᑦ Tamakiklugin
Species	ᐅᒪᔨᑦ	**Umajuin**						
Caribou	ᑐᑦᑐᐃᑦ	Tuktut	1,729	1,852	1,801	1,788	1,681	3,084
Musk-ox	ᐅᒥᖏᒪᐃᑦ	Umingmait	41	23	45	42	38	156
Moose	ᑐᑐᓂᐃᑦ	Tuktuvait	1	3	2	2	3	9
Polar bear#	ᓇᓂᐃᑦ#	Nanuit#	n/d	n/d	n/d	n/d	n/d	n/d
Tundra grizzly	ᐊᒃᓪᓚᐃᑦ	Akhait	4	3	3	6	5	19
Black bear	ᕿᓐᓄᕐᑕ ᐊᒃᓪᓚᐃᑦ	Kiniktut akhait		1	1			2
Wolf	ᐊᒪᕐᐃᑦ	Amagut	125	131	175	146	111	421
Arctic fox	ᑎᓘᖏᓂᐊᑦ	Tigiganiat	333	324	165	142	259	759
Coloured fox	ᖃᐅᓐᖏᑦᑐᑦ ᑎᓘᖏᓂᐊᑦ	Kalaliit tigiganiat	73	77	51	64	63	223
Muskrat	ᐊᐱᓐᖓᖏᓪᓗᐊᑦ	Kivgaluk		1		3	2	5
Wolverine	ᖃᓪᓚᐃᑦ	Kalvik	38	51	57	49	56	158
Lynx	ᐱᖕᒍᕐᕕᖕ	Pamiuqtuuq	1					1
Arctic hare	ᐅᒃᓪᑦ	Ukalik	252	258	281	257	259	803
Arctic ground squirrel	ᓂᖅᓂᑦ	Hikhik	31	16	21	21	17	63
Seals (unspecified)	ᓂᖕᑯᓪᓚᑦ	Natiit	91	105	73	81	101	309
Ringed seal	ᓇᑦᓂᑦ	Natiinat	1,363	1,639	1,556	1,635	1,502	2,711
Bearded seal	ᐅᑉᕼᐃᑦ	Ukyuk	273	354	338	336	292	964
Harp seal	ᖃᐃᕈᓪᓚᑦ	Qairulik	180	197	164	101	113	548
Harbour seal	ᖃᓂᒋᐊᑦ	Qanigiaq	3	7	5	9	5	29
Hooded seal	ᐊᐸᐃᑦ	Nahakakaktutut ittut natiit	1	48	6	2		56
Walrus	ᐊᐃᐸᑦ	Akvik	109	164	151	164	165	408
Narwhal	ᑐᒻᓪᓚᑦ ᖁᓕᓴᒻᑦ	Tuugaak	114	111	137	172	201	458
Beluga	ᖃᐅᔨᑦ ᖁᓕᓴᒻᑦ	Kilalugak	182	169	194	235	204	651
Bowhead	ᐊᖏᐃᑦ	Aivik	1		1		1	3
Geese (unspecified)	ᓄᖕᓪᓚᑦ	Kanguk	36	34	19	10	25	106
Snow goose	ᑲᖕᒍᐃᑦ	Kanguq	360	490	456	394	550	1,205
Canada goose	ᓄᖕᓪᓚᑦ ᐅᓗᐊᒍᓪᓚᑦ	Nikliknik	319	388	334	363	313	1,009
Ross's goose	ᖃᖏᖕᓴᐃᑦ	Kakat	2	5	2	2	2	13
Brant goose	ᓄᖕᓂᖕᓇᐃᑦ	Nirlirnaq	7	14	11	11	16	55
White-fronted goose	ᓄᖕᓪᓚᑦ	Nirlivik	10	15	10	8	15	50
Ducks (unspecified)	ᒥᑎᑦ	Tinmiat	3	7	4		5	17
Old squaw	ᐊᑭᐊᖕᓴᐃᑦ	Aahangik	15	18	22	15	13	58

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Study Year/ᖃᐅᔨᓴᖅᑎᑐᑦ ᐱᖁᔭᐃᓚᐅᑉᐳᖅ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Total
			96/97	97/98	98/99	99/00	00/01	ᑲᑎᒪᔨᖏᑦ Tamakiklugin
Species	**ᐅᒪᓂᖅ**	**Umajuin**						
Pintail	ᖃᓄᐊᓕᒃ	Arnaviaq	5	1	2	1	3	12
Mallard	ᑎᑎᓪᓗᒃ	Mitik		1			1	2
Eider duck	ᑎᑎᒃ	Kingalik	334	364	339	358	351	938
Tundra swan	ᖃᓄᕆᐃᒃ	Kukyuk	11	6	13	8	12	39
Common merganser	ᓇᐃᒃ	Nuyaralik	10	17	16	19	21	54
Red breasted merganser	ᑲᓇᖅᑐᖅ	Red breasted merganser		1	2	4	2	7
Scaup (unspecified)	ᑎᑎᒃ ᐊᐃᓱᒪᓂᖅ	Scaup		1				1
Greater scaup	ᐊᖏᓂᒪᓂᒃ ᑎᑎᒃ ᐊᐃᓱᒪᓂᖅ	Greater scaup				2	1	3
Lesser scaup	ᑎᕈᓂᒪᓂᒃ ᑎᑎᒃ ᐊᐃᓱᒪᓂᖅ	Lesser scaup				1	1	2
Black scoter	ᐱᓕᕆᐅᓪᓚᒃ	Black scoter	1	3	3			7
White-winged scoter	ᖃᐃᓕᓪᓚᓐᓇᕐᐊ ᐱᓕᕆᐅᓪᓚᒃ	White-winged scoter			3	1	7	11
Surf scoter	ᓂᓴᔨᑎᑕ ᐱᓕᕆᐅᓪᓚᒃ	Surf scoter				7	1	8
Loon (unspecified)	ᑎᓕᓂᒃ	Maligik			1	2	3	6
Common loon	ᑎᓕᓄᕆᐊᒃ	Tuulik	3	7		1	3	14
Arctic loon	ᑲᑦᓴᓂᒃ	Maliriq	5	2	4	2	6	17
Red-throated loon	ᖃᖅᓴᐅᒃ	Qaqhuaq	6	10	9	9	7	36
Yellow-billed loon	ᑎᓕᓄᕆᐊᒃ	Tuulik		6	1	2	2	9
Black guillemot	ᐱᓕᕆᐅᓪᓚᒃ	Black guillemot	10	8	11	8	10	42
Thick-billed murre	ᐊᓪᓚᐃᒃ	Thick-billed murre	13	38	23	35	30	100
Ptarmigan	ᐊᖏᓴᒃ	Akilgik	567	708	662	568	575	1,521
Sandhill crane	ᑕᑎᓴᖅᓯᒃ	Tatilgaq	1	4	3	6	5	18
Snowy owl	ᐅᑲᐱᕆᐊᒃ	Ookpik		2			2	4
Eggs (unspecified)	ᓚᖅᑉᓂᒃ	Manniit	15	3	4	13	47	79
Goose eggs	ᑲᖕᒍᐃᒃ ᓚᖅᑐᖅᓂᒃ	Uluaguliit manniit	132	145	185	148	259	608
Duck eggs	ᑎᑎᒃ ᓚᖅᑐᖅᓂᒃ	Tinmiat manniit	61	79	103	149	104	363
Tundra swan eggs	ᖃᓄᕆᐃᒃ ᓚᖅᑐᖅᓂᒃ	Kukyut manniit	1	1		1	1	4
Arctic tern eggs	ᐃᒥᖏᑕᒪᓪᓗᒃ ᓚᖅᑐᖅᓂᒃ	Emitkutailat manniit	13	29	9	26	30	88
Seagull eggs	ᓇᐅᔨᐃᒃ ᓚᖅᑐᖅᓂᒃ	Nauyat manniit	30	25	27	13	31	111
Thick-billed murre eggs	ᐊᓪᓚᐃᒃ ᓚᖅᑐᖅᓂᒃ	Thick-billed murre eggs	7		4	28		34
Black guillemot eggs	ᐱᓕᕆᐅᓪᓚᒃ ᓚᖅᑐᖅᓂᒃ	Black guillemot eggs		2	4	3	4	12
Eider down	ᑎᑎᒃ ᖃᓄᖅᑐᖅᓂᒃ	Mitiit qiviungit		6	2	8	6	21

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Study Year/ᖃᐅᔨᓴᖅ ᐊᑦᑐᐊ/Ihivgiukimayut Ukiumi			1	2	3	4	5	Total ᑲᑎᒪᔨᑦ Tamakiklugin
			96/97	97/98	98/99	99/00	00/01	
Species	**ᐅᒪᔪᑦ**	**Umajuin**						
Fish (unspecified)	ᐃᖃᓗᐃᑦ	Ikaluit	9	15	1			25
Arctic char	ᐃᖃᓗᐊᕆᑦ	Ikaliviit	1,515	1,576	1,625	1,722	1,655	3,188
Freshwater fish (unspecified)	ᑕᓚᐅᖏᓐᓄᑦᑐᒥ ᐃᖃᓗᐃᑦ	Tahinik Ikaluit	3				1	4
Lake trout	ᐃᓱᕋᐃᑦ	Ikalukpik	534	541	444	559	566	1,306
Northern pike	ᓯᓚᔪᓪᓕ	Hiulik	1	3	2	3		8
Arctic grayling	ᓱᓕᕆᐊᑐᒪᐃᑦ	Hulupaugaq	35	20	21	17	4	69
Whitefish	ᑲᐱᓯᔪᓪᓕ	Kapihiliit	71	113	92	100	95	272
Burbot	ᑎᑭᒃᔪᓪᓕ	Tiktaaliq	2	7	2	2	2	14
Arctic cisco	ᐅᑭᐅᖅᑕᒥ ᑲᐱᓯᔪᓪᓕ	Kapihilik	2	32	4	2	1	41
Least cisco	ᒥᑭᓂᓴᖅ ᑲᐱᓯᔪᓪᓕ	Eetuuk	1	1	1	1	1	5
Inconnu	ᑲᐱᓯᓕᖅᐸᐃᑦ	Aanakhiik	2	1		1		4
Ocean fish (unspecified)	ᑕᓚᐅᖅᒥ ᐃᖃᓗᐃᑦ	Tagiumi ikaluit	1					1
Cod	ᐅᒪᐃᑦ	Ugak	114	118	145	186	242	502
Sculpin	ᑲᓇᓴᐃᑦ	Kanayuk	101	70	109	97	79	307
Turbot	ᖃᓕᖅᔪᓪᓕ	Nataarnak	14	9	4	13	1	23
Clams	ᐊᑲᒧᒪᓴᖅ	Uviluq	65	109	122	134	47	320
Mussels	ᐅᐱᓗᐃᑦ	Uviluvaloet	8	2	31	25	22	71

6.4

‡‡ No data are available corresponding to the harvest numbers shown in the harvest estimates table which were provided by DSD.

‡‡ ᑎᑎᕕᒋᔭᓂᒃ ᐱᑕᖃᖏᑐᖃᓂᒃ ᐱᓱᐊᓕᓐᓂᒃ ᐊᖏᔪᑦ ᖃᕐᓂᐅᓂᖏᓐᓄᑦ ᐊᓕᑲᐅᒪᔭᓄᑦ ᐊᖏᔪᓄᑦ ᓇᓕᐅᑦᑎᓐᓄᓐᓂᒃ ᐃᓄᐃᑦᑐᓕᕆᓂᖅ.

‡‡ Nahagauhimaitut titigakhimajunik pitman kanuk angujaukatakhimajunik kanukitunit pijaumajut ikupiktulikijinik.

References
Appendices

References

All documents listed as unpublished are available from the NWMB Resource Centre.

American Ornithologists' Union. 1998. Check-list of North American Birds. 7th Edition. American Ornithologists' Union, Washington, D.C.

Berkes, F., M. Berkes, and H. Fast. 1995. Designing the Nunavut Wildlife Anguyanik (Harvest) Study. Volume 1. Recommendations, Budget, Implementation Plan. Final Report – June 1995. Unpublished.

Berkes, F., M. Berkes, and H. Fast. 1995. Designing the Nunavut Wildlife Anguyanik (Harvest) Study. Volume 2. Technical Background Report – June 1995. Unpublished.

Cleator, H. 2001. Status of Ringed Seals in Western Hudson Bay. Department of Fisheries and Oceans report to the Nunavut Wildlife Management Board. Unpublished.

Donaldson, J. 1983. 1981 Wildlife Harvest Statistics for the Baffin Region, Northwest Territories. Technical report no. 1, Baffin Region Inuit Association.

Donaldson, J. 1984. 1982 Wildlife Harvest Statistics for the Baffin Region, Northwest Territories. Technical report no. 2, Baffin Region Inuit Association.

Fleming, M. 2002. Commercial Eiderdown Collection Report: 2001-02. Sanikiluaq: Sanniit Cooperative Ltd. Unpublished.

Gamble, R.L. 1988. Native Harvest of Wildlife in the Keewatin Region, Northwest Territories for the Period October 1985 to March 1986 and a Summary for the Entire Period of the Harvest Study from October 1981 to March 1986. Canadian Data Report of Fisheries and Aquatic Sciences no. 688. Winnipeg: Department of Fisheries and Oceans.

Government of Nunavut. 2002. 1999 Population by Age, Ethnicity and Sex. Evaluation and Statistics Division, Department of Executive and Intergovernmental Affairs. Unpublished.

Jingfors, K. 1986. Inuit harvesting levels of caribou in the Kitikmeot Region, Northwest Territories, Canada, 1982-1984. Rangifer, special issue no. 1:167-172.

Joint Secretariat. 2003. Inuvialuit Harvest Study, Data and Methods Report 1988 – 1997, Inuvik: Inuvialuit Joint Secretariat.

Jones, C., R. S. Hoffmann, D. W. Rice, R. J. Baker, M. D. Engstrom, R. D. Bradley, D. J. Schmidly, and C. A. Jones. 1997. Revised Checklist of North American Mammals North of Mexico, 1997. Occasional Papers, Museum of Texas Tech University, Number 173. web site: http://www.nsrl.ttu.edu/pubs/opapers/op173.htm

McClane, A.J. 1978. Field Guide to Freshwater Fishes of North America. Holt, Rinehart and Winston, New York.

Minister of Indian Affairs and Northern Development and Tungavik Federation of Nunavut. 1993. Nunavut Land Claims Agreement: Agreement Between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in right of Canada. Ottawa: Supply and Services Canada.

NLCA, 1993. See Minister of Indian Affairs and Northern Development and Tungavik Federation of Nunavut. 1993.

Nunavut Wildlife Management Board. 1994. Resolutions, Regular Meeting No. 5, DATE (June X, 2004). Resolution 95 – 052.

Nunavut Wildlife Management Board. 1995. Terms or Reference for the Nunavut Wildlife Management Board Harvest Study Steering Committee. Unpublished.

Nunavut Wildlife Management Board. 1995. Minutes, Harvest Study Steering Committee Meeting Number 1. Attachment "C". Record of Decisions. Unpublished.

Nunavut Wildlife Management Board. 1995. Nunavut Wildlife Harvest Study, Situation Report, As of 7 November 1995. Unpublished.

Nunavut Wildlife Management Board. 1996. Nunavut Wildlife Harvest Study, Situation Report, As of 9 February 1996. Unpublished.

Nunavut Wildlife Management Board. 1997. Resolutions, Regular Meeting No. 16, November 1997. Resolutions 98 – 058 and 98 – 059.

Nunavut Wildlife Management Board. 1998. Nunavut Wildlife Harvest Study Fieldworker's Manual – Revised Edition. Unpublished.

Usher, P., and Brooke, L. 2001. Assessment of Options for Collecting Statistical Data on Wildlife Harvesting in Nunavut. Report prepared for Government of Nunavut. Unpublished.

Appendix I

Article 5, part 4 of the NLCA
PART 4: NUNAVUT WILDLIFE HARVEST STUDY

5.4.1
A Nunavut Wildlife Harvest Study (Study) shall be undertaken in, and cover, each of the three Regions of the Nunavut Settlement Area. Terms of reference for the Study are set out in Schedule 5-5.

5.4.2
The Study shall begin in each of the three Regions on or before the first anniversary of the date of ratification of the Agreement. The Study shall be carried out under the direction of the NWMB.

5.4.3
The research, data collection and fieldwork associated with the Study shall be designed to promote maximum harvester participation and shall be contracted to an appropriate DIO, and supervised by the NWMB.

5.4.4
The Study shall be undertaken over a period of five years, and shall be fully funded by Government. The NWMB shall prepare a budget for the Study which will be subject to review by Government.

5.4.5
The purpose of the Study shall be to furnish data, to establish current harvesting levels, to assist the NWMB in establishing levels of total allowable harvest and, in general, to contribute to the sound management and rational utilization of wildlife resources in the Nunavut Settlement Area. To this end, the Study shall:

(a) document the levels and patterns of Inuit use of wildlife resources for the purpose of determining the basic needs level; and
(b) gather, review and analyse existing biological, ecological and harvest data pertinent to the management of wildlife in the Nunavut Settlement Area.

5.4.6
Raw and interpreted data produced from the Study shall be fully and freely available to the Government of Canada, the Territorial Government and Inuit.

5.4.7
The NWMB shall ensure that the names of individual harvesters are not revealed when making available data pursuant to Section 5.4.6.

5.4.8
Without the prior written permission of the DIO and affected individuals, evidence obtained through the Study relating to an individual shall not be admissible in any proceeding where the individual may be held civilly or criminally liable.

5.4.9
The NWMB shall report annually on the progress of the Study. Upon completion of the Study, the NWMB shall publish a comprehensive summary of the findings of the research.

Appendix II

NOCIR Form

Nunavut Wildlife harvest study

NOTIFICATION OF CHANGE IN REGISTRATION

Field Worker. Fill in sections 1, 2, & 3 as required. Fax a Copy to your Regional Liaison Officer.

Section 1 | **Today's Date** / /

Name of Hunter | **Community**

Type of Hunter **Intensive** ☐ **Active** ☐ **Occasional** ☐

Is this hunter already registered for the Study? **Yes** ☐ **No** ☐

Hunter's current ID number

If you know it

Hunter's new ID number

RLO or Coordinator only to assign a new ID number

Section 2 | **The hunter identified above no longer hunts here because they are:**

Deceased ☐ **Incarcerated** ☐ **Moved** ☐ **Other** ☐

Date **MONTH:** **YEAR:**

Section 3 | **Fill in this section if the Hunter is moving**

Community moving **FROM:** **TO:**

(OFFICE ONLY) Will this hunter also be added to the interview list? YES NO

Appendix III

Nunavut Wildlife Harvest Study Data Sheet

Nunavut Wildlife
harvest study data sheet

Hunter Code: _____ Page: _____ of _____

Community: _____ Interviewer: _____

Hunting Code: (circle one)
1) Harvested
2) Did not harvest
3) Could not contact
4) No longer hunts here (e.g. moved, deceased, incarcerated)

Interview Date (d/m/y): ____/____/____

For month of: _____

---------- caribou only ----------

Date d/m/y	Species	Number	Location[1]		Sex[2]			Age Group of Caribou				Type of Caribou (Peary, Barren Ground, Reindeer and Island caribou)
			Place Name	Map Code	M	F	U	Adult	Yrlg	Calf	Unk	
	eider down[3]											

[1] caribou, muskox, walrus, narwhal, beluga, char, lake trout, king eider, common eider, both species of eider eggs, and eider down
[2] caribou, muskox, walrus, narwhal, beluga, king eider, and common eider only
[3] in the number column, record the number of nests that feathers were taken from

Comments: (about animals, hunting conditions, group hunts, commercial sales, etc.)

ᑭᒃᑯᓕᖅᓯᒪᔪᖅ
ᐅᓪᓗᒥᓂ

ᓄᓇᕗᑦ

ᑕᒪᑎᐅ ᑎᑎᕋᓱᒪᔪᑦ ᐅᖃᓕᒫᓂᕆᓚᓱᒪᓕᕐᓂᑐᑦ ᐊᑐᐃᓐᓇᐅᔭᖅᑐᑦ ᓄᓇᕗᒻᒥ ᐅᓚᔪᓚᓗᓴᕐᕕᐊᓂᑦ ᐊᑐᐃᓐᓇᖏᖅᓯᓂᖅ.

American Ornithologists' Union. 1998. ᓄᓇᕗᐃᑉᐸᖏᖅᓯᑦ ᐅᐊᓐᓇᓂᑐᑦ ᐊᒥᐊᓚᒃᑯ ᑎᓕᒥᖏᔨᑎᖅᑎᑦ. 7ᖅᑎᑦ ᐊᓪᓚᑕᐅᓱᒪᔪᑦ. ᐊᒥᐊᓚᒃᑯ ᑎᓕᒥᓚᓗᓴᑦ ᑲᑐᔾᔨᖏᑎᖅᑎᑦ, ᐅᐊᓱᖓᑕᓪ, ᑎ.ᓱ.

Berkes, F., M. Berkes, and H. Fast. 1995. ᐃᓚᓪᓕᑎᓇᓂᖅ ᓄᓇᕗᒻᒥ ᐅᒪᓕᖅᑕᐅᔪᓂᑐᑦ ᖃᐅᔨᖏᓂᐅᔪᓕᒥᑦᑲ. ᐊᓪᓚᓕᐅᔪᓄ 1, ᐊᑐᓕᔪᐅᔪᓕᔪᑦ, ᑭᓇᐅᔭᖅᑐᑎᓪᓕᖏᓚᓂᑦ, ᕿᓇᐅᑎᑦ ᐊᑐᓂᖅᑎᑕᐅᓂᕐᖏᓚᓂᑦ. ᑭᖑᓪᓕᕐᓂᖅᓱᐅᑎᑦ ᐅᓂᒃᑲ - ᓴᓄ 1995. ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ.

Berkes, F., M. Berkes, and H. Fast. 1995. ᐃᓚᓪᓕᑎᓇᓂᖅ ᓄᓇᕗᒻᒥ ᐅᒪᓕᖅᑕᐅᔪᓂᑐᑦ ᖃᐅᔨᖏᓂᐅᔪᓕᒥᑦᑲ. ᐊᓪᓚᓕᐅᓄᓄᓂᓂᑐᑦ 2. ᐃᓚᓕᐅᑎᑎᖅᓂᑐᑦ ᐅᓂᒃᑲ - ᓴᓄ 1995. ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ.

Cleator, H. 2001. ᖃᓄᐃᓐᓂᑦ ᓇᓕᓱᑦ ᑭᐅᓪᓚᐅᑦ ᑕᓚᐅᖏᓂᓯ. ᐃᒪᒋᑎᐅᑕᓕᓚᓴᒪᔪᑦ ᐅᓂᒃᑲᓕᐊᖏᓂᑦ ᓄᓇᕗᑦ ᐃᒪᓕᔪᓚᓗᓴᕐᕕᐊᒪᔪᓐᓇᑦ. ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ.

Donaldson, J. 1983. 1981ᒥ ᐃᒪᓕᖅᑕᐅᔭᓕᑦᑐᓂᓕ ᓇᐃᖅᑕᐅᓕᔪᓕᑦ ᖁᑭᖅᑕᒍᒍᒧᑦ, ᓄᓇᑎᐊᒋᒥ. ᐃᓚᓕᐅᑎᑎᖅᓂᖅ ᐅᓂᒃᑲ 1, ᖁᑭᖅᑕᒍᒍᒥ ᐃᓄᐃᑦ ᑲᑐᔾᔨᖏᑎᖅᑎᑦ.

Donaldson, J. 1984. 1982ᒥ ᐃᒪᓕᖅᑕᐅᔭᓕᑦᑐᓂᓕ ᓇᐃᖅᑕᐅᓕᔪᓕᑦ ᖁᑭᖅᑕᒍᒍᒧᑦ, ᓄᓇᑎᐊᒋᒥ. ᐃᓚᓕᐅᑎᑎᖅᓂᖅ ᐅᓂᒃᑲ 2, ᖁᑭᖅᑕᒍᒍᒥ ᐃᓄᐃᑦ ᑲᑐᔾᔨᖏᑎᖅᑎᑦ.

Fleming, M. 2002. ᓂᐅᕐᑭᐅᓴᓂᑦ ᖃᓄᖅᖁᑕᑕᐅᔭᓕᑦᑐᓂᓕ ᐅᓂᒃᑲᓂᑦ: 2001-02. ᓴᓂᓕᔪᐊᒋᒥ: ᓴᓂᑦ ᔨᐊᓱᒪᔪᖅᑎᓄᑦ. ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ.

Gamble, R.L. 1988. ᓄᓇᖅᑲᖅᑕᑦ ᐃᒪᓕᖅᓴᓐᓂᑦ ᑭᐅᓪᓚᒥ, ᓄᓇᑎᐊᖅ ᐱᑎᐊᖅᑐᒍ ᐅᓵᑐᓂ 1985ᒥᑦ ᐃᓪᓗ 1986ᒍᑦ ᐊᒪᒪᓗ ᐅᖃᐅᓯᓴᓚᐅᑦ ᓇᐃᓐᖅᑐᑦ ᐱᓕᐊᖅᑐᑦᑲᓂᐊᖅᓯᓂᑦ ᖃᐅᔨᖏᓂᐅᔨᑦ. ᑲᓇᑕᒥ ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ ᐅᓂᒃᑲᓕᐊᖏᓂᑦ ᐃᖅᑲᓚᓇᓂᒥᑦ ᐃᒪᒋᑎᐅᑕᓂᓐ ᖃᐅᔨᖏᓂᐅᔪᓕᓇᓂᑦ ᐃᓚᓕᐅᑦ 688. ᐅᐃᓂᐲᑦ: ᐃᒪᒋᑎᐅᑕᓚᓴᒪᔪᑦ.

ᓄᓇᑦ ᓚᕈᒪᔪᑦ. 2002. 1999ᒥ ᐃᓄᒋᑎᑎᒋᓂᖅᑐᑦ ᐅᑭᐅᖅᑕᒍᑦ, ᑭᓇᐅᓂᖓᔪᑦ ᐊᒪᓚᓇ ᐊᖓᔪᑕᐅᔪᓂ ᐊᓪᓚᓇᐃᓂ. ᖁᒥᖅᑭᐅᓂᑦ ᓇᐃᓕᐅᓚᓇᓐᓇᓪ, ᓚᕈᒪᓚᓇᓴᒪᓂᓪ. ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ.

Jingfors, K. 1986. ᐃᓄᐃᑦ ᖃᑎᒌᓄᑦ ᑕᑎᑐᒥᐅᓂ, ᓄᓇᑎᐊᖅ, ᑲᓇᑕ, 1982ᒥᑦ 1984ᒍᑦ. *Rangifer*, ᐊᓪᓚᓕᐅᓂ ᓇᐃᐅᑦ 1:167-172.

Joint Secretariat. 2003. ᐃᓄᓕᒪᓄᐃᑦ ᐃᒪᓕᖅᑕᐅᔭᓕᑦᑐᓂᓕ ᖃᐅᔨᖏᑎᑎ, ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ ᐱᓪᓚᕕᓪᓕᓪᓗ ᐅᓂᒃᑲᓂᑦ. 1988-1997 ᐃᓄᓕᒪᓄᐃᑦ: ᐃᓄᓕᒪᓄᐃᑦ ᑲᑐᔾᔨᖏᑎᑦ ᑎᒥᖅᓱ.

Jones, C., R. S. Hoffmann, D. W. Rice, R. J. Baker, M. D. Engstrom, R. D. Bradley, D. J. Schmidly, and C. A. Jones. 1997 ᓄᑦᖅᓯᒪᔪᖅᕕᓂᑦ ᓇᓚᐃᓚᔾᔪᑎᑎᒋᑦ ᐅᐊᓐᓇᓂᑐᑦ ᐊᒥᐊᓚᒃᑯ ᓂᕆᔨᑎᐅᔪᓂᑐᑦ ᒥᑭᑎᑎᒋᓂᖅ. ᒥᑭᑎᑎᒋᓂᖅ ᑲᑎᕕᒃᑲᓂᖅ, ᑕᓄᑑᓚᖏᖅᑐᑦ ᑎᑭᓯᑦ ᓴᓇᑐᓂᖏᓚᐅᓂ, ᓇᓚᐅᑎᖓ 173. ᖃᓇᑕᐅᔾᔨᖓᓂ ᑐᖃᓕᑎᖓ: http://www.nsrl.ttu.edu/pubs/opapers/op173.htm

McClane, A.J. 1978. ᑐᑭᒍᐊᓕᑎᑦ ᑕᓯᖁᐅᑕᓂᑐᑦ ᐃᖃᓗᓐᓂᑐᑦ ᐅᐊᓐᓇᓂᑐᑦ ᐊᒥᐊᓚᒃᑯ. ᕼᐅᑦᑐ, ᖁᐃᖅᕼᐊᖁᑦᑎ ᐊᓪᓚᓕ ᐅᐃᓚᑎᖅ, ᓂᐅ ᔨᐊᖅ.

ᒥᓴᑕ ᐃᓄᕋᓚᐅᖃᓕᓂᑦ ᐊᓪᓚᓕ ᑐᖅᓚᐃᓚᔾᔪᓂᑦ ᓄᓇᕗᒻᒥ. 1993. ᓄᓇᑦ ᓄᓇᕈᑎᒍᑦ ᐊᖅᑭᑎᑎ: ᐊᖅᑭᑎᑎᐅᔨᖅᖁᓪᓗᑦ ᐃᓄᓕᒪᓄᐃᑦ ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦᑐᑦ ᐃᓚᐃᓐᓇᓪ ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ ᐃᓄᓕᒪᓄᐃᑦ ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ ᐊᒥᐊᓚᒃᑯ ᐃᓄᓕᒪᓄᐃᑦ ᓄᓇᕗᒻᒥ. ᐊᑐᓂᑦ: ᓴᓇᓂᕈᑦᑎᓂᑦ ᐱᓕᕆᔨᑦᑎᓂᑦ ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ.

ᓄᓇᕈᑎᒍ, 1993. ᑕᑯᓗᒃ ᒥᓴᑕ ᐃᓄᓕᒪᓄᐃᑦᑐᓂᓕ ᐊᒥᐊᓚᒃᑯ ᐃᓄᓕᒪᓄᐃᑦ ᓄᓇᕗᒻᒥ. 1993.

ᓄᓇᕗᑦ ᐃᒪᓕᕐᓂᖅᓱᒪᔪᑦ ᑲᑎᒪᔨᖏᓂᑦ. 1984. ᐱᖓᓱᓕᖅᓯᒪᒍ, ᑲᑎᒪᓂᐃᑦᓴᖅ ᓇᐃᓐᑕ 5, ᑭᓇᖅᓴᓗ (ᓴᓄ, 2004). ᐱᖓᓱᓕᖅᓯᒪᓕᒃ 95-052.

ᓄᓇᕗᑦ ᐃᒪᓕᕐᓂᖅᓱᒪᔪᑦ ᑲᑎᒪᔨᖏᓂᑦ. 1995. ᓄᓇᕗᐃᑉᐸᖏᖅᓯᑦ ᒪᓂᕆᔨᑦᑎᓂᑦ ᓄᓇᕗᒻᒥ ᐃᒪᓕᕐᓂᖅᓱᒪᔪᑦ ᖃᐅᔨᖏᓂᐅᔪᓂᒃᑲᓂᕐᓂᑦ ᑲᑎᒪᔨᖏᓕᕆᓚᐅᓂᑦ. ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ.

ᓄᓇᕗᑦ ᐃᒪᓕᕐᓂᖅᓱᒪᔪᑦ ᑲᑎᒪᔨᖏᓂᑦ. 1995. ᑲᑎᒪᔨᑎᑎᓂᑦ ᐃᒪᓕᖅᑕᐅᔭᓕᑦᑐᓂᓕ ᖃᐅᔨᖏᓂᐅᔪᓕᒥᑦ ᑲᑎᒪᔨᖏᓕᕆᓚᐅᓂᑦ. ᑲᑎᒪᓂᐅᔨ ᓇᐃᓐᑕ 1. ᐃᖅᓯᓕᕐᓂᑎᖅᓂᑦ "ᑎᑎ". ᓇᓕᖅᖃᐃᑦ ᐃᓱᒪᓕᐅᕈᑕᐅᔪᓂᓂᓪ. ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ.

ᓄᓇᕗᑦ ᐃᒪᓕᕐᓂᖅᓱᒪᔪᑦ ᑲᑎᒪᔨᖏᓂᑦ. 1995. ᓄᓇᕗᒻᒥ ᐃᒪᓕᖅᑕᐅᔭᓕᑦᑐᓂᓕ ᖃᐅᔨᖏᓂᐅᔪᓕᒥᑦ. ᑲᑎᒪᔨᖏᓕᕆᓚᐅᓂᑦ ᑲᑎᒪᔨᖏᓂᐅᔪᓕᒥᑦ, ᐅᓂᒃᑲᓂᑦ 7 1995 ᑎᑭᑦᑐᒍ. ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ.

ᓄᓇᕗᑦ ᐃᒪᓕᕐᓂᖅᓱᒪᔪᑦ ᑲᑎᒪᔨᖏᓂᑦ. 1996. ᓄᓇᕗᒻᒥ ᐃᒪᓕᖅᑕᐅᔭᓕᑦᑐᓂᓕ ᖃᐅᔨᖏᓂᐅᔪᓕᒥᑦ. ᑲᑎᒪᔨᖏᓕᕆᓚᐅᓂᑦ ᑲᑎᒪᔨᖏᓂᐅᔪᓕᒥᑦ, ᐃᓕᐊᓗ 9 1996 ᑎᑭᑦᑐᒍ. ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ.

ᓄᓇᕗᑦ ᐃᒪᓕᕐᓂᖅᓱᒪᔪᑦ ᑲᑎᒪᔨᖏᓂᑦ. 1997. ᐱᖓᓱᓕᖅᓯᒪᒍ, ᑲᑎᒪᓂᐃᑦᓴᖅᒥ ᐃᓚᐃᓐᓇᓪ 16, ᓃᐃᐱᓗ 1997. ᐱᖓᓱᓕᖅᓯᒪᓕᒃ 98-058 ᐊᒥᓚᓇ 98-059.

ᓄᓇᕗᑦ ᐃᒪᓕᕐᓂᖅᓱᒪᔪᑦ ᑲᑎᒪᔨᖏᓂᑦ. 1998. ᓄᓇᕗᒻᒥ ᐃᒪᓕᖅᑕᐅᔭᓕᑦᑐᓂᓕ ᖃᐅᔨᖏᓂᐅᔪᓕᒥᑦ ᓴᓇᖅᑎᑦ ᐅᖃᓕᒫᓂᖅ - ᓄᑦᖅᓯᒪᔪᖅᕕᓂᑦ. ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ.

Usher, P., and Brooke, L. 2001. ᑐᓴᐅᒪᔪᓂᑦ ᓇᓕᕆᓚᐅᓂᑦ ᓄᓇᕗᑦᑎᓪᓗᒍ ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦᑐᓂᓕ ᓄᓇᕗᒻᒥ. ᐅᓂᒃᑲᓕᐊᖏᓂᑦ ᓄᓇᕗᑦ ᓚᕈᒪᓕᖅᑕᑦ. ᐊᓪᓚᓕᐅᓕᖏᓪᓕᑦ.

ᐅᐃᒍᖏᑦ I

ᐃᓕᓴᕐᓂᓄᓂ 5, ᐃᓕᖓ 4 ᓄᓇᑦᑕᑎᓂ
ᐃᓕᖓ 4: ᓄᓇᕗᑦ ᐅᒪᔨᖅᑕᐅᓯᒋᐊᓂᖅ ᖃᐅᔨᓴᖅ

5.4.1

ᓄᓇᕗᑦ ᐅᒪᔨᖅᑕᐅᓯᒋᐊᓂᒃ ᖃᐅᔨᓴᕐᑎᓴᖅ (ᖃᐅᔨᓴᖅ) ᐱᓕᕆᖏᓐᓄᐊᖅᓴᖅ ᐅᑯᓇᓂ, ᐱᓕᕆᓚᐲᒪᔨᑐᑦ, ᐱᖓᓱᑦ ᐊᐃᑎᑐᖅᓯᒪᔪᐃᓐᓇᑦ ᐊᑐᓂ ᓄᓇᕗᑦ ᓄᓇᑦᑕᑎᐅᓯᒪᔪᑦ ᐃᓗᐊᓂ. ᓇᓗᓇᐃᔨᐅᑎᑦ ᒪᓕᕆᐊᓵᓄᑦ ᖃᐅᔨᓴᖅ ᐱᓕᓗᒍ ᓴᓇᓇᐃᔨᖅᑕᐅᓯᒪᔪᑦ ᐊᖏᔪᑕᕐᓂᖅ 5-5.

5.4.2

ᖃᐅᔨᓴᓂᖅᓯᒪᔪᖅᓴᖅ ᐊᑐᓂ ᐱᖓᓱᑦ ᐊᐃᑎᑐᖅᓯᒪᔪᐃᓐᓇᑦ ᑕᐃᒃᓂᓂ ᑯᓘᑎᓂ ᓇᓕᐅᓂᖅᓯᐅᑎᑕᐅᓂᖓᓪᓕ ᐊᖏᑎᑎᑎᐅᓕ ᐊᑎᓕᐅᑎᑕᐅᓯᒪᓂᖓᓪᓕ ᐅᓪᓗᖓᓂ. ᖃᐅᔨᓴᓂᖅ ᐱᓕᕆᖓᓂᖅᓯᒪᔪᖅᓴᖅ ᑐᑭᒪᓕᕆᓂᐅᔪᓂᓂ ᓄᓇᕗᑦ ᐅᒪᔨᓕᓚᓴᕐᔪᐊᓘᓐᓃᑦ ᑲᑎᒪᔨᖏᑦ.

5.4.3

ᖃᐅᔨᓴᓂᖅ, ᓄᐊᕐᑎᓚᓂᖅ ᐊᓪᓚᑎᓴᕐᓂᒃ ᐊᒪᓚᐅ ᓴᓚᕐᔪᓂᓪᓕ ᖃᐅᔨᓴᓂᖅ ᐱᓪᓗᒍ ᐃᓂᓪᓚᖓᓂᖅᓯᒪᔪᖅᓴᖅ ᑲᔪᖏᖅᓴᓕᐅᑎᓯᒪᔪᓐᓇᖅᑐᒥᒃ ᐃᓚᐅᑎᐊᖅᑐᓂᑦ ᐅᓴᔪᕐᓴᐅᑎᓂᖅ ᐊᒪᓚᐅ ᐱᓕᕆᓂᐹᓴᖅᑕᐅᓯᒪᔪᖅᓴᖅ ᐱᓕᕆᓚᐲᒪᔨᓐᓇᖅᑐᒃᓗᑦ ᐃᓚᐅᑦ ᐅᑎᖅ ᑎᒥᖅᑎᐊᓂᖅ ᐊᒪᓚᐅ ᓇᕗᑦᑐᓐᓇᖅᑐᒃᓗᑦ ᐃᓚᐅᑦ ᓄᓇᕗᑦ ᐅᓇᓕᕆᔨᓴᕐᔪᐊᓘᓐᓃᑦ.

5.4.4

ᖃᐅᔨᓴᓂᖅᓯᒪᔪᖅᓴᖅ ᐅᑭᐅᓂ ᑕᕐᓚᓂᑦ, ᐊᒪᓚᐅ ᑭᓇᐅᔨᖅᑎᑎᑕᐅᑎᓪᓗᒍ ᓴᓪᓚᕐᔪᓂᖅ. ᓄᓇᕗᑦ ᐅᒪᔨᓚᓂᔪᓇᖅᑐᒥᑦ ᐊᑐᐃᓐᓇᐅᔪᓂᖅᓴᖅ ᑭᓇᐅᔨᖅᑎᑎᑕᐅᑎᓪᓗᒍ ᐱᓇᓱᖅᑐᓂᖅᓴᖅ ᖃᐅᔨᓴᖅᓯᕐᓚᐅᑦ ᕿᒥᕐᒥᐅᑕᖅᓯᒪᓂᖓᓪᓕ ᓴᓪᓚᕐᔪᓂᖅ.

5.4.5

ᖃᐅᔨᓴᓂᓕᑦ ᐱᔭᕆᐅᓯᒪᔪᖅᓴᖅ ᓴᖅᑭᖏᓕᓪᓕᑎᑦ ᐊᓪᓚᑕᕐᓴᐅᓂ, ᐊᓴᖅᑎᑎᖏᓕᓪᓕᑎᑦ ᒪᓐᓇᐅᑦᑐᖅᑐᒃᓴᖅ ᐅᒪᔨᖅᑕᐅᔨᓐᓇᖅᑐᒃᓗᑦ, ᐃᑲᔪᖅᑕᐅᑎᖏᓕᓪᓕᑎᑦ ᓄᓇᕗᑦ ᐅᒪᔨᓚᓂᔪᓇᖅᑐᒥᑦ ᐊᓴᖅᑎᑎᖏᓕᓪᓕᑎᑦ ᑭᓇᐅᔨᖅᑎᑎᑕᐅᑎᓪᓗᒍ ᐱᓪᓚᕐᔪᓂᖅᓴᖅ ᐅᒪᔨᖅᑕᐅᔨᓐᓇᖅᑐᒃᓗᑦ ᐃᓚᐅᑦ ᐃᓗᐊᓂᑦ ᐊᒪᓚᐅ ᐃᓗᓚᓂᐅᓚᓇᖅᑐᒥᓂᖅᑐᒃᓗᑦ ᐅᓂᓴᑎᑦ ᐱᓕᕆᖓᓂᖅᓯᐅᑎᓂᖅᑐᒃᓗᑦ ᓄᓇᕗᑦ ᓄᓇᑦᑕᑎᐅᓯᒪᔪᑦ ᐃᓗᐊᓂ. ᑕᒪᑐᒧᖏᑐᒃ, ᖃᐅᔨᓴᓂᖅ ᐃᒪᓕᐃᓐᓇᖅᑎᑦ:

(ᐃ) ᑎᑎᕐᑐᕆᓯᒪᔪᑦ ᑭᓚᓕᐅᑦᑐᑦᑐᓂ ᖃᓄᐃᑦᑐᖅᑐᓂ ᐃᓄᐃᑦ ᐅᓂᓴᑎᑦ ᐱᓕᕆᖓᓂᖅᓯᒪᔪᑦ ᓴᖅᑭᑎᓪᓗᒍ ᐅᓂᓴᑎᑦ ᐱᓕᕆᓚᐲᒪᔨᑐᑦ ᓇᓗᓄᐃᑦ ᓴᖅᑭᖏᓕᓪᓕᑎᑦ ᓇᓗᓄᐃᑦ ᐅᓂᓴᑎᑦ ᐱᓕᕆᓚᐲᒪᔨᑐᑦ ᓇᓗᓄᐃᑦ ᐅᓂᓴᑎᑦ ᐱᓕᕆᓚᐲᒪᔨᑐᑦ ᐊᑐᓂ;

(ᐱ) ᓕᐊᓕᓂᑦ, ᕿᒥᕐᒥᓂᑦ ᐊᒪᒪ ᑐᑭᓯᓚᓕᓂᑦ ᐊᑐᐃᓐᓇᐅᔨᓴᑦ ᐅᓂᓴᑎᑦ ᐱᓇᓱᖅᑐᒥᒃ ᐊᒪᓚᐅ ᐊᑎᓕᐅᑎᓯᒪᓂᑦ ᐅᓂᓴᑎᑦ ᐱᓕᕆᖓᓂᖅᓯᐅᑎᓯᒪᓂᑦ ᐱᒪᓂᖅᑕᐅᓯᒪᔪᑦ ᓄᓇᕗᑦ ᓄᓇᑦᑕᑎᐅᓯᒪᔪᑦ ᐃᓗᐊᓂ.

5.4.6

ᑎᑎᕐᑐᕆᓯᒪᔪᑦᑐᖅᓯᒪᔪᑦ ᑐᑭᓯᐅᓚᓯᒪᔪᓕᒃ ᖃᐅᔨᓴᖅᓯᒥᑦ ᐊᑐᐃᓐᓇᐅᔪᓂᖅᓴᖅ ᑕᒪᑎᑦᑐᖅ ᒪᓂᒪᑎᐊᖅᓯᑎᓂᑦ ᓴᓇᕗᑦᑐᖅᑐᑦ, ᑲᑎᒪᔨᖏᑦᑐᓂᑦ, ᑲᑎᒪᔨᖏᓐᓄᑦ ᐊᒪᓚᐅ, ᐃᓐᓄᓂᑦ.

5.4.7

ᓄᓇᕗᑦ ᐅᒪᔨᓚᓂᔪᓇᖅᑐᒥᑦ ᓇᓕᑐᑐᓯᐊᖅᓯᒪᔪᖅᓴᖅ ᐊᑎᓚᐅᑦᑐᓯᐊᓘᓐᓃᑦ ᐹᐃᓂᖏᓐᓄᑐᓂ ᐊᖏᔪᐊᖅᓯᑎᑎᑦ ᐱᖓᓱᖅᑕᐅᓯᒪᔪᖅᓴᖅ ᐊᑐᐃᓐᓇᐅᔪᓂᑕᐅᑎᑦ ᐊᒪᓚᐅ ᑭᓚᓕᐅᑦᑐᖅᓯᒪᔪᑦ ᒪᓕᓐᓄᑦ ᐊᑐᐃᓐᓇᐅᔪᓂᖅᓴᖅ ᐊᒪᓚᐅ ᐅᓇᓕᕆᔨᓴᕐᔪᐊᓘᓐᓃᑦ 5.4.6

5.4.8

ᓴᖅᑭᖏᓕᓪᓕᑎᑦ ᑎᑎᕐᑐᕆᓯᒪᔪᖅᓴᖅ ᐊᖏᔪᑕᕐᓂᖅᓴᖅ ᐃᓐᓄᓂᑦ ᑎᑎᕐᑐᕆᓯᒪᔪᑦ ᐊᒪᓚᐅ ᐊᑐᐃᓐᓇᐅᔪᓂᑕᐅᑎᓯᒪᓂᑦ ᐹᐃᓂᑦ, ᓇᓗᓇᐃᔨᐅᑎᑦ ᓇᓕᐅᓂᖅᓯᐅᑎᓯᒪᔪᑦ ᓇᓕᑐᑐᓯᐊᖅᓯᒪᔪᑦ ᖃᐅᔨᓴᖅᓯᒥᑦ ᐱᒪᓂᖅᑕᐅᓯᒪᔪᑦ ᐊᒪᓚᐅ ᐊᑐᐃᓐᓇᐅᔪᓂᑕᐅᑎᓯᒪᓂᑦ ᐃᓐᓄᓂᑦ ᐊᑐᐃᓐᓇᐅᔪᓂᑕᐅᑎᓯᒪ

ᐅᐃᒍᖏᑦ II

ᑐᓴᕆᑎ ᐊᓯᔾᔨᕈᑎᐅᔪᓂᖅ ᐊᑎᓕᐅᖏᓪᓗᓇᓂ

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ᑐᓴᖏᑎᕐᓯᔾᔪᑎ ᐊᓯᔾᔨᕈᑎᐅᔪᓂᖅ ᐊᑎᖏᖅᑕᐅᔪᓂᖅ

ᐊᓪᓚᖅᑎ. ᑕᑕᑎᖅᑎᑦ ᓇᓴᐅᑎᐅᖅᑐᑦ 1, 2, ᐊᓗᒪᓗ 3 ᐱᒃᓭᐊᖏᖅᑐᓕ. ᐊᑦᔨᖏᓂᖅ ᓯᖏᓇᖅᓯᑦ ᐊᐅᑦᓭᒥᕐᓯᐃᑦᑐᓗᒍ ᐊᐃᑦᑐᖅᓯᓯᒪᔪᓂᕐᓂᖅ ᑐᓴᐅᒥᓪᓚᕆᐅᔪᖅ.

ᓇᓴᐅᑎ 1	ᐅᑦᑐᒥ / /
ᐊᖏᓂᐊᖅᑎᐅᑦ ᐊᑎᖓ	ᓄᓇᓕᑦ
ᖃᓄᖅ ᐊᖏᓂᐊᖅᑎᐅᑎᒋᔭᖓ: ᐊᑦᓯᒃᓴᓪ ☐ ᑕᐃᒪᓐᓇᓪ ☐ ᖃᐅᑎᔪᓂᑦ ☐	
ᑕᑯᓗ ᐊᖏᓂᐊᖅᑎᐅᓕᖅ ᐊᑎᖃᖅᑕᐅᔪᕐᓂᖅᑐᑦ ᖃᐅᔨᓴᓂᒪᑦ? ᐃ ☐ ᐋᖅᑭ ☐	
ᐊᖏᓂᐊᖅᑎᐅᑦ ᐅᑦᑐᒥ ᓇᓗᓇᐃᔪᐅᑕᖓᑕ ᓇᓴᐅᑎᖓ ᖃᐅᔨᓴᓂᒪᑦ	ᐊᖏᓂᐊᖅᑎᐅᑦ ᓇᓗᓇᐃᔪᕈᒡᒐ ᓇᓴᐅᑎᐅᓕᖓᑕᖓ ᑐᓴᐅᒥᓪᓚᕆᐅᔪᖅ ᐃᓚᖓ ᐊᑐᐅᓪᓚᕆᐅᔪᖅ
ᓇᓴᐅᑎ 2	ᐊᖏᓂᐊᖅᑎᐅ ᓇᓗᓇᐃᖅᑕᐅᓕᖅ ᖃᔪᓂ ᑕᒪᓂ ᐊᖏᓂᓕᕆᔨᒋᔭᖅᑐᖅ ᐅᓂᐊ ᓇᒃᓚᐅ ᐱᑦᓗᒍ:
ᑐᓂᓯᔪᓕᖅᑐᖅ ☐ ᑎᒍᐅᒪᓕᖅ ☐ ᓄᑖᖅᑐᒥᓂᖅ ☐ ᐊᓕᐊᓂᖅ ☐	
ᐅᑦᑐᖓ ᑕᖅᑭᒥ: ᐅᑭᐅᒥ:	
ᓇᓴᐅᑎ 3	ᑕᑕᑎᖅᑎᑦ ᐅᓂᐊ ᐊᖏᓂᐊᖅᑎᐅᓕᖅ ᓄᑖᖅᑐᑐᒥᐅᔪᓂ
ᓄᓇᓕᒪᓂ ᓄᑖᖅᑐᖅ ᓇᑭᑦ: ᓇᒧᑦ:	

(ᐊᑦᓚᓚᒪᒥ ᑭᓯᐊᓂ) ᐊᖏᓂᓕᕆᔨᒋᔭᖅᑐᖅ ᑕᑯᓗ ᐱᖁᓯᐅᑎᖅᑎᐅᓂᓕᕆᓚᒃ ᐊᐱᖅᓯᖏᓐᓄᑦᓴᓂᑦ? ᐃ ᐋᖅᑭ

ᐅᐃᒍᖏᑦ III

ᓄᓇᕗᒻᒥ ᐅᒪᔪᖅᑕᐅᓯᑦᑐᓂᒃ ᖃᐅᔨᓴᕆᐊᐅᓪᓗᒍᓱᑦ ᓇᓕᖅᖏᑦ



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ᐊᖏᓇᓯᑎᐅᑦ ᓇᓂᓇᐃᖏᓪᓕ: _____ ᒪᔾᕐᑐᒍᖏᑦ: _____ ᐅᓄᓇᖏᓪᓕ _____

ᓄᓇᖏᓪᓕ:_____ ᐊᐱᔾᓯᕐᑐᖅ: _____

ᐊᖏᓇᓯᖅᓯᒪᔪᑦ ᓇᓂᓇᐃᐅᓄᑎᑦ: (ᐊᐅᓚᓂᔪ ᐊᑕᐅᓯᖅ)
1) ᐊᖏᓇᓯᓂᐅᑦᑐᖅ
2) ᐊᖏᓇᓯᓂᐅᖏᑦᑐᖅ
3) ᐊᐱᔾᓯᑕᐅᖏᑦᑐᖅ
4) ᐊᖏᓇᓯᓯᐊᓄᓕᕐᑐᖅ ᑕᒪᓂ (ᐃᓗᒪᖅ ᐊᐅᓪᓚᑦᑐᒥᓂᖅ, ᑐᔾᔪᐸᒥᓂᖅ, ᑎᐅᔭᐅᒪᔪᑦ)

ᐊᖏᓇᓯᖅᓯᒪᔪᑦ ᐅᓂᒃᑳᖅᑐᑦ: _____/_____/_____

ᑕᕆᒥ ᐅᓂᓂ: _____

---------- ᑐᑦᑐᓄᑦ ᑭᓯᐊᓂ ----------

ᐅᓪᓗᒥᒃ ᐅ/ᑕ/ᐊ	ᐅᒪᔪᑦ	ᐊᒥᓱᓂ ᖃᓄᖅ	ᓇᒻᒥᖅᓯᒪᔪᖅ [1]		ᑭᓱᓂᖅᓯᒪᔪᖅ [2]			ᐊᓯᖏᓪᓕᕆᔨᖅ ᐅᓪᓗᒥ ᑐᑦᑐᐃᓐᓇᑦ				ᖃᓄᐃᓕᑐᖅᓯᒪᔪᖅ ᑐᑦᑐᑦ (ᓯᓚᖏᓪᓕᐊᑕᐅᓂᖅ, ᖃᓄᖅᑐᑦᑐᒥᓂᖅ, ᑐᑭᓯᒋᐊᕐᓂᖅ)
			ᓄᓇᐅᓂ ᐊᑎᖅᑐᒃ	ᓄᓇᖅᑐᒥᓂ ᓴᓇᐅᑦᑎ	ᐊᒃ ᖃᓄᖅ	ᐊᑦ ᖃᓄᖅ	ᓄᓪᓕ ᐊᒃᑲᓐᓂᖅ ᑐᑦᑐᓄᑦ	ᐃᓐᓇ ᖃᓄᖅ	ᑎᒍᑎᓪᓕ ᖃᓄᖅ ᑐᑦᑐᓄᑦ	ᓄᓪᓕ ᖃᓄᖅ	ᓄᓪᓕ ᐊᒃᑲᓐᓂᖅ ᑐᑦᑐᓄᑦ	
	ᒥᑎᑦ ᖃᓄᐃᖅᑐᑦ [3]											

[1] ᑐᑦᑐᓄᑦ, ᐅᒥᓪᓚᓄᑦ, ᐊᑐᐃᑦ, ᑐᓴᕆᓂᑦ, ᑐᓴᓚᓂᑦ, ᑕᓯᖏᑦ ᐃᐃᓴᐃᖅᐅᓄᑦ, ᖃᖅᖏᓚᓂᑦ ᒥᑎᑦ, ᒥᑎᑦ, ᑕᒪᐃᖅᓂᓄᑦ ᒥᑎᓂᑦ ᒪᓐᓂᑦ, ᐊᖏᓚᓗ ᒥᑎᑦ ᖃᓄᐃᖅᑐᑦ
[2] ᑐᑦᑐᓄᑦ, ᐅᒥᓪᓚᓄᑦ, ᐊᑐᐃᑦ, ᑐᓴᕆᓂᑦ, ᑐᓴᓚᓂᑦ, ᖃᖅᖏᓚᓂᑦ ᒥᑎᑦ, ᒥᑎᑦ, ᑕᒪᐃᖅᓂᓄᑦ ᒥᑎᓂᑦ ᒪᓐᓂᑦ, ᐊᖏᓚᓗ ᒥᑎᑦ ᖃᓄᐃᖅᑐᑦ
[3] ᑕᑦᓂᓂ ᐊᒥᓱᓂᖅᑕ ᐊᑕᓂ, ᑎᑎᕋᖅᓯᒪᔪᑦ ᐊᒥᓱᓂᖅᑐᑦ ᐃᓕᓴᐃᓂᑦ ᓱᓇᐅᓂᒃ ᓄᐊᕐᓂᐃᐅᓕᕐᑐᑦ

ᐅᖃᐅᓯᓂᕆᑦ: (ᐱᓕᓂᑦ ᐅᒪᔪᑦ, ᐊᖏᓇᓯᓂᐅᑦ ᖃᓄᐅᓕᖅᓂᖅ, ᐊᒥᓱᓕᓂᑎᑎᒃ ᐊᖏᓇᓯᓂᑐᑦ, ᑭᓇᐅᔨᔪᓐᓇᑎᓂᑦ ᓂᐅᔨᕈᑕᐅᓕᕐᑐᑦ, ᐊᓯᖏᓂᓕᓂ)

Naunaiyautait
Ilanganiitut

Atukatakviit

Tamamik makpigaat titigakhimaitumik pihimayut pilaaktut NWMBkut titigakviani tutkuktuivianit.

American Ornithologists' Union. 1998. Check-list of North American Birds. 7th Edition. American Ornithologists' Union, Washington, D.C.

Berkes, F., M. Berkes, and H. Fast. 1995. Designing the Nunavut Wildlife Anguyanik (Harvest) Study. Volume 1. Recommendations, Budget, Implementation Plan. Final Report – June 1995. Unpublished.

Berkes, F., M. Berkes, and H. Fast. 1995. Designing the Nunavut Wildlife Anguyanik (Harvest) Study. Volume 2. Technical Background Report – June 1995. Unpublished.

Cleator, H. 2001. Status of Ringed Seals in Western Hudson Bay. Department of Fisheries and Oceans report to the Nunavut Wildlife Management Board. Unpublished.

Donaldson, J. 1983. 1981 Wildlife Harvest Statistics for the Baffin region, Northwest Territories. Technical report no. 1, Baffin Region Inuit Association.

Donaldson, J. 1984. 1982 Wildlife Harvest Statistics for the Baffin region, Northwest Territories. Technical report no. 2, Baffin Region Inuit Association.

Fleming, M. 2002. Commercial Eiderdown Collection Report: 2001-02. Sanikiluaq: Sanniit Cooperative Ltd. Unpublished.

Gamble, R.L. 1988. Native Harvest of Wildlife in the Keewatin Region, Northwest Territories for the Period October 1985 to March 1986 and a Summary for the Entire Period of the Harvest Study from October 1981 to March 1986. Canadian Data Report of Fisheries and Aquatic Sciences no. 688. Winnipeg: Department of Fisheries and Oceans.

Government of Nunavut. 2002. 1999 Population by Age, Ethnicity and Sex. Evaluation and Statistics Division, Department of Executive and Intergovernmental Affairs. Unpublished.

Jingfors, K. 1986. Inuit harvesting levels of caribou in the Kitikmeot Region, Northwest Territories, Canada, 1982-1984. *Rangifer*, special issue no. 1:167-172.

Joint Secretariat. 2003. Inuvialuit Harvest Study, Data and Methods Report 1988 – 1997, Inuvik: Inuvialuit Joint Secretariat.

Jones, C., R. S. Hoffmann, D. W. Rice, R. J. Baker, M. D. Engstrom, R. D. Bradley, D. J. Schmidly, and C. A. Jones. 1997. Revised Checklist of North American Mammals North of Mexico, 1997. Occasional Papers, Museum of Texas Tech University, Number 173. web site: http://www.nsrl.ttu.edu/pubs/opapers/op173.htm

McClane, A.J. 1978. Field Guide to Freshwater Fishes of North America. Holt, Rinehart and Winston, New York.

Minister of Indian Affairs and Northern Development and Tungavik Federation of Nunavut. 1993. Nunavut Land Claims Agreement: Agreement Between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in right of Canada. Ottawa: Supply and Services Canada.

NLCA, 1993. See Minister of Indian Affairs and Northern Development and Tungavik Federation of Nunavut. 1993.

Nunavut Wildlife Management Board. 1994. Resolutions, Regular Meeting No. 5, DATE (June X, 2004). Resolution 95 – 052.

Nunavut Wildlife Management Board. 1995. Terms or Reference for the Nunavut Wildlife Management Board Harvest Study Steering Committee. Unpublished.

Nunavut Wildlife Management Board. 1995. Minutes, Harvest Study Steering Committee Meeting Number 1. Attachment “C”. Record of Decisions. Unpublished.

Nunavut Wildlife Management Board. 1995. Nunavut Wildlife Harvest Study, Situation Report, As of 7 November 1995. Unpublished.

Nunavut Wildlife Management Board. 1996. Nunavut Wildlife Harvest Study, Situation Report, As of 9 February 1996. Unpublished.

Nunavut Wildlife Management Board. 1997. Resolutions, Regular Meeting No. 16, November 1997. Resolutions 98 – 058 and 98 – 059.

Nunavut Wildlife Management Board. 1998. Nunavut Wildlife Harvest Study Fieldworker’s Manual – Revised Edition. Unpublished.

Usher, P., and Brooke, L. 2001. Assessment of Options for Collecting Statistical Data on Wildlife Harvesting in Nunavut. Report prepared for Government of Nunavut. Unpublished.

Ilangani I

Ilanga 5, Ilauyuk 4 NLCAmi
ILAUYUK 4: NUNAVUMI UMAYUT UMAYUKHIUKHIMAYUT IHIVGIUGUTAIT

5.4.1
Nunavumi Umayut Umayukhiukhimayut Ihivgiuktauyukhat (Ihivgiugutit) piniaktut ovalo ilaulutik tamamik Aviktukhimayut Nunavumi Nunataagutit Angigutaani Iluani. Maliktakhait ihivgiuktut ilihimayut ilanganiitumi 5 – 5.

5.4.2
Ihivgiuktut piliniaktut tamamik Aviktukhimayuni tikitpat ovaluniit tikitinagu hivulik ublua angiktaukpat Angiguti. Ihivgiuktut havaktakhait ataani malilutik NWMBkunit.

5.4.3
Kinikhiatjutit, katitikhimayut katitigutait ovalo nunani havaktakhat mikhaanut ihivgiuktut hanauyakhimayukhat tuhaktitinahualugit akhut umayukhiuktit ilaupkailugit ovalo katraktililugit naamagiyainik DIOkunik ovalo munagiyaulutik NWMBkunit.

5.4.4
Ihivgiuktut piniaktut talimanik ukiunik ovalo kinauyakhait akiliktauniaktut Kavamatkunit. NWMBkut paknaiyakhimaniaktut kinauyakhat atugutikhainik ihivgiuktukhani ovalo ihivgiuktauluni Kavamatkunit.

5.4.5
Hunautjutikhait ihivgiuktut tunilutik katitikhimayukhanik, ilinahualutik ihuagiyaminik umayukhiuktakhanik naunaiyautikhainik, ikayugiagani NWMBkut iliyaagani atulaaktainik tamaat umayukhiulaaktainik ovalo tuninahualutik nakuuyumik munagitjutikhanik ovalo atutiagutikhainik umayut Nunavumi Nunataagutit Angigutaani Iluani. Taimaimat, ihivgiuktut piniaktut imaa:

(a) Titigalutik atugutingit umayunik ovalo kanuk Inuit atulikpaktait umayut pitkutait mikhaanut naunaiyagiami mikinikhaat atugutikhait naunaiyautikhainik; ovalo
(b) Katitiklutik, ihivgiulutik ovalo ihivgiufaalutik ukpatauyainik, nunainik ovalo umayukhiukhimayut katitikhimayunik atuktakhainik munagitjutikhainik umayut Nunavumi Nunataagutit Angigutaani Iluani.

5.4.6
Nutaat ovalo ukautitaakhimayut katitikhimayut hanahimayut ihivgiuktitlugit tamaat ovalo akiitumik pilaaktakhait Kavamatkut Kanatami, Nunavumi Kavamatkut ovalo Inuit.

5.4.7
NWMBkut piniaktut atiit Inuit umayukhiuktit takupkaktaulaitut pipkalaaligumiuk katitikhimayut malilugu ilangani 5.4.6.

5.4.8
Apigiyautinagit titigakhimayumik DIOkunit ovalo Inumit, naunaiyakhimayut pihimayut ihivgiuktitlugit mikhaanut Inumut atulaituk naalaktititilugit, Inuk akigaktuklaituk.

5.4.9
NWMBkut tuhaktitiniaktut ukiuk tamaat iniktigutainik ihivgiuktut. Inikat Ihivgiuktut, NWMBkut titiganiaktut inikpiakhimayumik ukautinginik nalvaakhimayut ihivgiuktitlugit.

Ilangani II

NOCIRnik makpigaat

Nunavut Anngutinik Naunaiqhaiyit

TUHAKTITITJUTAIT AALANGUGUTAIT TITIGAGUTIT

Nunani Havaktit: Titigalugit ilanganiitut 1, 2, & 3 pilaakata. Sukatukut tuyuklugit aatjikutait Aviktukhimayut Tuhaktituiyinut.

Ilanga 1	**Ublumi Ublua** / /
Atia Umayukhiukti	**Nunanga**
Kanugitumik Umayukhiukti	**Umayukhiunginaktuk** ☐ **Umayukhiukataktuk** ☐ **Ilaani Umayukhiukataktuk** ☐
Una umayukhiukti titigaktaakhimava ihivgiuktuni?	**Iihik** ☐ **Iik** ☐

Umayukhiuktip naunaiyautinga naamanga	**Umayukhiuktip nutaat naunaiyauinga naamanga**
Nalungitpagu	RLOkut ovaluniit Munagiyit tunilaaktut nutaamik naunaiyautit naamakhainik.

Ilanga 2	**Umayukhiukti naunaiyakhimayuk hamani umayukhiugunaituk ilaa:**

Tukuhimayuk ☐ **Itiktauhimayuk** ☐ **Nuutitihimayuk** ☐ **Aalanik** ☐

UBLUA:	**TATKIKHIUTI:**	**UKIUK:**

Ilanga 3	**Hamna titigalugu umayukhiukti nuutitilikat:**

Nuna Nuutitiliktaa:	**NAKIT:**	**NAMUT:**

(titigakviani talvatuak) Una umayukhiukti ilaunialika apikhukataktunut katitikhimayunut? IIHIK IIK

Ilangani III

Nunavumi Umayut Umayukhiukhimayut Ihivgiugutait katitihimayut makpigaat

Nunavut Anngutinik
Naunaiqhaiyit katitirutait

Angunaiqtup Naunaitkutaa:_____ Makpiraanga:____ uumani _____

Nunallaaq: _____ Apiqhuiyi: _____

Anguniaqtigut Naunaitkutit: (atauhiq titirarlugu)
1) Anguvaktuq
2) Angunngittuq
3) Takuyaunnginmat
4) Hamaniihuiqtuq (nuuttuq, huiqtuq, itiqtauyuq)

Apiqhuniup ublua u/t/u: ____/____/____

Tatqihiutaani: _____

---------- tuktunuinaq ----------

ublua u/t/u	huruat	qaffiit	nayuqtaa[1]		kituuva[2]			ukiunga tuktut katimayut				Nakit tuktu (Qakuqtalik, Nunavihmi, Kongit,Qikiqtarmiutaq)
			nunap atia	nunauyap naunaitkutaa	angulhaluk	arnahuluk	nauna	iniriq	nukatugaq	nuraq	nauna	
	kanguq qiviuq[3]											

[1] tuktuk, umingmak, aiviq, tuugalik, qilalugaq, iqalukpik, ihuuq, qingalik, amaulik, matiit manniit, qiuviunga matiup
[2] tuktuk, umingmak, aiviq, tuugalik, qilalugaq, qingalik, amaulik
[3] qaffiuyaakhaita titirarviani titiralugit qaffiuyaakhait ublut qiviut piyauhimayut

uqaqtakhaqaqat: (anngutit mikhaanut, qanurittaakhaa hila, inugiakpa anguniaqatigiit, niuvrutauniaqat, qanuliqaak.)



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Nunavut Wildlife Management Board

Draft Report on Inuit Knowledge Regarding Climate Change and the Baffin Bay Polar Bear Population

Martha Dowsley

October 2005

Executive Summary of Draft Report on Inuit Knowledge Regarding Climate Change and the Baffin Bay Polar Bear Population

Martha Dowsley

During spring, 2005, interviews were conducted with elders and senior hunters in the three Nunavut communities which harvest polar bears from the Baffin Bay population (Pond Inlet, Clyde River and Qikiqtarjuaq). Between 15 and 20 interviews were conducted in each community focusing on observations of changes in the polar bear population, observations on the climate during the last 15 to 20 years and also peoples' views of bear management. The results are presented by community, and include quotes from participants explaining their answers.

There are several general trends in the responses regarding the Baffin Bay polar bear population. 83% of respondents said that the population had increased. The reasons for this conclusion were that more bears were seen near the communities and near cabins and camps, and that hunters were encountering bear sign in areas not previously used by bears. Some people noted that these observations could reflect a change in bear behaviour rather than an increase in population. 62% of respondents said that bears are less fearful of humans, and 94% said that bears are causing more damage now than 15 years ago. 57% of respondents reported that bears tend to be skinnier now and 5 people in Clyde River reported an increase in fighting among bears.

Discussions about climate change showed that there is high variability in the environment. There were general trends indicating that the floe edge is closer to the shore now, the sea ice is thinner, there are fewer icebergs and glaciers have receded. People were not sure whether climate change was affecting polar bears or what those effects might be.

Respondents were asked several questions about polar bear management in the Baffin Bay area. People did not know much about polar bear hunting by Greenlanders. They also held varying opinions about the quota system and whether or not it was responsible for the increase in the bear population since the 1960s. When asked about their views on the biologists' studies of bears, there was again a mixed response, with some participants feeling concern for the long-term effects on bear health and quality of meat. Many respondents also did not really understand how the government is set up or how the biological studies were carried out, and also expressed shyness about asking for more information or help from government employees.

Conclusions

The results show there is some change that has resulted in more polar bears being seen around the Baffin Bay communities, and there are changes in bear behaviour and health. The fact that people are seeing more bears has led many people to believe there is an increase in the polar bear population. There are some trends in observations of climate change, but also much yearly variation. This topic should be studied further. Finally, the responses show that wildlife managers need to talk more to the communities about polar bear management and about the specific issues concerning the Baffin Bay population.

Draft Report on Inuit Knowledge Regarding
Climate Change and the Baffin Bay Polar Bear Population

Martha Dowsley

Introduction

This report summarizes the traditional knowledge relating to polar bear populations and climate change observed by Inuit in the three Baffin Bay communities –Pond Inlet, Clyde River and Qikiqtarjuaq, as expressed in interviews during spring of 2005. Participants were asked questions regarding polar bear population, behaviour and health (Section 1), climate change (Section 2) and understandings and views on the management of polar bears in Baffin Bay (Section 3).

Methodology

The interviews were conducted from April to June 2005 in the three Baffin Bay communities. Most interviews were conducted in the homes of the respondents (senior hunters and community elders), and generally included a translator. Interviews lasted between one hour to one and a half hours.

These questions were part of a larger interview related to my PhD thesis and the interviews were purposefully relaxed so that respondents could expand on topics that they knew a lot about or were more comfortable discussing. For this reason the number of respondents to each question varies. People were also generally unprompted with regards to possible explanations of their observations. This was done to allow them to express their own views and not be influenced by what I might want to hear.

Section 1 Observations on polar bear population and behaviour

Q 1 Has the polar bear population increased, decreased or stayed the same over the past 10 to 15 years?

Pond Inlet

All 15 respondents indicated that the bear population has increased. 13 people offered explanations. Seven said there were more bears around the community or cabins. Seven said there were more bears and bear signs on the land. One person said the bears were forced onto the land because there is less ice.

Some comments:

"There are too many polar bears now, most of them will be hungry and prone to attack people. Before there were never polar bears around here until recently."

"There were not many bears around Pond Inlet when I was growing up. We used to have caches of muktuk and seal. The polar bears only bothered them once in a while. Now there are lots of polar bears! I never suspected there would be polar bears in the western fiords and now there are. There are fewer seals there, but the bears are probably looking for food over there."

Clyde River

16 people answered this question. 14 said the population had increased. One said the increase was only slight and the other said there was no change. Nine of the people who said the population has increased gave reasons. 5 said there were more bears nearby, that people didn't have to go very far to hunt them anymore. 2 people said they were seeing lots of young bears and bears with no ear tags. Two other hunters gave different statements:

"When I was young at the Home Bay area, there was a lack of polar bears. But in April and May the big males come looking for females there now."

"There are too many bears. Before, when we went dog teaming for hunting we didn't come across many bears. We were getting 45 a year anyway. The government says that's too many. We should be able to get more now since we were able to get that when they were scarce."

Qikiqtarjuaq
16 people answered this question. Four people said they didn't know if the population had changed. Nine people said the population had increased and 3 said the population was the same.

Ten people explained their answers further. For the people who said the population had increased, 4 said they knew the population had increased because they were seeing bears near the community. One person said he had seen more signs out on the land. Two people said they had seen bears or signs where there didn't used to be any bears.

Three of the people that weren't sure offered these observations:
"I don't know. The polar bears are usually at the floe edge and the sea. But this year they are not really down at the sea. They are more by the land. Probably there is not enough to harvest there (not enough food at floe edge). And there are walruses by the floe edge so the seals are probably more close to land."

"I can't answer, but I think they increased, but it could be due to change of weather or the polar bears are following their prey. We say they have increased because the weather got warmer and probably the polar bears have come nearby the communities. They are coming more to the community."

"I tend to believe the biologists. They are saying there are fewer bears. So I'm sticking with them. Even though I've seen a lot of bears and they look like they're increasing."

Q 2 In open water season have you seen changes in polar bear behaviour such as when they come to shore or what they do once they are on shore?

Pond Inlet
7 people responded to this question. All indicated there was no change in when bears come to shore. 5 respondents stated during their interviews that bears had lost their fear of people. One elder explained this:

"Long ago polar bears would go away fast. When there are more animals of any kind they are less afraid. We used to have lots of caribou around town, even right here, beside the house. It was the same thing. When there are fewer animals, when the hunter is trying to catch them he has to be really quiet. But when there were lots of caribou, one was sleeping in front of the house. He didn't get up or care about the noise."

Clyde River
15 people answered this question at least in part. Three people said there was no change in behaviour of the bears when they come on shore. Five people said the bears are not scared of people anymore. One person noted that hungry bears do not scare easily, whereas well-fed bears do. The other respondents said there was no change in when the bears come on shore, though one person offered a more detailed answer:

"Usually they come after the break up season. They come to the fiords, some stay out swimming and come on land to sleep, some are more curious than others. They usually come after the land fast ice breaks up, when the multi-year ice washes in from the north. When you scare them away (from town) they get used to it and they learn you won't hurt them."

Qikiqtarjuaq
5 people answered this question. One said more bears are coming. One said he didn't know. The others indicated no change had occurred in timing or behaviour.

Q 3 Are there more or fewer bears around town now than 10-15 years ago?
Pond Inlet
7 people responded to this question. Six said more bears were coming. 1 person said the number varies. Even though many people used the presence of bears in town during the fall as an indication that their population had increased, some respondents gave more textured answers:

"It seems to be that more are coming to the community. When the polar bears are hunting they are not so careful because of the noises they always hear. Even dogs' barking damages their ears. So polar bears are not as successful at hunting so they come to the community to find food." (see health question, #6, for more details on this explanation).

"They started coming to town in the 1960s, early 1970s. Polar bears can think like a person, they won't forget things right away. If they come and find food around here, people chase them away and the polar bear will come again the next year. They will remember where they found food. If a bear is chased away from town, it will come back at night when things have quieted down."

"Polar bears don't like the smell of dogs and they used to stay away because we had dogs everywhere. Now there are fewer dogs so the bears come to the settlements. We used to cache meat and they didn't bother it. Now there are more bears and they dig up the caches."

Clyde River
14 people answered this question and all agreed that more bears were coming to town in the fall.

"More are coming to town, because there are more bears, not because they are extra attracted to town. It's a different bear almost every time, but skinny ones keep coming back."

"In the fall they seem to be hungry, they've been lying around for a long time. The town bears are also more likely to be young ones."

Qikiqtarjuaq
13 people responded to this question. Five said more bears come to the community in the fall. Two said more come to the island in general but not necessarily the community and 6 people said it is the same as at least 10 years ago.

"Back then we only saw them (around the community) when there was no ice. Now even in the winter they come around."

Q 4 Compared to 15-20 years ago, are there more, fewer or the same number of tracks, bear kills and bears seen when you go hunting in spring, summer, fall, winter?
Pond Inlet
9 people responded to this question. Four said there were more bears in all seasons, no one said there were more just in winter, four said there were more in spring, one said summer, and one said fall.

"Before we had a certain time to see polar bears –during March and April when the polar bears are looking for seal pups and during the full moon. Now any time we can see them."

"Since 1990, even when you go out boating you can see more, for example sleeping on the shore."

Clyde River
14 people responded. One person said it was the same as 15 years ago. Seven people said you could see more bear signs in all seasons. Three specified spring as having more bears and 4 specified fall as a time to see more bears than previously.

Qikiqtarjuaq
11 people responded to this question. Four said there were more bears in general. Two said there were fewer in the winter, while one person said there were more in winter. Three people said there are more in spring and one person said there are more in summer.

"They rotate. Some years they are in different places. In the last four years they have been further south, before that they were further north. 15 years ago in some places you could see more. A few weeks ago we saw more tracks to the north."

A sport hunt guide said that they couldn't find bears to the south of the community in spring 2005 and one of his clients was unsuccessful. He took the next client north and saw many bears.

Q 5 Is there more less or the same damage to cabins, meat caches and other equipment? If there is more damage, why is that?

Pond Inlet

The 11 respondents all agreed that bears cause more damage now than ten years ago. 5 people said it was nearly impossible to have a meat cache now. One person explained that people are building cabins out on the land more than before because tents are too vulnerable to bears. One respondent said that in the early 1960s it was also impossible to have a cache.

"They don't run away when they hear something. They don't care. They are causing more damage too, they even go up to tents and bother people."

Six respondents elaborated on their observations about more damage. Two respondents said that it was because the bear population was too high. Four people stated that the noises caused by machines, dogs and the act of conducting research on bears causes the bears to lose their hearing. The bears then cannot hunt as well and are not as afraid of humans. This results in bears coming around people more.

Clyde

14 people answered this question. 13 people replied that bears are causing more damage now, in particular to cabins and meat caches. One respondent didn't know if there was more now or not.

"There seems to be more damage, but you have to take into consideration that we're leaving more stuff out on the land than 15 years ago. But if you leave meat caches they are pretty much guaranteed to be gone."

"We used to cache 4 or 5 seals in a row, covered them just with gravel. Used to never be touched. But now it disappears even if we put rocks on it. Polar bears don't like to use their claws and scratch them (wear them down), so they stayed away from the gravel. They wouldn't dig it. Now they do."

A total of nine people explained why they thought there was more damage. Three people only explained it was because there are more bears now. Two people said it was because there are more bears and more fighting and some can't get food, so those bears come to where people are. Two respondents said the bears got used to people and the same ones kept coming back. Two respondents said there are more people and more food around, which was attracting bears.

Qikiqtarjuaq
Six people responded to this question. Five of them said there was more damage and one person said it was the same. All the people who said there was more damage elaborated on why. Three said it was because there are more human things around for bears to get into. One person said it was because there are more bears. One blamed the environment: "The bears are more hungry. There is a problem with the ice. The rough ice makes it hard for them to find seals, but there is the same number of seals."

Two people also mentioned a lack of fear:
"The only change I've noticed is when I was growing up the polar bears would scare easily and run away. Even when they were around shacks they didn't break windows or do damage but now they are not afraid. They used to avoid communities before and now they don't."

"More people are hunting them. In the past, using harpoons, only experienced hunters would go for bears, now with rifles, anyone can hunt, even women, so the bears are less afraid."

Q 6 What is the health of the bears that come to town?
Pond Inlet
Ten people discussed this question. Two people said there is no pattern. Eight said the bears that come to town are skinny.

Clyde River
For town bears there were three responses, one said skinny bears come to town, while another person said any kind come to town but skinny ones keep coming back. One person said there was nothing different in the health of town bears compared to other bears.

Qikiqtarjuaq
Only one person commented specifically on town bears. He said that the ones that are close to the community are fatter than ones further away.

Comments on the general health of bears
Pond Inlet
There were 7 comments about the general health of bears. 4 said it was variable
2 said there were more skinny bears in general now. The seventh respondent stated:
" I noticed since they started tagging bears, the ones with the tags were the skinniest. Even now when we look for bears, we go further to where they aren't so skinny and the meat is better."

Three elders talked about a loss of hearing in polar bears. One indicated that the bears no longer care about noises around people, one said that when an animal's population is high the animals lose their fear and don't mind loud sounds. Both of these could indicate that

bears are getting used to noises, however, the third respondent was adamant that the reason was hearing loss:

A: "There are many more polar bears and I know exactly why. Right now their hearing is worse because of helicopters and airplanes that did research on them, gunshot sounds, these things make them deaf. That's why they can get close to town."
Q: What about their sense of smell?
A: "They got used to our smell....For the proof that polar bears are losing their hearing due to how research is done, their hearing is worse from the tranquilizer. Back then the polar bears could hear dogs coming from far away and if the polar bear got away his ears were already damaged."

Clyde River
14 respondents discussed general bear health. Seven respondents said polar bears are skinnier over all, while one respondent said only males were skinnier now. Five people said there was more fighting among bears as evidenced by more scars, broken canines and the discovery of bears that had died from fighting. One person said cubs are leaving the dens earlier and one person mentioned that cubs leave their mothers earlier due to big males attacking them. Four people said there was no change in overall bear health.

One person mentioned hearing loss:
"Skidoos hurt their ears. IQ says when we used to hunt with dogs, if you missed a bear it would have damaged his hearing and he will be less lucky in hunting and get skinny. So hunters say 'it's too bad we missed that bear' not because they wanted to get it, but because they know that afterwards the bear will be damaged."

Qikiqtarjuaq
Six people commented on general bear health. Two people said it was variable. Three said there are more skinny bears. Two gave other comments:

"Now people are finding more dead bears that climbed the mountains and fell down – they were looking for eggs."

"The wolves are actually injuring and hunting the cubs and now the wolves are a problem by killing the cubs. We never used to see wolves so we were not aware of any killing of cubs. But for the past 3 or 4 years the number of wolves has increased. From IQ we know the caribou are coming, the wolves move before them, so probably the caribou are coming. A hunter has seen a cub that was killed by a wolf pack."

Section 2 Climate Change Questions

The issue of climate change is very complicated, especially since there is high yearly variability in environmental conditions. Certain aspects of the environment certainly seem to be different in all three communities, but interviewees gave varying answers to the questions. The low number of responses may indicate that although the respondents thought about that aspect of the environment they had not noticed changes and therefore did not say anything because they were specifically asked about changes.

Q 7 Have there been any changes in the ice? Floe edge, icebergs, rough ice, changes in amount of snow?

Pond Inlet

14 people replied to this question, 13 said there had been changes while the other person replied that there had not been. People were asked to expand on the sorts of changes they had seen in the past 10 to 15 years and were sometimes prompted with examples of the sorts of changes I was interested in.

Quality of Ice

Eight people said that the general quality of the sea ice has changed. Four mentioned that the ice is thinner now. One said the land fast ice is often more slushy, another said there is less multi-year ice and there is less ice in spring. Comments about the hunting area around Button point included that the ice there is thinner now, that there is no ice there now, and that it is more smooth ice and one can drive a skidoo there in winter now whereas one could not in the past.

Cracks in Sea Ice

One said there were fewer cracks now because the ice is thin and one said that nothing about cracks had changed.

Break up

Four people mentioned break up as being faster during July and that it begins up to two weeks earlier, while one person said the time of break up had not changed.

Freeze up

Three people mentioned that freeze up is later. In the past it was in October but now it takes place in November or December. During this time the ice is more brittle.

Icebergs

Ten people mentioned icebergs, nine of them said there were fewer icebergs now, while one said the number varies.

Floe Edge

Seven people mentioned the floe edge. Of these, 6 said it was closer now and the other respondent said that it was a bit different. Two of the people who stated that the floe edge was closer gave the following explanations:

"The icebergs are like nails, they hold the ice in. Since there are fewer icebergs there (around Button Point) the ice edge is closer."

"When I'm flying to and from Clyde River, there are not a lot of icebergs and the floe edge is closer to the land. In the Clyde River area, way back, when there were lots of icebergs, the floe edge was further out. Recently there are strong winds from the south so the icebergs left and the floe edge came in closer. The icebergs come from Greenland (between Greenland and Ellesmere) and they go into Clyde and the coast just north of it. The current is from the north and from Lancaster Sound coming east... The ice changes in Baffin Bay mean less ice patches so the bears come to land to hunt. Because polar bears can swim, but when they are tired they go to land. Probably Clyde people know more because when there is no ice on the ocean, the polar bears go to land, mostly by Clyde River."

Glaciers
4 respondents mentioned that the glaciers are receding.

Snow
Two people said there was more snow and one said there was less snow on the land.

Clyde River
16 respondents answered this question. Three said there had been no significant changes. The others expanded on their observations about specific features.

Ice quality
6 people mentioned that the ice is thinner now. One person explained that there is more snow on the ice and this insulates the ice and stops it from being so thick. Two people said ice quality was variable and there was no pattern of change.

"The ice is sharper now, not as hard as before. In the past the ice was really thick. The cracks were very narrow, deep and tapered down like a 'V'. Now they have straight edges."

"The salt water doesn't freeze as hard as before. Every year we chip the ice at seal breathing holes, today it is not as hard, not as brittle. Now in June the bottom of puddles (on the ice) is not slippery, it's not melting from the top, it's melting from everywhere through the ice, like the inside of a bone. Today the ice is also thinner. People used to say when the leads opened they looked tapered going down in them because of the thickness. They no longer look tapered."

Cracks in Sea Ice
Three people said there was no obvious trend regarding cracks. Two people said there were more cracks and one person said sometimes there are hardly any cracks.

Ice Bergs

There were 12 responses about icebergs. 10 people reported that there are fewer icebergs. Two people reported no change in the number of icebergs.

Floe Edge
Four people said the floe edge was closer now and one person claimed it was different now, but did not elaborate.

Rough Ice
Eight people discussed rough ice. Three said there was no change. Four people said there was more rough ice. Two of these people explained the rough ice is caused by there being fewer icebergs to hold in the ice. One person said the rough ice occurs when the wind is from the south or east.

Break up
Six people gave responses about spring break up. One said it is about the same as in the past. Five said it was earlier now. One person specified a change of about 2 weeks earlier.

Freeze up
Four people said it was a couple of weeks later now. One person said it is highly variable.

Glaciers
Two people mentioned glaciers and said that they are melting more around Clyde River.

Wind
Four people mentioned wind. One said it is variable, and one said there was less wind. The other two gave these comments:
"We used to only have wind from the north. 3 or 4 years ago the wind started coming from the south too."

"Seems like there is more wind. Seems to be more strong winds. It was soft snow in the south, less blowing snow. Now the snow is harder there (from being blown more)."

Qikiqtarjuaq
13 people responded to this question. One of these people said there was no change because everything is highly variable. The others gave details about specific changes.

Ice quality
Four people said the ice is thinner now and getting more dangerous. One also said there is less pack ice.

"I went bear hunting all the way to the Dewline on Durban Island and the ice there was moving up and down. That was 4 years ago in March. It was not like that there when I was growing up. It was solid."

Cracks
One person said cracks appear earlier in the spring and there are more of them. Another person said there are usually leads open in winter off the north end of the island but lately there haven't been.

Icebergs
8 people commented that there are fewer icebergs now.

Floe Edge
Six people all answered that the edge is closer to land now.

"The floe edge is closer to the land and there are hardly any icebergs. That's why the floe edge is close by. The icebergs keep the ice from going anywhere. They are like plugs."

Rough Ice
Two people mentioned there is more rough ice. One qualified that by explaining that the floe edge is closer and the rough ice is generally by that, so the rough ice is close to the land now.

Break up
Three people said break up is earlier now.

Freeze up
One person said freeze up is later and slower now.

Snow
Two people mentioned snow, one saying there is more and one saying there is less.

Glaciers
Three people discussed a snowcap that used to stay all year on a mountain on Qikiqtarjuaq Island. There used to be bear dens in this snow, but now the snow doesn't stay all year and the bears no longer den there.

Q 8 Have you heard of global climate change? Have you seen any evidence of it in your area?

Pond Inlet
Six people responded to this question. 5 said they believe the changes they have observed are caused by this. The other respondent said he did not think he had observed any changes that could be attributed to climate change.

Clyde River
15 people responded to this question. 9 people said it was getting warmer, while 6 people said the climate fluctuates a lot so there is no evidence of a warming trend.

Qikiqtarjuaq
10 people answered this question. Six said it was warmer now and one said there is more variation now. Two people made specific comments on changes:
"Yes, it has affected our area. In the past we could hunt for different animals further. Now we can't go further, we have to hunt nearby on the ice." This comment seemed to refer to the difficulty of traveling on the ice.

"I am experiencing it. In winter there are usually cracks from the points of land and I can put my net under water. But now there are hardly any cracks so I can't fish for char any more."

One said there was no change
"I don't know anything about the environment. I don't think there is any global change. It is now May and there should be spots where it should have melted but there aren't and it is still frozen. So it doesn't appear to be warmer."

Q 9 Could climate change contribute to what you have observed about polar bears?
Pond Inlet
Three people responded to this question, all said they didn't know.

Clyde River
Three people gave responses:
"No, because polar bears can go and follow the seals further, so they won't have trouble hunting. Also the snow covers the breathing holes but polar bears can still hunt, it's just for people."

"Seems like yes because polar bears are getting skinnier. If it gets warmer it will affect polar bears. They like to be cold."

"Yes, it could effect the polar bear's food, even with small amount of temperature change, the food will change. These days some livers (of seals) don't look good. Also the shedding of the seal fur. Molting is this time of year usually. Now you sometimes find ones that are molting in other times of the year."

Qikiqtarjuaq
Five people responded. Two said 'I don't know'. The other three gave comments:
"It may be. There are not enough icebergs and the denning areas have less snow and it is melting in summer. The bears are more hungry. There is a problem with the ice. The rough ice makes it hard for them to find seals, but there are the same number of seals."

"Harp seals usually have breathing holes during the winter but because the weather is always changing, the ice freezes over quickly and so the seals are on the surface of the ice. They move around on the top of the ice, they can't get back in their holes because the holes froze. Then they are killed by polar bears."

"Maybe the ice in the sea is melting and the bear have no where to go. It is very noticeable, they will go to land. There are no icebergs for them to go to."

Section 3 Understandings of Management

Q 10 What do you know about polar bear hunting by Greenlanders?

Pond Inlet

Four people discussed this question, three did not know much about it, but one commented:

"I've heard they are catching more. Sometimes polar bears go from here to Greenland and they don't have a quota system so it will affect our quota. They use polar bear skins for clothes so they are hunters too."

Clyde River

There were 5 responses to this question. Two said they didn't know anything. One said he heard they catch more polar bears there, while another only knew they use dog teams for hunting bears. The fifth person said:

"There is more hunting there because it's a part of their lives. More hunting there than here, it's like it was here 30 or 40 years ago."

Qikiqtarjuaq

Three people answered this question. Two said they didn't know much about it. The other said on television it shows they have polar bear clothes.

Q 11 Can you tell me about the quota system here? Do you agree with it?

Pond Inlet

10 people discussed the quota system. Five said they like the system while two specifically said they like the increase in the number of tags. Three people said they don't like the specific rules and two people want more tags. Most people gave comments:

"A few years ago I though the quotas were not useful, but then they increased the number of tags so I'm okay with it now. We wouldn't even need quotas now because people see bears and don't even try to get them. If we stopped using quotas we could probably manage. The fur value is decreasing so people don't even try to catch them. Soon the only money from them will be from sport hunt guiding."

"We can't have all the bears that there are. So it has increased the population of bears, it's like that all around. Before people would get all the bears. The population will decrease since we can only catch males, so soon the population of males will be so little."

"I like the idea of the quota. If we don't have a quota and there are more hunters we'll have fewer polar bears. The population will go down."

"I don't like the idea of the quota system. It's only in winter and none in summer and we should be able to get bears in summer. They are dangerous when they are hungry."

Clyde River
11 people discussed the quota system. Seven said they like the quota going back to 45. Two said they wanted it higher. One said he liked the system in general and didn't care if the quota was high or low. One person wanted the quota to allow the taking of any bear because males have tough meat.

"I like it at 45. I'd be concerned if the polar bear quota dropped and we still had problems and also if we couldn't fill the quota, that would be a major concern. But lots of bears come into town and there were a lot around this spring."

Qikiqtarjuaq
Three people responded to this question. These are their comments:
"A sad part is that elders used to eat cubs but they are not able to do that now and they miss that. The quota system is not very efficient. If I had to shoot one (in defense) it is taken away from the quota. There are too many bears now."

"It's much better (to have quota system). If we don't have it more bears get shot."

"I'm happy they increased the quotas because there will be fewer bears in the community. Recently at A's outpost camp there were three bears."

Q 12 Were there more or fewer bears before the quota system began?
Pond Inlet
Seven people responded to this question, all agreed that the quota system was at least partially responsible for the increase in the bear population.

"The population has increased since we got quotas, because we can only kill so many. They shouldn't have the quotas because the polar bears are dangerous. We should be able to get them year round."

Clyde River
4 people discussed this question. Two people said the bear population was the same before the quota and now. One said there were more bears but didn't know if the quota had caused this. The final respondent said this:

"We caught fewer bears before there was a quota. Now there are more bears. The quota allows more bears to be caught."

Qikiqtarjuaq
Only one person responded to this question: "Before there was no law about hunting season, now there is a law, that's why there are so many now."

Q 13 What do you think about biologists catching bears?
Pond Inlet
Seven people responded to this question. Two people said research hurts the bears' hearing and makes them skinny. One person said he like biologists and liked working

with Mitch Taylor. One person suggested studying them all year and another said he is now supportive of the research because the population did not move away. Some people were concerned about how research affects bears:

"The temper of the bears change and they become more dangerous."

"Sometimes we don't want to eat animals that have been researched. So when we get a polar bear with an ear tag, they way 'that's a government bear' and it's usually skinny. We really don't want to eat those ones that are tranquilized. We feel it isn't safe. Maybe it is, but that's what we feel. When we see polar bears being put to sleep and measured, we see them as being abused by those people."

Clyde River
Three people answered this question. Two people said they don't believe the biologists and that the population has increased. They suggested biologists should study the population all year round. A third person said that research hurts the bears' ears and makes them skinny.

Qikiqtarjuaq
Two people gave information about biologists:

"The NWMB appoints them to do research on bears."

"I don't go to meetings but we always hear about it. We hear that polar bear and caribou are decreasing and they tell us how many there are."
Q: Did the biologist tell you why the polar bears are decreasing?
"Because maybe they are being controlled and it is similar to retaliation."

Other Comments
During the interviews some people who were particularly knowledgeable were asked questions related to this study but not part of the questionnaire.

Pond Inlet
Q: the Government thinks there are fewer bears, but hunters are seeing more, what should be done?
A: " We're not really worried about that. It's like this, in Alaska there is no quota for bowheads, but we are getting more bowheads. So maybe what others do doesn't impact us.

Q: the Government thinks there are fewer bears, but hunters are seeing more, what should be done?
A: It's the same as if someone told me the cows are less numerous down south, I might say to stop killing them. I lived here my whole life and so I believe what I see, not the researchers.

Qikiqtarjuaq

Q: Some people think the sea ice is melting and that is why the polar bears are coming to land more. Could that be true?
A: I believe that is actually happening because the snow banks have melted and the ice tends to melt more quickly and when there are no icebergs they need to get dry on land so they have to come to land.

Q: Do you think the population could actually be decreasing because of climate change?
A: I sort of believe that too, knowing the dens have melted. The ice on the mountains on Qikiqtarjuaq melted starting in 1968 gradually, but that is an estimate.

General Comments About the Government

Several interviewees complained that government employees do not listen to their problems. I think most relate to a lack of communication between government representatives and local people. Here are the concerns expressed to me:

"Government should listen to Inuit, we should be able to hunt in summer. The quota should be open all year."

"Last summer someone caught a harp seal with a square head from sickness. Inuit don't want to eat sick or skinny seals. What should I do about these things?"
Me: Take a sample and give it to the wildlife officer.
"We tried to go to the officer but we are always told to just throw it away because they don't believe there is sickness or skinniness."

"I was camping with my brother and I killed a bear that was wrecking my tent near Tasialuit, south of Canso Channel, last summer. The wildlife officer wanted to come and take a picture but he never came. Why? Doesn't he care?
Me: Tell him again. Maybe he doesn't have money to give to you.
"I won't go to him again. He won't help if he didn't help the first time.

Conclusions

Population

People generally think the bear population has increased, because they have seen more bears near human habitation and also bears have been appearing in places that did not used to have bears.

Behaviour

Many respondents said that bear behaviour has changed to be more tolerant of people. In Clyde River people noticed more fighting among bears.

Health

People often reported that bears are skinnier now than in the past. No one mentioned any difference in the number of cubs seen per female bear, although this was specifically queried during the health section. Some elders are concerned about hearing loss in bears caused by noises from machines, dogs and research activities.

Climate Change and Possible Impacts on bears

Climate change observations varied widely among participants. There is a general consensus that there are fewer icebergs now than in the past, and as a result the floe edge is closer to the land. Respondents did not have a clear idea of how, or if, this was affecting bears.

In Qikiqtarjuaq the disappearance of year-round snow in denning areas on the island was mentioned often and given both as evidence of climate change and as evidence to how it might affect bears.

Management

Respondents generally expressed that the problem was that too many bears were seen around people and that it was dangerous.

Many people were ignorant of the management system or the reasons for it. They also expressed reluctance to seek better information from either their HTOs or the government. This behaviour may be cultural and should be addressed by wildlife managers.

Appendix 1 Interview Questions

Q 1 Has the polar bear population increased, decreased or stayed the same over the past 10 to 15 years?

Q 2 In open water season have you seen changes in polar bear behaviour such as when they come to shore or what they do once they are on shore?

Q 3 Are there more or fewer bears around town now than 10-15 years ago?

Q 4 Compated to 15-20 years ago are there more, fewer or the same number of tracks, bear kills and bears seen when you go hunting in spring, summer, fall, winter?

Q 5 Is there more less or the same damage to cabins, meat caches and other equipment? If there is more, why do you think that is happening?

Q 6 What is the health of the bears that come to town?

Q 7 Have there been any changes in the ice? Floe edge, icebergs, rough ice, changes in amount of snow?

Q 8 Have you heard of global climate change? Have you seen any evidence of it in your area?

Q 9 Could climate change contribute to what you have observed about polar bears?

Q 10 what do you know about pb hunting by Greenlanders?

Q 11 Can you tell me about the quota system here? Do you agree with it?

Q 12 What do you think about biologists catching bears?

Q 13 Were there more or fewer bears before the quota system began?

MARINE MAMMAL MONITORING AND MITIGATION DURING OPEN WATER SEISMIC EXPLORATION BY SHELL OFFSHORE INC. IN THE CHUKCHI AND BEAUFORT SEAS, JULY–SEPTEMBER 2006: 90-DAY REPORT

Prepared by

Alaska Research Associates, Inc.
1101 E. 76th Ave. Suite B, Anchorage, AK 99518

LGL Ltd., environmental research associates
P.O. Box 280, 22 Fisher Street, King City, Ont. L7B 1A6, Canada

and

Greeneridge Sciences, Inc.
1411 Firestone Rd., Goleta, CA 93117

for

Shell Offshore, Inc.
P.O. Box 576, Houston, TX 77001-0576

and

National Marine Fisheries Service, Office of Protected Resources
1315 East-West Hwy, Silver Spring, MD 20910-3282

and

U.S. fish and Wildlife Service, Marine Mammal Management
1101 E. Tudor Road, M.S. 341, Anchorage, AK 99503

LGL Report P891-1

January 2007

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by

Heather Patterson[b], Susanna B. Blackwell[c], Beth Haley[a],
Andrea Hunter[b], Meaghan Jankowski[b], R. Rodrigues[a],
Darren Ireland[a], Dale W. Funk[a]

[a] **LGL Alaska Research Associates, Inc.**
1101 East 76th Ave., Suite B, Anchorage, AK 99518, U.S.A.

[b] **LGL Limited, environmental research associates**
P.O. Box 280, 22 Fisher Street, King City, Ont. L7B 1A6, Canada

[c] **Greeneridge Sciences, Inc.**
1411 Firestone Rd., Goleta, CA 93117, U.S.A.

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LGL Report P891-1

January 2007

Suggested format for citation:

Patterson, H., S.B. Blackwell, B. Haley, A. Hunter, M. Jankowski, R. Rodrigues, D. Ireland and D. W. Funk. 2007. Marine mammal monitoring and mitigation during open water seismic exploration by Shell Offshore Inc. in the Chukchi and Beaufort Seas, July–September 2006: 90-day report. LGL Draft Rep. P891-1. Rep. from LGL Alaska Research Associates Inc., Anchorage, AK, LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Goleta, CA, for Shell Offshore Inc, Houston, TX, and Nat. Mar. Fish. Serv., Silver Spring, MD. 199 p.

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LIST OF ACRONYMS AND ABBREVIATIONS

~	approximately
AASM	Airgun Array Source Model
AEWC	Alaska Eskimo Whaling Commission
Bf	Beaufort Wind Force
BO	Biological Opinion
CAA	Conflict Avoidance Agreement
CFR	(U.S.) Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species
cm	centimeter
CPA	Closest (Observed) Point of Approach
CTD	conductivity, temperature, depth
dB	decibel
EA	Environmental Assessment
EFD	Energy Flux Density
ESA	(U.S.) Endangered Species Act
$f(0)$	sighting probability density at zero perpendicular distance from survey track; equivalently, 1/(effective strip width)
ft	feet
FRC	Fast Rescue Craft
GI	Generator Injector
GIS	Geographic Information System
GMT	Greenwich Mean Time
GPS	Global Positioning System
$g(0)$	probability of seeing a group located directly on a survey line
h	hours
hp	horse power
Hz	Hertz (cycles per second)
IHA	Incidental Harassment Authorization (under U.S. MMPA)
in^3	cubic inches
IUCN	International Union for the Conservation of Nature
kHz	kilohertz
km	kilometer
km^2	square kilometers
km/h	kilometers per hour
kt	knots
L-DEO	Lamont-Doherty Earth Observatory (of Columbia University)
LoA	Letter of Authorization
µPa	micro Pascal
m	meters
MBB	Multibeam Bathymetric (sonar)
MCS	Multi-Channel Seismic

min	minutes
MMO	Marine Mammal Observer
MMPA	(U.S.) Marine Mammal Protection Act
MONM	Marine Operations Noise Model
n	sample size
n.mi.	nautical miles
NMFS	(U.S.) National Marine Fisheries Service
No.	number
NTCL	Northern Transportation Co., Ltd.
PAM	Passive Acoustic Monitoring
PD	Power down of the airgun array to one airgun (in this study, from an output of 3147 in^3 to 30 or 155 in^3)
PE	Parabolic Equation
pk-pk	peak-to-peak
RAM	Range-dependent Acoustic Model
re	in reference to
rms	root-mean-square: an average, in the present context over the duration of a sound pulse
s	seconds
SD	Shut Down of airguns not associated with mitigation
s.d.	standard deviation
SEL	Sound Exposure Level: a measure of energy content, in dB re 1 $\mu Pa^2 \cdot s$
SOI	Shell Offshore, Inc.
SPL	Sound Pressure Level; the SPL for a seismic pulse is equivalent to its rms level
SZ	Shut Down of all airguns because of a marine mammal sighting near or within the safety radius
TTS	Temporary Threshold Shift
UNEP	United Nations Environmental Programme
"Useable"	Visual effort or sightings made under the following observation conditions: daylight periods within the Chukchi and Beaufort Seas, ***excluding*** periods 3 min to 1 h (pinnipeds) or 2 h (for cetaceans) after airguns were turned off (post-seismic), periods when ship speed was <3.7 km/h (2 kt), and periods with seriously impaired sightability. The following conditions were defined as involving seriously impaired sightability: all nighttime periods, and daytime periods with one or more of the following: visibility <3.5 km, Bf >5 (Bf >2 for porpoises), or >60º of severe glare between 90º left and 90º right of the bow. Sightings of marine mammals hauled out on the ice in both the Beaufort and Chukchi seas were considered "useable" for analyses. Sightings of cetaceans from the *Kilabuk* were considered "unuseable" for analyses.

EXECUTIVE SUMMARY

Background and Introduction (Chapter 1)

Shell Offshore, Inc. (SOI), collected marine seismic data in the Chukchi and Beaufort Seas during the summer of 2006 in support of potential future oil and gas leasing and development. Deep seismic acquisition for SOI was conducted in the Chukchi Sea by WesternGeco using the M/V *Gilavar*, a source vessel that towed an airgun array as well as hydrophone streamers to record reflected seismic data. Seismic acquisition was originally planned to be conducted in both the Chukchi and Beaufort Seas using the *Gilavar*; however, ice conditions during the 2006 field season precluded most data collection in the Beaufort Sea. Activities in the Beaufort Sea were confined to site clearance, shallow hazard surveys and geotechnical activities, which were conducted from the M/V *Henry Christoffersen*, an NTCL vessel.

Marine seismic surveys emit strong sounds into the water that could affect marine mammal behavior and distribution, or perhaps cause temporary or permanent reduction in hearing sensitivity. These effects could constitute "taking" under the provisions of the U.S. Marine Mammal Protection Act (MMPA) and the U.S. Endangered Species Act (ESA). The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) share jurisdiction over the marine mammal species that were likely to be encountered during the project. Cetaceans and most pinnipeds are managed by NMFS; Pacific walruses and polar bears are managed by USFWS.

SOI's seismic surveys and other exploration activities in the Chukchi and Beaufort seas were conducted under the jurisdiction of Incidental Harassment Authorizations (IHAs) issued by NMFS and USFWS. The IHAs included provisions to minimize the possibility that marine mammals close to the seismic source might be exposed to levels of sound high enough to cause hearing damage or other injuries, and to reduce behavioral disturbances that might be considered as "take by harassment" under the MMPA. Under current NMFS guidelines, "safety radii" for marine mammals around airgun arrays are customarily defined as the distances within which the received pulse levels are ≥180 dB re 1 μPa (rms) for cetaceans and ≥190 dB re 1 μPa (rms) for pinnipeds. Those safety radii are based on an assumption that seismic pulses at lower received levels will not injure these mammals or impair their hearing abilities, but that higher received levels *might* have some such effects. The IHA issued by NMFS required monitoring of the distances within which received sound levels would be ≥180 and ≥190 dB, and implementation of appropriate mitigation when marine mammals were seen within or about to enter those zones. The IHA also required monitoring of the distance within which received sound levels might be ≥160 dB re 1 μPa (rms).

NMFS and USFWS granted the IHAs to SOI on the assumptions that

- the numbers of whales and seals potentially harassed (as defined by NMFS criteria) during seismic operations would be "small",
- the effects of such harassment on marine mammal populations would be negligible,
- no marine mammals would be seriously injured or killed,
- there would be no unmitigated adverse effects on the availability of marine mammals for subsistence hunting in Alaska, and
- the agreed upon monitoring and mitigation measures would be implemented.

The main purpose of the mitigation program was to avoid or minimize potential effects of SOI's seismic survey on marine mammals. This required that shipboard personnel detect marine mammals

within or about to enter the designated safety radii, and in such cases initiate an immediate power down (or shut down if necessary) of the airguns.

Mitigation was also required at the 160 dB isopleth. This area was monitored by the chase boat that accompanied the seismic vessel. Power down of the seismic airgun array was required if an aggregation of 12 or more non-migratory bowhead or gray whales was detected ahead of, or perpendicular to, the seismic vessel track. Monitoring of the 120 dB isopleth around the seismic vessel was also required after 25 September in the Chukchi Sea and after 1 September in the Beaufort Sea. Power down was required if 4 migratory cow/calf pairs were detected within the surveyed 120 dB isopleth.

The primary objectives of the monitoring program were as follows:

1. provide real-time sighting data needed to implement the mitigation requirements;
2. estimate the numbers of marine mammals potentially exposed to strong seismic pulses; and
3. determine the reactions (if any) of marine mammals potentially exposed to seismic sound impulses.

This 90-day report describes the methods and results for the monitoring work specifically required to meet the above primary objectives.

Seismic Surveys Described (Chapter 2)

The *Gilavar* was used as the seismic source vessel during SOI's activities in the Chukchi Sea in 2006. The *Gilavar* was accompanied by the *Jim Kilabuk*, an icebreaker-class support vessel (chase vessel). The proposed deep seismic survey was originally scheduled to occur in two phases. Phase one commenced in July in the Chukchi Sea and was planned to continue there until late summer when the *Gilavar* and *Kilabuk* were to transit to the Beaufort Sea to conduct phase two seismic surveys on Shell lease-holdings in the mid- and eastern parts of the Alaskan Beaufort Sea. Heavy ice conditions delayed the date when operations could have transferred to the Beaufort Sea, and seismic operations continued in the Chukchi Sea. During September, SOI decided not to attempt to conduct deep seismic exploration in the Beaufort Sea during 2006 due to high concentrations of ice and other operational considerations. The *Gilavar*'s airguns and streamers were retrieved on 19 September and the *Gilavar* departed southward from the project area and left the Chukchi Sea on 23 September. The geographic region where the deep seismic survey occurred was located in the Chukchi Sea MMS OCS Program Area designated as Chukchi Sea Sale 193 (1989) and in the proposed 2002–2007 Chukchi Sea Program Area.

SOI used WesternGeco's 3147 in^3 3-string array of Bolt airguns for its 3–D seismic survey operations in the Chukchi Sea. For each airgun shot, WesternGeco's source array was composed of 3 identically-tuned Bolt airgun sub-arrays, each with 8 airguns and a total volume of 1049 in^3, operated at an air pressure of 2000 psi. This energy source was towed approximately 245 m behind the *Gilavar*. The system also included 6 hydrophone streamers 4200 m in length and spaced 100 m apart, which recorded reflected sound energy. Air compressors aboard the *Gilavar* were the source of high pressure air used to operate the airgun arrays. Seismic pulses were emitted at intervals of 25 m (~10 sec) while the *Gilavar* traveled at a speed of 4.5 to 5 knots (8.3–9.3 km/h).

SOI used the *Henry Christoffersen* to conduct site clearance and shallow hazards surveys of potential exploratory drilling locations within SOI's lease areas in the Beaufort Sea. The surveys were conducted between 8 Aug. and 2 Oct. 2006, on an intermittent basis as allowed by ice and weather conditions at specific nearshore areas ranging from east of Kaktovik west to Thetis Island near the Colville River Delta.

Offshore site clearance surveys use various geophysical methods and tools to acquire graphic records of seafloor and sub-seafloor geologic conditions. Small geophysical survey sources with limited energy output were employed to measure bathymetry, topography, geohazards, and other seabed characteristics. The strongest sound source was a cluster of four 70 in^3 airguns, which was used on 8 Aug. during the sound source measurements. Two 70 in^3 airguns were used during a deeper site clearance survey on 25 Sept. Those were the only dates in 2006 when SOI operated airguns in the Beaufort Sea. Other equipment used during the shallow hazards surveys included a bubble pulser operating at frequencies near 400 Hz for medium penetration and a chirp sonar operating at 2–7 and 8–23 Hz for shallow penetration. Other acoustic sources used to map the seafloor included multibeam bathymetric sonar operating at 240 kHz and side-scan sonar operating at 190–210 kHz.

SOI originally intended to conduct aerial surveys in the Beaufort Sea in support of deep seismic acquisition by the *Gilavar*. Since SOI did not conduct any deep seismic acquisition from the *Gilavar* in the Beaufort Sea in 2006, aerial surveys in the Beaufort Sea were only in support of the shallow hazards and site clearance activities conducted from the *Henry Christoffersen*.

A series of 8 north-south transect lines was established to monitor the project area in Camden Bay where SOI planned to conduct shallow hazard and site clearance surveys. Nine aerial surveys of the project area were conducted using a Twin Otter aircraft flown at 1000 ft above ground level at airspeed of approximately 120 knots. The first 7 surveys, conducted from 26 Aug. to 14 Sept., were pre-seismic surveys intended to collect baseline data on the distribution and abundance of marine mammals in the project area. On 23 and 24 Sept., surveys were flown to monitor the 120 dB zone around the *Henry Christoffersen* prior to seismic activities on 25 Sept.

Acoustic Modeling (Chapter 3).

Prior to conducting seismic and shallow hazards survey activities, SOI contracted with JASCO Research Ltd. to provide an acoustic model to estimate the extent of ensonification from the seismic acquisition and shallow hazards survey equipment in the Chukchi and Beaufort seas. The purpose of the modeling was to provide estimates of the received sound levels as a function of distance and aspect around the various acoustic sources when operating in the planned study regions. The model applied by JASCO takes account of the specific configuration of the airgun array. It also allows for the effects of the anticipated environmental conditions, including water properties, bathymetry, and bottom conditions, on the propagation of the sound through the water and bottom.

The main sound sources that were considered in this modeling study included three configurations of airgun arrays planned for use during seismic acquisition on the *Gilavar*. These consisted of one, two and three strings of airguns with 8 airguns per string and total volumes of 1049 in^3, 2098 in^3 and 3147 in^3 respectively. Also considered in the modeling were three potential shallow hazards survey sound sources. These were individual airguns of 10 in^3 and 20 in^3 volume, and a small airgun array consisting of four 70 in^3 airguns.

The acoustic modeling predicted distances at which the received sound level, on an rms basis, would be 190, 180, …, 120 dB re 1 μPa rms. In the original calculations the radii were "flat weighted" and did not take into account differences in hearing sensitivity among marine mammal groups. In addition, sensitivity weighting (*M*-weighting) was applied to underwater sound levels to weight the sound at various frequencies in accordance with the hearing characteristics of different marine mammal groups, i.e., baleen whales, toothed whales, and pinnipeds. The safety radii applied during initial airgun operations were the unweighted distances predicted by the modeling. Those predicted distances were used until the actual sound field around the operating airguns was measured empirically in the field (Chapter 4).

Acoustic Measurements (Chapter 4)

Seismic and shallow hazards surveys conducted by SOI relied on the generation of underwater acoustic pulses. Greeneridge Sciences, Inc., measured the underwater sound levels produced by the acoustic equipment that was used, including airguns and shallow-hazards sources, and by the vessels involved, including both seismic and support vessels. These measurements were acquired at the start of the respective periods of operation in the Chukchi and Beaufort Seas.

Values measured by Greeneridge were compared to the values that JASCO Research Ltd. had estimated (Chapter 3) by modeling, and were used to recommend updated mitigation radii for use by marine mammal observers on the seismic and shallow hazards ships during data acquisition.

Airgun pulses were received and analyzed at distances of 0.3–34 km in the Chukchi Sea and 0.06–20.5 km in the Beaufort Sea. Logarithmic sound propagation models were fitted to pulse sound pressure levels (SPL), sound exposure levels (SEL), and peak levels. A three-string array (24 airguns totaling 3147 in^3) used in the Chukchi Sea produced the highest values but showed little aspect dependence. A one-string array (8 airguns totaling 1049 in^3) used in the Chukchi Sea showed stronger aspect dependence, with the broadside aspect producing the highest values. Received levels produced by the small airgun array used in the Beaufort Sea (4 airguns totaling 280 in^3) were generally ~15–30 dB lower (depending on distance from the source) than those in the Chukchi Sea, mainly because the Beaufort Sea array was considerably smaller.

A comparison of empirical vs. modeled SPL values showed that the empirical distances exceeded predicted distances in most (but not all) situations. For the *three-string array,* the E:P (Empirical:Predicted) ratios ranged from 1.2× to 2.0× for the 160 dB, 180 dB, and 190 dB distances, depending on aspect. E:P ratios for the 120 dB distance were higher: 2.6× to 3.2× (considering only bow and stern aspect). For the *single-string array*, E:P ratios were somewhat higher for the 190 dB and 120 dB distances than for the 160–180 dB distances, but in some cases the empirical distances were in fact less than the predicted distances (E:P < 1.0). The E:P ratios for the airgun array used in the Beaufort Sea were in general lower (better) than those obtained in the Chukchi Sea.

Broadband (10–20,000 Hz) levels of vessel sound were analyzed as a function of distance from the sound source. Received levels at 500 m distance were 125–132 dB re 1 μPa for the seismic ship *Gilavar*, and 127–135 dB for the chase vessel *Jim Kilabuk*, depending on aspect (bow, stern, broadside). Both of these ships were recorded in the Chukchi Sea. In the Beaufort Sea, the received broadband level for the tug *Henry Christoffersen* at 500 m distance was ~122 dB re 1 μPa.

Monitoring and Mitigation Methods (Chapter 5)

The main purposes of the vessel-based monitoring program were to ensure that the provisions of the IHAs issued to SOI by NMFS and USFWS were satisfied, effects on marine mammals were minimized, and residual effects on animals were documented.

Under current NMFS guidelines, "safety radii" for marine mammals around airgun arrays are customarily defined as the distances within which received pulse levels are ≥180 dB re 1 μPa (rms) for cetaceans and ≥190 dB re 1 μPa (rms) for pinnipeds. Marine mammals exposed to ≥160 dB (rms) are assumed by NMFS to be potentially subject to behavioral disturbance. For the current seismic project there has also been concern that received pulse levels as low as 120 dB (rms) may have the potential to disturb some whales. In 2006, there was a requirement to implement special mitigation measures if specified numbers of bowhead cow/calf pairs might be exposed to ≥120 dB rms or if large groups (≥12

individuals) of bowhead or gray whales might be exposed to ≥160 dB rms. Sound levels were measured in the field to determine safety and disturbance radii to be used for mitigation during seismic acquisition and shallow hazards surveys.

The primary mitigation measures that were implemented during the seismic activities in the Chukchi and Beaufort seas included ramp up, power down, and shut down of the airguns. Mitigation was implemented by marine mammal observers (MMOs) onboard the *Gilavar* and *Kilabuk* who visually monitored the safety radii, and informed the airgun operators when a marine mammal was observed within or about to enter the appropriate safety radius.

In summary, during the seismic and shallow-hazards surveys in the Chukchi and Beaufort Seas, at least one MMO onboard the source vessel (*Gilavar* or *Henry Christoffersen*) maintained a visual watch for marine mammals during all daylight hours while seismic or shallow-hazards surveys were underway. During the surveys, two visual observers were on duty for 45% of the time watches were conducted on the *Gilavar* and for 2% of the time watches were conducted on the *Henry Christoffersen*. Observers focused their search effort forward of the vessel but also searched aft of the vessel while it was underway. Watches were conducted with the naked eye, Fujinon 7 × 50 reticle binoculars, and Zeiss 20 × 60 binoculars. MMOs instructed seismic operators to power down or shut down the airguns if marine mammals were sighted within or about to enter the appropriate safety radii.

An aerial survey program was conducted in support of the shallow-hazards program in the Beaufort Sea during fall of 2006 to advise the *Henry Christoffersen* as to the presence of marine mammals in the general area of operation. During the aerial surveys, observers also collected data on the distribution and abundance of marine mammals. Nine aerial surveys were conducted between 26 Aug. and 24 Sept. SOI's only use of airguns in the Beaufort Sea in 2006 occurred on 8 Aug. and 25 Sept., and was related to site clearance and shallow hazard surveys. Aerial surveys were conducted on 23 and 24 Sept. to monitor the 120 dB zone prior to airgun operations on 25 Sept.

In general, vessel-based data were categorized as "seismic", "post-seismic", or "non-seismic". "Seismic" included all data collected from the source vessel (*Gilavar* or *Henry C.*) while the airguns were operating. Non-seismic included all data obtained before the airguns were activated (pre-seismic) or >1 or >2 h (for pinnipeds and cetaceans, respectively) after the airguns were deactivated. Data collected during post-seismic periods from 3 min to 1 h (for pinnipeds) or 2 h (for cetaceans) after cessation of seismic activity were considered either "recently exposed" (3–30 min) or "potentially exposed" (30 min to 1 or 2 h) to seismic sound levels, and were excluded from analyses. Thus, the post-seismic data (3 min to 1 or 2 h after cessation of seismic) were not included in either the "seismic" or "non-seismic" categories.

Marine mammal sightings during the "seismic" and "non-seismic" periods were used to calculate sighting rates. Sighting rates were then used to calculate the corresponding densities of marine mammals near the survey and chase ships during seismic and non-seismic periods. These densities were used to estimate the numbers of marine mammals that may have been exposed to various levels of ensonification, and to determine the estimated take by harassment.

Monitoring and Mitigation Results (Chapter 6)

Marine mammal observers aboard the *Gilavar* conducted 13,527 km and 1537 h of visual observation and MMOs aboard the *Kilabuk* conducted 14,058 km and 1251 h of visual observation, together documenting 353 sightings of 442 pinnipeds and 115 sightings of 219 cetaceans (Table ES.1). There were numerous sightings of supply and chase vessels within 5km of each of the observation vessels.

TABLE ES.1. Summary of *Gilivar*, *Kilabuk*, and *Henry Christoffersen* operations, observer monitoring effort, and marine mammal sightings during SOI marine geophysical surveys in the Chukchi and Beaufort Seas 2006.

	Non-Seismic			Seismic		Total	
	Useable[a]	Other	Post-seismic	Useable[a]	Other	Useable[a]	Total
A. Gilavar							
Total operations in h	173	264	8	292	800	465.0	1537
Total operations in km	1677	2225	69.0	2537	7019	4214.0	13527
Marine mammal sightings (indv.)							
Cetaceans	52 (94)	20 (24)	3 (7)	1 (1)	4 (4)	53 (95)	80 (130)
Pinnipeds in water	64 (73)	9 (13)	19 (20)	60 (62)	37 (37)	124 (135)	189 (205)
Pacific Walrus	8 (11)	2 (3)	1 (2)	1 (1)	1 (1)	9 (12)	13 (18)
Pinnipeds on ice	13 (47)	2 (2)	0	0	0	13 (47)	15 (49)
Pacific Walrus	3 (35)	0	0	0	0	3 (35)	3 (35)
Polar Bears	0	0	0	0	0	0	0
B. Kilabuk							
Total operations in h	895	356	*NA*	*NA*	*NA*	895	1251
Total operations in km	10220	3838	*NA*	*NA*	*NA*	10220	14058
Marine mammal sightings (indv.)							
Cetaceans	0	35 (89)	*NA*	*NA*	*NA*	0	35 (89)
Pinnipeds in water	114 (130)	39 (42)	*NA*	*NA*	*NA*	114 (130)	153 (172)
Pacific Walrus	9 (17)	8 (11)	*NA*	*NA*	*NA*	9 (17)	17 (28)
Pinnipeds on ice	7 (28)	1 (1)	*NA*	*NA*	*NA*	7 (28)	8 (29)
Pacific Walrus	3 (23)	0	*NA*	*NA*	*NA*	3 (23)	3 (23)
Polar Bears	0	0	0	0	0	0	0
C. Henry Christoffersen							
Total operations in h	292	218	7	4	6	298	527
Total operations in km	3179	1783	85.0	60	38	3239	5145
Marine mammal sightings (indv.)							
Cetaceans	0	0	0	0	0	0	0
Pinnipeds in water	270 (288)	129 (145)	3 (3)	0	0	270 (288)	399 (433)
Pacific Walrus	0	0	0	0	0	0	0
Pinnipeds on ice	1 (1)	5 (5)	0	0	0	1 (1)	6 (6)
Pacific Walrus	0	0	0	0	0	0	0
Polar Bears	3 (4)	1 (5)	0	0	0	3 (4)	4 (9)
Power downs/shut downs							
Gilivar							48
Henry Christoffersen							0

Note: N/A means not applicable.

[a] See *Acronyms and Abbreviations for description of "useable" sightings.*

A total of 8213 km and 526 hours of visual observation was conducted aboard the *Henry Christoffersen*, during which 412 sightings of 451 marine mammals were logged. The ringed seal was the most abundant species recorded. No sightings were noted during the limited periods when airguns were in use in the Beaufort Sea. Few vessels were sighted during the cruise, and only two of these approached within 5 km of the *Henry Christoffersen*.

Based on the estimated densities of marine mammals in the Chukchi Sea during this project, about 416 different individual seals, 49 walruses, and 91 cetaceans would be expected to occur within the areas ensonified to ≥190 dB re 1 μPa (rms) for pinnipeds and 180 dB re 1 μPa (rms) for cetaceans at some time during the field season. Calculated estimates for individual pinnipeds and cetaceans potentially exposed to sound levels ≥160dB re 1 μPa (rms) were 1317 and 198 respectively.

No animals observed from the *Henry Christoffersen* were potentially exposed to sound levels ≥180 dB re 1 μPa (rms). Based on calculations involving estimated densities of marine mammals, there would have been approximately 180 seals exposed to sound levels ≥160 dB re 1 μPa (rms).

On the two days of aerial surveying in support of seismic activities on the *Henry Christoffersen*, 219.4 km of transect were flown, of which 188.4 km were flown in good surveying conditions. There was one sighting of a bowhead during these surveys.

1. BACKGROUND AND INTRODUCTION[1]

Shell Offshore, Inc. (SOI), collected marine seismic data in the Chukchi and Beaufort seas during the summer of 2006 in support of potential future oil and gas leasing and development. Deep seismic acquisition for SOI was conducted in the Chukchi Sea by WesternGeco using the M/V *Gilavar*, a seismic vessel that towed an airgun array as well as hydrophone streamers to record reflected seismic data. Seismic acquisition was originally planned to be conducted in both the Chukchi and Beaufort Seas using the *Gilavar*; however, ice conditions during the 2006 field season precluded most data collection in the Beaufort Sea. Activities in the Beaufort Sea were confined to site clearance, shallow hazard surveys and geotechnical activities, that were conducted from the M/V *Henry Christoffersen*, an NTCL vessel.

Marine seismic surveys emit sound energy into the water (Greene and Richardson 1988; Tolstoy et al. 2004a,b), and have the potential to affect marine mammals given the reported auditory and behavioral sensitivity of many such species to underwater sounds (Richardson et al. 1995; Gordon et al. 2004). The effects could consist of behavioral or distributional changes, and perhaps (for animals close to the sound source) temporary or permanent reduction in hearing sensitivity. Either behavioral/distributional effects or (if they occur) auditory effects could constitute "taking" under the provisions of the U.S. Marine Mammal Protection Act (MMPA) and the U.S. Endangered Species Act (ESA), at least if the effects are considered to be "biologically significant".

Numerous species of cetaceans and pinnipeds inhabit parts of the Chukchi and Beaufort seas. Two species listed as "Endangered" under the ESA do or may occur in portions of the survey area, including bowhead whale (*Balaena mysticetus*) and perhaps the fin whale (*Balaenoptera physalus*). The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) share jurisdiction over the marine mammal species that were likely to be encountered during the project. USFWS manages two species occurring in the Chukchi and Beaufort Seas, the walrus (*Odobenus rosmarus*) and the polar bear (*Ursus maritimus*); NMFS manages all the other marine mammals occurring in those areas.

Other species of concern (birds) that might occur in the survey area are the spectacled (*Somateria fischeri*) and Steller's (*Polysticta stelleri*) eiders that are listed as "Threatened" under the ESA. Of the two species, spectacled eiders are more abundant, have been documented farther offshore (40 km) in the Beaufort Sea, and use some lagoon systems in the Beaufort and Chukchi seas during their molt migration.

On 16 November 2005, SOI requested that NMFS issue Incidental Harassment Authorizations (IHAs) to authorize non-lethal "takes" of marine mammals incidental to SOI's planned seismic operations in the mid- and eastern parts of the Alaskan Beaufort Sea (SOI 2005a) and in the Chukchi Sea (SOI 2005b). The IHAs were requested pursuant to Section 101(a)(5)(D) of the MMPA. A single IHA to cover activities in both the Beaufort and Chukchi seas was issued to SOI by NMFS on 5 July 2006 (Appendix A). The IHA authorized "potential take by harassment" of various cetaceans and seals during the marine geophysical cruises described in this report. On 10 Jan. 2006, SOI also requested from USFWS an IHA to authorize potential "taking" of walruses and polar bears in the Chukchi Sea. USFWS issued that IHA to SOI on 29 June 2006 (Appendix B).

This document serves to meet reporting requirements specified in the IHA. The primary purposes of this report are to describe the seismic survey in the Chukchi and Beaufort seas, to describe the associated marine mammal monitoring and mitigation programs and their results, and to estimate the

[1] Chapter 1 by R. Rodrigues, B. Haley, and D. Ireland (LGL).

numbers of marine mammals potentially exposed to levels of sound generated by the project at or above presumed effects levels.

Incidental Harassment Authorization

IHAs issued to seismic operators include provisions to minimize the possibility that marine mammals close to the seismic source might be exposed to levels of sound high enough to cause hearing damage or other injuries. During this project, sounds were generated by the *Gilavar*'s airguns, as used during the seismic study, and by several types of lower-energy sound sources on the *Henry Christoffersen* including bottom mapping and seafloor imaging sonar, a chirp sonar, a bubble pulser, and a cluster of four small airguns. No serious injuries or deaths of marine mammals were anticipated from the seismic and shallow hazards surveys, given the nature of the operations and the mitigation measures that were implemented, and no injuries or deaths were attributed to these activities. Nonetheless, the seismic survey operations described in Chapter 2 had the potential to "take" marine mammals by harassment. Behavioral disturbance to marine mammals is considered to be "take by harassment" under the provisions of the MMPA. Appendix C provides further background on the issuance of IHAs relative to seismic operations and "take".

Under current NMFS guidelines (e.g., NMFS 2005a, 2006a), "safety radii" for marine mammals around airgun arrays are customarily defined as the distances within which the received pulse levels are ≥180 dB re 1 μPa (rms)[2] for cetaceans and ≥190 dB re 1 μPa (rms) for pinnipeds. Those safety radii are based on an assumption that seismic pulses at lower received levels will not injure these mammals or impair their hearing abilities, but that higher received levels *might* have some such effects. The mitigation measures required by IHAs are, in large part, designed to avoid or minimize the numbers of cetaceans and pinnipeds exposed to sound levels exceeding 180 and 190 dB (rms), respectively. The development and implementation of the safety radii for the current project are discussed in detail in Appendix C.

Disturbance to marine mammals could occur at distances beyond the safety (shut down) radii if the mammals were exposed to moderately strong pulsed sounds generated by the airguns or perhaps by sonar (Richardson et al. 1995). NMFS assumes that marine mammals exposed to airgun sounds with received levels ≥160 dB re 1 μPa (rms) are likely to be disturbed. That assumption is based mainly on data concerning behavioral responses of baleen whales, as summarized by Richardson et al. (1995) and Gordon et al. (2004). Dolphins and pinnipeds are generally less responsive than baleen whales (e.g., Stone 2003; Gordon et al. 2004), and 170 dB (rms) may be a more appropriate criterion of potential behavioral disturbance for those groups (LGL Ltd. 2005a,b). In general, disturbance effects are expected to depend on the species of marine mammal, the activity of the animal at the time of disturbance, distance

[2] "rms" means "root mean square", and represents a form of average across the duration of the sound pulse as received by the animal. Received levels of airgun pulses measured on an "rms" basis (sometimes described as Sound Pressure Level, SPL) are generally 10–12 dB lower than those measured on the "zero-to-peak" basis, and 16–18 dB lower than those measured on a "peak-to-peak" basis (Greene 1997; McCauley et al. 1998, 2000a,b). The latter two measures are the ones commonly used by geophysicists. Unless otherwise noted, all airgun pulse levels quoted in this report are rms levels. Received levels of pulsed sounds can also be described on an energy or "Sound Exposure Level" basis, for which the units are dB re $(1\ \mu Pa)^2 \cdot s$. The SEL value for a given airgun pulse, in those units, is typically 10–15 dB less than the rms level for the same pulse (Greene 1997; McCauley et al. 1998, 2000a,b), with considerable variability (Madsen et al. 2006; see also Chapter 4 of this report). SEL (energy) measures may be more relevant to marine mammals than are rms values, but the current regulatory requirements are based on rms values.

from the sound source, the received level of the sound and the associated water depth. Some individuals may exhibit behavioral responses at received levels somewhat below the nominal 160 or 170 dB (rms) criteria, but others may tolerate levels somewhat above 160 or 170 dB without reacting in any substantial manner. For example, migrating bowhead whales in the Alaskan Beaufort Sea show avoidance at received levels substantially lower than 160 dB re 1 μPa_{rms} (Miller et al. 1999; Richardson et al. 1999). In contrast, bowhead whales on the summer feeding grounds tolerate received levels of 160 dB or sometimes more (Richardson et al. 1986; G. Miller et al. 2005). Beluga whales also show avoidance at levels below 160 dB (G. Miller et al. 2005).

A notice regarding the proposed issuance of an IHA for the survey in the Chukchi and Beaufort seas was published by NMFS in the *Federal Register* on 3 May 2006 and public comments were invited (NMFS 2006a). On 24 Aug. 2006, NMFS published a second notice in the *Federal Register* to announce the issuance of the IHA (NMFS 2006b). The second notice responded to 32 comments received by NMFS during the 30-day public comment period. A copy of the IHA is included in this report as Appendix A.

The IHA issued by NMFS to SOI authorized harassment "takes" of one ESA-listed species (bowhead whale) as well as several non-listed species: gray (*Eschrichtius robustus*), killer (*Orcincus orca*), and beluga (*Delphinapterus leucas*) whales, harbor porpoises (*Phocoena phocoena*), and ringed (*Phoca hispida*), spotted (*Phoca largha*), and bearded (*Erignathus barbatus*) seals.

NMFS granted the IHA to SOI on the assumptions that

- the numbers of whales and seals potentially harassed (as defined by NMFS criteria) during seismic operations would be "small",
- the effects of such harassment on marine mammal populations would be negligible,
- no marine mammals would be seriously injured or killed,
- there would be no unmitigated adverse effects on the availability of marine mammals for subsistence hunting in Alaska, and
- the agreed upon monitoring and mitigation measures would be implemented.

USFWS determined in 2006 that proponents of arctic seismic projects should operate under IHAs issued by USFWS. The process of obtaining an IHA from USFWS was very similar to that of obtaining one from the NMFS. On 10 January 2006, SOI requested an IHA from USFWS for the incidental taking of walruses and polar bears in conjunction with seismic activities in the Chukchi Sea (SOI 2006). A notice regarding the proposed issuance by USFWS of an IHA for the survey in the Chukchi Sea was published in the *Federal Register* on 8 May 2006 and public comments were invited (USFWS 2006). This IHA was issued to SOI by USFWS on 29 June 2006. USFWS did not publish a second notice in the *Federal Register* to announce the issuance of the IHA. A copy of the USFWS IHA is included in this report as Appendix B. The IHA required SOI to observe a 190 dB safety radius for walruses and polar bears.

Mitigation and Monitoring Objectives

The objectives of the mitigation and monitoring program were described in detail in SOI's IHA applications (SOI 2005a,b, 2006) and in the IHA issued by NMFS to SOI (Appendix A). Explanatory material about the monitoring and mitigation requirements was published by NMFS and USFWS in the *Federal Register* (NMFS 2006a,b; USFWS 2006).

The main purpose of the mitigation program was to avoid or minimize potential effects of SOI's seismic survey on marine mammals. This required that shipboard personnel detect marine mammals within or about to enter the designated safety radii (190 dB for pinnipeds and 180 dB for cetaceans), and in such cases initiate an immediate power down (or shut down if necessary) of the airguns. A power down involves reducing the source level of the operating airguns, in this case by reducing the air volume. A shut down involves temporarily terminating the operation of all airguns. An additional mitigation objective was to detect marine mammals within or near the safety radii prior to starting the airguns, or during ramp up toward full power. In these cases, the start of airguns was to be delayed or ramp up discontinued until the safety radius was free of marine mammals insofar as this can be determined visually for a period of 30 minutes (see Appendix A and Chapter 5).

In 2006 mitigation was also required, as specified by the IHA, at the 160 dB isopleth. This area was monitored by the chase boat that accompanied the seismic vessel. Power down of the seismic airgun array was required if an aggregation of 12 or more non-migratory bowhead or gray whales was detected ahead of, or perpendicular to, the seismic vessel track and within the 160 dB isopleth. Monitoring of the 120 dB isopleth around the seismic vessel(s) was also required after 25 September in the Chukchi Sea and after 1 September in the Beaufort Sea. Power down would be required if 4 migratory cow/calf pairs were detected within the surveyed 120 dB isopleth.

The primary objectives of the monitoring program were as follows:

1. provide real-time sighting data needed to implement the mitigation requirements;
2. estimate the numbers of marine mammals potentially exposed to strong seismic pulses; and
3. determine the reactions (if any) of marine mammals potentially exposed to seismic sound impulses.

Specific mitigation and monitoring objectives identified in the IHAs are described in Appendices A and B. Mitigation and monitoring measures that were implemented during the activities in the Chukchi and Beaufort seas are described in detail in Chapter 5.

This 90-day report describes the methods and results for the monitoring work specifically required to meet the above primary objectives. Various other marine mammal and acoustic monitoring and research programs not specifically tied to the above objectives were also implemented by SOI (or by SOI plus other industry operators) in the Chukchi and/or Beaufort Seas during 2006. Results of those additional efforts are, for the most part, not mentioned in this 90-day report. Those additional results will be reported at a later date.

Report Organization

The primary purpose of this report is to describe the 2006 seismic survey activities in the Chukchi and Beaufort seas including the associated monitoring and mitigation programs, and to present results as required by the IHAs (Appendices A and B). This report includes six chapters:

1. background and introduction (this chapter);
2. description of SOI's seismic and site clearance studies;
3. sound source and propagation modeling prior to the field season;
4. sound source measurements during the field season;
5. description of the marine mammal monitoring and mitigation requirements and methods,

including safety radii; and

6. results of the marine mammal monitoring program, including estimated numbers of marine mammals potentially "taken by harassment".

Those chapters are followed by Acknowledgements and Literature Cited sections.

In addition, there are nine Appendices that provide copies of relevant documents and details of procedures that are more-or-less consistent during seismic surveys where marine mammal monitoring and mitigation measures are in place. These procedural details are only summarized in the main body of this report. The Appendices include

A. a copy of the IHA issued by NMFS to SOI for this study;

B. a copy of the IHA issued by USFWS to SOI for this study;

C. background on development and implementation of safety radii;

D. characteristics of the *Gilavar* and *Henry Christoffersen*;

E. details on visual and acoustic monitoring, mitigation, and data analysis methods;

F. conservation status and densities of marine mammals in the project region;

G. monitoring effort and list of marine mammals seen or heard during this cruise;

H. marine mammal sightings with power downs and shut downs during the seismic activities;

I. marine mammal density estimates for the project area.

2. SEISMIC SURVEYS DESCRIBED[3]

Chukchi Sea

The *Gilavar* was used as the source vessel during SOI's activities in the Chukchi Sea in 2006. The *Gilavar* was accompanied by the *Jim Kilabuk*, an icebreaker-class support vessel (chase vessel). Two other support vessels were also used in the Chukchi Sea at various times during the field season. The *Gulf Provider* was used as a supply vessel for transfer of personnel during crew changes, for fuel transfers to the *Kilabuk*, and to resupply the *Gilavar* with equipment and supplies. In addition, the *Peregrine*, a flat-bottom landing craft with minimal draft, was used for transfer of personnel and equipment from shore areas to the *Gulf Provider*. Appendix D contains a description of the vessels used during the seismic activities. These four vessels operated in accordance with the provisions of a Conflict Avoidance Agreement (CAA) between the seismic industry, the Alaska Eskimo Whaling Commission (AEWC), and the Whaling Captains Associations with respect to subsistence activities including but not limited to the hunts for bowhead and beluga whales. The objective of the CAA was to provide avoidance and other mitigation guidelines to be followed by industry participants working in or transiting the vicinity of active whaling crews. Under the terms of the CAA, communication centers were established at Barrow and Deadhorse, and Call Centers at Pt. Hope, Pt. Lay, Wainwright, and Kaktovik. The CAA outlined a communication program and specified times and areas to be surveyed in order to avoid any possible conflict with the subsistence hunts.

Operating Areas, Dates, and Navigation

The proposed deep seismic survey was originally scheduled to occur in two phases. Phase one commenced in July when sea ice conditions allowed access to the Chukchi Sea. Operations were originally planned to continue there until some date in late summer when the *Gilavar* and *Kilabuk* were to transit to the Beaufort Sea to conduct seismic surveys on Shell lease-holdings in the mid- and eastern parts of the Alaskan Beaufort Sea. Heavy ice conditions delayed the date when operations could have transferred to the Beaufort Sea, and seismic operations continued in the Chukchi Sea. During September, SOI decided not to attempt to conduct deep seismic exploration in the Beaufort Sea during 2006 due to high concentrations of ice and other operational considerations. The *Gilavar*'s airguns and streamers were retrieved on 19 September and the *Gilavar* departed southward from the project area and left the Chukchi Sea on 23 September.

The geographic region where the deep seismic survey occurred was located in the Chukchi Sea MMS OCS Program Area designated as Chukchi Sea Sale 193 (1989) and in the proposed 2002–2007 Chukchi Sea Program Area (see Fig. 2.1). Since the Chukchi Sea deep seismic program was conducted as a pre-lease activity, the exact locations where operations occurred remains confidential for business reasons. That is, the seismic data acquired in 2006 will be used by SOI to identify leases on which it may bid in a forthcoming competitive lease sale. However, in general, seismic acquisition occurred in the Chukchi Sea well offshore from the Alaska coast in OCS waters averaging greater than 40 meters (m) or 131 ft deep and outside the polynya zone.

The *Gilavar* left Dutch Harbor on 7 July to travel to the project area, and entered the Chukchi Sea on 10 July. Operations were then delayed due to ice conditions in the planned operating areas and to avoid potential disruption of the Pt. Lay beluga hunt. SOI's seismic contractor began deploying the seismic acquisition equipment on 21 July. After deployment of the airguns, the underwater sounds

[3] Chapter 2 by R. Rodrigues, B. Haley, and D. Ireland (LGL).

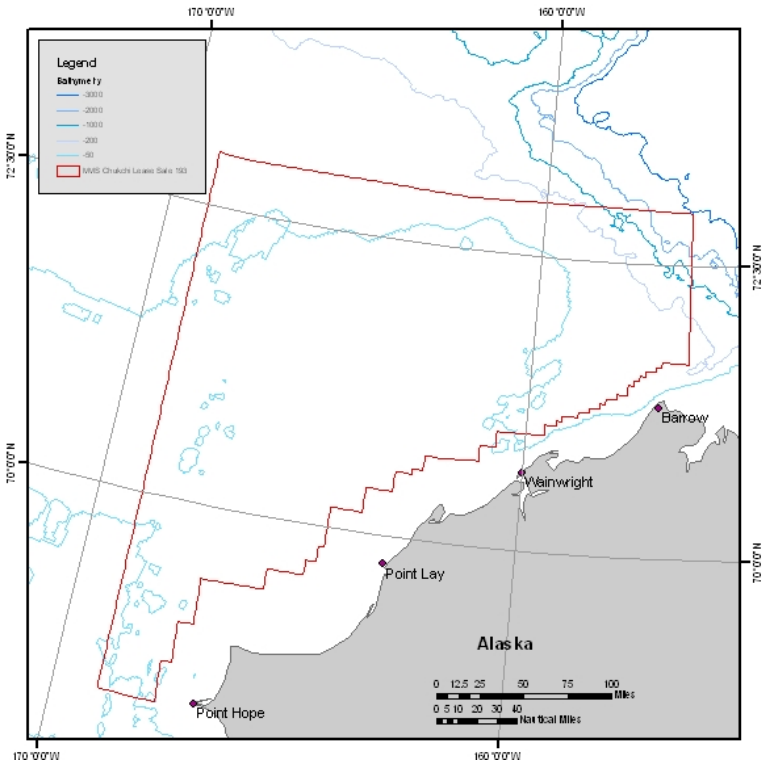

FIGURE 2.1. Location of the proposed MMS Chukchi Sea Lease Sale 193 within which SOI's 2006 high-energy seismic activities were conducted.

produced by the airgun array were recorded and analyzed to verify or refine the various radii to be used for mitigation purposes during the exploration activities (see Chapter 4 below). Those radii had been predicted prior to the field season via acoustic modeling procedures (see Chapter 3), but site-specific empirical measurements were required to confirm or refine the predictions. The airgun sounds were recorded as a function of airgun configuration, distance, and aspect on 21 and 22 July, and safety and disturbance radii based on these measurements were determined within 72 hrs. Seismic acquisition began on 27 July 2006 and continued through most of the field season until 19 September. SOI then determined that ice conditions and other operational considerations precluded continuation of the exploration program or a transition of the program into the Beaufort Sea, and seismic activities were terminated. SOI completed ~5297.4 km (3291.7 statute mi) of deep-seismic survey line in the Chukchi Sea in 2006.

Throughout the survey the *Gilavar's* position, speed, and water depth were logged digitally every ~60 s. In addition, the position of the *Gilavar*, water depth, and information on the airgun array were logged for every airgun shot while the *Gilavar* was on a seismic line and collecting geophysical data. The geophysics crew kept an electronic log of events, as did the marine mammal observers (MMOs) while on duty. The MMOs also recorded the number and volume of airguns that were firing when the *Gilavar* was offline (e.g., prior to shooting at full volume) or was online but not recording data (e.g., during airgun or computer problems).

Airgun Description

SOI used WesternGeco's 3147 in^3 3-string array of Bolt airguns for its 3–D seismic survey operations in the Chukchi Sea. WesternGeco's source array was composed of 3 identically-tuned Bolt airgun sub-arrays, each with 8 airguns and a total volume of 1049 in^3, operated at an air pressure of 2000

psi. Each string was 15 m in length, and each string was 8 m from the adjacent string(s). The individual airguns ranged in volume from 30 to 235 in^3, and each string included two 235 in^3 and two 125 in^3 airguns in 2-gun clusters. This energy source was towed approximately 245 m behind the *Gilavar*. The system also included 6 hydrophone streamers 4200 m in length and spaced 100 m apart, which recorded reflected sound energy. In general, the *Gilavar* towed this system along a predetermined survey track although adjustments were made during the course of the field season in accordance with ice conditions.

Air compressors aboard the *Gilavar* were the source of high pressure air used to operate the airgun arrays. Seismic pulses were emitted at intervals of 25 m (~10 sec) while the *Gilavar* traveled at a speed of 4 to 5 knots (7.4–9.3 km/h). The airgun arrays were towed at a depth of 6 m and were 8 m apart. Characteristics of the airgun arrays are detailed in Appendix D.

Beaufort Sea—Vessel-based Component

In addition to deep seismic surveys in the Chukchi Sea, SOI also conducted site clearance and shallow hazards surveys of potential exploratory drilling locations within SOI's lease areas in the Beaufort Sea as required by MMS regulations. Before drilling can begin, a site clearance survey and analysis is necessary to identify and/or evaluate potentially hazardous or otherwise sensitive conditions and sites at or below the seafloor that could affect the safety or appropriateness of operations. Examples of such conditions include subsurface faults, fault scarps, shallow gas, steep-walled canyons and slopes, buried channels, current scour, migrating sedimentary bedforms, ice gouging, permafrost, gas hydrates, unstable soil conditions, pipelines, anchors, ordnance, shipwrecks, or other geophysical or man-made features.

Offshore site clearance surveys use various geophysical methods and tools to acquire graphic records of seafloor and sub-seafloor geologic conditions. The data acquired and the types of investigations outlined below are performed routinely for most exploratory drilling and production facilities in marine areas, and for submarine pipelines, port facilities, and other offshore projects. High-resolution geophysical data such as two-dimensional, high-resolution multi-channel seismic, medium penetration seismic, subbottom profiler, side scan sonar, multibeam bathymetry, magnetometer, and possibly piston core sediment sampling are typical types of data acquired. These data are interpreted to define geologic, geotechnical and archeological conditions at the site and to assess the potential engineering significance of these conditions. The following section provides a brief description of the operations and instrumentation used during SOI's 2006 Beaufort Sea site clearance program insofar as they may impact marine mammals.

Operating Areas, Dates, and Navigation

The site clearance surveys were confined to very small specific areas within defined OCS blocks (Fig. 2.2). The surveys were conducted from the M/V *Henry Christofferson*. This vessel is 47 m (153 ft) long and the gross tonnage is 783 metric tons. It is powered by four Caterpillar V16 D399 diesel engines and can travel at a speed of 14 knots (see Appendix D). Small geophysical survey sources with limited energy output were employed to measure bathymetry, topography, geohazards, and other seabed characteristics. The strongest sound source was a cluster of four 70 in^3 airguns, which was used during the sound source measurements. Two 70 in^3 airguns were used during a deeper site clearance survey on 25 Sept. Chapter 4 describes results of measurements of sounds from this and other acoustical sources used during site clearance operations.

Measurements of sounds from the 4-airgun array and from other acoustic sources on the *Henry C.* were conducted on 8 Aug. in the Beaufort Sea east of Kaktovik (see Chapter 4 for details). The sound sources (including the cluster of 4 airguns) were operated for 2.5 hours on this date. Between

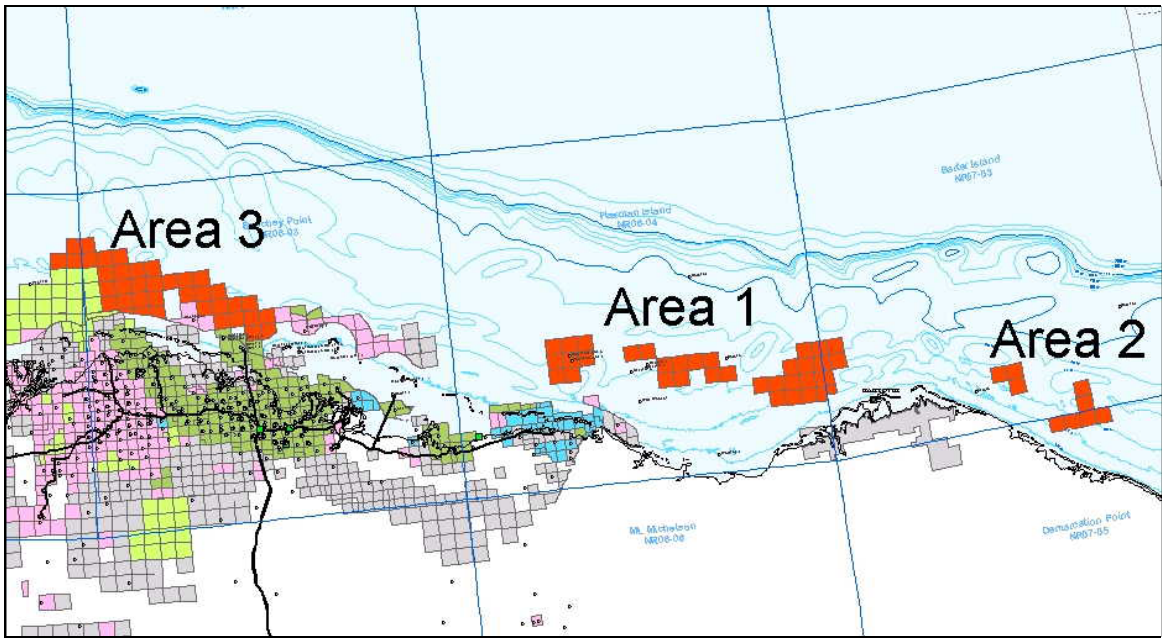

FIGURE 2.2. Location of SOI lease holdings in the Alaskan Beaufort Sea.

8 Aug. and 2 Oct. 2006, on an intermittent basis as allowed by ice and weather conditions, various types of site clearance surveys were conducted from the *Henry C.* These operations were in specific nearshore areas ranging from east of Kaktovik west to Thetis Island near the Colville River Delta (Fig. 2.2). Site clearance survey activities occurred on ~23 days during this period. However, during that period the airgun cluster (2 airguns) was operated only once for ~12 hrs on 25 Sept. At all other times during surveys, the acoustical sources in use were lower-energy medium- and high-frequency sources as described below. On days when surveys did not occur, the *Henry Christoffersen* was usually transiting to a new site or anchored while waiting for bad weather or ice conditions to subside.

Throughout the survey the *Henry Christoffersen*'s position, speed, and water depth were logged digitally every ~60 s. In addition, the position of the *Henry C.*, water depth, and information on the output of the airgun array or other geophysical tools were logged during all site clearance activities. The geophysics crew kept an electronic log of events, as did the marine mammal observers (MMOs) while they were on duty.

Geophysical Tools for Site Clearance

An airgun cluster consisting of four 70-in^3 airguns was planned for use during site clearance operations to locate potential hazards, such as gas deposits, at relatively shallow locations. The results of the source measurements indicated to the operators that the use of the 4-airgun array was excessive for their needs. Therefore, a pair of 70-in^3 airguns was the sound source used during the ~12-h of airgun operations on 25 Sept.

Several other lower-energy acoustic sources were operated for shallow-penetration subbottom surveys and to map the bottom. A bubble pulser operating at frequencies near 400 Hz was used for medium penetration and a chirp sonar operating at 2–7 and 8–23 Hz was used for shallow penetration. Other acoustic sources used to map the seafloor included a multibeam bathymetric sonar operating at 240

kHz and a side-scan sonar operating at 190–210 kHz. Characteristics of this equipment are described in more detail in Appendix D.

Beaufort Sea—Aerial Component

SOI originally intended to conduct aerial surveys in the Beaufort Sea in the summer (July to late Aug.) to collect pre-seismic baseline data and to conduct fall surveys (late Aug. to Oct.) as part of the monitoring and mitigation effort associated with seismic survey activities. Logistical problems early in the summer season precluded SOI's ability to conduct summer aerial surveys, and since SOI did not conduct any deep seismic acquisition from the *Gilavar* in the Beaufort Sea in 2006, the aerial surveys in the Beaufort Sea were only in support of the shallow hazards and site clearance activities conducted from the *Henry Christoffersen*.

A series of 8 north–south transect lines was established to monitor the project area in Camden Bay where SOI planned to conduct shallow hazard and site clearance surveys using their 240 in^3 airgun array (Fig. 2.3). Nine aerial surveys of the project area were conducted using a Twin Otter aircraft flown at 1000 ft above ground level at an airspeed of approximately 120 knots. The first 7 surveys, conducted between 26 Aug. and 14 Sept., were pre-seismic surveys intended to collect baseline data on the distribution and abundance of marine mammals in the project area. Surveys were flown on 23 and 24 Sept. to monitor the 120 dB zone prior to seismic activities on 25 Sept.

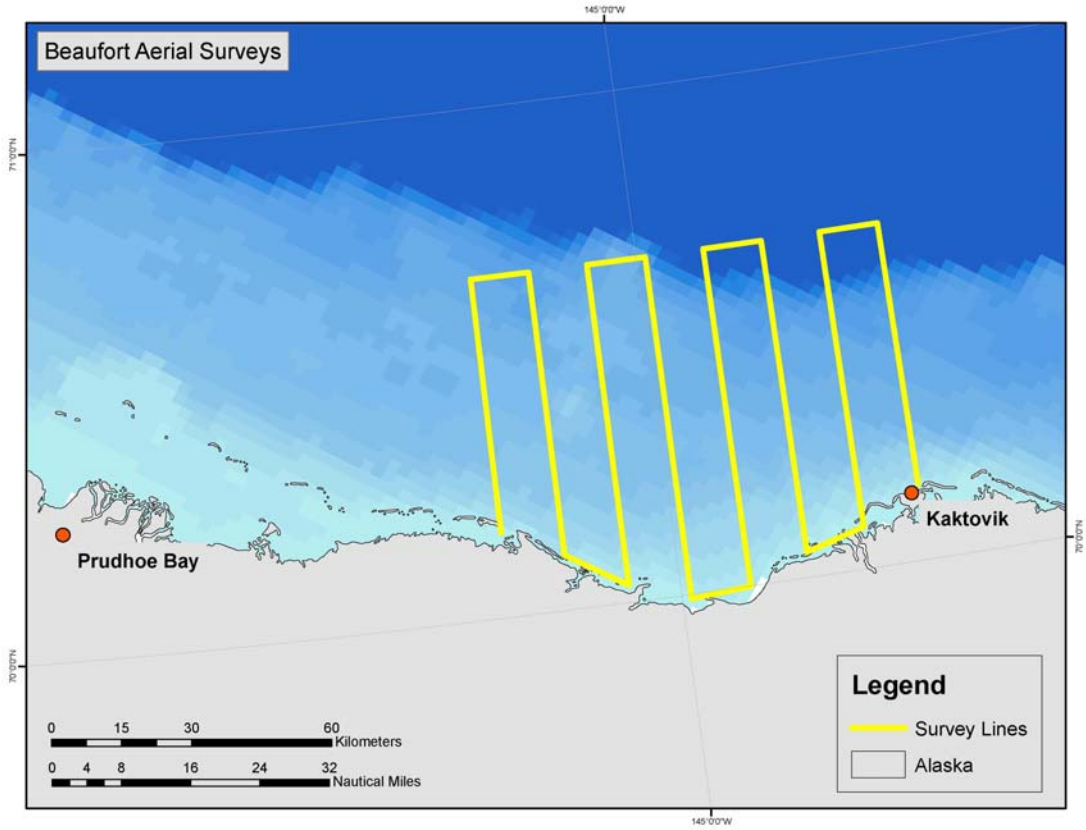

FIGURE 2.3. Approximate location of transect lines for aerial surveys of marine mammals in Camden Bay, Alaska 2006.

3. ACOUSTIC MODELING[4]

INTRODUCTION

Shell Offshore, Inc. (SOI), conducted seismic exploration activities in the Chukchi Sea and shallow hazards surveys in the Alaskan Beaufort Sea during summer 2006. Prior to conducting these activities SOI contracted with JASCO Research Ltd. to provide an acoustic model to estimate the extent of ensonification from the seismic acquisition and shallow hazards survey equipment in the Chukchi and Beaufort seas. The purpose of the modeling was

- to characterize the acoustic environment in the areas of the Chukchi and Beaufort seas where the seismic and shallow hazards programs were to be conducted,
- to predict the anticipated source characteristics of the emitted sounds, and
- to provide estimates of the received sound levels as a function of distance and aspect around the various acoustic sources when operating in the planned study regions.

Sound propagation modeling was performed for six locations, three in the Chukchi Sea and three in the Beaufort Sea, to provide predictions representative of the areas over which seismic exploration and shallow hazards surveys were to occur. The particular type of model used is state-of-the-art. It takes account of the specific configurations of the planned airgun arrays, and also allows for the anticipated effects of local environmental conditions on propagation of sound. Those propagation effects can have strong influences on received sound levels and other acoustic parameters, especially in shallow-water environments such as those where SOI's 2006 programs were to occur. The specific modeling approach used in this study has been subject to expert review by an IUCN scientific panel (Reeves 2005). Model input parameters, notably bathymetry, seabed properties, and sound velocity profiles for the water column, were chosen to be appropriate for the respective geographic regions and seasons modeled. The site locations for modeling were near the prospect or in areas similar with respect to the parameters mentioned above.

Use of acoustic modeling techniques to estimate the noise footprint associated with the seismic and shallow hazards survey activities provided a basis for planning the mitigation procedures that were implemented to minimize impacts of SOI's project on marine mammals. However, the project plans also provided for field measurements of the actual sound levels and characteristics early in the period of operation in both the Chukchi and Beaufort Seas. Results of those field measurements are described in Chapter 4 of this report. The modeling and field measurement programs were complementary to one another.

The main sound sources that were considered in this modeling study included three airgun arrays consisting of one, two and three strings of airguns with 8 airguns per string (i.e., totals of 8, 16 and 24 airguns with a total volumes of 1049 in^3, 2098 in^3 and 3147 in^3 respectively). Also considered in the modeling were three potential shallow hazards survey sources. These were individual airguns of 10 in^3 and 20 in^3 volume, and a small airgun array consisting of four 60 in^3 airguns for a total volume of 240 in^3. The 24-airgun 3147 in^3 configuration that was modeled closely matched the actual airgun configuration used by SOI for the Chukchi Sea seismic survey. The actual airgun configuration for the limited airgun operations during the 2006 shallow-hazards survey in the Beaufort Sea was a 4-airgun 280 in^3 array, slightly larger than the configuration that was modeled. Given that peak pressure from an airgun source increases in proportion

[4] Summarized by LGL from a detailed technical report (Austin et al. 2006b; 21 August 2006 version 3) by JASCO Research Ltd. for Shell Offshore Inc.

to the cube root of the source volume, an increase from 240 to 280 in^3 would have minimal effect on the received sound levels at any distance; at any location, the change would be less than 1 dB.

JASCO's modeling is a two-stage process. *(1)* A proprietary airgun array source-level model was used to characterize the sounds emitted by individual elements within each airgun array, and by the array as a whole. This source model took account of the specifications and spacing of the individual airguns planned for use during the 2006 seismic and shallow-hazards programs. *(2)* The modeled source levels were incorporated into an N×2-D sound propagation model, JASCO's Marine Operations Noise Model (MONM), to estimate the sound field as a function of distance and direction from each source. From this, JASCO estimated the ranges corresponding to the various safety and disturbance criteria that are typically applied during seismic programs conducted under Incidental Take Authorizations issued by the National Marine Fisheries Service (e.g., the 190, 180 and 160 dB re 1 μPa rms distances). Other distances of interest, including the 170 dB and 120 dB distances, were also estimated. This Chapter summarizes the methods and results of the sound source modeling. This summary of the modeling effort and results is based on JASCO's detailed technical report on the modeling, by Austin et al. (2006b).

JASCO SOURCE MODEL

JASCO currently employs a full-waveform airgun array signature model, called AASM, to compute the source level and directionality of airgun arrays (MacGillivray et al. 2004). The source signature model numerically simulates the oscillation and radiation of a collection of airgun bubbles. The theory of the airgun array model is beyond the scope of this report but is based on the pioneering work of Ziolkowski (1970) who first modeled the pressure waveforms of seismic airguns, with additional physics to account for pressure interactions between airguns, port throttling, bubble damping and GI-gun behavior, as described by such authors as Dragoset (1984), Laws et al. (1990), and Landro (1992). The source model includes four empirical parameters that are tuned so that the model output matches observed airgun behavior. The model parameters were fitted to a large library of real airgun data using a "simulated annealing" global optimization algorithm. The airgun data used in the optimization were obtained from a previous study (Racca and Scrimger 1986) that measured the signatures of Bolt airguns, ranging in volume from 5 in^3 to 185 in^3.

The output of the airgun array source model is a set of "notional" signatures for the individual array elements (i.e., the airguns). The notional signatures are the pressure waveforms of the individual guns, which are summed together with the appropriate phase delays to obtain the far-field source signature of the array (Parkes and Hatton 1986). The far-field array signature, in turn, is filtered into 1/3-octave pass bands to compute the source level of the array as a function of frequency band and propagation azimuth.

Seismic Sources Modeled

The three seismic airgun arrays modeled in this study were configured as per the specifications for the three arrays planned for use during the seismic program. One array had total volume 3147 in^3 and consisted of three sub-strings, with eight guns each. Each string of 8 airguns was 15 m in length, and the strings were spaced 8 m apart for total array dimensions of 16 m (cross-track) by 15 m (along-track). Individual airguns in each string ranged in volume from 30 in^3 to 235 in^3, and each string included two 235 in^3 airguns in a cluster. The second airgun array had a total volume of 2098 in^3 and consisted of two identical sub-strings as described above, with eight guns each (array dimensions 8 m cross-track by 15 m along track). The third airgun array had a total volume of 1049 in^3 and consisted of one 15-m-long sub-string (as described above) with eight guns total.

All three arrays were modelled using AASM to compute notional source signatures and 1/3-octave band source levels as a function of azimuth angle. The source depth was set at the anticipated operating depth of 6 m. Broadside and endfire overpressure signatures and corresponding power spectrum levels were calculated.

Shallow Hazards Sources Modeled

Shallow hazards surveying was to be accomplished using a source such as an individual airgun or a small airgun array, an echosounder, a bubble pulser, chirp sonar (sub-bottom profiler), a multibeam sonar, or a sidescan sonar. The source signatures of a single airgun of two different sizes (10 in^3 and 20 in^3) and of a small airgun array (4 airguns totaling 240 in^3) were modeled for this report. The 4-airgun source was the strongest source anticipated for use during the shallow hazards program. Sounds from a bubble pulser and chirp sonar were not modeled in advance of the field season, but were measured in the field at the start of the shallow-hazards program (Chapter 4). The multibeam and sidescan sonars operate at very high frequencies (240 kHz and 190–210 kHz, respectively) that are too high to be of concern for the marine mammal species that inhabit the Beaufort Sea and were not considered for this report.

SOUND PROPAGATION MODELING METHODOLOGY

Acoustic models can be used to predict sound transmission loss in defined environments. Subtracting the modeled transmission loss values (in decibels) from estimated source levels provides estimates of received levels at defined receiver positions. The transmission loss model used in this study is JASCO Research's MONM acoustic model. Airgun array source levels, predicted with AASM, were input to MONM and received levels were predicted.

MONM computes the expected received sound levels in terms of energy flux density (EFD), also referred to as Sound Exposure Level (SEL), for 3-dimensional range-varying acoustic environments. It does so by utilizing a wide-angled parabolic equation (PE) solution to the acoustic wave equation. The parabolic equation code in MONM is based on the Naval Research Laboratory's Range-dependent Acoustic Model (RAM), which has been extensively benchmarked for accuracy and is widely employed in the underwater acoustics community (Collins 1993). MONM computes acoustic fields in 3-D by modeling transmission loss along radial traverses at evenly-spaced angles covering a 360º swath from the source (known as N×2-D modeling). MONM employs several kinds of environmental data, including bathymetry, sound speed profiles, and geoacoustic profiles, and samples the acoustic environment every 50 meters in range along model traverses. MONM handles frequency dependence by computing acoustic transmission loss in 1/3-octave bands from 10 Hz to 2 kHz. MONM computes received sound pressure level by combining transmission loss with frequency-dependent source levels. MONM's sound level predictions have been validated against experimental data from shallow-water environments, and in those prior applications have proven to be highly accurate (Hannay 2004).

Environmental data for each modeling location, such as bathymetry, water column profiles, and geology were obtained from various sources for the appropriate times of year. For locations in the Chukchi Sea, environmental data appropriate to the month of July were used. For Beaufort Sea locations, data for the month of August were used.

SOUND LEVEL RADII

Seismic Airgun Array

MONM computes the received energy level of an airgun pulse in SEL units, expressed in dB re 1 $\mu Pa^2 \cdot s$ (e.g., Fig. 3.1), and does not directly compute peak or rms sound pressure level (SPL, in dB re 1 µPa rms). However, current U.S. regulatory requirements are based on the SPL (rms) metric, i.e., the root-mean-square sound pressure level calculated over the interval within 90% of the pulse energy reaches the receiver (sometimes abbreviated as "90% rms"). The rms value for a received airgun pulse is a function not only of distance, but also of the extent to which the pulse duration has been extended by propagation effects. To compute sound pressure levels directly, allowing for dispersion phenomena, would require calculation times that would be prohibitive for large geographic areas like those considered in the current study.

In order to convert the MONM results (in SEL units) to rms values compatible with the U.S. regulatory requirements, the "Fourier synthesis" technique as described in Jensen et al. (1994) has been used to develop a conversion procedure. For each source configuration and modeling site, the result is a set of predicted radii at which the received sound level, on an rms basis, would be 190, 180, …, 120 dB re 1 µPa rms. Table 3.1 shows the predictions for the three modeling sites in the Chukchi Sea and the three airgun configurations that were considered (1-, 2- and 3-string; 8, 16 and 24 airguns; 1049, 2098 and 3147 in^3). These values

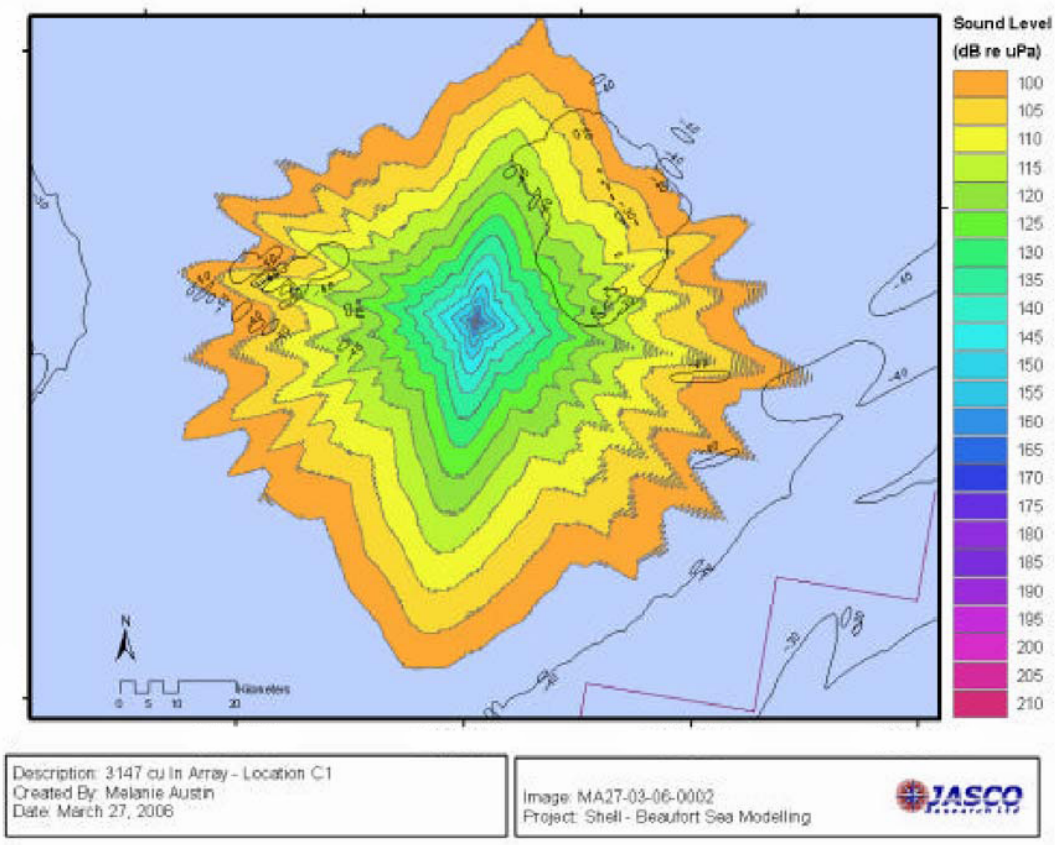

FIGURE 3.1. Map of predicted received levels on an energy basis, in Sound Exposure Level (SEL) units, at 10 m depth for a 3147 in^3 airgun array being towed approximately East–West at source location C1.

TABLE 3.1. Predicted rms radii, in kilometers, for the 1049 in^3, 2098 in^3 and 3147 in^3 airgun arrays operating at 3 modeled locations in the Chukchi Sea.

90% rms [dB re μPa]	C1			C2			C3		
	1049 in^3	2098 in^3	3147 in^3	1049 in^3	2098 in^3	3147 in^3	1049 in^3	2098 in^3	3147 in^3
120	21.27	24.73	25.95	23.08	29.42	30.96	31.3	40.34	41.91
130	14.95	17.70	18.41	15.46	19.11	20.35	20.91	26.06	27.4
140	9.9	12.03	12.55	9.73	12.47	13.24	13.02	16.86	17.28
150	6.2	7.56	7.95	5.79	7.72	8.16	7.53	10.05	10.51
160	3.59	4.25	4.53	3.18	4.40	4.62	3.80	5.25	5.67
170	1.73	2.05	2.19	1.67	2.10	2.20	1.88	2.17	2.44
180	0.61	0.76	0.81	0.64	0.80	0.85	0.58	0.77	0.82
190	0.09	0.22	0.23	0.11	0.11	0.13	0.05	0.23	0.23

are derived based on predicted received levels at a large number of grid points (e.g., Fig. 3.1), and there is some variability in the specific distance at which the received sound level would be expected to diminish to any given level. The tabulated distances for a given level (e.g., 180 dB rms) are those encompassing 95% of the locations at which the received level is expected to be ≥180 dB re 1 μPa rms.

The sound from the main 3-string airgun array is predicted to be ~5 dB stronger in the broadside direction than in the endfire direction (e.g., Fig. 3.1). This aspect dependence is predicted to be larger for a single string array than for a 2- or 3-string array (e.g., Fig. 3.2).

The radii calculated in Table 3.1 are "flat weighted" and do not take into account differences in hearing sensitivity among marine mammal groups. Sensitivity weighting (*M*-weighting) was applied to underwater sound levels to weight the sound at various frequencies in accordance with the hearing characteristics of different marine mammal groups. Weighting sound levels in this way decreases the contribution to the overall received level by sound energy in frequency bands outside the frequency range where the mammal in question hears well. Weighting curves appropriate for various categories of marine mammals exposed to strong sounds were first presented by the Advisory Committee on Acoustic Impacts on Marine Mammals in April 2004 (Gentry et al. 2004). They have subsequently been presented in more detail by J. Miller et al. (2005) and in Southall et al. (submitted).

Baleen whales hear well at low frequencies, which are the dominant frequencies in airgun pulses, and frequency weighting would not significantly affect the estimated 190, 180, …, 120 dB rms radii for baleen whales. However, pinnipeds and especially the "mid-frequency cetaceans" (like beluga whales) do not hear as well at low frequencies, and frequency weighting appropriate to those groups was expected to result in reduced effective radii for them. Tables 3.2 and 3.3 show how frequency weighting reduces the predicted rms radii for those two groups, as compared with flat weighting (Table 3.1).

Shallow Hazards Survey Sources

10 in^3 and 20 in^3 Airgun Sources

During the planning phase for this project, it was considered possible that an individual airgun might be used to survey for shallow hazards. It was anticipated that the largest-volume single airgun that might be used in this way would be 20 in^3. Alternatively, a single 10 in^3 airgun might be used. Either of

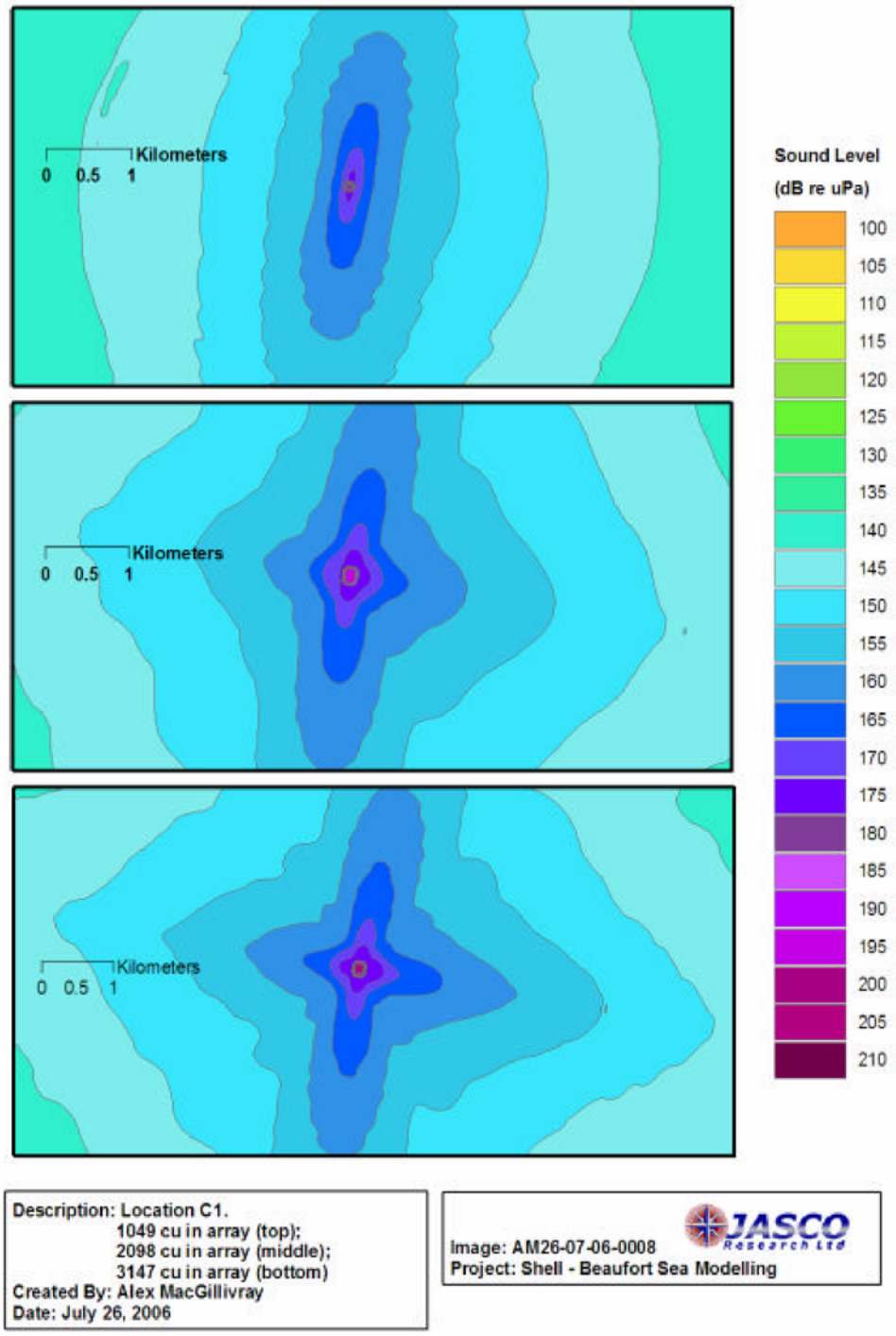

FIGURE 3.2. Maps of predicted received levels at 10 m depth, in SEL (energy) units, within several kilometers of a 1-string (top), 2-string (middle) and 3-string (bottom) airgun array being towed approximately East–West at source location C1.

TABLE 3.2. Predicted M_{mf}-weighted rms radii (as appropriate for "mid-frequency" odontocetes such as the beluga), in kilometers, for the 1049 in^3, 2098 in^3 and 3147 in^3 airgun arrays operating at 3 modeled locations in the Chukchi Sea.

90% rms [dB re μPa]	C1			C2			C3		
	1049 in^3	2098 in^3	3147 in^3	1049 in^3	2098 in^3	3147 in^3	1049 in^3	2098 in^3	3147 in^3
120	17.77	18.35	20.	18.13	20.95	22.7	24.95	28.7	30.85
130	12.3	12.71	13.64	12.16	13.37	14.64	16.26	17.41	18.7
140	7.92	8.64	9.22	7.38	8.83	9.51	9.62	11.38	11.79
150	4.75	5.43	5.76	4.14	5.38	5.88	5.08	6.72	7.03
160	2.88	3.15	3.48	2.38	3.16	3.41	2.63	3.58	4.09
170	1.4	1.65	1.77	1.26	1.65	1.67	1.35	1.66	1.90
180	0.61	0.76	0.81	0.64	0.80	0.85	0.58	0.77	0.82
190	0.09	0.22	0.23	0.11	0.11	0.13	0.05	0.23	0.23

TABLE 3.3. Predicted M_{pw}-weighted rms radii (as appropriate for pinnipeds in water), in kilometers, for the 1049 in^3, 2098 in^3 and 3147 in^3 airgun arrays operating at 3 modeled locations in the Chukchi Sea.

90% rms [dB re μPa]	C1			C2			C3		
	1049 in^3	2098 in^3	3147 in^3	1049 in^3	2098 in^3	3147 in^3	1049 in^3	2098 in^3	3147 in^3
120	19.82	20.10	21.65	21.08	23.65	25.35	28.8	32.65	34.65
130	13.85	14.36	15.14	14.01	15.33	16.59	19.11	20.36	21.75
140	9.07	9.89	10.47	8.63	10.20	11.01	11.42	13.68	14.04
150	5.60	6.33	6.81	5.09	6.28	6.73	6.53	8.12	8.73
160	3.41	3.50	3.88	2.93	3.71	3.86	3.41	4.43	4.74
170	1.58	1.92	2.05	1.47	1.94	1.99	1.52	1.97	2.26
180	0.59	0.75	0.79	0.63	0.79	0.84	0.57	0.76	0.81
190	0.07	0.22	0.22	0.10	0.24	0.22	0.03	0.22	0.22

these sources would be deployed at 1 m depth. The radii predicted for 90% rms levels, calculated using the Fourier synthesis technique, are presented in Table 3.4 (for the 20 in^3 source) and Table 3.5 (for the 10 in^3 source). Predicted radii both without and with frequency weighting, as described above, are shown. The predicted radii are small in part due to the small source, and in part due to the very shallow source depth (1 m). The latter would cause cancellation of a significant portion of the low frequency airgun energy through interactions between sound arriving via a direct-path and that arriving via a surface reflection path (surface ghost). Propagation modeling for these small sound sources was performed for two locations (B1 and B2) in the Beaufort Sea (Fig. 3.1).

240 in^3 Airgun Array

A small airgun array with total volume of 240 in^3 that could be used for shallow hazards surveying was also considered in the modeling. The array configuration consisted of two 2-gun clusters spaced 50 cm apart; each gun has a volume of 60 in^3. The radii predicted for the various 90% rms levels, without and with frequency-weighting, are presented in Table 3.6.

TABLE 3.4. Predicted rms radii, in kilometers, for a single 20 in^3 airgun operating at 2 modeled locations in the Beaufort Sea.

90% rms [dB re μPa]	B1			B2		
		M-weighted			*M*-weighted	
	Flat weighted	Mid Freq Cet	Pinniped in Water	Flat weighted	Mid Freq Cet	Pinniped in Water
120	18.77	16.86	17.68	19.24	17.51	18.70
130	12.31	11.22	11.64	7.01	5.99	6.67
140	4.24	3.75	3.99	2.84	2.16	2.53
150	1.49	1.33	1.42	1.09	0.70	0.86
160	0.58	0.57	0.57	0.30	0.15	0.21
170	0.16	0.15	0.16	0.05	0.03	0.04
180	0.05	0.005	<0.01	0.015	0.005	0.01
190	< 0.005	< 0.005	<0.01	< 0.005	<0.005	<0.01

TABLE 3.5. Predicted rms radii, in kilometers, for a single 10 in^3 airgun operating at 2 modeled locations in the Beaufort Sea.

90% rms [dB re μPa]	B1			B2		
		M-weighted			*M*-weighted	
	Flat weighted	Mid Freq Cet	Pinniped in Water	Flat weighted	Mid Freq Cet	Pinniped in Water
120	18.30	16.66	17.39	18.93	17.4	18.46
130	11.66	10.75	11.05	6.70	5.85	6.39
140	4.02	3.47	3.71	2.70	2.08	2.39
150	1.37	1.19	1.26	1.02	0.665	0.82
160	0.52	0.51	0.51	0.28	0.135	0.19
170	0.15	0.025	0.15	0.04	0.025	0.03
180	0.05	<0.005	<0.01	0.015	<0.005	0.005
190	< 0.005	<0.005	<0.01	< 0.005	<0.005	<0.01

TABLE 3.6. Predicted rms radii, in kilometers, for a 240 in^3 airgun array with 4 airguns operating at 2 modeled locations in the Beaufort Sea.

90% rms [dB re μPa]	B1			B2		
		M-weighted			*M*-weighted	
	Flat weighted	Mid Freq Cet	Pinniped in Water	Flat weighted	Mid Freq Cet	Pinniped in Water
120	35.98	31.96	34.58	40.48	38.42	39.91
130	19.31	16.94	18.16	26.09	24.85	25.73
140	7.37	5.88	6.53	9.33	8.41	8.93
150	2.90	2.15	2.36	3.47	2.89	3.16
160	0.99	0.62	0.71	1.34	1.07	1.16
170	0.30	0.28	0.28	0.48	0.44	0.45
180	0.15	0.14	0.15	0.15	0.14	0.15
190	0.02	0.005	<0.01	0.01	0.005	<0.01

CONCLUSIONS

The acoustic environments at locations of the Beaufort and Chukchi Seas have been characterized by JASCO Research Ltd. (Austin et al. 2006b) and summarized in this chapter. The noise sources considered were three seismic airgun arrays with total volumes of 1049, 2098 and 3147 in^3 and several potential shallow hazards sources including individual airguns and a small airgun array. The acoustic output of each source was modeled and used as input to a state-of-the-art sound propagation model. This, in turn, was used to predict the acoustic energy levels that would be received as a function of distance and direction from these sources operating at representative locations in the Chukchi and Beaufort Seas. From these predictions of the received sound field in energy units, JASCO determined the distances at which received sound levels were expected to diminish below various levels that are of relevance for regulatory purposes, as measured on an rms basis (190, 180, … , 120 dB re 1 μPa rms). These predictions were expected to be considerably more accurate than could be achieved with simpler models that do not take account of site specific environmental conditions, such as sound velocity profile, water depth, and bottom and sub-bottom conditions. All of those factors are taken into account in JASCO's modeling, to the extent that these variables are known when modeling is done.

Species specific sensitivity weighting was applied to all of the model results to provide alternative safety radii that account for the relative sensitivity of different marine mammal groups to low-frequency sounds such as those that dominate seismic airgun sound. *M*-weighting curves were applied for "mid-frequency" cetaceans such as beluga whales, and for pinnipeds listening in water. These weighting functions reduced the predicted effective rms radii for airgun noise by a small amount for pinnipeds and by a larger amount for mid-frequency cetaceans. Although these reduced radii were not applied as safety radii or when calculating the number of mammals exposed to various sound levels during the project, the results indicate that the standard "unweighted" procedures used for pinnipeds and toothed whales during the project were protective in this respect.

Predicted distances for various sources and received levels are tabulated in this chapter. The maximum distances at which rms received levels of 190, 180, 160 and 120 dB re μPa were predicted to occur during operation of the 3147 in^3 airgun array in the Chukchi Sea were 0.23 km, 0.85 km, 5.7 km, and 42 km, respectively. The sound from the main airgun arrays was predicted to be ~5 dB stronger in the broadside direction than in the endfire direction. Comparisons of many of the predictions summarized in this chapter with empirical measurements from the Chukchi and Beaufort Seas can be found in Chapter 4.

4. ACOUSTIC MEASUREMENTS[5]

INTRODUCTION

During July through most of September 2006, Shell Offshore Inc. (SOI) conducted 3D seismic surveys in the Chukchi Sea. During August through early October SOI conducted shallow-hazards surveys in the Beaufort Sea. Both types of surveys relied on the generation of underwater acoustic pulses. Arrays of airguns towed behind a vessel were used for both the seismic and the shallow-hazards survey, and additional acoustic sources were used for the shallow-hazards survey. Greeneridge Sciences, Inc., measured the underwater sound levels produced by the vessels involved, including both seismic and support vessels, and by the acoustic equipment that was used, including airguns and the other shallow-hazards sources.

Shutdown or power-down radii are the ranges from a sound source within which the presence of a protected species requires suspension or alteration of operations because of the possibility of adverse effects, as defined in the applicable permits and authorizations. These mitigation criteria are commonly established to avoid or minimize the possibility of hearing damage. They may also be designed to reduce behavioral disturbance. For airguns, the government-mandated shutdown or power-down radii used in this project were the maximum distances within which received levels of the pulsed sounds could exceed 190 dB re 1 μPa SPL[6] (for pinnipeds) or 180 dB re 1 μPa SPL (for cetaceans). In certain situations, mitigation would also be required when cetaceans were found within the 160 or 120 dB re 1 μPa SPL radii.

Before the onset of field work, JASCO Research Ltd. had estimated, by numerical modeling, the distances from the airgun arrays at which the broadband (rms) received levels would be 190 dB, 180 dB, 170 dB, 160 dB, and 120 dB re 1 μPa (see Chapter 3). Early in the respective periods of operation of the seismic and shallow-hazards vessels, Greeneridge Sciences measured the actual underwater sounds from these sources to establish appropriate mitigation radii for the seismic and shallow-hazards survey equipment. Measured values were used to recommend mitigation radii for use by marine mammal observers on the seismic ships during data acquisition and subsequent data analyses, and these empirically-determined values were compared to the values that had been predicted by modeling.

This chapter reports on data collected during two separate field trips involving three different vessels. The seismic ship *MV Gilavar* and the chase vessel *MV Jim Kilabuk* were used in the Chukchi Sea for seismic data acquisition, and the tug and shallow-hazards survey vessel *MV Henry Christoffersen* (or *Henry C.*) was used in the Beaufort Sea for acquisition of shallow-hazards data.

Objectives

Field objectives were similar in the Chukchi and Beaufort seas and included three components:

- Field measurements of the sounds produced by airguns (*Gilavar* and *Henry Christoffersen*) or sources used in shallow-hazards surveys (only *Henry C.*). These measurements were to be made at the beginning of the seismic surveys in each region, and the collected data were to be analyzed immediately to the extent necessary to establish the mitigation radii. Ranges at which broadband levels were received at 190, 180, 170, 160, and 120 dB (SPL) re 1 μPa were to be determined and reported within 72 hours to Shell.

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[5] By Susanna B. Blackwell, Robert G. Norman, Charles R. Greene Jr. (Greeneridge Sciences Inc.), and W. John Richardson (LGL).

[6] SPL: sound pressure level, i.e., root mean square (rms) pressure level averaged over duration of sound pulse.

- After the field season, the empirical data were to be further analyzed to obtain a more comprehensive assessment of pulse characteristics—including duration, peak level, and SEL (sound exposure level) as well as SPL (=rms)—as a function of range and aspect. Spectral properties of the pulses, in particular one-third octave band characteristics, were also to be documented.
- Field measurements of radiated propulsion sounds as a function of distance from all vessels involved: the seismic vessel *Gilavar* and the support/supply/chase vessel *Jim Kilabuk* in the Chukchi Sea, and the shallow-hazards survey vessel *Henry C.* in the Beaufort Sea.

Measurements were obtained in July (Chukchi Sea) and August (Beaufort Sea) 2006 and the results are presented in this report. Field reports including recommended mitigation radii were submitted to Shell on 26 July and 10 August 2006, respectively, for measurements in the Chukchi and Beaufort seas. The final versions of these field reports are appended to this chapter as Annexes 4.1 and 4.2.

METHODS

Equipment

Recordings were made using two Autonomous Seafloor Acoustic Recorders model B (ASAR-B). A picture and schematic representation of an ASAR-B are shown in Figure 4.1. The ASAR-B consists of a pressure housing containing the recording electronics and a rechargeable gel cell battery. The recorder includes a two-channel signal digitizer with 16-bit quantization. It was initially programmed to sample at 44.1 kHz on each channel, providing a useable frequency range of 5 to 20,000 Hz. One of the ASAR-Bs in the Beaufort Sea measurements was re-programmed to sample at 192 kHz, because of the presence of higher frequency sound sources (see below). Data were written to an 8 GB solid state memory (Flash card), providing ~13 hours of continuous recording at the 44.1 kHz sampling rate. For deployment on the sea floor the ASAR-B housing was mounted in the center of a pyramidal steel frame weighing ~41 kg (~90 lbs, Fig. 4.1). Hereafter ASAR-Bs will be referred to simply as ASARs.

Two different types of hydrophones were used concurrently, one on each recording channel:

- A calibrated ITC model 8212 broadband hydrophone with a low-noise preamplifier: This was the more sensitive of the two hydrophone types, best suited for recording sound levels below ~135 dB re 1 μPa (this type of hydrophone saturated at peak levels of about 145 dB re 1 μPa 0-peak).
- A calibrated ITC model 1032 spherical broadband hydrophone without preamplifier: This hydrophone was included to permit undistorted recordings of high-level sound pulses. This type of hydrophone saturated at peak levels close to 207 dB re 1 μPa 0-peak.

The hydrophone cables were threaded through the top of the pyramidal frame and the hydrophones were buoyed up from the sea floor by a glass sphere (Fig. 4.1A). When deployed, the two hydrophones were ~3.5 m (1032) and ~2 m (8212) off the sea floor. The hydrophone cables were faired to minimize strumming (see Fig. 4.1B).

All hydrophones had been calibrated before the onset of the field season at the ITC calibration facility in Goleta, California, which employs standards traceable to the National Standards for underwater sound measurements. The ITC 8212 hydrophones were recalibrated on 9 November 2006. Thorough calibration of the hydrophones and recording equipment allowed all results to be referred to the standard acoustic

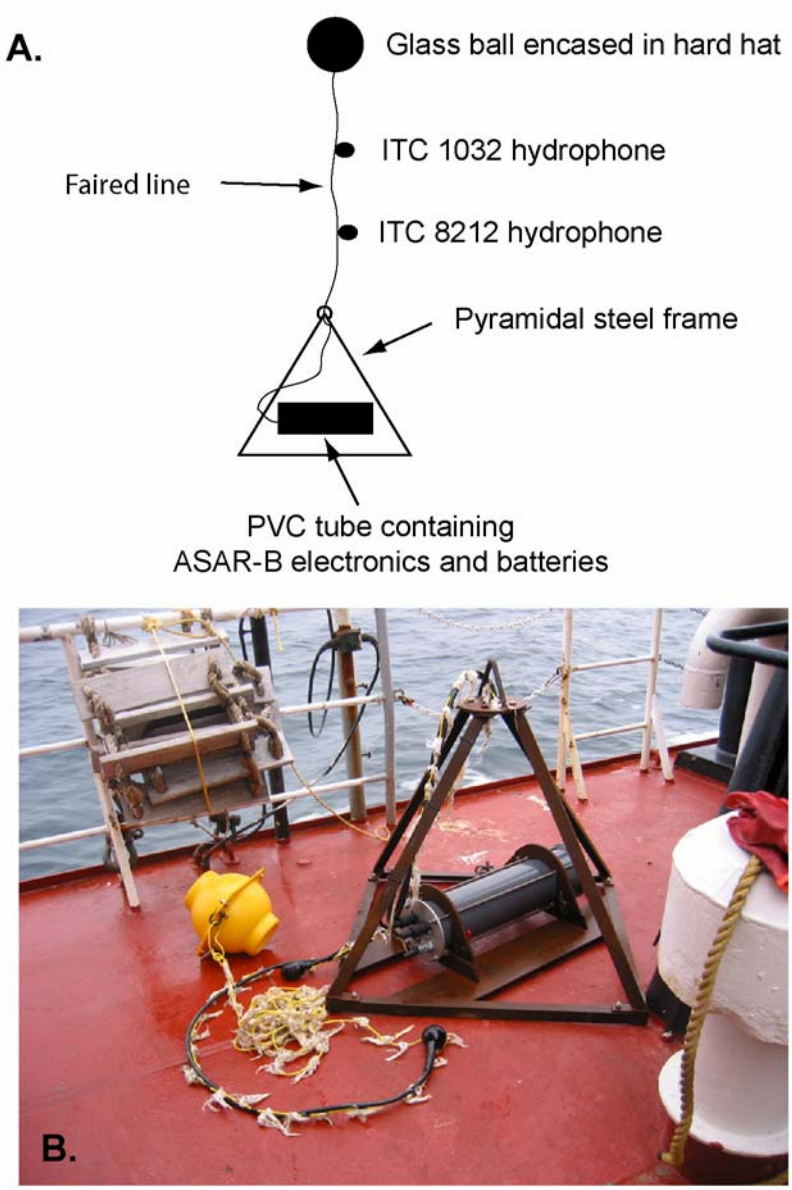

FIGURE 4.1. ASAR-B recorder. ***(A)*** Schematic diagram of the components of the ASAR-B recorder as deployed on the sea floor. Not drawn to scale. ***(B)*** An ASAR-B on the deck of the M/V *Kilabuk* after retrieval. The hydrophones are the black spheres on the cable in the foreground. The yellow sphere to the left of the frame is the hard hat containing the glass ball.

pressure of one micropascal (1 μPa). Both hydrophone types therefore had calibrated responses for the frequency range 5–30,000 Hz, and the ITC 1032 hydrophones were calibrated to 50 kHz.

A Seabird model 19Plus CTD (conductivity-temperature-depth) probe was used at each recording site to obtain a sound velocity profile.

Deployment Procedure

Both ASARs were used in each recording session. The basic layout was the same during measurements of vessel sounds and airgun / shallow-hazards survey sounds and is shown in Figure 4.2. In

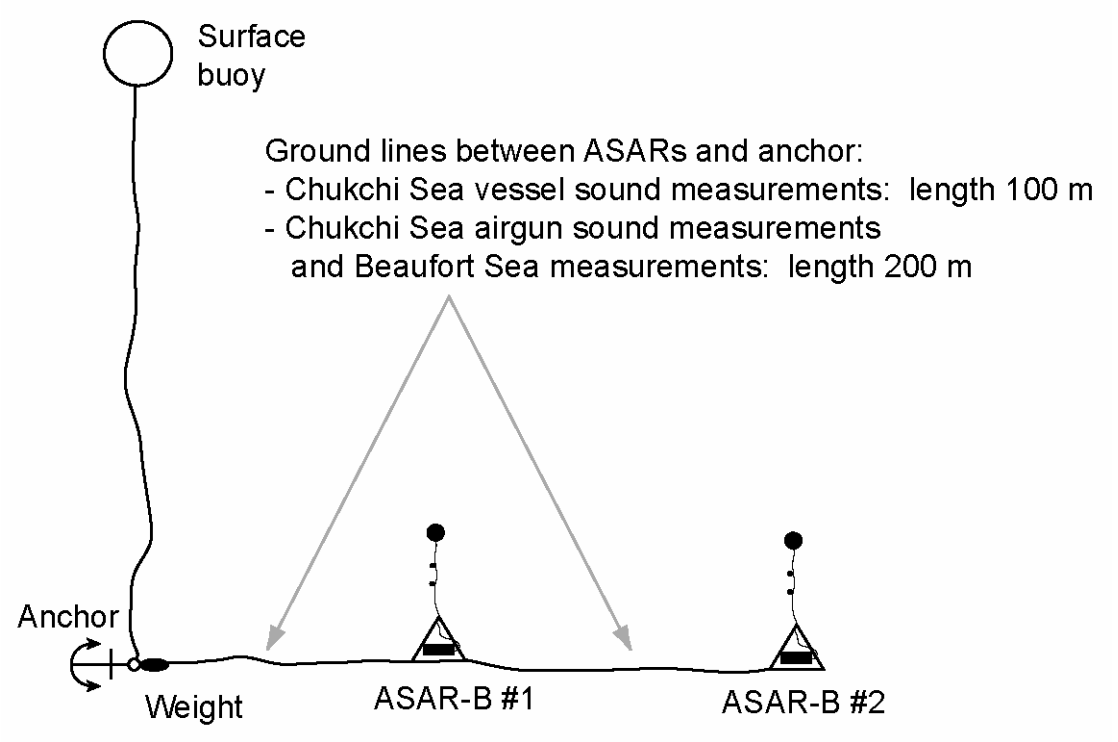

FIGURE 4.2. Deployment layout for ASAR-B recorders. A small weighted anchor is attached to a surface buoy to facilitate retrieval. A ground line connects the anchor to the first ASAR-B, itself connected by a ground line to the second ASAR-B. Anchor and recorders are laid out in a line on the seafloor.

the Chukchi Sea, deployments were done from the *Kilabuk*'s FRC (Fast Rescue Craft) with a crew of four people (boat driver, scientist, and two deck hands). In the Beaufort Sea, deployments were done directly from the deck of the *Henry C.* At the desired deployment location, the anchor and weight were lowered to the bottom with a line connecting them to a surface buoy. A GPS waypoint[7] for the location was obtained. A ground line connecting the anchor to the first ASAR was laid out in a straight line. The length of this line, and of the line between the two ASARs, was 200 m except in the Chukchi vessel sound measurements in which it was 100 m (Fig. 4.2). When the end of the ground line was reached, a "lowering line" was threaded through the "hoop" at the apex of the ASAR's pyramidal cage and the recorder was lowered to the sea floor. A GPS waypoint was obtained at the recorder location. The second length of ground line and the second recorder were deployed in similar fashion.

Deployments in the Chukchi Sea were made on 12 July to record vessel sounds of the *Kilabuk* and *Gilavar*, and on 21 July to record airgun sounds. In the Beaufort Sea the airgun and vessel sound recordings (*Henry C.*) were done concurrently during a single deployment of the ASARs on 8 August. Table 4.1 summarizes information pertaining to these deployments.

[7] A Garmin GPS model 12CX was used during the Chukchi Sea measurements. Deployment positions in the Beaufort Sea were recorded directly by the GPS on the *Henry Christoffersen*.

TABLE 4.1. Deployment dates, deployment locations (WGS84) and water depth for ASARs during recordings of vessel and airgun sounds.

	CHUKCHI SEA (M/V *Gilavar* and M/V *Jim Kilabuk*)		BEAUFORT SEA (M/V *Henry Christoffersen*)
	Vessel sounds	Airgun sounds	Vessel & airgun sounds
Deployment date	12 July 2006	21 July 2006	8 August 2006
ASAR-B #1 position:			
Latitude N	69° 23.40'	69° 35.90'	70° 10.09'
Longitude W	167° 33.33'	166° 00.16'	142° 12.61'
ASAR-B #2 position:			
Latitude N	69° 23.47'	69° 35.83'	70° 10.12'
Longitude W	167° 33.33'	165° 59.92'	142° 12.29'
Water depth (m)	52	42	48

Recording Procedure

After the ASARs were deployed the sound source — airguns (see specifics below) or vessel — was operated over a dedicated test course referenced to the ASAR positions. There were two main types of recording legs:

- endfire aspect with the sound source opening (stern aspect) or closing (bow aspect) range from the ASARs. In the Chukchi Sea measurements, the test course included travel directly over ASAR #2, but not ASAR #1. Therefore, strictly-endfire data were only available from ASAR #2, even though at farther distances ASAR #1 was at very close to endfire aspect, and the data recorded by both ASARs were identical. For the endfire aspect, measurements were obtained to ~10 km distance for vessel sound measurements in the Chukchi Sea, ~30 km for airgun sound measurements in the Chukchi Sea, and ~20 km for the Beaufort Sea measurements.
- crossfire aspect (broadside aspect) with the sound source passing laterally at several closest points of approach (e.g., 100 m, 500 m, 1000 m) from the recorders. We restricted broadside data to those collected while the sound source was within ±5° of broadside, i.e., within an ~10° span of angles (Fig. 4.3).

During all recordings, the time and GPS position of the sound source were logged every 4–20 sec, depending on the type of measurements:

- The Chief Positioning Specialist on the *Gilavar* provided source positions. During measurements of vessel sounds, the position of the *Gilavar*'s stern was logged every 10 sec. During measurements of airgun sounds the position of the geometric center of the airgun array was logged at every shot, which took place every 19–20 sec.
- During measurements of the *Kilabuk*'s vessel sounds, a handheld GPS receiver (Garmin GPS model 12CX) logged the *Kilabuk's* position every 16 sec.
- On the *Henry C.*, position information was provided by the Geo LLC navigator for every shot of the airgun cluster, about every 4 sec.

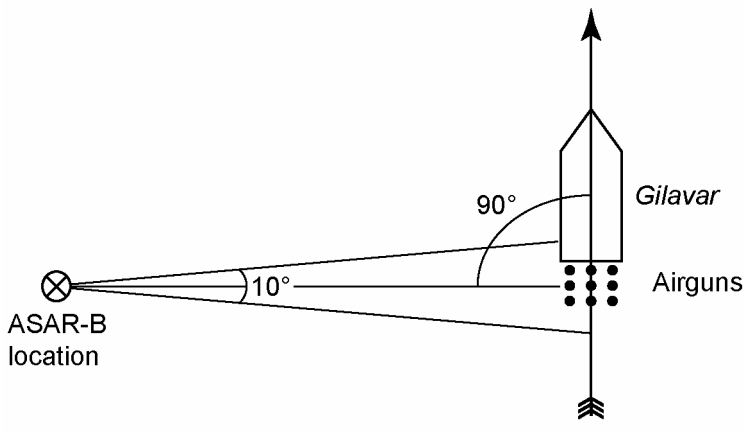

FIGURE 4.3. Circumstances in which data were included in the broadside category (see text).

Sound Sources

The ***Gilavar*** is a seismic research vessel, 84.9 m (279 feet) in length. It has five diesel electric engines, of which four are Bergen KRGB-9 units (2067 brake horse power or BHP each) and one is a Caterpillar 3516B (1855 BHP), for a total of 10,123 BHP. During the Chukchi Sea measurements, the *Gilavar* used two airgun array configurations:

- A three-string array with a total volume of 3147 in^3, with eight airguns per string (i.e., 24 guns total)
- A one-string array with a total volume of 1049 in^3, comprised of eight airguns.

Source depth was 6 m and firing interval was ~19 sec (50 m). Recordings were made using both array configurations consecutively. Although hydrophone streamers are deployed during production operations, they were not deployed during the sound source verification recordings.

The ***Jim Kilabuk*** is an icebreaking tug and supply vessel, 62.5 m (205 feet) in length. It has two turbo-charged diesel engines, for a total of 7200 brake horse power (BHP). The *Kilabuk* was previously (in the 1980s) named the *Canmar Supplier IV*.

The ***Henry Christoffersen*** is a pusher-towing tug, 56.4 m (185 feet) in length. The *Henry C.* has four engines at 1125 HP each for a total of 4500 BHP. The *Henry C.* used five different sound sources for shallow-hazards surveys. These included the following:

- An airgun cluster consisting of four 70 in^3 airguns in a tuned array cluster (total volume 280 in^3), at source depth 2.5 m, with firing interval of ~4 sec (6.25 m)
- A Seabat 8101 bottom mapping sonar operating at 240 kHz
- An SIS 1500 seafloor-imaging sonar operating at 190 kHz
- A chirp sonar (sub-bottom profiler) operating at 2–7 and 8–23 kHz, transducer depth ~1 m, 0.25–5 sec interval
- A bubble pulser operating at frequencies near 400 Hz, 0.5–5 sec interval

The airgun cluster was expected to be the strongest of these sound sources. Since the operational frequencies of the bubble pulser overlapped with those for the airguns, different pulse intervals for the two sources were used: 8 s for the airguns and 6 s for the bubble pulser. The Seabat 8101 bottom mapping

sonar and the SIS 1500 seafloor-imaging sonar both operate at frequencies >180 kHz. That is the highest frequency considered to be of possible influence to any species of marine mammal, including mid- and high-frequency specialists such as toothed whales (Odontocetes) (Miller et al. 2005). No measurements of sounds from these two high-frequency sources were planned since there should be no exclusion zones for seals or whales during their operation.

Retrieval Procedure

When recordings of sound-producing activities were complete, the ASARs were retrieved. In the Chukchi Sea, this was done using the *Kilabuk*'s FRC and a crew of five people (boat driver, scientist, and three deck hands). The surface buoy was retrieved first, followed by the anchor and weight, ASAR #1, and lastly ASAR #2 (see Fig. 4.2). All gear was hauled in by hand. On the *Henry C.*, the gear was hauled in from the port side of the vessel, with help from the vessel's main winch.

Data Analysis

Recorded data were saved as a series of 422.1 MB files which were transferred from the Flash card to laptop computers running MATLAB and custom analysis software. They were then calibrated in units of sound pressure over the data bandwidth (5–20,000 Hz or 5–90,000 Hz depending on sampling rate).

Broadband Analysis

For ***vessel sound measurements*** the data were partitioned into non-overlapping segments of 1 sec each and a broadband (10–20,000 Hz) sound pressure level was obtained for each 1-s segment.

For ***airgun sound measurements*** the sound pressure time series (see Fig. 4.5, later) was used for selecting samples for analysis. Four parameters were determined for each selected pulse (see McCauley et al. 1998, 2000a,b; Burgess and Greene 1999):

- **peak pressure**, i.e. the instantaneous maximum of the absolute sound pressure, in dB re 1 μPa;
- pulse **duration**, defined as the time interval between the arrival of 5% and 95% of the total pulse energy;
- pulse **sound pressure level** (SPL), squared pressure averaged over the pulse duration, in dB re 1 μPa;
- pulse **sound exposure level** (SEL), defined as the squared instantaneous sound pressure integrated over the pulse duration, in dB re 1 $\mu Pa^2 \cdot s$. This measure is related to the total physical energy conveyed in each pulse, and was calculated excluding the contributions of background sound as characterized by measurements between pulses.

SPL and pulse duration are highly interdependent. For example, low-level reverberation that extends the pulse length can result in a longer averaging time and thus a lower SPL. The SEL is not influenced by the duration, as it is a measure of the total energy in the pulse regardless of the pulse duration.

One of two propagation models was fitted by the least squares method to broadband levels of vessel sounds, or to the peak, SPL, and SEL values for seismic pulses, in order to characterize propagation loss underwater. These models were based on logarithmic spreading loss:

$$\text{Received Level } (\mathbf{RL}) = A + B \cdot \log(R) \quad (1)$$

$$\text{Received Level } (\mathbf{RL}) = A + B \cdot \log(R) + C \cdot R \quad (2)$$

In these equations, R is the range to the source in m and the units for **RL** are dB re 1 μPa or 1 $\mu Pa^2 \cdot s$. The constant term (A) is the hypothetical level 1 m from the source, extrapolated back to 1 m range based on far-field measurements. This hypothetical value would equal the actual level at 1 m only if the source were a point source and if loss rates were consistent at all distances from 1 m to the maximum measurement distance, neither of which is the case. The estimated A value is useful mainly as a basis for comparison with other sources operating in the same region. The spreading loss term (B), which is negative, varies with the dominant frequency in the pulse, water depth, bottom topography, and bottom composition. C (in dB/m) is the coefficient describing losses due to scattering and absorption; like B it is negative. The composition and topography of the seabed and sea surface roughness will affect such losses.

The choice of one model over the other is generally determined by the range and water depth over which the measurements were made. In our measurements, water depths were all similar, so our choice was determined by range. When the maximum measurement distance was less than ~10 km, Eq. (1) was used. When measurements extended to greater distances, as for most of the airgun sound measurements, the $C \cdot R$ term was expected to become significant, and Eq. (2) was used. C is a small number except in very shallow water and therefore its effect is difficult to measure until R becomes large.

Spectral Analysis

The spectral composition of each vessel's sound and of the airgun pulses was obtained from data recorded at short ranges (at or close to the CPA). Spectral processing yielded both one-third octave band levels and sound spectral density levels. The one-third octave band levels represent the amount of sound in parts of the frequency spectrum (bands) whose lower and upper frequencies differ by a factor of 1.26×. Spectral density levels represent the amount of sound in 1-Hz bands and are expressed in dB re 1 $\mu Pa^2/Hz$.

M-weighting

Hearing abilities differ among different types of marine mammals, with some marine mammals being more sensitive to low frequencies (e.g., baleen whales) while others are more sensitive to high frequencies (e.g., porpoises). In assessing the effects of sound on different types of marine mammals it is useful to weight the sounds reaching the animal by de-emphasizing frequencies which the animal of concern cannot hear, or hears only weakly. Ideally there should be a specific weighting function for each species of marine mammal, but audiograms are not available for most species. In the interim, all marine mammal species have been placed into one of five groups, based on their hearing function (Miller et al. 2005; Southall et al., submitted). These five groups are low-, mid-, and high-frequency cetaceans, pinnipeds in water, and pinnipeds in air. Three of these groups are of interest in this report: mid-frequency cetaceans (including beluga whales), pinnipeds in water (seals and walruses), and low-frequency cetaceans (bowhead and gray whales). The different M-weighting functions are determined by the variables f_{low} and f_{high}, which are conservative estimates of the lower and upper boundaries of effective hearing for each group:

- mid-frequency cetaceans: f_{low} = 150 Hz, f_{high} = 160 kHz;
- pinnipeds in water: f_{low} = 75 Hz, f_{high} = 75 kHz;
- low-frequency cetaceans: f_{low} = 7 Hz, f_{high} = 22 kHz;

The M-weighting functions have been defined primarily for applications involving exposure to strong sounds, including pulsed sounds (Miller et al. 2005; Southall et al., submitted). These functions are analogous to the C-weighting function that is widely used in characterizing effective levels of strong pulsed sounds insofar as they affect humans. Annex 4.3 shows the M-weighting functions in relation to frequency.

To assess the effect of *M*-weighting on broadband SPLs and SELs, a subset of seismic pulses was analyzed after being weighted according to the three types of *M*-weighting functions described above.

RESULTS

Seismic and Sonar Sound Measurements

Broadband Levels for Seismic Vessel Gilavar *(Chukchi Sea)*

On 21 July 2006 both ASARs were deployed in the locations given in Table 4.1. To maximize recording time, the ASAR start times were offset by 6 h (11:00 for ASAR #2 and 17:00 for ASAR #1). The *Gilavar* followed a predetermined course over and away from the ASAR locations, to provide recordings of airgun sounds from different distances and different aspects (bow, stern, broadside). The *Gilavar*'s course is shown in Figure 4.4. During these recordings the *Gilavar* traveled at a speed of ~5.5 knots (10.2 km/h or 6.3 mph).

Sound pressure time series of airgun sounds (three-string array), as recorded by ASAR #2 (hydrophone ITC 1032), are shown in Figure 4.5. Data recorded with the more sensitive hydrophone (model ITC 8212) were saturated for most of the obtained pulses, so we only present data obtained with the less sensitive hydrophone.

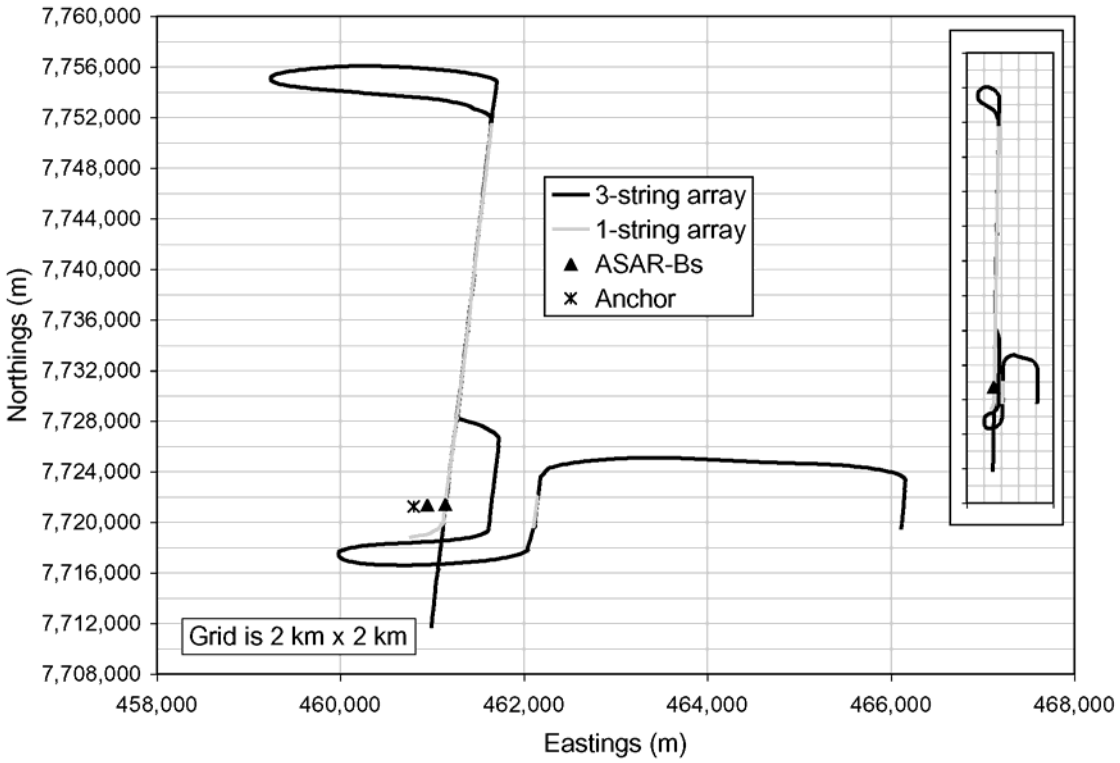

FIGURE 4.4. Track of the M/V *Gilavar* during airgun sound measurements, while towing a three-string airgun array (black) and a one-string array (gray), 21 July 2006, Chukchi Sea. The grid squares are 2 km × 2 km; the main map has been extended in the E–W direction to better show the ship track but the inset map shows the track to scale. Filled triangles show the ASAR locations.

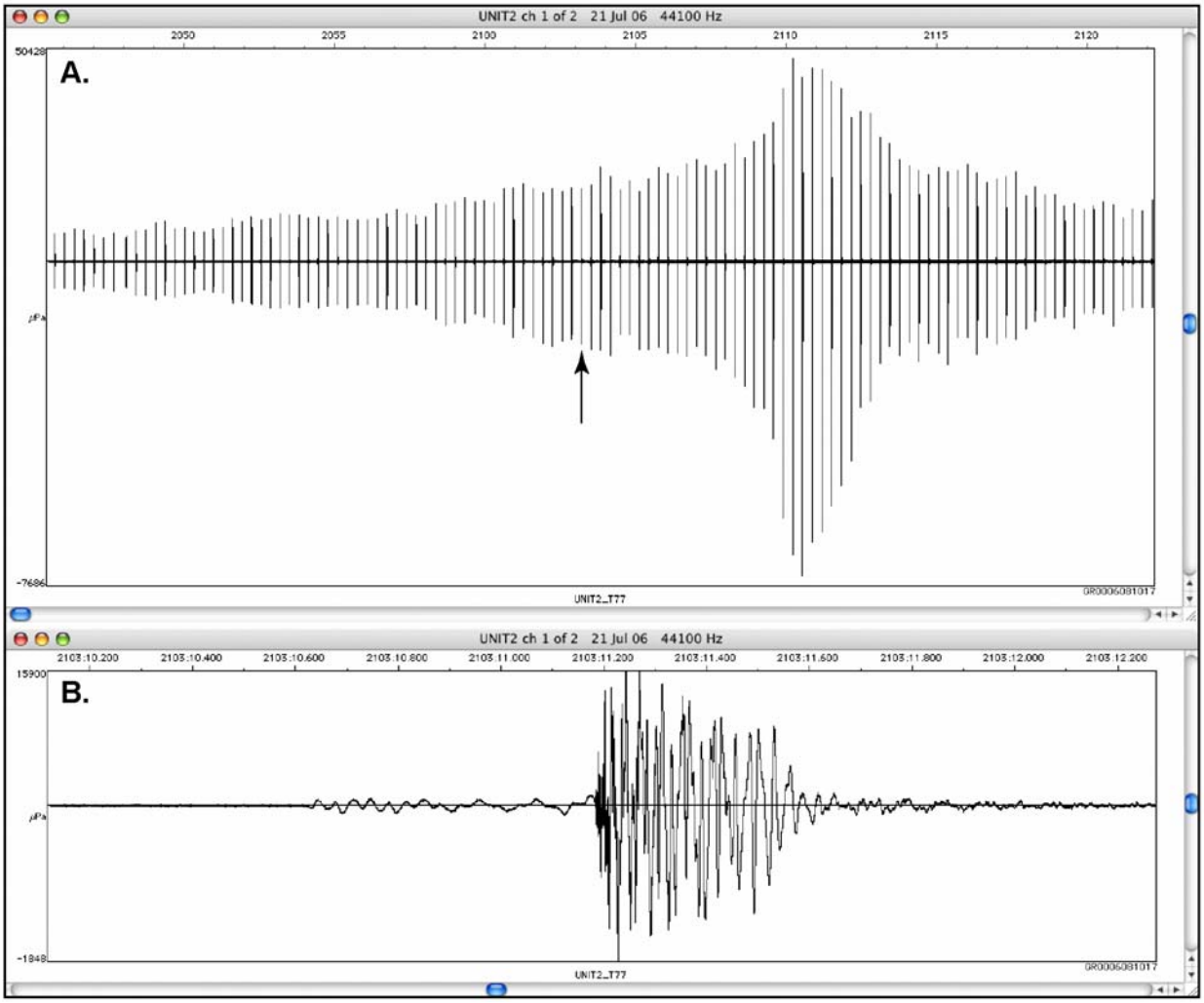

FIGURE 4.5. Sound pressure time series (SPTS) of airgun sounds as recorded on 21 July 2006 by ASAR #2, ITC 1032 hydrophone. ***(A)*** About 37 min of recording while the *Gilavar* passed by ASAR #2 at a distance of 1 km. Calculated distance from ASAR #2 to the center of the airgun array was 3880 m at the time of the first pulse shown, 1008 m at the CPA, and 2007 m at the time of the last pulse shown. ***(B)*** Detail of pulse shown by arrow in plot (A).

Three-String Array Configuration (3147 in^3).—Broadband levels of airgun sounds for the three-string array configuration are shown in Figures 4.6–4.9. Figure 4.6 shows bow aspect data for four pulse parameters as a function of distance from the airguns: peak level, SPL, SEL, and pulse duration. For peak, SPL, and SEL values Eq. (2) was fitted to the data. The resulting equations and correlation coefficients (R or r, as appropriate) are shown in Table 4.2.

Figures 4.7 and 4.8 show the same types of data as Figure 4.6, but for the stern and broadside aspects. Broadside data were only collected to a distance of ~5 km. Therefore Eq. (1) was fitted to the data, instead of the more complex model [Eq. (2)] which takes scattering and absorption losses into account but requires measurements over a larger span of distances.

Propagation effects, such as geometric dispersion, predictably lengthen pulse durations with increasing distance from the sound source (see Greene and Burgess 2000). This can be seen in Figures 4.6–4.8 for all three aspects.

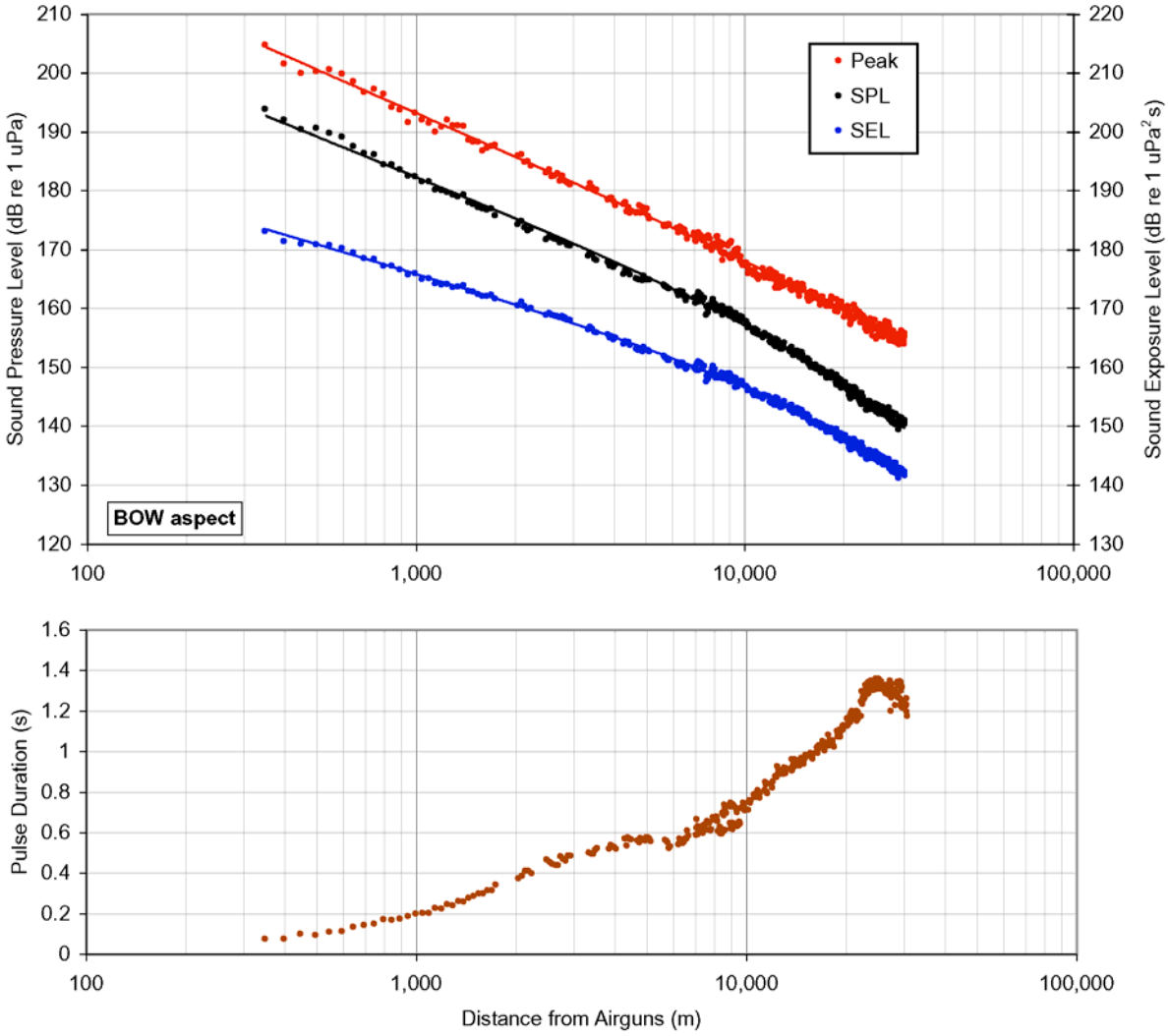

FIGURE 4.6. Received broadband levels of sound with *Gilavar*'s three-string array (3147 in^3) for **bow** aspect, as a function of distance from the airguns, 21 July 2006, Chukchi Sea. The top plot shows peak levels and SPLs, with values to be read on the left y-axis (dB re 1 μPa), and SELs with values to be read on the right y-axis (dB re 1 $\mu Pa^2 \cdot s$). Note that to avoid overlap, values on the two y-axes are offset by 10 dB. Equations for the regressions are given in Table 4.2. The bottom plot shows pulse duration as a function of distance from the airguns.

Figure 4.9 compares the fitted regression lines from Figures 4.6–4.8 in order to illustrate the effect of aspect (bow, stern, and broadside). For bow and stern aspects, the SPL and SEL regressions have been extrapolated beyond the maximum distances of our measurements to the range where the received level has diminished to 120 dB. These extrapolations are for purposes of comparison only, due to uncertainties in the propagation model and the effects of measurement variability on the regressions. However, for SEL, the consistency of the results for the 3 aspects suggests that—for this acoustic measure—measurement variability was small. Figure 4.9 shows that, for the *Gilavar*'s 3-string array, aspect dependence was relatively small, at least out to the maximum distance (5 km) at which broadside-aspect data were acquired.

TABLE 4.2. Values for variables *A*, *B*, and *C* [Eq. (1) and (2)] in the regressions shown in Figures 4.6–4.9; data were collected using the three-string airgun array in the Chukchi Sea. Values are shown for peak level, sound pressure level (SPL), and sound exposure level (SEL) for all three aspects (bow, stern, broadside). The multiple-*R* or *r*-value is also shown for each equation, as well as the range of distances over which the measurements were made and the sample size (number of pulses analyzed).

	A	*B*	*C*	*R* (or *r*)	Range of distances (km)	Sample size
BOW					0.35–30.6	391
Peak	266.4	–24.34	$-9.45\ 10^{-5}$	–0.997		
SPL	249.5	–22.26	$-3.25\ 10^{-4}$	–0.998		
SEL	224.6	–16.11	$-3.54\ 10^{-4}$	–0.998		
STERN					0.30–33.9	232
Peak	249.8	–19.90	$-2.24\ 10^{-4}$	–0.997		
SPL	247.2	–22.40	$-2.05\ 10^{-4}$	–0.997		
SEL	221.0	–15.44	$-3.55\ 10^{-4}$	–0.998		
BROADSIDE					0.52–5.16	54
Peak	253.5	–19.71	N.A.	(–0.986)		
SPL	239.7	–18.96	N.A.	(–0.994)		
SEL	222.9	–15.41	N.A.	(–0.994)		

One-String Array Configuration (1049 in^3).—Broadband levels of airgun sounds for the one-string array configuration are shown in Figures 4.10–4.12. Figure 4.10 shows stern aspect data for peak level, SPL, SEL and pulse duration, as a function of distance from the airguns. For all sound level parameters Eq. (2) was fitted to the data. The resulting equations and multiple-R values are shown in Table 4.3. The equivalent bow and broadside data are shown in Figure 4.11. Bow and broadside data were only collected to a distance of less than 2 km; therefore Eq. (1) was fitted to the data. The resulting equations and *r*-values are shown in Table 4.3.

Figure 4.12 compares the fitted regressions lines from Figures 4.10 and 4.11 in order to illustrate the effect of aspect. For the stern aspect, the regression has been extrapolated beyond the maximum distance of our measurements to the distance where the received level was 120 dB. (Data for bow and broadside aspects were not collected over a large enough range to justify extrapolation.) As predicted by the pre-field-season modeling (Chapter 3), aspect dependence was more marked for data collected with the one-string array, compared to the three-string array (*cf.* Fig. 4.9).

Relationship Between SPL, SEL, and Range.—Figure 4.13 summarizes the relationship between SPL, SEL, and the distance from the hydrophone to the airguns. The difference between SPL and SEL is mathematically related to pulse duration and is shown in Fig. 4.13A (i.e., if the actual data were plotted they would fall on the shown line and *r* would equal 1.0). Since we define pulse duration as the time interval between the arrival of 5% and 95% of the total pulse energy (see Methods section), SPL and SEL are equal (i.e., their difference is 0) when pulse duration = 0.9 sec. When x = 0.9, y = – 0.4576 – 10·log(0.9) = 0, as

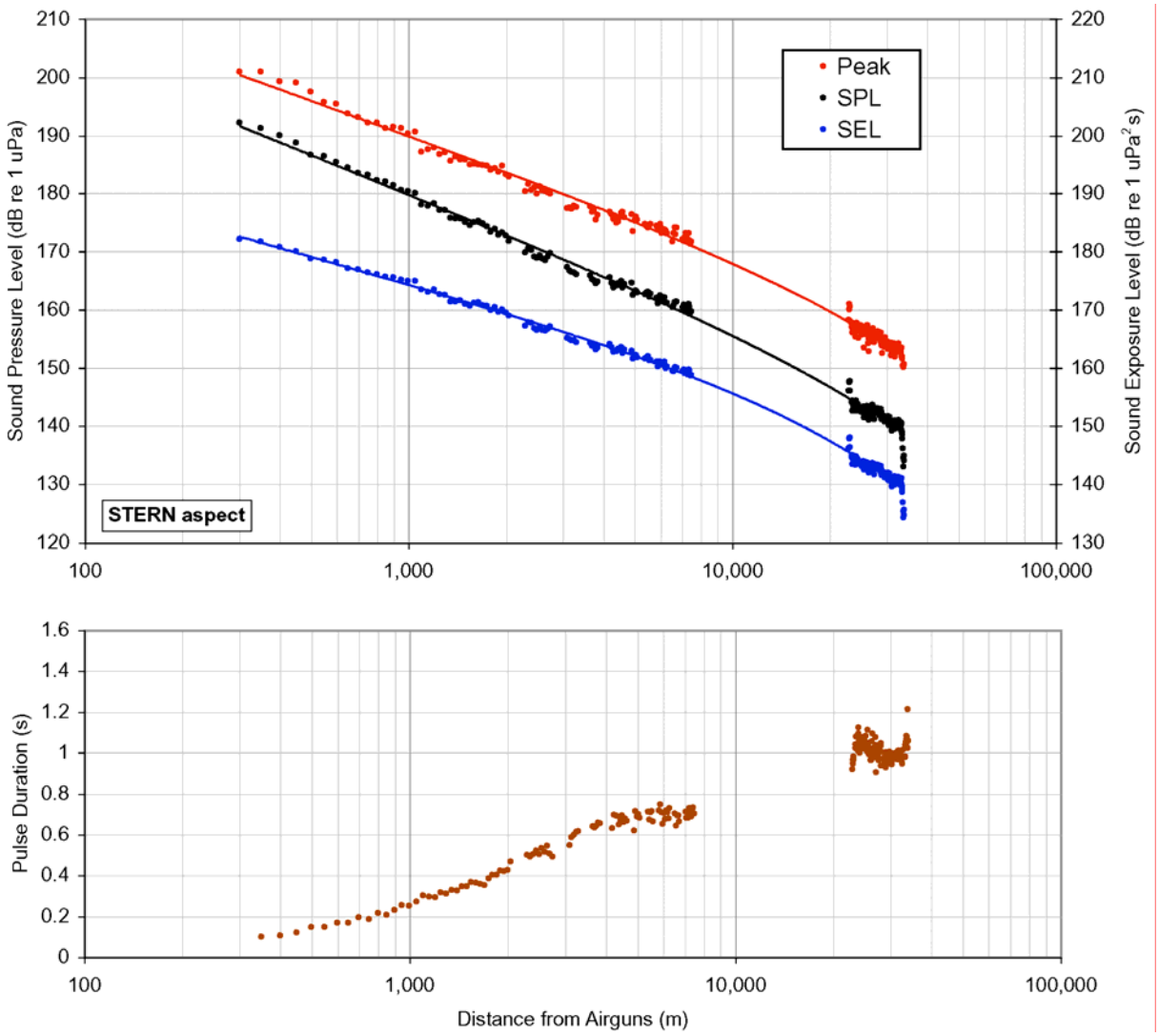

FIGURE 4.7. Received broadband levels of sound with *Gilavar*'s three-string array (3147 in^3) for **stern** aspect, as a function of distance from the airguns, 21 July 2006, Chukchi Sea. Plotted as in Figure 4.6.

10·log(0.9) = –0.4576 (see Fig. 4.13A). Figures 4.13B and C illustrate how the difference between SPL and SEL changes with distance from the airguns for data collected with the three- and one-string arrays, respectively. The difference between SPL and SEL values was highest closest to the sound source, with SPLs about 10 dB higher than SELs ~300 m from the airguns. Out to ~3 km the difference between SPL and SEL decreased by about 8.5 dB / tenfold change in distance. Beyond 10–16 km the difference becomes negative, i.e., SEL values are larger than SPL values. This reflects the fact that most pulse durations had been "stretched" by propagation phenomena to 1 sec or greater at distances beyond 10–16 km (Fig. 4.6, 4.7, 4.10).

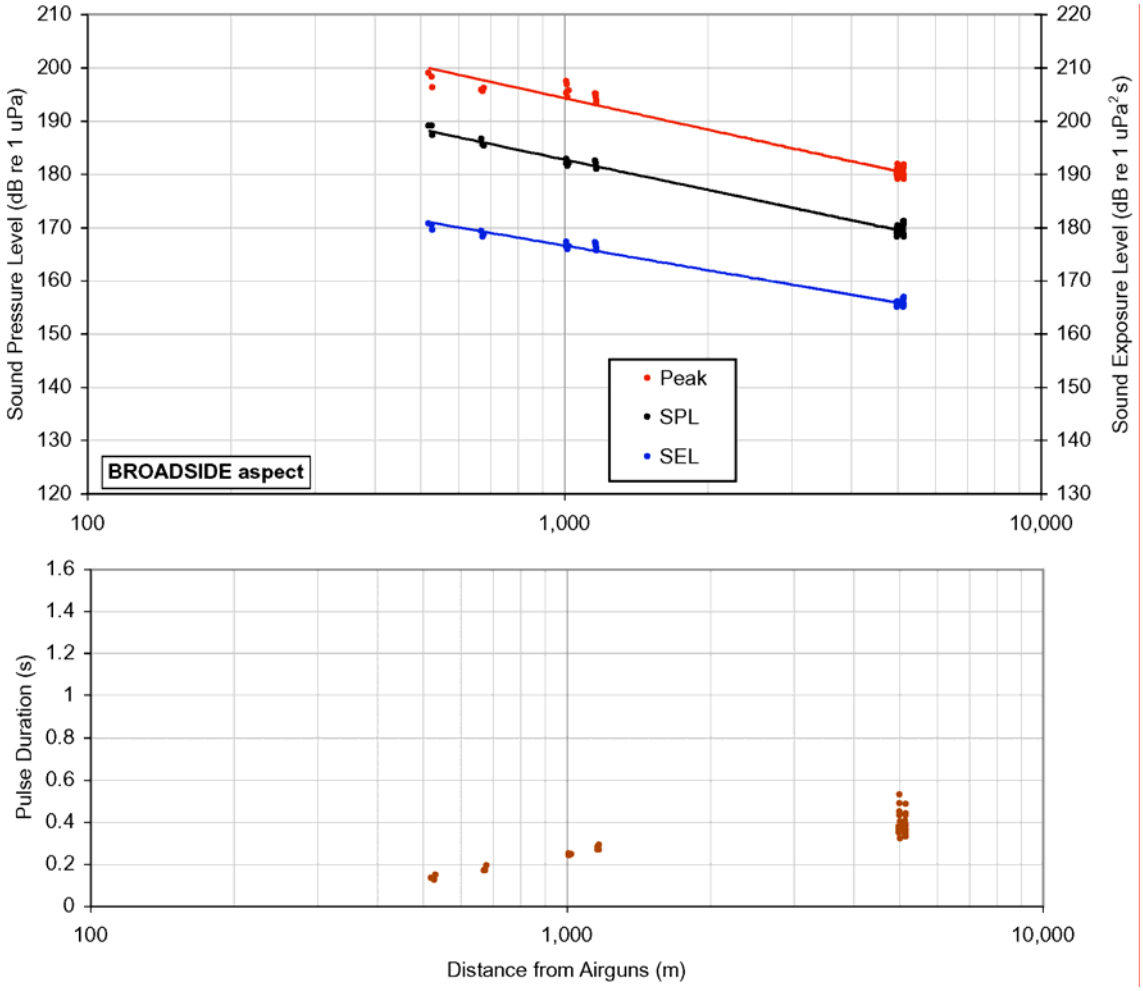

FIGURE 4.8. Received broadband levels of sound with *Gilavar*'s three-string array (3147 in^3) for **broadside** aspect, as a function of distance from the airguns, 21 July 2006, Chukchi Sea. Plotted as in Figure 4.6.

Comparison of Empirical and Modeled Radii for Airgun Sounds.—Table 4.4 summarizes the distances to a set of specified SELs and SPLs, as determined using the field measurements presented above for the one-string and three-string airgun arrays. These empirical distances are compared to distances predicted by sound propagation modeling (see Chapter 3). JASCO used their MONM acoustic model to generate SEL contours, from which SPLs were derived by Fourier synthesis analysis (see Chapter 3, Jensen et al. 2000). Because the contours produced by the MONM model are anisotropic (i.e., not distributed evenly in all directions), the predicted distances given in Table 4.4 are the radii encompassing 95% of the locations where the predicted SEL or SPL equals or exceeds the criterion value. For each array type, metric (SEL vs SPL), received level, and aspect (bow, stern, broadside) an "empirical : predicted" (E:P) ratio was calculated and is shown in Table 4.4.

Considering the SPL values (which are the ones used for mitigation purposes under current NMFS guidance), the empirical distances exceeded predicted distances in most (but not all) situations. For the *3-string array*, the E:P ratios for the 190-dB distance ranged from 1.5× to 2.0×, depending on aspect (Table 4.4A). The E:P ratios for the 180-dB distance around that array ranged from 1.2× to 1.7×. The ratios for the 160-dB distance ranged 1.5× to 1.8× (considering bow and stern aspect only). E:P ratios for the 120 dB

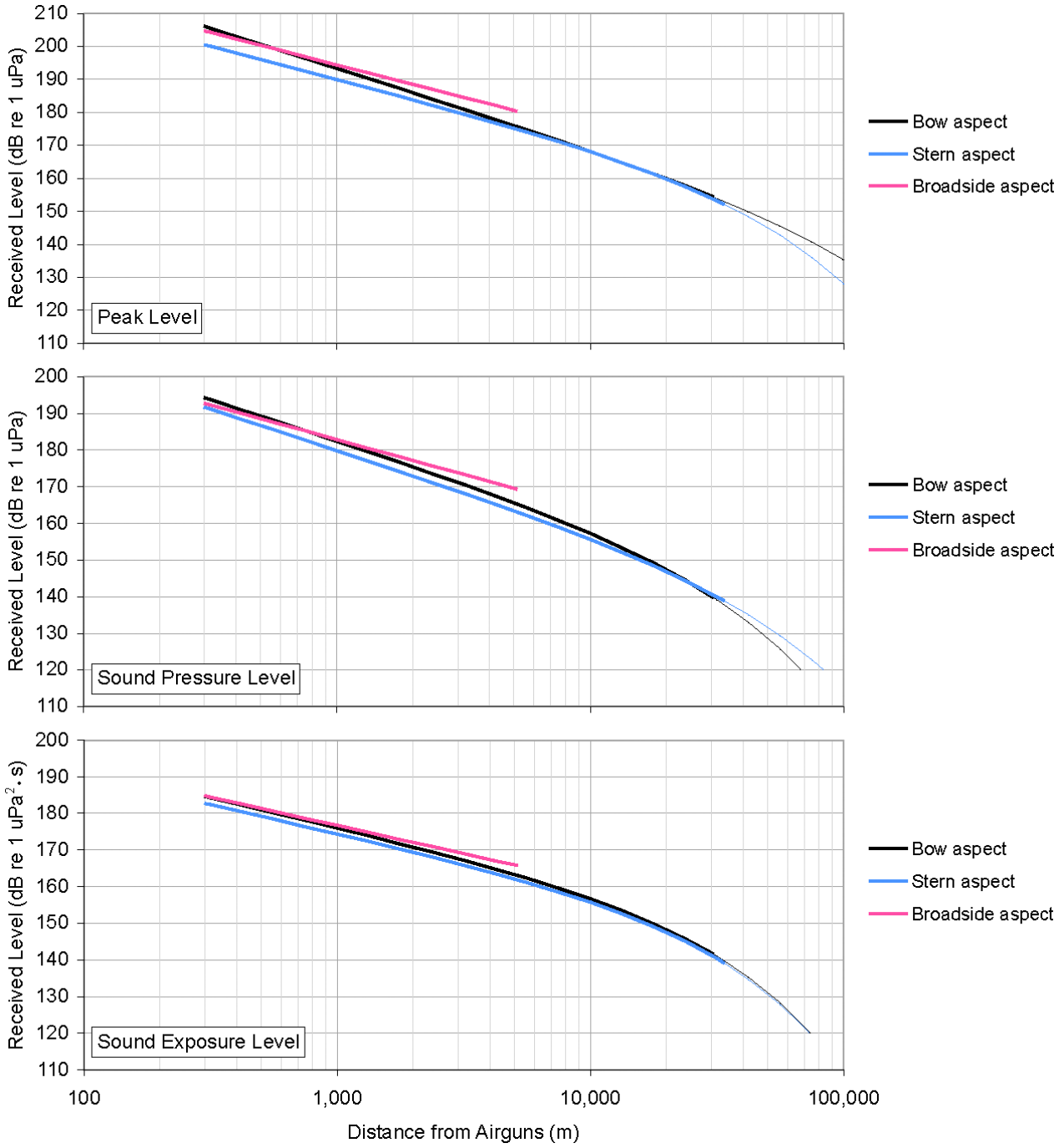

FIGURE 4.9. Summary of broadband levels for *Gilavar*'s three-string array configuration, 21 July 2006, Chukchi Sea. Data for all aspects are shown for peak (top plot), sound pressure (center plot), and sound exposure levels (bottom plot). Received levels which were obtained by extrapolating the regressions beyond the range of distances within which the measurements were made are indicated with a thinner line. Farthest measurement distances were 30.6 km, 33.9 km, and 5.2 km for bow, stern, and broadside data, respectively.

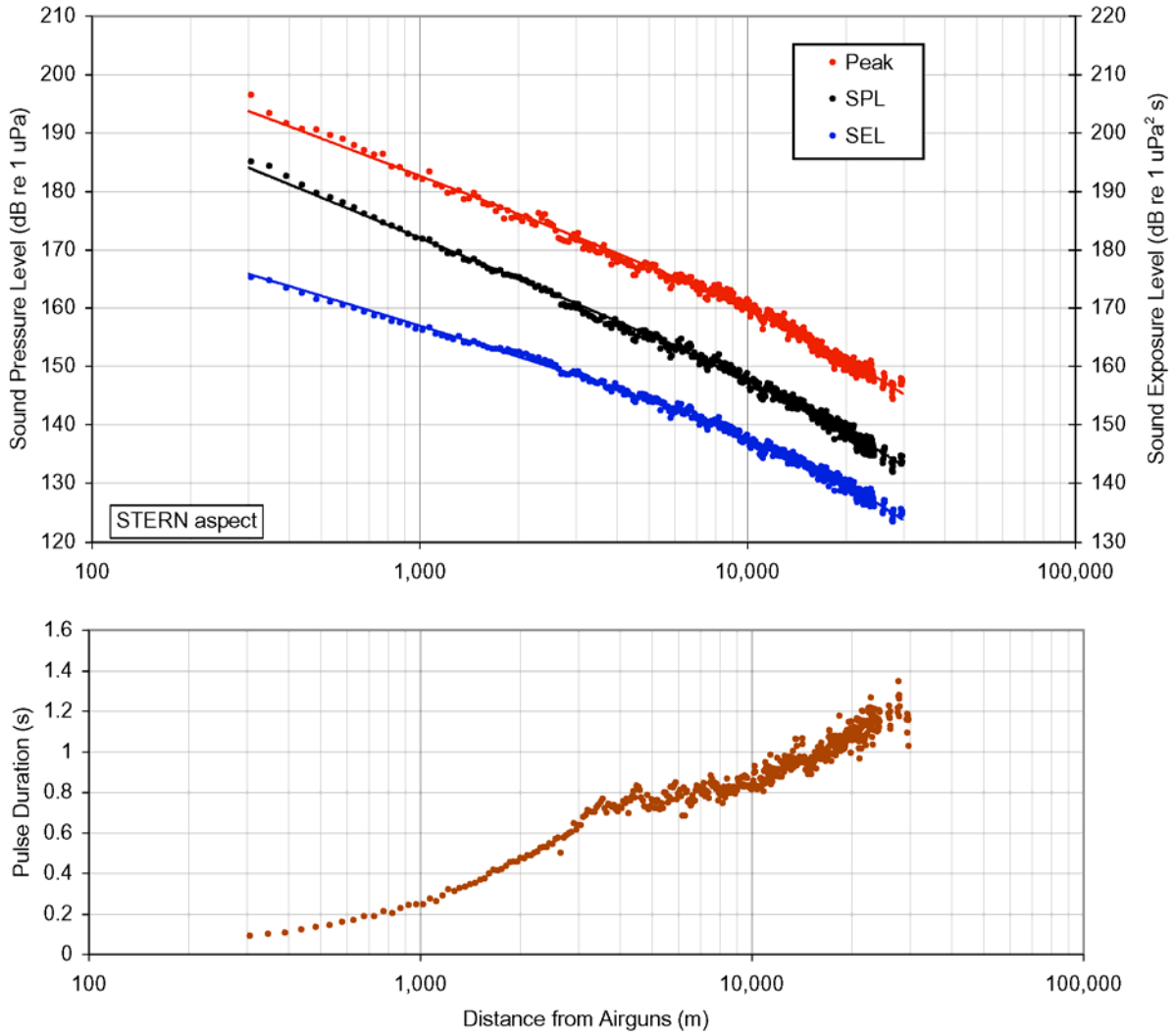

FIGURE 4.10. Received broadband levels of sound with *Gilavar*'s one-string array (1049 in^3) for **stern** aspect, as a function of distance from the airguns, 21 July 2006, Chukchi Sea. Equations for the regressions are given in Table 4.3. Otherwise plotted as in Figure 4.6.

distance were higher: 2.6× to 3.2× (again considering only bow and stern aspect). For the *single-string array*, the results also showed a tendency for higher E:P ratios when dealing with the 190 dB and 120 dB distances than when dealing with 160–180 dB distances. However, for the single-string array, the empirical distances were in fact less than the predicted distances (E:P < 1.0) in some cases (Table 4.4B). It should be noted that, because of ice conditions, the empirical measurements were taken at a location about 127 km from the C_1 site considered in JASCO's modeling. Differences in environmental conditions between those two sites probably accounted for some of the difference between empirical and predicted distances; the model would be expected to perform better if run for the actual site where the empirical measurements were acquired (D. Hannay, JASCO, pers. comm.).

Considering the SEL (energy) measure, the E:P ratios were higher than those for the SPL measure for almost all combinations of criterion level and aspect (Table 4.4). The underestimation of SEL levels by the model was particularly severe at the closer distances, i.e., those where the SEL value was 180–190

TABLE 4.3. Values for variables *A*, *B*, and *C* [Eq. (1) and (2)] in the regressions shown in Figures 4.10–4.12. Data were collected using the one-string airgun array in the Chukchi Sea. Values are shown for peak level, sound pressure level (SPL), and sound exposure level (SEL) for all three aspects (bow, stern, broadside). The multiple-*R* or *r*-value is also shown for each equation as well as the range of distances over which the measurements were made and the sample size (number of pulses analyzed).

	A	*B*	*C*	*R* (or *r*)	Range of distances (km)	Sample size
BOW					0.28–1.48	25
Peak	260.4	–24.94	N.A.	–0.992		
SPL	253.1	–25.99	N.A.	–0.992		
SEL	222.2	–17.87	N.A.	–0.991		
STERN					0.30–29.8	509
Peak	245.7	–20.94	$-2.25\ 10^{-4}$	–0.996		
SPL	240.6	–22.78	$-1.87\ 10^{-4}$	–0.997		
SEL	216.9	–16.54	$-3.06\ 10^{-4}$	–0.997		
BROADSIDE					0.17–1.16	7
Peak	247.2	–17.71	N.A.	(–0.998)		
SPL	242.2	–19.85	N.A.	(–0.999)		
SEL	210.7	–11.57	N.A.	(–0.997)		

dB re $(1\ \mu Pa)^2 \cdot s$. The SEL metric is not currently used for mitigation purposes, but would be used under the new procedures proposed by Southall et al. (submitted).

The fitted regressions resulting from Eq. (1) and (2) are based on a standard least-squares fit to the measured data, which means that about 50% of the empirical measurements fall above the line and 50% fall below (Fig. 4.6–4.8, 4.10, 4.11). Increasing the intercept value of each regression by 2 dB "elevates" each fitted curve by 2 dB, and nearly all the empirical measurements then are along or below the curves. Using these adjusted curves to determine mitigation radii results in protective radii that provide some margin for the inevitable variability in received levels. Table 4.5 is based on the same data as is Table 4.4, but the empirical distances are based on the curves with 2 dB added to all intercept values. The "E:P" ratios are larger in this case, as was to be expected when a protective factor was added to the empirical estimates but not to the model predictions.

Effect of M-weighting on Broadband SPLs and SELs.—Figure 4.14 illustrates the effects of *M*-weighting (as defined for mid-frequency cetaceans M_{mf}, pinnipeds in water M_{pw}, and low-frequency cetaceans M_{lf}) on SPLs (Fig. 4.14A) and SELs (Fig. 4.14B) for data collected in the Chukchi Sea. The amount (in dB) by which broadband (10–20,000 Hz) levels decreased as a result of being *M*-weighted is shown as a function of distance from the airguns. As expected given the varying low-frequency inflection points (f_{low}) for the three weighting functions, M_{lf} with $f_{low} = 7$ Hz had almost no effect on broadband SPLs or SELs, while M_{mf} with $f_{low} = 150$ Hz had the highest effect, and M_{pw} with $f_{low} = 75$ Hz had an intermediate effect. At close distances (400–650 m) pulse SPLs and SELs dropped by about 10 dB and 11 dB, respectively, for M_{mf}. At the same distance pulse SPLs and SELs dropped by about 5.5 dB and 6 dB,

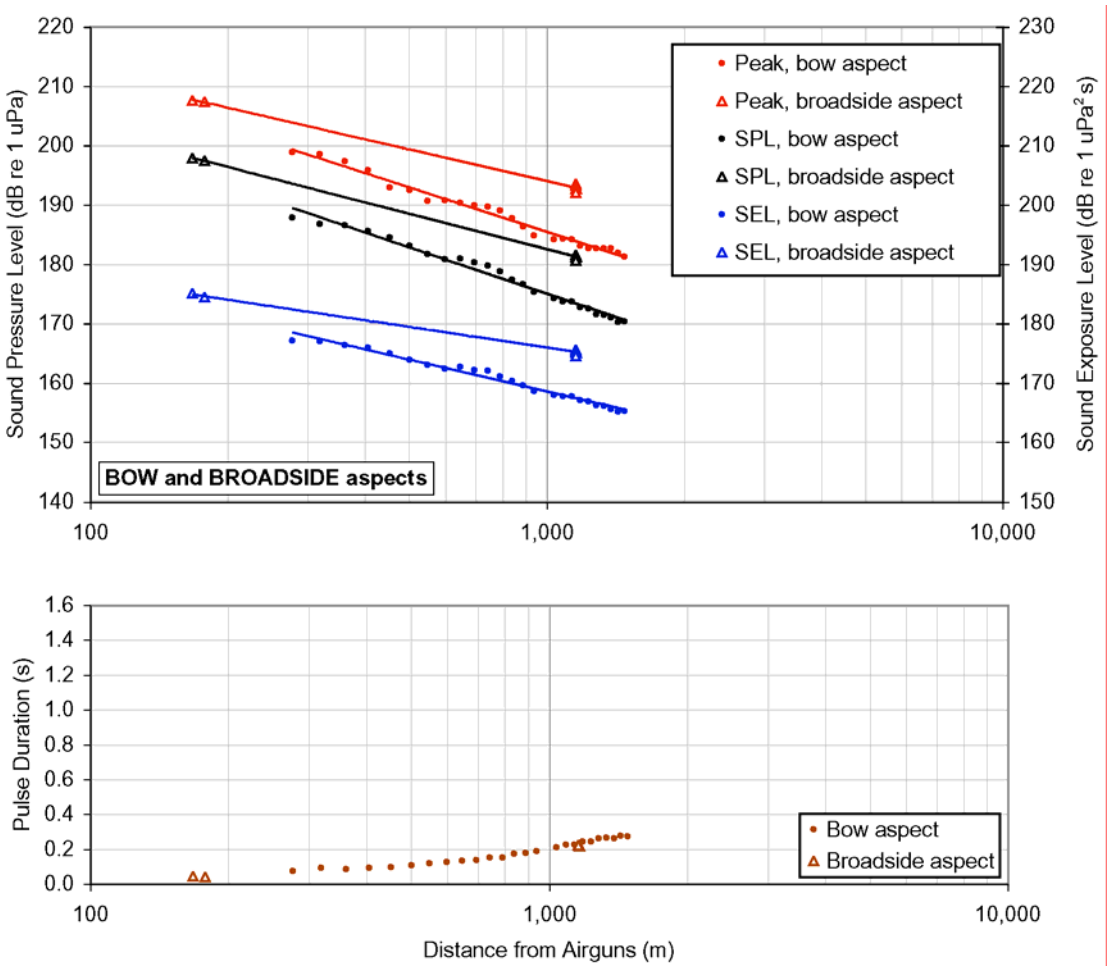

FIGURE 4.11. Received broadband levels of sound with *Gilavar*'s one-string array (1049 in^3) for **bow** (filled circles) and **broadside** (open triangles) aspects, as a function of distance from the airguns, 21 July 2006, Chukchi Sea. Plotted as in Figure 4.10.

respectively, for $M_{pw,}$. The effect of *M*-weighting decreased with distance from the sound source. At the farthest measurement distance, ~34 km, pulse SPLs and SELs dropped by less than 4 dB for M_{mf} and less than 2 dB for $M_{pw,}$. This was a result of the more rapid attenuation of the lower frequency components of the pulses with increasing distance.

To estimate how the 190 dB and 180 dB radii would change if *M*-weighted data were used instead of unweighted data, we fit two regressions to the points in Figure 4.14A, one for mid-frequency cetaceans and one for pinnipeds in water. The regressions were fitted to combined bow and stern aspect data. These represent the amounts (dB) by which SPLs drop as a result of M-weighting the data, as a function of distance from the airguns. For each distance (every m), we then subtracted the resulting decrease in SPL from the SPL regression shown in Figure 4.6 (bow aspect, three-string array) and reassessed the distances at which the 190 and 180 dB levels were reached. With unweighted data the 190 dB and 180 dB radii were 462 m and 1266 m, respectively (Table 4.4). For mid-frequency cetaceans (M_{mf}) these values decrease to 132 m and 455 m, respectively (28% and 36% of their former values, respectively). For pinnipeds in water (M_{pw}) these values decrease to 247 m and 776 m, respectively (53% and 61% of their former values, respectively).

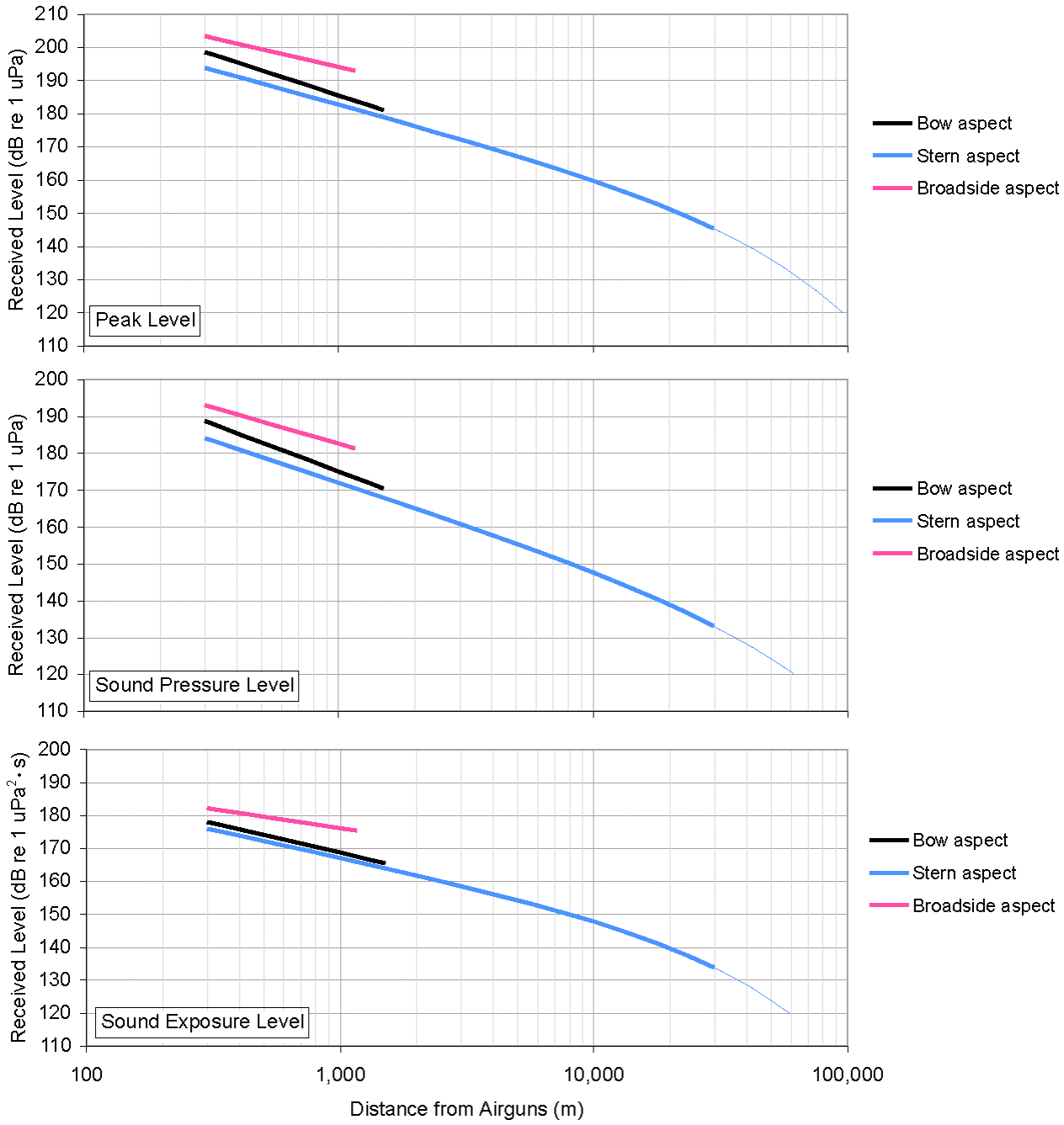

FIGURE 4.12. Summary of broadband levels for *Gilavar*'s one-string array configuration, 21 July 2006, Chukchi Sea. Data for all aspects are shown for peak (top plot), sound pressure (center plot), and sound exposure levels (bottom plot). Received levels which were obtained by extrapolating the regressions beyond the range of distances within which the measurements were made are indicated with a thinner line. Farthest measurement distances were 1.5 km, 29.8 km, and 1.2 km for bow, stern, and broadside data, respectively.

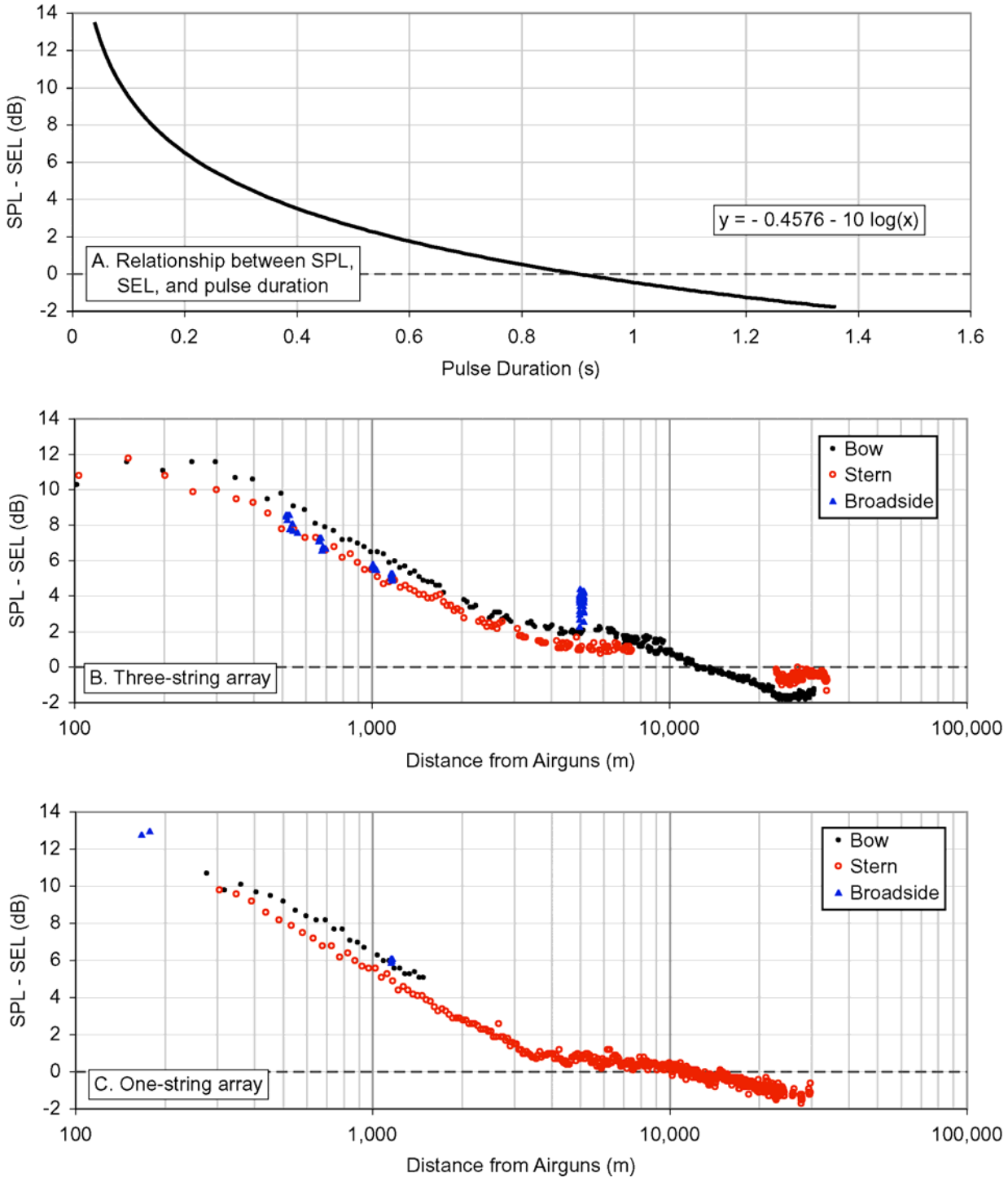

FIGURE 4.13. Relationship between SPL, SEL, pulse duration, and distance from *Gilavar*'s airguns for data collected in the Chukchi Sea. ***(A)*** SPL–SEL (i.e., the difference, for each analyzed pulse, in the received sound pressure level and sound exposure level) as a function of pulse duration. This relationship is defined mathematically as SPL–SEL = –0.4576–10 log(pulse duration). ***(B)*** SPL–SEL as a function of distance from the airguns for the three-string array data. ***(C)*** SPL–SEL as a function of distance from the airguns for the one-string array data.

TABLE 4.4. Distances to specified received sound exposure levels (SEL) and sound pressure levels (SPL) obtained with both array sizes used in the Chukchi Sea, and comparison with modeled values. All distances are in kilometers. C_1 is the site modeled by JASCO that most closely resembled the site where the empirical measurements were made. The "empirical : predicted" ratios were calculated with unrounded distances. For values shown in italics, the empirical distance was based on an extrapolation of the fitted curve beyond the range of the measured data.

	JASCO Predictions (km)	Empirical measurements (km)			"Empirical : Predicted" ratios		
		Bow	Stern	Broadside	Bow	Stern	Broadside
A. 3-string array	C_1, 3147 in^3						
SEL							
190 dB	0.03	*0.14*	*0.10*	*0.14*	*4.6*	*3.4*	*4.5*
180 dB	0.07	0.57	0.44	0.61	8.1	6.3	8.7
170 dB	0.53	2.19	1.82	2.70	4.1	3.4	5.1
160 dB	2.30	7.11	6.35	N.A.	3.1	2.8	N.A.
120 dB	25.95	*73.87*	*72.86*	N.A.	*2.8*	*2.8*	N.A.
SPL							
190 dB	0.23	0.46	0.36	*0.42*	2.0	1.5	*1.8*
180 dB	0.81	1.27	0.98	1.40	1.6	1.2	1.7
170 dB	2.19	3.32	2.64	4.72	1.5	1.2	2.2
160 dB	4.53	7.99	6.77	N.A.	1.8	1.5	N.A.
120 dB	25.95	*67.62*	*82.89*	N.A.	*2.6*	*3.2*	N.A.
B. 1-string array	C_1, 1049 in^3						
SEL							
190 dB	0.02	*0.06*	*0.04*	*0.06*	*3.2*	*2.1*	*3.1*
180 dB	0.06	*0.23*	*0.17*	0.45	*3.8*	*2.8*	7.5
170 dB	0.41	0.84	0.67	N.A.	2.0	1.6	N.A.
160 dB	1.50	N.A.	2.49	N.A.	N.A.	1.7	N.A.
120 dB	19.45	N.A.	*58.83*	N.A.	N.A.	*3.0*	N.A.
SPL							
190 dB	0.09	*0.27*	*0.17*	0.42	*3.0*	*1.8*	4.7
180 dB	0.61	0.65	0.45	*1.35*	1.1	0.7	*2.2*
170 dB	1.73	*1.57*	1.22	N.A.	*0.9*	0.7	N.A.
160 dB	3.59	N.A.	3.24	N.A.	N.A.	0.9	N.A.
120 dB	21.27	N.A.	*61.40*	N.A.	N.A.	*2.9*	N.A.

TABLE 4.5. Protective distances to specified received sound exposure levels (SEL) and sound pressure levels (SPL) obtained with both array sizes used in the Chukchi Sea, and comparison with modeled values. In this table, 2 dB have been added to all intercept values in the regressions used to calculate the size of radii. Otherwise as in Table 4.4. All distances are in kilometers.

	JASCO Predictions (km)	Field measurements (km)			"Field : predicted" ratios		
		Bow	Stern	Broadside	Bow	Stern	Broadside
A. 3-string array	C_1, 3147 in^3						
SEL							
190 dB	0.03	*0.19*	*0.14*	*0.18*	*6.2*	*4.5*	*6.1*
180 dB	0.07	0.75	0.59	0.82	10.7	8.4	11.7
170 dB	0.53	2.82	2.38	3.64	5.3	4.5	6.9
160 dB	2.30	8.73	7.89	N.A.	3.8	3.4	N.A.
120 dB	25.95	*78.36*	*77.35*	N.A.	*3.0*	*3.0*	N.A.
SPL							
190 dB	0.23	0.57	0.44	0.53	2.5	1.9	2.3
180 dB	0.81	1.54	1.20	1.79	1.9	1.5	2.2
170 dB	2.19	4.00	3.21	*6.02*	1.8	1.5	*2.8*
160 dB	4.53	9.38	8.09	N.A.	2.1	1.8	N.A.
120 dB	25.95	*71.94*	*89.17*	N.A.	*2.8*	*3.4*	N.A.
B. 1-string array	C_1, 1049 in^3						
SEL							
190 dB	0.02	*0.08*	*0.06*	*0.09*	*4.1*	*2.8*	*4.6*
180 dB	0.06	0.30	*0.22*	0.67	5.0	*3.7*	11.2
170 dB	0.41	1.08	0.87	N.A.	2.6	2.1	N.A.
160 dB	1.50	N.A.	3.19	N.A.	N.A.	2.1	N.A.
120 dB	19.45	N.A.	*63.55*	N.A.	N.A.	*3.3*	N.A.
SPL							
190 dB	0.09	0.32	*0.20*	0.53	3.5	*2.3*	5.9
180 dB	0.61	0.77	0.55	*1.70*	1.3	0.9	*2.8*
170 dB	1.73	*1.88*	1.49	N.A.	*1.1*	0.9	N.A.
160 dB	3.59	N.A.	3.91	N.A.	N.A.	1.1	N.A.
120 dB	21.27	N.A.	*67.26*	N.A.	N.A.	*3.2*	N.A.

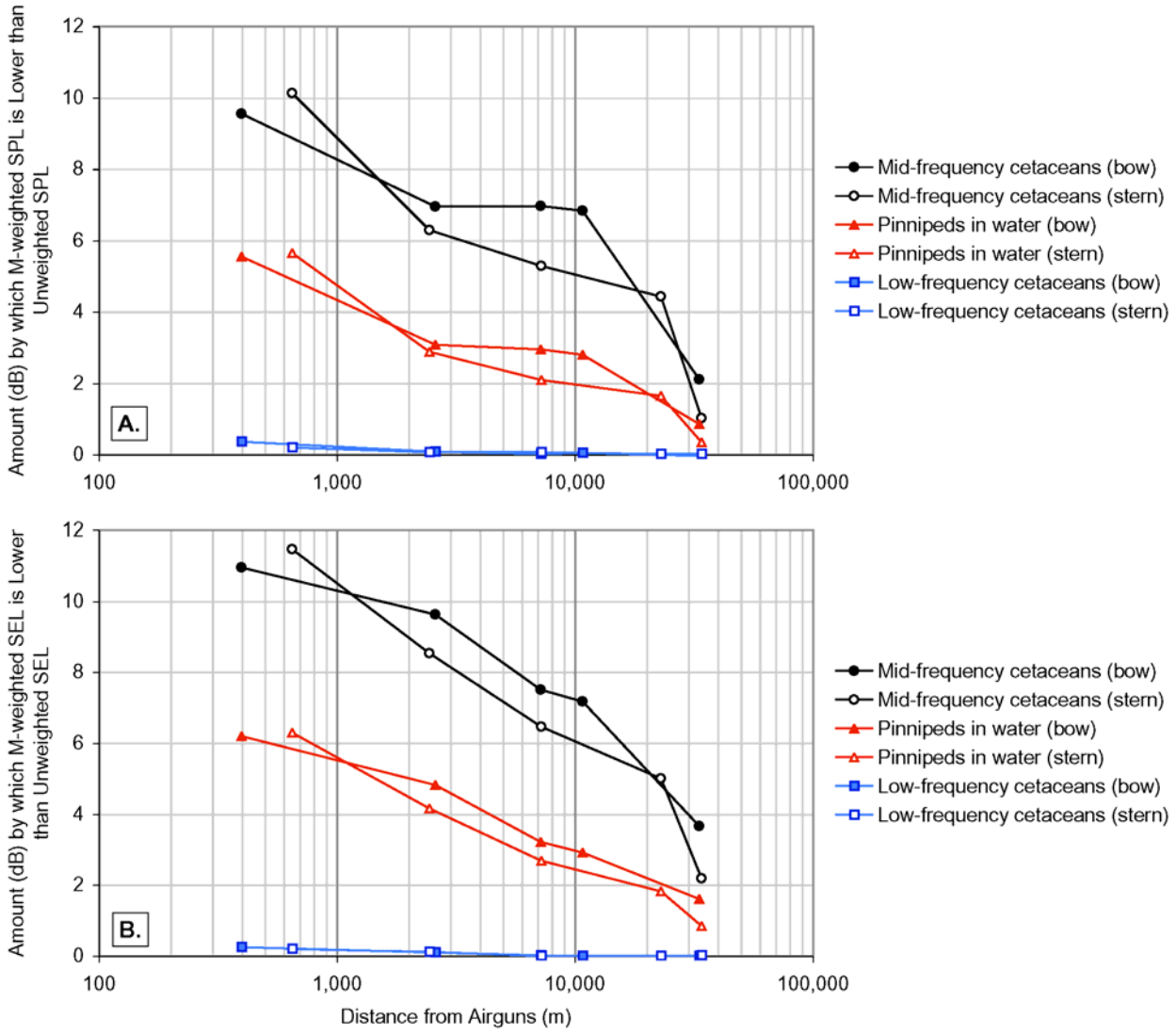

FIGURE 4.14. Effect of *M*-weighting on broadband levels, as a function of distance from the airguns (Chukchi Sea data). Both plots show the amount (dB) by which *M*-weighting decreases (A) pulse sound pressure levels (SPL) and (B) sound exposure levels (SEL). Three different types of *M*-weighting were used: for mid-frequency cetaceans (M_{mf}), pinnipeds in water (M_{pw}), and low-frequency cetaceans (M_{lf}). Each data point is the average of five consecutive pulses. Bow aspect data are distinguished from stern aspect data.

Broadband Levels for Shallow-Hazards Vessel Henry Christoffersen *(Beaufort Sea)*

On 8 August 2006, both ASARs were deployed in the locations given in Table 4.1, about 54 km east of Kaktovik off the north coast of Alaska. ASAR #1 was set to sample at 192 kHz (therefore filling its memory capacity in ~3 hours) and ASAR #2 at 44.1 kHz. Both ASARs started recording at 09:30 local time. The *Henry Christoffersen* followed a predetermined course over and away from the ASAR locations, providing endfire aspect data for various types of seismic sound sources. The *Henry C.*'s track is shown in Figure 4.15. The seismic and sonar sources were all operating simultaneously, but only on the outbound trip (away from the ASARs). While the sources were on, the *Henry C.* traveled at a speed of ~4 knots (7.4 km/h or 4.6 mph), using its two outer engines at reduced power (the two inner engines were turned off).

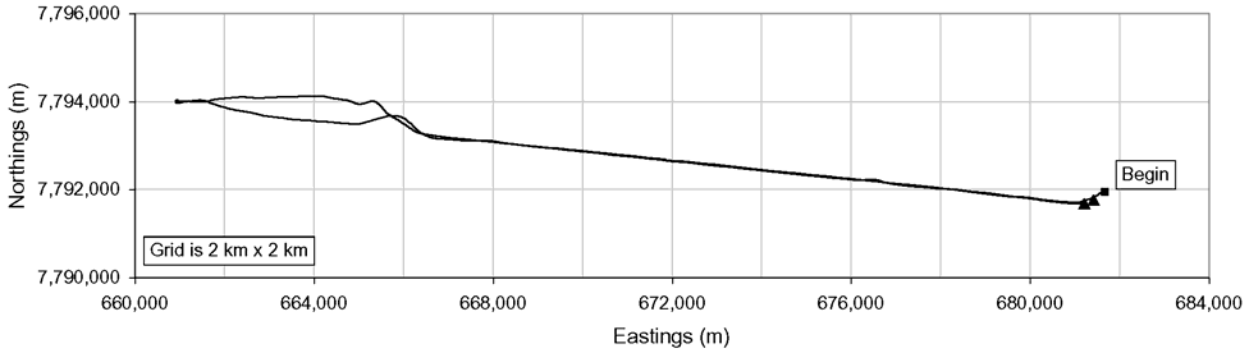

FIGURE 4.15. Track of the *Henry Christoffersen* during seismic, sonar, and vessel sound measurements. The grid squares are 2 km × 2 km. The *Henry C.* started its course at the filled square, steered over the two ASARs, then headed WNW at a speed of ~4 knots while seismic and sonar sound sources were turned on. On its return trip to the ASAR locations the *Henry C.* traveled at ~12 knots without any seismic or sonar sound sources turned on (see text for details). Filled triangles show the ASAR locations.

Airguns.—Figure 4.16 shows broadband levels for four pulse parameters as a function of distance from the Henry C.'s 4-airgun array: peak level, SPL, SEL and pulse duration. All aspects are combined, but the small, symmetric configuration of the four-gun array suggested there would be virtually no aspect dependence. For peak, SPL, and SEL values, Eq. (2) was fitted to the data. The resulting equations and multiple-*R* values are shown in Table 4.6. As expected, the received levels at a given distance were much lower for the small airgun array deployed from the *Henry C* than for the larger airgun arrays deployed from the Gilavar.

Comparison of Empirical and Modeled Radii for Airgun Sounds.—Table 4.7 summarizes the distances to a set of specified SELs and SPLs, as determined using the field measurements presented above for the *Henry Christoffersen*'s airgun array. These empirical distances are compared to distances predicted by sound propagation modeling (see Chapter 3). Note however that the empirical measurements were made with a 4-airgun 280 in^3 array whereas a 4-airgun 240 in^3 array was assumed in the modeling. JASCO used their MONM acoustic model to generate SEL contours, from which SPLs were derived by Fourier synthesis analysis (see Chapter 3, Jensen et al. 2000). Because the contours produced by the MONM model are anisotropic, the predicted distances given in Table 4.7 are the radii encompassing 95% of the locations where the predicted SEL or SPL equals or exceeds the criterion value. An "empirical : predicted" (E:P) ratio was calculated for each metric (SEL and SPL) and received level, as shown in Table 4.7. The E:P ratio was in general better (lower) for the Beaufort Sea measurements in Table 4.7 than the Chukchi Sea measurements in Table 4.4.

TABLE 4.6. Values for variables *A*, *B*, and *C* [Eq. (2)] in the regressions shown in Figure 4.16 for sounds from the airgun array towed by the *Henry Christoffersen*. Values are shown for peak level, sound pressure level (SPL), and sound exposure level (SEL) for all three aspects combined. The multiple-*R* value is shown for each equation as well as the range of distances over which the measurements were made and the sample size (number of pulses analyzed).

	A	*B*	*C*	Mult.-*R* value	Range of distances (km)	Sample size
					0.06–20.53	15
Peak	242.7	–21.70	$-6.31\ 10^{-4}$	–0.996		
SPL	233.4	–22.21	$-7.58\ 10^{-4}$	–0.993		
SEL	203.9	–15.72	$-7.47\ 10^{-4}$	–0.986		

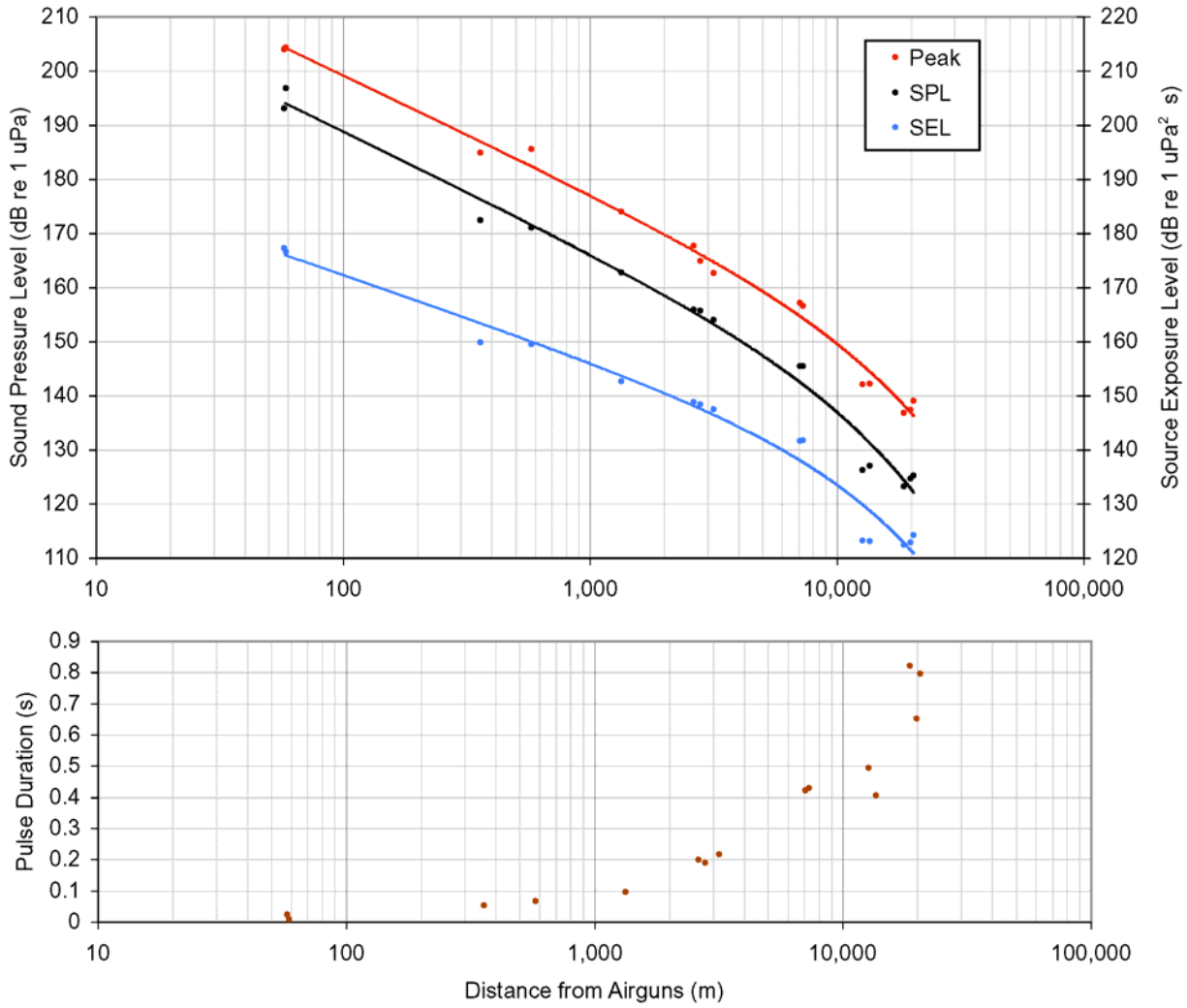

FIGURE 4.16. Received broadband levels of sound from airguns towed by the *Henry Christoffersen*, as a function of distance from the source (all aspects combined). The top plot shows peak levels and SPLs, with values to be read on the left y-axis (dB re 1 μPa), and SELs with values to be read on the right y-axis (dB re 1 $\mu Pa^2 \cdot s$). Note that to avoid overlap, values on the two y-axes are offset by 10 dB. Equations for the regressions are given in Table 4.5. The bottom plot shows pulse duration as a function of distance from the airguns.

The equations (Table 4.6) that resulted from fitting Eq. (2) to the empirical data were derived via a standard least-squares procedure, which means that about 50% of the empirical measurements fall above the line and 50% fall below. As for the Chukchi Sea, we calculated an alternate set of mitigation radii by increasing the intercept value of each regression in Table 4.6 so that almost all empirical data fall below the regression line. In the Chukchi data set, intercept values were increased by 2 dB. For the Beaufort measurements, we adjusted by 3 dB because of the somewhat greater variability in received levels at a given distance. These conservative radii and their comparison with the modeled ones are also shown in Table 4.7.

Chirp Sonar.—Received peak levels, SPLs, and SELs are shown in Figure 4.17 as a function of distance from the chirp sonar (sample size 73 pulses). Eq. (1) was fitted to the data for each parameter.

TABLE 4.7. Distances to specified received sound exposure levels (SEL) and sound pressure levels (SPL) obtained with 4-airgun array used in the Beaufort Sea, and comparison with modeled values. All distances are in kilometers. B_1 is the site modeled by JASCO that most closely resembled the site where the empirical measurements were made. However, modeling assumed a 240 in^3 array whereas the one used in the field was a 280 in^3 array. The "empirical : predicted" (E:P) ratios were calculated with unrounded distances. For values shown in italics, the empirical distance was based on an extrapolation of the fitted curve beyond the range of the measured data.

	JASCO Predictions (km)	Empirical Measure-ments (km)	E : P ratios
	B_1, 240 in^3		
SEL			
190 dB	0.005	*0.008*	*1.5*
180 dB	0.020	*0.033*	*1.6*
170 dB	0.055	0.14	2.6
160 dB	0.54	0.58	1.1
120 dB	23.42	*21.22*	*0.9*
SPL			
190 dB	0.02	0.089	4.5
180 dB	0.15	0.25	1.7
170 dB	0.30	0.68	2.3
160 dB	0.99	1.75	1.8
120 dB	35.98	*22.22*	*0.6*
SEL (with 3 dB added to intercept)			
190 dB	0.005	*0.012*	*2.4*
180 dB	0.020	*0.051*	*2.5*
170 dB	0.055	0.216	3.9
160 dB	0.54	0.87	1.6
120 dB	23.42	*24.08*	*1.0*
SPL (with 3 dB added to intercept)			
190 dB	0.02	0.12	6.1
180 dB	0.15	0.34	2.2
170 dB	0.30	0.91	3.0
160 dB	0.99	2.29	2.3
120 dB	35.98	*24.79*	*0.7*

Pulse durations are also shown as a function of distance from the sound source. Unlike seismic pulses (see Fig. 4.6–4.8, 4.10, 4.11 or 4.16), the durations of the "chirps" did not increase with distance, at least not over the small range of distances over which measurements were made (56–480 m).

Comparison of Empirical and Modeled Radii for Chirp Sonar.—The intercepts for both the SPL and SEL regressions (see Fig. 4.17) are below 190 dB so the data suggest that a 190 dB level was not reached at any distance from this source. However, there were no measurements at distances closer than

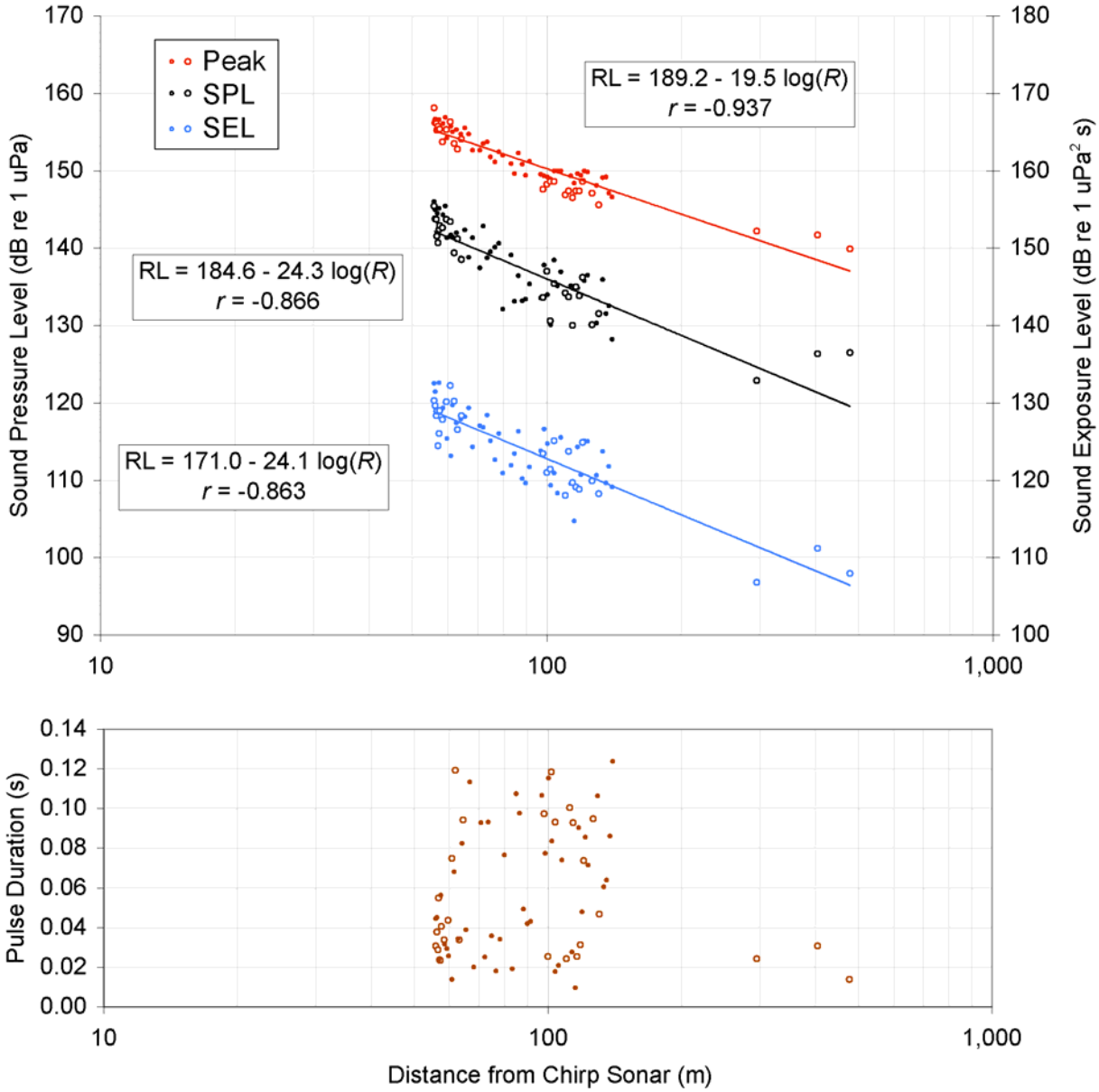

FIGURE 4.17. Received broadband levels of sound from chirp sonar towed by the *Henry Christoffersen*, as a function of distance from the source. The top plot shows peak levels and SPLs, with values to be read on the left y-axis (dB re 1 μPa), and SELs with values to be read on the right y-axis (dB re 1 $\mu Pa^2 \cdot s$). Filled circles are bow aspect data, open circles are stern aspect data. All data combined were used in the regressions. The bottom plot shows pulse durations as a function of distance from the chirp sonar.

~56 m, and no measurements were taken directly below the source. Using a ray tracing approach, JASCO estimated that 180 dB SPL would occur at a distance of 30 m for the B_1 location. This compares to an (extrapolated) estimate of ~1.6 m based on the empirical data shown in Figure 4.17.

Bubble-Pulser.—Received peak levels, SPLs, and SELs are shown in Figure 4.18 as a function of distance from the bubble pulser (sample size 48 pulses). Eq. (1) was fitted to the data for each parameter. Pulse durations are also shown as a function of distance from the sound source. As seen for the chirp sonar there was no change in pulse duration with distance. Bubble pulser sounds were of very short duration

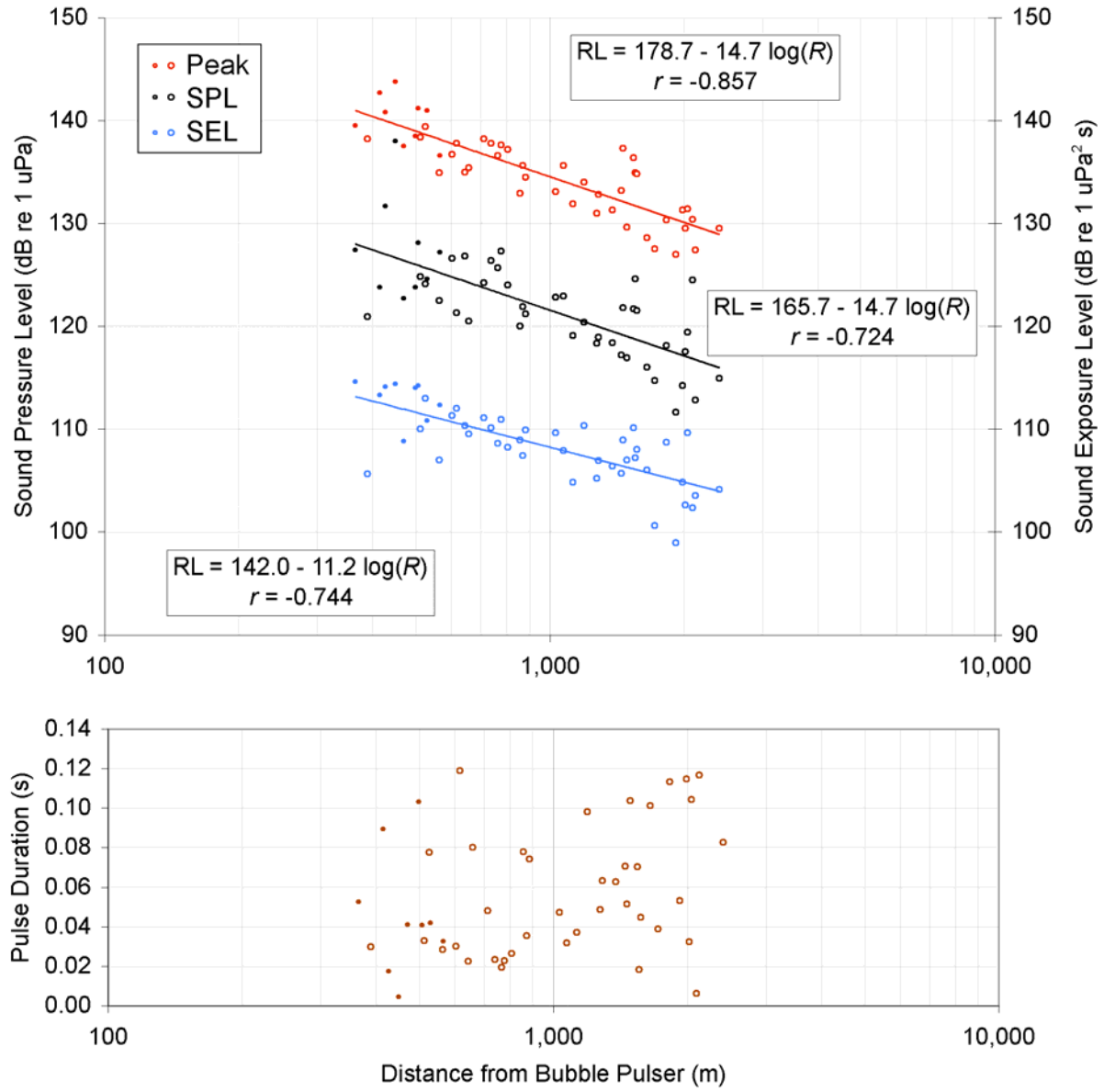

FIGURE 4.18. Received broadband levels of sound from bubble pulser towed by the *Henry Christoffersen*, as a function of distance from the source. The top plot shows peak levels and SPLs, with values to be read on the left y-axis (dB re 1 μPa), and SELs with values to be read on the right y-axis (dB re 1 $\mu Pa^2 \cdot s$). Filled circles are bow aspect data, open circles are stern aspect data. All data combined were used in the regressions. The bottom plot shows pulse durations as a function of distance from the bubble pulser.

(0.005 to 0.12 sec) and quite weak. Even for peak levels, the intercept of the regression (i.e., estimated nominal "source level" at 1 m) did not reach 180 dB re 1 μPa. However, there were no measurements at distances closer than ~56 m, and no measurements were taken directly below the source.

Spectral Analyses

Seismic Vessel Gilavar (Chukchi Sea).—Spectral density plots of seismic pulses at close and far ranges are presented in Figure 4.19. Each plot shows a broadside sample and an endfire sample taken at about the same distances. At close ranges (Fig. 4.19A) most of the pulse energy was below 300 Hz,

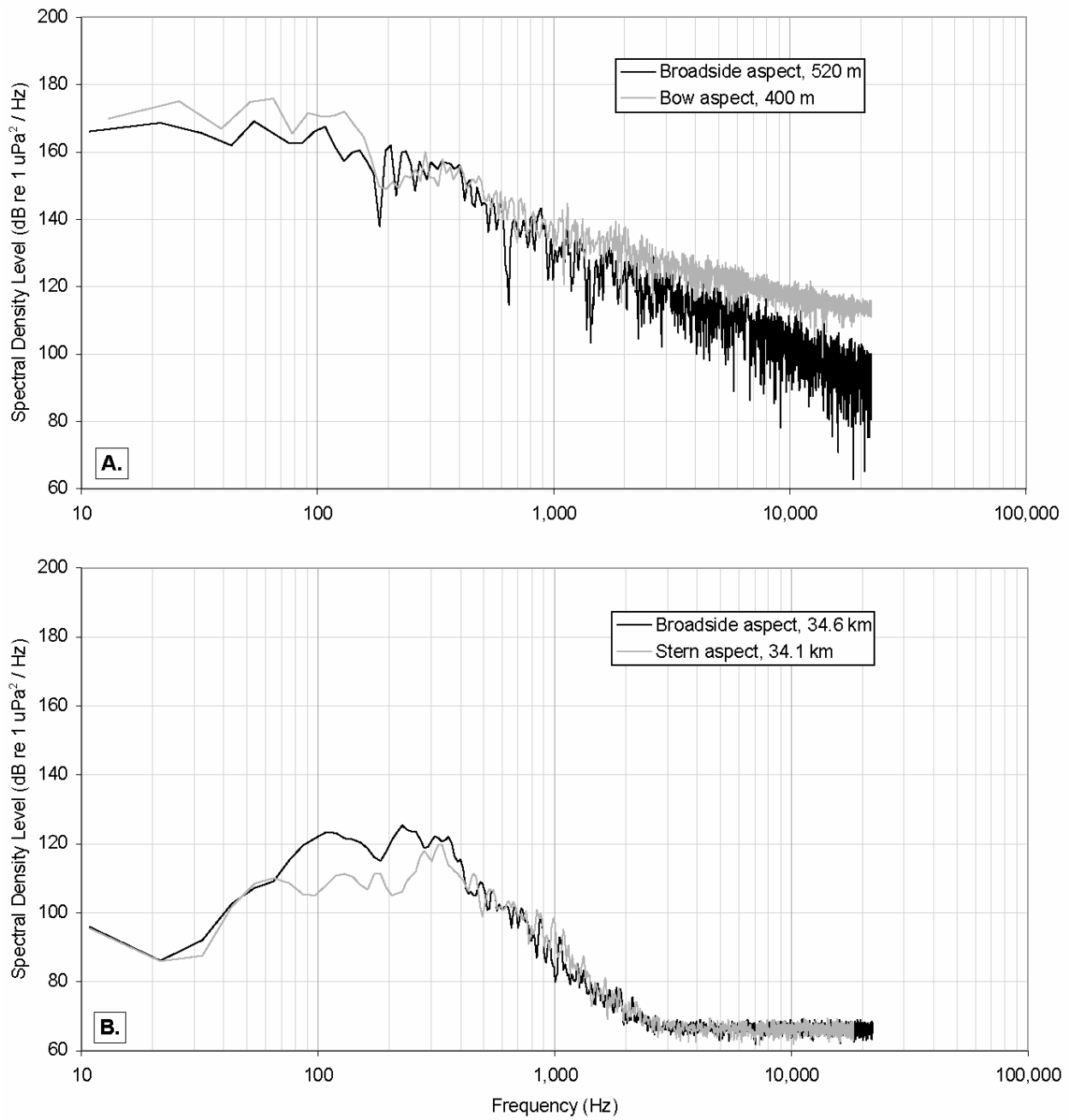

FIGURE 4.19. Spectral density levels for seismic pulses produced with the *Gilavar*'s three-string array, at ***(A)*** short ranges and ***(B)*** long ranges, 21 July 2006, Chukchi Sea. Two different aspects are shown in each plot. Each spectral density plot was produced by analyzing one typical pulse. FFT size was 4009 samples for all but the closest sample, for which it was 3392. This resulted in 11 and 13 Hz bin widths, respectively.

but there was still significant energy at higher frequencies. At the maximum measurement distance (~ 34 km), spectral density levels were lower at all frequencies, and most of the remaining pulse energy was between 70 and 400 Hz. Energy at higher and lower frequencies had attenuated (with distance) at a proportionally higher rate than occurred at 70–400 Hz.

Shallow-Hazards Vessel Henry Christoffersen (Beaufort Sea).—Spectral density plots of *airgun* pulses received at close and far ranges from the *Henry C.* are presented in Figure 4.20. The low-frequency components at close range could not be characterized because of the very short duration of the pulses received at that distance. In similar fashion to the seismic pulse measurements in the Chukchi Sea (Fig. 4.19), frequencies below ~70 Hz and above ~700 Hz have been attenuated in the distant sample (20.5 km).

The *chirp sonar* produced a 50 ms linear sweep of two sinusoids at frequencies of 2–7 and 8–23 kHz. This can be seen in Figure 4.21, showing a 0.13 s spectrogram of the chirp sonar sound source.

A spectral density plot of a pulse from the *bubble pulser* is shown in Figure 4.22. The bubble pulser was described as having most of its energy close to 400 Hz. The short duration of the pulse shown (0.04 s) resulted in low resolution (47 Hz) at the frequencies of interest. The spectral density plot shows a dip at 400 Hz, surrounded by two peaks, one at ~280 Hz and the other at ~610 Hz.

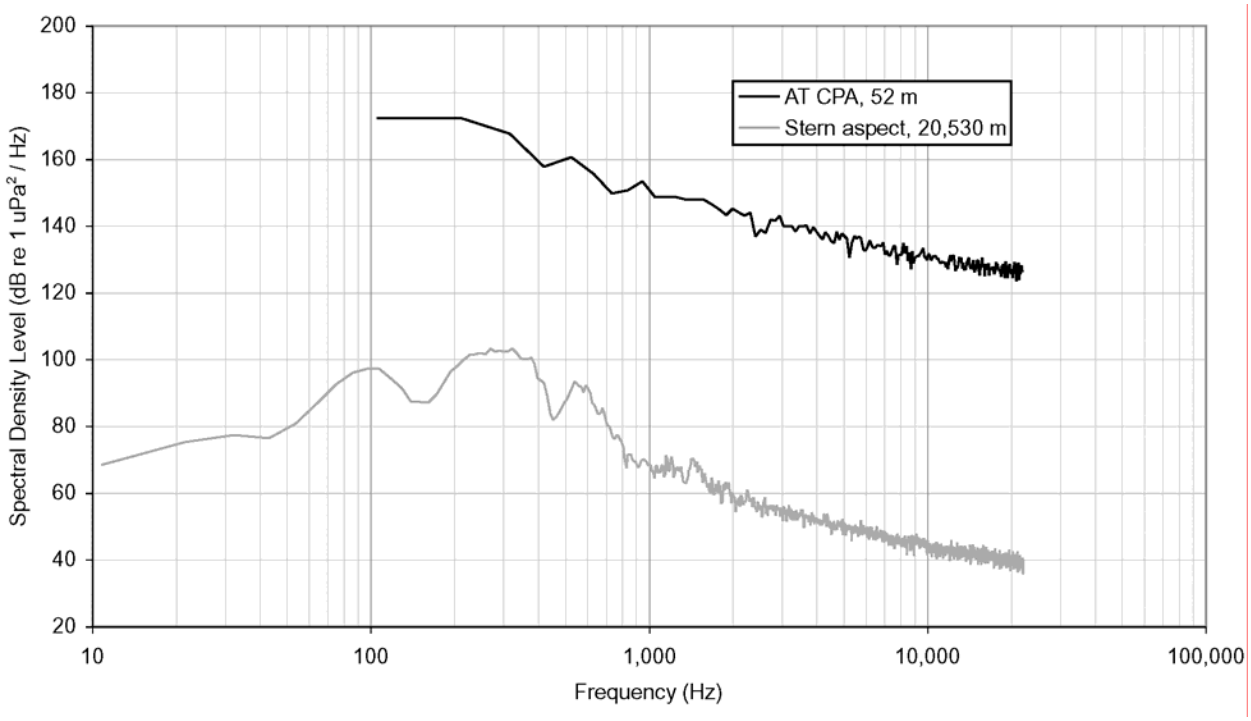

FIGURE 4.20. Spectral density levels for seismic pulses produced by the airgun array towed by the *Henry Christoffersen* at short and long range, 8 August 2006, Beaufort Sea. Each spectral density plot was produced by analyzing one typical pulse. FFT size was 420 and 4096 samples for the close and far pulse, respectively (the small FFT size was necessary for the CPA pulse, which was of extremely short duration). This resulted in 105 and 11 Hz bin widths, respectively.

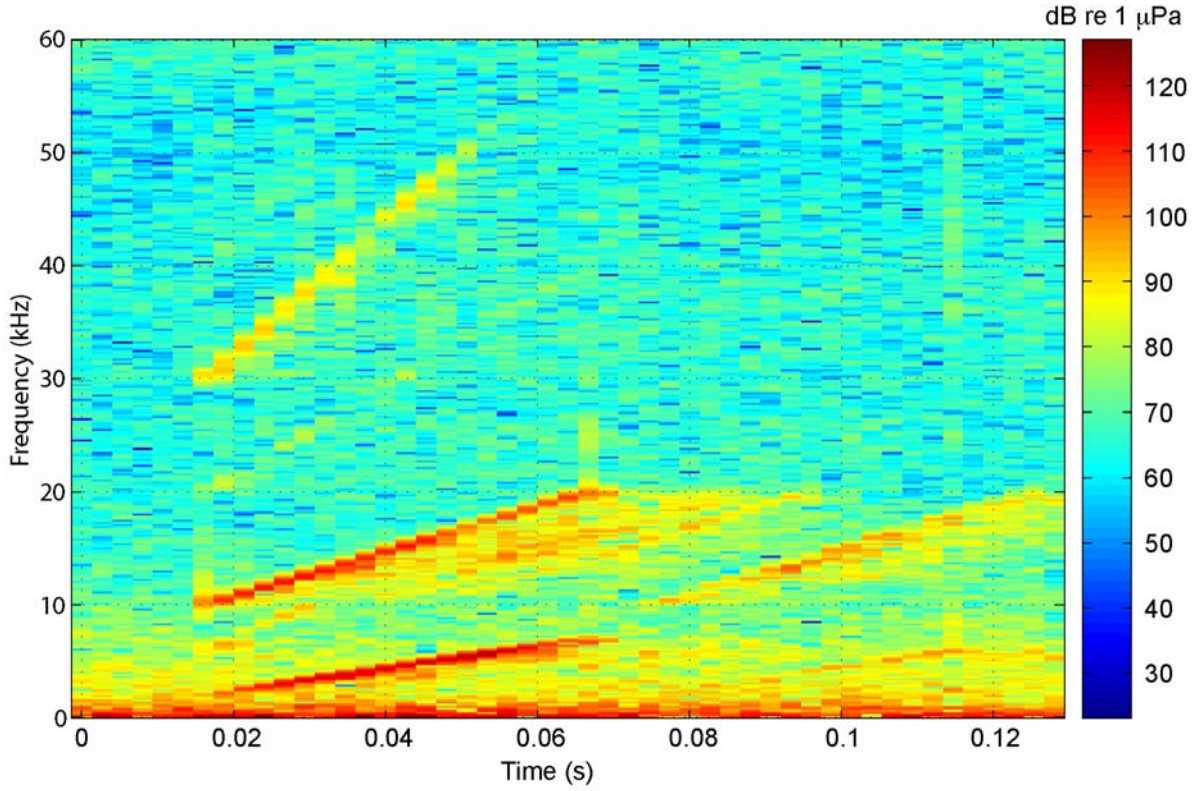

FIGURE 4.21. Spectrogram of the chirp sonar towed behind the *Henry Christoffersen*. This 0.13 sec sample was taken at the closest point of approach (56 m). The scale is in dB re 1 μPa.

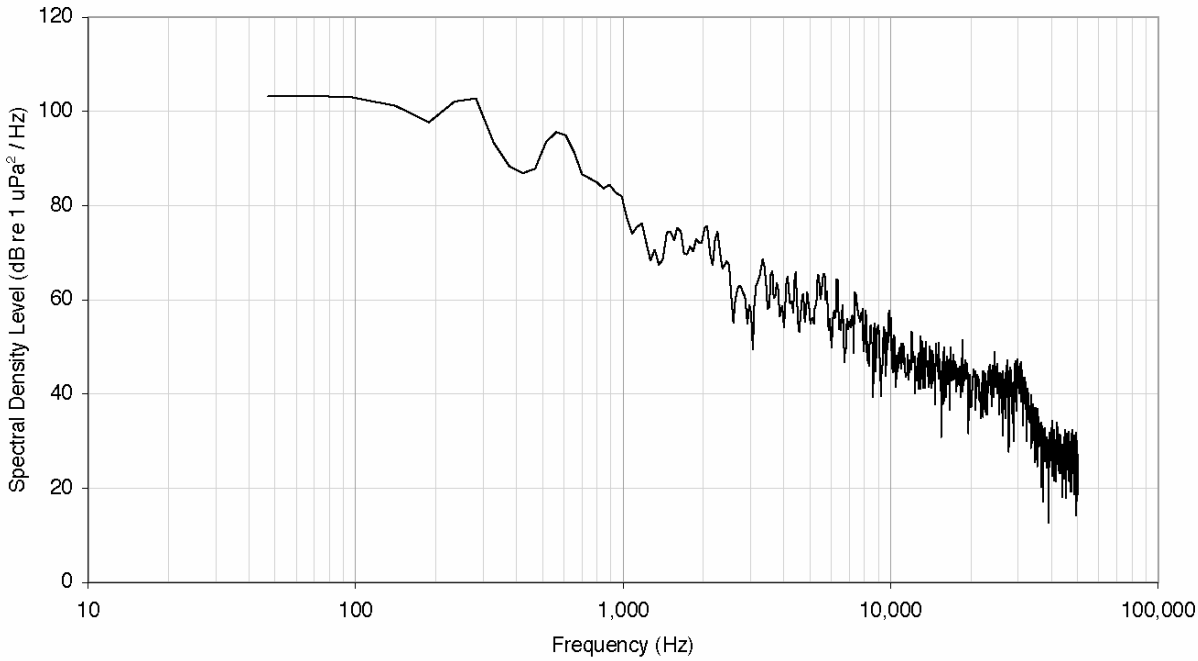

FIGURE 4.22. Spectral density levels for bubble pulser towed by the *Henry Christoffersen* at short range, 8 August 2006, Beaufort Sea. The spectral density plot was produced by analyzing one typical pulse 140 m from ASAR #1. FFT size was 4096 samples, resulting in a 47 Hz bin width. The short duration of the pulse limited the size of the FFT that could be used, and therefore low resolution at the frequencies of interest.

Vessel Sound Measurements

Measurement Circumstances

Gilavar and Kilabuk.—On 12 July 2006 both ASARs were deployed in the Chukchi Sea in the locations shown in Table 4.1. After deployment the *Kilabuk* and then the *Gilavar* followed a predetermined route over and away from the ASAR locations, to provide recordings of the vessel sounds from different distances and different aspects (bow, stern, broadside). As an example, the route taken by the *Gilavar* is shown in Figure 4.23. It is similar to the course followed during airgun sound measurements, but on a smaller scale (maximum distance from the ASARs was ~10 km, as opposed to ~30 km during the airgun sound measurements). The *Kilabuk* and *Gilavar* were traveling at speeds of ~10 and 12 knots (18.5 and 2.2 km/h, or 11.5 and 13.8 mph), respectively. The vessels passed over ASAR #2 in both directions[8] (eastward and westward) to provide bow and stern aspect data. They then zigzagged back and forth at several distances from the recorders to provide broadside data (see Fig. 4.23). While the *Kilabuk* followed its course the *Gilavar* idled 5.6 km southeast of the ASAR location. While the *Gilavar* followed its course the *Kilabuk* idled 9.3 km northwest of the ASAR location.

Henry Christoffersen.—On 8 August 2006 both ASARs were deployed in the Beaufort Sea in the locations shown in Table 4.1. The *Henry C.*'s course is shown in Figure 4.15. The vessel passed close to the ASARs[4] before heading WNW. On the outward (westerly) leg seismic and sonar sources were operating, and the ship was cruising at a speed of ~4 knots. On the return (easterly) leg the seismic sources were turned off and the ship was traveling at a speed of ~12 knots (22.2 km/h or 13.8 mph) with all four engines running. The vessel sound measurements presented in this report were taken from the return leg.

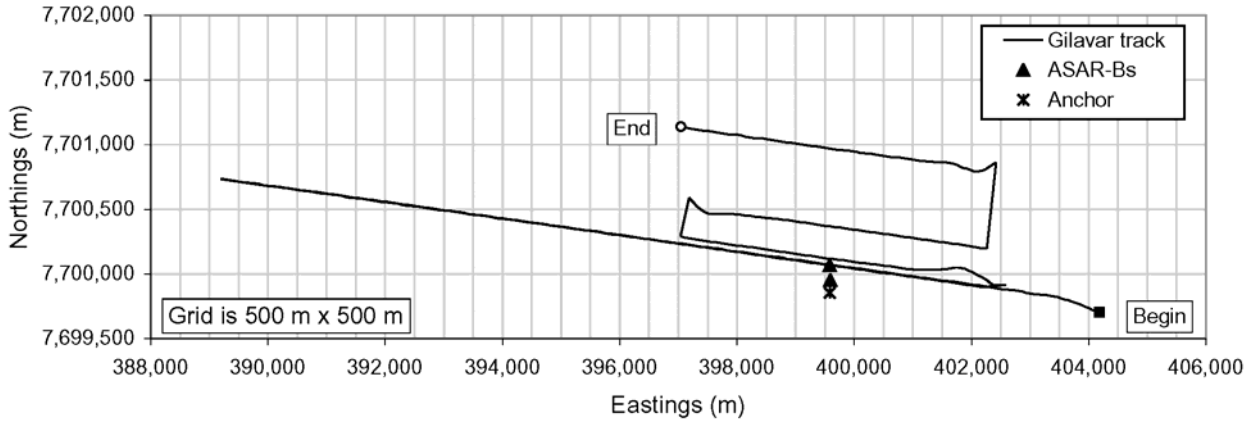

FIGURE 4.23. Track of the M/V *Gilavar* during vessel sound measurements. The grid squares are 500 m × 500 m; the map has been extended in the N-S direction to better show the ship track. The track starts at the filled square and ends at the open circle. Filled triangles show the ASAR locations. The first two runs (west and then east) were on top of each other and over ASAR #2 and provided bow and stern aspect data. The remaining runs provided broadside aspect data.

[8] Both the *Kilabuk* and the *Henry Christoffersen* missed passing directly over one or both ASAR-Bs.

Broadband Levels

Kilabuk and Gilavar.—Broadband (10–20,000 Hz) levels, as calculated for each non-overlapping 1-s segment throughout the entire vessel sound measurement session, are shown in Figure 4.24 as recorded by the ITC 1032 hydrophone on ASAR #2. The large spikes in received levels correspond to each vessel's closest points of approach during consecutive passes by the ASARs (see Fig. 4.23). Heightened levels indicated by diamonds correspond to the *Gilavar* turning around. Note that minimum ("background") levels during the *Gilavar's* run were lower than during the *Kilabuk's* run.

Broadband (10–20,000 Hz) levels are shown as a function of distance from the source in Figure 4.25 for the *Kilabuk* and in Figure 4.26 for the *Gilavar*. Data from both hydrophone types are mixed in these plots, with data from the ITC 1032 and ITC 8212 hydrophones used at received levels above and below ~125 dB re 1 μPa, respectively. These data are presented as a function of aspect: bow, stern, or broadside. Eq. (1) was fitted to each data set and the resulting equations are shown in each plot. When computing these regressions, data at increasing distances from the sound source were included until the broadband levels reached a minimum and remained constant. For example, broadband levels for the *Kilabuk* (Fig. 4.25) apparently reached background levels 2–3 km from the recorders. For both vessels, bow-aspect data in the near-field (less than 300 m) were also erratic and were excluded when fitting the curves.

Henry Christoffersen.— Broadband (10–20,000 Hz) levels are shown as a function of distance from the *Henry C.* in Figure 4.27. These are bow aspect data (ASAR #2, ITC 8212 hydrophone) obtained during the *Henry C.*'s eastward return trip to the ASAR locations (see Fig. 4.15), while seismic and sonar sources were turned off and the ship was traveling at 10–12 knots. Eq. (1) was fitted to the data acquired from distances up to 10 km, beyond which broadband levels remained constant and had presumably reached background values. The discontinuity in received levels at 9–10 km coincides with a sudden shift in water depth from ~45 to ~41 m.

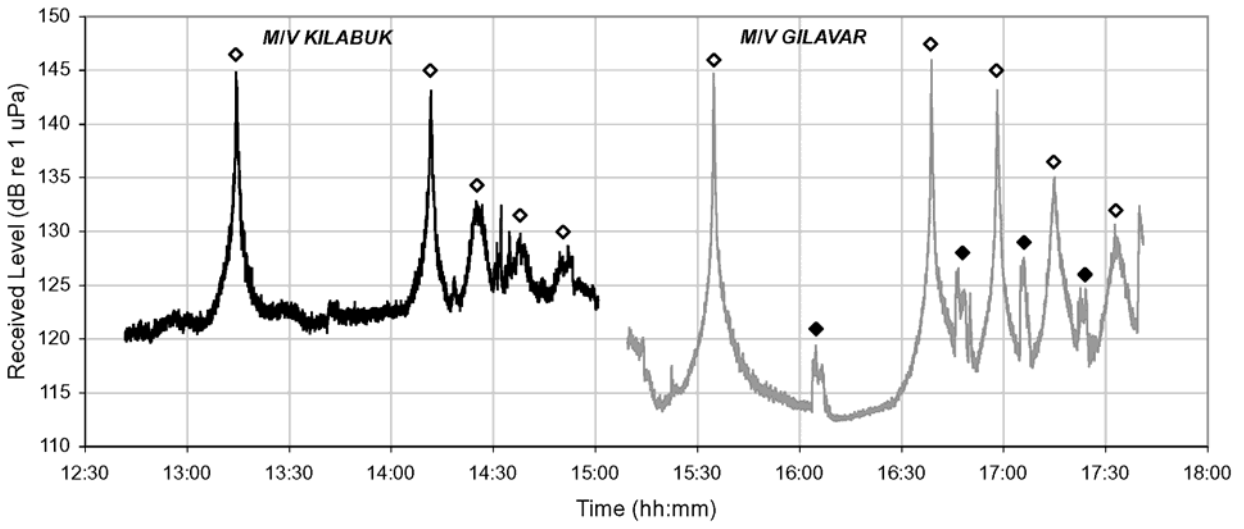

FIGURE 4.24. Broadband levels (one value for each 1-s interval) of vessel sounds as recorded by the ITC 1032 hydrophone (less sensitive) on ASAR #2, Chukchi Sea, 12 July 2006. The *Kilabuk* followed its track between 12:45 and 15:00 while the *Gilavar* stood by. Between 15:15 and 17:45 the *Gilavar* followed its track (see Fig. 4.20) while the *Kilabuk* stood by. Open diamonds indicate times when the vessels were at their closest points of approach to the ASARs on each pass. Closed diamonds indicate times when the *Gilavar* was turning around.

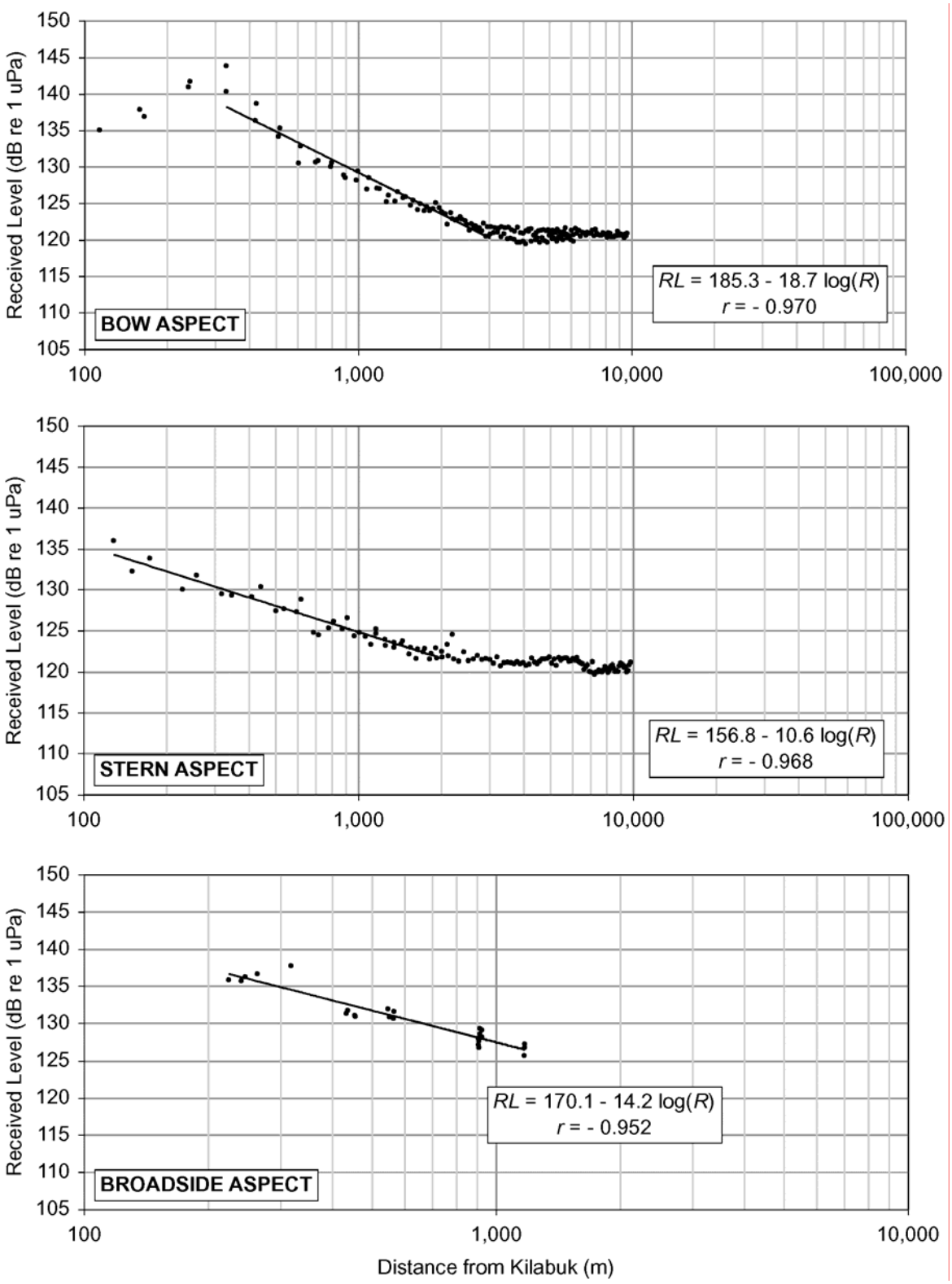

FIGURE 4.25. Broadband levels (10–20,000 Hz) of vessel sounds as a function of distance from the *Kilabuk*, for bow aspect (top), stern aspect (center), and broadside aspect (bottom). The regressions shown were calculated using data over the following ranges: ~300–3000 m for bow aspect, 100–2000 m for stern aspect, all data for broadside aspect (see text).

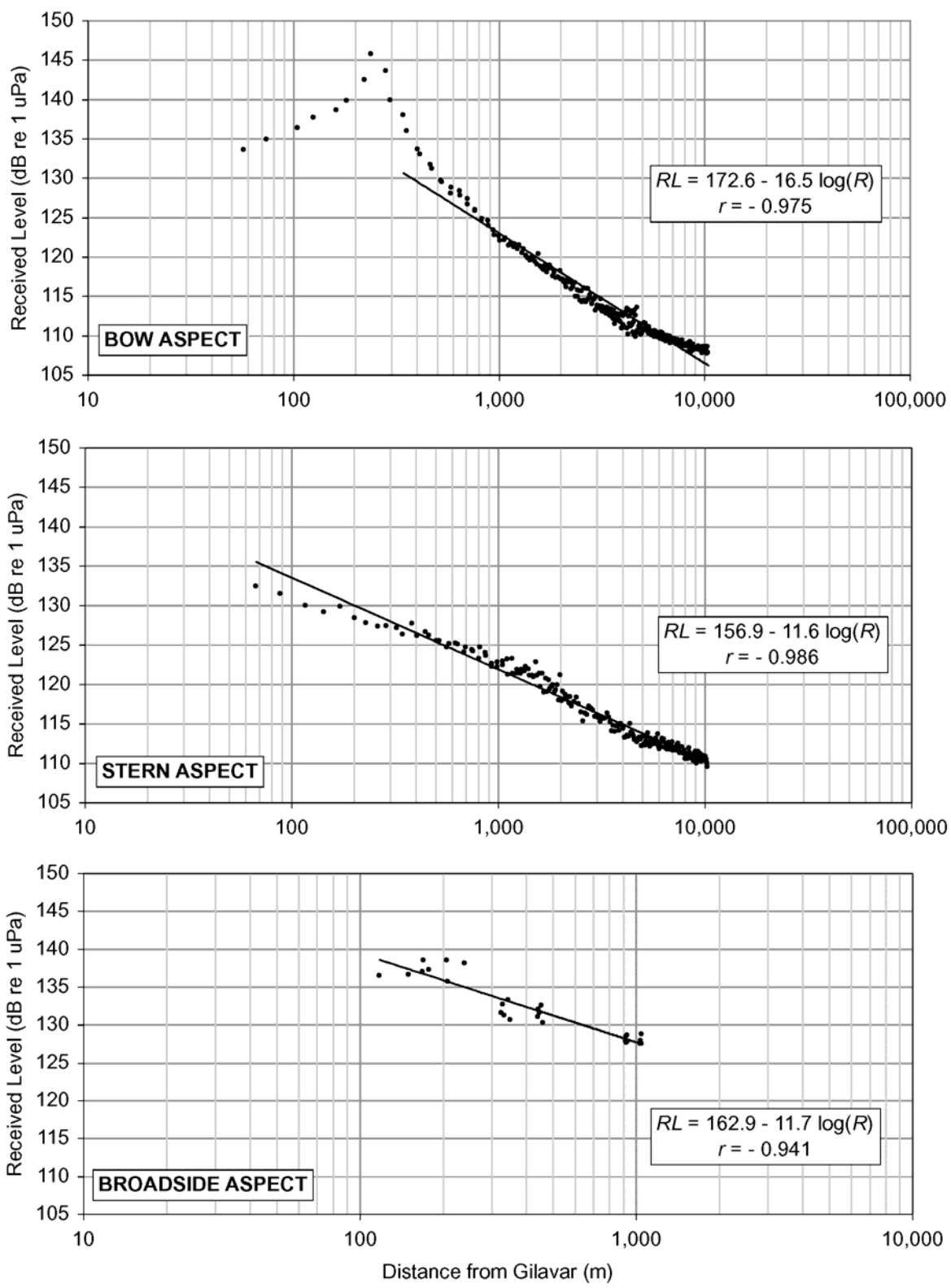

FIGURE 4.26. Broadband levels (10–20,000 Hz) of vessel sounds as a function of distance from the *Gilavar*, for bow aspect (top), stern aspect (center), and broadside aspect (bottom). The regressions shown were calculated using data over the following ranges: ~300–10,000 m for bow aspect, all data for stern and broadside aspects (see text).

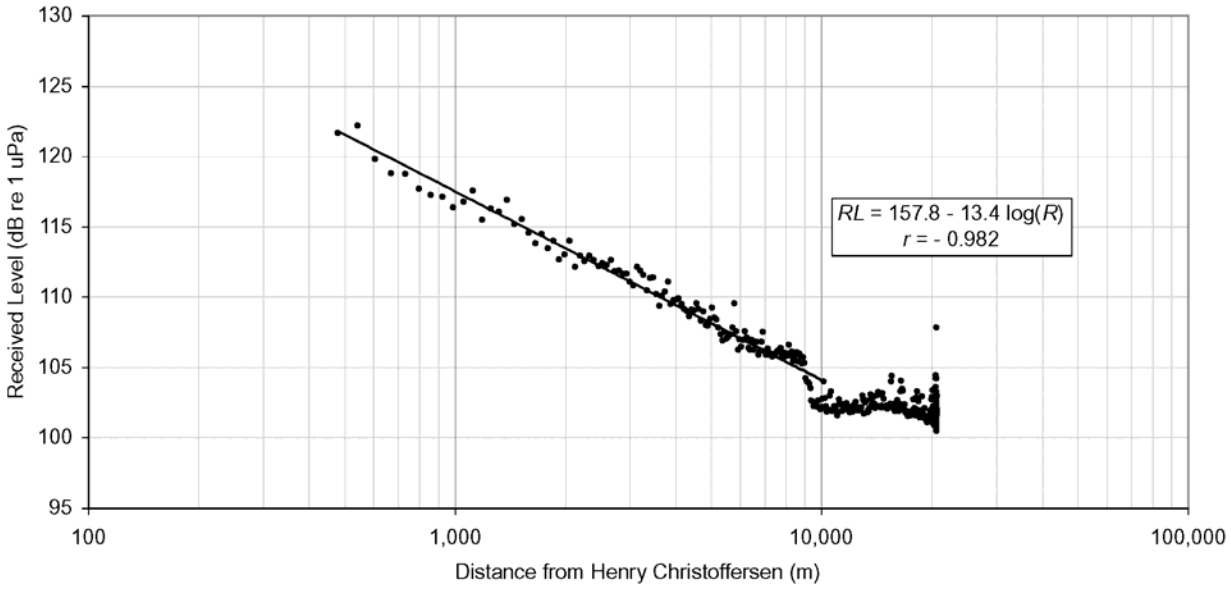

FIGURE 4.27. Broadband levels (10–20,000 Hz) of vessel sounds as a function of distance from the *Henry Christoffersen*.

Spectral Analyses

Kilabuk and Gilavar.—To describe the "sound signature" of each vessel, spectral analyses were performed on 10 s samples from recordings obtained when the vessels were close to the ASARs (i.e., with a high signal to background noise ratio). The results from these analyses are shown in Figures 4.28 and 4.29, showing one-third octave band levels and sound spectral density levels (respectively) for both ships. The *Gilavar* produced two large peaks at 15 and 31 Hz, and then several peaks at higher frequencies (359, 622, 1129, and 1246 Hz). The *Kilabuk* produced a series of peaks at low frequencies (32, 42, 45, 53, 67, 90, and 100 Hz).

Henry Christoffersen.—Spectral density levels for a 10 s sample while the *Henry C.* was about 310 m from the ASAR are shown in Figure 4.30. Again there are large peaks at low frequencies, 16–17 Hz, 47 Hz, and 93–94 Hz.

Sound Speed Profiles

Figure 4.31 shows sound speed profiles for the three sampling areas presented in this report: the locations of the recorders for the seismic measurements in the Chukchi Sea, the vessel sound measurements in the Chukchi Sea, and the seismic and vessel sound measurements in the Beaufort Sea. These profiles are relevant in assessing propagation of sound in each sampling area, and may be important in any future modeling or interpretation of the results presented above.

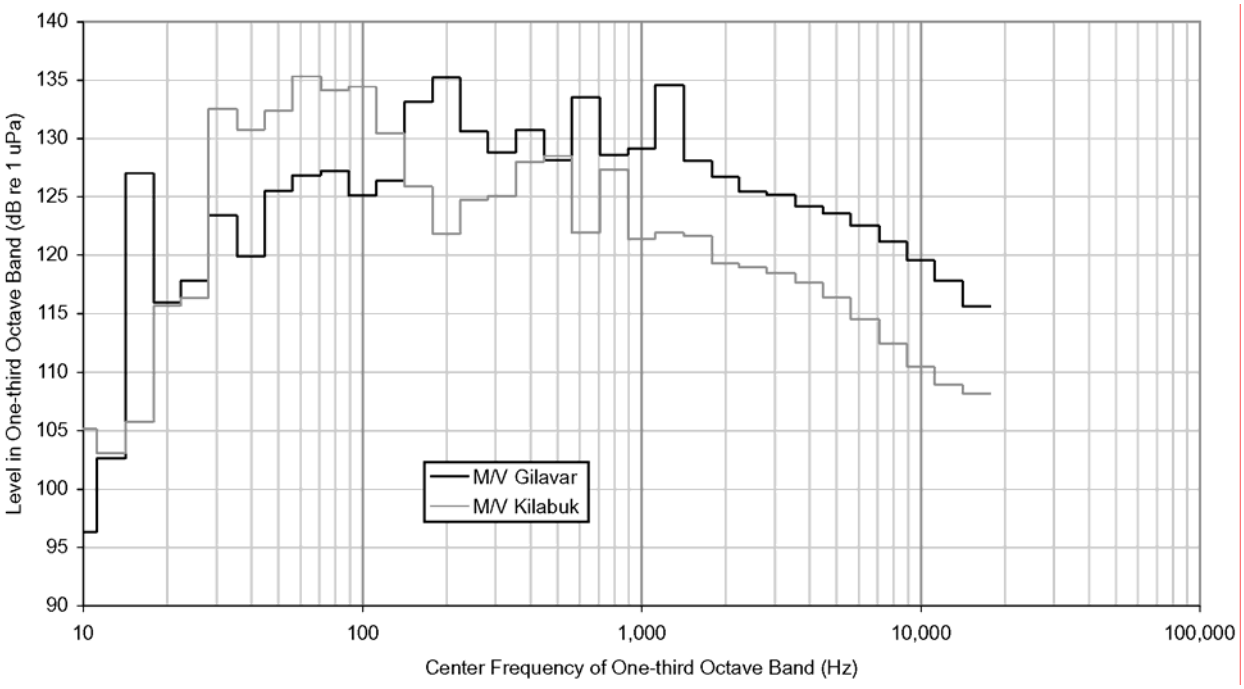

FIGURE 4.28. One-third octave band levels of vessel sounds for the *Gilavar* (black line) and *Kilabuk* (gray line). For each vessel, a 10 s sample was analyzed, taken at each vessel's closest point of approach to ASAR #2.

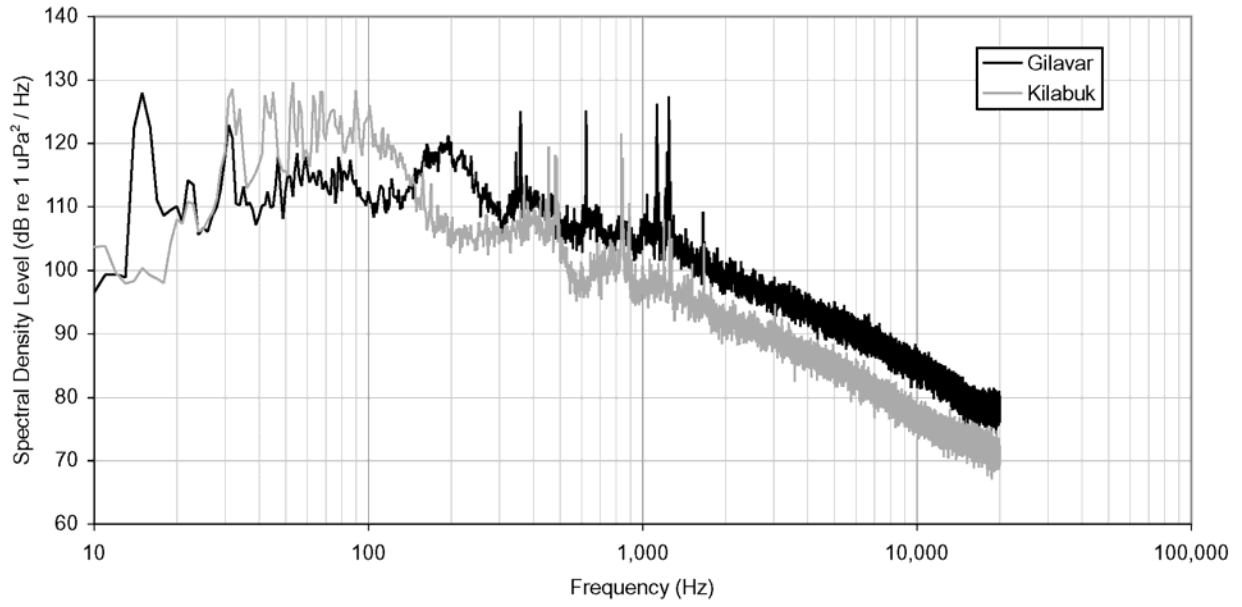

FIGURE 4.29. Spectral density levels of sounds from the *Gilavar* (black line) and the *Kilabuk* (gray line). For each vessel a 10 s sample was analyzed, taken at each vessel's closest point of approach to ASAR #2. FFT size was 44,100 samples, resulting in a 1 Hz bin width.

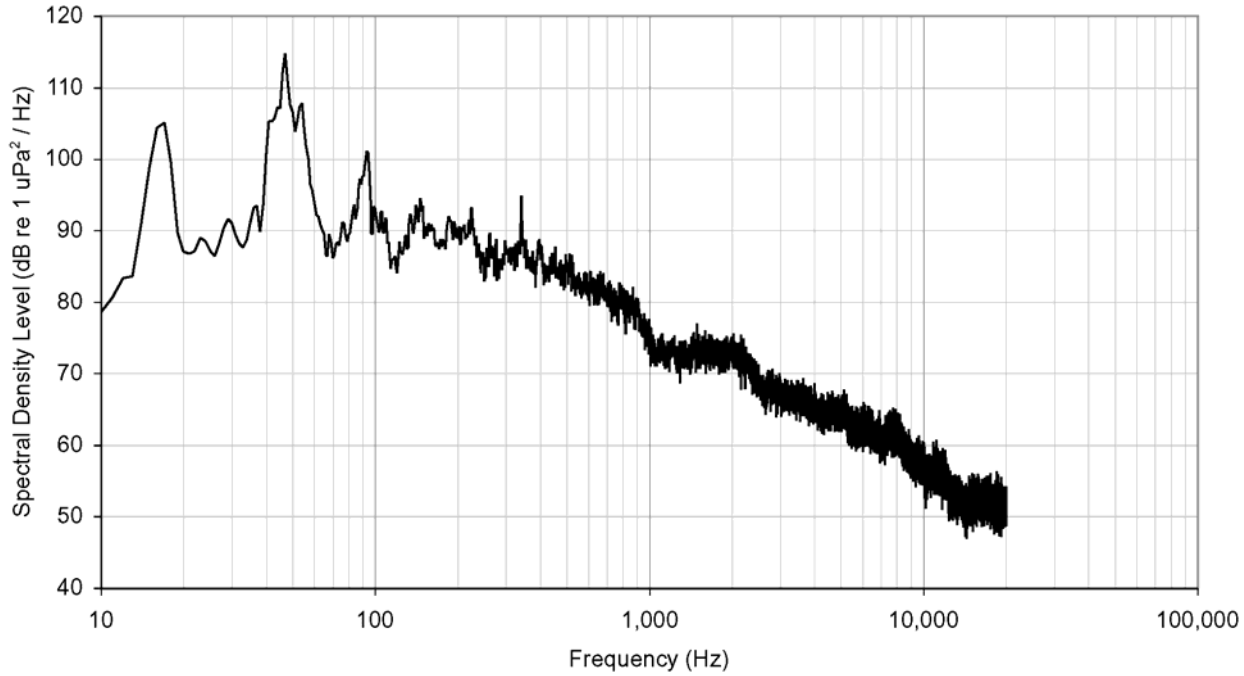

FIGURE 4.30. Spectral density levels of sounds from the *Henry Christoffersen*. A 10 s sample was analyzed, taken while the *Henry C.* was about 310 m from ASAR #2. FFT size was 44,100 samples, resulting in a 1 Hz bin width.

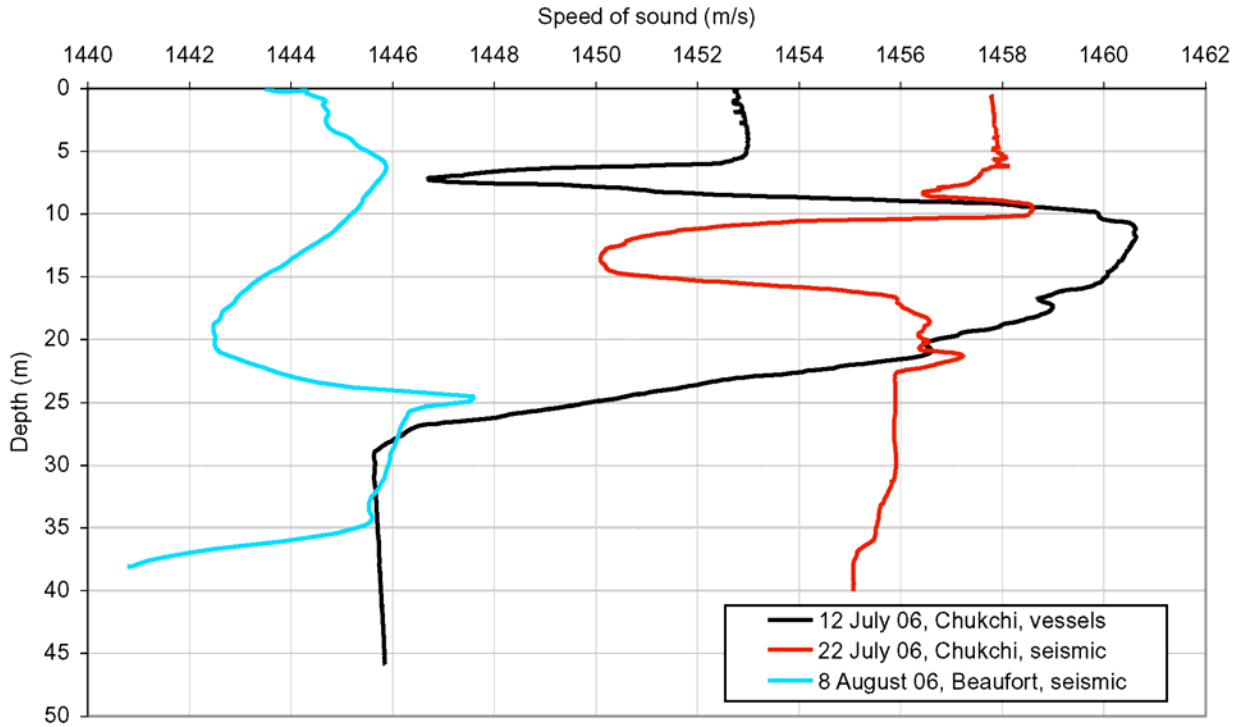

FIGURE 4.31. Sound speed profiles for three sampling locations in the Chukchi and Beaufort Seas (see text).

DISCUSSION

Seismic Sound Measurements

Airgun Pulse Properties

Figures 4.9 and 4.12 show that aspect dependence in the Chukchi Sea measurements was stronger for data collected with the one-string versus the three-string array. This was to be expected since, with the one-string array, there was only one "layer" of airguns (as opposed to three with three strings) and therefore no canceling between pulses traveling different distances to the receiver. This effect was predicted in quantitative terms in JASCO's pre-season modeling of the expected sound fields around the 1-string vs. 3-string arrays. With the one-string array, the highest values for all three level parameters—peak, SPL, and SEL—were found at broadside aspect. Stern aspect data had the lowest values. In three out of four cases (Table 4.4A) the distances to 190 dB and 180 dB (SEL and SPL) shown for the one-string array were 1.5–2 times greater for broadside data than for stern aspect data.

The broadside "face" of the airgun array does not change significantly as parallel strings are added, but the bow and stern "faces" significantly increase with the addition of parallel strings. Thus broadside values for the one-string vs. three-string arrays should be more similar than would be the stern or bow values for one-string vs. three-string arrays. A comparison of received levels (SPL, peak, SEL) at 1 km, as presented in Fig. 4.9 and 4.12, shows that bow and stern values are 7.2–7.8 dB lower for the one-string array compared to the three-string array, but broadside values are only 0.2–0.6 dB lower for the one-string array.

Received levels for all airgun pulse parameters were significantly lower for measurements made in the Beaufort Sea. The airgun cluster towed by the *Henry Christoffersen* included only 4 airguns with a total volume of 280 in^3, compared to 8 airguns totaling 1049 in^3 (one-string array) and 24 airguns totaling 3147 in^3 (three-string array) for the *Gilavar*. All else being equal, the amplitude of the pulses emitted by an array of airguns is proportional to the number of airguns and to the cube root of the total airgun volume (Caldwell and Dragoset 2000). Thus the pressure amplitude should be reduced by 83% (or 15.6 dB), between the *Gilavar*'s three-string (24 gun) array and the *Henry Christoffersen*'s four-gun cluster. The reduction in total gun volume from 3147 in^3 to 280 in^3 is expected to cause a further 45% reduction in amplitude (i.e., a further 7 dB). This adds up to an expected drop of ~23 dB between the *Gilavar*'s three-string array and the *Henry C.*'s four-gun cluster. In actuality, measured peak, SPL, and SEL values for the *Henry C.* were 16–20 dB lower than those for the *Gilavar* at 1000 m from the source, and 24–31 dB lower 10,000 m from the source.

Empirical Versus Predicted Radii

Table 4.4 shows that the difference between measured and predicted radii, as expressed by the E:P ratio, was generally smaller for SPLs than for SELs in the Chukchi Sea dataset. For SPLs the E:P ratios ranged between 0.7 and 4.7 (median = 4.1 and 2.9 for three-string and one-string arrays, respectively), whereas for SELs the E:P ratios ranged between 1.4 and 8.7 (median = 1.7 and 1.5 for three-string and one-string arrays, respectively). Since JASCO's MONM model generates SEL contours from which SPLs are calculated, this seems to indicate that there are variables that are either unknown and therefore not included in the model or that some variables have not been completely taken into account in the model. Differences in environmental conditions between the locations assumed in the model runs as compared with conditions at the ice-free locations where the empirical data were acquired presumably contributed to the deviations between empirical and predicted values. The sound speed profiles collected at the ASAR sites (see Fig. 4.31) are somewhat different than those used in the MONM model; however these differences would probably only contribute to discrepancies at distances larger than the ones of concern for the safety radii.

Differences in bottom properties at the ASAR vs. modeling sites, to the extent they existed, could have had an important effect on the predictions given the shallow water depth. Shallow depths normally cause strong dependence of propagation loss on the local bottom properties. Also, Figure 4.13 shows that the relationship between SPL, SEL, and distance from the sound source may be more complicated than assumed in converting JASCO's model output (in SEL) into the SPL values needed for mitigation purposes (see Chapter 3). Pulse duration and the SEL-to-SPL relationship depended on range, which was expected, but there also were nonlinearities in the way pulse durations increased with range.

Relationship Between SPL, SEL, and Source Distance

Sound exposure levels (SEL) do not depend on the duration of a pulse. Therefore SEL is the measure that is the least susceptible to variability from shot-to-shot, local propagation effects on pulse duration, and background noise. There is general agreement (Madsen 2005; Southall et al. submitted) that SEL is a better measure of an animal's exposure to pulsed or transient sound than is the commonly used SPL. In the dataset from the Chukchi Sea presented in this chapter, pulse-to-pulse variability was unusually low for all parameters (peak, SPL, SEL), but this was most likely due to homogenous physical conditions (i.e., water depth, bottom composition) in the recording area. Another advantage of SELs over SPLs is that a measure of cumulative sound exposure can be calculated when an animal is subjected to a sequence of short transient sounds (e.g., airgun or pile driving pulses) over extended time periods (see for example Madsen et al. 2006).

Despite the increasing popularity of SEL as a metric for reporting impulsive noise, current mitigation requirements and "take" criteria for noise transients, as applied in the U.S., are still based on the SPL metric. This includes the 180 and 190 dB re 1 μPa SPL safety radii for cetaceans and pinnipeds, respectively, and the 160 and 120 dB SPL disturbance criteria used in some situations. It is therefore important to understand the relationship between SPL, SEL, and distance from the sound source. Unfortunately most investigators have not reported their data in such a way as to allow comparisons with Figure 4.13. However, a few other studies provide relevant information as a function of distance from source:

- Greene and Burgess (2000, Fig. 3.5D) present SPLs and SELs for data collected in the Beaufort Sea in 23–26 m deep water and with a 5-m airgun tow depth. The difference between SPL and SEL was ~12 dB at 300 m range and ~5 dB at 6 km. In the Chukchi Sea we measured generally comparable differences, 10–12 dB at 300 m and 1–2 dB at 6 km (Fig. 4.13). Greene and Burgess (2000) did not make measurements at distances large enough for the SEL and SPL to assume equal numeric values.
- Austin et al. (2006), in a preliminary account of sound source verification measurements in the Chukchi Sea for GX Technology Corp., reported SPL–SEL differences of ~7 dB at 300 m and ~1.6 dB at 2.5 km. They made measurements to distances of over 50 km. Unlike the data we present in Fig. 4.13, there was no clear "cross-over" in their data (*cf.* Fig. 7 in Austin et al. 2006), where SEL values consistently exceeded SPL values. Instead their SPL and SEL values converged at ~3–9 km and then diverged out to the farthest measurement distance, with SEL values remaining on average smaller than SPL values. This suggests that, in their dataset, pulse durations did not exceed ~0.9 sec.
- Turner et al. (2006) is a preliminary report on similar measurements in the Chukchi Sea for ConocoPhillips. At ~300 m, SPL and SEL differed by ~10 dB and at 6 km by ~2 dB; this is nearly identical to results of Greene and Burgess (2000) from the Beaufort Sea. Beyond ~10 km in the data of Turner et al., SPL and SEL values were similar.

The results from these studies in the Chukchi and Beaufort seas indicate that the relationship between SPL, SEL, and distance from the sound source is not constant (e.g., see Fig. 4.6 vs. 4.16). It probably depends on the complex interaction between source spectrum and the dispersion characteristics of the propagation environment. A future regulatory focus on SEL rather than SPL would avoid many of the uncertainties involved with pulse durations and their effect on SPL-based safety radii. However, judging from the results of the present study, it will also be important to have an improved way of predicting SEL values for airgun arrays in advance of seismic projects: At least for the Chukchi Sea, the procedure used in 2006 under-predicted the SEL values and associated distances more seriously than it under-predicted the SPL values (Table 4.4).

Effects of M-weighting on Mitigation Results

The results presented in Figure 4.14 make it clear that *M*-weighting, as recommended by Miller et al. (2005) and Southall et al. (submitted), will affect the size of the 180 dB and 190 dB safety radii around an airgun array for certain species of marine mammals.

- For ***baleen whales*** such as bowhead and gray whales, with (presumed) good low-frequency hearing, weighting the received-level data will not change the size of safety radii appreciably. M_{lf}-weighted and unweighted SPL and SEL values are virtually the same (Fig. 4.14).

- For ***pinnipeds*** underwater, the M_{pw}-weighted 190 dB safety radius could shrink to roughly half of its unweighted value. However, the use of a 190- rather than 180-dB safety criterion for seals is at least in part in recognition of their reduced auditory sensitivity to low-frequency sound as compared to baleen whales. If M_{pw}-weighting is to be applied in deriving safety radii for seals, then it may be appropriate to use the M_{pw}-weighted 180 dB (not 190 dB) radius as the safety criterion for seals. The M_{pw}-weighted 180-dB radius is 168% of the unweighted 190-dB radii that are now used as the safety ranges for pinnipeds.

- For ***mid-frequency cetaceans*** such as beluga whales, the M_{mf}-weighted 180 dB safety radius would shrink to a third of its unweighted value.

Most power-downs and shut-downs of airguns during seismic production operations in the Chukchi and Beaufort seas are the result of ringed seal observations by the marine mammal observers (see Chapter 6). Therefore, taking *M*-weighting into account should lead to fewer such interruptions of seismic operations if the safety criterion is the M_{pw}-weighted 190 dB radius. If the safety criterion for seals were defined as the M_{pw}-weighted 180 dB radius, then the number of interruptions would actually increase.

Vessel Sound Measurements

Broadband (10–20,000 Hz) sound levels produced by the *Henry Christoffersen* in the Beaufort Sea were somewhat lower than those produced by the *Gilavar* and *Jim Kilabuk* in the Chukchi Sea. For both the *Gilavar* and *Kilabuk* the highest recorded broadband level was about 145 dB re 1 μPa at distances of ~200–300 m and broadband levels at 1000 m were between 120 and 130 dB. The highest level for the *Henry C.* was 122 dB at ~500 m and the value at 1000 m was ~117 dB re 1 μPa. Figure 3.19 in Greene and Burgess (2000) shows broadband levels as a function of range for four different ships (*Arctic Star, Western Endeavor*, *Saber Tooth,* and *Peregrine*) performing different activities in the Beaufort Sea or recorded over consecutive years. Overall, values for the *Henry Christoffersen* fall in the center of the cloud of points shown in the Greene and Burgess (2000) Figure, and the *Gilavar* and *Kilabuk* fall on the upper edge of that

cloud of points. The small landing craft *Peregrine*, which was also used during the 2006 seismic work described in this report (see Appendix D), was particularly quiet with broadband levels of ~111 dB and 95 dB re 1 μPa at distances of 200 m and 1000 m, respectively.

One noticeable difference between the *Gilavar* and *Kilabuk* data sets is the range at which "background" levels were reached, which was much shorter for the *Kilabuk* (~2 km) than the *Gilavar* (>10 km, see Fig. 4.24–4.26). This was due to different background levels rather than a difference in vessel broadband levels. The difference in background levels did not appear to correlate with changes in sea state; visual observations detected no obvious difference in sea state during the 2.25 hours separating the onset of each vessels' run. During the *Kilabuk* measurements the *Gilavar* was idling 5.6 km from the ASAR locations, whereas during the *Gilavar* measurements the *Kilabuk* was idling 9.3 km from the ASAR locations. However, it is unlikely that the idling *Gilavar* contributed noticeably to the background levels during the *Kilabuk*'s run, since during the zigzag portion of the *Gilavar*'s run, at distances of 0.3–1 km from the ASARs, minimum broadband levels were below "background" levels during the *Kilabuk*'s run (see Fig. 4.24, 16:45–17:30). Another possibility is the presence of another vessel within hearing range during the *Kilabuk*'s run, but we have no information on this possibility. Further spectral analyses would be needed to test these hypotheses.

In the mid-eighties, the *Jim Kilabuk* was named the *Canmar Supplier IV*. Greene (1985, 1987, also presented in Richardson et al. 1995) made recordings of broadband (20–1000 Hz) levels produced by the *Canmar Supplier IV*: ~147 dB at ~200 m, ~135 dB at ~1 km, and ~128 dB at ~10 km. These levels are noticeably higher than the ones presented for the *Kilabuk* in this report, and are also higher than any of the values reported in Figure 3.19 in Greene and Burgess (2000).

SUMMARY

During July through most of September 2006, Shell Offshore Inc. (SOI) conducted 3D/2D seismic surveys in the Chukchi Sea. During August through early October SOI conducted shallow-hazards surveys in the Beaufort Sea. Both types of surveys relied on the generation of underwater acoustic pulses. Greeneridge Sciences, Inc., measured the underwater sound levels produced by the vessels involved, including both seismic and support vessels, and by the acoustic equipment that was used, including airguns and shallow-hazards sources.

Before the onset of field work, JASCO Research Ltd. had estimated, by numerical modeling, the distances from the airgun arrays at which the broadband (rms) received levels would be 190 dB, 180 dB, 170 dB, 160 dB, and 120 dB re 1 μPa. Values measured by Greeneridge were compared to the values that had been predicted by modeling, and were used to recommend updated mitigation radii for use by marine mammal observers on the seismic and shallow hazards ships during data acquisition.

This chapter reports on data collected during two separate field trips involving three different vessels. The seismic ship MV *Gilavar* and the chase vessel MV *Jim Kilabuk* were used in the Chukchi Sea for seismic data acquisition, and the tug and shallow-hazards survey vessel MV *Henry Christoffersen* was used in the Beaufort Sea for acquisition of shallow-hazards data.

Airgun pulses were analyzed at distances of 0.3–34 km in the Chukchi Sea and 0.06–20.5 km in the Beaufort Sea. Logarithmic sound propagation models were fitted to pulse sound pressure levels (SPL), sound exposure levels (SEL), and peak levels. A three-string array (24 airguns totaling 3147 in^3) used in the Chukchi Sea produced the highest values but showed little aspect dependence. A one-string array (8 airguns totaling 1049 in^3) used in the Chukchi Sea showed stronger aspect dependence, with the broadside aspect producing the highest values. Received levels produced by the small airgun array used in the Beaufort Sea

(4 airguns totaling 280 in^3) were generally ~15–30 dB lower (depending on distance from the source) than those in the Chukchi Sea, mainly because the Beaufort Sea array was considerably smaller.

A comparison of empirical vs. modeled SPL values showed that the empirical distances exceeded predicted distances in most (but not all) situations. For the *three-string array,* the E:P (Empirical:Predicted) ratios ranged from 1.2× to 2.0× for the 160 dB, 180 dB, and 190 dB distances, depending on aspect. E:P ratios for the 120 dB distance were higher: 2.6× to 3.2× (considering only bow and stern aspect). For the *single-string array*, E:P ratios were somewhat higher for the 190 dB and 120 dB distances than for the 160–180 dB distances, but in some cases the empirical distances were in fact less than the predicted distances (E:P < 1.0). The E:P ratios for the airgun array used in the Beaufort Sea were in general lower (better) than those obtained in the Chukchi Sea.

A subset of pulses from the Chukchi Sea were *M*-weighted to assess the effect of *M*-weighting on the 190 dB and 180 dB mitigation radii. Three types of *M*-weighting functions were used, those for mid-frequency cetaceans (M_{mf}, e.g. beluga whales), pinnipeds in water (M_{pw}, e.g. ringed seals or walruses), and low-frequency cetaceans (M_{lf}, e.g. bowhead whales). M_{lf}-weighting had virtually no effect on mitigation radii as it barely affected received SPL, SEL, and peak levels. M_{mf}-weighting decreased the 180 dB and 190 dB mitigation radii by about two thirds. M_{pw}-weighting decreased the same mitigation radii by about a half. Since most shut-downs during production are due to the presence of ringed seals, using *M*-weighted data could decrease the number of shut-downs during production if the *M*-weighted 190 dB ratios were used as the safety radius.

Broadband (10–20,000 Hz) levels of vessel sound were analyzed as a function of distance from the sound source. Received levels at 500 m distance were 125–132 dB re 1 μPa for the seismic ship *Gilavar,* and 127–135 dB for the chase vessel *Jim Kilabuk*, depending on aspect (bow, stern, broadside). Both of these ships were recorded in the Chukchi Sea. In the Beaufort Sea, the received broadband level for the tug *Henry Christoffersen* at 500 m distance was ~122 dB re 1 μPa.

ACKNOWLEDGEMENTS

We wish to thank the captains and crews of the *Gilavar*, the *Jim Kilabuk*, and the *Henry Christoffersen* for their support in making these measurements. We could not have obtained any of these data without them. A special thanks to Chris Rollings (chief positioning specialist on the *Gilavar*) for providing the position data for the *Gilavar*. We also thank Michael Schlegel and his team (Geo LLC) for help and advice during the sound measurements from the *Henry C.* Dr. Bill Burgess (Greeneridge Sciences) reviewed the report and provided many useful comments. Dr. Dale Funk and Bob Rodrigues (LGL Alaska) also provided comments on a draft.

ANNEX 4.1: PRELIMINARY MEASUREMENTS OF *GILAVAR* AIRGUN SOUNDS

FIELD REPORT FOR VALIDATION MEASUREMENTS OF SOUNDS PRODUCED BY AIRGUNS ON *M/V GILAVAR* IN THE CHUKCHI SEA ON 21 JULY 2006

Prepared by Susanna B. Blackwell
Greeneridge Sciences, Inc.
120 Tamarack Drive
Aptos CA 95003
(831) 685 2773
susanna@greeneridge.com

Revised 6 August 2006[9]

On 21 July 2006 (at ~10:15 local time) two Autonomous Seafloor Acoustic Recorders model B (ASAR-Bs) were deployed on the seafloor ~200 m apart, close to the location 69º 35.85' N, 166º 0.0'W (water depth = 42 m). The recorders have a maximum recording time of about 13 hours at a 44.1 kHz sampling rate, so to maximize recording time their start times were offset. ASAR #2 started recording at 11:00 and ASAR #1 started recording 6 hours later, at 17:00. Between 11:00 on 21 July and 6:00 on 22 July the *M/V Gilavar* followed a course more than 125 km in length designed to provide information on airgun sounds at various distances (~200 m to nearly 35 km), different aspects (bow, stern, and broadside to the vessel) and for two array configurations (one-string and three-string).

Both ASARs were retrieved at ~6:15 on 22 July and 16 GB of acoustic data were downloaded to a laptop computer. Both recorders performed as expected.

The *Gilavar* provided us with time and location information for most of the airgun pulses produced during the recordings. A total of >700 pulses were individually selected and analyzed from most parts of the acoustic records. Groups of 10 consecutive pulses were analyzed about every 10 minutes from all tracks. All or most pulses were analyzed during the few hundred meters preceding and following the *Gilavar*'s closest point of approach (to the ASARs) during each pass. Each analyzed pulse was matched with the location information provided. Broadband sound pressure levels (SPL), which are equivalent to rms (root mean square) levels as used by NMFS for mitigation purposes, were determined for each analyzed pulse. These SPL values were plotted as a function of distance and a sound propagation equation of the type

$$\boldsymbol{RL} = a - b*\log(R) - c*R \qquad \text{Eq. I}$$

[9] This revision supersedes the draft of 26 July 2006, in which the distance estimates to 190 dB, 180 dB, 170 dB, and 160 dB were based on a simpler and less appropriate regression approach which did not take scattering and absorption losses into account.

was fitted to the data. ***RL*** is the received level and *R* is the distance (m) from the source. Two separate data sets were analyzed:

(1) Full array configuration (3 strings, 3147 in^3) – most of the data obtained were with the full array configuration. Data were split into three categories: (a) bow aspect (bow of ship oriented towards ASARs); (b) stern aspect (stern of ship and thus airgun array oriented towards ASARs) and broadside aspect (side of ship oriented towards ASARs). A separate regression was done for sound pressure level data for each of those three categories.

(2) Reduced configuration (1 string, 1149 in^3) – this configuration was used during a few hours in early morning on 22 July. Data were insufficient to split into the three aspect categories mentioned above, so a sound propagation equation was fitted to all pulses analyzed regardless of their aspect (the vast majority of the pulses belonged to the stern aspect category).

Values of *a* (intercept, see Eq. I), *b*, and *c* for the obtained equations are shown in Table 1. The scatter plots and regressions themselves are shown in Figure 1 for the three categories of data obtained with the three-string array, and in Figure 2 for data obtained with the one-string array. The equations shown in Table 1 were used to calculate the distances to 190 dB, 180 dB, 170 dB, 160 dB, and 120 dB re 1 μPa. These distances are shown in Table 2 for the three-string array and Table 3 for the one-string array. Each table also shows the radii predicted by sound propagation modeling done by JASCO Research Ltd. prior to the start of the field season, and the ratios between the field measurements and the predicted values.

With the full three-string array configuration (Table 2), the "field : predicted" ratios for the 190 dB, 180 dB, 170 dB, and 160 dB ranges are 1.2 to 1.9, with most being below 1.5, i.e. the measured values exceeded the modeled values, but generally by no more than a factor of 1.5x. The "field : predicted" ratios for the distances to the 120 dB level were higher, 2.4x to 3.3x. However, the empirical estimates shown in Table 2 are the result of extrapolations over 30+ km beyond the farthest measurement distances. A certain amount of uncertainty is therefore associated with these distances and the resulting ratios.

TABLE 1. Values for variables *a*, *b*, and *c* (Eq. I) in the regressions (sound propagation equations) fitted to four different data sets: pulses produced with the full array (3 strings), for three different aspects, and pulses produced with the reduced array (1 string). The multiple-*R* value is also shown for each equation as well as the range of distances over which the measurements were made and the sample size (number of pulses analyzed).

	a	*b*	*c*	*R* value	Range of distances (km)	Sample size
Full array						
- bow	248.74	22.02	0.000345	-0.998	0.2–30	193
- stern	248.17	22.66	0.000192	-0.994	0.2–34	153
- broadside	238.12	18.85	0.000436	-0.993	0.5–33	148
Reduced array	255.54	26.55	0.000132	-0.990	0.2–30	239

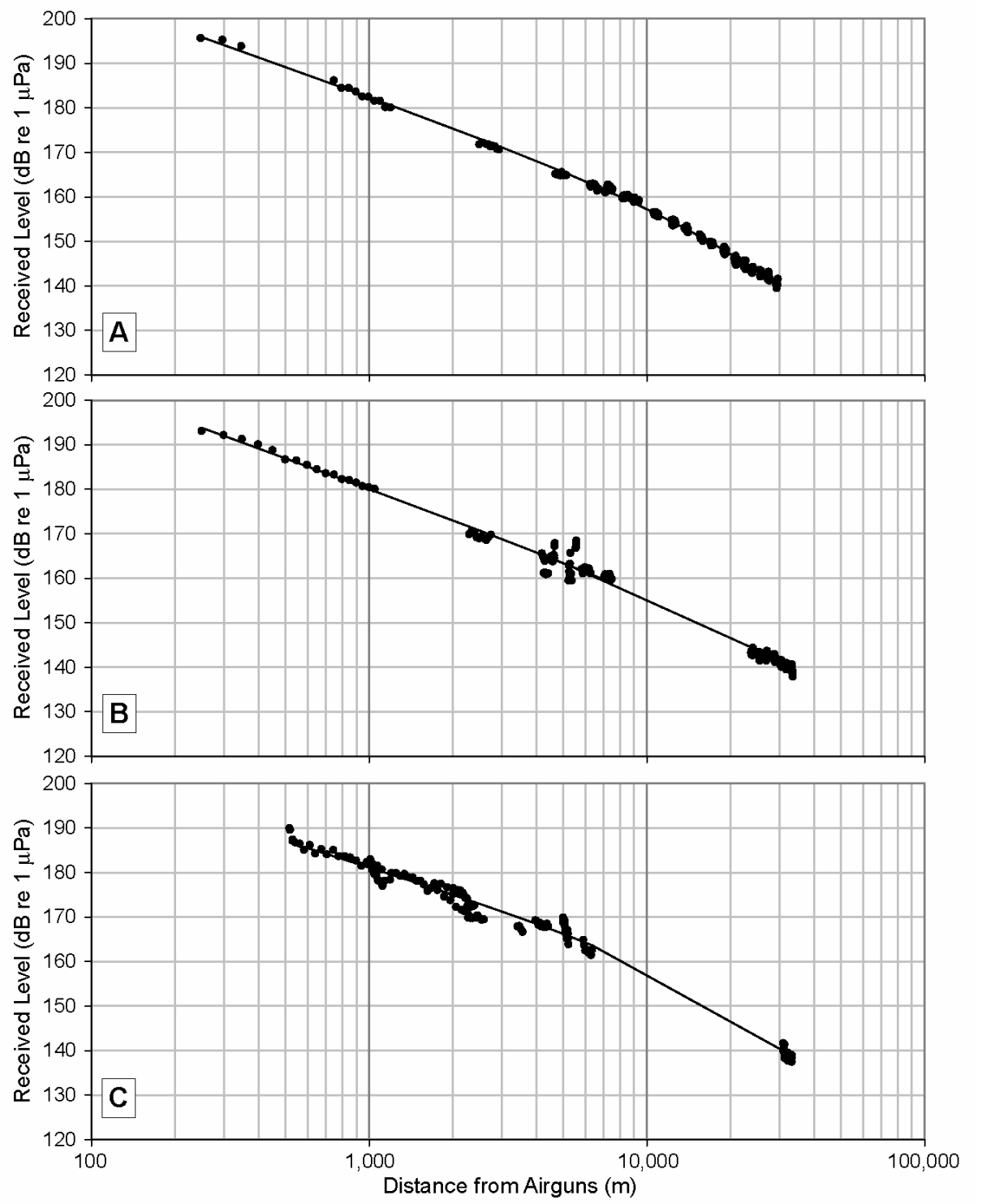

FIGURE 1. SPL values as a function of range for the three-string array. Equations for the lines shown are in Table 1. ***(A)*** Bow aspect; ***(B)*** Stern aspect; ***(C)*** Broadside aspect.

TABLE 2. Distances to specified received SPLs obtained for three-string airgun array, and comparison with modeled values. All distance values are in kilometers. The "field : predicted" ratios were calculated with unrounded distances.

	JASCO predictions	Field measurements			"Field : predicted" ratios		
	C_1, 3147 in^3	Bow	Stern	Broadside	Bow	Stern	Broadside
190 dB	0.23	0.44	0.35	0.33	1.9	1.5	1.4
180 dB	0.81	1.2	0.95	1.1	1.5	1.2	1.3
170 dB	2.19	3.2	2.6	3.3	1.5	1.2	1.5
160 dB	4.53	7.7	6.5	8.4	1.7	1.4	1.9
120 dB	26	65	84	62	2.5	3.3	2.4

TABLE 3. Distances to specified received SPLs obtained for one-string airgun array, and comparison with modeled values. All distance values are in kilometers. The "field : predicted" ratios were calculated with unrounded distances.

	JASCO predictions C_1, 1149 in^3	Field measurements	"Field : predicted" ratios
190 dB	0.26	0.28	1.1
180 dB	0.96	0.67	0.7
170 dB	2.5	1.6	0.6
160 dB	4.7	3.6	0.8
120 dB	35	61	1.7

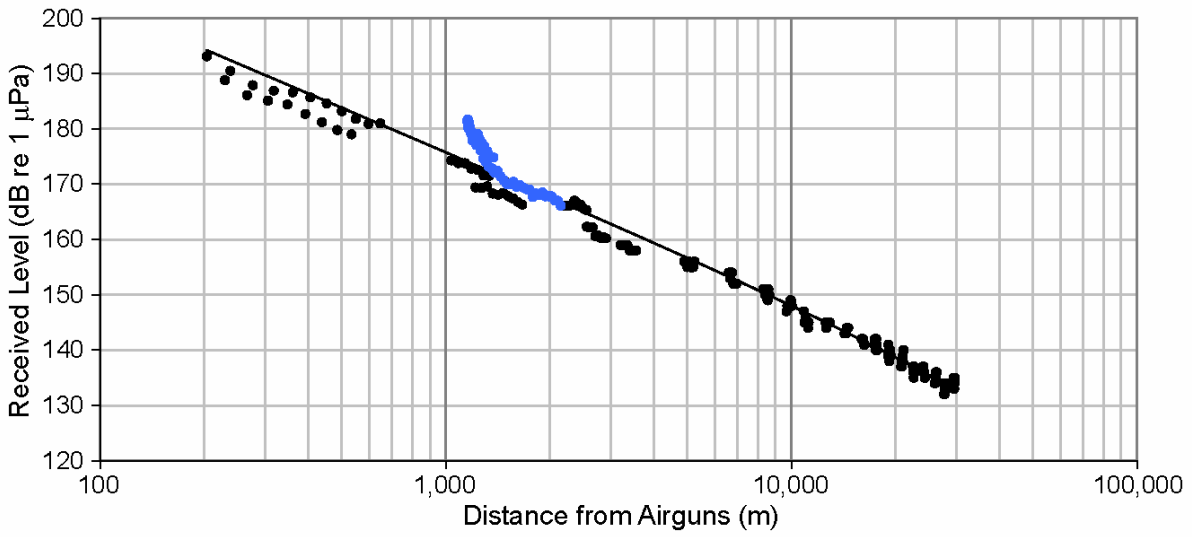

FIGURE 2. SPL values as a function of range for the one-string array. Stern and bow aspect data are shown in black symbols and broadside data are shown in blue symbols. All data were used in calculating the regression. The equation for the line is in Table 1.

There was good agreement between modeled and empirical values for the reduced array configuration (Table 3). The modeled radii for 180 dB, 170 dB, and 160 dB were actually larger than the empirical values, probably because of aspect effects. Most of the empirical data (~85%)

collected with the one-string array fell in the stern aspect category. Broadside data (blue symbols in Fig. 2) were collected during a 2.6 km long southward run ~1.2 km east of the ASARs, with the guns at full volume during the entire run. As the ASARs' latitude was close to the northern end of this run the data became progressively more "stern-like" as the *Gilavar* went south and range increased. For a single-string array aligned parallel to the ship's trackline, we would expect somewhat higher levels at the broadside aspect than from the bow or stern aspects. The empirical data are consistent with this.

Table 4 shows recommended mitigation radii for use by marine mammal observers on the *M/V Gilavar* for both types of arrays. The actual 190 dB, 180 dB, and 160 dB radii will vary depending on aspect (as shown in Table 2) and local conditions. For the ***three-string array*** the maximum of the 3 values (bow, stern, broadside) for each mitigation radius is therefore reasonable as a protective estimate and is shown in Table 4. For the ***one-string array***, the recommended mitigation distance for each criterion is the larger of the empirical or predicted distance (from Table 3). For the one-string array, distances in the cross-track (broadside) direction were not measured. As it is likely that the cross-track distances exceeded those in the along-track direction, the protective approach is to use the predicted distances where these exceed the measured along-track distances.

TABLE 4. Mitigation radii based on empirical data.

	Array size	
	Three-string 3147 in^3	One-string 1149 in^3
190 dB	440 m	280 m
180 dB	1200 m	960 m
160 dB	8.4 km	4.7 km

The actual 120 dB (rms) radius is inevitably more variable than are the radii for the higher received levels, given the longer distances that are involved and the effects of local variations in propagation conditions along those long propagation paths. Also, the necessity to use the fitted regression equations to extrapolate beyond the range of distances with empirical data results in some further uncertainty. Given these considerations, plus the different aspects that were involved, the span of the three estimates for the full 3-string array (62 km to 84 km, Table 2) is relatively narrow.

ANNEX 4.2: PRELIMINARY MEASUREMENTS OF SHALLOW HAZARDS SURVEY SOUNDS

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16 August 2006

To: Shell International Offshore Inc.
Attn: Mark Kosiara and Michael Macrander

From: Charles Greene, Greeneridge Sciences Inc.

Subject: Measurements of the tug propulsion sounds for *M.V. Henry Christoffersen*, 8 August 2006, Field Report #2

Reference: Measurements of the acoustic sources for the shallow hazard survey by *M.V. Henry Christoffersen*, 8 August 2006, Field Report dated 14 August 2006

Dear Mark and Michael:

This letter presents preliminary results of the measurements of received sound levels vs. distance for propulsion sounds from the tug M.V. Henry Christoffersen to the autonomous seafloor acoustic recorders, model B (ASAR-Bs), not including any survey sound sources. The vessel sounds correspond to survey conditions: only two of four engines, both operating at reduced power and at a speed on the order of 4 knots. The water depth at the recorder installation site was about 48 m and diminished to 37 m at the end of the 20 km course. The starting location was about 54 km east of Kaktovik and the course followed was about 280° T.

The sound level measurements were from the periods between survey pulses and hence represent broadband received levels vs. distance for the tug propulsion sounds. The tug has four engines, each driving a propeller lined up from side to side with two on the outside ("outboard") and two in the middle ("inboard"). The tug was operating on its two outboard engines at reduced power and was making a speed of about 4 knots, suitable for a survey.

This letter is intended for readers who are already familiar with the background and objectives for the measurements. Analyses for this report were for the broadband sounds without frequency analysis.

The letter presents the result of fitting an equation of the form

$$RL \text{ (received level in dB re 1 } \mu\text{Pa rms)} = A - B*\log(R) \quad \text{(for R in meters)}$$

to the measurements. The reference report used an equation with a – C*R term to account for absorption and scattering of the survey sound sources, but the range of distances available here (see below) is inadequate for expecting a rational result for such a term. The equation permits calculating the distances to specific broadband received levels like 120 dB re 1 μPa rms.

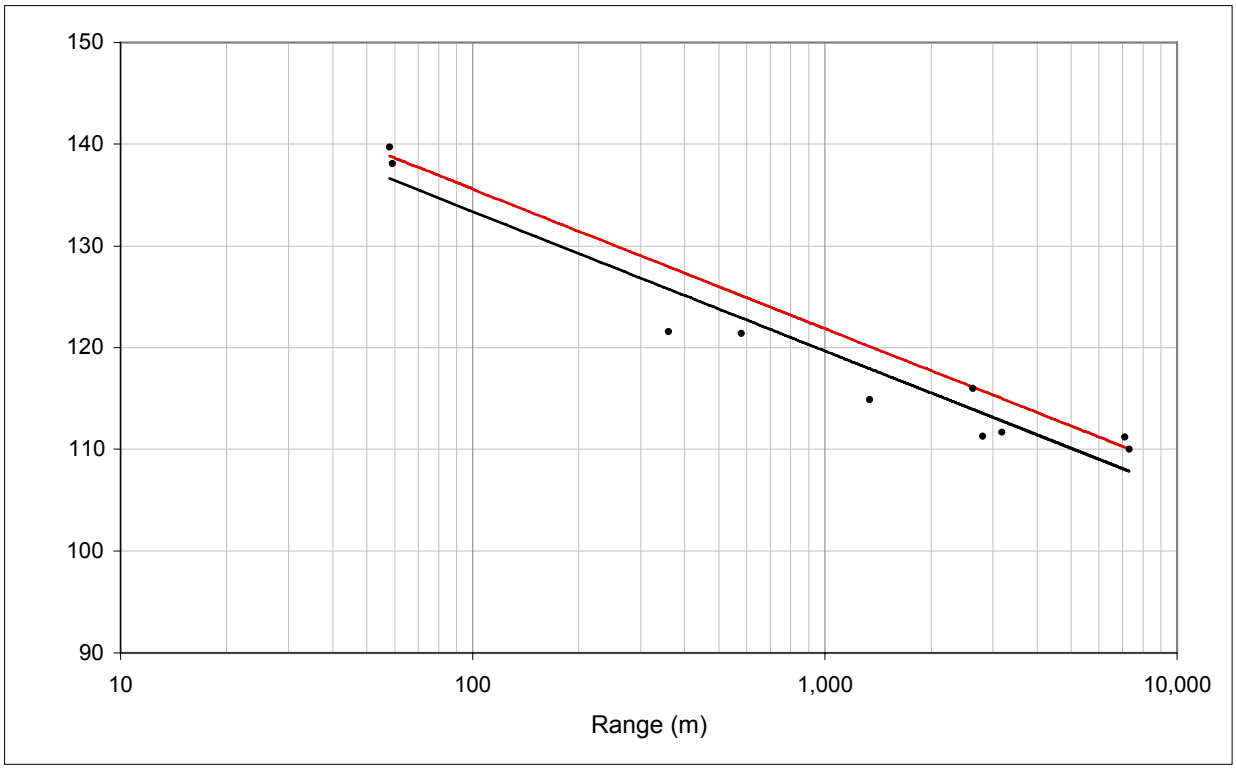
The following Figure shows 10 measured received levels at distances from 58 to 7,320 m. The most distant four measurements, for distances from 12,730 to 20,530 m, were all in the range from 100.1

to 101.4 dB re 1 µPa rms, showing no variation with distance, and are taken to be the background ambient noise level at the measurement site uninfluenced by the tug. They are not plotted. For the 10 remaining values, measured from 58 to 7320 m and resulting in sound pressure levels of 139.7 to 110 dB re 1 µPa rms, the following equation was derived by standard least-squares curve fitting:

RL (received level in dB re 1 µPa rms) = 160.8 – 13.71*log(R) (for R in meters).

The equation results in distances <1 m to 190, 180, and 170 dB and <2 m for the 160 dB received level. The coefficient of determination is 0.9754. The equation results in a distance of 950 m to a received level of 120 dB re 1 µPa rms. This is the distance that would be used in conjunction with an animal density in estimating the number of animals that might have been exposed to a 120-dB sound pressure level.

Because the fitted equation is based on a standard least-squares fit to the measured data, about 50% of the measurements fall above and 50% fall below the fitted curve. Increasing the constant term from 160.8 to 163 results in an equation that exceeds most of the measurement points and predicts a 120 dB (rms) distance of 1370 m. This is the distance beyond which a sound pressure level of 120 dB would not be expected to occur. The following Figure shows the measured data points and the lines corresponding to both the original regression result (lower) and the raised equation (upper).



The 950- and 1370-m distances cited above for the 120 dB contour and monitoring ranges are specifically for the tug operating with survey sources deployed and at slow speed with only two engines each operating at reduced power. For a transiting situation with four engines at normal power and higher speed, longer distances are inevitable. The sound recordings made on 8 August include measurements under those conditions from about 20 km to <100 m but have not been analyzed.

Please call or send email if you have questions about this preliminary material.

Sincerely,

Charles R. Greene
Tel and Fax: 805-967-7720
E-mail: cgreene@greeneridge.com

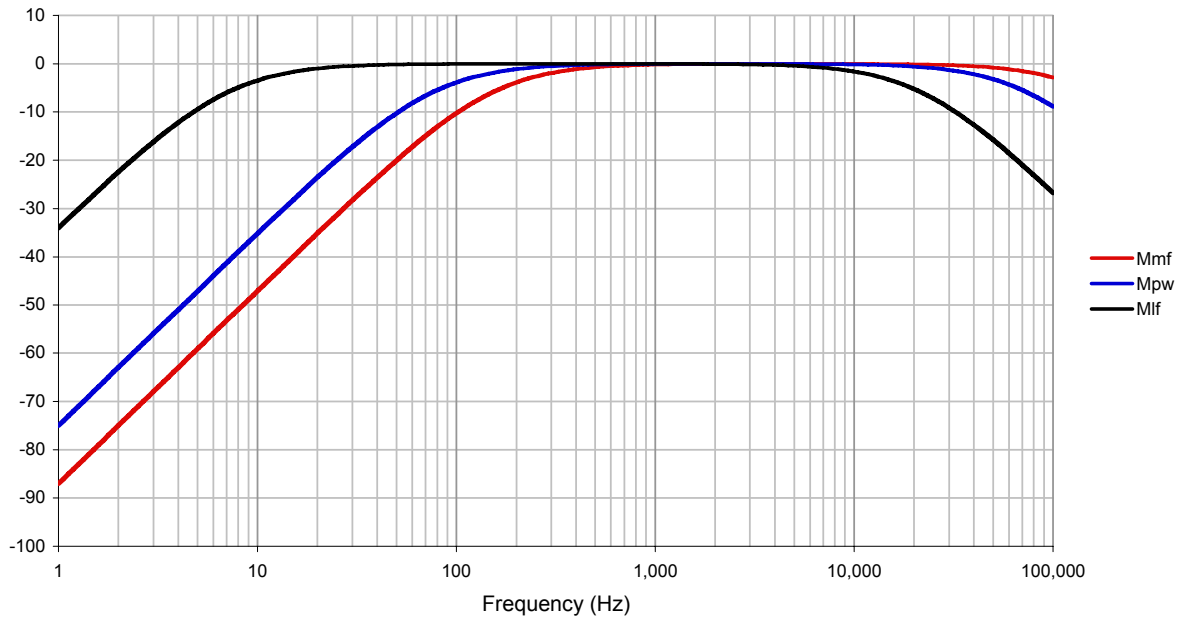
cc: Dale Funk, PhD, LGL Alaska, and W. John Richardson, Ph.D., LGL Ltd.

ANNEX 4.3: M-WEIGHTING FUNCTIONS

M-weighting is a filtering algorithm that de-emphasizes frequencies which an animal of concern cannot hear, or hears only weakly. In this report recordings of airgun sounds collected in the Chukchi Sea on 21 July 2006 were *M*-weighted to show the effect of this filtering on received sound pressure levels (SPL) and sound exposure levels (SEL). These results are presented in Figure 4.14. Three different types of *M*-weighting functions were used, one for mid-frequency cetaceans (which include beluga whales), one for pinnipeds in water (seals and walruses), and one for low-frequency cetaceans (bowhead and gray whales). The different *M*-weighting functions are determined by the variables f_{low} and f_{high}, which are conservative estimates of the lower and upper boundaries of effective hearing for each group. F_{low} and f_{high} take on the following values:

- mid-frequency cetaceans (M_{mf}): f_{low} = 150 Hz, f_{high} = 160 kHz;
- pinnipeds in water (M_{pw}): f_{low} = 75 Hz, f_{high} = 75 kHz;
- low-frequency cetaceans (M_{lf}): f_{low} = 7 Hz, f_{high} = 22 kHz;

The Figure below is a graphic representation of the three *M*-weighting functions described above. In this Figure unweighted data would be plotted as a horizontal line at y = 0. Similarly, frequencies between 1 kHz and 3 kHz are untouched by all three weighting functions. The break frequencies (listed above) are the points at which the frequency response has been de-emphasized by 6 dB.



5. MONITORING AND MITIGATION METHODS [10]

This chapter describes the marine mammal monitoring and mitigation measures implemented for SOI's seismic studies in the Chukchi Sea and Shallow hazards survey work in the Beaufort Sea, addressing the requirements specified in the IHAs (Appendices A and B). The section begins with a brief summary of the monitoring tasks relevant to mitigation for marine mammals. A summary of the mitigation measures required by NMFS and USFWS is then presented. The section ends with a description of the vessel-based and aerial survey monitoring and mitigation methods implemented for these surveys and a description of data analysis methods.

Monitoring Tasks

The main purposes of the vessel-based monitoring program were to ensure that the provisions of the IHAs issued to SOI by NMFS and USFWS were satisfied, effects on marine mammals were minimized, and residual effects on animals were documented. Tasks specific to monitoring are listed below (also see Appendix A):

- Provide qualified MMOs for the source and support vessels throughout the seismic surveys in the Chukchi and Beaufort seas.
- Visually monitor the occurrence and behavior of marine mammals near the airguns when the airguns are operating and during a sample of the times when they are not.
- Visually monitor the occurrence and behavior of marine mammals near support vessels when underway.
- Use support vessels to conduct visual surveys of areas where airgun sound could have received levels ≥160 dB re 1 μPa $_{rms}$.
- Record (insofar as possible) the effects of the airgun operations and the resulting sounds on marine mammals.
- Use the visual monitoring data as a basis for implementing the required mitigation measures.
- Estimate the number of marine mammals potentially exposed to strong airgun sounds.

Safety and Potential Disturbance Radii

Chukchi Sea—Gilavar

Under current NMFS guidelines (e.g., NMFS 2000), "safety radii" for marine mammals around airgun arrays are customarily defined as the distances within which received pulse levels are ≥180 dB re 1 μPa (rms) for cetaceans and ≥190 dB re 1 μPa (rms) for pinnipeds. The ≥190 dB re 1 μPa (rms) guideline was also employed by the USFWS for the animals under its jurisdiction (polar bears and walruses) in its IHA issued to SOI. These safety criteria are based on an assumption that seismic pulses at lower received levels will not injure these animals or impair their hearing abilities, but that higher received levels *might* have some such effects. Marine mammals exposed to ≥160 dB (rms) are assumed by NMFS to be potentially subject to behavioral disturbance. However, for certain groups (dolphins,

[10] Chapter 5 by R. Rodrigues, T.A. Thomas, B. Haley and H. Patterson (LGL).

pinnipeds), available data indicate that disturbance is unlikely to occur unless received levels are higher, perhaps ≥170 dB rms for an average animal.

For the current seismic project there has also been concern that received pulse levels as low as 120 dB (rms) may have the potential to disturb some whales. In 2006, there was a requirement to implement special mitigation measures if specified numbers of bowhead cow/calf pairs might be exposed to ≥120 dB rms or if large groups (≥12 individuals) of bowhead or gray whales might be exposed to ≥160 dB rms (MMS 2006). Monitoring of the 160 and 120 dB zones, which was required in the IHA issued by NMFS, is discussed below in the section on Special Mitigation Measures.

SOI's IHA applications described the anticipated underwater sound field around the planned 3147 in^3 airgun array with guns at a depth of 6 m (20 ft). The anticipated acoustic signature for this array was first computed using GSAP, WesternGeco's in-house signature modeling software, and sound output radii for the array were estimated (Table 5.1A).

Subsequent to submitting its applications, SOI contracted with JASCO Research Ltd. to model sound source characteristics using a different model (see Chapter 3). The JASCO implementation of a parabolic equation model was believed by SOI and NMFS to be superior in these waters because it accounts for effects of bathymetry, water properties, and the geoacoustic properties of seabed layers. The radii predicted by JASCO (Table 5.1B) were based on the worst case model predictions. This model was used by SOI to estimate sound level isopleths and radii for received rms sound levels between 120 and 190 dB. These predicted distances were multiplied by a safety margin of 1.5× to obtain initial protective marine mammal safety radii (based on the 190 and 180 dB rms criteria) as well as estimates of "disturbance radii".

Field measurements of the received airgun sounds as a function of distance and aspect were acquired prior to the beginning of routine seismic data acquisition (Blackwell 2006). In all cases involving the primary airgun array (3 strings; total of 24 airguns), measured radii were greater than modeled radii (Table 5.1C). The empirical measurements of the 180 and 190 dB rms radii, as presented by Blackwell (2006), were adopted as safety radii for the survey.

More extensive analysis of the field measurements was completed after the field season, as described in Chapter 4. Those analyses resulted in some refinements of the various radii (Table 5.1D). The refined values were not available for use by the MMOs in the field. However, the refined estimates have been used in Chapter 6 to estimate the numbers of marine mammals exposed to various sound levels.

Airguns operating underwater do not produce strong sounds in air. Accordingly, no shut downs or power downs were implemented for marine mammals on ice. (In any case, none of the sightings of marine mammals on the ice occurred during periods of airgun operation.)

Beaufort Sea—Henry Christoffersen

Sound levels for the equipment on the *Henry Christoffersen* were also modeled by JASCO (see Chapter 3 and Table 5.2A). The actual underwater sounds were recorded as a function of distance on 8 Aug. 2006 in the Beaufort Sea east of Kaktovik, and Table 5.2B,C shows the preliminary and final results of analyses of those data (from Greene 2006 and Chapter 4, respectively). Measured 190, 180, 170 and 160 dB (rms) distances were greater than corresponding predicted distances (Table 5.2). The measured 120 dB distance was less than the predicted distance. The preliminary measurements of the 190 and 180 dB (rms) radii were applied as the safety radii during seismic operations; the final values were used for the analyses in Chapter 6.

TABLE 5.1. Comparison of various predictions and measurements of the 190, 180, 170, 160 and 120 dB rms distances (in km) for sound pulses from the 3-string airgun array deployed from M/V *Gilavar* in the Chukchi Sea, Alaska, 2006.

Received Level (dB re 1 µPa $_{rms}$)	**A.** Radii based on WesternGeco modeling (SOI 2005a,b)	**B.** Radii based on JASCO modeling (Chapter 3)	**C.** Preliminary Measured Radii (Black-well 2006)	**D.** Final Measured Radii (km) (Chapter 4)
190	.120	0.23	0.44	0.46
180	.225	0.81	1.2	1.40
170	.425	2.19	3.3	4.72
160	.650	4.53	8.4	7.99
120	N/A	26	84[a]	82.89

[a] Broadside- and bow-aspect distances (those most relevant for mitigation) were estimated as 62 and 65 km.

TABLE 5.2. Comparison of various predictions and measurements of the 190, 180, 170, 160 and 120 dB rms distances (in km) for sound pulses from the 4-airgun cluster deployed from M/V *Henry Christoffersen* in the Alaskan Beaufort Sea, 2006.

Received Level (dB re 1 µPa $_{rms}$)	**A.** Radii based on JASCO modeling (Chapter 3)	**B.** Preliminary Measured Radii (Greene 2006)	**C.** Final Measured Radii (km) (Chapter 4)
190	0.02	0.12	0.09
180	0.15	0.33	0.25
170	0.30	0.88	0.68
160	0.99	2.22	1.75
120	35.98	24.5	22.2

Mitigation Measures as Implemented

The primary mitigation measures that were implemented during the seismic activities in the Chukchi and Beaufort seas included ramp up, power down, and shut down of the airguns. These measures are standard procedures during seismic cruises and are described in detail in Appendix E. Mitigation also included those measures specifically identified in the IHAs (Appendices A and B) as indicated below.

Standard Mitigation Measures

Standard mitigation measures implemented during the study included the following:

1. Safety radii implemented for the seismic activities were determined based on the preliminary results of the empirical sound measurement studies reported by Blackwell (2006; Table 5.1C) and by Greene (2006; Table 5.2B).
2. Power-down or shut-down procedures were implemented when a marine mammal was sighted within or approaching the applicable safety radius while the airguns were operating. At SOI's request, power-down and shut-down procedures were implemented for pinnipeds sighted within 600 m and 300 m of the *Gilavar*'s operating airguns (i.e., at distances greater than the 190 dB distance from the 3-string array and from a single airgun). This protective measure was in response to the observation of reactions by seals sighted outside the measured 190 dB radius but within 600 m of the airgun array.

3. A change in vessel course and/or speed alteration was identified as a potential mitigation measure if a marine mammal was detected outside the safety radius and, based on its position and motion relative to the ship track, was judged likely to enter the safety radius. In practice, this measure was not implemented because the Gilavar was unable to maneuver while towing the airguns and streamers.
4. A ramp-up procedure was implemented whenever operation of the airguns was initiated.
5. In order for seismic operations to start up during day or night, the full applicable safety radius must have been visible for at least 30 min.

The specific procedures applied during power downs, shut downs, and ramp ups are described in Appendix E. Briefly, a ***power down*** as implemented aboard the *Gilavar* involved reducing the number of operating airguns from the full array of 24 airguns to either one or two airguns when a marine mammal was observed approaching or was seen within the safety radius. Power down also occurred when the *Gilavar* was between seismic survey lines to reduce the area of ensonification. The 190 and 180 dB radii around the much-reduced source operated during a power down were 230 m and 360 m. A ***shut down*** involved suspending operation of all airguns. A shut down was sometimes implemented when a mammal was first sighted within or approaching its safety radius. At other times the airgun array was first powered down, and was later fully shut down if the mammal approached the safety radius around the small source that operated during power downs. A ***ramp-up*** involved a gradual increase in the number of airguns operating, with the number of operating guns generally being doubled every 5 min until the full array was operating.

Special Mitigation Measures as Required by NMFS

In addition to the standard safety radii based on the 190 and 180 dB (rms) distances for pinnipeds and cetaceans, respectively, NMFS (in the IHA) required SOI to monitor the 160 dB radius during all seismic activities. Also, SOI was required to monitor the 120 dB radius after 1 Sept. in the Beaufort Sea and after 25 Sept. in the Chukchi Sea during periods when seismic surveys were occurring. (In the Chukchi Sea, monitoring of the 120 dB zone would have been necessary at an earlier date if 4 migratory bowhead cow/calf pairs were observed during the vessel-based monitoring, or if bowhead whale hunters had determined that cow/calf pairs were passing Barrow in significant numbers.) None of those special criteria were met, so 25 Sept. was the operative date after which monitoring of the 120 dB zone was required in the Chukchi Sea.)

Depending on the results of the monitoring of the 160 dB or 120 dB zones, special mitigation measures were to be implemented:

1. Power-down or shut-down procedures were to be implemented if groups of 12 or more bowhead or gray whales were within the 160 dB (rms) radius while the airguns were in operation.
2. Power-down or shut-down procedures were to be implemented if 4 or more bowhead cow/calf pairs were within the 120 dB (rms) radius after the specified date.

The 160 dB radius was determined by Blackwell (2006) to extend ~8.4 km from the airgun source on the *Gilavar* and was monitored by MMOs onboard the *Kilabuk*. During monitoring of the 160 dB zone the *Kilabuk* followed a zig-zag pattern ~6–8 km ahead of the *Gilavar* (Fig. 5.1). MMOs onboard the *Kilabuk* searched the area ahead of the *Gilavar* within the 160 dB zone for marine mammals. Mitigation (i.e., power down or shut down of the airgun array) was to be implemented if a group of 12 or more bowhead or gray whales entered the 160 dB zone. However, no large groups of baleen whales were observed within the 160 dB zone and no power downs or shut downs were necessary to meet this IHA requirement.

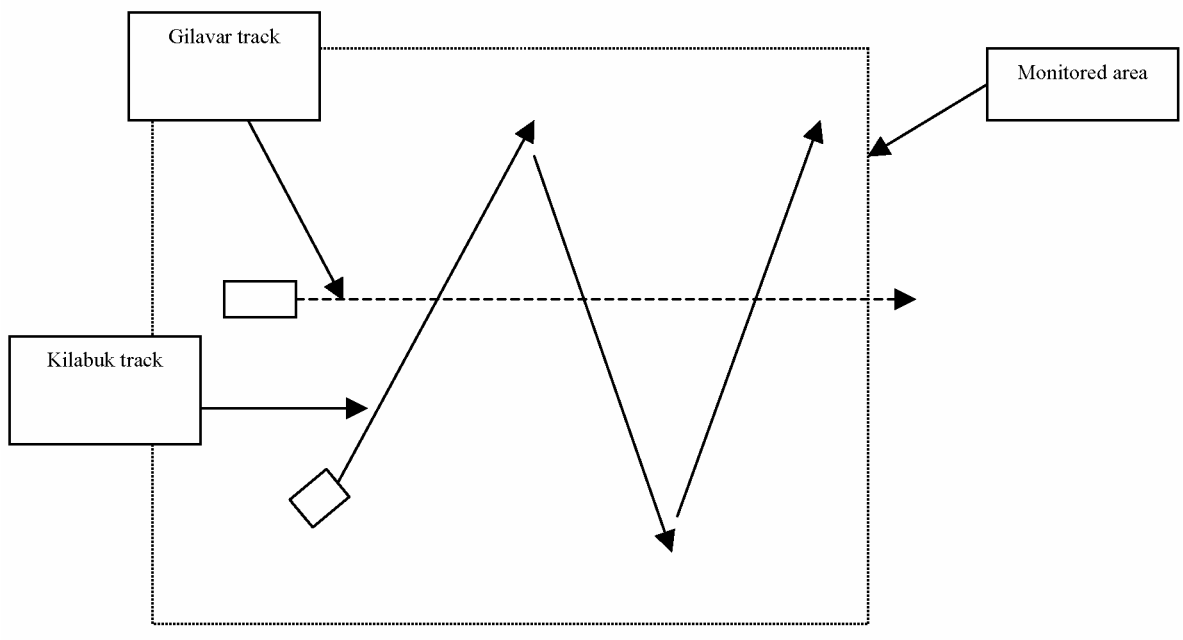


FIGURE 5.1. Diagram of the path of the *Kilabuk* in front of the *Gilavar* during monitoring of the 160 dB zone.

The 120 dB radius was estimated by Blackwell (2006) to extend as much as ~84 km from the *Gilavar,* and the 120 dB mitigation zone covered an area as much as ~22,167 km^2. Monitoring of the 120 dB zone was required at specified times in late summer and autumn due to concerns that seismic noise might disturb bowhead whales, particularly migrating cow/calf pairs, within the 120 dB radius. The IHA allowed for two mechanisms to monitor this large area including (1) the use of survey aircraft to locate cow/calf pairs within the 120 dB radius, and (2) the use of a dedicated passive acoustic monitoring (PAM) system capable of detecting bowhead whale calls within the 120 dB radius. The IHA required that seismic operations be shut down if 4 or more bowhead cow/calf pairs were seen within the 120 dB radius during the aerial monitoring, or if the PAM system detected one or more calling bowhead whales within the 120 dB radius.

In the Chukchi Sea, SOI terminated seismic activities prior to 25 Sept., the date when monitoring of the 120 dB radius was necessary. Therefore, aerial or PAM surveys of the 120 dB zone were not implemented in the Chukchi Sea.

In the Beaufort Sea, 25 Sept. was the one date after 1 Sept. when site clearance activities involving use of airguns were conducted from the *Henry Christoffersen*. An aerial survey was flown on 24 Sept., prior to the beginning of seismic activities, to determine whether bowhead cow/calf pairs were within the 120 dB zone. The aerial survey procedures are described below. No bowhead whales were observed during the survey flight on 24 Sept.

Visual Monitoring Methods

Vessel-Based Monitoring—Chukchi and Beaufort Seas

Visual monitoring methods were designed to meet the requirements identified in the IHAs (see above and Appendices A and B). The primary purposes of MMOs aboard the seismic, shallow hazards, and support vessels were as follows: ***(1)*** Conduct monitoring and implement mitigation measures to

avoid or minimize exposure of cetaceans to airgun sounds with received levels >180 dB re µPa (rms), or of pinnipeds to >190 dB. ***(2)*** Conduct monitoring and implement mitigation measures to avoid or minimize exposure of groups of 12 or more bowhead or gray whales to airgun sounds with received levels >160 dB re µPa (rms). ***(3)*** Document numbers of marine mammals present, any reactions of marine mammals to seismic activities, and whether there was any possible effect on accessibility of marine mammals to subsistence hunters in Alaska. Results of the monitoring effort are presented in Chapter 6.

The visual monitoring methods that were implemented during SOI's seismic exploration were very similar to those used during various previous seismic cruises conducted under IHAs since 2003. The standard visual observation methods are described in Appendix E.

In summary, during the seismic and shallow-hazards surveys in the Chukchi and Beaufort Seas, at least one MMO onboard the source vessel (*Gilavar* or *Henry Christoffersen*) maintained a visual watch for marine mammals during all daylight hours while seismic or shallow-hazards surveys were underway. During the surveys, two visual observer were on duty for 45% of the time watches were conducted on the *Gilavar* and for 2% of the time watches were conducted on the *Henry Christoffersen*. Observers focused their search effort forward of the vessel but also searched aft of the vessel while it was underway. Watches were conducted with the naked eye, Fujinon 7 × 50 reticle binoculars, and Zeiss 20 × 60 binoculars. MMOs instructed seismic operators to power down or shut down the airguns if marine mammals were sighted near or about to enter the appropriate safety radii.

MMOs onboard the *Kilabuk* conducted watches similar to those of MMOs onboard the *Gilavar* and *Henry Christoffersen*. The *Kilabuk* was the chase vessel for the *Gilavar* and generally traveled ~6 to 8 km ahead of the *Gilavar* to monitor the 160 dB radius, which Blackwell (2006) found to extend ~8.4 km from the *Gilavar* sound source. MMOs onboard the *Kilabuk* were thus prepared to notify MMOs onboard the *Gilavar* if groups of bowheads or gray whales (or bowhead cow/calf pairs) were sighted within the 160 dB radius, allowing the *Gilavar* to implement the appropriate mitigation. MMOs aboard the *Gulf Provider* also conducted watches similar to those of MMOs aboard other vessels; these data are not presented in this report but were used in the calculation of densities used to calculate take estimates. Appendix E provides further details regarding visual monitoring methods.

Aerial Surveys—Beaufort Sea

An aerial survey program was conducted in support of the seismic program in the Beaufort Sea during fall of 2006. The objectives of the aerial survey were

- to advise operating vessels as to the presence of marine mammals in the general area of operation;
- to collect and report data on the distribution, numbers, orientation and behavior of marine mammals near the seismic operations with special emphasis on migrating bowhead whales;
- to support regulatory reporting and Inupiat communications related to the estimation of impacts of seismic operations on marine mammals;
- to monitor the accessibility of bowhead whales to Inupiat hunters; and
- to document how far west of seismic activities bowhead whales travel before they return to their normal migration paths, and if possible, to document how far east of seismic operations the deflection begins.

SOI originally intended to conduct aerial surveys in the summer (July to late Aug.) to collect pre-seismic, baseline data although few cetaceans were expected to occur in the project area at that time. Fall

surveys (late Aug. to Oct.) were planned to obtain detailed data (weather permitting) on the occurrence, distribution, and movements of marine mammals, particularly bowhead whales, within about 50 km to the east and 70 km to the west of the primary seismic vessel, and to monitor the 120 dB radius for bowhead whales prior to seismic activities. Logistical problems early in the summer season precluded SOI's ability to conduct summer aerial surveys and the aerial survey program did not begin until 26 Aug.

SOI's seismic source vessel, the *Gilavar*, conducted seismic operations in the Chukchi Sea until late September at which time it was to transit to the Beaufort Sea to continue seismic acquisition within specific lease holdings. However, due to weather and ice conditions, the *Gilavar* terminated its seismic activities in late September and did not conduct deep seismic acquisition in the Beaufort Sea in 2006. SOI's vessel-based activities in the Beaufort Sea were confined to site clearance and shallow hazard surveys in the mid- and eastern Alaskan Beaufort Sea. Consequently, some of the original objectives of the aerial survey program could not be achieved. For example, since the *Gilavar* did not conduct any seismic activities in the Beaufort Sea, it was not possible to document any bowhead deflection away from and subsequent return to their migration path.

Nine aerial surveys were conducted between 26 Aug. and 24 Sept. SOI's only use of airguns in the Beaufort Sea in 2006 occurred on 25 Sept. and was related to site clearance and shallow hazard surveys. Aerial surveys on 23 and 24 Sept. to monitor the 120 dB zone were conducted prior to seismic activities on 25 Sept. Seven other aerial surveys between 26 Aug. and 14 Sept. were conducted to collect data on marine mammal distribution and abundance within the project area prior to any seismic activities. The general location of the aerial surveys and aircraft route are shown on Figure 5.2.

During the aerial surveys 2 primary observers were seated at bubble windows on opposite sides of the aircraft. The two primary observers searched the water visible through the bubble windows with the unaided eye concentrating on the area within 1 km of the aircraft. When a marine mammal was sighted, the observers dictated into a digital recorder the species, number of individuals, size/sex/and age class when determinable, activity, heading, swimming speed category (if traveling), sighting cue, ice conditions (type and percentage), and inclinometer reading. The inclinometer reading was recorded when the animal's location was 90° to the side of the aircraft track, allowing calculation of lateral distance from the aircraft trackline. In addition, each observer recorded the time, sightability (subjectively classified as excellent, good, moderately impaired, seriously impaired or impossible), sea state (Beaufort wind force), ice cover (in 10ths) and sun glare (none, up to 10% glare, 10–30% glare, >30% and <70% glare, and >70% glare) at 2-min intervals along the transect, and at the end of each transect. This provided data in units suitable for statistical summaries and analyses of effects of these variables (and position relative to seismic vessel) on the probability of detecting animals (see Davis et al. 1982; Miller et al. 1999; Thomas et al. 2002).

A third observer's primary duty was to enter data into a laptop computer although this observer also searched for marine mammals during periods when data entry was not necessary. Transect information, sighting locations, and environmental data were entered into a GPS-linked laptop computer by the third observer, and simultaneously recorded on audiotape for backup and validation. At the start of each transect, a designated primary observer recorded the transect start time and position, ceiling height (ft), cloud cover (in 10ths), wind speed (knots), wind direction (°T) and outside air temperature (°C). The laptop computer used Garmin Mapsource (ver 6.9) position logging software. Mapsource automatically stored the time and aircraft position at pre-selected intervals (typically at 6 sec for straight-line transect surveys) to a file as they were obtained. The observer operating the computer recorded a waypoint at the start and end of each transect, at 2-min intervals along the transect line coinciding with the environmental data collected by the primary observers, and when a marine mammal was sighted by any of the observers.

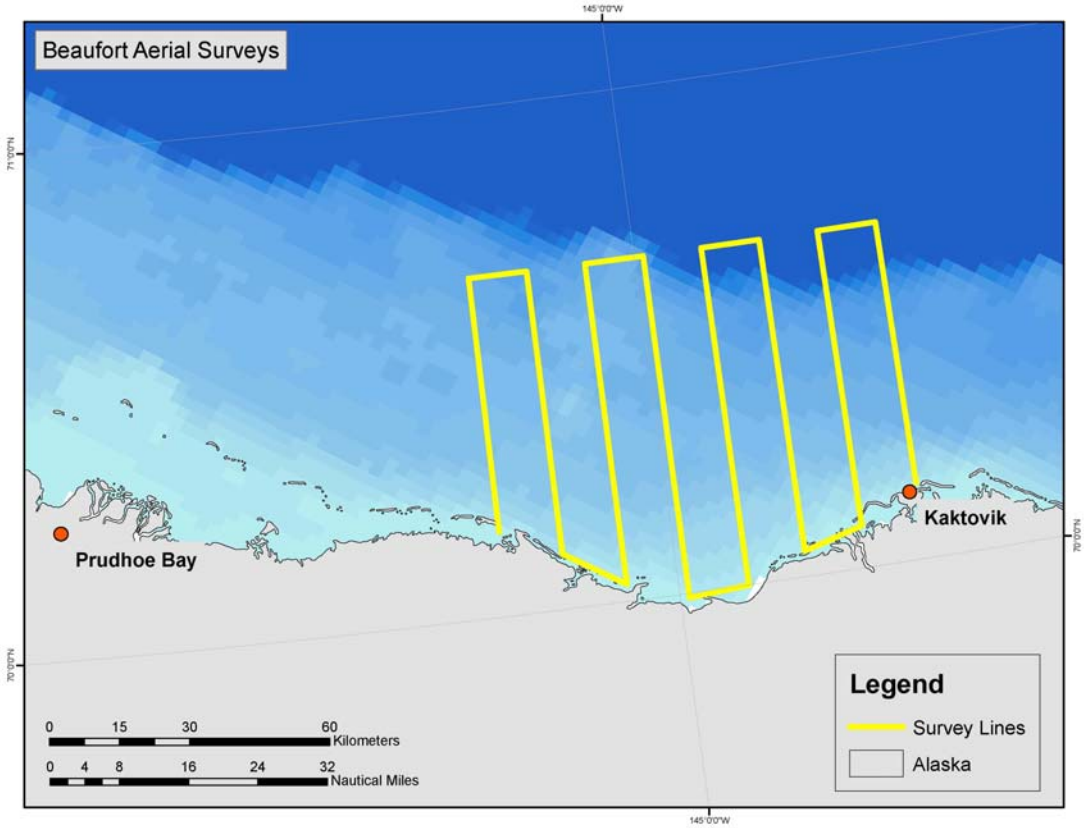


FIGURE 5.2. Approximate locations of transect lines for aerial surveys of marine mammals in Camden Bay, Alaska 2006.

Analyses

Vessel-Based Surveys

Categorization of Data.—Observer effort and marine mammal sightings were divided into several analysis categories related to vessel and seismic activity. The categories were similar to those used during various other recent seismic studies conducted under IHAs (e.g., Haley and Koski 2004; MacLean and Koski 2005; Smultea et al. 2005; Holst et al. 2005a,b; Ireland et al. 2005). These categories are defined briefly below, with a more detailed description provided in Appendix E.

In general, data were categorized as "seismic" or "non-seismic". "Seismic" included all data collected from the source vessel (*Gilavar* or *Henry C.*) while the airguns were operating. Non-seismic included all data obtained before the airguns were activated (pre-seismic) or >1 or >2 h (for pinnipeds and cetaceans, respectively) after the airguns were deactivated. Data collected during post-seismic periods from 3 min to 1 h (for pinnipeds) or 2 h (for cetaceans) after cessation of seismic activity were considered either "recently exposed" (3–30 min) or "potentially exposed" (30 min to 1 or 2 h) to seismic sound levels, and were excluded from analyses. Thus, the post-seismic data (3 min to 1 or 2 h after cessation of seismic) were not included in either the "seismic" or "non-seismic" categories. The 3 min cutpoint was considered appropriate because of the relatively slow speed during seismic operations (~4 kt or 7.4 km/h, average). The 1 and 2 h cutoff periods correspond to the time required to transit to an area in which the received sound level would not be likely to have much (if any) effect on the distributions of pinnipeds and cetaceans, respectively. The chosen sound levels were comparable to those used in other recent seismic

cruises (Haley and Koski 2004; MacLean and Koski 2005; Holst et al. 2005a; Ireland et al. 2005). Periods of time during which other vessels were sighted within 1 km of the *Gilavar* (for pinnipeds) and 5 km of the *Gilavar* (for cetaceans) were also excluded. At the time of publishing it was not possible to calculate the specific distance between the *Kilabuk* and *Gilavar* beyond the usual operating distance of ~3 nm or ~6 km apart. At this distance it is unlikely that the distribution of pinnipeds would have been affected by the seismic noise generated by the *Gilavar*; thus all pinniped sightings from the *Kilabuk* are included as 'non-seismic'. The distance at which the distribution of cetaceans may have been affected by the *Gilavar* was greater; therefore we did not classify cetacean sightings from the *Kilabuk* as either seismic or non-seismic.

This categorization system was designed primarily to distinguish potential differences in behavior and distribution of marine mammals with and without seismic surveys. The rate of recovery toward "normal" during the post-seismic period is uncertain. Marine mammal responses to seismic sound likely diminish with time after the cessation of seismic activity. The end of the post-seismic period was defined as a time long enough after cessation of airgun activity to ensure that any carry-over effects of exposure to sounds from the airguns would have waned to zero or near-zero. The reasoning behind these categories was explained in MacLean and Koski (2005) and Smultea et al. (2005) and is discussed in Appendix E.

Line Transect Estimation of Densities.—Marine mammal sightings during the "seismic" and "non-seismic" periods were used to calculate sighting rates (#/km). Sighting rates were then used to calculate the corresponding densities (#/km^2) of marine mammals near the survey and chase ships during seismic and non-seismic periods. Density calculations were based on line-transect principles (Buckland et al. 2001). Because of assumptions associated with line-transect surveys [sightability, $f(0)$, $g(0)$, etc.], only "useable" effort and sightings were included in density calculations. Effort and sightings were defined as "useable" when made under the following conditions: daylight periods both within the seismic survey area and during transit to and from that area, excluding

- periods 3 min to 1 or 2 h after the airguns were turned off (post-seismic), or
- when ship speed was <3.7 km/h (2 kt), or
- with seriously impaired sightability. (This included all nighttime observations, and daytime periods with one or more of the following: visibility <3.5 km, Beaufort sea state (Bf) >5 (Bf >2 for porpoises), or >60º of severe glare between 90º left and 90º right of the bow.)

When calculating sighting rates and densities in non-seismic periods (for comparison with those in seismic periods), only the observations in the Chukchi Sea were considered, i.e., observations during transit through the Bering Sea were excluded. Pinnipeds hauled out on the ice were encountered in both the Beaufort and Chukchi seas; these sightings were considered "useable" for analyses.

Correction factors for missed animals, i.e., $f(0)$ and $g(0)$, were calculated for gray whales, bowhead whales, unidentified whales, bearded seals, ringed seals, Pacific walruses, unidentified seals, and unidentified pinnipeds (see Appendix E). Other correction factors were taken from other related studies, as summarized by Koski et al. (1998) and Barlow (1999). This was necessary because of the low number of sightings of any individual species, making estimation of $f(0)$ from project specific data problematic, and because of the inability to assess trackline sighting probability, $g(0)$, during a study of this type.

Densities estimated from non-seismic observations were used to estimate the numbers of animals that presumably would have been present in the absence of seismic activities. Densities during seismic periods were used to estimate the numbers of animals present near the seismic operation and exposed to various sound levels. The difference between the two estimates could be taken as an estimate of the number of animals that moved in response to the operating seismic vessel, or that changed their behavior sufficiently to affect their

detectability to visual observers. However, in the case of the *Henry Christoffersen,* because of the very limited duration of airgun operations during this study, the reported densities during seismic periods are not reliable indicators of actual densities during seismic operations. Thus, a comparison of densities observed from the *Henry Christoffersen* during seismic and non-seismic periods is not a valid method for estimating changes in distribution or behavior during this study. Further details on the line transect methodology used during the survey are provided in Appendix D.

Estimating Numbers Potentially Affected.—For purposes of the IHA, NMFS assumes that any marine mammal that might have been exposed to airgun pulses with received sound levels ≥160 dB re 1 µPa (rms) may have been disturbed. When calculating the number of mammals potentially affected, we used the measured 160 dB radii with some adjustments based on JASCO's model for situations where specific measurements were not available (Tables 5.1D, 5.2C).

Two approaches were applied to estimate the numbers of marine mammals that may have been exposed to sound levels ≥160 dB re 1 µPa (rms):

1. Estimates of the numbers of potential *exposures* of marine mammals, and
2. Estimates of the number of different *individual* mammals exposed (one or more times).

The first method ("exposures") involved multiplying the following three values for each airgun configuration in use: (A) km of seismic survey; (B) width of area assumed to be ensonified to ≥160 dB (2 × 160 dB radius); and (C) densities of marine mammals estimated from this study (Appendix I). Thus, areas of water ensonified on more than one occasion, due to overlapping or adjacent tracklines, were counted in the area calculation as many times as they were ensonified.

The second approach ("individuals") involved multiplying the same three values, except that areas ensonified to ≥160 dB on more than one occasion, due to overlapping tracklines, were counted only once. The area of water considered ensonified in this calculation is therefore smaller than in the first calculation. During the Chukchi Sea surveys by the *Gilavar,* many of the tracklines were in close proximity to one another in comparison with the 160 dB distance, leading to much overlap of the areas ensonified to ≥160 dB during transits along the various tracklines. In this situation, the two approaches lead to very different values for the ensonified area, and the estimated number of exposures is much higher than the estimated number of individuals exposed.

The two approaches can be interpreted as providing maximum and minimum (respectively) estimates of the number of marine mammals that would have been exposed to sound levels ≥160 dB re 1 µPa (rms) if they did not show avoidance reactions. The actual number is probably somewhere between these two estimates. This approach was originally developed to estimate numbers of seals potentially affected by seismic surveys in the Alaskan Beaufort Sea conducted under IHAs (Harris et al. 2001). The method has recently been used in estimating numbers of seals and cetaceans potentially affected by other seismic surveys conducted under IHAs (e.g., Haley and Koski 2004; Smultea et al. 2004, 2005; MacLean and Koski 2005; Holst et al. 2005a,b). The methodology is described in detail in these past reports and in Appendix E.

Aerial Surveys

Seismic activities when each aerial survey was flown were determined from data compiled by the marine mammal observers on the seismic source vessels. In 2006, the seismic source vessel (*Henry Christoffersen*) conducted seismic activities on 25 Sept. No aerial surveys were flown on 25 Sept. due to poor weather conditions, but surveys were flown on 23–24 Sept. to monitor the 120 dB zone. Only these

surveys flown on 23–24 Sept. are analyzed in this report. Given the very limited airgun operations in the Beaufort Sea in autumn 2006, there are insufficient 2006 data with which to analyze differences in cetacean distribution with and without seismic activity.

Determination of Estimated Take by Harassment

160 dB Criteria.—NMFS practice in situations with intermittent impulsive sounds like seismic has been to assume that "take by harassment" (Level B) may occur if baleen whales are exposed to received levels of sounds exceeding 160 dB re 1 μPa rms (NMFS 2005b, 2006b). The reaction threshold for most toothed whales is unknown but presumably higher because of their poorer hearing sensitivity at low frequencies (NMFS 2005b; NMFS 2006b; Richardson et al. 1995; Richardson and Würsig 1997). However, the limited empirical data for beluga whales indicate that they may be relatively responsive to airgun sounds as compared with other toothed whales (G. Miller et al. 2005). The monitoring plan for 2006 called for estimates of the numbers of bowhead and beluga whales observed within the 160 dB (and 180 dB) zones, along with other estimates of take described later.

When calculating the number of cetaceans potentially affected, we used the nominal 160 dB (or 180 dB) distances for the situation in which the survey took place (Table 5.1D, 5.2C). As described above, two approaches were applied to estimate the number of exposures of marine mammals to sound levels ≥160 dB re 1 μPa (rms), and the number of different individual marine mammals exposed to such levels. These two approaches can be interpreted as providing maximum and minimum (respectively) estimates of the number of marine mammals that would have been exposed to sound levels ≥160 dB re 1 μPa (rms) if they did not show avoidance reactions.

120 dB Criteria.—Corresponding procedures were used to estimate the numbers of whales that either occurred within or avoided the zones within 24.5 km (Table 5.2B) of the airguns operated by the *Henry C*. The "120 dB criterion" was called for by MMS (2006) and the IHA issued by NMFS because 1996–98 monitoring results showed that most migrating bowheads avoided the areas within 20 km of the operating airgun arrays (Miller et al. 1999; Richardson et al. 1999). During the 1996–98 studies, received levels of airgun pulses at 20 km at times were as low as 120 dB re 1 μPa rms (Burgess and Greene 1999). Shell's IHA (NMFS 2005b, 2006b) required, during operations in the Beaufort Sea after 1 Sept., monitoring areas within the 120 dB distance for bowhead mother/calf pairs.

SOI's seismic operations in the Chukchi Sea terminated on 23 Sept. Because seismic operations in the Chukchi Sea did not occur after 25 Sept., there was no requirement to estimate numbers of cetaceans exposed to ≥120 dB rms in that area.

6. RESULTS OF SHELL'S MARINE MAMMAL MONITORING PROGRAM[11]

INTRODUCTION

This chapter provides background information on the occurrence of marine mammals in the Chukchi and Beaufort Seas, and describes the results of Shell's 2006 marine mammal monitoring program. In addition, the numbers of marine mammals potentially affected during project operations within the two study areas are estimated. The study areas, for the purposes of marine mammal data analyses, were the actual seismic survey areas and transit areas within the Chukchi Sea (see Fig. 2.1, 2.2).

The marine mammals known to occur along the cruise trackline across the Beaufort and Chukchi Seas belong to four taxonomic groups: odontocetes (toothed whales, including the beluga whale), mysticetes (baleen whales), pinnipeds (seals and walruses), and ursids (polar bear). Nine cetacean species and five species of pinnipeds are known to occur along the cruise trackline, along with the polar bear. Of the total 15 species, three (all cetaceans) are listed under the U.S. Endangered Species Act (ESA) as endangered: the bowhead, humpback, and fin whales. Appendix F summarizes the abundance, habitat, and conservation status of the marine mammal species likely to occur in the cruise area.

CHUKCHI SEA MONITORING

Monitoring Effort and Marine Mammal Encounter Results

This section summarizes the visual monitoring effort and sightings from the *Gilavar* and *Kilabuk* during the Chukchi seismic survey from 7 July to 25 Sept. 2006. Summaries of results of visual monitoring are presented here, with more detailed data presented in Appendices G and H, including survey effort in both kilometers and hours. A general summary of effort and sightings is shown in Table 6.1 and Appendix Table G.1. Marine mammals observed during transits outside the study area are summarized in Table G.2.

Seismic survey activities by the *Gilavar* occurred along 9556 km of trackline over a total of 1092 h (Fig. 2.1; Table G.1). In total, 27,585 km and 2788 h of visual observations were conducted within the Chukchi Sea study area, including 13,527 km and 1537 h of observation from the *Gilavar* and 14,058 km and 1251 h from the chase vessel *Kilabuk*. "Useable" survey conditions occurred during 52% (in km; 49% in h) of the total visual effort (Table G.1). "Useable" effort excluded periods 3 min to 1 h (for pinnipeds) or 2 h (for cetaceans) after the airguns were turned off, poor visibility conditions (visibility <3.5 km or extensive glare), and Bf >5. Periods of time during which other vessels were sighted within 1 km of the *Gilavar* (for pinnipeds) and 5 km of the *Gilavar* (for cetaceans) were also excluded. At the time of publishing it was not possible to calculate the specific distance between the *Kilabuk* and *Gilavar* beyond the usual operating distance of ~3 nm or ~6 km apart. At this distance it is unlikely that the distribution of pinnipeds would have been affected by the seismic noise generated by the *Gilavar*; thus all pinniped sightings from the *Kilabuk* are included as 'non-seismic'. The distance at which the distribution of cetaceans may have been affected by the *Gilavar* was greater; therefore we did not classify cetacean sightings from the *Kilabuk* as either seismic or non-seismic. As such, cetacean sightings from the *Kilabuk* are described but *not* included in any analyses

[11] By Heather Patterson, Tannis Thomas, Andrea Hunter, Meaghan Jankowski, Beth Haley, and Ross Harris (LGL).

TABLE 6.1. Detection rates for sightings from the Gilavar (10 Jul.−23 Sept. 2006) and Kilabuk (10 Jul.−4 Oct. 2006) during the Chukchi Sea cruise.

	Non-Seismic			Post-Seismic			Seismic			*Total*		
Effort Type	No. of Detections	Effort (km)	Detection Rate (No./1000 km)	No. of Detections	Effort (km)	Detection Rate (No./1000 km)	No. of Detections	Effort (km)	Detection Rate (No./1000 km)	No. of Detections	Effort (km)	Detection Rate (No./1000 km)
A. Gilavar												
Useable[a]												
Cetaceans	52	1677	31.0	N/A	N/A	N/A	1	2537	0.4	**53**	**4214**	**12.6**
Pinnipeds in water	64	1677	38.2	N/A	N/A	N/A	60	2537	23.6	***124***	***4214***	***29.4***
Pacific Walrus in water	8	1677	4.8	N/A	N/A	N/A	1	2537	0.4	***9***	***4214***	***2.1***
Pinnipeds on ice	13	1677	7.8	N/A	N/A	N/A	0	2537	0.0	***13***	***4214***	***3.1***
Pacific Walrus on ice	3	1677	1.8	N/A	N/A	N/A	0	2537	0.0	***3***	***4214***	***0.7***
Total All Pinnipeds	*77*	*1677*	*45.9*	*N/A*	*N/A*	*N/A*	*60*	*2537*	*23.6*	**137**	**4214**	**32.5**
Total Unidentified Pinnipeds	*8*	*1677*	*4.8*	*N/A*	*N/A*	*N/A*	*2*	*2537*	*0.8*	***10***	***4214***	**2.4**
Total All Pacific Walrus	*11*	*1677*	*6.6*	*N/A*	*N/A*	*N/A*	*1*	*2537*	*0.4*	***12***	***4214***	***2.8***
Total Seals	*58*	*1677*	*34.6*	*N/A*	*N/A*	*N/A*	*57*	*2537*	*22.5*	***115***	***4214***	***27.3***
Non-Useable[b]												
Cetaceans	20	2197	9.1	3	97	30.9	4	7019	0.6	**27**	**9313**	***2.9***
Pinnipeds in water	9	2225	4.0	19	69	275.4	37	7019	5.3	***65***	***9313***	***7.0***
Pacific Walrus in water	2	2225	0.9	1	69	14.5	1	7019	0.1	***4***	***9313***	***0.4***
Pinnipeds on ice	2	2225	0.9	0	69	0.0	0	7019	0.0	***2***	***9313***	***0.2***
Pacific Walrus on ice	0	2225	0.0	0	69	0.0	0	7019	0.0	***0***	***9313***	***0.0***
Total All Pinnipeds	*11*	*2225*	*4.9*	*19*	*69*	*275.4*	*37*	*7019*	*5.3*	**67**	**9313**	***7.2***
Total Unidentified Pinnipeds	*1*	*2225*	*0.4*	*0*	*69*	*0.0*	*2*	*7019*	*0.3*	***3***	***9313***	***0.3***
Total All Pacific Walrus	*2*	*2225*	*0.9*	*1*	*69*	*14.5*	*1*	*7019*	*0.1*	***4***	***9313***	***0.4***
Total Seals	*12*	*2225*	*5.4*	*18*	*69*	*260.9*	*30*	*7019*	*4.3*	***60***	***9313***	***6.4***
***Gilavar* Totals**												
Cetaceans	***72***	***3874***	***18.6***	***3***	***97***	***30.9***	***5***	***9556***	***0.5***	**80**	**13527**	**5.9**
Pinnipeds	***88***	***3902***	***22.6***	***19***	***69***	***275.4***	***97***	***9556***	***10.2***	**204**	**13527**	**15.1**
Unidentified Pinnipeds	*9*	*3902*	*2.3*	*0*	*69*	*0.0*	*4*	*9556*	*0.4*	13	13527	1.0
Pacific Walrus	*13*	*3902*	*3.3*	*1*	*69*	*14.5*	*2*	*9556*	*0.2*	16	13527	1.2
Seals	*70*	*3902*	*17.9*	*18*	*69*	*260.9*	*87*	*9556*	*9.1*	175	13527	12.9
B. Kilabuk												
Useable[a]												
Pinnipeds in water	114	10220	11.2	N/A	N/A	N/A	N/A	N/A	N/A	***114***	***10220***	***11.2***
Pacific Walrus in water	9	10220	0.9	N/A	N/A	N/A	N/A	N/A	N/A	***9***	***10220***	***0.9***
Pinnipeds on ice	7	10220	0.7	N/A	N/A	N/A	N/A	N/A	N/A	***7***	***10220***	***0.7***
Pacific Walrus on ice	3	10220	0.3	N/A	N/A	N/A	N/A	N/A	N/A	***3***	***10220***	***0.3***
Total All Pinnipeds	*121*	*10220*	*11.8*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	**121**	**10220**	***11.8***
Total Unidentified Pinnipeds	*0*	*10220*	*0.0*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	***0***	***10220***	***0.0***
Total All Pacific Walrus	*12*	*10220*	*1.2*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	***12***	***10220***	***1.2***
Total Seals	*109*	*10220*	*10.7*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	***109***	***10220***	***10.7***
Non-Useable[b]												
Pinnipeds in water	39	3838	10.2	N/A	N/A	N/A	N/A	N/A	N/A	***39***	***3838***	***10.2***
Pacific Walrus in water	8	3838	2.1	N/A	N/A	N/A	N/A	N/A	N/A	***8***	***3838***	***2.1***
Pinnipeds on ice	1	3838	0.3	N/A	N/A	N/A	N/A	N/A	N/A	***1***	***3838***	***0.3***
Pacific Walrus on ice	0	3838	0.0	N/A	N/A	N/A	N/A	N/A	N/A	***0***	***3838***	***0.0***
Total All Pinnipeds	*40*	*3838*	*10.4*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	**40**	**3838**	***10.4***
Total Unidentified Pinnipeds	*0*	*3838*	*0.0*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	***0***	***3838***	***0.0***
Total All Pacific Walrus	*8*	*3838*	*2.1*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	***8***	***3838***	***2.1***
Total Seals	*32*	*3838*	*8.3*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	***32***	***3838***	***8.3***
***Kilabuk* Totals**												
Pinnipeds	***161***	***14058***	***11.5***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	**161**	**14058**	**11.5**
Unidentified Pinnipeds	*0*	*14058*	*0.0*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	0	14058	0.0
Pacific Walrus	*20*	*14058*	*1.4*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	20	14058	1.4
Seals	*141*	*14058*	*10.0*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	141	14058	10.0
Overall Totals for Both Vessels												
Cetaceans	**72**	**3874**	**18.6**	**3**	**97**	**30.9**	**5**	**9556**	**0.5**	**80**	**13527**	**5.9**
Pinnipeds	**249**	**17960**	**13.9**	**19**	**69**	**275.4**	**97**	**9556**	**10.2**	**365**	**27585**	**13.2**
Unidentified Pinnipeds	9	17960	0.5	0	69	0.0	4	9556	0.4	13	27585	0.5
Pacific Walrus	33	17960	1.8	1	69	14.5	2	9556	0.2	36	27585	1.3
Seals	211	17960	11.7	18	69	260.9	87	9556	9.1	316	27585	11.5

Note: N/A means not applicable.

[a] Useable sightings are those made during useable daylight periods of visual observation, as defined in *Acronyms and Abbreviations*.

[b] Includes the "Post-Seismic" category.

or calculations. The project provided data on the summer occurrence, distribution, and abundance of marine mammals in the Chukchi Sea, an area where few systematic survey data had been collected previously.

Visual Survey Effort

Survey effort from the *Gilavar* and *Kilabuk,* in km and h, subdivided by seismic activity and Beaufort wind force, is summarized in Table G.1.

Gilavar.—During 13,527 km of *Gilavar* observations during the cruise, 4214 km of useable visual observations were made (Table G.1). MMOs observed almost exclusively from the bridge (99% of watch time, eye-height 10.8 m), with the remaining observations conducted from the flying bridge or stern (0.5% each). Of the 1537 h and 13,527 km of visual observation effort, 18 h and 156 km occurred during nighttime ramp up and the preceding half hour before the airguns were on. One observer was on visual watch aboard the *Gilavar* during 901 h (8626 km), with at least two observers on watch during the remaining 731 h (6636 km).

Kilabuk.—Within the Chukchi Sea, the MMOs aboard the *Kilabuk* observed over a distance of 14,058 km, with useable visual observations occurring during 13,377 km (Table G.1). Useable survey effort is shown in Table G.1. All visual observations from the *Kilabuk* were made from the bridge and during daytime. One observer was on visual watch aboard the *Kilabuk* during 1313 h (15,381 km), with at least two observers on watch during the remaining 28 h (497 km).

Beaufort Wind Force (sea state) during observations aboard the *Gilavar* and *Kilabuk* ranged from 0 to 8 within the Chukchi Sea, with 0.6% (in h) of the observation effort during conditions of Bf = 0 (Table G.1). The majority (65%) of the 2788 h of observation effort occurred with Beaufort Force 3 to 5 (wind speed 7–21 kt or 13–39 km/h). This is typical for the summer in the study region (Pilot Chart, date unkn.).

Visual Sightings of Marine Mammals and Other Vessels

Numbers of Marine Mammals Seen.—An estimated 674 individual marine mammals were seen in 480 groups through the Chukchi sea study area (Table 6.2). Twelve different marine mammal species were identified, with the gray whale being the most commonly identified (n = 117 individuals in 53 groups), followed by Pacific walruses (n = 104 in 36 groups; Table 6.3). In addition, 13 groups (34 individuals) of bowhead whales, 5 groups (5 individuals) of minke whales, and 10 groups (12 individuals) of bearded seals were identified. Of the 51 seals identified in the study area, 28 (or 55%) were ringed seals. Other seal species that were identified were spotted seals (20 individuals), bearded seals (15) and ribbon seal (1). There were many sightings of unidentified seals (n = 273 individuals in 258 groups); most of these were likely ringed seals, given the visual monitoring results and the known occurrence of this species throughout the study area.

The number of cetacean groups seen from the *Kilabuk* (n = 35) was less than half the number seen from the *Gilavar* (n = 80; see Tables ES.1 and 6.3. Pinniped sightings from the *Gilavar* were also more numerous than from the *Kilabuk* (n= 204 and 161, respectively), with 16 and 20 of these sightings being confirmed as Pacific walruses. A detailed list of sightings is provided in Table G.3.

Most of the 480 sightings (65% or 311 groups) made within the study area were "useable" (Table 6.2, 6.3). These "useable" sightings, along with the corresponding effort data, are the basis for the ensuing analyses comparing sighting rates and behaviors of marine mammals during seismic and non-seismic periods.

No deaths or injury of animals was observed during the seismic program. Numerous carcasses of whales, seals, and walruses were sighted; these are included in the summary of marine mammal sightings

TABLE 6.2. Numbers of sightings and of individual marine mammals, both (A) total, and (B) useable[a], observed in the study area from the Gilavar (10 Jul.−23 Sept. 2006) and from the Kilabuk (10 Jul.−4 Oct. 2006), during the Chukchi Sea cruise.

	Kilabuk		*Gilavar*								*Total*	
	Non-Seismic		Non-Seismic		Post-Seismic		Seismic		*Gilavar Total*			
Species	**Sightings**	**Indiv.**	**Sightings**	**Indiv.**	**Sightings**	**Indiv.**	**Sightings**	**Indiv.**	**Sightings**	**Indiv.**	**Sightings**	**Indiv.**
A. All Sightings												
Cetaceans												
Unidentified Whale	4	4	17	23	0	0	2	2	*19*	*25*	***23***	***29***
Odontocetes												
Beluga Whale	0	0	0	0	0	0	1	1	*1*	*1*	***1***	***1***
Harbor Porpoise	2	3	5	8	3	7	1	1	*9*	*16*	***11***	***19***
Mysticetes												
Bowhead Whale	8	24	5	10	0	0	0	0	*5*	*10*	***13***	***34***
Fin Whale	0	0	1	3	0	0	0	0	*1*	*3*	***1***	***3***
Gray Whale	13	47	40	70	0	0	0	0	*40*	*70*	***53***	***117***
Humpback Whale	1	1	0	0	0	0	0	0	*0*	*0*	***1***	***1***
Minke Whale	0	0	4	4	0	0	1	1	*5*	*5*	***5***	***5***
Unidentified Mysticete Whale	7	10	0	0	0	0	0	0	*0*	*0*	***7***	***10***
Total Cetaceans	***35***	***89***	***72***	***118***	***3***	***7***	***5***	***5***	***80***	***130***	115	219
Pinnipeds in Water												
Unidentified Pinniped	0	0	8	9	0	0	4	4	*12*	*13*	***12***	***13***
Odobenids												
Pacific Walrus	17	28	10	14	1	2	2	2	*13*	*18*	***30***	***46***
Phocids												
Bearded Seal	0	0	4	6	4	4	2	2	*10*	*12*	***10***	***12***
Ringed Seal	9	9	6	6	2	2	8	9	*16*	*17*	***25***	***26***
Spotted Seal	3	3	3	5	1	1	11	11	*15*	*17*	***18***	***20***
Unidentified Seal	124	132	42	46	11	11	70	71	*123*	*128*	***247***	***260***
Pinnipeds on Ice												
Unidentified Pinniped	0	0	1	1	0	0	0	0	*1*	*1*	***1***	***1***
Odobenids												
Pacific Walrus	3	23	3	35	0	0	0	0	*3*	*35*	***6***	***58***
Phocids												
Ribbon Seal	0	0	1	1	0	0	0	0	*1*	*1*	***1***	***1***
Ringed Seal	0	0	1	2	0	0	0	0	*1*	*2*	***1***	***2***
Spotted Seal	0	0	3	3	0	0	0	0	*3*	*3*	***3***	***3***
Unidentified Seal	5	6	6	7	0	0	0	0	*6*	*7*	***11***	***13***
Total Pinnipeds	***161***	***201***	***88***	***135***	***19***	***20***	***97***	***99***	***204***	***254***	365	455
Total Unidentified Pinnipeds	*0*	*0*	*9*	*10*	*0*	*0*	*4*	*4*	*13*	*14*	***13***	***14***
Total Pacific Walrus	*20*	*51*	*13*	*49*	*1*	*2*	*2*	*2*	*16*	*53*	***36***	***104***
Total Seals	*141*	*150*	*66*	*76*	*18*	*18*	*91*	*93*	*175*	*187*	***316***	***337***
B. Useable[a] Sightings												
Cetaceans												
Unidentified Whale	N/A	N/A	7	10	0	0	0	0	*7*	*10*	***7***	***10***
Odontocetes												
Harbor Porpoise	N/A	N/A	4	7	0	0	1	1	*5*	*8*	***5***	***8***
Mysticetes												
Bowhead Whale	N/A	N/A	5	10	0	0	0	0	*5*	*10*	***5***	***10***
Fin Whale	N/A	N/A	1	3	0	0	0	0	*1*	*3*	***1***	***3***
Gray Whale	N/A	N/A	31	60	0	0	0	0	*31*	*60*	***31***	***60***
Humpback Whale	N/A	N/A	0	0	0	0	0	0	*0*	*0*	***0***	***0***
Minke Whale	N/A	N/A	4	4	0	0	0	0	*4*	*4*	***4***	***4***
Unidentified Mysticete Whale	N/A	N/A	0	0	0	0	0	0	*0*	*0*	***0***	***0***
Total Cetaceans	***N/A***	***N/A***	***52***	***94***	***0***	***0***	***1***	***1***	***53***	***95***	53	95
Pinnipeds in Water												
Unidentified Pinniped	0	0	7	8	0	0	2	2	*9*	*10*	***9***	***10***
Odobenids												
Pacific Walrus	9	17	8	11	0	0	1	1	*9*	*12*	***18***	***29***
Phocids												
Bearded Seal	0	0	4	6	0	0	0	0	*4*	*6*	***4***	***6***
Ringed Seal	9	9	5	5	0	0	5	6	*10*	*11*	***19***	***20***
Spotted Seal	3	3	2	2	0	0	8	8	*10*	*10*	***13***	***13***
Unidentified Seal	93	101	38	41	0	0	44	45	*82*	*86*	***175***	***187***
Pinnipeds on Ice												
Unidentified Pinniped	0	0	1	1	0	0	0	0	*1*	*1*	***1***	***1***
Odobenids												
Pacific Walrus	3	23	3	35	0	0	0	0	*3*	*35*	***6***	***58***
Phocids												
Ribbon Seal	0	0	1	1	0	0	0	0	*1*	*1*	***1***	***1***
Ringed Seal	0	0	1	2	0	0	0	0	*1*	*2*	***1***	***2***
Spotted Seal	0	0	3	3	0	0	0	0	*3*	*3*	***3***	***3***
Unidentified Seal	4	5	4	5	0	0	0	0	*4*	*5*	***8***	***10***
Total Pinnipeds	***121***	***158***	***77***	***120***	***0***	***0***	***60***	***62***	***137***	***182***	258	340
Total Unidentified Pinnipeds	*0*	*0*	*8*	*9*	*0*	*0*	*2*	*2*	*10*	*11*	***10***	***11***
Total Pacific Walrus	*12*	*40*	*11*	*46*	*0*	*0*	*1*	*1*	*12*	*47*	***24***	***87***
Total Seals	*109*	*118*	*58*	*65*	*0*	*0*	*57*	*59*	*115*	*124*	***224***	***242***

Note: N/A means not applicable.

[a] Useable sightings are those made during useable daylight periods of visual observation, as defined in *Acronyms and Abbreviations*.

TABLE 6.3. Number of marine mammal sightings from the Gilavar (10 Jul.−23 Sept. 2006) and Kilabuk (10 Jul.−4 Oct. 2006) during the Chukchi Sea cruise, and number that were "useable" in analyses[a]. Numbers in parentheses are numbers of individuals.

	Gilavar **Sightings (Individuals)**		***Kilabuk*** **Sightings (Individuals)**		***Total*** **Sightings (Individuals)**	
Species	**All**	**Useable[a]**	**All**	**Useable[a]**	**All**	**Useable[a]**
Cetaceans						
Unidentified Whale	19 (25)	7 (10)	4 (4)	N/A	***23 (29)***	***7 (10)***
Beluga Whale	1 (1)	0	0	N/A	***1 (1)***	***0***
Harbor Porpoise	9 (16)	5 (8)	2 (3)	N/A	***11 (19)***	***5 (8)***
Bowhead Whale	5 (10)	5 (10)	8 (24)	N/A	***13 (34)***	***5 (10)***
Fin Whale	1 (3)	1 (3)	0	N/A	***1 (3)***	***1 (3)***
Gray Whale	40 (70)	31 (60)	13 (47)	N/A	***53 (117)***	***31 (60)***
Humpback Whale	0	0	1 (1)	N/A	***1 (1)***	***0***
Minke Whale	5 (5)	4 (4)	0	N/A	***5 (5)***	***4 (4)***
Unidentified Mysticete Whale	0	0	7 (10)	N/A	***7 (10)***	***0***
Total Cetaceans	***80 (130)***	***53 (95)***	***35 (89)***	***N/A***	**115 (219)**	**53 (95)**
Pinnipeds						
Unidentified Pinniped	13 (14)	10 (11)	0	0	***13 (14)***	***10 (11)***
Pacific Walrus	16 (53)	12 (47)	20 (51)	12 (40)	***36 (104)***	***24 (87)***
Bearded Seal	10 (12)	4 (6)	0	0	***10 (12)***	***4 (6)***
Ringed Seal	17 (19)	11 (13)	9 (9)	9 (9)	***26 (28)***	***20 (22)***
Ribbon Seal	1 (1)	1 (1)	0	0	***1 (1)***	***1 (1)***
Spotted Seal	18 (20)	13 (13)	3 (3)	3 (3)	***21 (23)***	***16 (16)***
Unidentified Seal	129 (135)	86 (91)	129 (138)	97 (106)	***258 (273)***	***183 (197)***
Total Pinnipeds	***204 (254)***	***137 (182)***	***161 (201)***	***121 (158)***	**365 (455)**	**258 (340)**
Total Seals	*175 (187)*	*115 (124)*	*141 (150)*	*109 (118)*	*316 (337)*	*224 (242)*
Total Marine Mammals	***284 (384)***	***190 (277)***	***196 (290)***	***121 (158)***	**480 (674)**	**311 (435)**

Note: N/A means not applicable.

[a] Useable sightings are those made during useable daylight periods of visual observation, as defined in *Acronyms and Abbreviations*.

(Table G.3). Where feasible, which was the majority of cases, carcasses were approached to closer range by the *Kilabuk*, observed in detail, and photographed by the MMOs. Most carcasses showed signs of advanced decomposition. The exceptions to this were walrus carcasses that were headless and undoubtedly taken by hunters.

Sightings with Airguns On.—Of the total 480 sightings, 102 were made while the airguns were operating, 356 were made during non-seismic periods, and the remaining 22 were noted during "post-seismic" periods (Tables ES.1, 6.2).

Power downs were requested on 10 occasions and shut downs were requested on 38 occasions when pinnipeds or cetaceans were sighted in the water within the 190 dB or 180 dB (rms) safety radii

(respectively) around the operating airguns. Further details on these encounters are provided later in this chapter (see *Mitigation Measures Implemented*) and in Appendix H.

Sighting Rates.—Sighting rates (# groups sighted per unit effort) during various types of MMO effort are presented in Table 6.1. Sighting rates for all types of marine mammals were higher from the *Gilavar* than the *Kilabuk*. This is not surprising given that observers on the *Gilavar* stood at a greater height above the water.

Based on the number of groups seen per kilometer, sighting rates were generally higher during non-seismic operations than during seismic conditions (Table 6.1). This is true regardless of whether the *Kilabuk* sightings are included. For cetaceans, the sighting rate from the *Gilavar* was only 0.5 detections/1000 km during seismic periods vs. 18.6 per 1000 km during non-seismic periods. The sighting rate for cetaceans was higher (30.9 detections/1000 km) during post-seismic periods, but the survey effort during post-seismic periods was low and the sightings involved very large aggregations of feeding gray whales.

Useable seal sighting rates were also higher during non-seismic than seismic periods, though the difference between seismic and non-seismic periods was not nearly as marked as for cetaceans. When all data are considered (meaning useable and non-useable), sighting rates for pinnipeds in water were actually highest during seismic periods. When considering only useable data, pinnipeds were seen in water more frequently during non-seismic periods. This was also true for pinnipeds on ice; however ice was less likely to be visible during seismic periods as it posed a navigational hazard. Detections of Pacific walruses in water were most frequent during post-seismic periods and nearly 0 during seismic periods. The extremely low number of detections could be an indication of displacement. If displacement was occurring, the high numbers of post-seismic sightings may indicate that animals were not displaced very far or for long periods of time.

The presence of fog (visibility <3.5 km) was the most common reason that sightings were considered non-useable. During seismic periods, the detection rate in non-useable periods was about ½ of that in useable periods, consistent with what would be expected during periods of poor vs. good visibility (Table 6.1). For non-seismic periods, the difference in detection rate between non-useable and useable periods was even greater than for seismic periods (Table 6.1).

Other Vessels.—While the *Gilavar* and *Kilabuk* were working in tandem, the vessels were typically within ~5 km of each other and often as close as a few hundreds of meters from each other. The location and proximity of the *Kilabuk* were extremely variable, and probably had some effect on the number of sightings and the behavior of marine mammals that were sighted. This effect, however, was not apparent to the MMOs in real time when they were observing marine mammals. Other than the *Kilabuk*, one other chase/supply vessel (the *Gulf Provider*) associated with the survey was sighted regularly. On some occasions this vessel relieved the *Kilabuk* and on other occasions the two vessels were present simultaneously. The seismic vessel *Western Patriot* was also operating in the area but was rarely close enough to be seen by the MMOs.

Distribution of Marine Mammals

Observations during the Chukchi Sea study indicate that phocid seals (spotted and ringed) were the most abundant marine mammals in the area (Tables 6.2, 6.3). It is expected that the majority of unidentified seals were ringed or spotted seals as bearded seals would be more easily confused with Pacific walruses (because of their size) and therefore classified as unknown pinnipeds. Pacific walruses were more abundant than bearded seals. All species of pinnipeds, with the exception of the one sighting of a ribbon seal, were seen during both seismic and non-seismic periods.

The gray whale was the most abundant species of cetacean, followed by the bowhead whale (Tables 6.2, 6.3). Harbor porpoises and minke whales were seen on multiple occasions and there was one sighting of a group of 3 fin whales plus one sighting of a single humpback whale. Harbor porpoises were seen during both seismic and non-seismic periods. The only large whale seen during seismic periods was one minke whale. The numerous gray whale sightings all occurred during non-seismic periods; however, it should be noted that the sightings of gray whales tended to be clustered and their distribution is more likely an indication of distribution of food resources than a response to seismic activity.

Specific locations of sightings are not mapped given the sensitivity of information about the exact locations where the seismic survey was done (see Chapter 2).

Marine Mammal Behavior

The data collected during visual observations provide information about behavioral responses of marine mammals to the seismic survey. The relevant data include estimated closest observed points of approach (CPA) to the vessel, movement relative to the vessel when the airguns were and were not firing, and observed behavior of animals at the time of the initial sightings.

Closest Observed Point of Approach

There was a statistically significant difference between the CPA distances for seals in water during seismic vs. non-seismic periods. When considering combined useable sightings from the *Gilavar* and *Kilabuk*, CPA during non-seismic periods was less than CPA during seismic periods (Wilcoxon rank sum test, $n = 56$ vs. 154; $Z = 6.139$, P 0.000; Table 6.4 and 6.5). When only *Gilavar* data are considered, the trend is reversed ($n = 56$ vs. 50; $Z = -2.3418$, P 0.0192). No meaningful comparison was possible for cetaceans because there was only one sighting from the *Gilavar* during seismic periods. Similarly, there were insufficient walrus data for statistical analyses of CPA. The mean CPA during seismic periods, as presented in Table 6.4, is underestimated if some animals avoided the airguns at distances beyond those where they could be detected by MMOs.

Although most sample sizes are small, the sighting-distance data from this study are not consistent with those from many previous seismic studies. In other studies, marine mammals were usually observed at greater distances from the vessel and lower sighting rates when the airguns were operating than when the airguns were silent (e.g., Smultea et al. 2004; Haley and Koski 2004; MacLean and Koski 2005; Holst et al. 2005a,b). This is also true for similar studies conducted in nearby Arctic regions (Harris et al. 2001; Haley and Ireland 2005).

Categories of Behavior

Marine mammal behavior is difficult to observe, especially from a seismic vessel, because individuals and/or groups are often at the surface only briefly, and there may be avoidance behavior. This causes difficulties in resighting those animals, and in determining whether two sightings some minutes apart are repeat sightings of the same individual(s). Only limited behavioral data were collected during this project because marine mammals were often seen at a distance from the vessel, and they were typically not tracked for long distances or durations while the vessel was underway. The two variables that were examined quantitatively to assess potential seismic effects on behavior were the categories of movement and behavior when the animal(s) were first observed (see Appendix Table E.1 for variables and definitions). The CPA distance recorded for each sighting was also an indicator of behavior (see above and Appendix Table G.3 for details on sightings). Results regarding movement and behavior are presented in Tables 6.6 and 6.7. (In those tables, cetacean data include only useable sightings from the *Gilavar*; however, seal and walrus data include useable sightings from both the *Gilavar* and the *Kilabuk*.)

TABLE 6.4. Closest observed points of approach (CPA) of useable marine mammal sightings from the Gilavar to the airguns during non-seismic and seismic periods during the Chukchi Sea survey 27 July–20 Sept. 2006.

		Non-seismic				Seismic			
Taxonomic Group	**# Sightings**	**Mean CPA (m)**	**s.d.**	***n***	**Range (m)**	**Mean CPA (m)**	**s.d.**	***n***	**Range (m)**
Cetaceans									
Mysticete	48	1898	1177	48	350 - 4641	N/A	N/A	0	N/A
Odontocete	5	589	261	4	370 - 930	507	N/A	1	N/A
Pinnipeds in Water	124	808	476	65	301 - 2165	633	340	59	308 - 2592
Unidentified Pinnipeds	9	834	383	7	301 - 1342	853	6	2	849 - 857
Pacific Walrus	9	1099	538	8	531 - 2165	350	N/A	1	N/A
Seals	106	756	469	50	306 - 2130	630	345	56	308 - 2592
Pinnipeds on Ice	13	977	488	13	462 - 2031	N/A	N/A	0	N/A
Unidentified Pinnipeds	1	750	N/A	1	N/A	N/A	N/A	0	N/A
Pacific Walrus	3	1363	255	3	1119 - 1628	N/A	N/A	0	N/A
Seals	9	874	517	9	462 - 2031	N/A	N/A	0	N/A

Note: N/A means not applicable.

TABLE 6.5. Closest observed points of approach (CPA) of useable marine mammal sightings to observers on board the Kilabuk during non-seimic periods during the Chukchi Sea cruise from 27 Jul.-5 Oct. 2006.

		Non-seismic		
Taxonomic Group[a]	**# Sightings**	**Mean CPA (m)**	**s.d.**	**Range (m)**
Pinnipeds in Water	114	149	200	1 - 774
Pacific Walrus	9	304	244	5 - 659
Seals	105	136	191	1 - 774
Pinnipeds on Ice	7	891	424	5 - 1193
Pacific Walrus on Ice	3	712	626	5 - 1193
Seals	4	1025	206	774 - 1193

[a] Includes only useable sightings as defined in *Acronyms and Abbreviations.*

Movement.—Movement was observed and recorded for 41 sightings of cetaceans (Table 6.6). (Of the total of 53 cetacean sightings, there were 12 sightings for which movement was either unknown or not recorded.) Of the 40 sightings during non-seismic periods for which movement was recorded, most were of cetaceans swimming parallel to the vessel (18 of 40, or 45%; Table 6.6) or swimming perpendicular (11 of 40, or 27.5%). The one cetacean sighting made during seismic activity was swimming away from the vessel.

TABLE 6.6. Numbers of useable sightings of marine mammals by movement category during seismic and non-seismic periods from the *Gilavar* (10 Jul.-23 Sept. 2006) and the *Kilabuk* (10 Jul.-4 Oct. 2006) within the Chukchi Sea. See Appendix E for definitions of movement categories.

	Movement Relative to Vessel[a]								
Taxonomic Group[b]	**Mill**	**Swim Perpen-dicular**	**Swim Away**	**Swim Parallel**	**Swim Toward**	**No Movement**	**Total of Known/Recorded Movement**	**Unknown/Not Recorded**	***Total***
Cetaceans									
Non-seismic	0	11	4	18	7	0	40	12	***52***
Seismic	0	0	1	0	0	0	1	0	***1***
Total	***0***	***11***	***5***	***18***	***7***	***0***	***41***	***12***	**53**
Seals in Water									
Non-seismic	6	19	30	13	2	5	75	86	***161***
Seismic	2	8	18	12	0	4	44	15	***59***
Total	***8***	***27***	***48***	***25***	***2***	***9***	***119***	***101***	**220**
Pacific Walrus in Water									
Non-seismic	5	4	6	0	0	0	15	2	***17***
Seismic	0	0	0	0	1	0	1	0	***1***
Total	***5***	***4***	***6***	***0***	***1***	***0***	***16***	***2***	**18**

[a] Includes only useable sightings as defined in *Acronyms and Abbreviations* .

[b] Cetacean sightings include only those from the *Gilavar* ; seal and Pacific walrus sightings include those from the *Gilavar* and the *Kilabuk* . All *Kilabuk* pinniped sightings were treated as non-seismic. See text for explanation.

Movement category was recorded for 119 seal sightings had movement records, of which 75 sightings were during non-seismic periods and 44 sightings were made during seismic periods. During both seismic and non-seismic periods, those seals in the water for which movement was recorded were most often seen swimming away from the vessel (40% during non-seismic; 41% during seismic; Table 6.6). Swimming perpendicular (25% during non-seismic; 18% during seismic) and swimming parallel (17% during non-seismic; 27% during seismic) were the next most frequently-observed movements in relation to the vessel. Only two sightings of seals in the water involved individuals swimming toward the vessel.

Of the 15 sightings of walruses in the water during non-seismic periods, six (40%) were of animals swimming away, five (33%) were of animals milling, and four (27%) were of animals swimming perpendicular. The one sighting of a walrus during seismic activity was swimming toward the vessel (Table 6.6).

The movement of pinnipeds first observed on ice was always categorized as hauled out and is therefore not presented in Table 6.6.

First Observed Behavior.—The most common "first observed behavior" of cetaceans, all but one sighting of which were during non-seismic periods, was blowing (43 of 52 sightings for which behavior was recorded, or 83%; Table 6.7). Looking and swimming/traveling were the most common "first observed behaviors" of seals in the water during non-seismic periods, accounting for 45% and 43% of the 159 non-seismic sightings respectively. However, swimming/traveling was observed first most often during seismic periods (41 of 59 sightings with behavior recorded, or 69%). Twenty-five per cent (15 of 59) of sightings of seals in the water during seismic periods were of animals looking. There were 17 sightings of Pacific walruses in the water during non-seismic periods, and one sighting during seismic periods. The first-observed behavior of 15 of those 18 sightings, including the one sighting during seismic, was swimming/traveling. The other three sightings were of animals looking at the vessel.

TABLE 6.7. Comparison of first observed behaviors of useable marine mammal sightings during non-seismic and seismic periods from the *Gilavar* (10 Jul.-23 Sept. 2006) and the *Kilabuk* (10 Jul.-4 Oct. 2006) within the Chukchi Sea. See Appendix E for definitions of behavior categories.

	First-observed Behavior[a]																
Taxonomic Group[b]	**Blow**	**Fluke**	**Dive / Forward Dive**	**Swim / Travel**	**Porpoise/ Surface Active Travel**	**Log / Raft**	**Rest**	**Spyhop / Look**	**Sink**	**Thrash**	**Feed**	**Mill**	**Surface Active**	**None**	**Total of Known/Recorded Behavior**	**Behavior Unknown/ Not Recorded**	***Total***
Cetaceans																	
Non-seismic	43	0	0	7	1	0	0	0	0	0	0	0	0	1	52	0	***52***
Seismic	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	***1***
Total	***43***	***0***	***0***	***8***	***1***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***1***	***53***	***0***	**53**
Seals in Water																	
Non-seismic	N/A	N/A	8	69	1	5	0	71	1	1	0	0	1	2	159	2	***161***
Seismic	N/A	N/A	2	41	0	0	0	15	0	1	0	0	0	0	59	0	***59***
Total	***N/A***	***N/A***	***10***	***110***	***1***	***5***	***0***	***86***	***1***	***2***	***0***	***0***	***1***	***2***	***218***	***2***	**220**
Pacific Walrus in Water																	
Non-seismic	N/A	N/A	0	14	0	0	0	3	0	0	0	0	0	0	17	0	***17***
Seismic	N/A	N/A	0	1	0	0	0	0	0	0	0	0	0	0	1	0	***1***
Total	***N/A***	***N/A***	***0***	***15***	***0***	***0***	***0***	***3***	***0***	***0***	***0***	***0***	***0***	***0***	***18***	***0***	**18**
Seals on Ice																	
Non-seismic	N/A	N/A	N/A	N/A	N/A	N/A	12	0	N/A	N/A	0	N/A	N/A	1	13	4	***17***
Seismic	N/A	N/A	N/A	N/A	N/A	N/A	0	0	N/A	N/A	0	N/A	N/A	0	0	0	***0***
Total	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***12***	***0***	***N/A***	***N/A***	***0***	***N/A***	***N/A***	***1***	***13***	***4***	**17**
Pacific Walrus on Ice																	
Non-seismic	N/A	N/A	N/A	N/A	N/A	N/A	0	0	N/A	N/A	0	N/A	N/A	0	0	3	***3***
Seismic	N/A	N/A	N/A	N/A	N/A	N/A	0	0	N/A	N/A	0	N/A	N/A	0	0	0	***0***
Total	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***0***	***0***	***N/A***	***N/A***	***0***	***N/A***	***N/A***	***0***	***0***	***3***	**3**

Note: N/A means not applicable.

[a] Includes only useable sightings as defined in *Acronyms and Abbreviations*.

[b] Cetacean sightings include only those from the *Gilavar*; seal and Pacific Walrus sightings include those from the *Gilavar* and the *Kilabuk*. All *Kilabuk* pinniped sightings were treated as non-seismic. See text for explanation.

Mitigation Measures Implemented

A total of 10 power downs and 38 shut downs of the airguns were requested due to sightings of pinnipeds approaching or within the safety radii applied during the Chukchi Sea cruise (Table 6.8; for a full account of each power down and shut down, see Appendix H). The applied safety radii for pinnipeds were 600 m from the *Gilavar's* airgun array for a power down and 300 m from the array for a shut down (Table 5.1). These **safety radii** were larger than the estimated and measured 190 dB rms **sound level radii** for *Gilavar*'s 3- and 1-string airgun arrays (see Table 4.4), leading to the application of protective mitigation measures. The 190 dB rms sound level distance used in assessing the likelihood of exposures (Table 6.8) is also protective, since the single largest measured 190 dB rms distance was applied, when in fact the 190 dB rms distance is not uniform around the vessel (see Table 4.4). Sound levels are also not uniform with depth (Greene and Richardson 1988; Tolstoy et al. 2004a,b), so animals would need to dive well below the surface to encounter sound levels ≥190 dB rms near the measured sound level radii.

No power downs or shut downs were implemented, or needed, for cetaceans. During periods when the airguns were operating, there were two sightings of cetaceans within 1100 m of the *Gilavar*, i.e., within the applied "180 dB rms" safety radius of 1100 m for power downs (sightings 230 and 266, Appendix Table G.3). However, only the two mitigation guns (155 in^3) were firing during both of these sightings, so the airguns were essentially already "powered down". Neither cetacean entered the 180 dB rms sound level radius of 360 m around the two airguns and it is very unlikely that either of the animals was exposed to sound levels ≥180 dB rms.

Of the 48 interruptions of airgun operations for sightings of pinnipeds, 14 shut downs occurred when the *Gilavar* was using its mitigation airguns (155 in^3). A further nine shut downs (six during ramp-ups) and one power down (also during a ramp-up) occurred when the *Gilavar* was firing eight airguns (1049 in^3). However, the majority of mitigation measures were implemented when the full 24-airgun array (3147 in^3) was in use: 15 shut downs (two during ramp-ups) and nine power downs (four of which were during ramp-ups).

If an animal approaches the airgun array during a ramp-up sequence, it is difficult to evaluate the level of sound exposure the animal may have received before mitigation occurred. The number and combined volume of firing airguns is often not precisely known at specific times during ramp-up sequences. It was assumed that, within the first 15 min of a ramp-up sequence, the volume was 1049 in^3 (8 guns), after which time it was assumed to be the full 3147 in^3 (24 guns). The assumed volume of firing airguns during ramp-ups will in most cases be an overestimate, decreasing the likelihood that animals were exposed to sound levels ≥190 dB rms.

All power downs or shut downs were the result of individual pinnipeds, except for one sighting of two ringed seals (sighting 318, Table 6.8). The majority of the 48 power downs (10) and shut downs (38) were for unidentified seals (29), followed by spotted seals (9), ringed seals (8), bearded seal (1), and Pacific walrus (1).

Of the 10 power downs, nine occurred when the full 24−airgun 3147 in^3 array was firing, so the estimated 190 dB rms sound level distance was 460 m (Tables 4.4, 5.1). The one exception was a power down from the 1049 in^3 array, where the 190 dB rms distance was 420 m (Table 4.4). Two of the ten power downs were unnecessary, as the seals involved did not actually come within the 600 m safety radius. Of the eight seals within the 600 m safety radius, two did not enter the 190 dB rms sound level distance. The remaining six cases involved individuals that were "likely" or "very likely" exposed to a received sound level of ≥190 dB rms. Those six seals approached the airguns to distances ranging from 310 to 417 m and diving well below the surface before the power downs occurred. These six likely exposures to ≥190 dB rms include four unidentified seals, one ringed seal, and one spotted seal.

TABLE 6.8. List of power downs (PZ) and shut downs (SZ) of the airguns implemented for pinnipeds sighted in or near the *Gilavar*'s safety radii (600 m for power downs, 300 m for shut downs), during the Chukchi Sea seismic survey, 27 Jul.−9 Sept. 2006. No power downs or shut downs were implemented for cetaceans. See Appendix Table G.3 for more details on these sightings. Also see Appendix H for an account of each power down and shut down.

Sighting ID	Species	Group Size	Day in 2006	Water Depth (m)	Initial Sighting Distance (m) from observer	Initial Movement[a]	Dove before mitigation?	Maximum airgun Vol. (in^3) prior to SZ or PZ	Estimated 190 dB sound level distance	CPA (m) to operating airguns before mitigation	Mitigation measure taken (SZ, PZ)	Exposed to ≥190 dB re 1 µPa (rms)?[b]
192	Pacific walrus	1	22-Jul	34	476	ST	Yes	1049	420	647	SZ	Very unlikely
193	Unidentified seal	1	22-Jul	34.8	200	SP	Yes	1049	420	396	SZ	Likely
203	Unidentified seal	1	27-Jul	39.1	30	SA	Yes	3147	460	317	PZ	Very likely
204	Unidentified seal	1	27-Jul	<100	200	PE	Yes	3147	460	483	PZ	Very unlikely
206	Unidentified seal	1	31-Jul	38.6	30	SA	Yes	3147	460	321	PZ	Very likely
210	Unidentified seal	1	3-Aug	<100	192	SP	Yes	1049	420	250	SZ	Very likely
211	Spotted seal	1	3-Aug	<100	192	SA	Yes	3147	460	400	PZ	Likely
215	Unidentified seal	1	6-Aug	38	100	SA	No	3147	460	389	SZ	Likely
218	Spotted seal	1	9-Aug	37.7	192	PE	No	3147	460	492	PZ	Very unlikely
219	Unidentified seal	1	15-Aug	38.5	500	NO	Yes	155	230	550	SZ	Very unlikely
360	Spotted seal	1	15-Aug	38.4	300	UN	–	155	230	424	SZ	Very unlikely
220	Spotted seal	1	16-Aug	35.3	350	SA	Yes	3147	460	555	SZ	Very unlikely
225	Unidentified seal	1	16-Aug	38.3	300	SP	No	155	230	600	SZ	Very unlikely
232	Spotted seal	1	16-Aug	38.3	275	SP	No	155	230	435	SZ	Very unlikely
241	Unidentified seal	1	16-Aug	38.4	306	UN	Yes	1049	420	435	SZ	Unlikely
246	Unidentified seal	1	16-Aug	37.7	306	UN	Yes	3147	460	476	SZ	Unlikely
260	Spotted seal	1	17-Aug	37.8	273	PE	Yes	155	230	553	SZ	Very unlikely
262	Unidentified seal	1	18-Aug	31.5	450	NO	Yes	1049	420	750	PZ	Very unlikely
264	Spotted seal	1	20-Aug	37.8	20	SP	No	3147	460	310	SZ	Likely
268	Unidentified seal	1	22-Aug	38.3	75	SP	Yes	155	230	344	SZ	Very unlikely
271	Unidentified seal	1	24-Aug	40	50	SP	No	155	230	344	SZ	Very unlikely
273	Ringed seal	1	25-Aug	35.5	80	SA	Yes	3147	460	304	SZ	Very likely
275	Unidentified seal	1	26-Aug	37.7	50	NO	Yes	3147	460	344	SZ	Very likely
276	Unidentified seal	1	26-Aug	39.7	75	SA	No	155	230	366	SZ	Very unlikely
277	Unidentified seal	1	26-Aug	39	100	SA	Yes	1049	420	389	SZ	Very likely
278	Unidentified seal	1	26-Aug	39	10	SP	Yes	3147	460	310	PZ	Very likely
279	Unidentified seal	1	27-Aug	39.1	75	UN	Yes	155	230	366	SZ	Very unlikely
281	Unidentified seal	1	28-Aug	37.8	450	SP	Yes	3147	460	653	PZ	Very unlikely
282	Bearded seal	1	28-Aug	38.3	50	SP	No	1049	420	327	SZ	Likely
283	Spotted seal	1	28-Aug	39.3	75	UN	Yes	155	230	344	SZ	Very unlikely
284	Unidentified seal	1	28-Aug	38.8	75	NO	Yes	3147	460	301	SZ	Very likely
285	Unidentified seal	1	28-Aug	38.1	150	SP	Yes	3147	460	366	SZ	Very likely
359	Ringed seal	1	28-Aug	34.8	200	SP	Yes	3147	460	323	SZ	Very likely
294	Unidentified seal	1	29-Aug	37.8	250	SP	Yes	1049	420	476	SZ	Very unlikely
295	Ringed seal	1	29-Aug	32.5	150	SP	Yes	3147	460	450	SZ	Likely
300	Ringed seal	1	29-Aug	34.9	240	SP	Yes	3147	460	360	SZ	Very likely
302	Unidentified seal	1	29-Aug	35.7	179	SA	Yes	3147	460	349	PZ	Very likely
304	Unidentified seal	1	30-Aug	39	75	SP	Yes	1049	420	366	SZ	Very likely
306	Ringed seal	1	30-Aug	38	400	SA	Yes	3147	460	417	PZ	Very likely
307	Spotted seal	1	30-Aug	37.7	70	UN	Yes	155	230	362	SZ	Very unlikely
314	Unidentified seal	1	31-Aug	<100	300	SP	Yes	3147	460	519	SZ	Very unlikely
318	Ringed seal	2	31-Aug	35.7	150	SA	No	155	230	308	SZ	Very unlikely
319	Unidentified seal	1	2-Sep	37.3	25	UN	Yes	3147	460	321	SZ	Very likely
320	Unidentified seal	1	12-Sep	33.9	5	SA	Yes	3147	460	305	SZ	Very likely
321	Unidentified seal	1	12-Sep	37.4	50	UN	Yes	155	230	344	SZ	Very unlikely
322	Unidentified seal	1	12-Sep	37.3	10	SA	Yes	1049	420	308	SZ	Very likely
324	Ringed seal	1	16-Sep	38	150	UN	No	155	230	366	SZ	Very unlikely
325	Ringed seal	1	18-Sep	35.5	130	PE	Yes	3147	460	343	SZ	Very likely

[a] Initial movement of group relative to vessel: PE=swimming perpendicular or across bow, ST=swimming toward, SA=swimming away, SP=swimming parallel, NO=none, UN=unknown.
[b] Categories of likelihood of exposure range from least likely to most likely: Very unlikely, Unlikely, Likely, Very likely.

Considering the 38 full shut downs, for all cases but one, powering down to the mitigation airguns would have sufficed to avoid exposing animals to a sound level ≥190 dB rms. The one case where the full shut down was necessary, to avoid exposing an animal to ≥190 dB rms from the mitigation airguns (155 in^3), involved a single bearded seal (sighting 282, Appendix H). The seal was 327 m away from the *Gilavar* when the shut down was initiated, and subsequently approached the airguns within 5 m after the shut down, at which time it dove and was not seen again. The remaining 37 full shut downs occurred because the applied safety radii were more protective than the measured 190 dB rms sound level distances, as mentioned above.

Of the 38 shut-downs, there was one case that involved a single Pacific walrus (sighting 192, Table 6.8) where the individual did not enter the 600 m safety radius before the shut down occurred. Of the remaining 37 cases, there were only 18 sightings involving 18 seals where individuals actually entered the 190 dB rms sound level distance before the airguns were shut down. Fifteen of these seals were likely or very likely exposed to ≥190 dB rms, coming within 250 to 450 m of the airguns and diving well below the surface before the shut downs occurred. The remaining three seals (sightings 215, 264, and 282, Table 6.8) were each sighted within the 190 dB rms sound distance and remained at the surface until after the shut downs occurred. All three seals were likely exposed to ≥190 dB rms before they surfaced and were initially detected. The 18 seals likely exposed to ≥190 dB rms included 11 unidentified seals, five ringed seals, one spotted seal, and one bearded seal.

Overall, considering both power downs and shut downs, there were 24 cases when seals were exposed to ≥190 dB rms. These included 15 unidentified seals, six ringed seals, 2 spotted seals, and one bearded seal.

Estimated Number of Marine Mammals Present and Potentially Affected

It is difficult to obtain meaningful estimates of "take by harassment" for several reasons: ***(1)*** The relationship between numbers of marine mammals that are observed and the number actually present is uncertain. ***(2)*** The most appropriate criteria for "take by harassment" are uncertain and presumably variable among species and situations. ***(3)*** The distance to which a received sound level exceeds a specific criterion such as 190 dB, 180 dB, 170 dB, or 160 dB re 1 μPa (rms) is variable. It depends on water depth, source depth, water-mass and bottom conditions, and—for directional sources—aspect (Chapters 3 and 4; see also Greene 1997; Greene et. al. 1998; Burgess and Greene 1999; Caldwell and Dragoset 2000; Tolstoy et al. 2004a,b). ***(4)*** The sounds received by marine mammals vary depending on their depth in the water, and will be considerably reduced for animals at or near the surface (Greene and Richardson 1988; Tolstoy et al. 2004a,b) and further reduced for animals that are on the ice.

Disturbance and Safety Criteria

Table 5.1 shows estimated received sound levels at various distances from the *Gilavar*'s 3147 in^3 3-string airgun array. The 160 and 170-dB radii are assumed behavioral disturbance criteria. The 180 and 190 dB radii are safety radii, used in determining when mitigation measures were required. During this and many other recent projects, NMFS has required that mitigation measures be applied to avoid or minimize the exposure of cetaceans and pinnipeds to impulse sounds with received levels ≥180 dB and ≥190 dB re 1 μPa (rms), respectively. NMFS commonly assumes that cetaceans and seals exposed to pulsed sounds with received levels ≥160 dB rms might be disturbed, although there is little evidence that most pinnipeds or delphinids exposed to airgun sounds with levels just above 160 dB rms are disturbed. The safety and disturbance radii summarized in Table 5.1D were used after the field season to estimate numbers of marine mammals exposed to various received sound levels.

Two methods were applied to estimate the number of pinnipeds and cetaceans exposed to seismic sound levels strong enough that they might have caused disturbance or other effects. The procedures include ***(A)*** minimum estimates based on direct observations, and ***(B)*** estimates based on pinniped and cetacean densities obtained during this study. The actual number of individuals exposed to, and potentially affected by, strong seismic survey sounds likely was between the minimum and maximum estimates provided below.

Estimates from Direct Observations

The number of marine mammals observed close to the *Gilavar* during the Chukchi Sea survey provides a minimum estimate of the number potentially affected by seismic sounds. This is likely an underestimate of the actual number potentially affected. Some animals probably moved away before coming within visual range, and not all of those that remained would have been seen by observers.

Pinnipeds Potentially Exposed to Sounds ≥190 dB re 1 µPa (rms).—During this project, there were 48 sightings involving 49 pinnipeds that resulted in the implementation of mitigation measures (Table 6.8). Of these 48 cases, there were 47 cases involving 48 seals that were within the "190 dB rms" pinniped safety radius of 600 m around the *Gilavar*'s airguns. However, given that the safety radius was larger than the measured 190 dB rms sound level distance, only 24 seals from 24 sightings came within the 190 dB rms distance. Of these 24 seals, 21 seals were likely exposed to ≥190 dB rms, as they were seen diving within the 190 dB rms sound distance before mitigation was implemented. The remaining three seals did not dive before mitigation action was taken, but were still likely to have been ensonified at a level ≥190 dB rms before they surfaced and were initially detected. Based on direct observations in the field, the 24 animals that were likely exposed to ≥190 dB include 15 unidentified seals, six ringed seals, two spotted seals, and one bearded seal. One pinniped, a ribbon seal, was sighted within the 160 dB radius. However, this animal was hauled out on ice and would not have received sound levels high enough to be considered a "take" according to NMFS criteria.

Cetaceans Potentially Exposed to Sounds ≥180 dB re 1 µPa (rms).—There were two sightings involving two individual cetaceans, one harbor porpoise and one minke whale, within 1100 m around the *Gilavar*'s airguns when they were operating (sightings 230 and 266, Table G.3). However, there were only 2 airguns (155 in^3) operating during both sightings, so no power down was implemented. Neither cetacean came within the 180 dB rms sound level distance for the two operating airguns, so they were very unlikely to have been exposed to ≥180 dB rms. However, each of these cetaceans was observed within the 160 dB radius of the 2 guns (1.37km).

Estimates Extrapolated from Density

The numbers of marine mammals directly sighted during the Chukchi Sea study no doubt underestimated the actual numbers present because some animals present near the trackline would not be seen by the observers. During daylight, animals are missed if they are below the surface when the ship is nearby. Some other mammals, even if they surface near the vessel, are missed because of limited visibility, intervening ice, glare, or other factors limiting sightability. High sea state (Bf) was a significant factor during limited periods of this cruise. Also, sound levels were estimated to be ≥160 dB re 1 µPa (rms) out to 8 km. This distance is well beyond those at which MMOs can detect even the more conspicuous animals under favorable sighting conditions during daytime. Furthermore, marine mammals could not be seen effectively during periods of darkness, which occurred for increasing numbers of hours per day after 14 August and nighttime observations were generally not required or attempted except prior to and during nighttime ramp-ups.

Also, some animals may have avoided the area near the seismic vessel while the airguns were firing (see Richardson et al. 1995, 1999; Stone 2003; Gordon et al. 2004; Smultea et al. 2004). Within the assumed 160–170 dB radii around the source (i.e., ~4.7–8 km), and perhaps farther away in the case of the more sensitive species and individuals, the distribution and behavior of pinnipeds and cetaceans may have been altered as a result of the seismic survey. This could occur as a result of reactions to the airguns, or as a result of reactions to the *Gilavar* or the *Kilabuk* themselves. The extent to which the distribution and behavior of pinnipeds might be affected by the airguns is uncertain, given variable previous results (Thompson et al. 1998; Harris et al. 2001; Moulton and Lawson 2002; Miller et al. 2005).

However, it is safe to assume that some pinnipeds that were on the ice as the two ships approached would have gone into the water in response to the *Kilabuk* before they were in view of observers on the *Gilavar*. Likewise, it is safe to assume that some cetaceans when approached by the seismic survey would have moved away before they were in view.

The methodology used to estimate the areas exposed to received levels ≥160 dB, ≥170 dB, ≥180 dB and ≥190 dB was described briefly in Chapter 5 *Monitoring and Mitigation Methods* and in more detail in Appendix E. Densities were based on data collected from the three vessels (*Gilavar*, *Kilabuk*, and *Gulf Provider*) during SOI's seismic operations in the Chukchi Sea. The density data are summarized in Appendix Table I.1..

The aforementioned densities were used to estimate both the number of *individual* marine mammals exposed to 160, 170, 180, and 190 dB, and the number of *exposures* of different individual marine mammals. These numbers provide estimates of the number of animals potentially affected by seismic operations, as described in Chapter 5 and Appendix E.

The estimates provided here are based on the actual amount of seismic surveying during this project. In contrast, the estimates provided in the IHA applications for this project (SOI 2005a,b) were based on the then-anticipated amount of survey, with an allowance for the possibility that some lines would be surveyed more than once. The estimates in the IHA applications assumed that there would be more seismic surveying than actually occurred. Thus, the present estimates are lower than those in the IHA application even though they are based on comparable density data. In addition, the following estimates assume that all mammals present were well below the surface where they would be exposed to the sound levels predicted in Table 5.1 at a given distance. In fact, some pinnipeds were hauled out on the ice, and remained there as the ship passed, and some pinnipeds and cetaceans in the water might remain close to the surface, where sound levels would be reduced by pressure-release effects (Greene and Richardson 1988). Finally, some pinnipeds and cetaceans may have moved away from the path of the *Gilavar* before it arrived, either because the *Kilabuk* frequently traveled in front of *Gilavar*, or because of an avoidance response to the approaching *Gilavar* and its airguns. Thus, the following estimates, though lower than those in the IHA Application, are nonetheless likely to overstate actual numbers exposed to various received sound levels.

Estimates of the densities of pinnipeds and cetaceans are given in Table I.1, including approximate corrections for sightability biases. These corrected densities were used to estimate the number of marine mammals that were exposed to various received levels of airgun sound, and thus potentially affected by seismic operations (Tables 6.9, 6.10).

Pinnipeds.—Table 6.9 summarizes the estimated numbers of pinnipeds that might have been exposed to received sounds with various levels relative to the number of "takes" requested in SOI's IHA application for the Chukchi Sea. These estimates are based on the ensonified area figures from Table E.1 and the density data from Table I.1. The latter Appendix table gives the density estimates derived from vessel-based surveys during both non-seismic and seismic periods. Note that the estimated numbers in Table 6.9A, based on density data from non-seismic periods, represent the pinnipeds that would have been exposed had the animals not shown localized avoidance of the airguns or the ship itself, and assume that all pinnipeds present were in the water. Some of the animals calculated (based on density) to be within the ≥190-dB zone would in fact move away before being exposed to sounds that strong. Also, some of those calculated to be in the ≥160- or ≥170 dB zones would be on the ice and not exposed to the underwater sounds.

TABLE 6.9. Estimated numbers of exposures, and estimated numbers of individual pinnipeds within the Chukchi Sea that might have been exposed to received levels of sounds at levels shown, divided into (1) seals and (2) Pacific walrus. Requested takes for the Chukchi Sea are also shown. Estimates are based on "corrected" densities of pinnipeds calculated from sighting effort (see text in Chapter 6 for species-specific estimates).

Exposure level in dB re 1µPa (rms)	A. Based on Non-seismic density[a]		B. Based on Seismic density[a]		*Requested Take*
	Exposures	Individuals	Exposures	Individuals	
1. Seals					
160	20512	1317	13194	847	2206
170	11389	872	7326	561	
180	3531	607	2271	390	
190	1145	416	737	267	
2. Pacific Walrus					
160	2397	154	90	6	
170	1331	102	50	4	
180	413	71	16	3	
190	134	49	5	2	

[a] These density estimates are presented in Appendix Table I.1

TABLE 6.10. Estimated numbers of exposures, and estimated numbers of individual cetaceans within the Chukchi Sea that might have been exposed to received levels of sounds at levels shown. Requested takes for the Chukchi Sea are also shown. Estimates are based on "corrected" densities of cetaceans calculated from sighting effort (see text in Chapter 6 for species-specific estimates).

Exposure level in dB re 1µPa (rms)	A. Based on Non-seismic density[a]		B. Based on Seismic density[a]		*Requested Take*
	Exposures	Individuals	Exposures	Individuals	
160	3089	198	62	4	422
170	1715	131	34	3	
180	532	91	11	2	
190	172	63	3	1	

[a] These density estimates are presented in Appendix Table I.1

(A) ≥160 dB (rms): We estimate that there would have been ~20,512 exposures of ~1317 different individual seals to airgun pulses with received levels ≥160 dB re 1 µPa (rms) during the survey if all seals were in the water and showed no avoidance of the ≥160 dB zone (Table 6.8A). Based on the available densities and prorating of unknown individuals, 4558 of the exposures would have been of spotted seals, 2012 of bearded seals, 1550 of ringed seals, and 257 of ribbon seals. The sighting rate of spotted seals was higher than

expected given the known prevalence of ringed seals in the area. Pacific walruses are estimated to have been exposed to ≥160 dB on 2397 occasions. Prorating of unidentified individuals may have artificially inflated the estimated takes of two species and underestimated the takes of one species. It is likely that ringed seals, known to be very common in the area, actually comprised a higher proportion of unidentified animals than did spotted seals. In addition, only one ribbon seal was sighted throughout the entire cruise and it is not likely that any significant number of this species were present during seismic operations.

The numbers of different individual seals and walruses that might have been exposed to levels ≥160 dB rms, calculated from sighting rates during non-seismic periods, were only 1317 and 154 as compared with the corresponding estimates of numbers of exposures (20,512 seals and 2397 walruses). The lower numbers of individuals than of exposures is a result of the fact that many areas were ensonified repeatedly to ≥160 dB as the seismic vessel moved back and forth along different seismic lines. Most animals that lingered in the area would have been exposed to levels ≥160 dB numerous times over an extended period, but the number of different individuals so exposed would be far less than the estimated number of exposure incidents.

(*B) ≥170 dB (rms):* On average, pinnipeds may be disturbed only if exposed to received levels of airgun sounds ≥170 dB re 1 µPa (rms). If so, then the estimated number of exposures would be ~56% of the corresponding estimates for ≥160 dB, based on the proportionally smaller areas exposed to ≥170 dB (Table E.1). Overall, there would have been ~11,389 exposures of seals, involving ~872 individuals, and 1331 exposures of walruses, involving 102 individuals, to seismic sounds ≥170 dB (Table 6.9A). Again, numbers of different individuals exposed were far lower than numbers of exposures (Table 6.9A).

(C) ≥180 dB (rms): Some pinnipeds no doubt were within the 180 dB radius (estimated as being up to 1.4 km, Table 4.4) around the operating airguns but were missed by the observers even during airgun operations conducted in good visibility conditions. It is estimated that there were 3531 exposures of 607 individual seals and 413 exposures of 71 individual walruses to sounds ≥180 dB (Table 6.9A). These figures assume that there was no effective avoidance by pinnipeds of the 180 dB radius around the approaching airguns.

(*D) ≥190 dB (rms):* Based on densities calculated from sighting rates during non-seismic periods, we estimated that there would have been 1145 exposures of 416 different seals and 134 exposures of 49 different walruses to airgun sounds at ≥190 dB (rms) if there were no avoidance (Table 6.9A). Even the smaller of these estimates is far higher than the number of pinnipeds (n = 21) that direct observations indicated were possibly exposed to ≥190 dB (Table 6.8). Some pinnipeds within the 190 dB radius presumably were missed during times when MMOs were on watch as well as at night when MMOs generally were not on watch. Even during times when MMOs are on watch, some seals at the surface can be missed due to brief surface times, poor visibility, rough seas, and other factors. Because of this, density-based estimates of exposures and exposed individuals are higher than those based on direct observation. However, estimates based on densities during non-seismic periods may be overestimates. The *Kilabuk* might be expected to displace some pinnipeds from the trackline before the *Gilavar* arrived, and some additional pinnipeds likely swam away in response to the approaching *Gilavar* to avoid exposure to such strong seismic sound. Therefore, the actual number exposed to ≥190 dB rms was probably lower than the above estimates. However, there was no tendency for observed CPA distances to be higher in seismic than non-seismic periods (Table 6.4). Thus, it is likely that actual numbers exposed to ≥190 dB rms were closer to those estimated based on density data than to the much lower figures based on direct observation.

Estimates Based on Densities during Seismic Periods: The estimates quoted in the above paragraphs are all based on densities recorded during non-seismic periods. Densities of seals recorded during seismic periods were similar to those recorded during non-seismic, but densities of unidentified pinnipeds and of walruses recorded with seismic were markedly lower than those during non-seismic periods (Table I.1). Lower densities might be expected during seismic periods, either because of displacement (to the extent it occurs) or the tendency of seismic activity to take place further away from pack ice. (Arctic pinnipeds tend to concentrate near ice in summer.) On the other hand, locally abundant food resources near seismic track lines may be responsible for occasional high densities there. On several occasions the *Gilavar* passed through very strong tide rips and fronts. These areas frequently contain prey biomass higher than surrounding areas and thus attract seals (Suryan and Harvey 1998). The minimum numbers of exposures and minimum numbers of individuals exposed, based on the corrected densities recorded during seismic periods, are summarized in Table 6.9B.

Overall, these minimum figures are somewhat lower than those based on densities during non-seismic periods. Again, the minimum estimates of the numbers of individuals exposed are much lower than the minimum estimates of numbers of exposures to various received levels. In other words, many of the individuals pinnipeds exposed to a given sound level were exposed to that level several times. This reflects the degree of overlap in the ensonified areas around different seismic lines.

Cetaceans.—The estimated numbers of cetaceans that might have been exposed to various levels of received sounds, relative to the number of "takes" requested in the IHA application, are summarized in Table 6.10. The density data used to calculate these numbers, for non-seismic as well as seismic periods, are presented in Table I.1. Note that the estimated numbers in Table 6.10A represent the cetaceans that would have been exposed had the animals not shown localized avoidance of the airguns or the ship itself. Many of the animals calculated (based on density) to be within the ≥180- or ≥190-dB zones would in fact move away before being exposed to sounds that strong. This is presumably at least part of the reason for the fact that estimates based on sightings during seismic periods (Table 6.10B) were much lower than those during non-seismic periods (Table 6.10A).

(A) ≥160 dB (rms): We estimate that there would have been ~3089 exposures of ~198 different individual cetaceans to airgun pulses with received levels ≥160 dB re 1 µPa (rms) during the survey if all cetaceans showed no avoidance (Table 6.10A). Based on the available densities, 1824 of the exposures would have involved gray whales, 589 bowhead whales, 179 beluga whales, 388 harbor porpoises, 54 fin whales, 40 minke whales, and 19 killer whales. As with pinnipeds, the prorating of unidentified individuals may have resulted in a slight overestimation of takes of less frequently seen species. Minimum estimates of the numbers of different individuals exposed to ≥160 dB were far lower than were the estimates of the number of exposures to that level. This reflects the overlap in the ensonified areas around different seismic lines, and the fact that an animal remaining in the area would have been exposed repeatedly to ≥160 dB.

(B) ≥170 dB (rms): On average, some odontocete species may be disturbed only if exposed to received levels of airgun sounds ≥170 dB re 1 µPa (rms). If so, then the estimated number of exposures would be ~56% of the corresponding estimates for ≥160 dB, based on the proportionally smaller areas exposed to ≥170 dB. Overall, there would have been ~1715 exposures of cetaceans, involving ~131 individuals, to seismic sounds ≥170 dB (Table 6.10A).

(C) ≥180 dB (rms): If there were no avoidance of airgun noise by cetaceans, it is estimated that there would have been ~531 exposures of ~91 individual cetaceans to seismic sounds ≥180 dB (Table 6.10A). However, most of these cetaceans probably moved away before the airguns were close enough to create a

received level ≥180 dB. As noted earlier, there were only two cetacean sightings from *Gilavar* when airguns were operating. It is possible that some additional cetaceans were present within the 180dB radius and not seen by the MMOs during good visibility conditions. However, under those conditions, most cetaceans present probably were seen.

Estimates Based on Densities during Seismic Periods: Only one species, the harbor porpoise, had useable sightings sufficient for the calculation of a density applicable to periods of seismic activity (Table I.1). The density of harbor porpoises during non-seismic periods was significantly higher. This may represent avoidance of the seismic operation by harbor porpoises. It could also be related, in part, to the fact that seismic surveys did not occur in close proximity to ice, where food was likely abundant. Based on the corrected densities recorded during seismic periods, the minimum numbers of exposures and minimum numbers of individuals exposed are summarized in Table 6.10B.

BEAUFORT SEA MONITORING

Vessel-based Monitoring Effort and Marine Mammal Encounter Results

This section summarizes the visual monitoring effort and marine mammal sightings from the *Henry Christoffersen* during the Beaufort Sea shallow hazards, bathymetric, and seismic survey work, 3 August to 3 October 2006. Summaries of results from visual monitoring are presented here, with more detailed data presented in Appendix G, including monitoring effort in both kilometers and hours (Tables G.4, G.5). A general summary of effort and sightings is shown in Table ES.1. All marine mammals were observed inside the study area shown in Figure 6.1, as no monitoring occurred during transit to and from Kaktovik through the Canadian Beaufort Sea before 3 August or after 3 October 2006 (Table G.7).

Visual Survey Effort

MMOs observed primarily from the conning tower of the *Henry C.* (eye-height ~15.4 m above water; 96.2% of watch time), with the remaining observations conducted from the bridge (eye-height ~8.4 m). During 8213 km of *Henry C.* cruise operations within the study area in the Alaskan Beaufort Sea, there was 5145 km of visual observation effort over 526 h; of that, 3239 km of effort over 296 h was classified as "useable" (Tables ES.1, G.4). Useable survey effort, subdivided by whether the airguns were firing or not and water depth strata, is shown in Appendix G (Table G.4). Seismic survey effort with the *Henry C.*'s small airgun system was very limited because of persistent, heavy, ice conditions. Airguns were operated for only 98 km over 10 h, with 4 h of airgun operations classified as useable for analysis purposes.

Beaufort Wind Force (Bf sea state) during observations ranged from 0 to 5 within the study area, with 41.6% of the total effort and 45.9% of the useable effort (in h) occurring during conditions of Beaufort 1 (Table G.5). Most useable observations were conducted during conditions with Bf ≤ 2 (73.9% in h; Table G.5). The prevailing low sea state was typically due to heavy floe ice coverage and the proximity of the vessel to pack ice throughout the survey area. None of the observations within the study area were deemed "non-useable" because of high Beaufort Wind Force.

Visual Sightings of Marine Mammals and Other Vessels

Numbers of Marine Mammals Seen.—An estimated 451 individual marine mammals were seen in 412 groups through the study area (Table 6.11). This included, during systematic observation periods, 408 sightings of seals (managed by NMFS) plus 4 sightings of polar bears (managed by USFWS). No walruses were identified from the *Henry C.* A detailed list of sightings is provided in Appendix G (Table G.6).



FIGURE 6.1. Beaufort Sea study area where the *Henry C.* conducted shallow hazards, bathymetric, and seismic surveys, 3 Aug. to 3 Oct. 2006. Monitoring effort began and ended in Kaktovik, Alaska.

Three different seal species were identified, with ringed seals being the most frequently identified species (n = 90 individuals in 80 groups), followed by spotted seals (n = 75 in 65 groups; Table 6.11). In addition, 15 groups (16 individuals) of bearded seals were observed. Of the 181 seals in the study area that were identified by MMOs, 90 (or 49.7%) were ringed seals. Most of the unidentified seals (n = 261 individuals in 248 groups) were likely ringed seals given the visual monitoring results and the known occurrence of this species throughout the study area. However, the unidentified seals moved too rapidly or were too far away for the observer to make a positive identification. Also, it seems likely that some of the seals identified as spotted seals were in fact ringed seals, given the much higher frequency of ringed than spotted seal sightings in the study area in the past.

No animal deaths were observed during monitoring, but on 12 August 2006 a polar bear was observed on ice feeding on a dead seal. The seal's death was likely due to direct predation, and was not attributed to seismic activity, as no seismic gear had been deployed from the *Henry C.* in over three days.

The majority of the 412 sightings (66.5% or 274 groups) within the study area were "useable" (Table 6.11). These "useable" sightings, along with corresponding effort data, are the basis for the ensuing analyses comparing sighting rates and behaviors of marine mammals seen during the cruise.

TABLE 6.11. Numbers of sightings (groups) and of individual marine mammals, both ***(A)*** total and ***(B)*** useable[a], observed from the *Henry C.* in the study area during the Beaufort Sea monitoring cruise, 3 Aug. to 3 Oct. 2006. No sightings were made during seismic activity.

	Non-Seismic		Post-Seismic		*Total*	
	Sightings (groups)	**Indiv.**	**Sightings (groups)**	**Indiv.**	**Sightings (groups)**	**Indiv.**
A. All Sightings						
Pinnipeds in Water						
Phocids						
Bearded Seal	14	15	0	0	***14***	***15***
Ringed Seal	79	89	0	0	***79***	***89***
Spotted Seal	64	74	1	1	***65***	***75***
Unidentified Seal	242	255	2	2	***244***	***257***
Pinnipeds on Ice						
Phocids						
Bearded Seal	1	1	0	0	***1***	***1***
Ringed Seal	1	1	0	0	***1***	***1***
Spotted Seal	0	0	0	0	***0***	***0***
Unidentified Seal	4	4	0	0	***4***	***4***
Total Pinnipeds	***405***	***439***	***3***	***3***	**408**	**442**
Ursids						
Polar bear	4	9 0	0	0 0	***4***	***9***
Total	***409***	***448***	***3***	***3***	**412**	**451**
B. Useable[a] Sightings						
Pinnipeds in Water						
Phocids						
Bearded Seal	11	11	N/A	N/A	***11***	***11***
Ringed Seal	45	45	N/A	N/A	***45***	***45***
Spotted Seal	46	55	N/A	N/A	***46***	***55***
Unidentified Seal	168	177	N/A	N/A	***168***	***177***
Pinnipeds on Ice						
Phocids						
Bearded Seal	0	0	N/A	N/A	***0***	***0***
Ringed Seal	0	0	N/A	N/A	***0***	***0***
Spotted Seal	0	0	N/A	N/A	***0***	***0***
Unidentified Seal	1	1	N/A	N/A	***1***	***1***
Total Pinnipeds	***271***	***289***	***N/A***	***N/A***	**271**	**289**
Ursids						
Polar bear	3	4 0	N/A	N/A 0	***3***	***4***
Total	***274***	***293***	***N/A***	***N/A***	**274**	**293**

Note: N/A means not applicable.

[a] Useable sightings are those made during useable daylight periods of visual observation, as defined in *List of Acronyms and Abbreviations*.

[b] Sightings of pinnipeds on ice and polar bears that occurred during "useable" sighting conditions.

Sightings with Airguns On.—No marine mammal sightings were noted during the 10 h (4 h useable) while the airguns were operating. There were three seal sightings during 7 h of post-seismic observation effort, all of which were classified as non-useable (Tables ES.1, 6.11). Thus, all useable sightings were

recorded during non-seismic periods, which constituted the overwhelming majority of the observation time (Tables ES.1, 6.11). No power downs or shut downs were required during seismic activity, as no marine mammals were sighted in the water within the 190 dB safety radius around the operating airguns, and no whales were sighted from the *Henry C.*

Sighting Rates.—The lack of sightings while the airguns were on (0 sightings in 10 h, of which 4 h were useable) could simply reflect the brief duration and location of seismic operations. However, it was also consistent with the possibility of a reduced sighting rate with seismic operations as compared to that in non-seismic periods (409 groups in 510 h, or 274 groups in 292 useable hours—Tables 6.11, G.4).

Sighting rates (# groups sighted per unit effort) during various types of MMO effort are presented in Table 6.12. During post-seismic operations, the sighting rate (in groups per km, all effort considered) was about half that during non-seismic conditions (35.3 vs. 82.4 groups/1000 km; Table 6.12).

The lower sighting rates under seismic and post-seismic conditions than under non-seismic conditions could have resulted if there was avoidance of airguns, but could also have occurred because the seismic operators took advantage of minimal ice conditions to conduct seismic activities. Operating the seismic gear away from pack ice margins and floe ice reduces the danger of damaging equipment in the ice. In summer and early fall, seals in the Beaufort Sea typically favor areas near drifting ice (Moulton and Lawson 2002). Polar bears would also presumably favor these same areas because of the higher density of seals. Fewer marine mammal encounters were expected in the open water where the seismic activities were conducted than within the ice floes and along the ice margin where much of the non-seismic observation effort was conducted. In non-seismic periods, the highest sighting rates were for pinnipeds in water (85.2 seals/1000 km of useable effort), distantly followed by polar bears (0.9 bears/1000 km) and pinnipeds on ice (0.3 seals/1000 km). The large difference in sighting rates between seals in water and seals on ice could be due in part to seals that were initially hauled out on ice entering the water as the vessel approached. Useable sightings only occurred during non-seismic periods.

Reduced visibility due to fog (visibility <3.5 km) was the most common reason that sightings and effort were considered non-useable (53.9% of non-useable data), followed by insufficient ship speed (speed < 2 knots, 32.6% of non-useable data). During non-seismic periods, the detection rate of non-useable sightings was about ⅞ of that for useable sightings (Table 6.12), which is a rather high fraction. In other studies, including the 2006 *Gilavar* effort in the Chukchi Sea (Table 6.1), sighting rates during non-useable periods have often been proportionally lower relative to those during useable periods.

Other Vessels.—The IHA required that MMOs record the number and characteristics of vessels <5 km from any marine mammal sightings (Appendix A). There were few vessels near the *Henry C.* during the 2006 monitoring period. Vessels that were present in the eastern half of the study area were generally barges. Most of these vessels were at distances >5 km; however two vessels were sighted at ~3.5 km from the *Henry C.* No marine mammals were sighted while another vessel was known to be within 5 km of the *Henry C.*; therefore, no obvious reactions by marine mammals to other vessels were observed.

Distribution of Marine Mammals

Marine mammal sightings in the study area are listed in Table G.6. Observations during the Beaufort Sea operations indicate that, as expected, the ringed seal was the most abundant species in the study area (Table 6.11). The large number of ringed seal sightings was expected based on limited previous survey efforts. Ringed seals were seen throughout the survey area wherever visual observations occurred, including before and after seismic operations (Fig. 6.1; Tables 6.11, G.6). The majority of mammal sightings occurred in the southern portion of the cruise, where ice coverage was presumably.

TABLE 6.12. Detection rates for sightings from the *Henry C.* during non-seismic, post-seismic, and seismic monitoring in the Beaufort Sea, 3 Aug. to 3 Oct. 2006. All pinnipeds were seals.

	Non-Seismic			Post-Seismic			Seismic			*Total*		
Effort Type	**No. of Detect.**	**Effort (km)**	**Detection Rate (No./1000 km)**	**No. of Detect.**	**Effort (km)**	**Detection Rate (No./1000 km)**	**No. of Detect.**	**Effort (km)**	**Detection Rate (No./1000 km)**	**No. of Detect.**	**Effort (km)**	**Detection Rate (No./1000 km)**
Useable[a]												
Pinnipeds in water	271	3179	85.2	0	0	--	0	60	--	***271***	***3239***	***83.7***
Pinnipeds on ice	1	3179	0.3	0	0	--	0	60	--	***1***	***3239***	***0.3***
Polar bears	3	3179	0.9	0	0	--	0	60	--	***3***	***3239***	***0.0***
Total useable	***274***	***3179***	***86.2***	***0***	***0***	***--***	***0***	***60***	***--***	**275**	**3239**	**84.9**
Non-Useable[b]												
Pinnipeds in water	134	1783	75.2	3	85	35.3	0	38	--	***137***	***1906***	***71.9***
Pinnipeds on ice	5	1783	2.8	0	85	--	0	38	--	***5***	***1906***	***2.6***
Polar bears	1	1783	0.6	0	85	--	0	38	--	***1***	***1906***	***0.5***
Total non-useable	***135***	***1783***	***75.7***	***3***	***85***	***35.3***	0	***38***	***--***	**143**	**1906**	**75.0**
All	***409***	***4962***	***82.4***	***3***	***85***	***35.3***	***0***	***98***	***--***	**418**	**5145**	**81.2**

[a] Useable detections are those made during useable daylight visual observations; see *Acronyms and Abbreviations* for the definition of "useable" observation effort.

[b] Includes the "Post-seismic" category.

greater, and could be considered the ice margin. The lowest concentration of marine mammal sightings occurred along the more northerly parts of the tracklines where ice coverage was less dense, or occurred outside the shallow-hazards survey areas, where there was less observation effort.

Polar bears were sighted infrequently, but throughout the duration of the cruise, in areas close to land and ice. Useable sightings occurred during August and September 2006, and there was a non-useable sighting in October. Of the two sightings in August, both were on ice. The first sighting was of a single adult bear feeding on a seal. The bear did not react overtly to the presence of the vessel. The second sighting was of a mother and cub. Both bears entered the water upon noticing the vessel and began swimming away. The single observation in September consisted of a lone adult swimming parallel to and heading astern of the vessel. The behavior of the animal did not appear to be altered due to vessel presence. On 1 October 2006, there was a sighting of 2 adults and 3 cubs resting on Cross Island; this was classified as "non-useable" due to insufficient visibility. An additional opportunistic sighting was recorded at Cross Island on 30 September 2006, but the data were not included in the results because the vessel was anchored when the observation occurred. Two adults and four other bears were resting on ice near whale bone piles north of the island.

Marine Mammal Behavior

The data collected during visual observations provide information about behavioral responses of marine mammals to the seismic survey. The relevant data collected from the *Henry C.* include estimated closest observed points of approach (CPA) to the vessel, movement relative to the vessel when the airguns were not firing, and observed behavior of animals at the time of the initial sightings. CPA of marine mammals to the vessel was calculated from the location airguns would have been positioned if deployed.

Closest Observed Point of Approach

The mean CPA for pinnipeds (seals) in water was 249 m (n = 271), which was about 1/6th of that for polar bears on ice and in the water combined (1486 m; n = 3). These figures consider only useable sightings, all of which were during non-seismic periods (Table 6.13). The difference is reduced if only the animals in water are considered (249 m vs. 593 m; n = 271 vs. 2), as the most distant polar bear sighting was on land. In the absence of any sightings during seismic periods, nothing can be said about CPA values during seismic vs. non-seismic periods.

TABLE 6.13. Closest observed points of approach (CPA) of useable marine mammal sightings during the *Henry C.'s* non-seismic and seismic operating periods in the Beaufort Sea, 3 August to 3 October 2006. No sightings were observed during seismic activity. All pinnipeds were seals.

		Non-seismic			
Taxonomic Group[a]	**No. of Sightings**	**Mean CPA (m)**	**s.d.**	***n***	**Range (m)**
Pinnipeds in Water	271	249	200	271	1301
Pinnipeds on Ice	1	97	--	1	--
Polar Bears	3	1486	1555	3	2943

[a] Includes only useable sightings as defined in *Acronyms and Abbreviations.*

For seals in water, the mean CPA distance found during this project was 249 m (n = 271). The mean CPA distance would be less than the mean of the initial sighting distances. Nonetheless, the mean CPA value for 2006 is higher than the mean initial sighting distances in 5 of 6 prior years of seismic monitoring in the Alaskan Beaufort Sea: In 1996 to 2001, mean sighting distances to seals observed during non-seismic periods ranged from 113 m in 1998 to 294 m in 2000 (Table 3.9 *in* Moulton and Lawson 2002). The relatively high mean value in 2006 (despite the fact that it summarizes CPA distances and not initial sighting distances) is probably related to two factors: the good visibility afforded by the high conning tower on the *Henry C.*, and to the relatively low Beaufort state that prevailed due to the proximity of ice.

Categories of Behavior

The two behavior variables that were examined quantitatively were the same as for the Chukchi Sea (see earlier): behavior category and movement category when the animal(s) were first observed (see Appendix E for variables and definitions). The CPA distance recorded for each sighting was also an indicator of behavior (see above and Appendix E).

Sample sizes for this cruise were small and there were no useable sightings during the limited seismic operations. However, previous studies in the Alaskan Beaufort Sea have provided comparable data on seal behavior in the presence and absence of airgun operations (e.g., Moulton and Lawson 2002). The 2006 data from non-seismic periods could be useful as a basis of comparison with any future related results. The 2006 results are presented in Tables 6.14 and 6.15.

Movement.—During non-seismic periods, pinnipeds (mainly ringed seals) in the water were most often seen swimming toward the vessel (24.6% of sightings for which "movement category" was recorded; Table 6.14). The second most frequently observed movement was swimming parallel to the vessel (12.5%). A single record of a pinniped first observed on ice was categorized as hauled out (although it dove into the water from the hauled out position).

A polar bear first observed on ice was included with all other polar bear sightings in Table 6.14 and recorded as stationary (no movement).

First Observed Behavior.—Across all categories of animals, the most common "first observed behavior" during non-seismic periods was "looking" (Table 6.15). Looking was the first observed behavior for 30.5% of the seal sightings during non-seismic periods. However, pinnipeds observed in the water were nearly as likely (24.4%) to dive as they were to look at the vessel as it approached (Table 6.15). The single pinniped that was observed hauled out on ice dove into the water as the vessel passed (Table 6.15). Polar bear activity was variable, as they were observed actively feeding or swimming during three separate useable sightings.

Mitigation Measures Implemented

No power downs or shut-downs of the airguns were necessary or requested due to marine mammal sightings within the 180 and 190 dB safety radii during the Beaufort Sea shallow-hazards survey. All sightings of marine mammals occurred during non-seismic periods.

Estimated Number of Pinnipeds Present and Potentially Affected

It is difficult to obtain meaningful estimates of "take by harassment" for several reasons, as enumerated in the corresponding Chukchi Sea section, earlier. During the 2006 vessel-based monitoring in the Beaufort Sea, there were additional factors to consider: • Several of the sightings were of seals and polar

TABLE 6.14. Movement categories recorded for useable marine mammal sightings in water during the *Henry C.*'s Beaufort Sea cruise, 3 Aug. to 3 Oct. 2006. All useable sightings were non-seismic and are presented as number of groups with number of individuals in parentheses. See Appendix E for definitions of movement categories. All pinnipeds were seals.

	Movement Relative to Vessel									
Taxonomic Group[a]	**Mill**	**Swim Away**	**Swim Parallel**	**Swim Toward**	**Flee**	**Swim Across Bow**	**No movement**	**Unknown**	**Total Known**	***Total***
Pinnipeds in Water										
Non-seismic	6(12)	99(102)	29(31)	57(63)	5(5)	17(18)	19(19)	39(39)	232(250)	***271(289)***
Polar Bears										
Non-seismic	--	2(3)	--	--	--	--	1(1)[b]	--	3(4)	***3(4)***

[a] Includes only useable sightings are as defined in *Acronyms and Abbreviations*.

[b] Polar bear observed on ice.

TABLE 6.15. First observed behavior of useable marine mammal groups during he *Henry C.*'s Beaufort Sea cruise, 3 Aug. to 3 Oct. 2006. All useable sightings were non-seismic and are presented as number of groups with number of individuals in parentheses. See Appendix E for definitions of behavior. All pinnipeds were seals.

Taxonomic Group	**Breach**	**Dive / Front Dive**	**Feed**	**Fluke**	**Log**	**Look**	**Rest**	**Surface Active**	**Sink**	**Surface-active Travel**	**Swim**	**Thrash**	**Travel**	**Unknown**	**Total Known**	***Total***
Pinnipeds in Water																
Non-seismic	1(1)	68(73)	4(4)	1(1)	5(5)	85(93)	2(2)	7(12)	7(7)	1(1)	56(56)	19(19)	15(15)	--	271(289)	***271(289)***
Pinnipeds on Ice																
Non-seismic	--	1(1)	--	--	--	--	--	--	--	--	--	--	--	--	1(1)	***1(1)***
Polar Bears																
Non-seismic	--	--	--	--	--	--	--	--	--	--	1(1)	--	1(2)	1(1)[b]	2(3)	***3 (4)***

[a] Includes only useable detections as defined in *Acronyms and Abbreviations*.

with seismic operations was very limited, and there were no useable marine mammal sightings with seismic operations.

Disturbance and Safety Criteria

Table 5.2 shows estimated received sound levels at various distances from a 4-airgun array with total volume 240 or 280 in^3. The 120, 160, and 170 dB rms radii quoted in Table 5.2B,C are assumed disturbance criteria, and they are based on limited acoustic measurements in the Beaufort Sea made by Greeneridge Sciences (see Chapter 4). The most protective empirical measurements by Greeneridge Sciences (see Chapter 4, Table 5.2B) were used to calculate areas ensonified and potential exposures.

The 180 and 190 dB radii are safety radii, used in determining when mitigation measures were required. During this and many other recent projects, NMFS has required that mitigation measures be applied to avoid, or minimize, the exposure of cetaceans and pinnipeds to impulse sounds with received levels ≥180 dB and ≥190 dB re 1 µPa (rms), respectively. Given the lack of mammal sightings during SOI's brief periods of airgun operations in the Beaufort Sea in 2006, no power downs or shut downs of the airguns were required. However, the safety and disturbance radii were used after the field season to estimate numbers of marine mammals exposed to various received sound levels.

This section applies two methods to estimate the number of pinnipeds exposed to seismic sound levels strong enough that they might have caused disturbance or other effects. The first procedure is based on direct observations of seals exposed to airgun sounds. The second is based on an indirect estimation process that involves calculating the total areas ensonified by various levels of sound (Appendix E, Table E.3), and multiplying those areas by the estimated density of seals within the study area (Appendix I, Table I.2).

Estimates from Direct Observations

The number of marine mammals observed close to the *Henry C.* during Beaufort Sea monitoring provides a minimum estimate of the number potentially affected by seismic sounds. This is likely an underestimate of the actual number potentially affected. Some animals probably moved away before coming within visual range, and not all of those that remained would have been seen by observers.

Seals Potentially Exposed to Sounds ≥190 dB re 1 µPa (rms).—During this project, no marine mammals were sighted within the small safety radius around the airguns while seismic operations were conducted. The estimated 180 dB and 190 dB radii shown in Table 5.2 are the *maximum* distances from the airguns where sound levels were expected to be ≥180 or ≥190 dB re 1 µPa (rms). These distances would have been applied as mitigation radii if any marine mammals had been seen during airgun operations. As no marine mammals were seen during airgun operations in the Beaufort Sea, the direct estimate of numbers exposed to ≥190 dB rms was zero.

Marine Mammals Potentially Exposed to Sounds ≥160 dB re 1 µPa (rms).—Likewise, no marine mammals were sighted in the water under "useable" (or non-useable) conditions during the Beaufort Sea cruise when the airguns were operating (Tables ES.1, G.6).

Estimates Extrapolated from Density

The numbers of mammals directly sighted by MMOs underestimate the actual numbers, as described in the Chukchi Sea section earlier. Indirect estimates based on the ensonified area and estimated mammal density provide alternative estimates that can avoid this underestimation.

The methodology used for the indirect estimates was described briefly in Chapter 5 and in further depth in Appendix E. Methods used to estimate the areas exposed to received levels ≥160, ≥170, ≥180 and ≥190 dB were described there. Densities of marine mammals in the study area were estimated based on direct observations during non-seismic periods, analyzed using standard line-transect estimation procedures, and adjusted to allow for missed animals.

The aforementioned densities were used to estimate both the number of different *individual* marine mammals exposed to 160, 170, 180, and 190 dB rms, and the number of *exposures* of marine mammals to the various levels. As discussed in the Chukchi Sea section, estimated number of exposures will exceed the estimated number of different individuals exposed if the airguns are towed back and forth through the same region a number of times, exposing some animals to airgun sound on more than one pass.

The estimates provided here are based on the actual airgun operations during the Beaufort Sea portion of this project. In contrast, the estimates provided in the IHA application and EA for this project were based on the then-anticipated amount of survey. The estimates in the IHA Application assumed that SOI would conduct far more seismic surveying in the Beaufort Sea than actually occurred. The requested "takes" by Shell Offshore Incorporated in the Beaufort Sea included those from the planned 3-D work that was not conducted. Thus, the present estimates of numbers actually exposed to various sound levels are lower than those anticipated in the IHA Application. In addition, the following estimates assume that all mammals present were well below the surface, and that mammals did not move away from the path of the approaching *Henry C.* Those assumptions probably did not apply to all animals, so (as described earlier for the Chukchi Sea), indirect estimates based on densities in non-seismic periods are probably overestimates. Also, the estimated number of animals exposed could be further overstated because the size of the airgun array assumed in these calculations (4 airguns totaling 280 in^3) exceeded the size used for the majority of seismic acquisition in the Beaufort Sea (2 guns totaling 140 in^3).

Pinnipeds.—Estimates of the densities of pinnipeds in the Beaufort Sea study area are given in Appendix I (Table I.2), based on useable sightings and observation effort from the *Henry C.* during non-seismic periods, and including approximate corrections for sightability biases. These corrected densities were used to estimate the number of marine mammals that were exposed to various received levels of airgun sound, and thus potentially affected by seismic operations (Table 6.16). The table summarizes the estimated numbers of seals that might have been exposed to sounds with various received levels, along with the number of "takes" for which authorization was requested in Shell's IHA Application for the Beaufort Sea (SOI 2005a). As noted in the preceding paragraph, the numbers in Table 6.16 are probably overestimated.

NMFS commonly specifies that marine mammals exposed to pulsed sounds with received levels ≥160 dB re 1 µPa (rms) should be considered potentially disturbed. However, most pinnipeds are unlikely to be disturbed appreciably by airgun sounds when exposed to received levels of 170 dB (Harris et al. 2001; Moulton and Lawson 2002). These are not considered to be "all-or-nothing" criteria; some individual mammals may react strongly at lower received levels, but others are unlikely to react strongly unless levels are substantially above 160 or 170 dB.

(A) ≥160 dB (rms): We estimate that there would have been ~180 exposures of ~149 different individual seals (ringed, bearded, and spotted) to airgun pulses with received levels ≥160 dB re 1 µPa (rms) during the shallow-hazards survey if all seals were below the surface of the water and showed no avoidance of the approaching vessel, and if the 4-airgun 280-in^3 source had been used for all airgun operations (Table 6.16). Given the predominance of ringed seals in the Beaufort Sea, most of the exposures would have been of ringed seals, with lesser numbers of exposures of bearded and spotted seals.

TABLE 6.16. Estimated numbers of exposures, and estimated minimum numbers of individual pinnipeds (ringed seals, spotted seals, and bearded seals) that might have been exposed, to sounds with various received levels during airgun operations from the *Henry C*. Numbers of exposures are overestimated as the calculations assume that all seals were in the water well below the surface, that they did not move away from the approaching airguns, and that all airgun operations were with a 4-airgun 280 in^3 array (see text). Also shown in boldface is the "harassment take" authorized by NMFS under the IHA.

Exposure level in dB re 1 µPa (rms)	**Estimated total**		***Requested Take***
	Exposures	**Individuals**	
160	180	149	***2206***
170	66	63	
180	24	23	
190	9	8	

(B) ≥170 dB (rms): Seals were unlikely to be disturbed unless exposed to received levels of airgun sounds ≥170 dB re 1 µPa (rms). If so, then the estimated number of exposures would be ~37% of the corresponding estimates for ≥160 dB, based on the proportionally smaller areas exposed to ≥170 dB. Overall, there would have been ~66 exposures of seals, involving ~63 individuals, to seismic sounds with received levels ≥170 dB (Table 6.16).

(C) ≥180 dB (rms): Some seals probably were within the 180 dB radius around the operating airguns but were not seen by the observers even though all airgun operations were in daylight. The 180 dB radius for the 4-airgun 280-in^3 source was empirically measured by Greeneridge Sciences as 250 m (Tables 4.7, 5.2). Based on the densities of seals estimated from this project's sighting data under non-seismic conditions, there would be ~24 exposures of seals to ≥180 dB, involving ~23 individuals, under the assumptions listed under (A) above (Table 6.16). The latter estimate far exceeds the zero seals observed directly in areas possibly exposed to ≥180 dB (Table G.6). The difference can be attributed, in part, to the fact that the estimates in Table 6.16 include any seals that

- avoided exposure to ≥180 dB by swimming away from the approaching shallow-hazards survey vessel before entering the 180 dB radius, or
- were present but missed by visual observers because of the inevitable difficulties in sighting small seals in the water in the presence of ice, glare, wave action, etc. [Earlier studies have shown that the detectability of ringed seals in the water diminishes rapidly as distance increases beyond about 50 m—Harris et al. (2001); Moulton and Lawson (2002).]

(D) ≥190 dB (rms): Likewise, based on the densities of seals calculated from our sighting data, we estimate that there would have been 9 exposures of 8 different seals to airgun sounds with received levels ≥190 dB (rms) given the usual assumptions: all seals were below the surface, they showed no avoidance, and the total volume of 4 airguns was 280 in^3 (Table 6.16). However, some of these seals likely would have swum away before the received level reached 190 dB. Others might not have been far enough below the surface to be exposed to ≥190 dB. Also, given the use of a smaller airgun source part of the time, the 190 dB radius sometimes would have been less than the assumed 89 m. Thus, the actual number exposed to ≥190 dB was probably lower than the above estimates.

Aerial Surveys for Cetaceans

Monitoring Effort

Aerial surveys were flown on 23–24 Sept. to "clear" the area out to the 120 dB distance, i.e., to assess the occurrence of bowhead whales within that distance of locations where the *Henry Christoffersen* was about to conduct airgun operations. During the aerial survey on 23 Sept., 45.1 km of transect surveys were flown, of which 35.5 km were flown in good conditions (Bf < 5 and/or sightability ≤ 3). There was one sighting of a bowhead whale during this survey (Fig. 6.2). On 24 Sept., 174.3 km of transect surveys were flown, of which 152.9 km were flown in good conditions. No whales were seen during this survey. Poor weather prevented complete surveys from being flown on either of the days.

Additional aerial surveys were flown by LGL for Shell in the Beaufort Sea during the 26 Aug. through 24 Sept. period. However, in the absence of airgun operations by the *Henry C.* on any dates in September other than 25 Sept., only the surveys on 23–24 Sept. were needed for purposes of "clearing" an area where the airguns were about to be used.

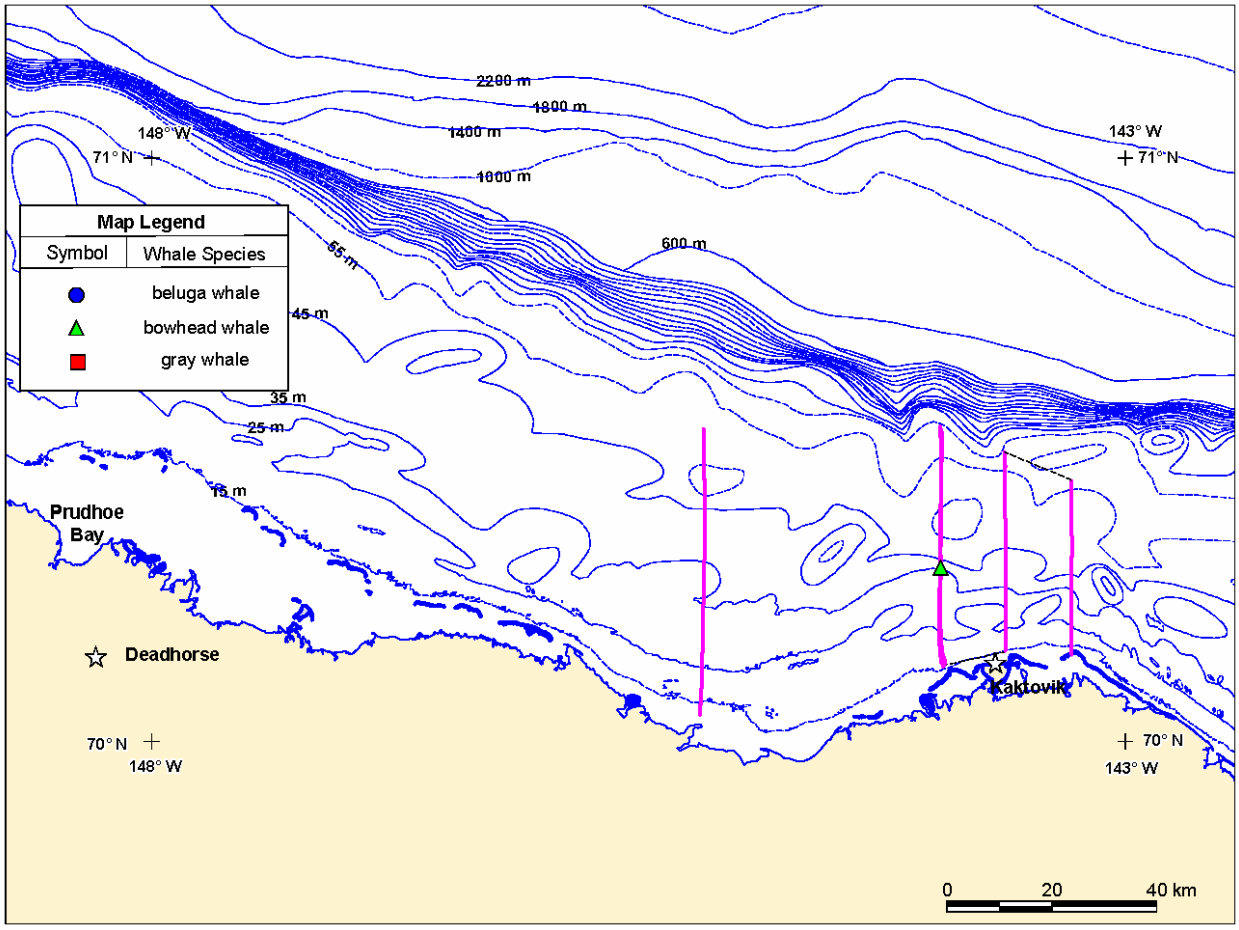


FIGURE 6.2. Aerial survey transects (purple lines) flown by LGL on 23–24 Sept. 2006 in the central Alaskan Beaufort Sea. The third transect from the right was flown twice, on both 23 and 24 Sept.; other transects were flown once.

Distribution of Cetaceans

All whale sightings during LGL/Shell aerial surveys in the Beaufort Sea during late August and September 2006 are shown in Figure 6.3.

In 2006, nearly all bowhead whales sighted during the surveys were found in waters between the 40 m and 100 m depth contours. Only one bowhead sighting occurred shoreward of the 30 m depth contour. Bowhead sightings were concentrated in waters from 40 m to 100 m deep, ~30 to 60 km from shore. Ice conditions during the 2006 field season consisted of a band of pack ice (5 to 40% ice cover) from the shore out to ~20 to 40 km. Beyond this band of ice the waters were open with 0% ice cover. Most bowhead sightings were either at the northern edge of the pack ice in about 5–10 % ice cover, or north of the pack ice in the open water. The most numerous bowhead sightings occurred on 4 Sept. with 13 sightings of 20 bowhead whales, and on 6 Sept. with 14 sightings of 22 bowhead whales. Numbers of sightings during the surveys prior to and after these two varied from 1 to 5. Group sizes throughout the field season varied from 1 to 4, and the predominant activity observed was traveling in a westerly direction.

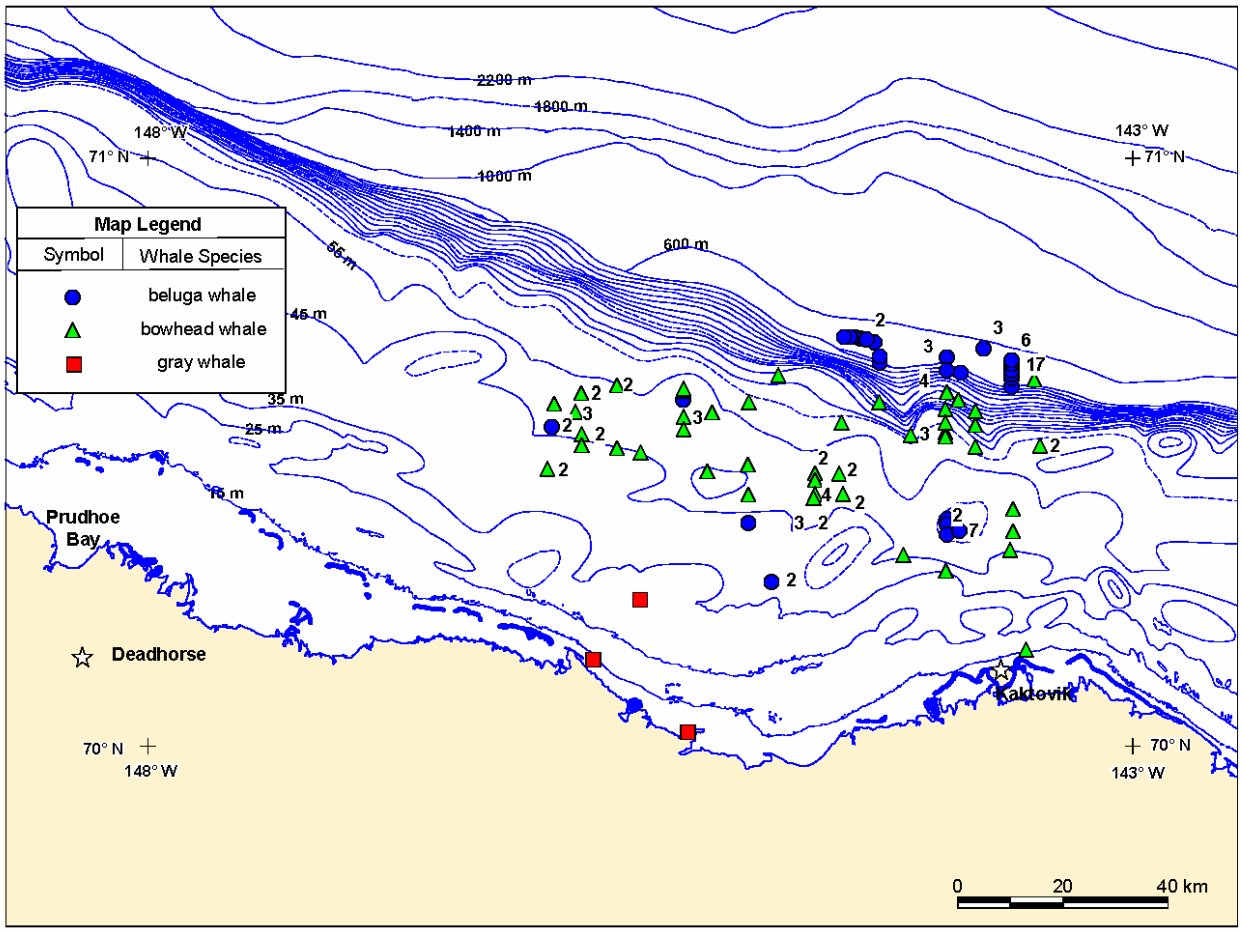


FIGURE 6.3. All whale sightings (on and off transect) in the 2006 SOI shallow-hazards survey area from 26 Aug. to 24 Sept. 2006 based on LGL/Shell aerial surveys. The center of the area of airgun operation on 25 Sept. 2006 is depicted with the ⊗ symbol. Numbers beside symbols indicate group sizes when group size > 1.

Beluga whale sightings were primarily concentrated at the northern end of the transect lines near the 200 m depth contour in 0% ice cover, with a few scattered sightings closer to shore around the 40 m depth contour (Fig. 6.3). The beluga sightings were most numerous on 6 Sept. with 22 sightings of 52 beluga whales. The numbers of sightings during surveys prior to and after 6 Sept. varied from 0 to 4. Group sizes varied from 1 to 7, except for one sighting of 17 beluga whales on 6 Sept. The predominant activity observed was traveling in a southwesterly direction.

Gray whales were seen near the Canning River Delta on three occasions (two on 4 Sept. and one on 14 Sept.). On all three occasions there was only a single whale observed. Of the three gray whales observed, two were traveling and the third was feeding.

Mitigation Measures Implemented

One bowhead whale was sighted on 23 Sept. (Fig. 6.2) but there were no sightings during the 24 Sept. survey. That cleared the area out to the 120 dB distance from the area of planned airgun operations, which proceeded on 25 Sept. No aerial surveys were flown on 25 Sept. due to poor weather conditions.

Estimated Number of Cetaceans Present and Potentially Affected

The three received level criteria that have been specified by NMFS as relevant in estimating cetacean "take by harassment" are as follows:

- 180 dB re 1 μPa (rms), above which there is concern about possible effects on hearing;
- 160 dB re 1 μPa (rms), above which avoidance and other behavioral reactions are likely; and
- 120 dB re 1 μPa (rms), above which displacement of migrating bowhead whales can occur (bowhead mother/calf pairs must be monitored and not exceed three) (NMFS 2006a).

180 dB Criterion.—NMFS (1995, 1999) concluded that noise pulses from a nearby seismic vessel might affect the hearing abilities of baleen whales if received levels exceed 180 dB re 1 μPa rms. The IHA issued for Shell's 2006 seismic program (NMFS 2006a; see Appendix A) called for immediate shutdown if cetaceans were detected within the 180 dB (rms) radius. It is assumed that the received rms pulse levels might have been 180 dB re 1 μPa or more at distances as great as 330 m (Table 5.2B) from the Henry C. The 330 m value is based on the preliminary field measurements and is more protective than the final field measurement of 250 m for 180 dB re 1 μPa (Table 5.2B,C).

MMOs working onboard the *Henry C.* saw no bowhead whales within (or beyond) the 180 dB distance on 8 Aug. or 25 Sept. when the airguns were operating. It is unlikely that an MMO would miss a bowhead within the 180 dB distance if it was at the surface, and even if it were submerged, the MMO probably would have seen the bowhead earlier or later when it did eventually surface. Thus, the estimated number of bowhead whales exposed to sound pulses with received levels ≥ 180 dB re 1 μPa rms is **zero**.

No beluga whales were sighted by MMOs working onboard the *Henry C.* within the 180 dB radius on 8 Aug. or 25 Sept. when seismic activity was underway. It is unlikely that a beluga was present during this time given the rarity of belugas in nearshore waters in this area during summer and autumn.

160 dB Criterion.—NMFS' practice involving impulsive sounds such as seismic has been to assume that a "take by harassment" may occur if cetaceans are exposed to received levels of sound that exceed 160 dB re 1 μPa rms. Takes of this type involve avoidance and other short-term changes in behavior that occur at distances well beyond those where there is any reasonable possibility of injury to the whales (Richardson

et al. 1986, 1995:372ff; Ljungblad et al. 1988; NMFS 1995). We assume that the 160 dB (rms) distance for Shell's 2006 shallow-hazard source may have been as much as 2.22 km (Table 5.2B) from the Henry C.

MMOs working onboard the *Henry C.* saw no bowhead whales within the 160 dB distance on 8 Aug. or 25 Sept. when airgun operations were underway. We have no specific information on the probability that boat-based observers will sight a bowhead that is within 2.22 km of the vessel. However, given that bowhead whales are below the surface a high proportion of the time, it is possible that a bowhead could have been within 2.22 km of the source vessel when the airguns were operating. However, bowheads were unlikely to have been in the area by 8 Aug. Also, the bulk of the bowhead migration in Sept. 2006 was well offshore, some 20 km north of the seismic operations. Thus, it is unlikely that many (if any) bowheads were within 2.22 km of the shallow-hazards survey vessel during the brief period of airgun operations.

No beluga whales were sighted by MMOs working onboard the *Henry C.* within the 160 dB distance on 8 Aug. or 25 Sept. when seismic activity was underway. It is unlikely that a beluga was present during this time given the rarity of belugas in nearshore waters in this area during late summer and autumn.

120 dB Criterion.—In 2006, NMFS specified that it should be assumed that a "take by harassment" may occur if ≥4 bowhead cow/calf pairs are exposed to received levels of sounds that exceed 120 dB re 1 μPa rms. Takes of this type, if they occurred, would involve avoidance and other short-term changes in behavior that sometimes occur at distances far beyond those where there is any reasonable possibility of injury to the whales (Richardson et al. 1986, 1995:372ff; NMFS 1995; Miller et al. 1999). It is assumed that the 120 dB (rms) distance for Shell's 2006 shallow-hazards source was as much as 22.2 km (Table 5.2B) from the Henry C. Again, that value considers all aspects and is based on modeling; the measured value, in the along-trackline direction, was 22.2 km (Tables 4.7, 5.2C).

One bowhead was sighted within the 120 dB distance on 23 Sept., two days prior to airgun operations. That survey provided about 15% coverage of the area within which received levels were expected to be ≥120 dB. It is conceivable that, had aerial surveys been flown on 25 Sept., there might also have been one or more sightings of bowhead whales on that day. Based on the overall distribution of bowhead whales in the 2006 field season, the presence of bowheads is plausible at that date and location. The average detection probability for bowhead whales during late summer/autumn aerial surveys in the central Beaufort Sea is 14.4%, considering all whale activities (Thomas et al. 2002). Based on that, and the one sighting on 23 Sept., the number of bowheads that may have been exposed to the 120 dB re 1 μPa is on the order of **fifteen** bowheads. The calving success of bowheads in 2006 has not been quantified but the proportion of the bowheads that are calves varies between about 2 and 10% of the population (Koski et al. 1993). Even if 2006 was an optimal calving year, it is unlikely that more than 1–2 mother/calf pairs would have been exposed to 120 dB based on the above considerations. These estimates would apply if the bowheads did not avoid the area around the operating seismic vessels before approaching the various radii.

Bowhead whales generally avoid areas around operating seismic vessels, but the avoidance distance varies widely depending on some combination of region, season, and bowhead activity. At some times and places, bowheads generally begin to show active avoidance upon receiving airgun sounds with levels above ~160 dB re 1 μPa rms (Richardson et al. 1986; Ljungblad et al. 1988; Richardson and Malme 1993; G. Miller et al. 2005; LGL unpubl. data). However, migrating bowheads in nearshore

waters of the Alaskan Beaufort Sea in autumn 1996–1998 showed avoidance at lower received levels and longer distances (Miller et al. 1999; Richardson et al. 1999).

SUMMARY OF CHUKCHI AND BEAUFORT SEA MONITORING RESULTS

Vessel-Based Monitoring Effort

Marine mammal observers aboard the *Gilavar* conducted 13,527 km and 1537 h of visual observation, and MMOs aboard the *Kilabuk* conducted 14,058 km and 1251 h of visual observation, together documenting 353 sightings of 442 pinnipeds and 115 sightings of 219 cetaceans. There were numerous sightings of supply and chase vessels within 5 km of each of the observation vessels.

A total of 8213 km and 526 hours of visual observation were conducted aboard the *Henry Christoffersen*, during which 412 sightings of 451 marine mammals were logged. Ringed seals were the most abundant. No sightings were noted during the brief period with airgun operations. Few vessels were sighted during the cruise, and only two of these approached within 5 km of the vessel.

Estimated Number of Marine Mammals Present and Potentially Affected

Based on direct observations from the *Gilavar*, it is estimated that 24 seals were potentially exposed to sound levels ≥180 dB re 1 µPa (rms). Estimates for individual pinnipeds and cetaceans potentially exposed to sound levels ≥160 dB re 1 µPa (rms) are 1317 and 198 respectively.

No animals observed from the *Henry Christoffersen* were potentially exposed to sound levels ≥180 dB re 1 µPa (rms). Based on calculations involving estimated densities of marine mammals, there would have been approximately 180 seals exposed to sound levels ≥160 dB re 1 µPa (rms).

Aerial Survey Effort

On the two days of surveying for mitigation purposes, 219.4 km of transect was flown, of which 188.4 km were flown in good surveying conditions. There was one sighting of a bowhead during these surveys.

AVAILABILITY OF MARINE MAMMALS FOR SUBSISTENCE PURPOSES

SOI exerted a concerted effort to assure that their seismic operations in the Chukchi and Beaufort Seas did not adversely affect subsistence hunting. Representatives of SOI visited rural communities in the spring, months before the project started, to discuss the project with the people who use the Chukchi and Beaufort Seas as their hunting ground. The SOI representatives sought input on how to best accomplish the seismic survey without interfering with subsistence harvests. SOI signed the CAA that outlined strategies of communication and operations to best avoid any impact on subsistence hunting.

In accordance with the CAA, SOI's seismic surveys were arranged to avoid areas of subsistence whaling during the hunting seasons at the various communities. Early in the season Shell's activities in the Chukchi Sea were delayed until after the beluga whale hunt was completed. Later in the year this coordination was effective in preventing the seismic activities from influencing the migration pattern of bowhead whales and affecting the whales' availability. The *Henry C.* worked in the western part of the SOI's Beaufort Sea study area until the whalers to the east, operating from Kaktovik and Cross Island, landed their quotas of whales. The *Henry C.* then moved to the east side of the study area while subsistence whaling was conducted out of Barrow.

All of the vessels involved in the SOI project communicated at least once daily with Communication Centers that were established to relay information between subsistence hunters and seismic and other vessel operators. The locations and activities of each vessel were reported to the Communication Centers. If subsistence hunting was being conducted in an area where seismic or other support activities had been planned, the communicators would have conveyed that information to the vessel personnel and the vessel's work location would have been adjusted accordingly. One instance of this occurred on 6 Sept. when a support vessel, being used to deploy acoustic recorders, turned back when Nuiqsut whalers asked them not to proceed offshore of the Cross Island area. Also, if the whalers had perceived a shift in the bowheads' migration route, the vessels would have been asked to move the operations further away from the subsistence hunting area.

Additional measures that helped reduce the impacts of the Shell operations on subsistence hunting were seasonal accommodations in operations of the *Henry C.,* the decision not to bring the *Gilavar* into the Beaufort Sea in Sept., and the decision to send the *Gilavar* south before many bowhead whales arrived in the Chukchi Sea (where one or two communities planned to conduct fall hunts in 2006). In general, the efforts of SOI to prevent their seismic operations from affecting the availability of marine mammals to subsistence hunters were successful. Kaktovik, Barrow, and Nuiqsut all had successful hunts in 2006.

7. ACKNOWLEDGEMENTS

We thank all of the marine mammal observers (MMOs)—biologists and Inupiat—who participated in the project. They were essential to the completion and success of this endeavor. We thank the captains and crews of the *Gilavar*, the *Jim Kilabuk*, the *Gulf Provider*, the *Peregrine*, and the *Henry Christoffersen* for their support during the cruises. Additionally, we appreciate the help of John Davis and his team at WesternGeco and Mike Schlegel and his team (Geo LLC). We thank the pilots and crew of ERA Aviation for their help with the aerial survey program. We also thank representatives of the National Marine Fisheries Service, U.S. Fish & Wildlife Service, North Slope Borough Department of Wildlife Management, Alaska Eskimo Whaling Commission and Minerals Management Service for their advice and comments during the "open-water meetings" convened by NMFS in April and October 2006 and at various other times. Michael Macrander, Paul Smith, Mark Kosiara, Bob Rosenbladt, Peter Littlewood, Dan Taylor, Travis Allen, Susan Childs, Jason Smith, and Rick Fox at Shell made it easy for us to do our jobs. Additional acknowledgements associated with the acoustical measurements are listed near the end of Chapter 4 in this report.

8. LITERATURE CITED

Amstrup, S.C. 1995. Movements, distribution, and population dynamics of polar bears in the Beaufort Sea. Ph.D. Dissertation. Univ. Alaska–Fairbanks, Fairbanks, AK. 299 p.

Amstrup, S.C., T.L. McDonald and I. Stirling. 2001. Polar bears in the Beaufort Sea: a 30-year mark-recapture case history. **J. Agric. Biol. Environ. Stat.** 6(2):221-234.

Angliss, R.P. and K.L. Lodge. 2004. Alaska marine mammal stock assessments, 2003. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-144. 230 p.

Austin, M., M. Laurinolli and D. Hannay. 2006a. Preliminary acoustic level measurements of airgun sources from GX Technology Corporation's 2006 Arctic Span Seismic Survey. Rep. from JASCO Res. Ltd., Victoria, B.C. [for GX Technol. Corp., Houston, TX]. 11 p.
Available at http://www.nmfs.noaa.gov/pr/permits/incidental.htm.

Austin, M., A. MacGillivray, M. Zykov and D. Hannay. 2006b. Seismic exploration of selected lease areas in the Alaskan Beaufort Sea and Chukchi Sea / Acoustics pre-season estimate modeling report. [vers. 3.0, 21 Aug 2006]. Rep. from JASCO Res. Ltd., Victoria, B.C., for Shell Intern. Explor. & Prod. Co., Houston, TX. 78 p.

Barlow, J. 1999. Trackline detection probability for long-diving whales. p. 209-221 *In*: G.W. Garner, S.C. Amstrup, J.L. Laake, B.F.J. Manly, L.L. McDonald and D.G. Robertson (eds.), Marine mammal survey and assessment methods. A.A. Balkema, Rotterdam. 287 p.

Bengtson, J.L., P.L. Boveng, L.M. Hiruki-Raring, K.L. Laidre, C. Pungowiyi and M.A. Simpkins. 2000. Abundance and distribution of ringed seals (*Phoca hispida*) in the coastal Chukchi Sea. p. 149-160 *In:* A.L. Lopez and D. P. DeMaster. Marine Mammal Protection Act and Endangered Species Act Implemention Program 1999. AFSC Processed Rep. 2000-11, Alaska Fish. Sci. Cent., Seattle, WA.

Blackwell, S.B. 2006. Field report for validation measurements of sounds produced by airguns on M/V *Gilavar* in the Chukchi Sea on 21 July 2006, 6 Aug. ed. Rep. from Greeneridge Sciences Inc., Santa Barbara, CA [for Shell Offshore Inc., Houston, TX]. 5 p. Available at http://www.nmfs.noaa.gov/pr/permits/incidental.htm. Also included in this report as Annex 4.1.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers and L. Thomas. 2001. Introduction to distance sampling/Estimating abundance of biological populations. Oxford Univ. Press, Oxford, U.K. 432 p.

Burgess, W.C. and C.R. Greene. 1999. Physical acoustics measurements. p. 3-1 to 3-65 *In:* W.J. Richardson (ed.), Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1998. LGL Rep. TA2230-3. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Anchorage, AK, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 390 p.

Burns, J.J. 1981. Ribbon seal-*Phoca fasciata*. p. 895-109 *In:* S.H. Ridgway and R.J. Harrison (eds.), Handbook of Marine Mammals. Vol. 2. Seals. Academic Press, New York.

Calambokidis, J. and J. Barlow. 2004. Abundance of blue and humpback whales in the eastern North Pacific estimated by capture-recapture and line-transect methods. **Mar. Mamm. Sci.** 20(1):63-85.

Calambokidis, J., G.H. Steiger, J.M. Straley, T.J. Quinn, II, L.M. Herman, S. Cerchio, D.R. Salden, M. Yamaguchi, F. Sato, J. Urban R., J. Jacobsen, O. von Ziegesar, K.C. Balcomb, C.M. Gabriele, M.E. Dahlheim, N. Higashi, S. Uchida, J.K.B. Ford, Y. Miyamura, P. Ladron de Guevara, S.A. Mizroch, L. Schlender, and K. Rasmussen. 1997. Abundance and population structure of humpback whales in the North Pacific Basin. Final Contract Report 50ABNF500113 to Southwest Fish. Sci. Cent., La Jolla, CA 92038. 72 p.

Caldwell, J. and W. Dragoset. 2000. Brief overview of seismic air-gun arrays. **The Leading Edge** 19(8, Aug.):898-902.

Clark, J.T. and S.E. Moore. 2002. A note on observations of gray whales in the southern Chukchi and northern Bering Seas, August-November, 1980-1989. **J. Cetac. Res. Manage**. 4(3):283-288.

Davis, R.A., W.R. Koski, W.J. Richardson, C.R. Evans and W.G. Alliston. 1982. Distribution, numbers and productivity of the Western Arctic stock of bowhead whales (*Balaena mysticetus*) in the eastern Beaufort Sea and Amundsen Gulf, summer 1981. SC/34/PS20. Int. Whal. Comm., Cambridge, UK. 13 p.

DFO Canada. 2004. North Atlantic Right Whale. Fisheries and Oceans Canada. Available at http://www.mar.dfo-mpo.gc.ca/masaro/english/Species_Info/Right_Whale.html

Dragoset, W.H. 1984. A comprehensive method for evaluating the design of airguns and airgun arrays. p. 75-84 *In:* 16th Annu. Proc. Offshore Technol. Conf, vol. 3.

Finneran, J.J., C.E. Schlundt, R. Dear, D.A. Carder and S.H. Ridgway. 2002. Temporary shift in masked hearing thresholds in odontocetes after exposure to single underwater impulses from a seismic watergun. **J. Acoust. Soc. Am.** 111(6):2929-2940.

Gentry, R., A. Bowles, W. Ellison, J. Finneran, C. Greene, D. Kastak, D. Ketten, J. Miller, P. Nachtigall, W.J. Richardson, B. Southall, J. Thomas and P. Tyack. 2004. Noise exposure criteria. Presentation to U.S. Mar. Mamm. Commis. Advis. Commit. on Acoustic Impacts on Marine Mammals, Plenary Meeting 2, Arlington, VA, April 2004. Available at http://mmc.gov/sound/plenary2/pdf/gentryetal.pdf.

George, J.C., J. Zeh, R. Suydam and C. Clark. 2004. Abundance and population trend (1978-2001) of Western Arctic bowhead whales surveyed near Barrow, Alaska. **Mar. Mamm. Sci.** 20(4):755-773.

Gordon, J., D. Gillespie, J. Potter, A. Frantzis, M.P. Simmonds, R. Swift and D. Thompson. 2004. A review of the effects of seismic surveys on marine mammals. **Mar. Technol. Soc. J.** 37(4):16-34.

Greene, C.R. 1985. Characteristics of waterborne industrial noise, 1980-84. p. 197–253 *In:* W.J. Richardson (ed.), Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1980–84. OCS Study MMS 85-0034. Rep. from LGL Ecol. Res. Assoc. Inc., Bryan, TX, for U.S. Minerals Manage. Serv., Reston, VA. 306 p. NTIS PB87-124376.

Greene, C.R. 1987. Acoustic studies of underwater noise and localization of whale calls. Sect. 2 *In:* LGL and Greeneridge, Responses of bowhead whales to an offshore drilling operation in the Alaskan Beaufort Sea, autumn 1986. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for Shell Western E & P Inc., Anchorage, AK. 128 p.

Greene, C.R., Jr. 1997. Physical acoustics measurements. (Chap. 3, 63 p.) *In*: W.J. Richardson (ed.), 1997. Northstar Marine Mammal Marine Monitoring Program, 1996. Marine mammal and acoustical monitoring of a seismic program in the Alaskan Beaufort Sea. Rep. TA2121-2. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for BP Explor. (Alaska) Inc., Anchorage, AK, and U.S. Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 245 p.

Greene, C.R. 2006. Measurements of the acoustic sources for the shallow hazard survey by M/V *Henry Christoffersen*, 8 August 2006, Field Report. Rep. from Greeneridge Sciences Inc., Santa Barbara, CA, for Shell Intern. Offshore Inc., Houston, TX. 4 p. Also included in this report as Annex 4.2.

Greene, C.R. Jr., and W.C. Burgess. 2000. Physical acoustics measurements, 1999. p. 3-1 to 3-45 *In:* W.J. Richardson (ed., 2000), Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1999. LGL Rep. TA2313-4. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Anchorage, AK, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 155 p.

Greene, C.R., Jr. and W.J. Richardson. 1988. Characteristics of marine seismic survey sounds in the Beaufort Sea. **J. Acoust. Soc. Am.** 83(6):2246-2254.

Greene, C.R., Jr., R. Norman and J.S. Hanna. 1998. Physical acoustics measurements. p. 3-1 to 3-64 *In:* W.J. Richardson (ed.), Marine mammal and acoustical monitoring of BP Exploration (Alaska)'s open-water seismic program in the Alaskan Beaufort Sea, 1997. LGL Rep. TA2150-3. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for BP Explor. (Alaska) Inc., Anchorage, AK, and U.S. Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 318 p.

Haley, B. and D. Ireland. 2005. Marine mammal monitoring during University of Alaska Fairbanks' marine geophysical survey across the Arctic Ocean, August–September 2005. LGL Rep. TA4122-3. Rep. from LGL Ltd., King City, Ont., for University of Alaska Fairbanks, Fairbanks, AK, and Nat. Mar. Fish. Serv., Silver Spring, MD. 96 p.

Haley, B., and W.R. Koski. 2004. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic program in the Northwest Atlantic Ocean, July–August 2004. LGL Rep. TA2822-27. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 80 p.

Hannay, D.E. 2004. Noise. In: Comparative environmental analysis (CEA). Sakhalin Energy Invest. Corp. Available at http://www.sakhalinenergy.com/documents/doc33ceachp4.pdf.

Harris, R.E., G.W. Miller and W.J. Richardson. 2001. Seal responses to airgun sounds during summer seismic surveys in the Alaskan Beaufort Sea. **Mar. Mamm. Sci.** 17(4):795-812.

Harwood, L.A., S. Innes, P. Norton and M.C.S. Kingsley. 1996. Distribution and abundance of beluga whales in the Mackenzie estuary, southeast Beaufort Sea, and the west Amundsen Gulf during late July 1992. **Can. J. Fish. Aquatic Sci.** 53(10):2262-2273.

Heide-Jørgensen, M.P., N. Hammeken, R. Dietz, J. Orr and P. Richard. 2001. Surfacing times and dive rates for narwhals (*Monodon monoceros*) and belugas (*Delphinapterus leucas*). **Arctic** 54(3):284-298.

Holst, M. 2004. Marine mammal monitoring during Lamont-Doherty Earth Observatory's TAG seismic study in the mid-Atlantic Ocean, October-November 2003. LGL Rep. TA2822-21. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory, Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 42 p.

Holst, M., M.A. Smultea, W.R. Koski, and B. Haley. 2005a. Marine mammal and sea turtle monitoring during Lamont-Doherty Earth Observatory's marine seismic program in the Eastern Tropical Pacific Ocean off Central America, November-December 2004. LGL Rep. TA2822-30. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 125 p.

Holst, M., M.A. Smultea, W.R. Koski, and B. Haley. 2005b. Marine mammal and sea turtle monitoring during Lamont-Doherty Earth Observatory's marine seismic program off the Northern Yucatan Peninsula in the Southern Gulf of Mexico, January-February 2005. LGL Rep. TA2822-31. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 96 p.

Ireland, D., M. Holst, and W.R. Koski. 2005. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic program off the Aleutian Islands, Alaska, July–August 2005. LGL Rep. TA4089-3. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 83 p.

IUCN (The World Conservation Union). 2003. 2003 IUCN Red List of Threatened Species. Available at http://www.www.redlist.org

IWC (International Whaling Commission). 2000. Report of the Scientific Committee from its Annual Meeting 3-15 May 1999 in Grenada. **J. Cetac. Res. Manage.** 2 (Suppl):1-65.

Jensen, F.B., W.A. Kuperman, M.B. Porter and H. Schmidt. 2000. Computational Ocean Acoustics. Springer-Verlag, New York Berlin Heidelberg. 578 p.

Keller, A.C. and L.R. Gerber. 2004. Monitoring the Endangered Species Act: revisiting the eastern North Pacific gray whale. **Endangered Species Update** 21(3):87-92.

Koski, W.R., D.H. Thomson and W.J. Richardson. 1998. Descriptions of marine mammal populations. p. 1-182 plus Appendices *In*: Point Mugu Sea Range Marine Mammal Technical Report. Rep. from LGL Ltd., King City, Ont., for Naval Air Warfare Center, Weapons Div., Point Mugu, CA, and Southwest Div. Naval Facilities Engin. Command, San Diego, CA. 322 p.

Landro, M. 1992. Modeling of GI gun signatures. **Geophys. Prosp.** 40(7):721-747.

Laws, M., L. Hatton and M. Haartsen. 1990. Computer modeling of clustered airguns. **First Break** 8(9):331-338.

LGL Ltd. 2005a. Request by the University of Alaska Fairbanks for an Incidental Harassment Authorization to allow the incidental take of marine mammals during a marine geophysical survey across the Arctic Ocean, August-September 2005. LGL Rep. TA4122-2. Rep. from LGL Alaska Res. Assoc. Inc., Anchorage, AK, for Univ. Alaska Fairbanks, Fairbanks, AK, and Nat. Mar. Fish. Serv., Silver Spring, MD. 84 p

LGL Ltd. 2005b. Environmental assessment of a marine geophysical survey across the Arctic Ocean, August-September 2005. LGL Rep. TA4122-1. Rep. from LGL Alaska Res. Assoc. Inc., Anchorage, AK, for Univ. Alaska Fairbanks, Fairbanks, AK, and Nat. Sci. Found., Arlington, VA. 98 p.

Ljungblad, D.K., B. Würsig, S.L. Swartz and J.M. Keene. 1988. Observations on the behavioral responses of bowhead whales (*Balaena mysticetus*) to active geophysical vessels in the Alaskan Beaufort Sea. **Arctic** 41(3):183-194.

MacGillivray, A.O., N.R. Chapman and D.E. Hannay. 2004. An airgun array source signature model for environmental impact assessments**. J. Acoust. Soc. Am.** 116(4, Pt. 2):2649.

MacLean, S.A. and B. Haley. 2004. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic study in the Støregga Slide area of the Norwegian Sea, August - September 2003. LGL Rep. TA2822-20. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory, Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 59 p.

MacLean, S.A. and W.R. Koski. 2005. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic program in the Gulf of Alaska, August–September 2004. LGL Rep. TA2822-28. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 102 p.

Madsen, P.T. 2005. Marine mammals and noises: problems with root mean square sound pressure levels for transients. **J. Acoust. Soc. Am.** 117(6):3952–3957.

Madsen, P.T., M. Johnson, P.J.O. Miller, N. Aguilar Soto, J. Lynch and P. Tyack. 2006. Quantitative measures of air-gun pulses recorded on sperm whales (*Physeter macrocephalus*) using acoustic tags during controlled exposure experiments. **J. Acoust. Soc. Am.** 120(4):2366–2379.

Martin, A.R. and T.G. Smith. 1992. Deep diving in wild, free-ranging beluga whales, *Delphinapterus leucas.* **Can. J. Fish. Aquatic Sci.** 49:462-466.

McCauley, R.D., M.-N. Jenner, C. Jenner, K.A. McCabe, and J. Murdoch. 1998. The response of humpback whales (*Megaptera novaeangliae*) to offshore seismic survey noise: preliminary results of observations about a working seismic vessel and experimental procedures. **APPEA J.** 38:692–708.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000a. Marine seismic surveys: Analysis of airgun signals; and effects of air gun exposure on humpback whales, sea turtles, fishes and squid. Rep. from Centre for Marine Science and Technology, Curtin Univ., Perth, W.A., for Austral. Petrol. Prod. Assoc., Sydney, N.S.W. 188 p.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch and K. McCabe. 2000b. Marine seismic surveys – a study of environmental implications. **APPEA J.** 40:692–706.

Miller, G.W., R.E. Elliott and W.J. Richardson. 1998. Whales. p. 5-1 to 5-124 *In*: W.J. Richardson (ed.), Marine mammal and acoustical monitoring of BP Exploration (Alaska)'s open-water seismic program in the Alaskan Beaufort Sea, 1997. LGL Rep. TA2150-3. Rep. from LGL Ltd., King City, Ont., and Greenridge Sciences Inc., Santa Barbara, CA, for BP Explor. (Alaska) Inc., Anchorage, AK, and U.S. Nat. Mar. Fish. Serv., Anchorage, AK., and Silver Spring, MD. 318 p.

Miller, G.W., R.E. Elliott, W.R. Koski, V.D. Moulton, and W.J. Richardson. 1999. Whales. p. 5-1 to 5-109 *In*: W.J. Richardson (ed.), Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1998. LGL Rep. TA2230-3. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Houston, TX, and U.S. Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 390 p.

Miller, G.W., R.E. Elliott, T.A. Thomas, V.D. Moulton and W.R. Koski. 2002. Distribution and numbers of bowhead whales in the eastern Alaskan Beaufort Sea during late summer and autumn, 1979-2000. p. 9-1 to 9-39 (Chap. 9) *In:* W.J. Richardson and D.H. Thomson (eds.), Bowhead whale feeding in the eastern Alaskan Beaufort Sea: update of scientific and traditional information, vol. 1. OCS Study MMS 2002-012; LGL Rep. TA2196-7. Rep. from LGL Ltd., King City, Ont., for U.S. Minerals Manage. Serv., Anchorage, AK, and Herndon, VA. 420 p. NTIS PB2006-100382.

Miller, G.W., V.D. Moulton, R.A. Davis, M. Holst, P. Millman, A. MacGillivray and D. Hannay. 2005. Monitoring seismic effects on marine mammals--southeastern Beaufort Sea, 2001-2002. p. 511-542 *In:* S.L. Armsworthy, P.J. Cranford and K. Lee (eds.), Offshore oil and gas environmental effects monitoring/Approaches and technologies. Battelle Press, Columbus, OH.

Miller, J.H., A.E. Bowles, R.L. Gentry, W.T. Ellison, J.J. Finneran, C.R. Greene Jr., D. Kastak, D.R. Ketten, P.E. Nachtigall, W.J. Richardson, B.L. Southall, J.A. Thomas and P.L. Tyack. 2005. Strategies for weighting exposure in the development of acoustic criteria for marine mammals. **J. Acoust. Soc. Am.** 118(3, Pt. 2):2019. Presentation to 150th Meet. Acoust. Soc. Am., Minneapolis, MN, Oct. 2005. Available at http:/www.oce.uri.edu/facultypages/miller/NoiseWeighting10182005.ppt.

MMS. 2006. Final Programmatic Environmental Assessment / Arctic Ocean Outer Continental Shelf Seismic Surveys – 2006. OCS EIS/EA MMS 2006-038. U.S. Minerals Manage. Serv., Alaska OCS Region, Anchorage, AK. 294 p. plus Figures, Tables and Appendices.

Moulton, V.D. and J.W. Lawson. 2002. Seals, 2001. p. 3-1 to 3-48 *In*: W.J. Richardson and J.W. Lawson (eds.), Marine mammal monitoring of WesternGeco's open-water seismic program in the Alaskan Beaufort Sea, 2001. LGL Rep. TA2564-4. Rep. from LGL Ltd., King City, Ont., for WesternGeco LLC, Anchorage, AK; BP Explor. (Alaska) Inc., Anchorage, AK; and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 95 p.

NMFS. 1995. Small takes of marine mammals incidental to specified activities; offshore seismic activities in southern California. **Fed. Regist.** 60(200, 17 Oct.):53753-53760.

NMFS. 1999. Small takes of marine mammals incidental to specified activities; seismic hazards investigation in southern California/Notice of receipt of application and proposed authorization for a small take exemption; request for comments. **Fed. Regist**. 64(43, 5 Mar.):10644-10648.

NMFS. 2000. Small takes of marine mammals incidental to specified activities; marine seismic-reflection data collection in southern California/Notice of receipt of application. **Fed. Regist.** 65(60, 28 Mar.):16374-16379.

NMFS. 2005a. Small takes of marine mammals incidental to specified activities; marine geophysical survey across the Arctic Ocean/Notice of receipt of application…. **Fed. Regist.** 70(89, 10 May):24539-24553.

NMFS. 2005b. Small takes of marine mammals incidental to specified activities; marine geophysical survey across the Arctic Ocean/Notice of issuance of an incidental take authorization. **Fed. Regist.** 70(156, 15 Aug.): 47792-47809.

NMFS. 2006a. Small takes of marine mammals incidental to specified activities; seismic surveys in the Beaufort and Chukchi seas off Alaska. **Fed. Regist.** 71(85, 3 May.):26055-26069.

NMFS. 2006b. Small takes of marine mammals incidental to specific activities; seismic surveys in the Beaufort and Chukchi seas off Alaska. **Fed. Regist.** 71(164, 24 Aug.):50027-50045.

Parkes, G.E. and L. Hatton. 1986. The marine seismic source. D. Reidel Publ. 128 p. ISBN 90-277-2228-5.

Racca, R.G. and J.A. Scrimger. 1986. Underwater acoustic source characteristics of air and water guns. DREP Tech. Rep. 06SB 97708-5-7055. Rep. from JASCO Res. Ltd., Victoria, B.C., for Def. Res. Estab. Pacific.

Reeves R. (ed). 2005. Report of the Independent Scientific Review Panel on the Impacts of Sakhalin II Phase 2 on Western North Pacific Gray Whales and Related Biodiversity, IUCN Report, February 2005.

Richardson, W.J. and C.I. Malme. 1993. Man-made noise and behavioral responses. p. 631-700 *In*: J.J. Burns, J.J. Montague and C.J. Cowles (eds.), The bowhead whale. Spec. Publ. 2. Soc. Mar. Mamm., Lawrence, KS. 787 p.

Richardson, W.J. and B. Würsig. 1997. Influences of man-made noise and other human actions on cetacean behaviour. **Mar. Freshwat. Behav. Physiol.** 29(1-4):183-209.

Richardson, W.J., B. Würsig and C.R. Greene Jr. 1986. Reactions of bowhead whales, *Balaena mysticetus*, to seismic exploration in the Canadian Beaufort Sea. **J. Acoust. Soc. Am.** 79(4):1117-1128.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme and D.H. Thomson. 1995. Marine mammals and noise. Academic Press, San Diego. 576 p.

Richardson, W.J., G.W. Miller and C.R. Greene Jr. 1999. Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea. **J. Acoust. Soc. Am.** 106(4, Pt. 2):2281.

Rugh, D., R.C. Hobbs, J.A. Lerczak and J.M. Breiwick. 2005. Estimates of abundance of the eastern North Pacific stock of gray whales (*Eschrichtius robustus*) 1997-2002. **J. Cetac. Res. Manage.** 7(1):1-12.

Shell Offshore, Inc. (SOI). 2005a. Application for incidental harassment authorization for the non-lethal taking of whales and seals in conjunction with a proposed marine geophysical (seismic acquisition) survey program in the mid and eastern Beaufort Sea, Alaska, during 2006. Submitted to the National Marine Fisheries Service by Shell Offshore, Inc., and WesternGeco.

Shell Offshore, Inc. (SOI). 2005b. Application for incidental harassment authorization for the non-lethal taking of whales and seals in conjunction with a proposed marine geophysical (seismic acquisition) survey program in the northern Chukchi Sea, Alaska, during 2006. Submitted to the National Marine Fisheries Service by Shell Offshore, Inc., and WesternGeco.

Shell Offshore, Inc. (SOI). 2006. Application for incidental harassment authorization for the non-lethal taking of Pacific walrus and polar bear in conjunction with a proposed marine geophysical (seismic acquisition) program in the northern Chukchi Sea, Alaska, during 2006. Submitted to the U.S. Fish and Wildlife Service by Shell Offshore Inc. and WesternGeco.

Small, R.J. and D.P. DeMaster. 1995. Alaska marine mammal stock assessments 1995. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-57, 93 pp.

Smultea, M.A. and M. Holst. 2003. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic study in the Hess Deep area of the Eastern Equatorial Tropical Pacific, July 2003. LGL Rep. TA2822-16. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory, Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 68 p.

Smultea, M.A., M. Holst, W.R. Koski and S. Stoltz. 2004. Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic program in the Southeast Caribbean Sea and adjacent Atlantic Ocean, April–June 2004. LGL Rep. TA2822-26. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 106 p.

Smultea, M.A., W.R. Koski and T.J. Norris. 2005. Marine mammal monitoring during Lamont-Doherty Earth Observatory's marine seismic study of the Blanco Fracture Zone in the Northeastern Pacific Ocean, October-November 2004. LGL Rep. TA2822-29. Rep. From LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 89 p.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas and P.L. Tyack. [Submitted]. Marine mammal noise exposure criteria: initial scientific recommendations. Submitted to Acoust. Soc. Am., Oct. 2006.

Stone, C.J. 2003. The effects of seismic activity on marine mammals in UK waters 1998-2000. JNCC Rep. 323. Joint Nature Conserv. Commit., Aberdeen, Scotland. 43 p.

Suryan RM and JT Harvey. 1998 Tracking harbor seals (*Phoca vitulina richardsi*) to determine dive behavior, foraging behavior, and haul-out site use. **Mar. Mamm. Sci.** 14(2):361-372.

Thomas, T.A., W.R. Koski and W.J. Richardson. 2002. Correction factors to calculate bowhead whale numbers from aerial surveys of the Beaufort Sea. p. 15-1 to 15-28 (Chap. 15) *In*: W.J. Richardson and D.H. Thomson (eds.), Bowhead whale feeding in the eastern Alaskan Beaufort Sea: update of scientific and traditional information, vol. 1. OCS Study MMS 2002-012; LGL Rep. TA2196-7. Rep. from LGL Ltd., King City, Ont., for U.S. Minerals Manage. Serv., Anchorage, AK, and Herndon, VA. 420 p.

Tolstoy, M., J. Diebold, S. Webb, D. Bohnenstiehl and E. Chapp. 2004a. Acoustic calibration measurements. Chap. 3 *In:* W.J. Richardson (ed.), Marine mammal and acoustic monitoring during Lamont-Doherty Earth Observatory's acoustic calibration study in the northern Gulf of Mexico, 2003. Revised ed. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. (Advance copy).

Tolstoy, M., J.B. Diebold, S.C. Webb, D.R. Bohenstiehl, E. Chapp, R.C. Holmes and M. Rawson. 2004b. Broad-band calibration of R/V *Ewing* seismic sources. **Geophys. Res. Lett.** 31: L14310.

Turner, S., M. Zykov and A. MacGillivray. 2006. Preliminary acoustic level measurements of airgun sources from ConocoPhillips' 2006 seismic survey in Alaskan Chukchi Sea. Rep. from JASCO Res. Ltd., Victoria, B.C. [for ConocoPhillips]. 10 p. Available at http://www.nmfs.noaa.gov/pr/permits/incidental.htm.

UNEP-WCMC. 2004. UNEP-WCMC species database: CITES-listed species. Available at http://www.unep-wcmc.org/index.html?http://sea.unep-wcmc.org/isdb/CITES/Taxonomy/tax-gs-search1.cfm?displaylanguage=eng&source=animals~main

USDI/MMS. 1996. Beaufort Sea Planning Area oil and gas lease sale 144/Final Environmental Impact Statement. OCS EIS/EA MMS 96-0012. U.S. Minerals Manage. Serv., Alaska OCS Reg., Anchorage, AK. Two volumes. Var. pag.

USFWS. 2000. Pacific walrus (*Odobenus rosmarus divergens*): Alaska Stock. p. 185-190 *In*: R.C. Ferrero, D.P. DeMaster, P.S. Hill, M.M. Muto, and A.L. Lopez (eds.) Alaska marine mammal stock assessments, 2000. NOAA Tech. Memo. NMFS-AFSC-119. U.S. Dep. Comm. NOAA, NMFS, Alaska Fisheries Science Center.

Zeh, J.E. and A.E. Punt. 2005. Updated 1978-2001 abundance estimates and their correlations for the Bering-Chukchi-Beaufort Seas stock of bowhead whales. **J. Cetac. Res. Manage.** 7(2):169-175.

Zerbini, A.N., P.R. Wade and J.M. Waite. 2004. Summer abundance and distribution of cetaceans in coastal waters of the western Gulf of Alaska and the eastern and central Aleutian Islands. p. 179 *In*: Abstract Book ASLO/TOS 2004 Ocean Research Conference. Honolulu, 15-20 Feb. 2004.

USFWS. 2006. Marine mammals: incidental take during specified activities. **Fed. Regist.** 71(88, 8 May.):26770-26781.

Ziolkowski, A. 1970. A method for calculating the output pressure waveform from an air gun. **Geophys. J. R. Astron. Soc.** 21:137-161.

ARCTIC
VOL. 36, NO. 1 (MARCH 1983) P. 5-64

Distribution and Migration of the Bowhead Whale, *Balaena mysticetus*, in the Eastern North American Arctic

RANDALL REEVES,[1] EDWARD MITCHELL,[1] ARTHUR MANSFIELD,[1] and MICHELE McLAUGHLIN[1,2]

ABSTRACT. Large catches of bowhead whales, *Balaena mysticetus*, were made in the Eastern Arctic of North America, principally in Davis Strait, Baffin Bay, the Lancaster Sound region, Hudson Bay, and southern Foxe Basin, between 1719 and 1915. Initial stock sizes have been estimated as 11 000 in 1825 for the "Davis Strait stock" and 680 in 1859 for the "Hudson Bay stock." The separate identity of these two putative stocks needs confirmation through direct evidence.

Three sets of data were used to evaluate historic and present-day trends in the distribution of bowheads in the Eastern Arctic and to test hypotheses concerning the nature, timing, and routes of their migration. Published records from commercial whale fisheries prior to 1915, unpublished and some published records from the post-commercial whaling period 1915-1974, and reported sightings made mainly by environmental assessment personnel between 1975 and 1979, were tabulated and plotted on charts. Comments made by whalers and nineteenth-century naturalists concerning bowhead distribution and movements were summarized and critically evaluated.

The major whaling grounds were: (1) the west coast of Greenland between ca. 60°N and 73°N, the spring and early summer "east side" grounds of the British whalers; (2) the spring "south-west fishing" grounds, including the northeast coast of Labrador, the mouth of Hudson Strait, southeast Baffin Island, and the pack ice edge extending east from Resolution Island; (3) the summer "west water" grounds, including Pond Inlet, the Lancaster Sound region, and Prince Regent Inlet; (4) the autumn "rock-nosing" grounds along the entire east coast of Baffin Island; (5) Cumberland Sound, a spring and fall ground; and (6) northwest Hudson Bay/southwest Foxe Basin.

The belief of whalers that some segregation occurs within the "Davis Strait stock" cannot be refuted or confirmed on the above evidence. However, the evident predominance of young whales and females with calves in early season catches at the Pond Inlet floe edge and in summer catches well inside Lancaster Sound and Prince Regent Inlet suggests that the route and timing of their migration differs from that of adult males. Apparently most of the whales taken on the autumn "rock-nosing" grounds were large males. The possibility that females and calves circumnavigate Baffin Island, returning south by way of Fury and Hecla Strait, is neither proven nor unproven.

Evaluation of harpoon recoveries did not yield irrefutable evidence of interchange between any presently recognized bowhead stocks; however, this evidence along with recognition of distinctive morphological features does indicate that bowheads exhibit site fidelity to some degree.

The conclusion is that the bowhead population in the Eastern Arctic, severely reduced by whaling activities, continues to occupy much of its former range and follows the same migratory schedule. There is no reliable and consistent evidence of appreciable recovery in absolute abundance of any Eastern Arctic stock.

Key words: bowhead whale, *Balaena mysticetus*, distribution, migration, population identity, whaling history, Davis Strait, Baffin Bay, Lancaster Sound, West Greenland, Hudson Bay, Foxe Basin

RÉSUMÉ. Entre 1719 et 1915, d'importantes prises de baleines boréales, *Balaena mysticetus*, ont été faites dans l'est de l'Arctique nord-américain, tout particulièrement dans le dètroit de Davis, la baie de Baffin, le détroit de Lancaster et la région environnante, la baie d'Hudson et la partie sud du bassin de Foxe. La population initiale du détroit de Davis a été évaluée à 11 000 baleines en 1825 et celle de la baie d'Hudson à 680 individus en 1859. L'existence séparée de ces supposées populations reste à être confirmée au moyen de preuves directes.

Trois sources de données ont été utilisées afin d'évaluer les tendances passées et présentes de la distribution des baleines boréales dans l'est de l'Arctique, ainsi que pour vérifier certaines hypothèses au sujet de la nature, du moment et des itinéraires de leur migration. Les données obtenues à partir de documents antérieurs à 1915, publiés par l'industrie baleinière, de documents publiés et non-publiés sur la chasse non-commerciale à la baleine entre 1915 et 1974 et d'observations rapportées en majeure partie par du personnel responsable de l'évaluation de l'environnement entre 1975 et 1979 furent compilées et utilisées pour tracer des cartes. Des commentaires de baleiniers et de naturalistes du 19ième siècle concernant la distribution et les déplacements des baleines boréales ont été résumés et évalués d'un oeil critique.

Les aires principales de chasse à la baleine étaient: (1) la côte ouest du Groenland environ entre le 60e et le 73e degré nord, correspondant aux pêcheries du "east side" fréquentées par les baleiniers britanniques au printemps et au début l'été; (2) les pêcheries dites du "south-west" fréquentées au printemps, incluant la côte nord-est du Labrador, l'embouchure du détroit d'Hudson, la partie sud-est de la Terre de Baffin et les abords de la banquise s'étendant vers l'est à partir de l'île Resolution; (3) les pêcheries de "west water" fréquentées durant l'été, incluant l'anse de Pond, la région du détroit de Lancaster et l'anse Prince Regent; (4) les pêcheries de "rock-nosing" fréquentées à l'automne le long de toute la côte est de la Terre de Baffin; (5) le détroit de Cumberland, en été et en automné; et (6) le nord-ouest de la baie d'Hudson et le sud-ouest du bassin de Foxe.

Les données précédentes ne permettent pas de confirmer ou de réfuter la croyance des baleiniers voulant qu'il existe une ségrégation au sein de la population du détroit de Davis. Cependant, les prises du début de la saison de chasse aux abords de la banquise de l'anse de Pond et celles faites à l'été bien à l'intérieur du détroit de Lancaster et de l'anse Prince Regent étant pour la plupart des jeunes baleines ou des femelles accompagnées de baleineaux, il est permis de supposer que ces individus accomplissent leur migration en des périodes et suivant des parcours qui diffèrent de ceux des mâles adultes. Il semblerait que la plupart des baleines capturées dans les pêcheries de "rock-nosing" aient été des mâles de forte taille. L'hypothèse selon laquelle les femelles et les baleineaux contourneraient la Terre de Baffin en retournant vers le sud par les détroits de Fury et de Hecla ne peut être ni prouvée ni réfutée. Une évaluation à partir du recouvrement de harpons ne fournit pas de preuve irréfutable d'échanges entre les populations reconnues de baleines boréales; cependant cette évaluation jointe à la reconnaissance de traits morphologiques distinctifs indiquent que les baleines boréales manifestent un certain degré de "homing".

En conclusion, il apparaîtrait que la population de baleines boréales de l'est de l'Arctique, grandement réduite par la chasse, occupe encore une grande partie de son territoire d'origine et suive les mêmes déplacements saisonniers. Il n'existe aucune preuve fiable consistante d'un retour en abondance des populations de l'est de l'Arctique.

Mots clés: baleine boréale, *Balaena mysticetus*, distribution, migration, l'identitié de la population, histoire de la pêche à la baleine, le détroit de Davis, la baie de Baffin, le détroit de Lancaster, ouest Groenland, la baie d'Hudson, le bassin de Foxe

Traduit par Michelle Durand, Charles Bédard, et Thérèse Cartier.

[1]Arctic Biological Station, 555 St. Pierre Boulevard, Ste. Anne de Bellevue, Québec, Canada H9X 3R4
[2]Present address: 220 Ste. Anne Street, Ste. Anne de Bellevue, Québec, Canada H9X 1N7

INTRODUCTION

The Eastern Arctic, defined here as Hudson Bay and the area north of 60°N latitude between the west coast of Greenland and the vicinity of Melville and Victoria islands (ca. 105°W longitude), once contained a large population of bowhead or Greenland whales, *Balaena mysticetus*. Ross (1974) estimated that no less than 686 bowhead whales were taken by American and Scottish whalers in the Hudson Bay fishery (including Hudson Bay, Foxe Basin, and Hudson Strait) from 1860 to 1915. He (Ross, 1979) also estimated that more than 28 000 were caught by the international fleet (Danish, Dutch, British, German, and American) operating in Davis Strait, Baffin Bay, and the Lancaster Sound region from 1719 to 1911. These substantial catches do not take into account animals killed or mortally wounded but not secured, orphaned calves, and baleen or oil which was lost in accidents, shipwrecks, or fires (Mitchell and Reeves, 1981).

Using mainly published data, Mitchell (1977 MS) made cumulative catch estimates of "initial" size of these two biological populations. For the "Davis Strait stock" he estimated about 6000 in 1729, and for the "Hudson Bay stock" about 680 in 1859 (Allen, 1978, gave 700). His estimate for Davis Strait was subsequently revised to 11 000 whales in 1825 (Mitchell and Reeves, 1981).

Whether the Eastern Arctic population of bowhead whales consists of more than one biological or fishable stock is a moot question. Judgments are based on circumstantial evidence and indirect evidence rather than on direct tracking or tagging data for individual animals. There is little doubt that, as Eschricht and Reinhardt (1861, 1866) emphasized, the bowhead's movements within a stock area are determined principally by ice conditions. The dynamic nature of the sea ice regime means that short- and long-term changes in bowhead distribution might be expected (e.g. Vibe, 1967) and that fragmentation or integration in the aggregate population may occur periodically. Basic patterns of migration, however, appear to remain the same except for differences caused by locally severe or mild ice conditions.

Ross (1974) was unable to decide whether whales winter in Hudson Bay on a regular basis. If they do, the case for a distinct stock there would be strengthened. Mitchell (1977 MS), while recognizing the inconclusive nature of the evidence, proposed two management stocks, one centered in Hudson Bay and Foxe Basin, the other in Davis Strait and Baffin Bay. These two putative stocks are recognized for management purposes by the International Whaling Commission (Allen, 1978). Further consideration of the stock identity question led Mitchell and Reeves (1981) to suggest the possibility that, historically at least, there may have been even more than two bowhead stocks in the Eastern Arctic. This question clearly requires closer scrutiny.

Although several good synthetic appraisals have been made of the bowhead's historic distribution and migration in the Eastern Arctic (Eschricht and Reinhardt, 1861, 1866; Brown, 1868; Gray, 1888; Southwell, 1898; Low, 1906; Ross, 1974), none of these alone is adequate for present management needs. It has been stated that the bowhead population is recovering from the serious depletion caused by commercial whaling and that its distribution remains essentially the same as it was during the nineteenth century (Mansfield, 1971). However, recent systematic surveys of former areas of occurrence have not upheld the view that the population is recovering (Davis and Koski, 1980). Particularly in light of continued whaling activities by Canadian Inuit (Mitchell and Reeves, 1982) and initiatives by oil and gas companies to extract and transport nonrenewable resources throughout much of the Canadian Arctic (Roots, 1980; Stirling *et al.*, 1981), a critical review of available data bearing on bowhead stock identity, distribution, migratory behaviour, and abundance in the Eastern Arctic is needed. The purpose of this paper is to contribute to such a review. [See Appendix A.]

MATERIALS AND METHODS

A search of the literature was made using Cooke and Holland (1978). Whaling and exploration literature was obtained principally from the libraries of McGill University (Montreal), the Arctic Biological Station, and various federal government departments, the National Library of Canada (Ottawa), and the private library of EDM. References that could not be found locally were obtained through interlibrary loan. As noted by Mitchell and Reeves (1981), the Danish colonial records mentioned by Eschricht and Reinhardt (1866:4) are of potential value in assessing the bowhead's movements along the west coast of Greenland. M. Klinowska (written comm., 8 September 1981) has established the fact that these "diaries" are available on microfilm from the Rigsarkivet in Copenhagen. Unfortunately, we had neither the resources to obtain and translate these documents nor the time to examine them for this study. [See Appendix B.]

All available sources were read and indexed for information on bowhead whales, particularly sightings, kills, and migration patterns. Southwell (1898) cautioned concerning the early literature that "too often the vague mentions of 'whales' seen leave the species so uncertain as to be valueless for any useful purpose." He added that "the chief and most reliable information is to be derived from those whose business it is to pursue and capture these animals in their summer haunts." Although we have borne in mind the danger of misidentification, we also have appreciated the fact that, to the British arctic whalers at least, "nothing is a fish but the Greenland whale" (Markham, 1875:38). In writings of arctic whalers it is generally safe to assume that references to "whale" or "fish" mean the bowhead (e.g. Lubbock, 1937). Almost invariably the narwhal or "unicorn" (*Monodon monoceros*) and the white whale or beluga (*Delphinapterus leucas*), the only other cetaceans regularly encountered in heavy ice where bowheads were hunted, are referred to as something other than "fish" or "whale". Bottlenose whales (*Hyperoodon ampullatus*) were sometimes seen and hunted, especially in lower Davis Strait in spring, and killer whales (*Orcinus orca*), often called "gram-

pus'' or ''swordfish'', were occasionally observed along the ice edge at the summer whaling grounds. Again, however, these species are almost always identified by a name or by characteristic features that make it clear they are not bowheads.

The following post journals in the Hudson's Bay Company Archives, Winnipeg, Manitoba, were read and indexed for mention of bowheads: Pangnirtung (1921-1939; 15 journals), Pond Inlet (1921-1939; 16 journals), Blacklead Island (1925-1931; 5 journals), Igloolik (1940; 1 journal), Arctic Bay (1937-1941; 6 journals), Coats Island (1918-1927; 3 journals), Padley (1937-1938; 1 journal), Frobisher Bay (1920-1936; 6 journals), Clyde River (1930-1936; 6 journals), Mansel Island (1930-1932; 3 journals) and Cape Dorset (1913-1941; 10 journals). In addition, a small sample of whaling journals and logbooks was read. This included the 22 logbooks covering the years 1877-1925 in the Stefansson Collection, Dartmouth College, Hanover, New Hampshire, and ''A Journal kept during a voyage to Baffin Bay in the ship Abram of Hull in search of Whales, commencing on the 11th day of March 1839 and ending [October 20, 1839]'', owned by the Manitoba Provincial Archives, Winnipeg.

The ''modern'' (post-1914) data used in this analysis come from various sources. In addition to published accounts and HBC Archives material, we consulted: the files of the Arctic Biological Station compiled by D.E. Sergeant, W. Hoek, and others; AWM's files used in the preparation of his short review on the bowhead's status in the Canadian Arctic (Mansfield, 1971); and reports of environmental assessment surveys conducted by private consulting companies on behalf of the petroleum industry. Sergeant and Hoek have been collecting information on bowheads from sighting cards distributed among personnel working in the Canadian Arctic since the early 1970s. Many of their records, as well as those in Mansfield's files, are from the Royal Canadian Mounted Police (RCMP) game reports, Canadian Armed Forces observers, game and wildlife officers in arctic settlements, pilots, missionaries, icebreaker personnel, scientists, and government representatives. Such records are generally not collected in any systematic fashion, and many are difficult to verify. On the other hand, much of the data from the environmental consulting firms was collected systematically.

It is important to point out that non-English-language literature has not been searched. Nor have we attempted to mine as thoroughly as we might have the English-language literature on bowhead occurrences along the Greenland coast. Thus, records for the Greenland side of Davis Strait and Baffin Bay are conspicuously missing from our charts and tables.

All sightings and kills of bowheads that we indexed, amounting to more than 900 entries, were tabulated and plotted on maps. Records were organized into three categories to reflect the type of source from which they originated and the type of effort used to collect them. The first category covers the period 1615 to 1913, during which extensive whaling and exploration occurred in northern regions (Table 1; Figs. 1,2). These records give a general picture of where and when early (pre-1914) whalers and explorers encountered bowheads in the Eastern Arctic. Tables 2 and 3 and Figure 3 include data for the period 1914 to 1974, from the end of commercial whaling for bowheads in the Eastern Arctic to the approximate beginning of intensive, systematic environmental assessment. Most of the information for this period comes from unpublished data in the Hudson's Bay Company Archives and AWM's files (see Mansfield, 1971), although a number of published records are included. Data from assessment surveys and the Arctic Biological Station sighting report program, spanning the period 1975 to 1979, are presented in Table 4 and Figure 4.

TABLE 1. Occurrence of the bowhead whale in the eastern Canadian Arctic, 1615-1913

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
1	Whale Sound, 77°30'N	1615	VII	5	''a great number''			Bylot, *in* Ellis, 1748:52.
2	Smith Sound	1615	VII		''a great number'', very large			Bylot *in* Ellis, 1748:52.
3	Whale Sound, 77°30'N	1616	VII	4	''great numbers''			William Baffin, *in* Scoresby, 1820:V.1:88.
4	Smith Sound	1616			''an abundance''			William Baffin, *in* Pennant, 1784-87: V.1:clxxxvi.
5	Hudson Strait	1631	VI	22	1			Fox, *in* Ellis, 1748:58-59.
6	Off ''Brook Cobham'' [Marble?] Island, Hudson Bay	1631	VII	28(?)	40 in a pod			Fox, *in* Ellis, 1748:58,68.
7	Off Cape Fullerton, Hudson Bay	1722	VII	9	Many			Scroggs *in* Ellis, 1748:81.
8	Off W coast of Hudson Bay, 64°08'N	1722	VII	15	Many			Scroggs *in* Ellis, 1748:82.
9	Off W coast of Hudson Bay, 64°50'N	1722			A number			Scroggs *in* Ellis, 1748:84.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
10	Roes Welcome Sound	1737	VII	28	Many			Dobbs *in* Ellis, 1748:90.
	"12 leagues above Deer Sound," Hudson Bay	1737	VII		A number		Black whales "of the whalebone kind".	Dobbs *in* Ellis, 1748:91.
	Along W shore of Roes Welcome Sound	1737	VIII	9-12	Many large		Black whales "of the right whalebone kind".	Dobbs *in* Ellis, 1748:[89].
	Off W coast of Hudson Bay, between 55° and 62°15'N	1737			Many		"An abundance" of "black whales."	Dobbs *in* Ellis, 1748:83.
11	Between Cape Southampton and Mansel Island, Hudson Bay	1746	VIII	2		1	Carcass seen floating, with an Eskimo harpoon in it, a thong of walrus hide attached to the harpoon.	Ellis, 1748:144.
12	Off Cape Fry, Hudson Bay, 64°32'N	1747	VII	18	Several		"Sporting" near the shore.	Ellis, 1748:241.
13	Roes Welcome Sound	1747	VII	23	Several			Ellis, 1748:244.
14	In Repulse Bay	1747	VIII	12-13	"a great many"			Ellis, 1748:270.
15	Along W shore of Hudson Bay	1747(?)	Late summer		Very large numbers			Ellis, 1748:322.
16	Uivak, Labrador	1772				1	Carcass found on shore or killed.	Haven, 1773:3.
17	Comfort Harbour, 7 mi S of Nain, Labrador, near 56°30'N	1773	II			1 (est.)	Carcass found covered with 1 fathom of snow and ice. It was "middling size", 64 ft (est.).	Anon., 1835:96-104.
18	Hebron [Kangertluksoak], NE Labrador coast	1771				2 killed		Taylor, 1974.
19	Saglek, NE Labrador coast	1771				1 killed		"
20	Nachvak, NE Labrador coast	1771				2 killed		"
21	Hebron [Kangertluksoak], NE Labrador coast	1772				2 killed		"
22	Nain area, NE Labrador coast [a barren seaward island in Nain area]	1773	II	16		1	Carcass found.	"
23	Hopedale [Arvertok], NE Labrador coast	1773	IV	17		1	This dead whale may have been mortally wounded in another area.	"
24	Nachvak, NE Labrador coast	1773				1 killed	"only one killed on whole coast" in 1773.	"
25	Hopedale [Arvertok], NE Labrador coast	1774				1 killed		"
26	Coast of Labrador N of Nain, NE coast	1775				6 killed		"
27	Near Okak, NE Labrador coast	1776	X	21	"some"			"
28	Near Okak, NE Labrador coast	1776	XI	11		1 struck	Lost.	"
29	Near Okak, NE Labrador coast	1776	XI	13		1 struck	Lost.	"
30	Near Okak, NE Labrador coast	1776	XI	27		2 struck	Lost.	"
31	Uivak and Kivalek, Okak area, NE Labrador coast	1776	8 XI to 4 XII		7		7 whales (total) were sighted during this time in the Okak area, 2 of which were struck but lost on 27 XI 1776, one on 11 XI, another on 13 XI, while 2 whales were seen 4 XII. Presumably these are included in the total of 7 and are described in above and following entries.	"
32	Near Okak, NE Labrador coast	1776	XII		4		Pursued but not caught.	"
33	Nain area, NE Labrador coast [a seaward island in Nain area]	1776				1	This drift whale may have been mortally wounded in another area.	"
34	Coast of Labrador N of Okak	1776				1 killed		"
35	Near Kivalek, Okak area, NE Labrador coast	1777	XII	7	2			"
36	Hebron [Kangertluksoak], NE Labrador coast	1777				1 killed		"
37	Near Okak, NE Labrador coast	1778	XI	3		1 killed, 60 ft long	With 5 harpoons which had 10 sealskin pokes attached.	"
38	Hopedale [Arvertok], NE Labrador coast	1778				1 killed		"
39	Saglek, NE Labrador coast	1778				1 killed	"Baleen whale".	"

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
40	Khernertut, Okak area, NE Labrador coast	1779	XI	21	2	1 killed	2 whales were sighted, of which 1 was killed with 3 harpoons.	Taylor, 1974.
41	Mouth of Okak Bay, NE Labrador coast		XI	28	"More"	1 killed	"More" whales were sighted, one of which was killed.	"
42	Nachvak, NE Labrador coast	1779				2 killed		"
43	Hebron [Kangertluksoak], NE Labrador coast	1779				2 killed		"
44	Hopedale [Arvertok], NE Labrador coast	1779				2 killed		"
45	Nain area, NE Labrador coast	1780	I	9		1 apparent kill	A dead whale with 3 seal skin pokes was seen driven out to sea.	"
46	Near Okak, NE Labrador coast	1780	X	27	Several		"Too early" for the Eskimos to be prepared for hunting.	"
47	3 leagues from Okak, NE Labrador coast	1780	XI	20		1	Found in a decayed state: "only good for lamps and dogs." May have been mortally wounded in another area.	"
48	Kivalek, near Okak, NE Labrador coast	1780	XI	27	"some"			"
49	Hebron [Kangertluksoak], NE Labrador coast	1780	XII	27		2 killed		"
50	Hopedale [Arvertok], NE Labrador coast	1780				1 attempted kill	Pursued but lost.	"
51	Nachvak, NE Labrador coast	1780				1	Found with "all his bones and fins."	"
52	Near Sungilik, Okak area, NE Labrador coast	1781	XI	7		1 struck	With 1 harpoon and an attached sealskin poke, but escaped.	"
53	Kivertlok, Okak area, NE Labrador coast	1781	XI - 28 XI		"plenty"	6 struck	3 were harpooned but lost, while 3 others were struck without harpoons penetrating the skin (one of these whales may already be described above, 7 XI 1781, struck near Sungilik, Okak area).	"
54	Near Okak, NE Labrador coast	1781	XI	28		1 killed		"
55	Nachvak, NE Labrador coast	1781				2 killed		"
56	Saglek, NE Labrador coast	1781				2 killed		"
57	Hebron, NE Labrador coast	1781				1 killed		"
58	Nain area, NE Labrador coast [a seaward island in Nain area]	1783	II	10		1	Carcass found.	Taylor, 1974;Anon.,1835:147.
59	Hebron, [Kangertluksoak], NE Labrador coast	1783				1 killed		Taylor, 1974.
60	Nachvak, NE Labrador coast	1783				1 killed, large		"
61	Near Hopedale, NE Labrador coast	1784	XI	26	2		Sighted and pursued, but escaped.	Taylor, 1974:32.
62	Uivak, near Okak, NE Labrador coast	1784				1 killed		Taylor, 1974.
63	Nachvak, NE Labrador coast	1784				2 killed		"
64	Hebron [Kangertluksoak], NE Labrador coast	1784				1 killed		"
65	Uivak, near Okak, NE Labrador coast	1784				1	Found, "with baleen".	"
66	Near Okak, NE Labrador coast	1784				1 killed		"
67	Nain area, NE Labrador coast [a seaward island in Nain area]	1785	V	14		1	Carcass found.	"
68	Near Hopedale [Arvertok], NE Labrador coast	1785	XI	22	1			"
69	Near Hopedale [Arvertok], NE Labrador coast	1785	XI	25	4		Eskimos were not ready for the hunt.	"
70	Near Hopedale [Arvertok], NE Labrador coast	1785	XI	29		1 struck	Lost.	"
71	Nain area, NE Labrador coast [a seaward island in Nain area]	1786	III	6		1	Carcass found.	"

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
72	Near Hopedale [Arvertok], NE Labrador	1786	VIII	1		1	Carcass found by Eskimos who cut out the baleen.	Taylor, 1974.
73	Near Okak, NE Labrador coast	1786	XI	2	7		"Too early".	"
74	Near Hopedale [Arvertok], NE Labrador coast	1788	XI	13	Several			"
75	Near Okak, NE Labrador coast	1789				Several struck	Lost.	"
76	Nachvak, NE Labrador coast	1789				2 killed		"
77	Saglek, NE Labrador coast	1789				1 killed		"
78	Hebron [Kangertluksoak], NE Labrador coast	1790				1 killed		"
79	Nachvak, NE Labrador coast	1790				1 killed		"
80	Saglek, NE Labrador coast	1790				1	Carcass found.	Taylor, 1974; Brice-Bennett, 1980 MS.
81	Napartok, NE Labrador coast	1790				1	Carcass found.	Taylor, 1974.
82	Near Okak, NE Labrador coast	1790				2 killed		"
83	Sillutalik, Okak area, NE Labrador coast	1794	I	17		1	Carcass found.	Brice-Bennett, 1980 MS.
84	Okak, NE Labrador coast	1793	X	15	1		First whale seen this season.	"
85	Okak, NE Labrador coast	1793	15 X - 8 XI		7+		Includes some sightings below.	"
86	Okak, NE Labrador coast	1793	X	20	2			"
87	Okak, NE Labrador coast	1793	21 X - 1 XI		Several			"
88	Okak, NE Labrador coast	1793	XI	2	"common"			"
89	Sungilik, Okak area [½ hour travel from Okak], NE Labrador coast	1793	XI	8	4			"
90	Okak, NE Labrador coast	1793	XI	9	A number	Attempted kills	Whales were hunted but none was struck.	"
91	Kivalek, Okak area, NE Labrador coast	1793	XI	9		2 struck		"
92	Uivak, Okak area, NE Labrador coast	1793	XI	9		2 struck	Harpoons did not hold.	Taylor, 1974.
93	Uivak, Okak area, NE Labrador coast	1793	XI	10		2 struck	Lost since the harpoons did not hold.	Brice-Bennett, 1980 MS.
94	Okak, NE Labrador coast	1793	XI	11	2	1 struck		"
95	Uivak, near Okak, NE Labrador coast	1793	XI	11		1 killed	Carcass carried out to sea by strong winds. First hunt of the year.	"
96	Kivalek, near Okak, NE Labrador coast	1793	XI	11	Several	1 killed large (80 ft est.)	The Eskimos spent 3 days cutting, dividing, and sharing this whale. First hunt of the year. The whale was described as medium-sized.	"
97	Okak, NE Labrador coast	1793	XI	17		1 struck	Lost.	Taylor, 1974; Brice-Bennett, 1980 MS.
*								
99	Kivalek, near Okak, NE Labrador coast	1793	XI	19	Several	1 killed, large		Brice-Bennett, 1980 MS.
100	Nachvak, NE Labrador coast	1793	Autumn			1 killed		"
101	Okak, area, NE Labrador coast	1793	XII	4	"Hardly any"			"
102	Near Kivalek, Okak area, NE Labrador coast	1793	XII	6-7	1		Most of the Eskimos were out in kayaks and so did not hunt this whale. The weather was mild and rainy.	"
103	Napartok, NE Labrador coast	1793	Autumn			Several struck; 2 found dead		Brice-Bennett, 1980 MS.
104	Hebron [Kangertluksoak], NE Labrador coast	1793				1 killed 1 found dead		Taylor, 1974; Brice-Bennett, 1980 MS.
105	Sillutalik, near Okak, NE Labrador coast	1794	I	17		1	Carcass found.	Brice-Bennett, 1980 MS.
106	Uivak, near Okak, NE Labrador coast	1794	IX	21		1	Carcass found.	Taylor, 1974; Brice-Bennett, 1980 MS.
107	Kivalek, near Okak, NE Labrador coast	1794	XI			2 struck	Lost.	"

*Key nos. apparently omitted were actually not used.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
108	Killinek [Port Burwell], Killinek Island, mouth of Hudson Strait	1794				2	Carcasses found.	Taylor, 1974: Brice-Bennett, 1980 MS.
109	Saglek, NE Labrador coast	1794				1 killed		Taylor, 1974.
110	Uivak, near Okak, and Okak, NE Labrador coast	1795			12	"some" killed	12 whales were sighted, "some found dead and some caught."	Taylor, 1974:33; Brice-Bennett, 1980 MS.
111	Nain area, NE Labrador coast ["on the coast"]	1795				2	Carcasses found.	Brice-Bennett, 1980 MS.
112	Saglek, NE Labrador coast	1796				1 killed	The only one killed on the whole coast this year.	Taylor, 1974; Brice-Bennett, 1980 MS.
113	Okak, NE Labrador coast	1796			some	Attempted kills		Brice-Bennett, 1980 MS.
114	Nachvak, NE Labrador coast	1797				Some	Nachvak Eskimos were "the only people who got whales."	"
115	Near Okak, NE Labrador coast	1799	Spring			1 killed, young		"
116	Okak and Kivalek, near Okak, NE Labrador coast	1799	Spring		Some	Attempted kills	The Eskimos could not approach near enough to the whales to harpoon any.	"
117	Near Okak, NE Labrador coast	1800	XI			1 killed, very large		"
118	Along coast N of Okak, NE Labrador coast	1800				5 killed		"
119	Nachvak, NE Labrador coast	1801				Several killed		"
120	Saglek, NE Labrador coast	1801				Several killed		"
121	Coast N of Okak, NE Labrador coast	1802				3 killed		"
122	Coast N of Okak, NE Labrador coast	1803	Autumn			5 killed		"
123	Coast N of Okak, NE Labrador coast	1804	Spring			2	Carcasses found.	"
124	Near Hopedale, NE Labrador coast	1804	VIII-IX			1	Carcass found.	"
125	Island, Nain area, NE Labrador coast	1805	I			1	Carcass found.	"
126	Kivalek Bay, Okak area, NE Labrador coast	1805	XI	16-17	Several	Attempted kill		"
127	Near Igloksoaktaligarsuk Island, Nain area, NE Labrador coast	1806	VII	10		1 killed, young, 20 ft (est.)	Possibly a right whale (*Eubalaena*)?	"
128	Churchill River area, Hudson Bay					3 killed		Hearne, 1795 *in* Preble, 1902:39.
129	Nain or Hopedale, Labrador	1806	Fall-early winter			1 killed	Saved mission Eskimos from famine.	Anon., 1835:281.
130	Nachvak area, Labrador	1811	VII	16		1	Large carcass found by Eskimos stranded on shore, in a very decayed state. It occupied a space 30 ft (est.) in diameter.	Kohlmeister and Kmoch, 1814:26-27.
132	73°37′N, 77°25′W near Cape Liverpool, N Bylot Island	1818	IX	1		1	Skeleton found 500 yd. (est.) above the high-water mark.	Ross, 1819:179.
133	73°30′00″N 77°24′09″W, Coast of NE Bylot Island, Lancaster Sound	1818	IX	2		1	Skeleton found on beach.	Fisher, 1821:74-75.
134	Near 63°59′29″N 61°26′10″W, off Hall Peninsula, SE Baffin Island	1819	VI	25	2		The first seen on the voyage.	Fisher, 1821:31.
135	63°59′29″N 61°26′10″W (chronometer), off Hall Peninsula, SE Baffin Island	1819	VI	26	1			Fisher, 1821:33.
136	160 mi (est.) S of entrance to Lancaster Sound	1819	VII	29	A number		The first whales sighted since the ship entered Baffin Bay at 70°N.	Fisher, 1821:56; Anon., 1821:22.
137	In Baffin Bay near entrance to Lancaster Sound	1819	VII	30	50 (est.)		During a 4-hour afternoon watch. Whales moving north and northwest.	Fisher, 1821:58; Anon., 1821:22.
138	73°31′16″N 77°44′41″W. In Possession Bay, NW coast Bylot Island, Lancaster Sound	1819	VII	31	A number		Seen close to shore; Fisher thought they would run aground.	Fisher, 1821:63; Anon., 1821:22.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
139	73°31′16″N 77°44′42″W. Stream-bank in Possession Bay, NW coast Bylot Island, Lancaster Sound	1819	VII	31 (ca.)		?	Whale bones found.	Fisher, 1821:60.
140	Near entrance to Navy Board Inlet	1819	VIII	1	A number			Fisher, 1821;Anon, 1821:25.
141	73°31′16″N 80°30′ to 82°W. Vicinity of mouth of Navy Board Inlet	1819	VIII	2	Large numbers		30-40 whales per watch were sighted, moving in pods like porpoises, diving and surfacing in concert. Traveling west.	Fisher, 1821:66; Parry, 1821:31.
142	At 86°56′W, western Lancaster Sound	1819	VIII	4	20-30			Fisher, 1821:70.
143	Lancaster Sound [western] or northern Prince Regent Inlet	1819	VIII	6	Several			Fisher, 1821:74.
144	Baffin Bay, 77°N	1819	VIII	8	1			Lubbock, 1937:211.
145	Near 72°13′N 90°29′W, central Prince Regent Inlet	1819	VIII	9	Large numbers			Fisher, 1821:80-81; Parry, 1821:42; Anon., 1821:31.
146	72°37′N 74°13′W, off entrance of Coutts Inlet, NE Baffin Island coast	1818	IX	5	2		Several very large icebergs in the area.	Ross, 1819:192.
147	70°40′N 68° W, near Agnes Monument, NE Baffin Island coast	1818	IX	10	Some large		Swimming rapidly southward. Some icebergs with loose ice in vicinity.	Ross, 1819:200.
148	Okak, NE Labrador coast	1812	Mid-I			1	Carcass found.	Brice-Bennett, 1980 MS.
149	Near Okak, NE Labrador coast	1813			Several	1 killed		"
150	Near Okak, NE Labrador coast	1816	Autumn			1 killed		"
151	Near Okak, NE Labrador coast	1818	X-XI			1 killed		"
152	Frozen Strait; Duke of York Bay	1821	VIII	17	"A great number"		"Playing about the beach."	Parry *in* Southwell, 1898:410; Parry, 1824:42; Lyon, 1824:48.
153	Near Okak, NE Labrador coast	1820	XII	4		1 killed		Brice-Bennett, 1980 MS.
154	In Repulse Bay	1821	VIII	22	"Whales seen"			Parry *in* Southwell, 1898:410; Parry, 1824:52.
155	Nachvak, NE Labrador coast	1821				1 killed		Brice-Bennett, 1980 MS.
156	Off Rouse Island, Hurd Channel	1821	VIII	28	3		"Probably" heading for Roes Welcome Sound.	Parry *in* Southwell, 1898:410; Parry, 1824:69.
157	Hebron [Kangertluksoak], NE Labrador coast	1821				1	Carcass found.	Brice-Bennett, 1980 MS.
158	Off E entrance to Fury and Hecla Strait.	1822	VIII	5(ca.)	Some			Parry *in* Southwell, 1898:410; Parry, 1824:301.
159	On the coast, Nain area, NE Labrador coast	1823	Autumn			1 (ca.38 ft)	Carcass found.	Brice-Bennett, 1980 MS.
160	Near Okak, NE Labrador coast	1823				1 (ca.56 ft.)	Carcass found.	"
161	Saglek, NE Labrador coast	1823				1 (ca.56 ft)	Carcass found.	"
162	Okak Bay, NE Labrador coast	1825			1			"
163	Hopedale area, NE Labrador coast	1827	VII			1	Carcass found with blubber and baleen intact.	"
164	Near 73°33′N 74°42′W, 13 leagues E of Possession Bay, S Lancaster Sound coast	1829	VIII	6		1	Carcass with blubber and baleen removed was seen.	Ross, 1835:88.
165	Possession Bay area, 73°50′N, Lancaster Sound	1829	VIII	7		1+	The "krang" of a whale, with some blubber, was retrieved from the water.	Ross, 1835:93.
166	Near 73°50′N 77°W, Lancaster Sound	1829	VIII	8		Some	The "remains of whales" were "still seen."	Ross, 1835:95.
167	Fury Point, W side of Prince Regent Inlet, 72°42′N 92°13′W	1829	VIII	14	Several			Ross, 1835:111.
168	Off Hazard Inlet, SW Prince Regent Inlet	1829	VIII	15	Many		"Many whales of a light colour came close to us [the *Victory*]", seemingly indifferent to the ship's presence. There was close-packed ice in the bays and inlets of southern Somerset Island, and heavy ice in northern Gulf of Boothia.	Ross, 1835:115.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
169	Near [somewhat S of] 71°59'N 93°32'W, NW Gulf of Boothia	1829	VIII	17	Many		Many whales were seen near a large rock, part of a reef extending into northwestern Gulf of Boothia. The whales seemed to be feeding and "enjoying themselves in perfect security." 1 large whale approached the ship. Inlets were filled with ice, and there were bergs and heavy ice in Gulf of Boothia.	Ross, 1835:119.
170	Near 70°59'N 93°02'W, NW Gulf of Boothia	1829	VIII	20	Many		Seen, together with some seals in close-packed, drifting ice with several leads of open water.	Ross, 1835.
171	Near 73°12'N 89°41'W. E side of Prince Regent Inlet	1819	VIII	13	Large numbers			Fisher, 1821:89.
172	73°12'N 90°34'W. Off NE coast Somerset Island	1819	VIII	16	Large numbers			Fisher, 1821:91.
173	Mouth of Wellington Channel, Barrow Strait	1819	VIII	22	5-6		Icebergs in area.	Fisher, 1821:93; Anon., 1821:112, 33-34; Parry, 1821:51.
174	71°30'N 71°15'W, near Cape Adair, NE coast Baffin Island	1820	IX	3		1	Whale bones found on coast.	Fisher, 1821.
175	Davis Strait, probably central or NE coast of Baffin Island	1820	IX	16	Several			Fisher, 1821:286.
176	Pond Inlet land-floe	1823	VII	27			Remains of hundreds of flensed whales seen along the Pond Inlet floe edge.	Lubbock, 1937:254.
177	Lancaster Sound	1823	VII	8-day period	Large numbers	Many	During an 8-day period there was a large run of whales. Several ships took 12+ whales, 1 or 2 ships took 15 whales each, 1 ship got "full" (36 whales?).	Lubbock, 1937:254-255.
178	Lancaster Sound	1823	VII		"Vast" numbers			Lubbock, 1937:254.
179	Lancaster Sound	1823	VII			Many	Many hundreds of flensed whales were left along the floe edge in Lancaster Sound and Baffin Bay.	Lubbock, 1937:254-255.
180	Near Duke of York Bay, northern Southampton Island	1824			Many			Lyon, *in* Preble, 1902:39.
181	Off Port Bowen, 73°14'N 88°55'W, E side Prince Regent Inlet	1825				1 killed	"Payable" size.	Markham, 1874:250.
182	"Southwest fishing", SE Baffin Island area, mouth of Hudson Strait, or coast of northern Labrador	1826	VI	26 (up to this date)		5-6	The *Brunswick* took 5 large whales and found 1 large dead whale, baleen of 10 ft 11 in. length.	Lubbock, 1937:262.
183	"West water", S of Cape Searle, central E Baffin Island coast	1826	VIII		Large numbers			Lubbock, 1937:263.
184	Davis Strait, between 60 mi NW of N end Disko Island, Greenland, and 68°37'N ca. 63°W	1827	II	1	Several		In holes of water; heavy ice.	Lubbock, 1937:266.
185	Davis Strait, between 60 mi NW of N end Disko Island, Greenland, and 68°37'N ca. 63°W	1827	II	2		1 killed	Baleen of 9 ft 4 in. length; in very heavy ice.	Lubbock, 1937:266.
186	Davis Strait, between 60 mi NW of N end Disko Island, Greenland, and 68°37'N ca. 63°W	1827	II	17		2 struck	Very heavy ice.	Lubbock, 1937:267.
187	Between 68°37'N ca. 63°W and 63°N 61°30'W, off SE Baffin Island, probably off mouth of Cumberland Sound	1827	III		Many		Solid ice 5 mi around.	Lubbock, 1937:268.
188	62°N 61°W, ca. 120 mi E of mouth of Frobisher Bay	1827	IV	30	2	1 struck/ lost		Lubbock, 1937:271.
189	Near 62°N 61°W, ca. 120 mi E of mouth of Frobisher Bay	1827	V	3-6		Some killed		"
190	Near 62°N 61°W, ca. 120 mi E of mouth of Frobisher Bay	1827	V	11		4 killed		"

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
191	Near 62°N 61°W, ca. 120 mi E of mouth of Frobisher Bay	1827	V	12		2 killed		Lubbock, 1937:271.
192	Davis Strait, "Southwest fishing", SE Baffin Island coast, mouth of Hudson Strait, or northern Labrador coast.	1827	V-VI			11 killed	170 tons of oil.	Lubbock, 1937:272.
193	Off Cape Searle, SE coast of Baffin Island	1828	IX	21		1	Carcass found.	Lubbock, 1937:275
194	South-East Bay [Disko Bay]	1829	IV	1-7		1 killed		Lubbock, 1937:277.
195	"West water" near 73°54'N at mouth of or in Lancaster Sound	1829	VII	14		1 killed	11 ft 3 in. baleen.	Lubbock, 1937:278.
196	Off Cape Coutts, NE coast Baffin Island	1830	IX	6		1	Carcass found.	Lubbock, 1937:282.
197	Southward of Cape Searle, SE coast of Baffin Island	1831	VIII	29		1 killed	Lost.	Lubbock, 1937:286.
198	Southward of Cape Searle, SE coast of Baffin Island	1831	VIII	29		1 killed	9 ft 8 in. baleen; 44 butts of blubber.	"
199	Southward of Cape Searle, SE coast of Baffin Island	1831	VIII	29		1 killed		"
200	Brodie Bay, NE coast of Baffin Island	1835	VIII		Many		Whalers kept away by the setting in of "young ice."	Anon. 1836:6.
201	Off Cape Broughton, northern end of Broughton Island, SE coast of Baffin Island	1835	IX	Last 2 weeks	Many	4 struck/ lost	Crew of *Viewforth* chased whales every day, striking but losing 4 (each weighing 15 to 20 tons).	Anon., 1836:8.
202	Southward of Cape Searle, SE coast of Baffin Island	1835	XI	11	"A great many"		"Playing" around the *Viewforth*. Belugas and narwhals seen among the bowheads.	Lubbock, 1937:309.
203	Southward of Cape Searle, SE coast of Baffin Island	1835	XI	13	Many			Lubbock, 1937:310.
204	Along NE coast of Baffin Island, in or N of Home Bay	1835	XI	29		2	Carcasses picked up by the *Abram*; these whales appeared to have died of disease; no wounds evident.	Lubbock, 1937:312.
205	Off Cornelius Grinnell Bay, in 62°57'N, SE coast Baffin Island ca. 4 mi offshore (est.)	1835	XII	27	1		Heard blowing in heavy ice.	Lubbock, 1937:317.
206	Okak, Labrador	1835 (ca.)			"Some"			Anon., 1835:122.
207	Near 70°59'N 93°02'W, along NW coast of Gulf of Boothia.	1829	VIII	21	2 large		Near shore, in heavy, thick ice with some leads of open water.	Ross, 1835:125.
208	Near 70°59'N 93°02'W, along NW shore of Gulf of Boothia	1829	VIII	22	1 large		In thick ice with some leads of open water.	Ross, 1835:126.
209	Near 70°36'N 92°06'W, along NW shore of Gulf of Boothia	1829	IX	2	1 small		In pack ice.	Ross, 1835:140.
210	Near 70°55'N 92°06'W, along NW shore of Gulf of Boothia	1829	IX	5	2		In heavy pack ice with icebergs; open water between shore and the pack.	Ross, 1835:142.
	N side of Elizabeth Harbour, NE coast of Boothia Peninsula	1829	IX	8		Some	Numerous bones of whales were found in or near the remains of Eskimo summer houses. These remains were "of so old a date as to show it was long since this part of the shore had been inhabited."	Ross, 1835:146.
212	Near Fury Beach, SW shore of Prince Regent Inlet	1832	VIII	23	1		Heard but not seen. There was thick, unbroken ice everywhere.	Ross, 1835:660.
213	Off Prince Leopold Island, near 73°56'N 90°W, in SE Barrow Strait	1832	IX	1	4		Prince Regent Inlet, Barrow Strait and Lancaster Sound were an "unbroken field of ice."	Ross, 1835:665.
214	Hebron [Kangertluksoak], NE Labrador coast	1834				1 attempted kill		Brice-Bennett, 1980 MS.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
215	Near Okak, NE Labrador coast	1835	Mid-XII			1	Carcass found; carried out to sea by swell.	Brice-Bennett, 1980 MS.
216	Near Cape Graham Moore 72°51′N 76°04′W, in Pond Inlet mouth	1849	VII	9	2 (female +calf)	1 killed, large female	First whales seen by Goodsir in Pond Inlet area. Female had 11 ft baleen.	Goodsir, 1850:66-69.
217	Off Pond Inlet, in Baffin Bay	1849	VII	10-20		"Occasional" small whale killed		Goodsir, 1850:76.
218	Off Pond Inlet	1849	VII	10-20	Some		"More or less plentiful."	Goodsir, 1850:75.
219	Pond Inlet area, 10 mi away	1849	VII	10-20	Many		They did not enter Pond Inlet very far. For some time "shoals" of narwhals had been seen before the appearance of the bowheads.	Goodsir, 1850:77-78.
220	Off mouth of Pond Inlet	1849	VII	10-20		1 killed	By a Kirkaldy whaler during the "run" of whales.	Goodsir, 1850:80.
221	Off mouth of Pond Inlet	1849	VII	10-20		1 killed, large	10-11 ft baleen; taken by the *Advice*.	"
222	Off mouth of Pond Inlet	1849	VII	10-20		1 killed	During the "run" of whales.	Goodsir, 1850:80.
223	Off mouth of Pond Inlet	1849	VII	10-20		2-3 attempted kills	The *Advice*.	Goodsir, 1850:85.
224	Off mouth of Pond Inlet	1849	VII	10-20		1 struck/ lost, large	The *Advice*.	Goodsir, 1850:85-86.
225	Off mouth of Pond Inlet	1849	VII	10-20	"Hundreds"		Whales were "pouring round the point of ice, and apparently running in towards the bay [Pond Inlet], almost in hundreds." It seems the whales did not actually enter Pond Inlet.	Goodsir, 1850:88; Lubbock, 1937:351.
226	Near Button Islands, 10 mi N (est.) offshore, E end Hudson Strait	1836	I	5	Several		Heavy ice.	Lubbock, 1937:318.
227	Just S of Pond Inlet	1838 (ca.)			"Several hundreds"		Heading north "in a continuous flock", apparently for the mouth of Lancaster Sound.	Brown, 1868:540.
228	Cumberland Sound	1846			Numerous large			Lubbock, 1937:346.
229	Vicinity of Chesterfield Inlet, NW Hudson Bay, ca. 63°N	1846	VII	13	Over 12, some very large			Rae, 1850:27.
230	Roes Welcome Sound, ca. 64-65°N	1846	VII	19-20	"A great many"			Rae, 1850:32.
231	Labrador coast	1848				1 attempted kill	By netting. The whale entered the net during the evening and carried it off.	Clark, 1887:248.
232	Off Pond Inlet and Coutts Inlet, NE coast of Baffin Island	1849	VII (ca.)			6 killed		Barron, 1895:7; Lubbock, 1937:351.
233	Off N side of Scott Inlet, NE coast of Baffin Island	1849	VII			Some		Barron, 1895:8; Lubbock, 1937:351.
234	Off Home Bay, NE coast of Baffin Island	1850	IX		Pod		This pod of whales described as "a run of whales."	Barron, 1895:12.
235	Off Home Bay, NE coast of Baffin Island	1850	IX			3 killed		Barron, 1895:12-13.
236	Off Cape Hooper, NE coast of Baffin Island	1850	End of season			14-21 killed	7 whalers took 2-3 whales each.	Lubbock, 1937:353.
237	Between 71°55′N 66°55′W and 70°44′N 63°44′W, 75 mi (est.) off NE Baffin Island coast, Cape Christian area	1851	III		2		In leads in the opening pack ice.	Kane, 1854:390.
238	Near 69°46′N 63°06′W, off Henry Kater Peninsula, NE Baffin Island coast	1851	IV	25	1			Kane, 1854:357.
239	Off Cape [Henry] Kater, SE tip of Henry Kater Peninsula, NE Baffin Island coast	1851	VII	20	1		Apparently it was unusual to see whales this far south at this time of year.	Barron, 1895:25.
240	Off Blacklead Island, Cumberland Sound	1851	IX			1 killed, large		Barron, 1895:27.
241	Off Blacklead Island, Cumberland Sound	1851	IX	Late in month		1 killed	Cut whale loose after capture.	Lubbock, 1937:26.
242	Cumberland Sound, inshore among bay ice	1851	IX	End of month	A number			Barron, 1895:29.
243	Near Neubuyan, Cumberland Sound	1852	Spring			A number killed, small		Lubbock, 1937:357.
244	Near Neubuyan, Cumberland Sound	1852	IX	Late		1 killed, small		Barron, 1895:41; Lubbock, 1937:357.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
247	Off Agnes' Monument, 2 mi SE of Cape Christian, NE coast of Baffin Island	1852	IX			4 killed	Severe weather caused 3 killed whales to break adrift from the ship and be lost.	Barron, 1895:36-37; Lubbock, 1937:356.
248	Off Niatlik [Niante?] Cumberland Sound	1852	IX	Late	A number		"Making a rapid passage southward."	Barron, 1895:43.
250	Home Bay, NE coast of Baffin Island	1852				1 killed		Lubbock, 1937:356.
251	Off Coutt's Inlet and Scott Inlet, NE coast of Baffin Island	1853	VII (ca.)			5 killed	The *Truelove* saw more whales after these 5 as they went south to Cape Dyer but did not get any.	Barron, 1895:50-51.
252	Off Pond Inlet, S side	1853	Summer		Several	1 struck/lost	*Truelove* late for the Pond Inlet whaling, but found an opening close to land on the south side and saw several whales, striking one.	Barron, 1895:50.
253	Off Home Bay, NE coast of Baffin Island	1854	VI (ca.)		A number			Barron, 1895:55.
254	Eclipse Sound	1854			"Plenty"	2 killed	*Eclipse* found Pond Inlet free of ice and went through it to discover Eclipse Sound. "Plenty of whales" were seen in the sound, but the ice was so full of holes and rotten that the ship could not get near them.	Barron, 1895:57.
255	Hudson Strait	1855	VIII	3		1 killed		Ferguson, 1938:182.
256	Foxe Channel	1855	VIII	31		2 killed		"
257	Cumberland Sound	1856	II			2 killed	Unusually mild weather.	Lubbock, 1937:363.
258	Cumberland Sound	1856	II		"Great numbers"		Formation of young ice prevented the approach of whalers.	Lubbock, 1937:363.
259	Off Marble Island, Hudson Bay	1856	VI	3		1 killed		Ferguson, 1938:187.
260	Off Marble Island, Hudson Bay	1856	VI	Mid-month		2 killed		"
261	Off Pond Inlet	1856	VII (ca.)			Several killed		Barron, 1895:72.
262	Off Pond Inlet	1856	VII (ca.)			4 killed	*Truelove* captured these whales before coming to the land floe off Pond Inlet.	"
263	Off Pond Inlet, at land floe edge	1856	VII (ca.)			4 killed	*Truelove* captured these whales after making fast to the land floe off Pond Inlet.	"
264	Off Pond Inlet, off land floe	1856	VII (ca.)			1 killed		Barron, 1895:73.
265	Off Pond Inlet, off land floe	1856	VII (ca.)			2 killed		"
266	Off Pond Inlet, off land floe	1856	VII (ca.)			1 killed	In loose ice.	Barron, 1895:73; Lubbock, 1937:364.
267	Off Pond Inlet, off land floe	1856	VII (ca.)			1 killed		Barron, 1895:73.
268	Off Pond Inlet, at the land floe	1856	VII			Large numbers killed	Whalers made fast to the land floe at Pond Inlet took large numbers of whales, some taking 6 or 7. Apparently the whales were travelling in "runs."	Barron, 1895:72.
269	Off Marble Island, Hudson Bay	1856	Mid-VI			4 killed		Ferguson, 1938:187.
270	Off Southampton Island, northern Hudson Bay	1856	Mid-VIII			2 killed		Ferguson, 1938:187-188.
271	S side of Home Bay, NE coast of Baffin Island	1856	IX (ca.)		A number			Barron, 1895:74.
272	Off Cape Hooper harbour, NE coast of Baffin Island	1856	X		A number			Barron, 1895:76.
273	Off Pond Inlet	1856				1 killed	In loose ice.	Lubbock, 1937:364.
274	65°01′N 55°20′W 100 mi (est.) off W Greenland coast	1857	VII	28	1			M'Clintock, 1863:112.
275	Off Scott Inlet, NE coast of Baffin Island	1857	VIII (ca.)		A few		Fired at 2 or 3 but missed.	Barron, 1895:85.
276	Off Niatlik [Niante?], S side Cumberland Sound	1857	X (ca.)		2		Travelling south at a rapid rate.	Barron, 1895:88; Lubbock, 1937:368-69.
277	Near 69°N 59°W, 150 mi (est.) off Cape Hooper, NE coast of Baffin Island	1858	III	9	1			M'Clintock, 1863:123.
278	68°17′N 58°20′W (est.), 100 mi (est.) off Broughton Island, NE Baffin Island coast	1858	IV	2	2			M'Clintock, 1863:125.
279	67°18′N 58°17′W, 75 mi (est.) off Cape Dyer, NE coast Baffin Island	1858	IV	6	1			"

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
280	63°41′N 58°49′W, 100 mi (est.) off entrance to Cumberland Sound	1858	IV	23	1 large			M'Clintock, 1863:126.
281	75°0′N 78°46′W, off E coast Devon Island	1858	VII	11	1			M'Clintock, 1863:129.
282	74°02′N 82°00′W, off mouth of Navy Board Inlet	1858	VII	17	2		In very loose ice.	M'Clintock, 1863:130.
283	Off Agnes' Monument, 2 mi SE of Cape Christian, NE coast of Baffin Island	1858	VII (ca.)		Several			Barron, 1895:96.
284	72°48′N 76°30′W (est.), off entrance to Pond Inlet	1858	VIII	4	Several			M'Clintock, 1863:131.
285	72°48′N 76°39′W, 3 mi SE of Cape Graham [Moore], SE tip of Bylot Island	1858	VIII	5	1			"
286	Between 72°47′N 77°09′W and 72°48′N 76°39′W, off E coast of Bylot Island	1858	VIII	1-5	Very numerous			"
287	Off Nugumut, Cumberland Sound	1858	IX (ca.)	Late	A number			Barron, 1895:98.
288	Above Nugumut, Cumberland Sound	1858	IX (ca.)	Late	Several		Travelling "up" Cumberland Sound at great speed. "If one rose to the surface it only gave one blast, and the next time it would be a couple of miles off."	Barron, 1895:101.
289	Above Nugumut, Cumberland Sound	1858	IX (ca.)	Late	1			Barron, 1895:101.
290	Above Nugumut, Cumberland Sound	1858	X	1		1 killed	19½ tons of oil and nearly 1 ton of baleen.	Barron, 1895:105-107; Warmow, 1859:88.
291	Cumberland Sound	1858	X	3-9 (ca.)	Many			Barron, 1895:107.
292	Off Hall Peninsula near Frobisher Bay	1858	X	1st week (ca.)	Many			"
293	Vicinity of Elwin Bay, W side of Prince Regent Inlet	1859	VIII	17	1			M'Clintock, 1863:144.
294	Off mouth of Pond Inlet	1849	VII	10-20		3 killed, 1-2 pursued		Goodsir, 1850:89-92.
295	Pond Inlet	1849	VII	17		1 killed, large female	In a crack in the ice.	Goodsir, 1850:94-98.
296	E side of one of the Wollaston Islands, 2 mi SW of NW tip of Bylot Island, on the shore of a cove	1849	VIII	Early		ca. 1	Remains of Eskimo summer house was found from "some seasons back"; "a few little bits of baleen" surrounded the house.	Goodsir, 1850:111.
297	Off Home Bay, NE Baffin Island coast	1849	IX (ca.)			1 killed, medium size		Goodsir, 1850:116.
298	Just S of Home Bay, NE Baffin Island	1849	IX (ca.)		"Numerous" "dozens"	1 killed, large	*Advice* came upon a "run" of whales.	Goodsir, 1850:116-117.
299	Just S of Home Bay, NE coast of Baffin Island	1849	IX (ca.)		"Dozens"	3-4 killed	Around a small ice-floe.	Goodsir, 1850:117.
300	Just S of Home Bay, N of Cape Searle, NE coast of Baffin Island	1849	IX (ca.)			1 killed, large		Goodsir, 1850:117-118.
301	Just S of Home Bay, N of Cape Searle, NE coast of Baffin Island	1849	IX (ca.)			1 large	Carcass found. "It had been mortally wounded by ... ships, far to the northward, and swam thus far ere it died ... It had just floated to the surface when it was first seen." It was large, with good baleen.	Goodsir, 1850:120-126.
302	Exeter Bay, SE coast of Baffin Island	1849	IX (ca.)			1 large	A "krang" (whale carcass stripped of blubber and baleen) of a large whale was found. The whale had been killed a few days before by a ship.	Goodsir, 1850:143.
303	Cape [Henry] Kater, off the land floe, SE tip Henry Kater Peninsula, NE coast of Baffin Island [Cape Raper, (Markham, 1874)]	1860	VI (ca.)			1 killed		Barron, 1895:123.
304	Between Scott Inlet and Cape Kater, NE coast of Baffin Island	1861	VII (ca.)		A number	1 killed		Barron, 1895:138.
305	Off Home Bay, NE coast of Baffin Island	1861	IX		Many		*Truelove* could not get near them due to bay ice.	Barron, 1895:140.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
306	Off Home Bay, NE coast of Baffin Island	1861	IX	Late in month (ca.)	Several			Barron, 1895:140.
307	Pond Inlet, off the land floe	1862	VI (ca.)			1 killed		Barron, 1895:151.
308	Pond Inlet, off the land floe	1862	VI (ca.)			13 killed		"
309	Off Pond Inlet, at the land floe	1862	VI (ca.)			9-12 killed	By 8 steam whalers made fast to the land floe off Pond Inlet.	"
310	Pond Inlet, off the land floe	1862	VI (ca.)			1 killed		"
311	Between Pond Inlet and Home Bay, NE coast of Baffin Island	1862	Late VI to early VII (ca.)		Many		By *Polynia*.	Barron, 1970:152.
312	64°56′N 66°W, S side of Cumberland Sound	1862	IX	26	1			Lubbock, 1937:458.
313	64°56′N 66°W, S side of Cumberland Sound	1862	IX	27	2			"
314	64°56′N 66°W, S side of Cumberland Sound	1862	IX	29	A number			Lubbock, 1937:459.
315	64°56′N 66°W, S side of Cumberland Sound	1862	IX	30	Several	1 killed		"
316	Home Bay, NE coast of Baffin Island	1862	IX	Late in month (ca.)	Many			Barron, 1895:157.
317	65°10′N 67°10′W, S side of Cumberland Sound	1862	X	6	Several			Lubbock, 1937:459.
318	65°10′N 67°10′W, S side of Cumberland Sound	1862	X	7	Many			Lubbock, 1937:459.
319	65°10′N 67°10′W, S side of Cumberland Sound	1862	X	8	Numerous			"
320	65°10′N 67°10′W, S side of Cumberland Sound	1862	X	9		1 killed, very large		Lubbock, 1937:378,459.
321	65°10′N 67°10′W, S side of Cumberland Sound	1862	X	11	2			Lubbock, 1937:459.
322	65°10′N 67°10′W, S side of Cumberland Sound	1862	X	12	1			Lubbock, 1937:459.
323	65°10′N 67°10′W, S side of Cumberland Sound	1862	X	13	Several			"
324	Cumberland Sound	1862	Late in season			3 killed	By the *Active*; 2 of these probably the same as 2 *Active* captures previously listed, 30 IX 1862 and 9 X 1862.	Lubbock, 1937:378.
325	In Niatlik [Niante?], Cumberland Sound	1863	VII (ca.)		Many			Barron, 1895:163.
326	Off Niatlik [Niante?], Cumberland Sound	1863	VII		A number			Barron, 1895:163.
327	Off Niatlik [Niante?], Cumberland Sound	1863	VII (ca.)			1 killed		Barron, 1895:161.
328	Off Niatlik [Niante?], Cumberland Sound *or* Niantilik [Niante Harbour?], SE coast of Cumberland Sound	1863	ca. IX 3 days [late in 1863 season]			5 killed, large		Barron, 1895:163; Lubbock, 1937:382.
329	"Southern fishery", between 72° and 73°N, 100 mi (est.) offshore	1863				1 killed, large		Lubbock, 1937:381.
330	"Southern fishery", between 72° and 73°N, 100 mi (est.) offshore	1863				7 killed, large	130 tons (est.) of oil.	"
331	"Southern fishery", between 72° and 73°N, 100 mi (est.) offshore	1863				1 killed, large	30 tons of oil.	"
332	150 mi up Roes Welcome Sound	1863	[probably VIII]			3 killed		"
333	Between Marble Island and Cape Fullerton, Hudson Bay	1863	[probably VIII]		"Full of whales"			Chapel *in* Lubbock, 1937:381.
334	Roes Welcome Sound	1863	[probably VIII]		"Legions of whales"			"
335	Exeter Sound, SE coast of Baffin Island	1865	VIII (ca.)		"Numbers"		"Plentiful, but moving rapidly across the bay."	Barron, 1895:190-191.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
336	Exeter Sound, SE coast of Baffin Island	1865	VIII (ca.)			1 killed		Barron, 1895:191.
337	Exeter Sound, SE coast of Baffin Island	1865	VIII (ca.)			2 killed		Barron, 1895:192.
338	Exeter Sound, SE coast of Baffin Island	1865	IX (ca.)		"Plentiful"		The ice in the sound often prevented whalers from getting near whales.	Barron, 1895:195.
339	Repulse Bay	1865	VIII	15-16		8 killed		Low, 1906:277; Nourse, 1879:190.
340	Off Pond Inlet	1866	VI	14	1			Smith, 1922:33.
341	Off Pond Inlet	1866	VI	14-30	Several	Attempted hunting		Smith, 1922:34.
342	Off Pond Inlet	1866	VI	30	1			"
343	Off Pond Inlet	1866	VI	30	1			Smith, 1922:35.
344	Off Pond Inlet	1866	VI	30		1 killed	Possibly same as one sighted earlier in day.	Smith, 1922:34-35.
345	Off Pond Inlet	1866	VI	30		1 killed	Possibly same as one earlier in day.	Smith, 1922:35.
346	Off Pond Inlet	1866	VII	31	3		*Diana* lowered her boats, but could not approach the whales due to the great quantity of loose ice, extending to the horizon.	Smith, 1922:41.
347	Off Pond Inlet, off the land floe	1866	VII	31	3			Smith, 1922:41-42.
348	Navy Board Inlet [close to shore, probably at mouth]	1865	VIII	10	1 large		Close to shore, moving west rapidly.	Philphots, 1869:372.
349	Off Pond Inlet	1866	VIII	1st 2 weeks	A few		In leads among the "ice-fields."	Smith, 1922:42.
350	Off Pond Inlet	1866	IX	3		1	Carcass seen in the ice.	Smith, 1922:56.
351	In middle of Baffin Bay, 150 mi from Scott Inlet, NE coast of Baffin Island	1866	IX	13	1			Smith, 1922:70.
352	Coast of Repulse Bay	1866	Summer			1 killed		Hall, 1876:196.
353	Off Button Islands, mouth of Hudson Strait	1867	III	8	1			Smith, 1922:220.
354	Prince Regent Inlet	1868				40 killed, mostly small		Lubbock, 1937:393.
355	Admiralty Inlet	1869			"Abounds in whales"		Remains ice-free in summer.	Hall, 1876:207.
356	Admiralty Inlet	1869				5 large, killed	By natives.	Hall, 1876.
357	12 mi (est.) N of Cape Hay, Bylot Island, in the open of Lancaster Sound	1871	VI	24	"Numbers"			Lubbock, 1937:399.
358	12 mi N of Cape Hay, Bylot Island, in Lancaster Sound	1871	VI	25		1 killed		"
359	12 mi (est.) N of Cape Hay, Bylot Island, in Lancaster Sound	1871	VI	26	Some			Lubbock, 1937:399.
360	Off Possession Bay, northern coast of Bylot Island	1871	VII	2	"Numbers"			"
361	In Pond Inlet, at edge of the land floe	1871	VII	6	A few		Among ice floes.	"
362	[Probably] in Pond Inlet	1871	VII	10	A few		A few whales and "great numbers" of narwhals were seen around the ship.	"
363	Admiralty Inlet, in the open water, near the land floe	1871	VII	23	"Great numbers"			"
364	Admiralty Inlet	1871	VII	27	"Great numbers"		Ice was heavy.	"
365	Near mouth of Admiralty Inlet	1871	VII	31	Many			Lubbock, 1937:400.
366	Near 61°N 63°W, off Resolution Island, mouth of Hudson Strait	1873	V	15	Some		First sighting of the season on the "southwest" ground.	Markham, 1874:37-38.
367	Near 61°N 63°W, off Resolution Island, mouth of Hudson Strait	1873	V	16	1			Markham, 1874:39.
368	Near 61°N 63°W, off Resolution Island, mouth of Hudson Strait	1873	V	16-20	Many			Markham, 1874:44.
369	Near 61°N 63°W, off Resolution Island, mouth of Hudson Strait	1873	V	20		1 killed		Markham, 1874:44.
370	Near 61°N 63°W, off Resolution Island, mouth of Hudson Strait	1873	V	21-22	Some			Markham, 1874:47.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
371	Near 61°N 63°W, NE of Resolution Island, mouth of Hudson Strait	1873	V	23		1 killed, 40-50 ft, male		Markham, 1874:50-57; Lubbock, 1937:403.
372	Off mouth of Lancaster Sound	1873	VI	Early in month	A number, mostly small			Markham, 1874:133.
373	Off mouth of Lancaster Sound	1873	VI	13		1 killed	The first captured by the Dundee fleet since leaving the "southwest fishing".	Markham, 1874:126.
374	Off mouth of Lancaster Sound	1873	VI	15	Some			Markham, 1874:131.
375	Off mouth of Lancaster Sound, off Cape Byam Martin, E coast of Bylot Island	1873	VI	15		4 killed, 2 males, 2 females		Markham, 1874:131; Lubbock, 1937:403.
376	Off mouth of Lancaster Sound	1873	VI	16		1 killed		Markham, 1874:135-136.
377	10 mi off entrance to Lancaster Sound	1873	VI	17	Some			Markham, 1874:136.
378	Off Cape Walter Bathurst, E coast of Bylot Island, off mouth of Lancaster Sound	1873	VI	19		1 killed		Markham, 1874:141-144; Lubbock, 1937:403.
379	Off entrance to Lancaster Sound	1873	VI	23	Several			Markham, 1874:150.
380	Off Cape Walter Bathurst, E coast of Bylot Island, off mouth of Lancaster Sound	1873	VI	23		2 killed, 1 male, 1 female		Markham, 1874:150-151; Lubbock, 1937:403.
381	Off Cape Bowen, NE coast of Baffin Island	1873	VI	24		1 killed, female	10 ft 4 in. baleen.	Markham, 1874:153; Lubbock, 1937:403.
382	Off mouth of Lancaster Sound	1873	VI	25	Some			Markham, 1874:152.
383	Off mouth of Lancaster Sound	1873	VI	25	Several			"
384	Off Cape Bowen, NE coast of Baffin Island	1873	VI	25		1 killed, male		Markham, 1874:154-156; Lubbock, 1937:403.
385	Off Prince Regent Inlet	1873	VI	28		1 killed, female		Lubbock, 1937:403.
386	5 mi (est.) off mouth of Prince Regent Inlet, in Lancaster Sound	1873	VI	30	Some, small			Markham, 1874:167.
387	Off mouth of Prince Regent Inlet, in Lancaster Sound	1873	VI	30		1 killed, small		Markham, 1874:167; Lubbock, 1937:403.
388	Off Batty Bay, W side of Prince Regent Inlet	1873	VI	30	Some			Markham, 1874:167.
389	Off mouth of Prince Regent Inlet, in Lancaster Sound	1873	VI	30		3 killed, 1 female, 2 males		Markham, 1874:168-171; Lubbock, 1937:403.
390	Off Port Leopold, S side Barrow Strait [sighting]; off Cape Hurd, SW Devon Island [capture]	1873	VI	30	2, female and calf	1 killed, female		Markham, 1874; 168-171; Lubbock, 1937:403.
391	Off mouth of Prince Regent Inlet, in Lancaster Sound	1873	VII	1	Some		The ship struck one whale with "its fore foot".	Markham, 1874:172.
392	Off mouth of Prince Regent Inlet, in Lancaster Sound	1873	VII	4	Several			Markham, 1874:188.
393	In Barrow Strait, off mouth of Prince Regent Inlet	1873	VII	5	5; 2 large, 2 small, 1 calf	4 killed, 2 females, 2 males		Lubbock, 1937:403.
394	Off mouth of Prince Regent Inlet, in Lancaster Sound	1873	VII	6	Some			Markham, 1874:191.
395	Off Point Sargent, SW Lancaster Sound	1873	VII	6		1 killed, female		Markham, 1874:191; Lubbock, 1937:403.
396	Off the "Middle Ice" of Baffin Bay, [off mouth of Lancaster Sound, between Cape Byam Martin and Cape Graham Moore]	1873	VII	9		1 killed, large male		Markham, 1874:293; Lubbock, 1937:403.
397	Off Cape Graham Moore, SE tip of Bylot Island	1873	VII	10	1	1 killed, large male		Markham, 1874:211-212; Lubbock, 1937:403.
398	Off Cape Graham Moore, SE tip of Bylot Island	1873	VI	13		1 killed, large male		Lubbock, 1937:403.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
399	Off Navy Board Inlet, in Lancaster Sound	1873	VII	19	1			Markham, 1874:223.
400	Off mouth of Admiralty Inlet, in Lancaster Sound	1873	VII	20	1			Markham, 1874:223-224.
401	In Admiralty Inlet	1873	VII	20		1 killed, small male		Lubbock, 1937:403.
402	In Admiralty Inlet	1873	VII	22	2			Markham, 1874:228.
403	Off Neill's Harbour [Port Neill?], E side of Prince Regent Inlet	1873	VII	29	Some	1 killed, large female		Markham, 1874:234-235.
404	Mouth of Prince Regent Inlet	1873	between 7 VII and 10 VIII		Pod of 50			Van Beneden, 1887:41.
405	Near Cape Garry, W side of Prince Regent Inlet	1873	between 7 VII and 10 VIII		3			"
406	Near Fury Beach, W side of Prince Regent	1873	between 7 VII and 10 VIII		Many			"
408	Off Batty Bay, W side of Prince Regent Inlet	1873	VIII	1	Some	1 killed, small male		Markham, 1874:239; Lubbock, 1937:403.
409	In Creswell Bay, W side of Prince Regent Inlet	1873	VIII	2	Some			Markham, 1874:241.
410	Off Cape Garry, W side of Prince Regent Inlet	1873	VIII	9	Some		Moving south.	Markham, 1874:260-261.
411	Off Cape Garry, W side of Prince Regent Inlet	1873	VIII	9		1 killed, male	Moving south.	Markham, 1874:260-261; Lubbock, 1937:403.
412	Off Cape Garry, W side of Prince Regent Inlet	1873	VIII	11		1 killed, large female	Last whale taken by *Arctic* in 1873 season; moving south.	Markham, 1874:268; Lubbock, 1937;403.
413	Off Cape [Henry] Kater, NE coast of Baffin Island	1873	VIII	20	Several			Markham, 1874:279.
414	70 miles off Cape Hewett, NE coast of Baffin Island	1873	VIII	27	Several			Markham, 1874:283.
415	Annanatook, Cumberland Sound	1877	X	24	1			Howgate, 1879:35.
416	Off Cape Kendall, Southampton Island	1878	VII	2 (ca.)		4 killed		Wakeham, 1898:59.
417	Off Fisher Strait, northern Hudson Bay	1878	VII	26		1 killed	43 bbl of oil.	Ferguson, 1938:24,26,34.
418	Off Cape Fullerton, W side of Roes Welcome Sound	1878	VIII	1		1 killed	83 bbl of oil.	Ferguson, 1938:35.
419	Off Whale Point, W side of Roes Welcome Sound	1878	VIII	24		1 killed, large	Blubber 18 in. thick in places. Oil yield was 130 bbl; the baleen weighed 2900 lb. Said to have been 95 ft long [sic].	Ferguson, 1938:41,42.
420	Off Depot Island, Hudson Bay	1878	VIII	16		1 killed, small		Ferguson, 1938:39.
421	Off Whale Point, W side of Roes Welcome Sound	1878	IX	5		1 killed	84 bbl of oil.	Ferguson, 1938:43.
422	Near New Gummiute, near Monument Island, head of Frobisher Bay	1878	Autumn			1 killed, large		Wakeham, 1898:59.
423	Off Depot Island, Hudson Bay	1879	V	29	1			Ferguson, 1938:150.
424	Off Depot Island, Hudson Bay	1879	V	31	1			Ferguson, 1938:151.
425	Off Depot Island, Hudson Bay	1879	V	31	1			"
426	Off Depot Island, Hudson Bay	1879	V	31	Some			"
427	Off Depot Island, Hudson Bay	1879	VI	3	Several			Ferguson, 1938:151,152.
428	Off Depot Island, Hudson Bay	1879	VI	3		1 killed	Lost in an ice jam and recovered the next day.	Ferguson, 1938:152.
429	Off Depot Island, Hudson Bay	1879	VI	4		1 killed	This whale and the one killed the previous day, and recovered on this date produced 145 bbl of oil.	"
430	Off Cape Fullerton, W side of Roes Welcome Sound	1879	VI	12	A number			Ferguson, 1938:153.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
431	Off Cape Fullerton, W side of Roes Welcome Sound	1879	VI	13	A number			Ferguson, 1938:153.
432	Off Cape Fullerton, W side of Roes Welcome Sound	1879	VI	14	1			"
433	Off Cape Fullerton, W side of Roes Welcome Sound	1879	VI	15	A number	1 killed		"
434	NE of Marble Island, Hudson Bay	1879	VI	15		1 killed	57 bbl of oil.	Ferguson, 1938:155.
435	Off W shore of Southampton Island, northern Hudson Bay	1879	VI	29	A number			Ferguson, 1938:159.
436	Off W shore of Southampton Island, northern Hudson Bay	1879	VI	30		1 killed	65 bbl of oil.	Ferguson, 1938:154.
437	Off W shore of Southampton Island, northern Hudson Bay	1879	VI	30		several killed (3+)	At least one whale killed per ship.	Ferguson, 1938:159.
438	Off W shore of Southampton Island, northern Hudson Bay	1879	VII	2	A number			Ferguson, 1938:160.
439	Off W shore of Southampton Island, northern Hudson Bay	1879	VII	3	A number			"
440	Off Whale Point, W side of Roes Welcome Sound	1879	VII	4-9	A number			"
441	Off Whale Point, W side of Roes Welcome Sound	1879	VII	14		1 killed	87 bbl of oil.	Ferguson, 1938:162,163.
442	Off Whale Point, W side of Roes Welcome Sound	1879	VII	16	A number			Ferguson, 1938:163.
443	Off Cape Kendall, SE Roes Welcome Sound	1879	VII	29		1 killed	95 bbl of oil.	Ferguson, 1938:168,169.
444	Port Burwell Harbour, Killinek Island, mouth of Hudson Strait	1884	VIII	15	"A number"		No ice yet in sight. Identification not definite.	Gordon, 1886:43.
445	Port Burwell harbour, Killinek Island, mouth of Hudson Strait	1884	IX	1	"Numerous"		Some small icebergs in Hudson Strait.	Gordon, 1886:43.
446	Skynner's Cove [Nachvak Bay], NE coast of Labrador	1884	X	16	1		No ice in the bay, but some icebergs in Davis Strait.	Gordon, 1886:45.
447	Cumberland Sound	1885				2 killed		Lubbock, 1937:417.
448	Prince of Wales Sound, Hudson Strait, southern coast	Between VIII 1885 and IX 1886			2			Gordon, 1887:75.
449	Prince of Wales Sound, Hudson Strait, southern coast	Between VIII 1885 and IX 1886				3	Pieces of skeletons found on the shore.	"
450	Port Laperiere [Cape Digges], outer Digges Island, SW end of Hudson Strait	1886	V	7	1 large		Heavy ice, with narrow, shifting leads of open water.	Gordon, 1887:54.
452	Barrow Strait	1886	VII	5		2 killed, juveniles, male and female	7 tons of oil together.	Van Beneden, 1887:24.
453	Near 61°40'N 67°30'W, north-central Hudson Strait	1886	VII	10	1		First bowhead of the season to be sighted. The northern part of the Strait was open water, while heavy ice was packed along the south shore of Hudson Strait.	Gordon, 1887:6.
454	Prince Regent Inlet	1888				3 killed, "smallish"		Lubbock, 1937:420.
455	Lancaster Sound	1888			13	8 killed	Only 13 whales were seen in Lancaster Sound in 1888, of which 8 were killed, including 3 in Prince Regent Inlet, described in previous entry.	"
456	At "Middle Ice", Baffin Bay [off the mouth of Lancaster Sound, between Cape Byam Martin and Cape Graham Moore]	1890	Mid-VI			1 killed, large		"
457	Prince Regent Inlet	1890	After VI		"Plenty"		In heavy pack ice.	Lubbock, 1937:422.
458	Prince Regent Inlet	1890				4 killed		"

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
459	Off Cape Eglinton, NE coast of Baffin Island	1890				1 killed		Lubbock, 1937:422.
460	Off Cape Kater, NE coast of Baffin Island	1890				1 killed		"
461	Along coast of Baffin Island	1890				5 killed, large	Including the 2 whales described in the previous two entries.	"
462	Off Baffin Island coast	1890			Many		"On the move," were difficult to approach.	"
463	Off Cape Eglinton, NE coast of Baffin Island	1892	XI	6	Large pod		Moving south.	Lubbock, 1937:425.
464	Off Cape Kater, NE coast of Baffin Island	1892	XI	9	Large pod		Believed to be same group as seen 3 days earlier off Cape Eglinton, 100 miles (est.) to the north. Moving southward, pursued by *Nova Zembla.*	"
465	Cumberland Sound, whaling station	1892				1 killed		"
466	Lancaster Sound	1893	End VI to mid-VII			10 killed, 1 escaped	By *Aurora,* including 4 females and 3 calves. One other calf escaped.	Lubbock, 1937:427.
467	Lancaster Sound	1893	End VI to mid-VII			1 killed, calf	Apparently the same as the one which escaped capture by the *Aurora,* described above.	Lubbock, 1937:427-429.
468	Near Coutts Inlet, NE coast of Baffin Island	1893	Mid-IX			4 killed		"
469	Coutts Inlet, NE coast of Baffin Island	1893	IX	27		2 killed		"
470	[probably] near Coutts Inlet, NE coast of Baffin Island	1893	X	8		1 killed		"
471	"West water", [probably Pond Inlet or Lancaster Sound]	1894				6 killed, "fair" size		"
472	Off Martin's Mountains, the southern point of Lancaster Sound	1894				1 killed, large	12 ft baleen.	"
473	Cumberland Sound whaling stations	1895				3 killed	20 tons of oil.	Lubbock, 1937:431.
474	Off Coutts Inlet, NE coast of Baffin Island	1895				2 killed		"
475	Off Coutts Inlet, NE coast of Baffin Island	1895				1 killed		"
476	Off Cape Kater, NE coast of Baffin Island	1897				1 killed		Lubbock, 1937:434.
479	Off Coutts Inlet, NE coast of Baffin Island	1899	[probably late in season]			2 killed		Southwell, 1900:70; Lubbock, 1937:437.
480	Eclipse Sound	1899				3 killed, small		"
481	Lancaster Sound	1899	Early VII			2 killed, female + calf		Southwell, 1900:69.
482	In Pond Inlet	1899				1 killed, very small	4 ft baleen.	"
483	In Pond Inlet	1899				1 killed		"
484	In Eclipse Sound	1899			"Considerable number"			Southwell, 1900:70.
486	In Lancaster Sound	1899				2 killed, small		Southwell, 1900:69.
487	Mostly in Lancaster Sound and Coutts Inlet, NE Baffin Island	1899				10 killed	*Diana* killed 10 whales, probably including the 2 above whales (see entry 486).	Southwell, 1900:70.
488	Off Coutts Inlet, NE coast of Baffin Island	1899				2 killed, large	*Balaena.*	"
489	Cumberland Sound whaling stations	1899				2 killed		Lubbock, 1937:437.
490	Coutts Inlet, NE coast of Baffin Island	1900				1 struck/lost		Lubbock, 1937:439.
491	Coutts Inlet, NE coast of Baffin Island	1900				1 struck/lost, large		Lubbock, 1937:438-439.
492	Cumberland Sound whaling station	1900				1 killed	10 cwt of baleen.	Lubbock, 1937:439.
493	Pond Inlet	1900				3 killed, small		"
494	Coutts Inlet, NE coast of Baffin Island	1900				2 killed, large	12 ft baleen.	"
495	Hudson Strait	1900				1 killed, small		"
496	At whaling station on Fisher Strait, southern coast of Southampton Island, northern Hudson Bay, several miles north of Cape Low on Bay of Gods Mercy	1899-1901				3 killed		"

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
497	Southampton Island	1901	IX			2 killed		Lubbock, 1937:440.
498	Cumberland Sound, whaling stations	1901				2 killed		Lubbock, 1937:441.
499	Hudson Strait	1902				1 killed, small	9 cwt of baleen. Ice was very thick.	Lubbock, 1937:442.
500	Hudson Strait	1902			Numerous		In thick ice.	"
501	Cape Haven whaling station, (62°54′N 64°37′W) between Frobisher Bay and Cumberland Sound, SE Baffin Island coast	1900-1903				A few killed		Low, 1906:12.
502	Cumberland Sound, whaling stations	1903				2 killed		Low, 1906:10-11.
503	[Probably] off Kekerten Island, Cumberland Sound, NE shore	1903				1 killed		Lubbock, 1937:444-445.
504	Off Kekerten Island, NE Cumberland Sound	1903				4 killed	2 by the *Ernest William.*	Lubbock, 1937:444.
505	Off Mansfield and more southern islands of east side of Hudson Bay	1903 (ca.)	Winter		Some			Low, 1906:257.
506	Off Whale Point, west side of Roes Welcome Sound, southern end	1903			"Plentiful"			Low, 1906:32.
507	Roes Welcome Sound	1904	Winter			1 killed	8 ft 9 in. baleen.	Lubbock, 1937:446.
508	Southern Roes Welcome Sound, between Cape Kendall and Cape Fullerton (63°58′N 88°47′W)	1904	Late VI		1 large			Low, 1906:34.
509	[Probably] eastern end of Pond Inlet	1904	Early summer			2 killed, small		Low, 1906:57.
510	Southampton Island, northern Hudson Bay	1904	To VII	20		1 killed, small		Low, 1906:272.
511	[Probably] Roes Welcome Sound or Repulse Bay	1904	VIII	14		1 killed	9 ft 3 in. baleen.	Lubbock, 1937:446.
512	Mouth of Pond Inlet, at Pond Inlet whaling station	1904	To VIII	23		2 killed, small	500 lb of baleen	Low, 1906:272.
513	Repulse Bay, at whaling station	1904				1 killed, small	500 lb of baleen.	Low, 1906:68,272.
514	North shore of Hudson Strait	1904				1 killed, large	3000 lb of baleen.	Low, 1906:272.
515	Northwestern Hudson Bay	1904			Several			Bernier, 1910:313.
516	Hudson Strait	1904			Several			"
517	Cumberland Sound	1904			A few		Much broken ice was tightly jammed into the sound all summer, preventing whaleboats from reaching open water to hunt.	Low, 1906:62.
518	Pond Inlet, [probably] at mouth in inlet	1908				1 killed		Lubbock, 1937:449.
519	Off mouth of Navy Board Inlet, in Lancaster Sound	1909	VIII	31	1			Bernier, 1910:477.
520	Kekerten Island, NE shore of Cumberland Sound	1909				1 killed, small	3 ft baleen.	Bernier, 1910:424.
521	Whaling stations in Hudson Strait, Cumberland Sound and Pond Inlet	1909				15 killed		Lubbock, 1937:450.
522	Jones Sound	1910	Within 4 days			7 killed, large		"
523	Whaling stations in Hudson Strait, Cumberland Sound and Pond Inlet	1910				18 killed		"
524	Hudson Strait, S side, ca. 9 leagues WNW of Charles Island, at or near 62°50′N	1814	VIII	11		1 attempted kill	In "a vacancy between the ice". First whale seen this voyage.	Chappell, 1817:131.
525	Off mouth of Cumberland Sound, 30 mi SW of 63°59′29″N 61°42′58″W, SSE of Cape Mercy, SE coast Baffin Island	1819	VI	27	1 large		It "raised its head to take breath near the ships" and went "down tail foremost between two pieces of ice" since it "could not turn over to go down in the usual way, head first."	Parry, 1821:9: Anon., 1821:15.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
526	Off SE entrance of Lancaster Sound, approx. 50 mi ENE of Possession Bay, Bylot Island. Near 74°01′57″N 74°59′58″W	1819	VII	30	At least some		"The headquarters of the whales." No ice in site. See Entry No. 137.	Parry, 1821:23-24; Anon., 1821:22.
527	75°33′N, 61°22′W	1818	VII	31		a male killed, ca. 46 ft		Ross, 1819:xlvi-xlvii,69-71.
528	Near 73°55′18″N 77°40′W, off Bylot Island, 10 mi N of Cape Liverpool in Lancaster Sound	1819	VIII	1	Several, incl. many young		Some loose and heavy streams of ice. See entry No. 140.	Parry, 1821:29; Anon., 1821:25.
529	Near 74°25′31″N 80°04′30″W. N of Cape Hay and Navy Board Inlet, mid-entrance of Lancaster Sound	1819	VIII	3	"a great number"			Parry, 1821:33.
530	Near 73°33′15″N 88°18′17″W, Prince Regent Inlet, near the beach	1819	VIII	15	1, very large			Parry, 1821:46.
531	Near 73°50′N 88°15′W, mouth of Prince Regent Inlet, due W of Cape York	1819	VIII	18		1 attempted kill		Parry, 1821:47.
532	Between Cape Crauford, W coast Admiralty Inlet, and Cape Fanshawe, Bylot Island, a few mi offshore, off east side of mouth of Navy Board Inlet, in Lancaster Sound	1820	VIII	31	1		Some bergs and land-fast ice along south side of Lancaster Sound.	Parry, 1821:268.
533	Principally near Clyde Inlet, also in area of Agnes Monument, NE Baffin Island coast	1820	IX	5	12+, large			Parry, 1821:276.
534	East of Clyde Inlet, NE Baffin Island coast	1820	IX	5		1 killed	*Friendship* of Hull.	"
535	Between S shore Clyde Inlet and Cape Kater, NE Baffin Island coast, 1 mi or so offshore	1820	IX	9	"Several young"			Parry, 1821:290.
	Between Cape Kater and Cape Hooper, off Home Bay, NE coast of Baffin Island	1820	IX	10		1	Carcass found.	"
536	Merchants Bay, SE coast Baffin Island, near S tip Padloping Island	1820	IX	13	"A great many"		Heavy ice with bergs.	Parry, 1821:292.
537	Just off Merchants Bay, SE coast of Baffin Island	1820	IX	14	"A great many"		Thick ice with bergs.	"
538	Hudson Strait mouth, ca 10 mi ENE of Black Bluff on Resolution Island	1821	VII	1	1 large		In lead; heavy ice with bergs.	Lyon, 1824:7.
539	Entrance of Hudson Strait, just S of Resolution Island	1821	VII	17	1		Heard blowing.	Lyon, 1824:12.
540	Near E entrance of Frozen Strait, in the strait	1821	VIII	12	1		Heavy moving ice was besetting ships.	Lyon, 1824:43.
541	Bay "at bottom" of Repulse Bay	1821	VIII	22	"Numerous"			Lyon, 1824:55.
542	Gore Bay, SE Melville Peninsula, western Foxe Basin	1821	VIII	27	2 large		Heading north.	Parry, 1824:71.
543	Near head of Lyon Inlet, SE Melville Peninsula, SW Foxe Basin	1821	IX	6-15	Several large		Heavy ice starting to fill mouth of Lyon Inlet.	Lyon, 1824:73.
544	Northernmost shore of Gore Bay, SE Melville Peninsula, SW Foxe Basin	1821	IX	19	Several		No ice in the bay.	Parry, 1824:106.
545	In Safety Cove, Lyon Inlet, SE Melville Peninsula	1821	27 IX - 3X		2 large		Much packed and young ice in the inlet.	Lyon, 1824:83.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
546	Near SE point of Winter Island, Foxe Channel, near 66°11′N 83°10′W	1821	X	8 (ca.)		Several attempted kills	Ice prevented boats from reaching the whales.	Parry, 1824:126.
547	In Foxe Channel, SE of SE extremity of Lyon Inlet	1821	XII	1	1			Lyon, 1824:96.
548	In Foxe Channel, S of SE tip of Lyon Inlet	1822	I	22	1			Lyon, 1824.
549	Near Tern Island, Igloolik area, NW Foxe Basin	1822	VIII	4		Several attempted kills		Lyon, 1824:255.
550	Near Tern Island, Igloolik Island area, NW Foxe Basin	1822	VIII	5		1 killed, female, 43 ft 9 in.	Longest baleen 9 ft 1.5 in.	Lyon, 1824:256.Parry, 1824:301.
551	Off eastern entrance of Fury and Hecla Strait, just E of northern tip of Neerlonakto Island	1822	VIII	13	Several		Loose ice drifting away from the floe.	Parry, 1824:307.
552	Off eastern entrance of Fury and Hecla Strait, just N of Neerlonakto Island	1822	VIII	15	1		In space free of ice between 2 islands (2 of the Bouverie Islands). Ice was broken up.	Parry, 1824:308.
553	20 mi N of Winter Island, SW Foxe Basin	1823	VIII	28	1			Lyon, 1824:453.
554	Some mi N of Whale Point, Roes Welcome Sound	1824	IX	9	"A few"		"It is remarkable that this should be the first time of meeting with them."	Lyon, 1825:90.
555	Entrance of Lancaster Sound, mostly along S side, to Prince Regent Inlet (Port Bowen)	1824	Early IX to end IX		20-30, several large and "payable"		Young ice forming rapidly everywhere.	Parry, 1826:36-37.
556	N of Port Bowen, E side of Prince Regent Inlet	1825	VII 1st 2 wks.		"A number"		In the open water to the northward of Port Bowen. This may have been in the mouth of Prince Regent Inlet.	Parry, 1826:89.
557	N of Port Bowen, E side of Prince Regent Inlet	1825	VII	13		1 killed, small	5 ft baleen. In open water. Ice breaking up along coast.	Parry, 1826:89.
558	"Neill's Harbour" (Port Neill), E side Prince Regent Inlet	1825	VIII	27	9-10		"Somewhat below the middle size." Most ice gone, much open water.	Parry, 1826:161.
559	Between Arctic Circle and 58°N, near 58°27′W. Along Greenland coast	1825	17 IX - 24 IX		"A few"			Parry, 1826:168.
560	68°45′N, 60 mi offshore (Greenland or Baffin Island coast)	1827	II	Early		1 killed		Back, 1970 [1836]:489.
561	Between Capes York and Kater, Prince Regent Inlet	1833-1834			"Hundreds"	28 killed		Hall, 1970:131.
562	Along coast of W side of Hudson Bay, near 63°06′14″N, Chesterfield Inlet area	1846	VII	13	"Upwards of a dozen", very large			Rae, 1850:27.
563	Near Cape Fullerton, SW Roes Welcome Sound	1846	VII	15	1 very large		Close to shore, Large pack ice in area.	Rae, 1850:29.
564	Off Whale Point, SW Roes Welcome Sound	1846	VII	19	"A great many"			Rae, 1850:32.
565	60°08′N, near 59°07′W, off mouth of Hudson Strait	1826	V	19	2			Duncan, 1827:4.
566	60°16′N, near 59°07′W, off mouth of Hudson Strait	1826	V	20	1			Duncan, 1827:5.
567	Near 61°N 60°W, off mouth of Hudson Strait, at edge of pack ice in Davis Strait	1826	V	23	1	1 struck/lost		Duncan, 1827:5-6.
568	Near 61°N 60°W, off mouth of Hudson Strait, along edge of Davis Strait pack ice	1826	V	24	2-3	1 killed	11 ft 6 in. baleen.	Duncan, 1827:6-7.
569	Near 61°N 60°W, off mouth of Hudson Strait, along edge of Davis Strait pack ice	1826	V	25	Several			Duncan, 1827:6.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
570	61°43′N 61°W, off mouth of Hudson Strait at pack ice edge	1826	V	26	1			Duncan, 1827:7.
571	Near 61°43′N 61°W, off mouth of Hudson Strait at pack ice edge	1826	V	29	Several			"
572	Near 62°11′N 61°W, off SE Baffin Island	1826	VI	5		1 killed	11 ft 7 in. baleen. Heavy ice.	Duncan, 1827:9.
573	61°50′N. near 61°W, off SE Baffin Island	1826	VI	9	1		"Straggling" ice.	Duncan, 1827:10.
574	Near 68°43′N, near south end Disco Island, Greenland coast, 50 miles from land	1827	II	2		1 killed	9 ft 4 in. baleen. Heavy ice.	Duncan, 1827:85; Lubbock, 1937:266-267.
575	Near 68°43′N, near south end Disco Island, Greenland coast, 50 miles from land	1827	II	1	Several		Heavy ice.	Duncan, 1827:85.
576	Near 68°58′N, Greenland coast, 50 miles from land	1827	II	7	Several			Duncan, 1827:87.
577	Near 68°58′N, Greenland coast, 50 mi from land	1827	II	8	Several			"
578	Greenland coast, at 68°58′N, 50 mi from land	1827	II	15	Several		In heavy ice, with "holes of water."	Duncan, 1827:89.
579	Greenland coast, 68°58′N, 50 mi from land	1827	II	16	Several		Heavy ice.	Duncan, 1827:90.
580	Greenland coast, near 68°58′N, 50 mi from land	1827	II	17	3-4	2 struck,	8 ft 1 in. baleen. At floe edge.	Duncan, 1827:90; Lubbock, 1937:267.
581	Greenland coast, near 68°58′N, 50 mi from land	1827	II	21	Several		Much "bay ice." Vessel was beset in ice.	Duncan, 1827:91.
582	67°34′N, near 62°30′W, off SE Baffin Island coast	1827	III	11	1		In lead of open water among "bay ice."	Duncan, 1827:104.
583	Near 67°25′N 62°30′W, off SE Baffin Island coast	1827	III	13	2		In "bay ice."	Duncan, 1827:105.
584	Near 67°25′N 62°30′W, off Baffin Island E coast	1827	III	14	Several			"
585	Near 67°25′N 62°30′W, off E coast Baffin Island	1827	III	15	1		Heavy ice.	"
586	67°24′N, near 62°30′W, off E coast Baffin Island (?)	1827	III	16	Some			"
587	61°37′N, 61°W, off mouth of Hudson Strait	1827	III	25	1			Duncan, 1827:109.
588	Near 61°37′N 61°W, off mouth of Hudson Strait	1827	III	26	Several			Duncan, 1827:110.
589	Near 61°37′N 61°W, off mouth of Hudson Strait	1827	III	27	Several			Duncan, 1827:110.
590	67°18′N, in middle Davis Strait	1858	IV	6	2			M'Clintock, 1860:99.
591	In Lancaster Sound and at "ice edge" (Pond Inlet floe edge?)	1858	VIII	Early	"Many"			M'Clintock, 1860:169.
592	Vicinity Prince Leopold Island, E Barrow Strait	1859	VIII	23	1			Sutherland, 1852:v.1:288.
593	Cape Searle area, NE coast Baffin Island	1846	Until mid-or late October		Several			Sutherland, 1852:v.2:325.
594	Pond Inlet floe edge	1845	VI or VII		"Literally swarming"		At the edge of the ice.	Sutherland, 1852:v.2:324-325.
595	N of Whale Point, near 64°56′33″N, Roes Welcome Sound, Southampton Island shore visible	1846	VII	20	Some large		Close-packed ice in area.	Rae, 1850:32.
596	Near Cape Hope, S end of Repulse Bay	1847	VIII	13	1 large			Rae, 1850:179.
597	Near 63°47′33″N, opposite Cape Fullerton, SW Roes Welcome Sound, just offshore	1847	VIII	17	1 large			Rae, 1850:183.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
598	Near 62°13'19"N, near Whale Cove, near S side of Corbett Inlet, NW Hudson Bay	1847	VIII	14	3 large			Rae, 1850:190.
599	Cyrus Field Bay, SE Baffin Island coast	ca. 1855 ("not many years ago" pre-1860)				1 struck		Hall, 1970:217, 1865:247.
600	Cumberland Sound	1857	Spring			1 killed	In open water by floe edge.	Hall, 1970:216.
601	In lower part of Frobisher Bay (or Cyrus Field Bay), SE Baffin Island coast	1860	Late VIII- early IX (est.)			1 killed		Hall, 1970:109.
602	Cyrus Field Bay, SE Baffin Island coast	1860	late IX	(ca. 20-25)		1 killed		Hall, 1970:115.
	Near Clark Harbour on Cornelius Grinnell Bay, SE Baffin Island	1860				1	Bones of whale killed previously.	Hall, 1970:89.
603	In Cyrus Field Bay, SE Baffin Island coast	1861	X	7-10		2 killed		Hall, 1970:411-412.
604	In Cyrus Field Bay, SE Baffin Island coast	1861	X	17		1 killed		Hall, 1970:419.
	On island along coast of Belcher Peninsula, head of Frobisher Bay, SE Baffin Island	1861					Bones of "huge" whale found, portions covered with moss.	Hall, 1970:350.
605	Repulse Bay	1864	VIII		Many, all small	20 killed		Nourse, 1879:65.
606	Whale Point, SE Roes Welcome Sound	1864	IX	1	Some			Nourse, 1879:59.
607	At "Noo-wook" (Nuvuk), between Whale Point and Wager Bay, W Roes Welcome Sound	1864	IX	8-9	Some		Close to shore.	Nourse, 1879:65.
608	Repulse Bay	1865	VII	end	1		Heard blowing.	Nourse, 1879:184.
609	Repulse Bay	1865	VIII	ca. 6	3		Near shore.	Nourse, 1879:186.
610	Repulse Bay	1865	VIII	30	2	1 killed	1500+ lb baleen.	Nourse, 1879:190-192.
611	Repulse Bay	1866	VIII	end	1		First whale of the season. Heard blowing.	Nourse, 1879:283.
612	Repulse Bay	1866	VIII	end		1 killed, large	9 ft 6 in. baleen, 60 bbl oil.	Nourse, 1879:286.
613	Repulse Bay	1867	VIII	late		1 killed		Nourse, 1879:324.
614	Repulse Bay	1868	VIII	31		1 killed	7 ft baleen.	Nourse, 1879:362-364.
615	Repulse Bay	1868	Summer			1 killed		Nourse, 1879:358.
616	Milne Inlet, bottom of Eclipse Sound	1869			Many		Bowheads "abound" here.	Nourse, 1879:370.
617	Lancaster Sound	1884	VII	1	"Good number"			Lindsay, 1911:153.
618	Lancaster Sound, probably Navy Board Inlet area	1884	VII	5		1 killed	10 ft baleen, 13 tons oil.	Lindsay, 1911:157-163.
619	Lancaster Sound, almost opposite mouth of Admiralty Inlet	1884	VII	6		1 attempted kill	Among loose ice.	Lindsay, 1911:163-164.
620	Lancaster Sound, opposite mouth of Admiralty Inlet	1884	VII	8		2 killed	Near ice edge.	Lindsay, 1911:166-168.
621	Lancaster Sound, opposite mouth of Admiralty Inlet, S side of sound	1884	VII	8	Some		"...the fish were coming up the south side [of Lancaster Sound]..."	Lindsay, 1911:168.
622	Lancaster Sound, near mouth of Admiralty Inlet	1884	VII	12		1 attempted kill	In loose ice.	Lindsay, 1911:173.
623	Lancaster Sound, probably near mouth of Admiralty Inlet	1884	VII	17		1 killed		Lindsay, 1911:175.
624	Lancaster Sound, probably area of mouth of Admiralty Inlet	1884	VII	18		1 attempted kill	Among loose ice.	Lindsay, 1911:177.
625	Lancaster Sound, probably near mouth of Admiralty Inlet, S side of sound.	1884	VII	19		1 killed	10½ ft baleen.	Lindsay, 1911:177-178.
626	Lancaster Sound, probably near mouth of Admiralty Inlet	1884	VII	19		1 killed	No ice.	Lindsay, 1911:181-182.
627	Lancaster Sound, probably near mouth of Admiralty Inlet	1884	VII	23			"...the place was swarming with whales, [but] we never got one."	Lindsay, 1911:186.

Table 1 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
628	Lancaster Sound, probably near mouth of Admiralty Inlet	1884	VII	23		1 attempted kill	In loose ice.	Lindsay, 1911:184-185.
629	Lancaster Sound, probably near mouth of Admiralty Inlet	1884	VII	23	1 large		In loose ice.	Lindsay, 1911:185.
630	Lancaster Sound, probably near mouth of Admiralty Inlet	1884	VII	23	2	1 struck/ lost	In loose ice.	Lindsay, 1911:185-186.
631	Lancaster Sound, probably near mouth of of Admiralty Inlet	1884	VII	23		1 attempted kill	In loose ice.	Lindsay, 1911:186.
632	S side of Lancaster Sound, probably near mouth of Admiralty Inlet	1884	VII	24		1 killed		Lindsay, 1911:187.
633	S side of Lancaster Sound, near mouth of Admiralty Inlet	1884	VII	28		1 killed		Lindsay, 1911:188-189.
634	S side of Lancaster Sound, probably near mouth of Admiralty Inlet	1884	VII	31		1 attempted kill		Lindsay, 1911:191.
635	S side of Lancaster Sound, probably near mouth of Admiralty Inlet	1884	VIII	1		1 killed, large		Lindsay, 1911:192.
636	S side of Lancaster Sound, probably near mouth of Admiralty Inlet	1884	VIII	4		1 struck/lost	In loose ice.	Lindsay, 1911:193-194.
637	S side of Lancaster Sound, probably near mouth of Admiralty Inlet	1884	VIII	6		1 attempted kill	Among pans of loose ice.	Lindsay, 1911:194.
638	S side of Lancaster Sound, probably near mouth of Admiralty Inlet	1884	VIII	6		1 attempted kill		Lindsay, 1911:194-195.
639	S side of Lancaster Sound, probably near mouth of Admiralty Inlet	1884	VIII	7	2	1 killed		Lindsay, 1911:195-197.
640	S side of Lancaster Sound, near mouth of Navy Board Inlet	1884	VIII	9		1 killed	Much ice in area.	Lindsay, 1911:198-199.
641	Near entrance of Hudson Strait, between Cape Chidley and Savage Islands	1886	VII	10	1		No ice.	Feilden, 1887:347.
642	Prince of Wales Sound, Hudson Strait	1886-1887				2		Payne, 1888:118.
643	Near 66°44′N 54°30′W, ca. 25 miles off Greenland coast	1910	VII	20	ca. 30		Not much ice.	Bernier, 1911(?):9.
644	At ice edge NE of Cape (Point?) Bathurst, South Bylot Island	1911	VI	28 (ca.)	1 large		Ice heavy around the coast.	Bernier, 1911(?):143.
645	Near Cape Adair, NE Baffin Island coast	1906	X		"Some"			Bernier, 1909:40.
646	Button Point, SW Bylot Island, on Pond Inlet	1907	VII	early	"Not many"			Bernier, 1909:43.

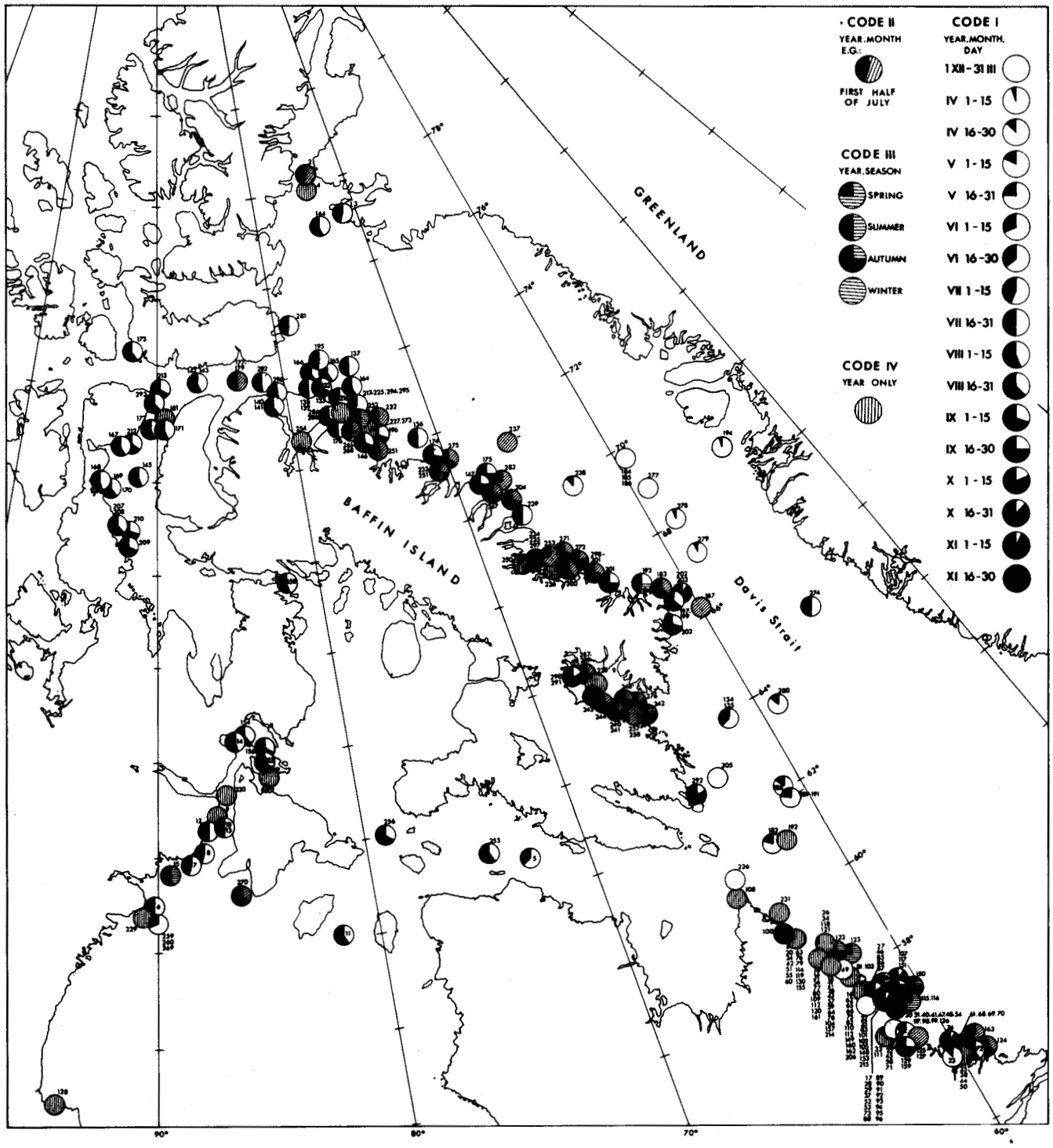


FIG. 1. Bowhead distribution, 1615-1859. Numbers refer to entries on Table 1. Key to plots on this figure applies to Figures 1-4.

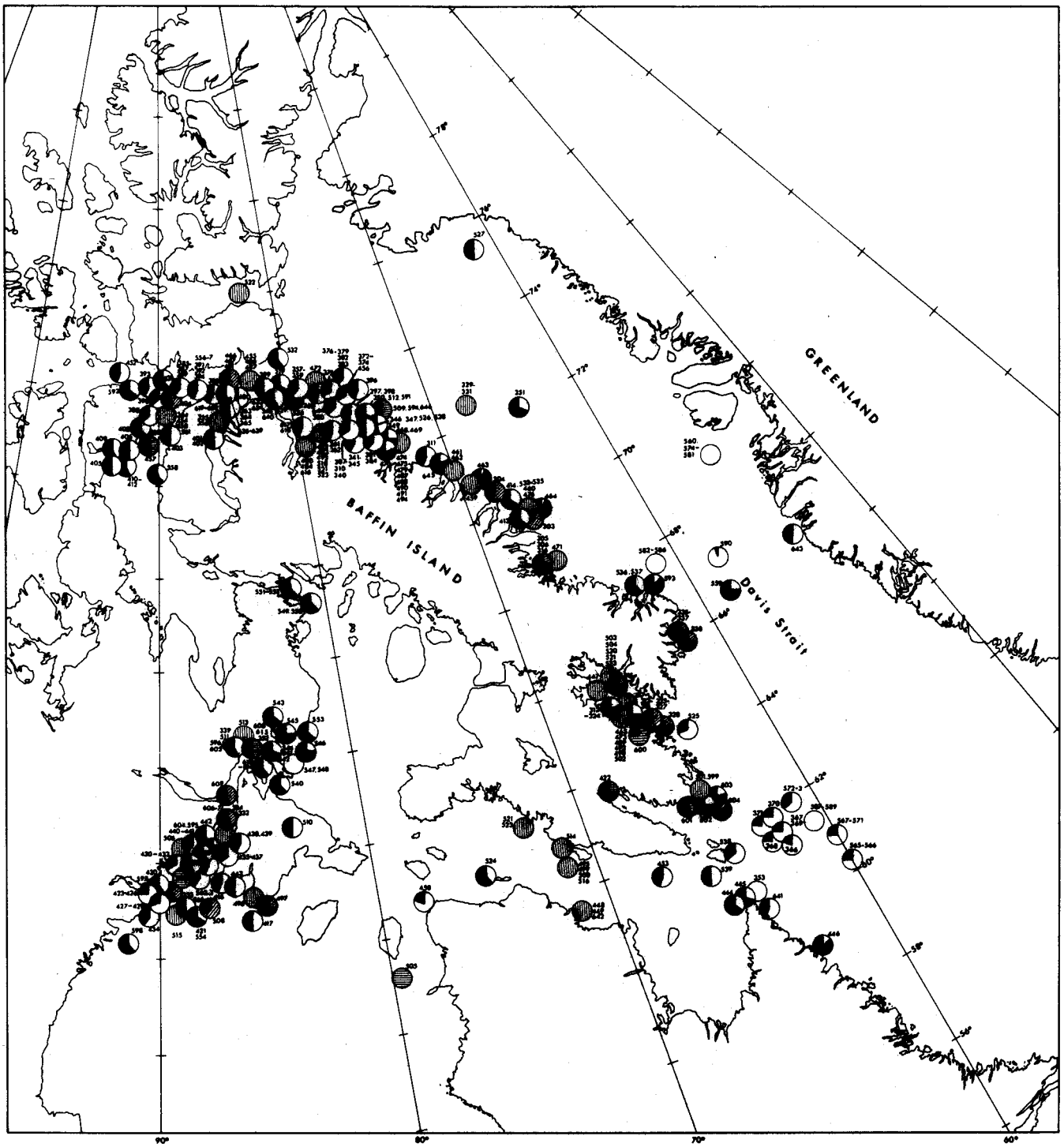


FIG. 2. Bowhead distribution, 1859-1913. Numbers refer to entries on Table 1.

TABLE 2. Occurrences of the bowhead whale in the eastern Arctic, 1919-1939, from Hudson's Bay Company post journals

Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
Coats Island, northern Hudson Bay	1919	VI	23	2 large		"Feeding" in harbour. Whales "quite numerous" here.	HBC Archives, Coats Island Post Journal, B.404/a/1, 1918-1920, Folio 33.
Coats Island, northern Hudson Bay	1919	VII	15		1 attempted kill	Whale observed coming up "through holes in the ice." Struck with 1 harpoon and many spears by Eskimos. Whale escaped with harpoon "in shoulder" and trailing a float, "bleeding badly" while being chased for 2 hours.	HBC Archives, Coats Island Post Journal, B.404/a/1, 1918-1920, Folio 35.
Near Cape Dorset, western end of Hudson Strait	1919	VIII	15		1 attempted kill	A "Right" whale. Attempted kill, harpoon missed.	HBC Archives, B.397/a/2, 1918-1920, Cape Dorset Post Journal, Folio 106.
Coats Island, northern Hudson Bay	1919	VIII	28	1		In the harbour of the HBC Post.	HBC Archives, Coats Island Post Journal, B.404/a/1, 1918-1920, Folio 41.
Coats Island, northern Hudson Bay	1919	IX	27	1		HBC Post harbour.	HBC Archives, Coats Island Post Journal, B.404/a/1, 1918-1920, Folio 46.
Coats Island, northern Hudson Bay	1920	X	1	1 large		Large whale seen moving south. "This is the first seen for the season."	HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 11.
Coats Island at "spring quarters" of Inuit	1921	VI	15	2 large		Natives reported seeing 2 large whales at their "spring quarters", the first seen since late the previous fall.	HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 59.
Near Beacon Point, Coats Island	1921	VI	23-28	1 large		Appears to have remained in the same area for period 23-28 June.	HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 60-61.
Coats Island, northern Hudson Bay	1921	VII	18		1 killed, 30 ft female	Killed with "Dart Piercing Bomb" by natives and HBC Post employees. The whale's tail broke the main boom of the whaleboat. Produced a total of 12,913 lb of blubber and 135 lb of baleen of average length of 2 ft.	HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 64.
Southwest coast of Coats Island, northern Hudson Bay	1921	VII	25	1 large			HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 66.
Coats Island, northern Hudson Bay	1921	VIII	4-6	1 large (>30 ft)	attempted kill		HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 69.
Coats Island, northern Hudson Bay	1921	IX	25	1 large			HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 77.
Cumberland Sound, near Pangnirtung post	1921 or 1922	X	8	1 large		"Black whale."	HBC Archives, B.455/a/2, Folio 2, Report upon Sundry Trips and Resources of Country. Cumberland Gulf. 1922.
Coats Island, northern Hudson Bay	1922	IV	24	1			HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 108.
Coats Island, northern Hudson Bay	1922	VI	16	1 large			HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 116.
Coats Island, northern Hudson Bay	1922	VII	1	1 large			HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 119.
Coats Island, northern Hudson Bay	1922	VII	2	2 large	1 struck/lost	Struck with a "Dart Piercing Bomb", but lost. The second whale was chased but not struck.	HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 119.
Coats Island, northern Hudson Bay	1922	VII	8	1		Chased, not struck.	HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 120.
Coats Island, northern Hudson Bay	1922	VII	29	1 large			HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 123.
Coats Island, northern Hudson Bay	1922	VII	30-31	1		Chased, not struck.	HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 123.
Coats Island, northern Hudson Bay	1922	VIII	1-10	1		One whale seen and chased repeatedly.	HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 125.
Ca. 40 mi off Cape Pembroke, NE tip of Coats Island	1922	VIII	11		1 large (75 ft long [sic.], baleen of 12 ft) killed	Natives unable to tow whale in, so set it adrift; no part was saved.	HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 127.
Coats Island	1923	X	6	1			HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 174.
Coats Island	1923	X	8-11	1	attempted shot		HBC Archives, Coats Island Post Journal, B.404/a/3, 1920-1927, Folio 174.
Native Point, Southampton Island	1925	VII	22	1			Southampton Island Post Journal, B.404/a/3, Folio 302.
Repulse Bay	1925	15 VIII - 12 IX		1	1 struck/lost	Bowhead, apparently same one, hunted repeatedly for 3 wk; struck but lost on 27 VIII.	HBC Archives, Southampton Island Post Journal, B.404/a/3, Folios 327-330.
Bowdoin Harbour, south of Cape Queen, western Hudson Strait	1929	II	27		1	"Right whale" found frozen in ice; baleen missing; "must have been killed by men last summer."	HBC Archives, Cape Dorset Post Journal, B.397/a/3, 1928-1929, Fo. 21d,23,28.
Repulse Bay, HBC Post	1931	VIII	4	1		"Saw no sign of black whale which has been reported to be in the vicinity."	HBC Archives, Repulse Bay Post Journal, B.472/a/1, 1930-1931, Folio 65.
Clyde River, HBC Post	1932	IX	7	1		"Fairly big" whale seen near post.	HBC Archives, Clyde River Post Journal, B.403/a/3, 1932-1933, Folio 28.

Table 2 (Continued)

Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
Mansel Island, NE Hudson Bay	1930	XI	10		1	"[Fox] signs are quite numerous especially around the Whale ... found last year .... The Whale Meat is presumably in such a putrid state that the dogs will not eat it."	HBC Archives, Mansel Island Post Journal, B.438/a/1, Folio 25.
Clyde River, NE coast of Baffin Island	1934	IX	13	2		Native saw 2 "Greenland whales" out of reach.	HBC Archives, Clyde River Post Journal, B.403/a/4, 1933-1934, Folio 81.
Clyde River, NE coast of Baffin Island	1939	VIII	30	1 large		Large "Greenland whale" seen in the Clyde River HBC Post harbour.	HBC Archives, Clyde River Post Journal, B.403/a/6, 1938-1939, Folio 254.

TABLE 3. Occurrences of the bowhead whale in the eastern Canadian Arctic, 1914-1974

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
1	S. Southampton Island	1924	XI	8	2 very large			Sutton and Hamilton, 1932:90.
1A	Southampton Island	1926	VII	22	1		Soon after breakup in harbour.	"
2	Southampton Island	1926	X	6	5			"
3	Southampton Island	1926	X	23		1 killed		Sutton and Hamilton, 1932:90; Manning, 1944:145; Copland, 1974:44.
4	Southampton Island	1927	VI	21	1 small		Before ice had entirely left the shore.	Sutton and Hamilton, 1932:90.
5	Southampton Island	1928	IX	17		1 killed, large		Sutton and Hamilton, 1932:90; Manning, 1944:145.
6	Southampton Island	1929	VII			1 killed, >45 ft		Sutton and Hamilton, 1932:90.
7	Southampton Island	1929	IX	25	6		One breached repeatedly.	Sutton and Hamilton, 1932:91.
8	Clearwater Fiord, Cumberland Sound	1946	VII			1 killed, 36 ft	First whale killed in this area since 1918.	Anderson, 1947.
9	Chase Island, Frobisher Bay, 63°05'N, 66°55'W	1954	VII	12	2; 1 large, 1 small			RCMP Game Report, July 30, 1954 (Mansfield files).
10	Cape Christian, E. Baffin Island, 70°32'N, 68°18'W	1954	VIII	End	1-2			RCMP Game Report, 1953-54 (Mansfield files).
11	Pangnirtung district, Cumberland Sound	1954			Herds of 5, 7, 8		Numbers of whales seen throughout year in this area, including young. Population thought to be increasing.	RCMP Game Report, 1955 (Mansfield files).
12	SW Hudson Bay	1955	Summer		1 large			Dr. W.J. Felts, Univ. of Minnesota (source uncertain).
13	63°08'N, 89°46'W, S. Roes Welcome Sound	1955	VIII	12	1			Icebreaker *Labrador* (Mansfield files).
14	71°31'N, 68°16'W, Cape Christian area, E. Baffin	1955	IX	20	2		Natives consider sightings becoming more frequent.	RCMP Game Report (Mansfield files).
15	64°03'N, 75°48'W, E of Cape Dorset, Northwest Hudson Strait	1955	XI	5	6; 3 large, 3 small		Close to shore, near tide rip.	Personnel of icebreaker *Labrador* (Mansfield files).
16	Navy Board Inlet, N. Baffin Island	1955	Autumn			1	Carcass found by Eskimos. No other details.	RCMP Game Report 1955-56 (Mansfield files).
17	71°20'N, 84°50'W, Easter Sound, Admiralty Inlet	1955	Autumn			1	Carcass found by Eskimos. No other details.	"
18	Cumberland Sound	1955			Herds of 5-10, est. 50 total		Including many young. An increase in sightings since 1954.	RCMP Game Report 1954-55 (Mansfield files).
19	SW Hudson Bay between Winisk and Churchill	1956	Summer		1 large			Pilot, Transair Ltd.
20	Navy Board Inlet	1956	Summer		A few			RCMP Game Report 1956 (Mansfield files).
21	71°40'N, 93°29'W, E end of Bellot Strait	1956	IX	22	1			Icebreaker *Labrador* (Mansfield files).
22	63°46'N, 82°30'W, Native Point, South Bay, Southampton Island, N. Hudson Bay	1956	XII			1 (15-20 ft)	Carcass embedded in shore ice; thought to be young bowhead.	Eskimos reported to Father Choque (Mansfield files).
23	Cumberland Sound	1956	Autumn			1	Attacked and killed by a large herd of killer whales.	RCMP Game Report 1956-57 (Mansfield files).

Table 3 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
24	Clearwater Fiord area and Cumberland Sound	1956			Many			RCMP Game Report 1956-57 (Mansfield files).
25	Near 71°05′N, 71°05′W, Scott Inlet, NE Baffin Island	1957	VI		2			U.S.C.G. Icebreaker *Westwind* (Mansfield files).
26	73°45′N, 79°50′W, Cape Hay, Bylot Island	1957	VII	4	3		Close inshore.	L.M. Tuck, Canadian Wildlife Service (C.W.S.), 1957 MS (Mansfield files).
27	Off Cape Christian, E. Baffin Island	1957	VIII	7	1			L.M. Tuck, C.W.S., aboard Can. Govt. ship *C.D. Howe* (Mansfield files).
28	Prince Regent Inlet	1957	VIII	26	1			Icebreaker *Labrador* (Mansfield files).
29	Navy Board Inlet	1957	Summer		A few			Eskimos, RCMP Game Report, 1957-58 (Mansfield files).
30	Cape Christian, E. Baffin Island	1957	Autumn		1			RCMP Game Report, 1957-58 (Mansfield files).
31	Cumberland Sound	1958-59			Some			RCMP Game Report, 1958-59 (Mansfield files).
32	Kivitoo, E. Baffin Island	1958-59			Some			"
33	Near 66°04′N, 59°28′W, Cape Walsingham, E. Baffin Island	1959	VIII	20	1		Whale identified as bowhead from a distance.	Capt. B. Blackwood, *A.T. Cameron* (pers. comm. in Mansfield files).
34	59°44′N, 62°50′W, off Cape Chidley, Davis Strait	1959	VIII	22	1		Identification unconfirmed.	Capt. B. Blackwood, *A.T. Cameron* (pers. comm. in Mansfield files).
35	Cape Christian, E. Baffin Island	1960	X		20 in a herd			RCMP Game Report, 1960-61.
36	71°14′N, 84°42′W, Easter Sound, end of Admiralty Inlet	1960			1		Carcass embedded in sand of a creek. Flesh of whale kept edible by permafrost.	Eskimos reported to J.B. Haining, HBC (Mansfield files).
37	Cumberland Sound	1960			Several		Sightings not considered unusual.	RCMP Game Report, 1959-1960 (Mansfield files).
38	Kivitoo-Broughton Island area, E. Baffin Island	1960			Several		Sightings not considered unusual.	RCMP Game Report, 1959-1960 (Mansfield files).
39	Makkovik, NE Labrador	1960				1	Part of skeleton found 8 ft deep, 330 ft inland. Skull 18 ft long.	Capt. R. Olford, D.O.T. (Mansfield files).
40	Kivitoo-Broughton Island area, E. Baffin Island	1960-1961	Summers		Several			Eskimos (Mansfield files).
41	74°41′N, 95°35′W, Cape Martyr, Cornwallis Island	1961	VII		1			Eskimos (Mansfield files).
42	Seahorse Point, E. Southampton Island, 63°47′N, 80°09′W	1961	VIII		A few		Seen every summer by hunters at Seahorse Point.	Joe Curly, Southampton Island (Mansfield files).
43	Imigen Island area, mouth of Nettilling Fjord, Cumberland Sound, 65°58′N, 66°58′W	1961	Spring		3-4		Sighted on numerous occasions.	RCMP Game Report, 1961 (Mansfield files).
44	Button Point, SE Bylot Island, and Navy Board Inlet areas	1961			Ca. 10		Largest numbers sighted by Eskimos in 25 years.	RCMP Game Report, 1961-62 (Mansfield files).
45	Off Cape Christian, E. Baffin Island	1961	IX-X				Herds of 6-20 whales seen periodically.	RCMP Game Report, 1961-62 (Mansfield files).
46	Off Term Point, NW Hudson Bay, 62°06′N, 92°30′W	1962	V	7	1			R.B. Tinling, Dept. N.Aff. and Nat. Res. (Mansfield files).
47	63°53′N, 82°30′W, Native Bay, SE Southampton Island	1962	X	13	2, ca. 40 ft		"In consort."	E.R. Mitchell, HBC (*in litt.*, 19 X 1962, Mansfield files).
48	Off Cape Christian, E. Baffin Island	1962	Autumn		6 in a herd			RCMP Game Report, 1962-63 (Mansfield files).
49	Foster Bay, NE Melville Peninsula	1963	VIII		1			Don Bissett (Mansfield files).
50	Igloolik Harbour, Igloolik Island, NW Foxe Basin	1963	VIII		1			Don Bissett (Mansfield files).
51	Off Cape Christian, E. Baffin Island	1963	Summer		Several herds			RCMP Game Report, 1963-64 (Mansfield files).
52	Button Point, SE Bylot Island, and Navy Board Inlet areas	1963			Ca. 30		Approximately 30 sightings of whales in these areas. Largest number seen by Eskimos in 25 years.	RCMP Report (Mansfield files).
53	Lake Harbour area, SE Baffin Island, in N. Hudson Strait	1963			3 large		Reported on 3 separate occasions.	"

Table 3 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
54	Cumberland Sound	1963			Many			RCMP Report (Mansfield files).
55	20 mi E of Hall Beach, E. Melville Peninsula	1963			Some			Pilots (Mansfield files).
56	72°50′N, 75°50′W, 6-8 mi off Button Point, S.E. Bylot Island	1964	V	25	1 large			Area Administrator, Pond Inlet (Mansfield files).
57	72°50′N, 77°45′W, Kaparoqtalik Glacier, S. Bylot Island	1964	VII	15	2 large		Close inshore, at foot of glacier.	"
58	72°40′N, 76°40′W, 1 mi NW of Guys Bight, NE Baffin Island, on Pond Inlet	1964	VII	27	2; 1 large, 1 small			"
59	72°40′N, 76°40′W, 1 mi NW of Guys Bight, NE Baffin Island, on Pond Inlet	1964	VII	29	1 large adult			"
60	68°31′N, 81°33′W, NE of South Ooglit Island, W. Foxe Basin	1964	VIII	7	1			Eskimo reported to D. Bissett, Area Administrator, Hall Beach, N.W.T. (*in litt.*, 9 IX 1964, Mansfield files).
61	72°40′N, 76°40′W, 1 mi NW of Guys Bight, NE Baffin Island, on Pond Inlet	1964	VIII	15	1 large			Area Administrator, Pond Inlet (Mansfield files).
62	72°50′N, 78°30′W, NE Eclipse Sound	1964	VIII	15	1 large			"
63	Near settlement of Repulse Bay, S. Melville Peninsula	1964	VIII	15	1			A.M. Millican, Regional Administrator, Churchill (*in litt.*, 29 X 1964, Mansfield files).
64	73°08′N, 80°35′W, ½ mi from Low Point, W. Navy Board Inlet	1964	VIII	16	3 large			Area Administrator, Pond Inlet (Mansfield files)
65	Vicinity Jens Munk Island, N. Foxe Basin	1964	VIII	20		1 killed	Natives reported to have sighted "as many as seven whales in one day" in the area.	Eskimos reported to D. Bissett, Area Administrator, Hall Beach, N.W.T. (*in litt.*, 9 X 1964, Mansfield files).
66	Vicinity Igloolik Island, N. Foxe Basin	1964	VIII	20	2; 1 adult, 1 calf	Attempted kill	Failed "due to a lack of gas for their boat."	"
67	59°44′N, 62°50′W, off Northern Labrador	1964	VIII	22	1		Identification uncertain.	Capt. B. Blackwood, aboard *A.T. Cameron* (Mansfield files).
68	Off Cape Christian, E. Baffin Island	1964	Summer		Several groups			RCMP Game Report, 1964-65 (Mansfield files).
69	66°08′N, 84°55′W, Frozen Strait, NE Southampton Island	1964	Summer		2			A.M. Millican, Regional Administrator, Churchill (*in litt.*, 29 X 1964, Mansfield files).
70	East of Manning Islands, 68°46′N, 80°03′W, NE Foxe Basin	1964	IX	4	1			Eskimos reported to D. Bissett, Area Administrator, Hall Beach, N.W.T. (*in litt.*, 9 IX 1964, Mansfield files).
71	73°05′N, 80°05′W, SE Navy Board Inlet	1964	IX	10	1 large			Area Administrator, Pond Inlet (Mansfield files).
72	73°05N, 80°05′W, SE Navy Board Inlet	1964	IX	11	1 large			"
73	73°05′N, 80°05′W, SE Navy Board Inlet	1964	IX	12	1 large			"
74	72°40′N, 77°30′W, 5 mi NE of Pond Inlet	1964	IX	28	1 small			"
75	Pond Inlet settlement, Pond Inlet	1964	IX		1, ca. 60 ft		Whale beached at Pond Inlet settlement, returned to sea after 1½ hr.	"
76	Pond Inlet settlement, Pond Inlet	1964	X	7	1 large		Close inshore, directly in front of settlement.	"
77	Near settlement of Repulse Bay, S. Melville Peninsula	1964	X	14	1			A.M. Millican, Regional Administrator, (*in litt.*, 29 X 1964, Mansfield files).
78	West end of Fury and Hecla Strait, NW Foxe Basin	1964			1			Gerry Anders (pers. comm., Mansfield files).
79	Jens Munk Island area, N. Foxe Basin	1964			Up to 7 in one day			Jens Munk Island Eskimos, reported to D. Bissett (Mansfield files).
80	East Igloolik Island area, N. Foxe Basin	1964				1 shot, large		Father Rousselière (Mansfield files).
81	Cumberland Sound	1964			Undetermined number			Residents of Cumberland Sound, reported to RCMP, Pangnirtung (Mansfield files).
82	Near shore of Jens Munk Island, N. Foxe Basin	1965	VII	End		1 killed, 55 ft	Just after ice breakup, with 4 harpoons and floats, .303 rifle.	Noah Peewatook and 3 other Eskimos (Mansfield files).
83	Milne Inlet, Eclipse Sound	1965	VIII	3	2			D. O'Halloran (*in litt.*, n.d., Mansfield files).

Table 3 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
84	72°06'N, 80°48'W, Koluktoo Bay, Milne Inlet, Eclipse Sound	1963	VIII	8	1 large		Within 50 yd of beach at Koluktoo Bay. Sounded, exposing tail fully.	T.R. Welch and A.W. Mansfield, Fisheries and Marine Service (F. and M.S.) (Mansfield files).
85	Cumberland Sound	1965	Summer		30			RCMP Game Report, 1965-66 (Mansfield files).
86	Settlement, Clyde Inlet, E. Baffin Island	1965	Autumn		1			"
87	Near settlement at Broughton Island, E. Baffin Island	1965			1			HBC trader, reported to D.C. Foote (Mansfield files).
88	Vicinity of Broughton and Padloping islands, E. Baffin Island	1965-66			Several			RCMP Game Report, 1965-66 (Mansfield files).
89	61°40'N, 71°58'W, off Wakeham Bay, Hudson Strait	1966	VII	11-18	1		First whale seen by this Eskimo in 40 years; similar to those his father hunted with Scottish whalers.	Eskimo, reported to W.F. Shields (Mansfield files).
90	Chesterfield Inlet, NW Hudson Bay	1966	VII		1		Same kind as Eskimo's father hunted with white men 50 years before.	Pilot of M.V. *Fort Severn*, reported to W.F. Shields (*in litt.*, n.d., Mansfield files).
91	63°43'N, 61°10'W, 70 mi E of Brevoort Island SE Baffin Island, in Davis Strait	1966	VIII	9	1		No ice.	J.A. Power, aboard *C.D. Howe* (Mansfield files).
92	68°33'N, 81°08'W, 10 mi S of Hall Beach, W. Foxe Basin	1966	IX	24	1		Only spout of whale seen, apparently too large for a beluga.	W.F. Shields (*in litt.*, n.d., Mansfield files).
93	Clearwater Fiord, Cumberland Sound	1966			2; 1 large, 1 small			P. Brodie, F. and M.S. (Mansfield files).
94	Clearwater Fiord, Cumberland Sound	1965-1967			2; 1 adult, 1 calf			Eskimos (Mansfield files).
95	66°34'N, 67°33'W, mouth of Millut Bay, Clearwater Fiord, Cumberland Sound	1967	VIII	2	1 large			W. Hoek, F. and M.S. (*in litt.*, n.d., Mansfield files).
96	66°34'N, 67°33'W, mouth of Millut Bay, Clearwater Fiord	1967	VIII	3	1 small		Might be calf of above whale. Seen with pod of white whales.	W. Hoek, F. and M.S. (*in litt.*, n.d., Mansfield files).
97	Few miles W of Igloolik Island, NW Foxe Basin	1967	IX	2	2	1	Moving southwest.	J.M. Bradley, McGill University (*in litt.*, n.d. [1968], Mansfield files).
98	Off Nuwuktee Island, few miles South of Jens Munk Island, NW Foxe Basin	1967				1 killed		J.M. Bradley, McGill University (*in litt.*, n.d. [1968], Mansfield files).
99	Pangnirtung district, Cumberland Sound	1967			Ca. 15			RCMP Game Report, 1966-67 (Mansfield files).
100	Ca. 5 mi from coast of Cape Christian, E. Baffin Island	1967			Many			RCMP Game Report, 1966-67 (Mansfield files).
101	Home Bay area, NE Baffin Island	1967			Several			"
102	Clearwater Fjord, Cumberland Sound	1967			2; 1 young, 1 adult		May be same as seen in this area by Eskimos, 1965-67, W. Hoek, VIII 1967, P. Brodie, 1966.	P. Brodie, F. and M.S. (Mansfield files).
103	Few miles W of Igloolik Island	1968	VII	26	1		One of 5 sightings in area — 1 supposedly consisting of a female and calf.	J.M. Bradley, McGill University (*in litt.*, n.d. [1968] Mansfield files).
104	Kivitoo, E. Baffin Island	1968	VIII		20 in a group			Ralph Durkea, DIAND (Mansfield files).
105	West of Igloolik Island, NW Foxe Basin	1968			2; 1 adult, 1 young			Eskimo, reported by J.M. Bradley, McGill University (Mansfield files).
106	West of Igloolik Island, NW Foxe Basin	1968			2			"
107	East coast of Cape Christian, E. Baffin Island	1968			Many			RCMP Game Report, 1967-68 (Mansfield files).
108	Clearwater Fiord, Cumberland Sound	1968			2; 1 young, 1 adult			P. Brodie, F and M.S (Mansfield files).
109	Midway between Button and Resolution Islands, Hudson Strait	1969	VII	20	1, ca. 50 ft		Black whale sighted at about 100 yd, was seen to blow twice, then sounded and disappeared. Moving E.	G. Sleno, F. and M.S. aboard M.V. *Calanus* (pers. comm. 1 VIII 1972, Mansfield files).
110	20 mi E. Arlangnuk Point, NE Melville Peninsula	1969	VII	22	1		Moving NE.	H. Baubier, Eskimos (Mansfield files).
111	Kivitoo, E. Baffin Island	1969	VIII		20 in a group			Ralph Durkea, DIAND (Mansfield files).
112	Clearwater Fiord, Cumberland Sound	1969	VIII		2; 1 adult, 1 calf			"

Table 3 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
113	Winter and Vansittart Islands region NW Foxe Channel	1969			"Many"		"Many of the large Greenland Whales are being seen" in this area; "it appears that they are coming back to this area more and more."	C. Livingston, DIAND, Economic Development Officer, Repulse Bay (*in litt.*, 6 IX 1969, Mansfield files).
114	40 mi SE of Resolute, Cornwallis Island, in Barrow Strait	1979			1		With 4-5 belugas.	Duncan Grant, Bradley Air Services (*fide* H. Kiliaan, AWSR*, Mansfield files); Hay and Sergeant, 1976:Fig. 3.
115	Millut Bay, Clear-water Fiord, Cumber-land Sound	1971	VIII	12-13	1			D.E. Sergeant, F. and M.S. (*in litt.*, 24 VIII 1971, Mansfield files).
117	Vicinity Repulse Bay, Southern Melville Peninsula	1971	IX	13	2	1 killed		D. Webster, Repulse Bay (*in litt.*, 18 X 1971, Mansfield files).
118	Near 68°51'N, 81°25'W, Southern Foster Bay, NE Melville Peninsula	1971	IX	17	Some large	1 killed, ca. 40 ft		P. Van de Velde (MS report, 1972, Mansfield files); (Mitchell and Reeves, 1981: Fig. 4; 1982).
119	2 mi from Repulse Bay settlement, Southern Melville Peninsula	1971	IX	End	2-3			D. Webster, Repulse Bay (*in litt.*, 18 X 1971, Mansfield files).
120	50 mi E of Repulse Bay, in Hurd Channel, S. Melville Peninsula	1971	IX	End	3			"
121	Repulse Bay settlement, S. Melville Peninsula	1971	X	18	1 large		Whale came within a few hundred yd of shore in front of settlement. This whale seen on 2 occasions and considered by locals to be looking for her calf which had been killed.	"
122	Upper half (NW) Frobisher Bay, SE Baffin Island	1972	VIII	ca. 10		1	Attacked and killed by killer whales.	Bill Mackenzie, GNWT, (Mansfield files; pers. comm., III 1980).
123	62°32'N, 66°25'W, Frobisher Bay, SE Baffin Island	1973	IV	3-4	1 large			Can. Armed Forces, reported by Capt. T.A. Favier, Yellowknife (*in litt.*, 29 V 1973) (Mansfield files).
124	63°40'N, 66°30'W, Frobisher Bay, SE Baffin Island	1973	IV	3-4	9 medium		Comment: Lat. 63°40'N places the sighting inland on the Hall Peninsula. Lat 62°40'N would make more sense. Therefore this sighting is plotted in the general lower Frobisher Bay area, indeterminate location.	"
125	Near Native Point, SE Southampton Island	1973	V	12	1 large			Reported by E. Bowden, Game Officer, Coral Harbour (*in litt.* from W.J. Barlishen to D.E. Sergeant, 20 VII 1973, Mansfield files).
126	74°35'N, 95°31'W, 5-10 mi SW of Griffiths Island, SW of Resolute Bay, S Cornwallis Island, in Barrow Strait	1974	VII	12	3; 2 adults, 1 young (½ adult size)			W. Henderson, Dominion-Pegasus Helicopters (AWSR*) (Mansfield files); Hay and Sergeant, 1976: Fig. 3.
127	Near Pisiktarfik Island, Eclipse Sound	1974	VIII	26	2			B. Fallis, Fisheries and Marine Service (pers. comm.); Hay and Sergeant, 1976:16, Fig. 3.
128	Vicinity of Cape Fullerton, SW Roes Welcome Sound	1919	summer			2 killed 1 struck/lost		Douglas, 1975.
129	In harbour [Little Auk Bay] of Danish Island, off E coast of Vansittart Island, Frozen Strait	1921	IX	29	1			Degebøl and Freuchen, 1935:273.
131	In harbour [Little Auk Bay] of Danish Island, off E coast of Vansittart Island, Frozen Strait	1922	VIII	17	1			"
132	In harbour [Little Auk Bay] of Danish Island, off E coast of Vansittart Island, Frozen Strait	1922	VIII	19	1		Apparently the same as seen 17 VIII 1922 in the same place (see above). "Feeding."	Degerbøl and Freuchen, 1935.
133	Opposite island, off E coast of Vansittart Island, Frozen Strait	1922	VIII	23	1			"
134	In harbour of Danish Island, off E coast of Vansittart Island, Frozen Strait	1922	VIII	27	1, very small		"About twice as large as a walrus."	"
135	Hammeren, in Frozen Strait	1922	IX	13	1 small		"Undoubtedly" the same as that seen 27 VIII 1922 (see above).	Degerbøl and Freuchen, 1935:273.
136	In Hurd Channel	1922	Mid-IX		1 small		Apparently same as seen 27 VIII and 13 IX, "living in the neighbourhood."	"
139	Repulse Bay settlement	1922	summer			1 killed, "medium size"		"

* Arctic Whale Sighting Record (from Arctic Biological Station, in files of D.E. Sergeant and W. Hoek).

Table 3 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
140	Pond Inlet floe-edge	1922	VIII			1 large	1 large whale driven by killer whale(s) into an ice lead where it was killed by 2 natives with repeated fire from .44 carbine or .303 rifle. The whale yielded 1600 lbs of baleen and 20 tons (est.) of oil.	Munn, n.d.:195-196; 1932:265; Anderson, 1934:72; Degerbøl and Freuchen, 1935: 274-275.
141	At Depot Island	1923	VII	4	3 large		Had been here 1-2 days.	Degerbøl and Freuchen, 1935.
142	Whale Point, SW Roes Welcome	1923	VII	5	3 large		Appear to be the same as seen 4 VII 1923 (see above entry).	"
143	Repulse Bay ["in the fiord"]	1923	VII	20-23	6	Attempted kill	Seen over "the past few days." Eskimos attempted hunt but failed and chased whales away.	Degerbøl and Freuchen, 1935:274.
144	Repulse Bay	1923	VII	23	2; 1 large female, 1 small calf			"
145	Repulse Bay	1923	IX	3	1			"
146	In harbour of Repulse Bay	1923	IX	4	1		Could be same whale as seen 3 IX.	Degerbøl and Freuchen, 1935.
147	Repulse Bay	1923	IX	8	1			Degerbøl and Freuchen, 1935:274.
148	Repulse Bay	1923	IX	9		1 killed, small (20 ft)	Not accompanied by its mother.	"
149	Danish Island, in Little Auk Bay, off E coast of Vansittart Island, Frozen Strait	1923	X	11	1 very small		The size of a walrus.	"
151	Near Kingua (Clear-water Fiord), head of Cumberland Sound	1928			2			Anderson, 1934:72.
152	In a rocky cove in Foxe Channel, vicinity SE Southampton Island	1939	IX	2	1 large			Boyer, 1940:6.
153	Lyon Inlet, SW Foxe Basin	1940				1 killed		Manning, 1943:105.
154	Evans Strait, South-ampton Island, S side.	1930-1944 (ca.)				3 killed	"In the last few years" by Aivilik Eskimos, using whalers' equipment from ca. 1900. The carcasses were used for fox bait.	Manning, 1944:145.
157	Clearwater Fiord, head of Cumberland Sound	1971	VIII	11-12	1		The whale was seen fluking up at a range of 150 yd. Its dives lasted 15-30 min.	Reported by D.E. Sergeant, F.M.S. (pers. comm.).
158	55°05'N, 76°52'W, ca. 6 mi S of Little Whale River, E side of Hudson Bay	1967	VIII	24	1 large		Ca. 100 yd from shore. Length of exposed back est. 40 ft; black.	W. Fitzhugh, Smithsonian Institution (*in litt.* 2 I and 12 I 1973).
159	Cape Christian, NE coast of Baffin Island, also Black Bluff area	1969? (probably 1968)			Some			RCMP Game Report, to 30 VI 1969.
160	Clyde Inlet, NE Coast of Baffin Island	Probably 1969, since reported 1970			Some			RCMP Game Report, to 30 VI 1970.
161	Patricia Bay, NE Baffin Island	Probably 1970, since reported 1971			1			RCMP Game Report, to 30 VI 1971.
162	Thule Harbour, North Star Bay, NW Greenland	1943	X	23	1			Vibe, 1967.
163	South Bay, Native Point, Southampton Island, N. Hudson Bay	1956	XII	10		1 small (15-20 ft)	Found frozen in ice. Same as record no. 22.	Father J. Choque (Mansfield files).
164	In Clearwater Fiord, Cumberland Sound	1973	VIII	27	1		"A single bowhead whale has visited Cumber-land Sound and Clearwater Fiord each year for the last decade."	Wood, 1974:19.
165	Franklin Strait, near entrance of Bellot Strait	1942	VIII mid-month		1		Ca. 40 ft whale. Confusion surrounds story, so this is a questionable record.	Farrar, 1974; see Finley and Johnston, 1977; Mitchell and Reeves, 1982.
166	Cumberland Sound	1972			2			Wood, 1974:19.
167	"In water adjacent to the camp" at Ipiar-juk (just inside Pond Inlet)	1967	VII	29	2 adults			Bissett, 1968:V.2:76-77.
168	"In water adjacent to the camp" at Ipiar-juk (just inside Pond Inlet)	1967	VIII	1	1 adult, 2 "immatures"			"
169	"In water adjacent to the camp" at Ipiar-juk (just inside Pond Inlet)	1967	VIII	4	4 adults			"
170	Between Ipiarjuk and Pond Inlet settlement, Pond Inlet	1967	VIII	4	1 adult			"

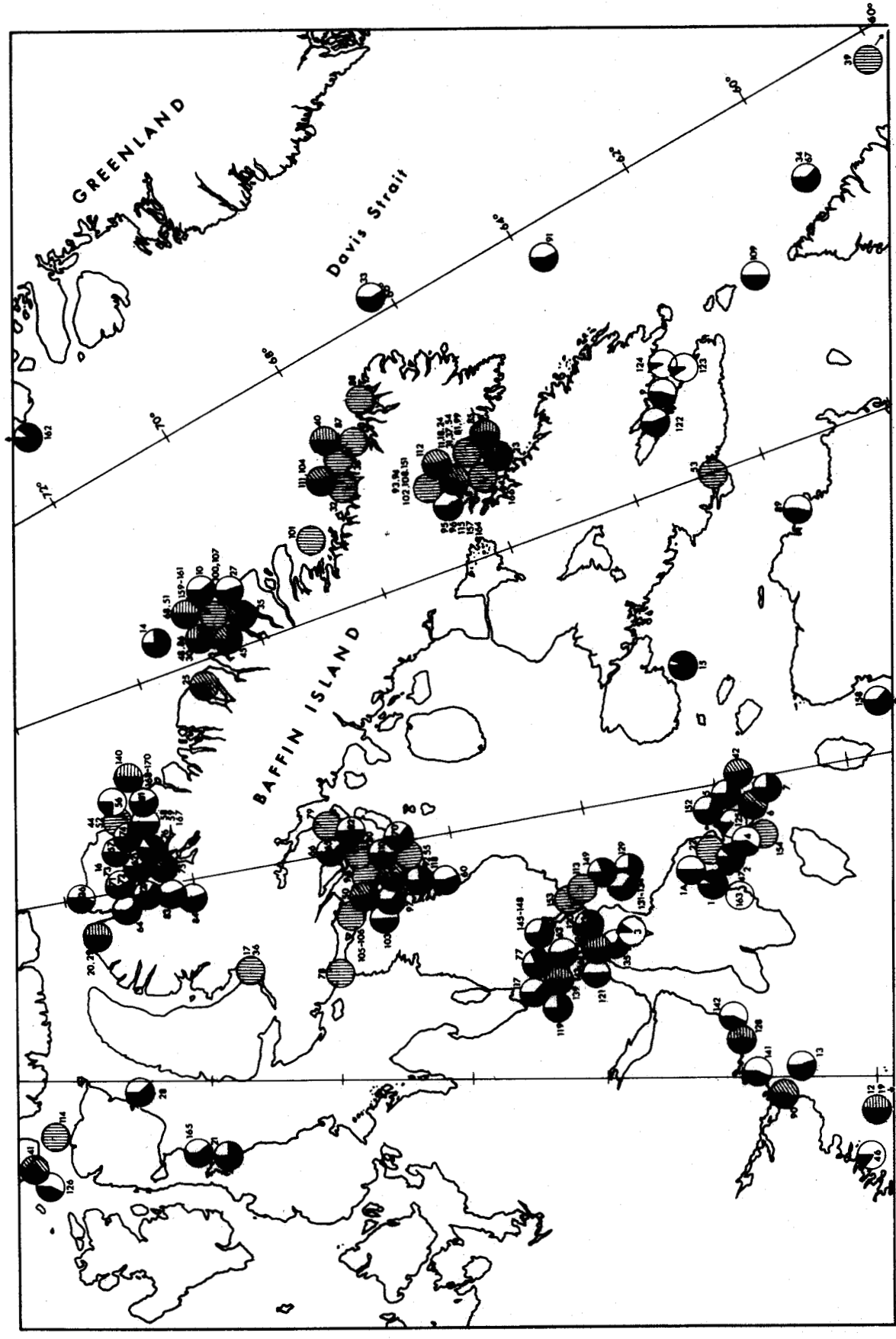


FIG. 3. Bowhead distribution, 1914-1974. Numbers refer to entries on Table 3.

TABLE 4. Occurrences of the bowhead whale in the eastern Canadian Arctic, 1975-1978

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
2	Near 78°43'N, 74°07'W, off Cape Sabine, eastern tip of Pim Island, Smith Sound	1975	V	23	1		About 200 m offshore, reportedly moving north.	Andreas Züst, ETH, Zürich. (AWSR*).
3	Near 73°40'N, 83°40'W, off Cape Joy, Admiralty Inlet	1975	VI	5	1 small		Motionless at surface, then disappeared after circled by helicopter. Two polar bears were on ice nearby.	K.Hay, Fisheries and Marine Service (F. and M.S.); Hay and Sergeant, 1976: Fig.1.
4	Near 73°45'N, 89°25'W, 20 miles ESE of Port Leopold, Somerset Island	1975	VI	5	1 large		Dove after being circled by helicopter.	K. Hay, F. and M.S.; Hay and Sergeant, 1976:Fig.1.
5	Between Cape Clarence and Prince Leopold Island, eastern Barrow Strait	1975	VI	6	1		Near the edge of fast ice near Prince Leopold Island. Whale dove before helicopter reached it.	K. Hay, F. and M.S.; Hay and Sergeant, 1976: Fig.2.
6	E side of Prince Leopold Island, eastern Barrow Strait	1975	VI	6	1		Blew 5-6 times, making shallow dives between blows, sounded, then was lost from view, moving north.	D.N. Nettleship, Canadian Wildlife Service (C.W.S.) (AWSR*; *in litt.*, 1 XII 1977).
7	72°40'N, 75°00'W, ESE of Bylot Island	1975	VI	11	2		Not positively identified as bowheads. Off fast ice, in about 5/10 small floe ice.	P.R. Young, Ice Observer, AES, (AWSR*).
8	73°03'N, 86°23'W, W side of Admiralty Inlet	1975	VII	23	1 35-40 ft		100 yd offshore, moving north at ice edge.	D.W. Doidge and R. Adams, F and M.S.; Hay and Sergeant, 1976:Fig.4.
9	Off Kakiak Point, W side of Admiralty Inlet	1975	VII	26	1		Among broken ice pieces. Moving south.	D.W. Doidge and R. Adams, F. and M.S.; Hay and Sergeant, 1976:Fig.4.
10	72°25'N, 86°10'W, NW of Yeoman Island, S. Admiralty Inlet	1975	VII	27	3		Moving south.	Eskimo hunters, Arctic Bay (source uncertain).
11	Southern Creswell Bay, Somerset Island	1975	VII	27	1 large			Finley, 1976:163-164, Fig. 37.
12	Near 72°41'N, 86°40'W, off Kakiak Point, W side of Admiralty Inlet	1975	VII	28	2		These 3 whales (#12 and 13) may be the same animals seen in this area by Arctic Bay hunters one day earlier (#10). Moving northeast.	B. Fallis, F. and M.S. (pers. comm.).
13	Near 72°44'N, 85°55'W, off Peter Richards Island, S. Admiralty Inlet	1975	VII	28	1		Moving north.	B. Fallis, F. and M.S. (pers. comm.).
14	Off Giants Castle, W side of Admiralty Inlet	1975	VII	30	1			D. W. Doidge and R. Adams, F. and M.S.; Hay and Sergeant, 1976: Fig. 4.
15	Near 72°49'N, 91°54'W, Fury Beach, SE Somerset Island, Prince Regent Inlet	1975	VIII	2	1		Lifted flukes on diving; dark in colour and ca. 30 ft long. Moving north.	J. Netterville, G.S.C. (AWSR*); Finley, 1976:164, Fig. 37.
16	Off Kakiak Point, W side of Admiralty Inlet	1975	VIII	8	1		Moving north at the edge of broken ice, 100-200 yd offshore.	D. W. Doidge and R. Adams, F. and M.S.; Hay and Sergeant, 1976: Fig. 4.
17	Near 75°48'N, 97°50'W, Goodsir Inlet, E. Bathurst Island	1975	VIII	1-10	1, 35-40 ft		Locality unconfirmed.	G.S.C. personnel, AWSR*.
18	Southern Creswell Bay, Somerset Island	1975	VIII	10	3 large		Pan ice.	Finley, 1976:164. Fig. 37.
19	72°43'N, 86°44'W, W side of Admiralty Inlet	1975	VIII	20	2; 1 large 1 smaller		Moving north.	D. W. Doidge and R. Adams, F. and M.S.; R. Reeves; Hay and Sergeant, 1976: Fig. 4.
20	Southern Wellington Channel	1975	VIII	22	1 large			Finley, 1976:164, Fig. 37.
21	1 mi E of Vista River, near 72°43'N, 86°44'W, W side of Admiralty Inlet	1975	VIII	25	1 large			D. W. Doidge and R. Adams, F. and M.S.; Hay and Sergeant, 1976: Fig. 4.
22	York Sound, SW side of Frobisher Bay	1975	VIII		1		Large black whale chased by several killer whales.	Bill Mackenzie (AWSR*; pers. comm., March 1980); Mitchell and Reeves, 1982.
23	Repulse Bay Area, Southern Melville Peninsula	1975	summer			1 (30 ft) killed		Eskimo hunters, reported by H. Trudeau and D.H. Dowler, F.M.S., Yellownife; Mitchell, 1977.
24	Near 65°50'N, 67°50'W, Netilling Fiord area, western Cumberland Sound	1975	End VIII to early IX		2; 1 adult, 1 young		Hunter's father and grandfather had never seen bowheads in this area before.	R. Redhead, Fish and Wildlife Officer, Pangnirtung (*in litt.*, 16 X 1975).
26	Near 73°44'N, 82°49'W, off Cape Charles Yorke, N. Borden Peninsula	1975	X	2	1		Moving east.	"
27	Coral Harbour Area, SE Southampton Island	1975			At least 1	Attempted kill	At least 1 whale known struck but lost.	Eskimo hunters, reported by M.C. Mercer, F. and M.S.; Mitchell, 1977.
28	Igloolik-Hall Beach area, NW Foxe Basin	1975			At least 1	Attempted kill	At least 1 whale known struck but lost.	"

* Arctic Whale Sighting Record (from Arctic Biological Station, in files of D.E. Sergeant and W. Hoek).

Table 4 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
29	65°33'N, 65°20'W, mouth of Kingnait Fiord, Cumberland Sound	1976	IV	19	1			Seemeeonie Keenianak, Spec. Const. RCMP, *fide* R. Redhead, F.W.O., Pangnirtung (AWSR*).
30	Off Cape Hay, northern Bylot Island	1976	V	25	1			Anon, MS., n.d. [1976].
31	Near 73°46'N, 81°39'W, eastern Lancaster Sound	1976	V	30	1			Johnson *et al.*, 1976:71.
32	Near 73°58'N, 80°28'W, eastern Lancaster Sound	1976	V	30	1			"
33	Near 73°55'N, 83°33'W, eastern Lancaster Sound	1976	VI	6	2			"
34	Mouth of Admiralty Inlet	1976	VI	6	2 large		Moving west.	R. Greendale, F. and M.S. (AWSR*).
35	Near 73°53'N, 82°29'W, eastern Lancaster Sound	1976	VI	14	1			Johnson *et al.*, 1976:71.
36	Near 73°55'N, 82°29'W, eastern Lancaster Sound	1976	VI	20	1			"
37	Near 73°53'N, 81°25'W, eastern Lancaster Sound	1976	VI	20	1			"
38	Near 74°17'N, 81°24'W, eastern Lancaster Sound	1976	VI	20	1			"
39	Near 74°22'N, 80°32'W, eastern Lancaster Sound	1976	VI	20	1			"
40	Near 74°15'N, 80°28'W, eastern Lancaster Sound	1976	VI	27	2			"
41	Near 74°32'N, 80°03'W, eastern Lancaster Sound	1976	VI	27	1			"
42	Pond Inlet floe edge, Pond Inlet	1976	Early summer		20 (est.)			Joe Enook *fide* Anon., 1976:pt.3:19.
43	Cape Hay, northern Bylot Island	1976	VII	1	1		Moving west.	Greendale and Brousseau-Greendale, 1976: Table 1.
44	Cape Hay, northern Bylot Island	1976	VII	1	1		Moving west.	Greendale and Brousseau-Greendale, 1976: Table 1.
45	Cape Hay, northern Bylot Island	1976	VII	4	1		"	"
46	Cape Hay, northern Bylot Island	1976	VII	12	2 large		"	"
47	Cape Hay, northern Bylot Island	1976	VII	12	1		"	"
48	Cape Hay, northern Bylot Island	1976	VII	13	1		"	"
49	Cape Hay, northern Bylot Island	1976	VII	13	1		"	"
50	Near 73°45'N, 82°29'W, eastern Lancaster Sound	1976	VII	13	1			Johnson *et al.*, 1976:71.
51	Cape Hay, northern Bylot Island	1976	VII	14	1		Moving west.	Greendale and Brousseau-Greendale, 1976: Table 1.
52	Cape Hay, northern Bylot Island	1976	VII	14	3; 2 large, 1 small		"	"
53	Cape Hay, northern Bylot Island	1976	VII	15	1		"	"
54	Cape Hay, northern Bylot Island	1976	VII	15	1		"	"
55	Cape Hay, northern Bylot Island	1976	VII	15	2 adults		"	"
56	Cape Hay, northern Bylot Island	1976	VII	15	2		"	"
57	Cape Hay, northern Bylot Island	1976	VII	15	1		"	"
58	Cape Hay, northern Bylot Island	1976	VII	17	2		"	"
59	Cape Hay, northern Bylot Island	1976	VII	17	1		"	"
60	Cape Hay, northern Bylot Island	1976	VII	17	1		"	"

Table 4 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
61	Near 74°25′N, 82°58′W, eastern Lancaster Sound	1976	VII	18	1			Johnson *et al.*, 1976:71.
62	Near 73°48′N, 80°34′W, eastern Lancaster Sound	1976	VII	19	1			"
63	Peel Sound	1976	VII	23	3			Anon. MS., n.d. [1976]:75.
64	Mouth of Admiralty Inlet	1976	VII	23	2			"
65	Near 72°39′N, 76°38′W, 2 mi NE of Guys Bight, NE Baffin Island	1976	VII	24	1		Moving south in broken ice at the floe edge.	K. Hay, F and M.S. (AWSR*).
66	Near 74°01′N, 83°33′W, eastern Lancaster Sound	1976	VII	26	1			Johnson *et al.*, 1976:71.
67	Near 74°08′N, 83°33′W, eastern Lancaster Sound	1976	VIII	8	1			"
68	Off Kakiak Point, W coast of Admiralty Inlet	1976	VIII	28	1		Moving south.	R. Greendale, F and M.S. (AWSR*).
69	Near 74°48′N, 80°01′W, mouth of Bethune Inlet, SE Devon Island	1976	VIII	29	1			Johnson *et al.*, 1976:71.
70	Near the tip of South Spit, E coast of Prince Leopold Island	1976	IX	5	3		Three whales sighted together moving north. Two were about the same size, the third slightly smaller. They surfaced about 10 times before being lost from view, moving fast, not sounding. Ice cover 30%.	E. Greene and D.N. Nettleship, C.W.S. (*in litt.*, 1 XII 1977; AWSR*).
71	Near 73°57′N, 83°00′W, eastern Lancaster Sound	1976	IX	6	1			Johnson *et al.*, 1976:71.
72	In bay W of South Spit, S coast of Prince Leopold Island	1976	IX	7	1		Whale seen moving east in bay west of the South Spit. It dove, remained submerged for 5 min, resurfaced, circled the bay, then turned back heading west; 40% pan ice.	E. Greene and D.N. Nettleship, C.W.S. (*in litt.*, 1 XII 1977;AWSR*).
73	74°01′N, 87°00′W, about 15 mi off Brodeur Peninsula, western Lancaster Sound	1976	IX	12	2-3		Whales were swimming among narwhals, moving northeast.	E. Greene and D.N. Nettleship, C.W.S. (*in litt.*, 1 XII 1977; AWSR*).
74	Near 69°08′N, 66°45′W, Cape Henry Kater, eastern Baffin Island	1976	IX	14	3		Two whales were together, the third 4-5 miles north, all moving south.	P. Rosseau, Fish and Wildlife Officer, Pangnirtung (AWSR*).
75	W of Arctic Bay, in Admiralty Inlet	1976	IX	22	2		Moving north.	Anon. MS., n.d. [1976]:75.
76	5-10 mi N of Henry Kater Peninsula, eastern Baffin Island	1976	IX	26	15 large		In a loose aggregation.	Webb, 1976:Pt.3:19, Map 4.
77	About 30 mi WNW of Kivitoo, eastern Baffin Island	1976	IX	26	2 large			Webb, 1976:Pt.3:19, Map 6.
78	About 23 mi WNW of Kivitoo, eastern Baffin Island	1976	IX	26	2 large			"
79	1-5 mi N of Henry Kater Peninsula, eastern Baffin Island	1976	IX	30	11 large		Probably the same group of 15 seen in this area 4 days earlier (#76), having moved southward.	Webb, 1976:Pt.3:19, Map 4.
80	About 5 mi E of Cape Raper, eastern Baffin Island	1976	IX	30	1 large			"
81	Near 69°25′N, 67°00′W, inshore and N of Henry Kater Peninsula, E of Aulitiving Island, eastern Baffin Island	1976	X	Early	20 (est.)			Connors, pilot, Bradley Air Services (AWSR*).
82	Mouth of a bay 12 mi NW of Cape Dyer, eastern Baffin Island	1976	XI	2-5	4-5		In a productive nearshore area, and thought to be recent arrivals to the area after a southward migration.	Joe Kreke, Apex Helicopters, *fide* Webb, 1976: Pt.3:19, A2.
83	Near Allen Island, 10 mi south of Robinson Sound, SE Baffin Island	1977	IV	3-9	2; 1 adult, 1 young			Hunters and Trappers Assoc. report (source uncertain).
84	Near 74°25′N, 85°34′W, central Lancaster Sound	1977	V	27	3-4			*Fide* D.W. Doidge, F. and M.S., aboard *Louis St. Laurent* (pers. comm.).
85	Near 74°25′N, 85°37′W, central Lancaster Sound	1977	V	27	1			"

Table 4 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
86	Near 74°25'N, 85°45'W, central Lancaster Sound	1977	V	27	1			*Fide* D.W. Doidge, F. and M.S., aboard *Louis St. Laurent* (pers. comm.).
87	74°25'N, 85°51'W, central Lancaster Sound	1977	V	27	3			"
88	74°21.5'N, 88°13'W, western Lancaster Sound	1977	V	28	2			"
89	74°23.3'N, 88°39'W, western Lancaster Sound	1977	V	28	2			"
90	Near 74°20'N, 90°02'W, immediately NW of Prince Leopold Island	1977	VI	2			One whale, identification uncertain, seen within 3 mi of coordinates given.	D.N. Nettleship, C.W.S. (*in litt.*, 1 XII 1977).
91	74°16'N, 81°00'W, entrance to Lancaster Sound	1977	VI	4	3-4 large		Large whales, black with some white underneath, V-shaped blow, no dorsal fin. Observed at 500-1000 yd. Small hole in heavy ice. Moving southwest.	J.D. Bradford, Dept. Fisheries and Env., Ottawa (AWSR*).
92	59°16'N, 56°50'W, Labrador Sea	1977	VII	31	2 large		V-shaped blow. Not positively identified as bowheads. Moving east.	R. McGregor, C.C.G.S. *Louis St. Laurent* (AWSR*).
93	67°53'N, 57°45'W, about 110 mi NE of Cape Dyer, in Davis Strait	1977	VIII	2	1 large		Large (55-60 ft) black whale seen in "bergy" water. Moving east-southeast.	P.H. Heck, Atmospheric Environment Service (AES) (AWSR*).
94	Near 74°22'N, 93°00'W, 30 mi SE of Resolute Bay, in eastern Barrow Strait	1977	IX	20	1			D.N. Nettleship, C.W.S. (*in litt.*, 1 XII 1977).
95	Erebus and Terror Bay between Cape Riley and Beechey Island, eastern Barrow Strait	1976	VII	19	3; 1 large, 2 smaller		Swimming nose-to-tail in lead.	P. Severs, M. Burnip, P. Lane, C. Parmenter (Mitchell files, 23 VII 1976).
96	Abandonment Bay, NE side of Cornwallis Island	1976	VII	23 (ca.)	Skull found			Bob O'Connor, Aero-Arctic Ltd., Yellowknife, (Mitchell files, 23 VII 1976).
97	63°18'N, 63°58'W, near Brevoort Island, SE coast of Baffin Island	1977	IX	14	1		Within 200 m of shore; photographed.	Allen and Conover, 1978a:4-15, Table 5-49, Pl.IV.
98	64°59'N, 63°20'W off Cape Mercy, mouth of Cumberland Sound, SE Baffin Island	1977	IX	14	1		Within 200 m of shore.	Allen and Conover, 1978a:4-15, Table 5-49.
99	Western Kennedy Channel, 20 km S of Cape Defosse, Judge Daly Promontory, NE Ellesmere Island (observed from 81°08'N, 66°20'W)	1978	VII	22	10-20		Large black whales in groups of 2-4, no dorsal fins, very large (>20 ft, likely >40 ft). Whales were slow-moving, seemed to "be enjoying still water and open area free of sea ice for at least 20 km." Moving north. Observers were here 5 yr but never saw bowheads in this area before. Davis and Koski (1980) indicate only 10-15 individual whales in sighting.	J. England, Dept. of Geography, Univ. of Alberta (AWSR*); Davis and Koski, 1980:442; Koski and Davis, 1979:133.
100	Clearwater Fiord, head of Cumberland Sound	1978	IX	17	1 small			B. Kemper, pers. comm., 2 X 1978.
101	Cape Adiar, NE coast of Baffin Island	1978	13 IX - 7 X		41		Migrating southeast within 1.5 km of coast.	Davis and Koski, 1980: Koski and Davis, 1979:128-130.
102	Along E coast of Bylot Island	1978	X	7	8			Davis and Koski, 1980; Koski and Davis, 1979:130.
103	62°25'N, 61°33'W, 150 km (est.) E of Loks Land, entrance to Frobisher Bay, in Davis Strait	1978	III	28	1		In heavy pack ice associated with leads.	Conover, Parsons and Orr, 1979:5-21, Fig. 5-35.
104	61°00'N, 63°07'W, 90 km (est.) SE of Resolution Island, entrance of Hudson Strait	1978	III	28	3; 2 large, 1 small		"The three animals seen together were first observed nose to nose...the largest whale was 2 to 3 m longer than the second whale which, in turn, was closely associated with a smaller animal. The smaller whale appeared about ⅔ to ¾ the body length of the second whale. The closer association of the two smaller whales suggested they were a female and calf. Even as the larger animal moved off, the smaller whale kept in close contact with the second largest whale." In heavy pack ice associated with leads.	"
105	60°39'N, 66°W, mouth of Hudson Strait	1978	IV	22	2; 1 large, 1 small		Probably female and calf.	Conover, Orr and Parsons, 1979: Fig. 4-54, Table 5-8-1.

Table 4 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
106	65°39′N, 62°40′W, mouth of Hoare Bay, SE Baffin Island	1978	IV	23	1			Conover, Orr and Parsons, 1979: Fig. 4-54, Table 5-8-1.
107	65°10′N, 64°58′W, in Cumberland Sound, near mouth	1978	IV	24	1			Conover, Orr and Parsons, 1979: Fig. 4-55, Table 5-8-1.
108	61°00′N, 64°06′W, mouth of Hudson Strait	1978	IV	25	1			"
109	60°58′N, 66°00′W, mouth of Hudson Strait	1978	V	7	1			Conover, Orr and Parsons, 1979: Fig. 4-56, Table 5-8-2.
110	65°20′N, 65°38′W, central Cumberland Sound	1978	V	13	1 large		Large whale but identification as bowhead uncertain.	"
111	64°50′N, 65°01′W, near mouth of Cumberland Sound	1978	V	13	1			"
112	65°07′N, 65°13′W, south-central Cumberland Sound	1978	VI	14	1			Conover, Orr and Parsons, 1979: Fig. 4-61, Table 5-8-3.
113	60°48′N, 57°46′W, southern Davis Strait	1978	VII	26	2, 40-45 ft		2 black whales seen. Ice-free, light sea, 5-ft waves, water temp +7°C, air temp. +8.1°C, wind southerly 10 kts, visibility 10 mi. [Identification uncertain.]	P.H. Heck, AES, C.C.G.S. *d'Iberville* (AWSR*).
114	5 mi E of Pond Inlet settlement, Pond Inlet	1978	VIII	8	3		Near ice in Pond Inlet, moving west, "surface feeding".	R.R. Wallace, Petro-Canada, M.V. *Theron* (AWSR*).
115	73°57′N, 88°35′W western Lancaster Sound	1978	VIII	12	1 ca. 50 ft		Greyish black, white patch, tail flukes observed. 3/10 first-year ice with few multi-year floes; first-year ice 38-61 cm thick. Water temp. -0.6°C, air temp. +1.2°C, overcast, winds E 10 kts, very light sea, waves < 1 ft.	P.H. Heck, AES, C.C.G.S. *d'Iberville* (AWSR*).
116	Cumberland Sound, between Kekerten Island and Kipisa	1979	VI	23	5-6, at least one a calf		First whale seen had small (12-22 ft) brownish calf on right side. This whale appeared to be resting on surface in calm water. Second whale seen 200 yd N of first. Size 50-55′, also appeared to be resting on surface, large part of body exposed. Another 2 whales seen in same lead, 150-200 yd W of second whale. Possibly calf with one whale since slight disturbance in water next to it. These last whales of similar size, 40-45 ft, separated by 30-50 yd of open water. No other whales seen in area. All whales seen in open leads in ice, with edge of ice floe ½ mi (est.) west of this sighting area. Open water to NW corner Cumberland Sound. SE of whales were ice and open leads. Visibility 30 mi, west wind at 15-18 mph, sky clear. First whale seen to blow, and flukes exposed.	Ken Birss, Bradley pilot, pers. comm., IX 1979.
117	63°20′N, 64°07′W, off southern tip of Brevoort Island, SE Baffin Island coast	1978	IX	7	1			Conover, Orr and Parsons, 1979: Fig. 4-69, Table 5-8-6.
118	63°44′N, 63°55′W, off Brevoort Island, SE Baffin Island coast	1978	IX	26	1			Conover, Orr and Parsons, 1979: Fig. 4-73, Table 5-8-6.
119	63°17′N, 63°59′W, off southern tip of Brevoort Island, SE Baffin Island coast	1978	IX	26	1			"
120	Entrance of Clearwater Fiord, head of Cumberland Sound	1978	IX	17	1		This sighting may be the same as that noted previously on this date in the same area (Entry No. 100); the above sighting was of a calf.	Conover, Orr and Parsons, 1979: Fig. 4-71, Table 5-8-6.
121	63°43′N, 64°21′W, off SE Baffin Island coast	1978	IX	17	1			Smith *et al.*, 1979:52.
122	63°54′N, 64°16′W, off SE Baffin Island coast	1978	IX	17	2; 1 large, 1 small			"
123	Ca. 61°N, 64°30′W, between Resolution Island and Button Islands, mouth of Hudson Strait	1977	IV	2	1 "whale" unidentified			Allen and Conover, 1978b:9, Fig. 4.
124	Peel Sound, 5 km off Cape Brodie, N Prince of Wales Island	1976	IX	4	1			Finley and Johnston, 1977:27, Fig. 8.
125	Between Atangmik and Napassoq, W. Greenland	1956	III			1 small killed		Freuchen and Salomonsen, 1958: 107; Anon., 1965.

Table 4 (continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
126	1 mi off Ekwan Point, NE of Attawapiskat, James Bay, on a trip to Akimiski Island	1978	VII	11	1		About 200 belugas seen in a line approximately 1 mi long on the surface. Many young in the pod, also 1 bowhead. Moving northeast.	J. Crawford, A.F.O.H. helicopter pilot, M.O.T., Ottawa (AWSR*).
127	Along E coast of Bylot Island	1978	X	6	2			Koski and Davis, 1979:130,125.
128	Off Cape Macculloch	1978	IX	9	2		Adult with young.	Koski and Davis, 1979:125,128.
129	SE of Clyde River, at 70°15′N, 67°45′W	1978	IX	1	2		Adults, swimming north along the coast.	"
130	West-central Admiralty Inlet	1978	VIII	24	5		One group of 3 and 2 single animals.	"
131	Milne Inlet and Eclipse Sound	1978	VIII 21 to IX 4		6+		Repeated sightings. Inuit of Pond Inlet believed bowheads to have been unusually abundant here this year.	Koski and Davis, 1979:125-128.
132	Off Cape Hay, Bylot Island	1978	VIII	3,5,6	3		Single animals, swimming west.	Koski and Davis, 1979:127.
133	Off NE corner of Devon Island, ca. 75°10′N, 80°W	1978	VI	8	1			Koski and Davis, 1979:124.
134	Off SE corner of Devon Island, ca. 74°20′N, 81°W	1978	V	23	2			"
135	Ca. 74°20′N, 79°W, at entrance to Lancaster Sound	1978	VI	20	1			"
136	Ca. 74°10′N, 75°W, off entrance to Lancaster Sound	1978	V	31	1			"
137	Ca. 74°N, 79°W	1978	VI	1	1			"
138	In outer Lancaster Sound	1978	V	17	1			"
139	Near S coast of Devon Island, ca. 74°10′N, 83°W	1978	V	9	1			"
140	Mouth of Lancaster Sound, ca. 74°N, 83°W	1978	VI	12	1			"
141	Mouth of Lancaster Sound, ca. 74°N, 83°W	1978	VII	11	1			"
142	Off Cape Hay, Bylot Island	1978	V	9	1			"
143	Off entrance to Lancaster Sound, ca. 73°40′N, 75°W	1978	V	31	1			"
144	Off entrance to Lancaster Sound, ca. 73°15′N, and 73°30′N, 75°W	1978	VII	5	3			"
145	Off eastern Bylot Island, ca. 73°N, 75°W	1978	V	31	2			"
146	Pond Inlet floe-edge	1978	VI	21	1			"
147	Pond Inlet floe-edge	1978	V	18	1			"
148	Pond Inlet floe-edge	1978	VI	10	1			"
149	Due E of Cape Macculloch, ca. 72°20′N	1978	VII	13	3			"
150	Due E of Cape Macculloch, ca. 72°20′N	1978	VI	11	2			"
151	Due E of Cape Macculloch, ca. 72°20′N	1978	VII	1	1			"
152	E of Pond Inlet, ca. 72°10′ - 72°30′N, 72°W	1978	VI	21	12			"
153	E of Cape Adair	1978	VI	21	1			"
154	E of Buchan Gulf, ca. 71°40′N, 71°W	1978	VII	1	1			"
155	Outer Buchan Gulf, NE Baffin Island	1978	VII	21	2			"
156	Outer Buchan Gulf, NE Baffin Island	1978	VIII	1	1			"
157	East of Coutts Inlet	1978	VII	10	1			"
158	Off eastern Bylot Island	1978	VII	11	1			"
159	Off Cape Graham Moore	1978	VII	8 or 9	1			"

Table 4 (Continued)

Key No.	Locality	Time of Occurrence Year	Mo.	Day	Sighting	Mortality	Remarks	Source
160	Off Cape Graham Moore	1978	VII	18	1			Koski and Davis, 1979:124.
161	Off Cape Graham Moore	1978	VIII	8	1			"
162	Pond Inlet	1978	VIII	8	2			"
163	East of Pond Inlet, ca. 72°30'N, 72°W	1978	VII	13	1			"
164	Mouth of Navy Board Inlet	1978	IX	24	2			"
165	Off eastern Bylot Island	1978	IX	29	1			"

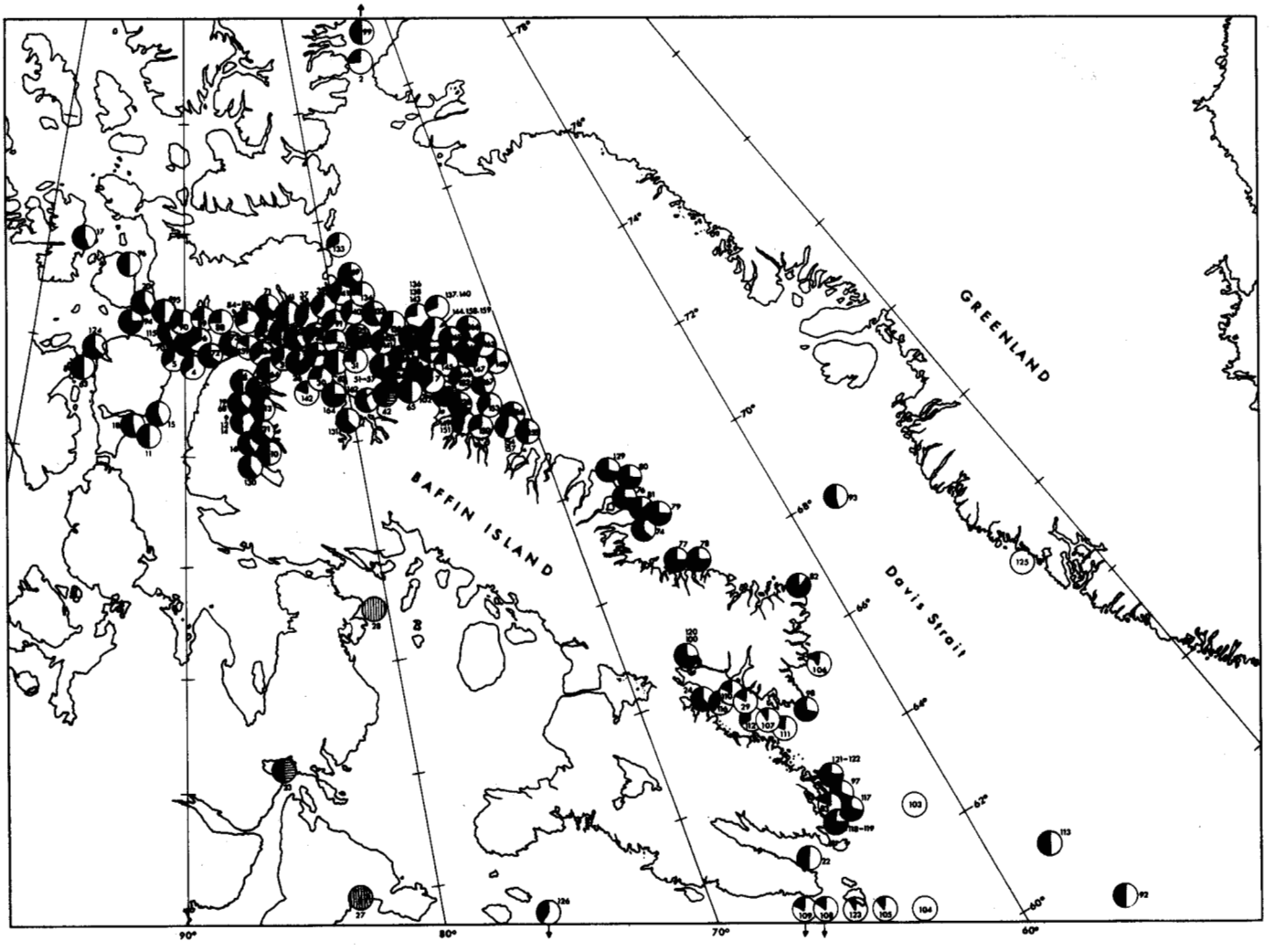


FIG. 4. Bowhead distribution, 1975-1979. Numbers refer to entries on Table 4.

RESULTS AND DISCUSSION

As Southwell (1887:187) stated: "from long experience of the habits and migration of the Whales, the regularity of which is remarkable, the Whalers know precisely where they should be found, under favourable circumstances, at certain definite periods; and not only so, but also the age and size which may be expected." We accept this premise, with the caution that climatic and technological limitations usually prevented the whalers from following the bowhead throughout the entire year. Their opinions about the whales' migratory behavior and wintering grounds, especially, were often based on inference and speculation, which nevertheless came from direct observations and efforts to hunt whales (Fig. 5). It is unrealistic to contemplate a research program today that would match the enormous searching effort by the nineteenth-century whalers. These men, some of them well informed and literate (e.g. Scoresby, 1820, 1823; Gray, 1888), collected a large sample of specimens, and those who recorded the size, sex, and length of "bone" (whalebone or baleen) of the whales they captured created a diffuse but invaluable set of data for modern whale biologists (Tables 5 and 6).

The nineteenth-century whalers, upon whose authority we have based most of our generalizations about historic bowhead distribution, established itineraries enabling them to catch bowheads at different seasons in different parts of the Eastern Arctic. These itineraries reflected not only the state of

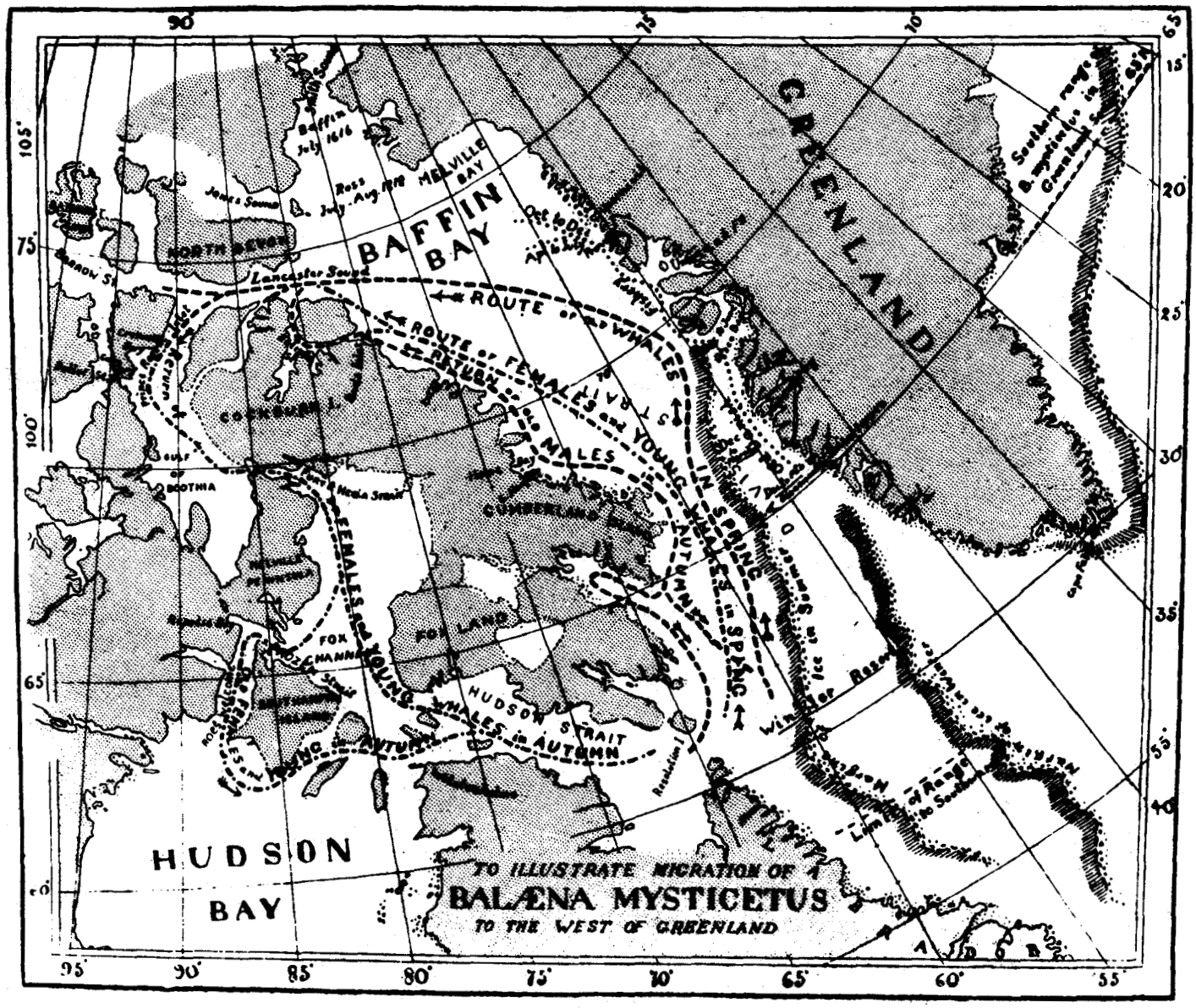


FIG. 5. This figure represents Thomas Southwell's (1898, Plate XII) understanding of the migration pattern of bowhead whales west of Greenland. It is based on nineteenth-century literature and on information received by Southwell directly from whalers. Thus, it contains some well documented insights. However, Southwell's chart reflects an unwarranted certainty about several aspects of the migration. For example, the impression that Repulse Bay and Roes Welcome Sound are supplied with bowheads exclusively by a segregated component of the Davis Strait stock during its annual circumnavigation of Baffin Island is almost certainly erroneous. Moreover, the indications that only old whales migrate along the Greenland coast in spring and that only old males migrate along the east coast of Baffin Island in autumn are probably, at best, only partially accurate.

TABLE 5. Catch of bowheads by *Cumbrian* of Hull in Davis Strait and Baffin Bay during 1823 (from Lubbock, 1937:254). The vessel's logbook for 20 August recorded: "Our success was beyond the most sanguine expectations, having on board as many whales as the ship could safely carry, 23 in number, yielding probably about 245 tons [of oil]" (Lubbock, 1937:255.).

Grounds	Date Captured	Sex	Length	Circumference	Depth of blubber	Breadth of tail	Length of jawbone	Length of whalebone	Length of fin
			Ft In.	Ft In.	Ft In.	Ft In.	Ft In.	Ft In.	Ft In.
In the "offing" on the "east side"	3 May	F	45 8	31 4	0 10	10 1	—	9 11	8 5
	21 May	F	48 4	35 8	1 0½	16 8	17 3	9 0	13 0½
	28 May	F	57 6	34 1	1 0	18 4	16 8	10 2	8 1
Landfloe at Pond's Bay; "west water"	11 July	M	40 8	24 8	0 10	14 10	16 1	8 6	7 11
	12 July	M	28 8	17 1	0 7	12 9	11 10	5 5	5 9
	12 July	F	42 8	22 0	0 11	14 10	16 0	9 6	7 6
	12 July	M	42 1	24 1	0 10½	14 6	—	8 1	7 5
	12 July	M	43 7	20 0	0 10	14 1	17 0	8 0½	6 0
"west water"; "south along the land floes" off NE Baffin Island	28 July	M	39 2	22 6	0 7¼	14 1	15 0	8 2	7 1
	28 July	F	42 1	23 0	0 8	16 0	15 3	8 7	7 0
	28 July	M	47 2	22 0	0 9	17 2	17 0½	9 0¼	7 11
	29 July	F	42 0	21 5	0 9	14 8	16 4	8 6	6 10½
	4 Aug.	M	43 11	20 2	0 8	14 8	—	9 3½	7 10
	4 Aug.	M	39 2	11 3	0 6	12 1	14 1	7 9¾	6 7
	6 Aug.	M	38 5	17 0	0 7½	12 7	16 4	8 0	6 1
	6 Aug.	F	47 8	21 1	0 10	15 1	16 10	9 6	8 1
	7 Aug.	F	43 8	20 10	0 9½	15 4	17 0	9 2	7 4
	9 Aug.	F	42 3	16 1	0 8¼	16 10	17 2	9 3	9 7
	12 Aug.	M	50 3	29 3	0 11	17 2	19 0	10 7	7 3
	13 Aug.	M	53 4	27 7	1 0½	20 1	19 4	10 9	10 5½
	14 Aug.	M	51 2	28 7	1 1½	19 6	—	10 6	9 3
	14 Aug.	F	44 3	23 3	0 9½	14 10	15 5	8 9	8 9
	17 Aug.	F	57 4	28 1	0 11	19 1	—	11 10	11 11

TABLE 6. Record of bowhead whales captured by *Cumbrian* of Hull in Davis Strait/Baffin Bay during 1827 season (from Lubbock, 1937:273). The 18 bowheads produced a total of 372 casks or 280 tons of oil ($\bar{x}$ = 15.6 tons), described by Lubbock (1937:271) as "the largest cargo in the annals of Arctic whaling."

Date	Grounds	Size of Bone Ft In.
3 May	"South-west Fishing"; lat. 62-63°	10 7
4 May	"	10 4
5 May	"	9 9
6 May	"	10 6
21 May	"	11 11
24 May	"	12 0½
21 June	"	10 10
26 June	"	11 7
5 Aug.	"West Water"	9 6
5 Aug.	"	9 9
8 Aug.	"	10 10
9 Aug.	"	11 6
11 Aug.	"	10 0
11 Aug.	"	10 6
11 Aug.	"	10 7
24 Aug.	"	11 3
31 Aug.	"	10 2
7 Sept.	"	9 0
(10 Sept.)	(")	(?)

knowledge as to the bowhead's distribution and movements but also the severe limitations on navigation imposed by ice conditions and day length. Below, we outline the pattern of whaling activity and identify the major whaling grounds.

West Greenland (Shore-Based)

From approximately 1719 onwards an international fishery for bowhead whales was conducted in Davis Strait and Baffin Bay (Scoresby, 1820:V.2:382-390; Ross, 1979). An important component of the fishery was centered in inshore waters of western Greenland and was prosecuted from Danish shore stations or "factories" (Eschricht and Reinhardt, 1861, 1866). In their landmark study of the distinction between the bowhead whale and the right whale, *Eubalaena glacialis*, Eschricht and Reinhardt reviewed bowhead distribution based on records kept by the Danish colonial administration.

The whaling occurred mainly between 60°N and 73°N latitude, a stretch of coastline covering about 200 Danish miles. It began during the early 1700s, and by 1860 only the station near Holsteinsborg remained active (Eschricht and Reinhardt, 1866:13).

The usual limits of the bowhead's distribution were considered to be Upernavik (ca. 73°N) in the north and Sukkertoppen (ca. 65-66°N), sometimes called "Sugar Loaf" by the British whalers (Barron, 1970:121), in the south. Although they were aware of sightings by Baffin (Ellis, 1748:52; Pennant, 1784-87:V.1:186) in Wolstenholme Sound and the entrance to Smith Sound (ca. 78°N) and by Ross (1819:V.1:88,154) at 75-76°N off northwest Greenland, Eschricht and Reinhardt (1861, 1866) had no knowledge of bowheads being seen or caught consistently in the great ice-choked bight called Melville Bay. Brown (1868:544) had "only heard of one instance in which it [the bowhead] has been seen as far north as the Duck Islands near the entrance of Melville Bay, and even for a considerable distance south of that it can only be looked upon as an occasional straggler." Several were seen early in September at about 75°N, 64°W (M'Clintock, 1863:114-115). Brown believed the whales seen in summer in northern Baffin Bay and Smith Sound went there only after having first crossed to the west side of Davis Strait. It is generally believed that bowheads rarely occur further north than 75°N latitude on either side of Baffin Bay

(Southwell, 1898; but see Lubbock, 1937:211; Fisher, 1819:93-94).

Brown (1868) and Eschricht and Reinhardt (1866) agreed that bowheads were seldom seen farther south along the Greenland coast than Sukkertoppen, the most southerly whaling station. Those that did reach these latitudes were usually young individuals (note, for instance, the whale taken in March 1956 at Atangmik and Napassoq [Freuchen and Salomonsen, 1958:107; Anon., 1965]).

There is evidence of a marked seasonal migration along the Greenland coast. During most of July and August bowheads are not to be found off western Greenland between 60° and 73°N latitude (Eschricht and Reinhardt, 1866). They appear off Upernavik during late September or October and remain through November and early December. At this time whales begin to appear near Godhavn and elsewhere in Disko Bay, where they usually remain until at least early May and usually into the first half of June. Their arrival at Holsteinsborg (near 67°N) can be as late as early January, and they usually disappear from here in March (see Rink, 1877:122,127). Bowheads were regularly caught at Sukkertoppen during December through February. Umanak Fiord, north of Disko Bay, is covered with ice for six months of the year, but bowheads make their appearance here in June and sometimes into early July. Bowheads are seen again at Upernavik from April to July.

Eschricht and Reinhardt (1866) considered "the motion and drift of the ice in Baffin's Bay" to be the main factor controlling bowhead distribution along the Greenland coast. The whale's "arrival at the coast is in the most remarkable manner contemporaneous with the arrival of those huge masses of drifting ice which, issuing from the northern and north-western part of Baffin's Bay, are known in Greenland by the name of the 'west-ice'" (Eschricht and Reinhardt, 1866:11). These authors had little doubt that "the whale comes from the north or north-west to its winter stations" (1866:9), suggesting a relationship between the bowheads wintering along the coast of Greenland and those found off Pond Inlet and in Lancaster Sound and adjacent waters during summer (see below). Brown (1868:543) believed most of the bowheads from the east side of Davis Strait crossed westward in the "middle ice" during June at about the latitude of Svartenhuk (ca. 71°30'N).

West Greenland (Pelagic) - "Disko Water" or "Black Hook Water"

Much of the Davis Strait whaling conducted by Dutch, German, and British vessels was centered on grounds near the west coast of Greenland, especially prior to 1817 when the first crossing of Melville Bay by whalers opened up the "west water" fishery of the Lancaster Sound region (see below). British vessels continued to visit these grounds during the second half of the nineteenth century, often after spending an early spring season sealing at Jan Mayen or Newfoundland. Some vessels prosecuted the "south-west fishing" off Resolution (for bowheads and later for bottlenose whales; see below) before proceeding to the Greenland coast; others went there directly, sometimes reaching Disko Island in March (M'Clintock, 1860:94). The latter were generally more likely to arrive in time to catch whales (see Lubbock, 1937:277).

An example of a "season on the east side" (Barron, 1970:12) is the cruise of the *Abram* of Hull in 1839 (*Abram*, 1839). After departing from Hull on 11 March, the *Abram* was at 67°43'N latitude off the Greenland coast on 26 April. The next day she made her first lowering for a bowhead and thence began cruising for whales "among the bay floes." With at least five other British vessels, the *Abram* remained off Disko Island until mid-May. The second half of the month was spent in the vicinity of Hare Island, lowering occasionally for whales. Although her aim was to reach the "Northern Passage to the NWest Coast of America" (i.e., the usual route via the "north water" to the Lancaster Sound region), the *Abram* and much of the fleet failed to clear the "middle pack" of Melville Bay. On 21 July she "bore away for the south fishing ground."

Barron (n.d. [1890], 1970 [1895]) had long experience on the east side whaling grounds. The *Truelove* would usually sail from Hull in March and reach the western coast of Greenland during the first half of April. Often her arrival at Whale Fish Island in Sydøstbugt ("S.E. Bay") was about a week too late, the natives informing the crew that many whales had been present before the ship's arrival (Barron, 1970:53,131). From Sydøstbugt the vessel would cruise in the "offing", or offshore in the pack ice. There was a saying among the whalemen: "With Riff Koll Hill and Disco dipping there you will see the whale fish skipping" (Barron, 1970:47). During the first half of April the "offing" about 60 mi from Riff Koll and 65-70 mi from Disko was considered a productive whaling ground (also see Lindsay, 1911:108). During spring there was a "good fishing station" just north of 68°N, "a few leagues from land" (Scoresby, 1820:V.2:387).

Barron (1970:93) believed the area between Fortune Bay and Godhavn to be a good early-season ground. As the season wore on, the vessels would head for Umanak Fiord ("N.E. Bay"), often cruising around Hare Island en route (1970:49,53,131). "Directly any water makes its appearance in Omenak Fiord ... the whales are seen there, and at other times in the offing, according to the state of the ice" (1970:181,18-19). Svartenhuk ("Black Hook") was an important landmark. After the whales had left the grounds off Svartenhuk, the whalers generally would begin their arduous advance toward the "north water", and little whaling would occur until the "west water" was reached. The "offing" of Svartenhuk constituted "fine whaling grounds in the month of May", but it was "the last [i.e. most northerly] on the east side of Davis Strait" (Barron, 1970:64).

Among the areas considered especially productive in late spring and early summer were, in addition to "S.E. Bay" and "N.E. Bay", Jacob's Bight, Hingston Bay, Horn Sound, and the ice west of Hare and Disko islands (Scoresby, 1820:V.2:387; Leslie *et al.*, 1835:440; Gray, 1888; Sutherland, 1852:V.1:44,51; Lubbock, 1937:243). By the early nineteenth century these grounds had become depleted

— "of late they have afforded but few whales" (Scoresby, 1820:V.2:387).

After about 1850 the British whalers began to lose confidence in the "east side". Sutherland (1852:V.1:41) called Umanak Fiord ("N.E. Bay") a "famous resort for whales" that had become "almost entirely deserted". He said the same of Hingston Bay (1852:V.1:164). Although bowheads certainly continued to be caught off western Greenland, they were "not nearly so plentiful as formerly, when the Davis-Strait whaler generally pursued his business on this portion of the coast; ... they are now so few that they have generally gone north before the arrival of those ships which have first proceeded to the Spitzbergen [Jan Mayen] sealing" (Brown, 1868:544). By the end of the century, Disko Bay was referred to as a place "where once a great fishing was carried on" (Gray, 1888; and see Southwell, 1898).

"South-West Fishing"

Rather than sailing directly to the Disko Bay area in spring, many British whalers began their season with a visit to the "south-west fishing". Markham's (1875) account is one of several allowing us to trace such an itinerary (Fig. 6; Table 7).

The *Arctic* sailed from Dundee on 3 May 1873, several days later than Captain Adams had intended. By 15 May she was at the "south-west fishing" in heavy pack ice east of Resolution Island. By all accounts this phase of the fishery was among the most difficult and unrewarding (Scoresby, 1820:V.2:389). As Gray (1888) put it: "Although numbers of large whales are usually seen, yet, owing to the boisterous weather and the compact nature of the ice, the fishing is seldom very successful."

Perhaps the best that can be said of this fishery is that the whales taken were often large (Lubbock, 1937:262; Duncan, 1827:7,9). For example, the *Cumbrian* caught eight bowheads in 1827 at the "south-west fishing", their bone averaging 10 ft 11 in. (Table 6).

The "south-west fishing" could begin as early as the first of April and last through June (Parry, 1821:302; Duncan, 1827:4-5,10-13; Jardine, 1837:V.6:96; Eschricht and Reinhardt, 1866:15; Lubbock, 1937:271-272,277). By the beginning of May "the fish at the South-West sometimes retire into the ice or to the northward"; some could still be caught there as late as July, "but only in icy situations, near the Labrador coast" (Scoresby, 1820:V.2:388). The grounds centered at about 61-62°N latitude and 60-64°W longitude, or generally at the mouth of Hudson Strait, along the southeast coast of Baffin Island to Cumberland Sound, and along the northeast coast of Labrador. Barron (1970:75) claimed the grounds actually began at 56°30'W longitude, or about 240 mi east of Resolution Island. In later years, the "south-west fishing" grounds were used for bottlenose whaling at the same season (Lindsay, 1911; Savours, 1960).

After taking a large male bowhead on 23 May, the *Arctic* left the "south-west fishing" and headed straight for "Lievely" (Godhavn), on the south end of Disko Island, where she arrived on 1 June (Markham, 1875). For most vessels that had tried the "south-west fishing" this was really just a way-station en route to Melville Bay; they were usually too late to make a serious attempt at whaling on the "east side" grounds. Rather, they would proceed along the coast until they met the "middle pack". If they managed to find a way through this "Death Trap" (Savours, 1960:130) and attained Cape York or

TABLE 7. Catch of bowhead whales by the *Arctic* of Dundee in Davis Strait and Baffin Bay during 1873 (from Markham, 1875:279). Markham (1875:255) described the *Arctic*'s cargo of oil as "the largest...ever gone home from Baffin's Bay."

Date	Place	Sex	Length of Whalebone	Weight of Whalebone	Tons of Oil	Remarks
			Ft In.	Tons Cwt.	Tons Cwt.	
23 May	Off Resolution Island	M	9 7	0 14	13 0	
15 June	Off Cape Byam Martin	F	5 4	0 2½	3 10	
"	"	M	5 6	0 2½	3 10	
"	"	F	3 5	0 2	2 0	
"	"	M	7 0	0 4	5 10	
19 June	Off Cape Walter Bathurst	F	11 7	1 5	19 0	
23 June	"	F	8 6	0 11	11 10	
"	"	M	7 0	0 5	6 0	
24 June	Off Cape Bowen	F	10 4	0 19	11 0	
25 June	"	M	8 10	0 12	10 0	
28 June	Off Prince Regent Inlet	F	9 2	0 13	12 0	
30 June	"	F	6 5	0 4	5 0	
"	"	F	10 4	1 0	20 0	With a young one or "sucker".
"	"	M	2 6	0 1	2 0	
"	"	M	4 0	0 2½	3 10	
5 July	In Barrow Straits.	F	11 9	1 5	20 0	With a "sucker".
"	"	M	6 6	0 5	7 0	
"	"	F	2 6	0 1½	4 0	
"	"	M	2 6	0 1½	3 0	
6 July	Off Point Sargent.	F	7 0	0 7	8 0	
9 July	Off middle ice, Baffin's Bay	M	10 6	1 2	18 0	
10 July	"	M	11 0	1 0	13 0	
13 July	"	M	9 6	0 16	14 0	
20 July	In Admiralty Inlet	M	5 3	0 2½	4 0	
29 July	In Prince Regent Inlet	F	10 0	1 0	14 0	
1 Aug.	"	M	6 9	0 7	6 0	
9 Aug.	Off Cape Garry	M	8 6	0 12	10 0	
11 Aug.	"	F	10 2	1 0	17 0	
TOTAL	13 females, 15 males		211 5	14 17	285 10	

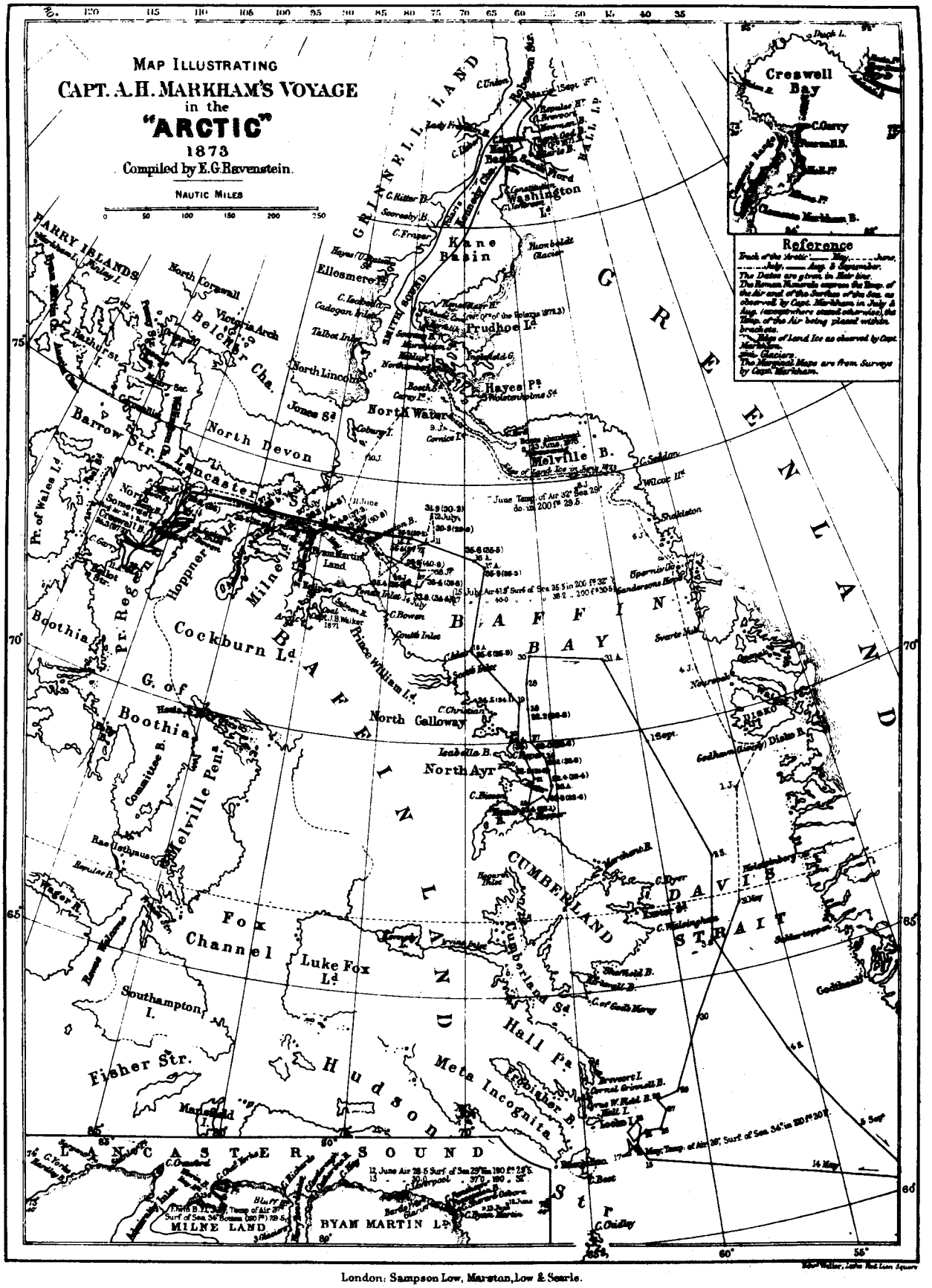


FIG. 6. Cruise track of the *Arctic* of Dundee during the 1873 season in Davis Strait and Baffin Bay (from Markham, 1875).

Cape Dudley Digges, they would usually be able to navigate through the "north water" and reach the Lancaster Sound region in June or July (e.g. Blake, 1874:79-80).

Between the "south-west fishing" and the "west water" of Lancaster Sound and Pond Inlet, the whalers did not expect to encounter many bowheads (Duncan, 1827:10-13; Southwell, 1898). However, some did see whales during the passage (e.g. Parry, 1821:9).

"West Water"

The *Arctic* reached the "north water" off Cape York on 9 June (Markham, 1875), which would be about a month early according to Lubbock (1937:279). From there she proceeded toward the mouth of Lancaster Sound. The fleet was working along the floe edge off Bylot Island and the mouth of Pond Inlet, the first whale being taken in the "west water" on 13 June.

While waiting for a passage up Lancaster Sound, the *Arctic* continued to work along the Bylot Island floe edge between Cape Byam Martin and Cape Graham Moore. The whales, according to one whaling captain, rarely appeared in Pond Inlet until 7 July, after which the inlet was "usually alive with fish" (Smith, 1922:39). Southwell (1898:407), however, maintained that the whales usually arrived in Eclipse Sound about 15 June (see Smith, 1922:34). Finally, on 27 June the *Arctic* reached Cape Hay and proceeded up the sound.

For most of the month of July, she cruised in Lancaster Sound and Prince Regent Inlet, finding whales to be abundant (Fisher, 1821:58 *et seq*; Gray, 1888; Lubbock, 1937:254, 399,422). (In 1868 the *Arctic* had taken 40 small bowheads in Prince Regent Inlet — Lubbock, 1937:393.) For a brief period in the middle of the month she returned to "our old fishing ground" off the mouth of Pond Inlet, where many large whales were present (see Smith, 1922:41-42). Low (1906:258) called this the place "where the principal summer catch is made." Brown (1868:544) stated that bowheads "accumulate in greatest numbers in the neighbourhood of Pond's Bay, and even up Eclipse Sound .... The Whales continue 'running' here until the end of June, and remain until about the end of August or beginning of September. The whalers think that if they can reach Pond's Bay by the beginning of August they are sure of a 'full' ship" (also see Goodsir, 1850:75,85). Admiralty Inlet sometimes had large numbers of whales in late July (Lubbock, 1937:399-400; Hall, 1876:207).

On the first of August the *Arctic* attempted to reach the Gulf of Boothia by way of Prince Regent Inlet, but ice conditions turned her back. All the whales in Prince Regent Inlet were said to be "heading in that direction [i.e. toward the Gulf of Boothia]" (Markham, 1875: 227). Several other authors wrote of the abundance of bowheads in Prince Regent Inlet and the northern Gulf of Boothia during July, August, and early September (Parry, 1826:94,160-161; Hall, 1970:131; Ross, 1835:119, 123-126,140-146,660; Low, 1906:56).

After taking her 28th whale off Cape Garry on 11 August, the *Arctic* returned directly to Scotland with "the largest cargo of oil that has ever gone home from Baffin's Bay" (Markham, 1875:255).

The *Arctic*'s early departure from the grounds must not be taken to mean that bowheads had disappeared from the Lancaster Sound region by mid-August. Parry (1826:36-37) apparently found them still numerous in many parts of the sound through the entire month of September, although the rapid formation of young ice would have driven out most of the whalers well before the beginning of October. Gray (1888) stated that the southward migration did not usually begin until late September, "on the formation of young ice in the sounds."

"Land-Floe Across"

Gray (1939) regarded certain years as "disastrous ... for the Davis Straits whales." These occurred when the land-floe persisted on the west side of Baffin Bay, blocking the entrances to Pond Inlet and Lancaster Sound ("the gate where the whales have to pass through" — Fairweather and Fairweather, 1928:24) until the arrival of the whaling fleet. The whalemen referred to this circumstance as a "land-floe across" (Gray, 1888). (Incidentally, 1873, the year of Markham's [1875] voyage, was not one of these "close seasons.")

Accounts by Sutherland (1852:V.2:324), Lindsay (1911), Lubbock (1937), and others testify to the large concentrations of bowheads that could assemble along the land-floe when their westward passage was obstructed. It was in such a "close season", 1823, that the *Dexterity* killed 20 whales "in a fall", i.e. in one lowering of her boats (Gray, 1939). On 14 July of that year there were no less than 41 sail made fast to the land-floe about eight miles north of Pond Inlet. Only one of these vessels was "clean" (without a catch), most having already caught from 8 to 14 whales. A similar situation existed in 1862, when the *Polynia* took 13 whales in less than two weeks (Barron, 1970:151).

"Rock-Nosing"

Although Markham's (1875) account may typify a successful season in the Lancaster Sound region, it gives no information about a third important segment of the British Davis Strait fishery: "rock-nosing". Those vessels that failed to fill their holds at the "south-west fishing" and the "west water" or "north water" of the Pond Inlet/Lancaster Sound region frequently headed for the fall fishing grounds inshore along the east coast of Baffin Island, also sometimes referred to as the "west water" or the "south-west fishing" (Lindsay, 1911: 203; Osborn, 1865:79), not to be confused with the Pond Inlet/Lancaster Sound whaling and the spring whaling off Resolution Island, respectively.

Toward the end of August or in early September the vessels generally would end their cruising along or "hooking onto" the floe-edge in Lancaster Sound and its adjoining inlets and fiords. While "rock-nosing", the vessels "lay at anchor in some harbor, and every morning the boats rowed out and watched for whales. It was cold, dreary work and very unpopular with the men; but whales late in the season were often large and well worth looking for" (Lindsay, 1911:203; also see Barron, 1895:13; Savours, 1960; Brown, 1868:544; *Eclipse*, 1906).

The whales were found "along the western edge of the 'mid-

dle pack'" at this season (Low, 1906:258; and see Smith, 1922:70). Virtually the entire Baffin coast between Cape Macculloch and Cape Dyer was used for "rock-nosing" (Savours, 1960:135; Lubbock, 1937; Lindsay, 1911:210 *et seq*; Goodsir, 1850:117). Barron (1970:194) claimed "it is singular that no whales have ever been captured off this Cape [Walsingham], or in the vicinity, " although he admitted they could be "plentiful" in Exeter Sound late in the year (1970:191).

Most of the vessels left for home between the first and the 20th of October (Brown, 1868:545; Gray, 1888), but some captains extended the season into early November, by which time their crews would usually be "rock-nosing" in Cumberland Sound (Savours, 1960) or along the Hall Peninsula between Cumberland Sound and Frobisher Bay (Barron, 1970:89).

"Rock-nosing" could begin from the south as well as the north. Vessels that failed to clear the "middle pack" often retreated along the Greenland coast and worked their way across Davis Strait at a lower latitude, making their first landfall at Cape Walsingham or Cape Searle, then proceeding northward along the East Baffin coast (Barron, 1970). The *Abram* (1839), for example, reached Baffin Island by the first week of August and took her first whale (11 ft 3 in. bone) off Cape Hooper on 4 August. From then until mid-September the vessel continued "rock-nosing" in company with several other vessels between Home Bay and Cape Searle. She set sail for home on 15 September.

In Figure 7 we have attempted to identify many of the harbors and headlands considered to be important refuges or landmarks by the "rock-nosers". Agnes' Monument, just north of Clyde River, was "a noted place for whales" (Barron, 1970:96), as were Cape Kater (Barron, 1970:138), Brodie Bay (Anon., 1836:6), and Home Bay (Barron, 1970:12,140). "Many heavy whales" were taken in late summer between Cape Kater and Home Bay as well (Barron, 1970:186).

Cumberland Sound

Although a large bowhead had been seen by John Davis when he discovered Cumberland Sound in July 1587 (Markham, 1889:61), the sound's commercial whaling potential was long overlooked. It was not until the later years of the Eastern Arctic fishery (i.e. after about 1840) that Cumberland Sound (also called Hogarth Sound and Northumberland Inlet; Kumlien, 1879:11) became recognized as a profitable whaling ground. William Penny did not find the abundance of whales he expected when he entered the sound in 1840 (Holland, 1970), but he was assured by the natives that the animals had been very numerous before his arrival (on 2 August) and that they would return "when the sun becomes low" (Tillotson, 1869:283). Cumberland Sound soon grew to be a popular area for early- and late-season whaling.

Low (1906:257) stated: "In March they [bowheads] are found along the edge of the land-floe of Cumberland gulf and Frobisher bay, where they remain until the beginning of May, when they cross to the Greenland coast." Natives of the sound claimed to see large numbers of bowheads at "the edge of the ice-floe" when they traveled long distances over ice to hunt

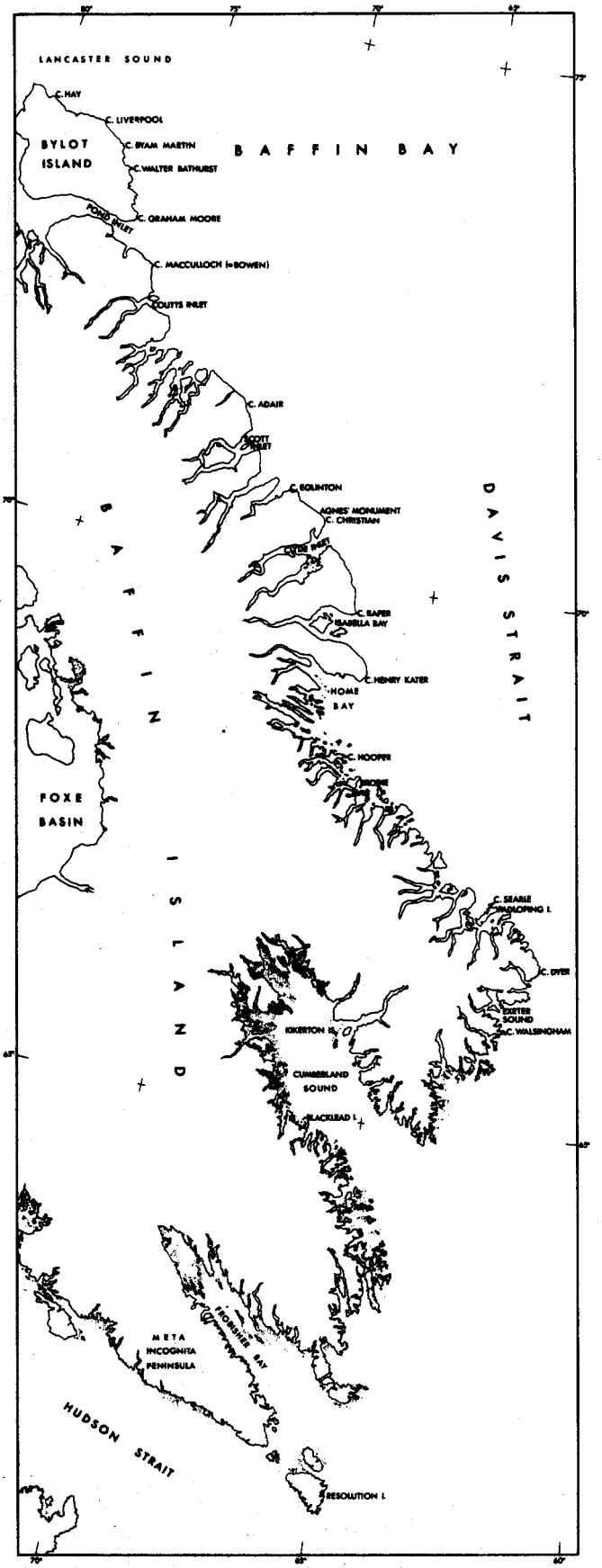


FIG. 7. The "rock-nosing" grounds along the east coast of Baffin Island, used principally for late-season (autumn) whaling. "Brodie" is Brodie Bay.

young seals early in the spring (Brown, 1868:545). American and Peterhead whalers in particular overwintered in Cumberland Sound (and occasionally Frobisher Bay; see Buddington *in* Clark, 1887:96) with the intention of gaining access to the "spring run of fish" (Lubbock, 1937:356-358; Faulkner, 1878; Buddington *in* Clark, 1887:95-96; Gray, 1888). Large catches could be made if the whalemen were on hand for "the first movement of the ice"; the brig *Georgiana* took 12 whales in two days here in 1853 (Buddington *in* Clark, 1887:96). The floe-edge was sometimes still 12-14 miles from land when the whalers began their early-season whaling activities (Barron, 1970:37).

"In October the whales again enter Cumberland gulf, and remain along the edge of the newly-formed land ice until December, when their position is unknown until their return in the following March" (Low, 1906:258). The *Hannibal* found bowheads "very numerous" in Cumberland Sound during late October 1859 (*WSL* 17(38):29 XI 1859; also see Barron, 1970:98,101,107; Lubbock, 1937:458-459). Bowheads had left the sound by 9 November — "a little later than sometimes they do" — when Faulkner (1878:176) overwintered there. On the other hand, Brown (1868:545) claimed the whales stayed in the sound until January, when freeze-up is complete (also see Howgate, 1879:37-43; Barron, 1970:194; Holland, 1970:32). Bowheads were also occasionally taken late in the season in Frobisher Bay (Wakeham, 1898:59).

The *Perseverance* (1877-1878) sailed from Peterhead on 19 July 1877 for Cumberland Sound. After reaching Blacklead Island on 18 August she proceeded up the sound to try the white whale driving at Kingwa (Clearwater) Fiord (see Mitchell and Reeves, 1981). She headed back down the sound at the end of August and began searching for bowheads, the first of which was seen on 27 October. Whales were then seen nearly every day until 9 November, when the hunt was terminated and the whalemen retired to winter quarters.

The following spring the crew of the *Perseverance* sighted their first bowhead on 7 April off Blacklead Island. The vessel (along with the *Alert* and *Polar Star*) cruised between Blacklead and Kikerton islands and around Wareham Island until mid-June, frequently sighting and lowering for bowheads.

Wintering Grounds

The one season for which the British and American whalers had little information on the bowheads' whereabouts was winter. Foul weather, ice, and long periods of darkness made whaling almost impossible. Forced overwintering by the whalers occurred from time to time and resulted in winter observations of bowheads. We have listed some records in Table 8.

In addition to the well-documented wintering grounds along the coast of western Greenland, it appears that bowheads winter along the line of moving pack ice from the mouth of Hudson Strait to the coast of Greenland. The mean maximum southern limit of the ice edge in winter (January-March) is from about 65°N latitude on the Greenland coast to 180 miles off Resolution Island (Markham, 1981:7). Southwell

TABLE 8. Sightings, kills and attempted kills of bowhead whales in winter (November-April) by overwintering nineteenth-century pelagic whalers or explorers

Date	Position	Remarks	Source
1 December 1821	In Foxe Channel, SE of SE extremity of Lyon Inlet	One whale seen	Lyon, 1824:96.
22 January 1822	In Foxe Channel, S of SE extremity of Lyon Inlet	One whale seen	Lyon, 1824:108.
1 February 1827	In holes of open water; between ca. 60 mi NW of Disco Island and 68°37′N, ca. 63°W	"Several" whales seen	Duncan, 1827:85; Lubbock, 1937:266.
2 February 1827	Between 69°13′N and 68°43′N; ca. 50 mi off west coast of Greenland	One whale killed; 9 ft 4 in. bone	"
7-8 February 1827	Among "bay ice"; ca. 68-69°N, off west coast of Greenland	"Several" whales seen	Duncan, 1827:87.
15-16 February 1827	Holes of water in ice; 68°58′N off west coast of Greenland	"Several" whales seen	Duncan, 1827:89-90.
17 February 1827	Ca. 69°N, ca. 60 mi NW of west coast of Greenland	3-4 whales seen; one struck but lost; one killed, 8 ft 1 in. bone	Duncan, 1827:90; Lubbock, 1937:267.
21 February 1827	Ca. 69°N, 63°W	"Several" whales seen	Duncan, 1827:91.
11-16 March 1827	Between 67°24′N and 67°34′N; in lanes of water among "bay ice"; well off the land, but longitude uncertain; apparently closer to Baffin than Greenland coast	Whales seen	Duncan, 1827:104-105; Lubbock, 1937:268.
25-27 March 1827	Ca. 61°30′N, 61°W; "South-west fishing"	Several whales seen and chased	Duncan, 1827:109-110.
25 April 1827	61°37′N, 61°W	One whale seen	Duncan, 1827:109.
27 April 1827	In "south-west fishery", ca. 61°N, 61°W	Whales chased	Duncan, 1827:110.
11-13 Nov. 1835	In heavy pack ice "southward of Cape Searle"	"A great many" whales seen	Lubbock, 1937:309-310.
27 Dec. 1835	62°57′N, in heavy ice near Resolution Island	A whale "heard"	Lubbock, 1937:317.
5 Jan. 1836	Within sight of Button Islands and Cape Chidley	Several whales seen	Lubbock, 1937:318.
11 Jan. 1836	60°N, off Labrador	Whales heard "frequently"	Lubbock, 1937:320.
28-29 Jan. 1836	Ca. 57-58°N, off Labrador	Three whales seen	Lubbock, 1937:323.
February, sometime in 1850s	Near entrance of Cumberland Sound	Two whales caught; "there were great numbers about"; weather "unusually mild".	Lubbock, 1937:363.
March or April 1951	Broken pack ice between 71°55′N, 66°55′W and 70°44′N, 63°44′W	One whale seen	Kane, 1854:390.
25 April 1851	Near 69°47′N, 63°W, off Henry Kater Peninsula, SE Baffin Island	One whale seen	Kane, 1854:357.
February 1855/56	Near Godhavn	Two captured; "great numbers" seen	Barron, 1970:70; Lubbock, 1937:363.
9 March 1858	Heavy pack ice ca. 90 mi west of Disko Island; ca. 69-70°N, 58-59°W	"Black whale" seen	M'Clintock 1860:85.
6 April 1858	67°18′N, in heavy pack ice of Davis Strait; within sight of Cape Dyer; ca. 58°W	Two whales seen	M'Clintock 1860:89.
Winter 1860/61 and 1861/62	Frobisher Bay, at the "edge of the ice"	"Several" whales captured	Clark, 1887:96.
27 December 1866, 4 and 9 January 1867	Off Marble Island (62°40′N)	"Several black whales" seen	Ross, 1974:92.
8 March 1867	Off Button Islands, mouth of Hudson Strait, in "South-West pack"	One large whale seen	Smith, 1922:220.
5 December 1872	Repulse Bay (66°15′N)	Two whales seen	Ross, 1974:92.
22 March 1914	Off Marble Island (62°40′N)	Bowhead sighting	"
"Depth of winter"	Off "Mansfield" (=Mansel) Island and other "more southern" islands on east side of Hudson Bay	Whales reportedly seen	Low, 1906:257.
13 April, year not stated	Depot Island - Fullerton area, NW Hudson Bay (63°50′N)	Bowhead sighting	Ross, 1974:91, Table 3.

(1898:407) was probably correct in asserting that the "southwest fishing" grounds east of Resolution Island were "doubtless the starting-place of the most southerly contingent of the migrating army of whales in Davis Strait."

There are areas of partially or well dispersed pack ice where some open water is consistently present in Smith Sound (the "North Water"), at both ends of Jones Sound, and in Frobisher Bay (Dey, 1981; Markham, 1981). "Recurring polynyas" have also been identified in Cumberland Sound, Bellot Strait, Committee Bay, and at the mouths of Lancaster Sound and Pond Inlet (Smith and Rigby, 1981; Stirling, 1981). In addition, intermittent leads occur along the coasts of Lancaster Sound, Prince Regent Inlet, and Cumberland Sound. It is possible that some bowheads winter in or near these areas. However, aerial surveys of the North Water, "the largest polynya in Canada and perhaps in the world" (Dunbar, 1981), in March-April 1978 and March 1979 failed to detect bowheads, and it was assumed that none were present (Finley and Renaud, 1980). A sighting during March 1981 in a crack in 95-99% pack ice north of Cape Dyer demonstrates the ability of bowheads to survive in apparently unpromising winter ice conditions (McLaren and Davis, 1981).

Brown (1868:545) acknowledged the belief, held by some, that the bowhead "leaves Davis Strait about the month of November, and produces young in the St. Lawrence River, between Quebec and Camaroa [Kamouraska?], returning again in the spring to Davis Strait." However, he does not seem to have subscribed to this notion himself: "It thus appears that they winter (and produce their young) all along the broken water off the coast of the southern portions of Davis Strait, Hudson's Strait, and Labrador" (also see Southwell, 1898; Low, 1906:258). "The Eskimo from the southern part of [Cumberland] sound and along the coast from Nugumeute [S.E. Baffin Island] to Hudson's Straits report whales as found in those localities all winter" (Kumlien, 1879:65).

Haven (1773:19) reported that whales (presumably bowheads) remained at the mouth of Nachvak Fiord, Labrador, all winter. Eighteenth-century records of Labrador Eskimos support the hypothesis that bowheads migrate along the northeast coast of Labrador in winter (Taylor, 1974). Unfortunately, Taylor's tables of bowhead occurrences do not give the dates (other than year). In his text, Taylor indicates that the whales "did not appear off the Labrador coast until November" (*cf.* our Table 1), and the Eskimo hunt apparently ended in most years by mid-December due to freezing of the bays (Taylor, 1974:32). Judging by the primitive methods used to capture the whales and the fact that baleen was an important product of the hunt, we have no doubt that most of the large whales hunted by the Eskimos of northeastern Labrador were balaenids. We are strongly inclined to agree with Taylor's supposition that most of them were bowheads, but we cannot rule out the possibility that right whales (*Eubalaena glacialis*), humpback whales (*Megaptera novaeangliae*), and even gray whales (*Eschrichtius robustus*) were at least occasionally caught (Spiess, 1978; Mitchell and Mead, 1977; Brice-Bennett, 1980 MS). The fact that one New England whaler returning from Davis Strait in 1729 received a quantity of baleen "at least fourteen feet long" from the "Indians" at Davis Inlet, Labrador, demonstrates that at least some of the whales stranded or killed along the Labrador coast were bowheads (Gosling, 1910:321-322).

The "Grand Bay whale" of the Basques and the "river St. Lawrence whale" of the Nantucket whalemen almost certainly refer to the bowhead (see Eschricht and Reinhardt, 1866; True, 1904; Allen, 1908). Thus, it appears that the idea of the bowhead entering the Strait of Belle Isle (Grand Bay) and Gulf of St. Lawrence has some merit. Elaboration of the arguments for and against a winter migration into these areas is outside the scope of this paper. Nevertheless, we consider it a distinct possibility that the early Basque whalers and later the Yankee pelagic whalers caught bowheads, at least early and late in their whaling seasons, in or near the Strait of Belle Isle.

Hudson Bay and Foxe Basin

Hudson Bay and Foxe Basin experienced a comparatively brief period of whaling activity, 1860-1915 (Ross, 1974, 1975). Almost all of the whaling in the bay was done by Americans and Scots. Ross examined a sample of logbooks and journals, plotting catches and routes followed by the whalers to show areas of whale abundance. Most kills were made in Repulse Bay, in the area north of Chesterfield Inlet, and near Marble Island (Ross, 1975:40). Roes Welcome Sound was the center of whaling activity, though the grounds eventually included Bay of Gods Mercy, the mouth of Fisher Strait, Frozen Strait, Duke of York Bay, and Lyon Inlet. Ross (1974) estimated the whaling grounds to encompass an area of 59 570 km^2, where he considered bowheads to be abundant from mid-May to mid-September (Ross, 1975:59, Map 12).

Most vessels entered Hudson Bay through Hudson Strait in summer, arriving at the grounds in mid-August (Ross, 1975:44). For approximately a month they cruised for whales in "the Welcome." "Usually both whales and whalers tended to move northward during the summer as ice conditions improved in the northern reaches of Roes Welcome Sound" (Ross, 1975:45). Sometime in September the vessels went into winter harbor, where they remained until at least the following June and sometimes until August. Marble Island, Depot Island, Cape Fullerton, and Repulse Bay were the principal wintering sites. Spring floe-edge whaling from boats began in May and continued until the ships could be dislodged from their winter harbors and deployed for cruising. After a second, and longer, season of summer whaling, most vessels left Hudson Bay by way of Hudson Strait.

Low's (1906:257) opinion concerning the migration of bowheads into and out of Hudson Bay was based on information he received from whalers:

> The whales are known to enter Hudson strait early in the spring; they have been captured around Big island in April and May, and at the western end of the strait in the latter part of May. They then cross to the west side of the bay along the edge of the open water, being found in June and early July along the land-floe on both sides of the southern part of Roes Welcome. As the Welcome clears of ice they proceed north to Repulse bay, and, still

later, pass through Frozen strait into Fox channel. Late in the autumn they again pass through Hudson strait going eastward.

Ross (1974) could find little evidence of bowheads being seen or killed in Hudson Strait. On the inbound passage, the whalers generally kept to the Baffin (north) side of the strait until reaching Big Island, then either headed toward the gap between Nottingham and Digges islands or continued straight westward (Ross, 1975:40-41). They usually kept to the middle of the strait on their return (eastward) passage (Ross, 1975:55,58). The lack of observations — Ross (1974) found only 16 Hudson Strait bowhead encounters in 69 logbooks and journals — may or may not indicate a low level of migratory movement in the strait. Ross (1974) stated: "Either whales seldom occurred in Hudson Strait or they were present at times when ships were absent." References to sightings or kills in the strait are not really unusual, occurring as early as May and as late as early August (Lubbock, 1937:439,442; Ferguson, 1938:182; Bernier, 1910:313; Gordon, 1887; Low, 1906:272). Most navigation occurred between mid-July and mid-September, so it is possible that the whales usually cleared the strait in advance of the whalers in summer and after them in fall. Observations of bowheads swimming predominantly east off Cape Hopes Advance between 15 October and 23 November 1980 (Finley *et al.*, 1982) provide some evidence that the whalers did indeed leave Hudson Strait before many bowheads did. The poor success of the lone whaling station in the strait, at Spicer Island, and the apparent failure of Eskimos living on the shores of Hudson Strait to make large or consistent catches, however, add to the uncertainty about the bowhead's migration through Hudson Strait (Ross, 1974).

The only alternate route into and out of Hudson Bay/Foxe Basin would be through Fury and Hecla Strait, which Bernier (1909:41) believed, on the basis of conversations with local natives, "opens every year in the month of September". Chapel (1860, *in* Ross, 1974) suggested that bowheads from Lancaster Sound moved south through Prince Regent Inlet and the Gulf of Boothia and into Foxe Basin through Fury and Hecla Strait. This movement would, perhaps, account for the possibility that the Repulse Bay area "received a separate influx [of whales] from Foxe Basin by way of Frozen Strait and Hurd Channel" (Ross, 1974), at least in some years.

While searching for a Northwest Passage, Parry (1824:301) reported sightings of bowheads in early August at about 69°30'N latitude, off the eastern entrance of Fury and Hecla Strait. As Ross (1974) put it, these observations by Parry "stand alone during the 19th century." An obstacle to evaluating the possibility of a consistent migration through Fury and Hecla Strait and the possible significance of Foxe Basin to the Eastern Arctic bowhead population is the lack of exploration and whaling activity in these areas (e.g. Manning, 1943). Lyon Inlet, Gore Bay, and the Winter Island area, where Parry (1824:101,106,126) reported bowheads in September and October (even surfacing in "small pools" created by the vessel as it worked through newly forming sheet ice), constituted the northern limits of the Hudson Bay commercial whale fishery (Ross, 1974, 1975).

In addition to whales migrating into and out of Hudson Bay/Foxe Basin, some may remain there year-round. Low (1906:257) stated that "some whales are supposed to remain during the winter in the waters of Hudson Bay, as they have been reported by the Eskimos as being seen in the depth of winter off Mansfield [Mansel?] and some of the more southern islands of the east side of the bay." Ross (1974) provided additional evidence of bowheads wintering in the bay, using the persistent shore lead, but he concluded: "Whether these scattered sightings represent outliers of a large winter-resident whale stock in Hudson Bay, or simply a few individual stragglers cut off from the outmigrating herd by encroaching ice, is uncertain."

Although it was believed until the 1940s that central portions of Hudson Bay remain open in winter, this view has since been refuted (Hare and Montgomery, 1949; Danielson, 1971). There is a shore lead around the edges of the bay, between the shelf of land-fast ice and the main body of heavy ice covering most of the bay in winter (Stirling, 1981:Fig.1). This shore lead can vary in width from one or one and a half miles to 30 or 40 nautical miles (Hare and Montgomery, 1949), with an average width of about 5 miles (8 km) along the western side of the bay (Danielson, 1971). The northwestern section of the bay, where virtually all whaling activity took place, "has perhaps a higher percentage of open water than any other part of the Bay because of the strong currents from Foxe Basin and the upwelling along the coast" (Hare and Montgomery, 1949:164). There are said to be small shore leads in winter along the east coast of Southampton Island (Danielson, 1971:96), and Stirling (1981:Fig.1) mapped a "recurring polynya" covering much of Roes Welcome Sound, continuous with the shore lead system of western Hudson Bay.

There is a polynya in northwestern Foxe Basin kept open in winter mainly by tidal activity and wind (Markham, 1981:9; Dey, 1981), and intermittent leads form in winter east of Prince Charles Island (Markham, 1981:195). A shore lead system similar to that in Hudson Bay exists in Foxe Basin, and polynyas are formed in the basin by widening of the shore lead off the lee shores of islands (Smith and Rigby, 1981:Figs. 9a-d).

Hudson Strait does not freeze over completely in winter, although pack ice is sufficiently dense to forbid conventional forms of navigation (Forward, 1956; Dey, 1981). Intermittent leads develop along much of the north side of the strait during winter (Markham, 1981:195).

It is possible that some bowheads winter in the Hudson Bay shore lead and near Southampton Island, in the Foxe Basin shore lead and polynyas, and in the dense, shifting pack ice of Hudson Strait. We think it unlikely, however, that the entire summer population overwinters in the bay.

Population Segregation

The whalers frequently remarked on the size of whales caught on different grounds. "Whales of different ages keep a

good deal together: hence young Whales frequent the bays; the old ones roam in the vicinity of the 'middle ice' of Davis Strait, and afterwards come into the bays; and those killed early in the year at Pond's Bay are chiefly young animals. Hence the whaler uses the terms 'middle-icers,' 'rock-nosers,' and 'Pond's-Bay fish' to designate not a separate species or even variety, but to express a geographical fact and a zoological habit" (Brown, 1868:545).

The hypothesis of a migration southward from Lancaster Sound, through Prince Regent Inlet, Gulf of Boothia, Fury and Hecla Strait, and Foxe Basin, then eastward through Hudson Strait, had substantial support among the whalemen, as did the argument that this segment of the migration involved females and young whales almost exclusively (Southwell, 1898;Fig.5). Gray (1888) claimed that the young whales found in May at the Cumberland Sound floe-edge "have migrated south during the previous autumn amongst the archipelago of islands forming the west side into Fox Channel [Foxe Basin], thence by Hudson's Strait to the pack-ice off Resolution Island." As Ross (1974) stated, however, "in the matter of Hudson Strait and Foxe Basin migration the whalemen's evidence was speculative or indirect." We have attempted to use evidence from the literature to evaluate various hypotheses concerning age- and sex-related segregation in bowhead populations.

The statement by Eschricht and Reinhardt (1866:11) that they did not find the number of females caught along the western coast of Greenland to be "out of proportion" to the number of males is taken as evidence against segregation of the sexes on the east side of Davis Strait. It is puzzling that Southwell (1898:406), who admitted that his own knowledge of whale distribution and movement along the Greenland coast was based largely on the work of Eschricht and Reinhardt, claimed "old males" cross Davis Strait to the Disko Island area in spring while "female and immature whales" move north in heavy ice along the Baffin Island coast. Barron (1970:49) mentioned a cow and calf taken at Svartenhuk or off Umanak Fiord ("N.E. Bay") and on another occasion a small bowhead taken early in the season off Disko — "the smallest I had seen upon the east side, with the exception of those which had not left their mothers" (Barron, 1970:160). This suggests that females with calves were not unusual here but that small bowheads unaccompanied by adults may have been seen only exceptionally on the "east side".

The "south-west fishing" clearly involved large whales of both sexes (Tables 6 and 7). At the spring whaling along the floe-edge of Cumberland Sound, there was a high percentage of small whales (Buddington *in* Clark, 1887:95-96; Barron, 1895:40). Both young and old bowheads were present at Cumberland Sound in May "amongst the pack-ice in the offing, the younger whales being nearest the land-floe" (Gray, 1888).

Perhaps the strongest case for segregation of young bowheads from adult males and females pertains to the Pond Inlet area in early summer. Here "the young fish always precede the older ones on their journey up from the south" (Markham, 1875:128). Thus, the whales caught early in the season at the floe-edge off Bylot Island and the mouth of Pond Inlet were expected to be small (Table 7; Parry, 1821:29-30; Gray, 1929); the whalers called these small whales "Pond's-Bay fish" (Brown, 1868:545) or "nursery fish" (Lubbock, 1937:343). A high proportion of the whales taken in "close seasons" supposedly were "nursery fish" or females accompanied by "suckers" (Gray, 1939). Whalers regarded Lancaster Sound as "the general nursery of the young whales" (Anon., 1821:25). In spite of these claims, captains who refrained from lowering for small whales sometimes succeeded in taking a number of large ones at the "Pond's Bay fishing" (Barron, 1970:7; Lubbock, 1937:351). Of the 20 whales taken by the *Cumbrian* between 11 July and 17 August 1823, presumably along the land-floe off Pond Inlet, eight were females averaging 45 ft 3 in. in total length, and 12 were males averaging 43 ft 2 in. (Table 5).

Deep inside Lancaster Sound and in Barrow Strait, Prince Regent Inlet, Admiralty Inlet, and Navy Board Inlet, many small individuals and females accompanied by calves were seen (Table 7; Parry, 1826:89,161). The argument follows for a separate southward migration along the west coast of Baffin Island by these components of the population.

One reason for the whalemen's strong opinion about such a migration scheme was that so few females and young whales were found in the "middle ice" of Baffin Bay in late summer and fall and on the "rock-nosing" grounds along the East Baffin coast (Barron, 1970:37; Gray, 1888; Southwell, 1898; Table 5). In contrast to the spring season, the whales taken in Cumberland Sound in fall were usually large (Faulkner, 1878:171; Lubbock, 1937:378,382,459; Barron, 1970:163). The *Abram* (1839) took whales with 11 ft 3 in., 9 ft 11 in., 11 ft, 10 ft, 9 ft 2 in., and 9 ft 1 in. baleen while "rock-nosing". But off Cape Searle on 12 September a "sucking whale" with 3 ft "bone" and yielding only three tons of oil was taken — an exception to prove the rule.

In his study of logbooks and journals pertaining to the Hudson Bay fishery, Ross (1974, 1975) indicated that small whales and females as well as adult males were killed there, and we are unaware of substantial published evidence demonstrating that the population of bowheads in Hudson Bay/Foxe Basin is anything but fully integrated.

We have considered the remarks of Scoresby (1820, 1823) as they relate to the question of seasonal segregation, although his experience was mainly in the bowhead fishery east of Greenland: in May he expected to find "grown fish" at ca. 79°N along the ice edge and in marginal broken ice, and small whales "of different ages" at ca. 80°N in what he called "fields, and sometimes in bays of the ice" (1820:V.2:209). In June, large whales were found "in every variety of situation" between 75°N and 80°N; small whales, "farther to the south than in the spring, at floes, fields or even among loose ice, but most plentifully about fields or floes, at the border of the main western ice" between 78°N and 78°30'N. Few "small fish" were encountered in July and afterward. Throughout the whaling season — April through July — "a very large kind of mysticetus" was caught in open water at ca. 76°N. Scoresby (1823:292) thought it "worthy of observation" that four whales taken during the second half of August off Davy Sound

at ca. 72°N were all large males. "This fact intimates a separation of the sexes at this season of the year; as upon all other occasions, I have almost invariably found an indiscriminate mixture of males and females."

Scoresby (1820:V.2:211) stated the hypothesis that whales caught at different latitudes or seasons are "distinguished by a difference of age or manners, and in some instances, apparently by a difference of species or sub-species." He cited observed variation of body proportions, particularly the ratio of head length to body length, as evidence of systematic differences. Eschricht and Reinhardt (1866:25) and Gray (1936) argued that the variation reported by Scoresby was more likely an expression of age or sex differences rather than one of systematic separation. Guerin's (1845) "Rock-nose" whale, "a distinct variety, if not a distinct species," arose from reasoning similar to Scoresby's. The "Rock-nose" supposedly was found principally in the bays and inlets of Davis Strait, where "it frequently places the extremity of its head, or nose as the whalers call it, close to the shore, upon a rock" (Guerin, 1845). In Guerin's view the "true Mysticetus" was to be found well away from the coasts, usually in the "middle ice", and only came near land in the fall during its southward migration. As Brown (1868:544-545) argued, Guerin's description of the "Rock-nose" as anything other than a normal bowhead is unconvincing.

On present evidence, we are unable to develop a plausible model accounting for seasonal segregation by age or sex in any bowhead population. However, the lore of early whalemen summarized above, together with recent research in Alaska (e.g. Braham *et al.*, 1980b; Carroll and Smithhisler, 1980), indicates that there is at least short-term segregation, and migratory routes and timing may differ according to age, sex, and possibly reproductive condition. Whether there are also systematic differences between or even within presently recognized regional stocks of bowheads is less certain (Mitchell, 1977 MS; Braham *et al.*, 1980a; Jarrell, 1981), but such possibilities merit further study.

Stock Separation - Harpoons as Markers

Whatever the degree of mixing between the Davis Strait/Baffin Bay and Hudson Bay/Foxe Basin populations, there is likely to be little interchange between either of these

TABLE 9. Some harpoon recoveries considered to suggest interchange between different stocks of bowhead whales

Date of Recovery	Stocks Involved	Summary of Evidence	Our Evaluation	Source
1716	Spitsbergen-Bering Sea	Whale washed ashore on western Kamchatka bearing "a harpoon of European workmanship, marked with Roman letters."	Eschricht and Reinhardt, critical commentators, chose to overlook the informant's illiteracy and the lack of documentation. They accepted the validity of the record.	Scoresby, 1820:V.1:9; Eschricht and Reinhardt, 1866:47.
1787	Spitsbergen-Davis Strait	Whaling captain found bowhead drifting in Davis Strait bearing harpoon recognized as that of his brother; later he learned the harpoon "had been put into the whale near Spitzbergen only two days before."	Distance between Spitsbergen and Davis Strait (at least 2500 km by way of either Kennedy Channel or round Cape Farewell) is too far for a whale to swim and/or drift in two days. No explanation of how harpoon was identified.	Eschricht and Reinhardt, 1866:24.
1805	Spitsbergen-Davis Strait	Capt. Franks unsuccessfully harpooned whale in Davis Strait; "later in the same year" his son killed whale near Spitsbergen with "his father's harpoon still sticking in it."	No explanation of how harpoon was identified.	"
1805	Spitsbergen-Davis Strait	Capt. Sadler killed whale at Spitsbergen "in which the harpoon of an Esquimaux was fixed."	Harpoon could easily have come from Eskimo inhabitants of East Greenland (Gray, 1935).	"
1812	Spitsbergen-Bering Sea	Bone harpoon found in whale "met with" in Spitsbergen area; see following entry for Scoresby's attribution.	Harpoon could easily have been from Eskimos of East Greenland (Gray, 1935).	Scoresby, 1820:V.1:10-11.
1813	Spitsbergen-Bering Sea	Crude stone lance found in whale near Spitsbergen; attributed by Scoresby to "some tribe [of Eskimos] inhabiting the shores of the frozen ocean, on the northern face of the American Continent, yet unexplored."	Lance could easily have been from Eskimos of East Greenland (Gray, 1935).	"
Before 1820	Spitsbergen-Bering Sea	Stone lance, "fixed to a piece of bone," found in a whale near Spitsbergen; see preceding entry for Scoresby's attribution.	Lance could easily have been from Eskimos of East Greenland (Gray, 1935).	"
1866	Spitsbergen-Davis Strait	"Esquimaux" harpoon found in small whale killed at 80°N off East Greenland	Harpoon could easily have been from Eskimos of East Greenland (Gray, 1935).	Southwell, 1898:412.
1870	Davis Strait-Bering Sea	Harpoon found in whale killed off Point Barrow (Alaska), marked "A.G." Attributed to bark *Ansel Gibbs* of New Bedford which had been whaling "in Cumberland Inlet [= Sound] and its vicinity for some ten or eleven years previously."	Other vessels might have had these initials.	Clark, 1887:98-99.
1928	Bering Sea-Spitsbergen(?)	"American" harpoon found in whale stranded on New Siberian Islands.	Plausible, but not conclusive.	Tomilin, 1967:32.
?	Spitsbergen-Bering Sea	"...northeast of Korea, they take every year a great number of whales, in some of which are found harpoons (*or* striking-irons) of the French and Dutch, who practise the whale-fishery at the extremities of Europe."	Unsubstantiated.	Scoresby, 1820:V.1:9-10; Eschricht and Reinhardt, 1866:46-47.
?	Spitsbergen-Davis Strait	Whale struck near entrance of Scoresby Sound (East Greenland) by Wm. Scoresby, Sr.; killed "the next day near the entrance of Omenak fjord, on the west coast [of Greenland], with the harpoons freshly imbedded in its body."	Minimum distance from Scoresby Sound to Umanak Fiord is 3000 km, an impossible distance for a whale, particularly an injured whale, to swim in one day. No explanation of how harpoon was identified.	Brown, 1868:540.
?	Spitsbergen-Bering Sea	Dutch harpoon marked "W.B." found in whale captured in "the sea of Tartary"; said to belong to William Bastiaanz, Admiral of the Dutch Greenland fleet, "and had been struck into the whale in the Spitzbergen sea."	Apparently based entirely on hearsay.	Scoresby, 1820:V.1:8-9; Zorgdrager, 1723:187 as cited by Eschricht and Reinhardt, 1866:47.

populations and those found east of Greenland (Spitsbergen stock) and west of the Northwest Passage (Bering Sea stock). All populations appear to follow such separate migration routes and schedules that their geographic isolation is for the most part assured (Tomilin, 1957, 1967:32,35).

The whaling literature contains numerous references to the finding or killing of whales with harpoons in them, indicating previous encounters with whalers. Frequently such discoveries have been considered as evidence for stock interchange (Eschricht and Reinhardt, 1866:24) or as proof of favorite geographic speculations (Scoresby, 1820:V.1:8-12; Brown, 1868:540-541). We have listed some of these harpoon recoveries in Table 9, and as can be seen, very few of them withstand critical scrutiny.

After reviewing these instances, we conclude that as evidence none are incontrovertible and few are even plausible. Southwell (1898:414) stated: "should an interchange of Atlantic and Pacific whales take place it is much more likely to be by way of the 'Northwest Passage' than along the shores of Asia and Europe". However, the route along the north coast of Eurasia, potentially linking the Spitsbergen and Bering Sea stocks, seems to have produced at least as many plausible records.

Recent observations of bowheads or probable bowheads in the eastern North Atlantic (i.e. Spitsbergen stock) led Jonsgård (1981) to postulate that at least some are "stragglers" from other stock areas. In particular, he wrote that "in all probability two bowhead whales" seen off southeast Greenland at 61°05'N latitude in early August "may have moved from western to eastern North Atlantic waters, because it seems to be well documented that eastern bowheads in former times only moved as far south as about 65°N in the Denmark Strait." He failed to mention, however, that infrequency of the bowhead's occurrence south of 65°N along the west coast of Greenland, especially in summer, is similarly well documented (Eschricht and Reinhardt, 1866:5; Brown, 1868).

Site Fidelity

There is some evidence that individual bowheads return to the same localities at the same seasons in successive years. Southwell (1898:403) was told by Captain Gray that "whalers come to know strongly-marked individuals, and recognise them from time to time, thus showing that the whales follow the same line of migration for many successive seasons." On the whaling grounds east of Greenland a whale "with a distinct white mark across one side of its nose" supposedly was seen in 1856 and again three years later in the same place. Another "with a growth like a bee-hive on the left side of its tail" was reportedly seen in 1867 and killed "almost on the same spot" five years later. Gray claimed to have seen yet another bowhead, this one with a "large white splash on its back," in 1880 and every year subsequently through 1886. The "most remarkable" repeat encounter with a bowhead, according to Southwell (1898:411), occurred in Davis Strait when the *Terra Nova* killed a large whale bearing a harpoon marked with the name of the *Jean* of Bo'ness. Supposedly at least 37 years had elapsed between the implantation of the *Jean*'s harpoon and the capture of the whale by the *Terra Nova*. Another bowhead was caught in 1863 by the *Active* of Peterhead, bearing a harpoon marked "Pow & Fawcos, Newcastle, 1839" (Lubbock, 1937:381). Unfortunately, no details about the localities of the initial strikes and the final captures of these two whales are given, and these records tell us nothing about site fidelity or longevity of bowheads.

Records of the shore whaling operations at West Greenland demonstrate that "the same individuals have been observed to return annually to the same bays and fiords" (Eschricht and Reinhardt, 1866:9). A whale captured in Amertlok Fiord in early January 1817 "had frequently been hunted in the preceding year, being readily identified by the loss of a piece of its tail and the growth of a large excrescence from the injured place." Another whale taken near Godhavn in mid-May 1837 was carrying a harpoon that had been implanted by a harpooner at the Danish "factory" at Godhavn in late February 1833.

Although details were not provided, Conover, Orr, and Parsons (1979:4-17) claimed that a bowhead sighting off Hall Peninsula in September 1978 was "a resight of an animal observed and photographed in mid-September, 1977."

It is evident that bowheads, like other large baleen whales, are conservative in their migratory habits.

CONCLUSIONS

There is no reason to believe the bowhead's distribution and migratory behaviour in the Eastern Arctic have changed in a major way during historic times, despite the drastic reduction in population size (Eschricht and Reinhardt, 1866:4,14; Southwell, 1898; Mansfield, 1971). Some whales continue to winter at the ice edge off Godhavn (Dalager *in* Vibe, 1967:81; Kapel, 1979:211) and in open water and loose pack ice elsewhere off West Greenland (McLaren and Davis, 1981). Spring sightings have been reported in recent years from Godhavn to as far north as 75°N latitude off Cape York (Anon., 1981). Thus it appears that the old whaling grounds along the coast of West Greenland are still visited seasonally by a few bowheads.

There are recent reports of bowheads wintering in the unconsolidated pack ice of Davis Strait (Turl, 1977), off Cape Dyer (McLaren and Davis, 1981), at the mouth of Hudson Strait, and just outside Cumberland Sound (Table 4; Fig. 4). Lack of reports from the Labrador coast may partly be explained by the low level of observation effort there. A spring migration through Lancaster Sound still occurs (Greendale and Brousseau-Greendale, 1976), as does a fall migration along the northeast coast of Baffin Island (Koski and Davis, 1979; Davis and Koski, 1980). Summering grounds such as Prince Regent Inlet, Admiralty Inlet, Navy Board Inlet, and Barrow Strait are still occupied, at least sparsely, and a noteworthy sighting of 10-20 bowheads was made in Robson Channel (Smith Sound) in late July (Koski and Davis, 1979; Davis and Koski, 1980). Concentrations of bowheads observed during summer months near Southampton Island in northern Hudson

Bay, in Repulse Bay, and in northern Foxe Basin suggest that the Hudson Bay/Foxe Basin stock also persists in its traditional areas of summer occupancy.

We can summarize the knowledge of the bowhead's migration — historic and present — as follows:

In winter, bowheads are distributed from the northeast coast of Labrador to the Greenland coast between Sukkertoppen and Godhavn. Although some appear to winter at the mouth of Hudson Strait, it is uncertain whether any remain in Hudson Bay or Foxe Basin for the entire winter. Probably at least a few whales do, but we doubt there is enough open water to support the entire population. Some bowheads may occasionally reach as far south along the Labrador coast as the Strait of Belle Isle, but reputed bowhead specimens from the Strait of Belle Isle and the Gulf of St. Lawrence need confirmation.

In spring, bowheads follow the ice edge northward in Davis Strait; some probably enter Hudson Strait and move westward into Hudson Bay as ice conditions permit. During May and June they can be expected to appear between Disko Bay and Upernavik on the east side of Davis Strait and from Resolution Island to the mouth of Cumberland Sound on the west side. Most of the whales wintering off West Greenland probably cross Davis Strait at about 72°N latitude and reach the floe edge off Pond Inlet and Lancaster Sound sometime in June or July. The Pond Inlet and Lancaster Sound regions likely serve as a summer feeding ground for some bowheads and as migration corridors for others.

During summer, when a maximum of open water is available, bowheads probably become more widely distributed than at any other time of year. They enter many of the sounds and inlets of the High Arctic as well as food-rich areas of northwestern Hudson Bay and western Foxe Basin, especially Roes Welcome Sound and Repulse Bay. Some individuals probably remain near the pack ice of Baffin Bay and Davis Strait, off the northeast coast of Baffin Island, in summer. Some movement through Fury and Hecla Strait may occur, but this remains a moot issue.

The fall migration begins in September and continues through much of October. Some whales that summered in the High Arctic move southward along the east coast of Baffin Island, reaching Cumberland Sound where a major concentration occurs in late autumn. Others cross to the West Greenland coast and begin to reappear at Upernavik in late September and October. Some of the whales that entered Prince Regent Inlet in summer may proceed southward through Fury and Hecla Strait into Foxe Basin. At least some of the whales that summer in Hudson Bay and Foxe Basin probably move eastward through Hudson Strait in the fall (see Finley *et al.*, 1982).

Because of the bowhead's consistent association with ice edge and broken pack ice habitat, some variability in distribution may be expected from year to year as ice conditions change.

The persistent belief of whalers that different components of the population make separate migrations is difficult to evaluate. Calves and small whales apparently form a large segment of the concentration at the Pond Inlet floe edge in late spring. Also, the dearth of young whales and old females along the east coast of Baffin Island in the fall was mentioned often enough by whalers to make it appear to have substance. The argument for a circumnavigation of Baffin Island by females and calves cannot be refuted on present evidence, although it is unlikely that *all* females and calves follow this route.

The statement by Eschricht and Reinhardt (1866) that no sex or age class predominated in the Greenland shore-based catch suggests that a separate Greenland stock could simply share a common summering range with Canadian stocks, then return to the east side of Davis Strait for the winter and early spring. Arguments can be made for one, two, or three stocks in the Eastern Arctic, considering that there are two well defined summering areas — northwestern Hudson Bay/southwestern Foxe Basin and the Lancaster Sound/High Arctic region — and three less well defined wintering areas — the western coast of Greenland, the area from Cumberland Sound to at least the central eastern coast of Labrador (possibly to the Strait of Belle Isle), and Hudson Strait/Hudson Bay.

Unlike the Western Arctic and Spitsbergen/Greenland Sea, where morphological differences have been recognized and discussed (Eschricht and Reinhardt, 1861, 1866; Scammon, 1874; Mitchell, 1977 MS; Braham *et al.*, 1980b), variability in size, proportions, and appearance of bowheads in the Eastern Arctic has been ascribed to age- or sex-related differences (Brown, 1868; *contra* Guerin, 1854).

The nature of available data makes it difficult to assess bowhead abundance in the Eastern Arctic. However, we can state that nothing we have seen in published accounts or in the unpublished records examined for this study inspires confidence in the population's ability to recover from overexploitation. In the absence of evidence to the contrary, we believe the population in Davis Strait/Baffin Bay numbers only a few hundred and therefore that it is still at much less than 10% of initial (1825) size. The population found during summer in Hudson Bay/Foxe Basin, much smaller initially, is probably also at a small fraction of its earlier level of abundance. Lack of systematic assessment makes it impossible to say more about this population's status.

ACKNOWLEDGEMENTS

We thank K. Nesheim for indexing references, A. Evely for securing and verifying references, G. Horonowitsch for data checking, and G. Ferrand for drafting the charts. Financial support for this project initially came from the Department of Indian and Northern Affairs (Contracts No. OTT 78-111 to C. Brice-Bennett and No. OTT 78-118 to M. McLaughlin). It was completed with support from Parks Canada (Contract No. 81-162 to R. Reeves), Petro-Canada, and People's Trust for Endangered Species.

REFERENCES

Cited below are: published sources, unpublished manuscripts with some standing that are publicly available, and unpublished manuscript materials. For the last of these (e.g. logbooks and journals) we give full details and repository. Many of the unpublished manuscripts are available for public sale and may be assigned document numbers, using such acronyms as: APOA (Arctic Petroleum Operators' Association), EAMES (Eastern Arctic Marine Environmental Studies), NR (Norlands Petroleums Ltd., The Lancaster Sound Study Reports), all of which are available through Pallister Resource Management Ltd., Bay 105, 4116 - 64 Avenue S.E., Calgary, Alberta, Canada T2C 1P4.

ABRAM. 1839. A Journal kept during a voyage to Baffin Bay in the ship *Abram* of Hull in search of Whales, commencing on the 11th day of March 1839 & ending [20 October 1839]. MS. 86 p. [On file at Provincial Archives of Manitoba, 200 Vaughan St., Winnipeg, Manitoba, Canada.]

ALLEN, J.A. 1908. The North Atlantic right whale and its near allies. Bulletin of the American Museum of Natural History 24(18):277-329.

ALLEN, J.H. and CONOVER, S.A.M. 1978a. Report on aerial surveys 77-2, 77-3, 77-4 - studies of seabirds and marine mammals in Davis Strait, Hudson Strait and Ungava Bay. Unpublished report by MacLaren Atlantic Limited for Imperial Oil Ltd., Aquitaine Company of Canada Ltd. and Canada Cities Services Ltd. Arctic Petroleum Operators' Association Project No. 134 and 138, December 1977. Variously paginated. [EAMES,ES 13.]

_____. 1978b. Report on the Davis Strait aerial survey 77-1. Unpublished report by MacLaren Atlantic Limited for Imperial Oil Ltd., Aquitaine Company of Canada Ltd. and Canada Cities Service Ltd. Arctic Petroleum Operators' Association Project No. 134, December 1977. 14 p. [EAMES, ES 12.]

ALLEN, K.R. (Chmn.) 1978. Report of the Scientific Committee. Twenty-Eighth Report of the International Whaling Commission. 38-89.

ANDERSON, G. 1947. A whale is killed. Beaver 277:18-21.

ANDERSON, R.M. 1934. Mammals of the Eastern Arctic and Hudson Bay. In: Bethune, W.C. Canada's Eastern Arctic. Its History, Resources, Population and Administration. Ottawa: Department of the Interior. 166 p.

ANONYMOUS. 1821. Letters written during the late voyage of discovery in the Western Arctic Sea. By an officer of the expedition. London: Printed for Sir Richard Phillips and Co. 124 p.

ANONYMOUS. 1835. The Moravians in Labrador. Second Ed. Edinburgh: William Oliphant and Son. 324 p.

ANONYMOUS. 1836. Sufferings of the ice-bound whalers, containing copious extracts from a journal taken on the spot by an officer of the Viewforth of Kirkaldy; and embracing full details of the Jane of Hull and of the wreck of the Middleton of Aberdeen. Second Ed. Edinburgh: William Whyte. 36 p.

ANONYMOUS. 1965. Gronlandshvalen. Inuit (Godthaab) 2:4-5.

ANONYMOUS. 1976. Sea mammal surveys in Baffin Bay and Davis Strait September, 1976. Unpublished report by R. Webb Environmental Services Ltd. for Shell Canada Resources Limited, Calgary, Alberta. Variously paginated.

ANONYMOUS. MS. n.d. [1976]. Aerial surveys of marine mammals of Lancaster Sound, 1975-76. Unpublished report by Renewable Resources Consulting Services Ltd. for Norlands Petroleums Ltd., Calgary, Alberta. 100 p. [NR 11.]

ANONYMOUS. 1981. Denmark (Greenland) progress report on cetacean research 1978-79. Thirty-First Report of the International Whaling Commission. 185-186.

BACK, G. 1970. Narrative of the Arctic Land Expedition to the mouth of The Great Fish River, and along the shores of the Arctic Ocean, in the years 1833, 1834, and 1835. Edmonton: M.G. Hurtig Ltd. 633 p. [First published London: John Murray, 1836.]

BARRON, W. n.d. An Apprentice's Reminiscences of Whaling in Davis's Straits. Narrative of the Voyages of the Hull Barque Truelove, from 1848 to 1854. By Capt. William Barron. Port of Hull, York, England: K Book Editions, Waplington Hall, Allerthorpe. 63 p. [First published Hull: M. Waller, 1890.]

_____. 1970. Old Whaling Days. Greenwich: The Conway Maritime Press. 211 p. [First published Hull: W. Andrews and Co., 1895.]

BENEDEN, P.-J. VAN. 1887. Histoire naturelle de la Baleine Franche (*Balaena mysticetus*). Academie Royale de Belgique, Mémoires couronnés et autres mémoires 40:1-55.

BERNIER, J.E. 1909. Report on the Dominion Government Expedition to Arctic Islands And The Hudson Strait on Board the D.G.S. "ARCTIC", 1906-1907. Ottawa: Printed by C.H. Parmelee, Printer to the King's Most Excellent Majesty. 127 p.

_____. 1910. Report on the Dominion of Canada Government Expedition to the Arctic Islands and Hudson Strait on Board the D.G.S. "ARCTIC". Ottawa: Government Printing Bureau. 529 p.

_____. [1911?]. Report on the Dominion Government Expedition to the Northern Waters and Arctic Archipelago of the D.G.S. "ARCTIC" in 1910. Ottawa: Department of Marine and Fisheries. 161 p.

BISSETT, D. 1968. Northern Baffin Island. An area economic survey. Vol. 2, Northern Baffin Island Report, 1967, A.E.R.S. 67 1. Ottawa: Industrial Division, Department of Indian Affairs and Northern Development. 131 p.

BLAKE, E.V. (ed.) 1874. Arctic experiences: containing Capt. George E. Tyson's wonderful drift on the ice-floe, a history of the Polaris expedition, the cruise of the Tigress, and rescue of the Polaris survivors. To which is added a general Arctic chronology. New York: Harper and Brothers. 486 p.

BOYER, E.C. 1940. North for big game. The Beaver 270(4):6-9.

BRAHAM, H.W., DURHAM, F.E., JARRELL, G.H. and LEATHERWOOD, S. 1980a. Ingutuk: a morphological variant of the bowhead whale, *Balaena mysticetus*. Marine Fisheries Review 42(9-10):70-73.

BRAHAM, H.W., FRAKER, M.A. and KROGMAN, B.D. 1980b. Spring migration of the Western Arctic population of bowhead whales. Marine Fisheries Review 42(9-10):36-46.

BRICE-BENNETT, C. MS. 1980. An overview of the occurrence of cetaceans along the Northern Labrador coast. Unpublished report in fulfillment of Contract No. OTT 78-111 for the Department of Indian Affairs and Northern Development, Ottawa, Ontario. 34 p.

BROWN, R. 1868. Notes on the history and geographical relations of the Cetacea frequenting Davis Strait and Baffin's Bay. Proceedings Zoological Society of London 1868:533-556.

CARROLL, G.M. and SMITHHISLER, J.R. 1980. Observations of bowhead whales during spring migration. Marine Fisheries Review 42(9-10):80-85.

CHAPPELL, E. 1817. Narrative of a voyage to Hudson's Bay in His Majesty's Ship Rosamond containing some account of the north-eastern coast of America and of the tribes inhabiting that remote region. London: J. Mawman. 279 p.

CLARK, A.H. 1887 1. - History and present condition of the fishery. The Whale Fishery. In: Goode, G.B. (ed.). The Fisheries and Fishery Industries of the United States. Section V. History and Methods of the Fisheries. In two volumes, with an atlas of two hundred and fifty-five plates. Vol. II. Washington: Government Printing Office. 3-218.

CONOVER, S.A.M., ORR, C.D. and PARSONS, J.L. 1979. Report on aerial surveys of birds & marine mammals in the southern Davis Strait between April and December 1978. Unpublished report by MacLaren Marex Inc. for Esso Resources Canada Ltd., Aquitaine Co. of Canada Ltd. and Canada Cities Services Ltd., Arctic Petroleum Operators' Association Project No. 146. Vol. 3, Marine Mammals. Variously paginated. [APOA 146-16; EAMES ES 18.]

CONOVER, S.A.M., PARSONS, J. and ORR, C. 1979. Report on aerial surveys of marine mammals & birds in southern Davis Strait & eastern Hudson Strait in March, 1978. Unpublished report by MacLaren Marex Inc. for Esso Resources Canada Ltd., Aquitaine Company of Canada Ltd. and Canada Cities Services Ltd. Arctic Petroleum Operators' Association Project No. 146. Variously paginated. [APOA 146-12; EAMES ES 14.5.]

COOKE, A. and HOLLAND, C. 1978. The Exploration of Northern Canada 500-1920 - A Chronology. Toronto: The Arctic History Press. 549+25 p.

COPLAND, A.D. 1974. Harvesting the northern seas. Beaver 305(3):40-46.

DANIELSON, E.W. Jr. 1971. Hudson Bay ice conditions. Arctic 24(2):90-107.

DAVIS, R.A. and KOSKI, W.R. 1980. Recent observations of the bowhead whale in the eastern Canadian High Arctic. Thirtieth Report of the International Whaling Commission. 439-444.

DEGERBØL, M. and FREUCHEN, P. 1935. Mammals. Report of the Fifth Thule Expedition 1921-24. Copenhagen: Gyldendalske Boghandel, Nordisk Forlag. 2(4-5):1-278.

DEY, B.B. 1981. Shipping routes, ice cover and year-round navigation in the Canadian Arctic. Polar Record 20(129):549-559.

DOUGLAS, W.O. 1975. Two whales within the hour. North 22(4):8-13.

DUNBAR, M.J. 1981. Physical causes and biological significance of polynyas and other open water in sea ice. In: Stirling, I. and Cleator, H. (eds.). Polynyas in the Canadian Arctic. Canadian Wildlife Service Occasional Paper Number 45:29-43.

DUNCAN, D. 1827. Arctic Regions, Voyage to Davis' Strait, by David Duncan, master of the ship Dundee. London: Printed by E. Billing, for the Author. 126 p.

ECLIPSE. 1906. Rough Book. Partial Logs of *Eclipse*, *Snowdrop* and other ships. In: Microfilm Edition of Arctic Logbooks in the Stefansson Collection. Introduction by Erika S. Parmi. 1877-1925. 22 logbooks. [On file in Stefansson Collection, Dartmouth College Library, Hanover, NH 03755, U.S.A.]

ELLIS, H. 1748. A voyage to Hudson's-Bay, by the Dobbs galley and California, in the years 1746 and 1747, for discovering a North West Passage; with an accurate survey of the coast, and a short natural history of the country. Together with a fair view of the facts and arguments from which the future finding of such a passage is rendered possible. To which is prefixed, an historical account of the attempts hitherto made for the finding a passage that way to the East-Indies. London: H. Whitridge. 336 p.

ESCHRICHT, D.F. and REINHARDT, J. 1861. Om Nordhvalen (*Balaena Mysticetus* L.) navnlig med Hensyn til dens Udbredning i Fortiden og Nutiden og til dens ydre og indre Saerkjender. K. Danske Videnskabernes Selskabs Skrifter, Series 5, naturvidenskabelig og mathematisk Afdeling. 5:433-590.

_____. 1866. On the Greenland Right-Whale. (*Balaena mysticetus*, Linn.), with special reference to its geographic distribution and migrations in times past and present, and to its external and internal characteristics. In: Flower, W.H. (ed.). Recent Memoirs on the Cetacea by Professors Eschricht, Reinhardt and Lilljeborg. London: Published for the Ray Society by Robert Hardwicke. 1-150.

FAIRWEATHER, J. and FAIRWEATHER, W.C. 1928. With the Scottish Whalers. The story of a Shipmaster's fifty-two years at sea. *and* Rotation of Stories. Printed for private circulation. 59 p.

FARRAR, F.S. 1974. Arctic Assignment. The Story of the St. Roch. Bonnezen, B.(ed.). Toronto: Macmillan of Canada. 154 p.

FAULKNER, J.P. 1878. Eighteen Months on a Greenland Whaler. New York: published for the author. 317 p.

FEILDEN, H.W. 1887. On the zoology of Captain Markham's voyage to Hudson's Bay in the summer of 1886. Transactions of the Norfolk and Norwich Naturalists' Society 4(3):344-353.

FERGUSON, R. 1938. Arctic harpooner, a voyage on the schooner Abbie Bradford, 1878-1879, by Robert Ferguson, edited by Leslie Dalrymple Stair, illustrated by Paul Quinn. Philadelphia: University of Pennsylvania Press. 216 p.

FINLEY, K.J. 1976. Studies of the status of marine mammals in the Central District of Franklin: N.W.T. June-August, 1975. Unpublished report by LGL Limited for Polar Gas Project, Toronto, Ontario. 183 p.

_____ and JOHNSTON, W.G. 1977. An investigation of the distribution of marine mammals in the vicinity of Somerset Island with emphasis on Bellot Strait, August-September 1976. Unpublished report by LGL Limited for Polar Gas Project, Toronto, Ontario. 91 p.

FINLEY, K.J., MILLER, G.W., ALLARD, M., DAVIS, R.A., and EVANS, C.R. 1982. The belugas (*Delphinapterus leucas*) of northern Quebec: distribution, abundance, stock identity, catch history and management. Canadian Technical Report of Fisheries and Aquatic Sciences No. 1123:1-57.

FINLEY, K.J. and RENAUD, W.E. 1980. Marine mammals inhabiting the Baffin Bay North Water in winter. Arctic 33(4):724-738.

FISHER, A. 1819. Journal of a Voyage of Discovery to the Arctic Regions, performed between the 4th of April and the 18th of November, 1818, in His Majesty's ship Alexander, Wm.Ed. Parry ... commander. By an officer of the Alexander. London: R. Phillips. 104 p.

_____. 1821. A Journal of a Voyage of Discovery to the Arctic Regions, in His Majesty's Ships Hecla And Griper, in the years 1819 & 1820. London: Printed for Longman, Hurst, Rees, Orme, and Brown, Paternoster-Row. 320 p.

FORWARD, C.N. 1956. Sea ice conditions along the Hudson Bay route. Ottawa: Department of Mines and Technical Surveys. Geographical Bulletin 8:22-50.

FREUCHEN, P. and SALOMONSEN, F. 1958. The Arctic Year. New York: G.P. Putnam's Sons. 438 p.

GOODSIR, R.A. 1850. An Arctic Voyage to Baffin's Bay and Lancaster Sound, in search of friends with Sir John Franklin. London: John Van Voorst. 152 p.

GORDON, A.R. 1886. Report of the Second Hudson's Bay Expedition under the Command of Lieut. A.R. Gordon, R.N., 1885. Ottawa: Department of Marine. 112 p.

_____. 1887. Report of the Hudson's Bay Expedition of 1886, under the command of Lieut. A.R. Gordon, R.N. Ottawa: Department of Marine and Fisheries. 133 p.

GOSLING, W.G. 1910. Labrador: its discovery, exploration, and development. Toronto: The Musson Book Company. 574 p.

GRAY, R. 1888. Whale fisheries. Encyclopaedia Britannica. Ninth Edition. 24:526-528.

GRAY, R.W. 1929. The extermination of whales. Nature 123(3096):314-315.

_____. 1935. Greenland whales and the Eskimos of N.-E. Greenland. The Scottish Naturalist 213:75-77.

_____. 1936. The Scoresbys and the Greenland whale. The Naturalist 145-151.

_____. 1939. Statistics of Peterhead whaling fleet. The Naturalist 987: 101-104.

GREENDALE, R.G. and BROUSSEAU-GREENDALE, C. 1976. Observations of marine mammals at Cape Hay, Bylot Island during the summer of 1976. Environment Canada, Fisheries and Marine Service Technical Report 680:1-25.

GUERIN, A.H. 1845. On the rock-nose of the whaler, a variety of the Baleana Mysticetus. Edinburgh New Philosophical Journal 39:266-269.

HALL, C.F. 1865. Arctic Researches and Life Among the Esquimaux: being the narrative of an expedition in search of Sir John Franklin, in the years 1860, 1861, and 1862. New York: Harper & Brothers. 595 p.

_____. 1876. Narrative of the North Polar Expedition. U.S. ship "Polaris", Captain Charles Francis Hall commanding. Edited under the direction of the Hon. G.M. Robeson, Secretary of the Navy, by Rear-Admiral C.H. Davis, U.S.N. Washington: Government Printing Office. 696 p.

_____. 1970. Life with the Esquimaux. A narrative of Arctic experience in search of survivors of Sir John Franklin's expedition. Rutland, Vermont & Tokyo, Japan: Charles E. Tuttle Co. 547 p.

HARE, F.K. and MONTGOMERY, M.R. 1949. Ice, open water, and winter climate in the Eastern Arctic of North America: Part 1. Arctic 2(2):79-89.

_____. 1949. Ice, open water, and winter climate in the eastern Arctic of North America: Part II. Arctic 2(3):149-164.

HAVEN, J. 1773. Extract of the Voyage of the Sloop George from Nain to reconnoitre the Northern parts of Labrador in the months of August and Sept., 1773. 25 p.

HAY, K. and SERGEANT, D.E. 1976. Interim Technical Report. Arctic Whale Project, Environmental-Social Program, Northern Pipelines (Arctic Islands Pipeline). 41 p.

HOLLAND, C.A. 1970. William Penny, 1809-92: arctic whaling master. Polar Record 15(94):25-43.

HOWGATE, H.W. (ed.). 1879. The Cruise of the Florence; or, extracts from the journal of the preliminary Arctic expedition of 1877-'78. Washington, D.C.: James J. Chapman. 183 p.

JARDINE, W. 1837. The Naturalist's Library. Mammalia. Vol. VI. On the ordinary Cetacea or whales. Edinburgh: W.H. Lizars. 264 p.

JARRELL, G.H. Ms. 1981. Cytogenetic and morphological investigation of variability in the bowhead whale, *Balaena mysticetus*. In: Tissue Structural Studies and Other Investigations on the Biology of Endangered Whales in the Beaufort Sea. Vol. 1: Research Unit 980:9-1—9-21. Final Report for the Period April 1, 1980 through June 30, 1981. [Draft Copy] Prepared for: U.S. Department of the Interior, Bureau of Land Management, Alaska OCS Office, Anchorage, Alaska. Submitted by: Department of Veterinary Science, University of Maryland, College Park, Maryland 20742.

JOHNSON, S.R., RENAUD, W.E., DAVIS, R.A. and RICHARDSON, W.J. 1976. Marine mammals recorded during aerial surveys of birds in eastern Lancaster Sound, 1976. Unpublished report by LGL Limited for Norlands Petroleums Limited, Calgary, Alberta. 180 p. [NR 8.]

JONSGÅRD, Å. 1981. Bowhead whales, *Balaena mysticetus*, observed in Arctic waters of the eastern North Atlantic after the Second World War. Thirty-First Report of the International Whaling Commission. 511.

KANE, E.K. 1854. The U.S. Grinnell Expedition in Search of Sir John Franklin, A Personal Narrative. New York: Harper and Brothers. 522 p.

KAPEL, F.O. 1979. Exploitation of large whales in West Greenland in the Twentieth Century. Twenty-Ninth Report of the International Whaling Commission. 197-214.

KOHLMEISTER, B. and KMOCH, G. 1814. Journal of a voyage from Okkak, on the coast of Labrador, to Ungava Bay, westward of Cape Chudleigh; undertaken to explore the Coast, and visit the Esquimaux in that unknown Region. London: Printed by W. McDowall, for the Brethren's Society for the Furtherance of the Gospel among the Heathen. 83 p.

KOSKI, W.R. and DAVIS, R.A. 1979. Distribution of marine mammals in Northwest Baffin Bay and adjacent waters. May - October 1978. Unpublished report by LGL Limited for Petro-Canada, Calgary, Alberta. xx + 305. [EAMES, EN 11.]

KUMLIEN, L. 1879. Contributions to the Natural History of Arctic America made in connection with The Howgate Polar Expedition, 1877-78. Washington: Government Printing Office. Bulletin of the United States National Museum 15:1-179.

LESLIE, J., JAMESON, R. and MURRAY, H. 1835. Narrative of Discovery and Adventure in the Polar Seas and Regions: with illustrations of their Climate, Geology, and Natural History; and an account of the Whale-Fishery. Edinburgh: Oliver & Boyd, Tweeddale Court and London: Simpkin, Marshall, & Co. 484 p.

LINDSAY, D.M. 1911. A voyage to the Arctic in the whaler *Aurora*. Boston: Dana Estes and Co. 223 p.

LOW, A.P. 1906. Report on the Dominion Government Expedition to Hudson Bay and the Arctic Islands on board the D.G.S. Neptune 1903-1904. Ottawa: Government Printing Bureau. 355 p.

LUBBOCK, B. 1937. The Arctic Whalers. Glasgow: Brown, Son & Ferguson, Ltd., Nautical Publishers. 483 p.

LYON, G.F. 1824. The Private Journal of Captain G.F. Lyon, of H.M.S. Hecla, during the recent voyage of discovery under Captain Parry. London: John Murray. 468 p.

_____. 1825. A brief narrative of an unsuccessful attempt to reach Repulse Bay, through Sir Thomas Rowe's "Welcome", in His Majesty's ship Griper, in the year MDCCCXXIV. London: John Murray. 198 p.

MANNING, T.H. 1943. Notes on the coastal district of the eastern Barren Grounds and Melville Peninsula from Igloolik to Cape Fullerton. Canadian Geographical Journal 26(2):84-105.

_____. 1944. Hunting implements and methods of the present-day Eskimos of north-west Hudson Bay, Melville Peninsula, and south-west Baffin Island. The Geographical Journal 103(4):137-152.

MANSFIELD, A.W. 1971. Occurrence of the Bowhead or Greenland Right Whale (*Balaena mysticetus*) in Canadian Arctic Waters. Journal of the Fisheries Research Board of Canada 28(12):1873-1875.

MARKHAM, A.H. 1874. A whaling cruise to Baffin's Bay and the Gulf of Boothia. An account of the rescue of the crew of the "Polaris." With an introduction by Rear-Admiral Sherard Osborn. London: S. Low, Marston, Low, and Searle. 319 p.

_____. 1875. A whaling cruise to Baffin's Bay and the Gulf of Boothia. And an account of the rescue of the crew of the "Polaris". Second Ed. London: Sampson Low, Marston, Low, and Searle. 307 + 40 p.

MARKHAM, C.R. 1889. A Life Of John Davis, *the navigator*, 1550-1605, Discoverer of Davis Straits. London: Gordon Philip & Son. 301 p.

MARKHAM, W.E. 1981. Ice Atlas. Canadian Arctic Waterways. Atlas Des Glaces. Voies D'eau De L'Arctique Canadien. Hull, Quebec: Canadian Government Publishing Centre, Supply and Services Canada. 35 p. text + 198 ice charts.

McLAREN, P.L. and DAVIS, R.A. 1981. Distribution of wintering marine mammals in southern Baffin Bay and northern Davis Strait, March 1981. Unpublished report by LGL Limited for Arctic Pilot Project, Calgary, Alberta. 85 p.

M'CLINTOCK, Captain. 1860. The Voyage of the 'Fox' in the Arctic Seas. A Narrative of the Discovery of The Fate of Sir John Franklin and His Companions. Boston: Ticknor and Fields. 375 p.

M'CLINTOCK, F.L. 1863. Meteorological Observations in the Arctic Seas. Made on board the Arctic searching yacht "Fox," in Baffin Bay and Prince Regent's Inlet, in 1857, 1858, and 1859. Reduced and discussed, at the expense of the Smithsonian Institution. By Charles A. Schott, Assistant U.S. Coast Guard Survey. Smithsonian Contributions to Knowledge 13(3):146 p. [First published separately May, 1862.]

MITCHELL, E. 1977. Canadian Progress Report on Whale Research - June 1975 to May 1976. Twenty-Seventh Report of the International Whaling Commission. 73-85.

_____. MS. 1977. Initial population size of bowhead whale (*Balaena mysticetus*) stocks: cumulative catch estimates. Unpublished report for International Whaling Commission, Cambridge, England. SC/29/Doc. 33. 113 p. typescript.

_____ and MEAD, J.G. 1977. History of the gray whale in the Atlantic Ocean. Proceedings (Abstracts), Second Conference on the Biology of Marine Mammals, San Diego, California, 12-15 December 1977. 11.

MITCHELL, E. and REEVES, R.R. 1981. Catch history and cumulative catch estimates of initial population size of cetaceans in the Eastern Canadian Arctic. Thirty-First Report of the International Whaling Commission. 645-682.

_____. 1982. Factors affecting abundance of bowhead whales *Balaena mysticetus* in the Eastern Arctic of North America, 1915-1980. Biological Conservation 22(1):59-78.

MUNN, H.T. n.d. Tales of the Eskimo. Being Impressions of a Strenuous, Indomitable, and Cheerful Little People. With Photographs by the Author. London: W. & R. Chambers, Limited. 196 p.

_____. 1932. Prairie Trails and Arctic By-Ways. London: Hurst and Blackett, Ltd. 288 p.

NOURSE, J.E. (ed.). 1879. Narrative of the Second Arctic Expedition made by Charles F. Hall: his voyage to Repulse Bay, sledge journeys to the Straits of Fury and Hecla and to King William's Land, and residence among the Eskimos during the years 1864-'69. U.S. Naval Observatory, Washington: Government Printing Office. 644 p.

OSBORN, S. 1865. Stray leaves from an Arctic journal, or eighteen months in the polar regions in search of Sir John Franklin's expedition in 1850-51. To which is added the career, last voyage, and fate of Captain Sir John Franklin. Edinburgh: William Blackwood and Sons. 334 p.

PARRY, W.E. 1821. Journal of a voyage for the discovery of a North-West Passage from the Atlantic to the Pacific; performed in the years 1819-20, in His Majesty's Ships Hecla and Griper, under the orders of William Edward Parry, R.N., F.R.S., and Commander of the expedition. With an appendix, containing the scientific and other observations. London: John Murray. 310 p.

_____. 1824. Journal of a second voyage for the discovery of a North-West Passage from the Atlantic to the Pacific; performed in the years 1821-22-23, in His Majesty's Ships Fury and Hecla, under the orders of Captain William Edward Parry, R.N., F.R.S., and commander of the expedition. London: John Murray. 572 p.

_____. 1826. Journal of a third voyage for the discovery of a North-West Passage from the Atlantic to the Pacific; performed in the years 1824-25, in His Majesty's Ships Hecla and Fury, under the orders of Captain William Edward Parry, R.N., F.R.S., and commander of the expedition. London: John Murray. 186 + 151 p.

PAYNE, F. 1888. The mammals and birds of Prince of Wales Sound, Hudson's Strait. Proceedings of the Canadian Institute (Toronto). Third series, Vol. 5, 1886-87. Paper no. 16:111-123.

PENNANT, T. 1784-85, 1787. Arctic Zoology. London: Henry Hughs. 3 Vols. in-4. 952 p.

PERSEVERANCE. 1877-78. Logbook of the *Perseverance* of Peterhead from a voyage to Cumberland Gulf, July 19, 1877 to August 8, 1878. In: Microfilm Edition of Arctic Logbooks in the Stefansson Collection. Introduction by Erika S. Parmi. 1877-1925. 22 logbooks. [On file in Stefansson Collection, Dartmouth College Library, Hanover, NH 03755, U.S.A.]

PHILPOTS, E.P. 1869. An account of the land in the vicinity of Cape Horsburgh, Lat. 74°44'24"N., Long. 79°W., and of the island discovered there. Royal Geographical Society Proceedings 13:372-375.

PREBLE, E.A. 1902. A Biological Investigation of the Hudson Bay Region. North American Fauna 22:1-140.

RAE, J. 1850. Narrative of an expedition to the shores of the Arctic Sea in 1846 and 1847. London: T. and W. Boone. 248 p.

RINK, H. 1877. Danish Greenland. Its People and Its Products. London: Henry S. King & Co. 468 p.

ROOTS, E.F. (ed.). 1980. Lancaster Sound: Issues and Responsibilities. Environmental Science Workshop for the Lancaster Sound Region, Kananaskis, Alberta, 6-8 November 1979. Ottawa: Canadian Arctic Resources Committee. 110 p.

ROSS, J. 1819. A Voyage of Discovery, made under the orders of the Admiralty, in His Majesty's Ships Isabella and Alexander, for the purpose of exploring Baffin's Bay, and inquiring into the probability of a North-West Passage. London: John Murray. 252 p. + App.

_____. 1835. Narrative of a Second Voyage in Search of a North-West Passage, and of a residence in the Arctic regions during the years 1829, 1830, 1831, 1832, 1833. Including the reports of Commander, now Captain, James Clark Ross, R.N., F.R.S., F.L.S., &c. and the Discovery of the Northern Magnetic Pole. London: A.W. Webster. 740 p.

ROSS, W.G. 1974. Distribution, migration, and depletion of bowhead whales in Hudson Bay, 1860 to 1915. Arctic and Alpine Research 6(1):85-98.

_____. 1975. Whaling and Eskimos: Hudson Bay 1860-1915. National Museums of Canada. National Museum of Man. Publications in Ethnology 10:1-164.

_____. 1979. The annual catch of Greenland (bowhead) whales in waters north of Canada 1719-1915: a preliminary compilation. Arctic 32(2):91-121.

SAVOURS, A. (ed.). 1960. Journal of a whaling voyage from Dundee to Davis Strait, 1894. Polar Record 10(65):126-137.

SCAMMON, C.M. 1874. The marine mammals of the north-western coast of North America, described and illustrated: together with an account of the American whale-fishery. San Francisco: J.H. Carmany & Co. 320 p.

SCORESBY, W., Junior. 1820. An Account of the Arctic Regions, with a history and description of the Northern Whale-Fishery. In two volumes. Edinburgh: Archibald Constable and Co. and London: Hurst, Robinson and Co. V.1:522+(82)p. V.2:574 p.

_____. 1823. Journal of a voyage to the Northern Whale-Fishery; including researches and discoveries on the eastern coast of West Greenland, made in the summer of 1822, in the ship Baffin Of Liverpool. Edinburgh: Archibald Constable and Co. London: Hurst, Robinson and Co. 472 p.

SMITH, C.E. 1922. From the Deep of the Sea. Being the Diary of the Late Charles Edward Smith. London: A. & C. Black, Ltd. 288 p.

SMITH, M. and RIGBY, B. 1981. Distribution of polynyas in the Canadian Arctic. In: Stirling, I. and Cleator, H. (eds.) Polynyas in the Canadian Arctic. Canadian Wildlife Service Occasional Paper Number 45:7-28.

SMITH, T.G., HAMMILL, M.H., DOIDGE, D.W., CARTIER, T. and SLENO, G.A. 1979. Marine mammal studies in southeastern Baffin Island. Canadian Manuscript Report of Fisheries and Aquatic Sciences 1552:1-70.

SOUTHWELL, T. 1887. Notes on the seal and whale fishery of 1886. The Zoologist, Third Series, 11(125):182-189.

_____. 1898. The migration of the right whale (*Balaena mysticetus*). Natural Science 12(76):397-414.

_____. 1900. Notes on the seal and whale fishery, 1899. The Zoologist, Fourth Series, 4(38):65-73.

SPIESS, A. 1978. Zooarchaeological evidence bearing on the Nain area Middle Dorset subsistence-settlement cycle. Arctic Anthropology 15(2):48-60.

STEPNEY, P.H.R. and WOOLEY, R.L. n.d. [1976]. Survey of marine mammals of Lancaster Sound, October 1975. Unpublished report by Renewable Resources Consulting Services Ltd. for Norlands Petroleums Limited, Calgary, Alberta. 55 p. [NR 12.]

STIRLING, I. 1981. Introduction. In: Stirling, I. and Cleator, H. (eds.). Polynyas in the Canadian Arctic. Canadian Wildlife Service Occasional Paper Number 45:5-6.

_____, CLEATOR, H., and SMITH, T.G. 1981. Marine mammals. In: Stirling, I, and Cleator H. (eds.). Polynyas in the Canadian Arctic. Canadian Wildlife Service Occasional Paper Number 45:44-58.

SUTHERLAND, P.C. 1852. Journal of a voyage in Baffin's Bay and Barrow Straits, in the years 1850-1851, performed by H.M. Ships "Lady Franklin" and "Sophia," under the command of Mr. William Penny, in search of the missing crews of H.M. Ships Erebus and Terror: with a narrative of sledge excursions on the ice of Wellington Channel; and observations on the natural history and physical features of the countries and frozen seas visited. In two volumes. London: Longman, Brown, Green, and Longmans. V.1:506 p. V.2:363 p.

SUTTON, G.M. and HAMILTON, W.J., Jr. 1932. The mammals of Southampton Island. Memoirs of the Carnegie Museum (Pittsburgh) 12(2)(Section 1):1-111.

TAYLOR, J.G. 1974. Labrador Eskimo settlements of the Early Contact Period. National Museum of Man, National Museums of Canada, Ottawa. Publications in Ethnology 9:1-102.

TILLOTSON, J. 1869. Adventures in the ice: a comprehensive summary of Arctic exploration, discovery, and adventure. Including experiences of Captain Penny, the veteran whaler, now first published. London: James Hogg & Son. 284 p.

TOMILIN, A.G. 1957. Zveri i SSSR prilezhashchikh stran. Tom 9, Kitoobraznye. Moskva: Izdatel'stvo Akademii Nauk SSSR. 756 p.

_____. 1967. Mammals of the USSR and adjacent countries. Vol. 9. Cetacea. [Translation of Tomilin, A.G., 1957.] Israel Program for Scientific Translations, Jerusalem. 717 p.

TRUE, F.W. 1904. The whalebone whales of the western North Atlantic compared with those occurring in European waters with some observations on the species of the North Pacific. City of Washington: Smithsonian Institution. Smithsonian Contributions to Knowledge 33:1-332.

TUCK, L.M. 1957. Wildlife investigations in the Cape Hay region, Lancaster Sound, 1957. Unpublished report for Canadian Wildlife Service. 59 p.

TURL, C.W. 1977. Sightings of marine mammals in the Arctic winter pack ice, 1976. In: Wood, F.G. (ed.). Second Conference on the Biology of Marine Mammals, San Diego, California, 12-15 December. Proceedings [Abstracts]. 58.

VIBE, C. 1967. Arctic animals in relation to climatic fluctuations. Meddelelser om Grønland 170(5):1-227.

WAKEHAM, W. 1898. Report of the Expedition to Hudson Bay and Cumberland Gulf in the Steamship "Diana". Under the command of William Wakeham Marine and Fisheries Canada in the year 1897. Ottawa: S.E. Dawson. 83 p.

WARMOW, M. 1859. Extract from Br. M. Warmow's journal of his residence in Cumberland Inlet, during the winter of 1857-1858. Periodical Accounts Relating to the Missions of the Church of the United Brethren, Established among the Heathen 23(242).87-92.

WEBB, R. 1976. [See ANON., 1976.]

WHALEMEN'S SHIPPING LIST AND MERCHANTS' TRANSCRIPT. New Bedford, Mass. Vol. 1, no. 1 (17 March 1843) to Vol. 72, no. 52 (29 December 1914).

WOOD, T.J. 1974. Wildlife in the vicinity of Baffin Island National Park: An assessment of the impact of Inuit hunting and other factors on wildlife populations in southeastern Baffin Island. Unpublished report for Canadian Wildlife Service, Fredericton, N.B. 35 p. typescript.

APPENDIX A

After this paper had already been submitted to press, the report of a parallel but independent study, based on extractions from manuscript whaling logbooks and journals, became available (Ross, W.G., and MacIver, A. 1982. Distribution of the kills of bowhead whales and other sea mammals by Davis Strait whalers 1829-1910. Unpublished report prepared for Arctic Pilot Project. iv + 75 p.). Ross and MacIver plotted 1024 bowhead kills in the Eastern Arctic, by decade (1820-1910) and by month (April-October). The pattern of distribution and migration suggested by their charts is essentially the same as we have outlined.

We find their interpretations of the material and their extrapolations difficult to evaluate because Ross and MacIver chose not to list the sources they consulted. "No particular advantage would be gained by listing these manuscript sources individually" (Ross and MacIver, 1982:71) — except that it is necessary to scholarly research.

APPENDIX B

Klinowska has undertaken this study, and has compiled a preliminary statement of some problems and literature (Klinowska, M. 1982 MS. Winter habits of the Bowhead Whale (*Balaena mysticetus*) in West Greenland from 1799 to 1836, in relation to catch and drift ice conditions. International Whaling Commission, Workshop on the Behaviour of Whales, Seattle, Washington, 19-23 April 1982. Paper SC/A82/BW 1, p. 1-10 typescript + Tables 1-6.)

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Research Document 2010/022 | **Document de recherche 2010/022**

Stock definition of belugas and narwhals in Nunavut

Définition des stocks de bélugas et narvals du Nunavut

P. R. Richard

Fisheries and Oceans Canada / Pêches et des Océans Canada
501 University Crescent / 501 Université Crescent
Winnipeg, MB
R3T 2N6

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ISSN 1499-3848 (Printed / Imprimé)
ISSN 1919-5044 (Online / En ligne)
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Canada

Correct citation for this publication:

Richard, P.R. 2010. Stock definition of belugas and narwhals in Nunavut. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/022. iv + 14 p.

ABSTRACT

This document provides information relevant to the definition of stocks of belugas and narwhals in Nunavut in response to a request from the Nunavut Wildlife Management Board. There is good evidence of seasonal geographic segregation between Nunavut beluga stocks, and even year-round in many cases. There is also good evidence of genetic, contaminant and morphological differences between many of them. Evidence for narwhal segregation between stocks is largely from tracking data, although some genetic and contaminant also hints at some degree of geographical partitioning. For hunting communities that rely on a predictable seasonal occurrence of animals for their subsistence, reducing chances of local depletion by hunting multiple stocks as suggested by present information is an appropriate approach to co-management.

RÉSUMÉ

Ce document présente de l’information pertinente à la définition des stocks de bélugas et narvals du Nunavut, en réponse à une demande d’avis scientifique du Conseil de gestion des ressources fauniques du Nunavut. Il existe de bonnes sources d’information portant sur la ségrégation géographique saisonnière et, dans bien des cas, annuelle des stocks de bélugas du Nunavut. Des résultats probants sur leur génétique, leurs niveaux de contaminants et leur morphologie supportent aussi ces conclusions. Chez les narvals, ce sont largement des résultats de suivis télémétriques qui supportent les conclusions relatives à la ségrégation saisonnière des stocks. Il y a aussi des données sur leur génétique et leurs niveaux de contaminants qui suggèrent des différences dans la répartition géographique de certains stocks. Pour des communautés de chasseurs qui comptent sur une présence saisonnière prévisible de ces espèces, l‘approche de cogestion appropriée pour réduire des risques de surexploitation locale est de définir autant de stocks que sont suggérés par l’information disponible.

INTRODUCTION

The Nunavut Wildlife Management Board (NWMB), in its review of advice provided by Fisheries and Oceans Canada (DFO) Science on Total Allowable Harvest (TAH) for Nunavut beluga and narwhal stocks, has asked DFO to provide clarification on its rationale for providing science advice on the basis of known summering stock aggregations rather than at the population level. The NWMB also asked for clarification about various terms used (e.g., population, stock, sub-stock, management unit) and for an update on the current stock identity of belugas harvested by hunters from Iqaluit and Kimmirut.

DISCUSSION

POPULATION TERMS USED FOR PROVISION OF ADVICE

Stock is a concept used variously in fisheries assessment but it generally refers to a resource unit, a group of animals that are subject to hunting removals (Stewart 2008). That means the age and sex classes of a population or mixed populations that are the valued target of the hunt.

The biological definition of a population is a reproductively isolated group of animals (Waples 1991). A “population” can also be a “stock” (a group of animals of interest) if it is reproductively isolated from other stocks.

Factors such as demographic and life history variability, habitat patchiness, environmental change, genetic sub-structuring and adaptability may result in temporally or spatially structured populations (Cope and Punt 2009). It is possible to have localized depletions or extinctions if this is not considered when harvesting occurs. It is therefore important to choose the definition of stock to suit the management goal. Avoiding local depletion is one such goal, particularly for hunting communities that rely on a predictable seasonal occurrence of animals for their subsistence. It is also promotes the conservation of genetic diversity which may result from adaptation to local conditions.

The term “sub-stock” was used by the Scientific Working Group of the Joint Commission on Conservation and Management of Narwhal and Beluga (JCNB) and the North Atlantic Marine Mammal Commission (NAMMCO) in the context of subdividing the widely accepted “Baffin Bay Narwhal” stock (SWG-JCNB 2005). This term was introduced in a conceptual model that proposed to sub-divide the previously defined Baffin Bay narwhal “stock” into smaller management units, given there was evidence that that overall stock might be composed of seasonally spatially discrete populations, which had annual site-fidelity to their summering ranges.

This review refers only to management “stocks”, keeping in mind that some of these stocks may or may not be “populations” in the biological sense. Reference to “sub-stocks” in previous documents should be interpreted as meaning “stocks”.

APPROACHES USED FOR STOCK DEFINITION

Stock definition of beluga and narwhal populations in Nunavut was derived from various sources of information:

1) studies of the seasonal range of the species in Nunavut and adjacent waters by documenting local and written reports of their occurrence,
2) appearance and behavioural differences of animals from different areas of Nunavut and adjacent waters,
3) studies of genetic and contaminant differences of animals from different parts of Nunavut and adjacent waters, and
4) tracking animals, using satellite-linked transmitters, to estimate their seasonal range and delimit areas of aggregations.

The combination of these data has allowed DFO and partners to identify six beluga stocks and five narwhal stocks in Nunavut, as well as several others in Nunavik, Greenland or Alaska. These are considered provisional management stocks in the sense that any new information that may inform these conclusions would be taken into consideration to revise the list if needed.

The use of summering stocks as management units is considered precautionary. As mentioned above, it is possible to have localized depletions or extinctions if this is not considered when harvesting occurs (Cope and Punt 2009). By adopting as many stocks as are suggested by available information, even if that information is preliminary and based on small samples, co-managers reduce the risk of over-exploitation associated with considering smaller stocks to be part of a more numerous and wider-ranging stock, when in fact they are segregated for all or part of the year and have some annual site fidelity to specific areas. An example of the depletion of a local beluga stock is the Ungava Bay stock, which has been severely depleted, perhaps eradicated, by commercial whaling (Reeves and Mitchell 1989). The numbers of belugas using Ungava Bay in summer in the past few decades is not known precisely but is so low that few, if any, are seen during surveys (Finley *et al.* 1982; Smith and Hammill 1986; Kingsley 2000; Gosselin *et al.* 2009). As a result, summer hunting in Ungava Bay has been closed, with a few exceptions, since 2005 (DFO 2009).

STOCK DEFINITION OF NUNAVUT BELUGA STOCKS

Nunavut beluga stocks were identified by various authors over the years (Sergeant and Brodie 1969, Sergeant 1973, Finley *et al*. 1982; Richard *et al.* 1990) and their identity was based on the disjunct distribution of beluga summering aggregations. Evidence that belugas returned annually to the same aggregation areas (“site fidelity”) was obtained when nine of 14 individually-marked animals seen in the Nastapoka estuary (Eastern Hudson Bay) in the summer of 1983 were resighted there the following summer (Caron and Smith 1990). During the summer, known individuals were repeatedly seen returning to the Nastapoka estuary after offshore visits (Caron and Smith 1990). More evidence of beluga annual site fidelity came from genetic and contaminant research (Helbig *et al.* 1990; Brennin *et al.* 1997; Brown Gladden *et al.* 1997, 1999; de March *et al.* 2002; de March *et al.* 2004), which showed that animals of both sexes with specific mitochondrial DNA (mtDNA) types were found in certain summering areas but not in others and that the measure of genetic distance between samples of beluga from different summering areas indicated that there was little exchange of individuals between them. Belugas from the Mackenzie Delta, Somerset Island, Cumberland Sound, the Nelson River, and Eastern Hudson Bay were also tracked over the summer, autumn and winter seasons. Tracked individuals from each summering aggregations did not overlap in distribution in either summer

or winter (Richard *et al.* 2001a, b; Richard and Stewart 2009; Smith 2008; Hammill, pers. comm.) and in some cases, neither in autumn or spring.

Appendix I lists the information used for stock definition of Nunavut beluga stocks. In summary, there is strong evidence from genetic, contaminant and tracking data to support the definition of the stocks of belugas in Nunavut. Local knowledge was useful input to the understanding of the seasonal occurrence of belugas in Nunavut waters but provided weak inference on their stock delineation. These summer aggregations of belugas are therefore considered separate stocks for the provision of advice on Total Allowable Harvest.

POPULATION IDENTITY OF BELUGAS HARVESTED BY IQALUIT AND KIMMIRUT

The stock(s) harvested by hunters from Iqaluit is not know for certain but is thought to be the Western-Northern-Southern (WNS) Hudson Bay beluga stock (Fig.1). The Western part of this population is identified by COSEWIC as the Western Hudson Bay beluga population. This stock is large (mean estimate of ~63,000 animals) and winters in Hudson and Davis straits. Belugas found in Frobisher Bay and hunted by Iqaluit residents in summer are thought to be strays from this large main stock which summers in Hudson Bay along the Kivalliq, Manitoba and Ontario coasts. It is plausible that a large stock ranges more widely than smaller ones. Most belugas caught around Kimmirut are taken in the autumn when the WNS Hudson Bay stock has moved into Hudson Strait (Smith 2008). They are similar genetically to those hunted in summer in Western and Northern Hudson Bay (de March and Postma 2003) and differentiate from those hunted in the High Arctic, West Greenland and Cumberland Sound (de March *et al.* 2002, de March *et al.* 2004). Finally, no tagged belugas from Cumberland Sound or eastern Hudson Bay have moved into Frobisher Bay or adjacent to Kimmirut (Richard and Stewart 2009; Mike Hammill, DFO, unpublished data), while several tagged belugas from the WNS stock (Nelson River) have been tracked close to Kimmirut in autumn and winter (Smith 2008).

STOCK DEFINITION OF NUNAVUT NARWHALS

Two stocks of narwhals were previously identified in Nunavut waters: the High Arctic stock (later referred to as the Baffin Bay stock by the JCNB and the Eastern High Arctic-Baffin Bay population by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)) and the Northern Hudson Bay stock (Strong 1988). There is some preliminary but equivocal evidence of genetic and contaminant differences that suggest the existence of more stocks of narwhals (de March *et al.* 2003; de March and Stern 2003) (Fig.2). The only stock of Nunavut narwhals which clearly differentiates by both methods from the other ones is the Northern Hudson Bay stock. There is also some tracking evidence of individual fidelity to summering areas between years and intra-year evidence that show that the individuals from different summering aggregations of narwhals do not mix during summer and, in the case of the Somerset stock, also not during autumn and winter. Figure 2 shows three stocks hypothesized by the JCNB, for which the only information is the occurrence of animals, either that they have been sighted in those areas (Parry Channel) or that they are hunted by Nunavut or Greenlandic hunters (Jones Sound, Smith Sound). Separate stocks were hypothesized for those areas given that, for other stocks, there is evidence of site fidelity and restricted geographic movements in summer (JCNB 2006) but there is no data to draw any clear statements on the distinctiveness of their range or genetic makeup.

Appendix II lists the information used for stock definition of Nunavut narwhals stocks. In summary, there is strong evidence from genetic, contaminant and tracking data to support the definition of the Northern Hudson Bay summering aggregation as a separate stock from other

narwhals in Nunavut. The evidence for defining other narwhal stocks is strongest from tracking data and weakest from genetics and contaminants. Although there are differences in the latter data, differences may be overshadowed by the fact that many landed animals are caught during seasons of migration, diluting differences between samples. Local knowledge was useful input to the understanding of the seasonal occurrence of narwhals in Nunavut waters but provided weak inference on their stock delineation. To reduce the chances of depletion of local stocks, the recommended precautionary approach is to also consider summer aggregations of narwhals as separate stocks for the provision of advice on Total Allowable Harvest.

REFERENCES

Brennin, R., B.W. Murray, M.K. Friesen, L.D. Maiers, J.W. Clayton and B.N. White. 1997. Population genetic structure of beluga whales (*Delphinapterus leucas*): Mitochondrial DNA sequence variation within and among North American populations. Can. J. Zool. 75: 795-802.

Brown Gladden, J.G., M.M. Ferguson and J.W. Clayton. 1997. Matriarchal genetic population structure of North American beluga whales *Delphinapterus leucas* (Cetacea: Monodontidae). Mol. Ecol. 6: 1033-1046.

Brown Gladden, J.G., M.M. Ferguson, M.K. Friesen and J.W. Clayton. 1999. Population structure of North American beluga whales (*Delphinapterus leucas*) based on nuclear DNA microsatellite variation and contrasted with the population structure revealed by mtDNA variation. Mol. Ecol. 8: 347-3 63.

Caron, L.M.J. and T.G. Smith. 1990. Philopatry and site tenacity of belugas, *Delphinapterus leucas*, hunted by the Inuit at the Nastapoka Estuary, eastern Hudson Bay. *In* Advances in research on the beluga whale, *Delphinapterus leucas*. *Edited by* T.G. Smith, D.J. St. Aubin and J.R. Geraci. Can. Bull. Fish. Aquat. Sci. 224. p. 69-79.

Cope, J.M. and A.E. Punt. 2009. Drawing the lines: resolving fishery management units with simple fisheries data. Can. J. Fish. Aquat. Sci. 66: 1256-1273.

de March, B.G.E. and L.D. Postma. 2003. Molecular genetic stock discrimination of belugas (*Delphinapterus leucas*) hunted in eastern Hudson Bay, Northern Quebec, Hudson Strait, and Sanikiluaq (Belcher Islands), Canada, and comparisons to adjacent populations. Arctic 56: 111-124.

de March, B.G.E. and G. Stern. 2003. Stock separation of narwhal (*Monodon monoceros*) in Canada based on organochlorine contaminants. DFO Can. Sci. Advis. Sec. Res. Doc. 2003/079. 16 p.

de March, B.G.E., L.D. Maiers and M.K. Friesen. 2002. An overview of genetic relationships of Canadian and adjacent populations of belugas (*Delphinapterus leucas*) with emphasis on Baffin Bay and Canadian eastern Arctic populations. NAMMCO Sci. Publ. 4: 17-38.

de March, B.G.E., D.A. Tenkula and L.D. Postma. 2003. Molecular genetics of narwhal (*Monodon monoceros*) from Canada and West Greenland (1982-2001). DFO Can. Sci. Advis. Sec. Res. Doc. 2003/080. 19 p.

de March, B.G.E., G. Stern. and S. Innes. 2004. The combined use of organochlorine contaminant profiles and molecular genetics for stock discrimination of white whales (*Delphinapterus leucas*) hunted in three communities on Southeast Baffin Island. J. Cetacean Res. Manage. 6: 241-250.

DFO. 2009. Stock assessment of Northern Quebec (Nunavik) Beluga (*Delphinapterus leucas)*. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/016. 12 p.

Dietz R., M.P. Heide-Jørgensen, P.R. Richard and M. Acquarone. 2001. Summer and fall movements of narwhals (*Monodon monoceros*) from northeastern Baffin Island towards northern Davis Strait. Arctic 54: 244-261.

Dietz, R., M.P. Heide-Jørgensen, P. Richard, J. Orr, K. Laidre and H.C. Schmidt. 2008. Movements of narwhals (*Monodon monoceros*) from Admiralty Inlet monitored by satellite telemetry. Polar Biology. DOI 10.1 007/s00300-008-0466-4.

Doan K.H. and C.W. Douglas. 1953. Beluga of the Churchill region of Hudson Bay. Bull. Fish. Res. Bd Can. 98: 1-27.

Doidge, D. 1990. Age-length and length-weight comparisons in the beluga, *Delphinapterus leucas*. *In* Advances in research on the beluga whale, *Delphinapterus leucas*. *Edited by* T. Smith, D. St. Aubin and J. Geraci. Can. Bull. Fish. Aquat. Sci. 224. p. 59-68.

Finley, K.J., G.W. Miller, M. Allard, R.A. Davis and C.R. Evans. 1982. The belugas (*Delphinapterus leucas*) of northern Quebec: Distribution, abundance, stock identity, catch history and management. Can. Tech. Rep. Fish. Aquat. Sci. 1123: 1-32.

Gonzalez, N. 2001. Inuit Traditional Ecological Knowledge of the Hudson Bay Narwhal (Tuugaalik) Population. Unpubl.Manusc. rep. prepared for Fisheries and Oceans Canada, Iqaluit, NU. 26 p.

Gosselin, J-F., V. Lesage and M. Hammill. 2009. Index estimates of abundance for beluga in eastern Hudson Bay, James Bay and Ungava Bay in summer 2008. DFO Can. Sci. Advis. Sec. Res. Doc.2009/006. 25 p.

Heide-Jørgensen, M.P. and J. Teilmann. 1994. Growth, reproduction, age structure and feeding habits of white whales (*Delphinapterus leucas*) in West Greenland waters. Meddr Grønland, Biosci. 39: 195-212.

Heide-Jørgensen, M.P., R. Dietz, K. Laidre and P. Richard. 2002. Autumn movements, home range and winter density of narwhals (*Monodon monoceros*) from Tremblay Sound, Baffin Island. Polar Biology 25: 331-341.

Heide-Jørgensen, M.P., P.R. Richard, R. Dietz, K.L. Laidre, J. Orr and H.C. Schmidt. 2003a. An estimate of the fraction of belugas (*Delphinapterus leucas*) in the Canadian high Arctic that winter in West Greenland. Polar Biol. 26: 318–326.

Heide-Jørgensen, M.P., R. Dietz, K.L. Laidre, P. Richard, J. Orr and H.C. Schmidt. 2003b. The migratory behaviour of narwhals (*Monodon monoceros*). Can J. Zool. 81: 1298-1305.

Heide-Jørgensen, M.P., R. Dietz, K.L. Laidre, P. Nicklen, E. Garde, P. Richard and J. Orr. 2008. Resighting of a narwhal (*Monodon monoceros*) instrumented with a satellite transmitter. Arctic 61: 395-398.

Helbig, R., P.T. Boag and B.N. White. 1990. Stock identification of beluga whales (*Delphinapterus leucas*) using mitochondrial DNA makers: preliminary results. Musk Ox 37: 122-128

JCNB. 2006. The Tenth Meeting of the Canada/Greenland Joint Commission on Conservation and Management of Narwhal and Beluga, Iqaluit, Nunavut, April 9-11, 2006. 83 p.

Jonkel, C.J. 1969. White whales wintering in James Bay. J. Fish. Res. Board Can. 26: 2205-2207.

Kilabuk, P. 1998. A Study of Inuit Knowledge of the Southeast Baffin Beluga. Nunavut Wildlife Management Board. vi + 74 p.

Kingsley, M.C.S. 2000. Numbers and distribution of beluga whales, *Delphinapterus leucas*, in James Bay, eastern Hudson Bay, and Ungava Bay in Canada during the summer of 1993. Fishery Bulletin 98:736-747.

Lewis, A.E., M.O. Hammill, M. Power, D.W. Doidge and V. Lesage. 2009. Movement and aggregation of Eastern Hudson Bay beluga whales (*Delphinapterus leucas*): a comparison of patterns found through satellite telemetry and Nunavik Traditional Ecological Knowledge. Arctic 62: 13:24.

Orr, J.R., D.J. St. Aubin, P.R. Richard and M.P. Heide-Jørgensen. 1998. Recapture of belugas, *Delphinapterus leucas*, tagged in the Canadian Arctic. Marine Mammal Science 14: 829-834.

Reeves, R.R and E. Mitchell. 1989. Status of white whales, *Delphinapterus leucas*, in Ungava Bay and Eastern Hudson Bay. Can. Field-Nat. 103: 220-239.

Remnant, R.A. and M.L. Thomas. 1992. Inuit traditional knowledge of the distribution and biology of High Arctic narwhal and beluga. Unpubl. rep. prep. by North/South Consultants Inc., Winnipeg, MB. 96 p.

Richard, P.R. and D.B. Stewart. 2009. Information Relevant to the Identification of Critical Habitat for Cumberland Sound Belugas (*Delphinapterus leucas*). DFO Can. Sci. Advis. Sec. Res. Doc. 2008/085. 28 p.

Richard, P.R., J.R. Orr and D.G. Barber. 1990. The distribution and abundance of belugas, *Delphinapterus leucas* , in eastern Canadian subarctic waters: a review and update. *In* Advances in research on the beluga whale, *Delphinapterus leucas*. *Edited by* T.G. Smith, D.J. St. Aubin and J.R. Geraci. Can. Bull. Fish. Aquat. Sci. 224. p. 23-38.

Richard, P.R., M.P. Heide-Jørgensen, J.R. Orr, R. Dietz and T.G. Smith. 2001a. Summer and autumn movements and habitat use of belugas around Somerset Island and adjacent waters. Arctic 54: 207-222.

Richard, P.R., A.R. Martin and J.R. Orr. 2001b. Summer and autumn movements of belugas of the Beaufort Sea Region. Arctic 54: 223-236.

Rosenberg, D.M. 2003. Mercury in beluga Whales in the Canadian Beaufort Sea: causes, consequences potential research. Fisheries Joint Management Committee Report 2003-2. v + 25 p.

Sergeant, D.E. 1973. Biology of white whales (*Delphinapterus leucas*) in western Hudson Bay. J. Fish. Res. Bd. Can. 30: 1065-1090.

Sergeant, D.E. and P.F. Brodie. 1969. Body size in white whales (*Delphinapterus leucas*). J. Fish. Res. Board Can. 26: 2561-2580.

Sergeant, D.E. and P.F. Brodie. 1975. Identity, abundance, and present status of populations of white whales, *Delphinapterus leucas*, in North America. J. Fish. Res. Board Can. 32: 1047–1054.

Smith, A. 2008. Beluga whale (*Delphinapterus leucas*) estuary use: a case study of the Nelson River estuary, Hudson Bay. M.Sc. Thesis, University of Manitoba.

Smith, T.G. and M.O. Hammill. 1986. Population estimates of white whales, *Delphinapterus leucas*, in James Bay, eastern Hudson Bay and Ungava Bay. Can. J. Fish. Aquat. Sci., 43: 1982-1987.

Smith, T.G. and A.R. Martin. 1994. Distribution and movements of belugas, *Delphinapterus leucas*, in the Canadian High Arctic. Can. J. Fish.Aquat. Sci. 51: 1653-1663.

Stewart, D.B, A. Akeeagok, R. Amarualik, S. Panipakutsuk and A. Taqtu. 1995. Local knowledge of beluga and narwhal from four communities in the Arctic. Can. Tech. Rep. Fish. Aquat. Sci. 2065. 48 p.

Stewart, R.E.A. 1994. Size-at-age relationships as discriminators of white whale (*Delphinapterus leucas*) stocks in the eastern Canadian Arctic. Meddr Grønland, Biosci. 39: 217-225.

Stewart, R.E.A. 2008. Redefining walrus stocks in Canada. Arctic 61: 292-308.

Strong, J.T. 1988. Status of the narwhal, *Monodon monoceros*, in Canada. Can. Field-Nat. 102: 391-398.

SWG-JCNB (Scientific Working Group of the Canada/Greenland Joint Commission on the Conservation and Management of Narwhal and Beluga). 2005. Report of the Joint Commission on the Conservation and Management of Narwhal and Beluga, Meeting of the Scientific Working Group, Nuuk, Greenland. October 2005.

Wagemann, R., R.E.A. Stewart, P. Béland and C. Desjardins. 1990. Heavy metals and selenium in tissues of beluga whale (*Delphinapterus leucas*) from the Canadian Arctic and the St. Lawrence Estuary. *In* Advances in research on beluga whale, *Delphinapterus leucas*. *Edited by* T.G. Smith, D.J. St. Aubin and J.R. Geraci. Can. Bull. Fish. Aquat. Sci. 224. 206 p. 191-206.

Waples, R.S. 1991. Pacific salmon, *Oncorhynchus* spp. and the definition of species under the Endangered Species Act. Mar. Fish. Rev. 53:11-22.

Westdal, K. 2008. Movement and diving of northern Hudson Bay narwhals (*Monodon monoceros*): relevance to stock assessment and hunt co-management. M.Env. Thesis. Department of Environment and Geography, University of Manitoba. 103 p.

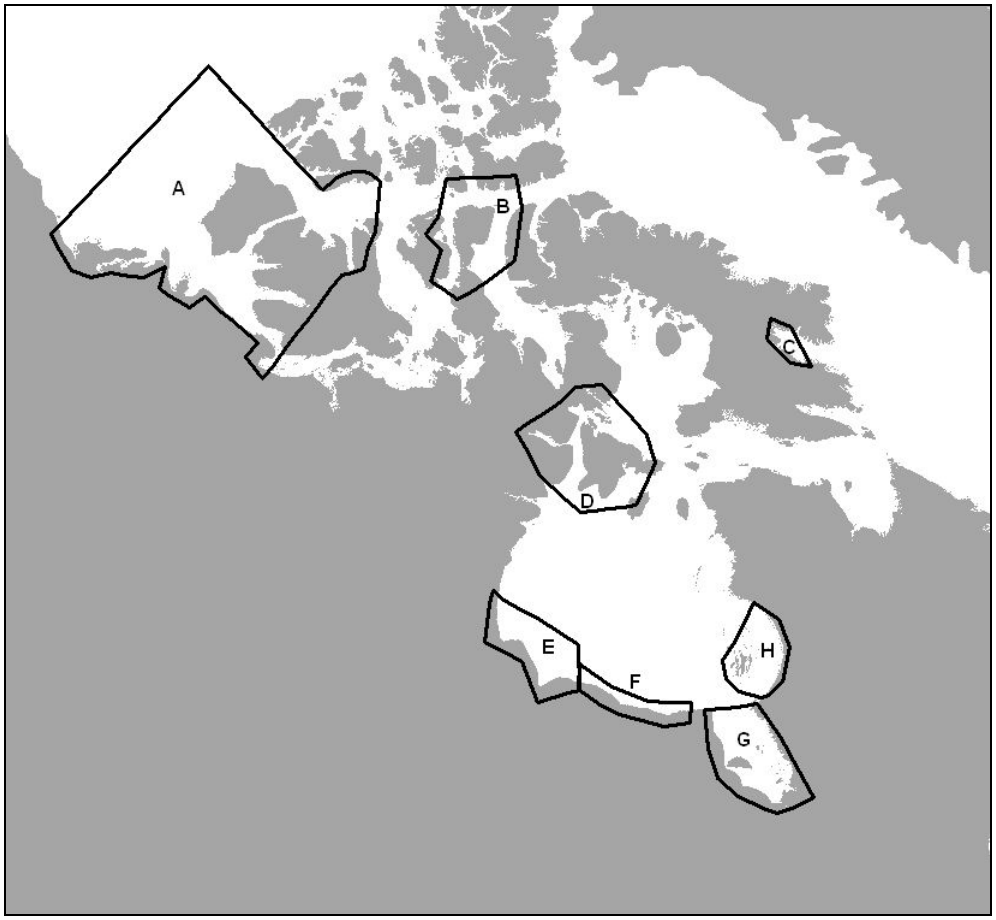

Fig. 1. Summer aggregation areas of Nunavut beluga whales (A: Eastern Beaufort Sea; B: Eastern High Arctic-Baffin Bay; C: Cumberland Sound; E-D-F: Western-Northern-Southern Hudson Bay (identified by COSEWIC as the Western Hudson Bay population); G: James Bay; H: Eastern Hudson Bay).

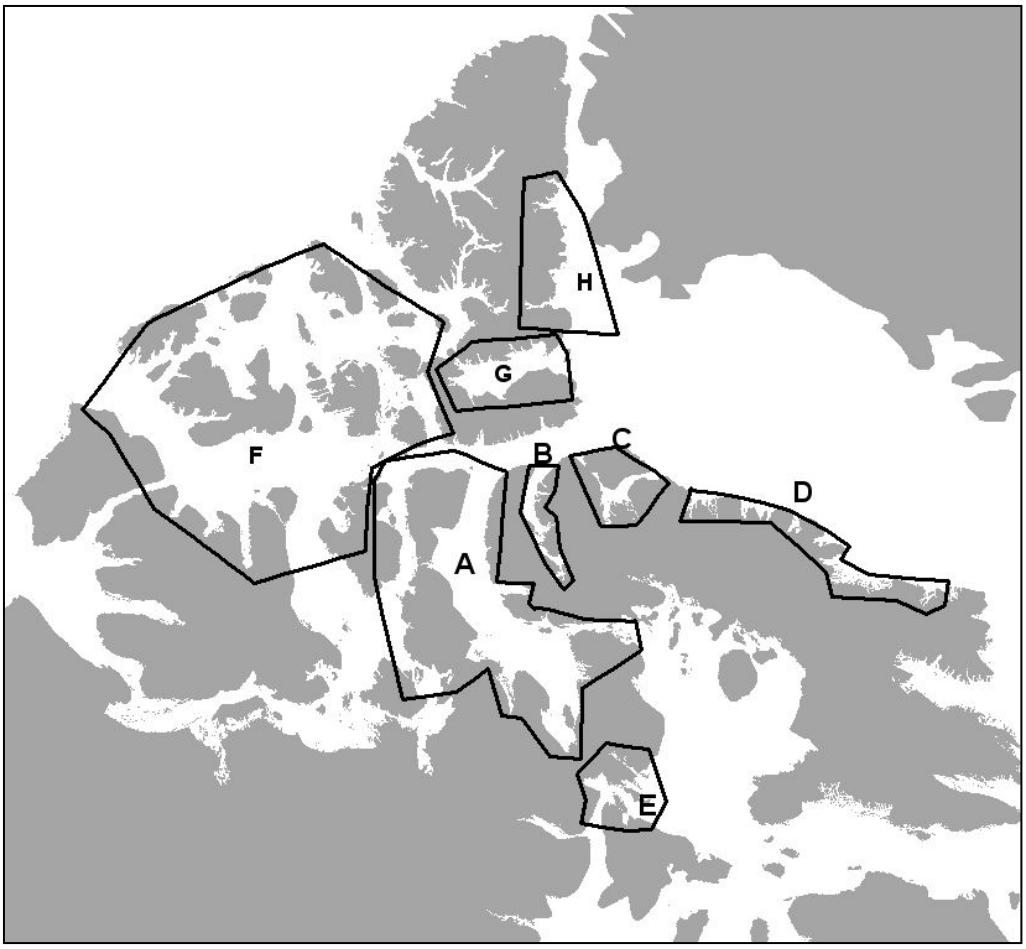

Fig. 2. Summer aggregation areas of Nunavut narwhals (A: Somerset Island; B: Admiralty Inlet; C: Eclipse Sound; D: East Baffin Island; E: Northern Hudson Bay; F: Parry Channel; G: Jones Sound; H: Smith Sound).

Appendix I: Information pertaining to stock definition of Nunavut beluga stocks

Western-Northern-Southern Hudson Bay Beluga stock (Identified by COSEWIC as Western Hudson Bay Beluga population)	
A) Seasonal range and aggregations based on local knowledge and reports	Repulse Bay, Churchill, Winisk, York Factory and Fort Severn residents report beluga occupying their area from May to September. Aggregation areas are in the estuaries of the Seal, Churchill, and Nelson rivers.
B) Appearance and behaviour	Belugas from Churchill and Arviat are on average smaller than the ones in Cumberland Sound, West Greenland, Somerset Island (Baffin Bay stock) and the Beaufort Sea but not different from those in Eastern Hudson Bay.
C) Genetics and contaminants	Churchill, Arviat, and Repulse Bay belugas differentiate genetically from those of Eastern Hudson Bay. Differences in concentrations of heavy metals were found between regions of the Arctic.
D) Seasonal range and aggregations based on tracking	Animals instrumented in July in the Churchill and Nelson river estuaries, MB, remained there at least until late-August or September. Tagged Nelson River estuary belugas migrated along the Kivalliq coast or offshore of islands along the Nunavik coast. All belugas tagged in WNS Hudson Bay wintered in Hudson Strait.
References	*A) Pers. comm. to author; Doan and Douglas 1953; Sergeant 1973; Richard et al. 1990; B) Sergeant and Brodie 1969, 1975; Doidge 1990; Stewart 1994; Heide-Jørgensen and Teilmann 1994; C) Brown Gladden et al. 1997, 1999; de March et al. 2002; de March and Postma 2003; Wagemann et al. 1990; Rosenberg 2003; D) Smith, 2008; P. Richard, DFO, unpubl. data.*
Eastern High Arctic - Baffin Bay Beluga stock	
A) Seasonal range and aggregations based on local knowledge and reports	Residents of Pond Inlet, Arctic Bay, Resolute Bay and Grise Fiord report spring movements west through Lancaster Sound, summer residence around Somerset Island and eastward return movement in the autumn. Belugas spend the winter in the North Water polynia of northern Baffin Bay.
B) Appearance and behaviour	Belugas from the High Arctic and west Greenland are on average larger than the ones in Hudson Bay.
C) Genetics and contaminants	Grise Fiord and West Greenland beluga mitochondrial DNA (mtDNA) samples differentiate genetically from those of Southeast Baffin Island. Differences in concentrations of heavy metals were found between regions of the Arctic.
D) Seasonal range and aggregations based on tracking	Animals tagged at the Cunningham Inlet and Elwin and Creswell bays were tracked into Peel Sound in late July – early August. They migrated east along the Devon Island coast in September and October. Many entered Jones Sound but wintered in the North Water polynia of northern Baffin Bay. A few moved to West Greenland for the winter. Two tagged belugas (one at Somerset Island in Aug.; on at Devon Island in Sept.) were resighted a year later near Somerset Island.

References	*A) Pers. comm. to author; Remnant and Thomas 1992; Stewart et al. 1995; B) Sergeant and Brodie 1969; Doidge 1990; Stewart 1994; Heide-Jørgensen and Teilmann 1994; C) de March et al. 2002; Wagemann et al. 1990; Rosenberg 2003; D) Smith and Martin 1994; Richard et al. 2001a; Heide-Jorgensen et al. 2003a; Orr et al. 1998.*
Cumberland Sound Beluga stock	
A) Seasonal range and aggregations based on local knowledge and reports	Residents of Pangnirtung report that belugas summer in and around Clearwater Fiord (Midlurialik) and range further into the west part of Cumberland Sound in autumn and spring. Belugas with distinct deformities have reportedly been seen for decades.
B) Appearance and behaviour	Pangnirtung hunters report that resident belugas are bigger in body size, have different maqtaq, and behave differently than other belugas sometimes found along the west coast of Cumberland Sound or at the flow edge in the spring.
C) Genetics and contaminants	Combined analysis of contaminants and genetics suggest that belugas hunted by Pangnirtung residents are not hunted in Iqaluit or Kimmirut. Differences in concentrations of heavy metals were found between regions of the Arctic.
D) Seasonal range and aggregations based on tracking	Belugas tagged near Clearwater Fiord followed similar patterns of seasonal movement to those described in (A). None left the Sound during the autumn. They wintered in a polynia at the northeast corner of the mouth of Cumberland Sound
References	*A) Pers. comm. to author; Kilabuk 1998 ; B) Pers. comm. to author; Kilabuk 1998; C) de March et al. 2004; Wagemann et al. 1990; Rosenberg 2003; D) Richard and Stewart 2009; P. Richard, DFO, unpubl. data.*
Eastern Beaufort Sea Beluga stock	
A) Seasonal range and aggregations based on local knowledge and reports	Kugluktuk hunters report occasional visits into Coronation Gulf from Dolphin and Union Strait by Eastern Beaufort Sea belugas.
B) Appearance and behaviour	
C) Genetics and contaminants	Eastern Beaufort Sea belugas show significant mtDNA genetic differences with belugas from Nunavut. Differences in concentrations of heavy metals were found between regions of the Arctic.
D) Seasonal range and aggregations based on tracking	Belugas of both sex tagged at the Mackenzie Delta in mid-July and early August, moved no further east than Amundsen Gulf or Viscount Melville Sound. In autumn, they migrated west into the Chukchi Sea, ending in the Bering Sea where they wintered.
References	*A) Lois Harwood, DFO Yellowknife, pers. comm.; C) Brown Gladden et al. 1997, 1999; Wagemann et al. 1990; Rosenberg 2003; D) Richard et al. 2001b; P. Richard, DFO, unpubl. Data.*

James Bay Beluga stock	
A) Seasonal range and aggregations based on local knowledge and reports	Belugas have been observed in James Bay in winter but they are seen by locals mainly in summer when they approach the coastline and enter river mouths.
B) Appearance and behaviour	
C) Genetics and contaminants	Preliminary results suggest that previously unknown genetic types occur in James Bay.
D) Seasonal range and aggregations based on tracking	Belugas tagged in summer in James Bay in both 2008 and 2009 have remained in the area well into December, showing no signs of migrating out of James Bay for the winter.
References	*A) Jonkel 1969; OMNR staff, pers. comm. to author; C) Lianne Postma, DFO, pers comm.; D) M. Hammill, DFO, pers. comm.*
Eastern Hudson Bay Beluga stock	
A) Seasonal range and aggregations based on local knowledge and reports	Nunavik hunters report that belugas in Hudson Strait in spring and early summer. Sanikiluaq hunters report that belugas usually arrive in late June, although some have occasionally been found in winter. In summer, hunters of both areas report that belugas are distributed throughout the Eastern Hudson Bay arc and around the Belcher Islands. Nunavik hunters observe belugas migrating east along the Nunavik Hudson Strait coast and into Ungava Bay in autumn.
B) Appearance and behaviour	Belugas from Eastern Hudson Bay are on average smaller than the ones in Cumberland Sound, West Greenland, Somerset Island (Baffin Bay stock) and the Beaufort Sea but not different from those in Western Hudson Bay.
C) Genetics and contaminants	Most belugas from Eastern Hudson Bay are differentiated genetically from belugas from all other stocks in Nunavut. They share genetic types with the St. Lawrence stock.
D) Seasonal range and aggregations based on tracking	Belugas tagged at the Little Whale and Nastapoka rivers remained in the Eastern Hudson Bay arc (including the Belcher Island waters) during summer. They migrated along the Nunavik coast to the Labrador Sea for the winter.
References	*A) Finley et al. 1982; Lewis et al. 2009; Pers. comm. to author; B) Doidge 1990; C) Brennin et al. 1997; Brown Gladden et al. 1997; de March and Postma 2003; D) Lewis et al. 2009; M. Hammill, DFO, pers. comm.*

Appendix II: Information pertaining to stock definition of Nunavut narwhal stocks

Somerset Island Narwhal stock	
A) Seasonal range and aggregations based on local knowledge and reports	Resolute hunters report seasonal occurrence of narwhals in Barrow Strait, Peel Sound and Prince Regent Inlet between spring and fall.
B) Appearance and behaviour	
C) Genetics and contaminants	Creswell Bay narwhal samples were genetically different from Repulse Bay and Pangnirtung samples.
D) Seasonal range and aggregations based on tracking	Animals tagged at Creswell Bay migrated through Lancaster Sound in October and November to reach mid-Baffin Bay for winter. Two returned to their Somerset Island summering area the following year. A third was resighted migrating through Lancaster Sound five years later.
References	*A) Pers. comm. to author; Remnant and Thomas 1992; C) de March et al. 2003; de March and Stern 2003; D) Heide-Jørgensen et al. 2003b, 2008.*
Admiralty Inlet Narwhal stock	
A) Seasonal range and aggregations based on local knowledge and reports	Arctic Bay hunters report seasonal occurrence of narwhals in or near Admiralty Inlet from May to December.
B) Appearance and behaviour	Some hunters reported observing two forms of narwhals: a larger one and a smaller one.
C) Genetics and contaminants	Arctic Bay narwhal samples were genetically different from Igloolik, Qikiqtarjuaq and Pangnirtung samples.
D) Seasonal range and aggregations based on tracking	Narwhals tagged in Admiralty Inlet migrated along Baffin Island to Davis Strait where they wintered. One returned to the mouth of Admiralty Inlet the following spring.
References	*A) Pers. comm. to author; Stewart et al. 1995; B) Remnant and Thomas 1992); C) de March et al. 2003; de March and Stern 2003; D) Dietz et al. 2008;*
Eclipse Sound Narwhal stock	
A) Seasonal range and aggregations based on local knowledge and reports	Pond Inlet hunters report seasonal occurrence of narwhals in or near Eclipse Sound area from spring to fall
B) Appearance and behaviour	Some hunters report differences in shape and colour of some narwhal observed.
C) Genetics and contaminants	
D) Seasonal range and aggregations based on tracking	Narwhals tagged in the Eclipse Sound area migrated along Baffin Island to Davis Strait where they wintered.
References	*A) personal communications to author; Remnant and Thomas 1992); B) Remnant and Thomas 1992; C) de March et al. 2003; D) Dietz et al. 2001; Heide-Jørgensen et al. 2002.*

East Baffin Island Narwhal stock	
A) Seasonal range and aggregations based on local knowledge and reports	Local hunters report seasonal occurrence of narwhals in East Baffin fiords and bays from spring to fall.
B) Appearance and behaviour	
C) Genetics and contaminants	Qikiqtarjuaq and Clyde River samples were genetically different from Repulse Bay, Arctic Bay, and Grise Fiord samples, and Qikiqtarjuaq samples from Pond Inlet samples. Contaminant differences were also found.
D) Seasonal range and aggregations based on tracking	N/A
References	*A) Pers. comm. to author; Remnant and Thomas 1992); B) Remnant and Thomas 1992; C) de March et al. 2003, de March and Stern 2003.*
Northern Hudson Bay Narwhal stock	
A) Seasonal range and aggregations based on local knowledge and reports	Local hunters report seasonal occurrence of narwhals in the Repulse Bay-Frozen Strait-Lyon Inlet area from spring to fall.
B) Appearance and behaviour	One hunter reported a larger darker form with a longer tusk than lighter-coloured narwhals but most hunters did not see noticeable differences.
C) Genetics and contaminants	Repulse Bay samples were genetically different from all the others. Contaminant samples were also different from narwhals from several other communities.
D) Seasonal range and aggregations based on tracking	Narwhals tagged in Lyon Inlet and Repulse Bay migrated through Foxe Channel and Hudson Strait in November and December to Davis Strait where they wintered. Two returned west through Hudson Strait the following spring.
References	*A) personal communications to author, Gonzalez 2001, Westdal 2008; B) Gonzalez 2001, C) de March et al. 2003; de March and Stern 2003; D) Westdal 2008.*

ARCTIC
VOL. 51, NO. 1 (MARCH 1998) P. 5–16

Fall Movements of Belugas *(Delphinapterus leucas)* with Satellite-linked Transmitters in Lancaster Sound, Jones Sound, and Northern Baffin Bay

P.R. RICHARD,[1] M.P. HEIDE-JØRGENSEN[2] and D. ST. AUBIN[3]

(*Received 25 September 1996; accepted in revised form 7 October 1997*)

ABSTRACT. Six adult belugas, *Delphinapterus leucas*, (2 males, 4 females) were instrumented with satellite-linked transmitters in Croker Bay, southeastern Devon Island in the Canadian High Arctic in mid-September 1995. Some days, the animals remained close to shore along the southeastern and eastern shoreline of Devon Island, presumably foraging for arctic cod *(Boreogadus saida)* and other prey. They spent the rest of the time in the deep waters of Lady Ann Strait, eastern Jones Sound, and the waters southeast of Coburg Island, presumably feeding on deepwater prey. Only males went farther north in waters off southeastern Ellesmere Island. The belugas' swimming speeds decreased in the later part of the study period. Their last transmissions came from the North Water, an area where belugas are known to winter. Results of this study were not sufficient to determine the extent of movement of belugas between the eastern Canadian Arctic and Greenland.

Key words: beluga, *Delphinapterus leucas*, High Arctic, North Water, satellite telemetry, swimming speed, fall migration

RÉSUMÉ. À la mi-septembre 1995, on a installé des émetteurs en liaison avec un satellite sur six bélugas adultes (*Delphinapterus leucas*) — 2 mâles, 4 femelles — dans la baie Croker, au sud-est de l'île Devon dans l'Extrême-Arctique canadien. Certains jours, les six bélugas se tenaient près des côtes sud-est et est de l'île Devon, probablement à la recherche de saidas (*Boreogadus saida*) ou d'autres proies. Ils ont passé le reste du temps dans les eaux profondes du détroit de Lady Ann, de l'est du détroit de Jones, et dans les eaux du sud-est de l'île Coburg, se nourrissant probablement de proies habitant les grands fonds. Seuls les mâles se sont rendus plus au nord dans les eaux au large du sud-est de l'île Ellesmere. La vitesse de nage des bélugas a diminué durant la dernière portion de l'étude. Les derniers signaux provenaient de l'Eau du Nord, une région où l'on sait que les bélugas passent l'hiver. Les résultats de cette étude sont insuffisants pour évaluer l'ampleur des déplacements de bélugas entre l'est de l'Arctique canadien et le Groenland.

Mots clés: béluga, *Delphinapterus leucas*, Extrême-Arctique, télémesure par satellite, vitesse de nage, migration automnale

INTRODUCTION

Thousands of belugas *(Delphinapterus leucas)* spend July and August in the waters surrounding Somerset Island in the central Canadian Arctic (Koski and Davis, 1980; Smith and Martin, 1994). They later migrate eastward along the southern shore of Devon Island and north along its eastern shore during September (Fig. 1). Large numbers of belugas are also observed migrating south along the northwestern coast of Greenland, appearing first in the northernmost district (Avanersuaq) in September. Shortly after, in early October, they are usually seen farther south, in the district of Upernavik (Heide-Jørgensen, 1994). Some belugas are also known to winter in the North Water (northwest Baffin Bay and Smith Sound), but the large majority of Canadian Arctic belugas are thought to winter in West Greenland near Disko Bay (Doidge and Finley, 1993). The number of belugas wintering in West Greenland has declined in the last two decades (Heide-Jørgensen et al., 1993; Heide-Jørgensen and Reeves, 1996).

Belugas from Grise Fiord (Canadian High Arctic) and central West Greenland attain similar size at physical maturity (Heide-Jørgensen and Teilmann, 1994; Stewart, 1994). The absence of morphological differences, however, does not prove conclusively that the two samples belong to the same stock. Satellite tracking of the movements of individuals can offer direct evidence of beluga stock relationships. The movements of belugas during summer and the early part of their fall migration in Barrow Strait and Lancaster Sound have been described by Smith and Martin (1994), who attached satellite-linked tags to 23 belugas. However, they were unable to determine whether those belugas moved between Canadian and West Greenland waters because the transmitters, which had been attached to the whales in summer, ceased transmitting in early autumn.

[1] Department of Fisheries and Oceans, Central and Arctic Region, Arctic Research Division, 501 University Crescent, Winnipeg, Manitoba R3T 2N6, Canada; richardp@dfo-mpo.gc.ca
[2] Greenland Institute of Natural Resources, c/o National Environmental Research Institute, Tagensvej 135, DK-2200, Copenhagen N, Denmark
[3] Mystic Marinelife Aquarium, 55 Coogan Blvd., Mystic, Connecticut 06355-1997, U.S.A.
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This study was designed to test the hypothesis that animals tagged along the Devon Island coast in September would cross to Greenland and to gather data on their migration routes. Also, information on the horizontal and vertical movements of tagged belugas during the fall would contribute to our understanding of beluga ecology. Finally, beluga numbers are usually estimated by aerial surveys, which can count only animals at or near the surface. Because of the need to determine how many diving belugas may have been missed during surveys, measures of the proportion of time belugas spent near the surface and at depth would also help with the interpretation of survey results.

In this paper on six belugas tagged at Croker Bay, Devon Island, in September 1995, we give details of their movements, swimming speeds, and habitat use in relation to ice and depth over the following nine weeks. Other papers in this issue describe the dive activity of the same animals (Heide-Jørgensen et al., 1998) and the results of a winter aerial survey of the North Water beluga population (Richard et al., 1998).

MATERIALS AND METHODS

Study Area

The study area included Croker Bay, Devon Island, eastern Lancaster Sound, eastern Jones Sound, and northwestern Baffin Bay north to Smith Bay, southeastern Ellesmere Island (Fig. 1). The waters in these areas are largely over 200 m deep. A deep trough, with depths over 400 m, runs along the east coast of Devon Island and then north and west into Jones Sound, where depths of more than 800 m occur in some parts. Waters along southeastern Ellesmere Island and east and southeast of Coburg Island are somewhat shallower, varying between 100 and 400 m in depth. Ice conditions in late September vary from year to year. Median ice cover calculated between 1959 and 1974 is medium (2/10 to 5/10) for Jones Sound and open water for the rest of the study area (Markham, 1981). The median time at which ice cover reaches 9/10 (i.e., winter ice) over the whole area is mid-October. By 21 September 1995, most of the study area had between 6/10 and 9/10 ice cover, and by 5 October, most of the area had 9/10 ice cover, including considerable multiyear ice (Weekly Composite Ice Charts, Canadian Ice Service, Environment Canada, 1995).

Aerial reconnaissance along the southeastern Devon Island coast on 10 and 11 September 1995 revealed that belugas were abundant in Croker Bay (Fig. 1) and that ice and weather conditions were suitable for a live capture operation. Croker Bay, a fjord approximately 40 km long and 15 km wide, varies in depth from 100 m to 400 m at its centre. It is forked at the northern end and has two active glaciers calving icebergs. A camp was set at the southeastern corner of the bay (approx. 74˚33′N 82˚55′W).

Live-capture and Tagging Methods

From our capture camp, we observed belugas generally moving southeastward along the shore and out of the bay, in groups of one to several hundred. We captured six of those belugas (2 males, 4 females) between 12 and 16 September 1995 by immobilizing them along the shore using a 1.2 m diameter hoop with a 1.4 m pursing net. While we attempted to take animals from different pods, it is possible that some belonged to the same pod, since we observed tagged animals returning into the bay hours after being released. The four captured females were accompanied by large calves, presumed to be 1–3 years old because they were grey-coloured and approximately two-thirds to three-quarters the size of the adult females (Caron and Smith, 1990; Doidge, 1990).

Blood for hematological and plasma chemical analysis, skin samples for genetic analysis, and blubber for contaminant analysis were taken from each beluga. Each was then equipped with a satellite-linked time-depth recorder (SLTDR) or "tag" (Table 1), and identification bands (Orr and Hiatt-Saif, 1992) were put on both flippers. After a 40–55 minute handling period, the animals were released. The accompanying calves stayed around the capture site during these procedures and swam away with the females upon their release. On two occasions during the period we spent in Croker Bay, a tagged beluga was resighted in groups of belugas that included calves, its behaviour apparently unaffected by the live capture or the tag. This also indicates that the belugas' movements were not all southeasterly in direction, and that some pods reentered Croker Bay after having passed our camp.

The tags, model SDR-T6, were manufactured by Wildlife Computers Ltd. (Redmond, Washington). They contained a transmitter (model ST-6, Telonics, Mesa, Arizona), a pressure transducer, and a microprocessor, cast in epoxy. The transmitters were glued into a flexible rubber saddle (Ureol® polyurethane) 5 mm thick designed by the Greenland Institute of Natural Resources (Fig. 2). The transmitter housings measured 17.3 × 9.7 × 2.8 cm and the saddle-mounts 22 × 22 × 6 cm. The entire package weighed about 1 kg in air. The tags were attached to the belugas by three 8 mm polyethylene surgical pins (PEHD 1000) through the dorsal ridge. The animals showed no visible reaction to the surgical procedure. The saddles were secured to the pins and held in place with washers. The ends of the pins were melted to prevent the bolts from being torn off.

Each unit had a power output of 0.5 watts and was powered by four lithium C cells (3.5V), which were capable of 54 000 transmissions at 0˚C. None of the transmitters were set on a duty cycle, and the only battery-saving features were a daily maximum of 1000 transmissions and a saltwater switch, which prevented transmissions after the switch was wet for more than 0.1 s. The minimum time between transmissions was 45 s. Each transmission contained 8 to 12 bytes of data in addition to its identifier number. Following every 15 transmissions, a status message relayed information about the total number of transmissions and the voltage of batteries. Data from the

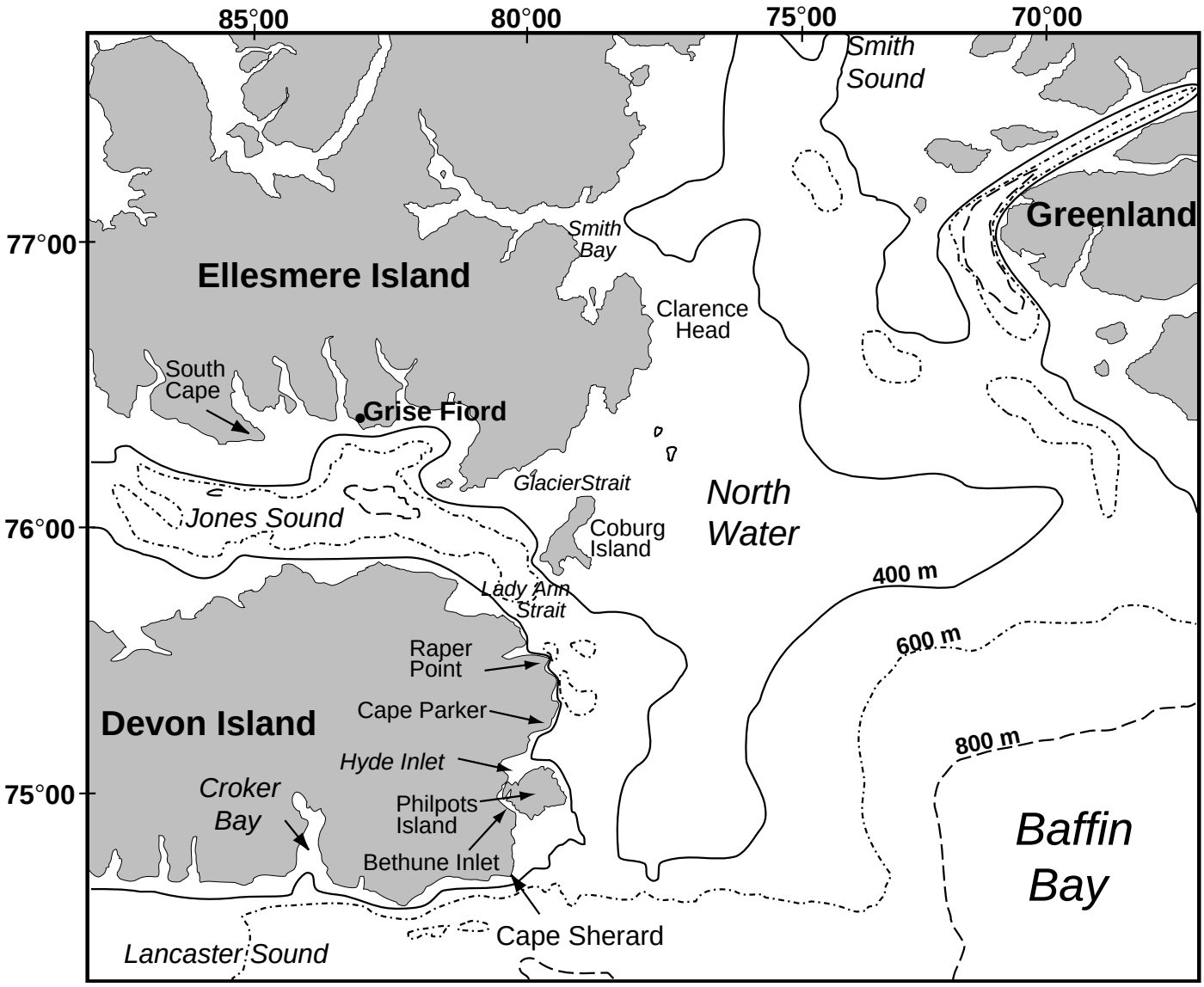


FIG. 1. Study area, with place names and bathymetric contours.

TABLE 1. Description of the belugas captured and duration of their tags' signals and locations. Quality locations (indices 1–3) are in error by 1 km or less.

Tag #	Sex	Length (cm)	Date of capture	Date of last location	Number of signals sent	Days till last signal	Days till last quality location
20688	M	465	14 Sept 95	16 Oct 95	18 350	37	33
20689	F	404	14 Sept 95	16 Oct 95	21 583	48	33
20690	F	368	12 Sept 95	17 Oct 95	21 200	37	34
20694	F	372	15 Sept 95	29 Oct 95	17 695	47	45
20695	F	392	16 Sept 95	4 Nov 95	26 089	52	50
20696	M	408	17 Sept 95	10 Nov 95	25 666	60	55

transmitters were received via the ARGOS Data Collection and Location System (DCLS) (ARGOS, 1988).

Analytical Methods

When sufficient numbers of signals were received during a satellite pass, the ARGOS DCLS estimated the position of the tag and assessed the quality of that estimate. We used only good-quality locations (quality indices of 1–3) with predicted errors less than or equal to 1 km. Location and movement tracks were plotted on polar azimuthal base maps. Distances were calculated using great circle arcs on a spherical model of the globe 6371.11 km in diameter (Maling, 1989, 1993).

Swimming speed was estimated using the great circle distance and the elapsed time between consecutive locations. Two sources of bias affect the estimation of swimming

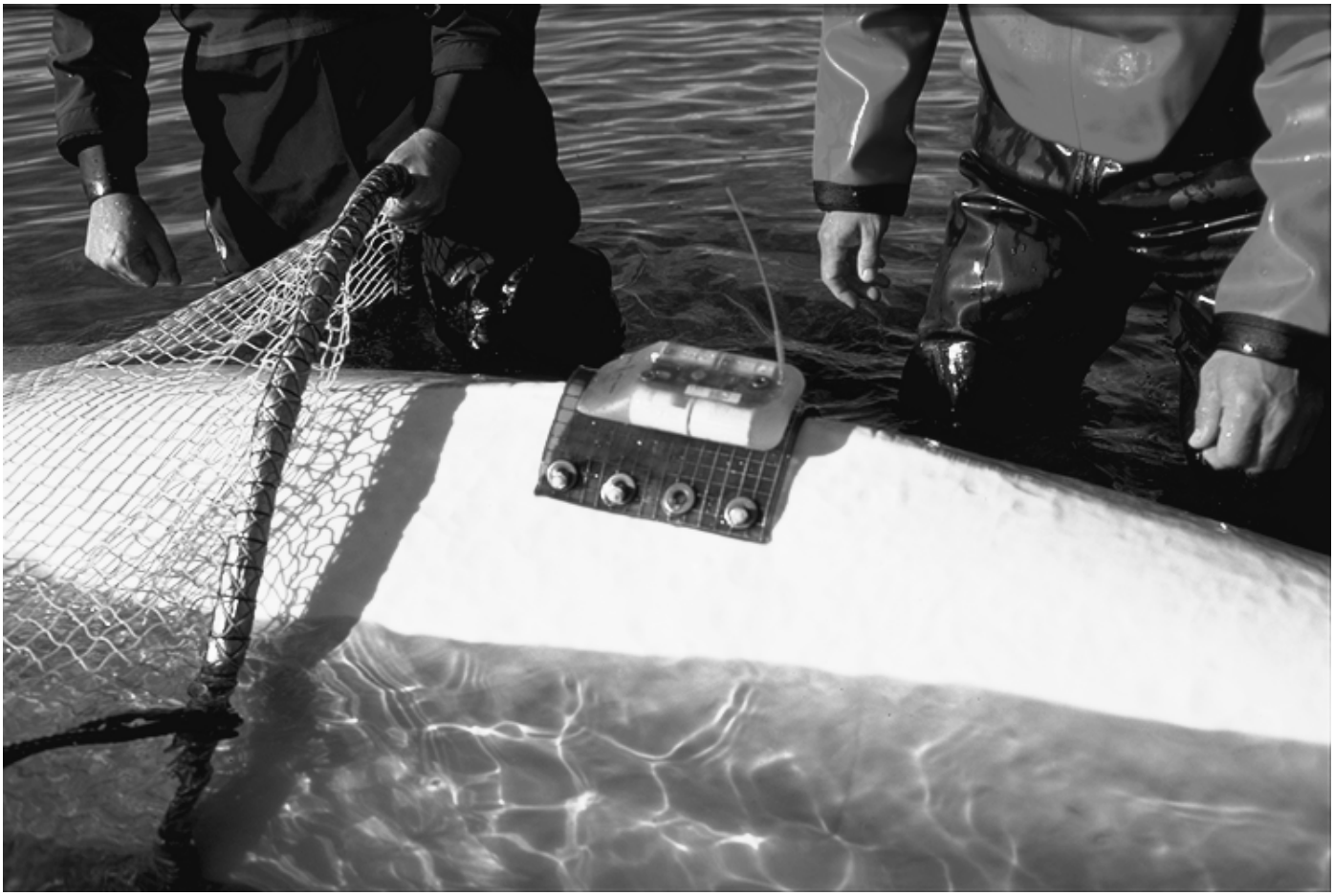


FIG. 2. Beluga equipped with a SLTDR tag pinned through the dorsal ridge. To the left is a hoop net used for live captures. (Photo: A. Rosing-Asvid)

speeds: a) for short time intervals (less than 0.5 hr), swimming speed estimates can be strongly biased downward or upward by errors in location; b) for intervals greater than 2 hr, estimates of swimming speed are biased downward when movements are not straight lines between the locations used to calculate travel distance. To reduce these biases, we calculated swimming speeds only for intervals between locations that were more than half an hour and less than two hours apart.

RESULTS

Tag Performance

The six tags transmitted for 37–60 days, sending between 17 695 and 26 089 signals (or "uplinks") to the satellites (Table 1). These signals produced good-quality locations (quality indices ≥ 1) for 33–55 days. The number of good quality locations varied among tags (Table 2) and declined with time in all six whales, resulting in fewer locations towards the end. Size or sex of the tagged animals did not appear to have influenced the longevity of transmissions since the two biggest animals, both males, had one of the longest and the shortest number of days of transmission (Table 1).

TABLE 2. Proportion of the quality 1–3 locations obtained from each tag.

		Locations			
Tag #	Total	Quality 1	Quality 2	Quality 3	Poor quality
20688 M	554	26.0%	14.6%	6.0%	53.4%
20689 F	567	18.0%	11.3%	4.8%	65.9%
20690 F	626	25.6%	15.5%	5.8%	53.1%
20694 F	526	18.3%	11.4%	3.2%	67.1%
20695 F	972	27.2%	16.7%	4.9%	51.2%
20696 M	1038	21.8%	10.2%	4.9%	63.1%

Distribution and Movements

All but one animal left Croker Bay and traveled east within a day of their release (Fig. 3). Female 20694 remained in Croker Bay for five days after release before heading east. Once out of Croker Bay, they all traveled close to shore along the southern and eastern coasts of Devon Island, reaching Hyde Inlet northwest of Philpots Island or Lady Ann Strait, eastern Jones Sound, and waters to the south of Coburg Island. All six animals entered Jones Sound and spent some time there. The two males went as far north as waters east of Clarence Head or Smith Bay, Ellesmere Island, while the four females remained south of Glacier Strait (Fig. 3).

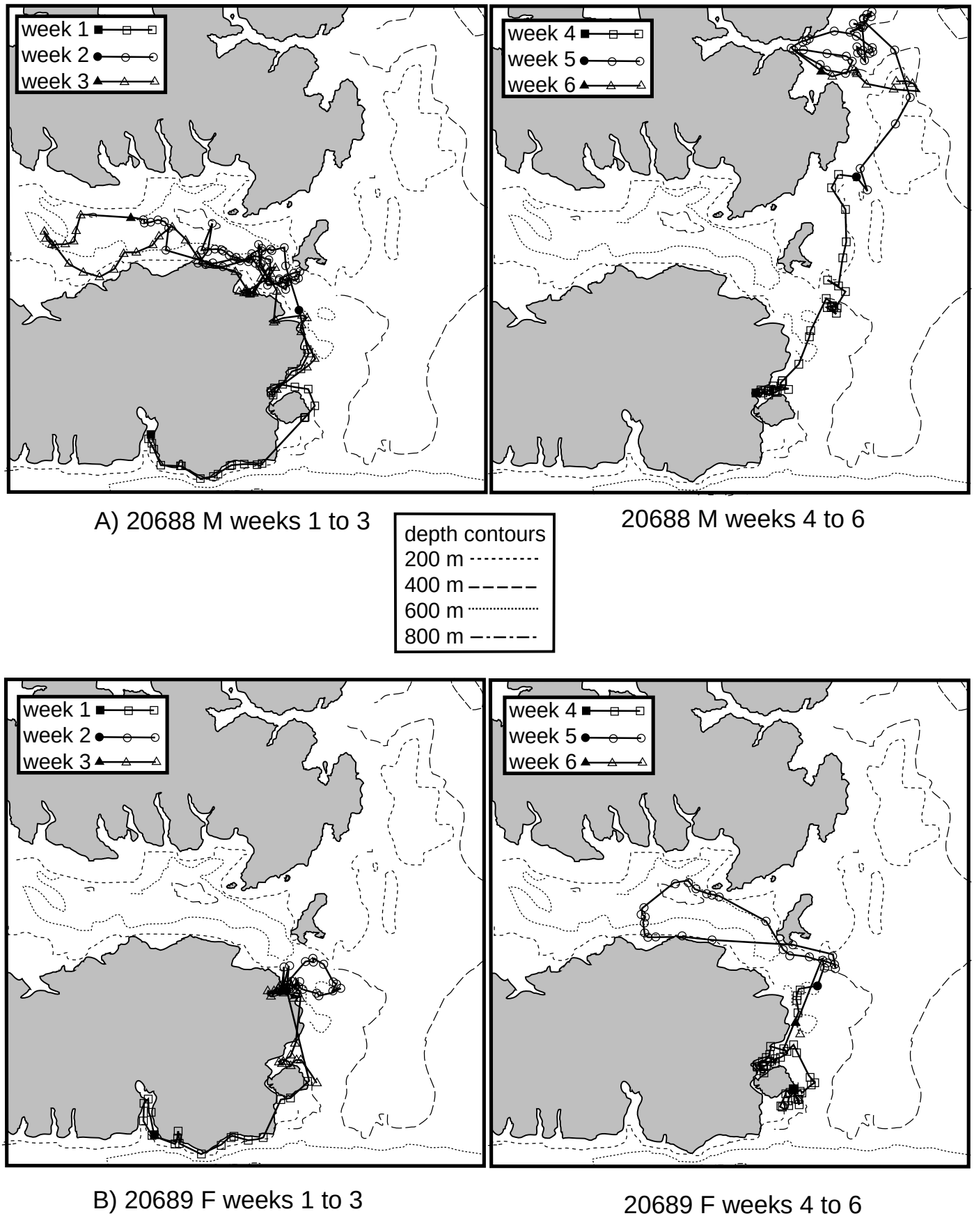
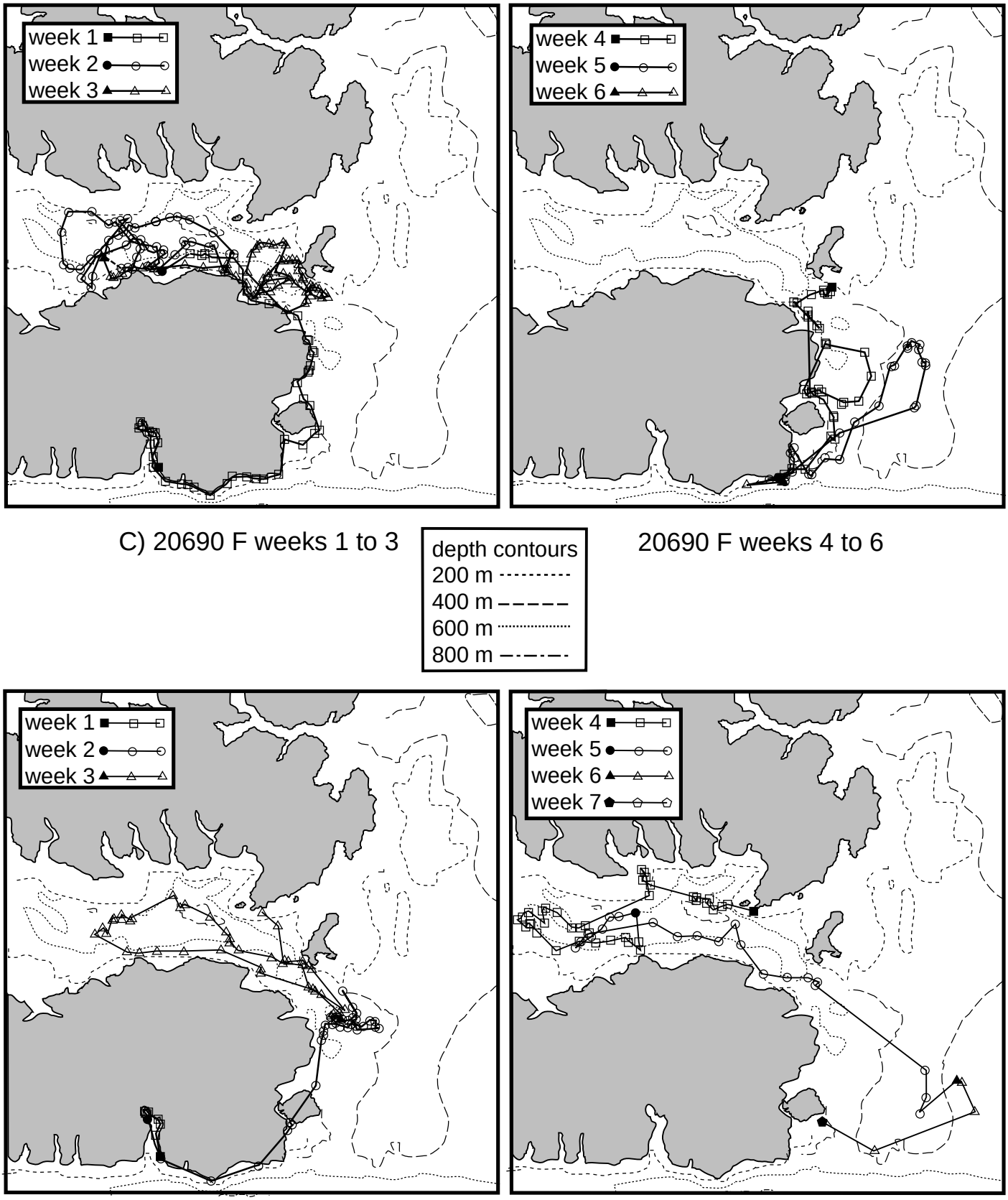


FIG. 3a and b. Weekly movements of the six tagged belugas, September to November 1995. The movement of each beluga is shown in two panels. Locations are plotted by calendar weeks (Sun-Sat). A different symbol is used to represent each calendar week. The first location in a calendar week is represented by a solid symbol; the remainder, by open symbols. Week 1 starts on 10 September 1995 and week 9 ends on 11 November.



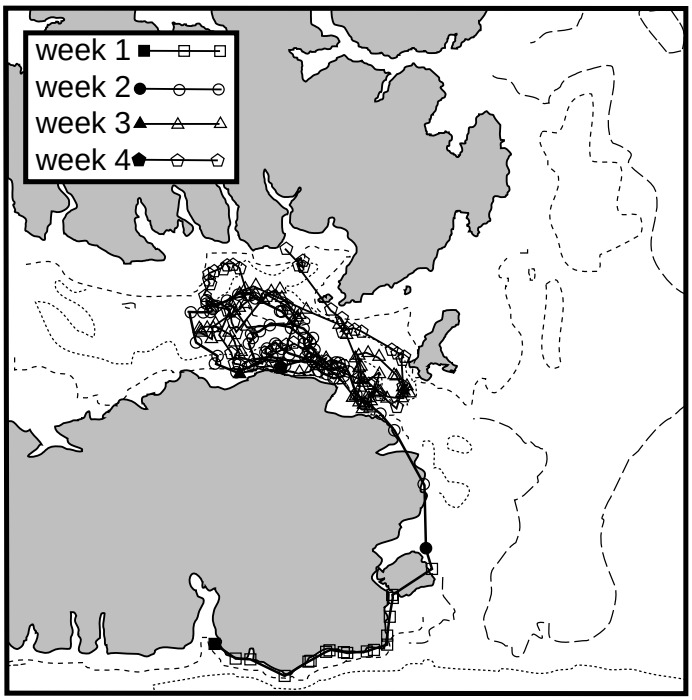
C) 20690 F weeks 1 to 3

20690 F weeks 4 to 6

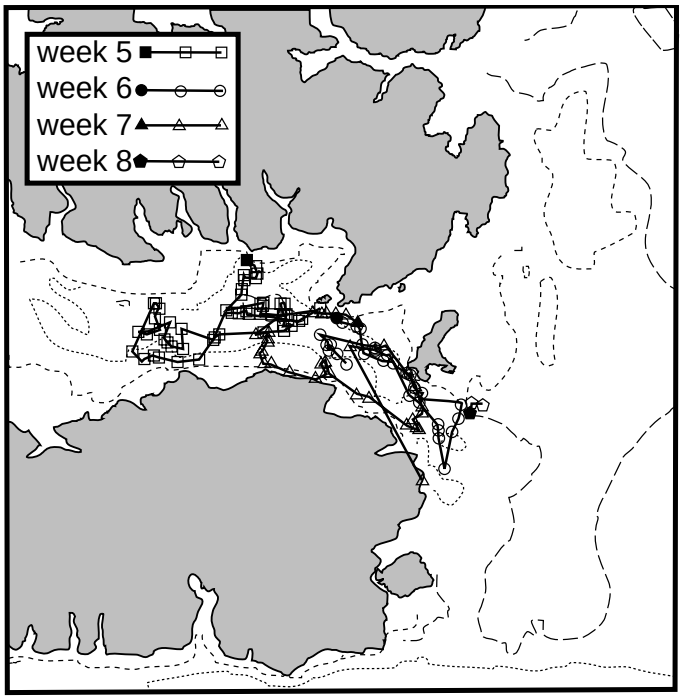
D) 20694 F weeks 1 to 3

20694 F weeks 4 to 7

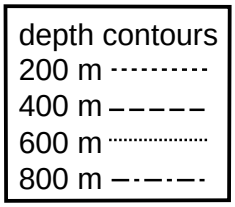
FIG. 3c and d. Weekly movements of the six tagged belugas, September to November 1995. The movement of each beluga is shown in two panels. Locations are plotted by calendar weeks (Sun-Sat). A different symbol is used to represent each calendar week. The first location in a calendar week is represented by a solid symbol; the remainder, by open symbols. Week 1 starts on 10 September 1995 and week 9 ends on 11 November.

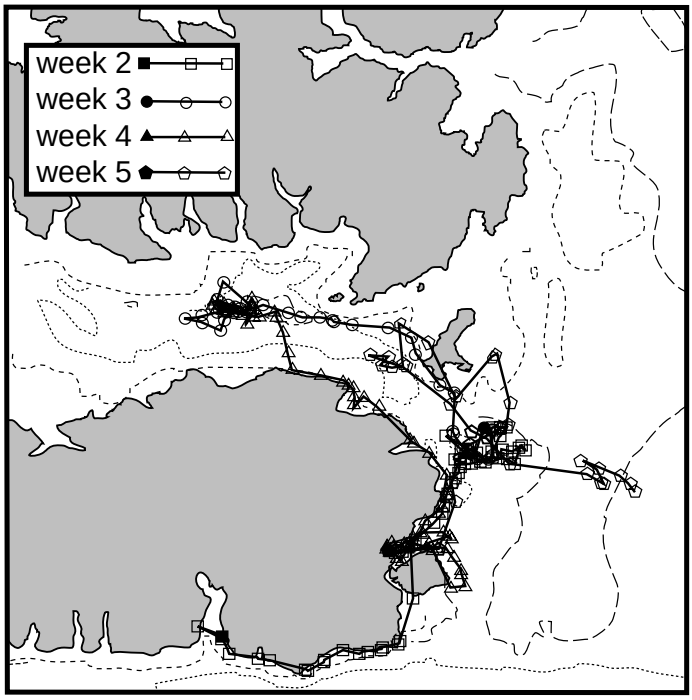


E) 20695 F weeks 1 to 4

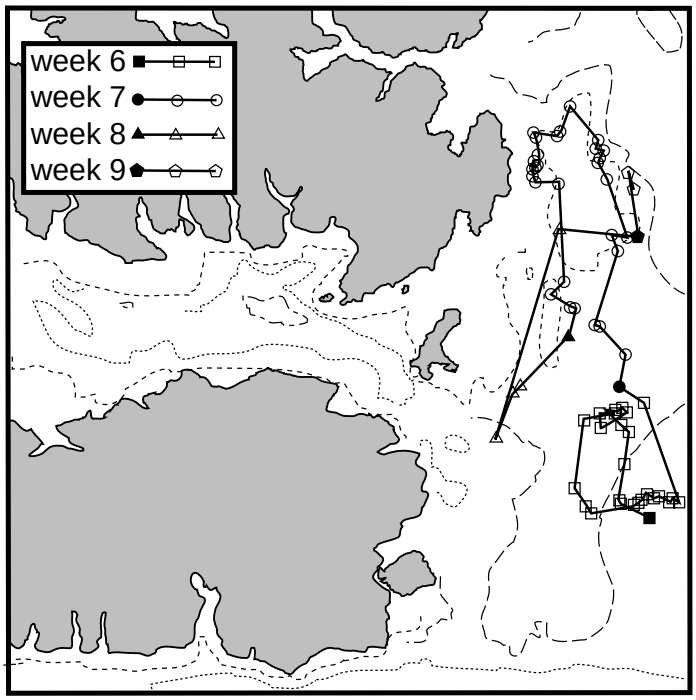


20695 F weeks 5 to 8





F) 20696 M weeks 2 to 5



20696 M weeks 6 to 9

FIG. 3e and f. Weekly movements of the six tagged belugas, September to November 1995. The movement of each beluga is shown in two panels. Locations are plotted by calendar weeks (Sun-Sat). A different symbol is used to represent each calendar week. The first location in a calendar week is represented by a solid symbol; the remainder, by open symbols. Week 1 starts on 10 September 1995 and week 9 ends on 11 November.

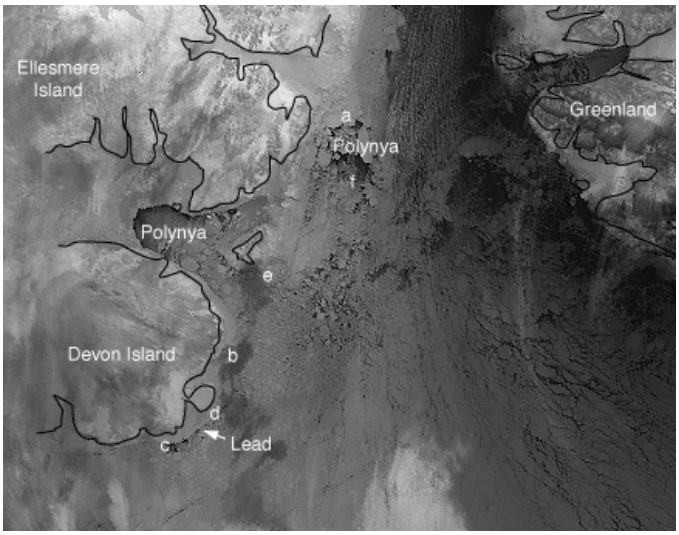


FIG. 4. NOAA satellite infrared image of the study area showing leads and polynyas of the North Water on 7 November 1995 (Source: Atmospheric Environment Service). Letters indicate the last recorded position of each animal: a) 20688M, b) 20689F, c) 20690F, d) 20694F, e) 20695F, f) 20696M.

Three areas were used by all six animals in the course of their movements: the southeastern shoreline of Devon Island, which all animals followed closely on their way east and north, and which was revisited by female 20690 in October; Lady Ann Strait and Jones Sound; and the waters southeast of Coburg Island. Two additional areas were used by some of the animals: Hyde Inlet, used by both males and female 20689; and the waters adjacent to Clarence Head, Ellesmere Island, used by both males.

Ice cover in the study area was greater than the median ice cover normally found at that time of year (Markham, 1981), and a lot of multiyear ice was mixed with newly formed ice. The tagged belugas traveled through ice cover varying between 2/10 and 9/10. Prior to ice consolidation (>9/10) in Jones Sound in early October, the whales moved to waters off eastern Devon Island, Coburg Island, and southeastern Ellesmere Island, where they could find ice leads and polynyas (Fig. 4).

None of the tagged belugas left Canadian waters during the period when the tags were operating, despite the fact that for all six whales transmissions lasted at least until mid-October, by which time belugas are typically seen migrating south along the West Greenland coast. Final recorded locations for all six whales came from the area of recurring winter leads and polynyas known as the North Water (Fig. 4).

Swimming Speeds

In most cases, estimated swimming speeds ranged from under 1 km/h to about 10 km/hr (Fig. 5). A few speeds (n = 7) were estimated at between 11 and 27.5 km/h. The mean swimming speeds of all animals combined decreased significantly from week to week (ANOVA $p = 0.002$). Four of the six animals (20688M, 20690F, 20695F, 20696M) showed a decline in weekly mean swimming speed over their period of transmission (Table 3). No swimming speeds greater than 6.3 km/h were recorded after October 15.

There was a significant interaction ($p = 0.0001$) in the ANOVA model between individual beluga and time (week) because two animals (20689F, 20694F) differed from the rest. Female 20689's weekly mean speeds showed no trend, and female 20694 stayed in Croker Bay during her first week, with resultant low swimming speeds. Her swimming speed increased in week 2 during her migration along the coast of Devon Island and declined thereafter in weeks 3 and 4 (Table 3). The sample size for 20694 was too small in weeks 5 and 6 to allow useful comparisons.

DISCUSSION

Soon after release, all but one of the tagged belugas moved to the eastern side of Devon Island, staying close to shore while migrating (Fig. 3). They occupied several bays of eastern Devon Island, such as Croker Bay, Bethune Inlet, Hyde Inlet, and unnamed bays opposite Lady Ann Strait, and later returned to these coastal areas after visiting Jones Sound. This coastal distribution pattern had previously been described by Koski and Davis (1979, 1980), who reported observing herds of hundreds and, in some cases, thousands of belugas along those shorelines and inside those bays. The fall concentrations of belugas in coastal areas of Devon Island may be related to the presence of arctic cod (*Boreogadus saida*), an important prey of belugas that occurs in large schools near shores in the Canadian High Arctic (Bradstreet et al., 1986). When discovered, such schools attract intense predation from birds and marine mammals, including belugas (Welch et al., 1993).

In deep fjords like Croker Bay, belugas may be foraging on other prey. Between 14 and 16 September, we observed hundreds of narwhals *(Monodon monoceros)* moving into Croker Bay. It is possible that both narwhals and belugas are attracted to Croker Bay by the same prey species. In addition to *Boreogadus saida*, narwhals are known to feed on Greenland halibut *(Reinhardtius hippoglossoides)* and on squid *(Gonatus fabricii)* in fjords of the Pond Inlet area (Finley and Gibb, 1982) and in Inglefield Bay, Greenland (Heide-Jørgensen et al., 1994).

All six tagged belugas spent between two and five weeks moving about eastern Jones Sound, Lady Ann Strait, and over the deep gully southeast of Coburg Island. The time-depth information shows that, while in those areas, the whales often dove to depths of 400–800 m or more, probably close to the seabed (Heide-Jørgensen et al., 1998). During those dives, it is probable that they were foraging for Greenland halibut, which usually occur at depths greater than 450 m (Scott and Scott, 1988). Greenland halibut remains have been observed by Grise Fiord hunters in ringed seal (*Phoca hispida*) holes and in the stomachs of hooded seals (*Cystophora cristata*) captured in Jones Sound (S. Akeeagok, Grise Fiord, pers. comm. 1995). Other potential deepwater prey are the squid (*Gonatus fabricii*) and the octopus (*Bathypolypus arcticus*).

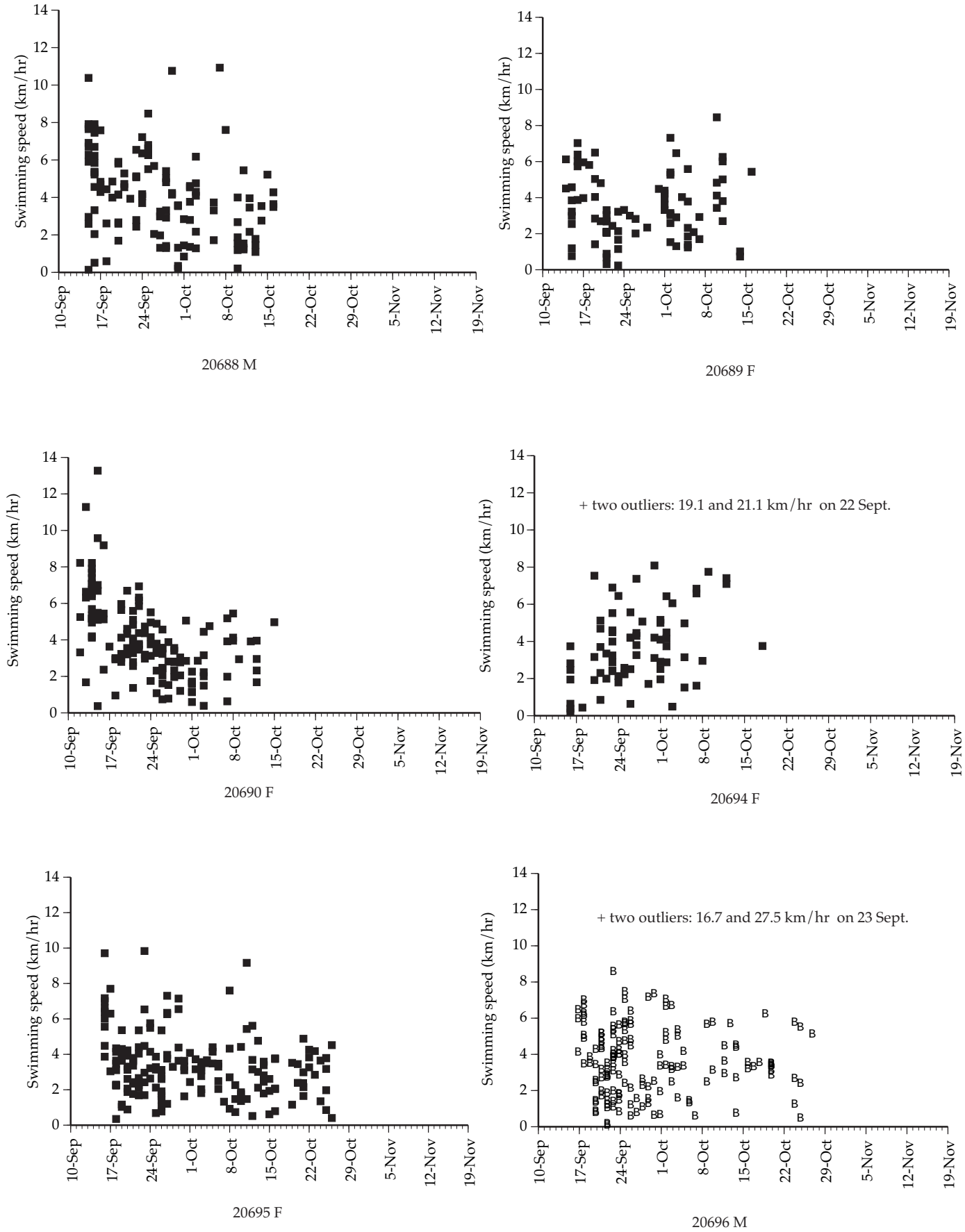


FIG. 5. Swimming speeds of tagged belugas over time.

TABLE 3. Mean weekly swimming speeds (km/h) of tagged belugas. Values are the mean, CV%, and (number of samples).

Beluga	WEEK							
	1 Sept 10–16	2 Sept 17–23	3 Sept 24–30	4 Oct 1–7	5 Oct 8–14	6 Oct 15–21	7 Oct 22–28	All weeks
M 20688 465 cm	5.3 47% (28)	4.9 34% (27)	2.9 53% (29)	4.6 65% (10)	2.7 55% (21)			4.1 21% (115)
F 20689 404 cm	4.4 42% (17)	2.5 56% (27)	3.7 39% (16)	2.9 57% (13)	4.3 51% (12)			3.4 20% (85)
F 20690 368 cm	5.6 42% (38)	4.0 33% (46)	2.4 45% (33)	3.1 52% (15)	3.3 37% (6)			4.0 17% (138)
F 20694 372 cm	1.6 85% (8)	4.7 102% (26)	4.1 41% (26)	4.2 61% (10)	7.3 3% (2)	3.8 0% (1)		4.1 39% (73)
F 20695 392 cm	4.7 48% (21)	3.4 49% (47)	3.5 53% (29)	3.0 49% (23)	3.0 62% (27)	3.1 34% (14)	2.6 57% (9)	3.4 14% (170)
M 20696 408 cm	5.7 20% (11)	4.0 94% (67)	3.5 65% (29)	3.4 52% (15)	3.8 36% (12)	3.7 27% (9)	3.4 64% (7)	3.9 24% (150)

All six tagged belugas left Jones Sound before week 6 (15–21 October), avoiding entrapment in the consolidating pack ice. Consolidated pack ice can form over all of Jones Sound as early as mid-October (Markham, 1981), and there are reports of past ice entrapments of belugas in Jones Sound which have resulted in mortality (Freeman, 1968; S. Akeeagok, Grise Fiord, pers. comm. 1995).

The six tagged belugas remained in the waters east of Ellesmere, Coburg, and Devon Islands until their tags stopped transmitting. This area, known as the North Water (Smith and Rigby, 1981), has recurring leads and polynyas throughout winter where belugas are known to occur (Finley and Renaud, 1980; Richard et al., 1998). Therefore, in late October and November, the distribution of belugas was probably determined by the availability of open leads or cracks in the pack ice, as observed during winter aerial surveys of the North Water (Finley and Renaud, 1980; Richard et al., 1998). Both males traveled farther north along and off Clarence Head. This segregation between males and females could be due to the fact that all four females had calves with them and may have been less inclined than males to venture away from the predictable open leads off eastern Devon Island (Fig. 4).

Although we tracked animals only into October–November, we think that the tagged animals remained in the North Water for the winter, for two reasons. First, they stayed there well beyond the time when belugas are normally observed migrating along the West Greenland coast (Heide-Jørgensen, 1994; M.P. Heide-Jørgensen and A. Rosing-Asvid, Greenland Institute of Natural Resources, Copenhagen and Nuuk, unpubl. data). Second, the reduction in swimming speeds in October noted above and the decline in surface times and dive rates reported by Heide-Jørgensen et al. (1998) are what we expected to observe from belugas settling into their wintering area. Another possibility is that the belugas migrated to Greenland later in the winter, at a time when belugas would go unnoticed by residents of northern West Greenland because of the darkness and heavy ice.

The timing of our live captures could have influenced the results if belugas that migrate to Greenland move along the southern coast of Devon Island earlier than those that winter in the North Water. We had timed our captures for early to mid-September to match the timing of migration of Somerset Island belugas in Lancaster Sound reported by other authors (Koski and Davis, 1979, 1980; Smith and Martin, 1994). However, two weeks before our expedition, on 28 August 1995, a pod of belugas was seen in Jones Sound by Grise Fiord residents, (D. Akeeagok, Grise Fiord, pers. comm. 1995). Also, during the 10–11 September flights over Croker Bay (i.e., 3–4 days before we captured our first beluga there), we observed several thousand belugas in the bay. Therefore, the animals we sampled may not have been representative of all migrants. Thus our relatively small sample, which may have included some animals belonging to the same pods, is of limited value for describing the migratory behaviour of Baffin Bay belugas in the fall. There is a need to tag more animals to answer the question about movements to Greenland.

None of the beluga tags reached their full potential of 54000 transmissions at 0˚C (Wildlife Computers, 1994). Furthermore, the diagnostics sent by the tags gave no indications that a drop in battery voltage was responsible for the cessation of transmissions. Therefore, we assume that transmissions ended because of tag loss. The longevity of our tags (mean number of days between first and last position = 42, Table 1) is comparable with longevity in other satellite-tagging projects on monodontids. For example, backpack transmitters of the same design put on five narwhals by Dietz and Heide-Jørgensen (1995) gave positions between 2 and 41 days (mean = 25 days). Tags with a different design used in the Beaufort Sea by Richard et al. (1997) gave positions between 7 and 91 days (mean = 41 days).

The declining trend in good-quality locations in our tags may not be the result of deteriorating tag performance, since the power diagnostic data sent by the tags did not show a sufficient decline in power output. This decline in locations could be due in part to the seasonal trend in the belugas' activity and in part to the progressive detachment of the tags, which would affect antenna orientation. In October and November, the average time belugas spent at the surface was about half as much as in September (Heide-Jørgensen et al., 1998). Signal interference by ice could also be a contributing factor.

ACKNOWLEDGEMENTS

We are most grateful to Sylvain de Guise of l'Université du Québec à Montréal for his veterinary and live capture expertise. We thank Aqqalu Rosing-Asvid for his enthusiastic help in the field and his excellent photographs. Clyde Kalluk of Resolute was an excellent boatman and field assistant. We are indebted to Eric Doig of Renewable Resources, G.N.W.T., the Polar Continental Shelf Project, First Air, Jack Orr, and Patt Hall (DFO) for their logistic support. Ron Goodson of Atmospheric Environment Service provided support in obtaining NOAA imagery. We thank the Resolute and Grise Fiord Hunters and Trappers Committees for their support and interest. We thank Holly Cleator, Lloyd Lowry, and two anonymous reviewers for their review of earlier drafts. Jack Orr drafted all the figures. The Greenland Institute of Natural Resources, the Commission for Scientific Research in Greenland, the Nunavut Wildlife Management Board, the Sea Research Foundation, and the Department of Fisheries and Oceans funded this project. This is Contribution No. 107 from the Sea Research Foundation.

REFERENCES

ARGOS. 1988. Users' manual, Version 1. Toulouse, France: CLS ARGOS.

BRADSTREET, M.S.W., FINLEY, K.J., SEKERAK, A.D., GRIFFITHS, W.B., EVANS, C.R., FABIJAN, M.F., and STALLARD, H.E. 1986. Aspects of the biology of arctic cod (*Boreogadus saida*) and its importance in arctic marine food chains. Canadian Technical Report of Fisheries and Aquatic Sciences 1491. 193 p.

CARON, L.M.J., and SMITH, T.G. 1990. Philopatry and site tenacity of belugas, *Delphinapterus leucas*, hunted by the Inuit at the Nastapoka estuary, eastern Hudson Bay. In: Smith, T.G., St. Aubin, D.J., and Geraci, J.R., eds. Advances in research on the beluga whale, *Delphinapterus leucas*. Canadian Bulletin of Fisheries and Aquatic Sciences 224. 69–79.

DIETZ, R., and HEIDE-JØRGENSEN, M.P. 1995. Movements and swimming speed of narwhals, *Monodon monoceros*, equipped with satellite transmitters in Melville Bay, northwest Greenland. Canadian Journal of Zoology 73:2106–2119.

DOIDGE, D.W. 1990. Age-length and length-weight comparisons in the beluga, *Delphinapterus leucas*. In: Smith, T.G., St. Aubin, D.J., and Geraci, J.R., eds. Advances in research on the beluga whale, *Delphinapterus leucas*. Canadian Bulletin of Fisheries and Aquatic Sciences 224. 59–68.

DOIDGE, D.W., and FINLEY, K.J. 1993. Status of the Baffin Bay population of beluga, *Delphinapterus leucas*. Canadian Field-Naturalist 107:533–546.

FINLEY, K.J., and GIBB, E.J. 1982. Summer diet of the narwhal (*Monodon monoceros*) in Pond Inlet, northern Baffin Island. Canadian Journal of Zoology 60:3353–3363.

FINLEY, K.J., and RENAUD, W.E. 1980. Marine mammals inhabiting the Baffin Bay North Water in winter. Arctic 33: 724–738.

FREEMAN, M.M.R. 1968. Winter observations on beluga (*Delphinapterus leucas*) in Jones Sound, N.W.T. Canadian Field-Naturalist 82(4):276–286.

HEIDE-JØRGENSEN, M.P. 1994. Distribution, exploitation and population status of white whales (*Delphinapterus leucas*) and narwhals (*Monodon monoceros*) in West Greenland. Meddelelser om Grønland, Bioscience 39. 135–149.

HEIDE-JØRGENSEN, M.P., and REEVES, R.R. 1996. Evidence of a decline in beluga, *Delphinapterus leucas*, abundance off West Greenland. ICES Journal of Marine Science 53:61–72.

HEIDE-JØRGENSEN, M.P., and TEILMANN, J. 1994. Growth, reproduction, age structure and feeding habits of white whales (*Delphinapterus leucas*) in West Greenland waters. Meddelelser om Grønland, Bioscience 39. 195–212.

HEIDE-JØRGENSEN, M.P., LASSEN, H., and TEILMANN, J. 1993. An index of the relative abundance of wintering belugas, *Delphinapterus leucas*, and narwhals, *Monodon monoceros*, off West Greenland. Canadian Journal of Fisheries and Aquatic Science 50:2323–2335.

HEIDE-JØRGENSEN, M.P., DIETZ, R., and LEATHERWOOD, S. 1994. A note on the diet of narwhals (*Monodon monoceros*) in Inglefield Bredning (NW Greenland). Meddelelser om Grønland, Bioscience 39. 213–216.

HEIDE-JØRGENSEN, M.P., RICHARD, P.R., and ROSING-ASVID, A. 1998. Dive patterns of belugas (*Delphinapterus leucas*) in waters near eastern Devon Island. Arctic 51:17–26.

KOSKI, W.R., and DAVIS, R.A. 1979. Distribution of marine mammals in NW Baffin Bay and adjacent waters, May-October 1978. Report prepared by LGL Ltd., Toronto, for Petro-Canada Explorations Ltd., Calgary. 305 p.

———. 1980. Studies of the late summer distribution and fall migration of marine mammals in NW Baffin Bay and E Lancaster Sound, 1979. Report prepared by LGL Ltd., Toronto, for Petro-Canada Explorations Ltd., Calgary. 239 p.

MALING, D.H. 1989. Measuring from maps: Principles and methods of cartometry. Oxford: Pergamon Press. 577 p.

———. 1993. Coordinate systems and map projections. 2nd ed. Oxford: Pergamon Press. 476 p.

MARKHAM, W.E. 1981. Ice atlas: Canadian Arctic waterways. Atmospheric Environment Service, Environment Canada. 198 p.

ORR, J.R., and HIATT-SAIF, M. 1992. A flipper band for individual identification of beluga whales (*Delphinapterus leucas*). Canadian Technical Report of Fisheries and Aquatic Science 1856. 9 p.

RICHARD, P.R., MARTIN, A.R., and ORR, J.R. 1997. Study of summer and fall movements and dive behaviour of Beaufort Sea belugas, using satellite telemetry: 1992–1995. Environmental Studies Research Funds Report 134. 38 p.

RICHARD, P.R., ORR, J.R., DIETZ, R., and DUECK, L. 1998. Sightings of belugas and other marine mammals in the North Water, late March 1993. Arctic 51:1–4.

SCOTT, W.B., and SCOTT, M.G. 1988. Atlantic fishes of Canada. Canadian Bulletin of Fisheries and Aquatic Sciences 219. 731 p.

SMITH, M., and RIGBY, B. 1981. Distribution of polynyas in the Canadian Arctic. In: Stirling, I., and H. Cleator, eds. Polynyas in the Canadian Arctic. Canadian Wildlife Occasional Paper 45. 7–28.

SMITH, T.G., and MARTIN, A.R. 1994. Distribution and movements of belugas, *Delphinapterus leucas*, in the Canadian High Arctic. Canadian Journal of Fisheries and Aquatic Science 51:1653–1663.

STEWART, R.E.A. 1994. Size-at-age relationships as discriminators of white whale (*Delphinapterus leucas*) stocks in the eastern Canadian Arctic. Meddelelser om Grønland, Bioscience 39. 217–226.

WELCH, H.E., CRAWFORD, R.E., and HOP, H. 1993. Occurrence of arctic cod (*Boreogadus saida*) schools and their vulnerability to predation in the Canadian High Arctic. Arctic 46:331–339.

WILDLIFE COMPUTERS. 1994. Satellite-linked time depth recorder V. 3.11: Instruction manual. Redmond, Washington: Wildlife Computers. 80 p.

Shell Kanumas A/S

Environmental Impact Assessment

2012 Anu-Napu 3D Seismic Survey in Baffin Bay Blocks 5 and 8

Shell Kanumas A/S
Operator

15 March 2012

Shell Kanumas A/S

Environmental Impact Assessment

2012 Anu-Napu 3D Seismic Survey in Baffin Bay Blocks 5 and 8, 2012

Shell Kanumas A/S has contracted Grontmij A/S in association with LGL Ltd. to conduct the Environmental Impact Assessment for 2012 Anu-Napu 3D Seismic Survey in Baffin Bay Blocks 5 and 8, 2012

Report prepared by

LGL Ltd., environmental research associates
22 Fisher Street, P.O. Box 280, King City,
Ontario, Canada L7B 1A6, vmoulton@lgl.com

in association with

Grontmij A/S
Granskoven 8, 2600 Glostrup
Denmark, rikke.carlsen@grontmij.dk

15 March 2012

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NON-TECHNICAL SUMMARY

This section provides a non-technical summary of the Environmental Impact Assessment (EIA) for Shell's proposed 3-D (three-dimensional) seismic survey offshore northwest Greenland in July to October 2012. The summary provides an overview of the regulatory requirements, a description of the Project, an overview of the environmental setting, the methods used to assess impacts, proposed mitigation measures, predicted impacts of seismic noise and other Project activities, and it identifies data gaps and uncertainties.

1.1 Regulatory, Policy and Administrative Framework

The EIA was prepared to meet appropriate Greenlandic legislation and regulatory requirements, incorporate relevant international standards, and integrate Shell's policies. Key guidance documents used to prepare this EIA include:

- Bureau of Minerals and Petroleum (BMP) Guidelines for application, execution, and reporting of offshore hydrocarbon exploration activities (excluding drilling) in Greenland, December 2011 (BMP 2011).
- Guidelines to environmental impact assessment of seismic activities in Greenland waters, 3rd revised edition, December 2011 (Kyhn et al. 2011).

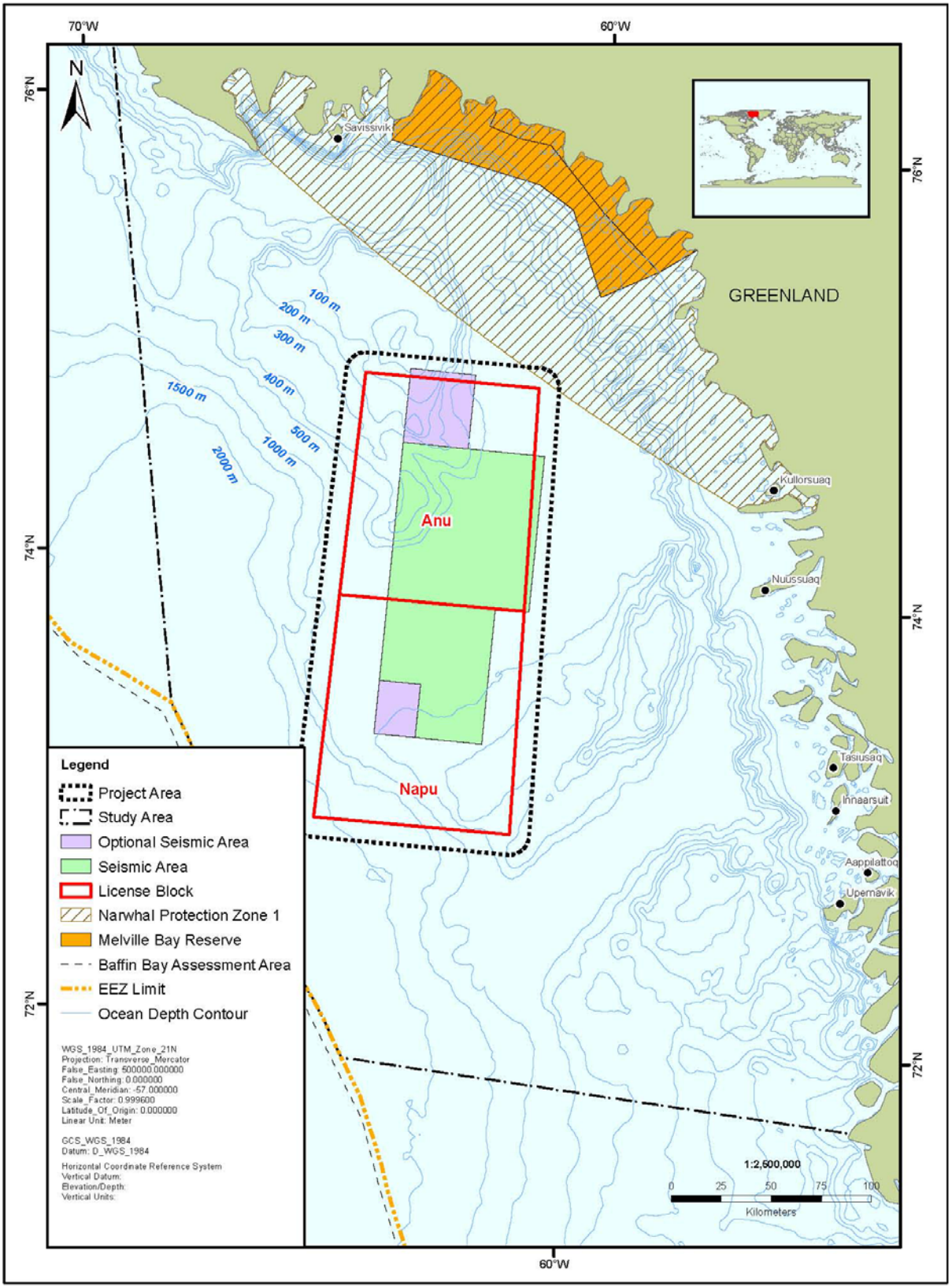
As required in the BMP Guidelines, Best Available Technology (BAT) and Best Environmental Practice (BEP; e.g., NORSOK, OSPAR, and MARPOL) were considered and incorporated into the Project where possible. Shell's Health, Safety, Security, Environment, and Social Performance Control Framework and Corporate Standards are incorporated into the Project and the EIA.

1.2 Project Description

Shell Kanumas A/S (Shell), acting as Operator on behalf of other oil and gas companies (Nunaoil, GDF SUEZ, and Statoil), is proposing to conduct a 3-D seismic survey program in the Anu (Block 5) and Napu (Block 8) licenses (see Figure 1-1). The objective of the survey is to obtain 3-D seismic data to identify potential targets for exploration drilling. The seismic survey is proposed to occur from mid July to mid October 2012. Water depths in the Seismic Area range from about 150 m to 700 m.

Two seismic ships (M/V *Polarcus Samur* and M/V *Polarcus Amani*) will be used to collect the data. Each ship will tow behind it two airgun arrays (each with a total volume of 4240 in^3) that will be activated in an alternating or "flip-flop" arrangement. The airguns emit short pulses of intense sound that are directed downward into the seafloor and the sound that echoes back is recorded on hydrophones located in streamers towed behind the seismic ships. Each ship will tow six 7-km long streamers spaced 200 m apart. The two seismic vessels will be supported by four chase vessels (typically two per seismic vessel), whose main task is ice management, and one supply vessel. The seismic vessels will maintain (as much as possible) a separation distance of at least 30 km when collecting seismic data. Each seismic vessel will have a total of about 50 crew members. The crew on the support vessels will be about 8–10 per vessel.

Shell proposes to collect seismic data along 118 survey lines (spaced 600 m apart and oriented in a north-south direction). The average length of each survey line is 120 km, which will require 15 h of surveying to complete; it will take the vessels 3.5–4 h to turn around to start the next survey line.



GSI B.V. - THE HAGUE **Author: Mark Fitzgerald** **Date: 03/14/2012** **Draw. No: 1**	**Shell Baffin Bay 3D Seismic** **Location of the proposed Shell Baffin Bay 3D seismic program in 2012, including Project Area, Study Area and Seismic Areas.**	**FIGURE No.** **1-1**

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1.3 Environmental Setting

The EIA provides a general overview of the baseline conditions in and near the area where Shell proposes to collect seismic data. The Strategic Environmental Impact Assessment (SEIA) prepared for the Baffin Bay assessment area by the Danish Centre for Environment and Energy (DCE; Boertmann and Mosbech 2011) was a key source of information. Emphasis in Shell's EIA was placed on the biological and socioeconomic components that could be affected by Project activities. Information on fish, invertebrates, seabirds, marine mammals, commercial fisheries, subsistence fisheries and subsistence hunting was reviewed. As part of the review, the conservation status of species occurring in and near the Project Area as assessed in Greenland (Red List) and internationally was determined. Baseline conditions were reviewed, particularly the distribution and abundance of species and their activities (i.e., breeding, migrating, feeding) in and near the proposed Seismic Area.

The SEIA identified bowhead whales, narwhals, beluga whales, and walruses as the most sensitive species to seismic noise. The occurrence of bowheads, belugas, and walruses do not generally overlap with the period when Shell is proposing to conduct the seismic survey—the exception are belugas that migrate in October (and November) in coastal waters shoreward of the Seismic Area. Of most relevance to this EIA are narwhals that summer primarily in coastal waters of Melville Bay and which are considered *Critically Endangered* on the Greenland Red List. The Melville Bay population is estimated at about 6000 narwhals but this estimate is thought to be low. Narwhals migrate south to a deep basin of Baffin Bay from mid October to mid December, depending on the year; they feed there during the winter. A Narwhal Protection Zone (NPZ I) has been established in Melville Bay that restricts seismic surveys from 1 June to 15 October. Shell's primary Seismic Area is more than 30 km from this protection zone.

1.4 Impact Assessment Methods

The methods used to assess the impacts of the Project were based in part on those used in the SEIA prepared by the DCE (Boertmann and Mosbech 2011). Key aspects of the environment, typically called Valued Ecosystem Components (VECs) in EIAs, were selected for assessment including several marine mammals (narwhal, beluga whale, bowhead whale, walrus, ringed seal, bearded seal, and polar bear), seabirds, fish and invertebrates as well as their eggs and larvae. Commercial fisheries (mostly Greenland halibut and shrimp), subsistence fisheries, and the marine mammal subsistence hunt were considered VECs as well.

The primary aspect of the proposed activity causing concern is the underwater noise created by the airgun arrays and the impacts that such noise could have on narwhals and other marine mammals, including belugas. To understand the effect of this noise, Shell conducted acoustic modelling of the airgun array to estimate how far and at what sound levels this noise will travel. This information along with previous studies of how VECs respond to noise, allowed for predictions of whether the Project could have negligible, minor, moderate, or major impacts (magnitude); the size or spatial extent (km^2) of the impact; and how long an impact could occur (duration). Each impact prediction is accompanied by a level of confidence. Measures were identified to reduce or mitigate these impacts. All of these factors were used to assess whether the proposed Project could significantly affect a VEC. In this EIA, a significant impact is defined as having a major magnitude of any duration or spatial extent; or having a moderate magnitude for a duration of greater than one year and over a spatial extent greater than 100 km^2. The magnitude of impacts can be rated as:

Major:
An impact on a VEC is rated major if it is judged to result in a 10%, or greater, change in the size or health of a population or the carrying capacity of its habitat, or affect the subsistence resource to an extent that is not socially tolerated. A change in a population can result from an absolute reduction in population size or from displacement of animals to areas outside the area of consideration.

Moderate:
An impact on a VEC is rated moderate if it is judged to result in a 1–10% change in the size or health of a population or the carrying capacity of its habitat, or noticeably affect the subsistence resource involved; impacts would be socially tolerated.

Minor:
An impact on a VEC is rated minor if it is judged to result in a <1% change in the size or health of the population or the carrying capacity of its habitat, or only slightly affect the subsistence resource involved.

Negligible:
Negligible impacts would result in no to very minimal impacts to a VEC.

1.5 Summary of Potential Impacts and Mitigation Measures

The main Project activity of concern is the underwater noise emitted by the airgun arrays and this was the focus of the EIA for each VEC. Particular emphasis was given to narwhals as well as belugas and ringed seals, and the impacts of noise on their hearing and behaviour. Other Project activities like routine discharges of grey water (showers, wash water) and black water (treated sewage), and the physical presence of vessels were also assessed but are not included in this non-technical summary because impacts were considered negligible.

1.5.1 Mitigation Measures

As required by BMP an Environmental Management Plan was prepared that includes the monitoring and mitigation measures planned to reduce impacts. Mitigation measures incorporate BEP and BAT and as a minimum follow appropriate BMP guidelines and legislation; mitigation measures are summarized in Table 1-1.

Table 1-1.Summary of key mitigation measures.

Airgun Array Noise
Avoid Narwhal Protection Zone I
Avoid narwhal and beluga migration periods
Seismic vessels will maintain minimum separation distance of 30 km whenever possible
Use of 2-4 Marine Mammal and Seabird Observers (MMSOs) on each seismic vessel and 2 MMSOs on each support vessel
Use of a Passive Acoustic Monitoring (PAM) system to detect marine mammal calls in low visibility conditions
Ramp up of the array
Delay of ramp up for marine mammals seen or heard inside safety zone (800 m for whales and 500 m for other marine mammals)
Shutdown of airguns for marine mammals seen inside of safety zone
Shutdown of airguns during line changes
General Ship Operations
Vessels will steer a straight course and maintain a constant speed whenever possible
Reduce vessel lighting whenever it is safe and possible to do so to reduce chances of attracting seabirds
Rescue and release any stranded seabirds
Project vessel crews will keep a log of sightings and contacts with fishing (and other) vessels
Emissions and Discharges
All Project vessels will only use diesel and gasoil with a sulphur content of less than 1.5% (weight)
Vessels will meet or exceed regulations (MARPOL) for vessel discharges and emissions
Unplanned Events
Emergency Response, Spill Response (include bunkering procedures), and Ice Management Plans
Oil spill drills and oil spill kits
Use of solid streamers and double-hulled seismic vessels
Communications
Meet with stakeholders, including communities to provide information about the Project and its potential impacts
Notification of the seismic survey details to BMP, Royal Greenland A/S, shipping and harbour authorities, and hunter associations before the start of the survey
Establish a grievance mechanism that offers various ways (e.g., telephone, email, personal contact) to enable local stakeholders to contact Shell directly to ensure timely resolution of concerns and complaints
Start-up Meeting to ensure Shell and its Contractors fully understand mitigations
Shell will contact the DCE prior to survey start to ensure that its monitoring and mitigation plan for marine mammals and seabirds meets DCE protocols

1.5.2 Overview of Previous Studies

A thorough review of previous studies on seismic noise impacts for all VECs was conducted for the EIA. As noted earlier, the impacts of seismic noise on marine mammal hearing and behaviour were assessed in the EIA. There is some evidence that belugas can incur temporary hearing loss (or impairment) if they are exposed to seismic noise at close distances. There have been no studies of permanent hearing damage caused by seismic noise. There have been few studies of beluga whale response to seismic surveys and no such studies are available for narwhals. Seismic monitoring programs (Miller et al. 2005) involving intensive aerial surveys and ship-based observations were conducted in the Canadian Beaufort Sea in 2001–2002. Results suggest that belugas tended to avoid the area of seismic operations (a 3-D survey) by 10–20 km. There have been no studies of narwhal hearing impairment or changes in behaviour of narwhals attributable to airgun sounds. For that reason, studies of beluga whales were used to assess potential impacts on both belugas and narwhals.

1.5.3 Residual Impacts

After inclusion of the above-noted mitigation measures, there are no significant residual impacts predicted for the proposed 3-D seismic program (Table 1-2). The majority of the potential impacts (for routine activities, potential accidental spills of small fuel amounts, and airgun array noise) considered for VECs have a magnitude rating of *negligible, negligible to minor,* or *minor*—the exception is the predicted impact of airgun array noise on narwhal behaviour, which was ranked as moderate. Based on a series of precautionary steps, it was predicted that 1.1% of the Melville Bay narwhal population may avoid the airgun arrays when the seismic vessels are at their closest point to the Narwhal Protection Zone I. The proportion of narwhals affected decreases when the seismic vessels are surveying at farther distances from Melville Bay. Narwhals are not predicted to incur hearing damage from seismic noise given that narwhals (and other marine mammals) are expected to avoid at least the immediate area around the airgun arrays, and that mitigation measures (ramp up delays and airgun shutdowns in an 800 m safety zone) will reduce exposure to sound levels thought to be high enough to cause hearing damage. Similarly, belugas are not expected to incur hearing damage and residual impacts on hearing were assessed as *negligible*. The impact of seismic noise on beluga whale behaviour was judged as *minor*; it was predicted that 0.2% of belugas may avoid seismic noise during their fall migration period.

Table 1-2. Summary of impact predictions for VECs and airgun array noise.

Project Activity / VEC	Impact Magnitude	Significance	Level of Confidence
Airgun Array Noise			
Narwhals: hearing impacts	Negligible	Not Significant	High
Narwhals: behaviour impacts	Moderate	Not Significant	Medium
Belugas: hearing impacts	Negligible	Not Significant	High
Belugas: behaviour impacts	Minor	Not Significant	Medium
Other marine mammals: hearing impacts	Negligible	Not Significant	High

Project Activity / VEC	Impact Magnitude	Significance	Level of Confidence
Other marine mammals: behaviour impacts	Minor	Not Significant	High
Seabirds	Negligible	Not Significant	High
Marine mammal hunt	Minor	Not Significant	Medium
Fish and invertebrates (including eggs and larvae)	Minor	Not Significant	Medium
Commercial fisheries	Negligible to Minor	Not Significant	High
Subsistence fishery	Negligible to Minor	Not Significant	High

The level of confidence in predictions for impacts of airgun array noise is ranked as medium for narwhal and beluga behaviour because there is no information on how narwhals respond to seismic noise and beluga studies are limited. Similarly, a confidence level of medium was given for fish and invertebrates because of limited information available on the impacts of airgun array noise.

1.5.4 Cumulative Impacts

The potential for cumulative impacts from all activities proposed has also been assessed. In addition to Shell's proposed 3-D seismic survey, ConocoPhillips and Maersk Oil are proposing to conduct seismic surveys during July to September 2012 in the Qamut and Tooq licenses. In addition, a shallow coring program (led by Shell) involving one drilling vessel is proposed for August and September at 11 coring sites in and north of the Anu license. It is possible that marine mammals, including narwhals, could be exposed to noise from some or all of these seismic and shallow coring operations. It is highly unlikely that the cumulative impact of the three seismic programs and shallow coring program would affect 10% or more (i.e., the criterion for assigning an impact rating of "major") of narwhals in the Melville Bay area. It is far more likely that the combined programs might affect 2-4% of the narwhal population and that impacts would be *not significant*. The level of confidence in this prediction is low to medium as it is uncertain if cumulative impacts would be additive or whether habituation would occur and behavioural response distances would decrease. Because of this, a precautionary approach has been taken in this EIA.

1.6 Data Gaps and Uncertainties

One of the key data gaps in this EIA is the absence of information on how narwhals respond to seismic noise—this reduces the confidence in impact predictions. There is even more uncertainty in how multiple seismic programs and a shallow coring program will contribute to potential cumulative impacts on narwhals (and other VECs). Discussions have commenced regarding DCE/GINR-led studies designed to investigate the potential cumulative impacts assessed in this EIA, with emphasis on narwhals. Three studies are planned including those on sound travel of seismic noise, narwhal response to seismic noise, and the impacts of seismic noise on subsistence hunting in Melville Bay. Shell is committed to working closely with BMP, DCE and other Operators to facilitate a successful research program. This program will serve to address data gaps and provide a better basis for mitigation measures in future years.

2 INTRODUCTION

Shell Kanumas A/S (Shell), acting as an operator on behalf of Nunaoil, GDF SUEZ, and Statoil, is proposing to conduct a 3-D seismic survey program offshore northwest Greenland in 2012. The seismic survey would involve the use of two seismic vessels to acquire 3-D survey data in the Anu (Block 5) and Napu (Block 8) licenses. The seismic survey is proposed to occur from mid-July to mid October 2012. This document is the Environmental Impact Assessment (EIA) prepared for the Greenland Bureau of Minerals and Petroleum (BMP) as part of the application process to acquire an approval to conduct offshore hydrocarbon exploration activities under the *Mineral Resources Act* (Section 86; BMP 2011). The EIA has been prepared in accordance with BMP's "Guidelines for application, execution and reporting of offshore hydrocarbon exploration activities (excluding drilling) in Greenland" (BMP 2011) and "Guidelines to environmental impact assessment of seismic activities in Greenland waters, 3rd revised edition, December 2011" (Kyhn et al. 2011).

2.1 Proponent

Shell is the operator for the proposed 3-D seismic survey program in the Anu (Block 5) and Napu (Block 8) licenses. Shell has acquired extensive operating and development experience in arctic and sub-arctic regions for over 40 years, and has developed the technology and expertise required to operate safely and effectively in remote and extreme conditions. In 2011, Shell, on behalf of a consortium of oil and gas companies, successfully conducted a geophysical site survey in and north of the Anu and Napu licenses. As part of the geophysical site survey, a marine mammal and seabird monitoring and mitigation program was implemented, and valuable data were collected that inform this EIA.

2.2 Scope

This EIA has been prepared to meet the applicable requirements of Greenland legislation and standards, and also follows appropriate international guidance and best practice. The most relevant legislation, standards, and guidance are referenced in Section 3. The geographical scope of this EIA includes the Anu and Napu licenses and a larger area where potential impacts of the Project could occur (i.e., the Study Area, as defined in Section 6.2; see Figure 4.1 later). LGL Limited, environmental research associates, in association withGrontmij A/S, prepared this EIA. Operational and management information was provided by Shell.

The purpose of this EIA is to

- Provide details of the Project;
- Describe the environmental components and commercial fisheries and subsistence harvesting activities within the Study Area;
- Identify and assess the nature, significance, and probability of potential environmental impacts associated with the proposed 3-D seismic survey; and
- Describe appropriate mitigation measures in the Environmental Management Plan (EMP), together with management and monitoring procedures that will seek to avoid or reduce potential impacts.

The following sections are included as part of this EIA:

- Section 1: Non-technical summary
- Section 2: Introduction (this section)

- Section 3: Regulatory, Policy and Administrative Framework
- Section 4: Project Description
- Section 5: Description of the Environment
- Section 6: Impact Assessment
- Section 7: Environmental Management Plan
- Section 8: Literature Cited

A number of technical appendices containing supporting information relevant to the EIA, such as technical vessel specifications, review of the physical environment, and detailed literature reviews on the effects of seismic noise on marine mammals and fish/invertebrates, are included in support of this EIA and referenced within the text.

3 REGULATORY, POLICY AND ADMINISTRATIVE FRAMEWORK

This EIA was prepared to meet appropriate Greenlandic legislation and regulatory requirements, incorporate relevant international standards, and integrate Shell's policies.

3.1 National Legislation and Guidelines

The following Greenlandic legislation and regulatory requirements for offshore petroleum exploration and environmental protection apply to the proposed 3-D seismic EIA and to the associated EMP. [This list is not meant to be exhaustive but does provide the key legislation and guidance documents relevant to the proposed seismic EIA.]

- Greenland Parliament Act no. 7 of 7 December 2009 on mineral resources and mineral resource activities (the Mineral Resources Act).
- BMP Guidelines for application, execution, and reporting of offshore hydrocarbon exploration activities (excluding drilling) in Greenland, December 2011 (BMP 2011).
- Guidelines to environmental impact assessment of seismic activities in Greenland waters, 3rd revised edition, December 2011 (Kyhn et al. 2011).
- NERI (DCE) and BMP Manual for seabird and marine mammal survey on seismic vessels in Greenland, May 2011 (Johansen et al. 2011a).
- Act no. 929 of 24 September 2009 issued by the Danish Environmental Protection Agency on the Protection of the Marine Environment (replacing Act no. 476 of 30 June 1993 on the Protection of the Marine Environment).
- Greenland Home Rule Executive Orders including those for protection and hunting of polar bears, walrus, and birds.
- Greenland Government Executive Orders including those for protection and hunting of large whales, seals, belugas and narwhals.

3.2 International Treaties, Conventions and Best Practice

As required in the BMP Guidelines (2011), Best Available Technology (BAT) and Best Environmental Practice (BEP) must be considered and incorporated into a seismic program where possible. International BEP Guidelines (e.g., NORSOK standards), international conventions (e.g., OSPAR), and IMO Conventions (e.g., MARPOL) have been used in the development of the EMP (see Section 7 for details).

3.3 Shell Environmental Management

The Project will be conducted within the framework of Shell's internal standards and Business Principles, as well as the environmental, health, and safety policies and procedures of its subcontractors. Environmental, Health and Safety management of the Project will follow the procedures and requirements as described in Shell's HSSE & SP Control Framework and Corporate Standards (Health, Safety, Security, Environment, and Social Performance; Table 3-1).

These policies and management procedures will be bridged to the contractors' own management system. Specifically regarding offshore seismic, Shell requires the Project to meet

- OGP HSE Aspects in a Contracting Environment for Geophysical Operations (2001);
- IAGC Environmental Guidelines for World-wide Geophysical Operations (2001); and
- IAGC Recommended Mitigation Measures for Cetaceans during Geophysical Operations (2001).

Table 3-1. Shell commitment and policy on health, security, safety, environment and social performance.

Commitment	Policy
Shell is committed to: • Pursue the goal of no harm to people; • Protect the environment; • Use material and energy efficiently to provide our products and services; • Respect our neighbours and contribute to the societies in which we operate; • Develop energy resources, products and services consistent with these aims; • Publicly report on our performance; • Play a leading role in promoting best practice in our industries; • Manage HSSE & SP matters as any other critical business activity; and • Promote a culture in which all Shell employees share this commitment.	**Every Shell Company:** • Has a systematic approach to HSSE & SP management designed to ensure compliance with the law and to achieve continuous performance improvement; • Sets targets for improvement and measures, appraises and reports performance; • Requires contractors to manage HSSE & SP in line with this policy; • Requires joint ventures under its operational control to apply this policy, and uses its influence to promote it in its other ventures; • Engages effectively with neighbours and impacted communities; and • Includes HSSE & SP performance in the appraisal of staff and rewards accordingly.

4 PROJECT DESCRIPTION

Shell is proposing to conduct a 3-D seismic survey program in portions of the Anu and Napu licenses from mid July to mid October 2012 (see Figure 4-1). The proposed 3-D seismic survey will be conducted by the seismic contractor Polarcus Seismic Limited (Polarcus). The seismic program is described below and provides information required in BMP's "Guidelines for application, execution and reporting of offshore hydrocarbon exploration activities (excluding drilling) in Greenland" (BMP 2011). As required in these BMP Guidelines, BAT and BEP have been incorporated into the survey design and vessel and equipment selection to minimize environmental impacts. This is discussed in detail in the EMP (see Section 7 later in the EIA).

4.1 Project Scope and Objectives

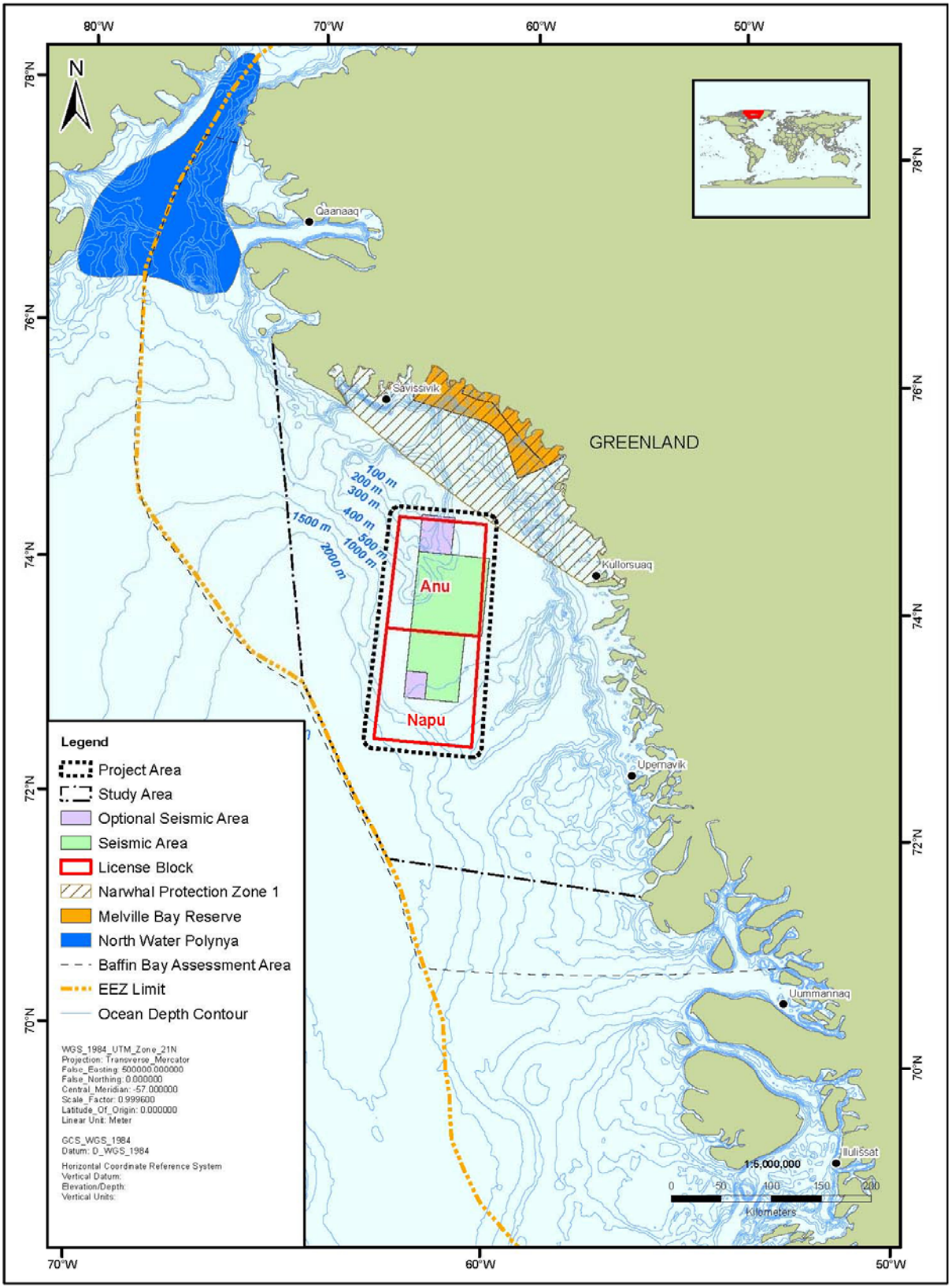
Shell is proposing to acquire ~8,637 km^2 of 3-D seismic data in 2012 to evaluate hydrocarbon reserves in the Anu and Napu licenses. An additional ~1,650 km^2 of 3-D seismic data could also be acquired (see "Optional" areas shown in Figure 4-1) if time and ice conditions permit. In order to acquire full-fold migrated seismic data in the Anu license, limited seismic data will be acquired in the adjacent Pitu block, and potentially the Qamut block as well.

4.2 Program Description

4.2.1 Survey Program and Schedule

The timing of operations is highly dependent on ice conditions. Project vessels are estimated to enter Greenland waters around 10 July 2012. It is expected that the vessels will begin seismic data acquisition by ~15 July. Survey completion is planned by 15 October 2012, after which time the vessels are expected to demobilize. The 15 October survey completion is planned because of the protection period (15 October–1 December) established for narwhals in Narwhal Protection Zone II, which overlaps with the Project Area. Table 4-1 provides the survey data requested in the Seismic EIA Guidelines (Kyhn et al. 2011).

The 3-D seismic data will be acquired by two seismic vessels (M/V *Polarcus Amani* and M/V *Polarcus Samur*) owned and operated by Polarcus Seismic Limited. Each seismic vessel will use identical airgun arrays (4240-in³ total volume; details provided in Section 4.2.4) and streamers (six solid streamers spaced at 200 m, 7 km in length; details provided in Section 4.2.5). The two seismic vessels will be supported by four chase vessels (typically two per seismic vessel), whose primary task is ice management, and one supply vessel. The seismic vessels will work independently, but will coordinate closely to maintain as much as possible a separation distance of at least 30 km when acquiring seismic data, in order to minimize seismic interference levels.



GSI B.V. - THE HAGUE **Author: Mark Fitzgerald** **Date: 02/21/2012** **Draw. No: 1**	**Shell Baffin Bay 3D Seismic** **Location of the proposed Shell Baffin Bay 3D seismic program in 2012, including Project Area, Study Area and Seismic Areas.**	**FIGURE No.** **4-1**

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TABLE 4-1. Survey data for Shell's 3-D seismic survey (as per Table 6.4.1 required in Seismic EIA Guidelines; Kyhn et al. 2011).

Specify	Description	Provided
Type of survey (2-D, high resolution (3-D), well testing, other)	3-D seismic survey	Yes
Map of the area with all transect lines	See Figure 4-2	Yes
Start and end dates for the survey	15 July–15 October 2012 (estimated)	Yes
Expected duration	3 months	Yes
Duty cycle of operation (in hours/ 24 hours). Number of hours in the dark per 24 hours.	Duty cycle 24/7. Number of hours of darkness in July and August: 0 h; September: 8 h; 1-15 October: 12 h	Yes
Number and types of accompanying vessels	One supply vessel and four chase vessels (all ICE-1A class)	Yes
Intended use of icebreakers. Will survey be carried out in ice?	No icebreakers will be used. The seismic survey can only be conducted in mostly open water.	Yes

Survey Design

Within the primary "Seismic Area", Shell proposes to acquire ~8,637 km^2 of 3-D seismic data. The seismic survey lines (118 survey lines spaced 600 m apart; ~14,388 line km in total) are oriented in a north-south direction in the Seismic Area (Figure 4-2). In order to acquire full fold seismic data, it is necessary to acquire shotpoints over a distance equal to half the streamer length (i.e., 3.5 km) at the end of each seismic line. Whether these shotpoints are taken at the northern or southern end of the Seismic Area depends on the shooting direction of each individual survey line, which is not presently known.

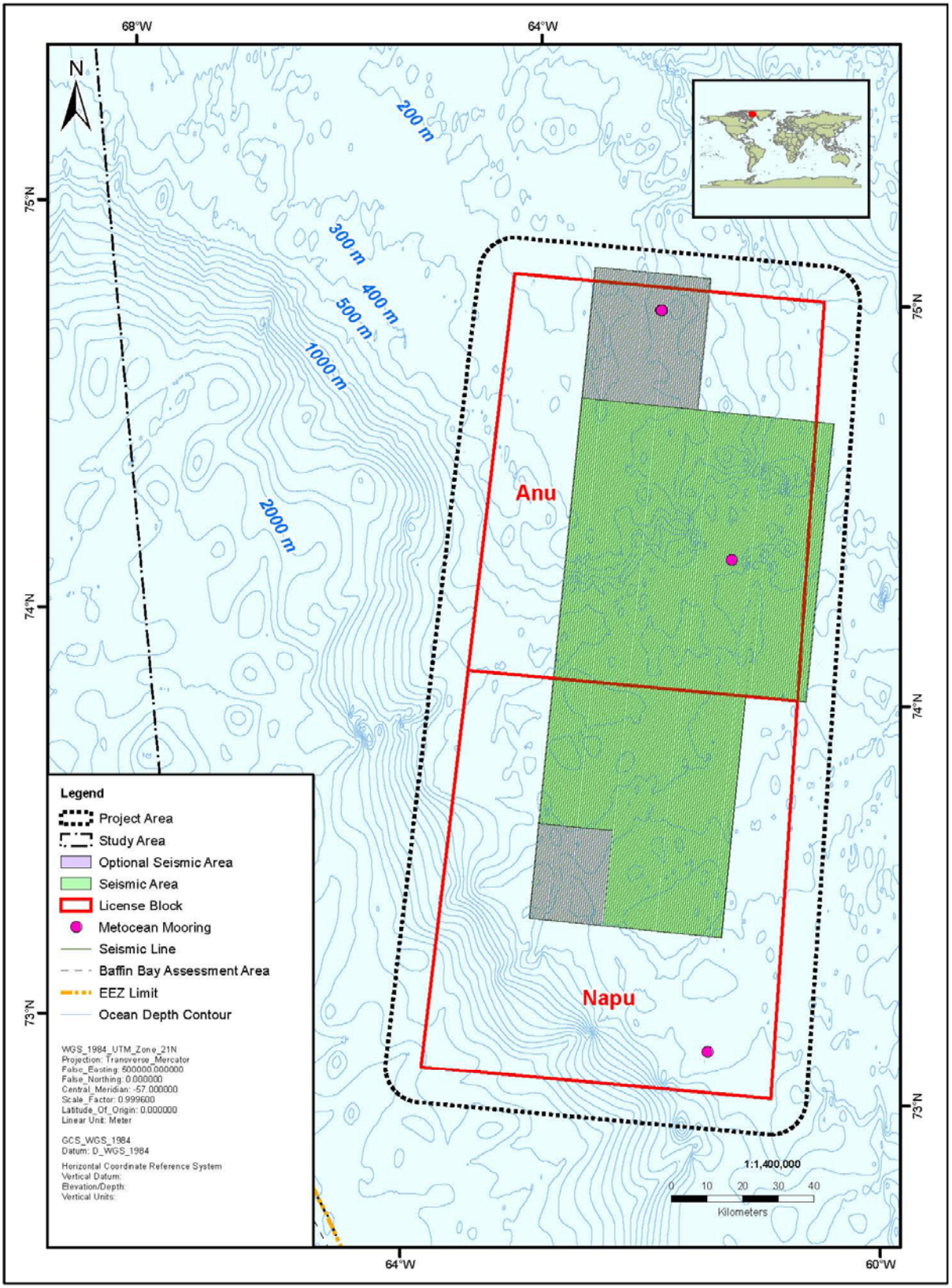
Shell's current plan is that the Seismic Area will be divided into east and west portions, i.e., an "East Block" and a "West Block". It is proposed that each of the seismic vessels will start on the eastern side of their respective block, as there is likely to be sea ice remaining in the west and southwest parts of the Seismic Area at the start of the planned survey. As ice conditions permit, the seismic vessels will move to the western portion of their blocks to acquire data in the ice-free waters.

As noted earlier, an additional ~1,650 km^2 of 3-D seismic data could also be acquired in two Optional Areas (Figure 4-1) if time and ice conditions permit. For efficiency reasons, an early judgment will be made as to whether data in the Optional Areas can be acquired or not. At the start of the survey, an attempt may be made to acquire data in either one or both of the Optional Areas. If the seismic production (forecast) is below expectations, only the primary Seismic Area will be surveyed.

The seismic vessels will survey at a speed of ~4.3 knots (8 km/h). Under normal operational conditions, the average length of each survey line is 120 km, which will require 15 h of surveying. It is estimated that line changes will require 3.5–4 h to complete. Each seismic vessel will alternately activate their two airgun arrays at an inline spacing of 25 m (i.e., 50 m for each source), or ~11 s (22 s each source).

Operation of Two Seismic Vessels

Shell is proposing to operate two seismic vessels simultaneously. In order to reduce the level of seismic interference between the seismic vessels, which has a negative effect on data quality, two measures will be taken. First, as much as possible, a minimum distance of 30 km will be maintained between the two seismic vessels during data acquisition. Second, the firing time of airgun arrays on one vessel (the 'slave vessel') will have a random jitter in relation to the firing time of the airgun arrays on the other vessel (the 'master vessel'). The magnitude of the jitter will be a maximum of~0.25–0.5 s.



GSI B.V. - THE HAGUE **Author: Mark Fitzgerald** **Date: 02/21/2012** **Draw. No: 1**	**Shell Baffin Bay 3D Seismic** **Survey lines for the proposed Shell Baffin Bay 3D seismic program in 2012.**	**FIGURE No.** **4-2**

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Other Data Collection
Each seismic vessel will collect bathymetry and gravity data, and possibly magnetic data. Sound speed profile data will be acquired on a weekly basis. The collection of these types of data is standard practice during marine seismic surveys.

Other Activities
The supply vessel will retrieve three metocean moorings that were deployed by Shell in 2011 (two of the locations are shown in Figure 4-2 and the third mooring is located in the southeast corner of the Napu license). These metocean moorings were deployed to measure ice cover and thickness. After servicing and recalibration, these moorings could be redeployed at the same approximate locations and retrieved the year after. There are no plans to conduct seabed sampling during the seismic program.

4.2.2 Seismic Vessels

The seismic survey will be conducted by two seismic vessels, the M/V *Polarcus Samur* and M/V *Polarcus Amani*. Both vessels are newly built, environmentally advanced vessels that have diesel-electric propulsion, high specification catalytic convertors, double hull, and advanced ballast-water treatment and bilge-water cleaning systems.

M/V *Polarcus Samur*
The *Polarcus Samar* (ICE-1A class; call sign C6XK8; Figure 4-3) was built in 2011 and is owned by Polarcus Samur Ltd. and registered in the Bahamas. It is 84.2 m long, with a beam of 17 m and a maximum draft of 6.7 m. The *Polarcus Samar* has cruising and maximum speeds of ~28 km/h (15 knots) and ~31 km/h (17 knots), respectively, but will travel at a speed of 8 km/h (4.3 knots) while conducting seismic surveying. The vessel is equipped with state of the art navigation, radar, communication and depth sounding equipment, bow and stern thrusters, and a Dynamic Positioning (DP) system. It has a fuel capacity of 1025 m^3 of gas-oil. It will have appropriate on-board environmental protection equipment or systems, and will house Marine Mammal and Seabird Observers (MMSOs). Appendix A provides more details about this vessel.

M/V *Polarcus Amani*
The *Polarcus Amani* (ICE-1A Super class; call sign C6ZD3) will be completed in 2012, and is owned by Polarcus Amani AS. It is 92 m long, with a beam of 21 m and a maximum draft of 7.5 m. The *Polarcus Amani* has a maximum cruising speed of ~30 km/h (16 knots) but will travel at a speed of 8 km/h (4.3 knots) while conducting seismic surveying. The vessel is equipped with state of the art navigation, radar, communication and depth sounding equipment, bow and stern thrusters, and a DP system. It has a fuel capacity of 1925 m^3 of gas-oil. It will have appropriate on-board environmental protection equipment or systems, and will house MMSOs. Appendix A provides more details about this vessel.

4.2.3 Support Vessels

The two seismic vessels will be supported by one supply vessel and four chase vessels; each of these support vessels will be ICE-1A class (or higher). The supply vessel will provide the seismic vessels with fuel, water, food, and materials. The main task of the chase vessels is to aid in ice management. At the time of this submission, the names of the support vessels cannot be confirmed. Information on the support vessels will be provided to BMP when it becomes available (most likely in March).



FIGURE 4-3. Seismic vessel M/V *Polarcus Samur*.

4.2.4 Seismic Source Array

Each of the *Polarcus Samur* and *Polarcus Amani* will tow two airgun arrays that will be activated in a flip-flop arrangement. The airgun arrays are deployed ~400 m astern of the vessels, and are towed at a separation of 100 m. Each array consists of three sub-arrays. Each sub-array consists of 12 airguns, one of which is considered a spare (i.e., a total of 33 active airguns for each of the two arrays). The total volume of each array will be 4240 in³ with individual airgun sizes ranging from 45 to 380 in³. Each array is operated at 2000 psi and has a broadband source level in the vertical direction of 262.6 dB re 1µPa (peak to peak) (as estimated by acoustic modelling; see Section 6.7). The arrays will be towed at a depth of 8 m, although this is possibly subject to minor adjustment. Table 4-2 and Figures 4-4 and 4-5 provide additional details on the airgun array. Acoustic properties of the airgun array required in the Seismic EIA Guidelines are provided in Section 6.7.

The 4240-in^3 array is required because it provides sufficient power required to collect seismic data at the deepest geological targets (Cretaceous) of the survey, which are 5–6 km below the seabed.

4.2.5 Recording Streamers

Six solid seismic streamers, each 7 km long, separated by a distance of 200 m, will be towed behind each seismic vessel (see Figure 4-6). The streamers contain sensors (hydrophones) spaced at ~1.8 m. Solid streamers will be used, so there is no risk of fluids being discharged, as could be the case with fluid filled streamers. Streamers will be deployed 9–11 m (to be decided) below the water surface, and each streamer will be equipped with a tail buoy that is used for positioning purposes.

The proposed geometry of six streamers spaced 200 m apart is close to the maximum towing width possible in the geophysical industry. A streamer spread of 12 streamers (as recommended by BMP in response to Shell's submission of Scope of Project document) at 200 m, for example, is not possible with present-day technology, nor desirable as the data quality would suffer greatly, based on modelling conducted by Shell.

TABLE 4-2. Array specifications for Shell's 3-D seismic survey (per Table 6.4.2 required in Seismic EIA Guidelines; Kyhn et al. 2011).

Specify	Description	Provided
Number and names of vessels towing airgun arrays	Two seismic vessels: M/V *Polarcus Amani* and M/V *Polarcus Samur*	Yes
For each vessel provide geometric layout of complete airgun array with individual volume specified (in psi per airgun and in^3 per airgun)	See Figure 4-4[a]	Yes
Size of total array (in^3 and psi for the entire array)	4240 in^3 and 2000 psi	Yes
Firing rate in shots/sec. Will sub arrays fire simultaneously or alternate?	For each vessel, shotpoint every 11 sec or 0.09 shots/sec. Arrays alternate.	Yes
Operation speed of the vessel in km/hours or knots.	8 km/h (4.3 knots)	Yes

[a] Each airgun is operated at the same pressure, i.e., 2000 psi.

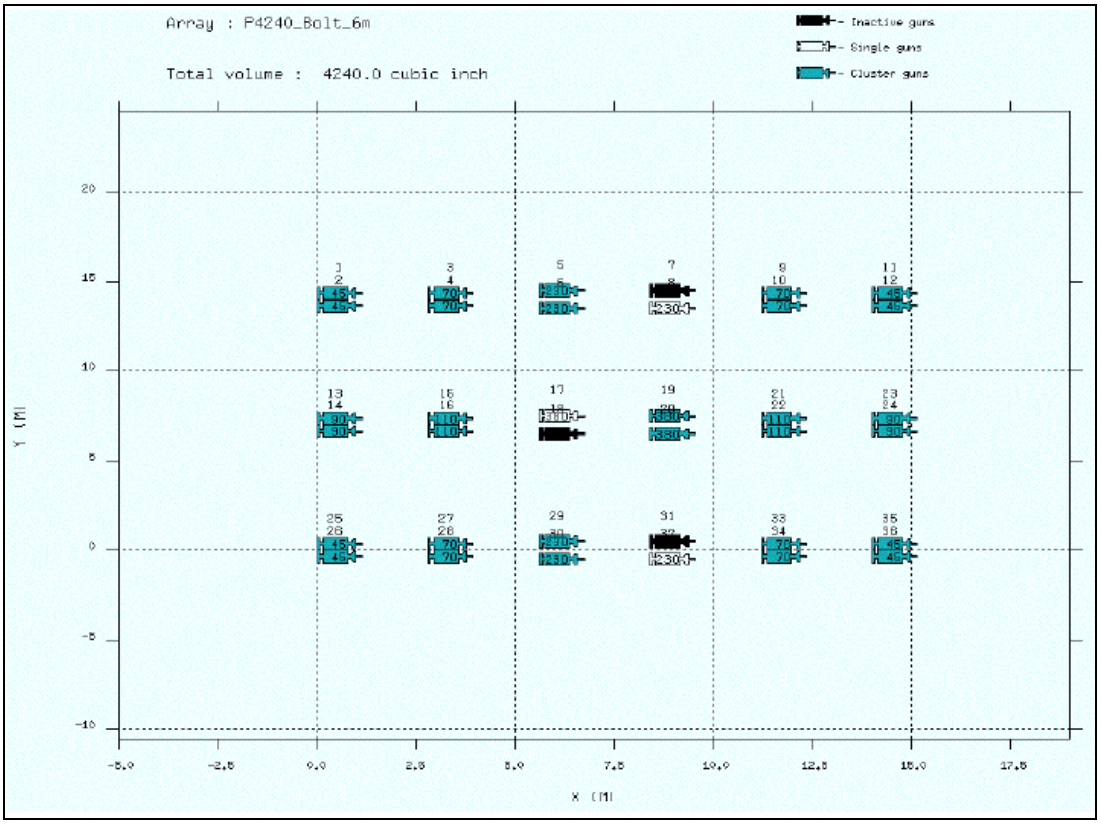


FIGURE 4-4. Geometric layout of airgun array.Volumes of each airgun are shown inside the airgun schematic (volumes range from 45 to 380 in^3); airguns shaded black are considered spares.

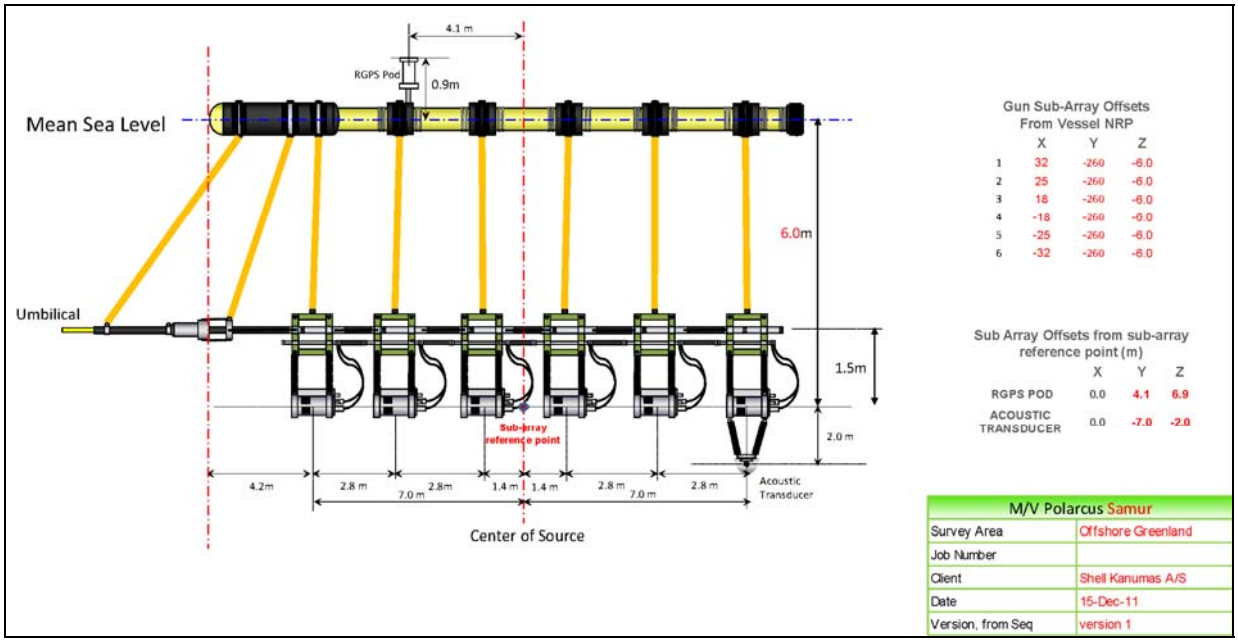


FIGURE 4-5. Schematic of airgun sub-array (identical on both seismic vessels).

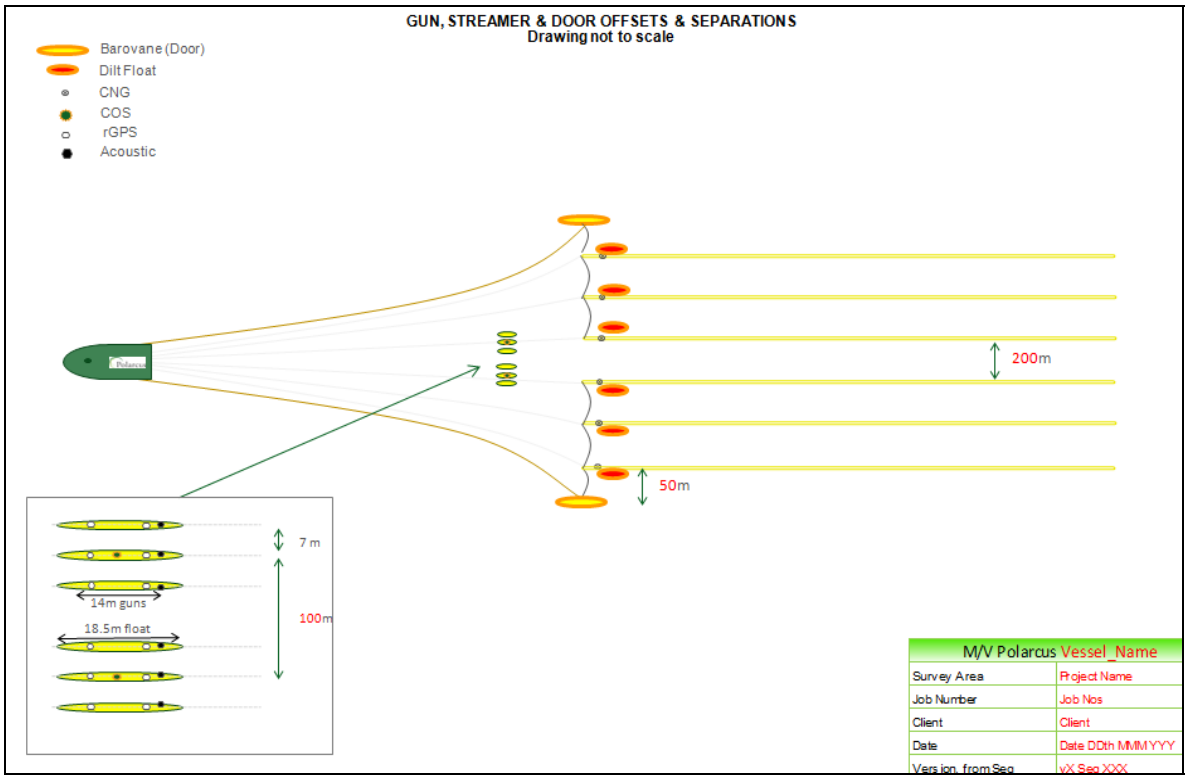


FIGURE 4-6. Schematic overview of preliminary towing geometry of each seismic vessel. CNG = centre of nearest (receiver) group; COS = centre of source; rGPS = relative GPS; Acoustic = acoustic pinger.

4.2.6 Additional Equipment

The seismic vessels will be equipped with a gravity meter and possibly a magnetometer. These are both passive recording devices that do not emit sound. Each of the seismic vessels is equipped with a Furuno FE-700 echosounder. The downward-facing Furuno FE-700 operates at a frequency of 50 kHz or 200 kHz and will be used to collect water depth information.

A pinger system will be used during seismic operations to position the airgun array and hydrophone streamers relative to the vessel. Sounds from the pingers are single code transmission of 256 ms. One pulse is emitted on command from the operator aboard the source vessel, which under normal operating conditions is once every ~8–16 s. Most of the energy in the sound pulses emitted by this pinger is at very high frequencies between 26 and 100 kHz. The signal is omni-directional.

For the 2012 Project, up to 15 sound velocity profiles will be acquired in the water column at various locations within the Seismic Area. This is a routine practice during seismic programs. Sound velocity profiles allow for more accurate interpretation of the acoustic data (i.e., seismic pulses) recorded by the seismic streamers. These data are acquired with a small, passive device that will be deployed by a support vessel. The device measures pressure, temperature, and salinity, from which the speed of sound can be calculated.

4.2.7 Visual and Acoustic Monitoring

Visual Monitoring
Shell will meet or exceed the requirements for MMSOs on each of the seismic vessels. At present, it is planned to place two MMSOs on the *Polarcus Samur*, four MMSOs on the *Polarcus Amani*, and two MMSOs on each of the support vessels. The MMSOs will be tasked with implementing monitoring and mitigation measures as detailed in the Seismic EIA Guidelines (Kyhn et al. 2011) and provided in the Environmental Management Plan (see Section 7). At present there is no intention to have a Fisheries Liaison Officer (FLO) on-board, unless this is required by BMP.

Passive Acoustic Monitoring
Both seismic vessels will implement Passive Acoustic Monitoring or PAM. The PAM system (see Table 4-3) consists of four small omni-directional, high bandwidth hydrophones in conjunction with pre-amplifier units that provide an improved signal to noise ratio. The hydrophones, along with a depth sensor, are contained in a 22.5-m section of cable deployed 200 m behind the seismic vessel. Another option is to deploy the hydrophones in a “mini-array” that can readily be interfaced to the airgun array using airgun array cable returns to the vessel’s instrument room. Operators of the PAM system would monitor two laptop computers, one each for high- and low-frequency analyses. The high-frequency system (employing a National Instruments DAQ card) is used to detect and localize ultrasonic pulses emitted by dolphins and porpoises. The low-frequency system is used to detect sounds produced by cetacean sounds in the 20 Hz–20 kHz range and up to a maximum of 48 kHz for 2 channels and 96 KHz for 1 channel if required. Further details of the PAM system are provided in Section 7.

4.2.8 Logistics

At the time of this submission, final plans for fuel, water, food, personnel transfer, and material supply are not entirely in place. In the preliminary plan, the supply vessel will provide consumables to both seismic vessels and the four chase vessels. It is anticipated that Project vessels will require refuelling every 16–21 days. Refueling will occur within the Project Area. The supply vessel will either acquire fuel from a tanker or the port of Illulisat. Refuelling will follow Polarcus bunkering procedures that have been established based on IMO maritime regulations.

TABLE 4-3. Specifications of PAM system for Shell's 3-D seismic survey (as per Table 6.4.4 required in Seismic EIA Guidelines; Kyhn et al. 2011).

Specify	**Description**	**Provided**
Number of hydrophones	Four small omni-directional high-bandwidth hydrophones	Yes
Threshold of the recording system	SNR-106 dB, Dynamic Range106 dB	Yes
Sample rate of the recording system	Sampling to 96 or 192 Ks/s giving 48–96 kHz	Yes
Where will hydrophones be placed?	In a 22.5-m long streamer towed behind the seismic vessels or in a mini-array interfaced with the airgun array.	Yes
Will there be duty cycling of recordings? In that case, when will the PAM system be used?	No.	Yes
Name of software	Pamguard, Ishmael 1.0, Sigview, PC Scope	Yes
Species covered	Ultrasonic pulses of dolphins, porpoises; vocalizations of mysticetes and odontocetes with frequencies ranging from 20 Hz to 20 kHz; up to 48 kHz in two channels and 96 kHz in one channel.	Yes
Estimated range accuracy, m.	50 m	Yes

Note: SNR = Signal to Noise Ratio.

Crew changes are likely to occur via vessel-to-vessel transfers. Crew changes will take place approximately every six weeks with an anticipated 2–3 crew changes per seismic vessel conducted during the Project. The base for crew changes will be Upernavik.

Each seismic vessel will have a total of ~50 crew members. The crew on the support vessels will be ~8–10 per vessel. Crew change details for the support vessels will only be known once the vessels have been contracted (expected in March).

4.2.9 Emissions, Discharges and Waste Management

Emissions to Air
The primary source of emissions to the atmosphere will be from vessel engines. Vessels will only use diesel and gasoil with a sulphur content of less than 1.5% (weight). It is estimated that the total fuel consumption of seismic vessels during the program will be 9,000 t. For the proposed Project, Polarcus has modelled emissions for the two seismic vessels assuming 8800 km^2 of data acquisition and a production speed of 4.5 knots. CO_2, So_x, and NO_x emissions were predicted as 19,316 tonnes, 3.0 tonnes, and 51.3 tonnes, respectively.

Liquid Discharges
Vessel discharges will not exceed those of standard vessel operations and will adhere as a minimum to appropriate regulations. The main discharges include grey water (wastewater from washing, bathing, laundry, and food preparation) and black water (human wastes from washrooms). All discharges will comply with requirements in the International Convention for the Prevention of Pollution of Ships, 1973, as modified by Protocol of 1978 (MARPOL 73/78) and its annexes. It is estimated that each seismic vessel will generate 5–6 m^3 of black and grey water per day.

Solid Wastes
Polarcus has a Garbage Management Plan in place that meets or exceeds MARPOL requirements (MARPOL 73/78, Annex V). All solid wastes will be sorted by type, compacted where practicable, and stored on board before disposal to an appropriate certified reception facility. Food waste from the seismic vessels will be burned onboard in the DNV approved incinerator. Sufficient and adequate facilities will be available on vessels to store solid wastes to the extent required. All wastes during the survey will be managed in accordance with MARPOL requirements (i.e., Annex IV and Annex V of the MARPOL Convention) and relevant national legislation, with consideration of best environmental practices (see Section 7).

5 DESCRIPTION OF THE ENVIRONMENT

5.1 Recent Assessments and Studies

The Project Area falls entirely within the boundaries of the Baffin Bay assessment area. Therefore, as recommended in the BMP Guidelines (2011), the information in this section refers to the SEIA for the Baffin Bay assessment area where appropriate (Boertmann and Mosbech 2011). Other key studies referenced in this section include Boertmann et al. (2009), Stjernholm et al. (2011), and Fissel et al. (2012).

In addition, as recommended in the Seismic EIA Guidelines (Kyhn et al. 2011), this section focuses on the biological components of the environment that are most likely to interact with the Project, notably marine mammals, fish, invertebrates, and seabirds, as well as commercial fisheries and subsistence harvesting. Seabird and marine mammal data were collected in the Study Area from a geophysical site survey vessel conducted in August–September 2011. The findings of this monitoring program are presented here.

5.2 Environmental Setting Overview

The Project Area occurs on the continental shelf and slope of West Greenland in water depths ranging from ~150 to >2000 m (Figure 4-1). Sections 5.3 to 5.6 provide a general overview of the baseline conditions in the Study Area, focused on the physical, biological, and socioeconomic components that could be affected by Project activities. As noted throughout these sections, there is a better understanding of environmental conditions in nearshore areas than in offshore areas, including the area where Shell is proposing to acquire seismic data.

5.3 Physical Environment

The physical environment in and near the Study Area is summarized here based on a report prepared by ASL Environmental Sciences Inc. (see Appendix B). A review of the physical environment of the larger Baffin Bay assessment area is provided in Section 3 of the SEIA (Boertmann and Mosbech 2011).

5.3.1 Weather

Of particular relevance to this Project are the effects that weather can have on Project operations as well as the ability of MMSOs to effectively monitor marine mammals and seabirds. In general, the Study Area has low wind speeds, precipitation levels, and air temperatures, with foggy conditions during summer.

Air Temperatures
The Study Area has mean air temperatures below 10ºC all year round. Summer (July–September) temperatures over the ocean are usually close to surface water temperatures, which typically range from -1.8ºC to 5ºC (Appendix B).

Winds
The steep coasts of Baffin Bay, with heights exceeding one kilometre, have a substantial impact on winds. Air flows along the steep coasts instead of across them. South easterly and easterly winds prevail along the northern coast of Greenland, and north westerly winds dominate over the open ocean (see Figure 6 in Appendix B). The mean wind velocity in and near the Study Area is ~4 m/s (14.4 km/h). The winds are the strongest and most persistent near the coast. In summer, the winds are generally from the southeast and in winter, the strongest winds blow from the northwest (Valeur et al. 1996). In summer (June–September), the frequency of occurrence of gale force winds was about 0.5% at a monitoring station located within the Study Area (Hansen et al. 2004).

Precipitation
Precipitation measurements, as determined from coastal weather stations at Upernavik and Pituffik (Cappelen 2008), indicate total precipitation levels of about 200 mm/year, which are small by comparison with southern Greenland. The largest monthly values of precipitation occur in late summer and fall with very low levels during the winter and early spring. Most of the precipitation occurs in the form of snow except in summer when rainfall does occur.

Fog
The estimated frequency of occurrence of fog in the open waters of July is ~30% in offshore areas and decreasing nearer the coastline (see Figure 10 in Appendix B). Fog conditions primarily occur because of advection of warm and moist air passing over the cold sea surface resulting from melting sea ice. Occurrences of fog decline later in the summer and in autumn with the reduced presence of sea ice.

5.3.2 Oceanography

The oceanographic conditions in and near the Study Area, including bathymetry, water masses, currents, freshwater inputs, and oceanic fronts are reviewed in Appendix B. Of particular relevance to the Project are wave conditions because of the potential influence on vessel operations.

Because of the moderate wind conditions in Baffin Bay, wave heights are characteristically small, with a 10% probability of exceeding 1.7 m at 72°N and 60°W for the four-month period August–November, 1985–1996 (Valeur et al. 1996). Larger waves can occur, but these are usually of short duration. Waves have minimum levels in the early summer months when considerable amounts of sea ice are present as well as the lower summer winds, whereas larger waves occur in the fall with more open water and higher winds.

5.3.3 Ice Conditions

Sea Ice

Sea ice is an important part of the marine physical environment of Baffin Bay, and can directly affect the Project. The operations are scheduled to avoid typical periods of sea ice cover in the Project Area. Over the past 30 years, the average ice break-up date in the Project Area (Anu and Napu blocks) has been the week of 16 July, and the ice breaks up earlier on 2 July in the northwest Qamut block and even earlier, 18 June–2 July, in the south westerly Tooq block (Figure 20 in Appendix B). The average freeze-up dates over the past 30 years have been well into November, i.e., 19 November in the Project Area. Of note, the average break-up dates over the past 13 years have been about three weeks earlier (in late June) than the 30-year climate normal value. There is also a recent trend toward reduced ice concentrations in the Project Area that persists through the summer months and into early autumn (see Appendix B).

The typical and extreme ice conditions in and near the Study Area over the past 30 years (1981–2010, inclusive) are described in Appendix B. In August, September, and October, sea ice is absent from the Project Area in most years. Sea ice has not been reported in the Project Area in August and September since 1996, with the exception of 2004, when low ice concentrations were observed in the Napu block because of unusually late lingering of the Middle Ice Pack.

Icebergs

In addition to sea ice, icebergs represent an important part of the physical environment of Baffin Bay that can directly affect the Project. Nearly all icebergs in Baffin Bay originate from tidewater ice sheets located in fjords between Disko Bay and Kap York in the northern half of West Greenland, with the most productive ice sheets located in Melville Bay (Figure 26 in Appendix B). Analysis of iceberg distributions in north eastern Greenland (Figure 28 in Appendix B) reveals that the highest densities of iceberg occur north of 75°N and east of 60°W within ~50–100 km of West Greenland, i.e., shoreward of the Project Area.

5.4 Biological Environment

5.4.1 Primary Productivity

Boertmann and Mosbech (2011) reviewed published studies of primary productivity in the Baffin Bay assessment area, and provided a series of maps of satellite-derived estimates of surface chlorophyll concentration. Total primary production in the arctic is from three sources: phytoplankton, ice algae on the underside of fast or drift ice, and benthic algae. In Lancaster Sound, Welch et al. (1992) estimated their contributions at ~90%, 10%, and 1%, respectively.

In most of Baffin Bay, there is a brief and intense phytoplankton bloom immediately after ice break-up, with high transient phytoplankton biomass and relatively low total primary production integrated over depth and season (Boertmann and Mosbech 2011). Exceptions are polynyas, areas of open water surrounded by ice, some of which are recurring and remain open throughout the winter. A notable example in the Baffin Bay assessment area is the North Water Polynya, which is “one of the most biologically productive marine areas in the Arctic” (Boertmann and Mosbech 2011:47). The North Water Polynya is located in Smith Sound, to the north and west of the Study Area (see Figure 4-1).

5.4.2 Zooplankton

Zooplankton provides the main pathway to transfer energy from phytoplankton to consumers at higher trophic levels, e.g., fish, marine mammals, and seabirds, thus has a critical role in marine food webs. High latitude zooplankton production follows the extremely strong seasonal pulse of phytoplankton (Parsons et al. 1984:26). Numerous taxa are included, e.g., chaetognaths, hydrozoans, ctenophores, pteropods molluscs, carnivorous amphipods, and larvaceans, but copepods, particularly calanoid copepods, are dominant. Boertmann and Mosbech (2011) provide additional general information about arctic zooplankton, and also summarize the scant information particular to the Baffin Bay assessment area. Much of that information concerns the North Water Polynya, which is located to the north and west of the Study Area

Studies were carried out near Melville Bay, at 75–76°N, 68–72°W, in summer 1980. The most dominant copepod species are *Calanus hyperboreus*, *C. glacialis*, and *C. finmarchicus*. Their vertical distribution was linked to food availability, salinity, and temperature. The *Calanus* species were most abundant in water with temperatures below <0°C, whereas other species, e.g., pteropods, were most abundant at temperatures >0°C (Boertmann and Mosbech 2011).

5.4.3 Benthic Flora

Studies of the marine benthic flora in the Baffin Bay assessment area are summarized in Boertmann and Mosbech (2011). Benthic flora are primarily found in shallow coastal environments. Whereas a considerable length of West Greenland shoreline occurs in the Study Area, none of it is closer than 60 km to the Project Area. The Project has no potential to affect benthic algae and thus this group is not discussed further here.

5.4.4 Benthic Fauna

Boertmann et al. (2009) indicated that the knowledge of benthic faunal species composition, diversity, and spatial variability in eastern Baffin Bay was limited. In support of the Eastern Baffin Bay SEIA (see Section 4.4 in Boertmann and Mosbech 2011), benthic surveys were conducted in 2008 along 22 inshore transects along the west coast of Greenland between 71°N and 78°N by NERI (now DCE) and GINR, many within the Study Area. Sampling was conducted in four depth ranges: 0–50 m, 50–100 m, 100–150 m, and 150–200 m. Photographs and grab samples were collected.

In photographs, the most abundant benthos were brittle stars (up to several 100/m^2), infaunal bivalves, scallops, and sea urchins. The abundance of large infaunal bivalves was generally highest at 10–50 m depths with a substrate of mixed soft sediment, gravel, and stones. An arctic community characteristic of water depths <50 m, marked by high biomass, the Macoma community, has been recorded in East and West Greenland and the Canadian Arctic, including northwestern Baffin Bay (Vibe 1939; Thorson 1957; Ockelmann 1958; Ellis 1960; Thomson 1982). Included in this community are the bivalves *Macoma calcarea* and *M. moesta*, *Astarte borealis*, *A. montagui*, *Serripes groenlandicus*, and *Mya truncata*, and the polychaete *Pectinaria granulata*.

In grab samples, average biomass was variable among stations (23–1030 g/m^2) and showed no clear relationship with depth or sediment type. Average biomass was ~200 g/m^2 at the three shallower depth ranges and ~175 g/m^2 at 150–200 m depths. Molluscs and polychaetes dominated biomass, whereas polychaetes and amphipods dominated numbers (Section 4.4 in Boertmann and Mosbech 2011).

Water depths in the Project Area range from ~150 to >2000 m, mostly deeper than the depths sampled in the benthic study described in Boertmann and Mosbech (2011). At depths 100–1000 m, polychaetes dominate benthic communities, and total biomass at these deeper areas is typically lower than that at shallow sites (Piepenburg 2005 in Boertmann et al. 2009). On the Spitzbergen shelf at 79°N, biomass decreased from ~40 g/m^2 at 200–300 m to ~5 g/m^2 at 2000 m (Wlodarska-Kowalczuk et al. 2004 *in* Boertmann and Mosbech 2011).

Information on the fish and large invertebrate species in northwest Greenland waters were summarised by Boertmann et al. (2009), Boertmann and Mosbech (2011), and Stjernholm et al. (2011). The first two are SEIAs that cover the Baffin Bay assessment area, covering ~71–80°N, and the third is an oil spill sensitivity atlas that covers the shoreline and the offshore areas between 72°N and 75°N. Other sources of information used here include peer-reviewed literature and technical reports.

5.4.5 Fish (Including Macroinvertebrates)

Macroinvertebrates

Northern shrimp.—The northern shrimp (*Pandalus borealis*) occurs on the West Greenland continental shelf from Cape Farewell at ~60°N to ~74°N (Boertmann and Mosbech 2011). It typically occurs in waters 100–600 m deep, mainly on the outer slopes of banks. Although northern shrimp are considered bottom dwellers, they migrate vertically at night and sometimes during the day to feed on the small planktonic organisms in the upper water column (Rose 2007).

Northern shrimp eggs are extruded in the summer and then carried by the female until the following spring (April–May) when the females move to shallower water (<150 m) where the larvae hatch (Boertmann and Mosbech 2011). The larvae are planktonic for 3–4 months, drifting passively with the currents. They subsequently settle to the ocean floor as far as 500 km from their hatching site (Rose 2007). Shrimp larvae are generally more abundant in waters <200 m deep (Pedersen and Smidt 2000). Important areas for shrimp larval development are the slopes of the banks, on the banks, and the shelf break. By the end of their first year, most northern shrimp have settled to the seafloor as juveniles (Rose 2007).

Snow crab.—The snow crab (*Chionoecetes opilio*) occurs over a broad depth range in the northwest Atlantic from Greenland south to the Gulf of Maine (DFO 2008). Snow crabs are patchily distributed along the west coast of Greenland in coastal areas and fjords, typically at 180–400 m depths (Stjernholm et al. 2011). Large males are most common on mud or mud/sand, whereas smaller crabs are common on harder substrates (DFO 2008). The snow crab life cycle is characterized by larval hatching in the spring, followed by a 12–15 week planktonic period during which the larvae develop through various stages before settling to the sea bottom (DFO 2008). Benthic juveniles of both sexes moult frequently. At ~4 years of age, they become sexually mature.

Iceland scallop.—Iceland scallops are generally found inshore and on banks at 20–60 m depths where current velocity is relatively high (Stjernholm et al. 2011). The West Greenland populations and commercial aggregations of Iceland scallop are generally found in coastal areas (Pedersen 1994). The Iceland scallop lives on the surface of hard substrates, rarely on soft, muddy bottoms (Crawford 1992 *in* Wroblewski et al.2009). In West Greenland, the largest aggregations are found in the Nuuk area, where most of the directed fishery has taken place (Pedersen 1994). In offshore areas there are only low concentrations of generally small scallops and large quantities of empty scallop shells, suggesting that offshore populations were once more abundant than they are currently.

Reproduction is by broadcast spawning, which is cued by rising water temperatures (Arsenault et al. 2000). Pedersen (1994) suggested a peak of spawning in late May–early June. After 6–10 weeks in surface waters, the planktonic larvae settle to hard sand and gravel surfaces (Arsenault et al. 2000).

Fish

Jørgensen et al. (2005 *in* Boertmann and Mosbech 2011) identified seven bottom fish assemblages in bottom trawls conducted in Davis Strait and Baffin Bay in 1999 and 2001. The trawls included the southern portions of the Study Area and Project Area (to 74°N) at depths down to 1500 m. Four of the identified fish assemblages were unique to Baffin Bay. The northern part of Baffin Bay (72–77°) was surveyed by bottom trawl in 2004 at depths 150–1418 m. This survey area included all of the Study Area. Forty-seven species were identified, 42 of them benthic species, with Greenland halibut being the dominant species caught. Other notable species caught in this survey included polar cod and arctic cod and arctic skate (*Raja hyperborea*).

The following species are those considered important between 72°N and 75°N (Stjernholm et al. 2011).

Greenland halibut.—The Greenland halibut is a deep-water, semi-pelagic flatfish that inhabits depths of ~400–2000 m (Rose 2007; Boje and Hareide 1993 *in* Gundersen et al. 2009). It spends most of its life on the bottom, but migrates into the water column to feed (Boertmann and Mosbech 2011). The reproductive biology of Greenland halibut is poorly understood (Gundersen et al.2009). Greenland halibut spawn a large number of pelagic eggs in winter at depths >1000 m and south of 67°N. The eggs and larvae drift northward and the larvae subsequently settle in the shallower waters of the banks. Greenland halibut are an important source of food for narwhals in winter (Boertmann and Mosbech 2011).

Lumpfish.—In the Northwest Atlantic, the lumpfish (or lumpsucker) ranges from Greenland south to Chesapeake Bay (DFO 2006). Lumpfish spend most of the year in deep, offshore waters, but in spring and early summer, typically May–June, they seek shallow coastal waters to spawn. Females lay two to three egg masses at intervals of 8–14 days. Once the eggs are deposited, females migrate back to deeper water leaving the males to guard the egg masses (DFO 2006). Larvae are released after 6–8 weeks of incubation. Juveniles are semi-pelagic, remaining in the top metre of the water column for their first year, during which they are often associated with floating algae. Lumpfish occur only in the southernmost part of the Baffin Bay assessment area (Boertmann and Mosbech 2011). Their northern distribution limit is at 72–75°N, so they are of limited importance there (Stjernholm et al. 2011).

Arctic char.—The arctic char is widespread in Greenland, including the most northerly areas (Muus 1990 *in* Boertmann and Mosbech 2011). Both resident and anadromous populations of arctic char occur there. Resident populations spend their entire lives in lakes and rivers, whereas anadromous populations migrate to the sea in summer to feed, and move back to freshwater in autumn to spawn and winter. Migratory char form an important resource for local consumption in Greenland (Riget and Böcher 1998 *in* Boertmann and Mosbech 2011). At sea, arctic char mainly stay in coastal areas, not far (up to ~25 km) from their natal river (Muus 1990 *in* Boertmann and Mosbech 2011).

Spotted wolffish.—The spotted wolffish occurs in the Arctic Ocean and on both sides of the North Atlantic from Labrador to the Barents Sea (DFO 2009). Off West Greenland, it is found as far north as Upernavik Fjord, and sporadically to Thule (FAO 2009). It is found offshore in cold, deep water, usually <5°C at 50–800 m depths (Kulka et al. 2007). Wolffish prefer a coarse sand and sand/shell hash bottom with rocky areas nearby for shelter, nest building, and spawning (Kulka et al. 2007). Reproduction occurs from April to December, mainly in June–August (FAO 2009). Large eggs are laid in deep water on the sea floor and are guarded primarily by males (DFO 2009). The larvae typically settle to the bottom when a body length of 4–7 cm is attained (FAO 2009). The species does not form large schools and migrations are local and limited (DFO 2009).

Polar cod.—The polar cod (*Boreogadus saida*), known elsewhere as arctic cod, is a pelagic or semi-pelagic species with a circumpolar arctic distribution. It can form large aggregations, often deep in the water column or near the bottom on the shelf (Boertmann and Mosbech 2011). It also occurs in coastal waters and is often associated with sea ice, in crevices and holes in the ice. Polar cod spawn large buoyant eggs in ice-covered waters in November–February, and the eggs incubate under the ice until larvae hatch in late spring when the ice starts to melt (Boertmann and Mosbech 2011).

The polar cod is an important forage species in the arctic marine food web. It is a key prey for many marine mammals and seabird species, especially the ringed seal, harp seal, beluga, narwhal, thick-billed murre, northern fulmar, black-legged kittiwake, and gulls (Boertmann and Mosbech 2011).

Capelin.—The capelin is a small, pelagic, schooling fish. It is a cold-water species that occurs widely in the northern Hemisphere. In the Disko Bay area, capelin spawn in huge numbers in spring in the subtidal zone along beaches and low rocky coasts (Mosbech et al. 2007). Capelin occur only in the southernmost part of the Baffin Bay assessment area (Boertmann and Mosbech 2011). Their northern distribution limit is at 72–75°N, so they are of limited importance there (Stjernholm et al. 2011).

5.4.5 Birds

Project activities, and thus expected potential impacts on birds, are primarily offshore and occur during the open-water season. Therefore, the following description focuses on the offshore avifauna during the July–October period. The avifauna of the offshore is less diverse than that of the nearshore/coastal waters of western Greenland. Two sources provided most of the information for this review: the recently released SEIA for the Baffin Bay Assessment Area (Boertmann and Mosbech 2011) and the report on marine mammal and seabird surveys conducted during a seismic site survey, 11 August–18 September 2011 (Abgrall and Harris 2011). Boertmann and Mosbech (2011) provided much useful information on the distribution, abundance, nesting, and ecology of coastal, nearshore, and offshore birds of the region. Information more specific to Shell's Project Area is provided in Abgrall and Harris (2011). The 2011 seismic site survey report includes seabird observations from 65–76°N, including areas well south of the areas of interest for 2012. The following discussion focuses on those observations made within the areas of interest for 2012, approximately 72–76°N. Whereas there is a good general understanding of the species, nesting concentrations, coastal occurrence, and general ecology of the avifauna of eastern Baffin Bay, data on the offshore occurrence of birds is limited.

During the open-water season, eastern Baffin Bay hosts a rich seabird community because of its combination of rich marine feeding areas and nearby suitable cliff-nesting habitat. Many seabirds nest in numerous colonies along the coast of northwest Greenland. Approximately 80% of the world's population of little auk nests along cliffs there: an estimated 33 million pairs. Northwest Greenland also supports the vast majority of Greenland's nesting thick-billed murres. Overall, the area supports birds during the spring and fall migrations, and for nesting, brood-rearing, moulting, and staging. Birds migrate to eastern Baffin Bay from the eastern Canadian Arctic, eastern Canada and northeastern United States, western Europe, and the south Atlantic. In total, it is estimated that at least one hundred million seabirds (adults and juveniles combined) move through Baffin Bay during September and October. Many of those are flightless adult and juvenile thick-billed murres on a swimming migration.

The most abundant species observed offshore during the 2011 seismic site survey were the northern fulmar, black-legged kittiwake, glaucous gull, thick-billed murre, and little auk (Abgrall and Harris 2011). Most of those are true pelagic seabirds, and all nest abundantly along the coast of northwest Greenland. Other species recorded less commonly offshore were the common eider, red phalarope, jaegers (pomarine, parasitic, and long-tailed), ivory gull, Iceland gull, arctic tern, and black guillemot. Table 5-1 summarizes the occurrence of birds recorded in and near the 2012 Project Area during the 2011 seismic site survey.

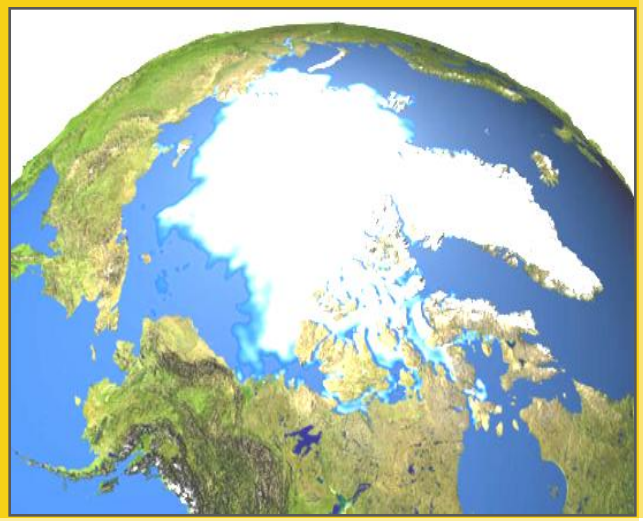
Table 5-2 presents the densities of on-transect sightings. During the 2011 seismic site survey, in areas north of 72°N, on-transect densities for all birds combined ranged from 1.96 birds/km^2 (August, latitudes 72–74°N) to 9.11 birds/km^2 (September, latitudes 74–76°N) (Table 5-2). The northern fulmar, black-legged kittiwake, glaucous gull, thick-billed murre, and little auk accounted for most of the on-transect sightings.

Populations of several species known to occur in the Project Area are on the Greenland Red List, and/or are otherwise of national or international importance. Table 5-3 presents the conservation status of these species (adapted from Table 3 *in* Boertmann and Mosbech 2011).

Shell in the Arctic

Presentation to Ecologic Institute's Arctic Summer College

August 13th 2012



Robert Blaauw

Senior Advisor- Global Arctic Theme

Shell International Exploration and Production

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DEFINITIONS AND CAUTIONARY NOTE

Reserves: Our use of the term "reserves" in this presentation means SEC proved oil and gas reserves for all 2009 and 2010 data, and includes both SEC proved oil and gas reserves and SEC proven mining reserves for 2008 data.
Resources: Our use of the term "resources" in this presentation includes quantities of oil and gas not yet classified as SEC proved oil and gas reserves or SEC proven mining reserves. Resources are consistent with the Society of Petroleum Engineers 2P and 2C definitions.
Organic: Our use of the term Organic includes SEC proved oil and gas reserves and SEC proven mining reserves (for 2008) excluding changes resulting from acquisitions, divestments and year-acerage pricing impact.

To facilitate a better understanding of underlying business performance, the financial results are also presented on an estimated current cost of supplies (CCS) basis as applied for the Oil Products and Chemicals segment earnings. Earnings on an estimated current cost of supplies basis provides useful information concerning the effect of changes in the cost of supplies on Royal Dutch Shell's results of operations and is a measure to manage the performance of the Oil Products and Chemicals segments but is not a measure of financial performance under IFRS.

The companies in which Royal Dutch Shell plc directly and indirectly owns investments are separate entities. In this presentation "Shell", "Shell group" and "Royal Dutch Shell" are sometimes used for convenience where references are made to Royal Dutch Shell plc and its subsidiaries in general. Likewise, the words "we", "us" and "our" are also used to refer to subsidiaries in general or to those who work for them. These expressions are also used where no useful purpose is served by identifying the particular company or companies. ''Subsidiaries'', "Shell subsidiaries" and "Shell companies" as used in this presentation refer to companies in which Royal Dutch Shell either directly or indirectly has control, by having either a majority of the voting rights or the right to exercise a controlling influence. The companies in which Shell has significant influence but not control are referred to as "associated companies" or "associates" and companies in which Shell has joint control are referred to as "jointly controlled entities". In this presentation, associates and jointly controlled entities are also referred to as "equity-accounted investments". The term "Shell interest" is used for convenience to indicate the direct and/or indirect (for example, through our 24% shareholding in Woodside Petroleum Ltd.) ownership interest held by Shell in a venture, partnership or company, after exclusion of all third-party interest.

This presentation contains forward-looking statements concerning the financial condition, results of operations and businesses of Royal Dutch Shell. All statements other than statements of historical fact are, or may be deemed to be, forward-looking statements. Forward-looking statements are statements of future expectations that are based on management's current expectations and assumptions and involve known and unknown risks and uncertainties that could cause actual results, performance or events to differ materially from those expressed or implied in these statements. Forward-looking statements include, among other things, statements concerning the potential exposure of Royal Dutch Shell to market risks and statements expressing management's expectations, beliefs, estimates, forecasts, projections and assumptions. These forward-looking statements are identified by their use of terms and phrases such as ''anticipate'', ''believe'', ''could'', ''estimate'', ''expect'', ''intend'', ''may'', ''plan'', ''objectives'', ''outlook'', ''probably'', ''project'', ''will'', ''seek'', ''target'', ''risks'', ''goals'', ''should'' and similar terms and phrases. There are a number of factors that could affect the future operations of Royal Dutch Shell and could cause those results to differ materially from those expressed in the forward-looking statements included in this presentation, including (without limitation): (a) price fluctuations in crude oil and natural gas; (b) changes in demand for the Shell's products; (c) currency fluctuations; (d) drilling and production results; (e) reserve estimates; (f) loss of market share and industry competition; (g) environmental and physical risks; (h) risks associated with the identification of suitable potential acquisition properties and targets, and successful negotiation and completion of such transactions; (i) the risk of doing business in developing countries and countries subject to international sanctions; (j) legislative, fiscal and regulatory developments including potential litigation and regulatory measures as a result of climate changes; (k) economic and financial market conditions in various countries and regions; (l) political risks, including the risks of expropriation and renegotiation of the terms of contracts with governmental entities, delays or advancements in the approval of projects and delays in the reimbursement for shared costs; and (m) changes in trading conditions. All forward-looking statements contained in this presentation are expressly qualified in their entirety by the cautionary statements contained or referred to in this section. Readers should not place undue reliance on forward-looking statements. Additional factors that may affect future results are contained in Royal Dutch Shell's 20-F for the year ended 31 December, 2010 (available at www.shell.com/investor and www.sec.gov). These factors also should be considered by the reader. Each forward-looking statement speaks only as of the date of this presentation, 26 June 2012. Neither Royal Dutch Shell nor any of its subsidiaries undertake any obligation to publicly update or revise any forward-looking statement as a result of new information, future events or other information. In light of these risks, results could differ materially from those stated, implied or inferred from the forward-looking statements contained in this presentation. There can be no assurance that dividend payments will match or exceed those set out in this presentation in the future, or that they will be made at all.

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Objectives and Agenda

Objectives

- Introduce Shell's Arctic business to the Forum
- To stimulate discussion around responsible Arctic development

Agenda

- Arctic business and Shell
- Addressing the "Myths"
- Discussion



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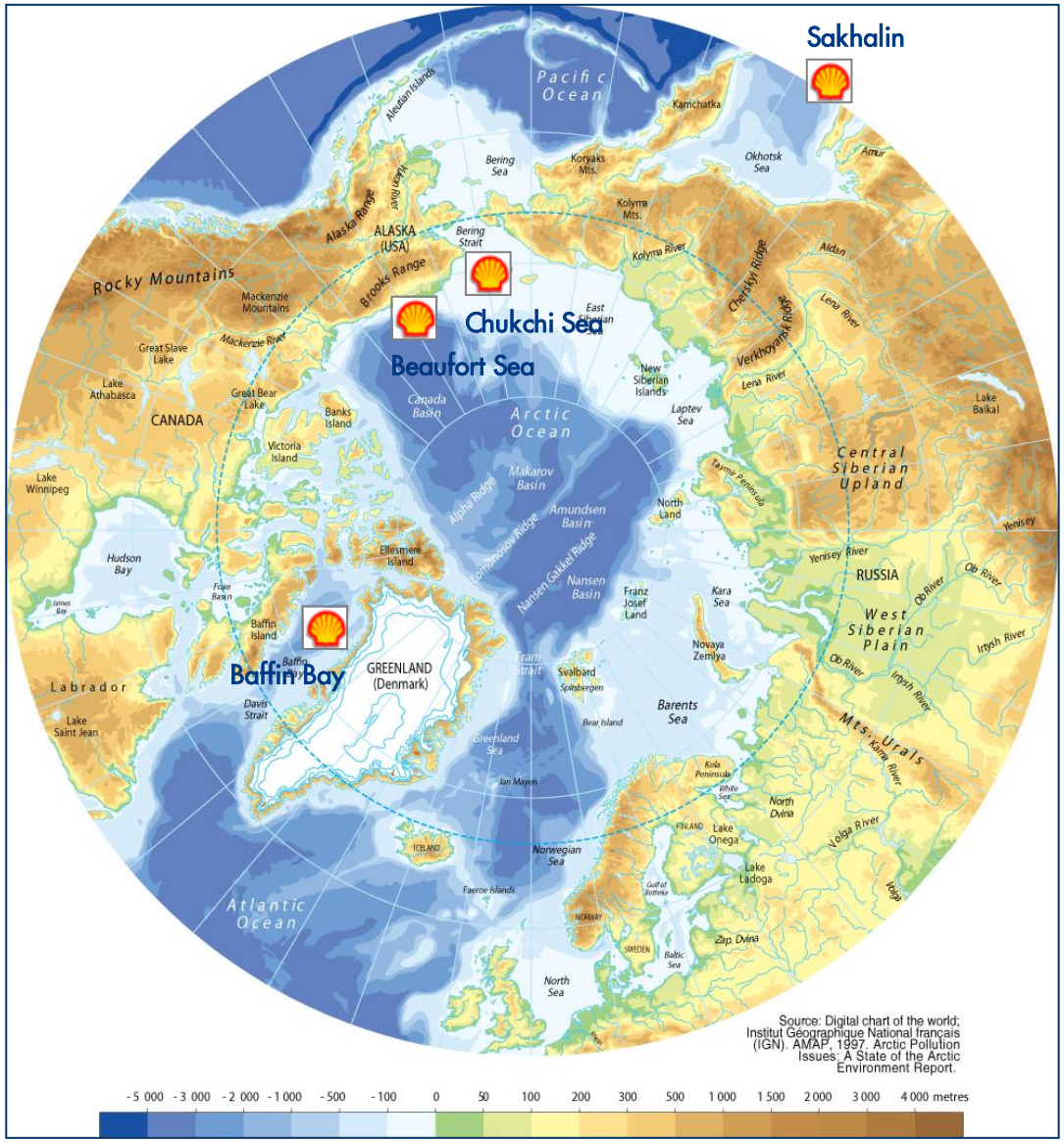
Arctic Overview- Our business





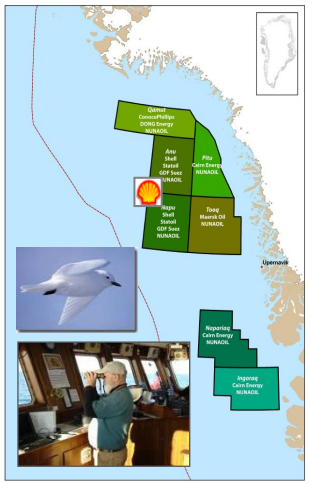












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Established position
Exploration or Production

Shell in the Arctic and Sub Arctic

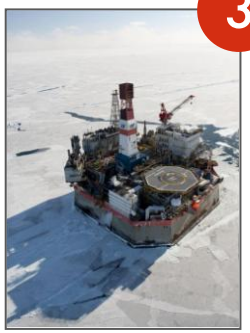

Anchorage Daily Times

MAJOR OIL STRIKE ANNOUNCED FOR SHELL'S COOK INLET WELL

Tests Indicate Daily Yields Of 600 Barrels

Alaska Oil Future Now Seen As Promising







1918 – Shell geologists look for oil in Alaska

1950-56 – First seismic surveys in Alaska

1958 – First onshore drilling Alaska peninsula

1963 – 1 – First offshore drilling, Cook Inlet, Alaska

1965 – First Cook Inlet production start, Alaska

1982 – 2 – Drilling from man-made Term Island, Alaska

1984 – Oil discovery in Beaufort Sea, Alaska

1987 – Seismic mapping of the Chukchi Sea, Alaska

1989 – Chukchi Sea exploration begins

1999 – 3 – First oil production from Sakhalin II

2004 – First production from Salym project, Siberia

2005 – Shell re-enters Alaska, acquires 179 licenses in the Beaufort Sea

2007 – Shell acquires 275 licenses in the Chukchi Sea, Alaska

2008 – Ormen Lange production starts, Norway

2009 – Sakhalin II LNG production begins, Russia. – 4

2010 – Shell acquires 2 Lease Blocks in Baffin Bay - West Greenland

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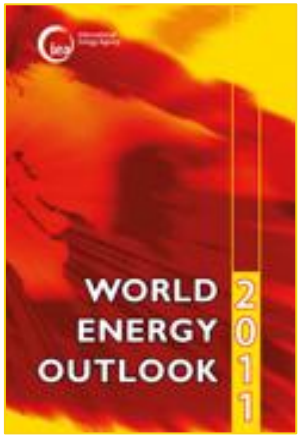
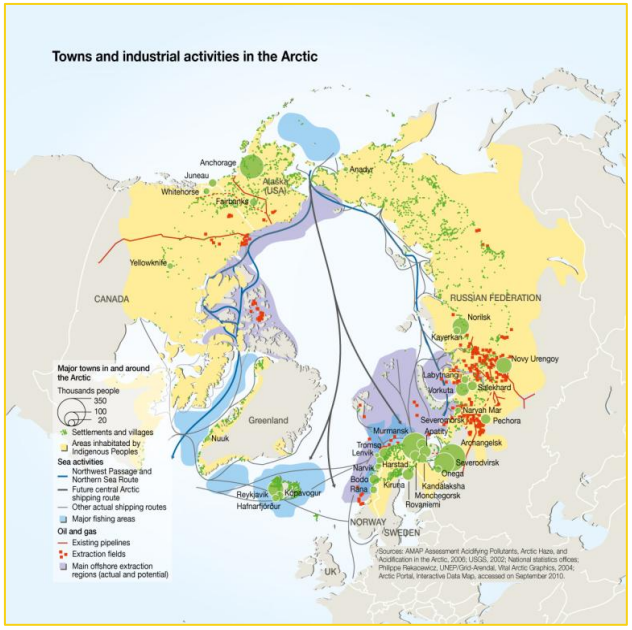
Dealing with common Myths

- Arctic oil and gas is not needed
- Gold rush for Arctic oil
- Climate Change enables oil exploration
- Pristine and undeveloped region
- No infrastructure to support operations
- Inadequate science of ecosystem
- Darkness / high seas and ice cover
- High Risks - Fiscal / Technical / Societal
- Inevitable Oil Spills - "Arctic Macondo"
- Lack of Industry Oil Spill Prevention and Response capability and limited R&D







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The global energy future to 2050

Rising Energy Demand	Supply Pressure	Climate Change

9 billion people; 75% living in cities
2 billion more than today

3-4 times as rich as today
as population in developing countries shifts from poverty to middle class

2 billion vehicles
800 million at the moment

50% more energy
supplying about 50% more energy than today in 2050. At the same time having to reduce CO_2 and GHG emissions

Half the energy intensity
using half the energy as now to produce each dollar of wealth

3 times today's renewables
energy from renewable sources will be 3 times as much as it is today

Source : UN, Shell Scenarios team

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Arctic basins

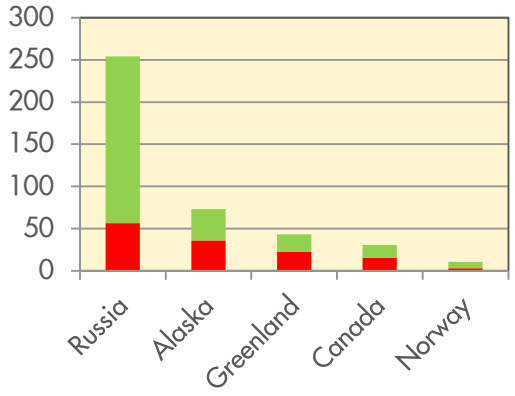
Large basin potential

- >10 bn boe YTF
- Most have limited data, highly uncertain estimates
- Major volumes are offshore (onshore only in Russia)

Arctic Global Resources

YTF (USGS 2008)		Global
Oil:	90 bln bbl	13%
Gas:	1669 tcf	30%
NGLs:	44 bln bbl	20%
Total	412 bln boe	22%

84% offshore



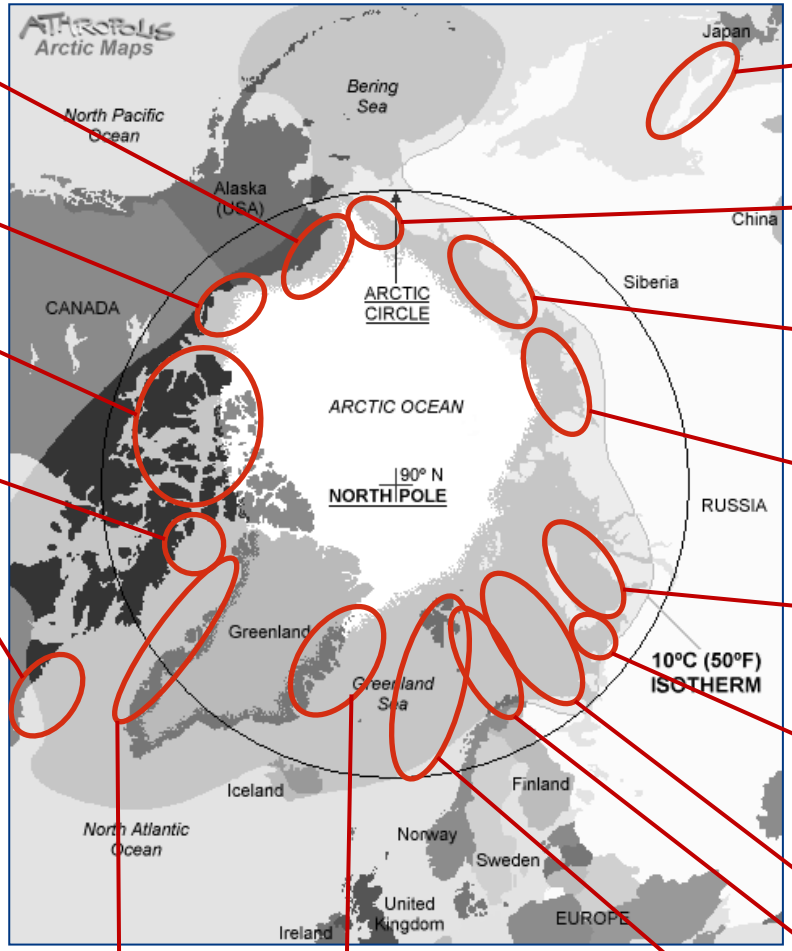
US Chukchi & Beaufort

Canada - Beaufort

Canada - Arctic Islands

Canada - Baffin

Canada Labrador



Russia - Sakhalin

Russia - Chukchi

Russia - East Siberia

Russia - Laptev

Russia - Kara

Russia - Pechora

Russia - Barents

West Greenland

East Greenland

Norway - Svalbard/Nordland

Norway - Barents

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No Gold Rush - Development takes time - TAPS example

18 Feb - Prudhoe Bay #1 Well test



29 Apr – haul road construction commences

1968/9 - Sag River #1 appraisal well drilled

1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977

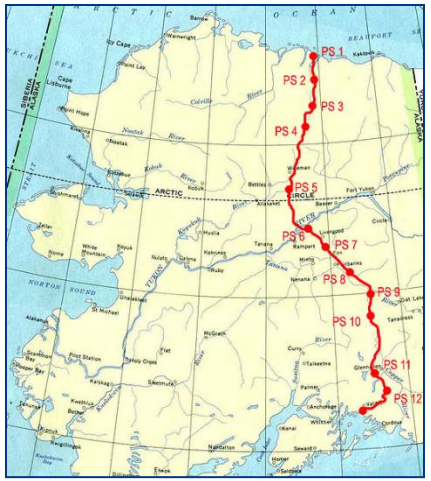
25 June - Prudhoe Bay discovery announced

10 Sept 1969 State Lease Sale

16 Nov – Alaska pipeline authorization signed into law by Nixon

28 July – 1st oil reaches Valdez

6 June - TAPS formal application to DOI for R.O.W.





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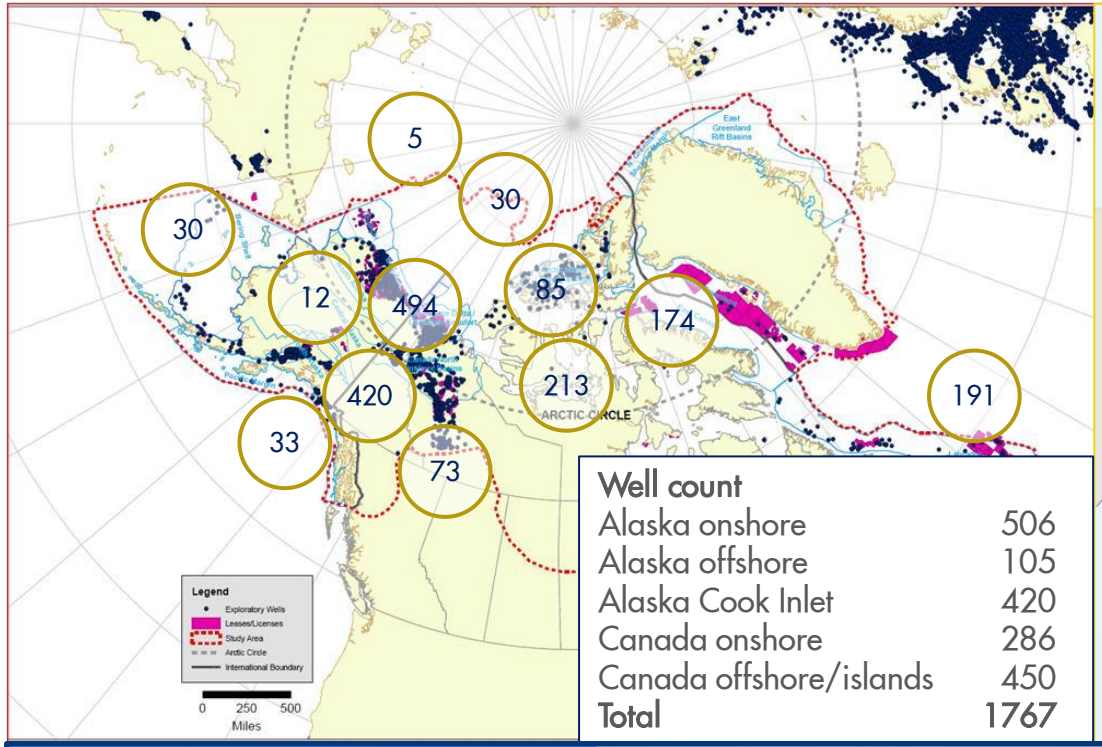
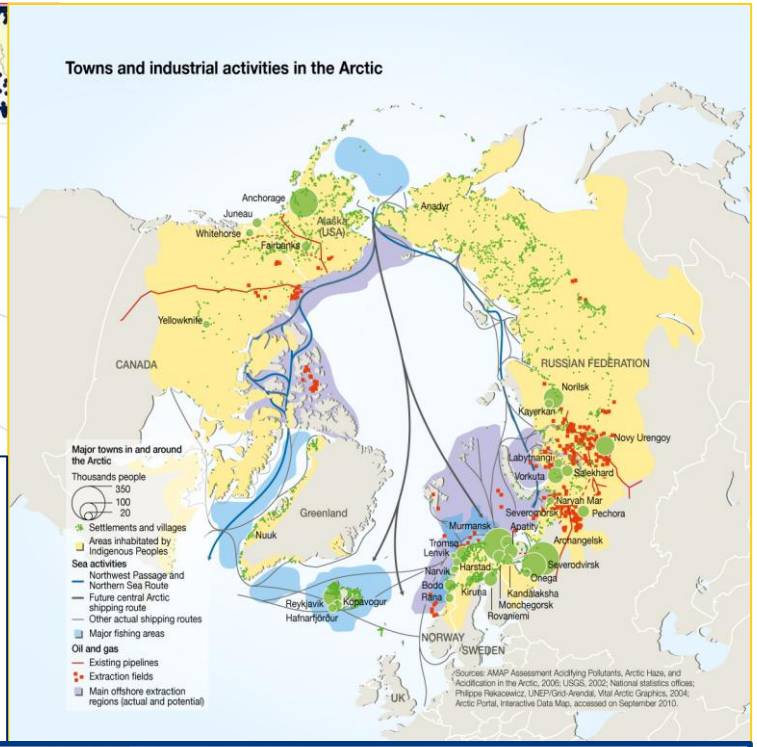
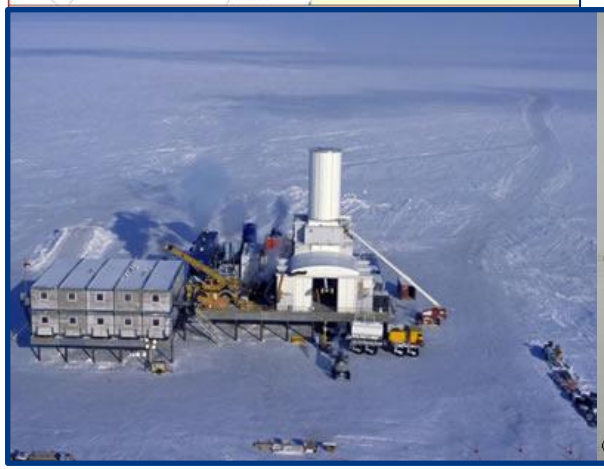
Undeveloped ?



Well count	
Alaska onshore	506
Alaska offshore	105
Alaska Cook Inlet	420
Canada onshore	286
Canada offshore/islands	450
Total	**1767**

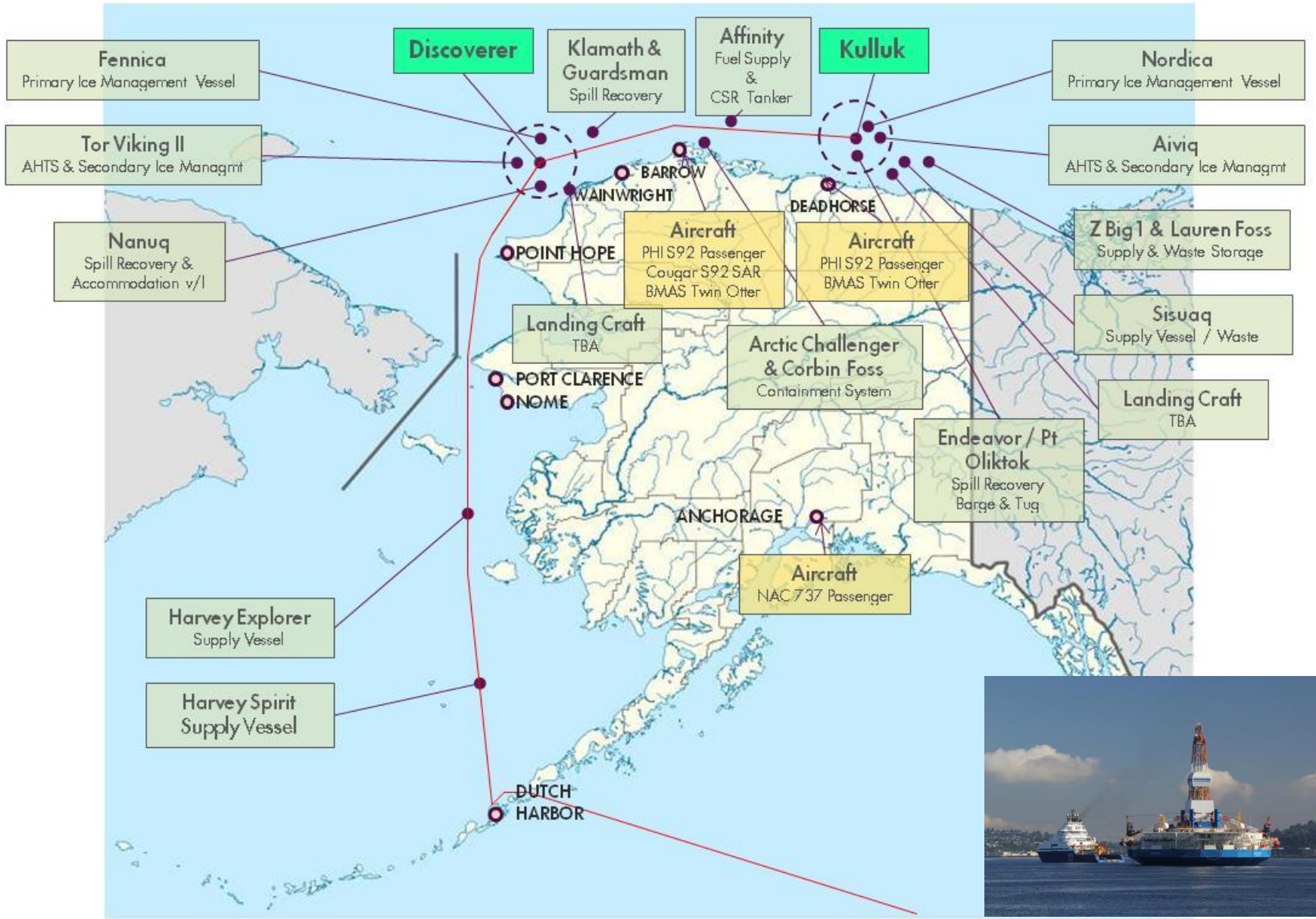








Logistics Fleet to Support 2 Drilling Rigs in 2012

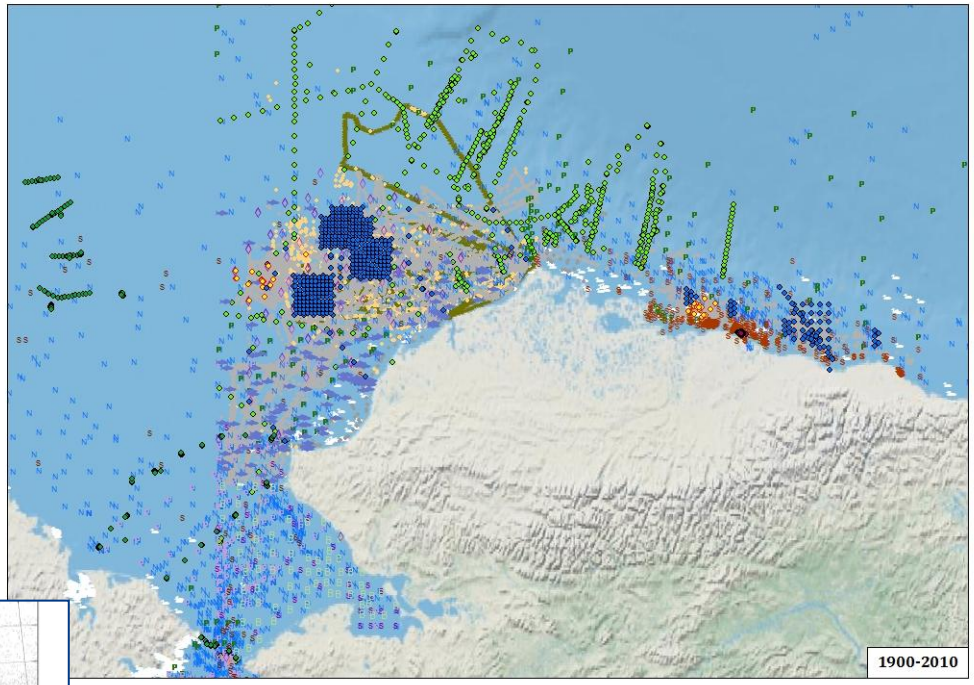


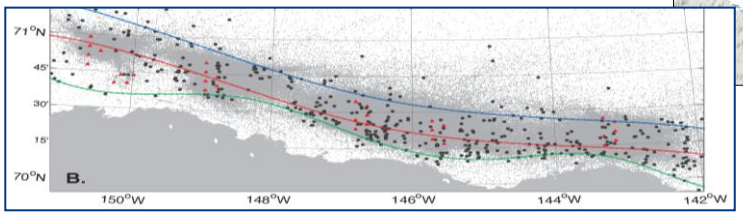
A century of science cooperation in Alaska

- Government agencies
- Local organizations
- Academia
- Research Institutions
- Oil companies

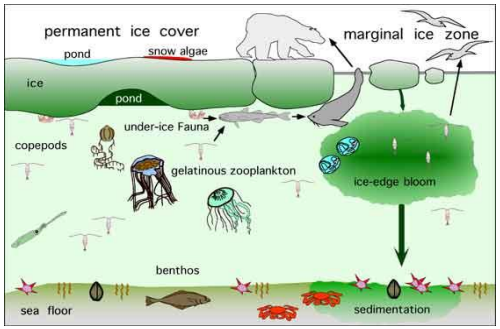




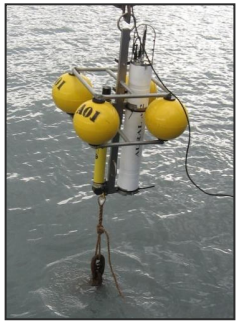












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Shell Arctic Capability - Technology

Core Arctic areas



Operating in ice



Footprint reduction



Oil spill response

+

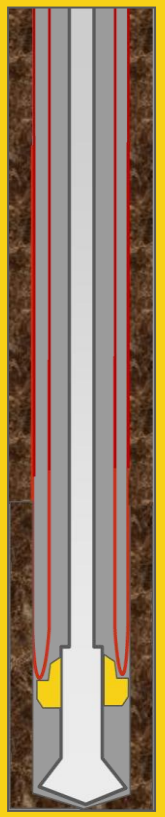
Larger Shell R&D portfolio



Flying Nodes



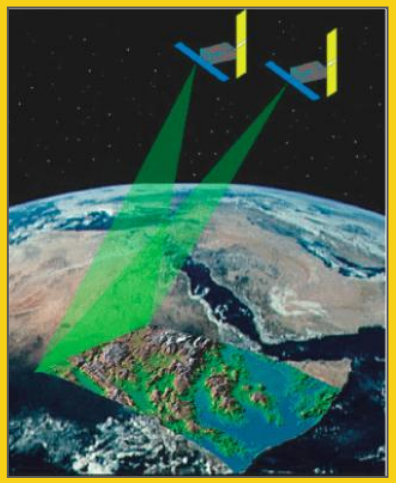
Floating LNG



Wells



Fiber Optics



Remote sensing



Subsea processing

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Focus on Arctic Oil Spill Prevention & Response (OSPR)

- Major advances since Gulf of Mexico spill
- Industry Response
- Well design, control & operations = prevention
- Shell leads OSPR issues / projects
- Shell promotes a full toolkit of response options
  - Mechanical
  - In-situ burning
  - Use of dispersants
- Major R&D aimed at further improvements
  - X-Prize
  - Arctic OSR Technology Joint Industry Project
- Capping and containment introduced in Alaska as well as 24/7 response capability



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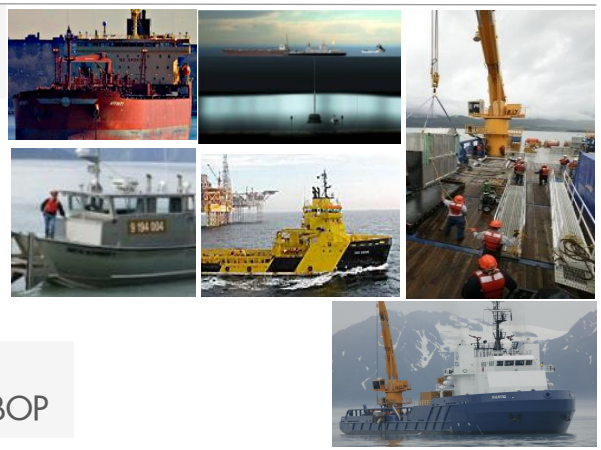
World Class Response Capabilities

Major Response Equipment: On-site, Near-shore and Onshore

On-site Recovery

Oil Spill Response Barge (OSRB)	Cap and Containment System
Arctic Tanker	Dedicated OSR vessel
Vessel of Opportunity	Booms and Storage Bladders
Skimming Vessels	Rope Mop Workboats

Resources Added Post Macondo
Another Set of Shear Rams on the BOP



Nearshore Recovery

Tracking Devices	Pre-staged Equipment and Personnel
Aerial Observation	Anchor Boom
Skimming Vessels	In-Situ Burning Boom
Mini Barges	



Onshore Recovery

Tracking Devices	Pre-staged Equipment and Personnel
Aerial Observation	Skimmers
Protection Boom	Workboats
Fast tanks	



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Work with stakeholders / Co-create Solutions

- Government Organizations
- Government Agencies
- Regulators
- Local Communities
- Community development partners
- Environmental partners
- NGOs
- Joint Venture partners
- Industry Associations
- Academia and R&D Institutions
- Civil Society Institutions / Think tanks
- Standards Agencies



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Alaska

General characteristics

- Politically complex
- Regulatory challenges
- Legal challenges
- Influential local population
- Unique ecosystem
- NGO Opposition

Shell

- 2012 plan to drill exploration wells
- Discoveries made in 1980's
- Investment to date + $4 billion
- 400+ lease blocks in Beaufort and Chukchi seas
- Positive contribution to employment and income Federal & State
- Company changing project







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Greenland

General characteristics

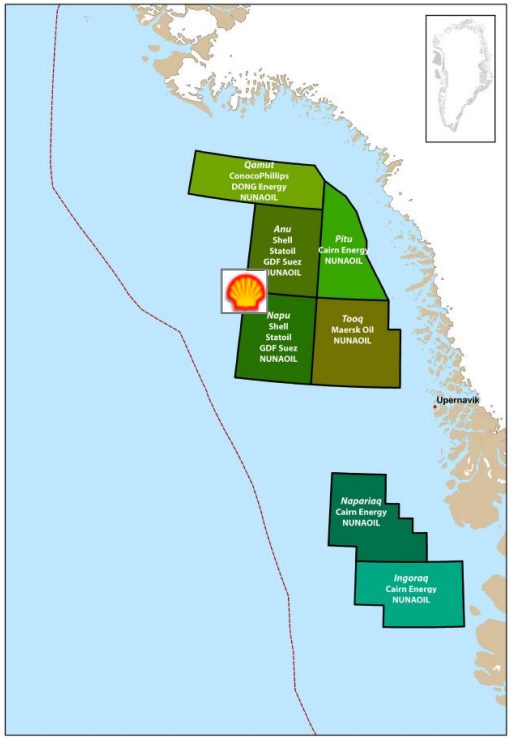
- Limited infrastructure and local capabilities, no industry development, 57000 inhabitants, Home Rule
- Expectations to become oil economy

Arctic frontier exploration

- Exploration has started
- No commercial discoveries yet (13 wells)
- Development is challenging due to sea ice & icebergs

Shell

- Two blocks 20,000 km^2, water depth upto1000m
- 3D seismic and coring in 2012, drilling in 2014 / 2015









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Sakhalin-II in Russia (sub-Arctic)

Mega integrated oil and gas project ($20+ bln)

- Non-Technical Risk issues managed
- First Russian offshore oil and gas
- First LNG project in Russia
- Engineering & Environmental Excellence Awards
- Produce above capacity of 9.6 mln tpa
- 8% of Japanese and 5% of Korean gas market









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February, 2013

SHELL GREENLAND A/S
2013 SITE SURVEY IN BAFFIN BAY
BLOCKS 5 (ANU) AND 8 (NAPU)

PRELIMINARY ENVIRONMENTAL IMPACT ASSESSMENT

RAMBØLL
Akvaplan niva DHI

2013 SITE SURVEY IN BAFFIN BAY BLOCKS 5 (ANU) AND 8 (NAPU) PRELIMINARY ENVIRONMENTAL IMPACT ASSESSMENT

Date **01/03/2013**

Ramboll
Hannemanns Allé 53
DK-2300 Copenhagen S
Denmark
T +45 5161 1000
F +45 5161 1001
www.ramboll.com

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Appendix 1: Introduction to Sound

Appendix 2: Acoustic Modelling

Appendix 3: Summary of calculations for estimates of percentage of populations and numbers of individuals exposed to seismic noise

LIST OF ABBREVIATIONS

µPa	Micropascal
2D HR seismic	Two-dimensional high-resolution seismic
BAT	Best Available Technology
BEP	Best Environmental Practice
BMP	Bureau of Minerals and Petroleum
dB	Decibel
DCE	Danish Centre for Environment and Energy (previously DMU/NERI, National Environmental Research Institute)
EBS	Environmental Baseline Survey
EIA	Environmental Impact Assessment
FLO	Fisheries Liaison Officer
HFO	Heavy fuel oil
HSSE & SP	Health, security, safety, environment and social performance.
IAGC	International Association of Geophysical Contractors
IUCN	International Union for the Conservation of Nature
kHz	Kilohertz
Km	Kilometer
m	Meter
MARPOL	Convention for the Prevention of Pollution from Ships
MBES	Multi Beam Echosounding
MMPP	Marine Mammal Protection Plan
MMSO	Marine Mammal and Seabird Observer
ms	Millisecond
NORSOK	NORSOK standards developed by the Norwegian petroleum industry
OGP	Oil & Gas Producers
OSPAR	Convention for the Protection of the Marine Environment of the North East Atlantic
Pa	Pascal
PAH	Polycyclic Aromatic Hydrocarbons
PAM	Passive acoustic monitoring
RMS	Root Mean Square
s	Second
SAR	Search And Rescue
SEIA	Strategic Environmental Impact Assessment
SEL	Sound exposure level
SPL	Sound pressure level
SSS	Side Scan Sonar
TAC	Total Allowable Catch

1. INTRODUCTION

Shell Greenland A/S (hereafter Shell) is the operator of the license blocks 5 (Anu) and 8 (Napu) in Baffin Bay, Greenland (Figure 1-1).

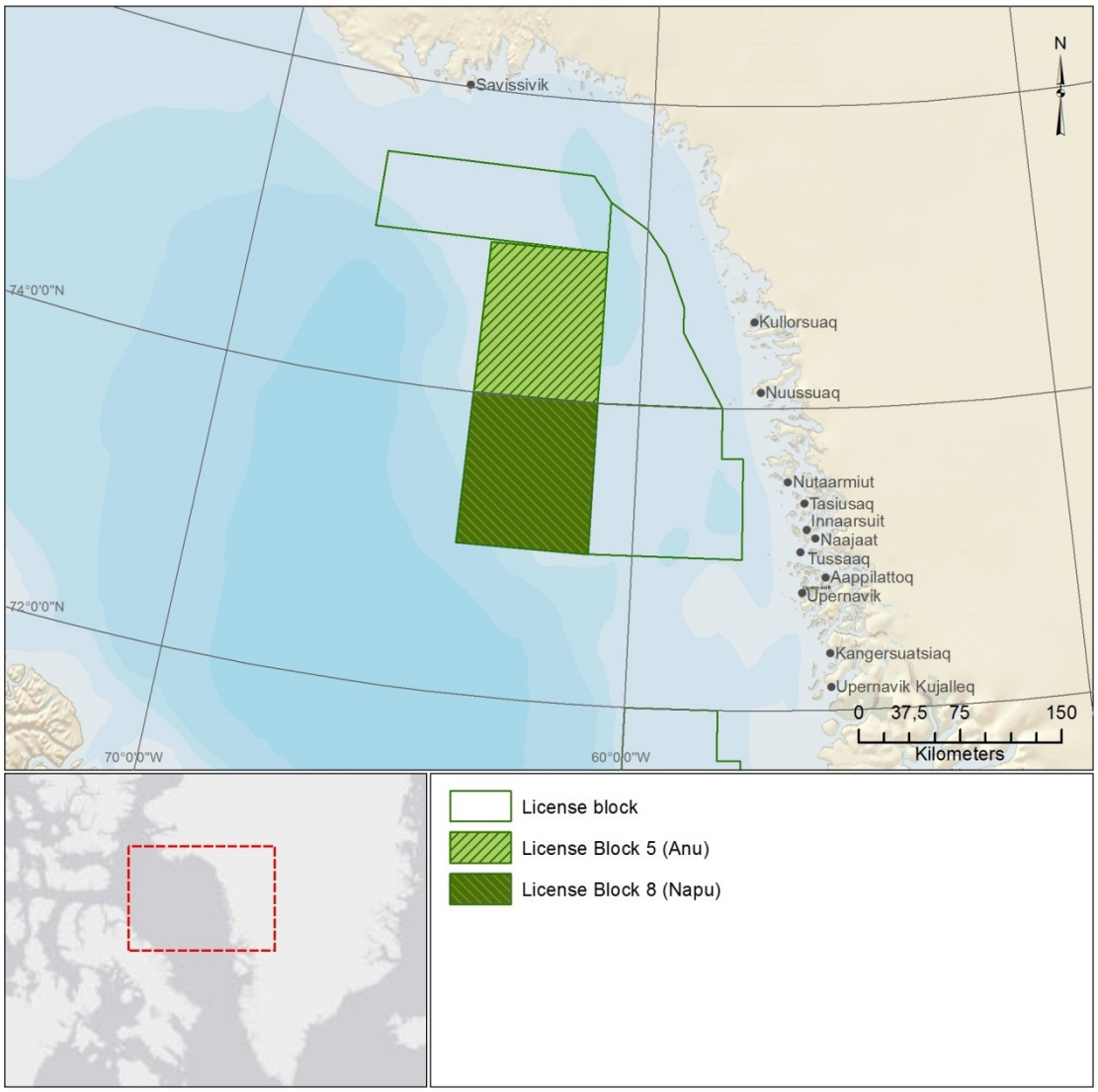

Figure 1-1 Location of the license blocks Anu (Block 5) and Napu (Block 8) in Baffin Bay, Greenland.

The two license blocks each cover an area of approximately 10,000 km^2. The licensees are the same for the two license blocks. In addition to Shell (the operator), the licensees are GDF SUEZ E&P Greenland AS, Statoil Greenland A/S and NUNAOIL A/S. License numbers for the two blocks are No. 2011/12 and No. 2011/14.

1.1 Exploration activities

To date, Shell has been the operator for a Site Hazards Survey (2011), a Shallow Coring Project (2012) and a 3D Seismic Survey (2012). Based on these, potential sites for exploratory drilling have been identified.

In 2013, Shell is planning to conduct a site survey of the potential drilling sites. The proposed 2013 activities are described in section 3.

1.2 Environmental impact assessment

Under the Greenlandic Mineral Resources Act, part 15, exploration-related activities require the submission of an Environmental Impact Assessment (EIA) or, if the activities are not expected of having adverse effect, an Environmental Mitigation Assessment /1/.

Preparation of an Environmental Impact Assessment (EIA) is a systematic process to identify, predict, evaluate and mitigate the environmental impacts of a proposed project, ensuring informed decision-making by the company and the authorities, in this case, the Bureau of Minerals and Petroleum (BMP).

This environmental impact assessment (EIA) for the 2013 site survey in Baffin Bay, has been prepared in accordance with a number of environmental acts, guidelines and manuals /1//2//3//4/.

The EIA presents the technical project, stating how the site survey will be conducted, in accordance with Best Available Technique (BAT) and Best Environmental Practice (BEP).
The impact assessment addresses a number of physical, chemical, biological and socioeconomic parameters. For each parameter, a description of existing conditions and an impact assessment is presented. For any expected, adverse impacts, mitigating measures will be evaluated and any residual impact will be further assessed. The findings of the EIA provide the basis for an Environmental Management Plan for the survey.

The preliminary EIA will be published by the BMP for public consultation. Answers to submissions will be coordinated by the BMP and published with the final EIA report. The process of the EIA and public consultation is summarised in Table 1-1.

Table 1-1 Time table for the EIA process

Activity	Expected timing
Preliminary EIA submitted to BMP	March 1st 2013
Public consultation	March 1st – April 26th 2013
Response to public and regulatory comments	Expected May 2013
Final EIA submitted	Expected June 2013

2. REGULATORY FRAMEWORK

2.1 Greenlandic legislation and guidelines

The 2013 site survey in Baffin Bay is an activity under the Greenland Parliament Act no. 7, 2009 on mineral resources and mineral resources activities (The Mineral Resources Act) /1/. An amendment to the Mineral Resources Act was adopted by Parliament and in effect by 1 January 2013.

The EIA has been prepared in accordance with Guidelines to environmental impact assessment of seismic activities in Greenland waters, December 2011 /3/ and Manual for seabird and marine mammal survey on seismic vessels in Greenland, May 2012 /4/.

2.2 International treaties, conventions and best practice

Greenland is a self-governing province of Denmark with extensive autonomy on matters of environment and biodiversity. Since the establishment of the home rule in 1979, Greenland has signed a number of international agreements and has undertaken obligations under several international conventions concerning the use, administration and protection of the environment.

As required by the BMP guidelines, offshore exploration activities are planned and executed in a way so that environmental risks are identified, assessed and reduced as much as reasonable practical. Best Available Technique (BAT) and Best Environmental Practice (BEP) shall be applied and used in order to minimise environmental impacts of the site survey. BAT and BEP guidelines (e.g. NORSOK and OGP standards), international conventions (e.g. OSPAR and MARPOL) have been observed in the preparation of the EIA and EMP.

2.3 Shell standards

Shell requires that EIAs are prepared in line with internationally recognised standards. International Finance Corporation Performance Standard 1 is used as a reference document, with Greenlandic requirements and guidelines taking priority.

The site survey will be conducted within the framework of Shell's internal standards and business principles, as well as the environmental, health, and safety policies and procedures of engaged contractors. Environmental, Health and Safety management of the site survey will follow the procedures and requirements as described in Shell's HSSE & SP Control Framework and Corporate Standards (Table 2-1).

Table 2-1 Shell commitment and policy on health, security, safety, environment and social performance.

Commitment	Policy
Shell is committed to: • Pursue the goal of no harm to people • Protect the environment • Use material and energy efficiently to provide our products and services • Respect our neighbours and contribute to the societies in which we operate • Develop energy resources, products and services consistent with these aims • Publicly report on our performance • Play a leading role in promoting best practice in our industries • Manage HSSE & SP matters as any other critical business activity • Promote a culture in which all Shell employees share this commitment	Every Shell Company: • Has a systematic approach to HSSE & SP management designed to ensure compliance with the law and to achieve continuous performance improvement • Sets targets for improvement and measures, appraises and reports performance • Requires contractors to manage HSSE & SP in line with this policy • Requires joint ventures under its operational control to apply this policy, and uses its influence to promote it in its other ventures • Engages effectively with neighbours and impacted communities • Includes HSSE & SP performance in the appraisal of staff and rewards accordingly.

3. PROJECT DESCRIPTION

3.1 Project overview

Shell, as operator, is planning to undertake a site survey during the summer season of 2013 as preparation for future exploration of the license blocks 5 and 8 in Baffin Bay. The 2013 site survey is expected to be carried out by one or two vessels and includes:

- A two-dimensional high resolution (2D HR) seismic survey in multiple survey sites (of app. 3 x 3 km)
- An Environmental Baseline Survey (EBS) in multiple survey sites (of app. 3 x 3 km)
- Service of metocean buoys deployed during the 2011 survey and serviced in 2012
- Deployment and recovery of Passive Acoustic Monitoring (PAM) buoys

The general objective of the site survey is to evaluate the presence of subsurface hazards, such as shallow gas pockets, and to obtain physical, chemical and biological characterisation of the immediate area around the potential drilling sites. The metocean monitoring activities are performed to gain a better understanding of the site-specific meteorological, oceanographic and ice conditions.

Key figures concerning the proposed 2013 survey especially in relation to the seismic activities are presented in Table 3-1 and compared to the 2012 survey in the same area.

Table 3-1 Key figures concerning the 2012 and 2013 surveys

	2012 survey	Proposed 2013 survey
Seismic survey area	~ 8,500 km^2	~ 90 km^2
Duration of seismic activities	~ 2.5 months	~ 10 days
Number of vessels	2 seismic (+ 5 support vessels)	1 seismic (+ possibly 1 EBS)
Size of air gun array	2 x 3,480 in^3	1 x 160 in^3

The following sections provide, in accordance with BMP's EIA Guidelines /3/, a description of the proposed type of work, area, schedule, equipment and materials for the planned 2013 site survey. Table 3-2, Table 3-4, Table 3-3 and Table 3-5 presents survey details in the format required by the BMP EIA Guidelines.

The locations and actual number of survey sites (possibly up to 10 survey sites) are not fixed at this stage. However, the survey sites will be within the three survey areas illustrated in Figure 3-1. The figure also illustrates locations of proposed metocean and PAM buoys. Actual number and exact location of survey sites and metocean and PAM buoys will be determined and communicated to BMP. It is expected that location of survey sites will be situated in the survey areas within the two license blocks. The surveys will be restricted to up to ten survey sites (each 3x3 km) and will occur at depths of 500 – 800 m.

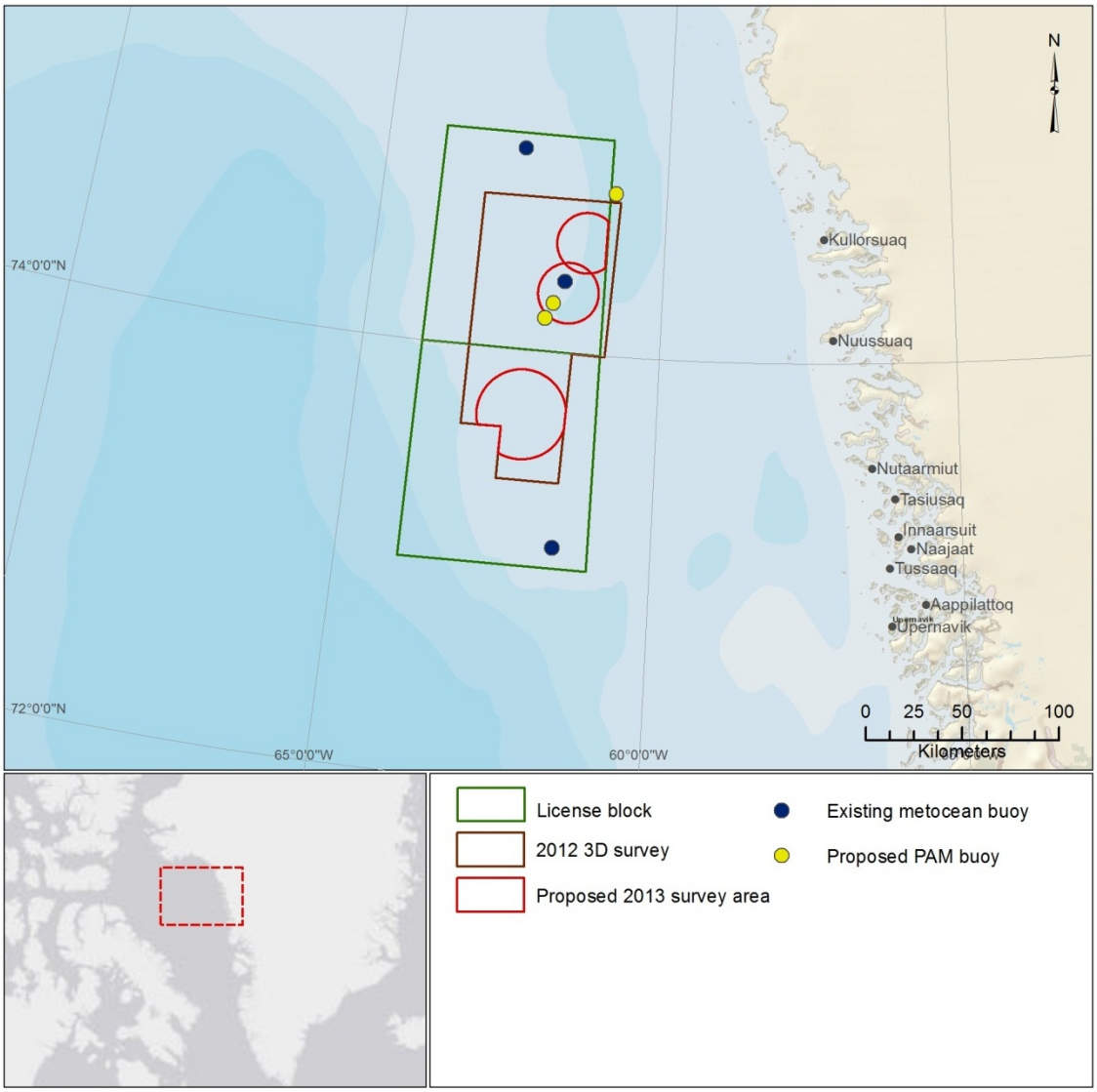

Figure 3-1 Proposed survey areas, locations of metocean buoys and PAM equipment

As illustrated in Figure 3-1 the 2D HR seismic survey is proposed within selected parts of the area covered by the 3D seismic survey conducted in 2012. The area to be covered by 2D HR seismic activities in the proposed 2013 survey is up to 90 km^2. As a reference it can be informed that the 3D seismic survey in 2012 covered approximately 8,500 km^2.

The planned site survey has been announced for tender as of December 19th 2012 and the proposals by potential contractors are requested on February 8th 2013. Award is expected mid-March. Therefore, specific details concerning e.g. vessels (expected up to two), equipment, logistic details etc. cannot be provided in this EIA.

As basis for the assessments in this EIA (see section 5), this section will build on relevant requirements specified to potential providers of this service. Furthermore, descriptions of typical and/or expected equipment for these types of surveys will be described based on experiences from surveys performed under the same licenses in 2011 and 2012 /5//6/.

3.2 Survey schedule and programme

3.2.1 General details

The timing of the site survey is highly dependent on ice conditions. The site survey is proposed to be undertaken in the period between July 15th and October 15th 2013 or as long as prevailing weather/ ice conditions allows. No 2D HR seismic shots will however be performed before August 1st 2013. Survey operations can normally continue 24 hours a day, seven days a week. See also section 3.3.3 and Appendix 2 concerning acoustic monitoring.

The speed and progress of the site survey is likely to be influenced by the weather and the presence of ice in the survey areas. The order of surveyed sites will for the same reason depend on weather and ice conditions and operational requirements.

3.2.2 2D High resolution seismic survey

The site survey includes a 2D HR seismic survey in up to ten 3 x 3 km survey sites within the survey areas in the two license blocks. The line spacing within the 3 x 3 km sites will be 100 m in main line direction with cross lines every 250 m adding up to approximately 135 km survey lines in total for each survey site. The target depth for the survey is maximum 1000 m below seabed.

With an assumed vessel speed of 4 knots the 2D HR seismic surveying is expected to be completed within approximately 24 hours at each survey site. In addition, tie lines to adjacent locations may be required. The specific line orientation within the survey sites will be specified at a later stage of the planning and is not considered of importance to this EIA.

The expected duration of the 2D HR seismic survey will involve the following operations and estimated time requirements within the time window for the planned site survey (August 1st to October 15th 2013):

- Mobilisation and transit to survey area – 7 days
- Survey operation, including transit between sites – 22 days
- Standby (weather downtime) – 4 days
- Demobilisation and transit - 4 days

Table 3-2 provides the survey data requested in the BMP EIA Guidelines for seismic activities in Greenland waters /3/.

Table 3-2 Survey data table

Specify	Description	Provided
Type of survey	2D HR seismic survey and EBS	Shell
Map of the area with all transect lines shown	See Figure 3-1 for survey areas. Specific survey sites (up to 10) are not yet defined Individual survey site sizes are 3 km x 3 km Line density 100 m / 250 m Transect lines not available yet	Shell
Start and end dates for the survey	Earliest start (mobilisation etc.): 15/07/2013 No 2D HR seismic shot before: 01/08/2013	Shell
Expected duration	See section 3.2.2	Shell
Duty cycle of operation (in hours / 24 hours). Number of hours in the dark per 24 hours	24 Hours, see section 3.3.3 concerning use of PAM / Hours of darkness in August: 0 h; September: 8 h; 1-15 October: 12 h	Shell
Number and types of accompanying vessels	No accompanying vessels are expected	Shell
Intended use of icebreakers Will survey be carried out in ice?	Icebreaker assistance is not expected, see section 3.4.	Shell

3.2.3 Environmental baseline survey

Environmental baseline survey (EBS) is proposed at the same sites as the 2D HR seismic surveys (see Figure 3-1) to obtain a physical, chemical and biological characterization of the sites. The EBS work consists of:

- An integrated bathymetry survey by Multibeam Echo Sounder (MBES) and Side Scan Sonar (SSS)
- Visual seabed inspections by Remotely Operated Vehicle (ROV)
- Benthic and sediment sampling by ROV or box corer and/or grab sampler

The expected duration of EBS will involve the following operations and estimated time requirements within the time window for the planned site survey (July 15th to October 15th 2013):

- Mobilisation and transit to survey area – 6 days
- Survey operations, including transit between sites – 51 days
- Standby (weather downtime) – 6 days
- Maintenance – 4 days
- Demobilisation and transit - 4 days

3.2.4 Metocean buoys maintenance

Metocean buoys were deployed in 2011. The buoys were serviced during the 2012 surveys and needs servicing again in 2013. These buoys will be retrieved, serviced and returned to the water. This activity will be carried out as part of the 2D HR seismic survey or the EBS within the time frames for the vessel conducting these services (see section 3.2.2 and 3.2.3).

3.2.5 Passive acoustic monitoring buoys

Deployment and recovery of Passive Acoustic Monitoring (PAM) buoys for recording acoustic output from seismic programme and recording marine mammal vocalizations. These activities will be conducted as part of the 2D HR seismic survey or the EBS within the time frames for the vessel conducting these services (see section 3.2.2 and 3.2.3).

3.3 Type and intensity of activities

3.3.1 BAT and BEP implementation

The survey vessels and equipment for the survey will be selected based on operational requirements and the environment in which the survey is being carried out, e.g. ice class of vessels and minimum size of airgun array used. The vessels and equipment used for the survey will comply with industry Best Available Techniques (BAT) and Best Environmental Practice (BEP).

BAT and BEP will be applied and used during the survey in order to minimise environmental impacts. Mitigation measures required to reduce the level of potential impacts in accordance with BAT and BEP are described in the specific impact sections.

3.3.2 Survey vessels

It is not known at the moment if the 2D HR seismic survey and the EBS will be performed from one or two vessels. Vessels will comply with conventions, laws, regulations and legal requirements that apply to the specific activities in this area.

Marine Mammal and Seabird Observers (MMSOs) will be on the vessel during the site survey, addressing mitigation of potential disturbance to marine mammals. The MMSOs will be tasked with implementing monitoring and mitigation measures as detailed in guidelines to environmental impact assessment of seismic activities in Greenland waters /3/ and in accordance with the DCE Manual for seabird and marine mammal survey on seismic vessels in Greenland, May 2012 /4/. The monitoring may be initiated outside Greenland waters, during vessel transit.

The MMSOs have two tasks.

- To watch systematically for marine mammals before start-up and during seismic survey in order to mitigate and observe safety distances to whales and seals.
- To collect data on abundance and distribution of seabirds and marine mammals through systematic surveys. This task shall be carried out both during times when seismic survey is conducted, and when sailing in transit.

During survey activities in conditions with poor visibility a Passive Acoustic Monitoring (PAM) system will be used on board the vessel. The system is expected to be running during the entire survey to continuously monitor the environment. The PAM system will be operated on board the survey vessel. Detected sounds are processed using specialized software. The MMSOs will be competent in operating the PAM system and interpret the detected sounds.

Details of the PAM system in Table 3-3 are requested in the EIA guidelines. These details will be available at contract award.

Table 3-3 Specifications of PAM system, will be available at contract award

Specify	Description	Provided
Number of hydrophones		
Threshold of the recording system		
Sample rate of the recording system		
Where will hydrophones be placed?		
Will there be duty cycling of recordings? In that case when will the PAM system be used?		
Name of software		
Species covered		
Estimated range accuracy, m.		

Furthermore, a Fisheries Liaison Officer (FLO) will be used if required by BMP to communicate and advise in matters related to the fishery. Refer to section 5.13 concerning fishery.

3.3.3 2D HR seismic survey equipment

The survey vessel for the 2D HR seismic survey will be capable of undertaking the following survey operations in water depths of up to 1,000 meters:

- Shallow seismic geohazard surveys
- Bathymetry surveys (single beam echo sounder)

The survey vessel will deploy the following equipment:

- Single Beam Echo Sounder
- Seismic source for geohazard surveys
- Streamer (solid or gel filled)

In addition to BMP requirements, all survey operations will as a minimum comply with the 2011 OGP Guidelines for the conduct of offshore drilling hazard site surveys /7/. Specifically regarding the offshore seismic survey, the contractor will meet “IAGC Environmental Guidelines for World-wide Geophysical Operations (2001)” and “IAGC Recommended Mitigation Measures for Cetaceans during Geophysical Operations (2009)”.

The contractor for the site survey has not been selected and no specific details on e.g. vessels can currently be provided. Figure 3-2 illustrates a typical 2D HR Seismic site survey. A small air gun (standard source configuration and volumes are expected for this survey) will provide the seismic source, with a 600 m solid or gel filled hydrophone streamer to record the seismic reflection towed behind the survey vessel.

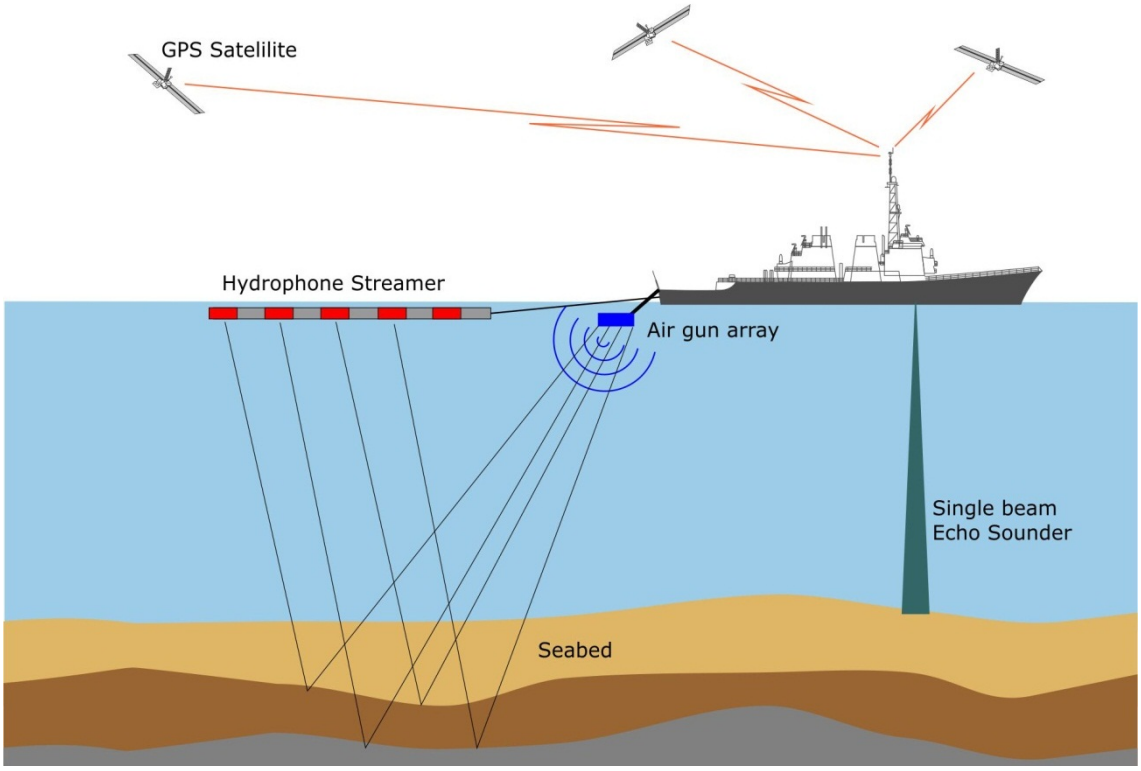

Figure 3-2 Schematic illustration of a typical 2D HR seismic survey setup.

Air guns produce, specifically sound at low frequencies (50-250 Hz) by venting high-pressure air into the water. This produces an air-filled cavity that expands rapidly, then contracts and re-expands to generate the pulsed signal which penetrates the subsurface and is reflected back to the streamers. A single beam echo sounder (SBES) will also be used during the 2D HR seismic survey to obtain knowledge of the seabed. A frequency of 210 kHz is expected for the SBES.

Table 3-4 and Table 3-5 provide the array specifications and acoustic properties of the airgun array requested in the EIA Guidelines for seismic activities in Greenland waters /3/. The presented data pertains to the acoustic modelling performed for this survey, Appendix 2.

For reference it can be informed that the 3D seismic survey conducted in 2012 in the same area was performed using 2 vessels each with an air gun array size of 3,480 in^3 and 6 streamers of 7 km each and supported by 4 chase vessels and 1 support vessel (this 2013 survey assumes an air gun array of 160 in^3, see Table 3-4).

Table 3-4 Array specifications

Specify	Description	Provided
Number and names of vessels towing airgun arrays	One or two vessel will be used for 2D HR seismic survey and EBS. No contracted operator yet.	Shell
For each vessel provide geometric layout of complete airgun array with individual volume specified (in PSI per airgun and in^3 per airgun)	Not available yet. Source configuration and volumes however expected to be standard for 2D HR: 4 x 40 in^3 sleeve gun array.	Shell
Size of total array (In^3 and PSI for the entire array)	160 in^3 is expected	Shell
Firing rate in shots/sec Will sub arrays fire simultaneously or alternate?	Shot point interval 6.25 m at 4 knots.	Shell
Operation speed of the vessel in km/hours or knots.	4 knots	Shell

Table 3-5 Acoustic properties of the airgun array

Specify	Description	Provided
Far field pressure signature (provide figure) **Frequency spectrum of the far field signature (broadband) (provide figure)**	See acoustic modelling report (Appendix 2)	DHI
Source level (source factor) of airgun array on acoustic axis below array, given in all of the following units:		
• **dB re 1 µPa zero- peak (broadband)**	230 dB re µPa	DHI
• **dB re 1 µPa peak- peak (broadband)**	236 dB re 1µPa	DHI
• **dB re 1 µPa rms (Over 90%* pulse dura-tion) (provide duration for rms calculation)**	50 ms pulse duration; 227 dB re 1 µPa	DHI
• **dB re: 1 µPa2s. per pulse**	214 dB re 1 $\mu Pa^2 \cdot s$	DHI
• **Energy, joule/m2 per airgun pulse**	Will be available following contract award	
Signal duration. (Define how it is measured)	50 ms; taken from literature	DHI
Map showing modelled sound pressure levels (rms*), peak-peak and sound exposure level (µPa2s) for the survey area and surroundings (to levels likely to affect marine mammals or nearest land)	See noise maps in acoustic modelling report (Appendix 2)	DHI
Provide description of the noise propagation model, including assumptions of sound speed profiles.	Parabolic Equation RAMgeo code, Sound Speed Profile taken from measurements done in 2012 (details; see acoustic modelling report; Appendix 2)	DHI

3.3.4 Environmental baseline survey equipment

Seabed morphology, seabed bathymetry and presence of biota on the seabed are determined by acoustic means through high resolution Side Scan Sonar (min 500 kHz, SSS) and Multi Beam Echosounding (200 or 400 kHz, MBES). The SSS and MBES will be Remote Operated Vehicle (ROV) or Autonomous Underwater Vehicle (AUV) mounted. Figure 3-3 illustrates a typical vessel for EBS.

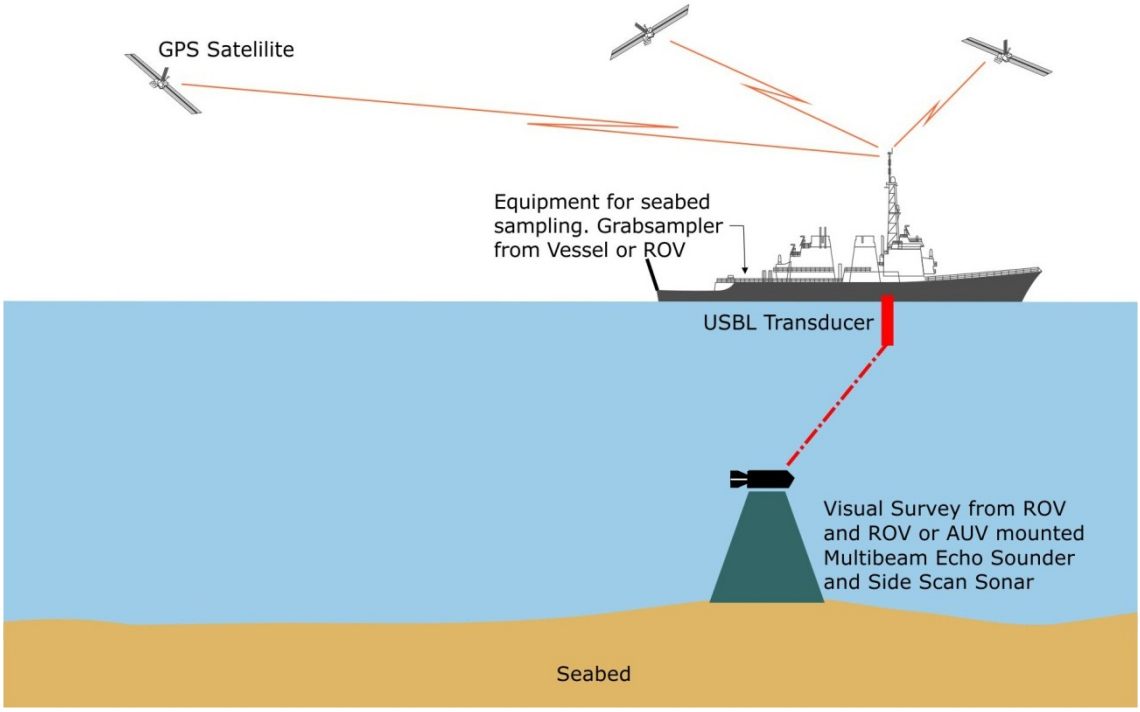

Figure 3-3 Schematic illustration of a typical environmental baseline survey.

Visual inspection will be carried out by means of an HD camera mounted on a ROV. Visual inspection and analysis is required for geophysical and biological seabed features. The visual surveys are executed cautiously to ensure that it does not cause damage to biota, especially if the target includes corals and/or sponges. Visual inspections will be carried out on seabed features with areas >25 m^2. A maximum of 3 inspections per survey site is expected..

Benthic and sediment sampling is proposed in eight stations for each of the survey sites to enable characterisation of benthic invertebrate assemblages and physical/chemical characterization as per OSPAR guidelines. Additional characterisation of epifauna will also be achieved through sampling at the seabed.

Numbers of samples and sampling strata associated with the physical and chemical analysis sediment samples will vary by parameter. The planned methods of collecting sediment samples as well as number of samples and sample specifications are indicated in Table 3-6 for each survey site. The physical footprint will depend on the actual sampling device and the number of samples. Assuming an impact area of 0.1 to 0.25 m^2 per sample and a number of rejected samples, a total area of 70 m^2 per survey site is roughly estimated.

Table 3-6 Planned EBS sampling and methods for each of the three survey sites

Sampling	Method	Station	Samples	Specifications
Seabed bathymetry	Side scan sonar and multi beam echosounder	Minimum area of 3 km x 3 km per survey site	-	-
Seabed features	Remotely operated vehicle w/ HD camera	Dependent on acoustic survey	-	-
Surficial sediment (Benthic invertebrate)	Box corer and/or grab sampler	Minimum of 8 stations per survey site	Minimum of 70 per survey site	Volume of each sample is 0.02 m^3 (0.32x0.32x0.2 m^3)
Surficial sediment (Chemistry)	Box corer and/or grab sampler	Minimum of 8 stations per survey site	Minimum of 116 per survey site	Weight of samples is between 50 and 300 g per sample Maximum depth of sampling is 6 cm
Epifauna	Small bottom trawl or dredge	Dependant on acoustic and ROV survey	One tow per sampling station	Contents of trawl or dredge

3.3.5 Metocean and PAM buoys

The monitoring equipment for the metocean and PAM buoys requires a means of securing them to the seabed. For ease of handling and deployment, steel weights are used as ballast. This is a relatively common method of securing such moorings and provides the necessary ballast which is easy to deploy and has a small seabed footprint. During deployment of the buoys it is possible that the steel weight will settle into the seabed. The planned method for recovery is to leave the steel weights on the seabed following recovery of the equipment. This will leave a physical footprint of less than 1 m^2 per buoy and the weights would degrade slowly over time.

An example of an metocean buoy setup is illustrated in Figure 3-4.

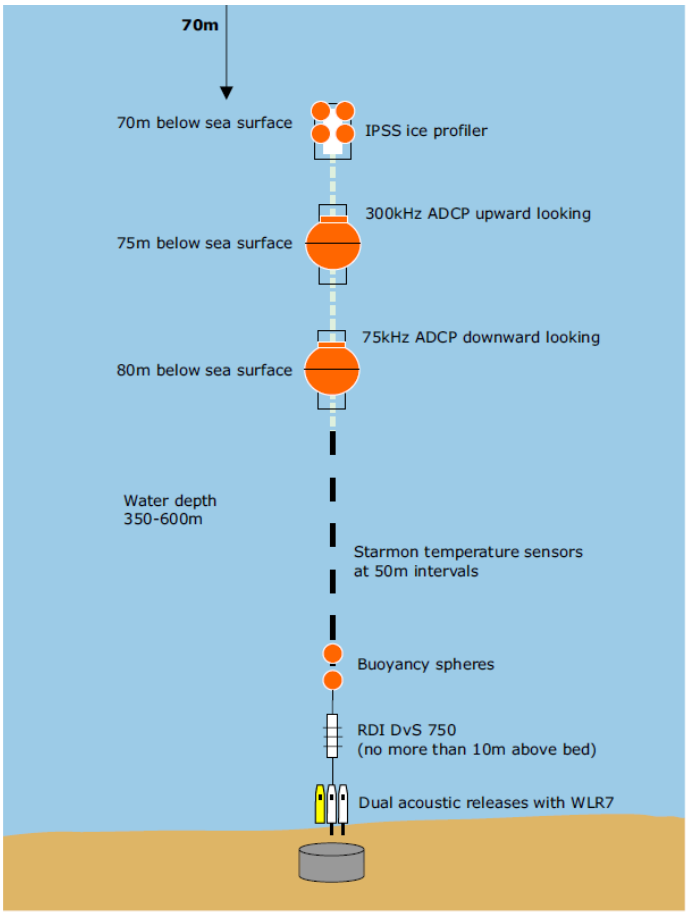

Figure 3-4 Principle of oceanographic mooring setup

3.4 Logistics

Upernavik is the proposed primary port for medical emergency response, with Aasiaat proposed as an alternative base.

Crew changes as needed are planned executed through the nearest suitable port or by crewboat from Upernavik.

Bunkering and resupply will only take place in accordance with the Manual of Permitted Operations (MOPO) developed specifically for this operation once the contractor has been selected.

Approximately 35 and 50 personal are expected to be stationed onboard the survey vessels for the 2D HR seismic survey and the EBS respectively, assuming two vessels.

A comprehensive ice management plan will be developed as part of the project preparations. The plan will outline how icebergs and growlers will be dealt with to ensure a safe operation of the vessel during operations and transit. This will include systems for iceberg/growler detection, tracking and avoidance procedures.

Icebreaker assistance is not expected, as the survey will only take place during conditions without first year ice.

3.5 Waste, emissions and discharges

3.5.1 Emissions to air

The main source of emissions to the atmosphere will be from the vessel's engines. The vessels will use marine gasoil with sulphur content less than 1.5 % (weight).

It is roughly estimated that the total fuel consumption from both the seismic vessel and the EBS vessel is expected to be approximately 2,500 tonnes in total for both surveys (EBS and seismic).

Standard industry emission factors /8/ are used to estimate emissions to air based on the fuel usage of 2,500 tonnes. The total emissions are presented in Table 3-7.

Table 3-7 Estimated emissions to air from vessels during 2013 survey

Component	Estimated total emissions (tonnes)
CO_2	7925
NO_x	175
Nm VOC	13
SO_x	7
N_2O	1
CO	18

3.5.2 Vessel liquid discharges

The main liquid effluents generated by the survey vessels will comprise:

- Greywater (water from culinary activities, shower and laundry facilities, deck drains and other non-oily waste water drains (excluding sewage))
- Treated blackwater (sewage)
- Drainage water
- Service water / vessel engine cooling water.

All discharges will comply with requirements set out in the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78) and its annexes.

The total volumes of planned discharges (from both EBS and seismic survey, assuming to vessels) are estimated at 4,500 litres of treated blackwater and 13,000 litres greywater. These estimates assume that black water and grey water are produced at a rate of up to 50 litres and 150 litres per person per day respectively /5/, for the expected number of persons on board i.e. 35 persons (EBS) and 50 persons (seismic survey). The total volume of discharged service water is expected to be small and spread over a large offshore area.

3.5.3 Vessel solid wastes

All solid wastes will be sorted by type, compacted where practicable and stored on board before disposal to an appropriate certified onshore reception facility. It is proposed that the survey vessels will bag solid waste materials and store them on board for disposal on return to the vessel's home ports. Should waste disposal be required in Greenland, an appropriate port will be used to provide waste handling / disposal facilities. Food waste will be macerated and disposed at sea. All wastes during the survey will be managed in accordance with MARPOL requirements, relevant national legislation and best practice principles.

3.5.4 Lights

During the open water season there is constant light in the Baffin Bay area until dark nights start in early September.

At 74°N, the midnight sun period, with the sun continuously above the horizon lasts from April to August. Up to the 12 h day/12 h night at autumn equinox (21st September) the number of daylight hours decrease gradually. By the end of the survey window (October), the day-length will have decreased to approx. 4 hours in the survey area, and by November 7, the polar night engulfs the survey area. The need for on-deck illumination thus increases during the survey.

All survey vessels will carry appropriate navigation lights for periods of poor visibility and night-time, including ice searchlights.

3.5.5 Noise

The vessels and the 2D HR seismic survey and other geophysical equipment generate underwater noise.

The largest sound pressure level will be generated by the survey airgun and the frequency content of the emitted pulse will be a function of the total airgun volume (see section 5.2.1). The signal is focused in a downward direction to limit spreading of sound.

High resolution seismic site survey uses a much smaller airgun than other seismic surveys, which typically use airgun arrays with a capacity far greater than 1,000 in^3. The airgun size expected for this survey is 160 in^3. Typical noise levels produced are presented in section 5.2.1.

3.6 Demobilisation

Demobilisation is pending further planning when contractor is selected. The vessels may demobilise in Greenland from the survey areas on completion of the site survey.

4. CONSIDERED ALTERNATIVES

4.1.1 Timing

The survey schedule is predominantly determined by ice conditions in the area, as well as availability of a suitable vessel tailored to operating in these conditions. Ice cover for much of the year prevents vessel movements in the area over large periods of time. The survey period between July 15th and October 15th 2013 has been identified as the open water season when the site survey can be carried out. No other alternatives could be considered.

4.1.2 Survey equipment

The proposed survey equipment uses sound of different frequencies and amplitudes to map the seabed and shallow sediments. The range of equipment provides varying degrees of coverage, detail and penetration into the seabed. The equipment has been selected to provide the coverage and detail required to address any potential seabed or shallow hazards.

The high resolution seismic spread will use an airgun to generate the seismic signal. Alternative sound sources include explosives and water guns, however, the air gun is preferred as it is the safest, most reliable and provides a consistent signal required for acquiring data. The airgun source proposed for this site survey is far smaller than the airgun source used for typical seismic surveys, which will often be in the order of twenty times larger. The smallest size of airgun will be used which is capable of delivering the signal strength required to map the sub-surface and identify potential hazards as per the survey scope of work.

The survey will utilise a towed streamer to record the returning sound signal generated by the airgun or airguns. An alternative to the use of a towed streamer is the use of Ocean Bottom Sensors. With this technique, cables are placed on the seabed with hydrophones and geophones to detect the reflected waves from the sound source. This technique is not suitable for use during a high resolution site survey which is of short duration. Instead, Ocean Bottom Sensors are primarily used for longer term projects where the sensors can remain in place over long periods. A towed streamer is therefore considered to be a relatively simple and safe method of seismic acquisition.

5. IMPACT ASSESSMENT (PLANNED EVENTS)

The environmental impact assessment (EIA) addresses a number of physical, chemical, biological and some socioeconomic parameters. For each parameter, a description of existing conditions is presented. The existing conditions are presented with reference to the recent strategic environmental impact assessment (SEIA) of Baffin Bay /9/ where appropriate. Since the license blocks are located more than 85 km from the coast, coastal resources and topics have largely been considered outside the area of influence for the site survey. As recommended in the seismic EIA guidelines /3/, focus is on the biological components of the environment that are most likely to be influenced by the site survey.

Based on the description of the existing conditions, an assessment of environmental impacts is performed. A set of impact factors related to the survey are identified, and potential impacts are assessed along the classical assessment lines: time, space and magnitude, in accordance with the methodology presented in section 5.1.

5.1 Method for impact assessment

The impact assessment is based on the survey plans as they appeared by late January 2013, and the description of the existing environment. Both planned and unplanned (accidental) impacts (resulting from planned and unplanned events, respectively) are assessed. This section describes the methodology used to assess the environmental impacts associated with the 2013 site survey.

Environmental impacts include both direct and any indirect, secondary, short-, medium- and long-term, permanent and temporary, positive and negative impacts caused by the project.

The methodology used for assessment of impacts includes criteria for categorizing environmental impacts. The impact assessment includes:

- Identification of potential project impacts
- Nature, type and reversibility of impact
- Intensity, scale and duration of impacts
- Sensitivity of resource/receptor
- Overall severity of impacts

The impact assessment methodology serves to provide means of characterising identified impacts and their overall severity. Following the assessment of overall severity, a further assessment of residual impacts are performed. Residual impact assessesthe impact upon the receiving environment after implementation of mitigation measures.

5.1.1 Identification of potential project impacts

The first step of identifying potential impacts consists of an identification of which sources or activities in the project may result in potential impacts and which receptors may be affected. Typical impacts are associated with:

- Noise
- Physical disturbance
- Waste
- Discharges to sea
- Emissions to air
- Light
- Unplanned events (assessed in section 6)

5.1.2 Nature, type and reversibility of impact

Impacts are initially described and classified according to their nature (either negative or positive), their type and their degree of reversibility. Type refers to whether an impact is direct, indirect, secondary or cumulative. The degree of reversibility refers to the capacity of the impacted environmental component/resource to return to its pre-impact state.

Nature, type and reversibility are elaborated upon in Table 5-1.

Table 5-1 Classification of impacts: Nature, type and reversibility of impacts

Nature of impact	
Negative	An impact that is considered to represent an adverse change from the baseline (current condition) or to introduce a new, undesirable factor.
Positive	An impact that is considered to represent an improvement to the baseline or to introduce a new, desirable factor.
Type of impact	
Direct	Impacts that result from a direct interaction between a planned project activity and the receiving environment.
Indirect	Impacts that result from other activities that are assessed to happen as a consequence of the project.
Secondary	Impacts that arise following direct or indirect impacts as a result of subsequent interactions within the environment.
Cumulative	Combined impacts of other survey activities and other human activities in the area (e.g. fishery)
Transboundary	Impacts across borders, i.e. impacts to the Canadian part of Baffin Bay.
Degree of reversibility	
Reversible	Impacts on resources / receptors that cease to be evident, either immediately or following an acceptable period of time, after termination of a project activity.
Irreversible	Impacts on resources / receptors that are evident following termination of a project activity and that remain for an extended period of time. Impacts that cannot be reversed by implementation of mitigation measures.

5.1.3 Intensity, scale and duration of impacts.

Predicted impacts are defined and assessed in terms of a number of variables, primarily intensity, scale and duration of an impact. Ascribing values to the variables are, for the most part, objective. However, awarding a value to certain variables may be subjective in that the extent, and even direction, of change often is difficult to define.

An explanation of the classifications and values applied in the EIA is presented in Table 5-2.

Table 5-2 Classification of impacts in terms of Intensity, scale and duration.

Intensity of impacts	
No impact:	No impacts on structure or function of the resource/receptor within the affected area.
Minor impact:	Minor impacts on structure or function of the resource/receptor within the affected area, but basic structure and /function remain unaffected.
Medium impact:	There will be partial impacts on structure or function inside the affected area. Structure/function of the resource/receptor will be partially lost.
Large impact:	The structures and functions of the resource/receptor are altered completely. Structure/function loss is apparent inside the affected area.
Geographical extent of impacts	
Local impacts:	There will be changes in the immediate vicinity of the survey area. Impacts are restricted to the survey sites (3x3 km).
Regional impacts:	There will be impacts outside the immediate vicinity of the survey sites (local impacts), and up to around 10 km outside the survey sites.
National impacts:	Impacts will be restricted to Greenland.
Transboundary impacts:	Impacts will be experienced outside of Greenland.

Duration of impacts	
Immediate:	Impacts during and immediately after the construction; however the impacts stop immediately when the activity is stopped.
Short-term:	Impacts throughout the period of site survey and up to one year after.
Medium-term:	Impacts that continue over an extended period, between one and ten years after the site survey.
Long-term:	Impacts that continue over an extended period, more than ten years after the site survey.

5.1.4 Sensitivity of resource/receptor

The overall significance of the impacts is evaluated on basis of the evaluation of the single impact variables, as described above, and on the sensitivity of the resource/receptors affected.
It is imperative to place some form of value (low, medium and high) on a resource/receptor that could potentially be affected by project activities. Such a value may be regarded as subjective to some extent.

However, expert judgement and stakeholder consultation ensure a reasonable degree of consensus on the intrinsic value of a resource/receptor. The allocation of a value to a resource/receptor allows for the assessment of a resource's/receptor's sensitivity to change (impact). Various criteria are used to determine value/sensitivity, including, amongst others, resistance to change, adaptability, rarity, diversity, value to other resources/receptors, naturalness, fragility and whether a resource/receptor is actually present during a project activity. These determining criteria are elaborated upon in Table 5-3.

Table 5-3 Criteria used to evaluate sensitivity of resource/receptor.

Sensitivity	
Low:	A resource / receptor that is not important to the functions/services of the wider ecosystem or that is important but resistant to change (in the context of project activities) and will naturally and rapidly revert to pre-impact status once activities cease.
Medium:	A resource / receptor that is important to the functions/services of the wider ecosystem. It may not be resistant to change, but it can be actively restored to pre-impact status or will revert naturally over time.
High:	A resource / receptor that is critical to ecosystem functions/services, not resistant to change and cannot be restored to pre-impact status.

5.1.5 Overall severity of impacts

The severity of the impact is then defined by comparing the intensity of the impact of the project and the sensitivity of the environmental receptors. It is qualified according to a scale which ranges from "none" to "significant", defined as presented in Table 5-4.

Table 5-4 Criteria for evaluation of the severity of impacts

Severity of impacts	
No impact:	There will be no impact on the environment.
Minor impact:	Minor adverse changes that might be noticeable, but fall within the range of normal variation. Impacts are short-term and natural recovery takes place in the short term.
Moderate impact:	Moderate adverse changes in an ecosystem. Changes may exceed the range of natural variation. Potential for natural recovery in the medium-term is good. However, it is recognised that a low level of impact may remain.
Significant impact:	The structure or function in the area will be changed, and the impact will also have impact outside the license blocks.

In the environmental impact assessment, every resource/receptor assessed will be accompanied by a table summarizing the assessment of the different variables of intensity, scale and duration,

and sensitivity of resource/receptor as well as the overall severity to give the reader a brief overview of the impacts, see Table 5-5.

Table 5-5 Criteria used in the environmental impact assessment for the Shell 2013 site survey.

Intensity of impact	Scale of impact	Duration of impact	Overall severity of impact[1]
None	Local	Immediate	No impact
Minor	Regional	Short-term	Minor impact
Medium	National	Medium-term	Moderate impact
Large	Transboundary	Long-term	Significant impact

[1]: Evaluation of overall significance of impact includes an evaluation of the variables shown and an evaluation of the sensitivity of the resource/receptor that is assessed.

Positive impacts are shown with a "+" in the comprehensive tables for the potential impacts.

5.1.6 Level of confidence

An assessment of scientific certainty (low, medium, and high levels of confidence) will be provided based on our confidence in the scientific information available when we have judged an impact as having a particular negative impact. Criteria are elaborated upon in Table 5-6.

Table 5-6 Criteria used to evaluate confidence of resource / receptor.

Confidence	
Low:	Based on incomplete understanding of cause-effect relationships and/or incomplete data specific to the License blocks.
Medium:	Based on good understanding of cause-effect relationships using data from elsewhere or incompletely understood cause-effect relationships using data specific to the License blocks.
High:	Based on good understanding of cause-effect relationships and data specific to the License blocks.

The category "high" is also applied where the assessment is based on a highly confident knowledge that the impact factor will not overlap with the resource, despite lack of local data.

5.1.7 Residual impact

Based on the assessment of the overall severity of impact, as described above, a residual impact is assessed. The residual impact is the impact upon the receiving environment after implementation of mitigation measures.

5.2 Summary of potential project impacts

The potential project impacts resulting from the planned 2013 site survey are summarized in Table 5-7, based on the project description (see section 3).

Table 5-7 Summary of potential project impacts. For details, please refer to section 3.

Potential project impact	Summary based on section 3
Physical disturbance from vessels and equipment	During the site survey up to two vessels are expected in the area (EBS and seismic vessel). The site survey is planned to be undertaken in the period between the 15th July and 15th October 2013. No 2D HR seismic shots will be fired before 1st of August 2013.
Noise	The 2D HR seismic survey equipment and the vessel propeller systems generate an amount of underwater noise. The largest sound pressure level will be generated by the survey airgun. As underwater noise is considered a primary impact, special focus will be given to this. Acoustic modelling is presented below.
Waste	All solid wastes will be sorted by type, compacted where practicable and stored on board before disposal to an appropriate certified reception facility. No waste will be abandoned offshore.
Planned discharges	All discharges will comply with requirements set out in MARPOL. The total volume of discharges (both EBS and seismic survey) is estimated at 4,500 l blackwater and 13,000 l greywater. The volume is discharged throughout the survey period, over a large offshore area.
Emissions	Emissions have been estimated based on fuel consumption in relation to the 2013 site survey. Total emissions (both EBS and seismic survey) are estimated at 7,925 ton CO_2, 175 ton NO_x, 13 ton nmVOC, 7 ton SO_x, 1 ton N_2O and 18 ton CO_2.
Light	All survey vessels will carry appropriate navigation lights for night-time and periods of poor visibility, including ice searchlights.
Unplanned events	Unplanned events are addressed in section 6.

5.2.1 Acoustic noise modelling

The 2D HR seismic surveys introduce sound pressure levels that have the potential to impact marine life (marine mammals and fish) at the sites and in adjacent areas. Acoustic modelling has been performed for the site survey, in accordance with the BMP guidelines and the model includes an estimate of the noise levels included in the model and the numerical modelling of the propagation loss from source out to a distance where impacts are not considered biologically important for the receivers.

An introduction to sound is presented in Appendix 1, presenting sound terminology. The acoustic modelling is included in Appendix 2.

An overview of the areas that will be explored using 2D seismic survey, as well as the Environmental Baseline Survey (multi-beam echosounder and side-scan sonar) is shown in Figure 5-1. The site survey will take place at up to ten locations within the proposed survey area. The noise modelling of the 2D seismic surveys is based on modelling at three sites (3x3 km) around proposed sites occurring at depths of 500 – 800 m. Noise generated by the additional survey methods (multibeam echosounder, side scan sonar) is also assessed. The modelling is presented in Appendix 2, and the results are summarised in this section.

Multi-beam echosounders are used to provide a detailed estimate of water depth. The equipment model Kongsberg EM 1002 multibeam echosounder produces pulsed signals with a duration of either 0.2, 0.7 or 2 msec. The main energy is centred around 95 kHz, and source sound pressure levels are reported to be 225 dB re 1µPa /14/.The beam pattern is broad in the plane defining the width of the echosounder's transducer and narrow in the plane defining its height.

Side-scan sonars use extremely high-frequency (100-500 kHz) pulses to map the upper layers of the seabed. The pulses are of very short duration (300-600 µsec), and source sound pressure levels are between 220-226 dB re 1µPa /14/.

2D High resolution seismic survey to investigate the proposed locations for drilling. The surveys are similar to conventional 2D seismic surveys, except that the source used is comprised of a smaller volume of compressed air such as in this case with the overall 160 cubic inches involving only four airguns. Looking at the source strength, Genesis /14/ and Wyatt /16/ provide a comprehensive review of a variety of airguns and airgun arrays. According to their analysis, the emitted sound field is a function mainly of the size and the number of airguns and the overall emitted psi values.

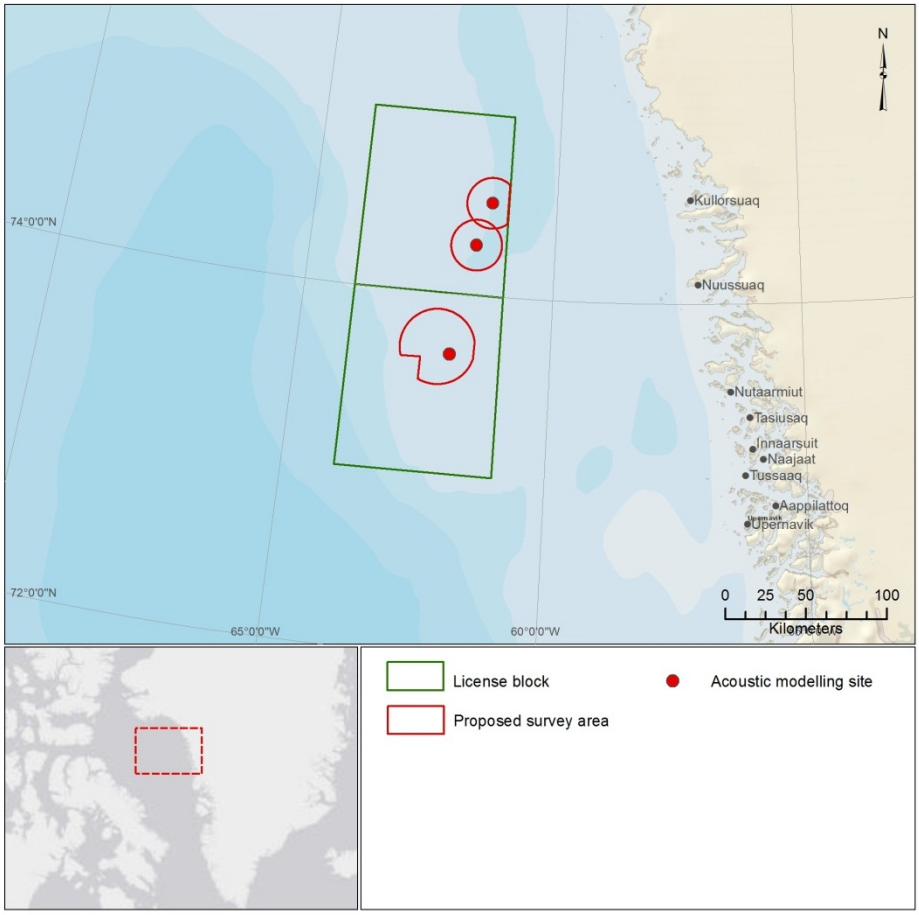

Figure 5-1 Overview of the survey areas and the three locations for which the modelling of the 2D seismic surveys was undertaken.

Based on information from the literature (for example /14/) we derived a zero-to-peak value of 230 dB re 1 µPa for the type of airgun array assessed to be used in the site survey. The difference between the zero-to-peak values and the peak values was set at 6 dB resulting in a peak-to-peak source sound pressure level of 236 dB re 1 µPa for the array /14/.

For the frequency spectrum we used a modelled far-field signature and the corresponding frequency spectrum for frequencies up to 1 kHz of a representative array (see /65/) and scaled it to meet the source strength identified for this study. We decided to include frequencies of up to 4 kHz (see Madsen /15/). For frequencies above 1 kHz, the source spectrum was extrapolated assuming an 18 dB / octave slope (see, for example Wyatt /16/). The resulting spectrum is shown in Figure 5-2.

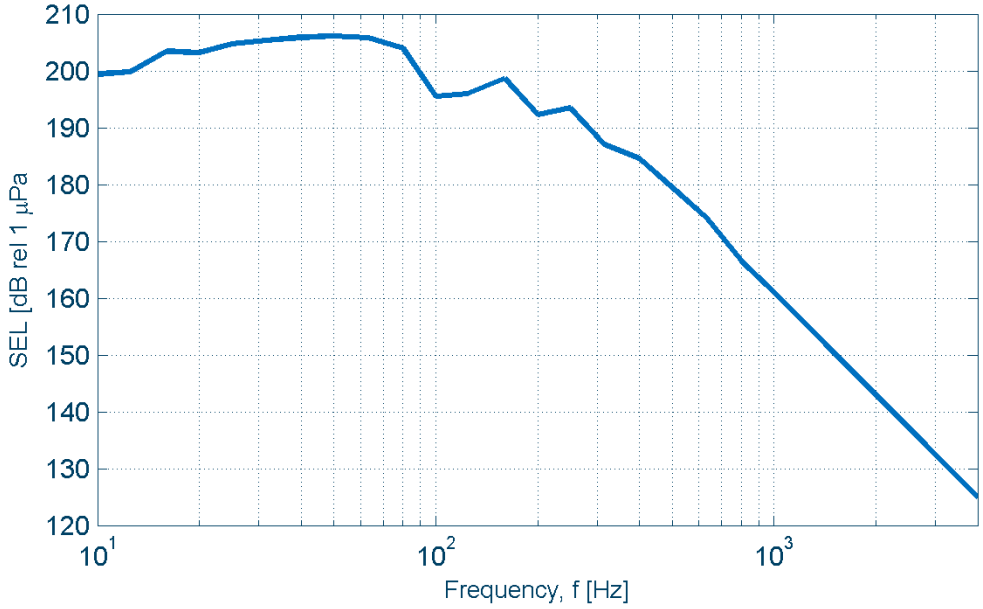

Figure 5-2 Frequency spectrum of seismic survey array far field signature.

Based on the derived spectrum, the resulting broadband SEL level was 214 dB re µPa^2·s. Genesis /14/ lists zero-to-peak and SEL values for a variety of airguns and airgun arrays, and based on their review it can be seen that on average the SEL values are about 20 dB below the zero-to-peak values. RMS values can then be derived from SEL values (see review by OSPAR /17/).RMS values could be derived by adding 13 dB to the corresponding SEL values.

5.2.2 Modelling results – summary of Appendix 2

2D seismic surveys are to take place at up to ten locations in Baffin Bay. The surveys will be restricted to areas (3x3 km) around proposed drilling sites and will occur at depths of 500 – 800 m. We present the results of an acoustic propagation modelling study of the expected noise exposure from the planned 2D seismic surveys to be included in the supplied EIA. The model is based on actual bathymetry information covering the entire area and basic knowledge of sediment properties. We also used detailed data on the vertical sound speed profiles during the time of the proposed survey (July – October). Horizontally, our model intends to cover all areas exposed to levels likely to affect marine mammals. Different from previous investigations, we also include frequencies above 2 kHz in the modelling to better match the acoustic sensitivity of some of the marine life in the area.

Based on information about the airgun array that will be used and literature data the acoustic modelling used a zero to peak source sound pressure level of 230 dB re 1 µPa as the input variable in this study. The resulting peak to peak source sound pressure level was defined as 236 dB re 1 µPa. For the frequency spectrum we used a modelled far-field signature and the corresponding frequency spectrum of a representative array and scaled it to meet the source strength identified for this study. Based on the derived spectrum, the resulting broadband SEL level was 214 dB re µPa^2·s. RMS values were directly derived from SEL values and resulted in a source sound pressure level of 227 dB re 1 µPa. The calculation of the sound levels at different distances from the sources was undertaken for frequencies up to 4 kHz using a 2D numerical model of the underwater acoustic propagation. The well-established AcTUP package was used, applying the RAMGEO code which is a full Parabolic Equation model.

An example of the noise propagation maps produced in the acoustic modelling is shown in Figure 5-3.

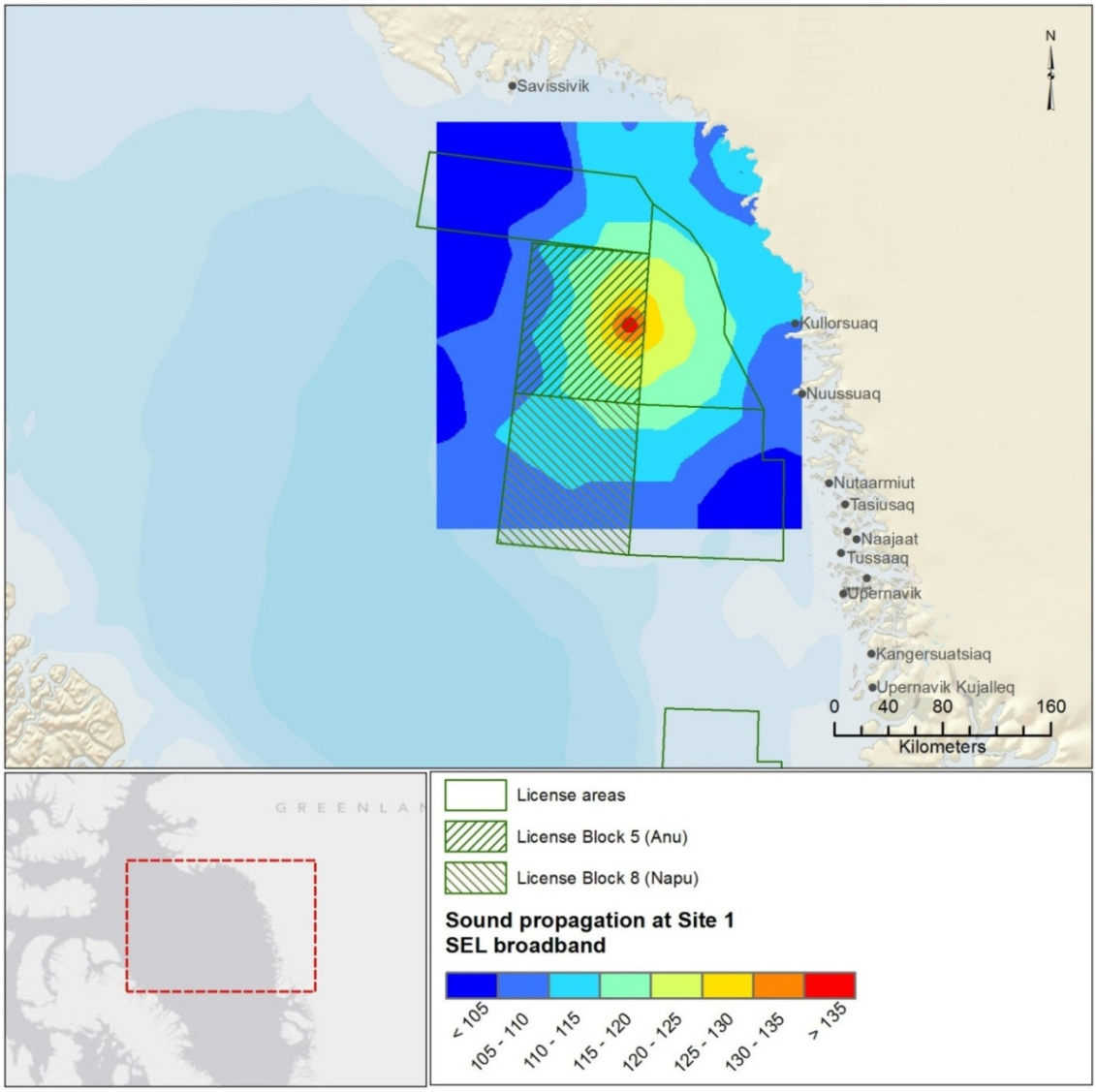

Figure 5-3 Example of noise propagation map at one of three sites where acoustic modelling has been undertaken [units are in dB re 1 µPa^2·s].

The results of the modelling show a sharp decrease of sound levels in the first km from the source and a smoother decline in sound pressure levels at a longer range. Higher frequencies than 1 kHz where attenuated more rapidly than those below 1 kHz although not as drastically as expected. Furthermore, the difference in propagation loss across sites was very small indicating that results obtained here can be transferred somewhat to other sites if the development is relocated.

Looking at the cumulative sound fields (sound over a 24 h period including the survey), it is clear that impact ranges can be larger than for single shots. Yet, the assumption that the acoustic energy just sums up at the receiver in the way suggested by the calculations, neglects that hearing might recover between pulses. Thus, the overall impact from the survey over the course of a one-day cycle might be smaller than indicated in the cumulative maps.

The survey area will comprise 3 x 3 km with transects at each 100 m. It will take app 12 h to travel this distance with the assumed survey speed of 4 kn. The total survey area will be this 90 km^2.

5.3 Climate and ice conditions

5.3.1 Existing conditions

As described in the SEIA /9/, the weather conditions in the Baffin Bay area are influenced by the North American continent and the North Atlantic Ocean, but also the Greenland Inland Ice and

the steep coasts of Greenland have a significant impact on the local weather. Atlantic depressions frequently cause strong winds off West Greenland. Also more local phenomena such as fog are common features near the shore.

Midnight sun, when the sun is continuously above the horizon, lasts from the 30th of April to the 12th of August at 74 °N. Up to the 12 h day/12 h night at autumn equinox (21st September) the number of daylight hours decrease gradually. By the end of the survey (mid October), the day-length will have decreased to approx. 4 hours in the survey area, and by November 7, the polar night engulfs the survey area.

The license blocks are situated within the Arctic climate zone, with average air temperature below 10° C year round. Summer temperatures over the ocean are usually close to surface water temperatures, which typically range from -1.8 to 5 °C.

In winter the waters of Baffin Bay are normally covered with sea ice from December to June. Two types of sea ice occur: fast ice, which is stable and anchored to the coast, and drift ice, which is very dynamic and consists of floes of varying size and density. The drift ice is often referred to as 'The West Ice' because it is formed to the west of Greenland /9/. The maximum extend of the west ice is usually seen in late March. In addition to sea ice, icebergs originating from calving glaciers occur in the entire region, and may be encountered during the site survey /10/.

5.3.2 Impact assessment

The **emissions** associated with the site survey (from up to two vessels) have been assessed in section 3.5. The estimated emissions from the site survey are considered comparable to those from other vessels in the area. It is assessed that no measurable impacts on climate and ice conditions will occur.

Table 5-8 Environmental impacts to climate and ice conditions in connection with the 2013 site survey.

Potential project impact	Intensity of impact	Scale of impact	Duration of impact	Overall severity of impact	Level of confidence
Emission of greenhouse gasses	Minor	Local	Long-term	No impact	High

5.4 Oceanography

5.4.1 Existing conditions

The oceanography in the license blocks and in Baffin Bay was reviewed in detail in an EIA from 2012 /6/, and is briefly summarized in the following.

The currents in Baffin Bay are dominated by a strong southward flow of cold water and ice from the Arctic Ocean. The relatively warm West Greenland Current crosses Baffin Bay from east to west.

Because of the moderate wind conditions in Baffin Bay, wave heights are characteristically small, usually below 1.7 m for the four-month period August–November, 1985–1996 /19/. Larger waves can occur, but these are usually of short duration. Waves have minimum levels in the early summer months when considerable amounts of sea ice are present as well as the lower summer winds, whereas larger waves occur in the fall with more open water and higher winds.

The water temperature at the surface is below −1 °C in winter. In summer, the surface temperature varies from 4–5 °C to 0 °C. At deeper waters, the temperature is low throughout the year. The salinity exceeds 34 ‰ in winter, partly due to sea ice formation, while summer salinity is typically 30-32 ‰.

5.4.2 Impact Assessment

In general, the oceanography in Baffin Bay is a product of large-scale and global processes. Presence of vessels performing seismic and environmental surveys within a period of a few months will not impact the oceanography.

Table 5-9 Environmental impacts to oceanography in connection with the 2013 site survey.

Potential project impact	Intensity of impact	Scale of impact	Duration of impact	Overall severity of impact	Level of confidence
-				No impact	High

5.5 Bathymetry

5.5.1 Existing Conditions

The coastal zone of the region is dominated by rocky shorelines with many archipelagos. Small bays with sand or gravel are found in sheltered areas. The Northern part (from Kullorsuaq and to Savissivik in the North) the coastal line is dominated by glaciers with Nunataks /10/.

The bathymetry of Baffin Bay with shallow sills both to the north and south creates a relatively isolated body of cold, deep, polar water. The shelf in eastern Baffin Bay is shallow (less than 200 m) and is generally a narrow strip (usually less than 80 km wide) along the coast and some banks. Outside the shelf depths reach more than 2,000 m in central parts of the bay /10/.

In the two license blocks, the depths vary from c. 150 m in the northwestern area and 2000 m in the southwest corner of the license blocks. The main part of the license blocks are at depths of 400-800 metres.

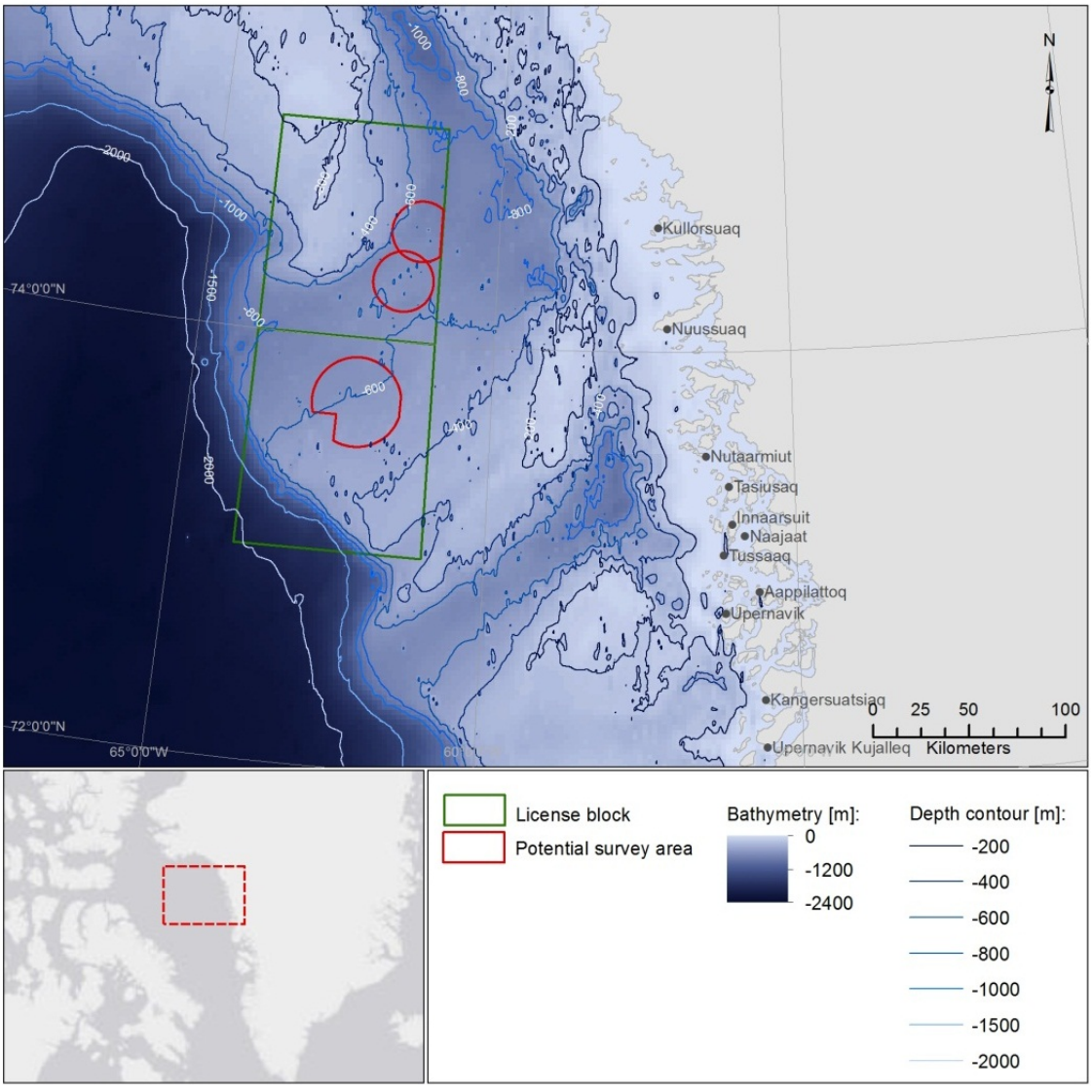

Figure 5-4 Bathymetry in Baffin Bay and the license blocks

5.5.2 Impact Assessment

As part of site survey, there will be some removal and relocation **of seabed material** in connection with grab/boxcorer sampling, trawl, ROV usage and deployment of moorings for oceanographic measuring equipment. This disturbance will be in the surficial sediment layers, and sampling will leave a shallow depression in the seabed. In areas of accumulation, sediments from neighbouring areas and fall-out from the water column will gradually re-fill such sampling marks, though this may take some time. The actual time will depend of the depths of the depressions and is assessed to be medium-term (1-10 years).

Based on the very local disturbance, and the medium-term duration, the disturbance is assessed to have no impact on the bathymetry of the area.

Table 5-10 Environmental impacts to bathymetry in connection with the 2013 site survey

Potential project impact	Intensity of impact	Scale of impact	Duration of impact	Overall severity of impact	Level of confidence
Seabed disturbance	None	Local	Medium-term	No impact	High

5.6 Water and sediment quality

5.6.1 Existing conditions

A benthic survey /6/ was done with a drop camera along 11 transects in the northern license block, and further north at depths of 600-750 m. These are the same depths as the planned 2013 site survey. Sediments consisted mainly of fine sand, and a few spread locations of gravel or gravel/sand mixture. Cobble, rubble, boulders, and shells accounted for minor proportions of the observed substrate at most survey sites.

In general, information on contaminants in water and marine sediments are only available near local discharge point, e.g. cities, settlements, former mine sites and Thule Airbase. Thus, no local sediment data from the survey sites exist, but in 2008, polycyclic aromatic hydrocarbons (PAH) were analysed in the surface sediment layer (0-1 cm depth) of Baffin Bay /20/. PAH levels were generally low and could be regarded as background levels.

The occurrence of contaminants in the marine environment and their potential impacts on biota has been studied in Greenland. Based on studies of contaminants in organisms, as summarized in the SEIA /9/, the overall conclusion was that lead levels in marine organisms from Greenland were low, whereas cadmium, mercury and selenium levels were high. No clear conclusions could be drawn in relation to geographical differences.

5.6.2 Impact assessment

Disturbance of seabed in relation to site survey sampling, ROV usage and deployment buoy anchors is expected to cause suspension of fine grained sediments, which subsequently resettle on the seabed. Such short-term, local disturbance is assessed to be of no impact to water and sediment quality.

Discharges of grey water and treated black water can lead to increased organic load of the sediments. This can in extreme cases stimulate growth in and changes of benthic faunal assemblages. . However, the release of fine particular material in a stream of freshwater will sink very slowly towards the seabed, and at 600 – 700 m depth, it will be spread over a large area and is not expected to cause any measurable impact on water or sediment.

Table 5-11 Environmental impacts to water and sediment quality in connection with the 2013 site survey

Potential project impact	Intensity of impact	Scale of impact	Duration of impact	Overall severity of impact	Level of confidence
Suspended sediments	Minor	Local	Short-term	No impact	High
Discharges	Minor	Local	Short-term	No impact	High

5.7 Plankton

5.7.1 Existing conditions

As described in the SEIA /9/, total primary production in the arctic is from three sources: phytoplankton, ice algae on the underside of fast or drift ice, and benthic algae. In most of Baffin Bay, there is a brief and intense phytoplankton bloom immediately after ice break-up in spring, with high transient phytoplankton biomass and relatively low total primary production integrated over depth and season. Exceptions are polynyas (which is not previously registered in the license blocks), areas of open water surrounded by ice, some of which are recurring and remaining open throughout the winter.

Zooplankton provides the main pathway to transfer energy from phytoplankton to consumers at higher trophic levels, e.g., fish, and thus has a critical role in marine food webs. High latitude zooplankton production follows the extremely strong seasonal pulse of phytoplankton. Numerous taxa are included, but copepods, particularly calanoid copepods, are dominant.

Studies carried out near Melville Bay showed that the most dominant copepod species are *Calanus hyperboreus*, *C. glacialis*, and *C. finmarchicus*. Their vertical distribution was linked to food availability, salinity, and temperature. The genus *Calanus* was most abundant in water with temperatures below <0 °C, whereas other species were most abundant at temperatures >0 °C /9/.

Although copepods are typically predominant in Arctic marine systems, there is a broad assemblage of other planktonic groups and their role has yet not fully been understood /9/.

The knowledge on plankton is not yet sufficient to designate any important or critical areas within Baffin Bay, except for the north water polynya which is situated in northern Baffin Bay /9/.

5.7.2 Impact assessment

Mortality of plankton has been observed at close range (within 5 m) of the source of the **seismic** shot /9//26/. The impacts of seismic noise are assessed to have no impact given the size of planktonic populations and their high natural mortality rate.

Discharges may influence planktonic organisms. The discharges associated with the site survey are minor and assessed to be of no measurable impact to water and sediment quality. It is assessed that there will be no impact to plankton.

Table 5-12 Environmental impacts to plankton in connection with the 2013 site survey

Potential project impact	Intensity of impact	Scale of impact	Duration of impact	Overall severity of impact	Level of confidence
Seismic noise	Minor	Local	Short-term	No impact	High
Discharges	Minor	Local	Short-term	No impact	High

5.8 Benthic flora and fauna

5.8.1 Existing conditions

The knowledge of benthos in Baffin Bay is sparse. Northern Baffin Bay (71-78 °N) was sampled with benthic grab and photography in 2008 /21/. Sampling depths ranged from 0-200 m. In their deepest depth range 150-200 m an average biomass of 175 g wet weight/m^2, and a dominance of polychaetes was recorded.



Figure 5-5 Typical substrate observed during the Baffin Bay drop camera-mediated borehole benthic habitat survey, September 2011 /6/.

In the license blocks, one benthic survey /6/ was done with a drop camera along 11 transects in the northern part of license block Anu, and further north outside the license blocks at depths of 600-750 m. These are the same depths as the planned 2013 site survey. The benthic fauna found by viewing video from 11 transects, consisted of shrimp (most common), brittle stars, sea stars, sea anemones, sponges and soft corals, and some other animal groups. The poor resolution of the pictures made it difficult to discover traces of infauna on the sediment surface, but it is very likely that burrowing polychaetes, molluscs and echinoderms will dominate the infaunal assemblages. The survey also reported strong bottom currents, which makes it likely that the dominant benthos will be filter feeders. The seemingly self-contradictionary combination of strong currents and soft sediment has previously been reported from locations in the Barents Sea /22/.

Single colonies of sponges were discovered in 6 transects in the 2011 survey and no sponge bed aggregations were reported. As observed by Christiansen /25/, sponge beds are present north of Svalbard (78 °N). In case of occurrence of dense sponge beds in the license blocks, further surveying and potential drilling operations should be planned accordingly.

Out of 24 different benthic fauna assemblages defined by Thomson /23/ on the Canadian side of Baffin Bay, nine occurred in Central (72 °N, 70 °E) and Northern (75 °N, 78 °E) Baffin Bay at depths of 500 - 1,088 m and on sand and silt substrates or both. A possibility of finding certain species within each assemblage was calculated, and is presented in Table 5-13. It is considered likely that the same species will occur at the same depths and sediment conditions as the license blocks.

Table 5-13 Short description of some of assemblages of benthic animals found in Central and Northern Baffin Bay /23/. The name gives an indication of the most common species in the particular assemblage.

Assemblage		Sediment	Central/Northern Baffin Bay	Abundance Northern/Central Baffin Bay
Anonyx pacificus	*Amphipod*	Silt	Northern/Central	Rare
Ophiura sarsi	*Brittle star*	Sand	Northern/Central	Common
Ctenodiscus	*Sea star*	Sand/Silt	Northern/Central	Common
Praxillura-Golfingia	*Polychaete - Sipunculid*	Sand/Silt	Northern/Central	Abundant
Lumbrineris - Acsidia	*Polychaete - Sea squirt*	Sand	Northern/Central	Rare
Nereis zonata	*Polychaete*	Silt	Northern/Central	Common/Abundant
Aglaophamus - Asychis	*Polychaetes*	Sand/Silt	Northern/Central	Abundant/Abundant
Samythella	*Polychaete*	Sand	Northern/Central	Abundant
Polyphysia crossa	*Polychaete*	Silt	Central	Abundant

Cold water coral (*Lophelia* sp.) reefs have been discovered in the Davis Strait south of Baffin Bay. It is considered unlikely that reefs will be found in the license blocks as the water temperatures here (1° C) are below the typical temperature range for cold waters corals (4-12° C) /24/.

5.8.2 Impact assessment

This impact assessment is based on the assumption that currents and sediment composition at the survey sites are similar to that found in the 20112 survey /6/. Impacts are summarized in table 6-13.

Grab- and boxcorer sampling, ROV usage and deployment of anchors will **disturb the seabed** by upwhirling. Upwhirled sediments might be carried downstream and fall down on the sea bed elsewhere, where they might resettle and cover epi- and infaunal organisms. Unless the ROV is settled on the seabed and is propelled forward, the amounts of upwhirled sediments will be local and short-term. The impact of resedimentation on benthic fauna is assessed to be negligible.

Removal of soft sediments by grab- or box corer sampler will leave a shallow depression in the sea bed. It may take several years before such depressions are refilled by natural sedimentation, but they will fairly quickly be recolonized. Thus impacts on faunal composition and abundance are negligible.

The deployment of steel weights as mooring for buoys will crush benthic animals directly hit. Some soft bottom benthos can regenerate body parts, but species that have hard calcareous skeletons, like clams or corals, are sensitive to crushing. The area of impact is quite small (1 m^2 per weight) and so the overall impacts of crushing will expectedly be negligible. It is planned to leave the steel weights at the seabed when the buoys are removed. The steel weights represent a permanent hard substrate in what is expected to be a soft bottom benthic community. This will give hard bottom benthos the opportunity to colonize the new substrate, and thus alter the local faunal composition on the spot. Fish, crustaceans and other animals often are attracted to such hard bottom structures in a monotonous soft sediment seabed landscape, where they may find both food and shelter. However, the overall assessment is that leaving the steel weights will have a negligible impact on the seabed fauna.

Recolonization of benthic habitats depend on the type of habitat, the growth rate of the fauna, the geographic extent of the impacted area and the presence of a pool of sexually mature individuals to recruit from. In cold waters fauna normally grow very slow and recolonization back to original species/size composition generally takes longer than further south.

Discharges of grey water and treated black water can lead to increased organic sedimentation. This can lead to changes of species composition and growth in the benthic fauna as a result of increased food availability. However, the release of fine particular material in a stream of freshwater will sink very slowly towards the seabed, and at 600 – 700 m depth, it will be spread over a large area and is not expected to cause any measurable impact on benthos.

Very few studies have been done to determine the impacts of **seismic** and sonar on sessile an in-faunal benthos. Christian et al. /26/ reported that close range seismic sound emission (2 m range) on snow crab eggs had impacts on larval development and settlement. But as the seismic survey and sonar is performed more than 600 m away from the sea bed, it is assessed that there will be no impact to benthic fauna.

Table 5-14 Environmental impacts to benthic fauna in connection with the 2013 site survey

Potential project impact	Intensity of impact	Scale of impact	Duration of impact	Overall severity of impact	Level of confidence
Seabed disturbance (upwhirling /resedimentation)	Minor	Local	Short-term	Negligible	High
Anchoring	Minor	Local	Permanent	Negligible	High
Discharges -> Increased organic downfall	Minor	Local	Short-term	No impact	High
Seismic noise	-	-	-	No impact	High

5.8.3 Mitigating measures

Deployment of anchors for buoys at the same place as grab samples/box corer has been taken, ensures a minimum of disturbed area on the seabed. A careful and slow approach of equipment to the seabed also minimizes the amount of sediments being temporarily suspended within the water column.

5.8.4 Residual impacts

As the mitigating measures are limited, the residual impacts of the survey activity to benthos are considered the same as the impacts expected before considering any mitigating measures.

5.9 Fish and shellfish

5.9.1 Existing conditions

The fish fauna of Baffin Bay is not well known, and limited specific knowledge from the actual survey area is available. The fish and shellfish fauna of Baffin Bay include populations of several species. According to Jørgensen /27/, at depths below app. 500 m, the Greenland halibut is the dominant species, while species like lumpfish, spotted wolffish, polar cod, capelin, greenland cod, atlantic cod, northern shrimp, snow crab and several species of sculpins, skates and rays also occur in the area. The key species are described below based on the SEIA /9/, the 2012 EIA /6/, and references therein.

The **Greenland halibut** (*Reinhardtius hippoglossoides*) is a circumpolar deep-water, semi-pelagic flatfish that inhabits depths of ~400–2,000 m. It spends most of its life on the bottom, but moves into the water column to feed. Off west Greenland, the Greenland halibut spawn at depths >1,000 m south of 67 °N. The eggs and larvae drift northward and the larvae subsequently settle in the shallower waters of the banks.

In the Northwest Atlantic, the **lumpfish** (*Cyclopterus lumpus*) is distributed from Greenland south to Chesapeake Bay. Lumpfish spend most of the year in deep, offshore waters, but in spring and early summer, typically May–June, they seek shallow coastal waters to spawn. The eggs are attached to the substrate at shallow waters, and the female migrate back to deeper

water immediately after spawning, leaving the male to guard the clumps of eggs for 6 – 8 weeks. The northern distribution limit of lumpfish in Baffin Bay is at 72–75°N.

The **spotted wolffish** (*Anarhichas minor*) occurs in the Arctic Ocean and on both sides of the North Atlantic from Labrador to the Barents Sea. Off West Greenland, it is found as far north as Upernavik and sporadically to Thule. It is found offshore in cold, deep water, usually <5°C at 50–800 m depths. Wolffish prefer coarse sand and sand/shell bottom with rocky areas nearby for shelter and spawning. The species does not form large schools and migrations are local and limited.

The **polar cod** (*Boreogadus saida*), known elsewhere as arctic cod, is a pelagic or semi-pelagic species with a circumpolar arctic distribution. It can form large aggregations, often deep in the water column or near the bottom on the shelf. It also occurs in coastal waters and is often associated with sea ice, in crevices and holes in the ice. Polar cod spawn large buoyant eggs in ice-covered waters in November–February, and the eggs incubate under the ice until larvae hatch in late spring when the ice starts to melt. The polar cod is an important forage species in the arctic marine food web as a key prey for many marine mammals and seabird species.

The **capelin** (*Mallotus villosus*) is a small, pelagic, schooling fish. It is a cold-water species that occurs widely in the northern Hemisphere. In the Disko Bay area, capelins spawn in huge numbers in spring in the subtidal zone along beaches and low rocky coasts. Capelin occur only in the southernmost part of the Baffin Bay, with an approximate northern distribution limit at 72–75°N.

Greenland cod (uvak, *Gadus ogac*) and **Atlantic cod** (*Gadus morhua*) are both found in coastal and open waters of Baffin Bay. The Greenland cod is a coastal/shallow water stationary species of limited commercial value, while the Atlantic cod historically has been an important fishery resource to Greenland. After two decades of virtual absence from west Greenland waters, the Atlantic cod stock during the latest years has reappeared in both coastal and offshore waters off west Greenland. However, the species hardly ranges as far north as the survey area.

The **northern shrimp** (*Pandalus borealis*) occurs all along the on the West Greenland continental shelf from Cape Farewell to ~74°N. It typically occurs in waters 100–600 m deep, mainly on the outer slopes and banks. Although northern shrimp are considered bottom dwellers, they migrate vertically at night and sometimes during the day to feed on the small planktonic organisms in the upper water column. The shrimp larvae are planktonic for 3–4 months, drifting passively with the currents. Shrimp larvae are generally more abundant in waters <200 m deep. Important areas for shrimp larval development are the slopes of the banks, on the banks, and the shelf break. By the end of their first year, most northern shrimp have settled to the seafloor as juveniles.

The **snow crab** (*Chionoecetes opilio*) occurs over a broad depth range in the northwest Atlantic from Greenland south to the Gulf of Maine. Snow crabs are patchily distributed along the west coast of Greenland in coastal areas and fjords, typically at 180–400 m depths /10/. Large males are most common on mud or mud/sand, whereas smaller crabs are common on harder substrates. The snow crab life cycle include larval hatching in the spring, followed by a 12–15 week planktonic period during which the larvae develop through various stages before settling to the sea bottom. Benthic juveniles of both sexes moult frequently. At ~4 years of age, they become sexually mature.

Iceland scallops (*Chlamys islandica*) are generally found inshore and on banks at 20–60 m depths where current velocity is relatively high /10/. The West Greenland populations are generally found in coastal areas. The Iceland scallop lives on the surface of hard substrates, rarely on soft, muddy bottoms. In West Greenland, the largest aggregations are found in the Nuuk area, where most of the direct fishery has taken place. In offshore areas there are only low concentrations of generally small scallops and large quantities of empty scallop shells, suggesting that offshore populations were once more abundant than they are currently.

5.9.2 Impact assessment

Potential impacts to fish are assessed in this section, based on the potential project impacts summarized in section 5.2. Please note that potential impacts to fisheries are assessed in section 5.13.

Noise from site survey has been assessed based on the modelled sound levels and criteria for behavioural and physiological response to underwater noise. There is little information available on the hearing abilities of species of particular relevance for the license blocks; Atlantic cod and Atlantic herring therefore serve as models for other fish species. The upper cut-off frequency of hearing in herring is expected to be the maximum upper cut-off frequency for all fish in the area.

Impacts to fish pertain to physical damage and behavioural changes. Fish behaviour in response to noise is not well understood. Sound pressure levels that may deter some species, may attract others. Physical damages to the hearing apparatus lead to permanent changes in the detection threshold (permanent threshold shift, PTS). This can be caused by the destruction of sensory cells in the inner ear, or by metabolic exhaustion of sensory cells, support cells or even auditory nerve cells. Hearing loss is usually only temporary (temporary threshold shift, TTS) and the fish will regain its original detection abilities after a recovery period. For PTS and TTS the sound intensity is an important factor for the degree of hearing loss, as is the frequency, the exposure duration, and the length of the recovery time.

Fish are highly sensitive to the particle motion of the sound field, and species with no airfilled cavities, such as a swim bladder, cannot detect pressure /28/. Regardless of the presence of air-filled structures, the adequate stimulus for the fish auditory system at frequencies below 100 Hz is particle motion /28/. At higher frequencies the sound pressure impinging on a swim bladder causes it to vibrate, thereby supplying an increase in particle motion stimulating the inner ear. For fish with swim bladder the sound pressure therefore becomes the dominant stimulus. Fish with swim bladders therefore have increased hearing sensitivity at higher frequencies /29/.

The Atlantic cod possesses a swim-bladder but has no special coupling between the swim-bladder and the inner ear. In the Atlantic herring the swim-bladder extends to the inner ear, where it is directly connected /30/. Particle motion measurements of noise sources are rarely made and have not been available for this report. Pressure measurements are therefore used when discussing the impact on fish. The hearing of Atlantic herring has been investigated by Enger /31/, and the hearing of Atlantic cod by several authors /32//33/. The audiograms of these species are shown in Figure 5-6. The thresholds of the audiograms are given in units of sound pressure. Cod can hear up to about 400 Hz, whereas herring can hear up to a few kHz.

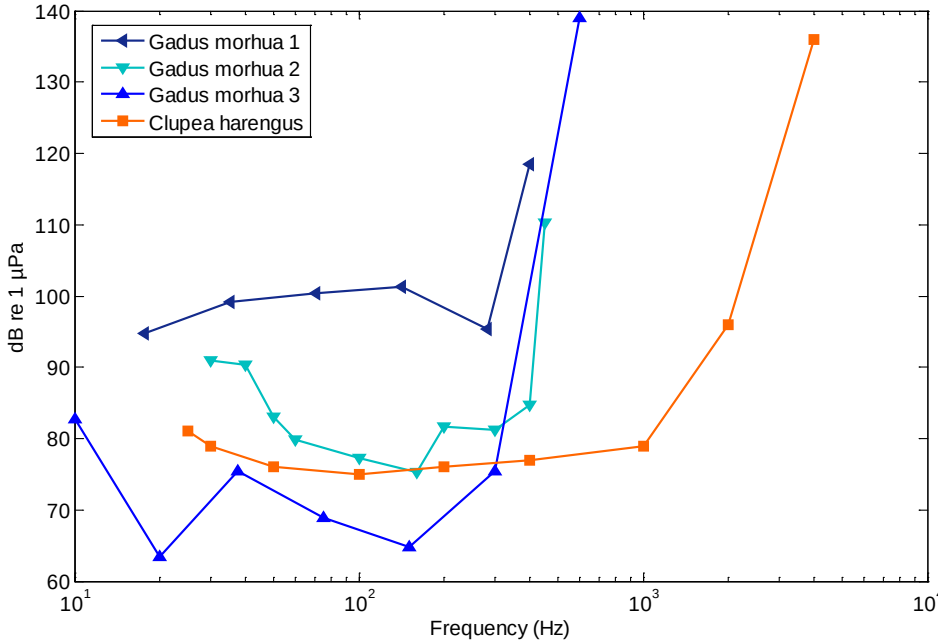

Figure 5-6 Audiogram of Atlantic cod (*Gadus morhus*) and Atlantic herring (*Clupea harengus*) modified from /30//31//32//33/.

Both herring and cod produce sound for communication, but in very different ways. The Atlantic herring produces sound by releasing air bubbles from the anal duct /34/. This creates a pulsed chirp consisting of a series of pulses with centroid frequencies ranging from 3 to 5.1 kHz /34/. Atlantic cod produces sound by contracting muscles associated with the swim-bladder, thereby vibrating the swim-bladder walls. As part of their mating behaviour Atlantic cod produces "grunts". These grunts have frequencies within the range of 50 to 120 Hz /35/. Atlantic cod has also been documented to produce a click sound associated with anti-predator behaviour. These sounds have a peak frequency of 5.95 kHz and a source level of 153 dB re 1µPa.

Fish behaviour in response to noise is not well known. Sound pressure levels that may deter some species, may attract others. One study by Thomsen /36/ does, however, demonstrate initial behavioural response in the Atlantic cod, when exposed to play-back pile-driving noise. Levels that caused response behaviour (= slowing down at onset of sound with overall increased swimming during exposure) were between a peak sound pressure level of 140 and 161 dB re 1 µPa. For both Atlantic cod and Atlantic herring a criterion of a zero-to-peak sound pressure level of 140 dB re 1 µPa will be used as a worst case scenario for the onset of behavioural reaction. Table 5-15 provides an overview of noise exposure criteria for fish used in this assessment.

Table 5-15 Fish noise exposure criteria used in the quantitative assessment.

Effect	Sound type	Sound pressure level /SEL	Source
PTS / Physical damage	Single pulses	206 dB re 1µPa peak	/37/
TTS	Single pules	187 dB re 1µPa^2-s SEL	/37/
Response	Multiple pulses	140 dB re 1µPa peak	/36/

The impact zones of multi-beam echosounders and side-scan sonars vary, as shown in Appendix 2. No frequency weighting has been used for fish.

Table 5-16 Zones of impact for noise sources, defining zones of PTS/TTS and avoidance behaviour in Atlantic cod and Atlantic herring. Data is from Genesis /14/. The line '-' indicates that no record to any range could be found for this sound level in calculations or the model so that effects are not evident. For fish no frequency weighting has been used.

	Effect	Sound pressure level /SEL	Maximum range to threshold location (m)
Multi-beam echosounder	PTS / Physical damage		-
	Response		N/A
Side-scan sonar	PTS / Physical damage		N/A
	Response		N/A
2D HR seismic	PTS / Physical damage	206 dB re 1µPa peak	-
	TTS	187 dB re 1µPa^2-s SEL	-
	Response	140 dB re 1µPa^2·s peak	49,170-58,990

It is clear from the modelling that any physical impacts to fish due to the exposure to single pulses are absent. However, behavioural response in marine fish can occur at ranges of app. 59 km. The differences between the three modelling sites are negligible.

With regards to the *intensity* injury and PTS is defined as a large effect, as the structure and function of the receptor are affected completely inside the affected area. As PTS is not affecting the whole hearing range of the receivers, we have defined this effect as being of medium intensity but of long-term duration. Following this logic, TTS is defined as a medium effect as well

but as it is reversible, it is one of short term duration. Behavioural responses can range from medium to minor, depending on the number of species affected.

The assessment of the different sound levels from all activities on fish species clearly indicates that echosounders and side scan sonar will only lead to minor or moderate impacts. For the 2D seismic surveys TTS can only occur very close to the source (<10 metres). The 2D seismic survey could also lead to avoidance, with behavioural impacts on fish assessed to potentially occur at a distance of 59 km from the source.In any case, the survey will be of only comparably short duration so that effects will be immediate and not of any longer duration. Overall, it can be concluded that the site survey planned for the summer of 2013 will have only moderate noise impacts on the biological environment in Baffin Bay.

Presence of the vessels may pose a potential impact, as noise from vessel engine and propellers may disturb fish. Also the passage of ships through ice infested waters may cause impacts to fish. The overturning of ice-floes has been seen to expose polar cod, living in crevices and hollows in the ice, for predation by gulls and other seabirds following the vessel. The extent of this type of impact is however expected to be negligible, as the survey will take place during the expectedly ice-free period.

Physical **disturbance of seabed** is assessed to have no impact on water and sediment quality. Except from the potential retrieval of individual specimens as part of the samples collected by the box-corer, no impacts to fish assemblages is foreseen.

Discharges of organic **waste** may potentially attract scavenging fish, but no measurable fish aggregations are expected in the license blocks. Temperature increase due to release of wastewater has limited extent and duration and will not cause any influence on marine fish.

Table 5-17 Environmental impacts to fish in connection with the 2013 site survey

Potential project impact	Intensity of impact	Scale of impact	Duration of impact	Overall severity of impact	Level of confidence
Noise (seismic) TTS	Medium	Local	Short term	Minor	Medium
Noise (seismic) Response	Minor	Regional	Immediate	Moderate	High
Presence of vessels	High	Local	Short-term	Minor	Medium
Disturbance of the seabed	Low	Local	Short-term	No impact	High
Planned discharges	Low	Local	Short-term	No impact	High

5.9.3 Mitigating measures

The proposed site survey in Baffin Bay is constrained to the open-water season. Choosing any other time of the year for doing the survey than the time window planned is not an option.

Mitigating measures are related to number of fixed stations deployed, location and general duration of investigations.

5.9.4 Residual impacts

As the need for and the possibilities to enforce mitigating measures are limited, the residual impacts of the survey activity to fish is considered the same as the impacts expected before considering any mitigating measures.

5.10 Marine mammals

5.10.1 Existing conditions

Marine mammals represent key species in the ecosystem of Baffin Bay in Western Greenland. No resident populations are present in the license areas, which are used by migrating species of marine mammals. Six key species of marine mammals are assessed to potentially occur in the

license blocks; Bowhead whale, Beluga whale, Narwhal, Harbour seal, Ringed seal and Walrus. Pilot whale, hooded seal, sperm whale and minke whale may also be present. These are detailed below, along with the polar bear, with reference to the SEIA for further information /9/. Other occurring species are mentioned briefly and summarized in table 1. Since most species are migratory and have a wide range of distribution, detailed information on presence/absence and seasonality are provided based on the best available information.

During survey activities undertaken in 2011 /75/, marine mammal sightings were recorded for a survey in a larger study area comprising the two license blocks. The results of the survey are presented in Figure 5-7. During the survey, MMSO's observed one unidentified baleen whale, which was observed in the southern license block. In the study area, 16 harp seal sightings (19 individuals), seven ringed seal sightings (9 individuals), and 15 unidentified seal sightings (20 individuals) were observed throughout the study area. Outside the study area, during transit to and from the study area and Nuuk, four minke whales and 78 seals were observed. No other marine mammals (incl. polar bears) were observed at any time during the survey.

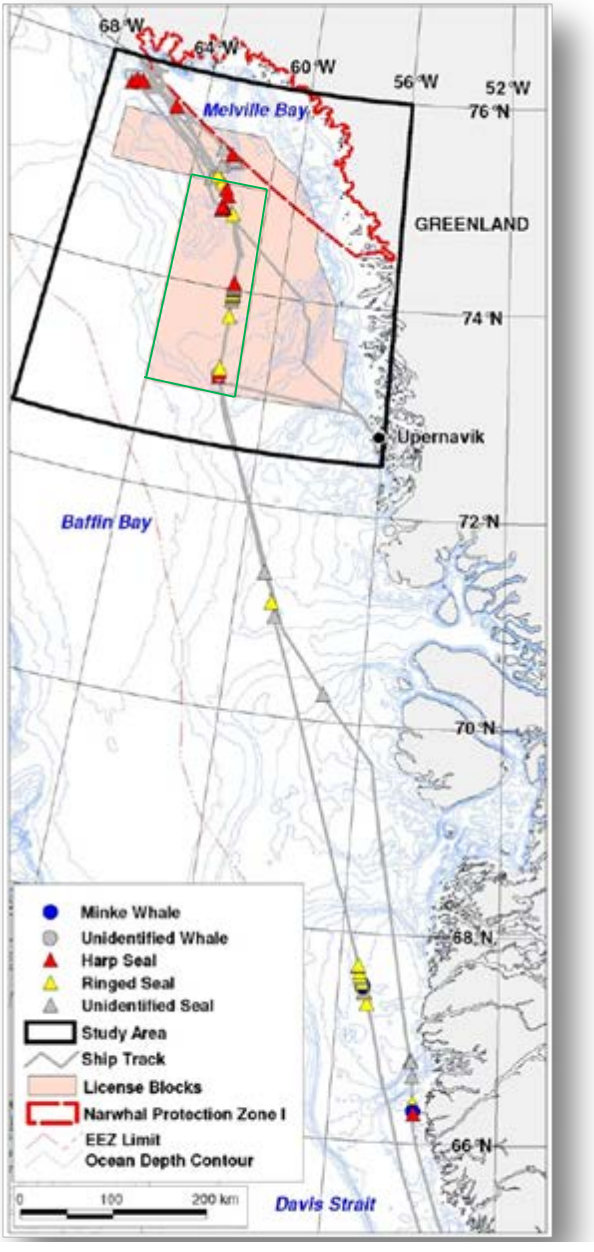

Figure 5-7 Distribution of marine mammal sightings in and around a study area during the August–September 2011. Figure derived from /75/. The license blocks relevant to this EIA are highlighted in green.

During survey activities in 2012, marine mammal sightings were undertaken for a survey in Baffin Bay (including the two license blocks). The survey included seven vessels, and preliminary results include both Baffin Bay as well as transit from Newfoundland, Nuuk and Upernavik.

Preliminary results (unpublished, results provided by Shell) of the 2012 MMSO activities in Baffin Bay show that the sightings included numerous seals, primarily harp, ringed and hooded seals, but also bearded and harbour seals. Most whales were observed during transit to and from the survey area, with sightings of sperm whale, minke whale and sei whale within the license blocks. In addition, a single polar bear was spotted within the two license blocks.

Table 5-18 Preliminary results of the MMSO activities during 2012 survey

Species	All observations		In license blocks	
	No. of animals	No. of observations	No. of animals	No. of observations
Harp Seal	1404	556	907	451
Unidentified seal	230	205	191	170
Long-finned pilot whale	167	14	56	3
Ringed seal	119	117	109	107
Hooded Seal	89	86	78	77
White-beaked dolphin	26	7	4	1
Sperm whale	20	15	16	13
Humpback whale	18	4		
Fin whale	17	14	3	2
Minke whale	15	12	3	3
Bearded seal	14	13	13	12
Sei Whale	14	5		
Large whale	12	12	3	3
Harbour porpoise	9	4		
Unidentified whale	8	5		
Fin/Sei whale	5	2		
Bottlenose Whale	4	2	1	1
Harbour seal	2	1	2	1
Hooded/bearded seal	1	1	1	1
Polar bear	1	1	1	1
Grand Total	**2175**	**1076**	**1388**	**846**

5.10.1.1 Whales

In the license blocks, the sea ice cover throughout the spring months represents a constraint to the presence of these animals, which will only reach such locations once the ice retreats /9/. The narwhal and beluga whale are specialised inhabitants of the Arctic and can be found in Baffin Bay year round /9/. Other species are generally only present in the area during ice-free periods of the summer.

The **narwhal** (*Monodon monoceros*) has very specific habitat requirements, ranging between 70 ^{o}N and 80 ^{o}N throughout Arctic and North Atlantic waters. Populations from Canada and West Greenland have high site fidelity to the winter pack ice of Davis Strait and Baffin Bay in regions along the continental slope.

Two narwhal populations are found near the license blocks during summer, one in Melville Bay and another in Inglefield Bredning further north. However, only the Melville Bay population is found in the license blocks, and they are found in the northeast corner of the area during summer. Migration through the license blocks appears to follow the 1,000-m contour southward. Narwhals from the Canadian High Arctic can migrate through the License blocks as early as late September–early October, and narwhals from Melville Bay migrate south from mid-October to mid-December, depending on the year /6/.

Narwhal feed primarily on Greenland halibut, together with other fish, squid and shrimp - mainly in the winter at deep water and possibly at or near the bottom /40/. Narwhals breed only once every 3 years between March and May with calves being born during the following summer.

Protection zones for narwhal are described in section 5.11.

The **beluga whale** (*Delphinapterus leucas*) is distributed throughout arctic and sub-arctic waters /41/. During the winter months, belugas congregate around areas of loose ice, feeding from the polynyas. They inhabit coastal waters, estuaries, shelf breaks, and deep basins during the summer months. In 2006 the abundance of belugas in West Greenland was estimated to 10,595 individuals, and concentrations of whales were mostly located in Disko Bay on the northern shore of Store Hellefisk Bank as well as along the eastern edge of the pack ice covering Baffin Bay and Davis Strait /6/. Approximately 30% of the Eastern Canadian high Arctic/Baffin Bay Beluga stock migrates to West Greenland for overwintering /39/.

Belugas that occur in and near the license blocks during part of the year are found in Lancaster Sound, Barrow Strait, Peel Sound, and Baffin Bay during the ice-free period /9/. Migration routes are primarily along the coast and through near shore waters, so few whales are expected in the license blocks at any time of year except perhaps in April–June, during the spring migration, when some animals travel through loose pack ice in offshore areas /6/.

Belugas acquire most of their annual food during the winter, which makes them particularly sensitive during this time of the year. They feed on polar cod and other fish but also squid and shrimps. Mating season is mainly between late February to early April, with calves being born between May and July in latitudes after a gestation period of over a year /9/.

During the winter **bowhead whales** (*Balaena mysticetus*) are observed in areas near the ice edge and in areas of unconsolidated pack ice. In the Baffin Bay-Davis Strait, bowhead whales move out of the summering areas as the ice forms during autumn towards the open water near the ice edge off West Greenland and eastern Baffin Island /42/. Bowhead whales seasonally use the eastern parts of Baffin Bay for feeding and undertake migrations /9/.

Although this species feeds mostly during the winter months at particular feeding grounds, it may also feed opportunistically during the spring migration. Their diet is based on crustacean zooplankton (copepods), epibenthic organisms, and some benthic organisms. Mating usually occurs during late winter and early spring. Soon after the calves are born (between April and June, but mostly in May), spring migration takes place.

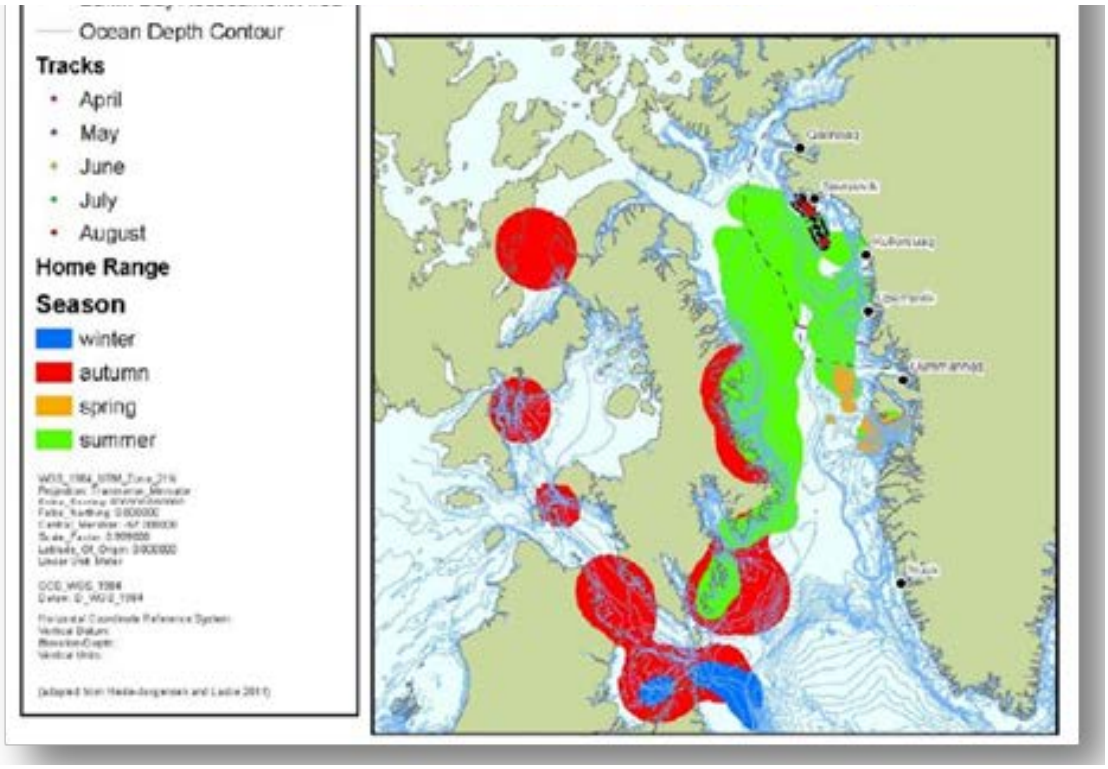

Figure 5-8 Seasonal home range distributions of bowhead whales in 2009. Adapted from 2012 EIA /6/.

Other whales may also be encountered in Baffin Bay. Minke whales (*Balaenoptera acutorostrata*) are common within Baffin Bay, but there is no knowledge on specific, important areas for this species within West Greenland. Sei whales (*Balaenoptera borealis*), fin whales (*Balaenoptera physalus*), humpback whales (*Megaptera novaegliae*) and blue whales (Balaenoptera musculus) can also occur in the south of Baffin Bay from June to November. Pilot whale (*Globicephala melas*), white-beaked dolphin (*Lagenorhynchus albirostris*) and bottlenose whale (*Hyperodon ampullatus*) may also occur /9/. Killer whales (*Orcinus orca*) could be encountered occasionally in the license blocks, mainly during the summer /6/.

5.10.1.2 Walrus and seals

The walrus and several species of seals occur in the Baffin Bay. Ringed seals and bearded seals are residents and more or less dependent on the sea ice , while harp seals and hooded seals are migrants and are present only when there is open water /9/.

Walruses (*Odobenus rosmarus*) breed in the Arctic pack ice during winter. Often walruses haul out on land or ice floes in groups of up to several thousand individuals. Five of the presumed eight sub-populations of Atlantic walrus are in Western and three are in Eastern Greenland. Walrus generally have an affinity for shallow water areas where they feed on a variety of benthic invertebrates, although they occasionally make dives to maximum 200–250 m depth, which makes most of the license blocks too deep for this species. However, a limited number of walruses spend the winter in leads and cracks between the land-fast ice and the moving pack ice in the license blocks. Moreover, there seems to be an unknown number of walruses that use this location as a migration corridor during spring and perhaps also autumn /9/.

A protection zone for walrus is are found north of the license blocks, see section 5.11. Protection period in the walrus protection zone is from 1 Oct. to 31 May.

The **ringed seal** (*Pusa hispida*) is the most common seal in the Arctic and is abundant in Baffin Bay. The ringed seal use sea ice exclusively as their breeding, moulting and resting habitat, rarely, if ever, coming onto land. Average densities of ringed seals on fast ice as well as on consolidated pack ice in the Baffin Bay area vary between 1.3–2 seals/km^2 in June. This density range can probably be applied to a large part of Baffin Bay /9/.

Females give birth in the spring (March to May). Moulting occurs from mid-May to mid-July. Then, the animals spend a considerable amount of time hauled out on ice at the edge of the permanent pack ice, or on remnant land-fast ice along coastlines. During this period, feeding activity is at its minimum. Outside the breeding and moulting seasons, this species is distributed in waters of nearly any depth. Ringed seals prey on small animals, and preferred prey tends to be schooling fish species, mainly polar cod.

The **bearded seal** (*Erignathus barbatus*) is a large seal, usually associated with the sea ice and is considered resident in Baffin Bay. They feed on fish and benthic invertebrates found in waters down to 100 m depth. Bearded seals make breathing holes where the ice stays relatively thin and they either winter in reoccurring leads and polynyas or they follow the pulse of the expanding and shrinking sea ice. Birth takes place in April–May on drifting ice or near ice edges with access to open water. Bearded seals are present throughout the Baffin where suitable habitats are available, and no particular important areas for the species are known /9/.

The **harp seal** (*Pagophylus groenlandicus*) is present in the license blocks from late-June to November. Harp seals are caught in large numbers in the coastal area near the license blocks, particularly in the late summer and autumn months. Their offshore prey is unknown, but amphipods are likely to be important. Around 10 % of the population of the seals from the West Atlantic population (estimated at about 6 million individuals) spend the summer and autumn foraging in Davis Strait and Baffin Bay /9/.

Hooded seal (*Cystophora cristata*) is a large migratory seal that does not breed in East Baffin Bay. It occurs late in the open-water season (July to October) and usually in offshore waters. It is a deep diver, feeding regularly below 500 m. The adult seals migrate to Davis Strait and Baffin Bay during the end of July /9/.

5.10.1.3 Polar bear

The **polar bear** (*Ursus maritimus*) relies almost entirely on the marine sea ice environment throughout their life cycle, and are known to travel great distances through the Arctic region generally on drifting oceanic ice floes, in search of food. Polar bears spend over 50 % of their time hunting for food, and their diet mainly consists of ringed and bearded seals /40/. Breeding occurs in March to May, and birth is generally thought to occur from late November to mid-January /38/.

Baffin Bay is an important polar bear habitat during autumn, winter and spring. When the central Baffin Bay field of consolidated pack ice disappears during spring and summer the polar bears either use eastern Baffin Island or the Melville Bay area as a summer retreat /9/.

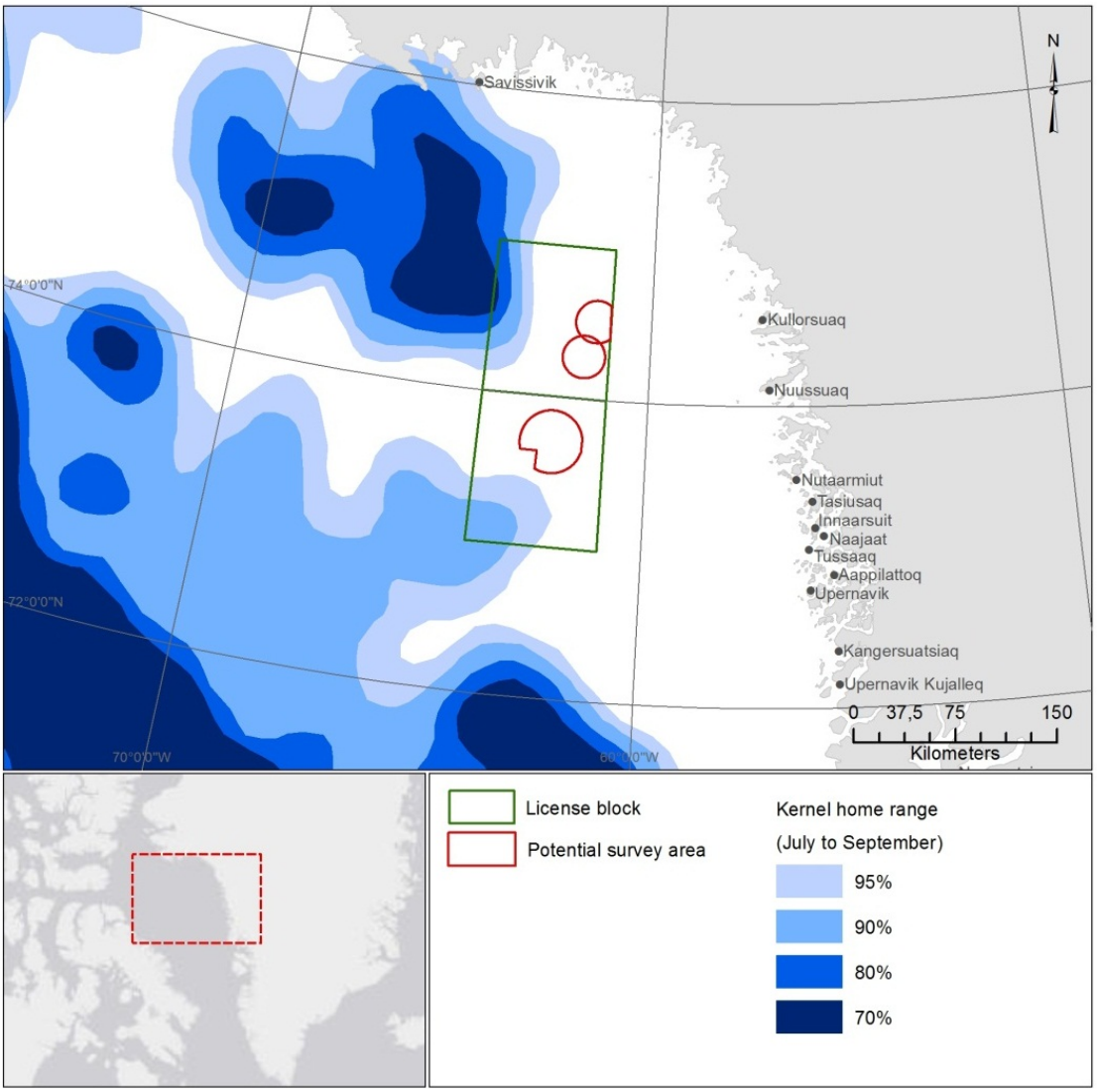

Figure 5-9 Polar bear Kernel home range (July to September). Adapted from Perry et al. (2011)

5.10.1.4 Overview of marine mammals

Table 5-19 provides an overview of marine mammals occurring in Baffin Bay, their main habitat and their red list status.

Table 5-19 Overview of marine mammals occurring in the strategic assessment area, their conservation status and hunting status (adapted from /9/).*LC=Least concern, DD=data deficiency, NT=not threatened, VU=vulnerable, ENCR=critically endangeres.

	Period of occurrence in Baffin Bay	Main Habitat	Biological activity	Greenland Red List status*	Distribution in the Baffin Bay SEIA area
Baleen Whales					
Minke Whale (*Balaenoptera acutorostrata*)	April-November	Coastal waters and banks	Feeding only. Winter breeding grounds are unknown	LC	Common in south
Fin Whale (*Balaenopetara physalus*)	June-October	Edge of banks and coastal waters	Feeding only	LC	Occasionally in south
Blue Whale (*Balaenoptera musculus*)	July-October	Edge of banks	Feeding only	DD	Occasionally in south

Humpback Whale (*Megaptera novaeangliae*)	June-November	Edge of banks and coastal waters	Feeding only	LC	Abundant in south
Sei Whale (*Balaenoptera borealis*)	June-October	Offshore	Uncertain	DD	Occasionally in south
Bowhead whale (*Balaena mysticetus)*	February-June	Pack ice and marginal ice zone	Feeding	NT	Locally abundant migrant and winter visitor
Toothed whales					
Narwhal (*Monodon monoceros*)	Whole year (mostly in summer and mid-seasons)	Winter: Edge of banks, deep water. Summer: Fjords, coastal waters. Migrants along 1000 m contour	Feeding November-March. Breeding March-May. Calfs are born in Summer/Fall	CR	Abundant summer and winter as a migrant
Beluga whale (*Delphinapterus leucas*)	October-November, April-June	Banks	Feeding November-March. Breeding February-late April. Calfs are born May-July	CR	Abundant migrant
Killer whale (*Orcinus orca*)	June-August	Ubiquitous	Feeding. Breeding in Summer.	NA	Occasional
Long-finned pilot whale (*Globicephala melas)*	June-August	Deep waters	Feeding. Breeding in Summer.	LC	Occasional in south
White-beaked dolphin (*Lagenorhynchus albirostris*)	Summer	Shelf waters	Feeding. Lack of breeding data	NA	Occasional in south
Sperm Whale (*Physeter macrocephalus*)	May-November	Deep waters	Feeding only	NA	Unknown
Harbour porpoise (*Phocoena phocoena*)	April-November	Coastal waters	Feeding only	DD	Only in south
Northern bottelnose whale (*Hyperodon ampullatus*)	Summer	Deep waters	Feeding only	NA/DD	Unknown
Walrus and seals					
Walrus (*Odobenus rosmarus*)	Whole year	Polynyas, mariginal ice zone, shallow water	Feeding. Breeding in winter. Pups are born mid-April to mid-June	ENCR	Migrants from adjacent areas
Ringed Seal (*Pusa hispida*)	Whole year	Waters with ice	Feeding. Breeding in late April-early May. Pups are born March-May	LC	Common and widespread

Hooded Seal (*Cystophora cristata*)	June-October	Mainly deep waters	Feeding only	LC	Common and widespread
Bearded Seal (*Erignathus barbatus*)	Whole year	Waters with ice	Feeding. Pups are born mid-March to mid-April	DD	Numerous
Harp Seal (*Pagophilus groenlandicus*)	June-October	Whole area	Feeding only	LC	Widespread and abundant
Carnivores					
Polar Bear (*Ursus maritimus*)	Whole year	Drift ice and ice edges	Breeding in March-May. Birth in late November - mid January	VU	Common, mainly with ice

5.10.2 Impact assessment

Potential project impacts are detailed in section 5.2. Of relevance to marine mammals are the potential project impacts noise, light and physical disturbance. Each potential project impact is assessed in relation to marine mammals, with focus on focal species of mammals in the area; bowhead whale, beluga whale, narwhal, harbour seal, ringed seal, walrus and polar bear. Similar impacts are expected for other marine mammal species.

Noise from seismic activities is considered the main potential impact to marine mammals. Marine mammals are sensitive to the pressure component of a sound field. Species-specific information on sensitivity is presented below, followed by an impact assessment.

Generally, the effect of noise on marine mammals can be divided into four broad categories that largely depend on the individual's proximity to the sound source:

- Detection
- Masking
- Behavioural changes
- Physical damages

It is important to note that the limits of each zone of impact are not sharp, and that there is a large overlap between the different zones. Behavioural changes, masking and detection also critically depend on the background noise level and all impacts depend on the age, sex and general physiological and behavioural states of the animals /60/.

Detection ranges depend on background noise levels which are unknown in this case. They are of great importance when discussing masking effects, but masking is not a directly relevant issue for pulsed sounds such as those used in the site survey /15/. This impact assessment is therefore restricted to physical damages and behavioural changes.

Physical damages to the hearing apparatus lead to permanent changes in the animals' detection threshold (permanent threshold shift, PTS). This can be caused by the destruction of sensory cells in the inner ear, or by metabolic exhaustion of sensory cells, support cells or even auditory nerve cells. Hearing loss is usually only temporary (temporary threshold shift, TTS) and the animal will regain its original detection abilities after a recovery period, but in prolonged exposures, where the ear is exposed to TTS inducing sound pressure levels before it has had time to recover, TTS may build, and a TTS of 50 dB or more will often result in permanent damage /62/. For PTS and TTS the sound intensity is an important factor for the degree of hearing loss, as is the frequency, the exposure duration, and the length of the recovery time.

Changes in behaviour are inherently difficult to evaluate. They range from very strong reactions, such as panic or flight, to more moderate reactions where the animal may orient itself towards the sound or move slowly away. However, the animals' reaction may vary greatly depending on season, behavioural state, age, sex, as well as the intensity, frequency and time structure of the

sound causing behavioural changes. According to Miller et al. /92/ (also see Southall /60/) exposures to sound pressure levels between 130 dB re 1 µPa and 150 dB re 1µPa from airgun array pulses induced behavioural reactions in wild beluga whales. Yet, not all individuals showed a reaction with no apparent changes in behaviour at received levels of well above 150 dB re 1µPa (see Miller et al. /92/). The EIA for the 2012 3D seismic survey /6/) used an exposure criterion of a sound pressure level of 150 dB re 1 µPa for behavioural impacts. Recent research on impulsive pile driving sounds /90//91/ and airgun pulses /89/ indicates that the harbour porpoise - a species particularly sensitive to acoustic disturbance – exhibit avoidance behaviour at received sound exposure levels of around 140 dB re 1 $\mu Pa^2 \cdot s$. This criterion will be used for all three species of cetacean for the 2D seismic surveys. Since for the echosunders and sidescan sonars, only sound pressure levels were available, we used a received sound d pressure level of 140 dB re 1 µPa as the criteria for behavioural reaction for these sources following a precautionary approach. Avoidance behaviour in ringed seals and bearded seals is induced at exposure levels exceeding sound pressure levels of 190 dB re 1µPa /60/. This criterion is also assumed for walruses.

Beluga whales and narwhals both use echolocation to navigate and forage. They emit broadband echo-location clicks of very short duration /46/. Beluga whale clicks are centred around 100-115 kHz and have peak-to-peak source levels up to 225 dB re 1µPa /46/. Narwhal clicks have peak frequency at 20 and 40 kHz, and the maximal peak-to-peak source level measured is 218 dB re 1µPa /47/. The hearing sensitivity has been investigated in the beluga whale both behaviourally and using ABR (latest by Finneran et al /48/) and the audiogram is presented in Figure 5-10. An audiogram shows the hearing sensitivity with frequency on the x-axis and sound level on the y-axis. In general, audiograms have a U – shape with the areas of best sensitivity at the lowest values. Hearing in the narwhal has not yet been investigated, but in the following it is assumed to be comparable to that of a beluga whale. Beluga whale hearing becomes increasingly directional with higher frequencies. This increase in hearing directionality at the frequencies relevant for echo-location improves their echo-location capabilities by making them less susceptible to background noise and clutter echoes (i.e. returning echoes from other objects than the intended target) /49/. Directional hearing at higher frequencies is also expected for narwhals, as it has been demonstrated in other echo-location toothed whales as well /50/. Beluga whales and narwhals both use a variety of different sounds for communication. They use clicks, but also sound with significantly lower frequencies known as whistles and pulsed calls. Beluga whale communication sounds range from 260 Hz to 20 kHz, but with dominant frequencies from 1 to 8.3 kHz /11//51/. Narwhal communication sounds are lower in frequency ranging from 400 Hz to 14.5 kHz /52/. Lowering the frequency content causes the sound to be emitted more omnidirectionally which could be advantageous when communicating in a group.

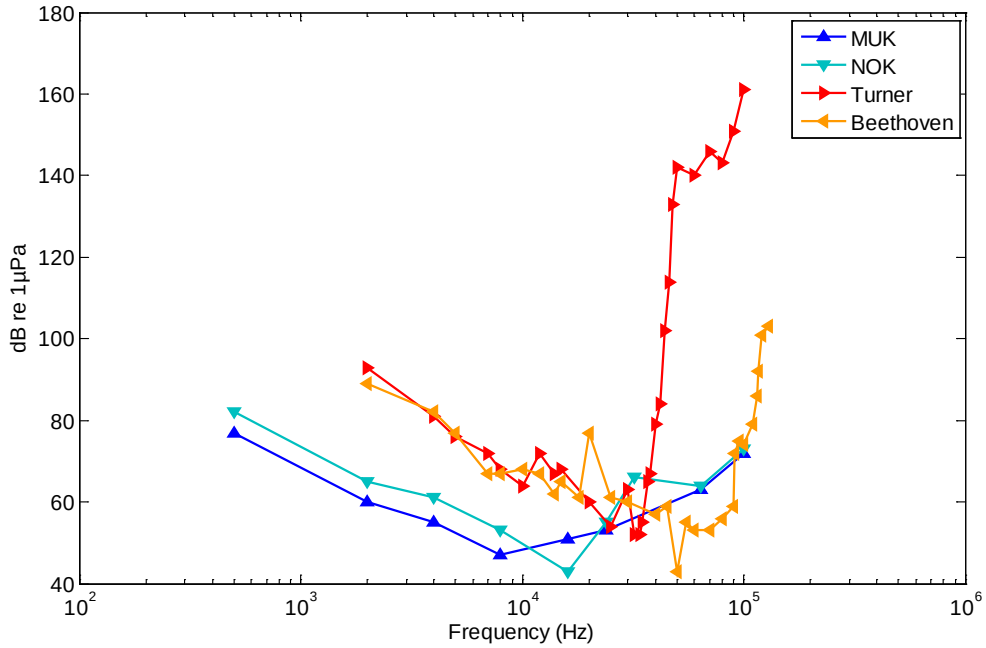

Figure 5-10 Audiogram of four beluga whales. Beethoven and Turner are modified from Ridgway et al. 2001. MUK and NOK are modified from /48/.

The hearing in baleen whales requires further investigation. However, anatomical studies of the inner ear in the northern right whale (*Eubalaena glacialis*), a close relative of the bowhead whale, suggest that this species has a hearing range from 10 Hz to 22 kHz /53/. This study is the only study to directly infer the complete hearing range of any baleen whale. Baleen whales are known to produce low frequency, high intensity calls for communication. Bowhead whales produce songs as well as calls, with a total frequency range for both types of sound being between 25 Hz and 2.6 kHz /54/.

Pinnipeds, such as walruses, bearded seals and ringed seals, are amphibious animals, and their hearing has evolved to function in both air and water, two acoustically very different media. The underwater hearing sensitivity of a male walrus can be seen in Figure 5-11. The hearing sensitivity has only been studied in a few species of pinnipeds. Studies of hearing thresholds for ringed seals and bearded seals are currently underway. However, the underwater hearing sensitivity of the harbour seal has been studied extensively (Figure 5-11) /56//57//58/ and will serve as a model for the underwater hearing sensitivity of ringed and bearded seals. The hearing thresholds of harbour seals are generally recommended to be used as a conservative estimate of the hearing thresholds for species where the hearing has not been investigated /60/. Pinnipeds produce a wide range of communication calls both over and underwater. Underwater calls are mainly associated with courtship behaviour and territoriality and are often produced by males /59/. Walruses produce underwater sounds with frequencies mainly below 1-2 kHz and may contain significant energy even at 10 Hz /11/. Bearded seals produce a variety of mating sounds with frequencies ranging from 200 Hz to 22 kHz /59/, and ringed seals produce sounds with frequency contents between 400 Hz and 16 kHz /11/.

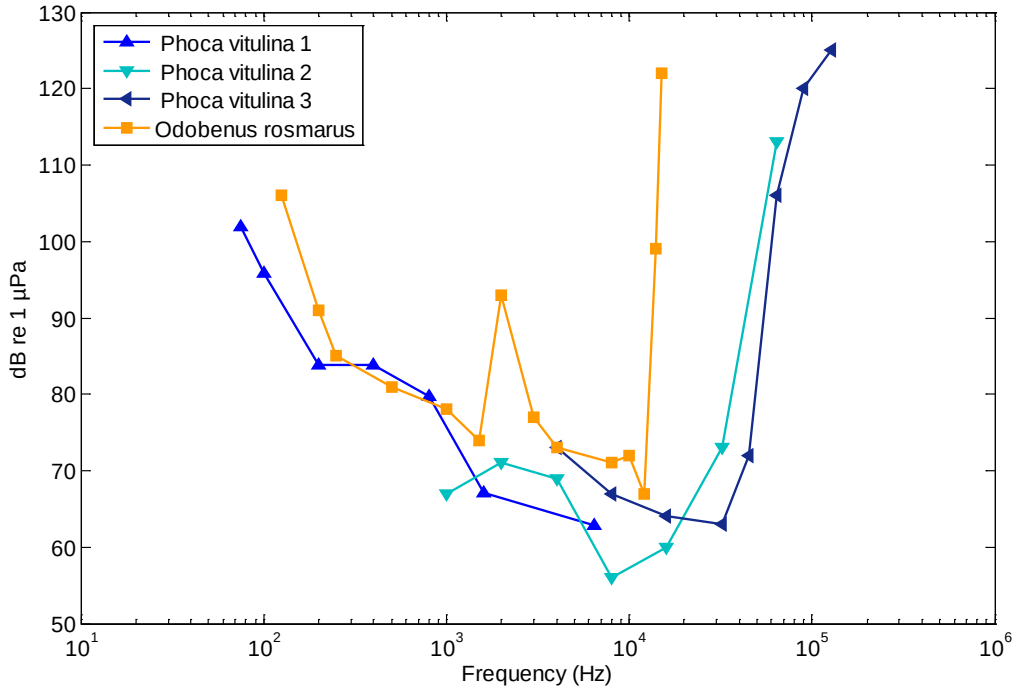

Figure 5-11 Audiogram of harbour seal and walrus. Harbour seal (*Phoca vitulina* 1-3) are modified from /56/ /57/ /58/. Walrus (*Odobenus rosamrus* is modified from Kastelein /55/.

For the quantitative assessment of impact ranges for behaviour and injury, criteria for marine mammals have been derived from a variety of sources (see /61//60/). The NMFS criteria /61/ are part of the US regulation (except, to our knowledge, the behaviour criteria). The NMFS criteria are based on the assumption that received levels that are lower than these criteria will not injure animals or impair their hearing abilities but higher received levels may have some effects. We have interpreted these criteria as the onset of TTS also noting the relatively low thresholds. Applicable are also the initial scientific recommendations on marine mammal noise exposure criteria as developed by a group of US experts /60/.

PTS has not been measured in any cetaceans, but Southall /60/ proposes peak sound pressure levels of 230 dB re 1µPa and SEL levels of 198 dB re: 1 µPa2-s (Mlf) as criteria both for single and multiple pulses. A study by Finneran /63/ measured TTS in a beluga whale when exposed to a single sound pulse from a seismic watergun. The TTS limit was at a peak-to-peak sound pressure level of 226 dB re 1 µPa (recovery to within 2 dB of the original hearing sensitivity after 4 min). A similar criterion for PTS and TTS will be assumed for narwhals and bowhead whales.

Table 5-20 provides an overview of noise exposure criteria for marine mammals used in this assessment. Studies of hearing thresholds for ringed seals and bearded seals are currently underway. However, the underwater hearing sensitivity of the harbour seal has been studied extensively and served as a model for the underwater hearing sensitivity of ringed and bearded seals.

Table 5-20 Marine mammal noise exposure criteria used in the quantitative assessment.

Effect	Taxa	Sound type	Sound pressure level / SEL	Source
Start of hearing effects - TTS	Cetaceans	Airgun pulses	180 dB re 1µPa	/61/
Start of hearing effects - TTS	Pinnipeds	Airgun pulses	190 dB re 1µPa	/61/
PTS	Cetaceans (Beluga, narwhal, bowhead whale)	Single - multiple pulse	230 dB re 1µPa peak	/60/
PTS	Cetaceans (Beluga, narwhal, bowhead whale)	Single - multiple pulse	SEL 198 dB re 1µPa^2-s (M_{lf}, M_{mf}, M_{hf})	/60/
PTS	Pinnipeds (in water)	Single pulse - multiple pulse	218 dB re 1µPa peak	/60/
PTS	Pinnipeds (in water)	Single pulse - multiple pulse	SEL 186 dB re 1µPa^2-s (M_{lf}, M_{mf}, M_{hf})	/60/
TTS	Cetaceans (Beluga, narwhal, bowhead whale)	Single pulses	224 dB re 1µPa peak	/60/
TTS	Cetaceans (Beluga, narwhal, bowhead whale)	Single pulses	183 dB re 1µPa^2-s SEL (M_{lf}, M_{mf}, M_{hf})	/60/
TTS	Pinnipeds (in water)	Single pulses	212 dB re 1µPa peak	/60/
TTS	Pinnipeds (in water)	Single pulses	171 dB re 1µPa^2-s SEL (M_{pw})	/60/
TTS	Pinnipeds in water	Single pulses	226 dB re 1µPa peak to peak	/63/
Onset of response	Cetaceans (Beluga, narwhal, bowhead whale)	Multiple pulses 2 D seismic / echosounder / side scan sonar	140 dB re 1µPa^2·s / 140 dB re 1µPa	/60//89/
Response	Seals	Multiple pulses	190 dB re 1µPa	/60/

Using the criteria for injury and avoidance behaviour described above, zones of impact for the different sound sources are calculated from the M-weighted sound pressure source levels. Mammals generally do not hear equally well over their entire range of hearing. Towards the lower and upper cut-off frequencies the perceived loudness becomes less than what is predicted from the audiogram /64/. This discrepancy in perceived loudness can be compensated by applying an equal-loudness filter. Southall /60/ developed equal-loudness filters for the different marine mammal groups, and in the following this M-weighting will be applied for the evaluation of noise impact where possible. More details about M-weighting are given in the acoustic modelling report.

Little information is available regarding the power spectra of the sound sources investigated here. In the following it is assumed that the main sound energy is centred at 95 kHz for the multi-beam echosounder and 100-110 kHz for the side-scan sonar. This gives a conservative estimate of zones of impact. These frequency ranges, and M-weighted source levels, are used to calculate the distance between the source and the injury and behavioural response threshold locations /60/.

- The assumed M-weighted sound pressure levels (SPL_M) for a multi-beam echosounder are 221 dB re 1 µPa for mid-frequency cetaceans and 215 dB re 1 µPa for pinnipeds, the frequency range of the echosounder is outside the hearing range of low-frequency cetaceans.
- The SPL_M for the side-scan sonar is very similar to the multi-beam echo-sounders with 222 dB re 1 µPa for mid-frequency cetaceans and 217 dB re 1 µPa for pinnipeds.

The zones of impact for the equipment associated with multi-beam echosounder and side scan sonar are collected in Table 5-21.

Table 5-21 Zones of impact for a multi-beam echosounder and side scan sonar, defining zones of PTS/TTS and avoidance behaviour in the beluga whale, narwhal, bowhead whale, walrus, bearded seal, ringed seal, Atlantic cod and Atlantic herring. Data on multi-beam echosounder noise is from Genesis /14/. ([a] criteria from the National Marine Fisheries Service). The line '-' indicates that no record to any range could be found for this sound level in calculations or the model so that effects are not evident.

	Effect	Sound pressure level /SEL	Maximum range to threshold location (m)
Multi-beam echosounder	PTS	Cetaceans (narwhal and beluga)	-
	PTS	Pinnipeds (in water)	-
	TTS	Cetaceans (narwhal and beluga)[a]	85
	TTS	Pinnipeds (in water)[a]	20
	Response	Cetaceans (Beluga, narwhal)	350 - 800
	Response	Seals (bearded and ringed seal)	20 – 250
Side-scan sonar	PTS	Cetaceans (narwhal, beluga and bowhead whale)	-
	PTS	Pinnipeds (in water)	-
	TTS	Cetaceans (narwhal and beluga)[a]	90
	TTS	Pinnipeds (bearded and ringed seal)[a]	35
	Response	Cetaceans (Beluga, narwhal)	350 - 800
	Response	Seals (bearded and ringed seal)	35 – 350

For the assessment of the impact zones from the 2D high resolution survey, numerical modelling of underwater noise was applied, as detailed in Appendix 2.

The results of the modelling for the seismic survey are shown in Table 5-22. The spatial dimension of the underwater noise field is assessed for single shots and a survey undertaken over 24 h, see Appendix 2. It is very clear from the assessment that any physical impacts due to the exposure to single pulses are restricted to very close ranges from the source. Behavioural response in cetaceans is assessed to occur at distances of up to 6 km from the source. The differences between the sites are negligible.

Table 5-22 Zones of impact for the 2D high resolution seismic survey (see detailed results in the acoustic modelling report, Appendix 2)

Effect	Taxa	Sound pressure level / SEL	Maximum range to threshold location 1,2 and 3 (m)
Start of hearing effects - TTS	Cetaceans	180 dB re 1µPa	70-80
Start of hearing effects - TTS	Pinnipeds	190 dB re 1µPa	-40
PTS	Cetaceans (Beluga, narwhal, bowhead whale)	230 dB re 1µPa peak	-
PTS	Cetaceans (Beluga, narwhal, bowhead whale)	SEL 198 dB re 1µPa^2-s (M_{lf}, M_{mf}, M_{hf})	-
PTS	Pinnipeds (in water)	218 dB re 1µPa peak	-
PTS	Pinnipeds (in water)	SEL 186 dB re 1µPa^2-s (M_{lf}, M_{mf}, M_{hf})	-
TTS	Cetaceans (Beluga, narwhal, bowhead whale)	224 dB re 1µPa peak	-
TTS	Cetaceans (Beluga, narwhal, bowhead whale)	183 dB re 1µPa^2-s SEL (M_{lf}, M_{mf}, M_{hf})	30 M_{lf}
TTS	Pinnipeds (in water)	212 dB re 1µPa peak	-
TTS	Pinnipeds (in water)	171 dB re 1µPa^2-s SEL (M_{pw})	50-
TTS	Pinnipeds in water	226 dB re 1µPa peak to peak	-
Response	Cetaceans (Beluga, narwhal, bowhead whale)	160 dB re 1µPa	230-250
Response	Cetaceans (beluga, narwhal, bowhead whale	140 dB re 1µPa	5,800 – 6,090
Response	Seals	190 dB re 1µPa	40-

With regards to the intensity we define injury and PTS as being a large effect, as the structure and function of the receptor are affected completely, and structure and function are lost completely inside the affected area. As PTS is not affecting the whole hearing range of the receivers, we have defined this effect as being of medium intensity but of long-term duration. Following this logic, TTS is defined as a medium effect as well but as it is reversible, it is one of short term duration. Behavioural responses can range from medium to minor, depending on the number of species affected.

Applying the NMFS criteria, echosounders are predicted to lead to TTS in narwhal and beluga at 85 m from the source and in pinnipeds at distances of 10 m from the source. Behavioural effects are expected from 20 m (seals) to 800 m (narwhal and beluga). The impact ranges for the side scan sonar are TTS at 90 m in belugas and narwhals and at 35 m in pinnipeds. Behavioural responses are expected at a maximum range of 800 m (narwhal). Seals are much less affected with behaviour to be expected up to 320 m from the source.

For the 2D high resolution surveys TTS will be limited to areas close to the source (80 m in cetaceans and 40 m for pinnipeds). The onset of behavioural response can be expected in all three cetacean species at distances of up to 6 km from the source with little difference between the sites. For seals, behavioural responses are only expected at close ranges (40 m).

The results of the impact assessment are summarized in Table 5-24. As can be seen, the effects of noise on marine organisms are directly coupled to the activities. With the exception of the bowhead whale, TTS may be induced at relatively short distances. If noise inter-pulse intervals are shorter than the TTS recovery periods, TTS may accumulate and could potentially result in PTS (see also assessment of cumulative SEL levels for the 2D seismic survey). However, for the received levels, duty cycles and exposure times of interest here, the possibility of PTS to occur based on multiple exposures is very low. Once survey activities subside, physical effects should disappear within a few days. Behavioural effects could result in animals leaving the area for longer periods, but should return to normal within a few months at most.

Estimates of number of individuals and percentage of population assessed to be physiologically or behaviourally impacted from single airgun pulses have been assessed. The assessment has been made based on the population and density estimates performed for the 2012 EIA for seismic activities in the two license blocks /6/ and the zones of impact assessed in the acoustic modelling. A summary of the calculations is presented in Appendix 3. As presented in Table 5-23, the numbers of affected individuals are very low, with less than 1 individual potentially impacted for all species.

Table 5-23 Estimates of number of individuals assessed to be physiologically or behaviourally impacted impacted from single airgun pulses. A summary of the calculations are presented in Appendix 3.

	Animals assessed to be physiologically impacted (TTS)		Animals assessed to be behaviourally impacted	
	Individuals[1]	Percentage of population[2]	Individuals[1]	Percentage of population[2]
Ringed seal	$7.0 * 10^{-3}$	$3.1 * 10^{-6}$	$7.0 * 10^{-3}$	$3.1 * 10^{-6}$
Narwhale (offshore)	$5.2 * 10^{-5}$	$3.5 * 10^{-7}$	0.29	$2.0 * 10^{-3}$
Beluga whale (summer)		$1.2 * 10^{-7}$		$6.9 * 10^{-4}$
Beluga whale (fall)		$1,2 * 10^{-6}$		$6,9 * 10^{-3}$
Bowhead whale		$1,2 * 10^{-5}$		$6,9 * 10^{-2}$
Walrus		$3,1 * 10^{-6}$		$3,1 * 10^{-6}$

Presence of vessels may contribute to the animals' habituation to human activities. However, limited interaction between the site survey and marine mammals in the area is expected. Marine mammal responses to vessels often include changes in general activity (e.g., from resting or feeding, to active avoidance), changes in surfacing-respiration-dive cycles, and changes in speed and direction of movement. Behavioural reactions tend to be reduced when animals are actively involved in a specific activity such as feeding or socializing, as reviewed by Richardson /43/. Whales react most noticeably to erratically moving vessels with varying engine speeds and gear changes, and to vessels in active pursuit. In general, large baleen whales are more susceptible to strikes than smaller toothed whales. A description of the response of the six focal species is presented in the following.

Belugas and Narwhals' response to vessels during ice-free seasons are variable, ranging from tolerance to avoidance. The response of belugas and narwhals appears to be dependent on the type of vessel, its speed and course, the whales' activity, and their previous exposure to industrial activity. According to Finley /44/narwhal and belugas' sensitivity to vessel presence in Lancaster Sound declined after repeated exposures. Narwhals revealed more subtle reactions to oncoming vessels than belugas, generally by slowing-down their movements or remaining motionless near the ice edge, as reviewed in /6/. In Baffin Bay few belugas are expected to occur, and narwhals from Melville Bay are not expected to be present in the license blocks. Thus, it is not expected that belugas and narwhals will be majorly exposed to vessels to cause disturbance or mortality. Marine mammal observers will also be onboard, mitigating this impact. Given the planned mitigation measures, it is assessed that the impacts will be negligible.

Bowhead whales seem to show avoidance reactions to approaching vessels at distances of 4 km or greater /43/. When vessels travel slowly, bowhead whales are often more tolerant, showing little or no reaction. Furthermore, bowhead whales engaged in social interactions or mating may be less responsive than other bowhead whales /6/. Bowhead whales may be encountered in the license blocks during the site survey period. However, the planned timeline for this project does

not overlap with major feeding or breeding periods/areas of the whales. Thus, it is believed that if encountered, a bowhead whale would be able to avoid the vessels and prevent ship strikes. Marine mammal observers will also be onboard, mitigating this impact. For this site survey it is thus assessed that the operations involved may not impact bowhead whales.

A study on walrus /45/ showed that when hauled-out on ice, the behavioural reaction of walruses depends mainly on vessel distance and speed. In addition, walrus respond at greater distances when a vessel approached from downwind as compared with upwind, and that this species shows less reaction in water than on ice. Thus, collisions between vessels and walrus do not seem to be of concern. However, walrus are not expected to be present in the license blocks, which is too deep for them to feed >200m. For this current study, walrus vessel avoidance reactions in water are expected to be localized and short-term.

There are few studies on pinnipeds' behavioural reaction to vessels. Hauled-out ringed seals often show short-term escape reactions to approaching ships within 250–500 m /38/. It seems that when in water seals are less responsive to approaching vessels than when on ice, and may even lead to curious behaviour /6/.

Polar bears have no natural predators and, given their position at the top of the food web, it is very sensitive to changes in the arctic marine ecosystem. According to Fay et al. (1984), most polar bears seem to be little affected by vessel presence, although different behavioural reactions have been documented. Generally, the responses tend to be short-term and usually described as avoidance by walking, running, or swimming away. However, other bears may not show any reactions at all /6/). Mothers with cubs are expected to be more protective and cautious, especially when more than one cub is present. Encounters between vessels and swimming polar bears are very unlikely, as few polar bears sightings are expected during the proposed period of the site survey.

Seabed disturbance and changes in food availability are assessed in previous sections. Certain marine mammals that may occur in the license blocks are known to feed on benthic animals, particularly the narwhal, beluga, bearded seal and walrus. However, belugas and narwhals acquire most of their dietary requirements during the winter, feeding very little, if at all, during the summer. Being located offshore at water depths of 400 – 800 meters, survey sites are at depths deeper than the feeding range for walrus, which is able to dive no deeper than c. 200 meters. Any seabed disturbances related to the site survey are considered to be of no influence to marine mammals.

The previous sections have assessed the impacts of the survey activities to fish and lover trophic ecosystem levels. No or minor impacts to neither pelagic crustaceans nor pelagic fish are expected. Based on this, it is assessed that there will be no impacts to whale or seal feeding in the license blocks, caused by alterations of the distributions of prey items.

The presence of moored hydrographic stations has some probability of causing **entanglement** of mammals. This may prove fatal to an individual becoming entangled. The moored equipment of the survey are expected to consist of ropes/wires being stretched between anchor, measuring instruments and flotation buoys all the time the equipment is deployed. Avoiding slack and loose piles of floating rope will reduces the risk of accidental entanglement of whales or seals. There is a low risk of entanglement and ship collision to individuals, and the overall impact is assessed to be none.

Navigational and deck- working **lights** used to illuminate working areas, are sources of artificial light being spread into the environment. Light may attract plankton and fish, serving as prey for marine mammals. However, planned activities are scheduled to take place within a time window from July to October, during which daylight dwindles, and illumination gradually becomes needed. It is assessed that light from the site survey on marine mammals will have no measurable impact.

Table 5-24 Environmental impacts to marine mammals in connection with the 2013 site survey

Potential project impact	Intensity of impact	Scale of impact	Duration of impact	Overall severity of impact	Level of confidence
Noise (MBES) TTS	Medium	Local	Short-term	Moderate	Medium
Noise (MBES) Response	Medium	Local	Short-term	Minor	Medium
Noise (SSS) TTS	Medium	Local	Short-term	Moderate	Medium
Noise (SSS) Response	Medium	Local	Short-term	Minor	Medium
Noise (seismic) TTS	Medium	Local	Short term	Minor	Medium
Noise (seismic) Response	Medium	Regional	Immediate	Moderate	Medium
Presence of vessels	Medium	Local	Short-term	Minor	Low
Seabed disturbance and changed food availability	-	-	-	No impact	High
Entanglement in mooring	Low	Local	Short	No impact	High
Light	Low	Local	Short	No impact	High

5.10.3 Mitigating measures

The mitigation measures applied are:

- Marine mammal observers, ensuring that the survey is delayed if animals are observed
- Soft start procedure gradually increasing the sound energy to provide time for mammals to leave the area
- Observations of a safety zone (500 m) where the survey is stopped if animals are observed
- Passive acoustic monitoring system, enabling registration of marine mammals under adverse weather conditions.

The site survey is undertaken applying the mitigating measures outlined above and no further mitigating measures are expected.

5.10.4 Residual impact

The planned mitigating measures would effectively alleviate the risk of temporary threshold shift. However, the measures would not be mitigating to behavioural impacts as ranges are larger and animals cannot be visually observed at these distances.

The residual impact to marine mammals is thus assessed to be minor.

5.11 Protected areas

5.11.1 Existing conditions

Figure 5-12 show protected areas in or near the license blocks. There are no Ramsar-areas, important bird areas (IBA) or areas protected according to the Greenland Nature Protection Law (Melville Bay reserve and Bird Protection areas) within the license blocks.

The license blocks are situated in a seismic protection zone for narwhal, appointed as a migration corridor (narwhal zone II). The protection zone is the fall migration habitat where the narwhals (and beluga whales) are present from 15 October at least until 1 Dec. Seismic activities in narwhal zone II shall be confined to a minimum in the protection period.

Narwhal zone I is the summer habitat, where narwhals are present when the sea ice melts in summer until fall migration (1 June to 15 Oct). Beluga whales also occur in this area from 1 October. The shortest distance from survey areas to the seismic protection zone for narwhal summer habitat is approximately 40 km.

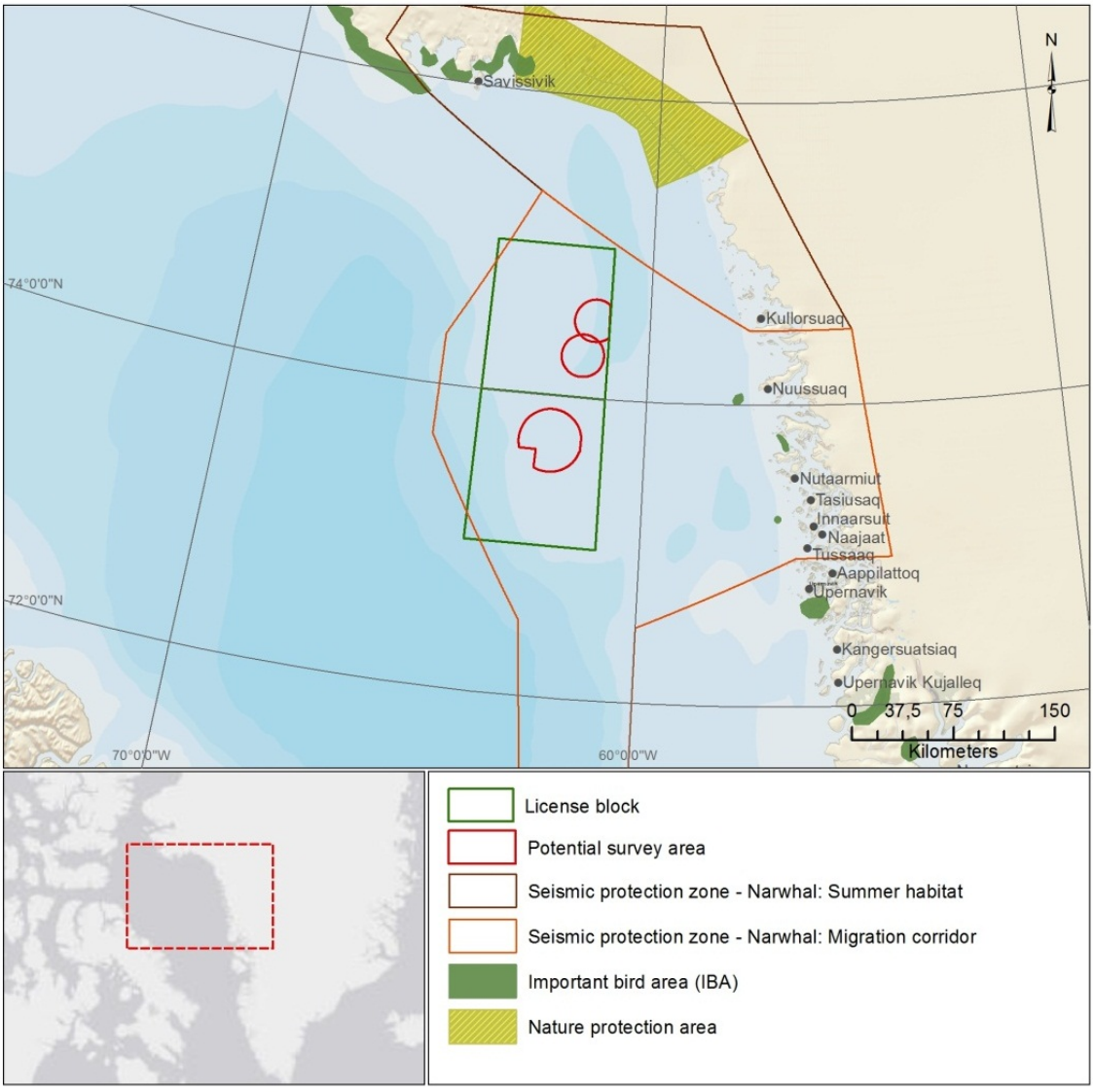

Figure 5-12 Protected and important areas in and near the license blocks.

5.11.2 Impact assessment

The license blocks only overlap with one type of protection zone: seismic protection zone for narwhal. The protection zone is the fall migration habitat where the narwhals (and beluga whales) are present from 15 October at least until 1 Dec. As there is no overlap between the site survey and the protection period, it is assessed that there will be no impacts to protected areas.

Table 5-25 Environmental impacts to protected areas in connection with the 2013 site survey

Potential project impact	Intensity of impact	Scale of impact	Duration of impact	Overall severity of impact	Level of confidence
None				No	High

5.12 Seabirds

5.12.1 Existing conditions

The highly productive waters off Northwest Greenland combined with suitable breeding habitats along the shores attract millions of seabirds during the open water season (May – September). Most of the seabirds found in the region are migratory and only visit the area during the breeding period. The birds arrive from early May from the eastern Canadian Arctic, eastern Canada, northeaster United States, Western Europe, and the south Atlantic, and many species aggregate in large breeding colonies containing several million pairs /9/.

Besides being an important breeding area, the Baffin Bay area supports large numbers of migrating birds traveling through the area to and from breeding sites in the northern parts of Canada and Greenland /9/.

The seabirds play an important role in the High Arctic ecosystem. Because they breed on land and forage at sea, they transport nutrients across the biogeographic boundary between the highly productive sea and the relatively low productive terrestrial ecosystem. Thus, colonial seabirds play a key role in fertilizing and sustaining the terrestrial ecosystem /66//67/.

Many seabird species in the Baffin Bay area are fish consumers and prey on species such as capelin, sand eel and polar cod. Other species live on benthic invertebrates or support the fish diet with large zooplankton species (copepods, amphipods and krill) /9/. Little auks are specialized on a planktivorous diet and prey entirely on zooplankton throughout the breeding period /69/. The different diet preferences are reflected in the foraging behaviour (foraging range, diving depth, timing etc.). Some species (such as guillemots) show diving depths of more than 100 meters while other species (such as little auks) mainly feed in the surface waters (10-50 meters) /70//9/. Some species are forced on long distance foraging trips due to unsustainable local foraging options and may travel more than 100 kilometres to locate suitable prey /9/.

The most numerous seabird species in High Arctic is the little auk (*Alle alle*) /84/. Estimated 80 % of the total world population (corresponding to 33 million birds) breeds in the Avanersuaq (Thule) district of Northwest Greenland /71/. In addition, the majority of the Greenland breeding population of Brünnich's Guillemots (*Uria lomvia*) breed in the area /9/. Also, northern fulmar (*Fulmarus glacialis*) and Black-legged kittiwake (*Rissa triactyla*) are common in Baffin Bay /9/. A list of important species for the area is presented in
Table 5-26.

Among the species found in the Baffin Bay area, several are of conservational concern and included on the Greenland Red List and/or are of national or international importance. The conservational status for selected species is presented in Table 5-26.

Table 5-26 Overview of selected seabird species found offshore in the Baffin Bay area. List modified from /9/.

Species	Greenland Red List status	National responsibility species*	Importance of Baffin Bay area**
Fulmar (*Fulmarus glacialis*)	Least Concern		High
Red-necked phalarope (*Phalaropus lobatus*)	Least Concern		Low
Red phalarope (*Phalaropus fulicarius*)	Least Concern		Low
Black-legged kittiwake (*Rissa tridactyla*)	Vulnerable		High
Glaucous gull (*Larus hyperboreus*)	Least Concern		Medium
Icelandic gull (*Larus glaucoides*)	Least Concern	Yes	Low
Sabines Gull (*Xema sabini*)	Near Threatened		Low
Ivory gull (*Pagophila eburnean*)	Vulnerable		Medium
Arctic tern (*Sterna paradisaea*)	Near Threatened		High
Atlantic puffin (*Fratercula arctica*)	Near Threatened		High
Brünnich's Guillemot (*Uria lomvia*)	Vulnerable		High
Black guillemot (*Cepphus grylle*)	Least Concern	Yes	High
Razorbill (*Alca torda*)	Least Concern		High
Little auk (*Alle alle*)	Least Concern	Yes	High

*National responsibility species (defined as more than 20 % of the global population in Greenland), species with isolated population in Greenland and species listed as 'Data Deficient' (DD) occurring in the assessment area. Only species which may occur in marine habitats are included.
**Importance of Baffin Bay SEIA area to population (conservation value) indicates the significance of the population occurring within the Baffin Bay assessment area in a national and international context.

On a large scale the general knowledge of seabirds in the area is well known whereas, detailed information of offshore distribution and area utilization is very sparse. Presumably the most important offshore areas include waters with early ice break-up and areas where upwelling events are recurrent /9/. However, a report on marine mammal and seabird surveys conducted during a seismic site survey in 2011 include seabird observation from 65-76° N between August and September /75/. The density of birds ranged from 0.83 birds/km^2 (August, 68–70 °N) to 9.11 birds/km^2 (September, 74–76 °N). The highest densities were observed in the most southerly (65–68 °N) and most northerly (74–76 °N) latitudes of the survey area. A list of species observed from those surveys is presented in Table 5-27.

Table 5-27 Summary of selected bird observations during a seismic site survey off northwest Greenland between 11 August and 18 September 2011, modified from /75/.

Species	Total number (individuals)
Fulmar (*Fulmarus glacialis)*	398
Red-necked phalarope (*Phalaropus lobatus)*	14
Red phalarope (*Phalaropus fulicarius)*	45
Arctic skua (*Stercorarius parasiticus)*	8
Black-legged kittiwake (*Rissa tridactyla)*	398
Glaucous gull (*Larus hyperboreus)*	122
Icelandic gull (*Larus glaucoides)*	1
Sabines Gull (Xema sabini)	1
Ivory gull (*Pagophila eburnean)*	2
Arctic tern (*Sterna paradisaea)*	4
Atlantic puffin *(Fratercula arctica)*	1
Brünnich's Guillemot (*Uria lomvia)*	118
Black guillemot (*Cepphus grylle)*	36
Little auk (*Alle alle)*	1,925
Eiders (*Somateria* spp.)	92

Harlequin duck (*Histrionicus histrionicus)*	1
Gyrfalcon (*Falco rusticolus)*	2
Peregrine falcon (*Falco peregrinus)*	1
Baird's sandpiper (Calidris bairdii)	1
Pomarine skua (*Stercorarius pomarinus)*	10
Long-tailed skua (Stercorarius longicaudus)	16

5.12.2 Impact Assessment

Noise from seismic surveying may negatively affect the seabirds as physical damage caused by sound waves, and may also cause a behavioural response. In addition, the physical presence of the seismic vessel itself may affect the birds, as reviewed in /9/.

Very little is known about under water hearing in diving seabirds and information on effects from underwater sound on birds are sparse. During a seismic exploration programme in Davis Strait, no behavioural response or mortality of the seabirds was detected /72/. Observations from operation seismic vessels in the Irish Sea also did not reveal any behavioural response of seabirds to the survey activities /73/. Birds diving very close (a few meters) to an air gun array, may potentially suffer damage to the auditory system. However, birds have the ability to regenerate the sensory cells in the inner ear and a possible hearing impairment, would thus be temporary.

Due to the highly mobile nature of birds, they are generally not considered to be sensitive to seismic surveys. This is supported by the few studies carried out this far that did not find any mortality impact or behavioural response of birds foraging close to a seismic survey vessel /73/.

Based on the available information there is no indications that noise related to seismic surveys (seismic sounds and vessel noise) causes any substantial disturbing or injuring impacts on seabirds.

Light and illumination may attract birds when it is dark or under certain weather conditions (such as snow or fog). Birds may fly into parts of the ships infrastructure and get injured, killed or stranded. Stranded and injured birds are often not capable to leave the vessel again and in most cases, they die from exposure, dehydration, or starvation over hours or days.

In Greenland, the problem especially relates to eiders. More that hundred individuals have been reported killed on a single ship in a study by Merkel and Johansen /74/. However, the study was carried out off southwest Greenland and collision was mainly reported for periods of darkness and snowy weather. During the ice free period there is constant light in the Baffin Bay area (a phenomenon called midnight sun). The sun will set in early September, when most birds have left the area. The potential negative impacts from ship lighting are thus expected to be limited to periods after August, and it is assessed that there will be no severe impacts to seabirds.

Table 5-28 Environmental impacts to seabirds in connection with the 2013 site survey

Potential project impact	Intensity of impact	Scale of impact	Duration of impact	Overall severity of impact	Level of confidence
Noise	Minor	Local	Short-term	No impacts	High
Light	Minor	Local	Short-term	No impacts	High

5.13 Commercial and recreational fishery

5.13.1 Existing conditions

The commercial fisheries make up nearly 90 % of the Greenlandic export and play a vital role in the country's national economy. The offshore commercial fishery is carried out by a fleet of modern stern-trawler. This is mobile and flexible vessels, being able to exploit resources over vast areas, and as such less dependent on specific fishing areas (except for limitations related to seabed topography vs. trawling).

The survey area is located some 100 km from the coast, which is out of the normal range for many coastal fishing vessels. The fishing activity in the survey area is expected to be carried out by large, flexible trawlers.

The months from August-October are important months for the commercial fishery, with 40 % of the annual catch caught during three months (see Figure 5-13).

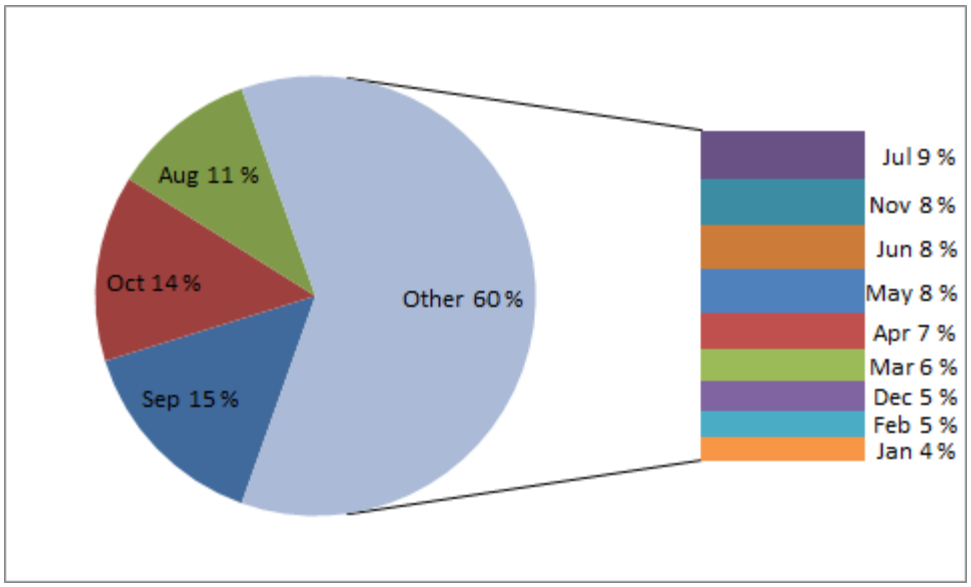

Figure 5-13 Annual variation in yearly landed species for the 2000-2010 in area 1A. The NAFO 1A area covers all west Greenlandic waters from 68˚50' to 78˚ N in the Baffin Bay. Source: www.nafo.int.

Most of the commercially important resources are found south of the survey area, and Baffin Bay only contributes marginally to the total Greenlandic fishery /27/. The recent Baffin Bay SEIA /9/ summarises fishing activity in the area as primarily targeting Greenland halibut, while the shrimp fishery mainly takes place south of the survey area. The general fishery pattern in Baffin Bay can be summarised as being performed by large trawlers registered in Greenland, targeting shrimp and Greenland halibut during autumn (August – October). The distribution of Greenland halibut fishery is shown in Figure 5-14.

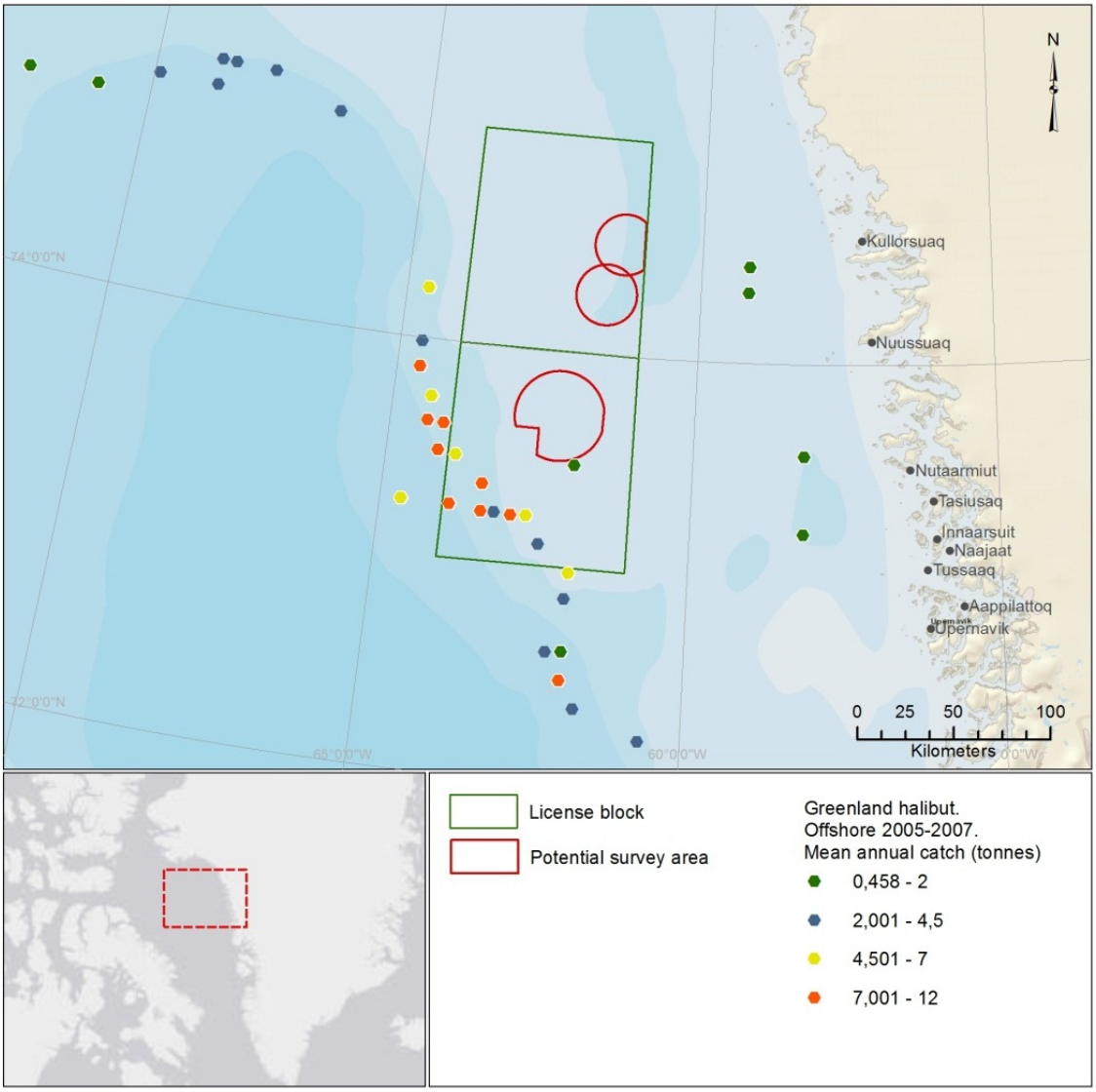

Figure 5-14 Distribution of Greenland offshore halibut fishery and size of landings from the assessment area. Redrawn from /9/

The shrimp population in West Greenland waters is decreasing due to poor recruitment. The catch quotas are decreasing accordingly (from an estimated catch in 2012 of 110 000 tons to a quota recommendation given by Pinngortitalerifiik (Greenland Institute of Natural resources) of 80,000 tonnes in 2013 /76/. This is likely to lead to reduced effort, and less important areas will tend to become even less interesting to the trawling fleet. Historically, the shrimp fishery has taken place south of the survey area, but the shrimp trawlers are flexible and independent of harbour/support facilities, and if ice conditions and catch rates are favourable in the survey area, the trawlers might be fishing in this region.

Greenland halibut is the second important commercial fish resource being harvested in the survey area. This stock seems to be stable, and a total allowable catch (TAC) of approx. 13 000 tons (the same as 2007 - 2012) is expected for 2013 /77/. Reduced availability of shrimp may encourage increased effort in the trawling for Greenland halibut, but it is considered unlikely that the survey area during 2013 will be of particular significance to Greenland halibut fishery. Despite a predicted increase in the population of Atlantic cod off west Greenland, this species has not (yet) increased in numbers sufficient to compensate for dwindling shrimp quotas.

The license blocks are located some 100 km from the coast and far from the major settlements and villages in west Greenland. The area thus is of limited or no interest to the smallest fishing and recreational vessels.

Local fishing and hunting historically form the backbone of Greenlandic household and culture. Greenlandic rural societies traditionally depend on harvesting a broad variety of nature resources, like fish, birds and mammals. Most of the harvested mammals are used for local consumption /self-sustained household and preparing traditional commodities like boots, clothes and works of art. International restrictions in trade of products derived from endangered and threatened mammal species has limited the possibilities for trading this type of commodities, and infrastructure development has reduced the necessity for local communities being self-sustained. However, hunting and fishing is still a very important part of the way of living.

5.13.2 Impact assessment

The most prominent impacts known to occur to fishing, is the operational inconveniences of presence of seismic vessels with limited manoeuvrability, and changes in fish behaviour due to the seismic noise, the latter expressed by avoidance behaviour and paused feeding.

Seismic data acquisition has been proven to influence catch rates of gadoid fishes (haddock and cod) in trawl fisheries in the Barents Sea /78/. This is valid for pelagic and semi pelagic fish with air-filled swim-bladder. Despite spending a significant amount of time in the pelagic /83/, the Greenland halibut has no swim-bladder, and is thus potentially less disturbed by seismic surveys.

The Greenland halibut fishery was in focus in connection with seismic surveys off Lofoten in Norway in 2008 and 2009 /82//79/. However, the expressed concern was merely a result of overlap in time with a strongly regulated fishery and not an indication that this species is particularly sensitive to seismic surveys.

Very limited knowledge exists on seismic impacts to crustaceans. Parry and Gason /80/ is one of the few studies addressing this topic, finding no impacts to lobster fishery

Physical presence of equipment may pose a hindrance to trawling activities. The survey is planned for the ice free period, coinciding with the period in which trawling is possible. None of the survey activities occupy large areas for any prolonged time, but even presence of one single installation (a hydrographic measuring station) in a trawl field is a hindrance requiring attention during trawling. The survey area is not known to be of significance to Greenland halibut trawling to an extent making alternative towing routes/areas less attractive. The current level of knowledge leaves no indications that mooring of instruments at the survey sites will lead to loss of fishing time due to necessary caretaking and avoidance by trawlers. The planned sampling leaves no anchor-mark like changes to the seabed; meaning no impacts to fishery besides the short time physical area occupation during sampling

Impacts from the planned 2013 surveys to fishing are summarised in Table 5-29.

Table 5-29 Environmental impacts to commercial and recreational fishery in connection with the 2013 site survey

Potential project impact	Intensity of impact	Scale of impact	Duration of impact	Overall severity of impact	Level of confidence
Noise and presence of vessel (from seismic and vessel operations)	Medium	Regional	Short-term	Minor impact (Limited fishery -> limited extent of impact)	High
Physical disturbance of the seabed	Low	Local	Short-term	No impact	High

Except the considerations made on seismic impacts to fishing, the planned activities of the survey are considered only to pose an insignificant and marginal influence to the expectedly limited fishery of the survey area during July – October 2013. The survey is not expected to cause any influence on the quality of fish and shellfish for human consumption.

5.13.3 Mitigating measures

A site survey of a specific location has limited, if any, possibilities to move the activity to other locations. Spatial mitigating measures to reduce influence on fisheries are thus limited to changes of the order in which the survey locations are visited. This should be considered in dialogue with any fishing vessels operating in the area during the survey.

The planned site survey in Baffin Bay is restricted in time by the heavy ice conditions most of the year. The ice-free time window sets limitations on timing of the survey, as well as trawling, thus overlap with any trawling activity in the area seems likely, given that fishing takes place. Choosing any other time of the year for doing the survey than the time window planned is not an option.

Mitigating measures in terms of order of magnitude of impact is related to number of fixed stations deployed, location and general duration of investigations.

5.13.4 Residual impacts

As the need for and the possibilities to enforce mitigating measures are limited, the residual impacts of the survey activity to fisheries is considered the same as the impacts expected before considering any mitigating measures.

5.14 Maritime traffic

5.14.1 Existing conditions

Maritime traffic in Baffin Bay is primarily fisheries, cargo and cruise ships, the number of which has been increasing in recent years /85/. According to Joint Arctic Command in Nuuk the marine traffic in the area is limited and primarily consists of:

- Cargo ships. The settlements in the Upernavik district received supplies by cargo ships. The cargo ships normally sail along the coast and are not expected in or near the license blocks. Only a very limited number of cargo ships are using the north-west passage.
- Cruise ships. Cruise ships are concentrated in the area near Ilulissant and do normally not sail offshore.
- Fishing vessels. As described in section 5.13, minor halibut fishing is taking place in the southern part of the license blocks and no shrimp fishing is conducted in the license blocks.

The Northwest Passage is the name given to a set of marine routes between the Atlantic and Pacific Ocean, spanning the straits and sounds of the Canadian Archipelago. The passage is a transportation corridor through one massive archipelago until it reaches open, but ice-infested waters in the Baffin Bay (east) and Beaufort Sea (west). Current shipping demand in the Northwest Passage involves up to 22 seasonal trips and occurs during the 100 day navigation season that span from mid-July to the end of October /85/.

5.14.2 Impact assessment

The amount of marine traffic in the license blocks is very limited in the license blocks as the majority of the maritime traffic is nearshore. On this background, it is assessed that the site survey will have no impact on maritime traffic.

Table 5-30 Environmental impacts to maritime traffic in connection with the 2013 site survey

Potential project impact	Intensity of impact	Scale of impact	Duration of impact	Overall severity of impact	Level of confidence
-	-	-	-	No impact	High

5.15 Tourism

5.15.1 Existing conditions

The most important asset for the tourist industry is the unspoiled, authentic and pristine nature.

Besides tourists staying in hotels and other accommodation on shore, cruise ships bring an increasing number of tourists to Greenland, with 23,500 visitors in 2011 /85/. The cruise ships focus on the coastal zone and they often visit very remote areas that are otherwise almost inaccessible and sightings of seabirds and marine mammals are among the highlights on these trips.

Tourism is increasing in importance in the Baffin Bay area and is one of the major sectors in the Greenland economy. Nature-based tourism in coastal regions is the primary component of this industry primary to the south of the license blocks. Cruise ships travel along the coast primarily in August and September.

5.15.2 Impact assessment

Tourism is primarily related to the coastal areas. As the license blocks are some 100 km from the shore, it is assessed that there will be no direct impact on tourism.

Table 5-31 Environmental impacts to tourism in connection with the 2013 site survey

Potential project impact	Intensity of impact	Scale of impact	Duration of impact	Overall severity of impact	Level of confidence
-	-	-	-	No impact	High

5.16 Cumulative impacts

Different impacts may together result in a different impact than each one would separately, as certain impacts can reinforce or counteract other impacts.

As per January 2013, no other seismic surveys are announced in Baffin Bay, and no other surveys are announced in the license blocks. As such, no cumulative impacts are expected in relation to survey activities.

5.17 Transboundary impacts

Transboundary impacts relate to impact across borders, i.e. impacts to the Canadian part of Baffin Bay, and could be associated with maritime traffic or propagation of underwater sound. No transboundary impacts have been identified as part of the environmental impact assessment.

5.18 Summary of impacts

The results of the impact assessment are presented in Table 5-32, along with level of confidence. As is evident from the table, some impacts associated with the 2013 survey are moderate. Applying the identified mitigating measures, the residual impact is reduced to minor.

The main activity of concern is the underwater noise emitted by the seismic activities and this is summarized below. Routine activities associated with the site survey, e.g. discharges of grey water (showers, wash water) and black water (treated sewage) as well as the physical presence of vessels were assessed, as were the impacts of the benthic sampling planned for the environmental baseline survey (EBS). Impacts of routine activities and benthic sampling are not detailed in this summary because impacts were assessed to be minor.

5.18.1 Fish

At depths below app. 500 m, the Greenland halibut is the dominant species, while species like lumpfish, spotted wolffish, polar cod, capelin, greenland cod, atlantic cod, northern shrimp, snow crab and several species of sculpins, skates and rays also occur.

Noise from site survey has been assessed based on the modelled sound levels and criteria for behavioural and physiological response to underwater noise. Any physical impacts due to the exposure to single pulses are restricted to very close ranges from the source. Behavioural response in marine fish can occur at ranges just below 60 km. Impacts to fish associated with the seismic survey are assessed to be moderate.

5.18.2 Marine mammals

No resident populations are known to occur in the license blocks. Based on dedicated aerial surveys, the SEIA and MMSO data several species of marine mammals have been identified in this area. Key species of marine mammals assessed to potentially occur in the license blocks are bowhead whale, beluga whale, narwhal, bearded seal, ringed seal, walrus and polar bear.

Noise from site survey has been assessed based on the modelled sound levels and criteria for behavioural and physiological response to underwater noise. Overall, the only physiological effects that can occur with this type of sound source under the modelled propagation scenario are temporary threshold shift in bowhead whales close to the source. Behavioural response is expected in cetaceans (narwhals, beluga whales and bowhead whales) at ranges up to 6 km from the source, while seals are much less affected with behaviour potentially affected within 40 from the source.

The mitigation measures applied are 1) Marine mammals observers ensuring that no marine mammals are in the area prior to seismic start-up, 2) Soft start procedure gradually increasing the sound energy to provide time for mammals to leave the area, 3) Observations of the ‘safety zone’ (500 m) where survey is delayed if animals are observed, and 4) Passive Acoustic Monitoring (on board) in low visibility conditions. All four methods would effectively alleviate the risk of temporary threshold shift, and the residual impact is thus considered minor. Yet the behavioural impacts would not be mitigated as distances are larger and animals cannot be visually observed at these distances.

5.18.3 Protected areas

The license blocks are situated in a seismic protection zone for narwhal, appointed as a migration corridor (narwhal zone II). The protection zone is established to protect the fall migration habitat where the narwhals (and beluga whales) are present from 15 October at least until 1 Dec. Seismic activities in narwhal zone II shall be confined to a minimum in the protection period. As there is no overlap between the site survey and the protection period, it is assessed that there will be no impacts to protected areas.

Table 5-32 Summary of the overall severity of impacts, mitigating measures and residuel impact for parameters related to the planned 2013 site survey. The level of confidence for each impact assessment is also provided.

Parameter	Overall severity of impact*	Mitigating measures	Residual impact	Level of confidence
Climate and ice conditions	No impact	N/A	No impact	High
Oceanography	No impact	N/A	No impact	High
Bathymetry	No impact	N/A	No impact	High
Water and sediment quality	No impact	N/A	No impact	High
Plankton	No impact	N/A	No impact	High
Benthic fauna	Minor impact	No mitigating measures applicable	Minor impact	High
Fish	Moderate impact	No mitigating measures applicable	Moderate impact	Medium-High
Marine Mammals	Moderate impact	Marine mammal observers ensuring no marine mammals in the vicinity prior to seismic start-up Soft start procedure gradually increasing the sound energy to provide time for mammals to leave the area Observations of a safety zone (500 m) where the survey is delayed if animals are observed Passive acoustic monitoring system, enabling registration of marine mammals under adverse weather conditions.	Minor impact	Low-High
Protected areas	No impact	N/A	No impact	High
Seabirds	No impact	N/A	No impact	High
Commercial and recreational fishery	Minor impact	Spatial mitigating measures to reduce influence on fisheries are limited to changes of the order in which the survey locations are visited. This should be considered in dialogue with any fishing vessels operating in the area during the survey.	Minor impact	High
Maritime traffic	No impact	N/A	No impact	High
Tourism	No impact	N/A	No impact	High
Cumulative impacts	No impact	N/A	No impact	High
Transboundary impacts	No impact	N/A	No impact	High

Table 5-33 Criteria used in the environmental impact assessment for the planned 2013 site survey.

Intensity of impact	Scale of impact	Duration of impact	Overall severity of impact[1]
No	Local	Immediate	No impact
Minor	Regional	Short-term	Negligible impact
Medium	National	Medium-term	Minor impact
Large	Transboundary	Long-term	Moderate impact
			Significant impact

[1]: Evaluation of overall significance of impact includes an evaluation of the variables shown and an evaluation of the sensitivity of the resource/receptor that is assessed.

The environmental impact assessment is based on the best available information at this time. The license blocks are situated in Baffin Bay, ~100 km from land, in an area with limited data coverage. The main knowledge gap thus relates to site-specific data for the environmental parameter. Some studies have been carried out, but no structured repetitive surveys have been carried out in the license blocks.

6. IMPACT ASSESSMENT (UNPLANNED EVENTS)

The planned site survey consists of seismic activities and sampling. Unplanned events include and accidental spill and loss of equipment during sampling. Loss of equipment during sampling refers to e.g. loss of streamer, or loss of an anchor. As the lost equipment is expected to be comparable to the dropped steel weights in association with the moorings assessed in section 5, loss of equipment is not further addressed.

Preventative measures and plans will be in place to avoid any fuel spillage or other accidental events during the site survey, as described in section 7. Plans and measures include: spill prevention plans and ship-board oil pollution prevention plans, crew training, adherence to the safety management procedures including proper bunkering procedures, and drills. An ice management plan will be implemented and minimize the likelihood of vessel collisions with icebergs. In the unlikely event of a spill, impacts will be minimized; including use of appropriate onboard spill kits.

6.1 Spill scenarios

For the purpose of this EIA, two scenarios for accidental fuel spill (of marine gas oil) were assessed. The first assumes a small spill during routine bunkering of a vessel and the second assumes total fuel loss (marine gas oil) from a vessel following a vessel collision (with another vessel or an iceberg).

- Scenario 1 assumes a fuel hose rupture during bunkering from a supply vessel to the seismic vessel. Based on a fuel transfer rate of ~100 m^3/h and assuming it would take one minute for ship personnel to notice the leak and stop the fuel pumps, ~1.7 m^3 of fuel could be spilled overboard.
- Scenario 2 is a worst-case scenario spill considering total fuel loss of the vessel. As the vessel for the site survey has not been selected, the volume considered in relation to the 2012 survey if used, resulting in a worst case spill of 1,925 m^3. Such a spill is considered to be unlikely.

Refuelling of the survey vessel may, if necessary, occur in the license blocks, some 100 km from the Greenland coast, including the coastal areas identified as sensitive to spills in the SEIA /9/and oil spill sensitivity atlas for coastal areas of northwest Greenland /10/. Based on wind and current patterns described in the existing conditions (section 5) and the 2012 EIA /6/, an offshore fuel spill within the license blocks is more likely to move away from the coast, than towards the coast /6/.

6.2 Impacts to the marine environment

The recent strategic environmental impact assessment (SEIA) /9/ reviewed potential impacts of accidental oil spills (including larger scale subsurface blowouts during exploration drilling) and the following assessment refers to the SEIA for further details.

Water quality, and possibly **sediment quality**, would be susceptible to an accidental spill. As reviewed in the 2012 EIA /6/ marine gas oil is a light oil that persists in the environment for much shorter periods than e.g. crude oil or heavy fuel oils. In cold water, only about 50% of the spilled gas oil would remain on the water surface after 12 hours, and a spill of gas oil would thus not persist for long periods on the water surface. The remaining gas oil is split, with about half dispersed in the water column and the other half lost to evaporation. Based on the worst case scenario, the amount of marine gas oil that could be lost during a vessel collision (with another vessel or an iceberg) would form a diminishing surface slick for a few days to a week /6/.

The scale of a spill in a worst-case scenario is thus assessed to be regional with a short-term duration, and assessed to be minor.

Plankton (incl eggs and larvae of fish and invertebrates) are sensitive to hydrocarbon exposure. The occurrence, abundance and distribution of eggs and larvae of marine fish and invertebrate in the license blocks are likely to be highly variable by season and dependent on a variety of potential for individual invertebrate eggs and larvae in the upper water column to sustain lethal

and sublethal effects following contact with high concentrations of hydrocarbons. In relation to fisheries, larvae of Greenland halibut and shrimp are found in deeper waters and would be less likely to come in contact with a fuel spill at the water's surface. In the event of an accidental spill (which will be local and short-term), it is assessed that minor impacts to plankton may occur.

Under natural conditions, most juvenile and adult **fish** can actively avoid contaminated water /9/. Impacts to fish populations is considered minor, but with uncertainty related to lack of life cycle knowledge on most species.

Due to expected low densities of **marine mammals** in the license blocks, and the limited amounts of light fuel onboard the survey vessels, accidental discharges of marine gas oil are not expected to cause any impacts to seals or whales. Whales and seals rely on a layer of blubber, rather than fur, for insulation (except seal pups) and are generally not sensitive to a minor spill. As noted in the SEIA, the primary species in the license blocks that would be vulnerable to exposure to marine gas oil is the polar bear, which could have reduced insulation capabilities.

The primary effects of an accidental spill on **fisheries** relates to physical effects on target species and fouling of gear. As noted in section 5.13, little fishery is expected in the license blocks, primarily targeting Greenland halibut. Direct impacts to ongoing fishing activity will likely be aborting fishing to take part in SAR operations. As impacts on fish and marine invertebrates from a spill of marine gas oil are expected to be minor, it is assessed that impacts on fisheries will be minor. Further impacts to fisheries due to market perceptions of poor product quality (no buyers or reduced prices, etc.) are more difficult to predict, since the actual (physical) impacts of the spill might have little to do with these perceptions.

Seabirds are extremely vulnerable to fuel spills in the marine environment, as reviewed in /9/. Even a small amount of fuel may destroy the insulating and water-resistant properties and affecting the buoyancy of the plumage causing the bird to die from hypothermia, starvation or drowning. In addition, birds may get intoxicated from ingestion or inhalation of fuels when they are cleaning their plumages or are feeding on contaminated food. Intoxication may cause irritation of the digestive organs, damages to liver, kidneys and salt glands and leading to anaemia. The aggregative nature of many species of seabirds in Baffin Bay (especially little auks and Brünnich's Guillemots increases the potential for larger mortalities in case of an oil spill.

Transboundary impacts relate to impact across borders, i.e. impacts to the Canadian part of Baffin Bay. With the worst-case spill assessed to be regional with a short-term duration, no significant transboundary impacts are expected to occur.

7. ENVIRONMENTAL MANAGEMENT PLAN

An environmental management plan (EMP) has been prepared to address implementation and monitoring of agreed mitigating measures for the site survey. In effect, the EMP links the EIA to the execution of the site survey.

The EMP includes a description of the management structure and outlines the mitigating measures agreed for the site survey.

7.1 Management structure

Shell is the operator for the license blocks and is managing the site survey activities.
The site surveys will be undertaken by a specialist contractor, who will be responsible for the day-to-day operation of the vessel and the site survey programme. A client representative will be stationed on board the vessel and will be responsible for ensuring compliance with contract scope and specifications, audit of data quality, monitoring implementation of project HSSE plan and monitoring project progress.

7.2 Planning phase

An Environmental Impact Assessment (EIA) must be prepared, describing the environmental conditions and assessing potential impacts. As part of the EIA seasonal considerations (e.g. pupping, migration of marine mammals) are addressed.

Airgun array must be chosen to use the lowest practicable power levels to achieve the geophysical objectives of the survey. The airgun array for the 2013 survey has yet to be selected, and the EIA includes acoustic modelling based on conservative assumptions. The assumptions are based on parameters from previous surveys, literature and experience.

The Seismic EIA Guidelines request operators to seek methods to reduce and/or baffle unnecessary high-frequency noise and to increase the directionality of the airguns. These potential mitigation measures have been assessed in a Joint Industry Programme study /87/. It was determined that the equipment necessary to reduce and/or baffle the airguns is not yet available.

Communication with the relevant stakeholders (e.g. authorities, other operators and local interest groups) will be established as a minimum according to regulatory requirements. In addition to informing about the project, such communication allows the operator to assess cumulative impacts, e.g. if seismic surveys are planned in neighbouring license blocks.

7.3 Survey phase

7.3.1 Marine mammals – seismic mitigating measures

As evidenced in this EIA, the main impact is that of airgun array noise on marine mammals. This EMP focuses on minimizing noise impacts and is based primarily on the best practice mitigation guidelines described in the BMP Guidelines /3/.

Marine mammal (and seabird; see below) **observations** will be performed from the survey vessels allowing an unobstructed view of the waters around the vessel. Whenever possible, the MMSOs will conduct observations from an outdoor platform. During periods of poor weather (high winds, rain/snow, or extreme cold temperatures), the MMSOs will continue monitoring for marine mammals and seabirds from the bridge for safety reasons. MMSOs aboard each of the seismic vessels will monitor for the presence of marine mammals (and seabirds) during all daylight hours. At all times, MMSOs will have access to a direct communication line with the survey room and the operator of the airguns. A safety zone of 500 m from the centre of the airgun array will be implemented for marine mammals, based on international best practice.

Table 7-1 summarizes the operational monitoring and mitigation measures proposed for Shell's seismic program. Flow-charts will be developed that clearly outline the decision-making process for implementing mitigation and monitoring procedures.

During periods of poor visibility (when the 500-m safety zone for marine mammals, respectively cannot be monitored because of darkness or poor sighting conditions such as fog, rain, snow, or sea states >3), **PAM** will be used during the pre-shooting watch period to monitor for vocalizing marine mammals within the safety zone. The safety zone monitored by the PAM system will be determined in the field to ensure it extends beyond 500 m to compensate for the system's accuracy. If any marine mammal is visually or acoustically detected within the safety zone during the pre-shooting watch period, the ramp-up will be delayed until the animal has been observed outside of the safety zone or 20 min has passed since the animal was last detected.

A **pre-shooting search** of 30 min (60 min in water depths of >200 m) will be conducted before the start of any airgun operations.

If the airgun array is shut down while on a transect line for any reason other than a marine mammal **shutdown**, the airgun array can be re-initiated at full power given that the shutdown is not longer than 5 min. Otherwise, a 20-min search and full ramp-up procedure will need to be initiated. When a marine mammal is observed to be on a course that will result in its entering the safety zone, a precautionary shutdown of the airgun array will be implemented.

The ramp-up or **soft start procedure** will occur over a minimum period of ~20 min. Ramp up will start with the smallest volume airgun and incrementally increase the number of airguns activated. The procedure will be planned such that the start of the survey line begins immediately following the ramp up (i.e., unnecessary airgun firing will be avoided). Ramp ups will not exceed 40 min in duration, and to the extent possible will be initiated during daylight hours. During periods of poor monitoring visibility (when the 500-m safety zone for marine mammals cannot be monitored because of darkness or poor sighting conditions such as fog, rain, snow, or sea states >3), PAM will be used during the ramp-up procedure to monitor vocalizing marine mammals within the safety zone. If any marine mammal is visually or acoustically detected within the safety zone during the ramp-up procedure, the airgun array will be reduced to the mitigation gun (smallest airgun in the array) and a new ramp-up procedure will be initiated once the animal has been detected outside of the safety zone or 20 min has passed since the animal was last detected.

When the airgun array is **shut down**, either because of marine mammals within the safety zone or for other reasons, the mitigation gun will continue to be used. If a marine mammal is observed within the 500-m safety zone for marine mammals, the airgun array will be reduced to the mitigation gun until the animal has left the safety zone. When this situation occurs, the airgun array can return to shooting at full power without requiring a ramp-up procedure in cases where (i) the animal is observed to have left the safety zone and (ii) the maximum time of the silent break (period between shut down and start up) is 5 min. If this period is longer than 5 min or the animal is not observed leaving the 500-m safety zone for marine mammals, a 20-min pre-shooting search period followed by a 20-min ramp-up procedure will be used before line shooting can resume.

Line Changes. The airgun array output will be shut down when the transit time to the next survey line is expected to be greater than 20 min (the amount of time it would take to conduct a full ramp-up procedure). A 30 min (60 min in water depths of >200 m) pre-shooting search and full ramp-up procedure will be initiated before the start of the next survey line.

If a transit between survey lines is expected to last less than 20 min, the airgun array can remain operational during transit, but preferably at a reduced power output (mitigation gun). No ramp-up procedure will be required at the start of the next survey line.

Table 7-1 outlines the measures that will be taken to avoid or mitigate environmental impacts. All crew members, including support crew, will be made aware of the standards and controls applicable to the conduct of this survey before surveying commences.

Table 7-1 Summary of operational monitoring and mitigation measures for Shell's 2013 site survey

Marine mammal and seabird observers (MMSOs)
• MMSO observations will be performed from the survey vessels on an elevated platform allowing an unobstructed view of the waters around the vessel. Whenever possible, the MMSOs will conduct observations from an outdoor platform.
• MMSOs aboard the seismic vessel will monitor for the presence of marine mammals during all daylight hours and via on board PAMs in low visibility conditions.
• MMSOs will have access to a direct communication line with the operator of the airguns.
• A safety/shut-down zone of 500 m for marine mammals will be implemented and monitored for the presence of marine mammals during all daylight hours.
Passive acoustic monitoring (PAM)
• During periods of poor visibility, the on board PAM system will be used during the pre-shooting watch period to monitor for vocalizing marine mammals within the safety zone. PAM will also be used at night and during fog.
• If any marine mammal is visually or acoustically detected within the safety zone during the pre-shooting watch period, the ramp-up will be delayed until the animal has been observed outside of the safety zone or 20 min has passed since the animal was last detected.
• PAM will also be used to shut down during acquisition.
Pre-shooting search
• A pre-shooting search of 30 min (60 min in water depths of >200 m) will be conducted before the start of any airgun operations.
Shutdown
• If any marine mammal is observed within the 500-m safety zone for cetaceans (and walruses) and other marine mammals, respectively, the airgun array will be reduced to the mitigation gun.
• A precautionary shutdown will be applied if a marine mammal is observed to be on a course that will result in its entering the shutdown zone.
Soft start
• The soft start procedure will occur over a minimum period of ~20 min. Soft start will not exceed 40 min in duration and to the extent possible will be initiated during • daylight hours.
• The ramp-up procedure will be planned such that the start of the survey line begins immediately following the ramp-up.
• Soft starts will to the extent possible will be initiated during daylight hours.
• During periods of poor monitoring visibility, the onboard PAM system will be used during the ramp-up procedure to monitor vocalizing marine mammals within the safety zone.
• If any marine mammal is detected within the safety zone during the soft start, the airgun array will be reduced to the mitigation gun and a new ramp-up procedure will be initiated once the animal has been detected outside of the safety zone or 20 min has passed since the animal was last detected.
• If any marine mammal is detected within the safety zone while on the transect line, the airgun array will be reduced to the mitigation gun and a new ramp-up procedure will be initiated if the silent break (period between shut-down and start-up) exceeds 5 minutes or 20 min has passed since the animal was last detected. If the animal is observed outside the safety zone within 5 minutes after shut-down, the airgun array can be started at full power without ramp-up.
• If the airgun array is shut down for any reason other than marine mammals while on the transect line, the airgun array can be re-initiated at full power given that the silent break is not longer than 5 min. Otherwise, a 20-min pre-shooting search and full ramp-up procedure will need to be initiated.

Line changes
• The airgun array output will be shutdown when the transit time to the next survey line is expected to be greater than 20 min.
• A 30 min (60 min in water depths of >200 m) pre-shooting search and full ramp-up procedure will be initiated prior to the start of the next survey line.
• If a transit between survey lines is expected to last less than 20 min, the airgun array can remain operational during transit, but preferably at a reduced power output (mitigation gun). No ramp-up procedure will be required at the start of the next survey line.

7.3.2 Seabirds

Systematic seabird surveys will be conducted to the maximum extent possible and by experienced seabird observers (MMSOs). Seabird observations will be undertaken using the follow the protocol outlined in the Manual for seabird and marine mammal survey on seismic vessels in Greenland on vessels that include MMSOs.

Deck lighting will be minimized (especially upward and horizontal-projecting light) to the extent that it is safe and practical to reduce the likelihood of birds stranding on Project vessels. Daily searches of Project vessels will be conducted for stranded birds. Project personnel will be made aware of bird attraction to the lights on offshore structures. However, some degree of lighting is required for safe work practices, and seismic surveying is conducted around the clock. The MMSOs will conduct daily searches of the ship, and the ship's crew will also be notified to contact the MMSOs if a bird is found.

7.3.3 Fisheries Interactions

The BMP Guidelines state that the licensee shall, upon BMP request, include one or more Fishery Liaison Officers (FLO) in the operation. If a FLO is required, a logbook of observations will be kept. It is not anticipated that a FLO will be required considering the location of the license blocks.

Vessel crews will keep a log of sightings and contacts with fishing (and other) vessels. In addition, a log will be kept of any unused fishing or other equipment removed from the sea for the purpose of clearing a path for the survey vessels. The log will include location, date, type of equipment, and any identifying marks.

No hunting or fishing will be permitted from Project vessels or from in-going or out-going individuals while on land during crew change operations.

7.3.4 General Ship Operations

Project vessels will operate in accordance with all applicable laws, standards and conditions while in Greenland waters.

The impacts of vessel traffic on marine mammals will be reduced by vessels steering a straight course and maintaining constant and moderate speed (less than 14 knots) whenever possible. Shell is committed to these mitigation measures to the extent that is possible and practical for their operations. Maintaining a constant and moderate speed will reduce changes in sound levels and frequencies of engine and propeller sounds that disturb marine animals.

7.3.5 Other Environmental Conditions

The BMP's Application Guidelines /2/ also note requirements related to other environmental conditions and considerations:

- When acquiring seismic data, the operation shall be conducted in accordance with the Best Practices listed in the BMP guidelines
- All non-degradable materials and structures shall be removed upon termination of the operation, unless BMP approves otherwise.
- Discharge of wastewater and kitchen waste shall be in compliance with the provisions of Annex IV and Annex V of the MARPOL Convention.
- Hunting and fishing is not permitted in connection with exploration activities, unless specific permission is given by the Greenland Government. [Note that hunting and fishing from Project vessels will not be permitted by Shell.]
- BMP may, when approving specific exploration activities, require the licensee to perform further impact studies and/or limit the operation to certain periods or from certain areas.
- Vessels engaged and machinery used in the exploration activities shall only use marine gasoil with a sulphur content less than 1.5 % (weight). Heavy fuel oil and oil with a sulphur content >1.5 % must not be used.

Shell will comply with each of these requirements (as described above) and will brief Project personnel about these and all other environmental commitments and requirements during in-person start up meetings before survey start (expected July 2013).

7.3.6 Reporting

Marine mammal and seabird observation databases, along with a monitoring report, will be submitted to BMP and DCE within two months of completion of the seismic program.

If a fisheries liaison officer is requested onboard, a logbook of observations will also be reported to BMP.

7.4 Communications

Engagement with local communities will take place before, during, and after the seismic operations to ensure that community concerns are heard and acted upon wherever possible. Other aspects of Shell's communication approach are provided below.

- Shell staff will be present in Greenland to maintain close relationships with stakeholders and to respond to potential issues.
- A grievance mechanism will be established, offering various ways (e.g., telephone, email, personal contact) to enable local stakeholders to contact Shell directly to ensure timely resolution of concerns and complaints.
- Shell will continue to communicate with other operators during the planning and operation phases to avoid interactions and minimize impacts.
- Shell will contact the DCE prior to survey start to ensure that its monitoring and mitigation plan for marine mammals and seabirds meets DCE protocols.
- Shell will be available to meet with local stakeholders after the proposed survey program to present the findings of the marine mammal and seabird monitoring program.
- To make sure that all survey personnel are aware of the environmental issues and mitigation measures that will be applied for the 2013 survey, Shell environmental and Project management personnel will hold a meeting with the survey vessel crews and managers before the start of the program to ensure full compliance.

7.5 Unplanned Events

As part of Shell's application for permission, Shell will submit to BMP a description of the safety management system and bridging documents for the health, safety, security, and environmental management systems in a separate document to this EIA, no later than 40 days prior to the anticipated survey start. These documents will include roles and responsibilities of all parties in the event of an emergency or accident during the 2013 program, including an Emergency Response Plan, Spill Response Plan that will include bunkering procedures to be used, and an Ice Management Plan. The following measures will also reduce the likelihood of an unplanned event.

- Vessel contractors will be made aware of relevant national legislation and guidelines, as well as follow International Maritime Organization best practices and guidelines such as *Guidelines for Ship Operating in Polar Waters*.
- Drills are a regulatory requirement and are carried out at regular intervals during which the oil spill response kit is checked. These oil spill drills encompass bunkering in port and at sea and machinery leaks, and form a part of the emergency onboard drills matrix.

BMP and Shell shall be notified immediately of any significant accidental event, including loss of life, missing persons, serious injury, fire, oil spill, and any threat to the personnel or the safety of the survey vessel. Any spills or unplanned releases will also be recorded and reported to appropriate authorities.

8. REFERENCES

/1/ Greenland Self-Government. 2009. Greenland Parliament Act of 7 December 2009 on mineral resources and mineral resource activities (the Mineral Resources Act).

/2/ Bureau of Minerals and Petroleum (BMP). 2011. Guidelines for Application, Execution and Reporting of Offshore Hydrocarbon Exploration Activities (Excluding Drilling) in Greenland.

/3/ Danish Centre of Environment and Energy (DCE). 2011. Guidelines to environmental impact assessment of seismic activities in Greenland waters, 3rd revised edition.

/4/ Danish Centre of Environment and Energy (DCE) and Bureau of Minerals and Petroleum (BMP). 2012. Manual for seabird and marine mammal survey on seismic vessels in Greenland.

/5/ Shell Kanumas A/S (ERM). 2011. Environmental Impact Asessement, High resolution seismic site survey 2011.

/6/ Shell Kanumas A/S (Grontmij & LGL). 2012. Environmental Impact Asessement, 2012 Anu-Napu 3-D Seismic Survey in Baffin Bay Blocks 5 and 8.

/7/ Oil and Gas Producers (OGP). 2011. Guidelines for the conduct of offshore drilling hazard site surveys, Report No. 373-18-1.

/8/ Oljeindustriens Landsforening (OLF). 2012. Veiledning til den Årlige Utslippsrapporteringen.

/9/ Boertmann, D. and Mosbech, A. (eds.) 2011. Eastern Baffin Bay - A strategic environmental impact assessment of hydrocarbon activities. Scientific Report no 9, from Danish Centre for Environment and Energy. 270 pp.

/10/ National Environmental Research Institute. 2011. Environmental oil spill sensitivity atlas for the Northern West Greenlant (72º-75º N) coastal zone. NERI Technical Report no. 828.

/11/ Richardson, W. J., Greene, C. R. Jr., Malme, C. I., and Thomson, D. H. 1995. Marine mammals and noise. Academic Press, New York.

/12/ McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M.-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J. and McCabe, C. 2000. Marine Seismic Surveys: Analysis and Propagation of Air Gun Signals; and Effects of Air-Gun Exposure on Humpback Whales, Sea Turtles, Fishes and Squid. Report on research conducted for The Australian Petroleum Production and Exploration Association.

/13/ Madsen, P.T., 2005. Marine mammals and noise: problems with root mean square sound pressure levels for transients. Journal of the Acoustical Society of America 117, 3952-3957.

/14/ Genesis. 2011. Review and Assessment of Underwater Sound Produced from Oil and Gas Sound Actibities and Potential Reporting Requirements under the Marine Strategy Framework Directive. Genesis Oil and Gas Consultants report for the Department of Energy and Climate Change – J71656.

/15/ Madsen, P. T., Wahlberg, M., Tougaard, J., Lucke, K., and Tyack, P. 2006. Wind turbine underwater noise and marine mammals:implications of current knowledge and data needs. Marine Ecolology Progress Series 309: 279-295.

/16/ Wyatt, R. 2008. Joint Industry Programme on Sound and Marine Life Review of Existing Data on Underwater Sounds Produced by the Oil and Gas Industry. Seiche Measurements Limited – S186 (1).

/17/ OSPAR, 2009. Overview of the impacts of anthropogenic underwater sound in the marine environment OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic (www.ospar.org).

/18/ Grønland Statistik. 2012. Grønlands energiforbrug 2011. Energy 2012-01.

/19/ Valeur, H.V., Hansen, C., Hansen, K.Q., Rasmussen, L. and Thingvad, N. 1996. Weather, sea and ice conditions in eastern Baffin Bay, offshore Northwest Greenland. A review. DMI Technical Report No. 96–12.

/20/ Sejr, M.K., Batty, P., Josefson, A., Blicher, M.E., Hansen, J. & Rysgaard, S. 2010. Survey of macrobenthic invertebrates in the eastern Baffin Bay including estimates of biochemical activity and

PAH levels in the sediment. Report from National Environmental Research Institute and Greenland Institute of Natural Resources, 28 pp.

/21/ Blicher, M., Josefson, A., Batty, P., Schiedek, D., Sejr, M.K., Hansen, J. & Rysgaard, S. 2008. Cruise report, benthic fauna in ecological key areas along the coast of Northwest Greenland. Greenland Institute of natural Resources, National Environmental Research Institute.

/22/ Mannvik, H-P., Wassbotn, I. & Cochrane, S., 2011. Miljøundersøkelse i Region IX og X Barentshavet 2010. Akvaplan-niva report no. 5000-03, 169 p + appendix.

/23/ Thomson, D. H., 1982. Marine Benthos in the Eastern Canadian High Arctic: Multivariate Analyses of Standing Crop and Community Structure. Arctic, Vol. 35, NO. 1, P. 61-74.

/24/ Neulinger, S., 2009. Cold-water reefs. Retrieved from http://www.coralscience.org/main/articles/climate-a-ecology-16/cold-water-reefs

/25/ Christiansen, S., 2010. Background Document for Deep-sea sponge aggregations. Ospar Commission Biodiversity series.

/26/ Christian, J.R., Mathieu, A., Thomson, D.H., White, D., and Buchanan, R.A., 2003. Effects of Seismic Energy on Snow Crab (Chionoecetes opilio). Report from LGL Ltd. and Oceans Ltd. for the National Energy Board, File No.: CAL-1-00364, 11 April 2003.

/27/ Jørgensen O. A., Hvingel, C. Møller, P. R. & Treble, M. 2005. Identification and mapping of bottom fish assemblages in Davis Strait and Southern Baffin Bay. – Can. J. Fish. Aquat. Sci. 62: 1833-1852.

/28/ Kalmijn, A. J. 1988. Hydodynamic and acoustic field detection, in Sensory biology of aquatic animals, edited by J. Atema, R. Fay, A. Popper, and W. Tavolga (Springer-Verlag, New York): 83-131.

/29/ Fay, R. R., and Popper, A. N. 1974. Acoustic stimulation of ear of goldfish (Carrassius auratus). Journal of Experimental Biology 61: 243-260.

/30/ Blaxter, J., Denton, E. J., Gray, J. A. B. 1981. Acousticolateralis system in clupeid fishes. In: Tavolga, WN, Ray, RR (Eds.). Hearing and sound communication in fishes. Springer-Verlag, New York, pp 39-56.

/31/ Enger, P. 1967. Hearing in herring. Comp. Biochem. Physiol., 22:527-538.

/32/ Buerkle, U. 1967. An audiogram of the Atlantic cod, Gadu morhua L. J. Fish. Res. Bd. Cananda, 24, 2309-2319

/33/ Chapman, C.J. and Hawkins, A.D. 1973. A field study of hearing in the Cod, Gadus morhua L. Journal of comparative physiology, 85: 147-167

/34/ Wahlberg, M., Westerberg, H. 2003. Sounds produced by herring (Clupea harengus) bubble release. Aquatic Living Resources. 16: 271-275.

/35/ Finstad, J. L., Nordeide, J. T. 2004. Acoustic repertoire of spawning cod, Gadus morhua. Environmental Biology of Fishes. 70: 427-433.

/36/ Thomsen, F., Mueller-Blenkle, C. Gill, A., Metcalfe, J., McGregor, P. K., Bendall, V., Andersson, M. H., Sigray, P., and Wood, D. 2012. Effects of Pile-driving on the Behavior of Cod and Sole. A.N. Popper and A. Hawkins (eds.), The Effects of Noise on Aquatic Life, Advances in Experimental Medicine and Biology 730. Springer Science+Business Media, LLC 2012.

/37/ Halvorsen, M. B. Casper, B. M., Woodley, C. M. Carlson, T. J., Popper, A. N. 2011. Predicing and mitigating hydroacoustic impacts on fish from pile installations. NCHRP Research Results Digest 363, Project 25.28, National Cooperative Highway Research Program, Transportation Research Board, National Academy of Sciences, Washington, D. C.

/38/ Encyclopedia of Earth. Eds. Cutler J. Cleveland (Washington, D.C.: Environmental Information Coalition, National Council for Science and the Environment). [First published in the Encyclopedia of Earth July 23, 2010; Last revised Date May 21, 2011; Retrieved January 11, 2013. www.eoearth.org.

/39/ Heide-Jørgensen, M.P., P. Richard, R. Dietz, K.L. Laidre, J. Orr, and H.C. Schmidt. 2003a. An estimate of the fraction of belugas (*Delphinapterus leucas*) in the Canadian High Arctic that winter in West Greenland. Polar Biol. 26:318–326.

/40/ IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 11 January 2013.

/41/ Jefferson, T.A., M.A. Webber, and R. Pitman. 2008. Marine Mammals of the World: A Comprehensive Guide to their Identification. Academic Press, London. 573 p.

/42/ Reeves, R.R. and M.P. Heide-Jørgensen. 1996. Recent status of bowhead whales, *Balaena mysticetus*, in the wintering grounds off West Greenland. Polar Res. 15 (2):115–125.

/43/ Richardson, W.J., C.R. Greene Jr., C.I. Malme, and D.H. Thomson. (1995). Marine Mammals and Noise. Academic Press, San Diego. 576 p.

/44/ Finley, K.J., G.W. Miller, R.A. Davis, and C.R. Greene. (1990). Reactions of belugas, *Delphinapterus leucas* and narwhals *Monodon monoceros*, to icebreaking ships In: T.G. Smith, D.J. St. Aubin and J. Geraci (eds.), Advances in research on the Beluga whale, (Delphinapterus leucas). Can. Bull. Fish. Aquat. Sci. 224:97-117.

/45/ Fay, F.H., B.P. Kelly, P.H. Genhrich, J.L. Sease, and A.A. Hoover. (1984). Modern populations, migrations, demography, trophics, and historical status of the Pacific walrus. Outer Cont. Shelf Environ. Assess. Program, Final Rep. Principal. Invest., NOAA, Anchorage, AK 37:231–376. 693 p. OCS Study MMS 86-0021; NTIS PB87-107546. 693 p.

/46/ Au, W. W. L. 1993. The sonar of dolphins. Springer-Verlag, New York.

/47/ Møhl, B., Surlykke, A.,Miller, L.A. 1990. High intensity narwhal clicks. Sensory abilities of cetaceans. J. A. Thomas, Kastelein, R. A. New York, Plenum Press.

/48/ Finneran, J. J., Carder, D. A., Dear, R., Belting, T., McBain, J., Dalton, L., Ridgway, S. H. 2005. Pure tone audiograms and possible aminoglycoside-induced hearing loss in belugas (*Delphinapterus leucas*). Journal of the Acoustical Society of America 117(6): 3936-3943.

/49/ Mooney, T.A., Nachtigall, P. E., Castellote, M., Taylor, K. A., Pacini, A. F., Esteban, J-A. 2008. Hearing pathways and directional sensitivity of the beluga whale, *Delphinapterus leucas*. Journal of Experimental Marine Biology and Ecology. 362: 108-116.

/50/ Kastelein, R. A., Janssen, M., Verboom, W. C., Haan, D. de 2005. Receiving beam patterns in the horizontal plane of a harbour porpoise (*Phocoena phocoena*). Journal of the Acoustical Society of America 118(2): 1172-1179.

/51/ Sjare, B. L., Smith, T. G. 1986a. The Vocal Repertoire of White Whales, Delphinapterus-Leucas Summering in Cunningham Inlet, Northwest-Territories.Canadian Journal of Zoology-Revue Canadienne De Zoologie. 64(2): 407-415.

/52/ Marcoux, M., Auger-Méthé, M., Humphries,M. M. 2012. Variability and context specificity of narwhal (*Monodon monoceros*) whistles and pulsed calls. Mar. Mam. Sci. 28(4): 649-665.

/53/ Parks, S. E., Ketten, D. R., O'Malley, J. T., Arruda, J. 2007. Anatomical Predictions of Hearing in the North Atlantic Right Whale. The Anatomical Record. 290: 734-744.

/54/ Tervo, O. M., Parks, S. E., Miller, L.A. 2009. Seasonal changes in the vocal behaviour of bowhead whales (*Balaena mysticetus*) in Disco Bay, Western-Greenland. J. Acoust. Soc. Am. 126(3): 1570-1580.

/55/ Kastelein, R. A., Mosterd, P., van Santen, B., Hagedoorn, M., de Haan, D. 2002. Underwater audiogram of a Pacific walrus (*Odobenus rosmarus divergens*) measured with narrow-band frequency-modulated signals. J. Acoust. Soc. Am. 112(5): 2173-2182.

/56/ Møhl, B. 1968. Auditory sensitivity of the common seal in air and water. The Journal of Auditory Research 8: 27-38.

/57/ Kastak, D., Schusterman, R. J. 1998. Low-frequency amphibious hearing in pinnipeds: Methods, measurements, noise and ecology. Journal of the Acoustical Society of America 103(4): 2216-2228.

/58/ Terhune, J.M. 1988. Detection thresholds of a harbour seal to repeated underwater high-requency, short-duration sinusoidal pulses. Can. J. Zool., 66:1578-1582.

/59/ Van Parijs, S. M., Lydersen, C., Kovacs, K. M. 2003. Vocalizations and movements suggest alternative mating tactics in male bearded seals. Animal Behaviour 65: 273-283.

/60/ Southall, B., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., Greene, C. R. Jr., Kastak, D., Ketten, D. R., Miller, J. H., Richardson, W. J., Thomas, J. A., Tyack, P. L. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aquatic mammals 33(4).

/61/ NMFS. 2003. Taking marine mammals incidental to conducting oil and gas exploration activities in the Gulf of Mexico. Federal register 68, 9991-9996.

/62/ Ketten, D. R. 2012. Marine Mammal Auditory system Noise Impacts: Evidence and Incidence. A.N. Popper and A. Hawkins (eds.), The Effects of Noise on Aquatic Life, Advances in Experimental Medicine and Biology 730. Springer Science+Business Media, LLC 2012.

/63/ Finneran, J. J., Schlundt, C. E., Dear, R., Carder, D. A., Ridgway, S. H. 2002. Temporary shift in masked hearing thresholds in odontocetes after exposure to single underwater impulses from a seismic watergun. J. Acoust. Soc. Am. 111(6): 2929-2940.

/64/ Moore, B. C. J. 2012. An Introduction to the Psychology of Hearing. Sixth edition. Emerald Group Ltd.

/65/ DHI. 2011. Modelling of Underwater Noise from Seismic Survey in Aruba - Report for WorleyParsons Spain. Hørsholm DHI in cooperation with ODS.

/66/ Gabrielsen, G. W., Taylor, J. R. E., Konarzewski, M. and Mehlum, F. 1991. Field and Laboratory Metabolism and Thermoregulation in Dovekies (Alle alle). Auk 108, 71-78.

/67/ Stempniewicz, L. 2001. *BWP* Update. Oxford Univ. Press, Oxford. BVP Update.

/68/ Wilson, L. J., Bacon, P. J., Bull, J., Dragosits, U., Blackall, T. D., Dunn, T. E., Hamer, K. C., Sutton, M. A. and Wanless, S. 2004. Modelling the spatial distribution of ammonia emissions from seabirds in the UK. Environmental Pollution 131, 173-185

/69/ Pedersen, C. E. and Falk, K. 2001. Chick diet of dovekies *Alle alle* in Northwest Greenland. Polar Biology 24, 53-58.

/70/ Falk, K., Pedersen, C. E. and Kampp, K. 2000. Measurements of diving depth in Dovekies (*Alle alle*). Auk 117, 522-525.

/71/ Egevang, C., Boertmann, D., Mosbech, A. and Tamstorf, M. P. (2003): Estimating colony area and population size of little auks Alle alle at Northumberland Island using aerial images. Polar Biology 26, 8-13.

/72/ Stemp, R. (1985): Observations on the effects of seismic exploration on seabirds. p. 217-233 In: G.D. Greene, F.R. Engelhardt, and R.J. Peterson (eds.), Proceedings of workshop on effects of explosives use in the marine environment. Cdn. Oil and Gas Admin., Env. Prot. Branch, Tech. Rep. No. 5. Ottawa.

/73/ Evans, P.G.H., Lewis, E.J. and Fisher, P. (1993): A study of the possible effects of seismic testing upon cetaceans in the Irish Sea. Rep. by Sea Watch Foundation, Oxford, to Marathon Oil UK Ltd. Aberdeen. 35 p.

/74/ Merkel, F.R. and Johansen, K.L. (2011): Light-induced bird strikes on vessels in south west Greenland. Marine Pollution Bulletin 62:2330-2336.

/75/ Abgrall, P. and R.E. Harris. 2011. Marine mammal and seabird monitoring of Shell Kanumas A/S's 2011 2-D seismic site survey off West Greenland. LGL Rep. TA8067. Rep. by LGL Limited, King City, ON, Canada, for Shell Kanumas A/S, Naerum, Denmark. 43 p.

/76/ Siegstad, H. 2012. Biologisk rådgivning 2013 – rejer. Biological advice on shrimp fishery 2013. Announcement no. 20.00-11/2012 from Greenland Institute of Natural resources, dated 29. October 2012.

/77/ Siegstad, H. 2012. Powerpoint presentation of fisheries advice downloaded from Greenland Institute of Natural resources web page 13.01.13.

/78/ Engås, A., Løkkeborg, S., Ona, E., Soldal, A.V. 1996. Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (Melanogramma aeglefinus). Can. J. Fish. Sci. 53: 2238-2249

/79/ Løkkeborg, S., Ona, E., Vold, A., Pena, H., Salthaug, A., Totland, B., Øvredal, J.T., Dalen, J., Handegard, N.O. 2010. Effekter av seismiske undersøkelser på fiskefordeling og fangstrater for garn og line i Vesterålen sommeren 2009. Fisken og Havet no. 2-2010, 74 sider [In Norwegian]

/80/ Parry G.D. & A. Gason 2006. The effect of seismic surveys on catch rates of rock lobsters in western Victoria, Australia. Fish. Res. 79: 272–284

/81/ Pedersen, G., Midtgard, M.R. & V. Øiestad 2003. Alvorlige oljeutslipp – konsekvenser for fiskemarkedet. Extensive oil spills and the effects on the fish market. Akvaplan-niva rapport 2578, 68 pp. Norwegian and English version.

/82/ Vold, A., Løkkeborg, S., Tenningen, M., & J. Saltskår 2009. Analyse av innsamlede fangstdata for å studere effekter av seismiske undersøkelser på fiskeriene i Lofoten og Vesterålen sommeren 2008. Fisken og havet nr. 5 - 2009. 47 pp. [In Norwegian]

/83/ Vollen, T & O.T. Albert 2008. Pelagic behavior of adult Greenland halibut (Reinhardtius hippoglossoides). Fish. Bull. 106:457–470.

/84/ Stempniewicz, L. 2001. BWP Update. Oxford Univ. Press, Oxford. BVP Update.

/85/ Grønlands statistik. 2013. www.stat.gl (accessed 4/2/2013)

/86/ Joint Arctic Command (telephone conversation, January 17th 2013)

/87/ Spence, J., R. Fisher, M. Bahtiarian, L. Boroditsky, N. Jones, and R. Dempsey. 2007. Review of existing and future potential treatments for reducing underwater sound from oil and gas industry activities. Rep. by Noise Control Engineering Inc., for Joint Industry Programme on E&P Sound and Marine Life.

/88/ Urick, Robert J. 1983. Principles of Underwater Sound, 3rd Edition. New York. McGraw-Hill.

/89/ Lucke, K., Siebert, U., Lepper, P. A., Blanchet, M. A. 2009. Temporary shift in masked hearing thresholds in a harbor porpoise (Phocoena phocoena) after exposure to seismic airgun stimuli. Journal of the Acoustical Society of America 125(6): 4060-4070.

/90/ Tougaard, J., Kyhn, L. A., Amundin, M., Wennerberg, D., Bordin, C. 2012. Behavioural reactions of Harbour Porpoise to Pile-Driving Noise. A.N. Popper and A. Hawkins (eds.), The Effects of Noise on Aquatic Life, Advances in Experimental Medicine and Biology 730. Springer Science+Business Media, LLC 2012.

/91/ Brandt MJ, Diederichs A, Betke K, Nehls G (2011) Responses of harbour porpoises to pile driving at the Horns Rev II offshore wind farm in the Danish North Sea. Mar Ecol Prog Ser 421:205–216.

/92/ Miller, G. W., Moulton, V. D., Davis, R. A., Holst, M., Millman, P., MacGillivray, A., et al. (2005). Monitoring seismic effects on marine mammals – southeastern Beaufort Sea, 2001-2002. In S. L. Armsworthy, P. J. Cranford, & K. Lee (Eds.), Offshore oil and gas environmental effects monitoring: Approaches and technologies (pp. 511-542). Columbus, OH: Battelle Press.

APPENDIX 1
INTRODUCTION TO UNDERWATER SOUND

For a better understanding of the technical terms used in this report, this Appendix will provide a short introduction into underwater sound.

Sound in water is a travelling wave in which particles of the medium are alternately forced together and then apart. The sound can be measured as a change in pressure within the medium, which acts in all directions, described as the sound pressure. The unit for pressure is Pascal (Newton per square metre). Each sound wave has a pressure component (in Pascals) and a particle motion component indicating the displacement (metres), the velocity (metres per second) and the acceleration (metres per second^2) of the molecules in the sound wave. Depending on their receptor mechanisms, marine life is sensitive to either pressure or particle motion or both. The pressure can be measured with a pressure sensitive device such as a hydrophone (an underwater microphone).
Due to the wide range of pressures and intensities and taking the hearing of marine life into account, it is customary to describe these using a logarithmic scale. The most generally used logarithmic scale for describing sound is the decibel scale (dB).

The sound pressure level (SPL) of a sound is given in decibels (dB) by equation 1:

$$SPL \text{ (in dB)} = 20 \log_{10} (P/P_0)$$

where P is the measured pressure level and P_0 is the reference pressure. The reference pressure in underwater acoustics is defined as 1 micropascal (µPa). As the dB value is given on a logarithmic scale, doubling the pressure of a sound leads to a 6 dB increase in sound pressure level. As the reference pressure for measurements in air is 20 µPa, and water and air differ acoustically, the dB levels for sound in water and in air cannot be compared directly.

Most animals, including marine mammals, are sensitive to sound pressure. On the other hand fish and many invertebrates are also sensitive to the local particle motion of the sound field.

Measurements of Sound
A sound wave can be analysed and measured in several different ways. Figure 1 illustrates the different measurement units.

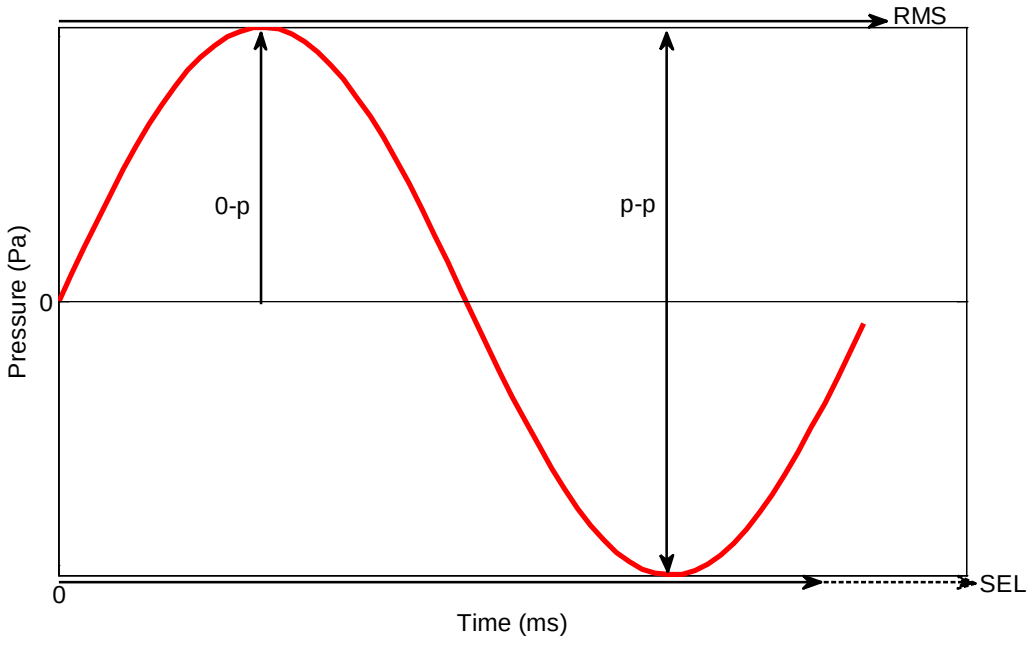

Figure A1-1 Waveform of a sine-wave with indications of the different measurement units.

The four different measurement units depicted in Figure 1 are:

- Zero-to-peak' (peak) – dB p; the interval from zero to the maximum amplitude of the signal.
- 'Peak-to-peak' (peak-to peak) – dB p-p; the interval from the lowest to the highest amplitude of the signal.
- 'Root-mean-square-pressure level (RMS) – dB rms; the square root of the average squared signal pressure divided by the duration of the signal. This term is synonymous for sound pressure level.
- 'Sound-exposure-level (SEL) – dB AE/dB SEL; the total energy content of the signal, measured by integrating the squared signal pressures over time.

All these measures are made on the pressure waveform of the signal. The re-calculation into decibels transforms the values into relative measures of intensity or energy.

For a simple sine-wave with signal duration ~ 100 ms, peak-to-peak levels will be the highest, followed by zero-to-peak, RMS, and finally SEL. However, if the duration is longer than 1 s, the SEL-level will be higher than the RMS level.

Peak and peak-to-peak sound pressure values refer to the amplitude of a given sound and are therefore not dependent on the choice of time window as are the RMS and SEL measures. They are suited for the description of short impulsive sounds such as airguns. In hearing studies the stimulus is often a pure tone measured with RMS, and therefore thresholds are often given in sound pressure levels. When calculating detection distances it is therefore easiest to use the sound pressure level of the signal to compare with the audiogram.

SEL-values are calculated by measuring the sound energy of a signal with reference to a 1 µPa RMS signal of duration 1 s (see above). SEL is given in the unit dB re 1 $\mu Pa^2 s$.

For transient sounds it is not sufficient to only report an RMS level, as both the peak and the RMS level is important when assessing the effects on animals. Further, the choice of time window for calculating the average is strongly affecting the resulting RMS level (Madsen 2005). Therefore, the choice of time window should always be reported. However, the RMS is often the only measurement available in many reports. In the following, the presented values are given in RMS units with unknown choice of time window.

APPENDIX 2
ACOUSTIC MODELLING

1. EXECUTIVE SUMMARY

2D seismic surveys are to take place at up to ten locations in Baffin Bay (West Greenland) in the summer of 2013. The surveys will be restricted to areas (3x3 km) around proposed drilling sites and will occur at depths of 500 – 800 m. 2 D seismic surveys go along with sound pressure levels that have the potential to impact marine life (marine mammals and fish) at the site and in adjacent areas. We present the results of an acoustic propagation modelling study of the expected noise exposure from the planned 2D seismic surveys to be included in the supplied EIA. The model is based on actual bathymetry information covering the entire area and basic knowledge of sediment properties. We also used detailed data on the vertical sound speed profiles during the time of the proposed survey (July – October). Horizontally, our model intends to cover all areas exposed to levels likely to affect marine mammals. Different from previous investigations, we also include frequencies above 2 kHz in the modelling to better match the acoustic sensitivity of some of the marine life in the area.

Based on information about the airgun array that will be used and literature data we used a zero to peak source sound pressure level of 230 dB re 1 µPa as the input variable in this study. The resulting peak to peak source sound pressure level was defined as 236 dB re 1 µPa. For the frequency spectrum we used a modelled far-field signature and the corresponding frequency spectrum of a representative array and scaled it to meet the source strength identified for this study. Based on the derived spectrum, the resulting broadband SEL level was 214 dB re µPa^2·s. RMS values were directly derived from SEL values and resulted in a source sound pressure level of 227 dB re 1 µPa. The calculation of the sound levels at different distances from the sources was undertaken for frequencies up to 4 kHz using a 2D numerical model of the underwater acoustic propagation. For this we used the well-established AcTUP package. We applied the RAMGEO code which is a full Parabolic Equation model.

For the quantitative assessment of impact ranges, we have chosen several criteria for marine mammals and fish derived from a variety of sources. The used NMFS criteria are part of the US regulation. Applicable are also the initial scientific recommendations on marine mammal noise exposure criteria as developed by a group of US experts. Recent work on fish has resulted in evidence based criteria for this taxa that we have applied directly.

The results of the modelling show a sharp decrease of sound levels in the first km from the source and a smoother decline in sound pressure levels at a longer range. Higher frequencies than 1 kHz where attenuated more rapidly than those below 1 kHz although not as drastically as expected. Furthermore, the difference in propagation loss across sites was very small indicating that results obtained here can be transferred somewhat to other sites if the development is relocated.

For the 2D high resolution surveys TTS will be limited to areas close to the source (80 m in cetaceans and 40 m in for pinnipeds). The onset of behavioural response can be expected in all three cetacean species at distances of approx. 6 km from the source with little difference between the sites. For seals, behavioural responses are only expected at close ranges (40 m).

For fish, the onset of any behavioural reactions can take place at a maximum distance of 59 km.

Looking at the cumulative sound fields (sound over a 24 h period including the survey), it is clear that impact ranges can be larger than for single shots. Yet, the assumption that the acoustic energy just sums up at the receiver in the way suggested by the calculations, neglects that hearing might recover between pulses. Thus, the overall impact from the survey over the course of a one-day cycle might be smaller than indicated in the cumulative maps.

2. INTRODUCTION

2D seismic surveys are to take place at up to ten locations in Baffin Bay (West Greenland) in the summer of 2013. The surveys will be restricted to areas (3x3 km) around proposed sites and will occur at depths of 500 – 800 m. The surveys will be restricted to areas (3x3 km) around the proposed drilling sites. 2D seismic surveys go along with sound pressure levels that have the potential to harm marine life (i.e. marine mammals and fish) at the site and in adjacent areas (for a review of seismic survey impacts refer to OSPAR, 2009). According to the BMP guidelines (see Kyhn et al., 2011), the areas where sound might impact marine life shall be modelled. This should include an estimate of the source levels included in the model and the numerical modelling of the propagation loss from source to a distance out where impacts are negligible. The modelling will make use of internationally accepted units (peak SPL, SEL etc.). The results of the modelling shall be included in the impact assessment on marine mammals and fish.

2.1 Aims

Here we present a model of the expected noise exposure from 3 locations areas located in the prospect areas for drilling in Baffin Bay to be included in the supplied EIA. The model is based on actual bathymetry information covering the entire area and basic knowledge of sediment properties. We also used detailed data on the vertical sound speed profiles during the time of the proposed survey (July – October). Horizontally, our model intends to cover all areas exposed to levels likely to affect marine mammals (see noise exposure criteria in the EIA report and Southall et al. 2007).

The seismic noise propagation model will result in sound levels at different ranges and depths from the airgun array (depths relevant for the species in the area). Noise levels presented in the model are:

- zero-to-peak sound pressure levels referenced to 1 µPa (zero-peak),
- Peak-to-peak sound pressure levels referenced to 1 µPa (peak-peak),
- rms sound pressure levels referenced to 1 µPa (rms measured over 90% of pulse duration, as defined by Madsen, 2005; in the following this will be referred to the sound pressure level following the terminology suggested by TNO, 2011)
- Sound exposure levels (SEL[1]) referenced to 1 $\mu Pa^2 \cdot s$ per pulse.

For the assessment of cumulative effects also the cumulated sound exposure level (across all airgun pulses) per 24 hours is being presented.

Modelling will cover all biologically relevant parts of the frequency spectrum as much as these frequencies carry any substantial distance out from the source.

3. METHODS

3.1 Model areas and environmental conditions

The modelling of the 2D surveys shall be performed at three locations in Baffin Bay shown in Table A2-1 and in Figure A2-1. These locations were the initially proposed survey sites but can be viewed as representative for similar conditions (nearby location and similar water depth) in the licensing blocks.

[1] The sound exposure level (SEL) is often used in the assessment of noise impact on the sea environment and is a measure of the total energy of the noise normalised to 1 second.

Table A2-1 Overview of the three survey locations (E = Easting; N = Northing).

Location Designation	Coordinates (WGS84/UTM21N)
Location 1	E: 370700, N: 8274502
Location 2	E: 360764, N: 8248717
Location 3	E: 343898, N: 8181657

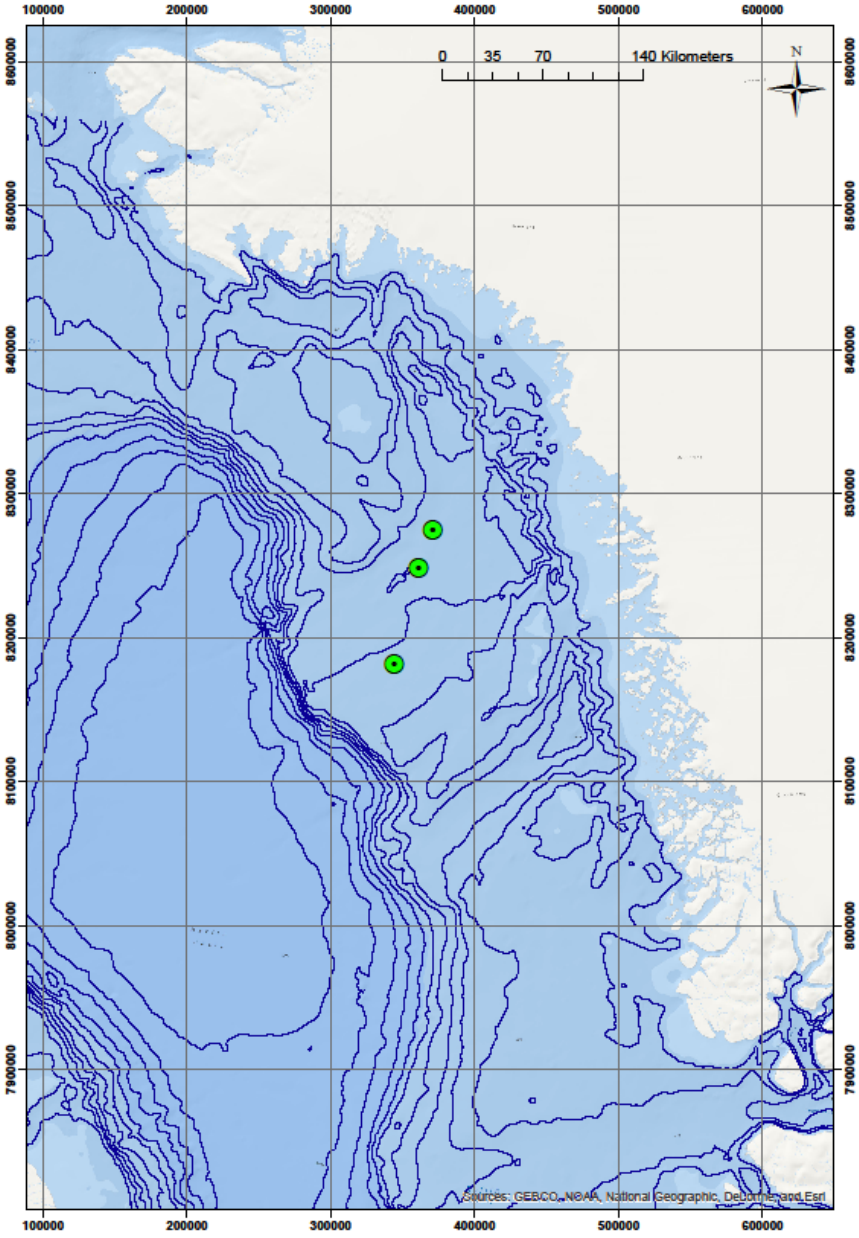

Figure A2-1 Overview of the three locations for which the modelling of the 2D seismic surveys was undertaken (green circles are chosen for better visibility only).

Based on previous investigations and literature data on the assumed sound spread (see for example OSPAR, 2009), it was assumed that the modelling area should at least include areas 150 km away from the source in all directions. We thus chose 10 azimuth traces with a length of 150 km each (depending on coastal barriers). An example of the **bathymetric** profile around one location is shown in Figure A2-2 (see also chapter 7.1). It is clear from the plots that study area (= survey area and 150 km radius around each source) is diverse and covers marine landscapes of several hundred to app. 2,500 metres of water depths.

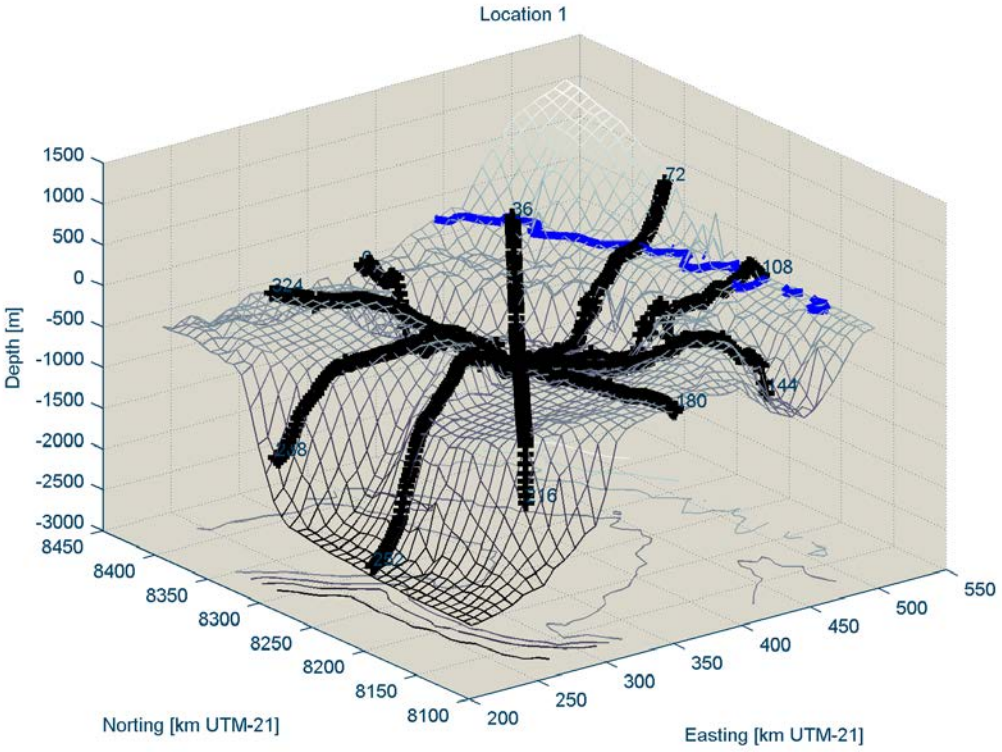

Figure A2-2 3-D bathymetric profile of source location 1 (source SRTM-30 geographic grid interpolated onto a 1 km x 1 km grid in UTM-21 coordinates; note that resolution mesh in the figures does not correspond to the actual resolution, but is only shown for reference; blue line = shore line; length of each trace is 150 km)

With regards to the **sound speed profile,** measurements undertaken by Shell in Baffin Bay Blocks 5 – 8 clearly show a rather uniform profile during that time of the year (Figure A2-3). We therefore took the average of each measurement at defined water depth intervals to arrive at an idealized plot for the survey time. Water depth > 700 m were extrapolated from the measurements.

The lowest sound speed in the water column is observed at depth ~70 m. Since sound rays bent towards regions of lower sound speed, the minimum in the profile acts as an acoustic waveguide, known as the Deep Sound Channel, in which energy from a source near the minimum may be trapped, allowing it to propagate with little loss to very large ranges; as much as several thousand kilometres. The axis of the deep sound channel is between the deep isothermal region and the mixed layer of almost constant temperature due to wind and wave activity.

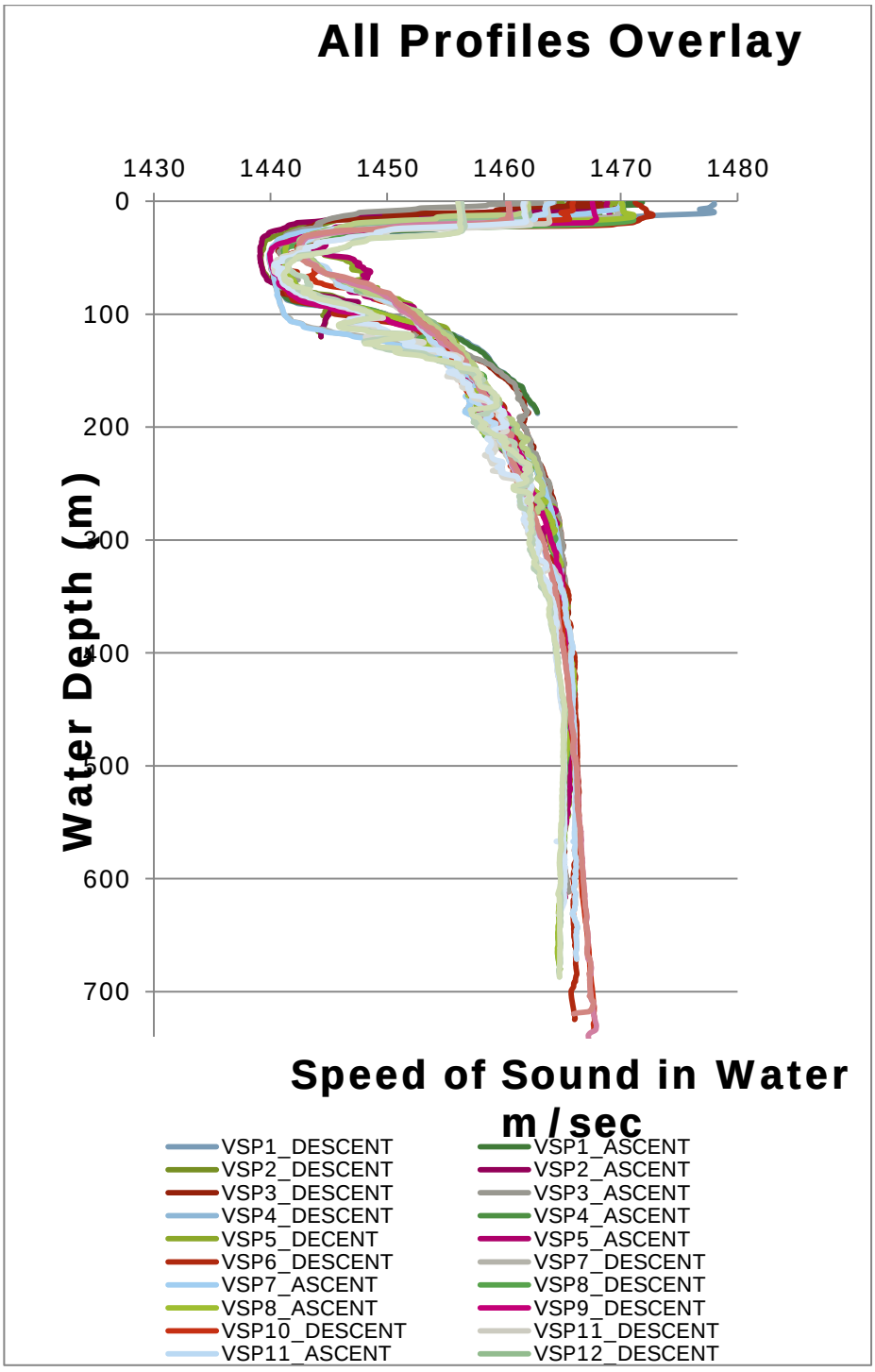

Figure A2-3 Measured sound speed profiles in Baffin Bay Blocks 5 – 8 during July - October 2012

The **geoacoustic data** was derived from Henriksen et al., 2000 from a representative cross-section of Baffin as well as from data gathered by Codispoti et al., 1968. The layers used in the modelling and the main parameters are depicted in Table A2-2.

Table A2-2 Overview of seabed geoacoustic profile used for the modelling (C_p = compressed wave speed, α = compressional attenuation, p = density).

Seabed layer (m)	Material	Geoacoustic property
0 – 20	Mud and clay	C_p = 1600 m/s α = 0.2 dB/λ P = 1.80 g/cm^3
20 – 160	Glacial deposits and coarse sediments	C_p = 1700 m/s α = 1.05 dB/λ P = 1.80 g/cm^3
➢ **160**	Glacial deposits and coarse sediments	C_p = 2000 m/s α = 0.85 dB/λ P = 2.05 g/cm^3

3.2 Survey parameters

The proposed activities for 2013 involve 2D high resolution seismic survey. In a 2D seismic survey, the vessel follows lines or a grid where the lines are a certain distance apart. One sound source is used, which is composed of several airguns to form an air gun array, and one hydrophone cable.

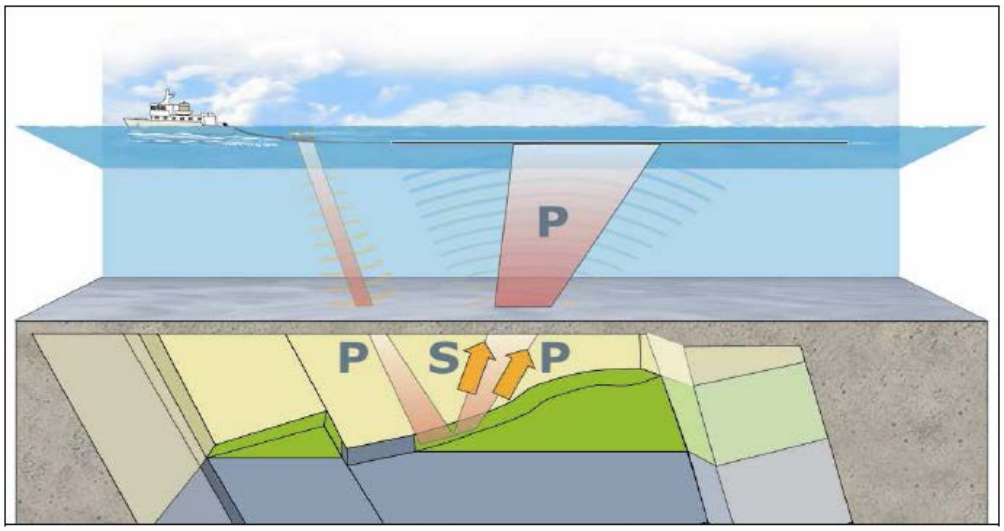

Figure A2-4 Schematic diagram for a 2D seismic survey. The vessel tows a sound source and a receiver cable with hydrophones. P=pressure waves. S=shear waves. (DNV 2007)

The following more detailed information on the survey design was acquired from the client.

Table A2-3 Main parameters of the 2 D survey

Survey information	Parameter
Type of survey (2D etc.)	2DHR
Start and end dates of each survey	Earliest start 15/7/2013; survey period is July – October 2013
Expected duration	Max 4 Weeks on site
Duty cycle of operation (in hours/24 hours)	24 Hours
Survey outline	Survey lines are 100 m apart (cross lines every 250 m)
Array specification	4x40" sleeve gun array
Array positioning	Source Depth 2.5m; Streamer Depth 2.5m
Firing rate in shots/sec	Shot point interval 6.25 m at 4 knots (1 shot per 3.125 s) 0.32 shot/sec (total ~13 h)
Operation speed of the vessel in km/hours or knots.	4 kn

3.3 Noise modelling

Air-gun arrays are designed to produce a single downward-directed impulse that propagates through the water column and into the seabed. Unavoidably, some sound energy also radiates horizontally from the array creating a complex radiation pattern. The presence of multiple propagation paths involving surface and bottom bounces as well as the re-radiation of sound reverberating within sub bottom layers increases the complexity of the received signal and can give rise to long reverberant wave forms of several seconds at long ranges.

3.3.1 Source information

The 2D survey that has to be assessed here is a site survey used to investigate the proposed locations for drilling. The surveys are similar to conventional 2D seismic surveys, except that the source used is comprised of a smaller volume of compressed air such as in this case with the overall 160 cubic inches involving only four airguns. Since the source is relatively simple, the directivity of the array was taken to be omni-directional providing the same noise radiation in all azimuth angles. This is a conservative approach as it will most likely lead to overestimation of the noise field in some cases.

Looking at the source strength, Genesis, 2011 and Wyatt, 2008, provide a comprehensive review of a variety of airguns and airgun arrays. According to their analysis, the emitted sound field is a function mainly of the size and the number of airguns and the overall emitted psi values (see Figure A2-5).

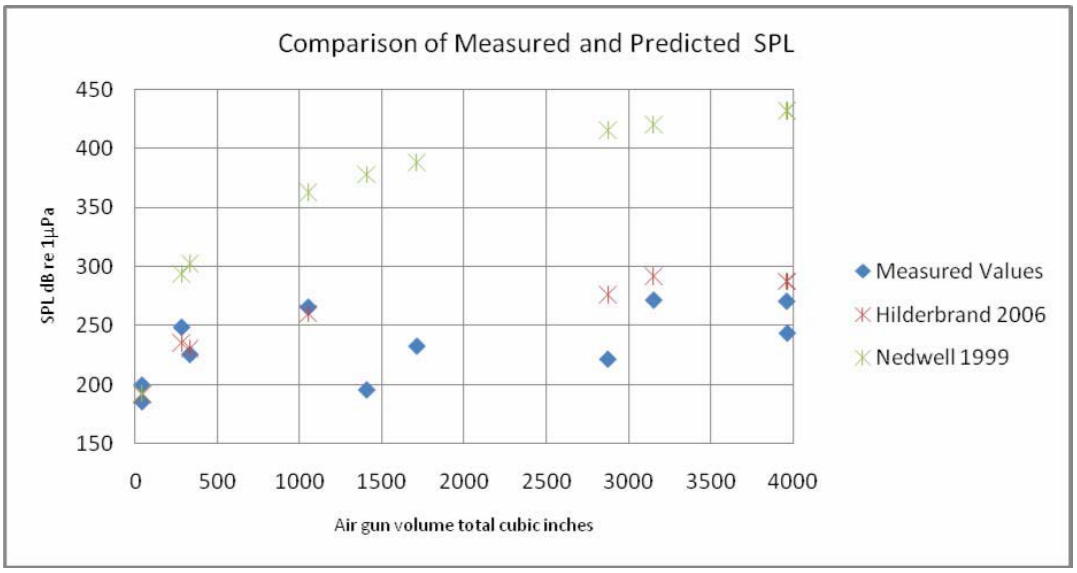

Figure A2-5 Comparison of measured and calculated air gun SPL in relation to airgun volume (from Wyatt, 2008).

As can be seen in Figure A2-5, the SPL below 500 cubic inches lie somewhere between 200 and 250 dB re 1 µPa. According to Ainslie, 2010, the zero to peak dipole source level of a 0.7 L 40 in^3 small gun was 224 dB re 1µPa at 1 m^2. A medium gun (2.5 – 1.0 L and 150 – 250 in^3) had a zero to peak dipole source level of 229 – 230 dB re 1 µPa. The latter represents the proposed volume for the Baffin Bay survey and as a conservative measure the higher zero to peak value of 230 dB re 1 µPa should be used in this study. The differences between the zero to peak values and the peak to peak values were set at 6 dB resulting in a peak-to-peak source sound pressure level of 236 dB re 1 µPa for the array (see Genesis, 2011).

For the frequency spectrum we used a modelled far-field signature and the corresponding frequency spectrum for frequencies up to 1 kHz of a representative array (see DHI, 2011) and scaled it to meet the source strength identified for this study. We decided to include frequencies of up to 4 kHz as it has been shown that they can, in some circumstances contribute to the noise levels and considerable distances, and also because the marine mammals subject to the assessment are sensitive in this frequency range (see Madsen et al., 2006). For frequencies above 1 kHz, the source spectrum was extrapolated assuming a 18 dB / octave slope (see, for example Wyatt, 2008). The resulting spectrum is shown in Figure A2-6.

[2] The sound source level is defined as the effective level of sound at a nominal distance of 1 meter. dB re. µPa. at 1 m.

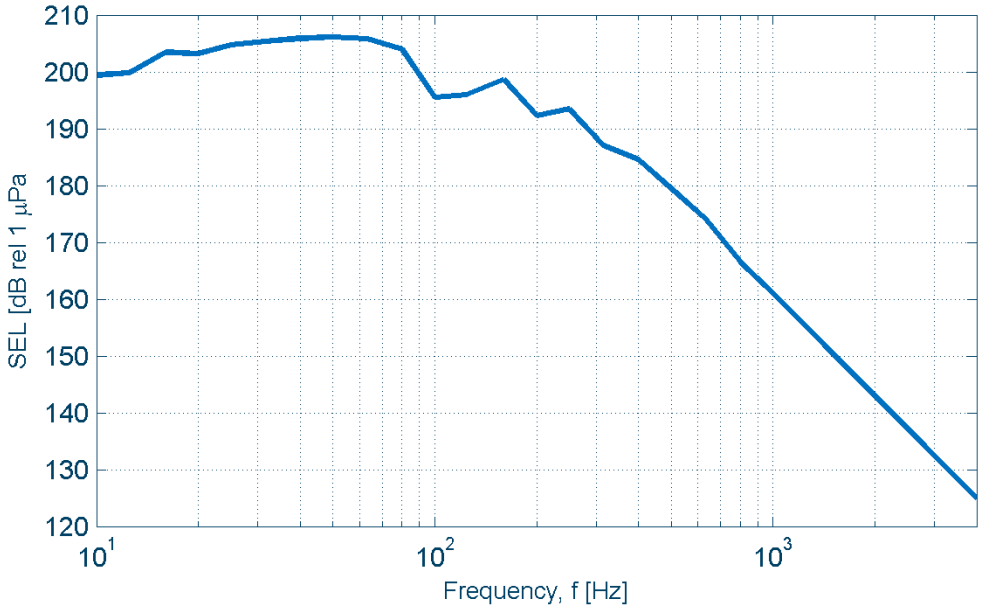

Figure A2-6 1/3 Octave frequency spectrum of seismic survey array far field signature.

Based on the derived spectrum, the resulting broadband SEL level was 214 dB re µPa^2·s. This corresponds well with measurements. Genesis, 2011 lists zero-to-peak and SEL values for a variety of airguns and airgun arrays, and based on their review it can be seen that on average the SEL values are about 20 dB below the zero-to-peak values. RMS values can then be derived from SEL values following

$$SPL_{rms} = SEL + 10\log_{10}\frac{T_1}{T_2} \tag{8.1}$$

where $T_1 = 1$ s (reference duration for SEL values) and T_2 = duration of the seismic pulse, in our case 50 ms (see review OSPAR, 2009).

After this formula, RMS values could be derived by adding 13 dB to the corresponding SEL values. The differences between the peak and the peak-to-peak value were set at 6 dB.

Table A2-4 Summary of source levels for the 4 x 40 in^3 airgun array used in the acoustical modelling

Variable	Dimension
Peak-to-Peak source sound pressure level	236 dB re 1 µPa
Zero-to-peak source sound pressure level	230 dB re 1 µPa
Source sound pressure level	227 dB re 1 µPa
Sound exposure level at 1 m	214 dB re 1 µPa^2·s

For the present study, the array layout was comparably simple. We thus opted for a conservative approach with the directivity of the seismic array defined as omnidirectional, i.e. the same noise radiated in all azimuth angles.

3.3.2 Sound propagation modelling

The calculation of the sound levels at different distances from the sources was undertaken for frequencies up to 4 kHz using a numerical model of the underwater acoustic propagation. For this end we used the well-established AcTUP package (Duncan and Maggi, 2006). We applied the RAMGeo code which is a full Parabolic Equation model. RAMGeo is based on the RAM[3] approach and was developed by Collins (1993) applying Padé series expansion. RAMGeo accounts for the change in speed of sound in the water column.

The sea surface is treated as a simple, perfectly reflecting boundary modelled as a pressure-release boundary. For a realistic treatment of seabed effect on wave propagation in the ocean, it is necessary to include absorption in the bottom material. The model includes propagation in the bottom seabed, but only handles compression waves (ocean bottom sediments modelled as fluids) not shear waves. Besides accounting for attenuation constants in the bottom layers, it is important to include density changes at the water-bottom interface as well as within the bottom itself for a realistic treatment of bottom effects on propagation. A simplified bottom description based on a number of constant-density layers was used. The lower boundary condition involves termination of the physical solution domain by an artificial absorption layer of several wavelengths thickness so as to ensure that no significant energy is reflected from the lower boundary. The absorption layer is modelled with a complex index of the refraction model.

The sound source properties of the airgun array were combined with the propagation model to calculate the sound propagation in discrete angular directions of the seismic array at 10 2D transects. We modelled specific 1/3 octave bands from 10 Hz to 4 kHz that are most relevant for the marine mammal species in the area. Based on our calculations we will provide exemplary maps of the sound pressure field as a function of distance (full maps in Appendix A). These ‘noise maps’ will be used for the impact assessment in the next step. In total, we have 3 positions of the seismic survey vessel and calculate the sound spread for each position (e.g. 3 noise events simulated times 10 acoustic propagation transects = 30 calculations).

As the three most important species in the region (walrus, beluga whale and narwhal) spend most of their time in the upper water column, the receiver depth[4] was set at 20 m in the modelling of the transmission loss of the 1/3 octave frequencies.

The Range-dependent Acoustic Model simulations were carried out based on the following simplified conditions and specific assumptions:

- The sea surface is treated as a simple, horizontal perfectly reflecting boundary ignoring the sea states, where in addition to waves the upper ocean will have an infusion of air bubbles which has a significant impact on the speed of sound in the surface part of the water column. Furthermore, the ocean surface of the area of investigation is assumed to be completely free of ice including the present of a partial ice cover and ice floes.
- The code is a 2D model ignoring 3D effects due to horizontal refraction of sound rays reflected by a sloped sea bottom. E.g. when the sea floor is shoaling, as is the case for the ocean over a sloping beach and the continental slope, and around seamounts and islands, a ray travelling obliquely across the slope experiences the phenomenon of horizontal refraction.
- Effects of underwater ambient noise and masking are not addressed in the model.
- Airguns arranged in arrays are tuned to focus sharply pulsed pressure downward into the ground. Thus energy emission and propagation in the horizontal are reduced. In the present numerical model the source is modelled as a point source, which is omni-directional. At low-frequencies, below a few hundred Hz, the sound source characteristics of an airgun appear omni-directional, however, each airgun becomes more multipolar with higher frequency. The extent of the airgun array and the directionality of the sound source are ignored in the noise propagation simulations.

[3] Range-dependent Acoustic Model (RAM)

[4] Note the reported levels are at a constant water depth and is not the maximum value in the water column at each discrete distance from the sound source.

The simplifications are expected to lead to a conservative estimate of the sound levels.

The spatial discretisation used in the finite difference model is defined in terms of the wavelength being modelled. Hence the simulations take into account sensitivity to frequency components. The radial resolution is

$$dr = \alpha\lambda \tag{8.2}$$

and the depth resolution is then defined as

$$dz = \beta\, dr \tag{8.3}$$

The modelling was carried out with the following discretisation for the different frequency domains.

Table A2-5 Spatial discretisation parameters for different frequency regions

Frequencies	α	β	Number of Padé tems
1 Hz - 50 Hz	$\frac{1}{40}$	2	8
51 Hz - 200 Hz	$\frac{1}{10}$	2	8
201 Hz - 1000 Hz	$\frac{1}{5}$	2	8
1001 Hz - 4000 Hz	$\frac{1}{5}$	2	8

In the sound propagation simulation at frequencies above 1 kHz the effect of the bathymetry surrounding the source is ignored.

3.4 Threshold values

For the quantitative assessment of impact ranges, we have chosen several criteria for marine mammals and fish that have been derived from a variety of sources (see NMFS, 2003; Southall et al., 2007; Halvorsen et al., 2011). The NMFS criteria are part of the US regulation (except, to our knowledge, the behaviour criteria), although depicting pulsed sounds in rms sound pressure levels is not without its problems (see discussion by Madsen, 2005). The NMFS criteria are based on the assumption that received levels that are lower than these criteria will not injure animals or impair their hearing abilities but higher received levels may have some effects. We have interpreted these criteria as the onset of TTS also noting the relative low values. Applicable are the initial scientific recommendations on marine mammal noise exposure criteria as developed by a group of US experts (Southall et al., 2007). Recent work on fish has resulted in evidence based criteria for this taxa (Halvorsen et al., 2011).

Table A2-6 provides an overview of noise exposure criteria for marine mammals and fish that have been used in this assessment.

Table A2-6 Marine mammal and fish noise exposure criteria used in the quantitative assessment (PTS = Permanent threshold shift; a permanent elevation of the hearing threshold in certain frequencies. TTS = Temporary threshold shift; a temporary elevation of the hearing threshold in certain frequencies.

Source	Effect	Taxa	Sound type	Sound pressure level / SEL
NMFS, 2003	Start of hearing effects - TTS	Cetaceans	Airgun pulses	180 dB re 1µPa
	Start of hearing effects - TTS	Pinnipeds	Airgun pulses	190 dB re 1µPa
Southall et al., 2007	PTS	Cetaceans (3hearing classes)	Single - multiple pulse	230 dB re 1µPa peak
	PTS	Cetaceans (3 hearing classes)	Single - multiple pulse	SEL 198 dB re 1µPa^2-s (M_{lf}, M_{mf}, M_{hf})
	PTS	Pinnipeds (in water)	Single pulse - multiple pulse	218 dB re 1µPa peak
	PTS	Pinnipeds (in water)	Single pulse - multiple pulse	SEL 186 dB re 1µPa^2-s (M_{lf}, M_{mf}, M_{hf})
	TTS	Cetaceans (3 hearing groups)	Single pulses	224 dB re 1µPa peak
	TTS	Cetaceans (3 hearing groups)	Single pulses	183 dB re 1µPa^2-s SEL (M_{lf}, M_{mf}, M_{hf})
	TTS	Pinnipeds (in water)	Single pulses	212 dB re 1µPa peak
	TTS	Pinnipeds (in water)	Single pulses	171 dB re 1µPa^2-s SEL (M_{pw})
Finneran et al. 2002	TTS	Pinnipeds in water	Single pulses	226 dB re 1µPa peak to peak
Halvorsen et al. 2011	PTS / Physical damage	Fish	Single pulses	206 dB re 1µPa peak
Halvorsen et al. 2011	TTS	Fish	Single pules	187 dB re 1µPa^2-s SEL
Southall et al. 2007	Response	Cetaceans (Beluga, narwhal, bowhead whale)	Single pulses	160 dB re 1µPa
Southall et al. 2007	Response	Cetaceans (Beluga, narwhal, bowhead whale)	Single pulses 2 D seismic surveys / echosounder sidesecan sonar	140 dB re 1µPa^2·s / 140 dB re 1µPa
Thomsen et al., 2012	Response	Marine fish (based on experiments on sole and cod)	Multiple pulses	140 dB re 1µPa peak
Southall et al. 2007	Response	Seals	Multiple pulses	190 dB re 1µPa

4. RESULTS

The following section presents the results of the simulations. First we present a brief description of how the different values are determined, followed by tabulated ranges to threshold values and finally exemplary plots of the sound propagation.

The following section presents the results of the simulations. First we present a brief description of how the different values are determined, followed by tabulated ranges to threshold values and finally exemplary plots of the sound propagation.

4.1 Sound levels

The output from the modelling in AcTUP is the Transmission loss (TL) 1/3 octave per frequency band

$$TL_f = -20\log_{10}\frac{p_{recived}}{p_{source}}\ [\text{dB}] \tag{8.4}$$

This transmission loss is then used to determine the received SEL (SEL^R) at any distance by subtracting the TL from the source level according to (8.5).

$$SEL^R = 10\log_{10}\left(\sum_f 10^{0.1\,SEL_f^{SRC}-0.1\,TL_f}\right) \tag{8.5}$$

Where SEL_f^{SRC} is the SEL for each 1/3 octave band with the centre frequency f. See source spectrum in Figure A2-6.

The M-weighted SEL is found as

$$SEL = 10\log_{10}\left(\sum_f 10^{0.1\,SEL_f-0.1\,M(f)}\right) \tag{8.6}$$

where the weighting factor is determined as

$$M(f) = -20\log_{10}\left(\frac{f^2 f_{hi}^2}{(f^2+f_{lo}^2)(f^2+f_{hi}^2)}\right) \tag{8.7}$$

where the cut-off frequencies are as listed in Table 3.1.

The weighting curves are plotted in Table A2-7.

Table A2-7 Functional hearing groups and associated auditory bandwidths (Southall et al. 2007)

Functional hearing group	Estimated auditory bandwidth	
	f_{lo}	f_{hi}
Low-frequency Cetaceans (LFC)	7 Hz	22 kHz
Mid-frequency Cetaceans (MFC)	150 Hz	160 kHz
High-frequency Cetaceans (HFC)	200 Hz	180 kHz
Pinnipeds (PINN)	75 Hz	75 kHz

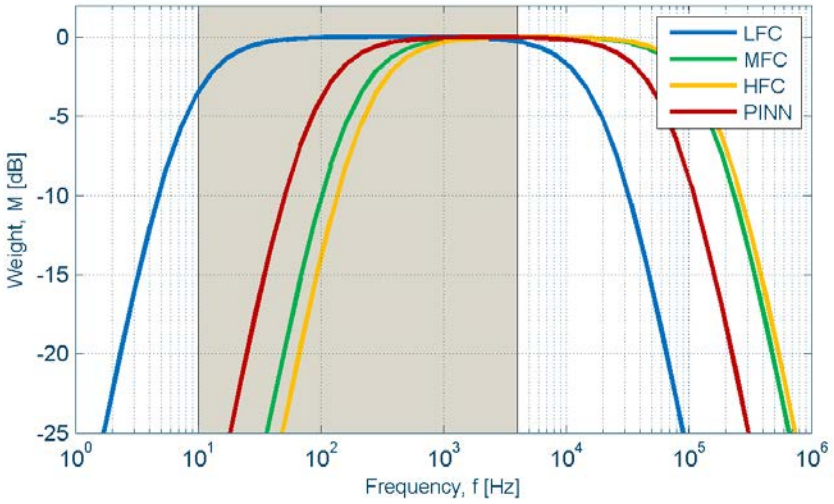

Figure A2-7 M-weights. The shaded area marks the modelled frequency area.

The overall received SEL level from (8.5) is used to determine an *overall* transmission loss

$$TL_{oa} = SEL_{oa}^{SRC} - SEL_{oa}^{R} \text{ [dB]} \tag{8.8}$$

Which is used to determine the received SPL_{peak} and SPL_{rms} values

$$SPL^{R} = SPL^{SRC} - TL_{oa} \tag{8.9}$$

This is done under the assumption that the shape of the frequency spectrum of SEL and SPL is equal.

4.2 Single shot distance to threshold levels

The following tables present the ranges in where a sound level above the given threshold is present. The ranges are determined as the maximum range as well as the mean range in the simulation of the 10 azimuthal traces.

Table A2-8 Distance to M-weighted SEL thresholds at each site (note: '-' no record in the modelling of any distance referring to the sound level so no evidence of impact (range $\lesssim 10$ m)).

M-weighted SEL (dB re 1 µPa²·s)	Distance to threshold level Location 1		Distance to threshold level Location 2		Distance to threshold level Location 3	
Source SEL = 214 dB	R_{max} (m)	R_{mean} (m)	R_{max} (m)	R_{mean} (m)	R_{max} (m)	R_{mean} (m)
198 M (LFC)	-	-	-	-	-	-
198 M (MFC)	-	-	-	-	-	-
198 M (HFC)	-	-	-	-	-	-
187 unweighted (overall SEL level) Fish	-	-	-	-	-	-
186 M (Pi)	-	-	-	-	-	-
183 M (LFC)	30	30	30	21	30	21
183 M (MFC)	-	-	-	-	-	-
183 M (HFC)	-	-	-	-	-	-
171 M (Pi)	50	50	50	50	50	50
140 unweighted	3 630	3 420	3 460	3 447	3 290	3 158

Table A2-9 Distance to SPL thresholds at each site

SPL (dB re 1 µPa)	Distance to threshold level Location 1		Distance to threshold level Location 2		Distance to threshold level Location 3	
Source SPL = 227 dB	R_{max} (m)	R_{mean} (m)	R_{max} (m)	R_{mean} (m)	R_{max} (m)	R_{mean} (m)
200	-	-	-	-	-	-
190	40	40	40	40	40	40
180	80	71	70	70	80	71
170	130	121	130	121	130	122
160	230	230	250	234	250	235
150	5 800	4 413	5 890	5 595	6 090	5 487
140	30 410	24 602	33 040	29 218	32 850	27 890
130	116 340	77 470	100 700	84 508	104 610	81 051
120	>150 000[5]	>150 000	>150 000	>150 000	>150 000	>150 000

Table A2-10 Distance to peak SPL thresholds at each site

Peak SPL_{0P} (dB re 1 µPa)	Distance to threshold level Location 1		Distance to threshold level Location 2		Distance to threshold level Location 3	
Source SPL_{0P} = 230 dB	R_{max} (m)	R_{mean} (m)	R_{max} (m)	R_{mean} (m)	R_{max} (m)	R_{mean} (m)
230	-	-	-	-	-	-
218	-	-	-	-	-	-
224	-	-	-	-	-	-
212	-	-	-	-	-	-
206	-	-	-	-	-	-
200	-	-	-	-	-	-
190	50	50	50	50	50	50
180	90	81	90	86	90	90
140	52 550	38 216	58 990	45 486	49 170	41 207

[5] Modelling area extends 150 000 m. No SPL levels below 120 dB was recorded, hence the notation >150 000

Table A2-11 Distance to peak SPL thresholds at each site

Peak SPL_{PP} (dB re 1 µPa)	Distance to threshold level Location 1		Distance to threshold level Location 2		Distance to threshold level Location 3	
Source SPL_{PP} = 236 dB	R_{max} (m)	R_{mean} (m)	R_{max} (m)	R_{mean} (m)	R_{max} (m)	R_{mean} (m)
230	-	-	-	-	-	-
218	-	-	-	-	-	-
224	-	-	-	-	-	-
212	-	-	-	-	-	-
206	-	-	-	-	-	-
200	40	40	40	40	40	40
190	70	70	70	70	70	70
180	120	120	120	120	120	120
140	69 236	69 228	100 650	79 743	98 680	72 402

4.3 Singe shot frequency dependent propagation loss

The subsequent section presents exemplary plots of the SEL from the simulations. In the transect contour plots the noise penetration into the seabed is not shown, although the phenomenon is included in the calculations.

The first plot presents the SEL in terms of the overall SEL as well as the four M-weighted SEL. The second figure is a zoom on the first kilometre. This reveals the very rapid attenuation of the sound levels within the first couple of hundred meters.

The third figure shows the source SEL frequency spectrum together with the received spectrum at 1 km, 5 km, 10 km, 50 km and 100 km from the source.

The fourth and final plot shows a two-dimensional transect of the SEL. The shaded area indicates the seabed.

We have chosen a single direction for each of the three locations, with different development in the bathymetry for illustration purposes.

4.3.1 Location 1: Direction 144 °N

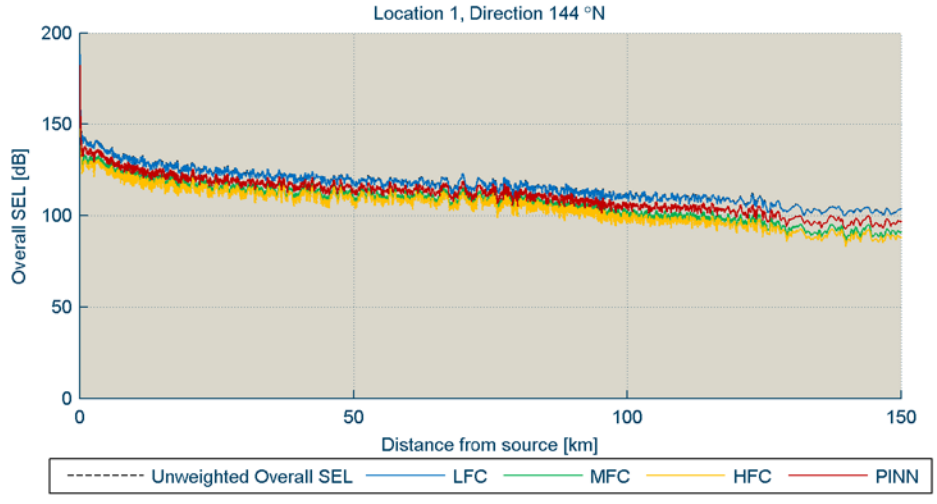

Figure A2-8 SEL along trace

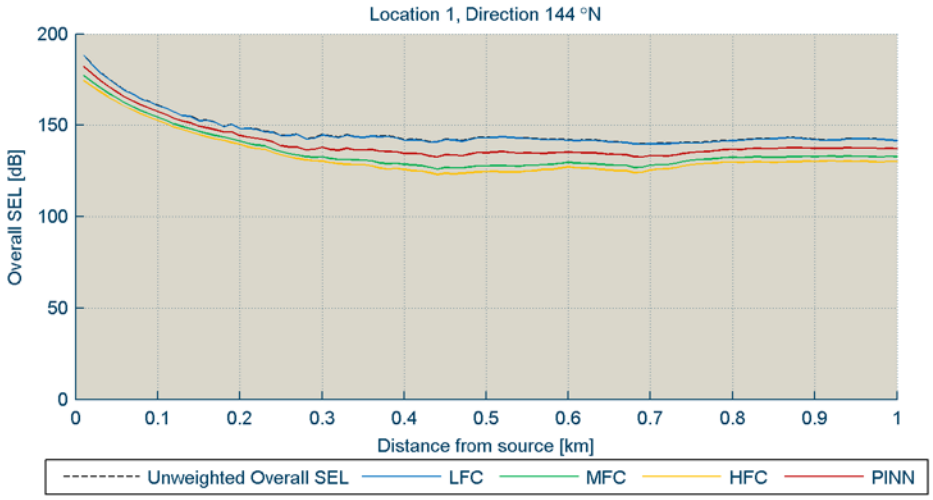

Figure A2-9 SEL along the first kilometre of the trace

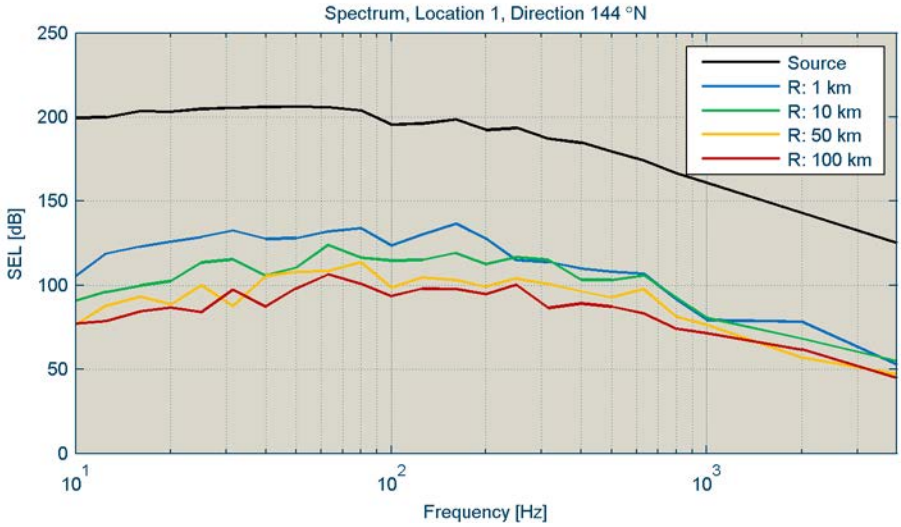

Figure A2-10 Source SEL frequency spectrum together with the received spectrum at 1 km, 5 km, 10 km, 50 km and 100 km from the source

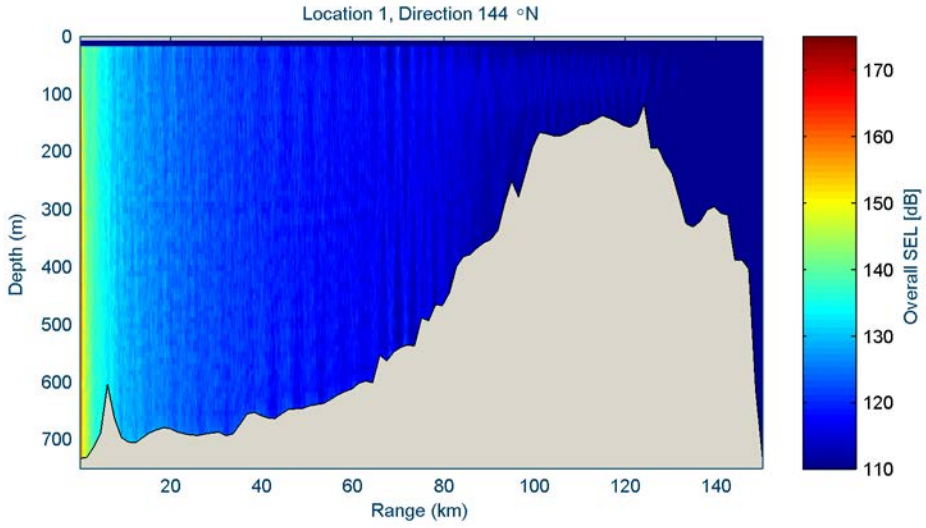

Figure A2-11 Two-dimensional transect of overall SEL along trace

4.3.2 Location 2: Direction 252 °N

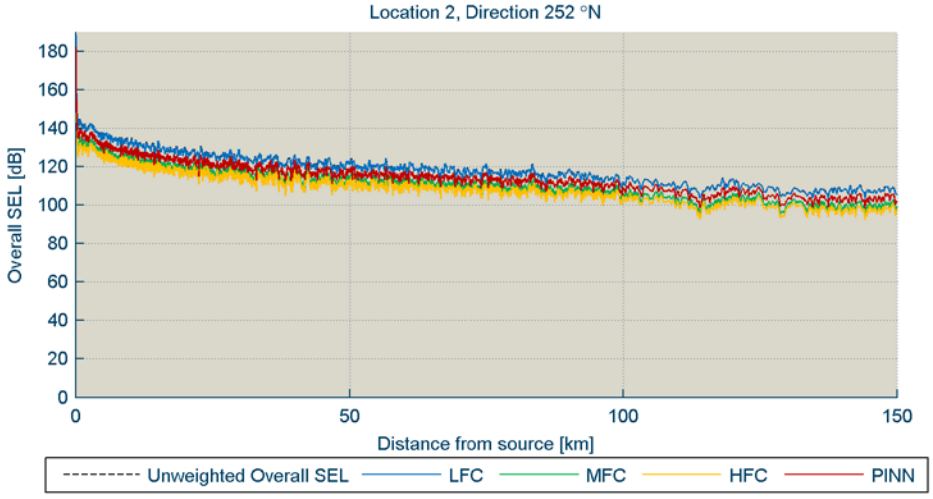

Figure A2-12 SEL along trace

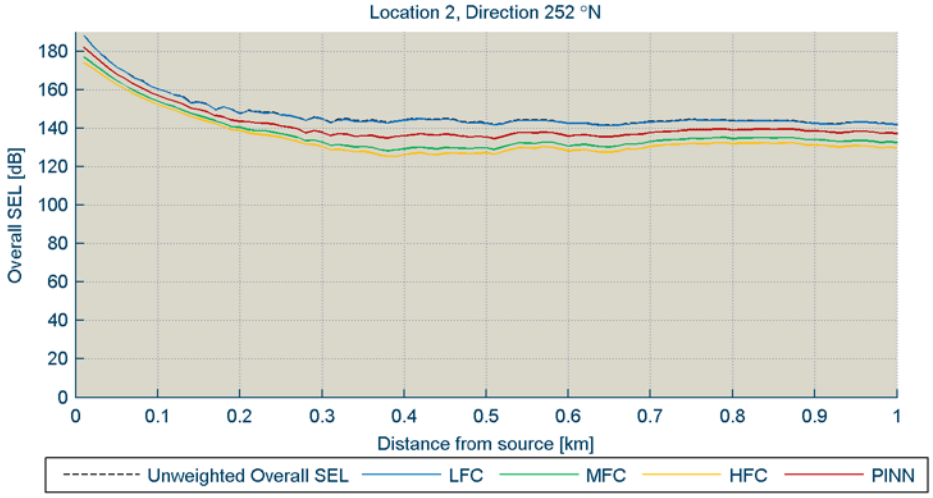

Figure A2-13 SEL along the first kilometre of the trace

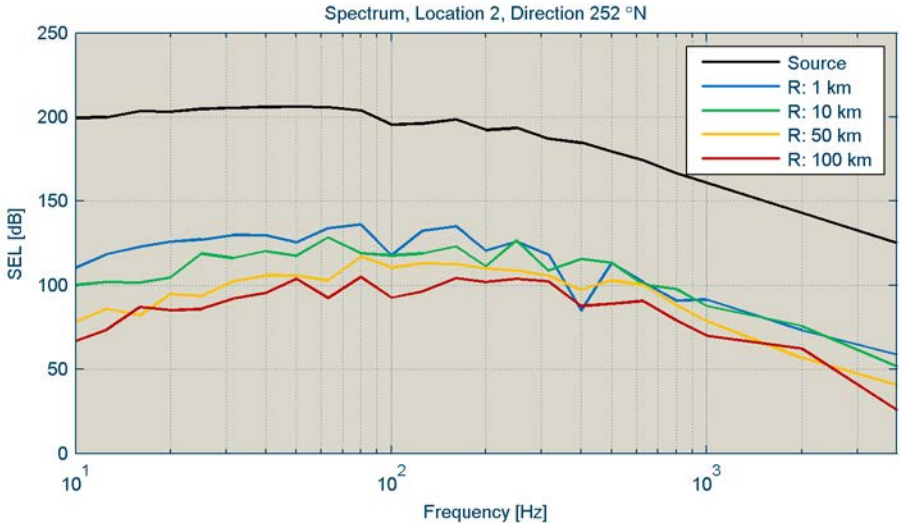

Figure A2-14 Source SEL frequency spectrum together with the received spectrum at 1 km, 5 km, 10 km, 50 km and 100 km from the source

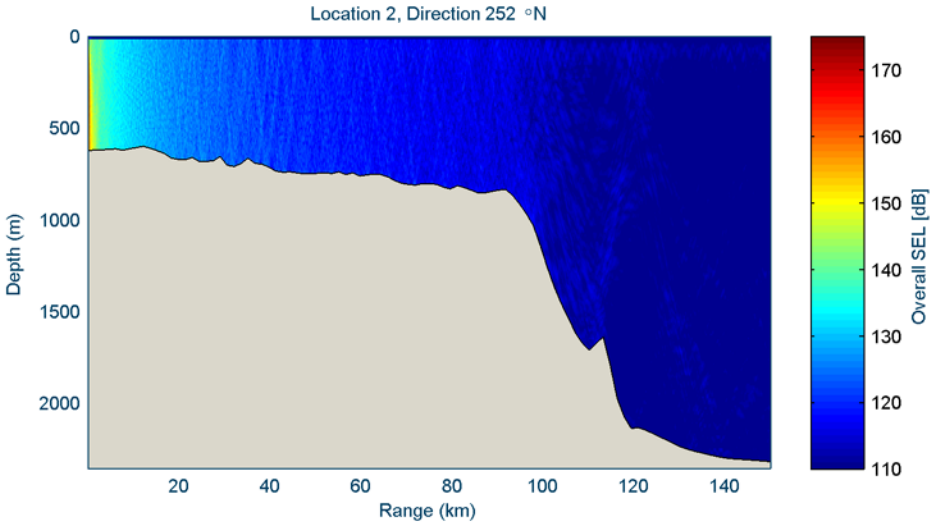

Figure A2-15 Two-dimensional transect of overall SEL along trace

4.3.3 Location 3: Direction 72 °N

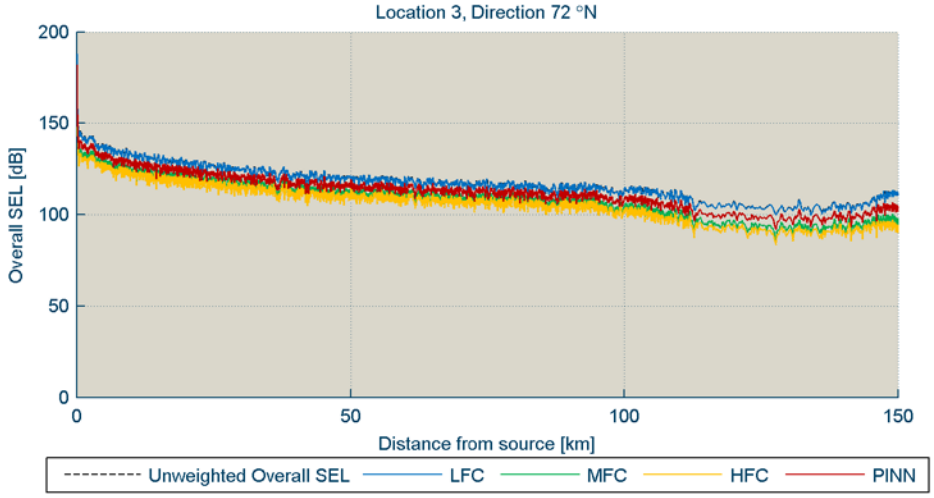

Figure A2-15 SEL along trace

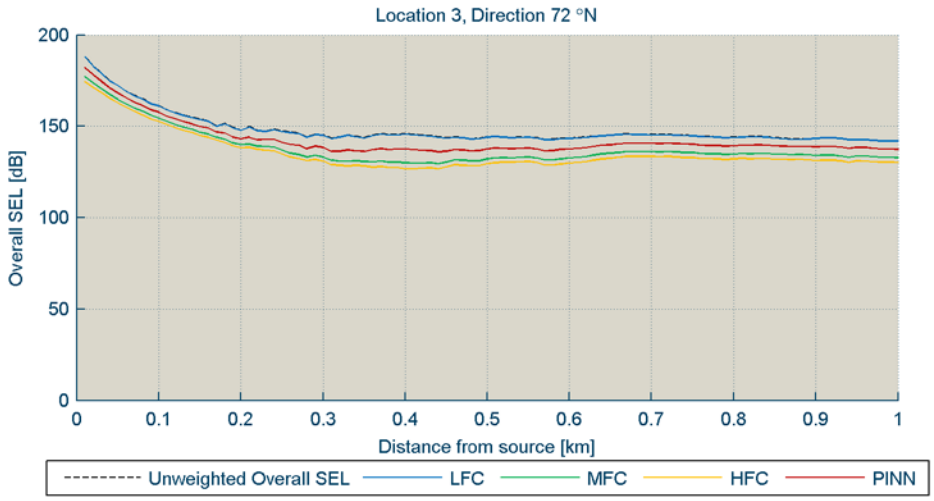

Figure A2-16 SEL along the first kilometre of the trace

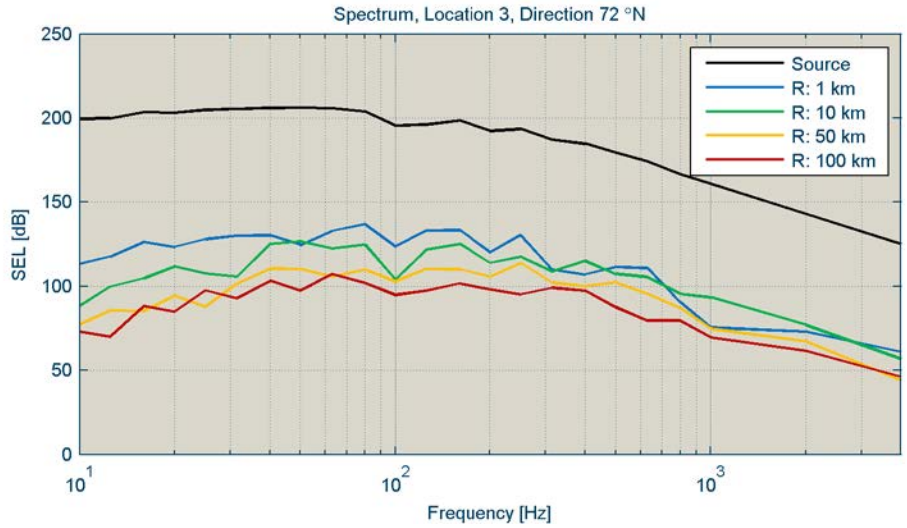

Figure A2-17 Source SEL frequency spectrum together with the received spectrum at 1 km, 5 km, 10 km, 50 km and 100 km from the source

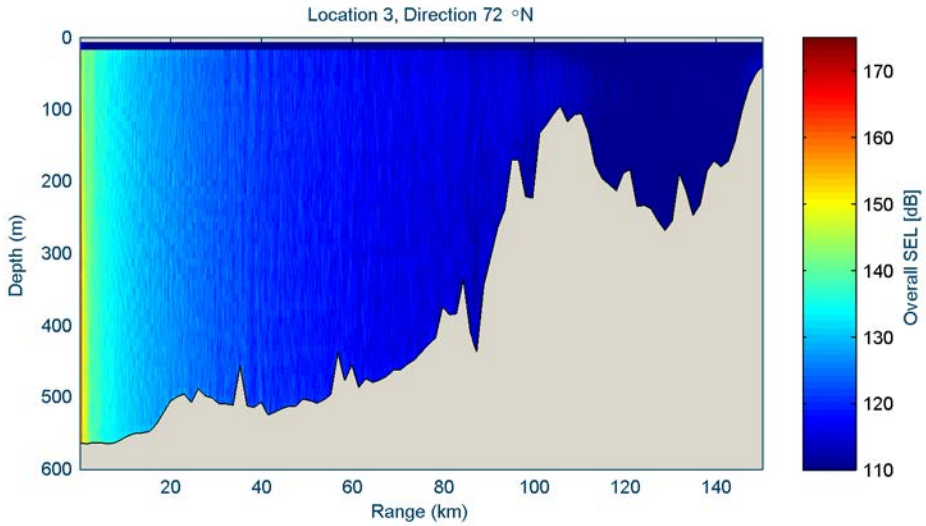

Figure A2-18 Two-dimensional transect of overall SEL along trace

4.4 Single shot noise maps

The noise maps for single shots are shown in Appendix B. It can be seen that the sound is not spreading omnidirectional due to the interactions with the bathymetry including sound absorption and propagation in the seabed. It is visible too; that the sound is degrading to relatively low levels close to receiver, although it will most likely be audible to marine life over the entire license block area with 105 dB re 1 $\mu Pa^2 \cdot s$ most likely exceeding ambient noise levels in most cases. It is visible also that the horizontal sound spread differs across regions but that the overall distribution of received sound exposure levels looks very similar between the three locations.

4.5 Cumulative SEL maps

Cumulative SEL has been used to assess the noise exposure for marine mammals exposed to multiple pressure pulses from the airgun array, with resulting impact ranges larger than for single shot.

As there are no other surveys occurring in 2013, only the Shell survey has been used to calculate the cSEL levels.

The cumulative sound exposure is calculated as

$$SE_{cum} = SEL_{single} + 10\log_{10} n \tag{8.10}$$

where n is the number of shots fired during a period of 24 hours at a single location. n=15,000. Hence the cumulative sound exposure level is 41.7 dB higher than the single shot SEL.

The maps for the cumulative footprint of the survey are shown in Appendix C. The horizontal spread of the sound is identical to the broadband levels but the overall received levels are higher compared to the broadband levels for the single shot.

5. CONCLUSIONS

In the present study the noise propagation from a seismic survey at three locations in the Baffin Bay area using an air-gun array was modelled. Detail site-specific input data was used in the simulations. The modelling is done in frequency domain for all 1/3-octave band frequencies between 10 and 4000 Hz. All calculations are done on a deterministic basis, hence the model does not account for ocean dynamics due to surface waves, currents, fluctuations in the sound speed profile arising from small-scale turbulence, etc. The results presented are to be viewed in light of an ensemble averaged basis.

On average the simulations show that the sound propagation across the three locations are similar, leading to very similar results with regards to the range over which impacts on marine life might occur.

Most of the acoustic energy of the seismic airgun pluses is located well below 1 kHz with the higher frequencies attenuating more rapidly than the lower ones. As attenuation due to viscosity reduces with decreasing frequency, low frequency propagation in the Deep Sound Channel can extend over vast distances in the ocean.

From the numerical calculations it is also apparent that the transmission loss is very high over the first km from the source which is in principal in line with expectations (see Jensen et al., 2011), although the level of decrease over the first few hundred meters is very high. In the far field, the sound propagates with much less loss compared to the near field.

As the difference between the three sites show very little variation in sound exposure level it is expected that the results obtained here very likely can be transferred somewhat to other sites if the development is relocated.

As expected, the computations show that the cumulative sound[6] results in higher impact ranges than for single shots. Yet, the assumption that the acoustic energy just sums up at the receiver in the way suggested by Southall et al., 2007, neglects that hearing might recover between pulses. Thus, the overall impact from the survey over the course of a one-day cycle might be smaller than indicated in the cumulative maps.

[6] A result of the total sound energy over the whole survey period released in 1 second

6. REFERENCES

Ainslie, M.A., 2010. Principles of sonar performance modellingSpringer in association with Praxis Publishing Chichester, UK.

Codispoti, L.A., Kravitz, J.H., Collins, M.D., 1968. Oceanographic Cruise Summary, Baffin Bay-Davis Strait-Labrador Sea, Summer 1967. Informal rept. 3 Sep-14 Oct 1967 Naval Oceanographic Office NSTL Station, MS

Collins, M. D. 1993. A split-step Pad´e solution for the parabolic equation method. The Journal of the Acoustical Society of America, 93(4), 1736–1742.

DHI, 2011. Modelling of Underwater Noise from Seismic Survey in Aruba - Report for WorleyParsons Spain. DHI in cooperation with ODS, Hørsholm

Duncan, A.J., Maggi, A.I., 2006. A Consistent, user friendly Interface for Running a Variety of Underwater Acoustic propagation Codes. Proceedings of ACOUSTICS 2006.

Genesis, 2011. Review and Assessment of Underwater Sound Produced from Oil and Gas Sound Activities and Potential Reporting Requirements under the Marine Strategy Framework Directive Genesis Oil and Gas Consultants Report for Department of Energy and Climate Change, Aberdeen.

Halvorsen, M.B., Casper, B.M., Woodley, C.M., Carlson, T.J., Popper, A.N., 2011. Predicting and mitigating hydroacoustic impacts on fish from pile installations. NCHRP Research Results Digest 363, Project 25-28, National Cooperative Highway Research Program, Transportation Research Board (available at http://www.trb.org/Publications/Blurbs/166159.aspx). National Academy of Sciences, Washington.

Henriksen, N., Higgins, A.K., Kalsbeek, F., Christopher; T., Pulvertaft, R., 2000. Greenland from Archaean to Quaternary Descriptive text to the Geological map of Greenland, 1:2 500 000. Geology of Greenland Survey Bulletin(185), 1-93.

Jensen, F.B., Kuperman, W.A., Porter, M., B.,, Schmidt, H., 2011. Computational Ocean Acoustics, Second Edition Springer, New York, Dordrecht, Heidelberg, London.

Kyhn, L.A., Boertmann, D., Tougaard, J., Johansen, K., Mosbech, A., 2011. Guidelines to environmental impact assessment of seismic activities in Greenland waters. Danish Centre for Environment and Energy, Roskilde.

Madsen, P.T., 2005. Marine mammals and noise: problems with root mean square sound pressure levels for transients. Journal of the Acoustical Society of America 117, 3952-3957.

Madsen, P.T., Johnson, M., Miller, P.J.O., Aguilar Soto, N., Lynch, J., Tyack, P., 2006. Quantitative measures of air gun pulses recorded on sperm whales (Physeter macrocephalus) using acoustic tags during controlled exposure experiments. Journal of the Acoustical Society of America 120(4), 2366-2379.

NMFS, 2003. Taking marine mammals incidental to conducting oil and gas exploration activities in the Gulf of Mexico, Federal register 68, 9991-9996.

OSPAR, 2009. Overview of the impacts of anthropogenic underwater sound in the marine environmentOSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic (www.ospar.org).

Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene, C.R.J., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A., Tyack, P., 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aquatic Mammals 33, 411-521.

Thomsen, F., Mueller-Blenkle, C., Gill, A., Metcalfe, J., McGregor, P., Bendall, V., Amdersson, M., Sigray, P., Wood, D., 2012. Effects of pile driving on the Behavior of Cod and Sole. In: Hawkins, A., Popper, A.N. (Eds.), Effects of Noise on Aquatic Life Springer, New York, pp. 387-389.

TNO, 2011. Standard for measurement and monitoring of underwater noise, part 1: physical quantities and their units In: Ainslie, M.A. (Ed.). TNO, Den Haag

Wyatt, R., 2008. Review of Existing Data on Underwater Sounds Produced by the Oil and Gas Industry. Joint Industry Programme on Sound and Marine Life, London.

7. ADDITIONAL FIGURES

7.1 3D Bathymetry of the locations

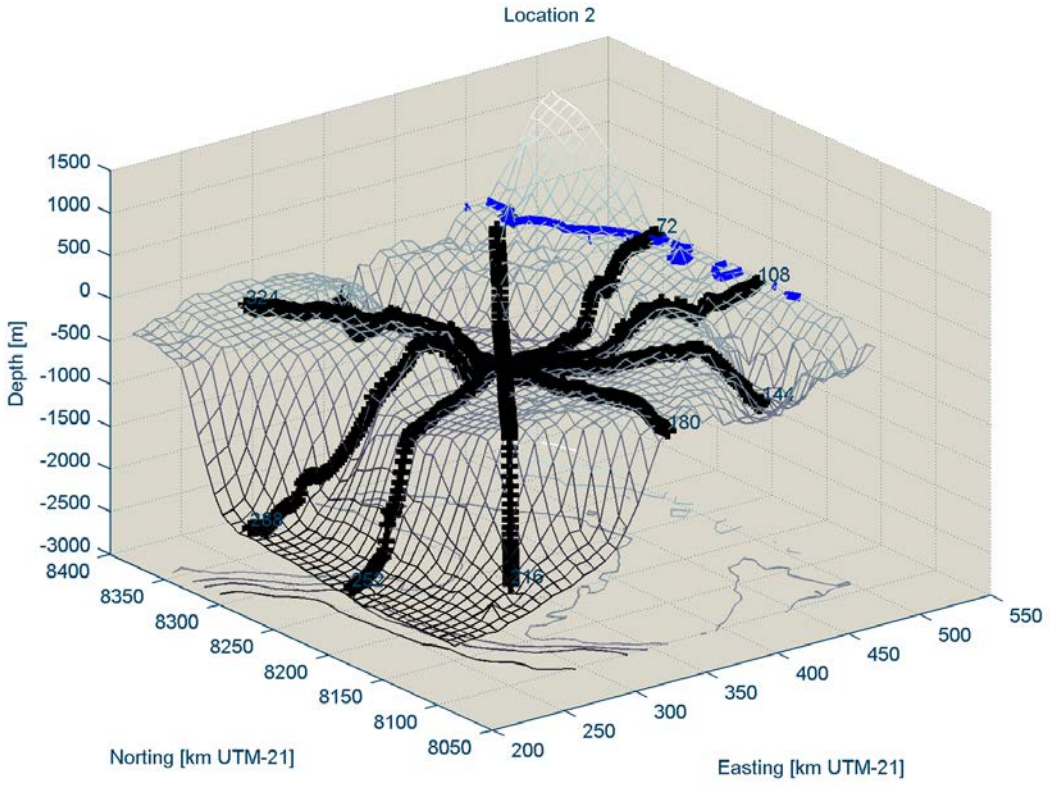

Figure A2-19 3D bathymetric profile of source location 2; source SRTM-30 geographic grid interpolated onto a 1 km x 1 km grid in UTM-21 coordinates; note that resolution mesh in the figures does not correspond to the actual resolution, but is only shown for reference; blue line = shore line)

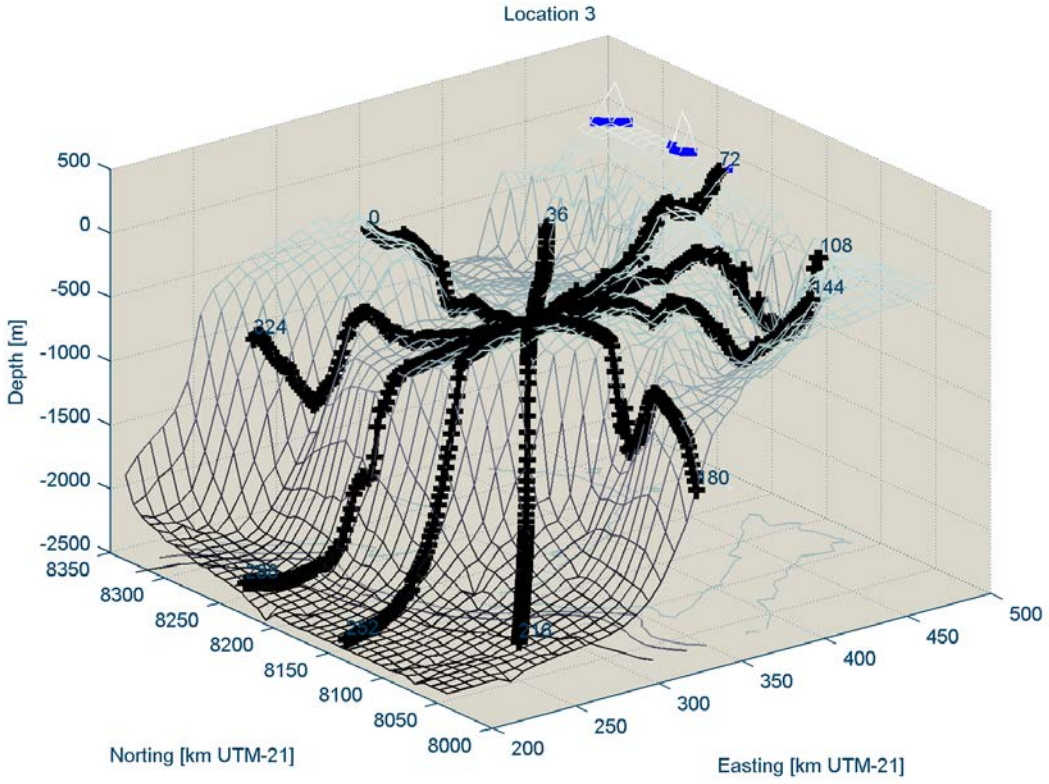

Figure A2-20 3D bathymetric profile of source location 3 source SRTM-30 geographic grid interpolated onto a 1 km x 1 km grid in UTM-21 coordinates; note that resolution mesh in the figures does not correspond to the actual resolution, but is only shown for reference; blue line = shore line)

7.2 Noise maps for single shots

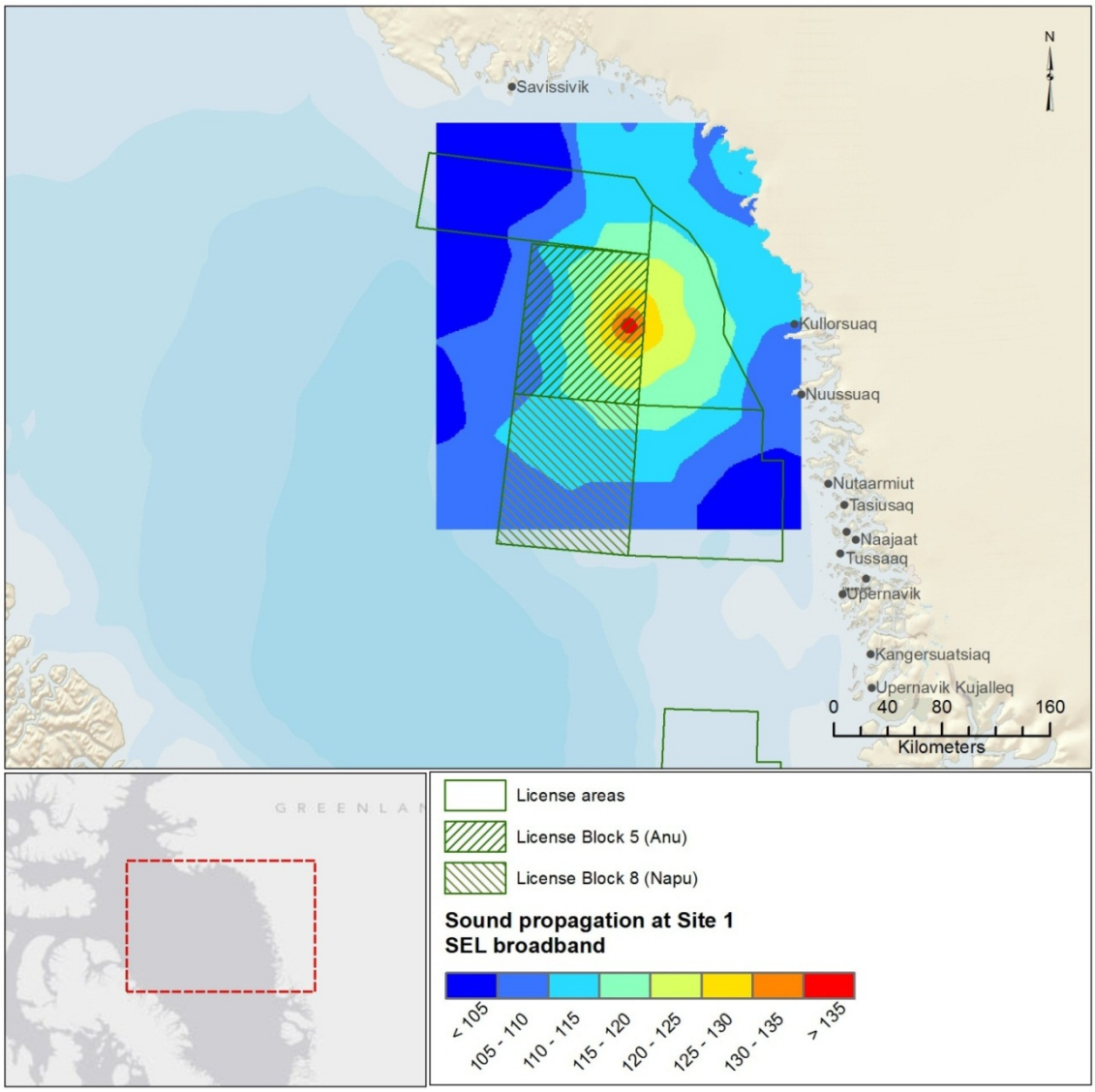

Figure A2-21 Broadband SEL levels at location 1 measured in dB re µPa²·s

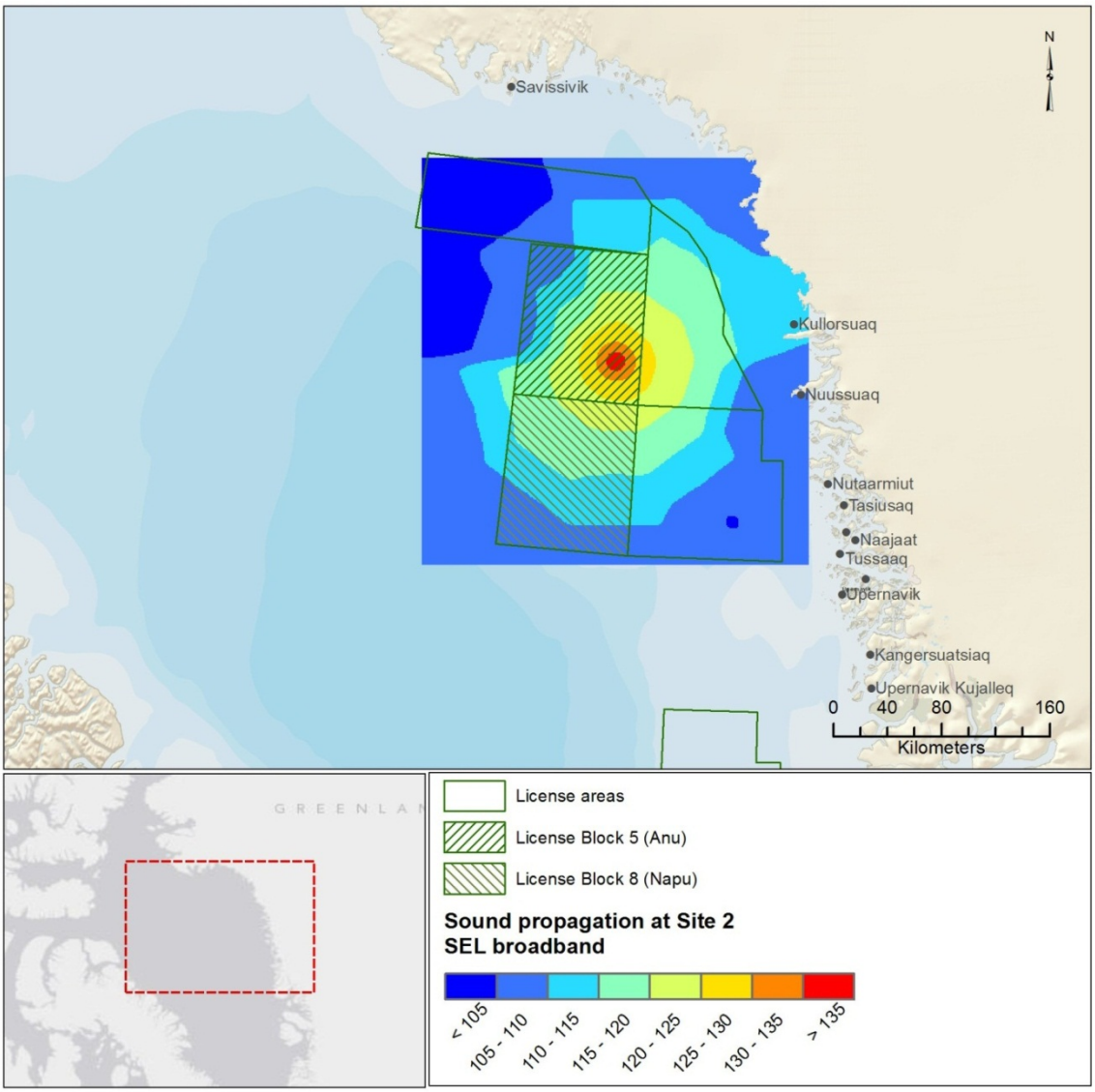

Figure A2-22 Broadband SEL levels at location 2 measured in dB re µPa^2·s

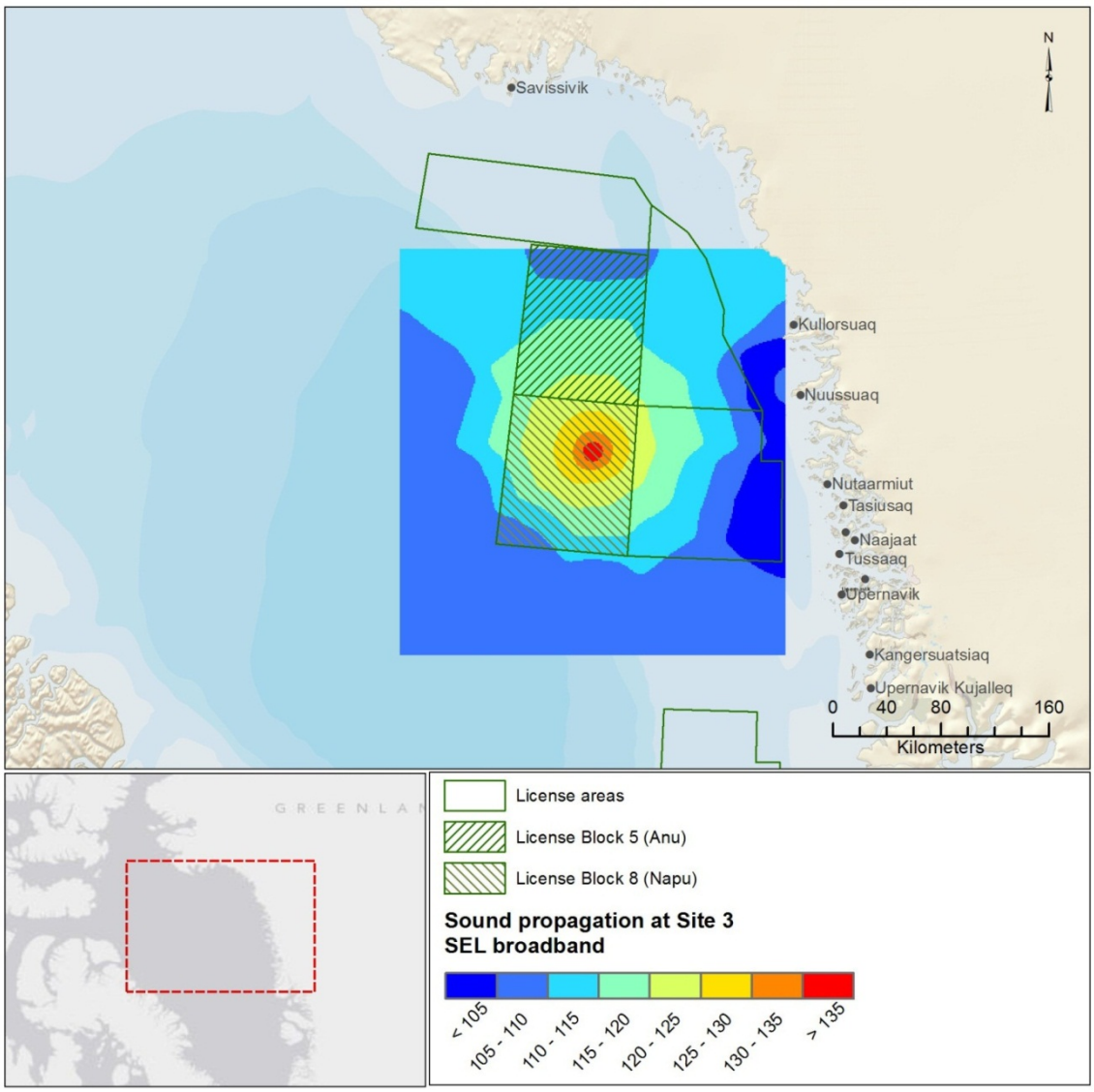

Figure A2-23 Broadband SEL levels at location 3 measured in dB re µPa^2·s

7.3 Noise maps cumulative SELs

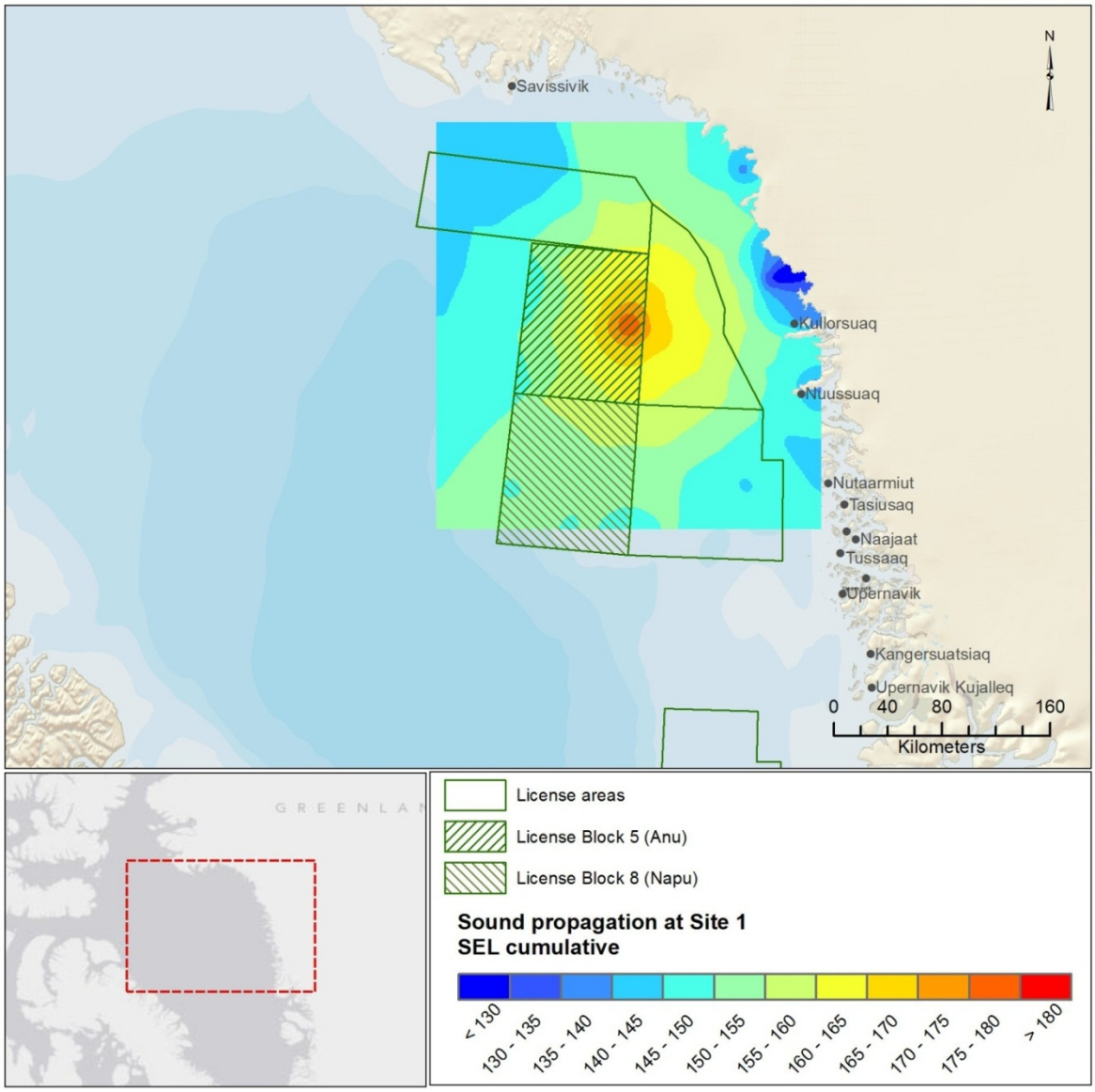

Figure A2-24 Cumulative SEL at location 1 measured in dB re µPa^2·s

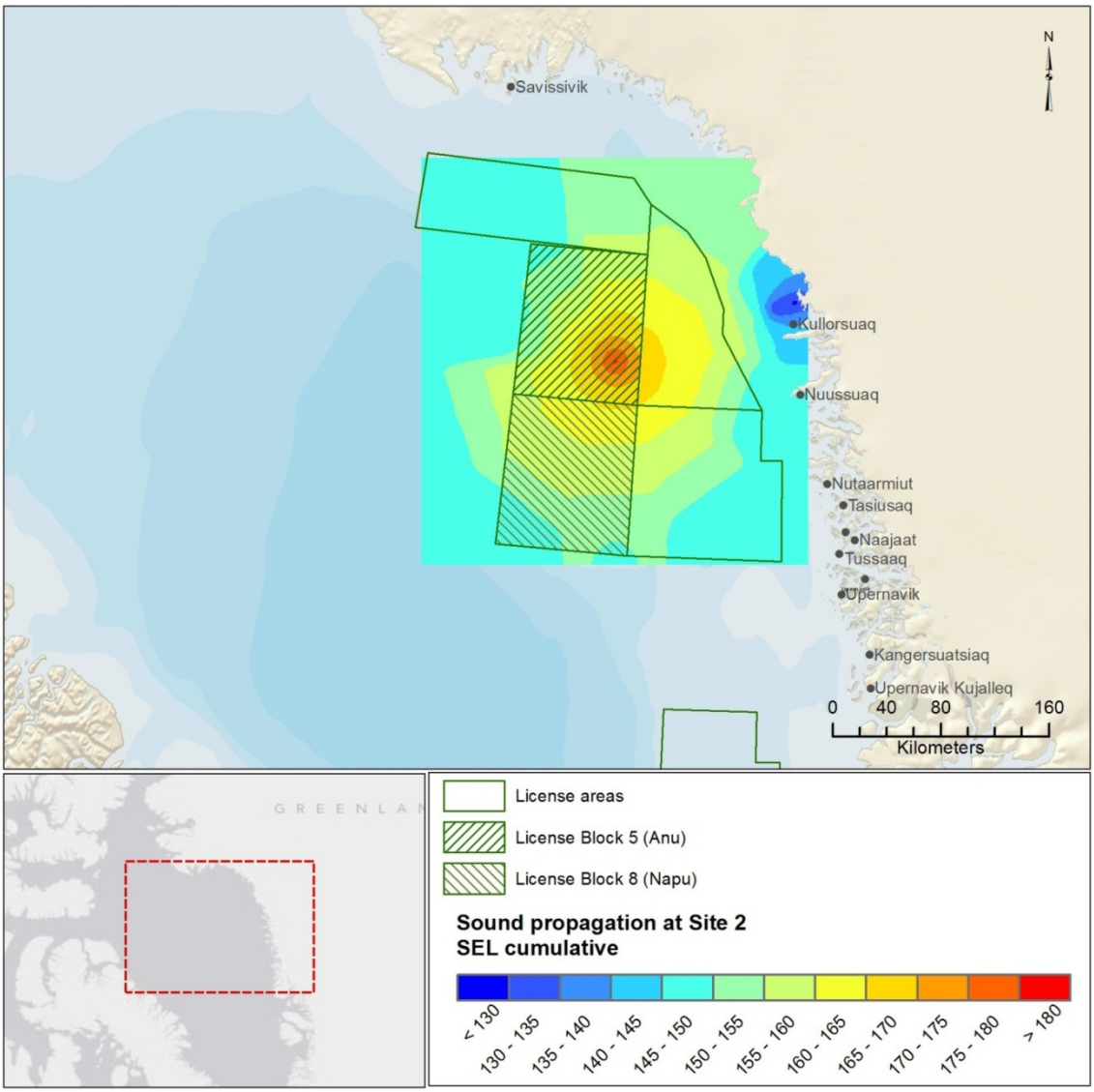

Figure A2-25 Cumulative SEL at location 2 measured in dB re µPa^2·s

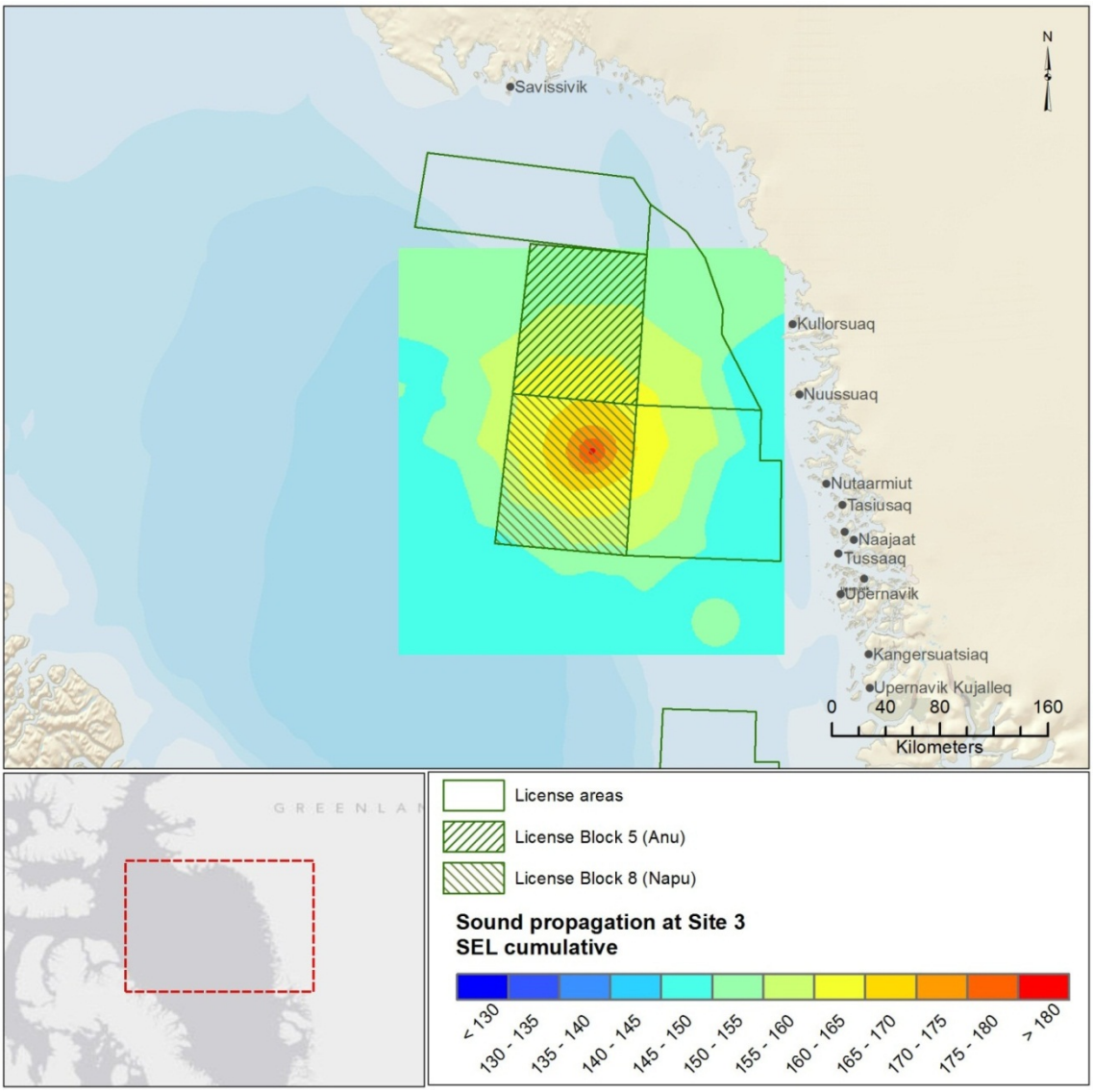

Figure A2-26 Cumulative SEL at location 3 measured in dB re µPa^2·s

7.4 Noise maps peak-to-peak SPLs

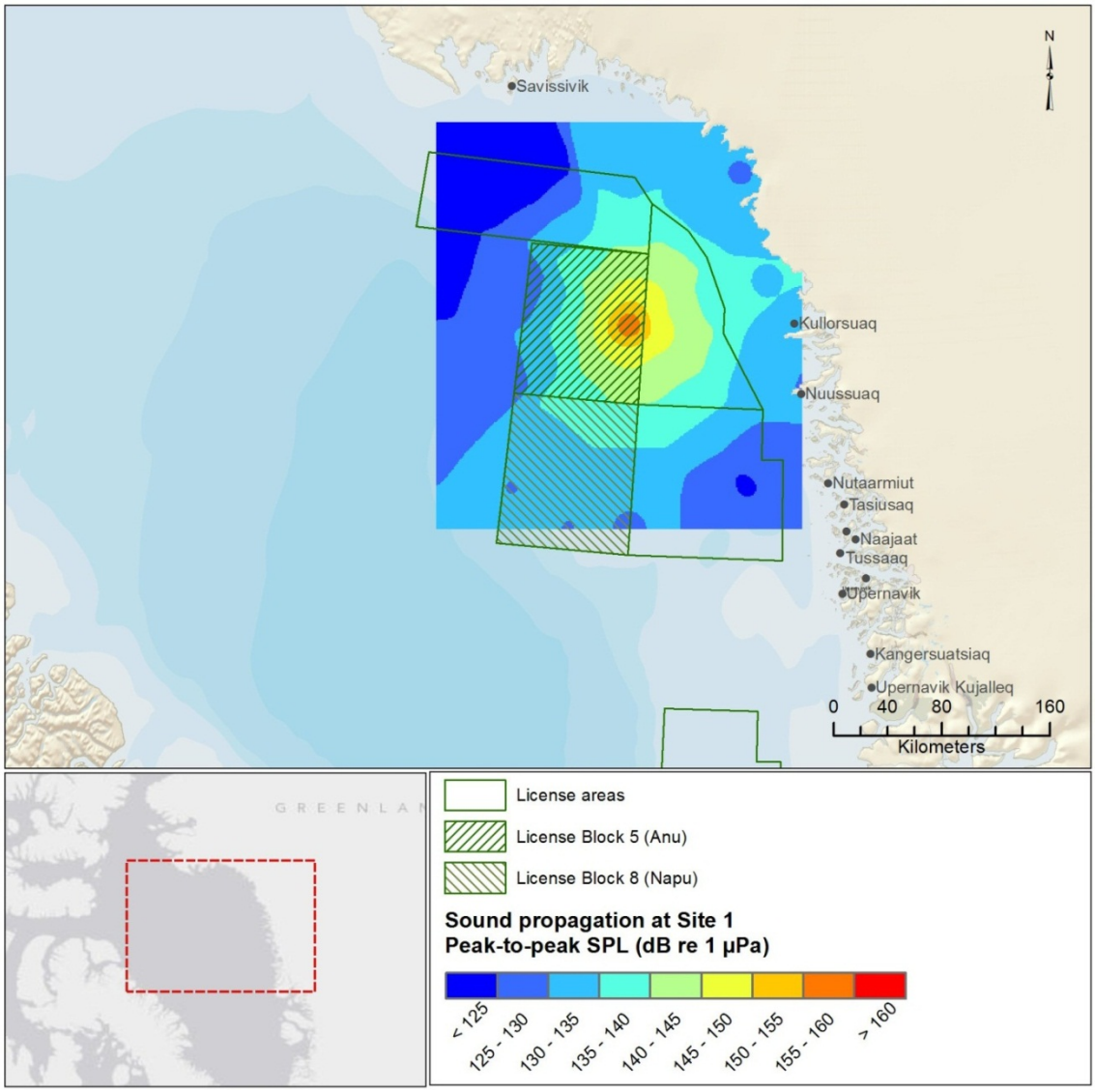

Figure A2-27 Peak-to-peak SPL at location 1

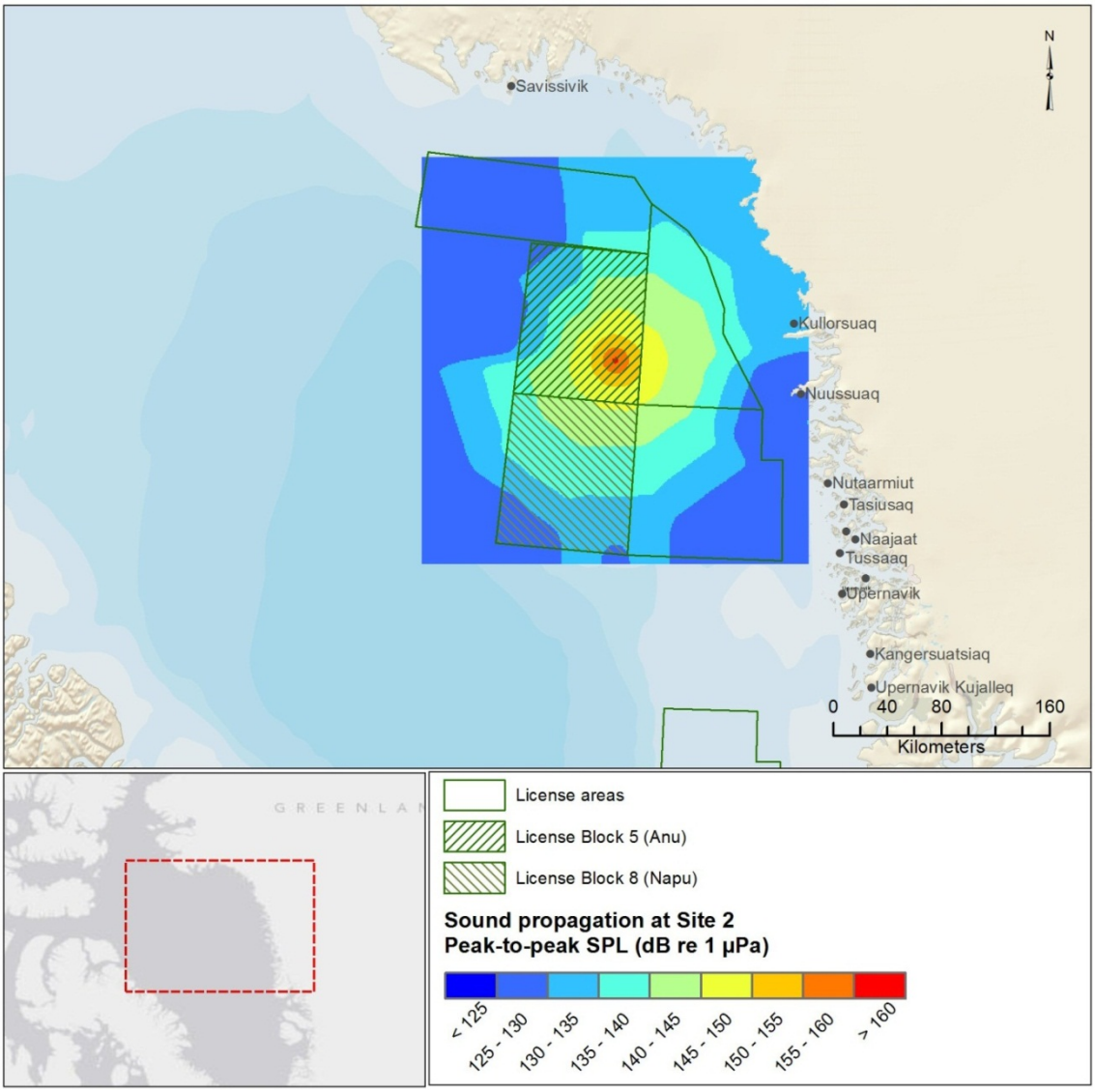

Figure A2-28 Peak-to-peak SPL at location 2

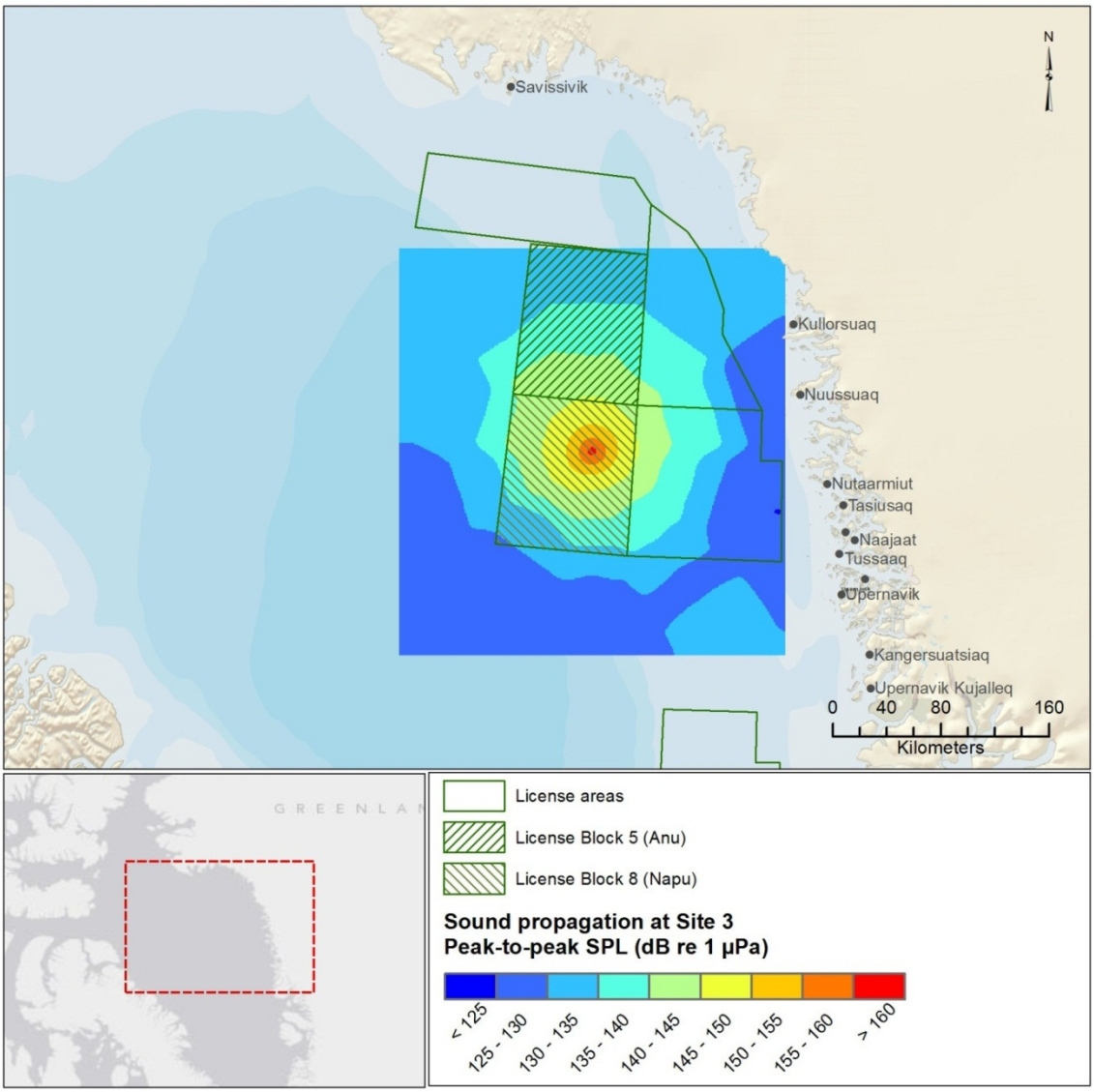

Figure A2-29 Peak-to-peak SPL at location 3

7.5 Noise maps rms SPLs

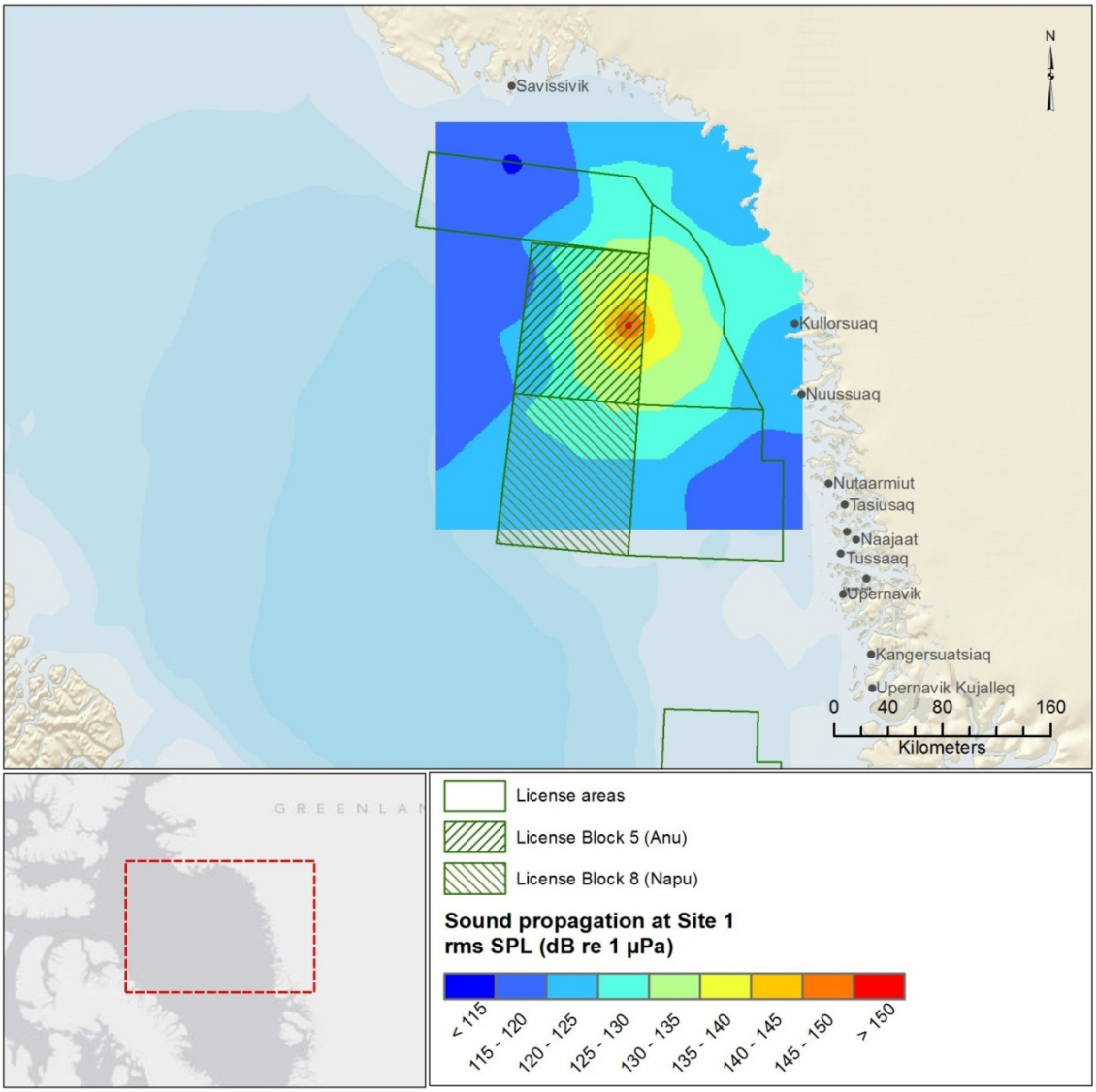

Figure A2-30 rms SPL at location 1

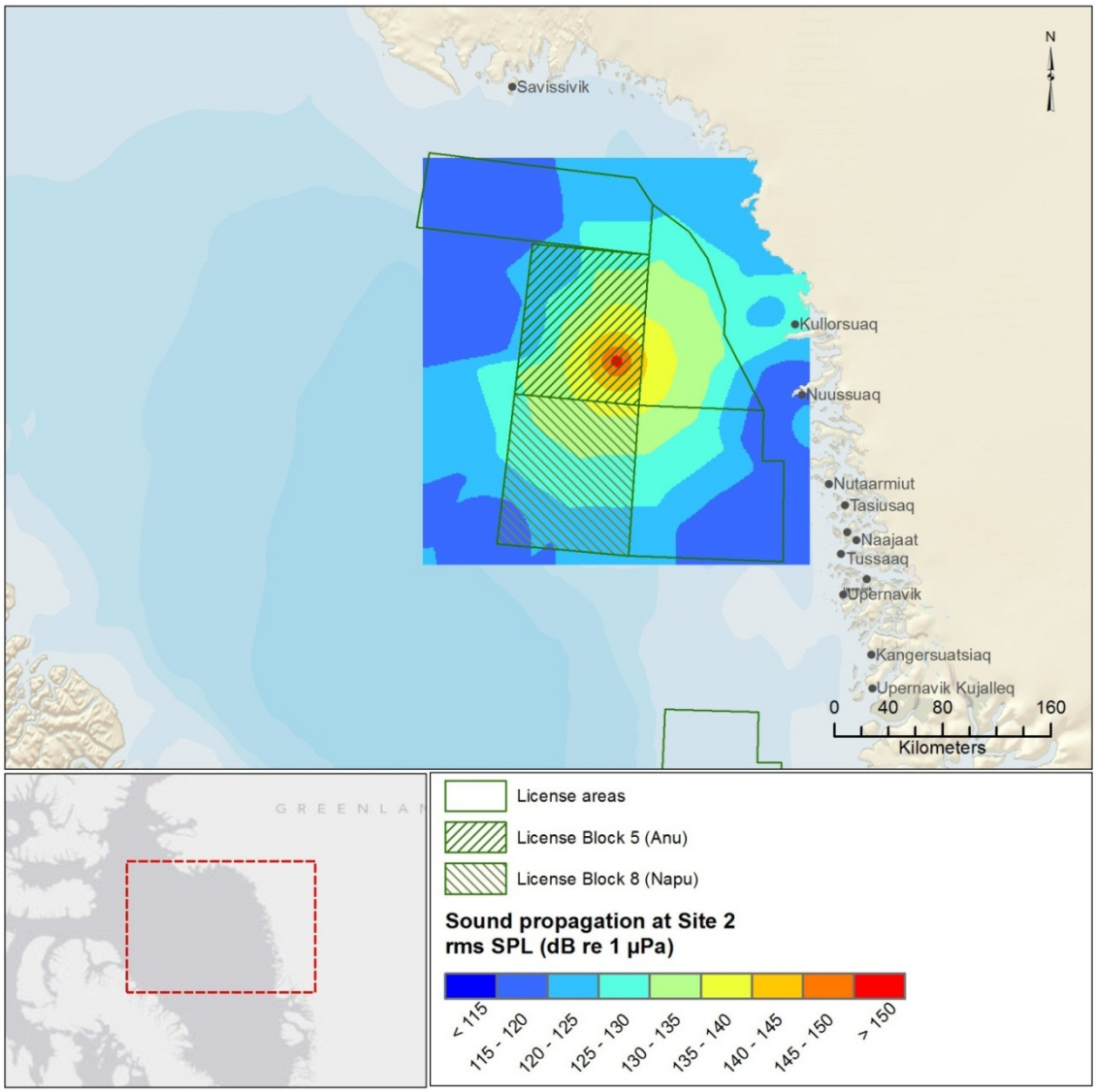

Figure A2-31 rms SPL at location 2

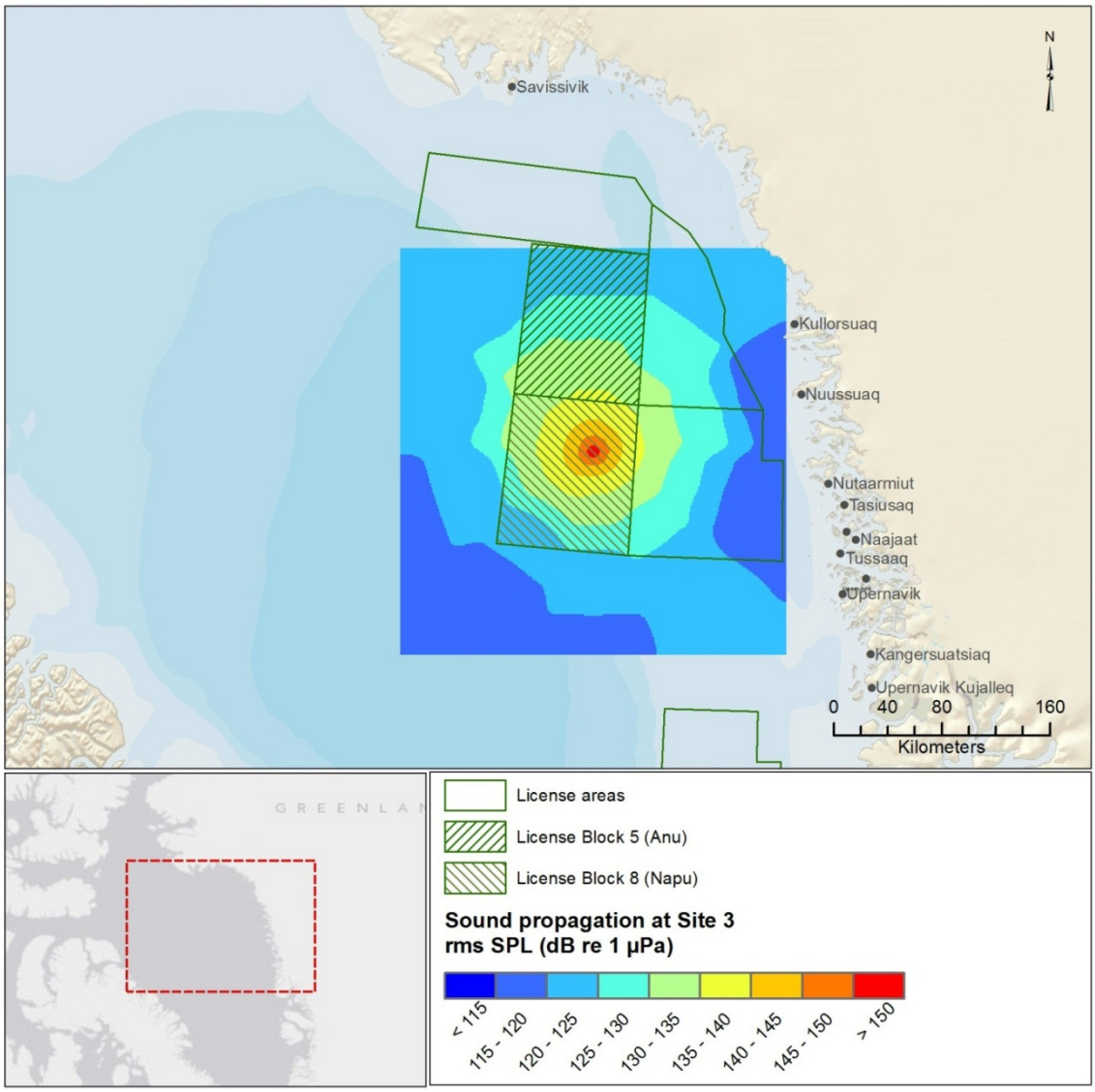

Figure A2-32 rms SPL at location 3

APPENDIX 3
SUMMARY OF CALCULATIONS FOR ESTIMATES OF PERCENTAGE OF POPULATIONS AND NUMBER OF INDIVIDUALS EXPOSED TO SEISMIC NOISE

Estimates of animals assessed to be physiologically impacted from the seismic surveys have been assessed, providing a percentage of the population assessed to be potentially impacted. The calculation has been performed in line with the 2012 EIA, for the following species:

- Ringed seal
- Narwhale (offshore)
- Beluga whale
- Bowhead whale
- Walrus

The assessment has been made based on the population and density estimates performed for the 2012 EIA for seismic activities in the two license blocks (EIA reference /6/) and the zones of impact assessed defined in the acoustic modelling.

The impact zones and subsequent estimates have been prepared without considering mitigating efforts, and therefore take a precautionary approach. As described in this EIA, for the 2D high resolution surveys TTS will be limited to areas close to the source (80 m in cetaceans and 40 m for pinnipeds). Behavioural response is expected in cetaceans (narwhals, beluga whales and bowhead whales) at ranges up to 6 km from the source, while seals are much less affected with behaviour to be expected less than 100 meters from the source.

The number of ringed seal and narwhals potentially exposed to each level of seismic sounds was estimated by multiplying the impact zones by the density of animals. The estimated numbers were then divided by the population size to estimate the proportion of the population exposed.

Table A3-1 Estimates of individuals and percentage of population of ringed seal and narwhale assessed to potentially be physiologically impacted.

	Density	Corrected density[a]	Estimated population size	Impact zone	Animals assessed to be physiologically impacted (TTS)	
	individuals /km^2	individuals /km^2	individuals	km^2	Individuals[b]	Percentage of population[c]
Ringed seal	1.39		228,000	0.005	7.0E-03	3.1E-06
Narwhale (offshore)	0.0026	0.0122	15,060	0.020	5.2E-05	3.5E-07

[a] corrected for availability bias by dividing by 0.21 (CV=0.09)

[b] density * impact zone

[c] impacted individuals / population * 100

Table A3-2 Estimates of individuals and percentage of population of ringed seal and narwhale assessed to potentially be behaviourally impacted.

	Density	Corrected density	Estimated population size	Impact zone	Animals assessed to be behaviourally impacted	
	individuals /km^2	individuals /km^2	Individuals	km^2	Individuals[1]	Percentage of population[2]
Ringed seal	1.39		228,000	0.005	7.0E-03	3.1E-06
Narwhale (offshore)	0.0026	0.0122	15,060	113	2.9E-01	2.0E-03

[a] corrected for availability bias by dividing by 0.21 (CV=0.09)

[b] density * impact zone

[c] impacted individuals / population * 100

For the other marine mammals, only an estimate of the percentage of the population, as the distributions of these species (beluga whale, bowhead whale, walrus, and polar bear) are not expected to overlap in any substantive way with the seismic survey. The percentage was determined by dividing the impact zone by the size of the Baffin Bay Strategic Environmental Assessment Study Area.

For belugas, the assessment was performed for both summer and fall. In the case of the summer beluga estimate, this number was further multiplied by 0.01 to account for the fact only 1% of the population could still occur in the Baffin Bay SEIA Study Area. When considering the fall migrating beluga estimate, this number was multiplied by 0.1 to account for the fact that only 10% of the population could still occur beyond 5 km from the coast during the migration.

Table A3-3 Estimates of percentage of population of beluga, bowhead whale and walrus assessed to potentially be behaviourally impacted.

	SEIA Assessment Area	Percentage of the population available	Impact zone	Animals assessed to be behaviourally impacted
	km^2	**%**	km^2	Percentage of population[a]
Beluga whale				
Summer (July–September)	163,845	1	0.020	1.2E-07
Fall (October)	163,845	10	0.020	1.2E-06
Bowhead whale	163,845	100	0.020	1.2E-05
Walrus	163,845	100	0.005	3.1E-06

[a] (Impact zone/Area) x percentage of the population available

Table A3-4 Estimates of percentage of population of beluga, bowhead whale and walrus assessed to potentially be behaviourally impacted.

	SEIA Assessment Area	Percentage of the population available	Impact zone	Animals assessed to be behaviourally impacted
	km^2	**%**	km^2	Percentage of populationa[a]
Beluga whale				
Summer (July–September)	163,845	1	113	6.9E-04
Fall (October)	163,845	10	113	6.9E-03
Bowhead whale	163,845	100	113	6.9E-02
Walrus	163,845	100	0.005	3.1E-06

[a] (Impact zone/area) x percentage of the population available

For further details regarding the calculations, please refer to the 2012 EIA for seismic activities in the two license blocks (EIA reference /6/).

ARCTIC
VOL. 61, NO. 3 (SEPTEMBER 2008) P. 292–308

Redefining Walrus Stocks in Canada

ROBERT E.A. STEWART[1]

(*Received 7 May 2007; accepted in revised form 21 December 2007*)

ABSTRACT. Defining management units is basic to the sound management of resources. Walrus (*Odobenus rosmarus rosmarus*) are hunted throughout their range in Canada and are subject to other human activities requiring management decisions. Current management units are based on a comprehensive review and a stock assessment completed in the mid 1990s. Between 1993 and 2004, satellite-linked radio tags provided information on the movements of walrus in Canada's High Arctic. These data were incorporated with other information that has become available since 1995 to reassess walrus management units in Canada. Tagging data and other information suggest that some finer discrimination of walrus populations is needed as a precautionary approach and to formulate testable hypotheses. Specifically, the previous North Water/Baffin Bay walrus stock may be considered to be three stocks: Baffin Bay, west Jones Sound, and Penny Strait-Lancaster Sound stocks. The Foxe Basin population appears to comprise two stocks (North Foxe Basin and Central Foxe Basin) rather than one. Previously suspected subdivisions in the Hudson Bay-Davis Strait population are substantiated by isotopic evidence although sampling on a finer geographic scale is required before this stock can be partitioned. There is new evidence to support the previously postulated separation of the walrus in the Southern and Eastern Hudson Bay stock from all others, but no evidence to warrant subdivision.

Key words: walrus, *Odobenus rosmarus*, satellite tag, genetic, isotope, contaminant

RÉSUMÉ. La définition des unités de gestion est fondamentale à la bonne gestion des ressources. Le morse (*Odobenus rosmarus rosmarus*) est chassé dans son aire d'extension au Canada, en plus d'être assujetti à d'autres activités humaines nécessitant des décisions en matière de gestion. Les unités de gestion actuelles sont fondées sur l'examen exhaustif et l'évaluation des groupes effectués vers le milieu des années 1990. Entre 1993 et 2004, des étiquettes radio par satellite ont fourni des renseignements sur les mouvements du morse dans le Grand Nord du Canada. Ces données ont été intégrées à d'autres informations disponibles depuis 1995 dans le but de réévaluer les unités de gestion du morse au Canada. Les données obtenues grâce aux étiquettes et d'autres informations laissent croire qu'il y a lieu d'avoir une discrimination plus raffinée des populations de morse en tant qu'approche de précaution et de formuler des hypothèses pouvant être mises à l'épreuve. Plus précisément, l'ancien groupe de morses des eaux du Nord et de la baie de Baffin peut être considéré comme trois groupes, soit les groupes de la baie de Baffin, du détroit Jones de l'ouest et des détroits de Penny et de Lancaster. Par ailleurs, la population du bassin Foxe semble comprendre deux groupes (le bassin Foxe du nord et le bassin Foxe du centre) au lieu d'un seul groupe. Les sous-divisions dont on se doutait auparavant pour ce qui est de la population de la baie d'Hudson et du détroit de Davis sont corroborées par des preuves isotopiques, quoiqu'un échantillonnage plus perfectionné s'avère nécessaire à l'échelle géographique avant que ce groupe ne puisse faire l'objet d'une répartition. Il y a de nouvelles preuves permettant de soutenir l'ancienne séparation hypothétique des groupes de morses dans le sud et l'est de la baie d'Hudson par rapport à tous les autres groupes, mais aucune preuve ne vient justifier une sous-division.

Mots clés : morse, *Odobenus rosmarus*, étiquette par satellite, génétique, isotope, contaminant

Traduit pour la revue *Arctic* par Nicole Giguère.

INTRODUCTION

In fisheries science, management units are often referred to as stocks, and managing organizations (e.g., DFO, 2001; NMFS, 2001) carry out stock assessments to determine stock status. Atlantic walrus (*Odobenus rosmarus rosmarus*) in Canada are the subject of such stock status assessments (DFO, 2000).

Historically, walrus occupied Canadian waters from Nova Scotia to perhaps 85° N and from the boundary with Greenland to roughly 100° W, but their range now is less extensive and more discontinuous (Born et al., 1995). Walrus breed in winter, between January and April (Born et al., 1995; Stewart and Fay, 2001), in restricted areas of open water or polynyas (Finley and Renaud, 1980; Stirling et al., 1981). Within their summer range, walrus are segregated by age and sex (Born et al., 1995), with mature males forming separate groups. In many areas, walrus haul out onto land to rest, but they also rest on floating ice.

Here I consider management units of walrus in Canada as the foundation for making management decisions affecting hunting and other human activities. I start by

[1] Department of Fisheries and Oceans, Freshwater Institute, 501 University Crescent, Winnipeg, Manitoba R3T 2N6, Canada; Robert.EA.Stewart@dfo-mpo.gc.ca

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reviewing conceptual aspects of defining management units and then examine the stock structure proposed by Born et al. (1995) that has been applied to recent walrus assessments (DFO, 2000). On the basis of isotopic profiles, Outridge et al. (2003) indicated that some of the stocks proposed by Born et al. (1995) should be further subdivided. I review published data on distribution, hunting availability, isotope and contaminant profiles, body size, and genetic data, as well as new data from walrus fitted with satellite-linked radio tags.

What is a Stock?

The concept of "stock" is common in fisheries management for making intraspecific subdivisions (usually focusing on the question "Which animals are taken where by whom?") to assist managers in making allocation decisions. But, while the term is prevalent in the literature, the concept of "stock" is not defined rigorously. Outside of fisheries, the word "stock" generally refers to the base from which other groups derive. Thus "stock" is analogous to the stem of a tree rather than its branches, an interpretation constant since at least the 14th century (Booke, 1981). In fisheries, "stock" has been used to delimit groups of fish, from systematic to management units (Booke, 1981).

The Fish and Agriculture Organization of the United Nations considered "stock" and "population" to be synonymous (Jefferson et al., 1993). The evolutionarily significant unit applied to Pacific salmon (*Oncorhynchus* spp.) stock issues was defined as (1) a population that is reproductively isolated and (2) an important part of the species evolutionary legacy (Waples, 1991). Waldman (2005:11) concluded that the first criterion, i.e., a population, is "essentially the definition of a stock." Secor (2005), however, cautioned against this interpretation and considered a stock to be a specific portion of a population in which anthropogenic activity influences population productivity. Two groups may not have different evolutionary potential, but still require management decisions at a lower taxonomic level (Taylor, 1997; Taylor and Dizon, 1999). I consider "stock" to be a subpopulation designation.

For operational purposes, Royce (1972) defined a stock as a management unit, a group of animals capable of independent exploitation or management. "Stock" is therefore defined by its interaction with humans: the segment of the fish population considered with respect to actual or potential utilization (Ricker, 1975).

The operational definition of stock based on anthropogenic interaction has at least three influential consequences. First, the delineation of the stock is dependant on the nature of the interaction. For example, trophy-sized male walrus, the object of sport hunts, may be a different stock than the part of the same population that supports the subsistence hunt in the same area. Trophies are selected on the basis of absolute size, and as long as the number of big males removed does not reduce the productivity of the population (surplus male hypothesis, but see Harris et al., 2002; Singer and Zeigenfuss, 2002), the number of animals available for subsistence hunting will not change. The edible walrus products of trophy-kills return to the subsistence consumers, so the sport hunt is not considered additive. This concept, a familiar one in wildlife management, is evidenced in different hunting seasons or bag limits for males and females of a species in one hunting district. However, the term "stock" is used infrequently by wildlife managers, who tend to get by with "demes" and "populations" (see for example Novaks et al., 1987; Harris et al., 2002).

Second, with respect to removals by hunting, the interaction basis for defining stocks means that if one has biological information on every landed walrus at a community, one has the definition of that hunted stock (except for killed and lost animals) at that location. Statistical differences in one or more parameters between harvests mean they are different stocks, or different harvest stocks (Waldman, 2005). Offsetting this advantage is the first influential consequence: sampling by biologists taking biopsies, for example, is an interaction quite different from hunting and may not accurately represent the intraspecific group that will enter the harvest stock.

Third, the perception of "stock" depends on the character set used to differentiate it (Ihssen et al., 1981; Waldman, 2005). Genetic data provide insights into population identity reflecting not only current distribution, but also ancestral patterns that may not relate to existing conditions (Swain et al., 2005; Waldman, 2005). Moreover, selective removal can alter gene flow and enhance population differentiation (Harris et al., 2002), and comparison of neutral genetic markers may not reflect locally adaptive traits or differences (Swain et al., 2005). Population parameters, behaviour, morphology, and meristics, to name a few methods, all present different views of the group being studied. Contaminant profiles and stable isotope signals used to identify stocks indicate that one group of animals lived its life—sampled its environment—differently than the other group (Outridge and Stewart, 1999; Innes et al., 2002; Outridge et al., 2003; Campana, 2005). These are real stock differences; removing animals at one locale characterized by certain chemicals may not affect the number of animals at another locale with different chemical profiles. Clayton (1981) advocated the use of multiple tests employing different types of data, noting that a difference in one type of data was sufficient to differentiate stocks. "A stock is a stock," according to Waldman (2005:12), if a marker discriminates it from other stocks. It is incumbent upon biologists to understand those differences in the context of population structure and ecology. Accepting differences regardless of the nature of the marker also tends to err on the side of conservation: erroneously identifying more stocks than exist is more protective than erroneously pooling stocks that are in fact different (Taylor, 1997; Taylor and Dizon, 1999). Conversely, negative results are not conclusive because other techniques may reveal differences (Waldman, 2005; Wirgin and Waldman, 2005).

Allowing that a stock may not be a self-replicating unit, it becomes important to understand the indirect effects mediated through interbreeding among stocks at the population level, where a population is an intraspecific group more likely to interbreed than to breed with members of another group (Pianka, 1988). Also inherent in this perspective is the separation in time and place that allows site-specific differences to accumulate and persist over time. Simultaneous hunts in separated parts of a walrus population's range may mean there are two stocks, but the distinction requires additional evidence of philopatry to those areas.

The population structure is the fundamental aspect of living resources (Secor, 2005). Population reproductive isolation is often achieved through geographic separation, which was an underlying consideration in the separation of walrus stocks described by Born et al. (1995). The geographic distribution of animals, as opposed to genetic or chemical stock-identifying markers, is something that can be seen in real time. Indeed, aside from trophy walrus, few walrus stocks could be discerned outside of the laboratory. So, if the stock is not a complete, self-sustaining unit but rather a distributional branch of a larger, interbreeding population, managers must return to the population structure and consider both the local group (stock) and the population that supports it (Secor, 2005).

Here I adopt Secor's (2005) definition that a stock is a specific part of a population impacted by human activity in a way that affects population productivity, with Ricker's (1975) caveat to include potential utilization. Therefore, I refer to walrus populations in Canada and assume they are best represented by wintering aggregations when breeding occurs (e.g., Sjare and Stirling, 1996). More widely dispersed aggregations or herds in the open-water season are expected to be segregated by age and sex, with at least female philopatry (Andersen and Born, 2000). Various parts of a population may be removed, sampled, or otherwise impacted at one or more location, and I refer to those aggregations as stocks. This conceptual framework parallels that used for "harvest stocks" of beluga (*Delphinapteras leucas*) by Innes et al. (2002) and of walrus by Outridge et al. (2003), except for the inclusion of summering herds that are not known to be exposed to hunting. It is a model similar to that proposed by Andersen and Born (2000) except that I consider separate breeding groups of walrus to be populations instead of subpopulations.

The final conceptual consideration is the degree of physical separation between two putative stocks. Stock distinctiveness is most easily envisaged when there is a large geographic separation, for example between Foxe Basin and south Hudson Bay walrus. But walrus were once more widely distributed in Canada, and current geographic isolation may be an artefact: isolated groups may be the end points of a once-contiguous distribution characterized not by geographic isolation, but by a cline of differences (Mayr, 1970; Royce, 1972; Gaskin, 1982). Evidence of clinal variation of genotypic and phenotypic characteristics, in which adjacent localities are not statistically different but at some increasing distance (cline width) two samples do differ significantly, may not be apparent outwardly, but is critical to sound management (Taylor and Dizon, 1999). Cline width is often estimated as the distance at which the frequency of the less common marker falls to 20% and the more common marker rises to 80% (Owen and Baker, 2001), or the 20/80 rule (May et al., 1975). Conceivably, with sufficient sampling, it may be possible to measure clinal widths in walrus for management purposes or to reveal structure within a continuous distribution using more powerful statistical techniques (Hoffman et al., 2006). For now, the concept of clinal variation is useful in interpreting the limited information available.

The Hypothesis

Born et al. (1995) identified four putative stocks of walrus in Canada (Fig. 1): North Water (Baffin Bay–Eastern Canadian Arctic); Foxe Basin; Northern Hudson Bay–Hudson Strait–Southeastern Baffin Island–Northern Labrador; and Southern and Eastern Hudson Bay. For brevity, and to base the names, as much as possible, on the relevant water bodies, I use these stock names: Baffin Bay (BB), Foxe Basin (FB), Hudson Bay-Davis Strait (HBDS), and Southern and Eastern Hudson Bay (SEHB). I test these hypothesized stock delineations using new information from satellite-linked radio tags that track movements of individuals and from published data. Born et al. (1995) identified a fifth stock, the West Greenland stock, which is discussed as an adjunct to the HBDS stock.

METHODS

A study area in the western reaches of Jones and Lancaster sounds was selected in which to test, using satellite telemetry, the hypothesis that walrus from Canada were also being hunted in Greenland. In consultation with local communities, terrestrial haulout sites distant from main hunting areas were selected for walrus tagging.

Males and females without calves were selected for attachment of satellite tags. A selected walrus was approached within ~20 m, and an immobilizing drug was administered by a pressurized dart propelled by a CO_2 rifle (Dan-Inject®) (Lanthier et al., 1999). Different immobilizing agents were used over the years (Table 1); the narcotics etorphine and carfentanil (Lanthier et al., 1999) were replaced, first with medetomidine-zolazepam-tiletamine (MZT), then with medetomidine-ketamine (MK) (R.E.A. Stewart and C. Lanthier, unpubl. data). Narcotics were reversed with naltrexone (Lanthier et al., 1999), and the other drugs, with atipamezole.

When the darted walrus was immobilized, neighbouring walrus were displaced to a safe distance by slowly approaching the herd. A satellite-linked transmitter/data collection tag was attached to a tusk with a bonding agent such



FIG. 1. Range of putative walrus stocks in Canada (redrawn from Fig. 3 of Born et al., 1995): 1 Foxe Basin; 2 Southern and Eastern Hudson Bay; 3 Northern Hudson Bay–Hudson Strait–Southeastern Baffin Island–Northern Labrador; and 5 North Water (Baffin Bay-Eastern Canadian Arctic). The numbering used by Born et al. (1995) has been retained (#4 – West Greenland, is outside Canada and has not been labeled).

as epoxy or Ray-Crete® and stainless steel bands. Tag design varied over the course of the study (Fig. 2, Table 1), but all tags except number 11270 (Telonics) were built by Wildlife Computers. Location data were restricted to ARGOS location quality (LQ) 0, 1, 2, and 3, defined by ARGOS as having precision radii of greater than 1500 m, less than 1500 m, less than 500 m, and less than 250 m, respectively (Service Argos, 2007). For each day (local time), the highest LQ was used. If there were several uplinks of maximum LQ in one day, they were averaged for a daily location. LQ 0 data may contain large location errors. LQ 0 data that were more than 1500 m inland were removed from the data set. After generating daily averages, days for which LQ 0 data were the best available were compared to LQ 1–3 data for improbably rapid movement. Location data of quality 1 or better when locations were 24 ± 1 h apart were used to establish a distance criterion (40 km/24 h, see Results). If a daily average LQ 0 location exceeded the distance criterion, the individual data points in the average were examined and extreme values removed until the daily average met the distance criterion or until there were no data for that day.

Relevant tag data are available only for the Baffin Bay stock. The literature was reviewed to obtain other data that might be useful in examining stock definitions for this and other stocks in Canada. Data included, but were not limited to, contaminant levels or signatures, isotopic profiles, disease occurrence or prevalence, and genetic composition. Stock definitions may also reflect the distribution of the human interaction with the stock, and I considered the distribution of approximately 1200 kill sites for walrus harvested between 1996 and 2001 (Priest and Usher, 2004: CD-ROM inclusion). None of the data available sampled the entire range of a putative stock, so the analysis compared point sources of information to determine similarities with or differences from other point sources.

RESULTS AND DISCUSSION

Eighteen tags were deployed between 1993 and 2004 (Table 1). Eleven tags were deployed in fiords on southwest Devon Island, Grinnell Peninsula (Devon Island),

TABLE 1. Tag history of 18 satellite-linked radio tags deployed on walrus between 1993 and 2004. Data are separated into two general areas (Jones Sound and Penny Strait/Lancaster Sound).

Deployed			PTT				Transmission		
Date	Site	Latitude/Longitude	No.	Type[1]	Walrus Sex	Immobilizing Agent[2]	Final Date	Duration[3]	Days with LQ ≥ 0
10/08/93	Brooman Pt	75° 31′/97° 23′	2509	W1	M	etorphine	30/08/93	20	17
11/08/93	Brooman Pt	75° 31′/97° 23′	2500	W1	M	etorphine	16/08/93	5	0
12/08/93	Brooman Pt	75° 31′/97° 23′	2508	W1	M	etorphine	08/09/93	27	15
13/08/93	Brooman Pt	75° 31′/97° 23′	2511	W1	M	carfentanil	13/08/93	0	1
13/08/93	Brooman Pt	75° 31′/97° 23′	2512	W1	M	carfentanil	17/08/93	4	1
14/08/93	Brooman Pt	75° 31′/97° 23′	2514	W1	M	carfentanil	16/08/93	2	5
15/08/93	Brooman Pt	75° 31′/97° 23′	11270	T1	M	carfentanil	28/08/93	13	7
25/08/01	Ryder Inlet	74° 50′/88° 33′	2511	W1	M	MK	27/09/01	33	3
11/08/03	Barrow Harbour	76° 32′/96° 02′	2511	W3	F	MK	31/08/03	20	14
19/08/03	Kearney Cove	74° 43′/90° 48′	3303	W3	M	MK	01/09/03	13	12
19/08/03	Kearney Cove	74° 43′/90° 48′	8198	W2	M	MK	19/08/03	0	0
25/08/98	Goose Fiord, S	76° 28′/88° 25′	2500	W1	M	MZT	25/09/98	31	24
24/08/99	Goose Fiord, N	76° 37′/88° 31′	8199	W2	M	MZT	15/11/99	83	36
25/08/01	Goose Fiord, N	76° 37′/88° 31′	2514	W1	F	MK	10/10/01	46	16
26/08/01	Goose Fiord, S	76° 28′/88° 25′	8199	W2	F	MK	13/10/01	48	29
24/08/04	Norfolk Inlet	76° 30′/91° 18′	49503	W3	F	MK	25/11/04	93	53
24/08/04	Goose Fiord, S	76° 28′/88° 25′	49504	W3	M	MK	13/11/04	81	36
25/08/04	Goose Fiord, S	76° 28′/88° 25′	2511	W3	F	MK	25/11/04	92	41

[1] Tag type and dimensions as in Figure 2.

[2] MZT = medetomidine-zolazepam-tiletamine, MK = medetomidine-ketamine.

[3] Duration is the day of final transmission minus the deployment date.

and at Brooman Point (Bathurst Island). Seven were deployed in Norfolk Inlet and Goose Fiord adjacent to western Jones Sound (Fig. 3).

There were 16 pairs (7 walrus in 5 years) of tag locations of LQ ≥ 1 approximately 24 h (23.8 ± 0.6, mean + 1 SE) apart. The average distance these tagged walrus moved was 10.8 ± 10.7 km/24 h. The maximum distance moved was 37.8 km in 24 h. Another tagged walrus (2511 in 2003) left a haulout and moved 32.4 km in 14 h, 4.7 km the next day, then 31.0 km to an occupied haulout the third day. Based on this animal and the maximum movement recorded in 24 h, I used 40 km sea distance, multiplied by the number of days for longer periods, to determine if the LQ 0 position was improbably far from adjacent positions. Of the 18 tags deployed, 16 provided at least one location. A total of 1337 locations of LQ ≥ 0 generated 310 daily locations over a maximum of 93 days. Tag data are discussed further in the stock-by-stock analysis that follows. In addition to other studies reviewed in the next sections, I also examined the incidence of diseases that may have been instructive for postulating population separations. Antibodies to canine distemper virus, phocine distemper virus, canine adenovirus, and influenza A antibodies (Duignan et al., 1994; Nielsen et al., 1996, 2000, 2001a; Philippa et al., 2004) did not reveal location differences. Brucella antibodies were not found in small collections of walrus from Grise Fiord (n = 5), Resolute Bay (n = 4) and Nunavik (n = 4), all of the Baffin Bay stock, but were found in Foxe Basin at low frequency (3.2%, n = 157, Nielsen et al., 2001b). Generally, incidence of antibodies was not useful in discerning stock differences.

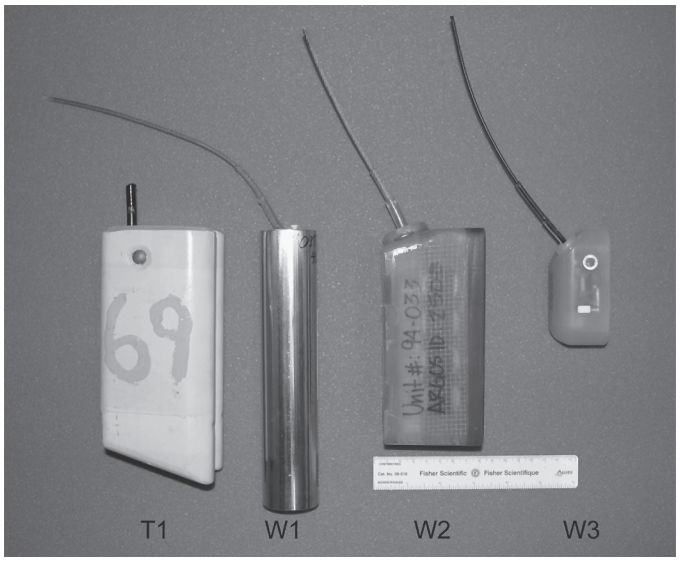

FIG. 2. Satellite radio tags used in this study with the surface contacting the walrus tusk to the right. Left to right: tags from Telonics (T1: 18.7 × 4 × 7.9 cm [length × width × depth], 1503 g) and Wildlife Computers (W1: 19.5 × 4 cm, 612 g; W2: 15 × 5.5 × 7 cm, 772 – 783 g; W3: 8.8 × 4.9 × 3.7 cm, 194 g) deployed on walrus.

Baffin Bay

Wintering areas (Fig. 4) occur in the Cardigan Strait-Fram Sound area at the west end of Jones Sound, around Dundas Island (Born et al., 1995; COSEWIC, 2006), the floe edges of Jones and Lancaster sounds, and in the North Water polynya between approximately 69° and 77° N on the Greenland coast (Born et al., 1995). The degree of separation among wintering areas is not known. Andersen

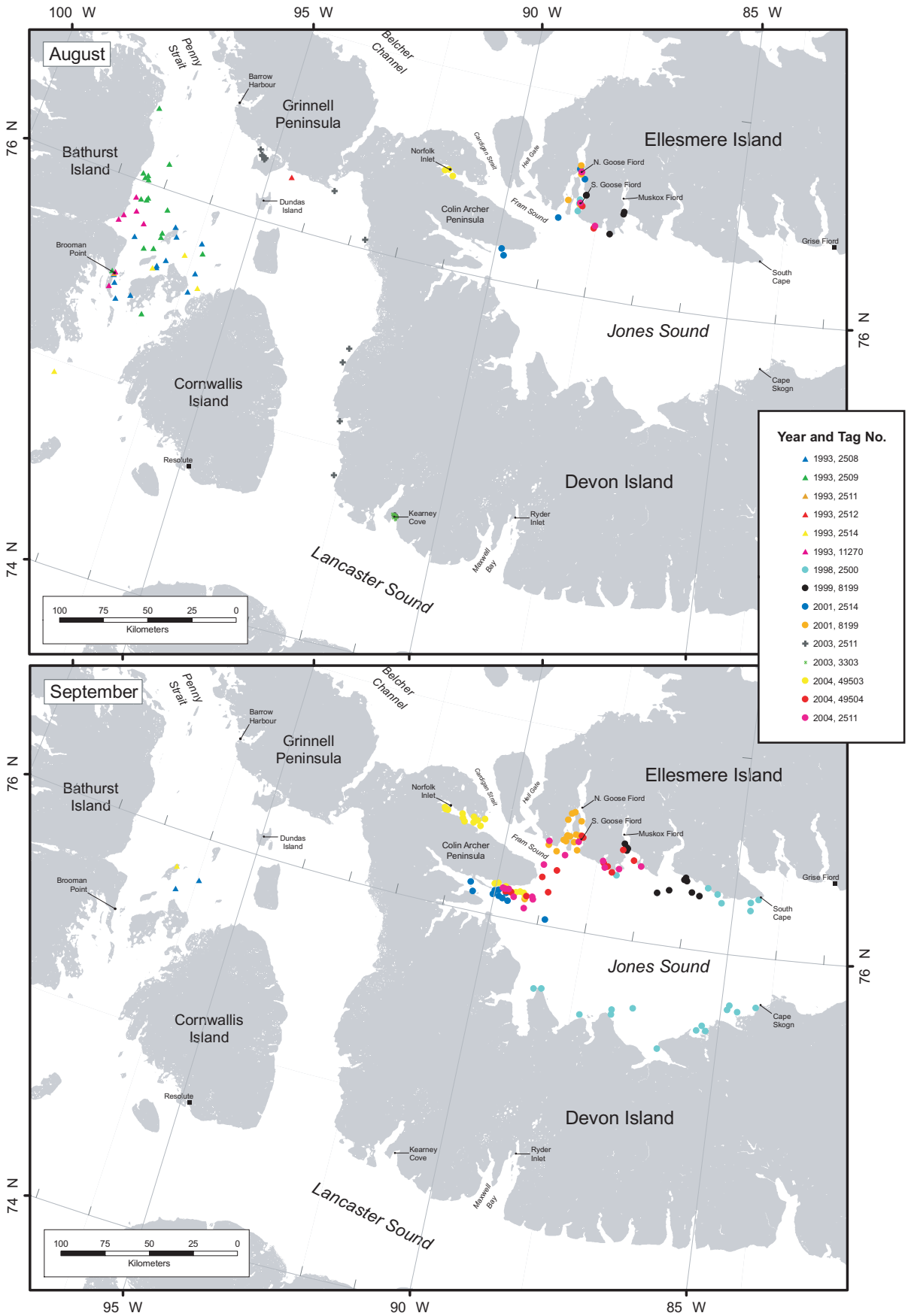

FIG. 3. Sites where satellite tags were deployed on walrus in 1993 and in 1998–2004, as well as daily locations (LQ ≥ 0) for 16 tags that returned data. See Table 1 for the number of tags deployed at each site. This panel: August and September locations.

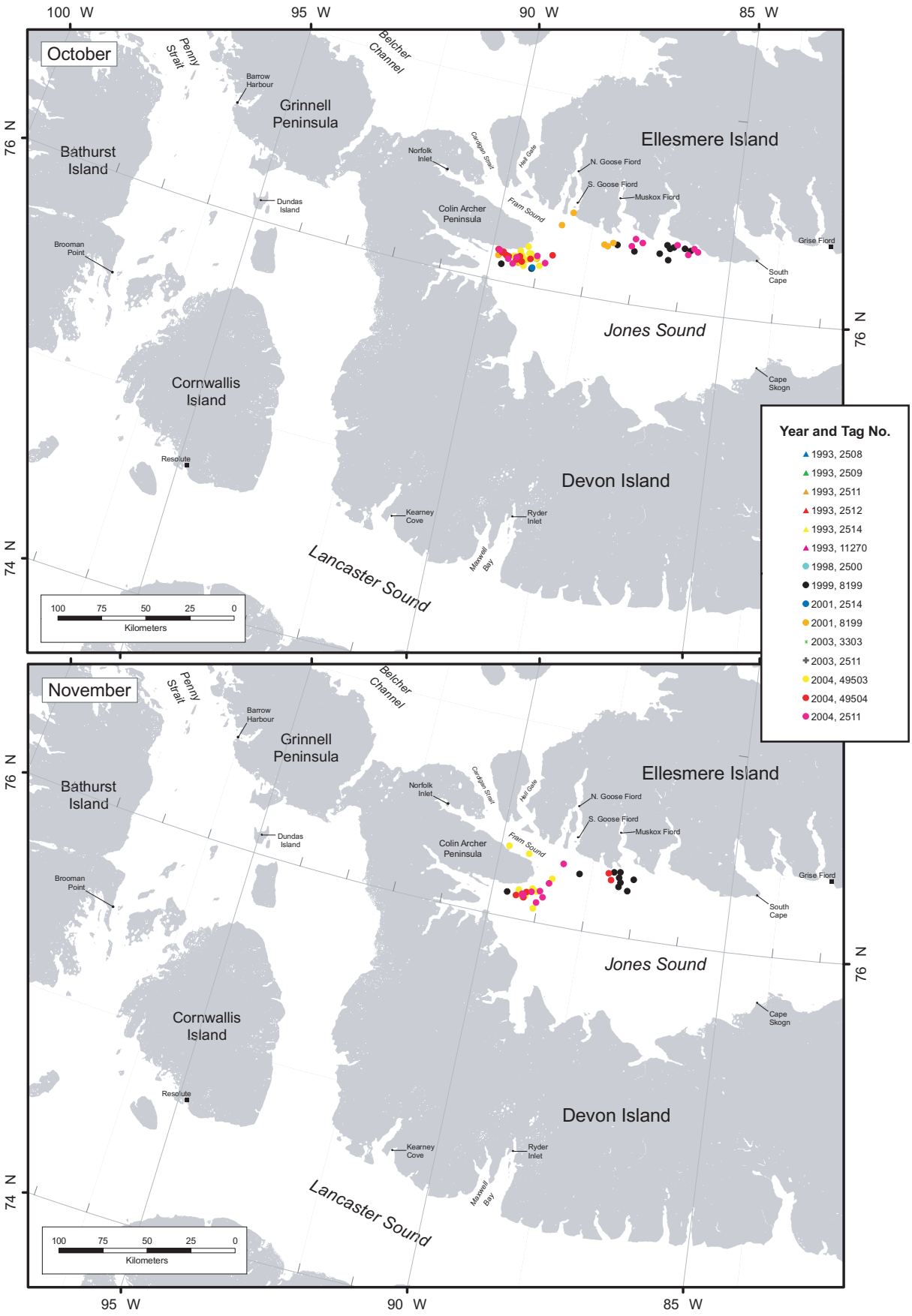

FIG. 3 cont'd. This panel: October and November locations.

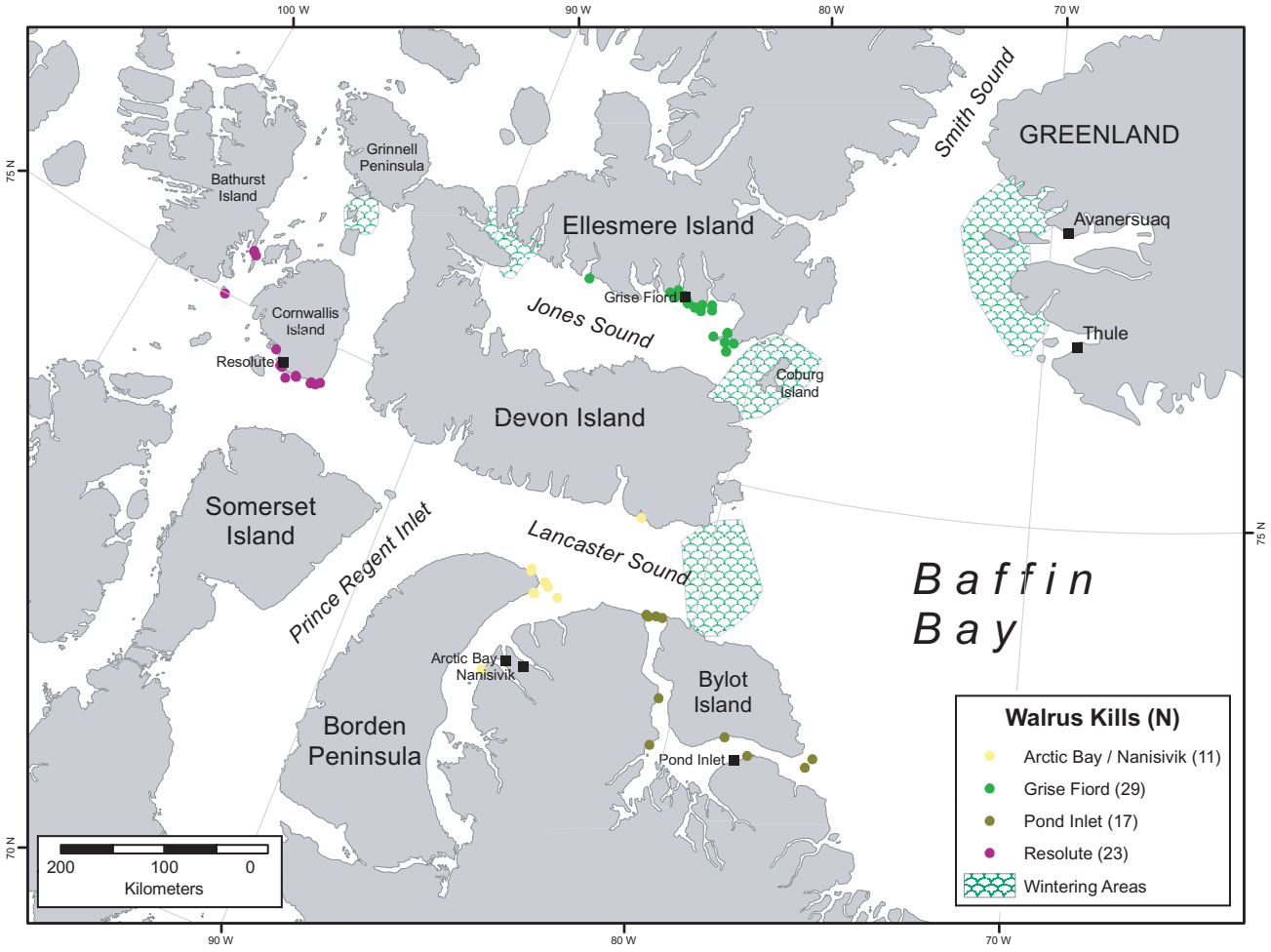

FIG. 4. High Arctic walrus harvesting locations for Grise Fiord, Resolute Bay, Pond Inlet, and Arctic Bay/Nanisivik (Priest and Usher, 2004) and wintering areas (Born et al., 1995). Each kill symbol may represent more than one animal killed; N is the number of walruses reported by each community in the Priest and Usher (2004) database.

and Born (2000) found genetic (mtDNA and microsatellite) differences between walrus landed in North Greenland and West Greenland and proposed that these two wintering groups are separate subpopulations with some male-mediated genetic exchange.

There are no walrus around Avanersuaq between mid-June and mid-July, when they may travel north into Smith Sound or west into Canada (Born et al., 1995). An inductively coupled plasma mass spectrometry (ICP-MS) comparison of lead isotope ratios ($^{206}Pb/^{207}Pb$ and $^{208}Pb/^{207}Pb$) of walrus landed at Grise Fiord and Thule (Outridge et al., 2003) had ambiguous results. There were no significant differences in mean ratios (Outridge et al., 2003), but only eight samples from Grise Fiord were available. However, approximately 80% of the animals at Thule and 20% at Grise Fiord were dissimilar, and the authors concluded that they represent different stocks. This conclusion is consistent with the 20/80 rule (May et al., 1975), but the small sample size at Grise Fiord dictates caution.

Harvest records (Priest and Usher, 2004) indicate hunters from Grise Fiord take walrus near town in August, farther east in September and October, and still farther east, near Coburg Island (Fig. 4), in February to May. Hunters from Pond Inlet hunt walrus in spring at the floe edges in Milne and Pond inlets and in summer farther into these inlets. Hunters from Arctic Bay report most of their harvest from the floe edge of Admiralty Inlet, also in spring. Therefore, walrus that winter at the mouth of Lancaster Sound could be taken in summer either to the north near Grise Fiord or to the south near Arctic Bay, Pond Inlet, and Resolute Bay. The winter hunt from Grise Fiord presumably draws from the group wintering at the mouth of Jones Sound.

None of the walrus, predominantly females, tagged in Norfolk Inlet or Goose Fiord moved farther east than a line between South Cape (~84° 25′ W) on Ellesmere Island and Cape Skogn (~84°10′ W) on Devon Island. Locations in October and November, after freeze-up, were confined largely to the mouth of Muskox Fiord and off the south coast of Colin Archer Peninsula (Fig. 3). Of the 26 hunts (30 walrus landed) recorded from 1996 to 2001, only one took place west of South Cape (Priest and Usher, 2004); most were farther east, at Grise Fiord, Lee Point, and Glacier Strait (Fig. 4). Aerial reconnaissance and local knowledge

also indicate that few walrus are seen between Grise Fiord and South Cape. The distribution of sightings and the tag data suggest that the walrus in western Jones Sound are a different stock than those in the eastern reaches.

Walrus tagged in western Jones Sound did not move through Hell Gate or Cardigan Strait. Exchange with Lancaster Sound walrus from Penny Strait through the Belcher Channel (Fig. 3) appears unlikely. Walrus seen north of Grinnell Peninsula in April 1977 moved west as summer progressed, rather than east towards Hell Gate and Cardigan Strait (Davis et al., 1978). This coastline is low and gradual, and the area is often ice-choked. Overall, the area appears unsuitable for walrus, although these features do not preclude passage by walrus. However, it appears to be an area of separation between a population that winters around Hell Gate and Cardigan Strait and another that winters around Dundas Island.

Walrus that summer in the Lancaster Sound area could be linked to Jones Sound and Foxe Basin stocks (next section). The one female walrus tagged in Penny Strait in August 2003 moved south to the area of Kearney Cove on southwest Devon in early September (Fig. 3). One male of a group of at least 40 males that occupied Kearney Cove at the same time was tagged and remained in that cove, also until early September. All other tags (n = 7) deployed in the areas of southwest Devon and Bathurst Island remained in that general area; none of those walrus travelled north out of Penny Strait or south into Prince Regent Inlet, although all seven tags stopped transmitting before September (Fig. 3), hence before freeze-up. There is no evidence of exchange between Penny Strait and Jones Sound around the west end of Grinnell Peninsula.

Walrus were taken by hunters from Resolute Bay in June to August (Priest and Usher, 2004). These hunters indicate walrus arrive in their hunting area (Fig. 4) from the east in spring. None of the walrus tagged (n = 5) east of Resolute Bay in August moved into the Resolute Bay hunting area that year. There is autumn movement from Penny Strait to Lancaster Sound. One adult male walrus tagged at Bathurst Island in 1993 was killed in June 1994 near Pond Inlet (Stewart, 2002). Another walrus observed at Bathurst Island in 1993 had previously been branded near Dundas Island (B. Sjare, pers. comm. 1993). There is direct exchange from Penny Strait to the mouth of Lancaster Sound, and it is possible that a walrus that summers near Cornwallis Island could winter variously at Dundas Polynya or the mouth of Lancaster Sound.

While there appears to be little or no exchange around the west end of Devon Island, potential mixing of walrus from Lancaster Sound and eastern Jones Sound is less clear. There may be differences in lead isotope ratios determined by ICP-MS between animals at Resolute Bay and those from Grise Fiord and Thule, but small sample sizes precluded statistical comparison (Outridge et al., 2003). More precise thermal ionization mass spectrometry (TIMS) analysis indicated differences between Grise Fiord and Resolute Bay samples, but these could not be compared statistically (Outridge et al., 2003). De March et al. (2002) found no differences among Grise Fiord (harvest, n = 4), Resolute Bay (harvest, n = 9), and Bathurst Island (biopsy, n = 9) samples using microsatellite frequencies and haplotypes. Subsequent microsatellite analysis of larger samples (Grise Fiord, n = 16; Resolute Bay, n = 13, R.E.A. Stewart and L. Postma, unpubl. data) agreed with de March et al. (2002). The differences in isotope ratios and lack of differences in genetic data suggest a single population divided into two stocks, but all the data are preliminary.

These combined data support subdivision of the putative Baffin Bay stock (Born et al., 1995), with the following caveats: genetic data were collected by different methods (biopsy and harvest samples); movement to the proposed wintering area near Colin Archer Peninsula is based on six tags; and females may be more philopatric than males (Andersen and Born, 2000). Adapting NAMMCO (2006) terminology, these newly defined subdivisions are: (1) the Baffin Bay stock, separated from West Greenland by genetic evidence (2) the West Jones Sound (WJS) stock, separated from the Baffin Bay by seasonal distribution and tag movements, and (3) the Penny Strait-Lancaster Sound (PS-LS) stock, separated from West Jones Sound by distribution and tag movements and from Baffin Bay by limited Pb isotope data. Such a stock structure indicates that walrus in the West Jones Sound stock have a much smaller probability of being harvested than was thought. Consequently, harvests in Lancaster Sound, at Grise Fiord, and at Avanersuaq are taken from stocks that are smaller than believed previously. Pb isotope data provide evidence of a cline within the Baffin Bay stock, but further subdivision is not yet possible.

Foxe Basin

Walrus in Foxe Basin generally winter at the floe edge around Rowley Island (Fig. 5) (COSEWIC, 2006). They move to summer areas around islands in northern Foxe Basin and are found routinely on pack ice.

Most walrus hunters in Foxe Basin are from Igloolik and Hall Beach, although hunters from Pond Inlet, Iqaluit, and Arctic Bay/Nanisivik also report landing walrus in Foxe Basin (Fig. 5). Walrus landed at Foxe Basin communities were distinguished from those landed at the HBDS communities of Akulivik, Coral Harbour, Repulse Bay, Loks Land, and Sisimiut (Fig. 6) by differences in lead isotope ratios (Outridge and Stewart, 1999; Outridge et al., 2003). Walrus taken at Akulivik also show differences in organochlorines (Muir et al., 1995). Walrus in Foxe Basin also appear to be larger than those from Hudson Bay (Garlich-Miller and Stewart, 1998). Foxe Basin walrus differ genetically from Baffin Bay walrus in haplotypes and microsatellites (Grise Fiord, Resolute Bay, Bathurst Island; de March et al., 2002) and lead isotope ratios (Grise Fiord, Resolute Bay, Thule; Outridge and Stewart, 1999; Outridge et al., 2003). Movement through Fury and Hecla Strait towards Lancaster Sound is considered unlikely (DFO, 2002).

Stewart et al. (2003) interpreted differences in lead isotope ratios of growth layer groups in the teeth of walrus

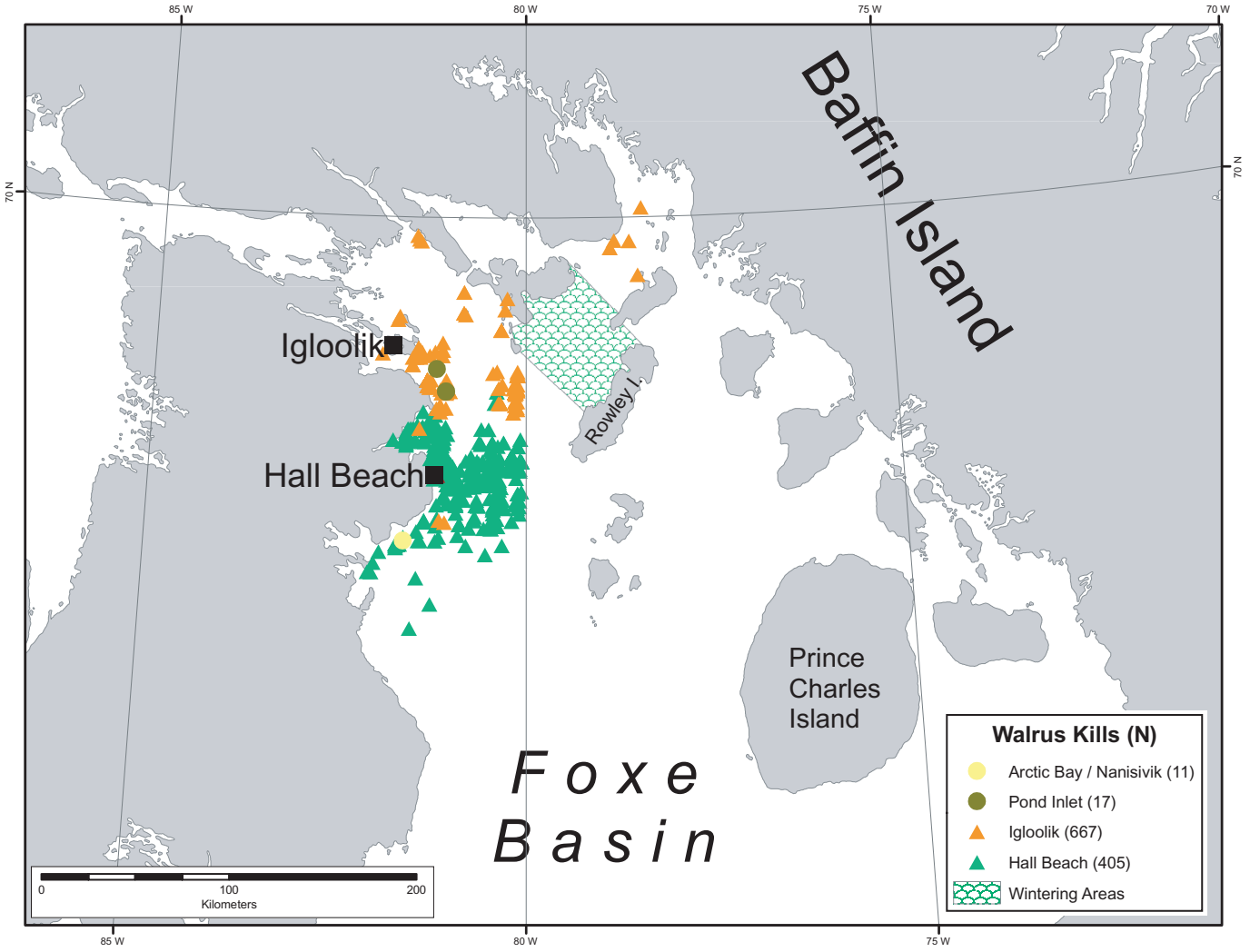

FIG. 5. Foxe Basin walrus harvesting locations for Igloolik and Hall Beach (Priest and Usher, 2004) and wintering areas (Born et al., 1995). Each kill symbol may represent more than one animal killed; N is the number of walruses reported by each community in the Priest and Usher (2004) database.

landed at Hall Beach to indicate changes in the way these male walrus sampled their isotopic environments. Although some of these layers resembled walrus teeth landed at three HBDS communities and one SEHB community, similarity does not prove congruence (Waldman, 2005). For example, walrus from east Greenland and Inukjuak on Hudson Bay have similar lead isotope ratios that reflect common geology, not common distribution (Outridge et al., 2003). Still it is plausible that some males from Foxe Basin moved into other walrus populations nearby and may have reproduced in those populations. Isotope evidence indicated that two of 11 adult males examined had left the Hall Beach area at maturation and returned some years later. Although this potential male-mediated exchange does not refute the conclusion by Born et al. (1995:9) that the Foxe Basin population is "largely isolated from other groups," it does suggest more complex interactions than expected previously.

Walrus landed by hunters at Hall Beach were not distinguishable from walrus landed at Igloolik by genetic (de March et al., 2002), heavy metal (Wagemann and Stewart, 1994), or major organochlorine data (Muir et al., 1995). But Outridge and Stewart (1999) reported differences in lead isotope ratios ($^{206}Pb/^{207}Pb$ and $^{208}Pb/^{207}Pb$) and trace elements even after removal of outliers. Peak landings at Igloolik and Hall Beach overlap in time (Priest and Usher, 2004), but are mostly separated in space (Fig. 5). Simultaneous hunting in two areas suggests two groups of walrus, but philopatry (habitual summering in one or the other area) is required for them to be considered stocks. The hunters from Igloolik take walrus mostly from the northern part of Foxe Basin, where there are areas of Palaeozoic rocks among the predominating Archean geology. The Hall Beach hunting area is underlain by older Proterozoic and Archean geology (Outridge and Stewart, 1999). The differences in isotopic signatures were thus consistent with long-term residency in different geological regimes. Inuit also identify two groups of walrus in this area on the basis of morphology and colour (DFO, 2000).

Therefore, there is evidence of stock separation within Foxe Basin. It is probable that, while landed walrus are from different stocks (the North Foxe Basin and Central

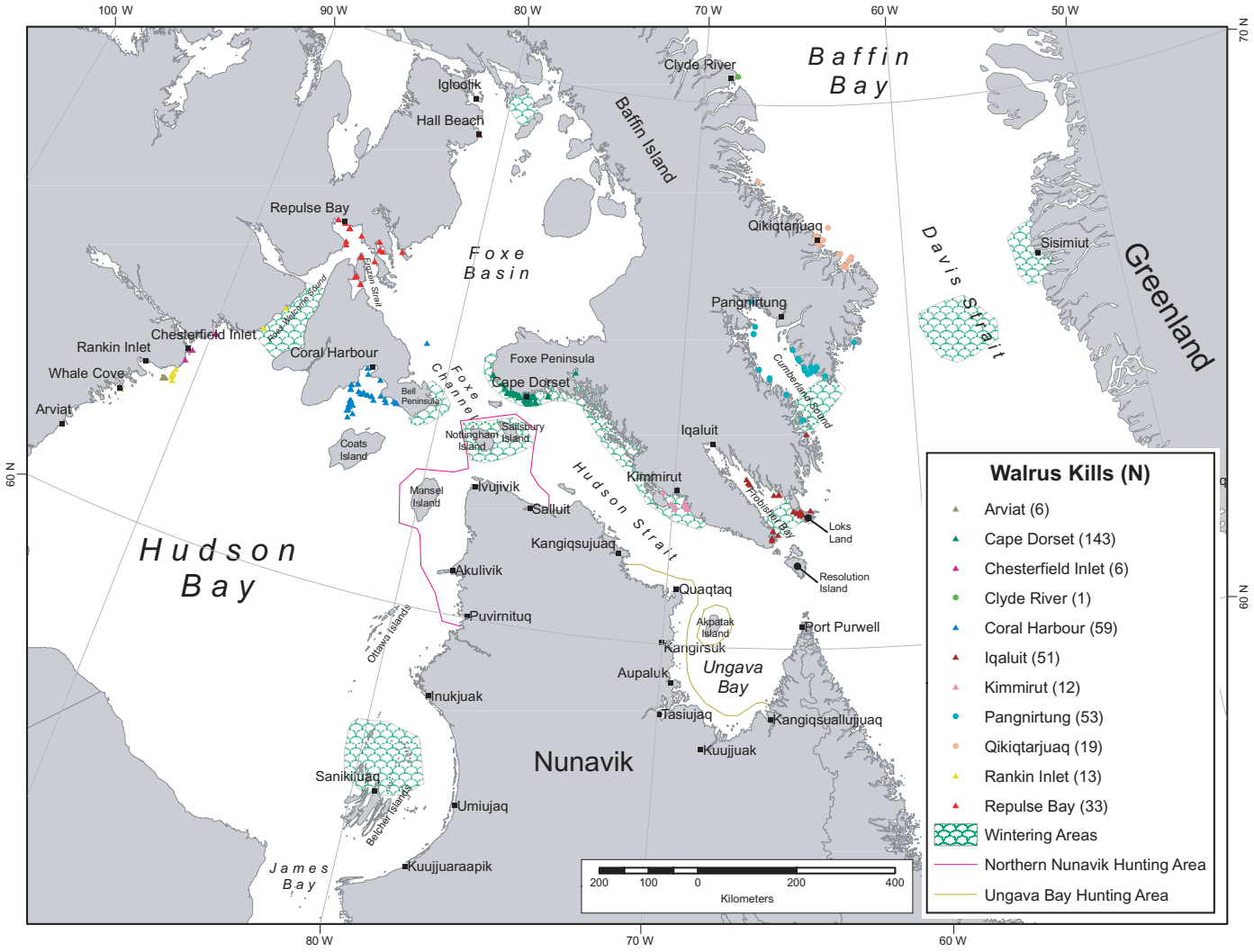

FIG. 6. Hudson Bay–Davis Strait walrus harvesting locations for Arviat, Cape Dorset, Chesterfield Inlet, Clyde River, Coral Harbour, Iqaluit, Kimmirut, Pangnirtung, Qikiqtarjuaq, Rankin Inlet, and Repulse Bay (Priest and Usher, 2004), Nunavik harvesting areas (interpreted from COSEWIC, 2006), and wintering areas (Born et al., 1995). Each kill symbol may represent more than one animal killed; N is the number of walruses reported by each community in the Priest and Usher (2004) database.

Foxe Basin stocks), both communities rely on a single interbreeding population that is characterized by primarily local movement.

Hudson Bay–Davis Strait

Walrus are found at several widely dispersed areas in winter (Fig. 6), including Roes Welcome Sound, Foxe Channel, the north shore of Hudson Strait, pack ice in Davis Strait, and probably (based on harvest dates) the mouths of Frobisher Bay and Cumberland Sound (Orr and Rebizant, 1987; Born et al., 1995; Priest and Usher, 2004; COSEWIC, 2006). There are no data to determine whether significant numbers of walrus change wintering areas between or within years.

Cape Dorset reports landing at least a few walrus almost every month, with peaks in March and November, which is the same time when Kimmirut lands about 75% of its catch (Priest and Usher, 2004). These communities may be sampling at the level of the population (wintering aggregation) that may include multiple stocks.

Walrus in HBDS are hunted at many other communities in Nunavut and Nunavik as well, usually in the open-water season. Harvests in Nunavut tend to be close to the communities, with little overlap of hunting areas. In Nunavik, however, the hunting areas of many communities overlap (Fig. 6). Along western Hudson Bay, three communities land a few walrus every year from coastal areas between Whale Cove and Roes Welcome Sound, usually in May to September. Hunters from Repulse Bay hunt mostly in Frozen Strait, with peak harvests occurring slightly later than in communities immediately to the south (Priest and Usher, 2004). It is possible that walrus at the west end of the HBDS stock are hunted by all these communities.

The distribution of HBDS walrus stretches 1500 km from east to west, along 2500 km of coastline, so clinal variation might be expected. Outridge et al. (2003) examined the lead isotopes of walrus landed at Repulse Bay,

Coral Harbour, Akulivik, Loks Land, and Sisimiut, as well as samples from FB and SEHB. They found statistical differences in $^{206}Pb/^{207}Pb$ ratios between Coral Harbour and both Akulivik and Sisimiut, which were not different from each other, as well as in $^{208}Pb/^{207}Pb$ ratios between Sisimiut and both Akulivik and Coral Harbour, which did not differ from each other. There were too few samples from intervening sites to allow statistical analysis, but there appeared to be some overlap between adjacent sites. Outridge et al. (2003) concluded that most communities were harvesting walrus that inhabited different geological areas, while noting overlap in adjacent values.

The temporal and spatial distribution of walrus harvests is consistent with Outridge et al.'s (2003) concept of local stocks that overlap each other along a cline. Peak harvests tend to occur from May to September and must reflect widespread availability. Four communities on northeast Hudson Bay report peak walrus harvests that overlap in both time (August–September, Priest and Usher, 2004) and space (Fig. 6), and share a stock. Conversely, seven communities on Ungava Bay (Fig. 6) hunt at Akpatok Island, mostly in July-August, a period concurrent with peak landings at Repulse Bay and Coral Harbour. Concurrent harvests in two locations over 800 km apart suggest different stocks.

Both Pangnirtung and Iqaluit hunters take 95% of their walrus between May and November over large areas that may overlap (Fig. 6). Some walruses are taken the rest of the year, but that does not reject the hypothesis that some walrus from southeast Baffin Island migrate to West Greenland for the winter breeding season. Those remaining in Canada may be immature animals, mature non-breeders, breeding animals that breed in both countries in different years, or animals that remain in Canada all year and that are joined seasonally by walrus from Greenland.

Walrus in the HBDS area have not been subjected to intense genetic scrutiny. Preliminary studies (NAMMCO, 2006) included the contradictory results that walrus from eastern Hudson Bay and Hudson Strait were both genetically different than walrus in West Greenland and also served as a source for West Greenland walrus. In these analyses, it was presumed that there was not an unsampled population between Hudson Strait and West Greenland (L.W. Andersen, pers. comm. 2005), but no samples from southeast Baffin Island walrus were available. A clinal model leads to two hypotheses: that southeast Baffin Island walrus will be intermediate between West Greenland and Hudson Strait walrus, and that southeast Baffin Island walrus will be the major source of immigrants to West Greenland.

Born et al. (1995) speculated there may be subunits within the HBDS range, but they noted the absence of data by which to partition this group. More recent data indicate that two groups of northern Quebec communities, one centered on Ivujivik and one in Ungava Bay (Fig. 6), share stocks with nearby communities in the group. Reviewed isotope analyses suggest that Nunavut communities harvest local animals, while the genetic studies suggest differences between animals harvested in different communities, but both types of studies were limited in geographic coverage. The range of HBDS walrus includes seven known wintering areas, and it is possible that many communities are harvesting from several stocks derived from one or a few populations (wintering aggregations). While evidence of subunits within the HBDS range has increased, it is not yet sufficient to define that substructure.

Southern and Eastern Hudson Bay

Walrus winter at the floe edges around the Sleeper and Belcher archipelagos (Fig. 7) (COSEWIC, 2006). The nearest neighbouring winter concentrations are in the HBDS population range, around Ivujivik-Nottingham-Salisbury islands and Bell Peninsula-Foxe Peninsula (Priest and Usher, 2004; COSEWIC, 2006), and they are likely separated from the SEHB population by distance and ice (Fig. 6).

Judging by information from the main hunting areas, dispersal from winter areas in the open-water season seems limited. Hunters from Sanikiluaq and Inukjuak hunt among the Sleeper and Belcher islands. Between June 1996 and May 2001, Sanikiluaq reported landing 25 walrus. Only 11 of those 25 reports included location data, but those 11 walrus were all taken at the north end of the Belcher Islands and at the Sleeper Islands (Priest and Usher, 2004). The harvest at Sanikiluaq occurs mostly in September and October (92% of 25 animals over five years, Priest and Usher, 2004). Hunters from Inukjuak hunt in the same area (Fig. 7) at about the same time. The locations of harvests reported by Kuujjuarapik and Umiujaq are unknown, but numbers may be small (Brooke, 1994, 1995).

Communities north of Inukjuak on the east side of Hudson Bay (Puvirnituq, Akulivik, Ivujivik, Salluit; Fig. 6) are thought to hunt the HBDS population. Hunters from Akulivik, the nearest community outside the SEHB area, hunt in September and October, so their hunt overlaps the Belcher-Sleeper hunt in time, but not in space as they hunt farther north, around Nottingham and Salisbury islands (Fig. 6). Walrus occupy the shoals near Cape Henrietta Maria in July-October at least, with several peak counts in September and October (COSEWIC, 2006). It is possible that some walrus that summer one year at Cape Henrietta Maria could summer in other years at the Belcher-Sleeper islands or even farther north, where they could be available to Akulivik hunters.

However, harvested walrus at Akulivik differed from those landed at Inukjuak. Muir et al. (1995) found significant differences in organochlorine concentrations and profiles in walrus landed at these two communities, which they attributed to differences in diet. Lead isotope ratios ($^{208}Pb/Pb^{207}$) and trace element profiles both showed significant differences between Inukjuak and Akulivik samples (Outridge and Stewart, 1999; Outridge et al., 2003). Concentrations of heavy metals appeared to differ between

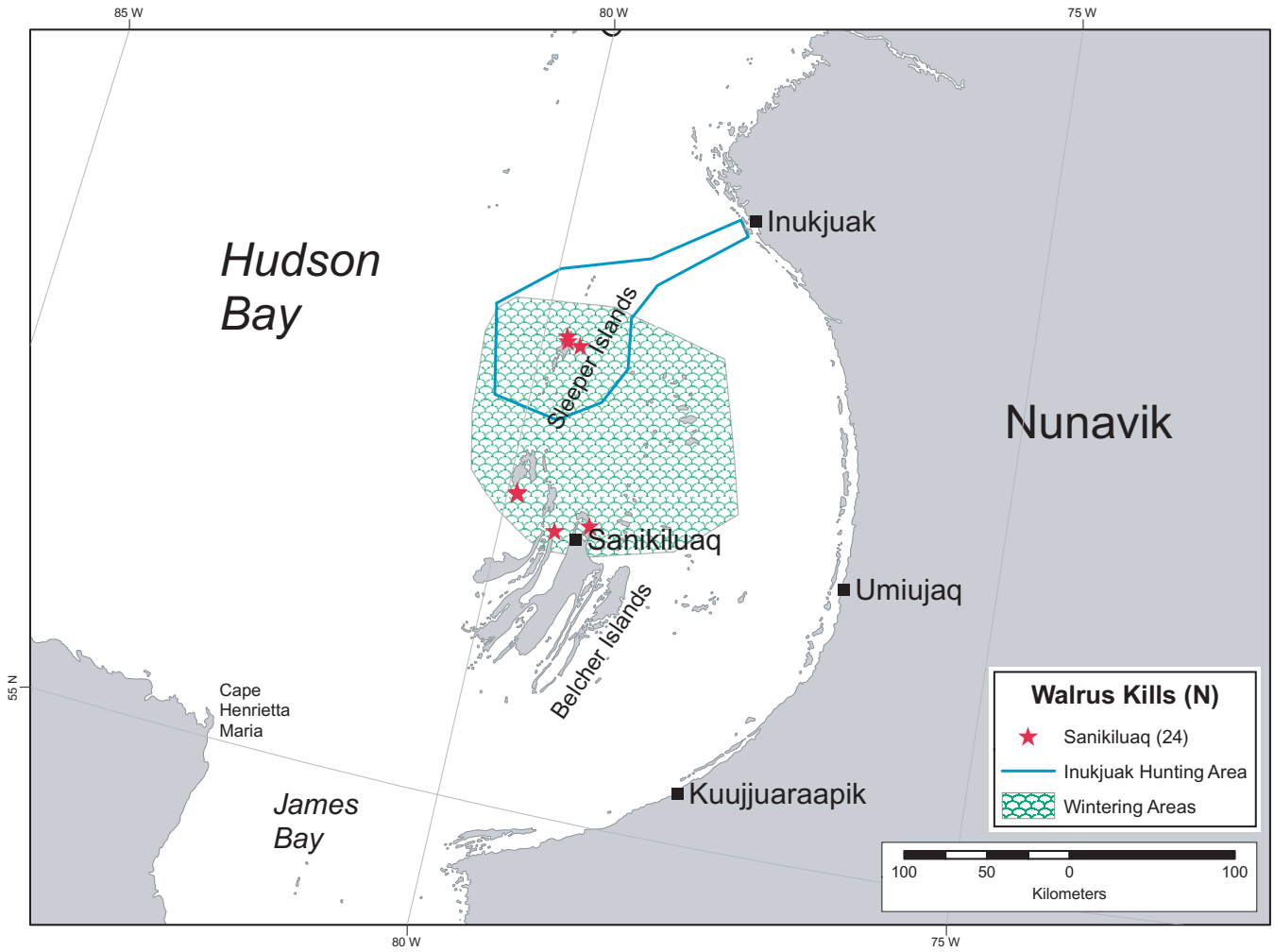

FIG. 7. Southern and Eastern Hudson Bay walrus harvesting locations for Sanikiluaq (Priest and Usher, 2004), Nunavik harvesting areas (interpreted from COSEWIC, 2006), and wintering areas (Born et al., 1995). Each kill symbol may represent more than one animal killed; N is the number of walruses reported by each community in the Priest and Usher (2004) database.

Inukjuak (Hg: 8.00 µg/g dry wt; Cd: 19.0 µg/g dry wt) and Akulivik (Hg: 4.20 µg/g dry wt; Cd: 30.0 µg/g dry wt), but sample sizes were small (9 and 4 respectively), and these differences were not statistically significant (Wagemann and Stewart, 1994).

Born et al. (1995) defined the SEHB population mostly on the basis of distribution, noting that evidence for separating it from other walrus groups in northeast Hudson Bay was not strong. Since then, new information shows significant stock differences between walrus landed at Inukjuak and at Akulivik. There are no new genetic data by which to assess the degree of interbreeding among walrus from southern and northern Hudson Bay and no new evidence to suggest subdividing this stock.

West Atlantic

Walrus were once common in the Gulf of St. Lawrence and around Nova Scotia but had been extirpated by the mid-1800s (Reeves, 1978). Five walrus were reported in the Gulf between 1992 and 1996, in four different sightings. Walrus are seen occasionally on the coast of Newfoundland (Kingsley, 1998) and Nova Scotia (Richer, 2003). Whether these observations mark recolonization of former range or random wanderings of a few individuals is unclear. Should they not be itinerant animals, the population size is small.

CONCLUSIONS

None of the new information presented here or published since the review by Born et al. (1995) refutes previous separation of stocks. It does, however, suggest further subdivision of some stocks of walrus in Canada (Table 2). Specifically, the Baffin Bay stock now appears to be three stocks: the Baffin Bay stock, the West Jones Sound stock, and the Penny Strait-Lancaster Sound stock. The Foxe Basin stock appears to be two stocks: North Foxe Basin and Central Foxe Basin. There is evidence of clinal variation in the Hudson Bay-Davis Strait stock. No changes are suggested for the SEHB stock.

TABLE 2. Summary of walrus stock revisions.

Previous Stock Designation (Born et al., 1995)	Proposed Stock Designation	Rationale	Comments
North Water (Baffin Bay-east Canadian Arctic)	West Jones Sound (WJS)	Distinguished from BB by distribution data (tags, harvest sites, survey observations, hunter observations)	Data are required to determine if this stock is a breeding population isolated from walrus wintering in east Jones Sound.
	Penny Strait–Lancaster Sound (PS–LS)	Distinguished from WJS by distribution data (tags, survey observations); Pb isotope analysis (TIMS)	Data are required to determine if this stock is also a breeding population isolated from walrus wintering in east Jones Sound and to evaluate differences between wintering areas (Dundas Polynya and east Lancaster Sound) within its range.
	Baffin Bay (BB)	Residual; Potential for further subdivisions	Pb isotope data show clinal variation between east Jones Sound and NW Greenland but sample sizes were small and new boundaries cannot be established.
Foxe Basin	Northern Foxe Basin (NFB) Southern Foxe Basin (SFB)	N and S stocks distinguished by Pb isotope ratios and distribution of harvest sites	Data are required to evaluate if these stocks form a single population.
North Hudson Bay–Hudson Strait–SE Baffin Island–N Labrador	Hudson Bay–Davis Strait (HBDS)	No change	Pb isotopes suggest clinal variation within this stock but new boundaries cannot yet be established. Data are required to assess movement of walrus between Canada and Greenland and in Canada.
Southern and Eastern Hudson Bay	Southern and Eastern Hudson Bay (SEHB)	No change	Data are required to evaluate relationships with other stocks and within the range of the SEHB stock

The new stock definitions are proposed here for three reasons. The first relates to management. It is more conservative to conclude erroneously that there are more stocks than to assume that there are fewer stocks (Taylor, 1997; Taylor and Dizon, 1999). Thus, while data that suggest subdividing stocks may be limited, it is more cautious to accept those data than to ignore them.

The second is that the recent information offers insights into the stock context of walrus populations. Walrus once had a wide and largely continuous range in Canada (Harington, 1966; Reeves, 1978) and likely were characterized by clinal variation. I suggest that females and younger animals tended to remain in more narrowly circumscribed ranges while mature males roamed among the herds and wintered in different areas over several years. Genetically different subpopulations of deer (*Odocoileus* spp.) are prevented from becoming more different by male dispersal (Harris et al., 2002). The roving male model (Suzuki et al., 1998; Stewart et al., 2003) takes this concept one step farther, in that males not only disperse from their natal area but adult males move among several breeding groups, including their natal area, over several years. Born et al. (2005) document a male walrus that returned to the same over-wintering breeding area in east Greenland in three years (1990, 2000, and 2001). Compared to the situation in Canada, these results may reflect greater fidelity to an over-wintering area or lower availability of over-wintering opportunities in east Greenland. It is possible this male over-wintered in other areas in other years.

As walrus distribution became more fragmented, female-mediated philopatry focused the population in areas of preferred habitat, including areas with less human disturbance. The roving males maintained some genetic continuity among groups, but widely separated groups became more distinct in several attributes. The roving male model was first applied to walrus by Stewart et al. (2003) to interpret different isotopic signatures at different ages in a male's life. This model is also consistent with female philopatry and moderate, male-mediated gene flow among populations (Andersen et al., 1998; Andersen and Born, 2000), and with distributional patterns seen in the High Arctic, Foxe Basin, and northern Hudson Bay to Davis Strait.

The third reason is that the newly proposed stock delineations and interpretation of the population structure of walrus in Canada generate several testable hypotheses. In Jones Sound, more data from genetics, natural markers, and tagging that cover a wider geographic distribution are required to clarify the extent of exchange of breeding animals

between west and east wintering areas, with eastern Lancaster Sound, and with NW Greenland. Isotope signatures in the growth layers of teeth may indicate that an individual has wintered in different areas over the course of its life. Similarly, sampling throughout the range of the HBDS stock is required to test between the hypotheses of clinal variation (e.g., Owen and Baker, 2001) or more dramatic subdivisions within the continuous distribution of walrus (e.g., Hoffman et al., 2006). More generally, additional genetic information would test predictions that females and juveniles at summer haulouts are closely related, but males in predominantly male groups are dissimilar, and that the harvests at Igloolik and Hall Beach differ in mtDNA, but not in genomic DNA. Genetics, natural markers, and tagging could test the hypotheses that adult males occupy several wintering areas over their lives, but females occupy only one or two, and that summer distributions reflect the philopatric movements of females from wintering areas.

ACKNOWLEDGEMENTS

This research was funded by the Nunavut Wildlife Research Trust, Nunavut Implementation Fund of the Department of Fisheries and Oceans (DFO), and from the DFO's standard operating budget. The Greenland Institute of Natural Resources provided tag 11270. The work could not have been accomplished without continuing support from the Polar Continental Shelf Project of Natural Resources Canada. The pleasant company and capable field assistance of C. Lanthier, A. Ryan, E. Born, L. Pijamini, E. Thomson, N. Lightfoot, C. Noah, E. Pijamini, M. Baktari, O. Iqaluk, and P. Nicklen are greatly appreciated. Graphics were prepared by B. Dunn, who also assisted with location analysis. The manuscript was improved by the thoughtful comments of S. Ferguson, P. Richard, A. Ryan, B. Stewart, and three anonymous reviewers. This research was conducted under Section 52 permits from DFO and Animal Use Permits from the Freshwater Institute Animal Care Committee.

REFERENCES

ANDERSEN, L.W., and BORN, E.W. 2000. Indications of two genetically different subpopulations of Atlantic walruses (*Odobenus rosmarus rosmarus*) in West and Northwest Greenland. Canadian Journal of Zoology 78:1999–2009.

ANDERSEN, L.W., BORN, E.W., GJERTZ, I., WIIG, Ø., HOLM, L.E., and BENDIXEN, C. 1998. Population structure and gene flow of the Atlantic walrus (*Odobenus rosmarus rosmarus*) in the eastern Atlantic Arctic based on mitochondrial DNA and microsatellite variation. Molecular Ecology 7:1323–1336.

BOOKE, H.E. 1981. The conundrum of the stock concept—are nature and nurture definable in fishery science? Canadian Journal of Fisheries and Aquatic Sciences 38:1479–1480.

BORN, E.W., GJERTZ, I., and REEVES, R.R. 1995. Population assessment of Atlantic walrus (*Odobenus rosmarus rosmarus* L.). Meddelelser Nr. 138. Oslo: Norsk Polar Institute. 100 p.

BORN, E.W., ACQUARONE, M., KNUTSEN, L.Ø., and TOUDAL, L. 2005. Homing behaviour in an Atlantic walrus (*Odobenus rosmarus rosmarus*). Aquatic Mammals 31:23–33.

BROOKE, L.F. 1994. A report on the 1994 Nunavik beluga and walrus subsistence harvest study. Unpubl. report to DFO under the Aboriginal Fisheries Strategy. Available from Makivik Corporation, C.P. 179, Kuujjuaq, Quebec J0M 1C0.

———. 1995. A report on the 1995 Nunavik beluga and walrus subsistence harvest study. Unpubl. report to DFO under the Aboriginal Fisheries Strategy. Available from Makivik Corporation, C.P. 179, Kuujjuaq, Quebec J0M 1C0.

CAMPANA, S.E. 2005. Otolith elemental composition as a natural marker of fish stocks. In: Cardin, S.X., Friedland, K.D., and Waldman, J.R., eds. Stock identification methods. Boston: Elsevier Academic. 227–245.

CLAYTON, J.W. 1981. The stock concept and the uncoupling of organismal and molecular evolution. Canadian Journal of Fisheries and Aquatic Sciences 38:1515–1522.

COSEWIC (COMMITTEE ON THE STATUS OF ENDANGERED WILDLIFE IN CANADA). 2006. COSEWIC assessment and update status report on the Atlantic walrus *Odobenus rosmarus rosmarus* in Canada. Ottawa: COSEWIC. Available online at: http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr%5Fatlantic%5Fwalrus%5Fe%2Epdf.

DAVIS, R.A., KOSKI, W.R., and FINLEY, K.J. 1978. Numbers and distribution of walruses in the central Canadian High Arctic. Report by LGL Limited. Toronto: Polar Gas Project. 50 p.

DE MARCH, B.G.E., MAIERS, L.D., and STEWART, R.E.A. 2002. Genetic relationships among Atlantic walrus (*Odobenus rosmarus rosmarus*) in the Foxe Basin and Resolute Bay-Bathurst Island area. Canadian Science Advisory Secretariat Research Document 2002/092. Available online at: http://www.dfo-mpo.gc.ca/csas/Csas/publications/ResDocs-DocRech/2002/2002_092_e.htm.

DFO (DEPARTMENT OF FISHERIES AND OCEANS). 2001. Fisheries and Oceans Canada: Stewards of Canada's waters. Ottawa: Communications Branch, Fisheries and Oceans Canada. DFO/6069. http://www.dfo-mpo.gc.ca/communic/scw-gec_e.htm.

———. 2002. Atlantic walrus. DFO Science Stock Status Report E5-21. Available at Stock Assessment Regional Office, Central and Arctic Region, 501 University Crescent, Winnipeg, Manitoba R3T 2N6 or www.dfo-mpo.gc.ca/csas. 19 p.

DUIGNAN, P.J., SALIKI, J.T., ST. AUBIN, D.J., HOUSE, J.A., and GERACI, J.R. 1994. Neutralizing antibodies to phocine distemper virus in Atlantic walruses (*Odobenus rosmarus rosmarus*) from Arctic Canada. Journal of Wildlife Diseases 30:90–94.

FINLEY, K.J., and RENAUD, W.E. 1980. Marine mammals inhabiting the Baffin Bay North Water in winter. Arctic 33:724–738.

GARLICH-MILLER, J.L., and STEWART, R.E.A. 1998. Growth and sexual dimorphism of Atlantic walrus (*Odobenus rosmarus rosmarus*) in Foxe Basin, Northwest Territories, Canada. Marine Mammal Science 14:803–818.

GASKIN, D.E. 1982. The ecology of whales and dolphins. London: Heinmann Educational Books Ltd.

HARINGTON, C.R. 1966. Extralimital occurrences of walruses in the Canadian Arctic. Journal of Mammalogy 47:506–513.

HARRIS, R.B., WALL, W.A., and ALLENDORF, F.W. 2002. Genetic consequences of hunting: What do we know and what should we do? Wildlife Society Bulletin 30:634–643.

HOFFMAN, J.I., MATSON, C.W., AMOS, W., LOUGHLIN, T.R., and BICKHAM, J.W. 2006. Deep genetic subdivision within a continuously distributed and highly vagile marine mammal, the Steller's sea lion (*Eumetopias jubatus*). Molecular Ecology 15:2821–2832.

IHSSEN, P.E., BOOKE, H.E., CASSELMAN, J.M., McGLADE, J.M., PAYNE, N.R., and UTTER, F.M. 1981. Stock identification: Materials and methods. Canadian Journal of Fisheries and Aquatic Sciences 38:1838–1855.

INNES, S., MUIR, D.C.G., STEWART, R.E.A., HEIDE-JØRGENSEN, M.P., and DIETZ, R. 2002. Stock identity of beluga (*Delphinapterus leucas*) in eastern Canada and West Greenland based on organochlorine contaminants in their blubber. NAMMCO Scientific Publications 4:51–68.

JEFFERSON, T.A., LEATHERWOOD, S., and WEBBER, M.A. 1993. Marine mammals of the world. FAO species identification guide. Rome: Food and Agriculture Organization of the United Nations.

KINGSLEY, M.C.S. 1998. Walrus, *Odobenus rosmarus*, in the Gulf and Estuary of the St. Lawrence. Canadian Field-Naturalist 112:90–93.

LANTHIER, C., STEWART, R.E.A., and BORN, E.W. 1999. Reversible anesthesia of Atlantic walrus (*Odobenus rosmarus rosmarus*) with carfentanil antagonized with naltrexone. Marine Mammal Science 15:241–249.

MAY, R.M., ENDLER, J.A., and McMURTRIE, R.E. 1975. Gene frequency clines in the presence of selection opposed by gene flow. American Naturalist 109:659–676.

MAYR, E. 1970. Populations, species, and evolution: An abridgement of "Animal species and evolution." Cambridge, Massachusetts: Harvard University Press.

MUIR, D.C.G., SEGSTRO, M.D., HOBSON, K.A., FORD, C.A., STEWART, R.E.A., and OLPINSKI, S. 1995. Can seal eating explain elevated levels of PCBs and organochlorine pesticides in walrus blubber from eastern Hudson Bay (Canada)? Environmental Pollution 90:335–348.

NAMMCO (NORTH ATLANTIC MARINE MAMMAL COMMISSION). 2006. Scientific Committee Report of the Thirteenth Meeting, Reine, Norway, 25–27 October 2005. NAMMCO /15/5. Presented at the Fifteenth Meeting of the Council, 14–16 March 2006, Selfoss, Iceland. http://www.nammco.no/webcronize/images/Nammco/766.pdf.

NIELSEN, O., NIELSEN, K., and STEWART, R.E.A. 1996. Serologic evidence of *Brucella* spp. exposure in Atlantic walruses (*Odobenus rosmarus rosmarus*) and ringed seals (*Phoca hispida*) of Arctic Canada. Arctic 49:383–386.

NIELSEN, O., STEWART, R.E.A., MEASURES, L., DUIGNAN, P., and HOUSE, C. 2000. A morbillivirus antibody survey of Atlantic walrus, narwhal and beluga in Canada. Journal of Wildlife Diseases 36:508–517.

NIELSEN, O., CLAVIJO, A., and BOUGHEN, J.A. 2001a. Serologic evidence of influenza A infection in marine mammals of Arctic Canada. Journal of Wildlife Diseases 37:820–825.

NIELSEN, O., STEWART, R.E.A., NIELSEN, K., MEASURES, L., and DUIGNAN, P. 2001b. Serologic survey of *Brucella* spp. antibodies in some marine mammals of North America. Journal of Wildlife Diseases 37:89–100.

NMFS (NATIONAL MARINE FISHERIES SERVICE). 2001. Marine Fisheries Stock Assessment Improvement Plan. Report of the National Task Force for Improving Fish Stock Assessments. NOAA Technical Memo. NMFS-F/SPO-56. Washington, D.C.: U.S. Department of Commerce.

NOVAKS, M., BAKER, J.A., OBBARD, M.E., and MALLOCK, B. 1987. Wild furbearer management and conservation in North America. Toronto: Ontario Trappers Association and Ministry of Natural Resources.

ORR, J.R., and REBIZANT, T. 1987. A summary of information on the seasonal distribution of walrus (*Odobenus rosmarus*) in the area of northern Hudson Bay and western Hudson Strait, NWT, as collected from local hunters. Canadian Data Report of Fisheries and Aquatic Sciences 624:1–16.

OUTRIDGE, P.M., and STEWART, R.E.A. 1999. Stock discrimination of Atlantic walrus (*Odobenus rosmarus rosmarus*) in the eastern Canadian Arctic using lead isotope and element signatures in teeth. Canadian Journal of Fisheries and Aquatic Sciences 56:105–112.

OUTRIDGE, P.M., DAVIS, W.J., STEWART, R.E.A., and BORN, E.W. 2003. Investigation of the stock structure of Atlantic walrus (*Odobenus rosmarus rosmarus*) in Canada and Greenland using dental Pb isotopes derived from local geochemical environments. Arctic 56:82–90.

OWEN, J.G., and BAKER, R.L. 2001. The *Uroderma bilobatum* (Chiroptera: Phyllostomidae) cline revisited. Journal of Mammalogy 82:1102–1113.

PHILIPPA, J.D.W., LEIGHTON, F.A., DAOUST, P.Y., NIELSEN, O., PAGLIARULO, M., SCHWANTJE, H., SHURY, T., VAN HERWIJNEN, R., MARTINA, B.E., KUIKEN, T., VAN DE BILDT, M.W., and OSTERHAUS, A.D. 2004. Antibodies to selected pathogens in free-ranging terrestrial carnivores and marine mammals in Canada. The Veterinary Record 155: 135–140.

PIANKA, E.R. 1988. Evolutionary ecology, 4th ed. New York: Harper & Row Publishers.

PRIEST, H., and USHER, P. 2004. The Nunavut Wildlife Harvest Study August 2004, Final Report. Iqaluit: Nunavut Wildlife Management Board.

REEVES, R.R. 1978. Atlantic walrus (*Odobenus rosmarus rosmarus*): A literature survey and status report. Wildlife Research Report 10. Washington, D.C.: U.S. Fish and Wildlife Service, Department of the Interior.

RICHER, S. 2003. Nova Scotians awake to find a rare walrus in their midst. *Globe and Mail*, June 12.

RICKER, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Bulletin 191. Ottawa: Department of the Environment, Fisheries and Marine Service.

ROYCE, W.F. 1972. Introduction to the fishery sciences. New York: Academic Press.

SECOR, D.H. 2005. Fish migration and the unit stock: Three formative debates. In: Cardin, S.X., Friedland, K.D., and Waldman, J.R., eds. Stock identification methods. Boston: Elsevier Academic. 17–44.

SERVICE ARGOS. 2007. Location accuracy. https://www.argos-system.org/html/system/faq_en.html#LOCATION%20ACCURACY.

SINGER, F.J., and ZEIGENFUSS, L.C. 2002. Influence of trophy hunting and horn size on mating behavior and survivorship of mountain sheep. Journal of Mammalogy 83:682–698.

SJARE, B., and STIRLING, I. 1996. The breeding behaviour of Atlantic walruses, *Odobenus rosmarus rosmarus*, in the Canadian High Arctic. Canadian Journal of Zoology 74:897–911.

STEWART, R.E.A. 2002. Review of Atlantic walrus (*Odobenus rosmarus rosmarus*) in Canada. Canadian Science Advisory Secretariat Research Document 2002/091. Available online at: http://www.dfo-mpo.gc.ca/csas/Csas/publications/ResDocs-DocRech/2002/2002_091_e.htm.

STEWART, R.E.A., and FAY, F.H. 2001. Walrus. In: Macdonald D., ed. The new encyclopedia of mammals. Oxford: Oxford University Press. 174–179.

STEWART, R.E.A., OUTRIDGE, P.M., and STERN, R.A. 2003. Walrus life-history movements reconstructed from lead isotopes in annual layers of teeth. Marine Mammal Science 19:806–818.

STIRLING, I., CLEATOR, H., and SMITH, T.G. 1981. Marine mammals. In: Stirling, I., and Cleator, H., eds. Polynyas in the Canadian Arctic. Ottawa: Canadian Wildlife Service Occasional Paper 45. 45–58.

SUZUKI, S., HILL, D.A., and SPRAGUE, D.S. 1998. Intertroop transfer and dominance rank structure of nonnatal male Japanese macaques. International Journal of Primatology 19:703–722.

SWAIN, D.P., HUTCHINGS, J.A., and FOOTE, C.J. 2005. Environmental and genetic influences on stock identification characters. In: Cardin, S.X., Friedland, K.D., and Waldman, J.R., eds. Stock identification methods. Boston: Elsevier Academic. 45–85.

TAYLOR, B.I. 1997. Defining "population" to meet management objectives for marine mammals. In: Dizon, A.E., Chivers, S.J., and Perrin, W.F., eds. Molecular genetics of marine mammals. Special Publication 3. Lawrence, Kansas: The Society for Marine Mammalogy. 49–65.

TAYLOR, B.L., and DIZON, A.E. 1999. First policy then science: Why a management unit based solely on genetic criteria can't work. Molecular Ecology 8:S11–S16.

WAGEMANN, R., and STEWART, R.E.A. 1994. Concentrations of heavy metals and selenium in tissues and some foods of walrus (*Odobenus rosmarus rosmarus*) from the eastern Canadian Arctic and sub-Arctic, and associations between metals, age, and gender. Canadian Journal of Fisheries and Aquatic Sciences 51:426–436.

WALDMAN, J.R. 2005. Definition of stocks: An evolving concept. In: Cardin, S.X., Friedland, K.D., and Waldman, J.R., eds. Stock identification methods. Boston: Elsevier Academic. 7–16.

WAPLES, R.S. 1991. Pacific salmon, *Oncorhynchus* spp. and the definition of "species" under the Endangered Species Act. Marine Fisheries Review 53(3):11–22.

WIRGIN, I., and WALDMAN, J.R. 2005. Use of nuclear DNA in stock identification: Single-copy repetitive sequence markers. In: Cardin, S.X., Friedland, K.D., and Waldman, J.R., eds. Stock identification methods. Boston: Elsevier Academic. 331–370.

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Stewart, R.E.A. 2008. Redefining walrus stocks in Canada. Arctic 61(3):292–308.

In Figure 6 (p. 302), please ignore the wintering area indicated in the middle of Davis Strait (ca. 65° N), which was included in error.

Midsummer observations on the behavior of wild polar bears (*Ursus maritimus*)

IAN STIRLING
Canadian Wildlife Service, 10025 Jasper Avenue, Edmonton, Alberta, T5J 1S6

Received February 12, 1974

STIRLING, I. 1974. Midsummer observations on the behavior of wild polar bears (*Ursus maritimus*). Can. J. Zool. **52**: 1191–1198.

Wild polar bears (*Ursus maritimus*) were observed from Caswall Tower, Devon Island (74°43′ N; 91°10′ W), from 24 July to 8 August 1973. A total of 602.7 bear hours of observations was recorded. Two types of hunting were observed, stalking and still-hunting. Of 288 hunts observed, 65 (22.6%) were stalks and 233 (77.4%) were still-hunts. All cubs observed hunted, but they exhibited great variety in patience and apparent skill. Scavenging and intraspecific competition for possession of kills were observed. When threatened, adult females with cubs were not subordinate to bears of any other age or sex classes. A diurnal rhythm was recorded in which bears slept most during the latter third of the 24-h cycle and least in the first third. The average of 17 sleeps longer than 60 min was 465 ± 301.3 min.

Basking ringed seals (*Phoca hispida*) alternated between lying flat and raising their heads to look about for predators. The mean duration of the lying and looking phases was 26.3 and 7.0 s respectively (n = 591 and 580). The variation between individual seals was greater than within individuals. If a group of seals hauled out together, all individuals maintained watchful behavior; no single animal acted as a "sentry" for the others.

STIRLING, I. 1974. Midsummer observations on the behavior of wild polar bears (*Ursus maritimus*). Can. J. Zool. **52**: 1191–1198.

De la tour Caswall dans l'ile de Devon (74°43′ N; 91°10′ O), on a observé des ours polaires (*Ursus maritimus*) en nature, du 24 juillet au 8 août 1973. On a pris note des observations durant 602.7 heures-ours. Les ours pratiquent deux types de chasse: la chasse en suivant la proie et la chasse à l'affût. De 288 chasses observées, 65 (22.6%) étaient du premier type et 233 (77.4%), du second type. Tous les oursons pratiquent la chasse, mais manifestent à le faire plus ou moins de patience et d'habileté apparente. On a observé les ours manger des restes et il existe une compétition intraspécifique pour les proies mortes. Lorsqu'elles sont menacées, les femelles adultes avec des petits ne se soumettent à aucun autre ours, de quelqu' âge ou sexe que ce soit. Les ours suivent un rythme journalier: ils dorment surtout dans le dernier tiers du cycle de 24 heures, alors que c'est dans le premier tiers qu'ils dorment le moins. La moyenne calculée sur 17 périodes de sommeil supérieures à 60 min est de 465 ± 301.3 min.

Des phoques (*Phoca hispida*) installés au soleil manifestent une alternance de deux comportements: en repos, couchés à plat, ou levant la tête pour surveiller les prédateurs. La durée moyenne des phases de repos et de surveillance est de 26.3 et de 7.0 respectivement (n = 591 et 580). La variation d'un individu à l'autre est plus grande que celle qu'on observe chez un même individu. Si des phoques se rendent à terre en groupe, tous les individus opèrent la surveillance; il n'y a pas de "sentinelle" faisant la surveillance pour tout le groupe.

[Traduit par le journal]

Introduction

The Canadian Wildlife Service has been conducting research on polar bears (*Ursus maritimus*) since 1961. The initial program was oriented toward the location of denning areas (Harington 1968), while more recent research has been directed toward population ecology (reviewed in Stirling and Jonkel 1972). To date, most information on behavior has been anecdotal because the bears have usually been disturbed before being sighted, although some information has been deduced from tracks.

This paper describes the midsummer behavior of wild undisturbed polar bears at Devon Island, in the Canadian High Arctic.

Materials and Methods

Polar bears were observed on the annual ice of Radstock Bay and Gascoyne Inlet, and the intermediate peninsula of land on SW Devon Island, Northwest Territories, from 24 July to 8 August 1973 (Fig. 1). Observations were made from the top of Caswall Tower (234 m) with 10 × 50 Bushnell binoculars and a 15 to 60 × Bausch and Lomb zoom balscope. Twenty-four-hour daylight permitted continuous observation of polar bears at all times when they were visible.

Most terms are self-explanatory but two should be noted. "Still-hunting" means that a bear lies, sits, or stands still by a pool or breathing hole waiting for a seal to come to the surface. Data were pooled in the category "lying (undetermined)" when I could not determine if a distant bear was sleeping or lying down still-hunting.

Ringed seals (*Phoca hispida*), the main prey species of polar bears, often bask on the sea ice, but they punctuate

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these resting periods by frequently raising their heads to look about. The frequency of head-raising was examined quantitatively for 20 seals for periods of up to 20 min duration (5 h 22 min total) to examine the protective value of this behavior in relation to polar bear predation.

Results and Discussion

A total of 602.7 bear hours (36 063 min) of observations was recorded. At one point, observation was continuous for almost 7 days (166 h). Additional qualitative notes (not included in the above totals) were made on bears not kept under continuous observation. Three individuals were observed continuously for over 70 h (one for over 90 h) before moving out of the range of vision or disappearing. Data were recorded for adults, subadults, and females with $1\frac{1}{2}$- and $2\frac{1}{2}$-year-old cubs.

Most details of the bears' activities could be determined up to a distance of about 7 km with the balscope. Although bears could be seen up to about 11 km distant, only major categories such as walking, standing, or lying could be determined with any degree of certainty.

Time Budget of Activities

Table 1 summarizes the proportion of time bears spent in each activity.

Two major categories may be noted. Even though there was some overlap, hunting (stalking and still-hunting) made up 24.4% of the total, while 66.6% of the time was spent inactively (sleeping, lying, and still-hunting). Except for the time that the bears actually spent stalking a seal on the ice, I considered walking as a separate category because sometimes when bears were travelling they went right past seals they could have stalked.

Hunting Behavior

Hunting fell into two categories, still-hunting and stalking, with several variations on each method. The three most common still-hunting stances were lying on the stomach (88.2%), standing (8.4%), and sitting (3.4%). Occasionally a crouching position was observed, but not frequently enough to be significant in the total.

The mean duration of lying still-hunts (55.1 ± 77.2 min, $n = 135$) greatly exceeded those of standing still-hunts (12.0 ± 16.0 min, $n = 52$) or sitting still-hunts (7.9 ± 13.2 min, $n = 36$). The mean durations of sitting and standing still-hunts were not significantly different from each other ($t = 1.25$, df = 88, $P > .2$), but both were significantly different from that of the lying still-hunt ($t = 3.63$, df = 171, $P < .001$ and $t = 3.96$, df = 187, $P < .001$ respectively). I interpret those results to mean that the principal method of still-hunting is lying, possibly because it is the easiest position in which a bear can remain motionless for a protracted period of time and presents the lowest silhouette against the sky (when viewed from below by a seal). The sitting and standing postures may simply provide

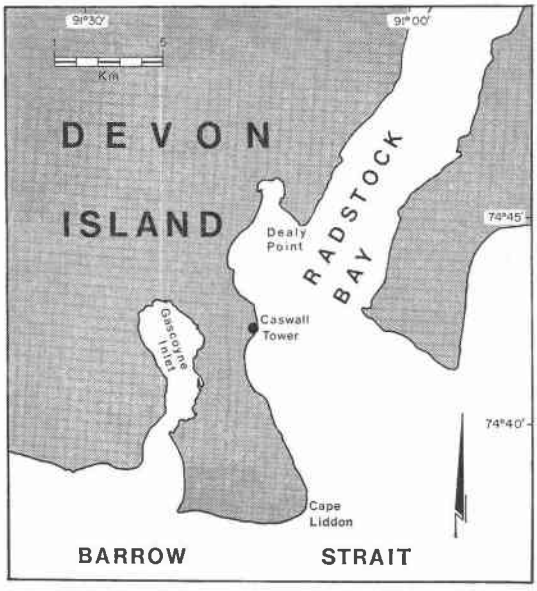

FIG. 1. The study area at SW Devon Island, N.W.T.

TABLE 1

The proportion of time polar bears spent in each activity from 24 July to 8 August 1973

Activity	No. minutes of observations	% of total
Sleeping	10 717	29.7
Walking	9 009	25.0
Still-hunting		
Lying	7 438	20.6
Sitting	285	0.8
Standing	709	2.0
Lying undetermined	4 432	12.3
Swimming	1 466	4.1
Feeding	840	2.3
Stalking		
Aquatic	258	0.7
Walking	173	0.5
Miscellaneous	736	2.0
	36 063	100.0

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relief from remaining in one position for a protracted period of time. However, a minimum of movement is made when the bears change postures because sound is readily transmitted through the ice into the water and a seal will not normally use a particular breathing hole if it hears a noise at the surface. Similar long periods of silent motionless waiting by Eskimo (Inuit) seal hunters using harpoons to still-hunt for ringed seals at breathing holes have become legendary in arctic literature (e.g. Hall 1864).

The mean length of the lying still-hunts of adult males ($x = 100.3 \pm 101.7$ min, $n = 41$) was significantly longer than for an adult female with a cub ($x = 57.5 \pm 72.6$ min, $n = 33$), probably because those of the female were often terminated prematurely by an interruption from the cub ($t = 2.77$, df = 74, $P < .01$). This conclusion is supported by the fact that although all cubs observed did lying still-hunts, the mean length was 17.1 ± 28.1 min, which was significantly shorter than those of their mothers ($t = 4.02$, df = 64, $P < .01$). The cub usually terminated its hunt before its mother and proceeded to walk about the area, eventually arriving beside the female and interrupting her. Only once did I observe an adult female, about to still-hunt, threaten her cub to make it remain at a distance.

Polar bear cubs usually remain with the adult female for $2\frac{1}{2}$ years although some may do so for longer. All of the cubs observed participated in seal hunting but there was great individual variation in both their manner and patience. The samples were too few for statistical comparison but some points may be made. The older cubs ($2\frac{1}{2}$ years) hunted more independently and at greater distances from the female than did the younger cubs ($1\frac{1}{2}$ years), i.e. up to 1–2 km apart compared with a maximum of about 0.5 km for $1\frac{1}{2}$-year olds.

Each of the two $2\frac{1}{2}$-year-old cubs caught a seal by still-hunting, although the mean duration of their hunts contrasted greatly; 2.6 min ($n = 15$) versus 28.0 min ($n = 4$). The seal caught by each bear was a young of the year (4–5 months old), suggesting that the less experienced prey may be more susceptible to young bears learning to hunt.

One of the $1\frac{1}{2}$-year-old cubs had a mean still-hunt duration of 41 min ($n = 4$). When hunting, this cub behaved like an adult. Similarly, on 2 April 1972, I followed an orphaned $1\frac{1}{3}$-year-old cub for several kilometers in the Beaufort Sea area. Its tracks showed an investigative pattern that did not appear to differ from that of an adult. Thus, it appears that even though there may be considerable variation among individuals, learning about hunting takes place at this early age. A major problem that such a small bear might encounter could be the difficulty of killing a large seal.

The most dramatic method of hunting to watch is the stalk of a basking seal. When a hunting bear saw a seal on the ice, it used one of two methods to try to get close enough to make a sudden dash and attempt to catch the seal before it went into the water. The bear either lowered its head and crept forward in a semi-crouched position, using whatever irregularities there were on the surface of the ice for cover or it slipped into the water and crept circuitously through the interconnected channels and pools that interlace the surface of the sea ice in summer. The distance between the bear and the seal at the time the final rush was made was difficult to estimate from several kilometers away but it appeared to be about 15 to 30 m. In no instance was a forepaw observed being used to cover the conspicuous black nose.

Although the stalking of seals by polar bears has often been commented on in the popular literature (e.g. Freuchen and Salomonsen 1959), probably because of its spectacular nature, that technique constituted only 22.6% (65/288) of the hunts observed in this study. No kills, or even near misses, were made by the nine bears that used the "walking stalk" a total of 38 times. In comparison, one kill and several near misses were made by the nine bears that used the aquatic stalk a total of 27 times.

The "aquatic stalk" was a specialty of one adult female in particular and she did 19 of the 27 such stalks observed. In addition she had a most individual style. While the other eight bears observed all lay flat in the water as they crept along, the whole hindquarters of this female stood vertically up in the air. It was interesting to note that the presence of this slowly moving white object did not appear to alarm the seals, even at fairly close range.

The other style of aquatic hunting observed involved the bear actually swimming under the ice between holes, surfacing to breath and look about, and diving again. The bears had such control that they could surface, breath, raise

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their heads slightly to look, and submerge without making a ripple in the water. The main value of this method appeared to lie in the possibility of surprising a seal by coming up through its exit hole, although it was used to stalk specific seals on at least two occasions. On one occasion a polar bear stalked a bearded seal in a series of dives for almost 300 m and finally missed it by less than a meter.

Efficiency of Hunting

A total of five ringed seals were caught in the 602.7 bear hours of observation, an average of one kill per 120.5 bear hours, or one kill per 5 bear days. This apparently low success rate was probably partially a product of ice conditions. There is a great abundance of natural holes in the ice during summer, any one of which a seal could surface through. This must lower a bear's probability of success at any particular hole, compared with still-hunting during winter or early spring, when there is a limited number of breathing holes, all of which must be maintained by the seals themselves.

Four kills were made by still-hunting and one by stalking (success rate of 1.8% and 1.5% respectively). Considering how infrequently kills were made, it would seem far more efficient, in terms of caloric expenditure per kill, to still-hunt rather than walk many kilometers in search of seals to stalk.

Feeding Behavior

Immediately after being captured, seals were taken away from the water's edge onto the ice and were bitten several times about the back of the head and upper neck. In the instances I observed, feeding on the seal began immediately afterwards. The only exception to this pattern in the five observations was when a $2\frac{1}{2}$-year-old cub caught a seal and ran about the ice with it, stopping periodically to shake or bite it. Twenty-three minutes after the cub caught the seal its mother noticed and went to the cub, and they both began to feed immediately. C. Jonkel (personal communication) has observed two cases in which a bear carried a seal carcass up to 2–3 km inland.

A total of 10 bears were observed feeding on the five freshly killed seals. When feeding, one or both forepaws were put on the carcass while the bear bit into the body and tore up. In all cases, the bear began eating at about the middle of the body. The skin and fat were eaten first, sometimes in a very exacting manner. For example, one bear about 0.5 km distant was observed carefully using its incisors like delicate clippers to remove only the fat from the carcass, leaving the meat. That bear, a $2\frac{1}{2}$-year-old that had just been deserted by its mother, also did two other interesting things: firstly, it left an estimated 20% of the fat and all of the rest of the carcass and secondly, in classical canine fashion, tried to cover the remains by turning its back and attempting to scratch bits of snow and ice over the remains. No similar behavior has been previously reported in polar bears, although C. Jonkel (personal communication) has seen it twice.

Data on the natural duration of feeding on a fresh kill were difficult to collect because feeding at three of the five kills was interrupted by other bears. Possibly this was why the two bears referred to earlier carried carcasses inland. One adult of unknown sex fed uninterrupted for 30 min and left the remains completely, while the subadult mentioned in the above paragraph fed for 72 min, went back to still-hunting, and returned twice more to feed on the carcass for periods of 10 and 20 min during the ensuing 171 min.

When more than one bear fed on a carcass at the same time, it became severed into two or more pieces after the skin and fat were removed. In all the instances observed, large pieces of the seal were left on the ice by the bears that first fed there. All of these carcasses were scavenged by other bears and it seems likely these remains could be important to the survival of subadults, or cubs orphaned unnaturally early, before they become completely self-sufficient.

Another important feature of feeding behavior was washing. After an initial feeding period of 20 to 30 min, a bear typically went and stood with its forepaws at the edge of, or actually in, a pool of water. The bear then licked off the upper and lower parts of the paws and its face, alternating between rinsing and licking. The washing procedure was repeated every 5 to 10 min thereafter. At the termination of feeding, up to 15 min might be spent in a final washing. From its frequent occurrence in all observations, it is apparent that washing is an integral part of feeding behavior in the polar bear.

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Sleeping and the Diurnal Rhythm

When sleeping, polar bears lay either on their sides with their backs to the wind, or on their stomachs with their hindquarters to the wind. Cubs lay in the lee of the female. The ice in the study area lacked pressure ridges or other substantial irregularities that might have been used for protection from wind.

The mean duration of 17 sleeps longer than 60 min was 465 ± 301.3 min (7 h 45 min). The longest single sleep recorded was 1407 min (23 h 27 min). Data from cubs were not included because their sleeping activities were largely determined by the female.

In 3 of the 17 observations, the bear slept on a gravel beach. Three kilometers south of Caswall Tower I found two sleeping pits dug by bears in the gravel ridges, similar to those described by Jonkel *et al.* (1972) on the west coast of Hudson Bay. The only other such pits recorded in the high arctic were recorded by Jonkel (personal communication) at Maxwell Bay, 17 km east of Radstock Bay and on the north coast of Devon Island.

Plotting of the total number of minutes of sleep on a 24-h basis (Fig. 2) indicated a diurnal fluctuation with significantly less sleeping in the first third of the day than the last ($\chi^2 = 989.8$, $P < .01$).

The diurnal sleeping pattern of the polar bear can be interpreted in relationship to the behavior of its major prey species, the ringed seal. Like several other species of polar pinnipeds, the maximum numbers of ringed seals haul out on the ice in the afternoon and minimum in the early hours of the morning, at which times they feed (Stefansson 1921; Smith 1973). Thus, the maximum number of seals are in the water, returning to the surface periodically to breath during the "night." Since polar bears appear to prefer still-hunting to stalking, the most advantageous time to hunt is when the probability of a seal surfacing at any particular hole is maximal, which is in the early hours of the morning. Of the five seals caught during the study, three were in the first third of the 24-h period, one in the second, and one in the latter third (Fig. 2).

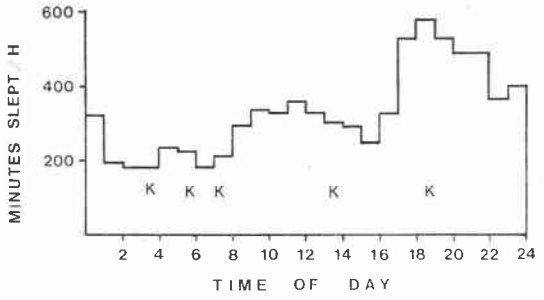

FIG. 2. Diurnal rhythm of sleeping by polar bears in midsummer. (K denotes the time a seal was killed by a polar bear.)

Swimming

Polar bears are strong swimmers and during the observation period 4.1% of the total time (24 h 26 min) was spent in the water. Bears of all ages and sex classes swam voluntarily. The data for all animals observed longer than 360 min (6 h) were pooled to determine the following proportions of time spent swimming by bears of each age and sex class: adult ♂ = 0.78%; adult ♀ = 0.62%; adult and subadult of unknown sex = 8.2%; and cubs = 4.50%. Clearly, the younger polar bears spend the most time in the water.

For the most part, the younger animals swam in pools and open leads without any apparent purpose. On several occasions cubs sprinted across the ice and dove into the water head-first in a manner similar to the final rush of an adult bear for a seal at the end of a stalk.

One bear brought what appeared to be seaweed up from the bottom, ate parts of it, and dove for more. Similar behavior has been documented in other areas (Lønø 1970; Russell 1971).

Two single smaller adults of unknown sex spent several hours at a time swimming in a particular direction along leads or between holes in the ice. One bear swam about 8 km, returning only momentarily to the ice surface to look about before reentering the water. Submergence times of 37, 40, 55, and 72 s were recorded.

Polar bears dove in two ways. The most common was to go down head-first, leaving the rear out of the water until the thrust of paddling drove the bear under. The other method, only used when stalking, was to surface only with the nose and then slip backwards under the water again.

Intraspecific Behavior

Meetings between unrelated polar bears were not common. Twelve encounters were seen during the study, or an average of one per 50.2 bear hours. Although the sense of vision appears to

be poor in polar bears, the sense of smell is acute so that most potential meetings of unrelated bears are avoided. Unrelated bears came into proximity of each other under two circumstances; when one bear travelled downwind toward a sleeping bear, and when food was competed for.

Adult females with cubs passed bears of unknown sex twice, and passed another family group and an adult male once each at distances of 150 and 300 m. No overt movements were made by either parties in any of the cases, although they watched each other closely while within sight and continued to peer backward over their shoulders for 10 to 20 min after separating.

An adult male came within 100 m of a larger second male lying still-hunting. The larger male simply walked about 30 m toward the smaller, which then turned and walked away for about 2 km before stopping. The simple visible effect of relative size was probably sufficient to determine dominance when both bears were clearly visible to each other. However, when a large adult male and a smaller bear of unknown sex suddenly met face-to-face swimming, both bears immediately veered away, presumably because there was nothing to permit each bear to quickly evaluate the status of the other. After swimming away about 50 m, the adult male turned and swam back toward the smaller bear, which then swam to the beach and fled to the top of the nearest hill about 0.5 km from the sea.

Predictably, when adult females with cubs twice came within 10 to 20 m of sleeping subadult bears of unknown sex, the latter fled instantly upon waking. Equally predictably, adult males dominated subadults of unknown sex sufficiently to exclude them from feeding on seal carcasses on two occasions.

Some of the outcomes of interactions between family groups and adult males were unexpected since males have always been assumed to be dominant to females with cubs. One instance of a male polar bear devouring a recently dead female with two cubs was reported by Jonkel (1970). However, the circumstances leading up to the event were unknown and it occurred in vegetated terrain rather than where visibility was unlimited.

In one instance during this study, a large adult male approached within 50 m of an adult female with a $2\frac{1}{2}$-year-old cub. She turned, lowered her head, and charged about 30 m twice and each time the male retreated. After the second encounter, the male turned and walked away on a round trip of 2 to 3 km before resettling to still-hunt where he had originally been.

A different adult female with a $2\frac{1}{2}$-year-old cub twice met adult males double her size while she was feeding on a fresh kill. In the first instance, the female and cub had already been feeding for 78 min. When the male arrived, they left immediately. The male fed for 49 min, and then for 2 h he followed the female and cub, which kept moving and watching behind them until the male finally stopped following.

Five days later, the same adult female as above killed a large ringed seal about 0.5 km upwind of a male twice her size that was still-hunting. Nine minutes later the male reached the kill. Rather than be displaced, the female lowered her head and charged for the male who also lowered his head to meet her. When they separated, the female was bleeding freely from a wound in her right shoulder and the male from a wound on his right side over the rib cage. The female then made a second charge of about 5 m toward the male, but he did not move. The male then returned the charge while the female stood firm. Then, after standing and looking at each other for about 30 s, the male, the female, and her cub all began to feed on the carcass together. After 21 min of feeding, the female and cub walked away to wash in a pool. Nine minutes later they attempted to return to the carcass but were chased off by the male. Meanwhile, a subadult of unknown sex arrived and walked back and forth seeking an opportunity to scavenge. After another 8 min of feeding, when the male went to wash at a pool, the cub approached the carcass. The male turned and ran toward the cub but when the female instantly charged the male he retreated. Then all three bears fed together again. One hundred minutes after the first encounter the female and cub left the carcass, washed, walked about 0.5 km west, and lay down while the cub licked the female's wound. Then, in a manner similar to the other adult male that interrupted this female at a kill, the adult male followed female and cub for about an hour before turning back to the remains of the carcass, which by this time was being scavenged by another female and her $2\frac{1}{2}$-year-old cub.

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These observations suggest that adult males do not necessarily dominate females with cubs. Undoubtedly an adult male could win a fight to the death with an adult female but he would likely sustain serious wounds himself. It is also worth noting, with reference to potential cannibalism, that females and cubs can run much faster than adult males. Thus, it is unlikely that intraspecific predation occurs at more than an incidental level.

In the case where the adult female and her cub deserted a seal carcass without dispute, they had already fed on it for 78 min, thus greatly reducing the value of contesting possession of it.

Cubs were extremely nervous in meetings with any unrelated bear. They either stayed behind the female if she faced another bear or ahead of her if she moved away.

Behavior of Basking Ringed Seals

It is relevant to consider some aspects of the behavior of ringed seals when hauled out on the ice in relation to the constant threat of predation by polar bears.

The most characteristic aspect of the behavior of hauled-out ringed seals is that they continuously alternate between lying flat and raising their heads to look about for predators. If a group of seals haul out together, all individuals continue to maintain this behavioral sequence. No single animal plays the role of "sentry" for the others.

In this study, the mean duration of the looking phase was 7.0 $\pm$ 8.9 s (n = 591) and of lying was 26.3 $\pm$ 37.6 s (n = 580). On two occasions, with sample sizes of fewer than 10, Stefansson (1913) calculated means of 4.5 and 5.5 s for the looking phase and 30.1 and 35.6 s for lying. However, there is little chance that the polar bear could learn to alternate between periods of stalking and stillness on the basis of such averages because variation between individuals was significantly different and greatly exceeded that within the individual (F = 6.67, df = 19 and 571, $P < .01$ for periods of head raised; F = 16.4, df = 19 and 560, $P < .01$ for periods of lying). Even when the seals were lying, it seemed that little of the time was spent sleeping, for although it was not quantified, a substantial proportion of the time appeared to be spent rubbing, scratching, or lying with the eyes open. It seems likely that this degree of alertness on the part of basking ringed seals contributes to the apparent preference of the bears for still-hunting by breathing holes.

Several prey species apparently find a degree of protection from predation by being clumped in distribution. However, this does not appear to be true of ringed seals, which are usually dispersed in small groups over the ice surface available, except during the molting period in late spring when large numbers may be hauled up in restricted areas. Of 141 seal groups tallied, 99 were single, 23 in pairs, 11 in 3's, and 4, 3, 1, in groups of four, five, and seven respectively.

For a large part of the year, the ringed seal is dependent on a resource in limited supply, self-maintained breathing holes. Clumping of seals about single or closely knit groups of breathing holes would be disadvantageous for the seals in two ways. The primary one is that in the event of discovery of the breathing hole by a polar bear, a whole group of animals would be vulnerable to a high level of predation by the bear with no form of escape (because of dependence on air) short of swimming away in the hope of finding another hole and being permitted to use it by the seals resident there. The possibility of one seal using another's breathing hole is belied by two observations which indicate the species is rather antisocial: a high proportion of ringed seal sub-ice vocalization is agonistic in nature (Stirling 1973) and ringed seals held together in captivity are highly aggressive to each other compared with species such as harp seals (*Pagophilus groenlandicus*) or harbor seals (*Phoca vitulina*) (K. Ronald, personal communication). The second disadvantage associated with clumping about a single breathing hole occurs when a group basks together. Although there may be some advantage in having several seals watching for predators, if a bear stalks near enough to charge, not all seals may be able to get down the breathing hole in time, which was what happened in the only successful kill by stalking that I observed.

Acknowledgments

This study was supported by the Canadian Wildlife Service, Department of the Environment. I am particularly grateful to the following: The Polar Continental Shelf Project for logistic support; my wife, Stella, for assistance in the field; D. Andriashek and Roxy Smiley for

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assistance in the tabulation of data; C. Jonkel and K. Ronald for permission to use unpublished observations; and C. Jonkel for constructive criticism of the manuscript.

FREUCHEN, O., and F. SALOMONSEN. 1959. The arctic year. Cape, London.

HALL, C. F. 1864. Life with the Esquimaux. Vol. 2. Sampson, Low, Son, and Marston, London.

HARINGTON, C. R. 1968. Denning habits of the polar bear (*Ursus maritimus* Phipps). Can. Wildl. Serv. Rep. Ser. 5.

JONKEL, C. 1970. Behaviour of captured North American bears (with comments on bear management and research). BioScience, 1970: 1145–1147.

JONKEL, C., G. B. KOLENOSKY, R. J. ROBERTSON, and R. H. RUSSELL. 1972. Further notes on polar bear denning habits. *In* Bears—their biology and management. *Edited by* S. Herrero. IUCN New Ser. No. 23. pp. 142–158.

LØNØ, O. 1970. The polar bear (*Ursus maritimus* Phipps) in the Svalband area. Nor. Polarinst. Skr. **149**: 103.

RUSSELL, R. 1971. The summer and autumn food habits of island and mainland populations of polar bears. A comparative study. M.Sc. Thesis, University of Alberta, Edmonton, Alberta.

SMITH, T. G. 1973. Population dynamics of the ringed seal in the Canadian Eastern Arctic. Fish. Res. Board Can. Bull. **181**.

STEFANSSON, V. 1913. My life with the Eskimo. McMillan, New York.

——— 1921. The friendly arctic. McMillan, New York.

STIRLING, I. 1973. Vocalization in the ringed seal (*Phoca hispida*). J. Fish. Res. Board Can. **30**: 1592–1594.

STIRLING, I., and C. JONKEL. 1972. The great white bears. Nat. Can. (Ottawa), **1**: 15–18.

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ARCTIC
VO. 48, NO. 2 (JUNE 1995) P. 147–154

Distribution and Abundance of Canadian Polar Bear Populations: A Management Perspective

MITCHELL TAYLOR[1] AND JOHN LEE[1]

(*Received 13 January 1992; accepted in revised form 16 January 1995*)

ABSTRACT. Seasonal fidelity to relatively local areas and natural obstacles to movements allow the range of polar bears (*Ursus maritimus*) in Canada to be divided into 12 relatively distinct populations. These divisions are not the only ones possible, and may not be the best ones; however, they were consistent with observed movements of marked bears. The average area of sea ice (mainly annual ice) that constitutes polar bear habitat for populations within and shared with Canada was estimated to total approximately 3.1 million km^2 in April each year. The density estimates of polar bears ranged between 1.1 and 10.4 bears per 1000 km^2 with a weighted mean of 4.1 bears per 1000 km^2. The sum of polar bear population estimates within or partially within Canada is approximately 12 700. However, the available data were insufficient to quantify the precision and accuracy of some population estimates.

Key words: abundance, Arctic, bear, distribution, polar bear, population, *Ursus maritimus*

RÉSUMÉ. La fidélité saisonnière des ours polaires (*Ursus maritimus*) à des régions suffisamment délimitées et des obstacles naturels à leurs déplacements permettent de diviser leur territoire au Canada en 12 populations relativement distinctes. Cette division n'est pas la seule possible et elle n'est peut-être pas la meilleure; elle cadre cependant avec les déplacements d'ours marqués que l'on a observés. On estime à environ 3,1 millions de km^2, en avril de chaque année, la superficie moyenne de la glace de mer (surtout de glace annuelle) qui constitue l'habitat de l'ours polaire pour les populations vivant à l'intérieur du Canada, ou communes à d'autres pays. L'estimation de la densité des ours polaires va de 1,1 à10,4 ours par 1000 km^2, avec une moyenne pondérée de 4,1 ours par 1000 km^2. Le total des populations d'ours polaires dont le territoire est situé en tout ou en partie au Canada est estimé à environ 12 700 individus. Les données disponibles sont cependant insuffisantes pour quantifier la précision et l'exactitude de certaines estimations de population.

Mots clés: abondance, Arctique, ours, distribution, ours polaire, population, *Ursus maritimus*

Traduit pour la revue *Arctic* par Nésida Loyer.

INTRODUCTION

Polar bears are not circumpolar nomads as was once believed (Pederson, 1945); neither do they exist as genetically isolated stocks (Larsen et al., 1983). Land barriers, sea ice type, and sea ice movements have been proposed as explanations for the limited exchange observed between geographical areas (Lentfer, 1974, 1983; Stirling et al., 1975, 1977, 1980, 1984; Jonkel et al., 1976; Schweinsburg et al., 1982; Furnell and Schweinsburg, 1984; Larsen, 1985). More recently, seasonal fidelity to local areas (home ranges) has been suggested as another factor that may explain the tendency of marked animals to be recaptured close to the initial capture site (Amstrup, 1986; Stirling et al., 1988). Sea ice and land barriers to movements and a continuum of overlapping home ranges are not mutually exclusive hypotheses, because the barriers to movements are relative rather than absolute.

The International Agreement for the Conservation of Polar Bears of 1972 (Stirling, 1986) triggered an increased effort by the five arctic nations (Canada, United States, Greenland/Denmark, Norway, Russia) to place polar bear management on a scientific basis throughout the circumpolar basin. This effort has been particularly intensive in Canada, where about 692 polar bears per year (1986/87–1990/91 annual average) are harvested or killed to defend life or property.

Our purpose is to examine the geographic boundaries of the 12 polar bear populations that are within or are shared with Canada, to list the population estimates available for these subgroups, to provide an estimate of the area of sea ice habitat used by polar bears in these populations, and thereby to estimate the density of each subgroup. We also consider some aspects of the existing data that may distort current perceptions of polar bear population numbers and spatial units.

Ricklefs (1986:507) notes: "Ecologists apply the term population very loosely to pragmatically defined assemblages of individuals of one species." Similarly, Lincoln et al. (1982:199) define a population as: "A group of organisms of one species, occupying a defined area and usually isolated to some degree from other similar groups." We use the term population to mean simply the individual polar bears that inhabit a given geographic area. We do not claim that the populations thus defined are genetically isolated, nor do we

[1] Department of Renewable Resources, 600, 5102 - 50th Avenue, Yellowknife, Northwest Territories X1A 3S8, Canada
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claim that the geographic boundaries are absolute. We acknowledge that immigration and emigration do occur.

For management purposes, populations should be sufficiently large that the effects of immigration and emigration on population dynamics can be ignored relative to rates of birth and death within the enclosed area. Canadian polar bear populations were chosen to conform to the above criteria, and to be as small as possible to confer a sense of stewardship on the communities that harvest polar bears from the population. Ideally, a boundary line would fall where there were land, sea-ice, or open-water barriers to movement; however, a continuum of overlapping home ranges could be meaningfully divided into populations if the units were sufficiently large. We examine only populations that have already been proposed as polar bear management units.

We did not attempt to determine which population boundaries were optimal, because the data were insufficient to approach that question in an objective way. Our data were mainly observations of movements of bears that were marked and recaptured, or marked and killed by hunters. These data were biased, in that the only movements that could have been observed were between locations where bears had been marked and locations where bears had been recaptured or killed. Both initial marking and subsequent recapture or hunting activities were geographically non-random. These data could not provide unbiased estimates of migration rates. However, these data were sufficient to examine the null hypothesis of equal use of adjacent areas (e.g., populations so small that individuals used adjacent population areas equally).

The populations proposed as management units were based partly on reconnaissance data that indicated sea ice and land barriers to movements (C. Jonkel as related by I. Stirling, pers. comm. 1992), discontinuities to movements as determined by mark-recapture and mark-kill (Lentfer, 1974, 1983; Stirling et al., 1975, 1977, 1980, 1984; Jonkel et al., 1976; Schweinsburg et al., 1982; Furnell and Schweinsburg, 1984; Larsen, 1985), and partly on management considerations given the geographic location of polar bear harvest activity. The current boundaries (Fig. 1) were established by the Canadian Federal-Provincial Polar Bear Technical Committee, which modified the initial boundaries after reviewing published and unpublished data, reconnaissance surveys, ice maps, land forms, and ocean currents (Calvert et al., in press).

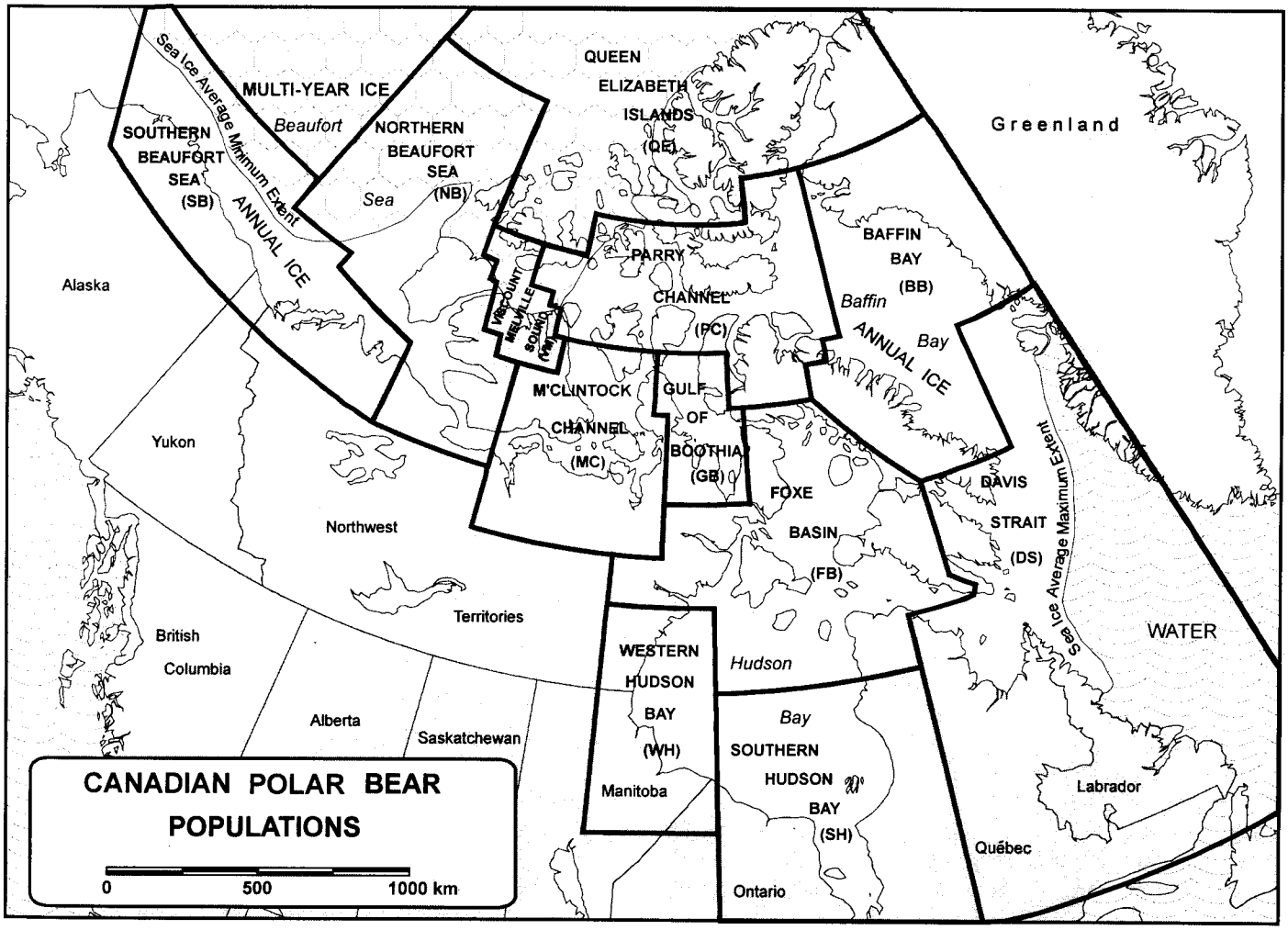


FIG. 1. Analysis based on the movements of marked and recaptured/killed polar bears indicates that Canada has twelve polar bear populations. Four are shared with other countries. The average southern limit of sea ice and the average northern retreat of sea ice are shown.

METHODS

Capture and Marking

Polar bears were captured mainly from a helicopter using remote injection equipment (Cap-Chur, Palmer Chemicals Ltd., Douglasville, Georgia). Capture and marking techniques have been described by Lentfer (1968), Larsen (1971), Schweinsburg et al. (1982), and Ramsay and Stirling (1986). Each animal handled was permanently marked with an individual identification tattoo and ear tags.

Population Boundaries

We evaluated population boundaries by comparing movements of individual animals between two adjacent areas (Lentfer, 1983). The null hypothesis was that a population in question occupies the two areas as all or a subset of its range (i.e., we hypothesize equal use of adjacent areas). If the proposed populations were too small to be meaningful, polar bears would as likely be found in an adjacent population as in the one where they were initially captured. We evaluated the null hypothesis of equal use of adjacent populations (e.g., I and II) with a Fisher's exact test (Fisher, 1958) analysis of a 2×2 contingency table which tabulates bears recaptured in population I that were marked in populations I and II, and bears recaptured in population II that were marked in populations I and II. The Fisher's exact test examines the equality of the ratios (I→I)/(II→I) to (I→II)/(II→II) which would be equal under the null hypothesis. We considered differences to be significant at the $p \leq 0.05$ level.

Some areas compared were adjacent to more than one area. Animals could have moved to adjacent areas that were not included in the relevant pair-wise comparison. The Bonferroni rule of joint confidence (Miller, 1966; Neu et al., 1974) was employed to determine the probability required for rejection of a family of 12 adjacent populations. Only pair-wise comparisons were made to ensure that all animals in a given analysis had access to both categories (Byers et al., 1984). Although no area bordered all other areas, the family of 12 (all areas possible) correction to the rejection criteria was chosen to ensure the test was conservative (i.e., that although the power of the test was reduced, the probability of rejecting a true null hypothesis by chance was definitely less than 0.05).

All marked individuals were permanently and uniquely marked in all populations, and the marks were assumed to be always recognized. The only exception was for the Foxe Basin and surrounding populations, where the mark-recapture data was augmented with between year (spring to spring) radio telemetry locations. Not all bears with radio collars were located each spring, and only one movement (April to April) was recorded per bear.

Population Estimates

Population estimates were obtained using various mark-recapture models (Calvert et al., in press; Table 1). The estimates for populations Southern Hudson Bay, Foxe Basin, Davis Strait, M'Clintock Channel, Gulf of Boothia, Southern Beaufort Sea, and Northern Beaufort Sea were calculated using an age-constant survival rate model (DeMaster et al., 1980) to estimate the number of marked animals in the population. The survival rate was estimated from the standing age structure (Chapman and Robson, 1960).

Density Estimates

We estimated the density of polar bears by dividing the population estimate by the average area of available habitat in April. Definition of available habitat was guided by Stirling et al. (1975) and Stirling (1988), who indicated that multi-year ice was not frequently used by polar bears. The area of polar bear habitat was delineated by the average southern extent of the ice pack in winter, and the average northern retreat of the ice pack in summer. Areas containing some multi-year ice, but south of the average summer ice edge, were included with areas that were ice free in summer as "polar bear habitat." The areas of habitat, excluding islands, were measured using a digital polar planimeter and on the basis of ice coverage information (Weeks, 1978; Dey et al., 1979). All areas were measured twice to determine the mean deviation, and to check for mechanical or operator error. The mean deviation was 0.89% and the maximum deviation was 2.7% in the replicate measurements. We used the average of the two measurements.

RESULTS

The data are summarized with Fisher's exact test tables (Fig. 2). The null hypothesis of equal use was rejected for pair-wise comparisons of all 12 proposed populations of polar bears (Fig. 1) within or shared with Canada (Table 1). The existing data were insufficient to estimate exchange rates between areas.

The sum of the population estimates indicated that the total population of polar bears within or shared with Canada was approximately 12 670 (Table 2). The existing data were inadequate to quantify the precision and accuracy of some individual or the summed estimates (Calvert et al., in press). The spring densities of Canadian polar bear populations ranged between 10.4 and 1.1 bears/1000 km^2 of habitat (Table 2). The average density was 4.1 bears/1000 km^2.

DISCUSSION

Our analysis was not sufficient to discriminate between the "barrier to movements" and the "overlapping home range" possibilities, because either mechanism would result in animals not moving freely between the two areas. Polar bears are extremely mobile, and absolute barriers to movements have not been identified for any populations. Mating between individuals from widely separated populations is probably

TABLE 1. Equal use tests for adjacent polar bear population areas are given for each North American pair. The rejection criteria for two-tailed 95% confidence intervals for families of 12 was determined to be $2 ¥ 10^{-3}$ using the Bonferroni rule of joint confidence.

Population Comparisons	Fisher's Exact Test (two-tailed probability)
Western Hudson Bay - Southern Hudson Bay	3.2×10^{-164}
Western Hudson Bay - Foxe Basin	6.4×10^{-178}
Southern Hudson Bay - Foxe Basin	1.8×10^{-67}
Foxe Basin - Baffin Bay	2.9×10^{-65}
Foxe Basin - Davis Strait	8.9×10^{-45}
Foxe Basin- Gulf of Boothia	7.1×10^{-39}
Foxe Basin - Parry Channel	2.6×10^{-106}
Baffin Bay - Davis Strait	6.4×10^{-42}
Baffin Bay - Parry Channel	1.7×10^{-65}
Viscount Melville Sound - M'Clintock Channel	2.2×10^{-39}
Viscount Melville Sound - Parry Channel	2.2×10^{-54}
Viscount Melville Sound - Queen Elizabeth Islands	4.8×10^{-5}
Viscount Melville Sound - Northern Beaufort Sea	4.9×10^{-46}
M'Clintock Channel - Gulf of Boothia	2.9×10^{-26}
M'Clintock Channel - Parry Channel	2.6×10^{-92}
M'Clintock Channel - Northern Beaufort Sea	5.7×10^{-80}
Gulf of Boothia - Parry Channel	1.2×10^{-40}
Parry Channel - Queen Elizabeth Islands	8.2×10^{-5}
Queen Elizabeth Islands -Northern Beaufort Sea	5.2×10^{-6}
Southern Beaufort Sea - Northern Beaufort Sea	1.3×10^{-32}

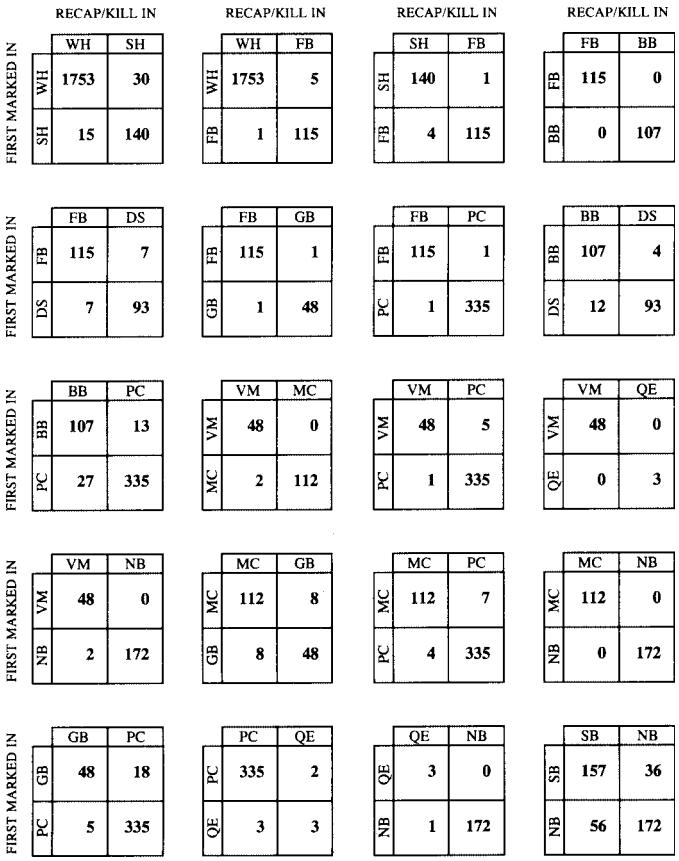


FIG. 2. Equal use tests for adjacent polar bear population areas were based on pair-wise comparisons (Fisher's Exact Test) of movements for the following populations: Southern Hudson Bay (SH), Western Hudson Bay (WH), Foxe Basin (FB), Davis Strait (DS), Baffin Bay (BB), Parry Channel (PC), Queen Elizabeth Islands (QE), Gulf of Boothia (GB), M'Clintock Channel (MC), Viscount Melville Sound (VM), Northern Beaufort Sea (NB), and Southern Beaufort Sea (SB).

TABLE 2. Current Canadian polar bear population numbers (Calvert et al., in press) and densities on the spring (April) sea ice are given for the Western Hudson Bay (WH), Southern Hudson Bay (SH), Foxe Basin (FB), Baffin Bay (BB), Davis Strait (DS), Viscount Melville Sound (VM), M'Clintock Channel (MC), Gulf of Boothia (GB), Parry Channel (PC), Queen Elizabeth Islands (QE), Southern Beaufort Sea (SB), and Northern Beaufort Sea (NB).

Population	Number	Habitat Area ($1000 km^2$)	Density per $1000 km^2$
WH[1]	1200	pooled[1]	3.5
SH[1]	1000	pooled[1]	3.5
90% of FB[1]	1820	pooled[1]	3.5
WH + SH + 90% FB[1]	4020	1148.4[1]	3.5
BB	470	413.5	1.1
DS	950	420.1	2.3
VM	230	46.8	4.9
MC	700	146.5	4.7
GB	900	86.8	10.4
PC	2000	338.0	5.9
QE	200	54.0	3.7
SB	1800	255.9	7.0
NB	1200	183.8	6.5
	Σ = 12 672[1]	Σ = 3 093.8	
		Weighted mean density:	4.1
		Standard deviation:	2.64
		Coefficient of variation:	0.528

[1] Approximately 90% of FB population is located in Hudson Bay in spring. The other 10% is distributed at very low density in Foxe Basin. The WH, SH, and FB populations are separate during the ice-free season. However, during the winter and spring, these populations are intermixed in Hudson Bay and western Hudson Strait. We pooled the three population estimates and used the total Hudson Bay-Hudson Strait area to determine a common spring density estimate for these populations. Foxe Basin sea ice was not included because of the strong currents and shallow water there. The sum of the population estimates includes the 10% of the FB population that is located in Foxe Basin in April.

not frequent, but there has been no suggestion that genetic differences between polar bears from different geographic areas are sufficient to provide barriers to interbreeding (Larsen et al., 1983; Cronin et al., 1991). The populations specified are intended as management units which may also be ecological units.

The data were not collected in a manner that would allow meaningful calculation of exchange rates across the proposed boundaries. Observations of mark-recapture polar bear movements depend on polar bear movements and on geographic allocation of capture and recapture effort. Logistic constraints and an emphasis in most areas on capturing as many bears as possible made the geographic allocation of capture effort highly non-random.

Population boundaries imply barriers to movements between populations. For many management purposes (e.g., allocation of polar bear quotas), it would be useful if these boundaries were absolute, so that harvest activities only affected the populations where the harvest occurred. However, limited exchange is also sufficient to establish useful

boundaries. In the case of overlapping home ranges, the size of the home range relative to the population area determines the usefulness of a proposed boundary. The average home range should be small compared to the population area. When there is an actual barrier to movements causing a discontinuity in distribution, the location of the boundary is fixed. Our population boundaries range between these two extremes. Although we rejected the hypothesis of equal use for all 12 populations, this is not a demonstration that these are the only or the best population units for management, or any other purpose. Our evidence and the existing data support the boundaries that are being used, but these boundaries may be modified as more information becomes available. Recent studies (Amstrup, 1995) suggest the boundaries proposed (Fig. 1) can be examined more critically using satellite telemetry.

Satellite telemetry results in Alaska (Amstrup, 1995) corroborate Stirling's (1988) suggestion that spring polar bear densities are low in areas dominated by multi-year ice. About 68% of the polar ice region (measured during maximum seasonal ice coverage) is suitable habitat for polar bears. The remainder is heavy multi-year pack ice. This multi-year ice is suitable for denning because of the snow drifts which form on the rough ice and the low densities of other (particularly adult male) polar bears (Amstrup and Gardner, 1994).

The two lowest densities estimated were for the Baffin Bay (1.1/1000 km^2) and Davis Strait (2.3/1000 km^2) populations. The estimate for the Baffin Bay population was calculated after a period of over-harvest that may have reduced the population (Lloyd, 1986). It is also possible that these populations were underestimated by studies that captured polar bears in coastal areas only. The high density observed for the Gulf of Boothia population (10.4/1000 km^2) is consistent with reconnaissance surveys (Taylor, unpubl. data) and local information. Alternatively, the high density recorded may suggest that the population estimate for this area should be used with caution until it can be confirmed.

Using similar methods, Amstrup and DeMaster (1988) estimated the density of polar bears in the Southern Beaufort Sea as 5.1/1000 km^2, and in the Canadian portion of the Southern Beaufort Sea and Northern Beaufort Sea as 8.3/1000 km^2.

The density of barrenland grizzly bears (*Ursus arctos*) along the arctic coast of Canada has been reported as 3.8–4.7/1000 km^2 (Nagy et al., 1983) and 10.0–10.5/1000km^2 (Clarkson and Liepins, 1992). Reynolds and Garner (1987) reported grizzly densities of 22.9/1000 km^2 in the western Brooks Range and 6.8/1000 km^2 in the eastern Brooks Range. The density of wolves (*Canis lupus*) in the National Petroleum Reserve in Alaska was reported to be 1.9–2.6/1000 km^2 (Stephenson, 1979), and in the Arctic National Refuge of Alaska 1.4–1.5/1000 km^2 (Weiler and Garner, 1987). Polar bear densities (average = 4.1/1000 km^2, Table 2) appear to be similar to other populations of carnivores at arctic latitudes.

Populations occurring in areas of mixed annual and multi-annual ice appear to support higher densities than areas that do not contain multi-year ice. The habitats of the Western Hudson Bay, Foxe Basin, Baffin Bay, and Davis Strait populations are mainly unconsolidated annual pack ice in spring. The estimated densities for these areas ranged between 1.0 and 3.2 per 1000 km^2. In comparison, the densities in areas where there is a mixture of relatively consolidated multi-year and annual ice (i.e., M'Clintock Channel, Gulf of Boothia, Parry Channel, Southern Beaufort Sea, Northern Beaufort Sea) ranged between 4.7 and 10.4 per 1000 km^2.

Comparison of densities in different areas is complicated by local differences in the spring sea ice habitat. Exclusion of the multi-year sea ice and land areas restricts the habitat to shorefast ice and active pack ice. Stirling et al. (1981) documented differences in polar bear densities between shorefast ice, floe edge, and active ice containing mixed annual and multi-year ice in the Beaufort sea. Some areas such as M'Clintock Channel and Amundsen Gulf are covered entirely by landfast ice. Other areas such as Hudson Bay and Baffin Bay are mainly unconsolidated annual pack ice. A measure which lumps both types of habitat must be regarded as a first approximation. However, the distribution of ice types and relative use by polar bears has been documented only for the eastern Beaufort Sea (Stirling et al., 1981).

Stirling (1988) suggested that the world total number of polar bears could be represented as 14 populations totalling 21 000 polar bears. The population estimates given were for overlapping areas in several cases, and some areas were not included. Stirling (1988) further suggested that the total population might be as large as 40 000 animals because of incomplete or inaccurate survey data. Extrapolation of the mean density observed in Canada to the total "polar bear habitat" (same criteria as in Methods) in the circumpolar basin suggests a world population of approximately 28 000 animals. A recent status report (IUCN/SSC Polar Bear Specialists Group, in press) estimated the total number of polar bears at between 21 470 and 28 370. On the basis of this range of estimates, Canada appears to contain roughly half of the world's polar bears.

The accuracy of polar bear mark-recapture population estimates has been limited by non-random capture of animals and poor estimates of adult survival. Logistic limitations have restricted most polar bear capture work to areas accessible from arctic communities. Analyses of recapture and harvest movement data document that polar bears show seasonal fidelity to local areas, and that the fidelity to a given location is greatest in areas where the sea ice melts completely (e.g., Hudson Bay) and in areas where movements are constrained by island archipelagos (Table 1, Stirling et al., 1975, 1977, 1980, 1984; Jonkel et al., 1976; Stirling and Kiliaan, 1980; DeMaster and Stirling, 1981; Schweinsburg et al., 1982; Taylor, 1982; Larsen et al., 1983; Lentfer, 1983; Furnell and Schweinsburg, 1984; Amstrup et al., 1986). The observed ratios of marked to unmarked animals (and the subsequent population estimates) have been influenced by the geographic areas where polar bears were marked, and the geographic areas where recapture effort was allocated. The degree of "capture bias" has not been quantified for any polar bear mark-recapture estimates.

The various multi-year mark-recapture models vary mainly in the manner by which the mortality of marked animals is

estimated. For reasons not clearly understood, models that estimate the survival of marked animals from multi-year mark-recapture sampling have not provided reasonable estimates of annual survival in some studies (DeMaster et al., 1980). Polar bear population estimates for the Southern Beaufort Sea (Amstrup et al., 1986), Northern Beaufort Sea (Stirling et al., 1988), Viscount Melville, M'Clintock Channel, Gulf of Boothia (Schweinsburg et al., 1981; Furnell and Schweinsburg, 1984), Parry Channel (Schweinsburg et al., 1982), Baffin Bay (Lloyd, 1986), Davis Strait (Stirling et al., 1980), Southern Hudson Bay (G. Kolenosky, unpubl. data 1992), and Svalbard (Larsen, 1985) use a modified Lincoln-Peterson method proposed by DeMaster et al. (1980) which estimates the survival of marked animals by log-linear regression of the standing age distribution. Chapman and Robson (1960) showed that the logarithmic transformation introduces bias into the geometric survival model. Caughley (1977) noted that either approach yields an estimate of survival rate only when the population is stable and stationary.

The assumption of stable age distribution cannot be tested directly without better estimates of survival rates. However, the assumption that the population is simultaneously stable and stationary (i.e., population growth rate = 1.0) can be examined by using observed recruitment and survival rate estimates to project the stable age population growth rate (λ_s). Caughley (1977:118) notes that if the population is at stable age distribution, and if the survival rate is age constant, the geometric rate of decline in numbers at age ($\varnothing$) will be the ratio of annual survival rate to λ_s. If $\lambda_s = 1.0$ (i.e., stationary), then $\varnothing$ = annual survival rate. A correct projection model using $\varnothing$ as the survival rate estimate should recover a λ of 1.0 for any stable age population regardless of its true rate of increase (Caughley, 1977:119). Chapman-Robson estimates of $\varnothing$ for the above-mentioned populations are included with the associated λ_s projections (Table 3). The population projections used cub survival and recruitment estimates at or exceeding the maximum average rates observed for arctic polar bears (Taylor et al., 1987). The assumption that the populations were stable and stationary was not supported for most areas examined (Table 3). The annual survival rate of weaned female polar bears must equal or exceed 0.93 or the population will decline (Table 3).

The age distributions must be unstable or Caughley's (1977:118) tautology would be satisfied. An unstable population is by definition not a stationary population because λ will vary year by year until the age distribution becomes stable. The estimate of λ may be incorrect because maximum rates for recruitment and reproduction were chosen. However, in all cases the projected λ was less than 1.0. Using vital rates less than the maximum would have increased the disparity observed in Table 3. If survival rates were overestimated, the population estimate would be biased upwards and if the survival rates were underestimated, the population estimates would be biased downwards. However, the implications for the population estimates which employed age structure survival estimates are unclear, because the direction and magnitude of bias in survival rate estimates have not been quantified.

TABLE 3. The truncated Chapman-Robson (1960) estimate of the age constant, annual rate of decrease in numbers per age class ($\varnothing$) is given for 7 populations of North American polar bears. The "Pooled" population was obtained by pooling all Canadian data except that collected from the Churchill, Manitoba (Western Hudson Bay) population. Assuming favourable recruitment and cub survival rates (Taylor et al., 1987) and assuming $\varnothing$ to be the annual survival of females older than age 2, the female population growth rate (λ) at stable age distribution is given. The annual survival of weaned female polar bears ($\varnothing$) must equal or exceed 0.93 or the population will decline. The populations are identified as follows: Baffin Bay (BB), Davis Strait (DS), Viscount Melville Sound (VM), M'Clintock Channel (MC), Gulf of Boothia (GB), Parry Channel (PC), Southern Beaufort Sea (SB), and Northern Beaufort Sea (NB).

Population	Reference	C-R $\varnothing$	λ
Pooled	Taylor, unpubl. data	0.861	0.938
BB	Taylor, unpubl. data	0.894	0.964
DS	Stirling et al. (1980)	0.932	1.004
VM+MC+GB	Furnell and Schweinsburg (1984)	0.871	0.946
PC	Schweinsburg et al. (1981)	0.879	0.952
SB	Amstrup et al. (1986)	0.888	0.959
NB	Stirling et al. (1988)	0.849	0.928

SUMMARY

It is currently suggested that there are about 12 700 polar bears in twelve populations that are within or shared with Canada. Our analysis supported the population divisions that have been proposed; however, the data to unambiguously define population boundaries were not available. These boundaries and estimates of the population numbers and population densities should be regarded as tentative. Difficulties with the data and analysis models allow unambiguous confidence intervals on population numbers for only a few areas. Similarly, investigations of ice type distribution and polar bear habitat preference have remained at reconnaissance levels except for the eastern Beaufort Sea. However, the consistency of density estimates developed from the corrected population estimates and a first approximation of spring polar bear habitat is reason to be optimistic about the accuracy of the various approximations.

The impact of toxic chemicals, global warming, point source contamination (oil spills), and harvest cannot be evaluated without accurate estimates of population numbers and a better understanding of polar bear movements and fidelity to local areas. The initial inventory of polar bears within or shared with Canada in only 20 years stands as a remarkable achievement. However, that inventory is dated and uncertain in many areas. Management of Canada's polar bear harvest within the guidelines of the International Agreement for the Conservation of Polar Bears will require a continued commitment to improving the information on polar bear distribution and abundance.

ACKNOWLEDGEMENTS

The figures were prepared by J.E. Troje and H.D. Cluff. I. Stirling, R.E. Schweinsburg, G. Kolenosky and their research associates contributed unpublished data. Particular thanks to the Canadian Federal-Provincial Polar Bear Technical Committee for their contributions and to H. D. Cluff, L. MacDonald, K. McCullough, F. Messier, C. Shank, I. Stirling, A. Sutherland, and anonymous reviewers for comments on earlier drafts.

REFERENCES

AMSTRUP, S.C. 1986. Research on polar bears in Alaska, 1983–1985. In: Polar Bears: Proceedings of the Ninth Working Meeting of the IUCN/SSC Polar Bear Specialists Group, 9–11 August 1985, Edmonton, Alberta, Canada. Gland, Switzerland: International Union for the Conservation of Nature and Natural Resources. 85–115.

———. 1995. Movements, distribution, and population dynamics of polar bears in the Beaufort Sea. Ph.D. dissertation. University of Alaska, Fairbanks, Alaska. 299 p.

AMSTRUP, S.C., and DEMASTER, D.P. 1988. Polar bear (*Ursus maritimus*). In: Lentfer, J.W., ed. Selected marine mammals of Alaska: Species accounts with research and management recommendations. Washington D.C.: Marine Mammal Commission. 39–56.

AMSTRUP, S.C., and GARDNER, C. 1994. Polar bear maternity denning in the Beaufort Sea. Journal of Wildlife Management 58:1–10.

AMSTRUP, S.C., STIRLING, I., and LENTFER, J.W. 1986. Past and present status of polar bears in Alaska. Wildlife Society Bulletin 14:241–254.

BYERS, C.R., STEINHORST, R.K., and KRAUSMAN, P.R. 1984. Clarification of a technique for analysis of utilization-availability data. Journal of Wildlife Management 48:1050–1053.

CALVERT, W., TAYLOR, M., STIRLING, I., KOLENOSKY, G.B., KEARNEY, S., CRETE, M., and LUTTICH, S. In press. Polar bear management in Canada 1988–1992. In: Wigg, Ø., Born, E., and Garner, G.W., eds. Proceedings of the 11th Working Meeting of the IUCN/SSC Polar Bear Specialists Group 1993. Occasional Papers of the IUCN Species Survival Commission (SSC) 7.

CAUGHLEY, G. 1977. Analysis of vertebrate populations. Toronto: John Wiley & Sons. 234 p.

CHAPMAN, D.G., and ROBSON, D.S. 1960. The analysis of a catch curve. Biometrics 6:354–368.

CLARKSON, P.L., and LIEPINS, I. 1992. Inuvialuit wildlife studies: Grizzly bear research progress report 1989–1991. Manuscript report. Yellowknife: Department of Renewable Resource. 26 p.

CRONIN, M.A., AMSTRUP, S.C., GARNER, G.W., and VYSE, E.R. 1991. Interspecific and intraspecific mitochondrial DNA variation in North American bears (*Ursus*). Canadian Journal of Zoology. 69:2985–2992.

DEMASTER, D.P., and STIRLING, I. 1981. Mammalian species – *Ursus maritimus*. The American Society of Mammalogists, Special Publication 145:1–7.

DEMASTER, D.P., KINGSLEY, M.C.S., and STIRLING, I. 1980. A multiple mark and recapture estimate applied to polar bears. Canadian Journal of Zoology 58:633–638.

DEY, B., MOORE, H., and GREGORY, A. 1979. Monitoring and mapping sea ice breakup and freeze-up of Arctic Canada from satellite imagery. Arctic and Alpine Research 11:229–242.

FISHER, R.A. 1958. Statistical methods for research workers. New York: Hafner. 356 p.

FURNELL, D.J., and SCHWEINSBURG, R.E. 1984. Population dynamics of Central Arctic polar bears. Journal of Wildlife Management 48:722–728.

IUCN/SSC POLAR BEAR SPECIALISTS GROUP. In press. Proceedings of the 11th Working Meeting of the IUCN/SSC Polar Bear Specialists Group 1993. Wigg, Ø., Born, E., and Garner, G.W., eds. Occasional Papers of the IUCN Species Survival Commission (SSC) 7.

JONKEL, C., SMITH, P., STIRLING, I., and KOLENOSKY, G.B. 1976. The present status of the polar bear in the James Bay and Belcher Islands area. Ottawa: Canadian Wildlife Service Occasional Paper No. 26. 42 p.

LARSEN, T. 1971. Capturing, handling, and marking polar bears in Svalbard. Journal of Wildlife Management 35:27–36.

———. 1985. Abundance, range, and population biology of the polar bear (*Ursus maritimus*) in the Svalbard area. Ph.D. thesis, University of Oslo, Norway. 127 p.

LARSEN, T., TEGELSTRØM, H., JUNEJA, R.K., and TAYLOR, M.K. 1983. Low protein variability and genetic similarity between populations of the polar bear (*Ursus maritimus*). Polar Research n.s. 1:97–105.

LENTFER, J.W. 1968. A technique for immobilizing and marking polar bears. Journal of Wildlife Management 32:317–321.

———. 1974. Discreteness of Alaskan polar bear populations. XI International Congress of Game Biologists. Stockholm, Sweden. September 3–7, 1973. 323–329.

———. 1983. Alaskan polar bear movements from mark and recapture. Arctic 36:282–288.

LINCOLN, R.J., BOXSHALL, G.A., and CLARK, P.F. 1982. A dictionary of ecology, evolution, and systematics. Cambridge: Cambridge University Press. 298 p.

LLOYD, K. 1986. Cooperative management of polar bears on northeast Baffin Island. In: Native People and Renewable Resource Management. The 1986 Symposium of the Alberta Society of Professional Biologists. 108–116.

MILLER, R.G. 1966. Simultaneous statistical inferences. New York: McGraw-Hill Book Company. 272 p.

NAGY, J.A., RUSSELL, R.A., PEARSON, A.M., KINGSLEY, M.C.S., and LARSEN, C.B. 1983. A study of grizzly bears on the barren-grounds of Tuktoyaktuk Peninsula and Richards Island, 1974 to 1978. Unpubl. report. Available from the Canadian Wildlife Service, 5320 – 122nd Street, Edmonton, Alberta T6H 3S5, Canada. 136 p.

NEU, C.W., BYERS, C.R., and PEEK, J.M. 1974. A technique for analysis of utilization-availability data. Journal of Wildlife Management 38:541–545.

PEDERSON, A. 1945. Der Eisbär: Verbreitung und lebensweise. Copenhagen: E. Bruun and Company. 166 p.

RAMSAY, M.A., and STIRLING, I. 1986. Long-term effects of drugging and handling free-ranging polar bears. Journal of Wildlife Management 50:619–626.

REYNOLDS, H.V., and GARNER, G.W. 1987. Patterns of grizzly bear predation on caribou in northern Alaska. International Conference on Bear Research and Management 7:59–67.

RICKLEFS, R.E. 1986. Ecology. Second Edition. New York: Chiron Press Inc. 966 p.

SCHWEINSBURG, R.E., FURNELL, D.J., and MILLER, S.J. 1981. Abundance, distribution and population structure of polar bears in the lower Central Arctic Islands. Wildlife Service Completion Report No. 2. Yellowknife: Government of the Northwest Territories. 79 p.

SCHWEINSBURG, R.E., LEE, L.J., and LATOUR, P.B. 1982. Distribution, movement and abundance of polar bears in Lancaster Sound, Northwest Territories. Arctic 35:159–169.

STEPHENSON, R.O. 1979. The numbers and distribution of wolves in NPR-A. Fairbanks, Alaska: Alaska Department of Fish and Game. 30 p.

STIRLING, I. 1986. Research and management of polar bears *Ursus maritimus*. Polar Record 23:167–176.

———. 1988. Polar bears. Ann Arbor: The University of Michigan Press. 220 p.

STIRLING, I., and KILIAAN, H.P. 1980. Population ecology studies of the polar bear in northern Labrador. Canadian Wildlife Service Occasional Paper No. 42. 21 p.

STIRLING, I., ANDRIASHEK, D., LATOUR, P.B., and CALVERT, W. 1975. Distribution and abundance of polar bears in the eastern Beaufort Sea. Beaufort Sea Technical Report Number 2. Victoria: Department of the Environment. 59 p.

STIRLING, I., JONKEL C., SMITH, P., ROBERTSON, R., and CROSS, D. 1977. The ecology of the polar bear (*Ursus maritimus*) along the western coast of Hudson Bay. Canadian Wildlife Service Occasional Paper No. 33. 64 p.

STIRLING, I., CALVERT, W., AND ANDRIASHEK, D. 1980. Population ecology studies of the polar bear in the area of southeastern Baffin Island. Canadian Wildlife Service Occasional Paper No. 44. 33 p.

STIRLING, I., ANDRIASHEK, D., and CALVERT, W. 1981. Habitat preferences and distribution of polar bears in the western Canadian Arctic. Report for Dome Petroleum Ltd., Esso Resources Canada Ltd. and Canadian Wildlife Service, Edmonton, Alberta. 49 p.

STIRLING, I., CALVERT, W., AND ANDRIASHEK, D. 1984. Polar bear (*Ursus maritimus*) ecology and environmental considerations in the Canadian High Arctic. In: Olson, R., Geddes, F., and Hastings, R., eds. Northern ecology and resource management. Edmonton: The University of Alberta Press. 201–222.

STIRLING, I., ANDRIASHEK, D., SPENCER, C., and DEROCHER, A. 1988. Assessment of the polar bear population in the eastern Beaufort Sea. Final Report to the Northern Oil and Gas Action Program. Edmonton, Alberta: Canadian Wildlife Service. 81 p.

TAYLOR, M.K. 1982. The distribution and abundance of polar bears (*Ursus maritimus*) in the Beaufort and Chukchi Seas. Ph.D. thesis, University of Minnesota. 353 p.

TAYLOR, M.K., BUNNELL, F., DEMASTER, D.P., and SCHWEINSBURG, R.E. 1987. Modelling the sustainable harvest of female polar bears. Journal of Wildlife Management 51: 811–820.

WEEKS, W.F. 1978. Sea ice conditions in the Arctic. Glaciological data, report GD-2, Arctic Sea Ice 1:1–20.

WEILER, G.J., and GARNER, G.W. 1987. Wolves of the Arctic National Wildlife Refuge: Their seasonal movements and prey relationships. ANWR Progress Report No. FY86-7. In: Arctic National Wildlife Refuge Coastal Plain Resource Assessment 1985 Update report. Baseline Study of the Fish, Wildlife, and their Habitats. Vol II, Section 1002C, Alaska National Interest Lands Conservation Act. Anchorage, Alaska: U.S. Fish and Wildlife Service. 692–763.

Questions and Responses from June and October Community Information Sessions

TGS NOPEC Geophysical Company ASA, Petroleum GeoServices and Multi Klient Invest AS

Northeastern Canada 2D Seismic Exploration Survey

November 2012

Introduction

This document has been prepared to share information and to continue communication with the communities of Kimmirut, Iqaluit, Pangnirtung, Qikiqtarjuaq, Clyde River and Pond Inlet. The questions in this document were asked in information sessions held in the communities in June and October 2012. Some of the responses were provided during the community sessions, however a few required additional research. All responses are included in this document.

All sources referenced throughout the report will be available at the hamlet office, or provided by email, upon request.

The questions and responses have been grouped into three subject areas:

- The Proposed Project
- Marine Mammals
- Seismic Surveys

The Proposed Project

Question: Who are you? What is the company that is doing this?
Response: We work for a company called NEXUS Coastal Resource Management. Our company was hired by Multi Klient Invest to facilitate dialogue with the communities. Multi Klient Invest AS is the company that will be operating and conducting the proposed 2D Seismic Survey.

Question: How far (depth) is it from the air gun to the ocean floor?
Response: The distance between the air gun and the ocean floor depends on the ocean bathymetry. The project map illustrates the bathymetry of Baffin Bay and Davis Strait. Bathymetry tells us how far away the ocean floor is from the surface. Since the air gun will be relatively near the surface of water (approximately 9 metres, or 27 feet), we can use the bathymetry to tell us how far the air gun will be from the surface. On this map, the darker the colour, going from light purple to dark blue, the further the ocean floor is from the surface. In some areas (dark blue), the air gun will be as far as 5km, roughly 15,000 feet or as close as 500 metres, which is roughly 1500 feet from the ocean floor.

Question: How long will the project take to complete?
Response: The proposed project could be over a span of five years, based on the results of the first year. The survey vessel will only be in operation during the ice-free months.

Question: How much impact will it (the proposed project) have?
Response: The design of the 2D seismic survey includes mitigation measures to lessen the project's impact on the environment. These mitigation measures include a 20 minute ramp up procedure, marine mammal observers, fisheries liaison officers, pollution prevention protocols, and communicating with communities. Past projects have shown that 2D seismic surveys have caused little to no effect to the marine environment.

Question: If and when something goes wrong on the project, is the company held accountable? How?
Response: The Project Proponents are committed to protecting the environment. There are protocols in place to prevent and clean up environmental damage caused by a vessel. These protocols follow international standards and regulations. The Arctic Shipping Pollution Prevention Act (ASPPA) and the Arctic Shipping Pollution Prevention Regulators (ASPPR) develop the protocols for having a vessel in Arctic waters. In addition, the vessel will have contingency plans and safety management systems on board. Also, the vessel will avoid areas of ice, as the survey cannot be completed near ice. This will reduce the chance of collision with an iceberg or ice floe.

Question: Was it the company's strategy to do this last minute so not many people would show up to the meeting?
Response: No, as was explained during the sessions, and in prior communications with the Hamlet, this information session is the first step of the engagement process. It was not the company's intention to have the meeting at the last minute. The purpose of this meeting is to explain the project and to gather community members' questions, concerns and suggestions and bring those questions, concerns and suggestions to the company. Communication with your community will continue. This can be in the form of further meetings, newspaper ads, posters, radio announcements, mail and email. Due to feedback about the meeting time, all future meetings will take into consideration that this is not an ideal time for public meetings.

Question: What happens with the information? Who has access?
Response: The information collected from the 2D seismic survey will be collected and held by the Project Proponent.

Question: What if they notice a lot of algae in the water during the survey? What will happen? Will the survey stop?
Response: This has been researched in the past. Studies have shown that algae are not negatively affected by the sound produced from 2D Seismic Surveys. The survey will not stop.

Question: This information is for the benefit of an oil company? For oil exploration, correct?
Response: The data and information documented throughout the survey can be used in a number of ways. In addition to learning about what's below the ocean floor, information about whales, fish, and the marine environment will be collected. The information collected may influence decisions that are made in the community. For example, we can further our understanding about whale migratory paths. The information collected about what's below the ocean floor is property of the Project Proponent and as such, they can sell that information to other companies.

Question: What type of benefit could a seismic test have (to residents)?
Response: There will be opportunities for residents to work on the project. As we have discussed, Marine Mammal Observers and Fisheries Liaison Officers will be hired from Nunavut. Community members that are trained to be Marine Mammal Observers and Fisheries Liaison Officers will bring new skills and knowledge back to Nunavut.

Question: What will the negative impacts be (from the project)?
Response: The potential impacts from the project may vary but a number of mitigation measures will be implemented to avoid or diminish these impacts. Possible effects of the project

on whales include short term behavioural changes and temporary hearing loss. As we have mentioned, the Project Proponents will be taking precautionary steps to avoid the possible negative effect of the project. These measures include following the 'Canadian Statement of Practice with respect to the Mitigation of Seismic Sound in the Marine Environment', having a Fisheries Liaison Officer to communicate with the fishery, and following the protocols put in place by Arctic Shipping Pollution Prevention Act (ASPPA), safety management systems, contingency plans, and the Arctic Shipping Pollution Prevention Regulators (ASPPR).

Question: Is this not the same project as the other seismic survey in Lancaster Sound that got stopped in 2010?
Response: No, this is not the Lancaster Sound project from 2010. This is a different project in a different area that is funded and operated by a different company.

Question: Will I have a say?
Response: Yes, that is why we are here. We are here on behalf of the Project Proponents to discuss the project with your community and to document your questions, concerns and ideas about this project. The Project Proponents would like to work with communities to so that the project can be mutually beneficial.

Question: What is the research for?
Answer: The research is to better understand the ocean floor for potential resource development

Question: Who is funding the project?
Answer: Multi Klient Invest is funding this project. They are wholly owned subsidiary of Petroleum GeoServices.

Question: Who is buying the data collected?
Answer: At this point in time no one has purchased the data collected. However, potential buyers of such information may include commercial fishery organizations, the Government and industry.

Marine Mammals

Question: Will the sound impact marine mammal migration?
Response: Sound generated by humans has been shown to impact some marine mammal migration. Determining the nature of the impact is a complex subject and depends on a variety of factors including: species, sex, age, presence of offspring, prior experience, time of year, location of the survey, and many others.

Bowhead whales have been shown to alter their migratory route by twenty to thirty kilometers in order to avoid the noise from seismic testing (Richardson, Miller & Greene, 1999). Humpback whales, gray whales and harbour porpoises have shown similar changes in behaviour, while some other species, such as sperm whales, have been shown to be far less deterred by the noise (Weilgart, 2007). However, summering bowheads showed no detectable avoidance of seismic surveys, no change in general activities or call activities (Richardson et al., 2007 in Weilgart, 2007).

While whales seem to generally avoid seismic noise, it has also been shown that some species, such as the humpback whale, will return to follow their normal migration route once they have passed the area of disturbance (McCauley et al. 2000). Determining the effect of man-made noise on migrating marine mammals remains highly uncertain.

Question: Is there research from Greenland that says if whales were harmed?
Response: Currently there are no scientific studies from Greenland looking at the effect of recent seismic survey activity on whales. This year a study was released providing insight into the seasonal presence of background noise in the North Atlantic (Klink et al, 2012). Observed seasonal variations in background noise levels were caused by human activities (seismic surveys, commercial shipping), ocean surface wind and whales communicating. The study did not determine if a seismic survey affected blue, fin and sperm whales. However, sounds from blue, fin and sperm whales were recorded seasonally at both study locations (Klink et al, 2012).

The National Environmental Research Institute of Denmark has also released guidelines for Environmental Impact Assessments in Greenland (Boertmann et al, 2009), which lists beluga, narwhal and bowhead whales, as well as walrus, as species particularly sensitive to seismic surveys (p.22).

Question: Is there an impact on hearing to whales and seals?
Response: It is difficult to know if an animal is negatively impacted as a result of this project. It is not ethical to capture marine mammals and subject them to testing in captivity. The available information on the impact of man-made noise to marine mammals and seals have been from modeling and direct observations during seismic surveys. Several papers have used models to predict the impact of sound intensity, measured in decibels (dB), on the hearing of marine mammals. The 'Canadian Statement of Practice on the Mitigation of Seismic Noise in the Marine Environment' states that at 500m, or 1500 feet, the sound intensity is at a level where no permanent damage would occur to marine mammals (based on what is known about marine mammals).

Question: Will the narwhal conservation area be bothered after this project is completed?
Response: No survey activity will occur within the narwhal conservation area and proposed seismic survey activity surrounding the conservation area is minimal. However, to mitigate any potential effects of the project on narwhal and other marine mammals during the proposed project, the proposed project will adhere to the 'Canadian Statement of Practice on the Mitigation of Seismic Noise in the Marine Environment'. If additional projects were to occur after this proposed 2D Seismic Survey, then Environmental Assessments would need to be completed for each project.

Question: Will the survey impact narwhal?
Response: The potential impacts, if any, on narwhal and other marine mammals will vary. These impacts may include behavioral changes, loss of hearing and the potential for death (if a marine mammal is directly underneath the sound source). However, to our knowledge, no marine mammal deaths have been directly linked to seismic surveys. The effect of seismic surveys on marine mammals will vary depending on the species and individuals within a species.

To limit the potential effect of the proposed project on narwhal and other marine mammals, the project proponent will implement mitigation measures. These mitigation measures include a 20-

minute ramp up procedure, marine mammal observers and passive acoustic monitoring. In addition, the proposed project will adhere to the 'Canadian Statement of Practice on the Mitigation of Seismic Noise in the Marine Environment'.

Question: How can you determine if you have harmed a marine mammal?
Response: In the marine environment, it is difficult to determine if a project has an effect on marine mammals as marine mammals are constantly moving and there are other factors in the environment that can affect marine mammals. These other factors can include ships, earthquakes, and icebergs breaking apart. To limit the potential effect of this project on marine mammals, the project will follow the 'Canadian Statement of Practice with respect to the Mitigation of Seismic Sound in the Marine Environment'.

Question: How would you know that whales are there if they are under water?
Response: Some surveys use passive acoustic monitoring, which will allow the vessel to listen for the whales under water. Passive acoustic monitoring is a technique used to listen for whales under the water. A hydrophone, which is an underwater microphone, is placed in the water and people listen to the hydrophone for sounds that whales make. Passive acoustic monitoring is being researched as a possible option for this project

In addition, there will be Marine Mammal Observers on board the survey vessel looking for whales at the surface of the water.

Question: What will happen if the animals are negatively impacted?
Response: It is difficult to know if an animal is negatively impacted as a result of this project. As we have mentioned, the project will follow the "Canadian Statement of Practice with respect to the Mitigation of Seismic Sound in the Marine Environment". The Canadian Statement of Practice was developed to lessen the potential for seismic survey to effect the marine environment.

Seismic Surveys

Question: If I were beside the air gun in the water would I survive?
Response: Determining the effects of a seismic blast on living creatures is a complex task which is not well understood. This is due to the difference in characteristics of sound in air versus water, different methods of measuring sound intensity and the range of frequencies which are able to be heard by a given creature (Cummings, 2003). While it is not possible to say for certain if a person could survive the blast from an air gun, they would certainly experience negative effects. One report suggests that the lethal zone for marine mammals from a large seismic air gun array is 7 meters (approximately 21 feet) (Parvin, Nedwell & Harland, 2007). Despite the lack of conclusive scientific evidence, the blasts from air guns are still considered "potentially lethal" (Popper and Hastings, 2009). Organisms close to the blast risk organ damage from the potential rupture of gas-filled cavities, such as the lungs or ears (Weilgart, 2007).

Question: Have there been any differences in the sand/mud or microorganisms on the ocean floor from seismic surveys?
Response: Studies have shown that algae and other microorganisms are not negatively affected by the sound produced from 2D seismic surveys.

Question: How far is the after affect going to carry?
Answer: Sound travels further in the water than in the air. Noise from other boats, and natural phenomenon, like earthquakes can be heard throughout the oceans. This constant background noise is present throughout the oceans and whales have begun to adapt to this noise by communicating in higher frequencies.

The effect of the seismic survey in a distance, will contribute to this background noise, but only for a short period of time. It is impossible to determine how far such as 100km or 1000km the sound from the project will travel and be distinguishable from other noises in the environment.

Question: How far does the sound travel under water?
Answer: The sound source will be pointed at the bottom of the ocean. However, there will be some sound that travels outwards from the sound source and sound will bounce off the ocean floor to be reflected back to the survey equipment.

Sound travels further under water than in the air. Noise from other boats and natural occurrences like earthquakes can be heard throughout the oceans. This constant background noise is present throughout the oceans and whales have begun to adapt to this noise by communicating in higher frequencies. It would be difficult to determine how far outwards from the sound source that the sound will travel.

References

Boertmann, D., Tougaard, J., Johansen, K. & Mosbech, A. (2009). Guidelines to environmental impact assessment of seismic activities in Greenland waters. National Environmental Research Institute, Aarhus University, Denmark. NERI Technical Report no. 723.

Cummings, Jim. (2003). Seismic Surveys: What We Don't Know Can Hurt. (The Acoustic Ecology Institute and Greenpeace). Retrieved from: http://www.acousticecology.org/oceanairgunexecsumm.html

Klinck, H., Nieukirk, S.L., Mellinger, D.K., Klinck, K., Matsumoto, H., & Dziak R.P. (2012). Seasonal presence of cetaceans and ambient noise levels in polar waters of the North Atlantic. Journal of the Acoustical Society of America. 132 (3), p. EL176-EL181.

McCauley, R. D., Fewtrell, J., Duncan, A. J., Jenner, C., Jenner, M-N., Penrose, J., Prince, R. I. T., Adhitya, A., Murdoch, J., and McCabe, K. (2000). Marine seismic surveys – a study of environmental implications. *Australian Petroleum Production and Exploration Association Journal*, p. 692–705.

Parvin S J, Nedwell J R, Harland E. (2007) Lethal and physical injury of marine mammals, and requirements for Passive Acoustic Monitoring. Subacoustech Report Reference: 565R0212, February 2007, To UK Government Department of Business, Enterprise and Regulatory Reform. Retrieved from: http://www.atlanticdisarray.org.uk/wordpress/wp-content/uploads/2012/01/Lethal-physical-injury-of-marine-mammals.pdf

Popper A., & Hastings, M.C. (2009). The effects of human-generated sound on fish. *Integrative Zoology*, 4, p. 43-52.

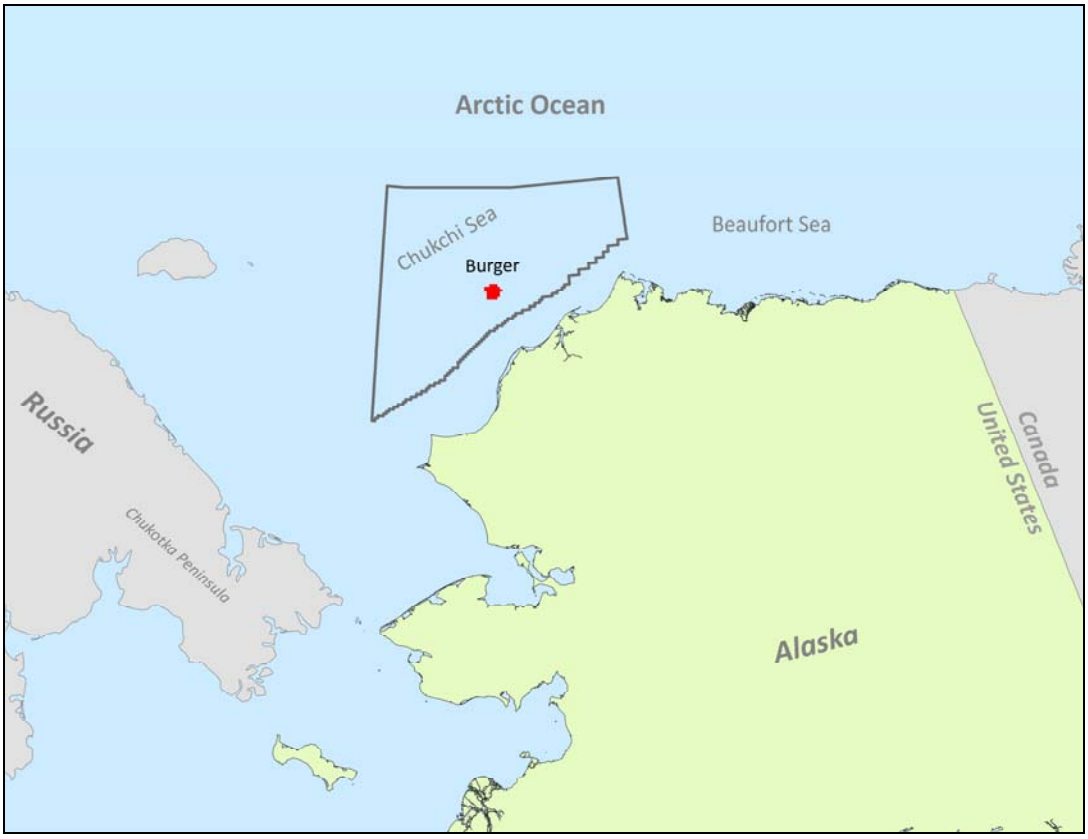
Richardson WJ, Miller GW, Greene CR. (1999). Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea. *Journal of the Acoustical Society of America,* 106, p. 2281-2281.

Weilgart, L. (2007). The impacts of anthropogenic ocean noise on cetaceans and implications for management. Canadian Journal of Zoology, 85, p. 1091-1116.

Chukchi Sea Planning Area

Shell Gulf of Mexico, Inc.
Shell Revised Chukchi Sea Exploration Plan
Burger Prospect: Posey Area Blocks 6714, 6762, 6764, 6812, 6912, 6915
Chukchi Lease Sale 193

Environmental Assessment



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December 2011

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Alaska Outer Continental Shelf

OCS EIS/EA
BOEM 2011-061

Chukchi Sea Planning Area

Shell Gulf of Mexico, Inc.
Shell Revised Chukchi Sea Exploration Plan
Burger Prospect: Posey Area Blocks 6714, 6762, 6764, 6812, 6912, 6915
Chukchi Lease Sale 193

Environmental Assessment

Prepared by:
Office of Environment
Alaska OCS Region

U.S. Department of the Interior
Bureau of Ocean Energy Management
Alaska OCS Region

December 2011

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Acronyms and Abbreviations

AAAQS .....Alaska Ambient Air Quality Standards
AAC .....Alaska Administrative Code
ACIA .....Arctic Climate Impact Assessment
ACP .....Arctic Coastal Plain
ADEC .....Alaska Department of Environmental Conservation
ADF&G .....Alaska Department of Fish and Game
ADNR .....Alaska Department of Natural Resources
AEWC .....Alaska Eskimo Whaling Commission
AFMP .....Arctic Fishery Management Plan
AI/AN .....American Indian and Alaskan Native populations
ANS .....aquatic nuisance species
ANWR .....Arctic National Wildlife Refuge
API .....American Petroleum Institute
APD .....Application for Permit to Drill
AQCP .....Alaska State Air Quality Control Plan
AQCR .....air quality control regions
ARBO .....Arctic Region Biological Opinion
ASRC .....Arctic Slope Regional Corporation
ASWG .....Alaska Shorebird Working Group
atm .....atmosphere (of pressure)
BACT .....Best Available Control Technology
bbls .....barrels
bbls/d .....barrels per day
Bcf .....billion cubic feet
Bcfg .....billion cubic feet of gas
BCB .....Bering-Chukchi-Beaufort Seas stock of bowhead whales
BE .....Biological Evaluation
BLM .....Bureau of Land Management
BO .....Biological Opinion
BOEM .....Bureau of Ocean Energy Management
BOEMRE .....Bureau of Ocean Energy Management, Regulation and Enforcement
BOP .....blowout preventer (system)
B.P. .....Before Present
BPXA .....British Petroleum Exploration (Alaska)
CAA .....Clean Air Act or Conflict Avoidance Agreement
CAH .....Central Arctic (caribou) Herd
CBD .....Center for Biological Diversity
CBS .....Chukchi/Bering Seas stock of polar bears
CEQ .....Council on Environmental Quality
CER .....Categorical Exclusion Review
CFCs .....chlorofluorocarbons
CFR .....Code of Federal Regulations
CI .....confidence interval
CIAP .....Coastal Impact Assistance Program
CIP .....Capital Improvement Program
CO .....carbon monoxide
COA .....Corresponding Onshore Area
COMIDA .....Chukchi Offshore Monitoring in Drilling Area
cp .....centipoise (measure of viscosity)
CWA .....Clean Water Act
CZMA .....Coastal Zone Management Act
CZMP .....Coastal Zone Management Program (or Plan)
DEW .....Distant Early Warning (system)

DO ..... dissolved oxygen
DPP..... Development and Production Plan
Draft EIS..... Draft Environmental Impact Statement
Draft SEIS ..... Draft Supplemental Environmental Impact Statement
EA..... Environmental Assessment
EEZ..... Exclusive Economic Zone
EFH ..... Essential Fish Habitat
EIS ..... Environmental Impact Statement
EJ..... Environmental Justice
EO..... Executive Order
EP ..... Exploration Plan
ERA ..... Environmental Resource Area
ESA ..... Endangered Species Act
FEIS..... Final Environmental Impact Statement
Final SEIS..... Final Supplemental Environmental Impact Statement
FMP ..... Fishery Management Plan
FONSI ..... Finding of No Significant Impact
FR ..... Federal Register
FWS..... Fish and Wildlife Service
G&G ..... geological and geophysical
Hz ..... Hertz
IHA..... Incidental Harassment Authorization
IPCC ..... Intergovernmental Panel on Climate Change
IWC ..... International Whaling Commission
ITA ..... Incidental Take Authorization
ITL..... Information to Lessees (Clauses)
LA..... Launch Area
LNG..... liquefied natural gas
LOA..... Letter of Authorization
LS ..... Land Segment
MAI ..... Maximum Allowable Increase
Mbbls..... thousand barrels
MBTA ..... Migratory Bird Treaty Act
Mcf ..... thousand cubic feet
MLC ..... mud line cellar
MMbbls ..... million barrels
MMC ..... Marine Mammal Commission
MMcf..... million cubic feet
MMPA..... Marine Mammal Protection Act
MMS..... Minerals Management Service
NAAQS ..... National Ambient Air Quality Standards
NEPA..... National Environmental Policy Act
NPFMC ..... North Pacific Fisheries Management Council
NHPA ..... National Historic Preservation Act
NMFS ..... National Marine Fisheries Service
NMML..... National Marine Mammal Laboratory
NO_x..... nitrogen oxides
NO_2 ..... nitrogen dioxide
NOA ..... Nearest Onshore Area
NOAA ..... National Oceanographic and Atmospheric Administration
NOI..... Notice of Intent
NPDES ..... National Pollutant Discharge Elimination System
NRC..... National Research Council
NSB ..... North Slope Borough
NSIDC..... National Snow and Ice Data Center
NTL ..... Notice to Lessees

O_3.....ozone
OCS .....Outer Continental Shelf
OCS Lands Act.....Outer Continental Shelf Lands Act
ODPCP .....Oil Discharge Prevention and Contingency Plan
OSRA .....Oil Spill Risk Analysis
OSRP.....Oil Spill Response Plan
PEA .....Programmatic Environmental Assessment
PM .....particulate matter
PM_{10} .....particulate matter equal to or less than 10 micrometers in diameter
$PM_{2.5}$.....particulate matter equal to or less than 2.5 micrometers in diameter
PSD.....Prevention of Significant Deterioration
ROD .....Record of Decision
RPM's.....Reasonably Prudent Measures
RUSALCA .....Russian-American Long-term Census of the Arctic
Lease Sale 193.....Chukchi Sea OCS Lease Sale 193
SBS.....southern Beaufort Sea stock of polar bears
SEIS.....Supplemental Environmental Impact Statement
SHPO.....State Historic Preservation Act
SIP .....State Implementation Plan
SO_x .....sulfur oxides
SO_2 .....sulfur dioxide
SO_4 .....sulfate
TOC.....total organic carbon
TTS.....temporary threshold shift
TAPS .....Trans-Alaska Pipeline System
ULSD .....ultra-low sulfur diesel
USC. .....United States Code
USDOC .....U.S. Department of Commerce
USDOI.....U.S. Department of the Interior
USEPA .....U.S. Environmental Protection Agency
VLOS .....very large oil spill
VOC .....volatile organic compounds
WAH .....Western Arctic (caribou) Herd
WCD.....Worst Case Discharge
ZVSP .....Zero-offset Vertical Seismic Profile

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SECTION 1. Purpose and Need

1.1 Purpose of the Proposed Action

Shell Gulf of Mexico Inc. (Shell) provided to the Bureau of Ocean Energy Management (BOEM) a Revised Exploration Plan (EP)—*Revised Outer Continental Shelf Lease Exploration Plan Chukchi Sea, Alaska* (2012 Shell Revised Chukchi Sea EP or Revised EP)—in October 2011 (Shell 2011a). The 2012 Shell Revised Chukchi Sea EP, which proposes exploratory drilling to evaluate the oil and gas resource potential of six of the company's Outer Continental Shelf (OCS) leases in the U.S. Chukchi Sea, was deemed submitted by BOEM on November 16, 2011.

The purpose of Shell's proposed action is to evaluate the oil and gas resource potential of six leases (OCS-Y-2280, OCS-Y-2267, OCS-Y-2321, OCS-Y-2294, OCS-Y-2278, and OCS-Y-2324) within a prospect known as "Burger" (Figure 1). The need for this action is established by BOEM's responsibility under the Outer Continental Shelf Lands Act (OCSLA) to make OCS lands available for expeditious and orderly development, subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs.

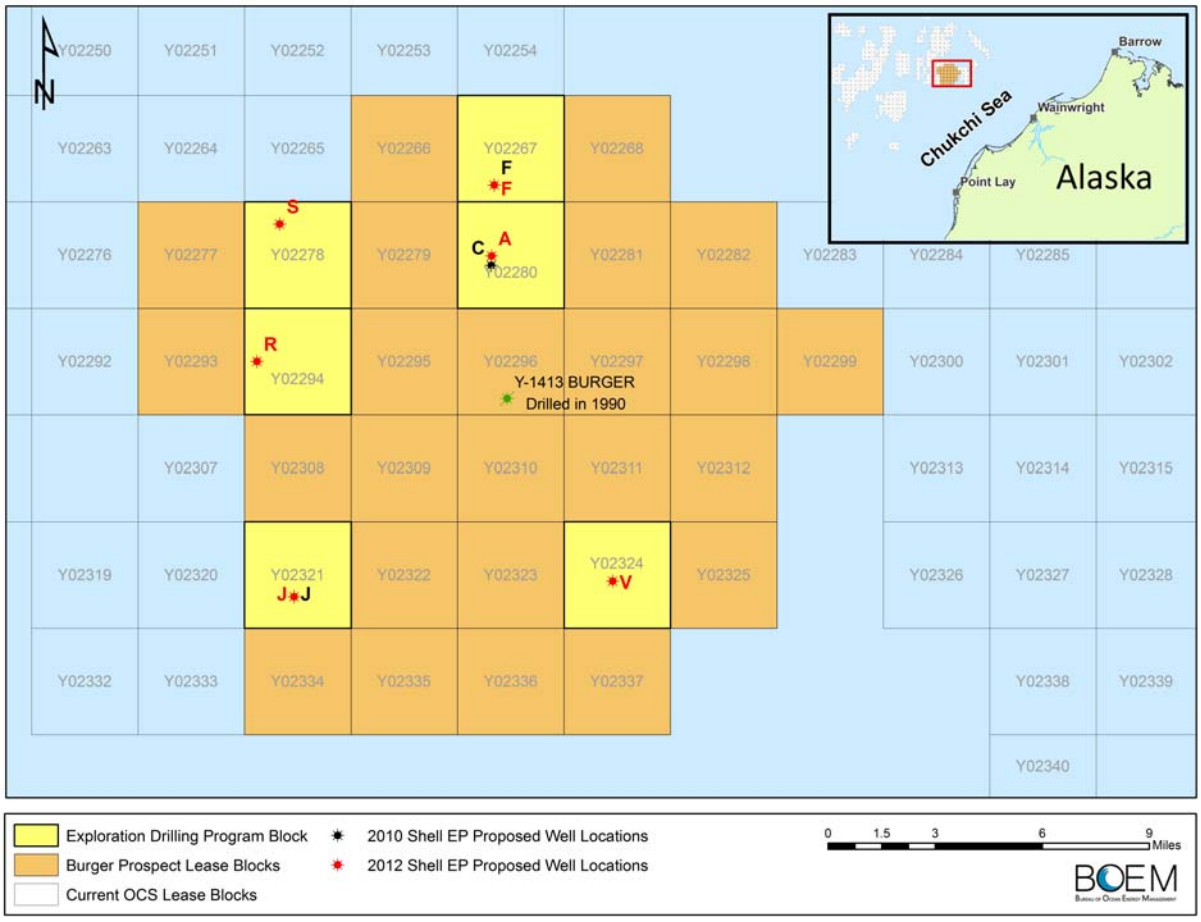

Figure 1. Location of Shell's proposed exploratory drilling in the Chukchi Sea.

BOEM has prepared this Environmental Assessment (EA) to assist with agency planning and decision making, in accordance with the following:

- The National Environmental Policy Act (NEPA)
- Council on Environmental Quality (CEQ) regulations at 40 CFR 1501.3(b) and 1508.9

- Department of the Interior (DOI) regulations at 43 CFR Part 46, and
- DOI policy in Section 516 of the Department of the Interior Manual (DM) Chapter 15 (516 DM 15).

1.2 Background

Shell acquired the Burger leases through Chukchi Sea OCS Lease Sale 193 (Lease Sale 193), held in February 2008. Under OCS leasing regulations at 30 CFR 556 and operating regulations at 30 CFR 250.180, a lease expires at the end of its primary lease term unless the lessee is conducting operations on the lease. Shell's leases have a primary term of ten years (30 CFR 556.37).

The 2012 Shell Revised Chukchi Sea EP makes changes to an initial Chukchi Sea Exploration Plan (initial EP; Shell, 2009) that was dated May 2009 and deemed submitted by BOEM on October 20, 2009 (see Table 1 for a direct comparison of the two EPs). After completing a technical and environmental review of the initial EP and supporting documents, MMS (now BOEM) issued (on December 7, 2009) an EA (USDOI, MMS, 2009a) and a Finding of No Significant Impact (FONSI)(USDOI, MMS, 2009b). The EA and FONSI are incorporated by reference into this document. The initial EP was approved with conditions on December 7, 2009.

Table 1. Comparison of Shell's initial EP (submitted in 2009) and the 2012 Shell Revised Chukchi Sea EP.

Parameter	Initial Chukchi Sea EP	2012 Shell Revised Chukchi Sea EP
Drilling Seasons	One season (July-October 2010)	Multiple seasons (July-October) commencing in 2012
Wells	Up to three wells	Six wells
Drilling Unit	Drillship M/V *Frontier Discoverer*	Drillship M/V *Noble Discoverer* (same drillship)
Prospects	Burger, Southwest Shoebill, Crackerjack	Burger
Potential Drill Sites	5 total - Burger C, F, J; Shoebill C; Crackerjack C	6 total – Burger A, F, J, R, S, V
Shorebase	Marine support from Wainwright, air support from Barrow	Marine support (and possibly air support) from Wainwright, air support from Barrow
Vertical Seismic Profile	None	One at each well
Drilling Waste	Water based muds and cuttings discharged	Water based muds and cuttings discharged
Primary Support Fleet	Anchor handler, ice management vessel, offshore supply vessel, shallow water landing craft	Anchor handler, ice management vessel, 2 offshore supply vessels, shallow water landing craft
Oil Spill Response	Oil Spill Response (OSR) vessel, OSR barge, Oil Storage Tanker (OST)	OSR vessel, OSR barge, OST, capping stack and containment system (additional barge, tug, and anchor handler)

Shell submitted their 2012 Shell Revised Chukchi Sea EP under BOEM operating regulations at 30 CFR 550 Subpart B. Shell proposes to drill up to six exploration wells on six leases, all of which are located on the Burger Prospect. Exploration activities would commence as soon as the 2012 open-water drilling season and would continue in subsequent open-water seasons until completion of the six-well plan. Shell would conduct its drilling operations using the ice-strengthened drillship M/V *Noble Discoverer* (*Discoverer*).

In support of the 2012 Shell Revised Chukchi Sea EP, Shell submitted the following:

- An environmental impact analysis (EIA) as Appendix F of the 2012 Shell Revised Chukchi Sea EP (Shell, 2011a).
- Oil Discharge Prevention and Contingency Plan (ODPCP)(Shell, 2011b) for the drilling program

- Environmental information and reports
- Site-specific geohazards survey data and assessment
- A Plan of Cooperation (POC) addendum to reduce potential conflicts with subsistence activities (Shell, 2011a: Appendix H)
- A description of Shell's Cultural Awareness and Environmental Awareness Programs
- Other mitigation measures, and
- Other information as required by BOEM regulations and lease stipulations

BOEM has completed a technical and environmental review of the 2012 Shell Revised Chukchi Sea EP and supporting information to ensure the proposed activities would be conducted in a manner that is consistent with protection of the human, marine, and coastal environments.

1.3 Previous Applicable Analyses

NEPA requires Federal agencies to conduct an environmental review of certain Federal actions at each stage of the OCSLA process. The appropriate level of NEPA review depends on the OCSLA stage (516 DM 15), the scope of the proposed activities, and the agency's findings on the potential effects of the proposed activities. BOEM has completed numerous NEPA reviews of Chukchi Sea OCS activities. Recent NEPA reviews relevant to the proposed action analyzed here include the following:

- Final Supplemental Environmental Impact Statement – Chukchi Sea Planning Area Oil and Gas Lease Sale 193 in the Chukchi Sea, Alaska (OCS EIS/EA BOEMRE 2011-041)
- Environmental Assessment – Shell Gulf of Mexico, Inc., 2010 Exploration Drilling Program, Burger, Crackerjack, and SW Shoebill Prospects, Chukchi Sea Outer Continental Shelf, Alaska, and Finding of No Significant Impact (OCS EIS/EA MMS 2009-061)
- Draft Environmental Impact Statement – Beaufort and Chukchi Sea Planning Areas Oil and Gas Lease Sales 209, 212, 217, and 221 (OCS EIS/EA MMS 2008-0055)
- Final Environmental Impact Statement – Chukchi Sea Planning Area Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea (OCS EIS/EA MMS 2007-026)
- Final Environmental Impact Statement – Outer Continental Shelf Oil & Gas Leasing Program: 2007-2012 (OCS EIS/EA MMS 2007-003)
- Final Environmental Impact Statement – Outer Continental Shelf Oil and Gas Leasing Program: 2002-2007 (OCS EIS/EA MMS 2002-2006)

These documents are available on the BOEM Alaska Region website at http://www.alaska.boemre.gov/ref/eis_ea.htm. Relevant sections of these documents are summarized and incorporated by reference into this EA. This EA tiers from the Lease Sale 193 Final EIS (USDOI, MMS, 2007a) and the Lease Sale 193 Final SEIS (USDOI, BOEMRE, 2011).

This EA also summarizes and incorporates by reference relevant information and analysis from the following documents:

- Revised Outer Continental Shelf Lease Exploration Plan Chukchi Sea, Alaska (2012 Shell Revised Chukchi Sea EP)(USDOI, BOEMRE, 2011)
- October 10, 2011 Biological Evaluation (BE) to NMFS (USDOI, BOEM, 2011)
- September 30, 2011 BE to US Fish and Wildlife Service (FWS)(USDOI, BOEMRE, 2011b)

- Letter of Authorization (LOA) and Incidental Harassment Authorization (IHA) Applications
- Biological Opinion for Beaufort and Chukchi Sea Program Area Lease Sales and associated Seismic Surveys and Exploratory Drilling (USDOI, FWS, 2009).
- Biological Opinion for Oil and Gas Leasing and Exploration Activities in the U.S. Beaufort and Chukchi Seas, Alaska; and Authorizations of Small Takes Under the Marine Mammal Protection Act (NMFS, 2008).
- Biological Opinion for Oil and Gas Leasing, Exploration Activities, in the U.S. Beaufort and Chukchi Seas, Alaska, Arctic Regional Biological Opinion (NMFS, 2006)

1.4 Statutory Framework

Shell's proposed exploration drilling activities are subject to an established regulatory framework that includes Federal and State regulations. Some, but not all, of the statutory framework governing oil and gas exploration on the OCS are listed below. A more detailed treatment of these requirements and how they relate to the proposed action is provided in Appendix F.

- OCSLA
- BOEM and Bureau of Safety and Environmental Enforcement (BSEE) Regulations
- Endangered Species Act
- Marine Mammal Protection Act
- Coastal Zone Management Act
- Clean Air Act
- Clean Water Act
- Oil Pollution Act of 1990
- National Historic Preservation Act
- National Invasive Species Act
- Magnuson-Stevens Fishery Conservation and Management Act

SECTION 2. Proposed Action and Alternatives

2.1 Summary of Alternatives

2.1.1 Alternative 1 – No Action

Under Alternative 1 – No Action, BOEM would not approve Shell's proposed exploration drilling activities. This alternative would delay or preclude Shell from evaluating potential hydrocarbon resources of certain lease blocks acquired under Chukchi Sea Lease Sale 193. This alternative would also delay or avoid potential environmental impacts associated with the Proposed Action.

2.1.2 Alternative 2 – Proposed Action

Under Alternative 2 – Proposed Action, BOEM would approve, with conditions, Shell's proposal to drill six exploration wells within the Burger Prospect. Activities could occur on six leases acquired in Chukchi Sea Lease Sale 193. These leases are OCS-Y-2280, OCS-Y-2267, OCS-Y-2321, OCS-Y-2294, OCS-Y-2278, and OCS-Y-2324 (Figure 1). Shell proposes to commence drilling the wells during the open-water-season (July through October) of 2012 and would continue during subsequent open water seasons. Shell would conduct drilling operations from the *Discoverer*, to be supported by additional vessels for ice management, anchor handling, crew transport and supplies, and spill response.

2.1.3 Alternative 3 – One Well per Season

Under Alternative 3 – One Well per Season, BOEM would approve, with conditions, the Proposed Action, but would limit exploration drilling to one well (drilled to total depth) per season. Multiple mud line cellars and "spuds" (a type of partial well where an initial casing is set) may be drilled in a given season, but Shell could only access the hydrocarbon-bearing zone or zones of one well per year. As a result, this alternative could spread the positive impacts, negative impacts, and risks associated with oil and gas exploration activities across additional open-water seasons.

2.2 Other Alternatives Considered But Not Analyzed

During development of the Environmental Assessment (EA), the following concepts were considered as potential alternatives, but were not carried forward for full analysis.

2.2.1 Alternative Technologies

An alternative considered but not further analyzed is the use of alternative technologies to explore the oil and gas potential of the six leases identified for potential exploration. BOEM is unaware of any alternate techniques that would serve the purpose of the Proposed Action.

2.2.2 Adaptive Seasonal Restrictions

BOEM also considered creating adaptive seasonal restrictions to determine the end of each year's drilling season. Ice, weather, and other important environmental conditions vary from one drilling season to the next. Utilizing real-time measurements of ice, weather, and other environmental conditions, combined with advanced hindcasting and forecasting techniques, it may be possible to make more informed, yearly determinations on how long drilling operations could safely proceed. Adaptive seasonal restrictions could effectively shorten or lengthen a given drilling season, depending on actual conditions.

This concept is not carried forward for full analysis as an alternative within this EA. The 2012 Shell Revised Chukchi Sea EP states that exploratory activities will cease by October 31st of each year. This independent limitation renders moot the advantages of potentially extending the drilling season should ice conditions prove favorable. Meanwhile, BOEM and BSEE already possess continuing

authority over all exploratory activities on the OCS (see Appendix F). If ice or other environmental conditions rendered continued exploration unsafe, BOEM and BSEE would use their existing authority to order Shell to cease exploratory activities prior to October 31st. Thus, mechanisms already exist to protect human safety and the environment in the event of unfavorable conditions.

2.2.3 Reduced Discharge

Stakeholders have also expressed concern that several waste streams associated with the proposed exploration activities—drilling fluids, drillings muds, and drilling cuttings—could lead to water quality impacts and bioaccumulation (particularly within animals harvested during subsistence activities). To address these concerns, stakeholders suggested that BOEM restrict the amount and type of wastes to be discharged, and offered Shell's reduced discharge plan for exploration drilling in the Beaufort Sea as a model for what BOEM should require as a condition of approval for the 2012 Shell Revised Chukchi Sea EP.

Potential effects associated with the discharge of drilling fluids, drilling muds, and drilling cuttings are analyzed in relevant portions of this EA, particularly sections analyzing potential impacts to water quality, fish and their habitat, lower trophic levels, and marine mammals. These analyses find that any effects on water quality, lower trophic levels, and fish and their habitat would be localized and minor. Any impacts to marine mammals would be negligible. No threats to subsistence resources or public health were identified.

Due to the low level of impacts associated with these discharges, a reduced discharge alternative is not carried forward for full analysis within this EA.

2.2.4 Alternative Drilling Plan

While commenting on a preliminary draft version of this EA, NMFS raised the possibility of an alternative drilling plan whereby BOEM would allow several wells to be partially drilled during one season, and then drilled to completion at an earlier time the following year. NMFS suggested that this plan would provide the following benefits: reducing the risk of a spill late in the season; providing additional time for any spill response; consolidating the necessary ZVSP into a single season; allowing ZVSP to occur much earlier in the season; and completing drilling operations earlier in the season to offset that operation from the fall migration of bowhead whales.

The suggested alternative drilling plan is not carried forward for full analysis as an alternative within the EA. This determination was based on consideration of the following:

- The EA analyses identified no substantive impacts associated with conducting ZVSP in consecutive years.
- The suggested alternative would require anchoring at each drill site twice, increasing the potential effects to benthic organisms.
- The suggested alternative would also require duplicate transits between drill sites, increasing overall transit time, transit related emissions, and anchor-handling-related emissions.
- The results from any one completed well would be used by Shell to determine whether a subsequent exploration well should be drilled, and if so, which well and whether any adjustments to the proposed location would be necessary. The suggested alternative would eliminate using the new well information to support decisions on subsequent wells and possibly result in the drilling of unnecessary wells.
- It is operationally preferable to permanently abandon a well if at all possible rather than temporarily abandon a well.

2.3 Proposed Mitigation Measure

This section presents a potential mitigation measure that, if implemented, would further address risks associated with late season drilling by assuring a greater opportunity for spill response and cleanup. This mitigation measure may be applied to either Alternative 2 or 3. If adopted, approval of the Revised EP could be conditioned on adherence to the restrictions described below.

Avoiding oil spills has always been, and will continue to be, the cornerstone of BOEM's regulatory program. This measure, however, is focused on mitigating the environmental impacts in the unlikely event of a large oil spill. It is a risk management tool that could be implemented as a condition of approval of the Revised EP. As such, this proposed mitigation measure could further guard against the types of adverse impacts analyzed in the Very Large Oil Spill analysis provided in the Sale 193 Final SEIS (USDOI, BOEMRE, 2011a: Section IV.E).

In the unlikely event of an oil spill, spill response and cleanup operations would begin immediately and continue as long as necessary. Stakeholders have expressed particular concern regarding an uncontrolled well incident resulting in an oil spill late in the drilling season, when encroaching seasonal ice can reduce the effectiveness of spill response and cleanup. To ensure a greater opportunity for late season spill response and cleanup, this proposed mitigation measure would institute a late season drilling hiatus. During the hiatus, no exploratory drilling would be allowed below the last casing point set prior to penetrating a zone capable of flowing liquid hydrocarbons in measurable quantities.

The first component of the late season drilling hiatus is the duration. Presented below for the decisionmaker are three Options, each reflecting a different mitigation strategy and, consequently, a different hiatus duration:

- **Option 1** institutes a 15-day late season drilling hiatus to ensure at least 15 days of ice-free spill response and cleanup. This timeframe also affords enough time to stop the flow of oil using capping technologies. (The estimated time for Shell to successfully deploy capping technology is 15 days.)
- **Option 2** institutes a 38-day late season drilling hiatus to ensure at least 38 days of ice-free spill response and cleanup. This timeframe also affords enough time to stop the flow of oil using capping technologies and drill a relief well via a second vessel. (The estimated time for Shell to drill a relief well for Burger J is 34–38 days.)
- **Option 3** institutes a 60-day late season drilling hiatus to ensure at least 60 days of ice-free spill response and cleanup.

Table 2. Comparison of three options with respect to duration.

Option	Hiatus Duration (Minimum Period for Ice-Free Cleanup)	Stop Flow of Oil?	Drill Relief Well?
1	15 Days	Yes	No
2	38 Days	Yes	Yes
3	60 Days	Yes	Yes

The second component of the late season drilling hiatus is the "trigger" date. This is the date from which BOEM would calculate backwards in order to determine when certain drilling activities must cease. The date of October 31st, the end of Shell's proposed drilling season, is a reasonable option. However, using a static calendar date, such as October 31st, would prove unresponsive to warming conditions in the Arctic. To respond to changing conditions and preserve maximum operational flexibility, BOEM investigated the feasibility of using scientific data and advanced ice forecasting techniques to determine a more flexible, science-based trigger. Unfortunately, current ability to accurately forecast sea ice conditions is rather limited—sea ice conditions in the Chukchi Sea are

difficult to predict with confidence beyond the very near term. Forecasting will, therefore, be reserved for future consideration.

This proposed mitigation measure will instead use a form of hindcasting, or counting backwards from the date of first ice encroachment in prior years, to determine the trigger date. By reviewing interpretations of satellite imagery provided by the National Ice Center (NIC), BOEM can determine the calendar date at which the drilling areas were no longer "ice free" during past seasons. By utilizing this earliest calendar date of ice encroachment within any of the last 5 years as the trigger date, and counting back from that date, a reasonably protective period can be determined, while still maintaining some flexibility as conditions change in the future.

For example, during the 2012 drilling season BOEM would evaluate satellite imagery from 2007-2011. The earliest calendar date at which sea ice encroached on a drilling site during any of those years would constitute the trigger date applicable to that site for the 2012 drilling season. If Option 1 is selected, no drilling below the last casing point (as defined above) could occur within 15 days of the location's trigger date. If Option 2 is selected, no such drilling below the last casing point could occur within 38 days of the location's trigger date. Finally, if Option 3 is selected, no drilling below the last casing point could occur within 60 days of the location's trigger date.

Preliminary interpretation of satellite imagery shows that between 2007 and 2011, November 1st is the earliest calendar date on which sea ice covered a drilling site contemplated under Shell's Revised EP. Using the preliminary determination of November 1 as the trigger date, Table 3 provides the ramifications of each Option with respect to the drilling season and the number of wells that could be drilled.

Table 3. Based on a preliminary trigger date of November 1, this table provides approximate dates, drilling season length, days to drill each well, and number of wells possible for each option.

Option	Hiatus Period	Trigger Date	Hiatus Period Begins	Total Days of Drilling Season[1]	Estimated Days to Drill Each Well[2]	Maximum Number of Wells Possible[3]
1	15 Days	November 1	October 17	106	32	3
2	38 Days	November 1	September 24	83	32	2
3	60 Days	November 1	September 2	61	32	1

[1] Reflecting drilling season commencing July 1.
[2] Reflecting Shell estimate of average time to drill each well to proposed total depth (PTD).
[3] Not accounting for travel between wells, positioning over well, anchoring, etc.

Each year, a new trigger date would be calculated for each site where Shell planned to conduct exploration drilling into hydrocarbon bearing zones. BOEM would calculate the trigger date using the best information available. Currently, the best information available for hindcasting is weekly and biweekly National Ice Center interpretation of sea ice data. Consistent with adaptive management principles, BOEM would continue to collect more and better data as technology improves, and would refine its hindcast calculations accordingly. BOEM would also consider developments in sea ice forecasting for potential use in determining the trigger date.

By the terms of Shell's proposal, no drilling would occur past October 31. Each of the Options under this Proposed Mitigation Measure would increase the time available for ice-free spill response and cleanup, assuming ice conditions occur as anticipated. The clean-up efforts would not, however, end with the first incursion of sea ice. As described in the Sale 193 Final SEIS, in-situ burning and mechanical recovery will continue until access is impossible. Once the oil is incorporated into the sheet ice and ice becomes stable, response can continue through excavation or trenching through the ice (USDOI, BOEMRE, 2011a: Section IV.E). Option 1 assures an ice-free period long enough to stop the flow of oil using capping technology. Options 2 and 3 assure ice-free periods long enough to cap the well and also complete a relief well. The estimated period of ice-free cleanup under Option 2 is up to three weeks longer than Option 1, but roughly two weeks shorter than Option 3. However, the

longer the hiatus period selected, the shorter the drilling season becomes. Thus a longer hiatus period increases the difficulty of achieving the proposed action.

These options will only have an impact in the unlikely scenario of a late-season oil spill. This mitigation measure could reduce the potential for the types of widespread and severe impacts that were analyzed in the Sale 193 Final SEIS (USDOI, BOEMRE, 2011a: Section IV.E), particularly in terms of late season and multi-year impacts. For instance, the longer the operator has to respond to oil in ice-free conditions, the more likely it is that the operator will be able to keep oil from becoming entrained in the ice and released in the spring. Successful spill response and cleanup could help prevent impacts to sensitive resources like the spring polynya system and migrating bowhead whales (USDOI, BOEMRE, 2011a: Section IV.E). Therefore, each option would provide incrementally greater chances of mitigating the impacts of a low probability, high impact late season oil spill.

2.4 The Proposed Action (Alternative 2)

2.4.1 Overview

Shell's proposal is to use a single drillship, the *Discoverer*, to complete a six-well exploration drilling program at locations on the Burger Prospect in the Chukchi Sea (see Table 4). For analysis purposes, BOEM assumes that all six wells would be drilled; however, the information on the subsea geology and properties of the potential reservoir formations obtained from drilling the initial wells may result in Shell's canceling subsequent wells or submission of a revised EP to relocate subsequent well sites. Shell's proposed activities would be conducted during the open-water season to avoid difficult ice conditions. Locations for each drill site are presented in Table 4. No shallow hazards or archaeological and historical resources are present at these drill sites.

Table 4. Proposed exploration drill sites.

Prospect	Area	Protraction	Lease	Shell Lease
Burger	Posey	NR03-02	6764	OCS-Y-2280
Burger	Posey	NR03-02	6714	OCS-Y-2267
Burger	Posey	NR03-02	6912	OCS-Y-2321
Burger	Posey	NR03-02	6812	OCS-Y-2294
Burger	Posey	NR03-02	6762	OCS-Y-2278
Burger	Posey	NR03-02	6915	OCS-Y-2324

The *Discoverer* would move through the Bering Strait and into the Chukchi Sea on or about July 1, and would continue on to the Burger Prospect as soon as ice and weather conditions allow. Once the drilling vessel is mobilized to a drill site and securely anchored to the seafloor, drilling operations commence. Exploration drilling activities may continue through October 31, ice conditions permitting.

Shell anticipates that conducting exploratory drilling activities would take an average of 32 days at each drill site. This estimate includes the following:

- Construct a mud line cellar (MLC)
- Drill the well from spud to proposed total depth (PTD)
- Log and evaluate the well
- Conduct a zero-offset vertical seismic profile (ZVSP)
- Plug and abandon the well in accordance with BOEM/BSEE requirements at 30 CFR 550(q)

The actual number of wells drilled in a given season would depend upon ice conditions, length of time available in each drilling site, and conditions of EP approval. Shell's predicted "average" drilling season is long enough for two to three exploration wells to be drilled from spud to PTD. Shell may elect to construct additional MLCs or upper hole segments (partial holes) depending on available time. Any well on which exploration drilling operations are suspended at the end of a drilling season will be secured in accordance with BOEM regulations. Shell would then either drill the well to total depth in the subsequent year, or permanently abandon the well. To allow for operational flexibility in response to variable ice conditions, Shell has indicated that it will submit an Application for Permit to Drill (APD) for all six proposed wells during the initial year.

Certain conditions may trigger a suspension of activities at a drillsite prior to concluding exploration drilling activities there. Within its Critical Operations and Curtailment Plan (COCP) and Ice Management Plan (IMP), which are attached as Appendices J and K of the 2012 Shell Revised Chukchi Sea EP (Shell, 2011a), Shell presents procedures for monitoring and reacting to ice in the prospect areas. If certain conditions of the COCP are triggered by environmental conditions at a drill site, Shell would suspend drilling operation, secure the well, and move offsite if necessary. The well would either be drilled to completion later that season, during a subsequent season, or secured and permanently abandoned prior to lease termination. The uppermost part of any equipment remaining in an abandoned well will remain at least 26 feet below the mudline.

Shell's proposed operations must comply with applicable Federal, State, and local laws, regulations, and permit requirements. Shell's proposed operations must also comply with all lease stipulations included within Chukchi Sea OCS Lease Sale 193. BOEM and BSEE retain specific authority to require additional mitigation (including shut down) as appropriate to respond to actual conditions encountered. In addition, Shell will have trained personnel and monitoring programs in place to ensure such compliance. BOEM, BSEE, and other Federal regulatory agencies would maintain continuing oversight of all of Shell's exploration activities. The following are the major applicable permits and authorizations that impose mandatory requirements and collectively ensure safety, protect the environment, avoid interference with subsistence resources and activities, and otherwise mitigate potential adverse impacts:

- Permit to Drill, issued by BSEE.
- Shell Chukchi Sea Regional ODPCP (Shell ODPCP), reviewed and accepted by BSEE.
- National Pollutant Discharge Elimination Systems (NPDES) Permit under the Clean Water Act (CWA), issued by the US Environmental Protection Agency (EPA).
- Air Quality Permits under the Clean Air Act (CAA), issued by EPA Region 10.
- Incidental Harassment Authorization (IHA) under the MMPA, issued by NMFS.
- Letter of Authorization (LOA) under the MMPA, issued by FWS.
- Nationwide Permit No. 8 coverage under the Rivers and Harbor Act, administered in relevant part by the U.S. Army Corps of Engineers (USACE).

2.4.2 Drill Sites and Operating Environment

More specific information on the locations of the proposed drill sites is provided in Table 5, below. Water depth at each location is approximately 150 ft or less. The community in closest proximity to the planned exploration activities is Wainwright, roughly 78 miles to the southeast.

Table 5. Possible drill sites for the 2012 Shell Revised Chukchi Sea EP Drilling Program

Drill Site	Lease Number	Surface Location		Water Depth (ft) at Proposed Drill Site
		Latitude (N)	Longitude (W)	
A	OCS-Y-2280	71° 18' 30.92"	163° 12' 43.17"	150
F	OCS-Y-2267	71° 20' 13.96"	163° 12' 21.75"	149
J	OCS-Y-2321	71° 10' 24.03"	163° 28' 18.52"	144
R	OCS-Y-2294	71° 16' 06.57"	163° 30' 39.44"	143
S	OCS-Y-2278	71° 19' 25.79"	163° 28' 40.84"	147
V	OCS-Y-2324	71° 10' 33.39"	163° 04' 21.23"	147

2.4.3 Seafloor Conditions at the Drill Sites

BOEM regulations (30 CFR 550.214) require an assessment of shallow hazards prior to drilling or installing mobile drilling units for offshore oil and gas activities. Geophysical surveys conducted over potential drilling sites are analyzed to identify potential shallow hazards and conditions that would pose engineering constraints. A hazard is defined as a feature or condition that presents difficulties that cannot be easily mitigated by design, implementation, or procedures. A constraint is defined as a feature or condition that presents difficulties but can be mitigated by design, implementation, or procedures.

In 2008 and 2009, Shell conducted shallow hazards surveys at each of the six planned drill sites. Shallow hazards survey reports and assessments for each drill site were submitted to BOEM under separate cover in April 2009. No shallow hazards or archaeological and historic resources are present at these sites. Additional information regarding shallow hazards surveying at the Burger Prospect is provided in Sections 1.3 and 1.4 of the Shell EIA (Shell, 2011a: Appendix F).

These leases are located on the relatively shallow continental shelf of the Chukchi Sea. The seafloor in the vicinity of each proposed well is largely flat, nearly featureless, and predominately composed of sandy mud. While ice gouges exist near several of the drill sites, they do not appear to have occurred within the last 20 years. One possible exception exists at Burger J, where "fresh-looking" gouge is reported. Additional information on bathymetry and relief at the drill sites is provided in Section 3.2.1 of Shell's EIA.

2.4.4 Drillship, Support Vessels, Oil Spill Response Vessels, and Aircraft

Shell would conduct drilling operations using the *Discoverer*, a 514 ft (156 m) modern drillship retrofitted for operating in Arctic OCS waters. The *Discoverer* has state-of-the-art drilling and well-control equipment. Drilling equipment is operated from a turret amidships. The vessel is stabilized

Table 6. Support Vessels for the *Discoverer*.

Function	Vessel (or similar)	Trip Frequency or Duration
Ice Management Vessel	*Fennica*	Will generally remain upwind of *Discoverer* (3–25 mi away) throughout the drilling season.
Anchor Handler	*Tor Viking*	To stay in the area of the *Discoverer* throughout the drilling season.
Offshore Supply Boat	*Harvey Spirit*	Up to 17 round trips (combined) for resupply between Dutch Harbor and *Discoverer* during the drilling season. Also, 4-6 refuel trips (combined) between the OST and the *Discoverer* during that same time period.
Offshore Supply Vessel	*C-Leader*	
Shallow Water Landing Craft	*Arctic Seal*	Up to 10 trips to Wainwright.

over the drilling site using an eight-point mooring system. Its hull has been reinforced for ice resistance. Detailed specifications for the *Discoverer* are provided in the 2012 Shell Revised Chukchi Sea EP (see Shell, 2011a: Table 1.c-1).

The *Discoverer* would be attended by several support vessels. The primary ice management vessel is the *Fennica*, which will be located several miles away from the drill site when not being used for ice management. The *Tor Viking*, an anchor handler, will remain close to the *Discoverer* throughout the drilling season. Drilling operations will also require a transfer of supplies from Dutch Harbor to the drilling vessels. The *Harvey Spirit* and the *C-Leader* will transport needed supplies. Shell may also call upon a fifth support vessel—a shallow water landing craft—to transport goods and/or personnel between the drill site and Wainwright. Table 6, below, contains information regarding the function, trip frequency, and trip duration of these support vessels. Approximate locations and transit routes for these support vessels are depicted in Figure 2 (above).

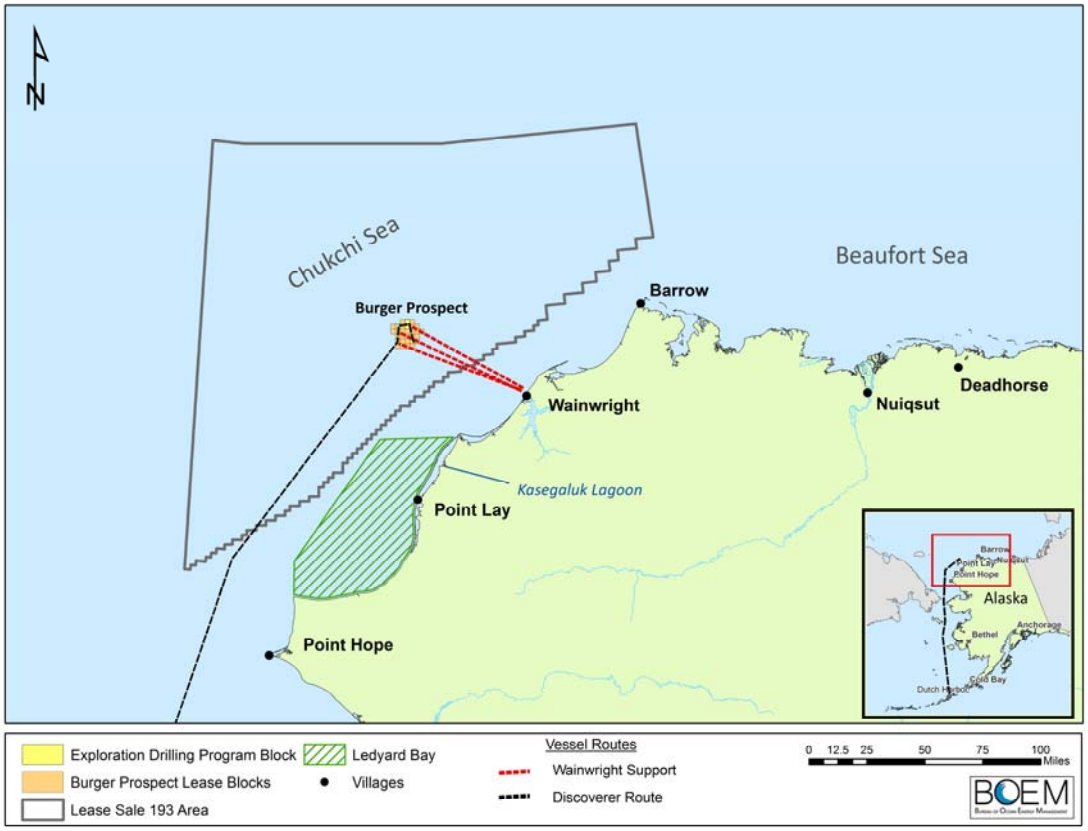

Figure 2. Approximate marine transit routes for support vessels.

Drilling operations will also be attended by a number of oil spill response vessels to be staged in various locations. Table 7 contains information regarding the function, trip frequency, and trip duration of these oil spill response vessels. A detailed description of the Shell ODPCP is provided in the Shell EIA.

Table 7. Oil Spill Response Vessels

Function	Vessel (or similar)	Trip Frequency or Duration
Oil Spill Response (OSR) Vessel	Nanuq	To stay in the vicinity of the *Discoverer* throughout the drilling season.
OSR Barge	Unspecified	To stay in the vicinity of the *Discoverer* throughout the drilling season.

Function	Vessel (or similar)	Trip Frequency or Duration
Tug (for OSR Barge)	Unspecified	To stay in the vicinity of the *Discoverer* throughout the drilling season.
Oil Spill Tanker (OST)	Mikhail Ulyanov	To be staged such that it can reach drilling site within 24 hours.
Containment Barge	Unspecified	Remains in a location from which it can respond, if needed.
Tug (for Containment Barge)	Unspecified	Remains in a location from which it can respond, if needed.
Anchor Handler (for Containment Barge)	Unspecified	Remains with containment barge.

Several aircraft would also be used in support of the Proposed Action. Information regarding the function, trip frequency, and trip duration of these aircraft is provided in Table 8. Anticipated transit routes are depicted in Figure 3.

Table 8. Aircraft functions, descriptions, and trip characteristics.

Function	Make and Model (or similar)	Trip Frequency and Duration
Transport from shorebase to regional jet service	Fixed Wing – Saab 340 B, Beechcraft 1900, Dash 8 or similar	Up to 4 trips / week between Wainwright and Barrow or Anchorage.
Crew rotation and supplies	Helicopter – S-92, EC225 or similar	Approximately 12 trips / week between shorebase and drilling site. Approximately 3.0 hrs / trip.
Search and Rescue	Helicopter – S-61, S-92, EC225 or similar	Stationed in Barrow. Utilized 40 hrs / week for proficiency training and emergency trips.

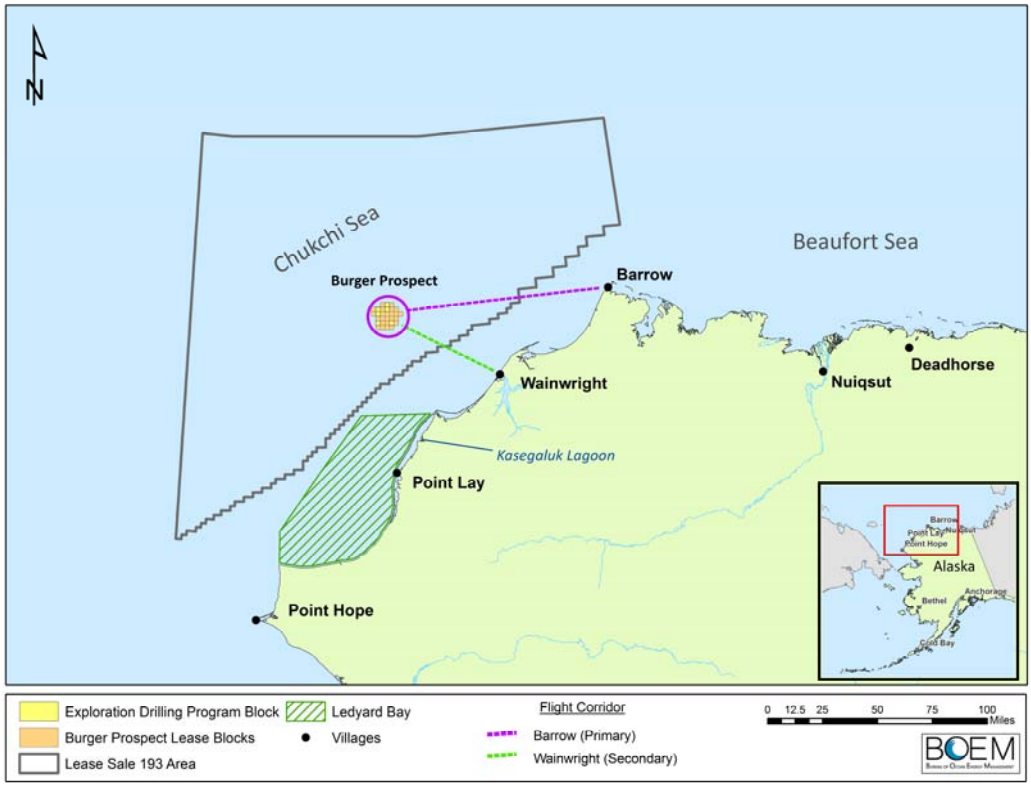

Figure 3. Approximate travel routes for aircraft.

2.4.5 Discharges and Waste Management

The drillship *Discoverer* will discharge several types of waste during exploration activities. These wastes include drill cuttings, spent drilling fluids, cuttings from water based intervals, domestic wastewater, excess cement, brine water from a desalination unit, (uncontaminated) deck drainage, non-contact cooling water, uncontaminated ballast water, (treated) bilge water, and BOP fluid. The drilling fluids to be discharged are water based mud (WBM) drilling fluids and may contain cuttings with adhered WBM. The drilling fluid would be recycled for use in multiple wells and diluted with seawater at 30:1 prior to its discharge into the sea. Additional information regarding these discharges, including quantities of discharges, is provided in Section 6.0 of the Revised EP and Section 2.7 of Shell's EIA. All discharges will be authorized under NPDES General Permit AKG-28-0000 or its replacement. Shell will only use water-based drilling fluids.

Support vessels will discharge domestic waste and treated sanitary waste. However, no untreated sanitary waste will be discharged, and no treated sanitary waste water will be discharged within three miles of the coastline.

Certain non-combustible, non-hazardous wastes will be transported to shore and disposed of in an approved landfill. Regulated wastes (i.e. paint, solvents, unused chemicals, batteries, lamps, used oil, and glycol) will be transported to a licensed facility.

2.4.6 Emissions

The majority of emissions caused by the Proposed Action would be associated with the drillship *Discoverer* and the support vessels, which include ice management ships, anchor handlers, supply ships, and oil spill response (OSR) vessels. The emissions result from the use of internal combustion engines that burn fossil fuel in two types of engines, main propulsion and auxiliary engines. The drillship and supporting vessels will emit the following regulated pollutants: nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), volatile organic compounds (VOC), and particulate matter less than 10 micrometers in diameter (PM_{10}) and 2.5 micrometers ($PM_{2.5}$). Emissions of these pollutants would also occur from operating heaters, boilers, and incinerators on the vessels, but at a much lower level.

How emissions are regulated depends on whether they come from a stationary or mobile source. The drillship *Discoverer* is considered a stationary OCS source during actual drilling, meaning the ship is securely anchored to the seabed and the propulsion engines are not operating (40 CFR Part 55.2). During drilling, the *Discoverer* would produce emissions from auxiliary engines used to generate electric power and heat, create pneumatic compression and hydraulic compression, move large pieces of equipment, and operate an incinerator primarily for domestic purposes. Emissions from support vessels operating within 25 miles of the *Discoverer* during actual drilling are considered emissions from the stationary source; however, the vessels are not considered part of the *Discoverer* stationary OCS source (40 CFR Part 55.2). These emissions, whose quantities are provided in the table below, are permitted in a PSD/NSR permit issued by EPA on 31 March 2010. Emissions from these engines are controlled by using ultra-low sulfur diesel (ULSD) fuel and Best Available Control Technology (BACT), such as selective catalytic reduction controls and diesel particulate filters. The combined use of ULSD fuel and BACT reduces emissions of VOCs and NO_x, and lowers emissions of particulate matter to near zero. Additional information regarding regulated air emissions is provided in Section 2.8 of Shell's EIA.

Shell is not required to account for emissions from mobile sources in the PSD permit. Mobile sources associated with the Proposed Action include all other marine vessels operating in the program planning area in support of the exploration activities. (This category also includes the *Discoverer* and all support vessels whenever they are in transit or otherwise not considered as a "stationary" source.) The primary pollutant from the operation of the marine vessels, whether operating as a stationary

source or mobile, would be NO_x, and in lesser amounts, CO and VOC emissions. Emissions from mobile source vessels are considered in the air quality analysis of this EA.

This EA also assesses emissions from helicopters and surface vehicles associated with the Proposed Action. Helicopters would be used for crew rotation, transport of materials and supplies, and search-and-rescue training. Emissions from helicopters will be accounted for by considering ground-based operations defined by the number of landing and takeoff cycles (LTO) throughout the drilling season (FAA, 1997). The helicopters would emit mostly emissions of CO, and in lesser amounts, VOC and NO_x. The operation of surface vehicles, most likely passenger vans, would be required to transport relief crews between the housing area and Barrow's airport for transport of personnel offshore to the drillship. The emissions would be accounted for by considering the number of crew changes required for the duration of the drilling season. The vehicles would emit mostly CO, and in lesser amounts, NO_x and VOCs.

2.4.7 Sound Generation

Several components of the Proposed Action would introduce sound into the environment. These are summarized below and described in more detail within Section 2.9 of Shell's EIA.

Drilling Sound

Sound levels generated by the *Discoverer* while drilling an exploration well have not been measured. However, Shell's EIA provides modeling of the propagation of sound that might be generated during exploration drilling on the Burger Prospect in the Chukchi Sea.

This modeling is based on a variety of information including sound levels recorded while *Discoverer* was drilling in a different location and sound levels generated by a different vessel while drilling in the U.S. Beaufort Sea, along with water depth, geoacoustic, and water sound speed profiles (based on salinity and temperature) specific to the area of Shell's Burger Prospect. Results of this modeling, along with measured underwater sound levels generated by the *Discoverer* during non-drilling activities, are provided in Tables 2.9-1 and 2.9-1 of Shell's EIA. Shell would perform in-field sound measurement while drilling.

Vertical Seismic Profile

Shell proposes to conduct Vertical Seismic Profile (VSP) for each well drilled (see Section 2.4 of Shell's EIA). A VSP gathers geophysical data in the well which is used to correlate to or "tie-in" the geophysical data collected during previous seismic surveys over the prospect. During a VSP, an airgun array is deployed at a location near or adjacent to the drilling vessel, while receivers are placed (temporarily anchored) in the wellbore. The airguns function by venting high-pressure air into the water. The pressure signature of an individual airgun consists of a sharp rise and then fall in pressure, followed by several positive and negative pressure excursions caused by oscillation of the resulting air bubble. The sizes, arrangement, and firing times of the individual airguns in an array are designed and synchronized to suppress the pressure oscillations subsequent to the first cycle.

Shell further proposes to conduct a particular form of VSP known as a zero-offset VSP (ZVSP), in which the sound source is maintained at a constant location near the wellbore. A typical sound source that may be used by Shell for its ZVSP surveys is an eight-airgun array which consists of four 150-in^3 airguns and four 40-in^3 airguns for a total size of 760 cubic inches. For each survey, Shell would use a crane to deploy the sound source over the side of the drillship to a depth of about 10-23 feet below the water surface. The receiver would be temporarily anchored in the wellbore at the appropriate depth. The sound source is then pressured up to 2,000 pounds per square inch and activated 5-7 times at approximately 20-second intervals. This process is then repeated with the receivers positioned at other portions of the wellbore until the entire exploration well is surveyed. Depending on the depth

of the well and the number of anchoring points, a normal ZVSP survey is conducted during a period of about 10-14 hours.

Recorded sound levels from a similar array that was used during a 2008 seismic survey in the Beaufort Sea are discussed in Section 2.9 of the Shell EIA and are provided in Table 9.

Table 9. Sound Source (airgun array) Specifications for ZVSP Surveys in the Beaufort.

Received Sound Level	Distance to Received Sound Level (Radius)	
190 dB re1µPa @ 1 m	1,719 ft	524 m
180 dB re1µPa @ 1 m	4,068 ft	1,240 m
160 dB re1µPa @ 1 m	12,041 ft	3,670 m
120 dB re1µPa @ 1 m	34,449 ft	10,500 m

Vessel Sound

A number of additional vessels (see Tables 6 and 7, above) would support the *Discoverer* and drilling operations. Each of these vessels would contribute sound to the environment. Vessel sounds have been reported extensively (Greene and Moore, 1995; Blackwell and Greene 2002, 2005, 2006). Numerous measurements of underwater vessel sound have been performed in support of recent industry activity in the Chukchi and Beaufort seas. Results of these measurements were reported in various 90-day and comprehensive reports since 2007. For example, Garner and Hannay (2009) estimated sound pressure levels of 100 dB at distances ranging from approximately 1.5-2.3 mi (2.4-3.7 km) from various types of barges. MacDonald et al. (2008) estimated higher underwater sound pressure levels from the seismic vessel *Gilavar* of 120 dB at approximately 13 mi (21 km) from the source, although the sound level was only 150 dB at 85 ft (26 m) from the vessel. Like other industry-generated sound, underwater sound from vessels is generally characterized by relatively low frequencies.

The primary sources of sounds from all vessel classes are propeller cavitation, propeller singing, and propulsion or other machinery. Propeller cavitation is usually the dominant noise source for vessels (Ross, 1976). Propeller cavitation and singing are produced outside the hull, whereas propulsion or other machinery noise originates inside the hull. There are additional sounds produced by vessel activity, such as pumps, generators, flow noise from water passing over the hull, and bubbles breaking in the wake.

Icebreakers contribute greater sound levels during ice-breaking activities than ships of similar size during normal operation in open-water (Richardson et al., 1995a). This higher sound production results from the greater amount of power and propeller cavitation required when operating in thick ice. Shell does not intend to break ice with its ice management vessels unless ice poses an immediate safety hazard at the drill site. The ice management vessels will instead push ice out of the area. Reported and predicted sound levels associated with icebreaking activities are provided in Tables 2.9-5, 2.9-6 and 2.9-7 of Shell's EIA.

Aircraft Sound

Several aircraft would support the *Discoverer* and drilling operations and introduce sound into the environment. The level and the duration of received underwater sounds depends on the altitude and aspect if the aircraft, receiver depth, and water depth. In general, received sound levels decrease as the altitude of the aircraft increases. Tables 2.9-3 and 2.9-4 of Shell's EIA provide detailed information for each type of aircraft supporting Shell's exploration activities.

2.4.8 Local Hire

Under the Proposed Action, Shell proposes to hire local residents in some positions, as discussed below:

Marine Mammal Observers

Shell will employ Marine Mammal Observers (MMOs) to conduct vessel-based monitoring for marine mammals throughout exploration drilling operations. These MMOs will be trained, experienced field observers, to include biologists and Iñupiat personnel. The MMOs will be stationed aboard the drillship and associated support vessels throughout the exploration drilling period. Their duties would include watching for and identifying marine mammals; recording their numbers, distances, and reactions to the exploration drilling operations; initiating mitigation measures where appropriate; and reporting the results.

Subsistence Advisors

Shell proposes to hire Subsistence Advisors (SAs) in each of the villages along the Chukchi Sea, as well as Kotzebue. Shell would share information and maintain a dialogue with each SA, so that conflicts with subsistence may be minimized or avoided.

Community and Call Center positions

Shell also proposes to employ local community members at its Community and Call Centers (Com Centers). These Com Centers will serve as information clearinghouses and enable communications between Shell operations and vessels, local subsistence users, and SAs.

Shell has also indicated that it would employ local residents as staff at its shorebase and, if necessary, contingency oil spill responders.

2.4.9 Analysis of Accidental Oil Spills

In the Lease Sale 193 Final EIS and Final SEIS (from which this EA tiers), BOEM analyzed a range of oil spill sizes—grouped by volume category—from small (<1,000 bbl) to very large (≥150,000 bbl). Likely consequences for environmental, social, and economic resources were evaluated. In this document BOEM updated the analysis of small and large oil spills provided in the Chukchi sea EA and the Arctic Multiple-Sale EIS.

To arrive at a spill volume and oil type for small (<1,000 bbl), large (≥1,000 bbl), and very large (≥150,000 bbls) spill size categories, BOEM used Shell's potential discharge volumes (Shell, 2011b: Table 2.3-1 summarized in Table 10. and in Appendix A of this EA). The potential discharge volumes are estimated without consideration of mitigation or response efforts. Mitigation and response are discussed in Sections 2.4.10 through 12 of this EA. Shell estimated a worst case discharge volume and provided this estimate to BOEM and BSEE (Wall, 2011, pers. comm.). BOEM concurs on geologic grounds with Shell's assertion that the Burger J well offers the highest potential discharge volume in both daily rate and cumulative flow. BOEM also independently modeled the WCD for Shell's Burger J well and verified that Shell's estimate is sufficient (Wall, 2011). BOEM's WCD calculation assumes no "bridging over" – a phenomenon whereby rocks, sand, clay and other debris can clog the hole and stop the blowout.

Table 10. Spill volume and oil type estimated for each BOEM spill size category (from Shell's potential discharge volumes).

BOEMRE Spill-Size Categories	Type	Oil Type	Potential Discharge Volume[1]	Volume estimated to reach water
Small (<1,000 bbl)	Fuel Transfer	Diesel	48 bbl	48 bbl
Large (≥1,000 bbl)	Diesel Tank	Diesel	1,555 bbl	0 bbl
Very Large (≥150,000 bbl)	Loss of Well Control	Crude Oil	750,000 bbl	121,779 bbl[2]

Note: [1]Total volume estimated with no mitigation or response
[2]Total volume estimated with mitigation and response as described in Sections 2.3.10 of this EA.

BOEM determined a reasonably foreseeable spill analysis scenario for Alternative 1 – No Action, Alternative 2 – Proposed Action, and Alternative 3 – One Well per Season. To determine the specific elements of the oil spill scenario BOEM reviewed and considered published documents and NEPA assessments on the likelihood of the potential discharges in the three spill size categories. BOEM evaluated the potential impact producing factors of an accidental oil spill for this EA. Further analytical details are found within Appendix A of this EA.

For purposes of analysis of Alternative 1, no small, large, or very large spills are estimated to occur in the project area as a result of Alternative 1 since no exploration activities associated with drilling would occur.

For purposes of analysis of Alternative 2 – Proposed Action and Alternative 3 – One Well per Season, BOEM estimates it is likely a small refined oil spill could occur. This estimate is based on consideration of 35 small exploration spills that have occurred while drilling 35 wells on the Arctic OCS. During the time of this exploratory drilling, industry has had 35 small spills totaling 26.7 bbl or 1,120 gallons (gal). Of the 26.7 bbl spilled, approximately 24 bbl were recovered or cleaned up. Table A-4 in Appendix A shows the exploration spills on the Beaufort Sea and Chukchi Sea OCS. No large spills (≥1,000 bbl) or very large spills (≥150,000 bbls) are estimated to occur (based on calculations and analyses presented in Appendix A of this EA) from the proposed exploration activities.

The large and very large crude oil spill occurrence estimates are based on the following: (1) the low rate of OCS exploratory drilling well-control incidents spilling fluids per well drilled; (2) the fact that since 1971, one large/very large spill has occurred from a loss of well control during temporary abandonment out of more than 15,000 exploratory wells drilled; (3) the low number (up to six) of exploration wells proposed in this action; (4) the fact that no crude oil would be produced and the wells would be permanently plugged and abandoned; (5) the history of Arctic OCS exploration spills, all of which have been small; (6) the fact that no large spills occurred while drilling 35 wells in the Arctic OCS; and (7) pollution prevention and oil spill response regulations and methods implemented by BOEM and Shell, respectively, since the *Deepwater Horizon* event.

Given the points made above, the most likely spill size that could occur is a small (<1,000 bbl) spill. For purposes of analysis, BOEM chose a 48 bbl diesel fuel-transfer spill (as identified in Shell's ODPCP Summary of Potential Discharges) to represent the spill volume and oil type for the effects analysis of a small spill for Alternative 2 and 3 (Shell, 2011b: Table 2.3-1).

To evaluate the potential effect of a 48 bbl diesel-fuel oil spill, BOEM estimated how much diesel fuel would evaporate, how much diesel fuel would naturally disperse, and how much diesel fuel would remain after a certain time period. The SINTEF oil weathering model (OWM) was used to generate these estimates. A 48 bbl diesel-fuel spill could evaporate and disperse in less than 3 days (Appendix A: Table A-7). The SINTEF OWM estimates do not include the mitigating effects of potential containment and recovery operations to remove spilled product. Such operations would include pre-booming downwind of vessels prior to transfer operations in accordance with BOEM lease stipulations, USCG requirements, and Shell's fuel transfer operating procedures. Also, recovery equipment would be deployed for the control and removal of diesel fuel resulting from a small spill. Should a 48 bbl diesel-fuel spill occur, the spill would be localized and persist less than 3 days.

Likely consequences for environmental, social, and economic resources from large and very large oil spills were evaluated in the Lease Sale 193 Final EIS and Final SEIS (from which this EA tiers). Although large are very large spills are not estimated to occur, summaries and impact conclusions for large and very large spills for each resource are included in Section 4.0.

2.4.10 Oil Discharge Prevention and Contingency Planning

No exploratory drilling may commence prior to submittal and BSEE approval of an Oil Discharge Prevention and Contingency Plan (ODPCP) that is consistent with applicable Federal regulations and

guidance. The ODPCP must demonstrate that the operator has the spill response resources, equipment, personnel, and strategies necessary to efficiently and effectively respond to a worst case discharge (WCD).

Shell prepared a Chukchi Sea Regional Exploration ODPCP to support its 2010 Chukchi Sea Exploration Plan (EP). That ODPCP was approved by the State of Alaska in March 2010 and by BOEMRE (now BSEE) in April 2010. Because the 2012 Shell revised Chukchi Sea EP included changes to drilling plans and WCD volumes, amendments to the approved ODPCP were necessary. BSEE requested specific changes to the approved ODPCP by letter dated November 16, 2011.

Shell discusses certain key components of its ODPCP in Section 8 of the EP and Section 2.10 of the EIA.

2.4.11 Compliance with Lease Stipulations

Shell's leases were obtained under the Chukchi Sea OCS Lease Sale 193 in February of 2008. Shell's proposed exploration activities must comply with all applicable stipulations.

Stipulation 1 – Protection of Biological Resources

Stipulation 2 – Orientation Program

Stipulation 3 – Transportation of Hydrocarbons

Stipulation 4 – Industry Site-Specific Monitoring Program for Marine Mammal Subsistence Resources

Stipulation 5 – Conflict Avoidance Mechanisms to Protect Subsistence Whaling and Other Marine Mammal Subsistence-Harvesting Activities

Stipulation 6 – Pre-Booming Requirements for Fuel Transfers

Stipulation 7 – Measures to Minimize Effects to Spectacled and Steller's Eiders During Exploration Activities

The full text of the lease stipulations associated with Lease Sale 193 and a summary of how Shell's proposed compliance with each stipulation are provided in Appendix G.

2.4.12 Other Mitigation Included in Shell's Exploration Plan

Discussed below are additional mitigation measures that Shell would implement during its proposed exploration drilling operations. This list is taken directly from Section 12.0(c) of the Revised EP and is provided here to inform the analysis of potential environmental impacts. These measures supplement, but do not supercede, requirements imposed by applicable laws, regulations, permits, authorizations, and lease stipulations.

Communications

- Shell has developed a Communication Plan and will implement this plan before initiating exploration drilling operations to coordinate activities with local subsistence users, as well as Village Whaling Captains' Associations, to minimize the risk of interfering with subsistence hunting activities, and keep current as to the timing and status of the bowhead whale hunt and other subsistence hunts. The Communication Plan includes procedures for coordination with Com Centers to be located in coastal villages along the Chukchi and Beaufort Seas during Shell's proposed exploration drilling activities.
- Shell will employ local SAs from the Beaufort and Chukchi Sea villages that are potentially impacted by Shell's exploration drilling activities. The SAs will provide consultation and guidance regarding the whale migration and subsistence activities. There will be one per village, working approximately 8-hr per day and 40-hr per week during each drilling

season. The subsistence advisor will use local knowledge (Traditional Knowledge) to gather data on subsistence lifestyle within the community and to advise in ways to minimize and mitigate potential negative impacts to subsistence resources during each drilling season. Responsibilities include reporting any subsistence concerns or conflicts; coordinating with subsistence users; reporting subsistence-related comments, concerns, and information; coordinating with the Com and Call Center personnel; and advising how to avoid subsistence conflicts. SAs will have a handbook that will specify work tasks in more detail.

Aircraft Travel

- Aircraft shall not operate below 1,500 ft (457 m) unless the aircraft is engaged in marine mammal monitoring, approaching, landing or taking off, in poor weather (fog or low ceilings), or in an emergency situation, while over land or sea to minimize disturbance to mammals and birds. Aircraft engaged in marine mammal monitoring shall not operate below 1,500 ft (457 m) in areas of active whaling; such areas to be identified through communications with the Com Centers.
- Aircraft will not operate within 0.5 mi (0.8 km) of walrus or polar bears when observed on land or ice.
- Shell will also implement non-MMO flight restrictions prohibiting aircraft from flying within 1,000 ft (300 m) of marine mammals or below 1,500 ft (457 m) altitude (except during takeoffs and landings or in emergency situations) while over land or sea. This flight will also help avoid disturbance of and collisions with birds.

Vessel Travel

- The *Discoverer* and support vessels will enter the Chukchi Sea through the Bering Strait on or after July 1, minimizing effects on marine mammals and birds that frequent open leads and minimizing effects on spring and early summer bowhead whale hunting.
- Drillship and support vessel transit routes will avoid known fragile ecosystems and the Ledyard Bay Critical Habitat Unit, and will include coordination through Com Centers.
- To minimize impacts on marine mammals and subsistence hunting activities, the drillship and support fleet will transit through the Chukchi Sea along a route that lies offshore of the polynya zone. In the event the transit outside of the polynya zone results in Shell having to break ice (as opposed to managing ice by pushing it out of the way), the drillship and support vessels will enter into the polynya zone far enough so that ice breaking is not necessary. If it is necessary to move into the polynya zone, Shell will notify the local communities of the change in the transit route through the Com Centers. As soon as the fleet transits past the ice, it will exit the polynya zone and continue a path in the open sea toward the drill sites.
- MMOs will be aboard the *Discoverer* and all support vessels (see the 4MP in Appendix D of the 2012 Shell Revised Chukchi Sea EP).
- Vessels will not operate within 0.5 mi (0.8 km) of walrus or polar bears when observed on land or ice.
- When within 900 ft (274 m) of marine mammals, vessels will reduce speed, avoid separating members from a group and avoid multiple changes of direction.
- Vessel speed is to be reduced during inclement weather conditions in order to avoid collisions with marine mammals.
- Shell will communicate and coordinate with the Com Centers regarding all vessel transit.

- Lighting on the drillship will be shaded and some have been replaced with ClearSky lighting. ClearSky lighting is designed to minimize the disorientation and attraction of birds to the lighted drillship to reduce the possibility of a bird collision (see the Bird Strike Avoidance and Lighting Plan in Appendix I of the 2012 Shell Revised Chukchi Sea EP).

Exploration Drilling Operations

- Drilling mud will be cooled to mitigate any potential permafrost thawing or thermal dissociation of any methane hydrates encountered during exploration drilling, if such materials are present at the drill site.
- Drilling muds will be recycled to the extent practicable based on operational considerations (e.g., whether mud properties have deteriorated to the point where they cannot be used further) so that the volume of the spent mud is reduced.
- Critical operations will not be started if potential hazards (ice floe, inclement weather, etc.) are in the vicinity and there is not sufficient time to finish the critical operation before the arrival of the hazard at the drill site (see COCP in Appendix J of the 2012 Shell Revised Chukchi Sea EP).
- All casing and cementing programs will be certified by a registered professional engineer.
- Airgun arrays will be ramped up slowly during ZVSPs to warn cetaceans and pinnipeds in the vicinity of the airguns and provide time for them to leave the area and avoid potential injury or impairment of their hearing abilities. Ramp ups from a cold start when no airguns have been firing will begin by firing a single airgun in the array. A ramp up to the required airgun array volume will not begin until there has been a minimum of 30 min of observation of the safety zone by MMOs to assure that no marine mammals are present. The safety zone is the extent of the 180 dB radius for cetaceans and 190 dB for pinnipeds. The entire safety zone must be visible during the 30-min lead-in.to an array ramp up. If a marine mammal(s) is sighted within the safety zone during the 30-min watch prior to ramp up, ramp up will be delayed until the marine mammal(s) is sighted outside of the safety zone or the animal(s) is not sighted for at least 15-30 min: 15 min for small odontocetes and pinnipeds, or 30 min for baleen whales and large odontocetes.
- The blowout prevention program will be enhanced through the use of two sets of blind/shear rams, increased frequency of BOP performance tests from 14 to 7 days, a remotely operated vehicle (ROV) control panel on the seafloor with sufficient pressured water-based fluid to operate the BOP, a containment system that includes capping stack equipment, treatment and flaring capabilities, a fully-designed relief well drilling plan, and provisions for a second relief well drilling vessel (Kulluk) to be available to drill the relief well if the primary drilling vessel is disabled and not capable of drilling its own relief well.

Ice Management

- Ice management will involve preferentially redirecting, rather than breaking, ice floes while the floes are well away from the drill site (see the Ice Management Plan in Appendix K of the 2012 Shell Revised Chukchi Sea EP).
- Real time ice and weather forecasting will be from the Shell Ice and Weather Advisory Center (SIWAC).

Oil Spill Response

- The primary OSR vessel will be on standby at all times when drilling into zones containing oil to ensure that oil spill response capability is available within one hour, if needed.
- Shell will deploy an OSR fleet that is capable of collecting oil on the water up to the WCD planning scenario which is greater than the calculated WCD flowrate of a blowout in the

unlikely event that one should occur. The primary OSR vessel will be on standby when drilling into zones containing oil to ensure that oil spill response capability is available within one hour, if needed. The remainder of the OSR fleet will be fully engaged within 72 hours.

- In addition to the OSR fleet, oil spill containment equipment will be available for use in the unlikely event of a blowout. The containment barge will be centrally located in the Beaufort Sea or Chukchi Sea and supported by an Invader Class Tug and possibly an anchor handler. The containment equipment will be designed for conditions found in the Arctic including ice and cold temperatures. This equipment will also be designed for maximum reliability, ease of operation, flexibility and robustness so it could be used for a variety of blowout situations.
- Capping stack equipment will be stored as equipment aboard one of the ice management vessels and will be available for immediate deployment in the unlikely event of a blowout. Capping stack equipment consist of subsea devices assembled to provide direct surface intervention capability with the following priorities:
  - Attaching a device or series of devices to the well to affect a seal capable of withstanding the MAWP and closing the assembly to completely seal the well against further flows (commonly called "capping and killing")
  - Attaching a device or series of devices to the well and diverting flow to surface vessel(s) equipped for separation and disposal of hydrocarbons (commonly called "capping and diverting")
- A polar bear culvert trap has been constructed in anticipation of OSR needs and will be available prior to commencing the exploration drilling operations.
- Pre-booming is required for all fuel transfers between vessels.

Air Emissions

- Primary generators on the *Discoverer* have been retrofitted with selective catalytic reduction SCR devices to reduce NOx emissions to under 0.5 grams/kilowatt-hour (g/kW-hr), and OxyCat to reduce CO by at least 80 percent, volatile organic compounds VOCs by at least 70 percent, and PM10 by at least 50 percent.
- All other engines on *Discoverer* will either be Tier 3 (low emissions) or have been retrofitted with CDPF devices to reduce CO, VOCs, and hazardous air pollutants (HAPs) by at least 90 percent and fine particulate matter by at least 85 percent.
- Propulsion and generation engines on the ice management vessel and anchor handler will have SCR devices to reduce NOx emissions to under 1.6 g/kW-hr, and OxyCat devices to reduce CO by at least 80 percent, VOCs by at least 70 percent, and PM10 to under 0.25 g/kW-hr.
- ULSD (0.0015 percent sulfur by weight) fuel will be purchased for the *Discoverer* and for support vessels, which will reduce SO2 emissions by more than 97%.

2.4.13 Environmental Monitoring

During exploration activities, Shell will monitor for the following:

Air Quality

Shell's PSD air quality permit (R10OCS/PSD-AK-09-01) under the Clean Air Act requires monitoring of air emissions.

Water Quality

The *Discoverer* will have waste monitoring equipment onboard and report discharges, as required by NPDES General Permit AKG-20-000 under the CWA.

Marine Mammals

The *Discoverer* and support vessels will each have Marine Mammal Observers (MMOs) onboard to observe marine mammals and record all observations, as per the requirements of Shell's Marine Mammal Monitoring and Mitigation Plan (4MP) submitted in support of the NMFS IHA application.

Other Environmental Conditions

As stated in Section 10.0 of the 2012 Shell Revised Chukchi Sea EP (excerpted below), Shell would also engage in other environmental monitoring activities during exploration drilling operations:

> In addition to monitoring of marine mammals, a comprehensive environmental monitoring program will be implemented during exploration drilling operations. A dedicated science vessel staffed by a team of physical and biological oceanographers will be responsible for assessing pre-, during, and post-drilling conditions in both biota and water and sediment quality. All drilling locations have been sampled at multiple times during the last three years to provide a baseline understanding of pre-existing conditions and interannual variability at these sites.
>
> Physical oceanography characteristics that will be monitored continuously at the each location throughout the drilling process include: surface wind direction and speed, ambient air temperature, current speed and direction throughout the water column, water temperature through the water column and salinity through the water column.
>
> Water chemistry and characteristics that will be monitored will include assessment of metals and organics through the water column at multiple fixed and random locations around the exploration drilling operation. These measurements will be made regularly before, during, and after drilling and will capture conditions during all significant phases of the exploration drilling operations and potential discharges. Physical characteristics of the water column will also be assessed including turbidity, temperature, and oxygen content in an effort to document and model plumes of released discharges.
>
> Biological observations will include assessments of benthos, epibenthos, zooplankton and phytoplankton, and fishes. In addition to characterization of the communities of these organisms at and near the drill site before, during, and after operations, samples of biota will be collected before and after operations for tissue analysis for metals and organics.
>
> Bird and mammal observations will be made from all surface operation vessels throughout the exploration drilling activities in accordance with the 4MP and Bird Strike Avoidance and Lighting Plan. (Shell, 2011a: Appendix C).

2.4.14 Adaptive Management

Consistent with DOI policies at 43 CFR 46.145 and 522 DM 1, BOEM and BSEE have developed standard operating procedures for implementing adaptive management of OCS activities. Under these procedures, BOEM and BSEE will conduct post-action reviews to evaluate whether monitoring, mitigation, and reporting requirements are meeting desired results, and will modify site-specific monitoring and mitigation requirements as needed.

SECTION 3. Affected Environment

The following subsections summarize environmental conditions and resources found within areas that could be affected by the Proposed Action or other alternatives. Each summary focuses on information relevant to understanding potential environmental impacts. More detailed discussion of the marine, coastal, and human environment of the Chukchi Sea planning area is contained within the broader NEPA documents listed in Section 1.3 and incorporated into this Environmental Assessment (EA) by reference.

3.1 Meteorology

The North Slope of Alaska, adjacent to the Chukchi Sea, is a polar climate characterized by moderate winds, cold temperatures during the winter, cool temperatures in the summer, and little annual precipitation (Ahrens, 2009). The region is dominated by subfreezing temperatures for most of the year, and the Chukchi Sea is almost totally ice covered from early December to mid-May. During the winter, winds can be strong and prolonged, leading to extreme ice pressures and dangerous wind-chill conditions. A brief warm and snow-free season follows in June, July, and August. Summers over the Chukchi Sea are influenced by the Western pacific low-pressure system, which moves northeast along the Chukchi coastline causing cloudy skies and light precipitation (USDOI, BOEMRE, 2011a). During the summer, fog occurs frequently as warmer air moves over the colder water, which is sometimes covered with ice. Because of the fog, low visibility of one-half mile or less can occur, most commonly during June, July, and August. The following sections will provide a discussion of climate change in the Arctic, the expected weather conditions at the drill sites, and the expected ice conditions at the drill sites.

3.1.1 Climate Change

A thorough scientific examination of climate change in the Arctic is provided by the Inter-governmental Panel on Climate Change (IPCC, 2007) and the Arctic Climate Impact Assessment (ACIA, 2005). The two reviews offer the most comprehensive compilation of information available on climate change, agreeing that the Arctic is experiencing variations that are accelerating faster than previously realized (Karcher et al., 2010). Other research concurs the Arctic is undergoing a rapid transition, including surface warming (affecting cloudiness) and changes in the cryosphere, the frozen water part of the Earth system that includes sea ice (Matthes, Rinke, and Dethloff, 2009). A thorough discussion of climate change in the Arctic is also provided in the 2011 Final SEIS in Section III.A.2 (USDOI, BOEMRE, 2011a). There is a potential for climate change impacts to natural resources, and those impacts are considered in the individual evaluations provided in Section 4.0-Environmental Consequences, where relevant. A more thorough discussion of the science behind climate change and affects on the Arctic are provided in Appendix E.

Concurrent with climate change is a change in ocean chemistry known as ocean acidification. This phenomenon is described in the IPCC Fourth Assessment Report (Climate Change 2007), a 2005 synthesis report by members of the Royal Society of London (Raven et al., 2005), and an ongoing BOEM-funded study (Mathis, 2011). The greatest degree of ocean acidification worldwide is predicted to occur in the Arctic Ocean. This amplified scenario in the Arctic is due to the effects of increased freshwater input from melting snow and ice, and from increased CO_2 uptake by the sea as a result of ice retreat.

3.1.2 Expected Weather Conditions at the Drill Sites

The exploration plan proposes operations during the summer months from July through October. During these months in Wainwright, Alaska, the warmest month is July with an average high temperature of 49.5° Fahrenheit (F.). The average high temperature ranges from 49.5° F. in July to 22.7° F. in October; the average low temperature ranges from 35.8° F. in July to 11.8° F. in October.

By November, the average temperature is less than 10.0° F. Local annual precipitation is 6.52 inches, with most precipitation falling in July and August. With little precipitation in the winter, operators at the drilling site should expect the majority of annual precipitation to fall in the summer (up to 5.35 inches of precipitation).

The wind is influenced by the season in the Chukchi Sea. The average wind speed is 6-11 miles per hour (mph) and in the winter winds are generally from the northeast. Wind velocity is less predictable in the summer. When considering the average wind speeds and temperatures common to the North Slope, daily wind chills will likely be 15° F. to zero° F. by late October, dropping into the minus 10° F. to minus 15° F. range in the event of a late fall storm (NWS, 2009).

There are approximately 6 to 10 storm days each month in the Chukchi Sea, where a storm is defined by wind speeds of 34 mph or more. Some storms have been known to last 8 to 14 days. Occasional sudden storms can occur in the Chukchi Sea, where the lack of natural wind barriers results in unrestricted winds. These storms bring cold temperatures and occur most frequently between September and November. The combined effect of cold temperatures and high winds during storms makes the North Slope of Alaska a risk to persons exposed to outside conditions for even brief periods of time.

3.1.3 Expected Ice Conditions at the Drill Sites

This sea-ice description builds upon discussion in sections III.A.4 of the Sale 193 Final EIS and Sale 193 Final SEIS. Information from the Arctic Multiple-Sale Draft EIS, Sections 3.2.4.2 and 3.2.4.3 (USDOI, MMS, 2008) and the Shell EIA (Shell Gulf of Mexico Inc., 2011 – Appendix F) is also summarized and incorporated by reference. Salient points from these documents are summarized as follows. There are three general forms of sea ice in the project area (including the shorebase and areas where oil spill response could occur): (1) landfast ice, which is attached to the shore, is relatively immobile, and extends to variable distances offshore; (2) stamukhi ice, which is grounded and ridged ice; and (3) pack ice, which includes first-year and multiyear ice and moves under the influence of winds and currents.

Shell's proposed drilling activities are planned for the Arctic summer "open-water" season. The proposed drill sites are far seaward of the typical extent of landfast ice during the time of operations. From 1999-2007 the formation of fast ice generally commenced during the first two weeks in October (Weinzapel et al., 2011). Stamukhi ice is not anticipated in the project area at the time of operations. Pack ice could move into the project area during the time of operations due to wind or currents.

The start of on-site exploration activities would begin after July 1, which coincides with the retreat of the ice in most years (early June to late July). The duration of open water (less than 10% ice concentration) in the central Chukchi Sea has lengthened by up to four weeks over the past 30 years to a summer average of 17 weeks. However, the range of open water is variable from year to year and ice could be present at the proposed drill sites. High concentrations (>10%) of ice in early July may delay start of operations.

Generally the ice retreat starts in the southern Chukchi and advances northward. There can be significant differences in the timing of pack ice retreat and melting between years as shown in Table 11 (Weinzapel et al., 2011). It should be noted that the five lowest September sea ice extents have occurred in the last five years (2007-2011; NSIDC, 2011a).

Floating pack ice could approach established drilling operations. Shell's Ice Management Plan (Shell, 2011a, Appendix K, Section 9.0(b) would be implemented to change the direction of approaching ice, rather than ice breaking, to ensure safe operations at all times. Ice-management activities would also include keeping ice from forming or piling up at the drillship's hull. Thick winter sea ice begins to form on the surface of the Chukchi Sea as early as late October or as late as mid December. From 1996 through 2007, the onset of freeze-up (first appearance of new ice) in the

Table 11. Sea Ice Free Conditions near the Burger Prospect from 1999 to 2011.

Year	Date Sea Ice Free	Year	Date Sea Ice Free
1999	August 31	2006	September 30
2000	August 15	2007	July 30
2001	August 5	2008	August 11
2002	August 12	2009	July 10
2003	July 7	2010	July 8
2004	June 15	2011	June 6
2005	June 21		

Source: Weinzapel et al., (2011; 1999-2007) modified by BOEM (2008-2011).

vicinity of the previously drilled Burger Prospect occurred between early October and the third week of November. The offshore transition period from very open drift ice to 90% (or more) ice concentration is highly unpredictable, taking anywhere from one week to a month. Nearly complete ice cover occurred in the area offshore of Wainwright as early as October 22 and as late as December 11 (1996-2007) (Shell, 2011a).

The Arctic sea ice is undergoing rapid changes. There are reported changes in sea-ice extent, thickness, distribution, age, and melt duration. In general the sea-ice extent is becoming much less in the Arctic summer and slightly less in winter; overall, the decline in sea-ice extent is increasing (NSIDC, 2011 a, b). The thickness of Arctic ice is decreasing (Hass et al. 2010), the distribution of ice is changing, and its age is decreasing (Comiso, 2011). Melt duration is increasing. These factors lead to a decreasing perennial Arctic ice pack.

Additional information on Arctic sea ice trends, including information specific to the Chukchi Sea, is presented in Section 3.2.3 of Shell's EIA (Shell, 2011a: Appendix K) and in Section 3.4 of Shell's Chukchi Sea Regional ODPCP (Shell, 2011b).

3.2 Resources

3.2.1 Air Quality

This section describes the existing condition of air quality in northern Alaska, particularly over the land areas of the North Slope adjacent to the Chukchi Sea, and existing sources of air pollutants. A summary of the weather and climate conditions typical for the location of the Proposed Action is provided in Section 3.1. Also in this section is a discussion of the federal and state regulatory framework governing air quality and its relation to the Proposed Action and the project alternatives. Additional information regarding the air quality analysis is provided in Appendix D, Air Quality.

Air Quality on the Alaskan North Slope

The US Environmental Protection Agency (EPA) does not specify the air quality conditions of locations over the open sea; only landside geographical locations with homogeneous air quality characteristics are classified according to quality of the air. These geographic regions are referred to as air quality control regions (AQCR). Sources of emissions on the OCS that are within 25 miles of the State's three-geographical mile (gm) seaward boundary (a total of 28 miles) are subject to the local requirements of the Corresponding Onshore Area (COA), which would be the onshore area that is geographically closest to the OCS source (40 CFR 55(a). The proposed location of drilling on the Chukchi Sea OCS is beyond the 25-mile threshold, meaning no COA is designated for the project. The Nearest Onshore Area (NOA) is 64 miles from the proposed drilling site. The EPA has defined Alaska's North Slope to be within the Northern Alaska Intrastate Air Quality Control Region (NAI-AQCR9), which includes all the area of Alaska north of the Brooks Range (40 CFR Part 81.246), and is designated as a Class II area, meaning specific rules apply to the protection of air quality (18 AAC

Part 50.015). The EPA has classified the North Slope as a clean air resource (attainment) because pollutant concentrations in the area are well below the National Ambient Air Quality Standards (NAAQS) and the Alaska Ambient Air Quality Standards (AAAQS) (EPA, 2011a).

Attainment Status

The EPA reports that the pollutant concentrations within the North Slope Borough from the very few existing sources of emissions are far below the NAAQS due to dispersion caused by nearly constant wind and low precipitation over the area (Serreze and Barrett, 2011). The wind is also the long-range transport mechanism of pollution from sources on the Eurasian continent during the winter and early spring.

Existing Sources of Emissions on the North Slope

There are few industrial development areas on the North Slope to contribute to the budget of air emissions. The largest source of emissions is the Prudhoe Bay Oil Field, the largest oil field in North America, located far from the NOA on the shore of the Beaufort Sea, about 200 miles southeast (straight-line distance) from Barrow, Alaska and about 280 miles from Wainwright, Alaska. The closest community to the NOA would be Wainwright. Wainwright has a population of under 600 persons (U.S. Census Bureau, 2009) and there are few sources of emissions. In support of the oil and gas industry, the area would provide small vessel marine support for the Revised EP, such as shallow water landing craft for the occasional transport of supplies or crews between offshore vessels and the marine support shore base facilities on Wainwright. Air support for the exploratory drilling plan will be based at the Barrow airport, located about 80 miles (straight-line distance) northeast of Wainwright. Numerous flights of medium-range jet aircraft operate between Fairbanks and the Barrow airport to facilitate the workers' rotating schedules and for delivery of equipment and supplies. Implementation of the proposed exploration plan would require Shell to use the existing onshore facilities at Wainwright and Barrow, and no new construction is planned. Therefore, the only expected increase in onshore emissions associated with the proposed exploration would be the operation of helicopters and surface vehicles to transport personnel at Barrow.

Arctic Haze

The Alaska Department of Environmental Conservation (ADEC) reports the Arctic atmosphere becomes contaminated with pollution through long-range transport in the winter months from emissions due to coal burning and metal smelting in Europe and Russia. Meteorological studies support the suggestion that about 95 percent of the pollution is coming from Europe and Russia propelled by winds associated with the seasonal Siberian high-pressure system (Serreze and Barrett, 2011). The phenomenon is referred to as Arctic haze, and consists of mostly sulfur oxides and soot, but includes both gaseous and aerosol components. The phenomenon usually begins in early winter and reaches a peak impact in March, after which time the haze dissipates. The haze particles are very lightweight, with a diameter usually in the range of 0.4-0.8 micrometers, so the particles may be suspended in the air for weeks, allowing light to scatter, which affects visibility. In the absence of Arctic haze, visibility in the area is greater than 160 statute miles. The EPA has determined the regional air quality over the North Slope continues to be better than the NAAQS, even with the seasonal occurrence of Arctic haze. Arctic haze would only be visible during the last stages of a summer drilling season, mostly likely in late October during the phenomenon's initial stages, and is not expected to interfere with exploration operations.

Regulatory Overview

Elevated concentrations of pollution in the ambient air, which is outside air where the general public has access, have been shown to cause harm to human health and the natural environment (EPA, 2010a, January 9). As such, federal and state air agencies are obliged to develop plans, regulations, and guidelines to protect ambient air as a natural resource (EPA, 2010b). The following sections

explore the various regulatory provisions established to protect air quality, particularly in the area of the North Slope and on the OCS in the Chukchi Sea.

Clean Air Act

The Clean Air Act (CAA), including the 1990 Amendments, is the comprehensive law giving the EPA authority to clean up areas of polluted air in the United States. Section 328 of the CAA authorizes the EPA to regulate sources on the Alaskan OCS under the OCS Air Regulations (40 CFR Part 55). A thorough review of the CAA is provided in Appendix D.

Federal OCS Air Regulations

Pursuant to CAA Section 328, the EPA establishes requirements to control air pollution from sources on the OCS, including Alaska. The requirements are published in the Code of Federal Regulations (CFR), Title 40, Part 55, and are referred to as the federal OCS Air Regulations (40 CFR Part 55). The federal OCS Air Regulations make a distinction between OCS sources located within 25 miles of the State's three-gm seaward boundary and sources located beyond the 25- mile threshold. The federal OCS Air Regulations provide an outline of the federal air quality requirements that apply at an OCS source relative to the 25-mile threshold, and describe the operating permit requirements.

Alaska Air Quality Control Rules

Air quality management in Alaska is regulated by the ADEC. The ADEC is responsible for the control of sources of emissions in all parts of Alaska, including permitting requirements and mitigating measures to conserve the clean air resources that are enjoyed in many locations in Alaska. These mitigation measures and controls are summarized in the Alaska State Air Quality Control Plan (AQCP) (ADEC, 2008). Those portions of the AQCP that address federal air quality control requirements are submitted for EPA approval and become part of the federally-required Alaska State Implementation Plan (SIP). In addition, the AQCP contains state requirements and control measures that are not necessarily required by the EPA and are not included in the SIP. The entire AQCP is adopted by reference into the Alaska Administrative Code (AAC) (18 AAC 50), making the SIP an enforceable plan that outlines how the state will achieve and maintain the established state and federal air quality standards.

3.2.2 Water Quality

Water quality is a term used here to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose such as protection of fish, shellfish, or wildlife. Important water quality properties include temperature, salinity, density, dissolved oxygen, nutrients, organic carbon, chlorophyll, total suspended sediment, light transmissivity, trace metal concentrations, and hydrocarbon concentrations. All these properties are important in determining the distribution, movement and feeding grounds of marine biota. Because the water column interacts continuously with the seafloor surface sediments (e.g. deposition and suspension of particulate matter), these two aspects of overall water quality are tightly linked.

This discussion of water quality in the Chukchi Sea incorporates and summarizes information from the Sale 193 Final SEIS (USDOI BOEMRE, 2011a) and Sale 193 Final EIS (USDOI MMS, 2007a).

Water Quality in the Northeastern Chukchi Sea

Water quality in the northeastern Chukchi Sea naturally varies throughout the year related to seasonal biological activity and naturally occurring processes, such as formation of surface ice, seasonal plankton blooms, naturally occurring hydrocarbon seeps, seasonal changes in turbidity due to terrestrial runoff, and localized upwelling of cold water. The rivers and streams that flow directly into the northeast Chukchi Sea contribute freshwater to the marine system, affecting salinity, temperature and other aspects of water quality (Table 17 in Section 3.2.5 presents the named

waterways that directly flow into the northeasten Chukchi Sea between Point Hope and Barrow). River waters from the southern Chukchi coastline are carried north by the Alaska Coastal current and also influence the northern Chukchi nearshore environment.

Anthropogenic (human-generated) pollution in the northeastern Chukchi Sea is primarily related to aerosol transport and deposition of pollutants (AMAP, 1997, 2004); pollutant transport into the region by sea ice, biota and currents (Chernyak, Rice, and McConnell, 1996); discharges from international ship traffic (and consequent potential for marine invasive species); and effects from increasing carbon dioxide in the atmosphere. The potential for ocean acidification is a concern in the Chukchi Sea. As carbon dioxide increases in the atmosphere, the ocean absorbs more carbon dioxide. This increase in carbon dioxide in seawater forces an increase in the hydrogen ion concentration while lowering the pH and bioavailability of calcium carbonate over time.

Regional industrial impacts on water quality have been and are relatively low at this time. Five exploration wells were drilled in the Chukchi Sea between 1989 and 1991. Some trace metals, hydrocarbons, and other pollutants contributed by Bering Sea water or permitted discharges into the southern Chukchi Sea may move northwards towards the drilling area with the Alaska Coastal Current (USDOI, MMS, 2007: III-19).

Water Quality in the Proposed Drilling Area

Specific to the Proposed Action area, Weingartner and Danielson (2010) examined the variations in winds, sea ice and water property distributions from July to October in 2008 and 2009. They found surface salinity ranges of 28.5 to 31.5 psu and surface temperature ranges of -1.0 to 5.0˚ C within 10 meters depth. Seasonal changes in water masses near the Burger Prospect were documented over the two seasons of research cruises (Table 12). They found that cold, salty winter water is replaced with warmer, fresher summer water, and that surface waters are warmer and fresher throughout the season when compared to bottom waters (Weingartner and Danielson, 2010).

Table 12. Range of surface salinity and surface temperature (to 10 meters depth) in the area of proposed drilling in the northeast Chukchi Sea.

2008			2009		
Date	Temperature (˚C)	Salinity	Date	Temperature (˚C)	Salinity
3-12 August	-1 – 1.5	30.5-32	14 – 29 Aug	0 - 7.5	29 – 30.5
18 Aug – 20 Sept	1 - 3.5	28.5-31.5	5 – 19 Sept	4.5 - 5	30 – 31.5
9 Sept – 9 Oct	0 - 5	29.5-30.5	26 Sept – 10 Oct	2 – 4	30-31

Source: Weingartner and Danielson (2010)

Trefry, Trocine and Cooper (2011) studied the distribution of 17 trace metals in sediments of the northeastern Chukchi Sea during open water seasons in 2009 and 2010. Assuming repeated re-suspension, these sediment concentrations would affect metal concentrations in the lower water column. They found anomalies at an old drill site in the Klondike lease area: 15 barium concentrations and one each of mercury, nickel and lead. The mercury, they concluded, originated from the cuttings brought up during drilling. Trefry, Trocine and Cooper (2011) determined that sediment concentrations of potentially toxic metals (silver, cadmium, mercury, lead and zinc) remained below sediment quality criteria developed by Long et al. (1995) throughout the study area, including at the old drill sites. More specifically, metal concentrations were below the Effects Low Range ELR and well below the Effects Median Range developed by Long et al. (1995) for a select number of metals in the sediments. Trefry, Trocine and Cooper (2011) suggest that sediment quality criteria be used cautiously, with an understanding of the limitations, and be used more as an indicator.

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Grebmeier and Cooper (2011) studied chlorophyll concentrations in the northeastern Chukchi Sea. They measured chlorophyll-a concentrations in the water column post-bloom, and found that most of the chlorophyll-a settled to sub-surface water and surface sediments. Higher chlorophyll-a values were found in surface sediments in the offshore waters of the northern Chukchi Sea (under Anadyr current water) compared to lower values in nearshore coastal water (influenced by Alaska Coastal current water). Total organic carbon (TOC) in surface sediments was highest in offshore waters of the northern Chukchi Sea and in the northeast section of the Chukchi Sea near upper Barrow Canyon, indicative of higher export production reaching the underlying sediments in these regions.

Neff et al. (2010) examined the chemical characterization of seafloor sediments in the region of the Burger and Klondike prospects in 2008. Their results showed that the concentration and distribution of hydrocarbons in surface sediments throughout the Burger and Klondike prospects were variable. They found higher concentrations in some surface and subsurface sediment samples at Klondike and Burger historic drill sites. With the exception of surface and subsurface sediments at the two historic drill sites, hydrocarbon concentrations at all the other sites within the prospects were within the range of background concentrations reported by other studies in Alaskan coastal and shelf sediments. There were higher concentrations of some types of hydrocarbons in the sediments at the Klondike drill site compared to the Burger drill site; the authors suppose the difference was related to the discovery of crude oil at the Klondike drill site (in 1989) versus the discovery of gas and condensate at the Burger drill site. The researchers also found elevated concentrations of barium in the upper 6 cm of sediments at the former 1989 drill sites compared to the rest of the sites sampled. Copper, mercury and lead were also higher than background in a few of the former drill site sediment samples.

Water Quality Regulations

The water quality of the Chukchi Sea OCS is currently within the criteria for the protection of marine life according to CWA, Section 403, and no waterbodies within the Arctic region are identified as impaired (CWA, Section 303) by the State of Alaska (ADEC, 2011). EPA regulations at 40 CFR 125.121 define when marine discharges may cause an unreasonable degradation of the marine environment. This determination considers the following ten criteria (40 CFR 125.122):

- The quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged.
- The potential transport of such pollutants by biological, physical, or chemical processes.
- The composition and vulnerability of the biological communities that may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain.
- The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the lifecycle of an organism.
- The existence of special aquatic sites including, but not limited to, marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs.
- The potential impacts on human health through direct and indirect pathways.
- Existing or potential recreational and commercial fishing, including finfishing and shellfishing.
- Any applicable requirements of an approved Coastal Zone Management Plan. (Note: The State of Alaska does not currently have an approved Coastal Zone Management Plan.)

- Such other factors relating to the effects of the discharge as may be appropriate.
- Marine water quality criteria developed pursuant to Section 304(a)(1).

3.2.3 Lower Trophic Levels

The affected environment of the lower trophic resources is discussed in detail in the Lease Sale 193 Final SEIS (USDOI, BOEMRE, 2011a: pp. 53-55) and is summarized below.

The Chukchi Sea shelf is among the largest and most productive of the world's continental shelves (Grebmeier et al., 2006). The high productivity of these waters has its origin in the northern Pacific currents that provide an upwelling of warm, nutrient-rich Pacific waters onto the wide expanse of the Bering Shelf and then travel northward (Pickart, et al., 2009). Each of these unique water masses contributes distinct sediment loads and assemblages of phytoplankton and zooplankton (Springer, McRoy, and Turco, 1989; Coyle, Chavtur, and Pinchuk, 1996). The waters of the Chukchi Sea are split into two major current flows that bifurcate into a path to the northwest into the Herald Canyon, and a path to the northeast across the Chukchi Sea and into the Beaufort Sea (Weingartner, et al., 2005; Pickart, et al., 2009). The continental shelf of the central Chukchi Sea is relatively shallow, with water depth averaging 50 meters. Sediment composition consists of high percentages of fine sand, silt and clay (Naidu, 1988; COMIDA, 2011). No known hotspots leading to unique marine mammal or pelagic bird feeding areas, or unique biological communities, exist directly within the Burger prospect or on the proposed exploratory drilling sites analyzed in this section. Hardrock communities are known to exist southwest of Wainwright near the Skull Cliffs region (Philips, et al., 1984).

The lower trophic organisms living in the Chukchi Sea consist of three diverse and abundant groups (Hopcroft, et al., 2008; Mathis, et al., 2009): the pelagic, epontic, and benthic communities.

Pelagic Communities. The pelagic communities consist of two major sub-groups, those that live on or near the surface (plankton) and those inhabiting the water column between the sea surface and benthic surface. The inhabitants of the pelagic realms between the surface and benthos are diverse and abundant, and form the basis for the high productivity of the area (Hopcroft, et al., 2008). Within Arctic waters, the combination of temperature, sea ice, and seasonal fluctuation in light regimes creates variation in the timing and extent of seasonal plankton blooms (Hopcroft, Kosobokova, and Pinchuk, 2009). Phytoplankton blooms (including zooplankton stocks) tend to occur in two separate events in early and late summer (generally July through August) with density and duration of blooms dependent upon weather conditions and nutrient fluxes (Kirchman, et al., 2009). The spatial distribution of phytoplankton and zooplankton communities in the Chukchi Sea has been frequently tied to the different water masses in the area. In 2008 and 2009, an oceanographic assessment of the plankton communities in the Klondike and Burger prospect areas of the Chukchi Sea was carried out by Hopcroft, Questel, and Clarke-Hopcroft, that included oceanographic and plankton data collections. These studies indicated that, despite the relative proximity of the two sites, there were statistical differences in the water masses and the plankton populations between them. Further, differences in water temperatures and spring bloom timing were also observed between the two sites (Hopcroft, Questel, and Clarke-Hopcroft, 2009, 2010).

Epontic Communities. The epontic organisms are the ice-dwellers that live on and within the multi-dimensional matrix of ice (Gradinger, Bluhm, and Iken, 2010). Primary production based on epontic organisms from melting ice contributes 4–26% to total primary production in seasonally ice-covered Arctic seas (Legendre et al., 1992). The mixing of nutrients and phytoplankton from the multiple watermasses creates the conditions for massive open-water plankton blooms that are further fed by ice algae and epontic organisms from the receding ice flows. This results in an excess within the pelagic column that cannot be utilized by the zooplankton (Grebmeier and Barry, 1991; Grebmeier, 2006), and a high benthic biomass as well (Feder, et al., 2005, 2007).

Benthic Communities. The benthic group consists of organisms living within the upper sedimentary matrix (infaunal organisms) and those living on or strongly associated with the benthic surface (epifaunal organisms). Benthic ecology studies done by Blanchard, Parris, and Nichols (2009, 2010) found that the benthic fauna of the Burger prospect area was diverse and very abundant. Average abundance, biomass, and diversity were higher at Burger than at nearby sites. No interannual differences occurred between 2008 and 2009 (Blanchard, Parris, and Nichols, 2009, 2010). The Chukchi Sea Offshore Monitoring in Drilling Area, Chemical And Benthos (COMIDA, 2011) monitoring was carried out in an area corresponding to the Chukchi Sea Lease Sale 193, including the Burger prospect site area. This work agreed with Blanchard, Parris, and Nichols (2008) in finding high diversity and biomass of invertebrate communities, including reports of high biomass of the snow crab (*Chionoecetes opilio*). Both studies found increases in biomass and diversity from south to north, and from west to east, within the lease areas of the Chukchi basin.

3.2.4 Fish

The three primary assemblages of Arctic fishes are marine fish, anadromous and migratory fish, and freshwater fish. The Alaskan Chukchi Sea and western Beaufort Sea support at least 98 fish species representing 23 families (Mecklenburg, Mecklenburg, and Thorsteinson, 2002).

Several important studies have contributed to the knowledge of the fish species that occur in the Chukchi Sea including: Norcross et al. (2010); Mecklenberg et al. (2007); Mecklenburg et al. (2002); Barber et al. (1997); Frost and Lowry (1983); Hopcroft, et al., (2008); Fechhelm et al. (1985); and Alverson and Wilimovsky (1966). A more detailed discussion of fish in the Chukchi Sea is presented in the Sale 193 Final SEIS (USDOI, BOEMRE, 2011a) and the Sale 193 Final EIS (USDOI, MMS, 2007a), portions of which are summarized and incorporated by referenced.

Marine Fish

The most common marine fishes (adult and juvenile) documented in various research cruises in the northeastern Chukchi Sea include: Arctic cod (*Boreogadus*); saffron cod (*Eleginus*); Bering flounder (*Hippoglossoides*); yellowfin sole (*Limanda*); sculpin species (families Cottidae and Hemitripteridae); sand lance (*Ammodytes*); capelin (*Mallotus*); eelpout species (family Zoarcidae); snailfish (Family Liparidae); alligator fish (Family Gasterosteidae) and prickleback species (Family Stichaeidae) (Table 13) .

The distribution of demersal marine fish in the northeastern Chukchi Sea was found to be a function of salinity, substrate type (sediment type and percent gravel) and bottom water temperature (Norcross et al., 2010; Barber et al., 1997; Mecklenburg et al., 2007).

Some Chukchi Sea marine fish species associate with drifting or fast ice to feed, hide, and spawn; these species are referred to as cryopelagic fishes. Most notable of the cryopelagic fish species in the northeastern Chukchi Sea is the Arctic cod which associates with ice in various life stages and seasons for shelter and as a forage habitat to feed on microorganisms on the underside of the ice. Under-ice amphipods are an important food source for Arctic cod (Lonne and Gulliksen, 1989; Gradinger and Bluhm, 2004). Rough, irregular textures of the underside-ice may provide preferred habitat for Arctic cod to avoid predators (Cross, 1982). Arctic cod are discussed in greater detail in the following section on Essential Fish Habitat (EFH).

NOAA has conducted nearshore fish sampling along the northern Chukchi sea coast (NOAA, 2011). Fish that were commonly captured over 15 sites were: staghorn sculpin, Arctic sculpin, saffron cod, sand lance, capelin, juvenile prickleback, and yellowfin sole.

Harvey et al. (2011) studied hydrocarbons in sediments and the possible toxicological effects on Arctic cod in the northeastern Chukchi Sea, including the area of the Burger and Klondike prospects. They used enzymatic activity and DNA damage to assess the possible effects. The results showed

Table 13. Marine fish that commonly occur in the northeastern Chukchi Sea in the region of proposed drilling and support operations.

Common Name	Taxonomic Names
Arctic cod	*Boreogadus saida*
Saffron cod	*Eleginus gracilis*
Bering flounder	*Hippoglossoides robustus*
Yellowfin sole	*Limanda aspera*
Sculpin species	Family Cottidae
Sailfin sculpin species	Family Hemitripteridae
Pacific herring	*Clupea pallasii*
Sand lance	*Ammodytes hexapterus*
Capelin	*Mallotus villosus*
Eelpout species	Family Zoarcidae
Alaska plaice	*Pleuronectes quadrituberculatus*
Starry flounder	*Platichthys stellatus*
Snailfish	Family Liparidae
Alligator fish	Family Gasterosteidae
Prickleback species	Family Stichaeidae

some significant differences between Arctic cod specimens examined from different stations; however, there were no overall differences between stations. All Arctic cod specimens showed low levels of oxidative stress and were comparable to baseline levels reported in previous studies.

Fox et al. (2011) sampled total mercury and monomethyl mercury in eight invertebrate species and in Arctic cod in the northeastern Chukchi Sea, including the area of the Burger and Klondike prospects. Total mercury concentrations in Arctic cod averaged 130+/- 24 ng/g (dry wt, fillets) and was best related to the mercury concentrations in the sediments. Monomethyl mercury concentrations averaged 122+/- 27.4 ng/g (dry wt, fillets). Total mercury and monomethyl mercury were found to biomagnify upwards in the trophic ladder. Zinc concentrations, used as the control, did not show biomagnification.

Anadromous and Migratory Fish

Anadromous fish that spend part of their life at sea and return to spawn in rivers and streams along the Arctic coast include five species of Pacific salmon (*Oncorhynchus* spp.) (Table 14). Of these five species, pink salmon (*O. gorbuscha*) and chum salmon (*O. keta*) occur most commonly in the northern Chukchi environment. Juvenile pink and chum salmon were captured in substantial numbers in offshore surveys that extended as far north as Point Lay (approximately 40 miles south of the proposed drilling) during the autumn of 2007 (Moss, et al., 2009). Salmon are discussed further in the following section (Essential Fish Habitat), which includes a list of anadromous rivers and streams used by salmon between Point Hope and Barrow.

Other anadromous fish in the northern Chukchi region include rainbow smelt (*Osmerus*), Dolly Varden-sea-run (*Salvelinus*) and Arctic lamprey (*Lampetra*), which spend some of their life in the marine environment and return to freshwater to spawn (Table 14). Some fish species in the Chukchi Sea follow a coastwise migration from freshwater to freshwater but do not spend substantial periods in the marine environment (e.g. some species of cisco and whitefish, *Coregonus*). Several fish species such as capelin, sand lance, saffron cod, and some sculpin species are not considered anadromous or coastwise migratory fish, but they move from offshore to nearshore for spawning and

rearing in nearshore habitats. For a more extensive list of Chukchi Sea fish species and their life history environments, refer to Appendix C of the Sale 193 Final SEIS (USDOI, BOEMRE, 2011a).

Table 14. Anadromous and migratory fish occurring in marine and coastal environments in the northeastern Chukchi Sea in the region of proposed drilling and support operations.

Common Name	Taxonomic Name
Pink salmon	*Oncorhynchus gorbuscha*
Chum salmon	*Oncorhynchus keta*
Coho salmon	*Oncorhynchus kitsutch*
Chinook salmon	*Oncorhynchus tshawtscha*
Dolly varden (sea-run)	*Salvelinus malma*
Rainbow smelt	*Osmerus mordax*
Arctic lamprey	*Lamptera camschatica*
Whitefish species	*Coregonus* sp.
Cisco species	*Coregonus*

Freshwater Fish

Fish that occur as freshwater residents in rivers, streams, and inlets draining to the northeastern Chukchi Sea include humpback whitefish, broad whitefish, sticklebacks, Dolly Varden, Arctic char, slimy sculpin, blackfish and Arctic grayling.

Fish as Part of the Trophic System

Ringed seals, ribbon seals, spotted seals, beluga whales, and several seabird species depend heavily on various life stages of Arctic cod (Bradstreet, 1982; Bradstreet and Cross, 1982). Polar bears, which feed on ice seals, are indirectly supported by the seals' predation of Arctic cod and saffron cod. Fish in the northeastern Chukchi also play an important role as predator in the trophic system, feeding on many types of organisms, including epibenthic invertebrates, infaunal invertebrates, zooplankton, and the various life stages of the many fish species themselves.

3.2.5 Essential Fish Habitat

The Chukchi Sea contains designated Essential Fish Habitat (EFH) for eight species. EFH for seven of these species overlaps with the Burger Prospect. Information regarding EFH contained in the Sale 193 Final SEIS (BOEMRE, 2011a) Sale 193 Final EIS (MMS, 2007a) is summarized and incorporated where relevant here. In addition to this analysis, BOEM will provide a separate EFH assessment for NMFS to satisfy its consultation requirements.

The Fishery Management Plan for Fish Resources of the Arctic Management Area (Arctic FMP) was approved by the Secretary of Commerce in 2009. The Plan closed the U.S. Arctic Area to commercial fishing. The Arctic FMP does not regulate subsistence or personal-use harvests of any fish, shellfish, birds, or marine mammals (NPFMC, 2009). Based on the best scientific information available at the time of publication, the Arctic FMP identified three species as potential commercial target species and defined EFH for certain life stages of those species (Table 15).

Table 15. Target species and life stage for which EFH has been described in the Arctic FMP for the Chukchi Sea.

Arctic Fishery Management Plan: EFH Species	Eggs EFH	Larvae EFH	Late Juvenile EFH	Adult EFH
Arctic cod (*Boreogadus saida*),			X	X
Saffron Cod (*Eleginus gracilis*)			X	X

Opilio Crab (*Chionoecetes opilio*)	X		X	X

The following subsections provide descriptions of the three target species identified in the Arctic Fishery Management Plan. Figures depicting location of EFH for these species are provided in the Sale 193 Final SEIS (USDOI, BOEMRE, 2011). Ecosystem Component Species and the Salmon Fishery Management Plan are then discussed.

Arctic Cod EFH

Arctic cod is widely distributed in the U.S. Arctic in the pelagic, demersal, and nearshore environments, depending on the time of year and the stage of their life history. The absolute numbers of Arctic cod and their biomass is one of the highest of any finfish in the region (Frost and Lowry, 1983). EFH is designated for adult and late juvenile Arctic cod. The general distribution areas for this life stage are located in pelagic and epipelagic waters from the nearshore to offshore areas along the entire shelf (0–200 m) and upper slope (200–500 m) throughout Arctic waters, and often associated with ice floes which may occur in deeper waters. The NPFMC has not determined EFH for eggs, larvae, and early juveniles (NPFMC, AFMP, 2009).

Saffron Cod EFH

Saffron cod occurs in the Chukchi Sea primarily in nearshore waters. Saffron cod move seasonally from summertime feeding offshore to inshore for spawning. Juveniles remain in the shallow nearshore water throughout the year. Saffron cod enter coastal waters and tide-influenced riverine environments. Adults and juveniles forage on the epibenthos, opportunistically taking small crustaceans and fish (Froese and Pauly, 2010). Saffron cod are important in the diet of several seabirds (Piatt, et al., 1989), ringed seals, spotted seals and beluga whales (Frost and Lowry, 1984; Lowry, Frost, and Burns, 1980).

Saffron cod have been captured in several surveys in the Chukchi Sea. Barber, et al. (1997) caught a high abundance of saffron cod in a demersal fish survey during August and September in 1990 and 1991 at sampling sites in the Chukchi Sea from Point Hope north. In 2004, saffron cod were collected in the Chukchi Sea in depths from 34–51 m as part of the Russian-American Long-term Census of the Arctic (RUSALCA) (Mecklenburg, et al., 2007, Norcross, et al., 2009). These studies indicate that saffron cod are influenced by water temperature, salinity, and substrate type and are commonly found nearshore in warmer coastal waters.

EFH is designated for adult and late juvenile saffron cod. The general distribution area for this life stage is located in pelagic and epipelagic waters along the coastline, within nearshore bays, under ice along the inner (0–50 m) shelf throughout Arctic waters, and wherever there are substrates consisting of sand and gravel. The NPFMC has not determined EFH for eggs, larvae, and early juveniles (NPFMC, 2009).

Opilio crab EFH

Opilio crab have been collected in various surveys over the past decades in the Chukchi Sea. A discussion of the current literature on the distribution, size, and density of opilio crab in the Chukchi Sea is presented in the Environmnental Assessment for the Arctic Fishery Management Plan (NMFS, 2009) and is incorporated by reference.

The benthic community in the Chukchi Sea is highly diverse and patchy. Adult opilio crab occur in the Chukchi Sea along the inner and middle shelf where benthic habitat consists mainly of mud. They have been collected at depths ranging up to 100 m and are commonly collected in the 25–40 m range. For EFH designation, the distribution of opilio crab eggs was inferred from the distribution of female opilio crab; EFH for opilio crab juveniles and pelagic larvae has not yet been designated. Opilio crab are important prey to several higher trophic species in the Chukchi Sea food web, including bearded seals.

EFH is designated for adult and late juvenile opilio crab. The general distribution area for this life stage is located in bottom habitats along the inner (0–50 m) and middle (50–100 m) shelf in Arctic waters south of Cape Lisburne, wherever there are substrates consisting mainly of mud. Essential fish habitat of snow crab eggs is inferred from the general distribution of egg-bearing female crabs. The NPFMC has not determined EFH for larvae and early juveniles (NPFMC, 2009). EFH designated for opilio crab is approximately 200 miles southeast of the proposed drilling site.

Ecosystem Component Species

The Arctic FMP describes and maps eight ecosystem component species that "are thought to be, should conditions allow, commercially viable." Based on literature published from various fish surveys, it is likely that six of the ecosystem component species (yellowfin sole, Bering flounder, starry flounder, capelin, rainbow smelt, and Alaska plaice) (Table 16) occur in the vicinity of the proposed project (Norcross, et al. 2010; Mecklenburg, et al., 2007, Barber, et al., 1994, 1997; Frost and Lowry, 1983; Mecklenburg et al., 2002; Mecklenburg, Moller, and Steinke, 2011; Hopcroft, et al., 2008, Froese and Pauly, 2003). The other two ecosystem component species, flathead sole and blue king crab, generally occur south of Bering Strait, which is approximately 350 miles south of the proposed exploration drilling.

Table 16. Ecosystem component species that occur in the region of the drilling prospect (habitat descriptions from the Arctic Fishery Management Plan (NPFMC, 2009)).

Ecosystem Component Species in the Action Area	Adult Habitat and Distribution	Adult Migration	Eggs, Larvae, Juveniles
Yellowfin sole (*Limanda aspera*)	Demersal in nearshore bays and continental shelf; inhabit sand, mud, gravel substrates.	Migrates between outer shelf (100-200m) and inner shelf (up to 50m) to feed and spawn.	Juveniles separate from adults and inhabit soft substrates to feed on infauna and to bury for protection. Larvae are planktonic, in shallow areas. Egg and larval distribution extents unknown.
Bering flounder (*Hippoglossoides robustus*)	Demersal in nearshore bays and along the inner shelf (0-50 m) and middle shelf (50-100 m); inhabits substrates consisting of sand and mud.	Adults known to migrate between outer shelf (100-200 m) spawning grounds and inner shelf (0 - 50 m) feeding grounds.	Juveniles (<2 yrs) inhabit shallow areas separate from adults. Egg and larval distribution extents are unknown.
Starry flounder (*Platichthys stellatus*)	Demersal in nearshore bays, estuaries, river mouths and along the entire shelf (0-200 m). Inhabit substrates consisting of sand, mud, and gravel.	Adults are known to seasonally migrate between outer shelf (100-200 m) summer areas and inner shelf (0 to 50 m) winter areas.	Juveniles inhabit shallow estuarine areas. Egg and larval distribution extents are unknown.
Capelin (*Mallotus villosus*)	Distributed in epipelagic and epibenthic waters along the coastline, within nearshore bays and along the inner shelf (0-50 m). Spawn in sand and gravel substrates within intertidal and subtidal shallow areas.	Migrate from coastal waters to intertidal and shallow subtidal areas for spawning.	Egg and larval distribution is unknown.
Rainbow smelt (*Osmerus mordax*)	Distributed in epibenthic waters along the nearshore in areas mainly consisting of sandy gravel and cobbles; spawn in freshwater streams.	Migrate from nearshore to inshore for spawning.	Egg and larval distribution is unknown
Alaska plaice (*Pleuronectes quadrituberculatus)*	Located in the lower portion of the water column (demersal) within nearshore bays and along the entire shelf (0 to 200 m). Adults are found in areas consisting of sand, mud, and Gravel.	Adults are known to migrate in association with seasonal ice movements and from the shelf to shallower areas (<100 m) for spring spawning.	Larvae and eggs have been found in the late spring and early summer throughout the entire shelf (0 to 200 m). Egg and larval distribution extents are unknown.

Salmon Fishery Management Plan

The Salmon Fishery Management Plan for Coastal Alaska (Salmon FMP) was approved in 1990 (NPFMC, 1990), designating EFH for the five Pacific salmon species (including all life stages) that occur in Alaska: pink salmon (*Oncorhyncus gorbuscha*), chum salmon (*O. keta*), coho salmon (*O. kisutch*), sockeye salmon (*O. nerka*), and king salmon (*O. tshawytscha*). Marine EFH for salmon includes all estuarine and marine areas used by Pacific salmon of Alaska origin, extending from the influence of tidewater and tidally submerged habitats out to the limit of the U.S. Exclusive Economic Zone (EEZ). Freshwater EFH for salmon includes all streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon as identified in the Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes (ADFG, 2011).

Pink and chum salmon are the most common of the five species documented in the Chukchi Sea (ADFG, 2011). In the marine environment, adult pink and chum salmon in Alaska seas can be found down to 200m (660 ft) depth. In the deeper waters of the continental slope and ocean basin, salmon occupy the upper water column. Moss, et al. (2009) trawled high densities of juvenile pink and chum salmon at or near the surface offshore in the Chukchi Sea in September, 2007

Alaska Department of Fish and Game maintains the Anadromous Waters Catalog of Alaska for the waterbodies and species documented to date (ADFG, 2011). Table 17 presents a list of the rivers and creeks used by salmon between Point Hope and Barrow based on the data in the Anadromous Waters Catalog. While the entrances to specific salmon-spawning streams are relatively easy to identify on the ground, other resource areas important to fish also exist along the Chukchi coastline, such as Kasegaluk Lagoon.

Table 17. Anadromous rivers and creeks located between Point Hope and Barrow.

Anadromous Waters	Salmon Species	General Location of Waterbody
Kukpuk River	Pink salmon	Point Hope
Sulupoaktak Channel	Pink salmon	Point Hope
Ayugatak Creek	Pink salmon	Cape Lisburne
Pitmegea River	Chum salmon, Pink salmon	Cape Lisburne
Kuchiak Creek	Chum salmon, Coho salmon	Point Lay
Kukpowruk River	Chum salmon	Point Lay
Kokolik River	Chum salmon, Pink salmon	Point Lay
Utukok River	Chum salmon, Pink salmon	Between Point Lay and Point Hope
Kungok River	Pink salmon	Wainwright
Kuk River	Pink salmon	Wainwright
Kugrua River	Chum salmon, Pink salmon	Wainwright
Mikigeakiak River	Pink salmon	Wainwright
Ivisaruk River	Pink salmon	Wainwright

Source: ADFG, 2011 - Anadromous Waters Catalog

Climate change in the Arctic affects the quality of EFH in several ways, including changes in seawater temperature and acidity, changes in extent and quality of sea ice habitat, and changes in freshwater discharge and nearshore salinities (Hopcroft, et al, 2008). These climate change factors could affect the range of EFH species, particularly of Pacific salmon extending north from the Bering Sea. Warming temperatures could affect characteristics of rivers and streams, such as the degree of ice cover in winter, basin runoff and stream flow regime.

3.2.6 Marine and Coastal Birds

Most birds occurring in the Chukchi Sea area are present on a seasonal basis. During spring migration, arrival times at coastal breeding areas usually coincide with the formation of leads. Many seabirds (such as murres) and sea ducks (such as common eiders and long-tailed ducks) will closely follow leads that typically form along the edge of the landfast ice. Migration times vary between species, but spring migration for most species takes place between late March and late May. Many birds that breed on the North Slope must migrate through the southern Chukchi Sea twice each year. Departure times from the Beaufort and Chukchi seas during postbreeding or fall migration vary between species and often by sex within the same species, but most marine birds will have moved out of the Chukchi Sea by late fall before the formation of sea ice.

The following sections summarize movement patterns, locations, and life history characteristics for several key avian groups. These groups include species that are the most numerous in the project area, are particularly sensitive to certain activities, have special legal status, and/or have common life history characteristics. The groups are Threatened and Endangered Birds, Cliff-Nesting Seabirds, Bering Sea Breeders and Summer Residents, High-Arctic Associated Seabirds, Tundra-Breeding Migrants, Waterfowl and Loons, Shorebirds, and Ravens and Raptors.

In 2007, MMS (now BOEM) prepared a Final EIS for oil and gas leasing and seismic surveying activities in the Chukchi Sea (USDOI, MMS, 2007a). This document was later updated in a Final Supplemental EIS (USDOI, BOEMRE, 2011a). These documents provided full descriptions of the most important marine and coastal bird species in the Chukchi Sea. These descriptions are summarized and updated below.

In July 2009, MMS (now BOEM) provided an updated Biological Evaluation (BE) to FWS for consultation on Steller's eider, spectacled eider, Kittlitz's murrelet, and yellow-billed loon (USDOI, MMS, 2009d). The FWS provided their Biological Opinion (BO) to BOEMRE (now BOEM) on September 3, 2009 (USDOI, FWS, 2009). Full descriptions of each species are provided in the 2009 BE and the 2009 BO. These descriptions are summarized and updated below.

Threatened and Endangered Birds

Threatened and endangered species in the Chukchi Sea include the spectacled eider (threatened) and Steller's eider (threatened). The Kittlitz's murrelet and the yellow-billed loon are candidate species under the ESA. All four species occur seasonally in the Chukchi Sea.

Spectacled Eider. Spectacled eider was listed as a threatened species under the ESA in May 1993 (58 FR 27474). The breeding population on the North Slope currently is the largest breeding population of spectacled eiders in North America. The North Slope population in the fall (October) is estimated to be 33,587 birds (Stehn et al., 2006). Spectacled eider density varies across the Alaskan Arctic Coastal Plain (ACP) (Larned, Stehn, and Platte, 2006).

Spectacled eiders make use of the spring lead system when they migrate from the wintering area. The spring lead system includes the Ledyard Bay Critical Habitat Unit and typically has represented the only open-water area along their path.

Spectacled eiders on the North Slope breed across the ACP, east to approximately the Canadian border. Once tundra nesting habitats are sufficiently melted to allow nesting (historically around June 10), most breeding pairs leave nearshore coastal areas to begin nesting—as many as a few thousand pairs might nest on the North Slope. Spectacled eider nesting density on the ACP is variable, ranging from 0 to 0.95 nests per square kilometer (Larned, Stehn, and Platte, 2006). The estimated nesting density in 2009 was 0.37 birds per square kilometer (Larned, Stehn, and Platte, 2010).

Male spectacled eiders leave the nesting area at the onset of incubation and seek open waters of the Chukchi and Beaufort seas until they move to molting areas in the Chukchi Sea or Russia. Many

postbreeding male spectacled eiders slowly begin to converge in offshore aggregations in Ledyard Bay starting in July and begin a flightless molt that lasts several weeks. Males that breed on the ACP (but return to molting areas in Russia) likely make limited use of Ledyard Bay and other coastal areas of the Beaufort or Chukchi seas on their westward migration. Some eiders crossing to Russia may take routes roughly west of Barrow (Sexson, Peterson, and Powell, 2010; Sexson, 2011) and an individual eider was observed during the early fall near the Klondike Prospect during seabird surveys in 2008 and 2009 (Gall and Day, 2010).

Female spectacled eiders begin to move to coastal areas at the end of their nesting effort. Females whose nests fail early on go to the coast and may linger in nearshore areas. Female spectacled eiders also use Ledyard Bay for flightless molt lasting a few weeks. Spectacled eider females and hatch-year birds are the last to arrive at Ledyard Bay around the end of the first week of September.

The Ledyard Bay area was designated critical habitat for the spectacled eider in 2001 (66 FR 9145). The critical habitat area includes the waters of Ledyard Bay within about 74 km (40 nmi) from shore, excluding waters <1.85 km (~1 nmi) from shore. The Ledyard Bay Critical Habitat Unit (LBCHU) is an important molting area for North Slope-breeding spectacled eiders in the summer (males) and fall (breeding females) (Sexson, 2010, 2011). The molt is an energetically demanding period, and eiders are believed to use LBCHU for molting because of a combination of environmental conditions, abundance and accessibility of prey organisms, and low level of disturbance and predation. Overall, many spectacled eiders remain in LBCHU until forced out by sea ice (typically late October through mid-November). Following the molt, spectacled eiders move to their wintering area south of St. Lawrence Island in the Bering Sea.

Steller's Eider. The Alaska breeding population of Steller's eider is listed as a threatened species under the ESA. It is the least-abundant eider in Alaska, representing less than 5% of the worldwide breeding population. Over 95% of the Alaskan breeding Steller's eiders occur on the Arctic Coastal Plain, with a small nesting population centered on Barrow. The ACP nesting population is estimated to be 576 (Stehn and Platte, 2009).

Steller's eiders are paired within flocks when they arrive on the ACP, typically from early to mid-June. They often nest on coastal wetland tundra, but some nest near shallow ponds or lakes well inland; the greatest breeding densities were found near Barrow, although they do not breed every year when present. The calculated average nesting density across the North Slope during 2002–2006 was 0.0045 birds/km^2 (USDOI, FWS, 2007).

Paired male Steller's eiders depart the North Slope after the nest is initiated in mid- to late June. Female eiders and their young-of-the-year typically depart the North Slope from late September to early October. Unlike spectacled eiders, Steller's eiders do not molt in the Chukchi Sea. During molt migration, Alaskan breeding Steller's eiders stop and rest in areas of the Alaska Chukchi Sea, often in nearshore waters (within 2 km or 1 nmi of shore) near Ledyard Bay and Icy Cape. There is less use at more northerly locations near Wainwright and Peard Bay. More males than females migrate from Alaska to areas along the coast of Chukotka, while males that do not go to Chukotka spend more time on the Alaska Chukchi Sea coast.

Although Steller's eiders may occur in nearshore waters of the Chukchi Sea, the total numbers probably are low given the small numbers that breed on the North Slope. No Steller's eiders were observed at the Burger prospect during seabird surveys in 2008 and 2009 (Gall and Day, 2010).

Kittlitz's Murrelet. The Kittlitz's murrelet is listed as a candidate species (Listing Priority Number 8) throughout Alaska under the ESA. This species nests as far north as Cape Beaufort (100 km northeast of Cape Lisburne) in the Amatusuk Hills. These birds are solitary nesters and extensive survey efforts are required to determine local abundance. Breeding along the Arctic Coastal Plain is unlikely due to lack of suitable habitat.

Murrelet foraging areas occur in the Chukchi Sea (Day, Gall, and Pritchard, 2011). Kittlitz's murrelets have been observed on an infrequent basis in the Chukchi Sea as far north and east as Point Barrow. Kittlitz's murrelets have not been regularly observed at sea, which suggests there is a great deal of annual variation in their occurrence in the Chukchi Sea. Small numbers of Kittlitz's murrelets were recorded during late fall seabird surveys in the Klondike and Burger Prospect areas in 2009, but none were observed in 2008 (Gall and Day, 2010).

Yellow-billed Loon. On March 25, 2009, the yellow-billed loon was designated a candidate species (Listing Priority Number 8) throughout its range under the ESA (74 FR 12932). Yellow-billed loons typically nest near large, deep, tundra lakes where they nest on low islands or near the edges of lakes to avoid terrestrial predators. In total, there are fewer than 5,000 yellow-billed loons on the Arctic coast breeding grounds and near shore marine habitat (Earnst et al., 2005). There may be approximately 1,500 yellow-billed loons, presumably non-breeding adults and immatures, in near shore marine waters or in large rivers during the breeding season. Breeding yellow-billed loons typically remain on their lakes until young are fledged.

Most yellow-billed loons from the ACP have moved into nearshore coastal waters by September. In addition, approximately 8,000 yellow-billed loons from the Canadian Arctic travel across the Chukchi Sea during spring and fall migration between Canada and wintering grounds in eastern Asia (Schmutz et al., 2010). Most loons stay very close to shore during fall migration until they reach the Lisburne Peninsula, where they head farther out to sea towards the Bering Strait (Rizzolo and Schmutz, 2010). Yellow-billed loons were observed at the Burger Prospect during seabird surveys in 2008 and 2009 (Gall and Day, 2010). Most sightings of yellow-billed loons represented low numbers of birds during the survey period; however, 24 were observed during the early fall period in 2009. No yellow-billed loons were observed during seabird surveys in the Chukchi Sea in late August and early September 2011 (Kuletz, 2011b). Low numbers, patchy distributions, and specific habitat requirements may make yellow-billed loons more susceptible to environmental perturbations such as disturbance, habitat alterations, and oil spills than species that are more abundant, widely distributed, and able to exploit a greater diversity of habitats.

Cliff-Nesting Seabirds

Common murres and thick-billed murres. Common murres and thick-billed murres breed as far north as Cape Lisburne and farther south at Cape Thompson. The Cape Lisburne colony is estimated to support about 400,000–500,000 murres (Dragoo, Schneeweis, and Kuehn, 2011). Murres are primarily piscivorous and rely on dispersed schools of offshore fish. Murre foraging areas from the two largest colonies overlap in an offshore area north of Cape Lisburne. In the fall, adult males remain with their hatch-year offspring and undergo a flightless molt in offshore molting areas north of the Bering Strait. Flightless individuals are not capable of undertaking large scale movements to other areas and tend to move south with prevailing currents.

Most observations of common and thick-billed murres totaled fewer than 100 during any survey period at the Burger Prospect during seabird surveys in 2008 and 2009 (Gall and Day, 2010).

Horned puffin and tufted puffin. The horned puffin and the tufted puffin are found in the Chukchi Sea area, with horned puffins restricted to cliff habitats like Cape Lisburne. Horned puffins are primarily piscivorous, rely on dispersed schools of offshore fish, and have been reported to forage in excess of 100 km offshore of breeding colonies. Tufted puffins breed at cliff colonies, but can also nest on suitable beach habitats by digging burrows or hiding under large pieces of driftwood or debris. Fewer than 10 horned or tufted puffins were observed during any survey period at the Burger Prospect during seabird surveys in 2008 and 2009 (Gall and Day, 2010).

Black-legged kittiwake. Breeding colonies of the black-legged kittiwake in the Chukchi Sea (Cape Thompson and Cape Lisburne) are at the northern limit of their breeding range in Alaska. There are

about 20,000-30,000 black-legged kittiwakes breeding at the Cape Lisburne colony (Dragoo, Schneeweis, and Kuehn, 2011). Divoky (1987) reported about 400,000 black-legged kittiwakes from mid-July until late September in pelagic areas of the Chukchi Sea. Flocks totaling in the low hundreds were observed during the early fall around the Klondike and Burger prospects during seabird surveys in 2008 and 2009 (Gall and Day, 2010).

Bering Sea Breeders and Summer Residents

Northern fulmar. The northern fulmar does not breed along the Chukchi Sea coast, and those observed in this area during the spring and summer are nonbreeders or failed breeders from southern areas. Divoky (1987) estimated 45,000 northern fulmars in pelagic waters of the southern Chukchi Sea during late August to mid-September. Flocks totaling in the low hundreds were observed during the late summer and early fall around the Klondike and Burger prospects during seabird surveys in 2008 and 2009 (Gall and Day, 2010).

Short-tailed shearwater. The short-tailed shearwater in the Chukchi Sea are most common in the southern portion, and are routinely found in the exploration program area from late August to late September. At northern latitudes, short-tailed shearwaters likely forage on dense patches of euphausiids and amphipods. Gall and Day (2010) suggested that the shearwaters can rapidly respond to changes in oceanic conditions and exploit food resources when and where they are available. For example, Kuletz (2011a) reported a single flock numbering over 15,000 short-tailed shearwaters in the western Beaufort Sea in late August–early September, 2011. Kuletz (2011b) reported over 4,000 shearwaters during a seabird survey in the Chukchi Sea in late August – early September 2011 (the most abundant species reported), with many flocks numbering between 150–300 birds. Similarly, flocks totaling in the low hundreds were observed during the early fall around the Klondike and Burger prospects during seabird surveys in 2008 and 2009 (Gall and Day, 2010); however, during the early fall period in 2009, almost 12,000 short-tailed shearwaters were observed near the Klondike Prospect.

Auklets. Three species of auklets (parakeet, least, and crested) breed as far north as the Bering Strait, but move into the Chukchi Sea from late August into early October. Kuletz (2011b) reported thousands of auklets during a seabird survey in the Chukchi Sea in late August – early September 2011, with all but a few least auklets south of Point Hope and numerous flocks of crested auklets north of Point Hope. Crested auklets were the most numerous alcid observed by Gall and Day (2010) during seabird surveys of the Klondike and Burger prospects in 2008 and 2009. Over 5,000 crested auklets were observed during the early fall at the Burger Prospect in 2009, with numbers in the thousands consistently reported during other survey periods that year. Crested auklet counts did not exceed 1,000 birds during any survey period in 2008. As with shearwaters, Gall and Day (2010) suggested that the auklets rapidly respond to changes in oceanic conditions and exploit food resources when and where they are available. Small flocks of least auklets were also observed during the Gall and Day (2010) surveys, numbering no more than 260 during any particular survey period. Parakeet auklets were seldom observed by Gall and Day (2010).

High Arctic-Associated Seabirds

Black guillemot. Black guillemot breed along the Chukchi Sea from Cape Thompson northward. Despite the relatively small breeding population in Alaska (the Chukchi and Beaufort seas have a combined total of fewer than 2,000 nesting birds), the post-breeding population of guillemots from the U.S. and Russia is estimated to be around 70,000 in pelagic areas of the Chukchi Sea. Black guillemots remain closely associated with sea ice throughout their lifetime, where they feed extensively on Arctic cod. Small numbers of black guillemot were observed during seabird surveys around the Klondike and Burger prospects in 2008, but none were counted in 2009 (Gall and Day, 2010).

Ross' gull. Ross' gulls may be encountered near Point Barrow. Many migrate south through the Chukchi Sea in the late fall and pass through the Bering Strait to winter in the Bering Sea. The Ross' gull was only observed during the late fall period at the Burger Prospect during seabird surveys in 2008 and 2009 (Gall and Day 2010). The numbers were 127 in 2008 and 48 in 2009.

Ivory gull. Ivory gulls are closely associated with the ice edge throughout their lifecycle and small numbers migrate through in fall to wintering areas in the northern Bering Sea. The ivory gull is uncommon to rare in pelagic waters of the Chukchi Sea during summer. Two ivory gulls were observed in the late fall at the Burger Prospect during seabird surveys in 2008 and 2009 (Gall and Day, 2010).

Arctic tern. Arctic terns nest near lakes of the ACP. Aerial surveys along coastal habitats of the entire ACP typically observe fewer than 1,500 birds, with most of these along the mainland areas along the Chukchi Sea (Dau and Bollinger, 2009). Arctic terns are rare in the pelagic waters of the Chukchi Sea. Small numbers were occasionally observed during seabird surveys at the Klondike and Burger prospects in 2008 and 2009 (Gall and Day, 2010).

Tundra-Breeding Migrants

Jaegers. The three species of jaegers (pomarine, parasitic, and long-tailed) are common in nearshore areas of the Chukchi Sea in summer until late September, when they move south to the Bering Sea. Jaegers are dispersed throughout pelagic areas of the Chukchi Sea, with no obvious high concentration areas. Small numbers of all three species were occasionally observed during seabird surveys at the Klondike and Burger prospects in 2008 and 2009 (Gall and Day, 2010).

Glaucous gull. Glaucous gulls are most common in the Chukchi Sea from late July to late September within 70 km of shore between Icy Cape and Barrow. Most glaucous gulls in the Chukchi Sea area breed inland near freshwater, but some breed at coastal seabird colonies. Glaucous gulls typically occur in low densities in the Chukchi Sea, but commonly congregate at food sources. Small flocks of glaucous gulls were observed during the Gall and Day (2010) surveys in 2008 and 2009, numbering no more than 70 during any particular survey period.

Waterfowl and Loons

Loons. Pacific loons are the most common loon species nesting and migrating along the Chukchi Sea coast. Red-throated loons are less common and nest on smaller ponds than Pacific loons. In spring, loons typically migrate along coastal routes, although some may use inland routes. Most of the postbreeding loon migration takes place in September. Most loons stay very close to shore during fall migration until they reach the Lisburne Peninsula, where they head farther out to sea towards the Bering Strait (Rizzollo and Schmutz, 2010). Observations of Pacific loons were most numerous during the early fall period at the Burger Prospect, when 181 were observed during seabird surveys in 2008 and 2009 (Gall and Day, 2010). In contrast, only one red-throated loon was observed (early fall at the Burger Prospect).

Long-tailed duck. The long-tailed duck is a common species in the Chukchi Sea after the first week of September until late October. Many long-tailed ducks molt in Kasegaluk Lagoon and Peard Bay on the Chukchi Sea coast. Molting long-tailed ducks tend to stay in or near the lagoons, feeding heavily in passes between barrier islands. Aerial surveys along coastal habitats of the entire ACP typically observe fewer than 7,500 long-tailed ducks, with about two-thirds of these associated with mainland habitats (Dau and Bollinger, 2009). Kasegaluk Lagoon and Peard Bay are important locations during molting and migration.

Fewer than 70 long-tailed ducks were observed during any survey period at the Burger Prospect during seabird surveys in 2008 and 2009 and most survey periods observed no long-tailed ducks (Gall and Day, 2010).

Common eider. The common eider typically migrates during spring along the Chukchi Sea coast using offshore open-water leads. Common eiders nest on barrier islands or spits along the Chukchi Sea coast. Aerial surveys along coastal habitats of the entire ACP typically observe fewer than 3,000 brant, with about half of these observed in the mainland areas along the Chukchi Sea (Dau and Bollinger, 2009)

Beginning in late June, postbreeding male common eiders begin moving towards molting areas in the Chukchi Sea; by late August, most common eiders in the Chukchi Sea are molting males. Most breeding female common eiders and hatch-year birds begin to migrate to molt locations in late August and September. Common molt areas in the Chukchi Sea are near Point Lay, Icy Cape, and Cape Lisburne. Kasegaluk Lagoon and Peard Bay also are important locations for molting and during migration. Hundreds of thousands of common eiders move through the Chukchi Sea during their migration to breeding grounds in eastern Canada.

After the molt is completed, some common eiders move offshore into pelagic waters, but most eiders remain close to shore. Five common eiders were observed in the early fall at the Burger Prospect during seabird surveys in 2008 and 2009 (Gall and Day, 2010).

King eider. The location and timing of offshore leads along the Chukchi Sea is a major factor determining routes and timing of king eider migration. Most king eiders begin to migrate through the Chukchi Sea, including Ledyard Bay, in mid-May. Many post-breeding male king eiders move to staging areas along the Chukchi Sea in mid- to late July. The typical staging time in Ledyard Bay was 17–24 days and Ledyard Bay may be a critical stopover area for foraging and resting during spring migration (Oppel, Dickson, and Powell, 2009). Peard Bay is also particularly important to molting and migrating king eiders. Hundreds of thousands of king eiders move through the Chukchi Sea during their migration to and from breeding grounds in eastern Canada.

No more than two king eiders were observed during any seabird survey period in 2008 at the Klondike and Burger prospects and no king eiders were observed in 2009 (Gall and Day, 2010).

Brant. Many brant migrate along the west coast of Alaska en route to breeding areas on the North Slope or the Canadian High Arctic. Brant typically nest on offshore spits, barrier islands, or on islands formed in large river deltas. Aerial surveys along coastal habitats of the entire ACP typically observe fewer than 2,500 brant, with about half of these observed in the mainland areas along the Chukchi Sea (Dau and Bollinger, 2009). Kasegaluk Lagoon is an important stopover location during postbreeding migration.

No brant were observed during seabird surveys in 2008 and 2009 (Gall and Day, 2010).

Greater white-fronted goose. The greater white-fronted goose breeds along the Chukchi Sea coast, typically within 30 km of the coast. Most greater white-fronted geese reach Alaska via overland routes. Several thousand can be observed at a time in Kasegaluk Lagoon, with migration peak in the first week of June and the last week of August. No greater white-fronted geese were observed during seabird surveys in 2008 and 2009 (Gall and Day, 2010).

Lesser Snow Goose. There are very few lesser snow geese nesting in Alaska. This species nests on an island in the Kukpowruk River delta (about 60 km south of Point Lay) in the southern portion of Kasegaluk Lagoon, one of two consistently used nesting colonies for lesser snow geese.

No lesser snow geese were observed during seabird surveys in 2008 and 2009 (Gall and Day, 2010).

Tundra swans. Tundra swans have been observed in Kasegaluk Lagoon with flightless young-of-the-year birds indicating that tundra swans breed there. No swans were observed during seabird surveys in 2008 and 2009 (Gall and Day, 2010).

Shorebirds

Although many shorebirds breed on tundra, they also rely on coastal areas such as beaches, barrier islands, lagoons, and mudflats for some portion of their lifecycle. These coastal areas are especially important habitats where shorebirds replenish energy reserves after breeding and prior to southward migration. The most common shorebird species breeding on the Arctic Coastal Plain include dunlin, semipalmated sandpiper, pectoral sandpiper, and red phalarope. Many shorebirds leaving the Beaufort Sea move west along the Chukchi Sea coast. Large numbers of shorebirds move west along the Chukchi Sea coast, stopping at high-productivity shoreline sites to replenish energy reserves and rest.

Other than phalaropes, described below, few shorebirds were observed at the Burger or Klondike prospects during seabird surveys in 2008 and 2009 (Gall and Day, 2010).

Phalaropes. Both red and red-necked phalaropes are present in the Chukchi Sea during the open-water periods. Phalaropes are common in pelagic waters as well as within a few meters of shore, where their distribution typically is tied to zooplankton abundance. Due to their reliance on zooplankton, their distribution is patchy and variable; however, because they are tied to a moving prey source they may be encountered throughout the Chukchi Sea in varying concentrations. Phalaropes were the most abundant shorebird species observed during seabird surveys at the Klondike and Burger prospects in 2008 and 2009, with fewer than 300 observed during any one survey period (Gall and Day, 2010).

Phalaropes are one of the most abundant species groups of shorebirds that use Kasegaluk Lagoon and Peard Bay, where they stage or stop over in nearshore marine and lacustrine waters.

Dunlin. Two subspecies of Dunlin breed in Alaska. Dunlins are another of the most abundant species of shorebirds that use Kasegaluk Lagoon, where they stage or stop over in silt tidal flats and salt-grass meadows. No dunlins were observed during seabird surveys in 2008 and 2009 (Gall and Day, 2010).

Raptors and Ravens

A variety of raptors and corvids may be present in the coastal zone along the Chukchi Sea coast. On the North Slope, raptors typically are more common within 20 km of the Brooks Range foothills and population densities are lower near the coast, especially during the breeding season. Snowy owls are the raptor most commonly encountered near coastal areas. Raptors and ravens seldom interact with the marine environment. One wayward short-eared owl was observed during the late summer period at the Burger Prospect by Gall and Day (2010) during seabird surveys in 2009.

3.2.7 Marine Mammals

Marine mammals are protected under the MMPA. Requirements of this Act generally prohibit the take by injury or harassment of marine mammals. More detailed information on distribution, life history parameters, and other relevant background can be found in the Sale 193 Final EIS (USDOI, MMS, 2007a) and Sale 193 Final SEIS (USDOI, BOEMRE, 2011a). Relevant new information and site specific information is presented here.

Seals

Observations of seals in the vicinity of the Burger Prospect have been reported in several surveys over the past 20 years. While these surveys use different methods and occurred under different circumstances, when taken together they can help to illustrate the use of the area by seals. Results of these survey reports are given in Table 18. Other information on the affected environment for seals is described below for each species.

Table 18. Numbers of individuals of seal species sighted by vessel-based and aircraft-based surveys in the vicinity of the Proposed Action, and the northeastern Chukchi Sea.

	Number of individuals reported by eight surveys							
Species Observed	**Brueggeman et al. 1991a – Popcorn, Burger, and Crackerjack Prospects 1990 walrus monitoring**	**Brueggeman et al. 1992a – Crackerjack and Diamond Prospects 1991**	**Brueggeman et al. 2010 – Klondike and Burger Prospects 2009**	**Brueggeman et al. 2009 – Klondike and Burger Prospects, pipeline route 2008**	**Reiser et al. 2010 – Burger, Snickers, Ulu, Caramel, and Honeyguide prospects 2009**	**Blees et al. 2010 – Seismic Survey NE Chukchi Sea 2010**	**Clarke et al. 2011c – COMIDA Final Report,:2008-2010 NE Chukchi Aerial Surveys**	**Haley et al. 2010 in Funk et al. 2010 – Chukchi Sea Vessel-Based Monitoring Program, NE Chukchi Sea 2006-2008**
Bearded Seal	79	3152	33	39	12	128	3-140	57-261
Ribbon Seal	1	**	**	1	**	1	**	1
Ringed Seal	146	668	18	6	29	35	**	102-587
Ringed/Spotted Seal	**	**	69	53	**	**	**	**
Spotted Seal	4	**	15	31	**	5	**	26-191
Steller Sea Lion	**	**	**	**	**	**	**	1
Unidentified Seal	**	660	44	84	25	161	**	151-911
Unidentified Pinniped	93	0	10	3	5	56	33-703	19-34

Bearded Seals. The bearded seal (*Erignathus barbatus*) is the largest of the northern seals (Kelly, 1988) and is largely ice-associated. Bearded seals stay mostly within the mobile pack ice, concentrating around its edge (Smith and Stirling, 1975) where they forage primarily on benthic organisms. Because of their epibenthic feeding habits, bearded seals are limited to feeding in water depths of 426 ft (130 m) or less (Nelson, Burns, and Frost, 1984). Surveys from 1990 to present have noted that bearded seals may occur near the proposed drill sites in variable numbers from year to year (Table 18).

Allen and Angliss (2011) reported there is no reliable population estimate for the bearded seal population in the Bering, Chukchi, and Beaufort seas, however, Cameron et al. (2010) estimated 155,000 bearded seals in the Beringian Distinct Population Segment (DPS) (Bering-Chukchi-Beaufort Sea subpopulation), about 27,000 of which are year long residents in the Chukchi Sea. Cameron et al. (2010) reported the population density of bearded seals in the Chukchi Sea to average 0.07 and 0.14 bearded seals/km^2 based on coastal aerial surveys flown between Barrow and Shishmaref, Alaska (Bengtson et al., 2005). The population data provide in Cameron et al. (2010) allows for a well informed effects analysis to be conducted. In December 2010, NMFS issued proposed rules to list bearded seals as threatened under the ESA.

Ringed Seals. Ringed seals are the most numerous and widely distributed of the northern seals and occur in all Arctic and sub-Arctic seas where seasonal or permanent ice is present (Kelly, 1988). The ringed seal (*Phoca hispida*) population in the Bering-Chukchi-Beaufort Seas has been estimated to

number at least 1 million seals (Kelly et al. 2010). Of this population, some are residents in the Chukchi Sea while others are residents in the Beaufort Sea or seasonal migrants that winter in the Bering Sea, and summer in the Chukchi or Beaufort seas. Surveys from 1990 to the present have noted that ringed seals may occur near the proposed drill sites in variable numbers from year to year (Table 18).

During summer, ringed seals are found dispersed throughout open-water, though in some locales they may frequent coastal areas. They are opportunistic feeders, consuming a wide variety of pelagic and epibenthic organisms. Arctic cod are their primary prey during the winter months (November to April), but in late spring and summer their diet shifts to marine crustaceans, such as gammarid and hyperiid amphipods, shrimp, euphausiids, mysids, and isopods (Lowry et al., 1980; Frost and Lowry, 1984). It is believed that they typically seek out areas where food items are plentiful during the open-water season and their population distribution shifts accordingly.

NMFS has formulated a minimum population estimate of ringed seals in the eastern Chukchi Sea at 249,000 (Allen and Angliss, 2011). In December 2010, NMFS issued proposed rules to list ringed seals as threatened under the ESA.

Ribbon Seals. Ribbon seals are distributed in pelagic waters across the northern North Pacific Ocean and adjacent Arctic and sub-Arctic waters (Boveng et al., 2008). Surveys from 1990 to the present have noted that ribbon seals may occur near the proposed drill sites in variable numbers from year to year (Table 18). This species spends most of the year in pelagic waters near the shelf slope feeding on fishes and squid, hauling out on ice to whelp, breed, and molt in the spring and early summer. The more important whelping, reproduction, and molting areas occur in a 150 km band starting at the southern edge of the ice front and extending north, and usually in waters <200 m deep but near the shelf slope, mostly south of the Bering Strait (Boveng et al. 2008). Ribbon seals eat a variety of crustaceans (e.g., shrimps, mysiids, and crabs) and squid, but their main prey is fish. Fish species include walleye pollock, Arctic and saffron cod, eelpout, capelin, Greenland halibut, pricklebacks, herring and Sandlance (Dehn et al. 2007; Nelson and Griese 2008).

Although there is no reliable population estimate for the Alaskan ribbon seal stock (Allen and Angliss, 2011), Burns (1981) estimated between 90,000 and 100,000 ribbon seals inhabit the Bering Sea. Numbers using the Chukchi Sea are expected to be lower since most ribbon seals are believed to spend their summers in the northern Bering Sea. The National Marine Mammal Laboratory (NMML) presently uses a provisional population estimate of 49,000 ribbon seals for the central and eastern Bering Sea (Allen and Angliss, 2011). In spite of the unknowns in NMFS Stock Assessment (Allend and Angliss, 2011), the Species Status Review (Boveng et al, 2008) and the provisional population estimate allow for a thorough effects analysis for this species in the Chukchi Sea. In December 2007, NMFS received a petition to list ribbon seals under the ESA; however, in December 2008 it was determined that an ESA listing was not warranted (Boveng et al., 2008).

Spotted Seals. A reliable spotted seal population estimate for the Bering, Chukchi, and Beaufort seas does not exist (Allen and Angliss, 2011). NMML developed a provisional population estimate of 101,568 +/- 17,869 spotted seals in the eastern and central Bering Sea survey areas, while others estimated 100,000–135,000 spotted seals form the Bering Sea spotted seal stock (Boveng et al., 2009). Surveys from 1990 to the present have noted that spotted seals may occur near the proposed drill sites in numbers that vary from year to year (Table 18). Though the NMFS Stock Assessment for this species states that no reliable population estimate for spotted seals exists, the Status Review's (Boveng et al., 2009) provisional population estimate, along with recent surveys in the northeastern Chukchi Sea (Table 18), provide sufficient information to support a reasoned effects analysis.

The primary haulout areas used by spotted seals in the eastern Chukchi are Kasegaluk Lagoon, and to a lesser degree other areas with substantial areas of sand or mud bars. Individual spotted seals

generally remain closer to the coast than those of other ice seal species, and evidence also indicates spotted seals are not as tightly linked to sea ice as are the other ice seal species.

Adult spotted seals eat a variety of fish, crustaceans, and cephalopods and their diet varies with age, season, and location. Young spotted seals consume euphausiids, copepods, and other crustaceans, and their preferred prey base generally increases in size as individual seals mature. Adult spotted seals consume salmon, Arctic cod, capelin and pollock, and flatfishes (Dehn et al., 2007; Nelson and Griese, 2008).

In May 2008, NMFS received a petition to list spotted seals under the ESA; however, in October 2009, NMFS determined an ESA listing is not warranted for spotted seals in the Bering, Chukchi, or Beaufort seas (Boveng et al., 2009).

Pacific Walrus

Observations of walrus in the vicinity of the Burger Prospect have been reported in several surveys over the past 20 years. While these surveys use different methods and occurred under different circumstances, when taken together they can help to illustrate the use of the drilling area by walrus. Results of these survey reports are given in Table 19. Other information on the affected environment for walrus is described below.

Table 19. Numbers of Pacific walruses sighted by vessel-based and aircraft-based surveys in the vicinity of the Proposed Action, and the northeastern Chukchi Sea.

	Number of individuals reported by eight surveys							
Species Observed	**Brueggeman et al. 1991a – Popcorn, Burger, and Crackerjack Prospects 1990 walrus monitoring**	**Brueggeman et al. 1992a – Crackerjack and Diamond Prospects 1991**	**Brueggeman et al. 2010 – Klondike and Burger Prospects 2009**	**Brueggeman et al. 2009 – Klondike and Burger Prospects, pipeline route 2008**	**Reiser et al. 2010 – Burger, Snickers, Ulu, Caramel, and Honeyguide prospects 2009**	**Blees et al. 2010 – Seismic Survey NE Chukchi Sea 2010**	**Clarke et al. 2011c – COMIDA Final Report,:2008-2010 NE Chukchi Aerial Surveys**	**Haley et al. 2010 in Funk et al. 2010 – Chukchi Sea Vessel-Based Monitoring Program, NE Chukchi Sea 2006-2008**
Pacific Walrus	24889	-	309	50	114	1042	5995-51991	763-2954
Unid. Pinniped	93	0	10	3	5	56	33-703	19-34

On February 10, 2011, the US Fish and Wildlife Service (FWS) completed a status review of the Pacific walrus (*Odobenus rosmarus divergens*) and determined that although listing the species as endangered or threatened was warranted, the listing was precluded by other higher priority actions (76 FR 7634). The Pacific walrus is currently listed as a candidate species under the ESA. The continuing loss of sea ice habitat and harvest levels are likely the biggest stressors on the population (Jay, Marcot, and Douglas, 2011). The most recent population survey was conducted in 2006. Due to weather constraints approximately 50% of the available walrus habitat was surveyed. The final population estimate of 129,000 (Speckman et al., 2010) represents a minimum population estimate since it was not possible to extrapolate from the area surveyed to the entire habitat area.

Pacific walrus range varies with the extent of sea ice. A few walrus may move into the eastern Beaufort Sea during the open water season, but most are found west of Barrow along the pack-ice front in the northeastern Chukchi Sea. Since 2007, walrus have increasingly used terrestrial haulout sites between Barrow and Cape Lisbourne when the sea ice retreats north of the Continental Shelf.

The spring migration usually begins in April, with most walrus moving north through the Bering Strait by late June. Walrus begin to migrate south with the advance of pack ice during the fall. Both of these migrations bring walrus through the proposed drilling area.

The number of walrus observed in the proposed drilling area during monitoring efforts associated with seismic surveys in 2006-2009 varied depending upon the location of sea ice, but occurrences of walrus in the area of the Burger Prospect are regular and common. A total of 5,626 walrus were observed in the Lease Sale 193 Area over a period of four years (2006-2009) by vessel based MMOs while monitoring seismic surveys in this area of the northeastern Chukchi Sea (Hannay et al, 2009). Brueggeman et al. (1990, 1991a) observed 85 walrus in or near the Burger Prospect area in 1989 and 534 in 1990, and 1,002 walrus were observed in two years (2008-2009) of baseline marine mammal surveys at the Burger Prospect (Brueggeman, 2009a, 2009b, 2010). A large number of walrus (1,042, mostly in groups of 1-4 individuals) were also observed just north of the Burger Prospect during the monitoring of a seismic survey program in August-September 2010 (Blees et al., 2010). Most of these observations (73 percent) occurred on just a few days (28–31 August) when a large number of walrus moved from a receding ice edge towards land (Blees et al., 2010). Their presence in the area is strongly linked to the presence of pack ice. The likelihood of encountering a walrus in or near the Burger Prospect will depend largely upon ice conditions at the time of exploration drilling activity, but it is likely that a number of walrus will occur in the area of the Burger Prospect during the planned exploration drilling program.

Mysticete Whales

Observations of mysticete whales in the vicinity of the Burger Prospect have been reported in several surveys over the past 20 years. While these surveys use different methods and occurred under different circumstances, when taken together they can help to illustrate the use of the area by whales. Results of these survey reports are given in Table 20. Other information on the affected environment for mysticete whales is described below for each species.

Table 20. Numbers of individuals of mysticete whale species sighted by vessel-based and aircraft-based surveys in the vicinity of the Proposed Action, and in the northeastern Chukchi Sea.

	Number of individuals reported by eight surveys							
Species Observed	**Brueggeman et al. 1991a – Popcorn, Burger, and Crackerjack Prospects 1990 walrus monitoring**	**Brueggeman et al. 1992a – Crackerjack and Diamond Prospects 1991**	**Brueggeman et al. 2010 – Klondike and Burger Prospects 2009**	**Brueggeman et al. 2009 – Klondike and Burger Prospects, pipeline route 2008**	**Reiser et al. 2010 – Burger, Snickers, Ulu, Caramel, and Honeyguide prospects 2009**	**Blees et al. 2010 – Seismic Survey NE Chukchi Sea 2010**	**Clarke et al. 2011c – COMIDA Final Report,:2008-2010 NE Chukchi Aerial Surveys**	**Haley et al. 2010 in Funk et al. 2010 – Chukchi Sea Vessel-Based Monitoring Program, NE Chukchi Sea 2006-2008**
Bowhead Whale	**	15	3	**	2	6	4-106	7-44
Fin Whale	**	**	**	**	**	**	1	4
Gray Whale	8	258	77	9	2	10	226-390	50-165
Humpback Whale	**	**	**	**	**	**	1	1-5
Minke Whale	1	**	2	1	**	5	**	3-10
Unidentified Mysticete Whale	**	0	**	**	14	20	**	3-113
Unidentified Cetacean	1	5	2	1	**	1	15-96	14-16

Bowhead Whale. Bowhead whale stocks occur in Arctic and sub-Arctic waters off eastern and western Canada, Alaska, Chukotka, and the sea of Okhotsk. The minimum population estimate for the western Arctic stock of bowhead whales off Alaska, western Canada, and Chukotka is 9,472 (Allen and Angliss, 2011). The Western Arctic bowhead whale stock generally occurs in seasonally ice-covered waters of the Arctic, generally north of 60° N. and south of 75° N. in the western Arctic Basin (Bering, Chukchi, and Beaufort seas)(Moore and Reeves, 1993). They have an affinity for ice and are associated with relatively heavy ice cover and shallow continental shelf waters for much of the year. Surveys from 1990 to the present have noted that bowhead whales may occur near the proposed drill sites. Numbers near the Burger Prospect are usually low (though variable from year to year) until September or October, when bowhead whale migrate in pulses out of the Beaufort Sea and through the Chukchi Sea.

During spring, bowheads migrate through spring lead systems to feeding areas in the eastern Beaufort Sea, and the vicinity of Barrow Canyon. A few individuals remain scattered through the Chukchi Sea during summer (Ireland et al., 2009); however, tracking data indicates most bowheads move to or between their primary feeding areas in the Beaufort Sea (ADFG, 2009). Moore and Reeves (1993) indicated the fall migration takes place in pulses or aggregations of whales. Iñupiat whalers report that smaller whales precede large adults and cow-calf pairs on the fall migration (Braham et al., 1984, as reported in Moore and Reeves, 1993). When the fall migration out of the Beaufort Sea occurs, large numbers of whales could pass through the leased areas; however, after passing Point Barrow, the migration paths of individual bowhead whales fan out across the Chukchi Sea with most heading towards the coastal waters of Chukotka where it is believed they feed (Quakenbush, Small and Citta, 2010) before eventually heading south to winter in the Bering Sea (ADFG 2009; Ireland et al., 2009). The numbers of bowhead whales detected in the northeastern Chukchi Sea by COMIDA flights and Marine Mammal Monitoring (by industry) show a little variance from year to year; however, evidence indicates bowhead whales are uncommon at the Burger Prospect until the fall migration commences, at which time large numbers of whales could migrate across the Chukchi Sea.

Preliminary data from satellite tracking (Quakenbush, Small and Citta, 2010), agency monitoring (Clarke et al., 2011a) and industry monitoring efforts (2006–2008) (Funk et al., 2010) have noted bowhead movement and feeding uses in the Chukchi Sea during summer and fall. Satellite tracking data (Quakenbush, Small, and Citta, 2010) for bowhead whales from 2006–2008 and passive acoustic monitoring (Moore, Stafford, and Munger, 2010) indicated most bowhead whales pass Barrow in September and October heading towards Wrangel Island (Russia). Once near Wrangel Island whales may linger up to 21 days, before traveling Southeast to coastal waters of Chukotka where they may feed for another 59 days, before departing for the Bering Sea.

The most common prey species found in the stomachs of harvested bowheads are euphausiids, copepods, mysids, and amphipods (Moore et al., 2010; Lowry, Sheffield, and, George 2004). Euphausiids and copepods are thought to be their primary prey since other crustaceans (isopods and decapods), and fish constitute minor fractions of their stomach contents. Carbon-isotope analysis of bowhead baleen indicates a significant amount of feeding occurs in wintering areas (Schell, Saupe, and Haubenstock, 1987). There are no known concentrations or notable feeding areas for bowhead whales in the northeastern Chukchi Sea. The nearest feeding area of particular consequence is in the vicinity of Barrow Canyon where the Beaufort and Chukchi Seas meet.

Fin Whale. Fin whales are widespread throughout temperate oceans of the world (Leatherwood et al., 1982; Perry, DeMaster, and Silber, 1999a) and in the Arctic Ocean (Allen and Angliss, 2011). Individual and small groups of fin whales seasonally inhabit areas within and near the Chukchi Sea Planning Area during the open water period. Based on observations and passive acoustic detection (Hannay et al., 2009; Delarue et al., 2010), and on direct observations from monitoring and research projects of fin whales from industry (e.g., Ireland et al., 2009) and government (e.g., Clarke et al., 2011c), fin whales are considered uncommon but regular visitors to the Alaska Chukchi Sea. An

increase in observations of fin whales in recent years may be due to factors including renewed marine mammal monitoring by industry, and/or an increase in fin whale use of the Chukchi Sea. Data from COMIDA and Marine Mammal Monitoring activities indicate that fin whales are uncommon to rare at the Burger Prospect. The North Pacific fin whale population is estimated to have ranged from 42,000-45,000 before whaling began (Ohsumi and Wada, 1974). Allen and Angliss (2011) provide a current, minimum population estimate of 5,700 for the proportion of the Northeast Pacific Stock of fin whales west of the Kenai Peninsula. Surveys from 1990 to present have noted very few fin whales occurring near the proposed drill sites (Table 20).

Although there may be some degree of specialization, most individuals probably prey on both invertebrates (including crustaceans and squid) and fish, depending on availability (Watkins et al., 1984; Edds and Macfarlane, 1987). There appears to be variation in the predominant prey of fin whales in different geographical areas depending on local abundance of prey species (NMFS, 2010). Perry, DeMaster and Silber (1999a: p. 49) reported fin whales "depend to a large extent on the small euphausiids and other zooplankton" and fish. Fin whales aggregate where prey densities are high (Piatt and Methven, 1992; Moore, Stafford, and Dahlheim, 1998) chiefly in areas with high phytoplankton production and along ocean fronts (Moore, Stafford, and Dahlheim, 1998).

The PBR level for fin whales = 11.4. Fin whales are not hunted by subsistence hunters (Allen and Angliss, 2011).

Gray Whale. Most of the Eastern North Pacific Stock of gray whales spends its summer feeding in the northwestern Bering Sea, and in the Chukchi Seas (Rice and Wolman, 1971; Berzin, 1984; Nerini, 1984), migrating to winter and calve in the waters of Baja California. Allen and Angliss (2011) reported a minimum population estimate of 18,017 individuals, putting the population at a level similar to what is believed to approximate the pre-commercial whaling population level. Primary feeding areas in the Chukchi Sea include the eastern Chukchi, some shoal areas, and the western Chukchi from Wrangel Island to the Bering Strait, but they may be found throughout the Chukchi Sea in shallow waters over the continental shelf. Gray whales are the species of cetacean most frequently detected during marine mammal monitoring in the northeastern Chukchi Sea during the open water season (Funk et al., 2010; Brueggeman et al., 2009a and 2009b). Surveys from 1990 to the present have noted that, relative to other cetaceans, gray whales are relatively common near the proposed drilling sites and throughout the northeastern Chukchi Sea (Table 20). Gray whale feeding areas offshore of northern Alaska are characterized by low species diversity, high biomass, and the highest secondary production rates reported for any extensive benthic community (Rugh et al., 1999).

Gray whales are primarily bottom feeders restricted to shallow continental shelf waters for feeding. They mostly remain in coastal waters although in the Chukchi and Bering seas they feed at greater distances from shore over the shallow continental shelf. Their primary prey include swarming mysids, tube-dwelling amphipods, and polychaete worms in the Bering and Chukchi seas, but they also consume red crabs, baitfish, and other food (crab and fish larvae, amphipods, fish eggs, cephalopods, megalops, etc.) opportunistically or off the main feeding grounds (Reilly et al., 2008).

Stoker (1990) studied one of the high-use areas, the central Chirikov Basin between St. Lawrence Island and the Bering Strait, and found gray whales disturb at least 6% of the benthos each summer while consuming >10% of the yearly amphipod production. According to Highsmith and Coyle (1992), gray whales rely on rich benthic amphipod populations in the Bering and Chukchi Seas to renew fat resources needed to sustain them during their winter migration to and from Baja California. Nelson et al. (1993) noted that in the Chukchi Sea, within areas where gray whales were observed feeding off Wainwright, amphipod species observed were *Ampelisca macrocephala*, *A. estrichti*, *Byblis gaimardi*, *Aty1us bruggeni*, *Ischyrocerus*, *Protomedeia* spp., *Grandifoxus*, and *Erichthonius*, with amphipods comprising 24 percent of the biomass (Feder et al., 1989).

Humpback Whale. Humpback whales are found in all oceans with apparent worldwide geographical segregation into at least 10-11 distinct populations. For management purposes, the IWC places all humpback whales in the North Pacific Ocean into one stock (Donovan, 1991); however, NMFS recognizes three "management units" or stocks within the North Pacific. Individuals from the Western North Pacific Stock (population est. 732) and the Central North Pacific Stock (population est. 5,833) could occur in the Bering Sea with access to the Chukchi and Beaufort seas (Allen and Angliss, 2011). To date there have been few observations of humpback whales in the northeastern Chukchi Sea. Surveys conducted from 2006-2008 noted a maximum of five humpback whales in a given season (Haley et al., 2010). They are very rarely sighted near the proposed drill sites or during area-wide surveys. On those rare occasions when they are seen, humpback whales are present only in extremely low numbers (Table 20).

Humpback whales are relatively generalized in their feeding compared to some other baleen whales. In the Northern Hemisphere, known prey includes euphausiids (krill), copepods, juvenile salmonids, *Oncorhynchus* spp., Arctic cod, *Boreogadus saida*; walleye pollock, *Theragra chalcogramma*; pollock, *Pollachius virens*, pteropods, and cephalopods (Johnson and Wolman, 1984; Perry, DeMaster, and Silber, 1999b).

Minke Whale. The distribution of minke whales is considered cosmopolitan because they can occur in polar, temperate, and tropical waters in most seas and areas worldwide. Minke whales, like some other species of cetaceans, migrate seasonally and are capable of traveling long distances. Some animals and stocks of this species have resident home ranges and are not highly migratory. The distribution of minke whales varies by age, reproductive status, and sex. Older mature males are commonly found in the polar regions in and near the ice edge, and often in small social groups, during the summer feeding season. Mature females will also migrate farther into the higher latitudes, but generally remain in coastal waters. Immature animals are more solitary and usually stay in lower latitudes during the summer. Minke whales are occasionally detected in the northeastern Chukchi Sea during the open water seasons (Funk et al., 2010) as indicated in Table 20.

Presently NMFS has been unable to produce a minimum population estimate for the Alaska Stock of minke whales (Allen and Angliss, 2011); however, an estimate of 1,003 was produced for the east-central and southeastern Bering Sea, based on surveys in the central-eastern Bering Sea (1999) and southeastern Bering Sea (2000). A subsequent survey of a 30-45 nm zone from Kenai Fjords to the central Aleutian Islands (2001-2003) led to an estimate of 1,233 minke whales for that area, with most sightings in the Aleutian Islands and in water <200 m. deep. Most likely the Alaska stock of minke whales numbers into the thousands; however, this is speculative because only a portion of this species' range has been surveyed. Still, minke whales are the most abundant rorqual in the world, and their population status is considered stable through virtually all of its range (NMFS, 2011). Minke whales opportunistically feed on crustaceans (e.g., krill), plankton (e.g., copepods), and small schooling fish (e.g., anchovies, dogfish, capelin, coal fish, cod, herring, eels, mackerel, salmon, sand lance, and wolfish)(Reeves et al., 2002).

Odontocete Whales

The toothed whales (Odontocetes) likely to occur in the proposed drilling area are the beluga (*Delphinapterus leucas*), harbor porpoise (*Phocoena phocoena*), and killer whale (*Orcinus orca*). Narwhals (*Monodon monoceros*) have rarely been observed in the Chukchi Sea and are considered by NMFS to be extralimital (FR 69959, Nov 9, 2011). Observations of odontocete whales in the vicinity of the Burger Prospect have been reported in several surveys over the past 20 years. While these surveys use different methods and occurred under different circumstances, when taken together they can help to illustrate use of the area by whales. Results of these survey reports are given in Table 21. Other information on the affected environment for odontocete whales is described below for each species.

Table 21. Numbers of individuals for respective odontocete cetacean species sighted by vessel-based and aircraft-based surveys in the vicinity of the Proposed Action, and the northeastern Chukchi Sea.

	Number of individuals reported by eight surveys							
Species Observed	**Brueggeman et al. 1991a – Popcorn, Burger, and Crackerjack Prospects 1990 walrus monitoring**	**Brueggeman et al. 1992a – Crackerjack and Diamond Prospects 1991**	**Brueggeman et al. 2010 – Klondike and Burger Prospects 2009**	**Brueggeman et al. 2009 – Klondike and Burger Prospects, pipeline route 2008**	**Reiser et al. 2010 – Burger, Snickers, Ulu, Caramel, and Honeyguide prospects 2009**	**Blees et al. 2010 – Seismic Survey NE Chukchi Sea 2010**	**Clarke et al. 2011c – COMIDA Final Report,:2008-2010 NE Chukchi Aerial Surveys**	**Haley et al. 2010 in Funk et al. 2010 – Chukchi Sea Vessel-Based Monitoring Program, NE Chukchi Sea 2006-2008**
Beluga Whale	3	1276	**	**	**	**	351-881	2
Harbor Porpoise	**	**	3	**	**	**	**	16-25
Killer Whale	**	12	**	**	**	**	**	1-2
Unidentified Odontocete Cetacean	**	0	**	**	**	2	**	2-4
Unidentified Cetacean	1	5	2	1	**	1	15-96	14-16
Unidentified Small Cetacean	**	0	**	**	**	**	**	**

Beluga Whale. Of the five stocks of beluga that occur in Alaska (Allen and Angliss, 2011) only the eastern Chukchi Sea and Beaufort Sea stocks occur in the Lease Sale 193 Area. Both stocks overlap in the Chukchi Sea and winter in the Bering Sea (Suydam et al., 2001; Miller, Elliott, and Richardson, 1998). Much of the Chukchi Sea stock congregates in Kasegaluk Lagoon in June and July, at which time the village of Point Lay conducts a subsistence hunt. In the spring, beluga whales migrate along open leads north from their wintering grounds in the Bering Sea, often near the coast. Fall migrant beluga whales from the Canadian Beaufort Sea transit the Alaskan Beaufort Sea in a more dispersed pattern, but often along the southern edge of the pack ice, to reach western Chukchi Sea waters primarily during September (Richard, Martin, and Orr, 1998). During this time, pods can exceed 500 individuals (Lowry, 1994). Preferred summer habitats are well north of the Burger Prospect.

The most reliable estimate of the number of beluga whales in the eastern Chukchi stock is 3,710 individuals based on 1989-1991 aerial surveys (Frost, Lowry, and Carroll, 1993; Allen and Angliss, 2011). Subsequently, partial surveys were conducted in 1998 (DeMaster, Perryman, and Lowry, 1998) and in July 2002 (Lowry and Frost, 2002). Belugas are not commonly observed in the area of the Burger Prospect but may be encountered there in small numbers during the drilling season. They have been observed there during BWASP surveys (Clarke et al., 2011c). MMOs monitoring marine mammal occurrence from vessels during seismic surveys in offshore waters of the northeastern Chukchi Sea reported 46 beluga whales from marine vessels in 2006-2008 (Hannay et al., 2009), but many more were observed during aerial surveys in more coastal waters. Belugas were not observed in the Burger Prospect area during past exploration efforts in 1989-1990 (Breuggeman et al., 1991). None were observed around the Burger Prospect during Shell's July-October 2008-2009 baseline marine mammal surveys (Hannay et al., 2009).

Harbor Porpoise. Harbor porpoises are found in relatively shallow coastal and shelf waters less than 330 ft (100 m) in depth (Allen and Angliss, 2011). Offshore of Alaska they are found from southeast Alaska throughout the Chukchi Sea shelf (Allen and Angliss, 2011) and have been observed as far north as the Barrow area (Suydam and George, 1992) and as far east as Harrison Bay in the Beaufort Sea (Funk et al., 2010). Although there is no official designation of separate stocks of harbor porpoises in Alaska, three stocks have generally been recognized, with harbor porpoises found in the Chukchi Sea being considered part of the Bering Sea group. Harbor porpoises use echolocation to find prey while foraging (Nowak, 1999). Harbor porpoises normally travel in small groups consisting of a few individuals, but form larger groups for feeding and mating purposes. Allen and Angliss (2011) provided a minimum population estimate of 40,039 for the Bering Sea stock of harbor porpoise.

Harbor porpoises are common cetaceans in the northeastern Chukchi Sea. They were the second most commonly observed cetacean by MMOs monitoring seismic surveys in the area, with a total of 106 observed over four years (Hannay et al, 2009). An average density of 0.0112/km^2 has been calculated for harbor porpoises based on these industrial surveys. They were not observed during exploration drilling efforts conducted in 1989-1991 (Breuggeman et al, 1991). None were observed within the Burger Prospect study area during baseline studies, but three were observed in more coastal waters during transit between the Burger Prospect and Wainwright in 2009 (Brueggeman, 2010). These data indicate that harbor porpoises may be encountered in the prospect area, or in transit to the prospect, in small numbers during the drilling season.

Killer Whale. Killer whales can be found in all Alaskan waters, although they are considered rare in the Chukchi Sea. Of the eight killer whale stocks recognized in the Pacific, the trans-boundary Alaska Resident stock, found from southeastern Alaska to the Chukchi Sea (Allen and Angliss, 2011) is the only stock likely to be encountered in the area of Shell's planned exploration drilling operations. Based on surveys conducted by the NMML, a minimum estimate of 1,123 killer whales comprises the Alaska Resident stock (Allen and Angliss, 2011).

MMOs recorded observations of 10 killer whales (in five groups) from vessels while conducting monitoring surveys for seismic surveys in the northeastern Chukchi Sea in 2006-2009 (Hannay et al., 2009). None were observed in the prospect during historical drilling in 1989-1991 (Breuggeman et al., 1991). None were observed in the Burger Prospect area during Shell's July-October, 2008-2009 marine mammal surveys, but a few were observed elsewhere in the Lease Sale 193 Area at that time (Brueggeman et. al., 2009a, 2009b). Although it is unlikely, they could be encountered in the prospect area in small numbers during the planned exploration drilling program.

Polar Bear

Observations of polar bears in the vicinity of the Burger Prospect have been reported in several surveys over the past 20 years. While these surveys use different methods and occurred under different circumstances, when taken together they can help to illustrate the use of the area by polar bears. Results of these survey reports are given in Table 22. Other information on the affected environment for polar bears is described below.

The polar bear (*Ursus maritimus*) was listed by FWS as a threatened species under the ESA on May 14, 2008 (73 FR 28212). The listing was based primarily on the observed and continuing decline of sea ice habitat which polar bears rely on for foraging, movements, breeding, and denning.

Polar bear distribution is determined largely by seasonal ice. When sea ice retreats northward over deep waters not commonly inhabited by seals, polar bears may remain with the ice, fasting; others may retreat to shore. Small numbers of polar bears have been observed during the drilling of most of the past exploration wells in the Chukchi and when conducting baseline marine mammal surveys near

Table 22. Numbers of polar bears sighted by vessel-based and aircraft-based surveys in the vicinity of the Proposed Action, and the northeastern Chukchi Sea.

	Number of individuals reported by eight surveys							
Species Observed	Brueggeman et al. 1991a – Popcorn, Burger, and Crackerjack Prospects 1990 walrus monitoring	Brueggeman et al. 1992a – Crackerjack and Diamond Prospects 1991	Brueggeman et al. 2010 – Klondike and Burger Prospects 2009	Brueggeman et al. 2009 – Klondike and Burger Prospects, pipeline route 2008	Reiser et al. 2010 – Burger, Snickers, Ulu, Caramel, and Honeyguide prospects 2009	Blees et al. 2010 – Seismic Survey NE Chukchi Sea 2010	Clarke et al. 2011c – COMIDA Final Report,:2008-2010 NE Chukchi Aerial Surveys	Haley et al. 2010 in Funk et al. 2010 – Chukchi Sea Vessel-Based Monitoring Program, NE Chukchi Sea 2006-2008
Polar Bear	25	0	4	1	0	0	1-17	3-8

the Burger Prospect during August-September 2008-2009 (Brueggeman, 2009). All observed bears were associated with pack ice.

The polar bear population in Alaska is considered to consist of two stocks, the Chukchi/Bering Sea stock and the southern Beaufort Sea stock, although there is considerable overlap between the two stocks (Amstrup et al., 2005). The two populations overlap between Point Hope and Point Barrow (Amstrup, 1995). In 2001, the southern Beaufort Sea stock was estimated at 2,200 bears (USDOI, FWS, 2010b). There currently is no reliable estimate for the Chukchi/Bering Sea stock, but the current estimate of at least 2,000 animals (Aars et al., 2006; USDOI, FWS, 2010a) is sufficient for evaluating potential impacts.

Polar bears are found throughout the Lease Sale 193 Area when ice is present. None were observed within the Burger Prospect study area in 2009, but four were observed in nearby waters (Brueggeman, 2010). All observed polar bears were associated with pack ice. A small number of polar bears may be encountered in the Burger Prospect during the planned exploration drilling operations, dependent on ice conditions.

FWS published a final rule on December 7, 2010 designating critical habitat for the threatened polar bear, effective January 6, 2011 (75 FR 76086). Designated critical habitat encompasses three areas or units: Unit 1 – sea ice, Unit 2 – terrestrial denning habitat, and Unit 3 – barrier island habitat. Potentially relevant here is the sea ice habitat that occurs seasonally over the Burger Prospect, as well as the habitat designated on and adjacent to barrier islands along the Chukchi shoreline.

3.2.8 Terrestrial Mammals

The affected environment for terrestrial mammals is the same as was described in the Sale 193 Final EIS (USDOI, MMS, 2007a) and the Sale 193 Final SEIS (USDOI, BOEMRE, 2011a). Relevant summery of those more detailed descriptions is provided below.

Individual caribou from the Western Arctic Herd (WAH) and Teshekpuk Lake Caribou Herd (TCH) are the only caribou that typically occur along the Chukchi coast between Barrow and Wainwright, Alaska. Male caribou from the WAH typically segregate out to their summer ranges at Cape Lisburne, while parturient females calve inland and seek the Brooks Range foothills for insect relief. Muskoxen prefer shrubby riparian areas, but occasionally visit the coast during summer. An occasional grizzly bear could be expected to periodically visit the coast searching for potential prey or

carrion. Arctic foxes and other furbearing species are ubiquitous throughout the area and would likely be found along the Chukchi coast.

3.2.9 Subsistence Activities

This section summarizes the affected environment for subsistence resources used by the people of the Chukchi Sea communities: Barrow, Wainwright, Point Lay, and Point Hope, Alaska.

Subsistence activities are assigned the highest cultural values by the Iñupiaq Eskimo of the North Slope and provide a sense of identity, in addition to being a pivotal economic pursuit. Subsistence is viewed by Alaskan Natives not just as an activity that is imbedded in the culture; it is viewed as the very culture itself (USDOI, MMS, 2009: pp. 213-223; Wheeler and Thornton, 2005). The bowhead whale is a subsistence resource of paramount importance, and, consequently, the social organization pertaining to the crew, the hunt, quantity, and distribution of the whale dominate when discussing North Slope Iñupiaq Eskimo subsistence. Bowhead whaling traditions underscore the central values and activities for the Iñupiat of the North Slope. Bowhead whale hunting strengthens family and community ties and the sense of a common Iñupiat heritage, culture, and way of life, and provides a strength, purpose, and unity in the face of rapid change (USDOI, MMS, 2008; EDAW, 2007). Although bowhead whaling traditions are unquestionably significant, harvest of other wild resources—including other marine mammals, caribou, fish, and avian species—are important to the local inhabitants in providing variety to the diet and needed nutrition, as well as satisfying basic nutritional needs when few or no bowhead whales are taken.

Barrow

Subsistence whaling and marine mammal hunting activities for the community of Barrow are summarized in Table 23. Updated information regarding specific groups of subsistence resources is described below.

Bowhead Whale. Barrow residents hunt the bowhead whale during both spring and fall. Historically, more whales have been harvested during the spring whale hunt, but changing ice conditions have increased the importance of the fall hunt. In 2011, Barrow whalers took 11 bowhead whales between October 8 and October 29 (AWEC, 2011, pers. comm.).

Beluga. Harvest of Beluga whales can occur in ice-free waters from the beginning of the spring whaling season through June and occasionally into July and August. Belugas are also occasionally harvested on both sides of the barrier islands of Elson Lagoon in the late summer.

Seals. The hunting of bearded seals (*ugruk*) is an important subsistence activity in Barrow. The bearded seal is a preferred food and bearded seal skins are a preferred covering material for the skin boats used for whaling. Most bearded seals are harvested during the spring and summer months in open water during the pursuit of other marine mammals in both the Chukchi and Beaufort seas.

Walrus. Walrus are harvested during a summer marine-mammal hunt west of Point Barrow and southwest to Peard Bay. Most hunters travel no more than 15-20 mi to hunt walrus, although recent reports indicate that hunters may travel as far as 100 mi north from Point Barrow. The major walrus-hunting effort occurs from late June through mid-September, with the peak season in August.

Caribou. Caribou are harvested throughout the year, with peak harvest periods from February through early April and from late June through late October. Some caribou hunting also occurs along rivers during the fall and in coastal areas during the summer when the animals seek relief from insects.

Migratory Birds. Migratory birds, particularly eider ducks and geese, provide an important food source for Barrow residents because of the dietary importance of birds as the first source of fresh meat in the spring. Most spring bird hunting occurs between April and June. In late August ducks and

geese are again hunted along the coast from Point Franklin to Admiralty Bay and Dease Inlet as they migrate south (USDOI, MMS, 2010).

A detailed description of Barrow's subsistence resources, their significance to the community, and the patterns of subsistence harvesting, is contained in Section III.C.2.c(3)(a) of the Lease Sale 193 Final EIS (USDOI, MMS, 2007a), Section 3.4.2.5.3 of the Arctic Multiple-Sale Draft EIS (USDOI, MMS, 2008) and Section III.C.2 of the Lease Sale 193 Final SEIS (USDOI, BOEMRE, 2011a), which are incorporated herein by reference. Information from these analyses has been updated by recent reports on subsistence mapping (USDOI, MMS, 2010) and on traditional knowledge (SRB&A, 2011), and the data from the recent studies indicates the activities take place in the area described in the detailed analyses as summarized in Table 24.

Table 23. Summary of subsistence harvest management, locations, and seasons for the Iñupiat community of Barrow.

Species	Management	Location	Season
Bowhead Whale	--NMFS (IHA) --Alaska Eskimo Whaling Commission	Spring Whaling: Ice leads from Point Barrow southwestward along the Chukchi Sea coast to the Skull Cliff area. See MMS, 2010 Map 10, and Shell 2011 Figure 3.11.7-4 for detailed depiction of bowhead whale subsistence use areas.	April to June: 92% of 158 whales landed from 1995 to 2010 were landed between April 25th and May 25th; 84% were landed between May 1st and May 25th.
Bowhead Whale	--NMFS (IHA) --Alaska Eskimo Whaling Commission	Fall Whaling: An area circumscribed by a western boundary extending approximately 10 mi west of Barrow, a northern boundary 30 mi north of Barrow, then southeastward to a point about 30 mi off Cooper Island, with an eastern boundary on the east side of Dease Inlet. Occasional use may extend eastward as far as Smith Bay and Cape Halkett. See MMS, 2010, Map 10, and Shell 2011 Figure 3.11.7-4 for detailed depiction of bowhead whale subsistence use areas.	September to October: 93% of 207 whales landed from 1995 to 2010 were landed between September 10th and October 20th; 84% were landed between September 19th and October 19th.
Beluga Whale	--NMFS (IHA) --Beluga Whale Committee	Spring leads between Point Barrow and Skull Cliff; later in the season, belugas are hunted in open water around the barrier islands off Elson Lagoon.	June to early July
Pacific Walrus	--FWS (LOA) --Eskimo Walrus Commission	From Point Franklin on the Chukchi Sea coast to Pitt Point on the Beaufort Sea coast and up to 60 mi offshore; nearshore from Pitt Point to Prudhoe Bay. See MMS, 2010, Map 33, and Shell 2011 Figure 3.11.7-3 for detailed depiction of Pacific Walrus subsistence use areas.	June to August
Polar Bear	--FWS (LOA) --Nanuuq Commission	Generally in the same vicinity used to hunt walrus.	January to March May to June
Bearded Seal (Ugruk)	--NMFS (IHA) --Ice Sea Commission	From 35 mi southwest of Wainwright on the Chukchi Sea coast to Dease Inlet on the Beaufort Sea coast and up to 90 mi offshore. See MMS, 2010, Map 31, and Shell 2011 Figure 3.11.7-4 for detailed depiction of bearded seal subsistence use areas.	November to January, some open water sealing
Ringed Seal	--NMFS (IHA) --Ice Seal Commission	From Point Franklin on the Chukchi Sea coast to Pitt Point on the Beaufort Sea coast and up to 60 mi offshore. Open water nearshore. See MMS, 2010, Map 29, and Shell 2011 Figure 3.11.7-4 for detailed depiction of ringed seal subsistence use areas.	November to January April to July

Species	Management	Location	Season
Spotted Seal	--NMFS (IHA) --Ice Sea Commission	Nearshore Chukchi coastline east as far as Dease Inlet and Admiralty Bay in the Beaufort Sea.	November to January July to September
Ribbon Seal	--NMFS (IHA) --Ice Seal Commission	Nearshore/offshore Chukchi coastline east as far as Dease Inlet and Admiralty Bay in the Beaufort Sea.	Some open-water sealing

Wainwright

Subsistence hunting of bowhead whales, beluga, Pacific walrus, polar bear, bearded seal, ringed seal, spotted seal, and ribbon seal for the community of Wainwright are summarized in Table 24. The hunting seasons and harvest location for various marine mammals sometimes overlap in location and time of year. Subsistence hunting in Wainwright has been described as occurring to the north or south of the community in any given year, but over time, the pattern of offshore subsistence hunting is a "fan spreading outward from Wainwright in all directions" (SRBA-ASR, 2011).

Bowhead Whale. Bowhead whales are Wainwright's most important marine resource and are available in the Wainwright area beginning in late April. Wainwright whalers recognize three distinct runs of bowhead whales, all of which occur before the proposed commencement of Shell's exploration activities. The first run occurs when leads first open in the ice. Historically, this would occur in late April but in recent years the leads have opened earlier in the spring and the whales have begun to appear in early April and sometimes even in March. The second run also requires open leads and occurs in late April to early May. The third run takes place in the second half of May and early June. Following the whaling season, as hunters pursue bearded seals in pack ice, they have reported bowhead whales still migrating and on a few occasions, whales have been reported in July near Wainwright and Icy Cape. In the fall, whales have been reported a few times near Wainwright in October, but they do not generally follow the coast southward from Barrow. In October 2010, Wainwright landed a whale in the autumn for the first time since at least 1974 and likely the first in more than 50 years (Suydam et.al., 2011). Bowhead whaling tracks for the October 2010 hunt are northeast of Wainwright, the furthest extending 37 miles northwest of Wainwright. Again, in 2011, the same Wainwright crew took a single bowhead whale on October 28 (AEWC, 2011, pers. comm).

Beluga. There are two separate periods when beluga whales migrate past Wainwright, one in early May and another in late June. Due to the focus on the bowhead harvest in May, Wainwright whalers only hunt belugas during the late June migration. Beluga whaling records from the July 2010 hunt indicate beluga whaling took place close to shore from Kaselgaluk Lagoon to the Sinaruruk River (SRBA-ASR, 2011).

Seals. Wainwright residents hunt four seal species: ringed, spotted, ribbon and bearded seals. Seal hunting records from March, April, June, and July 2010 show that the bearded seal was the species most hunted, although ring and spotted seals were targeted. The 2010 hunt occurred from Kasegaluk Lagoon at Akoliakatat Pass in the south to Point Franklin in the north, and as far as 37 miles offshore from Wainwright, with the highest concentrations of hunting directly offshore and within 10 miles of Wainwright (SRB&A-ASR, 2011).

Caribou. Caribou is the primary source of meat for Wainwright residents. Before freeze up, caribou hunting is conducted along inland waterways, particularly along the Kuk River system. Coastal hunting records in July 2010 report that caribou were hunted from a point just south of Pingorarok Pass in Kasegaluk Lagoon to a point approximately 20 miles northeast of Wainwright (SRBA-ASR, 2011).

Fish. Wainwright residents harvest a variety of fish in most marine and freshwater habitats along the coast and in lagoons, estuaries, and rivers. The most important local fish harvest occurs from September through November in the freshwater areas of the Kuk, Kugrua, Utukok, and other river

drainages. Marine fishing is conducted from Peard Bay to Icy Cape and in Kuk Lagoon. Fishing occurs exclusively in nearshore coastal areas.

Migratory Birds. The spring migration of ducks, murres, geese, and cranes begins in May and continues through June. A waterfowl harvest is initiated in May at whaling camps and continues through June. During the fall migration south, hunting success is limited. Eider hunting records in March through July 2010 indicate that hunting occurred from a point approximately 10 miles offshore from Akoliakatat Pass in the south almost to Point Franklin in the north (SRB&A-ASR, 2011).

Detailed information regarding Wainwright subsistence resources (summarized in Table 24) are available in Volume III, Section C.2.c(3)(c) of the Lease Sale 193 Final EIS (USDOI, MMS, 2007a), Section 3.4.2.6.1 of the Arctic Multiple-Sale Draft EIS (USDOI, MMS, 2008), and Section III,C.2 of the Lease Sale 193 Final SEIS (USDOI, BOEMRE, 2011a) which are incorporated herein by reference.

Table 24. Summary of subsistence harvest management, locations, and seasons for the Iñupiat community of Wainwright.

Species	Management	Location	Season
Bowhead Whale	--NMFS (IHA) --Alaska Eskimo Whaling Commission	Spring Whaling: Leads offshore of Wainwright; with whaling camps from 15 mi southwest to 30 mi northeast of Wainwright sometimes and up to 15 mi offshore; also some whaling has occurred 6 mi southwest and 6 mi northeast of Icy Cape and 6 mi offshore. See MMS 2008 Figure 3.4.2-72 and Shell 2011 Figure 3.11.7-6 for detailed depiction of bowhead whale subsistence use areas.	April to June, primarily May: 92% of 53 whales landed from 1995 and 2010 were landed between April 24th and May 29th; 84% were landed between April 24th and May 24th
Bowhead Whale	--NMFS (IHA) --Alaska Eskimo Whaling Commission	Fall Whaling: Northwest of Peard Bay	October 1 whale in 2010 (first autumn whale since at least 1974) and 1 whale in 2011.
Beluga Whale	--NMFS (IHA) --Beluga Whale Committee	Along the coastal lagoon systems. See Shell 2011 Figure 3.11.7-6 for detailed depiction of beluga whale subsistence use areas.	June to August
Pacific Walrus	--FWS (LOA) --Eskimo Walrus Commission	At the southern edge of the retreating pack ice. Walrus hunted at local haulouts with the focal area from Milliktagvik north to Point Franklin. See Shell 2011 Figure 3.11.7-5 for detailed depiction of walrus subsistence use area.	Mid-June to August August to September
Polar Bear	--FWS (LOA) --Nanuuq Commission	Around Icy Cape, at the headland from Point Belcher to Point Franklin, and at Seahorse Island.	August to March
Bearded Seal	--NMFS (IHA) --Ice Sea Commission	Nearshore directly offshore of Wainwright to the mouth of Kuk Lagoon. See Shell 2011 Figure 3.11.7-6 for detailed depiction of seal subsistence use areas.	April to August December to January
Ringed Seals	--NMFS (IHA) --Ice Sea Commission	Nearshore from Point Lay to Point Franklin. Not commonly harvested. Nearshore from Point Lay to Point Franklin. Not commonly harvested.	April to August December to January
Spotted Seal	--NMFS (IHA) --Ice Sea Commission	At Icy Cape and nearshore Point Lay to Point Franklin, with most taken in Kuk Lagoon. See Shell 2011 Figure 3.11.7-6 for detailed depiction of seal subsistence use areas.	September to October
Ribbon Seal	--NMFS (IHA) --Ice Sea Commission	Nearshore/offshore Point Lay to Point Franklin. See Shell 2011 Figure 3.11.7-6 for detailed depiction of seal subsistence use areas.	April to August

Point Lay

Detailed analyses of subsistence whaling and marine mammal hunting activities for the community of Point Lay are summarized in Table 25. These analyses are informed by a recent report on traditional knowledge for Point Lay (SRB&A, 2011) as well as by information developed from monitoring efforts of offshore subsistence hunting for key marine mammals (bowhead and beluga whales, walrus, seals, and polar bears) during the offshore boating season, March through October 2010.

Beluga. Point Lay's most important subsistence marine resource is the beluga whale. A major community activity centers around a single hunt in the summer, usually occurring during the first 2 weeks of July, within Kasegaluk Lagoon and on the outer coast of the barrier islands where schools of belugas migrating north are known to feed. Most hunting is concentrated south of the village in Kukpowruk and Naokok passes.

Bowhead. Point Lay recently received a bowhead whale quota and village whalers resumed spring and fall bowhead whaling, landing one whale in the spring of 2009, no whales during the spring 2010 hunt, and one whale in the spring 2011 hunt. No whales were landed during the fall hunts (AEWC, 2011, pers. comm.). Whaling records for the April and May 2010 hunt show activity concentrated within the lead system approximately 10 miles south and 10 miles north of Point Lay. Vessel tracks indicate that the whalers remained relatively close to Point Lay for the duration of the 2010 season, though the location of activities changes from year to year and may occur as far north as Utukok Pass (SBRA-ASR, 2011).

Seals. Bearded seal hunting records for April and June 2010 indicate that activities ocurred from a point near Omalik Lagoon in the south to Wainwright in the north, with the heaviest concentration of activity five to 10 miles offshore between Kukpowruk and Utukok Passes. Lack of sea ice has diminished the number of bearded seals that are available to Point Lay hunters (SRB&A-ASR, 2011).

Caribou. Coastal caribou hunting records for July, August, and September 2010 show activity along the coast between the southernmost point of Kasegaluk Lagoon and Utukok Pass, inside the lagoon or on the ocean side of the barrier islands (SRBA-ASR, 2011).

A summary of Point Lay's annual harvest of beluga whales, walrus, and polar bear from the 1980s-2007, as well as detailed information regarding other subsistence resources is available in Section 3.4.2.6.2, Figures 3.4.2-77 through 3.4.2-86 and Tables 3.4.2-10 , 3.4.2-11, and 3.4.2-6 of the Arctic Multiple-Sale Draft EIS (USDOI, MMS, 2008),Volume III, Section C.2.c(3)(d) of the Lease Sale 193 Final EIS (USDOI, MMS, 2007a), and Section III.C.2 of the Lease Sale 193 Final SEIS (USDOI, BOEMRE, 2011a) which are incorporated herein by reference.

Table 25. Summary of subsistence harvest management, locations, and seasons for the Iñupiat community of Point Lay.

Species	Management	Location	Season
Bowhead Whale	--NMFS (IHA) --Alaska Eskimo Whaling Commission	Leads offshore Point Lay. Point Lay took its first whales since 1941 on May 5, 2009 at a lead 10 mi northwest of the community. See SRB&A 2011 Map 18 and Shell 2011 Figure 3.11.7-8 for detailed depiction of bowhead whale subsistence use areas.	April to June: first whale taken since 1941 was a single bowhead in May 2009.

Species	Management	Location	Season
Beluga Whale	--NMFS (IHA) --Beluga Whale Committee	Hunt concentrated in Naokak and Kukpowruk Passes south of Point Lay where hunters use boats to herd the whales into the shallow waters of Kasegaluk Lagoon. If the July hunt is unsuccessful, hunters can travel as far north as Icy Cape, as far south as Cape Beaufort in search of whales and up to 20 mi offshore. See MMS 2008 Figure 3.4.2-77 and -78, SRB&A 2011 Map 11, Shell 2011 Figure 3.11.7-8 for detailed depiction of beluga whale subsistence use areas.	mid-June to mid-July
Pacific Walrus	--FWS (LOA) --Eskimo Walrus Commission	From Cape Beaufort to Icy Cape and up to 25 mi offshore. See MMS 2008 Figure 3.4.2-82, SRB&A 2011 Map 14 for Shell 2011 Figure 3.11.7-8 for detailed depiction of Pacific Walrus subsistence use areas.	June to August
Polar Bear	--FWS (LOA) --Nanuuq Commission	From Cape Beaufort to Icy Cape and up to 10 mi offshore. See MMS 2008 Figure 3.4.2-85 and SRB&A 2011 Map 12, for detailed depiction of polar bear subsistence use areas.	January to April
Bearded Seal (Ugruk)	--NMFS (IHA) --Ice Sea Commission	From Cape Beaufort to Icy Cape and up to 25 mi offshore. See MMS 2008 Figure 3.4.2-81 and SRB&A 2011 Map 13 for detailed depiction of bearded seal subsistence use areas.	June
Ringed Seals	--NMFS (IHA) --Ice Sea Commission	From Cape Beaufort to Icy Cape and up to 20 mi offshore. See MMS 2008 Figure 3.4.2-80 and SRB&A 2011 Map 13 for detailed depiction of ringed seal subsistence use areas.	March to May
Spotted Seal	--NMFS (IHA) --Ice Sea Commission	From 10 mi east of Cape Lisburne to Icy Cape and up to 25 mi offshore. See MMS 2008 Figure 3.4.2-83 and SRB&A 2011 Map 13 for detailed depiction of spotted seal subsistence use areas.	July to September
Ribbon Seal	--NMFS (IHA) --Ice Sea Commission	From Cape Beaufort to Icy Cape and up to 25 mi offshore.	March to May

Point Hope

Point Hope hunters harvest bowhead whales, beluga whales, seals, polar bear, and walrus. Table 26 summarizes harvest management, locations, and seasons for subsistence resources used by Point Hope. Updated information for certain groups is described below.

Bowhead. No other marine mammal is harvested with the intensity and concentration of effort that is focused on the bowhead whale. The traditional whaling season runs from mid-April to late May. Although fall whaling was planned for 2011 no bowhead whales were taken by Point Hope crews (AEWC, 2011, pers. comm.).

Caribou. Caribou is the primary source of meat for Point Hope residents. Caribou are available throughout the year, with peak harvest times occurring from February to March, and from late June through mid-November. Waterfowl and other migratory birds are another preferred subsistence food source, with most bird hunting occurring in the spring in nearshore coastal areas.

Detailed information regarding Point Hope subsistence resources (summarized in Table 26) are available in Volume III, Section C.2.c(3)(e) of the Lease Sale 193 Final EIS (USDOI, MMS, 2007a), Section 3.4.2.6.3 of the Arctic Multiple-Sale Draft EIS (USDOI, MMS, 2008), and Section III,C.2 of

the Lease Sale 193 Final SEIS (USDOI, BOEMRE, 2011a) which are incorporated herein by reference..

Table 26. Summary of subsistence harvest management, locations, and seasons for the Iñupiat community of Point Hope.

Species	Management	Location	Season
Bowhead Whale	--NMFS (IHA) --Alaska Eskimo Whaling Commission	Along the ice edge south and southeast of the point as far as Point Thompson. The pack-ice lead is rarely more than 6-7 mi offshore but hunting can range up to 15 mi offshore. See MMS 2008 Figure 3.4.2-96 and Shell 2011 Figure 3.11.7-10 for detailed depiction of bowhead whale subsistence use areas.	April to June: 95% of 39 whales landed from 1995 and 2008 were landed between April 16th and June 4th; 1 whale in 2009 (out of 1) 1 whale in 2010 (out of 2) 85% were landed between April 20th and May 25th, 0 out of 1 in 2009, 1 whale in 2010 (out of 2)
Beluga Whale	--NMFS (IHA) --Beluga Whale Committee	Same area used for the bowhead whale hunt In open water near the southern shore of Point Hope close to the beaches, as well as areas north of the point as far as Cape Dyer. See MMS 2008 Figure 3.4.2-99 and Shell 2011 Figure 3.11.7-10 for detailed depiction of beluga whale subsistence use areas.	March to June July to August
Pacific Walrus	--FWS (LOA) --Eskimo Walrus Commission	From Cape Thompson to Cape Lisburne and 15 mi east to Ayugatak Lagoon and up to 20 mi offshore See MMS 2008 Figure 3.4.2-98 and Shell 2011 Figure 3.11.7-9 for detailed depiction of Pacific Walrus subsistence use areas.	May to July
Polar Bear	--FWS (LOA) --Nanuuq Commission	Area south of the point and as far out as 10 mi from shore.	January to April October to January
Bearded Seal (Ugruk)	--NMFS (IHA) --Ice Sea Commission	From Cape Thompson to Cape Lisburne and 15 miles east to Ayugatak Lagoon and up to 20 mi offshore. See MMS 2008 Figure 3.4.2-97 and Shell 2011 Figure 3.11.7-10 for detailed depiction of bearded seal subsistence use areas.	January to June
Ringed Seals	--NMFS (IHA) --Ice Sea Commission	From Cape Thompson to Cape Lisburne and 15 mi east to Ayugatak Lagoon and up to 20 mi offshore. See MMS 2008 Figure 3.4.2-97 for detailed depiction of seal subsistence use areas.	January to June November to December
Spotted Seal	--NMFS (IHA) --Ice Sea Commission	From Cape Thompson to Cape Lisburne and 15 mi east to Ayugatak Lagoon and up to 20 mi offshore. See MMS 2008 Figure 3.4.2-97 for detailed depiction of seal subsistence use areas.	January to June November to December
Ribbon Seal	--NMFS (IHA) --Ice Sea Commission	From Cape Thompson to Cape Lisburne and 15 mi east to Ayugatak Lagoon and up to 20 mi offshore. See MMS 2008 Figure 3.4.2-97 for detailed depiction of seal subsistence use areas.	January to June November to December

3.2.10 Sociocultural Systems

Sociocultural systems encompass three concepts: (1) social organization, (2) cultural values, and (3) institutional organizations of communities. The term "social organization" refers to how people are divided into social groups and networks. The term "cultural values" refers to desirable values that are widely shared explicitly and implicitly by members of a social group. The term "institutional

organization" refers to the government and non-government entities that provide services to the community. These three concepts are interrelated. For most Alaska Natives, subsistence (and the relationship between people, land, water, and its resources) is the expression of cultural identity, and production of subsistence foods is the activity around which social organization and generational transmission of the culture occurs. Institutional organizations, in turn, reflect and affect the social organization and cultural values.

For the North Slope of Alaska, Iñupiat traditions and practices largely define social organization and cultural values, while the civil and tribal governments and Alaska Native Claims Settlement Act Native corporations largely define institutional organization. A detailed explanation of sociocultural factors appears in Section 3.4.3 of the Arctic Multiple-Sale Draft EIS (USDOI, MMS, 2008) and Section III.C.3 of the Sale 193 Final SEIS (USDOI, BOEMRE, 2011a). A summary of the major sociocultural trends occurring in North Slope communities is presented in cumulative effects analysis in
Section 4.7.

Subsistence activities are often central to many aspects of social organization and cultural values of the community, including patterns of family life, artistic expression, and community religious and celebratory activities. Although there have been substantial social, economic, and technological changes in Iñupiat lifestyle, subsistence continues to be the visible central organizing value of Iñupiat sociocultural systems and it is primarily through impacts to subsistence activities that impacts to sociocultural systems are assessed (USDOI, MMS, 2008, Section 3.4.3.1).

A recent study (SRB&A, 2009) of active harvesters, including harvesters from Wainwright, determined that the combination of offshore and cumulative onshore oil and gas development is perceived as constituting a new threat to subsistence on the North Slope, with impacts related to bowhead and caribou of greatest concern. Development is also seen as leading to social problems, including higher rates of substance abuse and suicide. The benefits brought by development are recognized, as well as the efforts underway to mitigate impacts. While there has been remarkable success in maintaining their subsistence lifestyle, since 2003 active harvesters have been experiencing the impacts of development at a higher rate, and well-being is declining.

A study of traditional knowledge of bowhead whales near Wainwright reports that whalers in that community are concerned about offshore oil and gas activities in the Chukchi Sea. For planned activities in the Chukchi Sea, the Wainwright whalers believe stringent conditions should be imposed to protect marine mammals and their food. The whalers believe that bowhead reaction to industry activity means whales would not travel southwest near the eastern coast of the Chukchi Sea where they might be accessible to whalers in the fall, but would stay offshore to the north as they migrate across to the Russian coast (Quakenbush and Huntington, 2010).

3.2.11 Economy

OCS oil and gas activities generate economic effects on the NSB, State of Alaska, and the Federal government in the form of direct and indirect employment, personal income associated with employment, and various types of revenues accruing to each level of government. The NSB receives revenues primarily from property taxes on high value onshore oil and gas infrastructure, as well the Federal government, State of Alaska, and local governments. The State of Alaska receives revenues from oil and gas activities in the form of property taxes, state corporate income tax, revenues associated with the Trans-Alaska Pipeline System (TAPS), and rentals and royalties from OCS leases as provided by Section 8(g) of OCSLA. Oil and gas activities generate revenues for the Federal government through royalties, bonus bids, and rental revenues.

The description and analysis of effects on the economy below focuses on the economy of the NSB, as the location, timing, and scale of the proposed exploration activities are not expected to generate economic effects at the State or Federal level.

Local Employment and Personal Income

Descriptions of the NSB economy in the Shell EIA (Shell, 2011a: Appendix F) are incorporated by reference, and salient points are summarized below. Additional information on the NSB economy is also provided below. The NSB is a mixed economy, characterized by a traditional cash economy and subsistence economy. The NSB economy is characterized by high unemployment and underemployment. Training programs and workforce development will continue to be important in the future to increase the low number of NSB residents that receive employment and personal income in the oil industry. More local hire is needed to increase employment and personal income benefits from oil and gas activities within the local communities.

Revenues

The NSB government receives a large share of its revenues from property taxes levied on high value onshore oil and gas infrastructure. As the depreciable value of that infrastructure has decreased, the revenues accruing to the NSB from oil and gas activities have also declined.

3.2.12 Public Health

The health and welfare of the residents of the NSB is a primary concern in any decision regarding proposed offshore oil and gas activity in the Chukchi Sea. Detailed discussion of public health within Chukchi Sea coastal communities is provided in the Shell EIA (Shell, 2011a: Appendix F), salient point of which are incorporated by reference and summarized below. The main public health issues in the NSB include:

- General health
- Psychosocial health
- Accidental injuries
- Nutrition
- Contaminant exposure to environmental pollutants
- Noncommunicable disease
- Cardiovascular and cerebrovascular disease
- Chronic lung disease
- Cancer
- Respiratory Infections
- HIV
- Maternal child health
- Sanitation
- Health services infrastructure
- Cultural stress mitigation

Indicators of general population health include life expectancy, mortality rates, infant mortality, and general health and well being surveys. North Slope communities have experienced a decline in epidemic infectious disease, with mortality rates declining and life expectancy increasing. Since the era of epidemic infectious diseases, the health status of North Slope communities is now characterized by increases in diabetes, cancer, and ongoing social and psychological stress and change.

3.2.13 Archaeological Resources.

Potential submerged archaeological resources in the project area range from historic to prehistoric. Historic resources include man-made objects or structures older than 50 years, such as shipwrecks, abandoned relics of historic importance, or submerged airplanes. The likelihood of historic resources occurring is determined by historical records and such areas are tentatively identified in the Alaska Shipwreck Database (cite). No such objects are listed for the area defined by activities described in the 2012 Shell Revised Chukchi Sea EP (USDOI, MMS, 2007a, Section III.C.4; USDOI, MMS, 2008, Section 3.4.4.2; USDOI, BOEMRE, 2011a: Section III.C.4; Shell, 2011a: Section 3.10).

Prehistoric submerged archaeological resources may occur in areas that were sub-aerially exposed during the low stand of sea level approximately 13,000 years before present (generally 60 meters below sea level on the Alaska OCS), an area which encompasses activities described in the 2012 Shell Revised Chukchi Sea EP. Relict terrestrial landforms such as preserved levees or terraces associated with paleo-river channels, river confluences, ponds, lakes, lagoons, or paleo-shorelines are areas where archaeological sites are most likely to occur. No prehistoric resources are expected in some areas of the shelf in water depths less than 60 meters, where: (1) there are no Quaternary sediments, and (2) where extensive ice gouging has reworked the Quaternary section (USDOI, MMS, 2007a, Section III.C.4; MMS, 2008: Section 3.4.4.2; USDOI, BOEMRE, 2011a: Section III.C.4; Shell, 2011: Section 3.10).

The coastline of the North Slope is an extensive area for the presence of archaeological resources. The National Register of Historic Places lists nine sites in the vicinity of Wainwright (http://www.cr.nps.gov/nr/index.htm). Other sites, which provide unique information about the region and its people, include buildings, shipwrecks, plane wrecks, and archaeological sites. These additional sites have been cataloged in the Alaska Heritage Resource Inventory maintained by the State of Alaska (http://dnr.alaska.gov/parks/oha/ahrs/ahrs.htm) and the Cultural Resource Site Inventory and Traditional Land Use Inventory maintained by the North Slope Borough. Several sites from these three inventories exist in the vicinity of Wainwright (North Slope Borough, Coastal Management Program, Map 2, Traditional Land Use and Archaeological Sites). The Borough's Iñupiat History, Language and Culture Division has instituted clearance procedures for protecting activities and values at historic, archaeological, and cultural sites, including TLUI sites, near development activities (http://www.north-slope.org/departments/planning/ihlc.php).

BOEM's review of the site-specific geophysical data indicates that there are no historic properties at the proposed drill sites.

3.2.14 Environmental Justice

Executive Order 12898 requires Federal Agencies to evaluate whether proposed projects would have "disproportionately high adverse human health (i.e., community health) and environmental effects…on minority populations and low income populations." Alaska Iñupiat Natives, a recognized minority, are the predominant residents of the North Slope and Northwest Arctic Borough, the area potentially affected by OCS oil and gas activities. The ethnic composition of Point Hope, Point Lay, Wainwright, and Barrow demonstrates that all four communities would be classed as minority communities on the basis of their proportional American Indian and Alaska Native residency.

SECTION 4. Environmental Consequences

The following subsections analyze potential direct, indirect, and cumulative effects on environmental resources as a result of Alternative 1 - No Action, Alterative 2 - Proposed Action, and Alternative 3- One Well per Season. Under each resource category, there is analysis of the potential direct and indirect effects associated with each alternative. Both action alternatives (Alternative 2 and 3) contemplate Shell's proposal to drill six exploration wells.

Alternative 3 would limit Shell to drilling one well to total depth per season, spreading proposed exploration activities across six or more drilling seasons. Under Alternative 2, Shell may drill these six wells in as few as two drilling seasons, but may extend operations into subsequent seasons. Consequently, effects on resources could fall somewhere between the opposite ends of the spectrum represented by as few as 2 seasons (Alternative 2) to at least 6 seasons (Alternative 3). This section discusses the potential effects of each alternative along this spectrum of possible adjustments to the scenario for each resource of concern.

Further variations may occur in terms of the length of a given drilling season. Shell proposes to drill up to October 31, but would not necessarily remain in the project area until that date each year. An early departure from the drilling area would also be more likely should the late-season drilling mitigation described in Section 2.3 be instituted. The effects analyses for each resource in Section 4 also account for potential variations in timing of activities within individual seasons.

Potential cumulative effects are then discussed under each resource category. Each cumulative effects subsection discusses past, present, and reasonably foreseeable future actions that could affect each resource, and analyzes the potential for each of the three alternatives to contribute (either incrementally or synergistically) to these impacts. Analysis of potential impacts from fuel and oil spills of various sizes is also included within each resource category. Assumptions informing this portion of the analysis are explained in Section 2.4.9 and Appendix A.

A level of effects determination (i.e. negligible, minor, moderate or major) is provided for each alternative. These determinations are based on the definitions provided in Appendix B.

4.1 Air Quality

The offshore oil exploration plan proposed for the Chukchi Sea would cause emissions of potentially harmful air pollutants that are regulated under the Clean Air Act (CAA, as amended, 42 USC §7401 et seq.). This section assesses the potential for adverse air quality effects due to the Proposed Action and the project alternatives, and evaluates the effects relative to CAA Section 165(a)(3) and Section 163(b)(2) and (4), for compliance with maximum allowable emission increases, and the National Ambient Air Quality Standards (NAAQS). The potential air quality impacts were assessed by evaluating the dispersion analysis based on an inventory of emissions projected to occur throughout an exploratory drilling plan of 120 days per year. The Proposed Action is located more than 25 miles from the three-geographical mile seaward boundary in the Chukchi Sea; therefore, the assessment was prepared pursuant to the federal OCS Air Regulations (40 CFR Part 55). Because of the location of the proposed drilling sites, the Proposed Action is not subject to Alaska air quality control rules and there is no designated Corresponding Onshore Area (COA) where State rules apply. The Nearest Onshore Area (NOA), the onshore area that is geographically closest to the drilling sites, is located 64 miles from the proposed drilling locations. Information reviewed and incorporated into this assessment includes the analytical review of projected emissions and pollutant concentrations as provided in the Shell EIA in Appendix F of the 2012 Shell Revised Chukchi Sea EP (Shell, 2011a). Additional information was available through the permit review documents prepared by the EPA, including the Statement of Basis (EPA, 2011a). Various sections in this environmental review provide information relative to the air regulations, meteorology, and climate of the Arctic; existing air quality

on the North Slope; and characteristics of the emission sources considered in the air quality assessment. A list of the relevant sections is provided in Appendix D, Air Quality.

4.1.1 Alternative 1 – No Action

Under this alternative, the exploration plan would not be approved and no new direct or indirect emissions would occur. As such, this alternative would have no impact on air quality.

4.1.2 Alternative 2 – Proposed Action

The air quality impact of the Proposed Action was assessed by preparing an inventory of emissions from direct and indirect sources. The inventory of marine vessel emissions considers the use of ultra-low sulfur diesel (ULSD) fuel and Best Available Control Technology (BACT) to reduce emissions to the lowest practicable levels. A summary of the annual emissions inventory is provided in Table 27. Nitrogen oxide (NO_x) emissions from the stationary OCS source are greater than 250 tons per year and the use of ULSD fuel and BACT is not sufficient to lower the value to below 250 tons per year. For this reason, the stationary OCS source is considered a major stationary source and Shell is required to submit an application for a Prevention of Significant Deterioration (PSD) pre-construction permit from EPA Region 10 in Seattle, Washington.

Table 27. Annual emissions summary.

Emission Source	Emissions[1] (tons per year)							
	NO_X	$PM_{2.5}$	PM_{10}	CO	SO_2	VOC	NH_3	CO_{2e}
Stationary OCS Source								
Discoverer Drillship	20.90	2.53	2.53	6.47	0.22	3.16	0.509[2]	12,805
Ice Management	37.20	6.15	6.35	29.15	0.27	6.83		16,676
Anchor Handlers	37.80	6.27	6.47	29.52	0.27	6.92		16,620
OSV Transit Mode	16.90	0.50	0.50	3.60	0.01	1.30		1,896
OSV Dynamic Positioning Mode	33.80	0.90	0.90	7.30	0.01	2.70		
OSR Vessels	98.10	1.04	1.44	27.61	0.27	9.74		5,561
OSR Work Boats	14.40	1.00	1.00	3.10	0.01	1.10		
Subtotal Stationary OCS Source	***259.10***	***18.39***	***19.19***	***106.75***	***1.06***	***31.75***	***0.509***	***53,558***
Major Source Threshold	250	250	250	250	250	250	250	None
Mobile Sources								
Auxiliary Marine Vessels	158.00	11.00	11.00	28.00	0.00	5.00	0.00	6,598
Aircraft	0.17	NA	NA	3.48	0.08	1.47		204
Surface Vehicles	0.003	0.00003	0.00006	0.033	0.00003	0.0016		NA
Subtotal Mobile Sources	***158.17***	***11.00***	***11.00***	***31.51***	***0.08***	***6.47***	***0.00***	***6,802***
Total Project Emissions	417.27	29.39	30.19	138.26	1.14	38.22	0.509	60,360

Note: CO_{2e} is the carbon dioxide equivalent, and represents greenhouse gas (GHG) emissions.
Annual refers to one total drilling season, approximately 120 days.
NA is not available.
Values of 0.00 are not zero, rather the values are less than 0.005 tons/year.

[1] Emissions are calculated with BACT.

[2] Emissions of NH3 were calculated from MLC and well-drilling, and from cementing/logging using the drillship *Discoverer*.

Source: Shell (2011a), Revised Outer Continental Shelf Lease Exploration Plan Chukchi Sea, Alaska. Table 7.a-3, Annual Potentials to Emit for Emission Units on the *Discoverer* and Associated Support Fleet. RFAI 2 and 4-*Discoverer*_EI_Chukchi_20110602_D.xls [BOEMRETables], [SCR-NH3 Emis], & [GHG Only]. Federal Aviation Administration (FAA). 2011. Emissions and Dispersion Modeling System (EDMS v. 5.1.3). Washington, D.C.:FAA Office of Environment and Energy.

The emission inventory reflects the worst-case scenario for annual emissions because in the analysis the drillship *Discoverer* is assumed to operate the entire 120-day drilling season, regardless of how many wells are actually drilled. For instance, drilling three wells would require approximately 102 days, not 120 days. As such, the inventory reflects the highest possible emissions for one drilling

season. The type and level of impacts to air quality are not expected to vary if Shell exits the drilling area sometime prior to late October. Impacts described under Alternative 2 are the worst-case possible impacts and would not be greater or more substantial in the event of a shorter drilling schedule.

The emission inventory for the OCS stationary source presented in Table 27 was translated into pollutant concentrations through computer dispersion modeling (ambient air analysis). A summary of the projected potential pollutant concentrations is provided in Table 28 and Table 29.

Table 28. Projected ambient air analysis of NO_2 and SO_2 emissions.

Projected Pollution Concentrations ($\mu g/m^3$)						
Pollutants and Averaging Periods	**NO_2**		**SO_2**			
	1-hr	**Annual**	**1-hr**	**3-hr**	**24-hr**	**Annual**
NAAQS	188	100	196	1,300	365	80
Max Allowable Increase (MAI)	--[1]	25	--[1]	512	91	20
Project-Only Impact (not including background concentrations)						
Point Lay	11.8	0.05	2.2	1.2	0.7	0.2
Percent of NAAQS	6.3%	0.1%	1.1%	0.1%	0.2%	0.3%
Percent of MAI	--[1]	0.2%	--[1]	0.2%	0.8%	1.0%
Exceeds 50%	No	No	No	No	No	No
Wainwright	4.9	0.03	2.2	1.2	0.7	0.2
Percent of NAAQS	2.6%	0.03%	1.1%	0.1%	0.2%	0.3%
Percent of MAI	--[1]	7.0%	--[1]	0.2%	0.8%	1.0%
Exceeds 50%	No	No	No	No	No	No
Total Impact (design concentrations added to background concentrations for total impact)						
Point Lay	11.8	0.05	2.2	1.2	0.7	0.2
Background Concentrations	41.0	2.0	14.0	14.0	14.0	0.4
Sum of Total Impact	*52.80*	*2.05*	*16.20*	*15.20*	*14.70*	*0.60*
Exceeds NAAQS	No	No	No	No	No	No
Wainwright	4.9	0.03	2.2	1.2	0.7	0.2
Background Concentrations	38.0	2.0	12.0	14.0	5.0	0.4
Sum of Total Impact	*42.9*	*2.03*	*14.2*	*15.2*	*5.7*	*0.6*
Exceeds NAAQS	No	No	No	No	No	No
Air Impact Boundary[2]	160.8	3.3	17.3	13.6	8.1	1.4
Background Concentrations	13.2	2.0	23.0	14.0	5.0	0.4
Sum of Total Impact	*174.0*	*5.3*	*40.3*	*27.6*	*13.1*	*1.8*
Exceeds NAAQS	No	No	No	No	No	No

[1] Maximum allowable increases (MAI) are not established for these pollutants or averaging periods.
[2] Air Impact Boundary is defined as 500 meters from the hull of the drillship *Discoverer*.

Sources: 40 CFR Part 52.21(c). Ambient Air Increments, Maximum Allowable Increases for a Class II Area.
CAA Section 163(b)(2). Class II Area Maximum Allowable Increases.
71 FR 61144 10/17/2006. National Ambient Air Quality Standards for Particulate Matter, Final Rule. (revokes PM10 annual standard)
EPA. July 6, 2011. Supplemental Statement of Basis for Proposed Outer Continental Shelf Prevention of Significant Deterioration Permits Nobel *Discoverer* Drillship. Table 6, 1-Hour NO_2 Modeled Impacts at Various Locations, Table 7, 1-Hour SO_2 Modeled Impacts at Various Locations, and Table 9, Maximum Modeled Impacts in the Chukchi Sea.
Shell. AERMOD Air Quality Impact Analysis of NO_2, SO_2, $PM_{2.5}$, PM_{10}, CO, and NH_3 - *Discoverer* Drillship. Table 6 Summary of Maximum Impacts at the Nearest Villages on the Chukchi Coast - Chukchi Sea. Prepared by Air Sciences.

Table 29. Projected ambient air analysis of PM_{10}, $PM_{2.5}$, and CO emissions.

Projected Pollution Concentrations ($\mu g/m^3$)					
Pollutants and Averaging Periods	**$PM_{2.5}$**		**PM_{10}[1]**	**CO**	
	24-hr	**Annual**	**24-hr**	**1-hr**	**8-hr**
NAAQS	35	15	150	40,000	10,000
Max Allowable Increase (MAI)	9[2]	4[2]	30	--[3]	--[3]
Project-Only Impact (not including background concentrations)					
Point Lay	0.2	0.003	0.2	298	132
Percent of NAAQS	0.6%	0.02%	0.13%	0.%	1.3%
Percent of MAI	2.22%	0.075%	0.67%	--[2]	--[2]
Exceeds 50%	No	No	No	No	No
Wainwright	0.3	0.003	0.2	298	132
Percent of NAAQS	0.9%	0.02%	0.1%	0.8%	1.3%
Percent of MAI	3.3%	0.08%	0.7%	--[2]	--[2]
Exceeds 50%	No	No	No	No	No
Total Impact (design concentrations that includes background concentrations)					
Point Lay	0.2	0.003	0.2	298	132
Background Concentrations	7.0	2.0	65.0	1029	1029
Sum of Total Impact	*7.20*	*2.00*	*65.20*	*1,327*	*1,161*
Exceeds NAAQS	No	No	No	No	No
Wainwright	0.3	0.003	0.2	298	132
Background Concentrations	13.0	2.0	114.0	959.0	945.0
Sum of Total Impact	*13.3*	*2.003*	*114*	*1257*	*1077*
Exceeds NAAQS	No	No	No	No	No
Air Impact Boundary [3]	12.4	0.4	11.5	562	329
Background Concentrations	11.0	2.0	79.0	959	945
Sum of Total Impact	*23.4*	*2.4*	*90.5*	*1,521*	*1,274*
Exceeds NAAQS	No	No	No	No	No

[1] The NAAQS for annual PM10 averaging period standard has been revoked; the averaging period was not analyzed.
[2] Maximum allowable increases (MAI) are established only for federal rules for these pollutants; not established for Alaska.
[3] Maximum allowable increases are not established for these pollutants or averaging periods under federal rules or for Alaska.
[4] Air Impact Boundary is defined as 500 meters from the hull of the drillship *Discoverer*.

Sources: 40 CFR Part 52.21(c). Ambient Air Increments for a Class II Area
CAA Section 163(b)(2). Class II Area Maximum Allowable Increase.
71 FR 61144 10/17/2006. National Ambient Air Quality Standards for Particulate Matter, Final Rule. (revokes PM10 annual standard)
EPA. July 6, 2011. Supplemental Statement of Basis for Proposed Outer Continental Shelf Prevention of Significant Deterioration Permits Nobel *Discoverer* Drillship. Table 6, 1-Hour NO2 Modeled Impacts at Various Locations, Table 7, 1-Hour SO2 Modeled Impacts at Various Locations, and Table 9, Maximum Modeled Impacts in the Chukchi Sea.
Shell. AERMOD Air Quality Impact Analysis of NO2, SO2, PM2.5, PM10, CO, and NH3 - *Discoverer* Drillship. Table 6 Summary of Maximum Impacts at the Nearest Villages on the Chukchi Coast - Chukchi Sea. Prepared by Air Sciences.

The data in Table 28 reflects the results of the ambient air analysis for the pollutants NO_2 and SO_2; whereas Table 29 provides results for the remaining pollutants $PM_{2.5}$, PM_{10}, and CO. Pollutant concentrations were modeled at three locations - along the air impact boundary (defined as 500 meters beyond the hull of the drillship *Discoverer*), at the nearest onshore location at Wainwright, and at the next nearest community at Point Lay. The modeling results at these locations are presented in the tables using two methods (1) concentrations resulting only from the project-related emissions (project-only impact), and (2) the design concentrations, which are the project-only impacts added to existing background concentrations (total impact). The tables show the comparison of the results to the maximum allowable increases and the NAAQS, indicating whether the project-only impacts

exceed 50 percent of either threshold. The tables also compare the design concentrations to the NAAQS, indicating whether the standards are exceeded (excluding ozone). These comparisons are the basis of the BOEM determination of the significant level of effect for air quality.

During actual drilling, the drillship *Discoverer* and support vessels operating within 25 miles of the drillship are collectively defined as a stationary OCS source. All other marine vessels operating in support of the exploration plan are considered mobile sources. The assessment of emissions from the stationary OCS source is based on the air quality technical analysis provided in the 2012 Shell Revised Chukchi Sea EP (Shell, 2011a), which includes an EIA in Appendix F. The air quality assessment in the Shell EIA focuses on the analysis supporting the application for the PSD air quality operating permit. The Revised EP and the permit application, together with all subsequent supporting documentation, include all drillship emission information and emission reduction measures required for a NEPA analysis of the stationary source (30 CFR Part 550.224 and Part 550.225). These documents also contained the required dispersion analysis necessary to determine air quality impacts at communities on the North Slope.

In the assessment of air quality impacts associated with the Proposed Action, the stationary OCS source inventory included emissions of greenhouse gases (GHG) and carbon dioxide equivalent emissions (CO_2e). In a June 2010 ruling by the EPA, referred to as the Tailoring Rule, the agency established a schedule for the applicability criteria that determine which new stationary sources are required to report GHG emissions from federal actions (75 FR 31514, June 3, 2010). The Tailoring Rule states that as of July 1, 2011, a new stationary source is not subject to GHG regulations unless the federal action emits or has the potential to emit 100,000 tons per year or more of CO_2e. The inventory shows potential emissions of CO_2e from both direct and indirect sources would be less than 61,000 tons per year. As such, the requirement for further analysis of GHG emissions would not apply to the Proposed Action.

Other emission sources would include auxiliary marine vessels, aircraft, and surface vehicles not directly involved in drilling activities and not part of the stationary OCS source during actual drilling. Rather, the sources are used to support the operation of the exploration plan, and include shallow water landing craft, barges, and tugs; and include helicopters and surface vehicles for the transportation of personnel. Helicopters were assumed to operate from the airport in Barrow, Alaska, where personnel are housed.

Black Carbon

Black carbon, commonly referred to as soot, is a pollutant with high radiative forcing that supports warming trends in the Arctic. Radiative forcing is the result of the difference between the expected amount of incoming and outgoing solar energy, where radiative forcing is measured in watts per square meter. The analysis required to find the actual value of this ratio is complicated, and involves not only black carbon but other factors such as natural deforestation and volcanic activity (Chandler, 2010). Soot emissions from diesel engines have a tendency to decrease the albedo, or reflectivity, of sea ice. The decrease in albedo contributes to warming and loss of sea ice. The drillship and other marine vessels proposed for the exploration plan use diesel engines for propulsion and drilling and would be the largest source of black carbon attributable to the exploration plan. However, the loss of sea ice is not affected solely by black carbon deposits, but depends on snow cover, ice age, ice thickness, and state of melting as well (Dorn, Dethloff, and Rinke, 2009). Also, the magnitude of Arctic snow albedo effects is seasonal, and the effect is not measurable in the dark Arctic winter (Kopp and Mauzerall, 2010). A mitigation strategy to decrease the emissions of particulate matter, the main source of black carbon from a diesel engine, is the use of ULSD fuel. Sulfur is emitted directly as a component of burning crude oil and is found in both gasoline and diesel. Using ULSD fuel controls emissions of NO_X and PM, which lowers the emissions of black carbon. Particulate filters on engines using ULSD fuel reduce PM emissions by 50 percent to near 100 percent. The State of

Alaska finalized a rule making the use of ULSD fuel mandatory in all highway, non-road, locomotive, and marine diesel engines (71 FR 32450, June 6, 2006). The drillship would be equipped with other emission reduction equipment, as required in the air quality permit for the drillship *Discoverer*. Thus, emissions of black carbon would be reduced to the greatest extent possible.

Small Fuel Spill

An oil spill, even a small spill of less than 1,000 barrels (bbl), would cause an increase in the concentrations of gaseous hydrocarbons (VOC) which could affect onshore air quality. Although effects would be localized and temporary, concentrations of criteria pollutants may exceed the federal and Alaska ambient air quality standards during the initial phases, particularly offshore in the vicinity of the event. However, major impacts at the spill-site may cause only minor impacts onshore, depending on how far from shore the spill occurs; impacts onshore would go down with increasing distance from the coastline. As surface oil evaporates or is removed, as any fires are extinguished, and as the use of additional clean-up equipment lessens, impacts would eventually decrease to a minor level. Accordingly, while initial impacts are estimated to be major at the spill site, the emissions from the oil spill at most onshore locations would be minor to moderate.

Emissions from the occurrence and clean-up of a large oil spill would consist primarily of VOCs created from oil on the surface of the water. However, in the event of an initial explosion of gas and oil, the result would be a large black plume of smoke causing short-term emissions of PM and the other products of combustion, such as NO_X, SO_X, CO, VOC, and CO_2. The fire could also produce polycyclic aromatic hydrocarbons (PAHs), which are known to be hazardous to human health. The severity of impacts would decrease following the initial event and emissions would be limited to mostly VOCs from the surface oil and emissions associated with engines from vessels and other equipment used for the clean-up process. By the time the oil reaches the shoreline, emissions from the surface oil would decrease due to weathering and decreased thickness of the oil layer. During the clean-up process, the impact to onshore air quality may increase slightly due to the combination of in situ burning, use of dispersants, and the use of vessels, surface vehicles, and aircraft to support the clean up. Eventually, the continuing decrease in surface oil, lessening use of clean-up equipment, and the effect of Arctic winds would be expected to decrease any onshore air quality impacts to minor levels of effect.

Large and Very Large Oil Spills

The potential effects of a large oil spill (≥ 1,000 bbl) in the Chukchi Sea were analyzed in the Sale 193 Final EIS (MMS, 2007), which found moderate to major effects on air quality during the initial event and during the response and cleanup process. Effects of evaporative hydrocarbon emissions would diminish with time because most of the surface oil would evaporate with time before reaching the shoreline. The potential effects of a very large oil spill (≥ 150,000 bbl) in the Chukchi Sea were analyzed in the Sale 193 Final SEIS (BOEMRE, 2011), which again found moderate to major effects on air quality during the initial event and during the response and cleanup process. As above, effects would diminish with time because most of the surface oil would evaporate before reaching the shoreline (where effects would be minor).

Level of Effect

Upon reviewing the relevant documents, and after evaluating the results of the emission inventory and ambient air analysis presented Table 28 and Table 29, BOEM expects much the same level of effect from the Proposed Action as characterized in the 2012 Shell Revised Chukchi Sea EP (Shell, 2011a). BOEM considers the Proposed Action to be compliant with the federal air quality standards and without potential to cause or contribute to any violation of the NAAQS, which define healthful outside air quality. Emission sources onshore would produce emissions far below the negligible level of 100 tons per year defined by BOEM. Accordingly, the Proposed Action is found to be compliant

with the relevant provisions of the CAA and the federal OCS Air Regulations (40 CFR Part 55). As such, the level of effect on air quality caused by the Proposed Action is considered minor for the exploration plan using the drillship *Discoverer*. A thorough description of the levels of effect relevant to air quality impacts are provided in Appendix D - Air Quality. The effects would occur each season that Shell conducts exploratory drilling operations under this exploration plan. The minor effects, however, are temporally limited and consecutive years of activity would not have any greater effect than described under this project alternative.

4.1.3 Alternative 3 – One Well per Season

The analysis of Alternative 2, the Proposed Action, reflected the maximum possible emissions from an exploration plan with actual drilling occurring for the maximum period of 120 days. Under this alternative only one well would be drilled per summer season, which would require drilling for fewer days than evaluated under Alternative 2 – Proposed Action. Therefore, impacts to air quality under Alternative 3 would not be greater, and would likely be much less, than the impacts described under Alternative 2. Overall, the level of effect on air quality that could occur under Alternative 3 is considered negligible to minor for the exploration plan using the drillship *Discoverer*. The annual effects of each season, while Shell conducts exploratory drilling operations under this Revised EP, will not be greater than the effects described under Alternative 2 – Proposed Action, and would be temporally limited. The type and level of impacts to air quality are not expected to vary if Shell exits the drilling area sometime prior to late October. Impacts described under Alternative 2 are the worst-case possible impacts and would not be any greater or more substantial in the event of a shorter drilling season. Under Alternative 3, the potential for a large or very large petroleum spill would be spread across additional seasons, but the potential environmental effects would be the same as was analyzed under Alternative 2.

4.1.4 Cumulative Effects

The Proposed Action includes the temporary use of marine vessels, aircraft, and surface vehicles, which are pollutant sources that could contribute to the emission budget within the North Slope Borough. Pollution from Alternative 2 or 3 could add to pollution from other activities in the region to have an adverse cumulative effect on air quality. Specifically, any additional activities occurring during the same time period and in the same general area requiring the use of large marine vessels may cause emissions to build up in the atmosphere to levels harmful to human health or wildlife, particularly when combined with existing emissions in the area. However, in consideration of the prevailing wind conditions over the open sea, the few emission sources onshore, and the distance of the proposed drilling sites from the shoreline, emissions from the Proposed Action—when combined with other operations in the Chukchi Sea—would likely be diluted and dispersed resulting in pollutant concentrations far below the air quality standards at the shoreline. The reasonably foreseeable cumulative effects would occur at nearly the same level each season that Shell conducts exploratory drilling operations under this exploration plan. For the life of the project, impacts to air quality from the Proposed Action and from reasonably foreseeable cumulative activities would amount to a minor level of effect. A thorough description of the relevant additional activities that are recent, ongoing, or reasonably foreseeable, and that could result in measurable adverse cumulative air quality impacts, is provided in Appendix C. The level of air quality effect when considered together with the emissions from the Proposed Action would be minor and would not result in adverse cumulative impacts to air quality.

4.2 Water Quality

4.2.1 Alternative 1 – No Action

Under this alternative, the proposed exploration drilling would not be approved, and no impacts to water quality would result.

4.2.2 Alternative 2 – Proposed Action

The proposed exploration activities would entail several types of discharges authorized by National Pollutant Discharge Elimination System (NPDES) General Permit AK280000 (Offshore Oil and Gas Exploration Facilities in Alaska), including drilling wastes (cuttings and water-based drilling fluids), excess cement, oil-free deck drainage, treated sanitary waste, blow-out preventer fluids, domestic waste, desalination waters, non-contact cooling water, bilge water, and ballast water. Non-hazardous solid waste, hazardous waste and used oil would be stored and taken to an approved onshore waste facility. Support vessels would discharge domestic wastewater and treated sanitary waste into the sea according to applicable NPDES Vessel General Permit regulations.

The type and degree of effects on water quality from discharges into the marine environment are influenced by several physical factors including: rate of discharge, depth of discharge, concentration of contaminants, currents, bathymetry, density layers, oxygen concentration and water temperature. These factors are considered by EPA under its NPDES permitting process. The paragraphs below describe the types of discharges and potential effects on water quality associated with the Proposed Action.

Drill Cuttings: An estimated 5,800 barrels of drill cuttings would be generated from each exploration well for a maximum of 17,400 barrels of drill cuttings discharged in a given season (an estimated total of 34,800 barrels of cuttings over the entire proposed program) and up to 35,800 barrels of drill cuttings overall. Discharged cuttings (occurring over 30-45 days for each well) would settle out of the water column, the rate of deposit depending on sediment mineralogy and grain size. It is estimated, based on volume excavated, that cuttings would settle out on the seafloor within approximately 276 horizontal feet down-current from the drill site. Near the drill site, the thickness of the deposition is estimated to be up to approximately 6 ft deep; the depth of the deposition decreases to 0.4 in at a distance of 276 horizontal feet from the drill site.

Discharge of drill cuttings would increase suspended sediment and turbidity in the water column in the vicinity of the drill sites, causing decreased light transmitivity and visibility. The newly deposited cuttings on the seafloor could resuspend into the water column as a result of currents and severe storm events. Hydrocarbon concentrations, including polycyclic aromatic hydrocarbons (PAH) and some metals could become elevated in the lower water column and seafloor sediments at the drill site from discharge of drill cuttings.

Drilling Fluid: An estimated 3,200 barrels of drilling fluids would be discharged to the sea from each exploration well. Under this alternative, that would be up to approximately 9,600 barrels in a given drilling season. Fluids would cause increased suspended material and would settle on the seafloor (estimates of seafloor coverage are included in the cuttings estimations above). Barium from discharge of drilling fluids would cause elevated concentrations in the lower water column and in seafloor sediments. These concentrations may persist for years in the sediments.

Mudline Cellars: Seafloor material would be excavated to construct up to four mud cellars in a season. Each well would disturb 1,018 ft^2 of seafloor for 3,053 ft^2 in each of two drilling seasons (6,107 ft^2 over the entire drilling program). Each mud cellar would excavate 619 yd^3 of seafloor for a maximum of 2,476 ft^3 per drilling season and 3,714 yd^3 total for the entire drilling program. Cuttings from the mud cellar excavations would be deposited on the seafloor below the temperature and salinity stratification layer. It is estimated that the maximum thickness of the sediment deposition

onto the seafloor would be 10.4 ft; the deposition would continue out to a horizontal distance of 449 ft from the excavation sites where it would be 0.4 in thick.

The excavation of four mud cellars in a season would increase sediment, suspended solids, and turbidity in the lower water column above background levels, dependent upon the mineralogy and grain size of the sediments excavated. Currents and severe storm events could resuspend and transport these newly deposited seafloor sediments.

Anchoring: Anchoring the drillship would disturb the seafloor area where each of the eight anchors is set. If re-positioning occurs, the estimated total number of anchors set per drill ship could be 16 per season or 64 over the entire program. Each anchor and chain would disturb 2027 ft^2; under this scenario, 34,432 ft^2 would be disturbed for each well for a total disturbance of up to 97,297 ft^2 of seafloor per year. The process of anchoring would introduce suspended sediment and turbidity into the lower water column. Sediment would then be deposited on to the seafloor down-current from the anchoring.

Wastewater Discharge: Non-contact cooling water would be discharged from the drillship at a rate of approximately 45,000 bbl of per day. The cooling water would be discharged above the salinity and temperature stratification layer and would mix in the surface waters. It is estimated that the discharge would be to be 1.4 C above ambient sea temperature, and the effects would be reduced by 99% within 164 horizontal feet.

Desalination brine would be discharged above the salinity-temperature stratification layer with slightly higher salinity and other dissolved constituents than the ambient receiving water. Salinity would briefly increase in the area near the discharge before it mixed with surface water.

Domestic wastewater and treated sanitary waste will be discharged from the drillship and support vessels. Organic materials in the wastes could cause temporary biological oxygen demand and increased suspended solids in the immediate area of the discharge. Residual chlorine would also be part of the waste discharge, which would mix and transport from the immediate area.

Small Spill: There is a potential for a small fuel spill (estimated at 48 bbl of diesel fuel) during fuel transfers between vessels. A fuel spill would introduce hydrocarbons and temporary toxicity to the surface water. The effects of a fuel spill would be limited by required deployment of booming equipment during fuel transfers and automatic shutdown of fuel lines triggered by decreased pressure. The effects would be localized and short-term.

Large and Very Large Oil Spill. Although very unlikely, it is possible that the Proposed Action could lead to a large or very large oil spill. For the purpose of analysis, BOEM estimates potential discharge volumes for this EA to be 1,555 bbl of diesel for a large spill and 750,000 bbl of crude oil for a very large spill. The Sale 193 Final EIS analyzed potential effects to water quality from large spills (≥ 1,000 bbl) and found that sustained degradation of water quality levels from hydrocarbon contamination would be unlikely. The Sale 193 Final SEIS analyzed potential effects to water quality from a very large spill (≥150,000 bbl) and found that a spill of this magnitude would lead to sustained degradation of water quality, violations of State and Federal criteria, and significant effects. These analyses remain sufficient to analyze the effects of large and very large spills in the Chukchi Sea, including potential spills of 1,555 bbl diesel and the 750,000 bbl crude oil estimated in this Environmental Assessment (EA).

Mitigation

The following aspects of the Proposed Action would mitigate potential water quality effects:

- Operations conducted under NPDES permit as authorized and administered by EPA
- Booming fuel transfer activities

- Equipment for early warning of a potential well-control event
- Oil spill response vessels in the immediate vicinity of the drilling operations
- Adherence to the following plans: Critical Operations and Curtailment Plan; Ice Management Plan; Well Control Contingency Plan; and Fuel Transfer Plan

Summary of Effects – Alternative 2

The volume of sediment, cuttings, and wastewater released to the water column in the region of Burger Prospect would cause higher levels of suspended solids, turbidity, hydrocarbon, metals, salinities and temperatures in the water column in the areas of the discharges. This would occur for two or more open water seasons. The EPA has determined that the discharges described under the NPDES permit for this proposed offshore oil and gas operation would not result in unreasonable or substantial water quality degradation in the Chukchi Sea. Discharge of drill cuttings, drilling fluids, mudline celler sediments and wastewater would be highly localized around the drill site. Some low-level metal and hydrocarbon signatures may be long lasting in the sediments at the drill sites as a result of the deposition of the cuttings and drilling fluids. The Proposed Action is not expected to cause unreasonable degradation of the marine environment. The level of effects for Alternative 2 would be minor according to the definitions established for this environmental assessment.

4.2.3 Alternative 3 – One Well per Season

Under Alternative 3, BOEM would authorize Shell to drill one well to depth per season. Drilling cuttings, water-based drilling fluids, excess cement, oil-free deck drainage, treated sanitary waste, blow-out preventer fluids, domestic waste, desalination waters, non-contact cooling water, bilge water, and ballast water would be discharged in accordance with the applicable NPDES permit. The quantity of materials discharged per well would be the same as the "per well" quantities described above for Alternative 2. Points of discharge, applicable permitting requirements, and mitigation measures are the same as for Alternative 2.

The key difference between these alternatives is that under Alternative 3, discharges from six wells would be spread out over six drilling seasons.

Summary of Effects: Alternative 3

This alternative would cause elevated levels of suspended solids, turbidity, hydrocarbon, metals, and localized salinities and temperatures in the water column at an individual, localized site each year for six years. Compared with Alternative 2, the effects of the drilling activities and discharges in Alternative 3 would affect a smaller spatial area at a less intense level, but over a longer time frame (six seasons). The total volume of sediment, cuttings, and drilling fluids released to the water column in the region of the Burger Prospect would be the same between the two alternatives.

The EPA determined that the discharges described under the NPDES permit for this oil and gas operation would not result in unreasonable or substantial water quality degradation in the Chukchi Sea. The effects of Alternative 3 (1 well for each of six seasons) would not cause unreasonable degradation of the marine environment. Therefore, the effects of Alternative 3 would be minor according to the Level of Effects established for this environmental assessment. These effects are not expected to vary if Shell leaves the drilling area each year sometime prior to late October.

Under Alternative 3, the potential for a large or very large petroleum spill could be spread across additional seasons, but the potential environmental effects on water quality would be the same as was analyzed under Alternative 2.

4.2.4 Cumulative Effects

Cumulative effects are discussed in detail in the Lease Sale 193 Final SEIS (USDOI, BOEMRE, 2011a: pp. 297-313) and in Appendix C of the current document. The number of marine cargo,

tourism and research vessels and barges in the Chukchi region is increasing as ice cover is reduced. This increases the risk of vessel accidents, vessel groundings, potential oil and cargo spills, permitted discharges, and introduction of marine invasive species.

These reasonably foreseeable activities would occur against the backdrop of climate change, which is anticipated to affect water quality in the future through warming of the sea surface, reduction in sea ice, and increased ocean acidity.

The incremental effects of the proposed exploratory drilling under Alternatives 2 and 3 would add a minor effect (through additional discharges to the sea) to the other ongoing activities. The discharges from this proposed project would be additive to the existing and future activities described here.

4.3 Lower Trophic Levels

4.3.1 Alternative 1 – No Action

Under the no action alternative, the proposed exploration activities would not be approved, and no effects to lower trophic resources would occur.

4.3.2 Alternative 2 – Proposed Action

Alternative 2 is the Proposed Action, wherein Shell intends to drill six exploratory wells on six separate sites within the Burger Prospect in the northeast Chukchi Sea. Up to three wells could be drilled to total depth (and an additional MLC constructed) in a given season, if conditions allow. But Shell's plan is flexible, and allows for the possibility of leaving the drilling area earlier than the proposed October 31st exit date.

Direct and indirect effects on the lower trophic resources could result from the following:

- Sediments displaced during anchoring of all vessels including drilling rigs.
- Construction of the MLCs and subsequent release of materials during drilling phases.
- Potential construction of accessory MLCs and partial wells beyond the six wells outlined in the proposed plan.
- The permitted discharges through the EPA NPDES permit.
- Potential of invasive species introduction.
- Potential liquid hydrocarbon spills during vessel refueling.

The effects on lower trophic populations would include the deposition of mercury, barium, and hydrogen sulfide on surface sediments due to sediment disruption, suspension, and deposition, and the perturbation of benthic environments due to ice gouging or advection of sediments from the Alaskan, Anadyr, Bering Sea, or Siberian Coastal currents. There are no known sensitive or unique biological communities within the leases of the proposed exploration drill sites that would be affected by these activities.

Anchoring. The *Discoverer* and its anchor handling vessel would deploy and retrieve eight anchors at each drill site during the proposed exploration period. There is also the potential that the drill ship could need to reposition the drill rig and re-anchor during drilling activities at any one exploration site. The total sediment displaced by the eight anchors used to moor the *Discoverer* during drilling operations, including anchor and chain scar volume during one deployment and retrieval event, is estimated at 3,122 yd^3 (2,387 m^3). Assuming eight deployments and retrievals of anchors--to account for two supplemental events where an MLC is constructed, or an adjustment of the drilling rig over one MLC that demands the anchors be repositioned at the site—the total sediment displaced, suspended, and deposited would be 24,979 yd^3 (19,908 m^3). A detailed discussion of anchor

deployment, retrieval, and resulting discharges can be found in Section 2.3 of the Shell EIA (Shell, 2011a: Appendix F).

The process of anchoring vessels during drilling activities results in disturbed and suspended sediment within the pelagic water column. This sediment drifts with the current and is deposited over benthic environments, thus burying the underlying benthic communities. Recolonization of benthic communities would occur within one year, but growth of benthic organisms such as mollusks or polychaete to size ranges that would be utilized by benthic foragers such as walrus would take several years. However, the limited spatial coverage of these events, proposed to be no more than several hundred yards of coverage per well site, would result in a negligible level of effect.

Drilling. An MLC would be constructed at each drill site as preparation for the drilling operations. The MLC is a circular hole drilled into the hard mud under the surface of the benthic environment at the seafloor. For the *Discoverer*, the diameter will be at least 20 ft (6.1 m), with a depth of approximately 40 ft (12.2 m) below mudline. Estimated volume of displaced or disturbed sediment per MLC is approximately 2,976 bbl (619 yd^3, or 473 m^3). The effects of suspension of discharges and sediments from drilling operations would include a localized loss of some pelagic organisms. This would be the result of their inability to carry out metabolic functions caused by the temporary effects of sediment suspension in the water column. Loss of these organisms would be localized and they would likely be rapidly by the advection of water, which would carry organisms from downstream locations. Sediment displaced during creation of the MLC would result in a localized loss of pelagic organisms due to sediment suspension, and burial as a result of deposition of sediments. These would create a localized and temporary (approximately one year for the recolonization of affected areas) loss of benthic organisms pelagic and benthic communities directly affected by the suspension and deposition of the displaced sediments.

Discharges. Permitted NPDES discharges will include desalination brine waters, cooling waters, domestic wastewaters, spent drilling fluids, treated deck drainage, excess cement and blow-out preventer fluid. These will cause local and temporary effects to surface and pelagic environments and will be negligible.

Invasive Species. Several factors may potentially introduce invasive species during the Proposed Action. These include the use of equipment imported from other regions that may contain internal or surface viable life stages of invertebrate organisms, the presence of fouling organisms on hulls or propellers, and the release of ballast waters not properly discharged in transit. In conducting its proposed exploration activities, Shell would be responsible for preventing the introduction of invasive species through compliance with the National Invasive Species Act and policies of the USCG (refer to Appendix F). Therefore, the anticipated level of effect associated with the potential introduction of invasive species is negligible.

Small Fuel Spill. The effects of a small oil spill (<1,000 bbl)—estimated for this EA as a potential 48 bbl diesel spill—would be dependent upon sea conditions at the time of the spill. With high wind conditions and rough seas, the diesel would be rapidly diluted and dispersed and effects of the spill would be negligible. In calmer waters evaporation of the diesel would be rapid, and the area covered by dispersion of the remaining hydrocarbons would be dependent upon wind speed, wind direction, and water temperature. Loss of benthic organisms due to hydrocarbon poisoning would probably not occur due to dispersion of hydrocarbons before reaching benthic surface. Effects on pelagic organisms would be localized, and the levels of effect would be negligible.

Summary of Anticipated Impacts. In summary, all the above direct and indirect effects from Alternative 2-Proposed Action on pelagic, benthic, and epontic lower trophic organisms would be limited by the number of wells actually constructed per open water season. Drilling all six wells within two seasons would create displacement, suspension, and deposition of sediments at a higher annual level than any other alternative discussed. It would also increase the accumulations from

release of discharges during drilling operations, and from drill and support ship discharges of NPDES permitted fluids, as described in Section 2 of the Shell EIA. The total effects of these activities would be minor. This determination is due to the potential of loss of benthic resources being compounded by the time required for resettlement and growth. These benthic lower trophic resources are important to trophic relationships in the region due to their capacity as bioturbators that increase the potential for regional productivity, and their potential as food resources for pelagic birds and marine mammals in the region. If the six-well drilling program extends beyond two seasons, the potential for effects on benthic invertebrate populations would decrease. The result would be negligible effects on the lower trophic resources. This would also result in reducing effects on productivity and, in turn, reduce indirect effects on upper level trophic resources such as pelagic bird and marine mammal populations.

Large Oil Spill. Effects of a large oil spill (≥ 1,000 bbl) on phytoplankton vary widely and are dependent on the concentration, type of oil or compounds used in the experiments, and the species being tested (Gonzalez, et al., 2009). Phytoplankton populations would be most affected during periods of spring and summer blooms that occur in early July through late August. Both laboratory and field studies have shown that hydrocarbons typically inhibit phytoplankton growth at higher concentrations (USDOI, MMS, 2007a). In cases where studies have been conducted following larger spills there was found to be little or no effects on phytoplankton populations (Diez, et al., 2009). This is thought to be due to the relatively rapid turnaround rate of phytoplankton generations (9-12 hours) and the influx of phytoplankton by advection from unaffected areas that replace population to pre-spill levels (National Research Council, 1985). Therefore, it is likely that the effects of a large oil spill on phytoplankton populations would be negligible.

The effects of petroleum based hydrocarbons on invertebrates have been observed by both field based observations and laboratory testing (Barron, 2007). Effects depend upon species tested, levels of exposure, and whether release of oil is at the surface (platform spill) or sub-surface (pipeline or wellhead). It is known that exposure to sunlight increases toxicity of petroleum by the enhanced creation of polcyclic aromatic hydrocarbons from raw crude (Duesterloh and Shirley, 2004). Effects of a large oil spill on zooplankton and benthic invertebrates would likely be minor due to the levels of oil released to the environment, with these effects being highly dependant upon the physical forcing mechanisms that move and break down the oil within the environment and resultant deposition of oil in the environment.

Very Large Oil Spill. Effects of a very large oil spill (≥ 150,000 bbl) are based on WCD calculations for the Burger Prospect of 750,000 bbl of crude oil. Potential for an oil spill of this magnitude is considered very low due to historical considerations discussed in Section 2.4.9 of this analysis. A very large oil spill analysis is provided in the Sale 193 Final SEIS, and although the magnitude of spill analyzed in that document is approximately 2.2 MMbbl, and the spill analyzed here is 750,000 bbl, the mechanics of spill response, the capacity of the physical environment to affect oil movement and weathering of hydrocarbons, and the ecology and biology of environmental degradation would be roughly similar in their potential to affect the environment of the Chukchi Sea planning area. The effects of a spill at this magnitude on lower trophic resources would be highly dependent upon season of year and resultant potential exposure of larval or other development stages of macroinvertebrates to crude oil byproducts, weather patterns, presence and classification of ice, residence time of oil within the water column or on the benthic surface, location of spill and spatial relationship to currents that could potentially advect the oil to other regions such as the Herald, Hanna, or Barrow Canyons and beyond into the Arctic Ocean, volume of oil reaching shore, and volume of oil in contact with benthic surfaces. Level of effects of a spill of this magnitude on pelagic lower trophic resources would likely be negligible on phytoplankton populations due to rapid recovery rate effected by advection of phytoplankton populations by way of regional currents and rapid (9-12 hours) generation time of phytoplankton resources. Zooplankton populations would be negligible to minor, based on potential effects of a culmination of factors as listed above and their

potential effects on the slower reproductive biology of zooplankton populations. Level of effects on benthic resources would be minor to moderate, for the same rationale as given for the zooplankton lower trophic populations.

Additional analysis of potential impacts to lower tropic levels from large and very large oil spills is available in the Sale 193 Final EIS (USDOI, MMS, 2007) and the Sale 193 Final SEIS (USDOI, BOEMRE, 2011), respectively.

4.3.3 Alternative 3 – One Well per Season

Alternative 3 would limit Shell to one well per season, but would also extend the presence of the drill rig and support vessels and the resulting environmental effects to six seasons. Alternative 3 would limit Shell to one well per season. This reduction of activity within one season could lead Shell to conclude work and lead to an early departure from the drilling area (before the Oct. 31st deadline), thus creating a shorter total time spent in the Burger prospect during any single open water season. This alternative would also extend the presence of the drill rig and support vessels and the resulting environmental effects to six seasons.

The level of effect on these resources would remain negligible. Potential impacts associated with petroleum spills are the same as analyzed under Alternative 2.

4.3.4 Cumulative effects

Cumulative effects are discussed in detail in the Lease Sale 193 Final SEIS (USDOI, BOEMRE, 2011a: pp. 297-313) and in Appendix C of the current document, and are summarized below.

The cumulative effects on surface and pelagic resources of the lower trophics include climate change and warming of surface temperatures, changes in sea ice resulting in an increase in length of the open water season, potential increases in severe weather activities, and ocean acidification stemming from these changes. Anthropogenic effects include deposition of soot from air emissions, accidental spills of petroleum byproducts from vessel activities, release of effluents from drilling and support vessels, and surface disturbance from the passage of military, research, recreation, subsistence, and industry marine vessels and aircraft. These activities present a potential for adverse effects on trophic resources, but the advection of water masses through the proposed exploration drilling sites would probably prevent population effects on the pelagic lower trophic resources, and would make the cumulative effects negligible, localized, and temporary.

Natural effects specific to the benthic environment include ice gouging and ice melt from glaciers and winter snow cover. These contribute to the seasonal influx of nutrients and sediments to rivers and streams within drainages for waters of the Alaskan, Anadyr, Bering, Chukchi, and Siberian currents. Ultimately, such nutrients and sediments will be deposited over benthic environments. Anthropogenic effects include release of drilling fluids and other permitted discharges, anchor deployment and retrieval, and all subsequent release and deposition of permitted discharges and sediments during drilling activities. Anchoring activities will occur during deployment and retrieval of data collection buoys. Other ancillary activities are benthic sampling including fish trawls, van Veen grabs, vibracore, and cone penetration tests conducted for biological, chemical, and geological analysis. These activities present a potential for adverse environmental effects, but the sand, silt, and mud substrate of the benthic environments would make the cumulative effects negligible, local, and temporary.

The reasonably foreseeable cumulative effects are likely to occur at similar levels each season that Shell conducts exploratory drilling operations. If for any reason (e.g. any variations of the proposed mitigation measures or selection of Alternative 3 are chosen) Shell concludes work and exits the drilling area earlier than the October 31st exit date, potential effects would be reduced due to the reduced time spent pursuing drilling activities. For the life of the project, the impacts to lower benthic

resources from the Proposed Actions and from reasonably foreseeable activities amount to a negligible level of effect.

4.4 Fish and Essential Fish Habitat

4.4.1 Alternative 1 – No Action

Under Alternative 1, the proposed drilling program would not be approved, and no impacts to fish or Essential Fish Habitat would result.

4.4.2 Alternative 2 – Proposed Action

The effects under this alternative would result from drilling six exploration wells to depth in as few as two drilling seasons. Shell estimates that it can drill up to three wells to depth and excavate an MLC in a given season. The type of effects on fish and Essential Fish Fabitat (EFH) that could occur under this alternative include the following:

Sound from Operations

The proposed operations would expose fish to sound associated with vessel engines, excavating mud cellars, drilling, anchoring, ice management, aircraft traffic, and vertical seismic profiling.

Sound introduced into the environment through these activities could affect fish through interference with sensory orientation and navigation, decreased feeding efficiency, disorientation, scattering of fish away from a food source, and redistribution of fish schools and shoals (Fay, 2009; Radford et al., 2010; Simpson, 2010; Slabbekoorn, et al., 2010; Purser and Radford, 2011). Sound and visual cues from aircraft taking off and landing could also cause startle effects to epipelagic fish. Pelagic species in the area of drilling include adult Arctic cod, adult salmon, herring, capelin, and similar species. These pelagic species could startle and scatter as noise continues and, in theory, receive reduced levels of sound.

Sedentary, burrowing, territorial, benthic-obligated fish, shallower near-shore fish, fish eggs and fish larvae in the area of the drillship would be exposed to higher noise levels due to their limited swimming behaviors, obligate life history characteristics, behavioral traits, or spatial limitations. Fish in this category that are in the drilling area include sculpin species, yellowfin sole, Bering flounder, starry flounder and sand lance. Foraging and reproduction behaviors of these benthic-obligate fish could be affected negatively by noise from the proposed activities.

Under Alternative 2 the effects of sound on fish and EFH could all occur in a two year period. The level of sound in a given year would be greater, and would occur across a larger spatial area, if all exploration activities are concentrated within two seasons.

Bottom Disturbance and Deposition

Excavating mud cellars, drilling wells, and anchoring drill ships would directly disturb benthic habitat, introduce sediment into the water column, and cause deposition onto down-current benthic habitat. These discharges and disturbances are quantified in Tables 30 and 31.

Table 30. Drill cuttings, drilling fluids, and mud cellar sediment discharged into water and on seafloor.

Alternative 2 -Discharge	3 wells in first season	3 wells in 2nd season	Total (6 wells) over drilling program of 2 seasons
Drill cuttings	17,400 barrels (total for 3 wells)	17,400 barrels (total for 3 wells)	34,800 barrels (total for 6 wells)
Drilling fluids	9,600 barrels (total for 3 wells)	9,600 barrels (total for 3 wells)	19,200 barrels (total for 6 wells)
Total for time period	27,000 (total for 3 wells)	27,000 (total for 3 wells)	54,000 barrels (total for 6 wells)

Table 31. Potential surface area disturbed by excavating mud cellars and anchoring ships.

Alternative 2- Surface Area	3 wells in first season	3 wells in 2nd season	Total (6 wells)
Mud cellar disturbance	3,053 ft^2 (total for 3 wells)	3,053 ft^2(total for 3 wells)	6,106 ft^2 (total for 6 wells)
Anchoring	97,297 ft^2 (total for 3 wells)	97,297 ft^2 (total for 3 wells)	194,594 ft^2 (total for 6 wells)
Total for time period	100,350 ft^2 (total for 3 wells)	100,350 ft^2 (total for 3 wells)	200,700 ft^2 (total for 6 wells)

The discharge of cuttings and drilling fluids would occur over 30-45 days for each well. During this time fish in the lower water column, including sculpin species, yellowfin sole, Bering flounder, starry flounder and sand lance, would be exposed to high suspended sediment and turbidity that could affect visibility (feeding ability), interrupt reproductive behaviors, smother benthic prey, and smother the fish themselves if they are not able to move from the area.

The newly deposited cuttings on the seafloor could resuspend into the water column via currents or severe storm events and have continuing effects. Hydrocarbon concentrations, including polycyclic aromatic hydrocarbons (PAH) and some metals, could become elevated in the lower water column and seafloor sediments from discharge of drill cuttings. This could expose benthic fish adults, eggs, and larvae in the immediate vicinity of the drill site to these concentrations and possibly cause physiological or toxicological effects.

Under Alternative 2, the effects of seafloor disturbance and sediment introduction and transport on fish and EFH could all occur in a two year period. Benthic habitat would be covered with excavated materials and drill cuttings and fish would be exposed to more extensive excavation and sedimentation effects for two or more open water seasons.

Permitted Discharges

Fish in the area of drilling would be exposed in each drilling season to discharge of cooling water, desalination brine, domestic wastewater, treated sanitary wastewater, and drilling fluids. Wastewater would be discharged at 19.6 ft below the sea surface, above the temperature-salinity gradient, where it would mix with the surface waters.

Pelagic fish, such as Arctic cod, pink salmon, chum salmon, herring and would be particularly exposed to these discharges. Approximately 45,000 bbl of cooling water per day would be discharged from the drillship at 1.4 C above ambient sea temperature. The effect would dissipate within 164 horizontal feet. Desalination brine would be discharged with slightly higher salinity and other dissolved constituents than the ambient receiving water. Domestic wastewater and treated sanitary waste would introduce organic materials and could cause temporary localized biological oxygen demand and increased suspended solids. Pelagic fish near the point of discharge for these wastes would likely move away from the waste plume. Fish eggs and larval stages of fish would have continued exposure.

Under Alternative 2 the effects of wastewater discharges on fish and EFH could all occur in a two year period. Both benthic and pelagic fish of most species and life stages near the drill sites would be affected by these discharges during each drilling season.

Shorebase Support Facilities

Shorebase support facilities (along with proposed runway improvements, fuel storage, boat ramp operations and field camp development referenced on pages 14-1 and 14-2 of the Revised EP) could affect nearshore and freshwater fish and EFH through wastewater discharges (permitted by the State), accidental discharges, vessel traffic, and noise. The fish that could be affected include Dolly Varden, rainbow smelt, cisco, Arctic char, Arctic grayling, pink salmon, and chum salmon.

Small Fuel Spill

There is a potential for small fuel spills (<1,000 bbl) during fuel transfers between vessels. Section 2.4.9 estimates a potential spill size of 48 bbl of diesel fuel for the Proposed Action. A fuel spill of this size and type would introduce hydrocarbons and effects with respect to toxicity to the surface water. Pelagic fish adults, juveniles, eggs, and larvae would be exposed. Acute and chronic effects could occur to the various life stages of the fish species in the area.

Large and Very Large Oil Spill

Although very unlikely, it is possible that the Proposed Action could lead to a large (≥ 1,000 bbl) or very large (≥150,000 bbl) oil spill. For the purpose of analysis, BOEM estimates potential discharge volumes for this EA to be 1,555 bbl of diesel for a large spill and 750,000 bbl of crude oil for a very large spill. The Sale 193 Final EIS (USDOI, MMS, 2007) analyzed potential effects to fish and EFH from large spills and found potential for immediate adverse impacts as well as changes in distribution and/or decrease in abundance of fish. The Sale 193 Final SEIS (USDOI, BOEMRE, 2011) analyzed potential effects to fish and EFH from a very large spill and identified direct and indirect effects to fish (which could become significant depending on the timing and trajectory of the spill) as well as significant impacts to EFH for Arctic cod, saffron cod, and all five species of Pacific salmon . These analyses remain sufficient to analyze the effects of large and very large spills in the Chukchi Sea, including potential discharges of 1,555 bbl and the 750,000 bbl, respectively, estimated for this EA.

Mitigation

The following aspects of the Proposed Action would mitigate potential water quality effects:

- Operations conducted under NPDES permit authorized and administered by EPA
- Booming fuel transfer activities
- Shell policy prohibiting workers from fishing (Childs, 2009)
- Equipment for early warning of a potential well-control event
- Oil spill response vessels in the immediate vicinity of the drilling operations
- Adherence to the following plans: Critical Operations and Curtailment Plan (in the event hazards are identified in the vicinity of the drilling operations); Ice Management Plan; Well Control Contingency Plan; and Fuel Transfer Plan

Summary of Effects of Alternative 2

Pelagic and benthic fish in the marine and nearshore environments would be affected for two or more seasons, and longer if their reproductive life cycle was disturbed, causing effects in later year classes. The effects of Alternative 2 on fish would be minor according to the Level of Effects established for this environmental assessment. The effects of Alternative 2 would occur over a larger spatial area per year as compared with Alternative 3, but the proposed action could be accomplished in fewer years. These effects are not expected to vary if Shell leaves the drilling area each year sometime prior to late October.

4.4.3 Alternative 3 – One Well per Season

The effects under this alternative would result from drilling one well to depth in the first open-water season and the same level of activity in five subsequent seasons.

The type of effects on fish and EFH that could occur under this alternative include the following:

Sound from Operations

The proposed operations would expose fish to sound associated with vessel engines, excavating mud cellars, drilling, anchoring, ice management, and aircraft traffic over six open water drilling seasons.

Vertical seismic profiling would expose fish to seismic noise for 10-14 hours per season. Under Alternative 3 the environmental effects of sound on fish and fish habitat would be similar to Alternative 2. However, these impacts would be dispersed over additional drilling seasons, and the level of sound would be less each season and would occur across a smaller spatial area. Populations of fish in the Burger Prospect would be exposed to less extensive sound but recur over a longer period of time.

Bottom Disturbance and Deposition

Excavating mud cellars, drilling wells, and anchoring drill ships would directly disturb benthic habitat, introduce sediment into the water column, and cause deposition onto down-current benthic habitat. Under Alternative 3 the effects of seafloor disturbance and sediment introduction and transport on fish and fish habitat would be similar to those effects under Alternative 2. The effects on fish and fish habitat, however, would recur over a longer time period (six open water seasons), and over a smaller spatial area each season.

Permitted Discharges

Under Alternative 3, pelagic and benthic fish of most species and life stages near drill sites would be exposed to wastewater discharges and drilling fluids over six seasons. The environmental effects of wastewater on fish and fish habitat would be similar to the environmental effects in Alternative 2. However, the effects would recur over a longer time period and over a smaller spatial area each season. The volume of wastewater and drilling fluids would be less each season, but the absolute volume discharged over six seasons would be similar to the absolute volume discharged under Alternative 2.

Shorebase Support Facilities

Under Alternative 3, shorebase support facilities could affect nearshore and freshwater fish and EFH through wastewater discharges (permitted by the State), accidental discharges, vessel traffic and noise. The fish that could be affected include Dolly Varden, rainbow smelt, cisco, Arctic char, Arctic grayling, pink salmon and chum salmon.

The effects on fish and fish habitat under Alternative 3 could be greater than the effects under Alternative 2 because the shorebase activities could continue for a longer period of time. Aircraft and vessel traffic may be less per season, but the worker activity would still affect nearshore and freshwater fish and fish habitat for six drilling seasons.

Small Fuel Spill

Under Alternative 3, the potential for a small fuel spill would be spread across additional seasons, but the potential environmental effects would be the same as was analyzed under Alternative 2.

Large and Very Large Oil Spill

Under Alternative 3, the potential for a large or very large petroleum spill would be spread across additional seasons, but the potential environmental effects would be the same as was analyzed under Alternative 2.

Mitigation

The following are ways in which fish and fish habitat effects would be mitigated:

- Operations conducted under NPDES permit authorized and administered by EPA
- Booming fuel transfer activities
- Shell policy prohibiting workers from fishing (Childs, 2009)
- Alaska Department of Environmental Conservation water regulations onshore

- Equipment for early warning of a potential well-control event
- Oil spill response vessels in the immediate vicinity of the drilling operations
- Adherence to the following plans: Critical Operations and Curtailment Plan; Ice Management Plan; Well Control Contingency Plan; and Fuel Transfer Plan

Summary of Effects of Alternative 3

Pelagic and benthic fish in the marine and nearshore environments could be affected for six drilling seasons, and longer if their reproductive life cycle was disturbed, causing effects in later year classes. Alternative 3 would cause minor effects on fish populations in the area of the northeastern Chukchi Sea. Compared with Alternative 2, the effects of the drilling activities and onshore activities on fish and EFH described above would affect a smaller spatial area per year, but effects would continue over additional seasons. These effects are not expected to vary if Shell leaves the drilling area each year sometime prior to late October.

4.4.4 Cumulative Effects

Cumulative effects are discussed in detail in the Lease Sale 193 Final SEIS (USDOI, BOEMRE, 2011a: pp. 297-313) and in Appendix C of the current document. The number of marine cargo, tourism and research vessels and barges in the Chukchi region is increasing as ice cover is reduced. This increases the risk of vessel accidents, vessel groundings, potential oil and cargo spills, permitted discharges, and introduction of marine invasive species. Commercial fishing is prohibited in the U.S. Arctic (NPFMC, 2009) and would not have an effect in the near future. Subsistence fishing that occurs in coastal villages is likely to continue at a similar level. These ongoing effects would be the background in which Shell's proposed exploration activities would occur.

Climate change is having an effect on the Arctic environment now and is anticipated to have major effects in the future, including warming sea surface, reduction in sea ice and increased ocean water acidity. These factors are and will continue to affect fish and fish habitat in a substantive way in the Chukchi Sea.

Under Alternatives 2 and 3, the effects of the proposed exploration drilling would add a minor effect to the other ongoing activities described here. These effects would be additive and primarily related to benthic habitat alternation, noise disturbance to dish and water quality effects on fish and fish habitat. These effects are not expected to vary if Shell leaves the drilling area prior to late October in one or more of the drilling seasons.

4.5 Marine and Coastal Birds

Section 3.2.6 describes the status of marine and coastal birds in the project area. Recent site-specific information is consistent with previous descriptions, and existing information is sufficient to fully evaluate the potential effects of the Proposed Action.

As identified in the Sale 193 Final EIS (USDOI, MMS, 2007a) and the Sale 193 Final SEIS (USDOI, BOEMRE, 2011a), there are several impact-producing factors associated with oil and gas exploration. The vertical seismic profiling component of the Proposed Action would occur in a localized area and be of short duration and no adverse effects from this activity are anticipated. Similarly, drilling noise would radiate from the site during active operation, but birds are not expected to approach the activity in ways that could harm them. Any displacement effects are anticipated to be extremely small, less so than those effects caused by the presence of the drilling structure.

The most important impact producing factors associated with the Proposed Action are:

- **Vessel presence and noise:** Some marine and coastal birds avoid close contact with vessels and can be temporarily displaced from localized areas when vessels transit through coastal and pelagic areas.
- **Aircraft presence and noise:** Some marine and coastal birds can be disturbed and/or temporarily displaced from localized areas when vessels transit through coastal and pelagic areas. Low-level flights are more likely to affect species that are sensitive to noise and vessel presence or are in a particular area because they are molting, broodrearing, or resting. Fewer disturbance events would result in less adverse effect than frequent or repeated disturbance events.
- **Avian Collisions:** Some seabirds, especially eiders, shearwaters, and auklets are more prone to collisions with structures and vessels than others because of their typical flight pattern or attraction to artificial light. Bird species that fly low over water have a greater potential to collide with offshore structures and ships, especially under conditions of poor visibility such as fog, precipitation, and darkness, and these can be injured or killed. Some birds can also be attracted to and can become disoriented by lights from vessels, which can increase the risk of collisions and result in injury or death.
- **Small Fuel Spills:** Small fuel spills can occur during vessel operations, such as fuel transfers. As explained in greater detail in the Lease Sale 193 EIS (USDOI, MMS, 2007a) and the SEIS (USDOI, BOEMRE, 2011a), spilled hydrocarbons can adversely affect marine and coastal birds because these species spend so much time on the water surface and are highly susceptible to mortality if contacted. BOEM assumes that any bird contacted by hydrocarbons would die.

Effects resulting from impact-producing factors are often similar among all marine and coastal bird groups described in section 3.2.6. Therefore effects are discussed generally below, with species-specific differences identified.

4.5.1 Alternative 1 – No Action

This alternative would not result in adverse effects to marine and coastal birds.

4.5.2 Alternative 2 – Proposed Action

This alternative would have a minor level of effect on marine and coastal birds.

Alternative 2 includes vessel and aircraft activities that could affect marine and coastal birds in the Chukchi Sea. Several species of marine and coastal birds could be subject to collisions with vessels and offshore structures. Also, a small spill (estimated at 48 bbl of diesel fuel) is anticipated to occur during the project period.

Threatened and Endangered Birds

Vessel Presence and Noise. Routine vessel support associated with the drilling operation is mitigated by these vessels using the shortest route between the shorebase and offshore drilling facility. Lease Stipulation 7 contains seasonal restrictions that will serve to prohibit vessels supporting Shell's drilling operations from transit into the LBCHU. Routine vessel traffic has limited potential to disturb birds and could temporarily move them a short distance to another location. Some marine and coastal birds have the potential to habituate to regular vessel traffic (Schwemmer et al., 2011). These small effects from the Proposed Action are not anticipated to persist from one year to another.

Aircraft presence and noise. Routine aircraft support associated with the drilling operation is mitigated by flight restrictions that minimize disturbance to marine and coastal birds while providing

for aircraft safety. Aircraft would typically fly at >1,500 altitude along the shortest route between the shorebase and offshore drilling facility.

Avian Collisions. The spectacled and Steller's eiders are ESA-listed species that have some tendency to strike vessels and structures because they fly low and fast over the ocean and often do not or cannot react in time to avoid them. Birds have only a restricted range of flight speeds that can be used to adjust their rate of gain of visual information as their environment changes (Martin, 2011).

Studies in the North Sea indicated that different colored lights caused different responses. White lights caused attraction, red caused disorientation, and green and blue caused a weak response (Poot et al., 2008). White lights were replaced with lights that appeared green, and this resulted in 2 to 10 times fewer birds circling the offshore platforms (Poot et al., 2008).

A study on the effects of anti-collision lighting systems on Northstar Island for eiders and other birds found in the Beaufort Sea showed that there was a significant slowing of flight speeds at night and movement away from the island when strobe lights (40 flashes per minute) were used. The lights did not cause other bird species to avoid the island but caused attraction. Therefore, the effectiveness was not clear and was inconsistent (Day et al., 2003; Day, Prichard, and Rose, 2005). Nevertheless, Shell is required under Stipulation 7 of its lease to make efforts to reduce light radiating from their exploration vessels and structures.

Despite required efforts to reduce light radiated from exploration vessels and structures, mitigation measures for lighting cannot be assumed to be totally effective and there is still the potential for some bird collision mortality. To address the potential for spectacled and Steller's eiders to collide with structures in the Chukchi Sea, the FWS developed a collision rate. Collision data for common eiders at Northstar Island was compared to the population estimate for common eiders migrating across the Beaufort Sea to provide a strike rate of 0.0017%. This collision rate was used as a surrogate to assess potential impacts to Steller‘s and spectacled eiders, by converting it to a percentage and applying that to the estimated population sizes of listed eiders that may migrate past a structure.

The FWS BO (USDOI, FWS, 2009) calculated that for each drilling program in the Chukchi Sea, on average, an estimated 0.44 spectacled eiders and 0.02 Steller‘s eiders could be killed each year. Although yellow-billed loons and Kittlitz‘s murrelets may also be vulnerable to collisions, the FWS had no records upon which to base a comparable estimate of potential collisions, and there was no evidence to suggest population level impacts to these species would result. The BO issued to BOEM included an incidental take statement that includes the incidental lethal take of ESA-listed eiders:

> …even if seismic surveys and exploratory drilling activities intersect with listed and candidate species the impacts are limited to at most the death of a very low number of individuals through collisions (<1 Steller‘s eider and 12 spectacled eiders over a total of 12 years), and possibly although very unlikely the death of a few individuals in the event a small spill contacts these birds.

The FWS BO includes a requirement for bird strike reporting so that incidental takes of listed birds can be monitored and adaptive management would take place in the event of unanticipated mortality levels. Bird strike reporting would be a condition of BOEM approval of the Revised EP.

To date, no ESA-listed eiders have been reported to collide with exploration structures or vessels. However, there have been at least two reports of small flocks of common eiders colliding with structures on offshore islands/peninsulas in the Beaufort Sea in the past three years. The episodic nature of these events suggests that several birds in a flock could be killed at one time during any one year and an increasing number of years would correspond with an increase in the potential for avian collisions to occur. Using the FWS collision rate, three open water seasons using a single drilling operation could, on average, result in 1.32 spectacled eiders and 0.06 Steller's eiders colliding with offshore structures. Such mortality would be considered a minor level of effect.

Small Fuel Spills. Section 2.3.10 describes spill prevention and response. While there is some potential for a fuel spill during the proposed operations (section 2.3.9), few threatened or endangered birds are anticipated to occur in the project area and few could be exposed to an accidental spill. Many offshore birds would likely avoid spill response activities. The most likely outcome is an accidental small spill that is immediately contained and would have a negligible level of effect on threatened and endangered birds. The effects evaluated could occur each season that Shell conducts exploratory drilling operations under this exploration plan. Consecutive years of activity would not have an additive effect.

If a small accidental spill—potential discharge estimated at 48 bbl for this EA—were to escape containment or response measures, it would not persist very long (<3 days), resulting in few opportunities to contact many threatened and endangered birds. Spill response measures include immediate attention to the Ledyard Bay Critical Habitat Unit, located about halfway between the drilling sites and shore. Under most prevailing environmental conditions, the LBCHU would be contacted days before the Chukchi Sea shoreline. Spectacled eiders and other (flightless) molting birds in the LBCHU would be most vulnerable after mid-July. The vessel activity associated with spill response could have limited success in keeping keep molting seaducks away from a spill because the birds are flightless. That is why it is most important to focus on keeping spilled oil from reaching the LBCHU. Furthermore, later in the open-water season, new migrants could arrive in a spill area on a regular basis, making hazing more difficult. Limited mortality from a small spill would be considered a minor level of effect.

Large and Very Large Oil Spill. Although very unlikely, it is possible that the Proposed Action could lead to a large (≥1,000 bbl) or very large (≥150,000 bbl) oil spill. For the purpose of analysis, BOEM estimates potential discharge volumes for this EA to be 1,555 bbl of diesel for a large spill and 750,000 bbl of crude oil for a very large spill. The Sale 193 Final EIS (USDOI, MMS, 2007) analyzed potential effects to marine and coastal birds from large spills and found potential for sublethal or lethal effects to birds contacted by spilled oil. The Sale 193 Final SEIS (USDOI, BOEMRE, 2011) analyzed potential effects to marine and coastal birds from a very large spill and found potential for significant impacts were spilled oil to reach important habitat areas. These analyses remain sufficient to analyze the effects of large and very large spills in the Chukchi Sea, including the 1,555 bbl diesel spill and the 750,000 bbl oil spill estimated for this EA.

Cliff-Nesting Seabirds

Mitigation measures intended to avoid or minimize adverse effects to threatened eiders also afford protection to cliff-nesting seabirds in those areas. Vessel and aircraft traffic are not anticipated to result in more than a negligible level of effect on cliff-nesting seabirds because they typically occur at low density in the area of exploration activity, and sensitive life stages are not subject to other than occasional vessel passage or aircraft overflight. Any adverse effects from a small spill would not be greater than those described for threatened or endangered birds. Few, if any, collisions by this species group are anticipated.

Bering Sea Breeders and Summer Residents

Mitigation measures intended to avoid or minimize adverse effects to threatened eiders also afford protection to Bering Sea breeders and summer residents. Vessel and aircraft traffic are not anticipated to result in more than a negligible level of effect to Bering Sea breeders and summer residents because they typically occur at low density in the area of exploration activity are not subject to other than occasional vessel passage or aircraft overflight. Adverse effects from a small spill would not be greater than those described for threatened or endangered birds.

Lighting attraction and disorientation appears responsible for seabirds colliding with vessels and structures. For example, Dick and Donaldson (1978) reported collisions by crested auklets (*Aethia*

cristatella) threatening to capsize an 86-ft long vessel when the vessel was using high-intensity lighting. Additional reports included in Dick and Donaldson (1978), Black (2005), and ADN (2006) suggest other similar occurrences by pelagic species such as shearwaters (*Puffinus* spp.), storm-petrels (Hydrobatidae), and whiskered auklets (*Aethia pygmaea*). Because several species of pelagic seabirds can occur in dense flocks in the Chukchi Sea and have the potential to be in the vicinity of or move past drilling structures and vessels engaged in exploration activities, it is likely that some birds will accidentally collide with exploration vessels and other structures and be injured or killed. Monitoring and reporting of bird strikes by drilling structure personnel is required and will allow the rapid detection of bird collision events before large-scale mortality occurs. Given that the pelagic seabird populations (especially shearwaters and auklets) in the Chukchi Sea are robust and number in the tens of thousands, a conservative estimate of collision mortality of fewer than 100 individual birds during the entire drilling program would not be considered more than a minor level of effect.

High Arctic-Associated Seabirds

Mitigation measures intended to avoid or minimize adverse effects to threatened eiders also afford protection to high Arctic-associated seabirds in those areas. Vessel and aircraft traffic are not anticipated to result in more than a negligible level of effect to high Arctic-associated seabirds because they typically occur at low density in the area of exploration activity and are not subject to other than occasional vessel passage or aircraft overflight. Adverse effects from a small spill would not be greater than those described for threatened or endangered birds. Few, if any, collisions by this species group are anticipated.

Tundra-Breeding Migrants

Mitigation measures intended to avoid or minimize adverse effects to threatened eiders also afford protection to tundra-breeding migrants in those areas. Vessel and aircraft traffic are not anticipated to result in more than a negligible level of effect to tundra-breeding migrants because they typically occur at low density in the area of exploration activity and are not subject to other than occasional vessel passage or aircraft overflight. Adverse effects from a small spill would not be greater than those described for threatened or endangered birds. Few, if any, collisions by this species group are anticipated.

Waterfowl and Loons

Mitigation measures intended to avoid or minimize adverse effects to threatened eiders also afford protection to waterfowl and loons in those areas. Vessel traffic is not anticipated to result in more than a negligible level of effect to waterfowl and loons because they typically occur at low density in the area of exploration activity and are not subject to other than occasional vessel passage. Adverse effects from a small spill would not be greater than those described for threatened or endangered birds.

As with threatened eiders, similar waterfowl species (i.e., common and king eiders) are prone to collide with offshore vessels and structures. The episodic nature of these events suggests that several birds in a flock could be killed at one time during any one year. Given that common eider and king eider populations are robust, the level of bird strike mortality could be numerically larger, but proportionate to those calculated for threatened eiders. A minor level of effect on species in the waterfowl and loon group from avian collisions is anticipated.

Shorebirds

Mitigation measures intended to avoid or minimize adverse effects to threatened eiders also afford protection to shorebirds in those areas. Vessel traffic is not anticipated to result in more than a negligible level of effect to shorebirds because they typically occur at low density in the area of exploration activity and are not subject to other than occasional vessel passage. Adverse effects from

a small spill would not be greater than those described for threatened or endangered birds. Few, if any, collisions by this species group are anticipated.

Raptors and Ravens

Activities associated with the Proposed Action are not anticipated to affect raptors and ravens.

4.5.3 Alternative 3 – One Well per Season

This alternative would result in a moderate level of effect to marine and coastal birds.

Unlike Alternative 2, the drilling program in Alternative 3 would be spread over 6 drilling seasons. The duration of each season's activity could be as long as specified for Alternative 2. There are no differences between the level of effects from vessel and aircraft presence and noise or small fuel spills resulting from this alternative as compared to Alternative 2; even though this alternative could more than double adverse effects on marine and coastal birds, these effects are not anticipated to persist from one year to the next.

As described under Alternative 2, however, eiders, shearwaters, and auklets are more prone to collisions with structures and vessels than other species. Despite the required efforts to reduce radiated light, mitigation measures for lighting cannot be assumed to be totally effective and there is still the potential for some bird collision mortality. While extending the drilling program to six years could more than double the estimated collision mortality (over 3 spectacled eiders and 0.14 Steller's eiders) compared to Alternative 2, such mortality would be considered a minor level of effect.

Some pelagic seabirds can occur in dense flocks in the Chukchi Sea and it is likely that some birds will accidentally collide with exploration vessels and other structures and be injured or killed. The more years a drilling operation occurs, the greater the potential that one of these large flocks could encounter a drilling structure, especially during periods of fog, rain, and/or darkness. Monitoring and reporting of bird strikes by drilling structure personnel is required and will allow the rapid detection of bird collision events before large-scale mortality (>100 individuals during one collision event) occurs. Given that the pelagic seabird populations (especially shearwaters and auklets) in the Chukchi Sea are measured in the tens of thousands, collision mortality over program duration (up to 7 years) could exceed hundreds of individuals. This collective mortality would be considered a moderate level of effect for this alternative.

Under Alternative 3, the potential for a large or very large petroleum spill would be spread across additional seasons, but the potential environmental effects would be the same as was analyzed under Alternative 2.

4.5.4 Cumulative Effects

Appendix C describes other past, present, and reasonably foreseeable future events that could occur in the project area and could affect bird populations. Activities associated with the action alternatives do not have a cause-effect relationship that would influence aspects of climate change discussed in Appendix C-3.4 (Climate Change).

Activities that impact marine and coastal birds include disturbances from vessel or low-level aircraft traffic, maritime spill accidents (i.e., bulk fuel deliveries to coastal villages), and bird collisions with vessels and structures in marine and coastal habitats would continue. Many of these activities include vessel and aircraft operations that are not subject to altitude or route restrictions and can affect marine and coastal birds.

Alternative 1 would not have an incremental contribution to the cumulative effect.

Alternative 2 would contribute to the collective impacts on bird populations in the project area. The reasonably foreseeable cumulative effects will occur at nearly the same level each season that

exploratory drilling operations are conducted. Alternative 2 could result in short-term effects from vessels and aircraft, but these effects are localized and would not persist from one year to the next. The primary adverse effect, avian collisions, could result in annual mortality to ESA-listed and other bird species. The impacts to marine and coastal birds from Alternative 2 and from reasonably foreseeable activities would amount to no more than a minor level of cumulative effect.

Alternative 3 would contribute to the collective impacts on bird populations in the project area. The reasonably foreseeable cumulative effects will occur at nearly the same level each season that exploratory drilling operations are conducted, but collision mortality could accumulate over the project timeline to over double that described for Alternative 2. The impacts to marine and coastal birds from Alternative 3 and from reasonably foreseeable activities would amount to no more than a moderate level of cumulative effect.

4.6 Marine Mammals

This analysis tiers from the Sale 193 Final EIS (USDOI, MMS, 2007a) and Sale 193 Final SEIS (USDOI, BOEMRE, 2011a) and applies the results of those analyses to the site specific information from the 2012 Shell Revised Chukchi Sea EP and Shell EIA. Relevant information from each of these documents in incorporated and summarized below. BOEM has identified the following effectors as having potential to affect marine mammals:

- Drilling
- Zero-offset Vertical Seismic Profile (ZVSP)
- Vessel Traffic
- Ice Management
- Aircraft Traffic
- Discharges
- Petroleum Spills

The greatest potential for the Proposed Action to impact marine mammals is through noise. Sounds are important to marine mammals because they use sound to navigate, communicate, find open water, avoid predators, and find food. Ambient or background sound levels in the Chukchi Sea have been measured at 80-100 dB under relatively calm seas (Brueggeman et al., 1990). Concern has focused on the intensity of impacts to marine mammals from sounds related to drilling, aircraft, and vessels, and its potential to cause deflection of whales from hunting and migration areas, masking of environmental sounds and intra-species communication, and physiological damage to marine mammal hearing. Avoidance behavior in response to sound energy noise by marine mammals such as temporary deflection from feeding areas or migration corridors is the most likely behavioral response expected as a result of Shell's exploration drilling activities in the Chukchi Sea. Extremely loud sounds could cause temporary or permanent damage to hearing ability (Kryter, 1985). Concerns that sound energy introduced into the environment of marine mammals could cause masking (the covering of sound that would otherwise have been heard) are present. Masking can interfere with the detection of important natural sounds. Underwater sound energy could possibly mask environmental sounds (Terhune, 1981) or communication between marine mammals (Perry and Renouf, 1987). The location of the proposed drill sites, more than 60 mi offshore and more than 25 mi from either Herald Shoal or Hanna Shoal, and the timing of the proposed activities (during the open-water period) decreases the likelihood of disturbance to large numbers of marine mammals from drilling noise.

Noise from aircraft traffic associated with proposed exploration activities may also cause some temporary behavioral disturbance, and possibly deflection away from the sound source. A marine mammal under water would typically only hear an aircraft at low altitude when it is within the area 13

degrees on either side of the vertical from where the animal is located (Richardson and Malme, 1993). According to Shell, aircraft other than marine mammal monitoring flights will not fly below an altitude of 1,500 ft (300 m), within 0.5 mi (800 m) of walrus or polar bears observed on land or ice, or within 500 yd (460 m) of whale groups. These flight restrictions are standard mitigation measures which are usually required by FWS and NMFS as part of the LOA and IHA process. Aircraft would follow flight corridors directly from shore at Wainwright to the drill site, and 5 mi inland when traveling from Wainwright to Barrow.

Vessel noise, vessel traffic, icebreaking, and ice-management could also have some level of effects on any pinnipeds or cetaceans visiting the vicinity of drilling or drilling support operations.

Discharges of wastewater, drill cuttings, and drilling fluids are unlikely to have any identifiable effects to marine mammals. The area disturbed or buried under sediments that precipitate out of the water column would only affect a relatively tiny portion of the sea floor. Additional analysis on the potential for the Proposed Action to affect lower trophic resources utilized by marine mammals is provided in Section 4.3.

4.6.1 Alternative 1 – No Action

If Alternative 1 is selected, the proposed exploration activities would not be approved, and there would be no effects on marine mammals.

4.6.2 Alternative 2 – Proposed Action

It is likely that some marine mammals will be present in the prospect area when the exploration drilling operations are ongoing. Potential adverse effects on marine mammals from the proposed exploration activities are organized first by species and then by mechanism of effect.

Seals

Drilling. Ringed seals have demonstrated very limited responses to drilling activities. While monitoring marine mammal distribution and reactions to drilling in the Beaufort Sea with the *Kulluk*, Brewer et al. (1993) observed ringed seals approaching within 33 ft (10 m) of the drilling vessel and concluded that seals were not disturbed by drilling activity. While monitoring marine mammals at another Beaufort Sea drill site, Gallagher, Brewer, and Hall (1992) observed seals within 115 ft (35 m) of the drillship *Northern Explorer II* indicating a high level of tolerance to such sounds and activities. Other studies of drilling activities in the Beaufort Sea have shown minor and temporary disturbance effects. Frost and Lowry (1988) concluded that local ringed seal populations were less dense within a 2-nautical mile buffer of manmade islands and offshore wells that were being constructed in 1985-1987. Moulton et al. (2003) found less marked differences in ringed seal densities on the same locations to be higher in years 2000 and 2001 after a period of habituation. Thus, it seems ringed seals may be somewhat disturbed by drilling operations for a period of time, until the activity has been completed. Adult ringed seals likely habituate to long-term effects of drilling, artificial island construction, and continuous operations that cumulatively created a much greater level of disturbance than what we expect from this project.

Concerns have been expressed that sound energy introduced into the environment of marine mammals could cause masking (covering of sounds that would otherwise have been heard) of other sounds that are present in the environment. Masking can interfere with the detection of important natural sound sources. Underwater drilling sounds could possibly mask some environmental sounds (Terhune, 1981) or communication between marine mammals (Perry and Renouf, 1987). However, in a study conducted by Cummings, Holliday, and Lee (1984), in which breeding ringed seals were subjected to recordings of industrial sounds, there were no documented effects on ringed seal vocalizations.

Because of the short duration of the proposed activities, unremarkable biological site characteristics, and the observed effects of offshore drilling on seals, we do not anticipate measureable population level effects to occur. Consequently drilling noise is expected to have a negligible level of effects on bearded, ribbon, ringed, and spotted seals in the vicinity of the prospects.

ZVSP. Seals do not echolocate as do odontocetes, and their use of sound mostly relates to intra-specific communication. Ringed seal reactions to seismic surveys are expected to be restricted to small distances and brief durations, with no long-term effects. Southall et al. (2007) proposed that auditory (PTS) injury could occur in seals exposed to single sound pulses at 218 dB re: 1 μPa in water; however, injury from most large seismic surveys would only occur if animals entered the zone immediately surrounding the source. The sounds levels produced by the airguns associated with proposed ZVSP activities are insufficient to elicit a TTS or PTS in any known seal species outside an area of a few meters at most.

Most ice seals spend greater than 80% of their time submerged in the water (Gordon et al., 2003); consequently, some could be exposed to sounds from ZVSP surveys that occur in their vicinity. Underwater audiograms for ice seals suggest that they have very low hearing sensitivity below 1 kHz, though they can hear underwater sounds at frequencies up to 60 kHz, making calls between 90 Hz and 16 kHz (Thomson and Richardson, 1995; Richardson et al., 1995b). The auditory bandwidth for pinnipeds in water is approximately 75 Hz to 75 kHz (Southall et al., 2007), and while seismic activity can contain sound up to 1 kHz, most of the emitted sound is less than 200 Hz, putting seismic noise at the very lowest end of the auditory spectrum for seals. Gordon et al. (2003) suggested that phocids may be susceptible to the masking of biologically important signals by low frequency sounds, such as those from seismic surveys, and while brief, small scale masking episodes might have few long term consequences.

Reported seal responses to seismic surveys have been variable and often contradictory, although they suggest ice seals often remain within a few hundred meters of large airgun arrays that are firing (Blees et al., 2010; Brueggeman et al., 1991; Harris, Miller, and Richardson, 2001; Miller and Davis, 2002).

Seismic surveying has limited potential to affect fishes and some invertebrate species that make up the ringed seal diet (USDOI, MMS, 2006). Potential impacts to prey species are analyzed in Section 4.4. If seismic surveys cause prey items to become scarce, either because they move out of an area or become more difficult to catch, seal distributions and feeding rates could be affected, especially those of newly weaned ringed seal pups (Gordon et al., 2003). It is also possible that damaged or disoriented prey could attract ice seals to seismic-survey areas, providing robust short-term feeding opportunities (Gordon et al., 2003).

Pinnipeds are unlikely to show a strong avoidance reaction to the moderately-sized airgun source that will be used for the ZVSP program. ZVSP operations are not expected to last beyond 10-14 hours at any drill site, greatly lessening the likelihood of a seal being exposed to noise from firing airguns. Visual monitoring from seismic vessels has shown only slight avoidance of large airgun arrays by pinnipeds, with small changes in behavior. Even if reactions of the species occurring in the proposed survey area are as strong as those evident in the telemetry study, reactions are expected to be confined to relatively small distances and durations, with no long-term effects on pinniped individuals or populations. Furthermore the very brief duration of ZVSP operations and the smaller size of the airguns should greatly lessen the potential for and level of effects to seals. Consequently the ZVSP seismic activities are expected to have a negligible level of effects on seal species in the vicinity of any discharging airguns.

Vessel Traffic. Most likely some seals will be present in the prospect area when the exploration drilling operations are occurring. The most common seal species in order of occurrence should be

ringed, spotted, and bearded seals, respectively, with very low ribbon seal occurrences. Seals appear to be fairly tolerant of vessel traffic.

Vessels underway will reduce speed and avoid multiple course changes when within 300 yd (275 m) of marine mammals in the water to avoid separating members from a group. Vessel speed will also be reduced during inclement weather conditions in order to avoid accidental collisions with marine mammals. No vessels will intentionally approach any marine mammal.

Vessel traffic may temporarily displace seals from preferred feeding areas, resting areas, or briefly alter travel routes of individual seals, resulting in small, immeasurable energetic costs. Richardson (1995c) found that vessel noise does not seem to strongly affect ice seals already in the water but seals on haulouts often respond more strongly to the presence of vessels by slipping into the water. Brewer et al. (1993) reported observations of ringed seals following ice management vessels in the Beaufort Sea, apparently feeding on fish and plankton in the disturbed waters.

During open water surveys in the Beaufort and Chukchi Seas (Harris, Miller, and Richardson, 2001; Blees et al., 2010; and Funk et al., 2010) ringed and bearded seals showed slight aversions to vessel activity. Funk et al. (2010) noted, among vessels operating in the Chukchi Sea where received sound levels were <120 dB, 40 percent of observed seals showed no response to a vessel's presence, slightly more than 40 percent swam away from the vessel, 5 percent swam towards the vessel, and the movements of 13 percent of the seals were unidentifiable. In the same Chukchi Sea surveys, 60 percent of the observed seals "…exhibited no reaction to vessels…", and 27 percent simply looked at the vessels. In the concurrent set of surveys conducted in the Beaufort Sea where sound levels were <120 dB, approximately 30 pecent of observed seals showed no reaction to vessel activity, 50 percent looked at the vessel, and 10 percent splashed in the water. Funk et al. (2010) concluded that bearded seals were more likely to occur near the pack ice margin than in open water, and that it is likely some individuals near the vessels were displaced to a limited extent. Brueggeman (2010) noted that in 2008 and 2009 ringed seal behavior was dominated by swimming (49 percent), diving (20 percent), and looking (18 percent) at the survey vessels.

Blees et al. (2010) reported a total of 16 ringed seals and 69 bearded seals were observed by monitoring vessels where the received noise levels were <120 dB during Statoil's 2010 seismic surveys in the Chukchi Sea. Of those observations the seals responded mainly by looking at the vessel (56.7%) or showed no reaction at all (32.8%). Blees et al. (2010) noted seals responded to the vessel by looking (37.5%) or simply did not respond to the vessel's presence (62.5%) when the M/V Geo Celtic was performing non-seismic activities. Summarily, the majority of seals encountered by Statoil's monitoring vessels reacted by looking at the vessel (51%) or by showing no obvious reaction (39%). Consequently ringed seals did not appear to be affected by vessel traffic with background noises below 120 dB in the 2006-2008 (Funk et al., 2010) or the 2010 (Blees et al., 2010) surveys, when they were in open water conditions and not hauled out on ice. However, in Blees et al. (2010) ringed, bearded, ribbon, and spotted seals were collectively grouped together in the analyses. Blees et al. (2010) noted seal observations by individual species; however, their analysis for sighting rates used the cumulative number of ice seal observations as a collective group rather than individual species, which would have been much lower.

It is possible that vessels could strike a small number of seals in open water conditions. Seals that closely approach larger vessels may potentially be drawn into bow-thrusters or ducted propellers. In recent years, gray and harbor seal carcasses have been found on beaches in eastern North America and Europe with injuries indicating the seals may have been drawn through ducted propellers (Thompson et al. 2010). However, adult seals are agile and should easily avoid vessels in open water conditions.

Considering most sea ice is absent from the prospect areas during the open water season, and the small impacts of vessel traffic on seals, the effects are expected to be brief and minor, mostly

resulting in temporary avoidance responses by seals, such as slipping off of ice and into the water, diving, or briefly avoiding approaching vessels.

Ice Management. The Proposed Action includes ice management and the potential for icebreaking in certain limited circumstances. Bearded seals showed very limited reactions to icebreaking and have been observed approaching to within 656 ft (200 m) of ice breakers (Brewer et al., 1993). Reeves (1998) reported some ringed seals have been killed by icebreakers moving through fast-ice breeding areas, and that the passing icebreakers could have far-reaching effects on the stability of large areas of sea ice. However, this project would occur during the open-water season, long after sea ice retreats north of the prospect areas and after all of the fast-ice has melted way. The whelping and molting seasons for all four seal species will have ended before commencement of the Proposed Action. As few seals are expected to linger in the area after the sea ice has retreated north, no seals should be crushed by icebreaking activities. As a result, icebreaking and ice-management should have a negligible level of effect on seals, resulting only in temporary avoidance in the open water.

Aircraft Traffic. A study noting counts of ringed seal calls in water performed by Calvert and Stirling (1985) suggests seal abundance in an area subjected to low-flying aircraft and other disturbances was similar to what was observed in less disturbed areas. Concentrations of animals hauled out on land seem to react more severely than the scattered small groups found on the sea ice in spring, and in summer spotted seals haul out in large numbers on the sand bars near Kasegaluk Lagoon. Surveys by Rugh, Shelden, Withrow (1997) found spotted seals showed immediate reactions to the presence of survey aircraft at altitudes up to 4,500 ft (1,370 m) and up to 2 km away. Shell's flight routes would go directly from Barrow or Wainwright out to sea, or 5 mi inland between Barrow and Wainwright, so disturbances of spotted seals at terrestrial haul outs are not expected.

Any other disturbances of seals by Shell's aircraft would be temporary and localized to small numbers of seals hauled out on remnant ice floes or already in the water. The potential impacts on seals from aircraft traffic would be greatly mitigated by the proposed flight corridor (Shell 2011a: Figure 13.e-2), which minimizes the portion of flights over coastal waters. Flights between Barrow and Wainwright would occur along a corridor 5.0 mi inland to minimize effects on subsistence and subsistence resources including marine mammals.

Furthermore, Shell has incorporated other measures to reduce the chance of disturbing seals by restricting aircraft to altitudes above 1,500 ft (457 m), unless the aircraft is engaged in marine mammal monitoring, approaching, landing or taking off, or in cases where personal safety requires lower altitudes. Aircraft traffic and noise would have a negligible level of effect on ice seals.

Discharges. The Proposed Action entails the discharges of wastewater, drill cutting, and drilling fluids. As noted above, the areas affected by these discharges would be small, would recover quickly, and would be in the general proximity of activities causing enough noise to discourage visitation by seals. Identifiable impacts to seals from discharges are therefore unlikely.

Small Fuel Spill. After reviewing the potential effects of a 48 bbl oil (the amount estimated for a small spill in this EA) or fuel spill on seals, BOEM finds a negligible level of effects applies. Such a small spill would be insufficient to produce any population level effects on small or large groups of seals. Ice seals are believed to have the ability to detect and avoid oil spills (Geraci, 1990; St. Aubin, 1990). Moreover, the weathering process should act to quickly break up or dissipate oil/fuel through the local environment to harmless residual levels that would eventually become undetectable.

Large and Very Large Oil Spill. Although very unlikely, it is possible that the Proposed Action could lead to a large or very large oil spill. For the purpose of analysis, BOEM estimates potential discharge volumes for this EA to be 1,555 bbl of diesel for a large spill and 750,000 bbl of crude oil for a very large spill. The Sale 193 Final EIS (USDOI, MMS, 2007a) analyzed potential effects to seals from large spills and found that contact with oil could affect individual seals in a variety of

negative ways. The Sale 193 Final SEIS (USDOI, BOEMRE, 2011a) analyzed potential effects to seals from a very large spill and found that exposure to oil, long-term exposure to contaminants, and decreased availability of prey could lead to short-term population impacts. These analyses remain sufficient to analyze the effects of large and very large spills in the Chukchi Sea, including the 1,555 bbl diesel spill and the 750,000 bbl oil spill estimated for this EA

Pacific Walrus

For management purposes, the Pacific walrus is considered a single stock, although there are some indications of separation between walrus from different breeding areas (Jay, Outridge, and Garlich-Miller, 2008). Exploration drilling on the Burger Prospect could impact walruses through disturbance, displacement, impacts to prey species, or accidental petroleum spills.

Drilling. The primary effects on walrus from exploration drilling are habitat loss and disturbance. Noise and activity associated with drilling may displace some walruses from the immediate area of the specific drill site (with ongoing operations). Walrus may be displaced from the immediate area of difference drill sites over the course of two or more open water seasons. The drill sites are located 60 miles or more from the coastline, and terrestrial haulouts are unlikely to be disturbed by exploration drilling activities. The proposed drill sites are in a central area near the Hanna and Herald Shoal areas, areas that are very productive for benthic invertebrates and may be important foraging areas for walrus in some years. Walrus would be displaced from specific drill site areas during active drilling; however, in recent years the sea ice has retreated too far northward for walrus to easily access these areas during the late summer and early fall open water season. The footprint of the drill ship and the activities associated with the drilling (crew change outs, re-supply vessels, possibly an icebreaker conducting ice management activities, spill response vessels on stand by) would likely displace walrus from the immediate area. Each drill site would have a mudline cellar (MLC) that would be approximately 30-40 ft deep and 325-350 ft^2 in size. In addition, approximately 17,000 ft^2 would be scarred by the anchors used to anchor the drill ship. These areas would not be available as foraging habitat until benthic invertebrates had time to re-colonize the area after the drill site had been abandoned. Dunton et al (2009) found healthy benthic communities in 2008 at sites in the Chukchi Sea that had exploration wells drilled in 1989. One drill rig active during the open water season would have a relatively small footprint when compared to the available habitat and is likely to have minor impacts to walrus in the Chukchi Sea. Shell may exit the drilling area prior to the end of October. The potential for large numbers of walrus to be displaced by ship traffic during the open water season is low.

ZVSP. One ZVSP will be conducted for each well. Walrus use sound for communication and spend a great deal of time foraging underwater. They may be exposed to sound from ZVSP. Temporary threshold shift (TTS) may occur after exposure to seismic pulses; however, this has not been documented for walrus. Walrus have good low-frequency hearing (Kastelein et al., 2002) and may be susceptible to masking of biologically significant signals by low frequency sounds, such as airgun pulses from seismic surveys (Gordon et al., 2003). ZVSPs would take place over a period of 10-14 hours at every well drilled. Walrus are likely to avoid remaining in the drill site area due to the noise and activity, which lessens the likelihood of their exposure. MMOs will be on watch during operations to avoid conducting ZVSP when walrus are present within the area ensonified at 180dB. Some walrus may move further away from the drilling operations if in the area when ZVSP occurs. Any impacts are likely to be limited to displacement of foraging walrus or of walrus swimming through the area.

ZVSPs will occur during the open water season when walrus densities are expected to be relatively low, and monitoring requirements and mitigation measures are expected to minimize interactions with large aggregations of walruses. Any impacts to walruses would be short in duration and would have a negligible overall impact on the Pacific walrus population.

Vessel Traffic. Documented reactions of walrus hauled out on ice to vessels include waking up, head raising, and entering the water (Richardson, 1995). Brueggeman et al. (1990, 1991) monitored the behavior of walrus, while on ice and in water, in response vessels associated with exploration drilling near Shell's prospects in 1989 and 1990. They reported that none of the observed groups of walrus exhibited escape behavior in response to anchored or drifting vessels. Responses of walrus to moving vessels varied depending in part upon the nearness of the vessels. The responses varied from no reaction, approaching the vessel, avoiding the vessel, abandoning the ice, and exhibiting escape behavior. The strongest reactions occurred when the vessel came within about 550 yd (500 m) of the walrus. Mitigation measures as described in Section 2.10 and in Shell's Polar Bear and Pacific Walrus Interaction and Avoidance Plan, which includes a 0.5 statute mi (800 m) exclusion zone around observed walrus for vessels in transit, will reduce contacts and avoid incidental takes of walrus during transit to and from the site.

The fleet associated with the proposed drilling operation could come into contact with individual or groups of walrus during transit or while at a drill site. Walrus may move through the drill site area while foraging or transiting between ice and shore. If pack ice remains in the area when drilling begins, walrus may be associated with the pack ice. In most cases, impacts to walrus would be limited to displacement from the area of activity. In the summer of 2010, a seismic operator in the Chukchi Sea operating near the proposed drill sites reported a large influx of walrus over several days as the walrus moved from the retreating pack ice to shore-based haul outs. The operator was directed to move operations to a different area until the walrus had moved through; disturbance to the walruses was minimized in this way.

Ice Management. Ice management operations are expected to have the greatest potential for disturbances to walrus. Brueggeman et al. (1991) reported that walrus moved 20-25 km from active icebreaking operations, where noise levels were near ambient. Icebreakers may assist vessels in transit to and from locations during ice conditions, and support drillship operations if ice moves into the operating theater or during late fall ice conditions. Ice management would occur at distances of 0.6 to 12 miles from the drill ship. Response distances of walrus to open water vessels and icebreakers are expected to vary, depending on the size of the ship, engine power, and mechanical characteristics of the icebreaker; vessel activities; noise-propagation conditions; the age and sex of individuals exposed; and the activities they are engaged in when exposed. Females with young calves are most vulnerable to disturbance events because the calves cannot remain in the water as long, cannot swim as far, and are more vulnerable to trampling when large groups of walrus stampede off of haulouts. Repeated disturbance from vessel traffic could cause walrus to abandon an area which would have energetic costs, and has the potential to separate calves from their mothers.

Aircraft Traffic. Sources of flights in the Proposed Action include industry crew changes and industry marine mammal surveys. Most offshore aircraft traffic in support of Shell's proposed drilling plan involves straight line flights for personnel transport and fixed-wing aircraft engaged in monitoring activities. The aircraft will primarily be flying over open water and are unlikely to disturb walrus that are in water. However, because of frequent low visibility due to fog, aircraft may not always be able to fly at heights that avoid disturbing walruses hauled out on the ice, or at coastal haul outs. Walrus may be displaced from ice floes or terrestrial haulouts temporarily by aircraft or may expend energy reserves avoiding aircraft. Females with calves react most readily to potential disturbance events. Walrus at terrestrial haul outs are vulnerable to injury or death during stampedes, with calves being the most vulnerable.

As walruses spend more time ashore due to receding sea ice, the potential for disturbance events increases. Increases in physiological stress of adults or juveniles may reduce fitness and have implications for productivity and survivorship over time. Requirements that industry flights stay at 1500 ft or more above ground level, and a minimum of ½ km from groups of walrus on ice or at terrestrial haul outs, have reduced the potential for disturbance. Flight corridors established from

shore bases to offshore industry operation sites reduce the potential for disturbing walrus by limiting the spatial extent of the over-flights. OCS industry associated flights are directed away from concentrations of walrus and have negligible impacts to walrus and no population level effects.

Discharges. Exploration drilling could result in the disposal of drilling fluids or cuttings onto the seafloor under terms of an EPA NPDES permit. The accumulation of these sediments on the seafloor could result in a direct loss of walrus foraging habitat. Exploration drilling fluids and cuttings may cause localized contamination of the seafloor in the Chukchi Sea. Trefry, Trocine, and Cooper (2011) found higher mercury levels at three stations within 500m of the 1989 exploration wells at Burger and Klondike in the Chukchi Sea than at the other 106 stations tested in the Chukchi Sea. A similar study (Shell, 2009) in the Beaufort Sea did not find any residual contamination.

The discharge of drilling fluids and cuttings during exploration activities is not expected to cause population-level effects to walrus, either directly through contact or indirectly by affecting prey species. Any effects would be localized primarily around the exploration drilling site because of the rapid dilution/deposition of these materials. The effects from such discharges are expected to be localized to a small proportion of available marine mammal habitat. Pacific walruses are a long lived species that feed primarily on benthic invertebrates, some of which are known to concentrate contaminants (Doroff and Bodkin, 1994). Warburton and Seagers (1993) compared metal concentrations from 56 liver and kidney samples collected from 1986 to1989 with 57 samples collected in 1981 to 1984 (Taylor, Schliebe, and Metsker, 1989). While still low, trace levels of selenium, arsenic and lead increased significantly between the two time periods. Selenium was the highest at 17.6 parts per million (ppm.) Levels of cadmium and mercury did not increase; however, cadmium levels remained high (mean of 166.5 ppm.). Both cadmium and mercury appear to be naturally occurring in the Chukchi Sea. Available data on contaminant levels in walrus have not identified any health impacts to walrus. Authorized discharges from exploration drilling are anticipated to result in a negligible level of effect on Pacific walrus.

Small Fuel Spill. A small spill (estimated at potential 48 bbl of diesel fuel for this EA) would dissipate over a few days and impacts from a small spill would result in a minor impact to some walrus rather than a population level effect. Because walrus are likely to avoid and disperse from areas with lots of human activity (such as clean up crews or drilling operations), it is likely that those walrus that are not oiled immediately would avoid the area of the spill as long as clean up activities were ongoing.

Large and Very Large Oil Spill. The potential impacts of small, large, and very large oils spills have been analyzed in the Sale 193 Final EIS and the Sale 193 Final SEIS and are summarized here. Impacts from a spill originating at the proposed drill sites or from a vessel in transit to or from the proposed drill site do not differ from the previous analysis. Although a very large oil spill is a highly unlikely event, it could result in a major impact to the walrus population if it were to occur in the Chukchi Sea at an area with a large concentration of the walrus population. For example, if a very large oil spill originating at the drill site were carried northward by the currents and came into contact with the pack ice edge where walrus were gathered in large numbers, it could have moderate or major impact.

Mysticete Whales

Mysticete whales include bowhead, gray, fin, humpback, and minke whales. Potential impacts to these species are analyzed below.

Drilling. Bowhead reaction to drillship-operation noise is variable. Individuals whose behavior appeared normal have been observed on several occasions within 10-20 km (6.2-12.4 mi) of operating drillships in the eastern Beaufort Sea, and there have been a number of reports of sightings within 0.2-5 km (0.12-3 mi) from drillships (Richardson et al., 1985a; Richardson and Malme, 1993). On several

occasions, whales were well within the zone where drillship noise should be clearly detectable to them. In other cases, bowheads have avoided drillships and their support vessels by 10-20 km (Richardson et al., 1985; Richardson and Malme, 1993).

Richardson and Malme (1993) point out that the data suggest stationary, continuous noise sources, such as stationary drillships, elicit less dramatic reactions with bowheads than mobile noise sources. Most observations of bowheads tolerating noise from stationary operations are based on opportunistic sightings of whales near ongoing oil-industry operations. Other cetaceans seem to habituate somewhat to continuous or repeated noise exposure when the noise is not associated with harmful events, implying that bowheads may habituate to certain, non-threatening noises. Davis (1987) monitored the responses of bowhead whales to drilling operations at the Corona and Hammerhead wells in the U.S. Beaufort Sea, and concluded the sound generated by the drilling operations did not impede their migration since the only responses he observed were temporary avoidance behaviors in some whales. Likewise BOEM expects drilling operations would have the same effect on mysticete whales in the Chukchi Sea, eliciting temporary avoidance behavior in a few of the whales within the potential zone of effects from drilling noise.

The distance at which bowheads may react to drillships is difficult to gauge, because some bowheads would be expected to respond to noise from drilling units by changing their migration speed and swimming direction to avoid closely approaching these noise sources. For example, in the study by Koski and Johnson (1987), one whale appeared to adjust its course to maintain a distance of 23-27 km (14.3-16.8 mi) from the center of the drilling operation, and migrating whales avoided the drillship by 10 km (6.2 mi), passing to the north and south of drilling operations. In this study no bowheads were detected within 9.5 km (5.9 mi), and few were observed within 15 km (9.3 mi) of the drillship. The study concluded that bowheads appeared to avoid the offshore drilling operation during their 1986, fall migration.

Another study by Richardson et al. (1995) concluded:

> …migrating bowheads tolerated exposure to high levels of continuous drilling noise if it was necessary to continue their migration. Bowhead migration was not blocked by projected drilling sounds, and there was no evidence that bowheads avoided the projector by distances exceeding 1 kilometer (0.54 nautical miles). However, local movement patterns and various aspects of the behavior of these whales were affected by the noise exposure, sometimes at distances considerably exceeding the closest points of approach of bowheads to the operating projector.

The results from these two studies illustrate the variable responses of bowhead whales to drilling activities have been noted since at least 1987.

Richardson et al. (1995) reported that bowhead whale avoidance behavior has been observed in half of the animals when exposed to 115 dB re 1 µPa rms broadband drillship noises. However, reactions vary depending on the whale activity, noise characteristics, and the physical condition of individual animals (Olesiuk et al., 1995; Richardson, 1995b; Kraus et al., 1997; NRC, 2003, 2005). The study concluded that the demonstrated effects were localized and temporary, and playback effects of drilling noise on distribution, movements, and behavior were not biologically significant, leading the MMS to conclude that drilling activity should have a minor level of effects on bowhead whales. Moreover, offshore drilling operations have occurred in the Beaufort Sea over the past several decades. In this time, the Western Arctic Stock of bowhead whales has concurrently increased to a level that may approach the bowhead whale carrying capacity of the Beaufort and Chukchi seas (Allen and Angliss, 2011).

Richardson et al. (1985) projected recordings of the drillship *Explorer II* at summering bowheads in the Canadian Beaufort Sea. Changes in behavior in response to the sounds were observed, and some whales showed avoidance behavior; however, the deflection away from the noise was considered weak (Richardson et al. 1985). During this study the investigators observed whales between 2.5 mi

and 12.4 mi (4 km and 20 km) from the drillship as drilling activity was occurring, and concluded the whales were undisturbed. In a similar study, Wartzok et al. (1989) projected recordings of the drilling vessel Kulluk, and no deflections were noted until sound pressure levels were ≥120 dB.

Gallagher, Brewer, and Hall (1992) monitored bowhead distribution during the drilling of the Galahad No. 1 well with the Explorer II in the Alaska Beaufort. They observed 96 bowheads during the monitoring effort, with the closest observation at 10.3 mi (16.5 km), and the average observation being 22 mi (34.8 km) from the drillship. Whales were noted farther offshore than historical trends suggested, and their routes took a more northerly bearing than expected as they approached the drill site, turning west after passing the drillship. These observations suggested a diversion effect due to drilling noise; however, the authors noted it was a heavy ice year and the whales were forced to migrate further offshore along a path aligned with the ice edge.

Brewer et al. (1993) observed 49 bowheads in the survey area while the *Kulluk* drilled the Kuvlum No. 1 well. The closest observed whale was 14 mi (23 km), and the average observation distance was 25 mi (40.3 km), from the drillship. The report noted drilling operations (drilling unit, icebreakers, and supply vessels) may have caused migrating bowhead whales to assume more clumped groupings, and shifted their distribution north, skirting around drilling operations. The start of the diversion was thought to begin about 19 mi (30 km) east of the drill site, but the authors noted the diversion was temporary as the whale distribution appeared to resume a typical track (uniform distribution and closer to shore). The investigators thought it unlikely that ice conditions were solely responsible for the changes in bowhead distribution.

Hall et al. (1994) observed the distribution of 373 bowhead whales around the Kuvlum No. 2 and No. 3 wells, which were also drilled by the Kulluk. They observed bowheads within 4.5 mi (7.2 km) of the drillship, and reported migrating bowheads much closer to shore than at a control area east of the drillship. A review of their plotted sightings indicated almost total avoidance of the area within 6.2 mi (10 km) of the drillship (Richardson et al., 1995b); however, the authors concluded the bowhead distribution patterns may have been due to sea ice, and that the distribution fell within the norms for fall distributions.

Few fin, humpback, and minke whales are expected to be in the vicinity of the Burger Prospect, and bowhead whales are expected to remain scarce at the Burger Prospect until their migration out of the Beaufort Sea begins in September. Gray whales are expected to occur throughout the eastern Chukchi Sea until their fall migration to Baja California begins (Funk et al. 2010; Blees et al. 2010; Brueggeman, 2010). Relatively few bowhead and gray whales, and fewer than 0-5 fin/humpback/minke whales are expected to be exposed to drilling noises from the Proposed Action. Based on the numbers reported by Shell (Shell, 2011a: Appendix C, Table 4.1.7-1) and this impacts analysis, the effects of sound energy generated by drilling on bowhead, and gray whales would be minor, while fin, humpback, and minke whales would be affected negligibly due to their low presence in the area.

ZVSP. An eight airgun array (4×40 in^3 airguns and 4×150 in^3 airguns, total volume of 760 in^3) would likely be used to perform ZVSP surveys at or near the end of each exploration well. Each ZVSP survey would last around 10-14 hours and include approximately 216 firings of the full airgun array, plus additional firing of a single 40-in^3 airgun to be used as a "mitigation airgun" while the geophones are relocated within the wellbore. The estimated source level used to model sound propagation from the airgun array is approximately 241 dB re 1µPa m rms, with most energy between 20 and 140 Hz (Shell 2011a: Appendix C: pp. 4-60).

From a behavioral perspective, seismic noise could mask whale vocalizations and interfere with their communications, and/or alter natural behaviors (i.e., displacement from migration routes or feeding areas; disruption of activities such as feeding, resting, or nursing) although it occurs at the lower end of the audible spectrum for mysticetes. Behavioral impacts may vary by gender, reproductive status,

age, accumulated hearing damage, type of activity engaged in at the time, group size, and/or whether the animal has heard the sound previously (e.g., Olesiuk et al., 1995; Richardson, 1995b; Richardson et al., 1995; Kraus et al., 1997; NRC 2003, 2005). Mysticete females with calves have exhibited heightened behavioral responses to seismic noise (Henley and Ryback, 1995; McCauley et al., 2000), while in other studies some bowheads ceased feeding when exposed to seismic noise, though others continued feeding (Fraker, Richardson, and Würsig, 1995; Richardson, Wells, and Würsig, 1985).

Gray whales are low-frequency hearing specialists, with an auditory range starting at 10 Hz and possibly extending to 30 kHz (Ketten, 1998). Erbe (2002) (inferring from gray whale vocalizations) suggested they may be sensitive to frequencies between 20 Hz and 4.5 kHz, with their greatest sensitivity occurring in the 20 Hz–1.2 kHz range. 10 kHz clicks have been reported, with main frequencies between 1.4 and 4 kHz. The lowest response threshold reported was 82–95 dB at 800 Hz (Erbe, 2002). Minke whales appear most sensitive to sound between 100 and 200 Hz, with good sensitivity between 60 Hz–2 kHz. High-frequency clicks were analyzed in two studies, indicating they have some sensitivity between 4 and 7.5 kHz, up to 20 kHz (Erbe, 2002).

Based on previous studies (Table 20), few fin or humpback whales are expected to occur in the eastern Chukchi Sea, and even fewer are anticipated to occur in the proposed activity area. Few bowheads should occur in the eastern Chukchi Sea (Table 20) before the fall migration from the Beaufort Sea commences in September. Thus, gray whales are the only mysticete expected to regularly occur in the eastern Chukchi Sea for much of the open water season. The small chance of encountering bowhead, humpback, fin, or minke whales greatly lowers the potential impact of the Proposed Action on those species. In the unlikely event of an encounter with one of these species, the repetitive noise of discharging 150-cm^3, and 40-cm^3 airguns is expected to deflect the whale away from the area of effects before any injury can occur. BOEM anticipates the effects to be generally similar to those noted for other mysticete whales because of shared morphological characteristics and similar biological needs.

A maximum of three ZVSP surveys could be conducted within a single season; subsequently, any disturbances from ZVSP airguns discharging could occur for a maximum of 42 hours for the entire open water season. Whales begin diverting when received levels of noise reach approximately 150-180 dB (Richardson, 1995c), and so it is reasonable to expect avoidance behavior from mysticetes to begin before they approach to within 12,041 ft (2.28 mi) or 3,670 m (3.67 km) of ZVSP operations (160 dB zone in Table 9). By applying MMOs and ramp-up protocols as mitigation measures for ZVSP operations, TTS and PTS effects to the hearing of baleen whales should be avoided. Consequently, BOEM anticipates a minor level of effects from ZVSP activities on bowhead and gray whales with an estimated average of 25 bowheads and 21 gray whales being exposed to airgun noise during each season (Table 4.1.7-1: Shell 2011a: Appendix F). In addition, a negligible level of effects on fin, humpback, and minke whales are expected, since an average of zero individuals of those species should be affected by ZVSP airgun noise in any single season (Table 4.1.7-1: Shell 2011a: Appendix F). The rating of negligible for fin, humpback, and minke whales is mostly due to their scarcity in the prospect areas, which greatly lessens the likelihood of encountering or affecting them during the ZVSP phase of the Proposed Action.

Vessel Traffic. Bowhead whales react to the approach of vessels at greater distances than they react to most other activities. Most bowheads exhibit avoidance of vessel traffic, although reactions are less dramatic to slower moving vessels and vessels that are not approaching the animals directly (USDOC, NOAA, NMFS, 2008). In the Canadian Beaufort Sea, bowheads observed in vessel-disturbance experiments began to orient away from an oncoming vessel at a range of 2-4 km (1.2-2.5 mi) and to move away at increased speeds when approached closer than 2 km (1.2 mi) (Richardson and Malme, 1993). Vessel disturbance during these experimental conditions temporarily disrupted activities and sometimes disrupted social groups, when groups of whales scattered as a vessel approached.

According to Richardson and Malme (1993), most bowheads begin to swim rapidly away when vessels approach rapidly and directly. Received noise levels as low as 84 dB re 1 µPa or 6 dB above ambient may elicit strong avoidance of an approaching vessel at a distance of 4 km (2.5 mi) (USDOI, MMS, 2008, incorporated by reference). Richardson and Finely (1989) noted that bowheads tend to react most strongly to vessels when the vessels were moving quickly and directly toward the whale than if the vessel was moving more slowly or in any other direction than at the whale.

Richardson, Wells, and Wursig (1985) found that bowheads react more strongly to vessel traffic than other industrial disturbances such as aircraft overflights and drilling, and that most bowheads began to turn away when vessels approached within 0.6-2.5 mi (1-4 km) of the whale. The whales usually tried to outrun the boat, and when the vessel approached to within a few hundred yards, the whales diverted from the vessel path or dove. In comparison, groups of whales scattered during this study, though fleeing generally stopped within minutes after the vessel passed, but remaining scattered for perhaps an hour or more. Additional behavioral responses to vessel traffic also included changes in respiration rates. Similar responses to vessels have been observed in fin (Ray et al., 1978 as cited in Richardson et al., 1985) and humpback whales (Baker et al., 1983 in Richardson, Wells, and Wursig, 1985).

Koski and Johnson (1987) made similar observations of bowheads in the Alaskan Beaufort where strong responses by feeding bowheads to large icebreakers and supply vessels were observed. Changes in whale behavior were temporary, with feeding often resuming while the moving vessel was still within 3.7- 6.0 mi (6.0-10.0 km). At least some of the whales were observed back at the same area the next day, indicating there were little if any effects on bowhead whales use of that area.

Wartzok et al. (1989) reported that bowheads generally ignored a small ship at distances greater than 547 yd (500 m). Over 180 whales voluntarily approached within 547 yd (500 m) of the vessel. Little response was noted unless there was a sudden change in sound level due to ship acceleration. These studies indicate that some bowheads will react more strongly than others to vessel traffic associated with Shell's exploration drilling program. Bowheads may alter their behavior and avoid the area within 0.6-2.5 mi (1-4 km) of the vessel. Any changes in behavior such as swimming speed and orientation, respiration rate, surface-dive cycles will be temporary and lasting only minutes or hours. Similarly, any consequent displacement of bowheads will be of a similar length of time and be restricted to a distance of a few miles (kilometers) from the vessel.

Gailey et al. (2007 citing Bogoslovskaya et al., 1981) noted eastern gray whales on summer feeding grounds, fled when Soviet catcher vessels approached within 350-550 m, but usually paid no attention to vessels at distances > 550m. Richardson (1995c: p. 264 - reporting from Schulberg, Show, and Van Schoik, 1989) noted many gray whales may show no deflection or change in their behavior until vessels approach to within 49-98 ft (15-30 m) of the whale. Underwater sound also may cause whales to avoid vessels moving within their immediate area, and gray whales are expected to exhibit avoidance of vessels in close proximity (USDOI, MMS, 2007a). However, any avoidance responses due to vessel traffic are expected to be minimal and temporary.

The most common baleen whale occurrences will likely be gray whales, along with small numbers of bowhead, and smaller numbers of minke whales. Fin and humpback whales most likely will not be encountered during the proposed activities if past observations are any indication of their presence at the leases; however, possible sightings cannot presently be ruled out. The reactions of fin, humpback, and minke whales to vessel traffic are expected to approximate those of bowheads and gray whales due to their morphological similarities.

The drillship and support vessels will not enter the Chukchi Sea earlier than July 1 when most of the spring bowhead migration is complete. Consequently few bowheads are expected to be encountered during the drilling operations, until the fall migration out of the Beaufort Sea. As a mitigation measure, vessels associated with the drilling program that are underway will reduce speed, avoid

separating members from a group of whales and avoid multiple course changes when within 300 yd (275 m) of marine mammals, including whales. Vessel speed also will be reduced during inclement weather conditions in order to avoid collisions with whales and other marine mammals. These mitigations should prevent any measureable disruptions to mysticete whales at the prospect areas. Consequently, BOEM concludes that vessel traffic and noise from the Proposed Action are expected to result in negligible effects on mysticete whales in the project area.

Ice Management. The Proposed Action would entail ice management activities, with some potential for icebreaking. Brewer et al. (1993) reported that in fall 1992, migrating bowhead whales avoided an icebreaker accompanied drillship by 25+ km. The ship was icebreaking almost daily. Richardson et al. (1995) noted that in 1987, bowheads also avoided another drillship with little icebreaking. Response distances vary, depending on icebreaker activities and sound-propagation conditions. Based on models in earlier studies, Miles, Malme, and Richardson (1987) predicted bowhead whales should respond to the sound of icebreakers at distances of 2-25 km (1.24-15.53 mi) from active icebreakers. The same study predicts about half of the bowhead whales in an area can be expected to show an avoidance response to an icebreaker underway in open water conditions at 2-12 km (1.25-7.46 mi) distance, or to an icebreaker pushing ice at 4.6-20 km (2.86-12.4 mi) distance, when the sound-to-noise ratio is 30 dB.

Richardson et al. (1995) concluded that exposure to a single playback of variable icebreaker sounds can cause statistically, but probably not biologically, significant effects on movements and behavior of migrating whales in lead systems during the spring migration east of Point Barrow. The study indicated the predicted response distances for bowheads around an actual icebreaker may be highly variable; but typically detectable effects on the movements and behavior of traveling bowheads are predicted to extend in a of 10-30 km (6.2-18.6 mi) radius, and sometimes to 50+ km (31.1 mi) radius. It should be noted that these predictions were based on reactions of whales to playbacks of icebreaker sounds in a lead system during the spring migration, and are subject to a number of factors that would not apply to the Proposed Action which would occur during the open water season. Infrasounds (sound at a range of frequencies below that of human hearing) that may be associated with icebreakers were not adequately represented in playback transmissions. Bowhead whales likely can hear or detect infrasounds (Richardson et al., 1995b).

Richardson et al. (1995: p.322) summarized:

> The predicted typical radius of responsiveness around an icebreaker like the Robert Lemeur is quite variable, because propagation conditions and ambient noise vary with time and with location. In addition, icebreakers vary widely in engine power and thus noise output, with the Robert Lemeur being a relatively low-powered icebreaker. Furthermore, the reaction thresholds of individual whales vary by at least ±10 dB around the "typical" threshold, with commensurate variability in predicted reaction radius.

Richardson et al. (1995) stated:

> If bowheads react to an actual icebreaker at source to noise and RL values similar to thosefound during this study, they might commonly react at distances up to 10-50 km from the actual icebreaker, depending on many variables. Predicted reaction distances around an actual icebreaker far exceed those around an actual drillsite…because of (a) the high source levels of icebreakers and (b) the better propagation of sound from an icebreaker operating in water depths 40+ m than from a bottom-founded platform in shallower water.

In order to limit the close contact between the whales and ice-management vessels and support-vessel operations, MMOs would be stationed on all support vessels to survey inside the exclusion zone (areas within isopleths of certain sound levels for different species) for marine mammals. If a marine mammal is sighted from a vessel within its relative safety radius, the vessel would reduce activity (reduce ice-management activities or speed if in transit) and sound level to ensure that the animal is

not exposed to sound energy above their relative safety levels. Full activity would not be resumed until all marine mammals are outside of the exclusion zone.

Although bowhead whales react to icebreaking and ice-management activities, these activities are expected to have a minor level of effect on the bowhead whale population in the Chukchi Sea for the following reasons: the timing of this project during the open-water season; the low likelihood of the presence of large amounts of sea ice; a scarcity of bowhead whales during the July-August segment of this project; and the short duration of this project. The reactions of gray, fin, humpback, and minke whales to icebreaking and ice-management activities are expected to be similar to that of bowhead whales. However, considering the observed paucity of fin and humpback whales in the project areas, a negligible level of is expected for these whale species, since no detectable population-level effects could be measured for either. Minke whales are slightly more common; however, they generally do not associate with ice. Grey whales, which are the most common cetacean species in the area for much of the open water season, also generally do not associate with ice. Consequently, negligible effects are anticipated for minke, and gray whales from icebreaking and ice management.

Aircraft Traffic. For whales, the most common reaction to aircraft traffic is avoidance behavior, such as diving. Richardson et al. (1985) monitored the responses of summering bowhead to overflights with both fixed wing (Islander) aircraft and helicopter (Sikorsky S-76) in a set of planned experiments. Overflights of fixed-wing aircraft sometimes evoked responses at altitudes of less than 1,000 ft (305 m), infrequently at altitude of 1,500 ft (457 m), and virtually never at altitudes greater than 2,000 ft (610 m). The researchers concluded bowhead whale behavior is generally not disturbed by aircraft if an altitude of 1,500 ft (> 457 m) is maintained. The most common bowhead reactions to overflights were sudden or hasty dives, and changes in orientation, and dispersal or movement out of the area. Changes in activity were sometimes noted. Bowheads that were engaged in social activities or feeding were less sensitive than those that were not. Whales in shallow water < 33 ft (< 10 m) were often very sensitive. No overt responses were observed to helicopter overflights at an altitude of 500 ft (153 m); however, others (Richardson, 1995b) have reported disturbances such as hasty dives in response to low-level helicopter overflights. Richardson and Malme (1993) reported that most bowhead whales in their study did not show a response to helicopters flying at altitudes above 500 ft (150 m).

Gray whales may also show avoidance behavior in response to air traffic sound energy. Moore and Clarke (2002: citing Southwest Research Associates 1988) reported migrating gray whales did not react overtly to a Bell 212 helicopter at > 425m (1,394 ft) altitude, but they occasionally reacted when helicopters were at altitudes of 305-365m (1,000-1,197 ft), and usually reacted when helicopters were below 250m (820 ft). Clarke, Moore, and Ljungblad (1989) found gray whale mothers with calves appear to be particularly sensitive to air traffic. Some gray whales have been observed reacting to sound energy generated by helicopters flying within 328 ft (100 m) of the whales (Richardson, 1998). As a mitigation measure Shell helicopters will be prohibited from flying at altitudes below 1,500 ft (457 m) except during take-offs, landings, marine mammal monitoring, and when conditions force an altitude reduction for personal safety reasons. Shell helicopter flights should therefore have little or no effect on gray or bowhead whales. Any changes in gray whale behavior due to aircraft traffic associated with Shell's exploration drilling program will be minor and temporary, lasting only minutes or hours.

Summarily, the most likely response of baleen whales to aircraft operations in support of the Proposed Action would be very brief and minor alterations in their swimming and diving behavior until the aircraft noise becomes inaudible. Consequently, the effects of aircraft presence and noise on bowhead, fin, gray, humpback, and minke whales are expected to be minor due to mitigations applicable to the Proposed Action.

Discharges. The Proposed Action entails the discharges of wastewater, drill cutting, and drilling fluids. As explained above, the areas affected by these discharges would be small, would recover quickly, and would be in the general proximity of activities causing enough noise to discourage visitation by mysticetes. Identifiable impacts to these whales from discharges are therefore unlikely.

Small Fuel Spill. After reviewing the potential effects of a 48 bbl oil or fuel spill on baleen whales, BOEM finds a negligible level of effects applies. Such a small spill would be insufficient to produce any population level effects on whales in the Chukchi Sea. Oil generally poorly adheres to the skin of mysticete whales, and cetaceans are believed to have the ability to detect and avoid oil spills (Geraci, 1990; St. Aubin, 1990). Moreover, the weathering process should act to quickly break up or dissipate oil/fuel through the local environment to harmless residual levels that would eventually become undetectable.

Large and Very Large Oil Spills. Although very unlikely, it is possible that the Proposed Action could lead to a large or very large oil spill. For the purpose of analysis, BOEM estimates potential discharge volumes for this EA to be 1,555 bbl of diesel for a large spill and 750,000 bbl of crude oil for a very large spill. The Sale 193 Final EIS (USDOI, MMS, 2007a) analyzed potential effects to mysticete whales from large spills and found potential for adverse impacts through direct contact, reduction of prey availability, toxic exposure, and disturbance from cleanup operations. The Sale 193 Final SEIS (USDOI, BOEMRE, 2011a) analyzed potential effects to mysticete whales from a very large spill and identified a variety of potential direct and indirect effects, some of which could become significant under certain circumstances. These analyses remain sufficient to analyze the effects of large and very large spills in the Chukchi Sea, including the 1,555 bbl diesel spill and the 750,000 bbl oil spill estimated for this EA

Odontocetes: Beluga, Harbor Porpoise and Killer Whales

This section summarizes and incorporates the analysis of potential impacts from drilling operations found in Sale 193 Final EIS (USDOI, MMS, 2007a), Sale 193 Final SEIS (USDOI, BOEMRE, 2011a), Shell's (Shell, 2011a: Appendix F), and NMFS' proposed IHA for the proposed exploration drilling (76 FR 69958, November 9, 2011). Densities of odontocetes are anticipated to be very low in the project area and few beluga, harbor porpoise, or killer whales are expected to come into contact with proposed exploration activities on or near the Burger Prospect. Since impacts to all three species would be similar, they are grouped for this analysis.

Drilling. Impacts to Odontocetes from drilling operations are primarily impacts from exposure to sound. Sound propagation from the drill ship *Discoverer* is anticipated to decrease below 120db at less than 2km from the drill ship. Based on a variety of marine mammal surveys of the drill site area and the northeastern Chukchi Sea, NMFS and Shell have estimated that zero beluga, harbor porpoise or killer whales will be exposed to drilling sound above 120dB. Negligible impacts to odontocetes are anticipated from exploration drilling in the vicinity of the Burger Prospect in the Chukchi Sea.

ZVSP. The proposed ZVSP airgun array has been estimated to reach 160 dB, but to decrease below that level at less than 4 km from the *Discoverer*. NMFS estimates that 4 beluga, 0 harbor porpoises, and 0 killer whales may be exposed to sound levels exceeding 160dB. Negligible impacts to odontocetes are anticipated from the planned vertical seismic profiling.

Vessel Traffic and Ice Management. Some odontocetes may be encountered during transit to or from the drill site, or as they move through the drilling area. This is the case regardless of whether Shell exits the drilling area in late October or sometime prior. In general, beluga, harbor porpoise, and killer whales react to vessels and to icebreaking by moving away from the source of the activity. Some may therefore be displaced during feeding or may have increased energetic costs during rapid avoidance of vessel traffic. NMFS and Shell have estimated that for this operation, ice breaking noise decreases below 120dB at a maximum distance of about 10 km. NMFS estimates that fewer than 5

individuals of each species would be exposed to sound levels exceeding 120dB. Vessel traffic and icebreaking are expected to have a negligible level of effect for beluga, harbor porpoise, or killer whales.

Aircraft Traffic. Aircraft have minimal impacts on beluga, harbor porpoise, and killer whales. Because sound doesn't pass through the air-water surface very well, odontocetes are not typically affected by flights that pass briefly overhead at elevations of 1500 ft or above along offshore straight line transit routes. Shell's proposed aircraft flights along predetermined routes and during marine mammal surveys are not anticipated to have more than a negligible impact to odontocetes.

Discharges. Discharges of fluids and cuttings from the proposed wells are unlikely to have direct effects to odontocetes. Under EPA guidelines, concentrations of drilling fluids drop below levels that would affect marine mammals within a few minutes, and are diluted within a few hundred meters. Impacts to the fish they prey upon or a significant decrease in water quality could result in an indirect effect on odontocetes, but this is not anticipated given the small scale of the habitat disturbance. Impacts to fish and water quality are fully discussed in those sections.

Small Fuel Spill. A small spill (estimated at a potential 48 bbl for this EA) of diesel fuel would dissipate over a few days. Impacts to odontocetes from a small spill are unlikely because odontocetes are unlikely to be in the vicinity of the drillship or associated vessels due to noise. Because odontocetes are likely to avoid and disperse from areas with lots of human activity (such as clean up crews or drilling operations), it is likely that odontocetes would avoid the area of the spill as long as clean up activities were ongoing.

Large and Very Large Oil Spill. The potential impacts of small, large, and very large oils spills have been analyzed in the Sale 193 Final EIS (USDOI, MMS, 2007a) and Sale 193 Final SEIS (USDOI, BOEMRE, 2011a) and are summarized here. Impacts from a spill originating at the proposed drill sites or from a vessel in transit to or from the proposed drill site do not differ from the previous analysis. A very large oil spill is a highly unlikely event, but could result in exposure to oil for odontocetes: through skin, inhalation, or ingestion of contaminated prey. Affects from this exposure in open water are likely to be limited to short term non-lethal effects such as skin irritation. A large or very large oil spill could result in moderate impacts to odontocetes.

Polar Bear

This section refers to the Chukchi Bering seas (CBS) stock of polar bears and the Southern Beaufort Sea (SBS) stock of polar bears, and the critical habitat established for polar bears within the U.S. and U.S. waters. There is a substantial area of overlap between the two stocks, and activities in the northern Chukchi Sea would have the potential to impact both populations. In general, polar bears are widely dispersed when on sea ice and few polar bears transit through the open water as far offshore as the project area is located (+60 miles). Polar bears have been observed in the northeastern Chukchi Sea during the open water season, primarily when the pack ice is in the immediate vicinity.

Exploratory drilling projects have the potential to disturb polar bears that are swimming between the pack ice and shore. Swimming can be energetically expensive for polar bears, particularly for bears that engage in long-distance travel between the leading ice edge and land. Bears that encounter open water exploratory drilling operations may be temporarily deflected from their chosen path, and some may choose to return to where they came from. However, bears swimming to shore are most likely heading for reliable food sources (i.e., areas where ringed seal concentrations are high or Native-harvested marine mammal carcasses are on shore), for which they have a strong incentive to continue their chosen course. Therefore, although some bears may be temporarily deflected and/or inhibited from continuing toward land due to exploratory drilling operations, this interruption likely would be brief in duration. Due to the vast area over which polar bears travel and their dispersed distribution, the number of bears affected in this manner likely would be very small.

Drilling. Polar bears are closely tied to the presence of the sea-ice platform for the majority of their life functions, including hunting (Amstrup, 2003). It is unlikely that open-water exploration drilling in the northeastern Chukchi Sea will impact polar bears or the abundance and availability of ringed and bearded seals, which are the primary prey of polar bears. Exploration drilling operations have a localized footprint of a few thousand square feet per well; in this case, more than 60 miles offshore. The drillship and associated vessels will move out of the Chukchi Sea towards the end of the open water season. Impacts to polar bears from the drilling noise are negligible and no adverse impacts to critical habitat are anticipated.

ZVSP. The proposed ZVSP airgun array has been estimated to reach 160dB, but to decrease below that level at less than 4 km from the *Discoverer*. Polar bears normally keep their heads above or at the water's surface when swimming, where underwater noise is weak or undetectable (Richardson et al., 1995a). The sound level of the ZVSP is not anticipated to reach the 190 dB level identified as the level of "take" for polar bears. Negligible impacts to polar bears are anticipated from the planned vertical seismic profiling and no adverse impacts to critical habitat are anticipated.

Vessel Traffic. Most vessel operations associated with the proposed exploration drilling plan will take place far offshore and in open water and are not expected to encounter polar bears. Polar bears may approach or avoid ice breakers. Brueggeman et al. (1991) observed polar bears in the Chukchi Sea during previous drilling operations and recorded their response to an icebreaker. While bears did respond (walking toward, stopping and watching, walking/swimming away) to the vessel, their responses were brief. Impacts to bears from vessels are likely to be limited to short-term disturbance and displacement from the immediate area of activity, resulting in some expenditure of energy. In general, impacts are anticipated to be negligible.

Ice Management. If icebreaking is needed to transit in or out of the Chukchi Sea, or if icebreakers need to manage ice that has approached the drill ship during active drilling, then polar bears may be encountered. Shell's ice management plan is to avoid pack ice by moving the drillship offsite if necessary. Although this is for the safety of the ship and crew, it also reduces the likelihood of a need for icebreaking or encounters with polar bears. Shell's intention is to wait to enter the Chukchi Sea until after July 1 when the ice has receded north of the drill site. During transit into the Chukchi Sea, Shell may encounter some broken melting ice. During transit out of the Chukchi Sea, Shell may encounter some first year ice. While at the drill site, ice management may involve nudging floes of ice away from the drill ship. This is usually done by using propwash to push the ice floe into a different part of the current so that it will flow past the drillship rather than into the drillship. No adverse impacts to critical habitat are anticipated.

Aircraft Traffic. Sources of flights in the Proposed Action include industry crew changes and industry marine mammal surveys. Flights during crew change outs will follow a fixed route from Wainwright to the drill site over open water and are unlikely to disturb polar bears. Polar bears may be displaced from ice floes or terrestrial sites temporarily during marine mammal surveys, which will follow a sawtooth pattern nearshore. Impacts from these short term temporary disturbances are limited to some expenditure of energy for individual bears.

As polar bears spend more time fasting onshore due to receding sea ice the potential for small repeated energetic costs to have health impacts increases. Increases in physiological stress of adult or juveniles may reduce fitness and have implications for productivity and survivorship over time. Requirements that industry flights stay at 1500 ft or above ground level and a minimum of ½ km from polar bears helps to reduce the potential for disturbance. Flight corridors established from shore bases to offshore industry operation sites reduce the potential for disturbances by limiting the spatial extent of the over-flights. Aircraft flights associated with Shell's offshore drilling plan are likely to have a negligible impact to polar bears and no adverse impacts to critical habitat

Discharges. The discharge of drilling fluids and cuttings during exploration activities is not expected to cause impacts to polar bears or critical habitat, either directly through contact or indirectly by affecting prey species. Any effects would be localized primarily around the exploration drilling site because of the rapid dilution/deposition of these materials. The effects from such discharges are expected to be localized to a small proportion of available marine mammal habitat.

Small Fuel Spill. For the purpose of analysis, it is estimated for this EA that a 48 bbl spill of diesel fuel could occur. Given the dispersed distribution of polar bears, it is likely that a small spill persisting for less than 2-30 days would affect few polar bears, resulting in a minor level of effect on polar bears and no adverse impacts to critical habitat.

Large and Very Large Oil Spill. The potential impacts of small, large, and very large oils spills have been analyzed in the Sale 193 Final EIS (USDOI, MMS, 2007a) and the Sale 193 Final SEIS (USDOI, BOEMRE, 2011a), respectively, and are summarized here.

In the unlikely event that a large (estimated at a potential discharge of 1,555 bbl for this EA) or very large spill (estimated at a potential discharge of 750,000 bbl) occurred at the drill site, it would likely be carried northward by the currents. If the oil came into contact with the pack ice, or became entrained in the ice, it could impact polar bears. If Polar bears come into contact with spilled fuel from a small spill or oil from a large or very large spill in water or on ice, their coats could become fouled. Polar bears rely on their thick fur to avoid hypothermia, and a heavily oiled bear would likely not survive. Polar bears could also ingest toxins while grooming or by foraging on seals that had become oiled (Amstrup et al, 2000; Amstrup et al, 1989; Durner and Amstrup, 2000). A large or very large spill that came ashore or fouled a large area of sea ice could impact polar bears directly (and indirectly through their prey) and could result in moderate or major impacts to polar bears as well as adverse impacts to critical habitat.

Cleanup operations following a large oil spill would involve multiple marine vessels operating in the spill area for extended periods of time, perhaps over multiple years. After a large spill, there typically are helicopter and fixed-wing aircraft over flights to track the spill and to determine distributions of wildlife that may be at risk from the spill. In the event of a large spill, both FWS and NMFS personnel would be on hand to conduct marine mammal surveys and to determine the best course of action to limit the potential impacts to marine mammals as much as possible. This may include prioritizing clean up to particularly sensitive areas, hazing animals away from spilled oil and clean up activities, and capturing oiled animals for transfer to rehabilitation facilities. The effects from cleanup activities on pinniped species would be largely the effects of disturbance from vessels, the effects of disturbance from aircraft, and the effects of the spilled oil itself.

4.6.3 Alternative 3 – One Well per Season

If Alternative 3 is selected, a maximum of one exploration well would be drilled in any season. Drilling six wells to total depth would require at least six seasons. The annual impacts from Alternative 3 would be slightly less than those described under Alternative 2, because there would be less disturbance from a single event compared with two or possibly three drilling events under Alternative 2. A shorter period of disturbance could reduce the probability of impacts and the number of animals impacted and would result in a smaller level of effects per season. The fleet would likely operate in the drill site area for a shorter time period each year, which would decrease the time period during which impacts could occur at the drill site in any one year. If drilling operations occur when there is the most open water and the least ice, the likelihood of encounters with walrus or polar bears, and possibly beluga, would decrease (although the likelihood of encountering polar bears or beluga is already very low).

However, this Alternative could have a greater total adverse effect on marine mammals. Whereas under Alternative 2 the drilling program could be completed in as few as two seasons, under

Alternative 3 the drillship and support vessels would enter, operate in, and exit the Chukchi Sea six or more times. Adverse effects could thus recur for a much longer (i.e. over twice as long) time period, becoming chronic. Consequently marine mammals might experience chronic exposures to the effects of exploration drilling under Alternative 3, which might lead to long-term direct and indirect effects that have yet to be observed or studied elsewhere in the Arctic, such as repeated vessel and aircraft traffic, drilling, and ZVSP seismic.

Under Alternative 3, the potential for a large or very large petroleum spill would be spread across additional seasons, but the potential environmental effects of such spills would be the same as was analyzed under Alternative 2.

4.6.4 Cumulative Effects

Past, present, and reasonably foreseeable future activities relevant to potential cumulative effects are described in Appendix C. Marine mammals in the Chukchi Sea could be adversely affected by predation and subsistence activities, climate change, and marine vessel and aircraft traffic.

Predation and Subsistence. Predation and subsistence hunting continue to have the greatest impact on certain marine mammal species in the northeastern Chukchi Sea. Shell's proposed action would not contribute to these impacts.

Climate Change. Decreasing sea ice may be changing patterns of habitat use for marine mammals, increasing the available range of some whales, but decreasing available habitat for ice seals, polar bear, and walrus. Changes in sea ice extent related to climate change are altering the behavior and foraging opportunities of both walrus and polar bears, and shoreline and barrier islands along the Chukchi Sea coastline are increasing in importance as habitat for these species. While major shifts in their productivity or migrations have yet to be measured to date, bowhead whales are expected to be adversely affected if sea ice losses continue. These changes are likewise anticipated to have a growing impact over the long term for ice seals. However, climate change effects are difficult to predict, and no marked effects from climate change are anticipated over the small number of years necessary to complete the proposed action. The incremental increase to effects caused by the proposed action would be negligible and would not change the overall level of cumulative impacts to marine mammals from other past, present, and reasonably foreseeable future actions.

Disturbance. Activities entailing the use of marine vessels and aircraft can impact marine mammals by temporarily altering their behavior. Potential behavior changes include deflections away from vessels or aircraft, cessation of calling, masking of received sounds, temporary separations of mother/calf pairs and interruptions of foraging, and resting or other behaviors, all of which have energetic costs. Temporary disturbances resulting from exploration activities associated with Alternatives 2 and 3 could add incrementally to temporary disturbances resulting from other activities in the region to have an adverse cumulative effect on marine mammals. Specifically, any additional activities occurring during the same time period and in the same general area, and requiring the use of large marine vessels or aircraft, may cause additional disturbances to these species. Appendix C describes the potential for ongoing aerial and vessel based wildlife surveys, routine vessel passage through the area for cargo transport, aerial wildlife surveys, and routine aerial transport of cargo and passengers. Vessel traffic may increase over the course of the lifetime of this project as more cargo ships and tourist cruises take advantage of the increase in open water in the Arctic. The incremental impacts of the proposed alternatives in conjunction with the ongoing activities in the region are expected to have a negligible level of cumulative effect on these species over the lifetime of this project.

Analysis of the likely range of adverse behavioral effects supports a conclusion that the activities would result in no more than temporary negligible to minor effects. No significant effects to mysticete whales in the Chukchi Sea have been observed with respect to shipping and commercial air

traffic, though the situation may change in the future. Due to their low numbers in the area, ribbon seals, minke, fin, and humpback whales are much less likely to be affected than are gray whales, ringed seals, spotted seals, and ribbon seals. Bowhead whales and beluga whales are highly unlikely to be affected by the proposed activities until the fall migration period out of the Beaufort Sea. Due to the fact that individual bowheads are migrating to Chukotka at this time, any impacts from the proposed actions would amount to individual bowheads skirting around the noise envelope before resuming their original route to their destination.

Conclusion. The effects of Alternatives 2 and 3 would have minute long-term detrimental effects on the marine mammals and their populations in the Chukchi Sea and should add little to the larger cumulative effects that are already occurring.

4.7 Terrestrial Mammals

For more in-depth analysis of the effects of drilling, seismic, and offshore exploration activities on terrestrial mammal species, populations, and their environment please review the Lease Sale 193 Final EIS (USDOI, MMS, 2007a) and Lease Sale 193 Final SEIS (USDOI, BOEMRE, 2011a). The effects on terrestrial mammals of the exploration drilling proposed here would be the same as was described in these documents, which are summarized and incorporated below.

The Western Arctic (WAH) and Teshekpuk Lake Caribou Herds (TCH), one or possibly two grizzly bears or moose, a few muskoxen, and Arctic foxes could be affected by aircraft travel along the proposed flight path between Barrow and Wainwright, Alaska. The flight path lies approximately five miles inland from the coast (Shell, 2011a, Appenidx F: Figure 2.2-1) and without mitigations, could disturb or drive caribou away from potential insect relief areas during July and August, or elicit escape reactions that could be injurious to individual animals. The proposed minimum flight altitude of 1,500 ft (457 m) (except for safety reasons) would mitigate the effects of air travel between Barrow and Wainwright. As discussed in Section V.II, page II-231 of the Arctic Multiple Sale Draft EIS, observation of caribou, muskox, moose, and grizzly bears have shown that flights above 1,000 ft have little effect upon them (USDOI, MMS, 2008).

No other impacts to terrestrial mammals are anticipated. Air and water quality effects are too small to be detected along the Chukchi coastal areas, vessel traffic will be far offshore, and any noise or other activities associated with the Proposed Action would be to far from the coast to have any effect. Consequently, aircraft presence and noise should have a negligible effect on terrestrial mammals within a few miles of the inland flight corridor between Barrow and Wainwright Alaska. Aircraft presence and noise beyond the Barrow-Wainwright flight path would have no effects on terrestrial mammals, since no other air travel is proposed for Alternatives 2 and 3. All other effectors would have no effect on terrestrial mammals in the region.

Small oil/fuel spills, discharges, and any air/water quality effects would be extremely small, if detectable at all, along the Alaskan coast, and vessel traffic will be far offshore preventing any noise or other activities from having effects on terrestrial mammal resources. A large spill is very unlikely to contact the coast since 1,555 bbl—the estimated potential discharge for a large spill in this EA—would weather before making landfall. As explained in the Sale 193 Final EIS (USDOI, MMS, 2007a) and the Sale 193 Final SEIS (USDOI, BOEMRE, 2011a), the potential for adverse effects to terrestrial mammals in the event of a large or very large oil spill is low. Therefore, negligible effects are anticipated for terrestrial mammals from small, large, or very large oil spills resulting from the Proposed Action.

Under Alternatives 2 and 3 there would be a negligible level of effects on some terrestrial species as a result of aircraft traffic and noise, while under Alternative 1 there would be no effects. Alternative 3 would only allow one well to be drilled per annum, which could potentially protract the effects beyond the estimated time to project completion under Alternative 2. Consequently, the cumulative

effects from aircraft traffic and noise under Alternative 3 could exceed what would otherwise occur under Alternative 2. However, the level of effects would still remain negligible under either alternative. All other determinations of no effect are consistent between the three different alternatives.

Caribou from the WAH and TCH would continue to experience annual mortality to predation, injuries, stress, subsistence hunting, and sport hunting. Climate change is expected to have profound detrimental effects to some species such as caribou, but beneficial effects on others, including shrinkage in winter range for the WAH (Murphy et al. 2010). For the duration of Alternatives 2 and 3, no major effects from climate change are anticipated so mortalities are expected to remain within what typically occurs per annum. By comparison the effects from the Proposed Action are expected to occur rarely, and as mitigated, have a negligible level of effect on any terrestrial mammal species in the area. Consequently BOEM does not expect the effects of Alternatives 2 or 3 to add appreciably to the cumulative effects over the duration of the proposed activities, or to long-term cumulative effects.

4.8 Subsistence Activities

This section describes the direct and indirect effects on subsistence activities that may result from the no action alternative and Proposed Action described in Section 2.

4.8.1 Alternative 1 – No Action

Under Alternative 1, the proposed exploration activities would not be approved, and no effects to subsistence activities would occur.

4.8.2 Alternative 2 – Proposed Action

Subsistence use by the communities of Barrow, Wainwright, Point Lay, and Point Hope and the place and time that each species is hunted and harvested are discussed in Section 3.2.10 above and in Tables 23, 24, 25, and 26. Direct adverse effects would result when activities described in the Proposed Action cause interference or disruption of subsistence activities. An example of a direct effect is when the physical presence of a drill ship prevents harvest activity from occurring in the area around a drill ship. Indirect adverse effects would result when the subsistence resource, the target species, is adversely affected, and therefore not available, available in reduced numbers, or is otherwise made undesirable for harvest. An example of an indirect effect is if noise from a drillship causes bowhead whales to divert from an area where hunting and harvest usually occur. In order for the effect to be realized, the exploration activities or their residual effects have to overlap in space and time with subsistence resources.

Potential direct and indirect effects will primarily result from vessel presence and vessel traffic interacting with subsistence activities, vessel and air traffic noise causing diversion of the resource away from the location of subsistence activities, and the increased level of activities offshore and onshore being incompatible with subsistence activities. The activities described under the Proposed Action would be completed within two years after commencement of exploration drilling.

An important consideration in assessing potential effects on subsistence activities is that most of Shell's proposed activities would occur in the summer and fall, from early July to late October. This is the time during which the Iñupiat from Barrow, Wainwright, Point Lay, and Point Hope have completed the spring bowhead whale hunt and other activities described in Section 3.2.10 and in Tables 23, 24, 25, and 26, such as the beluga whale hunt at Point Lay.

Table 32 (below) indicates for each village, the exploration activities that do or do not overlap in the space or time that the resource is normally hunted and harvested. For example, drilling activities on the Burger Prospect are not expected to disrupt subsistence activities. No documented subsistence

activities have occurred at the proposed offshore drill sites, so the activities do not overlap in space. Similarly, activities associated with the exploration occur before or after the time when the animals are normally hunted or harvested. For example, Shell will not begin activities until after the spring bowhead whale hunt is completed in the Chukchi Sea, so there is no overlap in time between exploration and harvest.

Most of the effects from the proposed activities result from avoidance behavior by the animal being hunted, which may divert the animal away from the location of subsistence activities. These typical behaviors, described in greater detail in the Arctic Multiple-Sale Draft EIS (USDOI, MMS, 2008: Section 4.4.1.8, 4.4.1.9, and 4.4.1.12) are:

- Bowhead whales may exhibit temporary avoidance behavior if approached by vessels at a distance of 1-4 km (0.62 to 2.5 mi), with behavioral changes lasting a few minutes in the case of vessels and up to 30 to 60 minutes in the case of seismic activity. No obvious response to helicopter overflights above 150 m (500 ft), avoidance behavior for other air traffic could persist up to 12 hours.
- Beluga whales, seals, walruses, and polar bears may be startled, annoyed, or flee intense noise with vessel traffic temporarily displacing (within 1-3 km [0.62 to 1.9 mi]) or interfering with marine mammal migration, and change local distribution for a few hours to a few days. Aircraft effects expected to be local and transient for seals. Walrus exhibit little reaction to aircraft above 305 m (1000 feet) but traffic may disturb walrus and seals from haulouts and cause them to enter the water.
- Caribou reaction to aircraft flying below 305 m (1,000 feet) include startle forcing herds and individuals to scatter, separating cows from calves, and possibly causing injury during panic.
- Reaction of birds to vessel traffic could displace birds from the area where the activity is occurring with little direct mortality. Aircraft noise could disturb birds, causing them to flush or move away from noise and approaching low-flying aircraft.

Table 32. Potential for the proposed activities to affect subsistence resources for Chukchi Sea Communities.

Subsistence Resource	Point Hope	Point Lay	Wainwright	Barrow
Bowhead Whale Spring Hunt	Completed prior to start of exploration activities. No overlap in space or time. Therefore, no effect.	Completed prior to start of activities. No overlap in space or time. Therefore, no effect.	Completed prior to start of activities. No overlap in space or time. Therefore, no effect.	Completed prior to start of activities. No overlap in space or time. Therefore, no effect.
Bowhead Whale Fall Hunt	Not traditionally undertaken. In addition, no overlap in space. Therefore, no effect	Not traditionally undertaken. In addition, however, no overlap in space. Therefore, no effect.	Potential direct and indirect effect from vessel and aircraft transit.	Potential direct and indirect effect from aircraft transit
Beluga	Overlap in time, no overlap in space. Therefore, no effect.	Overlap in time, no overlap in space. Therefore, no effect.	Potential effect from vessel and aircraft transit.	Potential effect from aircraft transit
Caribou	Overlap in time, no overlap in space. Therefore, no effect.	Overlap in time, no overlap in space. Therefore, no effect.	Potential effect from vessel and aircraft transit.	Potential effect from aircraft transit
Pacific Walrus	Overlap in time, no overlap in space. Therefore, no effect.	Overlap in time, no overlap in space. Therefore, no effect.	Potential effect from vessel and aircraft transit.	Potential effect from aircraft transit
Bearded Seal	No overlap in time or space. Therefore, no effect.	No overlap in time or space. Therefore, no effect.	Potential effect from vessel and aircraft transit.	Potential effect from aircraft transit
Ringed Seal	No overlap in time or space. Therefore, no effect.	No overlap in time or space. Therefore, no effect.	Potential effect from vessel and aircraft transit.	Potential effect from aircraft transit

Subsistence Resource	Point Hope	Point Lay	Wainwright	Barrow
Spotted Seal	No overlap in time or space. Therefore, no effect.	Overlap in time, no overlap in space. Therefore, no effect.	Potential effect from vessel and aircraft transit.	Potential effect from aircraft transit
Ribbon Seal	No overlap in time or space. Therefore, no effect.	No overlap in time or space. Therefore, no effect.	Potential effect from vessel and aircraft transit.	Potential effect from aircraft transit

Mitigation measures incorporated into proposed activities to minimize vessel and marine mammal interaction and subsistence activities include:

- The *Discoverer* and support vessels will enter the Chukchi Sea through the Bering Strait on or after July 1, minimizing effects on marine mammals and birds that frequent open leads and minimizing effects on spring and early summer bowhead whale hunting.
- Drillship and support vessel transit routes will avoid known fragile ecosystems and the Ledyard Bay Critical Habitat Unit, and will include coordination through Communication Centers (Com Centers).
- To minimize impacts on marine mammals and subsistence hunting activities, the drillship and support fleet will transit through the Chukchi Sea along a route that lies offshore of the polynya zone. In the event the transit outside of the polynya zone results in Shell having to break ice (as opposed to managing ice by pushing it out of the way), the drillship and support vessels will enter into the polynya zone far enough so that ice breaking is not necessary. If it is necessary to move into the polynya zone, Shell will notify the local communities of the change in the transit route through the Com Centers. As soon as the fleet transits past the ice, it will exit the polynya zone and continue a path in the open sea toward the drill sites.
- MMOs will be aboard the *Discoverer* and all support vessels.
- Vessels will not operate within 0.5 mi (0.8 km) of walrus or polar bears when observed on land or ice.
- When within 900 ft (274 m) of marine mammals, vessels will reduce speed, avoid separating members from a group and avoid multiple changes of direction.
- Vessel speed is to be reduced during inclement weather conditions in order to avoid collisions with marine mammals.
- Shell will communicate and coordinate with the Com Centers regarding all vessel transit.

As shown on marine vessel routes (Shell, 2011a: Figure 13.e-1) and flight corridors (Shell, 2011a: Figure 13.e-2), Point Hope and Point Lay summer and fall subsistence resource populations and harvests of bowhead whales, beluga, walrus, seals, and caribou would be out of range of any potential disturbance or disruption from Shell's activities or the residual effects of those activities. Provisions of Lease Stipulation No. 7—which directs surface vessels associated with exploration and delineation drilling operations to avoid travel within Ledyard Bay Critical Habitat Unit and directs aircraft to avoid operating below 1,500 feet above sea level over the Unit between July 1 and November 15—should eliminate effects from vessels and aircraft on subsistence activities that occur in the unit. The Proposed Action's mitigation measures put into place for Point Lay and Point Hope, such as the Com Centers and subsistence advisor program, would help ensure that communities and harvesters are informed as to Shell's activities offshore. Impacts to Point Hope and Point Lay subsistence activities are not expected but would be considered negligible. Although no effects are expected, subsistence resources could be rarely but periodically affected, but there would be no apparent effect on subsistence harvests. Impact to Barrow and Wainwright subsistence activities are expected to be

minor because the few potential effects would be accidental or incidental and would be very short term.

Using the proposed primary and alternate flight corridors (Shell, 2011a: Figure 13.e-2), the primary helicopter route between the shorebase and the Burger Prospect is from the Barrow airport where the helicopters are stationed, directly offshore to the Burger Prospect. Helicopters would alternatively travel between Wainwright and the Burger Prospect under special circumstances. The proposed alternative overland flight corridor between Barrow and Wainwright crosses an area that is recognized as being subsistence territory used by the Iñupiat of Barrow, Atqasuk, and Wainwright. Past use has been prolonged and consistent, as evidenced by the numerous house sites, camps, and other cultural features that dot the landscape (SRB&A, 1989a, 1989b; USDOI, MMS, 2010).

Active harvesters have expressed concerns about disruption or displacement of caribou and other wildlife by noise, with noise from helicopters being one source of particular concern (S.R. Braund and Assocs., 2009: p.18-30, 39-40). For example, Point Hope hunters report that while preparing to hunt "the caribou would be spooked by a small airplane flying around. Hunters reported that the caribou are taking a difficult route and they believe it is because of an airplane flying low near the mountains" (Umiak LLC, 2011). Point Lay hunters have expressed concerns that helicopter traffic is scaring caribou farther away from traditional hunting areas (ASRC Energy Services, 2009). Similarly, the Wildlife Director for the Native Village of Barrow, raised a concern in a meeting regarding affects from helicopter traffic, suggesting that there be no flying overland between Barrow and Wainwright because of observations that the caribou are being disturbed (Umiak LLC, 2011). Mitigation suggested by active harvesters to reduce the effects of overflights on subsistence resources includes (SRB&A, 2009):

- Planning ahead of time and locating activities to minimize exposure of wildlife to noise.
- Learn from locals, areas and times that are most sensitive for wildlife.
- Set altitude minimums by activity.
- Put in place a real-time monitoring and response communication system so harvesters out on the land and water can communicate directly with dispatchers.
- Alert harvesters to planned activities.
- Provide means so that harvesters and pilots can learn from each other and exchange ideas to minimize impacts.
- Conduct and annual survey of harvesters to monitor harvest success and reports of impacts to activities. Hold and annual workshop to discuss and respond to results.

Many of these suggested measures are included in the mitigations that have been incorporated into the Proposed Action to minimize effects from aircraft on subsistence activities and ensure communications with subsistence hunters, which include:

- Aircraft shall not operate below 1,500 ft (457 m) unless the aircraft is engaged in marine mammal monitoring, approaching, landing, or taking off, in poor weather (fog or low ceilings), or in an emergency situation, while over land or sea to minimize disturbance to mammals and birds.
- Aircraft engaged in marine mammal monitoring shall not operate below 1,500 ft (457 m) in areas of active whaling; such areas to be identified through communications with the Com Centers.
- Aircraft will not operate within 0.5 mi (0.8 km) of walrus or polar bears when observed on land or ice.
- Shell will also implement non-MMO flight restrictions prohibiting aircraft from flying within 1,000 ft (300 m) of marine mammals or below 1,500 ft (457 m) altitude (except

during takeoffs and landings or in emergency situations) while over land or sea. This flight will also help avoid disturbance of and collisions with birds.

- Implementation of a Communication Plan and will implement this plan before initiating exploration drilling operations to coordinate activities with local subsistence users, as well as Village Whaling Captains' Associations, to minimize the risk of interfering with subsistence hunting activities, and keep current as to the timing and status of the bowhead whale hunt and other subsistence hunts. The Communication Plan includes procedures for coordination with Com Centers to be located in coastal villages along the Chukchi and Beaufort Seas during Shell's proposed exploration drilling activities.
- Shell will employ local subsistence advisors (SAs) from the Chukchi Sea villages that are potentially impacted by Shell's exploration drilling activities. The SAs will provide consultation and guidance regarding the whale migration and subsistence activities.

Subsistence harvesters have expressed concerns about more outsiders present in hunting areas, making it difficult to hunt safely and without fear of misrepresenting subsistence hunting (SBR&A, 2009). The BOEM-approved Shell Cultural Awareness Program developed in response to BOEM Stipulation No. 2, Orientation Program, is "designed to increase sensitivity and understanding by Shell and its contractors of community values, customs, and lifestyles in the area they will be working, and how to avoid conflicts with subsistence activities" (Shell, 2011a: pp. 5–6). This measure should mitigate the concerns expressed by subsistence harvesters.

Wainwright would be 90 mi away and Barrow would be 150 miles away from drilling activities, respectively, and most summer and fall subsistence resource populations and harvests would be out of range of any potential disturbance from drilling activities. If the alternative aircraft route is used, helicopter traffic originating in Barrow will fly down the coast to Wainwright before proceeding offshore in a route intended to minimize effects to subsistence harvest activities. Vessel traffic to and from Wainwright would traverse marine subsistence areas.

Wainwright's bowhead and beluga whale hunts that occur in June would be completed prior to the start of exploration activities. Subsistence hunts for polar bear, bearded seal (*ugruk*), hair seals, fish, and birds would occur either in nearshore coastal areas at least 40 mi from activities or in the spring and winter seasons when drilling and vessel and helicopter traffic would not be present. In Wainwright, walrus hunting during August can occur up 40 mi from shore, still 20 mi from proposed activities. Walrus present within the vessel/flight corridor potentially could be disrupted by these activities, but IHA and LOA monitoring requirements, minimum flight elevations of 1,500 ft, and coordination with community Com Centers and subsistence advisors would likely mitigate potential disturbance to walrus so that the resulting impacts would be no more than negligible. Caribou hunting occurs in late summer and fall and caribou congregate nearshore between Barrow and Wainwright at this time. It is expected that the inland flight corridor and maintaining 1,500 ft while transiting between the two communities would not disrupt caribou movements or the subsistence hunt.

Wainwright's nascent fall bowhead whale hunt could be affected by aircraft and vessel traffic associated with exploration activities. While the location of the past harvest is northeast of Wainwright and close to shore, away from the vessel and aircraft route to the Burger Prospect, hunting in future years could be closer to the community. Adherence to the mitigation measures would ameliorate the effects of exploration-related air and vessel traffic on the bowhead whale harvest.

The effects described above could occur on an annual basis but do not persist past the end of each year's activities. If exploration activities terminate prior to the end of October in any year the types and level of impacts would be as described above because of the location and timing of subsistence activities. If the exploration activities continue past two years, the effects for each additional year would be the same as described above. Effects to subsistence activities for Barrow and Wainwright

could occur from incidental or accidental interactions between exploration drilling activities and subsistence activities because mitigation measures eliminate or practically reduce effects from routine activities. In addition, the effects to subsistence activities that occur are short term and are not expected to persist past the end of each year's drilling season. However, with adaptive management, effects that accidentally or incidentally occur in one year would be recognized and measures would be applied to activities where necessary to prevent recurrence in subsequent years.

The oil-spill analysis has determined that there is a low chance for an accidental small oil spill that likely would be operational in nature. For the purpose of this analysis, a 48 bbl fuel transfer spill was chosen. A 48 bbl diesel spill (the estimated potential discharge for this EA) would evaporate and disperse in less than 3 days before contacting critical nearshore subsistence areas. As required by Lease Stipulation 6, oil-spill containment booms would be deployed during any refueling activity, and would contain a small oil spill if one should occur.

The perception that an oil-spill could contaminate subsistence foods, particularly marine mammals or fish, might be of concern to the Iñupiat at Barrow, Wainwright, Point Lay, and Point Hope in terms of potential effects on health. Because subsistence activities do not occur in the vicinity of proposed drilling and any associated spill source, and because no fuel transfer is expected during transit between the Beaufort and Chukchi seas, the short-term effects of the analyzed small spill on subsistence activities are expected to be negligible to minor. No long-term effects are anticipated as effects are not expected to persist past the end of the drilling season.

A large spill of 1,555 barrels (the estimated potential discharge for this EA) or very large oil spill of up to 750,000 (the estimated potential discharge for this EA) would have similar effects to those described in detail in other lease sale EIS's for subsistence resources (USDOI, MMS, 2007a; USDOI, MMS 2008; USDOI, BOEMRE, 2011a). General effects from a large oil spill could be expected from the oil spill itself, actual or perceived tainting, and the cleanup disturbance that could occur after such a spill event. A spill affecting any part of the habitat used by the bowhead whale, other marine mammals (seals, walrus, beluga, polar bears), or caribou could taint the resource, so that (even if available for harvest) it could leave the species less than desirable and alter or stop the subsistence activity. Oil-spill-cleanup activities could produce additional effects on subsistence activities, potentially causing displacement of subsistence resources and subsistence hunters. All areas directly oiled, areas to some extent surrounding them, and areas used for staging and transportation corridors for spill response would not be used by subsistence hunters for some time following a spill. Oil contamination of beaches would have a profound impact on whaling because even if bowhead whales were not contaminated, Iñupiat subsistence whalers would not be able to bring them ashore and butcher them on a contaminated shoreline. The duration of avoidance by subsistence users would vary depending on the volume of the spill, the persistence of oil in the environment, the degree of impact on resources, the time necessary for recovery, and the confidence in assurances that subsistence harvest resources were safe to eat.

Summary – Alternative 2

With Shell's adherence to proposed mitigation, monitoring, communication, and response plans, short-term effects from drilling and air and vessel traffic on subsistence resources range from no effect to minor.

4.8.3 Alternative 3 – One Well per Season

Potential direct and indirect effects will primarily result from vessel presence and vessel traffic interacting with subsistence activities, vessel and air traffic noise causing diversion of the resource away from the location of subsistence activities, and the increased level of activities offshore and onshore being incompatible with subsistence activities. The activities described under this alternative would require at least six drilling seasons.

The effect of activities would be the similar to those effects described under Alternative 2, the Proposed Action, except that the effects may occur annually in each additional year of exploration activity. Point Hope and Point Lay summer and fall subsistence resource populations and harvests of bowhead whales, beluga, walrus, seals, and caribou would be out of range of any potential disturbance or disruption from Shell's activities or the residual effects of those activities. Effects on subsistence activities for Barrow and Wainwright could occur from incidental or accidental interactions between exploration drilling activities and subsistence activities because mitigation measures eliminate or practically reduce effects from routine activities. In addition, the effects to subsistence activities that occur are short term and are not expected to persist past the end of the each year's drilling season. Furthermore, with adaptive management, effects that accidentally or incidentally occur in one year would be recognized and measures taken to prevent recurrence in subsequent years.

Under Alternative 3, the potential for a large or very large petroleum spill would be spread across additional seasons, but the potential environmental effects would be the same as was analyzed under Alternative 2

Summary – Alternative 3

With Shell's adherence to proposed mitigation, monitoring, communication, and response plans, short-term effects from drilling and air and vessel traffic on subsistence resources range from no effect to minor.

4.8.4 Cumulative Effects

This section discusses the effect on subsistence resources which results from known past, present and reasonably foreseeable future activities and the incremental contribution of the Proposed Action and alternatives to the Proposed Action. The past, present, and reasonably foreseeable future activities have been identified in Appendix C.

This environmental analysis has identified vessel traffic, specifically marine vessel traffic, as an important impact source of anthropogenic sound introduced to the Chukchi Sea during the timeframe of the proposed activities.

Other vessel traffic is not controlled by the proposed project, and should be assumed to continue through the period of the exploration activities, including the fall whaling hunt at Barrow and Wainwright. These vessels could be icebreakers, USCG vessels, cargo vessels, other supply ships and tugs and barges, cruise ships, and vessels associated with scientific endeavors. The USCG estimates that from 2008 to 2010 the number of vessels in the Arctic increased from more than 100 to more than 130, and the number of transits through the Bering Strait increased from more than 245 to more than 325 (USCG, 2011). The estimated number of miles of non-seismic vessel traffic in the Chukchi Sea for July through October increased from approximately 2000 miles in 2006 to more than 11,500 miles in 2010 (Shell, 2011a: Appendix F, Table 4.2-2). Vessel tracks from 2009 indicate vessel transits in the vicinity of Barrow and Wainwright are concentrated to the west and south of the communities along the coast (Marine Exchange of Alaska, 2011). This area corresponds to the subsistence use areas described in Section 3.2.10 for those communities.

Air traffic not associated with the proposed project may involve flight patterns at a lower altitude than the 1,500 ft level that will be industry's standard for this project. Other air traffic associated with basic village transportation, freight and mail, and scientific endeavors would continue unabated. Shell calculated that an average of 306 commercial flights per month occurred from Wainwright airport between July and October, 2000 to 2008 (Shell 2011a: Appendix F, Table 4.1.11-6). As noted in Section 4.8, Alaska Native hunters have expressed concern about marine mammal and caribou reaction to aircraft noise impacting subsistence harvest. The air traffic noise has the potential to disrupt and disturb subsistence hunters from Chukchi villages.

Previous environmental analyses have concluded that cumulative effects from shipping and other sources "would continue to have a moderate level of effect on subsistence resource and harvest practices. The greatest source of large noncrude oil spills would occur from bulk fuel deliveries to coastal villages. The anticipated increase in marine traffic from tourism, research, and other shipping vessels could dramatically increase the potential for marine accidents and large fuel spills, which could result in major adverse effects on subsistence resources and harvest practices in the Chukchi Sea region" (USDOI, MMS, 2008: p. 4-896).

Activities described in the exploration plan would incrementally increase the number of marine vessel transits in the Chukchi Sea from mobilization of the drilling fleet in July, logistic support of activities of the offshore supply vessel during the drilling season (between Dutch Harbor and the drillsite, approximately 17 round trips or 34 transits of the Bering Strait), and oil spill response work boats (between the Wainwright supply base and oil spill response barge, approximately 12 round trips per week for two months). The supply vessel transits represent an increase of approximately 10 percent over the cumulative total for 2010. OSR work boat traffic will increase the number of trips from Wainwright. All these vessels will observe the vessel travel mitigation measures designed to avoid or minimize effects on subsistence activities.

Shell estimates that exploration activities will require the support of approximately 4 round trips per week of a fixed wing aircraft between Anchorage and Wainwright, an increase of approximately 10 percent over the average number of flights per month under the no action alternative. Exploration activities will require 12 round trip helicopter flights per week between Barrow and the drillsite. All helicopter flights will observe the aircraft travel mitigation measures designed to avoid or minimize effects on subsistence activities.

The incremental impacts of the Proposed Action on subsistence resources would be negligible for routine activities such as vessel and aircraft operations, and negligible to minor for an oil spill from a vessel. The Proposed Action's contribution to cumulative effects would be negligible and would result in no change in the moderate to major level of effect for subsistence resources from past, present, and reasonable foreseeable future actions.

4.9 Sociocultural Systems

This section describes the direct and indirect effects on sociocultural systems that may result from the Proposed Action and alternatives described in Section 2.

4.9.1 Alternative 1 – No Action

Under Alternative 1, the proposed exploration activities would not be approved, and no effects on sociocultural systems would occur.

4.9.2 Alternative 2 – Proposed Action

BOEM will only permit offshore oil and gas activities if disruption to subsistence harvest of resources can be minimized in such a manner that the disruption is short term and the result of incidental or accidental encounters. Under the Proposed Action, these encounters would come primarily from vessel traffic and aircraft traffic associated with the project. Because of the negligible to minor subsistence effects described in Section 4.8 from vessel traffic interacting with subsistence activities, vessel and air traffic noise causing diversion of the resource away from the location of subsistence activities, and the increased level of activities offshore and onshore being incompatible with subsistence activities, negligible effects on social organization and institutional arrangement are not expected to occur. Offshore activities are likely to cause some concern already present in North Slope communities regarding the potential effects of oil spills from the activities. Onshore supply base operations using existing facilities could result in concern over encroachment of oil facilities on the community, but these would be negligible at most and could be offset by the benefits of increased

opportunity from direct and indirect employment in the communities. The effects will occur each season that Shell conducts exploratory drilling operations under this exploration plan. The negligible effects, however, are temporally limited and consecutive years of activity would not have an additive effect.

The oil-spill analysis has determined that there is a low chance for an accidental small oil spill that likely would be operational in nature. For the purpose of this analysis, a 48 bbl fuel transfer spill was estimated. A 48 bbl diesel spill (the potential discharge estimated for this EA) would evaporate and disperse in less than 3 days before contacting critical nearshore subsistence areas. As required by Lease Stipulation 6, oil-spill containment booms would be deployed during any refueling activity, and would contain a small oil spill if one occurred.

A large spill of up to 1,555 barrels (the potential discharge estimated for this EA) or very large oil spill of up to 750,000 barrels (the potential discharge estimated for this EA) would have similar effects to those described in detail in other lease sale EIS's for sociocultural resources (USDOI, MMS, 2007a; USDOI, MMS, 2008; USDOI, BOEMRE, 2011a). The sociocultural impacts of a large or very large oil spill on Alaskan Native communities are interconnected with the subsistence lifestyle of these communities. Subsistence embodies the traditions of Alaskan Native culture with overlapping connections to other cultural, social, and economic institutions. Longer term disruptions to subsistence resources and practices would impact sharing networks, subsistence task groups, and crew structures, as well as cause disruptions of the central Iñupiat cultural value: subsistence as a way of life. These disruptions could cause breakdowns in family ties, a community's sense of well-being, and damage sharing linkages with other communities, and could curtail community activities and traditional practices for harvesting, sharing, and processing subsistence resources—a major impact on sociocultural systems. The effects of disruption to sociocultural systems would last beyond the period of oil-spill cleanup and could lapse into a chronic disruption of social organization, cultural values, and institutional organization.

BOEM views very large oil spills as having the potential to cause long-term significant effects that would disrupt or nearly eliminate subsistence harvests. Oil spills are never permitted and are always in violation of the law. Operators would be held accountable and responsible for mitigation and monitoring, loss or reduction of subsistence species, and effects on the local subsistence harvesters and the linked social organizations and institutions.

4.9.3 Alternative 3 – One Well per Season

Potential direct and indirect effects will primarily result from the potential of the proposed activities to interfere or disrupt sociocultural practices associated with subsistence. As described in Section 4.8, these effects result from vessel traffic interacting with subsistence activities, vessel and air traffic noise causing diversion of the resource away from the location of subsistence activities, and the increased level of activities offshore and onshore being incompatible with drilling seasons.

The effect of activities would be the similar to those effects described under Alternative 2-Proposed Action, except that the effects may occur annually in each additional year of exploration activity. Point Hope and Point Lay summer and fall subsistence resource populations and harvests of bowhead whales, beluga, walrus, seals, and caribou, discussed in the affected environment section, would be out of range of any potential disturbance or disruption from Shell's activities or the residual effects of those activities. Effects on subsistence activities for Barrow and Wainwright could occur only from incidental or accidental interactions between exploration drilling activities (such as vessel and air traffic) and subsistence activities because mitigation measures eliminate or practically reduce effects from routine activities. In addition, the effects on subsistence activities that occur are short term and are not expected to persist past the end of the each year's drilling season. Furthermore, with adaptive management, effects that accidentally or incidentally occur in one year would be recognized and measures taken to prevent recurrence in subsequent years.

4.9.4 Cumulative Effects

This section discusses the effects on sociocultural systems which result from known past, present, and reasonably foreseeable future activities, and the incremental contribution of the Proposed Action. Relevant past, present, and reasonably foreseeable future activities have been identified in Appendix C. The potential for the Proposed Action and alternatives to contribute to cumulative effects is assessed below.

Direct, indirect, and synergistic cumulative effects on sociocultural systems have been discussed in previous analyses (USDOI, MMS, 2007a; USDOI, MMS, 2008; USDOI, MMS, 2009; USDOI, BOEMRE, 2011a; SRB&A, 2009; Ristroph, 2010). These ongoing effects include the following trends:

- Adaptation to introduction of new technology, pressures, and legal/regulatory actions introduced through successive waves of contact between Natives and non-Natives, starting with whaling in the 19th century through oil and gas development in the 21st century.
- Changes in settlement patterns with greater centralization into larger communities.
- Continuation of pattern of centralized leadership of whaling captains and their families, cultural and nutritional dependence on subsistence foods, reliance on sharing and kinship, connection to family camps and traditional use areas, and a desire to control destination of their communities.
- Stress to sociocultural systems that result from the encroachment of oil-production facilities into areas used for subsistence.
- Population growth and employment and an influx of non-Native workers can cause long-term disruption to social organization and place increased demands on institutions that provide public service and health care.
- Problems North Slope communities are experiencing in social health and well being that could be exacerbated by additional development.
- Stress created by fear of an oil spill, a predevelopment impact-producing agent that is distinct from potential effects from routine operations.
- Response of institutions to strengthen Iñupiat traditions and culture in the face of these stresses.
- Positive effects from higher income and community infrastructure and services made possible from oil and gas activity.
- Continued adaptation of the communities to changing conditions brought about by changing climatic conditions in the Arctic.

These trends will continue over the period covered by the exploration plan. Overall, the effect of these trends constitutes a major effect on sociocultural systems, as recognized in the previous analyses.

Activities described in the exploration plan would incrementally contribute to some of the trends described above. For example, offshore activity contributes to the fear of an oil spill and there will be some population growth as a result of the influx of project workers into the communities. However, the effects on sociocultural systems would be very short term, not expected to persist beyond the end of the exploration drilling program. Mitigation measures, such as the orientation program, the plan of cooperation, and measures to minimize or avoid effects on subsistence, reduce the project's effects to a negligible level. Some positive effects, such as project-level employment of North Slope residents and increased economic activity for Native corporations will occur. These effects would occur over the life of the exploration program.

The incremental cumulative effect of the Proposed Action on sociocultural resources would be negligible and would result in no change in the major level of effect for sociocultural systems from past, present, and reasonably foreseeable future actions.

The perception of contamination to subsistence foods, particularly marine mammals or fish, might be of concern to the Iñupiat at Barrow, Wainwright, Point Lay, and Point Hope in terms of potential effects on health. Because subsistence activities do not occur in the vicinity of proposed drilling or any associated spill source, and because no fuel transfer is expected during transit between the Beaufort and Chukchi seas, the short-term effects of the analyzed small spill on subsistence activities are expected to be negligible to minor. No long-term effects are anticipated, as effects are not expected to persist past the end of the drilling season.

The activities that occur under this Alternative 3 would incrementally contribute to some of the trends described above, and would have approximately the same effect as the Proposed Action, except that the effects would occur over a period of six drilling seasons after the commencement of activities.

The incremental cumulative effect of Alternative 3 on sociocultural resources would be negligible. Incremental contributions from Alternative 3 would result in no change in the major level of effect for sociocultural systems from past, present, and reasonable foreseeable future actions. Under Alternative 3, the potential for a large or very large petroleum spill would be spread across additional seasons, but the potential environmental effects would be the same as was analyzed under Alternative 2.

4.10 Economy

The description and analysis of effects on the economy below focuses on the economy of the NSB, as the location, timing, and scale of the activities described in the 2012 Shell Revised Chukchi Sea EP are not expected to generate economic effects at the State or Federal level.

4.10.1 Alternative 1 – No Action

Under the No Action Alternative, the proposed exploration activities would not be approved, and no effects on the economy would occur.

4.10.2 Alternative 2 – Proposed Action

Descriptions of the NSB economy in the 2012 Shell Revised Chukchi Sea EP (Shell, 2011a) are incorporated by reference, and salient points are included below. Additional information on the NSB economy is also provided.

Employment and Personal Income. Shell's offshore exploration plan promises to provide specific benefits to some local residents in and around Barrow, Wainwright, Point Hope, and Point lay. Shell's proposed exploration drilling would offer employment to a relatively small number of local NSB residents, but more than previously proposed projects in the area. The MMO program would employ local Iñupiat residents to monitor and document marine mammals in the project area. The Subsistence Advisor program would recruit a local resident from each village to communicate local concerns and subsistence issues from residents to Shell. Shell's Com Center program would involve hiring individuals from Chukchi Sea villages. In total, Shell estimates that 196 direct jobs could be created annually for North Slope residents by Shell's exploration drilling program, spread out among job types including MMOs, subsistence advisors, community liaisons, communication and call centers, village OSR responders, contingency responders, and shorebase staff (Shell, 2011c). A more detailed discussion of local hire can be found in section 2.3.8.

Even with the potential employment and related personal income associated with the proposed activities, it appears that employment opportunities for local residents, especially Alaskan Natives, would remain comparatively low in oil industry-related jobs on the North Slope. Goods and services

would be obtained from local village contractors, when available, during the duration of the project. The proposed activities are short term and temporary and are expected to have a negligible effect on the economy of the NSB or communities of Barrow, Wainwright, Point Hope, and Point Lay. These effects do not constitute a significant change in the impacts previously identified and evaluated in the approved with conditions 2010 Chukchi Sea EP (USDOI, MMS, 2009a).

Revenues. The proposed exploration activities will not require development of additional onshore oil and gas infrastructure that the NSB and State of Alaska would receive property tax revenues from, and so the direct and indirect effects on revenues are expected to be negligible.

Small Fuel Spill. It is reasonably likely that the Proposed Action could result in a small oil spill. For the purpose of analysis, a 48 bbl fuel transfer spill was estimated for this EA. A 48 bbl diesel spill would disperse and evaporate within 3 days, generating minimal additional employment and personal income during that time.

Large and Very Large Oil Spill. Although very unlikely, it is possible that the Proposed Action could lead to a large or very large oil spill. For the purpose of analysis, BOEM estimates potential discharge volumes for this EA to be 1,555 bbl of diesel for a large spill and 750,000 bbl of crude oil for a very large spill. The Sale 193 Final EIS (USDOI, MMS, 2007a) analyzed potential effects to the economy from large spills and found that likely effects to the local economy include creating additional employment of 60-190 jobs with associated personal incomes for up to six months. The Sale 193 Final SEIS (USDOI, BOEMRE, 2011a) analyzed potential effects to the economy from a very large oil spill and found that a very large oil spill would generate thousands of direct, indirect, and induced jobs and millions of dollars in personal income associated with oil spill response and cleanup in the short run. In addition, revenue impacts from a hypothetical very large oil spill include additional property tax revenues accruing to NSB from any additional onshore oil spill response infrastructure, and any potential decline in Federal, State, and local government revenues from displacement of other oil and gas production. These analyses remain sufficient to analyze the effects of large and very large spills in the Chukchi Sea, including the 1,555 bbl diesel spill and the 750,000 bbl oil spill estimated for this EA.

4.10.3 Alternative 3 – One Well per Season

Under Alternative 3, exploration drilling activities will be less intensive in any single drilling season but more prolonged overall. Spreading out exploration drilling activities over additional drilling seasons would also prolong the potential direct and indirect impacts to employment and personal income, as described above, though the economic impacts would be lower in any single drilling season. As is the case with Alternative 2, these impacts would still be considered negligible, and would not constitute a significant change in the impacts to employment and personal income previously identified and evaluated in the approved with conditions 2010 Chukchi Sea EP (USDOI, MMS, 2009a). Under Alternative 3, the potential for a large or very large petroleum spill would be spread across additional seasons, but the potential environmental effects would be the same as was analyzed under Alternative 2.

4.10.4 Cumulative Effects

A thorough discussion of past, present, and reasonably foreseeable future actions affecting the Chukchi Sea environment is provided in Appendix C.

Activities associated with the Proposed Action are short term and temporary, involving relatively low levels of new employment and associated income, and no generation of property tax revenues accruing to the NSB or State of Alaska, and are therefore expected to have a negligible cumulative effect on employment, income, and revenue levels of the NSB.

Under Alternative 3, exploration drilling activities will be less intensive in any single drilling season but more prolonged overall. Spreading out exploration drilling activities over additional drilling seasons would also prolong the potential cumulative impacts to employment and personal income, as described above, though the impacts would be less intense in any single drilling season. As is the case with Alternative 2, these impacts would still be considered negligible, and would not constitute a significant change in the impacts to employment and personal income previously identified and evaluated in the approved with conditions 2010 Chukchi Sea EP (USDOI, MMS, 2009b).

4.11 Public Health

4.11.1 Alternative 1 – No Action

Under the No Action Alternative 1, the proposed exploration activities would not be approved, and no effects to public health would occur.

4.11.2 Alternative 2 – Proposed Action

The activities associated with the 2012 Shell Revised Chukchi Sea EP would be staged out of the Barrow, Wainwright, Point Hope, and Point Lay communities. Goods and services would be obtained from local village contractors, when available, for the duration of this project. These business interactions are not expected to adversely affect public health. Personnel traveling to these communities in support of Shell's operations will receive a 'fitness to work' medical review to prevent the spread of communicable diseases between Shell personnel as well as any local residents with whom Shell personnel come into contact with. Findings regarding air quality, emissions, and water quality remain the same as those impacts previously identified and evaluated in the approved with conditions 2010 Chukchi Sea EP (USDOI, MMS, 2009a) and are incorporated by reference.

It is reasonably likely that the Proposed Action could result in a small oil spill. For the purpose of analysis, a 48 bbl fuel transfer spill was estimated for this EA. A spill of this size and type would disperse and evaporate within 3 days, prior to reaching onshore communities or nearshore subsistence areas, resulting in minimal impacts to public health.

Although very unlikely, it is possible that the Proposed Action could lead to a large or very large oil spill. For the purpose of analysis, BOEM estimates potential discharge volumes for this EA to be 1,555 bbl of diesel for a large spill and 750,000 bbl of crude oil for a very large spill. The Sale 193 Final EIS (USDOI, MMS, 2007a) and the Sale 193 Final SEIS (USDOI, BOEMRE, 2011a) analyzed potential effects to public health from large and very large oil spills and found that effects to air quality, water quality, subsistence resources, and other environmental resources could cause impacts from the following: contact with contaminants, which could occur mainly through inhalation, skin contact, or intake of contaminated subsistence foods; reduced availability or acceptability of subsistence resources; periodic interference with subsistence-harvest patterns from oil spills and oil-spill cleanup; and stress due to fears of the long-term implications of a spill and the disruptions it would cause. These analyses remain sufficient to analyze the effects of large and very large spills in the Chukchi Sea, including the 1,555 bbl diesel spill and the 750,000 bbl oil spill estimated for this EA.

4.11.3 Alternative 3 – One Well per Season

Under Alternative 3, exploration drilling activities will be less intensive in any single drilling season but more prolonged overall. Spreading out exploration drilling activities over additional drilling seasons would also prolong the potential direct and indirect impacts to public health, as described above, though the impacts would be less intense in any single drilling season. As is the case with Alternative 2, these impacts would still be considered negligible, and would not constitute a significant change in the impacts to public previously identified and evaluated in the approved with

conditions 2010 Chukchi Sea EP (USDOI, MMS, 2009a). Under Alternative 3, the potential for a large or very large petroleum spill would be spread across additional seasons, but the potential environmental effects would be the same as was analyzed under Alternative 2.

4.11.4 Cumulative Effects

A thorough discussion of past, present, and reasonably foreseeable future actions affecting the Chukchi Sea environment is provided in Appendix C.

With the implementation of the mitigation described in Section 3 and the subsections above, the cumulative effects from the Proposed Action of the 2012 Shell Revised Chukchi Sea EP (Shell, 2011a) in combination with other 2012 survey activities described in Appendix C are considered to be negligible. These effects do not constitute a significant change in the impacts to public health previously identified and evaluated in the approved with conditions 2010 Chukchi Sea EP (USDOI, MMS, 2009a).

Under Alternative 3, exploration drilling activities will be less intensive in any single drilling season but more prolonged overall. Spreading out exploration drilling activities over additional drilling seasons would also prolong the potential cumulative impacts to public health, as described above, though the impacts would be less intense in any single drilling season. As is the case with Alternative 2, these impacts would still be considered negligible, and would not constitute a significant change in the impacts to public previously identified and evaluated in the approved with conditions 2010 Chukchi Sea EP (USDOI, MMS, 2009a).

4.12 Archaeological Resources

The NSB zoning ordinances ensure protection of archeological and cultural resources. NSB Municipal Code 19.70.050(E) states that development which is likely to disturb certain cultural or historic sites be required to avoid the sites or be required to consult with appropriate local, state, and federal agencies and survey and excavate the site prior to disturbance. NSB Municipal Code 19.70.050(F) requires that development not significantly interfere with traditional activities at cultural or historic sites. NSB Municipal Code 19.70.050(G) requires that development not cause surface disturbance of newly discovered historic or cultural sites prior to archaeological investigation.

Additional requirements pertaining to archaeological resources are contained in the NHPA and its implementing regulations, as well as in BOEM operational regulations at 30 CFR 550.194. The technical requirements for the archaeological resource surveys and reports that may be required under the regulations are detailed in the Alaska OCS Region Notice to Lessees NTL 05-A03. Under Section 106 of the National Historic Preservation Act, BOEMRE consults with the Alaska State Historic Preservation Office (SHPO) for OCS activities during the pre-lease process.

4.12.1 Alternative 1 – No Action

Under the No Action Alternative, the proposed exploration activities would not be approved, and no effects on archaeological resources would occur.

4.12.2 Alternative 2 – Proposed Action.

Exploration activities could impact offshore resources through vessel mooring, mudline cellar construction, discharge of drill cutting and drill fluids, and onshore construction activities.

Analysis for each drill site and anchor location (shown in the Revised EP on Figures 1.b-3 through 1-b.8, Bathymetry and Planned Drillship Anchor Locations) indicates that activities will avoid all sidescan sonar contacts and magnetic anomalies. Discharges of drilling fluids and cuttings would be dispersed before reaching the seafloor and would be deposited on top of the thin veneer of Holocene-age sediments that already cover any prehistoric cultural resources in the area. Drilling cuttings

produced during mudline cellar construction and drilling of the uppermost well interval will also be discharged on the seafloor surface. Discharges could result in seafloor scouring at the site of the discharge, which could potentially impact archaeological resources on or just below the seafloor. However, site assessments of the drill site did not identify any potential cultural resources on or below the seafloor.

No impacts to onshore archaeological resources are expected since Shell plans to use existing facilities at Barrow and Wainwright.

The effects of activities would be on a site-by-site basis regardless of the year in which the activity occurs.

Analysis of the shallow hazards survey reports and archaeological assessments listed in the Revised EP Section 5 (Shell, 2011a) indicates the following:

- Numerous side scan sonar targets are distributed across the survey areas. None of the targets were deemed in the analysis to be archaeologically significant.
- Numerous magnetic anomalies are distributed across the survey areas. Many of the anomalies form linear strings which closely correspond to fault picks, may represent subsurface geological features, or are unattributed. None of the magnetic anomalies corresponded to side scan sonar targets. None of the anomalies are deemed to be archaeologically significant.
- The previous point not withstanding, a cluster of seven magnetic anomalies south of the Burger V drill site cannot be identified through geophysical data, are of unknown origin, and will avoided by all activities, such as anchoring, associated with exploration.
- Pleistocene buried channels were identified in the area of Burger A, F, and S. Channel levees, internal strata and overbank deposits have been eroded and removed during subsequent marine transgression and covered with a thin veneer of Holocene age material. There are no landforms identified by the surveys which would be considered high probability areas for prehistoric occupation.
- Comparison of the reports listed above with the Revised EP Figures 1.b-3 through 1.b-8 indicates that anchor locations will avoid sidescan sonar targets and magnetic anomalies.

Shell describes the shallow hazards and archaeological surveys in Section 5 of the Revised EP. The Revised EP states that “all of the side-scan sonar contacts and magnetic anomalies will be avoided during the exploration drilling operations” (Shell, 2011a: p. 5-3).

Based on the above information, no historic or prehistoric properties are likely to be affected by the activities proposed in the Revised EP. Therefore, the Proposed Action will have a negligible effect on archaeological resources. If exploration activities terminate prior to the end of October in any year the types and level of impact would be as described above.

The oil-spill analysis has determined that there is a low chance for an accidental small oil spill that likely would be operational in nature. For the purpose of this analysis, a 48 bbl fuel transfer spill was estimated. A 48 bbl diesel spill would evaporate and disperse in less than 3 days before contacting critical nearshore subsistence areas. As required by Lease Stipulation 6, oil-spill containment booms would be deployed during any refueling activity, and would contain a small oil spill if one should occur. As there are no identified archaeological resources in the area of any of the drill sites, effects on historic resources from the initial event and offshore spill are not likely to occur.

In a large oil spill of up to 1,555 bbl (estimated potential discharge for this EA) or a very large oil spill of up to 750,000 bbl (estimated potential discharge for this EA) various aspects of the oil spill, offshore and onshore response, and cleanup have some potential to adversely affect archaeological resources. Regardless of water depth, because oil is a hydrocarbon, heavy oiling could contaminate

organic materials associated with archaeological sites, resulting in erroneous dates from standard radiometric dating techniques (e.g., 14C-dating). Interference with the accuracy of 14C-dating would result in the loss of valuable data necessary to understand and interpret the sites.

Offshore archaeological sites could be disturbed by vessel anchoring. The density of anchoring activity increases the potential to damage archaeological resources, although the use of dynamically-positioned response vessels would minimize the occurrence of anchoring. Onshore, oil-spill-cleanup activities that disturb soil or cause shallow permafrost to thaw have the potential to disturb archaeological resources. Contamination of archaeological resources through contact with oil would decrease data recovery. Onshore cleanup activity would introduce ground disturbing activities into remote areas and increase the likelihood of vandalism and pilferage of sites or structures. Measures such as orientation programs for clean-up workers, embedding of archaeologists in shoreline cleanup teams, and early identification of sites can mitigate some of these potential effects (USDOI, MMS, 2007a, 2008; USDOI, BOEMRE, 2011a).

Additional analysis of potential effects to archaeological resources from large and very large oil spills is provided in the Sale 193 Final EIS (USDOI, MMS, 2007a) and the Sale 193 Final SEIS (USDOI, BOEMRE, 2011a), respectively.

4.12.3 Alternative 3 – One Well per Season

Activities associated with Chukchi Sea exploration could impact the offshore resources through vessel mooring, mudline cellar construction, and discharge of drill cutting and drill fluids. The effects of activities would occur on a site-by-site basis regardless of the year in which the activity occurs. Effects would be the same as those effects described under Alternative 2, the Proposed Action, except that the potential for effects would be spread out amongst additional years of exploration activity.

Site assessments of the drill site did not identify any potential cultural resources on or below the seafloor or any potential cultural resources on shore affected by activities associated with the exploration plan. Therefore, Alternative 3 (like the Proposed Action) will have a negligible effect on archaeological resources.

Under Alternative 3, the potential for a large or very large petroleum spill would be spread across additional seasons, but the potential environmental effects would be the same as was analyzed under Alternative 2

4.12.4 Cumulative Effects

This section discusses the effect to the archeological resources which result from known past, present and reasonably foreseeable future activities and the incremental contribution of the Proposed Action and any alternatives to the Proposed Action.

Natural processes such as ice gouging, bottom scour, thermokarst erosion, and shoreline erosion have the greatest cumulative effect on archaeological resources in the Chukchi Sea area. These natural processes are ongoing and continue to have destructive effects on prehistoric and historic archaeological sites (USDOI, MMS, 2007a; USDOI, MMS, 2008).

Other OCS oil and gas activities in the Chukchi Sea could disturb the seafloor, but will have undergone a similar review to that for the Proposed Action. As such, cumulative effects on archaeological resources from these projects will be negligible. Similarly, construction of onshore infrastructure to support exploration activities will be limited and take place near population centers, most notably Wainwright. State and North Slope Borough policies on coastal development help ensure protection of archaeological resources similar to that afforded federally-authorized activities.

This Proposed Action would have a negligible effect on archaeological resources. The incremental contribution of the activities associated with this alternative result in no change in the negligible level of effect for this resource.

4.13 Environmental Justice

Significant effects with respect to environmental justice include impacts on human health or environment that cause disproportionate, high adverse effects on minority or low-income populations. This threshold would be reached in the event of significant impacts to subsistence harvest patterns, sociocultural systems, or public health. Tainting of subsistence foods from oil spills and contamination of subsistence foods from pollutants would contribute to potential adverse human health effects. Concerns that subsistence foods could be contaminated could also affect human health.

4.13.1 Alternative 1 – No Action

Under the No Action Alternative, the proposed exploration activities would not be approved, and no environmental justice issues would arise.

4.13.2 Alternative 2 – Proposed Action

This analysis considers the Proposed Action's direct and indirect effects on subsistence, sociocultural systems and public health as factors that would most affect environmental justice. Because the analyses above conclude that the proposed project would result in negligible direct and indirect effects to these resources, it follows that the proposed project would have non-existent to negligible direct and indirect effects on environmental justice. The effects evaluated will occur each season that Shell conducts exploratory drilling operations under this exploration plan. The negligible effects, however, are temporally limited and consecutive years of activity would not have an additive effect.

This conclusion is supported by the environmental justice analysis conducted by EPA for the Clean Air Act permits related to the Proposed Action concluded that

> "the activities proposed to be authorized…will not cause or contribute to air quality levels in excess of health-based standards for SO2, CO, PM10, PM2.5, Ozone or NO2. Region 10 therefore concludes that there will not be disproportionately high and adverse human health or environmental effects with respect to these air pollutants on minority or low-income populations residing in the North Slope, including coastal communities closest to the proposed operations. In reaching this conclusion, Region 10 considered the impact on communities while engaging in subsistence activities in areas where such activities are regularly conducted" (EPA, 2011).

The oil-spill analysis has determined that there is a low chance for an accidental small oil spill that likely would be operational in nature. For the purpose of this analysis, a 48 bbl fuel transfer spill was estimated. A 48 bbl diesel spill would evaporate and disperse in less than 3 days before contacting critical nearshore subsistence areas. As required by Lease Stipulation 6, oil-spill containment booms would be deployed during any refueling activity, and would contain a small oil spill if one occurred.

The perception that subsistence foods might be contaminated, particularly marine mammals or fish, might be of concern to the Iñupiat at Barrow, Wainwright, Point Lay, and Point Hope in terms of potential effects on health. Because subsistence activities do not occur in the vicinity of proposed drilling and any associated spill source, and because no fuel transfer is expected during transit between the Beaufort and Chukchi seas, the short-term effects of the analyzed small spill on subsistence activities are expected to be negligible to minor. No long-term effects are anticipated as effects are not expected to persist past the end of the drilling season. Therefore, small oil spills would amount to a negligible to minor effect.

A large spill of up 1,555 bbl (estimated potential discharge for this EA) or very large oil spill of up to 750,000 bbl (estimated potential discharge for this EA) would have similar effects to those described

in detail in other lease sale EIS's for environmental justice (USDOI, MMS, 2007a; USDOI, MMS 2008; USDOI, BOEMRE 2011a). The environmental justice impacts of a large or very large oil spill on Alaskan Native communities are interconnected with the subsistence lifestyle of these communities described in Section 4.8 and the attendant sociocultural systems effects described in Section 4.7. Given the overarching importance of subsistence resources to the indigenous populations—all defined minority populations—any major impacts to subsistence resources that create attendant major impacts on Alaska Native sociocultural systems would be expected to have consequent disproportionate, high adverse impacts on environmental justice.

BOEM views oil spills as having the potential to cause long term significant effects that would disrupt or nearly eliminate subsistence harvests. Oil spills are never permitted and are always in violation of the law. Operators would be held accountable and responsible for mitigation and monitoring, effects of loss or reduction of subsistence species on the local subsistence harvesters, and the linked social organizations and institutions.

4.13.3 Alternative 3 – One Well per Season

This analysis considers the proposed project direct and indirect effects on subsistence and public health as factors that would most affect environmental justice. Because the analyses above conclude that the proposed project would result in negligible direct and indirect effects to these resources, it follows that the proposed project would have non-existent to negligible direct and indirect effects on environmental justice. The effects evaluated will occur each season that Shell conducts exploratory drilling operations under this exploration plan. The negligible effects, however, are temporally limited and consecutive years of activity would not have an additive effect. Under Alternative 3, the potential for a large or very large petroleum spill would be spread across additional seasons, but the potential environmental effects would be the same as was analyzed under Alternative 2.

4.13.4 Cumulative Effects

This section discusses effects from known past, present, and reasonably foreseeable future activities and the incremental contribution of the Proposed Action.

Incidental or accidental short term encounters can be further eliminated through effective communication between the communities and BOEM and/or industry. The communication center operation and the subsistence advisor program are mitigation measures identified in the description of the Proposed Action and are examples of remedies for these types of disruptions.

This analysis considers that cumulative effects on subsistence, sociocultural, and public health are factors that would most affect environmental justice. Because the analysis concludes that cumulative effects on subsistence and local economic opportunities would be negligible, it follows that there will be negligible cumulative effects on environmental justice. The reasonably foreseeable cumulative effects would occur at nearly the same level each season that Shell conducts exploratory drilling operations under this exploration plan. For the life of the project, the impacts to environmental justice from the Proposed Action and from reasonably foreseeable cumulative activities would amount to a negligible level of effect.

SECTION 5. Consultation and Coordination

The following subsections describe formal and informal consultations undertaken by BOEM with respect to the Proposed Action, as well as public involvement in the development of this Environmental Assessment (EA). Also provided is a list of EA reviewers and preparers.

5.1 Endangered Species Act Consultation

BOEM consults with NMFS and FWS regarding potential impacts to listed species and designated critical habitat under each Service's jurisdiction.

Consultation with NMFS for the proposed exploration program is covered by the July 17, 2008, BO for Oil and Gas Leasing and Exploration Activities in the U.S. Beaufort and Chukchi Seas, Alaska and Authorization of Small Takes Under the Marine Mammal Protection Act (NMFS, 2008). In December 2010, NMFS proposed the ringed seal and the Beringia Distinct Population Segment of the bearded seal for listing under the ESA (75 FR 77476). In October 2011, BOEM concluded that the proposed exploration program would not jeopardize the continued existence of these ice-seals and conferencing under the ESA on the exploration plan was not required. While not required for the proposed exploration plan, on October 11, 2011, BOEM requested a programmatic conference opinion from the NMFS for the ice seals that could provide continuous ESA consultation coverage for the two ice seal species if they are listed in the near future.

BOEM last completed consultation with the FWS on September 3, 2009, a consultation that concluded with the BO for the Beaufort and Chukchi Sea Program Area Lease Sales and Associated Seismic Surveys and Exploratory Drilling (USDOI, FWS, 2009). Most of Shell's proposed exploration activities were covered by that consultation; however, on December 7, 2010, FWS finalized the designation of critical habitat for the polar bear (75 FR 76086). The designation identified the physical and biological features essential to the conservation of the polar bear. The FWS identified land-fast sea ice (sea ice that is frozen to the shoreline or to the seafloor and is relatively immobile) and pack ice (annual and multi-year ice that is in constant motion due to winds and currents) as critical sea ice habitats (75 FR 76086). Open water is not considered an essential feature for polar bears (75 FR 76086). BOEM has reinitiated section 7 consultation and, in September 2011, transmitted a Biological Evaluation to the FWS that assessed the potential effects of oil and gas exploration and development on the Arctic OCS Region for listed species and designated critical habitat. Any approval of the Proposed Action would be conditioned upon completion of this ESA consultation. This condition of approval will allow BOEM to incorporate any additional mitigation measures developed in ongoing section 7 consultations. BOEM has had ongoing communications with FWS regarding the Proposed Action and will continue to ensure compliance with the ESA.

5.2 Essential Fish Habitat Consultation

Pursuant to the Magnuson-Stevens Fisheries Conservation and Management Act, BOEM consulted with NMFS on the Sale 193 Final EIS (USDOI, MMS, 2007) regarding Pacific salmon EFH and on the Sale 193 Final SEIS (USDOI, BOEMRE, 2011) regarding Arctic cod, saffron cod and opilio crab. BOEM provided a determination of adverse effects in a consultation document sent to NMFS in July of 2011. NMFS replied with conservation recommendations in September of 2011. BOEM provided it reply to these conservation measures in October of 2011. BOEM would engage in additional EFH consultation prior to the commencement of the Proposed Action evaluated in the EA.

5.3 Marine Mammal Protection Act

To ensure compliance with the Marine Mammal Protection Act (MMPA), BOEM would require Shell to obtain an incidental harassment authorization (IHA) from NMFS and a letter of authorization

(LOA) from FWS before Shell commences BOEM-permitted exploration activities. Mitigation measures are included in the IHA and LOA to ensure the least practicable adverse impact on marine mammal species or stocks and to ensure that potential impacts to marine mammal populations will be negligible and have no unmitigable adverse impacts on the availability of marine mammals for subsistence uses. Shell is applying to NMFS for an IHA for the incidental take of whales and seals, and to FWS for an LOA for the take of polar bears and Pacific walrus.

5.4 National Historic Preservation Act Consultation

BOEM consulted with SHPO regarding Chukchi Sea issues in conjunction with the Sale 193 Final EIS (USDOI, MMS, 2007) and in conjunction with the Arctic Multiple-Sale Draft EIS (USDOI, MMS, 2008). SHPO provided its concurrence with BOEM's consultation letter on September 24, 2008. More recently, BOEM reviewed site-specific geophysical data associated with the 2012 Shell Revised Chukchi Sea EP (or Revised EP)and identified no historic properties at the proposed drill sites. On November 29, 2011 BOEM wrote a letter informing the SHPO of its determination that drilling of the six wells and related activities will have no effect on historic properties.

5.5 Reviewers and Preparers

Table 33 identifies the persons responsible for reviewing the 2012 Shell Revised Chukchi Sea EP and preparing this EA.

Table 33. Persons responsible for the preparation of this EA.

Name	Professional Position	Role in Preparation
Scott Blackburn	Technical Writer Editor	Technical Editor / Publisher (Primary)
Jerry Brian	Socioeconomic Specialist	Review & Analysis – Economy, Public Health
Mary Cody	Wildlife Biologist	Review & Analysis – Marine Mammals
Deborah Cranswick	Supervisory Environmental Protection Specialist	Project Manager
Chris Crews	Wildlife Biologist	Review & Analysis – Marine Mammals, Terrestrial Mammals
Nancy Deschu	Biologist	Review & Analysis – Water Quality, Fish & Essential Fish Habitat
Dan Holiday Ph.D.	Biological Oceanographer	Review & Analysis – Lower Trophic Levels, Cumulative Effects
Jim Lima, Ph.D.	Socioeconomic Specialist	Review & Analysis – Subsistence Activities, Sociocultural Systems, Environmental Justice, Archaeological Resources
Virginia Raps	Meteorologist	Review & Analysis – Air Quality, Climate Change, Meteorology
Mike Routhier	NEPA Coordinator	Project Coordinator
Mark Schroeder	Wildlife Biologist	Review & Analysis – Marine and Coastal Birds
Caryn Smith	Oceanographer	Review & Analysis – Petroleum Spills
Bill Swears	Technical Editor	Technical Editor / Publisher
Joe Talbott	NEPA Coordinator	Project Coordinator

5.6 Public Involvement

BOEM has provided several opportunities for public involvement regarding the 2012 Shell Revised Chukchi Sea EP and the preparation of this EA. These opportunities include:

- Posting a May 2011 version of the 2012 Shell Revised Chukchi Sea EP to the BOEM website for public review.
- Soliciting public comments on the 2012 Shell Revised Chukchi Sea EP. When BOEM "deemed submitted" the Revised EP, BOEM initiated a 21-day public comment period, from November 16, 2011 to December 7, 2011, to solicit public input regarding the Revised EP.
- Soliciting public comments on the preparation of this EA. When BOEM "deemed submitted" the Revised EP, BOEM notified the public that the agency was preparing an Environmental Assessment and requested public input. The public had 10-days, from November 16, 2011 to November 26, 2011, to comment. Six public comments were received and considered in developing this EA.

Opportunities for public input regarding exploratory drilling in the Arctic OCS have also been provided during numerous prior NEPA processes

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References

Aars, J., N.J. Lunn, and A.E. Derocher eds. 2006. Polar bears: proceedings of the 14th working meeting of the IUCN/SSC Polar Bear Specialist Group. 20–24 June 2005, Seattle, Washington, USA. IUCN, Gland, Switzerland and Cambridge, UK.

ACIA. 2005. Arctic Climate Impact Assessment. Cambridge, UK: Cambridge UP. http://www.acia.uaf.edu/.

Ahrens, C.D. 2009. Meteorology Today: An Introduction to Weather, Climate, and the Environment. Belmont, CA: Brooks/Cole.

Alaska Department of Environmental Conservation (ADEC). 2008. State Air Quality Control Plan. http://www.dec.state.ak.us/air/sip.htm.

Alaska Department of Environmental Conservation (ADEC). 2011. Division of Water, Water Quality Standards, Assessment and Restoration. Impaired Waters in the State of Alaska (Clean Water Act, Section 303). ttp: //www.dec.state.ak.us/water/wqsar/index.htm Retrieved November 21, 2011..

Alaska Department of Fish and Game (ADF&G). 2009. Summary maps of fall movements of bowhead whales in the Chukchi Sea. Fairbanks, AK: ADF&G. 6 p. http://www.adfg.alaska.gov/static/home/about/management/wildlifemanagement/marinemammals/pdfs/bow_move_chukchi_sea.pdf

Alaska Department of Fish and Game (ADF&G). 2011. ADF&G, Sport Fish, Anadromous Waters Catalog – Overview. Juneau, AK: Alaska Department of Fish and Game. http://www.adfg.alaska.gov/sf/SARR/AWC.

Alaska Eskimo Whaling Commission (AEWC). 2011. Personal Communication. Email from G. Leavitt, AEWC dated 12-8-2011 to to James Lima, Subsistence Analyst, BOEM. RE: Request for Information on the Fall Bowhead Whale Subsistence Activity. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

Allen, B.M. and R.P. Angliss. 2011. Alaska Marine Mammal Stock Assessment, 2010. NOAA Tech. Memo. NMFS-AFSC-223. 292 pp. http://www.nmfs.noaa.gov/pr/pdfs/sars/ak2010.pdf

Alverson, D.L. and N.J. Wilimovsky. 1966. Fishery investigations of the southeastern Chukchi Sea. In: N.J. Wilimovsky and J.N. Wolfe (eds), Environment of the Cape Thompson region, Alaska. Book 2, p.843-860. U.S. Atomic Energy Commission, Energy Res. Dev. Admin., Tech inf. Center, Oak Ridge, Tenn. U.S. Dept of Commerce National Technical Information Services PNE-481.

AMAP (Arctic Monitoring and Assessment Programme). 1997. Arctic Pollution Issues: A State of the Arctic Environment Report. Oslo, Norway: 188 p.

AMAP (Arctic Monitoring and Assessment Programme). 2004. AMAP Assessment 2002: Persistent Organic Pollutants in the Arctic. Oslo, Norway: Arctic Monitoring and Assessment Programme. 309 p.

Amstrup, S.C. 1995. Movements, distribution, and population dynamics of polar bears in the Beaufort Sea. PhD Dissertation, University of Alaska, Fairbanks, AK. 299 pp.

Amstrup, S.C., 2003. Polar Bear *Ursus maritimus*. In: Wild Mammals of North America: Biology, Management, and Conservation, G.A. Feldhamer, B.C. Thompson, and J.A. Chapman, eds. Baltimore, MD: Johns Hopkins University Press, pp. 587-610.

Amstrup, S.C., C. Gardner, K.C. Meyers, and F.W. Oehme. 1989. Ethylene glycol (antifreeze) poisoning in a free-ranging polar bear. *Veterinary and Human Toxicology 31*: 317-319.

Amstrup, S.C., G.M. Durner, and T.L. McDonald. 2000. Estimating Potential Effects of Hypothetical Oil Spills from the Liberty Oil Production Island on Polar Bears. Anchorage, AK: U.S. Geological Survey, Biological Resource Div., 42 pp.

Amstrup, S.C., G.M. Durner, I. Stirling, and T.L. McDonald. 2005. Allocating harvest among polar bear stocks in the Beaufort Sea. Arctic. 58: 247-259.

Anchorage Daily News (AND). 2006. Bird deaths puzzle Unalaska, Shearwaters: Captain said hail of creatures hit his boat for up to 30 minutes. September 1, 2006.

Applied Sociocultural Research, 2009. Annual Assessment of Subsistence Bowhead Whaling near Cross Island, 2001 to 2007, Final Report, OCS Study 2009-038 Anchorage, Alaska: Applied Sociocultural Research.

ASRC Energy Services, 2009. Subsistence Advisor Program Summary North Slope, Alaska (2007-2008). Prepared for Shell Exploration and Production Company. March 2009. Anchorage Alaska.

Baker, C., L. Herman, B. Bays, and G. Bauer. 1983. The impact of vessel traffic on the behavior of humpback whales in southeastern Alaska. Seattle, WA: National Marine Mammal Laboratory, 30 pp.

Barber, WE, RL Smith, M. Vallarino, RM Meyer. 1997. Demersal fish assemblages of the northeastern Chukchi Sea, Alaska . *Fishery Bulletin* 95 (2): 195-209.

Barron, M.G. 2007. Sediment-associated phototoxicity to aquatic organisms. *Human and Ecological Risk Assessment: An International Journal*. 13(2): 317-321.

Bengtson, J.L., L.M. Hiruki-Raring, M.A. Simpkins, and P.L. Boveng. 2005. Ringed and Bearded Seal Densities in the Eastern Chukchi Sea, 1999-2000. *Polar Biology 28*: 833-845. http://www.springerlink.com/content/0722-4060/28/11/.

Benoit, D., Y. Simard, J. Gagne, M. Geoffroy and L. Fortier. 2010. From polar night to midnight sun: Photoperiod, seal predation and the diel vertical migrations of polar cod (*Boreogadus saida*) under landfast ice in the Arctic Ocean. *Polar Biology* 33: 1505-1520.

Berzin, A.A. 1984. Soviet studies on the distribution and numbers of the gray whale in the Bering and Chukchi Seas from 1968 to 1982. pp. 409-19. In: M.L. Jones, S.L. Swartz and S. Leatherwood (eds.). The Gray Whale, *Eschrichtius robustus*. Orlando, FL: Academic Press. xxiv+600pp.

Black, A. 2005. Light induced seabird mortality on vessels operating in the southern ocean: incidents and mitigation measures. *Antarctic Science* 17(1): 67-68.

Blackwell, S.B., and C.R. Greene, Jr. 2002. Acoustic measurements in Cook Inlet, Alaska, during August 2001. Report prepared by Greeneridge Sciences, Inc. Anchorage, AK: NMFS.

Blackwell, S.B., and C.R. Greene, Jr. 2005. Underwater and in–air sounds from a small hovercraft. *Journal of the Acoustical Society of America* 118(6):3646–3652.

Blackwell, S.B., and C.R. Greene, Jr. 2006. Sounds from an oil production island in the Beaufort Sea in summer: characteristics and contribution of vessels. *Journal of the Acoustical Society Of America* 119(1):182–196.

Blanchard, A.L., H. Nichols, and C. Parris. 2009. 2008 Environmental Studies Program in the Chukchi Sea: benthic ecology of the Burger and Klondike survey areas. Annual Report for ConocoPhillips Alaska Inc. and Shell Exploration & Production Company, Anchorage, AK pp. 72. http://www-static.shell.com/static/usa/downloads/alaska/studies_2008_chukchi_sea_benthic_ecology.pdf.

Blanchard, A.L., H. Nichols, and C. Parris. 2010. 2009 Environmental Studies Program in the Chukchi Sea: Benthic Ecology of the Burger and Klondike Survey Areas. Final report. Fairbanks: University of Alaska Fairbanks. 86 pp.

Blees, M.K., K.G. Hartin, D.S. Ireland, and D. Hannay. 2010. Marine mammal monitoring and mitigation during open water seismic exploration by Statoil USA E&P Inc. in the Chukchi Sea, August-October 2010: 90-day report. LGL Rep. P119. Prepared by LGL Alaska Research Associates Inc., LGL Ltd., and JASCO Research Ltd. Anchorage, AK: Statoil USA E&P Inc., National Marine Fisheries Service, and U.S. Fish and Wildlife Service. 102 pp+ App. http://www.nmfs.noaa.gov/pr/pdfs/permits/2010_statoil_90day_report.pdf

Bluhm, B.A. and R. Gradinger. 2008. Regional variability in food availability for arctic marine mammals. *Ecological Applications*. 18(sp2): 77-96.

Bogoslovskaya, L., L. Votrogov, and T. Semenova. 1981. Feeding habits of the gray whale off Chukotka. SC/32/PS20. *Report of the International Whaling Commission 31*: 507-510.

Boveng, P.L., J.L. Bengtson, T.W. Buckley, M.F. Cameron, S.P. Dahle, B.P. Kelly, B A. Megrey, J.E. Overland, and N.J. Williamson. 2009. Status review of the spotted seal (*Phoca largha*). U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-200.153 p. http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-200.pdf

Boveng, P.L., J.L. Bengtson, T.W. Buckley, M.F. Cameron, S.P. Dahle, A. Megrey, J.E. Overland, and N.J. Williamson. 2008. Status review of the ribbon seal (*Histriophoca fasciata).* NOAA Tech Memo. NMFS-AFSC-191, NTIS No. PB2006-104582. 115 p. http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-191.pdf.

Bradstreet, M.S.W. 1982. Occurrence, habitat use, and behavior of sea birds, marine mammals and arctic cod at the Pond Inlet ice edge. *Arctic* 35(1): 28-40.

Bradstreet, M.S.W., and W.E. Cross. 1982. Trophic relationships at high Arctic ice edges. *Arctic* 35(1): 1-12.

Braham, H.W., B.D. Krogman and G.M. Carroll. 1984. Bowhead and white whale migration, distribution, and abundance in the Bering, Chukchi, and Beaufort seas, 1975-78. NOAA Tech. Rep. NMFS_SSRF-778. USDOC/NOAA/NMFS. NTIS PB84-157908. 39 p. http://aquaticcommons.org/2054/1/NOAA_Tech_Rpt_NMFS_SSRF_778.pdf

Brewer, K.D., M.L. Gallagher, P.R. Regos, P.E. Isert, and J.D. Hall. 1993. ARCO Alaska, Inc. Kuvlum #1 Exploration Prospect Site Specific Monitoring Program Final Report. Anchorage, AK: ARCO Alaska, Inc. 80 p.

Brueggeman, J.J. 2009a. Marine mammal surveys at the Klondike and Burger survey areas in the Chukchi Sea during the 2008 open water season. Report prepared by Canyon Creek Consulting, Seattle, Washington and provided to ConocoPhillips Alaska, Inc. and Shell Offshore Inc. 45pp.

Brueggeman, J.J. 2009b. 90-Day report of the marine mammal monitoring program for the ConocoPhillips Alaska shallow hazards survey operations during the 2008 open water season in the Chukchi Sea. Prepared for ConocoPhillips Alaska, Inc. by Canyon Creek Consulting LLC, Seattle, WA.

Brueggeman, J.J. 2010. Marine Mammal Surveys at the Klondike and Burger Survey areas in the Chukchi Sea during the 2009 open water season. . Anchorage, AK: ConocoPhillips, Inc. and Shell Exploration Company. 55 pp.

Brueggeman, J.J., C. Malme, R. Grotefendt, D. Volsen, J. Burns, D. Chapman, D. Ljungblad, and G. Green. 1990. Shell Western E&P Inc. 1989 walrus monitoring program: the Klondike, Burger, and Popcorn Prospects in the Chukchi Sea final report. Prepared by EBASCO Environmental. Houston, TX: Shell Western E&P Inc. 121 pp. plus appendices.

Brueggeman, J.J., D. Volsen, R. Grotefendt, G. Green, J. Burns, and D. Ljungblad. 1991. Shell Western E&P Inc. 1990 walrus monitoring program: the Popcorn, Burger, and Crackerjack Prospects in the Chukchi Sea. Prepared by EBASCO Environmental. Houston, TX: Shell Western E&P Inc.109 pp plus appendices.

Brueggeman, J.J., D.P. Volsen, R.A. Grotefendt, G.A. Green, J.J. Burns, and D.K. Ljungblad. 1991. 1990 Walrus Monitoring Program/The Popcorn, Burger and Crackerjack Prospects in the Chukchi Sea. Houston, TX: Shell Western E&P, Inc.

Brusca, R.C. and G.J. Brusca. 2002. Invertebrates. Sunderland, MA: Sinauer Associates.

Burns, J.J. 1981. Ribbon Seal-Phoca fasciata. *In* S.H. Ridgeway and R.J. Harrison (eds.) Handbook of Marine Mammals. Vol. 2. Seals. New York: Academic Press. pp. 89-109.

Calvert, W., and I. Stirling. 1985. Winter Distribution of Ringed Seals (*Phoca hispida*) in the Barrow Strait Area, Northwest Territories, Determined by Underwater Vocalization. *Can. J. Fish. Aquat. Sci*., 427: 1238-1243.

Cameron, M.F., J.L. Bengtson, P.L. Boveng, J.K. Jansen, B.P. Kelly, S.P. Dahle, E.A. Logerwell, J.E. Overland, C.L. Sabine, G.T. Waring, and J.M. Wilder. 2010. Status review of the bearded seal (*Erignathus barbatus*). U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-211, 246 p. http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-211.pdf.

Chandler, D.L. 2010. Explained: Radiative Forcing. March 10, 2010. Cambridge, MA: MITnews. http://web.mit.edu/newsoffice/2010/explained-radforce-0309.html.

Chernyak, S.M., C.P. Rice, and L.L. McConnell. 1996. Evidence of currently-used pesticides in air, ice, fog, seawater and surface microlayer in the Bering and Chukchi seas. *Marine Pollution Bulletin* 32(5): 410-419.

Clarke, J., S. Moore, and D. Ljungblad. 1989. Observations on the gray whale (*Eschrichtius robustus*) utilization and patterns in the northeast Chukchi Sea, July-October 1982-1987. *Canadian Journal of Zoology* 67: 2646-2653.

Clarke, J.T., C.L. Christman, M.C. Ferguson, and S.L. Grassia. 2011a. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 2006-2008. Final Report, OCS Study BOEMRE 2010-042. Seattle, WA: USDOC, NMFS, NOAA. Alaska Fisheries Center. http://www.alaska.boemre.gov/reports/2010rpts/2010_042.pdf.

Clarke, J.T., C.L. Christman, S.L. Grassia, A.A. Brower, and M.C. Ferguson. 2011b. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 2009. Final Report, OCS Study BOEMRE 2010-040. Seattle, WA: USDOC, NMFS, NOAA. Alaska Fisheries Center. http://alaska.boemre.gov/reports/2010rpts/2010_040.pdf

Clarke, J.T., M.C. Ferguson, C.L. Christman, S.L. Grassia, A.A. Brower, and L.J. Morse. 2011c. Chukchi offshore monitoring in drilling area (COMIDA) distribution and relative abundance of marine mammals: aerial surveys. Final Report, OCS Study BOEMRE 2011-06. Seattle, WA: USDOC, NMFS, NOAA. Alaska Fisheries Center. 286 pp. http://www.afsc.noaa.gov/nmml/PDF/COMIDA-2008-2010-Report.pdf.

Comida. 2011. Chukchi Sea Offshore Monitoring in Drilling Area, Chemical and Benthos. Unpublished data. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

Comiso, J. C. 2011. Large Decadal Decline of the Arctic Multiyear Ice Cover: *Journal of Climate.* Early online Release. August 9, 2011.

Coyle, K., V. Chavtur, and A. Pinchuk. 1996. Zooplankton of the bering sea: A review of russian-language literature. Alaska Sea Grant College Program Rep. Ecology of the Bering Sea: A Review of Russian Literature. Fairbanks, AK. pp. 96-01.

Craig, P. and L. Haldorson. 1986. Pacific salmon in the North American Arctic. *Arctic 39*(1): 2-7.

Craig, P.C., W.B. Griffiths, L. Haldorson, and H. McElderry. 1982. Ecological studies of arctic cod (*Boreogadus saida*) in Beaufort Sea coastal waters, Alaska. *Canadian Journal of Fisheries and Aquatic Science* 39: 395-406.

Crawford, R.E. 2003. Forage fish habitat distribution near the Alaskan coastal shelf areas of the Beaufort and Chukchi seas. Final Report for Contract 09-10-03 for the PWS Oil Spill Recovery Institute. Cordova, AK: PWS Science Center. 97 p.

Crawford, R.E. and J.K. Jorgenson. 1993. Schooling behavior of arctic cod (*Boreogadus saida*) in relation to drifting pack ice. *Environmental Biology of Fishes* 36: 345-357

Cross, W.E. 1982. Under-ice biota at the Pond Inlet ice edge and in adjacent fast ice areas during spring. *Arctic 35*(1): 13-27.

Cummings, W.C., D.V. Holliday, and B.J. Lee. 1984. Potential impacts of man-made noise on ringed seals: vocalizations and reactions. Final Report of the Principal Investigators Volume 64: 95-230, Outer Continental Shelf Environmental Assessment Program NOAA, Anchorage, AK NTIS PB87-107546. http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/0/390.pdf

Dau, C.P. and K.S. Bollinger. 2009. Aerial population survey of common eiders and other waterbirds in near shore waters and along barrier islands of the Arctic Coastal Plain of Alaska, 1-5 July 2009. Anchorage, AK: USDOI, FWS, Migratory Bird Management. 20 pp. http://alaska.fws.gov/mbsp/mbm/waterfowl/surveys/pdf/coei09rpt.pdf.

Davis, R.A. 1987. Integration and Summary Report. In: Responses of Bowhead Whales to an Offshore Drilling Operation in the Alaskan Beaufort Sea, Autumn 1986. Anchorage, AK: Shell Western E&P, Inc., pp. 151.

Day, R.H., A.E. Gall, and A.K. Prichard. 2011. The Status and Distribution of Kittlitz's Murrelet (Brachyramophus brevirostris) in northern Alaska. Final Report. Prepared for the U.S. Fish and Wildlife Service, Fish and Wildlife Field Office, Fairbanks, AK by ABR, Inc, Environmental Research and Services, Fairbanks, Alaska. 39 pp.

Day, R.H., A.K. Prichard, and J.R. Rose. 2005. Migration and collision avoidance of eiders and other birds at Northstar Island, Alaska, 2001-2004: Final Report. Prepared for BP Exploration (Alaska) Inc.; prepared by ABR, Inc. - Environmental Research & Services, Fairbanks, AK. 154 pp.

Day, R.H., A.K. Prichard, J.R. Rose, and A.A. Stickney. 2003. Migration and collision avoidance of eiders and other birds at Northstar Island, Alaska, 2001 and 2002. Prepared for BP Exploration (Alaska) Inc. Prepared by ABR, Inc.- Environmental Research & Services, Fairbanks, AK, 142 pp.

Dehn, L.A., G.G. Sheffield, E.H. Follmann, L.K. Duffy, D.L. Thomas, and T.M. O'Hara. 2007. Feeding Ecology of Phocid Seals and Some Walruses in the Alaskan and Canadian Arctic as Determined by Stomach Contents and Stable Isotope Analysis. *Polar Biology* 30: 167-181. http://canhr.uaf.edu/Publications/Dehn.pdf

Delarue, J., D.K. Mellinger, K.M. Stafford, and C.L. Berchok. 2010. Abstract: Where do the Chukchi Sea fin whales come from? Looking for answers in the structure of songs recorded in the Bering Sea and Western North Pacific. *J. Acoust. Soc. Am.* 127(3): 1758. http://scitation.aip.org/getpdf/servlet/GetPDFServlet?filetype=pdf&id=JASMAN000127000003001758000001&idtype=cvips&prog=normal&bypassSSO=1

DeMaster, D.P., W. Perryman, and L.F. Lowry. 1998. Beluga whale surveys in the eastern Chukchi Sea, July, 1998. Alaska Beluga Whale Committee Rep. 98-2. Juneau, AK: NMFS, Alaska Regional Office. 16 pp. http://www.arlis.org/docs/vol1/B/63666826.pdf.

Dick, M.H. and W. Donaldson. 1978. Fishing vessel endangered by crested auklet landings. *Condor* 80: 235-236.

Díez, I., A. Secilla, A. Santolaria, and J. Gorostiaga. 2009. Ecological monitoring of intertidal phytobenthic communities of the basque coast (N. spain) following the prestige oil spill. Environmental Monitoring and Assessment. 159(1): 555-575.

Divoky, G.J. 1987. The distribution and abundance of birds in the eastern Chukchi Sea in late summer and early fall. Final report. Anchorage, AK: USDOC, NOAA, Outer Continental Shelf Environmental Assessment Program, Arctic Environmental Information and Data Center, 96 pp. http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/0/64.pdf.

Donovan, G.P. 1991. Review of IWC Stock Boundaries. Report of the International Whaling Commission Special Issue 13. Cambridge, UK: IWC, pp. 39-68.

Dorn, W., Dethloff, K., and Rinke, A. 2009. Improved Simulation of Feedbacks Between Atmosphere and Sea Ice Over the Arctic Ocean in a Coupled Regional Climate Model. 2009. *Ocean Modelling* 29: 103-114. doi: 10.1016/j.ocemod.2009.03.010.

Doroff, A. M. and Bodkin, J. L. 1994. Sea otter foraging behavior and hydrocarbon levels in prey. In Marine Mammals and the Exxon Valdez, ed. T. R. Loughlin, pp. 193-208. Academic Press, San Diego, CA.

Dragoo, D.E., J.C. Schneeweis, and D.W. Kuehn. 2011. Biological Monitoring at Cape Lisburne, Alaska in 2011. Unpublished Report. Report No. AMNWR 2011\13. Homer, AK: USDOI, FWS, Alaska Maritime National Wildlife Refuge. 24 pp.

Duesterloh, S. and T.C. Shirley. 2004. The Role of Copepods in the Distribution of Hydrocarbons: An Experimental Approach. Anchorage, AK: US Dept. of the Interior, Minerals Management Service.

Dunton, K., S. Schonberg, and N. McTigue. 2009. Characterization of benthic habitats in Camden Bay (Sivulliq Prospect and Hammerhead drill sites), Beaufort Sea Alaska. Report prepared for Shell by University of Texas Marine Science Institute, Port Aransas, TX for Shell Exploration & Production Company, Anchorage, Alaska. 67 pp.

Durner, G.M., S.C. Amstrup, and T.L. McDonald. 2000. Estimating the Impacts of Oil Spills on Polar Bears. *Arctic Research of the United States* 14(Fall/Winter): 33-37.

Earnst, S.L., R.A. Stehn, R.M. Platte, W.W. Larned, and E.J. Mallek. 2005. Population size and trend of yellow-billed loons in northern Alaska. The Condor 107: 289-304. http://alaska.fws.gov/mbsp/mbm/waterfowl/pdf/EarnstEtal2005.pdf.

EDAW. 2007. Quantitative Description of Potential Impacts of OCS Activities on Bowhead Whale Hunting Activities in the Beaufort Sea. MMS OCS Study 2007-062. Anchorage, AK: USDOI, BOEM, Alaska Region.

Edds, P.L., and J.A.F. Macfarlane. 1987. Occurrence and general behavior of balaenopterid cetaceans summering in the St. Lawrence Estuary, Canada. Can. J. Zool. 65: 1363-1376.

Environmental Protection Agency (EPA). 2010a. Effects of Air Pollutants – Health Effects. January 9, 2010. http://www.epa.gov/eogapti1/course422/ap7a.html.

Environmental Protection Agency (EPA). 2010b. Pollutants in the Ambient Air. http://www.epa.gov/eogapti1/course422/ap2.html.

Environmental Protection Agency (EPA). 2011a. Nonattainment Areas for Criteria Pollutants. http://epa.gov/airquality/greenbk/ and http://epa.gov/airquality/greenbk/ancl.html#ALASKA.

Environmental Protection Agency (EPA). 2011b. Environmental Protection Agency. 2011. Supplemental Environmental Justice Analysis for proposed Outer Continental Shelf PSD, Permit No. R10OCS/PSD-AK-2010-01 & Permit No. R10OCS/PSD-AK-09-01.

Environmental Protection Agency (EPA). 2011c. Supplemental Statement of Basis for Proposed Outer Continental Shelf Prevention of Significant Deterioration Permits Nobel Discoverer Drillship, dated July 6, 2011. Seattle, WA: EPA Region 10.

Erbe, C. 2002. Hearing Abilities of Baleen Whales. Report CR 2002-065. Ottawa, Ont., Canada: Defense Research and Development Canada. http://pubs.drdc.gc.ca/PDFS/unc09/p519661.pdf

Fay, R. 2009. Soundscapes and the sense of hearing in fishes. *Integ. Zool.* 4(1): 26-32

Fechhelm, R G and W.B. Griffiths. 2001. Status of Pacific Salmon in the Beaufort Sea, 2001. Anchorage, AK: LGL Alaska Research Assocs. 13 pp.

Fechhelm, R.G., P.C. Craig, J.S. Baker, and B.J. Gallaway. 1985. Fish distribution and use of nearshore waters in the northeastern Chukchi Sea. NOAA and USDOI, MMS OCSEAP Final Rep 32:121-298

Feder, H. M., A.S. Naidu, J.W. Hameedi, S.C. Jewett, and W.R. Johnson. 1989. The Chukchi Sea continental shelf: benthos-environmental interactions: U.S. Dep. Comer., NOAA, OCSEAP, Final Rep. 68, p. 25-311.

Feder, H.M., A.S. Naidu, S.C. Jewett, J.M. Harneedi, W.R. Johnson, and T.E. Whitledge. 1994. The northeastern Chukchi Sea: benthos-environmental interactions. *Marine Ecology-Progress Series 111*: 171-190.

Feder, H.M., S.C. Jewett, and A. Blanchard. 2005. Southeastern Chukchi Sea (Alaska) epibenthos. *Polar Biology.* 28(5): 402-421.

Feder, H.M., S.C. Jewett, and A.L. Blanchard. 2007. Southeastern Chukchi Sea (Alaska) macrobenthos. *Polar Biology.* 30(3): 261-275.

Federal Aviation Administration (FAA). 1997. Air Quality Procedures for Civilian Airports & Air Force Bases. FAA-AEE-97-03. Washington, D.C.: FAA Office of Environment and Energy. http://www.faa.gov/regulations_policies/policy_guidance/envir_policy/airquality_handbook/media/Handbook.PDF

Fox, A.L, E.A. Hughes, R.P. Trocine, J.H. Trefry, N.D. McTigue, B.K. Lasorsa, and B. Konar. 2011, in review. Regulation of Zinc and Biomagnification of Mercury in Biota in the Northeastern Chukchi Sea. In Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA): Chemical and Benthos (CAB) Draft Final Report. Anchorage, AK: USDOI, BOEM. pp. 28-52.

Fraker, M.A., W.J. Richardson, and B. Wursig. 1995. Disturbance Reactions of Bowheads. In: Behavior, Disturbance Responses and Feeding of Bowhead Whales, *balaena mysticetus,* in the Beaufort Sea, 1980-1981. Unpublished Report. Washington, D.C.: USDOI, BLM. pp. 145-248. http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/1/1081.pdf

Froese, R. and D. Pauly, eds. 2010. FishBase. World Wide Web electronic publication. www.fishbase.org, version (11/2010).

Froese, R. and D. Pauly. Editors. 2003. FishBase. World Wide Web electronic publication. www.fishbase.org, version (retrieved Nov. 10, 2011).

Frost, K., L. Lowry, and G. Carroll. 1993. Beluga and spotted seal use of a coastal lagoon system. *Arctic* 46(1): 8-16.

Frost, K.J. and L.F. Lowry. 1983. Demersal Fishes and Invertebrates Trawled in the Northeastern Chukchi and Western Beaufort Seas, 1976-1977. NOAA Technical Report NMFS SSRF-764. Seattle, WA: USDOC, NOAA, NMFS, 22 pp.

Frost, K.J. and L.F. Lowry. 1984. Ringed Seal Monitoring: Relationships of Distribution and Abundance to Habitat Attributes and Industrial Activities. OCS Study MMS 84-0210. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

Frost, K.J. and L.F. Lowry. 1988. Effects of Industrial Activities on Ringed Seals in Alaska, as Indicated by Aerial Surveys. p. 15-25. In: Port and Ocean Engineering Under Arctic Conditions, Symposium on Noise and Marine Mammals, W.M. Sackinger, M.O. Jeffries, J.L. Imm, and S.D. Treacy, eds. http://www.poac.com/Papers/POAC87_V2_all.pdf

Funk., D.W., D.S. Ireland, R. Rodrigues, and W.R. Koski (eds.). 2010. Joint Monitoring Program in the Chukchi and Beaufort seas, open water seasons, 2006–2008. LGL Alaska Report P1050-2, Report from LGL Alaska Research Associates, Inc., LGL Ltd., Greeneridge Sciences, Inc., and JASCO Research , Ltd., for Shell Offshore, Inc. and Other Industry Contributors, and National Marine Fisheries Service, U.S. Fish and Wildlife Service. 506 p. plus Appendices. http://www-static.shell.com/static/usa/downloads/alaska/report_2006-2008_jmp_comprehensive_report_draft_final.pdf

Gailey, G., T. McDonald, R. Racca , O. Sychenko, A. Rutenko, and B. Würsig. 2007. Influences of Underwater Sound and Nearshore Vessel Activity on Western Gray Whale Behavior during the Installation of a Concrete Gravity Based Structure off Sakhalin Island, Summer 2005. Sakhalin Energy Investment Company LTD. Doc Number: 0000-S-90-04-T-8309-00-E, Rev. 01. 161 pp. http://cmsdata.iucn.org/downloads/wgwap_2_inf_7___mva.pdf.

Gall, A.E. and R.H. Day. 2010. Distribution and abundance of seabirds in the northeastern Chukchi Sea, 2008-2009. Unpublished Report for ConocoPhillips Company, Shell Exploration & Production Company, and Statoil USA E & P, Inc. by ABR, Inc. – Environmental Research & Services. Fairbanks, AK: Shell E&P. 68 pp.

Gall, A.E. and R.H. Day. 2011. Distribution and abundance of seabirds in the northeastern Chukchi Sea, 2008-2010. Report prepared by ABR, Inc. – Environmental Research & Services. Fairbanks, AK. Shell E&P. 86 pp.

Gallagher, M., K. Brewer, and J. Hall. 1992. Site Specific Monitoring Plan: Cabot Prospect: Final Report. Report prepared for Arco Alaska, Inc. by Coastal and Offshore Pacific Corp., Walnut Creek, CA. 78 pp.

Geraci, J.R. 1990. Physiologic and Toxic Effect on Cetaceans. *In* Sea Mammals and Oil: Confronting the risks. J.R. Geraci and D.J. St. Aubin, eds. New York, NY: Academic Press. pp. 167-197.

González, J., F.G. Figueiras, M. Aranguren-Gassis, B.G. Crespo, E. Fernández, X.A.G. Morán, and M. Nieto-Cid. 2009. Effect of a simulated oil spill on natural assemblages of marine phytoplankton enclosed in microcosms. Estuarine, Coastal and Shelf Science. 83(3): 265-276. http://www.sciencedirect.com/science/article/pii/S0272771409001796

Gordon, J.C, D. Gillespie, J. Potter, A. Frantzis, M. P. Simmonds, R. Swift, and D. Thompson. 2003. A review of the effects of seismic surveys on marine mammals. *Marine Technology Society Journal 37*(4): 16-34.

Gosselin, M., M. Levasseur, P.A. Wheeler, R.A. Horner, and B.C. Booth. 1997. New measurements of phytoplankton and ice algal production in the Arctic Ocean. *Deep Sea Research Part II: Topical Studies in Oceanography.* 44(8): 1623-1644. doi:10.1016/S0967-0645(97)00054-4.

Gradinger, R. and B. Bluhm. 2004. In-situ observations on the distribution and behavior of amphipods and Arctic cod (*Boreogadus saida*) under the sea ice of the High Arctic Canada Basin. *Polar Biology 27*: 595-603.

Gradinger, R., B. Bluhm, and K. Iken. 2010. Arctic sea-ice ridges--safe heavens for sea-ice fauna during periods of extreme ice melt? *Deep Sea Research Part II: Topical Studies in Oceanography.* 57(1-2): 86-95.

Grebmeier, J., and J.P. Barry. 1991. The influence of oceanographic processes on pelagic-benthic coupling in polar regions: A benthic perspective. *Journal of Marine Systems.* 2(3-4): 495-518.

Grebmeier, J., L.W. Cooper, H. Feder, and B. Sirenko. 2006. Ecosystem dynamics of the pacific-influenced northern Bering and Chukchi seas in the Amerasian Arctic. *Progress in Oceanography*. 71(2-4): 331-361.

Grebmeier, J.M. and L.W. Cooper. 2011, in review. Water Column Chlorophyll, Benthic Infauna and Sediment Markers. *In* Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA): Chemical and Benthos (CAB) Draft Final Report. USDOI, BOEM, Alaska OCS Region. p. 89-126.

Greene, C.R., Jr. and S.E. Moore. 1995. Man made noise. Chapter 6 *In* W.J. Richardson, C.R. Greene, Jr., C.I. Malme, and D.H. Thomson (eds.). Marine mammals and noise. San Diego, CA: Academic Press. pp. 101-158

Guerrero, J.L. and B. Peluso. 2011. Minke Whale. Juneau, AK: Alaska Department of Fish and Game. http://www.adfg.alaska.gov/static/education/wns/minke_whale.pdf

Haas, C.; Hendricks, S.; Eicken, H., and A. Herber. 2010. Synoptic airborne thickness surveys reveal state of Arctic sea ice cover. *Geophysical. Research. Letters.* 37(9): L09501.

Hall, J.D., M.L. Gallagher, K.D. Brewer, P.R. Regos, and P.E. Isert. 1994. ARCO Alaska, Inc. 1993 Kuvlum Exploration Prospect Site Specific Monitoring Program. Final Report. Anchorage, AK: ARCO Alaska.

Hannay, D., Martin, B., Laurinolli, M. and Delarue, J. 2009. Chukchi Sea Acoustic Monitoring Program. In: Funk, D.W., Funk, D.S., Rodrigues, R., and W.R. Koski, eds. Joint monitoring program in the Chukchi and Beaufort seas, open water seasons 2006-2008. LGL Alaska Report P1050-1, Report from LGL Alaska Research Associates, Inc., LGL Ltd., Greenridge Sciences, Inc., and JASCO Research, Ltd., for Shell Offshore, Inc. and other industry contributors, and National Marine Fisheries Service, U.S. Fish and Wildlife Service. 288 pp. plus appendices.

Harris, R.E., G.W. Miller, and W.J. Richardson. 2001. Seal Responses to Airgun Sounds During Summer Seismic Surveys in the Alaskan Beaufort Sea. *Marine Mammal Science* 17(4): 795-812.

Harvey, H.R., K.A. Taylor, H.V. Fink, and C.L. Mitchelmore. 2011, in review. Organic Contaminants in Chukchi Sea Sediments and Biota and Toxicological Assessment in the Arctic cod, *Boreogadus saida*. *In* Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA): Chemical and Benthos (CAB) Draft Final Report. Anchorage, AK: USDOI, BOEM. p. 28-52.

Henley, C.M. and L.P. Rybak. 1995. Ototoxicity in Developing Mammals. *Brain Res. Rev*. 204: 68-90.

Highsmith, R.C. and K.O. Coyle. 1992. Productivity of Arctic Amphipods Relative to Gray Whale Energy Requirements. *Marine Ecology Progress Series* 83: 141-150.

Hopcroft, R., B. Bluhm, R. Gradinger, T. Whitledge, T. Weingartner, B. Norcross, and A. Springer. 2008. *Arctic Ocean Synthesis: Analysis of Climate Change Impacts in the Chukchi and Beaufort Seas with Strategies for Future Research.* 1-184. Anchorage, AK: UAF, Institute of Marine Sciences.

Hopcroft, R., B. Bluhm, R. Gradinger, T. Whitledge, T. Weingartner, B. Norcross, and A. Springer. 2008. Arctic Ocean Synthesis: Analysis of Climate Change Impacts in the Chukchi and Beaufort Seas with Strategies for Future Research. Anchorage: UAF Institute Marine Sciences. 184 pp.

Hopcroft, R.R., J. Questel, and C. Clarke-Hopcroft. 2010. Oceanographic Assessment of the Planktonic Communities in the Klondike and Burger Surveys Areas of the Chukchi Sea: Report for Survey Year 2009. Fairbanks: UAF Institute of Marine Science. 54 pp. http://www.arlis.org/docs/vol1/C/705963617.pdf

Hopcroft, R.R., K.N. Kosobokova, and A.I. Pinchuk. 2010. Zooplankton community patterns in the Chukchi Sea during summer 2004: Observations and exploration of the Arctic's Canada basin and the Chukchi Sea: The hidden ocean and RUSALCA expeditions. *Deep Sea Research Part II: Topical Studies in Oceanography.* 57(1-2): 27-39.

Huntington, H.P. and L.T. Quakenbush. 2009. Traditional knowledge of bowhead migration patterns near Kaktovik and Barrow, Alaska. Report prepared for the Barrow and Kaktovic Whaling Captains Associations and Alaska Eskimo Whaling Commission. Juneau, AK: Alaska Department of Fish and Game. 13 pp. http://www.adfg.alaska.gov/static/home/about/management/wildlifemanagement/marinemammals/pdfs/tk_barrow_kaktovik.pdf

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate Change 2007 Synthesis Report, Core Writing Team, R.K. Pachauri, and A. Reisinger, eds. Geneva: IPCC, 104 pp. http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm.

International Whaling Commission (IWC). 2007. Report of the Scientific Committee. Annex F. Report of the sub-Committee on Bowhead, Right, and Gray Whales. Journal of Cetacean Research and Management (Suppl.), 9: 142-155.

Ireland, D. S., W. R. Koski, T. A. Thomas, J. Beland, C. M. Reiser, D. W. Funk, and A. M. Crander. 2009. Updated distribution and relative abundance of cetaceans in the eastern Chukchi Sea in 2006-8. Report to the IWC SC/61/BRG4. 14 pp. http://iwcoffice.org/_documents/sci_com/sc61docs/SC-61-BRG4.pdf

Jay, C. V, B. G. Marcot, and D. C. Douglas. 2011. Projected status of the Pacific walrus (Odobenus rosmarus divergens) in the twenty-first century. Polar Biol.

Jay, C.V., P. M. Outridge, J. L. Garlich-Miller. 2008. Indication of two Pacific walrus stocks from whole tooth elemental analysis. Polar Biology 31: 933-943.

Johnson, J.H. and A.A. Wolman. 1984. The Humpback Whale, *Megaptera Novaeangliae*. *Marine Fisheries Review* 464: 300-337.

Karcher, M., W.J.F. Harms., Dowdall, M., and P. Strand. 2010. On the Potential for Climate Change Impacts on Marine Anthropogenic Radioactivity in the Arctic Regions. *Marine Pollution Bulletin* 60: 1151-1159.

Kastelein, R.A., P. Mosterd, B. van Santen, M. Hagedoorn, and D. de Haan. 2002. Underwater Audiogram of a Pacific Walrus (*Odobenus rosmarus divergens*) measured with narrow-band frequency-modulated signals. J. Acoust. Soc. Am. Volume 112, Issue 5, pp. 2173-2182 (2002);

Kelly, B.P. 1988. Ringed seal, *Phoca hispida*. *In* J. W. Lentifer, editor. Selected Marine Mammal Species of Alaska: Species Accounts with Research and Managment Recommendations. Washington, D.C: Marine Mammal Commission. pp. 57-75.

Kelly, B.P., J.L. Bengtson, P.L. Boveng, M.F. Cameron, S.P. Dahle, J.K. Jansen, E.A. Logerwell, J.E. Overland, C.L. Sabine, G.T. Waring, and J.M. Wilder. 2010. Status review of the ringed seal (*Phoca hispida*). U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-212, 250 p. http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-212.pdf.

Ketten, D.R. 1998. Marine Mammal Auditory Systems: A Summary of Audiometric and Anatomical Data and its Implications for Underwater Acoustic Impacts. U.S. Department of Commerce, NOAA-TM-NMFS-SWFSC-256.USDOC, NOAA and North Slope Borough (NSB). 2005. Workshop on Bowhead Whale Stock Structure Studies in the Bering-Chukchi-Beaufort Seas: 2005-2006, Seattle, Wash., Feb. 23-24, 2005. Seattle, WA and Barrow, AK: USDOC, NOAA, AFSC, NMML and NSB, Dept. of Wildlife Management.

Kinney, P.J., ed. 1985. Environmental Characterization and Biological Utilization of Peard Bay. OCS Study MMS 85-0102. Anchorage, AK: USDOI, BOEM, Alaska OCS Region. pp. 97-440.

Kirchman, D.L., V. Hill, M.T. Cottrell, R. Gradinger, R.R. Malmstrom, and A. Parker. 2009. Standing stocks, production, and respiration of phytoplankton and heterotrophic bacteria in the western arctic ocean: The western artic shelf-basin interactions (SBI) project, vol.2. *Deep Sea Research Part II: Topical Studies in Oceanography.* 56(17): 1237-1248.

Kopp, R.E., and Mauzerall, D.L. 2010. Assessing the Climatic Benefits of Black Carbon Mitigation. *Proceedings of the National Academy of Sciences* 107(26): 11703-11708. doi: 10.1073/ pnas.0909605107.

Koski, W.R. and S.R. Johnson. 1987. Behavioral Studies and Aerial Photogrammetry. In: Responses of Bowhead Whales to an Offshore Drilling Operation in the Alaskan Beaufort Sea, Autumn 1986. Anchorage, AK: Shell Western E&P, Inc.

Kraus, S., A. Read, E. Anderson, K. Baldwin, A. Solow, T. Spradlin, and J. Williamson. 1997. A Field Test of the Use of Acoustic Alarms to Reduce Incidental Mortality of Harbor Porpoise in Gill Nets. Nature 388: 341.

Kryter, K.D. 1985. The effects of noise on man, 2nd ed. Academic Press, Orlando, FL. 688 p. http://books.google.com/books/about/The_effects_of_noise_on_man.html?id=1U1rAAAAMAAJ

Kuletz, K. 2011a. Norseman II 2011 Cruise Report. D. Pavlik, observer, and K. Kuletz, Principal Investigator. Report to BOEM. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

Kuletz, K. 2011b. 2011 CHAOZ Cruise Seabird Survey Report. A. Bankert (USFWS), observer, K. Kuletz, Principal Investigator. Report to BOEM. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

Larned, W., R. Stehn, and R. Platte. 2006. Eider breeding population survey Arctic Coastal Plain, Alaska 2006 Anchorage, AK: USDOI, FWS, Migratory Bird Management – Waterfowl Mgt. Branch. 53 pp. http://alaska.fws.gov/mbsp/mbm/waterfowl/surveys/pdf/nse2006rpt.pdf.

Larned, W., R. Stehn, and R. Platte. 2010. Waterfowl breeding population survey Arctic Coastal Plain, Alaska 2009. Anchorage, AK: USDOI, FWS, Migratory Bird Management – Waterfowl Mgt. Branch. 45 pp. http://alaska.fws.gov/mbsp/mbm/waterfowl/surveys/pdf/acp2009_report.pdf.

Leatherwood, S., R.R. Reeves, W.F. Perrin, and W.E. Evans. 1982. Whales, dolphins, and porpoises of the eastern North Pacific and adjacent Arctic waters: A guide to their identification. NOAA Tech. Rep., NMFS Circular 444. Seattle, WA: USDOC, NOAA, Fisheries Science Center.

Lee, S.H., T.E. Whitledge, and S. Kang. 2008. Spring time production of bottom ice algae in the landfast sea ice zone at Barrow, Alaska. *Journal of Experimental Marine Biology and Ecology*. 367(2): 204-212.

Legendre, L., S.F. Ackley, G.S. Dieckmann, B. Gulliksen, R. Horner, T. Hoshiai, I.A. Melnikov, W.S. Reeburgh, M. Spindler, and C.W. Sullivan. 1992. Ecology of sea ice biota. *Polar Biology*. 12(3): 429-444.

Logerwell, E., K. Rand, S.Parker-Stetter, J. Horne, T. Weingartner, and B. Bluhm. 2010. Beaufort Sea Marine Fish Monitoring 2008: Pilot Survey and Test of Hypotheses. Prepared by Alaska Fisheries Science Center, NOAA National Marine Fisheries Service. BOEMRE 2010-048. Anchorage, AK: USDOI, BOEM, Alaska OCS Region. 262 p.

Lonne, O. and B. Gullickson. 1989. Size, age, diet of polar cod (*Boreogadus saida*) in ice covered waters. *Polar Biology 9*: 187-191.

Lowry, L. and K. Frost. 1981. Distribution, growth and foods of arctic cod (*Boreogadus saida*) in the Bering, Chukchi and Beaufort seas. *The Canadian Field Naturalist* 95: 186-190.

Lowry, L., Frost, K., and J. Burns. 1980. Feeding of Bearded Seals in the Bering and Chukchi Seas and Trophic Interaction with Pacific Walruses. *Arctic 33*(2): 330-342

Lowry, L.F. 1994. Beluga whale. In Wildlife Notebook Series. Alaska Department of Fish and Game. Juneau, AK. http://www.adfg.state.ak.us/pubs/notebook/marine/beluga.php**.**

Lowry, L.F. and K. Frost. 2002. Beluga whale surveys in the eastern Chukchi Sea, July 2002. Alaska Beluga Whale Committee Report 02-2 submitted to National Marine Fisheries Service, Juneau, AK. 10 pp.

Lowry, L.F., G. Sheffield, and J.C. George. 2004. Bowhead whale feeding in the Alaskan Beaufort Sea based on stomach contents analyses. *J. Cetacean Res. Manage.* 63: 223.

MacDonald, J., C. O'Neil, R. Bohan, and D. Hannay. 2008. Underwater sound level measurements of airgun sources and support vessels from the Shell 2008 MV Gilavar survey at Chukchi Sea Site A. Unpublished report prepared by JASCO Research Ltd., Victoria, BC. Anchorage, AK: Shell E&P Co.

Marine Exchange of Alaska. 2011. Pacific Northern Waters Task Force Briefing, Nome, Alaska July 2011. http://www.housemajority.org/coms/anw/pdfs/27/Marine_Exchange_AK.pdf.

Martin, G.R. 2011. Understanding bird collisions with man-made objects: a sensory ecology approach. *Ibis* 153: 239-254.

Mathis, J. 2011. Biogeochemical Assessment of the OCS Arctic Waters: Current Status and Vulnerability to Climate Change. In Coastal Marine Institute, UAF, Annual Report No. 17. BOEMRE 2011-029. Anchorage, AK: USDOI, BOEM, Alaska OCS Region. http://alaska.boemre.gov/reports/2011rpts/2011_029.pdf

Mathis, J.T., N.R. Bates, D.A. Hansell, and T. Babila. 2009. Net community production in the northeastern Chukchi Sea: The western artic shelf-basin interactions (SBI) project, Vol. 2. *Deep Sea Research Part II: Topical Studies in Oceanography.* 56(17): 1213-1222.

Matthes, H., A. Rinke, K. Dethloff. 2009. Variability of Observed Temperature-Derived Climate Indices in the Arctic. *Global and Planetary Change* 69: 314-224. doi: 10.1016/ j.gloplacha.2009.10.004.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adihyta, J. Murdoch, and K. McCabe. 2000. Marine seismic surveys: analysis and propagation of air gun signals; and effects of exposure on humpback whales, sea turtles, fishes and squid. Prepared for the Australian Petroleum Exploration and Production Association from the Centre for Marine Science and Technology, Curtin University. CMST R99-15, 185, unpublished.

Mecklenburg C.W., P. R.Møller and D. Steinke. 2011. Biodiversity of Arctic marine fishes: Taxonomy and zoogeography. *Marine Biodiversity* 41:109-140

Mecklenburg CW, D.L. Stein, B.A. Sheiko, N.V. Chernova, T.A. Mecklenburg, and B.A. Holladay. 2007. Russian–American Long-term Census of the Arctic: benthic fishes trawled in the Chukchi Sea and Bering Strait, August 2004. *Northwest Nat. 88*: 168–187.

Mecklenburg, C.W., T.A. Mecklenburg, and L.K. Thorsteinson. 2002. *Fishes of Alaska.* Bethesda, MD: American Fisheries Society.

Miles, P.R., C. Malme, and W.J. Richardson. 1987. Prediction of drilling site-specific interaction of industrial acoustic stimuli and endangered whales in the Alaskan Beaufort Sea. OCS Study MMS 87-0084. 101 pp. http://www.alaska.boemre.gov/reports/1980rpts/87_0084/87_0084_1.pdf

Miller, G. W., and R. A. Davis. 2002. Marine mammal and acoustical monitoring of Anderson Exploration Limited's open-water seismic program in the southeastern Beaufort Sea, 2001. LGL Ecological Research Associates, Inc., LGL Report TA 2618-1. Anchorage, AK: LGL Ltd. 199 p.

Miller, G.W., R.E. Elliott, and W.J. Richardson. 1998. Whales. in: Marine mammal and acoustical monitoring of BP Exploration (Alaska)'s Open-Water Seismic Program in the Alaskan Beaufort Sea, 1997, LGL and Greeneridge, eds. LGL Report TA 2150-3. King City, Ont., Canada: LGL Ecological Research Associates, Inc. 124 pp.

Moore, S. E., K. M Stafford, and L. M. Munger. 2010. Acoustic and Visual Surveys for Bowhead Whales in the Western Beaufort and far Northeastern Chukchi Seas. *Deep Sea Research Part II* 57(1-2) 153-157.

Moore, S.E. and R.R. Reeves. 1993. Distribution and Movement. *In* The Bowhead Whale, J.J. Burns, J.J. Montague, and C.J. Cowles, eds. Special Publication of The Society for Marine Mammalogy 2. Lawrence, KS: The Society for Marine Mammalogy, pp. 313-386.

Moore, S.E., and J.T. Clarke. 2002. Potential Impact of Offshore Human Activities on Gray Whales (*Eschrichtius robustus*). *J. Cetacean Res. Manage.* 4(1): 19–25. http://www.afsc.noaa.gov/nmml/PDF/humanimpact.pdf.

Moore, S.E., K.M. Stafford, and M.E. Dahlheim. 1998. Seasonal Variation in Fin Whale Calls at Five Geographic Areas in the North Pacific. *Marine Mammal Science* 143: 617-627.

Moore,S. E,. J. C. George, G. Sheffield, J. Bacon, and C. J. Ashijan, 2010. Bowhead Whale Distribution and Feeding near Barrow, Alaska, in the late summer 2005-06. *Arctic* 63(2): 195-205.

Moss, J.H., J.M. Murphy, E.V. Farley, L.B. Eisner, and A.G. Andrews. 2009. Juvenile pink and chum salmon distribution, diet, and growth in the northern Bering and Chukchi seas. *N. Pac. Anadr. Fish Comm. Bull.* 5: 191–196.

Moulton, V.D., W.J. Richardson, M.T. Williams and S.B. Blackwell. 2003. Ringed seal densities and noise near an icebound artificial island with construction and drilling. *Acoustic Res. Let. Online* 4(4): 112-117.

Murphy, I.K., F. Huettmann, N. Fresco, and J. Morton. 2010. Connecting Alaska landscapes into the future: Results from an interagency climate modeling, land management and conservation project. Final Report. Fairbanks, AK: UAF, Scenarios Network for Alaska Planning. 96pp.

Naidu, A.S. 1988. Marine surficial sediments. Section 1.2. In: Bering, Chukchi and Beaufort Seas, coastal and ocean zones strategic assessment: data atlas. NOAA, Rockville, MD.

Naidu, A.S., A. Blanchard, J.J. Kelley, J.J. Goering, M.J. Hameed, and M. Baskaran. 1997. Heavy metals in Chukchi Sea sediments as compared to selected circum-arctic shelves. *Marine Pollution Bulletin.* 35(7 – 12) p 260 – 269.

National Marine Fisheries Service (NMFS). 2008. Endangered Species Act, Section 7, Biological Opinion: Oil and Gas Leasing and Exploration Activities in the U.S. Beaufort and Chukchi Seas, Alaska and Authorization of Small Takes Under the Marine Mammal Protection Act. Seattle, WA: NOAA. 140 pp. http://www.alaska.boemre.gov/ref/BioOpinions/2008_0717_bo.pdf.

National Marine Fisheries Service (NMFS). 2010. Recovery plan for the fin whale (*Balaenoptera physalus*). Silver Spring, MD: NMFS. 121 pp. http://www.nmfs.noaa.gov/pr/pdfs/recovery/finwhale.pdf.

National Marine Fisheries Service (NMFS). 2011. NOAA Fisheries Office of Protected Resources: Fin whale (*Balaenoptera physalus*) species description. http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/finwhale.htm.

National Research Council (NRC). 2003. Ocean Noise and Marine Mammals. Washington, DC: National Academies P.

National Research Council (NRC). 2003b. Oil in the Sea III: Inputs, Fates, and Effects Committee on Oil in the Sea: Inputs, Fates, and Effects, National Research Council. 280 pgs.

National Research Council (NRC). 2005. Marine Mammal Populations and Ocean Noise. Determining When Noise Causes Biologically Significant Effects. Washington, DC: National Academies P.

National Weather Service (NWS). 2009. NWS Windchill Chart. Available on the NWS Office of Climate, Water, and Weather Services Website at: http://www.nws.noaa.gov/om/windchill/.

Neff, J.M., G.S. Durell, J.H. Trefry and J.S. Brown. 2010. Environmental Studies in the Chukchi Sea 2008: Chemical Characterization. Prepared by Battelle Memorial Institute, Exponent Inc., Florida Institute of Technology, Neff & Associates. Service Contract No. 68393.0-SA-AKR. 157 p. Anchorage, AK: Shell E&P and ConocoPhillips Alaska.

Nelson, C.H., R.L. Phillips, J. McRea Jr., J.H. Barber Jr., M.W. McLaughlin, J.L. Chin. 1993. Gray Whale and Pacific Walrus Benthic Feeding Grounds and Sea Floor Interaction in the Chukchi Sea. OCS Study, MMS 93-0042. 51 p. + Appx. http://www.alaska.boemre.gov/reports/1990rpts/93_0042.pdf.

Nelson, M. and H. Griese. 2008. Ribbon Seal. Wildlife Notebook Series. Juneau, AK: Alaska Dept. of Fish and Game. 1 p. http://www.adfg.alaska.gov/static/education/wns/ribbon_seal.pdf.

Nelson, R.R., J.J. Burns, and K.J. Frost. 1984. The bearded seal (*Erignathus barbatus*). Pages 1-6 in J. J. Burns, ed. Marine Mammal Species Accounts, Wildlife Technical Bulletin No. 7. Juneau, AK: Alaska Department of Fish and Game.

Nerini, M. 1984. A review of gray whale feeding ecology. p. 423-450 In: M.L. Jones, S.L. Swartz and S. Leatherwood (eds.), The Gray Whale, *Eschrichtius robustus*. Orlando, FL: Academic Press. 600 p.

NMFS. 2008. Biological Opinion for Oil and Gas Leasing and Exploration Activities in the U.S. Beaufort and Chukchi Seas, Alaska; and Authorizations of Small Takes Under the Marine Mammal Protection Act, NMFS, 2008.

NMFS. 2009. Biological Opinion for Beaufort and Chukchi Sea Program Area Lease Sales and associated Seismic Surveys and Exploratory Drilling, USFWS, 2009.

NOAA. 2011. Nearshore Fish Atlas of Alaska. http://fakr.noaa.gov/habitat/fishatlas/.

Norcross, B.L., B.A. Holladay, M.S. Busby, and K.L. Mier. 2010. Demersal and larval fish assemblages in the Chukchi Sea. *Deep Sea Res II* 57: 57–70

North Pacific Fishery Management Council (NPFMC). 1990. Fishery Management Plan for the Salmon Fisheries in the EEZ off the Coast of Alaska. Anchorage, AK: NPFMC. 210 p.

North Pacific Fishery Management Council (NPFMC). 2009. Fishery Management Plan for Fish Resources of the Arctic Management Area. Anchorage, AK: NPFMC, 147 pp.

Nowak, R. 1999. Walker's mammals of the World, 6th Ed. Vol II. Baltimore: John Hopkins University Press.

NSIDC. 2011a. Summer 2011: Arctic sea ice near record lows. NSIDC Sea Ice News and Analysis. Boulder, Co: Cooperative Institute for Research in Environmental Sciences, National Snow and Ice Data Center; 2011; 04 October 2011. 4 pp. Available at http://nsidc.org/arcticseaicenews/2011/100411.html.

NSIDC. 2011b. Ice extent low at start of melt season; ice age increases over last year. NSIDC Press Release. Boulder, Co: Cooperative Institute for Research in Environmental Sciences, National Snow and Ice Data Center; 2011; 05 April 2011. 4 pp. Available at http://nsidc.org/arcticseaicenews/2011/040511.html (accessed April 10, 2010). Website

Ohsumi, S. and S. Wada. 1974. Status of Whale Stocks in the North Pacific, 1972. *Reports of the International Whaling Commission* 27. Cambridge, UK: IWC. pp. 167-175.

Olesiuk, P.E., L.M. Nichol, M.J. Sowden, and J.K.B. Ford. 1995. Effect of Sounds Generated by Acoustic Deterrent Device on the Abundance and Distribution of Harbor Porpoise (*Phocoena phocoena*) in Retreat Passage, British Columbia. Nanaimo, BC, Canada: Fisheries and Oceans Canada, Pacific Biological Station, 47 pp.

Oppel, S., D.L. Dickson, and A.N. Powell. 2009. International importance of the eastern Chukchi Sea as a staging area for migrating king eiders. *Polar Biology 32*: 775-783.

Perry, J.A. and D. Renouf. 1987. Further Studies of the Role of Harbor Seal (Phoca Vitulina) Pup Vocalizations in Preventing Separation of Mother-Pup Pairs. *Canadian Journal of Zoology* 66: 934-938.

Perry, S.L., D.P. DeMaster, and G.K. Silber. 1999a. The Fin Whale. *Marine Fisheries Review* 611: 44-51.

Perry, S.L., D.P. DeMaster, and G.K. Silber. 1999b. The Humpback Whale. *Marine Fisheries Review* 611: 24-37.

Philips, R.L., T.E. Reiss, E.W. Kempema, and E. Reimnitz. 1984. Nearshore Marine Geologic Investigations, Wainwright to Skull Cliff, Northeast Chukchi Sea. 84-108. Menlo Park, CA: USGS. 33 pp. http://www.dggs.dnr.state.ak.us/webpubs/usgs/of/text/of84-0108.PDF

Piatt, J., J.L.Wells, A. MacCharles, and B. Fadely. 1989. The distribution of seabirds and fish in relation to ocean currents in the southeastern Chukchi Sea. *In* Studies of high-latitude seabirds: Behavioural, energetic, and oceanographic aspects of seabird feeding ecology. Proceedings of Population Biology and Conservation of Marine Birds Symposium, Memorial University, St. John's, Newfoundland, April, 1989. W.A. Montevecchi, and A.J Gaston (eds). Occasional Paper Number 68, Canadian Wildlife Service.

Piatt, J.F. and D.A. Methven. 1992. Threshold Foraging Behavior of Baleen Whales. *Marine Ecology Progress Series* 84: 205-210.

Pickart, R.S., L.J. Pratt, D.J. Torres, T.E. Whitledge, A.Y. Proshutinsky, K. Aagaard, T.A. Agnew, G.W.K. Moore, and H.J. Dail. 2010. Evolution and dynamics of the flow through herald canyon in the western Chukchi Sea. *Deep Sea Research Part II: Topical Studies in Oceanography* 57(1-2): 5-26.

Poot, H., B.J. Ens, H. deVries, M.A.H. Donners, M.R. Wernand, and J.M. Marquenie. 2008. Green light for nocturnally migrating birds. *Ecology and Society* 13(2): 47. http://www.ecologyandsociety.org/vol13/iss2/art47/

Purser, J. and A.N. Radford. 2011. Acoustic noise induces attention shifts and reduces foraging performance in three-spined sticklebacks (*Gasterosteus aculeatus*). *PloS One Open Access* 6(2): 1-8.

Quakenbush, L. T. and H. P. Huntington. 2010. Traditional Knowledge Regarding Bowhead Whales in the Chukchi Sea near Wainwright, Alaska. Prepared by USDOI MMS and UAF School of Fisheries. OCS Study MMS-2009-063. Fairbanks, AK: UAF Coastal Marine Institute. http://www.alaska.boemre.gov/reports/2009rpts/2009_063.pdf.

Quakenbush, L. T., R. J. Small, and J. J. Citta. 2010. Satellite Tracking of Western Arctic Bowhead Whales. OCS Study BOEMRE 2010-033. Anchorage, AK: USDOI, BOEMRE, Alaska OCS Region. 65 pp. + Appx. http://www.alaska.boemre.gov/reports/2010rpts/2010_033.pdf

Radford, C.A., J.A. Stanley, C.T. Tindle, J.C. Montgomery, A.G. Jeffs. 2010. Localised coastal habitats have distinct underwater sound signatures. *Marine Ecology Progress Series* 401: 21–29.

Raven, J., K., K. Caldeira, H. Elderfield, O. Hoegh-Guldberg, P. Liss, U. Riebesell, J. Shepherd, C. Turley, and A. Watson. 2005. Ocean Acidification due to Atmospheric Carbon Dioxide. The Royal Society, London. 68 pages. Available at: http://www.royalsoc.ac.uk Reference at S:\NEPA Projects\EA\2011\2012 Shell Chukchi Sea EP\Draft EA\Support Documents\Raps\References.

Ray, G.C., Mitchell, E.D., Wartzok, D., Kozicki, V.M., and Maiefski, R. 1978. Radio tracking of a fin whale (*Balaenoptera physalus*). Science 202: 521-524.

Reilly, S.B., J.L. Bannister, P.B. Best, M. Brown, R.L. Brownell Jr., D.S. Butterworth, P,J. Clapham, J. Cooke, G.P. Donovan, J. Urbán, and A.N. Zerbini. 2008. *Eschrichtius robustus*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. http://www.iucnredlist.org/apps/redlist/details/8097/0.

Rice, D.W. and A.A. Wolman. 1971. The life history and ecology of the gray whale (*Eschrichtius robustus*). Am. Soc. Mamm. Spec. Publ. 3. Stillwater, OK: American Society of Mammologists. 142pp.

Richard, P.R., A.R. Martin, and J.R. Orr. 1998. Study of late summer and fall movements and dive behaviour of Beaufort Sea belugas, using satellite telemetry: 1997. MMS OCS Study 98-0016. Anchorage, AK: USDOI, BOEM, Alaska OCS Region. 25 pp.

Richardson, W.J. 1995a. Chapter 8: Marine mammal hearing. In W.J. Richardson, C.R. Greene Jr., C.I. Malme, and D.H. Thomson (eds.). 1995. Marine Mammals and Noise. San Diego, CA: Academic Press. pp. 205-240.

Richardson, W.J. 1995b. Chapter 9: Documented Disturbance Reactions. In W.J. Richardson, C.R. Greene Jr., C.I. Malme, and D.H. Thomson (eds.). 1995. Marine Mammals and Noise. San Diego, CA: Academic Press. pp. 241-324.

Richardson, W.J. 1998. Marine mammal and acoustical monitoring of BP Exploration (Alaska)'s open-water seismic program in the Alaskan Beaufort Sea, 1997. LGL Rep. TA2150-3. Rep. from LGL Ltd., Greeneridge Sciences Inc. Anchorage, AK: NMFS and BP Exploration Alaska, Inc.

Richardson, W.J. and C.I. Malme. 1993. Man-Made Noise and Behavioral Responses. *In* The Bowhead Whale, J.J. Burns, J.J. Montague, and C.J. Cowles, eds. Society for Marine Mammalogy Special Publication 2. Lawrence, KS: Society for Marine Mammalogy. pp. 631-700.

Richardson, W.J. and K. Finley. 1989. Comparison of behavior of bowhead whales of the Davis Strait and Bering/Beaufort stocks. OCS Study MMS-88-0056. Rep prepared by LGL Ltd., King City, Ont. Herndon, VA: USDOI, BOEM. 131 pp.

Richardson, W.J., C.R. Greene, Jr. , J.S. Hanna, W.R. Koski, G.W. Miller, N.J. Patenaude, and M.A. Smultea. 1995b. Acoustic Effects of Oil Production Activities on Bowhead and White Whales Visible During Spring Migration near Pt. Barrow, Alaska-1991 and 1994 Phases: Sound Propagation and Whale Responses to Playbacks of Icebreaker Noise. OCS Study MMS 95-0051. Anchorage, AK: USDOI, BOEM, Alaska OCS Region, pp. 1-392. http://www.alaska.boemre.gov/reports/1990rpts/95_0051/95_0051_1.pdf.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thomson. 1995a. Marine mammals and noise. San Diego, CA: Academic Press, Inc. 576 pp.

Richardson, W.J., M.A. Fraker, B. Wursig, and R.S. Wells. 1985. Behavior of Bowhead Whales, *Balaena mysticetus*, Summering in the Beaufort Sea: Reactions to Industrial Activities. *Biological Conservation* 32(3): 195-230.

Richardson, W.J., R.S. Wells, and B. Wursig. 1985. Disturbance Responses of Bowheads, 1980-1984. In: Behavior, Disturbance Responses, and Distribution of Bowhead Whales, Balaena mysticetus, in the Eastern Beaufort Sea, 1980-84, W.J. Richardson, ed. OCS Study MMS 85-0034. Anchorage, AK: USDOI, BOEM, Alaska OCS Region. pp. 255-306. http://www.alaska.boemre.gov/reports/1980rpts/85_0034/85_0034a.pdf.

Ristroph, Elizabeth. 2010. Alaska Tribes' Melting Subsistence Rights. *Arizona Journal of Environmental Law and Policy*. 1(1): 47 – 90.

Rizzolo, D.J. and J.A. Schmutz. 2010. Monitoring marine birds of concern in the eastern Chukchi nearshore area (loons). Annual Report 2010, prepared by USGS Alaska Science Center. Anchorage, AK: USDOI, BOEM, Alaska OCS Region. 25 pp.

Ross, D. 1976. Mechanics of underwater noise. New York: Pergamon. 375 pp. (Reprinted 1987, Peninsula Publ., Los Altos, CA).

Rugh, D.J., K.W. Shelden, and D.E. Withrow. 1997. Spotted seals, *Phoca largha*, in Alaska. *Marine Fisheries Review* 591: 1-18.

Rugh, D.J., M.M. Muto, S.E. Moore, and D.P. DeMaster. 1999. Status review of the eastern north Pacific stock of gray whales. NOAA Tech. Memo. NMFS-AFSC-103. 93 pp. http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-103.pdf.

Schell, D.M., S.M. Saupe, and N. Haubenstock. 1987. Bowhead Whale Feeding: Allocation of Regional Habitat Importance Based on Stable Isotope Abundances. In: Importance of the Eastern Alaskan Beaufort Sea to Feeding Bowhead Whales, 1985-86, W.J. Richardson, ed. OCS Study MMS 1987-0037. Herndon, VA: USDOI, MMS, pp. 369-415.

Schmutz, J.A., D.J. Rizzolo, K.G. Wright, F. Jair, C.R. DeSorbo, D.M. Mulcahy, and S.E. McCloskey. 2010. Migratory patterns of loons: A contrast among populations and species. 14th Alaska Bird Conference, Nov. 16-18, 2010, Anchorage, AK. http://ak.audubon.org/files/Audubon%20Alaska/documents/2010AlaskaBirdConferenceProgram.pdf

Schulberg, S., I. Show, and D. Van Schoik. 1989. Results of the 1987-1988 gray whale migration and landing craft air cushion interaction study program. U.S. Navy Contr. N62474-87-C-8669. Report from SRA Southwest Research Associates, Cardiff, CA for the Naval Facilities Engineering Command, San Bruno, CA 45 pp.

Schwemmer, P., B. Mendel, N. Sonntag, V. Dierschke, and S. Garthe. 2011. Effects of ship traffic on seabirds in offshore waters: implications for marine conservation and spatial planning. *Ecological Applications* 21(5): 1851-1860.

Serreze, M.C., and A.P. Barrett. 2011. Characteristics of the Beaufort Sea High. *Journal of Climate 24*, 159-182. doi: 10.1175/2010JCL13636.1.

Sexson, M, M.R. Peterson, and A.N. Powell. 2010. Distribution and migratory timing of threatened spectacled eiders in the Beaufort and eastern Chukchi seas. Poster presentation at the Canada-United Stat3s Northern Oil and Gas Research Forum, held November 30-December 2, 2010 in Calgary, Alberta Canada. http://www.arcus.org/files/meetings/279/281/presentations/sexson.pdf

Sexson, M. 2011. Personal communication (emails) to Mark Schroeder, Wildlife Biologist, BOEM regarding weekly updates of spectacled eider locations. These posts are currently available to the general public on request at http://alaska.usgs.gov/science/biology/seaducks/spei/index.php

Shell. 2009. Exploration Plan: 2010 Exploration Drilling Plan, Chukchi Sea Alaska. Anchorage, AK Shell Gulf of Mexico Inc. http://www.alaska.boemre.gov/ref/ProjectHistory/2009_Chukchi_Shell/2009_0811_Chukchi_EP_PublicCopy.pdf

Shell. 2011a. 2012 Revised Outer Continental Shelf Lease Exploration Plan, Chukchi Sea Alaska. Anchorage, AK: Shell Gulf of Mexico Inc. http://alaska.boemre.gov/ref/ProjectHistory/2012_Shell_CK/revisedEP/EP.pdf

Shell. 2011b. Draft Chukchi Sea Regional Exploration Oil Discharge Prevention and Contingency Plan, Revision 1. May 2011. Anchorage, AK: Shell Offshore Inc. http://alaska.boemre.gov/ref/ProjectHistory/2012_Shell_CK/revisedEP/EP.pdf.

Shell. 2011c. Revised Chukchi Sea Exploration Plan Errata (In response to a request for additional information [RFAI] from the Bureau of Ocean Energy Management dated October 28, 2011.). Anchorage, AK: Shell Offshore Inc. http://www.boem.gov/uploadedFiles/BOEM/Oil_and_Gas_Energy_Program/Plans/Regional_Plans/Alaska_Exploration_Plans/2012_Shell_Chukchi_EP/ChukchiErratadocumentOct28RFAI.pdf.

Shirley, T.C. and S. Duesterloh. 2004. An Experimental Investigation of the Role of Zooplankton in the Distribution of Hydrocarbons. OCS Study MMS 2004-034. Anchorage: USDOI, BOEM, Alaska OCS Region. 53 pp. http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/3/3345.pdf.

Simpson, S.D., M.G. Meekan, N.J. Larsen, R.D. McCauley, and A. Jeffs. 2010. Behavioral plasticity in larval reef fish: Orientation is influenced by recent acoustic experiences. *Behavioral Ecology* 21(5): 1098-1105

Slabbekoorn, H., N. Bouton, I. van Opzeeland, A. Coers, C. ten Cate, and A.N. Popper. 2010. A noisy spring: The impact of globally rising underwater sound levels on fish. *Trends Ecol Evol* 25: 419–427.

Smith, T.G., and I. Stirling. 1975. The breeding habitat of the ringed seal (*Phoca hispida*). The birth lair and associated structures. *Canadian Journal of Zoology* 53(9): 1297-1305.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine Mammal Noise Exposure Criteria: initial scientific recommendations. *Aquatic Mammals* 33(4). pp i-414.

Southwest Research Associates. 1988. Results of the 1986-1987 gray whale migration and landing craft, air cushion interaction study program. USN Contract No. PO N62474-86-M-0942. Final Report to Nav. Fac. Eng. Comm., San Bruno, CA. Southwest Research Associates, Cardiff by the Sea, CA. 31pp.

Speckman, S.G., V. Chernook, D.M. Burn, M.S. Udevitz, A.A. Kochnev, A. Vasilev, and C.V. Jay. 2010. Results and evaluation of a survey to estimate Pacific walrus population size, 2006. Marine Mammal Science DOI: 10.1111/j.1748-7692.2010.00419.x.

Springer, A.M., C.P. McRoy, and K.R. Turco. 1989. The paradox of pelagic food webs in the northern bering Sea—II. zooplankton communities. *Continental Shelf Research* 9(4): 359-386. http://www.sciencedirect.com/science/article/pii/0278434389900393.

SRB&A (Stephen R. Braund & Associates). 2011. Chukchi and Beaufort Seas National Pollutant Discharge Elimination System Exploration General Permits Reissuance: Report of Traditional Knowledge Workshops – Point Lay, Barrow, Nuiqsut, and Kaktovik. Final Report.

SRB&A (Stephen R. Braund and Associates). 1989a. North Slope Subsistence Study, Barrow, 1988. OCS Study MMS 89-0077. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

SRB&A (Stephen R. Braund and Associates). 1989b. North Slope Subsistence Study, Wainwright 1988. OCS Study MMS 89-0078. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

SRB&A (Stephen R. Braund, & Associates). 2009. Impacts and Benefits of Oil and Gas Development to Barrow, Nuiqsut, Wainwright, and Atqasuk Harvesters. Prepared for the North Slope Borough Department of Wildlife Management.

SRB&A-ASR. 2011. Stephen R. Braund and Associates and Applied Sociocultural Research. COMIDA: Impact Monitoring for Offshore Subsistence Hunting, 2010 Annual Report. Draft Report, June 2011.

St. Aubin, D.J. 1990. Physiologic and Toxic Effect on Pinnipeds. *In* Sea Mammals and Oil: confronting the risks, J.R. Geraci and D.J. St. Aubin, eds. New York, NY: Academic Press. pp. 103-127.

Stehn, R. and R. Platte. 2009. Steller's eider distribution, abundance, and trend on the Arctic Coastal Plain, Alaska, 1989-2008. Anchorage, AK: USDOI, FWS, Migratory Bird Management – Waterfowl Mgt. Branch. 35 pp.

Stehn, R., R. Platte, W. Larned, J. Fischer, and T. Bowman. 2006. Status and trend of Spectacled Eider populations in Alaska, 2006. Anchorage, AK: USDOI, FWS, Migratory Bird Management – Waterfowl Mgt. Branch. 17 pp.

Steidinger, K.A. and E. Garces. 2006. Chap. 4: Importance of Life Cycle History in the Ecology of Harmful Microalgae. *In* Ecology of Harmful Algae. Edited by E. Graneli and J T. Turner. 1st ed.Vol. 189. pp. 37-49. Berlin, DE: Springer-Verlag.

Stoker, S.W. 1990. Distribution and Carrying Capacity of Gray Whale Food Resources in the Northern Bering and Chukchi Seas. IWC unpublished paper SC/A90/G13. Cambridge, UK: International Whaling Commision.10pp.

Suydam R.S., L.F. Lowry, K.J. Frost, G.M. O'Corry-Crowe, and D. Pikok, Jr. 2001. Satellite tracking of eastern Chukchi Sea beluga whales into the Arctic Ocean. *Arctic* 543: 237-243.

Suydam, R. S., L. F. Lowry, K. J. Frost 2005. Distribution and Movement of Beluga Whales from the Eastern Chukchi Sea Stock During Summer and Early Autumn. OCS Study MMS 2005-035. Anchorage, AK: USDOI, MMS, Alaska OCS Region. http://www.alaska.boemre.gov/reports/2005rpts/2005_035.pdf

Suydam, R., J.C. George, B. Person, C. Hanns, and F. Sheffield. 2011. Subsistence harvest of bowhead whales (*Balaena mysticetus*) by Alaskan Eskimos during 2010. SC/63/BRG2. Cambridge, UK: International Whaling Commission. http://iwcoffice.org/_documents/sci_com/SC63docs/SC-63-BRG2%20.pdf

Suydam, R.S. and J.C. George. 1992. Recent sightings of harbor porpoises, Phocoena phocoena , near Point Barrow, Alaska. *Canadian Field-Naturalist* 1604: 489-492.

Taylor, D. L., S.S. Schliebe, and H. Metsker. 1989. Contaminants in blubber, liver, and kidney tissue of Pacific walruses. *Marine Pollution Bulletin* 20(9): 465-468.

Terhune, J.M. 1981. Influence of Loud Vessel Noises on Marine Mammal Hearing and Vocal Communication. In The Question of Sound from Icebreaker Operations. Proceedings of a Workshop. N.M. Peterson, ed. Toronto, Ontario, Canada: Arctic Pilot Project, Petro-Canada.

Thompson, D., S. Bexton, A. Brownlow, D. Wood, T. Patterson, K. Pye, M. Lonergan, and R. Milne. 2010. Report on Recent Seal Mortalities in UK Waters Caused by Extensvie Lacerations. Scottish Oceans Institute, Sea Mammal Research Unit, St. Andrews, Scotland. 20 p. http://www.smru.st-and.ac.uk/documents/366.pdf

Thomson, D.H., and W. J. Richardson. 1995. Chapter 7: Marine mammal sounds. In: Marine Mammals and Noise: W. J. Richardson, C. R. Greene, Jr., C. I. Malme and D. H. Thomson, eds. San Diego, CA: Academic Press. pp. 159-204.

Trefry and Trocine. 2009. Chemical Assessment in Camden Bay (Sivulliq Prospect and Hammerhead Drill Sites) Beaufort Sea AlaskaReport prepared for Shell Exploration & Production Co., Anchorage, Alaska. Florida Institute of Technology - Final Report July 2009. Anchorage, AK: Shell Exploration and Production.

Trefry, J.H., R.P. Trocine and L.W. Cooper. 2011, in review. Distribution and Provenance of Trace Metals in Recent Sediments of the Northeastern Chukchi Sea. *In* Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA): Chemical and Benthos (CAB) Draft Final Report. Anchorage, AK: USDOI, BOEM, Alaska OCS Region. p. 6-27.

U.S. Census Bureau. 2009. Wainwright City, Alaska. U.S. Census, http://factfinder.census.gov/servlet/ACSSAFFFacts?_event=Search&_cityTown=wainwright+city&_state=ak&_lang=en&_sse=on&ActiveGeoDiv=geoSelect&_useEV=&pctxt=fph&pgsl=040&_submenuId=factsheet_1&ds_name=ACS_2008_3YR_SAFF&_ci_nbr=null&qr_name=null&reg=null%3Anull&_keyword=&_industry=.

Umiak LLC. 2010. 2010 Subsistence Advisor Program, North Slope, Alaska. Anchorage, AK: Shell E&P Co.

United States Coast Guard (USCG). 2011. USCG D17 Arctic Brief 27 January 2011 Rear Admiral Christopher C. Colvin Commander Seventeenth Coast Guard District Coast Guard Forces Alaska Marine Exchange of Alaska. 2011. Pacific Northern Waters Task Force Briefing, Nome, Alaska, July 2011.

USDOI, BOEM. 2011. Biological Evaluation Oil and Gas Leasing and Exploration Activities in the Beaufort Sea and Chukchi Sea Planning Areas. Prepared by BOEM for NMFS, Alaska Region. 7 Oct. 2011. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

USDOI, BOEMRE. 2011a. Chukchi Sea Planning Area Oil and Gas Lease Sale 193 Final Supplemental Environmental Impact Statement. OCS EIS/EA BOEMRE 2011-041. Anchorage, AK: USDOI, BOEMRE, Alaska OCS Region. http://www.alaska.boemre.gov/ref/EIS%20EA/2011_041_FSEIS/2011_041x.htm.

USDOI, BOEMRE. 2011b. Biological Evaluation for Oil and Gas Activities on the Beaufort and Chukchi Sea Planning Areas Prepared for the Fish and Wildlife Service on Polar Bear and Polar Bear Critical Habitat, Steller's Eider, Spectacled Eider and Spectacled Eider Critical Habitat, Kittlitz's Murrelet, and Yellow-billed Loon. Prepared by BOEMRE for the FWS, September 2011. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

USDOI, BOEMRE. 2011c. Environmental Assessment: Shell Offshore Inc. 2012 Revised Outer Continental Shelf Lease Exploration Plan, Camden Bay, Beaufort Sea, Alaska. Anchorage, AK: USDOI, BOEM, Alaska OCS Region. www.alaska.boemre.gov/ref/EIS%20EA/2012_Shell_CamdenEP_EA/2011_039.pdf..

USDOI, FWS. 2007. Biological Opinion for Chukchi Sea Planning Area Oil and Gas Lease Sale 193 and Associated Seismic Surveys and Exploratory Drilling. . Anchorage, AK: USDOI, BOEM, Alaska OCS Region. http://www.alaska.boemre.gov/ref/BioOpinions/BO193/bo_193.pdf

USDOI, FWS. 2009. Final Biological Opinion for Beaufort and Chukchi Sea Program Area Lease Sales and Associated Seismic Surveys and Exploratory Drilling. Anchorage, AK: USDOI, BOEM, Alaska OCS Region. http://www.alaska.boemre.gov/ref/BioOpinions/2009_0903_BO4BFCK.pdf.

USDOI, FWS. 2010a. Polar bear (*Ursus maritimus*): Chukchi/Bering Seas stock. Final stock assessment report. http://alaska.fws.gov/fisheries/mmm/stock/final_cbs_polar_bear_sar.pdf.

USDOI, FWS. 2010b. Polar bear (*Ursus maritimus*): Southern Beaufort Sea stock. Final stock assessment report. Available at http://alaska.fws.gov/fisheries/mmm/stock/final_sbs_polar_bear_sar.pdf

USDOI, MMS. 2002. Final Environmental Impact Statement – Outer Continental Shelf Oil and Gas Leasing Program: 2002-2007 (OCS EIS/EA MMS 2002-006). Herndon, VA: USDOI, BOEM. http://www.boemre.gov/5-year/history2002-2007.htm

USDOI, MMS. 2003. Beaufort Multi-Sale EIS (USDOI, MMS, 2003, pgs. IV-28 – IV-34) and in Chapter IV, Environmental Consequences, of the 2011 Chukchi Sea Planning Area Sale 193 FSEIS (USDOI, BOEMRE, 2011).

USDOI, MMS. 2003. Beaufort Sea Planning Area Sales 186, 195, and 202 Oil and Gas Lease Sale Final EIS. OCS EIS/EA MMS 2003-001. Anchorage, AK: USDOI, BOEM, Alaska OCS Region. http://www.alaska.boemre.gov/ref/EIS%20EA/2003_001.pdf.

USDOI, MMS. 2006. Proposed Oil and Gas Lease Sale 202 Beaufort Sea Planning Area Environmental Assessment. OCS EIS/EA MMS 2006-001. Anchorage, AK: USDOI, BOEM, Alaska OCS Region. http://www.alaska.boemre.gov/ref/EIS%20EA/BeaufortEA_202/EA_202.htm.

USDOI, MMS. 2007a. Final Environmental Impact Statement – Chukchi Sea Planning Area Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea (OCS EIS/EA MMS 2007-026). Anchorage, AK: USDOI, BOEM, Alaska OCS Region. http://www.alaska.boemre.gov/ref/EIS%20EA/Chukchi_FEIS_193/feis_193.htm

USDOI, MMS. 2007b. Final Environmental Impact Statement – Outer Continental Shelf Oil & Gas Leasing Program: 2007-2012 (OCS EIS/EA MMS 2007-003). Herndon, VA: USDOI, BOEM. http://www.boemre.gov/5-year/2007-2012FEIS/Intro.pdf.

USDOI, MMS. 2008. Draft Environmental Impact Assessment: Beaufort Sea and Chukchi Sea Planning Areas, Oil and Gas lease Sales 209, 212, 217, and 221. OCS EIS/EA MMS 2008-055. Anchorage, AK: USDOI, BOEM, Alaska OCS Region. http://www.alaska.boemre.gov/ref/ EIS%20EA/ArcticMultiSale_209/_DEIS.htm

USDOI, MMS. 2009. Synthesis: Three Decades of Research on Socioeconomic Effects Related to Offshore Petroleum Development in Coastal Alaska. MMS OCS Study 2009-006. S.R. Braund and J. Kruse, eds. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

USDOI, MMS. 2009a. Environmental Assessment – Shell Gulf of Mexico Inc. 2010 Exploration Drilling Program, Burger, Crackerjack, and SW Shoebill Prospects, Chukchi Sea, Outer Continental Shelf, Alaska (OCS EIS/EA MMS 2009-061)**.** Anchorage, AK: USDOI, BOEM, Alaska OCS Region. http://www.alaska.boemre.gov/ref/EIS%20EA/ 2009_Chukchi_2010EA/2009_EA2010_Chukchi_EP.pdf

USDOI, MMS. 2009b. Minerals Management Service – Alaska OCS Region Finding Of No Significant Impact: Shell Gulf of Mexico, Inc. 2010 Exploration Drilling Program, Burger, Crackerjack, and SW Shoebill Prospects, Chukchi Sea Outer Continental Shelf, Alaska. Anchorage, AK: USDOI, BOEMRE, Alaska OCS Region. http://www.alaska.boemre.gov/ ref/EIS%20EA/2009_Chukchi_2010EA/fonsi.pdf

USDOI, MMS. 2009c. Synthesis: Three Decades of Research on Socioeconomic Effects Related to Offshore Petroleum Development in Coastal Alaska. MMS OCS Study 2009-006, Stephen R. Braund and Jack Kruse, editors.

USDOI, MMS. 2009d. An Assessment of the Potential Effects of Oil and Gas Leasing Activities in the Beaufort Sea and Chukchi Sea Planning Areas on Steller's Eider (*Polysticta stelleri*), Spectacled Eider (*Somateria fischeri*), Kittlitz's Murrelet (*Brachyramphus brevirostris*), Yellow-billed Loon (*Gavia adamsii*), and Polar Bear (*Ursus maritimus*). Final Version, July 2009. Anchorage, AK: USDOI, BOEM, Alaska OCS Region. http://www.alaska.boemre.gov/ ref/BioEvalations/2009_07_be.pdf

USDOI, MMS. 2010. Subsistence Mapping of Nuiqsut, Kaktovik, and Barrow. MMS OCS Study 2009-003. Stephen R. Braund and Associates. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

Wall, R.R. 2011. Personal Communication. Verification of Worst Case Discharge (WCD) for Shell Gulf of Mexico Inc. 2011 Exploration Plan. Memorandum From R.R. Wall Regional Supervisor (RS), Resource Evaluation, BOEM, Alaska OCS Region to Regional Director, BSEE, Alaska OCS Region, RS Leasing and Plans, BOEM Alaska OCS Region, RS Environment, BOEM Alaska OCS Region, Christy Bohl, Oil Spill Program Administrator, BSEE, Alaska OCS Region, and David M. Moore, BSEE Oil Spill Response Division, Herndon, VA. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

Warburton, J. and Seagers, D. J. 1993. Heavy metal concentrations in liver and kidney tissues of Pacific walrus: continuation of a base line study. Marine Mammals Management, U. S. Fish and Wildlife Service, Region 7, Alaska, Technical Report MMM 94-1. 23pp. .

Warner, G. and D. Hannay. 2009. Acoustic modeling of underwater noise from the Frontier Discoverer in the Chukchi and Beaufort seas. Version 1.0. Prepared by JASCO Applied Sciences. Anchorage, AK: Shell E&P Co.

Wartzok, D., W. Watkins, B. Wursig, and C. Malme. 1989. Movements and Behavior of Bowhead Whales in Response to Repeated Exposures to Noises Associated with Industrial Activities in the Beaufort Sea. Prepared by Purdue University. Anchorage, AK: Amoco Production. 228 pp.

Watkins, W. A., K. E. Moore, J. Sigurjónsson, D. Wartzok, and G. Notarbartolo di Sciara. 1984. Fin whale (Balaenoptera physalus) tracked by radio in the Irminger Sea. *Rit Fiskideildar* 8: 1-14.

Weinazpfel, R.; Harvey, G.; Andrews, J.; Clamp, L.; Dykas, J. 2011. Wind, waves and sea ice during the 1999-2007 open water seasons of the Beaufort and Chukchi Seas. In Offshore Technology Conference, Houston, Texas, 2-5 May 2011.

Weingartner, T., K. Aagaard, R. Woodgate, S. Danielson, Y. Sasaki, and D. Cavalieri. 2005. Circulation on the north central chukchi sea shelf. *Deep Sea Research Part II: Topical Studies in Oceanography*. 52(24-26): 3150-3174.

Weingartner, T.J.O. and S. Danielson. 2010. Physical Oceanographic Measurements in the the Klondike and Burger Survery Areas of the Chukchi Sea: 2008 and 2009. Prepared for; Conoco Phillips, Inc. and Shell Exploration and Production Company. Institute of Marine Science, University of Alaska Fairbanks, AK. October, 2010. 49 pp.

Welch, H.E., Crawford, R.E., and Hop, H.1993. Occurrence of Arctic cod (*Boreogadus saida)* schools and their vulnerability to predation in the Canadian High Arctic. *Arctic 46*: 331-339

Western Regional Climate Center (WRCC). 2010. Wainwright, Alaska (509729) Period of Record Monthly Climate Summary. Period of Record: 9/1/1949 to 1/31/1969. http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ak9729.

Wheeler, P. and T. Thornton. 2005. Subsistence Research in Alaska: A Thirty Year Retrospective. *Alaska Journal of Anthropology* 3(1):69-103.

Woodgate, R.A., K. Aagaard, and T.J.O. Weingartner. 2005. A year in the physical oceanography of the Chukchi Sea: Moored measurements from autumn 1990-1991. Deep Sea Research Part II 52(24-26) pp. 3116-3149. Doi: 10.1016/j.dsr2.2005.10.016.

Appendix A

Analysis of Accidental Oil Spills

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Appendix A. Analysis of Accidental Oil Spills

A-1. Introduction

This Appendix describes the results of the oil-spill analysis and includes the supporting documentation for those results. The-oil-spill analysis considers the potential accidental oil spill discharges and their likelihood of occurrence, and then outlines the accidental oil spill scenario framework for the impact analysis of the alternatives in this EA. The vessel, drilling, and fuel-transfer activities are described in the 2012 Shell Revised Chukchi Sea Exploration Plan (Revised EP) for Alternative 2-The Proposed Action, and Alternative 3-One well per season, were evaluated for both routine operations and accident conditions. It is not anticipated that oil spills occur as a routine activity. Therefore, oil spills are not considered a routine impact-producing factor. Oil spills are considered accidental events, and the Clean Water Act and the Oil Pollution Act include both regulatory and liability provisions that are designed to reduce damage to natural resources from oil spills. Therefore oil spills are treated as an accidental impact-producing factor. An accident is an unplanned event or sequence of events that results in an undesirable consequence. In this analysis the undesirable consequence is an oil spill in the environment.

BOEM carefully and thoroughly analyzed a range of oil spill sizes (from small [<1,000 bbl] to very large [≥150,000 bbl]) and the likely consequences to environmental, social, and economic resources in the Sale 193 FEIS and FSEIS, from which this EA tiers. BOEM updated those small and large oil spill and impact analyses in the Arctic Multiple Sale Draft EIS. A small spill was analyzed again in the 2009 Chukchi Sea EA. Both the Arctic Multiple Sale DEIS and the 2009 Chukchi Sea EA are incorporated by reference. This Appendix also incorporates by reference the 2012 Shell Chukchi Sea EIA, which is Appendix F of the 2012 Shell Revised Chukchi Sea EP (Shell, 2011a). Brief summaries, where relevant, are provided below, and the information is updated and augmented by new material as needed.

Section 1.1 below begins with the summary of estimated oil spill factors (number, size, source, oil type, duration, likelihood of occurrence, weathering characteristics) which collectively make up the oil spill scenario. The accidental oil spill scenario is used for impact analysis in Section 4.0 for Alternative 1-No Action, Alternative 2-The Proposed Action, and Alternative 3- One Well per Season in this EA. The remainder of this Appendix provides the information supporting the estimated oil spill factors.

A-2. Summary: Potential Oil Spill Size Categories

There are three potential size categories of oil spills in connection with exploratory operations in Alternative 2-The Proposed Action and Alternative 3-One Well Per Season: (1) a large spill (≥1,000 bbl) from exploration operations; (2) a very large spill (≥150,000 bbl) from a well-control incident; and (3) a small spill (<1,000 bbl) from exploration operations. Historical and modeling oil spill data demonstrates that the frequency of a large spill occurring during exploration is low and, therefore, this EA does not analyze the impacts of large spills from exploration operations. The occurrence of a very large spill resulting from a well-control incident is similarly very low. Nonetheless, this EA tiers to the BOEM's prior analyses of the impacts of a large and very large oil spill in the Sale 193 FEIS and SFEIS. See further discussion in Section 4.0 of this EA.

For purposes of the oil spill analyses for Alternative 1-No Action, no small, large, or very large spills are estimated to occur in the project area. In Alternative 1, none of the exploration activities described in the proposed action occur in the project area.

For purposes of the oil spill analyses for Alternative 2-The Proposed Action proposed action and Alternative 3- One Well per Season, it is likely that a small spill could occur. BOEM estimates a 48-bbl diesel fuel-transfer spill for the volume and type of a small spill, as identified in the Shell Chukchi Sea Regional Oil Discharge Prevention and Contingency Plan-Revision 1 (Shell ODPCP) summary of potential discharges (Shell, 2011b: Table 2.3-1).

For purposes of the oil spill analyses for Alternative 2-The Proposed Action and Alternative 3- One Well per Season, no large or very large crude or diesel oil spills are estimated from exploration activities. This is based on a review of potential discharges, historical oil spill and modeling data, and likelihood of oil spill occurrence. This estimate is based on (1) the low rate of OCS exploratory drilling well-control incidents spilling fluids per well drilled; (2) since 1971 one OCS spill (large/very large) has occurred during temporary abandonment while drilling more than 15,000 exploratory wells; (3) the low number (six) of exploration wells being drilled from this proposed action; (4) no crude oil would be produced and the wells would be permanently plugged and abandoned; (5) the history of exploration spills on the Arctic OCS, all of which have been small, (6) the fact that no large spills occurred while drilling 35 wells in the Arctic OCS; and (7) pollution prevention and oil spill response regulations and methods, implemented by BOEMRE (now BOEM), Shell Offshore Inc., and Shell Gulf of Mexico Inc., since the Deepwater (USDOI, BOEM, 2011; Shell, 2011b, Shell, 2011a).

2.1 Summary: Small Spills (<1,000 bbl) from Exploration Activities

Historical Beaufort Sea and Chukchi Sea OCS exploration spill data suggest that a small spill is likely to occur. Thirty five exploration wells were drilled in the Arctic OCS from 1981-2003. During that time period 35 small spills have occurred spilling a total of 26.7 bbl (of which 24 bbl was recovered). The most likely cause of a small oil spill during exploration could be operational, such as a hose rupture. The largest Arctic OCS exploration spill was less than 20 bbl (Section 1.3.1). For purposes of analysis of the Alternative 2 and 3, a 48-bbl diesel fuel-transfer spill was estimated as the small spill volume and oil type. The spill is estimated to last less than 3 days on the surface of the water, based on oil weathering model calculations. Section 4.0 of this EA analyzes the impacts of such a small spill in each of the EA sections on oil spill impacts to specific resources. Lease Stipulation 6 and Shell's fuel transfer plan procedures require pre-booming during fuel transfers, which would reduce or negate adverse effects from a small diesel fuel-transfer spill.

2.2 Summary: Large Spills (≥1,000 bbl) from Exploration Activities

Historical OCS crude and condensate spill data demonstrates that a large spill is unlikely to occur as a result of Alternative 2-The Proposed Action or Alternative 3- One Well per Season. No oil will be produced. All wells will be permanently plugged and abandoned in accordance with BOEM requirements on completion of drilling. Since 1971, one OCS spill (large/very large) has occurred during temporary abandonment from a well-control incident while drilling approximately 15,000 OCS exploration wells. All fuel-storage tanks will be internal to the drillship and should an internal storage tank rupture, it is unlikely a large diesel fuel spill would reach water. A large spill from internal diesel fuel tanks or a well-control incident escalating into uncontrolled flow is unlikely in connection with the exploration activities set forth in Shell's Revised EP, and therefore, this EA does not analyze the impacts of such a large spill scenario, but tiers to previous analysis of large spills in Sale 193 FEIS and incorporates by reference Arctic Multiple Sale DEIS.

2.3 Summary: Very Large Oil Spills (≥150,000 bbl) from Exploration Activities

A very large oil spill (VLOS) from a well-control incident during OCS exploratory drilling is a similarly unlikely occurrence. There is abundant and reliable scientific data on the infrequency of an exploration well-control incident occurring and releasing fluids, and further support for this conclusion is set forth below. A very large spill from a well-control incident is unlikely in connection

with the exploration activities set forth in Shell's Revised EP, and therefore, this EA does not analyze the impacts of such a scenario, but tiers to analysis of very large oil spills in the Sale 193 FSEIS.

BOEMRE (now BOEM) analyzed the potential impacts of a very large oil spill from a well-control incident escalating into a long duration flow (USDOI, BOEMRE, 2011: pp. 136–296). There are no site-specific anomalies that differentiate a very large oil spill release at Launch Area (LA) 11 from Shell's leases, and the oil-spill contacts are statistically similar. Thus, BOEM has analyzed the potential impacts from a very large well-control incident escalating into a loss of well control where fluids are released into the Chukchi Sea and tiers to that analysis. This impact analysis in USDOI, BOEMRE (2011) does not consider the mitigation of spill response. Shell's ODPCP response scenario addresses the potential immediate release of crude oil to the environment by a loss of well-control during drilling. Shell's ODPCP demonstrates the access to sufficient equipment and personnel needed to respond to a Worst Case Discharge flow rate of 25,000 barrels of oil per day (bopd) for 30 days.

A-3. Oil-Spill Volume and Type Estimates

Oil spills are an issue of great public concern in relation to the offshore oil and gas industry. Etkin (2009) estimates that petroleum industry spillage has decreased over the last 40 years; 70 percent less oil is spilling since the 1970s and 54 percent less in the decade 1998-2007 from the previous. Although total oil spill volumes are decreasing, even with consumption of oil increasing, the Deepwater Horizon Event has heightened the industry's, regulator's and public's awareness of the potential impacts of very large oil spill events.

Using information from the Shell ODPCP and EIA, BOEM reviewed and evaluated available information regarding the small, large, and very large oil spill volume estimates, oil spill types and the likelihood of the potential discharges. Using this information BOEM, determined a reasonably foreseeable spill analysis scenario. The analysts used the reasonably foreseeable spill analysis scenario to evaluate the potential oil spill impacts on their resources in Section 4 of this EA for Alternative 2-The Proposed Action and Alternative 3- One Well per Season. No oil spills are estimated to occur for Alternative 1-No Action.

3.1 Oil Spill Potential Discharge Volume

BOEM verified and then used Shell's potential discharge volumes (summarized below in Table A-1) as the likely spill volume and oil type for each of BOEM's small (<1,000 bbl), large (≥1,000 bbl), and very large (≥150,000 bbls) spill size categories (Shell, 2011a: Table 2-1). Within each of BOEM's spill-size categories, the estimated potential discharge volume is considered the representative volume for that size category (without pollution prevention and oil spill response measures). A 48-bbl diesel-transfer spill is the estimated volume of a small spill; a 1,555-bbl diesel-fuel tank-rupture spill is the estimated volume of a large spill, and the blowout worst-case discharge of 750,000 bbl is the estimated volume of very large spill (without pollution prevention and oil spill response measures). Section 3.2 below describes why and how Shell Offshore, Inc. calculated the worst-case discharge (WCD) and BOEM's verification of the WCD.

Table A-1. Summary of Potential Discharge Volumes and Relation to BOEM Spill Size Categories for Oil-Spill Analysis.

BOEM Spill-Size Categories	Type	Cause	Product	Size	Duration	Prevent Potential Discharge
Small <1,000 bbl	Transfer from fuel tanker to drill vessel	Hose rupture	Diesel	Approximately 2,000 gallons 48 bbl (Section 1.6)	5.5 minutes (ODPCP Section 1.6)	Transfer procedures in place; minimized by the weather restrictions, during unfavorable wind or sea conditions. Transfers are announced in advance; and verbal communication, in combination with

BOEM Spill-Size Categories	Type	Cause	Product	Size	Duration	Prevent Potential Discharge
						visual inspection, is the best method of discharge detection. Booming is in place during transfer.
Large ≥1,000 bbl	Diesel Tank	Tank rupture	Diesel	1,555 bbl	Minutes to hours (ODPCP Section 2)	The diesel tanks are internal to each drilling vessel rather than deck-mounted, where the potential for marine spills is much greater. As a result, a scenario involving tank rupture has not been included in the oil-spill-response plan, but will be monitored as part of an ongoing tank inspection program.
Very Large ≥150,000 bbl	Blowout	Uncontrolled flow at the mudline	Crude oil	750,000 bbl	30 days (ODPCP Section 1)	Blowout prevention equipment and related procedures for well-control. Layer I includes proper well planning, risk identification, training, routine tests, and drills on the rig. Layer II includes early kick detection and timely implementation of kick-response procedures. Layer III involves the use of mechanical barriers, including, but not limited to, blowout preventers, casing, and cement. Testing and inspections are performed to ensure competency. Shell (2011b): ODPCP Section 2.3.1

Source: USDOI, BOEM, 2011.

3.2 Worst-Case Discharge Calculation for the Oil Spill Response Plan

The BOEM and BSEE regulations set forth how the volume for a WCD calculation is determined for an Exploration Plan and oil-spill-response planning scenario (30 CFR and 254.47(b) and 550.213(g)). The WCD volume and storage capacities are calculated to address BOEM and BSEE's need to determine the adequacy of the company's spill-response capabilities and are shown in Table A-2.

Table A-2. Estimates of Cumulative WCD Volume by Citation and Source.

Citation	Source	Type and Location	Product	Size (bbl)	Duration
30 CFR 254.47(b)	Shell (2011b)	Uncontrolled flow at the mudline	Crude oil	750,000	30 days (ODPCP Section 1)
30 CFR 550.213(g) and NTL 2010-N06	Shell (2011b)	Uncontrolled flow at the mudline	Crude oil	<295,426-669,474[1]	Burger J, S, A, V, F, R. wells 34-38 days to drill a relief well
BOEM Verification	Wall (2011)	Uncontrolled flow at the mudline	Crude oil	253,234-279,954	Burger J well 34-38 days to drill relief well

Note: 1. The size in bbls range is estimated from the lowest bopd rate multiplied by the shortest number of days to drill a relief well to the cumulative volume for Burger J.

BSEE requires the WCD to be based upon the daily volume possible from an uncontrolled blowout flowing for 30 days (30 CFR 254.47(b) Determining the volume of oil of your worst case discharge scenario). The Shell planning scenario considers a daily release of 25,000 bbl of crude oil for 30 days (750,000 bbl total). This volume exceeds Shell's WCD calculated for the Burger J, S, A, V, F, R. wells (Section 2(g) of the Revised EP). Shell's ODPCP demonstrates access to sufficient equipment and personnel needed to respond to a well blowout with a 25,000 barrels of oil per day flow rate and total volume of 750,000 bbl.

Other BOEM regulations (30 CFR 550.213(g)-Blowout scenario) require a scenario for a potential blowout that will have the highest volume and maximum duration for a given well. Shell's blowout scenario provides for transiting and drilling a relief well for Burger J, S, A, V, F, R wells in up to 34–

38 days. The resulting estimated daily spill volume for Burger J, S, A, V, F, R wells ranges from 8,689–23,100 bopd. Again, these oil spill volumes are calculated without factoring in any intervention or response. Burger J is the highest flowing well. The cumulative volume ranges from 603,564–669,479 bbl for 34 and 38 days, respectively (Shell, 2011a: Section 8, Table 8.d.2). These volumes are below the 750,000 bbl used for planning purposes in Shell's ODPCP (Shell, 2011b).

The daily flow rate for a loss of well control resulting in a blowout is based on the WCD estimate provided by Shell and verified by BOEM (Wall, 2011). The WCD estimate does not reduce the cumulative volume by including intervention or response in the calculation. BOEM, Resource Evaluation conducted a verification of the WCD model submitted by Shell and concurs that the Burger J well has the highest potential discharge volume in both daily rate and cumulative flow. BOEM WCD results find that the cumulative discharges are all less than the cumulative discharges forecast by the Shell's WCD model (Wall, 2011). BOEM estimates the cumulative oil discharge at 34 and 38 days for the Burger J well is 253,234 and 279,954, respectively. BOEM further estimates the cumulative discharge at the end of day 90 is 613,076 bbl (Wall, 2011).

3.3 Comparison of WCD to Very Large Oil Spill

BOEM reviewed the very large oil spill (VLOS) elements analyzed in the Sale 193 SFEIS (Table A-3) to determine if the WCD estimates provided in the Shell Revised EP are within the scope of the VLOS scenario. In calculating the flow rate, length of flow, and volume, the Sale 193 FSEIS analysis did not consider a reduced volume that may be achieved through the use of oil spill countermeasures.

Table A-3. Comparison of Very Large Oil Spill Scenario Elements to Shell Worst Case Discharge Information.

Description	Chukchi Sea SFEIS	Burger J	Relative Change
Flow Rate	61,000-20,479 bopd	25,000 bopd[1]	Less than ½ the flow initially
Length of Flow	39-74 days	30 days	Shorter duration
Volume	2.2 Million barrels[2]	750,000 barrels	About 1/3 of the size
Oil Type	35 °API	30° API	Light versus medium crude
Location	Subsurface or Surface	Surface or Subsurface (subsurface modeled for WCD)	Subsurface likely will surface within 1000 m of the location of loss of well control

Source: Shell (2011b) and Wall (2011).

Key: °API = American Petroleum Institute gravity (API)
Bopd = barrels of oil per day
[1]Provided as required by 30 CFR 550.213(g), 550.219(a)(2)(iv) and 254.47(b)

The Burger J well was selected as the basis for comparison as it has the highest calculated WCD of the six exploration wells proposed in the Revised EP (Shell, 2011a: p. 2-3). BOEM analysis (Wall, 2011) establishes an initial flow rate of 13,091 bopd which differs from that provided by Shell's estimate of 23,100 bopd (Wall, 2011). This EA considers mitigation measures incorporated into Shell's Revised EP including the use of a capping and containment system to stem the discharge of oil to the marine environment within 15 days of a loss of well control incident. It is important to note that the volume of a very large oil spill estimated from a loss of well control event at Burger J is within the range analyzed in the Sale 193 FSEIS for both BOEM's and Shell's WCD scenario.

BOEM determined that the low-probability, very large oil spill scenario and conclusions with respect to the effects analysis provided in the Sale 193 FSEIS remain valid. That analysis is sufficient to inform the decision maker of the effects of a low-probability, very large oil spill in the vicinity of the Proposed Action. In addition, the use of a capping stack and containment system could limit further the amount of oil reaching the sea surface and spreading

A-4. Historical and Modeled Oil Spill Information

The following sections review the historical and modeled information on crude and condensate spills from exploration operations and well-control incidents during all drilling operations. The historical oil spill and model data indicate it is unlikely a large or very large oil spill will result from a well-control incident during drilling or other exploration operations. The Arctic OCS historical oil spill data indicate a small refined spill is likely to occur during exploration operations.

4.1 Historical Refined and Crude Spills from Exploration Operations on the Beaufort and Chukchi Outer Continental Shelf and Canadian Beaufort

BOEM estimates the chance of a large (≥1,000 bbl) oil spill from OCS exploratory activities to be very low. On the Beaufort Sea and Chukchi Sea OCS, the oil industry drilled 35 exploratory wells from 1981-2003. During the time of this exploratory drilling, industry has had 35 small spills totaling 26.7 bbl or 1,120 gallons (gal). Of the 26.7 bbl spilled, approximately 24 bbl (90%) were recovered or cleaned up. Table A-4 shows the exploration spills on the Beaufort Sea and Chukchi Sea OCS. All the explorations spills on the Beaufort Sea and Chukchi Sea OCS have been small, with the largest spill approximately 20 bbl. OCS spill data shows that 99.7% of all spills on the OCS are < 50 bbl in size (Anderson and LaBelle 2000, Table 13). Based on the historical OCS spill data and Arctic OCS exploration spill data, small spills of diesel, refined fuel, or crude oil may occur. Shell estimates a small spill size of 48 bbl for a transfer of diesel fuel during refueling operations in their potential discharge estimates. BOEM estimates a small

Table A-4. Exploration Spills on the Beaufort Sea and Chukchi Sea OCS (1981-2003).

Lease No.	Sale Area	Operator	Date	Facility	Oil	Amt. (Gal)	Cause of Spill	Response Action	Rec. (gal)
0344	71	Sohio	7/22/1981	Mukluk Island	Diesel	0.50	Leaking line on portable fuel trailer	Sorbents used to remove spill. Contaminated gravel removed.	0.05
0344	71	Sohio	7/22/1981	Mukluk Island	Diesel	1.00	Overfilled fuel tank on equipment	Sorbents used to remove spill. Contaminated gravel removed.	1.00
0280	71	Exxon	8/7/1981	Beaufort Sea I	Hydraulic Fluid	1.00	Broken hydraulic line on ditch witch.	Fluid picked up with shovels.	1.00
0280	71	Exxon	8/8/1981	Beaufort Sea I	Trans. Fluid	0.25	Overfilling of transmission fluid.	Fluid picked up and placed in plastic bags.	0.25
0280	71	Exxon	1/11/1982	Beaufort Sea I	Hydraulic Fluid	0.50	Broken hydraulic line.	Fluid picked up and stored in plastic bags.	0.50
0280	71	Exxon	1/11/1982	Alaska Beaufort Sea I	Diesel	3.00	Overfilled catco 90-3 tank.	Fluid picked up.	3.00
0280	71	Exxon	1/17/1982	Beaufort Sea I	Diesel	1.00	Tank on catco 90-14 overfilled.	Fluid picked up and stored in plastic bags.	1.00
0280	71	Exxon	1/21/1982	Beaufort Sea I	Hydraulic Fluid	0.25	Broken hydraulic line on ditch witch.	Fluid picked up.	0.25
0371	71	Amoco	3/16/1982	Sandpiper Gravel Island	Unknown	1.00	Seeping from Gravel Island.	Sorbent pads.	Unknown
0849	87	Union Oil	9/4/1982	Canmar Explorer II	Unknown	1.00	Transfer of test tank from drillship to barge.	None	None
0871	87	Shell Western	9/5/1982	Canmar Explorer II	Light Oil	0.50	Washing down cement unit, drains not plumbed to oil/water separator.	None	None
N/A	87	Shell	9/14/1982	Canmar II Drillship	Diesel	30.00	Tank vent overflowed during fuel transfer.	Deployed sorbent pads and pump.	30.00
0191	BF	Exxon	11/11/1982	Beechey Pt. Gravel Is.	Lube Oil	1.00	Loader tipped over lube oil drum	Oil cleaned up with sorbents. Contaminated gravel removed	1.00
0191	BF	Exxon	1/15/1983	Beechey Pt. Gravel Is.	Diesel	0.12	Fuel truck spilled diesel as it climbed a 40 degree ramp to island	Sorbents used and contaminated gravel removed	0.12
0191	BF	Exxon	1/23/1983	Beechey Pt. Gravel Is.	Hydraulic Fluid	2.50	Hydraulic line on backhoe broke	1 gallon in water. Boom deployed with sorbents, Contaminated gravel removed	2.50
0191	BF	Exxon	8/29/1983	Beechey Pt. Gravel Is.	Hydraulic Fluid	0.20	Hydraulic line on backhoe broke	Spill contained on island surface. Sorbents used and contaminated gravel removed.	0.25
0196	BF	Shell	8/30/1983	Ice Road to Tern Island	Hydraulic Fluid	10.0	Broken hydraulic line on rollogon	Unknown	Unknown
0191	BF	Exxon	2/26/1985	Beechey Pt. Gravel Is.	Hydraulic Fluid	0.37	Hydraulic line broke	Contaminated Snow Removed	0.37

Lease No.	Sale Area	Operator	Date	Facility	Oil	Amt. (Gal)	Cause of Spill	Response Action	Rec. (gal)
0196	BF	Shell	3/1/1985	Ice Road to Tern Island	Hydraulic Fluid	3.00	Hydraulic line broke	Unknown	3.00
0191	BF	Exxon	3/2/1985	Beechey Pt. Gravel Is.	Gasoline	0.01	Operational Spill	Snow shoved into plastic bag.	0.01
0191	BF	Exxon	3/4/1985	Beechey Pt. Gravel Is.	Waste Oil	2.00	Drum of waste oil punctured	Snow recovered	2.00
0196	BF	Shell	3/4/1985	Tern Gravel Island	Crude Oil	1.00	Well Separator overflowed, crude oil escaped	Line boom deployed	Unknown
0196	BF	Shell	3/6/1985	Tern Gravel Island	Crude Oil	15.00	Test burner was operating poorly	Containment Boom deployed	Unknown
0196	BF	Shell	9/24/1985	Tern Gravel Island	Crude Oil	2.00	Oil released from steam heat coil when Halliburton tank moved	Sorbents and hand shovel used	2.00
0191	BF	Shell	10/4/1985	Enroute to Tern Gravel Island	Jet fuel B	800.00	Wire sling broke during helicopter transport of fuel blivits	Contaminated Snow Removed. Test holes drilled with no fuel below snow.	Unknown
0196	BF	Shell	10/29/1985	Tern Gravel Island	Crude Oil	2.00	Test oil burner malfunction	Contaminated snow removed	2.00
0196	BF	Shell	6/27/1986	Tern Gravel Island	Crude Oil	3.00	Test oil burner malfunction	Spray picked up with sorbents. Bladed up dirty snow.	2.00
0943	87	Tenneco	1/24/1988	SSDC/MAT	Gear oil	220.0	Helicopter sling failure during transfer of drums to SSDC	Scooped up contaminated snow and ice	220.0
1482	109	SWEPI	7/7/1989	Explorer III Drillship	Hydraulic fluid	10.0	Hydraulic line connector	Sorbent pads	0.84
1092	97	AMOCO	10/1/1991	CANMAR Explorer	Hydraulic fluid	2.00	Hydraulic line rupture	None	None
0865	87	ARCO	7/24/1993	Beaudril Kulluk	Diesel	0.06	Residual fuel in bilge water	None	None
0866	87	ARCO	9/8/1993	CANMAR Kulluk	Hydraulic fluid	1.26	Seal on shale shaker failed	None	None
0866	87	ARCO	9/24/1993	CANMAR Kulluk	Fuel	4.00	Fuel transfer in rough weather	3 gallons on deck of barge recovered, none in sea	3.00
1597	124	ARCO	10/31/1993	CANMAR Kulluk	Fuel	0.50	Released during emptying of disposal caisson	None	None
1585	124	BP Alaska	1/20/1997	Ice Road to Tern Island	Diesel, Hydraulic Fluid	10.5	Truck went through ice; fuel line ruptured	Scooped up contaminated snow and ice. Some product entered water	Unknown

Source: USDOI, BOEM 2011. Note: No exploration drilling activities after 2003, rec. = recovered.

spill is likely and is a reasonably foreseeable scenario during exploratory drilling in the Chukchi Sea. The historical data shows small spills often are into containment or contained on vessels, platforms, facilities, or gravel islands, or onto ice, and may be cleaned up.

Table A-4 shows no large exploration spills occurred on the Beaufort Sea and Chukchi Sea OCS from 1981-2003. One large exploration spill occurred in the Canadian Beaufort Sea from an exploration well site, when the island eroded during a storm and a facility fuel tank was damaged, spilling approximately 2,440 bbl of diesel P-50 fuel oil (Hart Crowser, 2000). Diesel tanks used in Alternative 2-The Proposed Action and Alternative 3- One Well per Season are internal to the drillship and erosion would not be a causal factor for a large oil spill. If the internal diesel fuel tanks on the ship failed or leaked, it is unlikely a large spill would reach water.

4.2 Historical Crude and Condensate Oil Spills from Well-Control Incidents on the OCS and Alaska North Slope

The Gulf of Mexico, Pacific and Alaska OCS data show that a large/very large spill likely would not result from a well-control incident. BOEM considers well-control incidents that result in pollution to the environment to be very unlikely events. Well-control-incident events often are equated with very large oil spills because these spills receive media attention. However, in the last 39 years very few OCS well-control-incident events have resulted in spilled oil, and the volumes spilled often are small with the exception of the *Deepwater Horizon*. Five OCS well-control-incident events ≥1,000 bbl occurred between 1964 and 1970 and a sixth, the Macondo Well 252 (hereafter called the Deepwater Horizon event) occurred in 2010 in the Gulf of Mexico (Table A-5). Following the Santa Barbara well-control incident in 1969 and two large well control incidents in 1970 in the Gulf of Mexico

OCS, amendments to the OCS Lands Act and implementing regulations significantly strengthened safety, inspection, and pollution-prevention requirements for OCS offshore activities. Well-control training, redundant pollution-prevention equipment, subsurface safety devices and regular inspections were among the provisions adopted in the regulatory program (Visser, 2011). The year 1971 is considered reflective of the modern OCS regulatory environment. For 39 years no OCS well control incidents resulted in a large or very large oil spill. In 2010 and 2011 new regulations were again implemented to significantly strengthen safety, inspection, and pollution-prevention requirements for OCS offshore activities after the Deepwater Horizon event. These new regulations are discussed in USDOI, BOEM (2011, pages 4-90 - 4-99).

4.2.1 OCS Well Control Incident Rates

This section updates information in the 2009 Chukchi Sea EA Appendix A, Section A.1.c which discussed OCS well control incidents from 1971-2009 (USDOI, MMS, 2009). The year 1971 is considered reflective of the modern OCS regulatory environment. The term "loss of well control" was first defined in the 2006 update to the incident reporting regulations (30 CFR 250.188). Prior to this 2006 update, the incident reporting regulations included the requirement to report all blowouts, and the term blowout was undefined. Three relevant data sets are considered: (1) all well control incidents from 1971-2009 prior to the Deepwater Horizon event to update the 2009 Chukchi Sea EA baseline, then (2) well control incident rates from exploration and development drilling including the Deepwater Horizon event, and finally (3) oil spills associated with well control incidents from exploration drilling including the Deepwater Horizon event (USDOI, BOEMRE, AIB, 2011).

Table A-5. Number of well control incidents with pollution per year in the Gulf of Mexico and Pacific OCS Regions and total OCS wells.

Year	Total Number of Incidents	Incidents with Condensate/ Crude Oil	Condensate/Crude Oil Spilled (Barrels)			Product-ion	Drilling				Workover/ Completion	Well Type	Well Type	Wells Drilled
			Production, Workover, Completion, P&A	Drilling	Total Exploration and Development	Total	Total	Exploration	Development	Unknown	Total	Development	Exploration	Total
1956	1	0	—	—	0	—	1	—	1	0	—	204	46	258
1957	1	0	—	—	0	—	1	—	1	0	—	333	58	391
1958	2	1	0.9	—	0.9	—	1	1	—	0	1	210	65	275
1959	1	0	—	—	0	—	1	—	1	0	—	229	96	325
1960	2	0	—	—	0	1	1	1	—	0	—	290	138	428
1961	0	0	—	—	0	—	—	—	—	0	—	351	133	484
1962	1	0	—	—	0	—	1	—	1	0	—	385	159	544
1963	1	0	—	—	0	—	1	1	—	0	—	400	209	609
1964	7	3	10,280	100	10,380	4	3	2	1	0	—	507	234	742
1965	5	2	0.9	1688	1,688.9	1	4	1	3	0	—	648	194	842
1966	2	2	0.9	0.9	1.8	—	1	—	1	0	1	628	299	973
1967	2	1	0.9	—	0.9	0	—	—	—	—	2	638	321	988
1968	8	0	—	—	0	1	6	2	4	—	1	735	358	1094
1969	3	3	—	82,500.9	82,500.9	0	3	1	2	0	—	731	254	993
1970	3	2	118,000.0	—	118,000.0	1	1	—	1	0	1	756	248	1006
1956-1970	39	14	128,283.60	84,289.80	212,573.40	8	25	9	16	0	6	7,045	2,812	9,952
Major Regulatory Changes to Outer Continental Shelf Lands Act														
1971	6	2	460	—	460	2	2	1	1	0	2	620	285	909
1972	6	2	2	0.9	2.9	1	4	2	2	—	1	608	309	917
1973	3	1		0.9	0.9	0	3	2	1	—	—	569	321	890
1974	6	2	275	—	275	2	2	1	1	—	2	512	355	869
1975	7	1	0.9	—	0.9	—	5	4	1	—	2	569	334	904
1976	6	0	—	—	0	1	5	1	4	—	—	851	317	1169

Year	Total Number of Incidents	Incidents with Condensate/ Crude Oil	Condensate/Crude Oil Spilled (Barrels)			Product -ion	Drilling				Workover/ Completion	Well Type	Well Type	Wells Drilled
			Production, Workover, Completion, P&A	Drilling	Total Exploration and Development	Total	Total	Exploration	Development	Unknown	Total	Development	Exploration	Total
1977	10	1	2	—	2	1	4	3	1	—	5	975	398	1373
1978	12	1	0.9	—	0.9	—	8	4	4	—	4	935	361	1298
1979	5	2		1.8	1.8	—	5	4	1	—	—	895	420	1316
1980	8	1	1	—	1	2	4	3	1	—	2	943	412	1356
1981	10	5	66.7	0.9	67.6	1	3	1	2	—	6	1012	400	1412
1982	9	2	1.8	—	1.8	—	5	1	4	—	4	970	457	1427
1983	12	1	—	2	2	—	10	5	5	—	2	872	458	1330
1984	5	0	—	—	0	—	4	3	1	—	1	862	663	1525
1985	6	1	50	—	50	0	4	3	1	—	2	783	574	1361
1986	2	0	—	—	0	—	1	—	1	—	1	517	296	813
1987	8	2	61	—	61	3	2	2	—	—	3	534	439	973
1988	4	1	4.5	—	4.5	1	2	1	1	—	1	510	584	1094
1989	12	0	—	—	0	3	7	4	3	0	2	572	489	1061
1990	7	3	17.5	—	17.5	0	3	1	1	1	4	638	521	1159
1991	8	1	—	0.8	0.8	—	6	3	3	0	2	483	350	833
1992	3	1	—	100	100	—	3	3	—	—	—	376	229	605
1993	4	0	—	—	0	—	4	1	3	—	—	645	365	1010
1994	1	0	—	—	0	—	—	—	—	—	1	686	438	1124
1995	1	0	—	—	0	—	1	0	1	—	—	784	395	1179
1996	4	0	—	—	0	—	2	1	1	—	2	805	462	1267
1997	5	0	—	—	0	—	4	1	3	—	1	932	549	1481
1998	9	3	2.6	1.62	4.22	3	3	2	1	—	3	665	495	1161
1999	5	1	125	—	125	—	3	1	2	—	2	676	371	1048
2000	9	3	0.02	200.5	200.52	—	8	6	2	—	1	950	443	1396
2001	10	1	1	—	1	2	5	2	3	—	3	867	411	1278
2002	6	3	350.505	—	350.505	2	3	1	2		1	654	310	964
2003	5	1	10	—	10	2	2	0	1	1	1	557	354	911
2004	6	4	2.5	22.06	24.56	1	3	3	—	—	2	569	363	932
2005	4	0	—	—	0	—	4	1	3	—	—	482	355	841
2006	2	2	10	24.5	34.5	—	1	1	—	—	1	375	414	789
2007	8	—	—	—	—	2	2	2			4	328	300	630
2008	9	0	—	—	0	3	4	1	3		2	304	267	571
2009	6	2	27.94	—	27.94	1	1	1			4	179	147	338
2010	4	1	—	TBD	TBD	3	1	1			0	181	80	267
1971-2010*	**253**	**51**	**1,472.87**	**355.98**	**1,828.85**	**36**	**143**	**77**	**64**	**2**	**74**	**26,245**	**15,491**	**41,781**

Notes: Wells drilled columns include hydrocarbon, sulfur and salt wells. The total column includes core tests and relief wells in addition to exploration and development wells; therefore the total column may be slightly higher than the sum of the development and exploration wells columns for some years.

TBD - the final volume for the Deepwater Horizon that occurred on 4/20/2010 has not been determined by BOEM.

The 1971-2010 spill volume totals for the columns showing Drilling and Total Exploration and Development do not include the volume for the Deepwater Horizon incident that occurred on 4/20/2010.

Exploratory and Development/Production Operations From 1971-2009

There were 249 well control incidents during exploratory and development/production operations on the OCS (this includes incidents associated with exploratory and development drilling, completion, workover, plug and abandon, and production operations). During this period, 41,514 wells were drilled on the OCS and 15.978 billion barrels (Bbbl) of oil were produced. Of the 249 well control incidents that occurred during this period, 50 (20%) resulted in the spillage of condensate/crude oil ranging from <1 bbl to 450 bbls. The total spilled from these 50 incidents was 1,829 bbls. This volume spilled was approximately 0.000011447% of the volume produced during this period.

In 2010, four well control incidents occurred, including the Deepwater Horizon event. Although a final spillage volume from the Deepwater Horizon event has not been determined by BOEM, the current government estimate from Lubchenco et al. (2010) is 4.9 million bbls. The three other well control incidents that occurred in 2010 did not result in the spillage of condensate/crude oil.

Development and Exploration Well Drilling From 1971-2010

There were a total of 41,781 wells drilled in the OCS comprising of 40,565 wells in the Gulf of Mexico, 1,086 wells in the Pacific Region, 46 wells in the Atlantic Region and 84 wells in the Alaska Region. Of these, 26,245 were development wells, 15,491 were exploration wells and 43 were core tests or relief wells. The overall drilling well control incident rate is 1 well control incident per 292 wells drilled, compared to 1 well control incident per 410 development wells drilled, and 1 well control incident per 201exploration wells drilled. These well control incident rates include all well control incidents related to drilling operations whether they spilled oil or not.

Exploration Well Drilling From 1971-2010

Industry has drilled 223 exploration wells in the Pacific OCS, 46 in the Atlantic OCS, 15,138 in the Gulf of Mexico OCS, and 84 in the Alaska OCS, for a total of 15,491 exploration wells. During this period, there were 77 well control incidents associated with exploration drilling. Of those 77 well control incidents, 14 (18%) resulted in crude, condensate and oil in drilling mud spills ranging from 0.5 bbl to 200 bbls, for a total 354 bbls, excluding the estimated volume from the Deepwater Horizon event. From 1971-2010 one well control incident resulted in a spill volume of 1,000 bbls or more and that was the Deepwater Horizon event.

4.2.2 OCS and North Sea Well Control Incident Duration

This section summarizes information from well-control incidents that occurred during drilling from 1992 through 2006 on the OCS and includes all well-control incidents from drilling, even if no pollution occurred to the environment (Izon, Danenberger, and Mayes, 2007). Overall, the 1992-2006 period saw an improvement (decrease) in well-control-incident duration. Like the previous study (Danenberger, 1993), a significant number of well-control-incident events were of short duration. During the current study, 49% of the well-control incidents stopped flowing in 24 hours or less, compared with 57% during the previous study. In the current study, 41% lasted between 1 and 7 days, compared with 26% during the previous study. There were fewer well-control incidents that lasted more than 7 days. The well-control incident with the longest duration during the current study period was 11 days, compared with more than 30 days in the previous period (Izon, Danenberger, and Mayes, 2007).

The SINTEF blowout database was used to plot the duration of offshore blowouts in the U.S. and North Sea from 1980-2003. Ninety-six percent of offshore blowouts were 30 days or less in duration and 84% were 5 days or less in duration (Shell, 2011c).

4.2.3 Alaska North Slope Well Control Incident Information

The blowout record for the Alaska North Slope remains the same as reported previously in USDOI, MMS (2003) and summarized herein. Of the 10 blowouts, 9 were gas and 1 was oil. The oil blowout in 1950 resulted from drilling practices that are no longer used. A third study confirmed that no crude oil spills ≥100 bbl from blowouts occurred from 1985-1999 (Hart Crowser, Inc., 2000). The remaining blowouts released dry gas or gas condensate only, resulting in minimum environmental impact (NRC, 2003).

Scandpower (2001) used statistical blowout frequencies modified to reflect specific field conditions and operative systems at Northstar in the Beaufort Sea. This report concludes that the blowout frequency for drilling the oil-bearing zone is 1.5×10^{-5} per well drilled (all wells). This compares to a statistical blowout frequency of 7.4×10^{-5} per well (for an average development well). This same

report estimates that the frequency of oil quantities per well drilled for Northstar for a spill >130,000 bbl is 9.4×10^{-7} per well.

4.3 Historical Exploration Well-Control Incidents on the OCS and Canadian Beaufort

Thirty-five (35) exploration wells were drilled between 1981 and 2003 in the U.S. Chukchi and Beaufort seas. Historically, no exploration drilling blowouts occurred as a result of Chukchi Sea and Beaufort Sea OCS exploration drilling, nor have any occurred from the approximately 84 exploration and 14 deep stratigraphic test wells drilled within the Alaska OCS.

One exploration drilling blowout of gas has occurred on the Canadian Beaufort. Up to 1990, 85 exploratory wells were drilled in the Canadian Beaufort Sea, and one shallow-gas blowout occurred. A second incident was not included at the Amaluligak wellsite with the Molikpaq drill platform. This resulted in a gas flow through the diverter, with some leakage around the flange. The incident does not qualify as a blowout by the definition used in other databases and, therefore, was excluded (Devon Canada Corporation, 2004).

From 1971-2010 industry has drilled approximately 223 exploration wells in the Pacific OCS, 46 in the Atlantic OCS, 15,138 in the Gulf of Mexico OCS, and 84 in the Alaska OCS, for a total of 15,491 exploration wells. From 1971-2010, there were 77 well-control incidents associated with exploration drilling. Of those 77 well-control incidents, 14 resulted in spills of (1)drilling mud with oil or synthetic oil, (2) crude or (3) condensate. With the exception of the Deepwater Horizon event of 4.9 million barrels, spill sizes ranged from 0.5 bbl to 200 bbl (Table A-5). One OCS spill (large/very large) occurred from 1971-2010 during temporary abandonment of an exploration well. In summary, out of the more than 15,000 exploration wells drilled, one crude oil spill (large/very large) occurred during temporary abandonment and 13 small spills resulted in drilling mud oil, crude or condensate reaching the environment from well-control incidents during exploration drilling (Table A-5).

4.4 Fault Tree Model Exploration Well-Control Incident Frequencies

Bercha (2006, 2008) developed an oil-spill occurrence fault-tree model to estimate the oil-spill rates associated with exploration, development and production for Arctic OCS locations. The information from Bercha (2006) was used in the USDOI MMS (2007) oil-spill analyses in the Chukchi Sea which estimated approximately 1/2 of a large spill (≥1,000 bbl) over the 40 year exploration and development life of the lease sale which included drilling 3-6 exploration and 4-8 delineation wells. The majority of the fractional mean spill estimate was from the development phase.

Because limited historical spill data for the Arctic exist, Bercha incorporated Gulf of Mexico and Pacific OCS and North Sea data and modified the existing base data using fault trees to arrive at oil-spill frequencies for future exploration, development, and production scenarios. For offshore exploration drilling, Bercha (2006, 2008) used historical oil well blowout statistics derived from Holand (1997) for non-Arctic drilling operations and Scandpower's (2001) blowout frequency assessment for Northstar to estimate the expected size and frequency distribution of spills. Bercha reported the historical spill frequency for non-Arctic exploration well drilling as 3.42×10^{-4} per well for a blowout ≥150,000 bbl (23,848 m^3).

Where historical statistics are limited, it is possible to add variability in the fault tree, through a Monte Carlo simulation, to reduce the uncertainty in the fault tree analysis. To model the historical data variability for Arctic exploration well blowouts, Bercha applied a numerical simulation approach to develop the probability distribution for blowouts of 150,000 bbl (23,848 m^3) or greater, and arrived at a frequency ranging from a low of 1.5×10^{-4} per well to a high of 6.97×10^{-4} per well. The expected value for a blowout of this size was computed to be 3.94×10^{-4} per well (Bercha 2008). To address causal factors associated with blowouts, Bercha applied adjustments for improvements to logistics support and drilling contractor qualifications that resulted in lower predicted frequencies for

Arctic drilling operations. No fault-tree analysis or unique Arctic effects were applied as a modification to existing spill causes for exploration, development, or production drilling frequency distributions. For exploration wells drilled in analogous water depths to planned Chukchi Sea wells (30-60 m), Bercha (2008) estimated the adjusted expected value frequency is 6.12 per 10^{-4} per well for a blowout sized between 10,000 bbl (1,590 m^3) and 149,000 bbl (23,689 m3), and 3.54 x 10^{-4} per well for a blowout >150,000 bbl (23,848 m^3).

The adjusted frequencies discussed above were applied in a fault tree model to estimate the rate of large and very large oil spills. Both the historical non-Arctic frequency distributions and spill causal distributions were modified to reflect specific effects of the Arctic setting, and the resultant fault tree model was evaluated using Monte Carlo simulation to adequately characterize uncertainties treated as probability distribution inputs (described above) to the fault tree. Using the spill rates derived from the fault tree analysis BOEM estimated approximately 1/2 of a large spill over the 40 year exploration and development life of a lease sale.

4.5 Historical Worldwide Well Control Incident Spills ≥150,000 Barrels

Very large spills (≥150,000 bbl) happen very infrequently, and there are limited data for use in BOEM's statistical analysis and predictive efforts. The chance of a very large spill occurring is very low. Five of the six well control-incident events ≥1,000 bbl in the OCS database occurred between 1964 and 1970 (Table A-5). The sixth OCS well control incident resulting in a large spill was the Deepwater Horizon event. Although no official volume has been determined by BOEM or BSEE it is clear from the spill volume estimates that the Deepwater Horizon exceeds the threshold of a VLOS. The current estimate is 4.9 million bbls and is greater than the 150,000 barrel threshold for a VLOS (Lubchenco et al. 2010; McNutt et al. 2011).

Internationally, from 1965 through 2010, seven offshore oil well control incidents, resulting in an oil spill of greater than or equal to 150,000 bbl, were identified from the peer reviewed or "gray" literature (Table A-6). One of the well control incidents was the result of military action. There were roughly 1.066 trillion barrels of oil produced worldwide from 1965–2010 (British Petroleum, 2011). BOEM compares numbers of very large oil spills to overall production because the number of exploration wells worldwide is not publically and readily available. Using the 6 very large oil spills which were not a result of war, these data provide an approximate rate of about 1 very large offshore oil spill worldwide for approximately every 180 Bbbl of oil produced. Using international data increases the size of the data set and is more likely to capture rare events. However, it assumes that non-US events are relevant to US events to the extent that technology, maintenance, operational standards and other factors are equal. However, this is not likely to be the case (especially in cases of military action).

Table A-6. Historical Very Large Oil Spills from Offshore Well Control Incidents 1965-2010.

Name	Company	Spill Source	Activity	Location	Oil	Begin	End	Duration (Days)	Bbls	Source
Deep Water Horizon/ Macondo MC 252	BP	Expl. Well	Temporary Abandonment	U.S. OCS, Gulf of Mexico	Crude	4/20/ 2010	7/15/ 2010	87	4,900,000	McNutt et al. 2011. National Oil Spill Commission 2011.
Ixtoc	PEMEX	Expl. Well	Drilling	Mexico, Gulf of Mexico	Crude	6/3/ 1979	3/23/ 1980	295	3,500,000	OSIR, 1998; Etkin, 2009; Fingas, 2000; USDOC, NOAA, 1992.
Dubai		Dev. Well	Drilling			1973			2,000,000	Gulf Canada Resources Inc. 1982

Name	Company	Spill Source	Activity	Location	Oil	Begin	End	Duration (Days)	Bbls	Source
Nowruz Oil Field No. 3 Well*	Iranian Offshore Oil	Platform	Production	Iran, Persian Gulf	Crude	2/4/ 1983	9/18/ 1983	224	1,904,762	OSIR, 1998; Etkin, 2009; Fingas, 2000; USDOC, NOAA, 1992.
Abkatun 91	PEMEX	Prod. Well	Workover	Mexico, Gulf of Mexico, Bay of Campeche	Crude	10/ 23/ 1986		15	247,000	OSIR, 1998; Etkin, 2009; Fingas, 2000;
Ekofisk Bravo Platform B14	Phillips Petroleum	Prod. Well	Workover	Norway, North Sea, Ekofisk Oil Field	Crude	4/22/ 1977	4/30/ 1977	8	202,381	OSIR, 1998; Etkin, 2009; Fingas, 2000; USDOC, NOAA, 1992.
Funiwa No. 5 Well	Nigerian National Petroleum	Prod. Well	Drilling	Nigeria, Niger Delta/ Atlantic Ocean	Crude	1/17/ 1980	2/1/ 1980	14	200,000	OSIR, 1998; Etkin, 2009; Fingas, 2000; USDOC, NOAA, 1992.

Note: * Military attack-related events; cells with no data means the information is not readily available in the open literature.
Source: USDOI, BOEM, (2011) compiled from cited references

A-5. Oil-Spill Analysis Framework

There are three potential size categories of oil spills in connection with exploratory operations in Alternative 2-The Proposed Action and Alternative 3-One Well per Season: (1) a large spill (≥1,000 bbl) from exploration operations; (2) a very large spill (≥150,000 bbl) from a well-control incident; and (3) a small spill (<1,000 bbl) from exploration operations. Historical and modeling oil spill data demonstrates that the frequency of a large spill occurring during exploration is low and, therefore, this EA does not analyze the impacts of large spills from exploration operations. The occurrence of a very large spill resulting from a well-control incident is similarly very low. Nonetheless, this EA tiers to BOEM's prior analyses of the impacts of a large and very large oil spill in the Sale 193 FEIS and SFEIS. See further discussion in Section 4.0 of this EA. It is likely a small spill could occur during exploration operations and the oil spill analysis scenario further includes small oil spill factors.

5.1 Small Oil Spills

This section provides the small oil spill analysis framework used for the determination of impacts in Section 4.0 of this EA for Alternative 2-The Proposed Action and Alternative 3- One Well per Season. Historical Beaufort Sea and Chukchi Sea OCS exploration spill data, discussed in Section 1.3.1, suggest that the most likely cause of an oil spill during exploration could be operational, such as a hose rupture, and the spill could be relatively small. For purposes of analysis, a 48-bbl diesel fuel-transfer spill was chosen as the spill volume in the small category. This was based on historical spill size in the Beaufort and Chukchi OCS and OCS oil-spill analysis which indicated 99.7% of all OCS spills are <50 bbl (Anderson and LaBelle, 2000). The spill is estimated to last less than 3 days on the surface of the water, based on the SINTEF Oil Weathering Model calculations. In terms of timing, a small spill from the exploration activities could happen at any time from July to October. Conservatively, BOEM assumes that the vessel would not retain any of the 48 bbl of diesel fuel, and depending on the time of year, a small spill could reach the vessel and then the environment. The environment could be open water or open water and ice. The analysis of a small spill examines the weathering of the estimated 48 bbl diesel fuel spill. BOEM estimates the following fate of the diesel fuel without cleanup.

BOEM summarizes below the estimates for the fate and behavior of diesel fuel in the analysis of the effects of oil on environmental, economic and social resources in Section 4.0. BOEM outlines the

scenario assumptions for a small spill to provide a consistent analysis of small oil spill impacts by resource:

- One small spill occurs.
- The spill size is 48 bbl.
- The oil type is diesel fuel.
- All the oil reaches the environment; the vessel or facility absorbs no oil.
- There is no reduction in volume due to cleanup or containment. (Pollution prevention, containment and cleanup is analyzed separately as mitigation.)
- The spill could occur at any time of the exploration operations (July–October).
- The spill weathering is as shown in Table A-7, and the spill lasts less than 3 days on the water.
- The spill starts within Launch Area 11.
- The time and chance of contact from an oil spill are calculated from an oil-spill-trajectory model
- The chance of contact is analyzed from the location where it is highest when determining effects.

5.1.1 Modeling Simulations of Oil Weathering

To judge the effect of a small oil spill, BOEM makes estimates regarding how much oil evaporates, how much oil is dispersed, and how much oil remains after a certain time period. BOEM derives the weathering estimates of diesel fuel oil from the SINTEF Oil Weathering Model Version 3.0 (Reed et al., 2005) modeling results for up to 30 days. Table A-7 summarizes the results BOEM estimates for the fate and behavior of a 48-bbl diesel fuel spill. BOEM's estimate is slightly more conservative than the estimate in the Shell Appendix F, EIA Table 2.10-3 which used the ADIOS model and a water temperature 2 degrees higher. Both models provide a reasonable estimated range of the fate and behavior of diesel fuel under slightly different environmental conditions. Based on modeling simulations and historical response experience, a small, 48-bbl diesel fuel oil spill will be localized and short term.

Table A-7. Fate and Behavior of a Hypothetical 48-Barrel Diesel Fuel Oil Spill.

Scenario Element	Summer Spill[1]						
Time After Spill in Hours	1	2	3	6	12	24	48
Oil Remaining (%)	96	91	84	65	31	4	0
Oil Naturally Dispersed (%)	3	7	12	28	57	79	83
Oil Evaporated (%)	1	2	4	7	12	17	17
Thickness (mm)	0.7	0.5	0.5	0.3	0.1	0.1	0

Notes: Calculated with the SINTEF oil-weathering model Version3.0 of Reed et al. (2005) and assuming diesel fuel no 2.

[1] Summer (July through September), 12-knot wind speed, 2 degrees Celsius water temperature, 0.4-meter wave height.

5.2 Large and Very Large Accidental Oil Spills

This EA tiers to previous analyses of large and very large accidental oil spills. After the Exxon Valdez oil spill in 1989, BOEM, Alaska OCS Region analyzed very large spills in several OCS locations, two of which were in the Chukchi Sea (USDOI MMS, 1990a, b, 1991, 1995a, b, 1996, 1998, 2002, 2003a, b; USDOI, BLM and MMS, 1998, 2003; USDOI, BLM, 2005, USDOI, BOEMRE, 2011). The frequency of a very large spill (≥150,000) is very low, but its potential effects were most recently analyzed in Chukchi Sea Sale 193 FSEIS. The spill scenario was based on an

initial flow rate of 61,000-bbl declining to 20,479-bbls at 74 days and totaling approximately 2.2 MMbbl. In the unlikely event of a very large accidental oil spill, the potential for major impacts exist as was identified in USDOI, BOEMRE, (2011).

The chance of a large (≥1,000 bbl) spill during exploration activities is also low, but the potential consequences were analyzed in Section IV.C. the Lease Sale 193 Final EIS (USDOI, MMS, 2007), and Section 4.5 of the Arctic Multiple-Sale Draft EIS (USDOI, MMS, 2008). Based on OCS median spill sizes, the MMS (now BOEM) estimated a 1,500-bbl diesel, condensate or crude oil spill from a facility or a 4,600-bbl crude or condensate oil spill from a pipeline for purposes of analyzing a large spill volume (Anderson and LaBelle, 2000). Updated median U.S. OCS large spill sizes are discussed below. These median large spill sizes are not statistically larger than those previously analyzed. Therefore, the conclusions of large spill analysis referenced above would not change.

In preparation for the 2012-2017 Oil and Gas Leasing Program Programmatic EIS, median large OCS spill size estimates were updated (USDOI, BOEM, 2011). During the last 15 years (1996-2010), 7 oil spills ≥1,000 bbl occurred from U.S. OCS pipelines. The median spill size was 1,720 bbl (Anderson, in preparation as cited in USDOI, BOEM 2011). During the last 15 years (1996-2010), 2 oil spills ≥1,000 bbl occurred from U.S. OCS U.S. OCS platforms/rigs. Accounting for the previous trend, the median spill size was 5,066 bbl and over the entire record was 7,000 bbl (Anderson, in preparation as cited in USDOI, BOEM 2011). For purposes of oil spill analysis in the 2012-2017 Programmatic EIS, BOEM used the estimated median spill sizes rounded to the nearest hundred barrels of a 1,700 bbl pipeline spill and a 5,100 platform spill.

The conditional probabilities estimated by the Oil-Spill Risk Analysis (OSRA) model (expressed as percent chance) of a spill ≥1,000 bbl contacting environmental resource areas or land segments within a given time frame from launch areas (LA1-13) and pipeline segments (P1-11) assuming a spill occurs are discussed in USDOI, MMS (2007, 2008). In the unlikely event of a large accidental oil spill, there is potential for major impacts as identified in previous analyses (USDOI, MMS, 2007, 2008).

5.3 Hydrocarbon Spill Transport and Trajectory Analysis

The previously referenced large and very large oil spill analyses considered surface releases. Subsurface releases are estimated to rise to the surface in the moderate water depths (<50m) of the drill sites in a short period of time and within 1000-2000m of the release site (Daling et al., 2003). The proposed action and one well per season area water depths are relatively shallow (<46m [Shell, 2011a: Figures 1.b-3 through 1.b-8]). A subsurface release or a surface release would be represented by LA11 for Shell exploration well locations in Alternative 2-The Proposed Action and Alternative 3-One Well per Season.

5.3.1 Conditional Probabilities

The summer conditional probabilities (expressed as percent chance) from LA 11 (USDOI, MMS, 2007: Tables A2-25 through A2-27. A.2-30 through A.2-33 and A.2-37 through A.2-39) were previously compared to the Shell's 2010 lease blocks (USDOI, MMS, 2009). The conditional probabilities from LA 11 are statistically representative of the lease blocks cited in the 2010 Shell EP (USDOI, MMS, 2009) and the lease blocks in the 2012 Shell Revised Chukchi Sea EP (Johnson, 2011. per comm.). The chance of a large spill contacting, assuming a large spill occurs, is summarized specifically for the LA11 and compared to the Shell 2010 lease blocks. These conditional probabilities are representative of the lease blocks in the Revised EP and are inclusive in the conditional probability discussions in USDOI, MMS (2007) cited above. The estimated conditional probabilities do not factor in pre-booming or spill response; these are considered mitigation, and is analyzed and discussed as such in the impact sections of each resource. A

successful or partially successful spill response would reduce the chance of spill contact or make contact nonexistent.

Figures 4.3-1 through 4.3-3 in the Shell Chukchi Sea EIA (Shell, 2011a: Appendix F) show the locations of Environmental Resource Areas (ERA) and Land Segments (LS) in the nearshore region with a chance of contact from LA11 greater than or equal to 0.5% during summer. Tables A.5 and A.6 summarize the chances of contact below for all land segments, grouped land segments and environmental resource areas (ERAs) from Sale 193 LA11 and Shell's 2010 Burger lease blocks with a chance of contact greater than or equal to 0.5%. Figures A.1-2 through 3, in the Sale 193 FEIS Appendix A (USDOI, MMS, 2007), show the locations of ERAs, land segments, and grouped land segments.

Launch Area 11

Summer 3 Days. The OSRA model estimates the chance of a spill ≥1,000 bbl contacting ERAs 47-54 (ice/sea segments) is <0.5-3%. The chance of contacting ERA10 (Ledyard Bay Spectacled Eider Critical Habitat) is 8 %. The chance of contacting ERAs 39 and 40 (Point Lay and Wainwright Subsistence Area) is 1%. The chance of contacting ERA56 (ERA 56) is <3%. The chance of contacting ERA 36 is 34%. The chance of contacting Land or individual LSs is <0.5%. The chance of contacting any grouped land segment (GLS) is <0.5%.

Summer 10 Days. The OSRA model estimates the chance of a spill ≥1,000 bbl contacting ERAs 46-54 (ice/sea segments) is 6%. The chance of contacting ERA10 (Ledyard Bay Spectacled Eider Critical Habitat) is 14 %. The chance of contacting ERAs 39 and 40 (Point Lay and Wainwright Subsistence Area) is 7 and 6%, respectively. The chance of contacting ERA56 is 8%. The chance of contacting Land is 5%. The chance of contacting individual LSs is <0.5% except 73, 74 or 75 which is 1% for each. The chance of contacting ERA 36 is 40%. The chance of contacting a GLS is <0.5% except NPRA which is 1% and the United States Chukchi Coast which is 5%.

Summer 30 Days. The OSRA model estimates the chance of a spill ≥1,000 bbl contacting ERAs 46-54 (ice/sea segments) is <0.5-13%. The chance of contacting ERA10 (Ledyard Bay Spectacled Eider Critical Habitat) is 21 %. The chance of contacting ERAs 38, 39 and 40 (Point Hope, Point Lay and Wainwright Subsistence Area) is 1, 18, and 13%, respectively. The chance of contacting ERA56 (ERA 56) is 15%. The chance of contacting Land is 19%. The chance of contacting individual LSs is <0.5% except 71-81 which ranges from 1-3%. The chance of contacting a GLS is <0.5-4% except the United States Chukchi Coast, which is 19%.

Comparison to Shell 2012 Blocks.

In USDOI, MMS (2009) LA11 was compared to Shells Lease Blocks (OCS-Y-2280, 2267, 2321) on the Burger prospect. The existing conditional probability information for Burger (MMS, 2009) was determined to be representative for the Shell's 2012 lease blocks (OCS-Y-2280, 2267, 2321, 2294, 2278 and 2324) on the Burger prospect (Johnson, 2011, per comm.) In general, conditional probabilities from the Shell blocks are lower for nearshore areas and higher for ERAs directly adjacent to the blocks (Tables A-8 and A-9). Launch Area 11 is representative of the conditional probabilities for these blocks (OCS-Y-2280, 2267, 2321, 2294, 2278 and 2324).

Table A-8. Summer Conditional Probabilities (Expressed as Percent Chance) that an Oil Spill Starting at LA 11 Chukchi Sea Sale 193 or Lease Blocks 2267, 2280 and 2321 Will Contact a Certain Land Segment or Group of Land Segments Within 3, 10 or 30 Days Assuming a Spill Occurs.

		LA11			2267 Burger F			2280 Burger A			2321 Burger J		
ID	**Land Segment Name**	**3 Days**	**10 Days**	**30 Days**	**3 Days**	**10 Days**	**30 Days**	**3 Days**	**10 Days**	**30 Days**	**3 Days**	**10 Days**	**30 Days**
65	Buckland, Cape Lisburne	:	:	:	:	:	1	:	:	1	:	:	1
71	Kukpowruk River, Sitkok Point	:	:	1	:	:	:	:	:	:	:	:	:
72	Point Lay, Siksrikpak Point	:	:	1	:	:	:	:	:	:	:	:	:
73	Tungaich Point, Tungak Creek	:	1	2	:	:	:	:	:	:	:	:	1
74	Kasegaluk Lagoon, Solivik Isl.	:	1	3	:	:	:	:	:	:	:	:	:
75	Akeonik, Icy Cape	:	1	3	:	:	:	:	:	:	:	:	2
76	Avak Inlet, Tunalik River	:	:	1	:	:	:	:	:	:	:	:	:
77	Nivat Point, Nokotlek Point	:	:	1	:	:	:	:	:	:	:	:	2
78	Point Collie, Sigeakruk Point	:	:	2	:	:	2	:	:	3	:	1	3
79	Point Belcher, Wainwright	:	:	2	:	:	4	:	:	4	:	:	3
80	Eluksingiak Point, Kugrua Bay	:	:	1	:	:	3	:	:	3	:	:	2
81	Peard Bay, Point Franklin	:	:	1	:	:	2	:	:	2	:	:	1
82	Skull Cliff	:	:	:	:	:	1	:	:	:	:	:	:
ID	**Grouped Land Segment Name**	**3 Days**	**10 Days**	**30 Days**	**3 Days**	**10 Days**	**30 Days**	**3 Days**	**10 Days**	**30 Days**	**3 Days**	**10 Days**	**30 Days**
89	National Petroleum Reserve Alaska	:	1	4	:	:	6	:	:	6	:	:	7
90	Kasegaluk Lagoon Special Use Area	:	:	2	:	:	1	:	:	1	:	:	3
96	United States Chukchi Coast	:	5	19	:	1	14	:	1	16	:	2	18

Notes: ** = Greater than 99.5 percent; : = less than 0.5 percent; LA = Launch Area Rows with all values less than 0.5 percent are not shown.

Table A-9. Summer Conditional Probabilities (Expressed as Percent Chance) that an Oil Spill Starting at LA11 Chukchi Sea Sale 193 or Lease Blocks 2267, 2280 and 2321 Will Contact a Certain Environmental Resource Area Within 3, 10 or 30 Days Assuming a Spill Occurs.

		LA5			LA11			2267 Burger F			2280 Burger A			2321 Burger J		
ID	**Environmental Resource Area Name**	**3 Days**	**10 Days**	**30 Days**	**3 Days**	**10 Days**	**30 Days**	**3 Days**	**10 Days**	**30 Days**	**3 Days**	**10 Days**	**30 Days**	**3 Days**	**10 Days**	**30 Days**
—	LAND	:	:	6	:	5	19	:	1	14	:	1	16	:	2	18
1	Kasegaluk Lagoon	:	:	3	1	5	13	:	:	2	:	:	3	:	1	8
6	ERA 6	:	:	3	:	3	12	:	2	19	:	3	20	:	4	19
10	Ledyard Bay Spectacled Eider Critical Habitat	:	1	6	8	14	21	:	1	4	:	1	5	:	2	7
11	Wrangel Island 12 nmi Buffer	:	:	1	:	:	:	:	:	:	:	:	:	:	:	:
14	Cape Thompson Seabird Colony Area	:	:	1	:	:	1	:	:	:	:	:	:	:	:	:
15	Cape Lisburne Seabird Colony Area	:	:	2	:	1	3	:	:	1	:	:	1	:	:	2
18	ERA 18	:	:	7	:	:	5	:	:	4	:	:	4	:	:	5
20	Chukchi Spring Lead 2	:	:	:	:	:	1	na	na	na	na	na	na	na	na	na
21	Chukchi Spring Lead 3	:	:	:	:	2	3	na	na	na	na	na	na	na	na	na
22	Chukchi Spring Lead 4	:	:	:	1	2	3	na	na	na	na	na	na	na	na	na
35	ERA 35	:	1	4	6	12	18	8	21	36	10	22	37	5	15	27
36	ERA 36	6	13	22	34	40	46	11	23	35	17	29	40	67	71	76

ID	Environmental Resource Area Name	LA5			LA11			2267 Burger F			2280 Burger A			2321 Burger J		
		3 Days	10 Days	30 Days	3 Days	10 Days	30 Days	3 Days	10 Days	30 Days	3 Days	10 Days	30 Days	3 Days	10 Days	30 Days
38	Pt. Hope Subsistence Area	:	:	1	:	:	1	:	:	1	:	:	1	:	:	1
39	Point Lay Subsistence Area	:	:	3	1	7	13	:	:	2	:	:	3	:	1	5
40	Wainwright Subsistence Area	:	:	4	1	6	18	:	2	17	:	2	20	:	4	20
45	ERA 45	:	:	1	:	:	2	:	:	1	:	:	1	:	:	1
46	Herald Shoal Polynya	:	2	9	:	:	3	:	:	5	:	:	5	:	:	6
47	Ice/Sea Segment 10	14	22	29	:	3	9	:	5	13	:	5	12	:	7	16
48	Ice/Sea Segment 11	1	6	13	1	6	13	2	12	20	1	9	17	:	5	14
49	Hanna's Shoal Polynya	:	1	3	:	:	2	:	:	3	:	:	2	:	:	2
50	Ice/Sea Segment 12	:	:	3	3	6	10	:	6	14	:	5	12	:	2	7
51	Ice/Sea Segment 13	:	:	1	:	:	3	1	1	8	1	1	8	:	:	4
56	ERA 56	:	2	6	3	8	15	3	14	30	1	12	27	:	7	19
64	Peard Bay	:	:	:	:	:	2	:	:	4	:	:	4	:	:	3
70	ERA 70	:	:	1	:	:	:	:	:	1	:	:	1	:	:	:

Notes: ** = Greater than 99.5 percent; : = less than 0.5 percent; LA = Launch Area, na =ERA spatial location changed. Rows with all values less than 0.5 percent are not shown.

A-6. References

Anderson, C.M. and R.P. LaBelle. 2000. Update of Comparative Occurrence Rates for Offshore Oil Spill. *Spill Science and Technology* 65(6):303-321.

Bercha Group, Inc. 2006. Alternative Oil Spill Occurrence Estimators and their Variability for the Chukchi Sea - Fault Tree Method. OCS Study MMS 2006-033. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 128 pp. plus appendices.

Bercha Group, Inc. 2008. Alternative Oil Spill Occurrence Estimators and their Variability for the Chukchi Sea - Fault Tree Method. OCS Study MMS 2008-036. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 322 pp. plus appendices.

British Petroleum (BP). 2011. BP Statistical Review of World Energy 2011. London: BP. http//www.bp.com/centres/energy2002/2001inreview.asp.

Daling, P.S., M. Moldestad, O. Johansen, A. Lewis, and J. Rodal. 2003. Norwegian Testing of Emulsion Properties at Sea - The importance of oil type and release conditions. *Spill Science and Technology* 8(2):123-136.

Devon Canada Corporation. 2004. Devon Beaufort Sea Exploration Drilling Program. Calgary: Devon Canada Corp.

Etkin, D.S. 2009. Analysis of U.S. Oil Spillage. API Publication 356, Washington, D.C. American Petroleum Institute. http://www.api.org/ehs/water/spills/upload/356-Final.pdf.

Fingas, M. 2000. The Basics of Oil Spill Cleanup. Boca Raton, FL: Lewis Publishers.

Gulf Canada Resources, Inc. 1982. Analysis of Accidents in Offshore Operations Where Hydrocarbons Were Lost. Canada: Gulf Canada Resources, Inc.

Hart Crowser Inc. 2000. Estimation of Oil Spill Risk from Alaska North Slope, Trans Alaska Pipeline and Arctic Canada Oil Spill Data Sets. OCS Study MMS 2000-007. Anchorage AK: USDOI, BOEM, Alaska OCS Region. http://www.alaska.boemre.gov/reports/2000rpts/2000_007.pdf.

Holand, P. 1997. Offshore Blowouts Causes and Control. Houston, TX: Gulf Publishing Company.

Izon, D., E.P. Danenberger, and M. Mayes. 2007. Absence of Fatalities in Blowouts Encouraging in MMS Study of OCS Incidents 1992-2006. Drilling Contractor July/August: 84-89. http://www.drillingcontractor.org/dcpi/dc-julyaug07/DC_July07_MMSBlowouts.pdf.

Johnson, W.J. 2011. OSRA probabilities for 2012 activities. Email from Walter Johnson, Oceanographer, USDOI, BOEM, Headquarters to Caryn Smith, Oceanographer, USDOI, BOEM, Alaska OCS Region, November 16, 2011.

Lubchenco J., M. McNutt, B. Lehr, M. Sogge, M. Miller, S. Hammond, W. Conner. 2010. Deepwater Horizon/BP Oil Budget: What happened to the oil? Silver Spring, MD: NOAA. http://www.noaanews.noaa.gov/stories2010/PDFs/OilBudget_description_%2083final.pdf.

McNutt, M., R. Camilli, G. Guthrie, H. Hsieh, V.Labson, B. Lehr, D. Maclay, A. Ratzel, and M. Sogge. 2011 Assessment of Flow Rate Estimates for the Deepwater Horizon / Macondo Well Oil Spill Flow Rate Technical Group report to the National Incident Command, Interagency Solutions Group. Washington, D.C.: USDOI. http://www.doi.gov/deepwaterhorizon/loader.cfm?csModule=security/getfile&PageID=237763.

National Oil Spill Commission. 2011. Deep Water the Gulf Oil Disaster and the Future of Offshore Drilling Report to the President. Washington, D.C.: National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. http://www.oilspillcommission.gov/sites/default/files/documents/DEEPWATER_ReporttothePresident_FINAL.pdf.

National Research Council (NRC). 2003. Oil and the Sea III, Inputs, Fates and Effects. Washington, DC: The National Academies Press, 265 pp.

Oil Spill Intelligence Report (OSIR). 1998. Oil Spills from Production and Exploration Activities. Vol II no. 8. Cutter Information Corp, 4 pp.

Reed, M., N. Ekrol, P. Daling, O. Johansen, and M.K. and Ditlevsen. 2005. SINTEF Oil Weathering Model User's Manual Version 3.0. Trondheim, Norway: SINTEF Applied Chemistry. 39 pp. http://www.alaska.boemre.gov/reports/2005rpts/2005_020/Final%20Report/Appendix%20D/User%20Manual%20for%20SINTEF%20Oil%20Weathering%20Model%203_0.pdf.

Scandpower. 2001. Blowout Frequency Assessment of Northstar. 27.83.01/R1. Prepared for BP Exploration (Alaska). Kjeller, Norway: Scandpower, 40 pp. plus appendices.

Shell. 2011a. Revised Outer Continental Shelf Lease Exploration Plan Chukchi Sea, Alaska, Anchorage, AK. Shell Gulf of Mexico Inc.

Shell. 2011b. Chukchi Sea Regional Exploration Oil Discharge Prevention and Contingency Plan. Revision 1, May 2011 Anchorage, AK: Shell Offshore Inc.

Shell. 2011c. Beaufort Sea Regional Exploration Oil Discharge Prevention and Contingency Plan. Revision 1, May 2011 Anchorage, AK: Shell Offshore Inc.

USDOC, NOAA, 1992. Oil Spill Case Histories 1967-1991; Summaries of Significant U.S. and International Spills .Report no. HMRAD 92-11. Seattle, WA: USDOC, NOAA, Hazardous Materials Response and Assessment Division. http://response.restoration.noaa.gov/book_shelf/26_spilldb.pdf.

USDOI, BLM and MMS. 1998. Northeast National Petroleum Reserve-Alaska Final Integrated Activity Plan/ Final Environmental Impact Statement. BLM/AK/PL-98/016+3130+930. Anchorage AK: USDOI, BLM and MMS.

USDOI, BLM and MMS. 2003. Northwest National Petroleum Reserve-Alaska Final Integrated Activity Plan/Environmental Impact Statement. 3 Vols. BLM/AK/PL-04/002+3130+930. Anchorage, AK: USDOI, BLM and BOEM, Alaska OCS Region.

USDOI, BLM. 2005. Northeast NPR-A final Amended Integrated Activity Plan/EIS. BLM/AK/PL-05/006+1610+930. Anchorage, AK: USDOI, BLM

USDOI, BOEM. 2011. Outer Continental Shelf Oil and Gas Leasing Program: 2012-2017 Draft Programmatic EIS. OCS EIS/EA 2011-001. Herndon, VA: USDOI, BOEM.

USDOI, BOEMRE, AIB. 2011. Well control incident information for Supplemental EIS, Sale 193. Email from Melinda Mayes, BOEMRE, Headquarter to Fred King, Acting RSLE and Mike Routhier, NEPA Coordinator, BOEMRE, Alaska OCS Region. April 4, 2011.

USDOI, BOEMRE. 2011. Chukchi Sea Planning Area Oil and Gas Lease Sale 193 in the Chukchi Sea Alaska Final Supplemental EIS. OCS EIS/EA BOEM 2011-0041. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

USDOI, MMS. 1990a. Beaufort Sea Planning Area Oil and Gas Lease Sale 124, Final Environmental Impact Statement. OCS EIS/EA MMS 90-0063. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

USDOI, MMS. 1990b. Chukchi Sea Oil and Gas Lease Sale 126 Final Environmental Impact Statement. OCS EIS/EA MMS 90-0095. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

USDOI, MMS. 1991. Navarin Basin Oil and Gas Lease Sale 107 Final Environmental Impact Statement. OCS EIS/EA MMS 91-0008. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

USDOI, MMS. 1995a. Cook Inlet Planning Area Oil and Gas Lease Sale 149 Final Environmental Impact Statement. 2 Vols. OCS EIS/EA MMS 95-0066. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

USDOI, MMS. 1995b. Gulf of Alaska/Yakutat Planning Area Oil and Gas Lease Sale 158 Draft Environmental Impact Statement. 1 Vol. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

USDOI, MMS. 1996. Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final Environmental Impact Statement. OCS EIS/EA MMS 96-0012. 2 Vol. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

USDOI, MMS. 1998. Beaufort Sea Planning Area Oil and Gas Lease Sale 170 Final EIS. OCS EIS/EA MMS 98-0007. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

USDOI, MMS. 2002. Liberty Development and Production Plan, Final Environmental Impact Statement. OCS EIS/EA MMS 2002-019. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 3 Vols.

USDOI, MMS. 2003a. Beaufort Sea Planning Area Sales 186, 195, and 202 Oil and Gas Lease Sale Final EIS. OCS EIS/EA MMS 2003-001. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

USDOI, MMS. 2003b. Cook Inlet Planning Area Oil and Gas Lease Sales 191 and 199 Final EIS. OCS EIS/EA MMS 2003-055. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

USDOI, MMS. 2007. Chukchi Sea Planning Area Oil and Gas Lease Sale 193, and Seismic Surveying Activities in the Chukchi Sea Final EIS. OCS EIS/EA MMS 2007-026. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

USDOI, MMS. 2008. Beaufort Sea and Chukchi Sea Planning Areas Oil and Gas Lease Sales 209, 212, 217 and 221 Draft EIS. OCS EIS/EA MMS 2008-0055. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

USDOI, MMS. 2009. Environmental Assessment: Shell Offshore, Inc. 2010 Shell Gulf of Mexico, Inc. 2010 Exploration Drilling Program Burger, Crackerjack, and SW Shoebill Prospects Chukchi Sea Outer Continental Shelf, Alaska. OCS EIS/EA MMS 2009-061. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

Visser, R. C. 2011. Offshore Accidents, Regulations and Industry Standards. SPE Western North America Regional Meeting; Anchorage, AK. Houston, TX: Society of Petroleum Engineers. 9 pp.

Wall, R.R. 2011. Verification of Worst Case Discharge (WCD) for Shell Gulf of Mexico Inc. 2011 Exploration Plan. Memorandum From R.R. Wall Regional Supervisor (RS), Resource Evaluation, BOEM, Alaska OCS Region to Regional Director, BSEE, Alaska OCS Region, RS Leasing and Plans, BOEM Alaska OCS Region, RS Environment, BOEM Alaska OCS Region, Christy Bohl, Oil Spill Program Administrator, BSEE, Alaska OCS Region, and David M. Moore, BSEE Oil Spill Response Division, Herndon, VA. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

Appendix B

Level of Effect Definitions

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Appendix B. Level of Effect Definitions

B-1. Introduction

This appendix defines and explains the levels of effect used in the EA to evaluate potential environmental impacts. Impacts are described in terms of frequency, duration, general scope, and/or size and intensity. Each level considers such factors as the nature of the impact, the spatial extent, recovery times, and the effects of mitigation. The terms negligible, minor, moderate, and major are used to describe the relative degree or anticipated level of effect of an action on a specific resource. Following each term listed below for a specified resource are the general characteristics used to determine the anticipated level of effect. For each term, best professional judgment was used to evaluate the best available data concerning the affected resource.

For each resource, a "significance threshold" is also provided. Adverse impacts that do not meet the significance threshold are considered "not significant." Required mitigation measures may reduce otherwise "significant" impacts to a level of "not significant."

The absence of a significant effect does not equate to "no effect." As shown in the four-category scale, and in the numerous analyses that BOEM has undertaken, effects from activities can be adverse and noticeable before they reach the significance threshold. Furthermore, in the cumulative effects analysis, BOEM analyzes the combined effects of projected activities with other actions, because BOEM recognizes that effects that individually do not reach this significance threshold may exceed that significance threshold when considered collectively.

B-2. Air Quality

The levels of effect applied to the air quality analysis are based on the results of two levels of analyses, the emission inventory, and if required, the more rigorous ambient air analysis based on computer dispersion modeling. A thorough investigation of the applicable federal and state regulations upon which these levels of effect are based is provided in Appendix D, Air Quality.

2.1 Significance Threshold

A significant effect on air quality is determined when

(1) project-related emissions cause an increase in pollutant concentrations over the nearest onshore area of at least 20 square kilometers that

   (a) exceeds half of any of the National Ambient Air Quality Standards (NAAQS) (except for ozone); or

   (b) exceeds half of the maximum allowable increase for any pollutant for the Prevention of Significant Deterioration (PSD) for a Class II area under 40 CFR 52.21(c) or 18 AAC 50.020(b); or

   (c) is expected to exceed half the ozone NAAQS based on an analysis of the potential increase in the ozone precursor emissions of volatile organic compounds (VOC) and nitrogen oxides (NOX); or

(2) design concentrations violate the NAAQS or if applicable, the Alaska Ambient Air Quality Standards (AAQS).

2.2 Level of Effects

Negligible

- Emission rates would be less than 100 tons per year for VOCs and all pollutants regulated under the NAAQS, and, if applicable, the Alaska AAQS.

Minor

- Emission rates would be equal to or greater than 100 tons per year for VOCs and all pollutants regulated under the NAAQS, and, if applicable, the Alaska AAQS.

Moderate

- Project-related emissions cause pollutant concentrations of at least one pollutant to exceed one-half of the PSD maximum allowable increases; or
- Project-related emissions cause pollutant concentrations of at least one pollutant to exceed one-half of the NAAQS, and, if applicable, the Alaska AAQS; or
- Increases in emissions of NOx and VOC would result in the formation of ozone to a level that would be expected to exceed one-half the ozone NAAQS.

Major

- Design concentrations of at least one pollutant would equal or exceed one-half the NAAQS, and, if applicable, one-half the Alaska AAQS; or
- Increases in emissions of NOx and VOC would result in the formation of ozone to a level that would be expected to equal or exceed the ozone NAAQS.

B-3. Water Quality

The levels of effect applied to water quality analysis consider the context and intensity of impacts, EPA's NPDES permitting program, and criteria under 40 CFR 125.122:

(1) The quantities, composition and potential for bioaccumulation or persistence of the pollutants to be discharged;

(2) The potential transport of such pollutants by biological, physical or chemical processes;

(3) The composition and vulnerability of the biological communities which may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain;

(4) The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism.

(5) The existence of special aquatic sites including, but not limited to marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas and coral reefs;

(6) The potential impacts on human health through direct and indirect pathways;

(7) Existing or potential recreational and commercial fishing, including finfishing and shellfishing;

(8) Any applicable requirements of an approved Coastal Zone Management plan;

(9) Such other factors relating to the effects of the discharge as may be appropriate;

(10) Marine water quality criteria developed pursuant to section 304(a)(1).

3.1 Significance Threshold

A significant effect on water quality is determined by any of the following: (1) the action is likely to violate its National Pollution Discharge Elimination System permit; (2) in the event of an accidental spill of crude oil or refined oil, total aromatic hydrocarbon or total aqueous hydrocarbon criteria for the Alaska marine or fresh-water quality standards are exceeded; or (3) the action is otherwise likely to introduce changes in the physical, chemical, or biological characteristics of a waterbody which case an unreasonable degradation of the marine environment as defined at 40 CFR 125.121 and determined in accordance with 40 CFR 125.122.

3.2 Level of Effects

Negligible: Temporary and localized impacts to water quality that do not cause an unreasonable degradation under 40 CFR 125.122.

Minor: Long-term and/or widespread impacts to water quality that do not cause an "unreasonable degradation" under 40 CFR 125.122.

Moderate: Impacts to water quality that exceed NPDES permit criteria or cause a temporary or localized "unreasonable degradation" under 40 CFR 125.122.

Major: Impacts to water quality that cause long-term and widespread "unreasonable degradation" under 40 CFR 125.122.

B-4. Lower Trophic Organisms

4.1 Significance Threshold

An adverse impact that results in a decline in abundance and/or change in distribution requiring three or more generations for the indicated population to recover to its former status.

4.2 Level of Effects

Negligible:

- No measurable impacts. Population-level effects are not detectable.
- Localized, short-term disturbance or habitat effect experienced during one season that is not anticipated to accumulate across multiple seasons.
- No population level impacts to reproductive success or recruitment are anticipated.
- Mitigation measures are implemented fully and effectively or are not necessary.

Minor:

- Population-level effects are not detectable.
- Widespread annual or chronic disturbances or habitat effects not anticipated to accumulate across 1 year, or localized effects that are anticipated to persist for more than 1 year.
- Mitigation measures may be implemented on some, but not all, impacting activities, indicating that some adverse effects are avoidable.
- Unmitigatable or unavoidable adverse effects are short term and localized.

Moderate:

- Disturbances could occur, but not on a scale resulting in population-level effects.
- Widespread annual or chronic disturbances or habitat effects could persist for more than one year and up to a decade.

- Widespread implementation of mitigation measures for similar activities may be effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are short term and widespread, or long term and localized.

Major

- Disturbances occur that result in measurable population-level effects.
- Widespread seasonal, chronic, or effects from subsequent seasons are cumulative and are likely to persist for more than 1 decade.
- Mitigation measures are implemented only for a small portion of similar impacting activities, but more widespread implementation for similar activities could be more effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are widespread and long lasting.

B-5. Fish

5.1 Significance Threshold

An adverse impact that results in a decline in abundance and/or change in distribution requiring three or more generations for the indicated population to recover to its former status.

5.2 Level of Effects

Negligible:

- No measurable impacts. Population-level effects are not detectable.
- Localized, short-term disturbance or habitat effect experienced during one season that is not anticipated to accumulate across multiple seasons.
- No mortality or impacts to reproductive success or recruitment are anticipated.
- Mitigation measures are implemented fully and effectively or are not necessary.

Minor:

- Population-level effects are not detectable. Temporary, nonlethal adverse effects to some individuals.
- Widespread annual or chronic disturbances or habitat effects not anticipated to accumulate across 1 year, or localized effects that are anticipated to persist for more than 1 year.
- Low mortality levels may occur, measurable in terms of individuals or <1% of the local post-breeding fish populations.
- Mitigation measures may be implemented on some, but not all, impacting activities, indicating that some adverse effects are avoidable.
- Unmitigatable or unavoidable adverse effects are short term and localized.

Moderate:

- Mortalities or disturbances could occur, but not on a scale resulting in population-level effects.
- Widespread annual or chronic disturbances or habitat effects could persist for more than 1 year and up to a decade.
- Some mortality could occur but remains limited to a number of individuals insufficient to produce population-level effects.
- Widespread implementation of mitigation measures for similar activities may be effective in reducing the level of avoidable adverse effects.

- Unmitigatable or unavoidable adverse effects are short term and widespread, or long term and localized.

Major

- Mortalities or disturbances occur that have measureable and thus significant population-level effects.
- The action may adversely affect an endangered or threatened species or its habitat in a way that has been deemed to be critical under the Endangered Species Act of 1973.
- For fishes, the anticipated mortality is estimated or measured in terms of tens of thousands of individuals or >20% of a local breeding population and/or >5% of a regional population, which may produce short-term, localized, population-level effects.
- Widespread seasonal, chronic, or effects from subsequent seasons are cumulative and are likely to persist for more than 1 decade.
- Mitigation measures are implemented only for a small portion of similar impacting activities, but more widespread implementation for similar activities could be more effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are widespread and long lasting.

B-6. Marine and Coastal Birds

6.1 Significance Threshold

Threatened and Endangered Species: An adverse impact that results in a decline in abundance and/or change in distribution requiring one or more generation for the indicated population to recover to its former status.

All other Marine and Coastal Birds: An adverse impact that results in a decline in abundance and/or change in distribution requiring three or more generations for the indicated population to recover to its former status.

6.2 Level of Effects

Negligible

- Localized short-term disturbance or habitat effect experienced during one season that is not anticipated to accumulate across one year.
- No mortality is anticipated.
- Mitigation measures implemented fully and effectively or are not necessary.

Minor

- Widespread annual or chronic disturbances or habitat effects not anticipated to accumulate across one year, or localized effects that are anticipated to persist for more than 1 year.
- Anticipated or potential mortality is estimated or measured in terms of individuals or <1% of the local post-breeding population.
- Mitigation measures are implemented on some, but not all, impacting activities, indicating that some adverse effects are avoidable.
- Unmitigatable or unavoidable adverse effects are short-term and localized.

Moderate

- Widespread annual or chronic disturbances or habitat effects anticipated to persist for more than one year, but less than a decade.

- Anticipated or potential mortality is estimated or measured in terms of tens or low hundreds of individuals or <5% of the local post-breeding population, which may produce a short-term population-level effect.
- Mitigation measures are implemented for a small proportion of similar impacting activities, but more widespread implementation for similar activities likely would be effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are short-term but more widespread.

Major

- Widespread annual or chronic disturbance or habitat effect experienced during one season that would be anticipated to persist for a decade or longer.
- Anticipated or potential mortality is estimated or measured in terms of hundreds or thousands of individuals or <10% of the local post-breeding population, which could produce a long-term population-level effect.
- Mitigation measures are implemented for limited activities, but more widespread implementation for similar activities would be effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are widespread and long lasting.

B-7. Marine Mammals

7.1 Significance Threshold

Threatened and Endangered Species: An adverse impact that results in a decline in abundance and/or change in distribution requiring one or more generation for the indicated population to recover to its former status.

All other Marine Mammals: An adverse impact that results in a decline in abundance and/or change in distribution requiring three or more generations for the indicated population to recover to its former status.

7.2 Level of Effects

Negligible:

- Localized, short-term disturbance or habitat effect experienced during one season that is not anticipated to accumulate across multiple seasons. Temporary, nonlethal adverse effects to a few individuals are possible.
- May cause brief behavioral reactions such as temporary avoidances of or deflections around an area. No mortality or population-level effects are anticipated.
- The action is not anticipated to affect an endangered or threatened species or critical habitat under the Endangered Species Act of 1973.
- Mitigation measures are implemented fully and effectively or are not necessary.
- Unmitigatable or unavoidable adverse effects are difficult to measure or observe.

Minor:

- Localized, disturbance or habitat effects experienced during one season may accumulate across subsequent seasons, but not over one year.
- Temporary, nonlethal adverse effects to some individuals. May cause behavioral reactions such as avoidances of or deflections around a localized area. Mortality or population-level effects are not anticipated.
- The action may adversely affect an endangered or threatened species or critical habitat under the Endangered Species Act of 1973.

- Mitigation measures are fully implemented or are not necessary.
- Unmitigatable or unavoidable adverse effects are short term and localized.

Moderate:

- Widespread annual or chronic disturbances or habitat effects could persist for more than 1 year and up to a decade.
- Mortalities or disturbances could occur, but would be below the estimated Potential Biological Removal[1] (PBR). Population-level effects are not anticipated.
- The action is likely to adversely affect an endangered or threatened species or modify critical habitat under the Endangered Species Act of 1973.
- Widespread implementation of mitigation measures for similar activities may be effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are short term and widespread, or long term and localized.

Major

- Widespread seasonal or chronic effects from subsequent seasons are cumulative and are likely to persist for more than 1 decade.
- Mortalities or disturbances could occur at or above the estimated Potential Biological Removal (PBR), which could be a population-level effect.
- The action may adversely affect an endangered or threatened species or critical habitat under the Endangered Species Act of 1973, but would not necessarily jeopardize the continued existence of an ESA-listed species.
- Mitigation measures are implemented only for a small portion of similar impacting activities, but more widespread implementation for similar activities could be more effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are widespread and long lasting.

B-8. Sociocultural Systems

Sociocultural systems include social organization, cultural values, and institutional arrangements. The level of significance effect would be reached at the high level. The level of effects used for sociocultural systems is as follows:

8.1 Significance Threshold

A disruption of social organization, cultural values, and/or institutional arrangements with a tendency towards displacement of existing social patterns.

8.2 Level of Effects

Negligible: Periodic disruption of social organization, cultural values, and/or institutional arrangements occurs without displacement of existing social patterns.

Minor: Disruption of social organization, cultural values, and/or institutional arrangement occurs for a period of less than one year, without a tendency toward displacement of existing social patterns.

Moderate: Chronic disruption of social organization, cultural values, and/or institutional arrangements occurs for a period of more than one year, without a tendency toward displacement of existing social patterns.

Major: Disruption of social organization, cultural values, and/or institutional arrangements with a tendency towards displacement of existing social patterns.

B-9. Subsistence

9.1 Significance Threshold

Adverse impacts which disrupt subsistence activities, or make subsistence resources unavailable, undesirable for use, or only available in greatly reduced numbers, for a substantial portion of a subsistence season for any community.

9.2 Level of Effects

Negligible

- Subsistence resources could be periodically affected with no apparent effect on subsistence harvests.

Minor

- Adverse impacts to subsistence activities are of an accidental and/or incidental nature and limited to a short-term.

Moderate

- Adverse impacts which disrupt subsistence activities, or make subsistence resources unavailable, undesirable for use, or only available in greatly reduced numbers, for a substantial portion of a subsistence season for any community.

Major

- Adverse impacts resulting in one or more important subsistence resources becoming unavailable, undesirable for use, or available only in greatly reduced numbers for any community.

B-10. Economy

The effects levels used for this analysis focus on the impacts associated with the proposed activities on socioeconomic systems, including employment, personal income, and revenues accruing to the local, state, and federal government.

10.1 Significance Threshold

Economic effects that would cause important and sweeping changes in the economic well-being of the residents or the area or region. Local employment is increased by 20% or more for at least 5 years.

10.2 Level of Effects

Negligible

- No measurable effects beyond short term, periodic impacts.

Minor

- Adverse impacts to the affected activity or community are unavoidable without proper mitigation.
- Impacts would not disrupt the normal or routine functions of the affected activity or community. Economic systems would be impacted for a period of up to 1 year.
- Once the impacting agent is eliminated, the affected activity or community will return to a condition with no measurable effects from the proposed action without any mitigation.

Moderate

- Impacts to the affected activity or community are unavoidable. Proper mitigation would reduce impacts substantially during the life of the project.
- Effects on economic systems would be unavoidable for a period longer than 1 year.
- The affected activity or community would have to adjust somewhat to account for disruptions due to impacts of the project.
- Once the impacting agent is eliminated, the affected activity or community will return to a condition with no measurable effects from the proposed action if proper remedial action is taken.

Major

- Impacts to affected community are unavoidable.
- Proper mitigation would reduce impacts somewhat during the life of the project.
- The affected activity or community would experience unavoidable disruptions to a degree beyond what is normal.
- Once the effect producing agent is eliminated, the affected activity or community may retain measurable effects of the proposed action indefinitely, even if remedial action is taken.

B-11. Public Health

11.1 Level of Effects

Negligible

- Infrequent minor acute health problems, not requiring medical attention.
- No measurable effects on normal or routine community functions.
- No long-term consequences for Public Health or well being.

Minor

- Public Health affected, but the effects would not disrupt normal or routine community functions for more than one week.
- Effects would not occur frequently.
- Effects would not affect large numbers of individuals.
- Effects could be avoided with proper mitigation.

Moderate

- Adverse effects on Public Health occurring for brief periods of time that do not result in or incrementally contribute to deaths or long-term disabilities.
- Effects can be prevented, minimized, or reversed with proper mitigation.
- Effects could occur more frequently than minor events, but would not be frequent.

Major

- Effects on Public Health would be unavoidable and would contribute to the development of disabilities, chronic health problems, or deaths.
- Alternatively, occurrence of minor health problems with epidemic frequency.
- Effective mitigation might minimize the adverse health outcomes but would not be expected to reverse or eliminate the problem.

B-12. Archaeology

12.1 Level of Effects

Negligible

- This category equates to No Historic Properties Affected as defined by 36 CFR 800.4(d)(1), the Code of Federal Regulations that promulgates Section 106 of the National Historic Preservation Act of 1966 as amended.

Minor

- This category equates to a finding of No Historic Properties Affected when the Agency identifies a potential conflict within an Area of Potential Effect due to the presence of a geomorphological feature and revises the plan to avoid it prior to consultation with the State Historic Preservation Officer.

Moderate

- This category equates to a finding of No Adverse Effect as defined by 36 CFR 800.5(b) when the SHPO identifies a conflict that requires a change in plan to avoid effects on an Historic Property as defined by 36 CFR 800.16(l)(1&2).

Major

- This category equates to a finding of Adverse Effect as defined by 36 CFR 800.5(C) requiring mitigation and a Memorandum of Agreement.

B-13. Environmental Justice

Executive Order 12898 requires Federal Agencies to evaluate whether proposed projects would have "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low income populations."

13.1 Significance Threshold

The significance threshold for Environmental Justice is when minority or low-income populations experience disproportionate, high adverse human health or environmental effects from the proposed action. Disproportionately high adverse impacts are those impacts which exceed the significance thresholds for subsistence, sociocultural, or public health effects for minority populations or low income populations.

13.2 Level of Effects

The levels of effect for Environmental Justice correspond to the levels of effects for subsistence, sociocultural, or public health effects as experienced by minority populations or low income populations.

B-14. References

USDOI, MMS. 2008. Cape Wind Energy Project Draft Environmental Impact Statement. OCS EIS/EA MMS 2007-024. Herndon, VA: USDOI, BOEM.

Notes:

[1] Marine mammal stock management is often based on a theoretical concept called Potential Biological Removal (PBR). The PBR is defined as the maximum number of animals, not including natural mortalities, which may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustained population. An optimum sustained population is defined as the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem. For example, as the bowhead whale population continues to grow, it continues to approach its carrying capacity. Contemporary population ecology suggests that at carrying capacity, a stable population is achieved when mortality equals productivity.
The PBR is calculated as the product of the minimum population estimate, one-half the theoretical productivity rate, and a "recovery factor". For example, the current estimate for the rate of increase for the bowhead whale stock (3.3%) should not be used as an estimate of maximum productivity because the population is currently being harvested and because the population has recovered to population levels where the growth is expected to be significantly less than maximum productivity. For the Western Arctic bowhead whale stock, the population size is estimated to be 9,472 (estimated in 2001), the theoretical productivity rate is 0.2, and the recovery factor is 0.5. The PBR is generally only used by the NMFS to guide decisions regarding the allowable removal of individual animals from a stock.
The conceptual PBR is used in the level of effects to identify a threshold whereby maximum population growth is sustained or not. If an anticipated effect could result in a loss of whales that exceeded the PBR, this would be inferred to be a population-level effect. In reality, given the conservative values used to derive the PBR, the loss of marine mammals that exceeded calculated PBR could be entirely consistent with a stable population.

Appendix C

Cumulative Effects

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Appendix C. Cumulative Effects

C-1. Cumulative Effects Defined

The Council on Environmental Quality (CEQ) Regulations defines cumulative effects at 40 CFR 1508.7:

> **Sec. 1508.7 Cumulative impact**.
>
> "Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

C-2. Cumulative Effects Scenario

The scope of this assessment includes the incremental impact from the action alternatives plus the aggregate effects of other activities that are known to occur or that can be reasonably expected to occur at the same time as, and in the vicinity of the proposed action, and which have a potential to affect the same resources as the proposed action.

This cumulative effects scenario tiers from information provided in Chapter 5 of the Lease Sale 193 Final SEIS (USDOI, BOEMRE, 2011). That information is incorporated by reference and summarized below. Further, it is updated to consider the years 2012 through 2017 and reflect the past, present, and reasonably foreseeable activities which may occur within the special confines and within the time period of the proposed action.

C-3. Impact Sources

The main sources of impacts which could have a cumulative impact with the proposed action on the resources in the Arctic OCS are: (1) marine vessel traffic, (2) aircraft traffic, (3) subsistence and other community activities, (4) scientific research activities, and (5) oil and gas-related.

3.1 Marine Vessel Traffic

Past marine vessel traffic has been associated with subsistence hunting, oil exploration, research, and military activities. Weather and ice have traditionally limited marine vessel traffic in the proposed exploration area to the open-water period of July through September.

The number of marine vessels in the Chukchi Sea has increased in recent years due to advances in the technology of ice strengthening and ice breaking capacities of marine vessels, changes in ice cover and classification of ice, and increased interest in scientific and economic pursuits in the area. Vessel traffic related to the Proposed Action would include the drillship and support vessels. Other reasonably foreseeable traffic in the U.S. Chukchi Sea includes small craft involved in the fall whaling hunt at Barrow and Wainwright; USCG vessels; cargo vessels; other supply ships, tugs, and barges; cruise ships; and vessels associated with scientific endeavors. The USCG estimates that from 2008 to 2010 the number of vessels in the Arctic increased from around 100 to more than 130, and the number of transits through the Bering Strait increased from around 245 to more than 325 (USCG, 2011). The estimated number of miles of non-seismic vessel traffic in the Chukchi Sea for July through October increased from approximately 2,000 miles in 2006 to more than 11,500 miles in 2010 (Shell, 2011: Appendix F, Table 4.2-2). Vessel tracks from 2009 indicate vessel transits in the vicinity of Barrow and Wainwright are traditionally concentrated along the coast (Marine Exchange

of Alaska, 2011). This area corresponds to the subsistence use areas described in Section 3.2.10 for those communities.

Marine vessels are the greatest contributors of anthropogenic sound introduced to the Chukchi Sea. Sound levels and frequency characteristics of vessel sound generally are related to vessel size and speed. Larger vessels generally emit more sound than do smaller vessels. Same size class vessels travelling at higher rates of speed generally emit more sound than the same vessels travelling at lesser speeds. Vessels underway with a full load, or vessels pushing or towing loaded non-powered vessels, generate more sound than unladen vessels in a similar size class. The most common sources of marine vessel mechanical components that generate sound waves are propulsion engines, generators, bearings, and other mechanical components, as well as fathometers and other vessel navigation and operations equipment, all of which create and propagate sound into the marine environment through the vessel hull. The most intense level of sound pressure introduced into the water from an underway marine vessel originates from cavitation associated with the action of spinning propellers. Moored vessels generate sound from the operation of engines and pumps. Cranes or other similar operational equipment performing construction activities or other work functions at docks may transmit sound directly to the environment or indirectly through propagation of sound waves through the hull .

It is reasonably foreseeable that vessel traffic will increase over the proposed period of the exploration plan. This traffic would likely include industry activities in the form of seismic surveys, seafloor archaeological and biological surveys, seafloor geotechnical programs, biological monitoring surveys, research activites, coastwise commercial and community vessel traffic, and military actions.

3.2 Aircraft Traffic

Past air traffic activities in the area of the proposed exploration drilling and support activities have been limited to movement of people and supply materials between industry operations, native villages, and military outposts.

Air traffic has increased in recent years, mostly from increases in academic and commercial ventures, and increases in military operations. Aircraft traffic in the Arctic includes fixed wing and helicopter flights for research programs and marine mammal monitoring operations; cargo flights for supplies to villages and for commercial ventures including oil and gas related activities (such as crew changes and supply flights); flights for regional and inter-village transport of passengers; air-ambulance and search and rescue emergency flights; general aviation for the purpose of sport hunting and fishing or flightseeing activities; and multi-governmental military flights. Air traffic not associated with the proposed project may involve flight patterns at a lower altitude than the 1,500-ft limit required for aircraft related to the proposed action. Shell calculated that an average of 306 commercial flights per month occurred from Wainwright airport between July and October, 2000 to 2008 (Shell 2011: Appendix F, Table 4.1.11-6).

Air traffic is expected to continue at present levels for the reasonably foreseeable future.

3.3 Subsistence Activities and Other Community Activities

Subsistence hunting and other community activities associated with regional native villages such as Wainwright and Point Lay have persisted for millennia, and are expected to continue during the period of proposed activities. Additional information regarding these activities is provided in Chapters 3 and 4.

Overall, vessel traffic associated with native village activities within the proposed exploration drilling area is expected to be consistent with the level of traffic observed in recent years. Most vessel traffic in the region is nearshore, or is a result of exploration activity and academic or industry research efforts. Nearshore traffic is expected to consist of barges (with their associated towing / pushing vessels) transiting through the area during open water conditions within 12.5 mi (20 km) of the coast

(Shell, 2011b: 4-131). With the reduction in ice cover and increase in open water season, cumulative vessel traffic in the region due to military, tourism, and foreign shipping interests may increase (Arctic Marine Shipping Assessment, 2005)

3.4 Scientific Research Activities

A sizable scientific research effort by governmental, non-governmental, and academic organizations operating from marine vessels and aircraft occurs annually in the Chukchi Sea. The programs conducted by these organizations are expected to continue through the period of the proposed action. Marine environmental baseline studies involve deployment of oceanographic equipment for collecting water and sediment samples, and use of nets and trawls for fish sampling and collection of phytoplankton, zooplankton, benthic invertebrates, and pelagic invertebrates. Also continuing will be observations of marine and coastal birds and marine mammals using standardized survey transect methods and passive acoustic monitoring. Metocean buoys and acoustic wave and current meters will continue to be deployed for studies of physical oceanography and climate. Previous environmental assessments, such as the environmental assessment for Shell's Beaufort Sea marine research program, describe the techniques used and the effects of these programs in detail (USDOI, BOEMRE, 2011).

Pacific Arctic Group (PAG). Ongoing activities in the general Beaufort and Chukchi Sea regions include multinational efforts carried out by the Pacific Arctic Group (PAG). Organized under the International Arctic Science Committee (IASC), the PAG mission is to serve as a Pacific Arctic regional partnership to plan, coordinate, and collaborate on science activities of mutual interest to the Arctic region. Some of these activities could coincide in time and space with Shell's proposed exploration plan activities. The Diversified Biological Observatory is a multi-national cooperative effort coordinated by the PAG, with the USA, Canada, Russia, Japan, China, and Korea contributing cruise data from past, ongoing, and planned research programs. The programmatic sampling includes continuation of collections from prior and existing research stations, including BOEM-funded projects. Focus is on four geographical research areas within the Bering Sea, Bering Strait, Chukchi Sea, and Beaufort Sea. This work includes the synthesis of studies in fields including physical oceanography, marine chemistry, biological oceanography and marine biology (primary productivity, zooplankton, phytoplankton, ice algae, epontic, pelagic, and benthic collections), and marine mammal and marine bird ecology (PAG, 2011).

Bowhead Whale Feeding Ecology Study (BOWFEST). August–September 2012. NOAA Fisheries and National Marine Mammal Laboratory. The BOWFEST (NMML, 2011a) is a multiyear BOEMRE-funded study which was started in 2007 that focuses on late summer oceanography and prey densities relative to whale distribution over continental shelf waters within 100 miles north and east of Point Barrow, Alaska. National Marine Mammal Laboratory (NMML), will conduct aerial surveys, acoustic monitoring, and boat-based surveys to provide information on the spatial and temporal distribution of bowhead whales in the study area.

2012 Low-level Aerial Coastal Survey. This plan includes implementation of aerial surveys of coastal areas to approximately 23 mi (37 km) offshore between Point Hope and Point Barrow. These surveys will continue until exploration drilling operations in the Chukchi Sea are completed. Flight altitudes and speeds will comply with LOA and 4MP guidelines. These flights will occur in addition to activities described in the Aircraft Traffic section of this appendix. Saw-tooth flight transects were designed by placing transect start/end points every 34 mi (55 km) along the offshore boundary of this 23 mi (37 km) wide nearshore zone, and at midpoints between those points along the coast. The transect line start/end points will be shifted along both the coast and the offshore boundary for each survey based upon a randomized starting location, but overall survey distance will not vary substantially. The coastline transect will simply follow the coastline or barrier islands. "No-fly" zones around coastal villages or other hunting areas established during communications with village representatives will be in place until the end of the hunting season.

Chukchi Sea Acoustic Oceanographic Zooplankton (CHAOZ). July – September, 2012. CHAOZ goals are to conduct passive acoustic/biological/biophysical surveys of whales, their prey, and their environment in the Bering, Chukchi, and Beaufort seas for three field seasons, 2010–2012. The study includes research vessel transects from Wainwright, Icy Cape, Point Lay, Cape Lisburne, and Point Hope into the Chukchi and Bering seas for deployment of acoustic and ice buoys, CTD casts, zooplankton sampling, and for collection of marine mammal observation data. In addition, biological and population studies of large whales will be continued by deploying radio and satellite transmitters on whales, conducting photo-identification, and biopsy sampling.

Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA). Mid-June – October, 2012. NOAA Fisheries and National Marine Mammal Laboratory. The Northeast Chukchi Sea aerial cetacean survey COMIDA (NMML, 2011b) is a BOEM-funded project designed to understand the distribution and relative abundance of cetaceans by using aerial surveys during the open-water (ice-free) months, from mid-June to the end of October. Surveys follow standard line-transect protocols. Flights begin and end in Barrow, AK. The science team flies in either a De Havilland Twin Otter Series 300 or Aero Commander 690A fixed wing aircraft at altitudes between 1,000-1,500 feet and at 100-110 kts speed. Surveys are flown every day, weather permitting.

2012 Shell Chukchi Sea EP Biological Monitoring Program. In addition to monitoring of marine mammals, a comprehensive environmental monitoring program will be implemented during exploration drilling operations. A dedicated science vessel staffed by a team of physical and biological oceanographers will be responsible for assessing pre-, during, and post-drilling conditions in both biota, and water and sediment quality. All of Shell's proposed drilling locations have been sampled at multiple times during the last three years to provide a baseline understanding of pre-existing conditions and interannual variability at these sites. Physical oceanography characteristics that will be monitored continuously at each location throughout the drilling process include surface wind direction and speed, ambient air temperature, current speed and direction throughout the water column, water temperature through the water column, and salinity through the water column. Water chemistry and characteristics that will be monitored will include assessment of metals and organics through the water column at multiple fixed and random locations around the exploration drilling operation. These measurements will be made regularly before, during, and after drilling, and will capture conditions during all significant phases of the exploration drilling operations and potential discharges. Physical characteristics of the water column will also be assessed (including turbidity, temperature, and oxygen content) in an effort to document and model plumes of released discharges. Samples of biota will be collected before and after operations for tissue analysis for metals and organics. Bird and mammal observations will be made from all of Shell's support vessels throughout the exploration drilling activities in accordance with the 4MP and Bird Strike Avoidance and Lighting Plan.

Hanna Shoal Ecosystem Study (Hanna Shoal). July – October 2012, with similar proposed operating schedules through 2016. This research project will include benthic sampling, food web analysis, and contaminant measurements and focuses on the Hanna Shoal area, located between the boundary of the Chukchi and Arctic Ocean waters and the Burger prospect. Water column primary and secondary production and biomass also will be measured. Cruise zooplankton data will be supplemented by data from moored zooplankton-sensing acoustic Doppler current profilers (ADCP) (units that are capable of distinguishing copepod and euphausid biomass signatures). Moored and shipboard instruments of currents, sea ice drift, and hydrography (including geochemistry) will examine circulation and density fields. Instrument moorings will be used for long term profiling of temperature and salinity, including under ice measurements in winter. Additional oceanographic data may be obtained from other projects such as the proposed extension of the Chukchi oceanographic study. These data include HF radar, moored ADCPs, meteorological buoys, and gliders. Formal integration with the results of other BOEM-funded projects will be made through the planned

"Marine Mammal/Physical Oceanography Synthesis" to provide upper trophic components to the study. Coordination will occur with other international, NSF, NOAA, ADEC, and industry research in the Chukchi Sea.

It is reasonable to foresee there will be further research efforts in this region during the projected period of the exploration period, due to continuing interest in the changing ice and climate patterns. For example, the Pacific Arctic Group (PAG), organized under the International Arctic Science Committee, plans, coordinates, and collaborates on science activities of mutual interest to the Arctic region. It is not presently known exactly what research PAG will conduct, but it is reasonably foreseeable that the projects specified above are only a sample of the total research that will be conducted in the Chukchi during the duration of the proposed activities.

3.5 Oil and Gas Related Activities

Past oil and gas related activities in the Chukchi Sea OCS include exploration wells drilled at the Burger prospect in 1990 and at the Klondike prospect in 1989, exploration seismic surveys,shallow geologic hazards surveys, geotechnical sampling programs, baseline biological studies and surveys, and other environmental studies and sampling programs.

Current reasonably foreseeable oil and gas activities in the Arctic OCS include Shell's multiple-well exploration drilling program on leases in the Beaufort Sea, which would occur concurrently with Shell's proposed activities in the Chukchi Sea. Shell proposes using dedicated and independent drilling and support vessels for the Chukchi Sea and Beaufort Sea operations, with some shared oil spill response resources. Weather, ice, and other environmental conditions at the specific locations would ultimately dictate the sequence of Shell's operations. Shell's Beaufort Sea and Chukchi Sea exploration drilling project areas are more than 400 mi apart. Discharges and emissions associated with drilling at the two project areas would not overlap in space. Sound generated from the various project stages would not overlap in space. Because of the travel time for migrating species between the project areas, some individual animals could be exposed to sound from both drilling operations.

Other current and ongoing activities related to oil and gas, such as vessel and air traffic in state waters and onshore, are expected to remain at their current levels for the duration of the proposed action.

Additional industry activities that may occur during the time frame of the proposed action include potential exploration projects by Statoil USA E&P Inc. and Conoco Philips; however, no exploration plans for these activities have been submitted to BOEM. Should Arctic lease sales be included in the 2012-2017 Five-Year OCS oil and Gas Leasing Program, potential bidders would likely propose to conduct exploration seismic surveys under BOEM-issued G&G permits. It is reasonably foreseeable that one or more such surveys could occur during the timeframe of the proposed action. BOEM would complete environmental evaluations, including cumulative effects analysis, for any such proposed activities.

C-4. Climate Change and Ocean Acidification

Climate change is an ongoing consideration in evaluating cumulative effects on environmental resources of the Arctic region (NOAA, 2011). It has been implicated in changing weather patterns, changes in the classification and seasonality of ice cover, ocean surface temperature regimes, and the timing and duration of phytoplankton blooms in the Chukchi Sea. These changes have been attributed to rising CO_2 levels in the atmosphere and corresponding increases in the CO_2 levels of the waters of the world's oceans. These changes have also led to the phenomena of ocean acidification (IPCC, 2007; Royal Society, 2005). This phenomenon is often called a sister problem to climate change, because they are both attributed to human activities that are leading to increased CO_2 levels in the atmosphere. The capacity of the Arctic Ocean to uptake CO_2 is expected to increase in response to climate change (Bates and Mathis, 2009). Further, ocean acidification in high latitude seas is

happening at a more advanced rate than other areas of the ocean. This is due to the loss of sea ice that increases the surface area of the Arctic seas. This exposure of cooler surface water lowers the solubility calcium carbonate, which results in lower saturation levels of calcium carbonate within the water, and in turn leads to lower available levels of the minerals needed by shell-producing organisms, such as pteropods, foraminifers, sea urchins, and molluscs (Fabry et al., 2009; Mathis, 2011).

C-5. References

Arctic Marine Shipping Assessment. 2005. http://www.arctic.gov/publications/AMSA/current marine use.pdf.

Bates, N.R., and Mathis, J.T., 2009, The Arctic Ocean marine carbon cycle; evaluation of air-sea CO2 exchanges, ocean acidification impacts and potential feedbacks, Biogeosciences Discussions 6. pp. 6695-6747. http://www.biogeosciences-discuss.net/6/6695/2009/bgd-6-6695-2009-print.pdf.

Shell. 2011. 2012 Shell Revised Exploration Plan for the Chukchi Sea. Shell Gulf of Mexico Inc. http://alaska.boemre.gov/ref/ProjectHistory/2012_Shell_CK/2012x_.HTM.

CHAOZ (Chukchi Sea Acoustic Oceanographic Zooplankton) http://alaska.boemre.gov/ess/ongoingStudies/Ongoing_studies.pdf. Entry available online or at ARLIS.

COMIDA. 2011. (Chukchi Offshore Monitoring in Drilling Area) http://alaska.boemre.gov/ess/ongoingStudies/Ongoing_studies.pdf.

Fabry, V.J.; McClintock, J.B.; Mathis, J.T.; Grebmeier, J.M., 2009, Ocean acidification at high latitudes: the bellwether. Oceanography, 22(4) 160-171.

Intergovernmental Panel on Climate Change (IPCC) 2007. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp. http://www.ipcc.ch/.

NMML (National Marine Mammal Laboratory). 2011a. Cetacean Assessment & Ecology Program BOWFEST Survey Project: Preliminary Data. http://www.afsc.noaa.gov/NMML/cetacean/bwasp/flights_BOWFEST.php. Entry available online or at ARLIS.

NMML (National Marine Mammal Laboratory). 2011b. Cetacean Assessment & Ecology Program. COMIDA Survey Project: Preliminary Data. http://www.afsc.noaa.gov/NMML/cetacean/bwasp/flights_COMIDA.php.

Pacific Arctic Group (PAG). 2011. http://pag.arcticportal.org/

PAG, 2011. http://pag.arcticportal.org/

USDOC, NOAA. 2011. State of the Climate Global Analysis. http://www.ncdc.noaa.gov/sotc/global/. Entry available online or at ARLIS.

Appendix D

Air Quality

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D-1. Introduction

Outside air becomes polluted and air quality conditions deteriorate when small particles, liquids, and potentially harmful gases are released into the atmosphere by a variety of sources. The emission sources may be natural or man-made, and may be stationary or mobile. Natural (biogenic) sources of air pollutants include, but are not limited to, volcanoes and forest fires that produce dust and smoke; sea salt aerosols; and vegetation, which is a source of pollen and organic compounds during evaporation (EPA, 2010a). Man-made (anthropogenic) sources are related to human activities such as transportation (motor vehicles, aircraft, and marine vessels); industrial and residential heating; construction; and specifically any activity associated with the combustion of fossil fuels (EPA, 2010a). Stationary anthropogenic sources are fixed-site producers of emissions, which are primarily power-generating-plants requiring fuel combustion, and industrial processes, such as refineries, chemical manufacturing facilities, and smelting (EPA, 2010c). A drillship temporarily anchored to the seabed floor on the Outer Continental Shelf (OCS) is also considered a stationary source (40 CFR Part 55.2). Mobile anthropogenic sources are powered by onboard engines. Mobile sources account for more than half of all the air pollution in the United States, where the primary source is the automobile (EPA, 2010b). Other mobile sources include marine vessels, aircraft, equipment used for construction, agriculture, and recreation vehicles. Regardless of the type of emissions source, or whether sources are permanent or temporary, emissions can build up in the atmosphere in concentrations larger than what can be tolerated without humans suffering some sort of harm.

The information provided in this appendix supplements the discussion of air quality conditions and impacts contained in the 2012 Shell Revised Chukchi Sea EP. In addition to the information provided in this EA, the Shell Revised Chukchi Sea EP provides an examination of air quality conditions and impacts in the environmental impact analysis. Further, supplemental information regarding the inventory of emissions, computer modeling, and results of the ambient air analysis is included in the air operating permits submitted by Shell to Environmental Protection Agency (EPA) Region 10 in Seattle. The review of air quality impacts in this EA examined and relied on the information in the Shell and EPA documents.

D-2. Regulatory Overview

The outside air, referred to in the regulations as ambient air, becomes polluted when harmful gases and particles build up in concentrations sufficient to directly or in indirectly cause measurable damage to human health, wildlife, or property (Monks, Granier, & Stohl et al., 2009). Thus, emissions of pollutants and the buildup of pollutant concentrations are regulated under local, state, and federal regulations.

The assessment of air quality was prepared pursuant to the National Environmental Policy Act (NEPA, 1969) and is regulated primarily by the requirements of the Clean Air Act (CAA, 1990). The ambient air in Alaska is further regulated through the state's Air Quality Management Program contained in the State Implementation Plan when federal actions are proposed within 25 miles of the three-geographical mile seaward boundary (ADEC, 2010c). When a proposed federal action is expected to cause emissions of any of the pollutants regulated under the CAA, the environmental review must contain an assessment of air quality. The assessment should include a description of existing conditions of sufficient scope and depth to discern the baseline characteristics of air quality over the project area. The assessment should also include an analytical evaluation of the projected emissions under each alternative considered in the environmental assessment. The project in the Chukchi Sea proposes the operation of a drillship and various support vessels, which are powered by fossil fuel. Operation of the ships' engines will create emissions of regulated pollutants, thus this environmental review to include consideration of emissions from the Proposed Action.

The condition of air quality is measured and reported in the assessmentrelative to established criteria, or standards, that define the acceptable concentration of specific pollutants in the ambient air. Under the CAA, the Environmental Protection Agency (EPA) is responsible for establishing and maintaining the National Ambient Air Quality Standards (NAAQS) (National Primary and Secondary Ambient Air Quality Standards, 2010), which limit concentrations of the following potentially harmful air pollutants, known as the criteria pollutants:

- Carbon monoxide (CO)
- Lead (Pb)
- Nitrogen dioxide (NO_2)
- Ozone
- Particulate matter ($PM_{2.5}$ and PM_{10})
- Sulfur dioxide (SO_2)

For each of these pollutants, the EPA establishes primary standards intended to protect public health, and secondary standards for the protection of other aspects of public welfare, such as preventing materials damage, preventing crop and vegetation damage, and assuring good visibility. Each state establishes standards similar to the NAAQS and publishes the standards in the State Implementation Plan (SIP). State standards may be more stringent than the NAAQS and could include additional pollutants. The Alaska Department of Environmental Conservation (ADEC) established ambient air quality standards for Alaska, which are published in the Alaska SIP (ADEC State Implementation Plan, 2010). A summary of the Alaska AAQS and the NAAQS is provided in 2. The table defines the standards in terms of pollutant concentrations, stated either in parts per million (ppm), micrograms per cubic meter ($\mu g/m^3$), or in milligrams per cubic meter (mg/m^3).

Table D-2. Alaska and National Ambient Air Quality Standards.

Pollutant	Averaging Period	Alaska AAQS	National NAAQS (Primary and/or Secondary Standards)	
Carbon Monoxide (CO)	8-hour	10 mg/m^3	10 mg/m^3	Primary Only
	1-hour	40 mg/m^3	40 mg/m^3	Primary Only
Lead	Rolling 3-month	0.15 $\mu g/m^3$	0.15 $\mu g/m^3$ (2008 Standard)	Both
	Calendar Quarter	Not Applicable	1.5 $\mu g/m^3$ (1978 Standard)	Both
Nitrogen Dioxide (NO_2)	Annual	100 $\mu g/m^3$	100 $\mu g/m^3$	Both
	1-hour	Not Established	188 $\mu g/m^3$ (2010 Standard)	Primary Only
Ozone	8-hour (2008 Standard)	0.075 ppm	0.075 ppm	Both
	8-hour (1997 Standard)	Not Established	0.08 ppm	Both
	1-hour	Not Established	0.12 ppm	Both
Particulate Matter ($PM_{2.5}$)	Annual	15.0 $\mu g/m^3$	15.0 $\mu g/m^3$	Both
	24-hour	35 $\mu g/m^3$	35 $\mu g/m^3$ (2006 Standard)	Both
Particulate Matter (PM_{10})	24-hour	150 $\mu g/m^3$	150 $\mu g/m^3$	Both
Sulfur Dioxide (SO_2)	Annual	80 $\mu g/m^3$	80 $\mu g/m^3$	Primary Only
	24-hr	365 $\mu g/m^3$	365 $\mu g/m^3$	Primary Only
	30-minute	50 $\mu g/m^3$	Not Established	
	3-hour	1300 $\mu g/m^3$	1300 $\mu g/m^3$	Secondary Only
	1-hour	Not Established	0.075 ppm (2010 Standard)	Primary Only
Ammonia (NH_3)	8-hour	2.1 mg/m^3	Not Established	

Sources: Alaska Department of Environmental Conservation (ADEC). Ambient Air Quality Standards. 18 ACC §50.010, 2011.

EPA. National Primary and Secondary Ambient Air Quality Standards. 40 CFR Part 50.4 – 50.13.

Each air quality standard is subject to limitations, such as restrictions on how many times during a calendar year a standard may be violated and still comply with the standard. These limitations are provided in the federal regulations at 40 CFR Part 50.4-50.13, *National Ambient Air Quality Standards*; for the State of Alaska, the limitations are stated in the Alaska Administrative Code (AAC), Title 18, Chapter 50, *Air Quality Control*. Several of the NAAQS have been recently established or revised. The relevant EPA code revisions are listed in the following sections that include explanations of the revisions and implications to the Proposed Action.

2.1 Lead

The EPA updated the lead standard in 2008 to add a rolling three-month average of 0.15μg/m^3 (73 *FR* 66964, 11/12/2008). The existing 1978 standard, 1.5 μg/m^3 as a quarterly average, remains in effect for some areas previously designated nonattainment for the older standard, and until the appropriate SIPS to attain or maintain the 2008 standard are approved. The 1978 quarterly average is not listed in the Alaska SIP as a standard; however, ADEC submitted a request in April 2010 to amend Alaska's State Air Quality Control Plan, as part of the SIP, to adopt the NAAQS for lead (ozone, and $PM_{2.5}$ are also included); approval of the Alaska amendment by EPA is pending (ADEC, 2010c).

Lead is not a pollutant considered in the air quality impacts analysis for this EA because lead is not a pollutant resulting from burning diesel fuel or unleaded fuel. The criteria pollutants of concern for the Proposed Action are $NO_{2/x}$, $SO_{2/x}$, PM_{10}, $PM_{2.5}$, and VOC.

Lead is not a pollutant considered in the air quality impacts analysis for this EA because lead is not a relevant pollutant resulting from burning diesel fuel or unleaded fuel. The criteria pollutants of concern for the Proposed Action are $NO_{2/x}$, $SO_{2/x}$ PM_{10}, $PM_{2.5}$, and VOC.

2.2 Nitrogen Dioxide (NO_2)

The EPA final rule for the new one-hour standard was published in February 2010 (75 *FR* 6474, 2/9/2010). The annual average concentration standard for nitrogen dioxide is sometimes stated as 0.053 ppm (40 CFR Part 50.22(c)). For the purpose of the emission inventory in this analysis, emissions of nitrogen oxides (NO_X) are conservatively considered to be entirely composed of NO_2. Shell demonstrated in the ambient air analysis included the operating permits that emissions from the Proposed Action would comply with this new standard (Shell, 2011b).

2.3 Ozone

The EPA has made several adjustments in recent years to the standard for ozone. The EPA proposed a revision to the 2008 eight-hour standard and has delayed the final rule until July 29, 2011. The final rule is proposed to be an annual standard within the range of 0.060 to 0.070 ppm (73 *FR* 16436, 3/28/2008; 75 *FR* 2938, 1/19/2010; Kelly, 2010). The ADEC submitted a request in April 2010 to amend Alaska's State Air Quality Control Plan, as part of the SIP, to adopt the NAAQS for ozone (lead and $PM_{2.5}$ are also included). Approval by EPA is pending. Ozone is not specifically addressed in the air quality assessment because ozone is not a pollutant emitted directly from any source. Rather, ozone is formed in the atmosphere in the presence of precursor pollutants, nitrogen oxides (NO_X) and volatile organic compounds (VOC) and sunlight. Thus the levels of NO_X and VOC are an indication of potential ozone development. The air quality analysis for the Proposed Action includes the projected emissions of NO_X and VOC (Shell, 2011a; Shell, 2011d).

2.4 Particulate Matter (PM_{10} and $PM_{2.5}$)

The newest standard for $PM_{2.5}$ is the 24-hour average concentration set at 35 $\mu g/m^3$ (71 *FR* 61144, 10/17/2006). The ADEC submitted a request in April 2010 to amend Alaska's State Air Quality Control Plan, as part of the SIP, to adopt the NAAQS for $PM_{2.5}$ (lead and ozone are also included). Approval by EPA is pending. Shell demonstrated in the ambient air analysis included the operating permits that emissions from the Proposed Action would comply with this new standard (Shell, 2011a; Shell, 2011d).

2.5 Sulfur Dioxide (SO_2)

The EPA updated the SO_2 standards to include a primary one-hour average of 0.75 ppm; at the same time EPA revoked both the primary annual and 24-hour standards, effective August 23, 2010 (75 *FR* 35520, 6/22/2010). However, the two revoked standards will stay in effect for an interim time until the required SIPs are approved, and also for one year after the new designations are made. This will serve the anti-backsliding goals of the CAA. The three-hour standard for SO_2 is sometimes stated as 0.5 ppm (40 CFR Part 50.59a). For the purpose of the emission inventory in this analysis, emissions of sulfur oxides (SO_X) are conservatively considered to be entirely composed of SO_2. Shell demonstrated in the ambient air analysis included the operating permits that emissions from the Proposed Action would comply with this new standard (Shell, 2011a; Shell, 2011d).

2.6 Regulatory Jurisdiction

Emission sources on land areas of the United States are controlled by each state, and the Alaska Department of Environmental Conservation (ADEC) has jurisdiction over proposed federal projects that have the potential to affect the North Slope of Alaska. The North Slope is considered a Class II area for purposes of air quality management, meaning the area has clean outside air with scenic vistas and esthetic value (42 USC 7472(b); Godish, 2004). While not protected to the same degree as a wilderness area or national park, a Class II area requires protection from new emission sources that would be large enough to degrade the air quality. As such, a proposed federal action with the potential to affect a Class II area may require an air quality operating permit or pre-construction permit (18 AAC 50).

The territorial waters extending seaward from the Alaskan coastlines are also subject to protection under the CAA. However, these areas are not regulated that way land areas are and pose unique challenges for CAA compliance. Federal projects proposed within three geographical miles (gm) of shore (the seaward boundary) are subject to State rules and jurisdiction; beyond the seaward boundary, EPA has jurisdiction. In the case of Alaska, the jurisdiction lies with EPA Region 10 in Seattle, Washington. When the proposed project is within 25-gm of the seaward boundary, the EPA has the discretion to incorporate State rules that are applicable for implementing the CAA; beyond the 25-gm boundary, however, federal rules apply (Submerged Land Act, 43 USC 1301, 1312). Federal rules for regulating emissions on the OCS are specifically provided for in the CAA under Section 328 *Air Pollution from Outer Continental Shelf Activities* (42 USC 7627) and are established as the OCS Air Regulations (40 CFR Part 55). Additional EPA regulation of emission sources on the OCS is authorized under the New Source Review program, which includes the Prevention of Significant Deterioration rule and the Title V operating rule.

2.7 Definitions

The following definitions are developed from 40 CFR Part 55.2, and are modified as they would apply directly to the Alaskan OCS in Chukchi seas. The definitions are helpful in describing the methods and procedures of the air quality assessment.

Attainment area – a geographical area where EPA defines the air quality as a clean resource, and pollutant concentrations are as good as or better than the NAAQS or the Alaska AAQS. An area may be an attainment area for one pollutant and a nonattainment area for others.

BACT – Best Available Control Technology; any Prevention of Significant Deterioration (PSD) permit would be required to use BACT to reduce emissions.

Corresponding Onshore Area (COA) – the onshore area that is geographically closest to the OCS source, and applies when the proposed location of the source would be located within 25 miles of Alaska's three-gm seaward boundary.

Design concentration – the translation of the emission inventory to pollutant concentrations, with the background concentrations added to the project-related concentration values to disclose total maximum concentrations.

Exploratory OCS source – a temporary source on the Alaskan OCS conducted for the sole purpose of gathering information. This includes an EP intended to determine the characteristics of the reservoir and may involve the extraction of oil and gas.

Federal waters – those waters located outside the three-geographical mile Submerged Lands Act boundary.

Major stationary source is defined distinctly depending on the location of the source and the attainment status of the associated COA.

1. PSD rules apply on the state and federal level, only in an attainment area for sources with the potential to emit (PTE) 250 tons per year or more, and only for emissions of NO_2, PM_{10}, and SO_2 (40 CFR Part 52.21(c)). A source that is major for VOC or NO_X shall be considered major for ozone.
2. Title V rules for the OCS apply regardless of the attainment status, and apply on the state and federal level. Fugitive emissions are not subject to Title V for OCS sources. A major source under Title V has the PTE 100 tons per year of any regulated pollutant. Regulated pollutants include all the criteria pollutants regulated under the NAAQS; and the Alaska AAQS adds reduced sulfur compounds and ammonia. Precursor emissions of VOC are also included because VOC is regulated under the general conformity rule (40 CFR Part 93), and VOC are related to the definition for a major source of ozone in 40 CFR Part 52.21.

Nearest Onshore Area (NOA) – Geographically, the onshore land area closest to a proposed project

New OCS source – an Alaskan OCS source not already existing and does not include an action proposing modifications for an existing source. The following regulations apply to new OCS stationary sources:

1. Prevention of Significant Deterioration (PSD) rules apply under 40 CFR 52.21, when the source is located beyond 25 miles of Alaska's three-gm seaward boundary, and applies inside the boundary when PSD rules already apply on the COA. The PSD rules apply when the COA is designated as attainment; otherwise NSR rules would apply to nonattainment and maintenance areas. The North Slope Borough of Alaska is designated as attainment and is subject to the PSD rules when the source has the PTE 250 tons per year or more. Alaska adopts the rules in 40 CFR Part 52, Subpart C, Air Programs, according to Class designation; and the North Slope Borough is a Class II area. Any PSD permits must be approved and issued before construction may begin on the project; thus PSD permits are also referred to as pre-construction air permits.

2. Title V of the CAA for the OCS: The federal Title V rule applies to the OCS under 40 CFR 71 (outside the OCS Part 70 applies for Title V permits), whether or not the source is located beyond 25 miles of Alaska's three-gm seaward boundary, and applies inside the boundary where the Title V rule already applies on the COA. Title V air permits are issued by states under 40 CFR Part 70 and EPA regional offices issue Title V permits under 40 CFR Part 71 in Indian country and in other situations, such as for the OCS.

Nonattainment area – a geographic area identified by the EPA as not meeting either the NAAQS or the Alaska AAQS for one or more of the regulated pollutants.

OCS source – any equipment, activity, or facility which:

1. Emits or has the PTE any air pollutant, and;
2. Is regulated or authorized under the Outer Continental Shelf Lands Act ("OCSLA") (43 U.S.C. §1331 et seq.); and
3. Is located on the OCS or in or on waters above the OCS. This definition shall include marine vessels only when they are:
    a. Permanently or temporarily attached to the seabed, erected on the seabed, and used for the purpose of exploring, developing or producing resources from the seabed (Section 4(a)(1) of OCSLA (43 U.S.C. §1331 et seq.)); or
    b. Physically attached to an OCS facility, in which case only the stationary sources aspects of the vessels will be regulated.

Potential emissions – the maximum emissions of a pollutant from an OCS source operating at its design capacity. Any physical or operational limitation on the capacity of a source to emit a pollutant, including air pollution control equipment (such as BACT) and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as a limit on the design capacity of the source if the limitation is federally enforceable. Emissions from vessels servicing or associated with an OCS source shall be considered direct emissions from such a source while at the source, and while en-route to or from the source when within 25 miles of the source, and is referred to as the PTE for an OCS source.

Maximum Allowable Increases (MAIs) – ambient air increments caused by a stationary source, in areas designated as Class I, II, or III; increase in pollutant concentration over the baseline concentration; the MAIs are the maximum allowable increase, measured in micrograms per cubic meter.

2.8 Air Operating Permits

Air operating permits issued by EPA and ADEC will ensure that emission levels caused by the Shell Revised Chukchi Sea EP will remain low enough to prevent harm to human health and the environment under all operating scenarios. Shell's permit applications include an emission inventory and ambient air analysis (dispersion modeling) that include the worst-case highest hourly, enforceable emission rates from the *Discoverer* and its support vessels. The CAA regulations require certain facilities that emit criteria pollutants or hazardous substances to obtain a permit establishing limits on the types and amounts of emissions, governing operating parameters for pollution control and monitoring devices, and monitoring and record-keeping requirements. Refer to the definitions in this appendix for a major stationary source, new OCS sources, and potential emissions. In this case, EPA Region 10 will issue the air permits for the *Discoverer*.

Air Quality Permit under the Clean Air Act (CAA), issued by the U.S. Environmental Protection Agency (EPA) Region 10. The EPA regional offices have jurisdiction to approve and issue air quality operating permits under the New Source Review (NSR) program. As such, for proposed federal actions on the Alaska OCS, EPA Region 10 in Seattle, Washington, requires and has jurisdiction to

approve and issue air permits under the NSR program. Under the NSR program, Shell has applied for a Prevention of Significant Deterioration (PSD) air quality operating permit, which is a pre-construction permit to operate the drillship *Discoverer* (40 CFR part 52.21). The permit is intended to limit and regulate air emissions in a Class II area of otherwise clean air on the North Slope of Alaska, adjacent to the Chukchi Sea. The first PSD permit application associated with the Chukchi Sea EP was submitted by Shell on December 19, 2008, and the EPA issued PSD Permit AK-09-01 on March 31, 2010. The permit was overturned on December 30, 2010, by the Environmental Appeals Board (EAB) and the permit was remanded back to EPA for further consideration (EAB, 2010). Shell provided EPA with additional analyses in response to the remand order and EPA published notice of the issuance of the revised draft PSD permit on July 1, 2011 (EPA, 2011). The EPA issued the revised PSD Permit R10OCS/PSD-AK-09-01 on September 19, 2011 (EPA, September 19, 2011) On October 24, 2011, the permit was challenged by Petitioners requesting review by the EAB, after which the EAB directed the EPA to respond by November 16, 2011, to address the Petitioners' arguments and determine whether the Petitioners have satisfied the requirements to grant an EAB review (EPA, October 26, 2011). The EPA responded to the Petitioner's arguments on November 16, 2011, and requested the EAB deny the petitions for review (EPA, November 16, 2011). While the status of the permit may not be fully resolved at the time of the preparation of this environmental review, approval of the Shell Revised Chukchi Sea EP by BOEM is conditional upon issuance of the final PSD permit.

D-3. NEPA Air Quality Analysis

In the course of preparing the air operating permits, Shell conducted an analysis of emissions for the *Discoverer*, which includes all the marine support vessels associated with the drillship. The analysis included computer modeling, which was conducted according to the protocols submitted to EPA by Shell for the *Discoverer* (Shell, 2011b). The analysis and air quality modeling conducted by Shell was required for the application of a PSD permit for the *Discoverer*. The air quality assessment required for this NEPA environmental review by the BOEM is distinct from the requirements for an air permit application and relies, in part, on the emission inventory and the ambient air analysis (dispersion analysis) conducted by Shell for the permit applications. However, the finding by BOEM for air quality impacts in this EA is a finding based on the BOEM independent review of air quality impacts and not a finding on the permits. The emission inventory includes the following pollutants for compliance with the NEPA guidelines and Alaska regulations:

- Nitrogen oxides (NO_X)
- Fine particulate matter ($PM_{2.5}$)
- Coarse particulate matter (PM_{10})
- Carbon monoxide (CO)
- Sulfur oxides (SO_X)
- Volatile organic compounds (VOC)
- Lead (Pb)
- Ammonia (NH_3)
- Carbon dioxide equivalent emissions (CO_2e)

The emission inventory for the drillship *Discoverer* is provided in EA Section 4.1.2, Table 20. The emission inventory was translated into an ambient air analysis through computer dispersion modeling using the EPA AERMOD model. The dispersion analysis was conducted for the NAAQS, and includes:

- Nitrogen dioxide (NO_2)
- Fine particulate matter ($PM_{2.5}$)
- Coarse particulate matter (PM_{10})
- Carbon monoxide (CO)
- Sulfur dioxide (SO_2)

The results of the dispersion analysis are provided in the application documents for the air operating permits for the *Discoverer*, and are provided in this EA in Section 4.1.2, Table 21. BOEM thoroughly reviewed and evaluated the methods and results of the analyses prepared by Shell to ensure the accuracy and credibility of the results. The results of the air impact analysis show concentrations of pollutants associated solely with the Proposed Action would comply with the BOEM level of effect for air quality.

D-4. Air Quality Levels of Effect

The levels of effect applied to the air quality analysis are based on the results of two levels of analyses, the emission inventory, and if required, the more rigorous ambient air analysis based on computer dispersion modeling. Further, the levels of effect consider whether the Proposed Action is:

- Temporary or permanent
- Located within or beyond 25 miles from the Alaska seaward boundary (25-mile threshold)
- Associated with a COA that is designated as a Class I, Class II, or Class III area
- Adjacent to a COA that is designated attainment or nonattainment
- Location of the NOA

The levels of effect are first defined by applying threshold values to the emission inventory. The emission inventory is the first step in assessing the potential for adverse impacts to air quality due to a proposed federal action. While the inventory is not intended to define the severity of the impact, the character of the emission inventory can provide insight to the potential for future impacts. An inventory that demonstrates emissions that equal or exceed established thresholds can initiate further more rigorous analyses that will provide the 'hard look' required under NEPA (Robertson v. Methow Valley Citizens Council, 1989). Inherent in the hard look provision is the necessity to consider and investigate the relevant issues using the most appropriate expertise and methodology available. Thus, Accordingly, BOEM applied thresholds provided in the long-established EPA guidelines for air operating permits, the PSD permit and the Title V permit rules. The OCS Air Regulations require air operating permits under 40 CFR Part 55.6, Permit Requirements, and include Clean Air Act (CAA) Title V permits and PSD permits.

4.1 CAA Title V Threshold

The requirement for a Title V permit for an OCS source is found at 40 CFR Part 55.6(c)(3), which invokes the rules under 40 Part 71. The Part 71 Title V permit program is intended to document a state's major sources of stationary emissions regardless of the attainment status of the geographical area. A Part 71 permit is required for projects with stationary sources proposed on the OCS regardless of whether the project is located within or beyond the 25-mile threshold. The Part 71 permit is an enforceable permit issued by the EPA after the source has begun to operate. Under Part 71, a permit is required when a stationary source has the PTE 100 tons or more of any regulated pollutant, including VOCs (42 USC 7602(j); 42 USC 7661a(b)(3)(B)(ii)(I, II, & III)). For the purpose of the BOEMRE air quality levels of effect, a proposed action that has the PTE less than 100 tons per year of any regulated pollutant would be considered a negligible source. In summary, a Title V Part 71 air operating permit on the Alaska OCS applies under the following conditions:

- Attainment or nonattainment area
- Obtain after construction
- Within or beyond the 25-mile boundary on the OCS adjacent to the coastline
- Federal EPA authority (EPA has authority on the OCS, whereas the Part 70 Title V is authorized by the state agency; Part 70 is nearly identical to Part 71)
- Major stationary source has emissions equal to or greater than 100 tons per year
- Applies to all regulated criteria and precursor pollutants

4.2 PSD Threshold

The EPA requires operating permits for new and modified stationary sources, referred to as pre-construction permits. A pre-construction permit is enforceable and must be obtained before construction on the federal action commences. This permit program is promulgated under the New Source Review rules (NSR), where NSR applies to areas of nonattainment and PSD rules apply to the attainment areas. The PSD permit program is intended to limit the amount of pollution emitted from a major stationary source to the best extent possible and reasonable in an area with otherwise clean air. On the OCS, a PSD permit may be required when the location of the proposed action is either within or beyond the 25-mile threshold (40 CFR Part 55.13(d)).

A project sponsor will apply for a PSD permit when a stationary source on the OCS has the PTE 250 tons or more of any regulated pollutant, including VOCs, even after BACT and ORR are applied (40 CFR 52.21(b)(1)(i)(b)). An action proposed on the OCS that creates a new stationary source with the PTE 250 tons per year or more of any criteria or precursor pollutant, controlled or uncontrolled, is defined as a major source. Under the rules for a PSD major source, an ambient air analysis is necessary to compare results to MAIs defined in the PSD rule.

The EPA establishes MAIs for pollutant concentrations under the PSD rule. The MAIs apply in much the same way as the emission thresholds apply to the emission inventory, except MAIs are expressed in pollutant concentrations, such as parts per million (ppm) or micrograms per cubic meters ($\mu g/m^3$), and are the result of computer dispersion modeling. Referred to as ambient air incremental increases, the MAIs are applied according to the classification of the Proposed Action's COA, such as Class I, Class II, or Class III. Alaska's North Slope Borough is a Class II area (i.e. not a wildlife refuge) (40 CFR Part 52.21(c) Class II). The MAIs applicable to the Alaskan OCS adjacent to the Chukchi Sea are provided in this EA in Section 4.1.2, Table 21. In summary, PSD air pre-construction permit for stationary sources on the Alaska OCS applies under the following conditions:

- Attainment or unclassified area
- Obtain before construction begins (pre-construction)
- Within or beyond the 25-mile threshold on the OCS adjacent to the coast line
- Federal EPA authority, and when applicable, Alaska DEC has jurisdiction for the COA
- Major stationary source has emissions equal to or greater than 250 tons per year
- Requires BACT and/or other owner-requested restrictions
- Applies to all New Source Review (NSR) regulated pollutants, which are NO_2, $PM_{2.5}$, PM10, and SO_2
- Public comment procedures are required

4.3 Defining the Four Levels of Effect

To ensure protection of outside air and to control the impact to human health, the BOEM set criteria to define the levels of effect from a proposed project. Air Quality levels of effect assigned by BOEM to federal projects proposed for the OCS are limited to four categories, negligible, minor, moderate, and major. The purpose of the air quality levels of effect is to determine whether or not the proposed project would have the potential to create a significant impact to air quality and human health by violating the BOEM criteria defining a moderate or major effect. To categorize a moderate or major effect, the BOEM relied on references to the maximum allowable increase thresholds permitted under the PSD rules, and the maximum allowable pollutant concentrations established under the NAAQS and the Alaska AAQS.

To categorize the smallest projects, the BOEM relied on emission rates described in the well-established federal and Alaska permitting programs. Under both the Title V and PSD permit criteria, emission rates less than 100 tons per year are not considered major. A sensitivity analysis of NO_x emissions was conducted to discern the effect of limiting project emissions to just 100 tons for a proposed season of exploratory drilling operations on the Alaska OCS, which is approximately 120 days per year. The sensitivity analysis showed that if typical vessels proposed for exploratory drilling were to operate until the emissions of NO_X reached 100 tons, the operation could continue for only 35 days, when the time needed to complete only one well to total depth requires 34 to 44 days. The BOEM believes projects with emission rates less than 100 tons per year defines a small project with respect to air quality, and the effects could be reasonably defined as negligible. Although no ambient air analysis would likely be conducted for such a small project, the emissions would be presumed to conform to the BOEM pollutant concentration limitations for maximum allowable increases, the NAAQS, and the Alaska AAQS. Consequently, when considering proposed projects with projected emission rates greater than 100 tons per year, the expected level of effect would increase with the size of the project to minor, moderate, or major effects.

Based on this methodology, the following levels of effect are defined for air quality impacts and are summarized in Appendix B, Level of Effect Definitions.

4.3.1 Negligible Level of Effect

A negligible level of effect reflects a small proposed project with low emission rates. No further analysis would be required. The proposed project would meet the BOEM criteria for protecting Alaska's outside air and ensure little or no impact to human health. The following statements describe a proposed project that would have a negligible level of effect:

- New sources of air emissions are unavoidable over an area of at least 20 square kilometers on the nearest onshore area; and
- Project-related sources would have maximum uncontrolled PTE emissions that are less than 100 tons per year for VOCs and all pollutants regulated under the NAAQS, and, if applicable, the Alaska AAQS; and
- Project-related emissions would not have the potential to cause pollutant concentrations of any pollutant to exceed one-half of the PSD maximum allowable increases; and
- Project-related emissions would not have the potential to cause pollutant concentrations of any pollutant to exceed one-half of the NAAQS (excluding ozone), and, if applicable, the Alaska AAQS (excluding ozone); and
- Increases in emissions of NO_x and VOC would not have the potential to result in the formation of ozone to a level that would be expected to exceed one-half the ozone NAAQS; and

- Design concentrations are presumed to not have the potential to cause or contribute to a violation of any NAAQS (excluding ozone), and, if applicable, the Alaska AAQS (excluding ozone).

4.3.2 Minor Level of Effect

A minor level of effect reflects a proposed action with emission rates that could define a major source of emissions under the PSD rule. If the emissions constitute a major source, an ambient air analysis would be available for comparison to the relevant BOEM thresholds. The following statements describe a proposed project that would have a minor level of effect:

- New sources of air emissions are unavoidable over an area of at least 20 square kilometers on the nearest onshore area; and
- Project-related sources would have maximum uncontrolled PTE emissions that are equal to or greater than 100 tons per year for VOCs and all pollutants regulated under the NAAQS, and, if applicable, the Alaska AAQS; and
- Project-related emissions would not cause pollutant concentrations of any pollutant to exceed one-half of the PSD maximum allowable increases; and
- Project-related emissions would not cause pollutant concentrations of any pollutant to exceed one-half of the NAAQS (excluding ozone), and, if applicable, the Alaska AAQS (excluding ozone); and
- Increases in emissions of NO_x and VOC would not result in the formation of ozone to a level that would be expected to exceed one-half the ozone NAAQS; and
- Design concentrations would not cause or contribute to a violation of any NAAQS (excluding ozone), and, if applicable, the Alaska AAQS (excluding ozone).

4.3.3 Moderate Level of Effect

A moderate level of effect reflects a proposed action with emissions that could define a major source of emissions under the PSD rule. If the emissions constitute a major source, an ambient air analysis would be available for comparison to the relevant BOEM thresholds. The following statements describe a proposed project that would have a moderate level of effect:

- New sources of air emissions are unavoidable over an area of at least 20 square kilometers on the nearest onshore area; and
- Project-related sources would have maximum uncontrolled PTE emissions that are equal to or greater than 100 tons per year for VOCs and all pollutants regulated under the NAAQS, and, if applicable, the Alaska AAQS; and
- Project-related emissions would cause pollutant concentrations of at least one pollutant to exceed one-half of the PSD maximum allowable increases; or
- Project-related emissions would cause pollutant concentrations of at least one pollutant to exceed one-half of the NAAQS (excluding ozone), and, if applicable, the Alaska AAQS (excluding ozone); or
- Increases in emissions of NOx and VOC would result in the formation of ozone to a level that would be expected to exceed one-half the ozone NAAQS; and
- Design concentrations would not cause or contribute to a violation of any NAAQS, and, if applicable, the Alaska AAQS (excluding ozone).

4.3.4 Major Level of Effect

A major level of effect reflects a proposed action with emissions that could define a major source of emissions under the PSD rule. If the emissions constitute a major source, an ambient air analysis would be available for comparison to the relevant BOEM thresholds. The following statements describe a proposed project that would have a major level of effect:

- New sources of air emissions are unavoidable over an area of at least 20 square kilometers on the nearest onshore area; and
- Project-related sources would have maximum uncontrolled PTE emissions that are equal to or greater than 100 tons per year for VOCs and all pollutants regulated under the NAAQS, and, if applicable, the Alaska AAQS; and
- Project-related emissions would cause pollutant concentrations of at least one pollutant to exceed one-half of the PSD maximum allowable increases; or
- Project-related emissions would cause pollutant concentrations of at least one pollutant to exceed one-half of the NAAQS (excluding ozone), and, if applicable, the Alaska AAQS (excluding ozone); or
- Increases in emissions of NO_x and VOC would result in the formation of ozone to a level that would be expected to equal or exceed the ozone NAAQS; or
- Design concentrations of at least one pollutant would equal or exceed one-half the NAAQS (excluding ozone), and, if applicable, one-half the Alaska AAQS (excluding ozone).

D-5. References

Alaska Department of Environmental Conservation (ADEC). 2010b. Request for SIP Amendment. Larry Hartig, ADEC Commissioner, and Dennis McLerran, EPA Region 10 [Letter].

Alaska Department of Environmental Conservation (ADEC). 2010c. State Air Quality Control Program: State Implementation Plan [public review draft].

Environmental Protection Agency (EPA). 2010a. Sources of Pollutants in the Ambient Air. Available on the EPA Air Pollution Training Institute Website at http://www.epa.gov/eogapti1/course422/ap3.html

Environmental Protection Agency (EPA). 2010b. Sources of Pollutants in the Ambient Air – Mobile Sources. Available on the EPA Air Pollution Training Institute Website at http://www.epa.gov/eogapti1/course422/ap3a.html

Environmental Protection Agency (EPA). 2010c. Sources of Pollutants in the Ambient Air – Stationary Sources. Available on the EPA Air Pollution Training Institute Website at http://www.epa.gov/eogapti1/course422/ap3b.html

Monks, P.S., Granier, C., Fuzzi, S., Stohl, A., Williams, M.L., Akimoto, H., and Amann, M., et al. 2009. Atmospheric composition change – global and regional air quality. Atmospheric Environment 43 (33): 5268-5350. doi: 10.1016/j.atmosenv.2009.08.021

Shell Offshore Inc., 2011a, AERMOD Air Quality Impact Analysis of NO2, SO2, PM2.5, PM10, CO, and NH3 – Discoverer Drillship: Supplement to March 18 and April 29, 2011, AERMOD Impact Reports, Technical Memorandum prepared by Tim Martin, Air Sciences Inc., dated May 19, 2011.

Shell Offshore Inc., 2011b, Discoverer Drillship Impact Evaluation for SO2 and NO2 using AERMOD – Chukchi and Beaufort Seas, Shall Alaska Exploratory Drilling Program, prepared by Air Sciences Inc., dated March 18, 2011.

Shell Offshore Inc., 2011c, Engineering Calculations for the Drillship Discoverer, prepared by Air Sciences Inc., file Discovereer_EI_20110602_D.xls.

Robertson v. Methow Valley Citizens Council, 104 L.Ed.2d 351, 109 S.Ct. 1835 (1989).

Appendix E

Climate Change

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Appendix E. Climate Change

E-1. Introduction

Climate change in the Arctic is projected to be more pronounced than in other areas of the globe (ACIA, 2005). However, Arctic climate has a larger natural variability and is highly complex and, therefore, climate projections may have greater uncertainty. The changes have not been uniform over the area. Large changes have taken place abruptly, spanning just a few decades. The changes include melting glaciers, melting sea ice and permafrost, shifting precipitation and snowfall patterns, and unusual forest and tundra growth. These changes have results in changes in wildlife habitat and migration, changes in fish populations, changes in agricultural zones, and an increase in forest fires (NOAA, 2011).The driving factors are complex but involve changes in solar radiation, atmospheric circulations, ocean circulations, and the cryosphere. The assessments of climate change and effects in the Arctic given here are based on the 2007 publication by the Intergovernmental Panel on Climate Change (IPCC, 2007) and the Arctic Research Center's Arctic Climate Impact Assessment (2005). These two reports are considered to include the most thorough scientific evaluation of climate change (Karcher, 2010).

E-2. Temperatures

The Arctic climate is undergoing changes as a result of global climate change as well as natural cyclical variations. The Arctic Climate Impact Assessment (ACIA, 2005) summarized spatial and temporal temperature trends in the Arctic based on observations from the Global Historical Climatology Network database (Peterson and Vose, 1997) and the Climate Research Unit database (Jones and Moberg, 2003). The greater amount of warming in the Arctic compared to that for the globe as a whole is consistent with climate model projections (IPCC, 2007). In general, temperatures increased from 1900 to the mid-1940s, decreased until about the mid-1960s, and then increased again up to the present. From 1966-2003, the average rate of temperature change for the Arctic was 0.40 °C (0.7 °F) per decade (ACIA, 2005). When temperature trends are broken down by season, the largest changes occurred in winter and spring.

An analysis by Rigor, Colony, and Martin (2000) for the entire Arctic Ocean for the period 1979-1997, indicates an increase in surface air temperature of about 1.0 °C (1.8 °F) per decade in the eastern Arctic, whereas the western Arctic shows no trend. During fall, the trends show cooling of about 1.0 °C (1.8 °F) per decade over the Beaufort Sea and Alaska. During spring, a warming trend of 2 °C (3.6 °F) per decade can be seen over most of the Arctic. Summer shows no significant trend.

A trend analysis for first-order observing stations in Alaska for the period of 1949-2007 shows an average temperature change of 1.9 °C (3.4 °F). The largest increase was seen in winter and spring, with the smallest change in autumn. The trend has been far from linear. There was a decrease in temperature in the period from 1949-1976 followed by an abrupt increase in temperature in the period from 1973-1979. Since 1979, little additional warming has occurred in Alaska with the exception of Barrow and a few other locations (Rigor, Colony, & Martin, 2000).

E-3. The Arctic Oscillation

The Arctic Oscillation (AO) refers to opposing atmospheric surface pressure patterns in the northern middle and high latitudes (NSIDC, 2011). The AO can be described as the relative difference in the intensity of the semipermanent low-pressure center over the North Pole (north of 20 North latitude). The AO describes the degree to which cold Arctic air is able to penetrate into the middle latitudes. The character of the AO is believed to be related to weather patterns many thousands of miles away.

When surface pressure is low in the Arctic, this is the positive stage. Under these circumstances the middle latitude jet stream moves strongly and consistently from west to east. This keeps cold air from leaving the polar regions. When the AO index is negative, there is high pressure in the Arctic, the zonal winds are weaker, and the cold air moves more freely into the middle latitudes. In the negative phase, the polar jet stream slows and begins to deform allowing low pressure centers to form farther south. When the pressure centers remain stationary for a number of days, the normal circulation of the atmosphere is disrupted. This systematic back and forth fluctuation of the weather systems defines the AO. Since the 1970s, the AO tended to stay in the positive phase. However, there is evidence that the AO is tending to be more negative and this may be contributing to unusually warmer temperatures over the Northern Hemisphere (Applied Information Systems, 2011).

E-4. Ocean Acidification and Sea Ice

Concurrent with climate change is a change in ocean chemistry known as ocean acidification. This phenomenon is described in the IPCC Fourth Assessment Report (Climate Change 2007), a 2005 synthesis report by members of the Royal Society of London (Raven, Caldeira, Elderfield et al., 2005), and an ongoing BOEM-funded study (Mathis, 2011). The greatest degree of ocean acidification worldwide is predicted to occur in the Arctic Ocean. This amplified scenario in the Arctic is due to the effects of increased freshwater input from melting snow and ice, and from increased CO_2 uptake by the sea as a result of ice retreat.

E-5. Precipitation and Storms

Precipitation in the Arctic exhibits an upward trend, consistent with what is observed in mid-latitudes. Mean annual precipitation in the Arctic has increased at the rate of 1.4% per decade in the period from 1900-2003 and at a rate of 2.2% per decade in the period from 1966-2003. A few studies also indicate that an increasingly larger portion of precipitation falls in the form of rain (ACIA, 2005). Storms in the Bering, Chukchi, and Beaufort Seas affect coastal areas of Alaska during much of the year. There has been an increase in fall-season storms in the last several years. With the storms, high wind events are more frequent on the western and northern coast. In addition, there is an increase in the loss of seasonal sea ice. The projected increase in surface temperatures is expected to cause a shift in the Pacific storm track. The Bering Sea may experience a large decrease in atmospheric pressure, which suggests a possible increase in the number of storms. The incidence of longer periods without sea ice would provide heat and moisture to the Arctic Ocean perhaps increasing the frequency or intensity of the storms (NOAA, 2011).

E-6. References

Applied Information Systems. March 2, 2011. Arctic oscillation (AO) and North Atlantic Oscillation (NAO). Accessed November 26, 2011, http://www.appinsys.com/globalwarming/AO_NAO.htm.

Arctic Climate Impact Assessment (ACIA). 2005. Arctic Climate Impact Assessment. Cambridge, UK: Cambridge University Press. Available at http://www.acia.uaf.edu/.

IPCC. 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel of Climate Change., S. Solomon, D Qin M. Manning Z. Chen M. Marquis K. B. Avery M. Tignor and H. L. Miller, eds. New York: Cambridge University Press, 996 pp.

Jones, P.D. and A.Moberg. 2003. Hemispheric and Large-Scale Surface Air Temperature Variations: An Extensive Revision and an Update to 2001. Journal of Climate 16:206-223.

Karcher, M., Harms, I., Standring, W.J.F., Dowdall, M., Strand, P. 2010. On the Potential for Climate Change impacts on Marine Anthropogenic Radioactivity in the Arctic Regions. Marine Pollution Bulletin (60). Pp. 1151-1159.

Mathis, J. 2011. Biogeochemical Assessment of the OCS Arctic Waters: Current Status and Vulnerability to Climate Change. Ongoing study, focus shifted from North Aleutian Basin to Chukchi Sea, latest report in: Coastal Marine Institute, UAF, Annual Report No. 17. Submitted to USDOI, Bureau of Ocean Energy Management, Regulation, and Enforcement. BOEMRE 2011-029. Available at http://alaska.boemre.gov/reports/2011rpts/2011_029.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2011. Why and How do Scientists Study Climate Change in the Arctic? What are the Arctic Climate Indices? NOAA, http://www.arctic.noaa.gov/essay_bond.html. Accessed November 26, 2011.

Peterson, T.C. and R.S. Vose. 1997. An Overview of the Global Historical Climatology Network Temperature Database. Bulletin of the American Meteorological Society 78:2837-2849.

Raven, J., K., K. Caldeira, H. Elderfield, O. Hoegh-Guldberg, P. Liss, U. Riebesell, J. Shepherd, C. Turley, and A. Watson. 2005. Ocean Acidification due to Atmospheric Carbon Dioxide. The Royal Society, London. 68 pages. Available at: http://www.royalsoc.ac.uk

Rigor, I.G., R.L. Colony, and S. Martin. 2000. Variations in Surface Air Temperature Observations in the Arctic, 1979-97. Journal of Climate 13(5): 896-914.

Appendix F

Statutory Framework

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Appendix F. Statutory Framework

F-1. OCSLA and Operating Regulations

The Outer Continental Shelf Lands Act (OCSLA) establishes a four-stage process OCS activities: (1) a five-year leasing program; (2) individual lease sales; (3) exploration; and (4) development and production. BOEM, along with BSEE, is responsible for regulating and monitoring oil and gas operations on the OCS. BOEM regulates operations to

- promote orderly exploration, development, and production of mineral resources; and
- prevent harm or damage to, or waste of, any natural resource, and life or property, or the marine, coastal, or human environment.

Proposed EPs are reviewed under the process established by 30 CFR 550. Exploration activities on the OCS must be conducted pursuant to an approved EP and an approved Application for Permit to Drill (APD). The EP must contain all information required by the regulations, to include a detailed description of the exploration program, a thorough environmental impact assessment, an oil spill response plan, and other documentation. BOEM, along with BSEE, conducts a thorough technical and environmental review of the activities proposed in the EP and their compliance with applicable lease stipulations and applicable law. BOEM conducts NEPA analyses for proposed OCS activities and includes measures, if necessary, in permits, plan approvals, and other authorizations to minimize potential adverse effects to the human, marine, and coastal environment (30 CFR Parts 550 and Part 551). In the event that its EP is approved, the operator may submit an APD. The APD must contain detailed information about the drilling program to allow evaluation of operational safety and pollution-prevention measures. BSEE is responsible for technical review and approval of Applications for Permits to Drill (APDs), for ensuring safe OCS operations, and for monitoring OCS activities to ensure compliance with Federal laws, regulations, lease stipulations, permit or plan conditions, and required mitigation. BSEE is also responsible oversight of pollution prevention and oil spill contingency and response planning for OCS operations. BSEE's regulations are at 30 CFR Part 250 and Part 254. Approval of an APD is based on any conditions that must be met from the EP.

F-2. Endangered Species Act

The Endangered Species Act (ESA) requires the protection and conservation of threatened and endangered species and the habitat in which they live. The ESA is administered by Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS). Section 10 of the ESA prohibits the unauthorized take of listed species. The FWS and NMFS may authorize the incidental take of listed species through an Incidental Take Statement (ITS), a Letter of Authorization (LOA) or an Incidental Harassment Authorization (IHA). Where activities under a proposed EP may incidentally take a listed species, BOEM may grant an approval of the EP with conditions. However, an incidental take authorization from FWS and/or NMFS would be required prior to BSEE approval of the APD, and prior to commencement of any EP activities.

In addition, Section 7 of the ESA requires interagency cooperation and consultation for Federal activities that may affect listed species. During the consultation process, the FWS and NMFS may set terms and conditions and make conservation recommendations for proposed activities (including OCS activities such as exploration drilling) in order to minimize potential adverse impacts to listed species and any designated critical habitat. It is BOEM's responsibility to ensure that measures to protect endangered and threatened species are implemented. BSEE has the responsibility to ensure that the

operations are conducted in compliance with the ESA conditions stated in the approval of the EP or subsequent requirements from FWS and NMFS.

F-3. Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) establishes Federal responsibility to conserve marine mammals. The MMPA is administered by NMFS and FWS. The NMFS has jurisdiction over all Arctic marine mammals except for the polar bear and Pacific walrus, which fall under FWS jurisdiction.

The MMPA prohibits the unauthorized take of marine mammals. The term "take" in this context is defined broadly and includes acts of harassment. The MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or a marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment]. The FWS and NMFS can authorize the incidental take of marine mammals, but only where the taking will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses.

An incidental take authorization (which can take the form of a Letter of Authorization (LOA) or an Incidental Harassment Authorization (IHA)) sets forth the permissible methods of taking and requirements pertaining to the mitigation, monitoring, and reporting of such takings. If an activity may affect the availability of a marine mammal species or stock for taking for subsistence uses, the proposed monitoring plan must be independently peer-reviewed prior to the issuance of the MMA authorization.

F-4. Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) mandates that a State with an approved Coastal Zone Management (CZM) plan reviews certain OCS activities to ensure that they are conducted in a manner consistent with the State's approved plan. State participation is on a voluntary basis. The State of Alaska's CZM plan ended on June 30, 2011, after the state legislature did not reauthorize statutory support for the program. No CZMA consistency review is required for the proposed action.

F-5. Clean Air Act

The Clean Air Act (CAA) (Clean Air Act, as amended, 42 USC §7401 et seq.) was enacted in 1963 to control outside air emissions resulting from stationary sources, such as power plants, and mobile transportation sources (EPA, 2011). Major amendments in 1970, 1977, and 1990 expanded the act, which is now a comprehensive mandate that protects human health, the environment, and the economy. The CAA regulates air pollution on both federal and state levels, and guides local air agencies. On these three levels, regulators work in partnership to prepare emission inventories, develop emission control measures, and set up air monitoring networks (Martineau & Novello, 2004).

Emission sources on land areas of the United States are controlled by each State, and the Alaska Department of Environmental Conservation (ADEC) has jurisdiction over proposed federal projects that have the potential to affect the North Slope of Alaska. The North Slope is considered a Class II area for purposes of air quality management, meaning the area has clean outside air with scenic vistas and esthetic value (42 USC §7472(b)). While not protected to the same degree as a wilderness area or national park, a Class II area requires protection from new emission sources that would be large enough to degrade the air quality. As such, a proposed federal action with the potential to affect a Class II area may require an air quality operating permit or pre-construction permit (18 AAC 50).

Proposed operation of the drillship *Discoverer* on the Chukchi Sea is included in the Shell application for a PSD permit, which provides an analysis comparing project emissions to the NAAQS, and includes an accounting of CO_{2e} emissions. The status of the permit, PSD AK-09-01, at the time of the preparation of this environmental review is provided in Appendix D-Section 2.8. Any approval of the 2012 Shell EP by the BOEM will be conditional until the required final PSD permit is issued.

F-6. Clean Water Act

The Clean Water Act (CWA) governs the control of water pollution. A major component of the CWA is the National Pollution Discharge Elimination System (NPDES) program, which prohibits the unpermitted discharge of pollutants from point sources.

The EPA has authority to permit discharges on the OCS. Until recently, the EPA maintained a general permit for wastewater discharges from oil and gas exploration in the Arctic. This permit expired on June 26, 2011. EPA states that it will reissue the exploration general permits for the Beaufort and Chukchi Sea prior to the 2012 drilling season. A decision to approve of Shell's EP would constitute a conditional approval. Under the conditional approval, BOEM/BSEE will not approve an APD or authorize activities until Shell receives all necessary permits and authorizations – including coverage under a NPDES permit.

F-7. Oil Pollution Act of 1990

The Oil Pollution Act of 1990 (OPA) establishes a program governing the removal of spilled oil, and requires planning for and respond to oil spills. Under OPA and BOEM and BSEE regulations at 30 CFR 554, exploration plans must include an Oil Discharge Prevention and Contingency Plan (ODPCP) for BOEM and BSEE review. The ODPCP must demonstrate the applicant's ability to prevent, or rapidly and effectively manage, oil spills that may result from exploratory drilling discharges. Approval of the ODPCP is a prerequisite to approval of the EP.

F-8. National Historic Preservation Act

The National Historic Preservation Act (NHPA) establishes policies and procedures related to the preservation of historic and cultural resources. Section 106 of the NHPA requires federal agencies to consult with the State Historic Preservation Office (SHPO) regarding any undertaking with the potential to affect historic properties. Consultation regarding Chukchi Sea Oil and Gas Lease Sale 193 concluded in March 2007. BOEM approval of this proposed EP would require additional consultation.

In consulting under Section 106, BOEM utilizes archaeological resource surveys and reports required by agency regulations at 30 CFR 550.194. In preparing their EP, Shell conducted surveys to determine whether any of the lease blocks proposed for exploratory drilling contained shallow hazards or archaeological or historic resources. Shell has submitted that these lease blocks do not contain such conditions, and BOEM has agreed with that determination.

F-9. National Invasive Species Act

The National Invasive Species Act of 1996 (NISA) amends the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA) (16 U.S.C. 4710-4751) to regulate activities with the potential for introducing invasive species into the marine environment. Under the authority of NISA and NANPCA, the USCG maintains implementing regulations (33 CFR 151) that apply to vessels brought onto the Alaska OCS and which are intended to reduce the transfer of invasive species.

F-10. Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801-1882) (MFCMA), as amended, establishes mechanisms for conserving and managing commercial fisheries. The Act creates eight Regional Fishery Management Councils (FMC), which prepare Fishery Management Plans (FMP) for each commercial species (or related group of species) of fish in need of conservation and management within each respective region. The MFCMA also requires each FMC to designate essential fish habitat, or EFH, for every FMP that they develop. EFH is defined as those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity. The MFCMA and its implementing regulation require Federal agencies to consult with NMFS regarding any action they authorize, fund, or undertake that may adversely affect designated EFH. NMFS then provides conservation recommendations to the action agency.

F-11. New Requirements for OCS Oil and Gas Operations

Following the Deepwater Horizon explosion and resulting oil spill in the Gulf of Mexico, comprehensive reforms to offshore oil and gas regulation and oversight were developed and implemented. The Secretary's Safety Measures Report, dated May 27, 2010, presents recommendations for immediate and long-term requirements to improve the safety of oil and gas operations in shallow and deep waters. In light of the Safety Measures Report, the MMS issued Notice to Lessees and Operators (NTL) 2010-N05, Increased Safety Measures for Energy Development on the OCS.

Pursuant to 30 CFR 550.213(g) and 30 CFR 550.219, an Exploration Plan (EP) must be accompanied by a blowout scenario description and information regarding oil spills, including calculations of the worst case discharge scenario. Under the new requirements for enhanced drilling safety (NTL 2010-N06, Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the OCS), operators must demonstrate that they are prepared to deal with the potential for a blowout and worst-case discharge.

NTL 2010-N10-*Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources* requires to be included with every APD a statement signed by an authorized company official stating that the operator will conduct all authorized activities in compliance with all applicable regulations, including the Increased Safety Measures for Energy Development on the Outer Continental Shelf rulemaking (75 FR 62246). In compliance with the NTL and pursuant to 30 CFR Part 254, each operator using subsea blowout preventers (BOPs) or BOPs on floating facilities must submit information demonstrating that it has access to and can deploy surface and subsea containment resources that would be adequate to promptly respond to a blowout or other loss of well control.

The new Drilling Safety Rule imposes requirements that will enhance the safety of OCS oil and gas drilling operations. It addresses both well bore integrity and well control equipment and procedures. Well bore integrity provides the first line of defense against a blowout by preventing a loss of well control through the appropriate use of drilling fluids and the well bore casing and cementing program. Applications for Permits to drill must meet new standards for well-design, casing, and cementing, and be independently certified by a professional engineer.

The new Workplace Safety Rule covers all offshore oil and gas operations in federal waters, including equipment, safety practices, environmental safeguards, and management oversight of operations and contractors. The Workplace Safety Rule makes mandatory the previously voluntary practices in the American Petroleum Institute's (API) Recommended Practice 75 (RP 75). Companies are required to develop and maintain a Safety and Environmental Management System

(SEMS). A SEMS program is a comprehensive management program for identifying, addressing, and managing operational safety hazards and impacts, with the goal of promoting both human safety and environmental protection.

Appendix G

OCS Lease Sale 193
Lease Stipulations

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Appendix G. OCS Lease Sale 193 Lease Stipulations

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Stipulation 6. Pre-Booming Requirements for Fuel Transfers

Stipulation 7. Measures to Minimize Effects to Spectacled and Steller's Eiders During Exploration Activities

Shell's leases in the Chukchi Sea were obtained under Lease Sale 193 held in February 2008. The full text of the lease stipulations is provided below. Following each lease stipulation is a description of Shell's planned actions to comply with the stipulation.

Stipulation No. 1. Protection of Biological Resources

If previously unidentified biological populations or habitats that may require additional protection are identified in the lease area by the Regional Supervisor, Field Operations (RS/FO), the RS/FO may require the lessee to conduct biological surveys to determine the extent and composition of such biological populations or habitats. The RS/FO shall give written notification to the lessee of the RS/FO's decision to require such surveys.

Based on any surveys that the RS/FO may require of the lessee or on other information available to the RS/FO on special biological resources, the RS/FO may require the lessee to:

(1) Relocate the site of operations;
(2) Establish to the satisfaction of the RS/FO, on the basis of a site-specific survey, either that such operations will not have a significant adverse effect upon the resource identified or that a special biological resource does not exist;
(3) Operate during those periods of time, as established by the RS/FO, that do not adversely affect the biological resources; and/or
(4) Modify operations to ensure that significant biological populations or habitats deserving protection are not adversely affected.

If any area of biological significance should be discovered during the conduct of any operations on the lease, the lessee shall immediately report such finding to the RS/FO and make every reasonable effort to preserve and protect the biological resource from damage until the RS/FO has given the lessee direction with respect to its protection.

The lessee shall submit all data obtained in the course of biological surveys to the RS/FO with the locational information for drilling or other activity. The lessee may take no action that might affect the biological populations or habitats surveyed until the RS/FO provides written directions to the lessee with regard to permissible actions.

Shell's Actions – Stipulation No. 1

In their 2012 Shell Revised Chukchi Sea EP (Shell, 2011a), Shell describes proposed actions to comply with Stipulation No. 1 as follows:

> No areas of special biological significance have been identified within or near the blocks identified in the revised Chukchi Sea EP.
>
> In addition to the shallow hazards surveys, which provide detailed information on the seafloor sediments and relief, Shell conducted or participated in the funding or in the facilitation of several types of environmental studies in and near the prospects in 2008, 2009, and 2010 to gather baseline data regarding resources in the project area. These studies included coastline surveys to assess the relative environmental sensitivity of Chukchi Sea coastline segments, walrus tagging and monitoring studies, seal tagging and monitoring studies, bird and marine mammal surveys, assessments of the benthic invertebrate communities, oceanographic studies, and sediment quality assessments at the planned drill sites. The results of the marine mammal and bird surveys are summarized in Shell's EIA (Shell, 2011: Appendix F).
>
> These studies also indicated that there are no areas of special biological significance in the vicinity of the drill sites. Video reconnaissance surveys were conducted at historical drill sites at Burger in 1989, and the results were submitted to BOEMRE at that time. These surveys also found a relatively flat and featureless seafloor with a silty substrate and a benthic fauna typical of the Lease Sale 193 Area (Finney 1989, Boudreau 1989).

Stipulation No. 2. Orientation Program

The lessee shall include in any exploration plan (EP) or development and production plan (DPP) submitted under 30 CFR 250.211 and 250.241 a proposed orientation program for all personnel involved in exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) for review and approval by the RS/FO. The program shall be designed in sufficient detail to inform individuals working on the project of specific types of environmental, social, and cultural concerns that relate to the sale and adjacent areas. The program shall address the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals and provide guidance on how to avoid disturbance. This guidance will include the production and distribution of information cards on endangered and/or threatened species in the sale area. The program shall be designed to increase the sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which such personnel will be operating. The orientation program shall also include information concerning avoidance of conflicts with subsistence activities and pertinent mitigation.

The program shall be attended at least once a year by all personnel involved in onsite exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) and all supervisory and managerial personnel involved in lease activities of the lessee and its agents, contractors, and subcontractors.

The lessee shall maintain a record of all personnel who attend the program onsite for so long as the site is active, not to exceed 5 years. This record shall include the name and date(s) of attendance of each attendee.

Shell's Actions – Stipulation No. 2

In their 2012 Shell Revised Chukchi Sea EP (Shell, 2011a), Shell describes proposed actions to comply with Stipulation No. 2 as follows:

> Shell has developed and is currently implementing an approved orientation program for Shell and contractor personnel involved in Shell's Alaska Venture exploration drilling program that was first approved by the Alaska OCS Region of the BOEMRE RS/FO on 15 February 2007. An outline of the

program was again submitted to BOEMRE with the initial Chukchi Sea EP, and found by the BOEMRE RS/FO on 7 December 2009 to satisfy the requirements of Stipulation No. 2. Shell revised the orientation program based on BOEMRE comments regarding the 2009 orientation program, and submitted the complete orientation program to BOEMRE for approval on 9 June 2011.

All Shell and contractor personnel involved in field exploration drilling activities will attend the orientation training annually. All other Shell and contractor personnel will attend the program at least once at the time they join the team. Shell will retain and maintain a record, for at least 5 years, of all personnel who attend the program, including relevant attendee and program information.

Shell has designed a specific program that addresses environmental, social, and cultural concerns related to the project area. The program is designed to increase sensitivity and understanding by Shell and its contractors of community values, customs, and lifestyles in the area they will be working, and how to avoid conflicts with subsistence activities. The program stresses the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals and provides guidance on how to avoid disturbance.

Shell's Cultural Awareness Program addresses the following:

- Alaska Native Ethnic Breakdown
- Brief history of land claims
- Formation of regional corporations, and region within which Shell is working
- History of the North Slope
- Cultural diversity
- Comparison of cultural values of Alaska Natives v. non-Natives
- Patterns of language
- Communication skills and body language
- Guidelines on cultural artifacts
- Local community values and customs
- Whaling

Shell has further developed a Health, Safety, Security and Environment (HSSE) Awareness Program, which addresses the following:

- Shell's HSSE Commitment
- Intervention policy
- Journey Management requirements
- Personal Protective Equipment requirements
- General Alaska Venture Hazards, such as earthquakes and volcanoes
- Medical emergencies
- Security
- North Slope Safety requirements
- Shell Alaska Venture Standards and Procedures
  - Cold Climate Work Standard
  - Firearms Use in Wildlife Confrontations
  - Procedure for Vessel-to-Vessel Personnel Transfers
- Incident Reporting
- Environmental Awareness
  - ESA – Major Provisions
  - Endangered and threatened species
  - MMPA of 1972
  - Marine mammal interactions
  - Sensitive Habitats on the North Slope
  - Wildlife interactions
  - Prohibited activities of hunting, trapping and fishing
  - Environmental requirements, for air, spills and waste
  - Environmental training

Stipulation No. 3. Transportation of Hydrocarbons

Pipelines will be required: (a) if pipeline rights-of-way can be determined and obtained; (b) if laying such pipelines is technologically feasible and environmentally preferable; and (c) if, in the opinion of the lessor, pipelines can be laid without net social loss, taking into account any incremental costs of pipelines over alternative methods of transportation and any incremental benefits in the form of increased environmental protection or reduced multiple-use conflicts. The lessor specifically reserves the right to require that any pipeline used for transporting production to shore be placed in certain designated management areas. In selecting the means of transportation, consideration will be given to recommendations of any Federal, State, and local governments and industry.

Following the development of sufficient pipeline capacity, no crude oil production will be transported by surface vessel from offshore production sites, except in the case of an emergency. Determinations as to emergency conditions and appropriate responses to these conditions will be made by the RS/FO.

Shell's Actions – Stipulation No. 3

Lease Stipulation No. 3 is not applicable to the activities described by the 2012 Shell Revised Chukchi Sea EP (Shell, 2011a).

Stipulation No. 4. Industry Site-Specific Monitoring Program for Marine Mammal Subsistence Resources

A lessee proposing to conduct exploration operations, including ancillary seismic surveys, on a lease within the blocks identified below during periods of subsistence use related to bowhead whales, beluga whales, ice seals, walruses, and polar bears will be required to conduct a site-specific monitoring program approved by the RS/FO, unless, based on the size, timing, duration, and scope of the proposed operations, the RS/FO, in consultation with appropriate agencies and co-management organizations, determines that a monitoring program is not necessary. Organizations currently recognized by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) for the co-management of the marine mammals resources are the Alaska Eskimo Whaling Commission, the Alaska Beluga Whale Committee, the Alaska Eskimo Walrus Commission, the Ice Seal Commission, and the Nanuk Commission. The RS/FO will provide the appropriate agencies and co-management organizations a minimum of 30 calendar days, but no longer than 60 calendar days, to review and comment on a proposed monitoring program prior to Minerals Management Service (MMS) approval. The monitoring program must be approved each year before exploratory drilling operations can be commenced.

The monitoring program will be designed to assess when bowhead and beluga whales, ice seals, walruses, and polar bears are present in the vicinity of lease operations and the extent of behavioral effects on these marine mammals due to these operations. In designing the program, the lessee must consider the potential scope and extent of effects that the type of operation could have on these marine mammals. Experiences relayed by subsistence hunters indicate that, depending on the type of operations, some whales demonstrate avoidance behavior at distances of up to 35 miles. The program must also provide for the following:

1) Recording and reporting information on sighting of the marine mammals of concern and the extent of behavioral effects due to operations;
2) Coordinating the monitoring logistics beforehand with the MMS Bowhead Whale Aerial Survey Project and other mandated aerial monitoring programs;
3) Inviting a local representative, to be determined by consensus of the appropriate co-management organizations, to participate as an observer in the monitoring program;
4) Submitting daily monitoring results to the RS/FO;

5) Submitting a draft report on the results of the monitoring program to the RS/FO within 90 days following the completion of the operation. The RS/FO will distribute this draft report to the appropriate agencies and co-management organizations;
6) Allowing 30 days for independent peer review of the draft monitoring report; and
7) Submitting a final report on the results of the monitoring program to the RS/FO within 30 days after the completion of the independent peer review. The final report will include a discussion of the results of the peer review of the draft report. The RS/FO will distribute this report to the appropriate agencies and co-management organizations.

The RS/FO may extend the report review and submittal timelines if the RS/FO determines such an extension is warranted to accommodate extenuating circumstances.

The lessee will be required to fund an independent peer review of a proposed monitoring plan and the draft report on the results of the monitoring program for bowhead whales. The lessee may be required to fund an independent peer review of a proposed monitoring plan and the draft report on the results of the monitoring program for other co-managed marine mammal resources. This peer review will consist of independent reviewers who have knowledge and experience in statistics, monitoring marine mammal behavior, the type and extent of the proposed operations, and an awareness of traditional knowledge. The peer reviewers will be selected by the RS/FO from experts recommended by the appropriate agencies and co-management resource organizations. The results of these peer reviews will be provided to the RS/FO for consideration in final MMS approval of the monitoring program and the final report, with copies to the appropriate agencies and co-management organizations.

In the event the lessee is seeking a Letter of Authorization (LOA) or Incidental Harassment Authorization (IHA) for incidental take from NMFS and/or FWS, the monitoring program and review process required under the LOA or IHA may satisfy the requirements of this stipulation. The lessee must advise the RS/FO when it is seeking an LOA or IHA in lieu of meeting the requirements of this stipulation and must provide the RS/FO with copies of all pertinent submittals and resulting correspondence. The RS/FO will coordinate with the NMFS and/or FWS and will advise the lessee if the LOA or IHA will meet these requirements.

The MMS, NMFS, and FWS will establish procedures to coordinate results from site-specific surveys required by this stipulation and the LOA's or IHA's to determine if further modification to lease operations are necessary.

This stipulation applies to the following blocks:

NR02-06, Chukchi Sea:
6624, 6625, 6674, 6675, 6723-6725, 6773-6775, 6822, 6823, 6872

NR03-02, Posey:
6872, 6873, 6918-6923, 6967-6973, 7016-7023, 7063-7073, 7112-7123

NR03-03, Colbert
6674, 6723, 6724, 6771-6774, 6820-6824, 6869-6874, 6918-6924, 6966-6974, 7015-7024, 7064-7074, 7113-7124

NR03-04, Solivik Island
6011-6023, 6060-6073, 6109-6122, 6157-6171, 6206-6219, 6255-6268, 6305-6317, 6354-6365, 6403-6414, 6453-6462, 6502-6511, 6552-6560, 6601-6609, 6651-6658, 6701-6707, 6751-6756, 6801-6805, 6851-6854, 6901-6903, 6951, 6952, 7001

NR03-05, Point Lay West

6014-6024, 6062-6073, 6111-6122, 6160-6171, 6209-6221, 6258-6269, 6307-6317, 6356-6365, 6406-6414, 6455-6462, 6503-6510, 6552-6558, 6602-6606, 6652-6655, 6702, 6703

NR04-01, Hanna Shoal
6223, 6267-6273, 6315-6323, 6363-6373, 6411-6423, 6459-6473, 6507-6523, 6556-6573, 6605-6623, 6654-6671, 6703-6721, 6752-6771, 6801-6819, 6851-6868, 6901-6916, 6951-6964, 7001-7010, 7051-7059, 7101-7107

NR04-02, Barrow
6003-6022, 6052-6068, 6102-6118, 6151-6164, 6201-6214, 6251-6262, 6301-6312, 6351-6359, 6401-6409, 6451-6456, 6501-6506, 6551, 6552, 6601, 6602

NR04-03, Wainwright
6002-6006, 6052, 6053

NS04-08, (Unnamed)
6816-6822, 6861-6872, 6910-6922, 6958-6972, 7007-7022, 7055-7072, 7104-7122

This stipulation applies during the time periods for subsistence-harvesting described below for each community.

Subsistence Whaling and Marine Mammal Hunting Activities by Community

Barrow: Spring bowhead whaling occurs from April to June; Barrow hunters hunt from ice leads from Point Barrow southwestward along the Chukchi Sea coast to the Skull Cliff area. Fall whaling occurs from August to October in an area extending from approximately 10 miles west of Barrow to the east side of Dease Inlet. Beluga whaling occurs from April to June in the spring leads between Point Barrow and Skull Cliff; later in the season, belugas are hunted in open water around the barrier islands off Elson Lagoon. Walrus are harvested from June to September from west of Barrow southwestward to Peard Bay. Polar bear are hunted from October to June generally in the same vicinity used to hunt walrus. Seal hunting occurs mostly in winter, but some open-water sealing is done from the Chukchi coastline east as far as Dease Inlet and Admiralty Bay in the Beaufort Sea.

Wainwright: Bowhead whaling occurs from April to June in the spring leads offshore of Wainwright, with whaling camps sometimes as far as 10 to 15 miles from shore. Wainwright hunters hunt beluga whales in the spring lead system from April to June but only if no bowheads are in the area. Later in the summer, from July to August, belugas can be hunted along the coastal lagoon systems. Walrus hunting occurs from July to August at the southern edge of the retreating pack ice. From August to September, walrus can be hunted at local haulouts with the focal area from Milliktagvik north to Point Franklin. Polar bear hunting occurs primarily in the fall and winter around Icy Cape, at the headland from Point Belcher to Point Franklin, and at Seahorse Island.

Point Lay: Because Point Lay's location renders it unsuitable for bowhead whaling, beluga whaling is the primary whaling pursuit. Beluga whales are harvested from the middle of June to the middle of July. The hunt is concentrated in Naokak and Kukpowruk Passes south of Point Lay where hunters use boats to herd the whales into the shallow waters of Kasegaluk Lagoon where they are hunted. If the July hunt is unsuccessful, hunters can travel as far north as Utukok Pass and as far south as Cape Beaufort in search of whales. When ice conditions are favorable, Point Lay residents hunt walrus from June to August along the

entire length of Kasegaluk Lagoon, south of Icy Cape, and as far as 20 miles offshore. Polar bear are hunted from September to April along the coast, rarely more than 2 miles offshore.

Point Hope: Bowhead whales are hunted from March to June from whaling camps along the ice edge south and southeast of the point. The pack-ice lead is rarely more than 6 to 7 miles offshore. Beluga whales are harvested from March to June in the same area used for the bowhead whale hunt. Beluga whales can also be hunted in the open water later in the summer from July to August near the southern shore of Point Hope close to the beaches, as well as areas north of the point as far as Cape Dyer. Walruses are harvested from May to July along the southern shore of the point from Point Hope to Akoviknak Lagoon. Point Hope residents hunt polar bears primarily from January to April and occasionally from October to January in the area south of the point and as far out as 10 miles from shore.

This stipulation will remain in effect until termination or modification by the Department of the Interior after consultation with appropriate agencies.

Shell's Actions – Stipulation No. 4

In their 2012 Shell Revised Chukchi Sea EP (Shell, 2011a), Shell describes proposed actions to comply with Stipulation No. 4 as follows:

> Although none of the blocks listed in Stipulation No. 4 are included in those planned for exploration drilling in Shell's revised Chukchi Sea EP, Shell will voluntarily submit to the BOEMRE a site-specific 4MP in support of its application for an IHA (Appendix C). Shell plans to be an active participant in future NMFS Open Water meetings and an active participant in the independent peer review of the monitoring plan and reports generated for future activities. The 4MP is located in Appendix D. Since issuance of Stipulation No. 4, Wainwright whaling crews have conducted fall whaling, with the first harvest of a fall bowhead in more than 90 years occurring in October 2010. Wainwright residents have expressed their intent to conduct fall whaling in the future when it is possible to do so. Shell's POC, 4MP, and other mitigation measures are designed to address this change in area subsistence activities.
>
> Shell intends to use contractors based in the North Slope Borough (NSB) and Northwest Arctic Borough (NWAB) that will in turn provide job opportunities to local residents, including recruitment and training of SAs and MMOs. Summaries of key components of the program are presented below.
>
> Marine Mammal Observers
>
> Vessel-based monitoring for marine mammals will be done throughout the period of exploration drilling operations to comply with expected provisions in the IHA and LOA that Shell receives. Those provisions will be implemented during the exploration drilling program by a team of trained MMOs. The presence of MMOs onboard drilling and support vessels will be a core component of compliance with the 4MP. The MMOs will be responsible for collecting basic data on observations of marine mammals and for implementing mitigation measures including vessel avoidance measures and factored into decisions concerning operational shutdown. The observations made by MMOs serve as the primary basis for estimation of impacts to marine mammals. Because their ranks include representatives of the Alaska Native community, the MMOs also serve as an important means of providing local hire and local oversight of the monitoring program. MMOs will be stationed on the drillship, ice management vessel, anchor handler and other drilling support vessels engaged in transit to and between drill sites, exploration drilling, and other operational and intermittent activities to monitor for marine mammals.
>
> Aerial Survey Program
>
> With agreement from hunters in the coastal villages, aerial surveys of coastal areas to approximately 23 mi (37 km) offshore between Point Hope and Point Barrow will begin in early- to mid- July and will continue until exploration drilling operations in the Chukchi Sea are concluded. The objectives of the aerial survey are to collect data on the distribution and abundance of marine mammals in coastal

areas of the eastern Chukchi Sea; and to collect and report data on the distribution, numbers, orientation and behavior of marine mammals, particularly beluga whales, near traditional hunting areas in the eastern Chukchi Sea.

Acoustic Recorders

A combination of acoustic recorder technologies will be employed to document the distribution of marine mammals; the distribution of marine mammals in relation to activities; to add clarity to the characterization of exploration drilling sound levels, character, and propagation; and to document presence of marine mammals in subsistence hunting areas. This will be accomplished by deploying several acoustic recorder buoys in a wide area surrounding the planned locations. Acoustic monitoring instruments have been deployed in the Chukchi Sea in past years in late July. With drilling scheduled to commence in early July, the deployment date would be pushed forward to occur after ice out and before exploration drilling. This is expected to be in late June / early July. Over-wintering sonobuoys have also been located in the proposed exploration drilling area since 2007. In that early drilling related activities would be initiated upon arrival and while the arrays are being deployed, these over-wintered recorders would capture the sound associated with early activities.

Sound Modeling

Sound modeling will be conducted during the exploration drilling program in the Chukchi Sea.

Sound Source Verification

Field measurement sound propagation profiles of vessels and the drillship will be conducted during different operational modes, so as to determine those activities that produce the greatest opportunities for mitigation. Initial sound source verification of the drillship and support vessels will be conducted within five days of arrival at the prospect. Shell will maintain acoustic recorders in the area of exploration drilling activities for the duration of the exploration drilling program.

Additional Studies

Shell plans to participate in additional studies of marine resources in the Chukchi Sea in an effort to gain an understanding of baseline conditions and the distribution of critical resources, to gain an understanding of interactions between industry activities and marine resources, and to contribute to the understanding of resource status and conservation/management needs. The list of potential studies and monitoring projects includes:

- Baseline studies of the air quality, oceanography, sediment chemistry, benthic an planktonic communities, fish, marine birds, and marine mammals in the Burger Prospect area
- Marine mammal distribution and response to industry activities in the northeastern Chukchi Sea
- Participation in, and funding of, walrus and ringed seal tagging studies
- Collection of subsistence use of coastal and offshore waters though a system of Subsistence Advisors
- Drilling waste discharge and benthic community monitoring

With the exception of the discharge monitoring, Shell has been participating in these studies since 2006. Reports summarizing the methods and findings of the studies are listed in Sections 5.0(a), (b), and (c). Discharge monitoring studies Shell expects to conduct are described in Section 10.0.

Stipulation No. 5. Conflict Avoidance Mechanisms to Protect Subsistence Whaling and Other Marine Mammal Subsistence-Harvesting Activities

Exploration and development and production operations shall be conducted in a manner that prevents unreasonable conflicts between the oil and gas industry and subsistence activities. This stipulation applies to exploration, development, and production operations on a lease within the blocks identified below during periods of subsistence use related to bowhead whales, beluga whales, ice seals, walruses, and polar bears. The stipulation also applies to support activities, such as vessel and aircraft traffic, that traverse the blocks listed below or Federal waters landward of the sale during periods of subsistence use regardless of lease location. Transit for human safety emergency situations shall not require adherence to this stipulation.

This stipulation applies to the following blocks:

- **NR02-06, Chukchi Sea**
  6624, 6625, 6674, 6675, 6723-6725, 6773-6775, 6822, 6823, 6872
- **NR03-02, Posey**
  6872, 6873, 6918-6923, 6967-6973, 7016-7023, 7063-7073, 7112-7123
- **NR03-03, Colbert**
  6674, 6723, 6724, 6771-6774, 6820-6824, 6869-6874, 6918-6924, 6966-6974, 7015-7024, 7064-7074, 7113-7124
- **NR03-04, Solivik Island**
  6011-6023, 6060-6073, 6109-6122, 6157-6171, 6206-6219, 6255-6268, 6305-6317, 6354-6365, 6403-6414, 6453-6462, 6502-6511, 6552-6560, 6601-6609, 6651-6658, 6701-6707, 6751-6756, 6801-6805, 6851-6854, 6901-6903, 6951, 6952, 7001
- **NR03-05, Point Lay West**
  6014-6024, 6062-6073, 6111-6122, 6160-6171, 6209-6221, 6258-6269, 6307-6317, 6356-6365, 6406-6414, 6455-6462, 6503-6510, 6552-6558, 6602-6606, 6652-6655, 6702, 6703
- **NR04-01, Hanna Shoal**
  6223, 6267-6273, 6315-6323, 6363-6373, 6411-6423, 6459-6473, 6507-6523, 6556-6573, 6605-6623, 6654-6671, 6703-6721, 6752-6771, 6801-6819, 6851-6868, 6901-6916, 6951-6964, 7001-7010, 7051-7059, 7101-7107
- **NR04-02, Barrow**
  6003-6022, 6052-6068, 6102-6118, 6151-6164, 6201-6214, 6251-6262, 6301-6312, 6351-6359, 6401-6409, 6451-6456, 6501-6506, 6551, 6552, 6601, 6602
- **NR04-03, Wainwright**
  6002-6006, 6052, 6053
- **NS04-08, (Unnamed)**
  6816-6822, 6861-6872, 6910-6922, 6958-6972, 7007-7022, 7055-7072, 7104-7122

Prior to submitting an exploration plan or development and production plan (including associated oil-spill response plans) to the MMS for activities proposed during subsistence-use critical times and locations described below for bowhead whale and other marine mammals, the lessee shall consult with the North Slope Borough, and with directly affected subsistence communities (Barrow, Point Lay, Point Hope, or Wainwright) and co-management organizations to discuss potential conflicts with the siting, timing, and methods of proposed operations and safeguards or mitigating measures that could be implemented by the operator to prevent unreasonable conflicts. Organizations currently

recognized by the NMFS and the FWS for the co-management of the marine mammals resources are the Alaska Eskimo Whaling Commission, the Alaska Beluga Whale Committee, the Alaska Eskimo Walrus Commission, the Ice Seal Commission, and the Nanuk Commission. Through this consultation, the lessee shall make every reasonable effort, including such mechanisms as a conflict avoidance agreement, to assure that exploration, development, and production activities are compatible with whaling and other marine mammal subsistence hunting activities and will not result in unreasonable interference with subsistence harvests.

A discussion of resolutions reached during this consultation process and plans for continued consultation shall be included in the exploration plan or the development and production plan. In particular, the lessee shall show in the plan how its activities, in combination with other activities in the area, will be scheduled and located to prevent unreasonable conflicts with subsistence activities. The lessee shall also include a discussion of multiple or simultaneous operations, such as ice management and seismic activities, that can be expected to occur during operations in order to more accurately assess the potential for any cumulative affects. Communities, individuals, and other entities who were involved in the consultation shall be identified in the plan. The RS/FO shall send a copy of the exploration plan or development and production plan (including associated oil-spill response plans) to the directly affected communities and the appropriate co-management organizations at the time the plans are submitted to the MMS to allow concurrent review and comment as part of the plan approval process.

In the event no agreement is reached between the parties, the lessee, NMFS, FWS, the appropriate co-management organizations, and any communities that could be directly affected by the proposed activity may request that the RS/FO assemble a group consisting of representatives from the parties to specifically address the conflict and attempt to resolve the issues. The RS/FO will invite appropriate parties to a meeting if the RS/FO determines such a meeting is warranted and relevant before making a final determination on the adequacy of the measures taken to prevent unreasonable conflicts with subsistence harvests.

The lessee shall notify the RS/FO of all concerns expressed by subsistence hunters during operations and of steps taken to address such concerns. Activities on a lease may be restricted if the RS/FO determines it is necessary to prevent unreasonable conflicts with local subsistence hunting activities.

In enforcing this stipulation, the RS/FO will work with other agencies and the public to assure that potential conflicts are identified and efforts are taken to avoid these conflicts.

Subsistence-harvesting activities occur generally in the areas and time periods listed below.

Subsistence Whaling and Marine Mammal Hunting Activities by Community

Barrow: Spring bowhead whaling occurs from April to June; Barrow hunters hunt from ice leads from Point Barrow southwestward along the Chukchi Sea coast to the Skull Cliff area; fall whaling occurs from August to October in an area extending from approximately 10 miles west of Barrow to the east side of Dease Inlet. Beluga whaling occurs from April to June in the spring leads between Point Barrow and Skull Cliff; later in the season, belugas are hunted in open water around the barrier islands off Elson Lagoon. Walrus are harvested from June to September from west of Barrow southwestward to Peard Bay. Polar bear are hunted from October to June generally in the same vicinity used to hunt walruses. Seal hunting occurs mostly in winter, but some open-water sealing is done from the Chukchi coastline east as far as Dease Inlet and Admiralty Bay in the Beaufort Sea.

Wainwright: Bowhead whaling occurs from April to June in the spring leads offshore of Wainwright, with whaling camps sometimes as far as 10 to 15 miles from shore. Wainwright hunters hunt beluga whales in the spring lead system from April to June but only if no bowheads are in the area. Later in the summer, from July to August, belugas can be hunted along the coastal lagoon systems. Walrus hunting occurs from July to August at the southern edge of the retreating pack ice.

From August to September, walruses can be hunted at local haulouts with the focal area from Milliktagvik north to Point Franklin. Polar bear hunting occurs primarily in the fall and winter around Icy Cape, at the headland from Point Belcher to Point Franklin, and at Seahorse Island.

Point Lay: Because Point Lay's location renders it unsuitable for bowhead whaling, beluga whaling is the primary whaling pursuit. Beluga whales are harvested from the middle of June to the middle of July. The hunt is concentrated in Naokak and Kukpowruk Passes south of Point Lay where hunters use boats to herd the whales into the shallow waters of Kasegaluk Lagoon where they are hunted. If the July hunt is unsuccessful, hunters can travel as far north as Utukok Pass and as far south as Cape Beaufort in search of whales. When ice conditions are favorable, Point Lay residents hunt walruses from June to August along the entire length of Kasegaluk Lagoon, south of Icy Cape, and as far as 20 miles offshore. Polar bears are hunted from September to April along the coast, rarely more than 2 miles offshore.

Point Hope: Bowhead whales are hunted from March to June from whaling camps along the ice edge south and southeast of the point. The pack-ice lead is rarely more than 6 to 7 miles offshore. Beluga whales are harvested from March to June in the same area used for the bowhead whale hunt. Beluga whales can also be hunted in the open water later in the summer from July to August near the southern shore of Point Hope close to the beaches, as well as areas north of the point as far as Cape Dyer. Walruses are harvested from May to July along the southern shore of the point from Point Hope to Akoviknak Lagoon. Point Hope residents hunt polar bears primarily from January to April and occasionally from October to January in the area south of the point and as far out as 10 miles from shore.

Shell's Actions – Stipulation No. 5

In their 2012 Shell Revised Chukchi Sea EP (Shell, 2011a), Shell describes proposed actions to comply with Stipulation No. 5 as follows:

> Shell has actively engaged the NSB, NWAB, and the subsistence communities of Kaktovik, Nuiqsut, Barrow, Wainwright, Point Lay, Point Hope, Kivalina, Kotzebue, Shishmaref, Kiana, Savoonga, and Gambell, and co-management organizations, including the Alaska Eskimo Whaling Commission (AWEC), Alaska Beluga Whale Committee, the Alaska Eskimo Walrus Commission, the Ice Seal Commission, and the Alaska Nanuuq Commission, to discuss potential conflicts between planned oil and gas activities and subsistence use activities. Shell's EP lease blocks do not lie within the stipulation area, but support activities associated with the exploration drilling program will transit the stipulation area.
>
> Plan of Cooperation
>
> Shell began consulting with potentially affected subsistence communities, stakeholders and federal, state, and local agencies in 2006 and prepared a POC for its Chukchi Sea open water activities (3D seismic activities and vessel transit) in November 2007. Shell continued with these consultations through 2011. Shell will continue to engage with subsistence stakeholders to build on its past efforts to inform and engage the communities that could be potentially affected by exploration drilling activities in the Chukchi Sea. It is also noted that a POC is required for an IHA from the NMFS and USFWS. Since issuance of Stipulation No. 4, Wainwright whaling crews have conducted fall whaling, with the first harvest of a fall bowhead in more than 90 years occurring in October 2010. Wainwright residents have expressed their intent to conduct fall whaling in the future when it is possible to do so. Shell's POC, 4MP, and other mitigation measures are designed to address this change in area subsistence activities.
>
> Shell met with public and community leaders beginning in January-April 2009 specifically to discuss the planned 2010 exploration drilling program in the Chukchi Sea as detailed in the initial Chukchi Sea EP, and to hear their concerns. Shell prepared a written POC based on that effort, which described when and where the meetings were held, what was presented by Shell, the comments received, and Shell's responses to these comments. The POC also identified mitigation measures that Shell prepared

in response to these concerns. A copy of the POC was attached as an appendix to the initial Chukchi Sea EP, and was forwarded to NMFS as part of the IHA requirements. Shell's consultation efforts have continued since that time, and in February-April of 2011, Shell held a series of meetings specifically to discuss the exploration drilling activities outline in the revised Chukchi Sea EP. The dates and locations of the meetings held in 2009, 2010, and 2011 as part of consultation effort associated with exploration drilling in the Chukchi, along with the persons Shell met with, are listed below in Table 11.0-1. Shell has prepared an addendum to the POC submitted with the 2010 Chukchi Sea EP, which provides information on the meetings held specifically to address the revised Chukchi Sea EP. The POC addendum is attached in Appendix H of this document.

Marine Mammal Co-Management Groups

Shell facilitated quarterly meetings with the co-management groups including the AEWC, Alaska Beluga Whale Committee, the Alaska Eskimo Walrus Commission, the Ice Seal Commission, and the Alaska Nanuuq Commission beginning in June 2006, and continues to meet with these groups. Shell met with representatives of these co-management groups again in 2011 to discuss the revised exploration drilling program as indicated above in Table 11.0-1 to inform them of our planned activities and discuss potential conflicts that could arise with regards to the siting, timing, and method of the planned operations as well as mitigation measures designed to avoid or minimize any such effects. Shell also attends the Open Water Meetings held annually, which include the co-management groups AEWC, NMFS, BOEMRE, USFWS, and other industry participants. Shell attended the Open Water Meeting for 2011 in Anchorage on 7-8 March 2011, at which time details regarding the exploration drilling program described in the revised Chukchi Sea EP were discussed.

Stipulation No. 6. Pre-Booming Requirements for Fuel Transfers

Fuel transfers (excluding gasoline transfers) of 100 barrels or more will require pre-booming of the fuel barge(s). The fuel barge must be surrounded by an oil-spill-containment boom during the entire transfer operation to help reduce any adverse effects from a fuel spill. The lessee's oil spill response plans must include procedures for the pre-transfer booming of the fuel barge(s).

Shell's Actions – Stipulation No. 6

In their 2012 Shell Revised Chukchi Sea EP (Shell, 2011a), Shell describes proposed actions to comply with Stipulation No. 6 as follows:

> A copy of Shell's Fuel Transfer Plan (Alaska Fuel Operating Condition and Standard) is provided in Appendix M. On 7 December 2009, BOEMRE approved the booming configuration presented in the Fuel Transfer Plan submitted with the approved initial Chukchi Sea EP, which is the same as is presented in the attached Fuel Transfer Plan in Appendix M of this revised Chukchi Sea EP. Additional details for fuel transfers are provided in Appendix D of the Chukchi Sea Regional ODPCP. Under Shell's procedures all vessel-to-vessel, and dock-to-vessel transfers of fuel will be pre-boomed during the planned exploration drilling program covered by this revised Chukchi Sea EP.

Stipulation No. 7. Measures to Minimize Effects to Spectacled and Steller's Eiders During Exploration Activities

This stipulation will minimize the likelihood that spectacled and Steller's eiders will strike drilling structures or vessels. The stipulation also provides additional protection to eiders within the blocks listed below and Federal waters landward of the sale area, including the Ledyard Bay Critical Habitat Area, during times when eiders are present.

(A) General conditions: The following conditions apply to all exploration activities.

> (1) An EP must include a plan for recording and reporting bird strikes. All bird collisions (with vessels, aircraft, or drilling structures) shall be documented and reported within 3 days to MMS. Minimum information will include species, date/time, location, weather,

identification of the vessel, and aircraft or drilling structure involved and its operational status when the strike occurred. Bird photographs are not required, but would be helpful in verifying species. Lessees are advised that the FWS does not recommend recovery or transport of dead or injured birds due to avian influenza concerns.

(2) The following conditions apply to operations conducted in support of exploratory and delineation drilling.

(a) Surface vessels (e.g., boats, barges) associated with exploration and delineation drilling operations should avoid operating within or traversing the listed blocks or Federal waters between the listed blocks and the coastline between April 15 and June 10, to the maximum extent practicable. If surface vessels must traverse this area during this period, the surface vessel operator will have ready access to wildlife hazing equipment (including at least three *Breco* buoys or similar devices) and personnel trained in its use; hazing equipment may located onboard the vessel or on a nearby oil spill response vessel, or in Point Lay or Wainwright. Lessees are required to provide information regarding their operations within the area upon request of MMS. The MMS may request information regarding number of vessels and their dates of operation within the area.

(b) Except for emergencies or human/navigation safety, surface vessels associated with exploration and delineation drilling operations will avoid travel within the Ledyard Bay Critical Habitat Area between July 1 and November 15. Vessel travel within the Ledyard Bay Critical Habitat Area for emergencies or human/navigation safety shall be reported within 24 hours to MMS.

(c) Aircraft supporting drilling operations will avoid operating below 1,500 feet above sea level over the listed blocks or Federal waters between the listed blocks and the coastline between April 15 and June 10, or the Ledyard Bay Critical Habitat Area between July 1 and November 15, to the maximum extent practicable. If weather prevents attaining this altitude, aircraft will use pre-designated flight routes. Pre-designated flight routes will be established by the lessee and MMS, in collaboration with the FWS, during review of the EP. Route or altitude deviations for emergencies or human safety shall be reported within 24 hours to MMS.

(B) Lighting Protocols. The following lighting requirements apply to activities conducted between April 15 and November 15 of each year.

(1) Drilling Structures: Lessees must adhere to lighting requirements for all exploration or delineation drilling structures so as to minimize the likelihood that migrating marine and coastal birds will strike these structures. Lessees are required to implement lighting requirements aimed at minimizing the radiation of light outward from exploration or delineation drilling structures to minimize the likelihood that birds will strike those structures. These requirements establish a coordinated process for a performance-based objective rather than pre-determined prescriptive requirements. The performance-based objective is to minimize the radiation of light outward from exploration/delineation structures while operating on a lease or if staged within nearshore Federal waters pending lease deployment.

Measures to be considered include but need not be limited to the following:

- Shading and/or light fixture placement to direct light inward and downward to living and work structures while minimizing light radiating upward and outward;
- Types of lights;

- Adjustment of the number and intensity of lights as needed during specific activities;
- Dark paint colors for selected surfaces;
- Low-reflecting finishes or coverings for selected surfaces; and
- Facility or equipment configuration.

Lessees are encouraged to consider other technical, operational, and management approaches that could be applied to their specific facilities and operations to reduce outward light radiation. Lessees must provide MMS with a written statement of measures that will be or have been taken to meet the lighting objective, and must submit this information with an EP when it is submitted for regulatory review and approval pursuant to 30 CFR 250.203.

(2) Support Vessels: Surface support vessels will minimize the use of high-intensity work lights, especially when traversing the listed blocks and federal waters between the listed blocks and the coastline. Exterior lights will be used only as necessary to illuminate active, on-deck work areas during periods of darkness or inclement weather (such as rain or fog), otherwise they will be turned off. Interior lights and lights used during navigation could remain on for safety.

For the purpose of this stipulation, the listed blocks are as follows:

NR02-06, Chukchi Sea:
6624, 6625, 6674, 6675, 6723-6725, 6773-6775, 6822, 6823, 6872

NR03-02, Posey:
6872, 6873, 6918-6923, 6967-6973, 7016-7023, 7063-7073, 7112-7123

NR03-03, Colbert
6674, 6723, 6724, 6771-6774, 6820-6824, 6869-6874, 6918-6924, 6966-6974, 7015-7024, 7064-7074, 7113-7124

NR03-04, Solivik Island
6011-6023, 6060-6073, 6109-6122, 6157-6171, 6206-6219, 6255-6268, 6305-6317, 6354-6365, 6403-6414, 6453-6462, 6502-6511, 6552-6560, 6601-6609, 6651-6658, 6701-6707, 6751-6756, 6801-6805, 6851-6854, 6901-6903, 6951, 6952, 7001

NR03-05, Point Lay West
6014-6024, 6062-6073, 6111-6122, 6160-6171, 6209-6221, 6258-6269, 6307-6317, 6356-6365, 6406-6414, 6455-6462, 6503-6510, 6552-6558, 6602-6606, 6652-6655, 6702, 6703

NR04-01, Hanna Shoal
6223, 6267-6273, 6315-6323, 6363-6373, 6411-6423, 6459-6473, 6507-6523, 6556-6573, 6605-6623, 6654-6671, 6703-6721, 6752-6771, 6801-6819, 6851-6868, 6901-6916, 6951-6964, 7001-7010, 7051-7059, 7101-7107

NR04-02, Barrow
6003-6022, 6052-6068, 6102-6118, 6151-6164, 6201-6214, 6251-6262, 6301-6312, 6351-6359, 6401-6409, 6451-6456, 6501-6506, 6551, 6552, 6601, 6602

NR04-03, Wainwright
6002-6006, 6052, 6053

NS04-08, (Unnamed)
6816-6822, 6861-6872, 6910-6922, 6958-6972, 7007-7022, 7055-7072, 7104-7122

Nothing in this stipulation is intended to reduce personnel safety or prevent compliance with other regulatory requirements (e.g., U.S. Coast Guard or Occupational Safety and Health Administration) for marking or lighting of equipment and work areas.

Shell's Actions – Stipulation No. 7

In their 2012 Shell Revised Chukchi Sea EP (Shell, 2011a), Shell describes proposed actions to comply with Stipulation No. 7 as follows:

> Stipulation No.7 has 4 parts. Part A(1) mandates that EP's for exploration drilling anywhere in the Chukchi include a plan for recording and reporting bird strikes, and therefore applies to Shell. Parts A(2) and B(2) place restrictions and lighting requirements on vessel and aircraft operations in certain listed blocks, in federal waters shoreward of those blocks, and in the Ledyard Bay Critical Habitat Unit (LBCHU), during specific dates, and these restrictions would apply to any activities associated with Shell's EP that would take place in these areas during these dates. Part B(1) places lighting requirements on drilling structures and applies to the use of drilling structures anywhere in the Chukchi Sea, and therefore applies to Shell's EP. Part B(2) also places restrictions on the use of lights on support vessels in the listed blocks and federal waters shoreward of these blocks, and these restrictions would apply to any vessel traffic associated with Shell's EP that would occur in these specific areas.
>
> Shell has developed a Bird Strike Avoidance and Lighting Plan (Appendix I) that covers the planned exploration drilling program in the revised Chukchi Sea EP. In development of the plan, Shell considered all the measures identified for consideration in the stipulation, and selected the most proven and practical measures to minimize the likelihood that marine birds will strike the drillship or support vessels. Shell's plan includes:
>
> - Bird strike monitoring will include recording and reporting bird strikes for the collection of information on bird strikes and lighting configuration. This information can be used to better understand methods to reduce bird strikes.
> - Avian monitoring including visual observations and radar assessments to determine bird use of the prospect areas during the drilling season.
> - Installing shading and directing some drillship lights inward and downward to living and work structures to minimize the amount of light radiating from the drillship.
> - Lighting modifications including replacing some lights on the drillship with ClearSky light technology where applicable to reduce the amount of red light output.
> - Minimizing the use of high-intensity work lights on support vessels.
> - Restricting aircraft and vessel traffic such as restrictions on travel routes and flight altitudes, including: the avoidance of travel within the LBCHU between 1 July and 15 November by the drillship and all support vessels.
>
> In addition, Shell plans to conduct both visual and radar assessments of the numbers and species of birds around the drill sites during the operations, and investigate the reactions of the birds to the vessels. This data should aid in the assessment of risk for future programs and provide some indication of the efficacy of the mitigation measures. The risk of Shell's exploration drilling program having an effect on marine birds, especially Steller's eiders and spectacled eiders, due to collisions, is minimal because exploration drilling would occur after the spring migration of most of these species, and more than 64 statute mi (103 km) offshore where the bird presence is relatively low.

References

Shell. 2011a. 2012 Revised Outer Continental Shelf Lease Exploration Plan, Chukchi Sea Alaska. Anchorage, AK: Shell Gulf of Mexico Inc. http://alaska.boemre.gov/ref/ProjectHistory/2012_Shell_CK/revisedEP/EP.pdf

Appendix H

Worst Case Discharge Verification

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United States Department of the Interior
BUREAU OF OCEAN ENERGY MANAGEMENT
Alaska OCS Region
3801 Centerpoint Drive, Suite 500
Anchorage, Alaska 99503-5823

NOV 16 2011

Memorandum

To: Regional Director, Bureau of Safety and Environmental Enforcement (BSEE), Alaska OCS Region
Regional Supervisor, Leasing and Plans, Bureau of Ocean Energy Management (BOEM), Alaska OCS Region
Regional Supervisor, Environment, BOEM, Alaska OCS Region
Christy Bohl, Oil Spill Program Administrator, BSEE, Alaska OCS Region
David M. Moore, Chief, Oil Spill Response Division, BSEE, Herndon

From: Rance R. Wall
Regional Supervisor, Resource Evaluation, BOEM, Alaska OCS Region

Subject: Verification of Worst Case Discharge (WCD) Model for *Shell Gulf of Mexico Inc.* 2011 Chukchi Sea Exploration Plan

Summary of Worst-Case-Discharge (WCD) Verification Results

Resource Evaluation (*BOEM*, Alaska OCSR) has conducted a verification of the worst-case-discharge (WCD) model submitted by *Shell Gulf of Mexico Inc* (hereafter *Shell GOMI*) as part of their May, 2011 Chukchi Sea Exploration Plan. The proposed exploration plan includes 6 wells at the Burger structure—the Burger "J", Burger "S", Burger "A", Burger "V", Burger "F", and Burger "R" wells. Of these 6 wells, the Burger J well is presented as offering the highest potential oil discharge rate. Table 1 replicates table 2.g-1 in the public part of the *Shell GOMI* 2011 EP proposal and lists the maximum or "WCD" oil discharge rates for each of the 6 wells.

A gas accumulation, possibly capping an oil accumulation, was discovered at the Burger structure by the Burger 1 well, a two-(open-water) season well that was completed in 1990 (Craig and Sherwood, 2004) on a lease acquired in a 1988 lease offering. The 1988 leases were all relinquished by 1996, but many Burger leases were re-acquired in lease sale 193 in 2008. The Burger 1 well and the six proposed exploration wells are located in figure 1.

BOEM concurs with the *Shell GOMI* assertion that the Burger J well offers the highest potential discharge volume in both daily rate and cumulative flow. To validate the *Shell GOMI* WCD model for the Burger J well, *BOEM* used the *AVALON/MERLIN* software to evaluate an independent *BOEM* geological model for the WCD well based upon proprietary seismic data and geological forecasts.

The key finding is that the independent *BOEM* WCD model forecasts an oil WCD rate of 13,091 bbls/day that is considerably less than the *Shell GOMI* oil WCD rate of 23,100 bbls/day. Similarly, the *BOEM* model forecasts cumulative oil discharges over 30-, 34-, and 38-day time periods that are all considerably less than the cumulative discharges forecast by the *Shell GOMI*

WCD model. The *BOEM* and *Shell GOMI* results are compared in table 2. **The *Shell GOMI* worst-case-discharge model for the Burger J well in the 2011 Chukchi Sea exploration plan is therefore verified as a "worst case" by the independent *BOEM* WCD model.**

Geological Setting of Burger J Well

The Burger J well proposes to test the south flank of the Burger structure and a possible extension of a hydrocarbon accumulation discovered in 1990 by the Burger 1 (OCS Y-1413-1) well. The Burger structure is approximately 25 miles in diameter and covers nearly 200,000 acres within closure (i.e., potential hydrocarbon capture area within prospect) (Craig and Sherwood, 2004, p. 1 and pl. 2). Although the 1990 well encountered a gas accumulation and recovered some gas samples with liquids, it left many questions unanswered about the contents of the greater structure at distance from the well.

The Burger 1 well encountered two gas-bearing sandstones. The uppermost gas sandstone was encountered at about 2,000 ft (measured) within the Cretaceous (Albian or 100-112 millions of years old [Ma.])-age Nanushuk Group (numerical age brackets from Walker and Geissman, 2009). The deeper gas sandstone at 5,560 ft (measured) forms the key discovery at Burger and is informally termed the "Burger" sandstone. The Burger sandstone appears to be Valanginian (or 136-140 Ma.) in age (Mickey et al., 2006), somewhat older than the closely analogous Hauterivian-age (130-136 Ma.) Kuparuk sandstone that forms the principal oil reservoir in the 2.76-billion-barrel Kuparuk oil field (AKDOG, 2009) west of Prudhoe Bay.

The Burger sandstone is 107 ft in thickness and Craig and Sherwood (2004) estimated that 86 ft or 80% of the sandstone contains gas in sufficient saturations to support flow into a wellbore. Alternate assumptions and threshold criteria in subsequent *BOEM* reservoir models indicate that the aggregate thickness of hydrocarbon flow units could exceed 90 ft. No flow tests were conducted on the Burger sandstone although wireline "RFT" devices (termed "repeat formation testers" that extend probes into the wall of the wellbore and capture small quantities of pore fluids) recovered natural gas and petroleum liquids.

The recovered Burger sandstone petroleum liquids range from 32-57°API and appear to reside primarily in solution in the gas. Gas wetness (ratios of large-carbon-number gas molecules to methane [C1]) are elevated in the rock column beneath the Burger sandstone in the Burger 1 well, as shown in figure 2. Core samples indicate a high level of residual oil trapped within the Burger sandstone (fig. 3) and some ratios among gases (methane, ethane, butane, etc.) suggest that the gas may be in contact with free oil (Craig and Sherwood, 2004, fig. 17). Certain wireline log responses suggest free liquid saturations in the lower part of the Burger sandstone although alternate interpretations related to rock composition may explain log responses that mimic liquid saturations (Craig and Sherwood, 2004, fig. 6). These observations have spurred speculations that an oil pool exists beneath the gas encountered in the upper part of the Burger sandstone at the Burger 1 well. The *BOEM* worst-case-discharge model is constructed around an (unproven) assumption of the existence of an oil-saturated Burger sandstone at the Burger J well.

The porosity and permeability of the Burger sandstone were documented by a series of 16 rotary sidewall cores obtained in the Burger 1 well. The core porosity and permeability data are charted in figure 4. Two data groups are observed, corresponding to an upper sand member with

excellent reservoir quality and a lower "muddy" sand member with diminished reservoir quality owing to the presence of detrital clays. Sherwood (2011) used the core data to calibrate a log-based model for the porosity and permeability of the Burger sandstone, shown in figure 5. The arithmetic averages (porosity, 0.271; permeability, 249 mD) of the "pay"[1] zones in the log-based models were extended to the WCD reservoir modeled for the proposed Burger J exploration well and are among the WCD input data listed in table 3.

Samples of gas and petroleum liquids were captured from the Burger sandstone at 3 depth points by RFT devices and petroleum liquids were extracted by solvents from several rotary sidewall core samples. These petroleum liquids are believed to be mostly "condensate" that resides in solution in the gas and separates from the gas when lifted to surface pressure and temperature. As shown in table 4, the API gravities of the recovered liquids range from 57.2° down to a minimum of 32°. Many of the analyses of sidewall cores reported high residual oil saturations, as shown in figure 3, but the recovered quantities were too small for gravity determinations. The RFT recoveries of liquids with API gravity <40° API could include some of the residual oil widely noted in the sidewall cores. Analyses for carbon-13 isotopes of RFT liquids and the liquids extracted from sidewall core samples are listed in table 4 and charted in figure 6. The carbon-13 isotope data for the Burger petroleum liquids plot near the 36°-37.2° API gravity oils of Umiat field and imply a correlative source or thermal history; the association further suggests a high gravity for the residual oil in the Burger sandstone and the hypothetical oil column beneath the gas. A 35.3° API gravity oil was recovered at the Klondike 1 well, but figure 6 shows that the Klondike oil is quite different from the Burger liquid petroleum in terms of carbon-13 isotopes. In the end, the gravity of the residual oil in the Burger sandstone is not explicitly known and the gravity of a hypothetical oil column beneath the gas remains a matter for speculation. Because the lowest gravity oil recovered in the Burger 1 well was a 32° API oil recovered with gas in the upper, gas-charged sand member, it seems likely that the gravity of the residual oil and perhaps the hypothetical oil column beneath the gas is somewhat less than 32° API. For purposes of WCD modeling of the Burger J well, an oil of 30° API gravity was assumed.

The Gemini Solutions *AVALON/MERLIN* Computer Model for Worst-Case Discharge

The computer model used to forecast the flow of fluids out of the Burger J well is a state-of-the-art proprietary commercial program by *Gemini Solutions, Inc.*, of Richmond, Texas (http://www.geminisi.com/). The program is constructed as a desktop finite-difference simulator that divides the active flow system into many small cells and then iterates through time-increments of flow with mathematical re-assessments that successively modify the state of each cell in the flow system. Cells may be defined in radial or Cartesian coordinates and both types of models are typically tested and compared. Finite-difference models use approximations to relevant differential equations to calculate changes (e.g., pressures, fluid saturations, etc. in the case of fluid flow) within each cell. The incremental approach minimizes approximation errors by confining individual calculations to small, individual cells and makes it possible to quantify behavior across complex systems with internal discontinuities (e.g., flow from reservoir to open well to casing to production manifold to pipeline, etc.). The model is robust, offering the

[1] *"pay" zones have hydrocarbon saturations (ratio of hydrocarbon to brine) sufficiently high to permit the flow of hydrocarbons out of rock pores and to the wellbore. In this model the adopted threshold for "pay" is a 40% hydrocarbon (oil or gas) pore saturation (Sherwood, 2011, p.14).*

capability to model fluid behavior through fundamental compositional data or through measured physical properties that can be used to forecast (through correlations) other properties.

The *Gemini Solutions Inc* model consists of two components, "*AVALON*" and "*MERLIN*", that respectively simulate: 1) flow up a system of tubular passages (or "tubulars"); and 2) inflow (into the bottom of a well) from a pressurized porous reservoir. The correlative capacities of these two components of the flow system determine the discharge rate that can be achieved through the exit point at the top of the well.

In theory, the maximum possible discharge rate can be limited by either the aggregate outflow capacity of the tubulars or by the reservoir inflow capacity at the base of the well. In the design of development wells and take-away pipelines, these two components of the flow system, the tubulars and the reservoir, are balanced to achieve the most efficient long-term recovery of formation hydrocarbons from the field. For a high-yield reservoir the outflow discharge rate is usually limited by the choke effect of wellbore tubulars that are insufficient to accommodate the maximum potential inflow from the reservoir.

The capacity for flow up the open (uncased) wellbore and the casing is governed by the tubular sizes (diameter and length), roughness, frictional resistance, the driving formation pressure, and the density characteristics and thermal effects of the multiphase oil-gas-water mix (ranging from gassy liquid(s) to wet gas) moving upward through the wellbore. Flowing bottom-hole pressures at the base of the tubulars are likewise a function of the aggregate density of the multiphase wellbore fluids, frictional and gravitational resistance to flow, ambient pressure (wellhead exterior), and reservoir pressure.

The inflow from the reservoir formation is chiefly governed by flowing bottom-hole pressure, pore system size and connectivity, formation pressure, drive mechanism, fluid compositions, fluid properties at reservoir conditions of pressure and temperature, and the length of the wellbore segment passing through the reservoir formation. The geological model for inflow is discussed further below in order to illustrate how key geological variables control discharge rate.

Darcy Radial Flow Equation and Sources of Basic Data for Burger J WCD Model

The most important variables for the reservoir inflow component of the discharge model include the aggregate thickness of flow units (h), initial (pore) pressure (p_i), flowing bottom-hole pressure (p_{wf}), and permeability-to-oil (k_o) of the reservoir formation. Inflow rates are particularly sensitive to permeability, which at extremes can vary across 7 orders of magnitude (0.01-10,000 mD) or greater. Other important variables include oil viscosity (μ_o) and oil formation volume factor (B_{oi}), which can vary by several factors. Possible quantitative ranges for variables are listed in the key below the following equation to convey a sense of variance among the key variables and relative sensitivities to outcome.

At any particular instance, the flow of fluids out of a reservoir and into a well, or "inflow", is grossly governed by the Darcy radial flow equation, as summarized in its simplest form for an oil reservoir below. The purpose of including the equation here is to illustrate the roles of the key variables in determining oil flow rate, denoted in the convention of petroleum engineers as "q_o". Note that in the basic Darcy equation the discharge-limiting constraint imposed by the wellbore

tubular system is represented only by the assumed bottom-hole flowing pressure (p_{wf}). In practice, the latter is supplied by the *AVALON* analysis of the system of tubulars from the reservoir to the surface. As can be seen in the Darcy radial flow equation, p_{wf} acts to oppose inflow; when $p_{wf} = p_i$, the inflow rate (q_o) is zero.

Darcy radial flow *(steady-state) equation from Ahmed (2010, p. 435, equation 6-144)*

$$q_o = \frac{0.00708 * k_o * h * (p_i - p_{wf})}{\mu_o * B_{oi} * ((\ln r_e / r_w) + S)}$$

where

q_o= oil flow rate, barrels/day;
k_o=permeability to oil, mD, typically 0.01- >10,000 mD;
h= thickness, ft, typically 10-200 ft;
p_i = initial reservoir pore pressure, psi, typically 1,500-20,000 psi;
p_{wf} = bottom-hole flowing pressure, psi, typically 300-8,000 psi;
μ_o = oil viscosity, cp, typically 0.1 to 30.0 cp;
B_{oi} = oil formation volume factor, reservoir bbls per stock-tank bbl, typically 1.0-3.0;
r_e = drainage radius, ft, typically 1,000-60,000 ft;
r_w = radius of well, ft, typically 0.35 to 0.73 ft;
S = skin factor, dimensionless, typically 0-500.

Many other variables of lesser importance that do not appear in the Darcy radial flow equation are required for the *AVALON/MERLIN* reservoir inflow simulator. Table 3 summarizes some of the key reservoir and fluid properties and model parameters that formed the input data to the reservoir inflow model. Variables that appear in the Darcy radial flow equation above are highlighted.

In the Burger J well discharge model, no factors related to the near-wellbore alteration of the reservoir formation that might limit flow rate or arrest the discharge were incorporated into the model. The "skin factor (S)" shown in the Darcy radial flow equation above usually quantifies the plugging of reservoir pores (by drilling fluid solids) that often accompanies the drilling of a well; for the Burger J model "S" is set to zero (no effect on discharge rate). Furthermore, the *BOEM* WCD model assumes that no "bridging" or collapse of the open segment of the wellbore is present to restrict or terminate flow. And, no near-wellbore reservoir boundaries (such as faults) are invoked to limit the potential drainage area.

Reservoir pressure and temperature are forecast from data collected in the Burger 1 well located 8.5 statute miles northeast of the Burger J location (fig. 1). The tracing of the Burger sandstone reservoir formation to the Burger J location is accomplished by extending associated seismic reflection(s) away from the Burger 1 well through a grid of proprietary seismic data. Estimates for reservoir porosity and permeability are based on core and log data from the Burger 1 well.

The gross thickness of the Burger sandstone at the Burger J location is extrapolated from the Burger 1 well. The fraction (here, 85%) of the gross sandstone interval that offers sufficient porosity and permeability to flow hydrocarbons to a wellbore is estimated to be 91 ft, which forms the "h" value or the aggregate thickness of flow units for the Burger J WCD model.

The WCD oil saturation model is based on the maximum hydrocarbon saturation obtained by log calculations for the Burger sandstone at the Burger 1 well. The WCD well is modeled as in possible pressure communication with an area within a radius of 43,000 ft of the well, although the actual area of pressure support during the 90-day event is apparently within a radius of less than 1,500 ft. [2]

The oil discharged from the Burger J well is assumed to be 30° API crude oil on the basis of observations discussed above. The oil in the Burger J reservoir is assumed to be saturated (contains the maximum amount of dissolved gas possible at the inferred reservoir temperature and pressure). Therefore, the bubble-point pressure (pressure at which dissolved gas breaks out of solution and forms bubbles in the oil) is assumed to equal the initial reservoir pressure (p_i). The pressure-temperature model, the assumed oil gravity, and the assumption of saturation then lead through various correlations and calculations to estimates for B_{oi} (oil volume factor, in reservoir barrels [rb] per surface or "stock tank" barrel [stb]), Rsi (dissolved gas content, in surface or standard cubic ft [scf] per stock tank barrel [stb]), μ_o (oil viscosity, in centipoise [cp]), reservoir oil density (g/cm^3), and static pressure gradient for reservoir oil (in psi/ft). Most of the fluid and rock parameters were obtained through the use of industry-accepted correlations as published by many sources including Craft and Hawkins (1959), Craft et al. (1991), Standing (1977, and other references therein), McCain (1973, and references therein), and Ahmed (2010, and many references therein).

The drive mechanism for the oil discharge is assumed to be pressure depletion and expansion of a gas cap and exsolved solution gas. The estimate for specific gas gravity is based on analyses of gas samples obtained by RFT sampling of pore fluids at the Burger 1 well. Estimates for fluid and rock compressibility are based upon assumptions about rock consolidation, porosity, pressure, temperature, dissolved gas content, relative fluid saturations, and brine composition. The brine salinity is based on formation waters recovered in an RFT sample at the Burger 1 well. The estimate for brine viscosity is based upon the salinity assumption and reservoir temperature.

The Burger J WCD model adopted a system of radial cells with an initial (innermost) cell radius of 12 ft. Outward from the well, cell radii progressively enlarge approximately 15% for each cell increment (15% wider than the adjacent inner cell).

Comparison of Worst-Case-Discharge Modeling Results

The *BOEM* WCD model for discharges at the Burger J well incorporates flow from an oil-bearing Burger sandstone that is speculated to be penetrated by the open-hole part of the well. Gas in proportion to oil is also discharged. Water discharge is negligible. The results of the *Shell GOMI* and *BOEM* WCD models, including cumulative oil and gas discharges at 15, 30, 34, 38, and 90 days are summarized in table 2. The *Shell GOMI* forecasts for maximum (WCD) discharge rate and cumulative oil discharge are considerably greater at all points of comparison through the flow period.

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[2] *Based upon model runs of various drainage areas that produced negligible differences in flow.*

***BOEM* WCD Model for the Burger J Well**

A comprehensive discharge schedule for the Burger J *BOEM* WCD model over a 90-day period is reported in tables 5a and 5b. Figure 7 provides a chart that illustrates the flow patterns among selected elements of tables 5a and 5b.

Following the blowout, the oil discharge in the *BOEM* model climbs rapidly to a maximum daily rate of 13,091 bbls/day over the course of day 1. After peaking in day 1, figure 7 shows that the oil discharge rate in the *BOEM* model declines abruptly (overall, 14.5% per day[3]) through the first 3 days of flow, moderately (overall, 1.1% per day) from day 3 to day 18, and thereafter declining more slowly (overall, 0.15% per day) out to 90 days. The overall annualized oil discharge decline rate over 90 days is approximately 95%/year.

Some key timelines and cumulative oil discharge estimates follow (also listed in tbls. 2, 5a and 5b):

- At the end of day 15, the cumulative oil discharge reported in the *BOEM* WCD model is 121,779 bbls. *Shell GOMI* does not publicly provide a discharge quantity at day 15.

- At the end of day 30, the cumulative oil discharge reported in the *BOEM* WCD model is 226,145 bbls. *Shell GOMI* does not publicly provide a WCD discharge quantity at day 30. *Shell GOMI* instead adopts a quantity of 750,000 bbls at day 30 (Shell, 2011, tbl. 8.d-1, p. 8-2) as the basis for their Oil Discharge Prevention and Contingency Plan (ODPCP). This quantity is considerably larger than the actual modeled discharges at 34 and 38 days, reported below and in table 2.

- At the end of day 34, the cumulative oil discharge reported in the *BOEM* WCD model is 253,234 bbls whereas the *Shell GOMI* WCD model reports a cumulative discharge of 603,564 bbls (Shell, 2011, tbl. 8.d-2, p. 8-3).

- At the end of day 38, the cumulative oil discharge reported in the *BOEM* WCD model is 279,954 bbls whereas the *Shell GOMI* WCD model reports a cumulative discharge of 669,479 bbls (Shell, 2011, tbl. 8.d-2, p. 8-3).

- Finally, at the end of day 90, the cumulative oil discharge reported in the *BOEMRE* WCD model is 613,076 bbls. *Shell GOMI* does not report a 90-day cumulative oil discharge.

Also shown in tables 2, 5a, and 5b are the substantial cumulative gas discharges from the Burger J WCD event. At the end of day 15, the cumulative gas discharge reported in the *BOEM* WCD model is $60{,}161*10^3$ cubic feet (by convention reported as 60,161 Mcf). At the end of day 30, the cumulative gas discharge reported in the *BOEM* WCD model is 113,426 Mcf. At the end of day 34, the cumulative gas discharge reported in the *BOEM* WCD model is 127,185 Mcf. At the end of day 38, the cumulative gas discharge reported in the *BOEM* WCD model is 140,821 Mcf. And, at the end of day 90, the cumulative gas discharge reported in the *BOEM* WCD model is 311,739 Mcf.

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[3] *Calculated as: decline (fraction per day) = [(final rate/initial rate)^(1/number of days)] - 1*

References Cited

Ahmed, T., 2010, Reservoir Engineering Handbook: Fourth Edition, Elsevier, Gulf Professional Printing, Burlington MA and Kidlington, UK, 1,454 p.

AK DOG (Alaska [State] Division of Oil and Gas), 2009, 2009 Annual Report, Section 1: Historic and Forecast Production. Available on line at http://dog.dnr.alaska.gov/Publications/Documents/AnnualReports/Section1_2009.pdf (accessed 03 Nov'11).

Craft, B.C., and Hawkins, M.F., 1959, Applied Petroleum Reservoir Engineering: Prentice Hall, Englewood Cliffs, NJ, 437 p.

Craft, B.C., Hawkins, M.F., and Terry, R.E., 1991, Applied Petroleum Reservoir Engineering: 2nd edition, Prentice Hall, Upper Saddle River, New Jersey, 07458, 431 p.

Craig, J.D., and Sherwood, K.W., 2004, Economic Study of the Burger Gas Discovery, Chukchi Shelf, Northwest Alaska: Minerals Management Service Report published online in 2001, revised December 2004, and re-posted in January 2005, 77 p. Available online at http://www.alaska.boemre.gov/re/reports/REREPORT.HTM (accessed 03 Nov'11).

Masterson, W.D., 2001, Petroleum filling history of central Alaskan North Slope fields: Ph.D. thesis, University of Texas at Dallas, Dallas, Texas, 222 p.

McCain, W.D., Jr., 1973, The Properties of Petroleum Fluids: Petroleum Publishing Company, Tulsa, OK, 325 p.

Magoon, L.B., and Bird, K.J., 1985, Alaskan North Slope Petroleum Geochemistry for the Shublik Formation, Kingak Shale, Pebble Shale, and Torok Formation: in: *Alaska North Slope Oil/Rock Correlation Study,* American Association of Petroleum Geologists, Studies in Geology No. 20, Magoon, L.B., and Claypool, G.E. (eds.), p. 31-48.

Mickey, M.B., Haga, H., and Bird, K.J., 2006, Micropaleontology of Selected Wells and Seismic Shotholes, Northern Alaska: U.S. Geological Survey Open File Report 2006-1055. Available online at: http://pubs.usgs.gov/of/2006/1055/.

Molenaar, C.M., 1982, Umiat field, an oil accumulation in a thrust-faulted anticline, North Slope of Alaska: in: *Geological Studies of the Cordilleran Thrust Belt, Volume II,* R.B. Powers (ed.), Rocky Mountain Association of Geologists, p. 537-548.

Shell (Gulf of Mexico, Inc.), 2011, Revised Outer Continental Shelf Lease Exploration Plan, Chukchi Sea, Alaska; Burger Prospect: Posey Area Blocks 6714, 6762, 6764, 6812, 6912, 6915; Chukchi Sea Lease Sale 193: May 2011 (and revised version received 11 oct'11). Submitted to Bureau of Ocean Energy Management, Regulation and Enforcement, U.S. Department of the

Interior, Alaska OCS Region. Available for public access at http://alaska.boemre.gov/ref/ProjectHistory/2012_Shell_CK/2012x_.HTM (accessed 14 nov'11).

Sherwood, K.W., 2011, Determination of Burger Sandstone Properties for WCD Modeling: Internal BOEM report dated 12 july 2011, file: *Burger_Sandstone_por_perm_model_WCD.doc*, 33 p.

Standing, M.B., 1977, Volumetric and phase behavior of oil field hydrocarbon systems: Society of Petroleum Engineers of AIME, Dallas, TX, 130 p.

Walker, J.D., and Geissman, J.W., (compilers), 2009, Geologic Time Scale (Chart): Geological Society of America. Doi: 10.1130/2009.CTS004R2C.

If you have any questions, please contact myself (907-334-5321), Robert Peterson (907-334-5340), Kirk Sherwood (907-334-5337), or Michael Lu (907-334-5335).

Attachments

cc: Chief, REAS
Chief, RAS
K. Sherwood
M. Lu

Table 1: Shell Offshore Inc Calculated WCD Oil Discharge Rates, 2011 Chukchi Sea EP

Potential Well	Calculated Worst Case Discharge (bbls/day)
Burger J	23,100
Burger S	19,127
Burger A	19,031
Burger V	13,812
Burger F	11,763
Burger R	8,689

data from table 2.g-1 (public version) of revised Shell GOMI Chukchi Sea Exploration Plan as received 11 oct'11 by BOEM-Anchorage. Highlighted well is worst-case-discharge well for the exploration plan.

Table 2. Comparison of Worst-Case-Discharge Modeling Results for Burger J Well

WCD Model-Oil	Maximum Daily Oil Rate (bbls/day)	Cumulative Oil Discharge at Day 15 (bbls)	Cumulative Oil Discharge at Day 30 (bbls)	Cumulative Oil Discharge at Day 34 (bbls)	Cumulative Oil Discharge at Day 38 (bbls)	Cumulative Oil Discharge at Day 90 (bbls)
Shell GOMI	23,100*	Proprietary	750,000**	603,564***	669,479***	Not Reported
BOEM	13,091	121,779	226,145	253,234	279,954	613,076

WCD Model-Water	Maximum Daily Water Rate (bbls/d)	Cumulative Water Discharge at Day 15 (bbls)	Cumulative Water Discharge at Day 30 (bbls)	Cumulative Water Discharge at Day 34 (bbls)	Cumulative Water Discharge at Day 38 (bbls)	Cumulative Water Discharge at Day 90 (bbls)
Shell GOMI	Proprietary	Proprietary	Proprietary	Proprietary	Proprietary	Not Reported
BOEM	0	0	0	0	0	0

WCD Model-Gas	Maximum Daily Gas Rate (Mcf/day)	Cumulative Gas Discharge at Day 15 (Mcf)	Cumulative Gas Discharge at Day 30 (Mcf)	Cumulative Gas Discharge at Day 34 (Mcf)	Cumulative Gas Discharge at Day 38 (Mcf)	Cumulative Gas Discharge at Day 90 (Mcf)
Shell GOMI	Proprietary	Proprietary	Proprietary	Proprietary	Proprietary	Not Reported
BOEM	5,634	60,161	113,426	127,185	140,821	311,739

bbls= barrels; Mcf=1,000 standard cubic feet (measured at standard conditions of 1 atmosphere and 60°F).

* the *Shell GOMI* oil WCD rate declines over the discharge period as reported in proprietary section 3.0 of the exploration plan.

** the 30-day cumulative volume of 750,000 bbls is proposed by *Shell GOMI* for purposes of developing an Oil Discharge Prevention and Contingency Plan (ODPCP). The 30-day volume is calculated for the ODPCP by assuming a worst-case daily volume of 25,000 bbls/d held constant over 30 days (25,000*30=750,000) as noted in table 8.d-1 on page 8-2 of the *Shell GOMI* Chukchi Sea exploration plan.

*** these values are WCD model cumulative volumes excerpted (by *Shell GOMI*) from proprietary section 3.0 and made public in table 8.d-2 on page 8-3 of the Chukchi Sea exploration plan. Note that these values are exceeded by the 750,000 bbls developed by *Shell GOMI* as the basis for their Oil Discharge Prevention and Contingency Plan (ODPCP) in the Chukchi Sea exploration plan.

Table 3. Summary of Selected Model Input Data for *BOEM* WCD Model for Burger J Well

Initial Reservoir Pressure (p_i, psi)	3,186	Oil Gravity (°API)	30
Flowing Bottom-Hole Pressure (p_{wf}, psi) - Modeled by *AVALON/MERLIN*	~1,000	Initial **Boi** or FVF (reservoir volume/standard volume)	1.27
Reservoir Temperature, °F (°R)	138 (598)	Initial Rsi or GOR (standard cubic feet/surface or standard bbl)	579
Reservoir Porosity (fraction of rock)	0.27	Bubble Point Pressure (psi)	3,186
Reservoir Horizontal Permeability (**k**, mD)	249	Dead (Gas-Free) Oil Viscosity at Standard (Surface) Conditions (μ_{OD}, cp)	5.86
Reservoir Vertical Permeability (**k**, mD)	25	Oil Viscosity (μ_O, cp)	1.28
Aggregate Thickness Flow Units (**h**, ft)	91	Skin Factor (**S**)	0
Drainage Radius (r_e, ft)	43,000	Reservoir Oil Density (g/cm^3)	0.778
Well Radius at Reservoir (r_W, ft)	0.35-0.52	Static Pressure Gradient of Reservoir Oil (psi/ft)	0.337
Initial Oil Saturation (fraction of porosity)	0.81	Specific Gas Gravity (Air=1.0)	0.6
Residual Oil to Gas (fraction)	0.30	Formation Compressibility, Cf (microsips or v/v/psi*10^{-6})	2.9
Residual Oil to Water (fraction)	0.30	Oil Compressibility, Co (microsips or v/v/psi*10^{-6})	9.7
Critical Gas Saturation	0.10	Brine Compressibility, Cw (microsips or v/v/psi*10^{-6})	3
Endpoint for Oil Relative Permeability Curve (kro, fraction of "k")	0.90	Total Compressibility, Ct (microsips or v/v/psi*10^{-6})	11.2
Endpoint for Water Relative Permeability Curve (krw, fraction of "k")	0.15	Brine Salinity (ppm NaCl)	37,700
Endpoint for Gas Relative Permeability Curve (krg, fraction of "k")	1.00	Brine Viscosity (cp)	0.53
Exponent for Oil-Water Relative Permeability Curve (n_{OW}, a curve shape factor)	3.5	Water Volume Factor (B_W, reservoir volume/standard volume)	1.012
Exponent for Oil-Gas Relative Permeability Curve (n_{OG}, a curve shape factor)	3.5	Assumed Casing Roughness (inches)	0.0018
Exponent for Water Relative Permeability Curve (n_W, a curve shape factor)	3.5	Assumed Open-Hole Roughness (inches)	0.1
Exponent for Gas Relative Permeability Curve (n_G, a curve shape factor)	3.5	Ambient Wellhead Temperature (°F)	30

psi, pounds per square inch; °R, °Rankine (=°F+460); Boi, oil volume factor (aka FVF or formation volume factor); rb/stb, reservoir barrels per stock-tank barrel of oil (at 1 atmosphere and 60°F); Rsi, gas saturation (aka GOR or gas-oil ratio); scf/stb, standard cubic feet of gas per stock-tank barrel of oil (at 1 atmosphere and 60°F); cp, centipoise. Highlighted (yellow) variables appear in the Darcy radial flow equation.

Table 4: Burger 1 Oil & Condensate Geochemistry and $\Delta^{13}C$ Isotopes

Formation	Sample Source	Sample Depth	Sample Fraction	Shell Sample No.	API Gravity	Sulfur %	Saturates-Carbon Isotope ($\Delta^{13}C$)	Aromatics-Carbon Isotopes ($\Delta^{13}C$)	Whole Oil/Extract-Carbon Isotopes ($\Delta^{13}C$)
Burger SS	RFT 4	5586 ft md	PSRD 995	AKO-0-178A	44.1	nr	-27.34	-26.73	-28.20
Burger SS	RFT 4	5586 ft md	PSRD 1730	AKO-0-177A	39.4	0.06	-27.27	-26.94	-27.95
Burger SS	RFT 4	5586 ft md		AKO-0-175C	32	nr	nr	nr	nr
Burger SS	RFT 6	5606 ft md	nr	AKO-0-176A	54.7	0.04	-28.53	-27.45	-28.48
Burger SS	RFT 8	5648 ft md	RFS-BC 1141	AKO-0-186	51.3	nr	-28.38	-27.15	-28.63
Burger SS	RFT 8	5648 ft md	Cylinder 1080	AKO-0-185	57.2	nr	nr	nr	-28.66
Burger SS	RFT 6	5606 ft md	Sond Oil/Lab	AKO-O-179A	nr	nr	-28.57	-28.64	-27.77
Burger SS	na	na	Extract Mud Additives	AKO-S-6462	nr	nr	-27.89	-27.48	-27.59
Burger SS	SWC Extract	5581-5594 ft md	Combined from rotary swc's 7 (5581 ft), 6 (5586 ft), and 5 (5594 ft)	AKO-S-6494	nr	nr	-28.55	-27.81	-28.41
Burger SS	SWC Extract	5605-5610 ft md	Combined from rotary swc's 9 (5606 ft) and 10 (5610 ft)	AKO-S-6495	nr	nr	-28.76	-27.29	-28.06
Burger SS	SWC Extract	5644-5647 ft md	Combined from rotary swc's 14 (5644 ft), 2 (5646 ft), and 23 (5647 ft)	AKO-S-6755	nr	nr	-28.64	-27.55	-28.19
Burger SS	SWC Extract	5,624 ft md	Extract/RSWC	AKO-S-6821	nr	0.26	nr	nr	nr
Burger SS	SWC Extract	5,644 ft md	Extract/RSWC	AKO-S-6825	nr	0.2	nr	nr	nr
Burger SS	SWC Extract	5,644 ft md	Extract/RSWC	AKO-S-6825	nr	0.23	nr	nr	nr
Valanginian SS	SWC Extract	6157-6178 ft md	Combined from rotary swc's 20 (6157 ft), 16 (6167 ft), and 17 (6178 ft)	AKO-S-6756	nr	nr	-29.11	-27.91	-28.72

Table 5a. *BOEM* Worst-Case Discharge Model Results for Burger J Well, Chukchi Sea, Alaska
Flow Period Day 1 to Day 40; Radial Coordinate Cell System; Innermost Radius = 12 ft

Discharge Period (days)	Oil Discharge Rate (bbls/day)	Gas Discharge Rate (Mcf/day)	Water Discharge Rate (bbls/day)	Producing Gas-Oil Ratio (scf/bbl)	Cumulative Oil Discharge (bbls)	Cumulative Gas Discharge (Mcf)	Cumulative Water Discharge (bbls)	Flowing Bottom-Hole Pressure (psia) at Center of Reservoir	Reservoir Pressure in Cell Containing Well (psia)
0	0	0	0	0	0	0	0	0	3,186
1	13,091	5,634	0	430	13,091	5,634	0	1,062	2,216
2	8,900	4,235	0	476	21,991	9,869	0	992	2,110
3	8,196	4,197	0	512	30,187	14,066	0	985	2,097
4	8,088	4,130	0	511	38,275	18,196	0	987	2,088
5	7,995	4,084	0	508	46,270	22,260	0	990	2,080
6	7,913	4,003	0	506	54,183	26,263	0	992	2,073
7	7,835	3,948	0	504	62,018	30,211	0	995	2,065
8	7,757	3,897	0	502	69,775	34,108	0	995	2,057
9	7,676	3,843	0	501	77,451	37,951	0	999	2,052
10	7,597	3,793	0	499	85,048	41,744	0	1,002	2,045
11	7,528	3,751	0	498	92,576	45,495	0	999	2,036
12	7,455	3,711	0	498	100,031	49,206	0	996	2,026
13	7,330	3,666	0	500	107,361	52,872	0	996	2,020
14	7,244	3,649	0	504	114,605	56,521	0	994	2,013
15	7,174	3,640	0	507	121,779	60,161	0	991	2,008
16	7,100	3,639	0	513	128,879	63,800	0	984	2,005
17	7,128	3,599	0	505	136,007	67,399	0	990	2,004
18	6,969	3,624	0	520	142,976	71,023	0	994	2,002
19	7,031	3,599	0	512	150,007	74,622	0	984	1,995
20	7,012	3,589	0	512	157,019	78,211	0	985	1,993
21	6,991	3,578	0	512	164,010	81,789	0	984	1,992
22	6,964	3,561	0	511	170,974	85,350	0	988	1,992
23	6,980	3,553	0	509	177,954	88,903	0	985	1,989
24	6,887	3,556	0	516	184,841	92,459	0	988	1,987
25	6,947	3,511	0	505	191,788	95,970	0	987	1,984
26	6,901	3,515	0	509	198,689	99,485	0	987	1,983
27	6,886	3,503	0	509	205,575	102,988	0	988	1,981
28	6,868	3,492	0	509	212,443	106,480	0	988	1,980
29	6,844	3,480	0	509	219,287	109,960	0	990	1,979
30	6,858	3,466	0	505	226,145	113,426	0	988	1,977
31	6,735	3,483	0	517	232,880	116,909	0	992	1,975
32	6,829	3,417	0	500	239,709	120,326	0	989	1,972
33	6,771	3,435	0	507	246,480	123,761	0	989	1,970
34	6,754	3,424	0	507	253,234	127,185	0	990	1,969
35	6,734	3,415	0	507	259,968	130,600	0	989	1,967
36	6,707	3,404	0	508	266,675	134,004	0	991	1,966
37	6,723	3,391	0	504	273,398	137,395	0	989	1,964
38	6,556	3,426	0	523	279,954	140,821	0	993	1,962
39	6,695	3,343	0	499	286,649	144,164	0	986	1,957
40	6,616	3,381	0	511	293,265	147,545	0	986	1,956

bbls, barrels; bbls/day, barrels per day; Mcf, thousands of standard cubic feet (at standard conditions of 1 atmosphere and 60°F); Mcf/day, thousands of standard cubic feet per day; scf, standard cubic feet

Table 5b. *BOEM* Worst-Case Discharge Model Results for Burger J Well, Chukchi Sea, Alaska

Flow Period Day 41 to Day 90; Radial Coordinate Cell System; Innermost Radius = 12 ft

Discharge Period (days)	Oil Discharge Rate (bbls/day)	Gas Discharge Rate (Mcf/day)	Water Discharge Rate (bbls/day)	Producing Gas-Oil Ratio (scf/bbl)	Cumulative Oil Discharge (bbls)	Cumulative Gas Discharge (Mcf)	Cumulative Water Discharge (bbls)	Flowing Bottom-Hole Pressure (psia) at Center of Reservoir	Reservoir Pressure in Cell Containing Well (psia)
41	6,596	3,377	0	512	299,861	150,922	0	985	1,954
42	6,583	3,374	0	512	306,444	154,296	0	985	1,952
43	6,574	3,381	0	514	313,018	157,677	0	979	1,949
44	6,553	3,362	0	513	319,571	161,039	0	983	1,950
45	6,490	3,384	0	521	326,061	164,423	0	983	1,949
46	6,553	3,343	0	510	332,614	167,766	0	981	1,947
47	6,515	3,359	0	516	339,129	171,125	0	981	1,946
48	6,508	3,355	0	516	345,637	174,480	0	981	1,945
49	6,502	3,350	0	515	352,139	177,830	0	981	1,945
50	6,497	3,349	0	516	358,636	181,179	0	980	1,943
51	6,488	3,341	0	515	365,124	184,520	0	981	1,943
52	6,465	3,344	0	517	371,589	187,864	0	982	1,943
53	6,564	3,304	0	503	378,153	191,168	0	979	1,941
54	6,415	3,371	0	525	384,568	194,539	0	981	1,941
55	6,457	3,325	0	515	391,025	197,864	0	981	1,940
56	6,453	3,321	0	515	397,478	201,185	0	982	1,940
57	6,445	3,317	0	515	403,923	204,502	0	981	1,939
58	6,433	3,309	0	514	410,356	207,811	0	984	1,940
59	6,450	3,308	0	513	416,806	211,119	0	982	1,938
60	6,381	3,319	0	520	423,187	214,438	0	984	1,938
61	6,454	3,285	0	509	429,641	217,723	0	983	1,937
62	6,416	3,295	0	514	436,057	221,018	0	983	1,936
63	6,411	3,291	0	513	442,468	224,309	0	983	1,936
64	6,405	3,287	0	513	448,873	227,596	0	983	1,935
65	6,398	3,283	0	513	455,271	230,879	0	983	1,935
66	6,400	3,278	0	512	461,671	234,157	0	983	1,934
67	6,359	3,285	0	517	468,030	237,442	0	984	1,934
68	6,529	3,226	0	494	474,559	240,668	0	980	1,932
69	6,299	3,333	0	529	480,858	244,001	0	983	1,931
70	6,363	3,261	0	513	487,221	247,262	0	984	1,931
71	6,359	3,258	0	512	493,580	250,520	0	984	1,930
72	6,352	3,255	0	512	499,932	253,775	0	984	1,930
73	6,342	3,249	0	512	506,274	257,024	0	985	1,930
74	6,352	3,246	0	511	512,626	260,270	0	984	1,929
75	6,295	3,256	0	517	518,921	263,526	0	986	1,929
76	6,361	3,232	0	508	525,282	266,758	0	984	1,927
77	6,317	3,235	0	512	531,599	269,993	0	984	1,926
78	6,313	3,231	0	512	537,912	273,224	0	984	1,926
79	6,306	3,228	0	512	544,218	276,452	0	984	1,925
80	6,295	3,222	0	512	550,513	279,674	0	986	1,925
81	6,306	3,219	0	511	556,819	282,893	0	984	1,924
82	6,242	3,231	0	518	563,061	286,124	0	986	1,924
83	6,305	3,200	0	508	569,366	289,324	0	984	1,922
84	6,268	3,210	0	512	575,634	292,534	0	984	1,921
85	6,261	3,207	0	512	581,895	295,741	0	984	1,921
86	6,254	3,205	0	512	588,149	298,946	0	984	1,920
87	6,245	3,203	0	513	594,394	302,149	0	984	1,919
88	6,247	3,197	0	512	600,641	305,346	0	984	1,918
89	6,188	3,211	0	519	606,829	308,557	0	985	1,918
90	6,247	3,182	0	509	613,076	311,739	0	982	1,916

bbls, barrels; bbls/day, barrels per day; Mcf, thousands of standard cubic feet (at standard conditions of 1 atmosphere and 60°F); Mcf/day, thousands of standard cubic feet per day; scf, standard cubic feet

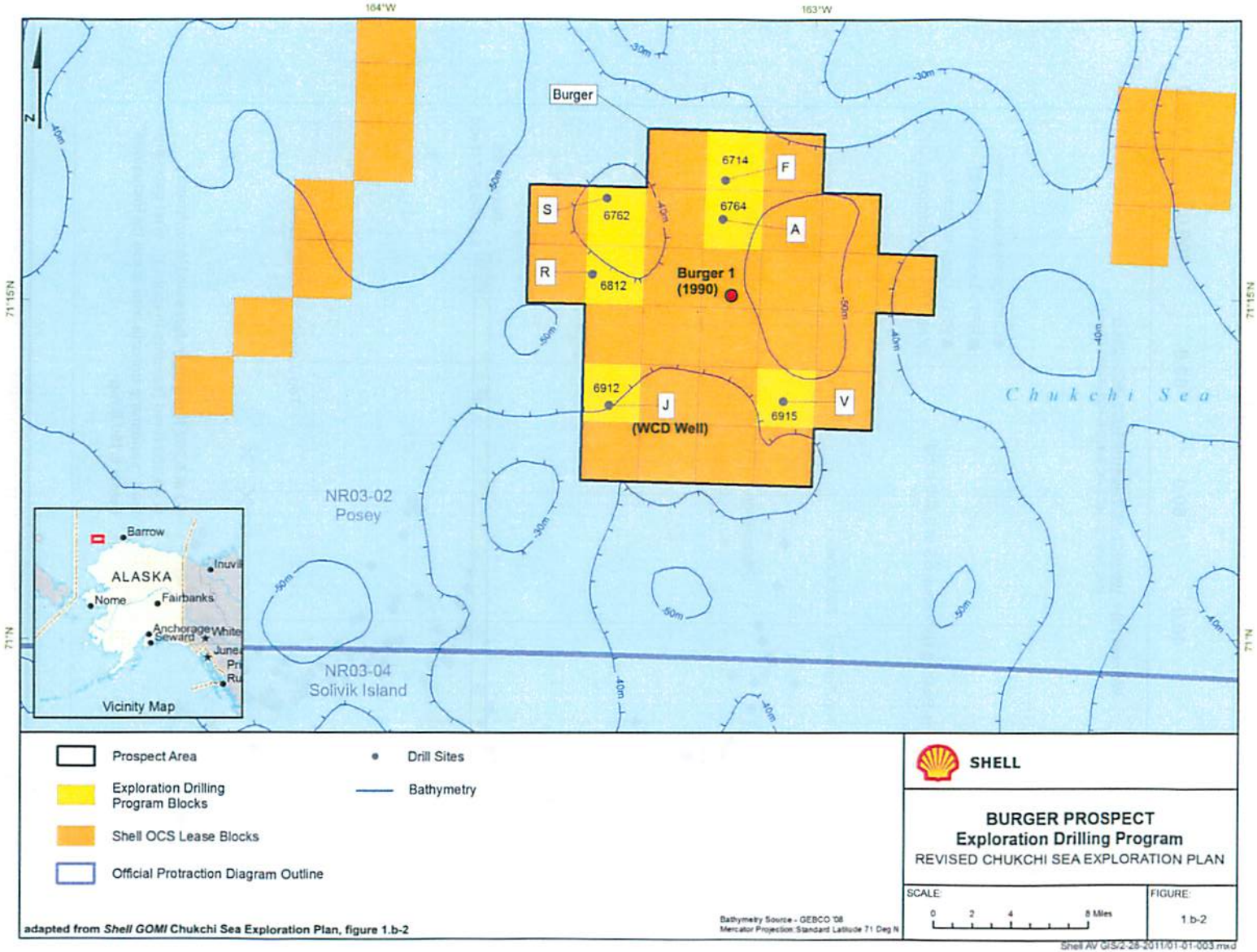

Figure 1. Location of Burger 1 discovery well and six exploration wells proposed in the *Shell GOMI* Chukchi Sea exploration plan of May 2011. The Burger "J" well is the exploration plan WCD well.

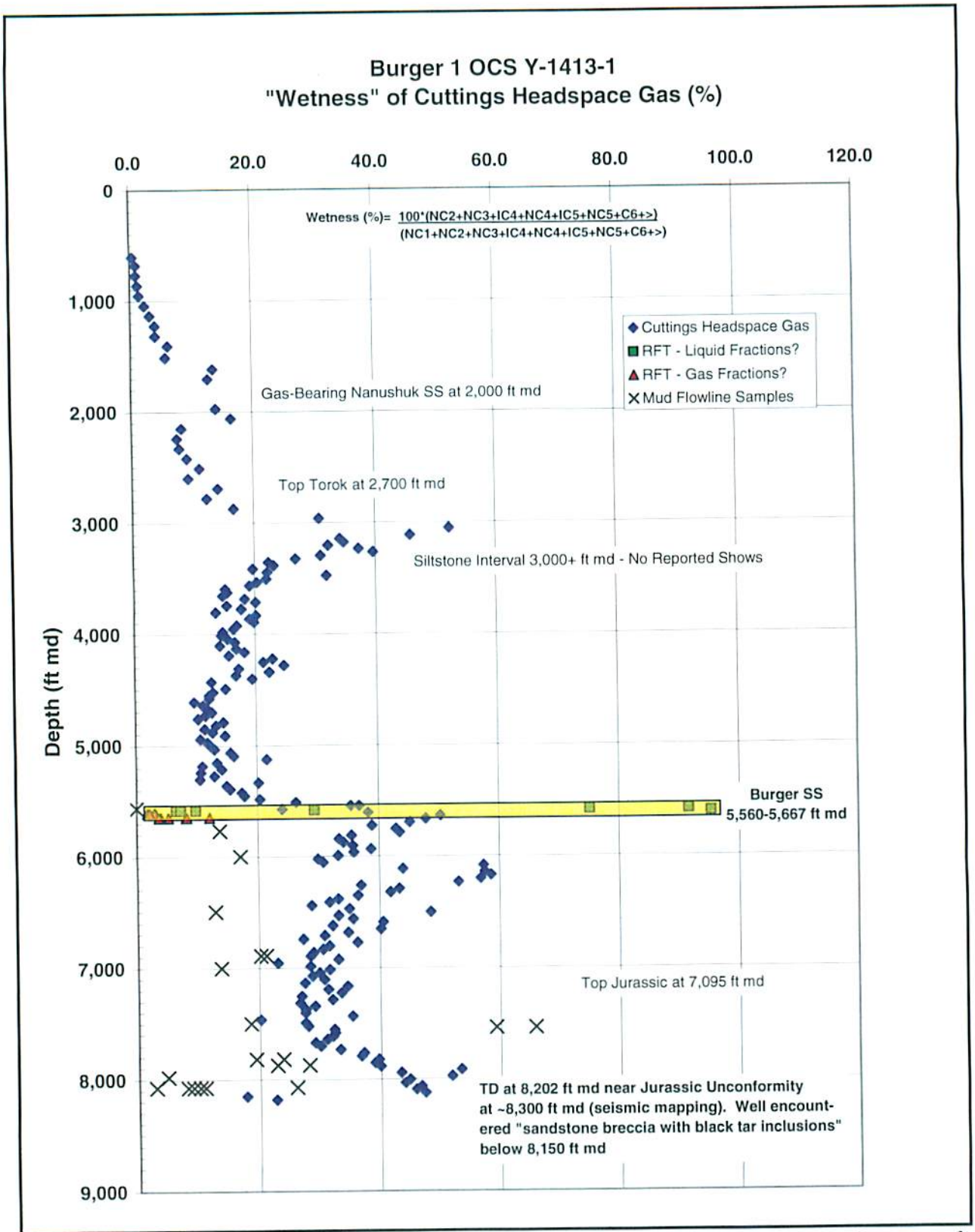

Figure 2. Gas wetness values are elevated below the Burger sandstone (highlighted in yellow) and at a second sandstone at about 6,200 ft, suggesting the possibility of a column of petroleum liquids beneath the gas column in the Burger sandstone at the Burger 1 well.

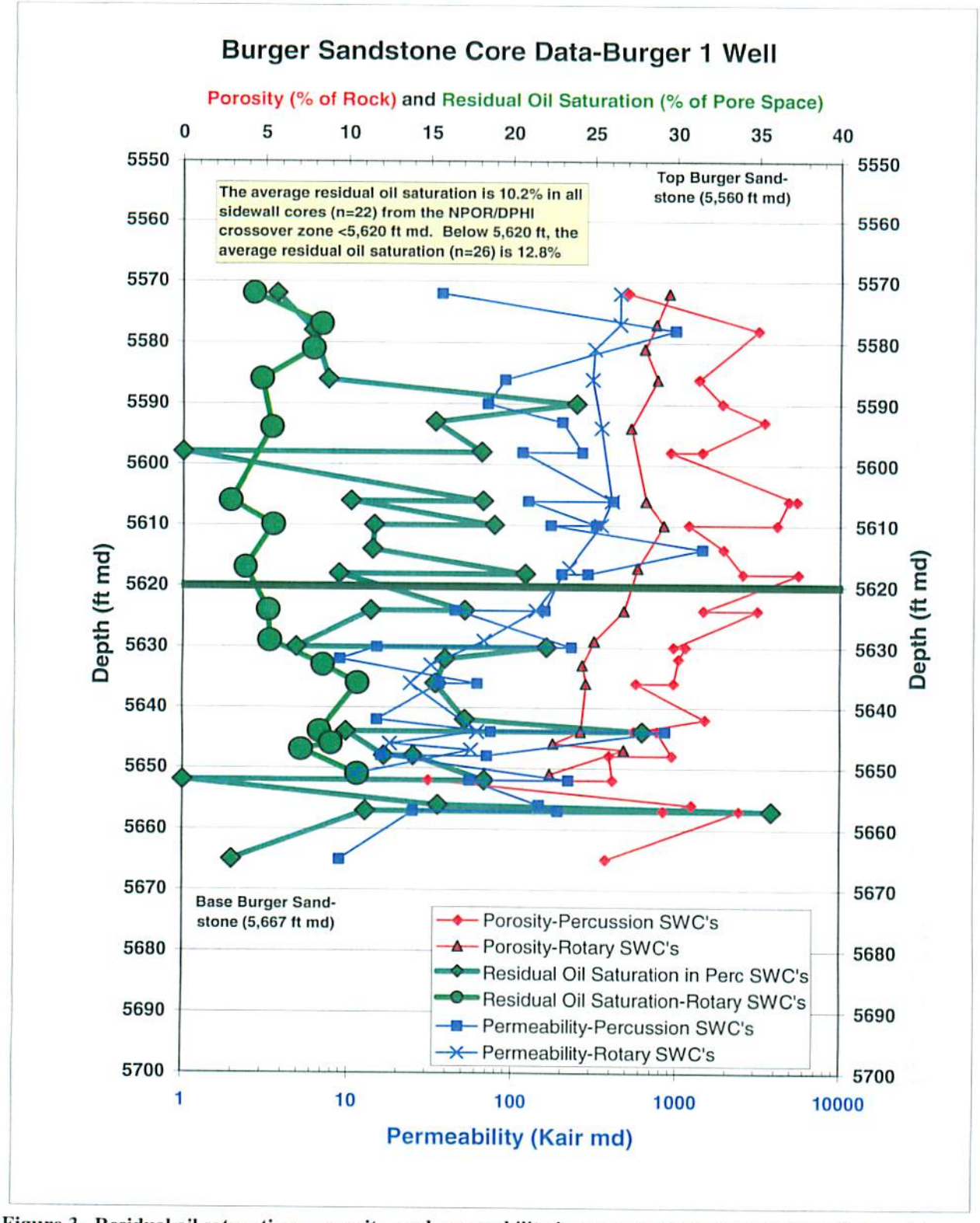

Figure 3. Residual oil saturations, porosity, and permeability in rotary and percussion sidewall cores taken in the Burger sandstone in the Burger 1 well. In general, higher residual oil saturations are observed in the relatively low-permeability sandstones of the lower clay-rich member (below 5,620 ft md bkb). The residual oil saturations in the upper gas-saturated sand member suggest that an oil charge of the entire sandstone may have preceded the later (and present) gas charge.

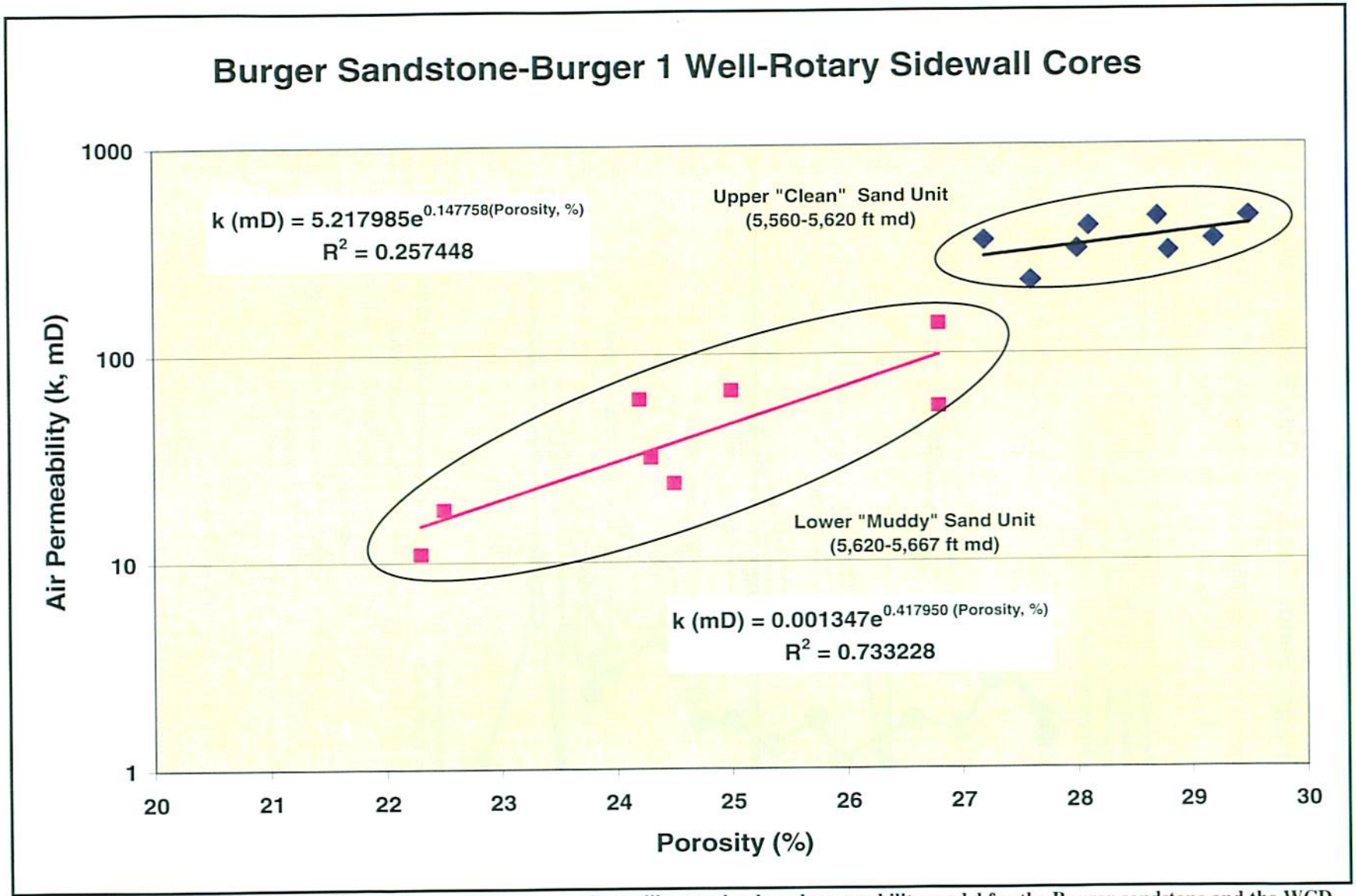

Figure 4. Rotary sidewall core data for the Burger sandstone used to calibrate a log-based permeability model for the Burger sandstone and the WCD reservoir anticipated at the Burger J proposed exploratory well. The sandstone is divided into two members that include an upper clay-free member and a lower clay-rich member. The upper member contains most of the "pay" or potential hydrocarbon flow units.

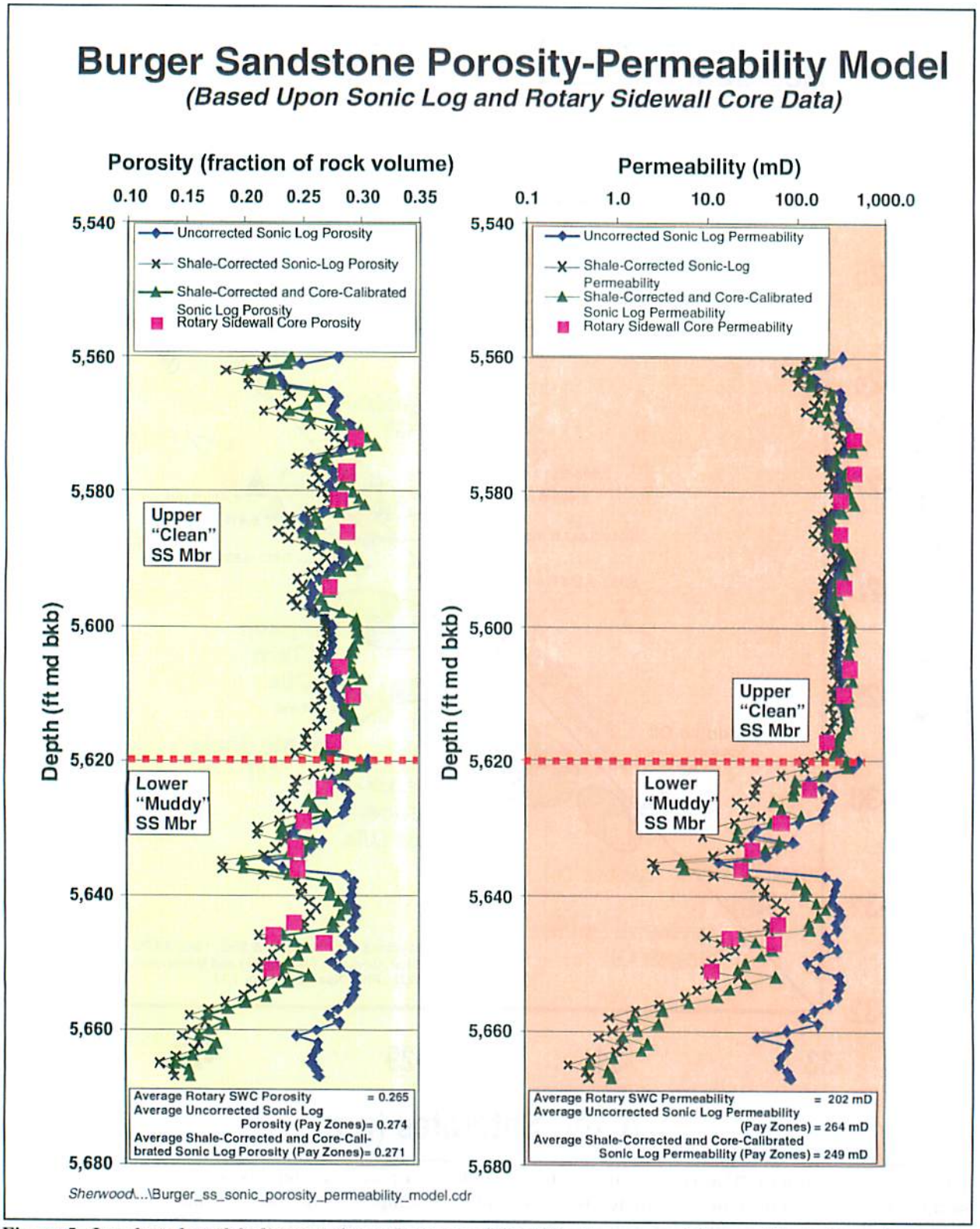

Figure 5. Log-based models for porosity and permeability of the Burger sandstone calibrated by rotary sidewall core data. Arithmetic averages for these models (porosity, 0.271; permeability, 249 mD) were adopted to characterize the Burger sandstone WCD flow unit at the proposed Burger J exploration well.

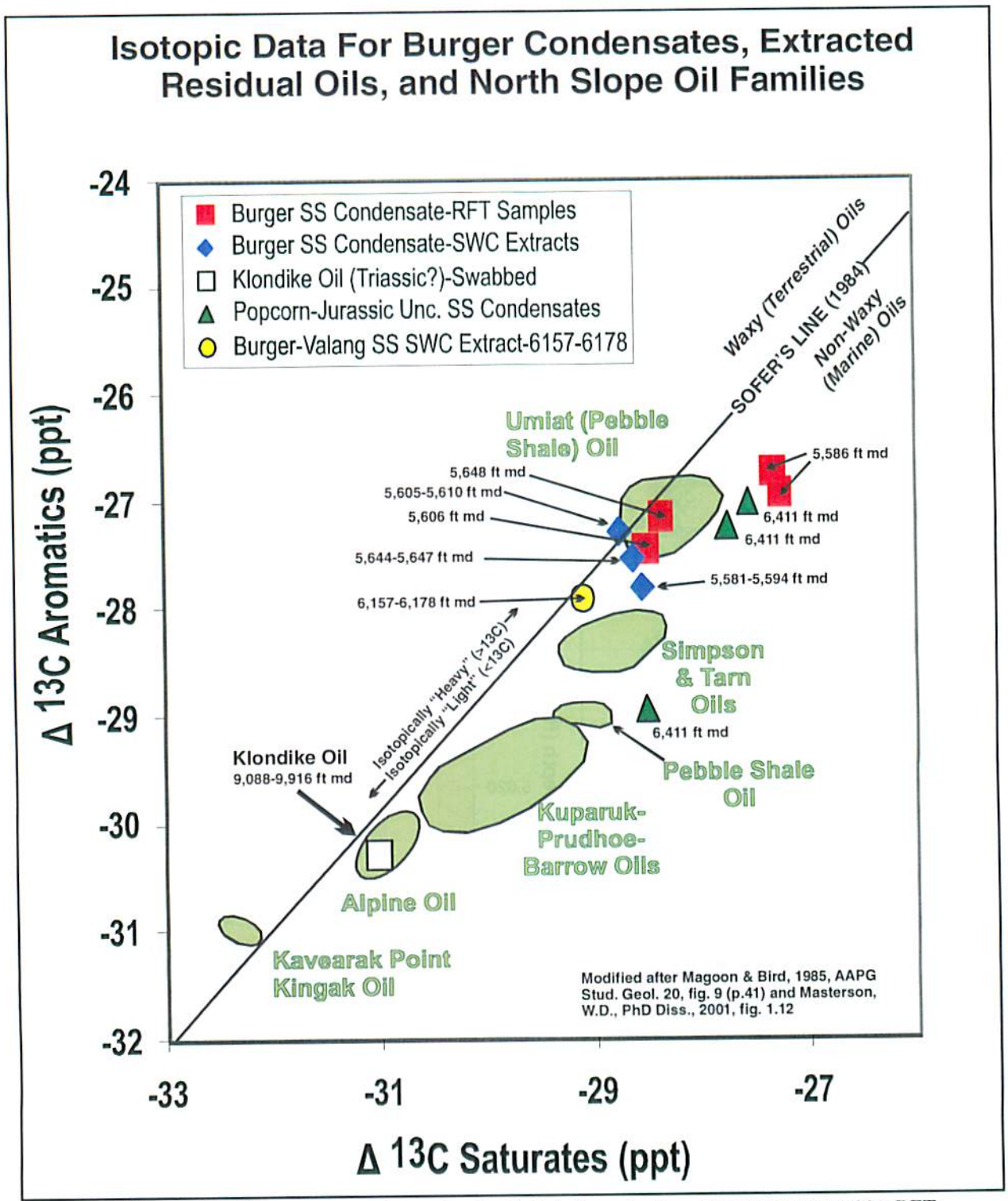

Figure 6. $\Delta^{13}C$ (ratio to ^{12}C as compared to a standard) data for petroleum liquids recovered by RFT sampling devices and for liquids extracted from sidewall core samples in the Burger 1 well. Burger petroleum liquids compare most favorably to the 36-37.2° API oils (Molenaar, 1982, p. 547) at the Umiat field near the Colville River in the National Petroleum Reserve-Alaska.

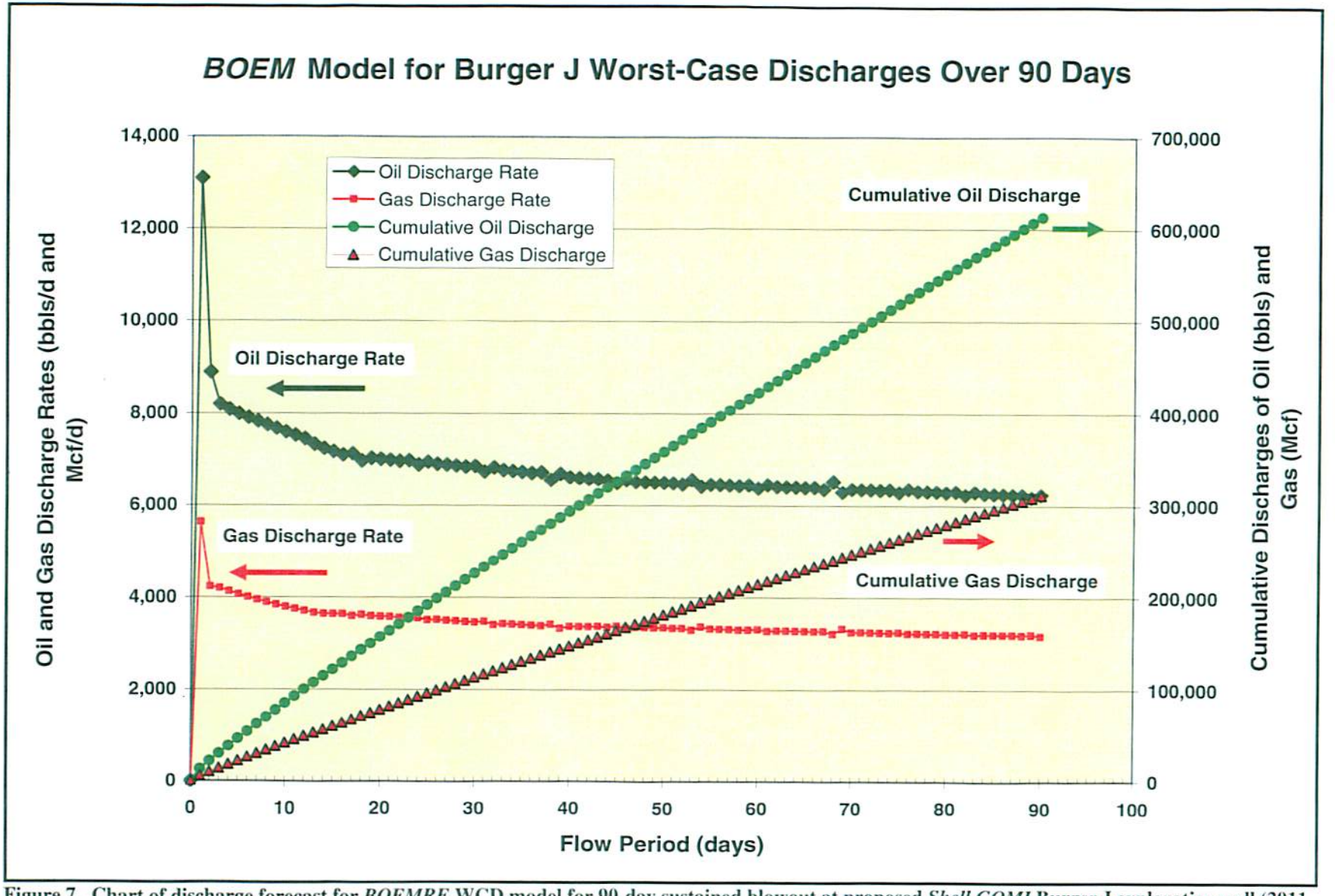

Figure 7. Chart of discharge forecast for *BOEMRE* WCD model for 90-day sustained blowout at proposed *Shell GOMI* Burger J exploration well (2011 *Shell GOMI* Chukchi Sea exploration plan [Shell [2011]).

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally-owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. Administration.



BEHAVIOR OF BOWHEAD WHALES, *BALAENA MYSTICETUS*, SUMMERING IN THE BEAUFORT SEA: A DESCRIPTION[1]

BERND WÜRSIG,[2] ELEANOR M. DORSEY,[3] MARK A. FRAKER,[4]
ROGER S. PAYNE,[3] AND W. JOHN RICHARDSON[5]

ABSTRACT

Behavior of bowhead whales summering in the Canadian Beaufort Sea was observed from an airplane and occasionally from shore during 1980-82, mainly during August. Behavior varied between years. In 1980, whales alternated periods of socializing with periods of feeding in several different ways: near the bottom (as evidenced by surfacing with mud), in the water column (suspected during long dives), and skim-feeding at the surface. In 1981, more time was spent apparently feeding in the water column, with some socializing and skim feeding. In 1982, almost all activity appeared to be feeding in the water column. In 1980, most whales studied were in water only 10-40 m deep. In 1981 they were farther from shore and in > 20 m depth, and in 1982 long (10-30 min) dives were common in depths of 40-600 m. Variability in distribution and behavior presumably was related to availability of prey.

Besides feeding and socializing, we saw sporadic bouts of aerial activity (breaches, tail slaps, etc.) and log play. During 1981 and 1982 we observed young-of-the-year calves apparently waiting at the surface while adults fed below. In 1982, two such lone calves played with debris in the water.

During near-surface skim feeding, whales often associated in V-shaped or echelon formations, with up to 14 animals staggered behind and to the side of each other, all moving in the same direction at the same speed, with mouths wide open. We hypothesize that such coordinated movement may increase the efficiency of feeding on concentrations of small invertebrates.

In recent years, much has been learned about behavior of several species of baleen whales (e.g., Payne 1983). Most long-term studies of whales have been carried out during winter, when social interactions, mating, and calving occur more often than feeding. Recently, however, detailed studies have been conducted in summer, when whales are primarily feeding (e.g., Dorsey 1983).

This paper describes the general behavior of bowhead whales, *Balaena mysticetus*, in the summers of 1980-82. A companion paper gives a quantitative description of the surfacing, respiration, and dive patterns (Würsig et al. 1984). This study was done to provide background data necessary to interpret observations of bowhead behavior in the presence of offshore industrial activities (Richardson et al. in press).

The Western Arctic population of bowheads winter in the Bering Sea, and migrate north and east to the eastern Beaufort Sea in spring. During summer (late June to early September), most are off northwestern Canada in Amundsen Gulf and the eastern part of the Beaufort Sea (Fig. 1). In the commercial whaling era in the 19th century, many bowheads apparently summered in the Chukchi and western Beaufort Seas off Alaska (Townsend 1935), but bowheads are no longer present in significant numbers off Alaska in summer (Dahlheim et al. 1980). The eastern Beaufort Sea is believed to be a major feeding area for bowheads (Fraker and Bockstoce 1980), but previous to 1980 there had been no comprehensive studies of bowheads in that area.

METHODS

Aerial Observations

We observed from a Britten-Norman[6] Islander aircraft based at Tuktoyaktuk (Fig. 1). The Islander has two piston engines, high wing configuration, and low

[1]This paper has been reviewed by the U.S. Minerals Management Service (MMS) and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of MMS, nor does mention of trade names or commercial products constitute MMS endorsement or recommendation for use.

[2]Moss Landing Marine Laboratories, P.O. Box 450, Moss Landing, CA 95039.

[3]New York Zoological Society, Weston Road, Lincoln, MA 01773; present address: Center for Long Term Research, Inc., Weston Road, Lincoln, MA 01773.

[4]LGL Ltd., Environmental Research Associates, 22 Fisher Street, King City, Ontario L0G 1K0, Canada; present address: Sohio Alaska Petroleum Co., Pouch 6-612, Anchorage, AK 99502.

[5]LGL Ltd., Environmental Research Associates, 22 Fisher Street, King City, Ontario L0G 1K0, Canada.

[6] Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Manuscript accepted October 1984.
FISHERY BULLETIN: VOL. 83, NO. 3, 1985.

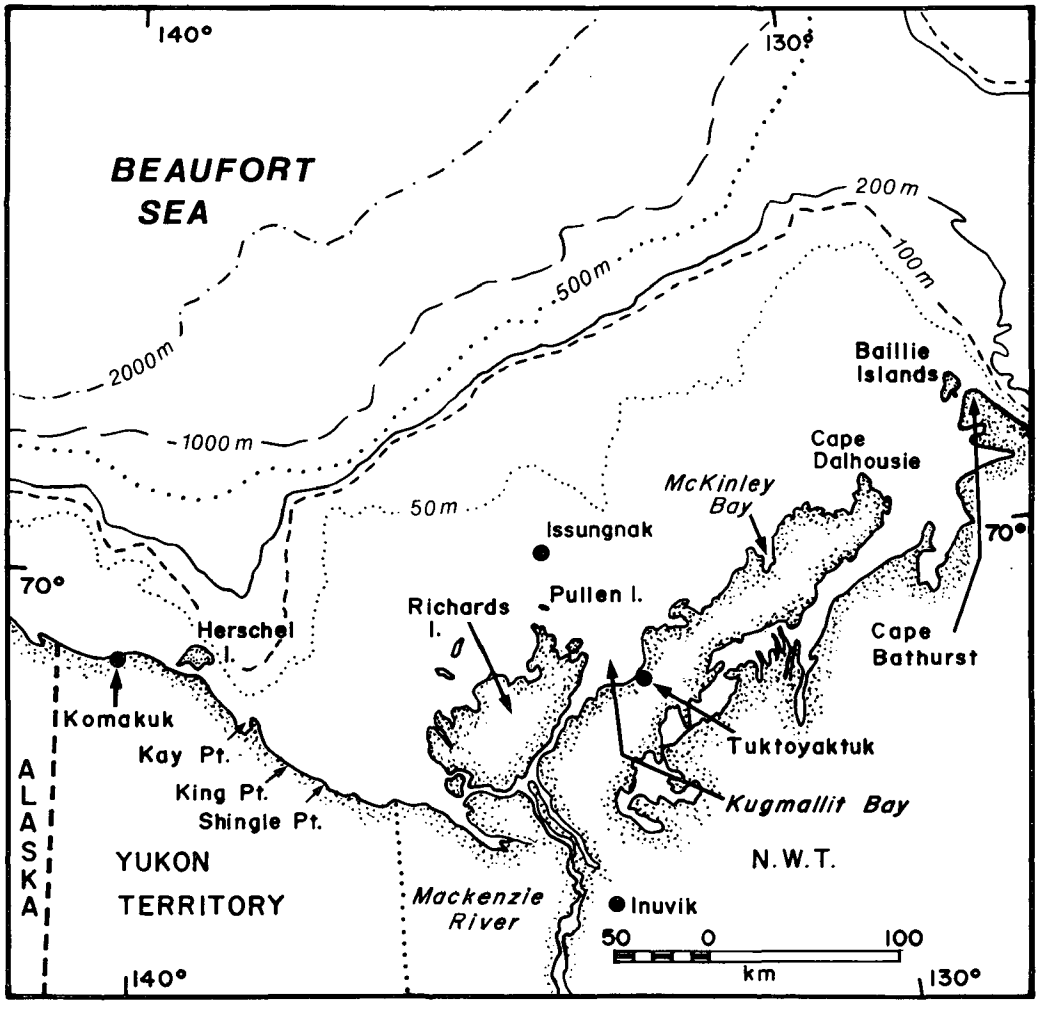

FIGURE 1.—The eastern Beaufort Sea.

stall speed. An OnTrac VLF/Omega navigation system indicated the latitude and longitude. A hand-held color video camera (JVC-CV-0001 in 1980 and 1981, Sony HVC-2000 in 1982) connected to a portable video cassette recorder (Sony SLO-340 in 1980 and 1981, Sony SL-2000 in 1982) was used through the side windows to record oblique views of bowheads.

Our usual strategy was to search until we encountered bowheads, and then circle over them as long as possible while making observations. If contact was lost, we searched for another group. We created a fixed reference point about which to circle when bowheads were below the surface by dropping a fluorescein dye marker. Near the start of most periods of circling above whales, a sonobuoy (AN/SSQ-41B or AN/SSQ-57A) was dropped to broadcast underwater sounds to the aircraft, where they were recorded.

In 1980-82, we flew for a total of 340 h during 71 offshore flights. Of this time, we circled over bowheads for 97.7 h during 46 flights. Flight duration was typically 4-5.5 h. Flights were made between 3 and 31 August 1980, 31 July and 8 September 1981, and 1 and 31 August 1982. We encountered bowhead whales during every day we flew in 1980, and during the majority of days in 1981 and 1982.

We usually did not fly when wind speed exceeded 25 km/h; in more severe conditions whales are difficult to detect and behavior cannot be observed reliably. While searching for whales, we usually flew at 457-610 m (1,500-2,000 ft) above sea level (ASL),

and at 185 km/h. While circling over whales, we reduced speed to 148 km/h. Bowheads rarely appeared to be disturbed by the aircraft when it remained at or above 457 m (Richardson et al. in press).

The aircraft crew usually consisted of four biologists and the pilot. Three biologists were seated on the right side of the aircraft, which circled clockwise during behavioral observations. Biologists seated in the right front (copilot's) seat and in the seat directly behind it described behaviors. These descriptions were recorded onto audiotape, onto the audio channel of the video recorder, and, in 1981, directly onto data sheets by a biologist in the left rear seat. The biologists in rear seats videotaped whales, handled sonobuoys, and kept records. All personnel on board were in constant communication through an intercom.

While circling bowheads, we usually were able to obtain consistent records of 12 variables and types of behavior:

1) Location of sighting (and, therefore, water depth);
2) Time of day;
3) Individually distinguishing features, if any, on whales;
4) Number of individuals visible in area and number of calves;
5) Headings and turns of each whale in degrees true;
6) Distances between individuals (estimated in whale lengths);
7) Length of time at surface, and sometimes length of dive;
8) Timing and number of respirations or blows, including underwater blows;
9) Possible indications of feeding: mouth open, defecation, mud streaming from mouth;
10) Socializing, possible mating, probable nursing by calves;
11) Aerial activity: breaches, tail slaps, flipper slaps, lunges, rolls;
12) Type of dive: flukes out, peduncle arch, predive flex.

Descriptions of these behaviors appear later.

In most parts of this paper we consider only the observations under "presumably undisturbed" conditions. Bowheads were considered "potentially disturbed" if our aircraft was at < 457 m ASL, if a boat was underway within 4 km, or if sonobuoys showed that industrial noise was readily detectable in the water. The "presumably undisturbed" behavioral observations were distributed by hour of day and water depth as presented in Figures 2 and 3.

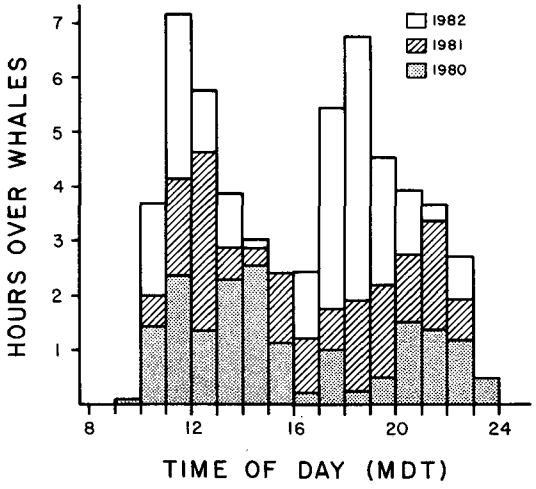

FIGURE 2.—Hourly distribution of behavioral observation time from the air of bowhead whales.

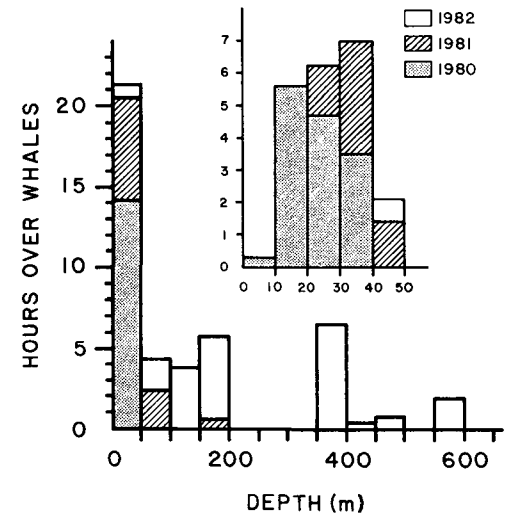

FIGURE 3.—Distribution of behavioral observation time from the air by depth of water of bowhead whales. The inset shows effort for the 0-50 m range by 10 m intervals.

Shore-Based Observations

Shore-based observations were obtained in 1980 and 1981 from the east end of Herschel Island, Yukon (lat. 69°35'N, long. 138°51'W), and about 225 km west of Tuktoyaktuk (Fig. 1). A surveyor's theodolite was used from a high point (50 m ASL in 1980,

90 m ASL in 1981) on the coast. We used a Wild T1 theodolite with 6-s accuracy and 30-power optics in 1980, and a Nikon NT-2A with 20-s accuracy and 30-power optics in 1981. Horizontal and vertical bearings were later translated to x and y map coordinates. This transiting technique, developed by R. Payne, is described by Würsig (1978). The station was in use from 19 August to 1 September 1980, and 23 August to 13 September 1981.

Locations of most whales within a 10 km radius of the theodolite station during fair weather and daylight hours were documented. Unfortunately, whales rarely approached Herschel Island closer than 5 km during the 1980 field season, so details of behavior were difficult to discern. In 1981, fewer whales were seen, but they were closer to shore, allowing more detailed behavioral observations.

RESULTS

The Surfacing-Dive Cycle

In the Beaufort Sea in summer, nonmigrating bowhead whales typically alternate between dives of variable length, depending on activity, and surfacings within which there are several respirations. This pattern differs slightly from that during migration, when sounding dives (around 15 min long) are separated by periods when several brief surfacings, each with a single respiration, alternate with "series" dives about 15 s long (Rugh and Cubbage 1980; Carroll and Smithhisler 1980). Presumably, migrating animals dive between respirations to avoid hydrodynamic drag imposed by the air-water interface. No such submergence is necessary for a whale that is not moving rapidly through the water. However, the basic repertoire of breathing several times in relatively, closely spaced series and then not breathing for many minutes (during the long dive) is similar during both prolonged directed movement and more stationary activity. The pattern extends to some degree even to whales that remain at the surface for long periods (up to 30 min or more during surface skim feeding, socializing, or play). They generally breathe several times within a few minutes, and then cease breathing for a longer time, despite their near proximity to the surface and the availability of air. Similar patterns are seen in other whales, including right whales, *Eubalaena glacialis*, (Kraus et al. 1982) and gray whales, *Eschrichtius robustus*, (Sumich 1983). Durations of surfacings and dives, intervals between successive blows, and number of blows per surfacing are described in Würsig et al. (1984).

Surfacing and Respiring

Whales in water deeper than about 30-45 m usually surface head and blowhole first after a sounding dive, with the body oriented at some angle (such as 30°) from horizontal. When whales do not dive very deeply (as in shallow water), the surfacing is less due to active swimming upward, and the head and tail surface at approximately the same time.

A blow is an exhalation of air by a whale. Blows can occur above or below the surface. Surface blows are usually visible as a white cloud of water spray, but may be so weak as to be undetectable. The first blow after a surfacing usually appears strong, probably because it is a more forceful exhalation and because water is present above the blowholes during or just after surfacing. On calm days and when whales lie at the surface with the blowholes exposed, the blowholes are relatively dry, and blows may be difficult to detect. Blows of calves can also be difficult to see.

Surface exhalations of gray; humpback, *Megaptera novaeangliae*; fin, *Balaenoptera physalus*; and southern right whales, *Eubalaena australis*, are almost always followed immediately by an inhalation (B. Würsig, pers. obs.). Hence we suspect, following Scoresby (1820), that exhalations and inhalations generally occur together in bowhead whales as well.

Diving and Associated Behavior

The predive flex is a distinctive concave bending of the back seen several seconds before many dives. The whale flexes its back by about 0.5-1 m, so that the snout and tail disrupt the surface. Considerable white water is created at these two points. The whale then straightens its back and lies momentarily still before arching the back convexly as it begins its roll forward and down. The predive flex is seen from low vantage points as an abrupt lifting of the head, because the flukes apparently only touch the water surface from below.

The predive flex was seen more often during 1980 than during 1981 or 1982. Although it occurred previous to dives well over 50% of the time in 1980, it occurred in only 8% of the observations (before 29 of 352 dives) in 1981. For 1982, we have especially detailed analyses of predive flexes. In that year, predive flexes occurred in presumably undisturbed noncalves before 32 of 132 dives (24.2%); flexes occurred more often in late August than earlier (Table 1). Dives following predive flexes were, on the average, about twice as long as dives without predive flexes (19.00 ± SD 7.877 min, n = 13, vs. 10.15 ±

TABLE 1.—Dives preceded by a predive flex among noncalf bowheads early and late August 1982. The frequency of occurrence is significantly higher after 19 August (chi-square = 4.29, df = 1, $0.025 < P < 0.05$).

	Up to 19 Aug. 1982	After 19 Aug. 1982	Total
Dives with predive flex	9	23	32
Dives without predive flex	49	51	100
Total	58	74	132

7.465 min, $n = 36$; Mann-Whitney U = 97.5, $P < 0.01$). Five dives were preceded by two predive flexes, with the flexes separated by a blow. Two dives were preceded by three flexes. We have no data on durations of dives following multiple flexes.

During the dive, which can at times be predicted by the predive flex, the whale makes its body convex and pitches forward and down. If the angle of submergence is steep, the tail is usually raised above the surface; if not, the tail may remain below or just touch the surface. Rarely do bowheads sink down without visibly arching the back.

In 1982, 59 of 138 dives (42.8%) were preceded by raised flukes. Of the 32 dives preceded by one or more predive flexes, 21 also showed raised flukes. These two predive behaviors tended to occur together ($\chi^2 = 3.94$, $P < 0.05$, df = 1), and dives with raised flukes were significantly longer than those not preceded by raised flukes (18.67 ± SD 9.966 min, $n = 12$, vs. 10.05 ± 6.956 min, $n = 38$; Mann-Whitney U = 114, $P < 0.01$).

There was no difference in durations of surfacings concluded with and without raised flukes. However, surfacings including predive flexes tended to be longer than those without predive flexes (3.09 ± SD 1.038 min, $n = 14$, vs. 1.79 ± 1.284 min, $n = 52$; $t = 3.50$, df = 64, $P < 0.001$), probably because durations of surfacings and dives are correlated (Würsig et al. 1984).

The function of the predive flex is unknown. Flexes occur more often before longer dives (which may take the whales deeper in the water column). Raising the flukes before a dive appears related to the steepness of the dive; whales that roll forward while dropping the front of the body at least 30° below the water surface usually raise their flukes. The weight of the raised tail stock in the air must help propel the animal downward (much as human skin divers raise their legs above the surface during the initiation of a steep dive). Although raised flukes are common during steep dives in many whales, the predive flex has not been reported in other species.

The Underwater Blow

The underwater blow is a burst of air emitted underwater. The bubble burst is circular and up to 15 m in diameter when it arrives at the surface. Release of air underwater was recorded about 10 times via nearby (< 1 km away) sonobuoys; the noise was detectable for 3-4 s, but the white water and expanding concentric wave were visible much longer. On one occasion, we definitely saw that the air came from the blowhole rather than the mouth, and we believe that this is always true. We saw underwater blows immediately after whales dove and just before they surfaced, but more usually in the middle of the dive, when the whales were out of sight.

Underwater blows were most frequent in 1980 during periods of pronounced feeding in water < 14 m deep (see Feeding section). In 1980, we saw 158 underwater blows in 30.4 observation hours; in 1981, 57 blows in 30.8 observations hours; and in 1982, only 6 blows in 36.5 observation hours. (The difference between years is statistically significant; $\chi^2 = 189$, df = 2, $P < 0.001$.) Concurrently, whales tended to be found in progressively deeper water from 1980 to 1982.

Underwater blowing occurred more often in the morning and evening than around solar midday in both 1980 and 1981 (Fig. 4; solar noon occurs about 1500 MDT in the eastern Beaufort Sea). The midday "lull" in underwater blowing coincided with a peak in frequency of socializing, the main nonfeeding behavior observed (see Social Behavior section below). Nemoto (1970) suggested that baleen whales in general show a high level of feeding activity in the

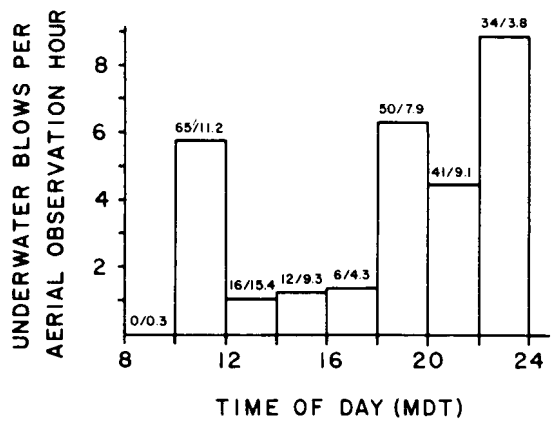

FIGURE 4.—Number of underwater bowhead whale blows per aerial observation hour in relation to time of day, 1980 and 1981 combined. There were few underwater blows in 1982. The numbers at the top of each column are number of blows seen/number of observation hours.

morning and a lower level during midday, but we have no direct evidence of this in bowheads.

Although underwater blows seem to occur more often in shallow water when whales may be feeding, we have not included this behavior as a definite part of feeding. There is only a general similarity to bursts of bubbles associated with feeding humpback whales in the North Atlantic (Hain et al. 1982), and the bubble nets reported for humpbacks by Jurasz and Jurasz (1979) are very different.

Social Behavior

Behavior was termed social when whales appeared to be pushing, nudging, or chasing each other, or when they were within half a body length of one another. Whales within half a body length almost always stayed close to each other, and oriented towards each other or interacted in some manner. Thus, our use of proximity as an indication of sociality was appropriate. Interactions between mothers and calves, and between whales skim feeding in close proximity, were not included as social interactions in this analysis. Whales may, of course, communicate by sound, and thus may socialize over far greater distances than those described here. Our sonobuoys often detected bowhead calls while socializing was underway. However, we could not verify whether acoustic communication was occurring between any particular whales, so we restricted our definition of socializing to visible behavior. Synchronous diving and surfacing over areas many kilometers in diameter (see below) may represent a different form of social interaction from what we discuss in this section. Because groups of whales usually could not be reidentified positively from one dive to the next, we treated observations of social behavior at intervals of > 5 min as independent for the purpose of counting number of interactions. Conversely, we did not score social behavior by one group more than once in 5 min when counting frequency.

Frequency of Socializing

Social behavior was seen less frequently in late August-early September than in early August, both in 1980 and 1981 (Table 2). Rugh and Cubbage (1980) and Carroll and Smithhisler (1980) reported a higher incidence of social interactions during the spring migration around Alaska than we saw at any time. The apparent waning of social activity from early to late August may be part of a continuing decrease from a higher level in spring.

Little socializing was observed in 1982. In presumably undisturbed whales, we observed only seven cases, all on 8, 19, and 23 August. Throughout August 1982, most whales were alone and making long dives. The overall socializing rate for each year (Table 2) demonstrates the dramatic decrease in socializing in 1982 compared with the two previous years. This decrease may be related to the increase in 1982 in the average distance from shore and depth of water at locations where bowheads were studied. However, we found no consistent trend for socializing to occur more often in shallow water than in deep water within 1 yr.

There was some indication of hour-to-hour variation in amount of social activity in all 3 yr (Fig. 5). In 1980 and 1981, it peaked around 1400-1600 MDT, the noon period by sun time. In 1982, the few (7) cases were recorded from 1600 to 2000 MDT, somewhat after solar noon (Fig. 5). In both 1980 and 1981, there was another peak after 2000 MDT. Why whales should engage in more social activity around noon (and possibly in the evening) than at other times is unknown. However, diel rhythms are well known in several mammals (e.g., Saayman et al. 1973 for bottlenose dolphins; Matsushita 1955 for sperm whales; Schevill and Backus 1960 for humpback whales). The increased level of socializing around noon may reflect a lowered level of feeding at that time, which Nemoto (1970) suggested for baleen whales in general.

Physical Interactions

During surface interactions with nearby whales, socializing whales often turned. In contrast, nonsocializing whales often surfaced and dove again without changing direction. In the 3 yr, turns oc-

TABLE 2.—Number of social interactions per aerial observation hour, divided into about 10-d periods, in 1980, 1981, and 1982. Only presumably undisturbed periods are included.

Year	1-10 Aug.	11-20 Aug.	21-31 Aug.	1-10 Sept.	Overall
1980	28/7.0 = 4.0	6/2.9 = 2.1	8/7.7 = 1.0	—	42/17.6 = 2.4
1981	14/4.3 = 3.3	12/5.5 = 2.2	9/3.3 = 2.7	4/4.0 = 1.0	39/17.1 = 2.3
1982	1/1.5 = 0.7	3/7.6 = 0.4	3/12.8 = 0.2	—	7/21.9 = 0.3

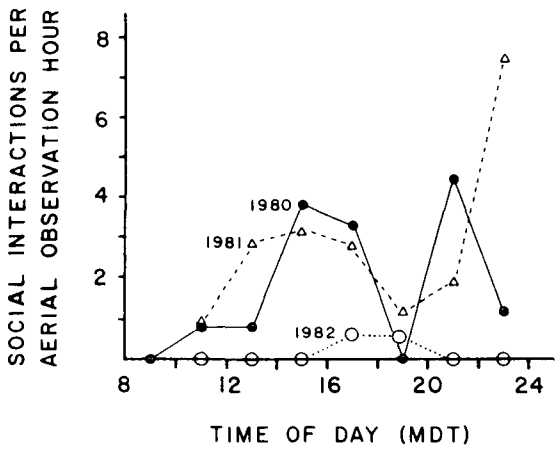

FIGURE 5.—Number of bowhead whale social interactions per aerial observation hour in relation to time of day.

curred during 53 of 133 (40%) surfacings with socializing, and in 128 of 484 (26%) without socializing ($\chi^2 = 9.04$; df = 1, $P < 0.005$).

When bowhead whales touched, they often appeared to push each other. Pushing or touching was usually done with the head, while oriented head to head, or head to tail. However, we also saw whales of adult size dive under the bellies of other whales and apparently nudge or push the other whales near their genital areas. At other times, whales dove under each other at very close range without any indication that they were touching.

Apparent chase sequences involved two or three whales in a line, usually < 2 body lengths apart. During these chases one whale often turned abruptly left or right, and the second (and third) followed. Movement was faster during chases than at all other times when we saw presumably undisturbed whales at the surface.

Both touching and chasing may at times represent low levels of sexual activity, but this is unproven because we cannot determine the sex of a bowhead whale from a distance. Payne and Dorsey (1983) and Tyack and Whitehead (1983) described physically interacting right and humpback whales, respectively, which appeared to be engaging in social-sexual activity.

Possible Mating

In 1981, we twice observed apparent mating. The more prolonged observation was on 10 August 1981, within a 25 km^2 area where there were 20-30 whales whose main activity was socializing. Two whales interacted for over 1 h with chases, flipper caresses, belly-to-belly orientation, rolls toward and away from each other, head nudges to the genital area and to the rest of the body, tail slaps, and flipper slaps. One whale, a recognizable animal that we termed "Whitespot", was about 1-2 m longer than the other ("B") and was the more aggressive. Although B originally nudged the genital area of Whitespot, it was Whitespot who appeared to initiate flipper caressing and rolls toward B. The two whales rolled their ventral surfaces together for about 5 s, but B then rolled its ventrum in the air in an apparent attempt to avoid ventral contact with the larger animal. As it rolled away from Whitespot, B defecated, and when Whitespot moved its head toward the genital area of B, B defecated two more times in rapid succession. B then dove away from Whitespot, and Whitespot followed it at the surface in an apparent chase. Whitespot then stopped and, alone at the surface, rolled two times and tail slapped while on its back. It then dove, and the two appeared together again at the surface 4 min later, with no further energetic surface interaction.

We do not know the sex of either animal, but it appeared that Whitespot was attempting to copulate with the reluctant animal. Some of us (Würsig and Payne) have observed southern right whale females frequently roll their ventra away from aggressive males, leaving their genital areas above the surface of the water, where the males cannot reach them. Everitt and Krogman (1979) photographed very similar behavior of a group of six bowheads off Barrow, AK, in May. Our observations here were highly reminiscent of such behavior. Although adult females are slightly larger than adult males in both right and bowhead whales, we commonly see large southern right whale males in pursuit of smaller females, which attempt to avoid the males.

On 25 August 1981, two bowheads briefly placed their ventral surfaces together and clasped each other with their flippers. After 1 min, they rolled apart, blew, and dove slowly as a third whale approached. The mutual rolling and leisurely diving indicated that, if this was copulatory behavior, it was mutually undertaken by the two whales in contrast to the previous example.

Group Structure and Stability

Two observations of recognizable bowheads provided evidence about group structure and stability. We observed a distinctively marked pair of adults, one accompanied by a calf, at about lat. 70°10'N, long. 133°50'W on 7 August 1980. We saw a similar-

ly marked group of two adults and a calf, almost certainly the same whales, on 20 August at lat. 70°07'N, long. 131°30'W, which is about 85 km from the place they had been seen 2 wk earlier. This observation suggests that some groups of bowheads are maintained for at least a few weeks. The observation also suggests that females with calves may sometimes be accompanied by escorts, as has been observed for wintering humpback whales (Herman and Antinoja 1977).

Feeding

Feeding appeared to occupy much of the time of the bowheads that we observed, but we had to rely on indirect clues, such as observations of swimming with open mouth, mud streaming from the mouth, or presence of feces in the water, to indicate that feeding had taken place. The four possible types of feeding behavior that we identified were 1) water-column feeding; 2) near-bottom feeding; 3) skim feeding; and 4) mud tracking. Of these, the first three rather clearly represented feeding, whereas the function of the last was less certain. As noted above, underwater blowing showed some association with feeding, but the connection was uncertain.

In 1980, certain feeding behaviors occurred in particular areas: only water-column feeding was seen near the Issungnak artificial island site (Fig. 1), whereas only skim-feeding was seen off the Tuktoyaktuk Peninsula near McKinley Bay. In 1981, there was less evidence for feeding, although we suspect that most feeding occurred in the water column. In 1982, when whales dove for long periods (up to 30 min), we suspected water-column feeding to be occurring at almost all times.

Water-Column Feeding

Water-column feeding could not be observed directly. Whales were scored as feeding in the water column when they dove for long periods, and when, between long dives, there was much defecation and only slow forward motion. Defecation is simply an indication of prior feeding. However, particular behaviors such as a series of long dives usually continued for many hours, so occurrence of defecations between long dives was considered indicative of ongoing feeding in the water column.

The frequency of apparent water-column feeding was not constant. In 1980, we saw bowheads water-column feeding from 3 to 22 August. Thereafter, few whales were present in the area where we had observed this behavior, and whales seen elsewhere did not seem to feed in the water column. In 1981, when we saw less defecation, we only scored as water-column feeding some adult whales that dove for prolonged periods on 24 August, while calves remained at the surface. In 1982, most whales made long dives. These whales probably were feeding in the water column, even though we saw little defecation at the surface. Feeding below the surface may have occurred during many other dives besides those that we classified as dives with water-column feeding.

Observations on 3 August 1980 typify water-column feeding behavior. On this date, bowheads were north of Kugmallit Bay where water depth was 18-38 m. The surface water was turbid, brackish water from the Mackenzie River, but beneath this surface layer, there was a second layer of clearer, saline Beaufort Sea water (Griffiths and Buchanan[7]). The whales occurred in groups of 2-10 animals, and occasionally as individuals without others nearby. Group members showed a high degree of synchrony, often surfacing very close together and remaining close at least until they dived again. Not only did the members of a group surface and dive synchronously, but various groups spread over an area several kilometers in diameter all tended to be at the surface or beneath it at the same time.

While the animals were at the surface, they moved slowly forward while taking a series of breaths. As each individual dived, it raised its tail clear of the water, and disappeared from view in the turbid water. Thus, these dives must have taken the whales well below the surface. When the whales were at the surface, they often disturbed the turbid surface layer, exposing dark patches of seawater from deeper depths. However, while submerged after a dive that was preceded by raised flukes, they did not affect the thin surface layer, indicating that they were probably feeding in the underlying clearer ocean water. Defecation was frequent, suggesting that feeding may have taken place recently. The feces clouds were red-orange.

Bottom Feeding

On 12 August 1980, we noticed clouds of mud suspended in the water about 25 km west of Issung-

[7]Griffiths, W. B., and R. A. Bachanan. 1982. Characteristics of bowhead feeding areas. *In* W. J. Richardson (editor), Behavior, disturbance responses and feeding of bowhead whales *Balaena mysticetus* in the Beaufort Sea, 1980-81, p. 347-455. Unpubl. Rep., 456 p. LGL Ecological Research Associates, Inc., Bryan, TX, for Bureau of Land Management, U.S. Department of the Interior, Washington, DC. Available from Minerals Management Service Alaska OCS Region, P.O. Box 101159, Anchorage, AK 99510.

nak artificial island (Fig. 1). The clouds represented suspended mud and not plankton because the material was of the same color as mud dredged up by industrial activities. Whales surfaced with large amounts of muddy water streaming from their mouths, indicating they had been feeding from or near the bottom. This behavior occurred in 24-29 m of water and seemed very localized. We saw no indication of bottom feeding in the same area on 22 August 1980, but we had observed similar mud clouds nearby on 9 August, when prolonged observations were not possible. On 25 August 1981, whales again surfaced with mud streaming from their mouths. The location was 15 km south of the position where we observed such behavior in 1980; water depth was only 10-13 m.

These are, to our knowledge, the first published behavioral observations of apparent near-bottom feeding by bowhead whales. However, Johnson et al. (1966), Durham (1972), and Lowry and Burns (1980) detected pebbles and bottom-dwelling species in bowhead stomachs.

Bottom-feeding whales were usually separated from other whales by 150-300 m when at the surface. On 12 August 1980, at least 10 whales were bottom feeding within an area of 3 km radius. Whether they were feeding on inbenthic or epibenthic invertebrates we do not know. In the eastern Beaufort Sea, the average biomass of inbenthic animals greatly exceeds that of epibenthic animals (Griffiths and Buchanan footnote 7). However, the latter may occur in dense swarms in certain places. For a balaenid whale, such swarms would seem to be a much more suitable type of food than inbenthic organisms. Mud might be taken inadvertently along with epibenthic animals.

Skim Feeding

The only feeding type that we observed directly was skim feeding. In the third week of August 1980, we observed whales moving slowly and deliberately at the surface with their mouths open wide. Usually the rostrum just broke the surface of the water, and was parallel to it. In these cases, the lower jaw was dropped to varying degrees, as could be seen from the depth of the white chin patch. In 1980, skim feeding was observed along the Tuktoyaktuk Peninsula in water 12-22 m deep. Whales occasionally skim fed alone, but more often did so in groups of 2-10 or more individuals. During any one observation period, they stayed in the same general area by repeatedly turning and did not appear to make any net geographic movement. However, we found groups of skim-feeding whales in different locations on different days.

During 1981, we witnessed skim feeding on a large scale only on the evening of 18 August, 32 km NNW of Pullen Island in water 25 m deep. About 20-30 whales in the 25 km^2 area were swimming with mouths open; they travelled slowly, usually just below the surface ($\sim$ 2-3 m deep). Copepods were unusually abundant in near-surface waters at this location and time (Griffiths and Buchanan footnote 7). On 23 and 24 August 1981, we saw one isolated example on each day of a whale feeding at the surface briefly (observed for < 1 min) in approximately the same area as on 18 August.

Typically, skim-feeding whales were oriented with their backs at the water's surface. However, they occasionally swam on their sides with mouths open at an angle of about 60°, and once we saw two whales separated by three body widths swimming on their sides, belly to back. In one instance, a skim-feeding whale swam inverted for at least 3 min, with the underside of its chin at the surface.

Frequently, the skim-feeding whales swam in echelon formation, each whale swimming just behind the preceding whale, but offset laterally by one-half to three body widths, reminiscent of geese in V formation (Fig. 6). At other times, they swam abreast and parallel to one another. Videotape from 18 August 1981 showed that whales within the echelons were a mean of 0.53 whale lengths apart (SD = 0.599, $n = 66$), or about 8 m. These distances were measured from different echelons or from the same echelon at intervals of at least 5 min. We videotaped a recognizable whale for almost 3 h on this day as it skim fed in changing echelon formations, usually taking the lead position. Echelons were clearly dynamic in terms of membership, size, and organization. In 1981, the mean echelon size was 4.7 animals (SD = 4.05, $n = 23$). While the largest such formation observed in 1980 contained 5 individuals, the largest in 1981 contained 14 animals.

We suspect that echelon feeding increases the feeding efficiency of those animals staggered behind and to the side of other individuals, perhaps by helping them to catch prey that escape or spill from the mouth of the whale in front, or by reducing the ability of prey to escape to the side. Skim feeding in echelon may allow more effective exploitation of concentrated patches of small prey than would be possible if whales were feeding alone. If so, the change in efficiency that accrues when echelons are formed may have an important cost/benefit effect on energy expended per whale. The predominant prey types of bowheads include copepods and euphausiids (Lowry

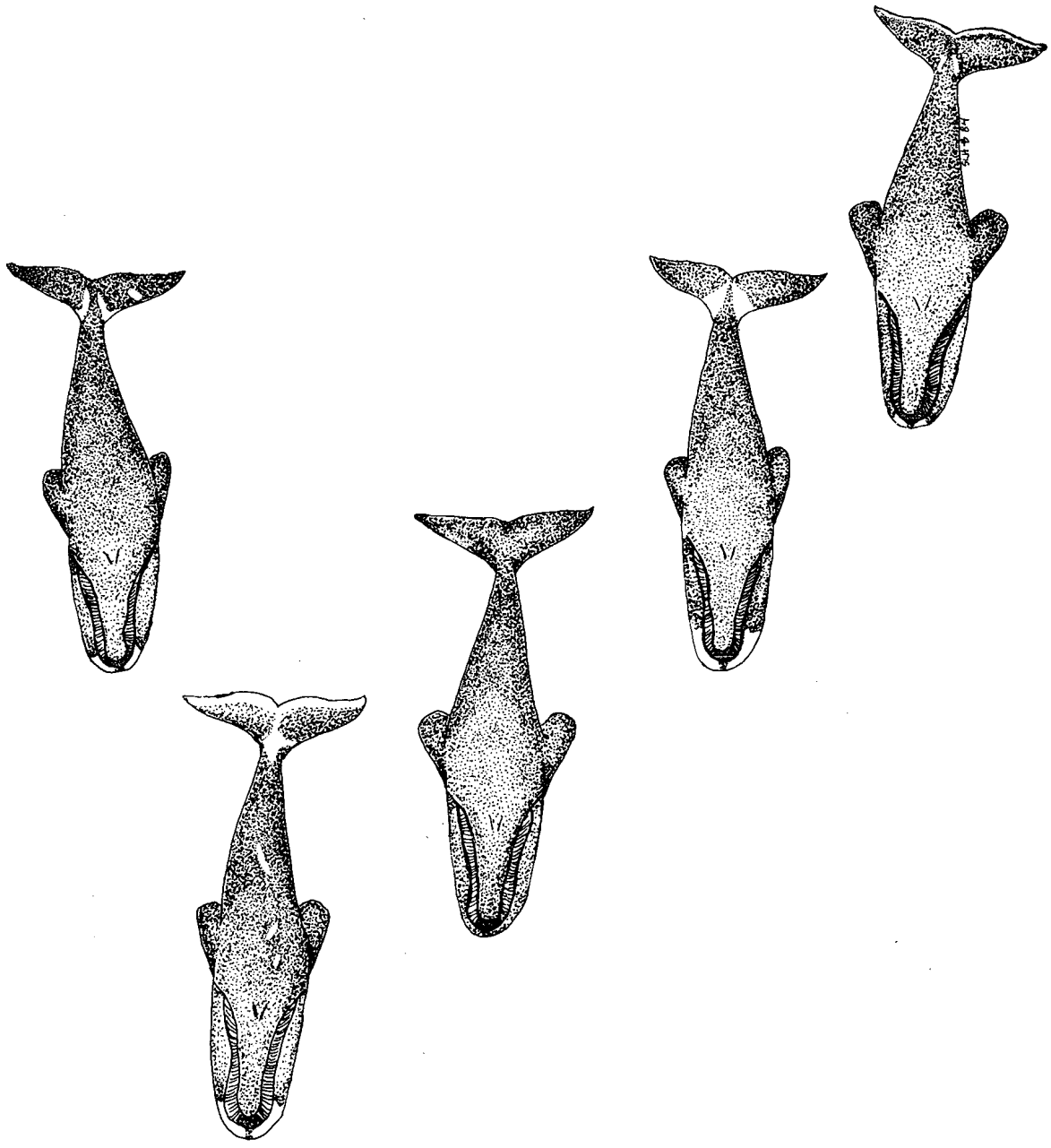

FIGURE 6. – Five bowhead whales skim feeding in echelon formation. Drawing after a 35 mm photograph and video footage from the air.

and Burns 1980). The latter are adept at avoiding most sampling gear because of their rapid movement. However, bowheads at times collect euphausiids in very large numbers, despite the bowhead's slow swimming speeds relative to the better known euphausiid predators such as rorquals. Perhaps echelon feeding is especially helpful in catching fast-swimming prey such as euphausiids.

During 1982, little direct evidence for feeding was noted. We saw no skim feeding at the surface, and noticed only nine isolated instances when a whale's mouth appeared to be open slightly. These brief, slight

openings of the mouth contrasted sharply with the sustained large gapes observed in 1980 and 1981, and probably did not represent feeding. In southern right whales, Payne (pers. obs.) has observed mouth opening that he interprets as yawning following sleep.

Mud Tracking

Mud tracking occurred when whales swimming in shallow water (< 12 m depth) disturbed the bottom sediments with each fluke beat, producing clouds of mud joined by a narrower trail of muddy water. These elongated clouds of mud were different from mud clouds produced during presumed bottom feeding. Although we often could not see the whales, in at least a few instances their mouths were open. We saw mud tracking during only three flights in the third week of August 1980.

Mud tracking probably represented incidental disturbance of bottom sediments by a whale feeding near the bottom in shallow water. We saw no evidence that bowheads ever turned and swam back along a mud track made previously. The mud tracks tended to be straight, and some extended for well over 1 km. At certain times, clouds of mud streamed from the whale's body as it swam near the surface. In this case, we suspect that the whales had contacted the bottom, and that the mud had stuck to their bodies. Sometimes, mud-tracking whales exhaled while submerged, producing a characteristic burst of bubbles (see section on The Underwater Blow).

Defecation

Defecation usually was evident as a cloud (2-3 m diameter) of red-orange feces near the surface. Whales almost invariably were moving forward or diving when they defecated, and over 50% of the bowheads observed defecating in 1980 did so while the tail was arched up high out of the water just before the dive. The anus was thus close to or at the surface. No part of the body appeared to touch the feces cloud, which was visible at the surface for up to 10 min. When whales moved forward while defecating, the feces were more dispersed and disappeared within 1-2 min. Brown (1868) noted that feces of eastern arctic bowheads were also red. Renaud and Davis[8] observed red clouds of feces off the Tuktoyaktuk Peninsula in 1980.

Defecation was seen more often in 1980 (23 cases during 30.4 h over whales) than in 1981 (11 cases during 30.8 h over whales). The difference is statistically significant ($\chi^2 = 4.39$, df = 1, $0.025 < P < 0.05$), and may be related to year-to-year differences in feeding patterns. In 1982, we saw only one defecation (by a lone whale playing with a log). Because we can only observe defecations by whales at the surface, we compared the rates in reference to the number of whale-hours of observation at the surface. In 1980, there were 2.29 defecations/whale-hour at the surface, as opposed to 0.73 in 1981, and 0.09 in 1982 ($\chi^2 = 27.58$, df = 2, $P < 0.001$). This decrease could result either from decreased defecation (indicative of less feeding), or from an increasing tendency to defecate under the surface where we could not observe it. During 1982, dives were longer than in the 2 previous years (Würsig et al. 1984), and we suspect that much water-column feeding was taking place.

Adult-Calf Pairs

Calves of the year are a light tan color, distinct from the dark black of noncalf bowheads. An adult that remained close to a calf was assumed to be the calf's mother. For the closely related southern right whale in winter, Payne and Dorsey (1983) found that in unambiguous adult-calf pairs, the adult was always a female, and that identified calves were always seen with the same individually identified female. At times, we saw apparent nursing as calves submerged briefly, oriented toward the teat region of the adult. In 1982, we made longer observations of calves than in either 1980 or 1981.

The relative lengths of six calves measured from videotape sequences recorded during August 1981 were a mean of 0.57 ± SD 0.052 adult body lengths. Many of the calves we observed in August 1982 appeared to be smaller, about one-third adult size. This is corroborated by the fact that 14 calves measured via photogrammetry in August-early September 1982 were 4.1-7.6 m long, or 33-45% (mean 41%) of the length of the accompanying adult (Davis et al.[9]). It may be that births occurred earlier in the year in 1981 than in 1982, or that the females videotaped in 1981 were smaller, on average, than those measured in 1982.

[8]Renaud, W. E., and R. A. Davis. 1981. Aerial surveys of bowhead whales and other marine mammals off the Tuktoyaktuk Peninsula, N.W.T., August-September 1980. Unpubl. Rep., 55 p. LGL Ltd., Toronto, for Dome Petroleum Ltd., Box 200, Calgary, Alberta T2P 2H8, Canada.

[9]Davis, R. A., W. R. Koski, and G. W. Miller. 1983. Preliminary assessment of the length-frequency distribution and gross annual reproductive rate of the western arctic bowhead whale as determined with low-level aerial photography, with comments on life history. Unpubl. Rep., 91 p. LGL Ltd., Toronto, for National Marine Mammal Laboratory, National Marine Fisheries Service, NOAA, 7600 Sand Point Way N.E., BIN C15700, Seattle, WA 98115.

When an adult and calf were both at the surface, they were usually within one adult-length of each other. Videotape sequences showed the mean distance apart to be 0.61 adult whale lengths (SD = 0.564, n = 8, range = 0.1-1.5), or about 9 m. The calves spent most of the time lying beside the adult, and facing in the same direction as the adult. At times, the calf strayed up to two whale lengths from the adult, and then oriented toward the adult. While the adult lay at the surface, the calf often submerged near the belly of the adult with its tail close to the adult's tail. This position is probably indicative of nursing. The calf then often swam under the adult, surfaced on the other side, respired one or two times, and submerged again toward the adult's belly, alternating sides with each surfacing. The calf also appeared at times to rest, lying quietly on the back and tail of the adult.

Calves were sighted at similar frequencies in all 3 yr (Table 3). However, durations of surfacings by calves were longer in 1982 than in 1980-81. Because of this, calves accounted for 15% of whale-hours of observation in 1982, but only 3% in 1981, and 4% in 1980 (Table 3).

Calves Alone

In 1982, calves spent almost 40% of their time at the surface unaccompanied by an adult. This was comparable with their behavior in 1981, but unlike 1980 when they were rarely seen alone. (Table 3).

On 24 August 1981, we saw three calves separated from each other and from the closest adults by 100 m to more than 300 m. It was, therefore, often not possible to assign calves to particular females. The nearest adults spent much time submerged, but the calves remained stationary at the surface. At one point, we videotaped an adult that surfaced 4.9 adult lengths from a calf lying stationary at the surface. During another videotaped sequence, an adult-calf pair, 0.2 lengths apart, was separated from a lone calf by 7.6 adult lengths. We suspect that the adults were feeding in the water column while calves waited at the surface.

In 1982, we observed four lone calves at the surface, on 18, 19, and 23 August, and on three of these occasions we saw the calf rejoin its presumed mother. On 18 August, a lone calf surfaced and oriented straight toward an adult at a distance of 1.6 km. When it came within 75 m of the adult, the adult also began to swim rapidly toward the calf. During a second incident on the same day, a calf and adult swam rapidly toward each other from at least 300 m distance. In both cases, the two dove simultaneously after coming together. On 23 August 1982, an adult surfaced 180 m from a lone calf, and the adult oriented toward the calf. When the two whales were $\sim$ 120 m apart, the calf also oriented toward the adult, but the adult was mainly responsible for closing the distance between them, as it swam at medium speed toward the calf. When the two whales were $\sim$ 20 m apart, the calf dove and reappeared 18 s later, reoriented by 180°, lying to the right of the adult, and facing in its direction. The calf then

TABLE 3.—Calf sightings and observation time in 1980, 1981, and 1982. Only flights with behavioral observations are considered, and both presumably undisturbed and potentially disturbed periods are included. The number of sightings of calves is an approximate count because multiple counts of the same calf were possible in cases where the calf and its mother were not individually recognizable.

	1980	1981	1982
No. sightings of calves	12	16	16
No. flights	14	18	14
Calf sightings/flight	0.86	0.89	1.14
Hours in plane over whales	30.4 h	30.8 h	36.5 h
Calf sightings/hour	0.39	0.52	0.44
Calf time at surface with mother	20.4 min	17.5 min	63.1 min
Calf time at surface alone	1.6 min	12.7 min	38.2 min
Total calf time at surface	22.0 min	30.2 min	101.3 min
% of calf surface time alone	7.3%	42.1%	37.7%
Whale-hours of observation at surface	10.03 h	14.98 h	10.95 h
Calf-hours of observation/ whale-hour of observation	0.037	0.034	0.154
Calf time at surface/ sighting	1.57 min	1.89 min	6.33 min

submerged several more times toward the belly of the adult, probably nursing.

Our observations of adults and calves orienting accurately toward one another at distances up to 1.6 km apart suggest that there was acoustic communication between the two. There is possible evidence for this from the incident on 23 August 1982. The rate of low-frequency tonal frequency-modulated calls, which we suspect to be long-distance contact calls, increased while the mother and calf were swimming toward each other from some distance apart, and then ceased altogether once the two whales were joined. Several unusual higher pitched calls of undetermined origin were also recorded by a sonobuoy near the calf while the two whales were separated.

Nursing

When the lone calf of 23 August 1982 joined its mother after a separation of at least 71 min, we observed the longest probable nursing bout seen during the study. As the two animals approached each other head on, the calf dove out of sight for the first apparent nursing dive when they were still about 22 m apart. The calf dove toward the teat region of the adult six times in all, with submergences lasting 18, 11, 27, 17, 12, and 10 s (mean = 15.8 ± SD 6.37 s). These brief dives were separated by brief surfacings lasting 6, 6, 9, 11, 23, and 17 s (mean = 12.0 ± SD 6.75 s). Each surfacing included a single respiration. Nursing ended as the calf and adult dove out of sight at the same time. Although there was no apparent progression in the durations of the calf's nursing dives over the entire nursing bout, surfacings tended to lengthen, suggesting an appeasement of the calf's eagerness to nurse. The duration of the probable nursing bout from the start of the first nursing dive to the start of the deep dive by both mother and calf was 2.78 min.

The other bouts of probable nursing were shorter, sometimes < 1 min, and involved adult-calf pairs that had not recently been separated, as far as we knew. Usually, all that we could see was one or two short dives by the calf toward the teat region of the mother at the end of a surfacing sequence, followed immediately by a dive by both animals.

Other Behaviors

Aerial Activity

Bowhead whales sometimes leaped or breached from the water, forward lunged, or slapped the tail or a pectoral flipper onto the water. During breaches, 50-60% of the body length left the water. The whale emerged head first at a small angle from the vertical, usually with the ventrum down. It then twisted and fell back onto the water on its side or back. Forward lunges differed from breaches in that the body came out of the water at a shallower angle and did not twist; the whale reentered belly first. The forward lunge had a larger forward component than did the breach.

Breaches, tail slaps, and flipper slaps sometimes occurred in bouts. Within bouts, intervals between successive breaches were generally greater than those between tail or flipper slaps. For example, breaches, tail slaps, and flipper slaps by one whale that engaged in all three behaviors on 6 August 1980 were at average intervals of 46, 8, and 4 s, respectively.

The incidence of aerial activity was comparable in the 3 yr (0.60, 0.93, and 0.82 bouts/whale-hour in 1980, 1981, and 1982), but much lower than reported for spring migration. Rugh and Cubbage (1980) saw breaching by 23% of all bowheads (n = 280) observed passing Cape Lisburne, AK, in spring.

Play

Although many social interactions may involve play, we could not distinguish low levels of mating activity or aggression from play. We scored play behavior only when whales spent some time at the surface associating with an object other than a conspecific. We saw no such behavior in 1980, but several incidents in 1981 and 1982. Few such interactions have been described for other baleen whales.

LOG PLAY.–We witnessed whales playing with logs in the water on two occasions in 1981, and once in 1982. Log play, which consisted of a whale nudging, pushing, or lifting a log, lasted 5 s, 10 min, and at least 1.5 h during these three observations. In 1981, other researchers saw bowheads playing with logs twice in the same general area as our 1981 observations (C. R. Evans and J. Hickie[10]). During two of our three observations the water was ensonified by noise pulses from distant seismic exploration (Richardson et al. in press). However, there was no proof of a connection between log play and seismic noise.

Some elements of log play by bowheads were similar to play with seaweed observed in southern

[10]C. R. Evans, Biologist, and J. Hickie, Biologist, LGL Ltd., Environmental Research Associates, 22 Fisher St., King City, Ontario L0G 1K0, Canada, pers. commun. September 1981.

right whales (Payne 1972). Both involved lifting the object with the head, moving the object along the back, and patting it with the flippers. Two log-playing bowheads attempted to push the log under water with the head. This action was reminiscent of a motion commonly made by male right whales when attempting to mate with uncooperative females (Payne, pers. obs.).

CALF PLAY.—On two occasions in 1982, lone calves at the surface interacted with debris in the water, and the actions had the appearance of play.

The first incident occurred over 12.3 min on 19 August 1982, when a lone young-of-the-year calf followed a line of surface debris ~ 2 m wide, probably composed mainly of invertebrates. The calf stayed at or just below the surface and oriented directly along the windrow, changing course as the line meandered left or right. Although the calf appeared to have its mouth open slightly for brief periods, it did not appear to feed extensively, if at all. However, its movements thoroughly disrupted and dispersed the line of debris. The movements were rapid and jerky, reminiscent of any uncoordinated young mammal. The calf lunged forward while in the debris on three occasions, and slapped its tail onto the water surface twice. For ~ 30 s, it moved rapidly along the line, ventrum up, with rapid up-and-down movements of the tail for the entire time. The sequence ended when the calf dove out of sight at the end of the windrow; we did not see it with an adult. Although the incident did not seem to represent concerted feeding, this "play" by the calf may have been practice in skills required for feeding.

A second incident of "calf play" occurred on 23 August 1982. This calf was first encountered hanging quietly just below the surface, or moving forward very slowly. During slow movement, it entered an area marked by dispersed fluorescein dye from one of our dye markers (see section on Methods). The dye covered an area about 40 m by 100 m. Immediately upon entering the area of bright green water, the calf became active. During the 22.3 min of association with the dye, the calf rolled ventrum up eight times for 5-20 s each time, and moved back and forth within, and to the edge of, the dye-clear water interface. Although not as active and not beating its tail as fast as the calf in the windrow, this calf made abrupt turns of > 90° on 25 occasions during its stay in the dye, reorienting itself at the dye's edge in order to remain within the dye. The calf ultimately moved out of the dye and oriented toward an approaching adult. When the two joined, the calf apparently began nursing.

Synchrony of Activity and Orientations

There was often an impressive degree of synchrony of basic behaviors among members of quite widely spaced groups. We observed apparent synchronization of behaviors on time scales ranging from seconds to days.

Synchrony in General Activity

During 1980, we found that all or most bowheads in various areas did the same thing for up to several days. Some days later, the whales had usually moved, and whales were then found elsewhere engaged in different activities. For example, on 3 and 5 August 1980, whales north and east of Issungnak artificial island were mainly engaged in water-column feeding, with frequent defecation. By 6 and 7 August, whales in this area shifted to more surface-active behavior, interacting in groups with pushes and apparent chases. We saw little defecation at this time. On 12 August, at least 15 animals about 30-40 km west of this area were all apparently bottom feeding.

Whales were encountered in two additional areas in 1980: east of Pullen Island (19 and 20 August) and just west of McKinley Bay (19-22 August). In the Pullen Island area, all whales were mud tracking as described above. In the second area, mud also was evident, but there was much less underwater blowing. Some animals had mouths open at the surface. On 22 and 23 August 1980 almost all whales we encountered were skim feeding in groups of 10-30 animals north of McKinley Bay. However, in the Issungnak area farther west, substantial numbers of whales were still water-column feeding. On 27, 29, and 31 August 1980, whales interacted in small groups of 2-5 individuals. Some small groups oriented SSW, perhaps indicating the beginning of migration.

In summary, during 1980 (but not 1981 or 1982) we found that whales in various areas did much the same thing for up to ~ 5 d, but then shifted location, activity, or both. A partial explanation for the synchrony of behavior seen in 1980 may be that whales moved to exploit new food resources, and that the most appropriate feeding mode changed according to site-specific conditions. In the subsequent 2 yr, it appeared that whales were doing more water-column feeding in deeper water, perhaps because of a more consistent food supply.

Synchrony in Dives and Surfacings

We sometimes had the impression that all whales

in an area were synchronizing their surfacings and dives. Many were too far apart to be in visual contact. Ljungblad et al (1980) also reported synchrony among whales engaged in water-column feeding ~75 km east of Kaktovik, AK. They reported that "... whales were observed on the surface almost at regular intervals and gave the impression of resting between dives; then, suddenly, no whales would be seen in any quadrant for several minutes."

Although synchrony in surfacings by animals far apart suggests acoustic contact between animals, it is not proof of communication over that distance. The synchrony could be established through independent responses to common external cues. It could also occur if the animals were close together and visually synchronized before observations began; the observed synchrony would then be a residual phenomenon that persisted because of whales diving and surfacing for similar lengths of time. None of these possible explanations – acoustic communication, common external cues, or residual phenomenon – can be either proven or discounted at this time.

Synchrony in Orientations

Analysis of orientations provides additional evidence that widely separated whales at times synchronize their behavior during summer. Our best data were from three flights in 1980 when we flew in a straight line. At these times, we counted each individual only once. Rayleigh and χ^2 tests (Batschelet 1972) show that whale orientations were significantly nonrandom (Table 4).

For flights when we circled to make detailed behavioral observations, we analyzed orientations using the first heading noted for each surfacing of a whale. Because we were making repeated observations on the same animal in some cases, any consistency in orientations during those flights is attributable in part to different whales, and in part to subsequent surfacings of the same whale. In 1980 and 1981, the whales were oriented nonrandomly during 7 of the 11 flights with enough data for analysis (Table 4). The headings changed from day to day, however, and bore no apparent relationship to the general behavior of the whales. In 1982, no significant departures from uniformity were found during any of the five flights with sufficient data for analysis.

The headings on the latest day with observations in 1980 and 1981 usually were not in the direction to be expected at the beginning of the westward migration. On 31 August 1980, most bowheads observed while we circled north of the Tuktoyaktuk Peninsula were oriented north, east, or south (mean 121°T (true), Table 4). However, later that day on a direct flight, we found other bowheads to be oriented toward the south (mean 189°T). In this same general area, Renaud and Davis (footnote 9) also recorded a slight eastward tendency for bowheads seen on 21-24 August 1980, but a significant southwestward tendency (236°T) on 3-4 September 1980. On 8 September 1981, most whales west of Herschel Island were oriented toward the northeast (62°T), again not the direction to be expected at the beginning of westward migration. These results support our impression that most of the whales we observed were not migrating.

TABLE 4.—Bowhead orientations, judged relative to true north from the air, 1980-81. Only during the direct flights was each observation known to represent different animals. During the circling flights, each whale was scored an unknown number of times (but only once per surfacing).

Date	No. of animals with these orientations									Vector mean direction	Rayleigh test	Chi-square test *P*
	N	NE	E	SE	S	SW	W	NW	Total			
Direct flights												
11 Aug. 1980	16	1	3	0	5	2	10	6	43	321°	<0.001	<0.001
12 Aug. 1980	7	5	16	5	7	6	9	2	57	bimodal	n.s.	<0.025
31 Aug. 1980	1	1	1	3	8	8	0	1	23	189°	<0.001	[1]
Circling flights												
31 Aug. 1980	4	4	6	3	11	1	0	2	31	121°	<0.05	/
10 Aug. 1981	0	3	0	2	0	4	0	1	10	—	n.s.	/
10 Aug. 1981	3	1	7	2	1	6	0	1	21	bimodal	n.s.	/
13 Aug. 1981	12	9	11	1	1	0	1	1	36	43°	<<0.001	/
18 Aug. 1981	2	5	10	5	6	1	2	1	32	111°	<0.001	/
18 Aug. 1981	3	0	0	0	0	1	6	0	10	289°	<0.005	/
23 Aug. 1981	0	4	1	1	0	0	0	0	6	62°	<0.02	/
24 Aug. 1981	1	0	3	2	5	8	10	5	34	243°	<0.001	/
6 Sept. 1981	1	7	2	1	0	2	3	3	19	—	n.s.	/
7 Sept. 1981	2	5	1	1	0	2	2	3	16	—	n.s.	/
8 Sept. 1981	1	8	3	1	1	0	0	0	14	62°	<0.001	/

[1] / means cell sizes too small for a chi-square test.

We do not know whether consistent orientations represented a type of social synchrony, or whether the whales independently reacted to environmental stimuli (such as currents or wave orientations). Norris et al. (1983) and Braham et al. (1984) reported gray and bowhead whales, respectively, that may have been feeding by stationing themselves against a current. Shane (1980) has reported a similar stationing against the current for bottlenose dolphins in Texas. Gray whales in lagoons have been observed to move in the same direction as the tidal current (Norris et al. 1977), but in that case movement may have been related to avoiding shallow water as the tide receded.

Miscellaneous Observations

Speed of Travel

In 1980 and 1981, some data were gathered on bowheads visible from Herschel Island. The whales were usually > 3 km from shore, and detailed behavioral observations were infrequent. However, speed was sometimes measurable with a surveyor's theodolite. Whales rarely changed direction within any one 30 s period, so we calculated speeds from theodolite readings taken within 30 s of each other. This criterion was changed to 60 s for 30 August 1981, when a whale was followed at the surface for a long period, and changed direction relatively little.

For 1980, average speed was 5.1 km/h (n = 18, SD = 2.93) at the surface, and 4.3 km/h (n = 4, SD = 0.79) below the surface. The 1980 speeds are comparable with the most reliable estimates derived by Braham et al. (1979) and Rugh and Cubbage (1980) for migrating bowheads: 4.8-5.9 km/h and 4.7 ± SD 0.6 km/h, respectively. However, based on additional data, Braham et al. (1980) estimated the mean speed at Point Barrow in spring to be 3.1 ± SD 2.7 km/h. Speeds during active migration along the coast of Baffin Island in fall were 5.0 ± SD 1.3 km/h (n = 22) based on theodolite observations from a cliff (Koski and Davis[11]).

On 30 August 1981, an adult whale traveling east was observed continuously for 1.52 h. Its behavior was unusual – it did not submerge during the entire time. Its mean speed was 2.3 ± SD 1.26 km/h, considerably slower than the speeds mentioned above. Its mean blow interval was 10.0 ± SD 13.55 s (n = 420), significantly lower than the mean for all other undisturbed whales observed from Herschel Island (14.6 ± 9.56; n = 60; t = 2.54, $P < 0.02$).

On 8 September 1981, a mother-calf pair was observed by theodolite for 1.8 h. The average speed of the calf was 8.9 ± SD 5.57 km/h (n = 28). During this rapid movement, the calf exhibited breaches, forward lunges, tail slaps, and flipper slaps.

Associations of Bowheads with Other Species

We saw several marine mammal species in the same general areas in which we observed bowheads: ringed seals, *Phoca hispida*; white whales, *Delphinapterus leucas*; and a gray whale. There was no obvious interaction between these species and bowhead whales. The gray whale was about 500 m from the closest bowhead. The Canadian Beaufort Sea is the extreme northeastern limit of the gray whale's summer range (Rugh and Fraker 1981).

Flocks of up to 50 phalaropes (*Phalaropus* sp.) were often present near skim-feeding bowheads. These birds often alighted on water that had been disturbed by the whales, sometimes only a few meters from the whales. Phalaropes and bowheads probably feed on some of the same plankton species. The whalers used the presence of phalaropes as an indicator of where "whale feed" was present and, therefore, where whales were likely to be found (J. R. Bockstoce in press). Aside from phalaropes, we noticed glaucous gulls, *Larus hyperboreus*; arctic terns, *Sterna paradisaea*; and unidentified gulls circling briefly over whales on eight occasions.

DISCUSSION

Activities of Bowheads in Summer and Other Seasons

From 1980 through 1982 we observed a steady progression in the August distribution of bowhead whales near Tuktoyaktuk from shallow water nearshore to deeper water farther from shore (Fig. 3; Richardson et al.[12]). Such a dramatic difference in distribution over the 3 yr may be due to many different ecological and behavioral factors. Disturbance

[11]Koski, W. R., and R. A. Davis. 1980. Studies of the late summer distribution and fall migration of marine mammals in NW Baffin Bay and E Lancaster Sound, 1979. Unpubl. Rep., 214 p. LGL Ltd., Toronto, for Petro-Canada Explorations, Calgary. Available from Pallister Resource Management Ltd., 700 - 6th Avenue S.W., Calgary, Alberta T2P 0T6, Canada.

[12]Richardson, W. J., R. A. Davis, C. R. Evans, and P. Norton. 1983. Distribution of bowheads and industrial activity, 1980-82. *In* W. J. Richardson (editor), Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1982. Unpubl. Rep., p. 269-357. LGL Ecological Research Associates, Inc., Bryan, TX, for U.S. Minerals Management Service, Reston, VA. Available from Minerals Management Service Alaska OCS Region, P.O. Box 101159, Anchorage, AK 99510.

by industrial activity in nearshore waters is also a possibility (see footnote 12). The fact that predominant feeding modes shifted from year to year is consistent with the "variable food supply" explanation. In 1980, whales in shallow water exhibited bottom feeding and skim feeding, while whales in slightly deeper water apparently fed in the water column. In 1981, most feeding appeared to be water-column feeding and skim feeding. In 1982, whales made long dives and presumably were often feeding in the water column.

Bowhead whales have finely fringed baleen, the longest of any whale species, and are adapted to strain small zooplankters from the sea. Stomach contents indicate that, at least in Alaskan waters, bowheads feed mainly on copepods, euphausiids, and amphipods (Marquette et al. 1982). Summering bowheads tend to occur at locations where copepod abundance is above average (Griffiths and Buchanan footnote 7). Lowry and Burns (1980) examined five whales killed off Barter Island, AK, in autumn and found about 60% copepods and about 37% euphausiids in their stomachs. However, all five whales may have fed at least partially near the sea floor; about 3% of the stomach contents consisted of mysids, amphipods, other invertebrates, and fish. Durham (1972) also suggested, based on stomach content analyses showing mud-dwelling tunicates, vegetation, silt, and small pebbles, that bowheads feed at times near the bottom. Lowry and Burns concluded from stomach content analyses that ". . . a feeding dive probably involves swimming obliquely from surface to bottom and back, feeding the entire time." Although this may be true at times, there is no direct information on underwater feeding behavior. We suspect that bowheads can detect concentrations of prey and open their mouths when appropriate. The bowhead whale is perhaps a more catholic feeder than once thought, capable of taking advantage of many different types of prey items at various positions in the water column and near the bottom. Year-to-year changes in distributions and availability of prey may account for the distributional changes that we have observed, but data on yearly changes in prey are lacking.

During spring migration around Alaska, bowhead whales appear to do little feeding; their stomachs usually are nearly empty (Marquette et al. 1982). On the other hand, feeding continues in autumn after bowheads have moved from the Canadian to the eastern part of the Alaskan Beaufort Sea (Lowry and Burns 1980; Marquette et al. 1982). Some feeding occurs in autumn as far west as the Point Barrow area (Lowry et al. 1978; Braham et al. 1984), and perhaps farther west off the Soviet coast (Johnson et al. 1981).

Feeding is not the only activity of bowheads in summer. Socializing, perhaps with occasional sexual activity, is also important. In 1982, however, there was less socializing than in 1980-81. Whales were in close proximity to each other less in 1982. This year-to-year difference in proximity may be related to the difference in type of feeding. While skim feeding at the surface, whales are often in close echelons. The proximity necessary for echelon feeding offers more chance for socializing, and socializing before or after feeding in echelon may be important to that mode of feeding. When whales appear to feed in the water column, however, they usually do not stay as close together. Thus, this type of feeding may neither require nor stimulate aggregations of animals, and the suspected predominance of water-column feeding in 1982 may explain the low socializing rate that year. Even when there is no close socializing, however, animals are often in a dispersed group within which acoustic communication is probably possible. Our observations of surfacing and dive synchrony by whales spread over distances of several kilometers indicate that they may have been in touch by acoustic communication.

The primary mating period of bowhead whales occurs in spring, including the spring migration (Everitt and Krogman 1979; Carroll and Smithhisler 1980; Johnson et al. 1981; Nerini et al. 1984). We saw some evidence for sexual activity in the Canadian Beaufort Sea in both 1980 and 1981, but not in 1982. Even the active rolling at the surface that we observed in 1981, however, was not as boisterous as observed by Everitt and Krogman in spring. Also, we found an indication of less social activity in late August-early September than in early August. This apparent waning in social activity may be a continuation of the waning of sexual activity that started in late spring.

Many calves are born in winter or spring before the whales reach Point Barrow, although some may be born in early summer (Davis et al. footnote 9). During summer, the activities of female bowheads with accompaning calves are closely coordinated with those of their calves, and differ in some details from the activities of other adult bowheads (this study; Würsig et al. 1984). At least some calves remain with their mothers for the fall migration (Davis and Koski 1980). We know of no information concerning the age of weaning of bowhead calves, but in the closely related right whale, at least some calves remain with their mothers for 1 yr and ultimately separate from their mothers after returning to the

wintering area (Taber and Thomas 1982).

Aerial activity similar to what we observed in the eastern Beaufort Sea – breaches, tail slaps, pectoral flipper slaps, and rolls – has been observed in bowheads during spring migration (Rugh and Cubbage 1980; Carroll and Smithhisler 1980). It appears that aerial behavior is more frequent during spring migration than on the summer feeding grounds, and this may be related to the high levels of social-sexual activities during spring.

Comparisons with Other Baleen Whales

Bowhead whales spend their entire lives in arctic and near-arctic waters. This habit separates them from all other baleen whales, which may move into temperate or subtropical waters (Lockyer and Brown 1981). However, behavior is in large part determined by feeding mode and related ecological factors (Gould 1982), and here similarities between bowhead whales and several other species are evident.

Gray, bowhead, and right whales are often found in shallow water, and all three species feed on small invertebrates. Gray whales usually feed near the bottom (Bogoslovskaya et al. 1981; Nerini and Oliver 1983), whereas right and bowhead whales may skim their food at or near the surface (see Watkins and Schevill 1976, 1979 for right whales). But all three species are adaptable in feeding behavior. Gray whales apparently will feed on mysids associated with kelp (Darling 1977) or on crab *Pleuroncodes* in the water column (Norris et al. 1983). Right whales also feed below the surface, probably straining swarms of copepods and other small invertebrates in the water column (Pivorunas 1979). While it has long been known that bowhead whales feed at the surface and in the water column (Scoresby 1820), it was recently established from stomach content analyses (Durham 1972; Lowry and Burns 1980), and by observing bowhead whales surfacing with muddy water streaming from their mouths (this study), that bowheads sometimes feed near or on the bottom. It is not surprising that there are many similarities in the behavior of these species. Bowhead and right whales, in particular, are morphologically and taxonomically quite similar, and appear to obtain their food in very much the same ways. In fact, Rice (1977), mainly relying on a detailed comparison of morphology of bowhead and right whales, suggested that they be put in the same genus, *Balaena*.

The sleeker rorquals (Balaenopterid whales) generally gather their food more actively by lunging through concentrations of prey, and at least in the case of humpback whales, have developed complicated behavioral strategies for confining and concentrating their prey (Jurasz and Jurasz 1979; Hain et al. 1982). The rorquals are more often found in deeper water far from shore, and their behavior in general appears to be less similar to that of the bowhead whale than its behavior is to that of gray and right whales.

Gray whales spend part of the winter in warm water, near the shores of Baja California, and most of the summer they feed in the northern Bering and southern Chukchi Seas. Western Arctic bowheads make much shorter migrations, spending their winter in the pack ice of the Bering Sea and their summer predominantly in the Beaufort Sea. The two species thus use the Bering Sea at different seasons and for different purposes – gray whales to feed in summer and bowheads apparently to mate and calve in winter. Like bowhead whales summering in the Beaufort Sea, the primary activity of gray whales summering in the Bering and Chukchi Seas is feeding. However, both bowheads and gray whales (Sauer 1963; Fay 1963) occasionally socialize during summer.

Right whales, like bowhead whales, often appear to feed in the water column or at the surface (Watkins and Schevill 1976, 1979) and may stay in the same general area for days. While skim feeding, both species at times aggregate into echelons. In right whales, these echelons usually consist of only 3-6 whales (Payne, pers. obs.), while up to 14 bowhead whales have been seen skim feeding in echelon. However, Payne observed right whales during winter when little feeding occurs, so apparent differences in feeding details may be due to seasonal factors.

Apparent differences between the social activity of bowheads and right whales may also be largely attributable to the different times of year when they have been studied. The same kinds of nudges and pushes have been observed for interacting whales of both species, but the winter-spring social activity of right whales is much more boisterous than the summer social activity of bowheads. Observations of bowhead whales in spring indicate that their social-sexual activity at that season can be as boisterous as is seen in mating groups of right whales (Everitt and Krogman 1979; Carroll and Smithhisler 1980; Rugh and Cubbage 1980; Johnson et al. 1981). The belly-up position of a female bowhead photographed in spring in the Alaskan Beaufort Sea (Everitt and Krogman 1979) indicates that females may attempt to evade potential mates who pursue them in large mating aggregations in the same way that female right

whales evade males in Argentine waters (Payne and Dorsey 1983). A photograph showing a remarkably similar mating group of right whales is shown in the article by Payne (1976). The fact that similar-looking social aggregations are seen in both species argues for a similar social system, although it does not show that the social systems are similar in all details.

Female right whales have young only at intervals of 3 yr or more (Payne, pers. obs.). The same appears to be true of bowheads (Davis et al. footnote 9; Nerini et al. 1984). This long calving interval may help to explain why bowhead and right whales have not made as dramatic a recovery from commercial exploitation as has, for example, the gray whale. Payne also found that right whale females that calve along the shore of southern Argentina in winter are usually not present in the years between calving. Each winter, a different segment of the population of mature females is present, in a 3-yr cycle. It is not known whether this cycling extends to the summer feeding grounds of these right whales. During the present 3-yr study, year-to-year variation in feeding and social behavior was dramatic, but we do not know whether this was due in part to some cyclic and synchronized activity of individual whales. We suspect that variable prey distibution was largely responsible.

ACKNOWLEDGMENTS

This project, including preparation of this paper, was funded by contracts from the Bureau of Land Management and the Minerals Management Service, U.S. Department of the Interior, to LGL Ecological Research Associates. We thank the Polar Continental Shelf Project of the Department of Energy, Mines, and Resources (Canada) for logistical help. Dome Petroleum Ltd. and Esso Resources Canada Ltd. shared data and assisted with logistics. NORCOR Engineering and Research Ltd. provided the Islander aircraft, and J. Merilees was its capable pilot. Personnel of the Beaufort Weather Office were helpful. K. Finley, P. Tyack, and R. Wells helped with aerial observations. K. Hazard, G. Silber, S. Taber, P. Thomas, and M. Würsig collected data from Herschel Island. C. Greene of Polar Research Laboratory set up the sonobuoy system. S. Heimlich-Boran prepared the illustrations of bowheads in this paper. J. Bird, L. Guinee, and V. Rowntree of the New York Zological Society, and C. R. Evans, R. Wells, and M. Würsig assisted with data analysis. H. Braham provided helpful suggestions on an earlier draft. We thank all of these organizations and individuals.

LITERATURE CITED

BATSCHELET, E.
1972. Recent statistical methods for orientation data. *In* S. R. Galler, K. Schmidt-Koenig, G. J. Jacobs, and R. E. Belleville (editors), Animal orientation and navigation, p. 61-91. NASA SP-262, Natl. Aeronaut. Space Admin., Wash., D.C.

BOGOSLOVSKAYA, L. S., L. M. VOTROGOV, AND T. N. SEMENOVA.
1981. Feeding habits of the gray whale off Chukotka. Rep. Int. Whaling Comm. 31:507-510.

BRAHAM, H. W., B. D. KROGMAN, AND G. M. CARROLL.
1984. Bowhead and white whale migration, distribution, and abundance in the Bering, Chukchi, and Beaufort Seas, 1975-78. U.S. Dep. Commer., NOAA Tech. Rep. NMFS SSRF-778, 39 p.

BRAHAM, H., B. KROGMAN, J. JOHNSON, W. MARQUETTE, D. RUGH, M. NERINI, R. SONNTAG, T. BRAY, J. BRUEGGEMAN, M. DAHLHEIM, S. SAVAGE, AND C. GOEBEL.
1980. Population studies of the bowhead whale (*Balaena mysticetus*): results of the 1979 spring research season. Rep. Int. Whaling Comm. 30:391-404.

BRAHAM, H. B. KROGMAN, S. LEATHERWOOD, W. MARQUETTE, D. RUGH, M. TILLMAN, J. JOHNSON, AND G. CARROLL.
1979. Preliminary report of the 1978 spring bowhead whale research program results. Rep. Int. Whaling Comm. 29:291-306.

BROWN, R.
1868. Notes on the history and geographical relations of the Cetacea frequenting Davis Strait and Baffin's Bay. Proc. Zool. Soc. Lond., 35:533-556.

CARROLL, G. M., AND J. R. SMITHHISLER.
1980. Observations of bowhead whales during spring migrations. Mar. Fish. Rev. 42(9-10):80-85.

DAHLHEIM, M., T. BRAY, AND H. BRAHAM.
1980. Vessel survey for bowhead whales in the Bering and Chukchi Seas, June-July 1978. Mar. Fish. Rev. 42(9-10):51-57.

DARLING, J. D.
1977. Aspects of the behavior and ecology of Vancouver Island gray whales, *Eschrichtius glaucus* Cope. M.S. Thesis, Univ. Victoria, 200 p.

DAVIS, R. A., AND W. R. KOSKI.
1980. Recent observations of the bowhead whale in the eastern Canadian High Arctic. Rep. Int. Whaling Comm. 30:439-444.

DORSEY, E. M.
1983. Exclusive adjoining ranges in individually identified minke whales (*Balaenoptera acutorostrata*) in Washington state. Can. J. Zool. 61:174-181.

DURHAM, F. E.
1972. Greenland or bowhead whale. *In* A. Seed (editor), Baleen whales in eastern North Pacific and arctic waters, p. 10-14. Pacific Search Press, Seattle, WA.

EVERITT, R. D., AND B. D. KROGMAN.
1979. Sexual behavior of bowhead whales observed off the north coast of Alaska. Arctic 32:277-280.

FAY, F. H.
1963. Unusual behavior of gray whales in summer. Psychol. Forsch. 27:175-176.

FRAKER, M. A., AND J. R. BOCKSTOCE.
1980. Summer distribution of bowhead whales in the eastern Beaufort Sea. Mar. Fish. Rev. 42(9-10):57-64.

GOULD, J. L.
1982. Ethology, the mechanisms and evolution of behavior. W. W. Norton & Co., N.Y. 544 p.

HAIN, J. H. W., G. R. CARTER, S. D. KRAUS, C. A. MAYO, AND H. E. WINN.
1982. Feeding behavior of the humpback whale, *Megaptera novaeangliae*, in the western North Atlantic. Fish. Bull., U.S. 80:259-268.

HERMAN, L. M., AND R. C. ANTINOJA.
1977. Humpback whales in the Hawaiian breeding waters: Population and pod characteristics. Sci. Rep. Whales Res. Inst. 29:59-85.

JOHNSON, J. H., H. W. BRAHAM, B. D. KROGMAN, W. M. MARQUETTE, R. M. SONNTAG, AND D. J. RUGH.
1981. Bowhead whale research: June 1979 to June 1980. Rep. Int. Whaling Comm. 31:461-475.

JOHNSON, M. L., C. H. FISCUS, B. T. OSTENSON, AND M. L. BARBOUR.
1966. Marine mammals. *In* N. J. Wilimovsky and J. N. Wolfe (editors), Environment of the Cape Thompson region, Alaska, p. 877-924. U.S. At. Energy Comm., Oak Ridge, TN.

JURASZ, C. M., AND V. P. JURASZ.
1979. Feeding modes of the humpback whale, *Megaptera novaeangliae*, in Southeast Alaska. Sci. Rep. Whales Res. Inst. 31:69-83.

KRAUS, S. D., J. H. PRESCOTT, P. V. TURNBULL, AND R. R. REEVES.
1982. Preliminary notes on the occurrence of the North Atlantic right whale, *Eubalaena glacialis*, in the Bay of Fundy. Rep. Int. Whaling Comm. 32:407-411.

LJUNGBLAD, D. K., M. F. PLATTER-RIEGER, AND F. S. SHIPP, JR.
1980. Aerial surveys of bowhead whales, North Slope Alaska: final report: fall 1979. Nav. Ocean Syst. Cent. Tech. Doc. 314, 181 p. Naval Ocean Systems Center (Code 5131), San Diego, CA.

LOCKYER, C. H., AND S. G. BROWN.
1981. The migration of whales. *In* D. J. Aidley (editor), Animal migration, p. 105-137. Soc. Exp. Biol. Semin. Ser. 13, Cambridge Univ. Press.

LOWRY, L. F., AND J. J. BURNS.
1980. Food utilized by bowhead whales near Barter Island, Alaska, autumn 1979. Mar. Fish. Rev. 42(9-10):88-91.

LOWRY, L. F., K. J. FROST, AND J. J. BURNS.
1978. Food of ringed seals and bowhead whales near Point Barrow, Alaska. Can. Field-Nat. 92:67-70.

MARQUETTE, W. M., H. W. BRAHAM, M. K. NERINI, AND R. V. MILLER.
1982. Bowhead whale studies, autumn 1980–spring 1982: harvest, biology and distribution. Rep. Int. Whaling Comm. 32:357-370.

MATSUSHITA, T.
1955. Daily rhythmic activity of the sperm whale in the Antarctic Ocean. Bull. Top. Soc. Sci. Fish. 20:770-773.

NEMOTO, T.
1970. Feeding pattern of baleen whales in the ocean. *In* J. H. Steele (editor), Marine food chains, p. 130-141. Oliver and Boyd, Edinburg.

NERINI, M., H. BRAHAM, W. MARQUETTE, AND D. RUGH.
1984. Life history of the bowhead whale. J. Zool. (Lond.). 204:443-468.

NERINI, M. K., AND J. S. OLIVER.
1983. Gray whales and the structure of the Bering Sea benthos. Oecologia 59:224-225.

NORRIS, K. S., R. M. GOODMAN, B. VILLA-RAMIREZ, AND L. HOBBS.
1977. Behavior of California gray whale, *Eschrichtius robustus*, in southern Baja California, Mexico. Fish. Bull., U.S. 75:159-172.

NORRIS, K. S., B. VILLA-RAMIREZ, G. NICHOLS, B. WURSIG, AND K. MILLER.
1983. Lagoon entrance and other aggregations of gray whales (*Eschrichtius robustus*). *In* R. Payne (editor), Communication and behavior of whales, p. 259-293. AAAS Selected Symp. 76, Westview Press, Boulder, CO.

PAYNE, R.
1972. Swimming with Patagonia's right whales. Nat. Geogr. 142:576-587.
1976. At home with right whales. Nat. Geogr. 149:322-339.
1983. Introduction. *In* R. Payne (editor), Communication and behavior of whales, p. 1-6. AAAS Selected Symp. 76, Westview Press, Boulder, CO.

PAYNE, R., AND E. M. DORSEY.
1983. Sexual dimorphism and aggressive use of callosities in right whales (*Eubalaena australis*). *In* R. Payne (editor), Communication and behavior of whales, p. 295-329. AAAS Selected Symp. 76, Westview Press, Boulder, CO.

PIVORUNAS, A.
1979. The feeding mechanisms of baleen whales. Am. Sci. 67:432-440.

RICE, D. W.
1977. A list of the marine mammals of the world. U.S. Dep. Commer., NOAA Tech. Rep. NMFS SSRF-711, 15 p.

RICHARDSON, W. J., M. A. FRAKER, B. WURSIG, AND R. S. WELLS.
In press. Behaviour of bowhead whales, *Balaena mysticetus*, summering in the Beaufort Sea: reactions to industrial activities. Biol. Conserv.

RUGH, D. J., AND J. C. CUBBAGE.
1980. Migration of bowhead whales past Cape Lisburne, Alaska. Mar. Fish. Rev. 42(9-10):46-51.

RUGH, D. J., AND M. A. FRAKER.
1981. Gray whale (*Eschrichtius robustus*) sightings in eastern Beaufort Sea. Arctic 34:186-187.

SAAYMAN, G. S., C. K. TAYLER, AND D. BOWER.
1973. Diurnal activity cycles in captive and free-ranging Indian Ocean bottlenose dolphins (*Tursiops aduncus* Ehrenburg). Behaviour 44:212-233.

SAUER, E. G. F.
1963. Courtship and copulation of the gray whale in the Bering Sea at St. Lawrence Island, Alaska. Psychol. Forsch. 27:157-174.

SCHEVILL, W. E., AND R. H. BACKUS.
1960. Daily patrol of a *Megaptera*. J. Mammal. 41:279-281.

SCORESBY, W., JR.
1820. An account of the Arctic regions, with a history and description of the northern whale-fishery. Archibald Constable and Co., Edinburgh: 2 Vols. Reprinted (1969) by David and Charles (Holdings) Ltd., Newton Abbot, Devon, Engl.

SHANE, S. H.
1980. Occurrence, movements, and distribution of bottlenose dolphin, *Tursiops truncatus*, in southern Texas. Fish. Bull., U.S. 78:593-601.

SUMICH, J. L.
1983. Swimming velocities, breathing patterns, and estimated costs of locomotion in migrating gray whales, *Eschrichtius robustus*. Can. J. Zool. 61:647-652.

TABER, S., AND P. THOMAS.
1982. Calf development and mother-calf spatial relationships in southern right whales. Anim. Behav. 30:1072-1083.

TOWNSEND, C. H.
1935. The distribution of certain whales as shown by logbook records of American whaleships. Zoologica (N.Y.) 19:3-50.

TYACK, P., AND H. WHITEHEAD.
1983. Male competition in large groups of wintering humpback whales. Behaviour 83:132-154.

WATKINS, W. A., AND W. E. SCHEVILL.
1976. Right whale feeding and baleen rattle. J. Mammal. 57:

58-66.

1979. Aerial observation of feeding behavior in four baleen whales: *Eubalaena glacialis, Balaenoptera borealis, Megaptera novaeangliae,* and *Balaenoptera physalus.* J. Mammal. 60:155-163.

WÜRSIG, B.

1978. On the behavior and ecology of bottlenose and dusky dolphins. Ph.D. Thesis, State Univ. New York, Stony Brook, 326 p.

WÜRSIG, B., E. M. DORSEY, M. A. FRAKER, R. S. PAYNE, W. J. RICHARDSON, AND R. S. WELLS.

1984. Behavior of bowhead whales, *Balaena mysticetus,* summering in the Beaufort Sea: surfacing, respiration and dive characteristics. Can. J. Zool. 62:1910-1921.

Environ Monit Assess (2007) 134:93–106
DOI 10.1007/s10661-007-9810-3

Feeding of western gray whales during a seismic survey near Sakhalin Island, Russia

S. B. Yazvenko · T. L. McDonald · S. A. Blokhin · S. R. Johnson · H. R. Melton · M. W. Newcomer · R. Nielson · P. W. Wainwright

Received: 21 April 2006 / Accepted: 11 April 2007 / Published online: 7 August 2007
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Abstract Exxon Neftegas Limited, as operator of the Sakhalin-1 consortium, is developing oil and gas reserves on the continental shelf off northeast Sakhalin Island, Russia. DalMorNefteGeofizika (DMNG) on behalf of the Sakhalin-1 consortium conducted a 3-D seismic survey of the Odoptu license area during 17 August–9 September 2001. A portion of the primary feeding area of the endangered western gray whale (*Eschrichtius robustus*) is located in the vicinity of the seismic survey. This paper presents data to assess whether western gray whale bottom feeding activity, as indicated by visible mud plumes, was affected by seismic operations. The mitigation and monitoring program associated with the seismic survey included aerial surveys during 19 July–19 November 2001. These aerial surveys documented the local and regional distribution, abundance, and bottom feeding activity of western gray whales. Data on gray whale feeding activity before, during and after the seismic survey were collected, with the whales assumed to be feeding on the benthos if mud plumes were observed on the surface. The data were used to assess the influence of seismic survey and other factors (including environmental) on feeding activity of western gray whales. A stepwise multiple regression analysis failed to find a statistically significant effect (α=0.05) of the seismic survey on frequency of occurrence of mud plumes of western gray whales used as a proxy to evaluate bottom feeding activity in Piltun feeding area. The regression indicated that transect number (a proxy for water depth, related to distance from shore) and swell height (a proxy for sea state) were the only variables that had a significant effect on frequency of whale mud plumes. It is concluded that the 2001 seismic survey had no measurable effect (α=0.05) on bottom feeding activity of western gray whales off Sakhalin Island.

M.W. Newcomer, deceased

S. B. Yazvenko (✉) · S. R. Johnson · P. W. Wainwright
LGL Limited, environmental research associates,
9768 Second Street,
Sidney, BC V8L 3Y8, Canada
e-mail: yazvenko@lgl.com

T. L. McDonald · R. Nielson
Western EcoSystems Technology,
2003 Central Avenue,
Cheyenne, WY 82001, USA

S. A. Blokhin
Pacific Research Center for Fisheries and Oceanography
(TINRO-Center),
4 Shevchenko Alley,
Vladivostok 690950, Russia

H. R. Melton
ExxonMobil Upstream Research,
P.O. Box 2189, 3319 Mercer Street,
Houston, TX 77252-2189, USA

M. W. Newcomer
22371 Hartman Dr.,
Los Altos, CA 94024, USA

Keywords Feeding activity · Mud plume · Multiple regression · Sakhalin Island · Odoptu · Seismic survey · Air gun · Western gray whales · Environment · Oil · Continental shelf

Introduction

The Western North Pacific population of gray whale (*Eschrichtius robustus*), hereinafter western gray whale, feeds off northeastern Sakhalin Island, Russia. A primary feeding area (Piltun feeding area) lies parallel to shore from 52°37.5′ N to 53°37.5′ N in a narrow strip (ca. 100×5 km) mainly within the 20-m isobath along the coast of northeast Sakhalin Island and adjacent to Piltun Bay. Western gray whales are one of the most endangered populations of large cetaceans. The International Union for the Conservation of Nature (IUCN) listed the western gray whale as critically endangered, based on its geographic and genetic separation from the eastern population (LeDuc et al. 2002) and because of the likelihood that fewer than 50 reproductively active individuals remain in the population (Hilton-Taylor 2000). This population is also listed as Category 1 ("threatened by extinction") in the Red Book of the Russian Federation (Anonymous 2001).

Exxon Neftegas Limited, as operator of the Sakhalin-1 consortium, is developing oil and gas reserves on the nearshore continental shelf off northeast Sakhalin Island, Russia. DalMorNefteGeofizika (DMNG) on behalf of the Sakhalin-1 consortium conducted a 3-D seismic survey of the Odoptu license area during 17 August–9 September 2001. The data presented here were collected to evaluate whether the feeding activity of western gray whales was affected during this seismic survey. Feeding activity index is defined as the proportion of gray whale groups observed with mud plumes relative to the total number of gray whale groups recorded in the Piltun survey grid. To reduce and assess potential impacts of the seismic survey on western gray whales, mitigation and monitoring programs were designed and implemented (Johnson 2002; Johnson et al. 2007). One component of the monitoring program included replicated and systematic aerial surveys. The aerial surveys determined the local and regional distribution, abundance and bottom feeding-related activity of western gray whales. The distribution and abundance of gray whales in relation to the 2001 Odoptu 3-D seismic survey are addressed elsewhere (Yazvenko et al. 2007).

This paper presents the results of observations of gray whale bottom feeding-related activity before, during and after the seismic survey in 2001. The goal of this study was to determine whether the feeding activity index changed in relation to the seismic survey. Specifically, the objectives were (1) to determine if bottom feeding activity of gray whales was affected by the seismic survey in the Odoptu Block area and assess the influence of various environmental factors and seismic-survey related parameters on this activity, and (2) to characterize the spatial and temporal variability of feeding activity of gray whales within the study area. "Feeding" is used throughout the paper to indicate the activity resulting in visible mud plumes. No inference is made related to the quantity and quality of food intake resulting from this activity.

Materials and methods

Aerial survey area

The Piltun aerial survey grid developed for the 3-D seismic survey covered coastal areas, (two transects in waters <20 m deep; two transect lines (hereinafter "lines") outside the 20 m isobath), near and seaward of Piltun Bay and adjacent to the Odoptu seismic block, i.e., areas where gray whales have been found to aggregate to feed (Blokhin et al. 1985, 2002, 2003, 2004; Berzin et al. 1988, 1990, 1991; Blokhin 1996; Sobolevsky 2000, 2001; Weller et al. 2000, 2001; Yazvenko et al. 2002; Vladimirov et al. 2005; Meier et al. 2007). Four ~90-km long lines were established parallel to the shore, spaced 2 km apart covering from 52° 43′ N to 53° 31′ N; each line was subdivided into five "blocks" numbered sequentially from south to north (Fig. 1). This sampling grid included all areas where western gray whales were known to feed in the Piltun feeding area prior to 2001.

Survey design

After several attempts failed due to weather, the first successful aerial survey was flown on 19 July. Surveys were usually conducted daily or several times per day, weather permitting, until 19 November, more

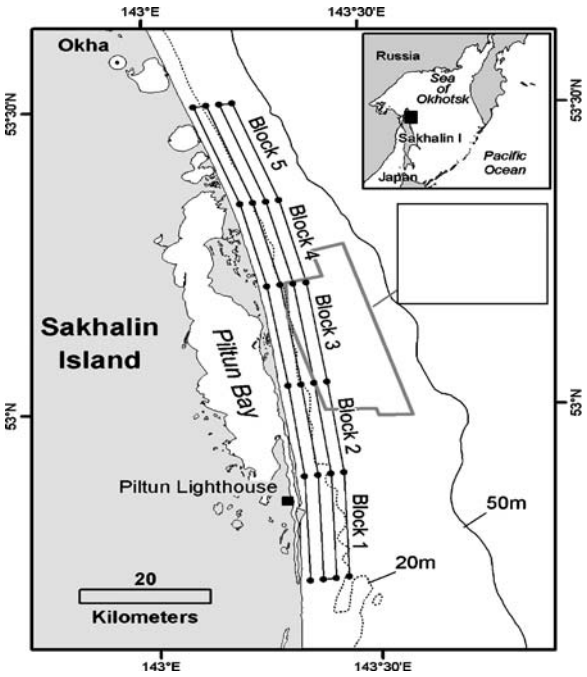

Fig. 1 Piltun aerial survey grid developed for the 3-D seismic survey monitoring with four 90-km-long transects parallel to coast and numbered seawards. Each of the four transects was subdivided into five "blocks"

than 2 months after seismic operations ceased (see Table 1).

The seismic survey ceased at 3:45 A.M. on 9 September 2001. All surveys conducted on or after 9 September occurred after the cessation of the seismic survey. All but one survey were flown at 300 m above sea level (ASL); the survey on 7 October was flown at various altitudes due to rapid changes in weather conditions. Survey procedures generally followed those recommended by the High Energy Seismic Survey (HESS 1999) team guidelines for southern California waters. Aerial surveys were an important part of the mitigation and monitoring program and used in daily planning (Johnson 2002; Johnson et al. 2007). Other components of the program included a vessel-based marine mammal monitoring program (Meier et al. 2002), acoustic monitoring of noise levels on the periphery of the area frequented by gray whales (Borisov et al. 2002; Rutenko et al. 2007), and a shore-based gray whale behaviour monitoring program (Würsig et al. 2002; Gailey et al. 2007).

Prior to 4 August, aerial surveys were conducted in a twin-engine MI-8 helicopter. Surveys were flown with three marine mammal observers, one on each side of the aircraft behind the pilots and one in the front nose-pod of the cockpit (i.e., forward of and between the pilot and co-pilot). Beginning on 4 August, an Antonov 28 (AN-28) twin engine turboprop fixed-wing aircraft was used. Two side observers and a data recorder conducted surveys. Both aircraft were equipped with a radar altimeter. In addition to the aircraft GPS, marine mammal observers had a dedicated Garmin© III+ GPS that every 30 s automatically logged track-line positions of the survey route (see Yazvenko et al. 2002 and Blokhin et al. 2002 for details).

Survey procedures

A whale sighting was defined as an observation of a group, i.e., of one or more western gray whales and/or one or more mud plumes that are usually visible when gray whales feed on benthic organisms and expel bottom sediment at or near the surface. A gray whale or a group of whales was considered associated with mud plume(s) if the distance between a whale and the closest plume was less than five body lengths apart. Otherwise, a mud plume was considered not associated with whales and eliminated from the analysis (14.8% sightings). Whales were considered a group

Table 1 Periods of the 2001 field season and frequency of aerial surveys

Period	Seismic activities	Aerial surveys	Mud plumes recorded
19 Jul morning–2 Aug morning	No seismic survey	One to two surveys a day, weather permitting	Yes
Afternoon 2 Aug–16 Aug	Seismic calibration	One to four surveys a day, weather permitting	Yes
17 Aug–8 Sept	Seismic survey	One to three surveys a day, weather permitting	Yes
9 Sept–27 Oct	No seismic survey	One to three surveys a day, weather permitting	Yes
28 Oct–14 Nov	No seismic survey	No surveys	N/A
15–19 Nov	No seismic survey	One to two surveys a day, weather permitting	Yes

using the same criterion (less than five body lengths between whales). GPS coordinates were recorded as way-points at the point of closest approach to a gray whale/plume sighted during the survey, i.e., when the whale and/or plume was directly perpendicular to the aircraft. Clinometers were used to measure the vertical angle to gray whale individuals and groups, as well as to mud plumes. These angles were used to determine the distance of the sighting from the aircraft. Location information for seismic support vessels and small craft was recorded in the same manner as for whales and mud plumes.

During an average 4.1 min surface-respiration-dive cycle recorded in 2001 in the Piltun feeding area ("surface time" plus "dive time" in Würsig et al. 2002), gray whales spent approximately 1.6±1.84 min on the surface ("surface time") and 2.5±0.92 min underwater ("dive time"). Thus, gray whales were on the surface for about 40% of the time in the Piltun feeding area, though the variability of "surface time" was high. At ground speeds of ~180 km/h for the MI-8 and ~200 km/h for the AN-28, the availability of gray whales (Buckland et al. 1993) averaged 0.446 for both aircraft and all sightability conditions (J. Muir, LGL Limited, unpublished data).

Data analysis

The geographic areas defined by each of the five blocks × four line combinations (Fig. 1) were viewed as the main experimental units upon which whale sightings, environmental variables, and seismic survey variables were measured. Only 3.5% of gray whales were sighted on lines 3 (covering the strip 4–6 km offshore) and 4 (covering the strip 6–8 km offshore), the two lines farthest offshore, which lie for the most part outside the 20-m isobath (Yazvenko et al. 2002). Therefore, 96.5% of the sighted gray whales were located within 4 km of shore. Because a high proportion of zeros (surveys without whale sightings) on lines 3 and 4 would adversely influence the stability of the analyses, lines 3 and 4 were excluded from the analyses. Similarly, only 1% of whales were sighted on all lines in block 5, the northernmost of the five surveyed blocks (Fig. 1); therefore, data from this block were omitted from the analyses.

The response variable for this analysis was the proportion of feeding groups of whales observed during each survey of each of the eight blocks (geographic areas). Whale groups engaged in feeding behavior were defined to be those observed in close proximity to a feeding plume. If a group of whales was associated with a feeding plume, it was assumed that all members of the group were feeding. The response of the logistic regression analysis can be written,

$$\text{Feeding Index} = \pi_i = {}^{f_i}/_{w_i},$$

where f_i was the number of groups of whales observed on survey i definitely associated with a feeding plume, and w_i was the number of groups of whales on survey i that were associated with a feeding plume (i.e., f_i) plus the number of groups of whales definitely not associated with a feeding plume. A survey was defined as one flight over one of the geographic areas.

Overall, data for 728 groups of 740 gray whales were used. Whale sightings that occurred while the aircraft was turning or travelling to another transect were excluded from regression analyses. Only the gray whale sightings that were definitely associated with mud plume(s) or were definitely not associated with mud plume(s) were included in these analyses (69% of sightings). During surveys, the sightability of whales and mud plumes decreased with distance from the transect (Fig. 2; Yazvenko et al. 2002). To limit this effect, only groups and plumes sighted within 400 m of either side of the aircraft were included in the analyses. No distance analysis (Buckland et al. 1993) was performed, because it was the ratio of whale groups with plumes *vs* total whale groups, rather than density of whale groups, that was the object of the study. This ratio was not likely to be affected by slight changes in sightability with distance from the aircraft. Plus, the "object" being detected was different in numerator and denominator. In numerator, "plumes+whales" were detected while in denominator, it was "whales." Application of correction methods would be complicated; therefore, only those data where the detection was high were considered.

Multiple regression analysis of gray whale bottom-feeding activity

Stepwise multiple regression (Neter et al. 1983) was used to consider (1) environmental variables that could influence feeding activity and (2) seismic sound variables associated with the seismic survey that could

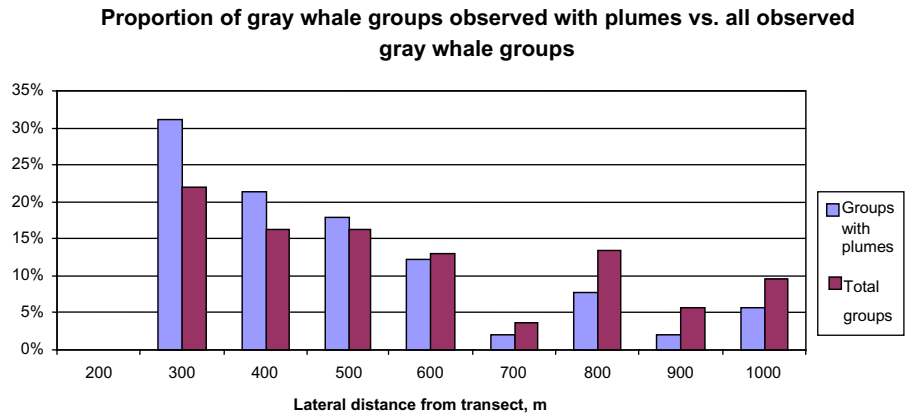

Fig. 2 Proportion of gray whale groups presumed bottom-feeding (gray whales definitely associated with mud feeding plumes) *vs* proportion of all gray whales sighted at different distance intervals from the transect. Only sightings on lines 1 and 2 in the Piltun survey area were considered. Sightings within the blind strip beneath the aircraft (<200 m of the transect centerline at survey altitude of 300 m) are not included

influence whale feeding activity. The regression model was fitted to the observed data. If estimated seismic sound energy levels explained a significant fraction of the residual variation in the proportion of whale groups observed with mud plumes not explained by environmental variables, we reasoned that seismic survey noise had influenced the proportion of whale groups that were observed with mud plumes.

The response variable for this analysis was the feeding activity index (π) obtained during each survey of each of the eight geographic areas. The logistic model used here was similar to a regular regression model in that it related a function of the proportion of whale groups with mud plumes to a linear function of study variables (Eq. 1):

$$\begin{aligned}\text{logit}(E[\pi_i]) &= \ln\left[\frac{E[\pi_i]}{1-E[\pi_i]}\right] \\ &= \beta_0 + \beta_1 X_{1i} + \ldots + \beta_p X_{pi}\end{aligned} \quad (1)$$

where β_j were unknown coefficients, and X_{ji} were values of the jth explanatory variable measured during the ith survey. The variance of π_i was modelled as (Eq. 2):

$$var\,(\pi_i) = \phi[w_i \pi_i (1-\pi_i)] \quad (2)$$

where ϕ was an unknown *over-dispersion* parameter to be estimated. The over-dispersion parameter ϕ was estimated as the sum of squared Pearson residuals divided by residual degrees of freedom. Wald χ^2 statistics (=estimate^2/estimate's variance) were computed to indicate the significance of variables in the final model and to test differences between one level and its reference.

Stepwise multiple regression with forward variable selection was used to create a logistic model containing significant environmental variables. During each forward step of this procedure, environmental and other non-seismic variables in consideration (Table 2) were added one-at-a-time and the χ^2 score statistics testing the hypothesis of no contribution to the overall fit was computed. Score statistics were adjusted for variables already in the model. The most significant variable was then added to the model. Following each forward step, an iterative reassessment was conducted of the significance of variables in the current model. The statistical significance of terms now in the model was assessed using χ^2 score tests and the variable with the greatest p value was removed (provided that the p value was greater than α=0.05). This process continued until no variables significantly contributed to the model during a forward step, and no variable was eliminated through iteration.

During model selection, linear terms for main effects (e.g., *date* and *hour*) were required in the model before quadratic terms were allowed. As a result, only linear effects that were not previously in the model, and quadratic effects of variables already in the model, were available for addition during the forward steps.

To avoid model instability caused by large numbers of missing values, *b_speed, c_speed, u_speed, b_dir, c_dir, u_dir* were excluded from consideration.

Table 2 The list of environmental and other non-seismic related variables considered for inclusion in the logistic regression model for the gray whale feeding activity analysis

Variable	Description
line	Transect line number (1 or 2)
block	Block number (1 to 4)
visibility	Visibility index (0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5)
white_caps	Incidence of white-caps (0, 0.5, 1, 1.5, 2)
fog	Index of fog (0, 1, 2)
wind_direction	Direction of wind (N, E, S, W)
wind_speed	Wind speed (m/s)
air_temp	Air temperature (°C)
wave_height	Wind wave height (m)
swell_height	Swell height (m)
swell_period	Swell period (s)
level	Estimated tide (m)
storm3	Hours since storm with wave height >3 m
storm4	Hours since storm with wave height >4 m
date	Julian date (number of days since January 1, 1960)
time	Hours since midnight
sea state	Sea state index (0, 0.5, 1, 1.5, 2, 2.5)
overcast	Percent overcast (%)
aircraft	MI-8 (helicopter) or AN-28 (fixed-wing)
*aircraft*fog*	Interaction between aircraft and fog
*aircraft*visibility*	Interaction between aircraft and visibility
*aircraft*white_caps*	Interaction between aircraft and white_caps
*aircraft*overcast*	Interaction between aircraft and overcast
wave_period[b]	Wind wave period (s)
sun[b]	Index of sun (0, 0.5, 1)
depth[b]	Depth (m)
b_speed[a]	Bottom current speed (mm/s)
b_direction[a]	Bottom current direction (N, E, S, W)
u_speed[a]	Surface current speed (mm/s)
u_direction[a]	Surface current direction (N, E, S, W)
c_speed[a]	All-depths average current speed (mm/s)
c_direction[a]	All-depths average current direction (N, E, S, W)
B2T1[a]	Shoreward distance (m) from block center to T1 position
seg3h	Sound energy estimate for preceding 3 h period
seg3d	Sound energy estimate for preceding 3 day period
rubin3h[a]	Position of Rubin relative to block center position in preceding 3 h period
rubin3d[a]	Position of Rubin relative to block center position in preceding 3 day period
atlas3h[a]	Position of Atlas relative to block center position in preceding 3 h period
atlas3d[a]	Position of Rubin relative to block center position in preceding 3 day period

[a] Variables removed from analysis due to large number of missing observations or insufficient data.

[b] Variables removed from analysis due to high collinearity with another variable.

Multiple collinearity (Neter et al. 1983) existed between *line* and *depth* (Pearson correlation coefficient $r=0.88$) and between *sun* and *overcast* ($r=-0.824$); therefore, *depth* and *sun* were dropped from consideration. Because *wave_height* was included in the model and served as a reliable measure of sea state, *sea state* was subsequently removed. The variable *B2T1*, shoreward distance from the center of the block to the point where sound energy estimates were calculated, was unique to every block and thereby was confounded with the *block* variable. *B2T1* was dropped from consideration because *block* was easier

to interpret. To avoid fitting too many parameters in the model, interactions between any of the categorical variables – *aircraft*, *visibility, white_caps, fog*, and *overcast* – were not considered in this analysis. One of the important variables that would be beneficial to the logistic regression analysis, *prey availability*, was not considered because of the lack of site-specific data.

Certain variables listed in Table 2 represented industrial effects and were not considered for inclusion in model as environmental variables. Some of these industrial variables relied on definition of a 'T1' point. The T1 point for each of the 20 geographic areas in the study area (Fig. 1) was the geographic center of the area, except in cases where the geographic center was in water less than 20 m deep. In those cases, the T1 point was moved perpendicularly offshore to the closest point on the 20-m isobath (Yazvenko et al. 2002). Autonomous sonobuoys with bottom-mounted hydrophones were used to measure received sound levels in the study area in the frequency band 10–5000 Hz and to transmit them to a shore station where the signals were monitored in real time. Sonobuoys were deployed along the 20-m isobath, at the offshore edge of the Piltun feeding area (Rutenko et al. 2007). The shift of the T1 point farther offshore towards the seismic source was a conservative step to allow for a more specific and accurate determination of estimated seismic energy reaching the block. This determination was based on case-by-case modelling of propagation from the offset T1 point to the geographic center of the geographic area.

Seismic survey-related variables of interest included estimates of total sound energy, *seg*, at T1 during the 3-h (*seg3h*) and 3-day (*seg3d*) period preceding an aerial survey (Yazvenko et al. 2002). An estimate of sound energy from the seismic survey for specific locations and time periods was computed based on the gun volume of the shots during that period. These estimates were computed by (1) computation of sound energy per shot at 1 m from the source, (2) computation of sound attenuation through the water column using a simple spreading model, specifically $25\times\log_{10}$(distance), (3) computation of received energy for each seismic shot by applying the spreading model to the distance between the sound source and T1 locations, and (4) summation of the resulting estimates of received energy per shot at T1 locations over the time period of interest.

Sound energy 1 m from the source during both the calibration and seismic survey was estimated for 100 in^3 (55% of the shots), 370 in^3 (2.5%), 1,640 in^3 (40%) and 3,090 in^3 (2.5%) air gun volumes (Borisov et al. 2002; Rutenko et al. 2007). Sound energy 1 m from source was estimated for the remaining air gun volumes by interpolation. Average energy received at T1 locations per shot for all shots in a given period was estimated by dividing the sum of the individual shot energies (from the previous steps) by the number of shots fired during the relevant period.

Following stepwise selection of a model containing environmental variables, *seg3h* and *seg3d* were added separately to the model containing significant environmental variables. The "best" of the three models was determined by inspection of individual Wald *t* tests for *seg3h* and *seg3d* and choosing the one with the smallest *p* value ($\alpha\leq 0.05$). If both seismic variables had *p* values greater than $\alpha=0.05$, i.e., their effects on the model were statistically insignificant at $\alpha=0.05$, and the model containing only environmental variables was chosen as the "best" of the three models. Significance of any seismic sound term would indicate a seismic survey effect if a statistically significant portion of the variation of whale feeding activity could be explained by sound energy variables that could not otherwise be explained by environmental conditions.

To check that temporal autocorrelation in the proportion of whales with mud plumes was not adversely affecting significance levels of terms in the final logistic model, deviance residuals from the final model were assessed for temporal correlation using Moran's I statistic (Moran 1950). The Moran's I varies between −1.0 and +1.0. If the points that are close together in time have similar values, the Moran's I value is high. If temporal correlation was found in the residuals, generalized mixed linear model estimation procedures were used to specifically allow for temporal correlation. However, generalized mixed linear models were difficult to construct and were avoided when possible.

Results

To more closely examine trends in feeding activity during the study period, the mud-plume dive data were partitioned into time periods that corresponded to the different seismic survey regimes (Fig. 3).

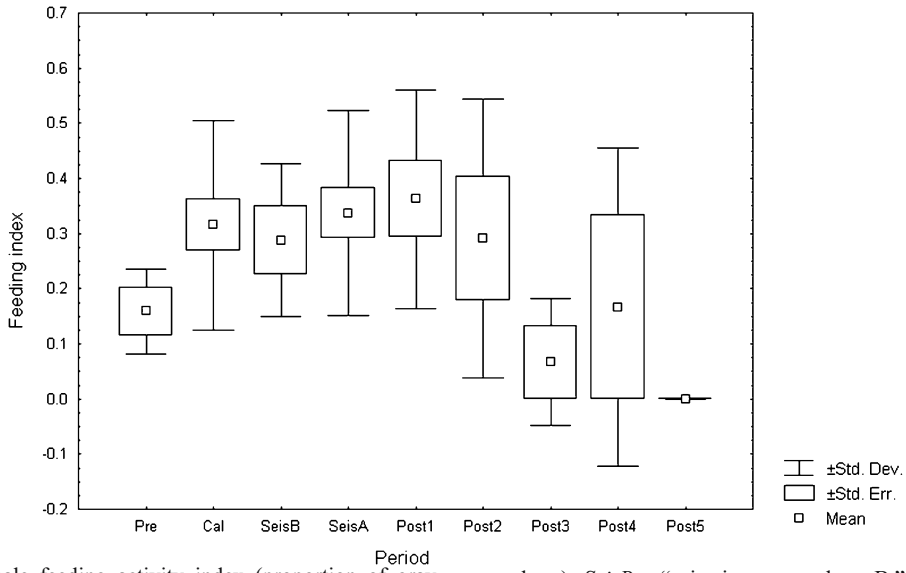

Fig. 3 Gray whale feeding activity index (proportion of gray whale groups definitely associated with mud feeding plumes relative to all observed gray whale groups) recorded on-transect in the Piltun survey area averaged over different periods of the Odoptu seismic survey in 2001. Period codes are as follows: *Pre* – "pre-seismic" period, July 19–Aug 2 (morning); *Cal* – "calibration," Aug 2 (afternoon)–Aug 16; *SeisA* – "seismic survey phase Am," Aug. 17–20 (relatively lower sound levels nearshore); *SeisB* – "seismic survey phase B," Aug. 21–Sept 9 (relatively higher sound levels nearshore); *Post1* – "post-seismic phase 1," Sept. 9–19; *Post2* – "post-seismic phase 2," Sept. 20–30; *Post3* – "post-seismic phase 3," Oct 1–10; *Post4* – "post-seismic phase 4," Oct 11–20; *Post5* – "post-seismic phase 5," Oct 21–Nov 19. Sightings within the blind strip beneath the aircraft (<200 m from the transect on each side of the aircraft at the survey altitude of 300 m ASL) are not included

Figure 3 compares the mean feeding activity index observed before, during and after the seismic survey. The changes in the range of feeding activity indices increased significantly (two-tailed t test; p=0.007) from pre-seismic period (19 July–2 August morning) to calibration period (2 August afternoon–16 August), and remained unchanged from the calibration period through the seismic period, indicating that gray whales continued to be engaged in feeding activity at approximately a constant rate from early August throughout the duration of the seismic survey (17 August–9 September). Feeding activity indices show more variability after seismic survey stopped. Feeding activity did not significantly change for about 3 weeks after the end of seismic survey (periods Post1 and Post2: 9–30 September 2001) but significantly decreased (*vs* seismic survey period) during period Post3 (1–10 October 2001; two-tailed t test; p= 0.003) and ceased during period Post5 (21 October–19 November 2001).

The only environmental variables selected by stepwise multiple regression were transect line and swell height. Total estimated sound level during the previous 3-day period (p=0.183) or previous 3-h period (p=0.54) did not explain a significant amount of residual variation when added to the environmental variable model. The final model of average proportion of western gray whale groups observed with mud plumes in 2001 is given in Eq. 3.

$$\ln\left(\frac{E[\pi]}{1-E[\pi]}\right) = -0.0929 + 2.0088(line = 1) - 0.3546(swell\_hgt) \quad (3)$$

Standard errors, 95% confidence intervals, and significance of each term in the final model are presented in Table 3. Temporal autocorrelations in residuals of the final model that were close in time were around zero (Moran's I=0.045, 95% CI=−0.41 to 0.50). Table 3 and Fig. 4 show the probability that a whale group was associated with mud plume(s) as a function of swell height for Transects 1 and 2. Figure 4 suggests that swell height negatively affects observed whale feeding activity. The negative relationship may be partly attributable to the decreasing visibility of mud plumes under increasing swell height.

Table 3 Coefficients, standard errors, test-statistics, *p* values, and odds ratio estimates for variables in the final logistic regression model for the gray whale feeding activity analysis

Parameter	DF	Odds ratio estimate	Standard error	χ^2	*p* value
Intercept	1	−0.0929	0.4901	0.036	0.8497
line=1	1	2.0088	0.4401	20.83	<0.0001
swell_height	1	−0.3546	0.1425	6.19	0.0128

Discussion

The difficulty in studying the effect of noise on foraging-related activity in most baleen whales is exemplified by the dearth of literature on this subject (but see Malme et al. 1986; Miller et al. 1999; Richardson et al. 1995; Richardson 1999). The proximity of western gray whales in the Piltun feeding area to the summer 2001 seismic survey necessitated monitoring the possible effects of seismic survey noise on their foraging activities. Because gray whales are the only baleen whales that are predominantly bottom-feeders, they often create highly visible mud plumes at the surface as they forage on benthic prey. These mud plumes were used to identify gray whales feeding on benthos rather than whales engaged in feeding on non-benthic organisms, traveling, resting, or other activities.

The association of visible mud plumes with successful bottom feeding that results in high quality and quantity of food intake is only a hypothesis that is based upon direct underwater observations of feeding whales, studies on and near feeding troughs, stomach content of harvested whales and linked whale/prey distribution data. An unknown proportion of the dives that produced mud plumes may have been unsuccessful attempts to feed. Therefore, the utility of mud plumes as proxies of successful bottom feeding remains unknown. Available data indicate that both eastern gray whales (Thomson 1983; Bass 2000; Dunham and Duffus 2001, 2002; Meier 2003; Moore et al. 2003; Patterson 2004) and western gray whales (Fadeev 2003, 2004, 2005) consistently feed in areas with high biomass of potential prey and tend to avoid areas with low prey biomass.

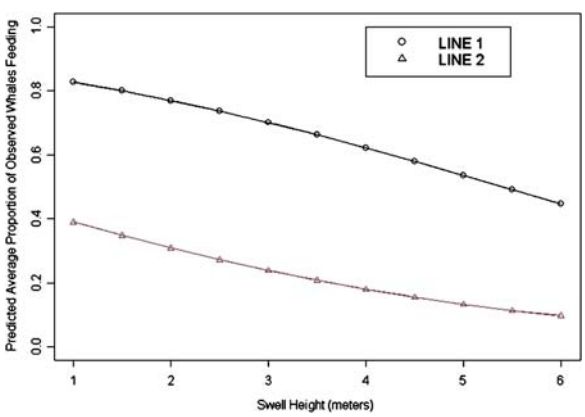

Fig. 4 Predicted average proportions of gray whales with mud plumes as a function of swell height (m) on transect lines 1 and 2

There are other factors that confound interpretation of mud plume sighting data as a direct measure of feeding activity. The sightability of mud plumes was potentially affected by a variety of factors, some of which were analyzed (mainly weather conditions), while others (e.g., bottom sediment type, water turbidity, etc.) were not considered due to lack of site-specific data.

This study is the first systematic study of possible effects of a seismic survey on the feeding of western gray whales. Few studies addressing potential effects of seismic survey noise on the feeding of gray whales have emerged over the last 20 years. Eastern gray whales in the Chukchi Sea did not appear to respond to distant (>36 km) seismic noise (Ljungblad et al. 1982). In one study in the Bering Sea, 10% of eastern gray whales stopped feeding at received seismic sound levels >163 dB re 1 μPa, while other whales continued feeding at 177 dB re 1 μPa (Malme et al. 1986). In that study, whales that stopped feeding and moved away from strong noise levels resumed feeding within 1 h after seismic noise ended. During the Odoptu 3-D seismic survey no overt reactions to seismic sounds similar to those reported by Malme et al. (1986) were noted and no displacement from the general feeding area was observed (Yazvenko et al. 2002, 2007; Würsig et al. 2002; Gailey et al. 2007).

We assessed the effects of seismic surveys on the percentage of whale groups engaged in foraging activity in the entire Piltun feeding area, as well as within individual blocks varying in proximity to the seismic operations. We did not detect significant (p= 0.183 for sound measured during the previous 3-day period; p=0.54 for sound measured during the previous 3-h period) changes in the proportion of groups of whales with mud plumes during the Odoptu 3-D seismic survey. In a companion paper (Yazvenko et al. 2007), statistical models suggest that during the 3-D seismic survey in 2001, about 5–10 whales (corrected

for availability) may have moved from the portion of the Piltun feeding area immediately west of the Odoptu block southward to the portion of the Piltun feeding area nearer the mouth of Piltun Bay.

The analysis was structured to investigate possible effects on an hourly, daily and weekly temporal scales. Possible short-term (h) and mid-term (several days) changes in whale feeding activity index were examined using a set of seismic survey-related variables (Table 2). None of the hour-scale or day-scale seismic survey-related variables that were tested were found to have effect on feeding activity of whales at α=0.05. However, the power of the analyses presented here may be limited, judging by the high variability in the feeding activity index data (Fig. 3).

A companion study of the distribution of western gray whales found that hour-scale seismic survey-related variables were not correlated with the distribution of whales (Yazvenko et al. 2007). Only one seismic survey-related variable, sound energy accumulated over the preceding 3 days, was significantly correlated with the distribution of gray whales, indicating that the noise was having an effect on the distribution of whales on the scale of days but not of hours.

Another companion study investigated the effect of the 2001 seismic survey on onshore western gray whale counts. None of the seismic survey-related variables examined in this analysis explained a significant amount ($p<0.05$) of residual variation in whale counts. *P* values ranged from 0.24 to 0.95 (Würsig et al. 2002; Gailey et al. 2007).

In the study of gray whale behavior (Gailey et al. 2007) changes in 5 out of 11 monitored behavioral traits were found to be significantly correlated with seismic survey variables, which may indicate that whales traveled more during periods of higher seismic sound energy exposure.

The mitigation strategy employed during the 2001 Odoptu 3-D seismic survey (Johnson et al. 2007) was based on the existing literature on gray whales and other cetaceans, and calibrations were made to determine the buffer distance needed to reduce exposure levels below those known to cause cessation of feeding and avoidance responses. Mitigation minimized the number of gray whales that were exposed to seismic sound levels above 163 dB_{rms} re 1 μPa (Johnson et al. 2007). Throughout the 2001 feeding season, gray whales continued to occupy the main feeding area along the northeast Sakhalin Island coast adjacent to Piltun Bay, and no data indicated displacement outside the Piltun feeding area (Yazvenko et al. 2002, 2007). This is consistent with other studies that suggest gray whales have been using the Piltun location as the primary feeding area every year since 1984 for which distribution data on gray whales were collected (Blokhin et al. 1985, 2002, 2003, 2004; Berzin et al. 1988, 1990, 1991; Blokhin 1996; Würsig et al. 1999; Weller et al. 2000, 2001, 2002, 2004; Sobolevsky 2000, 2001; Yazvenko et al. 2002; Vladimirov et al. 2005, 2006). This is also consistent with the report that there was no indication that western gray whales exposed to seismic survey noise in 1997 were displaced away from the Piltun feeding area (Würsig et al. 1999).

Studies of western gray whales conducted in 2002–2005 indicate no apparent population-level, or biologically significant (NRC 2005) effects of the 2001 seismic survey either on the number of gray whales present in subsequent years (Blokhin et al. 2003, 2004; Vladimirov et al. 2005, Meier et al. 2007), body condition (Weller et al. 2002, 2004; Yakovlev and Tyurneva 2003, 2004, 2005), or reproductive success (Weller et al. 2002, 2004; Yakovlev and Tyurneva 2003, 2004, 2005). Comparisons among years for all monitored behavioral parameters revealed no statistically significant differences between the results of 2001 and 2002–2003, years in which no industrial activity took place near the Piltun feeding area (Würsig et al. 2002, 2003, 2004). Recent estimates of the size of the non-calf component of the western gray whale population indicate 122 individuals in the population in 2005 *vs* ca. 100 in 2001 (Weller et al. 2002; Cooke et al. 2006). In spite of this encouraging evidence, the population remains severely endangered, and its future is highly uncertain.

Conclusions

Available data do not show statistically significant effects of the Odoptu 3-D seismic survey on the bottom feeding activity of western gray whales in the vicinity of Piltun Bay:

1. The overall feeding activity index (proportion of whale groups with visible mud plumes per all

observed groups) of western gray whales in the vicinity of the Piltun Bay in 2001 did not show statistically significant (α=0.05) correlation with the Odoptu 3-D seismic survey (Fig. 3). One of the goals of the mitigation strategy was to ensure that gray whales did not significantly change their feeding activity during the seismic survey. Available data suggest that the whales continued to be engaged in bottom feeding activity during the seismic period at levels that were similar to or higher than those in the pre- and post-seismic survey period.

2. The only environmental variables selected by the stepwise multiple regression that explained a statistically significant proportion of variation in the whale feeding index data were transect line (proxy for depth) and swell height (proxy for overall sea condition). Seismic survey-related variables, viz., total estimated sound level during the previous 3-day period or previous 3-h period, did not explain a significant amount of residual variation when added to the environmental variable model. The *p* values for these two variables were 0.183 and 0.54, respectively.

Acknowledgements Many people helped in the collection and analysis of the data and preparation of this report, and many of our Russian colleagues participated in the organization of this project. Alexander Burdin (Alaska Sea Life, Seward, Alaska) and Vyacheslav Shuntov (TINRO-Center, Vladivostok, Russia), provided valuable advice regarding the initial design and suggested participants for the project. We especially acknowledge the support of Yuri Blinov (TINRO-Center), Vladimir Radchenko (SakhNIRO, Yuzhno-Sakhalinsk, Russia) and Anatoly Vyalov (SakhNIRO).

Field support was provided by Exxon Neftegas Limited (Yuzhno-Sakhalinsk). We thank David Simerka, Brien Reep, Greg Manelick, Michael Allen, Dmitry Mayorov, Alexei Kovalev, Julian Skaretski (all from Exxon Neftegas Limited), and Julia Iazvenko (PICES, Canada) for their assistance in the field program. Valery Vladimirov (VNIRO, Moscow, Russia) and Gennady Fedoseev provided valuable advice and consultation during the field program. Robin Tamasi and Lucia Ferreira (LGL) provided assistance with mapping and data analysis, both in the field and during report preparation. W. John Richardson (LGL) provided valuable advice throughout the project. Michael Jenkerson (ExxonMobil) provided information on acoustic aspects of the study and gave critical assistance both in the field and during data analysis. Daniel Egging and Caroline Martin (ExxonMobil) gave advice and support throughout this project. The authors would like to thank Gary Searing (LGL), Sonya Meier (LGL), James Hall (ExxonMobil), Gordon Glova (LGL) and Judy Muir (LGL) for their input and review of this manuscript.

This study was supported by Exxon Neftegas Limited (ENL), Yuzhno-Sakhalinsk, Russia. The preparation of this paper was jointly supported by ENL and Sakhalin Energy Investment Company, Yuzhno-Sakhalinsk, Russia.

References

Anonymous (2001). *Krasnaya Kniga Rossiiskoi Federatsii. Zhivotnye*, *[The Red Book of Russian Federation. Animals]*, Ast and Astrel, Balashikha, Aginskoe (862 pp.). Available at http://www.biodat.ru/db/rb/index.htm.

Bass, J. (2000). Variations in gray whale feeding behaviour in the presence of whale-watching vessels in Clayoquot Sound, 1993–1995. Ph.D. Thesis, University of Victoria, Victoria, BC (156 pp.).

Berzin, A. A., Vladimirov, V. L., & Doroshenko, N. V. (1988). Results of aerial surveys to study the distribution and abundance of cetaceans in the coastal waters of the Sea of Okhotsk in 1986–1987. In N. S. Chernysheva (Ed.), *Nauchno-issledovatel'skie raboty po morskim mlekopitayushchim severnoi chasti Tikhogo okeana v 1986–1987* (pp. 18–25). Moscow, USSR: All-Union Research Institute for Fisheries and Oceanography (VNIRO).

Berzin, A. A., Vladimirov, V. L., & Doroshenko, N. V. (1990). Aerial surveys to determine the distribution and number of polar whales, gray whales and beluga whales in the Sea of Okhotsk in 1985–1989. *Izvestiya Tikhookeanskogo Nauchno-Issledovatelskogo Instituta Rybnogo Khozyaistva I Okeanografii (TINRO), 112*, 51–60.

Berzin, A. A., Vladimirov, V. L., & Doroshenko, N. V. (1991). Results of aerial surveys to study the distribution and abundance of whales in the Sea of Okhotsk in 1988–1990. In L. A. Popov (Ed.), *Nauchno-issledovatel'skie raboty po morskim mlekopitayushchim severnoi chasti Tikhogo okeana v 1989–1990* (pp. 6–17). Moscow, USSR: All-Union Research Institute for Fisheries and Oceanography (VNIRO).

Blokhin, S. A. (1996). Distribution, numbers and behavior of gray whales (*Eschrichtius robustus*) of the American and Western populations in the areas of their distribution off the coasts of the Far East. *Izvestiya Tikhookeanskogo Nauchno-Issledovatel'skogo Instituta Rybnogo Khozyaistva I Okeanografii (TINRO), 121*, 36–53.

Blokhin, S. A., Doroshenko, N. V., & Marchenko, I. P. (2003). The abundance, distribution, and movement patterns of gray whales (*Eschrichtius robustus*) in coastal waters off the northeast Sakhalin Island coast in 2002 based on the aerial survey data. Report by TINRO-Center, Vladivostok, Russia, to Exxon Neftegas Limited and Sakhalin Energy Investment Company, Yuzhno-Sakhalinsk, Russia (pp. 29). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_gray_whale&l=whale_recent_research.

Blokhin, S. A., Doroshenko, N. V., & Yazvenko, S. B. (2004). The abundance, distribution, and movement patterns of gray whales (*Eschrichtius robustus*) off the coast of Northeastern Sakhalin Island in June–December 2003 based on aerial survey data. Report by TINRO-Center, Vladivostok, Russia,

to Exxon Neftegas Limited and Sakhalin Energy Investment Company, Yuzhno-Sakhalinsk, Russia (140 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_gray_whale&l=whale_recent_research.

Blokhin, S. A., Maminov, M. K., & Kosygin, G. M. (1985). On the Korean-Okhotsk population of gray whales. *Report of the International Whaling Commission, 35*, 375–376.

Blokhin, S. A., Vladimirov, V. L., Lagerev, S. I., & Yazvenko, S. B. (2002). *Abundance, distribution, and behavior of the gray whales (Eschrichtius robustus), based on aerial surveys off northeast coast of Sakhalin from July to November 2001* (41 pp.). Report SC/02/WG03 to Western Gray Whale Technical Committee. Ulsan, South Korea: International Whaling Commission.

Borisov, S. V., Gritsenko, A. V., Jenkerson, M. R., Rutenko, A. N., & Hodzevich, A. V. (2002). Evaluating and monitoring acoustic transmission from the Odoptu 3D seismic survey, 5 August–9 September, 2001. Report by V. I. Il`icev Pacific Oceanological Institute, Far East Branch of Russian Academy of Sciences, Vladivostok, Russia,and ExxonMobil Upstream Research Company, Houston, TX, for Exxon Neftegas Limited, Yuzhno-Sakhalinsk, Russia. Available from Exxon Neftegas Limited, c/o ExxonMobil Development Company, 17001 Northchase Drive #466, Houston, TX 77060, Attn: Daniel Egging.

Buckland, S. T., Anderson, D. R., Burnham, K. P., & Laake, J. L. (1993). *Distance sampling: estimating abundance of biological populations* (446 pp.). London, United Kingdom: Chapman & Hall.

Cooke, J. G., Weller, D. W., Bradford, A. L., Burdin, A. M., & Brownell, R. L., Jr. (2006). Population assessment of Western Gray Whales in 2006. Paper SC/58/BRG30 presented to the Scientific Committee, International Whaling Commission (10 pp.).

Dunham, J. S., & Duffus, D. A. (2001). Foraging patterns of gray whales in central Clayoquot Sound, British Columbia, Canada. *Marine Ecology Progress Series, 223*, 299–310.

Dunham, J. S., & Duffus, D. A. (2002). Diet of gray whales (*Eschrichtius robustus*) in Clayoquot Sound, British Columbia, Canada. *Marine Mammal Science, 18*, 419–437.

Fadeev, V. I. (2003). Benthos and prey studies in feeding grounds of the Okhotsk-Korean population of gray whales. Report on materials from field studies on the research vessel *Nevelskoy* in 2002. Report by the Institute of Marine Biology, Far East Branch of Russian Academy of Sciences, Vladivostok, Russia, for Exxon Neftegas Limited and Sakhalin Energy Investment Company, Yuzhno-Sakhalinsk, Russia (118 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_gray_whale&l=whale_recent_research.

Fadeev, V. I. (2004). Benthos and prey studies in feeding grounds of the Okhotsk-Korean population of gray whales. Report on materials from field studies on the research vessel *Nevelskoy* in 2003. Report by the Institute of Marine Biology, Far East Branch of Russian Academy of Sciences, Vladivostok, Russia, for Exxon Neftegas Limited and Sakhalin Energy Investment Company, Yuzhno-Sakhalinsk, Russia (191 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_gray_whale&l=whale_recent_research.

Fadeev, V. I. (2005). Benthos and food supply studies in feeding areas of the Okhotsk-Korean gray whale population. Report on materials from field work aboard the research vessel Akademic Oparin. Report by the Institute of Marine Biology, Far East Branch of Russian Academy of Sciences, Vladivostok, Russia, for Exxon Neftegas Limited and Sakhalin Energy Investment Company, Yuzhno-Sakhalinsk, Russia (157 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_ gray_whale&l=whale_ recent_research.

Gailey, G., Sychenko, O., & Würsig, B. (2004). Western gray whale behavior and movement patterns: Shore-based observations off Sakhalin Island, July–September 2003. Report by Texas A&M University, Galveston, TX, for Sakhalin Energy Investment Company Limited and Exxon Neftegas Limited, Yuzhno-Sakhalinsk, Russia (79 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_gray_whale&l=whale_recent_research.

Gailey, G., Würsig, B., & McDonald, T. L. (2007). Abundance, behavior, and movement patterns of western gray whales in relation to a 3-D seismic survey, Northeast Sakhalin Island, Russia. *Environmental Monitoring and Assessment* (this issue).

HESS (1999). High Energy Seismic Survey (HESS) review process and interim operational guidelines for marine surveys offshore southern California. Report from High Energy Seismic Survey Team for California State Lands Commission and the U.S. Minerals Management Service, Camarillo, CA (39 pp.). Available at www.mms.gov.omm/pacific/lease/fullhessrept.pdf.

Hilton-Taylor, C. (2000). *2000 IUCN red list of threatened species*. IUCN/SSC, Gland, Switzerland, and Cambridge, United Kingdom (61 pp.). (with 1 CD-ROM).

Johnson, S. R. (2002). *Marine mammal mitigation and monitoring program for the 2001 Odoptu 3-D seismic survey, Sakhalin Island, Russia.* Report SC/02/WGW19 to the Western Gray Whale Technical Committee, International Whaling Commission, Ulsan, South Korea (47 pp.).

Johnson, S. R., Richardson, W. J., Yazvenko, S. B., Blokhin, S. A., Gailey, G., Jenkerson, M. R., et al. (2007). A western gray whale mitigation and monitoring program for a 3-D seismic survey, Sakhalin Island, Russia. *Environmental Monitoring and Assessment* (this issue).

LeDuc, R. G., Weller, D. W., Hyde, J., Burdin, A. M., Rosel, P. E., Brownell, R. L., Jr., et al. (2002). Genetic differences between western and eastern North Pacific gray whales (*Eschrichtius robustus*). *Journal of Cetacean Research and Management, 4*, 1–5.

Ljungblad, D. K., Moore, S. E., Van Schoik, D. R., & Winchell, C. S. (1982). Aerial surveys of endangered whales in the Beaufort, Chukchi, and northern Bering seas. NOSC TD 486, U.S. Naval Ocean Systems Center, San Diego, CA (406 pp.). NTIS AD-A126542/0.

Malme, C. I., Würsig, B., Bird, J. E., & Tyack, P. (1986). Behavioral responses of gray whales to industrial noise: Feeding observations and predictive modelling. *Outer Continental Shelf Environmental Assessment Program, Final Report of Principal Investigators, 56*, 393–600. Report 6265 (OCS Study MMS 88-0048) by Bolt Beranek, & Newman, Inc., Cambridge, MA, for National Oceanic and Atmospheric Administration, Anchorage,

AK. Available as NTIS PB88-249008 from U.S. National Technical Information Service, 5285 Port Royal Road, Springfield, VA.

Meier, S. K. (2003). A multi-scale analysis of habitat use by gray whales (*Eschrichtius robustus*) in Clayoquot Sound, British Columbia, 1997–99. M.Sc. Thesis, University of Victoria, Victoria, BC (140 pp.).

Meier, S. K., Lawson, J., Yazvenko, S. B., Perlov, A. S., Maminov, M. K., Johnson, S. R., et al. (2002). Vessel-based marine mammal monitoring during the 2001 3-D seismic survey of the Odoptu block, northeast Sakhalin Island, Okhotsk Sea, Russia. Report by LGL Limited, Sidney, BC, for Exxon Neftegas Limited, Yuzhno-Sakhalinsk, Russia (38 pp.). Available from Exxon Neftegas Limited, c/o ExxonMobil Development Company, 17001 Northchase Drive #466, Houston, TX 77060, Attn: Daniel Egging.

Meier, S. K., Yazvenko, S. B., Blokhin, S. A., Wainwright, P. W., Maminov, M. K., & Yakovlev, Yu. M. (2007). Distribution and abundance of western gray whales, northeast Sakhalin Island, Russia, 2001–2003. *Environmental Monitoring and Assessment* (this issue).

Miller, G. W., Elliott, R. E., Koski, W. R., Moulton, V. D., & Richardson, W. J. (1999). Whales. In W. J. Richardson (Ed.), Marine mammal and acoustical monitoring of Western Geophysicals open-water seismic program in the Alaskan Beaufort Sea, 1998. Report TA2230-3 by LGL Limited, King City, ON, and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Houston, TX, and US National Marine Fisheries Service, Anchorage, AK, and Silver Spring, MD (pp 5-1–5-109).

Moore, S. E., Grebmeier, J. M., & Davies, J. R. (2003). Gray whale distribution relative to forage habitat in the northern Bering Sea: Current conditions and retrospective summary. *Canadian Journal of Zoology, 81*, 734–742.

Moran, P. A. P. (1950). Notes on continuous stochastic phenomena. *Biometrika, 37*, 17–23.

Neter, J., Wasserman, W., & Kutner, M. H. (1983). *Applied linear regression models* (547 pp.). Homewood, IL: Irwin.

NRC (National Research Council) (2005). *Marine mammal populations and ocean noise: Determining when noise causes biologically significant effects* (135 pp.). Washington, DC: National Academy.

Patterson, H. M. (2004). Small-scale distributions and dynamics of the mysid prey of grey whales (*Eschrichtius robustus*) in Clayoquot Sound, British Columbia, Canada. M.Sc. Thesis, University of Victoria, Victoria, BC (170 pp.).

Richardson, W. J. (Ed.) (1999). Marine mammal and acoustical monitoring of Western Geophysicals open-water seismic program in the Alaskan Beaufort Sea, 1998. Report TA2230-3 by LGL Limited, King City, ON, and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geo-physical, Houston, TX, and US National Marine Fisheries Service, Anchorage, AK, and Silver Spring, MD (390 pp.).

Richardson, W. J., Greene, C. R., Jr., Malme, C. I., & Thomson, D. H. (1995). *Marine mammals and noise* (576 pp.). San Diego, CA: Academic.

Rutenko, A. N., Borisov, S. V., Gritsenko, A. V., & Jenkerson, M. R. (2007). Calibrating and monitoring the mitigation zone and estimating acoustic transmission for the 2001 3D seismic survey. *Environmental Monitoring and Assessment* (this issue).

Sobolevsky, E. I. (2000). Marine mammal studies offshore northeast Sakhalin, 1999. Report by the Institute of Marine Biology, Far East Branch Russian Academy of Sciences, Vladivostok, for Sakhalin Energy Investment Company Limited, Yuzhno-Sakhalinsk, Russia, (149 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_ western_gray_whale&l=whale_recent_research.

Sobolevsky, E. I. (2001). Marine mammal studies offshore northeast Sakhalin, 2000. Report by the Institute of Marine Biology, Far East Branch Russian Academy of Sciences, Vladivostok, for Sakhalin Energy Investment Company Limited, Yuzhno-Sakhalinsk, Russia, (199 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_gray_whale&l=whale_recent_research.

Thomson, D. H. (Ed.) (1983). Feeding ecology of gray whales (*Eschrichtius robustus*) in the Chirikof Basin, summer 1982. Report by LGL Alaska Research Associates Anchorage, AK, for U.S. Department of Commerce, NOAA/OCSEAP, Juno, AK. (Vol. 43, 209–460.)

Vladimirov, V. A., Blokhin, S. A., Vladimirov, A. V., Vladimirov, V. L., Doroshenko, N. V., & Maminov, M. K. (2005). Distribution and abundance of gray whales of the Okhotsk-Korean population in the Northeastern Sakhalin Waters in July– September 2004 (based on shore, aerial and vessel-based surveys). Report by the All-Russian Research Institute for Fisheries and Oceanography (VNIRO), Moscow, Russia, and the Pacific Research Center for Fisheries and Oceanography (TINRO-Center), Vladivostok, Russia, to Exxon Neftegas Limited and Sakhalin Energy Investment Company, Yuzhno-Sakhalinsk, Russia (136 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_gray_whale&l=whale_recent_research.

Vladimirov, V. A., Blokhin, S. A., Vladimirov, A. V., Maminov, M. K., Starodymov, S. P., & Shvetsov, E. P. (2006). Distribution and abundance of gray whales of the Okhotsk-Korean population off northeastern Sakhalin, June–November 2005 (based on data from onshore, aerial and vessel-based surveys). Report by the All-Russian Research Institute for Fisheries and Oceanography (VNIRO), Moscow, Russia, and the Pacific Research Center for Fisheries and Oceanography (TINRO-Center), Vladivostok, Russia, to Exxon Neftegas Limited and Sakhalin Energy Investment Company, Yuzhno-Sakhalinsk, Russia (189 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_-gray_whale&l=whale_recent_research.

Weller, D. W., Burdin, A. M., Bradford, A. L., Ivashchenko, Y. V., Tsidulko, G. A., Lang, A. R., et al. (2004). Western gray whales off Sakhalin Island, Russia: A joint Russia–US scientific investigation, July–September 2003. Report by National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Southwest Fisheries Science Center, La Jolla, CA, Kamchatka Branch of Pacific Institute of Geography, Russian Academy of Sciences, Petropavlovsk, Russia, and Alaska Sealife Center, Seaward, AK (41 pp.). Available at www.ifaw.org/ifaw/dfiles/file_453.pdf.

Weller, D. W., Burdin, A. M., Bradford, A. L., Tsidulko, G. A., Ivashchenko, Y. V., & Brownell, R. L., Jr. (2002). Gray whales off Sakhalin Island, Russia: June–September 2001. A joint U.S.-Russian scientific investigation. Report by Texas A&M University, Galveston, TX, Kamchatka Institute of Ecology and Nature Management, Russian Academy of Sciences, Petropavlovsk, Russia, and National Marine Fisheries Service, NOAA, Southwest Fisheries Science Center, La Jolla, CA, for Sakhalin Energy Investment Company Limited, Yuzhno-Sakhalinsk, Russia (75 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_gray_whale&l=whale_recent_research.

Weller, D. W., Burdin, A. M., Bradford, A. L., & Würsig, B. (2001). Gray whales off Sakhalin Island, Russia: June–September 2000. A joint U.S.-Russian scientific investigation. Report by Texas A&M University, Galveston, TX, and Kamchatka Institute of Ecology and Nature Management, Russian Academy of Sciences, Petropavlovsk, Russia, for Sakhalin Energy Investment Company Limited, Yuzhno-Sakhalinsk, Russia (56 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_gray_whale&l=whale_recent_research.

Weller, D. W., Würsig, B., Burdin, A. M., Reeve, S. H., & Bradford, A. L. (2000). Gray whales off Sakhalin Island, Russia: June–October 1999. A joint U.S.-Russian scientific investigation. Report by Texas A&M University, Galveston, TX, and Kamchatka Institute of Ecology and Nature Management, Russian Academy of Sciences, Petropavlovsk, Russia, for Sakhalin Energy Investment Company Limited, Yuzhno-Sakhalinsk, Russia (69 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_gray_whale&l=whale_recent_research.

Würsig, B., Gailey, G., McDonald, T. L., Nielson, R., Ortega-Ortiz, J., Wainwright, P. W., et al. (2002). Western gray whale occurrence patterns and behavior: Shore-based observations off Sakhalin Island, August–September 2001. Report by Texas A&M University, Galveston, TX, for Exxon Neftegas Limited, Yuzhno-Sakhalinsk, Russia (70 pp.). Available from Exxon Neftegas Limited, c/o ExxonMobil Development Company, 17001 Northchase Drive #466, Houston, TX 77060, Attention: Daniel Egging.

Würsig, B., Gailey, G., Sychenko, O., & Petersen, H. (2003). Western gray whale occurrence patterns and behavior: Shore-based observations off Sakhalin Island, August–September 2002. Report by Texas A&M University, Galveston, TX, for Sakhalin Energy Investment Company Limited and Exxon Neftegas Limited, Yuzhno-Sakhalinsk, Russia (48 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_gray_whale&l=whale_recent_research.

Würsig, B., Weller, D. W., Burdin, A. M., Blokhin, S. A., Reeve, S. H., Bradford, A. L., et al. (1999). Gray whales summering off Sakhalin Island, Far East Russia: July–October 1997. A joint U.S.-Russian scientific investigation. Report by Texas A&M University, Galveston, TX, and Kamchatka Institute of Ecology and Nature Management, Russian Academy of Sciences, Petropavlovsk, Russia, for Sakhalin Energy Investment Company Limited and Exxon Neftegaz Limited, Yuzhno-Sakhalinsk, Russia (101 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_gray_whale&l=whale_ recent_research.

Yakovlev, Yu. M., & Tyurneva, O. Yu. (2003). Photo-identification of the Korean-Okhotsk gray whale (*Eschrichtius robustus*) population in 2002. Report by the Institute of Marine Biology, Far East Branch of Russian Academy of Sciences, Vladivostok, Russia, to Exxon Neftegas Limited and Sakhalin Energy Investment Company, Yuzhno-Sakhalinsk, Russia (30 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_ gray_whale&l=whale_recent_research.

Yakovlev, Yu. M., & Tyurneva, O. Yu. (2004). Photo-identification of the Korean-Okhotsk gray whale (*Eschrichtius robustus*) population along the northeast coast of Sakhalin Island, Russia, 2003. Report by the Institute of Marine Biology, Far East Branch of Russian Academy of Sciences, Vladivostok, Russia, to Exxon Neftegas Limited and Sakhalin Energy Investment Company, Yuzhno-Sakhalinsk, Russia (52 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_gray_whale&l=whale_recent_research.

Yakovlev, Yu. M., & Tyurneva, O. Yu. (2005). Photographic identification of gray whales (*Eschrichtius robustus*) of the Korean-Okhotsk population on the northeast shelf of Sakhalin Island, Russia, 2004. Report by the Institute of Marine Biology, Far East Branch of Russian Academy of Sciences, Vladivostok, Russia, to Exxon Neftegas Limited and Sakhalin Energy Investment Company, Yuzhno-Sakhalinsk, Russia (75 pp.). Available at http://www.sakhalinenergy.com/en/library.asp?p=lib_sel_western_ gray_whale&l=whale_recent_research.

Yazvenko, S. B., McDonald, T. L., Blokhin, S. A., Johnson, S. R., Meier, S. K., Melton, H. R., et al. (2007). Distribution and abundance of western gray whales during a seismic survey near Sakhalin Island, Russia. *Environmental Monitoring and Assessment* (this issue).

Yazvenko, S., McDonald, T. L, Meier, S. K., Blokhin, S. A., Johnson, S. R., Vladimirov, V. L., et al. (2002). Aerial marine mammal monitoring during the 2001 3-D seismic survey of the Odoptu block, northeast Sakhalin Island, Okhotsk Sea, Russia. Report by LGL Limited, Sidney, BC, for Exxon Neftegas Limited, Yuzhno-Sakhalinsk, Russia (153 pp.). Available from Exxon Neftegas Limited, c/o ExxonMobil Development Company, 17001 Northchase Drive #466, Houston, TX, 77060, Attn: Daniel Egging.

Appendix A: List of Acronyms

2D- two dimensional
3D- three dimensional
4D- four dimensional
AFA- Arctic Fisheries Alliance
CLO- Community Liaison Officer
COSEWIC- Committee on the Status of Endangered Wildlife in Canada
dB- Decibel
DFO- Department of Fisheries and Oceans
EA- Environmental Assessment
EIA- Environmental Impact Assessment
FAO- United Nations Food and Agriculture Organization
FLO- Fisheries Liaison Officer
HTO- Hunters and Trappers Organization
Hz- Hertz
IQ- *Inuit Qaujimajatuqangit*
IWC- International Whaling Commission
JCNB- Joint Commission on Narwhal and Beluga
MKI- Multi Klient Invest AS
MMO- Marine Mammal Observer
MSD- Minimum Safe Distance
NAMMCO- North Atlantic Marine Mammal Commission
NEB- National Energy Board
NEXUS Coastal- NEXUS Coastal Resource Management
NW- Northwest
NWMB- Nunavut Wildlife Management Board
Pa: Pascal
PGS- Petroleum Geo-Services
PTS- Permanent Threshold Shift
QIA- Qikiqtani Inuit Association
RMS- root mean square
SARA- *Species at Risk Act*
SE- Southeast
TGS- TGS-NOPEC Geophysical Company ASA
TTS- Temporary Threshold Shift

Appendix B: Definitions

dB re 1 µPa[1]: A unit of measure for sound. The relative pressure in decibels for a sound signal can take on different values depending on the method used to characterize the pressure of the signal. For underwater sounds the reference pressure preference is an rms (root mean square) pressure of 1 µPascal. This is why the units for decibels are given as "dB re1 µPa," indicating that the reference pressure is 1 µPa rms. If the sound pressure sound used is the rms pressure of a sound wave containing a single frequency, then this equation gives the relative intensity, I, in decibels of the sound wave.

Epibenthic[2]**:** A term referring to the region of the ocean just above the ocean bottom and extending to a height of about 3m (10 feet) and to the organisms in it.

Epipelagic[2]**:** A term referring to the uppermost layer of the ocean water column, down to a depth of above 200m.

Estuary[2]**:** The area (semi-enclosed) near the mouth of a river where seawater and freshwater meet.

Floe Edge[3]**:** Point at which ice ends and opens sea water begins.

Moulting[4]**:** The manner in which an animal sheds old feathers, hair, or skin to make way for new growth.

North Water[5]**:** The North Water Polynya (an area of open water surrounded by sea ice) lies between Greenland and Canada (Ellesmere Island) in northern Baffin Bay. The North Water Polynya is approximately 85,000 square kilometres and is one of the most biologically productive marine areas in the Arctic Ocean.

Pack Ice[2]**:** Any mass of floating pieces of ice, 3m or less in diameter, driven together to form a solid layer.

Pelagic zone[2]**:** The open ocean, excluding the ocean bottom and the shore.

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[1] University of Rhode Island. (2013). Introduction to Signal Levels. Retrieved July 8, 2013 from http://www.dosits.org/science/advancedtopics/signallevels/

[2] Charton, B. (2008). The Facts on File Dictionary of Marine Science. Infobase Publishing. USA. 481p.

[3] The Winnipeg Art Gallery. (2002). Glossary. Retrieved July 10, 2013 from http://www.virtualmuseum.ca/Exhibitions/Holman/english/glossary.php3

[4] Oxford Dictionaries (2013). Moult. Retrieved July 8, 2013 from http://oxforddictionaries.com/definition/english/moult

[5] Oceans North Canada (n.d.). From the North Water Polynya to Lancaster Sound. Retrieved July 6, 2013 from http://oceansnorth.org/north-water-polynya-lancaster-sound

Appendix C: Environmental Report Newfoundland and Labrador 2012

ENVIRONMENTAL OBSERVATIONS

DURING THE MKI 2D SEISMIC REFLECTION SURVEY

LABRADOR SEA

4th June – 31st August 2012

9th – 10th November 2012



Submitted to:
Canada Newfoundland and Labrador
Offshore Petroleum Board
On behalf of Multi Klient Invest AS
Program # 45120-020-002

31st January 2013

Submitted by:

RPS Energy (Halifax)
Liberty Place, 2nd Floor
1545 Birmingham Street
Halifax, Nova Scotia, B3J 2J6
Tel: (902) 425-1622
Fax: (902) 425-0703
Web: www.rpsgroup.com/energy/

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1 INTRODUCTION

In 2012, Multi Klient Invest AS (MKI) conducted a two dimensional (2D) seismic survey utilizing the M/V Sanco Spirit in the Labrador Sea and Davis Strait. This survey was a continuation of a seismic survey conducted by MKI in 2011. Environmental data collected during the 2012 survey are presented in this report. Seismic acquisition took place between 5th June and 31st August and from 9th to 10th of November 2012.

This report is produced to comply with the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) regulations for final reporting. The environmental data in this report includes marine mammal, seabird, and fisheries observations made during the course of the program by the designated Marine Mammal Observers and Fisheries Liaison Officers employed onboard the Sanco Spirit for the duration of the survey.

Geographical restrictions included no surveying within 12 nautical miles of the Newfoundland/Labrador Coast as well as maintaining 5 nautical mile distance from all fixed installations within the survey area.

1.1 SEISMIC EQUIPMENT AND SOUND EMISSIONS

MKI operates the dedicated seismic research vessel, M/V Sanco Spirit, which is the same vessel MKI utilized during the seismic survey in the Labrador Sea in 2011. The M/V Sanco Spirit was accompanied by the support vessel M/V Spanish Mist.

A summary of the seismic source array specifications are presented in Table 1. The source was towed approximately 127 m astern of the vessel at a depth of 9m ± 1m. In addition, a single 2D PGS Geo-Streamer ® of 8100 m active length was towed at 20m ± 1m depth.

Table 1. Seismic Source Array Specifications

Specification	Value
Number of Airgun Arrays	1
Number of Airgun Subarrays	4
Number of Airguns operating at Full Power	40
Maximum Operating Volume	4808 in^3
Operating Pressure	2000 psi
Shotpoint Interval	25 m
Maximum Source Output (zero to peak)	86.25 μbar
Maximum Source Output (peak to peak)	179.1 μbar
Peak Frequency	206 Hz

1.2 SEA STATE AND VISIBILITY

Sea state was based on the standard Beaufort scale (0 to 12), where at zero, the seas are glassy calm; at 4, small waves have formed with breaking crests; and at 12, huge waves are mixed with foam and driving spray (hurricane). Visibility for sighting animals was based on the observers' ability to see long distances to the horizon, from zero to 10 km from the vessel.

Wind speed, ranged from very calm (Beaufort 1) to very rough (Beaufort ≥7) across all months (Table 2). While half of all marine mammal sightings occurred during conditions of between Beaufort 3 and 4, some animals were detected in moderate to rough conditions, considered Beaufort 5 or higher (Table 2). The average wind force across all months was Beaufort 4 with corresponding wave heights of between 0.5 and 1.2m. Visibility for each month ranged from dense fog to clear conditions to the horizon. Average visibility was considered good (>6km) in June and August, but was often reduced to less than 1 km in July due to fog. Although July had the poorest visibility, the number of animal sightings that month was greater than any other month (Table 2).

Table 2. Beaufort Wind Force During Marine Mammal Sightings by Month

Beaufort Scale	Description	Wave Height (m)	Number of Marine Mammal Sightings				Total Sightings at Wind Force
			June	July	August	September	
0	Glassy	0	0	0	0	0	0
1	Ripples	< 0.1	0	8	5	0	13
2	Small wavelets	0 - 0.1	2	16	8	0	26
3	Smooth wavelets	0.1 - 0.5	7	13	32	0	52
4	Small wavecaps	0.5 - 1.2	17	19	9	0	45
5	Moderate waves, some spray	1.2 - 2.4	4	19	4	1	28
6	Rough, larger waves	2.4 - 4	4	3	4	1	12
≥7	Very rough	4 - ≥ 6	4	0	1	0	5
	Total sightings		38	78	63	2	181
	Average wind force		4	4	3.6	4.9	
	Average visibility (km)		6.3	4.7	7	9.2	

2 MARINE MAMMAL OBSERVATIONS

2.1 MITIGATIVE REQUIREMENTS

This survey followed the mitigation measures specified in the Environmental Assessment of the project (YOLO and RPS 2012), and adhered to the "Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment" and complied with Canada's Species at Risk Act (SARA).

Marine Mammal Observers also adhered to the "Joint Nature Conservation Committee Guidelines for Minimizing Acoustic Disturbance to Marine Mammals from Seismic Surveys" (2004). Seismic operators minimize additional noise in the marine environment by limiting soft starts to no more than 40 minutes prior to the survey line. Soft starts are carried out over a minimum time of 20 minutes.

As outlined in the Environmental Assessment (YOLO and RPS 2012), a "safety zone" of 500 m around the air source array is established to conform to a 180 dB re 1 uPa sound pressure contour. Procedures required slowly bringing the source up to a specified full power and shutting down the source if a Schedule 1 SARA-listed species (Table 3) was within the safety zone. Soft starts were to be delayed if a marine mammal or turtle was sighted within the requisite safety zone during the required 30 minute observation period before each survey line.

Table 3. Summary of Marine Mammal Mitigation Requirements for 2D Seismic Surveys

Activity	**Mitigation Measure**
Source mitigation zone	500 m
Pre-watch period	30 minutes
Length of soft start	20 to 40 minutes
Delay soft start	If a marine mammal or turtle in the safety zone
Shutdown during production	If a SARA-listed species is observed in the safety zone
Shut down species	Beluga whale (*Delphinapterus leucas*)
	Blue Whale *(Balaenoptera musculus*)
	Fin Whale (*Balaenoptera physalus*)
	North Atlantic Right Whale (*Eubalaena glacialis*)
	Northern Bottlenose Whale (*Hyperoodon ampullatus*)
	Sowerby's Beaked Whale (*Mesoplodon bidens*)

MKI contracted four marine mammal observers for the duration of the project. MKI contracted from Global Seismic MMO and Fisheries Liaison Ltd (UK) two experienced marine mammal observers, Ashley Noseworthy and Rhonda Reidy. The two additional Inuit observers were contracted from Sikimuit Environmental Management located in St. John's, Newfoundland. The two experienced MMOs and one Inuit observer were stationed onboard the research vessel. The additional Inuit observer was stationed on the supply vessel.

All observers were dedicated to sighting marine mammals within the ship's vicinity prior to, and during, seismic source operations, as well as ensuring adherence to the mitigation and commitments in the environmental assessment report. In addition, the observers collected marine mammal observations in the absence of source activity, to the extent reasonably practical.

2.2 MARINE MAMMAL OBSERVATION METHODS

A Marine Mammal Observer and Inuit Observer visually scanned the safety zone for 30 minutes prior to the start-up of the air source array, and maintained continuous observations during all source activity from the bridge, which provided a 360° viewing platform, 11 metres above sea level. Binoculars were used for long distance scans for marine mammals, in addition to continuous scans without binoculars. Sea surface cues used by the observers to detect animals included the following:

Blows from cetacean species;
Splashes, which are often the initial cue for small cetaceans;
Feeding seabird flocks (often associated with feeding cetaceans);
Sightings of backs and dorsal fins (or the heads or bodies of pinniped species);
Underwater shapes or a coloured patch;
An oil slick at the water surface; and
Frontal zones that form natural boundaries in the water where marine mammals often feed.

The distance of any sightings from the ship was determined by using a clear ruler as a simple range stick that is based on a methodology used in bird surveying (Heinmann 1981), and calibrated against radar measurements of vessel-to-vessel distances. Holding the ruler in hand and stretching the arm out straight, the observers place the 0-centimetre line on the horizon. When an animal was sighted, the observer lined up the place where it surfaced to a corresponding line on the ruler to determine its distance using a formula from the aforementioned publication.

The recording of marine mammal observations, as well as daily seismic activity and observer effort, used a similar format to the forms provided in the document titled “Recommended Seabird and Marine Mammal Observation Protocols for Atlantic Canada,” developed by LGL Ltd (March 2004).

2.3 OBSERVER EFFORT AND DATA COLLECTION SUMMARY

Acquisition of seismic data was from 5th June to 31st August 2012. The survey resulted in 11936 km seismic acquisition in 1407 hours (45 survey lines). Approximately 74% of the survey was spent in production or in transit. The remaining time were delays due to inclement weather, deviation for sea ice, or a shut-down for a protected whale species, or was spent in transit to and from the port in St. John's, Newfoundland.

Table 4. Summary of Timing on Survey Operations

Activity	Days	Hours	% of Total
Seismic Acquisition	59	1407	60
Line Change and run out	14	332	14
Other	19	452	26
Total Survey Time	**93**	**2191**	**100**

Out of 1429 total monitoring hours in daylight, approximately 1156 hours (80%) were while the source was actively in use (Figure **1**) (Noseworthy and Reidy 2012). Although seismic acquisition ended on August 31st, the data included 7.5 hours of observer effort during transit to port on September 1st.

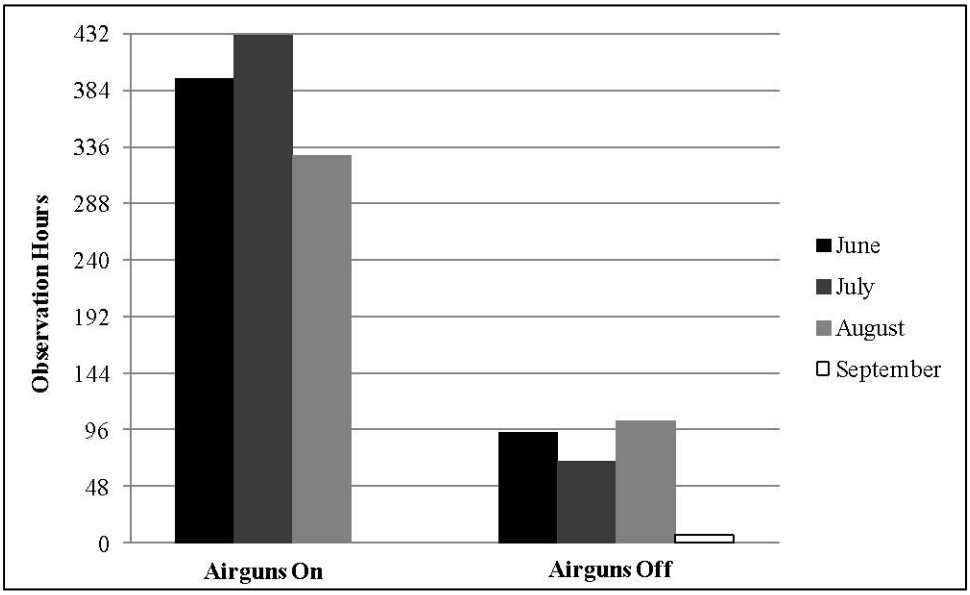

Figure 1. Total Monitoring Hours

From 9th to 10th November, the total time spent on the survey was 33.33 hours, with 17.78 hours of seismic acquisition.

2.4 MARINE MAMMAL OBSERVATIONS

For June, July, and August, a total of 1416 animals were recorded in 181 discrete sightings, with the majority of animals identified to the species level (Table 5). One species accounted for a large percentage of the sightings during the survey, this being the long-finned pilot whale (Globicephala melas). In a single sighting, there were anywhere from 1-100 individuals. Although the long-finned pilot whale was the abundant species at 1061 animals, we could not differentiate repeated sightings of the same individuals over the hours and days of monitoring in the same geographic region. Unidentified dolphins were the second most abundant species at 447 animals in 15 sightings. Fin whales (Balaenoptera physalus- 27 individuals) and sei whales (Balaenopter borealis- 16 individuals) were the dominant large whale species in the survey area.

Table 5. Summary of Marine Mammal Observations

	Total Number Sightings Airguns		Total Number Animals Airguns	
Species	**On**	**Off**	**On**	**Off**
Atlantic White Sided Dolphin	0	1	0	12
Blue Whale	1	0	1	0
Fin Whale*	14	2	24	3
Harbour Porpoise	0	1	0	1
Harp Seal	1	0	2	0
Humpback Whale	2	1	2	1
Killer Whale	0	1	0	6
Long-finned Pilot Whale	44	12	805**	157
Minke Whale	6	0	8	0
Northern Bottlenose Whale	2	0	11	0
Polar Bear	1	0	1	0
Sei Whale	6	1	15	1
White Beaked Dolphin	2	3	11	23
Unidentified Baleen Whale	17	2	28	2
Unidentified Cetaceans	1	0	2	0
Unidentified Dolphin	12	3	225***	24
Unidentified Seal	4	0	9	0
Unidentified Whale	36	3	36	3
Unknown Marine Mammal	2	0	3	0
Total	151	30	1183	233

* Only one SARA-listed species (a single fin whale) entered the mitigation one when the guns were on, and the guns were immediately shut down

** Includes one sighting in which no individuals are accounted for, sighting was too far away to estimate # of animals.

*** Includes two sightings in which no individuals are accounted for, sighting was too far away to estimate # of animals

Species identification of whales was often not possible when only the blow was observed, or when the animal was too far from the vessel to reliably distinguish similar species. These unidentified animals were recorded to the lowest possible taxonomic level.

Other factors, such as cetacean group size or surfacing behaviour, were important in the likelihood of spotting and identifying a marine mammal. Locations of all marine mammals recorded during the survey were plotted according to their position relative to the vessel. These locations are plotted individually for dolphins (Figure **2**), whales (Figure **3**), and pinniped (Figure **4**); a summary of all marine mammal observations are shown in Figure **5**.

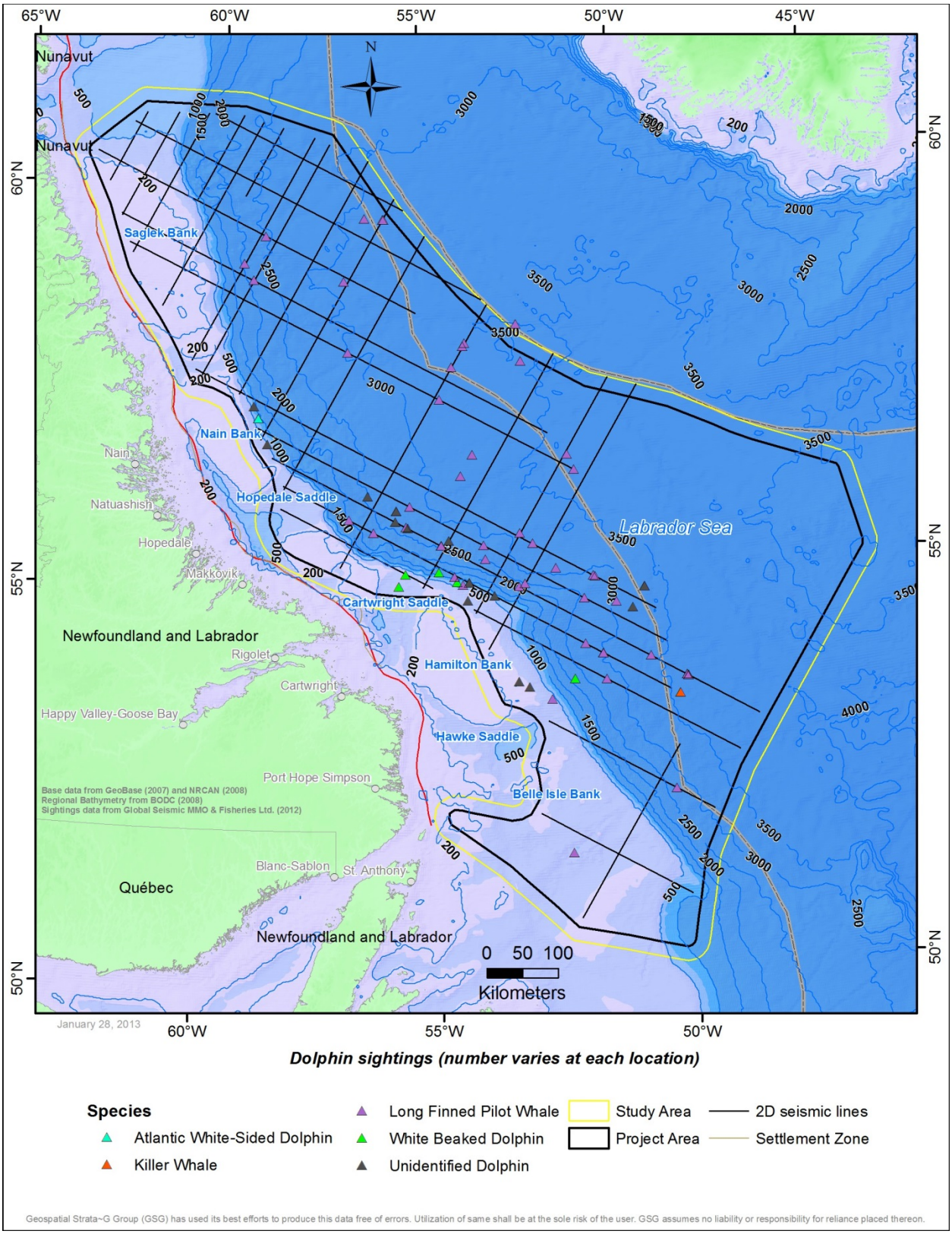

Figure 2. Dolphins Recorded During the Survey

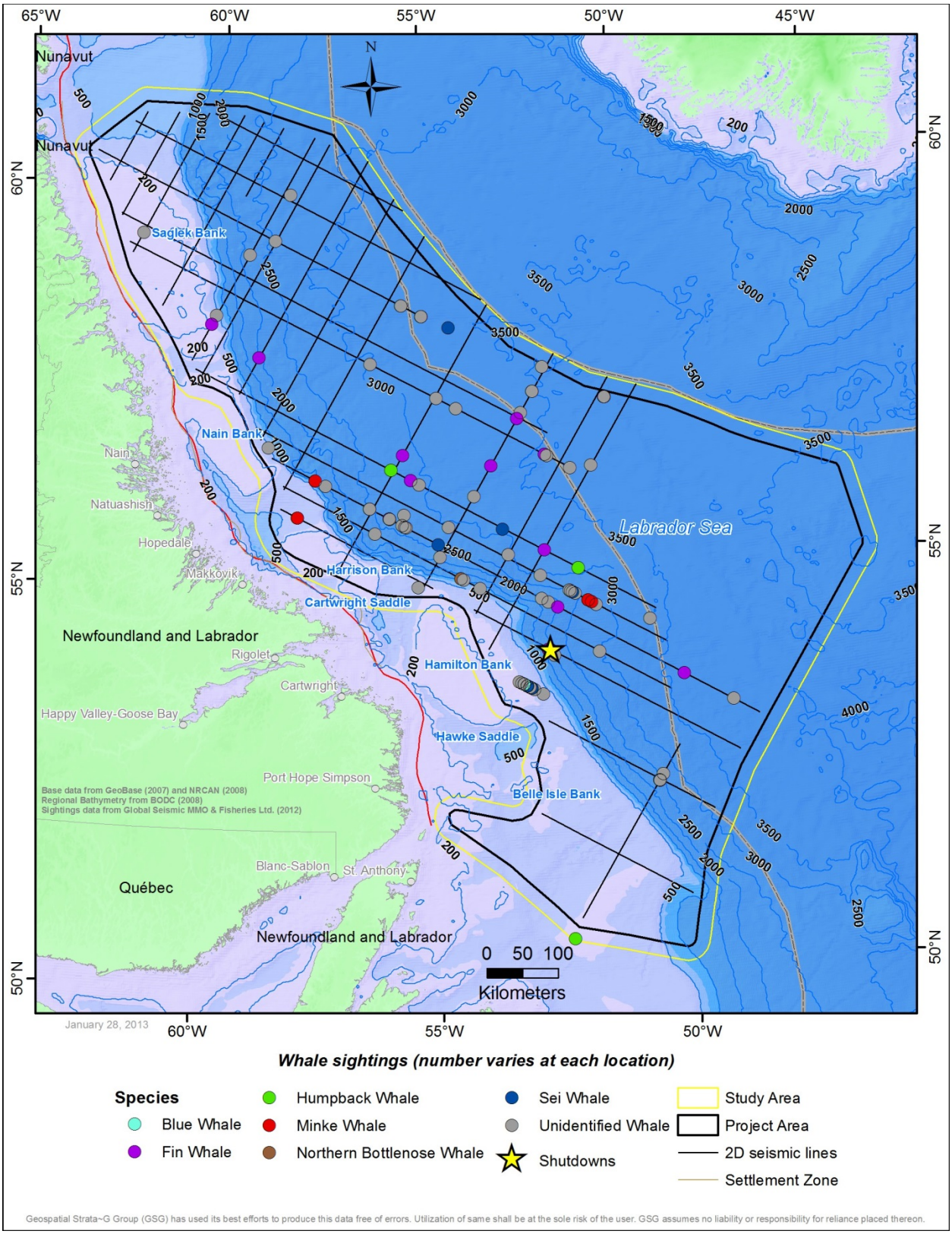

Figure 3. Whales Recorded During the Survey

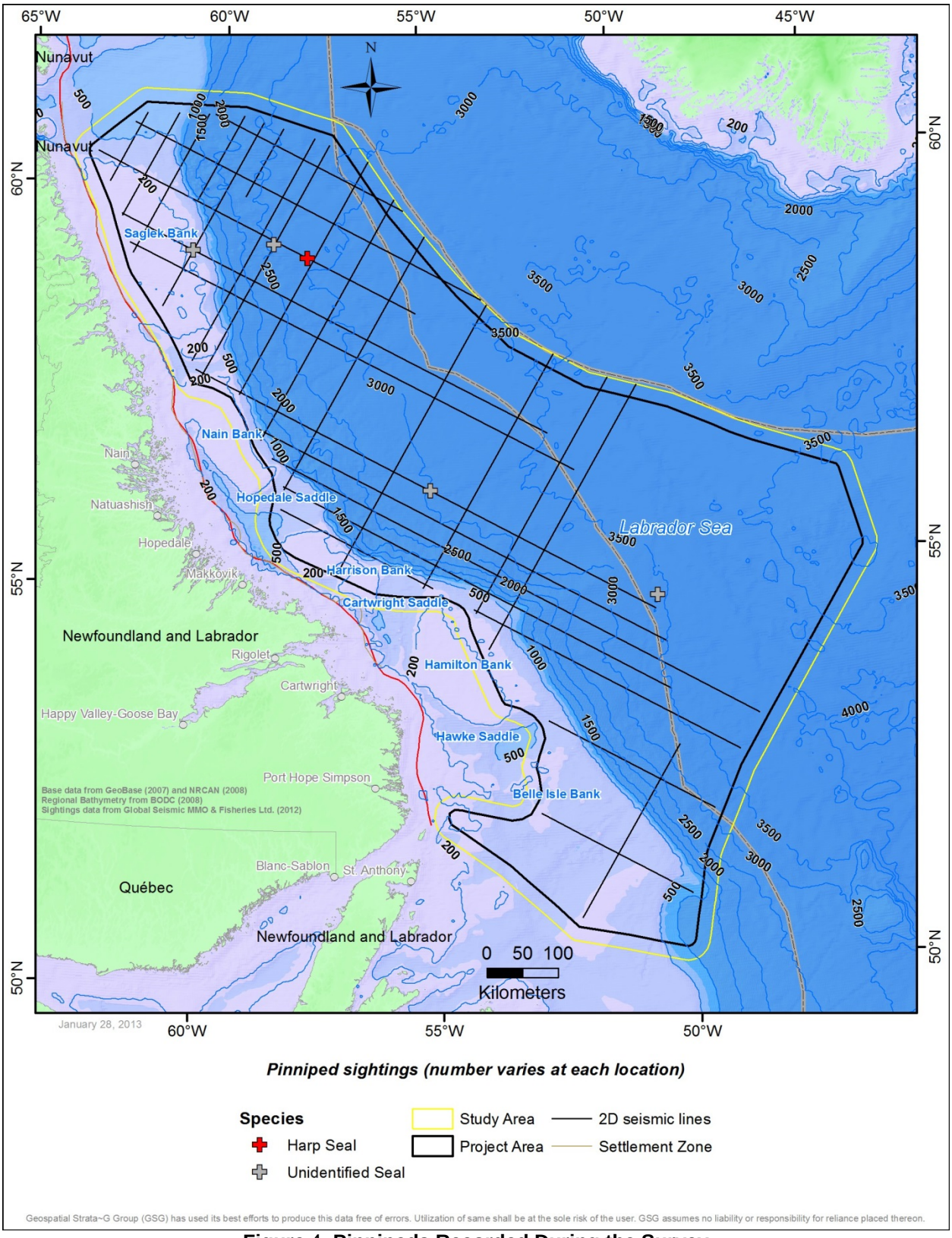

Figure 4. Pinnipeds Recorded During the Survey

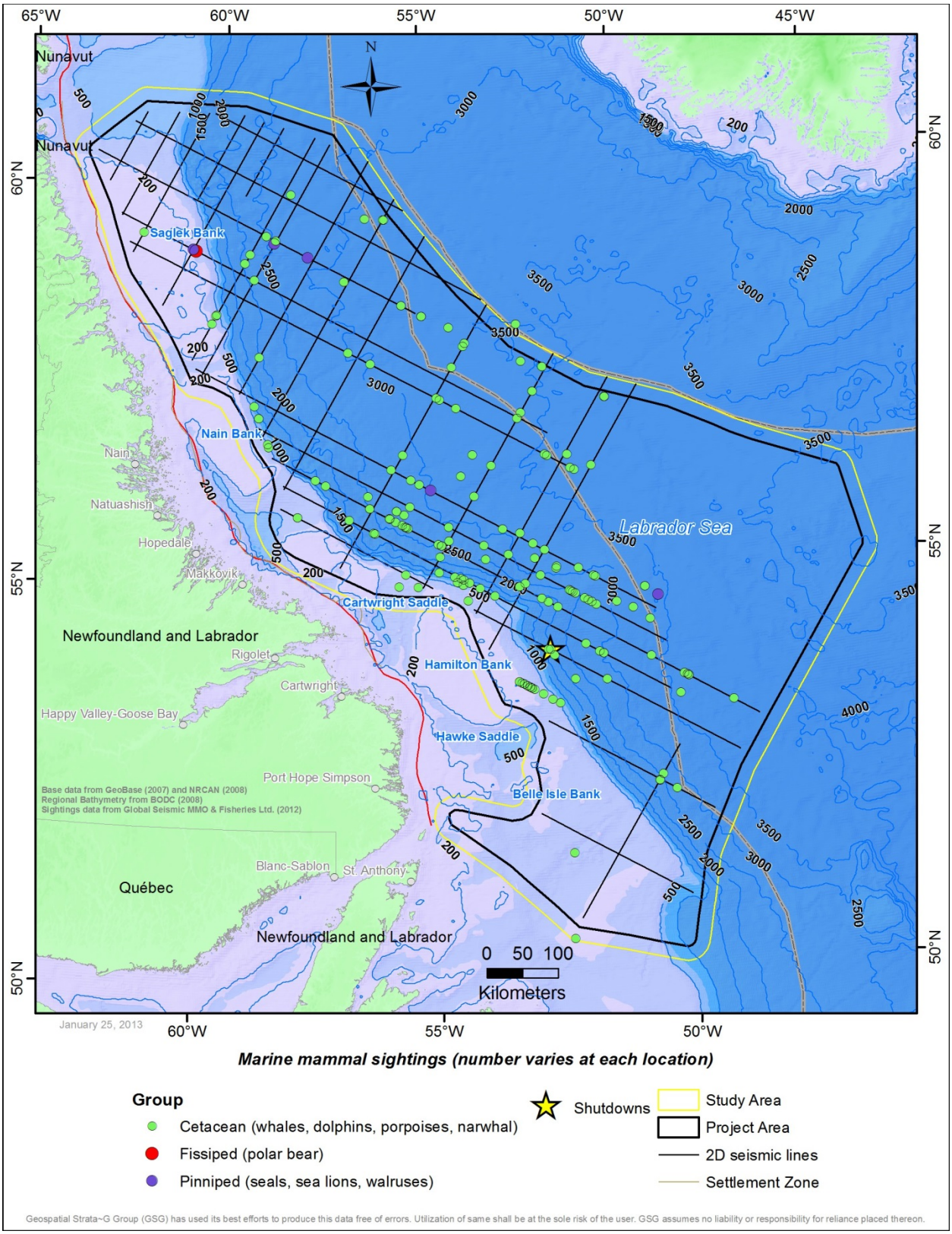

Figure 5. All Marine Mammals Recorded During the Survey

During the survey from 9th-10th November there was one sighting of two Atlantic White-sided Dolphins while in transit to the line. No mitigations were necessary.

2.5 MITIGATING ACTION

2.5.1 Soft starts

Seismic acquisition occurred between 5th June and 31st August 2012. All pre-survey watches were of the minimum required length of 30 minutes. For the 45 survey lines, 32 soft starts achieved full power with no prior testing of the guns. Nine soft starts immediately followed gun tests; four soft starts ended at reduced volumes of between 4628 and 4786 in^3 due to malfunctions in single guns. All soft starts occurred over the minimum required 20 minute period.

On two occasions due to technical issues the ramp up time to full power was achieved earlier than anticipated and before the start of the line. An additional 18 minutes of gun firing ahead of the start of line on the 8th August was due to a fault with the gun controller. The second incident on the 17th August was associated with PDU errors on the cable and the vessel having to abort the run in to the start of line.

A total of 41 gun tests occurred during the survey that included one test of the man overboard kill switch on 22nd June 2012.

2.5.2 Delays and shutdowns

The source was shut down due to a fin whale that was sighted crossing into the mitigation zone on 27th July (Figure **3**). This shut down resulting in a loss of 4.6 hours of seismic acquisition while the vessel turned to re-acquire the missed section of line. Two additional fin whales were observed at 800m from the source within minutes of the shutdown. At no time did a marine mammal cause a delay during a soft start or gun test.

2.6 SUMMARY

One shutdown of the source while in production occurred when a fin whale was within the 500-metre mitigation zone (Figure **3**); at no time was a marine mammal sighted in the mitigation zone 30 minutes before a soft start or gun test. Due to the near continuous acquisition of seismic data during daylight hours, a high proportion of monitoring hours (and thus, observation of marine mammals) occurred during active source use.

Although sea conditions impacted the detection of animals, with high numbers of observations in calm seas and good visibility, a broader perspective of sightings showed that detections were similarly high on days with increasing wave heights (e.g. Beaufort ≥ 4).

3 INUIT OBSERVER PROGRAM

MKI, in keeping their commitment to Newfoundland and Labrador benefits, employed Inuit observers for the duration of the Labrador Sea survey. These observers were also retained for the duration of the follow on Newfoundland Slope survey from September to November.

An Inuit Observer was always present on the acquisition vessel, M/V Sanco Spirit, while a second Inuit Observer simultaneously participated in the program from onboard the support vessel, M/V Spanish Mist. To facilitate their training on the seismic ship, the Inuit Observers each worked a minimum of one 5-week rotation onboard M/V Sanco Spirit. Communications between the observers on the seismic research vessel and the supply vessel were maintained by VHF radio. Animals sighted by the Inuit Observer on the supply vessel were included in a daily, weekly, and monthly report supplied to the MKI representative onboard the research vessel, while sightings from the Inuit observer onboard M/V Sanco Spirit were incorporated into the marine mammal observation data.

Every effort was made to involve the Inuit Observers in accurately identifying and recording the presence of marine mammals during daylight hours while the vessel was engaged in active surveying. Daily procedures onboard the M/V Sanco Spirit required the Inuit Observer to maintain a constant watch for marine mammals during their shift, and to experience real-time data entry of marine mammal observations and hourly sea state, weather, and vessel position information. A Marine Mammal Observer was always on duty with the Inuit Observer to provide direction and feedback throughout the survey. In addition, every evening the Inuit Observer on the support vessel radioed his daily sightings to a Marine Mammal Observer on the M/V Sanco Spirit. The Inuit Observers demonstrated improvement in species identifications and general knowledge of data recording techniques over the 5 months.

4 SEABIRD OBSERVATIONS

Seabird observations were undertaken by the marine mammal observers. Observations were conducted on ten-minute watches, opportunistically, a minimum of twice per day. Table 6 provides a list and enumeration of the species sighted. Figure **6** shows the location of the bird sightings.

Table 6. Seabird Observations

Species	Number of Individuals
Arctic Tern	3
Atlantic Puffin	1
Black Legged kittiwake	291
Common Murre	15
Common Shearwater	1
Common Tern	4
Dovekie	15
Great Black backed Gull	2
Glaucous Gull	1
Greater Shearwater	1175
Gull sp.	51
Herring Gull	30
Jaeger sp.	27
Murre sp.	86
Northern Fulmar	2024
Northern Gannet	22
Pine Siskin	26
Pomarine Jaeger	6
Red necked Phalarope	30
Shearwater sp.	23
Skua sp.	3
Sooty Shearwater	20
Storm Petrel sp.	17
Swallow	12
Thick billed Murre	5
Tern sp	2
Wilson's Storm Petrel	2
Unknown Gull	13
Unknown	29
Unknown Murre	43
Total	3979

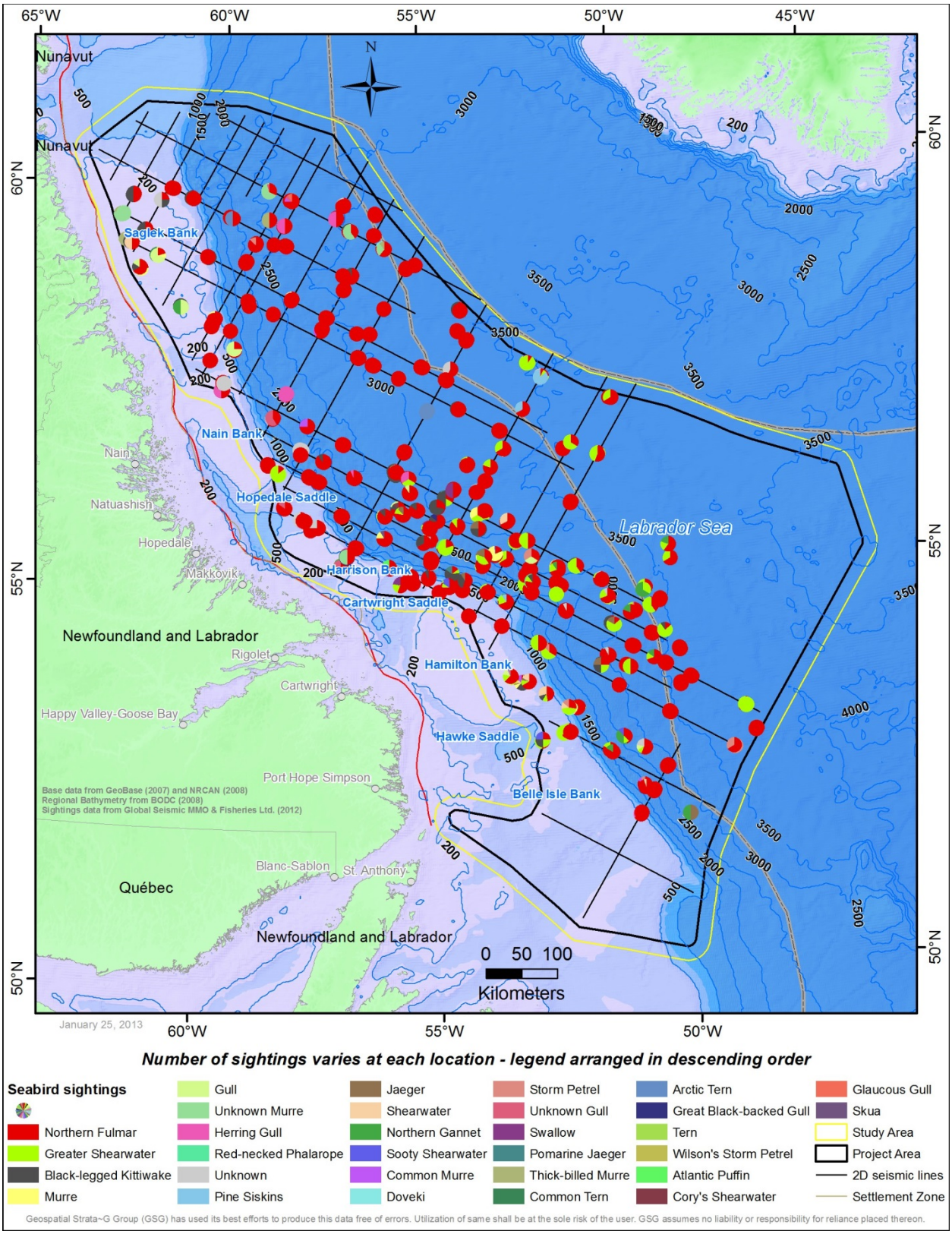

Figure 6. Bird Sightings

5 FISHING ACTIVITY

The Fisheries Liaison Officer (FLO) documented each time there was contact with fishers. To help with monitoring the fishing activities and avoiding potential conflicts, for much of the survey the vessel was receiving maps from Canadian Department of Fisheries and Oceans (DFO) showing fishing vessels' distribution. The maps were delivered daily except for the weekends.

To ensure good communications between MKI and the fishery representatives (FFAW), weekly meetings were held. At these meetings activities for the previous week were reported and discussed along with a proposed acquisition plan for the upcoming week. Additional contacts with local fishers groups were made by the shore-based Vessel Supervisor. Updates of the operations were submitted to Canning and Pitt Ltd who were the Single Point of Contact (SPOC) for the vessel and liaison with the fishing communities. The information was distributed at noon and midnight every day and included: vessel's position, heading, and estimated position at the end of each 12 hour period.

Independently to the above communications, Daily and Weekly Reports from the onboard FLO were submitted to PGS, TGS, and FFAW.

Fishing vessels in transit, contacted by FLO (no issues reported)

- 2nd June - Labrador Storm
- 4th June - Beothuk, Tiquesha Quest
- 20th June - Royal Venture
- 23rd June - Katsheshuk II
- 25th June- Ocean Prawns
- 8th July - Mercy Phoenix
- 14th July - Atlantic Enterprise

Fishing vessels harvesting, contacted by FLO (no issues reported)

- 6th June- "Newfoundland Prize on her last tow when first contacted then proceeding to port"
- 4th July – "Katsheshuk II, harvesting shrimp CPA= 8nm"
- 18th July – "Cape Dorset, harvesting shrimp, CPA= 13nm"
- 21st July – "Newfoundland Lynx, Atl. Enterprise, Katsheshuk II, Labrador Storm, and North Eagle, CPA = 4nm"
- 28th July – "Cape Dorset, harvesting shrimp, CPA=2nm"
- 7th August- "Katsheshuk II, Newfoundland Pioneer, Ocean Prawns, harvesting shrimp"

A total of 52.62 hours of stand-by were attributed to fishing activities as a result of extended line changes to avoid specific areas that were being heavily fished.

The return to the Labrador Sea survey on 9th – 10th of November was an attempt to acquire the last remaining line of the survey. Fishing activity on and around this line location was particularly heavy throughout June to September so a commitment had been made to FFAW not to attempt to acquire this line at that time but to return at the end of the seismic season.

6 POTENTIAL ENVIRONMENTAL EFFECTS OF THE LABRADOR SURVEY

The potential effects of the MKI seismic survey were assessed in both the EA Addendum Report and EA Update Report submitted as part of 2012 Geophysical Operations Authorization. The reports concluded that the vessel presence, noise emissions, and potential accidental events associated with the proposed seismic survey were not predicted to result in any significant adverse environmental effects on fish and shellfish, marine and migratory birds, marine mammals, sea turtles, species-at-risk, sensitive areas, or fisheries in the Labrador Shelf Study Area following mitigation as outlined in the reports and shown here in Table 7.

As a result of these mitigations, there were no observed significant effects imposed on any Valued Ecosystem Components (VEC), no claims for compensation made for fishing gear damage or loss and no spills. In addition the marine mammal and seabird observations and the fisheries liaison officer communications with commercial vessels included in this report indicate that the survey was compliant with the mitigative actions outlined above as well as with the Canadian Statement of Practice.

We therefore believe that as a result of the 2012 Labrador survey ecological processes will not be disturbed outside natural variability, and ecosystem structure and function will not be critically affected. All effects are reversible, of limited duration, magnitude, and geographic extent.All effects were reversible, of limited duration, magnitude, and geographical extent.

Table 7. Mitigation Measures, Follow up, and Monitoring

VEC	Mitigation Measures	Follow up and Monitoring
Marine and Migratory Birds	• Compliance with PGS vessel WMP, *Canada Shipping Act,* OWTG and MARPOL for all discharges. • A fuel transfer plan will be developed and implemented. • Any handling of stranded birds will follow CWS and industry protocols. • A dedicated Environmental Observer will be on board the seismic vessel to record marine birds. • Vessel compliant with audit prior to survey. • Avoidance of bird colonies.	• Sightings data for seabirds, will be summarized in a monitoring report which will be submitted to C-NLOPB, and CWS. • Records of bird strandings will be provided to the C-NLOPB, and CWS for distribution to interested parties.
Marine Fish and Shellfish	• Adherence to the *Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment,* to the extent reasonably practical. • To minimize sudden changes in noise levels, a 20 to 40 minute ramp up procedure will be implemented.	• No follow up or monitoring required for routine activities
Marine Mammals and Turtles	• Before start of the operations, a meeting will be held with MKI representatives and TGS seismic company representatives to review sail lines, scheduling, anticipated fishing vessels and gear types, mitigating measures, expectations of all parties and Emergency Response Plans.	• A trained Environmental Observer will record marine mammal and turtle observations. • All spills will be reported.

VEC	Mitigation Measures	Follow up and Monitoring
	• An Environmental Observer will be onboard the vessel throughout the duration of the survey and will record sightings of marine mammals on a daily basis as per protocol. • A 20 to 40 minute ramp-up procedure will be undertaken for seismic surveys. • Ramping up will be delayed if a marine mammal is observed in the 500 m safety zone. • Air sources will be shut down or reduced to a smaller air source while the vessel is doing turns between survey lines. • The Environmental Observer will ensure the delay or shut down of seismic operations if SARA-listed Schedule 1 mammals or turtles are present within 500 m. • Collision avoidance practices, including constant speed and course maintained by seismic and support vessels. • Vessels will maintain a steady course and speed, and use existing travel routes, where possible. MARPOL standard procedures.	
Species at Risk	• Adherence to the *Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment* to the extent reasonably practical. • Same as above for marine birds, marine turtles and marine mammals	• A trained Environmental Observer will record marine mammal, sea turtles and seabird observations. • All spills will be reported.
Sensitive Areas	• Vessel compliant with audit prior to survey. • Maintenance of streamer equipment and responsible management of such equipment. • Compliance with OWTG (NEB *et al.* 2002) for all discharges. • Avoidance of bird colonies by vessel.	• No follow up or monitoring required for routine activities • All spills will be reported.
Commercial Fisheries	• A Notice to Shipping and notification on the CBC Fisheries Broadcast on the location and scheduling of seismic activities will be issued. • Communication mechanisms will be developed with the fishing industry and DFO research surveys. • The Fisheries Liaison Observer on the vessel will monitor fishing activity in the vicinity of the seismic vessel and serve as a liaison between the fishing vessels and the seismic vessel; • Arrange for a Single Point of Contact • MKI will comply with C-NLOPB compensation guidelines.	• No follow up or monitoring required for routine activities

7 REFERENCES AND SOURCES

DFO. 2007. Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment.

Heinmann, D. 1981. A range finder for pelagic birds censusing. Journal of Wildlife Management 45 (2): 489-493.

Noseworthy, A. and Reidy, R. 2012. Marine Mammal Observations During a Marine 2-D Seismic Reflection Survey, Labrador Sea and Davis Strait (Phase 2), June 1-September 1, 2012. 20p.

TGS/PGS/MKI 2012. Final Report Labrador Sea 2012. 32p.

YOLO and RPS Energy. 2012. Update report. Environmental impact assessment for marine 2D seismic reflection survey Labrador Sea and Davis Strait. Multi Klient Invest AS. Report prepared for C-NLOPB by YOLO Environmental Inc. and RPS Energy, March 2012.

ENVIRONMENTAL OBSERVATIONS

DURING THE MKI 2D SEISMIC REFLECTION SURVEY

NORTHEASTERN NEWFOUNDLAND SLOPE

4th September – 8th November 2012



Submitted to:
Canada Newfoundland and Labrador
Offshore Petroleum Board
On behalf of Multi Klient Invest AS
Program # 45120-020-003

31st January 2013

Submitted by:

RPS Energy (Halifax)
Liberty Place, 2nd Floor
1545 Birmingham Street
Halifax, Nova Scotia, B3J 2J6
Tel: (902) 425-1622
Fax: (902) 425-0703
Web: www.rpsgroup.com/energy/

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1 INTRODUCTION

In 2012, Multi Klient Invest AS (MKI) conducted a 2D seismic survey utilizing the M/V Sanco Spirit on the Northeast Newfoundland slope. Environmental data collected during this survey are presented in this report. The seismic survey took place between 4th September and 8th November 2012.

This report is produced to comply with the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) regulations. The environmental data in this report includes marine mammal and seabird observations and fisheries communications for the duration of the survey.

Geographical restrictions included no surveying within 12 nautical miles of the Newfoundland/Labrador Coast as well as maintaining 5 nautical mile distance from all fixed installations within the survey area.

1.1 SPECIAL CONSIDERATIONS

MKI had two separate Geophysical Authorizations within the C-NLOPB jurisdiction for data collection within the 2012 season. MKI collected seismic data in the Labrador Sea, prior to and after this survey on the Newfoundland Slope; as a result, there are no transiting or mobilization times to report for this particular survey.

1.2 SEISMIC EQUIPMENT AND SOUND EMISSIONS

MKI operates the dedicated seismic research vessel, M/V Sanco Spirit. MKI contracted two supply vessels during the course of the survey to accompany the M/V Sanco Spirit. The first support vessel contracted was the M/V Spanish Mist (4th September to 23rd October); the second support vessel contracted was the M/V Blain through until completion of the program (23rd October to 9th November).

A summary of the seismic source array specifications are presented in Table 1. The source was towed approximately 127 m astern of the research vessel at a depth of 9m ± 1m. In addition, a single 2D PGS Geo-Streamer ® of 8100 m active length was towed.

Table 1. Seismic Source Array Specifications

Specification	Value
Number of Airgun Arrays	1
Number of Airgun Subarrays	4
Number of Airguns operating at Full Power	40
Maximum Operating Volume	4808 in^3
Operating Pressure	2000 psi
Shotpoint Interval	25 m
Maximum Source Output (zero to peak)	86.25 μbar
Maximum Source Output (peak to peak)	179,1 μbar
Peak Frequency	206 Hz

1.3 SEA STATE AND VISIBILITY

Sea state was based on the standard Beaufort scale (0 to 12), where at zero, the seas are glassy calm; at 4, small waves have formed with breaking crests; and at 12, huge waves are mixed with foam and driving spray (hurricane). Visibility for sighting animals was based on the observers' ability to see long distances to the horizon, from zero to 10 km from the vessel.

Wind speed, based on sea state, ranged from very calm (Beaufort 1) to very rough (Beaufort ≥7) across all months (Table 2). While almost half of all marine mammal sightings occurred during conditions of between Beaufort 3 and 4, some animals were detected in moderate to rough conditions, considered Beaufort 5 or higher (Table 2). The average sea state across all months was Beaufort 4. Visibility for each month ranged from dense fog to unlimited visibility; average visibility was considered good (>6km) during all months. Although October had the poorest visibility, as well as the greatest average sea state, the number of animal sightings were greater in October than the other two months.

Table 2. Beaufort Wind force during marine mammal sightings by Month

Beaufort Scale	Description	Wave Height (m)	Number of Marine Mammal Sightings			Total Sightings at Wind Force
			September	October	November	
0	Glassy	0	0	0	0	0
1	Ripples	< 0.1	3	6	9	18
2	Small wavelets	0 - 0.1	13	12	1	26
3	Smooth wavelets	0.1 - 0.5	16	13	0	29
4	Small wavecaps	0.5 - 1.2	18	14	12	44
5	Moderate waves	1.2 - 2.4	9	6	1	26
6	Rough, larger waves	2.4 - 4	3	10	0	13
≥7	Very rough	4 - ≥6	0	9	0	9
	Total sightings		62	70	23	155
	Average wind force		3.8	5.0	3.8	
	Average visibility (km)		7.6	6.6	7.1	

2 MARINE MAMMAL OBSERVATIONS

2.1 MITIGATIVE REQUIREMENTS

This survey followed the mitigation measures specified in the Environmental Assessment of the project (YOLO Environmental Inc. 2012), and adhered to the "Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment" and complied with Canada's Species at Risk Act (SARA).

Marine Mammal Observers adhered to the Joint Nature Conservation Committee Guidelines for Minimizing Acoustic Disturbance to Marine Mammals from Seismic Surveys (2004). Seismic operators minimize additional noise in the marine environment by limiting soft starts to no more than 40 minutes prior to the survey line. Soft starts are carried out over a minimum time of 20 minutes.

As outlined in the Environmental Assessment (YOLO Environmental Inc. 2012), a "safety zone" of 500 m around the air source array is established to conform to a 180 dB re 1 uPa sound pressure contour. Procedures required slowly bringing the source up to a specified full power and shutting down the source if a Schedule 1 SARA-listed species (Table 3) was within the safety zone. Soft starts were to be delayed if a marine mammal or turtle was sighted within the requisite safety zone during the required 30 minute observation period before each survey line.

Table 3. Summary of Marine Mammal Mitigation Requirements for 2D Seismic Surveys

Activity	Mitigation Measure
Source mitigation zone	500 m
Pre-watch period	30 minutes
Length of soft start	20 to 40 minutes
Delay soft start	If a marine mammal or turtle in the safety zone
Shutdown during production	If a SARA-listed species is observed in the safety zone
Shut down species	Beluga whale (*Delphinapterus leucas*)
	Blue Whale *(Balaenoptera musculus*)
	Fin Whale (*Balaenoptera physalus*)
	North Atlantic Right Whale (*Eubalaena glacialis*)
	Northern Bottlenose Whale (*Hyperoodon ampullatus*)
	Sowerby's Beaked Whale (*Mesoplodon bidens*)

MKI contracted four marine mammal observers (MMO) for the duration of the project. MKI contracted from Global Seismic MMO and Fisheries Liaison Ltd (UK) two experienced marine mammal observers, Ashley Noseworthy and Michael Force. The two additional Inuit observers were contracted from Sikimuit Environmental Management located in St. John's, Newfoundland. The two experienced MMOs and one Inuit observer were stationed onboard the research vessel. The additional Inuit observer was stationed on the supply vessel.

All observers were dedicated to sighting marine mammals within the ship's vicinity prior to, and during, seismic source operations, as well as ensuring adherence to the mitigation and commitments in the environmental assessment report. In addition, the observers collected marine mammal observations in the absence of source activity, to the extent reasonably practical.

2.2 MARINE MAMMAL OBSERVATION METHODS

A Marine Mammal Observer and an Inuit Observer visually scanned the safety zone 30 minutes prior to the start-up of the air source array, and maintained continuous observations during all airgun activity from the bridge, which provided a 360° viewing platform, 11 metres above sea level. Binoculars were used for long distance scans for marine mammals, in addition to continuous scans without binoculars. Sea surface cues used by the observers to detect animals included the following:

Blows from cetacean species;
Splashes, which are often the initial cue for small cetaceans;
Feeding seabird flocks (often associated with feeding cetaceans);
Sightings of backs and dorsal fins (or the heads or bodies of pinniped species);
Underwater shapes or a coloured patch;
An oil slick at the water surface; and
Frontal zones that form natural boundaries in the water where marine mammals often feed.

The distance of any sightings from the ship was determined by using a clear ruler as a simple range stick that is based on a methodology used in bird surveying (Heinmann 1981), and calibrated against radar measurements of vessel-to-vessel distances. Holding the ruler in hand and stretching the arm out straight, the observers place the 0-centimetre line on the horizon. When an animal was sighted, the observer lined up the place where it surfaced to a corresponding line on the ruler to determine its distance using a formula from the aforementioned publication.

The recording of marine mammal observations, as well as daily seismic activity and observer effort, used a similar format to the forms provided in the document titled “Recommended Seabird and Marine Mammal Observation Protocols for Atlantic Canada,” developed by LGL Ltd (March 2004).

2.3 OBSERVER EFFORT AND DATA COLLECTION SUMMARY

Seismic data was acquired from 6th September to 8th November 2012. The survey resulted in 7956.80 km seismic acquisition in 993.96 hours (42 survey lines). Approximately 72% of the survey was spent in production or in transit (Table 4). The remaining time was delays due to inclement weather, deviation for sea ice, or a shut-down for a protected whale species.

Table 4. Summary of Timing on Survey Operations

Activity	Days	Hours	% of Total
Seismic Acquisition	41.42	993.96	63
Line Change and run out	5.84	140.23	9
Other	18.09	434.28	27
Total Survey Time	**65.35**	**1568.47**	**100**

Out of 666.8 total monitoring hours in daylight, approximately 527.9 hours (79%) were during active gun use (Figure **1**). Cumulative monthly observation hours ranged from a total of 307.2 hours in October (guns on and off), to 84.7 hours in November (Figure **1**) (Noseworthy and Force 2012).

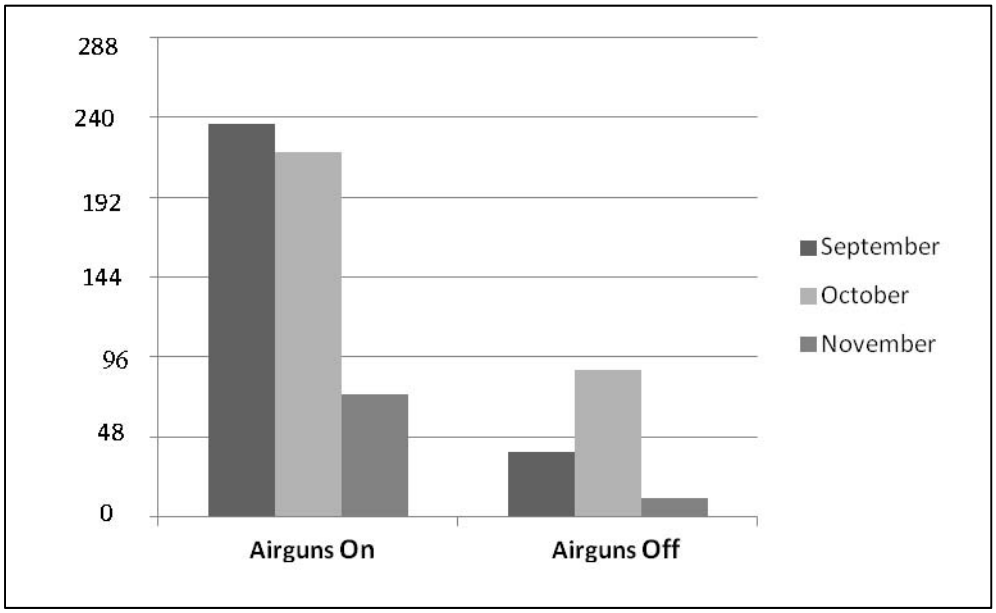

Figure 1**. Total Monitoring Hours**

2.4 MARINE MAMMAL OBSERVATIONS

A total of 2012 animals were recorded in 155 discrete sightings, with the majority of animals identified to the species level (Table 5). A single sighting could range from 1 to 280 individuals. One species accounted for a large percentage of the sightings during the survey, this being the long-finned pilot whale (Globicephala melas). Although the long-finned pilot whale was the abundant species at 1572 animals, we could not eliminate the possibility of repeated sightings of the same individuals.

Table 5. Summary of Marine Mammal Observations

	Total Number Sightings Airguns		Total Number Animals Airguns	
Species	On	Off	On	Off
Atlantic White Sided Dolphin	4	4	133	12*
Fin Whale	3	0	4	0
Humpback Whale	6	6	12	11
Long-finned Pilot Whale	60	3	1277**	295
Minke Whale	2	1	2	1
Northern Bottlenose Whale	1	2	1	9
Sei Whale	1	1	2	1
Sperm Whale	17	4	23	4
White Beaked Dolphin	1	3	5	13
Unidentified Baleen Whale	2	3	2	4
Unidentified Dolphin	7	4	110	63
Unidentified Whale	15	2	23	2
Unknown Cetacean	2	1	2	1
Total	121	34	1596**	416*

*Could not determine # of individuals for one of the included sightings.
**Could not determine # of individuals for two of the included sightings.

Sperm whales (Physeter marcocephalus) and humpback whales (Megaptera novaengliae) were the dominant large whale species in the area with 27 and 23 animals identified, respectively.

Species identification of whales was often not possible when only the blow was observed, or when the animal was too far from the vessel to reliably distinguish similar species. These unidentified animals were recorded to the lowest possible taxonomic level.

Other factors such as cetacean group size, surfacing behaviours, and environmental conditions such as sea state, visibility, and relative sun angle were important in detecting and identifying a marine mammal. Location of all marine mammals recorded during the survey were plotted according to their position relative to the vessel, and plotted individually for dolphins (Figure **2**) and whales (Figure **3**); a summary of all marine mammals observed are shown in Figure **4**.

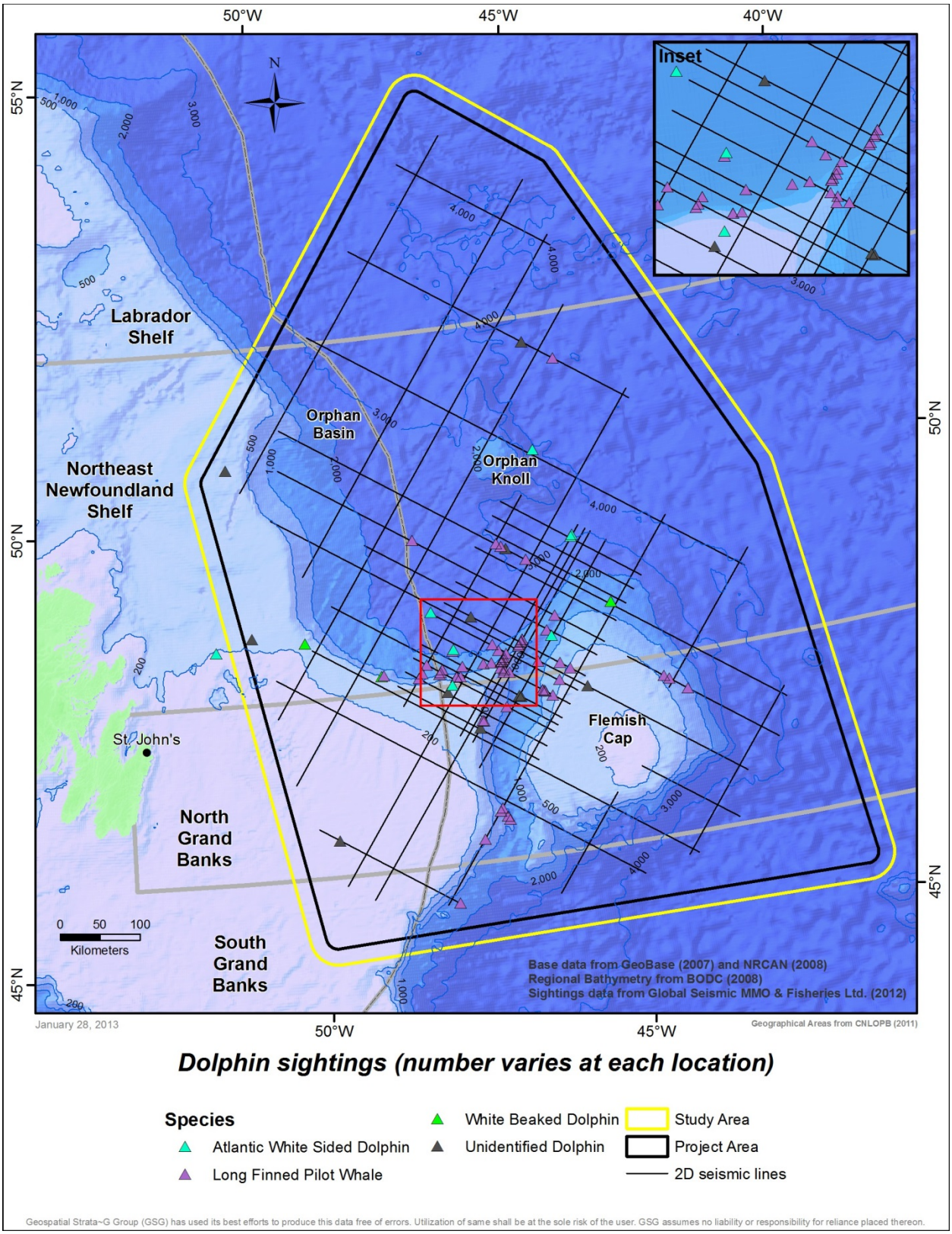

Figure 2. Dolphins Recorded During the Survey

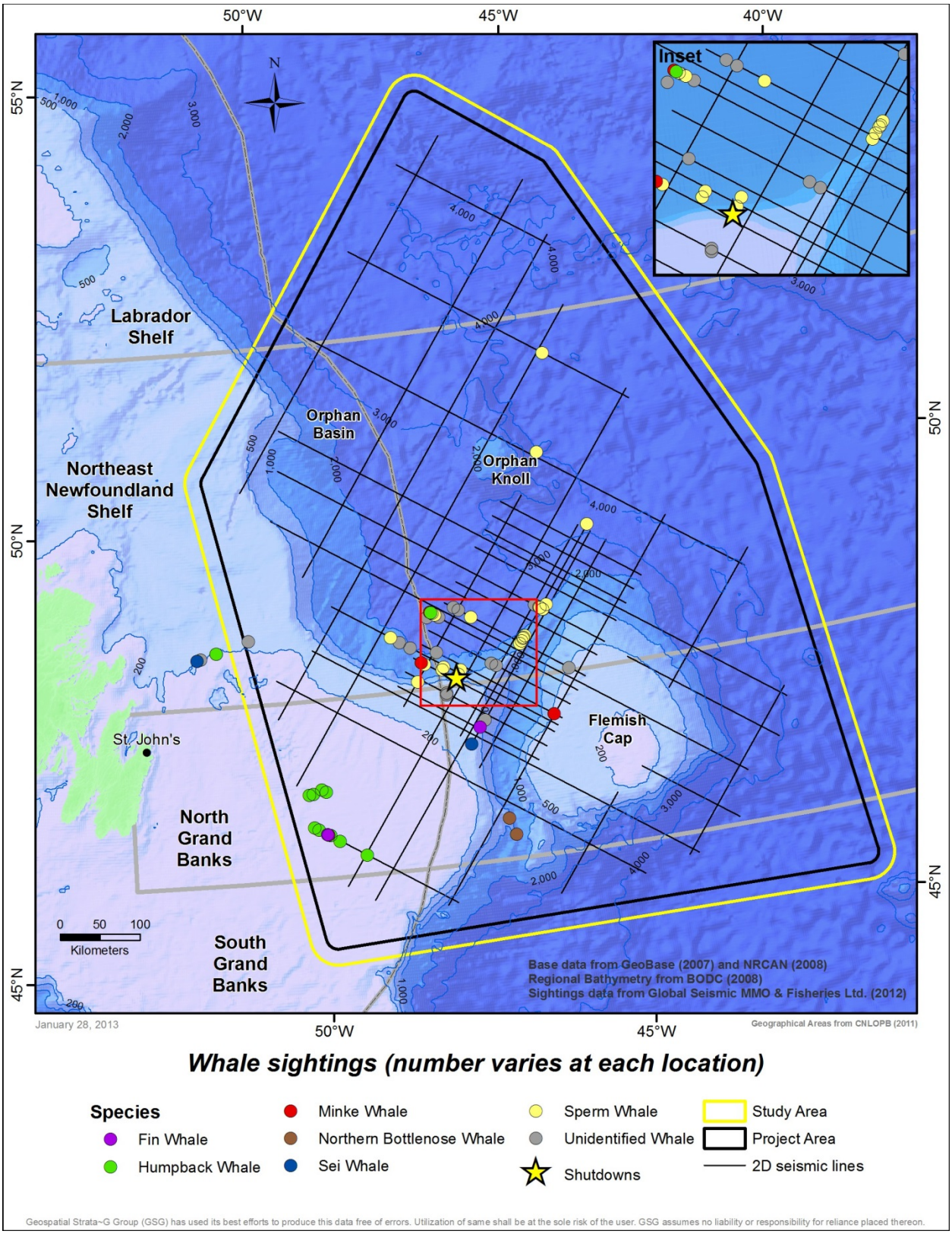

Figure 3. Whales Recorded During the Survey

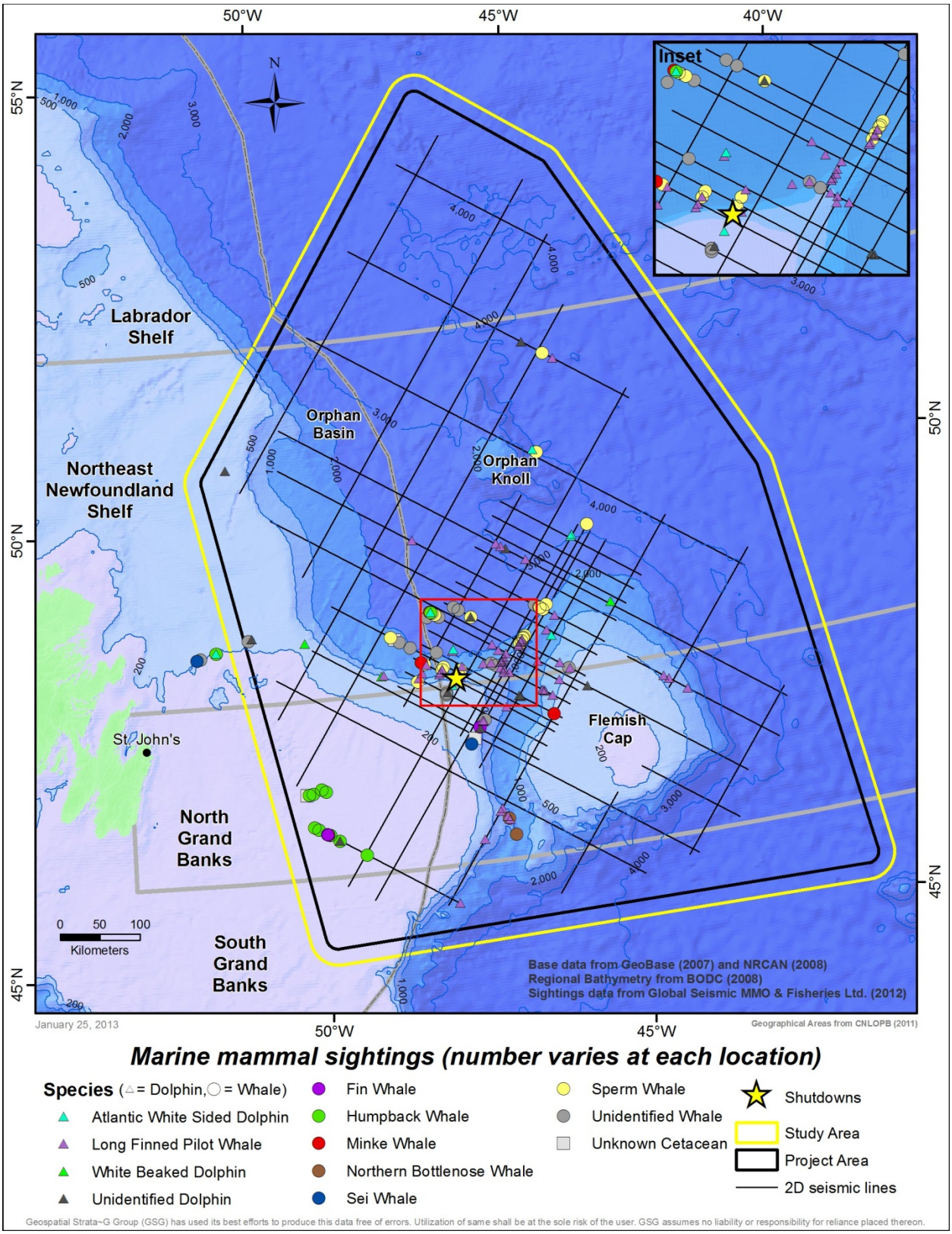

Figure 4. All Marine Mammals Recorded During the Survey

2.5 MITIGATING ACTION

2.5.1 Soft starts

Seismic acquisition occurred between 6th September and 8th November 2012. All watches prior to surveying were of the minimum required length of 30 minutes, as per the Canadian Statement of Practice. For the 42 survey lines, 41 soft starts achieved full power with no prior testing of the guns. Only one soft start immediately followed a gun test, and no soft starts ended at reduced volume, all reached the maximum operating volume (4808 in^3). All soft starts occurred over the minimum required period of 20 minutes. A total of 26 gun tests occurred during the survey..

2.5.2 Delays and shutdowns

The only soft-start delay occurred on 24th October 2012, when a humpback whale was sighted within the mitigation zone during the 30 minute required pre-watch. Soft start was delayed 20 minutes.

The source was shut down on 2nd November 2012 due to a northern bottlenose whale that was sighted crossing into the mitigation zone; this resulted in a loss of 4.13 hours of seismic acquisition while the vessel turned to re-acquire the line.

2.6 SUMMARY

Every effort was made to record the presence of marine mammals during daylight hours while the vessel was transiting or engaged in active surveying. Effort was also put forth during hours when the seismic source was not active, to obtain more information regarding the distribution of marine mammal species within the survey area.

3 INUIT OBSERVER PROGRAM

MKI, in continuing their commitment to Newfoundland and Labrador benefits kept Inuit observers onboard for the duration of both the Labrador Sea and Newfoundland Slope surveys.

As previously mentioned, the Inuit Observers were provided by Sikimuit Environmental Management from St. John's Newfoundland. One Inuit Observer was present on the acquisition vessel from 4th September to 10th October 2012. A second Inuit Observer simultaneously participated in the program from onboard the support vessel for the entirety of the project. Communications between the observers on the research vessel and supply vessel were maintained by VHF radio. All animals sighted by the Inuit Observer on the supply vessel were included in a daily, weekly, and monthly report supplied to the MKI representative on board the research vessel. Animals sighted by the Inuit Observer on M/V Sanco Spirit were incorporated into the marine mammal observation data.

4 BIRD SIGHTINGS

Seabird observations were undertaken by the marine mammal observers. Observations were conducted on ten-minute watches opportunistically a minimum of twice per day. Table 6 provides a list and enumeration of the species sighted. Figure **5** shows the location of the bird sightings for the survey.

4.1 STRANDED BIRDS

MKI obtained from Canada Wildlife Services a Bird Handling Permit, handling instructions and release protocols for any stranded Storm Petrels.

There were six Leach's Storm-petrels found on four different days on the M/V Sanco Spirit. The first instance, on October 17th, two petrels were found in the morning. The Petrels were put in a box by the MMO and left to rest; they were released at ~10:45 am. Plumage indicated that one bird was young as it was fresh with no wear. The other showed moulting in the tail and new central tail feathers.

The other four petrels found were of indeterminate age; two found on 23rd October on the gun deck. The one found on 2nd November on the gun deck was underweight. The final petrel was found on 6th November.

All protocols were followed as outlined in the Storm-Petrel Handling Instructions.

Table 6. Bird Species Sighted

Species	Total Number Sightings
Alcid species	7
Atlantic Puffin	6
Black-legged Kittiwake	334
Bohemian Waxwing	2
Common Murre	3
Dovekie	177
Great Black-backed Gull	283
Glaucous Gull	1
Greater Shearwater	759
Great Skua	5
Gull species	49
Herring Gull	30
Jaeger species	48
Leach's Storm Petrel	12
Lesser Black-backed Gull	2
Long-tailed Jaeger	1
Murre species	9
Northern Fulmar	2459
Northern Gannett	1
Parasitic Jaeger	16
Passerine species*	2
Phalarope species	2
Pomarine Jaeger	2
Razorbill	1
Skua species	29
Shearwater species	16
Snow Bunting*	3
Sooty Shearwater	11
South Polar Skua	3
Storm Petrel species	14
Thick-billed Murre	22
Wilson's Storm Petrel	1
TOTAL	**4310**

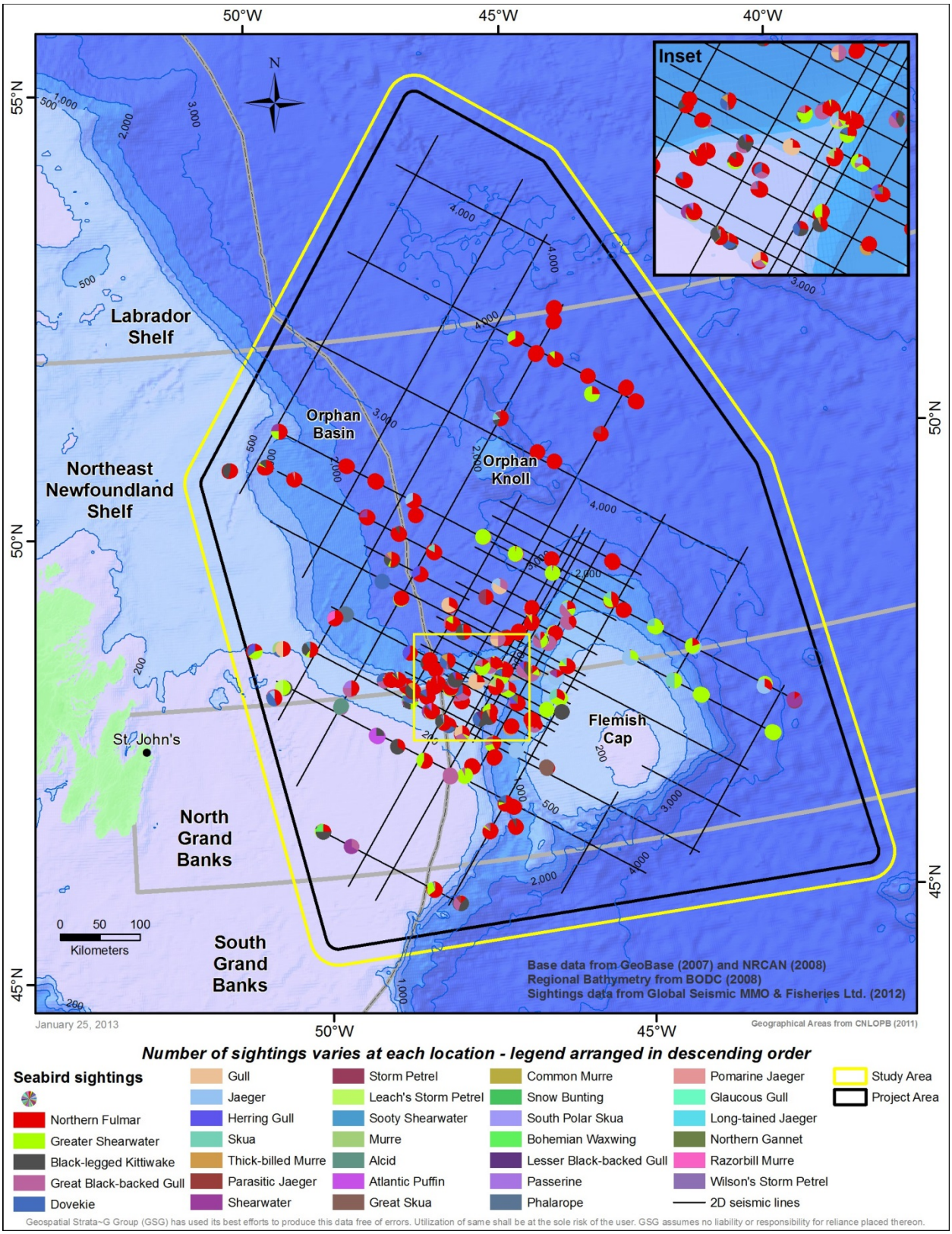

Figure 5. Bird Sightings Recorded During the Survey

5 FISHING ACTIVITY

The Fisheries Liaison Officer (FLO) onboard the seismic research vessel reported that there was only a single occurrence of contact with a harvesting fishing vessel.

Fishing vessels in transit, contacted by FLO (no issues reported)

September-nil
October-nil

Fishing vessels harvesting, contacted by FLO (no issues reported)

September-Nil
October 7th (We encountered a few fishing vessels on the 7th of Oct., but they were approximately 20 miles away according to the radar.)
October 12th (One fishing vessel was encountered on the 12th of October but was well away from the Sanco Spirit's operations. Contact was made by the FLO)
November – Nil

During September, to help with monitoring the fishing activities and avoiding potential conflicts, the vessel was receiving maps from Canadian Department of Fisheries and Oceans (DFO) showing fishing vessels' distribution. The maps were delivered daily except for the weekends. However at the end of September the DFO changed their operating procedures and the KLM files were no longer available to the vessel on a daily basis.

Weekly meetings were held between MKI and the fishery representatives (FFAW). Additional contacts with local fishers groups were made by the shore-based Vessel Supervisor. Updates of the operations were submitted to Canning and Pitt Ltd who were the Single Point of Contact (SPOC) for the vessel and liaison with the fishing communities. The vessel information was distributed at noon and midnight every day and included: vessel's position, heading, and estimated position at the end of each 12 hour period.

Independently to the above communications, daily and weekly reports from the onboard FLO were submitted to PGS, TGS, and FFAW.

17.38 hours of stand-by were attributed to fishing activities as a result of extended line changes to avoid specific areas where the DFO end of season crab survey was being performed.

6 ENVIRONMENTAL EFFECTS OF THE SURVEY

The potential effects of the MKI seismic survey were assessed in the EA report submitted as part of the 2012 Geophysical Operations Authorization. The report concluded that the vessel's presence, noise emissions, and potential accidental events associated with the proposed seismic survey were not predicted to result in any significant adverse environmental effects on fish and shellfish, marine and migratory birds, marine mammals, sea turtles, species-at-risk, sensitive areas, or fisheries in the Northeast Newfoundland Slope area following mitigations as outlined in Table 7.

Table 7. Mitigative Measures and Follow up

VEC	Mitigation Measures	Follow Up
Species at Risk	Before start of the operations, a meeting will be held with MKI representatives to review sail lines, scheduling, anticipated fishing vessels and gear types, mitigating measures, expectations of all parties and Emergency Response Plans. Trained Observers will be onboard the seismic and supply vessel throughout the duration of the survey will record sightings of marine mammals, seabirds and sea turtles on a daily basis. The Fisheries Liaison Officer will be onboard the seismic vessel Adherence to the Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment, to the extent reasonably practical. A 20 to 40 minute ramp-up procedure will be undertaken. Ramping up will be delayed if a marine mammal at risk or sea turtle is observed in the 500 m safety zone. Airguns will be shut down or reduced to a smaller airgun while the vessel is doing turns between survey lines. The MMO will ensure the delay or shut down of seismic operations if endangered or threatened whales are present within 500 m. Any re-start of the airgun array will follow the ramping up procedure vessels will maintain a steady course and speed, and use existing travel routes, where possible. Compliance with CCR WMP, Canada Shipping Act and MARPOL for all discharges. Turtle/debris guard attached to tailbuoy	A trained observer will record marine mammal, sea turtles and seabird observations. Records of sea turtle sightings will be reported to the Atlantic Leatherback Turtle Working Group. Sightings data for seabirds, marine mammals and sea turtles will be summarised in a monitoring report which will be made available to CNLOPB for their distribution to DFO and CWS. All spills will be reported.
Sensitive Areas	Operations will not take place within the EBSA until after July.	
Ocean Resource Users	A Notice to Mariners on the location and scheduling of seismic activities will be issued. Communication mechanisms will be developed with the fishing industry and DFO research surveys. Fisheries observers on the seismic vessel will monitor fishing activity and serve as a liaison between the fishing and seismic vessels; A Notice to Shipping and notification on the CBC Fisheries Broadcast on the location and scheduling of seismic activities will be issued. MKI will comply with C-NLOPB's compensation guidelines.	The FLO report will document daily vessel activities and fisher interactions and submitted to the CNLOPB upon completion of the program

As a result of these mitigations, there were no known significant effects imposed on any Valued Ecosystem Components (VEC), no claims for compensation made for fishing gear damage or

loss, and no spills.In addition, the marine mammal and seabird observations and the fisheries liaison officer communications with commercial vessels included in this report indicate that the survey was compliant with the mitigative actions outlined above and the Canadian Statement of Practice.

We therefore believe that as a result of the 2012 Northeastern Newfoundland Slope survey ecological processes were not disturbed outside natural variability, and ecosystem structure and function will not be critically affected. All effects were reversible, of limited duration, magnitude, and geographical extent.

7 REFERENCES

DFO. 2007. Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment.

Heinmann, D. 1981. A range finder for pelagic birds censusing. Journal of Wildlife Management 45 (2): 489-493.

Noseworthy, A. and Force, M. 2012. Marine mammal observations during a 2-D seismic survey of the northeastern Newfoundland slope (Phase 1). Report by Global Seismic MMO and Fisheries Liaison Ltd. 20p.

RPS Energy. 2012. Update report. Environmental impact assessment for marine 2D seismic reflection survey Labrador Sea and Davis Strait. Multi Klient Invest AS. Report prepared for C-NLOPB by YOLO Environmental Inc. and RPS Energy, March 2012.

TGS/PGS/MKI 2012. Final Report NE Newfoundland Slope 2012. 32p.

Appendix D: Sound

Sound is a periodic wave-like fluctuation of air pressure. The amount by which the pressure changes is known as the sound pressure, and the rate at which the fluctuations occur is the frequency. High frequency sound is characterized by screeches and whistles, low frequency sound by rumbles or booms.

The sound pressure level is a measure of the sound pressure differences using the logarithmic decibel (dB) scale. A ten-fold increase of sound pressure on a linear scale corresponds to a rise of sound pressure level of 20 on the decibel scale. Thus taking the pressure of a just-audible sound and assigning this a value of 0dB, a sound of ten times the pressure of the just-audible sound has a level of 20dB[1].

Table 1 shows the intensity of sounds (naturally occurring and anthropogenic) in the ocean. The proposed project will adhere to the 'Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment[2], which states that the surveying activities will stop if a whale, seal, walrus or polar bear comes within the 500 metres marine mammal safety zone.

[1] Definition of sound was obtained from the Dictionary of Environmental Science and Technology. [1] Porteous, A. (2008). Sound. *Dictionary of Environmental Science and Technology. 4th Edition*. John Wiley & Sons Ltd. West Sussex, England.

[2] DFO. (2007). Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment. 5p.

Table 1: Naturally Occurring and Anthropogenic Sounds in the Ocean (IAGC[3])

Naturally occurring sounds

Individual, identifiable sound sources	Source level dB re1µPa-m (rms)	Frequency band of major amplitude	Normal Duration	Directionality
Undersea Earthquake[4]	269	0.1-20Hz	10s of seconds to minutes	Omnidirectional
Volcanic eruptions[5]	252	Broadband	Seconds to hours	Omnidirectional
Sperm Whale Clicks[6]	236	5-40kHz	10s of µs	Focused
Killer Whale[7]	206	12-80kHz	80-120µs	Focused
Mysticete moans[8]	190	10-25Hz	10s of seconds	Omnidirectional
Individual snaps of Snapping Shrimp[8]	171	Broadband inc. up to 200kHz	ms	Omnidirectional

Anthropogenic sound

Individual, identifiable sound sources	Source level dB re1µPa-m (rms)	Frequency band of major amplitude	Normal Duration	Directionality
10lb of TNT[9]	267	Very broadband	ms	Omnidirectional
7900 in^3 Airgun array[10]	247, 235	5-500Hz	30 ms	Vertically focused
Single 30 in^3 airgun[11]	221	Variable 1.5-36kHz	60ms	Omnidirectional
Echosounders[12]	223	10-600Hz	A few ms	Strongly vertically focused
Supertanker[10]	187	6.8Hz	Weeks	Omnidirectional in vertical plane
Pile driving[10]	153	30-40Hz and 100 Hz	Days	Omnidirectional

[3] IAGC. Seismic surveys and marine mammals.

[4] Wenz,G.M. 1962. Acoustic ambient noise in the oceans; Spectra and sources. Journal of the Acoustical Society of America 34:1936-1956.7

[5] Based on information presented on the SURTASS website: http://www.surtass-lfa-eis.com

[6] Mohl, B et al. 2003. The monopulsed nature of sperm whale clicks. J. Acoust.Soc.Am 114, 1143-1154.

[7] Au et al. 2004. Echolocation signals of free-ranging killer whales and modeling of foraging for Chinook salmon. Journal of the Acoustical Society of America 115:901-909.

[8] National Research Council (NRC). (2003). Ocean Noise and Marine Mammals. National Academies Press, Washington, D.C.

[9] Urick, R.J. 1975 . Principles of underwater sound. McGraw-Hill, New York

[10] Richardson WJ, Greene CR Jr, Malme CI and Thomson DH 1995. Marine Mammals and Noise. 7900 Cubicinch

[11] Bolt Associates Inc. Technical Literature: Single 30 Cubic Inch Air Gun

[12] Clay CS, Medwin H. 1977. Acoustical oceanography: principles and applications. John Wiley & Sons

Appendix E

Underwater Sound Propagation from a 4718 in^3 Airgun Array

Baffin Bay/Davis Strait 2-D Seismic Survey Program

Submitted to:
Troy Nelson
Arcis Seismic Solutions
Calgary, AB

Author:
Marie-Noël R Matthews

26 August 2013

P001204-002
Document 00637
Version 1.0 DRAFT

Document Version Control

Version	Date	Name	Change
1.0	2013 Jul 19	M.-N. R Matthews	Draft released to client for review.

Suggested citation:

Matthews, M.-N. R. 2013. *Underwater Sound Propagation from a 4718 in^3 Airgun Array: Baffin Bay/Davis Strait 2-D Seismic Survey Program*. JASCO Document 00637, Version 1.0 DRAFT. Technical report by JASCO Applied Sciences for Arcis Seismic Solutions.

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1. Introduction

1.1. Project Overview

JASCO Applied Sciences Ltd. (JASCO) conducted an acoustic modelling study for Arcis Seismic Solutions (Arcis), a TGS company, to characterize acoustic propagation from an airgun array operating along proposed (Year 1) survey lines within the Canadian waters of Baffin Bay and Davis Strait (Figure 1).

The modelled airgun array consists of four strings of 12 airguns with a total volume of 4718 in^3. The underwater acoustic signature of the array was predicted using JASCO's specialized computer model that accounts for individual airgun volumes and the array geometry. Sound levels at distances from the source were predicted using an underwater acoustic propagation model and the modelled source levels. These predictions were made for one water temperature profile representative of the operational months (June to October), at eight locations within the survey area and along a 200 km (108 nm) survey line. These predictions account for source directivity and the range-dependent environmental properties in the area.

This report presents the modelled results as single-shot (i.e., per-pulse) sound fields and cumulative sound field for 24 h of seismic operations. Section 2 discusses the methodology for predicting the source levels and modelling sound propagation. Section 3 describes the specifications of the source, the source locations, and the environmental parameters required by the propagation model. Section 4.1 presents the modelled source levels and Section 4.2 presents the modelled sound fields in two formats: tables of maximum and 95% distances to sound level thresholds and sound field contour maps showing the directivity and range to various sound level thresholds. Distances from the airgun array to sound level thresholds are provided for:

- Peak sound pressure levels (SPLs) of 230-212 dB re 1 µPa;
- Root-mean-square (rms) SPLs of 200 through at least 150 dB re 1 µPa, in 10 dB increments;
- Unweighted and marine mammal-weighted sound exposure levels (SELs) of 200 through at least 150 dB re 1 µPa^2·s, in 10 dB increments; and
- Figures of cumulative SELs of 200 through at least 180 dB re 1 µPa^2·s, in 10 dB increments, and 198, 186, 183, and 171 dB re 1 µPa^2·s for each marine mammal functional hearing group.

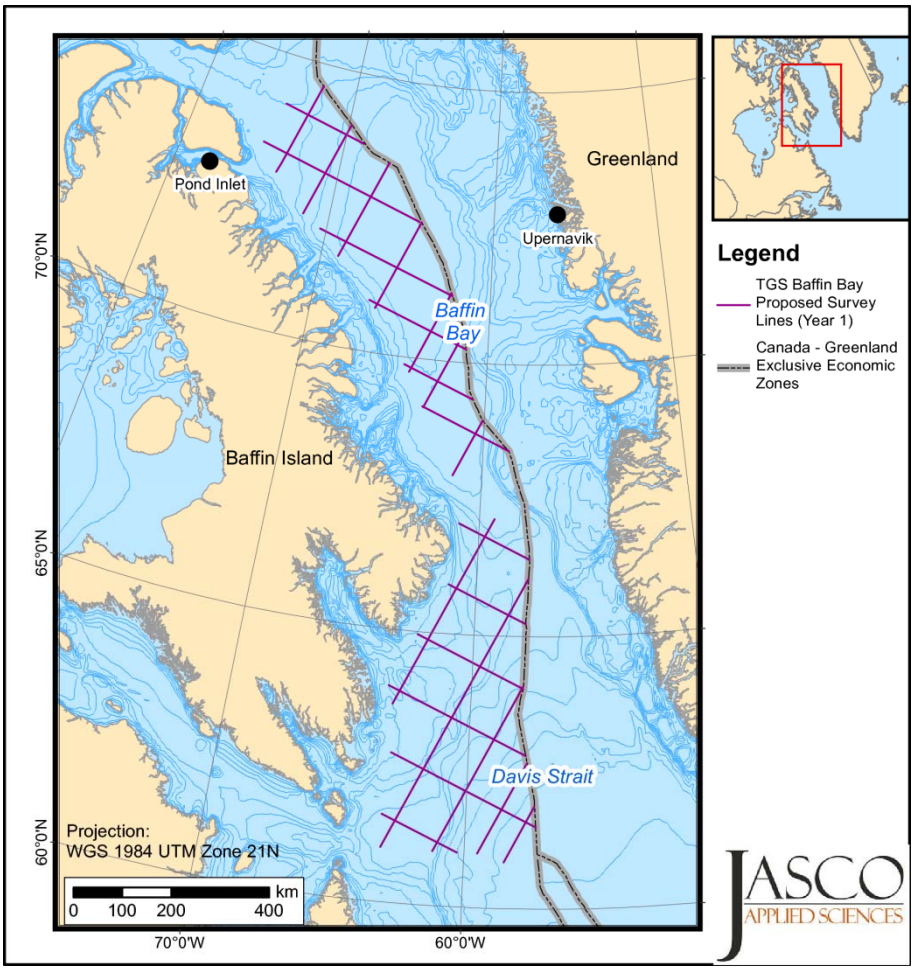


Figure 1. Overview of seismic survey area. Blue contours indicate water depth.

1.2. Acoustic Metrics

Underwater sound amplitude is measured in decibels (dB) relative to a fixed reference pressure of p_o = 1 µPa. Because the loudness of impulsive noise, from seismic airguns for example, is not generally proportional to the instantaneous acoustic pressure, several sound level metrics are commonly used to evaluate the loudness of impulsive noise and its effects on marine life.

The zero-to-peak sound pressure level (SPL), or peak SPL (L_{pk}, dB re 1 µPa), is the maximum instantaneous sound pressure level in a stated frequency band attained by an acoustic event, $p(t)$:

$$L_{pk} = 10\log_{10}\left(\frac{\max\left(\left|p^2(t)\right|\right)}{p_o^2}\right) \quad (1)$$

The peak SPL metric is commonly quoted for impulsive sounds, but it does not account for the duration or bandwidth of the noise. At high intensities, the peak SPL can be a valid criterion for assessing whether a sound is potentially injurious; however, because the peak SPL does not consider the event duration, it is not a good indicator of perceived loudness.

The root-mean-square (rms) SPL (dB re 1 µPa, symbolized L_p) is the rms pressure level in a stated frequency band over a time window (T, s) containing the acoustic event:

$$L_p = 10 \log_{10} \left(\frac{1}{T} \int_T p^2(t) dt \Big/ p_o^2 \right) \quad (2)$$

The rms SPL can be thought of as a measure of the average pressure or as the effective pressure over the duration of an acoustic event, such as the emission of one acoustic pulse or sweep. Because the window length, T, is a divisor, acoustic events more spread out in time have a lower rms SPL for the same total acoustic energy.

The sound exposure level (SEL, dB re 1 µPa^2·s, symbolized L_E) is a measure of the total acoustic energy contained in one or more acoustic events. The SEL for a single event is computed from the time-integral of the squared pressure over the full event duration (T_{100}):

$$L_E = 10 \log_{10} \left(\int_{T_{100}} p^2(t) dt \Big/ T_o p_o^2 \right) \quad (3)$$

where T_o is a reference time interval of 1 s. The SEL represents the total acoustic energy delivered over the duration of an acoustic event at a receiver location. It measures the sound energy to which an organism at that location would be exposed.

Because the rms SPL and SEL are both computed from the integral of square pressure, these metrics are related by a simple expression, which depends only on the duration of the energy time window T:

$$\begin{aligned} L_p &= L_E - 10 \log_{10}(T) \\ L_{p90} &= L_E - 10 \log_{10}(T_{90}) - 0.458 \end{aligned} \quad (4)$$

The second of the formula above (for L_{p90}) applies to a commonly used rms SPL metric for impulsive events that considers only the interval between 5% and 95% of the pulse energy; the 0.458 dB reduction accounts for the rms SPL containing 90% of the total energy from the SEL for an individual acoustic event.

SEL can be a cumulative metric if calculated over periods of time that contain multiple events. The cumulative SEL (L_{EC}) can be computed by summing (in linear units) the SELs of the N individual acoustic events (L_{Ei}).

$$L_{EC} = 10 \log_{10} \left(\sum_{i=1}^{N} 10^{\frac{L_{Ei}}{10}} \right) \quad (5)$$

1.3. Marine Mammal Frequency Weighting

The potential for anthropogenic noise to affect marine animals depends on how well the animal can hear the noise (Southall et al. 2007). Noises are less likely to disturb or injure animals if they are at frequencies that the animal cannot hear well except when the sound pressure is high

enough that it can cause physical injury. For sound levels that are too low to cause physical injury, frequency weighting based on audiograms may be applied to weight the importance of sound levels at particular frequencies in a manner reflective of an animal's sensitivity to those frequencies (Nedwell and Turnpenny 1998, Nedwell et al. 2007).

Based on a literature review of marine mammal hearing and on physiological and behavioural responses to anthropogenic sound, Southall et al. (2007) proposed standard frequency weighting functions—referred to as M-weighting functions—for five functional hearing groups of marine mammals:

- Low-frequency cetaceans (LFCs)—mysticetes (baleen whales)
- Mid-frequency cetaceans (MFCs)—some odontocetes (toothed whales)
- High-frequency cetaceans (HFCs)—odontocetes specialized for using high frequencies
- Pinnipeds in water (Pw)—seals, sea lions, and walrus
- Pinnipeds in air (not addressed here)

The discount applied by the M-weighting functions for less-audible frequencies is less than that indicated by the corresponding audiograms (where available) for member species of these hearing groups. The rationale for applying a smaller discount than suggested by audiograms is due in part to an observed characteristic of mammalian hearing that perceived equal loudness curves increasingly have less rapid roll-off outside the most sensitive hearing frequency range as sound levels increase. This is why, for example, C-weighting curves for humans, used for assessing loud sounds such as blasts, are flatter than A-weighting curves, used for quiet to mid-level sounds. Additionally, out-of-band frequencies, though less audible, can still cause physical injury if pressure levels are sufficiently high. The M-weighting functions therefore are primarily intended to be applied at high sound levels where impacts such as temporary threshold shift (TTS) or permanent threshold shift (PTS) in hearing may occur. The use of M-weighting is considered precautionary (in the sense of overestimating the potential for impact) when applied to lower level impacts such as onset of behavioural response. Figure 2 shows the decibel frequency weighting of the M-weighting functions for the four underwater functional marine mammal hearing groups, based on Southall et al. (2007).

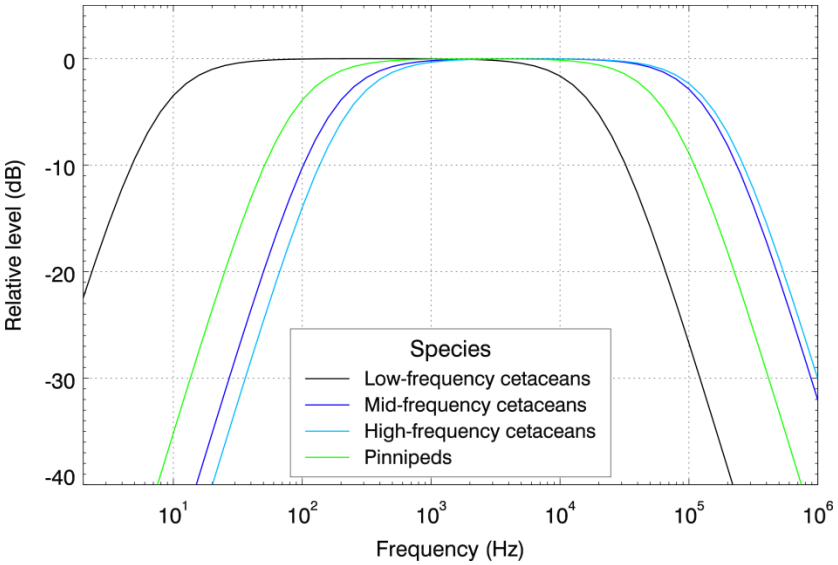


Figure 2. The standard M-weighting functions for the four underwater functional marine mammal hearing groups as defined by Southall et al. (2007).

The M-weighting functions have unity gain (0 dB) through the passband and their high and low frequency roll-offs are approximately –12 dB per octave. The amplitude response in the frequency domain of the M-weighting functions is defined by:

$$G(f) = -20\log_{10}\left[\left(1+\frac{f_{lo}^2}{f^2}\right)\left(1+\frac{f^2}{f_{hi}^2}\right)\right] \quad (6)$$

The roll-off and passband of these functions are controlled by the parameters f_{lo} and f_{hi}, the estimated upper and lower hearing limits specific to each functional hearing group (Table 1).

Table 1. The low (f_{lo}) and high (f_{hi}) frequency weighting parameters for the four underwater functional marine mammal hearing groups as defined by Southall et al. (2007).

Functional hearing group	f_{lo} (Hz)	f_{hi} (Hz)
Low-frequency cetaceans (LFC)	7	22 000
Mid-frequency cetaceans (MFC)	150	160 000
High-frequency cetaceans (HFC)	200	180 000
Pinnipeds in water (Pw)	75	75 000

1.4. Acoustic Impact Criteria

The acoustic thresholds used in this report were chosen based on the National Marine Fisheries Service (NMFS) rms SPL criteria and criteria presented by Southall et al. (2007). The NMFS criteria are based on the Marine Mammal Protection Act (MMPA 2007). For impulsive sound sources, broadband received rms SPLs of 160 dB re 1 µPa or greater are assumed to cause disruption of behavioural patterns (i.e., harassment) of marine mammals (MMPA 2007). For non-impulsive sources, the behavioural harassment levels are 120 dB re 1 µPa or greater. For all

non-explosive sources (impulsive and non-impulsive), concerns about temporary and/or permanent hearing impairment to cetaceans exist at broadband received rms SPLs of 180 dB re 1 µPa or greater and to pinnipeds at broadband received rms SPLs of 190 dB re 1 µPa or greater (MMPA 2007). Expressed in rms units, the criterion accounts for not only the energy of the acoustic event, but also the length of the event (see Equation 2). The disadvantage of the rms criterion is that it ignores important attributes of exposure such as exposure duration, sound frequency composition, and repetition rate. Also, these levels are calculated from the unweighted acoustic signals, so the criterion ignores the differences in animals' hearing sensitivity with frequency.

The Noise Criteria Group, sponsored by NMFS, was established in 2005 to address shortcomings of the 180–160 dB re 1 µPa (rms SPL) criteria. The goal of the Noise Criteria Group was to review literature on marine mammal hearing and on their behavioural and physiological responses to anthropogenic noise, as well as to propose new noise exposure criteria. In 2007, the findings were published by an assembly of experts (Southall et al. 2007). The publication introduced new threshold levels, which are now widely employed. They are commonly referred to as the *Southall criteria*.

The *Southall criteria* are dual-criteria because they are based on both zero-to-peak (peak) SPL of acoustic waves, expressed in dB re 1 µPa, and total (cumulative) SEL, expressed in dB re 1 µPa^2·s. A received sound exposure is assumed to cause injury if it exceeds either the peak SPL or SEL criterion, or both. These criteria are presented in Table 2. Lower levels were established for pinnipeds than for cetaceans. The peak SPL is not frequency weighted, whereas the SEL is M-weighted for the given marine mammal group as defined by Southall et al. (2007; Section 1.3). The SEL criterion does not account for the length of the acoustic event, only the total received energy produced by one or multiple events (see Equation 3).

Table 2. Southall criteria for injury and behavioural disturbance (Southall et al. 2007). The zero-to-peak sound pressure level (peak SPL) criterion is unweighted, whereas each sound exposure level (SEL) criterion is M-weighted for the given marine mammal functional hearing group.

Marine mammal hearing group	Injury: Impulsive sources		Injury: Non-impulsive sources		Behavioural disturbance: Impulsive sources	
	Peak SPL (dB re 1 µPa)	cSEL (dB re 1 µPa^2·s)	Peak SPL (dB re 1 µPa)	cSEL (dB re 1 µPa^2·s)	Peak SPL (dB re 1 µPa)	cSEL (dB re 1 µPa^2·s)
Low-frequency cetaceans (LFC)	230	198	230	215	224	183
Mid-frequency cetaceans (MFC)	230	198	230	215	224	183
High-frequency cetaceans (HFC)	230	198	230	215	224	183
Pinnipeds underwater (Pw)	218	186	218	203	212	171

2. Methods

2.1. Acoustic Source Model

The source levels and directivity of the proposed airgun array were predicted with JASCO's Airgun Array Source Model (AASM, MacGillivray 2006). This model is based on the physics of oscillation and radiation of airgun bubbles described by Ziolkowski (1970). The model solves the set of parallel differential equations governing bubble oscillations. AASM also accounts for nonlinear pressure interactions among airguns, port throttling, bubble damping, and generator-injector (GI) airgun behavior as discussed by Dragoset (1984), Laws et al. (1990), and Landro (1992). AASM includes four empirical parameters that are tuned so model output matches observed airgun behavior. The model parameters fit to a large library of empirical airgun data using a "simulated annealing" global optimization algorithm. These airgun data are measurements of the signatures of Bolt 600/B airguns ranging in volume from 5 to 185 in^3 (Racca and Scrimger 1986).

AASM produces a set of notional signatures for each array element based on the following:

- Array layout
- Volume, tow depth, and firing pressure of each airgun
- Interactions between airguns in the array

These notional signatures are the pressure waveforms of the individual airguns at a standard reference distance of 1 m, and they account for the interactions with the other airguns in the array. The signatures are summed with the appropriate phase delays to obtain the far-field[1] source signature of the entire array in all directions. This far-field array signature is filtered into 1/3-octave passbands to compute the source levels of the array as a function of frequency band and azimuthal angle in the horizontal plane (at the source depth). It can then be treated as a directional point source in the far field.

A seismic array consists of many sources and the point-source assumption is not valid in the near field where the array elements add incoherently. The maximum extent of the near field of an array (R_{nf}) is:

$$R_{nf} < \frac{l^2}{4\lambda} \tag{7}$$

where λ is the sound wavelength and l is the longest dimension of the array (Lurton 2002, §5.2.4). For example, for the airgun array described in Section 3.1, $l \approx 24$ m so the maximum near-field range is < 1 m at 10 Hz and ~ 195 m at 2000 Hz. Beyond these ranges the array is assumed to radiate like a directional point source and is treated as such for propagation modelling.

[1] The far field is the zone where, to an observer, sound originating from a spatially-distributed source appears to radiate from a single point. The distance to the acoustic far field increases with frequency.

The interactions between individual elements of the array create directionality in the overall acoustic emission. Generally, this directionality is prominent mainly at frequencies in the mid-range of several tens to several hundred hertz; at lower frequencies, with acoustic wavelengths much larger than the inter-airgun separation distances, directivity is small. At higher frequencies, the directional pattern is too fine to be resolved and the effective directivity is less.

The pressure signatures of the individual airguns and the composite 1/3-octave-band source levels of the array, as functions of azimuthal angle (in the horizontal plane), were computed with AASM as described above. While effects of source depth on bubble interactions are accounted for in the AASM source model, the surface-reflected signal (i.e., surface ghost) is not included in the far-field source signatures. The surface reflections, a property of the medium rather than the source, are accounted for by the acoustic propagation models.

2.2. Sound Propagation Models

Underwater sound propagation (i.e., transmission loss) at frequencies of 10 to 2000 Hz was predicted with JASCO's Marine Operations Noise Model (MONM) and Full Waveform Range-dependent Acoustic Model (FWRAM). Received per-pulse SELs in all directions were modelled with MONM, and peak and rms SPLs were modelled with FWRAM along a select few transects.

MONM computes acoustic propagation via a wide-angle parabolic equation solution to the acoustic wave equation (Collins 1993) based on a version of the U.S. Naval Research Laboratory's Range-dependent Acoustic Model (RAM), which has been modified to account for an elastic seabed (Zhang and Tindle 1995). The parabolic equation method has been extensively benchmarked and is widely employed in the underwater acoustics community (Collins et al. 1996). MONM accounts for the additional reflection loss at the seabed due to partial conversion of incident compressional waves to shear waves at the seabed and sub-bottom interfaces, and it includes wave attenuations in all layers. MONM incorporates the following site-specific environmental properties: a bathymetric grid of the modelled area, underwater sound speed as a function of depth, and a geoacoustic profile based on the overall stratified composition of the seafloor.

MONM computes acoustic fields in three dimensions by modelling transmission loss within two-dimensional (2-D) vertical planes aligned along radials covering a 360° swath from the source, an approach commonly referred to as *N*×2-D. These vertical radial planes are separated by an angular step size of $\Delta\theta$, yielding $N = 360°/\Delta\theta$ number of planes (Figure 3).

MONM treats frequency dependence by computing acoustic transmission loss at the centre frequencies of 1/3-octave bands. Sufficiently many 1/3-octave bands, starting at 10 Hz, are modelled to include the majority of acoustic energy emitted by the source. At each centre frequency, the transmission loss is modelled within each vertical plane (*N*×2-D) as a function of depth and range from the source. The 1/3-octave band received (per-pulse) SELs are computed by subtracting the band transmission loss values from the directional source level in that frequency band. Composite broadband received SELs are then computed by summing the received 1/3-octave-band levels.

The received SEL sound field within each vertical radial plane is sampled at various ranges from the source, generally with a fixed radial step size. At each sampling range along the surface, the sound field is sampled at various depths, with the step size between samples increasing with depth below the surface. The step sizes are chosen to provide increased coverage near the depth of the source and at depths of interest in terms of the sound speed profile. For deep water areas (> 2000 m), sampling may not be performed at depths beyond the diving capabilities of marine mammals in the area of interest. For this study, the entire water column was sampled. The received SEL at a sampling location is taken as the maximum value that occurs over all samples within the water column below, i.e., the maximum-over-depth received SEL (Figure 3). These maximum-over-depth SELs are presented as colour contours around the source (e.g., Figure 4).

MONM's predictions have been validated against experimental data from several sound source verification programs (Hannay and Racca 2005, Aerts et al. 2008, Funk et al. 2008, Ireland et al. 2009, O'Neill et al. 2010, Warner et al. 2010, Racca et al. 2012a, Racca et al. 2012b). An inherent variability in measured sound levels is caused by temporal variability in the environment and the variability in the signature of repeated acoustic impulses (sample sound source verification results are presented in Figure 5). While MONM's predictions correspond to the averaged received levels, cautionary estimates of the threshold radii are obtained by shifting the best-fit line (solid line, Figure 5) upward so the trend line encompasses 90% of all the data (dashed line, Figure 5).

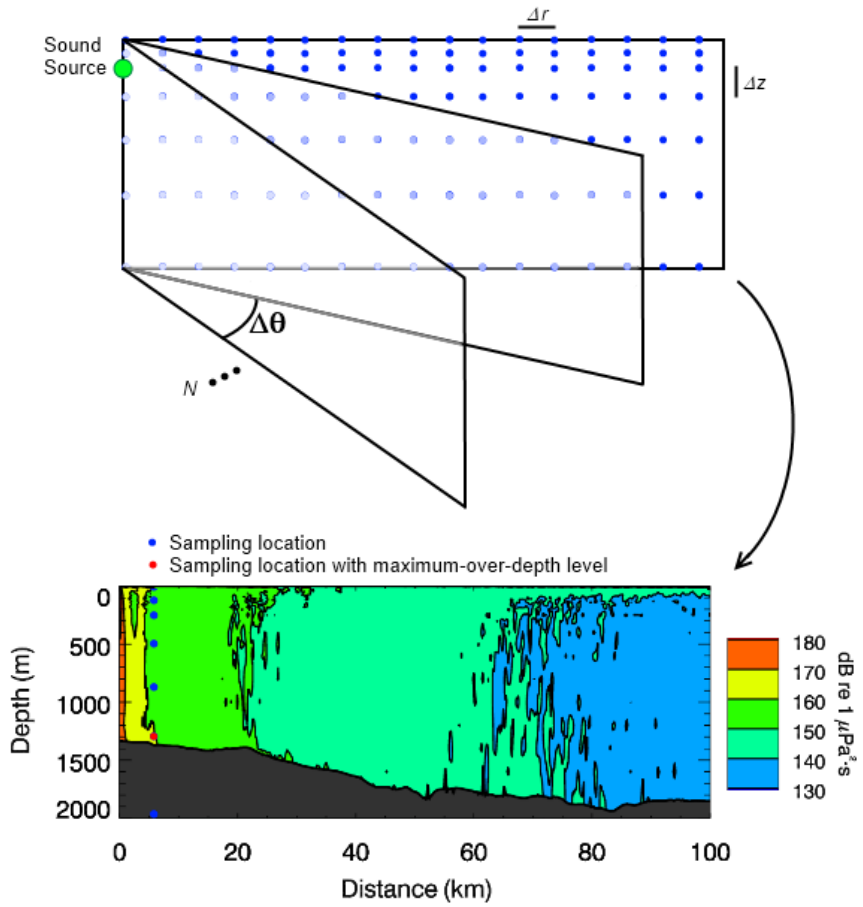


Figure 3. The *N*×2-D and maximum-over-depth modelling approach.

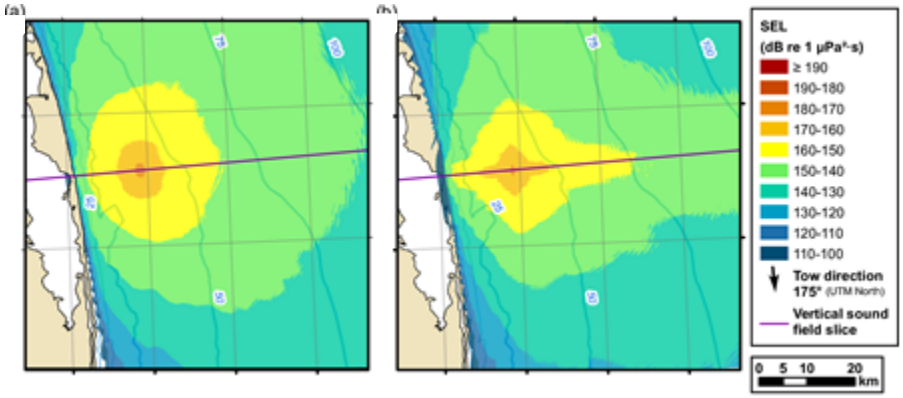


Figure 4. Maximum-over-depth sound exposure level (SEL) colour contour maps for two sources.

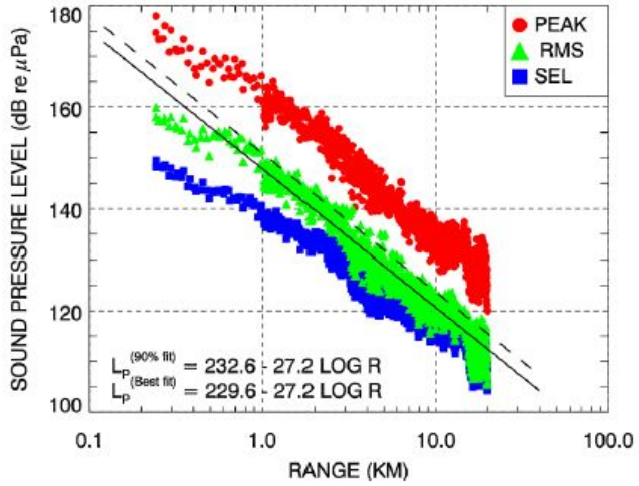


Figure 5. Peak and root-mean-square (rms) sound pressure level (SPL) and sound exposure level (SEL) versus range from a 20 in^3 airgun array. Solid line is the least squares best fit to rms SPL. Dashed line is the best-fit line increased by 3.0 dB to exceed 90% of all rms SPL values (90th percentile fit) (Fig. 10 in Ireland et al. 2009).

In the Beaufort and Chukchi Seas, sound source verification results show that this 90th percentile best-fit is, on average, 3 dB higher than the original best-fit line for sources in water depths greater than 20 m (Aerts et al. 2008, Funk et al. 2008, Ireland et al. 2009, O'Neill et al. 2010, Warner et al. 2010, Racca et al. 2012a, Racca et al. 2012b). Consequently, in this report a factor of 3 dB was added to the predicted received levels to provide cautionary results reflecting the inherent variability of sound levels in the modelled area.

FWRAM conducts time-domain calculations and is therefore appropriate for computing time-averaged rms SPL, as well as peak SPL values for impulsive sources. FWRAM computes synthetic pressure waveforms versus range and depth for range-varying marine acoustic environments using the parabolic equation approach to solving the acoustic wave equation. Like MONM, FWRAM accounts for range-varying properties of the acoustic environment. It uses the same algorithmic engine as MONM and uses the same environmental inputs (bathymetry, water sound speed profile, and seabed geoacoustic profile); however, FWRAM allows the computation of pressure time series (that is, a reconstructed signal waveform) at any range from the source.

2.3. Estimating rms SPL from Modelled SEL

An objective definition of acoustic-event duration is needed to compute rms SPL. Following suggestions by Malme et al. (1986), Greene (1997), and McCauley et al. (1998), the duration for an impulsive acoustic event is conventionally the interval during which 90% of the acoustic energy is received. Although the 90% rms SPL of an acoustic event is easily measured in situ (at least for signals well above background noise), this metric is generally difficult to model because the adaptive integration period, implicit in the definition of the 90% rms SPL, is sensitive to the specific multipath arrival pattern and can vary greatly with distance from the source or with receiver depth.

To predict the 90% rms SPL for an airgun array pulse (or airgun array shot), it is necessary to model the full waveform of the acoustic event; full-wave modelling, however, is computationally expensive and often prohibitively time consuming. Considering those challenges, MONM, as detailed in Section 2.2, was used for a more efficient computation of the SEL field. The synthetic pressure waveforms were modelled with FWRAM along a few azimuths. Both rms SPL and SEL were computed from the synthetic pressure waveforms along these azimuths and the offset between them was calculated. This range-, depth-, and azimuth-dependent offset was linearly interpolated (in dB scale) between azimuths. This offset between SEL and rms SPL predicted by FWRAM was applied to the SEL values predicted by MONM to yield rms SPL for the entire modelled sound field. This approach combines the accuracy of the pulse length estimates provided by FWRAM with the greater computational efficiency of MONM.

2.4. Estimating Peak SPL

Zero-to-peak and peak-to-peak SPLs were calculated from the synthetic pressure waveforms modelled with FWRAM (see Section 2.2) along the four transects from each of the eight modelled sites. The SPLs were linearly interpolated (in dB scale) between azimuths to produce estimates of 3-D sound fields.

2.5. Estimating Cumulative SEL

During a seismic survey, concentrated acoustic energy is introduced into the environment with each firing of a seismic source. The Southall Criteria account for the total acoustic energy a marine mammal is subjected to. An assessment of the cumulative acoustic field at a given location must consider not only the parameters of each pulse, but also the number of pulses delivered in a given time period and the relative source position. Quite a different issue, which is not considered here but bears mentioning as a qualifier to any estimates, is that individuals of most species do not remain stationary throughout the exposure period and therefore their dose accumulation depends on their movement.

The industry standard tow speed of a seismic array is around 2–5 knots, with a repetition interval of 10-25 s. The number of pulses to be modelled for 24 h of seismic operation is thus in the thousands. Because individually modelling the acoustic fields from this many seismic events would be prohibitively time consuming, and given that the offset between the consecutive airgun pulses is small, the process can be simplified by estimating the acoustic fields for all pulses from a small number of modelled per-pulse sound fields at representative source locations.

In this study, the sound fields at each pulse location along the modelled seismic line were estimated by geometrically shifting and aligning single-pulse sound fields from four locations along the seismic line. The most appropriate SEL field for each pulse was selected based on the closest match in water depth between the desired location and one of the modelled single-

pulse fields. The acoustic energy for the individual shifted sound fields was then summed to estimate the cumulative SEL (cSEL) field from all the acoustic events during the given period.

Because full modelling of sound fields at the sample sites covered only a limited area due to computational time demands, the summing of geometrically-shifted fields left sectors of only partial overlap at far ranges. To avoid inaccurate estimation of cumulative values in those regions, the per-pulse SEL sound fields were extrapolated in range, so their coverage would encompass the full area of the cumulative field. Sound levels were extrapolated beyond the edges of the modelled regions by assuming cylindrical spreading transmission loss, $TL = 10 \cdot \mathrm{Log}(R)$, which is consistent with the rate of decay predicted by the modelling.

The cSEL field estimated through this approach is not as accurate as would be obtained by fully modelling sound propagation at every pulse location. Small-scale site-specific sound propagation features, however, tend to be blurred and become less relevant when sound fields from adjacent pulses are added. Larger scale sound propagation conditions, primarily dependent on water depth, therefore dominate the cumulative field. The present method is acceptably accurate in reflecting those large-scale features, thus providing a meaningful estimate of a wide area cSEL field in a computationally feasible framework.

3. Model Parameters

3.1. Acoustic Source Parameters

Acoustic source levels were modelled for an airgun array consisting of four strings with an 8 m separation. The airguns are fired simultaneously at 2000 psi air pressure. The airgun array was modelled at a 9 m tow depth. The modelled configuration consists of 39 active and 9 inactive airguns, with a total volume of 4718 in^3. Figure 6 presents the airgun distribution in the horizontal (*x*-*y*) plane. Table 3 presents the array specifications.

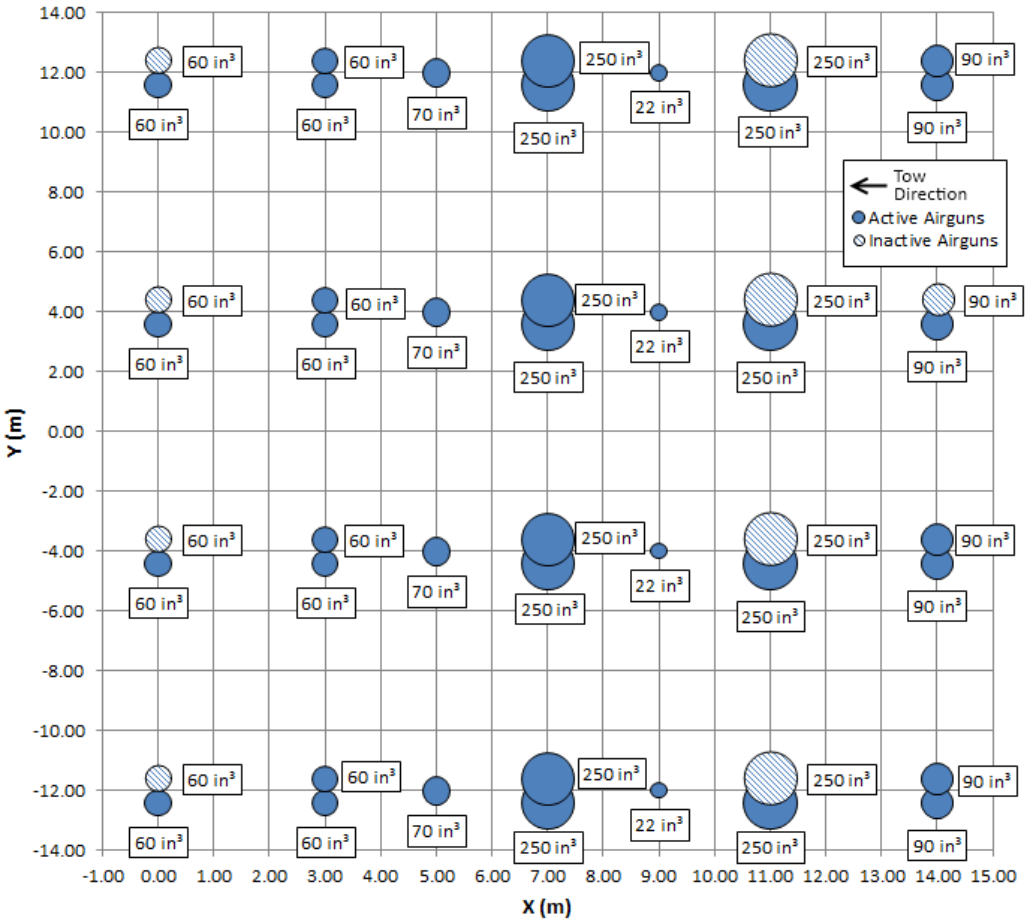


Figure 6. Layout of modelled airgun array (4718 in^3 total firing volume, 9 m tow depth), composed of 39 active and 9 inactive airguns. Relative symbol sizes and labels indicate airgun firing volume.

Table 3. Specifications of the modelled airgun array configuration (4718 in^3 total firing volume, 9 m tow depth). The airguns are fired simultaneously at 2000 psi air pressure.

Gun	*x* (m)	y (m)	Vol (in^3)	Gun	*x* (m)	y (m)	Vol (in^3)	Gun	*x* (m)	y (m)	Vol (in^3)	Gun	*x* (m)	y (m)	Vol (in^3)
1	0	11.6	60	13	0	3.6	60	25	0	-4.4	60	37	0	-12.4	60
2	0	12.4	-	14	0	4.4	-	26	0	-3.6	-	38	0	-11.6	-
3	3	11.6	60	15	3	3.6	60	27	3	-4.4	60	39	3	-12.4	60
4	3	12.4	60	16	3	4.4	60	28	3	-3.6	60	40	3	-11.6	60
5	5	12	70	17	5	4	70	29	5	-4	70	41	5	-12	70
6	7	11.6	250	18	7	3.6	250	30	7	-4.4	250	42	7	-12.4	250
7	7	12.4	250	19	7	4.4	250	31	7	-3.6	250	43	7	-11.6	250
8	9	12	22	20	9	4	22	32	9	-4	22	44	9	-12	22
9	11	11.6	250	21	11	3.6	250	33	11	-4.4	250	45	11	-12.4	250
10	11	12.4	-	22	11	4.4	-	34	11	-3.6	-	46	11	-11.6	-
11	14	11.6	90	23	14	3.6	90	35	14	-4.4	90	47	14	-12.4	90
12	14	12.4	90	24	14	4.4	-	36	14	-3.6	90	48	14	-11.6	90

3.2. Modelled Scenarios

The eight modelled sites (Sites 1–8) characterize the acoustic propagation throughout the survey area, based on the water depth and their position within the survey area (Figure 7). Peak SPL, rms SPL, and per-pulse SEL sound fields were modelled at each site, accounting for the array tow direction and the range-dependent environmental properties in the modelled area. Per-pulse SEL sound fields were modelled at four different sites (Sites A–D) to estimate the cumulative SEL sound field along a 200 km (108 nm) seismic line, representing 24 h of seismic operation (Figure 7). Table 4 presents the coordinates, array tow directions, and water depths of the modelled sites.

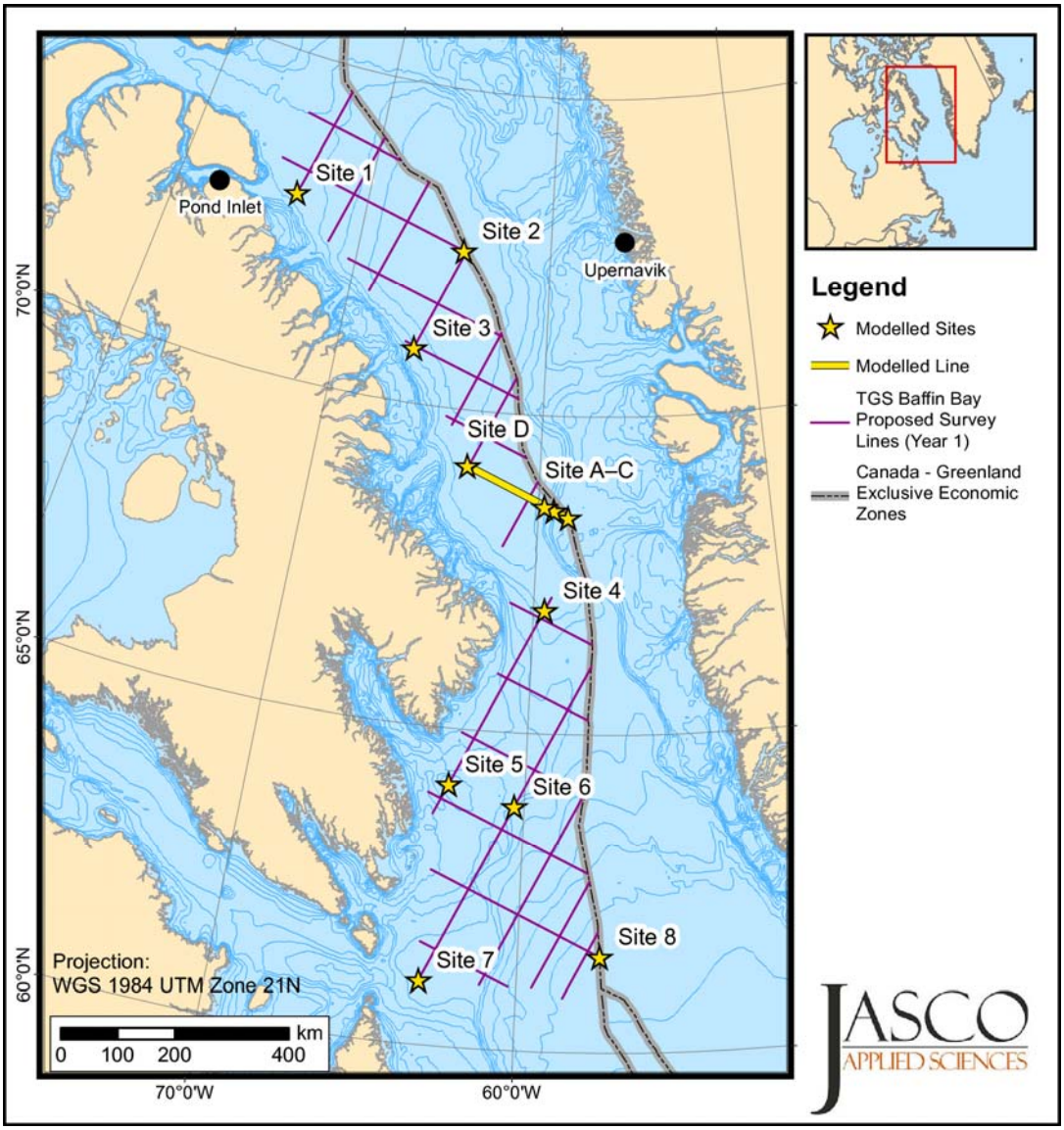


Figure 7. Overview of modelled sites and modelled seismic line. Sites 1–8 were used to model per-pulse sound fields and Sites A–D were used to estimate cumulative sound exposure levels (cSELs) along the modelled line. Blue contours indicate water depth in metres.

Table 4. Locations, array tow directions, and water depths of the modelled sites. The tow direction is from UTM North. Site A is located at the start of the modelled seismic line, and Site D at the end.

Site	Latitude	Longitude	Easting (m)	Northing (m)	UTM Zone	Depth (m)	Tow direction
Modelled sites for estimates of per-pulse sound fields							
1	72°51'26"N	74°12'49"W	539928.7	8084968.9	18	799	013°
2	72°29'09"N	65°26'58"W	447919.2	8043800.7	20	2275	290°
3	70°51'34"N	67°39'09"W	597040.7	7863841.3	19	1497	020°
4	66°56'07"N	60°26'58"W	388513.3	7426440.7	21	993	023°
5	64°07'12"N	63°15'08"W	512284.2	7110415.2	20	127	023°
6	63°50'12"N	61°39'14"W	335442.3	7083120.1	21	489	023°
7	61°00'00"N	64°49'47"W	490784.2	6762804.6	20	599	023°
8	61°29'57"N	58°43'07"W	485015.7	6818414.6	21	2674	297°
Modelled sites for estimates of cumulative sound fields							
A (start)	68°24'57"N	58°42'49"W	430338.3	7590175.8	21	254	295°
B	68°31'03"N	59°20'13"W	404513.7	7602387.2	21	500	295°
C	68°34'48"N	59°44'45"W	388798.8	7610004.7	21	1002	295°
D (end)	69°08'09"N	63°13'11"W	253141.4	7682031.5	21	1852	295°

3.3. Environmental Parameters

3.3.1. Bathymetry

Water depths throughout the modelled area were extracted from the SRTM30+ (v6.0), a global topography and bathymetry grid with a resolution of 30 arc-seconds (~ 300 × 900 m at the studied latitude; Rodriguez et al. 2005). The bathymetry for a 400 × 400 km area centred on each modelled site was re-gridded, by minimum curvature gridding, onto a Universal Transverse Mercator (UTM) projection (see Table 4) with a horizontal resolution of 100 × 100 m.

3.3.2. Sound Speed Profile

Ocean sound speed profiles were derived from location-specific temperature and salinity profiles from the U.S. Naval Oceanographic Office's Generalized Digital Environmental Model (GDEM) database (Teague et al. 1990, NAVO 2003, Carnes 2009). The latest release of the GDEM database (version 3.0) provides average monthly profiles of temperature and salinity for the world's oceans on a latitude/longitude grid with 0.25° resolution. Profiles in GDEM are provided at 78 fixed depth points, to a maximum depth of 6800 m and are based on historical observations from the U.S. Navy's Master Oceanographic Observational Data Set (MOODS).

The GDEM temperature-salinity profiles were converted to sound speed profiles according to the equations of Coppens (1981):

$$\begin{aligned} c(z,T,S,\phi) &= 1449.05+45.7t-5.21t^2-0.23t^3 \\ &\quad +(1.333-0.126t+0.009t^2)(S-35)+\Delta \\ \Delta &= 16.3Z+0.18Z^2 \\ Z &= (z/1000)(1-0.0026\cos(2\phi)) \\ t &= T/10 \end{aligned} \tag{8}$$

where z is water depth (m), T is water temperature (°C), S is salinity (psu), and φ is latitude (radians).

During the operational period (from June to October), the profiles structures are similar for all sites, with little monthly variations below a depth of 100 m. They present high sound speed at the surface, a minimum at about 50 m below the sea surface, and a gradual increase with depth. A sharp sound channel, promoting long-range sound propagation, is present during most operational months. It is most pronounced in August, when the minimum sound speed is found between depths of 50 and 100 m. Thus, the sound speed profile for August is estimated to be the most conducive to sound propagation, and it was used in this study to provide cautionary distances to sound level thresholds. The estimated sound speed geographic variations for August and an example of monthly variations at one site for June to October are shown in Figure 8.

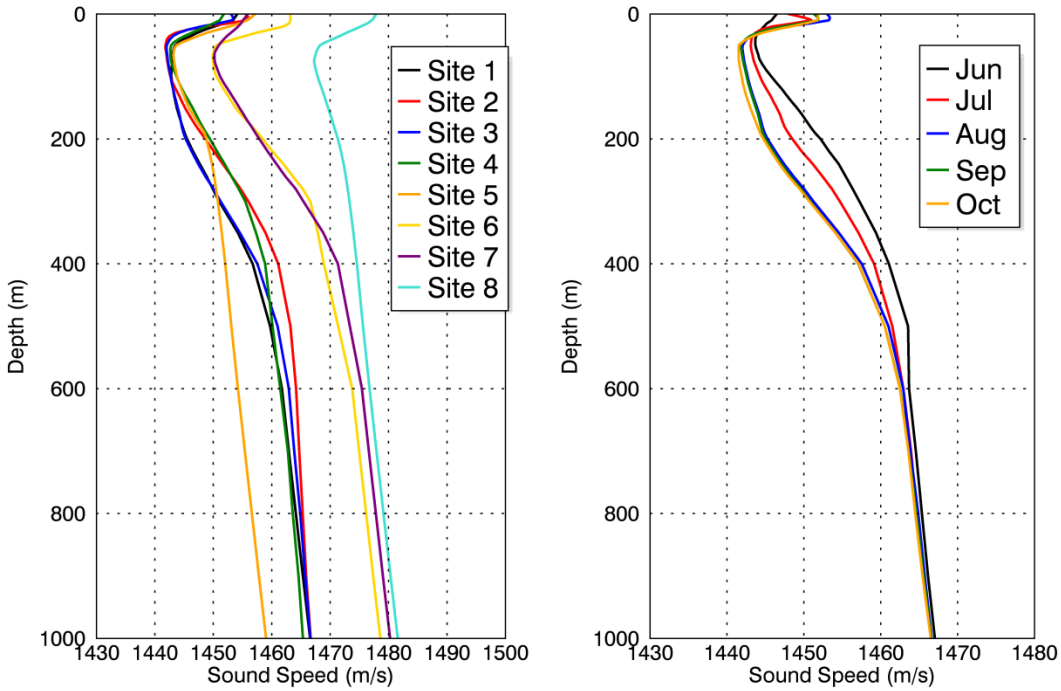


Figure 8. Estimated sound speed profiles, derived from GDEM data: (a) geographic variations in August (Sites 1–8) and (b) monthly variations (Site 3).

3.3.3. Geoacoustics

The elastoacoustic properties of seabed sediments within the survey area were estimated from publically available information on the geological properties in Baffin Bay and Davis Strait, in conjunction with empirical formulas.

The geoacoustic profile, required by the sound propagation model, is formed of these six descriptive parameters:

- Sediment layer thickness (m)
- Relative density: Bottom material density relative to water density
- Compressional-wave sound speed (m/s): Phase speed of longitudinal body waves (P-waves) in bottom materials
- Compressional-wave attenuation (dB per wavelength): Rate of attenuation of longitudinal body waves in bottom materials
- Shear-wave sound speed (m/s): Phase speed of transverse body waves (S-waves) in bottom materials
- Shear-wave attenuation (dB per wavelength): Rate of attenuation of transverse body waves in bottom materials

Geoacoustic properties may be measured (e.g., sediment core samples and sub-bottom profiler data) or estimated based on sediment type and empirical formulas (Hamilton 1980, Buckingham 2005).

Funck et al. (2007) describe the sediment layer thickness and compressional-wave sound speed of the main geological layers in Davis Strait between Nuuk, Greenland, and Resolution Island, Canada. They identified a thick stratified layer (500-2000 m) of post-cretaceous sediment in western Davis Strait and northern Labrador Sea. Praeg et al. (2007) studied in more detail the surficial sediments layer found on the continental shelf off northeastern Baffin Island. Specific information on the sediment density, compressional-wave attenuation, shear-wave sound speed, and shear-wave attenuation were not available at the time of modelling. Thus, empirical formulas presented by Hamilton (1980) and Buckingham (2005) were used to estimate the remaining geoacoustic properties, based on the sediment types described by Funck et al. (2007) and Praeg et al. (2007).

Because the modelled area is large and limited geoacoustic information is available, three simplified geoacoustic profiles were constructed to represent the major features of the sediment column at the modelled sites: shallow Baffin Island continental shelf (< 300 m), deep Baffin Island continental shelf (~ 300–600 m), and deep basins in deeper sites (> 600 m; Table 5). In general, the shallower part of the Baffin Island continental shelf (< 300 m) is characterized by a relatively thin layer of silt and clay sediments that has been scoured by icebergs and strong currents, leaving large outcrops of bedrock (Codispoti and Kravitz 1968, Funck et al. 2007, Praeg et al. 2007). In the deeper area of the Baffin Island continental shelf (~ 300–600 m), the sediment layers range from silt and clay to coarse sand and gravel, up to 180 m thick in troughs made by the scouring of icebergs at a time when the water level was

lower. Fewer areas of exposed bedrock are present (Codispoti and Kravitz 1968, Funck et al. 2007, Praeg et al. 2007). Farther from shore, where the water deepens to > 2500 m, thicker surficial layers (> 500 m) of clay and silt have accumulated (Codispoti and Kravitz 1968, Funck et al. 2007).

The first geoacoustic profile represents geoacoustic parameters found in the shallower regions of the continental shelf (Sites 5 and A). The second represents the geoacoustic parameters found in the deeper regions of the continental shelf (Sites 6, 7, and B). The third represents geoacoustic parameters found in the deeper basins of deeper sites (Sites 1–4, 8, C, and D). The resulting profiles are shown in Tables 6–8.

Table 5. Classification of modelled sites per geoacoustic profile.

Modelled geoacoustic profile	Area location and type	Water depth	Modelled sites
1	Baffin Island continental shelf, shallow	< 300 m	Sites 5, A
2	Baffin Island continental shelf, deep	~ 300–600 m	Sites 6, 7, B
3	Deep basins in deeper sites	> 600 m	Sites 1–4, 8, C, D

Table 6. Estimated geoacoustic profile for Sites 5 and A, representing a multi-layered bottom found in water depths ≤ 300 m. Within each depth range, each parameter varies linearly within the stated range.

Depth below seafloor (m)	Material	Density (g/cm^3)	Compressional sound speed (m/s)	Compressional attenuation (dB/λ)	Shear sound speed (m/s)	Shear attenuation (dB/λ)
0–200	Coarse sediments interfingered with bedrock outcrops	2.0–2.3	2000–2700	0.70–0.50	300	4.0
> 200	Bedrock	2.5	3500	0.35		

Table 7. Estimated geoacoustic profile for Sites 6, 7, and B, representing a multi-layered bottom found in water depths 300–600 m. Within each depth range, each parameter varies linearly within the stated range.

Depth below seafloor (m)	Material	Density (g/cm^3)	Compressional sound speed (m/s)	Compressional attenuation (dB/λ)	Shear sound speed (m/s)	Shear attenuation (dB/λ)
0–180	Silt, clay, and mud mixture		1650–2000	0.66–0.70		
180–500	Glacial drift and coarse sediment		2000–2700	0.70–0.50	200	3.0
> 500	Bedrock		3500	0.35		

Table 8. Estimated geoacoustic profile for Sites 1–4, 8, C, and D, representing a multi-layered bottom found in water depths >600 m. Within each depth range, each parameter varies linearly within the stated range.

Depth below seafloor (m)	Material	Density (g/cm^3)	Compressional sound speed (m/s)	Compressional attenuation (dB/λ)	Shear sound speed (m/s)	Shear attenuation (dB/λ)
0–500	Deep water silt, clay, and mud		1850–2700	0.70–0.50	200	3.0
> 500	Bedrock		3500	0.35		

3.3.4. Geometry and Model Volumes

Sound fields from single seismic pulses were modelled over two resolutions: finer resolution close to the source and coarser resolution farther from the source. Sound fields from single seismic pulses used to estimate cumulative SEL were only modelled over the coarser resolution. The area of finer resolution was 10 × 10 km centred on the source, with a horizontal separation of 5 m between receiver points along the modelled radials. This area was modelled to resolve the detailed features of the sound footprint, close to the source. The area of coarser resolution was 200 × 200 km centred on the source, with a horizontal separation of 20 m between receiver points along the modelled radials. This area was used to model the significant features of the sound footprint without loss of accuracy. Within the coarser-resolution area, the maximum distance to sound levels ≥150 dB re 1 µPa (rms SPL) was estimated.

Per-pulse SEL and rms SPL sound fields were modelled with a horizontal angular resolution of $\Delta\theta = 2.5°$ for a total of $N = 144$ radial planes. The receiver depths span the entire water column over the modelled areas, from 0.1 to a maximum of 3530 m, with step sizes that increased from 1 to 500 m, with increasing depth. Peak SPL, rms SPL, and SEL sound levels at Sites 1–8 were modelled using FWRAM along four radial planes, i.e., with a horizontal angular resolution of $\Delta\theta = 90°$. The receiver depths span the entire water column over the modelled areas with a step size of 5 m, and a range step size of 25 m, to a maximum range of 50 km. The cumulative

SEL was modelled within a 380 × 280 km area, along one seismic line. The cumulative SEL footprint represents 7981 pulses fired along a 199.5 km (107.7 nm) survey line (Section 3.2).

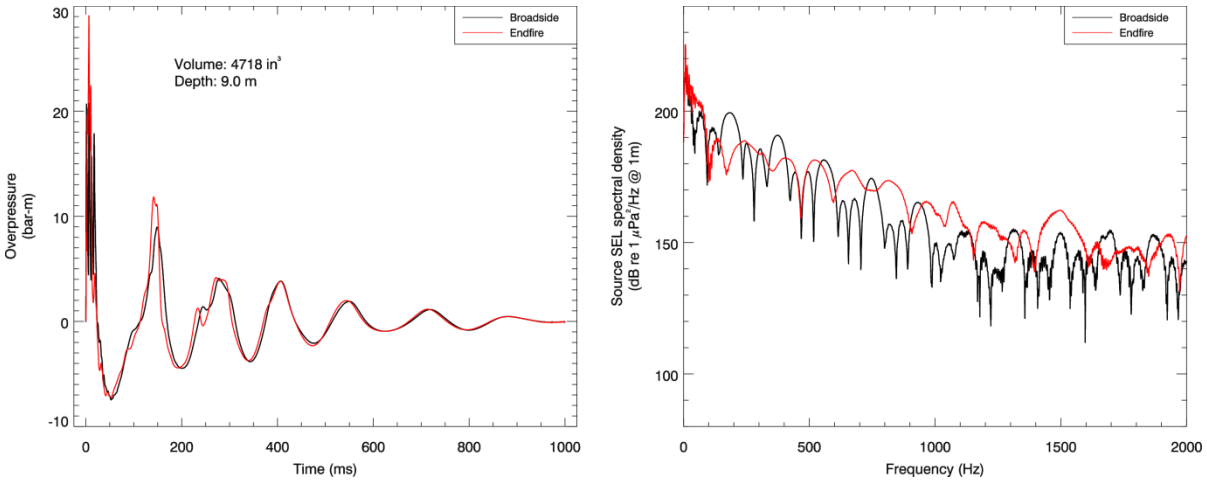
The array tow direction was set to the bearing of the corresponding seismic lines, a tow depth of 9 m.

4. Results

4.1. Acoustic Source Levels and Directivity

The pressure signatures of the individual airguns and the composite 1/3-octave-band source levels of the array, as functions of azimuthal angle (in the horizontal plane), were modelled with AASM (Section 2.1). While effects of source depth on bubble interactions are accounted for in the AASM source model, the surface-reflected signal (i.e., surface ghost) is not included in the horizontal far-field source signatures. The surface reflections, a property of the medium rather than the source, are accounted for by the acoustic propagation models. The source levels and signatures for the 4718 in^3 airgun array respectively acted as the acoustic source for the MONM and FWRAM sound propagation models.

The broadside (perpendicular to the tow direction) and endfire (parallel to the tow direction) horizontal overpressure signatures and corresponding power spectrum levels for the 4718 in^3 array at a 9 m tow depth, are shown in Figure 9 and Table 9. The signatures consist of a strong primary peak related to the initial firing of the airguns, followed by a series of irregular pulses associated with bubble oscillations. The spectrum contains peaks and nulls resulting from interference among airguns in the array, where the frequencies at which they occur depend on the volumes of the airguns and their locations within the array. The maximum (horizontal) 1/3-octave-band source levels over all directions are plotted in Figure 10. The horizontal 1/3-octave-band directivities in Figure 11 shows that the source is not an omnidirectional point source at frequencies ≥125 Hz. Most energy is produced at frequencies below 500 Hz (Figure 9b, 10, and 11).



(a) (b)

Figure 9. Predicted (a) overpressure signature and (b) power spectrum in the broadside and endfire (horizontal) directions of the 4718 in^3 array. Surface ghosts (effects of the pulse reflection at the water surface) are not included in these signatures as they are accounted for by the MONM propagation model.

Table 9. Horizontal source level specifications (10–2000 Hz) for the seismic airgun array (4718 in^3) at 9 m tow depth, computed with AASM in the broadside and endfire directions. Surface ghost effects are not included as they are accounted for by the MONM propagation model.

Direction	Zero-to-peak SPL (dB re 1 µPa @ 1 m)	SEL (dB re 1 µPa^2 @ 1 m)		
		0.1–2 kHz	0.1–1 kHz	1–2 kHz
Broadside	243.4	224.7	224.7	178.2
Endfire	249.3	226.7	226.7	186.0

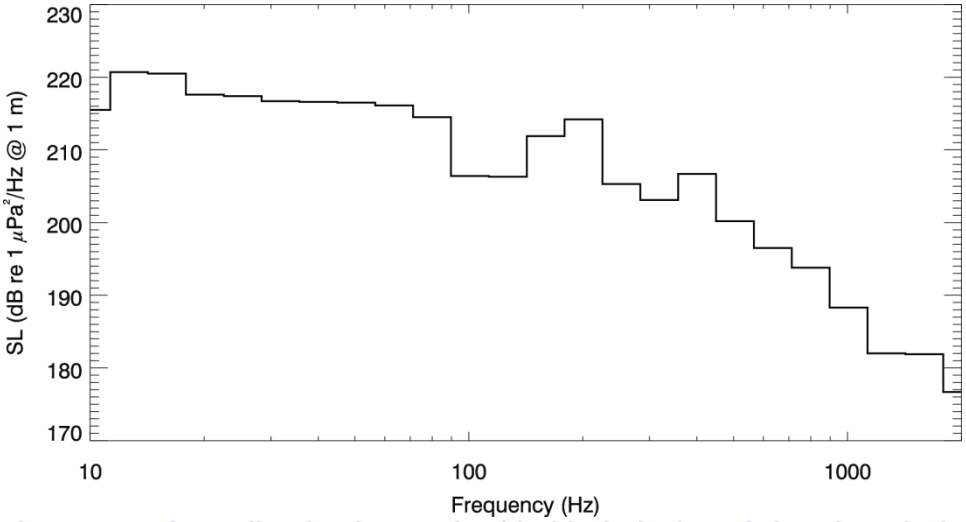


Figure 10. Maximum directional source level (SL) in the horizontal plane, in each 1/3-octave band, for the 4718 in^3 airgun array at 9 m tow depth.

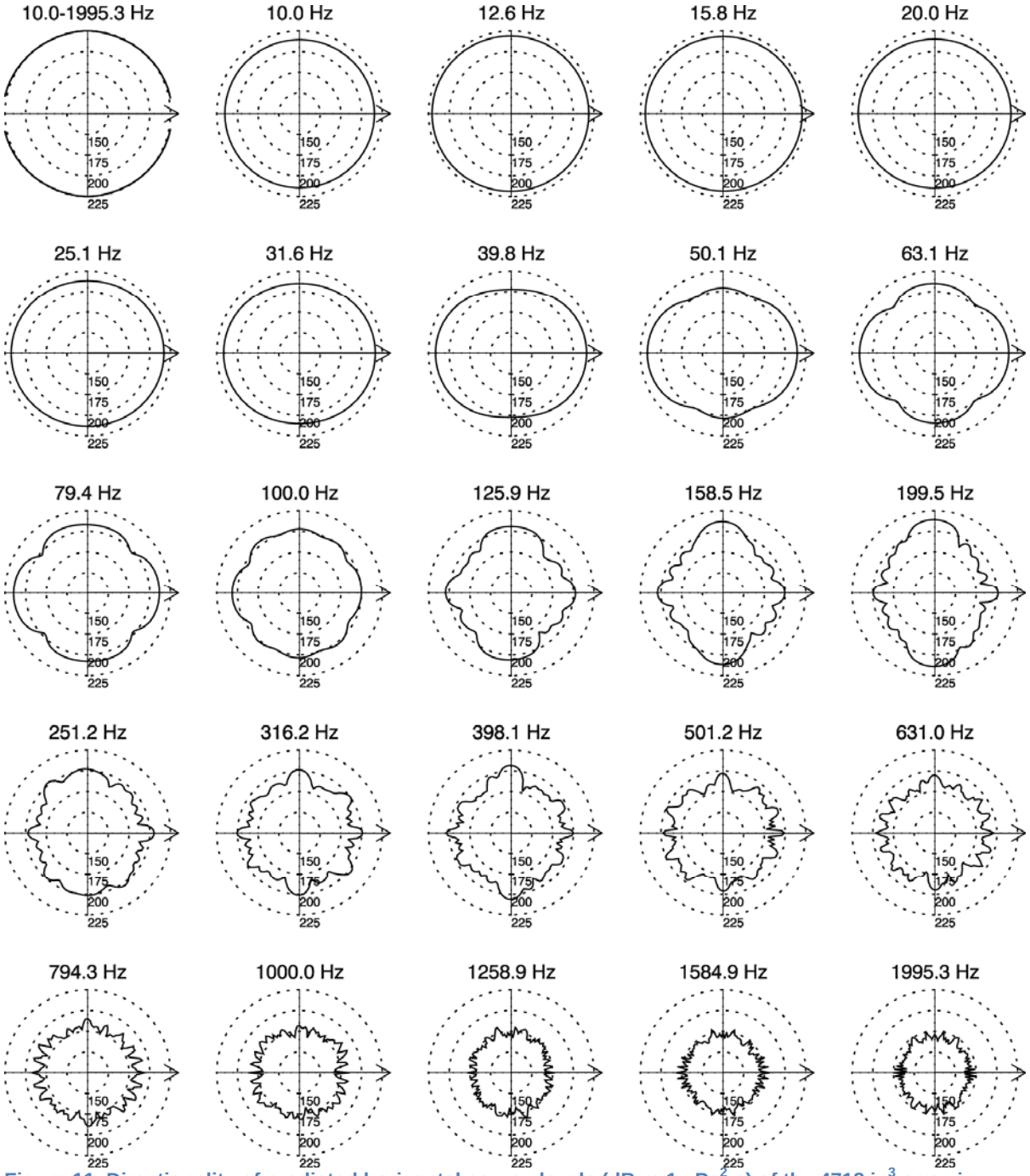


Figure 11. Directionality of predicted horizontal source levels (dB re 1 μPa^2·s) of the 4718 in^3 array in 1/3-octave bands. The 1/3-octave-band centre frequencies are indicated above each plot.

4.2. Sound Propagation

The underwater sound fields predicted by the propagation models were sampled so that the received sound level at each point in the horizontal plane was taken to be the maximum value over all modelled depths for that point (see Section 2.2). The resultant maximum-over-depth sound fields are presented below in two formats: as tables of distances to sound levels and, where the distances are long enough, as contour maps showing the directivity and range to various sound levels.

The predicted distances to specific levels were computed from the maximum-over-depth sound fields. Two distances, relative to the source, are reported for each sound level: (1) R_{max}, the maximum range at which the given sound level was encountered in the modelled maximum-over-depth sound field, and (2) $R_{95\%}$, the maximum range at which the given sound level was encountered after exclusion of the 5% farthest such points. The $R_{95\%}$ is provided since the maximum-over-depth sound field footprint may not be circular and, along a few azimuths, may extend far beyond the main ensonification zone. Regardless of the geometric shape of the maximum-over-depth footprint, $R_{95\%}$ is the predicted range encompassing at least 95% of the area (in the horizontal plane) that would be exposed to sound at or above that level. The difference between R_{max} and $R_{95\%}$ depends on the source directivity and the heterogeneity of the acoustic environment. The $R_{95\%}$ excludes ends of protruding areas or small isolated acoustic foci not representative of the nominal ensonification zone.

4.2.1. Peak SPL

The maximum (R_{max}) and 95% ($R_{95\%}$,) horizontal distances (based on modeled maximum-over-depth values) from the array to peak SPL injury and behavioural thresholds of 230, 224, 218, and 212 dB re 1 µPa (Southall et al. 2007; Section 1.4), were modelled at Sites 1–8. However, distances to level thresholds greater than 212 dB re 1 µPa are not reached at distances greater than the minimum length of the array (14 m). Thus, only distances to the Southall behavioural disturbance threshold for pinnipeds in water (212 dB re 1 µPa^2·s) are presented in Table 10.

Table 10. Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances from the airgun array to peak sound pressure levels (peak SPLs; 10 Hz to 2 kHz) behavioural disturbance threshold for pinnipeds in water (Southall et al. 2007; Section 1.4), based on modelled maximum-over-depth values.

Peak SPL (dB re 1 µPa)	Site 1		Site 2		Site 3		Site 4	
	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)
212	46	40	18	18	38	36	45	41
Peak SPL (dB re 1 µPa)	**Site 5**		**Site 6**		**Site 7**		**Site 8**	
	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)
212	38	36	38	36	38	36	< 14	< 14

4.2.2. rms SPL

The maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (based on modelled maximum-over-depth values) from the array at Sites 1–8 to rms SPL of 200–150 dB re 1 µPa, in 10 dB increments, are presented in Table 11. The rms SPL footprints are presented in Figures 12–19.

Table 11. Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances from the airgun array to root-mean-square (rms) sound pressure levels (rms SPLs; 10 Hz to 2 kHz), based on modelled maximum-over-depth values.

rms SPL (dB re 1 µPa)	Site 1		Site 2		Site 3		Site 4	
	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)
200	78	67	73	63	79	67	81	67
190	259	215	241	204	247	210	252	213
180	1 021	878	729	614	810	659	689	567
170	3 339	2 995	1 525	1 363	4 138	4 042	4 065	3 008
160	11 671	8 115	7 467	7 106	7 529	5 442	12 366	7 382
150	61 196	29 582	51 162	28 209	40 959	26 922	45 558	30 123
140	> 100 000		> 100 000		> 100 000		> 100 000	
rms SPL (dB re 1 µPa)	Site 5		Site 6		Site 7		Site 8	
	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)
200	76	65	76	65	79	68	74	63
190	404	346	220	192	249	206	237	197
180	1 592	1 398	613	560	796	657	680	596
170	4 121	3 294	2 646	2 348	2 803	2 531	1 834	1 618
160	10 846	8 373	9 038	6 360	8 174	6 689	14 185	8 786
150	31 085	19 500	36 547	19 846	40 223	20 193	55 096	23 913
140	> 100 000		> 100 000		> 100 000		> 100 000	

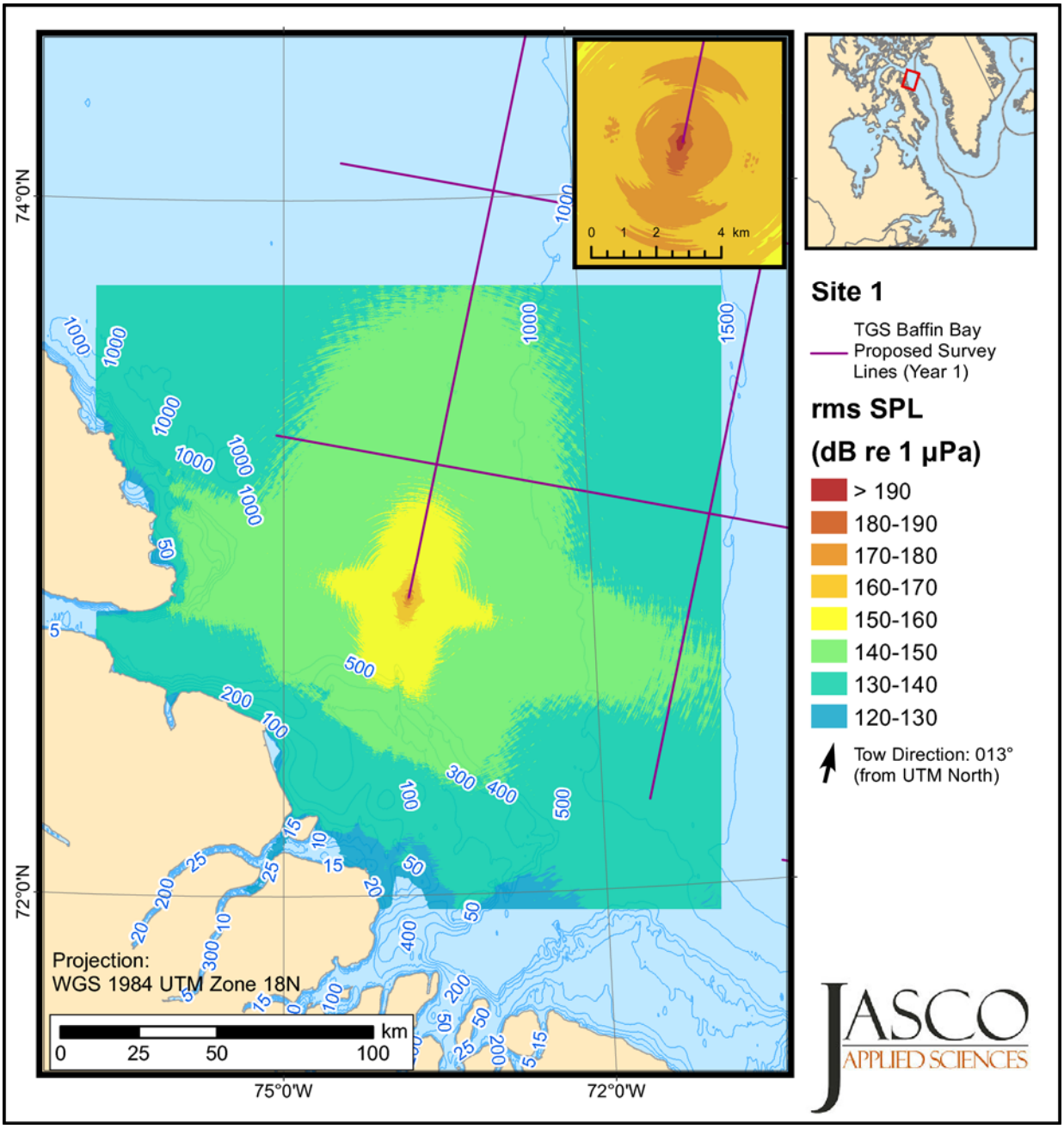


Figure 12. The root-mean-square (rms) sound pressure levels (SPLs) at Site 1: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

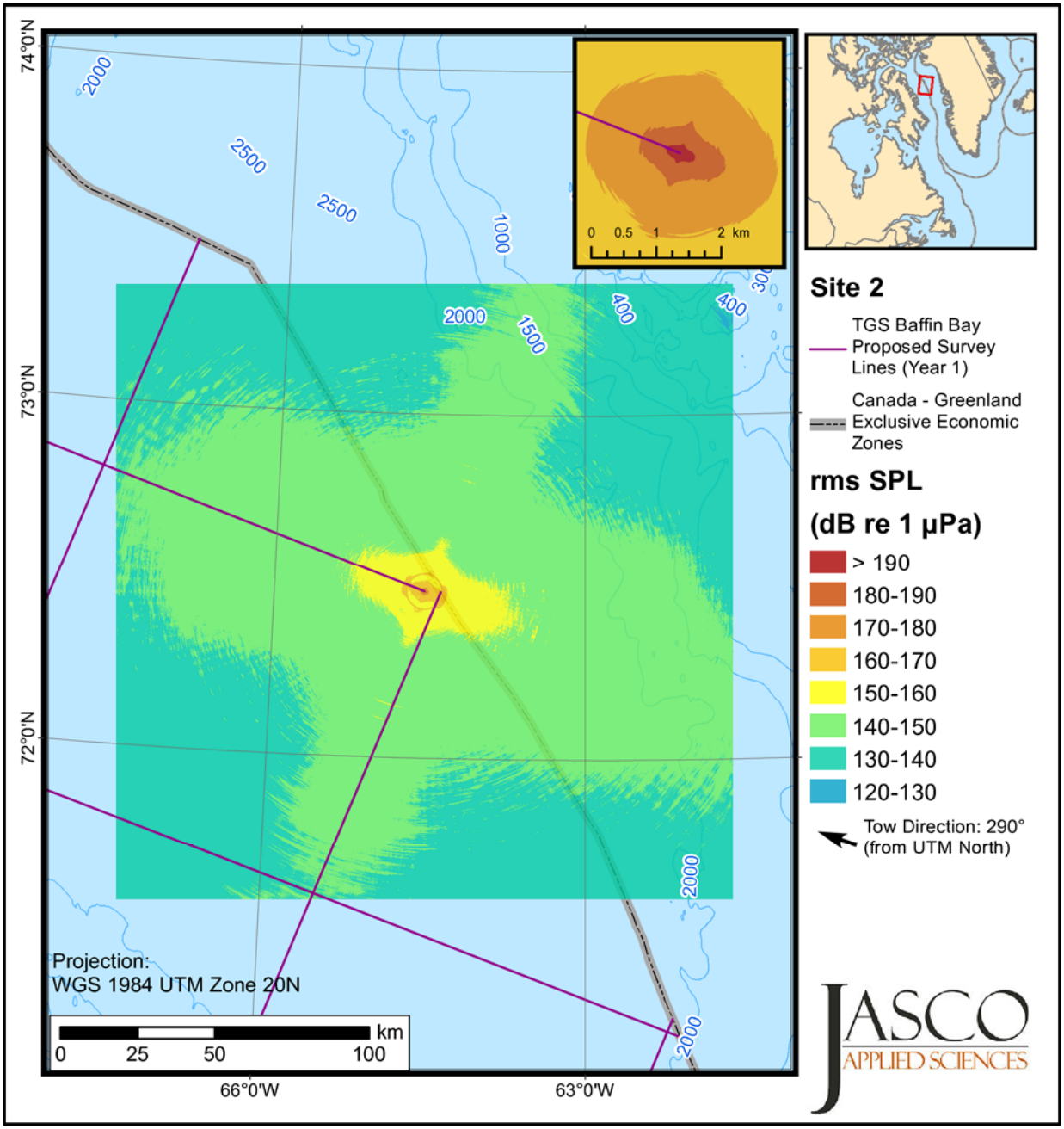


Figure 13. The root-mean-square (rms) sound pressure levels (SPLs) at Site 2: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

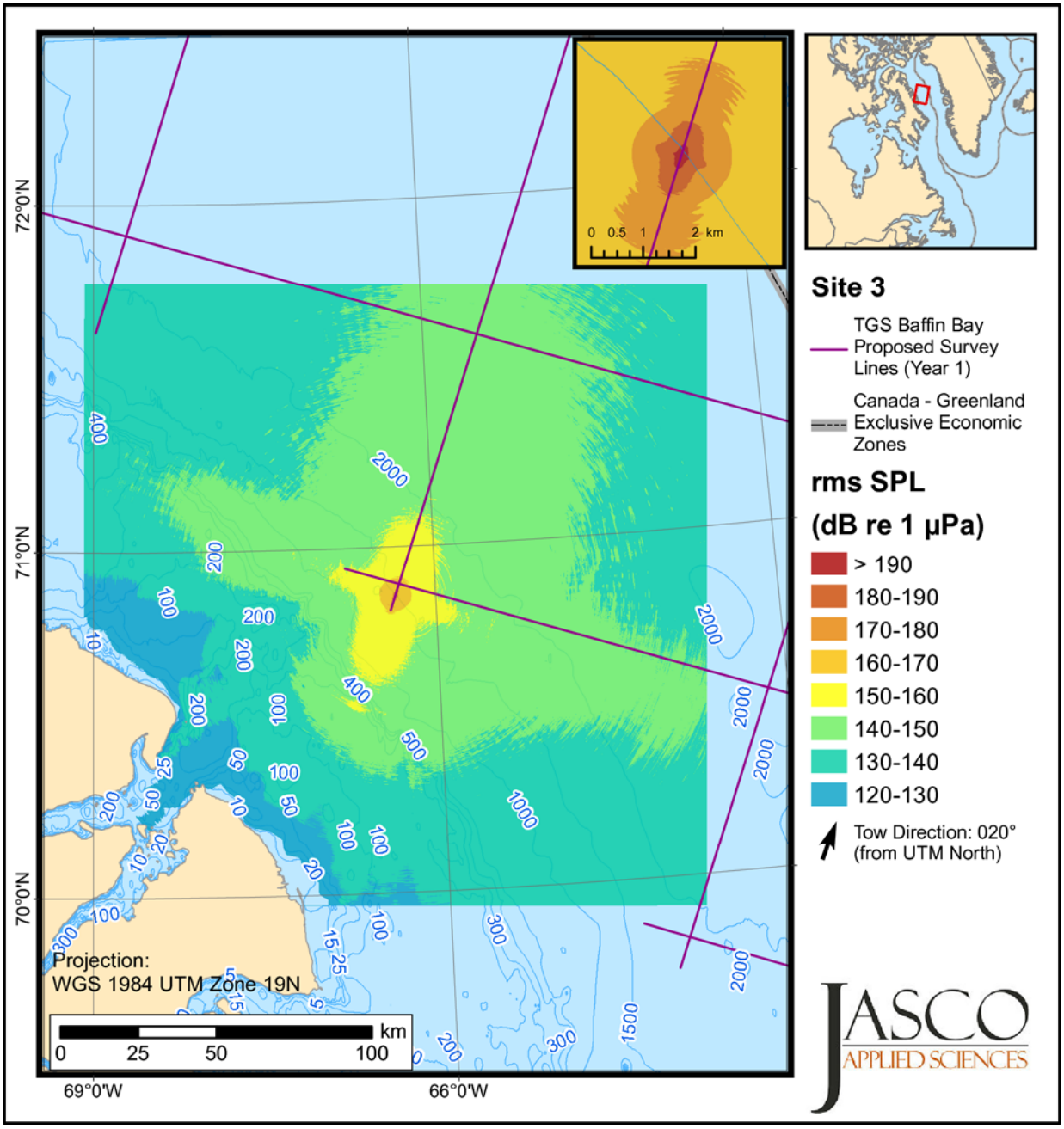


Figure 14. The root-mean-square (rms) sound pressure levels (SPLs) at Site 3: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

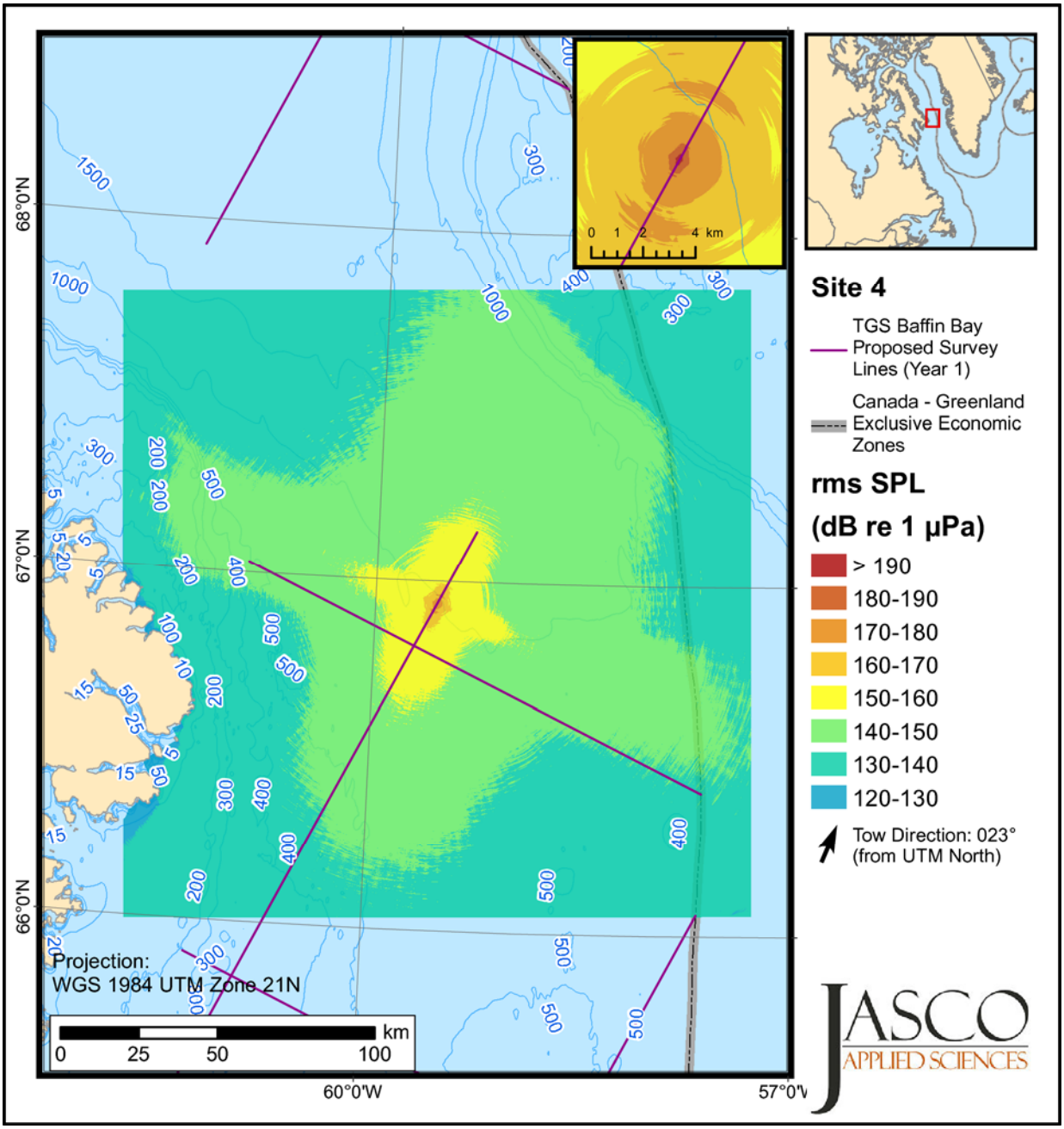


Figure 15. The root-mean-square (rms) sound pressure levels (SPLs) at Site 4: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

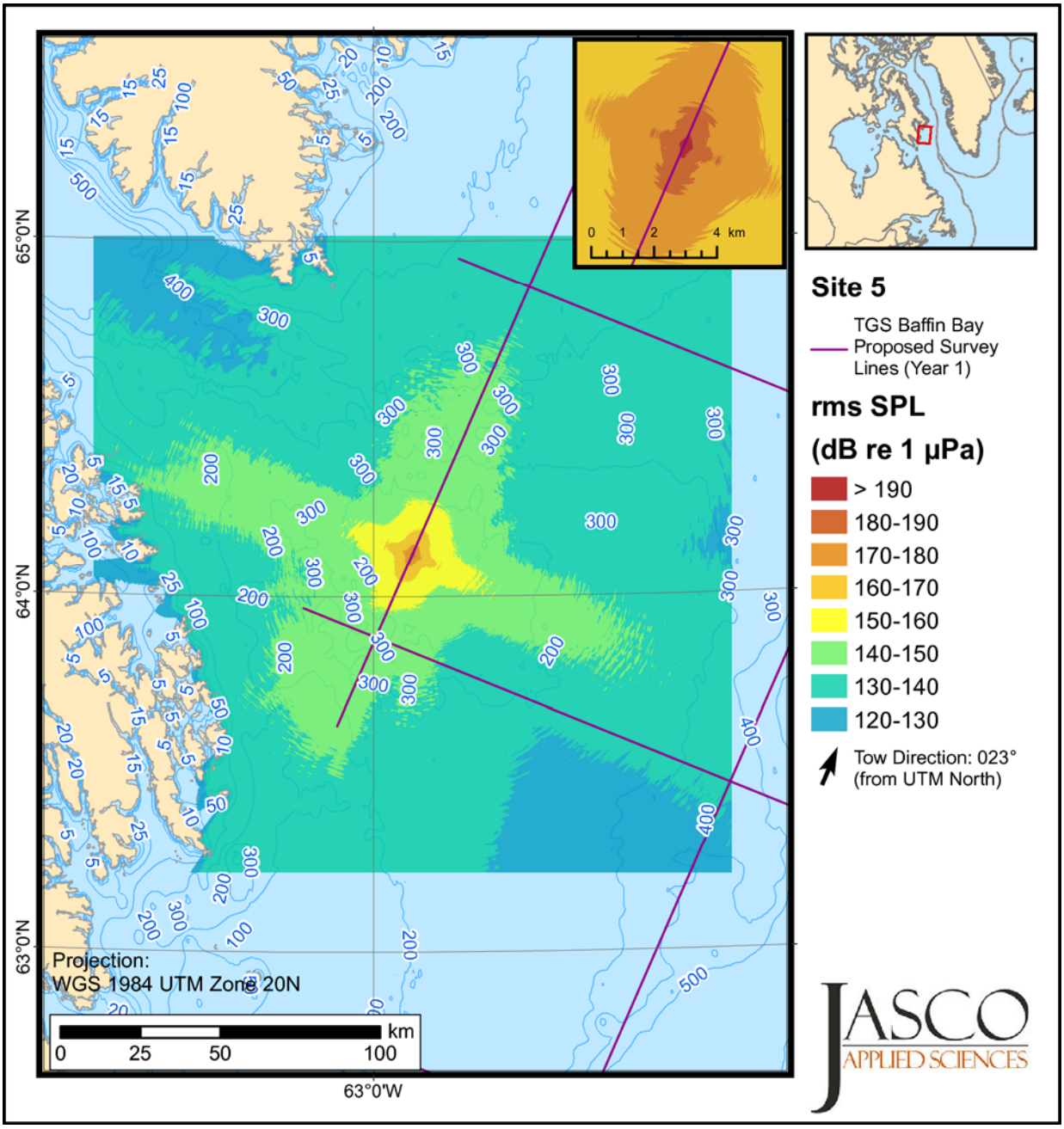


Figure 16. The root-mean-square (rms) sound pressure levels (SPLs) at Site 5: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

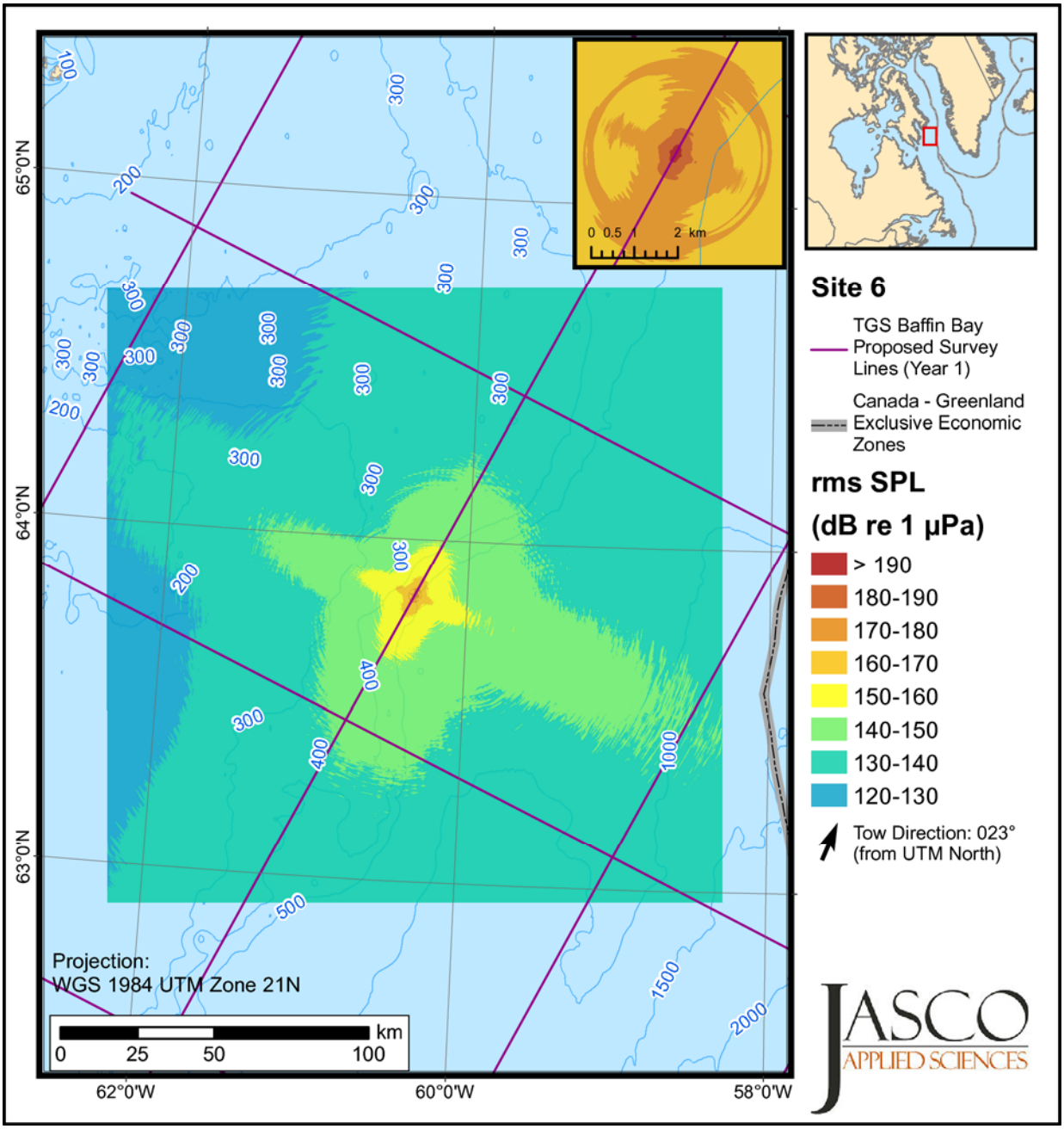


Figure 17. The root-mean-square (rms) sound pressure levels (SPLs) at Site 6: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

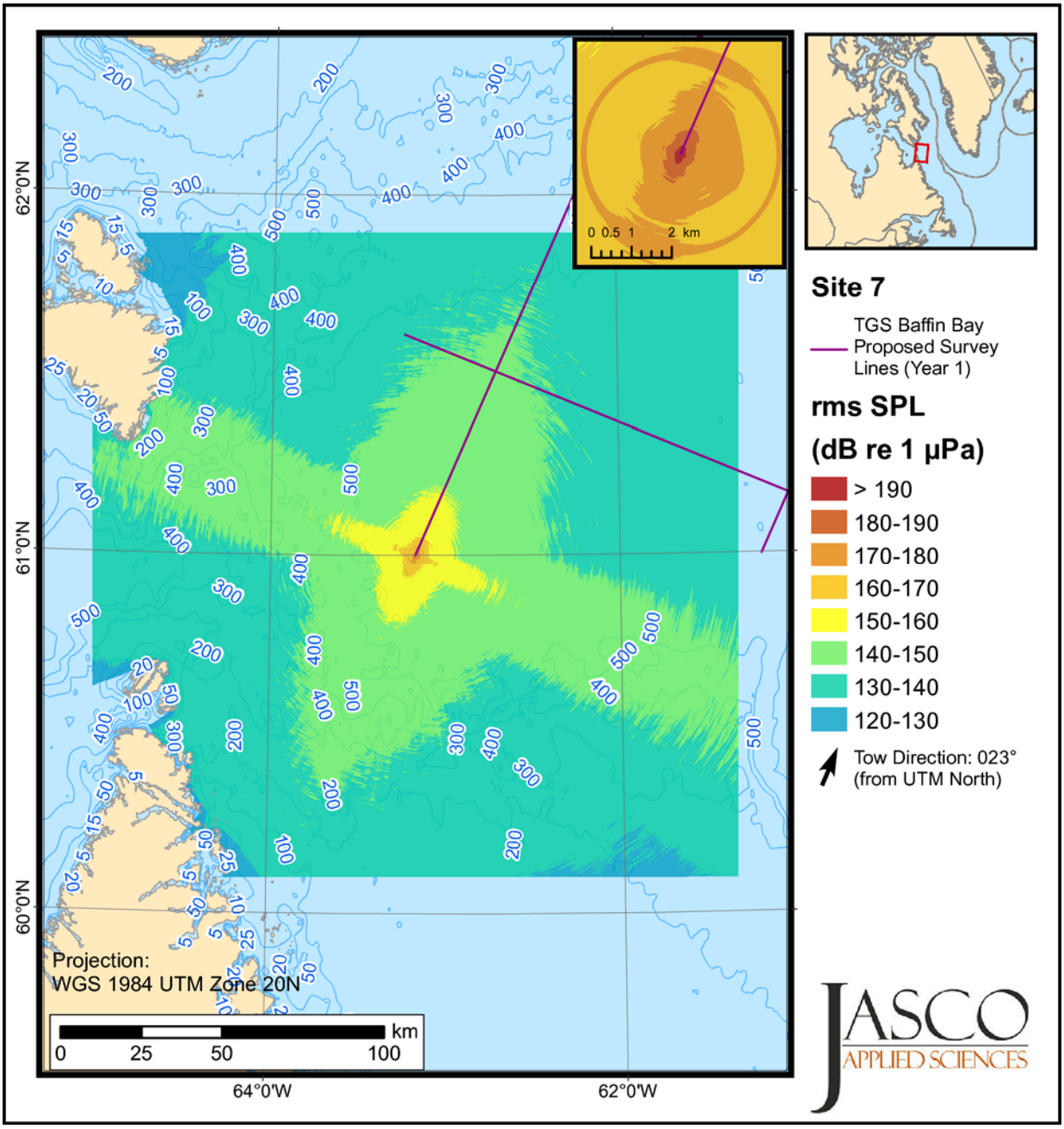


Figure 18. The root-mean-square (rms) sound pressure levels (SPLs) at Site 7: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

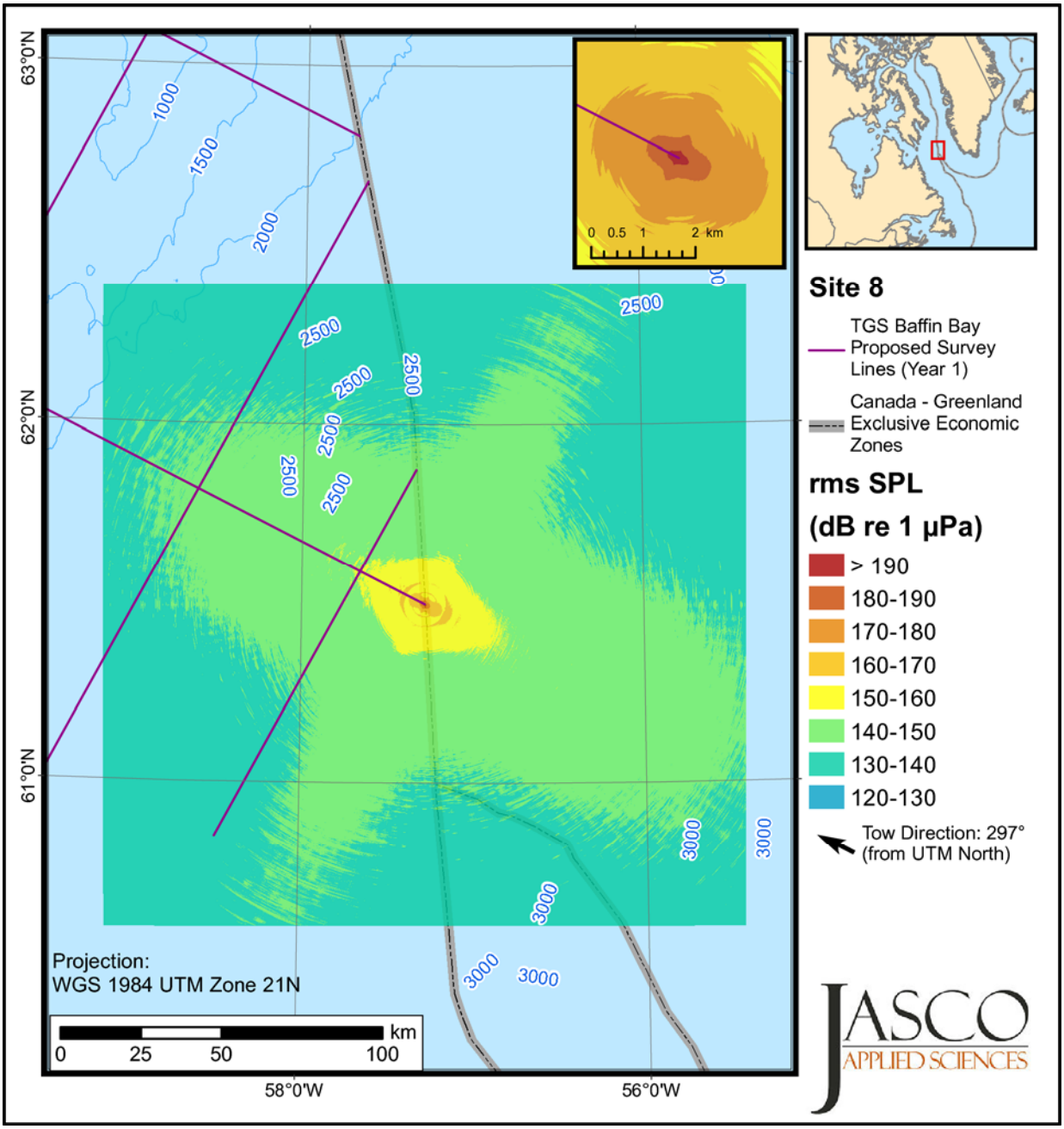


Figure 19. The root-mean-square (rms) sound pressure levels (SPLs) at Site 8: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

4.2.3. Per-Pulse SEL

The maximum (R_{max}) and 95% ($R_{95\%}$,) horizontal distances (based on modeled maximum-over-depth values) from the array at Sites 1–8 to per-pulse SEL of 200–150 dB re 1 µPa^2·s, in 10 dB steps, are presented in Table 12. The per-pulse SEL footprints are presented in Figures 20–27.

Table 12. Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances from the airgun array to given per-pulse sound exposure levels (SEL; 10 Hz to 2 kHz), based on modelled maximum-over-depth values.

Per-pulse SEL (dB re 1 µPa^2·s)	Site 1		Site 2		Site 3		Site 4	
	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)
200	32	27	32	27	32	27	34	28
190	103	89	101	86	106	90	103	89
180	328	290	329	277	335	283	336	287
170	1 857	1 567	1 072	914	2 197	1 047	2 053	1 696
160	11 671	8 230	5 994	4 805	7 529	5 798	12 366	7 453
150	61 196	29 574	51 162	28 427	40 959	25 803	45 558	30 136
140	> 100 000		> 100 000		> 100 000		> 100 000	
Per-pulse SEL (dB re 1 µPa^2·s)	Site 5		Site 6		Site 7		Site 8	
	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)
200	34	29	32	27	32	27	29	27
190	204	188	105	89	103	89	101	86
180	957	818	355	296	337	293	329	277
170	3 839	3 047	1 612	1 304	1 669	1 472	1 092	901
160	10 846	8 376	8 096	5 604	7 262	5 590	5 981	5 099
150	31 085	19 499	36 547	19 873	45 957	23 903	55 096	24 666
140	> 100 000		> 100 000		> 100 000		> 100 000	

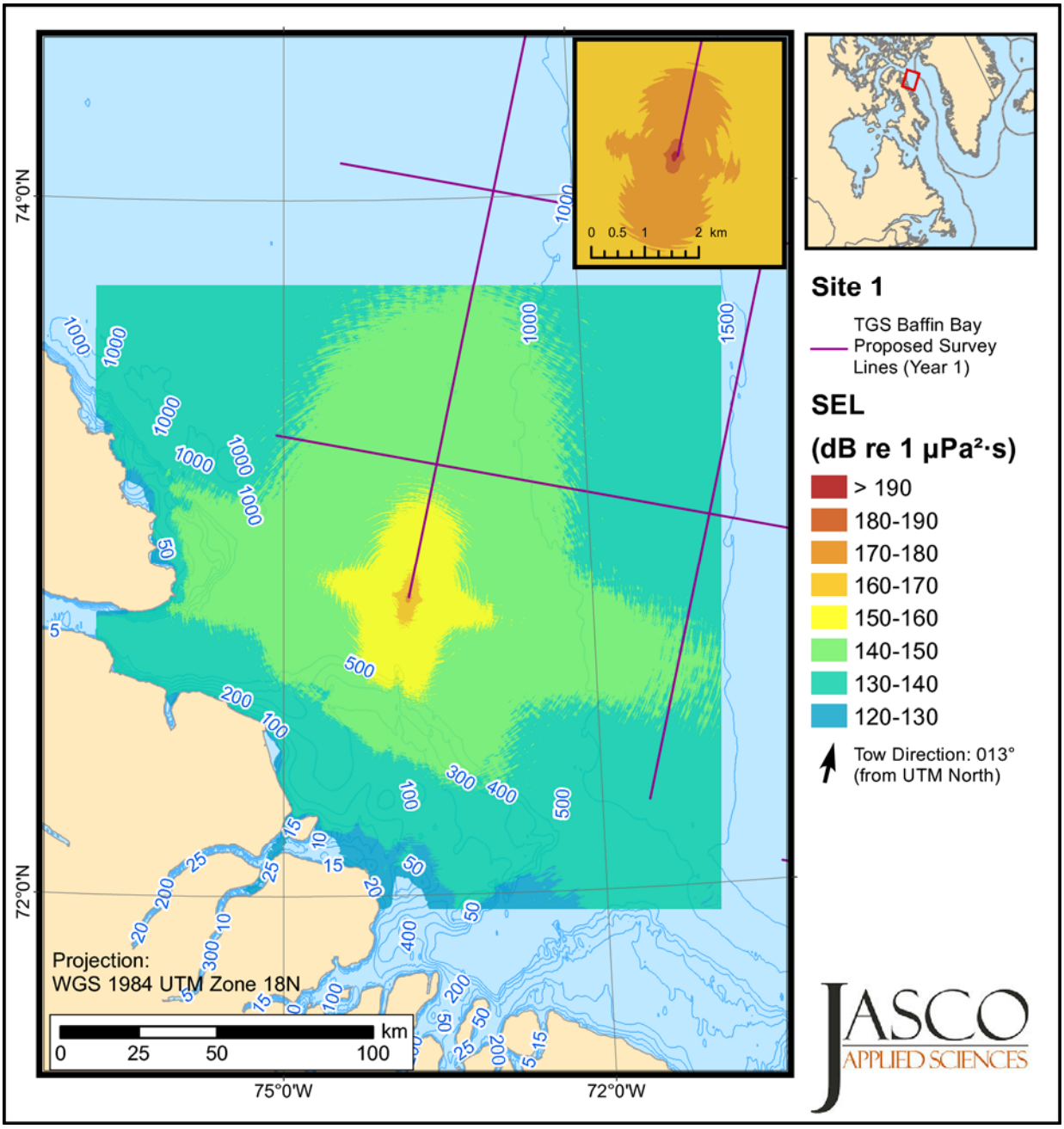


Figure 20. Per-pulse sound exposure levels (SELs) at Site 1: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

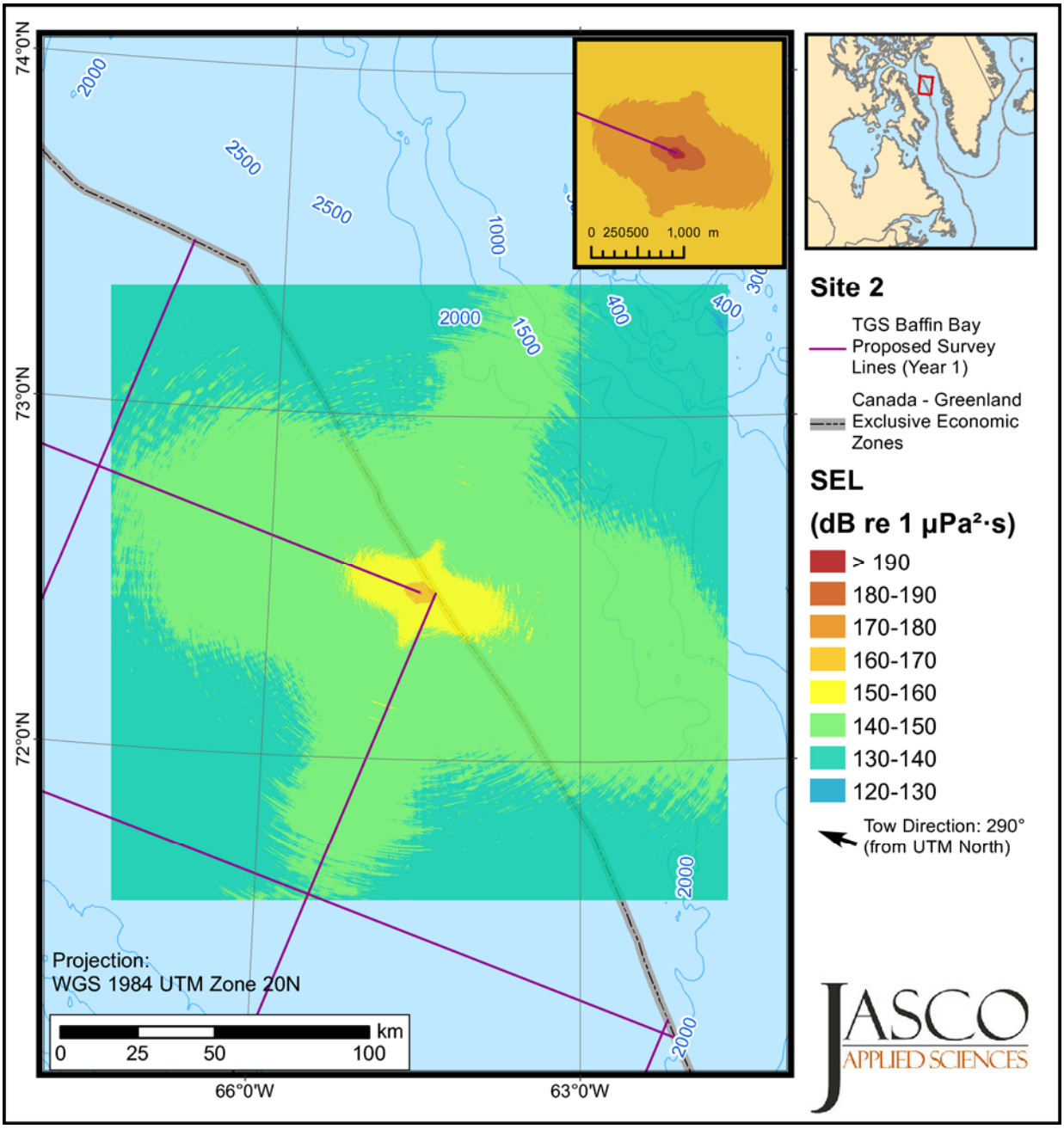


Figure 21.Per-pulse sound exposure levels (SELs) at Site 2: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

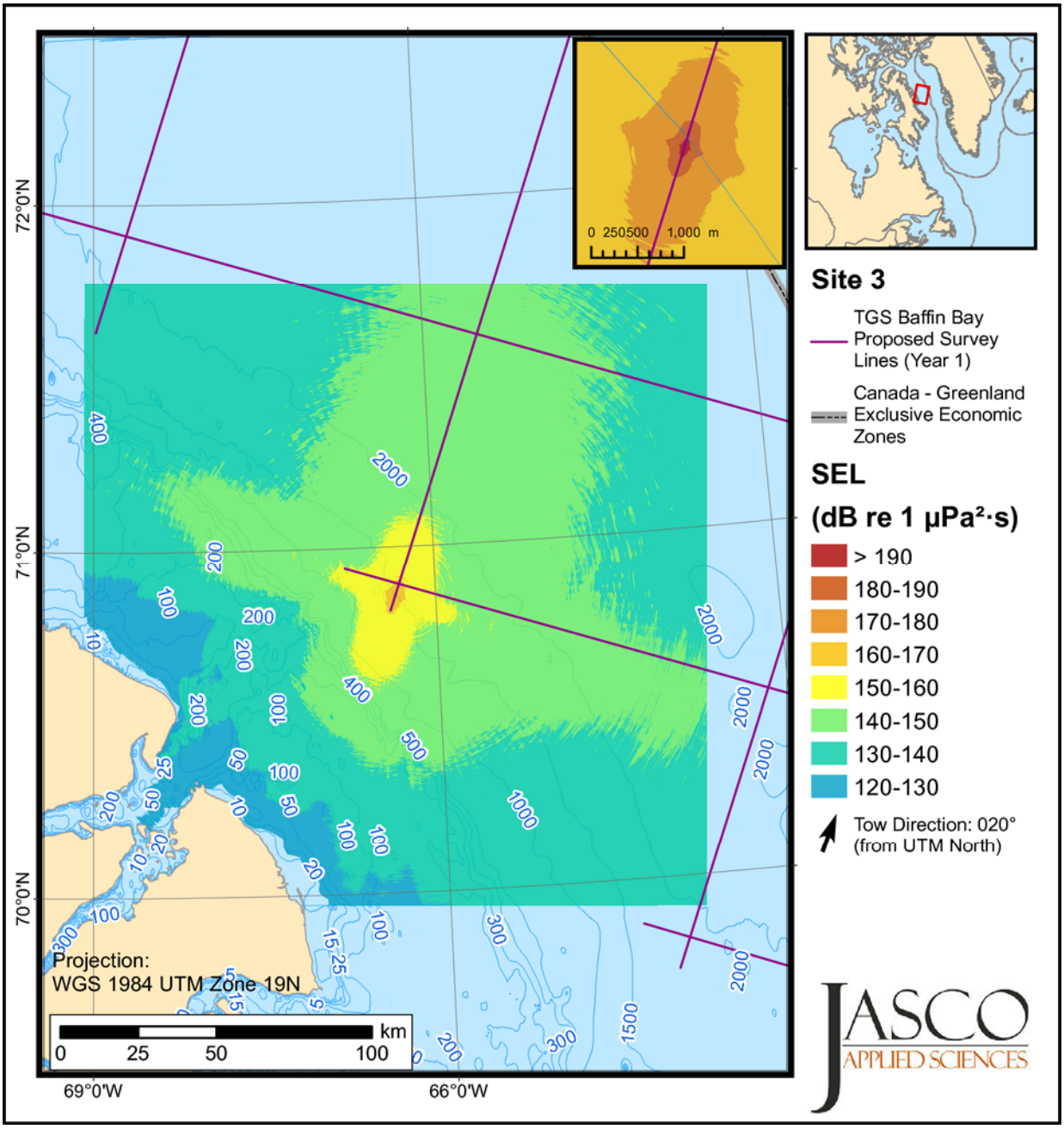


Figure 22. Per-pulse sound exposure levels (SELs) at Site 3: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

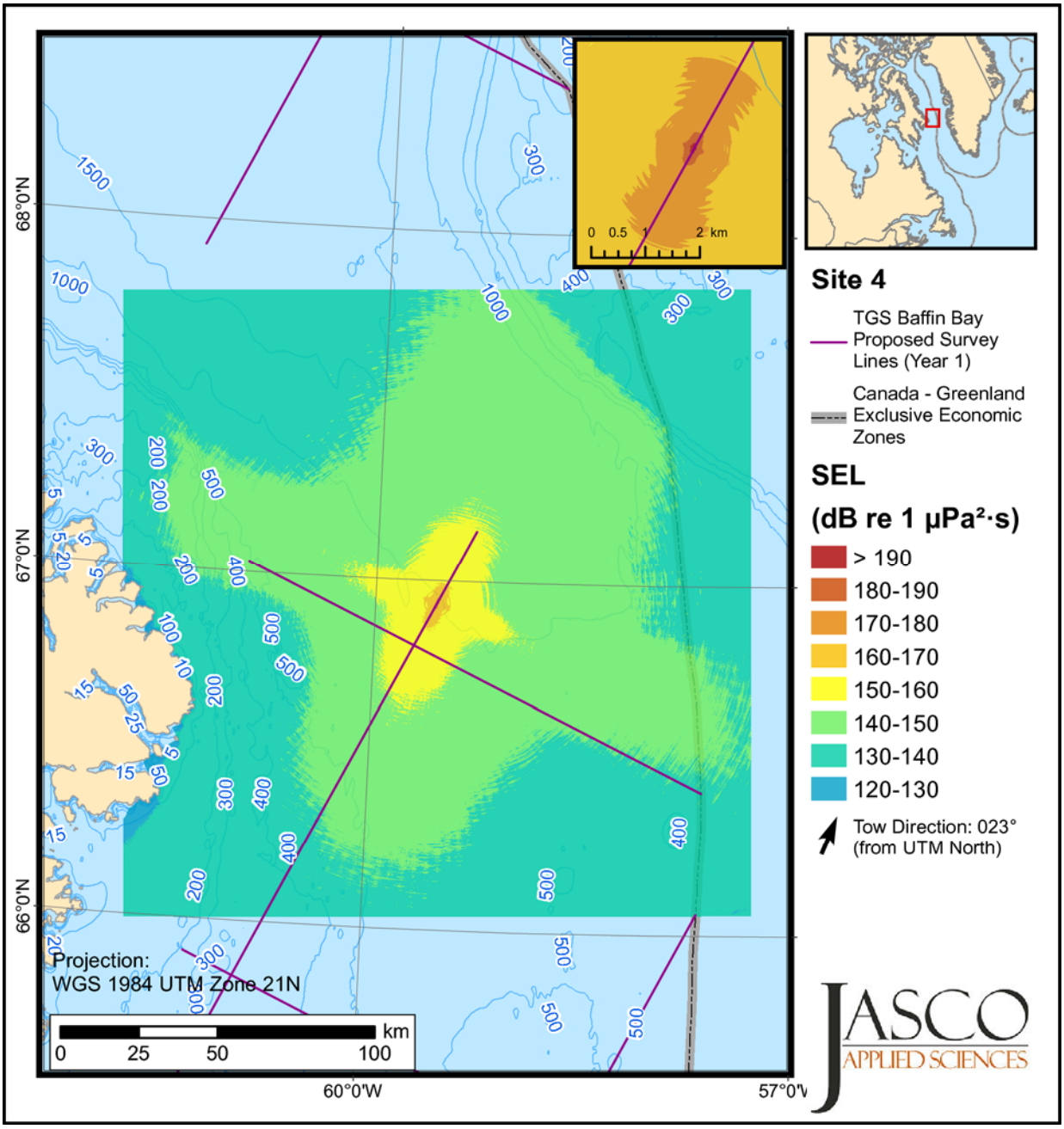


Figure 23. Per-pulse sound exposure levels (SELs) at Site 4: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

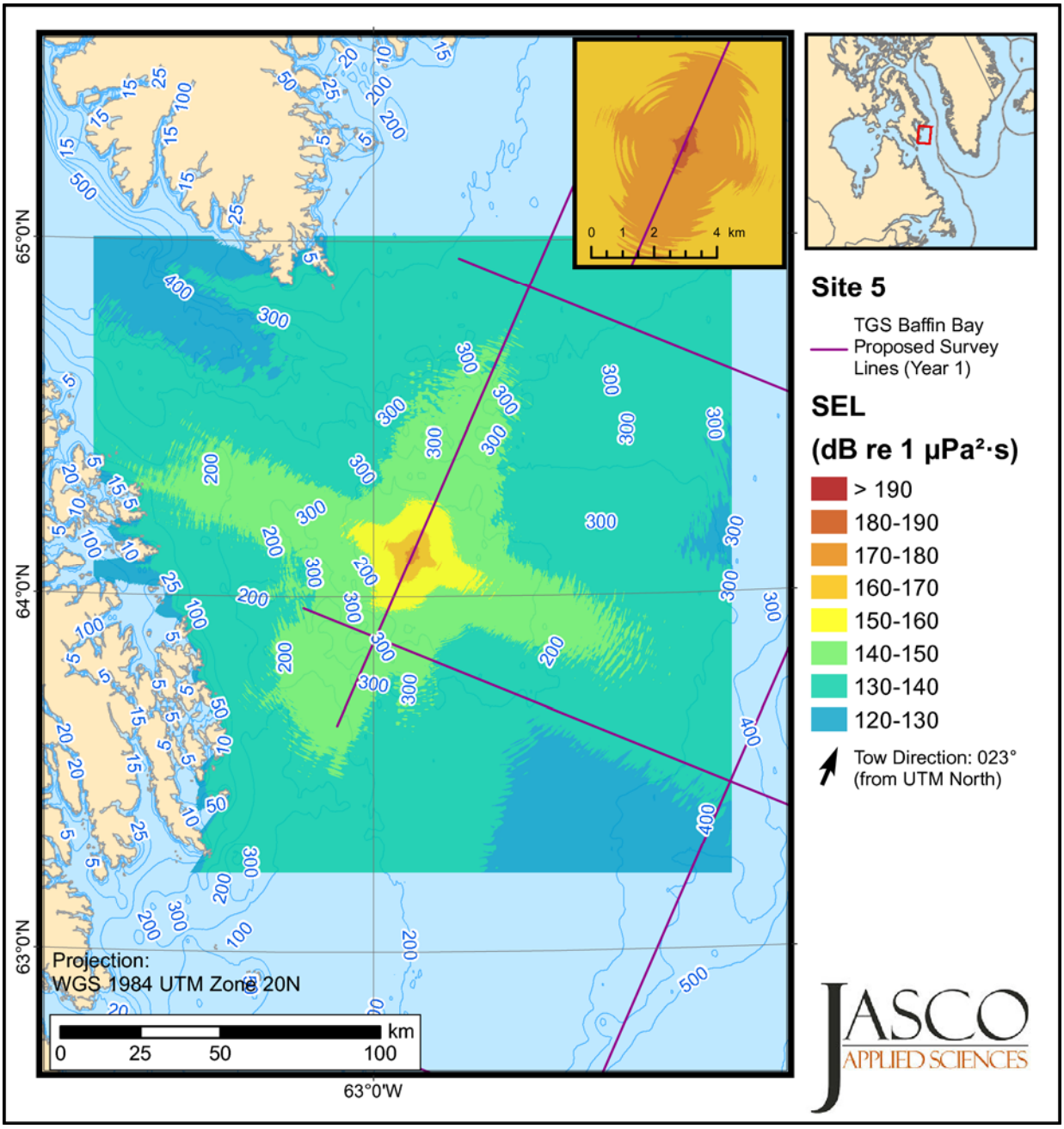


Figure 24. Per-pulse sound exposure levels (SELs) at Site 5: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

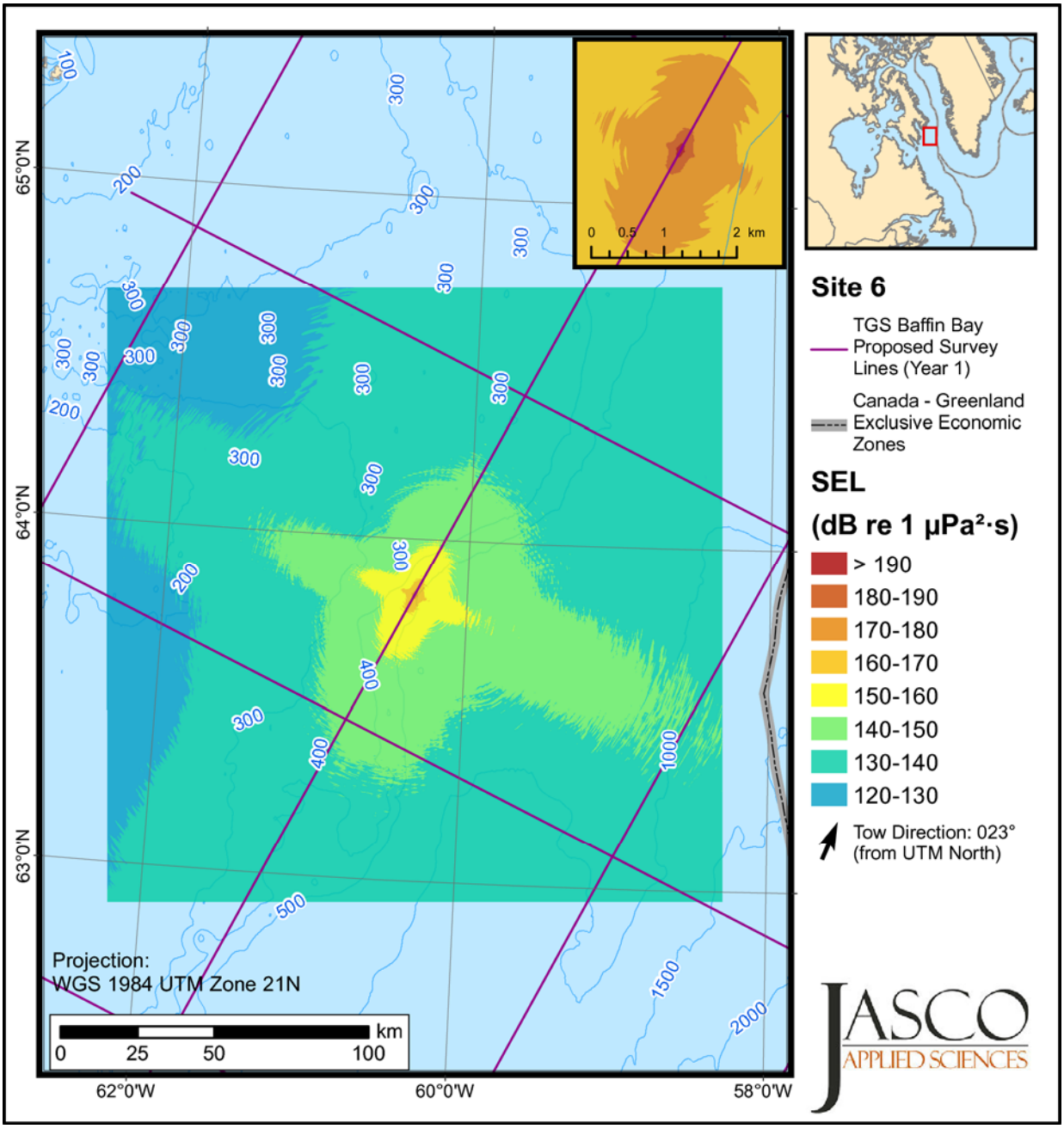


Figure 25. Per-pulse sound exposure levels (SELs) at Site 6: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

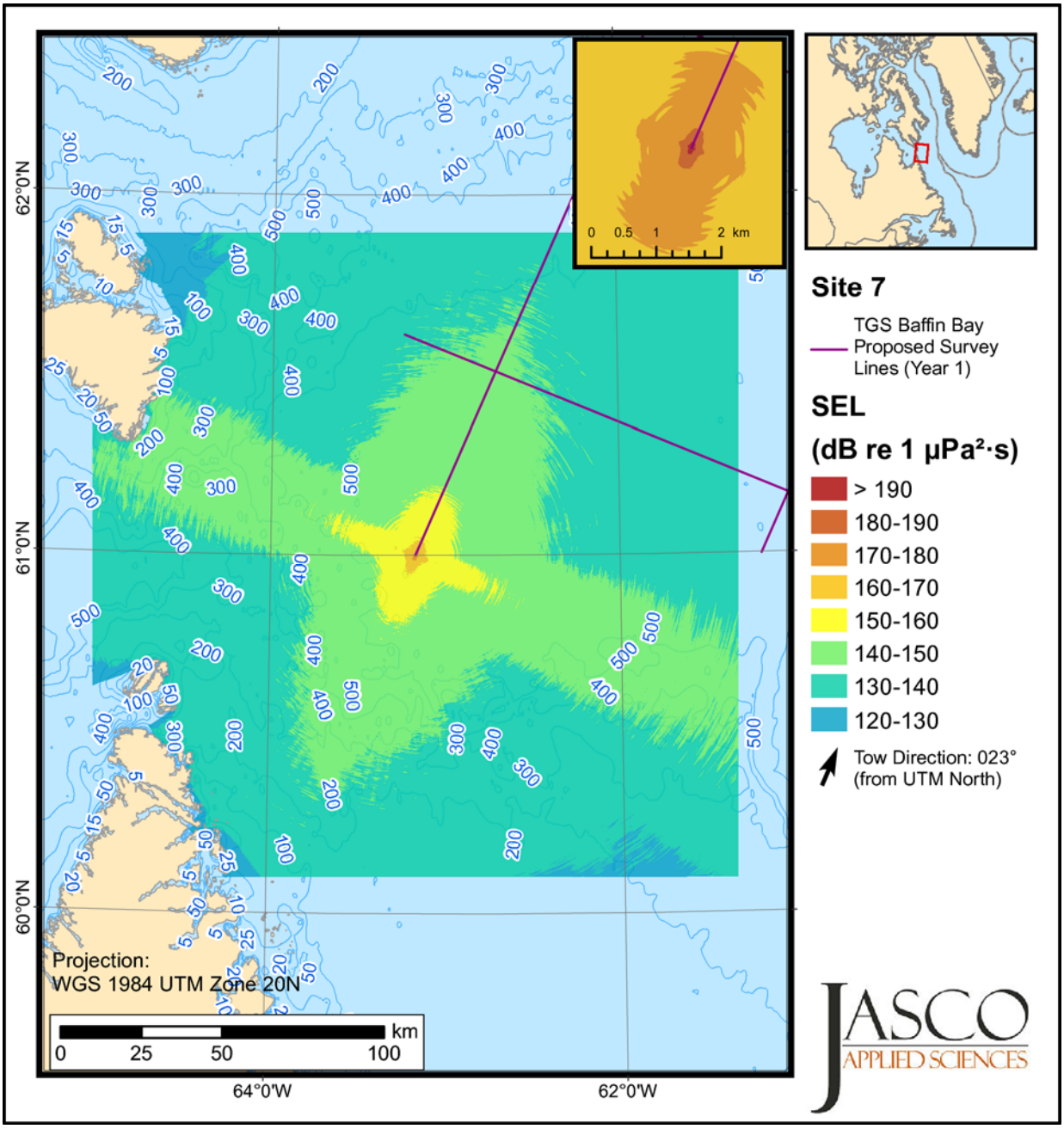


Figure 26. Per-pulse sound exposure levels (SELs) at Site 7: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

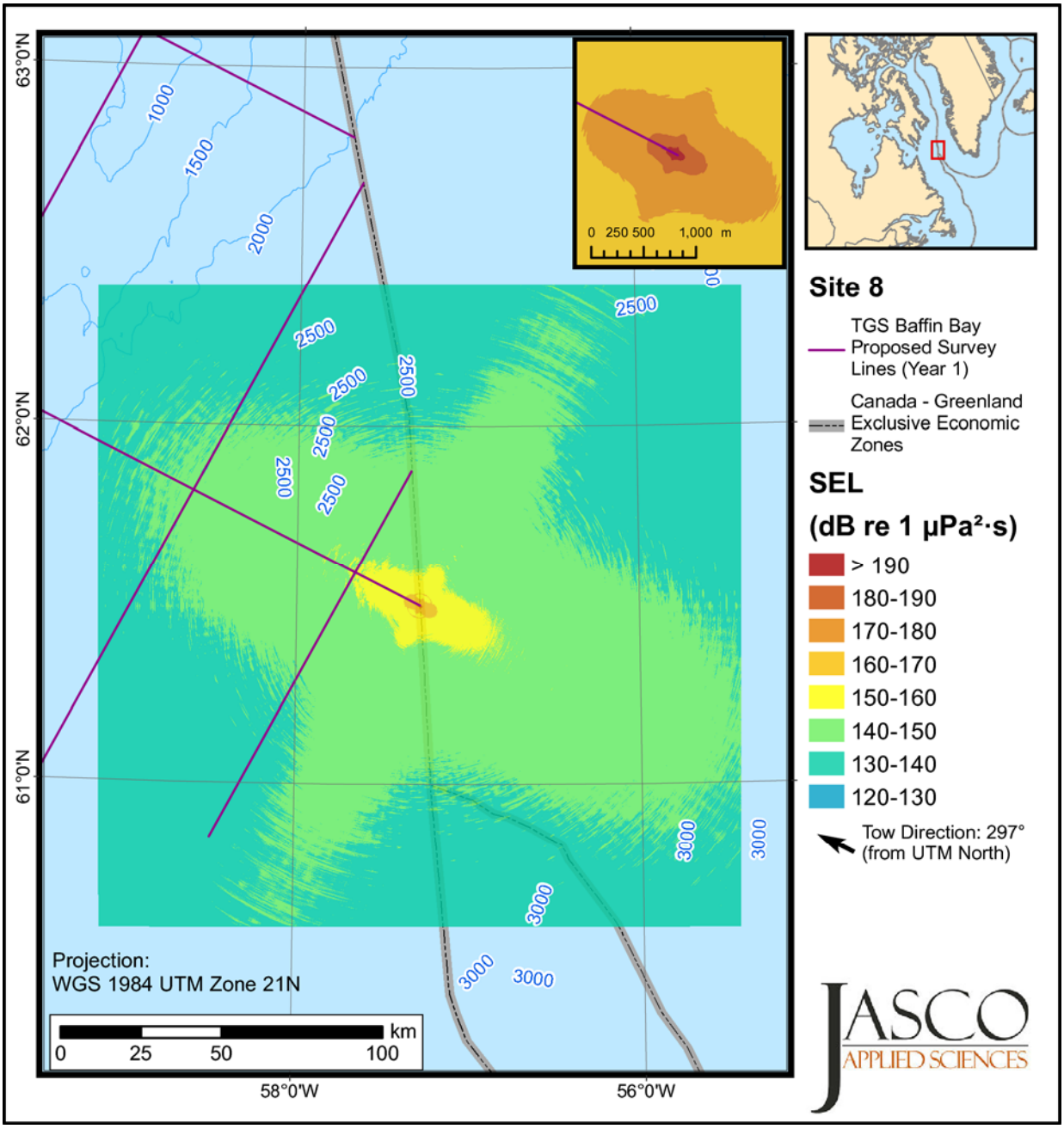


Figure 27. Per-pulse sound exposure levels (SELs) at Site 8: Received maximum-over-depth sound levels from the 4718 in^3 airgun array for a single shot. Blue contours indicate water depth in metres.

4.2.5. Cumulative SEL

Figures 28–32 are contour maps of unweighted and M-weighted cSEL footprints (based on modelled maximum-over-depth values) along the modelled seismic line.

The maps present contours of:

- 190 to at least 150 dB re 1 µPa^2·s, in 10 dB increments on each map
- 198 and 183 dB re 1 µPa^2·s for cetacean-weighted footprints, corresponding to Southall's injury and behavioural disturbance thresholds (Southall et al. 2007; Section 1.4)
- 186 and 171 dB re 1 µPa^2·s for pinniped-weighted footprint, corresponding to Southall's injury and behavioural disturbance thresholds (Southall et al. 2007; Section 1.4)

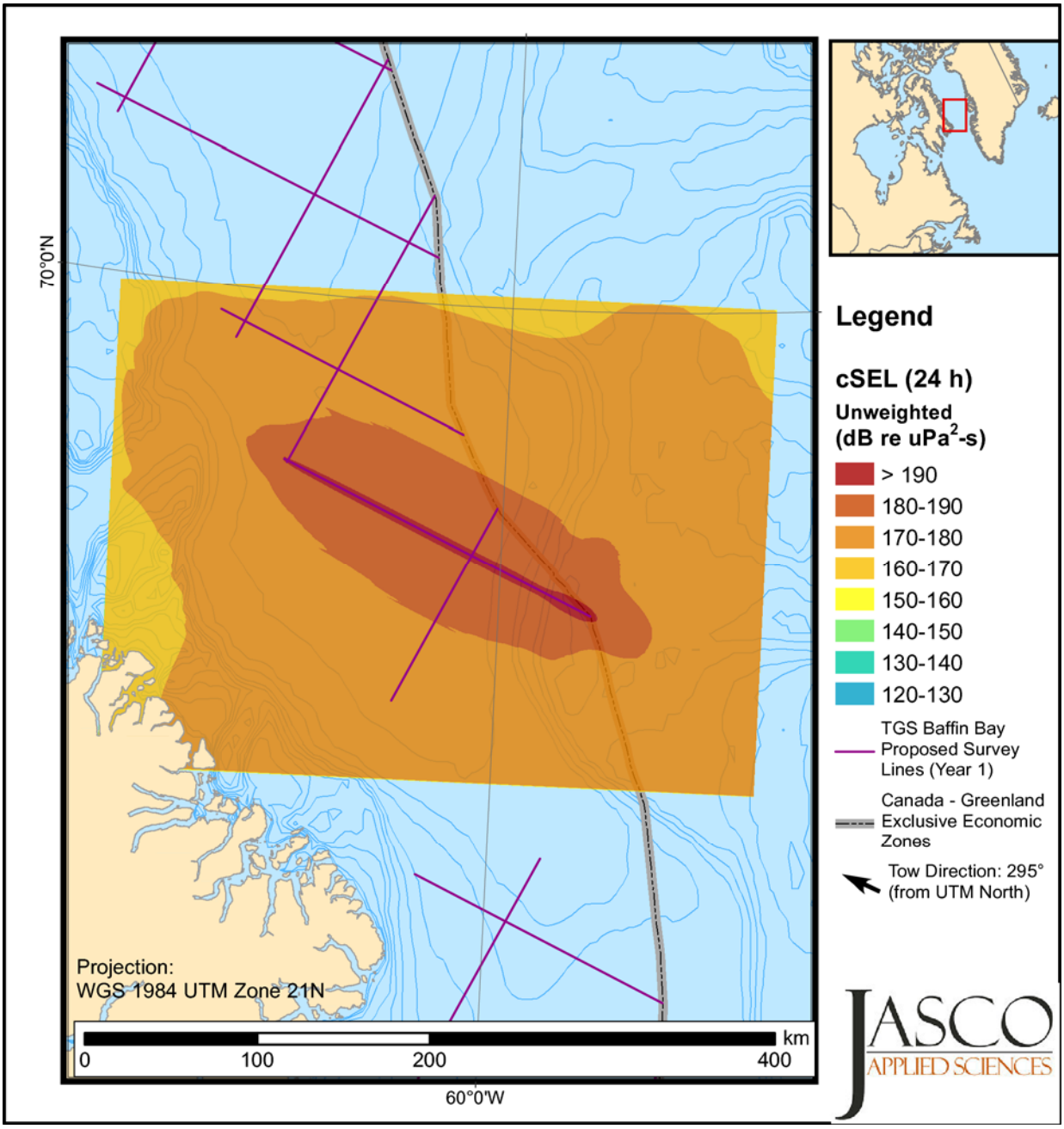


Figure 28. Unweighted cumulative sound exposure levels (cSELs): Received maximum-over-depth sound levels from the 4718 in^3 airgun array for 24 h of seismic survey operations. Blue contours indicate water depth in metres.

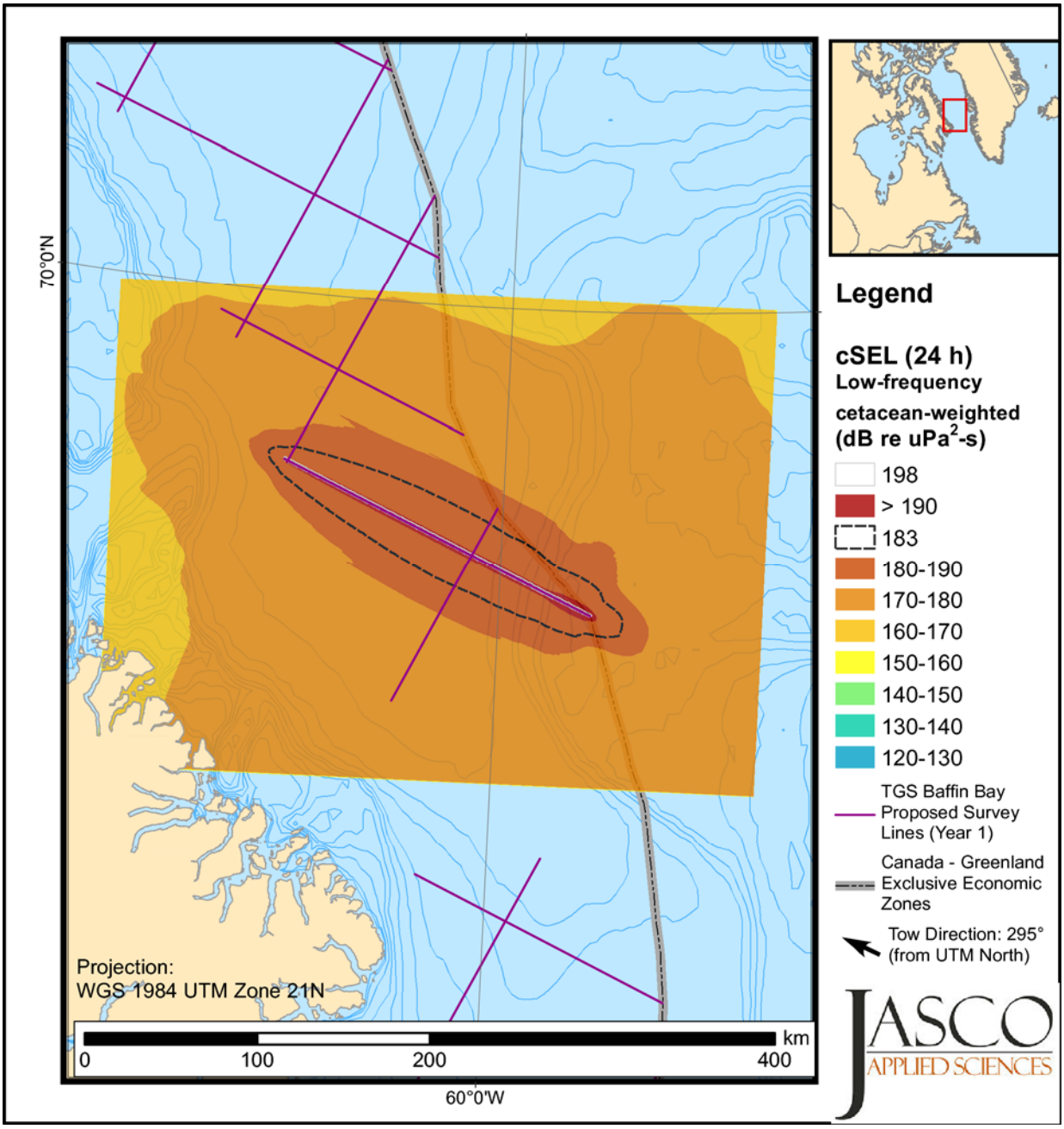


Figure 29. Low-frequency cetacean-weighted cumulative sound exposure levels (cSELs): Received maximum-over-depth sound levels from the 4718 in^3 airgun array for 24 h of seismic survey operations. Blue contours indicate water depth in metres.

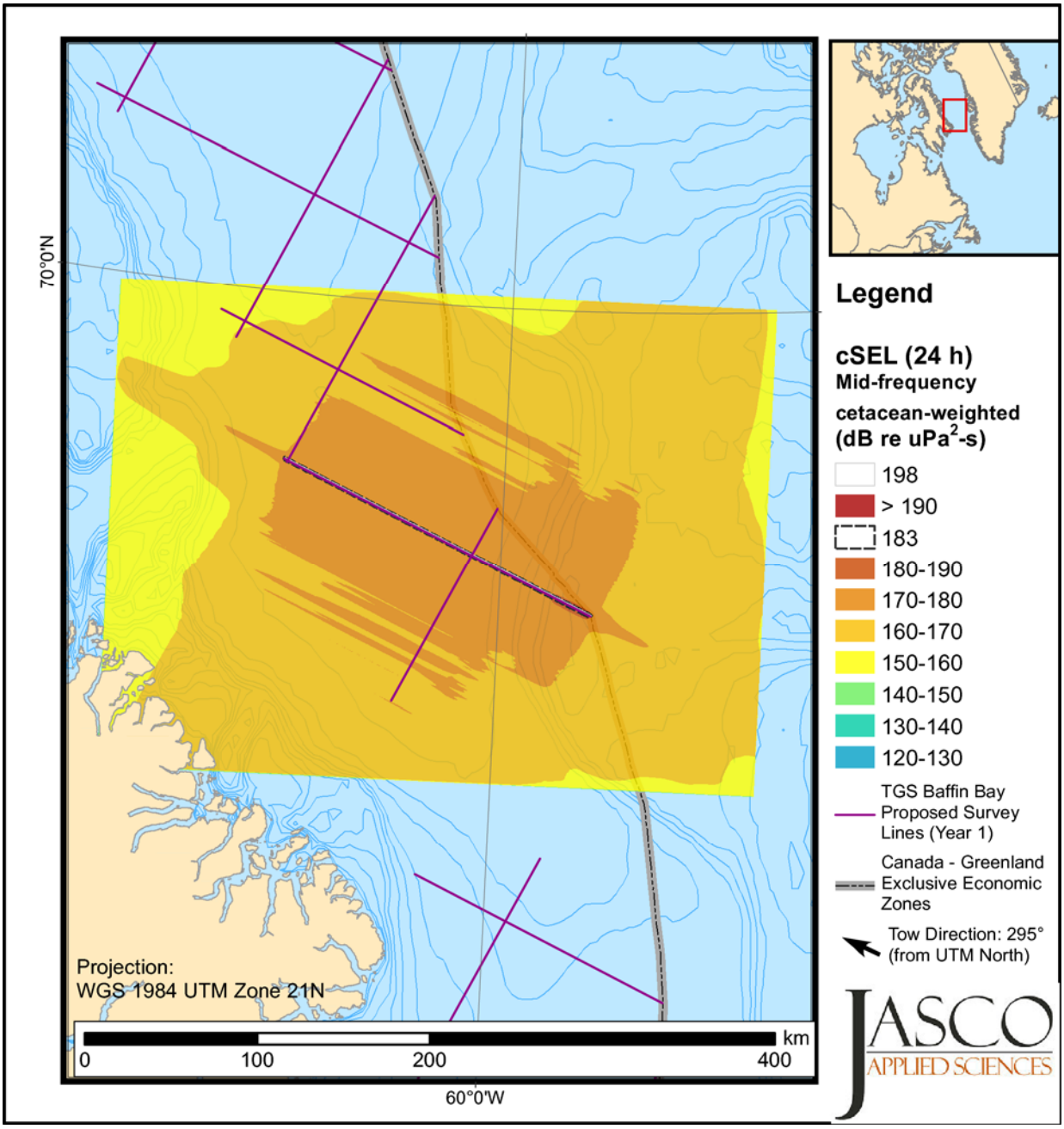


Figure 30. Mid-frequency cetacean-weighted cumulative sound exposure levels (cSELs): Received maximum-over-depth sound levels from the 4718 in^3 airgun array for 24 h of seismic survey operations. Blue contours indicate water depth in metres.

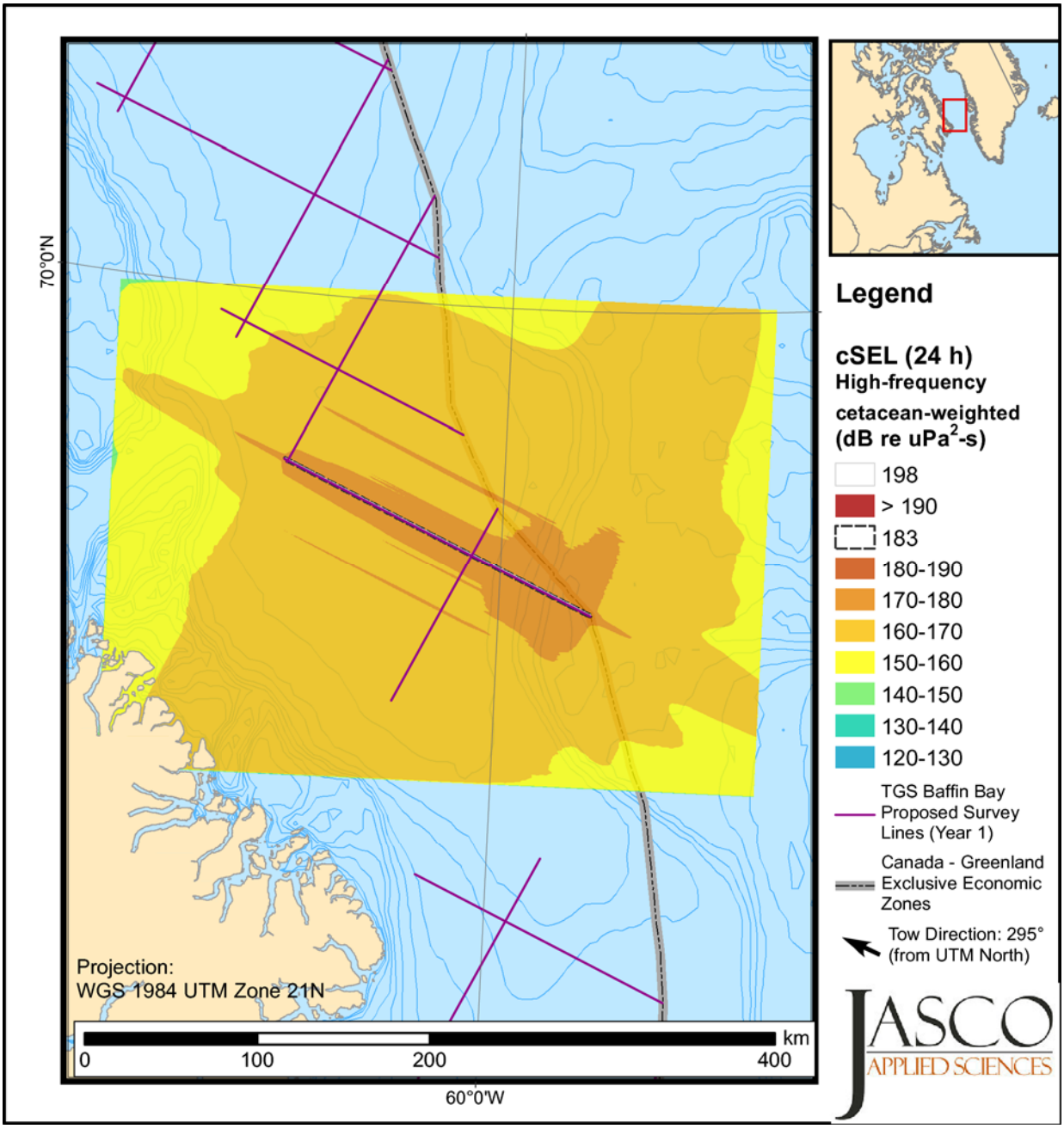


Figure 31. High-frequency cetacean-weighted cumulative sound exposure levels (cSELs): Received maximum-over-depth sound levels from the 4718 in^3 airgun array for 24 h of seismic survey operations. Blue contours indicate water depth in metres.

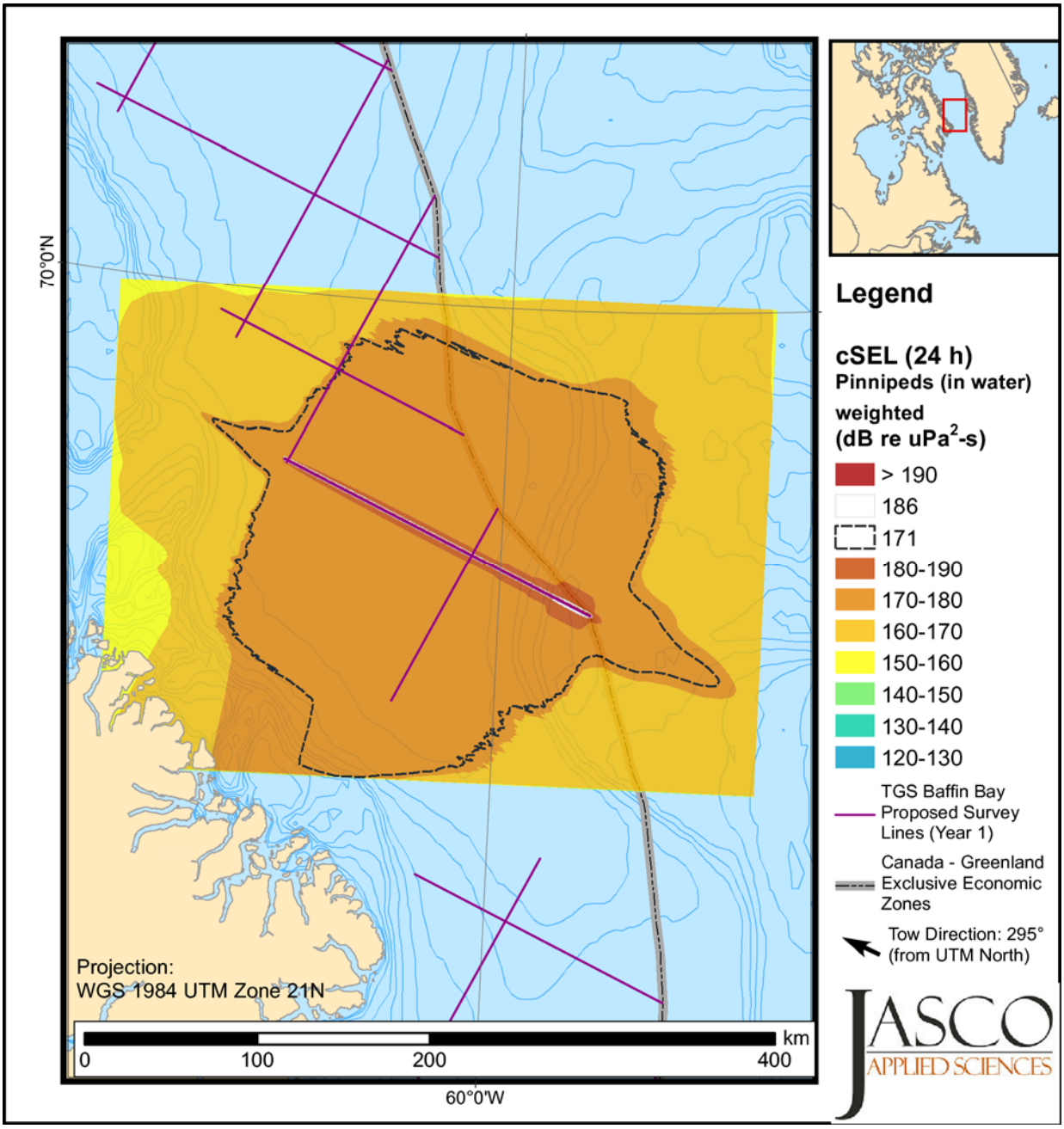


Figure 32. Pinniped-weighted cumulative sound exposure levels (cSELs): Received maximum-over-depth sound levels from the 4718 in^3 airgun array for 24 h of seismic survey operations. Blue contours indicate water depth in metres.

5. Discussion

Peak sound pressure levels (SPLs), root-mean-square (rms) SPLs, and per-pulse sound exposure levels (SELs) for August were modelled at eight sites. These sites provide a sample representative of the depth regimes present in the survey area in the Canadian waters of Baffin Bay and Davis Strait (see Table 4, Figure 7).

In general, distances to sound levels depend on the water depth at the source location and along the propagation path, and on the geoacoustic properties of the site. Sound propagation at Site 5, the shallowest modelled site, produces the longest distances to rms SPLs and per-pulse SELS of ≥ 170 dB (Tables 11 and 12). Although the predicted distances to lower sound levels are site-dependent because of variations in water depth along the propagation paths, distances to rms SPL and per-pulse SELS of 150 dB are generally longer for sites in deeper water.

Cumulative SELs (cSEL) were modelled along one seismic line at the centre of the survey area, where the water depth varied from approximately 250 m in the southeast, to 1850 m in the northwest (see Table 4, Figure 7). Results are presented for unweighted and M-weighted sound level thresholds, in accordance with the Southall Criteria (Southall et al. 2007). Since the main frequency bands of the airgun array lie outside the passband of the high-frequency cetacean filter, that M-weighting filter reduces the distances to sound level thresholds the most (Figures 28–32), compared to distances to unweighted cSELs. Conversely, the low-frequency cetacean filter reduces the distances the least, since the main frequency bands of the airgun array lie within that filter's passband.

Literature Cited

[MMPA] Marine Mammal Protection Act. 2007. Marine Mammal Protection Act of 1972, amended Sections 3, 101, and 104, 2004; and amended Sections 107 and 501-509 (Title V). 2007 (webpage). http://www.nmfs.noaa.gov/pr/laws/mmpa/text.htm.

[NAVO] Naval Oceanography Office (US). 2003. *Database description for the Generalized Digital Environmental Model (GDEM-V) (U).* MS 39522-5003. Oceanographic Data Bases Division, Stennis Space Center.

Aerts, L., M. Blees, S. Blackwell, C. Greene, K. Kim, D. Hannay, and M. Austin. 2008. *Marine mammal monitoring and mitigation during BP Liberty OBC seismic survey in Foggy Island Bay, Beaufort Sea, July-August 2008: 90-day report.* LGL Report P1011-1. Report by LGL Alaska Research Associates Inc., LGL Ltd., Greeneridge Sciences Inc. and JASCO Applied Sciences for BP Exploration Alaska.

Buckingham, M.J. 2005. Compressional and shear wave properties of marine sediments: Comparisons between theory and data. *J. Acoust. Soc. Am.* 117(1):137-152.

Carnes, M.R. 2009. *Description and Evaluation of GDEM-V 3.0.* NRL Memorandum Report 7330-09-9165. US Naval Research Laboratory, Stennis Space Center, MS. 21 p.

Codispoti, L.A. and J.H. Kravitz. 1968. *Oceanographic Cruise Summary Baffin Bay-Davis Strait Labrador Sea, Summer 1967*. 68-23 Naval Oceanographic Office. 27 p.

Collins, M.D. 1993. The split-step Padé solution for the parabolic equation method. *J. Acoust. Soc. Am.* 93:1736-1742.

Collins, M.D., R.J. Cederberg, D.B. King, and S.A. Chin-bing. 1996. Comparison of algorithms for solving parabolic wave equations. *J. Acoust. Soc. Am.* 100:178-182.

Coppens, A.B. 1981. Simple equations for the speed of sound in Neptunian waters. *J. Acoust. Soc. Am.* 69:862-863.

Dragoset, W.H. 1984. A comprehensive method for evaluating the design of airguns and airgun arrays. *16th Annual Proc. Offshore Tech. Conf.* Volume 3. pp. 75–84.

Funck, T., H.R. Jackson, K.E. Louden, and F. Klingelhöfer. 2007. Seismic study of the transform-rifted margin in Davis Strait between Baffin Island (Canada) and Greenland: What happens when a plume meets a transform. *Journal of Geophysical Research* 112(B04402):22 p.

Funk, D., D. Hannay, D. Ireland, R. Rodrigues, and W. Koski (eds.). 2008. *Marine Mammal Monitoring and Mitigation during Open Water Seismic Exploration by Shell Offshore Inc. in the Chukchi and Beaufort Seas, July–November 2007: 90-Day Report.* LGL Report P969-1. Prepared by LGL Alaska Research Associates Inc., LGL Ltd., and JASCO Research Ltd. for Shell Offshore Inc., National Marine Fisheries Service (US), and US Fish and Wildlife Service. 218 p. http://www-static.shell.com/static/usa/downloads/alaska/shell2007_90-d_final.pdf.

Greene, C.R., Jr. . 1997. *Physical acoustics measurements. In:* Richardson, W.J. (ed.). Northstar Marine Mammal Monitoring Program, 1996: Marine Mammal and Acoustical Monitoring of a Seismic Program in the Alaskan Beaufort Sea. LGL Rep. 2121-2. Report from LGL Ltd., King City, ON, and Greeneridge Sciences Inc., Santa Barbara, CA, for BP Explor. (Alaska) Inc., Anchorage, AK, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD, pp. 3-1 to 3-63.

Hamilton, E.L. 1980. Geoacoustic modeling of the sea floor. *J. Acoust. Soc. Am.* 68:1313-1340.

Hannay, D. and R. Racca. 2005. *Acoustic Model Validation*. Document 0000-S-90-04-T-7006-00-E, Revision 02. Technical report for Sakhalin Energy Investment Company Ltd. by JASCO Research Ltd. 34 p. http://www.sakhalinenergy.com/en/documents/doc_33_jasco.pdf.

Ireland, D.S., R. Rodrigues, D. Funk, W. Koski, and D. Hannay. 2009. *Marine Mammal Monitoring and Mitigation during Open Water Seismic Exploration by Shell Offshore Inc. in the Chukchi and Beaufort Seas, July–October 2008: 90-Day Report.* LGL Report P1049-1. Prepared by LGL Alaska Research Associates Inc., LGL Ltd., and JASCO Applied Sciences for Shell Offshore Inc., National Marine Fisheries Service (US), and US Fish and Wildlife Service. 277 p.

Landro, M. 1992. Modeling of GI gun signatures. *Geophysical Prospecting* 40:721–747.

Laws, M., L. Hatton, and M. Haartsen. 1990. Computer modeling of clustered airguns. *First Break* 8:331–338.

Lurton, X. 2002. *An Introduction to Underwater Acoustics: Principles and Applications.* Springer, Chichester, U.K. 347 p.

MacGillivray, A.O. 2006. *Acoustic Modelling Study of Seismic Airgun Noise in Queen Charlotte Basin.* MSc Thesis. University of Victoria, Victoria, BC. 98 p.

Malme, C.I., P.W. Smith, and P.R. Miles. 1986. *Characterisation of Geophysical Acoustic Survey Sounds*. Report by BBN Laboratories Inc. for Battelle Memorial Institute to the Minerals Management Service, Pacific Outer Continental Shelf Region.

McCauley, R.D., M.-N. Jenner, C. Jenner, K.A. McCabe, and J. Murdoch. 1998. The response of humpback whales (Megaptera novaeangliae) to offshore seismic survey noise: preliminary results of observations about a working seismic vessel and experimental exposures. *Austral. Petrol. Prod. & Explor. Assoc. J.* 38:692-707.

Nedwell, J.R. and A.W. Turnpenny. 1998. The use of a generic frequency weighting scale in estimating environmental effect. *Workshop on Seismics and Marine Mammals* 23–25th June, London, U.K.

Nedwell, J.R., A.W.H. Turnpenny, J. Lovell, S.J. Parvin, R. Workman, and J.A.L. Spinks. 2007. *A validation of the dBht as a measure of the behavioural and auditory effects of underwater noise.* Report No. 534R1231 prepared by Subacoustech Ltd. for the UK Department of Business, Enterprise and Regulatory Reform under Project No. RDCZ/011/0004. www.subacoustech.com/information/downloads/reports/534R1231.pdf.

O'Neill, C., D. Leary, and A. McCrodan. 2010. Sound Source Verification. (Chapter 3) In Blees, M.K., K.G. Hartin, D.S. Ireland, and D. Hannay (eds.). *Marine mammal monitoring and mitigation during open water seismic exploration by Statoil USA E&P Inc. in the Chukchi Sea, August-October 2010: 90-day report*. LGL Report P1119. Prepared by LGL Alaska Research Associates Inc., LGL Ltd., and JASCO Applied Sciences Ltd. for Statoil USA E&P Inc., National Marine Fisheries Service (US), and US Fish and Wildlife Service. pp. 3-1 to 3-34.

Praeg, D., B. MacLean, and G. Sonnichsen. 2007. *Quaternary geology of the northeast Baffin Island continental shelf, Cape Aston to Buchan Gulf (70° to 72°N) (offshore Nunavut).* Open File 5409. Geological Survey of Canada. 98 p.

Racca, R., A. Rutenko, K. Bröker, and M. Austin. 2012a. *A line in the water - design and enactment of a closed loop, model based sound level boundary estimation strategy for mitigation of behavioural impacts from a seismic survey. 11th European Conference on Underwtaer Acoustics 2012.* Volume 34(3), Edinburgh, United Kingdom.

Racca, R., A. Rutenko, K. Bröker, and G. Gailey. 2012b. *Model based sound level estimation and in-field adjustment for real-time mitigation of behavioural impacts from a seismic survey and post-event evaluation of sound exposure for individual whales.* Acoustics 2012 Fremantle: Acoustics, Development and the Environment, Fremantle, Australia. http://www.acoustics.asn.au/conference_proceedings/AAS2012/papers/p92.pdf.

Racca, R.G. and J.A. Scrimger. 1986. *Underwater Acoustic Source Characteristics of Air and Water Guns*. DREP Tech. Rep. 06SB 97708-5-7055. Report by JASCO Research Ltd. for Defence Research Establishment Pacific (Canada).

Rodriguez, E., C.S. Morris, Y.J.E. Belz, E.C. Chapin, J.M. Martin, W. Daffer, and S. Hensley. 2005. *An Assessment of the SRTM Topographic Products.* JPL D-31639. Jet Propulsion Laboratory, Pasadena, CA.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr., D. Kastak, D.R. Ketten, J.H. Miller, et al. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals* 33(4):411-521.

Teague, W.J., M.J. Carron, and P.J. Hogan. 1990. A comparison between the Generalized Digital Environmental Model and Levitus climatologies. *Journal of Geophysical Research* 95(C5):7167-7183.

Warner, G., C. Erbe, and D. Hannay. 2010. Underwater sound measurements. (Chapter 3) *In:* Reiser, C.M., D.W. Funk, R. Rodrigues, and D. Hannay (eds.). *Marine Mammal Monitoring and Mitigation during Open Water Shallow Hazards and Site Clearance Surveys by Shell Offshore Inc. in the Alaskan Chukchi Sea, July-October 2009: 90-Day Report*. LGL Report P1112-1. Report by LGL Alaska Research Associates Inc. and JASCO Applied Sciences for Shell Offshore Inc., National Marine Fisheries Service (US), and US Fish and Wildlife Service. pp. 3-1 to 3-54. http://www-static.shell.com/static/usa/downloads/alaska/report_2009_shell_90-d_report_plus_appendices.pdf.

Zhang, Y. and C. Tindle. 1995. Improved equivalent fluid approximations for a low shear speed ocean bottom. *J. Acoust. Soc. Am.* 98(6):3391-3396.

Ziolkowski, A. 1970. A method for calculating the output pressure waveform from an airgun. *Geophysical Journal of the Royal Astronomical Society* 21(2):137-161.